

STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA —

6. PLANT FOSSILS FROM TALCHIR BEDS OF SOUTH REWA GONDWANA BASIN

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ABSTRACT

Ten plant types from Goraia (Talchir beds) in the South Rewa Gondwana basin have been described. Besides *Noeggerathiopsis hislopi*, *Gangamopteris cyclopteroides* and some of its varieties, four types are new to the Talchir beds. They are *Cordaicarpus furcata*, *Samaropsis goraiensis*, *Pavanocladus* (?) *indica* and *Arberia umbellata*. The occurrence of the conifer *Pavanocladus* (?), which is hitherto known only from Brazil, is reported for the first time from India.

INTRODUCTION

THE present collection of plant fossils was made in 1951 by one of us (K. M. LELE) from a section of Talchir rocks

exposed on the north bank of Johilla river N.W. of the village Goraia (23°20'50": 81°2'43", TEXT-FIG. 1). The only fossil known previously from this locality was an equisetaceous stem (FEISTMANTEL, 1880, p. 183). The section exposed at the place of collection (indicated by a cross in the map) is about 20 ft. thick, comprising of calcareous sandstone at the base followed in succession by grey shale, micaceous sandstone, greenish grey shale, earthy yellow to khaki-coloured muddy micaceous silt (unstratified), another grey shale and lastly greenish yellow, coarse-grained micaceous sandstone. The strata show a gentle dip towards north-east.

The material which is described below has come entirely from a single bed of greenish grey shale, about 4 in. thick. The bed is fairly unweathered and compact in the upper half while the lower portion is extremely fragile and crumples into very thin flakes of rock. It is this weathered zone which contains almost all the fossil impressions in a state of considerable overlapping and crowding. Much of the weathering and decay is owing to its close proximity to the waters of Johilla river. The vegetation growing around the fossil spot has also added to the continuous decay of the bed which is clearly illustrated by the occurrence of fine

rootlets of modern plants penetrating deep inside the laminae of the weathered shale zone.

The stratum, immediately overlying the fossiliferous bed, also contained badly preserved remains of certain stems which are not considered here. Besides, a large number of microfossils have been recovered from the two grey shales above and below the fossiliferous bed of the section. The microflora is of considerable interest, both in regard to variety and abundance of spores. It will be described later.

DESCRIPTION

Genus — *Gangamopteris* McCoy

1. *Gangamopteris cyclopteroides* Fstm. (Pl. 1, Fig. 12)

