intriguing and that too in a population confined to a single locality. In this connection, further correlation studies between raphide idioblasts formation and early growth and differentiation of embryo is suggestive of a possible clue for their precocious or belated formation in the plant organs and tissues.

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THE GENESIS OF EMBRYO IN *UTRICULARIA BIFIDA* LINN.— A REINVESTIGATION

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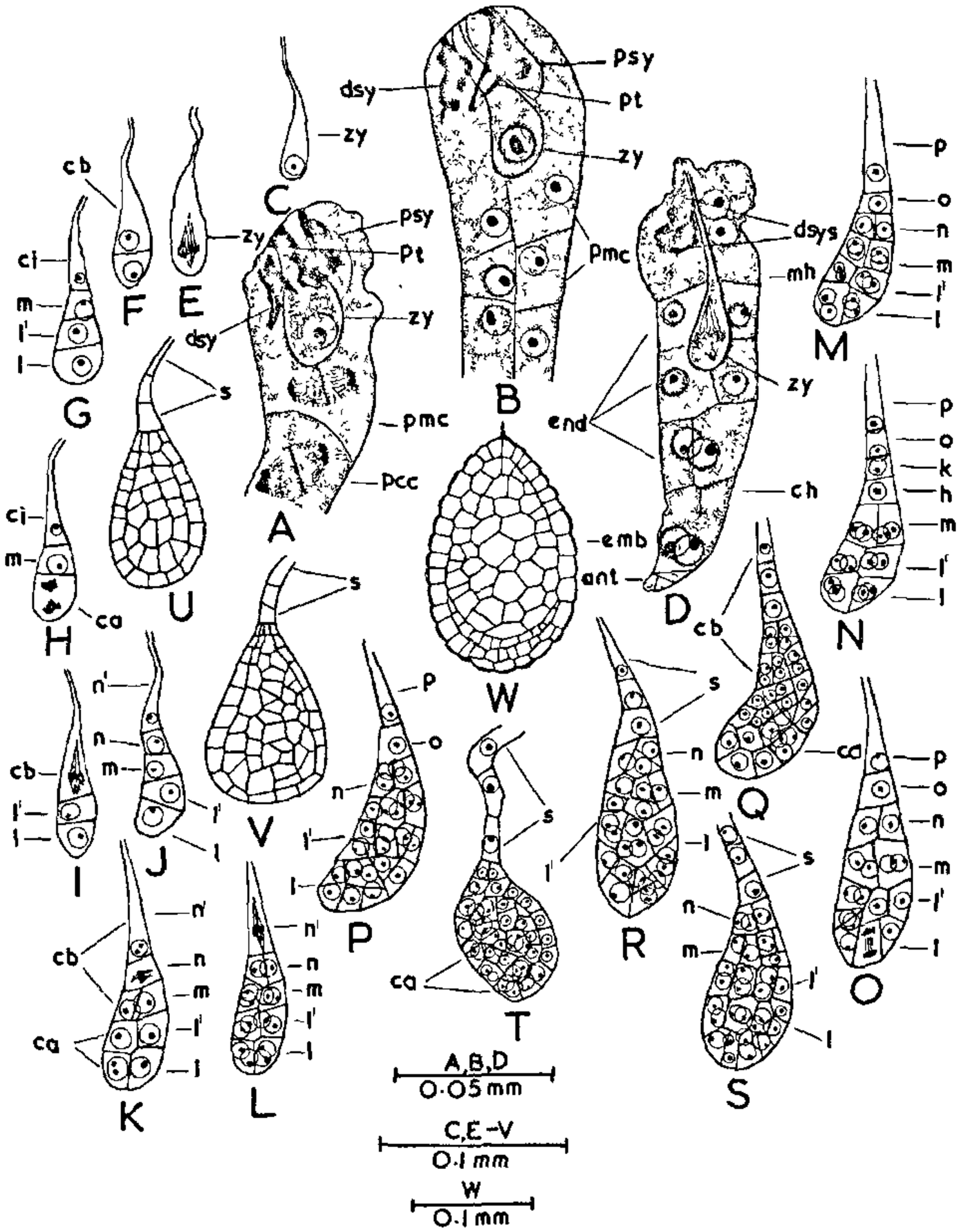
THE genesis of embryo is exceptionally diversified in species of *Utricularia* L. However, basing on the early proembryonal stages, three principal types—the Onagrad, the Solanad and the Chenopodiad—are hitherto known in the genus[1–7]. Further, infrequent occurrence of other specific types may also occur in the same species[5,6]. Recently in *Utricularia bifida*[7], collected from Purulea (Bihar), both Chenopodiad and the Onagrad types of embryogeny have been described. To check this, the same species collected from Vazeedu, Cumbum Taluq, Andhra Pradesh, the present study was undertaken and the results are rewarding.

