

## VI. THE EXCRETORY SYSTEM

The excretory system in the digenetic trematodes generally consists of a median excretory bladder which is joined by a variable number of collecting ducts which further ramify into smaller ductules and fine capillary vessels, each terminating at a flame cell. The excretory vesicle communicates with the exterior through a median excretory pore situated at the posterior tip of the worm.

The excretory system of trematodes was first delineated by Fraipont (1880) who observed flame cells in adult forms. In an extensive paper, Kawana (1950) described the development of the entire excretory system in cercarial stages of F. hepatica. Some histochemical studies were made on the adult excretory system of F. hepatica by Stephenson (1947d). The fine structure of flame cells was first investigated by Kummel (1959 & 1960) in the miracidium of F. hepatica and, Pentelouris and Threadgold (1963) described the occurrence and ultrastructure of flame cells in the tissue slices of adult F. hepatica. Such studies however, have not so far been made on Fasciola gigantica.

The excretory system of F. gigantica essentially does not much deviate from that of F. hepatica as it comprises a median excretory vesicle, extending approximately two third

antero-posteriorly of the entire body length. The width of the vesicle markedly varies, depending on whether it is filled or empty. The anterior end of the vesicle is bifid (Pl. XII, 1) and each of the branches receives main collecting tubes which further branch into finer collecting tubules and finally ramify into the excretory tubules. The network resulting from the ramification of the anterior main collecting tubes is related to the one third (anterior) region while many other main collecting tubes following similar ramifying pattern appear to join directly the excretory vesicle. On either side of the vesicle, approximately 12 main collecting tubes open at intervals.

The excretory pore is provided with a well developed Sphincter (Pl. XIX, 2; XXIX, 4), which is innervated by lateral efferent branches of the ventral longitudinal posterior nerves (Pl. IX, 1). This pore appears roughly round in cross section, whose lumen is lined with a tegumental layer which is about 20  $\mu$ m in thickness and continues into the excretory vesicle upto an approximate height of 0.5 mm, starting from the excretory pore (Pl. VII, 3; XII, 1; XXIX, 3). This tegumental layer is in continuity with the general body tegument. The surface of this tegument is thrown into longitudinal valleys which are probably analogous with the transverse valleys of general tegument as described in Chapter I. This tegument is followed by a thick amorphous

basement layer which in further followed by circular and longitudinal muscle layers like that of the general body tegument. The subtegumental cells are also arranged in clusters along the entire region where the vesicle lumen is lined by the tegument (Pl. VII, 3). The sphincter region exhibits an intense acetylcholinesterase activity (Pl. XXIX, 3,4). In case where the excretory vesicle was found filled with fluid the pore with sphincter was observed to be in an evaginated condition with open excretory pore, while in the empty and collapsed vesicle the sphincter was found invaginated, with the pore closed, depicting the notched posterior tip. In addition to the circular, the longitudinal muscles, dorsoventral muscles from all sides are also attached to the sphincter region (Pl. VII, 3).

The lumen of the vesicle, collecting tubes and excretory tubules are cellular with attenuated epithelial cells. The nuclei are oval, small, or elliptical, each measuring about 2  $\mu\text{m}$  in diameter. The epithelium rests on a comparatively thin basement membrane which is followed by thin muscle layers. In addition to these muscle layers, dorsoventral muscles are also attached to the vesicle at places on the corresponding dorsal and ventral sides (Pl. XII, 2).

The end of fine collecting tubules are usually bifid. The termini of the excretory tubules are equipped with the flame cells (Pl. XII, 3-5). Each flame cell approximately

measures about 10 x 20  $\mu\text{m}$ , with a round nucleus, having hyaline nucleoplasm. The base of the cell body is provided with flagellar tuft into the lumen of the basal stalk of the flame cell.

In the epithelium of excretory vesicle lipid depositions were detected histochemically (Pl. XIX, 6). Same moiety was also observed in the tubules and the flame cells.

The details of various histochemical tests performed on the excretory system have been furnished in Table - VII.

The excretory system of F. gigantea however, follows the same general plan as was described in F. hepatica (Kawana, 1940), with a slight exception of the approximate number of the main collecting tubes opening into the vesicle. Perhaps the number may be variable according to the length of the parasite viz., the length of the excretory bladder.

The bifurcation of the excretory vesicle at its anterior end presumably reveals the remnant feature of the confluence of the two distinct tubes in cercarial stage and might be having same course of development as in F. hepatica (Kawana, 1940).

The cellular lining of the excretory system also confirms the nature of the system as a close system lined with definite epithelia, rather than a simply loose fluid filled net-work as has often been described in some other digenetic trematodes (Willey, 1930; Dawes, 1946).

The function of the excretory pore appears to be regulated by a need-based neuromuscular activity, as already evidenced by the intense acetylcholinesterase localization in this region.

The excretion of fat globules has already been demonstrated in F. hepatica (von Brand & Weinland, 1924) and has been histochemically confirmed by Stephenson (1947d). The present studies also confirm the views of Stephenson (1947d) that fat is excreted through the excretory system of trematodes. Prenant (1922) also presumed the excretion of fat and mentioned the large fat droplets in the cells are released into the lumen by the cell wall rupturing locally.

TABLE - VII

Results of various histochemical tests performed on the excretory system of Fasciola gigantica

Tests performed	Excretory Vesicle	Collecting tubes	Excretory tubules	Flame cells	Excretory sphincter
PAS	-	-	-	-	++
PAS, after diastase digestion	-	-	-	-	-
Best's Carmine	-	-	-	-	++
Best's Carmine after diastase digestion	-	-	-	-	-
Alcian blue	-	-	-	-	-
Mercury bromophenol blue	++	++	++	++	+++
Acid Solochrome Cyanine	++	++	++	+	+++
Pyronine Y & Methyl green	-	-	-	-	+ Pink
Sudan black B	+++	++	++	++	+
Acetone Sudan black B	-	-	-	-	++
Silver impregnation	-	-	-	-	+
Indoxyl acetate	-	-	-	-	+++
Indoxyl acetate, after Eserine	-	-	-	-	-
Acetylthiocholine iodide	-	-	-	-	+++

+++ = intensely stained; ++ = moderately stained;

+ = slightly stained; - = no stain.