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Heterocellular Gap Junctions in Vitellogenic Follicles of *Campodea spp.* (Diplura)

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Synopsis

Oocyte-follicle cell interface has been examined ultrastructurally in the ovaries of *Campodea spp.* Gap junctions between the oocyte and enveloping follicle cells (termed: heterocellular gap junctions) occur only during vitellogenesis. These junctions are located between the tips of follicle cell processes and the oocyte surface.

Introduction

The occurrence of heterocellular gap junctions (*i. e.* gap junctions between the oocyte and enveloping follicle cells) in the ovaries of insects was first suggested by electrophysiological studies performed by Wollberg *et al.* (1976). Recently, such junctions have been described in the ovaries of several insect species (Woodruff, 1979; Huebner, 1981; Biliński and Klag, 1982; Biliński *et al.*, 1985; Mazzini and Giorgi, 1985; Giorgi and Postlethwait, 1985). Experiments with the injection of fluorescent dyes have demonstrated that these junctions are in functional state at least during the period of yolk accumulation (Woodruff, 1979; Woodruff and Anderson, 1984; Biliński *et al.*, 1985). Heterocellular gap junctions are assumed to play a part in the coordination of the joint differentiation of the oocyte and the follicular epithelium and in the transfer of low molecular weight molecules from the follicle cells to the oocyte (Huebner, 1981; Telfer *et al.*, 1982; Biliński *et al.*, 1985). Moreover, the fact that oocyte-follicle cell contacts are lost during atresia (Huebner, 1981) shows that heterocellular gap junctions play a key role in the regulation and/or maintenance of normal oocyte growth (Huebner, 1981).

In this paper the occurrence of oocyte-follicle cell gap junctions in the ovary of *Campodea spp.* is reported.

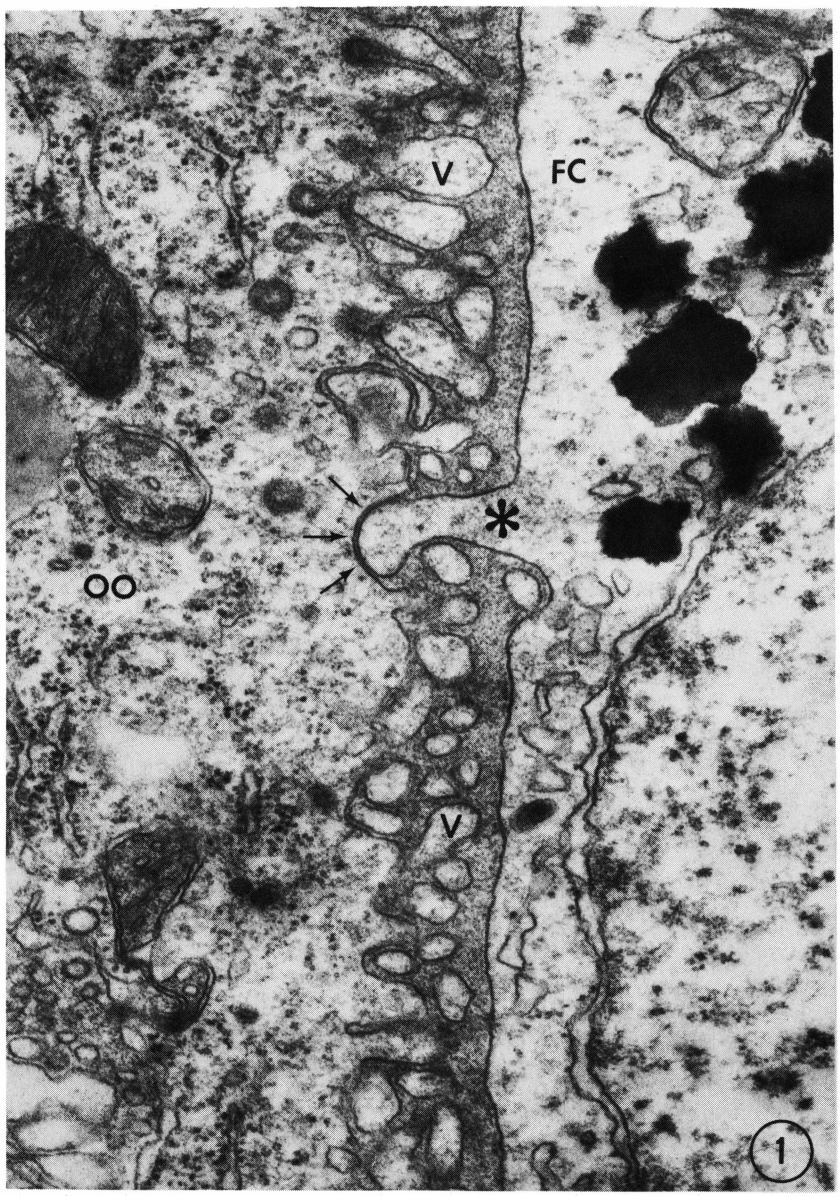

Fig. 1. The oocyte-follicle cell interface during vitellogenesis. fc, follicle cell; oo, oocyte; v, microvilli; arrows, gap junction; asterisk, follicle cell process. × 42,800.

