

plants was highest in 0.1% EI. Such variants were grouped as follows :—

(a) *Tall plants* (Height ranged from 30.50 cm to 31.70 cm) were much taller than the normal and were healthy and vigorous, with a large number of branches. The branches were widespread. Leaves were longer and narrower than the control and variation in leaf shape was conspicuous. They were characterised by early flowering and good yield of seed.

(b) *Bushy plants* (Height ranged from 18.70 cm to 21.70 cm) were comparatively short, stout and healthy. Very short internodes and very high number of branches gave a bushy appearance. Variation in leaf shape and pod shape were conspicuous. Flowering was almost normal but yield was comparatively high.

(c) *Dwarf plants* (Height ranged from 13.50 cm to 15.50 cm) were much shorter and did not look healthy. Considerable variation in leaf shape was noticed with characteristic late flowering and yield. Pollen sterility was high.

(d) *Stunted plants* (Height ranged from 8.50 cm to 10.0 cm) were very short without any branch or very rarely with a single branch and were completely sterile.

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### A BIFURCATED SEEDLING OF *CARTHAMUS TINCTORIUS* LINN.

AMONG seedlings of *Carthamus tinctorius* grown in an experimental plot, some had a bifurcated shoot and some a bifurcated root while a few had a bifurcated shoot as well as root. The anatomy of a seven week old seedling of the latter category was investigated (Fig. 1).

The common axis about 1.71 cm long, from either end of which the bifurcations start, has normal anatomical features, though stunted in growth as compared to a normal seedling. The cotyledonary node is pentalacunar with a median flanked by two small laterals and two larger ones, the latter being the products of split laterals common to both cotyledons. The first foliar node bearing a pair of opposite leaves

at right angles to the cotyledonary plane, shows similarity to the cotyledonary node excepting for the absence of the split lateral (Fig. 2). The larger laterals near the leaf margins leave independent gaps at the foliar node. The median gaps of the first leaf pair are not closed resulting in two horse-shoe shaped vascular groups in the axis (Fig. 2). At the points of insertion of the leaves, the cortex shows gradually deepening invaginations. Simultaneously, procambium formation followed by vascular differentiation at the gaps change the two horse-shoes into two separate vascular rings (Fig. 3). With the completion of the cortical invaginations, the bifurcation is complete and two independent axes result. These show alternate phyllotaxy (mirror image of each other) with typically trilacunar nodes. The bearing of this nodal variation on the question of the derivation of a trilacunar condition from a multi or penta-lacunar one can only be speculative without wider sampling.

