

ARAUCARIA INDICA AND TWO OTHER CONIFERS FROM THE JURASSIC-CRETACEOUS ROCKS OF MADHYA PRADESH, INDIA

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ABSTRACT

This paper reports the occurrence of the living genus *Araucaria* in the Jurassic-Lower Cretaceous flora of the Jabalpur Formation, Madhya Pradesh. The species of this genus, *Araucaria indica* (Sahni) n. comb., is based on leaves and seed-scales. Also, a new genus *Satpuria* is instituted to accommodate linear conifer leaves, the affinities of which are yet uncertain. Under this genus, *S. sehoraensis* n. sp. and *Satpuria* sp. are described from the same formation.

INTRODUCTION

IN the Upper Gondwanas of Madhya Pradesh, detached linear leaves of *Desmiophyllum indicum* Sahni (1928) are found near Jhirnapur, Jatamao, Parsapani, Hasnapur, Hard River, Imjhiri, Sehora, Jabalpur, Bansa and Chandia; near Sehora, Bansa and Chandia they are in abundance. Till now their affinities were not fully certain. Associated with *Desmiophyllum indicum*, in the beds of Sehora, Jabalpur, Bansa and Chandia detached seed-scales *Araucaria pantiana* Bose & Maheshwari (1973) are found which were first referred to the living genus *Araucaria* by Pant and Srivastava (1968) on the basis of their close similarity with seed-scales of *Araucaria columnaris* (Forster) Hooker. Recently, a large number of *Desmiophyllum indicum* leaves have been collected from most of these localities. They are now studied in detail. It is observed that these leaves in their morphology, venation pattern, structure and distribution of stomata and other epidermal characters resemble leaves of the section *Colymbea* of the genus *Araucaria*. Likewise, they are described under the living genus as *Araucaria indica* (Sahni) n. comb. It is also noticed that the said seed-scales *Araucaria pantiana* belong to *A. indica* by virtue of possessing similar cuticular features especially structure and distribution of stomata.

During the course of this study, many shale samples from Hard River and Sehora (Sher River) were macerated in bulk. Out of the Sehora shales some isolated small leaves and linear leaf fragment are obtained

whose affinities are yet uncertain. These leaves are described here under a new genus *Satpuria*. Presently two species, *S. sehoraensis* n. sp. and *Satpuria* sp. are distinguished.

DESCRIPTION

Family — ARAUCARIACEAE

Genus — *Araucaria* Jussieu

Araucaria indica (Sahni) n. comb.

Pl. 1, figs. 1-10; Text-fig. 1A-J

IA. Leaves:

- 1877 *Podozamites lanceolatus* Schimp. (Lindl. & Hutt. sp.): Feistmantel, p. 91, pl. 3, figs. 7-14.
Podozamites lanceolatus genuinus: Feistmantel, p. 91, pl. 4, figs. 1-10.
Podozamites (lanceolatus) spathulatus F.: Feistmantel, p. 92, pl. 4, figs. 11, 12.
- 1882 *Podozamites lanceolatus* Schimp. (Lindl. & Hutt.): Feistmantel, p. 39, pl. 2, figs. 2-5.
Podozamites spathulatus Feistmantel, p. 40.
- 1915 *Podozamites lanceolatus*: Holden, p. 223, pl. 11, figs. 7, 10 (cuticle).
- 1920 ?*Phoenicopsis* sp.: Seward & Sahni, p. 37, pl. 7, figs. 76, 76a. Also figured in Seward, 1919, p. 453, fig. 813.
- 1928 *Desmiophyllum indicum* Sahni, p. 8, pl. 5, fig. 61-64 (cuticle).
- 1959 *Desmiophyllum indicum* Sahni: Pascoe, p. 991, pl. facing p. 990, fig. 8a, b.

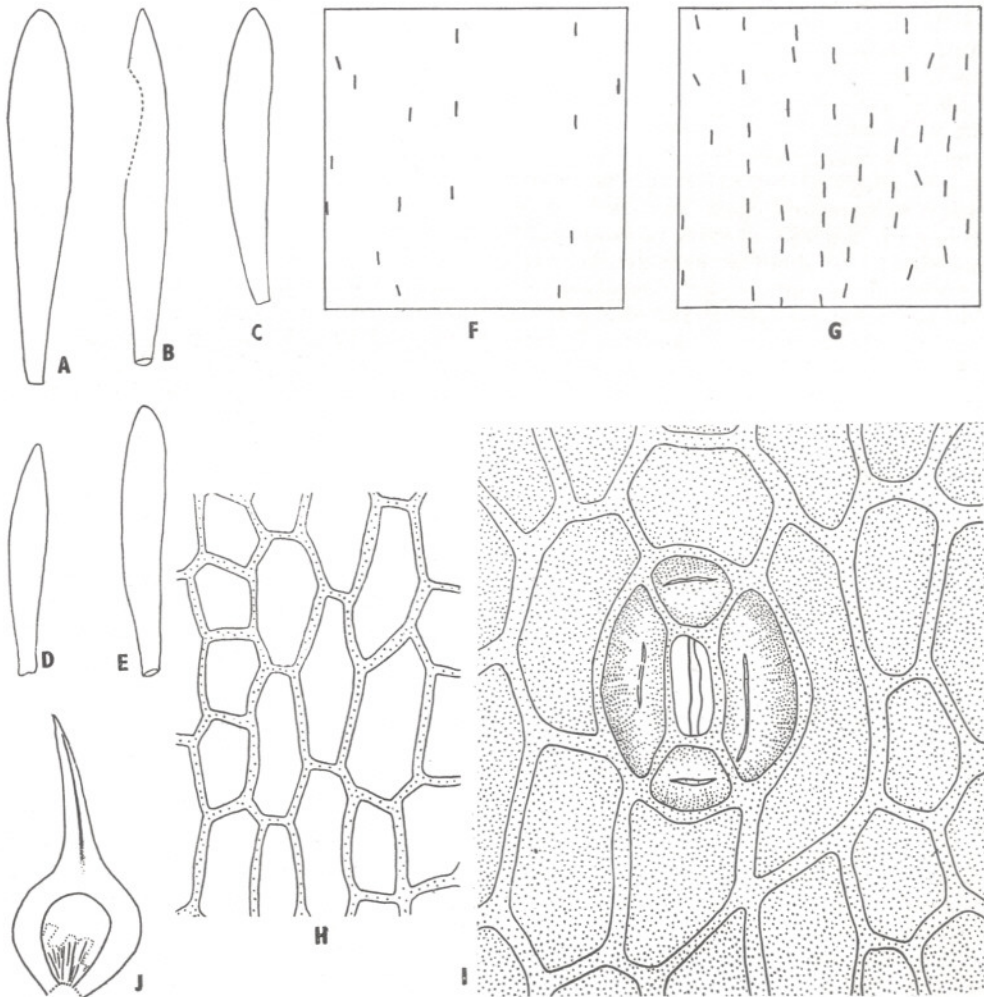
IB. Doubtful specimens:

