ciency. The impairment of adenosine uptake in P5N deficient erythrocytes is of interest, even though the results cannot lead to an understanding of the main reason for hemolysis of the erythrocyte.

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Morphology of the intercapsular segment of the oviduct in the golden hamster with special reference to ovum-transit from ruptured follicles to the ampulla

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Summary. The intercapsular segment of the oviduct in the golden hamster is not a simple duct which has constant outer and inner diameters. After penetrating the bursa ovarica the ICS has a circular constriction and the corresponding oviductal lumen is narrowed.
Key words. Hamster, golden; oviduct, hamster; intercapsular segment, morphology; oviductal lumen.

The oviduct is not a simple duct with a uniform luminal width and homogeneous functional features through the whole length, but is complex. For example, in the isthmic portion the lumen is narrow, the luminal surface is lined with relatively sparsely-ciliated epithelium and the oviductal wall is thick[1,2], while in the ampulla the lumen is ample, the surface epithelium has abundant with cilia and the muscle layer is not so highly developed[3,4]. Therefore, investigators think that ova are transported by ciliary action in the ampulla and are propelled by oviductal contraction in the isthmus. One cannot always deal with the morphology and functions of the oviduct as a whole. In the present study, we demonstrate that the intercapsular segment (ICS)[5] of the oviduct in the golden hamster has a constricted region at its root, and discuss its functional significance in the transport of ova.

Materials and methods. Animals. Female golden hamsters with b.wt varying from 90 to 120 g were used. They were kept in an air-conditioned room with automatic illumination switched on at 05.00 h and off at 19.00 h. Under these lighting conditions adult females showed a viscous vaginal discharge in the morning of day 1 of the estrus cycle and ovulated between 01.00 and 04.00 h of day 1[6-8].

Endocast of the ICS. A 21-gauge needle attached to a tuberculin syringe containing 50 µl of metacrylate resin was inserted into the ampulla through an incision in the ampullary wall and 20 to 40 µl of the resin was injected toward an ovarian end of the oviduct. Then the oviduct with the bursa ovarica and ovary was isolated and put into a 1% NaOH solution. The tissue was completely eroded after incubation at 37 °C for 24 h. The endocast was rinsed in a distilled water, air-dried, gold-coated and observed under a scanning electron microscope. Endocasts on day 1, 2, 3, 4 and during ovulation were made.

Injection of a dye into the bursal cavity. Under ether anesthesia 20 µl of 1% alcian blue 8GX (AB) dissolved in 0.9% NaCl was injected into the bursal cavity through the fat pad surrounding the bursa. 30 min later the ICS with part of the ampulla was removed and histological sections were made. Hamsters in the non-ovulatory period and in the ovulatory period were used.

Specimens for photomicroscopy (PM), scanning and transmis-

sion electron microscopy (SEM and TEM). The ICS was isolated and fixed in 2% glutaraldehyde in 0.1 M phosphate buffer solution (PBS) at pH 7.4. Specimens for SEM and TEM were postfixed in 2% OsO_4 in 0.2 M PBS. They were dehydrated in a graded series of ethanol solutions. Specimens for SEM were infiltrated with isoamyl acetate and those for TEM with propylene oxide. PM specimens were embedded in glycol metacrylate[9] after dehydration. SEM specimens underwent critical point drying in CO_2 and gold-coating. TEM specimens were embedded in an epoxy resin, sectioned and stained with lead citrate[10].

Results. The oviduct penetrates the bursa ovarica from the mediolateral wall and emerges in the bursal cavity at the medioventral wall, extending the tip to a crevice formed between lobulations of the ovary (fig. 1). The ICS is approximately 1.0 mm long with a flattened ovarian end and the ostium tubae is loosely closed (fig. 1, 2). The bursal root of the ICS is markedly constricted (fig. 2, arrows). Endocasts of the ICS show a correspondent narrowing of the lumen (fig. 3, arrows) regardless of the stage in the estrus cycle. The entire surface of the ICS is covered with ciliated columnar epithelial cells and secretory cells (fig. 4). The ICS did not allow marked passage of AB from the bursal cavity to the ampulla either in

