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On the Gill-structure of a Cobitid Fish— *Lepidocephalichthys guntea* (HAM.)

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The general morphology and structure of the gills of fishes have been described by many prominent workers in this field. Mention can be made of DUVERNOY (1839), RIESS (1881), BIETRIX (1895), PLEHN (1901), FAUSSEK (1902), RAUTHER (1925), SCHOTTLE (1932), GOODRICH (1930), BEVELANDER (1935), ACRIVO (1938), BIJTEL (1949) and others. DATTA MUNSHI (1960) worked on the gill-structure of some Indian fresh water teleosts and classified them into four categories, taking into consideration the extent of the interbranchial septum and the relative disposition and modification, if any, of the primary gill-lamellae.

The fish under this study is a small fresh water cobitid and reveals certain structure in the gills which have not been reported by earlier workers on any of the teleostean fishes.

Material and Methods

In order to study the gross anatomy of the gills, small pieces of gill were fixed in Zenker's, Helly's and Bouin's fluid. The fixed materials were declacified in 3% nitric acid in 70% alcohol. Sections were cut at 6-8μ, stained with haematoxylin and eosin. In Zenker's solution, acetic acid replaced by equal volume of formic acid gave the best histological preparations. It also avoided decalcification of the tissue since the formic acid present in the solution declacified the tissues while it was in process of fixation.

Parts of the gill-epithelium were also dissociated in normal saline and stained with methylene blue to study the dissociated cell components.

Results and Discussion

Four pairs of gills are present in this fish, of which the fourth gill is slightly reduced in size than the others. The epi-, cerato- and hypobranchial elements bear the gill-lamellae. The largest gill-lamellae are borne by ceratobranchial elements. The size of the gill-lamellae go on decreasing on the epi and hypobranchial elements.

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In a transverse section of gill, two regions are distinguishable—the inner gill-head and the outer interbranchial septum which joins the two hemibranchs (fig. 1). The head of the gill is covered by a thick epithelium which is highly secretory in function due to the presence of mucous gland cells and eosinophilic glandular cells. Large numbr of taste-buds occur on the margin of the gill head. Each taste bud is a pear shaped multicellular structure embedded in the epitheloid layer. The efferent branchial vessel and the pre- and post-trematic nerve lie in a groove of the bony arch. The abductor muscle is situated on the outer side of the gill arch (fig. 1). The abductor muscle peesent on the oral side of the gill arch is to be looked upon as the pars branchials of deep constrictor branchialis of LIGHTOLLER (1939). The abductor muscles perhaps are exclusively concerned for coughing movements in a forward direction (BIJTEL, 1949).

The gill rakers are in two rows on each gill arch. Each gill raker is a short stumpy structure, supported by a bony element. The epithelial coverage contains large number of mucous glands and taste-buds.

The interbranchial septum is a triangular area containing the heads of the gill rays, afferent branchial vessel and the adductor muscle. The adductor muscles arise from the basal extremities of the two successive gill-rays of a hemibranch and inserted on the gill-ray of the opposite hemibranch. Regarding the arrangement, origin and insertion of the adductor muscles, the fish under investigation falls into type 1 of BIJTEL (1949). BIJTEL (1949) is of the opinion that since the adductor muscles lack rhythmical movements, they do not take part either in the circulation of the blood or for the renewal of the respiratory water but rather they are concerned only in cleaning of the gills during the coughing movements. The primary gill-lamellae are situated alternately on both sides of the interbranchial septum.

The primary gill-lamellae are long blade-like structures, each supported by a gill-ray. The heads of the gill rays of both the hemibranchs are connected by ligaments. The inter-surface of the lamellae is bounded by a layer of epithelial cells in which the mucous glands abound. Large number of taste-buds occur on the margin of the primary gill-lamellae (fig. 1). Each taste bud is a multicellular organ, comprising large number of tall gustatory cells and supported by small basal cells (Fig. 4). Each taste bud is innervated by a nerve which is distinguishable in histological preparations. When the taste-buds are cut near the bases, they give the appearannce of flower-like structure (fig. 2). But when they are cut more or less at the middle they look like multicellular branchial glands (fig. 4).

BEVELANDER (1936) while working on the gill-epithelia of fishes described three types of branchial glands namely, unicellular, multicellular and transitional types. The histological observations on the gills of this fish shows that BEVELANDER's unicellular glands are the mucous gland cells present in the epithelium covering the gill arch and the primary gill-lamellae. There are large number of taste-buds present

on the gill-rakers, gill arch and the primary gill-lamellae. The presence of taste buds on the margin of the primary gill lamellae is interesting. The taste buds of the primary lamella when cut across either at the base or near the apex, give the appearance of transitional or multicellular type of branchial glands. Probably this was mistakely taken by BEVELANDER (1936) as multicellular branchial glands. His views, therefore, require modification.

There is one afferent and one efferent branchial vessel in each gill arch. The primary afferent vessel runs along the margin of the gill ray, and gives off blood vessels to the secondary lamellae. The primary efferent blood vessel runs along the outer boarder of the primary gill-lamellae.

