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A new species of *Glandulataenia* Pant from the Triassic of Nidpur, M.P., India

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ABSTRACT

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The present paper embodies a detailed account of the morphological features of *Glandulataenia pantii*, a new species of the leaf genus *Glandulataenia* Pant. It differs from the two earlier described species of *Glandulataenia, G. glandulata* and *G. triassicus* in a number of features. *Glandulataenia pantii* leaf is comparatively smaller in size and narrower in width and has a higher concentration of lateral veins per centimetre. The midrib is distinct and narrower than those of the earlier described species and is persistent up to apex. Between the lateral veins, are dark coloured circular glands, whose frequency varies in basal, middle and apical regions of the leaf. Leaves are amphistomatic, stomata usually restricted to areas in between lateral veins and on the midrib as well as lateral veins. Stomata haplocheilic, irregular to transverse in orientation. Guard cells sunken, each with 4 to 6 undifferentiated subsidiary cells. Cells over midrib elongated, rectangular, narrow usually thin, straight walled. Cells of lamina thin, sinuous walled.

Key-words—Triassic, *Taeniopterid*, Cycadean, Glandular leaf, Nidpur, *Glandulataenia pantii*, India.

निदपुर, मध्य प्रदेश, भारत के ट्राइऐसिक से प्राप्त *ग्लैंडुलैटेनिया* पंत की एक नवीन प्रजाति

नूपुर भौमिक एवं नीलम दास

सारांश

वर्तमान शोध-पत्र पत्ता वंश *ग्लैंडुलैटेनिया* पंत की एक नवीन जाति *ग्लैंडुलैटेनिया पंती* के आकारिकीय लक्षणों विस्तृत लेखा-जोखा को साकार करता है। ये बहुत-से लक्षणों में *ग्लैंडुलैटेनिया, जी. ग्लैंडुलेटा एवं जी. ट्राइऐसिकस* की दो पहले वर्णित से भिन्न है। *ग्लैंडुलैटेनिया पंती* पत्ता अपेक्षतया आकार में छोटा तथा चौड़ाई में संकीर्णतर है तथा पार्श्व शिरा प्रति सेंटीमीटर की उच्चतर सांद्रता है। पार्श्व के बीच शिराएं गहरे रंग की वृत्तीय ग्रंथि हैं जिसकी बारंबारता पत्ता के आधार, मध्य एवं शीर्षस्थ प्रदेशों में परिवर्तित होती है। पतृतियाँ उभयरंध्री हैं, रंध्र प्रायः पार्श्व शिरा एवं मध्य शिरा के बीच के क्षेत्रों और साथ ही साथ पार्श्व शिरों तक सीमित हैं। रंध्र हैप्लोकाइलिक, अभिविन्यास में अनुप्रस्थ के अभियमित हैं। प्रत्येक 4 से 6 अविभेदित सहायक कोशिकाओं सहित द्वार कोशिका जलमग्न हैं। मध्यशिरा दीर्घित के ऊपर कोशिकाएं, आयताकार, संकीर्ण सामान्यतया तनु, सरल दीवारी। तनु पटल, लहरदार दीवारी की कोशिकाएं।

मुख्य शब्द - ट्राइऐसिक, टैनिओटेरिड, सायकैडी, ग्रंथिमय पत्ता, निदपुर, *ग्लैंडुलौटेनिया पंती*, भारत।

Changing Scenario in Palaeobotany and Allied Subjects
Editor : J.S. Guleria

INTRODUCTION

THE form genus *Glandulataenia* was instituted by Pant (1990) for all those taeniopterid - type leaves which exhibited glands between side veins and sometimes also over the midrib, thus making them very distinct from all other non-glandular taeniopterid leaves. Earlier impressions and compressions of such leaves collected from the *Dicroidium*-bearing Triassic beds of Nidpur, Madhya Pradesh, India, were assigned to form-genus *Taeniopteris* Brongniart by Srivastava (1971). The Nidpur leaf form-genus was called *Taeniopteris glandulata* on account of the presence of gland-like circular, resin bodies in between secondary veins. This material of *T. glandulata* was later transferred to a new genus by Pant (1990) and was called as *Glandulataenia* with the Type species called as *Glandulataenia glandulata* comb. nov. Besides *G. glandulata* from the Nidpur beds Pant (1990), reported another new species called *G. triassicus*. In addition to these two species, the siliceous Triassic shales of Nidpur also indicate the occurrence of a comparatively smaller sized, taeniopterid leaf type, bearing distinct glands or resin-like bodies scattered on the lamina in between lateral veins, lateral veins and marginal veins and sometimes also on midrib. The smaller taeniopterid leaves are closely comparable to the type species *G. glandulata* in a number of features. As such the smaller sized taeniopterid leaves are also being assigned to genus *Glandulataenia* Pant after slightly emending its generic diagnosis. The paper embodies a detailed account of the newly reported species *G. pantii*.

GEOLOGY

The *Dicroidium*-bearing Nidpur beds were discovered by Satsangi (1964) in the Gopad River Section, west of Singrauli Coalfield, Sidhi District, Madhya Pradesh, India. The fossiliferous beds are exposed on the left bank of Gopad River about 2 kms north-east of the Nidpur Village (24°7': 81°53') in between two faults (F^2 and F^3) adjacent south of confluence of Sehra Nala with Gopad River. These are called "Nidpur beds" and the area is referred as "Marhwas area" (24°0'-24°10': 81°50'-82°0') named after the Marhwas Village. The country around Marhwas and Nidpur villages is a flat alluvial plain, exposing mainly fossiliferous sediments in the river cuttings (Fig. 1). The Nidpur beds occupy the topmost part of Pali sequence and are lithologically comprised of sandstone, siltstone and grey coloured carbonaceous shale. The Nidpur beds, about 300 m south of Sehra-Gopad confluence are bracketed between two faults (Tiwari & Ram-Awatar, 1989). The sediments between F_1 and F_2 are typically Upper Permian containing *Glossopteris – Vertebraria* dominant megaflora.

