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Histological Observations on the Cutaneous Processes on the Head of *Azuma emmnion* and *Hemitripterus villosus*

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Abstract Histological structures of cutaneous processes on the head of the fringed blenny and *Hemitripterus villosus* were compared with that of the barbels of fish. The cutaneous processes are very similar to the barbel in microscopic constituents but with the following difference that the former lacks both a supporting axial rod and a network of blood vessels in core of the dermis. Accordingly, this process seems to be useful as a feeler in recognition of food. In *H. villosus*, a covering layer, presumably a cuticle, overlies the outer surface of the epidermis of the cutaneous process which may be called multifid cutaneous flap. The nature and source of the covering layer material require further researches. That most of the terminal buds found in the epidermis of the multifid flap are remarkably taller than those buried in the ordinary head skin except the multifid flaps and that their summit attains nearly to the superficial boundary of the covering layer may probably be correlated with the presence of this layer.

Azuma emmnion Jordan et Snyder and *Hemitripterus villosus* (Pallas) commonly occur in waters of Aomori and Hokkaido. It is well-known that the head of these two kinds of fishes is provided with numerous cutaneous processes which are called tentacle, cutaneous fringe or flap according to their aspects. The histological structure of the cutaneous process, however, has not yet been investigated, as far as the author knows. The present paper deals with this problem in comparison with the structure of barbels of fishes.

Materials and methods

The materials used in this investigation were obtained from Mutsu Bay near the Marine Biological Station of Asamushi. For examination by light microscopy, segments of the cutaneous process were fixed in Bouin's and Zenker's fluid, and then were embedded in paraffin. The sections were cut at 8μm, and were stained with Delafield's haematoxylin and eosin, and with Heidenhain's Azan stain.

Results

A fringed blenny, *Azuma emmnion*

In the head, cutaneous or dermal processes are found on the snout, top of the head, ventral margin of the cheek and the preoperculum, and also on the chin. The processes on the first two parts of the head may be called tentacle, and those on the remaining three parts of the head may be named cutaneous fringe, according to their appearance, respectively. The tentacle consists of one cylindrical main body and a few side branches. The tip of the main body, occasionally that of the side branch, is divided into finger-like projections which end with knobs (Fig. 1, A).

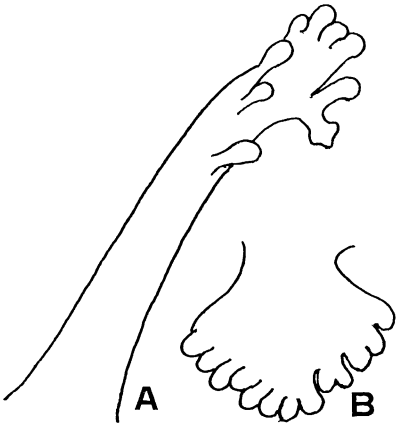

Fig. 1. Diagram showing two forms of the cutaneous processes on the head of the fringed blenny. A, tentacle. B, cutaneous fringe.

The cutaneous fringe is fan-shaped, and its distal margin also divides into finger-like projections (Fig. 1, B). The longest tentacles are one pair located on antero-dorsal side of the orbit, and their length measures about 7 mm in a fish of head length of 30 mm. Most of the fringes are about 3 mm long in the specimen mentioned just above.

The tentacle and fringe have identical microscopic constituents, formed of epidermis and dermis (Fig. 2, B). The epidermis is a stratified epithelium consisting of about ten layers of cells. Most of them are cuboid, while two or three layers above the basement membrane consist chiefly of columnar cells. Among the epithelial cells, a considerable number of terminal buds are found, but mucous cells are visible very rarely. The terminal buds are more closer in the distal part than in the proximal of the tentacle and