- 1879 *Podozamites* comp. *lanceolatus* Schimp.: Feistmantel, p. 210, pl. 9, figs. 9, 10.
- 1962 *Desmiophyllum indicum* Sahnii: Lele, p. 80, pl. 4, figs. 42-44.

II. Seed-scales:

- 1877 *Araucarites cutchensis* Feistm.: Feistmantel, p. 16, in part, pl. 14, figs. 1, 4, 8, 9, 13.

- 1882 *Araucarites cutchensis* Feistm.: Feistmantel, p. 44, in part, pl. 3, figs. 9, 11; pl. 12, fig. 5.
- 1928 *Araucarites cutchensis* Feistm.: Sahnii, p. 31, pl. 5, figs. 65-67.
- 1968 *Araucaria cutchensis* (Feistmantel) Pant & Srivastava, p. 202, pl. 1, figs. 1-8, text-fig. IA-I (cuticle).
- 1969 *Araucarites cutchensis* Feistm.: Randhawa *et al.*, pl. 52, fig. 5.
- 1973 *Araucaria pantiana* Bose & Maheshwari, p. 211, pl. 1, figs. 16, 17; pl. 2,



TEXT-FIG. 1 — *Araucaria indica* (Sahnii) n. comb.: A-E, leaves, nos. A 459/925, 29928, 29985, 29981, A119/925, all $\times 1$. F, ?upper cuticle of leaf showing distribution and orientation of stomata in 1 sq mm, slide no. 30055-1 $\times 40$. G, ?lower cuticle of leaf showing distribution and orientation of stomata in 1 sq mm, slide no. 30055-1 $\times 40$. H, cells of ?upper cuticle of leaf, slide no. 30055-1 $\times 250$. I, stoma and epidermal cells of leaf, slide no. 29967-1, $\times 500$. J, seed-scale, specimen consumed, $\times 1$ (A, E, from Sehora; B-D, F-J, from Bansa).

figs. 20-25; text-figs. 10-5, 2A, C-E (cuticle).

Diagnosis — Leaves linear, strap-shaped, variable in form towards distal end, narrowing gradually towards base and then generally widening slightly at the attachment region. Distal end abruptly narrowing to a pointed or broadly rounded blunt apex or narrowing steadily to an acute apex. Margin entire. Veins usually indistinct, few, about 3 or 4 at the base and becoming about 8 higher up, running more or less parallel and usually converging towards the apex.

Cuticle on both surfaces similar, thick. Stomata present on both surfaces more or less in equal number, but absent at the extreme base. Sometimes stomata few, or rarely absent on ?lower surface. Stomata arranged in single rows, some outside the rows. Stomatal rows parallel to the length of leaf, consisting of 2-12 stomata or up to 21 stomata in a single row, rows usually 2-5 (sometimes up to about 8) cells apart, varying number of rows may be arranged in bands at various distances. Stomata of the same row usually 2-5 cells apart, sometimes subsidiary cells touching each other. Distance between the rows variable in the case of lesser stomata on ?lower surface. Stomata mostly longitudinal, sometimes oblique, rarely transverse in orientation. Stomata commonly dicyclic, stomatal apparatus oval to circular, subsidiary cells mostly 4 (2+2), sometimes 5, rarely 6, sunken, surface usually more thickened towards the outer wall, thinner more or less in the middle and thicker again towards the inner wall, sometimes having another thickened band in the middle as well and surface thinner on its either side, surface usually having one or few thin strips and some times fine striations. Encircling cells generally surrounding subsidiary cells, usually slightly sunken and may be thinner in the middle. Commonly part of encircling cells or adjacent cells along with subsidiary cells more cutinized to form a larger stomatal pit. Guard cells usually showing hyaline areas at poles and forming slightly to fairly thickened rim at their periphery. Epidermal cells on both the surfaces variable in shape and size, rectangular, squarish or polygonal, generally arranged length-wise in short files between the stomatal rows. Cells between stomata of the same row usually broader than their length. Anticlinal walls straight, sometimes slightly

curved, may be pitted, about 3-9 μ thick. Periclinal walls smooth, sometimes marked with fine striations or thin strips. Sometimes hypodermal cells cutinized.

Seed-scales (largely based on Pant & Srivastava, 1968 and Bose & Maheshwari, 1973) more or less wedge-shaped with prolonged tip, 2.3-4 cm long and 0.9-1.5 cm wide at broadest point, typically showing a contracted base, an expanded middle part and a prolonged tip 1.5-2.5 cm long and 0.5-0.7 cm wide at broadest point beyond shoulders of scale. Expanded part bearing a single medianly placed seed. Seed possibly embedded, obovoid, 0.7-1.7 cm long and 0.4-1.0 cm wide at broadest point, surface of seed often showing fine longitudinal striations. Scales often showing a triangular ligule 4 mm long and 3 mm wide, present in the expanded part between base of tip and distal end of seed. Prolonged tip having a median ridge extending up to ligule.

