ACTA BIOLOGICA SZEGED. 24 (1–4), pp. 89–96 (1978)

PRELIMINARY STUDIES ON THORACIC GANGLION-CELLS OF MAY-FLY LARVA (PALINGENIA LONGICAUDA OLIV., EPHEMEROPTERA)

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(Received March 10, 1977)

Abstract

The thoracal ganglion cells of the may-flay larva are studied, and the paracrystalline bodies and the cytosomes with different structures are described. Both of these originate from the mitochondria, or more exactly the paracrystalline bodies from the mitochondria and the cytosomes themselves from the crystalline bodies. It is considered possible that these play a part in the matter-energy transport of the cell.

Introduction

Apart from the generally-known cell organelles, we are aware of more and more organelles that occur only in a few sorts of cells and only under certain conditions. The structures, origin and particularly the activities of the latter have from many points of view not been clarified.

Of late, investigations into transforming mitochondria (ÁBRAHÁM, 1972; KUCERNROWICS, 1953) or, e.g. cytosomes have been coming more and more into prominence. The latter were particularly investigated in the case of molluscs (Mollusca), in connection with problems of the generation and storage of energy (CHALAZONITIS et al., 1968; LACY et al., 1956; NOLTE et al., 1965;ZS. -NAGY, 1967; 1969).

The aim of the present paper is to give an account of the structure of special organelles found in the thoracic ganglion-cells of may-fly larva, and their possible activity in the cell. These organelles can be compared well with the cytosomes described for molluscs (Mollusca).

Materials and Methods

Our investigations were performed on the thoracic ganglia of may-fly larva (*Palingenia longicauda* OLIV.) at different developmental stages. After Bouin and Carnoy fixing some of the ganglia were stained with haematein-eosin, or chromhaematoxylin-floxin, corresponding to the aims of the light-microscopic investigations, while for electron-microscopic investigations the fresh matter (immediately after being collected)was fixed in a pre-fixing mixture with glutaraldehyde (KARNOVSKY, 1965) and then in buffered osmium tetroxide (pH 7,2—7,4). Semi-thin sections were contrasted with toluidine-blue, and ultra-thin ones according to REYNOLDS' method (1963). Micrographs were made with a TESLA BS-500 electron microscope.

Result and discussion

In each of the three thoracic segments of may-fly larva one pair of ganglia is situated. The last of these (ggl. metathoracale) is a ganglion complex (CSOKNYA et al., 1977).

All the nerve cells comprising the ganglia are peripheral in position. According to their size, they are either large (giant) (180 μ) or small (40 μ) cells. In both cells, we could observe granules that could be stained strongly with the staining procedures applied. Besides the even granulation of the cytoplasm it is obvious that the large cells contained "empty" vacuoles in almost every case; these were mostly to be observed on the side opposite to the axon. The cytoplasm of nerve cells showed a similar picture in any larval stage.

After studying our electron-micrographs, we could establish that in the perikaryons of nerve cells there are particularly many mitochondria and dense-bodies of very varied appearance and structure. The latter, on the basis of their structures are not uniform. All transitory forms can be recognized from the forms with an almost regular, "crystalline arrangement" to those containing a loose membrane system (pictures in Plates I, II, III, IV and V).

Most characteristic are the solitary paracrystalline bodies (Plate I, Figs. 1—2), with a size of 1.6—1.7 μ on the average, but even larger ones can sometimes be observed. It is characteristic of their structure that they are limited from outside by a unitary membrane, and in their interior strongly dense membranes are stratified upon one another, at a distance of 100 Å (CSOKNYA et al., 1976).

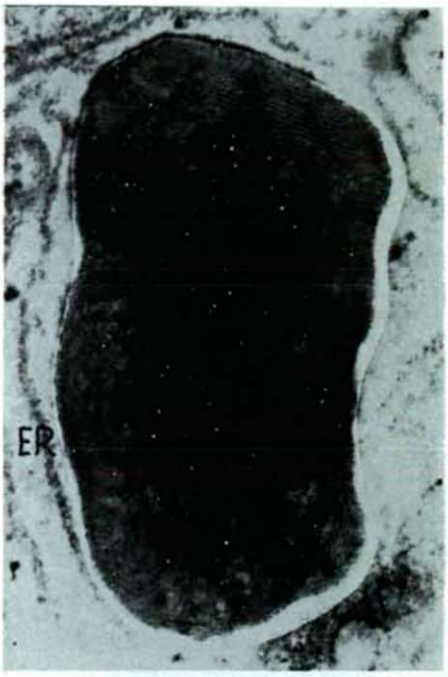
We may often observe their arrangement in groups as well (Plate I, Fig. 3), where the fusion of the single paracrystalline bodies in only rarely to be seen. These locally grouped bodies gradually loose their regular internal arrangement, and granules of changing size and density appear in them. This phenomenon can also be observed in the case of solitary bodies.

