

SOME FOSSIL GYMNOSPERMS FROM THE SATPURA BASIN, MADHYA PRADESH, INDIA

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ABSTRACT

Some gymnospermous plant remains recovered from the Jurassic-Lower Cretaceous rocks (Gondwana) of the Hoshangabad and Narsinghpur districts, Madhya Pradesh have been described. These are *Pachypteris indica* (Oldham & Morris) Bose & Roy, *Brachyphyllum eikaiostomum* Sukh-Dev & Bose, *Brachyphyllum* sp., *Araucarites cutchensis* Feistmantel, *A. minutus* Bose & Maheshwari and *Coniferocaulon rajmahalense* Gupta. Of these, *P. indica*, *B. eikaiostomum* and *B. sp.* are in the form of incrustations.

Key-words — Gymnosperms, Fossil plants, Satpura Basin, Gondwana, Jurassic-Lower Cretaceous (India).

सारांश

सतपुड़ा बेसिन, मध्य प्रदेश, भारत से कुछ अनावृतबीजी पादपाश्रम — सुखदेव एवं जेबा-बानो

मध्य प्रदेश में होशंगाबाद एवं नरसिंहपुर जनपदों की जुरेसिक-अधर क्रीटेशियस कालीन चट्टानों से प्राप्त कुछ अनावृतबीजी अवशेषों का यहाँ वर्णन किया गया है। ये पैकिएटेरिस इंडिका (ओल्डहम एवं मोरिस) बोस एवं रॉय, ब्रेकिफिलम आइकेओस्टोमम सुखदेव एवं बोस, ब्रेकिफिलम जा०, अँराकेराइटिस कच्छेन्सिस फायस्टमन्टेल, अँ० माइन्यूटस बोस एवं माहेश्वरी तथा कोनिफेरोकोलॉन राजमहलेन्से गुप्ता हैं। इनमें से पे० इंडिका, ब्रे०-आइकेओस्टोमम तथा ब्रेकिफिलम जा० परंपटाश्रम के रूप में पाये गये हैं।

INTRODUCTION

THE Upper Gondwanas of the Satpura Basin are well known for the richness of plant fossils, preserved as impressions and incrustations. Some petrified wood pieces are also known but these are poorly preserved. This flora, as is presently known, is constituted by pteridophytes, pteridosperms, cycadophytes, *Ginkgo* and conifers. Amongst them conifers are in abundance, pteridophytes and cycadophytes are common and pteridosperm and *Ginkgo* are very poorly represented. However, this flora is being studied in detail recently. In this paper *Pachypteris indica*, *Brachyphyllum eikaiostomum*, *Brachyphyllum* sp., *Araucarites cutchensis*, *A. minutus* and *Coniferocaulon rajmahalense* are described.

DESCRIPTION

PTERIDOSPERMS

Genus — *Pachypteris* Brongniart

Pachypteris indica (Oldham & Morris)
Bose & Roy

Pl. 1, figs 1-8; Text-fig. 1A-G

Specimens recorded earlier from the Jabalpur Formation:

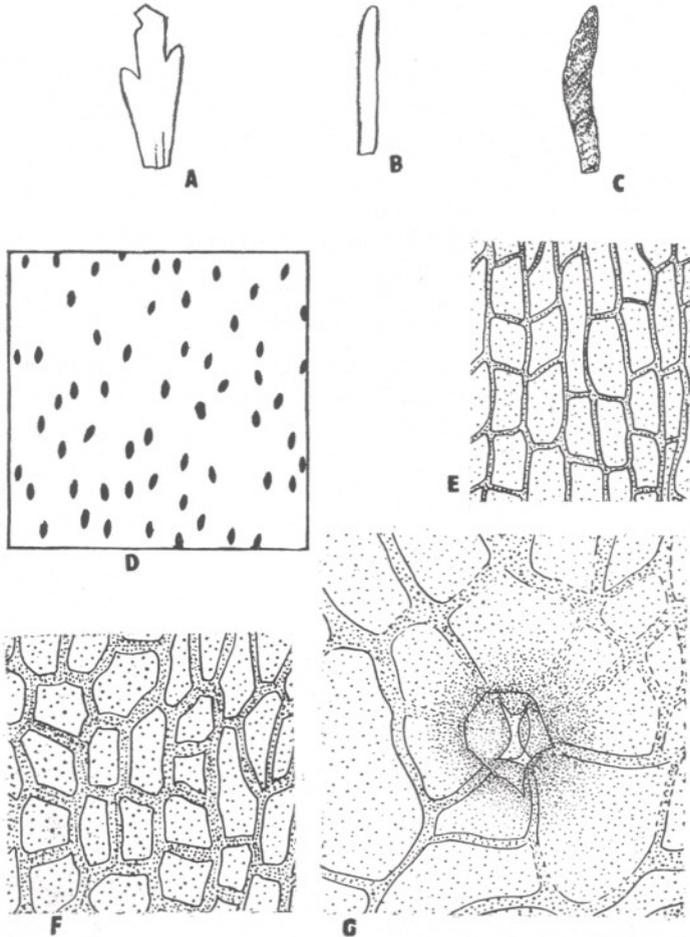
- 1863 *Taxodites* (?) *indicus* Oldham & Morris, pl. 33, fig. 5.
1877 *Palissya indica* Oldham: Feistmantel, p. 15, pl. 8, figs 1-5.
1915 *Retinosporites indica* Holden, p. 219, pl. 11, figs 1, 4, 9, 11.
1928 *Retinosporites indica* (Oldham & Morris): Sahni, p. 16.

