The Function of Thoracic Processes found in Females of the Common Wood-louse, *Porcellio scaber*[1)]

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(With 5 Text-figures)

The offspring of the common wood-louse, *Porcellio scaber*, is fostered after hatching for a while in the brood chamber of the mother. The brood chamber is formed of incubate lamellae of five pairs and equipped with four elongated epithelial processes which hang from the dorsal wall of the chamber. So far as the author is aware, there is available no report on the processes. Accordingly the author took the fact as the subject of this short note.

The author wishes to acknowledge his indebtness to Prof. Tohru Uchida, under whose direction the study has been carried on.

External morphology

The brood chamber is formed by five thoracic segments from the third to the seventh. Each segment possesses a pair of incubate lamellae which arise each from the root of the periopod and from the lower surface of the chamber as in the majority of other malacostracans. The four processes mentioned above are situated on the ventral median line and hang down from the thoracic epithelium of the third to seventh segments (Fig. 1). Among these processes, the third one, belonging to the fifth thoracic segment is the largest being nearly equal in length to the incubate lamella, while the first and fourth are fairly short. After fixation, these processes are broader, quite opaque at the basal portion and gradually narrowed ; they become translucent near the tip which is often densely surrounded with a considerable amount of opaque mucous mass. In living materials, the processes and the thoracic epithelium are both almost transparent. Therefore, they can hardly be distinguished from the embryos which are likewise nearly transparent, though the yolk shows shining brown or green, according to the developmental stages. The processes are soft, rich in mucus ; they each form a blind sac with many vacuoles, in which pale fibers are running along the long axis of the surface. The epithelium of them is continuous with that of the ventral thoracic parts. There is externally observable through the transparent epithelium the mass of thoracic ganglia, more or less ash-colored, lying immediately above

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the process. Also observable are the digestive canal and two paired parts of dark brown liver. The processes here considered are not yet formed before the breeding season, thence no difference in the two sexes. After the embryos have hatched out and larvae left the chamber, the incubate lamellae become in close contact to the ventral thoracic epithelium and the processes inserted have been reduced.

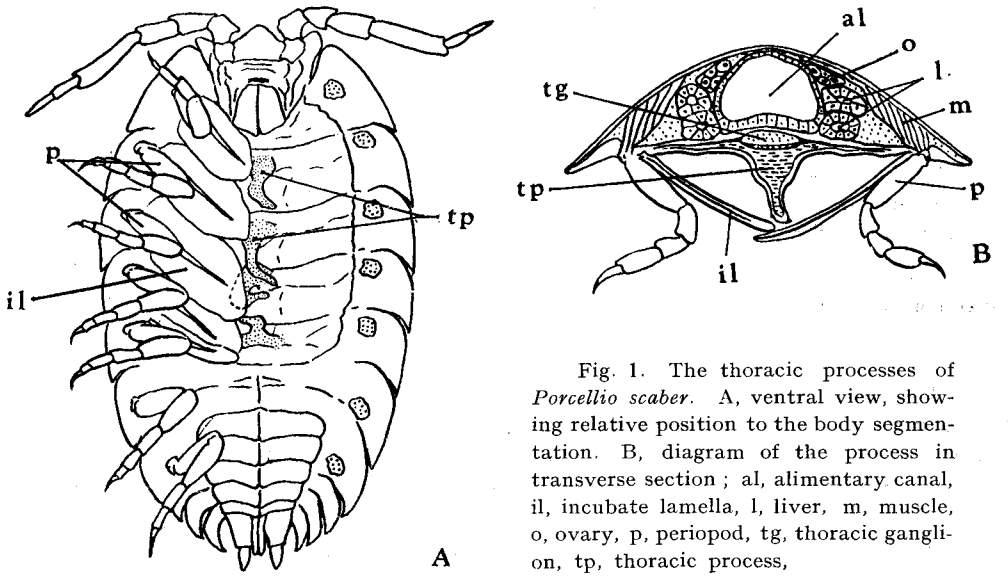

Fig. 1. The thoracic processes of *Porcellio scaber*. A, ventral view, showing relative position to the body segmentation. B, diagram of the process in transverse section ; al, alimentary canal, il, incubate lamella, l, liver, m, muscle, o, ovary, p, periopod, tg, thoracic ganglion, tp, thoracic process,

Internal morphology

For the microscopical investigation mature females were fixed with Bouin's solution, cut in 10 μ thick sections and stained with Delafield's haematoxylin-eosin or Mallory's triple staining.