The secondary lamellae are well developed, leaf like structures present on both sides of a primary lamella. As seen in histological preparations, each secondary lamella consists of the vascular layer in the middle, surrounded on both sides by thin connective tissue and covered on the outer side by a very thin layer of squamous type of epithelium (fig. 3). The vascular layer is traversed by many thin blood capillaries which run more or less parallel to each other. The blood capillaries are formed and supported by the typical pilaster cells. The connective tissue consists of spindle-shaped cells and large eosinophil cells (fig. 3).

The presence of taste-buds on the margin of the primary gill-lamellae has not been reported in the lamellae of any of the Teleostean fishes. Its presence in large numbers on the gill head and on the margin of the gill-lamellae indicates that the gill of *L. guntea* is highly sensitive as regards gustatory function. The histochemical and cytological nature of the mucous gland cells and large eosinophilic (acidophil) cells and their probable role in the physiology of the gills will be discussed elsewhere.

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Summary

Lepidocephalichthys guntea shows the development of large acidophil (eosinophilic) cells as well as both abductor and adductor muscles in the gills. The presence of large number of taste-buds on the margin of the primary lamella is a new result reported here. These taste-buds when cut across at the base or at the middle, give the appearance of transitional or multicellular branchial glands as erroneously reported by BEVELANDER (1935).

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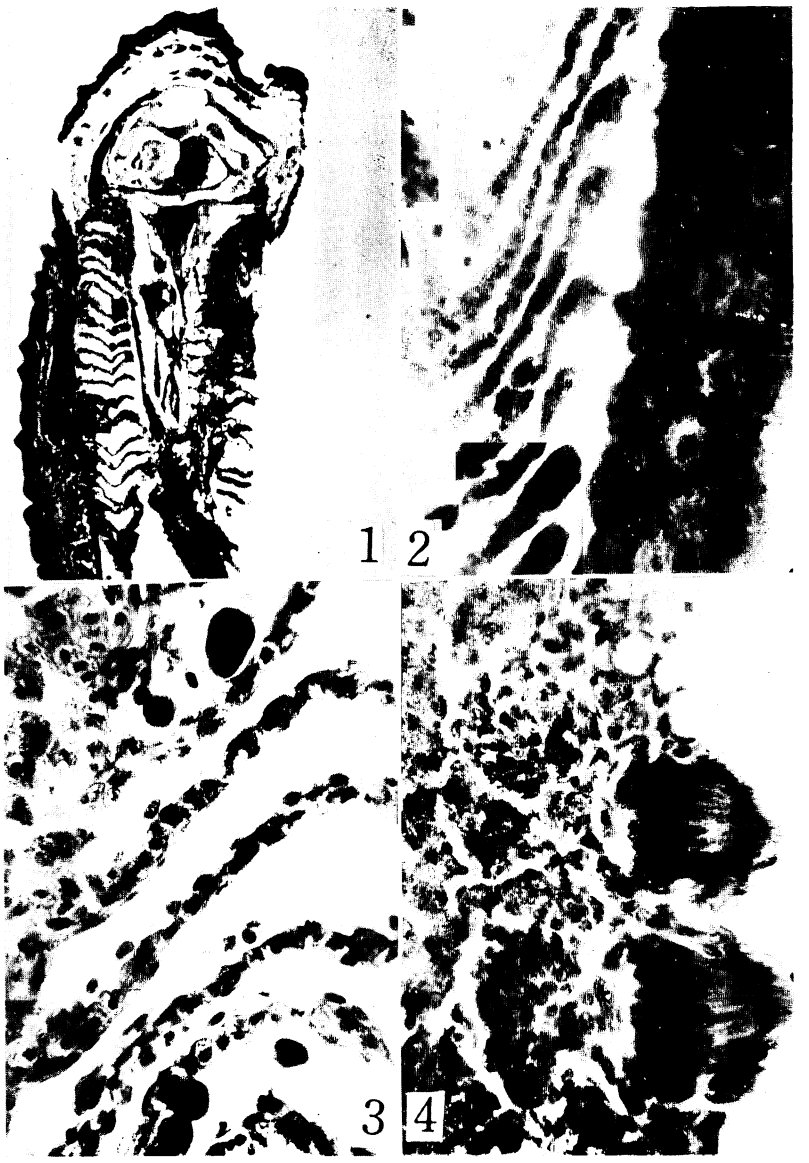
Explanation of Plate 13

Fig. 1. T. S. of the gill-arch to show the general distribution of taste-buds, afferent and efferent blood vessels, abductor and adductor muscles ×430.
Fig. 2. Several taste-buds cut across at the base on the margin of the primary gill-lamella ×1200.
Fig. 3. Pilaster cells and blood capillaris in a secondary lamella ×1200.
Fig. 4. Two taste-buds magnified at the margin of the primary lamella and two cut across (H. P.) ×430.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