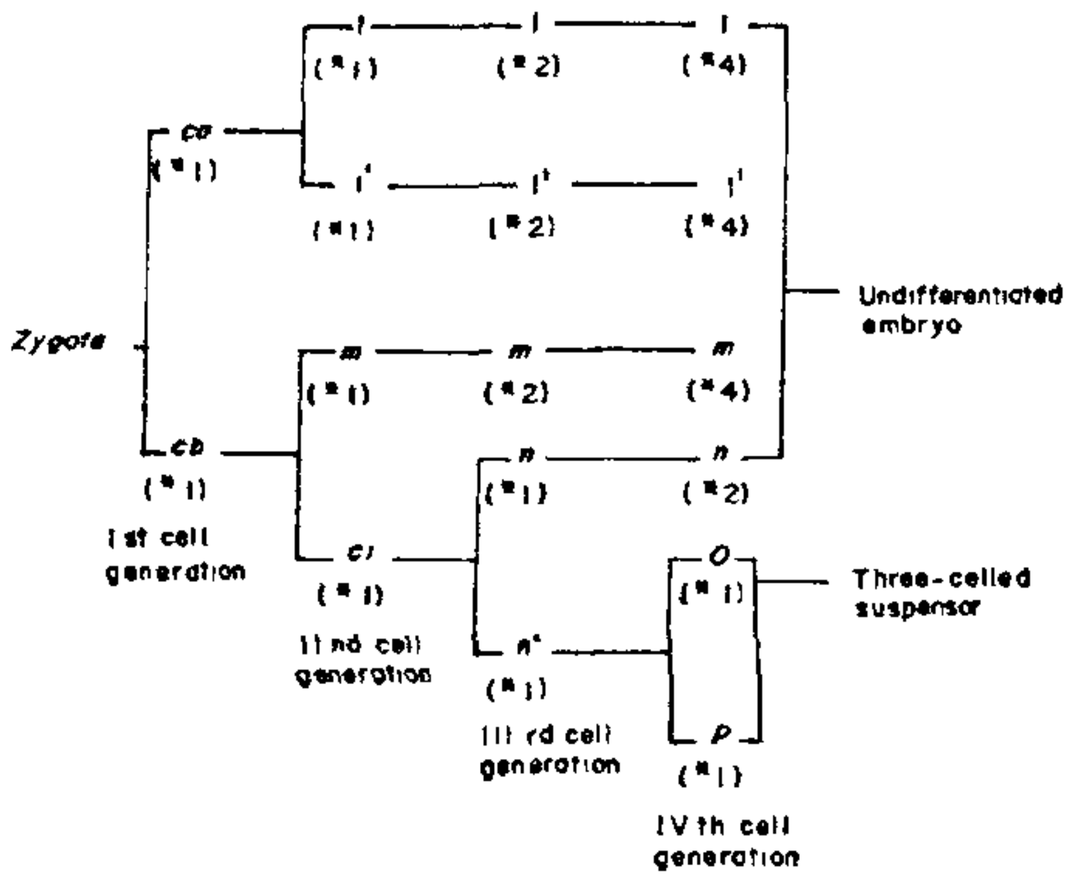
As in other species of the genus[1–7] the zygote elongates into a long tube with the nucleus positioned in the bulbous apex of the zygote (figures A–C). The first division, which is transverse, is initiated in the zygote only after the *ab initio* cellular endosperm has become 10-celled (figures D, E), thus evidencing a delayed division of the zygotic nucleus. Consequently a two-celled proembryo with the apical cell *ca* and a long tubular basal cell *cb* is formed (figure F). These cells soon divide to form a proembryo with four superposed cells *l*, *l'*, *m* and *ci* (figure G). This is the end of the second cell generation. The proembryonal tetrad belongs to the C_2 category of Soueges[8]. However, in a few preparations the segmentation of the cells of the two-celled proembryo occurs successively rather than simultaneously (figures H, I). At the third cell generation the tiers *l*, *l'* and *m* segment longitudinally and the cell *ci* transversely forming two superposed cells *n* and *n'* (figures J, E). Soon the quadrants are organised in *l*, *l'* and *m* whereas *n* divides once along longitudinal plane resulting in two juxtaposed cells and *n'* along transverse plane organising two superposed cells *o* and *p* (figures L, M). However, in a few preparations the tier *n* segments transversely, instead longitudinally, resulting in linearly aligned cells *h* and *k* (figure N). This represents the end of fourth cell generation and the proembryo becomes 16-celled and the cells disposed in either six tiers (figure M) or seven tiers (figure N). Further divisions in the tiers *l*, *l'*, *m* and *n* are very erratic and consequently an undifferentiated pear-shaped embryo is developed (figures O–W) and the major part of the embryo (figure W) comprises large polygonal cells abundantly rich in starch grains. The only discernible differentiation in the embryo is the occurrence of a region of small meristematic cells at the region shown in figure W, and it is supposed that this region organises the plumule in future. The outer walls of the epidermal cells, which lie free from the seed coat of the ripe seed, of the embryo become cutinized (figure W). The suspensor, which is distinctly differentiated during early ontogeny (fourth cell generation) of the embryo (figures M, N), becomes gradually inconspicuous and withers away by about the time a mature embryo is formed (figure W) and finally the remnants even are lost.

