

STUDIES IN THE INDIAN MIDDLE GONDWANA FLORA —

2. PLANT FOSSILS FROM THE SOUTH REWA GONDWANA BASIN

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ABSTRACT

Plant fossils from the Middle Gondwana (Trias) beds of the South Rewa Gondwana basin are described. The flora consists of 15 genera and 16 recognizable species. Five species are new. The present findings serve to furnish the first record of certain interesting genera, viz. *Lycopodites*, *Danaeopsis*, *Marattiopsis*, *Psuedoctenis*, *Baiera* and *Desmiophyllum* from the Indian Triassic formations as well as confirm the occurrence of *Cladophlebis*, *Glossopteris*, *Noeggerathiopsis* and *Araucarites*.

It is suggested that this flora is the Indian representative of the general *Dicroidium* flora that flourished during the Triasso-Rhaetic times on the southern continents. The palaeobotanical evidence, as a whole, constitutes a strong point in support of a Middle Gondwana.

INTRODUCTION

A SMALL part of the present collection (1952-54) constituting *Dicroidium* remains has already been described in my previous paper (LELE, 1961). The present paper deals with a large part of the remaining material consisting of Pteridophytes, Pteridosperms and Gymnosperms. A few plant fossils belonging to the Aiyengar collection (1929) are also incorporated here. For the various fossil localities, reference may be made to the map shown in Text-fig. 1 in my previous paper (LELE, 1961). The palaeobotanical and geological evidence inclines me to regard these localities as Triassic (Middle Gondwana) in age. This evidence would be discussed separately elsewhere.

The fossils are mostly fragmentary and specific identifications are often difficult or impossible. The impressions are preserved on dark brown ferruginous rocks varying between shales to fine-grained shaly sandstones. Textural variations in the rock are also present at some localities. Various methods have been tried to obtain better photographs. Immersion of the fossil under xylol, alcohol or water was often found to be very useful in bringing out better contrast, relief and venation characters.

DESCRIPTION

Genus: *Lycopodites* Brong.
1. *Lycopodites sahnii* sp. nov.

Pl. 1, Figs. 1, 2; Text-figs. 1, 2

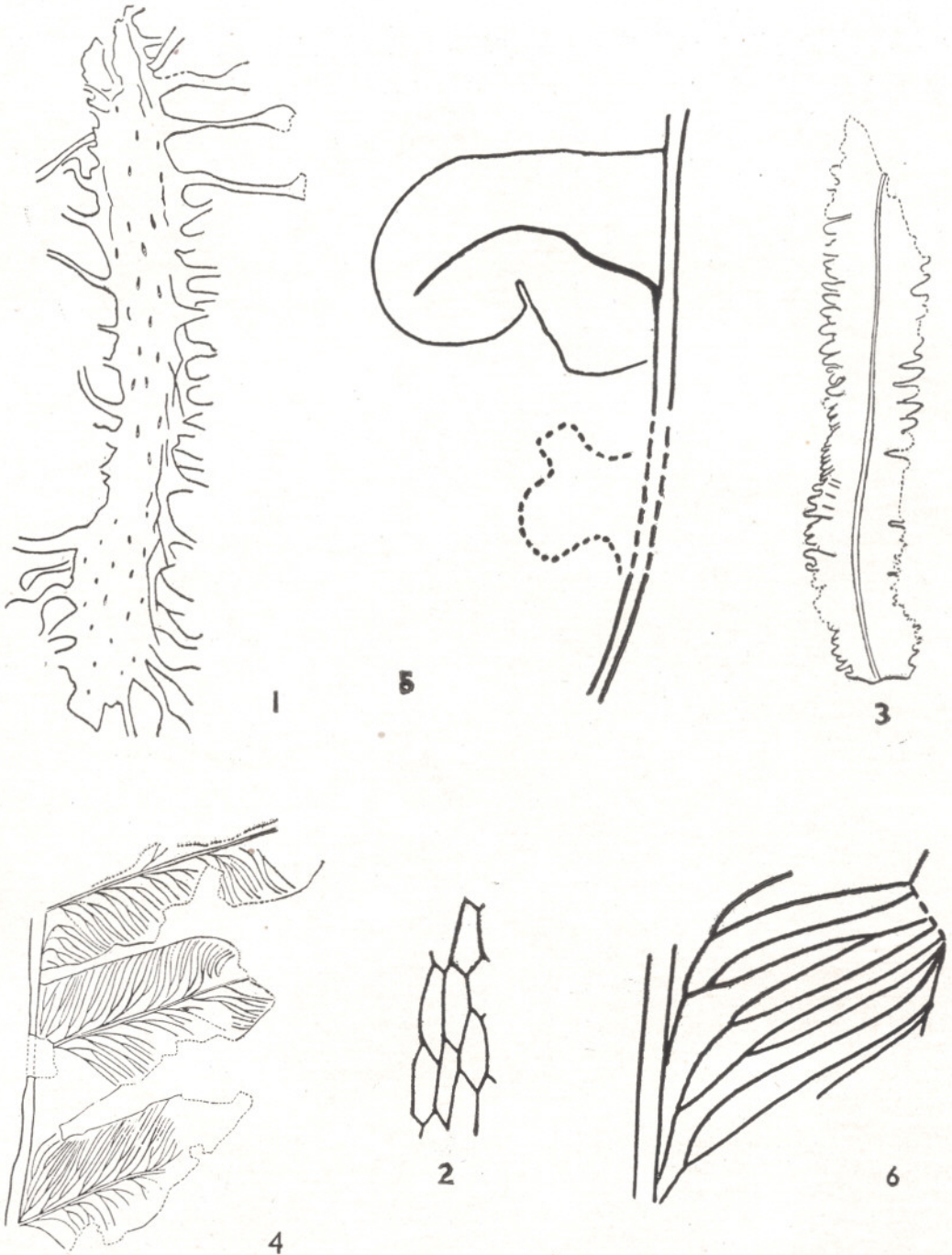
Diagnosis — Flattened stems, surface with narrow elongate, linear to elliptical remains of leaf-bases suggesting spiral arrangement of leaves over the stem; leaf-base with a single depression in the centre (? vascular supply); stem surface sculptured with \pm parallel striations converging towards the leaf-bases, leaves very narrow, linear, delicate, filamentous, close apart, their maximum exposed length 3-4 mm, breadth of leaves in the middle part about 0.5 mm, base broad, about 1 mm.; few parallel striations present on the leaf-surface.

Holotype — 8986 (PL. 1, FIGS. 1, 2; TEXT-FIGS. 1, 2); India, South Rewa Gondwana basin, Beli, Middle Gondwana (Trias). B.S.I.P. Museum.

The collections from near Beli (Localities 12, 13) has yielded two specimens of a flattened stem impression which is assigned to the genus *Lycopodites*.

The type specimen, obtained from locality 12 is shown in Pl. 1, Fig. 1; Text-fig. 1. The stem is incomplete, 2.3 cm. in length and 3 mm. in breadth. On the flattened surface of the stem are seen somewhat narrow elongated, linear to narrow elliptical scars which are the impressions left by the leaves at their base. These leaf-scars exhibit a spiral arrangement (PL. 1, FIG. 2). Some of the well-preserved scars seem to bear a single depression situated in the centre of the trace which may be the portion of the vascular bundle. Besides the leaf-traces, the surface of the stem when observed under high magnification, is sculptured with fine parallel striations which tend to converge towards the leaf-scars.

The leaves (PL. 1, FIG. 1) are seen arising at right angles from the sides of the stem. They are very delicate, narrow, linear, filamentous and more or less closely set.



TEXT-FIGS. 1-6 — 1, *Lycopodites sahnii*, drawing of the type specimen shown in Pl. 1, Fig. 1. \times ca. 3. 2, *Lycopodites sahnii*, a few epidermal cells observed under incident light on the distal portion of the leaf. \times 100. 3, *Marattiopsis* sp. A., showing form of the frond and the indented margins. \times ca. 3.5. 4, *Danaeopsis gracilis*, drawing of the type specimen shown in Pl. 2, Fig. 18 \times ca. 1.5. 5, *Danaeopsis gracilis*, drawing of the specimen shown in Pl. 2, Fig. 19. The leaf has a bluntly rounded apex. \times 2. 6, *Danaeopsis gracilis*, drawing of photograph shown in Pl. 2, Fig. 20, showing marginal anastomosis of secondary veins. \times 6.

