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Title: On the structure of the seminal receptacle in cyclopids (Copepoda, Cyclopoida).

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On the structure of the seminal receptacle in cyclopids (Copepoda, Cyclopoida).
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Translated by J.E.M.Horne.

The seminal bag, or seminal receptacle, forms a characteristic organ of cyclopids, serving for retention of the sperms discharged from the spermatophores. It occupies a median position on the genital segment, situated near the abdominal surface of the segment, where it is revealed by a special unpaired opening on its longitudinal axis. On the sides this opening is enveloped with chitin, forming a small papilla turning up into the cavity of the seminal bag. Near the external opening into the bag discharge the short channels of the oviducts. Each channel is strengthened with the help of a special chitinised strand running from the integument of the segment. The walls of the seminal receptacle are devoid of glandular cells and are covered with thin cuticle. (Rylov, 1948).

The structure of the seminal receptacle, more precisely its form, is fairly widely used in diagnosis and undoubtedly can be more widely applied in the systematics of the group. Within the limits of the family Cyclopidae it is possible to distinguish crustaceans with three basic types of seminal bag. The differences consist of the position which this organ occupies in the genital segment. In the majority of species of the genus Cyclops the seminal receptacle is located in front of and behind the external opening with the channels of the oviducts. The second type is found in species of the genus Acanthocyclops, in which the seminal bag is located in the anterior part of the genital segment, over the external opening. And finally, the position of the greater part of the seminal receptacle behind the opening with the channels of the oviducts is characteristic for species of the genus Mesocyclops. Taking into account the importance of the organ for diagnostic purposes, but also the significant variability of its form in individuals

of one species, we carried out a series of observations on its formation in ontogenesis and during the life of the adult stage. As material for observation we used laboratory cultures of three species: Acanthocyclops americanus (Marsh) from the plankton of the Moscow River, Cyclops vicinus Uljan and Mesocyclops leuckarti Claus from the plankton of the channel section of the upper part of the Gor'kovsk reservoir.

Observations on the first species were carried out during two years (1965-1966), on the other two during five months (July-December) of 1967. Conditions of culture approximated to those in the experiments of A.V.Monakov (1959), but temperature was taken into account by a thermograph in the neighbourhood of a small aquarium vessel, which provided minimal divergence of temperature of the water and the air. We succeeded in obtaining a sequence of generation with gradual and directional changes of temperature, as it usually goes on in nature.

Results of the observations on a series of characteristics (duration of metamorphosis, length of life, level of fecundity, rate [? time] of reproduction, etc.) appeared close to the data of authors carrying out similar observations in nature. (Meshkova, 1952; Monakov, 1959; Shuskina, 1964). Therefore one must assume that the cited materials on the morphology and ontogenesis of the seminal receptacle can be utilized in the study of natural populations.

408 measurements of the seminal receptacle and numerous drawings underlay the present work. The establishment of the organ in ontogenesis proceeds at the time of the moulting of the copepodite of the 5th stage. The seminal bag is formed from the chitinous intersegmental fold between the first and second segments of the abdomen, which after this form a single unit - the genital segment. Immediately after moulting the seminal receptacle is almost devoid of a cavity and has united walls. The form specific for the species is shown only after some time: from a few hours to a day or more. But only after copulation and the filling up of the cavity of the seminal receptacle by sperm does it acquire the final size and form normal for the species,

and in the absence of copulation the seminal bag retains its initial size, significantly smaller in comparison with the normal.

