

## AN UNUSUAL CILIUMLIKE PROCESS

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A generalization, made as a result of the use of the electron microscope, is that cilia, flagella, sperm tails, and a number of sensory structures are based on a single structural plan, the essential features of which are a ring of nine double tubules or cylinders surrounding, except in the sensory structures, a pair of tubules. Recently, this same association of nine outer elements with an inner core has been demonstrated in the myofilaments of different muscles (1), but, though the numerical, and possibly functional, similarities are striking, the myofilament is some ten times smaller. A similar ar-

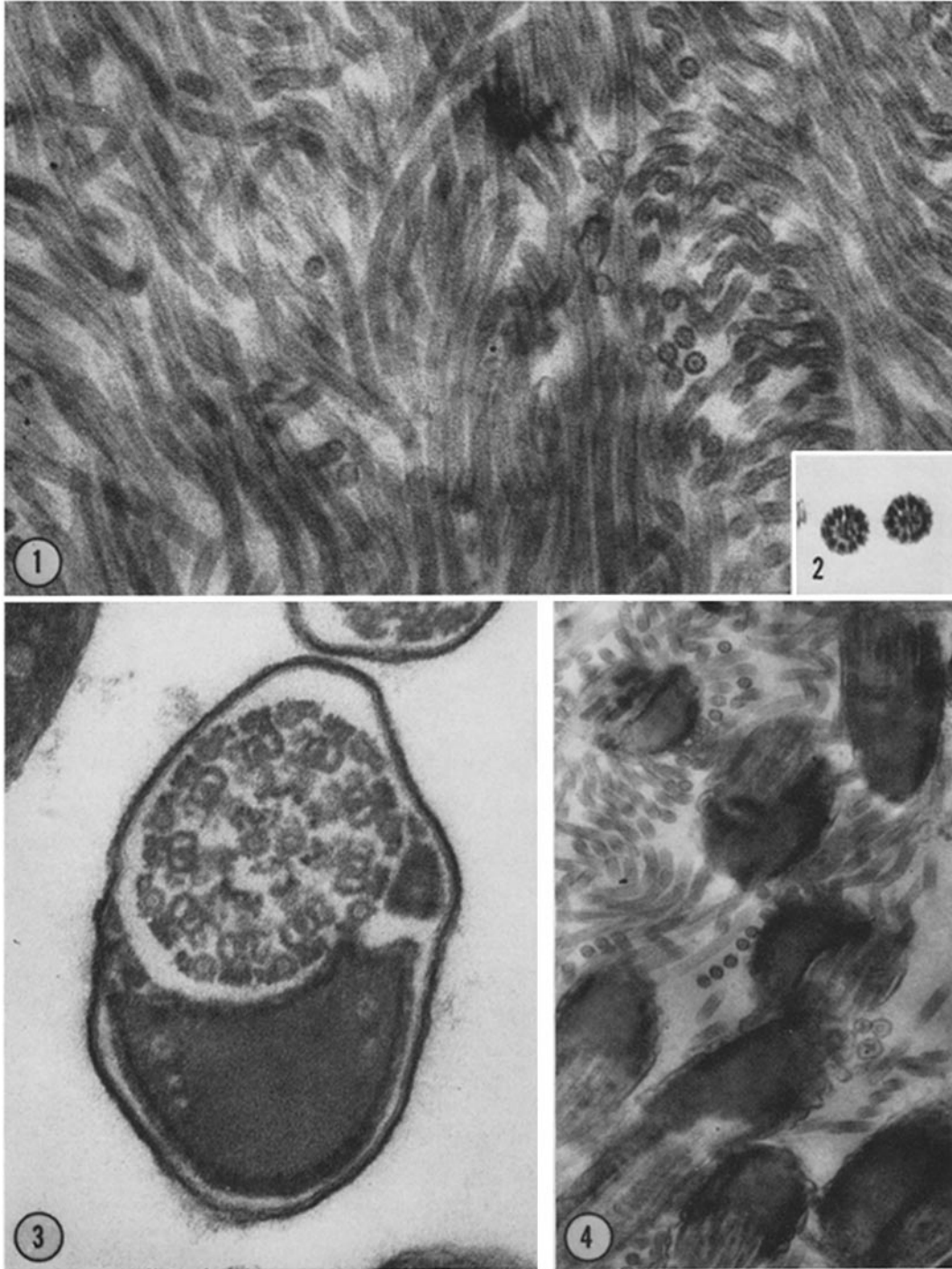


FIGURE 1 Electron micrograph showing the long undulating shape of the ciliumlike processes in the seminal receptacle of *Drosophila melanogaster* ♀.  $\times 68,000$ .