MATERIAL AND METHODS

The account of *Glandulataenia pantii* is based on two hand-specimens and a number of detached compressed fragments of leaves extracted out of the rock matrix by maceration with HF. The material was collected during repeated visits to the Middle Triassic beds on the banks of Gopad River at Nidpur, Sidhi District, Madhya Pradesh, India. The new species is comparatively rare in occurrence than the two earlier described species *G. glandulata* and *G. triassicus*. The shale is otherwise littered with compressed fragments of *Dicroidium, Glottolepis, Glossopteris,* seeds and other fructifications. A good number of compressed, sizeable specimens of *G. pantii* representing the apex, middle and basal portions of the leaf were recovered by bulk maceration of shales.

External features were studied under strong unilateral light. Leaf parts extracted by maceration from the rock matrix by HF were mounted in canada balsam to make them semi-translucent. The compressed fragments of the leaves on hand-specimens were studied by using the Peel Technique method. Cuticles were prepared after maceration of the leaf material in Schulze's solution and mounting them in glycerin jelly after staining with safranin. For photomicrography Wild Leitz microscope was used.

SYSTEMATICS

Class—CYCADOPSIDA

Order—INCERTAE SEDIS

Genus—*GLANDULATAENIA* Pant 1990

Emended diagnosis—Leaves elongated, entire, distinct midrib persistent up to apex or slightly excurrent. Lamina lateral to midrib, veins arise at wide or acute angles but immediately bending outward to meet the marginal vein. Lateral veins occasionally or frequently forked, anastomoses between lateral veins rare, interstitial areas have rows of characteristic rounded glands. Leaves hypostomatic or amphistomatic, stomata haplocheilic usually confined to areas between veins, subsidiary cells irregular and undifferentiated from epidermal cells, not forming a definite ring.

Discussion—The diagnosis of genus *Glandulataenia* is being emended to include all those taeniopterid-type gland-bearing leaves whose midrib extends slightly beyond the lamina indicating leaf apex as being emarginate as in the case of *T. cetilocus* reported from Molteno Formation S. Africa (Anderson & Anderson, 1989). Another feature worth mentioning is the frequently forking nature of lateral veins in the newly described species *G. pantii*, quite unlike the character mentioned for *Glandulataenia* where lateral veins