Cuticle of scale on both surface similar, tough, 3.5-4.5 μ thick over 'wings' and up to 7 μ thick elsewhere. Stomata absent over seed (rarely a few present), 'wings' and along median ridge of tip. Distal part of scale beyond seed amphistomatic with more or less equal number of stomata, or one surface with lesser stomata than the other. Stomata on both surfaces tending to be arranged in uniseriate longitudinal rows alternating with commonly 1 to 4 cell wide non-stomatiferous bands, this alternation tending to be ill-defined towards non-stomatiferous basal part. Non-stomatiferous bands often becoming wider on pauci-stomatic surface due to presence of widely spaced alternating stomatal rows. Stomata mostly longitudinal, some oblique, rare ones transverse in orientation. Stomata commonly dicyclic. Subsidiary cells mostly 4 (2+2), sometimes 5, rarely 6, partially overlapping guard cells, surface generally more thickened towards outer wall, thinner more or less in the middle and again more thickened towards inner wall, commonly another thickened band present in the middle and surface thinner on either side of it, surface having one or few thin strips. Encircling cells generally slightly sunken, may be thinner in the middle. Commonly part of encircling cells or adjacent cells along with subsidiary cells more cutinized to form a larger stomatal pit. Guard cells sunken in a shallow pit, 63-105 μ in length and 17-38 μ in breadth,

peripheral outline of guard cells represented by a moderately thickened rim along their (epidermal) dorsal wall, common wall of guard cells often obscure; guard cells usually showing hyaline areas at poles. Cells within stomatal rows less regularly arranged, polygonal, rectangular or rhomboidal, often wider than long, 35 to 45 μ long and 17 to 28 μ wide, lateral and end walls straight, surface having thin slits or fine striations. Cells along non-stomatiferous bands arranged in longitudinal rows, somewhat elongated, rectangular or polygonal, 31-67 μ long and 21-46 μ wide, walls like cells along stomatiferous bands. Sometimes hypodermal cells cutinized. Cells towards boundary of seed, over 'wing' and in expanded proximal part of scale less regularly arranged, polygonal, rectangular or rhomboidal, often wider than long. Cells over 'wing' elongated, 67-172 μ long and 17-52 μ wide, lateral and end walls straight, surface smooth. Cells over seed elongated, polygonal, lateral and end walls thick, straight, surface wall smooth.

Holotype — Specimen no. J1/11, Geological Survey of India, Calcutta (Sahni, 1928, pl. 5, fig. 62).

Occurrence — Type locality Hard River near Hasnapur and other localities near Jhirnapur, Jatamao, Parsapani, Hasnapur, Imjhiri, Sehora, Jabalpur, Bansa and Chandia, Madhya Pradesh.

Horizon & Age — Jabalpur Formation; Bansa-Chandia area, Lower Cretaceous and other localities, Jurassic-Lower Cretaceous.

Remarks — In majority of the leaves stomata are present more or less in equal number on both the surfaces. In others, stomata are few or rarely absent on one surface. It is observed in only one case that it is the lower surface which has got few stomata. It remains to be confirmed if this is always the case. In seed-scales also both the stomatiferous surfaces are yet to be identified.

Discussion — The strap-shaped linear leaves mentioned above are commonly found in the Jabalpur Formation. They were first referred to a cycad, *Podozamites lanceolatus* (Lindl. & Hutt.) Schimper by Feistmantel (1877, 1882). Holden (1915) studied their cuticular structure. Seward and Sahni (1920) opined that most probably they are species of *Phoenicopsis*. But, later Sahni (1928) described them as a new species under the genus *Desmiophyllum* Lesquereux sensu

Solms-laubach (1904), because in the absence of evidence of their mode of attachment with the parent stem their affinities were not certain. Sahni, however, observed their close association with the araucarian seed-scales occurring in the same beds, and thus suspected for them araucarian possibility as well. The genus *Desmiophyllum* was erected by Lesquereux (1878) for a specimen, from the Coal Measures of Pennsylvania, bearing sublinear parallel-veined leaves in bundles of 3 or 4 coming out from a common point of the articulated stem. Some leaves are found singly on the same stem, but about their attachment Lesquereux is not certain. Later, Solms-Laubach (1904, refer Seward, 1919; Sahni, 1928) revived this genus as a convenient term for the linear leaves, which in the absence of evidence of their mode of attachment cannot satisfactorily be placed in the better defined genera *Phoenicopsis* or *Podozamites*. But the fact is, the genus *Desmiophyllum* is based on a dubious specimen of the Coal Measures of Pennsylvania. In the present case, with more available evidence, the Indian leaves appear araucarian belonging to *Araucaria*. They resemble very much or rather appear identical in external morphology, venation pattern, longitudinally orientated stomata arranged in rows and in their structure and other epidermal characters, with the section *Colymbea* of the genus *Araucaria*. Florin (1937, p. 50) has also clearly stated that these leaves (then known as *Desmiophyllum indicum* Sahni) in their epidermis, especially structure and arrangement of stomatal apparatus, do not belong to Ginkgophyte or Cordaite but to Araucariaceae and indeed to the genus *Araucaria*. Florin has further stated that this position is well in accord because the leaves in *Araucaria* also fall several times. Recently, some single-seeded-scales having ligule and resembling most these leaves in their cuticular structure have been assigned to the living genus *Araucaria*, as *A. pamtiana* (Pant & Srivastava, 1968; Bose & Maheshwari, 1973). So the general morphology of these leaves and venation pattern (i.e. converging veins towards apex), epidermal features, deciduous nature (too frequent here) and their seed-scales, all collectively show overwhelmingly their identity with the genus *Araucaria*; hence likewise they are assigned to the said genus. The evidence regarding the attachment of these leaves now

appears of lesser importance in view of the other aforesaid facts.