After two-three clutches noticeable changes in form and size of the seminal receptacle have still not taken place (fig. 1,b and 2, b). Subsequently the quantity of sperm drawn in through the channels of the oviducts by the eggs of the following clutch passing along them is reduced and the remaining sperm swells, filling up the freed space. In addition, they become noticeable of outline as separate sperms, assuming for lack of space a many-angled form. Such "honeycomb contents" of the seminal receptacle, according to the expression of Walter (1922), is characteristic precisely for this stage of its functioning. It matches approximately the middle period of the reproduction of the female. The following clutches affect so significant a reduction of the quantity of sperm that the remaining sperms, continuing to swell, assume a rounded form and come loose from the wall of the organ, concentrating in the centre, near the channels of the oviducts. The space freed within the organ is well marked (fig. 1c). With its appearance begins the shrivelling of the wall of the organ, usually noticeable in its posterior edge; the posterior fringe becomes at first slightly, but subsequently always more wrinkled. The length of the seminal bag with each successive clutch becomes significantly smaller (fig. 3). Besides the size, the form of the organ and the character of its contents change. The chitinised fringe along the edge of the bag, found from the beginning of the reproductive stage only in certain species of the genus Acanthocyclops for example in A.americanus, becomes always more marked, and subsequently also broader. The space, freed with the contraction of the organ, inside the segment fills up with a spongy mass. The remaining sperms are open to calculation, their diameter becoming significantly more than previously (fig. 1d and 2c).

Finally, with the retaining of the capacity to function by the ovary, the seminal receptacle to the end of the period of reproduction and of the life of the individual appears empty.(fig. 1e). The reality of repeated copulation with a sufficient number of males almost at any time in natural conditions excludes the chance of finding similar examples. In our cultures copulation repeatedly recurred, but in the investigated species it is doubtful if it had any marked significance. A small duration of life (a high level of

elimination), as a rule, does not give the chance to realise not only the potential possibility of the ovary, but also to exhaust the stock of sperm, received even during a single copulation. Individuals netted in nature after repeated copulation, about which it is possible to judge by the structure of the seminal receptacle and the presence of spermatophores, produced at the rate of one or two clutches and died.

In individuals growing-up completing reproduction in the experiment, the character of the age changes of the organ is such that with repeated copulation all the sperms from the spermatophores are not able to enter the seminal receptacle. During the following 4-5 days the renewed stock of them is spent almost wholly on the next clutch (fig. 1d). On the basis of these factors it is possible to surmise that the cavity of the organ is absent (fig. 1e), inasmuch as its dorsal and ventral walls come together.

Thus the irreversibility of the changes in the seminal receptacle presents the possibility of utilising this structure as one of the indicators of the growth of the individual.

