

On *Euryphyllum* Feistmantel and its epidermal features

Shaila Chandra & K.J. Singh

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The leaf form genus *Euryphyllum* Feistmantel 1879 is known by two species, viz., *E. whittianum* Feistmantel 1879 and *E. obovatum* Maithy 1970 from the Karharbari bed of Giridih Coalfield, India. Both these species are based on the external morphology only. For the first time epidermal features of this leaf are reported from the Early Permian beds of Talchir Coalfield and a new species—*E. maithyi* has been established. Besides, three specimens assignable to the type species of the genus *E. whittianum* are also recorded. All the specimens hitherto described and or transferred under this leaf genus have also been re-examined alongwith its possible affinities and affiliation.

Key-words—Plant megafossils, *Euryphyllum*, Talchir Coalfield, Early Permian (India).

Shaila Chandra & K.J. Singh, Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India.

सारांश

यूरीफिल्लम् फाइस्टमॅन्टेल एवं इसके उपचर्मीय लक्षण

शैला चन्द्रा एवं कमलजीत सिंह

भारत के गिरीडीह कोयला-क्षेत्र के करहरबारी संस्तर से यूरीफिल्लम् फाइस्टमॅन्टेल 1879 पूर्ण प्रजाति की यू. विटियानम् फाइस्टमॅन्टेल 1879 एवं यू. ओबोवेटम माइती 1970 नामक दो जातियाँ ज्ञात हैं। ये दोनों जातियाँ आकारिकीय लक्षणों पर ही आधारित हैं। पहली बार तलचिर कोयला-क्षेत्र के प्रारम्भिक परमियन संस्तरों से इनके उपचर्मीय लक्षण वर्णित किये जा रहे हैं तथा इन्हीं पर आधारित यू. माइतियाई नामक एक नई जाति बनाई गई है। इसके अतिरिक्त यू. विटियानम् से मिलते जुलते तीन प्रादर्श भी अभिलिखित किये गये हैं। अभी तक वर्णित अथवा स्थांतरित सभी प्रादर्शों का पुनः अध्ययन भी किया गया है।

IN the Glossopteris flora there are several leaf forms which overlap each other in their generic characters. The main characters are presence or absence of midrib and anastomoses formed by the secondary veins. *Noeggerathiopsis* Feistmantel 1876, *Euryphyllum* Feistmantel 1879 and *Rubidgea* Tate 1867 are three leaf forms which neither possess a distinct midrib, nor their secondary veins form reticulation instead are simply forked.

The name *Euryphyllum* was given by Feistmantel in 1879 to some ovate-spathulate asymmetrical leaf with narrow tapering base and obtuse apex from Early Permian bed of Giridih Coalfield. The leaf possessed erect, dichotomous, sub-parallel veins in the middle region and more or less arched towards margin. The leaf *Rubidgea* Tate 1867 is a distinct genus in having median veins like those of *Gangamopteris* McCoy but here the secondary veins do not reticulate

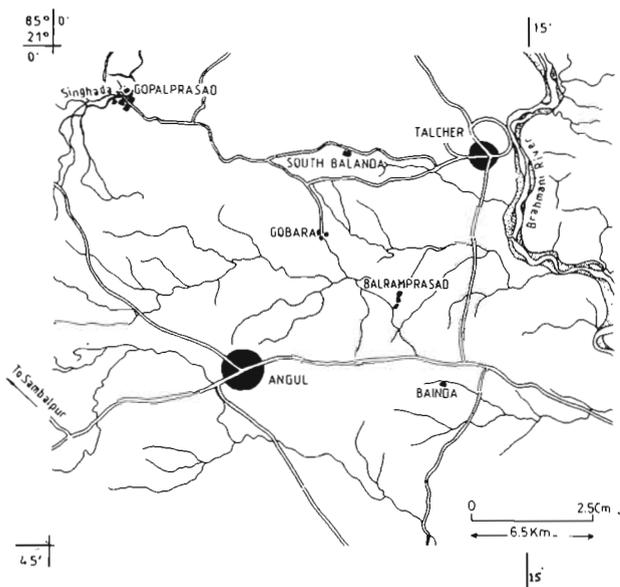
to form anastomoses. *Noeggerathiopsis* Feistmantel 1876 comes closest to *Euryphyllum* as it also has erect, dichotomous, subparallel veins throughout the lamina. In *Euryphyllum* the secondary veins arch out towards margin, while in *Noeggerathiopsis* they run straight. Arber (1905) considered *Euryphyllum* as a broader form of *Noeggerathiopsis hislopi* and therefore placed them under *N. whittianum*. Later on the distinction between the two was considered adequate for warranting a new generic name by Zeiller (1902), Seward and Sahni (1920), Maithy (1965) and Srivastava (1977). In addition to *Euryphyllum whittianum* Feistmantel 1879, Maithy (1970) instituted a new species *E. obovatum* from the same bed and locality.

