The Fine Structure of the Epithelial Cells of the Mouse Prostate*

II. Ventral Lobe Epithelium

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ABSTRACT

The fine structure of the epithelial cells of one component of the prostatic complex of the mouse—the ventral lobe—has been investigated by electron microscopy. This organ is composed of small tubules, lined by tall simple cuboidal epithelium, surrounded by smooth muscle and connective tissue. Electron micrographs of the epithelial cells of the ventral lobe show these to be limited by a cell membrane, which appears as a continuous dense line. The nucleus occupies the basal portion of the cell and the nuclear envelope consists of two membranes. The cytoplasmic matrix is of moderately low density. The endoplasmic reticulum consists of elongated, circular, and oval profiles representing the cavities of this system bounded by rough surfaced membranes. The Golgi apparatus appears localized in a region between the apical border and the nucleus, and is composed of the usual elements found in secretory cells (3, 9). At the base of the cells, a basement membrane is visible in close contact with the outer aspect of the cell membrane. A space of varying width, which seems to be occupied by connective tissue, separates the epithelial cells from the surrounding smooth muscle fibers and the blood vessels. Bodies with the appearance of portions of the cytoplasm, mitochondria, or profiles of the endoplasmic reticulum can be seen in the lumina of the acini and on the bases of these pictures and others of the apical region the mechanism of secretion by these cells is discussed. The fine structural organization of these cells is compared with that of another component of the mouse prostate—the coagulating gland.

INTRODUCTION

In a study of the fine structure of the epithelium of the prostatic complex of the mouse, a description was presented of one of the components, the anterior lobe or coagulating gland (2). In this paper, observations pertaining to a second component, the ventral lobe, will be described, and the differences in organization of both lobes will be discussed.

Details of the material and methods which have been used in this investigation are to be found in the first paper of this series.

OBSERVATIONS

General Description (*Figs. 1, 4 to 6*).—The epithelial cells of the ventral lobe are of the tall cuboidal type. Their oval nuclei lie in the lower third of the cell, and are bounded by two dense membranes of the nuclear envelope. The cell is entirely surrounded by the plasma membrane which appears as a dense line of uniform width, presenting at some points intricate systems of plicae. The cytoplasmic matrix is of moderate density. The mitochondria appear as dense bodies, bounded by a double membrane and show a system of internal folds or cristae. The endoplasmic reticulum consists mainly of elongated profiles, representing flattened cisternae. The Golgi apparatus consists of smooth surfaced profiles corresponding to vacuoles, and closely packed flattened vesicles, the content of which is of low density. Various types of smooth surfaced profiles, vesicles, vacuoles, or granules are scattered throughout the cytoplasmic matrix, but concentrated mainly in the apical pole. The basement membrane appears

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as a narrow band of homogeneous material applied to the outer surface of the cell membrane.

Cell Membrane.—The cytoplasm of the epithelial cells is bounded by a dense, smooth surfaced membrane, in its lateral, basal, and apical aspects (Figs. 1, 5, 6). At the zone of contact, the plasma membranes of the two adjacent cells are separated by an intermediary layer of lesser density (Fig. 5). Plications of the plasma membranes are visible, in some preparations (Figs. 1, 5).

Cytoplasmic Matrix.—This is represented by homogeneous material of moderate density, in which small dense particles are randomly scattered (Figs. 5, 6).

Mitochondria.—Most of the profiles observed are of the elongated or circular type. The mitochondrial matrix is visible as a dense homogeneous material. Their outer boundaries consist of two dense membranes separated by a narrow space of lesser density. The system of internal folds is similar to that described for other mammalian tissues (Figs. 4 to 6). In some cells, mitochondria which depart from this description are visible. They seem swollen, the matrix is of lower density, and show a lamellar system of internal membranes, oriented mainly in the long axis of the organelle (Fig. 7). Bodies with these characteristics are sometimes observed free in the lumen of the tubule (Fig. 8).

