

A NEW SPECIES OF *GLOSSOPTERIS* FROM THE BARAKAR FORMATION OF LOWER GONDWANA OF INDIA

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ABSTRACT

A new species of *Glossopteris*, *G. ornatus* sp. nov., has been described from the Barakar Formation of the Raniganj Coalfield, West Bengal. The specimen shows ten leaves arranged in two close apparent whorls made up of closely arranged spiral leaves. All the leaves are morphologically similar and possess the same type of epidermal structures.

Key-words — *Glossopteris*, Whorled leaves, Barakar Formation, Permian (India).

सारांश

भारत के अधर गोंडवाना के बाराकार चरण से चक्रिक ग्लॉसॉप्टेरिस की एक नवीन जाति - शैला चन्द्रा एवं अश्विनी कुमार श्रीवास्तव

पश्चिम बंगाल में रानीगंज कोयला-क्षेत्र के बाराकार चरण से प्राप्त ग्लॉसॉप्टेरिस की एक नवीन जाति, ग्लॉसॉप्टेरिस ऑर्नेटस न० जा०, वर्णित की गई है। यह प्रादर्श दो चक्रों में विन्यस्त दस पत्तियाँ प्रदर्शित करता है। एक चक्र की सभी पत्तियाँ बाह्य-आकारिक दृष्टिकोण से समरूप हैं तथा इनकी बाह्य-त्वचीय संरचनायें भी एक जैसी हैं।

INTRODUCTION

IN recent years a good deal of work has been done on the study of the *Glossopteris* Flora of India and as a result many new genera and species have been added to the flora. *Glossopteris*, being the dominant genus of the flora, has been extensively studied from different localities and different geological horizons of the Lower Gondwanas. Several species of *Glossopteris* have been instituted on the basis of morphological and epidermal characters. Epidermal characters have been studied by Sahni (1923), Srivastava, P. N. (1956), Pant and his co-workers (1968, 1970, 1971a, b, 1974), Srivastava, S. C. (1969) and Chandra and Surange (1976a, b, 1977).

Uptil now nearly 65 species of *Glossopteris* have been described mainly based on the morphological characters and a few on epidermal features. So far the epidermal characters of *Glossopteris* species are known only from the Raniganj Formation. The present work, for the first time, records the

epidermal structures of the *Glossopteris* leaves from the Barakar Formation.

A single specimen with its counterpart contains ten leaves arranged apparently in a whorl. At first glance the leaves appear as if radiating from a common central point but these are arranged in two closely set spiral with 5 leaves in each spiral. The leaves of two apparent whorls alternate with each other and one can see that they were attached at two levels.

The specimen with its counterpart has been collected from a carbonaceous shale exposed in a quarry near Churulia Railway Station, Raniganj Coalfield. The carbonaceous shales belong to the Barakar Formation. The leaves are preserved with carbonized crust and the cuticular preparations were made from different regions of the leaves. Cellulose acetate pulls with carbon were macerated by Schultz's method and the cuticular pieces were stained in safranin and mounted in DPX mountant.

For the study of shape and venation pattern, we have followed the grid method

proposed by Chandra and Surange (1976a, b, 1977a, b). The terminology of Dilcher (1974) and Hickey (1973) has been used to describe the leaves. All the type slides and the specimen are preserved at the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

DESCRIPTION

Glossopteris ornatus sp. nov.

Pl. 1, fig. 1; Pl. 2, figs 2-6; Text-figs 1-5

Diagnosis — Leaves oblong to lorate, length/width ratio 4:1; apex acute, base acute to cuneate, midrib persistent, striated, narrower towards apex; secondary veins arise at an angle of 45° , slightly arched; meshes linear, narrow, hexagonal to polygonal near midrib, short and square near margin.

Holotype — B.S.I.P. Museum specimen no. 35324.

Locality — Churulia, Raniganj Coalfield, West Bengal.