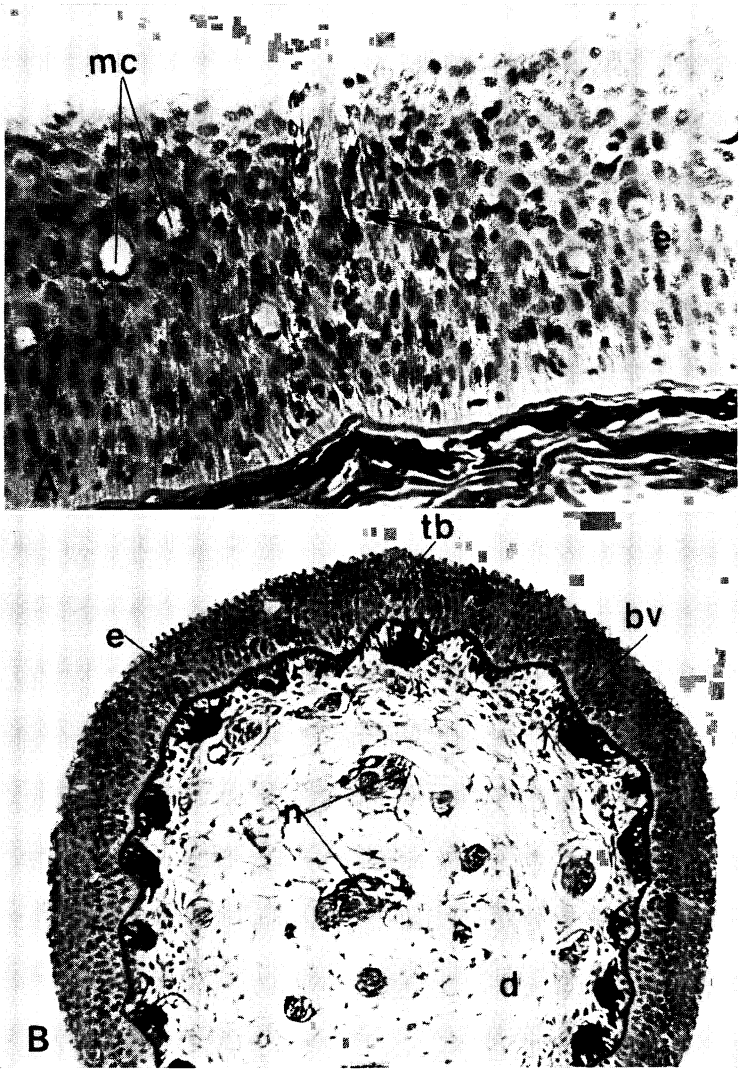

Fig. 2. Photomicrographs of the tentacle and ordinary head skin of the fringed blenny. A, A part of transection of the cheek skin. ×ca. 840. B, Cross section of the tentacle on the antero-dorsal side of the orbit. ×ca. 450. bv, blood vessel; d, dermis; e, epidermis; mc, mucous cell; n, nerve fibers; tb, terminal bud. Arrow indicates the structure suggesting an undeveloped terminal bud.

fringe. In the epidermis of ordinary head skin other than the tentacle and fringe, the terminal buds are scanty, whereas mucous cells are relatively numerous (Fig. 2, A). In the epidermis mentioned just above, structures suggesting an undeveloped or incomplete terminal bud were frequently observed (Fig. 2, A).

The dermis consists of loose connective tissue which encloses a few number of bundles of nerve fibers and blood vessels (Fig. 2, B). Unlike the barbel, the core of the dermis of the tentacle and fringe lacks both an axial rod and a network of blood vessels. The dermal melanophores are scattered in the connective tissue just below the basement membrane.

Hemitripterus villosus

Most of cutaneous processes are located on the snout, the upper jaw and the lower jaw. They are flattened algae-shaped as a whole, and may be called literally multifid cutaneous flap. The longest flap found on the lower jaw measures about 19 mm in a fish of head length of 80 mm. Most of the remaining flaps are about 10 mm or less in length in the above-mentioned specimen. All flaps have alike histological structures, and consist of the epidermis and dermis, as in the fringed blenny. Different from the fringed blenny, it is noteworthy that a covering layer regularly surrounds the outside of the epidermis of the flap of *H. villosus* (Fig. 3, A and B). This covering layer has almost the same thickness as that of the epidermis, and contains no evidences of cellular structure. When the epidermis rises, the covering layer also protrudes to outer side, looking just like a small mountain (Fig. 3, B). Vertical striations usually extend throughout the total length of this layer. The distance between each striation is almost equal to the width of an individual epidermal cell forming the external boundary of the epidermis. The covering layer is jelly-like in appearance, but was not intensely stained with the PAS technique, and was stained light yellow overlapped with light blue by Azan stain. The nature and source of the material of the covering layer could not be ascertained in the present investigation. It was frequently observed that such marine planktons as diatomes attached to the external surface of this layer. The covering layer is sometimes found on the epidermis of the ordinary head skin other than the cutaneous flap, but it is generally thinner than that of the flap. Whether or not the covering layer is always found on the ordinary head skin is uncertain, though it seems probable that this layer is frequently missing during histological preparation.