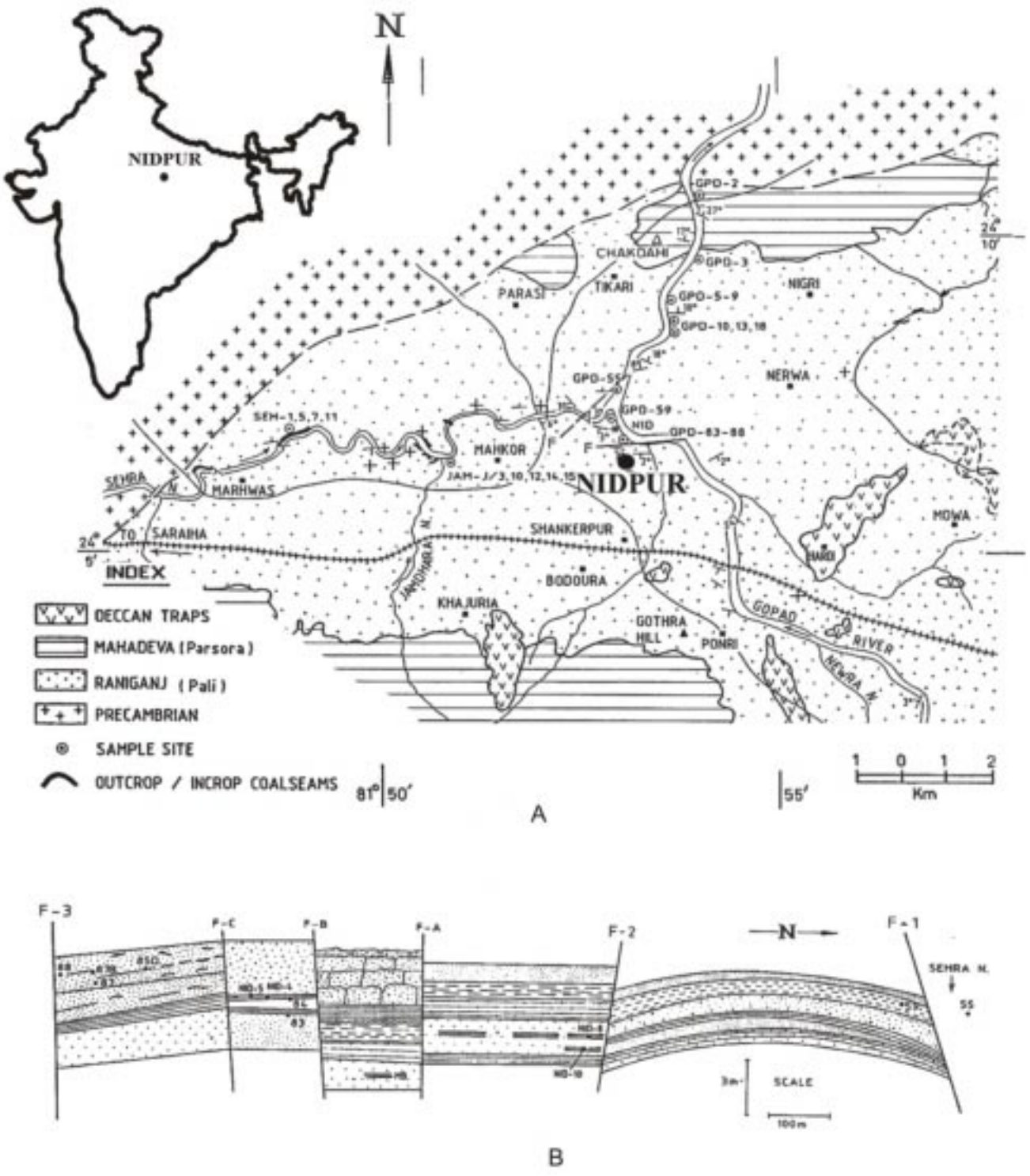

Fig. 1—(A). Geological map showing northwest position of Singrauli Coalfield showing Marhwas area where the Nidpur beds are situated (after Raja Rao, 1983). (B) Generalized section of the Nidpur beds and associated sequence along Gopad River. F-1, F-2, F-3 major faults, F-A, F-B, F-C, faults represented by minor dislocation. Sediments between F-1 and F-2 contain *Glossopteris-Vertebraria* dominant megaflora Nidpur beds between F-2 and F-3 contains *Dicroidium* bearing flora (after Tiwari & Ram-Awatar, 1989).

Character	*G. glandulata* Pant	*G. triassicus* Pant	*G. pantii* sp. nov.
Leaf width	1.2 cm	2.5 cm	2-8 mm
Leaf tip	tapering	tapering	emarginate
Leaf base	non petiolate	petiolate	unknown
Midrib width in middle	1.5 mm	1.5 mm	0.5-0.8 mm
Number of vascular strands in midrib	4-5	7	5-6
Angle of departure of lateral veins from midrib	70º	60º	40º-50º -leaf apex 60º-70º -middle 20º-30º -base
Forking of lateral veins	occasional, forking anywhere on lamina except near margin.	occasional, forking anywhere on lamina except near margin.	frequent, forking usually near midrib, rare near margin.
Thickness of lateral veins	130 µm	118 µm	45 µm
Concentration of lateral veins per cm	15-25	11-28	30-40 in middle of leaf
Leaf type	hypostomatic	hypostomatic	amphistomatic
Stomatal frequency on lower epidermis	80 per sq mm	70 per.sq.mm	150 per. sq. mm.
Stomatal apparatus	haplocheilic, subsidiary cells 4 - 6, surface papillae directed towards pore. Stomatal pore 20µm long × 6 µm.	haplocheilic, monocyclic, subsidiary cells 4-7 obscurely papillate. Stomatal pore 2-6 µm.	haplocheilic, subsidiary cells 4-6, poral walls unevenly thickened, stomatal pore 20 µm long × 7 µm wide on lower epidermis.
Stomata on midrib	rare	rare	present in 1or 2 rows, orientation transverse, subsidiary cells 4, two polar and two lateral.
Number of glands between veins	4-12	15	2-8
Glands on midrib	rare	rare	often
Nature of glands	-	-	secretory, often showing two winged pollen grains sticking to the surface.

Fig. 2—A Table showing morphological characters of 3 species of *Glandulataenia* Pant from Indian Triassic beds.

Fig. 3—*Glandulataenis pantii* sp. nov. (A). Holotype specimen No. 50,205. Handspecimen showing two almost completely preserved leaves with midrib, lateral veins and dot-like glands. Apical region of leaf of Holotype (Sp. No. 50,205a) showing midrib extending slightly beyond lamina. (B). Middle region of leaf showing well-preserved midrib and lateral veins of one side of lamina. Leaf margins entire and parallel. Slide No. 50,206. (C). Pull from middle region of leaf overlapping the Holotype showing midrib, forking lateral veins, 5-7 interstitial glands. A few glands present on midrib as well as lateral veins. Slide No. 50,205 b. (D, E). Apical fragments of leaves showing midrib extending beyond lamina and unforked lateral veins. Slide Nos. 52,502 and 52,501. (F, G). Leaf fragments showing middle region of leaves, with prominent midrib and frequently forking lateral veins. Interstitial glands of varying sizes, those near midrib larger than those near margins. Slide Nos. 52,504 and 52,508. (H). Fragment of a very narrow leaf showing occurrence of glands on the midrib as well as between lateral veins. Slide No. 52,512. (I). Fragment of basal region of leaf showing midrib with longitudinal strands, forking lateral veins and glands of various sizes. Slide No. 52,519. (J). Basal regions of leaf showing narrow lamina with varying sizes of interstitial glands and elongated cells of marginal vein. Slide No. 52,520. (K). Fragment of basal region of leaf showing broad midrib, with longitudinal strands and undulate margin. Slide No. 52,505. (L). Leaf fragment showing glands of varying sizes, present in between veins and also over the marginal vein. Slide No. 52,509. (M). Fragment of leaf showing midrib with longitudinal strands, forking lateral veins and glands of various sizes in between lateral veins and also over them. Slide No. 52,507. (N). Fragment of basal region of leaf showing midrib extending below base possibly indicating remains of a petiole. Slide No. 52,514. (O). Fragment of basal region of leaf showing broad midrib with glands over it. Slide No. 52,513.