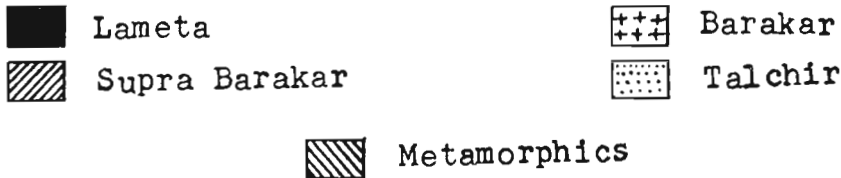
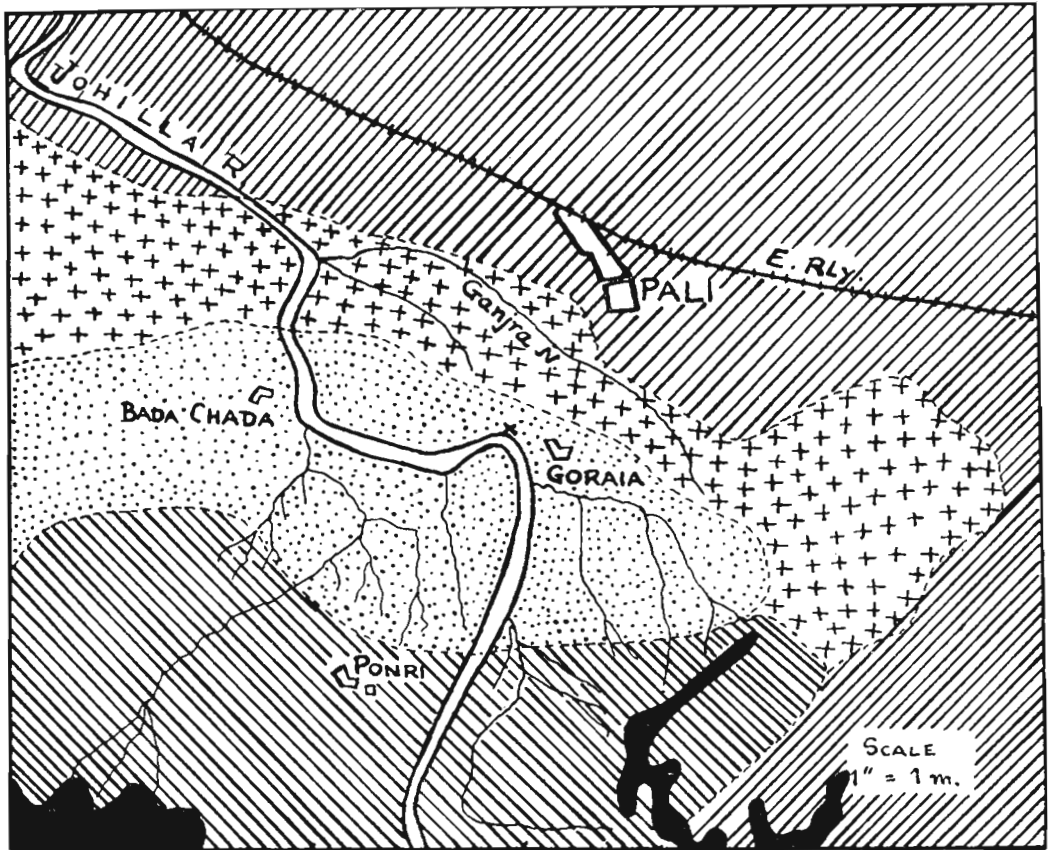
Leaves referable to this species are fairly common in the fossiliferous bed, but the impressions are fragmentary and ill-preserved. In Pl. 1, Fig. 12, is shown a broader form which is incomplete both at the apex and base. No definite midrib is present, although there is an apparent indication in the median portion of the frond where all the veins converge to run downwards towards the base. The secondary veins are arched and close, forming long meshes which are comparatively broader near the median line.

Under *Gangamopteris cyclopteroides* various forms have been included by Feistmantel (1879, 1881) as its different varieties. These leaves possess similar venation pattern but different forms. Our specimen is incomplete and, therefore, cannot be compared with any of these varieties. As far as venation is concerned, it is comparable to the Talchir-Karharbari forms described by Feistmantel under the name *Gangamopteris cyclopteroides*.

2. *Gangamopteris cyclopteroides* var. *attenuata* Fstm.

(Pl. 1, Fig. 7)

The incomplete specimen (FIG. 7) represents the lower portion of a frond, 6 cm. in length. The frond is 2 cm. at the broadest



TEXT-FIG. 1 — Geological sequence in the Johilla valley, South Rewa Gondwana basin. After Hughes (1884). The cross indicates the place of fossil collection.

part and narrows down to 7 mm. at the base. Secondary veins radiate out from a subparallel group of median nerves. They are broadly arched and form narrow elongate meshes.

This variety of *G. cyclopteroides* has been reported by Feistmantel (1879, p. 14) from Rikba (Talchir beds) and Karharbari.

3. *Gangamopteris* cf. *angustifolia* McCoy

(Pl. 1, Fig. 6)

A single incomplete specimen of *Gangamopteris* (FIG. 6) in the collection is charac-

terized by a narrow, linear form and more or less subparallel margins. The apex is not preserved but appears to have been acute or acuminate. Secondary veins arise with a broad curve from a subparallel group of median nerves which are faintly visible. The meshes are narrow and medium in length.