This structural loosening is the beginning of a process leading to the complete transformation of the bodies. Such states in transformation are shown by the pictures of Plates II, III and IV. At the end of the process (in our opinion) the bodies become empty and these forms evacuated in groups may have corresponded to the vacuoles observable by light-microscope.

In their varied appearance and structural building-up, these organelles show considerable conformity with the characteristic bodies described from the central nervous systems of shell-fishes and snails, the cytosomes (CHALAZONITIS et al., 1968; FÄHRMANN, 1961; LACY et al., 1958; ZS.-NAGY, 1967). Because of their respiratory-enzyme content, these cell organelles are sharply differentiated from the lysosomes, but a genetic connection is assumed between them and the mitochondria (FÄHRMANN, 1961; NOLTE et al., 1965; ZS.-NAGY, 1969). We, too, want to confirm this latter fact with our morphological observations. A part of the mitochondria of the ganglion-cells exhibit a regular structural building-up, while in others the internal lamellar system is much richer, the membranes are arranged close to each other and, simultaneously with this, their density strongly changes (Plate V, Figs. 1, 2 and 3).

On the basis of our electron-microscopical experiences, we see that these bodies

Plate I



1

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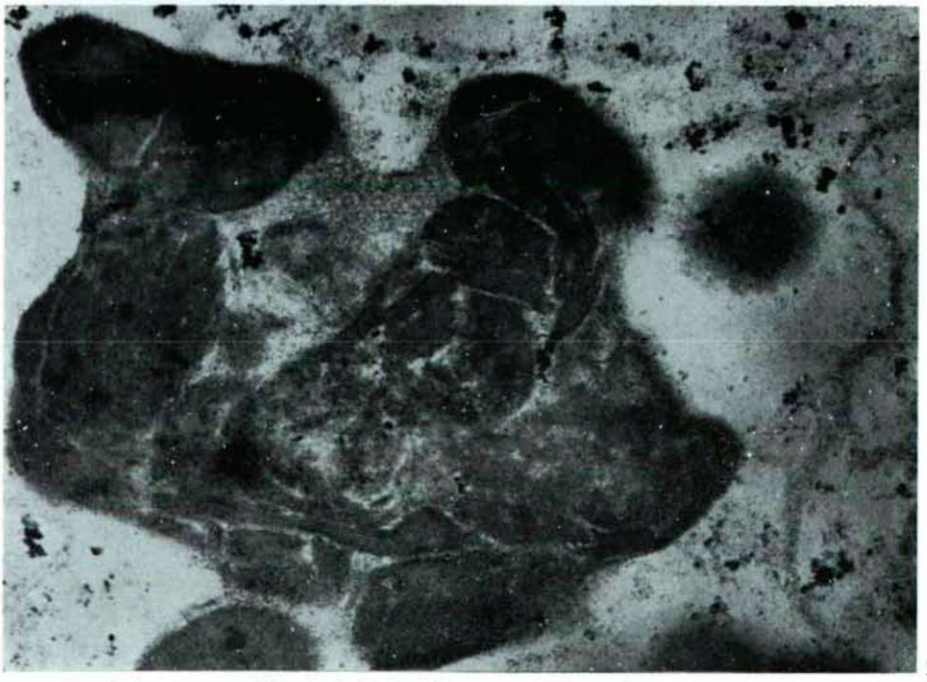