A. indica is compared specifically with some species of the section *Colymbea* of *Araucaria*. The anticlinal walls of epidermal cells in *A. araucaria* (Mol.) K. Koch, *A. bidwillii* Hook. and *A. angustifolia* (Bertol.) O. Ktze are abundantly pitted; in *A. angustifolia* they are also closely wavy (Florin, 1931, pl. 31, fig. 5; pl. 32, figs. 1, 2; text-figs. 8-10, 53c-e). In *A. indica* the anticlinal walls of epidermal cells are mostly straight and entire, sometimes curved and rarely minutely pitted. The leaves of *A. bidwillii* and *A. araucana* are quite distinct in their morphological characters.

Among the fossils, certain species of *Pseudotorellia*, e.g. *P. nordenskiöldii* (Nath.) Florin, *P. ephela* (Harris) Florin and some others do show some resemblance with *A. indica* in external features, but *Pseudotorellia* is primarily a hypostomatic ginkgolean genus which further differs in the cuticular details. Moreover, the leaves of *Pseudotorellia* are smaller in size in which the veins are not converging towards apex.

Attribution of Seed-scales to the Leaves — The seed-scales *Araucaria pantiana* Bose & Maheshwari resemble the leaves, herein described, in the distribution and structure of stomatal apparatus. Both these organs also occur in the same beds of Sehora, Jabalpur, Bansa and Chandia. These resemblances have also been pointed out earlier by Sahni, 1928; Pant and Srivastava, 1968; Bose and Maheshwari, 1973. Hence, on the basis of these similarities in cuticular structure and close association of the said leaves and seed-scales, they are considered here organs of the same species, *Araucaria indica* (Sahni) n. comb.

Genus — *Satpuria* n. gen.

Diagnosis — Leaves bifacial, subulate, spatulate, or more or less lanceolate, sessile or short-stalked. Margin entire. Apex acute or obtuse. Venation parallel, sometimes veins may dichotomize. Amphistomatic or stomata may be present on one side only. Stomata haplocheilic, usually arranged in rows, orientated transversely, longitudinally or obliquely. Subsidiary cells mostly 4-6.

Discussion — Leaves of more or less similar characters are described generally under the

genus *Desmiophyllum* Lesquereux sensu solms-Laubach (1904, see Seward, 1919; Sahni, 1928). The genus *Desmiophyllum* is based on specimen of dubious characters. It consists of sessile, sublinear leaves borne in groups of 3-5 on the articulated stem. Some leaves also occur singly on the same stem, but their exact position whether attached or unattached is not certain (Lesquereux, 1878). Under this uncertain situation, we have decided to institute a new artificial genus for the detached sessile or short-stalked leaves, having parallel venation—sometimes veins may dichotomize as in *Agathis* (Seward & Ford, 1906, p. 345, fig. 20A), which apparently resemble the living genera *Araucaria* (section *Eutacta*), *Agathis*, or *Podocarpus* (section *Nageia*). During the Jurassic-Cretaceous time both *Araucariaceae* and *Podocarpaceae* plants were found in India and also in the Southern Hemisphere.

The genus *Pseudotorellia* Florin superficially resembles *Satpuria*. Though at present the venation pattern in the genus *Satpuria* is not distinctly visible but from the course of bands of elongated epidermal cells in the lamina it is inferred to be parallel, where some veins dichotomize. In this character the genus *Satpuria* resembles somewhat *Pseudotorellia*. The genus *Pseudotorellia*, however, differs markedly in its cuticular features. Firstly, the genus includes hypostomatic leaves with always longitudinally orientated stomata. Secondly, the stomata are in indistinct strips. Thirdly, the walls of the guard cells and lateral subsidiary cells have special thickenings. In *Satpuria* the leaves are amphistomatic or stomata may occur on one side only and are transversely, longitudinally or obliquely orientated. Secondly, the stomata may be grouped in strips. Thirdly, the guard cells and lateral subsidiary cells do not possess special cutinization characteristic of the genus *Pseudotorellia*, their cutinization occurs in the normal manner.

The genus *Eretmophyllum* Thomas is a much larger leaf with a prominent, elongate petiole. Its stomata are irregularly orientated. The genus *Satpuria* includes sessile or short-stalked leaves. Its stomata are usually transverse or longitudinal, some oblique in orientation.

Genotype — *Satpuria sehoraensis* n. sp.

Type Locality — Near Sehora, Narsinghpur District, Madhya Pradesh.

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

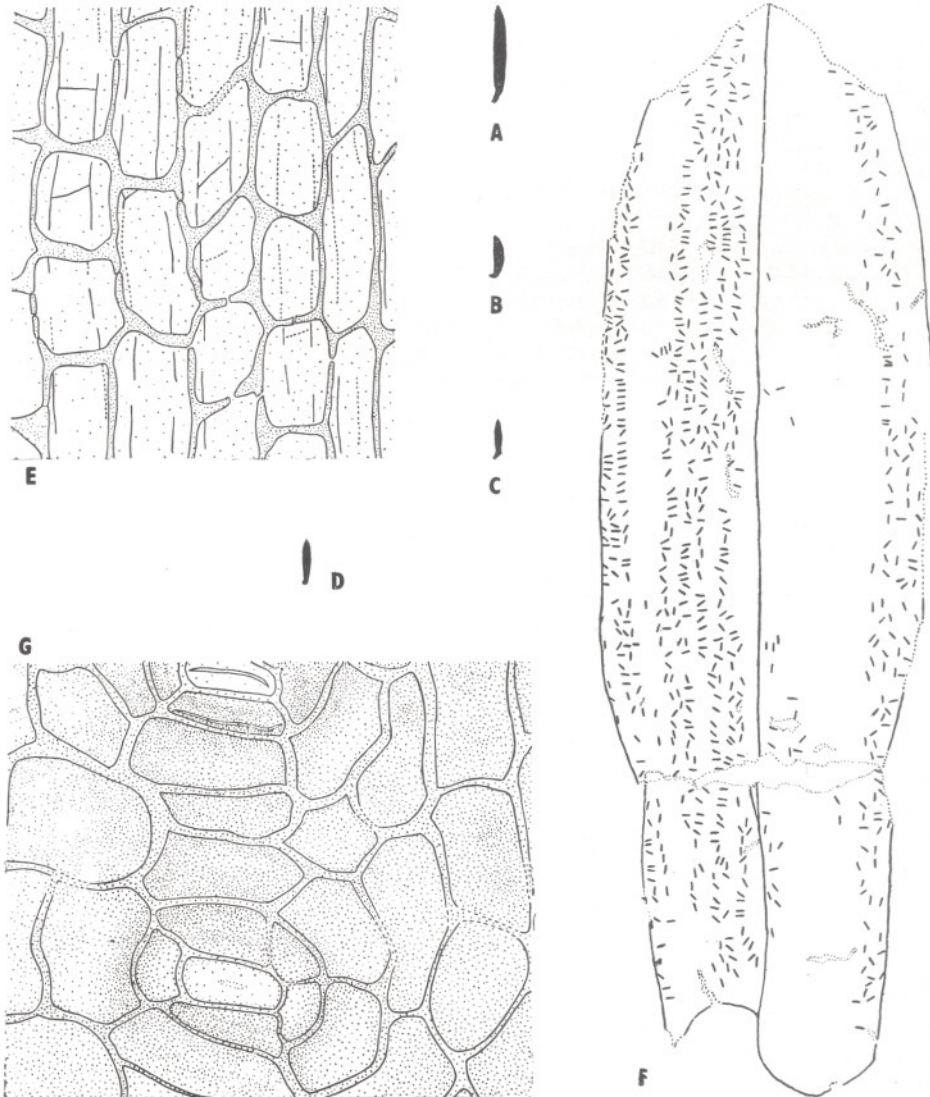
Satpuria sehoraensis n. sp.

