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A COMBINED HISTOLOGICAL, HISTOCHEMICAL AND SCANNING ELECTRON MICROSCOPICAL STUDY OF THE CANINE RESPIRATORY TRACT

A thesis submitted to the Faculty of Veterinary Medicine
University of Glasgow
For the Degree of Doctor of Philosophy

by

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Department of Veterinary Anatomy,
University of Glasgow,
June, 1986.

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Vol.II.

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VOLUME II

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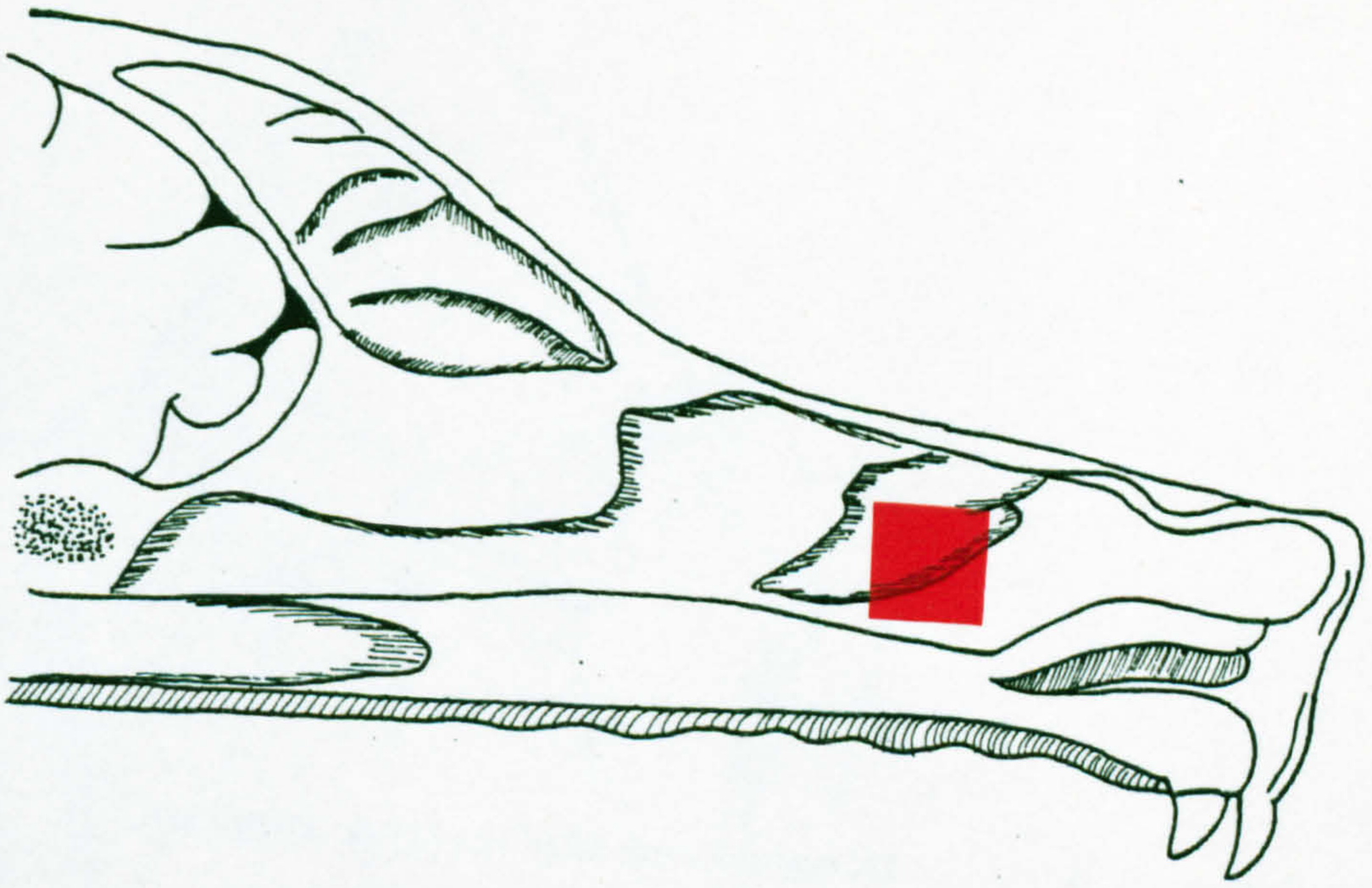
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CHAPTER 3

Fig. 3.1 Diagram of a mid-line sagittal section of the canine head, showing the region of the nasal septum sampled.
(Red marker)

Fig. 3.2 Diagram of a sagittal section (lateral to mid-line) of the canine head, showing the areas of the nasal fossa sampled.
1 = ventral concha; 2 = ethmoidal concha; 3 = nasopharynx.



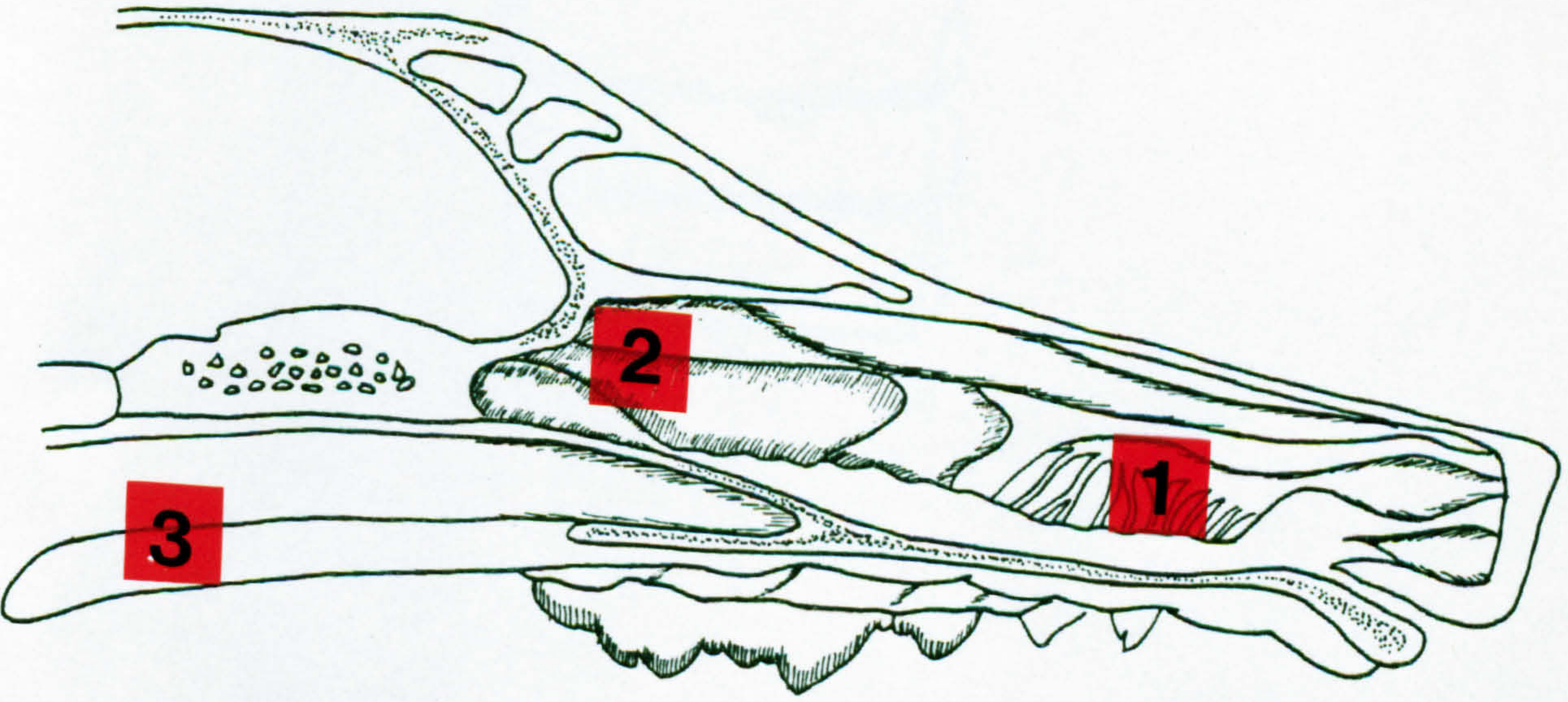

2
1
3

Fig. 3.3 Diagram of the canine larynx, showing the areas sampled. 1 = epiglottis; 2 = ventral larynx.

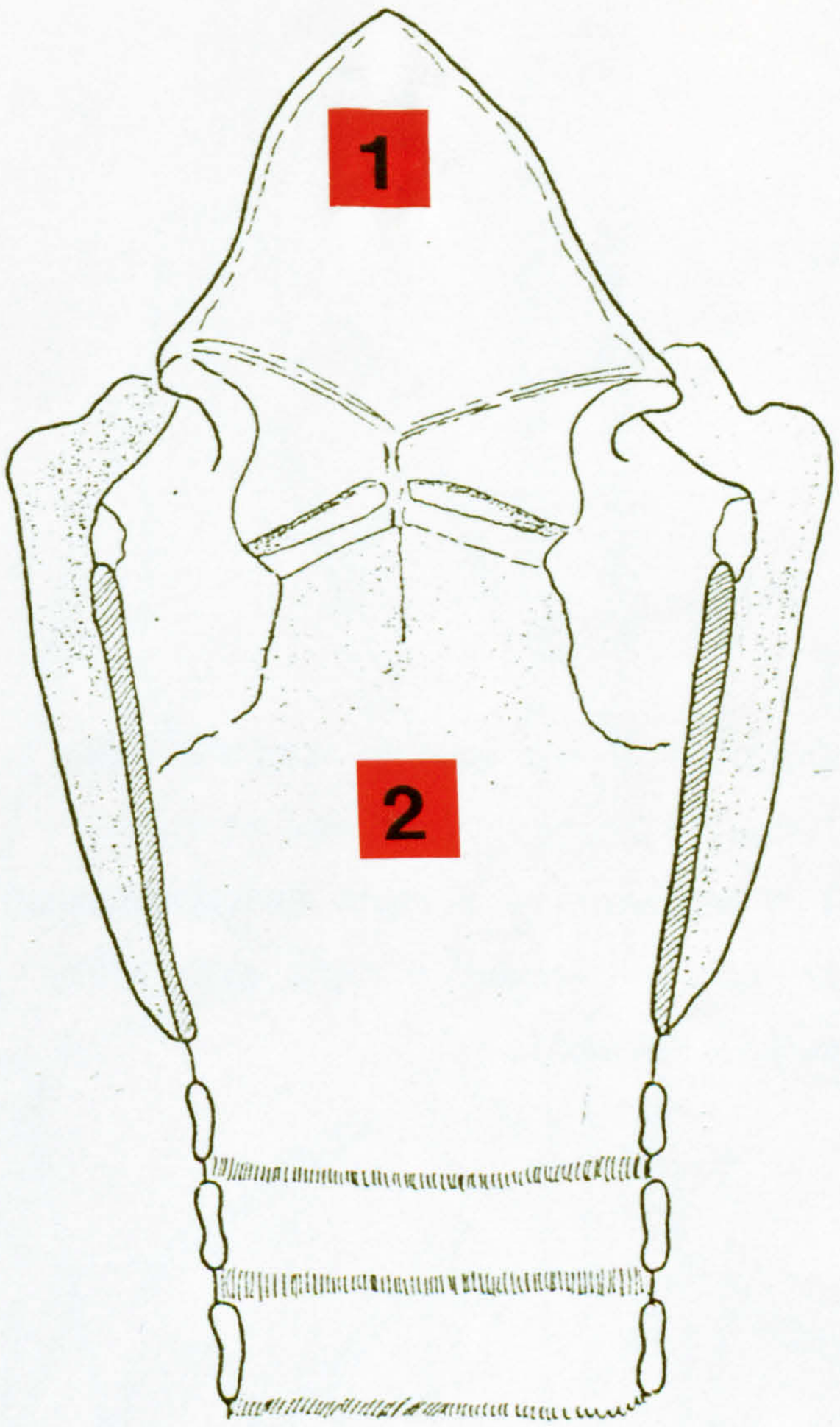

1
2

Fig. 3.4 Diagram of the canine trachea and lungs, showing the areas sampled. 1 = trachea; 2 = right extrapulmonary bronchus; arrows = right and left caudal bronchi.

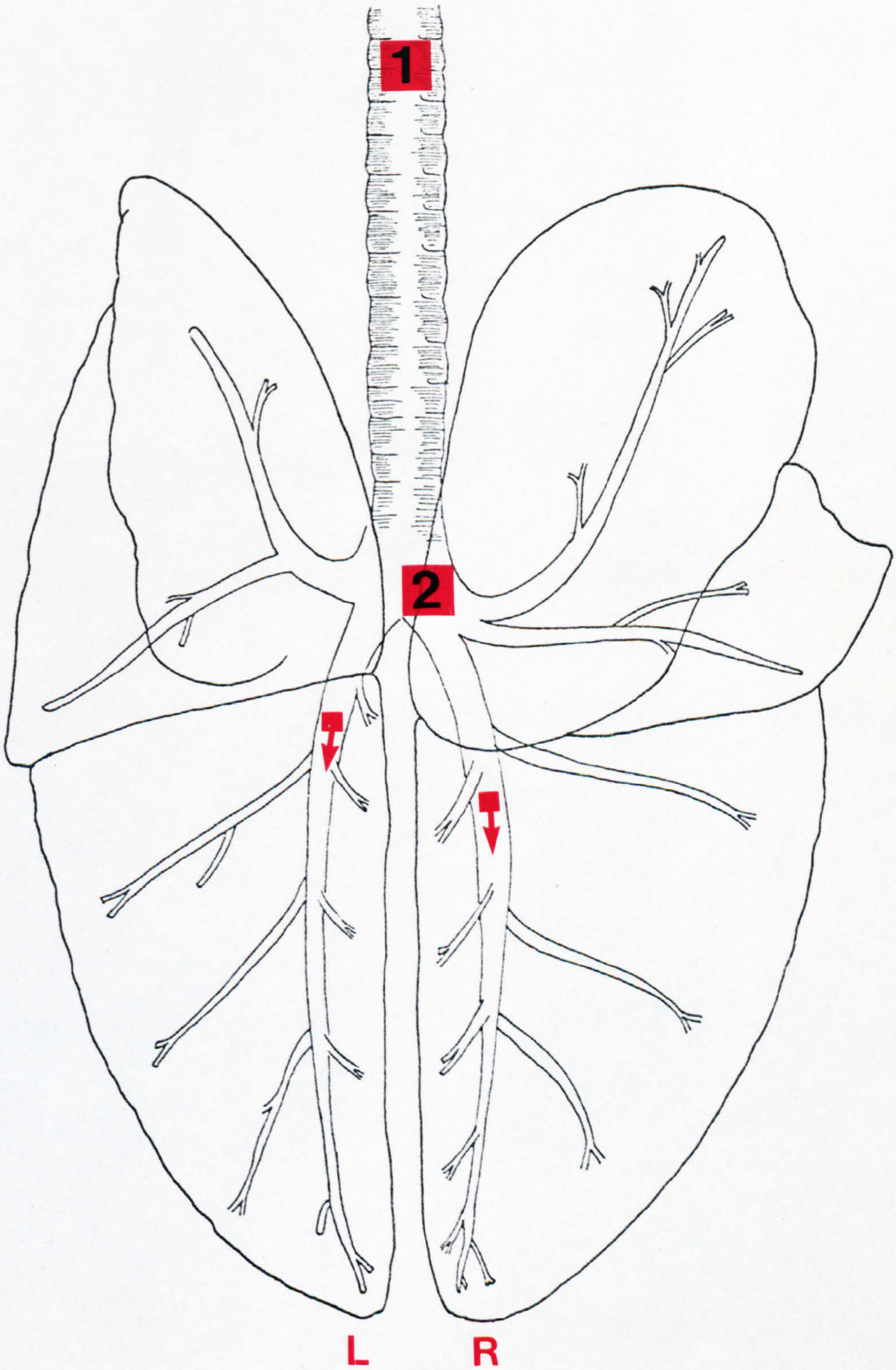
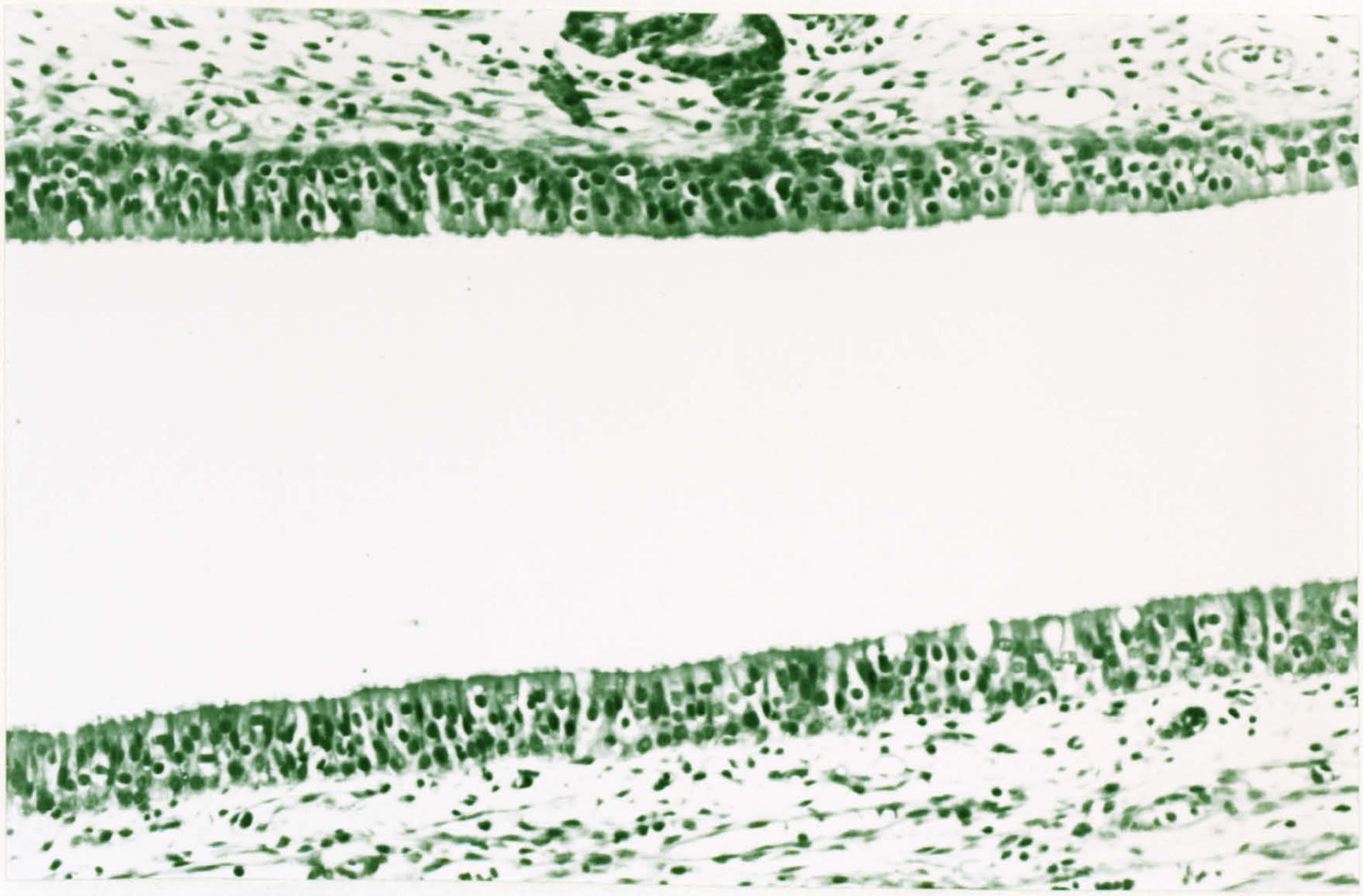

1
2
L
R

Fig. 3.5 Ventral concha. The epithelium is of the pseudostratified columnar ciliated type.
HE x 180.

Fig. 3.6 Ventral concha. Note the numerous goblet cells.
PAS x 350.



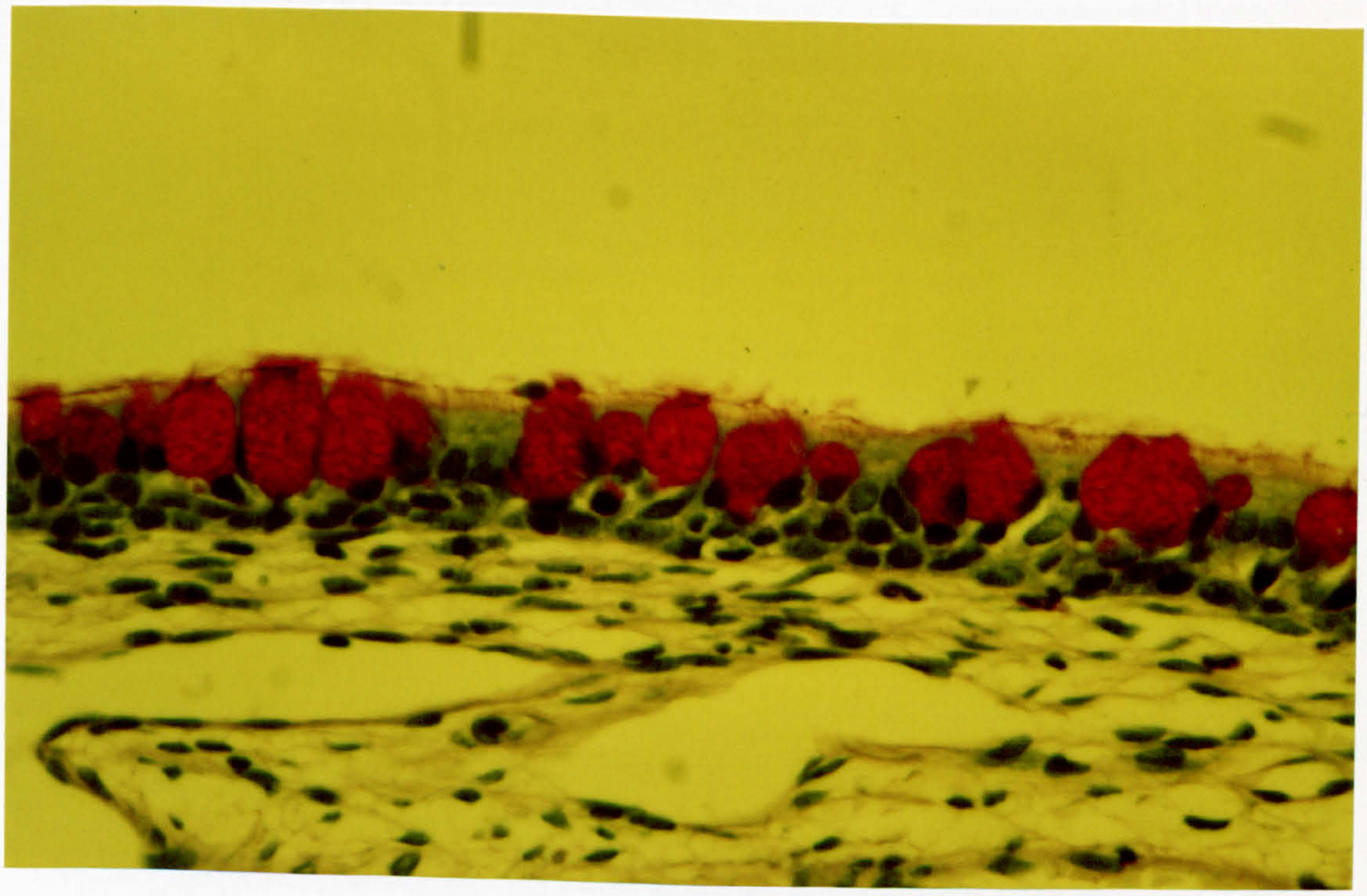
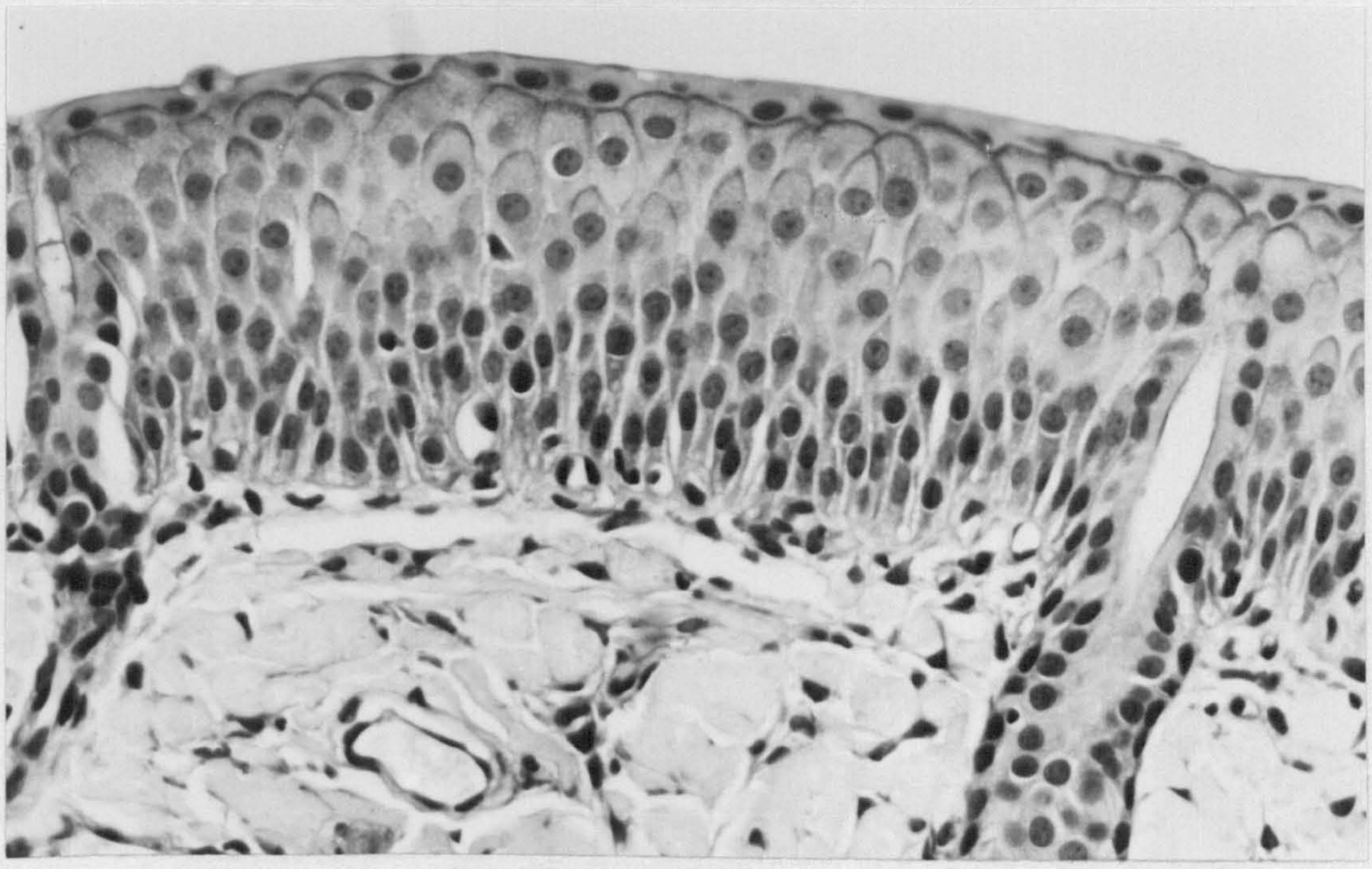


Fig. 3.7 Alar fold of ventral concha. The epithelium in this region is of the stratified transitional type. HE x 400.

Fig. 3.8 Nasal vestibule. Note the stratified squamous keratinising epithelium. HE x 180.