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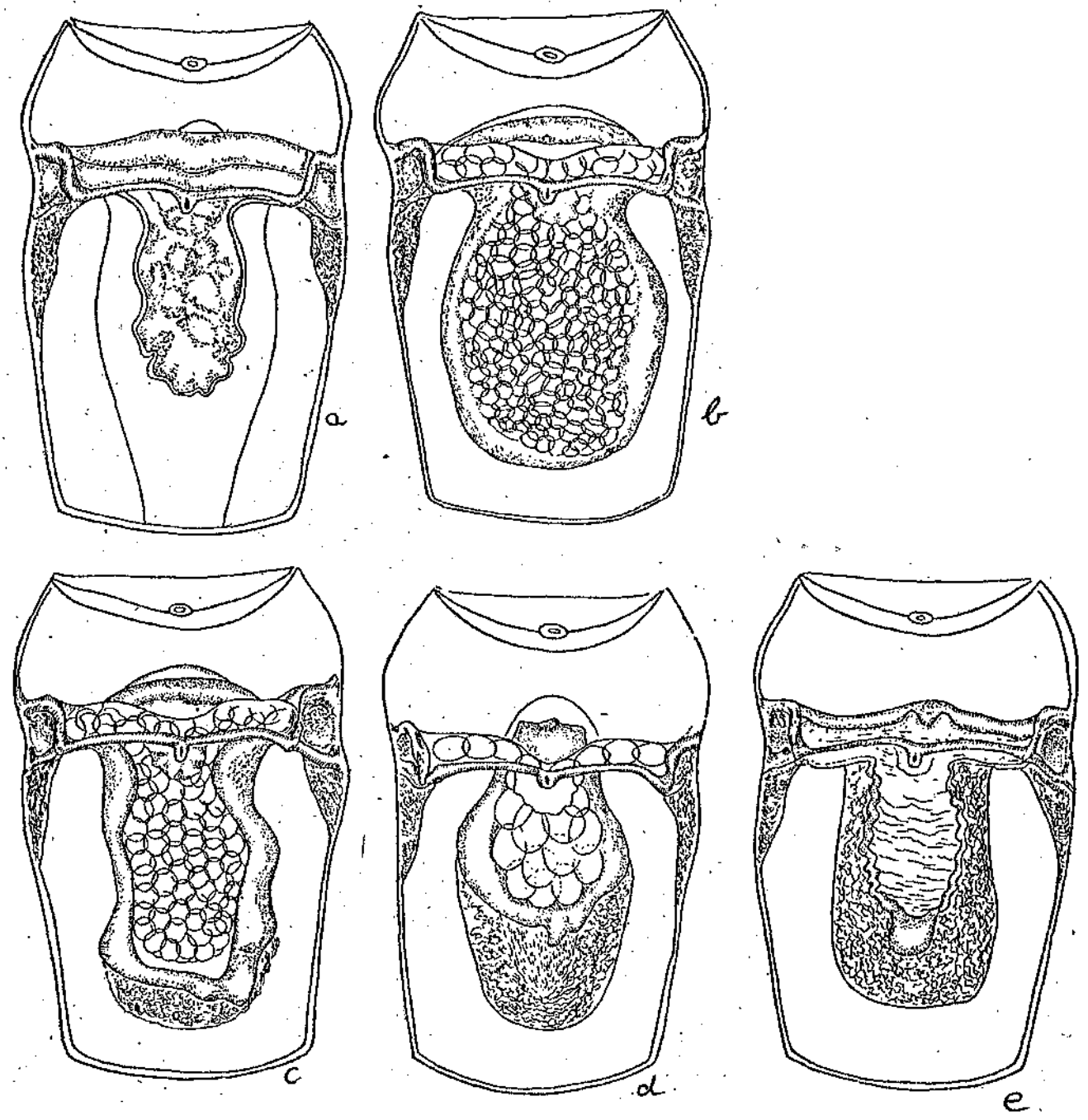
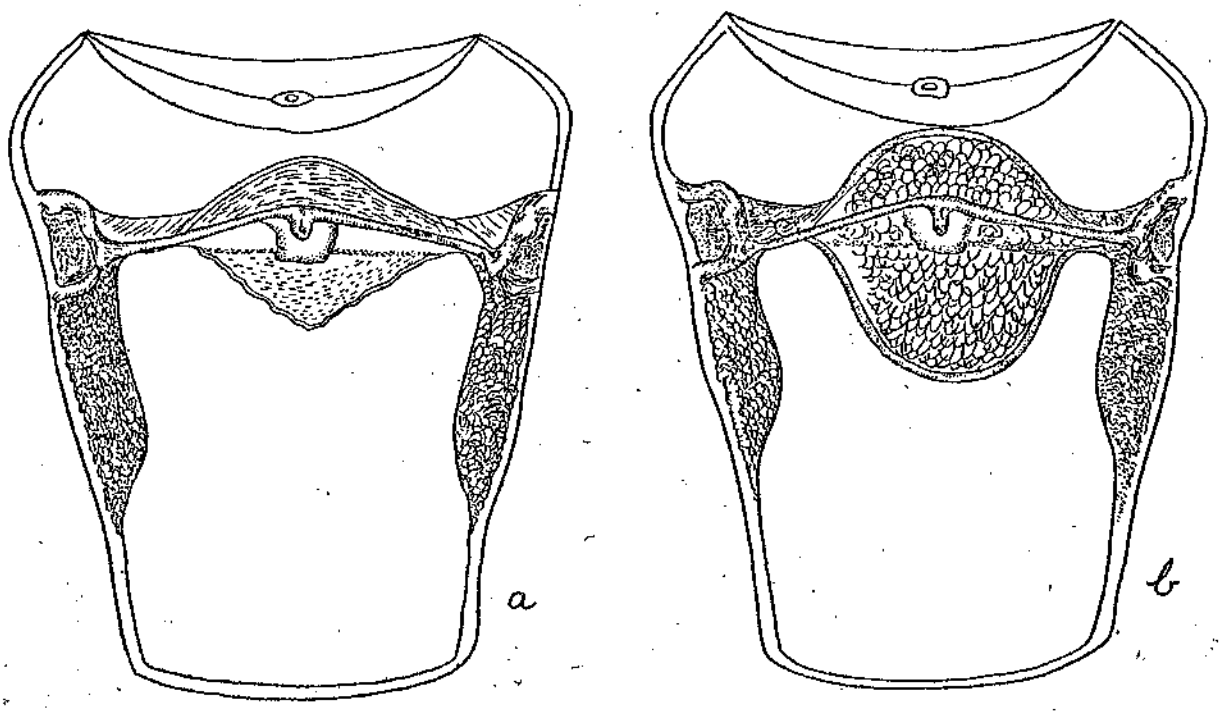


