Studies on Scolopendra morsitans Linn., Part II: Digestive and Excretory Systems

by

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Introduction

Bucherl (1939) has described the digestive and excretory system of *Scolopendra viridicornis* but his account is very sketchy. A summary of the morphology of the digestive system of *Scolopendra morsitans* has been published by the author (1962). The present paper gives a comprehensive account of the digestive and excretory systems.

Material and Method

The studies were mostly based on living specimens collected in and around the city of Gorakhpur (Uttar Pradesh) particularly in the Kushmi Forest. The living animals were kept in captivity in large petri dishes with fine wire gauze covers. The petri dishes were kept in cupboards or covered with cloth as the animals shun light. For histological studies the material was fixed in alcoholic Bouin. The sections were stained with Delafield's haemotoxylin and eosin.

The digestive system

The alimentary canal and the salivary glands.

The alimentary canal (Fig. 1) is a straight tube extending from the mouth to the anus. It is surrounded by a layer of fat body which is very thick on the ventral side forming more or less a sheet between the alimentary canal and the ventral nerve cord while on the dorsal side it remains scattered. The alimentary canal is divisible into three parts, the foregut (stomodaeum), midgut or mesenteron and the hindgut (proctodaeum). The foregut and the hindgut are internally lined with chitin and therefore ectodermal in origin, whereas the mesenteron does not have any such lining and must therefore, be endodermal in origin. The foregut is longer than midgut and hindgut combined together.

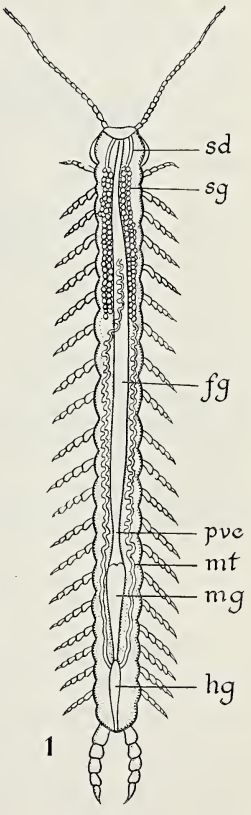


Fig. 1. Entire digestive system. fg, foregut; hg, hindgut; mg, midgut; mt, malpighian tubule; pvc, proventriculus; sd, salivary duct; sg, salivary gland.

The mouth (Fig. 2) is situated on the ventral side of the head. It i bordered anteriorly by a foliaceous labrum and on the sides by the gnathal lobes of the mandibles and posteriorly by a small hypopharynx. Behind the hypopharynx the first maxillae are united in a labium-like manner and form more or less a functional labium as has been pointed out by SNODGRASS (1952). The apical segments of the telopodites of the first maxillae are situated ventrally to the mandibles and help in closing the mouth by moving towards the middle line.

The preoral cavity (Fig. 2). The space enclosed by the mouth parts and in which lies the hypopharynx is the preoral cavity. This is a small space lying entirely outside the mouth. The hypopharynx divides the preoral cavity into two parts; the anterior part — the food meatus — and the ventral part — the salivary meatus. The food meatus forms a canal, the dorsal end of which is the cibarium or the food chamber. The salivary meatus is narrow and the basal part forms the salivarium. In the salivarium is the opening of the common salivary duct.

The foregut (Fig. 1). The mouth leads into the buccal cavity which opens into the pharynx. The pharynx is a small, narrow tube of more or less uniform thickness and extending to the posterior end of the brain. The oesophagus extends from the posterior end of the brain to the 14th leg-bearing segment. It is the longest part of the alimentary canal and narrows posteriorly. This narrow part is extremely muscular and forms the proventriculus, the posterior end of which is sphincter-like.

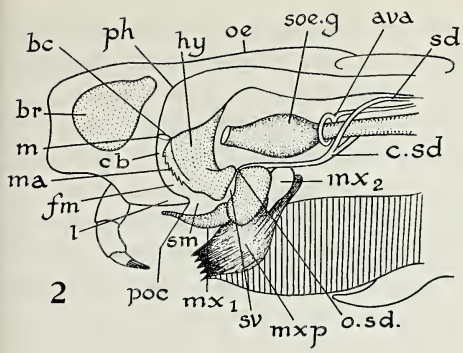
The midgut extends from the 14th to the 18th leg-bearing segment and is the only area where the absorption of the digested food can take place. It possesses a sphincter at its posterior end.