In the majority of cases, their length is not completely known. Their maximum exposed length is from 3 to 4 mm. Along the profile the leaves are about 1 mm. apart. The breadth of the leaves is usually about 0.5 mm. in the middle part. Towards the base they are somewhat broader, measuring nearly 1 mm. across. The surface of the leaves is marked with fine, parallel striations, about 8-10 or more in number near base.

Imprints of epidermal cells have been observed under incident light in the distal portion of the leaves. The cells (TEXT-FIG. 2) are not well preserved, small, narrow, elongated and thin-walled. Their approximate size is $80-120 \times 25-45 \mu$.

Comparison — It seems that the fossil can well be incorporated in the genus *Lycopodites* and that it shows greater affinity with Lycopodiales than with any other plant group. That a lycopodiaceous plant might occur in these rocks is also suggested by the presence of a large number of megaspore impressions in the same bed containing the stem. The megaspores will be described elsewhere.

The fossils under consideration do not compare with any of the known species of *Lycopodites*. From India a single species, viz. *L. gracilis* is known from the Jurassic rocks of Rajmahal Hills (FEISTMANTEL, 1877, p. 87; SEWARD & SAHNI, 1920, p. 18). This species is readily distinguishable by the form of the leaves. As a matter of fact, our present knowledge of the Mesozoic lycopods is far from complete which affords no means for comparison. Hence the present specimens are referred to a new species.

Genus: *Schizoneura* Schimper & Mougeot
2. *Schizoneura gondwanensis* Feist.

Pl. 1, Fig. 3

There is a single incomplete specimen (PL. 1, FIG. 3) in the collection from Salaia (Locality 8) which is referred to the species *Schizoneura gondwanensis*. The fossil shows an axis about 7 cm. long and 5 mm. broad in the middle part. To the one end of the axis a leaf is attached. The leaf measures 4 cm. in length and 1.3 cm. towards the upper part. The apex of the leaf is not preserved. There are at least 16 distinct, parallel, longitudinal veins on the sheath. Commissural lines are not visible. Feistmantel (1880, p. 62) records the maximum number of veins seen on the leaf-sheath of *Schizoneura gondwanensis* as 14.

The present specimen has little more veins in number. However, the Salaia specimen is quite similar to the forms of *S. gondwanensis* recorded by Feistmantel from the Karharbari to the Panchet Stage. The present specimen is more like the Raniganj and Panchet forms (FEISTMANTEL, 1880, p. 61).

3. *Equisetalean Remains*

(i) *Stem* — Equisetalean stems are common at a number of localities. These stems are devoid of leaves or leaf-sheaths and cannot, therefore, be satisfactorily identified. However, it seems probable that these leafless stems belong mostly to *Schizoneura* or *Phyllothea* and in some cases to *Equisetites*.

(ii) *Nodal Diaphragm* (PL. 1, FIG. 4) — The isolated nodal diaphragm shown in Pl. 1, Fig. 4 is the single specimen found in the collection from Daigaon (Locality 7). It measures about 8 mm. in diameter. There are about 20 ridges radiating from a central cavity. On other blocks a few fragmentary stems are present but they are too imperfectly preserved to permit identification. Under these circumstances it is difficult to say as to what equisetalean genus this fossil be assigned. Amongst the Lower Gondwana equisetalean genera *Schizoneura* and *Phyllothea* are common, while *Equisetites* is more abundant in the Upper Gondwana rocks. The relation of the present nodal diaphragm with one of these can only be suggested at present.

Genus: *Sphenopteris* Brongniart
4. *Sphenopteris polymorpha* Feist.

Pl 1, Fig. 5

There are about 10 specimens obtained from Salaia (Locality 8) which are referred to this species. One of the more complete specimens is about 8 cm. long and 5.5 cm. broad. It represents a compound frond the axis of which is "winged", about 1.5 mm. wide, bearing more or less opposite pinnae at a wide angle. A pinna from this specimen is shown in Pl. 1, Fig. 5. The pinnules are of diverse shapes; oval with rounded apex and with almost entire margin to somewhat triangular, with denticulations or lobes. Primary nerve of the pinnules bifurcates to give rise to a Sphenopteroid type of venation.

The species *S. polymorpha* is well-known in the Barakar and Raniganj stages of the Lower Gondwana (FEISTMANTEL, 1880, p. 76). The present specimen is closely comparable with

the one figured by Feistmantel (*loc. cit.* PL. XVII, FIG. 3).

The Indian Upper Gondwana species of *Sphenopteris* (OLDHAM & MORRIS, 1863; FEISTMANTEL, 1877, p. 70; 1877a, p. 85; SITHOLEY, 1954), are not comparable with the present form.

Remarks—From the present area Feistmantel (1882, p. 10) has recorded this species from two localities (Localities 1, 3) which he classed under Raniganj. However, the available field evidence appears to suggest that the present locality (No. 8) together with Feistmantel's above mentioned localities represent a horizon which is somewhat younger than Raniganj (Permian).

5. *Sphenopteris* sp. A.

Pl. 1, Figs. 6, 7

This is a small, incomplete frond (PL. 1, FIGS. 6, 7) collected from Daigaon (Locality 7) measuring 2.3×1.4 cm. The rachis bears a few pinnules at acute angle. The pinnules are linear, somewhat contracted at the base and possess acuminate apices. One of them measures 1 cm. \times 4 mm. At one or two places they are lobed towards base. A faint median vein gives out at acute angles a number of forked secondary veins.

The present specimen is too small and the only one available for study. It is, therefore, difficult to identify it with the known species. However, judged from the somewhat lobed pinnules and their slightly contracted base, the specimen can be referred to *Sphenopteris*. It differs from *S. polymorpha* in possessing more linear type of pinnules which are basally somewhat contracted and have an acuminate apex. The Upper Gondwana species of *Sphenopteris* also differ from the present specimen. The present specimen can, therefore, be referred to *Sphenopteris* sp. A till more data is available.

6. *Sphenopteris* sp. B.

Pl. 1, Fig. 8

A single incomplete specimen obtained from Mirli (Locality 18) is referred to the genus *Sphenopteris*. The specimen (PL. 1, FIG. 8) is very small, only 7 mm. long and 4 mm. broad. The rachis bears alternate, cuneate pinnules possessing two or three lobes. The apex is obtuse. Veins are not seen.

The specimen is too imperfect for specific identification. The general shape and lobing of pinnules recalls the Upper Gondwana-species *Sphenopteris arguta* (cf. OLDHAM & MORRIS, 1863, PL. XXXII, FIGS. 1, 2, 3; FEISTMANTEL, 1877a, PL. II, FIG. 8). However, the imperfect nature of the specimen does not permit its identification with *S. arguta* with confidence. It is, therefore, referred to as *Sphenopteris* sp. B.

7. *Sphenopteris* sp. C.

Pl. 1, Figs. 9, 10

Two specimens referable to *Sphenopteris* from Beli (Locality 12) and Kamtadand (Locality 9) are shown respectively in Figs. 9 and 10. They possess a number of more or less ovate pinnules with obtusely pointed apex and narrow base. The lower margin of the pinnules is roundly curved and is markedly narrowed near attachment. A midvein gives out forked lateral veins and rapidly becomes indistinct a short distance away from the base. The fragmentary nature of the specimens does not permit comparison.

Genus: *Cladophlebis* Brongt.

The genus *Cladophlebis* is characteristic of the Jurassic floras. Its occurrence from the Triassic strata is known from Australia (WALKOM, 1917), Tasmania (WALKOM, 1925a), New Zealand (ARBER, 1917) and South Africa (DU TOIT, 1927). In India it is represented by several species in the Upper Gondwana (Jurassic). The Triassic record of *Cladophlebis* from India is very imperfect. The material described below is unfortunately not sufficiently well preserved for definite specific identifications. At any rate, the evidence helps to furnish a definite occurrence of the genus *Cladophlebis* in the Triassic Gondwanas of India.

Cladophlebis sp. cf. *C. denticulata* Brongt.

Pl. 1, Figs. 11, 12; Pl. 2, Figs. 13, 14

Three specimens in the collection from near Beli (Locality 12) and one from Daigaon (Locality 7) are here referred to *Cladophlebis*. The specimen from Beli (PL. 1, FIGS. 11, 12) represents an incomplete pinna, measuring 3 cm. in length and 1.3 cm. in breadth. The axis of the pinna is slender, a little less than 1 mm. broad. The pinnules are alternate, closely set, somewhat overlapping, small,

ovate-linear to somewhat falcate, about 7 mm. long and 3-4 mm. broad, with an acute apex (PL. 2, FIG. 13). The lower margin of the pinnules is somewhat roundly curved and (?) contracted near the base. The midrib of the pinnules is persistent for most part and becomes evanescent near apex. Forked secondary veins arise at an acute angle and usually dichotomize once more before reaching the margin (PL. 1, FIG. 12).

