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MORPHOLOGICAL AND ANATOMICAL STUDIES IN HELOBIÆ

X. Trends of Specialization in Placentation in Helobiae*

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THE name Helobiæ was first used by Engler and Prantl[3] for a group of families including Potamogetonaceæ, Najadaceæ, Aponogetonaceæ, Scheuchzeriaceæ, Alismaceae, Butomaceæ and Hydrocharitaceæ. The seven families of the order are placed together chiefly on account of their aquatic habitat, presence of squamulæ intravaginales within the leaf bases, more or less complete absence of endosperm in seed, and enlarged embryo. However, the floral structures which are considered to be most conservative do not show any marked similarity. The vascular pattern of the flower and placentation also show a great variation.[7-14] The present study deals with some probable trends of specialization in placentation in the Helobiæ.

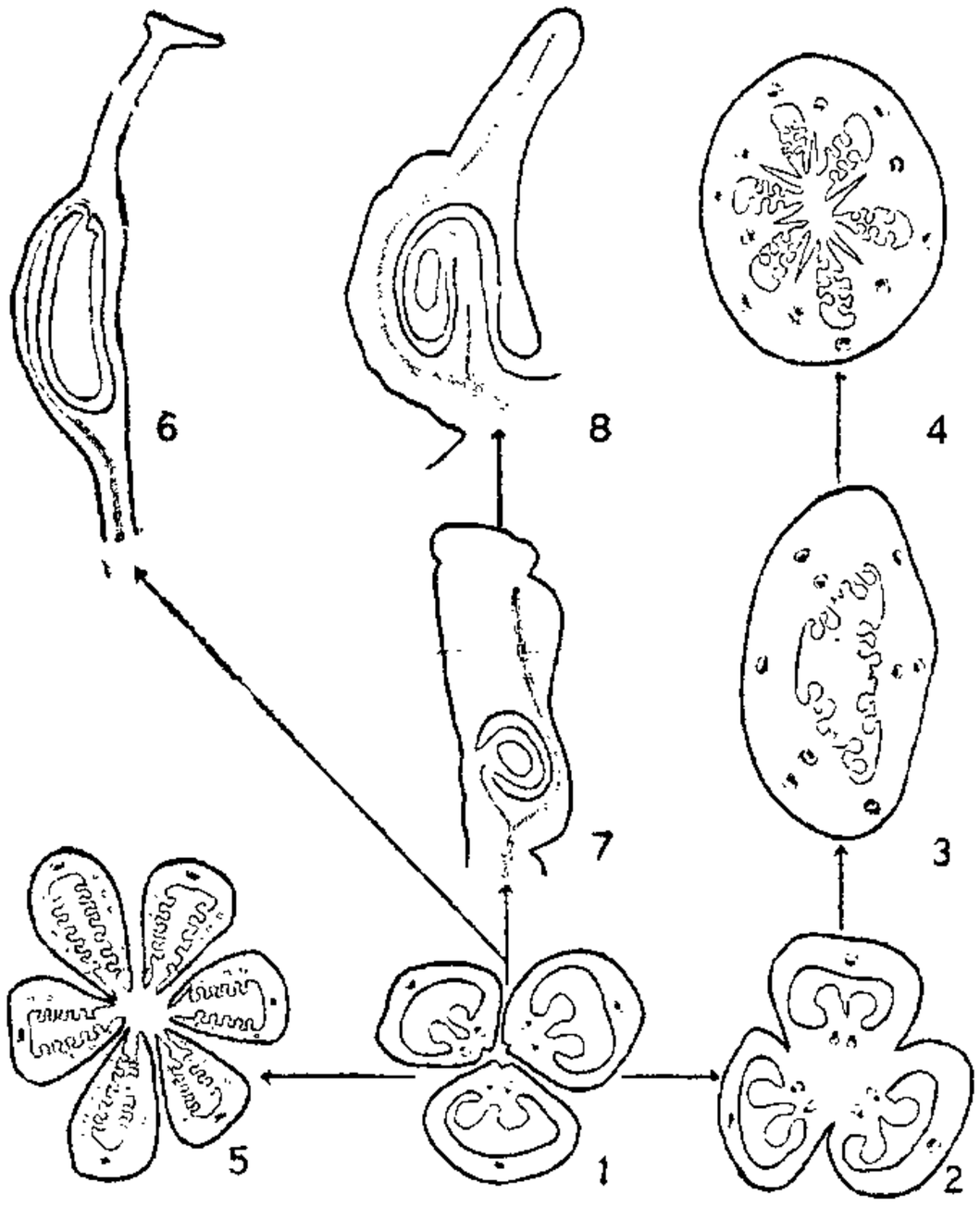
A wide range in placentation has been observed in different families of the order. They show median and apical (Potamogetonaceæ), basal (Najadaceæ, Scheuchzeriaceae, Alismaceæ); marginal and axile (Aponogetonaceæ); laminar or superficial (Butomaceæ); and parietal (Hydrocharitaceæ) placentation.