Material and Methods

The methods employed are described by Biliński and Tylek (1987).

Results and Discussion

During vitellogenesis the oocyte surface is supplied with short, irregular microvilli (Fig. 1), at the bases of which numerous pinocytotic vesicles are observed (Fig. 1). Elements of rough endoplasmic reticulum, ribosomes and mitochondria occur also in the cortical ooplasm (Fig. 1). It should be stressed out that the oocyte microvilli make no contact with the follicle cell membrane.

Detailed examination of the oocyte-follicle cell interface has shown that apical plasma membrane of the follicle cell is equipped with fine processes (Fig. 1, asterisk). These processes are infrequent and occur predominantly in the central part of the follicle cell. The follicle cell processes traverse the perioocytic space to make contact with the oocyte surface (Fig. 1). At the contact sites of the processes with the oocyte plasma membrane, the gap junctions are observed (Fig. 1, arrows). The two plasma membranes, within the junction, are parallel and spaced about 3—4 nm apart.

The follicle cell processes as well as the oocyte microvilli are immersed in dense flocculent substance that fills the whole perioocytic space (Fig. 1).

The organization of the oocyte-follicle cell contacts in *Campodea* shows much similarity to that in another apterygotan insect — *Acerentomon* (Biliński and Klag, 1982). In this species heterocellular gap junctions occur also between specialized follicle cell processes and the oocyte surface. In contrast, in pterygotan insects such junctions occur at the contact sites of the tips of the oocyte microvilli with the comparatively flat membrane of the follicle cell (Biliński *et al.*, 1985) or between interdigitating microvilli of the oocyte and the follicle cells (Huebner, 1981; Giorgi and Postlethwait, 1985).

In the species studied heterocellular gap junctions are observed only during vitellogenesis; they are not found in pre- and postvitellogenesis. Similarly, in *Tribolium* (Biliński *et al.*, 1985) and *Oncopeltus* (Woodruff and Anderson, 1984) such junctions before the phase of yolk accumulation are infrequent and/or nonfunctional. At the onset of vitellogenesis in these species the number of gap junctions increases and thus the follicle cells become dye-coupled to the oocyte (Woodruff and Anderson, 1984; Biliński *et al.*, 1985). These observations lead to the suggestion that the formation of heterocellular gap junctions (or the increase of their number) is due to the action of a juvenile hormone, which is known to act at the beginning of the vitellogenesis in insects.

References

Biliński, S., W. J. Hage and J. G. Bluemink, 1985. Gap junctions between the follicle cells and the oocyte during oogenesis in an insect, *Tribolium destructor* (Coleoptera). *Roux's Arch. Devl. Biol.* 194: 296-300.

————, and J. Klag, 1982. Gap junctions between oocyte and follicle cells in *Acerentomon sp.* (Insecta, Protura). *Int. J. Invert. Reproduct.* 5: 331-335.

————, and W. Tylek, 1987. Intermediate nurse cells in *Campodea spp.* (Diplura). Differentiation and possible role during oogenesis. *In* H. Ando and Cz. Jura (eds.), Recent Advances in Insect Embryology in Japan and Poland, 23-29. Arthropod. Embryol. Soc. Jpn. (ISEBU Co. Ltd., Tsukuba).

Giorgi, F. and J. H. Postlethwait, 1985. Development of gap junctions in normal and mutant ovaries of *Drosophila melanogaster*. *J. Morphol.* 185: 115-129.

Huebner, E., 1981. Oocyte-follicle cell interaction during normal oogenesis and atresia in an insect. *J. Ultrastruct. Res.* 74: 95-104.

Mazzini, M. and F. Giorgi, 1985. The follicle cell-oocyte interaction in ovarian follicles of the stick insect *Bacillus rossius* (Rossi) (Insecta: Phasmatodea). *J. Morphol.* 185: 37-49.

Telfer, W. H., E. Huebner and D. S. Smith, 1982. The cell biology of vitellogenic follicles in *Hyalophora* and *Rhodnius*. *In* R. C. King and H. Akai (eds.), Insect Ultrastructure, Vol. 1, 118-149. Plenum, New York.

Wollberg, Z., E. Cohen and M. Kalina, 1976. Electrical properties of developing oocytes of the migratory locust, *Locusta migratoria*. *J. Cell Physiol.* 88: 145-157.

Woodruff, R. I., 1979. Electrotonic junctions in *Cecropia* moth ovaries. *Devl. Biol.* 69: 281-295.

————, and K. L. Anderson, 1984. Nutritive cord connection and dye-coupling of the follicular epithelium to the growing oocytes in the telotrophic ovarioles in *Oncopeltus fasciatus*, the milkweed bug. *Roux's Arch. Devl. Biol.* 193: 158-163.

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