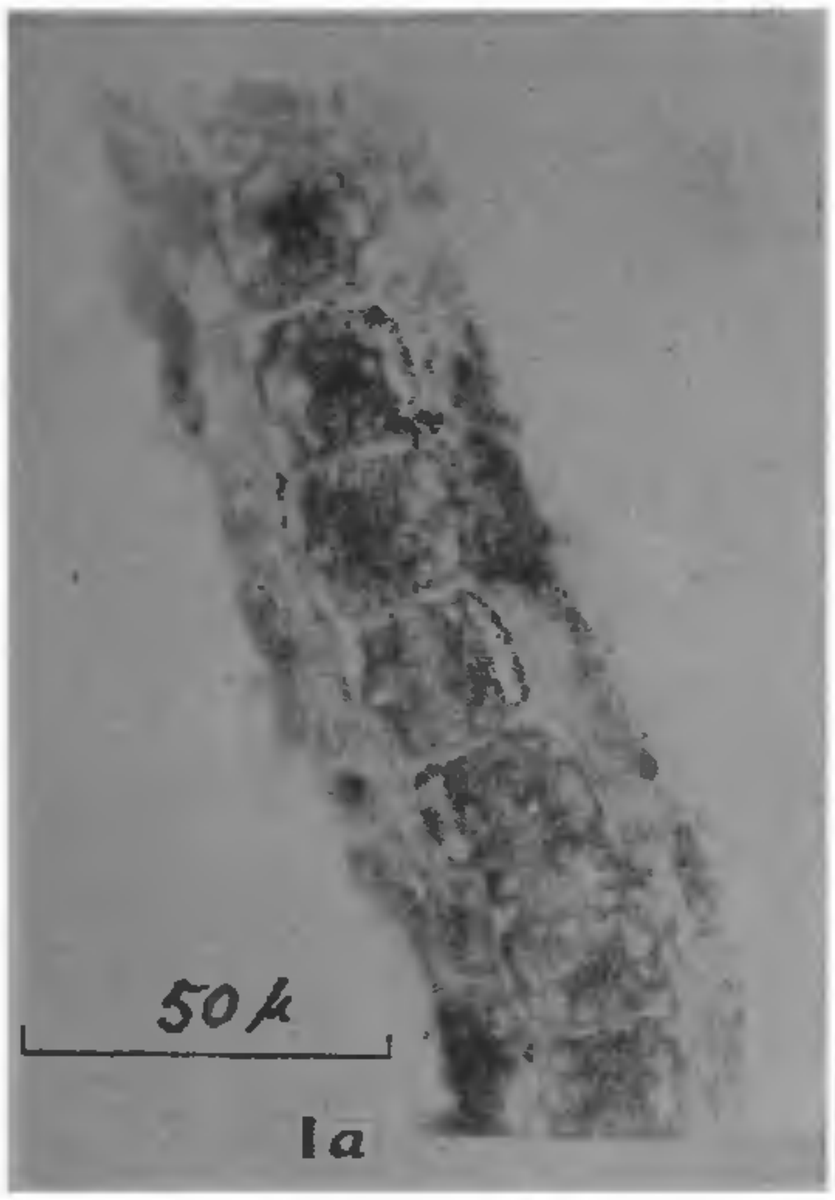
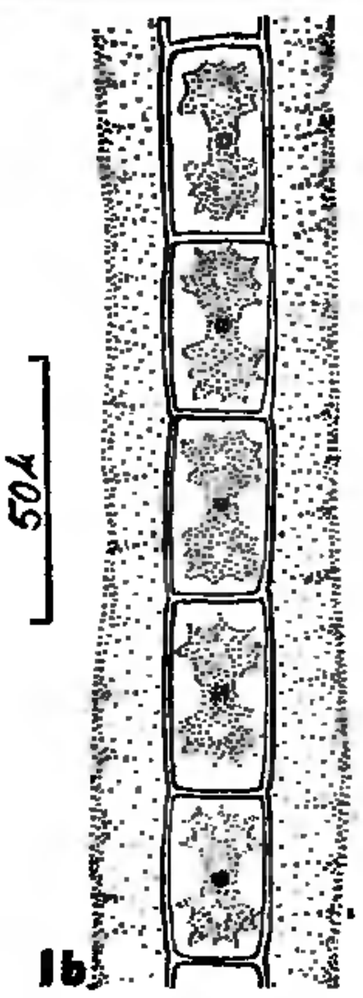
mucilagenous nature of the sheath (Figs. 1 *a* and 1 b). The alga was kept growing in





FIGS. 1 *a* & 1 *b*. *Zygnema czurdæ*. Fig. 1 *a*. Filament showing a broad mucilagenous sheath. Fig. 1 *b*. Camera lucida sketch of a filament showing a non-stratified mucilagenous sheath.