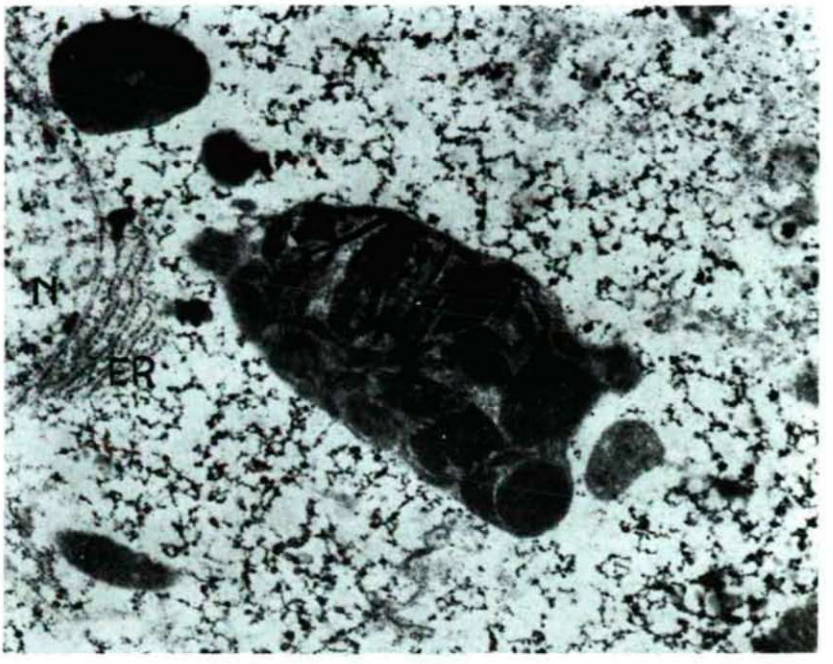
3

Fig. 1. A paracrystalline body limited by an endoplasmatic reticulum (ER- endoplasmatic reticulum). x48 000
Fig. 2. Solitary crystalline body. x48 000.
Fig. 3. Accumulated paracrystalline bodies. x36 000.

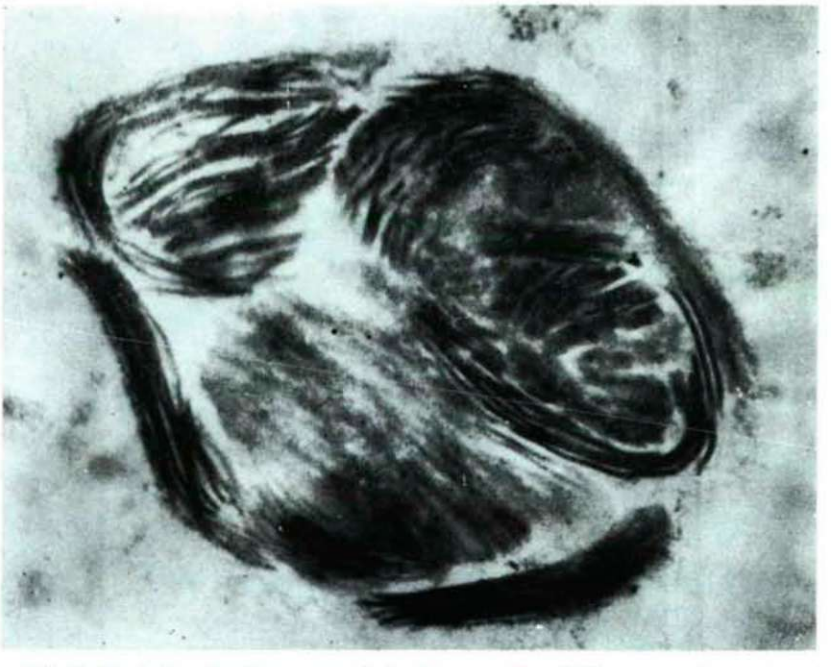
Plate II

Transforming crystalline bodies. x28 000.