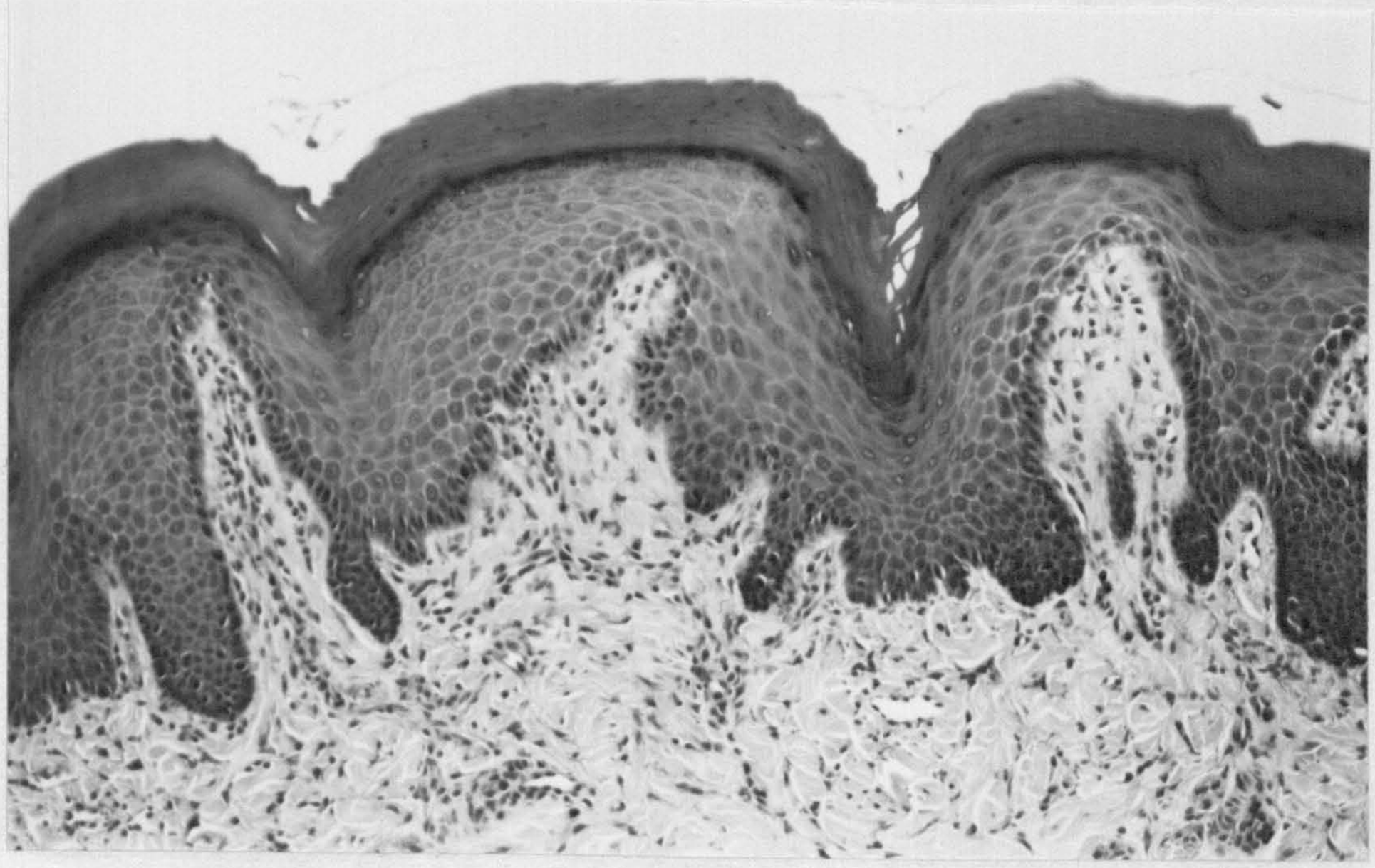


Fig. 3.9 Ventral concha. Most of the goblet cells contain acidic (blue) mucosubstances.
AB-PAS x 350.

Fig. 3.10 Nasal septum. The epithelium is of the pseudostratified columnar ciliated type with many goblet cells.
HE x 350.

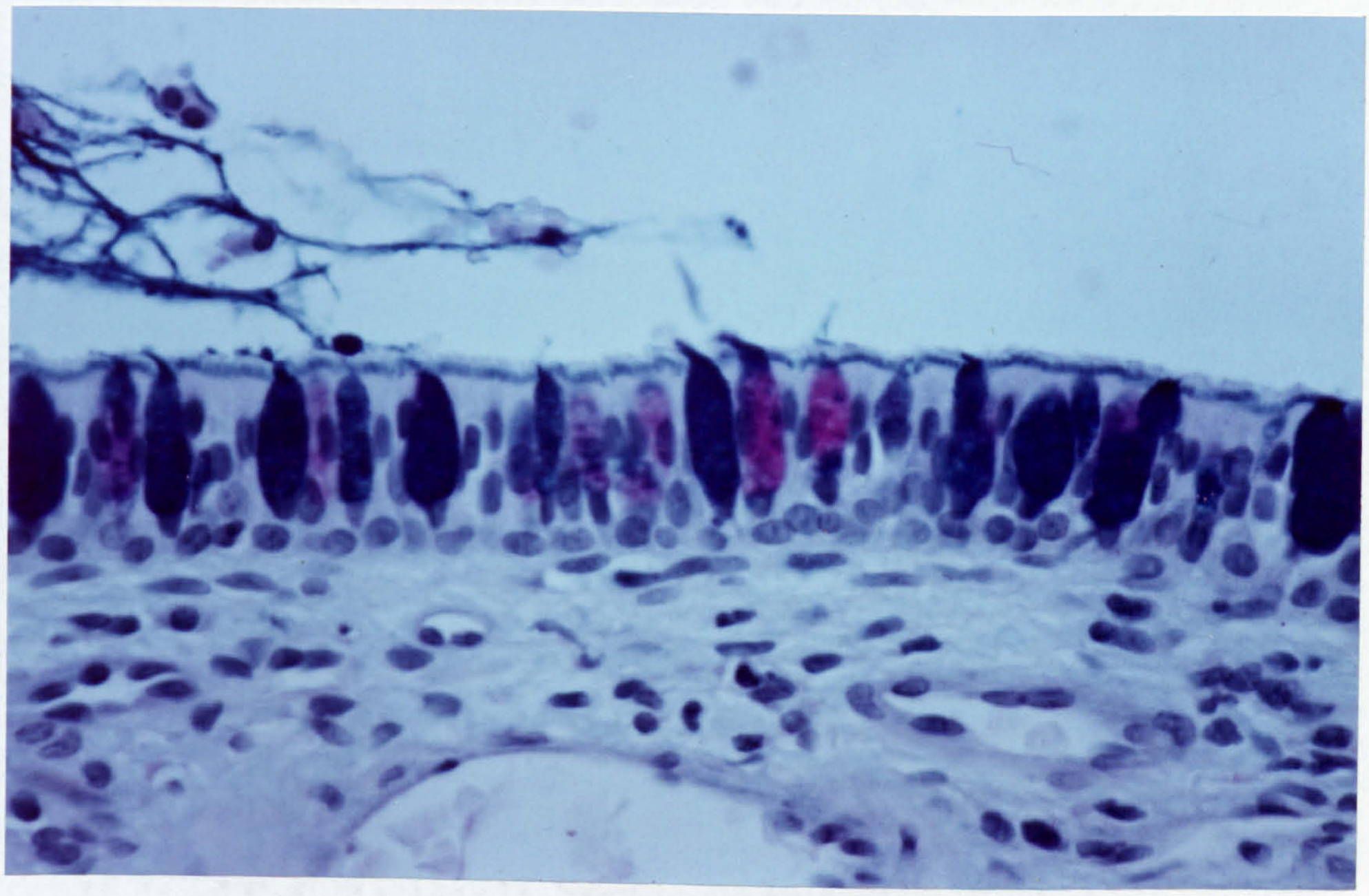
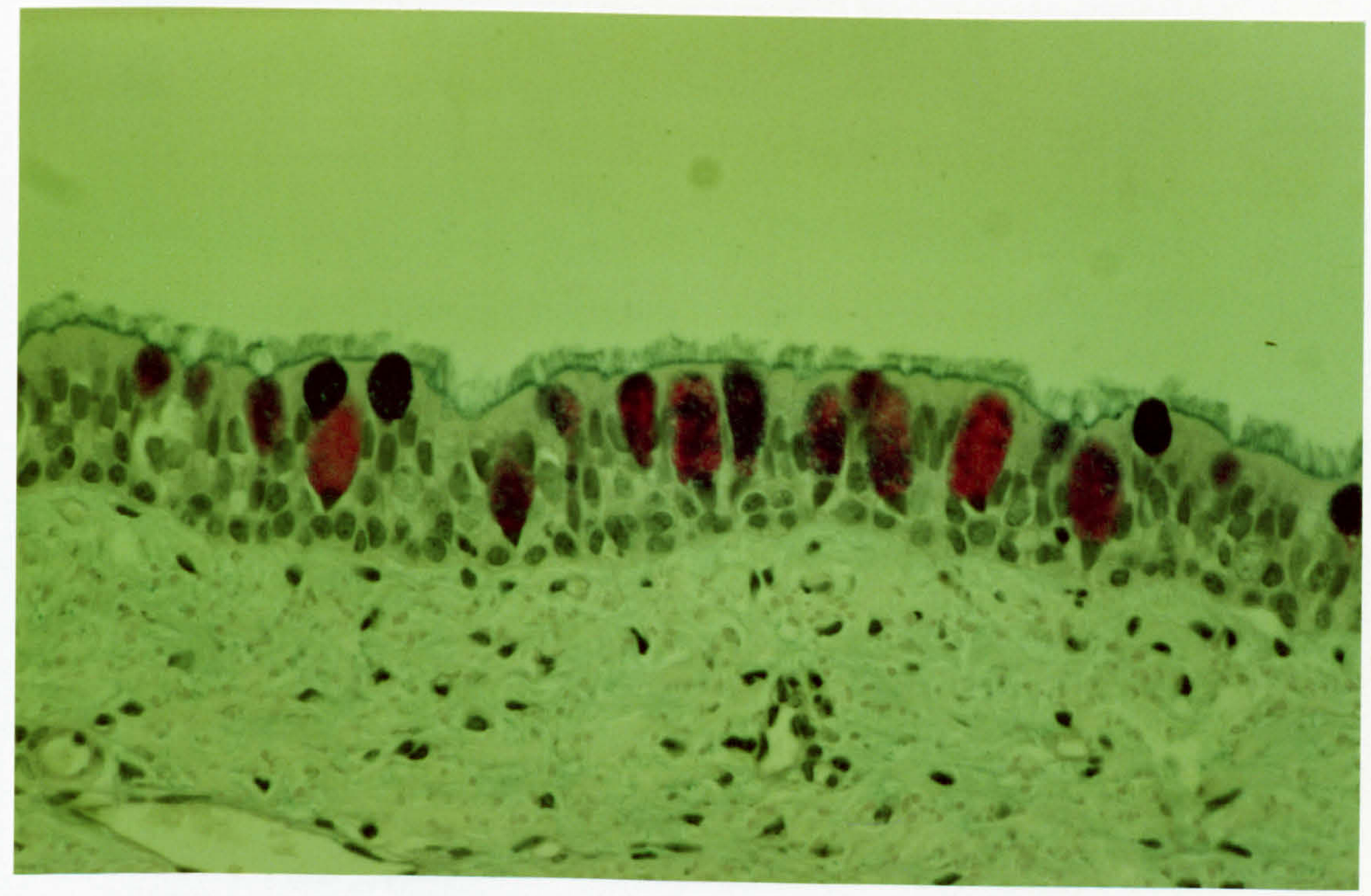




Fig. 3.11 Nasal septum. Most of the goblet cells in this section contain mixed mucosubstances. AB-PAS x 350.

Fig. 3.12 Nasal septum. A submucosal gland, showing neutral (red), acidic (blue) and mixed units. AB-PAS x 400.



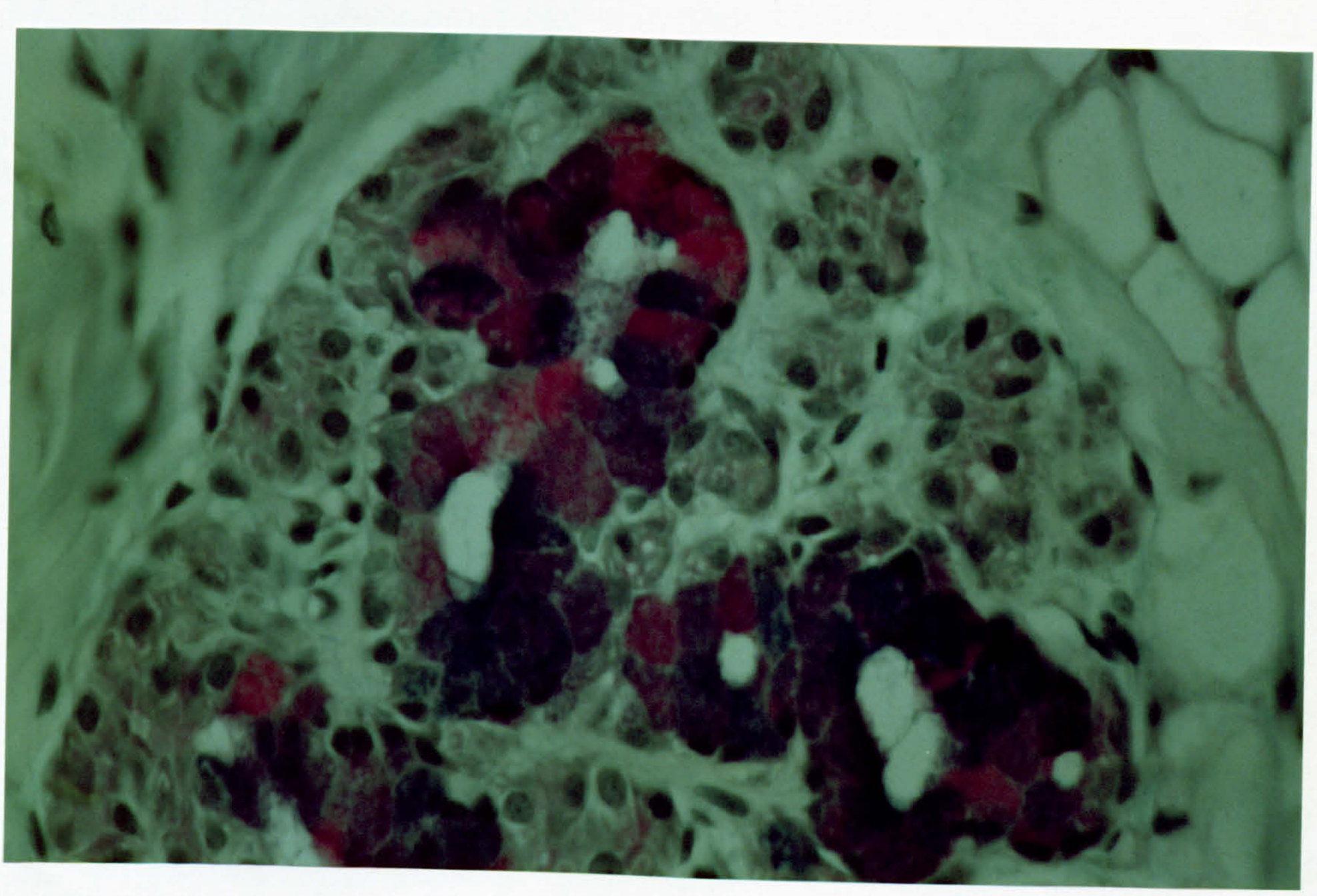
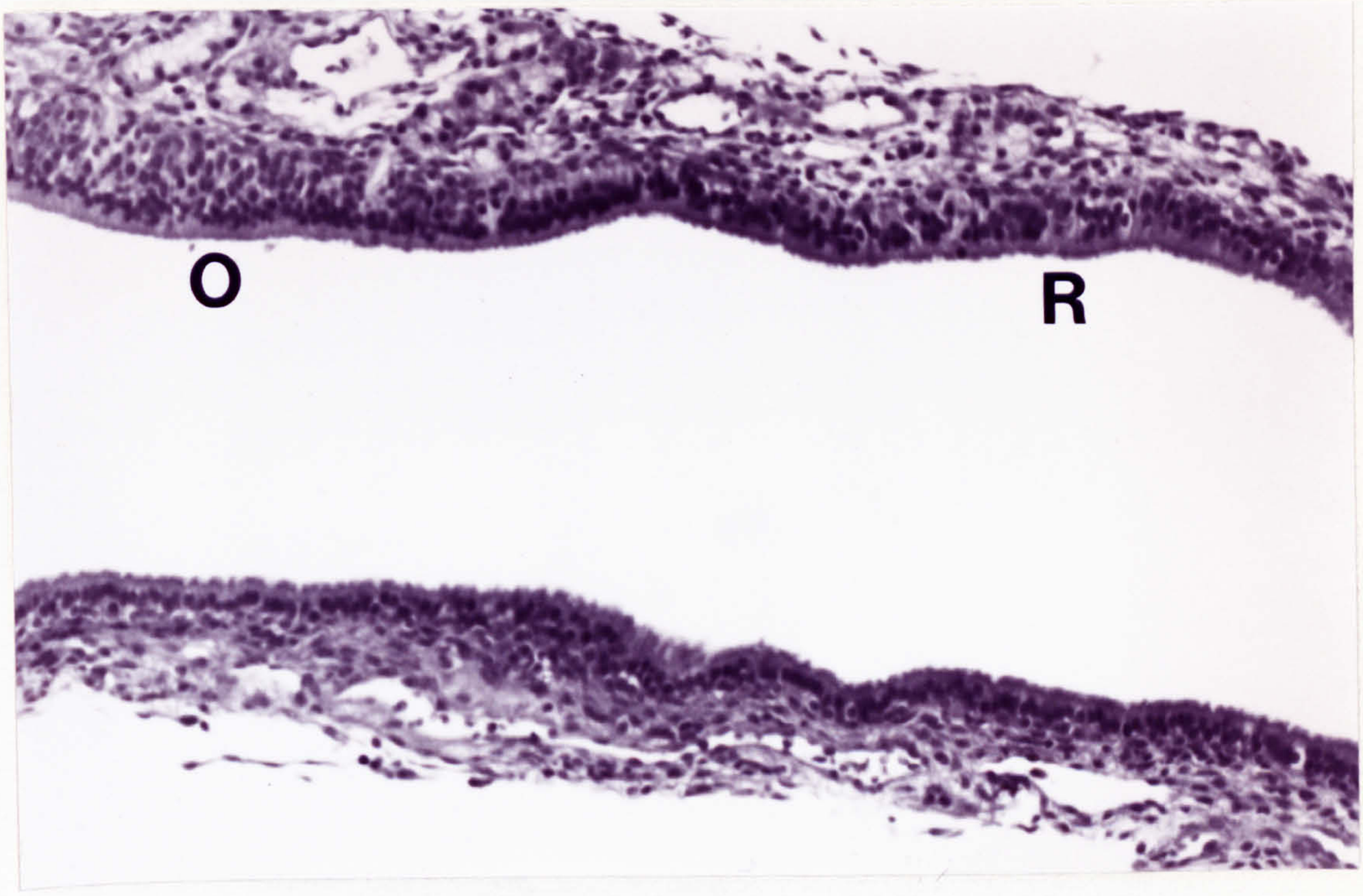


Fig. 3.13 Ethmoidal concha. A junctional zone between the thick olfactory (O) and respiratory (R) mucosae.
HE x 180.

Fig. 3.14 Ethmoidal concha. Note the blue-stained serous glands of Bowman.
AB-PAS x 250.


O
R

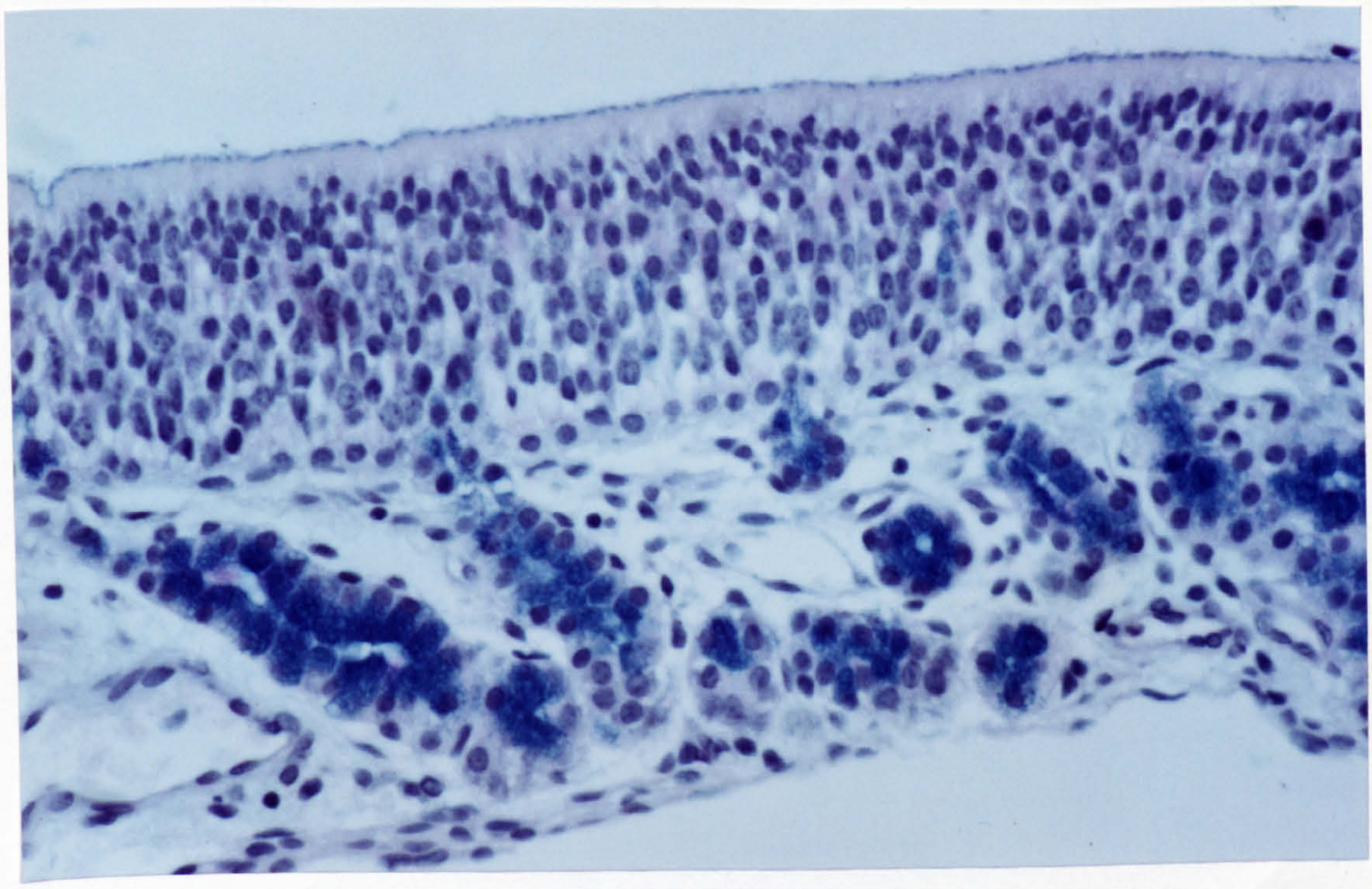
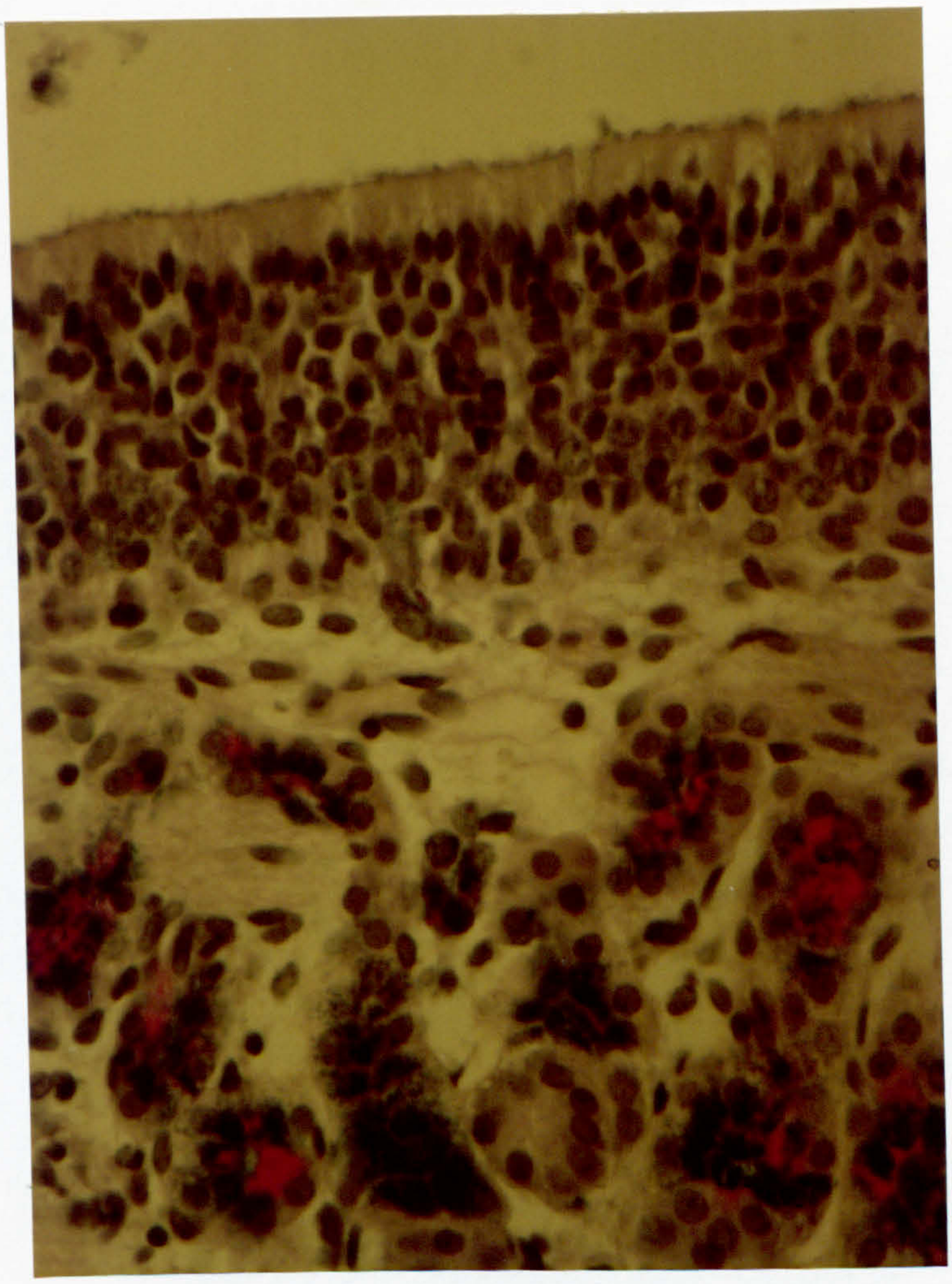


Fig. 3.15 Ethmoidal concha. In this case some of the glandular units are stained red (neutral mucosubstance). AB-PAS x 250.

Fig. 3.16 Nasopharynx. The epithelium is of the pseudostratified columnar ciliated type with many goblet cells. AB-PAS x 300.