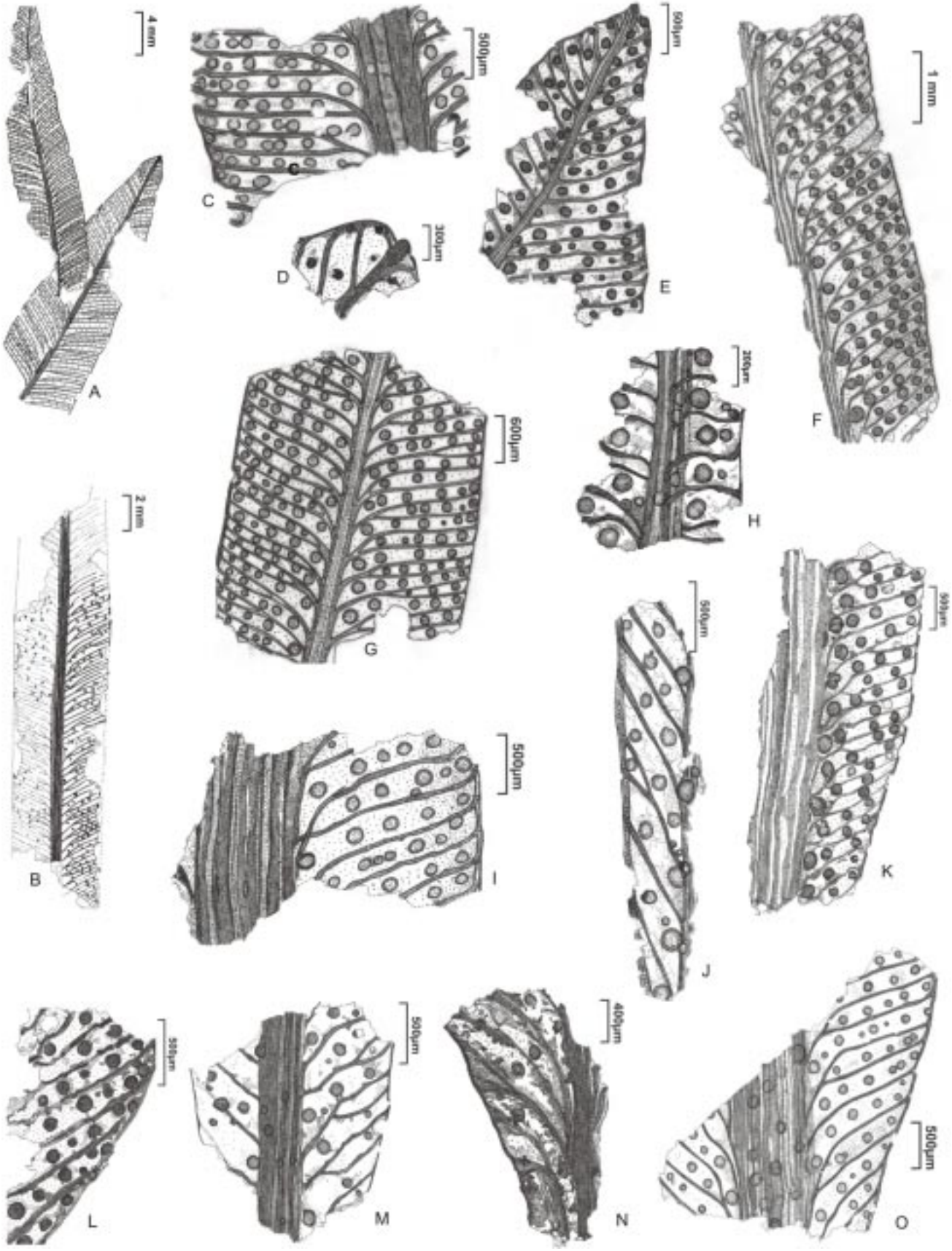
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Fig. 3

are mentioned as being occasionally forked. Besides this, the leaves of *Glandulataenia* Pant had earlier been described by Srivastava (1971) under the name *Taeniopteris glandulata* where the specimens were mentioned as being fragmentary with badly preserved cuticle and where stomata could not be detected. In his diagnosis of the new genus *Glandulataenia*, Pant (1990) had described the leaves as being hypostomatic. The leaves of the presently described species however, are amphistomatic and so this character too, is being incorporated in the generic diagnosis of *Glandulataenia.*

Type-species—*Glandulataenia pantii* sp. nov.

(Pl. 1; Figs 3-4)