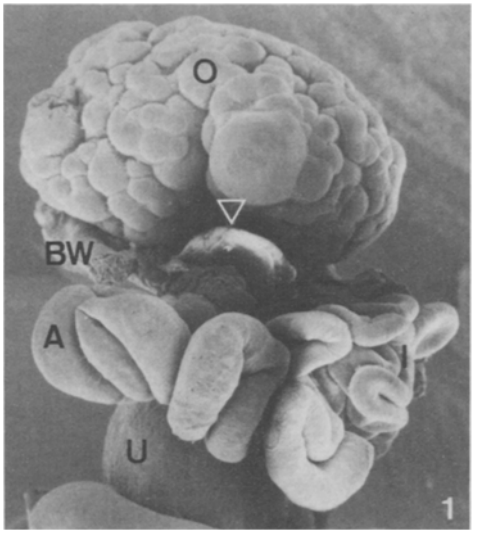

Figure 1. Scanning electron microscope picture showing positional relations among the ovary (O), bursal wall (BW), ICS (an open triangle), ampulla (A), isthmus (I) and uterus (U). Note the position of the ostium tubae which rests under an eave of the ovary. The ICS is not long enough to reach follicles situated on the opposite side of the ovary. The major part of the bursa ovarica was removed for clear visualization. × 20.

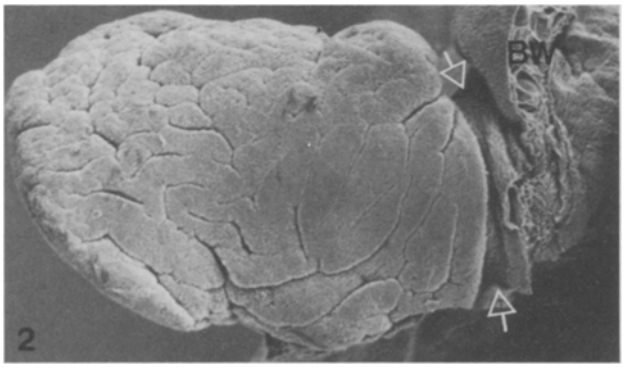

Figure 2. The outer diameter of the ICS just after passing through the bursal wall is constricted (arrows). ×50.

Figure 3. The endocast of the ICS during ovulation disclosed a narrowing of the lumen (arrows) which corresponds to the constriction presented in figure 2. ×100.

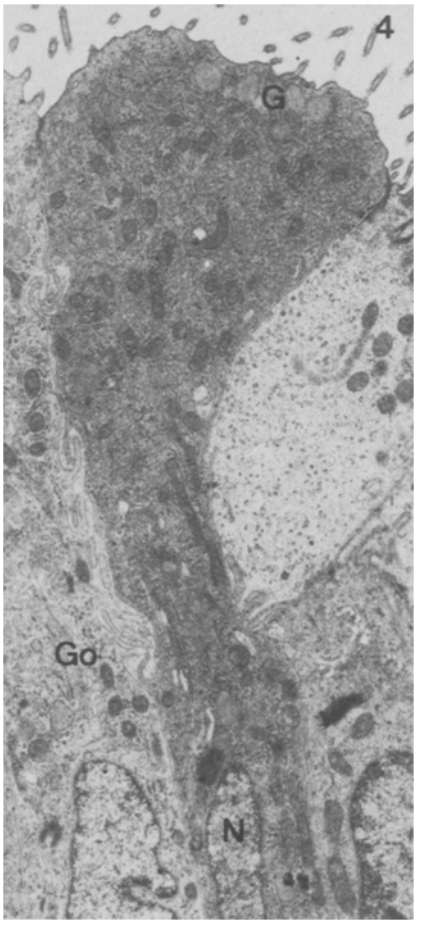

Figure 4. A TEM photograph of secretory and ciliated epithelial cells on the bursal surface of the ICS. Ultrastructures of secretory cells are not different from those that line the oviduct luminal surface except that the former cells release secretory granules (G) into the bursal cavity, not into the oviductal lumen. Go, Golgi apparatus; N, nucleus. ×6000.

the non-ovulatory or in the ovulatory period (fig. 5); the dye hesitated to pass the ostium tubae and a slow and sparse transit of the dye particles through the ICS looks as if the dye were carried by simple diffusion.