Golgi Complex.—The location of this structure apical to the nucleus corresponds closely to that observable by light microscopy (Figs. 1, 2). The main Golgi components are represented by elongated, circular, and oval profiles, corresponding to flattened vesicles, tubules, and vacuoles which make up this complex. These elements are bound by smooth surfaced membranes. The content of the larger vacuoles is of low density, while that of the flattened vesicles, tubules, and smaller vacuoles is similar in density to the cytoplasmic matrix (Fig. 4).

Endoplasmic Reticulum.—In these prostatic cells, the endoplasmic reticulum is represented by elongated, oval, and circular profiles, bounded by thin membranes with Palade particles attached to the surface facing the cytoplasmic matrix (Figs. 4 to 6). These particles also appear freely scattered in the cytoplasmic matrix. The intracisternal spaces show a structureless content of low density (Figs. 4 to 6). The flattened vesicles or cisternae may be oriented in approximately parallel rows, or may show a random distribution. In some instances concentric ring forms are visible (Fig. 6). Certain of the flattened vesicles may also show circular or oval dilations (Fig. 6).

Apical Region.—This shows structural variations even between adjacent cells (Figs. 6 to 8). The most obvious of these variations are described in terms of the cisternal profiles present and the morphological characteristics of the mitochondria (Figs. 6 to 8).

Free Border and Lumen.—In favorable sections minute cytoplasmic projections, cut at different angles, are visible. These, as well as the entire free border, are covered by the cell membrane. In some cases the lumen of the acinus is occupied by material (Figs. 6, 7), which from its appearance may be presumed to have been detached from the apex of the cell (Fig. 7). Some elements in the lumen resemble mitochondria, or profiles of the endoplasmic reticulum (Fig. 8).

The Nucleus.—The nucleus is situated towards the basal region of the cell, and is rounded or elliptical in shape (Fig. 1). The nuclear content consists of amorphous substance and granular material. The nuclear envelope is made up of two dense membranes separated by a narrow area of lower density. The outer nuclear membrane has small dense particles on the surface facing the cytoplasm (Fig. 5).

The Basement Membrane.—This extracytoplasmic component, consisting of a structureless layer of moderate opacity, is in apposition to the outer aspect of the cell membrane and is separated from the surrounding smooth muscle fibers or blood vessels by a space containing connective tissue elements (Fig. 5). The positive reaction for alkaline phosphatase as seen with light microscopy (Fig. 3) comprises a much wider area than the basement membrane.

DISCUSSION

The observations presented here show that a pronounced difference exists between the structure of the epithelium of the ventral lobe and that of the coagulating gland (2) of the mouse prostate. These two lobes of the prostatic gland have a common embryological origin, and their histological and cytological characteristics with the light microscope are very similar (1). Very little work has been done on the biochemistry and physiology of the mouse prostate. In the rat, however, marked differences in the biochemical and physiological properties of these two prostatic lobes have been

demonstrated (4). The most striking differences observed between the two lobes in our preparations exist in the distribution and characteristics of the endoplasmic reticulum. In the ventral lobe, the system of cavities of the endoplasmic reticulum is predominantly in the form of flattened vesicles, and occupies only a small portion of the cytosome. In the epithelium of the coagulating gland, on the other hand, the cisternae are greatly dilated and occupy a large part of the cytosome. It has been postulated (2) that the cavities of the endoplasmic reticulum of the coagulating gland may be occupied by albuminous material which may then be secreted into the lumen of the acini. In the ventral lobe, due to the marked flattening of the cavities of the endoplasmic reticulum, it seems unlikely that the mechanism of secretion consists in a transport of material through the intracisternal spaces for ultimate release into the lumen of the acini. This mechanism has been suggested for other secretory organs (5–8). The various aspects presented by the apical pole of these cells (Figs. 6 to 8) would tend to indicate a secretion mechanism of a different nature. The variations in the structural organization of the cytoplasm in this region, as well as the indications of extrusion of portions of the cytoplasm (Fig. 7) would indicate an apocrine type of secretion. It is also necessary to consider the possible participation of the Golgi complex in the secretory process for PAS and Sudan black–positive material is found in the region where the Golgi is located (which also shows a positive acid phosphatase test), and these same reactions are positive in the intraluminal secretion also (1). Furthermore, some of the smooth surfaced profiles present in the apical pole of the cell, near the free border (Figs. 6 to 8), are quite similar to some of the profiles which constitute the Golgi complex (Fig. 4).

