

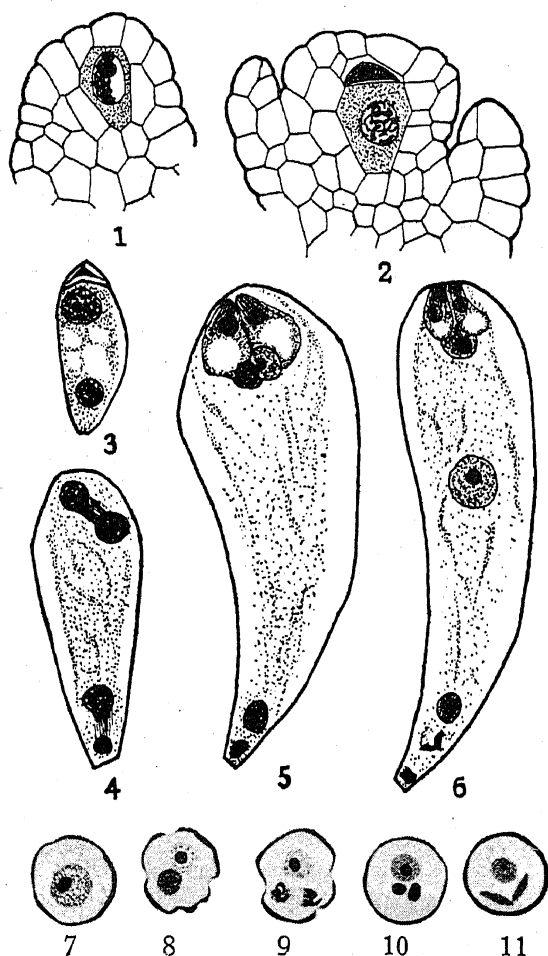
different animals and on the two sides of the same individual will have to be explained adequately. The factor that determines or influences the development of the individual number of the testis lobes is not known, and it seems to me that individual and lop-sided variations have no specific or physiological significance.

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Contribution to the Morphology of  
*Limnophyton obtusifolium* Mzq.

PLANTS of the family *alismaceae* have been investigated by several workers, each obtaining somewhat different results from the other. Schaffner worked out *Alisma plantago* in 1896 and *Sagittaria latifolia* in 1897 and reported an eight-nucleate embryo sac. Dhalgren in 1928 worked out *Alisma plantago* and a few other genera



of the family and finds a six-nucleate embryo sac.

A considerable quantity of material of *Limnophyton obtusifolium* was collected from Bharatpur to obtain a close series of stages giving the development of the female gametophyte. The flowers are borne in 4-5 whorls on a long peduncle. They are of two kinds either purely male or hermaphrodite. Hermaphrodite flowers occur in larger numbers in the lower whorls and are fewer in the upper ones. There are six stamens and numerous free carpels.

**Female gametophyte:** There is a hypodermal archesporial cell (Fig. 1) which functions directly as the mother cell without cutting off a wall cell. After the first reduction division is completed; it divides into two cells of which the upper degenerates early (Fig. 2) and the lower divides twice and produces a four-nucleate embryo sac (Figs. 3 and 4). Two nuclei are at the chalazal end and two are at the micropylar end. The former do not divide further, and the micropylar nuclei divide but once producing four nuclei. The mature embryo sac is thus six-nucleate (Fig. 5). There is the usual egg-apparatus; one of the group of the four micropylar nuclei functions as the upper polar nucleus; and of the two lower, one is the lower polar nucleus and the other represents the single antipodal nucleus. This is the smallest nucleus of all the nuclei in the embryo sac and soon degenerates. The difference in the size of this nucleus as compared with the others can be seen even at the four-nucleate stage. The upper polar descends down to meet the lower polar in the middle of the embryo sac (Fig. 6).

**Male gametophyte:** A single row of hypodermal cells in each anther lobe, as is usually described for other plants, is not distinguishable. A group of sporogenous cells differentiates in each lobe and the outer cells differentiate into a tapetum, which gives rise to a true periplasmodium. The microspore mother cells undergo two successive divisions to form isobilaterally arranged tetrads. The microspore nucleus (Fig. 7) divides producing a large tube and a smaller generative nucleus (Fig. 8). The latter again divides (Fig. 9) producing two spherical male nuclei (Fig. 10), which later become spindle shaped (Fig. 11). The mature pollen grain is thus tri-nucleate.

**Embryo:** The development of the embryo follows the usual course laid down for the monocots. The basal cell is very large and conspicuous. The endosperm is of the Helobiales type.