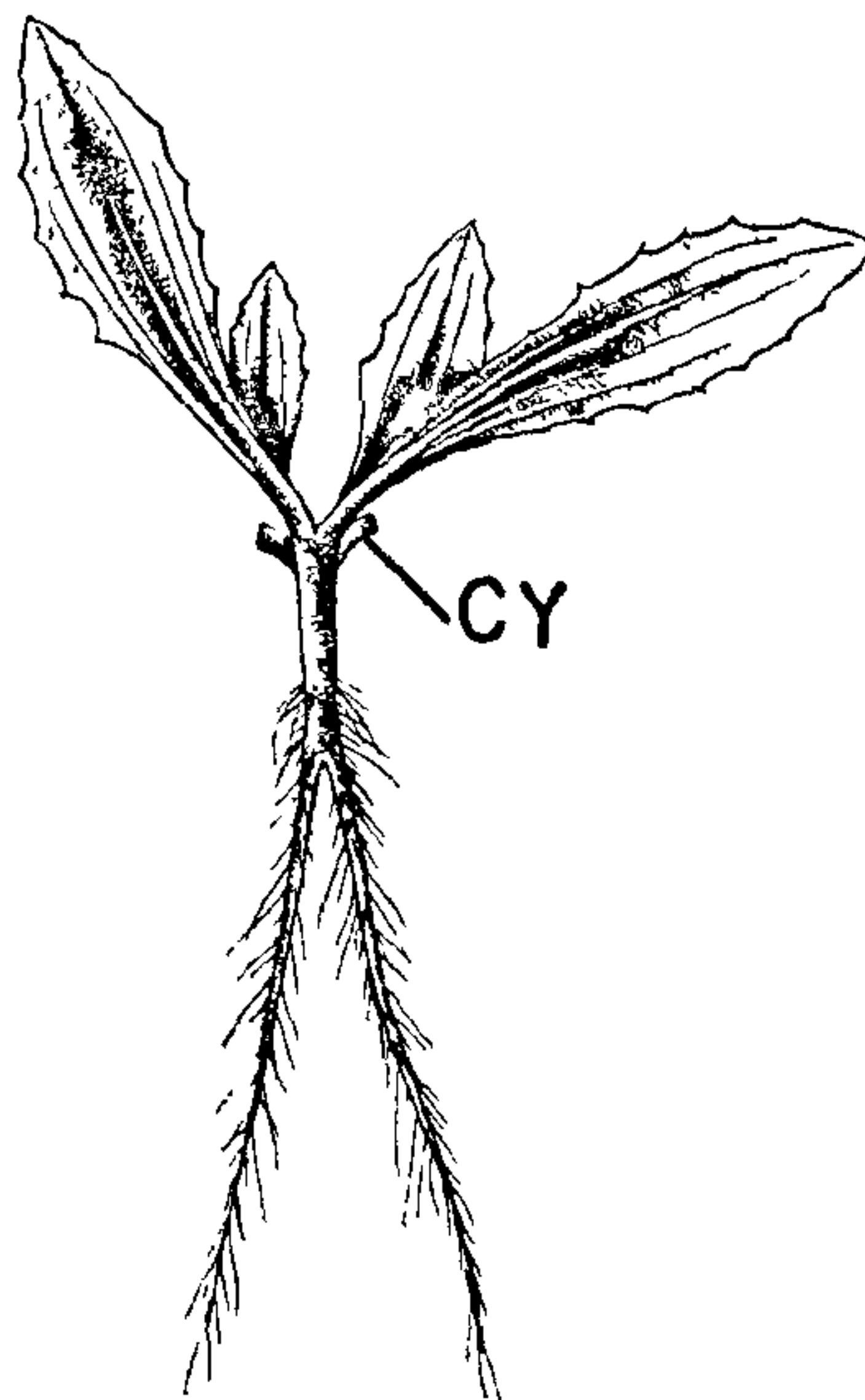
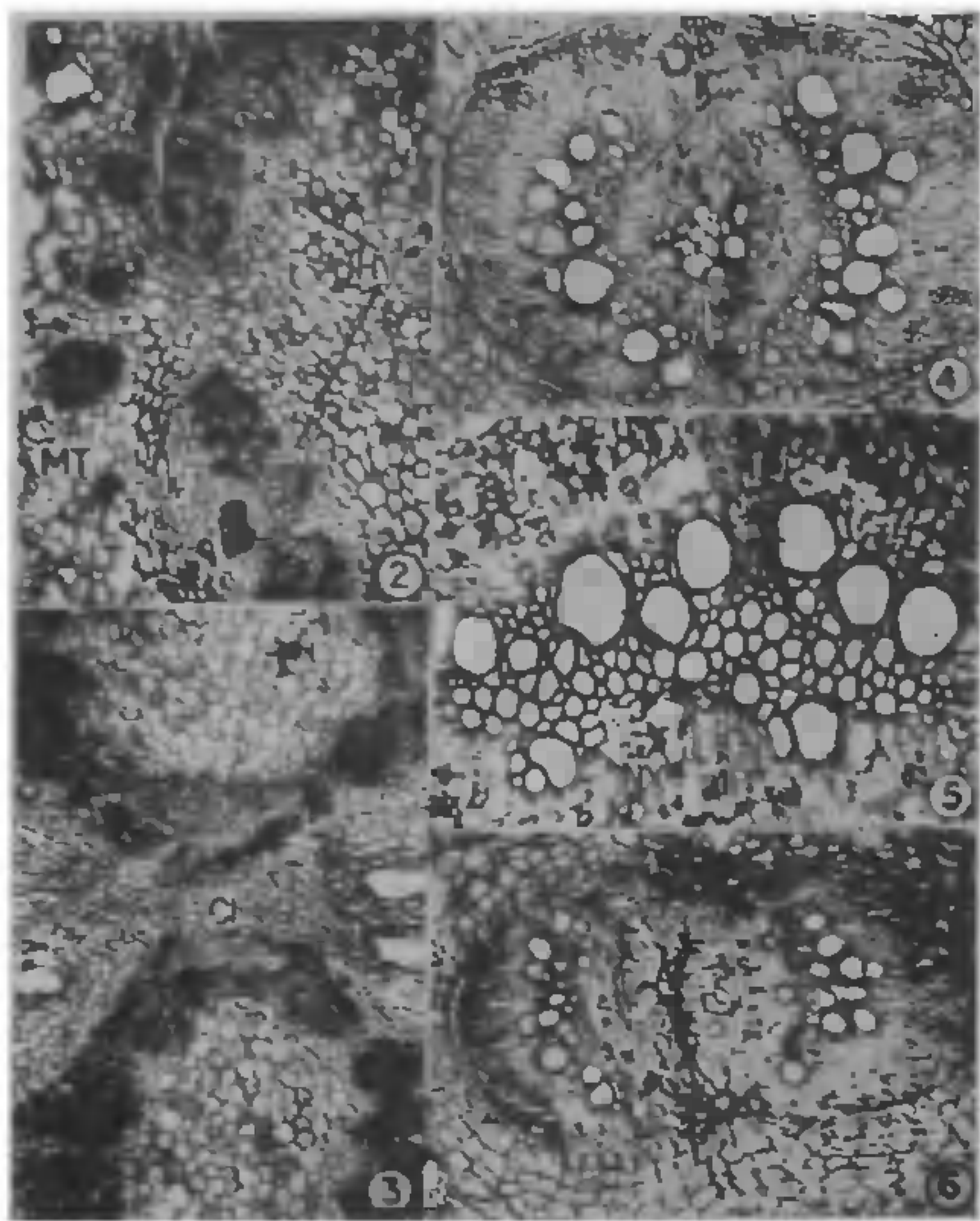


FIG. 1. Bifurcated seedling of *Carthamus tinctorius*.