All the hitherto reports of leaves of *Euryphyllum* are based on their external morphological features alone and we have no knowledge about their epider-

mal features. Our present specimens of *Euryphyllum* from the Early Permian beds of Talchir Coalfield, Orissa are significant as we could obtain well-preserved cuticles so as to enable us to study the epidermal features of this leaf form for the first time. The study is useful in ascertaining the affinities of this less known and rare form of the Glossopteris flora.

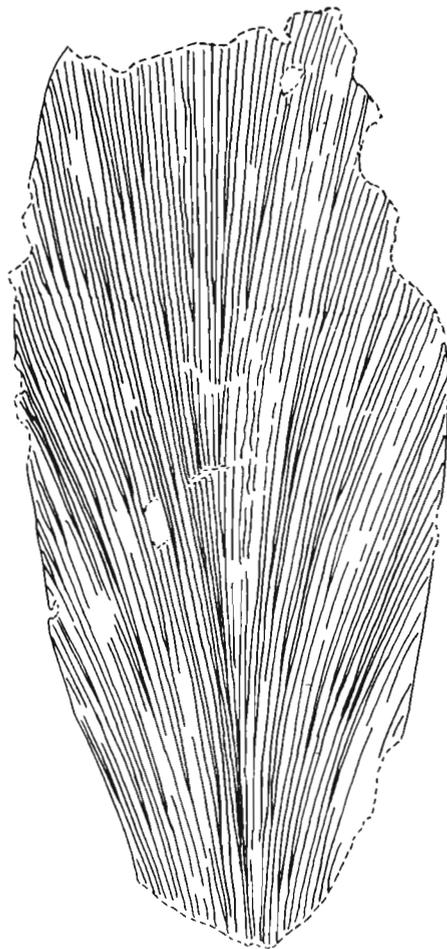
LOCALITY

The studied carbonaceous specimens, numbering four, were collected from a shale band, exposed at South Balanda Colliery in the Talchir Coalfield, Orissa. Exact location of the collection site can be seen in the locality map of the area (Text-figure 1). The other elements of the collected flora are conifers, *Gangamopteris*, *Noeggerathiopsis*, *Glossopteris*, *Surangephyllum*, *Raniganjia* and some axes in order of dominance. The typical Glossopteris assemblage resembles the Karharbari flora (Early Permian age)



Text-figure 1—Map showing a part of Talchir Coalfield, Orissa, depicting the fossil locality.

reported from Giridih Coalfield (Feistmantel, 1879; Maithy, 1965), Auranga Coalfield (Srivastava, 1977) and South Karanpura Coalfield (Kulkarni, 1971). All the four specimens identified as *Euryphyllum* are compressions on hard carbonaceous shales. The cuticles were pulled out by applying cellulose acetate solution and macerated in usual manner following Schultz's method.



Text-figure 2—*Euryphyllum maithyi* sp. nov., showing slightly asymmetrical, obovate leaf with obtuse apex and incomplete base. Specimen no. BSIP 36865. x 2.

PLATE 1

1. *Euryphyllum maithyi* sp. nov. Slightly asymmetrical, obovate leaf showing obtuse apex and incomplete base. Specimen no. BSIP 36865. x 2.
2. *Euryphyllum whittianum* Feistmantel. Incomplete leaf. Specimen no. BSIP 36866. x 2.
3. *E. whittianum* Feistmantel. Slightly asymmetrical leaf with narrow base. Specimen no. BSIP 36867. x 2.
4. *E. whittianum* Feistmantel. A portion of another specimen of this species (Pl. 2, fig. 4) enlarged to show median straight veins and lateral arched, forked, coarse veins. x 4.
5. *E. maithyi* sp. nov. Lower epidermis showing polygonal cells, stomata with overhanging papillae and stomatal pore. Slide no. BSIP 36865-1. x 450.

