

Araliaceous fossil flower from the Deccan Intertrappean beds of Madhya Pradesh, India

V.D. KAPGATE¹, D.K. KAPGATE¹ AND M.T. SHEIKH²

¹Department of Botany, J.M. Patel College, Bhandara 441 904, India.

²Department of Botany, Institute of Science, Nagpur 440 006, India.

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ABSTRACT

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Araliaceous fossil flower belonging to the genus *Tetraplasandra* Hillebr. is reported from the Deccan Intertrappean beds of Mohgaonkalan, Chhindwara District, Madhya Pradesh. The flower is characterized by its very small size with horny projections on the ovary wall and thallamus.

Key-words—Fossil flower, Deccan Intertrappean, Late Cretaceous-Early Eocene, Mohgaonkalan, Araliaceae, *Tetraplasandra*.

भारत में मध्य प्रदेश की दक्कन अंतःद्रेपी संस्तरो से प्राप्त अरेलियासीय पुष्प जीवाश्म

वी.डी. कपगटे, डी.के. कपगटे एवं एम.टी. शेख

सारांश

मध्य प्रदेश में छिंदवाड़ा जिले के मोहगाँवकलाँ की दक्कन अंतःद्रेपी संस्तरो से *टेट्राप्लेसेंड्रा* हिलेब्र वंश से संबंधित अरेकेसीय पुष्प जीवाश्म मिला है। यह पुष्प छोटे आकार के साथ अंडाशय भित्ति एवं थैलेमस पर शृंगवत प्रक्षेपण से अभिलक्षणित है।

संकेत-शब्द—पुष्प जीवाश्म, दक्कन अंतःद्रेपी, अंतिम क्रिटेशस-प्रारम्भिक इओसीन, मोहगाँवकला, अरेलियासी, *टेट्राप्लेसेंड्रा*।

INTRODUCTION

Various fossil flowers have been recovered from the black silicified cherts of Mohgaonkalan, Chhindwara District, Madhya Pradesh, India. Apart from monocot flowers, a number of dicot flowers namely *Sahnianthus parijai* (Shukla, 1944; Chitaley, 1955; Dayal, 1967); *Sahnipushpum shuklai* (Verma, 1956; Prakash, 1956; Prakash & Jain, 1963; Chitaley, 1964); *Sahnianthus dinecterium* (Shukla, 1958);

Deccanthus savitrii (Chitaley & Kate, 1972); *Chitaleypushpum mohgaoense* (Paradkar, 1971); *Raoanthus intertrappea* (Chitaley & Patel, 1973); *Flosofemina intertrappea* and *Flosovirulis deccanensis* (Kar *et al.*, 2003), *Chenopodianthus mohgaoense* (Kapgate *et al.*, 2006) are recorded. The present dicot fossil flower is distinct from all the known records because of strangely lobed base of the ovary and described herewith in detail.

The species is based on single small, well preserved specimen of flower bearing thallamus and pedicel.

SYSTEMATICS

Order—MAGNOLIOPSIDA

Family—ARALIACEAE

Genus—TETRAPLASANDRANTHUS gen. nov.

Tetraplasandranthus deccanii sp. nov.

Pl. 1.1-6; Pl. 2.1-10; Figs 1-19

Description—The flower from its transverse serial sections appears to be a smallest form amongst the known Deccan Intertrappean flower, 1.03 mm in width at apical region, 1.30 mm at middle and 0.80 mm towards basal region, globular in shape (Pl. 1.1, 2; Figs 1-6), pedicelate, bracteolate, hermaphrodite, actinomorphic, pentamerous polytepalous and hypogynous (Pl. 1.1; Figs 1-8).

Pedicel—Pentangular, 57 to 65 μm thick, consists of thin walled, rounded to hexagonal cells of

parenchyma and central vascular tissue (Pl. 2.9; Fig. 8).