Diagnosis—Leaves narrow, oblanceolate, medium to small sized, length unknown (approximately 5 cm), width up to 8 mm in middle, tip emarginate, base more or less tapering, petiole not seen, lamina laterally attached, margin entire, smooth to little undulate. Midrib distinct, strong, at base up to 1 mm wide with 5-6 longitudinal strands but narrowing at apex having fewer strands (1-3). Lateral veins closely spaced (30-40 per 10 mm) in middle region, frequently forking near midrib and occasionally near margin in middle and basal regions, but generally unforked in apical region of leaf. Areas between lateral veins showing large to small 40-200 µm wide orbicular gland-like bodies usually in a row. Leaf amphistomatic. Upper epidermis bearing gland-like bodies, stomatiferous, stomata haplocheilic generally confined in between veins, irregularly scattered to transversely orientated. Stomatal frequency 130 per sq mm, stomatal index 16, subsidiary cells 4-6, similar to epidermal cells but unevenly thickened towards stomatal pore. Epidermal cells between veins narrowly rectangular to polygonoid. Walls of cells finely sinuous to meandering. Area between veins also showing a row of orbicular, small to large, dark brown coloured areas (glands). Each gland comprised of 7-12 thick walled cells. Cells arranged along periphery are dark having very thick walls with almost obliterated lumen while cells towards centre, lighter, having comparatively thinner walls with wider lumen. Upper epidermal cells over midrib elongated, arranged in longitudinal rows. Cells over longitudinal strands of midrib, narrowly rectangular with straight to undulating lateral walls. Anticlinal walls of cells appearing straight. Epidermis of midrib in between longitudinal strands stomatiferous, stomata haplocheilic, transversely orientated tending to be arranged in rows. Stomatal apparatus usually surrounded by four subsidiary cells differentiated into two polar and two lateral cells. Thickness of both anticlinal and periclinal cell walls thicker than that of cell walls of laminar cells being approximately 2-5 µm thick. Epidermal cells over lateral veins longer, narrower, thicker walled arranged in longitudinal rows. Upper cuticle of lamina similar to upper epidermis but cell walls over areas between lateral veins thinner and obscure. Lower epidermis of lamina thinner, non-glandular, stomatiferous. Form and size of cells between veins like upper epidermis, but arrangement of cells less regular. Stomata haplocheilic, distributed randomly in areas between veins, orientation of stomata irregular, stomatal frequency about 150 per sq. mm and stomatal index 17. Subsidiary cells 4-6 (usually 5) like ordinary epidermal cells. Polars and laterals not differentiated, walls of cells finely sinuous about 1-3 µm thick. Poral walls of subsidiaries thicker than lateral walls. Epidermal cells over lateral veins narrow, elongated and arranged in longitudinal rows. Cells of lower epidermis over midrib similar to upper epidermal cells over midrib. Lower cuticle of lamina thin and delicate.

Holotype – Specimen No. 50205.

Repository—Divya Darshan Pant collection Museum, Botany Department, Allahabad University, India.

Locality – Nidpur, Sidhi District, M.P., India.

Horizon –Triassic (Middle Gondwana).

DESCRIPTION, COMPARISON AND DISCUSSION

Description of the new species *G. pantii* is based on two hand-specimens bearing compressions of three almost complete small leaves in our collection. In one hand-specimen representing the Holotype (Pl. 1·1; Fig. 3A) two leaves were found close to each other with the basal region of one of the leaves partly overlapping the middle region of the other leaf. The overlapped leaf is almost complete with intact apical region but the basal part is unpreserved. The leaf shows a distinct midrib, which is slightly excurrent making the leaf apex emarginate. The overlapping leaf is devoid of the extreme tip and base but shows a well-developed midrib and lamina of middle region. The other hand specimen (Pl. 1·2; Fig. 3B) shows a single leaf whose middle region is preserved but extreme apex and base are lacking. The leaf is narrow with entire parallel margins. In addition to these, innumerable fragments of basal, apical and middle regions of leaves have been recovered from bulk maceration of rock matrix in HF and HNO_3.

The leaves of *G. pantii* are smaller in size, narrower in width, lanceolate to linear lanceolate in shape with midrib extending slightly beyond the leaf tip making the tip-appear emarginate (Pl. 1·3, 4; Fig. 3D, E). The width of middle region of leaves ranges from 2 to 8 mm. Lateral veins are closely spaced (Pl. 1·5; Fig. 3G), 30 - 40 per cm, and about 45 µm wide extending at 35° above horizontal, curving upwards from robust midrib before joining marginal strand at lamina margin (Pl. 1·5; Fig. 3F, G, H, I). Thickness of marginal strands averaging 50 µm. Lateral veins frequently once forked in middle and basal region, usually forking near midrib but occasionally forking midway between midrib and margin (Pl. 1·5, 6; Fig. 3F, G, K, M) or rarely near the margin (Pl. 1·9). Lateral veins rarely forked near apex (Pl. 1·3, 4; Fig. 3D, E). Width of the midrib ranges from 0.8 to 1 mm at the base and gradually narrows towards apex. There are