Pl. 2, figs. 11-19; Pl. 3, figs. 25, 26; Text-fig. 2A-G

Diagnosis — Leaves small, strap-shaped, gradually narrowing towards base and apex,

or fairly of uniform breadth in the middle and rather abruptly narrowing towards both ends, sessile or short-stalked, base or stalk narrow and bent. Margin entire. Apex acute or sub-acute. Venation indistinct, microscopically from the course of bands of elongated cells, veins appear parallel with a few dichotomizing.

Cuticle on both sides almost of same thickness. Stomata abundant on upper side, lesser or absent on lower side, usually absent



TEXT-FIG. 2 — *Satpuria sehoraensis* n. gen., n. sp. **A-D**, leaves, nos. 464/925-1, 464/925-2, 464/925-3, 464/925-4, all $\times 1$. **E**, epidermal and hypodermal cells, slide no. 464/925-(10) $\times 250$. **F**, leaf showing distribution of stomata on upper side (towards left) and lower side (towards right); Holotype, slide no. 464/925-7 $\times 16$. **G**, stoma and epidermal cells, slide no. 464/925-15 $\times 500$ (A-G from Sehora).

on the extreme basal portion of both sides. Stomata arranged in short to fairly long single-stoma-wide files, files running \pm parallel to the long axis of leaf, some occurring outside of files, sometimes files grouped in bands. On upper side, stomatal files either covering the entire surface or leaving variable spaces amongst themselves, at times avoiding the veins for variable distances. On lower side stomata rarely occurring on almost entire surface but still remaining lesser in number. Stomatal apparatus oval to circular, slightly sunken. Subsidiary cells 4 or 5, slightly more thickened towards the periphery and thinner towards inside, or thicker in the middle and thinner on either side, generally surrounded by a ring of encircling cells. Stomata in a file generally transversely orientated, commonly oblique, sometimes longitudinally placed, lying close to each other in a transversely compressed manner and commonly their subsidiary cells touching each other, rarely sharing a common subsidiary cell, or lying at variable distances from one another. Guard cells thinly cutinized, aperture slit-like and raised. Epidermal cells squarish, rectangular or polygonal, generally serially arranged, usually elongate between the files and broader between stomata of the same file, at times this distinction prominently pronounced. Veins frequently discernible, usually on the upper side by elongated epidermal cells arranged serially, from them venation appearing parallel with some veins dichotomizing. Anticlinal walls straight, may be slightly curved. Periclinal walls unevenly cutinized. Thin slits may be present on ordinary epidermal cells and subsidiary cells. Hypodermis present.

Holotype — Slide no. 464/925-7, Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Locality — Near Sehora, Narsinghpur District, Madhya Pradesh.

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

Comparison — A large number of detached leaves are found in the shales of Sehora which resemble *Araucaria indica* (described earlier) broadly speaking in shape (except the basal bent portion) but not in size, in distribution of stomata and but not their orientation. The leaves in *Satpuria sehoraensis* are much shorter and narrower than *A. indica*. The stomata in *S. sehoraensis* are generally trans-

versely orientated, commonly oblique, sometimes longitudinal, whereas in *A. indica* they are mostly longitudinal, sometimes oblique and rarely transverse. Both the species, however, resemble in having much more stomata on the upper side and fewer or none on the lower.

Satpuria sehoraensis bears small sessile or short-stalked, straight to sickle-shaped leaves which somewhat approach the narrow-elongate leaves of *Agathis australis*, but markedly differ in being much smaller in size. The leaves of the other species of *Agathis* are much larger. Quite unlike *A. australis*, the upper side of leaves in *S. sehoraensis* has much more stomata than the lower. The stomata in *S. sehoraensis* are more frequently transversely and compactly arranged in contrast to *A. australis*. The pattern of differential cutinization of the surface wall of subsidiary cells is also different in both the species. *Araucaria rulei* is comparable to *S. sehoraensis* in the orientation of stomata and their abundance on the upper side of leaves. However, in the living species *A. rulei* stomatal files are grouped in bands and epidermal cells have pitted to closely sinuous anticlinal walls. The leaves of *A. rulei* are larger in size.

Pseudotorellia costata kiritchk. (Baranova *et al.*, 1975) somewhat looks like *S. sehoraensis* in the form of the leaves, it is however, easily distinguished by the generic characters of its cuticle as discussed earlier.