Thallamus—simple and pentangular, the floral parts based on the thallamus (Pl. 1.6; Pl. 2.7; Fig. 7), thickness 155 to 175 μm , made up of thick walled parenchymatous hexagonal ground tissue bounded by single layered epidermis, numerous vascular bundles are seen in the tissue of thallamus (Pl. 1.6; Pl. 2.7; Fig. 18). Well developed fibrous horny projections are given out horizontally through the ground tissue of the thallamus which further extends towards the base of ovary wall. Projections are expands at their terminal end like a disc/horn (Pl. 1.6; Pl. 2.6: Fig. 7), 25 to 35 μm in length and 18 to 20 μm in width at their terminal end. It might be vascular tissue of the floral parts. A single rounded canal seen below the projection, might be a secretory canal (vittae) (Pl. 1.6: Pl. 2.6; Fig. 7).

Bracteole—Two, attached almost at the base of the ovary and reaches up to the length of perianth lobes (Pl. 1.1-6; Figs 1-6); ovate to concave in shape, broad in the middle and acute at their apex, 110 to 170 μm broad and 0.55 to 0.66 μm in width consists of thin walled parenchymatous cells, gibbous at the base (Pl. 1.6; Fig. 7).

Tetraplasandranthus deccanii gen. et sp. nov

Fig. 1—T.S. flower showing bracteole (br.ol.), perianth (p.), anther lobes (An.) and capitate stigma (stg.). Slide no. 4.

Fig. 2—Flower showing prominent bracteoles, imbricate aestivation of perianth lobes, anthers and style. Slide no. 14.

Fig. 3—Bilocular hairy ovary and filaments. Slide no. 42.

Fig. 4—Flower with filaments, bilocular ovary with horny projections. Slide no. 60.

Fig. 5—Bilocular ovary with two ovules and horny projections on the ovary wall. Slide no. 72.

Fig. 6—Disappearing ovary with projections. Slide no. 85.

Fig. 7—Pentangular thallamus with horny projections and gibbous perianth lobes. Slide no. 105.

Fig. 8—Pentangular pedicel. Slide no. 115.

Fig. 9—Capitate stigma showing its hairy nature. Slide no. 8.

Fig. 10—Stony style with its tissue. Slide no. 15.

Fig. 11—Single perianth lobe with its tissue and central vasculature. Slide no. 10.

Fig. 12—Bilobed anther showing anther wall (ep.), pollen sac (p.s.) and isolated pollen grains (p.). Slide no. 14.

Fig. 13—Tri-colpate and psilate pollen grains. Slide no. 18.

Fig. 14—Ovary wall with its details and single ovule in the locule. Slide no. 95.

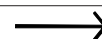
Fig. 15—Wall of the ovary showing inner fibrous (i.z.), middle thick (m.z.) and outer arenchymatous zones (o.z.) with few canals (c) and outer epidermal layer (ep). Slide no. 92.

