

Occurrence of the Genus *Pachypteris* in the Triassic of India

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ABSTRACT

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The leaf genus *Pachypteris* Brongniart occurs commonly in Mesozoic rocks throughout the world. In India, the genus has hitherto been known only from the Lower Cretaceous strata of Rajmahal, Jabalpur, Bhuj and Pariwar formations. However, a few specimens collected from the Janar River beds of Tiki Formation, in their gross features and cuticular details, evidently represent a new species of the genus. The species, named as *Pachypteris hirsuta* sp. nov., in addition to its obvious hypostomatic lamina, is characterized by the presence of polygonal trichome bases. Each trichome base is surrounded by a ring of radially elongated cells.

From Janar River beds, species of *Lepidopteris*, *Dicroidium*, *Xylopteris*, *Sphenobaiera* and *Baiera* have been described earlier. *Pachypteris* is a further addition to this assemblage. On the basis of faunal and floral remains, Tiki Formation has been dated as Upper Triassic. Occurrence of *Pachypteris* is hereby recorded for the first time from Indian Triassic strata.

Key-words—*Pachypteris*, Tiki Formation, Upper Triassic, India.

भारत के ट्राइऐसिक में पैक्रीप्टेरिस वंश की उपस्थिति

पंकज के. पाल एवं मौमिता बसु

सारांश

समूचे विश्व में मध्यजीवी चट्टानों में पत्ती वंश पैक्रीप्टेरिस ब्रॉन्गिनआर्ट सामान्यतः पाया जाता है। भारत में अब तक यह वंश केवल राजमहल, जबलपुर, भुज एवं परिवार शैलसमूहों के अधः चाकमय स्तरी में पहचाना गया है। टिकी शैलसमूह के जनर नदी संस्तरों से संगृहीत कुछेक नमूने उनके समग्र लक्षण और उपचर्मा विवरण, वंश की नवीन जाति सुस्पष्ट रूप से रूपायित करते हैं। पैक्रीप्टेरिस हिरसुटा नवजाति नामक जाति, अपनी सुस्पष्ट अधोरंध्री पटल के अतिरिक्त, बहुभुज त्वचारोम आधारों की मौजूदगी से अभिलक्षणित है। प्रत्येक त्वचारोम आधार त्रिज्यतः दीर्घित कोशिकाओं के वलय से घिरा है।

जनर नदी संस्तरों से लेपिडोप्टेरिस, डिक्रोइडियम, जायलोप्टेरिस, स्फेनोबैएरा और बैएरा की जाति पहले वर्णित की जा चुकी हैं। इस समुच्चय में पैक्रीप्टेरिस और जोड़ी है। प्राणिजात व पुष्पी अवशेषों के आधार पर, टिकी शैलसमूह की आयु ऊपरी ट्राइऐसिक जितनी है। भारतीय ट्राइऐसिक स्तरी से पहली मर्तबा एतद्वारा पैक्रीप्टेरिस की प्राप्ति अभिलिखित की गई है।

संकेत-शब्द—पैक्रीप्टेरिस, टिकी शैलसमूह, ऊपरी ट्राइऐसिक, भारत।

INTRODUCTION

The leaf genus *Pachypteris* Brongniart occurs commonly in Mesozoic rocks throughout the world and in India, the genus has hitherto been known only from the Upper Jurassic-Lower Cretaceous strata. Recently, a few specimens have been collected from the Janar River beds of the Tiki Formation (Fig. 1). In their available gross features and cuticular characters those were found to represent a new species of the genus *Pachypteris* Brongniart. The species is characterized by the presence of polygonal trichome bases with a ring of radially elongated cells. From Janar River beds, species of *Lepidopteris*, *Dicroidium*, *Xylopteris*, *Sphenobaiera* and *Baiera* have been described earlier; *Pachypteris* being a further addition to this assemblage. Janar River beds have been dated as Early Upper Triassic on the basis of floral and faunal remains (Pal, 1984; Satsangi, 1988).

