

A CONTRIBUTION TO THE FLORAL ANATOMY OF *NEPENTHES KHASIANA* HOOK F.

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ABSTRACT

Two kinds of multicellular trichomes, glandular and non-glandular, occur on the abaxial side of the perianth lobes, androphore and ovary wall; sunken multicellular glands are generally present on the adaxial surface of the perianth lobes. The development of these trichomes and glands shows that they are epidermal in origin. The flowers are uni-sexual. The perianth is tetramerous and each perianth lobe is traversed by three bundles. The origin and distribution of the staminal traces recall the condition in fasciculate androecium. The ovary is tetralocular below and unilocular above. The placentae which lie along the septal radii receive the half ventrals of adjacent carpels but do not fuse to form common ventral bundles. Thus the placentation may be described as tending towards the parietal condition. The stigma is commissural.

INTRODUCTION

NEPENTHACEAE include only a single genus *Nepenthes*, with about 60 species (Lawrence, 1959). They have been placed under Monochlamydae by Bentham and Hooker (1862-1883), Sarraceniales by Gundersen (1950), Rendle (1959) and Melchior (1964), Aristolochiales by Hutchinson (1959) and Nepenthales by Takhtajan (1966). Except for some brief observations of Saunders (1937), there is no published account on the floral anatomy of the family. The present paper deals with the floral anatomy of *Nepenthes khasiana* Hook. f.

MATERIALS AND METHODS

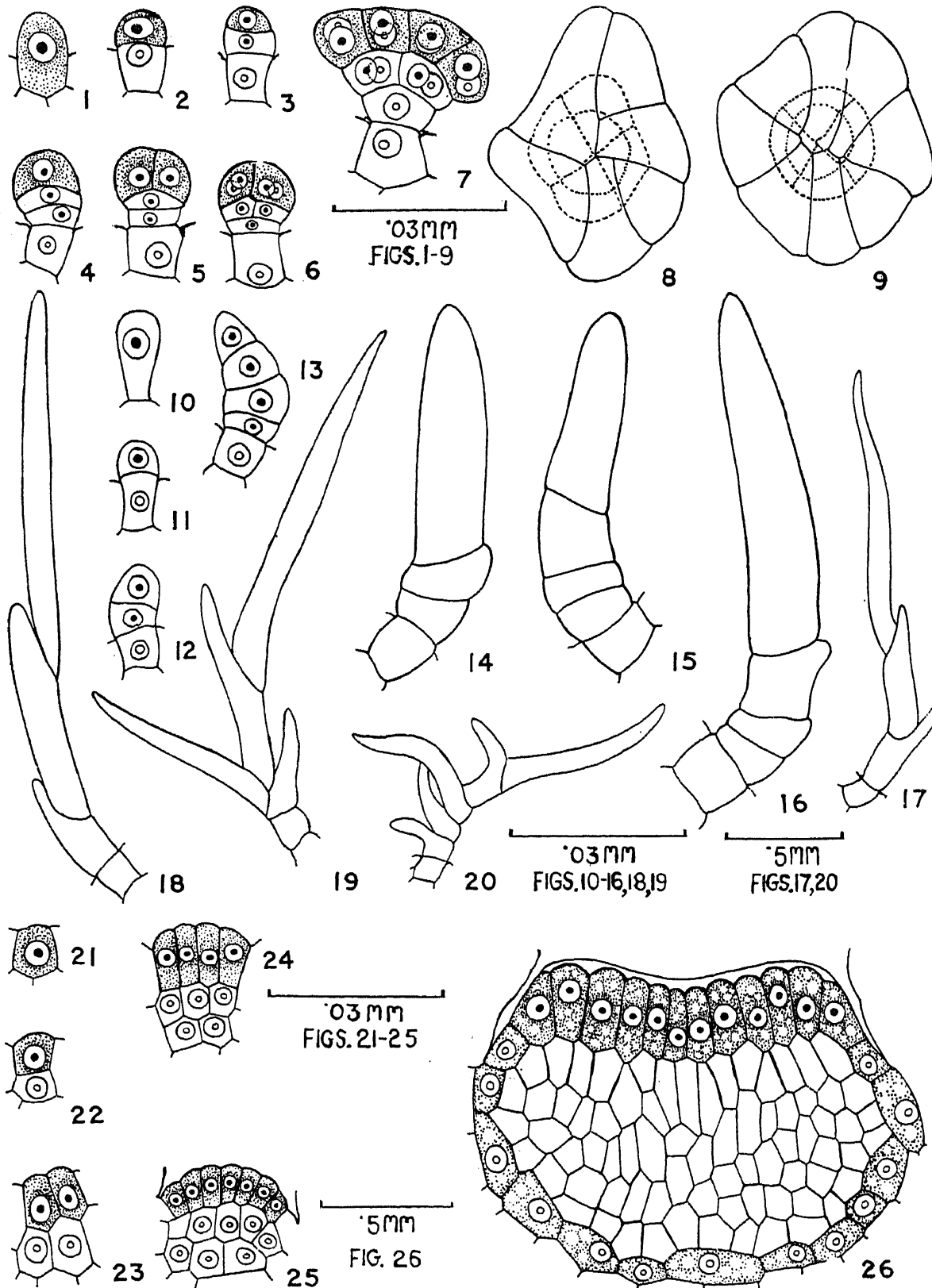
The materials were collected by Mr. N. P. Balakrishnan at Jorrajn, Assam, and was fixed in F.A.A. The voucher specimens have been deposited in the Botanical Survey of India herbarium (CAL). Usual methods of dehydration, infiltration and imbedding were followed. Sections were cut at 6-12 microns and stained in crystal violet using erythrosin as counter stain.

