

ON SOME FOSSIL PLANTS FROM KARKATI, KAMTADAND AND PARSORA, IN THE SOUTH REWA GONDWANA BASIN, CENTRAL INDIA

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ABSTRACT

The fossil plants collected by the author in the year 1944 from three different localities in the South Rewa Gondwana basin, Central India, are described in this paper.

1. Karkati (23° 22' : 81° 6') has yielded pure *Glossopteris* flora consisting of three species of *Glossopteris* — *G. indica*, *G. Browniana*, *G. angustifolia* —, one species each of *Sphenopteris* and *Dictyopteridium*, an equisetaceous stem and a fossil of uncertain affinity.
2. At Kamtadand (23° 25' : 81° 6') were found one species each of *Glossopteris*, *Vertebraria*, *Dicroidium* and an equisetaceous stem. This interesting mixture of *Glossopteris* with *Dicroidium* suggests a somewhat younger age than that of Karkati flora. Fox (1931) has stated that there is no admixture of the two floras — *Glossopteris* and *Thinnfeldia* (*Dicroidium*) at any place. But this mixed flora from Kamtadand shows that Fox's view is not correct.
3. Parsora (23° 26' : 80° 5' 30"). Here a few very poorly preserved leaves, doubtfully referred to *Glossopteris*, have been found.

INTRODUCTION

THE fossil flora from Parsora and Karkati, in the South Rewa Gondwana basin, is of great importance, as it is this flora which led Feistmantel (1882) to institute a much-disputed Middle Gondwana Age. The importance of the above flora, coupled with a suggestion from the late Professor Sahni, prompted me to arrange a tour to some of the South Rewa fossil localities including Parsora, Kamtadand and Karkati. The collection from these localities has proved to be of some importance.

Feistmantel based his transitional beds on the fossil evidence from Parsora and Daigaon. Fox (1931) questioning the transitional beds writes that the horizon at Parsora is some 800 ft. above the beds at Karkati, Pali and Daigaon, known as Pali-Daigaon beds. He thinks that there are two distinct floras, one at and about Parsora, and the other at Pali-Daigaon beds, and believes that there is no admixture of the two — *Glossopteris* flora and *Thinnfeldia* (*Dicroidium*) flora at any place. But in my own collection I have found *Glossopteris*, *Vertebraria* and *Dicroi-*

dium from a single horizon at Kamtadand, a locality situated between Parsora and Karkati. This mixed flora suggests the presence of the transitional beds. However, I feel that on this basis alone the long-disputed problem of the Middle Gondwanas cannot be finally settled. A regular systematic mapping of the whole area along with a thorough Palaeobotanical, lithological and stratigraphical study of the various localities concerned would be necessary before a final decision, agreeable to both, palaeobotanists and the geologists, could be arrived at.

I feel highly indebted to late Professor Birbal Sahni for his guidance, ready help and valuable advice, and express a deep sense of gratitude. It would not be out of place to thank Mr. Ganesh Prasad, Assistant Conservator of Forest, and Mr. Bankey Behari Lal, the then officiating Ranger at Pali for providing me all the facilities and help needed in the field.

The specimens in this paper are described locality-wise to facilitate the study of the flora at different places.

DESCRIPTION

I. FOSSILS FROM KARKATI

Karkati village lies about 4 miles north-east of Birsinghpur Railway Station on the Katni-Bilaspur branch of the South Eastern Railway passing through South Rewa, Central India (Madhya Pradesh). The plant-bearing stratum at this locality is exposed in a sectional view on the southern and the western sides of a small hillock, at a ground level to the north of the Karkati village. The same stratum can be traced almost continuously from the hillock section towards the village where the bed is exposed flat at the surface of the ground.

Glossopteris indica Schimp.