The marginal placentation is considered to be the simplest by the supporters of the classical concept (*see* Puri, 1952).[5] This is the condition in monomerous gynacea, which are generally believed to be most primitive and is shown by the primitive ranalian families where carpel is an involutely folded structure. Amongst Helobiæ this condition is met with in the Aponogetonaceæ where the carpels are free in the upper region and open in young condition like those of the primitive ranalian families. Each carpel bears two marginal rows of ovules and has a vascular supply of three bundles, one dorsal and two carpellary ventrals (Fig. 1). It has been visualized that the marginal placentation is the basic condition for the Helobiæ and the evolution seems to have progressed from this condition along three different lines leading to axile, superficial and basal placentation. Further specialisation in axile placentation has resulted in parietal placentation.

In one line of specialization the marginal placentation has given rise to axile placentation. This is seen in *Aponogeton* where the carpels though free are basally and adaxially connate. In the basal region the ovary is distinctly chambered, the two half placentæ are borne on the fused margins of the same carpel and derive their vascular supply from the ventrals of the same carpel (Fig. 2). Further the ventral bundles lie on the same radii as the carpellary dorsals and are inversely oriented. Thus the fusion of the carpels bearing ovules at their margins have resulted in axile placentation.

Further specialization towards parietal placentation which is prevalent in Hydrocharitaceæ has been brought about from axile placentation by more and more receding of placentæ towards the periphery so that the ventral bundles and their placentæ have occupied the peripheral position. The ventral bundles of the two adjacent carpels have also fused among themselves to form the vascular supply of parietal placentæ (Fig. 3). It may be pointed out here that in a number of families parietal

placentation is believed to be derived from axile placentation.[4,5]



FIGS. 1–8. Showing trends of specialization in placentation in Helobiæ. Figs. 1–2. Cross-sections of ovary of *Aponogeton natans* from upper and basal regions respectively. Figs. 3–5. Cross-section of ovaries of *Blyxa octandra*, *Ottelia alismoides* and *Butomus umbellatus* respectively. Figs. 6–8. Longitudinal sections of carpels of *Zannichellia palustris*, *Potamogeton indicus* and *Sagittaria guayanensis* respectively.

In certain members of the family Hydrocharitaceæ such as *Hydrocharis, Ottelia, Enhalus*, etc., the condition becomes rather interesting in that the ovary is incompletely divided into chambers and most of the inner surface of the ovary wall, except along the dorsal line, is covered with ovules (Fig. 4). This is sometimes described as laminar placentation.[1] However, Puri[5] explains similar condition in some members of Rafflesiaceæ and Papaveraceæ that in such cases the placenta enlarge considerably and project towards the centre, there are apparently no true septæ but merely placental lamellæ and thus he described the placentation as parietal. Such a condition occurring in certain members of Hydrocharitaceæ seems to have been derived from normal parietal placentation prevalent in majority of members of the family.

In the second line of specialization the marginal placentation has resulted in superficial placentation which is seen in Butomaceæ, where the ovules appear to arise from most of the ventral surface except the dorsal suture (Fig. 5). This condition might have resulted by the excessive enlargement of the fertile ventral surface of the carpellary margins which bears ovules.[6] The rest of the ventral surface become suppressed except in the neighbourhood of midrib. This view gets support from the condition seen in some species of *Gentiana* where the two halves of a parietal placenta separate apart from each other due to the extension of the intervening regions of the carpellary margins and thus bringing about the superficial placentation.[4]

Specialization along a third line has resulted in median, apical and basal placentation prevalent in Potamogetonaceæ, Najadaceæ, Scheuchzeriaceæ and Alismaceæ. In the course of evolution probably all the ovules present on margins of carpels got lost except for the one. This suppression may be in either direction—up or down. If the surviving ovule was a distal member then a condition similar to *Zannichellia* (apical placentation) has resulted (Fig. 6). If the lowest ovule survived, then a condition which is seen in some Potamogetonaceæ like *Potamogeton* and *Ruppia* (median placentation) has resulted (Fig. 7). Further shifting down of the ovule into the base of the ovary resulted in the basal placentation (Fig. 8). Eber[2] also considers that the basal condition of the ovule of *Najas* is derived from the condition in Potamogetonaceæ. The Alismaceæ also show in *Damasonium* a series of stages in reduction from marginal to basal placentation : *D. polyspermum* has several ovules ; *D. stellatum* two ovules ; and *D. californicum* a solitary ovule.[1] Thus in these cases the basal placentation has resulted from marginal placentation by reduction in vascular supply of the carpel and loss in member of ovules.

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