MATERIAL AND METHODS

The specimens, preserved as compressions with well preserved phytollemma, were collected from the beds of grey micaceous shales belonging to the Tiki Formation exposed on the east bank of Janar River, 1.25 km SSW of Harai Village, Shahdol District, Chhattisgarh, India (Fig. 1). The shale was quite soft and it was easy to degage the buried parts of the specimens. Also, a few isolated lamina-segments were recovered from shale samples macerated in bulk. For bulk-maceration, shale samples were treated with Hydrofluoric acid for 2 to 3 days. Then these were washed thoroughly in distilled water for acid removal by using a 150 mesh standard sieve. From the organic residue leaf-segments were sorted out and allowed to dry at room temperature. Morphographic studies of the specimens were made under a WILD M3B

Stereobinocular Microscope. Cuticular preparations of phytollemma were made through maceration with concentrated nitric acid overnight followed by a brief treatment with dilute alkali (5% NaOH). The two cuticular surfaces were separated with a barber's nail-cutter and were mounted in glycerol-jelly to study under a Leica DMLB Bright-field Microscope using transmitted light. For scanning electron microscopic observations dry specimens were first coated with gold and then studied under Hitachi S-530 Scanning Electron Microscope (SEM).

SYSTEMATICS

Genus—PACHYPTERIS Brongniart

Type species—*Pachypteris lanceolata* Brongniart

Pachypteris hirsuta sp. nov.

(Pl. 1.1-10; Fig. 2A-D)

Diagnosis—Leaf at least once pinnate, imparipinnate; rachis winged; lamina segments rhomboidal-ovate, closely spaced; single vein after emergence forking 2-3 times; stomata numerous and evenly spaced on lower surface of lamina, stomata not present on upper surface, sometimes a few stomata present in the proximal region of a lamina segment; epidermal cells polygonal; anticlinal walls straight or minutely sinuous, with frill-like cutin projections; periclinal walls usually smooth, sometimes with a low papilla; stomata monocyclic or imperfectly dicyclic; subsidiary cells 5-6, usually with a low papilla, sometimes papillae well developed and overhanging the stomatal pit; stomatal pit rectangular-oval; guard cells sunken, thinly cutinized; trichome bases sparsely distributed over both surfaces of lamina, circular or polygonal in outline, surrounded by 6-7 radially elongated cells.

Holotype—BU Specimen No. J/27 of the Palaeobotany and Palynology Section, Botany Department, Burdwan University.

Locality—East bank of Janar River, 1.25 km SSW of Harai, Shahdol District, Chhattisgarh, India.

Horizon & Age—Tiki Formation, Upper Triassic.

Etymology—The specific epithet refers to the trichomaceous nature of the frond.

Types and figured specimens, slides and SEM-stub of cuticular preparations are deposited in the Palaeobotany Repository of Botany Department, Burdwan University.

Description—The description is based on four specimens of once pinnate frond fragments and a few isolated lamina-segments recovered from shale samples macerated in bulk (Pl. 1.1; Fig. 2A-C). Two of the specimens exhibit the apical parts and show the imparipinnate nature of the leaves. As the base of the leaf is not preserved in any of the specimens,

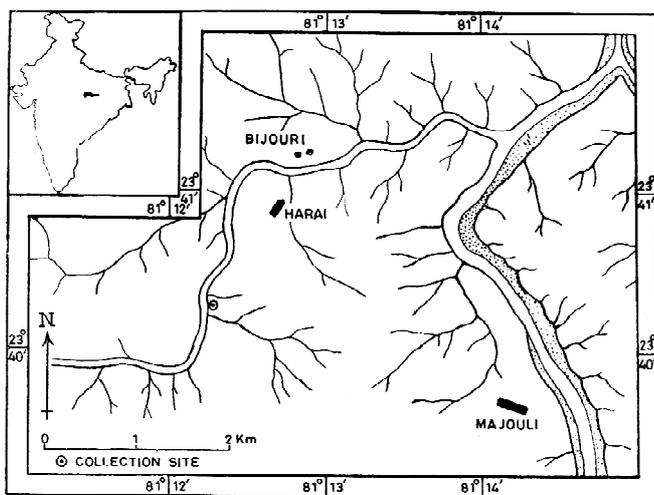


Fig. 1—Map showing the fossiliferous locality on Janar River, near Harai Village, Shahdol District, Chhattisgarh, India.