Pl. 1, Figs. 1-4

There are impressions of *Glossopteris indica* on red ferruginous shale pieces numbered

R.S. 3a/1; R.S. 3a/15a and R.S. 3b/6. They show characteristic features of *Glossopteris indica*, that is, distinct midrib, secondary veins numerous, crowded, arising at an acute angle, slightly arched, oblique; meshes narrow, elongated and uniform. There is a single almost complete impression on 3a/1 (PL. 1, FIG. 1). It measures 10 cm. long and about 2.5 cm. broad. In this specimen the midrib does not seem to reach the apical point and the impression is slightly asymmetrical, thus it shows a stage intermediate between *Glossopteris indica* and *Glossopteris decipiens* (PL. 1, FIGS. 1-2). The impression on 3a/15a is very small being 5.8 cm. long and 2 cm. broad. It seems to be the impression of a young leaf of *G. indica* (PL. 1, FIG. 3).

On shale piece R.S. 3b/6 there is an incomplete impression probably of the portion near the apical part of a leaf of *Glossopteris indica*. It is 5 cm. broad and shows typical features of the species (PL. I, FIG. 4).

***Glossopteris browniana* Brong.**

PL. 1, FIGS. 5, 6

There is a small impression of a beautifully preserved, almost complete leaf on shale R.S. 3b/3, in which the following characters can be clearly seen.

Fronde 6 cm. long and 1.9 cm. broad, spatulate, asymmetrical, acute, broadest near the apex, decreasing gradually towards the base; midrib distinct, persistent, broad, made up of acutely diverging sub-parallel veins; secondary nerves arched, reaching the margin at an open angle; meshes large, polygonal or elongate-polygonal except near the margin where they are narrow and elongated.

***Glossopteris angustifolia* Brong.**

PL. 1, FIGS. 7, 8

There is a small impression on shale 3b/6 which, though incomplete, clearly shows the distinguishing features of the species.

Fronde linear, 1.1 cm. broad; midrib narrow; lateral veins arising at an acute angle, straight; meshes narrow elongate.

***Sphenopteris polymorpha* Feist.**

PL. 1, FIGS. 9-14; PL. 2, FIG. 15

Small incomplete impressions of compound leaves are preserved on shale pieces R.S. 3a/6 and 3b/5.

The specimen on 3a/6 has the following features.

An incomplete pinnate type of compound leaf, pinnules contracted at the base, lower pinnules more deeply lobed than those near the apex; lobes crenulate, terminal lobe rounded, number of lobes unequal on the two sides; rachis delicate, finely ribbed; midribs of the pinnae alternate, coming out at a wide angle from the rachis (PL. 1, FIG. 9).

This species was instituted by Feistmantel (1876, pp. 356-358; PL. 16, FIGS. 5-7 & PL. 17) from Raniganj. Later he described some more specimens from Raniganj group of the Raniganj coalfield (FEISTMANTEL, 1880, pp. 76-77, PL. 15a, FIGS. 1-9).

Specimen on R.S. 3b/5 has mostly all the above features, but here the rachis seems to be winged (PL. 1, FIGS. 11, 12). Some pinnae are nicely preserved. These are oval, lanceolate, entire or very slightly crenulate.

This specimen is only a part of a big compound leaf. It is comparable to some extent to *Sphenopteris lobifolia* Morris (ARBER, 1905, p. 132), from the Permo-Carboniferous rocks of Australia.

There are two more small fragments of a compound leaf preserved on shale pieces R.S. 3b/3 and 3b/12.

The impression on 3b/3 (PL. 1, FIGS. 13, 14) is a very small fragment of a frond. It shows very clearly, many of the characters of the specimen on 3b/5, described above such as the shape, size and nature of the pinnules, and the venation in general.

Another small portion of a frond showing part of the main rachis, two veins of the pinnae, and a few of the pinnules is preserved on R.S. 3b/12 (PL. 2, FIG. 15). By the shape of the pinnules and their venation it seems that the fragment belongs to *Sphenopteris polymorpha*.

***Dictyopteridium sporiferum* Feist.**

PL. 2, FIGS. 16, 17

The specimen is preserved on shale piece R.S. 3a/2 with a counterpart R.S. 3a/8. It shows a spindle-shaped lanceolate body, 3 cm. long and slightly less than 0.9 cm. broad, covered with small depressions of about $\frac{1}{2}$ mm. in diameter, arranged in oblique rows. These are almost round in shape, excepting a few near the margin, which are slightly oval. The counterpart shows only a part of the above impression, and has got tubercles in place of the depressions.

