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Persorption – the Way of Large Sized Corpuscle Particles via the Lymphatic System*

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Summary

By using large granules and ordinary Indian ink, the phenomenon of "persorption" can be shown by the light microscope, with a movement of particles away from the surface of the villi into the lymphatic system.

The term "persorption" is used exclusively to describe the paracellular uptake of particles from the digestive tract. Historical observations suggest that large particles, in the microscopic range may find their way through the epithelial cell layer in the digestive tract. Nevertheless, such a transit of large particles would appear at first sight to be impossible. In preliminary investigations some of these historical findings could be reproduced and the mechanisms of this process are now described, under the title of this paper, as "persorption" (1–26).

Material and Methods

As particles in the experiments we used large granules (cornflour) which had a diameter of up to about 70 μm and ordinary commercial Indian ink (*G. Wagner*) whose particles were also about the same size. They were either given by mouth or applied directly to the mucous membrane of the small intestine, sometimes together with patent blue violet (Byk Gulden, Constance) and sodium fluorescein (Merck, Darmstadt). The villi of the duodenum and jejunum were examined in various species of animal.

Results

As the particles moved away from the surface of the villi of the intestinal mucous membrane (Fig. 1 untreated, Figs. 2–8 treated), they could be detected after a few minutes in the thoracic duct and after ten minutes in the blood and the urine. After applying the test particles (ink, as well as large granules) to the intestinal mucosa their paracellular passage through the layer of enterocytes can be followed with the light microscope (Figs. 2–6). It appears that the particles are forced by the mechanism of the villus pump in the subepithelial region into the space of Gruenhagen which has now become dilated (Figs. 6–8).

The mechanism is as follows:
Penetration of individual particles into the goblet cells (Fig. 5), which are then detectable in the basal intercellular space.

Penetration of the particles into the desquamation zone of the epithelium (Fig. 6) especially at the apex of the villus, and into the intercellular cleft (Fig. 6), from whence further transport continues subepithelially (Fig. 6–8) and from there in lymphatic vessels or capillaries, or through the stroma of the villi into the central lacteal (or sinus) (Fig. 2).

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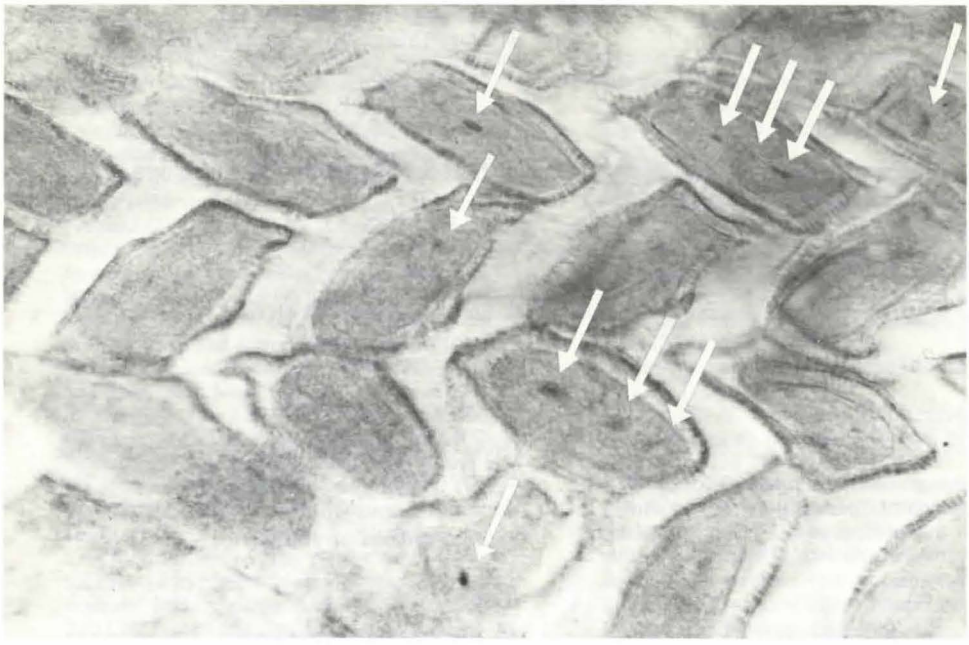

Fig. 2 Ink "persorbed" at the periphery of the rhomboid villi with dilated Gruenhagen spaces and delineated central chylar vessel (arrow). Surface section through the jejunum, swan. Cleared in oil of wintergreen. Negative magnification 25x, positive magnification 83x

Fig. 1 Jejunum with finger-shaped villi. Dog. Fixed in glutaraldehyde. Negative magnification 25x, positive magnification 83x

Fig. 3 "Persorbed" ink, combined with sodium fluorescein on the surface of the villi which are running longitudinally. Duodenum, King Pheasant. Negative magnification 20x, positive magnification 67x