These processes are all found to be similar in structure, composed of a single layer of epithelial cells and a core of loose connective tissue. The nuclei of the epithelial cells are oval in shape, about 5 μ in diameter, containing numerous bits of chromatin and appearing transparent (Fig. 2, E). The connective tissue developed inside the epithelium is loose and compact at the ceiling of the chamber, while that of the processes is rather loose with a wide intercellular space filled with many blood cells and granular substance. At the apical region of the process the space is smaller and the connective tissue appears to attach there more closely to the epithelium than at the pedestal.

In the loose connective tissue blood cells are scatteringly found. They are usually grouped into two types : those with or without spherical granules in

cytoplasm. The blood cells of the first type are compactly filled with many spherical granules which invest a nucleus, generally oval and sometimes flat in shape (Fig. 2, A). They are not the same as the granular substance in the processes, the former cells being larger and more deeply stained with eosin or orange G than the cells of the latter. The blood cells of the second type are globular or spindle-shaped and each is filled with hyaline cytolpasm containing a nucleus irregularly shaped and rich in chromatin particles as shown in Fig. 2, D. There exists no difference between the two types as to number and distribution. Besides, there are often found a few blood cells modified from those types just described, as is shown in Fig. 2, B and C.

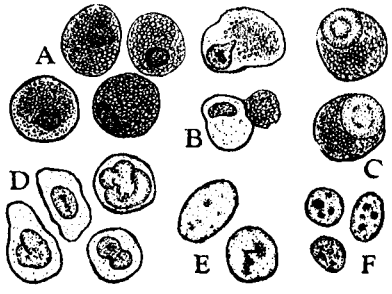

Fig. 2. Various types of blood cells seen in processes, A-D. E and F, illustrating the nuclei of epithelium and of connective tissue.

Recently, George and Nichols (1948), working on several crustaceans, classified the blood cells after the category of vertebrates. According to them, these cells represent only the forms in various stages during the hematogenesis ; more specifically, the hyaline lymphoid cell becomes later a cell full of coarse refractile granules. Although the blood cells of the two types just noted resemble in form those described by George and Nichols, their conclusion can not easily be applied to the present author's observation.

Occasionally in triple staining the core of the process has been dyed orange streaked with blue ; that is to say, anilin blue shows strong affinity to the connective tissue at the pedestal part close to the ganglion, but weak at the tip. The granular substance tends to be stained in the similar way. On the outer surface of the process and of the embryos, a mass of granular substance congeals thickly including a small number of blood cells. That mass can be usually differentiated into three layers by triple staining. The first layer attached to the embryo is very thick, stained well with orange G and light with anilin blue. It contains fine granular substance, comparatively coarse. The second layer is thin and forms a rigid granular mass stained darkly in anilin blue and orange G. The third layer, the thickest of the three, generally deep orange and sometimes red in color, generally surrounds the process and comprises the blood cells without granules. The mass is frequently divided into many layers which are piled up in regular order. Before the breeding season the connective tissue is thick only below the ganglion and the blood cells are scanty in the intercellular space. Particularly the fine granular substance is not found there.

So far as the observations go, the relationship between the processes and the

ganglia is as follows. The ventral nerve cord of *Porcellio* is ladder-like in form and surrounded by the connective tissue of the process. The thoracic ganglia lie just above the pedestal portions of corresponding processes, connected with each other by a pair of longitudinal connectives. In transversal sections, the ganglia are enclosed each with a capsular membrane and the ganglionic contents are dorso-ventrally divided into two parts as shown in Figs. 3 and 4 ; one or a few layers of

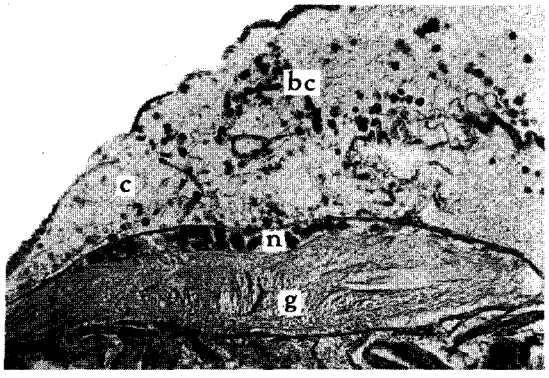

Fig. 3. Longitudinal section of a process ; bc, blood cell, c, connective tissue, e, epithelium, g, ganglion, and n, nerve cell. ×250.

