

A Free Larval Stage in the Life-history of a Fluvial Gasteropod

ANIMALS living in inland waters, it is well known, are generally characterised by direct development, free larval stages being exceptional and confined only to a few groups. Among the Molluscs, the bivalve *Dreissensia*¹ is the only freshwater form which is known so far to have a free larval stage in its development. *Dreissensia*, however, is a recent immigrant into inland waters,¹ the immigration having taken place in the eighteenth century, when it appeared in the rivers Volga and the Danube.²

Recently, in the course of my studies on the Melaniidæ, a purely freshwater family of Gasteropods, I found that there is a free-swimming veliger phase in the life-history of *Melania* (*Radina*) *crenulata* (Desh.). One variety of this species, var. *tirouri*, inhabits the Coleroon River (Madras Pcy.), about eight miles from its mouth. Preston³ records the occurrence of this variety in the South Pennar (near Cuddalore), Vizagapatam, Andamans, Celebes, and Philippines.

The majority of Melaniidæ are viviparous, and the young are retained in the brood pouch. Moore⁴ recorded the occurrence of a brood pouch in the Tanganyika Melaniidæ, *Tiphobia*, *Tanganyicia*, *Nassopsis*, etc. Among the Indian Melaniidæ, I have observed a brood pouch in the different species of *Melania*, *Melanoides* and *Acrostoma*.⁵ Speaking generally, and with special reference to the Indian species, the ova are fertilised in the receptaculum seminis, whence they pass into the brood pouch wherein they undergo their complete development. The young are retained in the brood pouch for a considerable time, and at the time of liberation are found to possess well-formed shells, and resemble the adults in all respects excepting size.

During the breeding season the brood pouch is usually found to be fully packed with developing eggs, and young ones with sculptured shells, the latter being more conspicuous. In the case of *Melania crenulata* the breeding

season commences about the month of November and extends till the following April. During this period the brood pouch contains thousands of developing eggs, and a few veligers just escaped from the vitelline membrane but no juvenile forms. The enormous number of eggs is a remarkable feature, for, in other species like *Melanoides tuberculatus* or *Melanoides scabra*, only a few embryos and young ones, about two hundred at the most, are found in the brood pouch. Further, the histological structure of the brood pouch of *Melania crenulata* is different from that in the other species, for in the latter the epithelium is modified in relation to the nutritional needs of the post-embryonic and juvenile stages. These features, the enormous number of eggs, the absence of juvenile stages in the brood pouch and modification of the brood pouch epithelium, led me to suspect the presence of a free-swimming larval stage in the life-history of *Melania crenulata*.

Accordingly, intensive observations were made in the laboratory and in the field, and I was able to discover a veliger phase of about two weeks' duration, which is spent in active swimming in the river water. In the first instance, about half-a-dozen veligers were found swimming in the water in the aquarium. Subsequently, examination of water from the river revealed the occurrence of a few free-swimming veligers. For observing the complete development, an attempt was made to rear in the laboratory the larvæ that were obtained by cutting open the brood pouch, and liberating those that had escaped out of the egg membrane, but this was only partly successful. I have been quite successful, however, in rearing in the laboratory veligers collected from the river, by using a mixture of sea water and water from the river.

The full grown veliger of *Melania* has the typical form met with in the life-history of marine Gasteropods, and has two velar lobes provided with long cilia by means of which it swims about rapidly. As stated already, the veliger phase lasts for about two weeks, About

the sixth day of free life the rotatory action of the crystalline style begins, and is very clearly discernible.

Yet another interesting feature was observed. My collections of the veligers were made during March-April, and I noticed during this period a remarkable abundance of the larvæ in the river at high tide (the influence of the tides is felt to a little extent in the river at the place where this *Melania* occurs) on the day previous to the full moon as well as on the full moon day and on the following day. Similarly about the time of the new moon the larvæ were abundant, though not to the same degree. As the breeding season was over by the middle of April, I have to wait till the next season for making further observations on this aspect.

The Melaniidæ are considered to have been probably derived from the Cerithiidæ,⁶ and are not known until the Cretaceous period. I do not know of any evidence to show that *Melania crenulata* is so recent an immigrant into fresh waters like *Dreissensia*. In its anatomy *Melania crenulata* resembles very closely other Melaniids such as *Melania tuberculatus*, *Melanoides scabra*, etc. Yonge,⁷ speaking with reference to the Tanganyika Melaniidæ suggested that viviparity and brood pouch might be adaptations for penetration into deep water by freshwater Prosobranchs. I do not consider this view to be tenable, for, as Yonge himself noted, a brood pouch is not confined to the forms living in deep waters, and many of the Melaniids in which I studied the brood pouch are inhabitants of very shallow water. In my view the brood pouch seems to be associated with the migration into inland waters. It may be considered as reminiscent of the saline medium of the ancestors of the Melaniidæ (even as the amniotic cavity is associated with the acclimatization of the aquatic vertebrates to land, and is reminiscent of the ancestral aquatic medium). Immigration inland is generally attended with the suppression of the free larval stages. In most of the freshwater Gasteropods the eggs are provided with albumin and usually

with a protective jelly also, and the larval stages are passed through in the egg. In the case of most of the Melaniidæ, the brood pouch affords a suitable environment for the later stages of development as the albumin in the eggs of other genera, and as sea water does for the larvae of the marine species. *Melania crenulata* and a few closely related species, as I will show in a later account, probably never ventured far inland, but have remained near the mouths of rivers, and being subject to a certain extent to the influence of tides and a low degree of salinity still liberate veligers into the partly saline medium. But in most other Melaniids, associated with a greater degree of penetration into inland waters and acclimatization to freshwater, we notice a complete retention of the veligers in the brood pouch, wherein they swim freely, and are nourished by the secretion of the brood pouch epithelium. In *Paludomus*⁸ we have an instance of a Melaniid in which acclimatization to freshwater may be considered to be perfect, and which has no brood pouch, the eggs being laid in water.⁹

Further investigations are in progress, and I hope to discuss at length, in due course, this and other interesting features of the family Melaniidæ.

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¹ Carpenter, *Life in Inland Waters*, 1928, pp. 11 and 78.

² Pelseneer, *Mollusca in Treatise on Zoology* (edited by Lankester), 1906, p. 264.

³ Preston, *Fauna of British India, Mollusca, Gasteropoda and Pelecypoda*, 1915.

⁴ Moore, *Quart. Micro. Sci. Jour.* (n. s.), 1898, **41**, 159.

⁵ Seshaiya, *Journ. of the Annamalai University*, 1936, **5**, 177.

⁶ Cooke, *Cambridge Natural History, Mollusca*, 1913, pp. 17 and 417.

⁷ Yonge, *Nature*, 1938, **142**, 464.

⁸ Seshaiya, *Rec. Indian Museum*, 1934, **36**, 209.

⁹ Ramanan, *Non-marine Mollusca of Madras*, 1900.