- 1940 *Retinosporites indica*: Florin, p. 64.
 1968 *Pachypteris indica* (Oldham & Morris): Bose & Roy, p. 2, pl. 1, figs 3-5, 7; pl. 2, figs 10-14; pl. 3, figs 15, 16, 10-20; text-figs 1A-C, 2A-H, 3A-C, 4A-D, 5A.
 1972 *Pachypteris indica* (Oldham & Morris) Bose & Roy: Bose & Kasat, p. 178, text-fig. 1A-F.

Description—Fragmentary pinnae, measuring up to 2.6×0.9 cm. Rachis flattened, 1 mm wide. Pinnules alternate or subopposite, linear, up to 1.1 cm in length and about 2 mm in breadth, attached to rachis at an angle of 40°-50° by entire decurrent base, in apical region most part

of the pinnules fused with each other leaving a small cuneate-shaped portion free. Margin entire. Apex obtuse, or obtusely pointed. Veins obscure. Cells of pinna rachis similar on both sides, mostly rectangular or somewhat squarish, serially arranged. Cell walls thick, straight, sometimes slightly wavy at places. Surface wall smooth. Stomata rarely present on lower side.

Lamina hypostomatic, but rarely a few stomata present on upper side near base or 1-2 stomata near apical region. Upper cuticle slightly thinner than lower. Cells irregular in shape and size, polygonal, rectangular or squarish. Midvein region about 7-10 cells broad, towards basal portion



TEXT-FIG. 1—*Pachypteris indica* (Oldham & Morris) Bose & Roy. A. Specimen no. PP-5 × 2. B. Specimen no. PP-4 × 2. C. Specimen no. PP-3 × 2. D. Showing distribution of stomata slide no. PP-4-(1) × 40. E. Showing epidermal cells of rachis, slide no. 39/1441-(1) × 250. F. Showing epidermal cells of upper cuticle, slide no. PP-4-(1) × 250. G. Single stoma magnified, slide no. PP-4-(1) × 500.

marked by elongated and serially arranged cells. Cell wall thick, straight or slightly wavy. In some cells of lamina and rachis a slightly thin or thick oval or circular area present which may be papilla or hair base. Cells of lower side almost similar to the cells of upper side, irregular in shape and size, mostly polygonal. Cell walls thick, straight or slightly wavy at places. Surface wall smooth. Stomata irregularly distributed over entire surface, rarely mid-vein region devoid of stomata or when present may be a few. Stomata longitudinally orientated, sometimes obliquely placed. Subsidiary cells 6-8, mostly 7 in number, inner side thickly cutinized forming a sort of papillae and mostly covering the stomatal pit. Guard cells thinly cutinized, sunken. Encircling cells unequal in size, unspecialized, may or may not be discernible.

Collection — Specimen nos. 39/1441, PP-3, PP-4 and PP-5, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Localities — Near Parsapani, Hoshangabad District and Hard River near Hasnapur, Narsinghpur District.

Horizon & Age — Jabalpur Formation, ?Upper Jurassic-Lower Cretaceous.

Remarks — In the Jabalpur Formation, so far *Pachypteris indica* was only known from Sehora and Bansa. At Sehora it is quite common, whereas at Bansa it is extremely rare. Recently a few fragments of *P. indica* have also been found at Parsapani and Hard River section. In external characters and cuticular features the specimens match with the ones described from Sehora.

CONIFERALES

Genus — *Brachyphyllum* Brongniart

Brachyphyllum eikaiostomum Sukh-Dev & Bose

Pl. 2, figs 1-7; Text-fig. 2A-F

Description — Leafy twigs straight or slightly curved, stiff, up to 5 mm wide, repeatedly branched in one plane, branches making wide angles. Leaves small, spirally borne, rhomboidal, about 1.5-2.5 mm in length and breadth, closely attached, contiguous or leaving a negligible space, almost completely appressed to stem, not keeled.

Upper side of the leaf much reduced, apparently not visible, only whole of lower side seen. Attachment area rhomboidal. Margin entire, microscopically frilled. Apex acute or obtuse.