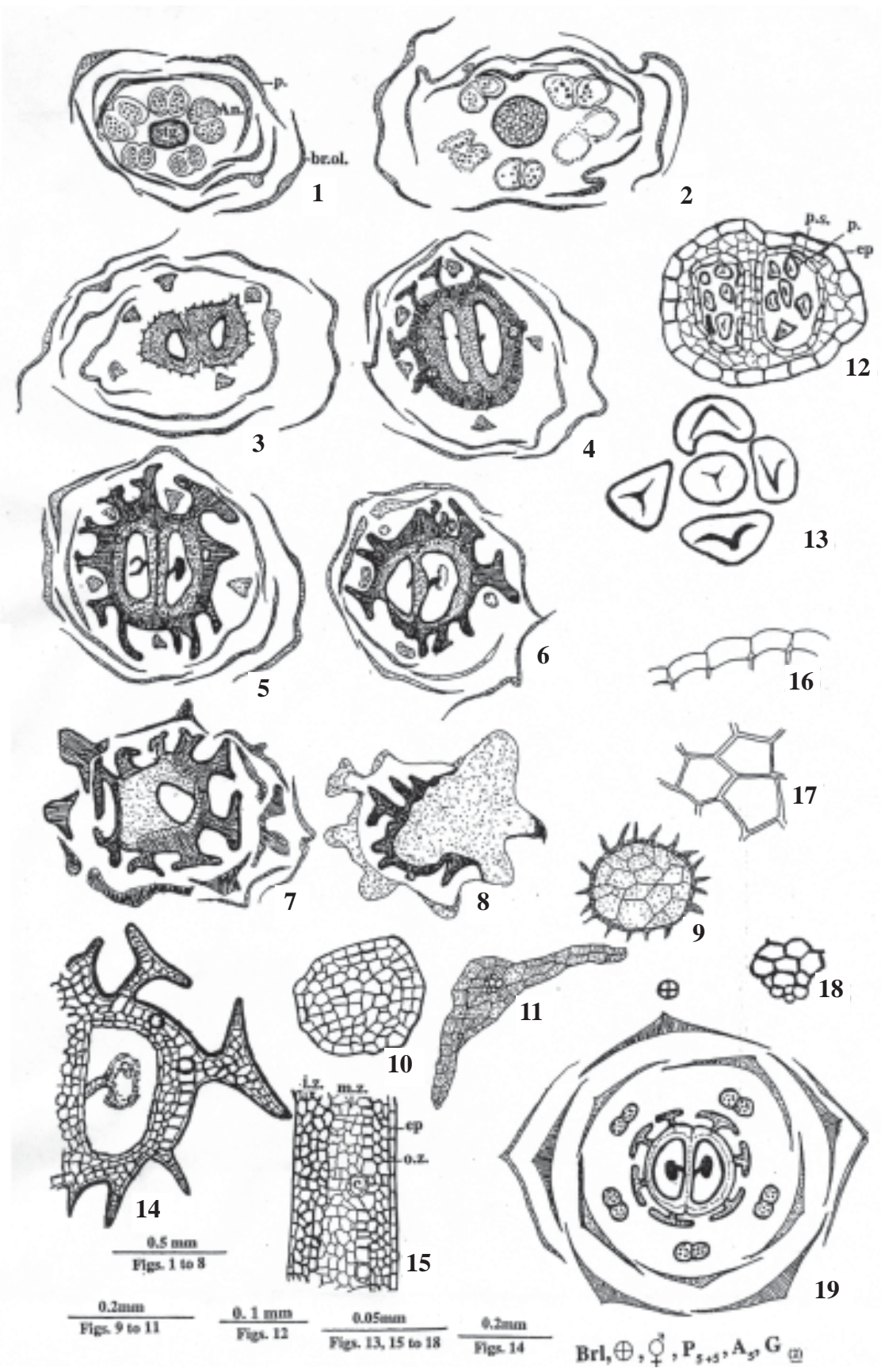
Fig. 16—Epidermal layer of the anther wall. Slide no. 4.

Fig. 17—Hexagonal cells of the thallamus. Slide no. 102.

Fig. 18—Vasculature in thallamus and pedicel. Slide no. 125.

Fig. 19—Floral formula and floral diagram of the flower.





Perianth—Perianth consists of ten, free, uniseriate tepals arranged in two whorls of five each showing polytepalous condition of the flower, somewhat equal in size and arranged at equal distance from the centre of the flower giving actinomorphic appearance to the flower, aestivation imbricate type (Pl. 1.1; Figs 1-6). Tepal lanceolate, ovate to rhomboid in shape and acute at apex, 0.92 to 1.1 mm broad and 130 to 185 μm thick, mostly tubular (Pl. 1.1; Figs 1-6), made up of 1 to 2 layered, thin walled parenchymatous cells. At central region the perianth lobes are multilayered somewhat bigger cells of parenchyma with few vascular elements (Pl. 1.2; Fig. 11), broad and thick at the base (Pl. 1.1-5; Figs 1-6).