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Explanation of Plates

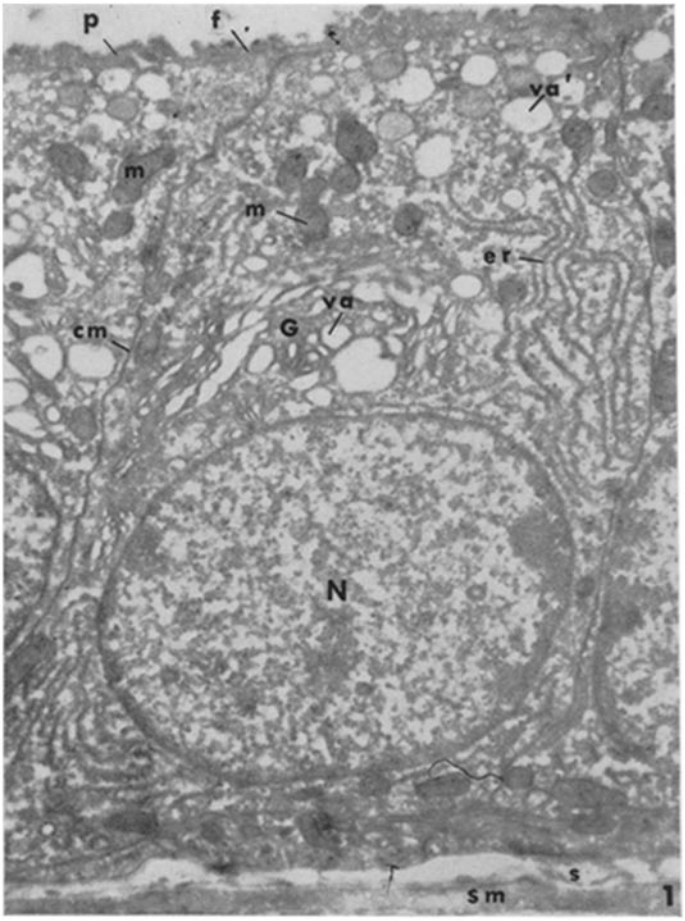
Plate 281

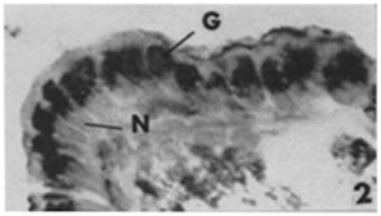
Fig. 1. General view of an epithelial cell. The nucleus (*N*) is situated in the basal half of the cell, the Golgi complex (*G*), shows vacuoles of low density (*va*), and the endoplasmic reticulum (*er*) principally located in the basal two-thirds consists mainly of elongated profiles. An interstitial space (*s*) is visible between the basement membrane and the smooth muscle fibers (*sm*). Mitochondria (*m*) and vacuoles of low density (*va'*) are seen towards the apical region. The free border (*f*) showing microprojections (*p*), and the cell membrane (*cm*) can also be seen. × 10,000.