Leaves amphistomatic. Upper cuticle thinner than the lower. On Upper side stomata always irregularly distributed over entire surface. On lower side too, stomata irregularly distributed over entire surface but sometimes leaving a somewhat obscure central astomatic region. Details of stomata and ordinary epidermal cells similar on both sides. Stomata distant or lying close to each other, mostly obliquely placed, some transversely or longitudinally orientated. Epidermal cells squarish rectangular or polygonal with usually rounded corners, irregularly packed, anticlinal walls mostly 7.5-10 μ thick, straight or slightly curved, commonly pitted or broken; periclinal wall usually with thickened, circular or irregularly shaped area, some cells marked with fine striations or having narrow, longitudinal slits. Stomata oval or circular, sunken; subsidiary cells mostly 5 or 4 (range 4 to 7), surface wall less cutinized than ordinary epidermal cells, sometimes almost of same thickness, cutinization more towards periphery, progressively less towards inner wall. Guard cells slightly sunken, thinly cutinized. Stomatal pore slit-like.

Collection — Specimen nos. 29067/331B, 29101/331, 29129/331B and 29143/331B, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Locality — Near Sehora, Narsinghpur District.

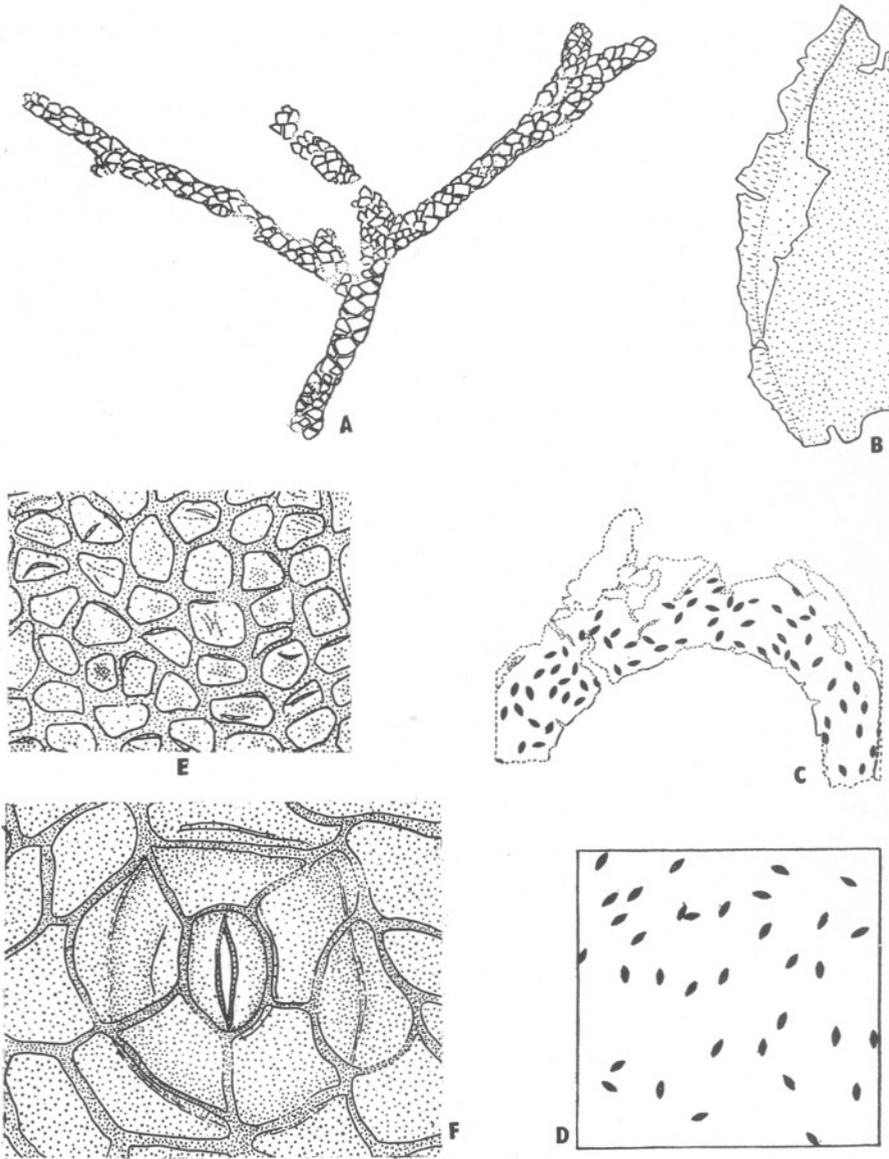
Horizon & Age — Jabalpur Formation, ?Upper Jurassic-Lower Cretaceous.