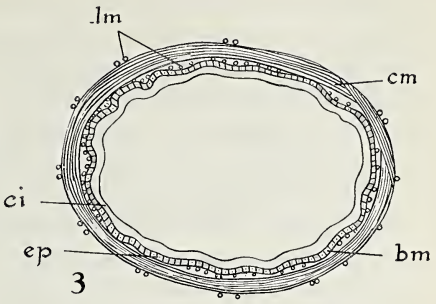
The hindgut or rectum is short and narrow, opening outwardly through the anus. There are at the anterior end of the hindgut a pair of long slender malpighian tubules. Externally a faint ring is present between the midgut and rectum. The rectum runs in a straight line to open at the anus. The anus is situated at the terminal end of the anal segment, and is closed by lip-like folds (SHUKLA, 1962).

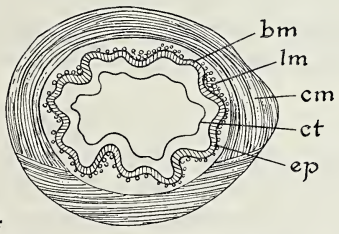
The salivary glands (Fig. 1). A pair of salivary glands is situated on each side of the foregut, extending from the posterior end of the first segment to the seventh. Each gland is a mulberry-shaped structure and from its anterior end runs a salivary duct. When the ducts of the two sides reach in the anterior part of the first segment (Fig. 2) they run antero-ventrally. In the posterior region of the head the two ducts fuse below the nerve cord at the posterior end of the sub-oesophageal ganglion, to form the common salivary duct. The common salivary duct runs anteriorly below the sub-oesophageal ganglion to open at the base of the first maxillae in the salivarium.

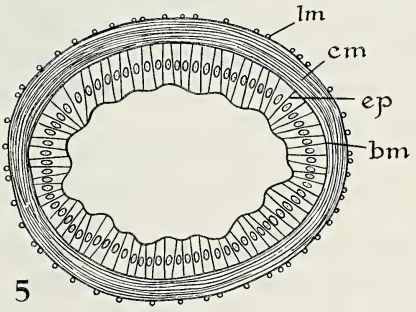
HISTOLOGY

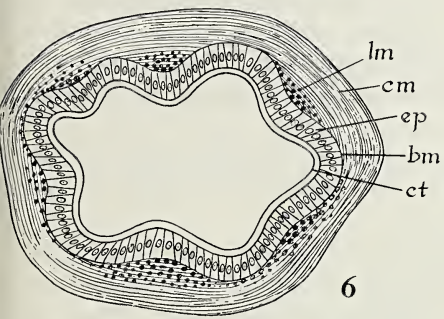
The wall of the buccal cavity, pharynx and the anterior part of the oesophagus (Fig. 3) consists of an outermost layer of circular muscle fibres, on the external surface of which are found a few bundles of longitudinal fibres, and the inner surface of which has a layer of longitudinal muscles. The epithelium is thin, covered by a basal membrane and lined by a thick chitinous intima. The three layers form shallow longitudinal folds.











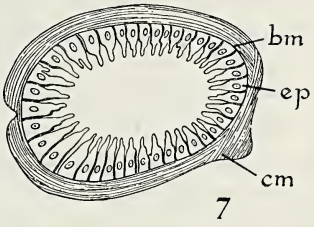


Fig. 2 Sectional diagram of head. ava, anterior ventral aorta; bc, buccal cavity; br, brain; cb, cibarium; c. sd, common salivary duct; fm, food meatus; hy, hypopharynx; l, labrum; m, mouth; ma, mandible; mx1, first maxilla; mx2, second maxilla; mxp, maxilliped; oe, oesophagus; o. sd, opening of salivary duct; ph, pharynx; poc, preoral cavity; sd, salivary duct; sm, salivary meatus; soe. g, suboesophageal ganglion; sv. salivarium.

Fig. 3. A transverse section of foregut, anterior region. bm, basal membrane; ci, chitinous intima; cm, circular muscles; ep, epithelium; lm, longitudinal muscles.