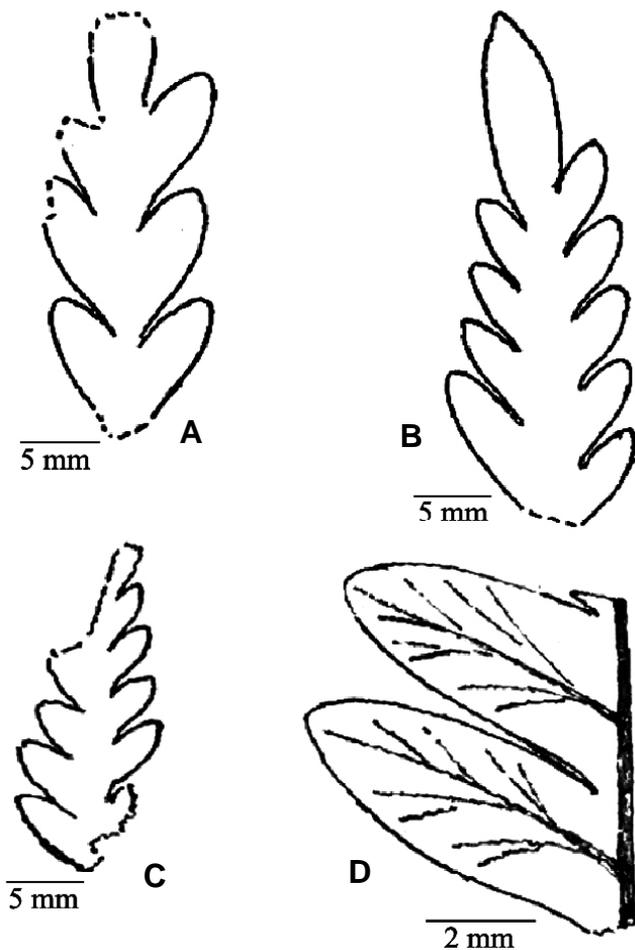


Fig. 2—*Pachypteris hirsuta* sp. nov. A. Holotype, BU Specimen No. J/27. B-C. Isotypes, BU Specimen Nos J/42 and J/35 respectively. D. Transfer preparation of a part of the specimen in fig. 2B, viewed with transmitted light, showing details of venation.

it is not possible to ascertain whether the specimens represent the parts of once-pinnate or bipinnate fronds. Lamina-segments are closely spaced, opposite or sub-oppositely disposed, rhomboidal to ovate in shape, 2.0 to 5.0 mm long and 1.0 to 3.0 mm wide. Each segment is attached by entire base with its basisopic margin decurrent on the rachis and continuous with the acroscopic margin of the pinnule below, thus forming a wing on each lateral side of the rachis. Lateral margins of lamina-segments are entire and their apices are blunt. Texture of lamina is relatively thick and venation is faintly visible. A single vein soon after entering the segment, forks two to three times (Fig. 2D).

Cuticle of lamina is nearly $2.5 \mu\text{m}$ thick. Upper surface is slightly thicker than the lower one (Pl. 1.3, 4). Epidermal cells are polygonal and mostly isodiametric. Sometimes the veins are faintly marked on lower surface by rows of slightly elongated cells. Anticlinal walls of epidermal cells are more or

less straight with cutin processes. Cutin processes are always relatively well-developed on upper surface than those on the lower one. Height of the processes varies in different specimens. The best developed ones have been noticed in specimen no. J/35, where on the upper surface of lamina, they are $4 \mu\text{m}$ high and $5 \mu\text{m}$ apart and those on the lower surface are $2.5 \mu\text{m}$ high and $6.0 \mu\text{m}$ apart (Pl. 1.8). The least developed cutin processes, merely $1.0 \mu\text{m}$ high and $6.0 \mu\text{m}$ apart, were seen in specimen no. J/27. Periclinal walls of epidermal cells are usually smooth but at places a cell on its surface bears a papilla. The number of papillate cells is more on lower surface than on upper. Papillae are usually low and solid but in specimen no. J/42 they are hollow and quite well developed. Stomata are numerous and evenly distributed on lower surface of pinnule. Upper surface of lamina is generally devoid of stomata. However, exceptionally a few stomata may occur in the proximal region of the upper surface of a lamina segment. Subsidiary cells are 5-6 in number and usually more cutinized than ordinary epidermal cells. Each subsidiary cell usually bears a low solid papilla over its surface. Occasionally, papilla of subsidiary cell is slightly better developed and overhangs the stomatal pit. But in specimen no. J/42 papillae of subsidiary cells are well developed and are always overhanging the stomatal pit (Pl. 1.7). Often two or three subsidiary cells of a stoma are accompanied by an encircling cell outside them (Pl. 1.6). Stomatal pit is rectangular to oval. Guard cells are sunken and thinly cutinized. Stomatal aperture is narrowly elliptic. Trichome bases present on both surfaces of lamina, sparsely distributed. Each trichome base is polygonal or circular in outline and is surrounded by 6-7 radially elongated cells (Pl. 1.9, 10).