Remarks — *Brachyphyllum eikaiostomum* Sukh-Dev & Bose (1974) was so far known only from the Lower Cretaceous of Bansa, South Rewa Basin. Though the present specimens are older in age, yet they resemble to the ones described from Bansa.

Brachyphyllum sp.

Pl. 3, figs 1-6; Text-fig. 3A-D

Description — Fragmentary leafy twig, about 5 mm wide. Leaves spirally borne, closely placed, overlapping, arising from more or less rhomboidal leaf-base cushion. Leaves small, about 2×2 mm, ovate or

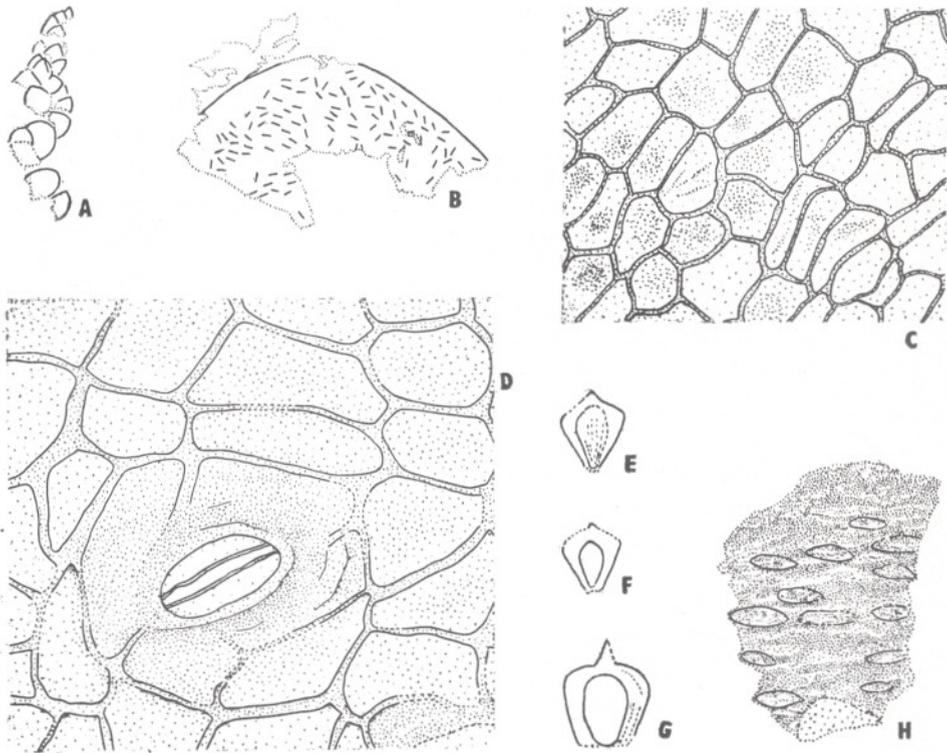


TEXT-FIG. 2 — *Brachyphyllum eikaiostomum* Sukh-Dev & Bose. A. Specimen no. 29067/331B $\times 1$. B. Showing marginal flange towards left side, slide no. 29129/331B-(4) $\times 40$. C. Upper cuticle showing distribution of stomata, slide no. 29067/331B-(3) $\times 20$. D. Part of lower cuticle showing distribution of stomata, slide no. 29067/331B-(1) $\times 40$. E. Showing epidermal cells of lower cuticle, slide no. 29067/331-(1) $\times 250$. F. Single stoma enlarged, slide no. 29101/331-(2) $\times 500$.

rhomboidal with rounded corners, thick free part of leaf shorter than breadth of basal cushion. Margin more or less entire. Apex obtuse or broadly rounded.

Cuticle on both sides almost of same thickness. On upper side stomata irregularly

scattered, more crowded towards upper half, a few stomata forming small groups. Stomata obliquely, transversely or longitudinally orientated. Epidermal cells variable in shape and size, polygonal, rectangular or squarish, or almost of same length and breadth or at



TEXT-FIG. 3 — A-D. *Brachyphyllum* sp. A. Specimen no. 65/1444 \times 2. B. Upper cuticle showing distribution of stomata, slide no. 65/1444-(1) \times 20. C. Showing epidermal cells, slide no. 65/1444-(2) \times 250. D. Single stoma magnified, slide no. 65/1444-(2) \times 500. E, F. *Araucarites minutus* Bose & Maheshwari. E. Specimen no. 18/1435 \times 1. F. Specimen no. 0/1435 \times 2. G. *Araucarites cutchensis* Feistmantel, specimen no. 70/1438 \times 1. H. *Coniferocaulon rajmahalense* Gupta, specimen no. 26/1442 \times 2.

times broader than their length. Commonly lateral and end-walls slightly curved or wavy, mostly 5μ thick, corners thickened. Surface wall frequently thickened in the middle, sometimes thickening give a false impression of papillae but never forming definite papillae. Stomatal apparatus large, oval to circular, amphicyclic, subsidiary cells of adjacent stomata commonly in contact, 4-5 rarely 6, lateral- and end-walls prominent, surface slightly more cutinized than ordinary epidermal cells and usually forming a thickened ridge. Stomatal pit oval or oblong; guard cells thinly cutinized. Encircling cells mostly rectangular, other features similar to ordinary epidermal cell.