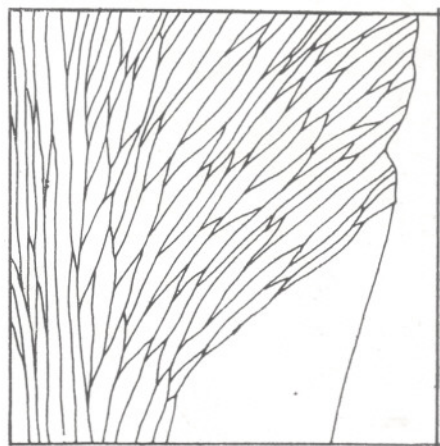
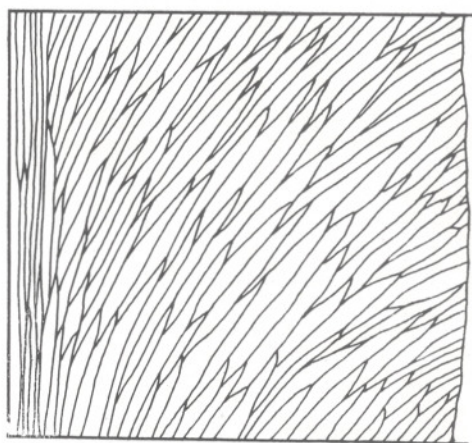
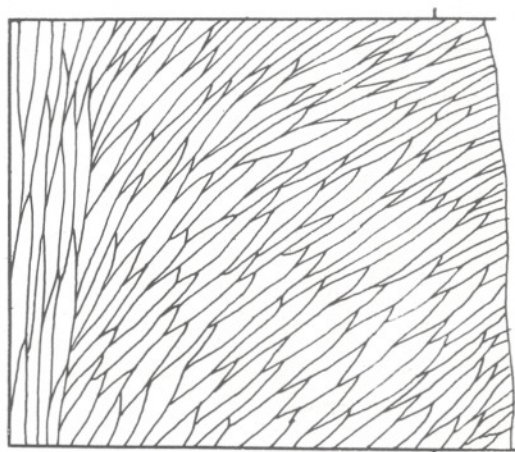
Horizon — Barakar Formation.

Description — Ten leaves, some of which are complete, are preserved on a carbonaceous shale. The specimen shows 5 leaves arranged in one plane and 5 leaves in another plane. This arrangement, however, suggests that there were two close spirals, one over the other and very closely placed. The leaves of one spiral are alternate with the leaves of the other spiral.

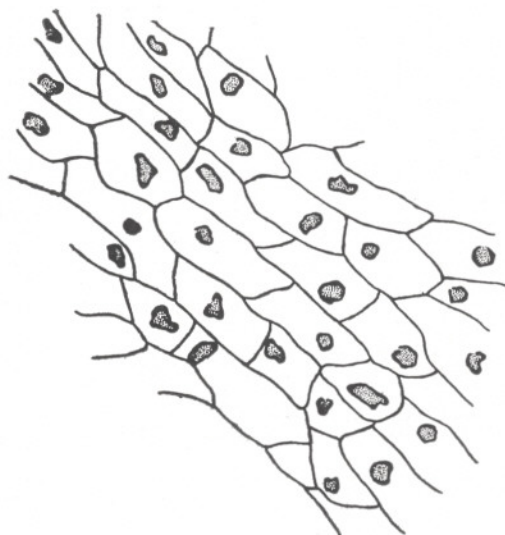
The secondary veins arise from the midrib at an angle of 45° and then slightly arch, the arching becoming more apparent as the lamina broadens (Text-fig. 1). The secondary veins divide 2 to 3 times and the branches of adjoining veins unite to form linear, narrow, hexagonal to polygonal meshes. Near the margin, meshes become short and square. The venation pattern is similar in the apical, basal and the middle region of the leaf (Text-fig. 1).

All the leaves of the two close spirals have yielded well-preserved cuticles from the apical, basal, middle and the midrib regions. The cuticle over the midrib is distinct and different from those of the laminar region.

The upper epidermis is differentiated into vein and mesh areas. Cell walls are straight. Each cell shows a single papilla in the centre.



TEXT-FIG. 1 — The venation of lower, middle and upper part of a leaf in 1 sq cm is magnified 3 times.



TEXT-FIG. 2 — Upper epidermis showing a single papilla in the centre of each cell. Nonstomatiferous $\times 190$.



TEXT-FIG. 3 — Lower epidermis showing 3 stomata $\times 190$.