Androecium—Stamens five, free, equal in size and length from the base of the flower, placed alternately to the perianth lobes (Pl. 1.1, 2; Figs 1-2), basifixed, filament 38 to 39 μm thick, made up of 3 to 4 layers of parenchymatous compact cells (Pl. 1.3, 4; Fig. 3), anthers rounded to oval in shape, 225 to 240 μm in diameter, bilobed with two distinct loculi and two pollen sacs (Pl. 1.2; Pl. 2.2; Fig. 12), made up of prominent thin walled, rectangular parenchymatous cells, cells 12 to 20 μm in size and loosely arranged, bounded by single layered epidermis (Pl. 2.2; Fig. 16), locule elongated to oval in shape, 110 to 120 μm thick joined by a row of connective tissue (Pl. 2.1; Fig. 12), free isolated pollen grains preserved in groups in the centre of each locule. Pollen grains rounded to triangular in polar view while elongated to oval in equatorial view, 33 to 35 μm in polar view and 45 to 50 μm in equatorial view (Pl. 2.3, 4), psilate and tricolpate nature in their polar axis (Pl. 2.4; Fig. 13). Exine thick without any ornamentation, intine thin. Anther morphology and pollen sac organization indicate loculicidal dehiscence of the anther (Pl. 2.1, 2).

Gynoecium—sessile, hairy consisting of style, stigma and ovary, stigma capitate, 180 to 190 μm in diameter, consists of thick walled parenchymatous cells, central portion of the stigma somewhat hollow (Pl. 2.1; Fig. 2). Given out tiny hair through the epidermal portion (Pl. 2.1; Fig. 9), style short, circular and terminal, 127 to 135 μm thick at terminal end, 140 to 170 μm thick at basal end, solid with centrally placed compact cells and vascular tissue (Fig. 10). Ovary bicarpellary, bilocular, syncarpous, superior, oval to globular in shape, 600 to 750 μm in length and 410 to 500 μm in breadth (Pl. 1.4, 5; Figs 3-6), ovary wall without projections 110 to 120 μm thick and with projections 130 to 140 μm (Pl. 1.5; Figs 5, 6), consists of three zones - outer, middle and inner, outer zone 40-50 μm thick, made up of single layered cutinised epidermis with numerous tiny hairs at terminal end and spiny to horny projections (rib like) at the basal end, followed by 1 to 2 layered arenchymatous cells bearing few canals (vittae) (Pl. 1.5; Pl. 2.8; Figs 14, 15), middle zone 30-35 μm thick, made up of 2 to 3 layered thick walled, compactly arranged sclerenchymatous cells, inner zone 20 to 30 μm thick, made up of 2 to 3 layered, fibrous tissue bearing vascular elements (Pl. 2.8; Fig. 15). Septum broad 120 μm thick, consists of stony fibrous tissue with vascular elements, central fibrous tissue of the septum somewhat split in the centre showing bicarpellary nature of the ovary (Pl. 1.5; Fig. 6). A single orthotropous ovule is seen attached to the septum by a small placenta showing axile placentation (Pl. 2.5; Fig. 5). Locule elongated, oval in shape, 80 to 100 μm in breadth and 350 to 370 μm in length few parenchymatous tissue is seen in each locule (Pl. 1.5; Pl. 2.8).

Floral formula: See Fig. 19.

PLATE 1

Tetraplasandranthus deccanii gen. et sp. nov



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| 1. | Terminal portion of the flower exposed on fossiliferous chert showing perianth lobes, anthers and stigma. x 80. Slide no. 4. | 4. | Middle portion of the flower showing distinct ovules and spines on ovary wall. x 80. Slide no. 26. |
| 2. | Flower showing capitate stigma, five anthers and perianth lobes. x 80. Slide no. 8. | 5. | Bilocular ovary with spiny projections. x 80. Slide no. 26. |
| 3. | Appearing bilocular ovary and filaments. x 80. Slide no. 15. | 6. | Thallamus with horny appendages and secretory canal. x 80. Slide no. 26. |