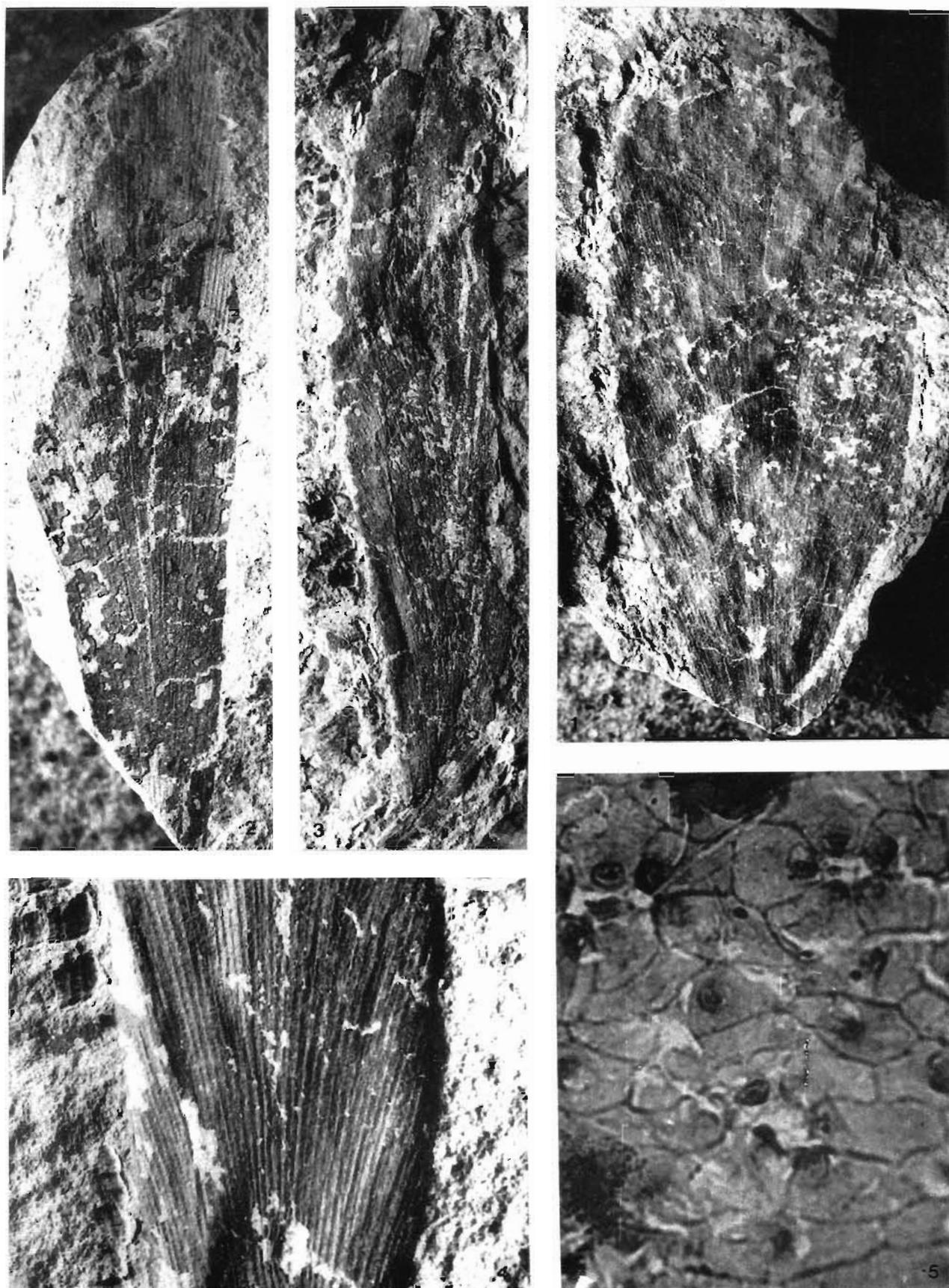
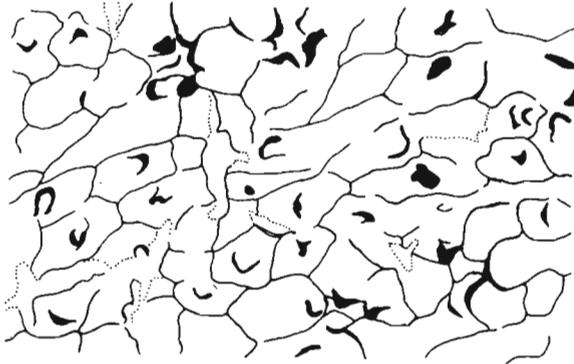
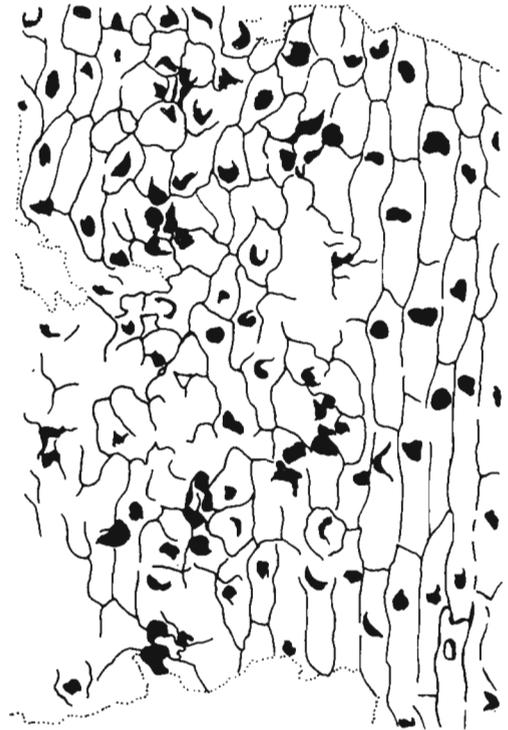