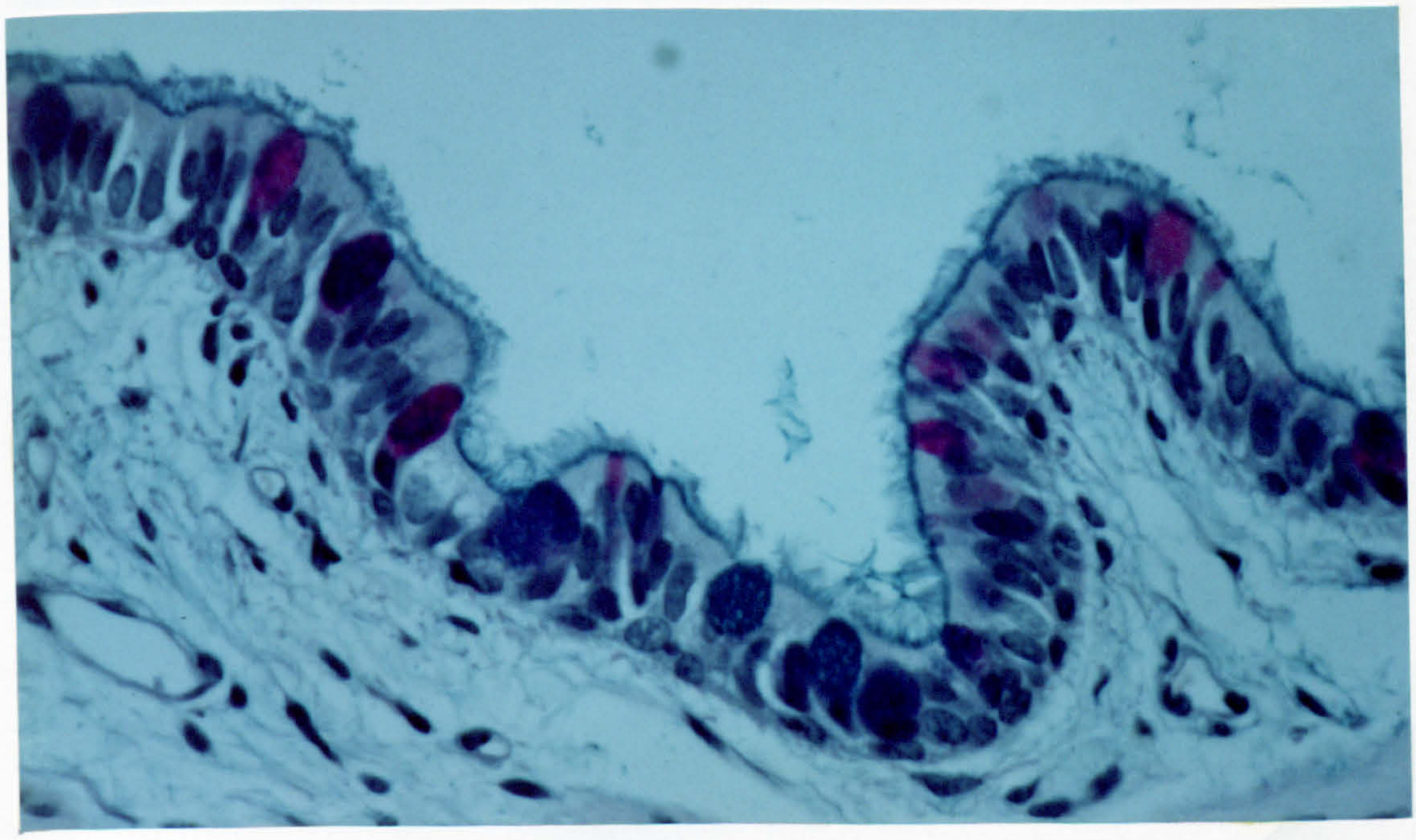
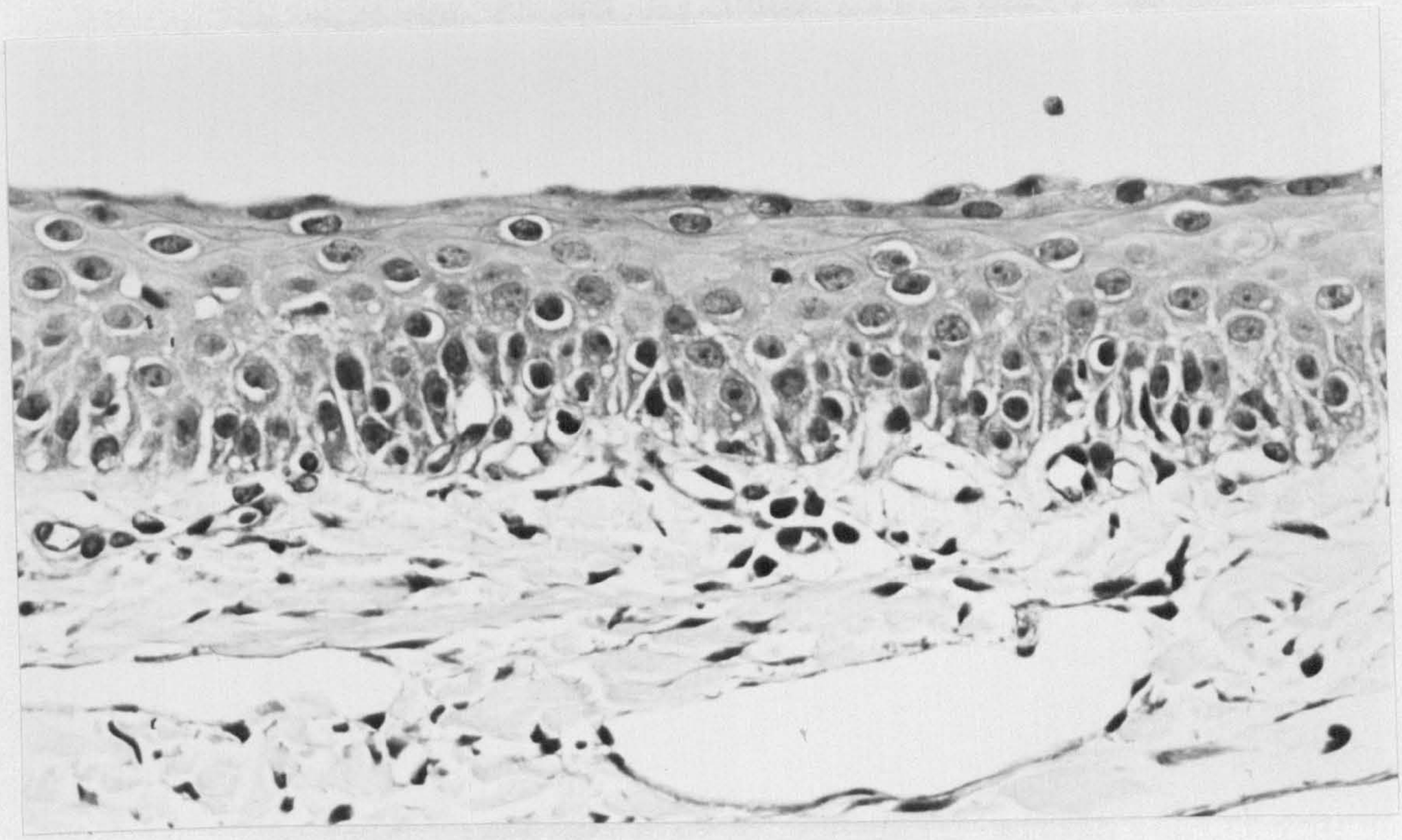


Fig. 3.17 Nasopharynx. This region near the free edge of the soft palate is lined by stratified squamous non-keratinising epithelium.
HE x 350.

Fig. 3.18 Epiglottis, dorsal surface. The epithelium here is of the stratified squamous non-keratinising type.
HE x 180.



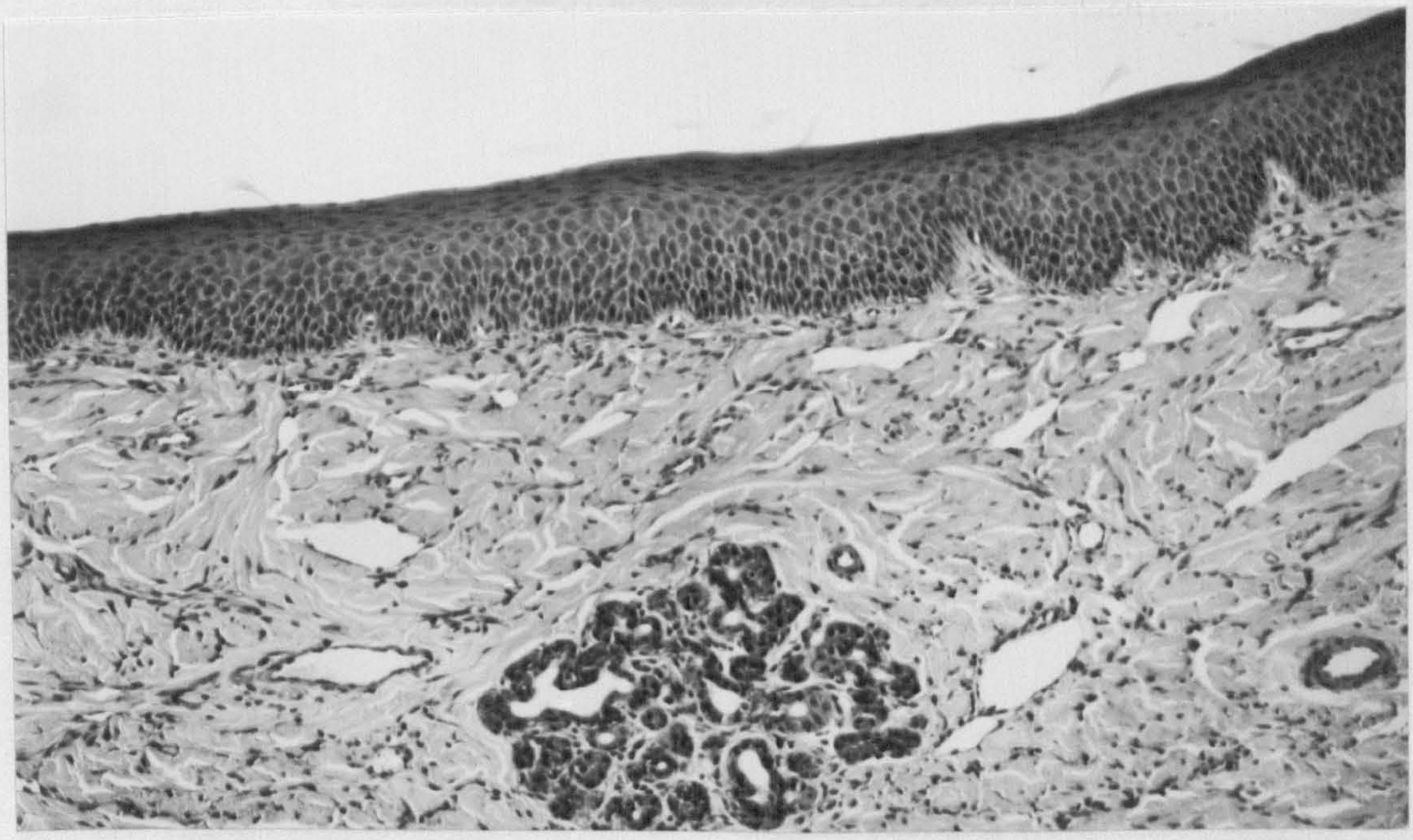
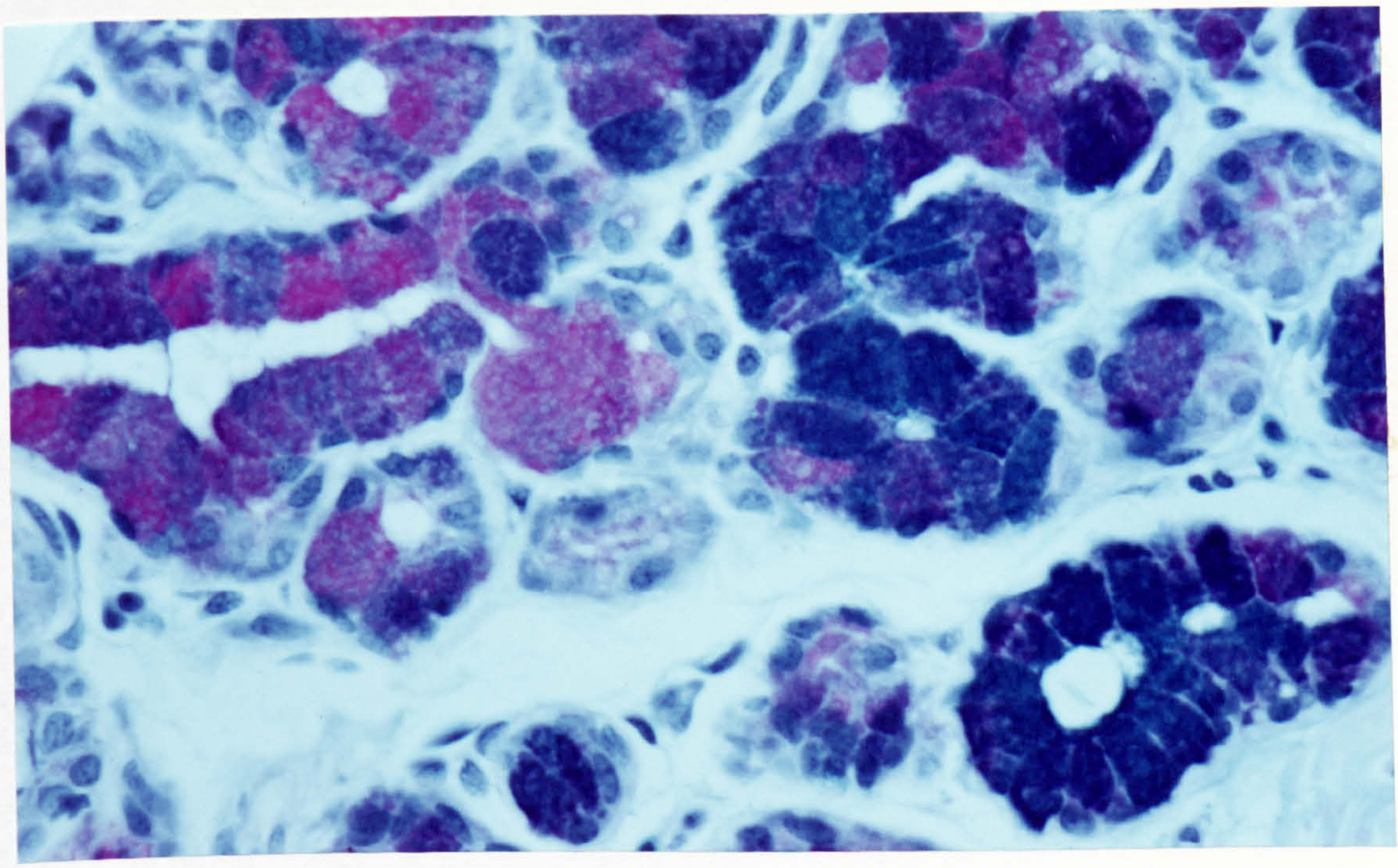


Fig. 3.19 Epiglottis. Many glands are shown containing acid or mixed mucosubstances.
AB-PAS x 400.

Fig. 3.20 Ventral larynx. In this specimen, the epithelium is of the pseudostratified columnar ciliated type.
PAS x 350.



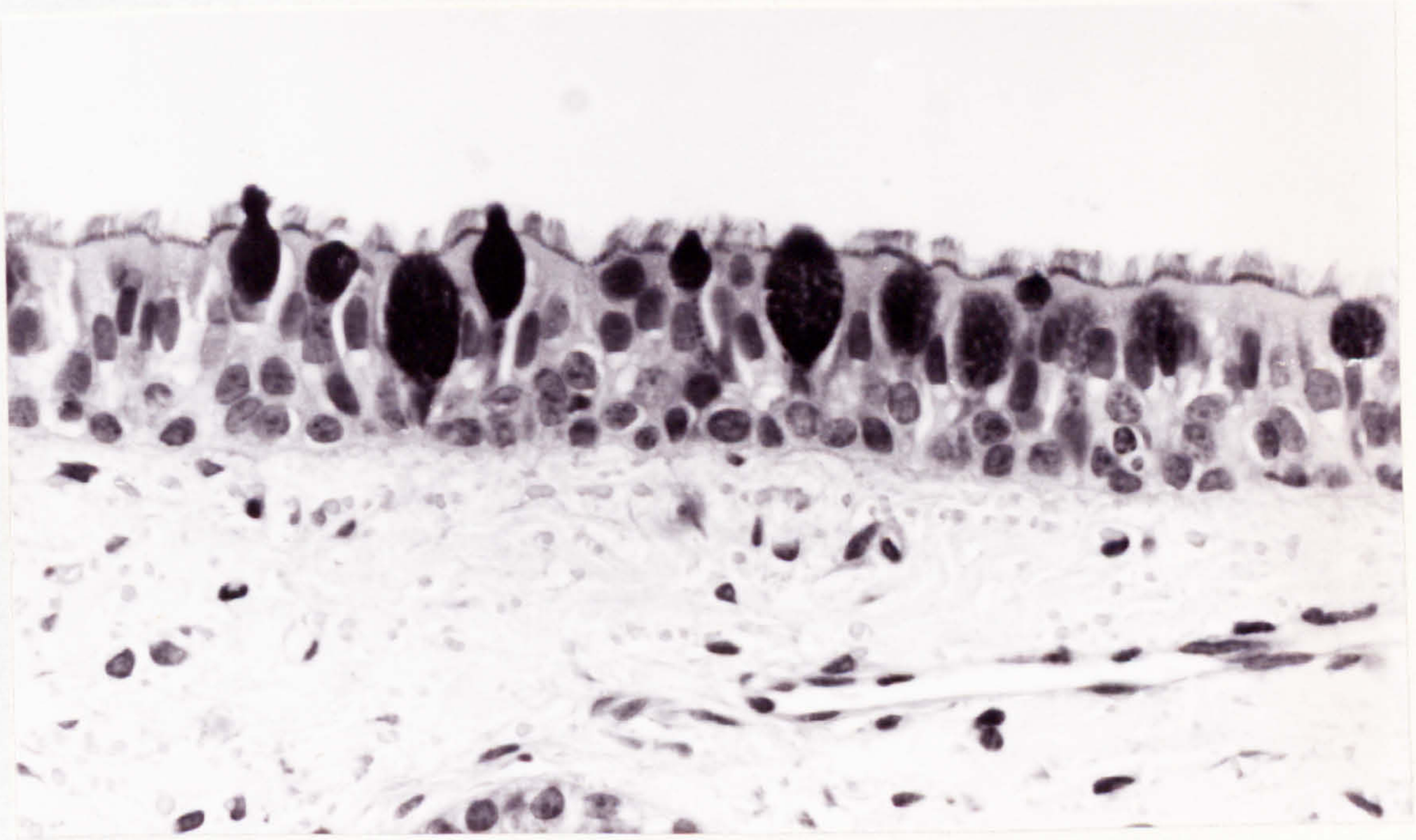


Fig. 3.21 Ventral larynx. Note the stratified squamous non-keratinising epithelium.
HE x 200.

Fig. 3.22 Trachea. A dorsal view showing the characteristic folded epithelium.
C = Tracheal Cartilage;
M = Trachealis Muscle.
HE x 80.



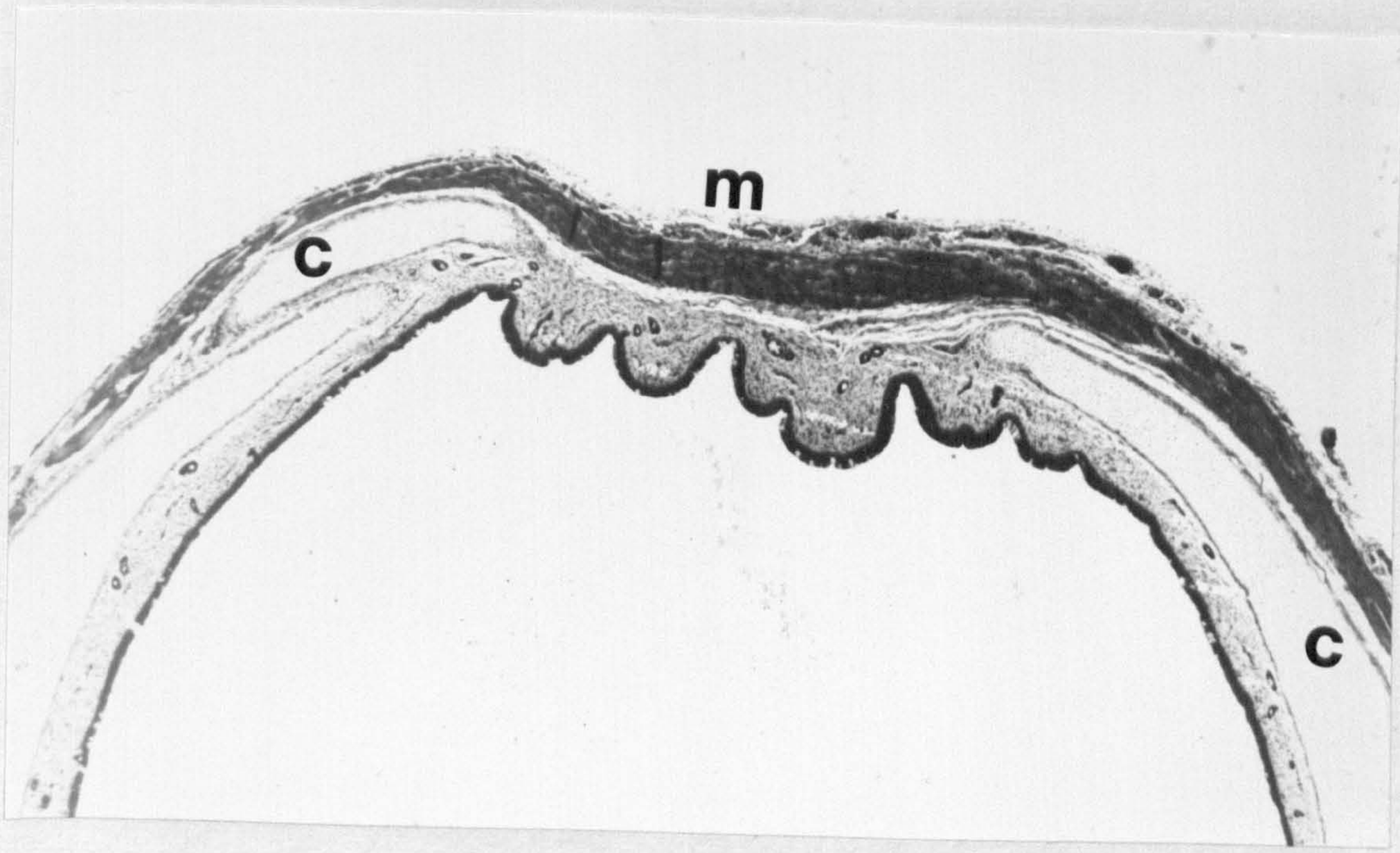
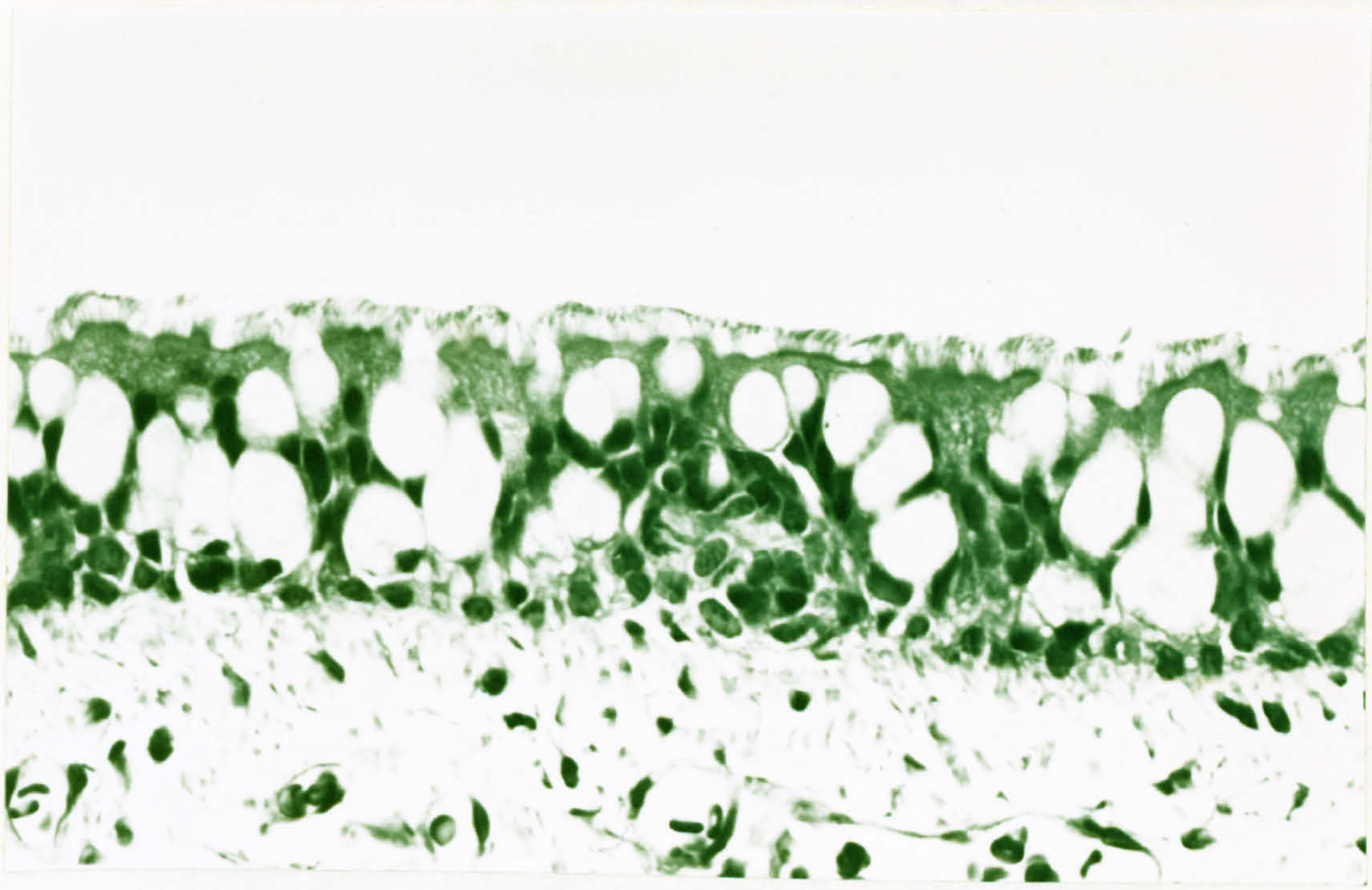

m
c
c

Fig. 3.23 Trachea. The epithelium is of the pseudostratified columnar ciliated type with many goblet cells. HE x 350.

Fig. 3.24 Trachea. These tracheal glands contain mainly acidic and, to a lesser extent, mixed mucosubstances. AB-PAS x 400.



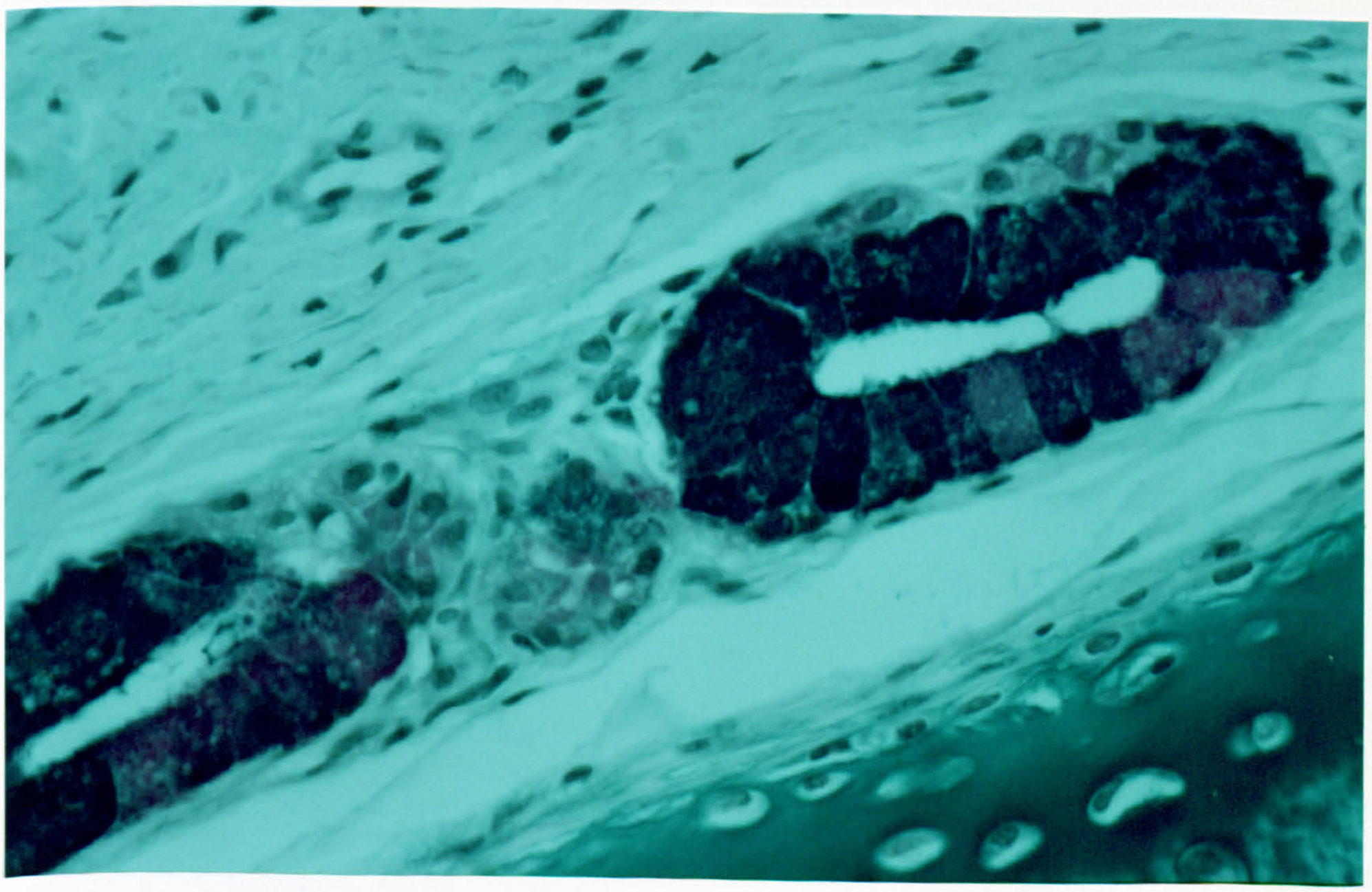
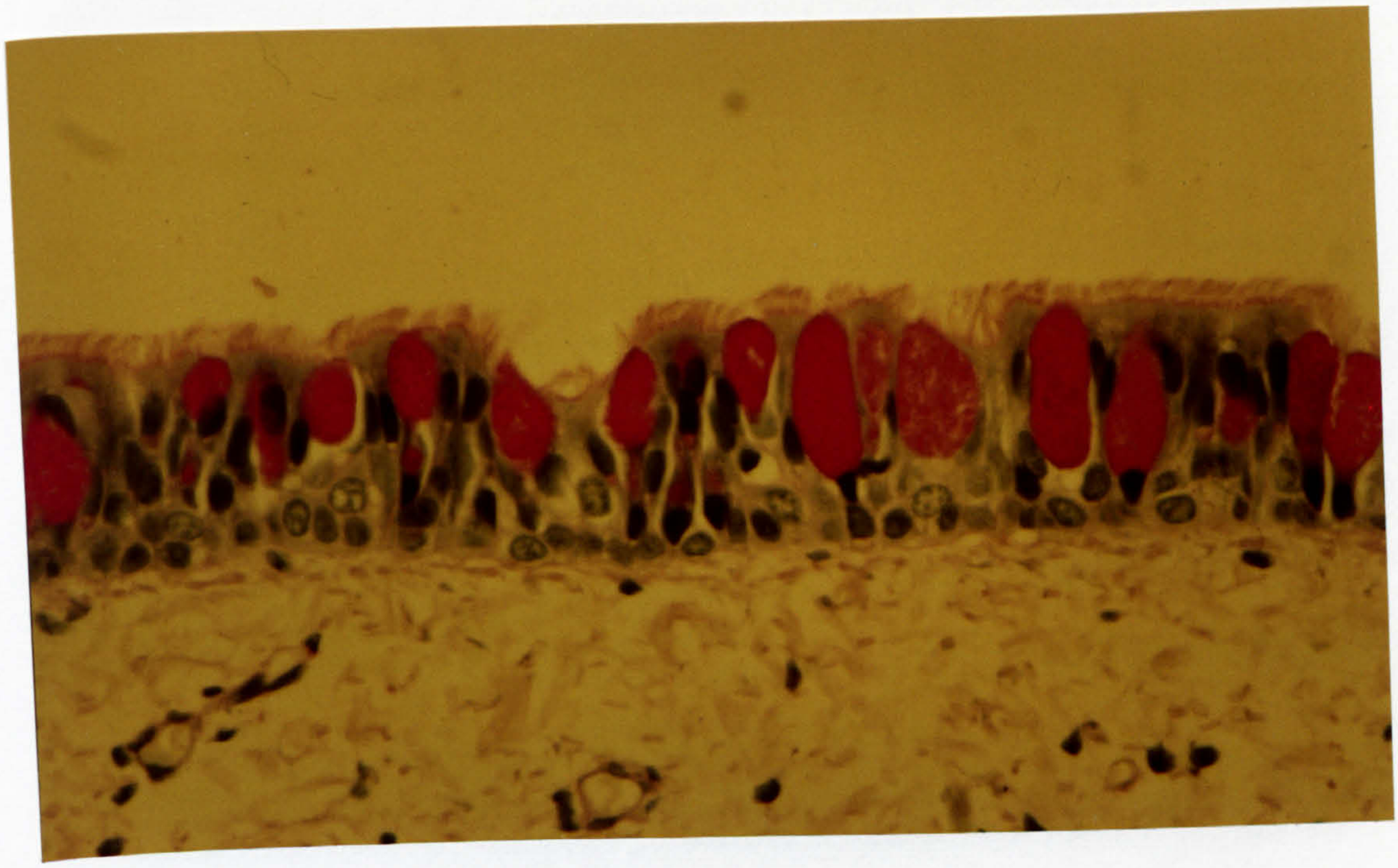


Fig. 3.25 Extrapulmonary bronchus. Note the numerous goblet cells in the pseudostratified columnar ciliated epithelium.
PAS x 350.

