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On the formation of ephippia in some Cladocera (Crustacea).
A.V. Makrushin & G.I. Markevich. (1982)
Zool. Zh. 61, 9, 1425-27.
Translated by J.E.M. Horne.

The determination of relative connections between families and genera of Cladocera, necessary for the construction of their natural systems, must be based on various criteria, among them on the structure of the ephippia. Of particular interest is the study of the process of formation and structure of the ephippium in Macrothricidae, different representatives of which differ significantly among themselves according to this criterion (Makrushin 1976). In the offered article are presented the results of an investigation of the features of formation of the ephippium in seven species of Macrothricidae and in the moinid Moina weismanni Ishikawa (Moinidae).

Bunops serricaudata (Daday) was taken from laboratory culture, obtained from ephippia collected in the littoral zone of Rybinsk reservoir. Ophryoxus gracilis (Sars), Acantholeberis curvirostris (O.F. Müller), Streblocerus serricaudatus (Fischer) and Lathnura rectirostris (O.F. Müller) were taken in the neighbourhood of Leningrad, Ilyocryptus sp. and Drepanothrix dentata (Euren) in the neighbourhood of Saratov. Moina were recovered from dry silt brought from the Namagan district of the Uzbek SSR. For the investigation we used a histological method - fixation in Bouin's fluid, preparation of paraffin sections of thickness 7 micrometres, stained with Heidenhein's iron haematoxylin. We studied the structure of the surface of the ephippium of Bunops by scanning electron microscope ISM-25-S with an accelerating voltage of 15 kv. On the surface of the ephippium we first sprayed a layer of gold.

The shell of Cladocera consists of two sheets of hypodermis. The external sheet forms the external envelope of the ephippium, the internal (lining the brood pouch from within) - is the internal envelope. In Bunops the ephippium begins to differentiate from the valves of the shell before the passing of the latent eggs into the brood pouch, during their trophoplasmatic growth in the ovaries. In individuals, the latent eggs of which are already in the brood pouches, on the external surface of the valves of the shell are visible numerous, closely packed swellings of chitin. (fig. 1, I, K, 1).

The female glues the ephippium to filamentous algae (Markevich 1980). It is heavier than water and contains two eggs. (Keilhack 1909; Dejdar 1927). Sometimes encountered in culture are Bunops ephippia with a single egg and empty, probably, one must presume, an abnormal event. In fig. 1, D is shown a section of an ephippium of this species. Because the surface of the envelope of the ephippium was inclined on the plane of the section at an acute angle, the external (3) and internal envelopes (6) fell in fairly broad bands in the section. The external envelope at low magnification appears divided into hexagons (fig. 1, D; 2, A). With stronger magnification it is seen that each hexagon represents a dome-shaped swelling of chitin (fig. 2, B). Along the edge of the ephippium the swellings are absent (fig. 2, C).

The internal envelope of the ephippium - derived from the internal sheet of the hypodermis of the shell - is amorphous (fig. 1, D, I, K, 4, 6). The origin of the gluing substance, thanks to which the ephippium is glued to

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filamentous algae, and the location of this substance in the ephippium have not been clarified. The eggs in the ephippium of Bunops are disposed in locules * - bulges in the valves.

In Moina, as in Bunops, the accumulation of yolk in the latent egg is accompanied by a change in the external sheet of the hypodermis of the shell. After transfer of the latent egg into the brood pouch the surface of this sheet is already covered with a layer of pressed-together chitinous chambers (fig. 1, G, 2). The released ephippium drops to the bottom.

Hyocryptus (fig. 1, A), Acantholeberis (fig. 1, B), Lathonura (fig. 1, C), Ophryoxus (fig. 1, E), Drepanothrix (fig. 1, F) and Streblocerus (fig. 1, H) differ from Bunops and Moina thus, that in them with the formation of the ephippium there does not appear any kind of structure in the outer layer of chiton of the shell (1). Drawings of sections of ephippia of Ophryoxus and Acantholeberis are presented by Fryer (1972). In these, both envelopes of the ephippium have the appearance of simple sheets of chitin.

Methods of formation of the ephippium in Macrothricidae are diverse. In gamogenetic females of Drepanothrix (fig. 1, F) and Streblocerus (fig. 1, H), the cells of the internal sheet of the hypodermis of the valves of the shell (9) are increased and secrete a thick layer of modified, perhaps, sticky chitin (5). It is known that Streblocerus sticks ephippia to underwater objects (Fryer 1972). In Acantholeberis (fig. 1, B), the internal sheet of the hypodermis also produces a sticky secretion (5), but the histological picture in this case is different (Makrushin 1976), Lathonura sticks its ephippia by modified chitin of the hind gut and postabdomen (Makrushin 1970; Fryer 1972). In Ophryoxus the ephippia are devoid of a sticky substance (Makrushin 1972) and are fastened to underwater objects with the aid of hooks (Fryer 1972).