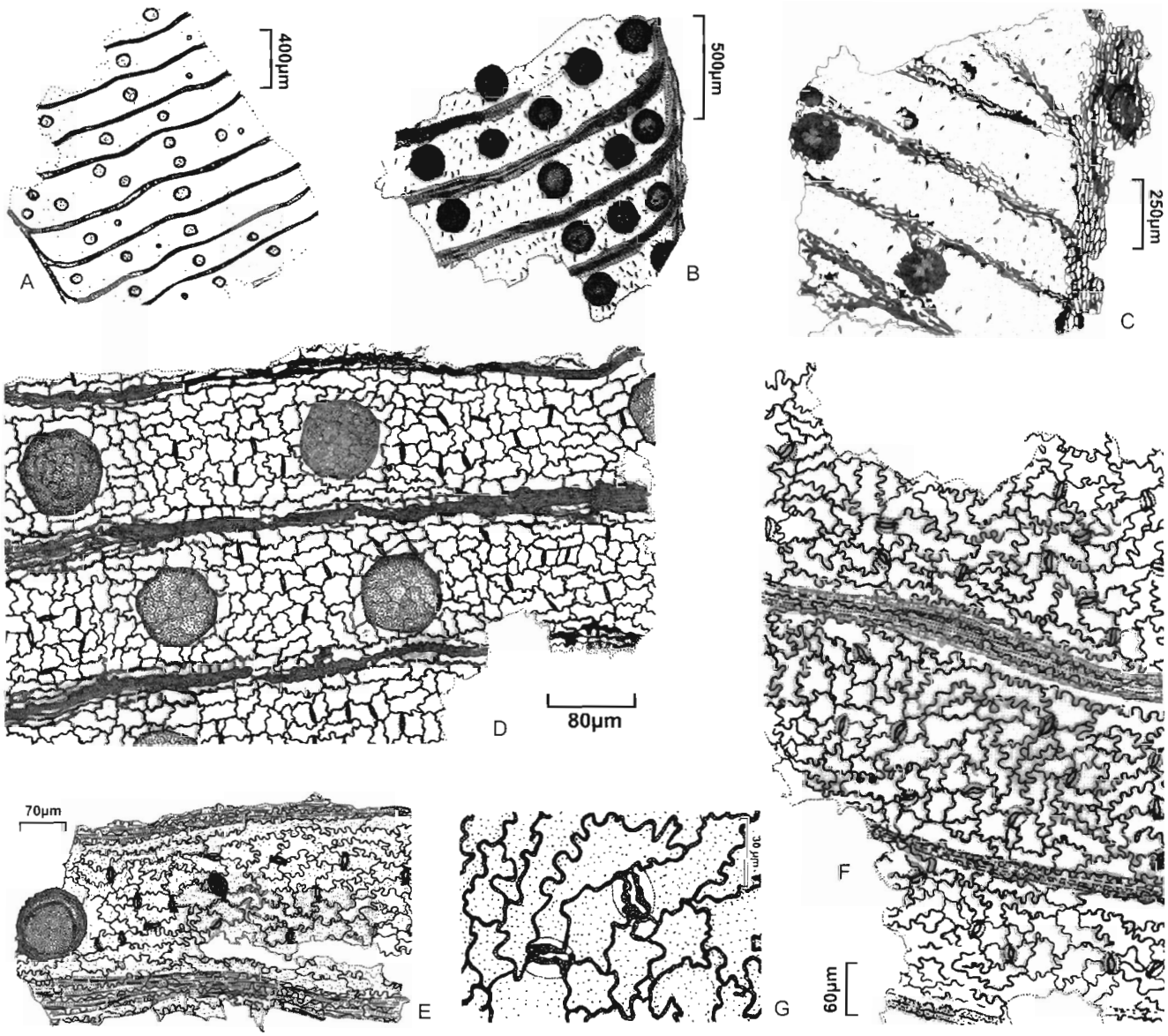

Fig. 4—*Glandulataenia pantii* sp. nov. (A). Fragment of leaf lamina showing occasional occurrence of two rows of glands in between two lateral veins. Slide No. 52,533. (B). Portion of upper epidermis of leaf showing numerous dot-like stomata and interstitial glands of approximately same size. Slide No.52,522. (C). Fragment of upper epidermis of leaf showing glands on lamina and midrib and irregularly distributed stomata between lateral veins. Slide No. 52,523. (D, E). Gland bearing upper epidermides of two leaf fragments from middle region of leaves showing polygonal to irregularly shaped cells with less to more sinuous walls, and stomata tending to be arranged in transverse rows. Slide Nos. 52,537 and 52,531. (F). Lower epidermis of lamina showing somewhat irregular arrangement of stomata and two lateral veins. Slide No. 52,532. (G). Magnified portion of lower epidermis of leaf lamina in fig. F showing sinuous walled cells and two stomata. Slide No. 52,532.

5-6 longitudinal strands at base and middle (Pl. 1·5, 6; Fig. 3I, K, O) but number of strands decreases towards apex (1-3) (Pl. 1·3, 4; Fig. 3D, E).

Naturally macerated translucent pulls from the Holotype occasionally showed well-preserved scalariform thickenings on tracheids of midrib and lateral veins (Pl. 1·11) but no secondary wall thickenings were observed on cells of marginal veins. Cells comprising the marginal strands were narrow, elongated and thick walled (Fig. 3J). The substance of some less naturally macerated fragments of leaves showed lighter coloured circular to irregular patches surrounded by darker coloured areas possibly representing the partially decayed mesophyllous tissue of leaves. The amphistomatic epidermis of leaf lamina showed a higher frequency of stomata in the lower epidermis compared to the gland-bearing upper epidermis. Besides the lamina, stomata were also found

occurring on the midrib and sometimes over lateral vein (Pl. 1·12). Stomata are irregularly scattered on both upper and lower epidermides but sometimes showed tendency to be transversely orientated and arranged in the basal region of lower epidermis (Pl. 1·10; Fig. 4D). However, stomata in epidermis of midrib region appeared to be arranged in one or two longitudinal rows, in regions between longitudinal strands. The stomata in stomatiferous region are transversely orientated, surrounded by 4 rectangular to polygonoid subsidiary cells. Epidermal cells above longitudinal strands are devoid of stomata and arranged in longitudinal files. Cells rectangularly elongated, with slightly meandering lateral walls and straight to oblique cross walls. Walls almost as thick as cells of stomatiferous area (Pl. 1·12).