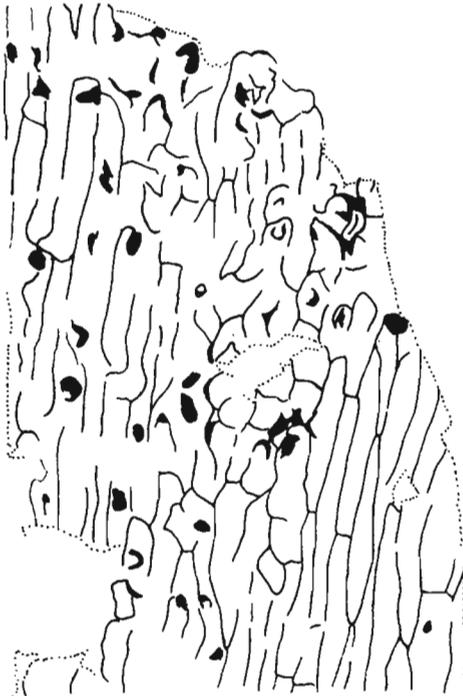
PLATE 1



Text-figure 3—*Euryphyllum maithyi* sp. nov., upper epidermis showing polygonal cells with papillae. Slide no. BSIP 36865-1. x 450.



Text-figure 5—*Euryphyllum maithyi* sp. nov., lower epidermis showing elongated narrow cells of vein region and polygonal cells in between vein region, median papilla in each cell. Slide no. BSIP 36865-1. x 300.



Text-figure 4—*Euryphyllum maithyi* sp. nov., upper epidermis showing elongated as well as polygonal cells and orientation of stomata. Slide no. BSIP 36865-1. x 350.

DESCRIPTION

Euryphyllum maithyi sp. nov.