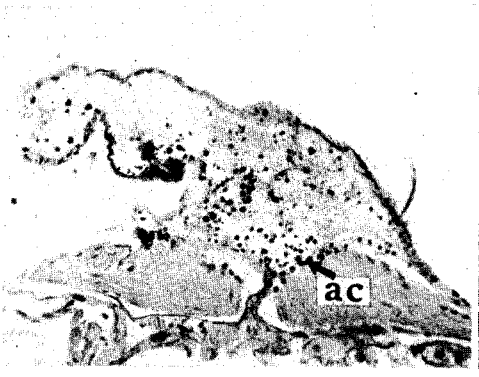

Fig. 4. Sagittal section of a process at the level of anterior cell group (ac). ×250.

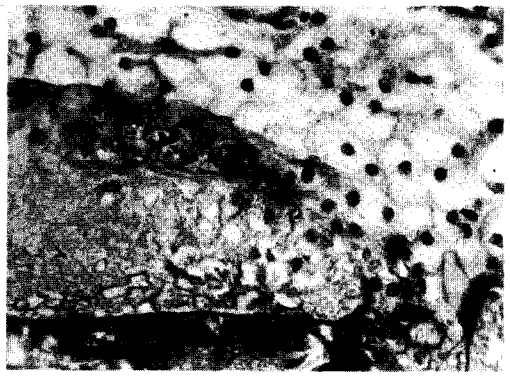

Fig. 5. Cross section of a ganglion at the level of anterior cell group, showing surrounding connective tissue of the process. ×500.

nerve-cell-groups lie on the ventral part and many nerve fibers run anteroposteriorly in the dorsal part. The cell body is generally fairly small, 5–10 μ in diameter, with a coarsely granulated nucleus and scanty, nearly transparent cytoplasm. On the anteroventral and slightly dorsolateral surface of the ganglion, from just

where a pair of longitudinal connectives arise, lies a mass of cell bodies, which was named the anterior cell group by Walker (1935) in his work with *Oniscus*. Most of these nuclei are oval in shape, 10–15 μ in diameter, containing chromatin particles in plenty. It is noticeable that the capsular membrane over the anterior cell group is almost obscure and the cell bodies appear to be merged into the connective tissue of the process, while the remaining capsular membrane is clearly distinct, bordering the tissue cells. Fig. 5 represents a cross section of the anterior cell group with an indistinct capsular membrane, where both the nuclei of the connectivetissue-cells and the blood cells of the two types are observed to be wedged together. There can be observed a few small nuclei of unknown origin, which are situated in the connective tissue just beside the cell bodies. Regardless of the breeding season, the capsular membrane is distinct when the ganglion has no corresponding process.

With regard to the function of the processes, it seems probable that they afford a storing place for mucous mass, by which the embryos are bred during the course of development, though the mucus is transformed into the granular substance as a result of fixation. The development of the terrestrial isopods has been studied by several investigators, as McMurrich (1895), Bobretzky (1874), Goodrich (1939) and so on, but there is no description on the processes. In the marine isopods *Ligia* and *Idothea* no organs comparable to these processes were found by the present writer. When the embryos of *Porcellio* are removed from the brood chamber, they can live for several weeks only when kept in about 1/2 M Ringer's solution which is in the concentration nearly like sea water. So the thoracic processes appear to be an organ adapted to terrestrial life changed from the ancestral marine life.

Summary

1) Some anatomical descriptions were presented on four elongate processes of female thoracic segments of *Porcellio scaber*. They are formed only in the breeding season. These processes seem to be storing places of the mucous mass surrounding the embryos during the course of development.

2) The thoracic ganglion enclosed by a distinct capsular membrane lies just above the process. The membrane covering a small area around the anterior cell group is obscure and the cell bodies seem to be directly in contact with the connective tissue. The membrane is so distinct when the ganglion has no corresponding process, that the ganglionic contents may possibly be correlated with the formation or function of the process.

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