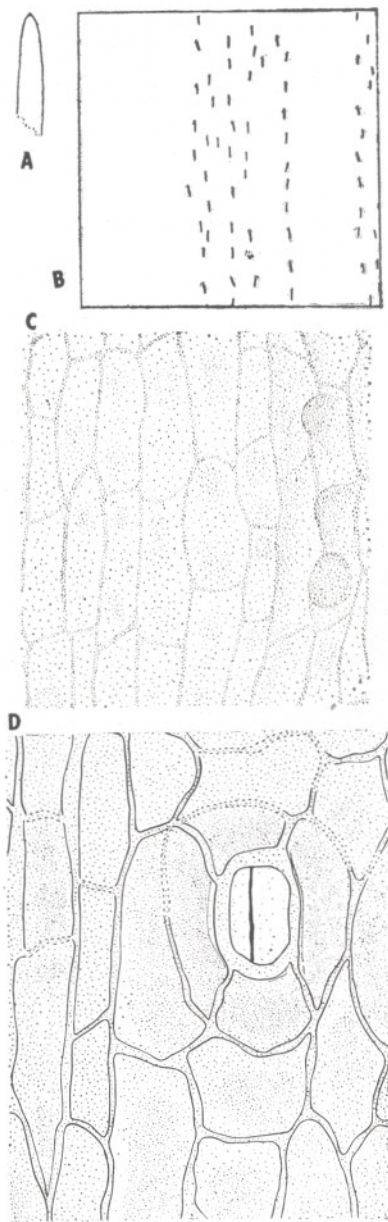
Satpuria sp.

Pl. 3, figs. 20-24; Text-fig. 3A-D

1877 ?*Podozamites hacketi* Feistm.: Feistmantel, p. 92, pl. 7, figs. 4, 5, 4a, 4b, 5a, 5b.

Description — Leaves fragmentary, elongate, more or less parallel-sided, narrowing towards distal end into an obtusely pointed apex, available width up to 3 mm. Margin entire.

Cuticle of almost same thickness on both the sides, one of the sides stomatiferous. Stomata on the stomatiferous side present in longitudinal bands, bands consisting of about 2-10, single, short to elongate files. Files lying closely, some stomata out of file. Stomata crowded in the bands, mostly longitudinally and commonly obliquely orientated. Stomata in a file contiguous (but not sharing a common subsidiary cell) to a



TEXT-FIG. 3 — *Satpuria* sp. **A**, upper part of leaf, no. C459/925 \times 1. **B**, showing distribution and orientation of stomata in 1 sq mm of cuticle, slide no. 464/925-16 \times 40. **C**, cells of stomatiferous side, some cells having papillate thickenings, slide no. 464/925-16 \times 250. **D**, single stoma magnified, slide no. 464/925-16 \times 500 (A-D from Sehora).

few cells apart, stomata of the adjacent files having their subsidiary cells either touching with one another or few cells apart. Subsidiary cells 4-6, slightly sunken, more cutinized than the ordinary epidermal cells, cutinization mostly forming a raised thickened band, sometimes having small papillate thickening and thin strips as well. Guard cells thinly cutinized, aperture narrow, slightly raised. Ordinary epidermal cells outside the stomatal bands elongate, parallel to the length of leaf, mostly placed end to end in long series, rectangular or polygonal, lateral and end walls straight, sometimes slightly curved, indistinct at places, surface wall generally thickened into a longitudinal ridge near one of the lateral walls of a cell and commonly papilla-like small thickenings also present, the papilla-like thickening better developed on the ends of the stomatal bands, end walls transverse or oblique. Cells in the stomatal bands variable in shape and size, shorter, broader or almost as broad as long or longer. On the other side (non-stomatiferous) epidermal cells shorter, squarish, rectangular, or polygonal, placed end to end in short to long series. Lateral and end walls straight, occasionally slightly curved, sometimes not clearly marked, end walls transverse or oblique, surface wall sometimes having ridge-like thickening close to lateral walls.

Collection — Specimen nos. C459/925 and 464/925 (464/925-15 slide), Birbal Sahni Institute of Palaeobotany Museum, Lucknow.

Locality — Near Sehora, Narsinghpur District, Madhya Pradesh.

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

Comparison — Only two fragmentary leaves of *Satpuria* sp. are found. In their general appearance they show closeness to *Podozamites hacketi* Feistmantel (1877) described from the same locality. Since the complete form of *Satpuria* sp. and the cuticular details of *P. hacketi* are not known, therefore their mutual relationship can not be discussed completely at present. *Satpuria* sp. resembles to some extent *Araucaria indica* (described earlier) in having generally longitudinally orientated stomata. But, both the species are quite distinct. The stomatal files in *Satpuria* sp. form distinct bands of crowded stomata, whereas, in *A. indica* the stomatal files are loosely

arranged and if at all they form bands, stomata are not crowded. Moreover, both the species differ in the shape of the stomatal apparatus and thickening of subsidiary and other epidermal cells.

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EXPLANATION OF PLATES

PLATE 1

1. *Araucaria indica* (Sahni) n. comb., leaf, specimen no. 28642, Bansa. × 1.
2. *A. indica*, leaf, specimen no. 30105B, Bansa. × 1.
3. *A. indica*, leaf, specimen no. 218/925, Sehora. × 1.
4. *A. indica*, apical part of the leaf of fig. 3 enlarged, showing veins converging towards apex. × 4.
5. *A. indica*, a single stoma of leaf magnified, slide no. 30629-1, Bansa. × 500.
6. *A. indica*, cuticle of one surface of leaf showing distribution of stomata in short longitudinal rows, slide no. 30629-1, Bansa. × 100.
7. *A. indica*, seed-scale, specimen no. 30062, Bansa. × 1.
8. *A. indica*, seed-scale, specimen no. 30665, Bansa. × 1.
9. *A. indica*, cuticle of seed-scale, showing distribution of stomata, slide no. 30100-1, Bansa. × 100.
10. *A. indica*, two stomata of the seed-scale of fig. 9 further magnified. × 500.

