EMBRYOLOGICAL AND CYTOLOGICAL STUDIES
IN THE FAMILY ASCLEPIADACEÆ

4. On the development of Embryo-sac and Endosperm
in Daemia extensa Br.

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INTRODUCTION

A search through the available literature on megasporogenesis and embryogeny
of Asclepiadaceæ has shown that Frye⁸ described in Asclepias, several-celled
archesporium, a compact antipodal tissue and finally 16 to 32 free endosperm
nuclei before the egg showed any sign of segmentation. Similarly Sabet⁶ by his study of Calotropis
procera observed several features of interest such as small antipodals, additional and abnormal embryo-sacs and the fertilised
egg resting until the endosperm had become cellular and had almost filled the
sac. The latest contribution on the embryology of Asclepiadaceæ is by
Pardi⁵ who investigated the development of megaspores and embryo-sac
in seven species of five genera and described linear, T-shaped and inverted
T-shaped tetrads, 8-nucleate normal embryo-sacs, small antipodals and distinctly pointed and beak-like synergids. For some time past, the writer also has been studying this part of the life-history in Daemia extensa and
has come across a number of features which deserve special mention.

MEGASPOROGENESIS AND ORGANISATION OF THE EMBRYO-SAC

Almost simultaneously with the formation of microspore tetrads, hemispherical protuberances begin to bulge out from the placentas and
in course of time each constitutes the nucellus of the nascent ovule. At
an angle of the naked nucellus, a hypodermal cell recognised by its increasing size and larger nucleus forms the archesporium which directly functions
as the megaspore mother-cell. Its nucleus after two successive divisions
gives rise to four megaspores which are generally arranged in the normal
linear fashion (Fig. 1 B) but occasionally inverted T-shaped tetrads are seen. An L-shaped tetrad which appeared to be somewhat intermediate between
the linear type and the inverted T-shaped one was also seen; this had another
peculiarity, viz., the absence of walls between the respective spores. Whether
the walls were not laid down at all or that they were formed and disappeared later could not be determined with respect to this case. It is, however, of interest to note in this connection that in Carex acuta, Juel has reported the absence of wall formation during the development of microspores from the microspore mother-cell. Similarly in Eichhornia crassipes investigated by Smith, the four megaspores of the linear tetrad are not separated by walls. In all cases of different types of tetrads, it is the outermost megaspore that functions while the other three begin to disintegrate (Figs. 1A and 1B). This is an interesting feature, for in the large majority of
Angiosperms, it is the innermost megaspore that grows further while the outer three degenerate. In Asclepiadaceae also, usually the lowest megaspore forms the embryo-sac as mentioned by Sabet\textsuperscript{6} and Pardi\textsuperscript{8} though Frye\textsuperscript{3} and Francini\textsuperscript{4.2} have reported the occasional functioning of other megaspores as well. It appears that about the time, the lower megaspores are undergoing degeneration, a single massive integument develops and surrounds the nucellus almost over-topping it so that the ovule apparently looks naked. The functional megaspore enlarges considerably and as in \textit{Damia tomentosa}\textsuperscript{4} elongates, becomes slightly curved and narrows down at one of its extremities. Ultimately it becomes deeply seated in the ovule by the activity of cells lying above.

The history of the gametophyte from the megaspore to the completion of the egg-apparatus is of the normal type. The antipodals are small, ephemeral and probably take no part in the activities of the embryo-sac. The polar nuclei fuse before the synergids are fully developed though sometimes their fusion is postponed to just before fertilisation. In conformity with the pointed micropylar extremity of the sac, the mature synergids develop beak-like extensions which, further, show delicate longitudinal striations (Fig. 2). At this stage a long and narrow micropyle can be seen on one side and the disintegrating antipodals on the other. With respect to the above characters of the embryo-sac, it may be mentioned that Pardi\textsuperscript{8} described in several species of Asclepiadaceae the pointed beak-like synergids and Sabet\textsuperscript{6} observed the short life of the antipodals in a few genera of the same family.

**Fertilisation and Development of the Endosperm**

The pollen tube and the discharge of its contents are observed in a number of preparations and it is noticed that in the fertilised ovules, there are generally no synergids. These evidently become disorganised during fertilisation though in one case their remains were seen as late as the production of proembryo.

The primary endosperm nucleus is always the first to divide and as the binucleate condition is reached, the ovule increases in its size until it acquires a tapering elongated form. In the earlier stages, endosperm develops by free nuclear division and it is at the 8-nucleate stage that walls first appear. Sabet\textsuperscript{6} who observed walls at the 16-nucleate stage, emphasised the fact that early cell-wall formation in endosperm is a common feature in Asclepiadaceae. The endosperm now begins to develop with a remarkable rapidity and for some time there is no sign of the division of the egg. A rudimentary proembryo was seen for the first time when the endosperm
had already formed an extensive tissue (Fig. 3). In this case, the endosperm had a large number of nuclei near the proembryo and was almost encircling it.

**PROEMBRYO**

The fertilised egg rests for some time and, as indicated above, does not start its development until a certain amount of endosperm has been formed. It is probably at the 32-nucleate stage that the first segmentation of the egg takes place. The first division could not be seen but Fig. 3 leaves no doubt that it is transverse and that the second one is parallel to it, so that a proembryo of three cells in a row is formed. The same figure
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indicates that the end cell divides by a longitudinal wall and that the upper two cells also divide longitudinally though in this particular case the dividing walls are not yet laid down.

An abnormal proembryo with four nuclei (Fig. 4) was observed in one case. It did not, as yet, show any wall formation but from the position of the nuclei, it is obvious that the early divisions were irregular.

REFERENCES

2. . . . Ibid., 1927b, 34, 403.