On lower side stomata few, mostly in short discontinuous files. Stomatal details same as of upper side. Epidermal cells squarish, rectangular or polygonal, lateral

and end-walls straight or slightly curved, mostly 7.5μ thick, surface wall commonly thickened in the middle. Encircling cells like upper surface.

Collection — Specimen no. 65/1444, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Locality — Near Sehora, Narsinghpur District.

Horizon & Age — Jabalpur Formation, ?Upper Jurassic-Lower Cretaceous.

Comparison — Only a fragmentary shoot was collected from Sehora. The cuticle on both the surfaces is rather fragile. However, some of the leaves did give little information concerning the stomatal distribution on both the sides. In form and size of leaves and their rather loose arrangement on the shoot, *Brachyphyllum* sp. may be compared with *B. bansaensis* Sukh-Dev and

Bose, *B. suryanarayanii* Sukh-Dev & Bose (1974), *B. scalbiensis* Kendall, *B. crucis* Kendall (1947), *B. scotti* Kendall (1949) and *B. tropiclimorphum* Wesley (1956). But in all the latter species, stomata are present on both the sides concerning almost the entire surface and they are either scattered or arranged in rows. In *B. bansaensis* Sukh-Dev & Bose the stomata are irregularly distributed over entire lower surface leaving sometimes the apical and the central portion. Whereas, in this species only a few stomata are met with on lower surface. Moreover, in *Brachyphyllum* sp. the ring of encircling cells are prominent and stomata on upper surface are more crowded unlike *B. bansaensis* where the stomata on upper surface are a few in number and ring of encircling cells are not well-defined. *B. suryanarayanii* can be easily distinguished from *Brachyphyllum* sp. in having characteristic angular stomatal pit and subsidiary cells are provided with over hanging papillae. *B. scalbiensis* Kendall differs from *Brachyphyllum* sp. in having stomata of both upper and lower sides arranged in well-marked longitudinal rows. *B. crucis* Kendall have subsidiary cells with bulging surface forming broad papillae. Epidermal cells of *B. scotti* Kendall differs from *Brachyphyllum* sp. in having a larger solid papilla.

Genus — *Araucarites* Presl

Araucarites cutchensis Feistmantel

Pl. 3, figs 7-9; Text-fig. 3G

Description— Detached seed scales, mostly incomplete near tip, 1.5-2.0 cm long and 1.3-1.5 cm wide at broadest region, wedge-shaped. Tip bluntly pointed, incomplete, about 3 mm long and 2 mm broad; base truncate. Seeds medianly placed, adnate, pear-shaped, 1.2 cm long and 0.7 cm broad, dorsal surface having longitudinal striations. Ligule absent. On either sides of the seed free part of scales up to 3.5 mm broad.

Collection— Specimen nos. 5/1437, 70/1438 (C.P. 8/1438), 10/1441 and 42C/1441, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Localities — Hard River, Narsinghpur District and near Parsapani, Hoshangabad District.

Horizon & Age — Jabalpur Formation, ?Upper Jurassic-Lower Cretaceous.

Comparison — Our specimens resemble closely *Araucarites cutchensis* Feistmantel described by Bose and Maheshwari (1973, pl. 1, figs 1-4) from Kutch and Vemavaram. In size they also resemble *A. cutchensis* described by Halle (1913, pl. 8, figs 5, 7) from Graham Land.

Some of the smaller specimens of *A. milleri* described by Seward (1911, pl. 5, fig. 97) from the Jurassic of Sutherland somewhat resemble *A. cutchensis* in overall shape. *A. cutchensis* may also be compared with *Araucaria* sp. described by Berry (1924, figs 2, 2a) from Patagonia.

Araucarites minutus Bose & Maheshwari

Pl. 3, figs 10-12; Text-fig. 3E, F

Description — Seed scales up to 0.4-1.0 × 0.5-1.0 cm in size, cuneate, distal region with rounded shoulders. Scales narrow at base, laterally expanded, about 3-4 mm in width on either sides of seed, narrowing gradually towards base, tip short, obscure. Seeds small, centrally placed, obovate 4-8 mm long and 3-5 mm broad at widest region, having fine longitudinal striations. Ligule absent.

Collection — Specimen nos. 62/1434, 0/1435, 5/1435, 6/1435 and 18/1435 (C.P. 21/1435), Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Localities — Morand River near Jhirnapur and near Jatamao, Hoshangabad District.