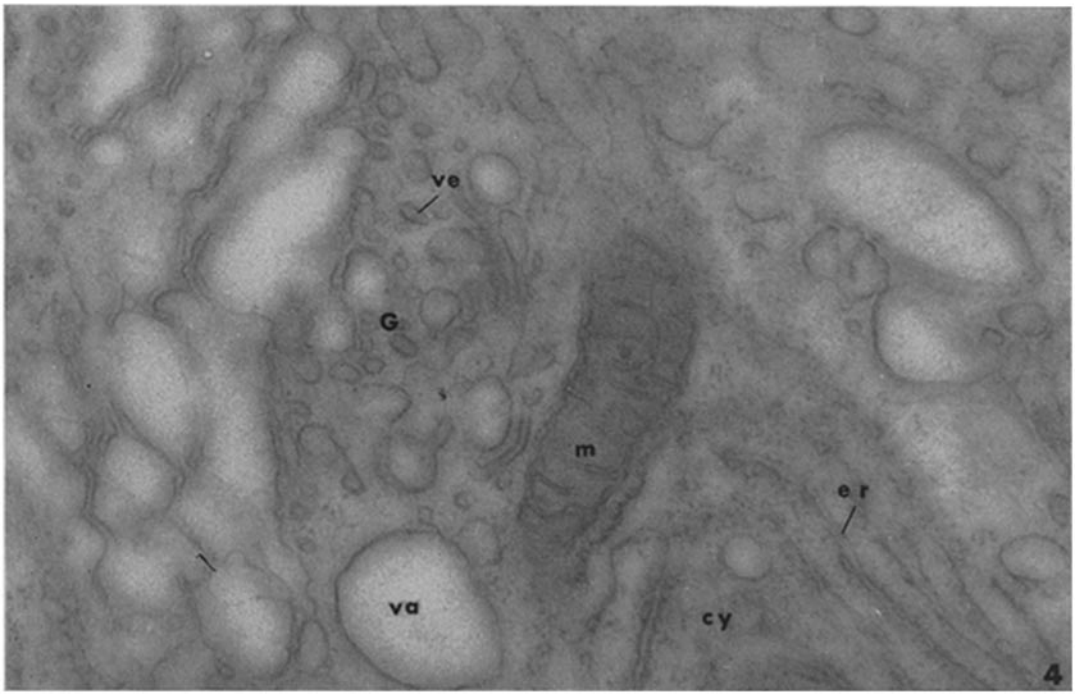
Fig. 2. Photomicrograph of the epithelium treated with Da Fano's method for the demonstration of the Golgi (*G*) complex. The complex is obviously located apical to the nucleus (*N*), in agreement with electron microscopic observations. Compare this with Fig. 1. × 1,600.

Fig. 3. Photomicrograph of the epithelium. Gomori's method for alkaline phosphatase was used in making the preparation. Positive reaction (*k*) in a region much wider than the basement membrane is evident. Compare with Fig. 5. × 1,600.

Fig. 4. Electron micrograph of an epithelial cell showing the Golgi (*G*) region in detail. Smooth surfaced profiles corresponding to the typical vesicles (*ve*) and vacuoles (*va*) are visible. The content of the vacuoles is of low density. A mitochondrion (*m*) and profiles of the endoplasmic reticulum (*er*) are also seen in this region. Palade granules are scattered through the cytoplasmic matrix (*cy*). × 70,000.







(Brandes and Portela: Ventral lobe of mouse prostate)