Fig. 3.26 Extrapulmonary bronchus. In this specimen, many neutral (red) staining cells are to be seen.
AB-PAS x 350.

Fig. 3.25 Extrapulmonary bronchus. Note the numerous goblet cells in the pseudostratified columnar ciliated epithelium.
PAS x 350.

Fig. 3.26 Extrapulmonary bronchus. In this specimen, many neutral (red) staining cells are to be seen.
AB-PAS x 350.



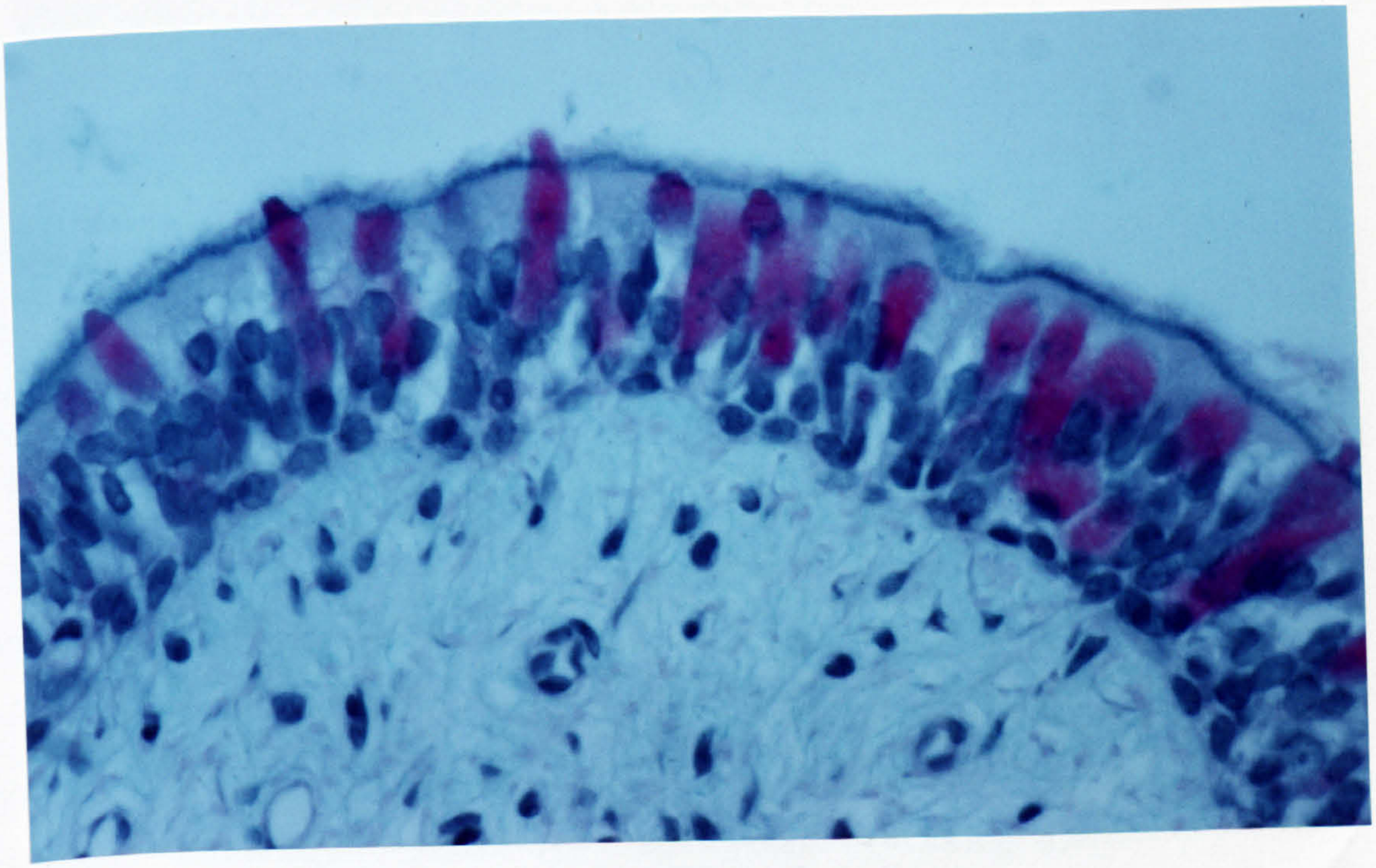
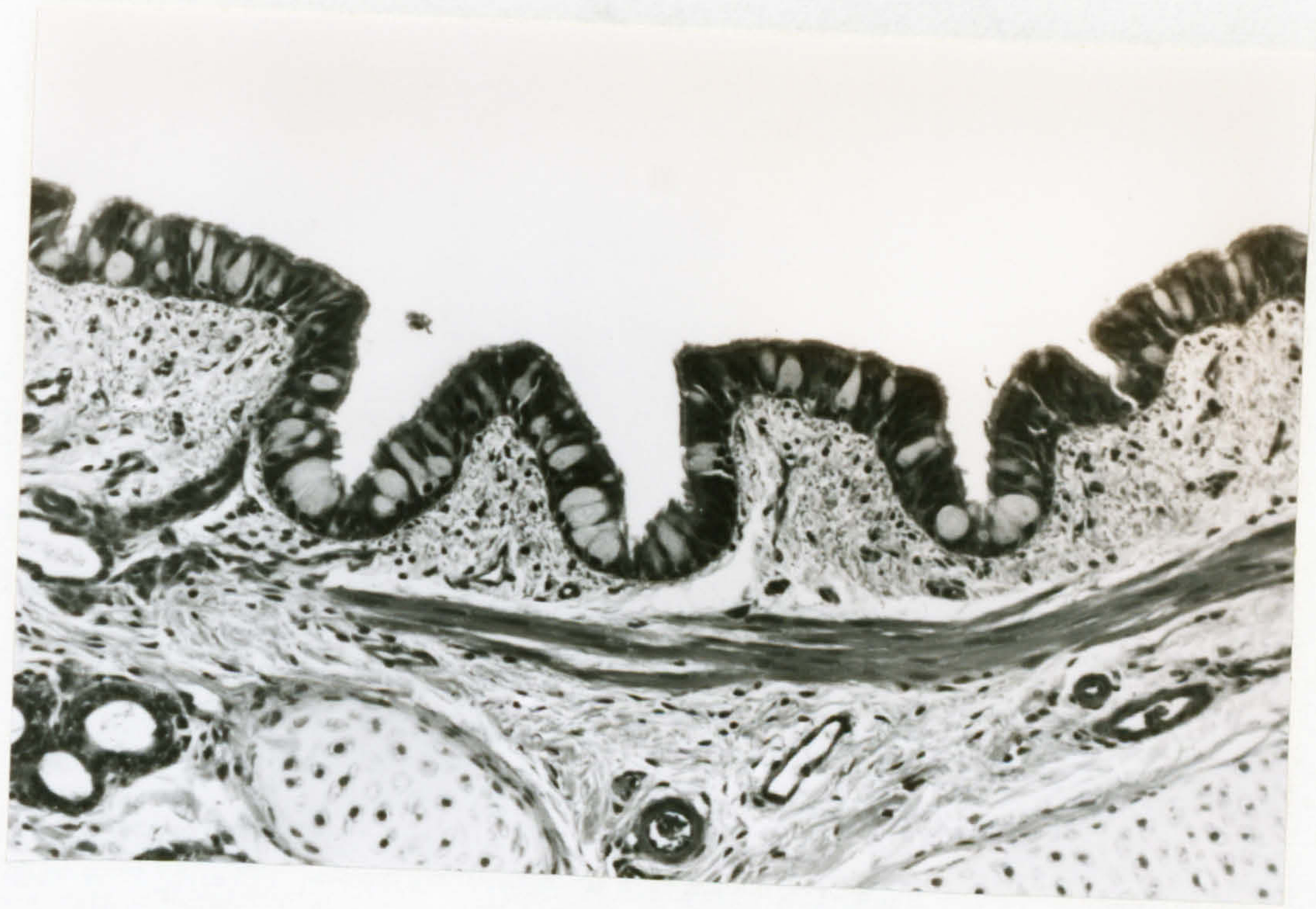


Fig. 3.27 Bronchus. A low power view of the bronchial wall. Note the many clear-staining goblet cells. HE x 180.

Fig. 3.28 Bronchus. This photomicrograph shows the characteristic pseudostratified columnar ciliated epithelium with many goblet cells. PAS x 350.



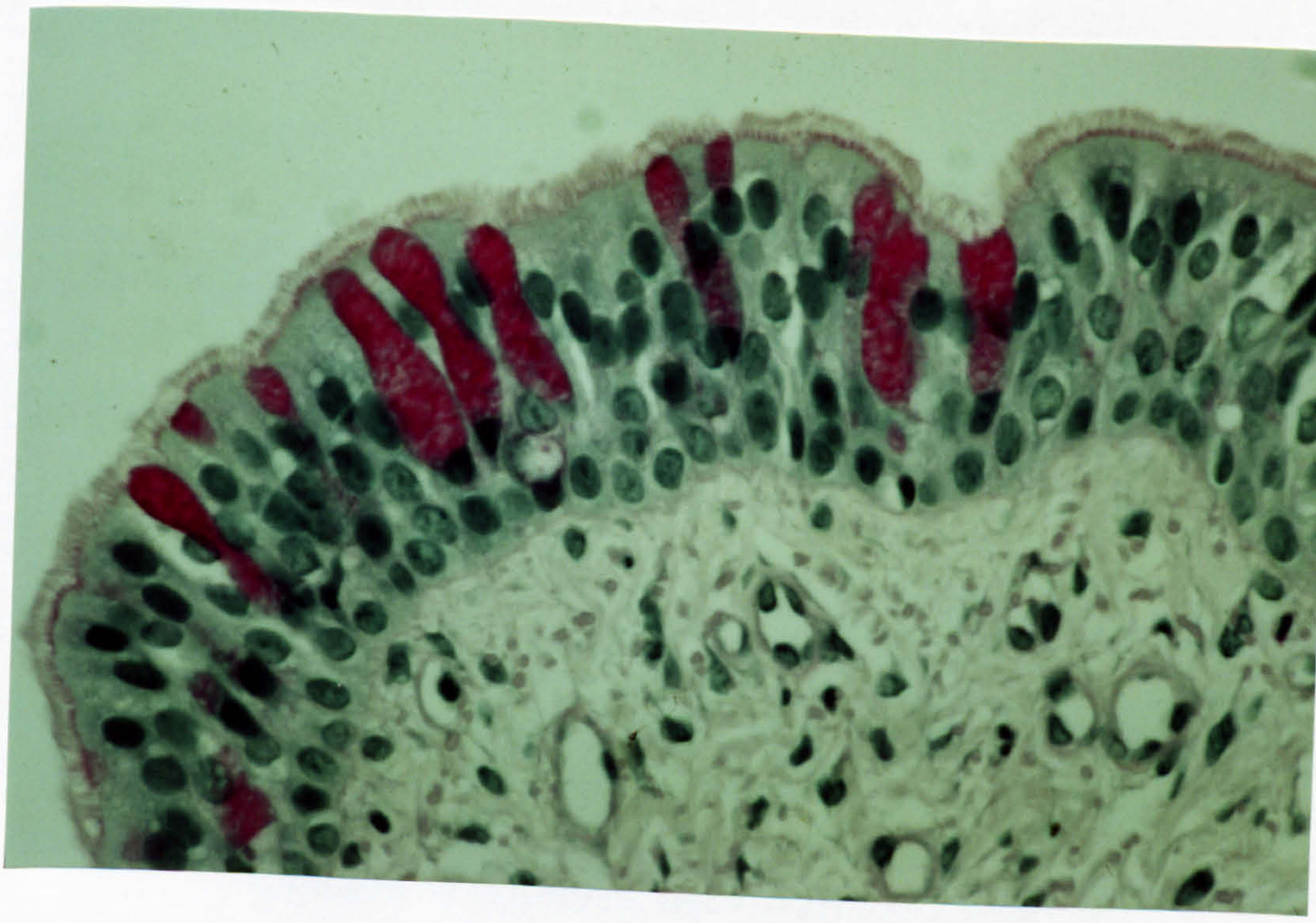
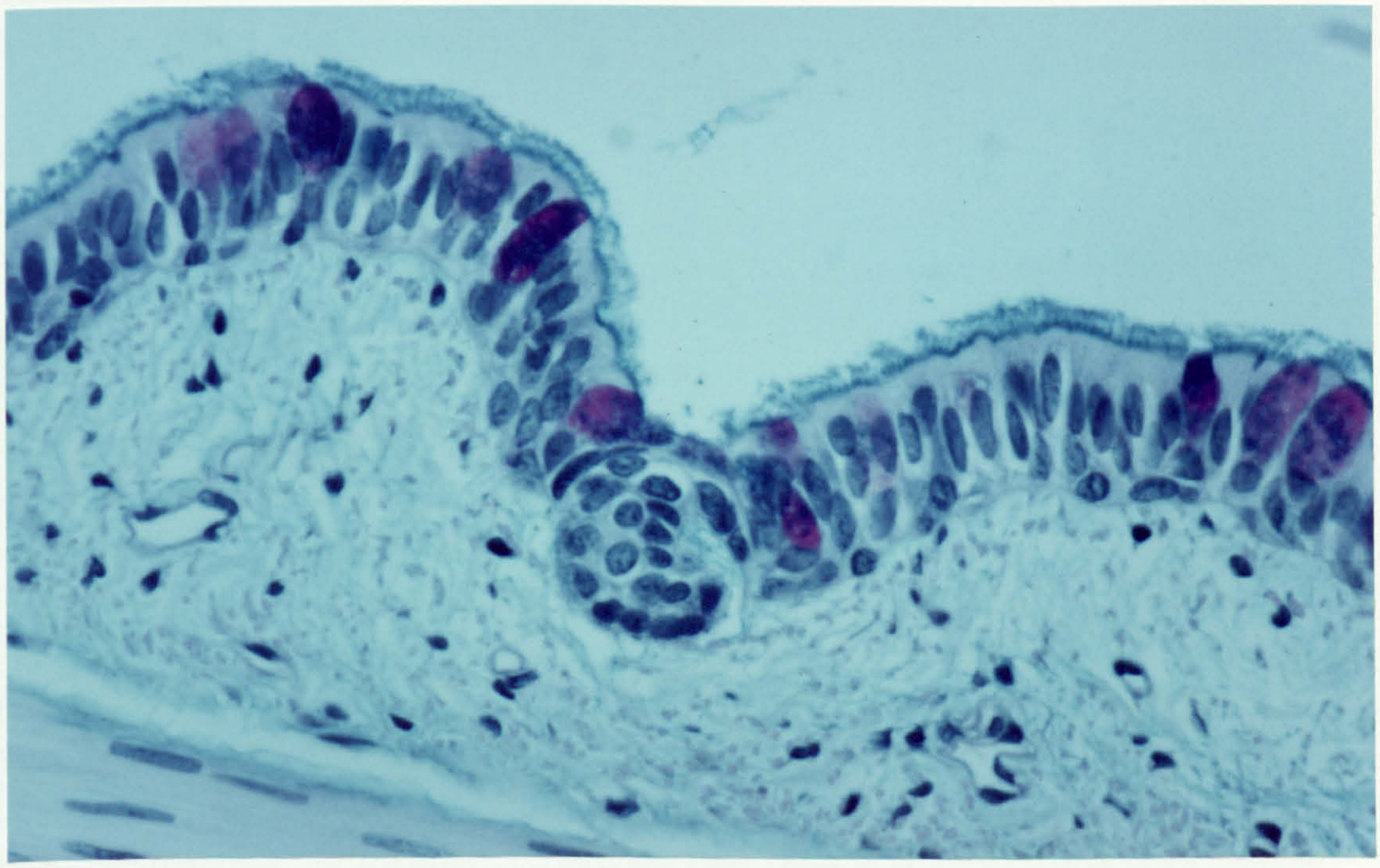


Fig. 3.29 Bronchus. Most of the goblet cells in this photomicrograph contain mixed mucosubstances. AB-PAS x 250.

Fig. 3.30 Bronchiole. A large bronchiole showing numerous goblet cells. Note the unstained submucosal glands. AB-PAS x 250.



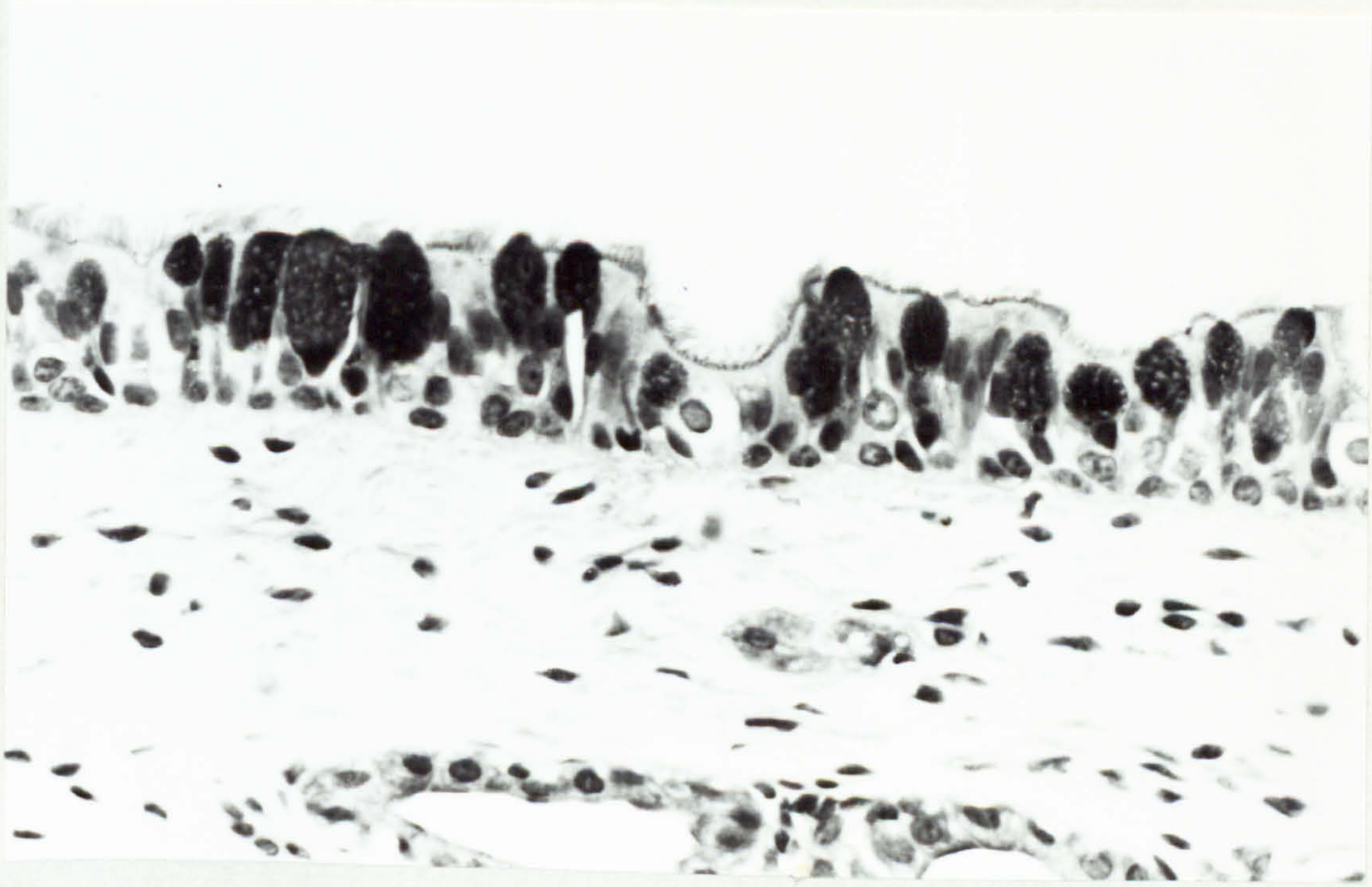
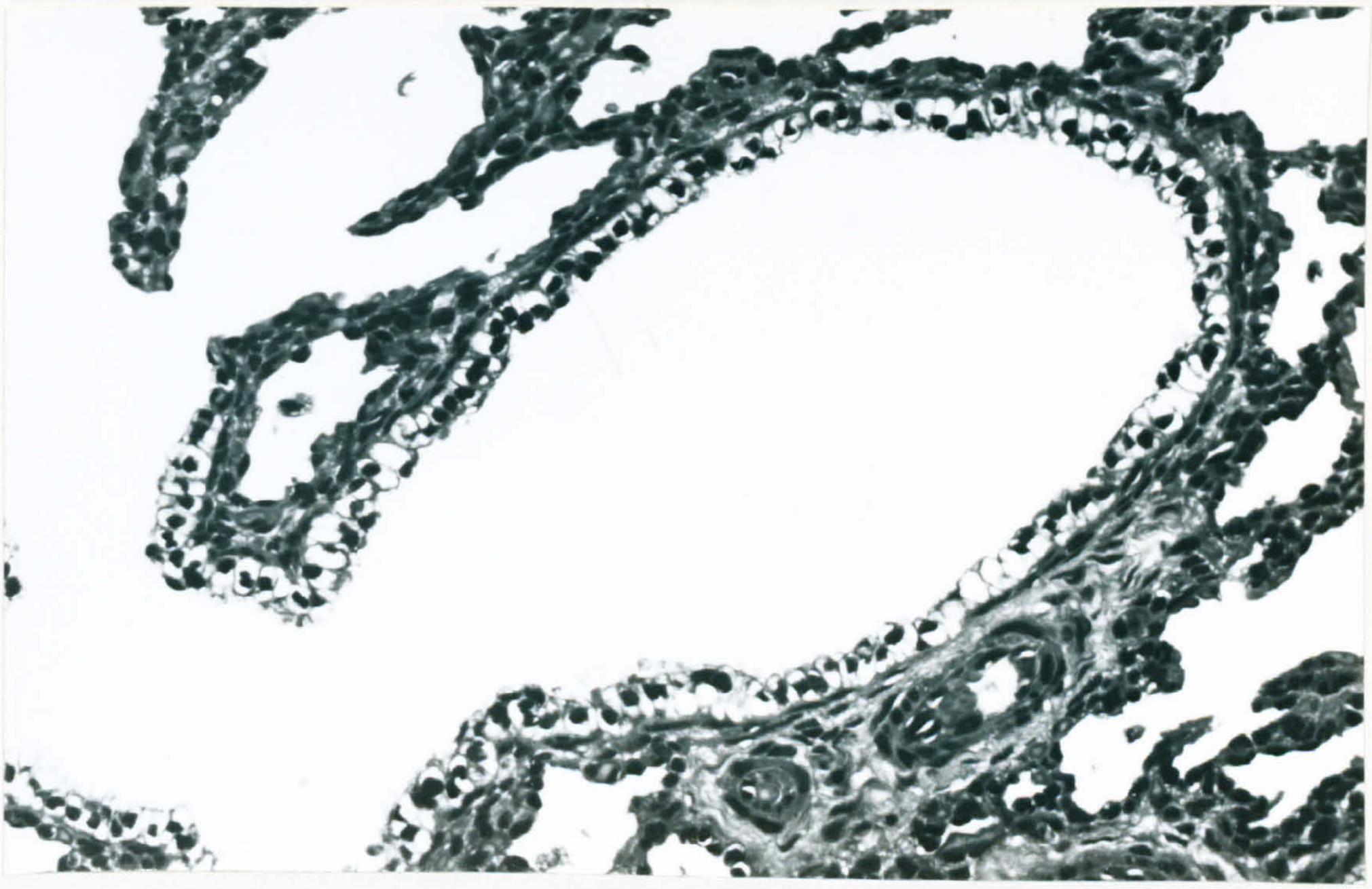


Fig. 3.31 Terminal bronchiole. Note the low columnar or cuboidal epithelium; the cytoplasm of these cells is poorly stained. HE x 200.

Fig. 3.32 Terminal bronchiole. Note the peripheral (red) staining of the bronchiolar epithelial cells. PAS x 350.