G. angustifolia has been recorded by Feistmantel (1879, p. 16; 1881, p. 55) from Talchir beds of Deogarh (Karon) field and Karharbari beds of Karharbari field. Our specimen differs from them in having more broadly arched secondary veins. The

venation of our specimen, however, agrees with that of *G. angustifolia* recorded by Walkom (1922, p. 31) from Australia, although the Australian specimen is somewhat bigger in size.

4. *Gangamopteris* sp.

(Pl. 1, Fig. 11)

The specimen is very small, about 2 cm. long and 7 mm. across at the broadest part near the apex. The form of the leaf is spatulate with a narrow base and obtusely round apex. Secondary veins are not clearly visible but a few meshes can be made out at one or two places.

The frond is unusually small and the preservation is bad. It cannot, therefore, be compared definitely with any of the known fronds of *Gangamopteris*. However, such a small frond of *Gangamopteris* has not so far been recorded from Talchir, Karharbari or even younger beds.

Genus — *Noeggerathiopsis* Feistmantel

5. *Noeggerathiopsis hislopi* (Bunb.) Fstm.

(Pl. 1, Figs. 1, 2)

Noeggerathiopsis hislopi is one of the few common plant elements of the fossiliferous bed. The fronds are mostly incomplete. One of them (FIG. 1) is almost complete and fairly large in size. It shows the characteristic features of the species and compares in all respects with the Talchir-Karharbari forms described by Feistmantel (1879, 1881).

In the same block, there is another much smaller specimen which is reproduced in Fig. 2. The leaf is 2.2 cm. in length and about 8 mm. across at the broadest part. The venation is not very clear but it appears to be similar to *N. hislopi*. A few prominent veins start from the base and run almost straight towards the apex dividing at least once in the lower half of the leaf.

Such a small frond of *Noeggerathiopsis* has not been figured so far. The leaf of *N. hislopi* ranges in size from 6 to 23 cm. or more in length and from 1 to 5 cm. across at the broadest part. Another species, *N. stoliczkanus*, of which only single specimen is known, measures 8 × 2.4 cm. and is bigger than our specimen.

N. hislopi is known from Talchir beds but *N. stoliczkanus* is known from Karharbari only. Seward & Sahni (1920, p. 7) red-

cribed *Cordaites* (*Noeggerathiopsis*) *stoliczkanus* which was described previously by Feistmantel as *Glossozamites stoliczkanus* but its distinction from *Noeggerathiopsis hislopi* is not yet clear. Except for the size our small frond resembles *N. hislopi* in every other respect and, therefore, it is included under this species.

Genus — *Cordaicarpus* Geinitz

6. *Cordaicarpus furcata* sp. nov.

(Pl. 1, Figs. 9, 10; Text-fig. 2)

Impressions of small unwinged seeds are present in fairly large number on the shales. The seeds are oval or pear-shaped, somewhat flattened at the base and bifid at the apex. In some seeds a small depression is noticeable at the base which perhaps marks the place of its attachment with the megasporophyll or stalk. The seeds vary in size from 4 to 5 × 3 to 4 mm. In some specimens a very narrow, uniform, slightly thick border is sometimes faintly visible (sarcotesta?). A few lines are seen running longitudinally round the border of some seeds. The sarcotesta is drawn out for about 1 mm. at the apex and is bifid, enclosing a V-shaped sinus which perhaps served as micropyle. These beak-like projections are delicate and may not always be preserved.

From Talchir beds the genus *Cordaicarpus* is not known. It is, however, reported from a bed in the Punjab Salt Range (VIRKKI, 1938, p. 150) which is about 20-25 ft. above the boulder bed. Krishnan (1949, p. 248) includes it under Talchir series. The specimen from the Punjab Salt Range is clearly divided into two symmetrical halves by a well-marked and straight median line and the apex is simply pointed. Moreover, it possesses a distinct border 0.5-1 mm. in breadth. *C. furcata* does not show any of these characters.