This genus and species was created by Feistmantel (1881) to describe two impressions from the Barakar and the Raniganj groups. One of the specimens (FEISTMANTEL, 1881, PL. 23a, FIG. 4) is 3.4 cm. long and 0.8 cm. broad. It shows round tubercles of about $\frac{1}{2}$ mm. in diameter all over the surface. The tubercles near the edges are slightly oval in shape. The other specimen (FEISTMANTEL, 1881, PL. 23a, FIG. 14) is also of the same size, 3.4 cm. long and 0.8 cm. broad, but the number of the tubercles on the surface is slightly less, and consequently they are further apart than in the previous case.

One more specimen has been figured by Feistmantel as *Dictyopteridium sporiferum* from the Karanpura coalfield (FEISTMANTEL, 1886, PL. 5a, FIG. 3), but though this specimen is almost of the same size as the previous ones, being 3 cm. long and 1.1 cm. broad, it looks very different from them in the nature of the tubercles, which probably have been very roughly figured.

Zeiller (1902, pp. 24-26; FIG. 8) has described one large and very clear specimen measuring 7.7 cm. long and 1.4 cm. broad from Reohal ($23^{\circ} 52' : 82^{\circ} 22'$) in the South Rewa Gondwana basin, Central India. The specimen occurs in association with *Glossopteris indica*, *G. Browniana*, *G. damudica*, *G. angustifolia*, *Vertebraria indica* and *Schizoneura gondwanensis*, and is referred to the Damudas. Zeiller's specimen has also been mentioned by Arber (1905) and Rao (1935). The latter author has made an attempt to compare this form with *Rhizomopsis* Gothan and Sze, a form belonging to the *Gigantopteris* flora of China.

Walkom (1922, PL. 9, FIG. 48) has also described a specimen of *Dictyopteridium sporiferum* from Lower Bowen Series, Dawson river, Queensland, Australia. It has a linear lanceolate body, about 0.6 cm. wide and 5 cm. long. Walkom's figure is not very clear, however, it is interesting to note the occurrence of this species in the Lower Bowen Series (Lower Permian) of Australia, which is equivalent to the Damudas of India.

The present specimen resembles Feistmantel's specimen from the Raniganj group in almost every details, and is described for the first time from the Pali beds in the South Rewa Gondwana basin. These beds have been referred to the Raniganj Series, and the present specimen is one more addition from this series.

It has not been possible to assign this genus to any definite position; and even the nature of the specimen is not definitely known. Feistmantel (1881) regarded them as the fertile leaflets of some fern, while Zeiller (1902) thinks that they are probably either roots or fleshy rhizomes bearing roots. The examination of the present specimen does not help to make any further advance over these views.

Equisetaceous stem

Pl. 2, Fig. 18

A stem impression, 6.7 cm. long and 1.5 cm. broad, with a single node having ridges and grooves, parallel and alternating at the node is found on shale R.S. 3b/8. Nothing more can be said about this specimen. It is recorded here only to show the presence of an equisetaceous stem in these beds.

Incertae Sedis

Pl. 2, Figs. 19, 20

The impression on shale R.S. 3b/3 shows the following characters.

Corrugated, linear parallel strips with fine thin ridges and flat channels; midribs of the strips running through the middle of the channels; no secondary nerves visible.

Between the ridges and the midrib there are very fine reticulations, which are very clearly seen under the binocular microscope. In the counterpart there are very fine grooves in place of the ridges, and the surface between the grooves is convex. This resembles to a considerable extent with a broad leaf-segment of *Schizoneura gondwanensis*. Broad midrib of segments and fine ridges formed at the meeting place of two segments are the characters common to this specimen and *Schizoneura gondwanensis*. But the fine reticulations in between the ridges and midrib, and the corrugation found in this specimen has not been clearly seen in *Schizoneura*. In the absence of further details a definite determination of such a fragmentary piece is rather difficult; however, its probability of being a part of a leaf segment of *Schizoneura* cannot be ignored.