Pl. 1, figs 1, 5; Pl. 2, figs 1, 2, 3; Text-figures 2, 3, 4, 5, 6

Diagnosis—Leaf slightly asymmetrical, obovate, apex obtuse, base appears to be narrow, curvature of leaf margins asymmetrical; dichotomous sub-parallel veins emerging from base, densely spaced, density 5-6 veins/cm², central veins straight, veins in lateral portion divergent and arched towards margin; lamina amphistomatic, stomata evenly distributed between veins, absent in vein region; cells of upper and lower epidermis straight-walled, much elongated, nar-

PLATE 2

1. *Euryphyllum maithyi* sp. nov. Lower epidermis showing elongated narrow cells of vein region and polygonal cells in between vein region, median papilla in each cell. Slide no. BSIP 36865-1. x 300.
2. *E. maithyi* sp. nov. Upper epidermis showing polygonal cells and orientation of stomata. Slide no. BSIP 36865-1. x 450.
3. *E. maithyi* sp. nov. Enlargement of stomata showing six subsidiary cells and overhanging papillae. Slide no. BSIP 36865-1. x 1000.
4. *E. whittianum* Feistmantel. Almost complete leaf with smooth margin and narrow base. Specimen no. BSIP 36868. x 2.

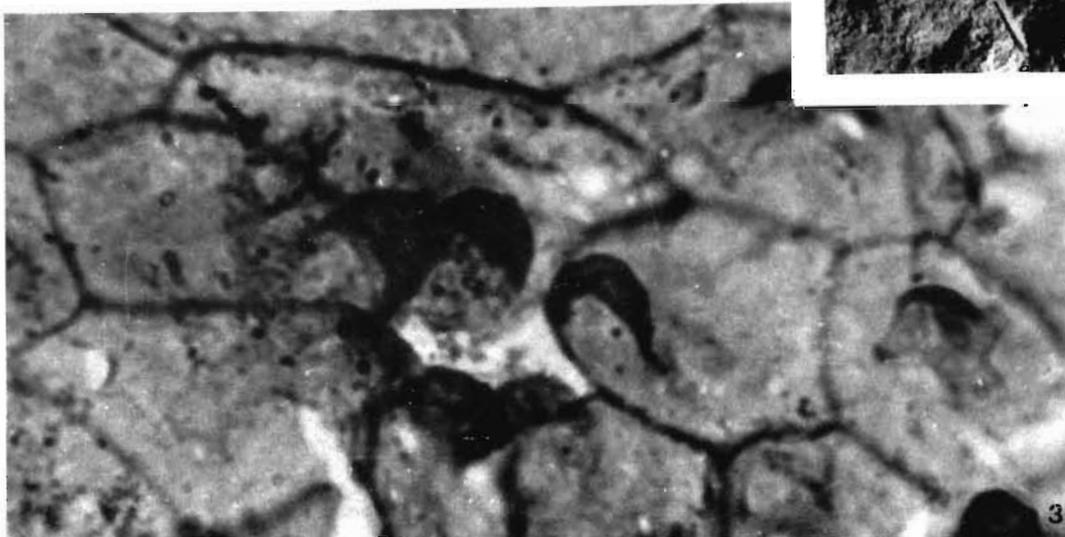
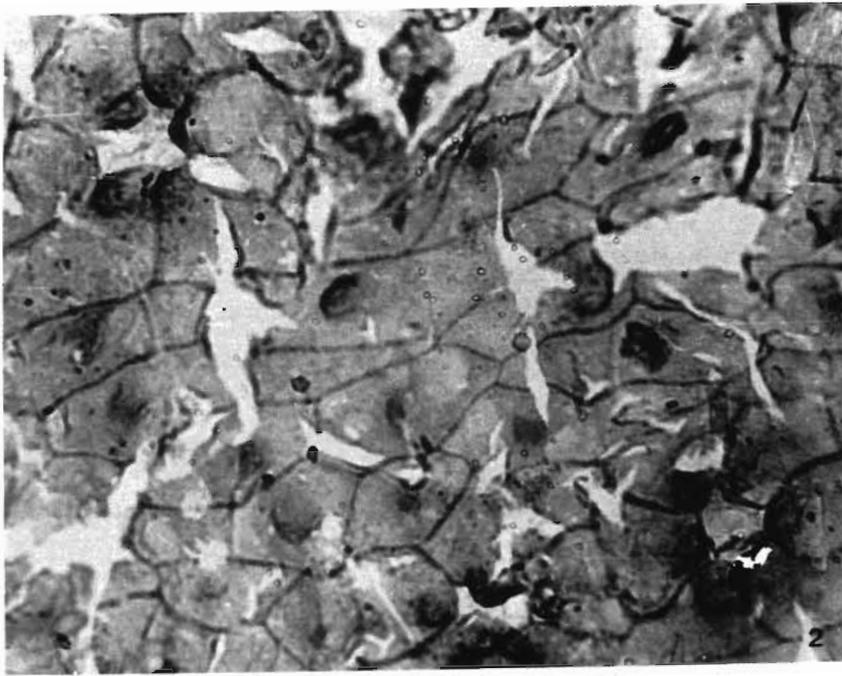
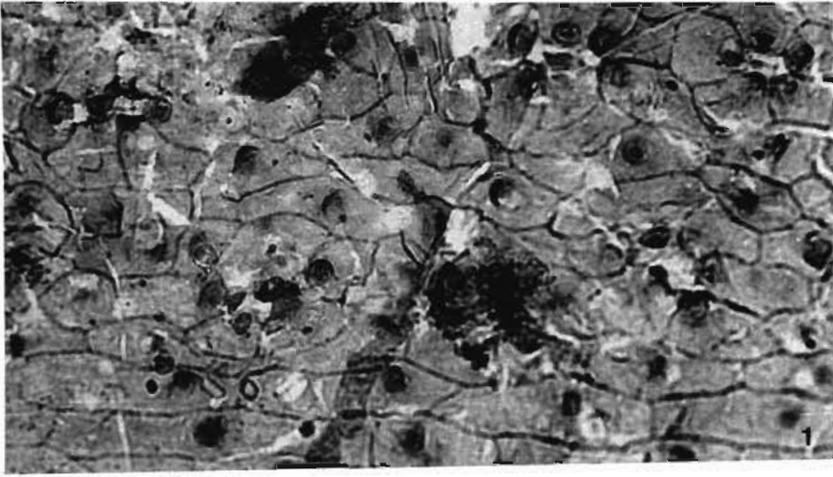