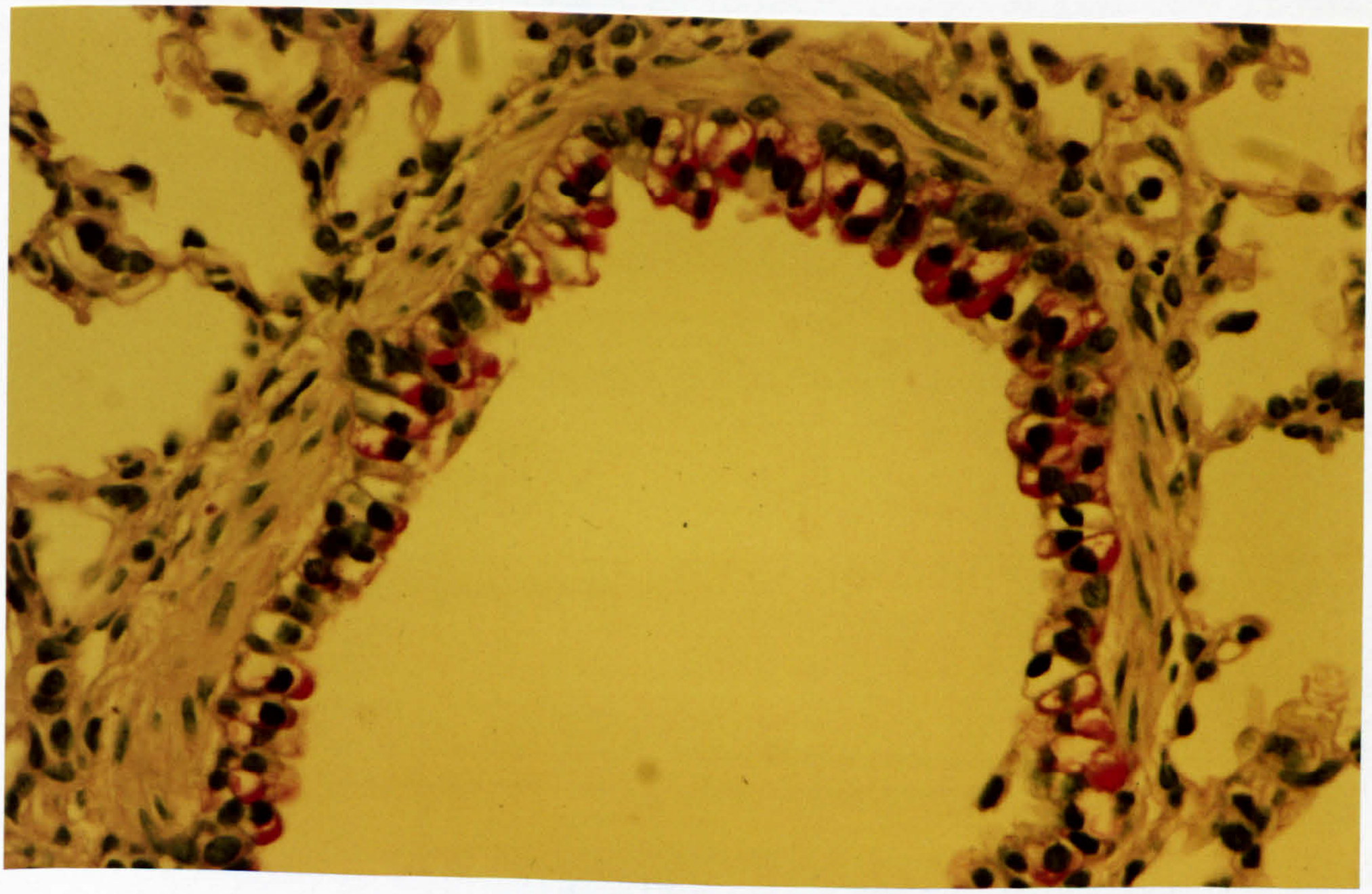
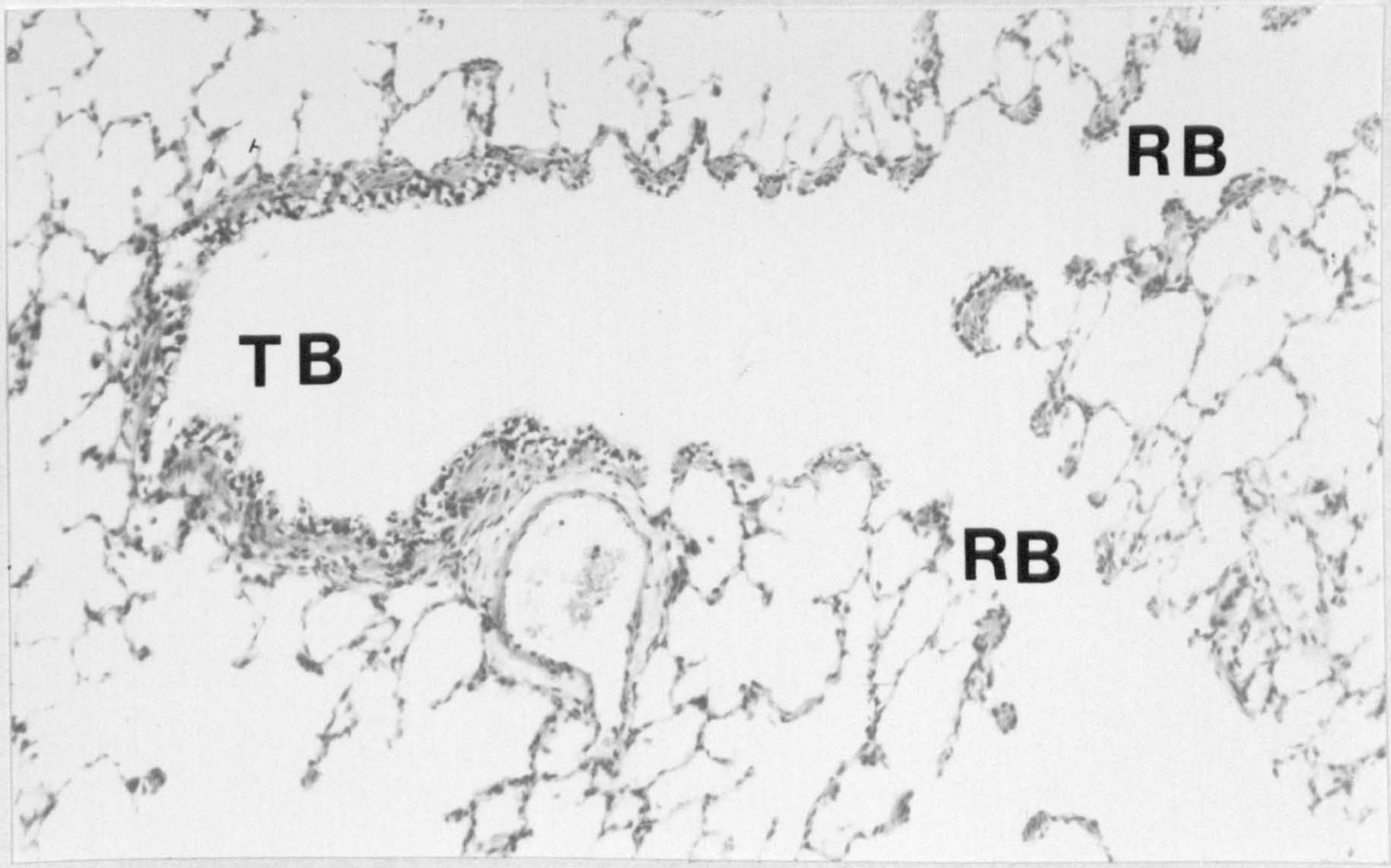


Fig. 3.33 Respiratory bronchiole. This photomicrograph shows a terminal bronchiole (TB) branching into two respiratory bronchioles (RB). HE x 120.

Fig. 3.34 Alveolar duct. In this photomicrograph, a respiratory bronchiole (RB) leads into an alveolar duct (AD). HE x 180.


TB
RB
RB

RB
AD

Fig. 3.35 Ventral concha. The surface epithelium is completely ciliated; many goblet cells can be seen. SEM x 1920.

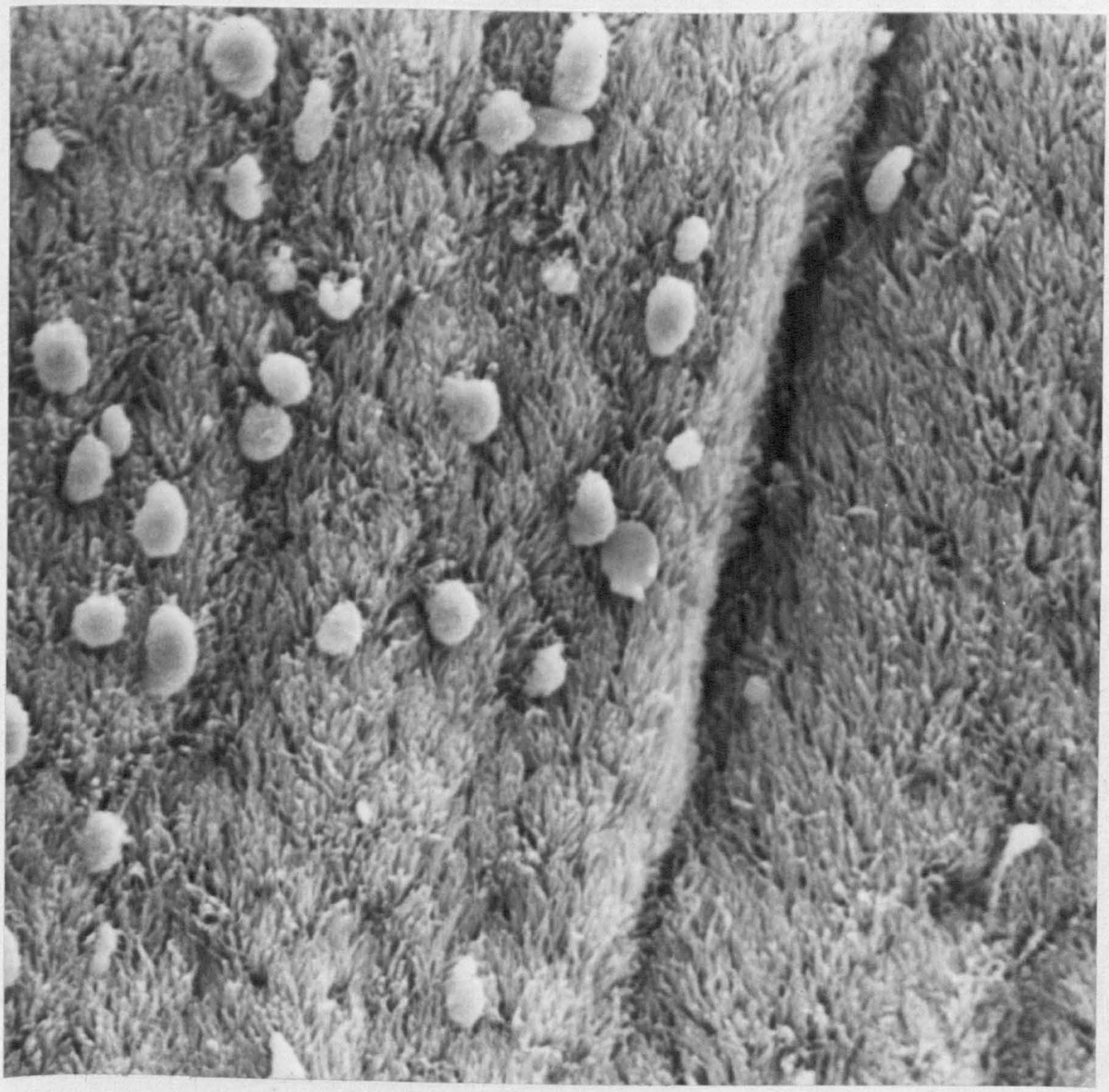
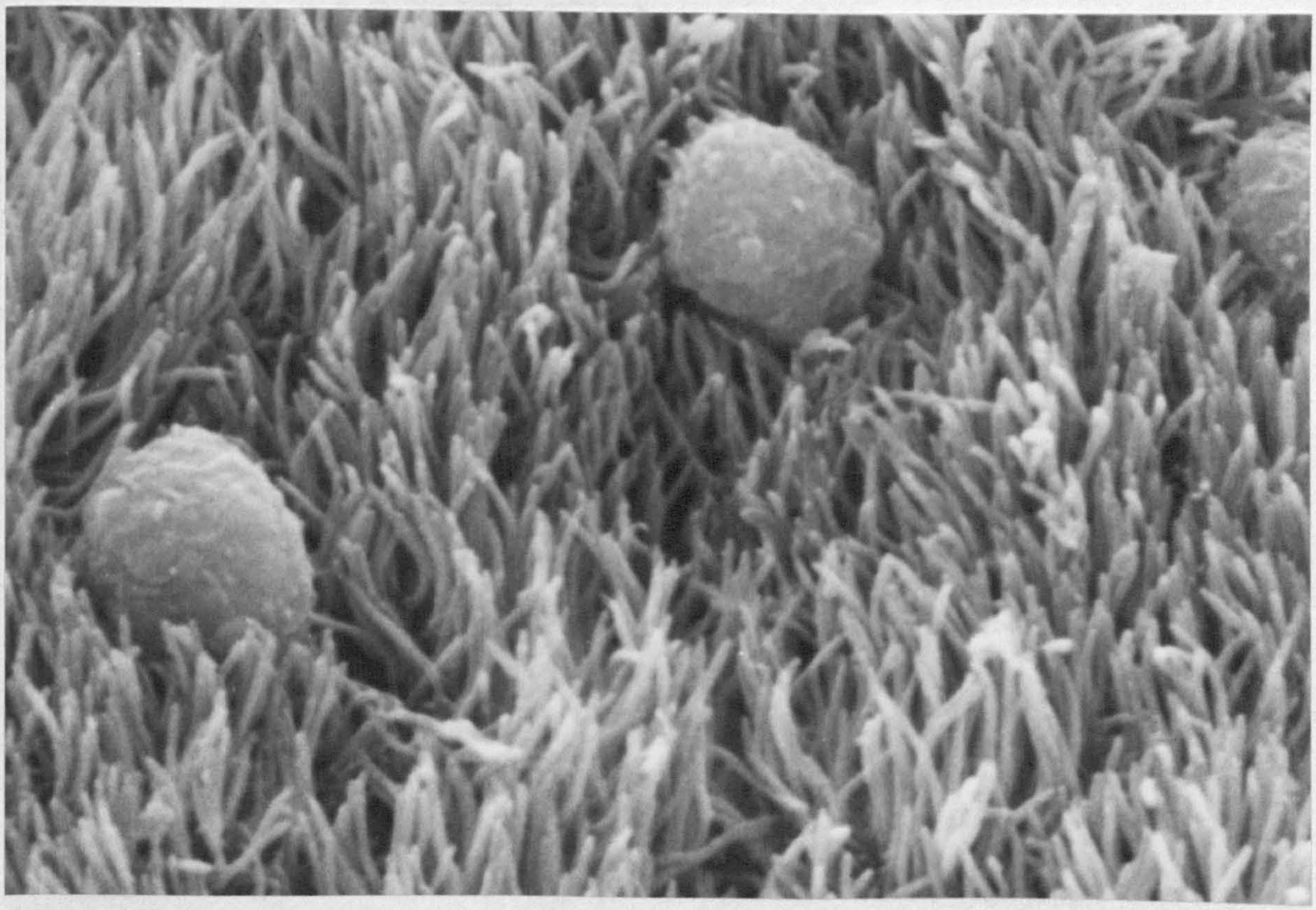


Fig. 3.36 Ventral concha. Two goblet cells can be seen protruding between the cilia.
SEM x 7,500.

Fig. 3.37 Ventral concha. In this photomicrograph, goblet cells are discharging mucus onto the ciliated carpet.
SEM x 7,500.



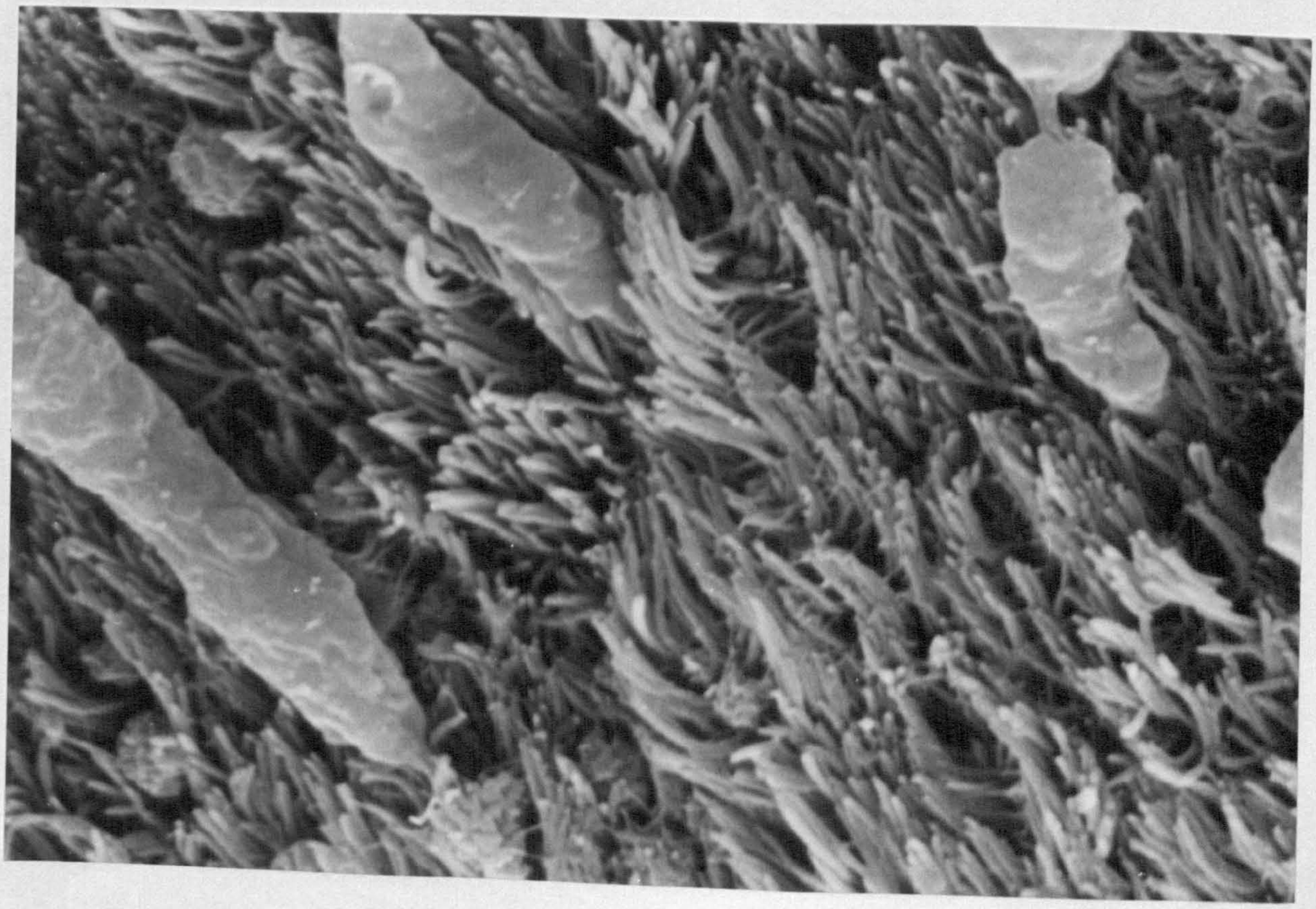


Fig. 3.38 Ventral concha. Note the thin columnar ciliated cells. SEM x 7,500.

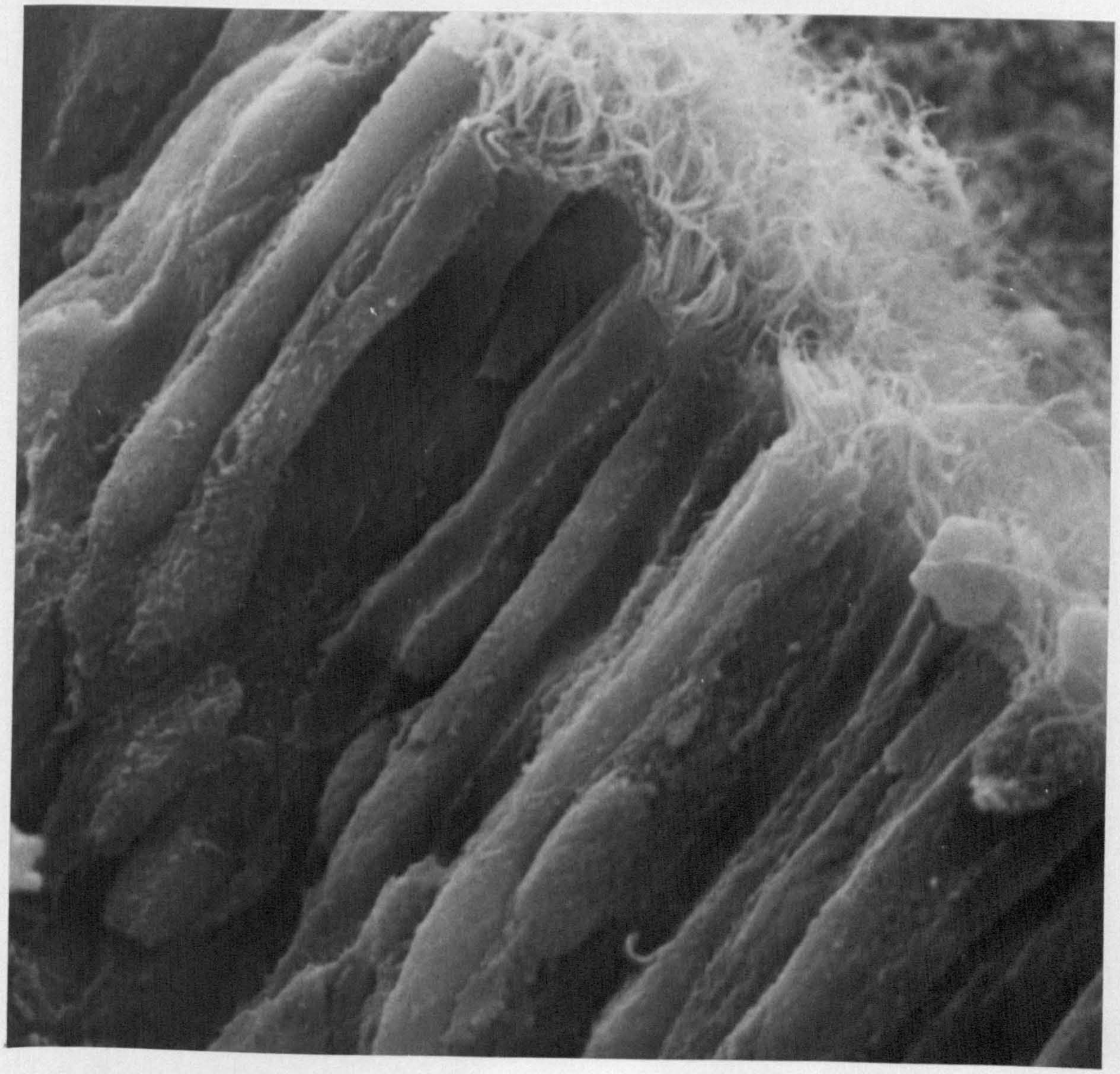


Fig. 3.39 Ventral concha. In this fractured specimen, two goblet cells each containing granules of mucus can be seen.
SEM x 7,500.

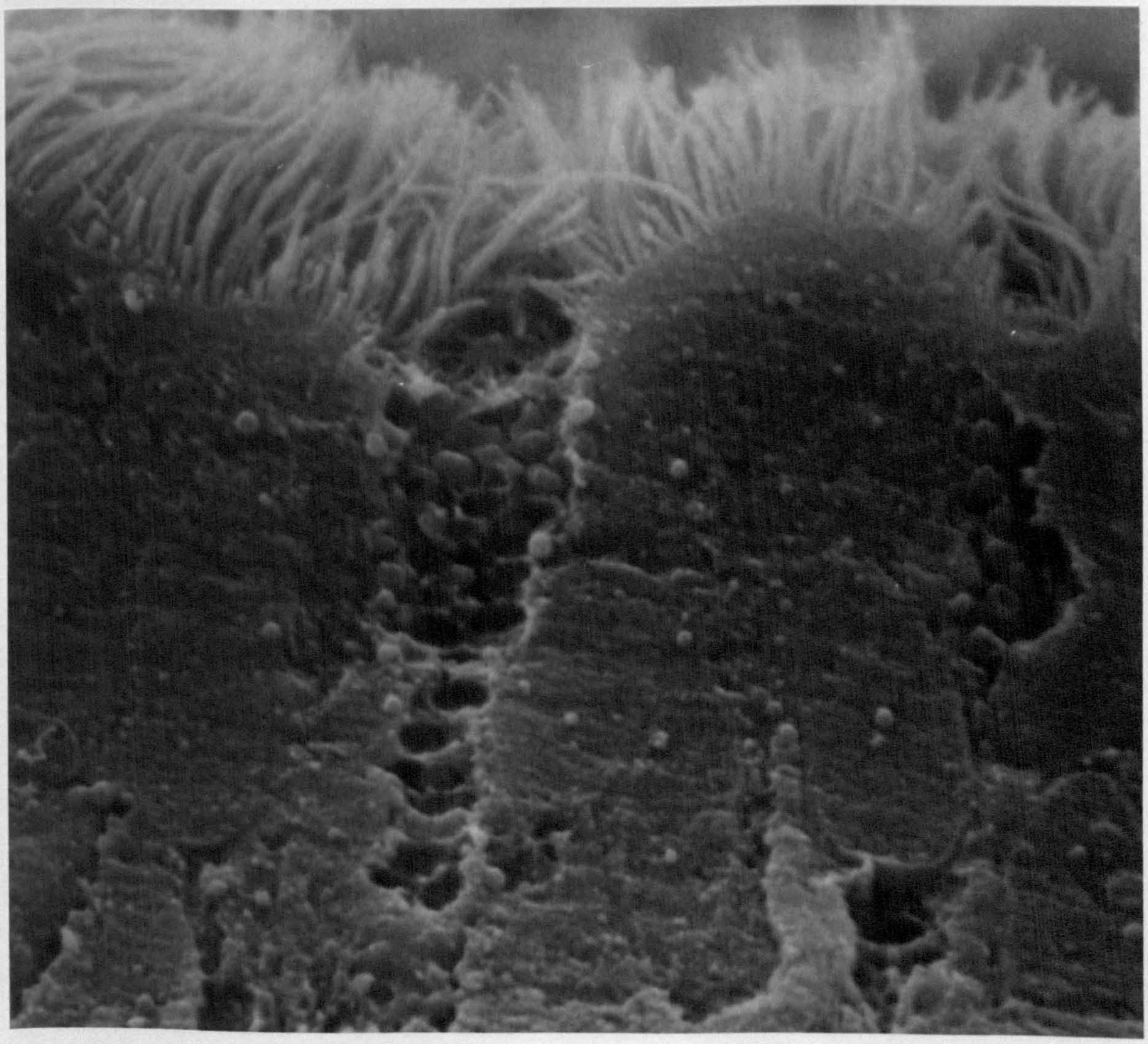


Fig. 3.40 Ventral concha. Dispersed among the ciliated cells, a number of flat non-ciliated cells can be seen. These cells have sparse surface microvilli. Note the secretion granules emerging from the centre of the cell.
SEM x 7,500.

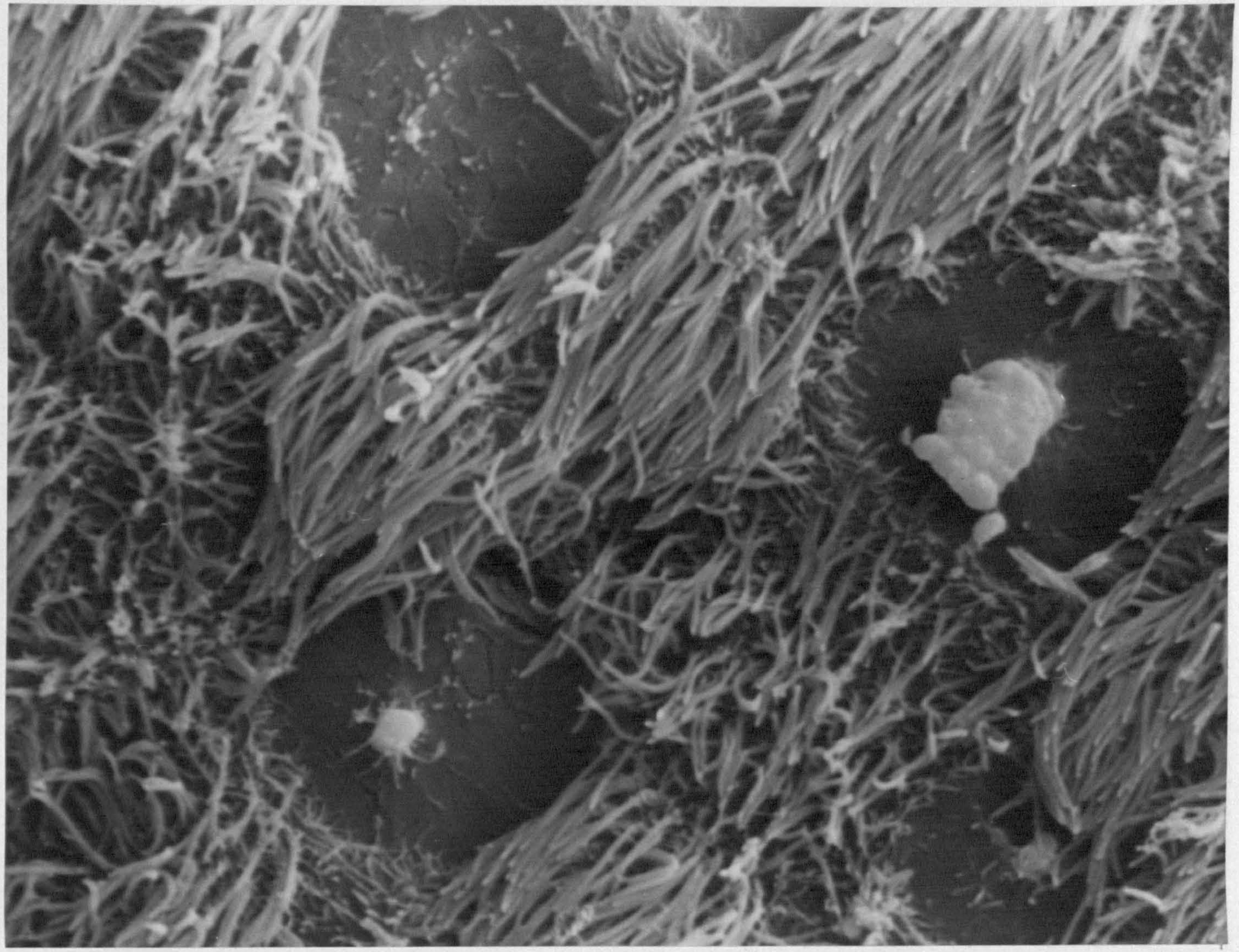


Fig. 3.41 Ventral concha. A higher power view of a conchal secretory cell. Surrounding ciliated cells are sparsely ciliated.
SEM x 15,000.

