THE LATERAL LINE SYSTEM OF CYCLOSTOMES

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Introduction

In 1907, Ayers and Worthington reported that they found "fully formed and functional" lateral line grooves in Eptatretus stouti (Bdellostoma dombeyi). Earlier scientists had not been able to find lateral line grooves in hagfish and the report of Ayers and Worthington has not been generally accepted in the textbooks (Hardisty, 1979, p. 10; Starck, 1982, p. 518).

There has been a tendency for European authors not to accept Ayers and Worthington's observation. The reason for this, it will be shown, is the generic difference between the hagfish species on the European Atlantic coast and in the Pacific.

On the other hand, the lamprey lateral line system was described by Maurer in 1895. It is aberrant (Holmgren, 1942), but clearly recognizable, although with some primitive characteristics (Yamada, 1973).

Materials and methods

Specimens of Myxine glutinosa, Paramyxine atami, Eptatretus stouti, E. deani, E. burgeri and E. cirrhatus were studied, by use of the dissecting microscope, for the presence of lateral lines on the head skin.

Only specimens of E. stouti and E. burgeri, with a total length of 205-510 mm, were studied by light and electron (SEM and TEM) microscopy.

For light microscopy, head skin samples were fixed in Bouin's fluid, embedded in paraffin, sectioned, and stained with iron haematoxylin/eosin.

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Head skin biopsies were taken after anaesthesia in MS 222, fixed for SEM in 2% glutaraldehyde in diluted seawater (Holland and Jespersen, 1973), dehydrated in ethanol, dried by use of the Freon critical point method and mounted on specimen stubs covered with Scotch double-stick tape. The specimens were rotary coated with gold and viewed in Stereoscan S4 or Hitachi HHS-2R scanning electron microscopes.

For TEM, head skin biopsies were fixed in 3% glutaraldehyde in 0.2 M phosphate buffer, pH 7.1, in 0.45 M sucrose. Postfixation was in 1% OsO₄ in the same buffer and, after dehydration in ethanol, specimens were embedded in Epon. Specimens of *Petromyzon fluviatilis* were studied macroscopically and under the dissecting microscope.

Results

The pit lines of lampreys are well known and were not studied in any detail. For comparison they are figured together with the lateral line system of *E. stouti* (Fig. 1). It is obvious from the first glance that the system is more elaborate in the lamprey and that the only similarity to be found at this level of observation is the localization on the head rostral and caudal to the eye.

It was not possible to find the lateral line system in *Myxine glutinosa*. In all species of *Eptatretus* and *Paramyxine*, however, it could be observed.

Macroscopically, the lines found on the head of *E. burgeri* or *E. stouti* could easily be distinguished on live or clean-fixed specimens. In fixed specimens there is frequently a layer of slime covering the whole animal, giving it a greyish appearance. If the slime is scraped off, the line can be found in the darker underlying skin. Species differences were not studied, but it appears that the main pattern is similar for all *Eptatretus* studied. Considerable individual variation was noted in *E. burgeri* and *E. stouti* in the number of grooves in the different locations. In the rostral line group the variation was from 2 to 5 parallel lines. In the caudal line group a similar variation could be noted in both the horizontal and vertical lines. In *Paramyxine* and *E. cirrhatus* the grooves in front of the eyes seemed to be missing.

In the light microscope (Fig. 2), cross-sectioned grooves appear as epithelial invaginations covered with cells having the same staining reaction as the rest of the epithelium surface cells. These cells are the small mucous cells (Blackstad 1963) with a characteristic dark staining (Fig. 2). Except for these cells the epidermis is composed of large mucous cells, thread cells and undifferentiated cells. The epidermis is about 200 μm (10 cell layers) thick. In the dermis beneath the groove, a concavity can be observed indicating the presence in the dermis of another groove corresponding to the epidermal one. In no case could any trace of a covered epidermal canal be found.

The scanning electron microscope clearly demonstrates the presence of an open, 10–30 μm wide groove (Fig. 3) and also reveals a certain surface specialization of the epidermal cells in the groove. The microvilli generally found on the epidermal