Cells of upper epidermis of lamina narrowly irregular to polygonal in shape (20-) 44 (-75) µm long × (12-) 23 (-38) µm wide with less to deeply sinuous cell walls (1-) 3 (-5) µm thick, amplitude of sinuousity ranging from (2.5-) 6 (-15) µm and wave length varying from (8-) 11 (-20) µm. Stomata usually scattered between veins. Guard cells sunken, (15-) 18 (-22) µm long × (5-) 6 (-7) µm wide. Upper epidermal cells of midrib over longitudinal strands averaging (75-) 87 (-100) µm long × (30-) 33 (-36) µm wide. Cells of midrib between longitudinal strands stomatiferous. Guard cells sunken 15-21 µm long × 5-6 µm wide. Stomatal pore narrow, slit-like, 20 µm long × 6 µm wide, subsidiary cells (20-) 26 (-30) µm long × (12-) 19 (-23) µm wide (Pl. 1·13; Fig. 4D, E).

Cells of lower epidermis between veins less regularly arranged than upper epidermis about (15-) 40 (-80) µm long × (10-) 19 (-30) µm wide. Guard cells sunken, (12-) 17 (-22) µm long × (5-) 6 (-8) µm wide. Subsidiary cells show distinctly sinuous walls about 1-3 µm thick, amplitude of sinuousity ranging from (6-) 10 (-12) µm and wave length varying from (10-) 13 (-20) µm. Stomatal pore distinct, 20 µm long × 7 µm wide (Pl. 1·10; Fig. 4F, G). The substance of leaf showed frequent occurrence of dark coloured, circular, gland-like bodies in between the lateral veins and sometimes on midrib, lateral veins and marginal veins as well (Pl. 1·16, 7, 8; Fig. 3H, J, L, M, O; 4C).

Translucent pulls of leaf substance from near apical region of one hand-specimen usually showed a single row of 3-4 glands of approximately the same size seeming to lie equidistantly from each other in between the lateral veins, while pulls from the middle region of overlapping leaf showed a higher number of closely placed gland (5-7) in interstitial areas (Fig. 3C). The position and size of glands also showed variation. Some of the glands were present quite close to each other while others seemed to be equidistant (Fig. 3I). Besides this, intermixed with the larger glands also occurred smaller glands, which could have developed later on lamina. The specimen also showed presence of glands on the midrib (Pl. 1·6; Fig. 3J, M, O; 4C). Frequency of the glands at extreme tip and near base showed gradual decrease from being 1-2 at tip to 2-3 at base (Pl. 1·3, 6; Fig. 3E, K, M). Usually the glands were present in a single row but occasionally they occurred irregularly scattered appearing to be present in more than one row (Pl. 1·8; Fig. 4A). In some of the leaf fragments glands were so closely placed that the original gland appeared to have become forked. Sometimes glands were of very small size (less than 1/5th) and occurred sporadically between the larger ones (Pl. 1·7; Fig. 3G, H, L, M). Presence of the small sized glands intermixed with larger sized glands presumably indicated continuous production of glands on the lamina and midrib of the leaf. In quite a number of leaf fragments, one or a few glands seemed to have disintegrated or been displaced leaving circular outlines instead (Pl. 1·7; Fig. 3L). Quite a

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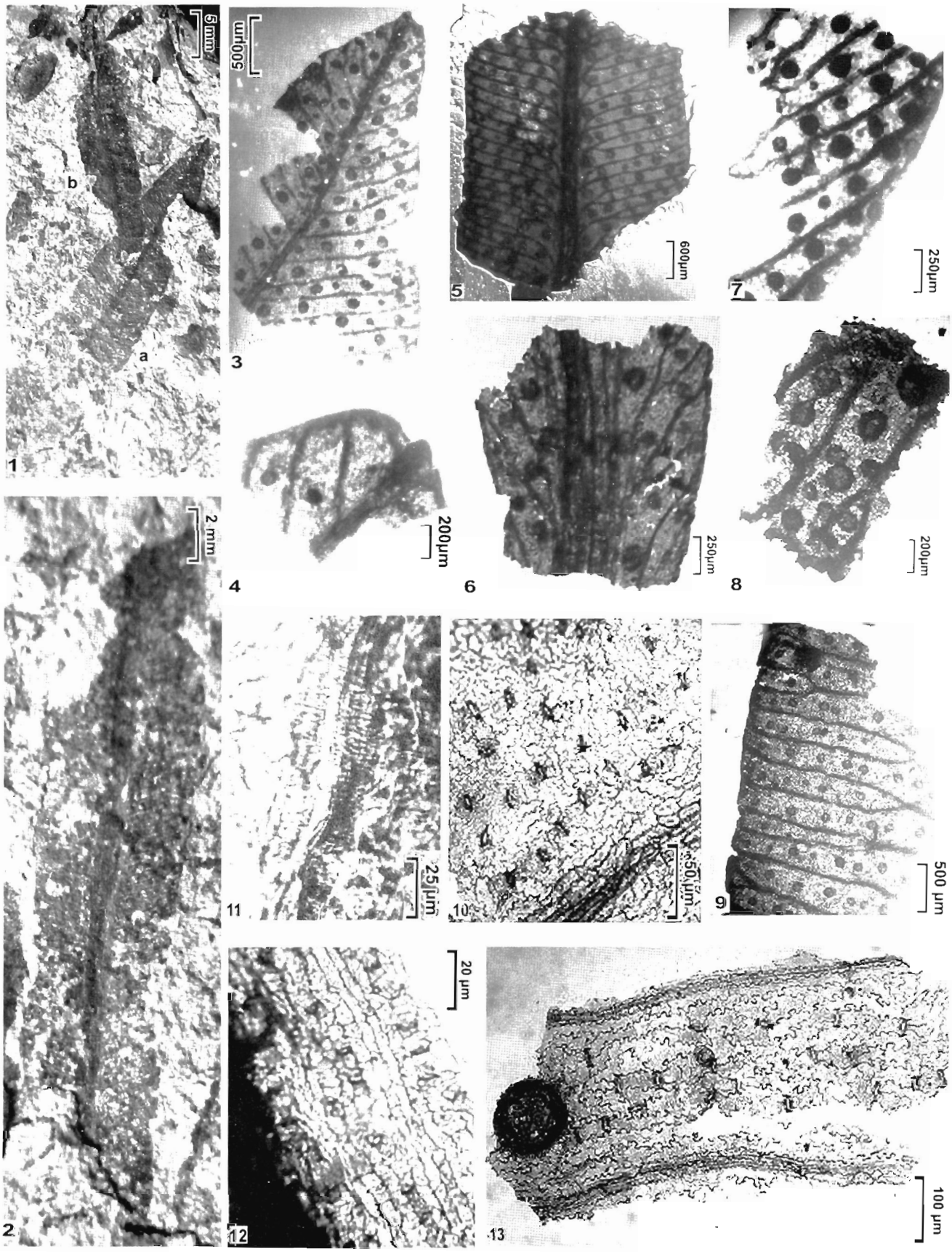
PLATE 1