PLATE 2

rower, generally arranged in rows parallel to veins, cells between vein region of varying shapes, all cells with a median papilla; stomata of either side haplocheilic, monocyclic, guard cells longitudinally orientated, stomatal pore highly cutinized, polygonal with wide opening, neighbouring cells 5-7 like other cells, hanging and covering stomatal pore, each with a papilla.

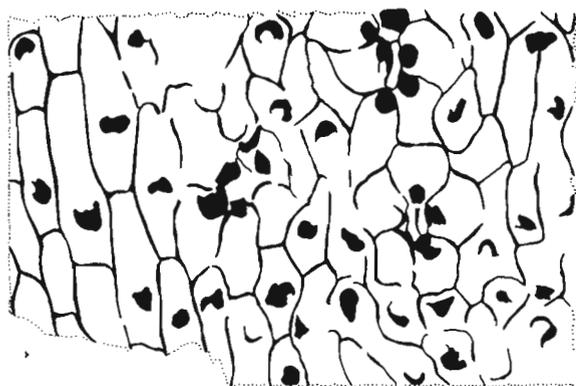
Holotype—Specimen no. BSIP 36865.

Locality—South Balanda Colliery, Talchir Coalfield, Orissa, India.

Age—Karharbari Formation; Early Permian.

Description—The diagnosis of the new species is based on an incomplete leaf and few stray pieces collected from South Balanda Colliery of Talchir Coalfield, Orissa. The obovate leaf is 6.2 cm long and 2.8 cm broad at its widest part. The apex is obtuse while the incomplete base appears to be narrow. Curvature of smooth leaf margin is slightly asymmetrical. Veins are densely spaced throughout lamina, at central region almost straight and fork several times, while the veins towards the margin are slightly arching. The veins of the leaf do not anastomose, usually unbranched, closely crowded and forked and more or less uniform in thickness throughout the lamina.

Both the surfaces of the leaf show almost similar cells and structure of the stomata. The cells of the upper epidermis on the vein area are 87-110 μm in length and 17-23 μm in width, while cells in between the veins are 37-58 μm in length and 15-25 μm in width. All the cells of both the surfaces possess a



Text-figure 6—*Euryphyllum maithyi* sp. nov., lower epidermis showing polygonal cells, stomata with overhanging papillae. Slide no. BSIP 36865-1. x 450.

