A NOTE ON THE OCCURRENCE OF SEX ORGANS IN AELOSOMA.[1]

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The genus *Aelosoma*, representing the family *Aphanoneura*, and containing the most primitive members of the oligochaetous annelids, is remarkable, among other things, in that sexual reproduction occurs very rarely, the asexual method being the usual one. The latter consists in a process of fission or budding, by which the young individual is constricted off from the posterior portion of the parent, this process often taking place so rapidly that chains of individuals are formed, representing three or more generations. This process is continuous during the life of the individual, and probably amply suffices, as far as numbers are concerned, to insure the maintenance of the species. Sexual reproduction does, however, step in occasionally, and has been described by U'Ddekem in 1862,[2] and more recently by Stolc[3] and Maggi.[4] According to these authors a testis is found in the fifth segment, (counting the prostomium as the first); an ovary

1 Contributed from the Laboratory of Entomology and General Invertebrate Zoology of Cornell University.
2 Bull. Acad. Sci. Roy. Belg. XII.
3 SB. Bohm. Gesc. 1889.
4 Soc. Ital. Nat. Sci. I.

with a central opening in the sixth segment; pairs of spermatothecae in the third, fourth, and fifth segments; and a clitellum confined to the ventral surface of the fifth, sixth and seventh segments.

Among a number of individuals of an undescribed species of *Aelosoma*, taken from the vivarium of the University of Pennsylvania about December 1st, 1901, ten were found containing the sex products in various stages of development. Of these three were hermaphroditic, four contained ova alone, and three male sex cells alone. Thus while this species is plainly hermaphroditic, it seems probable that eggs and sperms do not mature simultaneously in the same individual. The occurrence of ripe spermatozoa, (represented in Fig. 5), and immature ova in the same individual indicates that the species is protandrous, but the evidence is insufficient to decide this question. Many of those in which sex cells were found were also reproducing asexually in the usual manner.

The ova, (Fig. 1), are found in the fifth, sixth, and seventh segments, in some cases in only one of these segments, in others in all three. One individual, however, contained ova in the fourth, fifth and sixth segments. They are attached to the thin peritoneal layer lining the body cavity, and lie below the stomach and lateral to the ventral blood vessel, In Fig. 1 the larger of the two ova represented is by far the largest observed, measuring ca. 55 micra across, and is probably approaching maturity. It occupies a median position, compressed between the stomach wall (st.) and the ventral hypodermis (hyp.), the walls of the ventral blood vessel (b. v.) having been ruptured. The smaller ovum occupies the usual position. Both ova possess a vesicular nucleus (germinal vesicle) containing scattered chromatin granules and a large nucelolus, enclosing a vacuole. The cytoplasm is packed with deeply staining yolk granules. The number of ova is small in all of my preparations, one of the best showing only eight in the three ova-bearing segments. No evidences were found of an oviduct, a clitellum, or of spermatothecae.

Although no clear evidence of the presence of testes was found the ripening male sexual elements (Figs. 2–5) were seen floating free in the body cavity, being found in greatest abundance near the point where stomach and intestine join. They appear as groups or nests of cells, more or less spherical in form. Four kinds of these can be readily distinguished by the character of their component cells; the primary spermatocytes, the secondary spermatocytes, the spermatids, and the spermatozoa. The primary spermatocytes, (Fig. 2), form cell nests made up of comparatively few cells, in size the largest of the series, their nuclei measuring ca. 3.9 micra in diameter. As Fig. 2 shows,

the nuclei lie at the outer ends of their cells; each contains a closely packed ball of chromatin granules, separated from the nuclear membrane by a slight space, while at the periphery of the nucleus is a large and conspicuous nucleolus (plasmasome). The cytoplasm is faintly granular. The secondary spermatocytes make up cell masses similar to those of the primary spermatocytes, differing from the latter only in the size and number of the component cells. The cell masses of which the spermatids are composed, however, present a very different appearance, (Fig. 4). The nuclei, although now much reduced in size, still show the closely packed ball of chromatin granules and the prominent nucleolus characteristic of the two former stages, and have also