FIGURE 2 Cross-section of two ciliumlike processes.  $\times 156,000$ .

FIGURE 3 Cross-section of sperm tail showing absence of any structure resembling a ciliumlike process.  $\times 160,000$ .

FIGURE 4 Electron micrograph showing ciliumlike processes amongst the sperm in the seminal receptacle.  $\times 41,000$ .

rangement of elements is found in the  $\alpha$ -keratin molecule (2), but this is half as small again.

It is, therefore, unusual to find a ciliumlike process with a circle of ten, and not nine, elements, and this is apparently the first report of such processes.

#### MATERIAL AND METHOD

The coiled seminal receptacles of *Drosophila melanogaster* females were dissected out in saline and immediately fixed in chilled phosphate-buffered osmium tetroxide (1%) for 1 hr. The tissues were embedded in Epon, and contrast in sections was improved with lead acetate or citrate.

#### OBSERVATIONS

Sections of the distal part of the coil of the seminal receptacles of inseminated females show that amongst the sperm tails in the lumen there may be a number of much smaller elongated structures which are not found in the narrow proximal parts of the receptacle (Fig. 1). Cross-sections of these structures (Fig. 2) show a number of remarkable features. First, there is an outer ring of ten, not nine, elements. Second, these elements are V-shaped and not tubules or cylinders as in cilia and flagella. Third, there is no encircling membrane. Fourth, their diameter is about 500 A, in contrast with that (1500 to 2000 A) (3) of the axial filament complex. Lastly, their undulating appearance suggests that they may be motile.

Though their structure is clear, their source is unknown. I have never seen them in the receptacles of virgin females, nor have they been seen to be attached to the walls of the receptacles in the inseminated flies. The only other possible source is the male, but I have not so far found them in any sections of testes, nor have they been reported by other electron microscopists who have worked with *Drosophila* (e.g. references 4-6).

Perhaps significantly, the processes occur in roughly the same numbers as the accompanying sperm. This, and their lack of a membrane, might suggest that they are derived by degeneration from the sperm themselves. However, their size is against this explanation. A cross-section of a sperm tail (Fig. 3) shows that there is no component structure large enough to play this role.

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#### DISCUSSION

In the sperm tail (Fig. 3) the tubular fibers of the outermost ring have the same structure as the two in the center, and similar fibers have been reported to occur in two unrelated insects (7, 8). It is, therefore, tantalizing that the fibers in the sperm of yet another insect, *Acheta domestica* (9), are composed, not of concentric rings, but of ten outer fibrils arranged around four inner. But, again, this structure is smaller than the ciliumlike processes under discussion, being about half the size.

Completing the list of structures which are possibly related are the stereocilia, as found in the membranous labyrinth (10) and oviduct (11). While the stereocilia have about the same diameter as the new processes, their internal structure, if they have any fibrils at all, is not clear, and thus any similarity may only be functional (see also reference 12).

Though the testis seems to be ruled out as their origin, the ciliumlike processes may be formed elsewhere in the genital tract of the male. This has not yet been examined. Another possibility, though remote, is that the processes have their origin in a parasite.

One assumes that these processes have a function. If so, it may be concerned with their apparent motility. Often the processes are oriented in the same way as the sperm, that is, parallel to the length of the receptacle. It is possible that the processes act in the same way that the flagella of flame cells do to keep a current of fluid moving. The sperm of *Drosophila* are extremely long (>2 mm) and they appear to migrate within the female between the seminal receptacle and the spermathecae. Furthermore, the sperm appear to have to turn back on themselves at some stage if they are to be correctly oriented at fertilization. All this activity may require that the surrounding fluid should be stirred up more than is possible by the sperm alone, especially if these are moved to some extent by the muscles of the surrounding organs. Work in progress may supply an answer.

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