II. FOSSILS FROM KAMTADAND

In the Kamrai river (Ghorari nalla) east of Kamtadand or Kamta-tola (a part of Goira

village), at Bardahi ghat, some five miles north-east of Birsinghpur Railway Station on Katni-Bilaspur branch of South Eastern Railway.

Glossopteris indica? Schimp.

Pl. 2, Fig. 21

On a piece of red shale R.S. 4/3 there are impressions of three incomplete fronds. The leaves are ovate, lanceolate; with a distinct midrib persisting to the apex. Secondary veins arise at an acute angle from the midrib, make a slight bend and pass straight to the margin. The meshes are not very clearly seen. Thus they show most of the important characters of *Glossopteris indica*, except that, considering the size of the leaves, in this case the lateral veins look rather thicker than they should be, and the reticulations of the secondary veins too, are not very distinct. Therefore, the assignment of these specimens to *Glossopteris indica* is provisional.

Vertebraria indica Royle

Pl. 2, Fig. 22

There is a clear specimen of *Vertebraria indica* preserved on shale piece R.S. 4/8 with a counterpart, showing the following characters.

Specimen about 7 cm. long and 0.75 cm. broad, curved, with three longitudinal grooves separating four rows of rectangular plates, transverse ridges wide apart.

This specimen looks slightly different from the common form of *Vertebraria indica*, the only species known definitely so far, in having four rows of plates, which are comparatively much longer than broad. But it is quite possible that the present specimen may be a very young branch of *Vertebraria*. It is closely comparable to the branches of *V. indica* from the Raniganj coalfield (FEISTMANTEL, 1880, PL. 13a, FIGS. 1, 2), and also from South Rewa (FEISTMANTEL, 1882, PL. 5a, FIG. 1).

Dicroidium hughesi Feist.

Pl. 2, Figs. 23, 24

There are two impressions, one on shale R.S. 4/4 and the other on shale R.S. 4/5.

The specimen on shale piece 4/4 (PL. 2, FIG. 23) represents an apical portion of a compound leaf. Here the pinnae are much smaller than of the specimen on shale 4/5 (PL. 2, FIG. 24). The general arrangement of pinnae, their shape, midrib, rachis, and venation of leaflets in this case agrees in every details with the specimen on shale 4/5 which is described below.

Specimen on shale 4/5 consists of a small portion of rachis with three pinnules, out of which only two are complete. Rachis broad; pinnae with a well-defined midrib arising at an acute angle from the rachis, broadly linear; base broad, gradually narrowing down towards an acute apex, and attached to the rachis by the whole breadth; the lower edge of the lamina decurrent and continuous with that of the next pinnule; secondary veins of the pinnules not very clear. One of the pinnules is 7.7 cm. long and 2.3 cm. broad.

Halle (1927) has compared a Palaeozoic genus *Protoblechnum* from Central Shansi, China, with *Danaeopsis hughesi* Feistmantel. Though it is difficult to justify the validity of this comparison, yet the existence of a plant outside the *Glossopteris* province, having a very close resemblance with *D. hughesi*, is a matter of great interest.

Dicroidium (Danaeopsis) hughesi has been described by du Toit (1929) from the Upper Beaufort Stage (Lower Triassic) in South Africa, which is considered equivalent to Parsora Stage (India). du Toit (1934) believes that somewhere between the Lower and Middle Triassic almost all Palaeozoic types disappeared and the *Thinnfeldia (Dicroidium)* flora made its entry, but here we find the presence of the elements of *Thinnfeldia* flora along with the disappearing *Glossopteris* flora.

Equisetaceous stem

Pl. 2, Figs. 25, 26

The specimen is preserved on shale R.S. 4/9 with a counterpart 4/10. It is a jointed thin stem, 16 cm. long and 0.8-1.2 cm. broad, and ribbed. The ribs are fine, ending in several small depressions at the nodes, which are swollen. Internodes are long. The internode which is complete measures about 7 cm. Between the ridges there are very fine parallel lines. There are no leaf scars at the nodes and so the generic identity of the stem remains obscure.

III. FOSSILS FROM PARSORA

The fossiliferous bed is exposed in the Kamrai river (Ghorari nalla) near the deserted site of South Parsora, some 7 miles N.N.E. of the Birsinghpur Railway Station, South Eastern Railway.