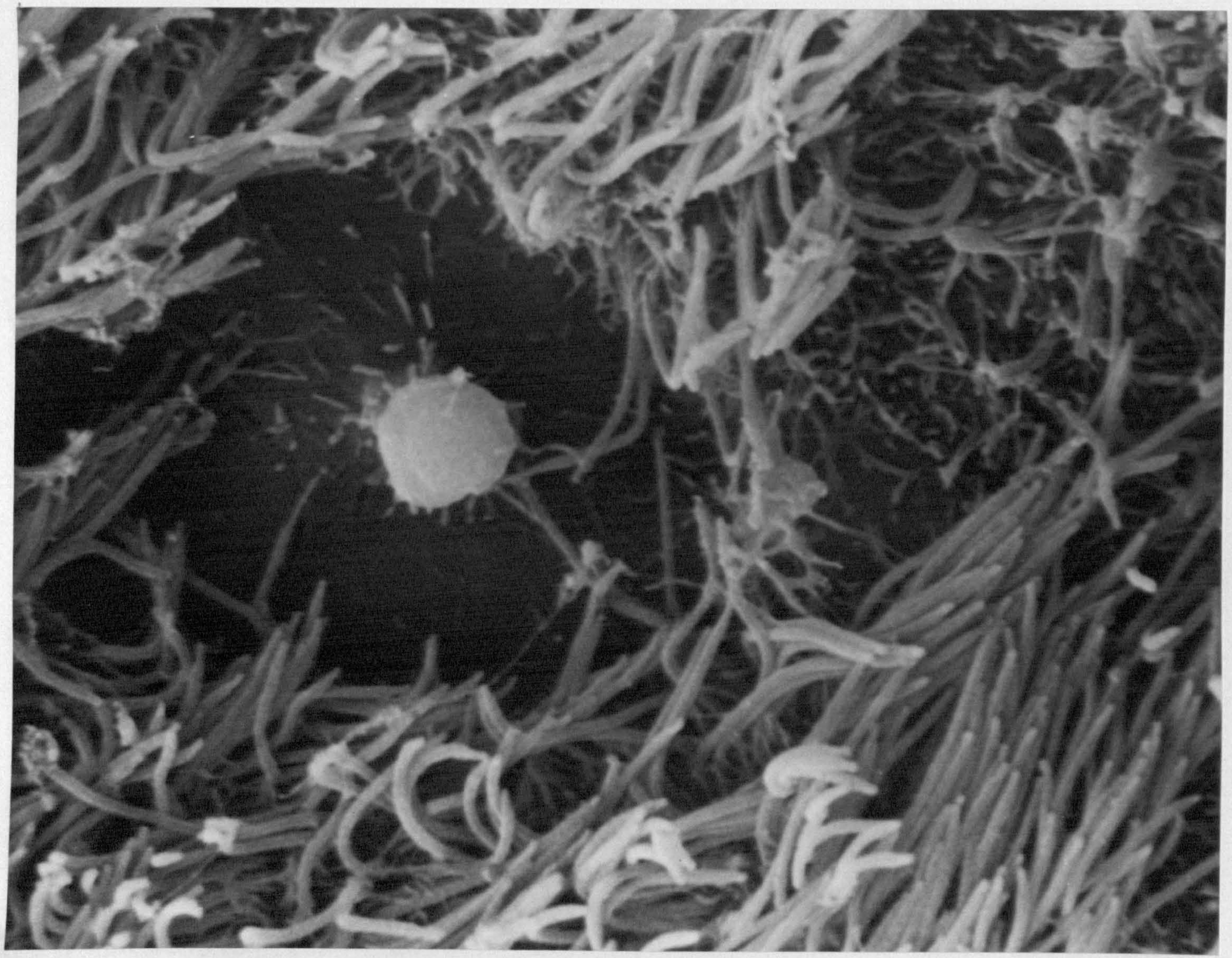


Fig. 3.42 Ventral concha, rostral region. The surface epithelial cells are rounded, sparsely ciliated and covered with many microvillous processes.
SEM x 7,500.

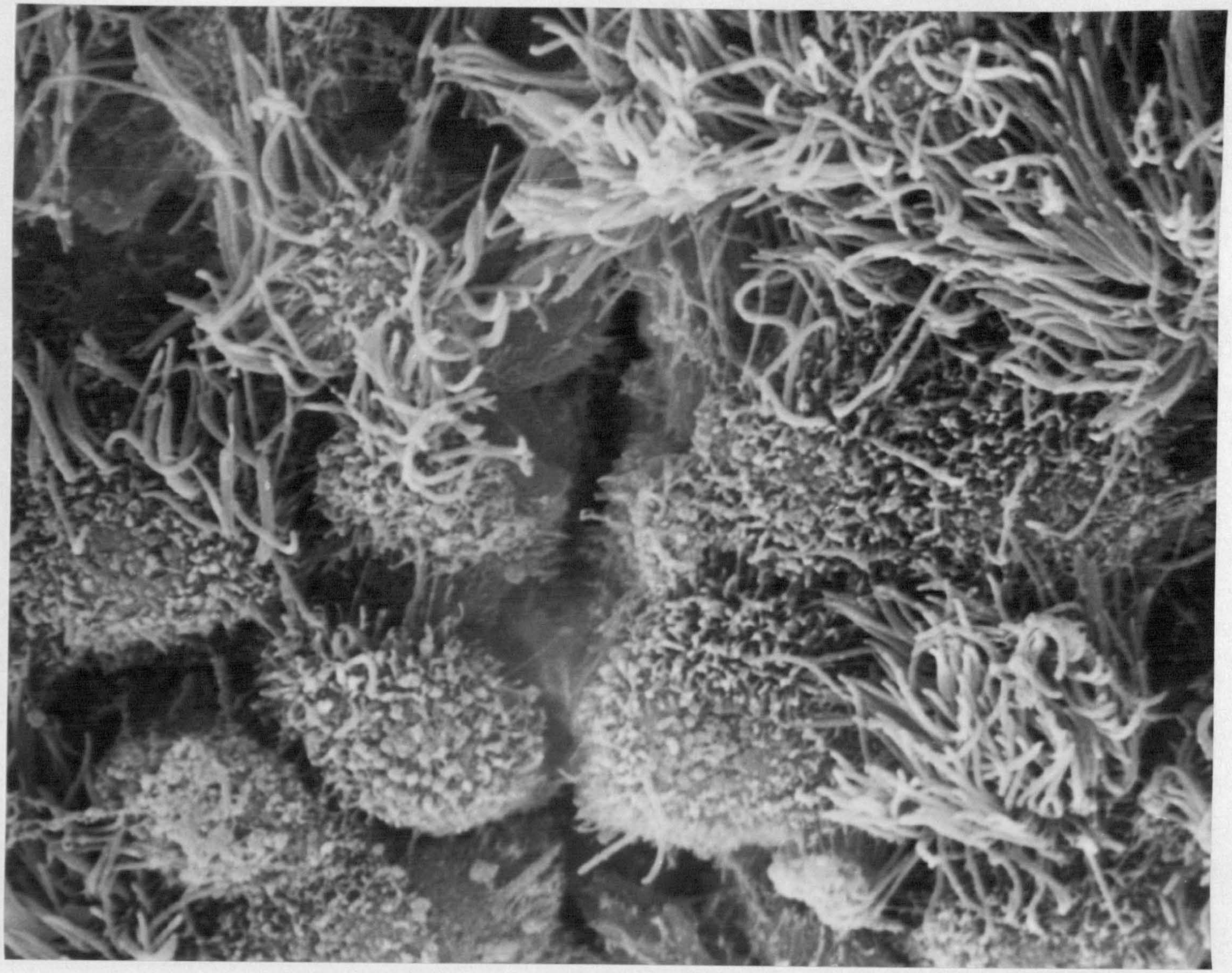


Fig. 3.43 Alar fold. The surface squamous epithelial cells are flat, devoid of cilia and their surfaces have a roughened appearance due to many stubby microvillous processes. Note the circular structure in the centre of one of the cells.
SEM x 7,500.

Fig. 3.44 Alar fold. Note the presence of many curved microplicae on the cell surface.
SEM x 15,000.

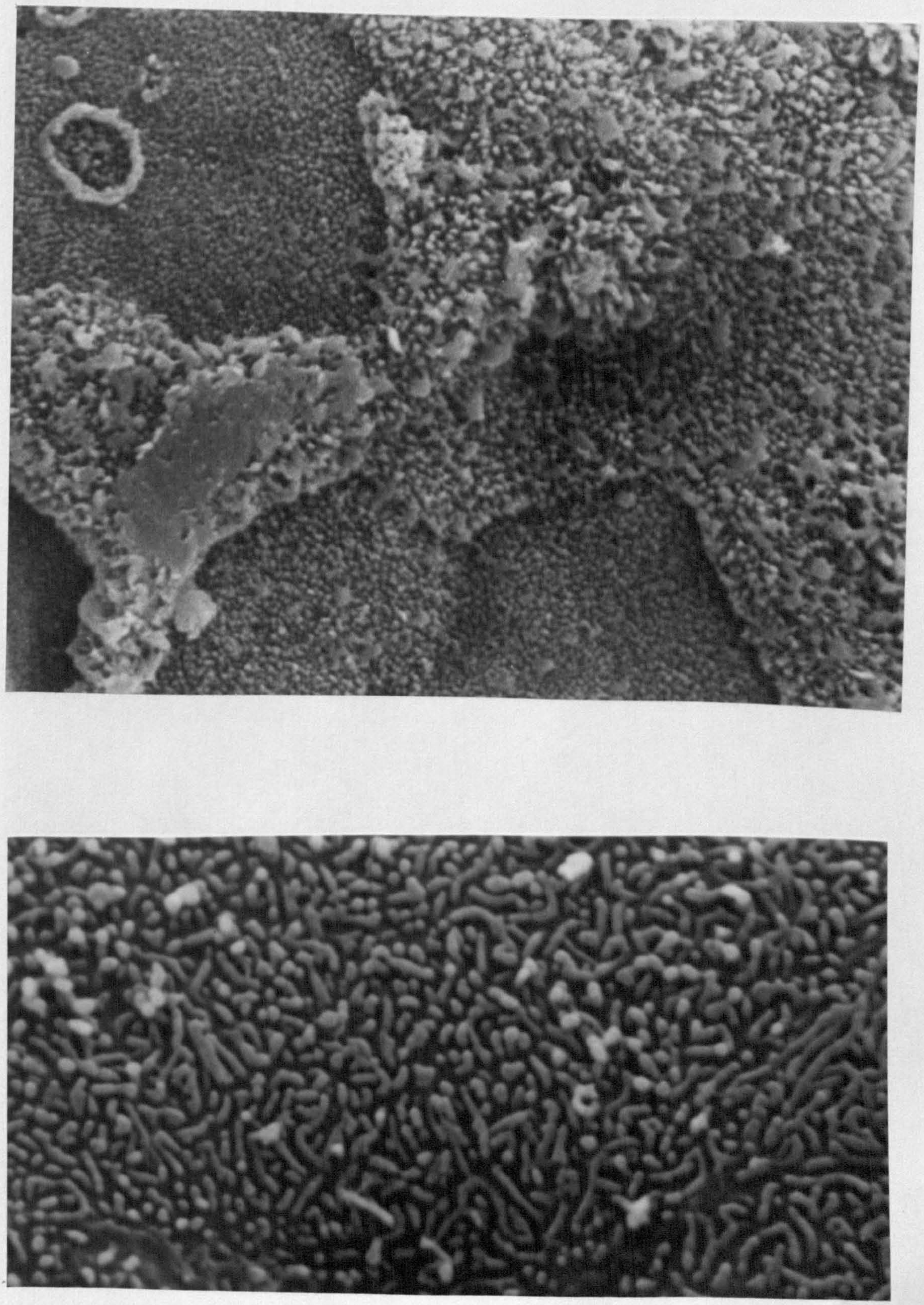


Fig. 3.45 Nasal septum, rostral border. The surface squamous cells are covered with microplicae giving the cells a mosaic appearance. The cell borders can be clearly identified.
SEM x 7,500.

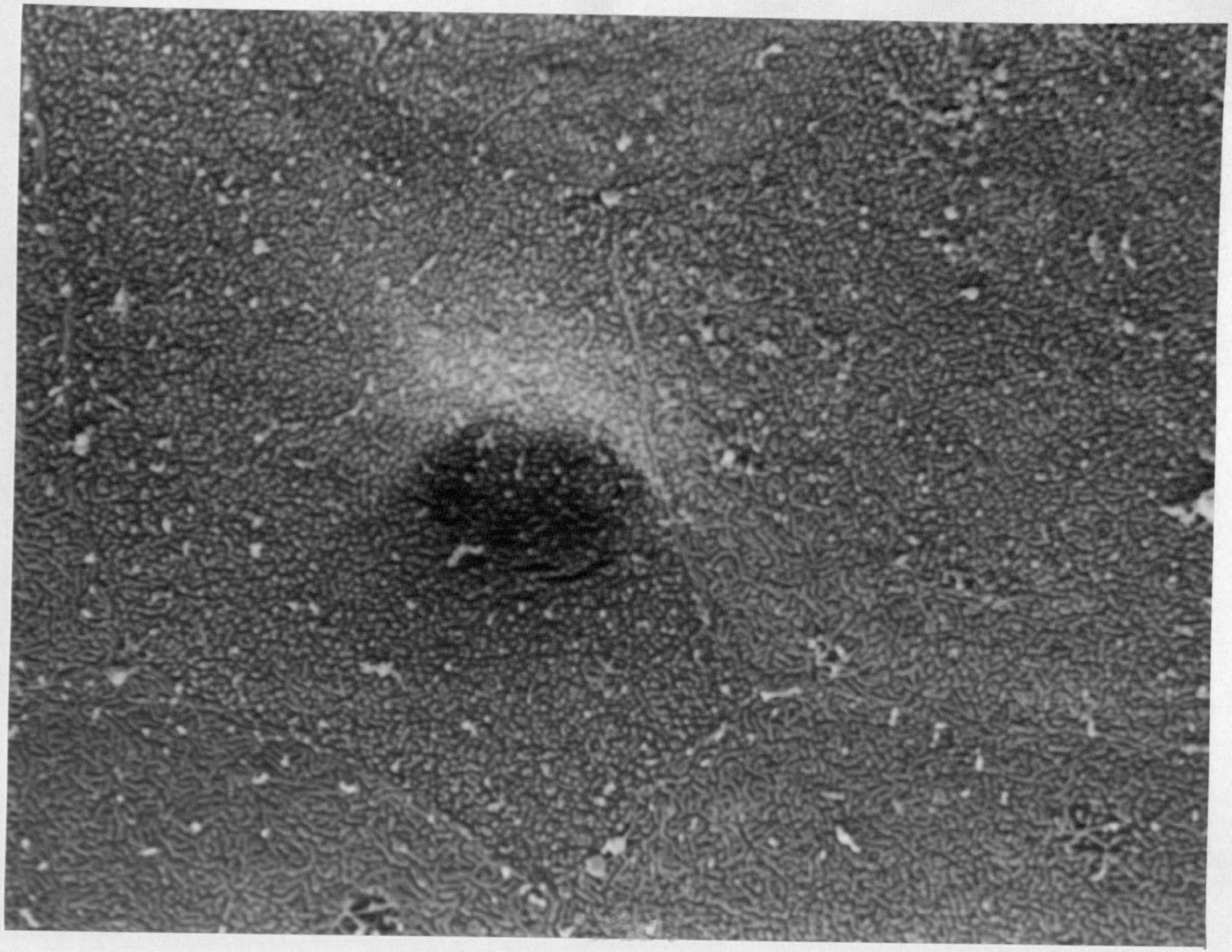


Fig. 3.46 Nasal septum, rostral border. Many individually distinct squamous cells can be seen. Note the circular depressions left by desquamated cells.
SEM x 1920.

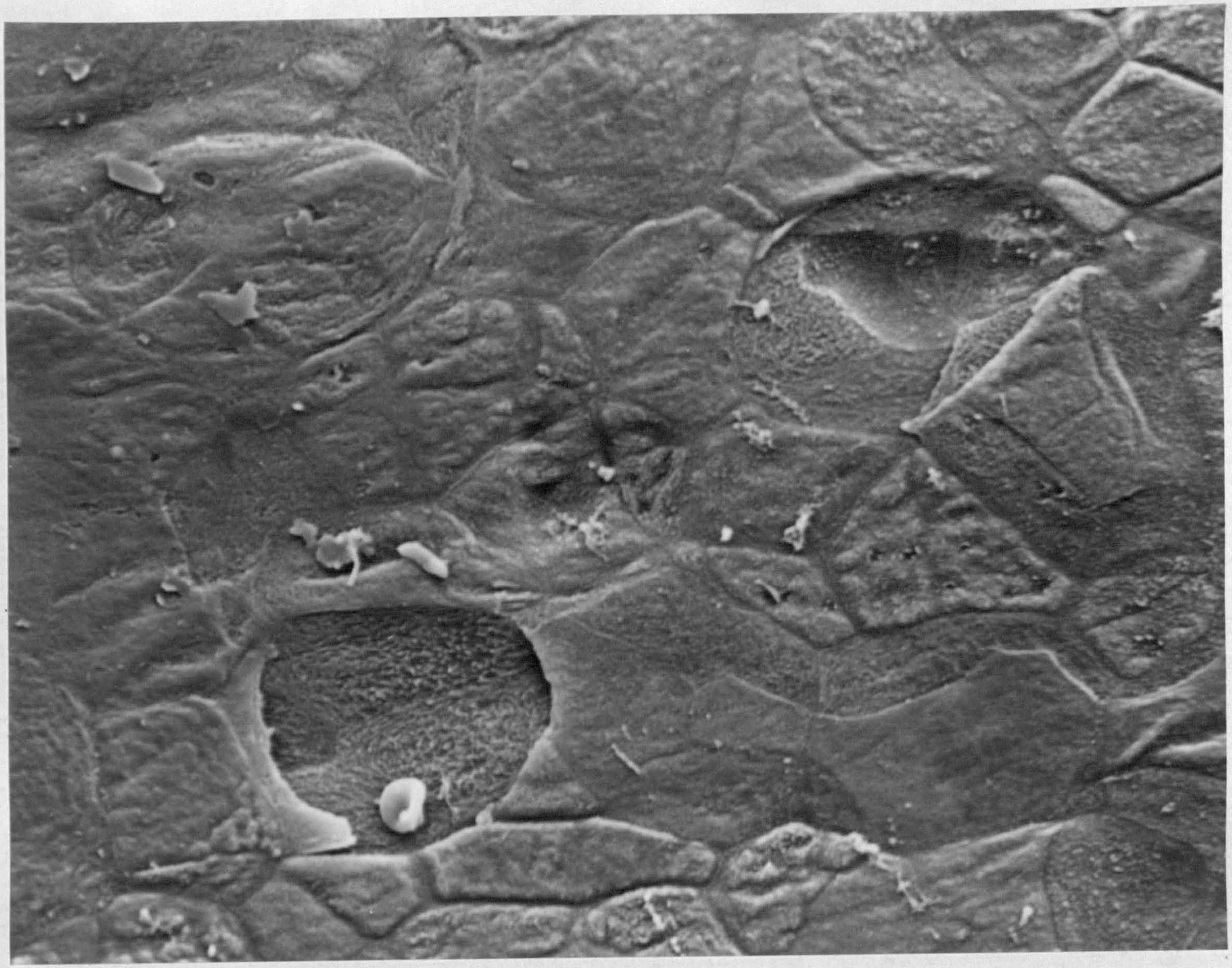
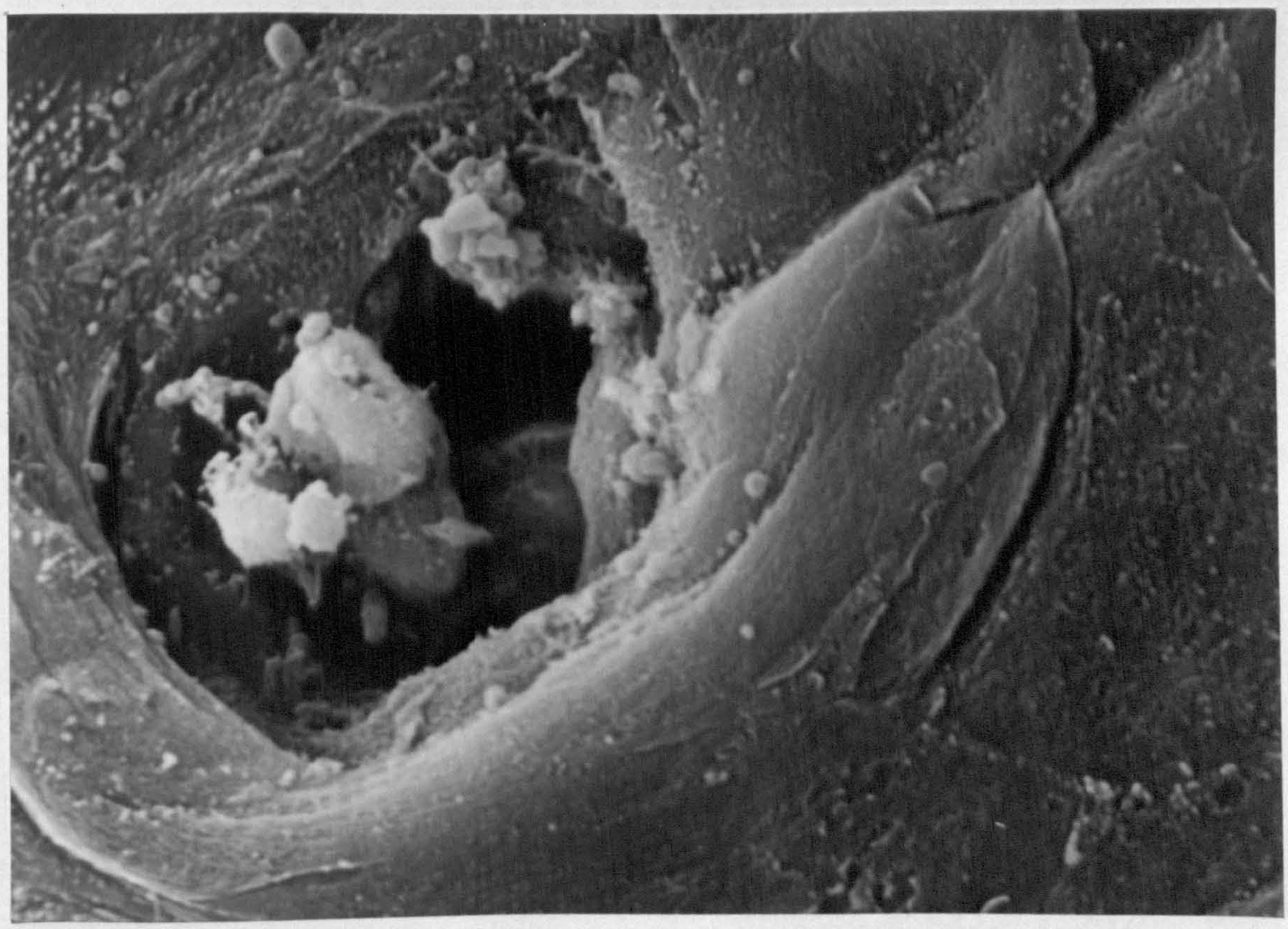


Fig. 3.47 Nasal septum, rostral border.
A large gland orifice can be seen.
SEM x 1920.

Fig. 3.48 Nasal septum, rostral border.
Many rod-shaped bacteria are present on the squamous epithelial surface.
SEM x 1920.



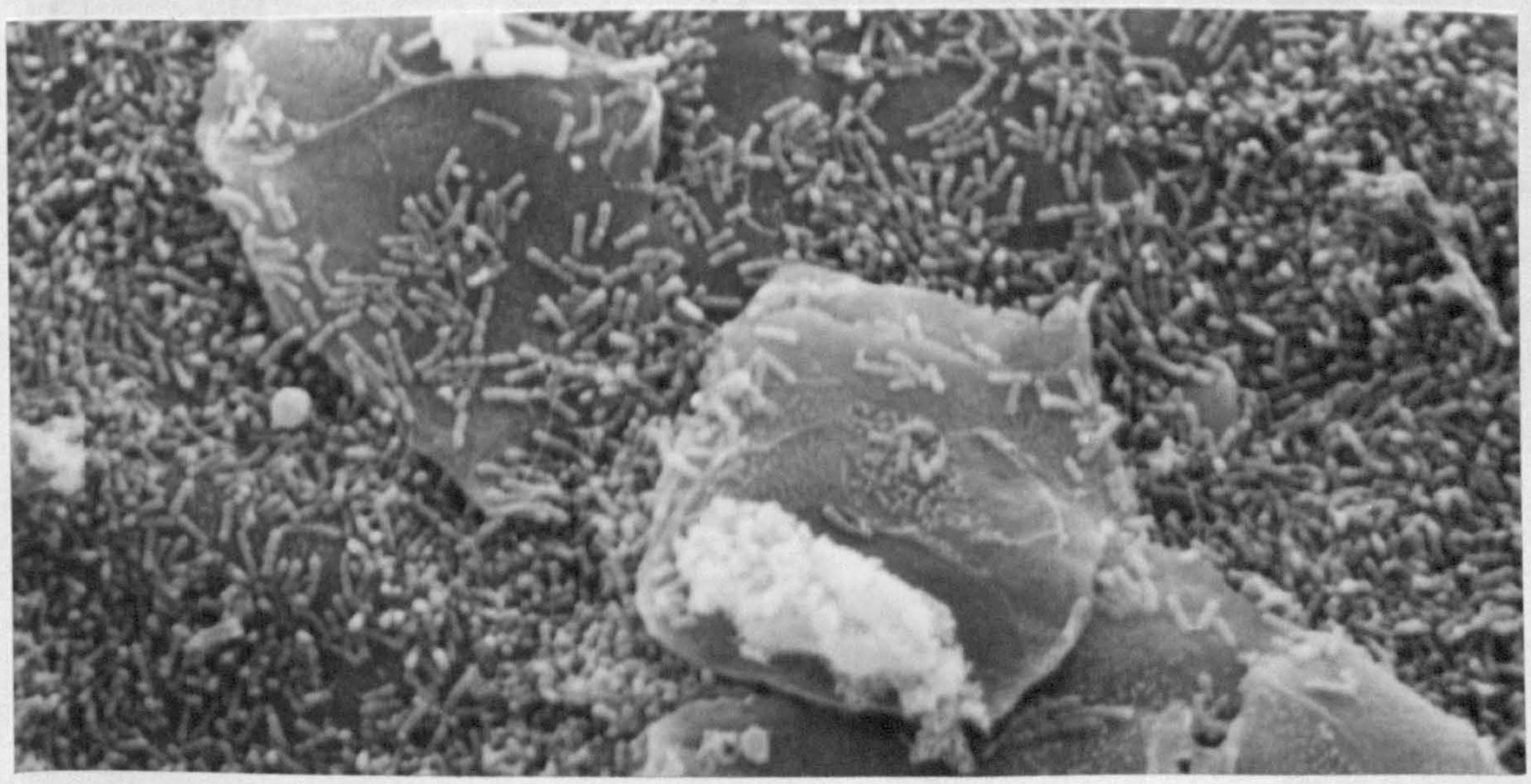
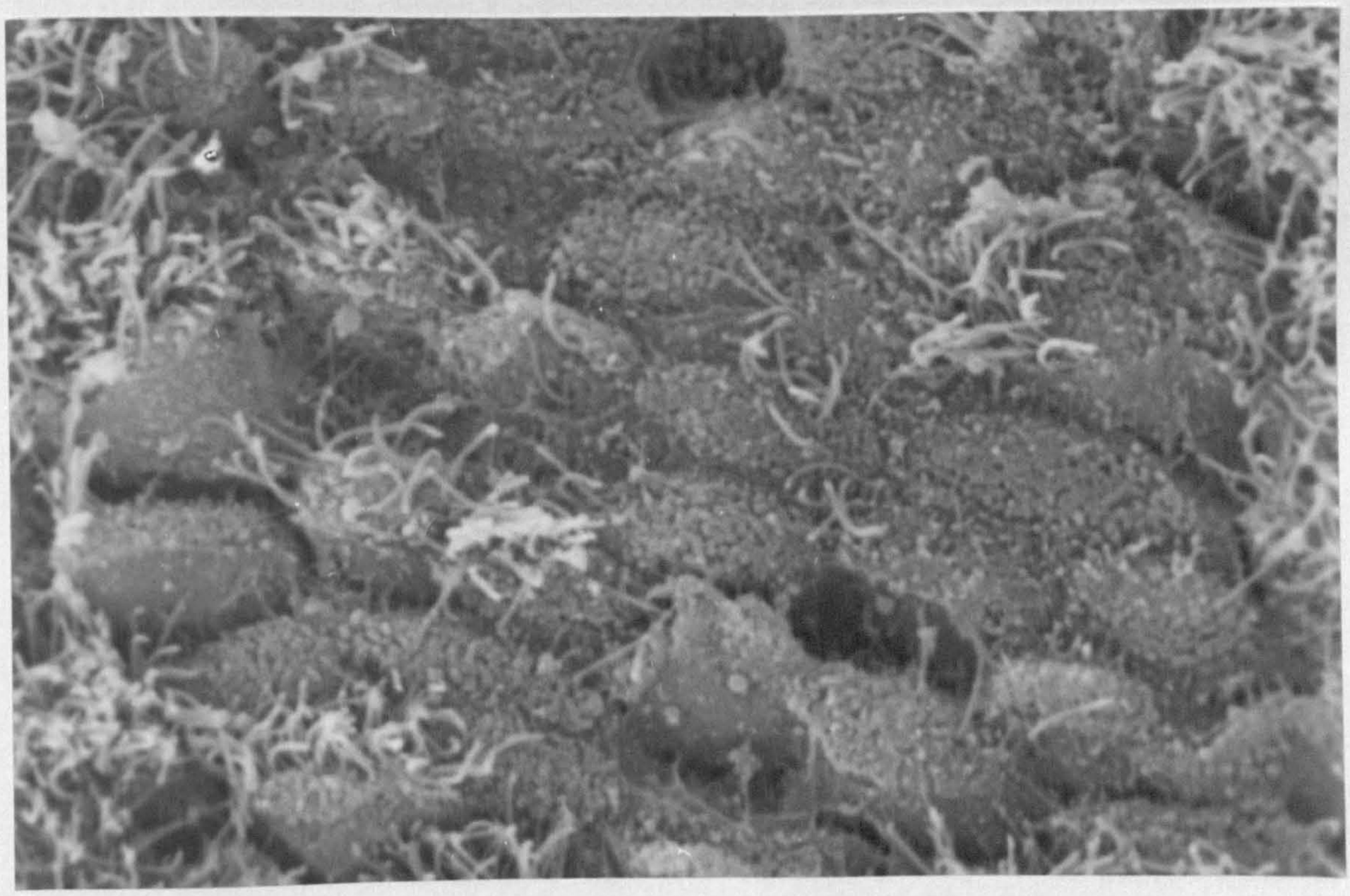


Fig. 3.49 Nasal septum. In this junctional zone, the surface epithelial cells have a poorly ciliated "cobblestone" appearance.
SEM x 3,750.

Fig. 3.50 Nasal septum. At this level, there is total ciliation. Note the presence of goblet cells and a gland orifice.
SEM x 3,750.



