G. W. Bailey, Ed., *Proceedings of the 43rd Annual Meeting of the Electron Microscopy Society of America*

ULTRASTRUCTURE OF THE SPERMATOPHORE OF A MEALWORM BEETLE

C.S. Bricker and G.M. Happ

Dept. of Zoology, University of Vermont, Burlington, Vermont 05405

The male mealworm beetle, Tenebrio molitor, transfers sperm to the female by means of a spermatophore, or sperm sac. This study was undertaken to determine the ultrastructure of the spermatophore and the origins of its components.

For ultrastructural studies spermatophores were fixed in 3% glutaraldehyde in 0.1 M phosphate buffer, pH 7.2, post-fixed in OsO_4, dehydrated in ethanol and embedded in Spurrs resin. Silver sections were cut on a Reichert Om U2 microtome, stained with uranyl acetate and lead citrate, and examined in a Philips 201 microscope at 60kV.

The spermatophore is an elongate sac composed of an inner cylinder within an outer wall. A lumen is located between the outer wall and cylinder, and contains sperm and secretory products from the TAGs (a pair of tubular-shaped reproductive accessory glands). The outer wall consists of 4 or 5 concentric layers formed by the secretory products from the paired bean-shaped accessory glands (BAGs). The cylinder contains the same layers as the outer wall, but in a reversed order of location, plus a central core which is a mixture of different products and possibly cell debris (Fig. 1).

The secretory epithelium of the BAGs is comprised of eight cell types, each of which produces a distinct secretory granule.[1] Each cell type empties its product into the BAG lumen to form a secretory "plug". The two plugs derived from the BAGs come together in the ejaculatory duct where they are molded into the spermatophore. Some of the secretory granules can be mapped within the spermatophore on the basis of morphological similarities between granules in the spermatophore and those in the BAG.

The granules of cell types 1 and 3 form layers in both the outer wall and cylinder. Cell type 2 granules have been located at the posterior tip. Secretory granules from cell types 4, 5, and possibly 8 are found in the core of the cylinder. The membranes of cell type 7 secretions line the lumen, forming the inner layer of the outer wall and the outer layer of the cylinder.

Cell type 6 constitutes the largest cell number in the BAGs and contributes the largest mass of secretory product. For this reason we expected type 6 secretions to form the fibrous layers of both the outer wall and cylinder. The interconnected fibrous network of these layers was shown by embeddment-free microscopy using diethylene glycol distearate[2] (Fig. 2). BAGs examined after fixation in 1% formaldehyde with 0.5% glutaraldehyde reveal an internal fibrous structure in cell type 6 granules (Fig. 3). A definite correlation between type 6 granules and the fibrous layers will depend on immunoelectron microscopy using monoclonal antibodies currently being developed against cell type 6 specific proteins.

REFERENCES

1. P.J. Dailey et al., J. Morph. 166(1980)289.
2. D.G. Capco et al., J. Cell Biol. 98(1984)1878.
3. This work was supported by NIH-AI-15662.

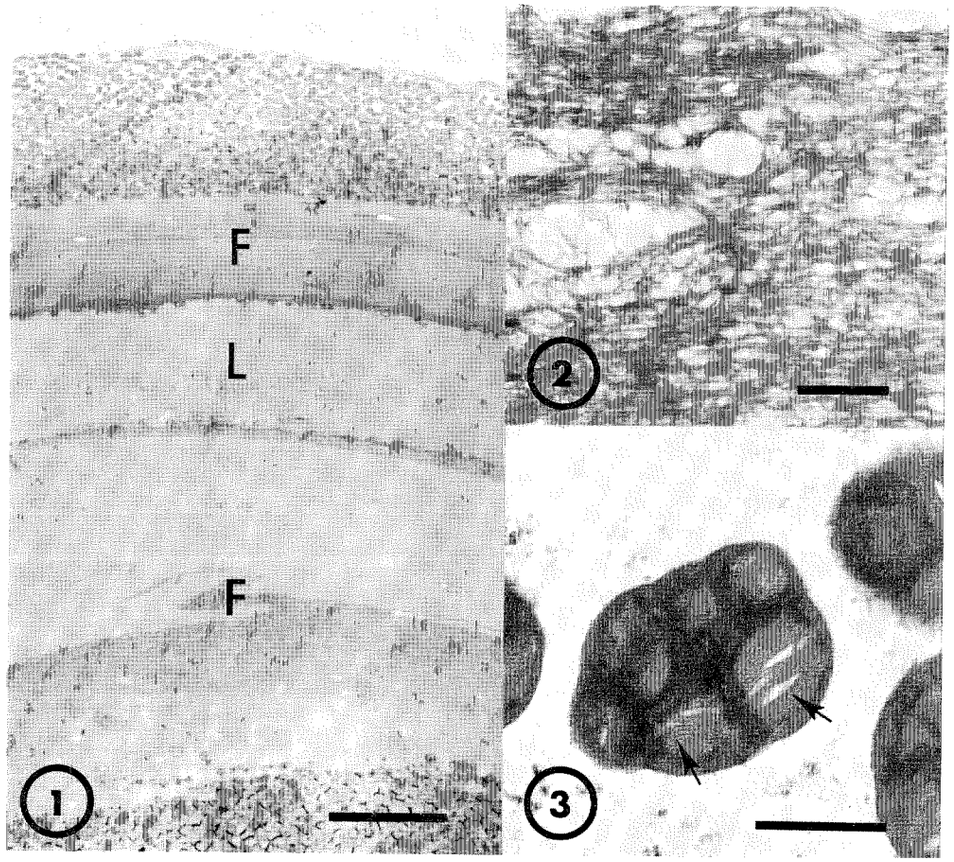

Fig. 1 Spermatophore cross section. Note the fibrous layers (F) and lumen (L). Bar = 5 μm.
Fig. 2 Diethylene glycol distearate embeddment-free section of spermatophore fibrous layer. Bar = 0.5 μm.
Fig. 3 Cell type 6 granule in BAG. Arrows indicate internal fibrous structure. Bar = 0.5 μm.