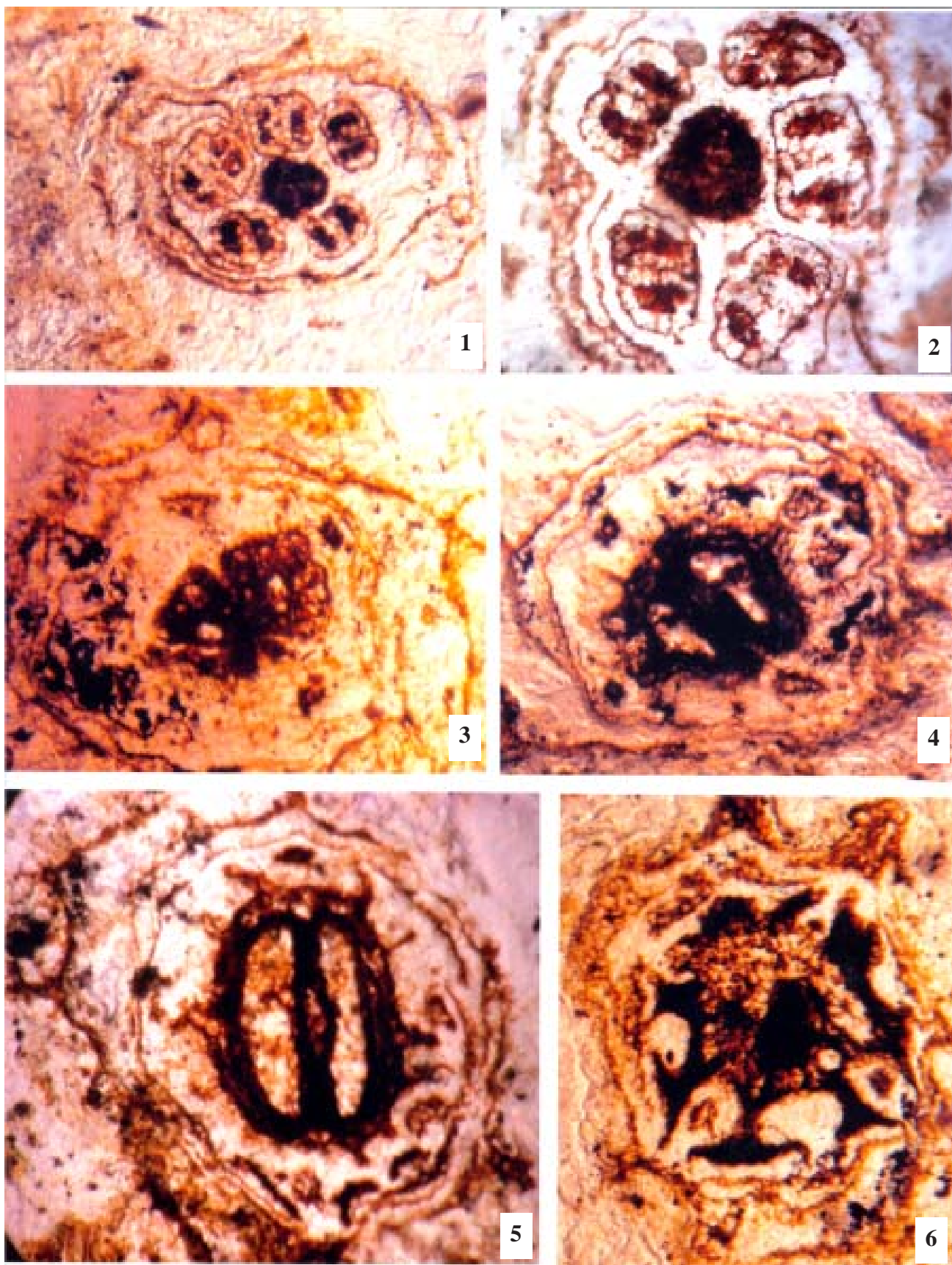


PLATE 1

DISCUSSION

The present fossil flower characterized by very small size (1.03 to 0.8 mm) and globular shape, pedicelate, pentangular thallamus; 5 stamens, alternate with tepals, imbricate aestivation, tricolpate pollen grains, capitate stigma, bicarpellary ovary, horn like projections on the ovary wall and thallamus (Ribs) and presence of secretory canals (vittae). All the known fossil flower except *Chenopodanthus mohgaoense* describe earlier are multicarpellary and gamopetalous in nature (Kapgate *et al.* 2006). The fossil flower *Chenopodanthus mohgaoense* is sessile, bracteolate, hermaphrodite, actinomorphic, pentamerous, polytepalous and hypogynous with bicarpellary syncarpous, superior ovary. It differs from the present fossil flower in shape and size of the flower (1.66 to 1.22 mm), as well as absence of pedicel and thallamus and horny appendages on the ovary wall and thallamus. A critical study of the flowers of dicotyledonous living families revealed that the characters of present fossil flower collectively indicate its affinity with the families Apiaceae, Araliaceae, Alangiaceae and Rubiaceae (Hooker, 1885; Gamble, 1957; Lawrence, 1969; Saldanha & Nicolson, 1978; Hutchinson, 1979; Mathew, 1981). The above families show closer resemblances with the present specimen in almost all the features except in the nature of ovary which is usually inferior but some of the genus *Pagamea*, *Gaertnera*, *Tresanthera*, *Coryphothamnus*, *Mitrasacmopsis*, *Lucya*, *Canthiopsis*, *Mastixiodendron*, *Synaplantha* and *Leptomischus* of family Rubiaceae possesses