Fig. 4. A transverse section of proventriculus. bm, basal membrane; cm, circular muscles; ct, chitinous intima; ep, epithelium; lm, longitudinal muscles.

Fig. 5. A transverse section of midgut. bm, basal membrane; cm, circular muscles; ep, epithelium; lm, longitudinal muscles.

Fig. 6. A transverse section of rectum. bm, basal membrane; cm, circular muscles; ct, chitinous intima; lm, longitudinal musles.

Fig. 7. A transverse section of a malpighian tubule, bm, basal membrane; cm, circular muscles; ep, epithelium.

The wall of the posterior part of the foregut (Fig. 4) and the proventriculus show similar layers to those of the anterior part, but their condition varies. The layer of the circular muscles is very thick while the inner longitudinal muscles are confined to the bases of the folds. The folds are more pronounced and arranged in two groups, large and small, the large folds alternating with the small folds. The chitinous intima is also thick and folded.

The wall of the midgut (Fig. 5) consists of a layer of elongated epithelial cells and is thicker than that of the foregut, a basal membrane, and an inner circular and outer longitudinal muscle coat. The epithelial layer forms short folds projecting into the cavity. Both the muscular coats are thin, having only a few fibres. The wall of the hindgut (Fig. 6) is thicker than that of the midgut. The increase in thickness is due to the presence of transverse folds in its wall. The chitinous lining is thin, the epithelial cells are elongated, the inner longitudinal muscle layer is comparatively thick and the circular muscle layer is more or less similar to that of the foregut.

The food and the mechanism of feeding

The *Scolopendra* chiefly come out in search of their food during night time. They feed on various kinds of insects, larvae and earthworms found in damp surroundings. The author used to feed them on insects, such as termites, their larvae, and also small pieces of earthworms. They were seen fighting among themselves for food. When a small piece of earthworm was dropped in the glass vessel with two individuals, one of them actually tried to snatch away the piece from the other.

The older individuals often devour the younger if they are kept together. They can live without food for several weeks. The older animals can survive without food for a longer period than the younger ones.

As reported previously, *Scolopendra* can be fed on coconut (Mathur, 1926) and milk (Misra, 1942); the author also fed them successfully on milk, tea, coffee, bread, biscuits and even fleshy fruits. They can also take water. When the animals take water or milk they keep their antennae raised up high and move the head upwards and downwards. Thus the animal can also live comfortably on a vegetarian as well as on a liquid diet.

When the animal is fed with milk or even water, it raises its anterior portion of the body and catches the meshes of the cover of the petri dish with the tips of its maxillipeds thus hanging itself with the mouth facing up. In this way milk can easily be dropped with a dropper into its mouth. It has been further observed that after taking a drop or two of milk it passes its right or left antenna between the palps of the second maxilla by bending the head, as if to clean it. Sometimes the antenna of only one side is passed a number of times before that of the other side is moved. When the animal is fed on milk the apical segments of the telopodites of the first maxillae move apart to open the mouth and it then sucks the milk. Thereafter the maxillary palps of the second maxillae are thrust in the mouth, then the mesal surface of the first maxillae close the approach to the mouth.

Similar behaviour is shown when the animal is stimulated in the mouth region.

The mouth cavity is exposed and the maxillary palps are inserted into it. Once so stimulated, this behaviour is repeated a number of times.

The food is pushed into the preoral cavity by the palps of the second maxillae, where it is mixed with the saliva. Then the food enters with the aid of the apical segments of the first maxillae into the food meatus where it is cut into pieces by the mandibles and passed into the cibarium. Thereafter the food is pushed into the mouth by the hypopharynx. The apical segments of the telopodites of the first maxillae remain ordinarily in close apposition against each other beneath the mandibles and thus covering the mouth. The living prey is paralized with poison and is held between the claws of the maxillipeds before it is eaten. However, BHATIA (1924) mentions that the actual method of taking food is difficult to observe.

The excretory system

The malpighian tubules (Fig. 1) are paired, slender and translucent, attached to the anterior end of the hindgut at the level of the 19th body segment. BUCHERL (1939) also mentions that the tubules arise from the hindgut in *Scolopendra viridicornis* but WANG & WU (1948) believe that these tubules arise from the hind end of the midgut in *Scolopendra subspinipes*. Each tubule is long and strongly convoluted especially in the middle part; it is about one and a half times the length of the animal and extends anteriorly into the 5th segment.