From Karharbari beds two seeds are known. One is *Samaropsis milleri* (Fstm.) Seward, which was later redescribed by Seward & Sahni (1920, p. 9). It is a large seed and possesses a distinct, flattened border. Another seed which is still bigger is described by Zeiller under the name *Cordaicarpus indicus* and possesses a narrower border. Seward (1917, p. 352), however, substituted the generic name *Samaropsis* for this species also. Both these seeds are quite distinct from *Cordaicarpus furcata*.

As regards the vertical distribution only one species, *Cordaicarpus indicus*, is known from the Karharbari beds (ZEILLER, 1902; SAHNI, 1921). But for the Punjab Salt Range the genus has not been reported hitherto from any of the Talchir localities of India. A definite occurrence of *Cordaicarpus* has now been recorded from Talchir beds of Goraia.

It should be mentioned here that the distinction between the genera *Samaropsis* and *Cordaicarpus* is not always easy in borderline cases. According to Seward *Samaropsis* possesses broader and more clearly defined border than that of *Cordaicarpus*. The difference is of degree only and it remains a matter of individual discretion while choosing between the name *Samaropsis* and *Cordaicarpus*, specially when the wing is not broad enough. Typical example is that of *Cordaicarpus indicus* which has been placed in *Samaropsis* by Seward, but other authors still prefer to place it in *Cordaicarpus* (SAHNI, 1921).

Diagnosis — Small pear-shaped unwinged seed, 4.5×3.4 mm.; sarcotesta drawn out for about 1 mm. and bifid at the apex. A very narrow border with longitudinal striations sometimes visible.

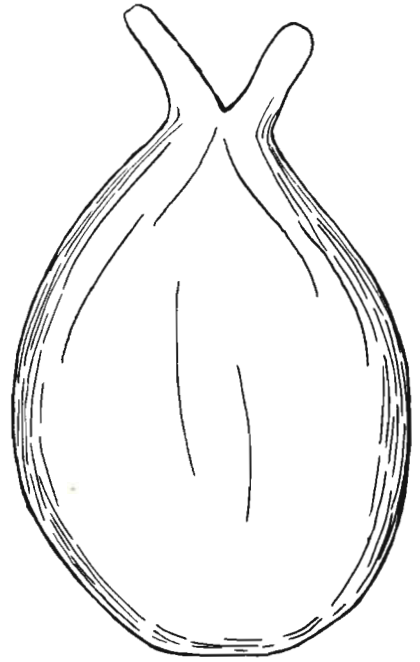
Genus — *Samaropsis* Goepfert

7. *Samaropsis goraiensis* sp. nov.

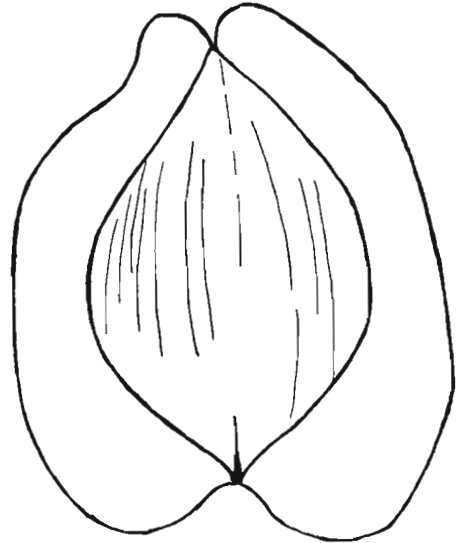
(Pl. 1, Figs. 3, 4, 14; Text-fig. 3)

There are four specimens of winged seeds which have been referred to a single new species of the genus *Samaropsis*. The seeds are incompletely preserved. The type specimen (Pl. 1, Figs. 3, 4; TEXT-FIG. 3) is, however, complete measuring 8×6 mm. The sclerotesta, measuring about 7×4 mm., is pear-shaped, both the ends being finely pointed. The sarcotesta is about 1.5 mm. wide in the middle. It narrows towards the apex and gradually widens towards the base which is distinctly cordate. Other seeds do not show any marked difference in size.