superior ovary as the fossil flower (Groeninckx *et al.*, 2007). However, these genus somewhat differ morphologically from the present specimen (Groeninckx *et al.*, 2007). An extensive comparison of the present flower with the flowers of all the available genus of the above family indicate that the genus *Tetraplasandra* Hillebr. of family Araliaceae shows nearest resemblances to the present flower (Lowry, 1990). *Tetraplasandra gymnocarpa* (Pl. 2.10) is only species of *Tetraplasandra* which has small (2 mm across), actinomorphic flower with pentamerous, five stamens alternate with petals, tricolpate pollen grains, bicarpellary superior ovary with single ovule per cell and ovary with nectary base (Annemarie Costello & Timothy J. Motley, 2004). Thus, most of the characters exhibited by the present fossil flower resemble with the genus *Tetraplasandra gymnocarpa* Hillebr. of family Araliaceae, hence it is proposed to designate this fossil as *Tetraplasandranthus deccanii* gen. et sp. nov. The generic epithet is based on the comparable extant genus *Tetraplasandra* while the specific epithet is after Deccan Intertrappean beds from where the fossil specimen was collected.

Holotype—VDK / Ang. (FI) - Sl. No. 1 to 125.

Repository—Botany Department, J.M. Patel College, Bhandara.

Locality—Mohgaon Kalan, Chhindwara District, Madhya Pradesh.

Horizon—Deccan Intertrappean beds.

Age—Late Cretaceous - Early Eocene.