Glossopteris? sp.

Pl. 2, Figs. 27, 28

There are several incomplete and indistinct leaf impressions preserved on red ferruginous shales. The impression on shale piece R.S. 5/6 (PL. 2, FIG. 27) shows an incomplete leaf. In this the midrib is made up of several parallel veins, though these are not very clear. The secondary veins and the meshes also are not distinct.

Though the impression looks like that of a *Glossopteris* leaf, yet it cannot be assigned to it with certainty. It would be no wonder if these impressions turn out to be the fragments of *Dicroidium hughesi*.

On shale R.S. 5/2 (which has a counterpart R.S. 5/5) there are several fragmentary impressions of fronds, only one of which is figured here (PL. 2, FIG. 28). In this the veins, which show closer resemblance to those of the *Glossopteris* leaf, are clearly seen; however, it is very difficult to assign it to a definite species.

The resemblance of these impressions with *Glossopteris* and the importance of the presence of *Glossopteris* flora at Parsora have necessitated these fragments to be figured and described here.

DISCUSSION

The facts based on the study of the flora from the three localities mentioned in this paper are summarized as follows:

I. Karkati Flora

The flora obtained from Karkati is a pure *Glossopteris* flora. It consists of

Glossopteris indica,
Glossopteris Browniana,
Glossopteris angustifolia,
Sphenopteris polymorpha,
Dictyopteridium sporiferum
 An equisetaceous stem, and
 A fossil of unknown affinity.

The last one could not be identified, but it is comparable to *Schizoneura gondwanensis*

to some extent. Thus the large number of genera and species of the *Glossopteris* flora present in this locality give sufficient proof of its richness.

II. Kamtadand Flora

The material from Kamtadand has yielded an interesting flora consisting of

Glossopteris indica?,
Vertebraria indica,
Dicroidium hughesi, and
 An equisetaceous stem.

Though the impression of *Glossopteris* is not very clear, and its presence is not free from doubt, yet the presence of *Vertebraria* is definite beyond any doubt. Depending on this it can be said that here the elements of *Glossopteris* flora and those of *Thinnfeldia* (*Dicroidium*) flora are found together. This clearly shows that the *Thinnfeldia* flora originated before the disappearance of the *Glossopteris* flora from the scene, and that for some time at least both floras lived together.

The presence of *Thinnfeldia* flora at Kamtadand also suggests that this horizon may be higher than that at Karkati, although the evidence is still rather too meagre to prove this beyond doubt. Pure flora at one locality and mixed flora at another nearby locality having the same lithological features may also be due to the difference in the ecological associations (SAHNI & RAO, 1956).

III. Parsora Flora

The flora represented in this collection from the Parsora beds is very poor. It consists of a few badly preserved leaves which are doubtfully referred to *Glossopteris*, these may possibly be the incomplete pinnae of *Dicroidium hughesi*.

Feistmantel (1882) has recorded in a collection made at this locality by T. W. H. Hughes in the years 1880 and 1882

Danaeopsis hughesi,
Thinnfeldia odontopteroides,
Asplenium whitbyense, and
Noeggerathiopsis hislopi.

Although the identity of *Asplenium whitbyense* is very doubtful, and that of the species referred by Feistmantel to *Noeggerathiopsis hislopi* still needs confirmation, yet it seems that here, too, we have a mixture of the *Glossopteris* and the *Thinnfeldia* (*Dicroidium*) floras.

The occurrence of *Glossopteris* and *Noeggerathiopsis* with *Thinnfeldia* at Parsora places this horizon very near to that at Kamtadand. The poor preservation of the fossils and the extreme resistance of the red rock to maceration has made any further investigation very difficult.