PLATE 2

(All from Sehora)

11. *Satpuvia sehoraensis* n. gen., n. sp., slide nos. 464/925-1A & B. × 2.
12. *S. sehoraensis*, slide no. 464/925-2. × 2.
13. *S. sehoraensis*, slide no. 464/925-3. × 2.
14. *S. sehoraensis*, slide no. 464/925-4. × 2.
15. *S. sehoraensis*, showing upper side of leaf (towards left) and lower side (towards right), slide no. 464/925-5. × 10.
16. *S. sehoraensis*, apical part of leaf, showing distribution of stomata in files on both sides, slide no. 464/925-6. × 10.
17. *S. sehoraensis*, showing stomata and epidermal cells, slide no. 464/925-8. × 150.
18. *S. sehoraensis*, part of the cuticle of fig. 6 further magnified, showing distribution of stomata. × 30.
19. *S. sehoraensis*, leaf showing distribution of stomata on upper side (towards left) and lower side (towards right), holotype, specimen in slide no. 464/925-7. × 10.

PLATE 3

(All from Sehora)

20. *Satpuria* sp., specimen no. C459/925. $\times 1$.
21. *Satpuria* sp., above mentioned specimen magnified. $\times 2$.
22. *Satpuria* sp., cuticle showing stomatiferous and non-stomatiferous surface of the leaf, slide no. 464/925-16. $\times 40$.
23. *Satpuria* sp., a single stoma magnified, slide no. C459/925-1. $\times 500$.
24. *Satpuria* sp., part of cuticle magnified, showing stomata and epidermal cells, slide no. 464/925-16. $\times 150$.
25. *Satpuria sehoraensis* n. gen., n. sp., part of cuticle magnified, showing stomata and epidermal cells, slide no. 464/925-6. $\times 150$.
26. *S. sehoraensis*, three stomata magnified, slide no. 464/925-15. $\times 500$.



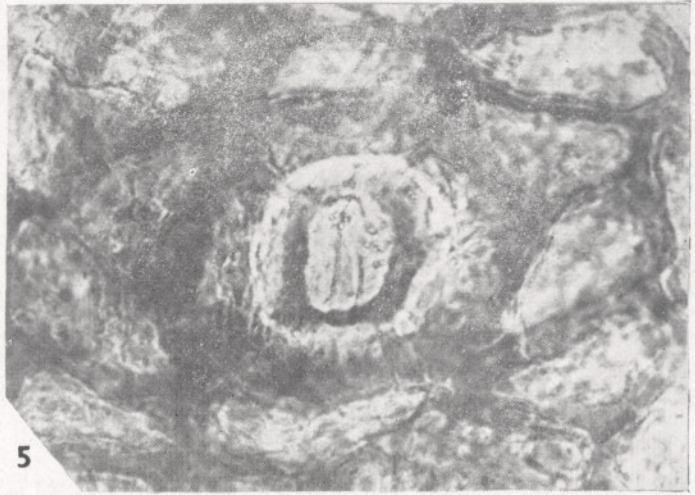
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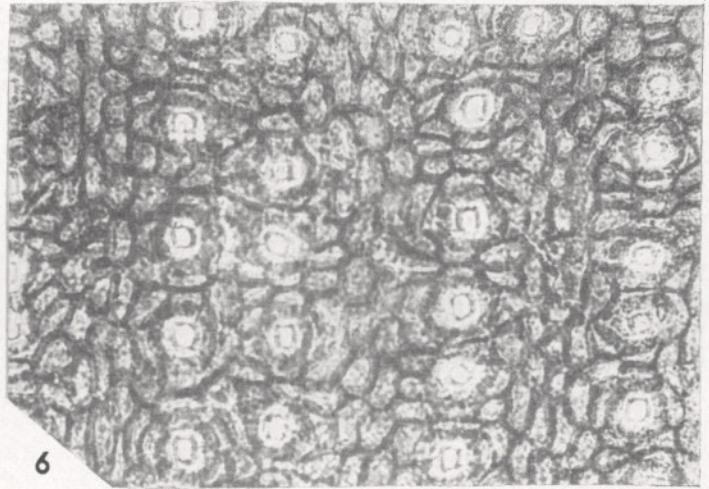
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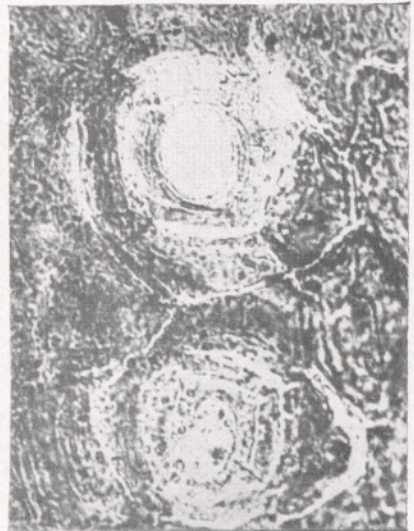