Bunops occupies a peculiar place among the Macrothricidae. The dome-shaped swellings of chitin on the external envelope of the ephippium of this species are like the air chambers of the ephippia of Daphniidae and Moinidae, not described anywhere else in the Cladocera. In the Daphniidae the air chambers are found also in the external envelope of the ephippium and are formed, according to the results of investigations by Wolff (1904) and Zwack (1905, 1907) as in Bunops and in Moina by the external sheet of the hypodermis of the valve of the shell.

In the ephippium of Bunops, as in Daphniidae and Moinidae, constant for the species is the number of eggs, which are placed in the locules. Whether this similarity of Bunops with Daphniidae and Moinidae indicates their affinity or it originates in them independently is not clear. Macrothricidae differ among themselves not only by the ephippia but, as was shown by Wingstrand (1978), by peculiarities of spermatogenesis and structure of spermatozoa. In the opinion of this author, the Macrothricidae is a heterogeneous group, originating from different ancestors.

* lit. "spoons" (translator)

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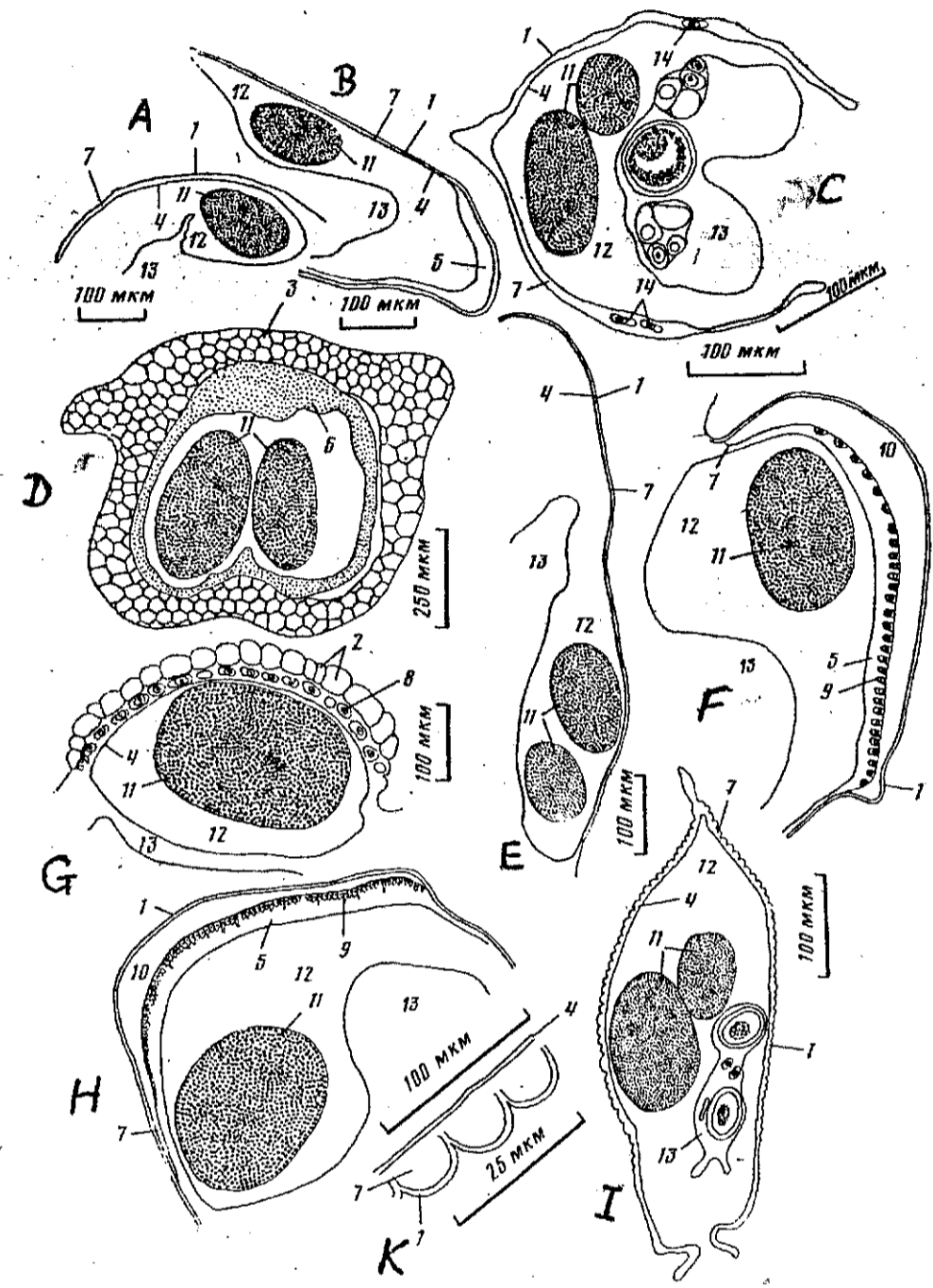