Fig. 1 Changes of form of the seminal receptacle of Mesocyclops leuckarti during the period of sexual activity of the female.

a - after moulting of the copepodite of the 5th stage;
b - after copulation and discarding of spermatophores;
c - in the second half of the period of reproduction;
d - after the discharge of the last clutch;
e - shortly before the dying of the individual



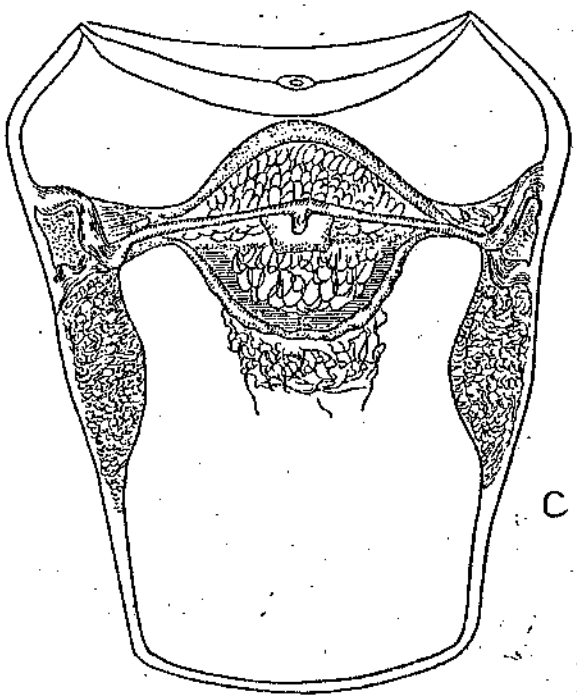


Fig. 2 Morpho-functional condition of the seminal receptacle of Cyclops vicinus.

a – at the beginning of the adult stage

b – in the middle of the period of reproduction

c – at the end of the period of reproduction

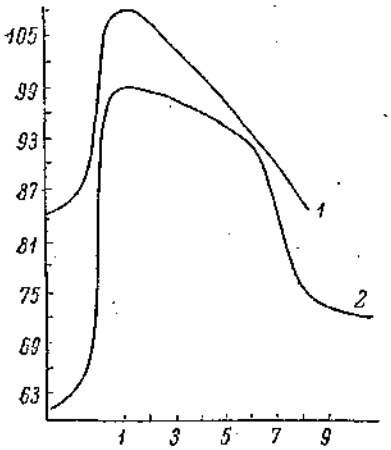


Fig. 3 Changes in length of the seminal receptacle during the life of the adult stage of two species of cyclopid.

1 – Mesocyclops leuckarti;

2 – Cyclops vicinus.

Abscissa – ordinal number of clutches during life of female;
Ordinate – length of seminal receptacle, microns.

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.