In these seeds an apical canal enclosed by sarcotesta is present (FIG. 14; TEXT-FIG. 3). The cleft or the "micropyle"



2



3

TEXT-FIGS. 2 & 3 — 2, *Cordaicarpus furcata* sp. nov. $\times 17$. 3, *Samaropsis goraiensis* sp. nov. $\times 8$.

reaches right up to the pointed apex of the nucule.

The present seed differs from all the known species of *Samaropsis*. From only one Talchir locality in the South Rewa Gondwana basin Feistmantel (1882, pp. 17, 50) has figured an incomplete specimen of *Samaropsis* and although it comes closer to our species in size, it does not show the characteristic pear-shaped nucule pointed at both ends. The Karharbari seed, *S. milleri*, is bigger and quite distinct from our specimen. *S. raniganjensis* described by Seward & Sahni (1920, p. 8) from Raniganj group is said to be identical with the *Samaropsis* described by Feistmantel (1879, p. 30) from Karharbari beds. Our specimen differs from it in having the nucule pointed at both the ends, presence of cleft-like micropyle at the apex and a wing which is broader and cordate at the base. Some of the seeds from Talchir group from other localities figured by Feistmantel (1886) are fragmentary and it is difficult to compare them with our specimens. The present seed is, therefore, described under a new specific name.

Diagnosis — Small winged seed, about 8×6 mm., sclerotesta pear-shaped, pointed at both the ends. Sarcotesta 1.5 mm., broadens towards the base which is cordate. A fine canal or micropyle present at the apex.

Genus — *Paranocladus* Florin

8. *Paranocladus* ? *indica* sp. nov.

(Pl. 1, Figs. 13, 15)

There are about half a dozen specimens of small sterile foliage shoots in our collection, all of them probably representing lateral shoots. In two specimens there is an indication of branching which appears to be irregular and perhaps scattered (Pl. 1, Fig. 13). The branches are densely clothed with leaves. The leaves are of one kind, spirally arranged and somewhat spreading. They are cuneate-lanceolate, entire, uninerved and perhaps decurrent. The tips are acute or acuminate.

From the Upper Carboniferous and Lower Permian of the southern hemisphere three genera of conifers are definitely known. They are *Buriadia* (SEWARD & SAHNI, 1920, p. 12), *Paranocladus* (FLORIN, 1940-45, p. 319) and *Walkomiella* (FLORIN, 1940, p. 3). *Buriadia* is distinct in habit, possesses somewhat sparsely clothed, spreading branch-

lets with leaves as a rule repeatedly forked at the apices and traversed by dichotomizing bundles. *Walkomiella* again is different in habit, possesses squamiform, somewhat concavely curved leaves. Our specimen, however, agrees with the generic description of *Paranocladus* which possesses irregularly branched lateral shoot system. The branches are covered by homomorphic, spirally arranged leaves, either somewhat spreading or adpressed which are entire, bifacial, broadly decurrent and probably uninerved.

Two species of *Paranocladus* are known, viz. *P. dusenii* from Iraty Shales (Passa Dois Series) and *P. ? fallax* from Tuberao Series from the State of Parana in Brazil. In external morphology *Paranocladus* ? *indica* appears to be different from both the Brazilian species. *P. dusenii* is based mainly on epidermal characters which are not known in *P. indica*.

It is interesting to note that all the three southern genera of conifers have now been found in the Lower Gondwanas of India.

