Cell Membrane Changes during Contact with Some Micro-organisms

THE use of the electron microscope has facilitated more detailed investigation of cell membrane activities than was previously possible. Among these activities are pinocytosis, micropinocytosis, rhopheocytosis, phagocytosis and desmosome formation. This communication reports some interesting changes which were observed in the morphology of cell membranes during contact with micro-organisms.

During an investigation of rat ileum, bacterial micro-organisms were observed near the luminal surface of the columnar cells of the ileum. The plasma membrane of the columnar cell showed an unusual change at the position of contact with the bacterial capsule. At this site there were no microvilli and the outer capsule of the bacterium appeared to be fused with the cell membrane. The cell membrane, while normal elsewhere, was now much thicker; its normal thickness of 70 Å had increased to 200 Å–250 Å (Fig. 1). Small osmiophilic granules about 60 Å in diameter were observed in the cytoplasm on the periphery of the area of contact. Reimann has described these changes in the cytoplasm and terminal web in this area[1].

The nature and function of this type of cell membrane interaction are unknown. It may represent a cellular defence mechanism or it may be a result of injury to the plasma membrane. A normal counterpart of this type of plasma membrane thickening is found in the macula adherens region between adjoining cells[2].

Another cell membrane change was observed at the point of entry of reovirus III into hepatocytes during the pathogenesis of murine hepatitis induced by reovirus. As the virus approached the cell, the cell membrane became slightly thicker and denser, and the virus was then taken into the cell by micropinocytosis[3]. The walls of the micropinocytic vesicle were formed from this thickened dense membrane, surrounded by a fuzzy halo (Fig. 2).

Similar vesicles have been observed in normal liver[4] and in other cells[5]. Their function is believed to be concerned with protein transport and this seems almost certain in the mosquito oocyte where the vesicles have also been seen[6]. Possibly the same type of interaction which occurs with protein molecules also occurs with the virus capsid, which results in its uptake into the cell. Such an interaction would be determined by the physico-chemical structure of both the virus capsid and the cell membrane. The physico-chemical possibility of such an interaction would determine host cell specificity.

The sites of interaction may be the morphological equivalent of the chemical "receptor sites" postulated by virologists, and responsible for virus adhesion, host cell specificity, and cellular uptake.

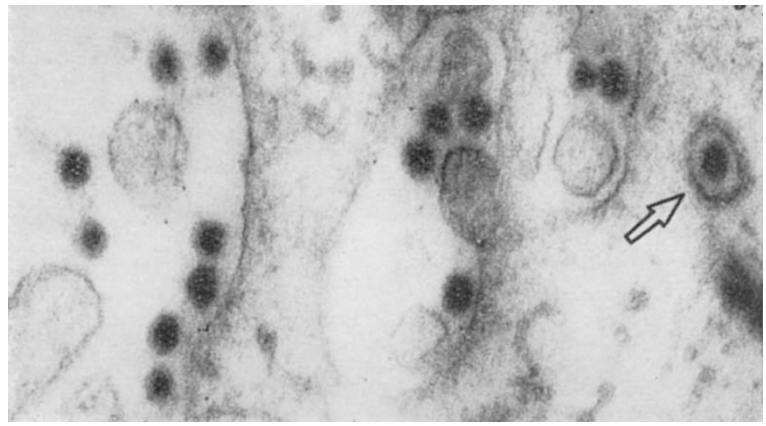

Fig. 2. Reovirus III entry into the sinusoidal surface of a hepatocyte. The wall of the vesicle which surrounds the ingested virus particle (arrow) is composed of thickened membrane surrounded by a fuzzy halo. (× c. 81,300.)

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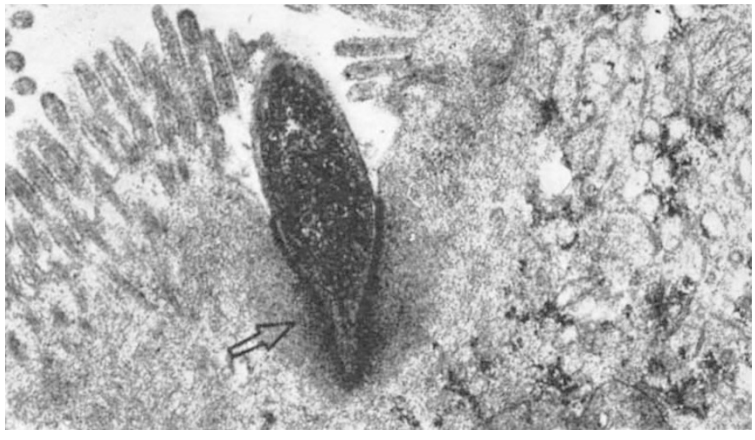

Fig. 1. Site of contact of bacterial body with the cell membrane of a lining columnar cell of rat ileum. The cell membrane shows marked thickening measuring 200 Å–250 Å. A number of fine granules (arrow) can be distinguished near the site of thickening. (× c. 27,000.)

Differentiated Cell Types and the Regulation of Collagen Synthesis

COLLAGEN synthesis, the principal differentiated function of the fibroblast, is carried out by homogeneous cell populations cultured under defined conditions[1–5]. Because hydroxyproline is formed from proline in collagen, the rate of collagen synthesis can be determined with great sensitivity by measuring the incorporation of radioactive amino-acids[3,6]. This communication shows that different types of cell vary over a range of at least 10^4 in the rate at which they synthesize this protein. In cells of fibroblastic origin the property is, of course, most highly developed. In some non-fibroblastic cell types synthesis occurs at about 2–3 per cent of the rate characteristic of the fibroblast, while in others it is completely suppressed. The data indicate three possible levels at which the synthesis may be maintained in different cell types.

The origins of the cell types investigated are shown in Table 1.

Dense and essentially non-growing cultures of each cell type were exposed for at least