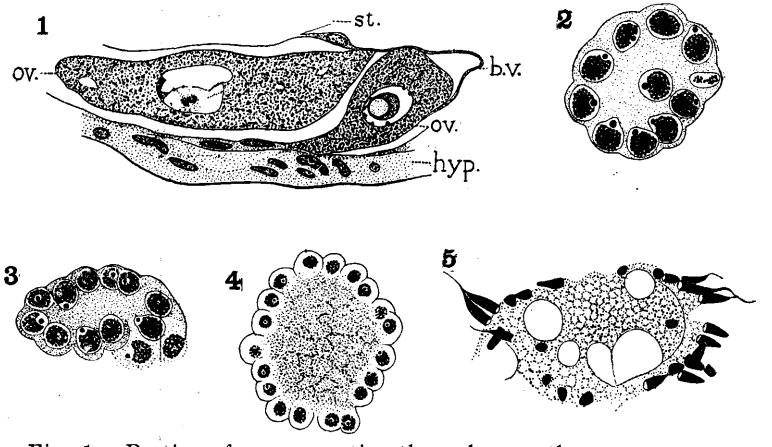

Fig. 1. Portion of a cross-section through seventh segment, two ova (ov.), lying between the stomach wall (st.), and the ventral hypodermis (hyp.); Fig. 2, primary spermatocytes; Fig. 3, secondary spermatocytes; Fig. 4, spermatids; Fig. 5, spermatozoa. Fig. 1, x 770; Figs. 2–5, x 1050.

maintained their position at the periphery of the cell mass. Each nucleus is now surrounded by an area of clear cytoplasm, the clear areas of the different cells being contigous, so that the cell mass is divided into an external zone of clear and transparent cytoplasm, within which is a mass of darkly granular cytoplasm, which already shows signs of vacuolization. This latter mass, of course, represents the inner ends of the spermatids. Between the spermatids and the ripe spermatozoa, no intermediate stages were found. The spermatozoa, (Fig. 5), consist of a long fusiform chromatic portion, which no doubt represents the spermatid nucleus, and which tapers posteriorly to join with a slender tail, composed of clear cytoplasm. The anterior end of the chromatic portion is sharply truncate, and somewhat concave. In this concavity lies the biconcave, clear, apical body. The

spermatozoa surround a mass of protoplasm, within which their heads are buried. This mass, greatly vacuolated, and clearly in process of degeneration, represents the granular mass formed by the central ends of the spermatids. Thus only a slight portion of the original cytoplasm takes part in the formation of the spermatozoan, by far the larger portion being cast aside. It is, of course, possible that this mass may serve for a time to nourish the spermatozoa, although it would seem likely that the blood lymph contained in the coelom would suffice to perform that function.

In the maturation of the male germ cells one point is especially noteworthy, namely, the appearance of a large nucleolus in the spermatocytes of both orders and in the spermatids. With but rare exceptions, throughout the animal kingdom the maturation divisions occur without the intervention of even a brief resting stage. The formation of a nucleolus, then, of such a considerable size in comparison with the cell size is remarkable in indicating the occurrence of a long resting stage between the two maturation divisions, and also a long pause before the metamorphosis of the spermatid into the spermatozoon.

With respect to the sexual reproduction of *Aelosoma* several questions arise, which are still unanswered. For example, it is important to discover what factors determine the occurrence of sexual reproduction; whether due to changes in temperature, food supply, or to some other cause; the breeding habits should be carefully studied, and the complete history of the sex cells recorded. Species of *Aelosoma* are found abundantly in our inland ponds and streams, and are easily kept in aquaria throughout the year, I hope these facts may stimulate some one to the further investigation of the life history of this beautiful form.