Diagnosis — Branching irregular, branches densely clothed with homomorphic, spirally arranged somewhat spreading leaves. Leaves cuneate, lanceolate, entire, perhaps decurrent and uninerved; the tips acute or acuminate.

Genus — *Arberia* White

9. *Arberia umbellata* sp. nov.

(Pl. 1, Fig. 8)

The collection includes a megasporophyll-like organ (Pl. 1, Fig. 8) similar to those described by White (1908) under the name *Arberia*. The specimen measures 1.5 cm. in length and 1.2 cm. at the broadest part. It has a slender stalk about a millimeter in width which expands upwards into a flattened head bearing a number of recurved processes, on the margin of which were perhaps borne the ovules in inverted position. One of the processes faintly shows something like an attached ovule of *Cordaicarpus* type but as the preservation is bad, this cannot be confirmed.

Feistmantel (1881, p. 59) had figured one inflorescence or a fructification from the Karharbari beds which was later included by White (1908) under *Arberia indica*. The genus *Arberia* was instituted by White for including small-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" (WHITE, 1908, p. 537). These bodies are obviously some sort of megasporophylls bearing ovules. Lundqvist (1919, p. 19) described *Arberia* (?) *brasiliensis* from Brazil which shows an axis with recurved branches and *Cordaicarpus* seeds in organic connection. Our specimen is different from this and is more akin to *Arberia indica* and *Arberia minasica* (SEWARD, 1910, p. 516), except that in *A. umbellata* the head appears to be shortened, umbrella-like and the processes are long and strongly recurved, overlapping those which are below them. In *A. indica* the processes are in the form of curled lobes which are truncated.

Diagnosis — A megasporophyll-like body; stalk slender, flattening above into a head with a number of overlapping, strongly recurved processes on either side.

10. Equisetaceous Stem

(Pl. 1, Fig. 5)

The occurrence of equisetalean stems is already known from this locality. Our collection also contains fragmentary impressions of stems possessing badly preserved ribs on their surface. One of them is shown in Pl. 1, Fig. 5.

COMPARISON AND DISCUSSION

From Talchir beds of India very few plants have been recorded so far (see TABLE 1), every locality yielding only a few forms. However, in the upper Rikba stage there is an evidence of plant life in abundance and it is regarded as similar to that of immediately succeeding Karharbari stage. For this reason the two floras have been grouped under one name, the Talchir-Karharbari flora. The discovery of a number of fossil plants in Talchir beds of Goraia opens up the possibility of finding plant life of that period at other localities also. And only when we know more about the Talchir flora we shall be in a better position to judge the relationship between the flora at the commencement of the Gondwana period, and those succeeding it.

As regards the flora from the Talchir beds of South Rewa Gondwana basin, although the types are few, fossil plants have been

reported from six different localities (see TABLE 1). From Goraia Feistmantel (1880, p. 183) reported only one equisetaceous stem but the recent collection made by one of us and described here resulted in the discovery of ten fossil types. The fossil plants are as follows (HUGHES, 1884, p. 14).

**Gangamopteris cyclopteroides*

**Gangamopteris cyclopteroides* var. *attenuata*

Gangamopteris major

Gangamopteris cf. *spathulata*

Glossopteris sp.

**Noeggerathiopsis hislopi*

Samaropsis sp.

Vertebraria indica

*Equisetaceous stems

Species marked with asterisks are found at Goraia also. *Samaropsis* sp. reported by Feistmantel (1882, p. 50) from South Rewa is an incomplete specimen and appears different from *Samaropsis goraiensis* described by us. As regards varieties of *Gangamopteris cyclopteroides* we have very few in our collection, but another collection may yield some more forms. *Glossopteris* sp. and *Vertebraria indica* are absent from Goraia collection. Feistmantel (1882, p. 17), however, made a report of *Glossopteris* sp. from South Rewa but has not given any description or a figure.

From Goraia four new types have been added.

Cordaicarpus furcata sp. nov.

