IV. MYOARCHITECTURE

Musculature in the trematodes is one of the most developed systems, sustaining the body shape and movements. This system comprises muscle fibres arranged in bundles and invested in a network of reticulin (Alvarado, 1951), containing nuclei in the muscle fibres, and the myoblasts attached with the former.

Although fairly well developed in the Trematodes, this system has not been extensively worked out, except preliminary studies by Bettendorf (1897), Alvarado (1951) and Pantelouris (1965).

In *F. gigantica*, the lay-out of the somatic muscles is as follows:

Peripheral Musculature

Beneath the Hypoderm there is a layer of transverse muscles, comprising delicate fibres, attached to the cuticular basement layer, covering about 10 µm in thickness. Following this layer is the longitudinal muscle layer, about 15 µm thick. The fibres of both muscle layers are arranged in definite bundles (Pl. II, 1). These two types of muscle bundles criss-cross each other forming distinct lacunae (Pl. XVI, 2; XVII, 3).

This peripheral musculature occurs throughout the body as a muscular sheath.

These muscle bundles are enclosed by an interstitial material. The nuclei are also present in the muscle fibres, more frequent in the longitudinal than the transverse muscles, each measuring about 5 μm. The myoblasts exist in many possible shapes and size. The detailed structure of these myoblasts has already been given in Chapter I. There may be present one myoblast, attached to single fibre or single myoblast could be attached to many fibres through cytoplasmic processes (Pl. VIII, 1-5; XVI, 4). Delicate neurofibrils arising from nerve cells extend upto the muscles where these fibres have been observed to end in minute nerve endings at places.

Anterior diagonal musculature

The diagonal muscles form an arch-like pattern between the oral end and the anterior margin of the acetabulum (Pl. VI, 3). These are present both on the dorsal as well as the ventral sides in the same region and are arranged in definite bundles in a cris-cross pattern (Pl. VI, 1). Nuclei of the muscle fibres, myoblasts, and nerve endings are also found in these bundles (Pl. VIII, 9-13). In transverse sections these muscle bundles appear in an arch; the two ends of which do not attach at the exact lateral points, but slightly away from the longitudinal muscles (Pl. VI, 3). The myoblasts related to these muscles are most pronounced. They are found even in the formative stages with prolongation of muscle fibres (Pl. VII, 5; XXVI, 1).

The dorsoventral musculature

Distinct muscle bundles commencing from dorsal and ventral peripheral longitudinal muscles traversing dorsally and ventrally (Pl. VI, 3-5) are present throughout the body. Some of these are fairly well developed and traverse from dorsal to the ventral side, mainly along the lateral margins, but some of them end midway and are attached at the intestinal crura (Pl. VII, 4). The nuclei are most frequent and prominent in these muscle fibres and the large-sized myoblasts are also attached to them (Pl. VIII, 9-12). These muscles are also adequately innervated which is evidenced by the presence of numerous nerve-endings terminating thereat (Pl. VIII, 13; XVI, 3).

Musculature of the Acetabulum

The acetabulum, measuring 1.5 mm in diameter, is a cup-shaped structure. Its cavity is provided with the non-spinose cuticle and dorsally it is delimited by the basement membrane (Pl. XX, 2). The outer most muscular layer comprises meridional fibres, having nuclear profile like that of the peripheral transverse muscles (Pl. VIII, 1). These fibres are attached over the basement layer. There are characteristic radial muscles attached to the meridional fibres showing striated pattern. The marginal radial muscles are more compact and relatively thicker bundles than the central ones (Pl. VIII, 1). The spaces in between the radial muscles is packed with parenchyma. Myoblasts and nerve endings are observed in this region (Pl. VIII, 6-8, 14-16). In between the radial muscle bundles,particularly on marginal sides and outer and inner periphery run the circular muscle fibres. These circular muscles are compactly arranged under the edges of the sucker, forming a sphincter. In addition to these, the dorso-ventral muscles are also attached to the basement layer of dorsal side of the acetabulum from all sides (Pl. VII, 1). At places, particularly on the lateral side, muscles from dorsal side cross those of the ventral side (Pl. VI, 5).

Musculature of the oral sucker and the pharynx

In F. gigantica, the oral sucker is a funnel-shaped structure with a slightly basal extention on the ventral side (Pl. IX, 8-10). The funnel cavity is lined by the cuticle, measuring about 10 um in thickness. The inner limiting outline lacks the cuticle, as found in the acetabulum but the uniform strech of basement layer extends from the

Muscles (Pl. VI, 2), which probably facilitate the upward and downward movements of the entire pharynx.

Periintestinal muscles

The intestinal crura are surrounded by delicate circular muscles which are attached to the basement layer underneath the intestinal epithelium. To these circular muscles are attached dorsoventral muscles in all directions (Pl. VII, 2). Nuclei and myoblasts are also found in and along these muscles.

The cytological and histochemical details of these myoblasts have been discussed elsewhere (Chapter I), and the histochemical nature of all types of muscle fibres are similar to those described for peripheral musculature in Chapter I, Table III.

The transverse and longitudinal peripheral muscles are responsible for their complex body movements. Contrary to the view of Pantelouris (1965), nuclei are found in the peripheral musculature in F. gigantica, in the ascending frequency of the sequence of muscle's position of the worm's body. The nuclei are found in various shape and size in different muscles. With this fact the present author intend to draw a hypothesis that the frequency of nuclear presence in the muscles is probably dependent on the age of the muscle. In other words, the sequence of development of various body muscles can be determined with the help of number and shape of the nuclei.

adjacent body wall (Pl. XVIII, 6; XX, 4). Centrally there is an opening. The outer most layer measures about 10 μm thick and passes through the lower central opening of the sucker. The radial muscles are arranged in a regular manner. On the inner and outer margins, inbetween the radial muscles run the circular muscles, specially on the marginal sides, forming a sphincter. The opening from the middle of the oral sucker leads into an oral muscular pharynx, divisible into an upper prepharynx and the lower 'pharynx'. This division is superficial, internally there is no structure to separate the two parts. There appears a circular muscular constriction in between the prepharynx and the basal opening of the oral sucker, the interspaces being occupied by the parenchyma internally, and covered with the continous cuticle of the sucker cavity externally which also extends into the lumen of the pharynx. This zone is fairly innervated by a neural plexus (Pl. VI, 2). The outer muscle of the pharynx is a continuous circular sheath and there radial muscles are also present. The spaces are packed with parenchyma on both the margins of pharynx. Next to the circular muscles run the longitudinal muscles. The outer circular muscle layer is dorsal to the basement layer and at the region of oesophageal junction they form a sphincter. In addition, two stout lateral muscle bands run longitudinally starting from the base of the pharynx and are attached to the lower base of the oral sucker. These are probably protractor and retractor

In case this inference is tenable, the sequence of development of different muscles should be as follows: the outer transverse muscles and the meridional muscles of the suckers as well as the outer circular muscles of pharynx seem to develop first, and the anterior diagonal musculature later. This is evidenced by the cytological details of these diagonal muscles which show many proliferating fibres with large amount of perinuclear cytoplasm.

Contrary to Alvarado (1951), the circular muscles arranged in the intestinal crura seem to perform peristaltic movements, while the dorsoventral muscles attached to these circular muscle may be responsible for dilation and contraction of the intestinal lumen. There might be the possibility that the dorsoventral muscle bundles may create alternate contractile and extensile activities thereby resulting peristaltic movements in the intestinal crura.