Fig. 4 "Persorbed" ink at the margin of the triangular appearing villus, combined with patent blue violet and sodium fluorescin, appearing centrally. Jejunum, swan. Cleared in oil of wintergreen. Negative magnification 32x, positive magnification 107x

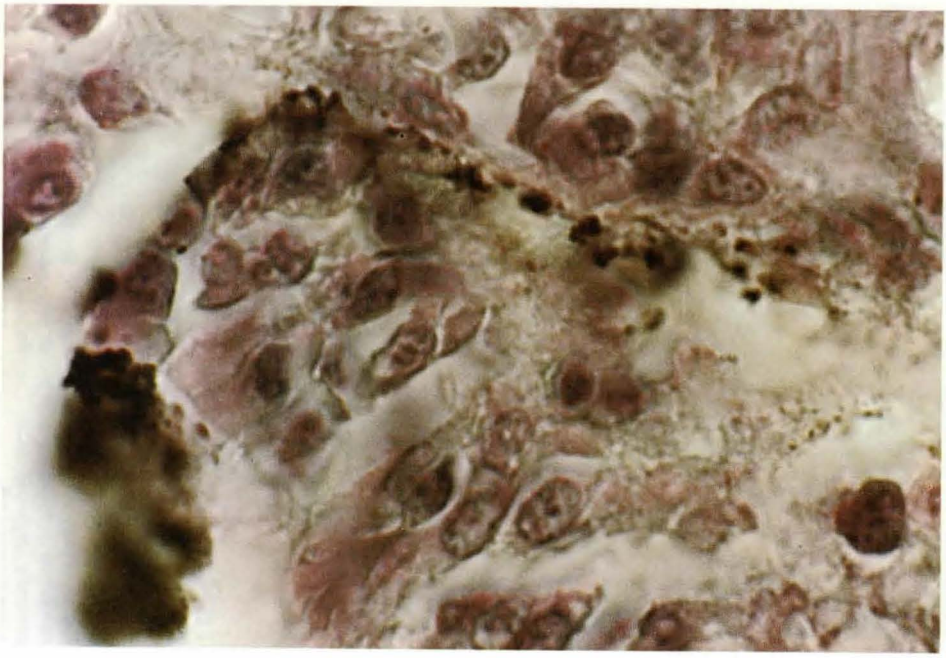

Fig. 6 Penetration of ink particles into the desquamation zone of the epithelium. Jejunum, chicken. Hematoxylin and eosin. Negative magnification 500x, positive magnification 1665x

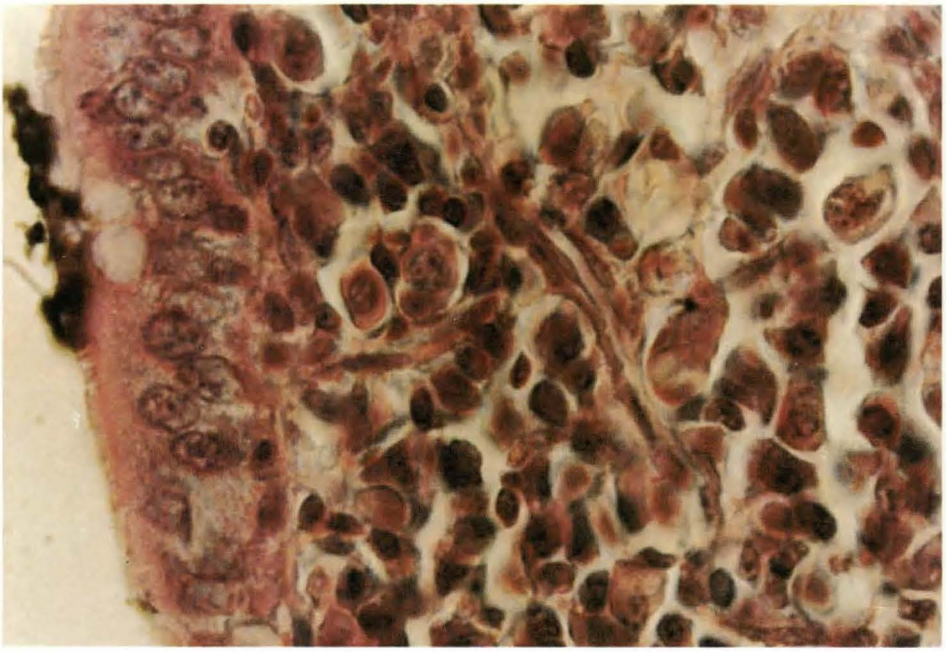

Fig. 5 Goblet cells within the villus, with the contained ink particles. Jejunum, chicken. Hematoxylin and eosin. Negative magnification 500x, positive magnification 1665x