OBSERVATIONS

Multicellular trichomes and glands.—Multicellular trichomes of two types, glandular and non-glandular are distributed on the abaxial side of the perianth parts, androphore in male flowers and ovary in female flowers. During the development of the glandular trichomes some epidermal cells become conspicuous by their larger size, prominent nuclei and dense cytoplasm. They slightly project above the level of the other epidermal cells (Fig. 1). Such a cell divides transversely forming two cells (Fig. 2); the lower functions as the basal or foot cell while the upper divides transversely twice to form a row of three cells (Figs. 3, 4). Among the three cells thus formed, the topmost cell develops into the head. It undergoes two vertical divisions at right angles to one another forming four cells, each of which again divides anticlinally (Figs. 5–7). Thus the head consists of eight cells arranged in a tier (Fig. 9). Sometimes the final divisions are not synchronous with the result the head may show less than eight cells (Fig. 8). Now, while the subterminal cell undergoes two vertical divisions at right angles to one another, resulting in a tier of four cells, the next lower cell does not divide (Figs. 6, 7). Thus the two succeeding tiers of cells below the glandular head function as the stalk of the uniseriate glandular trichome.

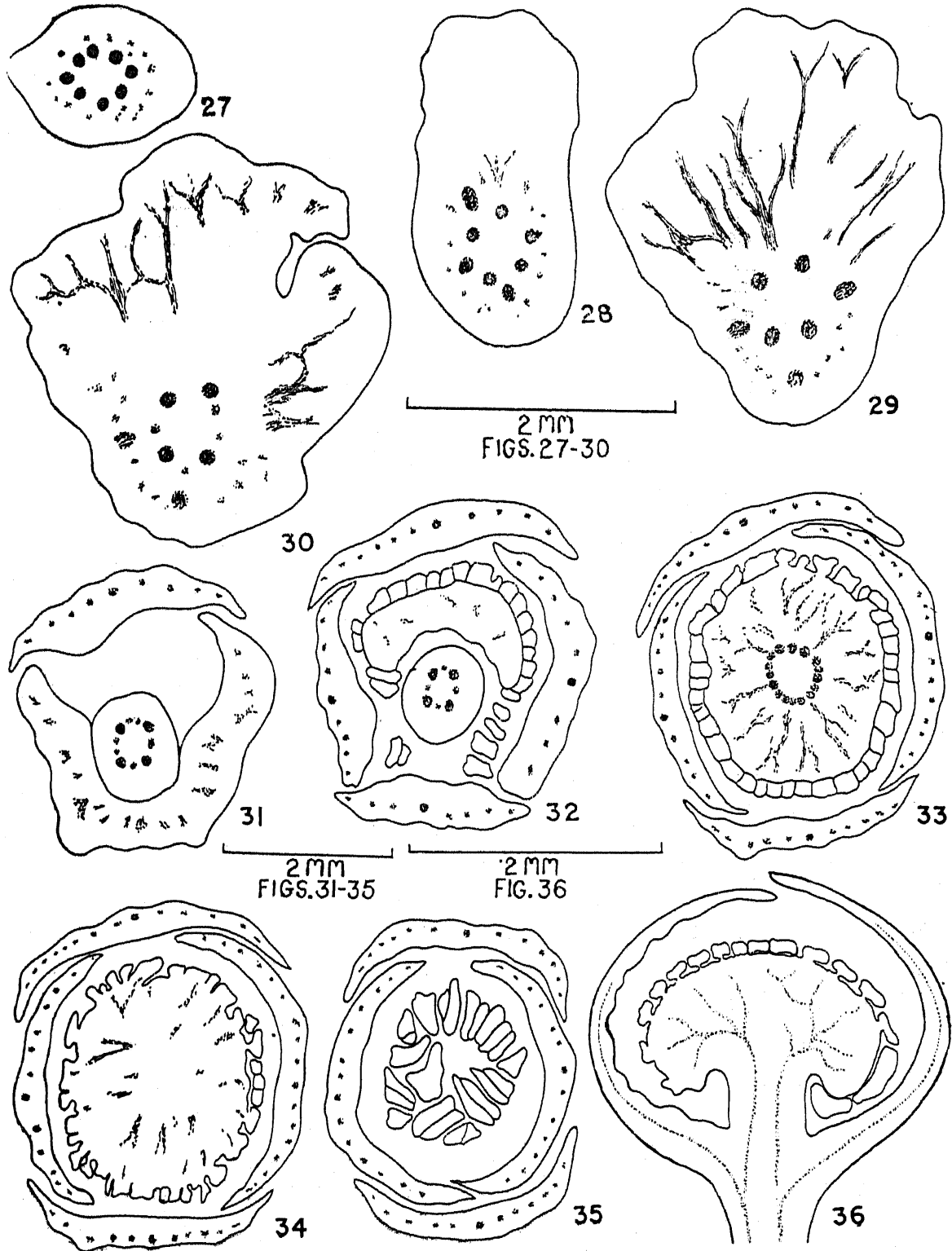