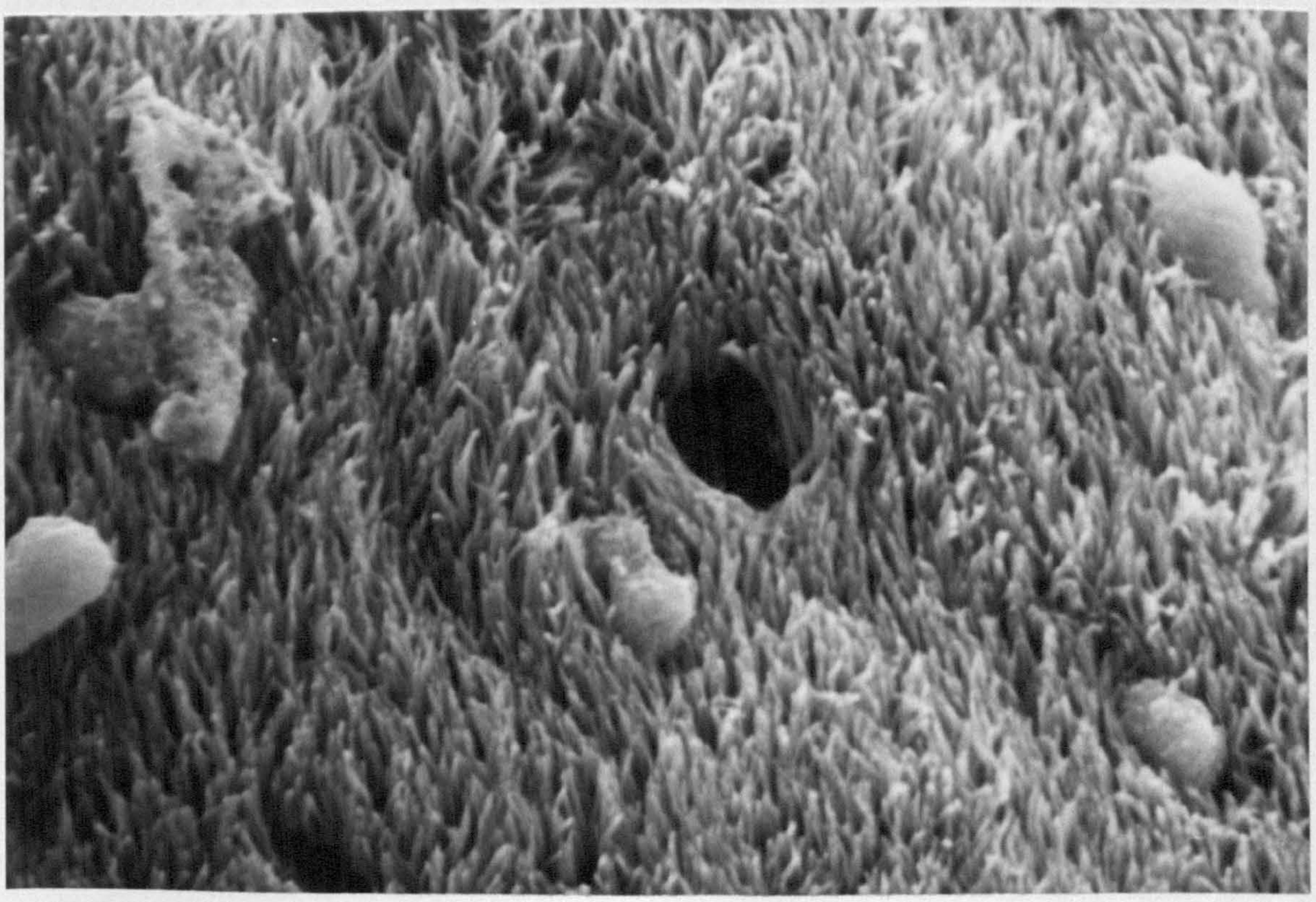


Fig. 3.51 Nasal septum. Note the strands of mucus on the ciliated surface.
SEM x 3,750.

Fig. 3.52 Nasal septum. A secretory cell similar to those found in the ventral concha (see Figs. 3.40 and 3.41). The surrounding cells are sparsely ciliated.
SEM x 7,500.

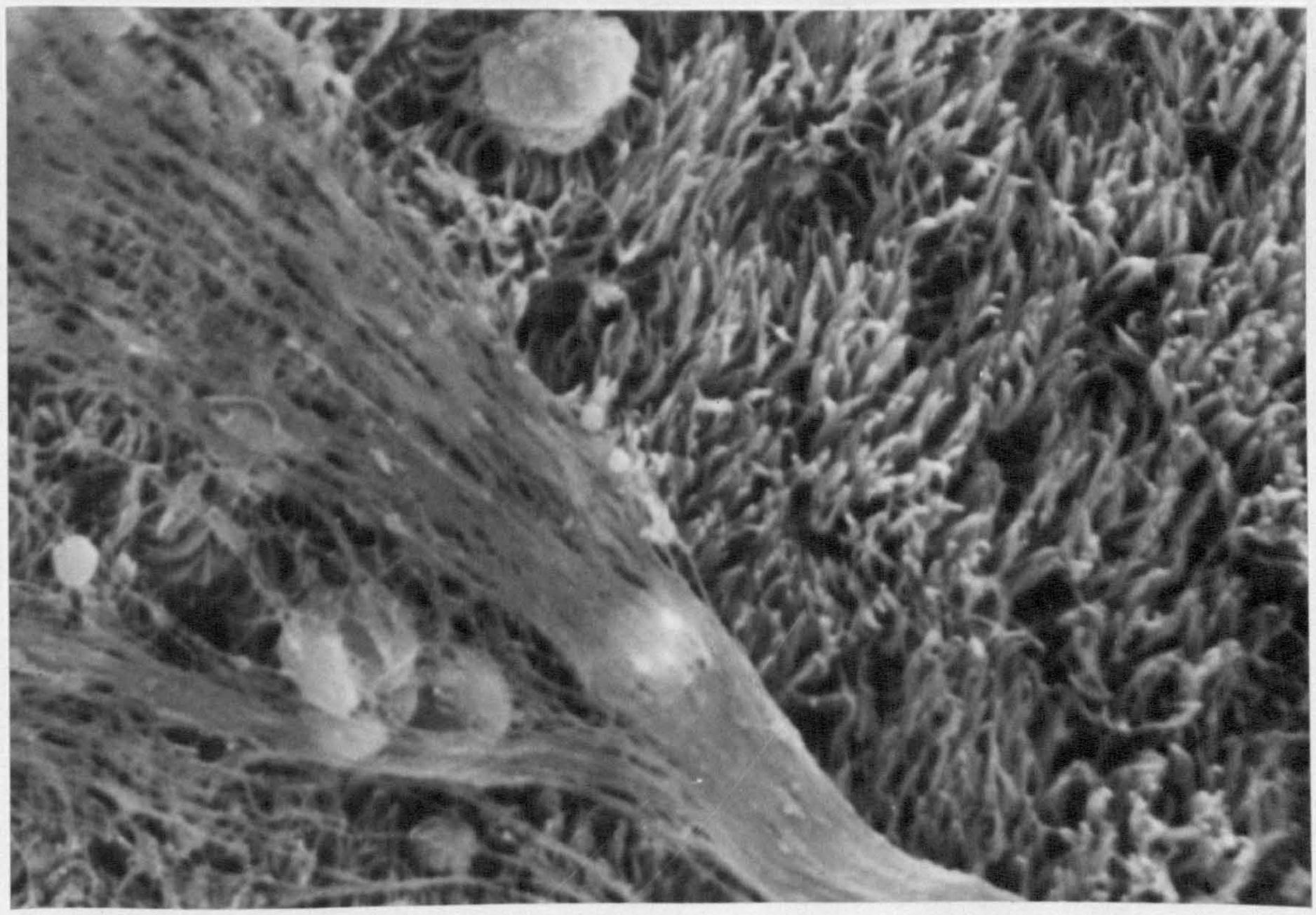


Fig. 3.53 Ethmoidal concha, olfactory epithelium. Note the tangled mat of slender cilia and olfactory vesicles with their short stubby cilia (arrows).
SEM x 15,000.

Fig. 3.54 Ethmoidal concha, olfactory epithelium. Note the presence of large numbers of secretory droplets.
SEM x 3,750.

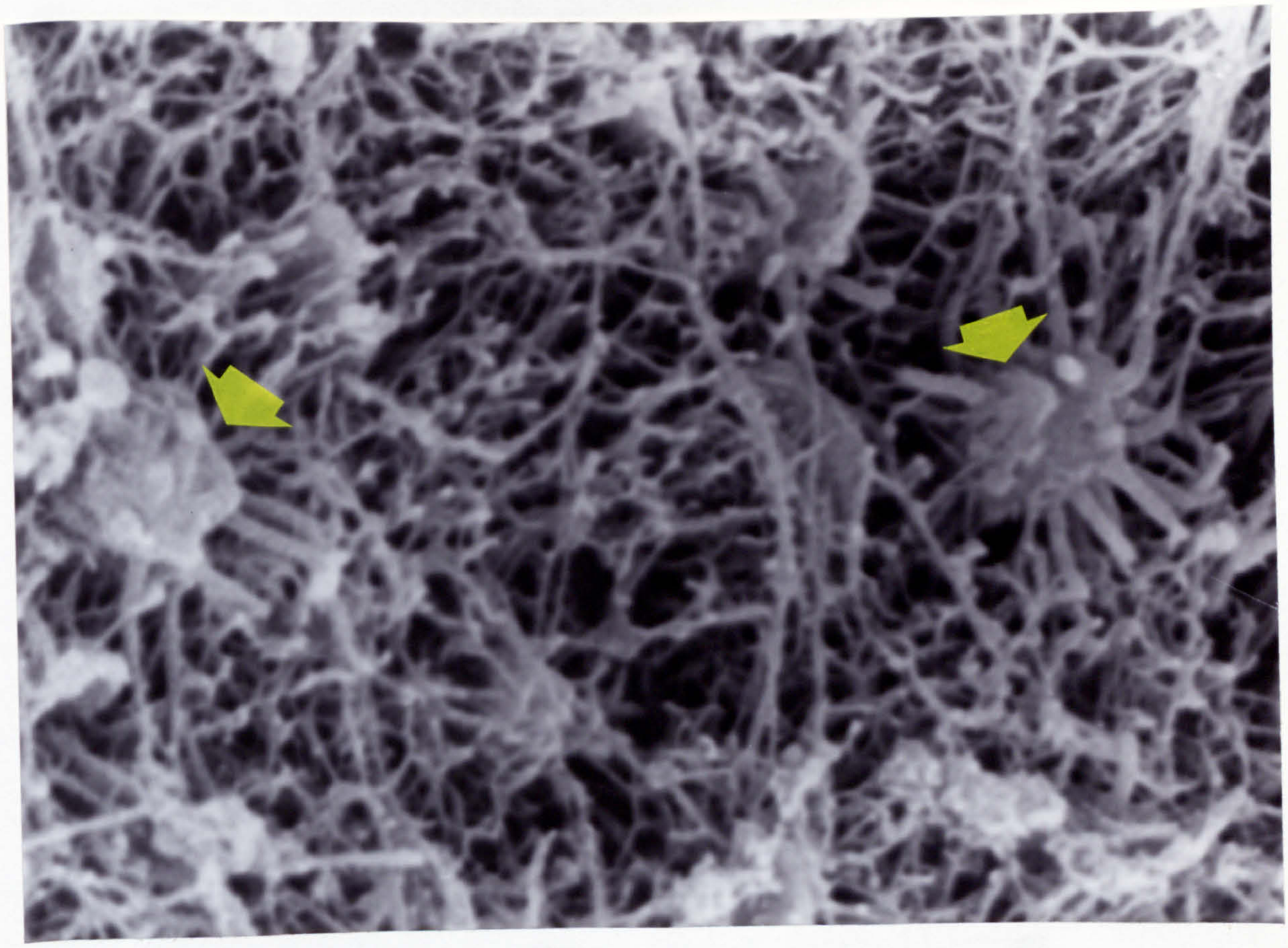


Fig. 3.55 Ethmoidal concha. Note the sharp transition between olfactory epithelium (in the upper part of the photomicrograph) and ciliated respiratory epithelium. Three olfactory vesicles can be seen. SEM x 7,500.

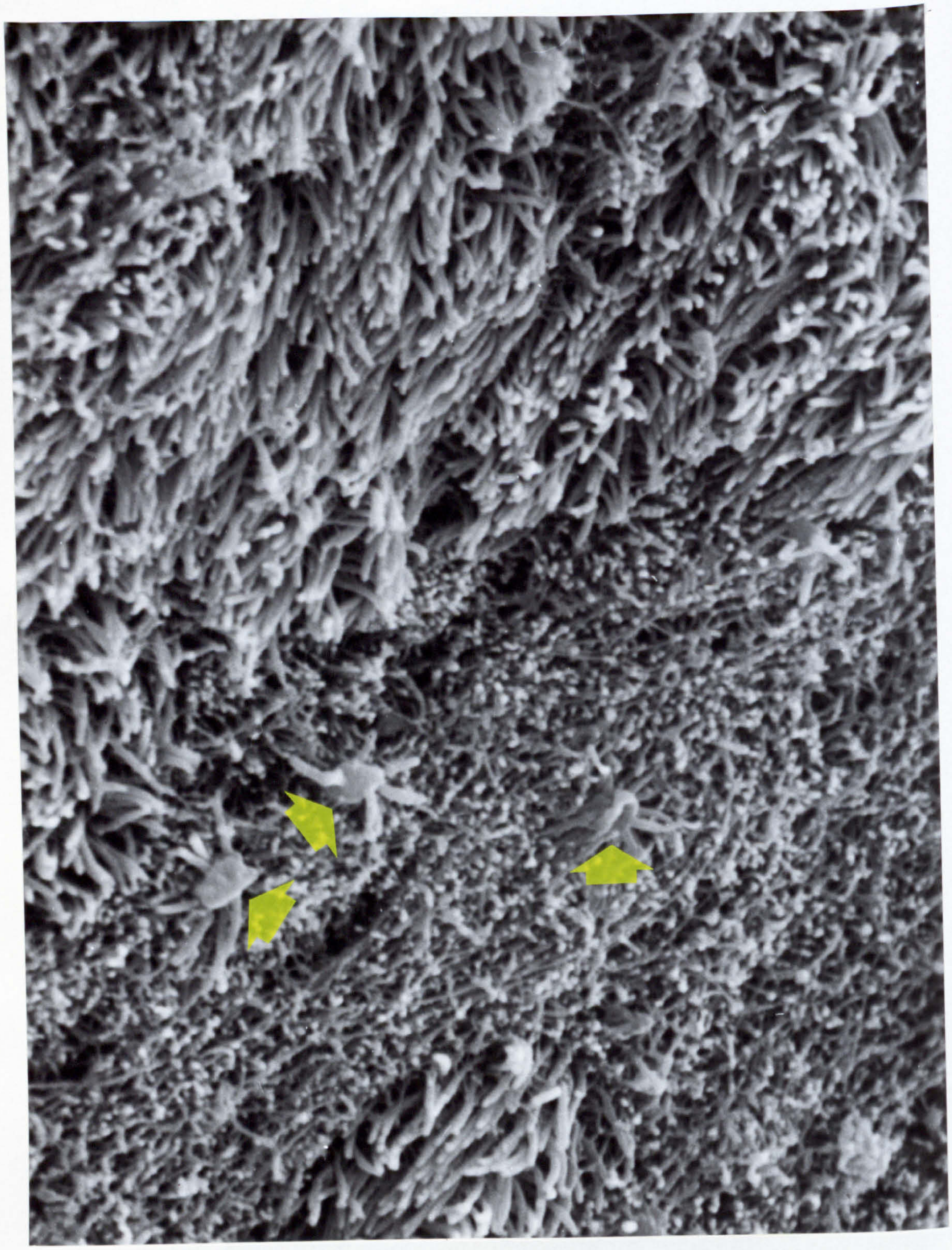
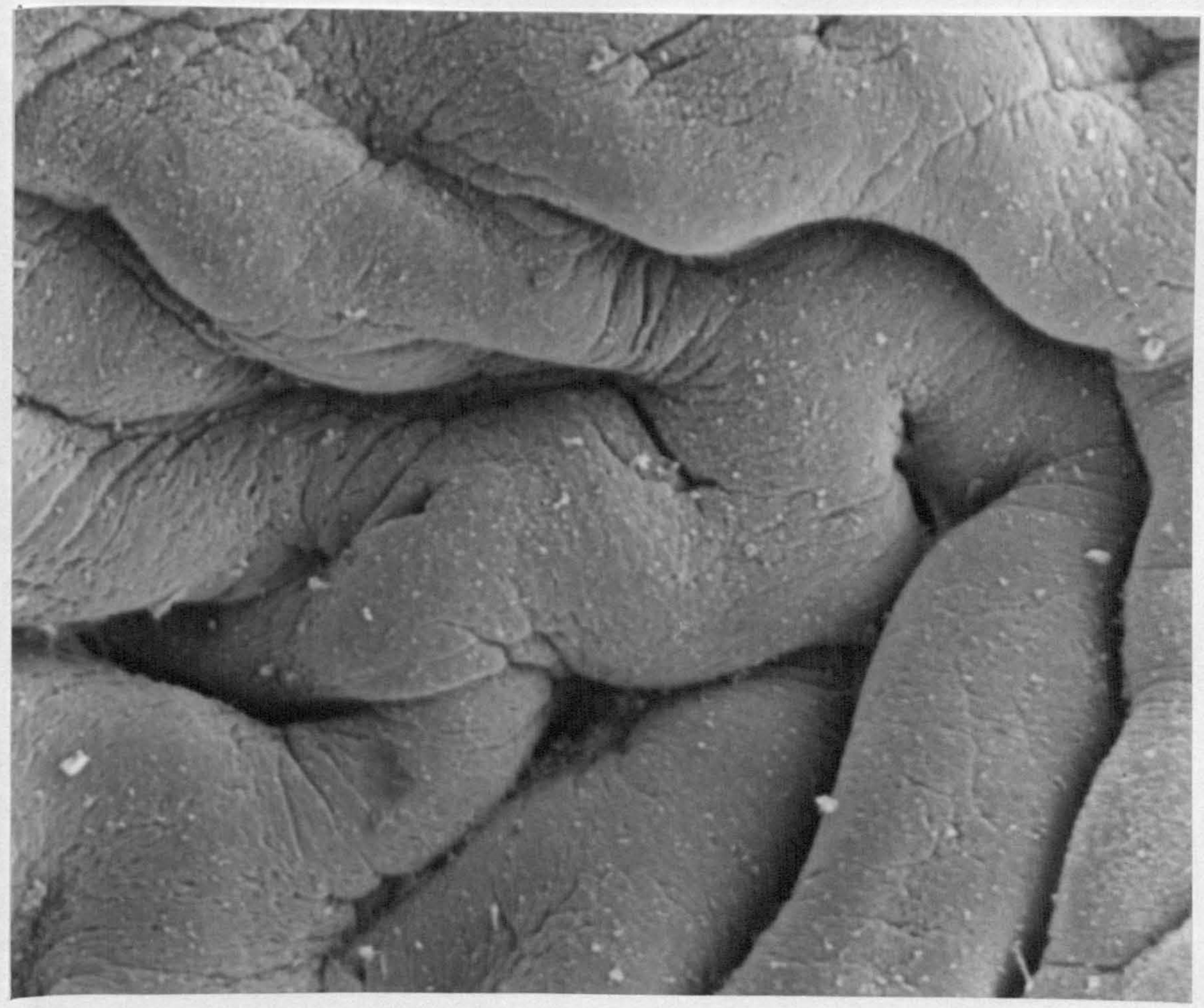


Fig. 3.56 Nasopharynx. The surface is irregularly folded.
SEM x 120.

Fig. 3.57 Nasopharynx. Note the goblet cells protruding from the ciliated carpet.
SEM x 15,000.



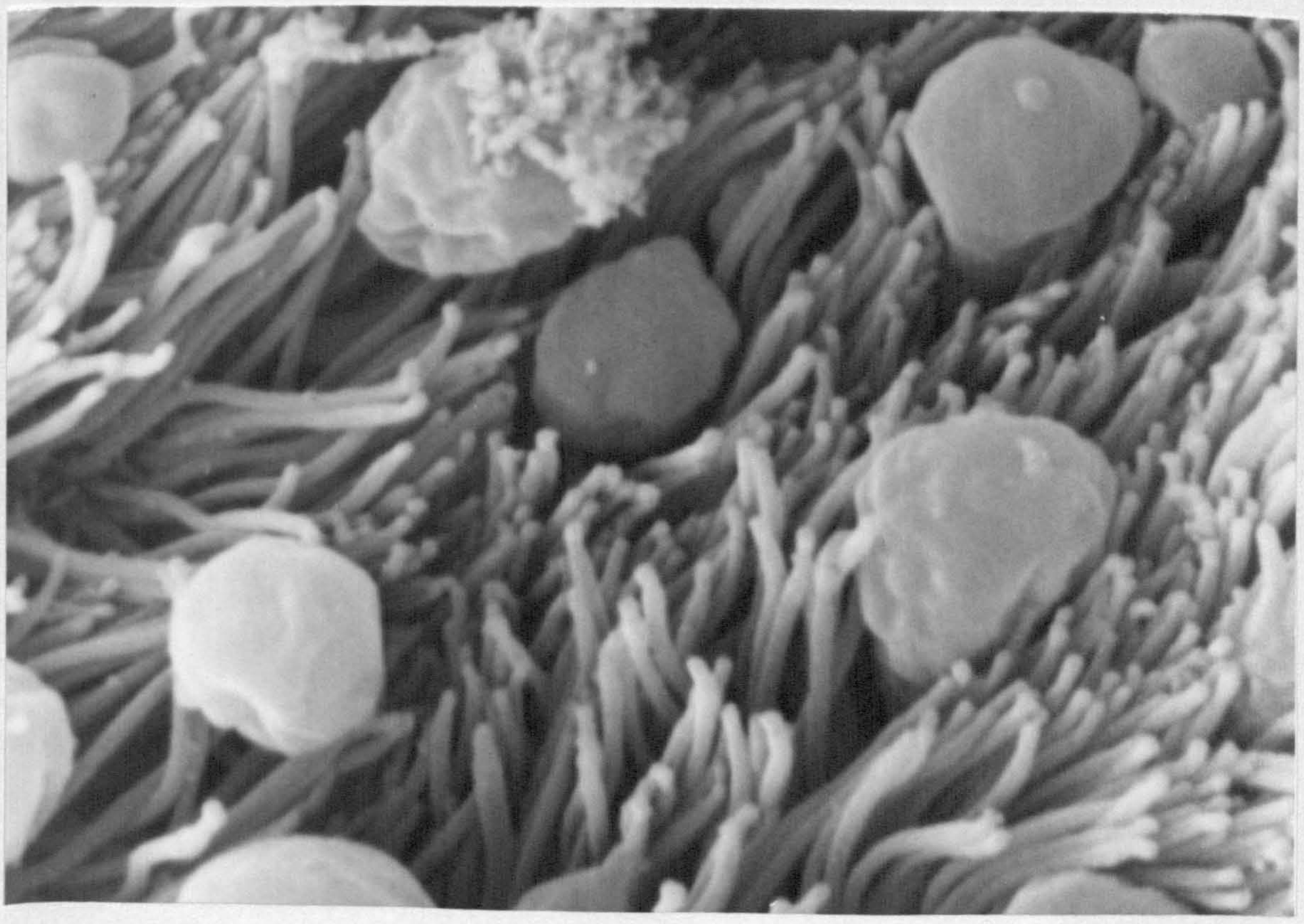


Fig. 3.58 Nasopharynx. In this specimen, the epithelium is of the stratified squamous type. Note the deep fissures and the desquamating squamous cells. SEM x 480.

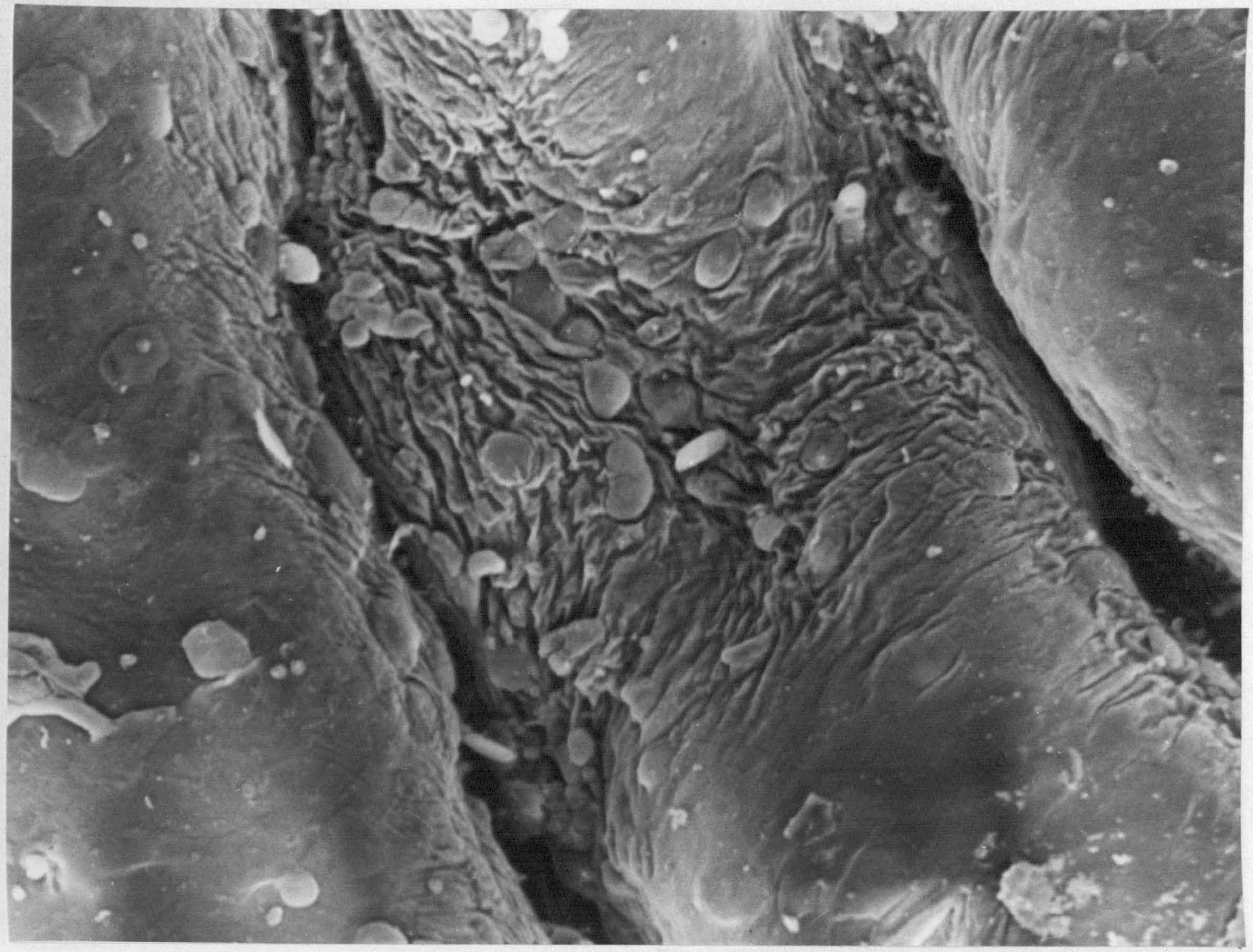


Fig. 3.59 Nasopharynx. Surface of the squamous cells showing microplicae in some while others show short stubby microvillous processes. SEM x 3,750.

Fig. 3.60 Nasopharynx. Surface of two adjacent squamous cells, each studded with short stubby microvilli. SEM x 15,000.