Plate III



1

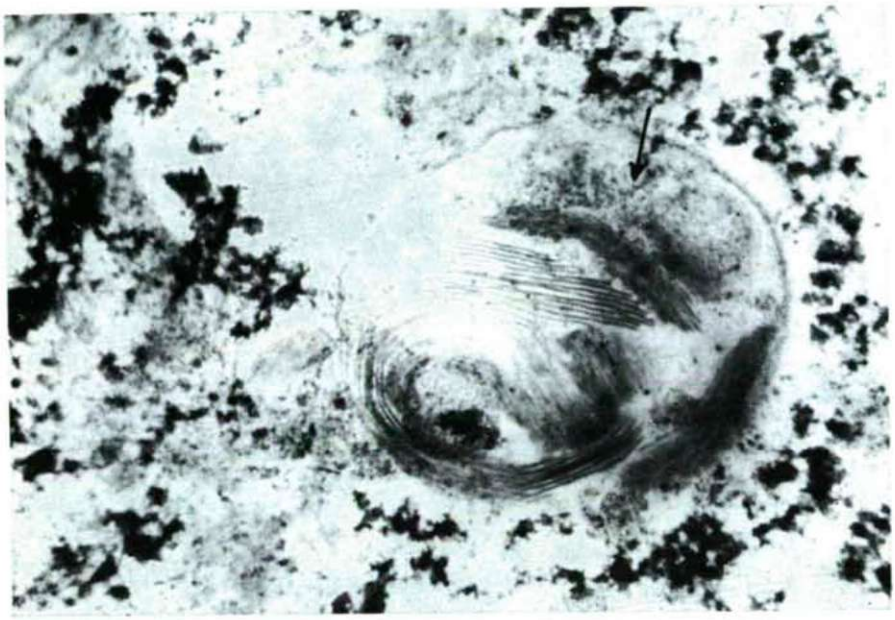


2

Fig. 1. Crystalline bodies progressively disintegrating. (ER — endoplasmatic reticulum, N-nucleus). x16 000.
Fig. 2. Bodies of a loose membrane — system. x64 000.

Plate IV

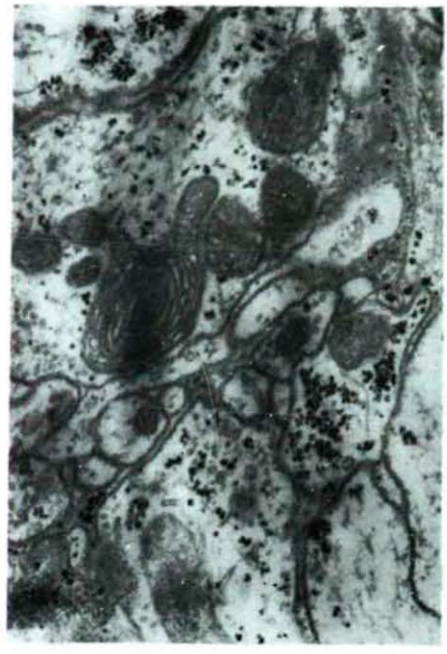
1



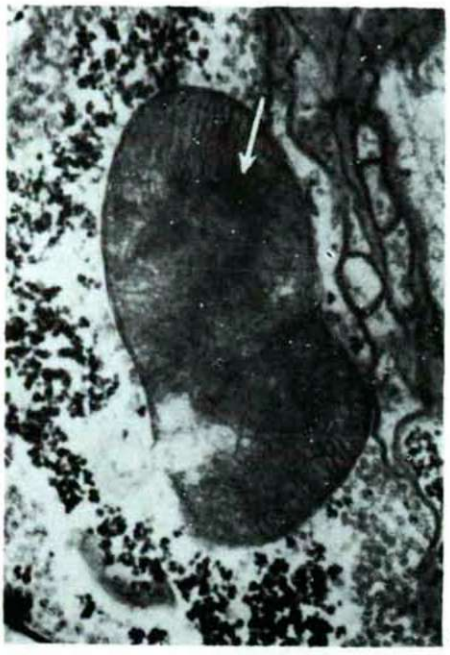
2

Fig. 1. In the centre of crystalline bodies dense granules appear at first. (Granules are indicated by arrows). x36 000.
Fig. 2. A gradually evacuating body. (The arrow is pointing at the matrix of changing density.) x36 000.

Plate V



1



2

3

Fig. 1. A transforming mitochondrium from the thoracic ganglion-cell of the larva. x20 000.
Fig. 2. A transforming mitochondrium. (The arrow is pointing at the change in density of membranes.) x28 000.
Fig. 3. A transitory form between the mitochondrium and the paracrystalline body. x48 000.

are in fact, transforming, changing mitochondria, with insertion of the paracrystalline bodily state.

The literature data indicate that the cytosomes appear as a "Stoffwechseldepot", mostly under anoxic conditions (NOLTE et al., 1965; ZS.-NAGY, 1975). The anoxic conditions are explained by the low development of the metabolic organelles of the individuals examined.

Whether these organelles conform in full with the cytosomes described from molluscs (Mollusca) we want to decide later, by means of histochemical and experimental investigations.

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