Horizon & Age — Jabalpur Formation, Jurassic.

Comparison — All the specimens are preserved in the form of impressions. They match exactly with *Araucarites minutus* Bose & Maheshwari (1973, pl. 1, figs 10-15) described from Sehora, Narsinghpur District, Madhya Pradesh.

In general morphology of the seed-scales our specimens also resemble *A. minimus* described by Archangelsky (1966) from Tico', Argentina. But the specimens described by Archangelsky differ in having acuminate tip and a prominent ligule. Some of the specimens described as *A. cutchensis* by Halle (1913, pl. 8, figs 3, 4, 9, 10) from Graham Land and Seward and Holtum (1922, pl. 12, fig. 17) from Ceylon (Sri Lanka) resemble *A. minutus* in size and general shape of the seed-scales. Graham Land specimens, however, have long pointed apices.

The specimens described as *A. cutchensis* by Arber (1917, pl. 8, fig. 5; pl. 13, fig. 4) differ from the present specimens in their size and having broad rounded apical region.

Genus — *Coniferoaulon* Fliche

Coniferoaulon rajmahalense Gupta

Pl. 3, fig. 13; Text-fig. 3H

Description—Cylindrical coniferous stems, 4.3×1.2 cm in flattened condition. Surface marked with irregular, transversely extended grooves. Some of the grooves having elliptical protuberances or depressions of about 3.6×2.3 mm in size.

Collection—Specimen nos. 2/1436 and 26/1442, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Localities—Near Khatama, Hoshangabad District and Hasnapur Hills, Narsinghpur District.

Horizon & Age—Jabalpur Formation, ?Upper Jurassic-Lower Cretaceous.

Comparison—The present specimens are fragmentary and not well-preserved. They resemble *Coniferoaulon rajmahalense* Gupta in external features. *C. rajmahalense* is known from the Rajmahal Hills, Bihar (Bancroft, 1913; Sahni, 1931; Gupta, 1954) and Sehora, Madhya Pradesh (Bose, 1959). Amongst these, the specimen of Sahni (1931, pl. 12, fig. 53) is very similar to our specimens.

ACKNOWLEDGEMENT

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EXPLANATION OF PLATES

PLATE 1

Pachypteris indica (Oldham & Morris) Bose & Roy

1. Specimen no. 39/1441. \times 1, Hard River.
2. Specimen no. PP-4. \times 4, Parsapani.
3. Specimen no. PP-3. \times 4, Parsapani.
4. Specimen no. PP-5. \times 4, Parsapani.
5. Slide no. PP-3-(2). \times 10, showing distribution of stomata.
6. Slide no. PP3-(2). \times 40, showing non-stomatiferous upper and stomatiferous lower surface.
7. Slide no. PP5-(5). \times 150, showing cells of pinna rachis.
8. Slide no. PP4-(1). \times 300, stomata magnified showing papillae of subsidiary cells overhanging the stomatal pore.

PLATE 2

Brachyphyllum eikaiostomum Sukh-Dev & Bose

1. Specimen no. 29067/331B. \times 1, Sehora.
2. Part of above specimen enlarged. \times 3.
3. Specimen no. 29143/331B. \times 1.
4. Part of fig. 1, magnified. \times 3.
5. Stomata magnified, slide no. 29067/331-(1). \times 500.

6. Slide no. 29067/331-(1). \times 150, part of lower cuticle showing distribution of stomata.
7. Part of leafy branch magnified from fig. 1. \times 3.

PLATE 3

1. *Brachyphyllum* sp., specimen no. 65/1444. \times 1, Sehora.
2. Above specimen enlarged. \times 4.
3. Upper cuticle showing distribution of stomata slide no. 65/1444-(1). \times 30.
4. Part of upper cuticle magnified showing crowded stomata, slide no. 65/1444-(1), \times 150.
5. Showing stomata and epidermal cells, slide no. 65/1444-2. \times 150.
6. Single stoma enlarged, slide no. 65/1444-(1). \times 500.
7. *Araucarites cutchensis* Feistmantel, specimen no. 70/1438. \times 1, Parsapani.
8. Specimen no. 10/1441. \times 1, Hard River.
9. Specimen no. C42/1441. \times 1, Hard River.
10. *Araucarites minutus* Bose & Maheshwari, specimen no. 5/1435. \times 1. Morand River near Jhirnapur.
11. Specimen no. 6/1435. \times 1.
12. Specimen no. 0/1435. \times 1.
13. *Conifero-caulon rajmahalensis* Gupta, specimen no. 26/1442. \times 1, Hasnapur.