The papillae are quite characteristic and they are often elongated with flat bases. The cells of the mesh area are rectangular and tend to be arranged in rows. The cells over the vein area are narrow and

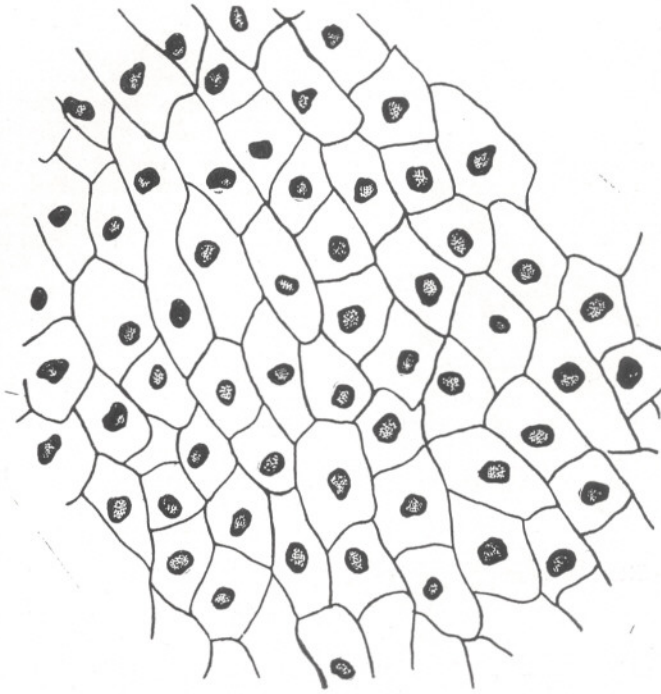
slightly thicker than those over the mesh area. Cuticles over the midrib is thick with broad, rectangular, straight-walled cells, arranged in longitudinal rows. Each cell shows a well-preserved papilla. The stomata are absent.

The lower epidermis is thinner than the upper epidermis and is well-differentiated into vein and mesh areas. Cell outlines are obscure but wherever visible, they appear to be straight. Single papilla is situated in each cell, but it is not always well-preserved as in the upper epidermis. It is likely that the papillae of the cells might have disintegrated during maceration. The cells of the mesh area are irregular in shape. The cells over the veins are thicker than those in mesh area and are linear and elongate. The stomata are monocyclic and irregularly arranged in the mesh area. Stomatal pits are overarched by papillae. The subsidiary cells are 4 to 7 in number and the guard cells are broad and without papillae. The epidermis of the midrib region is also stomatiferous and the stomatal structure and the distribution is similar to that of the mesh area of the lower epidermis.

COMPARISON

Morphologically the present leaves are comparable with *Glossopteris indica* Schimper, *Glossopteris arberi* Srivastava, *Glossopteris spatulata* Pant & Gupta, *Glossopteris brongniartii* Pant & Gupta, *Glossopteris nautiyalli* Pant & Singh and *Glossopteris longifolia* Pant & Singh. In *G. indica* the secondary veins are straight, form short and broad meshes near the midrib and long and narrow meshes towards the margin, but in *G. ornatus* the secondary veins are arched and form long and narrow meshes throughout the lamina. *G. arberi* and *G. spatulata* differ from the present species in having large leaves where the meshes are fairly long and open. The meshes of *G. nautiyalli* and *G. longifolia* are open and short near the margin, longer between midrib and margins and again short near margins whereas in the present species meshes are linear and longer throughout the lamina. The leaves of *G. brongniartii* show comparatively close and narrow meshes which are without any arching.

Epidermal features of *Glossopteris ornatus* are comparable with *G. papillosa*

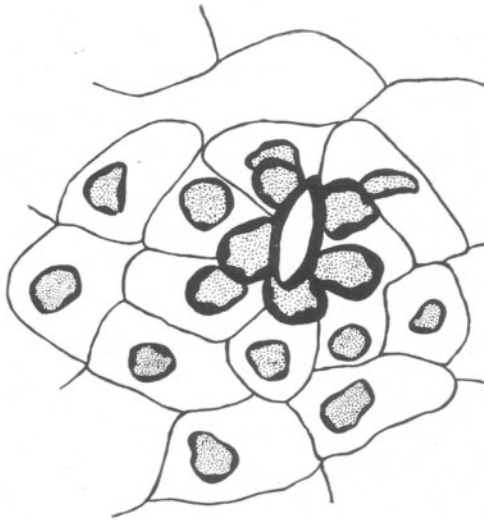


TEXT-FIG. 4A.



