

OBSERVATIONS ON THE HISTOLOGY OF THE ALIMENTARY TRACT OF *LITTORINA* *IRRORATA* (SAY)

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INTRODUCTION

The morphology of the alimentary tract of *Littorina* was reported on by Werner (1950). It will therefore be necessary merely to proceed with a discussion of the histological findings.

MATERIALS AND METHODS

Half of the denuded snails were fixed in toto. The alimentary tracts of the remainder of the snails were dissected out in Ringer's solution. Zenker's sublimate-bichromate, Helly's, and Bouin's picro-formol fixatives were used. Dehydration was carried out in ethyl alcohol. Tissues were cleared in cedar wood oil and embedded in parawax. Longitudinal and cross sections were cut serially of both the entire animal and the dissected tract. Tissues were cut from three to five microns. For routine staining Harris's hematoxylin with an alcoholic eosin counter stain was used. The iron hematoxylin and Feulgen techniques were used to verify the nuclear patterns. Mallory's connective tissue stain was employed to ascertain the connective tissue pattern.

OBSERVATIONS

The esophagus is a thin-walled structure. Its walls are thrown up into internal epithelial folds (Fig. 1). The typical cell which is found in the epithelial lining of the esophagus is of the ciliated columnar variety. This type cell, in turn, is present in another form; the highly modified, highly distended glandular cell (Figs. 1, 2). These cells, often referred to as "goblet cells," are very distended with mucin and are definitely larger than their precursors, the ciliated columnar cells. Heidermanns (1924) claims that such cells have cycles of secretion and ciliation. While in the secretory stage, such cells lose their cilia. In the post-secretory stage a regeneration of the cilia occurs. One can state in support of Heidermanns's contention that in this investigation all cells which were observed in the pre- and late post-secretory stages were ciliated, while those cells which were examined in the secretory stage were devoid of ciliation. The mucous cells are present throughout the entire esophageal portion of the tract, being present in various developmental stages. Figure 1 depicts one set of such cells actually in the process of secretion. The cytoplasm of these cells assumes various transitional forms ranging from an alveolar to a relatively clear reticular variety. Quite typically the secreting mucous cells of the esophagus are found arranged in clusters.

The normal ciliated columnar cells are predominately tall, thin, and irregular in contour. The nuclei are small, oval in shape, highly chromatic, and are stratified at various levels. The result of such a staggering of the nuclei is the appearance of pseudo stratification.

The muscular structure of the esophagus consists of definitely circularly arranged layers of muscle fibers. These fibers are generally disposed in a parallel fashion, occasionally irregularly interwoven. The numerous nuclei are arranged, more or less, with their axes orientated along the main direction of the muscle fibers. The muscular layer is, in turn, covered by a connective tissue sheath which surrounds not only this region but all of the alimentary tract.

The stomach, in cross section, appears as a greatly enlarged portion of the esophagus. Epithelial folds are present but are most irregular in both size and arrangement. Figure 3 is a cross section taken through the anterior part of the stomach. Three divisions are apparent: the small terminal portion of the esophagus, the large centrally situated stomach, and the beginning of the intestine. The epithelial lining of the stomach consists of tall ciliated columnar cells. Fine granules are distributed in the ground substance of these cells, being denser toward the distal end of the cells. The peri-nuclear regions of the cells appear to be relatively vacuolated. The rounded nuclei are basally situated one third of the distance from the basement membrane. Occasionally, the nuclei are staggered in position, thus presenting again, to the casual observer, the appearance of stratification. The nuclei are sharply marked off from the cytoplasm by a distinct nuclear membrane. Nucleoli are readily observed throughout. The columnar cells rest on a constantly perceptible basement membrane. (Fig. 4). The muscular layer of the stomach is very poorly developed. There is instead a vague, loosely arranged type of alveolar connective tissue.

Morphologically, the remainder of the alimentary tract is divided into the intestine and the rectum; histologically, however, there is no necessity for this division. In cross section (Fig. 5) the intestine is a highly convoluted tubule. The lumen shows fecal pellets. The typical cell present is again the tall, ciliated, columnar cell. In this instance, the ciliation is considerably longer than in any other portion of the tract.

Plate I. (Opposite page.) Fig. 1: Longitudinal section through the esophagus. Clusters of goblet cells visible in the process of secretion, X 150. Fig. 2: Cross section through the esophagus showing typical ciliated columnar cells and adjacent goblet cells, X 2000. Fig. 3: Cross section through anterior portion of stomach showing the terminal part of esophagus, large medially situated stomach, and the beginning of the intestine with enclosed fecal pellets, X 150. Fig. 4: Cross section through the stomach, X 2000. Fig. 5: Cross section through the intestine, X 150. Fig. 6: Cross section through the intestine, X 2000.