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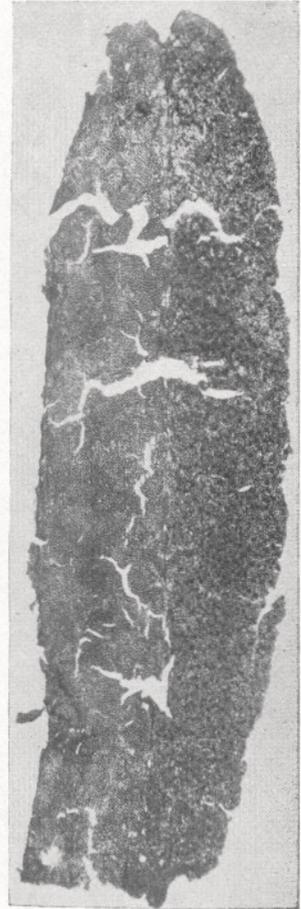
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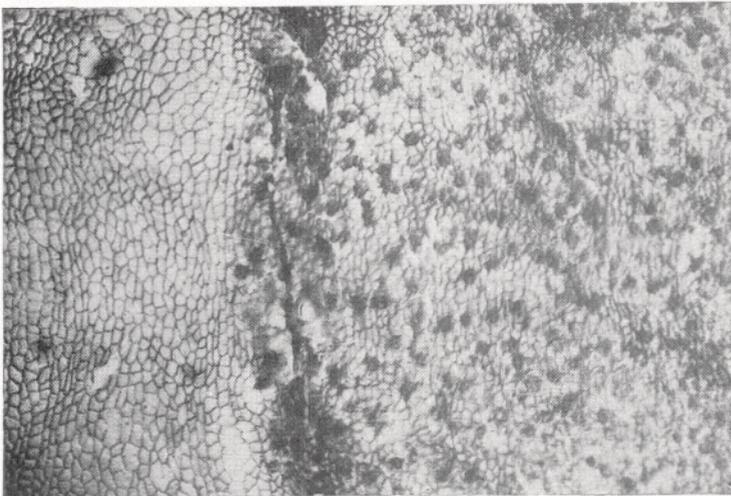
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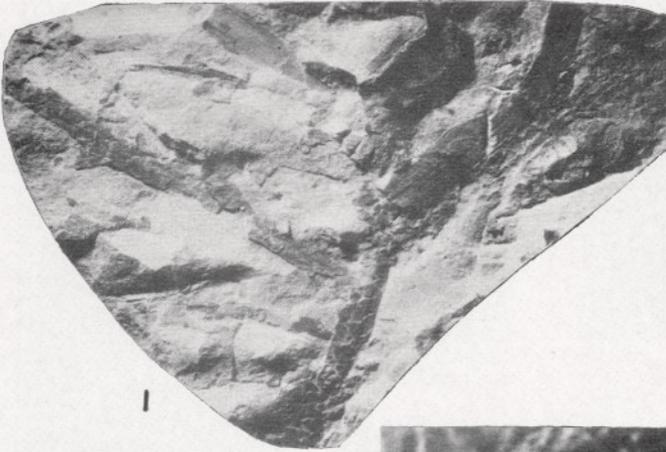
