Embryological Evidence for the Relationships of the Lythraceæ and Related Families

HUTCHINSON (1926) in his recent classification of the Dicotyledons has made a great departure in the systematic position of the Lythraceæ and related families from that usually assigned to these in the older systems. Bentham and Hooker (1862–83), Engler and Gilg (1924), Bessey (1915) and Wettstein (1924) have all placed the families Lythraceæ, Sonneratiaceæ and Onagraceæ along with families like Myrtaceæ and Combretaceæ in the order Myrtales (or Myrtifloræ). Hutchinson completely disregards this generally accepted view, and places the former families quite apart from the latter in a separate order Lythrales. This order, including Lythraceæ, Crypteroniaceæ, Sonneratiaceæ, Punicaceæ, Oliniaceæ, Onagraceæ, Halorrhagaceæ and Callitrichaceæ, is derived by him from the Caryophyllales through the sub-family Sileneæ, while the Myrtales, including only the families Myrtaceæ, Lecythidaceæ, Melastomaceæ, Combretaceæ and Rhizophoraceæ, is supposed to represent the epigynous forms of the Theales and some Tiliales.

During the last five years the writer has been closely associated with several investigations on the embryology of both the Centrospermæ, which includes the order Caryophyllales of Hutchinson, and Lythraceæ and Sonneratiaceæ. The data obtained from these investigations appear to throw definite light on the supposed relation between the Caryophyllaceæ and the latter families.

The Caryophyllaceæ have certain characteristic embryological features. The mature pollen, as Schnarf (1931) says, is tri-nucleate. Its form, as known from *Arenaria, Silene* and *Dianthus,* is that of a pentagonal dodecahedron (Kerner and Oliver, 1895). There are as many germ pores as the faces of the grain. The ovule is always more or less campylotropous (Gibbs, 1907; Rocén, 1927; Woodcock, 1926 and 1928; Joshi, P. C., 1936). The micropyle is formed only by the inner integument. The nucellus is capped by several layers of cells

formed by periclinal divisions in the epidermis (Souèges, 1922).* The development of the embryo-sac corresponds to the *Normal*-type. The antipodals degenerate early (Schnarf, 1931), though in some other families of the Centrospermæ they persist up to the time of fertilisation or even afterwards (Joshi, 1936*b*), and may even multiply (Maheshwari, 1929; Bhargava, 1932; Kajale, 1937*b*). Diverticula commonly arise from the embryo-sac. After fertilisation the embryo-sac assumes an annular form. The embryo development corresponds to what has been designated as the *Caryophyllaceous*-type (Souèges, 1922). The embryo proper in this case develops from more than one cell of the filamentous proembryo and the basal cell formed by the first transverse division of the oospore never divides further. It becomes greatly enlarged and haustorial. The endosperm is present in the mature seed as a cap of cells over the radicle, and, as is well known, the mature embryo is annular and surrounds a central mealy perisperm (Rocén, 1927; Woodcock, 1926 and 1928).

The Lythraceæ (Joshi and Venkateswarlu, 1935*a*, 1935*b* and 1936) agrees with the Caryophyllaceæ in the development of the embryo-sac and in the early degeneration of the antipodals. In all other characters it is markedly different. The ellipsoidal-spherical pollen grains possess only three germ pores arranged in an equitorial manner. They are two-nucleate at the time of shedding. The generative nucleus divides into two male nuclei in the pollen-tube only just before fertilisation. The ovule shows absolutely no signs of campylotropy. It is generally anatropous. The micropyle is formed by both the integuments. The nucellus is not covered at its apex by any epidermal cap, but generally shows a hypostase below the chalazal end of the embryo-sac. There is no formation of any diverticula from the embryo-sac. The embryo development corresponds to the *Capsella*-type. The structure of the mature seed is also quite different. There is neither any perisperm nor endosperm. The embryo is quite straight.

The family Sonneratiaceæ agrees in most of its embryological characters with the Lythraceæ (Venkateswarlu, 1937), and the Onagraceæ, although it differs in the development of the embryo-sac, agrees in other respects with the Lythraceæ. It has certainly no characters common with any of the Caryophyllales. On the other hand, as Tischler (1917), Mauritzon (1934) and Joshi and Venkateswarlu (1936) have indicated, the *Oenothera*-type of embryo-sac can be derived from that of the Lythraceæ.

The above embryological studies thus indicate quite clearly that Lythraceæ and allied families are not closely related to the Caryophyllaceæ as suggested by Hutchinson (1926). For the present it would be better to keep them along with the other families of the Myrtales.

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* Rocén disagrees with Souèges in this respect, but from what is known of other Centrospermæ (Joshi, 1936*a*; Joshi and Rao, 1936; Kajale, 1937*a* and 1938; and the literature cited in these papers) the writer thinks Souèges' observations to be quite correct.

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