Samaropsis goraiensis sp. nov.

Paranocladus? *indica* sp. nov.

Arberia umbellata sp. nov.

The conifer genus *Paranocladus* has been reported for the first time from India. This genus was created by Florin (1940-45, p. 319) for a conifer found in the Permo-Carboniferous deposits of the State of Parana in Brazil. This find of the South American conifer in the Lower Gondwanas completes the finding of all the three known southern hemisphere genera of conifers in India. As regards *Arberia*, it is known so far only from the Karharbari stage. Talchir and Karharbari specimens, of course, differ from each other, but this genus represents only the reproductive part of some plant which might have been present both in Talchir as well as in Karharbari deposits. The two likely genera it may have belonged to are *Gangamopteris* and *Noeggerathiopsis*, the probability of the latter genus being more. The genus *Cordaicarpus* is also known only from the Karharbari stage except in Kathwai in the Punjab

Salt Range from where Virkki (Mrs. K. Jacob) has reported *Cordaicarpus sahnii*.

So far a good assemblage of plants from Talchir beds is known only from Rikba. *Noeggerathiopsis hislopi*, equisetaceous stems and all the varieties of *Gangamopteris cyclopteroides* from Goraia are also known from Rikba (FEISTMANTEL, 1886). The species of *Samaropsis* appears to be different at two places, but the coniferous branchlet (it is not *Paranocladus*), *Vertebraria indica* and two species of *Glossopteris* have not been found at Goraia. However, it may be pointed out that *Cordaicarpus*, *Paranocladus*? and *Arberia* have also not been reported from Rikba.

A good number of forms have also been recorded from the Punjab Salt Range at Kathwai by Virkki (1938). This flora shows several new forms which have not been found

either at Rikba or Goraia (see TABLE 1). Virkki reported two species of *Glossopteris* and only three species of *Gangamopteris* in addition to *Sphenopteris*, ?*Pecopteris*, ?*Schizoneura*, *Cardiocarpus* and *Ottokaria*-like fronds. This material was collected from carbonaceous shales of the basal portion of the speckled sandstone series from a horizon only about 20-25 ft. above the Talchir boulder bed. Predominance of *Glossopteris* species over the *Gangamopteris* species, together with the presence of ?*Schizoneura*, *Sphenopteris*, ?*Pecopteris* and *Ottokaria* is rather striking. Krishnan (1949, pp. 312, 313) correlates this plant bed with that of Rikba. But when more authentic Talchir forms are known, it will be possible to judge correctly the position of the Salt Range flora in relation to Talchir flora from other localities in India.

