

5. Some Disputed Points in the Anatomy of the Limpets.

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The three points to which reference is made in this paper are the right, or large, nephridium, the coelom and the subradular organ. The species upon which I have worked is *Acmaea testudinalis* Müller; of this animal I have had abundant material both living and preserved in various ways. With these advantages it has been possible to settle some points hitherto in dispute.

Nephridium. In a previous paper I have described the nephridium in another species of *Acmaea* as having much the same form and extent as in *Patella*, being a large sac beset, especially in the anterior part, with numerous out-pocketings, enwrapping the viscera on the right side and behind and sending forward on the left side a dorsal branch which extends to the pericardium (Cf. Willcox, *Jena. Zeitschr.* Bd. 32. p. 439—441). These conclusions having been challenged by Haller (*Zool. Anz.* Bd. 33. p. 62), I have recently undertaken a study of the fresh organ, with especial reference to the character of its epithelium. This is undoubtedly of a secretory nature. The cells vary in shape from cubical to columnar, are beset with long and very delicate cilia and are laden with dark green granules which render the entire organ very conspicuous and prevent the possibility of a mistake as to its extent. Such cells have already been described by R. Perrier (*Ann. d. Sciences nat.* (7.), T. 8. p. 143) as the primitive nephridial cells of the Gasteropoda. The right nephridium in the two species of *Acmaea* which I have studied is similar to that of *Patella* and presents no extraordinarily primitive features. If we may draw an inference from these forms regarding *Lottia (Acmaea) viridula*, the form studied and figured by Haller, we must conclude that he is in error in describing the right nephridium as a small sac occupying the right anterior part of the body and opening posteriorly into the large coelom. The greater part of what he considers coelom is indubitably nephridium.

Coelom. Between the ventral face of the viscera on the left side and the underlying muscle is a space whose interpretation has given rise to much dispute. Haller believes it a part of his coelom, separated from the right half (which is in reality a part of the nephridium) by an imperfect septum. Pelseener in a paper quoted by Haller but which I have not yet been able to see states that he considers it a true

coelom; in my own work on *A. fragilis* I believed that I traced it into connection with blood sinuses and therefore interpreted it as a part of the primary body cavity or haemocoel. While I am not now prepared to say with certainty whether it is a haemocoel or a coelom, I am convinced that Haller's observations are incorrect. What he considers the right half of the coelom is an undoubted part of the nephridium as shown by the epithelium. The space now in question shows no trace of an epithelium of this sort. Furthermore in *A. testudinialis* the space is not restricted to the left side of the body but extends for a considerable distance to the right, lying between the nephridium and the viscera.

Subradular organ. Finally Haller has affirmed the existence of a subradular organ in various *Docoglossa*, while the statement has been categorically denied by Thiele, whose observations have received general credence. For a summary of the existing state of opinion see Simroth's edition of Bronn's Mollusca, Abth. Gasteropoda, p. 321. It is therefore with pleasure that I have discovered what I believe to be Haller's subradular organ, though the pleasure is tempered with regret since I must add that in my own earlier work on *A. fragilis* I entirely failed to appreciate the nature of the structure and did not even describe it.

The subradular organ is a somewhat cushionlike projection from the under side of the odontophore just behind the tip of the radula. It is divided by a V-shaped groove into an anterior and a posterior part both of which are clothed with long columnar epithelial cells. In the posterior part only have I been able to make out any differentiation of cells; here, intermixed with the common epithelium which appears to be ciliated, though I can not be quite sure of this, are fusiform cells which have much the appearance of sense cells. I have not as yet made out the innervation of this organ; I may however say with assurance that no compact ganglion lies within it. The subepidermal mass consists of connective tissue traversed by irregularly arranged muscle fibres.

Until a complete study has been made of both epithelium and innervation, it is impossible to say whether this is to be interpreted as a vestigial organ or as one which is still functionally active.

Since reading the paper of which the above is an abstract I have found two preserved specimens in which the odontophore was protruded from the mouth and the radula so retracted that the subradular organ formed the tip of the odontophore. Whether this was an artefact remains to be determined.

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