The epidermis has unequal thickness and is made of several layers of epithelial cells which are mostly polygonal or cuboidal, while they are columnar above the basement membrane. The external boundary of the epidermis consists of pear-shaped epithelial cells with broad apex which divides into a number of villus-like projections. The phase-contrast microscopical observation reveals that the villus-like projections extend into the covering layer, and that granules are visible in the cytoplasm above the nucleus which is situated at proximal part of the pear-shaped epithelial cell. Whether these granules have an intimate relation to the source of the covering layer material is unknown. The villus-like projections mentioned above seem to correspond to microvillar ridges observed by Whitear (1970) electron-microscopically in surface epidermal cells of several fishes. A considerable number of terminal buds and granular cells are buried among the epithelial cells, but mucous cells are absent (Fig. 3, A). Most of the terminal buds project over the external boundary of the epidermis and occasionally their summit attains nearly to the superficies of the covering layer (Fig. 3, A and C). Accordingly, such a terminal bud is almost twice as high as that of the ordinary terminal bud existing in the epidermis of the head skin other than the cutaneous flaps. This phenomenon seems to be correlated with the presence of the covering layer. The cutaneous flap is more richly furnished with the terminal buds than the ordinary head skin. The structure and stainability to histological dyes of the granular cells of this fish are reported already in the previous paper (Satō, 1967), so the author may dispense with the description of it.