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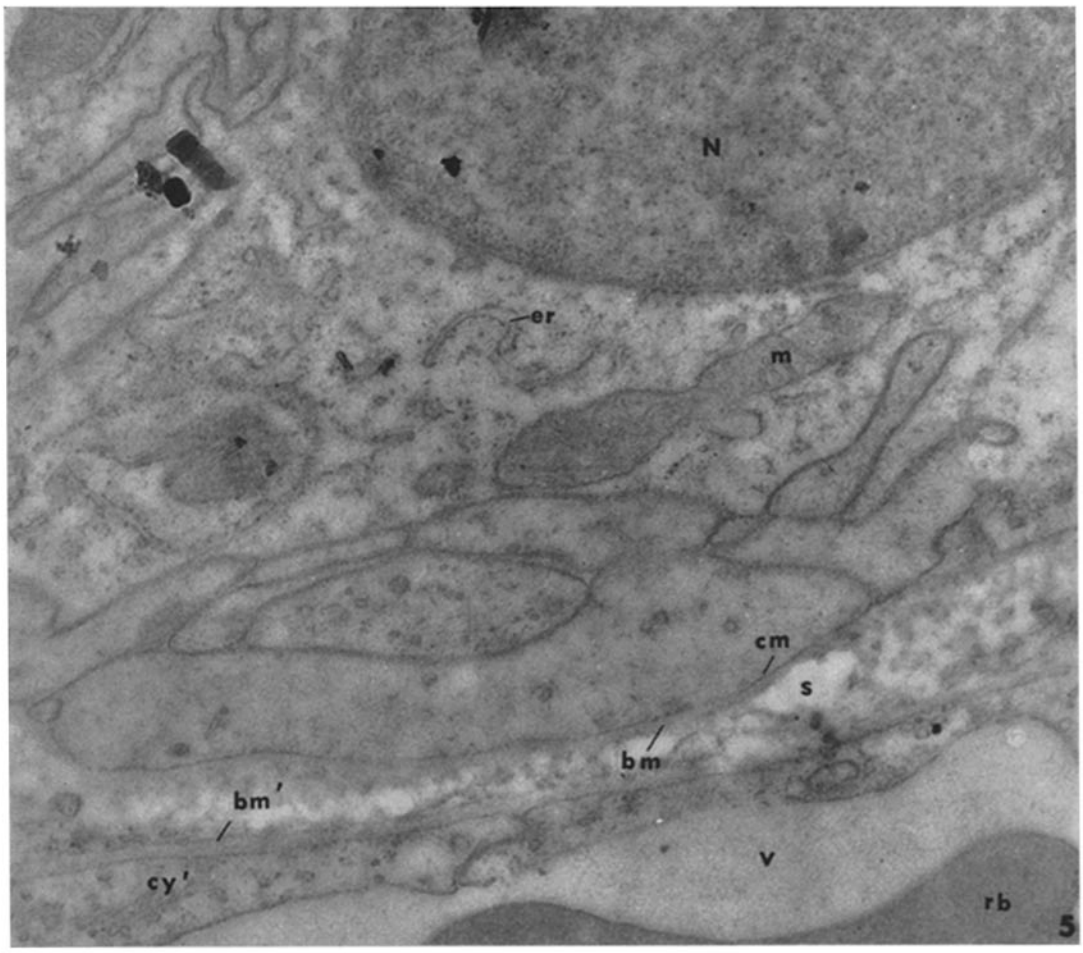
FIG. 5. Basal portion of a cell showing the relation of the epithelial cells to the neighboring blood vessels. The profiles of the endoplasmic reticulum (*er*), are less numerous than in the apical pole. Palade granules and mitochondria (*m*) are present. Part of a capillary (*v*) containing a red cell (*rb*) is seen at the bottom of the figure. The endothelial cell of the capillary (*cy'*) is contiguous with a basement membrane (*bm'*), which is separated from the basement membrane of the epithelial cell (*bm*) by an interstitial space (*s*) containing connective tissue elements. The cell membrane (*cm*) is shown at the base of the cell. × 39,000.

FIG. 6. Apical region of epithelial cell. The profiles of the endoplasmic reticulum are predominantly of the thin, elongate type (*er*), representing sections through flattened vesicles. Palade granules can be seen scattered through the cytoplasmic matrix (*cy*) and also applied to the outer aspect of the limiting membranes of the profiles of the endoplasmic reticulum. A cortical layer of cytoplasmic matrix (*a*) devoid of small particles, is visible immediately beneath the free border (*f*). Smooth surfaced profiles, as well as mitochondria (*m*) are present in this region. Various unidentified profiles can be seen lying free in the lumen (*L*). × 39,000.