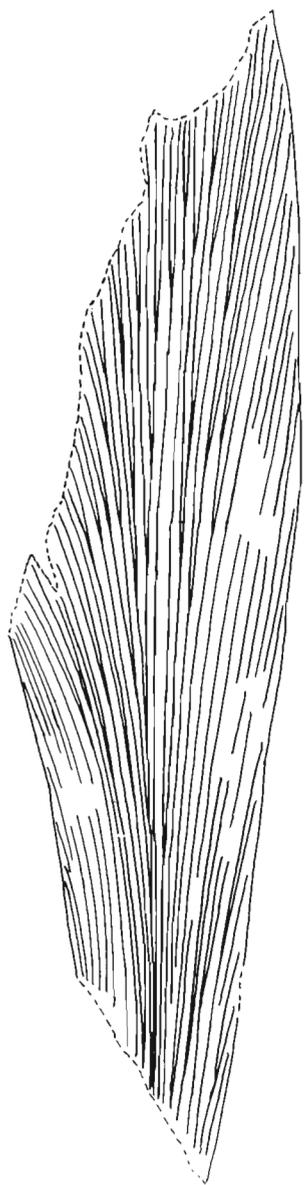
single median papilla, generally circular in surface view, 5-8 μm in length and 10-12 μm in width. The haplocheilic stomata, 60-72 μm in length and 42-58 μm in breadth, are generally longitudinally orientated. The guard cells of the stomata are 15-22 μm in length and 8-12 μm in width and partially covered by the thickening of the anticlinal walls of 5-7 subsidiary cells. The stomatal opening is of varying shape. The guard cells do not show any thickening. The general pattern of epidermal features are very similar to that of any other gymnospermous leaf.

Comparison—The present leaf which we have assigned to a new species, *E. maithyi*, resembles *E. obovatum* rather closely and it would have been simpler if our specimens could be referred to Maithy's species. We are, however, unable to do so for reasons : (i) a close comparison is not possible with Maithy's specimen no. 19949 from the Giridih Coalfield as it is not available in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow; (ii) even if the specimen was available a close comparison was not possible as Maithy's specimen was an impression; (iii) Maithy's specimen is described as symmetrical leaf while ours is a slightly asymmetrical like that of *E. whittianum*, and (iv) for the first time the epidermal features are recorded of this less known and rare leaf form of *Glossopteris* flora. The type species *E. whittianum* Feistmantel 1879 is an ovate-spathulate leaf with narrow tapering base and obtuse apex while newly designated species *E. maithyi* is an obovate leaf.

Euryphyllum whittianum Feistmantel 1879

Pl. 1, figs 2, 3, 4; Pl. 2, fig. 4; Text-figures 7, 8

There are three specimens in the collection which we are including under the type species *E. whittianum* Feistmantel 1879. One of our specimen (Pl. 2, fig. 4) is almost complete except for the basal part and measures 8.2 cm in length and 1.6 cm in breadth. Photographed specimens from Talchir Coalfield are slightly narrower forms than the specimen of type species. Cuticular preparations do not show as good and preserved epidermal features as in *E. maithyi*. However, the epidermal features in both the species are very much similar. The type species *E. whittianum* is so far known by very few specimens and its report from Talchir Coalfield further confirms the

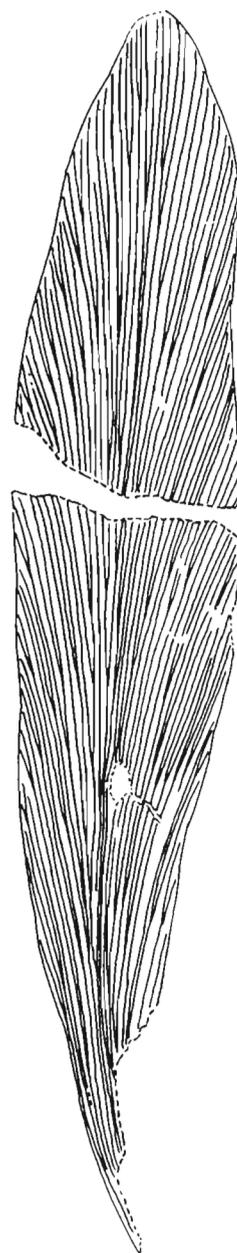


Text-figure 7—*Euryphyllum whittianum* Feistmantel, showing an incomplete leaf. Specimen no. BSIP 36866. x 2.

existence of this form genus in the lower strata of Gondwana basins.