Discussion. In mice[11], rats[12] and golden hamsters[13] the bursal cavity is completely separated from the peritoneal cavity. During ovulation ova are released into the bursal cavity, travel through the bursal fluid, arrive somewhere on the surface of the ICS and go into the oviduct. As was demonstrated here, the ICS is limited both in position and length for catching ova released away from the ICS. There must be some force that attracts or transports ova to the ICS. Fischel[14] thought that the bursal wall contracts and flushes bursal fluid into the oviduct during ovulation and this flow carries ova. The same mechanism is postulated by Martin et al.[15]; however, those authors also said that they failed to observe such a flow by injection of a dye into the bursal cavity in the peri-ovulatory period in the golden hamster. Blandau's[16] observation is that by ciliary-driven currents ova are attracted to the ostium tubae from ruptured follicles within 5 seconds in rats. Our experiments with dye injection support the result of Martin et al. Mahi-Brown and Yanagimachi[17] demonstrated in vitro that a cumulus cell mass placed in close proximity to or in contact with the ICS is transported into the oviduct, but it is not, if it is put a little away from the ICS. There is no doubt about the presence of focal currents caused by ciliary activity in an adjacent area of the ICS, but their presence does not always mean that they are strong enough to 'attract' such a large cell mass as an ovum-cumulus cell complex far away from the ICS in a convex cavity of the bursa ovarica.

The situation is entirely different, when an ovum-cumulus cell complex is in touch with the ciliated surface of the ICS. As some investigators have demonstrated, electrostatic forces and, most probably, chemical and physical interactions between the ciliary tips and the cumulus matrix may enhance the efficiency of ciliary activity for transporting materials[17-19]. In others words, although ovum-propelling forces generated by the contractile activity of the oviduct should be taken into account, as the contact surface between the ovum-cumulus complex and the ciliary tips increases, the velocity of transit of the complex becomes higher[20]. This means that in the narrow lumen of the oviduct the ovum-cumulus complex is transported more rapidly. Setting aside an alternative discussion of whether contractile activity of the oviductal smooth muscle or ciliary activity of the oviductal epithelium provides the main force to convey the ovum-cumulus complex, the narrow region of the ICS is obviously advantageous for a rapid transport of the complex from the ICS to the ampulla by ciliary activity.

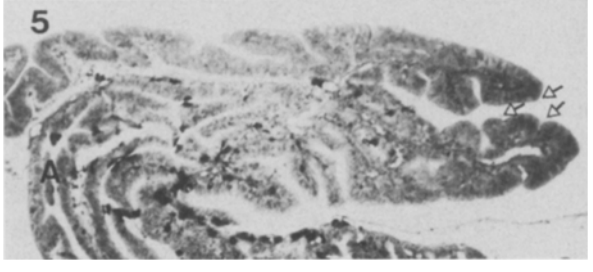

Figure 5. A longitudinal section of the ICS during ovulation. AB particles are seen in the ostium tubae (arrows), but did not go further. ×25.

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Demonstration of the structural connections of the longitudinal muscle cells and circular muscle cells, and interconnections between the two, in the alimentary canal of an oligochaete, *Branchiura sowerbyi* B.

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Summary. The longitudinal and circular muscle cells of the alimentary canal of the oligochaete worm *Branchiura sowerbyi* show intercell couplings. These couplings occur between adjoining cells of the same or of the other orientation.
Key words. Worm, oligochaete; *Branchiura sowerbyi;* oligochaetes; alimentary canal; muscle cells, longitudinal; muscle cells, circular.

Gardy[1] observed antiperistaltic contraction waves of the intestine in the earthworm *Lumbricus terrestris* by means of X-rays, and Naitoh[2] reported several types of contraction waves in the different regions of the alimentary canal of an intact aquatic oligochaete worm *Branchiura sowerbyi.* Both reports suggest that the normal movements of the alimentary canal of Oligochaeta are propagations of contractions in oral and/or aboral directions from their sites of origin. In the present study, we want to describe the fine structure of the muscle cells of an oligochaete alimentary canal, especially as related to the prop-