Pringsheim's biphasic soil-water medium,[5] and even after about two months, it retained its sheath. Some of the filaments were fertile and the species has been identified as *Z. czurdæ*.

It is too early to assess the value of a firm sheath as a taxonomic character within the group. It also cannot be ascertained at present whether this character is a genetically based constant feature or is a mere response to ecological conditions.

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A NOTE ON THE DEVELOPMENT OF ENDOSPERM AND EMBRYO IN *UTRICULARIA GRAMINIFOLIA* VAHL

Utricularia is an embryologically heterogeneous member of Lentibulariaceæ. Recently, there have been several reports on the variations in the embryogeny of this genus which consist of the investigations on *U. flexuosa* (Khan, 1954), *U. cœrulea* (Kausik, 1956), *U. arcauta* (Farooq, 1965), *U. uliginosa* (Farooq, 1965) and *U. stellaris* (Farooq, 1967). The present investigation records the endosperm development and the variations in the early development of embryo in *U. graminifolia* Vahl.

The pollen grains germinate on the stigmatic lobes and a number of pollen tubes pass through the stylar canal and creep above the surface of the placenta after reaching the ovarian cavity. The pollen tubes meet the egg cell outside the micropyle and fertilization is effected which results in the destroying of one of the synergids and the formation of a zygote and a primary endosperm nucleus.

The development of the endosperm is of *ab-initio* Cellular type. The first division of the primary endosperm nucleus takes place in the centre of the embryo sac and is accompanied by a transverse wall. Consequently, the embryo sac becomes divided into two distinct chambers—a primary micropylar and a primary chalazal chamber. The next division in both the chambers is followed by incomplete vertical walls, therefore, the two cells of each chamber are not completely separated from each other. Sometimes the second division is delayed in the chalazal chamber. Each one of the four cells of the endosperm, thus formed, now divides by a transverse wall to form an eight-celled endosperm, the cells

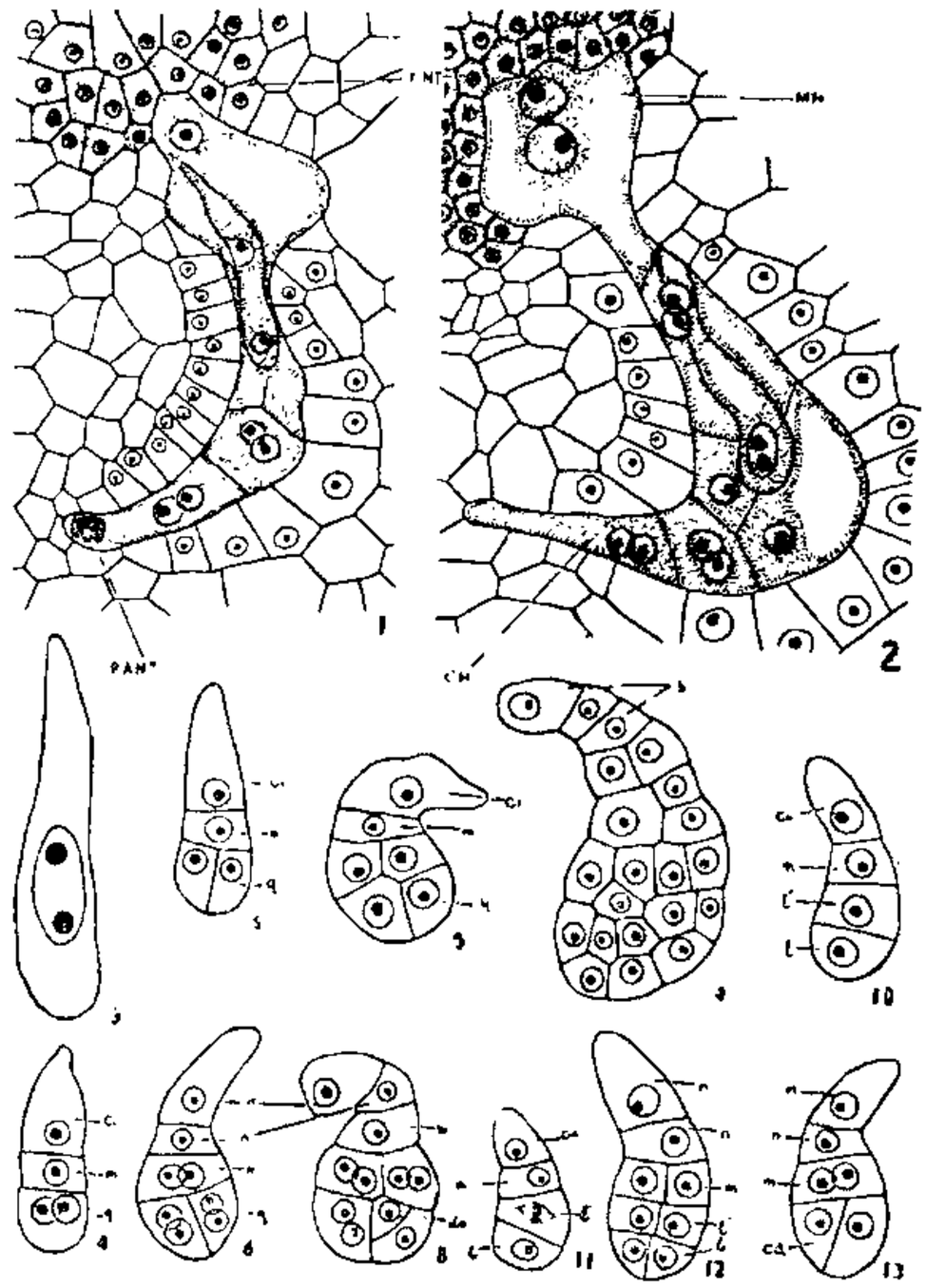
of which are disposed in four tiers. The terminal tiers at the micropylar region and the chalazal region function as the micropylar and the chalazal haustoria respectively while the central two tiers give rise to the endosperm proper by further divisions (Figs. 1 and 2). The micropylar haustorium is very aggressive. It is lobed in the beginning but as the haustorium enlarges, the lobed nature is lost. It extends into the placental nutritive tissue, breaking the cells that come in contact with it. It remains two-nucleate throughout the course of development, the nuclei being very large and conspicuous (Fig. 2).