Discussion—The leaf form genus *Euryphyllum* was instituted by Feistmantel in 1879 for a specimen from the Karharbari beds of Giridih Coalfield. The type specimen consists of a partially flattened axis, 5.5 cm broad with two leaves associated with it. Feistmantel included the leaf form in the Coniferae but recognised the possible relationship with *Noeggerathiopsis*. Arber (1905) regarded these leaves as

broader forms of *Noeggerathiopsis hislopi* and therefore placed them under *N. whittianum*. According to Seward and Sahni (1920) the leaves are similar to *N. hislopi* but differ in their more spatulate and slightly asymmetrical lamina and in the more divergent and numerous forked veins. There is striking resemblance between the leaves of *Euryphyllum* and some fronds



Text-figure 8—*Euryphyllum whittianum* Feistmantel, an almost complete leaf with smooth margin and narrow base. Specimen no. BSIP 36868. x 2.

of *Gangamopteris* but a close observation reveals the difference between the two. Seward and Sahni (1920) believed that the leaves belonged to the axis with which they are closely associated. They confirmed the observations of Zeiller (1902) that the two leaves were probably cordaitalean and preferred to retain the designation *Euryphyllum* on the grounds that the leaves exhibited distinctive features which could be of generic rank. Maithy (1965, 1970) also recognised *Euryphyllum* as a separate genus and further reported *E. whittianum* 1965 and also instituted a new species *E. obovatum* Maithy 1970 from the same bed and locality as that of *E. whittianum* by Feistmantel. Later, Srivastava (1977) reported one more specimen of the type species from the Karharbari beds of Auranga Coalfield and included some of the specimens of *Noeggerathiopsis hislopi* described by Kurtz (1894, 1921) from Argentina. It is difficult to comment on the basis of photographs alone about their identification of the Argentinian specimens by Kurtz as they hardly reveal any characters. Thus it can be seen that there are very few specimens world over which can be definitely assigned to the leaf form *Euryphyllum*.

Till date we have no knowledge regarding the epidermal features of the genus *Euryphyllum*. For the first time, it has been possible for us to recover cuticles from a specimen from the Talchir Coalfield assigned under a new species. The epidermal features are quite distinct and exhibit typical gymnospermic characters.

Externally *Euryphyllum* comes closest to *Noeggerathiopsis* and *Rubidgea* and their generic differences and distinctness have been discussed above. We have ample data on the epidermal features of several species of *Noeggerathiopsis* as demonstrated by Pant and Verma (1964) and Lele and Maithy (1964). Internally also the gross morphological features of epidermis of both the leaf genera *Noeggerathiopsis* and *Euryphyllum* are quite similar. In both the forms the lower epidermis shows alternately arranged non-stomatiferous and stomatiferous bands above and in between the vein areas, respectively. However, the stomatiferous and non-stomatiferous bands are less pronounced in *Euryphyllum* than in *Noeggerathiopsis*. This leads us to believe that the veins in *Euryphyllum* are not as coarse as they are in *Noeggerathiopsis*.

All the cells of both the layers are papillate in *Euryphyllum* while in majority of the species of *Noeggerathiopsis*, the papillae are absent in lower epidermis or are occasionally present. There is less distinction between lower and upper epidermal features in *Euryphyllum* but there is marked difference between the two epidermal layers in *Noeggerathiopsis*. Stomata in both the genera are haplocheilic and arranged in ill defined longitudinal rows between the veins. The subsidiary cells around stomata are heavily cutinized and papillate in *Euryphyllum*, while subsidiary cells in some of the species in *Noeggerathiopsis* are non-papillate. By and large the epidermal features of both the leaf forms are very similar in orientation and general pattern. It can safely be presumed that *Euryphyllum* also belongs to Cordaitales as mentioned by Zeiller (1902) and perhaps in the same family as for *Noeggerathiopsis*. The epidermal features of both the forms indicate that the plants those bore these leaves were growing under extreme cold conditions and adversities as they are always found in the lower strata of Gondwana sediments.

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