The development of the non-glandular trichome also takes place by the enlargement of an epidermal cell which soon becomes papillose (Fig. 10). It shows a conspicuous nucleus, surrounded by dense cytoplasm. Soon it divides transversely forming an upper and lower cell (Fig. 11); while the latter cell functions as the foot and lies embedded among the remaining epidermal cells (Fig. 12), the former cell divides to form a linear row of 4–5 cells (Figs. 12–16). Each cell of this row develops into a spine (Figs. 17, 18). Since all the cells do not develop into spines simultaneously, the septate trichome presents the appearance of false branching (Figs. 19, 20).

Sunken multicellular glands are present on the adaxial surface of the perianth lobes. Each gland develops from a single epidermal cell which soon becomes conspicuous by its large size, dense cytoplasm and prominent nucleus (Fig. 21). It divides transversely forming an outer and an inner cell (Fig. 22). The outer cell undergoes repeated vertical divisions to form a layer of radially elongated cells (Figs. 23, 24) covered by a cuticle (Fig. 25). These cells show prominent nuclei embedded in a deeply stained vacuolate cytoplasm. Simultaneously, the lower cell undergoes repeated divisions to form a mass of glandular tissue (Figs. 22–26). This tissue is surrounded laterally and below by a layer of thin-walled tangentially elongated parenchyma cells (Fig. 26) with vacuolate cytoplasm.