Cuticle of rachis is nearly $3.5 \mu\text{m}$ thick and slightly thicker above than below. Cells along the middle region are elongated and are arranged more or less in longitudinal files. Cells of wings are mostly polygonal. Anticlinal walls of epidermal cells are straight and the cutin projections are comparatively less developed than those of the lamina. Periclinal walls of epidermal cells are usually flat. Stomata are rather sparse. On upper surface stomata occur in the middle region and on lower surface those are confined to the wings only (Pl. 1.2). Trichome bases occur rarely on both surfaces.

COMPARISON AND DISCUSSION

The specimens, being pinnately compound fronds with primarily hypostomatatic lamina supplied by a single primary vein, are to be assigned to the genus *Pachypteris* Brongniart. In size, shape and venation pattern, *Pachypteris hirsuta* resembles *P. crassa* described by Townrow (1965) from the Rhaeto-Liassic of Tasmania and *P. pinnata* described by Townrow and Jones (1969) from the Upper Triassic of Australia. However, *P. hirsuta* could readily be distinguished from both *P. crassa* and *P. pinnata* by its possession of characteristic trichome bases and relatively thick cuticle over the lamina.

Like *P. hirsuta*, *P. elegans* Archangelsky (1966), known from the Lower Cretaceous of Argentina, possesses trichome bases on the lamina. In contrast to *P. hirsuta*, the subsidiary cells surrounding a stoma of *P. elegans* are totally devoid of cutinized papillae. Among the hitherto known Indian species of *Pachypteris*, *P. indica* (Oldham & Morris) Bose & Roy and *P. haburensis* Bose *et al.*, described from the Upper Jurassic-Lower Cretaceous strata of India (Bose & Banerji, 1984; Bose *et al.*, 1982; Pal *et al.*, 2004), differ from *P. hirsuta* by their linear-lanceolate pinnules. Moreover, the cuticle of *P. indica* is devoid of trichome bases. Cuticular features of *P. haburensis* are not known so far. *P. specifica* Feistmantel, another species known from the Indian Upper Jurassic – Lower Cretaceous (Bose & Banerji, 1984; Pal *et al.*, 2004), differs from *P. hirsuta* by its lanceolate - oval pinnules and the absence of trichome bases.

Pal (1984) described *Lepidopteris madagascariensis* Carpentier, *Dicroidium hughesii* (Feistmantel) Gothan, *D. zuberi* (Szajnocha) Archangelsky, *Dicroidium* sp., *Xylopteris* sp., *Sphenobaiera janarensis* Pal and *Baiera* sp. from the Janar River beds. *Pachypteris hirsuta* is an addition to this assemblage. The Janar River beds are dominated by *Dicroidium zuberi*. *Pachypteris hirsuta* to some extent outwardly resembles some of the smaller forms of *Dicroidium zuberi*. However, the venation in the ultimate lamina-segments of the two taxa differs considerably. Ultimate lamina-segment of *Pachypteris hirsuta* is supplied by a single primary vein, while in *Dicroidium zuberi* several primary veins enter the base of a pinnule. Moreover, *Pachypteris hirsuta* differs from *Dicroidium zuberi* in having primarily hypostomatic lamina with characteristic trichome bases and cutinized projections

from the anticlinal walls of the epidermal cells. The occurrence of the genus *Pachypteris* in the Janar River beds shows the coexistence of the two corystospermaceous leaf genera, *Dicroidium* and *Pachypteris*, in Indian peninsula during the Upper Triassic.