The epithelium of the tubules (Fig. 7) consists of large columnar cells lying on a basal membrane. Outside these cells there is a layer of circular muscle fibres.

The outer surface of the malpighian tubules is very richly supplied with tracheae. The tubules of a freshly killed specimen contain clear fluid with some cellular material.

Summary

The alimentary canal is a straight tube extending from the mouth to the anus. The mouth is bordered anteriorly by a labrum, laterally by the gnathal lobes of the mandibles and posteriorly by the hypopharynx. The preoral cavity is divided by the hypopharynx into the food meatus and salivary meatus. The mouth opens in the cibarium and the salivary duct in the salivarium. A pair of long slender malpighian tubules are attached to the anterior end of the hindgut. The salivary glands are paired and mulberry-shaped.

The wall of the foregut consists of circular muscles, a few external longitudinal muscles, a layer of internal longitudinal muscles, the epithelial layer and a chitinous intima.

Scolopendra have been fed on insects, larvae, earthworms, milk, tea, coffee, fleshy fruits and biscuits. Their feeding mechanism has also been described.

Acknowledgements

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Enkele Nederlandse Mallota-vangsten (Diptera, Syrphidae). In de collectie van het Rijksmuseum van Natuurlijke Historie te Leiden bevinden zich twee exemplaren van *Mallota fuciformis*: ♂ Wassenaar, 14.V.1925, leg. H. C. BLÖTE, en ♀ Amstelveen, 8.V.1915. De soort is zeer zeldzaam en is in de laatste jaren nooit meer gevangen. Misschien komt dit vanwege haar hommelachtig uiterlijk, waardoor ze verwisseld kan worden met *Volucella bombylans* L. en in mindere mate met ♀ *Eristalis intricarius* L. De vroege vangdata sluiten *V. bombylans* uit, daar deze soort pas in juni verschijnt. Verder is *M. fuciformis* duidelijk groter dan de eveneens vroeg vliegende *E. intricarius* en ze vliegt alleen op bloemen van struiken, zoals Japanse Kers.

Door Dr. SPEIJER werd op 13.VI.?1943 in „De Schaffelaar" te Barneveld een ♂ gevangen van **Mallota cimbiciformis** Fall. (faun. nov. spec.). Deze soort lijkt sterk op een forse honingbij. De achterlijfsbeharing is spaarzaam en de tergieten hebben de bruine bijekleur met smalle bruingele achterrandjes. De larven van deze soort zijn gevonden in molm van loofbomen in het Hyde Park te Londen door COE. Ook dit exemplaar bevindt zich in de collectie van het Rijksmuseum.

V. S. VAN DER GOOT, Zoölogisch Museum, Afd. Entomologie, Amsterdam.

Hydraecia petasitis Doubleday (Lep., Noctuidae). Elke lepidopteroloog zal natuurlijk met belangstelling het verslag gelezen hebben, dat de heer BOGAARD van zijn succesvolle kweek heeft gepubliceerd. Het moet nu zeker niet moeilijk zijn nieuwe vindplaatsen van de soort te ontdekken. De voedselplant is weliswaar lokaal, maar komt toch op heel wat plaatsen in Nederland voor. Dit lijkt me veel interessanter dan ook naar Slikkerveer te trekken of de heer BOGAARD lastig te vallen.

Wat me overigens in zijn verslag wel opvalt, is dat geen enkele rups blijkbaar geparasiteerd was. Dit is wel in sterke tegenstelling met de kolonie, die de heer VAN AARTSEN ontdekte en die hevig geïnfecteerd bleek te zijn.

Dat de vlinders niet of weinig zouden vliegen, is natuurlijk niet waar. Flevoland was maar nauwelijks een paar jaar droog, of de heer VAN DE POL vond de soort al in de vanglamp van de Plantenziektenkundige Dienst te Lelystad. Dit wijst wel op een sterke drang tot uitbreiding van het areaal en dat kan nu eenmaal niet zonder vliegen. — LPK.