REFERENCES

- FEISTMANTEL, O. (1879). The Fossil Flora of the Lower Gondwanas: The Flora of the Talchir-Karharbari Beds. *Mem. Geol. Surv. India. Pal. Indica.* 3(1).
- Idem (1880). Palaeontological Notes from Karharbari and South Rewa Coalfields. *Rec. Geol. Surv. India.* 13(3): 183.
- Idem (1881). Flora of the Talchir-Karharbari beds (Suppl.). *Mem. Geol. Surv. India. Pal. Indica.* 3(1).
- Idem (1882). The Fossil Flora of the South Rewah Gondwana Basin. *Ibid.* 4(1).
- Idem (1886). The Fossil Flora of the Gondwana System: The Fossil Flora of Some of the Coalfields in Western Bengal. *Ibid.* 4(2).
- FLORIN, R. (1940). On *Walkomiella* n. gen. A genus of Upper Palaeozoic Conifers from Gondwanaland. *K. Svensk. Vet. Handl.* 18(5): 1-23.
- Idem (1940-45). Die koniferen des Obercarbons und des Unteren Perms. *Stockholm.*
- HUGHES, T. W. H. (1884). The Southern Coalfields of the Rewah Gondwana Basin. *Rec. Geol. Surv. India.* 21(3): 1-103.
- KRISHNAN, M. S. (1949). Geology of India and Burma. *Madras.*
- LUNDQVIST, G. (1919). Fossil Pflanzen der Glossopteris flora aus Brasilien. *K. Svensk. Vet. Handl.* 60(3): 1-36.
- SAHNI, B. (1921). The Present Position of Indian Palaeobotany. *Proc. 8th Indian Sci. Cong. Calcutta (Pres. Add.)*: 152-175.
- SEWARD, A. C. (1910). Fossil Plants. 2. Cambridge.
- Idem (1917). *Ibid.* 3. Cambridge.
- SEWARD, A. C. & SAHNI, B. (1920). Indian Gondwana Plants — A Revision. *Mem. Geol. Surv. India. Pal. Indica.* N.S. 7(1).
- VIRKKI, C. (1938). A Lower Gondwana Flora from the Salt Range, Punjab. *Proc. 25th Indian Sci. Cong.*: 150.
- WALKOM, A. B. (1922). Palaeozoic Floras of Queensland: The Flora of the Lower and Upper Bowen Series. *Queens. Geol. Surv. Publication No.* 270: 1-45.
- WHITE, D. (1908). Fossil Flora of the Coal Measures of Brazil; Commissao de estudos das minas de carvão de pedra do Brazil, *Rio De Janeiro.*
- ZEILLER, C. R. (1902). Observations sur Quelques plantes fossiles des Lower Gondwana. *Mem. Geol. Surv. India. Pal. Indica.* N.S. 2.

EXPLANATION OF PLATE 1

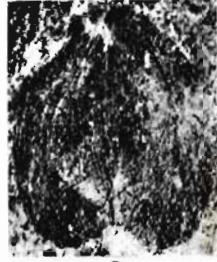
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|---|---|
| 1. <i>Noeggerathiopsis hislopi</i> . × Nat. size. | 9. <i>Cordaicarpus furcata</i> sp. nov. Type specimen. × Nat. size. |
| 2. <i>N. hislopi</i> . A small front. × 2. | 10. <i>Cordaicarpus furcata</i> in Fig. 9 enlarged. × 3. |
| 3. <i>Samaropsis goraiensis</i> sp. nov. Type specimen. × 4. | 11. <i>Gangamopteris</i> sp. × Nat. size. |
| 4. <i>Samaropsis goraiensis</i> sp. nov. Type specimen. × Nat. size. | 12. <i>Gangamopteris cyclopteroides</i> . × Nat. size. |
| 5. Equisetaceous stem. × Nat. size. | 13. <i>Paranocladus? indica</i> sp. nov. Paratype. × 3. |
| 6. <i>Gangamopteris</i> cf. <i>angustifolia</i> . × Nat. size. | 14. <i>Samaropsis goraiensis</i> sp. nov. Paratype. × 2. |
| 7. <i>Gangamopteris cyclopteroides</i> var. <i>attenuata</i> . × Nat. size. | 15. <i>Paranocladus? indica</i> sp. nov. Type specimen. × 3. |
| 8. <i>Arberia umbellata</i> sp. nov. Type specimen. × 3. | |



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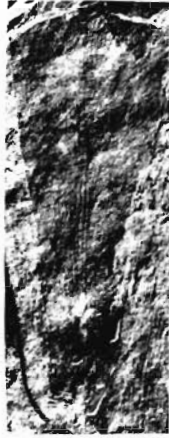
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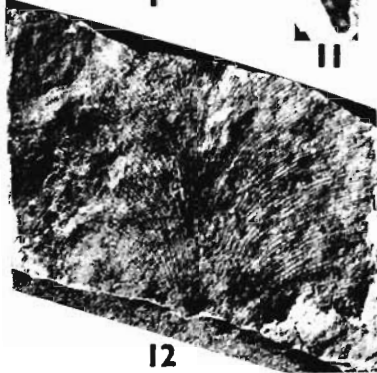
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