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Observations on the morphology and secretory activity of the thoracic glands in *Chrysocoris stollii* Wolff

(Heteroptera : Pentatomidae)

With 4 text figures

Introduction

Several workers have given the description of the structure and function of the thoracic glands in the Heteroptera. In *Rhodnius* Wigglesworth (1952) found them embedded in the thoracic fat body; in the Pyrrhocorid *Iphita* Nayar (1953) observed these occuring superficially over the thoracic fat body in the form of loose collection of cells, whereas in *Dysdercus*, another Pyrrhocorid, Wells (1954) noted each thoracic gland in the form of a rope of syncytial cytoplasm with a row of large nuclei and with the anterior terminal part of the gland intimately connected with the prothoracic tracheal trunk and the posterior part with the salivary gland. The need for the study of the thoracic gland in many more Heteropterans is thus evident. The present paper contains a brief description of the thoracic glands of *Chrysocoris stollii* Wolff (Pentatomidae) together with a study of its secretory activity.

Material and technique

The bugs were reared in the laboratory. For studying the topography and structure of the thoracic glands, full grown fourth fifth instar nymphs were dissected and for studying the secretory cycle, various stages of these instars — freshly moulted, middle aged, fully grown, old and about to moult nymphs, as well as freshly moulted adults, were chosen. The bugs were dissected in Insect Ringer's solution in as short a time as possible, the thoracic glands were removed along with the tracheae and a part of the fat body with which they were attached, spread over a slide and fixed in a drop of chilled Carnoys fluid for 5 to 10 minutes. The use of Methylene blue and Janus Green B to stain the internal organs while dissecting was found very helpful. On treatment with the fixative, the material usually adhered to the surface of the slide. Finally the fixative was drained out and the material washed, stained in Delafield's or Iron-alum haemotoxylin and eosin, dehydrated and mounted in Canada Balsam. Microtome sections were cut 6 micra thick and stained likewise. Diagrams were made with the help of camera lucida.

Observations

Structure: By pushing aside the salivary gland and the associated long tubular accessory glands, a large white mass of thoracic fat body situated between the

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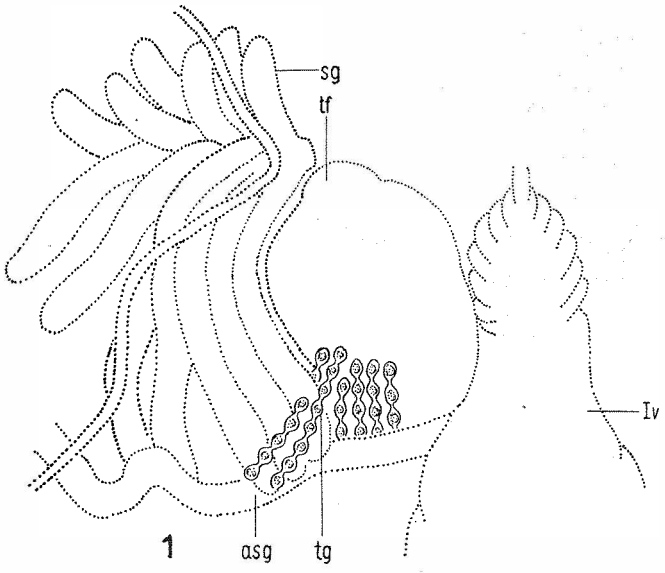

Fig. 1. Thoracic gland of one side in situ

lower face of the salivary gland and the first ventriculus is exposed (Fig. 1). On the inner, posterior part of each fat body are seen eight to ten cytoplasmic strings, each containing a single row of fairly large nuclei embedded in cytoplasm which, in turn, is invested by a distinct protoplasmic sheath. These strings constitute the thoracic gland of one side and they are held firmly in position by fine tracheal branches which bind them,on one hand, with the salivary gland and, on the other, with the prothoracic tracheal system, specially with the trachese originating from the spiracle. The nuclei are oval or spherical and stain deeply, the nuclear membrane is distinct and chromatin granules are conspicuous. The protoplasmic sheath is tough and membranous and is stained feebly with eosin.

Secretory cycle: The secretory activity of the thoracic glands has been studied in the last two nymphal instars viz. the fourth and fifth instars. In the fourth nymphal instar, just after moult, each thoracic gland is much reduced in size. The nuclei are small, elongated in shape, compact and dense and the nuclear membrane cannot be distinguished from the chromatin material. The cytoplasm is scanty, smooth and almost without granules.

