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SEX RECOGNITION IN CYCLOPS.

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The sexual behavior of copepods presents several points of similarity with that of the amphipods which was described by the writer in a previous paper.¹ In both groups the males clasp and swim about with the females for a long time previous to copulation ; and in both groups the behavior of the female is much the same while being clasped by the male. Having an opportunity to study a thriving culture of *Cyclops fimbriatus* in which pairing was actively going on the endeavor was made to ascertain if the method of the sex recognition employed in the amphipods occurs also in this species of a quite distantly related group.

Male *Cyclops*, as is well known, have the first antennæ enlarged and modified to form a clasping organ. In *Cyclops fimbriatus* the male usually clasps the female just in front of an enlargement at the base of the abdomen. Females carrying eggs are sometimes seized, and also females not more than half grown. Males show great eagerness in grasping the females, and they can be compelled to release their hold only with difficulty. They may be poked about roughly with a needle and the posterior part of the body may be cut off without causing them to leave the female. I have often picked up pairs in a fine pipette and forcibly squirted them out several times without succeeding in separating the two sexes.

As the pairs of *Cyclops* swim through the water the males are usually the more active. Frequently the female remains entirely quiet with the appendages drawn close to the body, and the body flexed ventrally, allowing herself to be passively carried about by her mate. At other times the female may swim as actively as the male. In general the behavior of the females and their attitude while being carried closely resemble what is found among the Amphipoda. So also does their behavior when the males come in contact with them and attempt to seize them. The

¹ BIOLOGICAL BULLETIN, Vol. 5, 1903.

female during the efforts of the male to clasp her around the base of the abdomen usually lies quiet with the appendages drawn close to the body. She may be seized by the legs, tip of the abdomen, or any other part of the body, but the male works around until he gets into his normal position which he sometimes attains only after much labor. Females vary greatly however in respect to their willingness to be clasped by the male, certain individuals resisting seizure for a long time.

So far as could be detected the males do not seek or follow the females at a distance as Parker concluded they did in *Labidocera*. The association of the sexes seems to be due merely to chance collisions. Males often attempt to seize other copepods with which they collide regardless of their sex. The males resist such attempts at seizure and dart quickly away, while the females often stop and submit readily to the clasping propensities of their companions. Several males were injured so that they could not resist seizure, and in many cases they were seized by other males who worked industriously until they got their burden clasped around the base of the abdomen in the usual way. These associations did not last long however; the active males apparently appreciating that something was wrong soon swam away. Recently killed females were often seized and in some cases carried about for a while, but they were finally dropped. Males seem rather more prone to seize dead females than members of their own sex. In one case I saw three males tugging away at a dead female, and they were soon joined by a fourth male who participated in the same effort.

It is possible that the odor of the female determines to a certain extent the sexual behavior of the males, but my experiments yielded no evidence of this. Several females were put into a tube one end of which was covered with fine gauze and the tube was then placed obliquely in water in which were numerous males. The males showed no tendency to congregate around the end of the tube where the females were confined. In another experiment several females were placed in a glass tube in which a small plug of loose cotton was inserted a short distance from one end. This end was laid obliquely in the water. The males showed no tendency to enter the open mouth of the tube as they

might be expected to do if they were attracted by the odor of the females. The experiment of removing the organ of smell which was performed in the case of the amphipods would be a fruitless one in *Cyclops*, as the seat of smell is located to a considerable degree at least in all probability in the same organs that are used for clasping.

It is evident that mating in *Cyclops* is brought about much as it is in the Amphipoda. The males have a strong tendency to clasp other copepods; the females tend to remain quiet in a condition somewhat resembling the death feint while being seized by the males. It is not improbable that olfactory stimuli may cause the males to remain with the females longer than they otherwise would, and they may render the males rather more prone to seize females than other males, but so far as could be determined by watching the behavior of the animals the specific reaction of the two sexes to certain kinds of contact stimuli is the main factor in bringing about their association.