Fig. 1. Sections of the brood pouch of gamogenetic females:
 A - *Ilyocryptus* sp., B - *Acantholeberis curvirostris*, C - *Lathonura rectirostris*, E - *Ophryoxus gracilis*, F - *Drepanothrix dentata*,
 G - *Moina weismanni*, H - *Streblocerus serricaudatus*, D, I, K - *Bunops serricaudatus*.

A, B, E, F, G, H - longitudinal sections
 C, I - transverse sections
 D - longitudinal section of ephippium; K - transverse section of a part of the valve of the shell of the female, in which the latent egg is found in the brood pouch; 1 - external layer of chitin of the shell; 2 - chitinous chambers; 3 - external envelope of the ephippium; 4 - internal layer of chitin of the shell; 5 - layer of changed sticky chitin; 6 - internal envelope of ephippium; 7 - hypodermis; 8 - enlarged cells of external sheet of hypodermis, forming the chitinous chambers of the ephippium; 9 - enlarged cells of internal sheet of hypodermis, forming the layer of sticky chitin; 10 - gap between chitin and hypodermis developed in the process of preparing the preparation; 11 - latent eggs; 12 - space of brood pouch; 13 - body of crustacean; 14 - cells of unknown nature.
 Scale (micrometres). A - C, E - I - 100; D - 250; K - 25.

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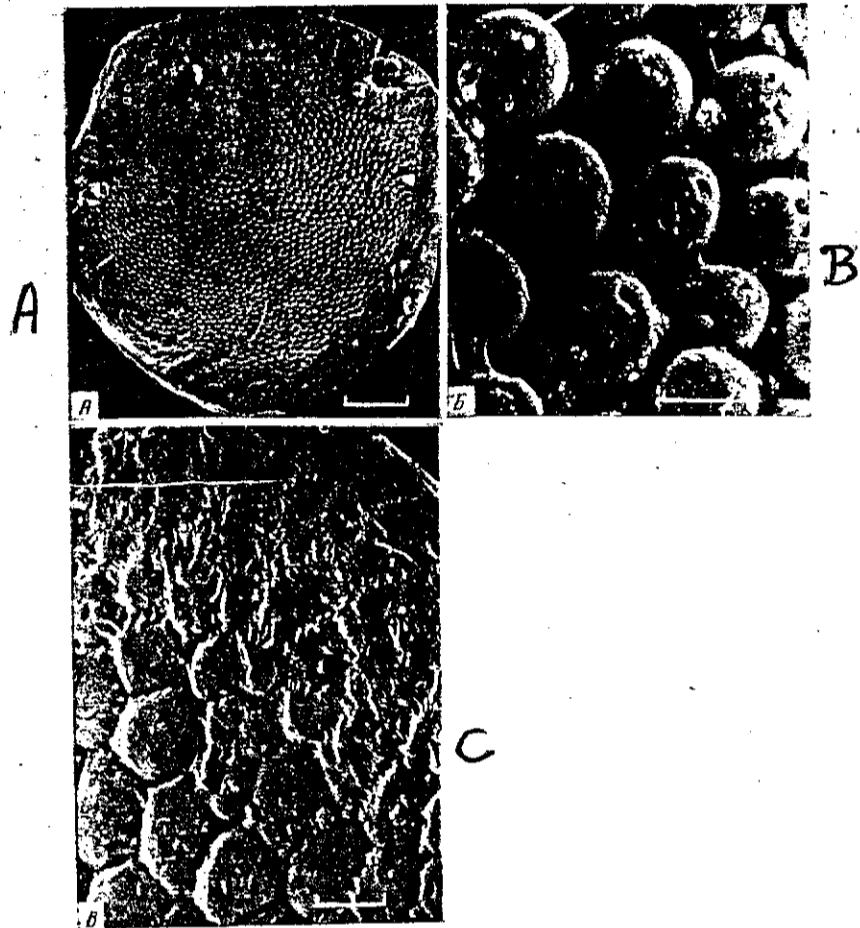


Fig. 2. Ephippia of *Bunops serricaudata* by scanning electron microscope.
A - general views; B - dome-shaped swellings of chitin in centre of
ephippium; C - edge of ephippium.
Scale (μm) A - 100; B, C - 10.

Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.