The other frond from Daigaon shown in PL. 2, FIG. 14 is a compound leaf. The rachis bears opposite pinnae on either side, one of them on the right side measuring about 1.5 cm. in length. The pinnae are attached by a broad base and gradually taper towards an acute apex. They are somewhat falcate. Their margin is entire or somewhat denticulate. Secondary veins arise from the pinna rachis with a fork and further dichotomize.

From Parsora (Locality 10), Feistmantel (1882, p. 29; PL. 8, FIGS. 2, 3) has recorded some imperfect specimens as *Asplenium whitbyense*. In more recent years these specimens are believed to belong to *Cladophlebis denticulata* (COTTER, 1917, pp. 24-30; FOX, 1931, p. 183; SAHNI, 1922, p. clxiii; 1926, p. 246). My specimens specially those from Beli do not completely agree with the Parsora specimens. However, it seems probable that the species *C. denticulata*, in a comprehensive sense, might accommodate all these records.

10. *Cladophlebis* sp. (? cf. *C. shensiensis* P'an)

PL. 2, FIG. 15

The solitary specimen (PL. 2, FIG. 15) has come from Kamtadand (Locality 9). It shows few separate more or less falcate, entire acute pinnules which are attached by their whole base to a slender axis. The anterior margin of the pinnules is concave and the posterior margin strongly convex. The venation, as far as is visible, consists of a midvein which is almost as strong as the secondaries. It vanishes in the middle part of the pinnule by branching into veinlets. The lateral veins are given out at an acute angle and dichotomize more than once.

The shape and venation of the pinnules recall the Upper Triassic species *Cladophlebis shensiensis* of P'an (1936, p. 15). Unfortunately, however, the present specimen is too fragmentary for definite identification.

Genus: *Marattiopsis* Schimp.

11. *Marattiopsis* sp. A.

PL. 2, FIGS. 16, 17; Text-fig. 3

There is a single interesting specimen from Kamtadand (Locality 9) which I am disposed to include under the generic name *Marattiopsis*. The leaf (PL. 2, FIG. 16; TEXT-FIG. 3) is incomplete, narrow, linear, measuring 2.2 cm. \times 4 mm. The midrib is persistent and about 0.5 mm. broad. The margin of the lamina shows moderately deep denticulations. Most of the denticulations have, however, broken and, therefore, look blunt, but in complete cases they are \pm pointed. The secondary veins are coarse and badly preserved. It is, however, discernible that the veins arise from the midrib with a gentle curve near the emergence and then run more or less at right angles to the midrib. In most cases they seem to be single, but occasionally may be forked close to the emergence. The surface of the leaf is wrinkled which indicates the rather fleshy nature of the frond.

The frond appears to be fertile. At the apex of each vein there is an elongated swelling (PL. 2, FIG. 17) which might represent synangia. The details regarding the synangia cannot be studied as they appear to lie on the other side of the frond. The position of the synangia appears to be Marattaceous.

The well-known Indian Jurassic form *Marattiopsis macrocarpa* Morris described by Seward & Sahni (1920, p. 20) shows no comparisons with the present specimen. Other best known species of *Marattiopsis* from other countries have been critically revised by Harris (1931, pp. 64-67). It seems that certain features like the shape of the base of the pinnae, the length of the sporangia and the width of the pinnae, etc., have greater importance in specific identification. Unfortunately, however, most of these characters cannot be satisfactorily ascertained in the present specimen because of its unsatisfactory preservation. This solitary specimen is, however, much smaller and narrower and seems to differ in this respect from other well-known species of *Marattiopsis*. It might possibly turn out to be a distinct species. For the present, however, it is described as *Marattiopsis* sp. A.

Remarks — The genus *Marattiopsis* is more characteristic of the Triassic and Jurassic vegetation of the world. From the Trias of the Southern Continents, du Toit (1927)

has recorded *M. muensteri* from S. Africa. But his identification has been disputed (HARRIS, 1931, p. 65). The occurrence of this genus, recorded for the first time from the Triassic Gondwana of India is, therefore, interesting.

Genus: *Danaeopsis* Heer

12. *Danaeopsis gracillis* sp. nov.

Pl. 2, Figs. 18-20; Text-figs. 4-6

Diagnosis — Fronds pinnate, rachis slender, pinnae moderately small, with \pm bluntly rounded apex and somewhat decurrent lower margin, midrib persistent almost up to apex, secondary veins arising with a curve, bifurcating at or close to their emergence and dichotomizing at least once more at the middle course and occasionally anastomosing near the margin, in the decurrent basal part a few veins directly arise from the rachis. Fertile pinnae unknown.

Holotype — 8987 (PL. 2, FIG. 18; TEXT-FIG. 4); *Paratype* — 8990 (PL. 2, FIG. 19; TEXT-FIG. 5); India, South Rewa Gondwana basin, Beli, Middle Gondwana (Trias). B.S.I.P. Museum.

There are three specimens in the collection from near Beli (Locality 12) which are assigned to *Danaeopsis*.

The type specimen shown in Pl. 2, Fig. 18; Text-fig. 4 consists of a slender rachis about 3 cm. long and 1 mm. broad to which three closely set and moderately small leaves are attached by the whole of their base and at an angle of nearly 45 degrees. The longest pinna (top) measures 2.5 cm. in length and the middle one has a breadth of 1.2 cm. The leaves are broadly linear, with more or less parallel sides for the most part and a slightly broader base. Near the apex the leaves terminate into a more or less bluntly rounded apex (PL. 2, FIG. 19; TEXT-FIG. 5). The lower margin of the leaves is somewhat decurrent near the base.

The midrib is fairly prominent and persistent for the most part except near the apex where it thins out. Secondary veins (PL. 2, FIG. 18; TEXT-FIG. 4) commonly arise with a curve, passing out towards the margin at a wide angle. The veins are wider apart near the midrib but tend to come closer and are commonly curved up near the margin. Their frequency is about 2-3 per mm. in the middle part. They are forked at or close to their emergence and dichotomize at least once near the middle course before reaching

the margin (PL. 2, FIGS. 18, 20). In the decurrent basal part of the lower margin of the pinna, a few forked veins are seen to directly arise from the rachis.

At a few places, specially near the margin, the secondary veins are seen to anastomose (PL. 2, FIG. 19; TEXT-FIG. 4). The single isolated pinna on the left side of the rachis in the specimen shown in Fig. 18 also shows at one or two places near the margin the anastomosis of two adjacent ultimate veins (PL. 2, FIG. 20; TEXT-FIG. 6). The anastomosis of secondary veins is a feature important to *Danaeopsis* and its genotype *D. marantacea* (GOTHAN & WEYLAND, 1954, p. 113; HALLE, 1927, p. 131).

The species *D. marantacea* Presl. and *D. fecunda* Halle 1921 (also see SZE, 1956, p. 135) differ from the present form in having considerably large and robust fronds characterized by lanceolate-linear and fairly long pinnae which are often slightly narrowed at the basal part and gradually taper towards a broadly rounded apex. The present specimens, however, strongly suggest a small and slender type of frond characterized by small pinnae with bluntly rounded apex and somewhat decurrent lower margin. The venation agrees more with *D. fecunda*, but anastomosis of veins in the present case is not so frequent.

The above two species, in sterile state, are fairly comparable to each other, but their fertile pinnae are somewhat different (SZE, 1956, pp. 136, 137). Although the present specimens are only sterile, they seem to be distinct from the known species and deserve a new name.

Remarks — The genus *Danaeopsis* is characteristic of the Triasso-Rhaetic formations. The specimens originally described as *Danaeopsis hughesi* by Feistmantel (1882, p. 25) from Parsora (Triassic) have now been proved to belong to *Dicroidium* (LELE, 1961). The present species is evidently the first record of *Danaeopsis* from the Triassic of India.

Genus: *Glossopteris* Brongt.

13. *Glossopteris browniana* Brongt.

The ferruginous sandy shales near Salaia (Locality 8) contain a large number of *Glossopteris* leaves. The collection includes three specimens of *Glossopteris browniana*. These specimens compare with some of those figured by Feistmantel from the Barakar and Raniganj stages.

14. *Glossopteris indica* Schimp.

This well-known species is represented at Salaia (Locality 8) by about a dozen specimens.

15. *Glossopteris communis* Feist.