The chalazal haustorium is less aggressive when compared to the micropylar haustorium and lies in the midst of the chalazal nutritive tissue. It consists of two nuclei which migrate to the base of the haustorium in later stages. The antipodals persist upto the early stages of endosperm development and are obliterated later (Fig. 1).

The zygote (Fig. 3) divides only after considerable amount of endosperm tissue is formed. It elongates producing a long tube which penetrates through the endosperm cells. The zygote nucleus lies at the dilated end of the tube in the centre of the embryo sac. The first division of the zygote nucleus is followed by a transverse wall and results in the formation of an apical cell *ca* and a basal cell *cb*. The basal cell *cb* is long and tubular while the apical cell is small. The basal cell invariably undergoes a transverse division to form *ci* and *m* while the divisions in the terminal cell are not uniform. It may divide longitudinally producing two juxtaposed cells *q*, so that the resultant pro-embryonal tetrad is T-shaped conforming to the A_2 series of Soueges classification (Figs. 4 and 5). The quadrants (Fig. 6) divide again to form octants which are disposed in two tiers (Figs. 7 and 8). The middle cell *m* divides vertically twice, to form four cells (Figs. 6 and 7) and contributes towards the formation of hypocotyledonary region (Fig. 9).

In some cases the terminal cell divides by a transverse wall producing a linear proembryonal tetrad (Fig. 10) which fits into the C_2 series of Soueges classification. The cells are designated as *l* and *l'* from *ca* and *m* and *ci* obtained from *cb*. Of these, the cells *l* and *l'* form the embryo proper while a part of the cell *m* or the whole of *m* is utilized for the formation of hypophysis and the hypocotyl regions (Figs. 11 and 12).

In yet other cases an oblique division was observed in the terminal cell which resulted in a tetrad corresponding to the B_2 series (Fig. 13).



FIGS. 1-13. *Utricularia graminifolia* Vahl: Development of endosperm and embryo. Fig. 1 L.S. ovule showing multicellular endosperm, zygote and the persistent antipodals. Fig. 2. L.S. ovule showing multicellular endosperm, zygote and the chalazal and the micropylar haustoria. Fig. 3. Zygote. Figs. 4–5. T-shaped proembryonal tetrads. Figs. 6–9. Stages in the development of embryo. Fig. 10. Linear proembryonal tetrad. Figs. 11–12. Stages in the development of the embryo. Fig. 13. Proembryo showing an oblique wall in the *ca*. (CH, Chalazal haustorium; ENDCLS, Endosperm cells; MH, Micropylar haustorium; PANT, Persistent antipodals; PNT, Placental nutritive tissue.) (All figs., × 300).

A T-shaped tetrad is more frequent when compared to the other types. Irrespective of the shape of the tetrad, the middle cell *m* contributes to the formation of the hypocotyl and further divisions in either case are irregular after the first periclinal division (Figs. 8 and 9). A mature embryo is undifferentiated.

The variations in the development of embryo in *U. graminifolia* Vahl further support the earlier records in other species of *Utricularia* investigated so far.

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