Sahni and Rao (1956) include all the three above localities under Parsora group belonging to Upper Triassic.*

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REFERENCES

- ARBER, E. A. N. (1905). The *Glossopteris* flora. British Universities catalogue. London.
- DU TOIT, A. L. (1929). A short review of the Karroo fossil flora. *Compt. Rend. 15th Internat. Geol. Cong. South Africa*. 2.
- Idem (1934). The division of the late Palaeozoic formations of Gondwanaland. *Report of the 16th Internat. Geol. Cong. Washington*. 1933.
- FEISTMANTEL, O. (1876). *Journal Asiatic Society, Bengal*. 45.
- Idem (1880). The flora of the Damuda and the Panchet divisions. *Fossil Flora of the Gondwana System*. 3(2).
- Idem (1881). The flora of the Damuda and the Panchet divisions. *Fossil Flora of the Gondwana System*. 3(2) cont.
- Idem (1882). The fossil flora of the South Rewa Gondwana basin. *Mem. Geol. Surv. India. (Palaeo. Ind. Series 12)*. 4(1).
- Idem (1886). The fossil flora of the Gondwana system. *Mem. Geol. Surv. India*. 4(2).
- FOX, C. S. (1931). The Gondwana System and related formations. *Mem. Geol. Surv. India*. 58.
- HALLE, T. G. (1927). Palaeozoic plants from Central Shansi. *Geol. Surv. China. Palaeontologia Sinica. Ser. A*. 2(1).
- RAO, H. S. (1935). *Rhizomopsis* Gothan and Sze, and *Dictyopteridium* Feistmantel. *Rec. Geol. Surv. India*. 69(2): pp. 171-173.
- SAHNI, M. R. & C. N. RAO, (1956). A note on the correlation of the Parsora and Tiki beds of Vindhya Pradesh (Abstract). *Proc. Internat. Geol. Congr. Mexico*. 1956.
- WALKOM, A. B. (1922). Palaeozoic floras of Queensland, Pt. I. The flora of the Upper and the Lower Bowen Series. *Queensland Geol. Surv. Pub.* 270.
- ZEILLER, R. (1902). Observations sur quelques plantes fossiles des Lower Gondwanas. *Palaeontologia New Ser.* 2(1): 24-26.

EXPLANATION OF PLATES

PLATE 1

1. *Glossopteris indica* Schimper. R.S. 3a/1. × 13/16.
2. A portion of the leaf (*G. indica*) in photo 1 enlarged to show the veins. × 2.
3. *G. indica* Schimper. R.S. 3a/15a. × 1.
4. *G. indica* Schimper. R.S. 3b/6. × 1.
5. *Glossopteris Browniana* Brongniart. R.S. 3b/3. × 1.
6. A portion of *G. Browniana* in photo 5 enlarged. × 2½.
7. *Glossopteris angustifolia* Brongniart. R.S. 3b/6. × 1.
8. *G. angustifolia* in photo 7 enlarged. × 2½.
9. *Sphenopteris polymorpha* Feistmantel. R.S. 3a/6. × 1.
10. *S. polymorpha* in photo 9 enlarged. × 2½.
11. *S. polymorpha* Feist. R.S. 3b/5. × 1.
12. *S. polymorpha* in photo 11 enlarged. × 2½.
13. *S. polymorpha* Feist. R.S. 3b/3 at s. × 1.
14. *S. polymorpha* in photo 13 enlarged. × 2½.

PLATE 2

15. *Sphenopteris polymorpha* Feist. R.S. 3b/12. × 2.
16. *Dictyopteridium sporiferum* Feist. R.S. 3a/2. × 1.
17. *D. sporiferum* on photo 16 enlarged. × 2½.
18. An equisetaceous stem. R.S. 3b/8. × 1.
19. An unidentified leaf. R.S. 3b/3 at n. × 1.
20. Unidentified leaf in photo 19 enlarged. × 2½.
21. *Glossopteris indica*? Schimper. R.S. 4/3. × ¾.
22. *Vertebraria indica* Royle. R.S. 4/8. × 1.
23. *Dicroidium hughesi* (Feistmantel). R.S. 4/4. × ¾.
24. *D. hughesi* (Feist.). R.S. 4/5. × ¾.
25. An equisetaceous stem. R.S. 4/9. × 1.
26. A single node of the stem in photo 25 enlarged. × 2.
27. *Glossopteris*? R.S. 5/6. × 1.
28. *Glossopteris*? R.S. 5/2. × 1.