This species was recorded by Feistmantel (1882, p. 9) from near Ghogri, a place which I regard as either the same or very near to Salaia (Locality 8) from where more specimens of *G. communis* have now been collected.

16. *Glossopteris* sp.

Pl. 2, Fig. 21; Text-fig. 7

There are two fragmentary specimens obtained from near Beli (Locality 14) which are referred to *Glossopteris*. One shown here (FIG. 21; TEXT-FIG. 7) measures 1.8×1.1 cm. and has a somewhat delicate, about 0.5 mm. broad midrib. The veins arise at a wide angle with some curve near their emergence. Although the specimen is incomplete, a few anastomoses are clearly visible towards the lower part which justify its reference to *Glossopteris*.

The specimen seems to be rather small and may represent a narrow linear frond like *Glossopteris angustifolia*.

It may be pointed out that the above specimen from Beli shows close resemblance with the one recorded by me (LELE, 1955, PL. 2, FIGS. 18, 21) from Parsora (Locality 10) as *G. ? browniana*. The Parsora specimen, which is more complete, represents a small, narrow-linear, spatulate frond comparable with *G. angustifolia*. While its reference to *G. browniana* seems very doubtful, it is equally difficult to assign it to *G. angustifolia* with certainty. The venation of the specimens from Parsora and Beli is very similar and perhaps the two are specifically indistinguishable. It is, however, more appropriate to leave the Parsora and Beli specimens as *Glossopteris* sp. till more material is available.

Remarks — At one time the occurrence of *Glossopteris* in the Parsora beds was doubted or denied (Fox, 1931). The presence of this genus at Parsora and Beli is now well established. Both these localities are stratigraphically of the same age (Triassic).

Genus: *Taeniopteris* Brongt.

17. *Taeniopteris* sp. cf. *T. feddeni* Feist.

Pl. 2, Fig. 22

There is a single specimen obtained from near Beli (Locality 14) which can be best referred to the genus *Taeniopteris*.

The frond (PL. 2, FIG. 22) is incomplete, measuring 2.8 cm. in length and 2.5 cm. at the broader part. The midrib is slender, about 1 mm. wide. The lamina is not entire but apparently dissected into two or three imperfect segments producing a false resemblance to the pinnae of *Pterophyllum* or *Nilssonia*. However, a closer examination of the specimen shows that the segments are not regular in outline, and it seems probable that the leaf was originally entire as in *Taeniopteris* but was torn irregularly during the course of preservation.

The secondary veins arise from the midrib at right angles. They are forked or simple. Their frequency per centimeter is 24-28.

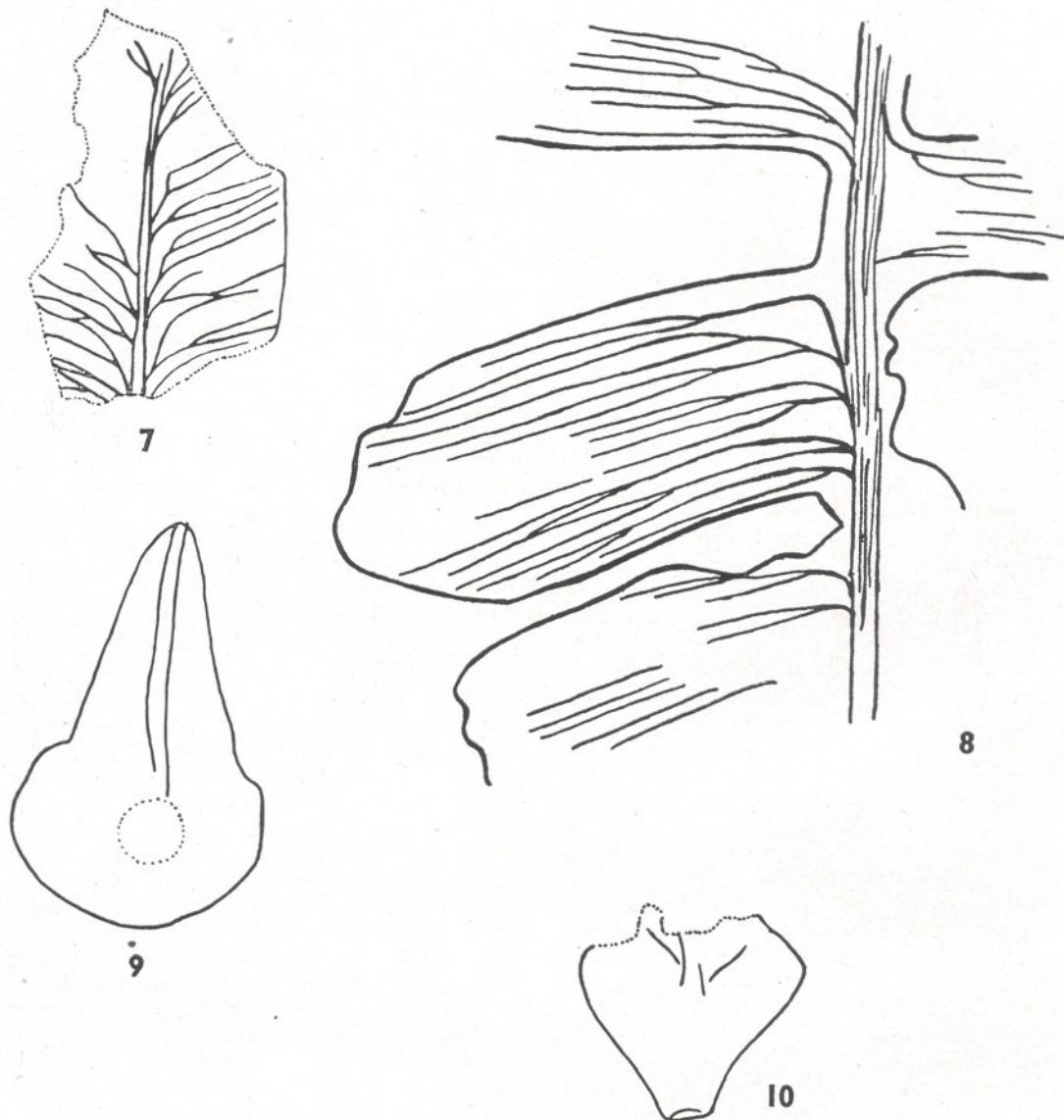
Feistmantel (1881, pp. 88-90) has described *Macrotaeniopteris danaeoides* and *M. feddeni* from the Lower Gondwana (Barakar and Raniganj Stages) of India. These species have subsequently been transferred to *Taeniopteris* by Arber (1905, p. 120). Amongst these the species *T. feddeni* (cf. FEISTMANTEL, 1881, PL. XXIA, FIG. 3; PL. XXIIA) compares closely with the present specimen in the delicate nature of the midrib, the closely set secondary veins and their frequency (cf. *loc. cit.* PL. XXIA, FIG. 3). However, the fronds of *T. feddeni* are normally considerably large in size, and show other characters in the secondary veins at different points in the same frond which cannot be seen in the present specimen owing to its unsatisfactory preservation. It can, however, be compared with *T. feddeni*. The Upper Gondwana forms of *Taeniopteris* described by Oldham & Morris (1863, pp. 32, 41) (some of them under *Stangerites*) and by Feistmantel (1877, pp. 43-52) under *Angiopteridium* and *Macrotaeniopteris* differ widely from the present specimen in respect of the nature of midrib and venation.

Genus: *Pterophyllum* Brongt.

18. *Pterophyllum* ? *sahnii* Lele

Pl. 3, Fig. 23

The species *Pterophyllum sahnii* was described by me (LELE, 1955, p. 28) on material collected from Parsora (Locality 10).



TEXT-FIGS. 7-10 — 7, *Glossopteris* sp. drawing of specimen in Pl. 2, Fig. 21 showing anastomosing secondary veins. $\times 3$. 8, *Pseudoctenis balli*. drawing of part of the specimen shown in Pl. 3, Fig. 24 to show cross-connection in the secondary veins reproduced in Pl. 2, Fig. 26. $\times 5$. 9, *Araucarites indica*, form of the cone-scale shown in Pl. 4, Fig. 33. $\times 6$. 10, ? *Araucarites* sp., form of the scale shown in Pl. 4, Fig. 38. $\times 6$.