I am indebted to Dr. P. Maheshwari who suggested the problem and under whose directions the work was carried out.

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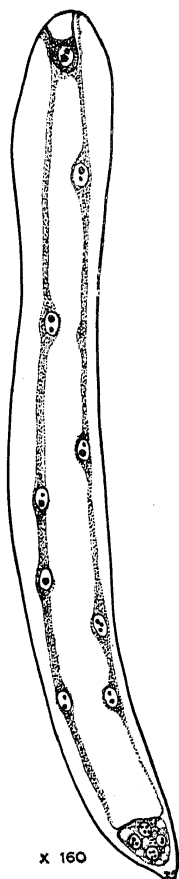
The Development of the Endosperm in  
*Asphodelus tenuifolius* Cav.

IN a recent paper written by me in collaboration with Singh<sup>1</sup> there appears a statement that "The endosperm nucleus divides first and a free nuclear endosperm is formed". Further study made by me shows that the latter part of the statement needs to be modified.

The primary endosperm nucleus lies at the base of the embryo sac just above the antipodal cells which begin to disappear very soon after fertilisation. When it divides a wall is formed separating a small

chalazal chamber from a large upper chamber. The nucleus in the chalazal chamber divides only once or twice, while the other nucleus in the upper chamber undergoes several free nuclear divisions. The figure shows an embryo sac in which the fertilised egg is still undivided though the endosperm is separated into two chambers of which the upper has several free nuclei and the lower has only four nuclei. This type of endosperm development is known as the Helobiales type and has already been reported in another sp. of *Asphodelus* by Stenar<sup>2</sup>, who writes:—

"Bei *Asphodelus fistulosus* ist die basale Zelle klein und kann leicht übersehen werden. In den wenigen Präparaten mit Endospermstadien, die mir zur Verfügung



x 160

<sup>1</sup> Maheshwari, P., and U. B. Singh. "Development of the Female Gametophyte of *Asphodelus tenuifolius*." *Jour. Ind. Bot. Soc.*, 9, 31, 1930.

<sup>2</sup> Stenar, Helge. "Zur Embryologi der Asphodeline-Gruppe." *Svensk. Bot. Tidskr.*, 22, 145, 1928.

stehen, enthält die untere Kammer vier Kerne. In dem ältesten beobachteten Stadium waren diese mehrfach grösser als die Kerne im zentralen Endosperm."

It is due to the small size of the chalazal chamber (as noted by Stenar also) and the lack of median sections that it was overlooked in my earlier preparations.

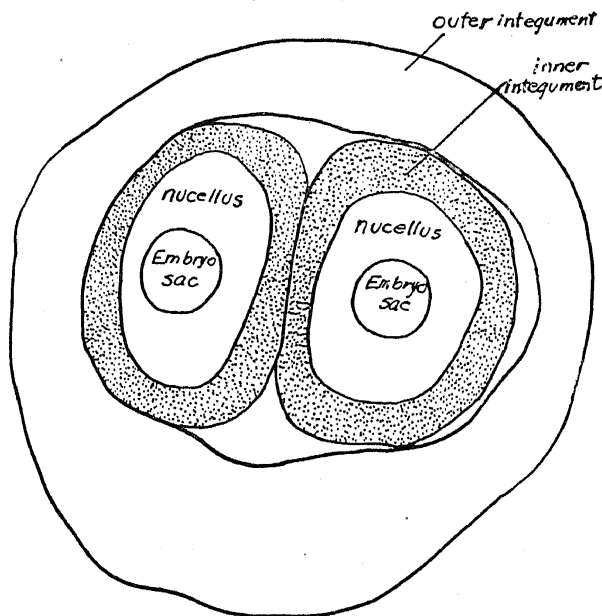
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A Note on the Life History of *Hydrilla verticillata* Presl.

THIS note presents briefly the results of a detailed study of the flower and seed development of this plant, with special reference to the deviations from the normal course of development found in angiosperms.

*Male flower*: During the development of the microspores the tapetum forms a periplasmodium. The tetrads are isobilateral. The pollen is tri-nucleate at the time of shedding, consisting of a vegetative nucleus and two lenticular male cells. There is no fibrous layer in the anther, which is



evidently in adaptation with the aquatic habitat of the plant.

*Female flower*: The ovules appear as protuberances from the inner surface of the ovarian cavity and the archesporial cells are usually distinguishable at a surprisingly early stage. There are 1-3 sporogenous cells in each nucellus, but only one goes through