Thus, the derivatives of *ca*, *m* and *n* are involved in the formation of the embryo proper, whereas the daughter cells of *n'* form the uniseriate three-celled ephemeral suspensor (figures K–W). Thus, the embryogenesis corresponds to the period I Megarchetype III in the Series C_2 of the embryonic classification of Soueges[8] or to the Chenopodiad pattern keying to the Chenopodiad variation of Johansen[4] as there has been no differentiation of epiphyseal initial in the tier *l* and this can be re-



Figures A–W. Embryogenesis in *Utricularia bifida* Linn. **A.** L. s. micropylar part of embryo sac showing the differentiation of micropylar and chalazal chambers; note the division of the endosperm nuclei, the zygote, remnants of the pollen tube, degenerated synergid and persistent synergid; **B.** L. s. part of the cellular endosperm showing micropylar chamber with elongating zygote, remnants of the pollen tube, degenerated synergid and persistent synergid; note the endosperm initials; **C, E–M.** Stages in the development of the embryo; **D.** L. s. of tencelled endosperm; note the zygote in division in the micropylar haustorium, the chalazal haustorium, central tiers of cells organising the endosperm proper and degenerating antipodals; **W.** L. s. undifferentiated embryo; note the outer walls of the epidermal cells cutinized and the suspensor withered (*ant*—antipodal cells; *ch*—chalazal haustorium; *dsy*—degenerated synergid; *dsys*—degenerated synergids; *emb*—embryo; *end*—endosperm; *mh*—micropylar haustorium; *pcc*—primary chalazal chamber; *pmc*—primary micropylar chamber; *psy*—persistent synergids; *pt*—pollen tube; *zy*—zygote).

capitulated by the divisional sequence at early stages of embryogeny as given below:



Our observation on the principal type of embryogeny concurs with that of the earlier workers[7]. However, more work on this species collected from several places is really desirable before one confirms or refutes the report of the occurrence of T-shaped proembryonal tetrad besides the linear ones, tending toward the genesis of Onagrad type of embryogenesis[7].

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TRENDS OF SPECIALIZATION IN ENDOSPERM OF THE CYPERACEAE

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THE endosperm development in the Cyperaceae is *ab initio* free nuclear. This is the uniform pattern observed in the family[1–6]. The present study in 10 taxa (*Pycreus pumilus* Nees., *Cyperus alternifolius* Willd., *Mariscus paniceus* Vahl. *Eleocharis atropurpurea* Kunth., *Fimbristylis cymosa* R. Br., *Scirpus supinus* Linn., *Eriophorum comosum* Wall., *Fuirena ciliaris* Linn., *Remirea maritima* Abul., *Scleria lithosperma* Roxb.) confirmed the above findings. Customary methods of microtomy were followed.

The variation has been observed in the number of endosperm nuclei at zygote stage (figures 1–6). During embryogenesis endosperm nuclei are evenly distributed except in *Eriophorum comosum* where at chalazal end they form a dense mass. Later, cellularization occurs in this region and it becomes well marked from the remaining part (figures 7, 8). However, there is no formation of endosperm nodule.

The free nuclear stage is replaced by cellular one. The variation has been recorded regarding the onset of cellular stage in the taxa investigated. At one end of the series are species like *Scleria stoksiana*[7] and *S. lithosperma* (present work) where cellularization sets in at the bicelled stage of the proembryo (figures 15–17). In *Pycreus pumilus* and *Cyperus alternifolius* it becomes cellular at the proembryonic tetrad stage. Occasionally this event may occur at 3-celled stage in *Cyperus alternifolius* (figure 2) a condition reported in *Pycreus puncticulatus, Kyllinga triceps,*[8] and *Fimbristylis quanguangularis*[3]. Next in order fall taxa like *Fimbristylis cymosa, Scirpus supinus* and *Remirea maritima*, where at the third cell generation wall formation is completed. This has been reported in *Cyperus alopecuroides*[4] and *Kyllinga brevifolia*[6]. At the other end of the series one can visualise majority of the investigated members where wall formation is completed only at the close of the fourth cell generation when dermatogen initials are cut off in the proembryo[2, 5, 7]. In the present work such a condition is observed in *Eleocharis atropurpurea* (figure 3), *Scirpus supinus* (figure 5), *Eriophorum comosum*, and *Fuirena ciliaris.*

After the onset of the cellular phase the endosperm increases in bulk during the maturation of the seed. The two trends can be visualised to indicate the increase in bulk. In the majority of the taxa it is