Amongst the small collection of Aiyengar from Daigaon (Locality 7), there is a very incomplete specimen (PL. 3, FIG. 23) of a Cycadophytic frond which is doubtfully referred to *P. sahnii*. On the right side of a stout rachis measuring 3 mm. wide, a single broad segment is seen laterally attached at

right angles. The incomplete segment measures 2×2.4 cm. Veins usually arise with a fork at or near the emergence and then run parallel to the edge of the segment rarely showing bifurcation again. In the middle portion their frequency is about 16 per centimeter which agrees with that of

P. sahnii. Perhaps better and more well-preserved specimens from this locality might confirm the presence of this species.

Genus: *Pseudoctenis* Sew.

19. *Pseudoctenis balli* (Feist.) Sew.

Pl. 3, Figs. 24-26; Text-fig. 8

There are about a dozen specimens of a cycadophytic frond in the collection from Salaia (Locality 8) which can be referred to the species *Pseudoctenis balli*. The fronds are commonly small in size. The one reproduced in Pl. 3, Fig. 24 is 5.8 × 2.7 cm. It has a slender rachis which is longitudinally striated and bears laterally attached pinnae. The apical pinnae are somewhat obliquely set. They are comparatively narrow and short in the lower part and become broader and longer higher up. In the other specimen (Pl. 3, Fig. 25) the pinnae are more or less equal. The base of the pinnae is somewhat contracted and decurrent, while their tip is roundly truncate. The veins are nearly 3 per millimeter. Usually they arise with a curve, are forked near the emergence and may further dichotomize (Pl. 3, Fig. 24). At a few places in the uppermost segment of the specimen in Fig. 24 cross-connections are visible. The left-hand pinna, third from top, also shows anastomosis (Pl. 3, Fig. 26; TEXT-FIG. 8).

The present specimens agree closely with those originally described by Feistmantel (1881a, p. 256, PL. II, FIGS. 3, 4) as *Anomozamites balli* and subsequently (ibid, 1886, p. 37; PL. IIA, FIGS. 4-8; PL. IIIA, FIG. 2) as *Platypteridium balli*. Ultimately, it was transferred to *Pseudoctenis balli* by Seward (1917, p. 586) and redescribed by Seward and Sahni (1920, p. 14, PL. 4, FIG. 41).

Remarks — In India this species was so far known only from the Barakar Stage (Lower Gondwana; Permian) of the Auranga Coal-field (FEISTMANTEL, 1886). However, from the African Triassic beds du Toit (1927, p. 384) has recorded *P. cf. balli*. The African specimen is bigger but it also shows relatively smaller pinnae in the lower part as in my specimens.

The genus *Pseudoctenis* is characteristic of the Triasso-Rhaetic strata. It is well represented in the *Dicroidium* flora of South Africa (DU TOIT, *loc. cit.*; pp. 384-391) by half a dozen species. From the Queensland Triassic Walkom (1917, p. 19; PL. 7, FIGS. 1-2) described *P. cathiensis* which has fairly

long pinnae. From India the occurrence of *P. footeana* Feist. (SEWARD & SAHNI, 1920, p. 33) was so far the only known example from the Mesozoic rocks (Upper Gondwana). The present finding furnishes the first record of this genus from the Triassic beds.

Genus: *Baiera* Braun

20. *Baiera indica* sp. nov.

Pl. 3, Figs. 27, 28

Diagnosis — Frond more or less wedge-shaped, deeply dissected into a number of parallel-sided, narrow, linear, thin segments forking usually not more than once and at a somewhat acute angle; segments 1.5-3 mm. broad, length incomplete, about 3.4-4 cm., petiole not evident; veins (?) few, 4-5, thin, parallel.

Holotype — 8924 (PL. 3, FIGS. 27, 28) India, South Rewa Gondwana Basin, Beli Middle Gondwana (Trias). B.S.I.P. Museum

Amongst the fossils from near Beli (Locality 13) there is a single interesting specimen of a ginkgoalean frond strongly recalling *Baiera*. The specimen (PL. 3, FIG. 27) is not perfectly complete. It is more or less wedge-shaped, measuring 5 cm. in length and about 4 cm. across along the broadest region. The frond is deeply incised into a number of parallel-sided, narrow, linear segments measuring about 3.4-4 cm. in length and 1.5 to 3 mm. in breadth. The frond does not exhibit a repeated dichotomy, most of the segments being usually once forked at a somewhat acute angle. A few incomplete and fragmentary segments are seen overlapping the frond obliquely. Complete segments are absent owing to which the nature of their tip cannot be ascertained. The substance of the leaf is thin. The frond is incomplete near its base and apparently there is no indication of a distinct petiole.

The venation is poorly preserved. A few segments, however, show about 4-5 thin, parallel lines running through the lamina (PL. 3, FIG. 28) which appear like veins. Branching in veins is not visible. In case of the two extreme left segments (PL. 3, FIG. 27) there is a distinct median line which seems to join a little below the point of incision of the two segments. Is it probable that the median line represents a suture along which further incision could take place?

A precise distinction between the leaves of *Ginkgoites* and *Baiera* has frequently been

found difficult. Judged according to the schemes suggested by Harris (1935, pp. 47-50) and Florin (1936, pp. 44, 45), it seems justifiable to include the present specimen under *Baiera*.

Comparison — The occurrence of *Baiera* in India is limited to a doubtful specimen from the Upper Gondwana (Jurassic) rocks of Rajmahal Hills (MEHTA & SUD, 1953, PL. 1, FIG. 1). The Rajmahal specimen does not possess narrow, linear and parallel-sided segments as in the present case. Both are, therefore, distinguishable. This genus is well represented in the Triassic rocks of Africa (DU TOIT, 1927, p. 373; SEWARD, 1903, p. 64), Australia (WALKOM, 1917, pp. 10-12), Tasmania (WALKOM, 1925a, p. 85) and Argentina (KURTZ, 1921). Of the above records the Australian example *B. ipsviciensis* Shirley and the Tasmanian specimen *B. tenuifolia* possess narrow linear segments as in the present specimen. However, they show more elaborate dichotomy and the number of veins is also more. The present frond is, therefore, ascribed to a new species.

Remarks — The genus *Baiera* has an important place in the *Dicroidium* flora of the Southern Hemisphere. Its occurrence, recorded for the first time from the contemporary Indian flora, is hence interesting.

21. Leaves Referable to *Ginkgoales*

The record of ginkgoalean remains from India is far from complete. Till recently the occurrence of *Ginkgoites* was confined to *Ginkgoites lobata* described by Feistmantel (1877a, p. 18) from the Jabalpur group, and *G. crassipes* and *Ginkgoites* sp. described by the same author (1879, p. 31) from the Madras Coast. Recently Sah (1952; 1953) and Mehta & Sud (1953) have contributed more specimens referred to *Ginkgoites* sp. from the Rajmahal Hills. All these records are of Upper Gondwana (Jurassic) age. The Triassic *Ginkgoales* were hitherto completely unknown from India, although they are well represented in the contemporaneous strata (*Dicroidium* flora) in other parts of Gondwanaland. Apart from *Baiera indica* described above, a few very fragmentary remains have now been obtained from the Triassic strata of the present area. Although it is extremely difficult to identify them with confidence, it seems likely that these fragments might represent isolated segments of some Ginkgoalean fronds.

(i) *Leaf Type A* (PL. 3, FIGS. 29-31) — Two incomplete impressions in the collection from near Beli (Locality 14) represent one type of leaf.

The first specimen (PL. 3, FIG. 29) and its counterpart (PL. 3, FIG. 30) measures 2.8 cm. in length and 1.3 cm. at its broadest part. The lamina is apically incised about 4 mm. deep into two lobes which have roundly pointed tips. The margin of the lamina is somewhat parallel but towards the lower end, the right-hand side margin tends to narrow down (PL. 3, FIG. 29) which suggests that near the base (which is not preserved) the leaf gradually tapered, as in the lobes of *Ginkgoites* or *Baiera*. Veins are rather coarse, bifurcating near the lower end and going up in the two lobes, somewhat converging near their tips. The distance between the veins in the middle part of the leaf is nearly 1 mm.

The other specimen (PL. 3, FIG. 31) shows a comparatively deeper incision, although one of the lobes is broken. The tip of the other lobe is similar to that of the other specimen. Veins are, however, about 2 per mm. and not so coarse.

The material is not sufficient to determine with any pretence to accuracy the generic position of the present specimens. It seems, however, probable that they represent a portion of some ginkgoalean frond akin to *Ginkgoites* or *Baiera*. Comparisons may be suggested to a certain extent with the lobes of *Ginkgoites taeniata* (BRAUN) described by Harris (1935, p. 19; TEXT-FIGS. 9, 10). Similarly some specimens described under *Baiera* cf. *australis* McCoy by Halle (1913, p. 37; PLS. 4, 5) also possess lobes which in fragmentary state may look like the present specimens.