Below the basement membrane is the dermis

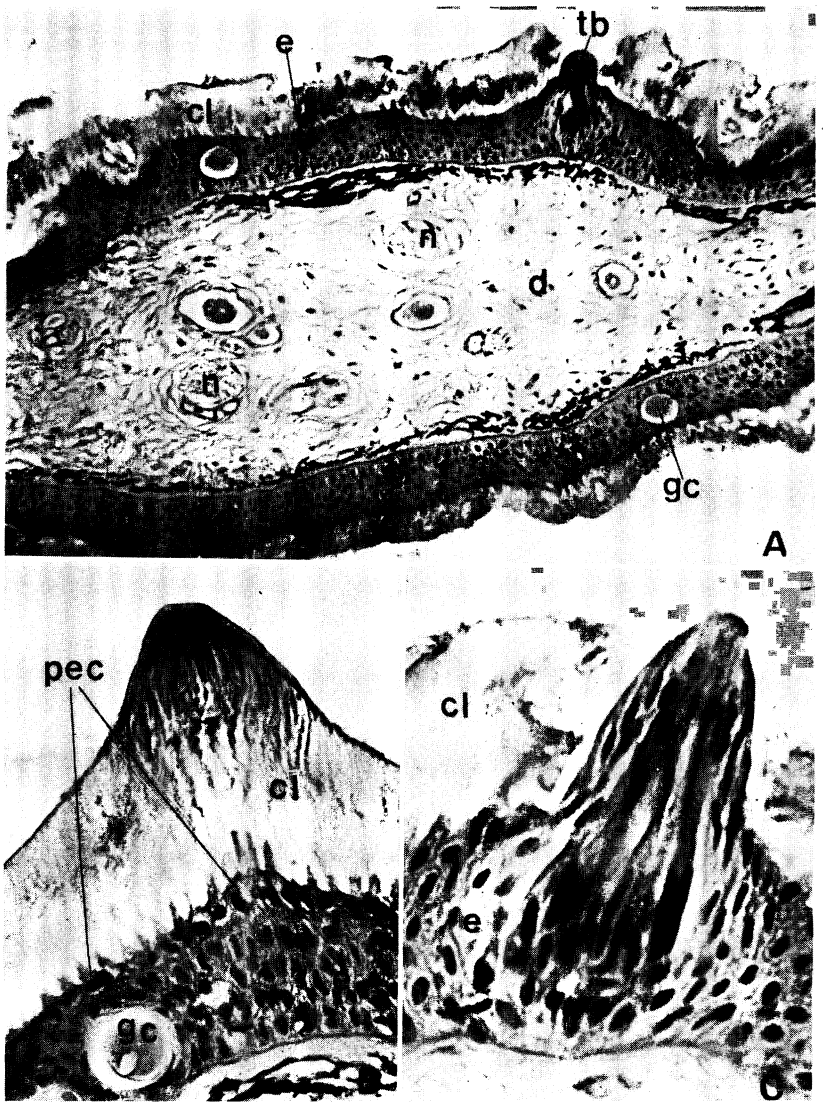

Fig. 3. Photomicrographs of the multifid flap of *Hemitripterus villosus*. A, Cross section of the flap on the lower jaw. ×ca. 370. B, A part of transection of the flap on the upper jaw, showing the covering layer and pear-shaped epithelial cells. ×ca. 930. C, A part of transection of the flap on the lower jaw, showing tall terminal bud. ×ca. 1500. cl, covering layer; gc, granular cell; pec, pear-shaped epithelial cell. Other letters, vide Fig. 2.

which consists of loose connective tissue enclosing a few number of nerve fibers and blood vessels. The core of the dermis has neither an axial rod nor a network of blood vessels, as in the fringed blenny (Fig. 3, A). The dermal melanophores are abundantly lying along the basement membrane.

Discussion

The most remarkable difference between the cutaneous processes and the barbels of fish is that the former lacks both a supporting axial rod and a network of blood vessels in the core of the dermis (for the barbels, see

Baecker, 1926). In other histological structures except that mentioned just above, these two show similarity: both consist of epidermis and dermis, and possess a considerable number of terminal buds buried among the epidermal cells, though the cutaneous process is not so richly supplied with the terminal buds as the barbel. Accordingly, it is conjectured that the cutaneous process is useful as a feeler in recognition of food. In the efficiency as the feeler, however, the cutaneous process seems to be inferior to the barbel, because the former is, in addition to being generally short, supplied with less terminal buds and never moves voluntarily.

One characteristic of the cutaneous flap of *H. villosus* is the presence of the covering layer which overlies the external surface of the epidermis of the flap. Whitear (1970) studied the skin surface of several kinds of fish by electron-microscopy and concluded that the cuticle consists of an external coating layer, probably of mucopolysaccharide, which is secreted from the surface epidermal cells, not from the goblet mucous cells. Since the goblet mucous cells have not been seen in the flap of *H. villosus* and each vertical striation found in the covering layer corresponds to each of the surface epidermal cells of the flap, it is reasonable to suppose that the covering layer is not secreted from the mucous cells, but from the surface epidermal cells. However, it is questionable whether the surface epidermal cells are the single source of the covering layer, because the granular cells are also buried in the epidermis of the flap, though the coloration of the covering layer stained by the Azan is different from that of the contents of the granular cell which are coloured reddish orange. The covering layer may probably be identical with the cuticle described by Whitear (1970), but the author will hesitate to regard this layer as the cuticle until the source of this layer has been ascertained.

The pear-shaped epithelial cells forming external border of the epidermis of the flap of *H. villosus* are somewhat similar to elongated cylindrical cells scattered in the superficial layer of the epidermis of the skin of *Blepsias cirrhosus draciscus* (Satō, 1977). Judging from the structure and occurrence of the pear-shaped epithelial cells, they do not seem to be a receptor cell, but presumably a secretory cell contributive to formation of the covering layer. This problem, however, remains to be solved, the present investigation leading to no definite conclusion.

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フサギンポ およびケムシカジカの頭部皮質突起の組織学的観察

佐藤　光雄

上記2種の硬骨魚の頭部にみられる皮質突起の組織学的構造を，魚類のひげのそれと比較してみた．両者間の著しく異なる点は，皮質突起の真皮部中心に支持軸および血管叢が欠けていることである．その他の構造は大体類似している．従って上記の皮質突起は，ひげとほぼ同じような機能をもつものと推測される．なおケムシカジカの皮質突起の表面にはかなり厚い被覆層があり，このために皮質突起の表皮に存在する終末球の丈が高くなり，その頂が被覆層の遊離面とほぼ同じ高さに達していることが注目される．この被覆層はWhitear (1970) の報告にある cuticle と同じものと考えられるが，今後なお検討を要する．

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