TEXT-FIG. 4B.

TEXT-FIG. 4 A-B.— A. Upper epidermis of the midrib region. Nonstomatiferous $\times 190$. B. Lower epidermis of the midrib region showing 2 stomata $\times 190$.



TEXT-FIG. 5 — Stomata magnified $\times 485$.

Srivastava, *G. vulgaris* Pant & Gupta, *G. colpodes* Pant and *G. fibrosa* Pant in having single median papilla on both the epidermal surfaces of the lamina. But the epidermal cells of *G. papillosa* are almost square to pentagonal in shape, the cell walls are quite thick and the papillae are larger in diameter. *G. vulgaris* shows single median papilla in each cell on both the surfaces of the epidermis but the midrib region is without papillae and the cell walls are straight to arched. The cell walls of the lower and upper epidermis of *G. colpodes* are usually wavy but straight near margins and over the midrib, whereas in the present species the cell walls are always straight. The cells of upper epidermis of *G. fibrosa* show single median to numerous papillae or longitudinal striations.

DISCUSSION

Whorled leaves of *Glossopteris* have earlier been noticed by Dana (1849), Feistmantel (1881a, b), Seward (1960), DuToit (1927), Walton and Wilson (1932), Thomas (1952), Plumstead (1958), Pant (1967) and Pant and Singh (1974). Amongst them Dana

(1849, pl. 12, fig. 13C) described 20 or more leaves of *G. browniana* type arranged in a whorl. Bunbury (1861, pl. 10, fig. 3) described seven leaves attached to an axis. Feistmantel (1881a) illustrated some whorled leaves as *Sagenopteris longifolia* (pl. 40A, fig. 1) and *S. polyphylla* (pl. 41A, fig. 34). Feistmantel's *S. longifolia* shows six leaves which are closely comparable in venation pattern with *G. angustifolia* type. Similarly, *S. polyphylla* shows seven petiolate leaves where the venation pattern is closely comparable to *G. retifera* type. DuToit (1927, text-fig. 4) described a specimen under *Sagenopteris longicaulis* where eight leaves of *Glossopteris* type are apparently arranged in two whorls. Thomas (1952, pl. 1, figs 1, 2, 3) described whorled leaves of *Glossopteris* under *G. longicaulis* which possessed 1 cm long and 1.5 mm wide petioles. He also found that the leaves described by DuToit (1927) under *Sagenopteris longicaulis* are identical with the leaves of *G. longicaulis*. Later in 1958, he changed the name of *G. longicaulis* as *G. verticillata*. Seward (1910, fig. 339) figured a specimen showing whorled leaves. But this specimen was again refigured by Walton and Wilson (1932, text-fig. 1). The leaves are of *Glossopteris retifera* type. Plumstead (1958) described clusters of *Glossopteris* leaves whose leaves are comparable to *G. angustifolia*. Pant (1967) also described some specimens which show whorled arrangement of *Glossopteris* leaves. These leaves are of *G. retifera* type. Recently Pant and Singh (1974) described two species, viz., *G. maculata* (pl. 25, figs 16-19) whose leaves are *G. retifera* type and *G. sastrii* (pl. 27, figs 33-38) whose leaves are *G. conspicua* type.

From the above discussion it appears that the apparently whorled arrangement of leaves of *Glossopteris* which are in fact in close spirals in living condition can be classified into five distinct types on the basis of their venation pattern and form. They appear to be distinct genera.