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PLATE 1

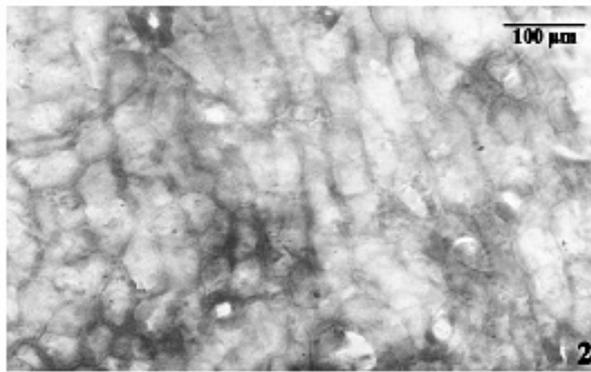
Pachypteris hirsuta sp. nov.



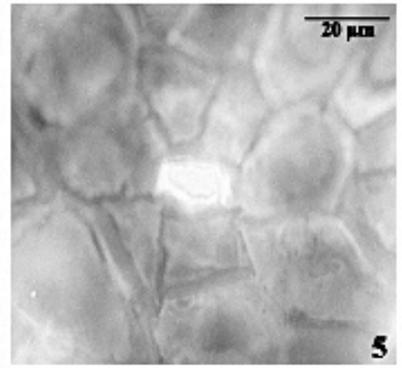
1. Holotype, BU Specimen No. J/27.
2. Cuticle from the lower surface of the rachis, showing longitudinal files of elongated cells along the nonstomatiferous middle region and polygonal cells with stomata in the wings, BU Slide No. J/27-1.
3. Cuticle from the nonstomatiferous upper surface of the lamina, BU Slide No. J/27-2.
4. Cuticle from the stomatiferous lower surface of the lamina, BU Slide No. J/27-2.
5. A stoma with rectangular stomatal pit surrounded by six subsidiary cells, occasional presence of low solid papillae over the periclinal walls of subsidiary cells and other epidermal cells are visible, BU Slide No. J/27-2.
6. A partially dicyclic stoma, BU Slide No. J/27-2.
7. A stoma with five subsidiary cells, each bearing a well-developed papilla overhanging the stomatal pit, BU Slide No. J/42-2.
8. A few cells in the upper cuticle of the lamina showing well-developed cutin processes, BU Slide No. J/35-2.
9. A trichome base on the upper surface of lamina showing its polygonal outline and surrounded by 5-6 radially elongated cells, BU Slide No. J/27-2.
10. Scanning Electron Micrograph of the inner side of the lower cuticle of lamina showing a trichome base, BU Stub No. J/27-1.