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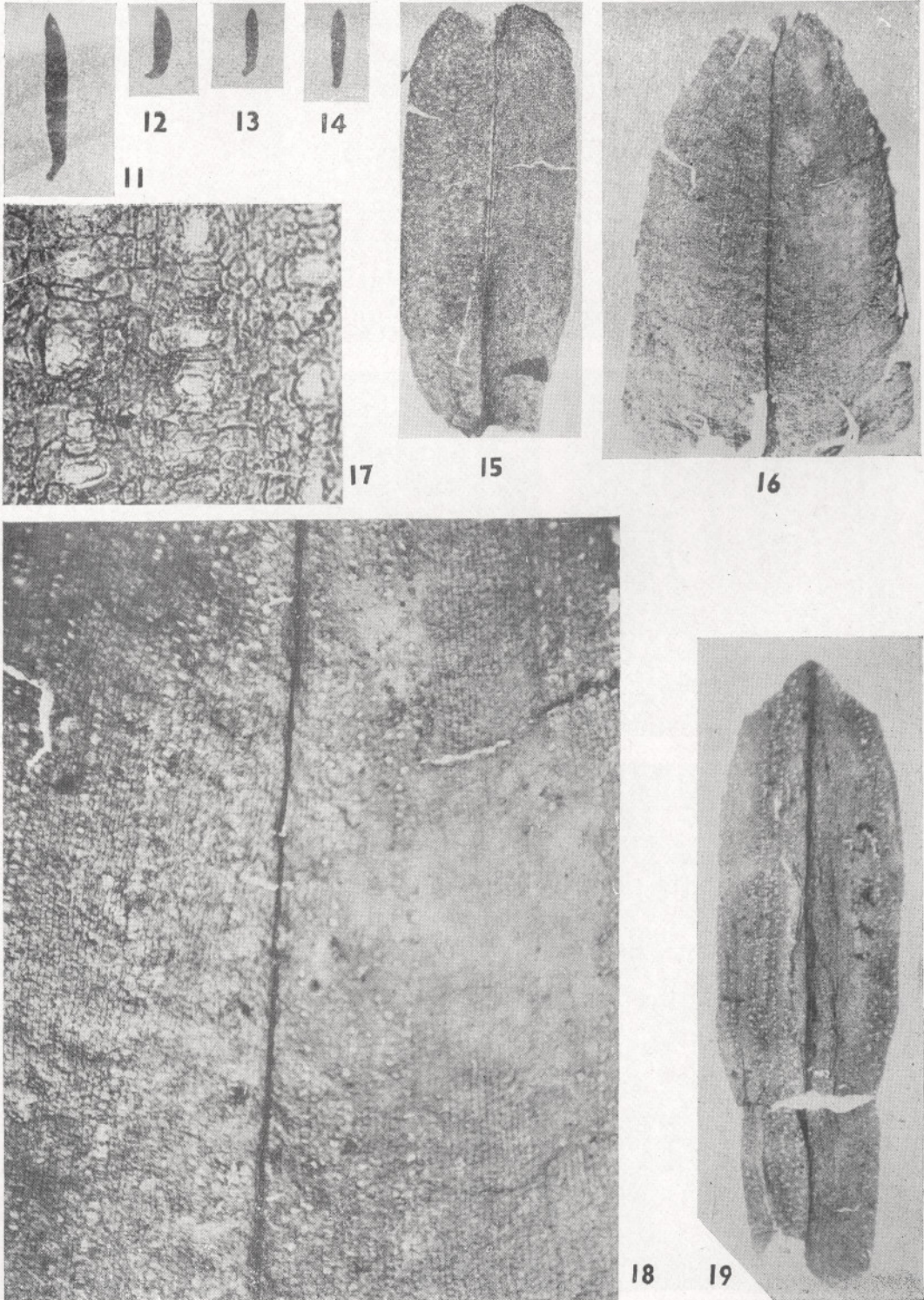
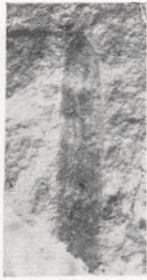


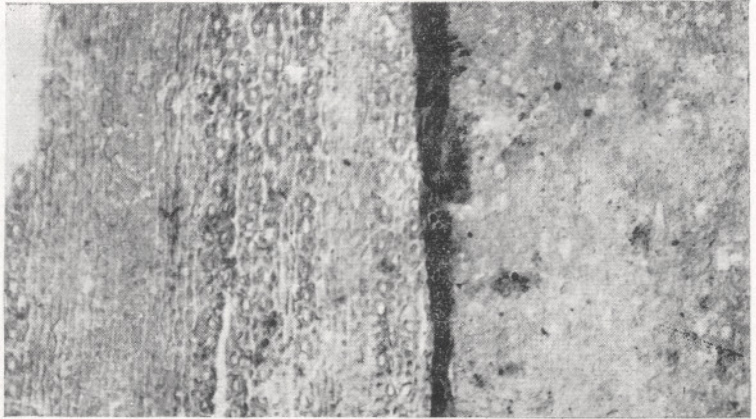
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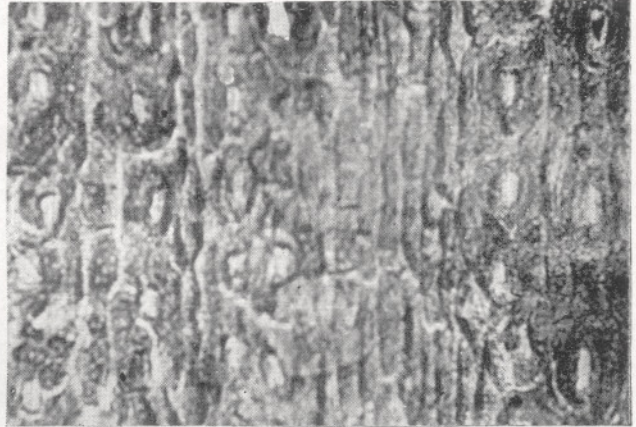


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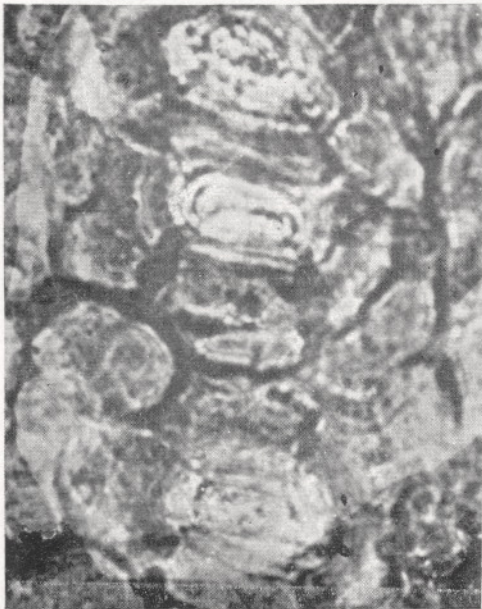
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