As the nymphs become older, the average size of the nuclei and the amount of cytoplasm around them show progressive increase. In the six days old fourth instar nymph, the nuclei reach their maximum size, the cytoplasm increases further in quantity and shows a large number of granules and several vesicles. Finally in the nymphs about 48 hours before the next moult, the nuclei are again reduced in size and the place of vesicles is taken by vacuoles. The remain-

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ing cytoplasm is smooth and homogenous and devoid of granules. The size and nature of nuclei and cytoplasm in the different stages are given in table 1.

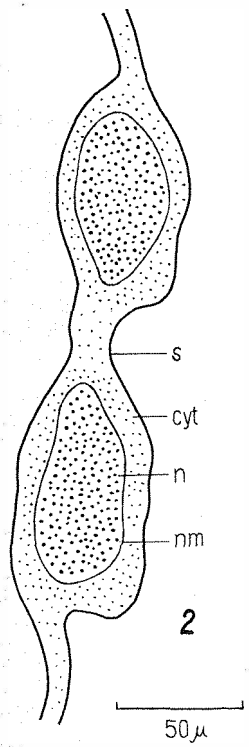

Fig. 2.

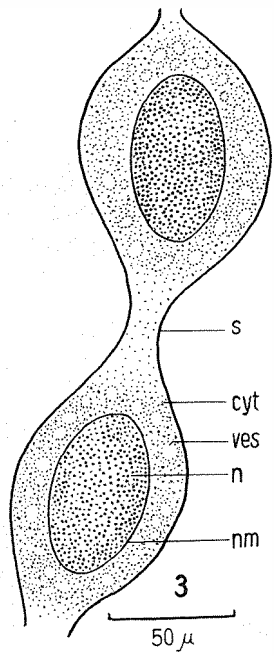

Fig. 3.

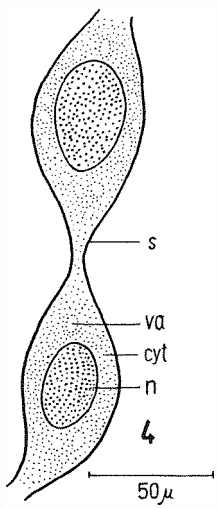

Fig. 4.

Fig. 2. Whole mount of the thoracic gland of two days old fifth nymphal instar
Fig. 3. Some cells of a string of thoracic gland of six days old fifth nymphal instar
Fig. 4. Some cells of a string of thoracid gland of half an hour old fifth nymphal instar

A similar cycle of activity is demonstrated by the thoracic glands in the fifth nymphal instar in regard to the changes in the nuclei and cytoplasm (table 2).

In the adults shortly after the final moult, the glands start disintegrating. The nuclei become attenuated and irregular and the cytoplasm around them is inconspicuous. In the adults after 24 hours of the final moult, the gland cannot be traced.

Discussion

The structure and position of the thoracic glands show great difference from order to order, but within most orders in which investigations have been carried out, they are comparatively uniform in nature (Cf. Coleoptera, Srivastava 1959

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Table 1

Nuclear and cytoplasmic changes in the fourth nymphal instar

Age of the nymphsince last moult	Average size of nuclei (area in sq. μ in whole mounts)	Condition of Nucleus	Condition of cytoplasm
1 hour	457.99	Chromatin granules indistinct	Smooth and without granules
70 hours	796.35	Chromatin granules discernible	Fine granules present
140 hours	1513.35	Chromatin granules prominent; nuclear membrane distinct	Prominent granules and vesicles present
170 hours	787.42	Nucleus reduced in size	Vacuoles present; vesicles absent; cytoplasm smooth

Table 2

Nuclear and cytoplasmic changes in the fifth nymphal instar

Age of the nymph since last moult	Average size of nuclei (area in sq. μ in whole mounts)	Condition of Nucleus	Condition of cytoplasm
1 hour	801.01	Chromatin granules indistinct	Smooth and without granules
48 hours	1225.96	Chromatin granules appear	Fine granules appear
110 hours	1887.54	Granules become larger	Amount of cytoplasm increases with granules of larger size
150 hours	3665.99	Nucleus with large chromatin granules	Large granules and vesicles present
190 hours	1335.64	Nucleus reduced in size	Vacuoles appear and cytoplasm smooth

and 1960; Lepidoptera, TOYAMA 1902, FUKUDA 1940). In the Heteroptera, however, they show wide variation, not only within the order, but sometimes even among members of the same family. For instance, in the Pyrrhocoridae NAYAR (1953) observed these in the form of loose collection of cells in *Iphita*, while WELLS (1954) found them in the form of a syncytial rope of cytoplasm in *Dysdercus*. Thus the nature of thoracic glands appears to be unrelated to taxonomy. However, as might be expected from a knowledge of their development (WELLS 1954), they are usually found associated with the salivary gland system in this order. Besides in most insects, they are associated with the prothoracic tracheal system.