Genus: *Noeggerathiopsis* Feist. 22. *Noeggerathiopsis hislopi* Bunb.

PL. 3, Fig. 32

There are two specimens in the collection from Daigaon (Locality 7) which are identified as *Noeggerathiopsis hislopi*. One of them reproduced in Fig. 32 shows the basal part of the frond and measures 5.5 × 1.5 cm. A number of prominent veins arise from the base and go straight up in a slightly diverging manner. They are seen to dichotomize during their upward course. The present specimens are quite comparable with the Lower Gondwana forms (FEISTMANTEL, 1880,

p. 23, PL. XIX, FIGS. 1-6; PL. XX, FIGS. 1, 1a; 1886, p. 40; PL. XIII, FIG. 5).

Remarks — The species *N. hislopi* is well known from the Lower Gondwana (Palaeozoic) of India. It is also recorded from the Triassic rocks of Parsora (Locality 10) by Feistmantel (1882, p. 41, PL. 9, FIGS. 1-3) and by Lele (1955, p. 28).

That this Lower Gondwana species persisted in the Middle Gondwana (Triassic) is further strengthened by its first record from Daigaon beds (Locality 7).

Genus : Araucarites Presl.
23. Araucarites indica sp. nov.

Pl. 4, Figs. 33-37; Text-fig. 9

Diagnosis — Detached cone scales, moderately small in size, proximal outline more or less round or bluntly pointed, distal portion drawn out into a long triangular spine possessing a distinct median groove reaching up to the position of seed; seed represented by a single rounded scar; surface of scale with small, isodiametric, polygonal, thick-walled, irregularly arranged cells.

Holotype — 9016 (PL. 4, FIG. 33; TEXT-FIG. 9); *Paratype* — 9016 (PL. 4, FIG. 34); India, South Rewa Gondwana Basin, Beli, Middle Gondwana (Trias). B.S.I.P. Museum.

Four specimens of detached cone scales are referred to a new species of *Araucarites*.

The type specimen obtained from near Beli (Locality 12) (PL. 4, FIG. 33; TEXT-FIG. 9) measures 9×6 mm. The proximal outline of the scale is more or less round or in others it may be bluntly pointed (PL. 4, FIG. 34). The distal portion is drawn out into a long triangular spine about 5 mm. long and nearly 3 mm. across at its base. A distinct median groove is present on the spine and ends in close proximity of the position of seed. A comparatively bigger but incomplete specimen from the same locality (PL. 4, FIG. 35) shows the spine and the median groove more prominently. The seed is not preserved but there seems to be a more or less round area which perhaps marks the position of a single, small seed. The specimen from near Beli (Locality 14) shown in PL. 4, FIG. 36 is not so well-preserved but shows identical features.

The surface of the scale shows imprints of small epidermal cells under strong incident light. The cells (PL. 4, FIG. 37) observed in the type specimen are usually somewhat

isodiametric, polygonal and appear to be rather thick-walled. They are arranged irregularly and measure nearly $20-40 \times 15-30$ microns in size. No stomata could be seen.

From the Jurassic of India (Upper Gondwana) two species of detached cone scales, viz. *A. cutchensis* and *A. macropterus* are known (FEISTMANTEL, 1876, p. 62; 1877b, p. 24). Recently Singh (1956) has found a new petrified cone scale, viz. *A. nipaniensis* from the Jurassic strata. From the Triassic beds at Parsora (Locality 10), I described *A. parsorensis* (LELE, 1955, p. 30).

The scales of *A. cutchensis* are usually somewhat triangular in outline, longer than broad, and in most cases the spine is given out from a more or less flat distal surface (cf. FEISTMANTEL, 1877a, PL. XIV, FIGS. 2, 3, 6-9, 14-16). A better and perhaps more representative specimen of this species is reproduced by Seward & Sahni (1920, PL. VI, FIG. 63). The other species *A. macropterus* is characterized by large and almost circular scales (SEWARD & SAHNI, *loc. cit.* p. 34). The scale of *A. nipaniensis* is distinguished by a comparatively small seed placed on a very prominently winged cone scale. In its shape also, this scale is easily distinct from all others. The scales of *A. parsorensis* are broadly triangular, almost as long as broad and the ovule occupies almost the whole length of the scale.

The present specimens are rather small, more or less rounded in outline and the spine is proportionately more conspicuous and has a well-marked groove. They can be distinguished on these grounds from the above species. The epidermal character of the present specimen is also different from that of *A. parsorensis* and *A. nipaniensis*. It is, therefore, proposed to describe the scales in question under a new specific name.

24. ? Araucarites sp.

Pl. 4, Figs. 38-41; Text-fig. 10

There are three specimens obtained from near Beli (Locality 12) which appear like detached scales although it is not certain whether they are araucarian. They are thin and characterized by a triangular form. The specimen (PL. 4, FIG. 38; TEXT-FIG. 10) measures 4 mm. in length and 5 mm. at the broadest distal end. The tip, if there

was any, is not preserved in any specimen. The distal margin is irregular. The scale tapers towards the proximal region and ends into a somewhat truncate narrow base. No seed is present on the scale. The second specimen (PL. 4, FIG. 39) is relatively bigger.

The third specimen (PL. 4, FIG. 40) shows imprints of epidermal cells on the surface under incident light. The cells (PL. 4, FIG. 41) are polygonal, thin-walled, slightly longer than broad, and seem to be arranged along the proximo-distal axis of the scale. They measure approximately $25\text{-}50 \times 20\text{-}30 \mu$ in size.

The scales in question are rather strikingly small in size and have a thin, delicate appearance. A seed or a corresponding scar is also not evident. It seems probable that these objects are young scales.

Genus: *Desmiophyllum* Lesq.

The generic name *Desmiophyllum* is a useful and convenient designation for linear leaves which otherwise cannot be precisely assigned to genera like *Phoenicopsis*, *Podozamites* or sometimes even *Noeggerathiopsis* (*Cordaites*) because of lack of evidence regarding the mode of attachment with shoots. There are a number of leaves in the present collection for which it is safer to employ the non-committal term *Desmiophyllum* as has already been done by Sahni (1928, p. 8).

The genus *Desmiophyllum* was known so far only from the Upper Gondwana rocks of India. The specimens now obtained from the present area show that this genus also occurs in the Triassic strata.

25. *Desmiophyllum indicum* Sahni

Pl. 4, Figs. 42-44

The difficulty of assigning detached leaves to genera like *Phoenicopsis* and *Podozamites* is well illustrated by the Upper Gondwana species *Desmiophyllum indicum* described by Sahni (1928, p. 8). The leaves included under this species comprise a large number originally described by Feistmantel (1877a; 1879, 1882) as different species of *Podozamites* as well as a specimen assigned to *Phoenicopsis* sp. by Seward (1919, p. 453) and subsequently doubtfully regarded as *Phoenicopsis* sp. by Seward & Sahni (1920, p. 37).

Ultimately Sahni (1928, see Synonymy) placed all of them under *Desmiophyllum indicum*.

The collection from near Beli (Locality 12) has yielded a single specimen which is closely comparable to the forms included under *D. indicum* by Sahni. The specimen is complete but is broken into two parts which are respectively preserved in the hand specimen (PL. 4, FIG. 42) and its counterpart (PL. 4, FIG. 43). The reconstructed leaf is shown in Pl. 4, Fig. 44. The total length is 2.5 cm. and the widest apical part measures 7 mm. across. The form of the leaf is spatulate, the apex being round. The leaf gradually tapers to a blunt-ended base. Veins are few in the basal part and gradually increase in number higher up owing to dichotomy. Sahni (*loc. cit.*) states that the number of veins at the base is smaller (3 or 4) than it is higher up (7 or 8). In the present specimen the number of veins, at least in the higher portion, is greater. However, the size and shape of the present leaf, together with the general character of the venation strongly favour its reference to *D. indicum*.

Remarks — This species was so far known only from the Upper Gondwana rocks (Jurassic). The present find affords the first evidence of its occurrence in the Triassic strata (Middle Gondwana).

26. *Desmiophyllum taeniatum* sp. nov.

Pl. 4, Figs. 45-47

Diagnosis — Detached ribbon-shaped leaves, 1-2.5 cm. broad, (?) tips obtusely rounded; (?) base probably tapering, veins many, about 20-22 per cm., mostly parallel, simple but rarely branched.