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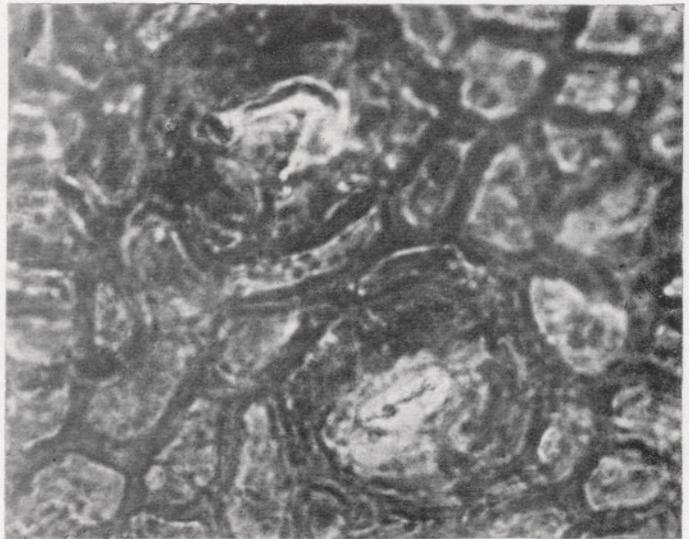
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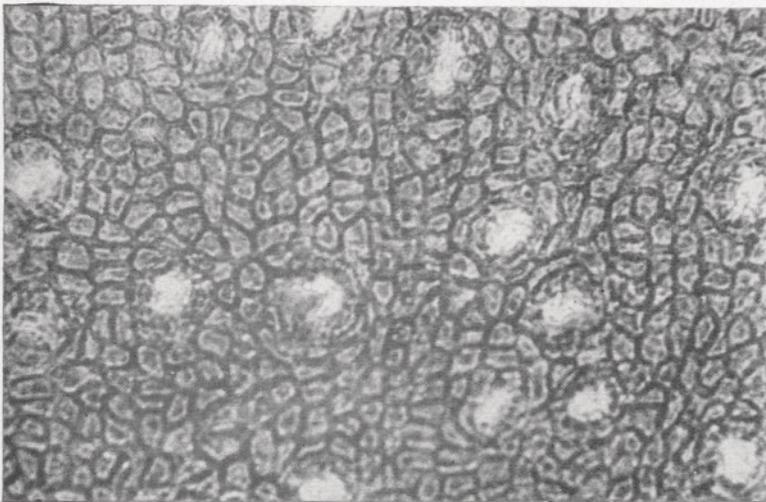
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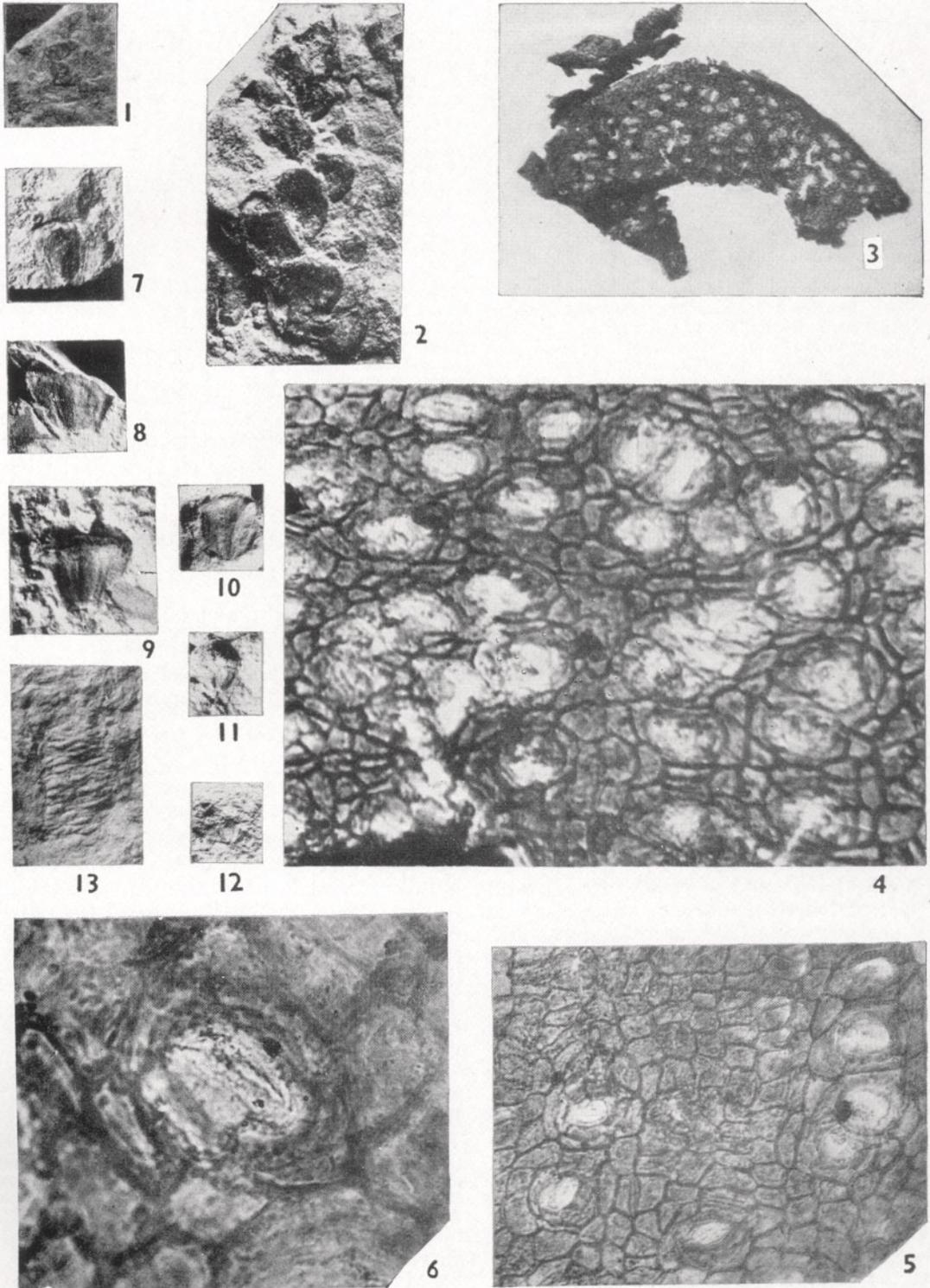


PLATE 3