FIGS. 1-26. *Nepenthes khasiana*.—Multicellular trichomes and glands. Figs. 1-6. Stages in development of multicellular glandular trichomes. Fig. 7. Mature glandular trichome. Figs. 8 and 9. Top views of glandular trichomes. Figs. 10-18. Stages in development of non-glandular trichomes. Figs. 19-20. Falsely branched mature trichomes. Figs. 21-25. Stages in development of sunken multicellular glands. Fig. 26. Mature sunken multicellular gland.

Flowers.—The flowers are pedicellate, regular, unisexual, with a perianth consisting of four tepals in two pairs, the two medians overlapping the two lateral members, as frequently seen in tetramerous flowers (Figs. 32–35, 40–43, 45, 46). In the male flower there are numerous stamens arranged



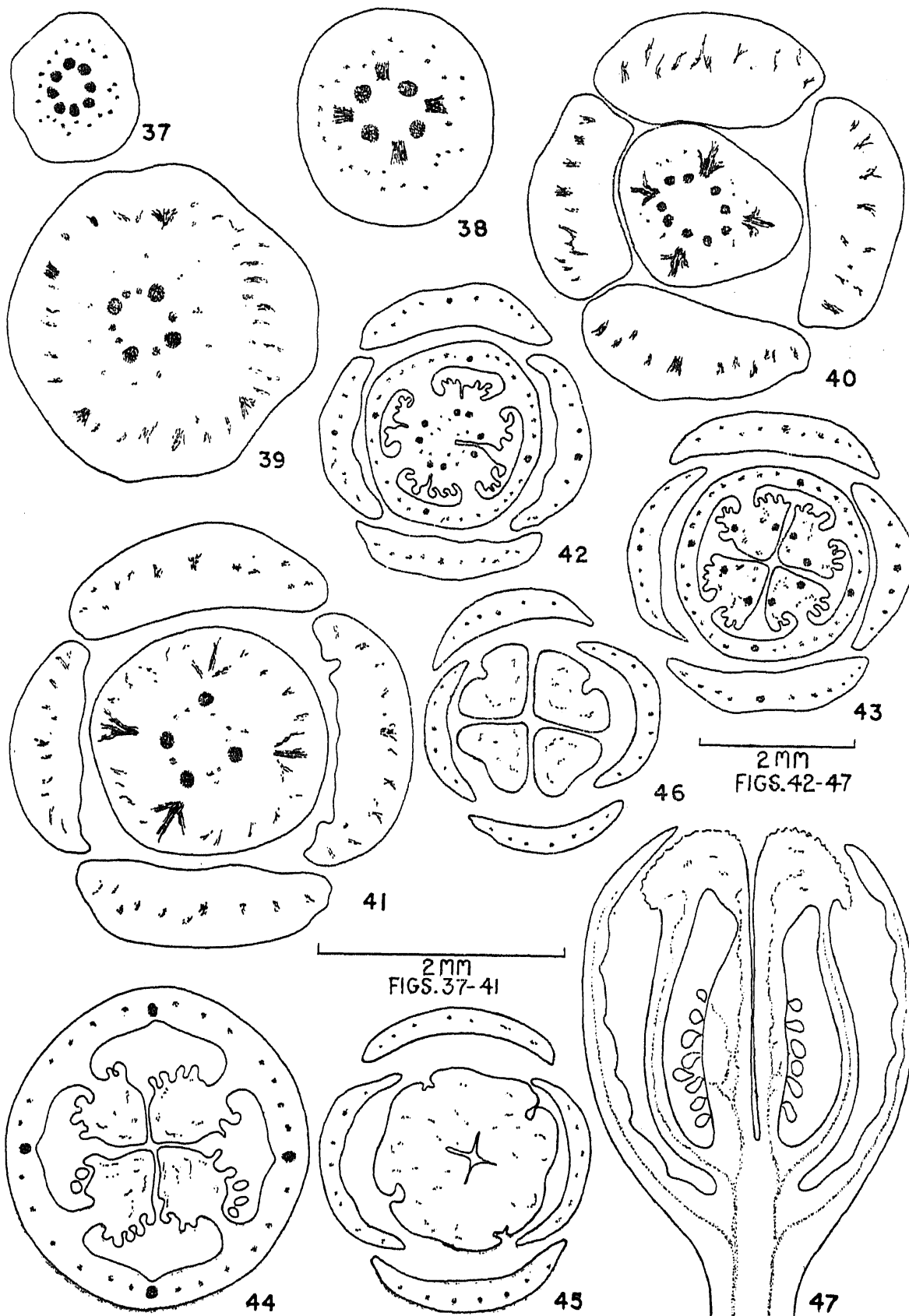
FIGS. 27–36. *Nepenthes khasiyna*.—Floral anatomy. Figs. 27–35. Serial transections of male flower buds showing origin and distribution of traces to different floral parts. Fig. 36. Longisection of male flower bud, showing course of vascular bundles in different floral parts.