Holotype — 8876 (PL. 4, FIG. 45); *Paratype* — 8976 (PL. 4, FIG. 46); India, South Rewa Gondwana basin; Beli; Middle Gondwana (Trias). B.S.I.P. Museum.

From near Beli (Locality 14) some good specimens have been obtained. A block shown in Fig. 45 contains three long, ribbon-like leaves which are about 1 cm. broad. The two margins of the leaf are almost parallel for the most part and tend to converge to an obtusely round termination which may be the apex. The other end (? base) is in no case found preserved. Perhaps the leaves have had a considerable length. In another specimen (PL. 4, FIG. 46), however, the leaf

appears to become narrower at one of the ends which may be the base. Commonly the leaves are about 1 cm. broad but there are other leaves which may be narrower or broader (about 2.5 cm. across) than those reproduced here.

The veins are parallel, usually fairly clear and generally 20-22 per centimeter. The frequency is, however, subject to some variation. The veins are not branched in the majority of cases, but in one case (PL. 4, FIG. 45, extreme right leaf) a vein is seen to dichotomize near the basal end towards the right-hand margin of the leaf (\times). This is further enlarged in Pl. 4, Fig. 47.

Comparison — The present specimens are readily distinguishable from the Indian Jurassic species *D. indicum* by their long ribbon-shaped form and much greater number of parallel and mostly simple veins. As regards the bluntly round apex and linear elongate shape of these leaves, they resemble some specimens described as *Phoenicopsis elongatus* from the Mesozoic rocks of South Africa (SEWARD, 1903), Australia and Tasmania (WALKOM, 1917, 1925) and Argentina (KURTZ, 1921). The present specimens cannot, however, be assigned to *Phoenicopsis* or to *P. elongatus* which is characterized by unbranched, simple, parallel veins. Although the veins in the present specimens are mostly parallel, they rarely show clear evidence of dichotomy. The present form is, therefore, regarded as distinct and is referred to a new species under *Desmiophyllum*. The Rhaetic specimen described as *Desmiophyllum* sp. by Gothan (1914, p. 73, PL. 30, FIG. 1) seems closely comparable with some broader examples of *D. taeniatum*.

Genus: *Conites* Sternb.

Pl. 4, Figs. 48, 49

A few cones found near Beli (Locality 12) in very incomplete state are best referred to the non-committal genus *Conites*.

The specimen in Fig. 48 has a few rhomboidal scars arranged spirally and measuring usually about $1.1-1.5 \times 1$ mm. No trace of vascular supply is evident. The other specimen (PL. 4, FIG. 49) and its counterpart differs from the previous one in possessing somewhat bigger scales which also appear to have narrow lateral wings. The scales are more or less rhomboidal in shape and spirally arranged. One of the comparatively bigger scales measures about 3×1 mm. in size,

Some of them bear a distinct circular elevation (? vascular supply) situated more or less in the centre (PL. 4, FIG. 49, V). Some traces of badly preserved epidermal cells are also visible on the surface of the scales under incident light.

CONCLUSION

That *Dicroidium* is a genus dominant in, and important to, the Triasso-Rhaetic formations of the South Rewa Gondwana Basin has now become quite clear (LELE, 1961). Amongst other genera associated with *Dicroidium* at Parsora I have already recorded the interesting occurrence of *Pterophyllum* and *Araucarites* (LELE, 1955). The present findings now bring to light more forms which were so far unknown to these formations. Of special mention are *Cladophlebis*, *Danaeopsis*, *Marattiopsis*, *Pseudocatenis*, *Baiera*, *Desmiophyllum* and *Araucarites*. These genera at once attest to the post-Palaeozoic age of the beds and the evidence viewed as a whole is strongly suggestive of a Triassic-Rhaetic Age. This contention finds further support from the fact that many of these genera, including the genus *Dicroidium*, are important to the *Dicroidium* flora known from the Triasso-Rhaetic formations of the Southern Continents. In fact, it seems justifiable to regard the Triasso-Rhaetic flora as the Indian representative of the Southern *Dicroidium* flora.

Another aspect of this flora is that while some of these genera are well represented in the Indian Jurassic flora (*Ptilophyllum* flora), there are also present a few hardy relics from the older *Glossopteris* flora such as *Glossopteris*, *Schizoneura* and *Noeggerathiopteris*. This peculiar assembly of plants with *Dicroidium* as their pioneer only adds strength to my previous contentions (LELE, 1955). The palaeobotanical character of the Triassic flora is, on the whole, distinct from both the Lower and the Upper Gondwana floras. This distinctiveness, in my opinion, constitutes a strong point in support of grouping the Triasso-Rhaetic formations into what is called a Middle Gondwana.

ACKNOWLEDGEMENT

I am grateful to Professor K. R. Surange for his guidance during the course of these investigations.

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EXPLANATION OF PLATES

(All photographs are from untouched negatives. The specimens are preserved in the Birbal Sahni Institute of Palaeobotany.)

PLATE 1

1. *Lycopodites sahnii* sp. nov. Stem showing the delicate leaves on the two sides in profile. Photographed by immersion under alcohol. Holotype No. 8986; B.S.I.P. coll. Near Beli (Loc. 12). × 2.
2. The above specimen enlarged to show the spirally arranged leaf-bases on its surface. × 3.
3. *Schizoneura gondwanensis* Feist. An axis bearing an incomplete leaf. No. 5157, B.S.I.P. coll. Salaia (Loc. 8). Nat. size.
4. Nodal diaphragm. No. 25/720, Aiyengar coll. Daigaon (Loc. 7). × Nat. size.

5. *Sphenopteris polymorpha* Feist. A pinna enlarged from the specimen. Photographed by immersion under xylol. No. 9056, B.S.I.P. coll., Salaia (Loc. 8). × 2.
6. *Sphenopteris* sp. A. No. K25/721, Aiyengar coll.; Daigaon (Loc. 7). × 2.
7. Counterpart of the above specimen showing venation. × 2.
8. *Sphenopteris* sp. B. Specimen enlarged to show the shape and lobing of the pinnules. Photographed by immersion under xylol. No. K25/826, Aiyengar coll.; Near Mirli (Loc. 18). × 5.
9. *Sphenopteris* sp. C. No. 8950, B.S.I.P. Coll.; near Beli (Loc. 12). × 2.