1. *Glossopteris verticillata* type
2. *Glossopteris retifera* type
3. *Glossopteris angustifolia* type
4. *Glossopteris conspicua* type
5. *Glossopteris ornatus* type

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EXPLANATION OF PLATES

PLATE 1

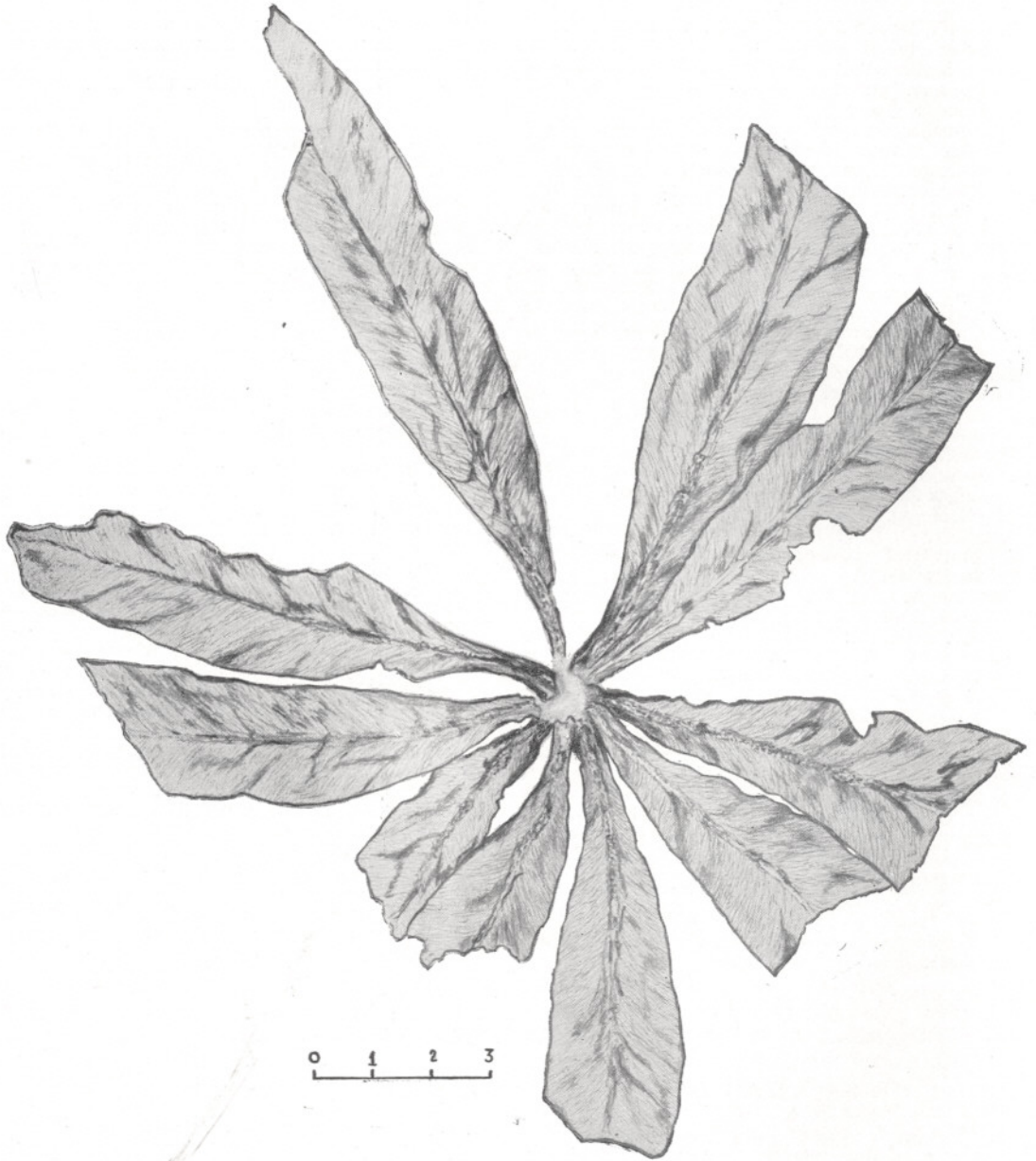
- Glossopteris ornatus* sp. nov. holotype; pencil sketch of the specimen showing two whorls of leaves. Each whorl shows 5 leaves, specimen no. 35324.

PLATE 2

- One leaf (holotype) from the whorl enlarged to

show the venation pattern and form. $\times 2$, specimen no. 35324.