in a ring (Fig. 33) and borne on the androphore (Fig. 36) which in turn consists of a short stalk continued into an expanded upper portion. The anthers are extrorse. There are no vestiges of the gynoeceium. In the female flower, the ovary is superior, 4-carpellary, 4-locular at the base becoming unilocular above since the septa do not meet in the centre (Figs. 42-44). The loculi are opposite the tepals (Figs. 42, 43). The style is very short and the stigmas commissural (Fig. 47).

Floral anatomy: Male flower.—In the male flower the pedicel shows a ring of eight vascular bundles (Fig. 27). Peripheral to this ring are a number of smaller bundles. In the thalamus region four of the eight bundles diverge outward and these constitute the traces for the perianth lobes (Figs. 28-30). As they diverge out they undergo branching (Figs. 28-30). The smaller traces lying outside the inner ring of bundles also traverse into the perianth lobes (Figs. 27-30). After the demarcation of the perianth supply, the central stele consists of four larger and four smaller bundles arranged in a ring. The larger bundles lie on the radii alternating the midribs of the perianth lobes (Figs. 31, 32). All these bundles extend into the androphore where they unite to form a ring of vascular tissue (Fig. 33). From this ring numerous traces arise and these supply the stamens (Figs. 33, 34). The vascular tissue is completely utilized for the staminal supply (Figs. 35, 36). In this connection mention may be made of the work of Wilson and Maculans (1967) who reinvestigated the vascular anatomy of *Myristica fragrans* and *M. malabarica*. The vascular anatomy of the male flowers of these taxa closely resembles the situation met with in the male flowers of *Nepenthes khasiana*.

Floral anatomy: Female flower.—The pedicel shows a ring of eight vascular bundles (Fig. 37). External to this are a number of smaller bundles distributed in an irregular manner (Figs. 37, 38). In the region of the thalamus four of the eight inner bundles serve as the perianth traces. They diverge and undergo branching (Figs. 38-40). The traces thus formed and the smaller traces outside the main stele distribute themselves to the four perianth lobes (Figs. 38-41). After the perianth supply is organized, the central stele shows a ring of bundles of which four are larger and prominent, alternating with smaller ones (Fig. 39). From the larger bundles the dorsal carpellary traces are organized (Figs. 40, 41). These, as they emerge out, undergo repeated branching and as a result the ovary wall is thus traversed by a large number of bundles in addition to the dorsal bundles (Figs. 40-44). The central stele at this level shows a ring of prominent bundles surrounded by some smaller bundles which in turn diverge out and enter the ovary wall. The larger bundles unite to form four bundles which lie along the radii of the

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FIGS. 37-47. *Nepenthes khasiana*—Floral anatomy. Figs. 37-46. Serial transections of female flowerbuds showing origin and distribution of traces to different floral parts. Fig. 47. Longisection of flower bud showing course of vascular bundles in different floral parts.

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