Glandulataenia pantii sp. nov.

1. Holotype, Specimen No. 50,205. Two almost completely preserved leaves, showing midrib, lateral veins and dot-like glands. The tip of one of the leaves (Sp. No. 50,205a) shows a midrib extending beyond leaf lamina.
2. Leaf showing strong midrib, lateral veins and dot-like glands. Extreme tip and base of leaf not preserved. Specimen No. 50,206.
3. Apical portion of leaf showing slightly excurrent midrib, unforked lateral veins and interstitial glands of varying sizes. Slide No. 52,501.
4. Apical fragment of another leaf with slightly protruding midrib. Slide No. 52,502.
5. Fragment of middle region of leaf showing midrib, frequently forking lateral veins and glands. Slide No. 52,508.
6. Fragment of basal region of leaf showing a broad midrib with 5 - 6 longitudinal strands and a few scattered glands. Lateral veins forming acute angles with midrib and often forked. Slide No. 52,515.
7. Fragment of leaf lamina showing lateral veins and interstitial glands of varying sizes. One of the glands showing disintegration represented by a circular space on lamina. A number of smaller glands seen in the vicinity of disintegrating gland. Slide No. 52,509.
8. Fragment of leaf showing more than one row of interstitial glands on lamina. Slide No. 52,510.
9. Fragment of a leaf showing forking of some lateral veins near the margin before joining marginal strand. Slide No. 52,521.
10. Lower cuticle from base of leaf lamina showing sinuous-walled epidermal cells, elongated, thick-walled cells of a lateral vein, and stomata tending to be arranged in transverse rows and appearing to lie parallel to vein. Slide No.52,533.
11. A lateral vein showing scalariform thickenings on tracheidal wall. Slide No. 52,538.
12. Upper epidermis of midrib showing stomatiferous and non-stomatiferous areas. Slide No. 52,540.
13. Upper cuticle of leaf lamina showing sinuous-walled epidermal cells, and stomata between lateral veins. There is a single gland and in its vicinity, a two-winged pollen grain. Slide No. 52,531.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13

PLATE 1

number of glands showed two winged pollen grains either on their surface or in the vicinity (Pl. 1·13), suggesting thereby not only a sticky nature of glandular secretion but also that they were visited by insects that deposited some of the two-winged pollen grain contents, possibly sticking to their legs on the leaf surface and near glands. It may be mentioned here that none of the leaf fragments so far examined showed any insect remains adhering to the glandular cuticle.

In one instance, a leaf fragment was subjected to overmaceration with the object of having a clearer view of gland structure. The result of over maceration showed not only complete dissolution of epidermal cells but also dislodging of the glands from the dissolving epidermis. The glands had not dissolved but become lighter in colour and were found moving freely as circular bodies on the leaf cuticle. The over macerated leaf cuticle showed no cell outlines but only impressions of veins.

Leaves of *G. pantii* are smaller in size with more or less emarginate leaf tip because of the slightly excurrent midrib whereas leaves of *G. glandulata* and *G. triassicus* were larger in size with oblong, oval to spatulate apex in *G. glandulata* and oval to tapering apex in *G. triassicus*. Besides this, the new species showed a higher concentration of lateral veins (per cm), which were frequently forked, and the leaf epidermides were amphistomatic. In addition to these characters *G. pantii* differed from the two previously described species *G. glandulata* and *G. triassicus* in many more features (Fig. 2). Another taeniopterid leaf frequently bearing large, circular scattered resin bodies on the leaf is *T. cetilocus* reported from the Triassic of Molteno Formation, S. Africa by Anderson and Anderson (1989). Although the leaf is larger in size as compared to *G. pantii* and its lateral veins showed occasional anastomoses, it resembled *G. pantii* in having an emarginate leaf tip. The S. African taeniopterid leaf *T. cetilocus* is closely similar to *G. pantii* in showing not only presence of resin bodies (glands) between veins, but also exhibiting an emarginate leaf tip. Since all taeniopterid leaves bearing interstitial glands were segregated into a new genus *Glandulataenia* nov. by Pant (1990) the authors feel that even *T. cetilocus* should be assigned to *Glandulataenia* and renamed as *G. cetilocus* similar to the suggestion made by Pant (1990) for inclusion of *T. dunstanii* as a species of *Glandulataenia, G. dunstanii* comb. nov.

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