Cyclic changes associated with the secretory activity of the glands connected with moulting and metamorphosis of *Chrysocoris* are similar to those in *Dysder-*

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cus and *Oncopeltus* (WELLS 1954) and *Tenebrio* (SRIVASTAVA 1960). No relationship between secretory cycle and feeding activity, as reported by WIGGLESWORTH (1952), has been observed. The critical period lies about 48 hours before the moult.

Unlike *Rhodnius* (WIGGLESWORTH 1952) and *Dysdercus* (WELLS 1954), in which degeneration of the glands starts in the adult only when metamorphosis has been fully accomplished and *Platysamia* (WILLIAMS 1952) and *Tenebrio* (SRIVASTAVA 1960) in which degeneration commences in the late pupa, in *Chrysocoris*, degeneration commences immediately on completion of the last moult and they are already attenuated and degenerating in the adult shortly after its emergence.

Summary

There is a pair of thoracic glands, one on each side, lying superficially on the thoracic fat body and connected with the prothoracic tracheal trunk at one end and the salivary gland at the other. Each gland consists of eight to ten beaded strings of cytoplasm, containing single rows of large nuclei and covered with a prominent cytoplasmic sheath. The glands show cyclic secretory activity in each nymphal instar. They are much reduced and contain smaller nuclei and clear cytoplasm in freshly moulted nymphs. As the nymphs grow, the nuclei enlarge, the cytoplasm becomes granular, and finally, when the nuclei have reached their maximum size, the cytoplasm shows vesicles filled with secretion. About 48 hours before the next moult, secretory material is discharged, vesicles are replaced by vacuoles and the glands shrink. In adults, about 12 hours after the last moult, the gland is much attenuated, degeneration begins, and after 24 hours it has disappeared.

Zusammenfassung

Es gibt ein Paar Brustdrüsen, eine auf jeder Seite, die oberflächlich auf dem Thorax-Fettkörper liegen und an einem Ende mit dem Prothorax-Tracheenstrang und am anderen Ende mit der Speicheldrüse verbunden sind. Jede Drüse besteht aus acht bis zehn Perlschnüren von Cytoplasma, die einzelne Reihen großer Kerne enthalten und von einer deutlich sichtbaren Cytoplasma-Hülle umgeben sind. Die Drüsen zeigen eine zyklische Sekretionstätigkeit in jedem Nymphenstadium. Bei frisch gehäuteten Nymphen sind sie stark reduziert und enthalten kleinere Kerne und klares Cytoplasma. Mit dem Nymphenwachstum vergrößern sich die Kerne, das Cytoplasma wird körnig, und wenn die Kerne schließlich ihre maximale Größe erreicht haben, zeigt das Cytoplasma mit Sekretion gefüllte Blasen. Ungefähr 48 Stunden vor der nächsten Häutung wird das Sekret abgesondert, die Blasen werden durch Hohlräume ersetzt, und die Drüsen schrumpfen zusammen. Beim reifen Stadium ist die Drüse ungefähr 12 Stunden nach der letzten Häutung stark verkleinert, die Degeneration setzt ein, und nach 24 Stunden ist sie nicht mehr wahrnehmbar.

Резюме

Имеется пара грудных желез, на каждой стороне одна, которые лежат на поверхности грудного жирного тела и которые связанны с одним концом с переднегрудной трахеей и с другим концом с слюнной железой. Каждая железа состойт из восьми до десяти ниток из цитопласмы, которые имеют несколько больших ядер и которые окруженны цито-пласмической оболочкой. Железы показывают циклическое секреторное действие в каждой стадии нимф. Сразу после линяния они сильно редуцированны и содержат маленькие ядра и прозрачную цитопласму. С ростом нимф увеличиваются ядра, цитопласма станет зернистым и если ядра имеют свою максимальную величину,

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цитопласма показывает пузырки, наполненные секретом. Примерно 48 часов перед линянием выделяется секрет, пузырки заменяются полостямн и железы сморщиваются. При зрелой стадии железа примерно двенадцать часов после последнего линяния сильно уменьшенна, начинается дегенерация и после 24 часов она уже на заметна.

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Abbreviations

asg. — Accessory salivary gland; *cyt.* — Cytoplasm; *gr* — Granules; *n.* — nucleus; *nm.* — Nuclear membrane; IV. — First ventriculus; *s.* — Protoplasmic sheath; *Sg.* — Salivary gland; *tf.* — Thoracic fat body; *tg.* — Thoracic gland; *va.* — Vacuoles; *ves.* — Vesicles.

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