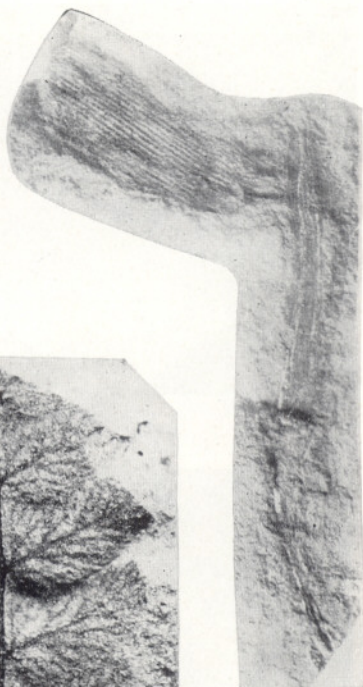
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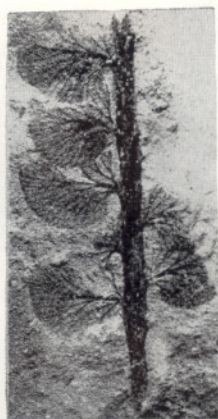
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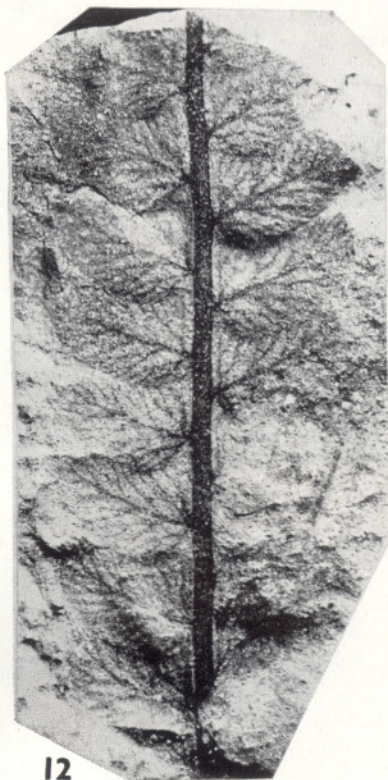
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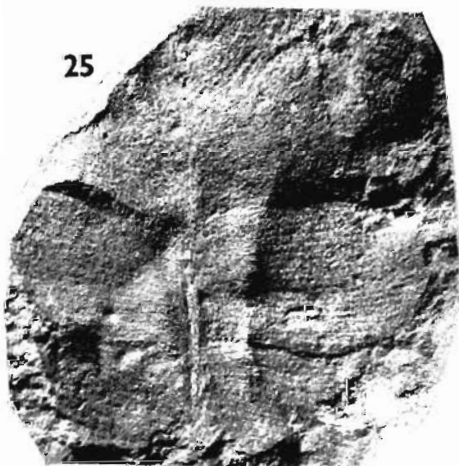
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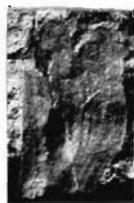
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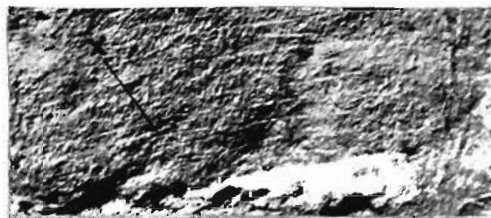
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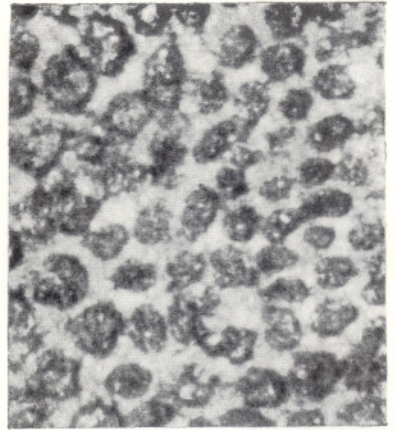
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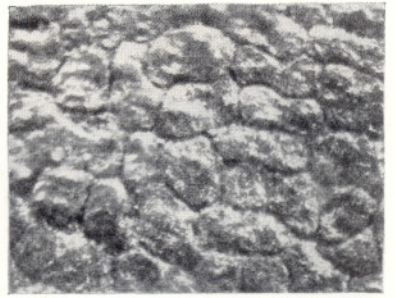
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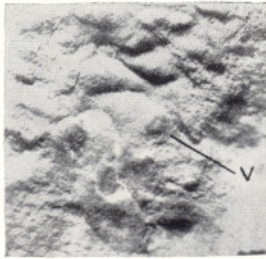
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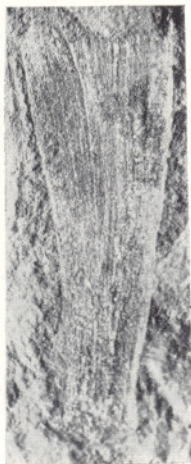
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10. *Sphenopteris* sp. C. Another specimen showing venation and shape of pinnules. Photographed by immersion under alcohol. No. K25/554, Aiyengar Coll.; Kamtadand (Loc. 9). × 2.
 11. *Cladophlebis* sp. A. No. 8993, B.S.I.P. Coll.; near Beli (Loc. 12). × Nat. size.
 12. The above enlarged to show form and venation of the pinnules. × 3.

PLATE 2

13. *Cladophlebis* sp. cf. *C. denticulata* Bgt. Counterpart of specimen in Pl. 1, Fig. 11, showing the shape of the pinnules. × 3.
 14. *Cladophlebis* sp. cf. *C. denticulata* Bgt. Showing a number of ± falcate, opposite, linear pinnules and their venation. No. K25/719, Aiyengar Coll.; Daigaon (Loc. 7). × 2.
 15. *Cladophlebis* sp. (? cf. *C. shensiensis* P'an). No. 8765, B.S.I.P. Coll.; Kamtadand (Loc. 9). × 3.
 16. *Marattiopsis* sp. A. No. 9096, B.S.I.P. Coll.; Kamtadand (Loc. 9). × Nat. size.
 17. A part of the above enlarged to show the swellings on the margin which are suggestive of sporangia. × 6.
 18. *Danaeopsis gracilis* sp. nov. Enlargement of the type specimen showing form and venation. Holotype, No. 8987, B.S.I.P. Coll.; near Beli (Loc. 12). × 2.
 19. *D. gracilis* sp. nov. Another specimen showing the bluntly rounded apex of leaf and marginal anastomosis of veins. Paratype, No. 8990, B.S.I.P. Coll.; near Beli (Loc. 12). × 2.
 20. *D. gracilis* sp. nov. The isolated leaf lying on the left of the rachis in Fig. 18 enlarged to show the venation and marginal anastomosis of secondary veins. × 6.
 21. *Glossopteris* sp. Specimen enlarged to show anastomosing secondary veins. No. 9004; B.S.I.P. Coll.; near Beli (Loc. 12). × 3.
 22. *Taeniopteris* sp. cf. *T. feddeni* (Feist.), No. 8884; B.S.I.P. Coll., near Beli (Loc. 14). × Nat. size.

PLATE 3

23. *Pterophyllum ? sahnii* Lele. No. K25/722, Aiyengar Coll., Daigaon (Loc. 7). × 2.
 24. *Pseudoctenis balli* (Feist.) No. 5164, B.S.I.P. Coll., Salaia (Loc. 8). × 2.
 25. *P. balli* (Feist.) Another specimen showing more or less equal segments. No. 9045, B.S.I.P. Coll., Salaia (Loc. 8). × 3.
 26. *P. balli* (Feist.). Part of the pinna (3rd left from top) in Fig. 24 enlarged to show cross-connection in the veins at one place (×). × 5.
 27. *Baiera indica* sp. nov. Holotype, No. 8924, B.S.I.P. Coll.; near Beli (Loc. 13). × Nat. size.

28. Segments enlarged from the above showing what appears like parallel veins. × 3.

29. ? *Ginkgoalean* leaf Type A. No. 8887, B.S.I.P. Coll.; near Beli (Loc. 14), showing a bifid apex and somewhat narrowing basal part. × Nat. size.
 30. Counterpart of the above. × Nat. size.
 31. ? *Ginkgoalean* leaf Type A. Another incomplete specimen showing a comparatively deeper apical incision. No. 8876, B.S.I.P. Coll.; near Beli (Loc. 14). × Nat. size.
 32. *Noeggerathiopsis hislopi* (Bunb.). A fragment showing lower half of the leaf and venation. No. K25/723, Aiyengar Coll., Daigaon (Loc. 7). × Nat. size.

PLATE 4

33. *Araucarites indica* sp. nov. Holotype, No. 9016, B.S.I.P. Coll., near Beli (Loc. 12). × 3.
 34. *A. indica* sp. nov. Paratype, No. 9016, B.S.I.P. Coll.; near Beli (Loc. 12). × 3.
 35. *A. indica* sp. nov. Comparatively bigger specimen showing a prominent median groove in the tip. No. 8978, B.S.I.P. Coll.; near Beli (Loc. 12). × 3.
 36. *A. indica* sp. nov. No. 8886, B.S.I.P. Coll.; near Beli (Loc. 14). × 3.
 37. Thick-walled epidermal cells as seen under incident light on the scale shown in Fig. 33. × 200.
 38-40. ? *Araucarites* sp. Triangular scale-like objects with ± truncate proximal end and broken distal portions. Nos. 9008, 8999 and 9008, B.S.I.P. Coll.; near Beli (Loc. 12). × 3.
 41. Thin-walled epidermal cells as seen under incident light on the specimen shown in Fig. 40. × 200.
 42. *Desmiophyllum indicum* Sahn. Lower portion of the leaf. No. 9003, B.S.I.P. Coll.; near Beli (Loc. 12). × 3.
 43. Counterpart of the above showing spatulate apex and bifurcating veins. × 3.
 44. Reconstruction of the complete leaf by composing Figs. 42 and 43. × 3.
 45. *Desmiophyllum taeniatum* sp. nov. Three ribbon-shaped leaves. One end (? apex) of the middle leaf is rounded and slightly narrow. Holotype, No. 8976, B.S.I.P. Coll.; near Beli (Loc. 14). × Nat. size.
 46. *D. taeniatum* sp. nov. The leaf gradually narrows down in the lower part (? base). Specimen No. and locality same as above. × Nat. size.
 47. *D. taeniatum* sp. nov. The part at x in the specimen in Fig. 45 enlarged to show a dichotomizing vein. × 3.
 48. *Conites*. No. 8971, B.S.I.P. Coll.; near Beli (Loc. 12). × 6.
 49. *Conites*. Showing a distinct circular elevation (V) on some of the scales. No. 8959, B.S.I.P. Coll.; near Beli (Loc. 12). × 6.