PLATE 2

Tetraplasandranthus deccanii gen. et sp. nov

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| <ol style="list-style-type: none"> 1. Terminal portion of the flower showing capitate, hairy stigma and alternately placed anthers. x 90. Slide no. 10. 2. Single bilobed anther with two pollen sacs, connective, pollen grains and anther wall. x 250. Slide no. 20. 3. Pollen grains with their equatorial and polar axis. x 250. Slide no. 20 4. Tri-colpate and psilate pollen grain. x 400. Slide no. 24. 5. Ovary wall with its details and ovules on axile placentation. x 350. Slide no. 85. | <ol style="list-style-type: none"> 6. Enlarge view of horny projections and vittae. x 400. Slide no. 100. 7. Thallamus with projections. x 400. Slide no. 105. 8. Three layers of ovary wall with its vasculature. x 400. Slide no. 90. 9. Tissue of the pedicel. x 400. Slide no. 115. 10. Living genus <i>Tetraplasandra gymnocarpa</i> (After – Annemarie Costano & Timothy J. Motley, 2004). |
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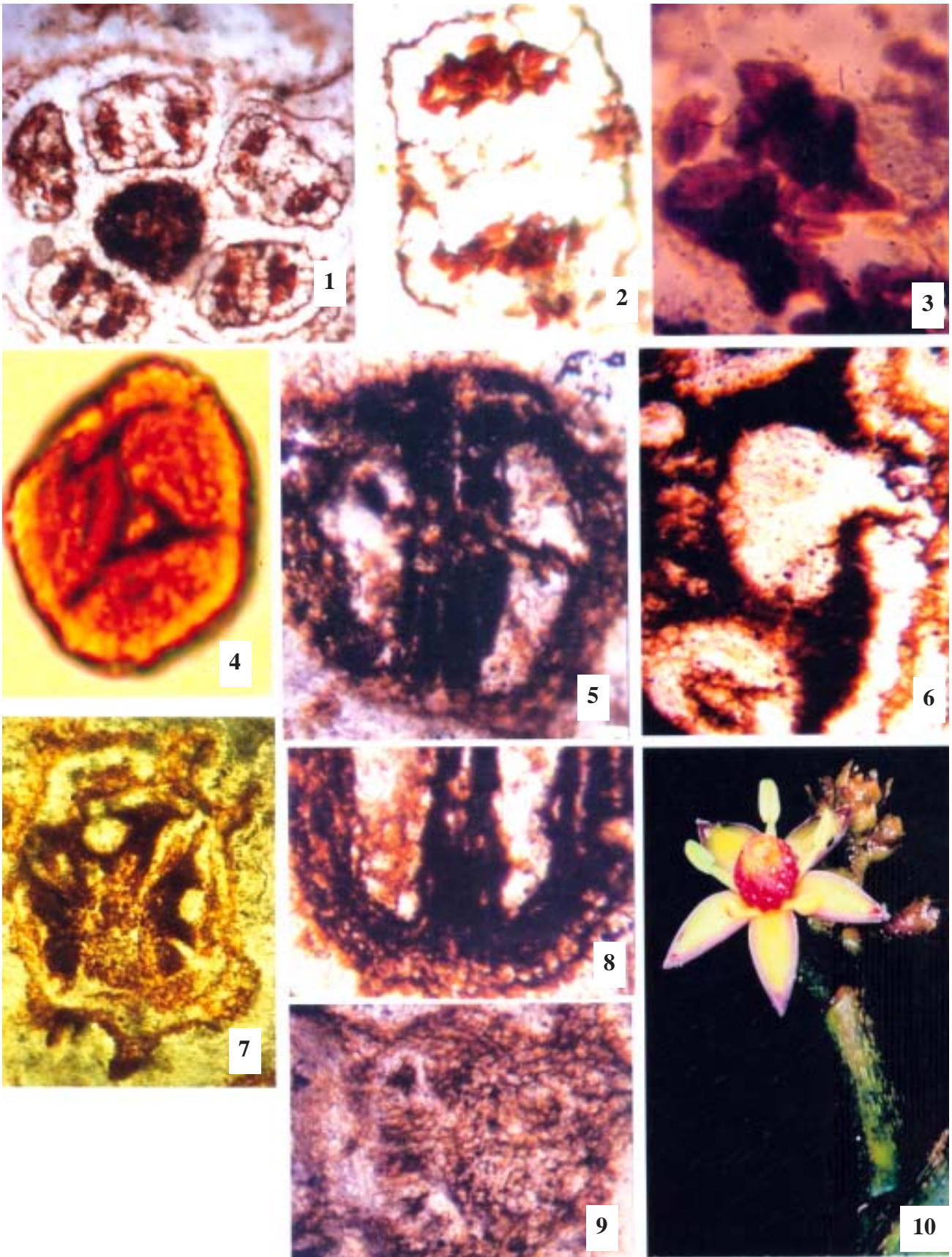


PLATE 2

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