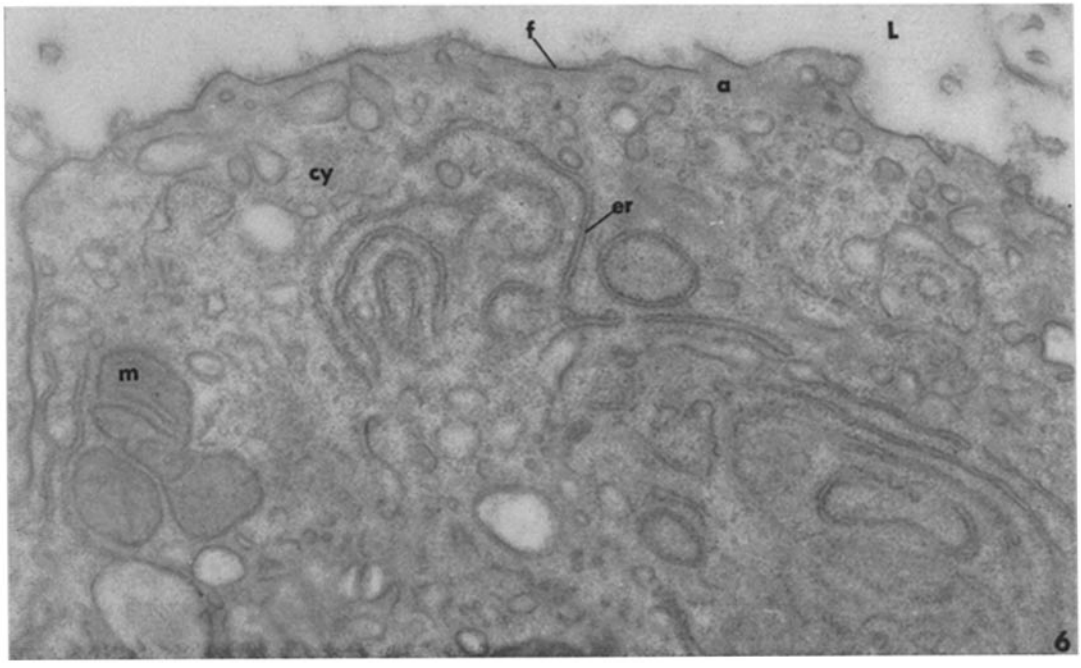


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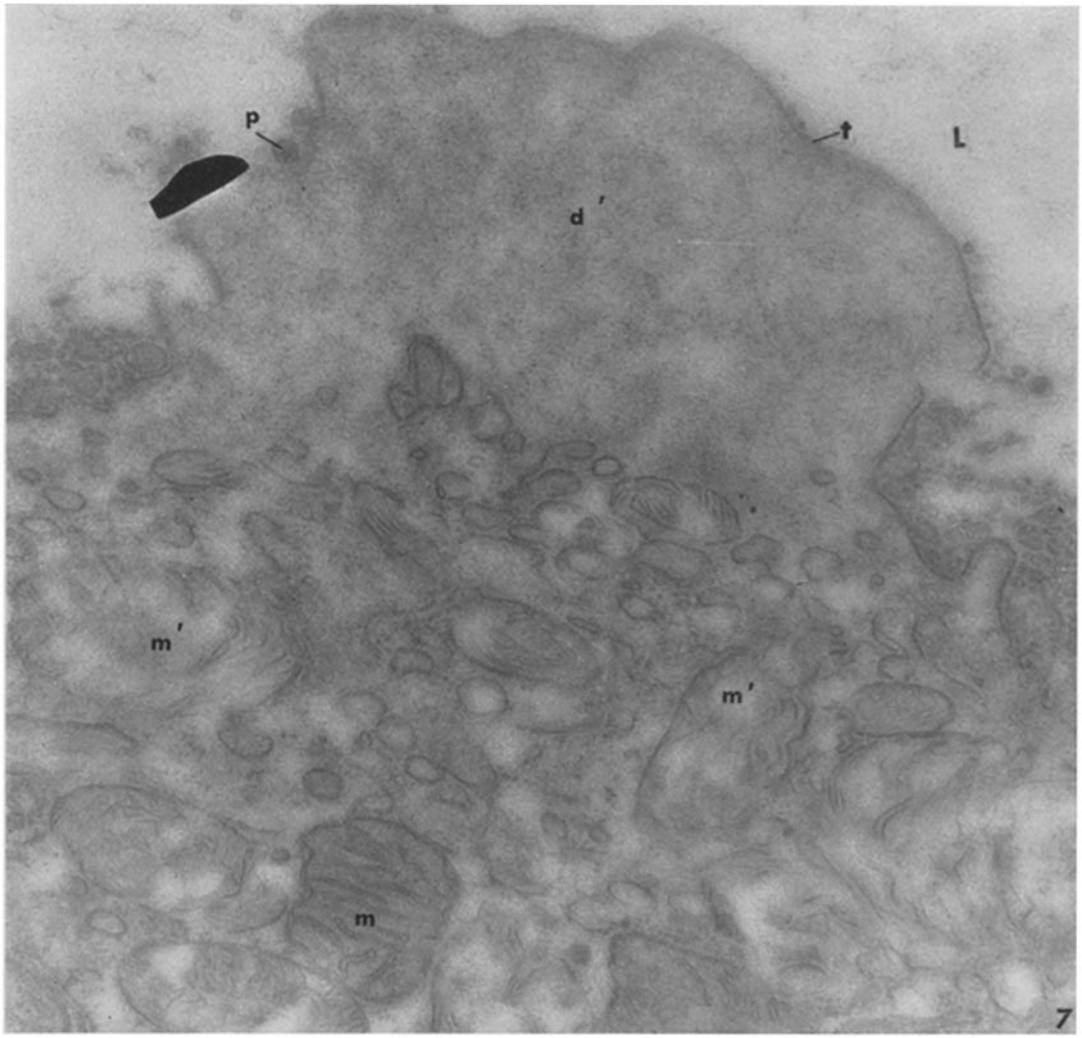
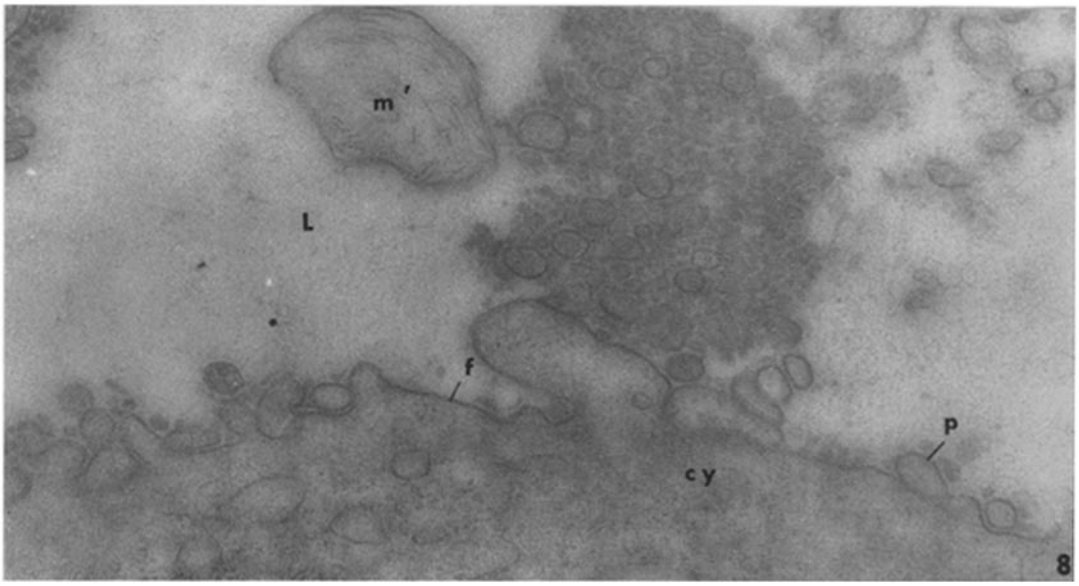
FIG. 7. Apical pole of cell, showing microprojections (*p*) and an homogeneous portion of cytoplasm (*d'*), protruding into the lumen (*L*). It is covered by the cell membrane, cut obliquely in places (*t*). The cytoplasm beneath this protrusion contains numerous profiles, predominantly of the smooth surfaced variety. Some mitochondria (*m*) are of the more common type, with the internal membranes disposed as cristae perpendicular to the long axis. Others (*m'*), are swollen, their matrix is of lower density, and they show internal lamella organization of an unusual character. × 52,000.

FIG. 8. Apical region of the cell, showing microvilli (*p*) and the presence in the lumen (*L*) of what appears to be a mitochondrion (*m'*). Other profiles present in the lumen appear to represent vesicles or detached microvilli. × 52,000.





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