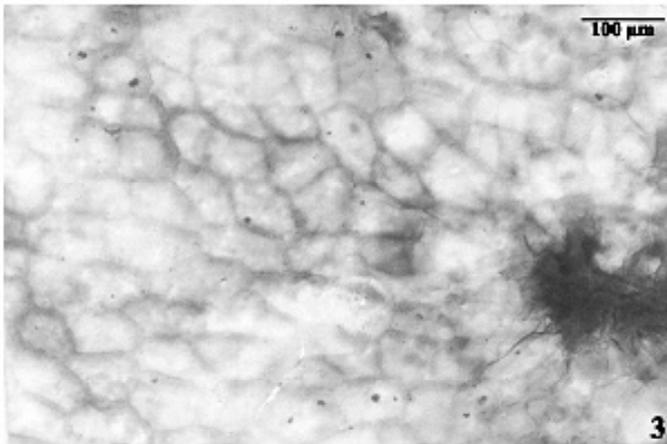
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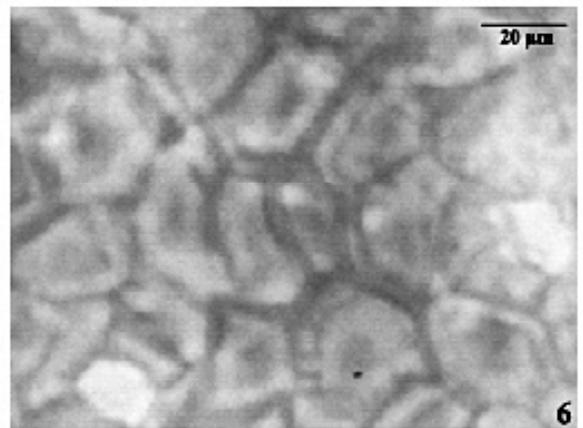
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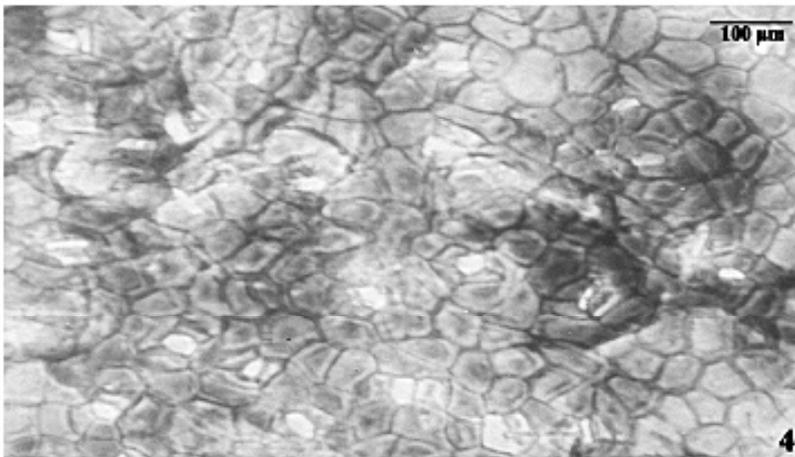
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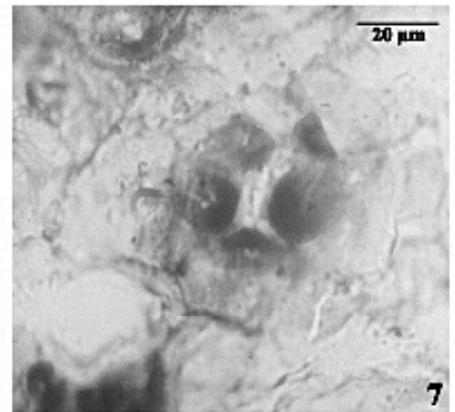
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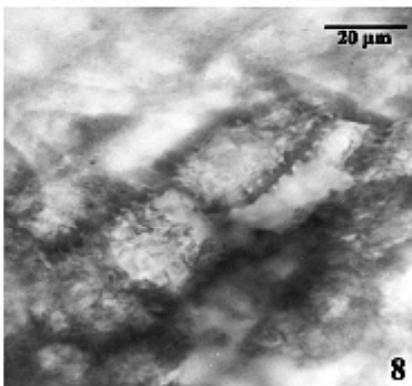
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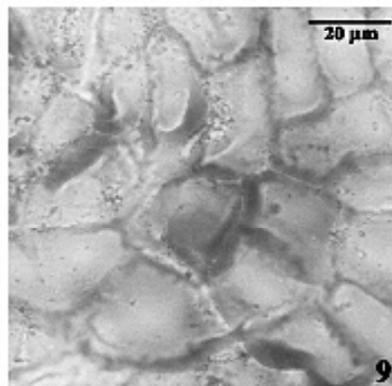
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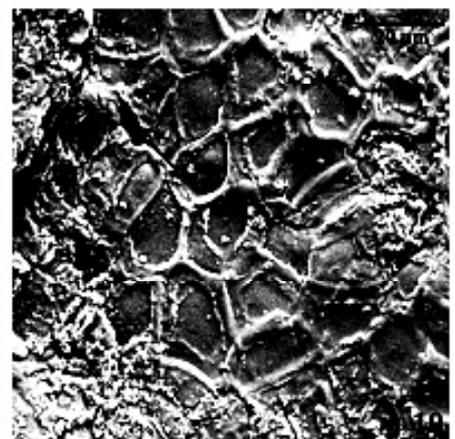


PLATE 1