The normal diarch root with a solid metaxylem core develops a lenticular pith resulting in the splitting of the metaxylem (Fig. 4). Two arcs of cambium, formed at the periphery of the pith cut off phloem towards the inside (against the pith) and xylem to the outside (against the metaxylem) (Fig. 5). Just proximal to the bifurcation (1.19 cm) the pith splits into two due to necrosis of some cells across the centre, the two vascular arcs still being joined at the common protoxylem poles (Fig. 4). Further distally, bifurca-

tion is complete resulting in two separate radially arranged vascular groups (Fig. 6).



FIGS. 2-6. Fig. 2. T.S. of shoot at the first foliar node,  $\times 60$ . Fig. 3. T.S. of shoot just proximal to bifurcation,  $\times 60$ . Fig. 4. T.S. of root showing early stage of bifurcation,  $\times 100$ . Fig. 5. T.S. of root showing one arc of the vasculature,  $\times 150$ . Fig. 6. T.S. of root showing the two separate vascular groups,  $\times 60$ . (CI, cortical invagination; CY, cotyledon; CPP, common protoxylem pole; HV, part of horse-shoe-shaped vascular group; IC, inner cambium; IP, inner phloem; LT, lateral trace; MT, median trace; NP, necrotic pith cells; NX, new xylem.)

Antony Davis<sup>1</sup> defined dichotomous branching "as the forking of a shoot (root or any other organ) resulting from a division into two parts of the single apical dome or a group of cells located at the apex". Though of frequent occurrence in cryptogams, it is rare in higher plants and difficult to establish at the growing point by anatomical methods. Mechanical causes like accidental damage to the apex are ruled out because of identical bifurcation of the shoot and root reported here. In many palms an axillary bud develops to simulate a bifurcation. The equally developed axis with mirror image foliar patterns rule out this possibility. The first foliar leaves are already laid down in the mature embryo of *Carthamus tinctorius* (paper communicated to FLORA) and so the dichotomy might have been established in the embryo itself. Possibly specific microclimatic or hormonal effects

at the embryonic stage may be responsible. The mirror image leaf arrangement in the two axes which is considered usual with real forking lends support to considering this as a case of true dichotomy or forking.

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#### LEAF ARCHITECTURE IN *LYGODIUM JAPONICUM* (THUMB) SW. AND *ANEMIA SCHIMPERIANA* PR.

BIRHORST<sup>1</sup> has considered Lygodiaceae and Anemiaceae as full fledged families, though *Lygodium* and *Anemia* were earlier kept in Schizaeaceae<sup>3,5</sup>. The former not only differs from the latter and other two or three genera, in having indefinite growth of its leaf, but in possessing a protostele and gutter shaped petiole, as well as in its cytology<sup>11</sup>. Recently venation pattern, dermatypes and stomates have been stressed in resolving [the problem of systematics<sup>4,7,9</sup>. An attempt has, therefore, been made here, to see whether or not *Lygodium* and *Anemia* possess similar types of venation pattern, dermatypes and stomates. Hair in Schizaeaceae has been described earlier as simple filamentous, soft and long<sup>1,3,5</sup> and stomates as euperimesogenous (adetostomy) in *A. hirsuta* desmo-mesogenous (suspended or hanging) in *A. buniifolia* and eupolomeso-perigenous (applied) in *A. adiantifolia*<sup>6</sup>.

The material of *L. japonicum* was collected from Palampur (H.P.) and *A. schimperiana* procured from Calicut (Kerala). Epidermal peelings were prepared and pinnules were cleared<sup>2,8</sup>. The terminology used was after Claessens and Cotthem<sup>4</sup>, Gupta and Ithambie<sup>6</sup> and Hickey<sup>7</sup> for stomates, dermatypes and leaf architecture respectively. The primary rachis, which is endowed with power of unlimited growth, bears acropetally developed secondary rachii in *L. japonicum*. Each of them trifurcates. The growth of central one remains arrested while the laterals move away and bear 3-5 pinnules. *A. schimperiana* possesses bipinnate fronds with 5-7 imparipinnate pinnules. Each pinnule is obovate with obtuse apex and base, convex serrated margin and stiff texture, whereas the pinnules of *L. japonicum* are ovate with obtuse apex, lobate base, straight serrated margin and coriaceous texture. The main rachis of *L. japonicum* is weak and smooth, as the plant is a climber, whereas it is stout, 5-20 cm long and profusely clothed with about 5 mm long brown hair in *A. schimperiana*. Venation is flabellate in both the genera. About 6% areole formation