- Cuticle of the upper epidermis showing vein and mesh area. Non-stomatiferous. $\times 65$, slide no. 5935.
- Cuticle of the lower epidermis showing 2 stomata. $\times 390$, slide no. 5935.
- Cuticle of upper epidermis from the midrib region. Non-stomatiferous. $\times 65$, slide no. 5934.
- Cuticle of the lower epidermis from midrib region showing stomata. $\times 390$, slide no. 5936.



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PLATE 1

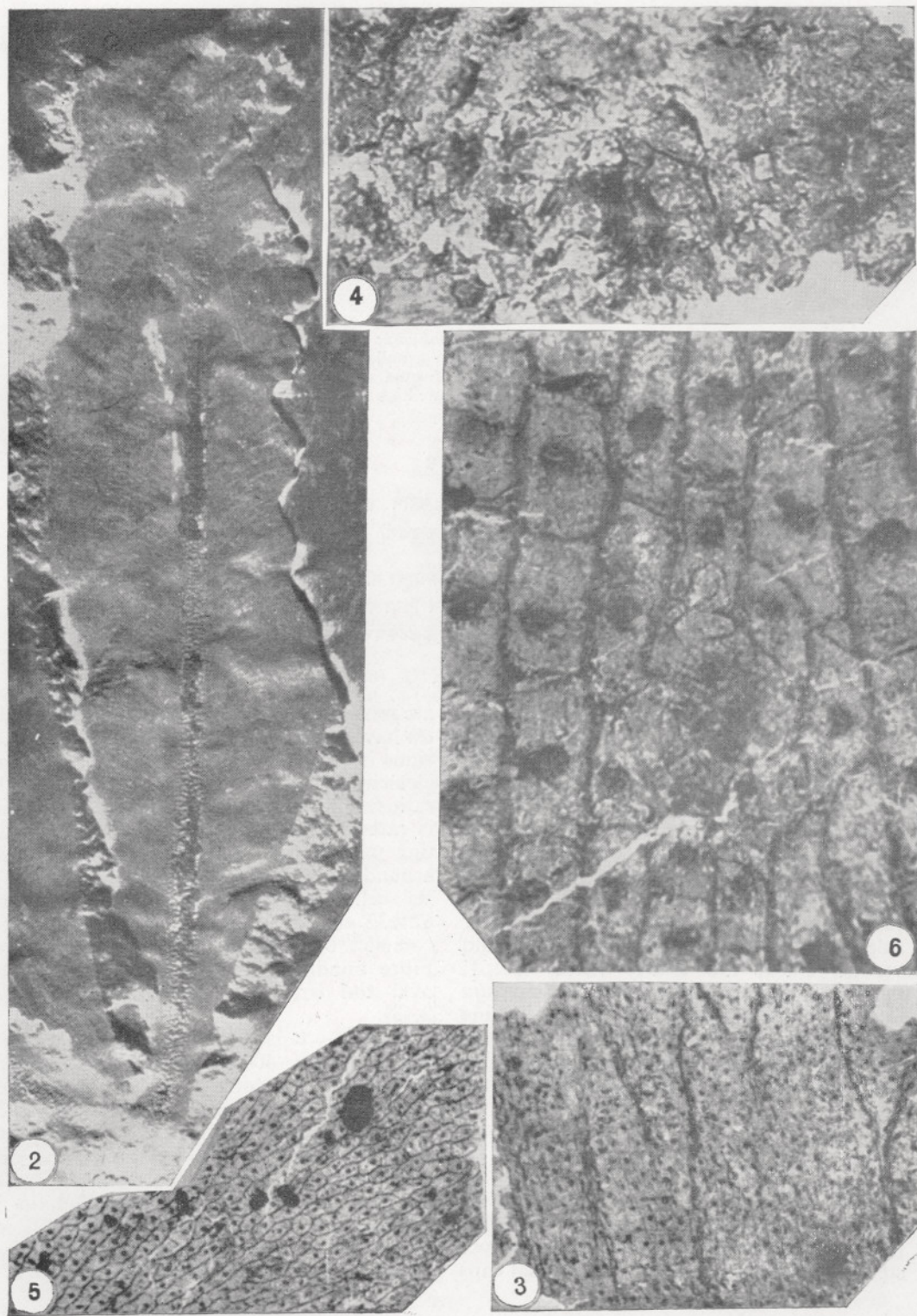


PLATE 2