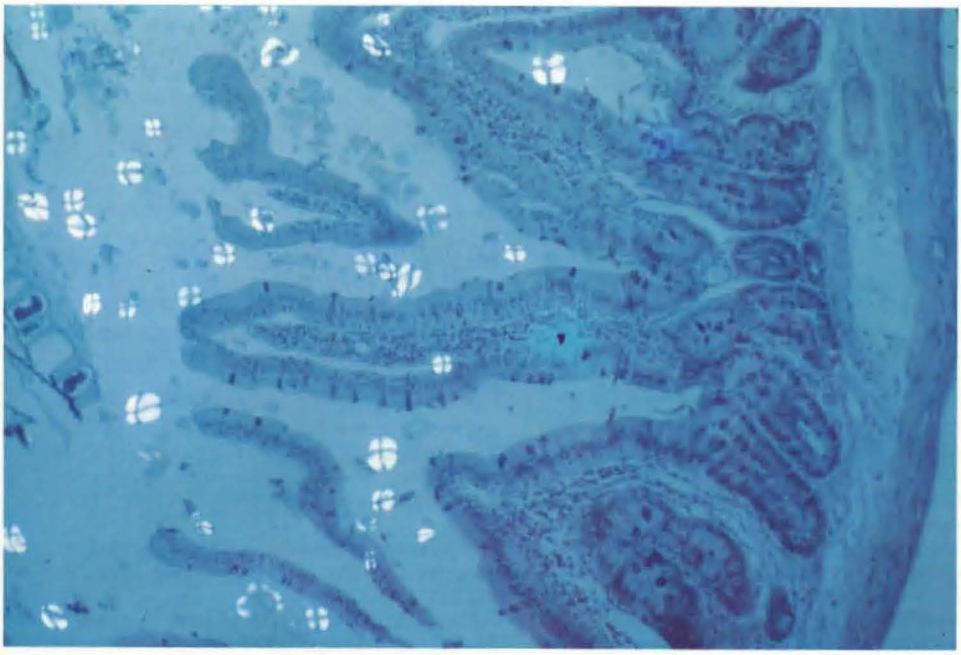

Fig. 8 Progress of the persorption basalwards. Large granules in the middle third of the villus, lying subepithelially. Jejunum, rat. (Volkheimer). Negative magnification 16x, positive magnification 53x

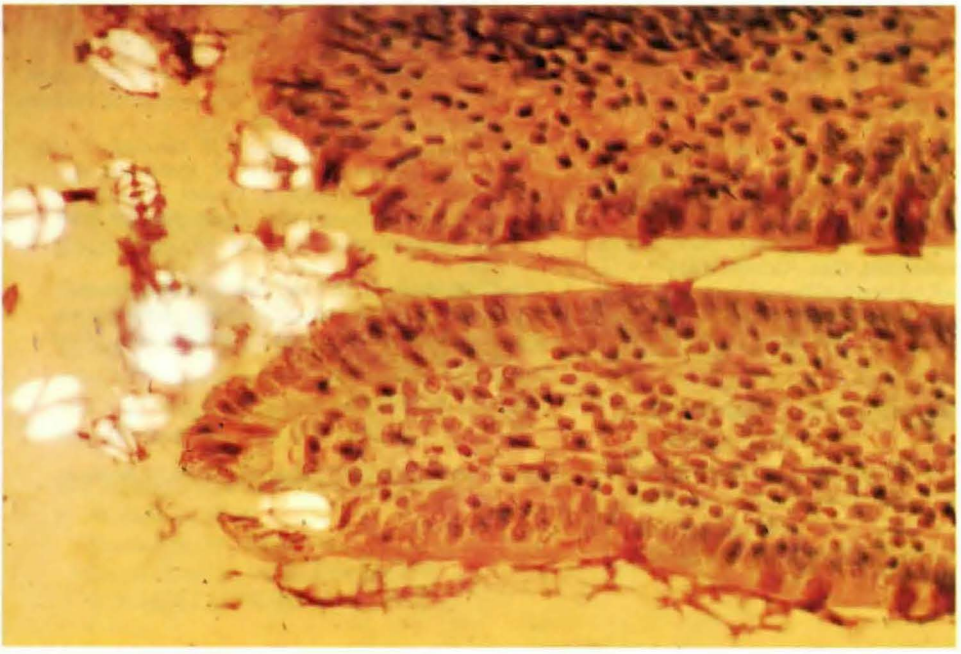

Fig. 7 Persorption of large granules at the apex of the villus, between the enterocytes in the subepithelial region. Jejunum, rat. (Volkheimer). Negative magnification 63x, positive magnification 210x

A network of lymphatics, such as can be demonstrated a few seconds after an application of a vital stain was not seen with this type of absorption, i.e. "persorption".

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