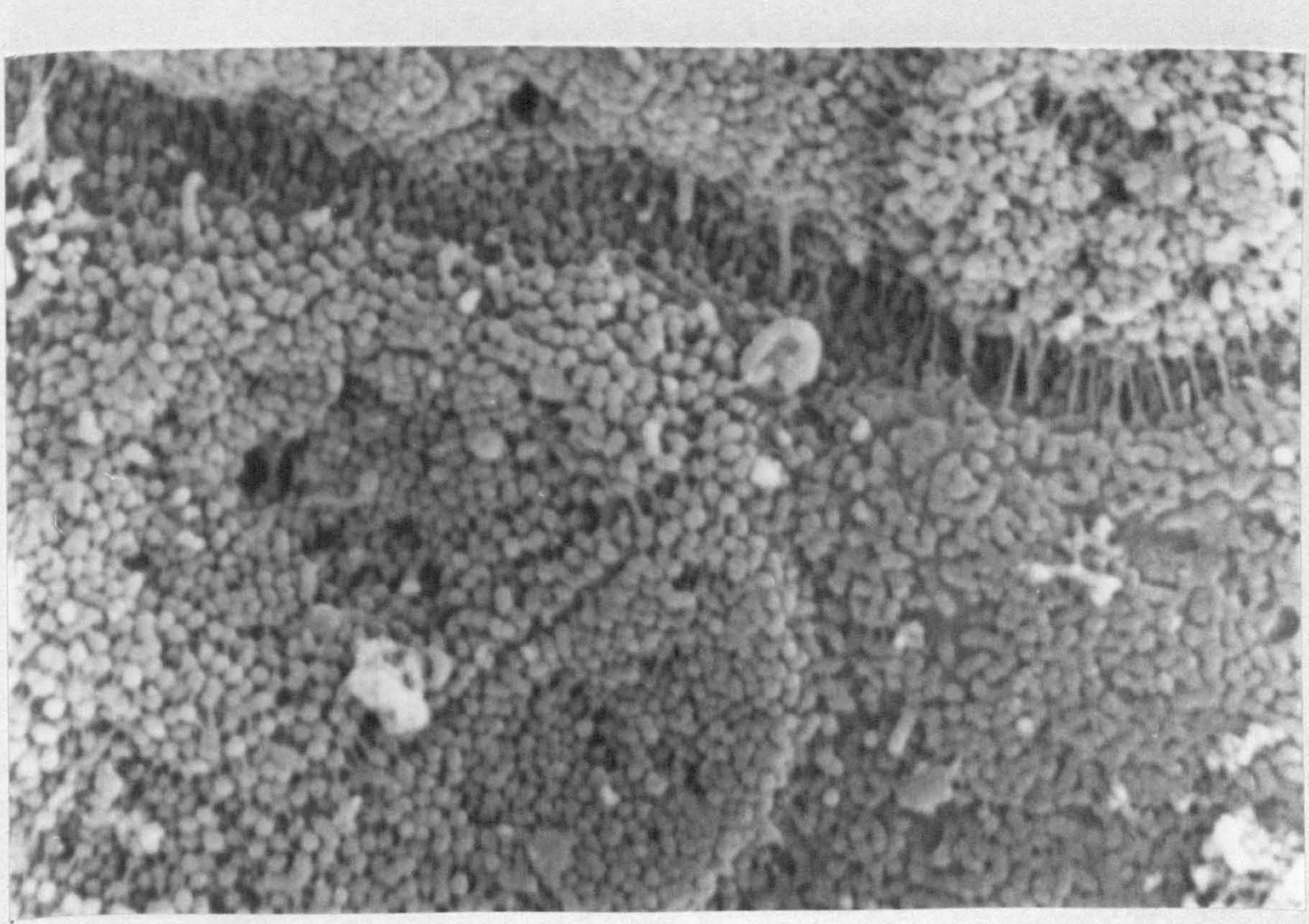


Fig. 3.61 Nasopharynx. In this specimen, the surface has an irregular "cobblestone" appearance. SEM x 1920.

Fig. 3.62 Nasopharynx. A higher power view of a junctional zone between respiratory and squamous epithelium. Here, many cells have only a sparse complement of cilia; others are non-ciliated and their surface is covered by many stubby projections. SEM x 7,500.

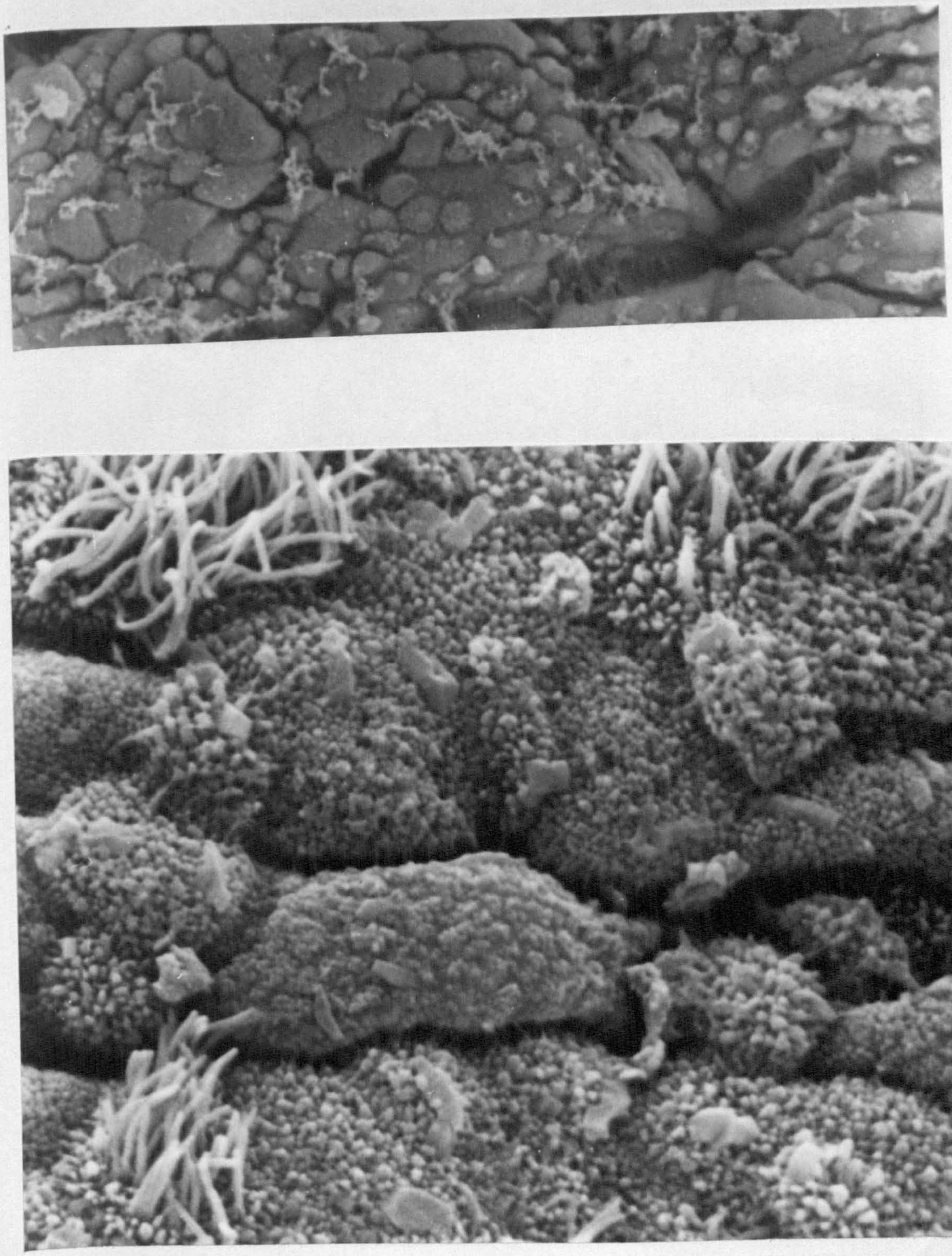
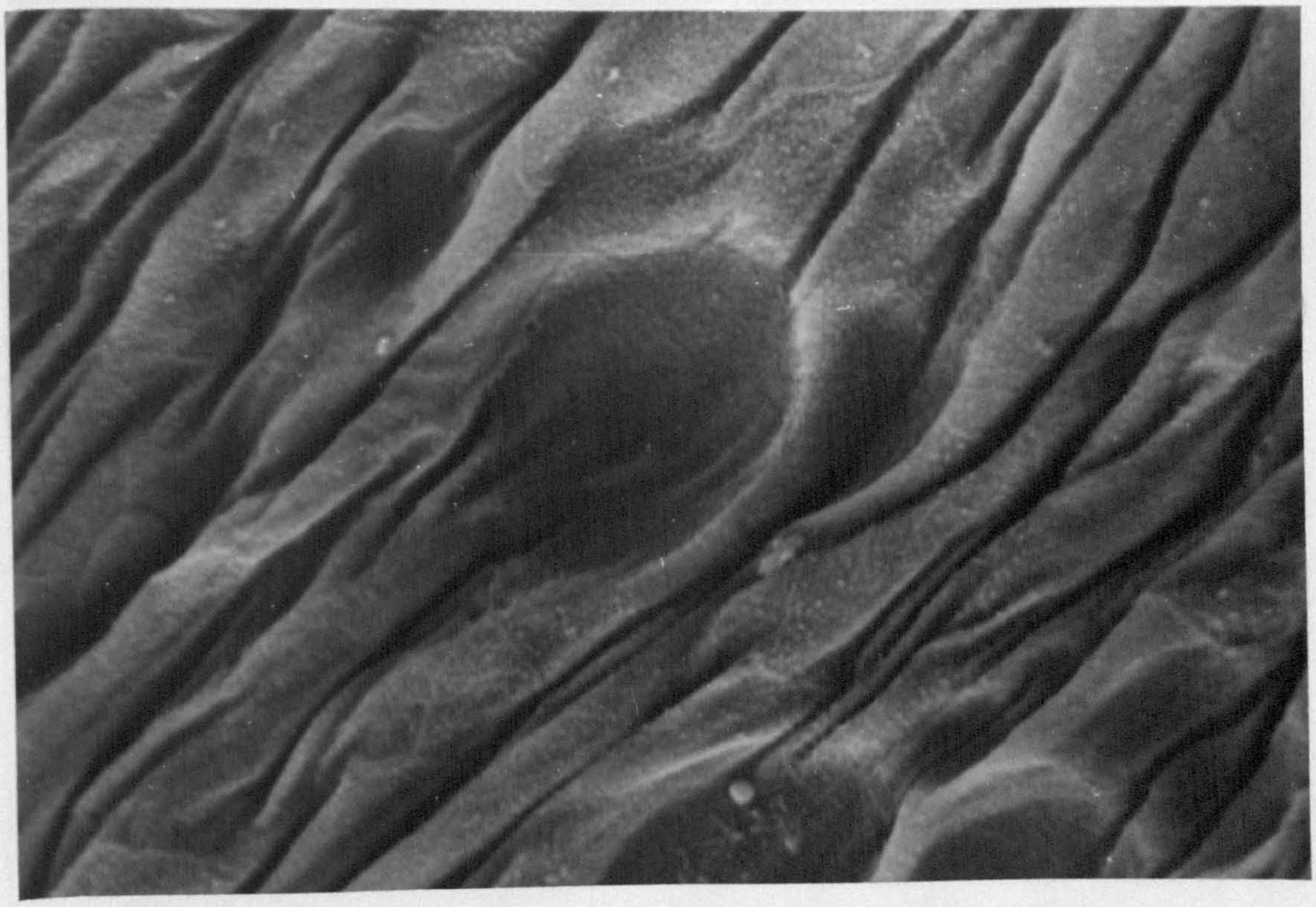


Fig. 3.63 Epiglottis. A low power view showing irregular surface fissures. SEM x 1920.

Fig. 3.64 Epiglottis. Note the surface squamous cells covered with short microvilli and microplicae. SEM x 3,750.



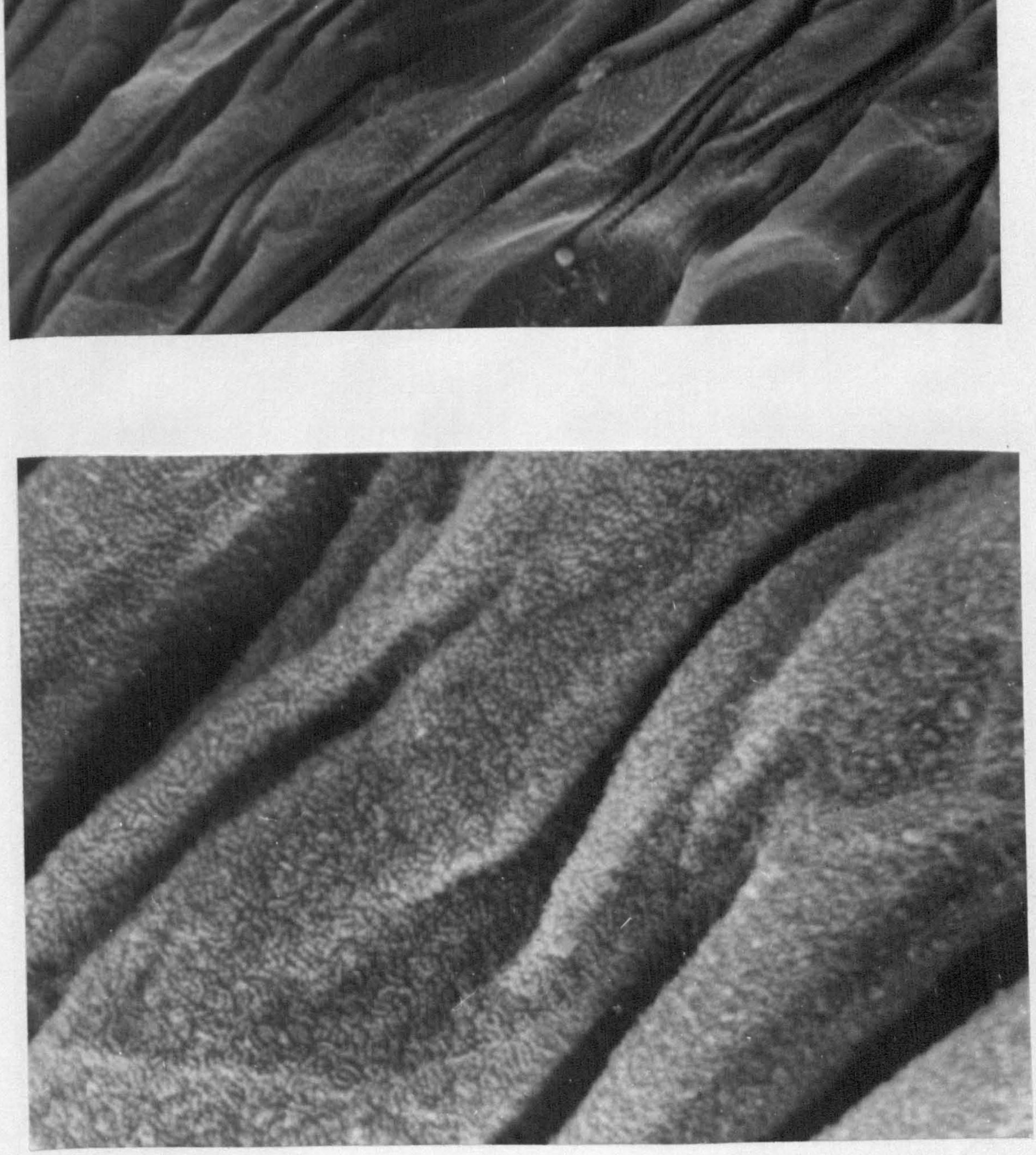
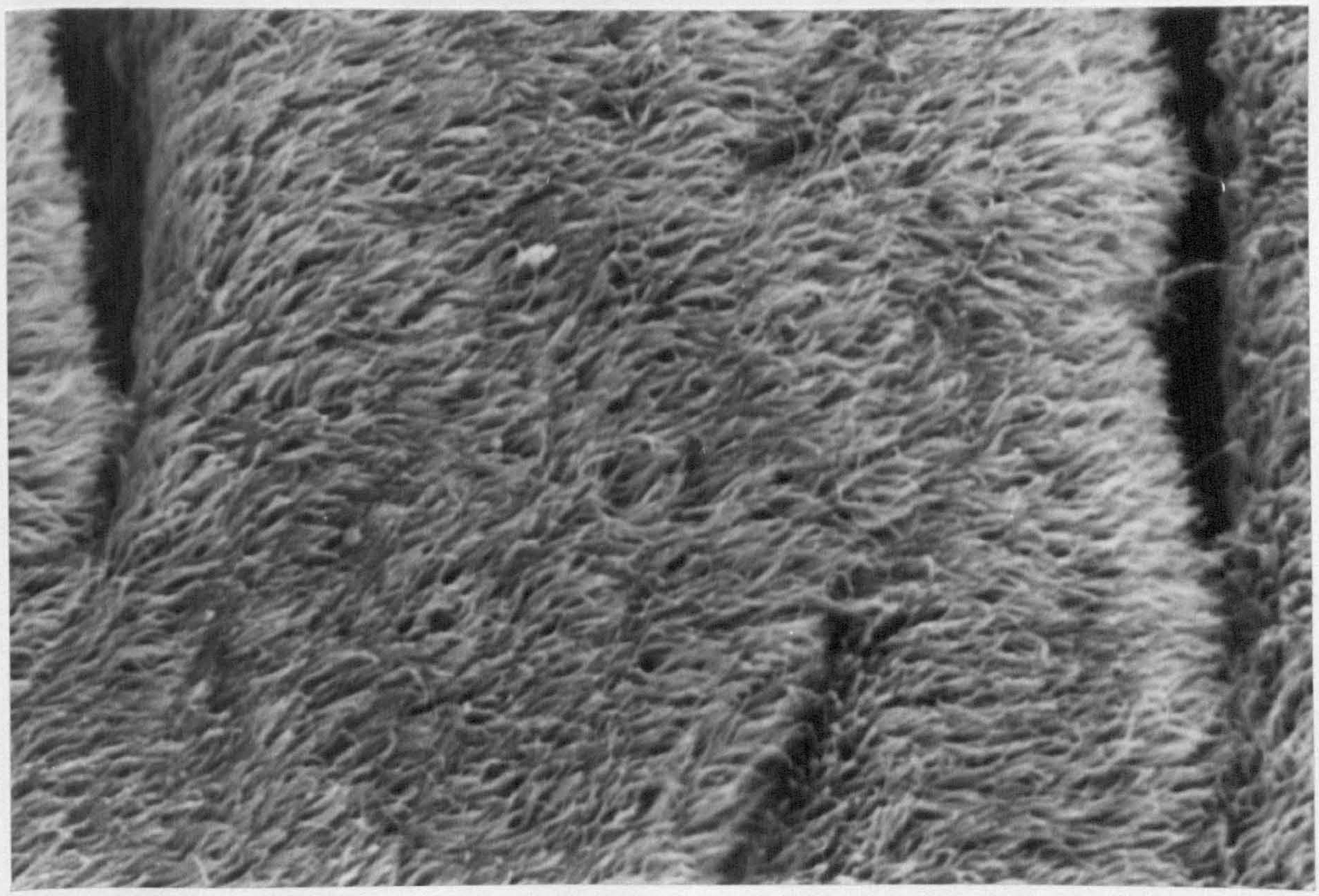


Fig. 3.65 Ventral larynx. In this specimen, the epithelium is completely ciliated. SEM x 1920.

Fig. 3.66 Ventral larynx. Many goblet cells can be seen. SEM x 3,750.



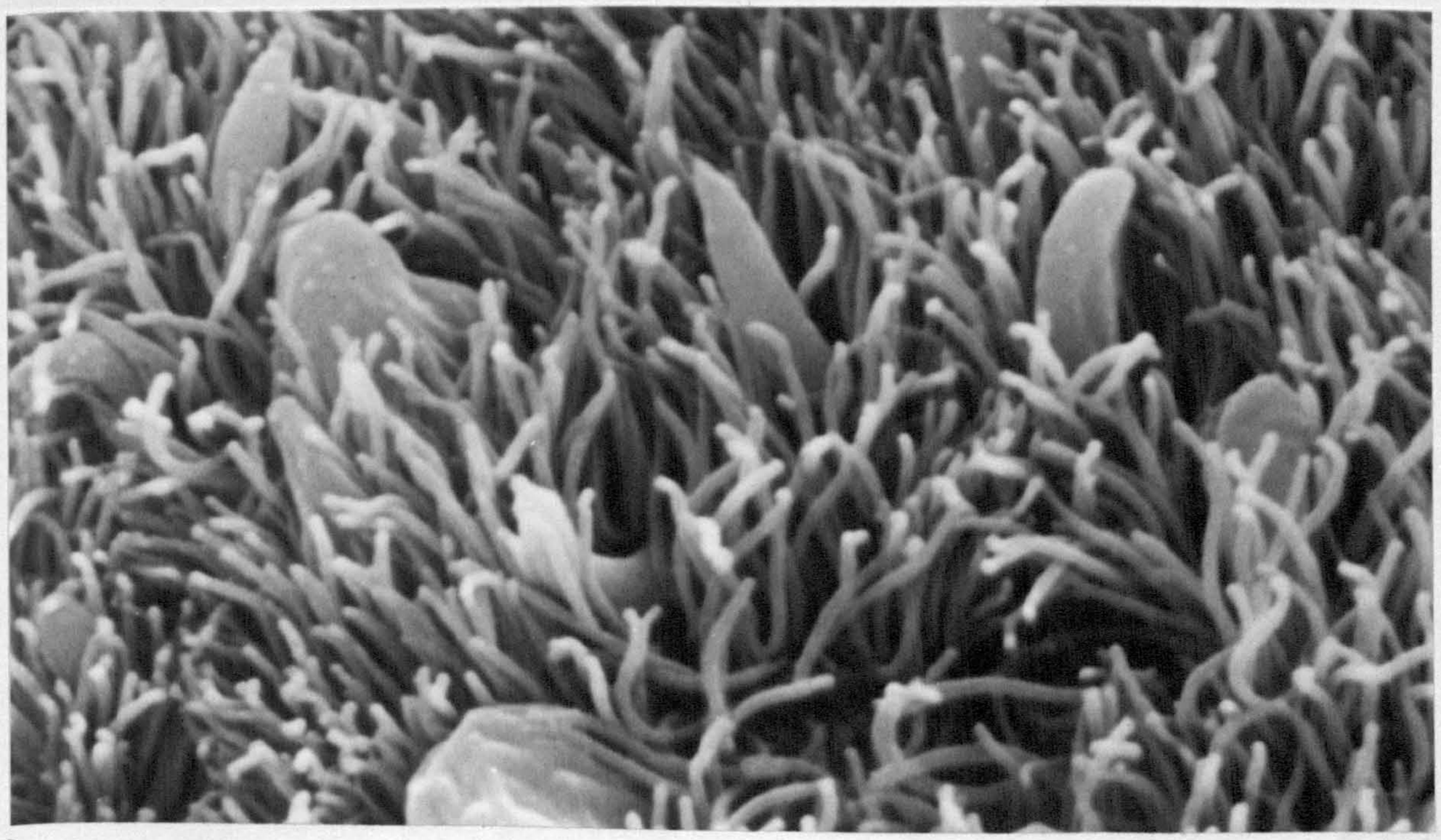
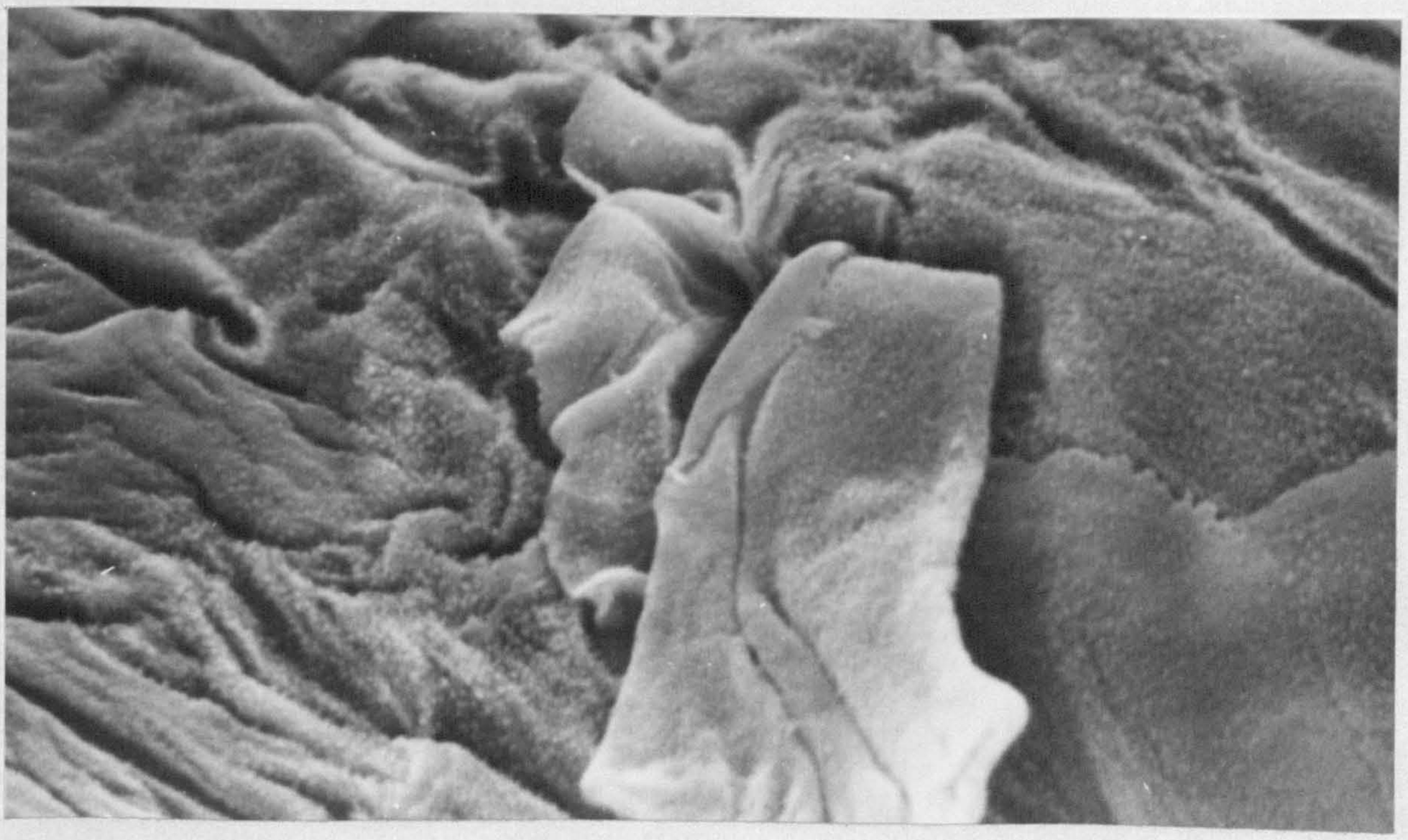


Fig. 3.67 Ventral larynx. Here, the epithelium is of the stratified squamous type. Note the desquamating cell.
SEM x 3,750.

Fig. 3.68 Ventral larynx. A low power view showing the irregular folded surface with a few surface squames.
SEM x 240.



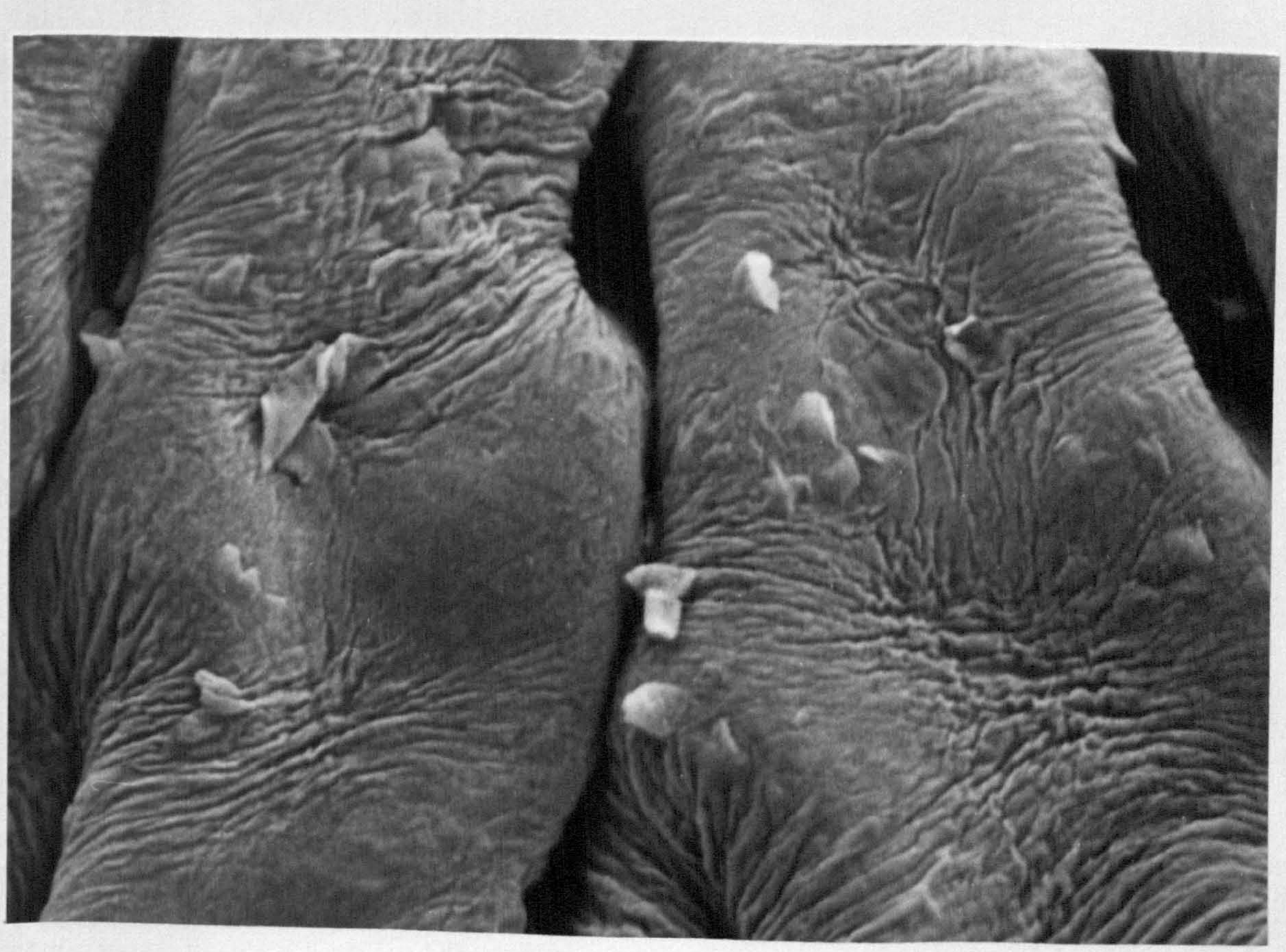


Fig. 3.69 Ventral larynx. This is a junctional zone between respiratory and non-respiratory (squamous) epithelium. Note the relatively few ciliated cells and the overall "cobblestone" appearance of the surface epithelial cells.
SEM x 1920.

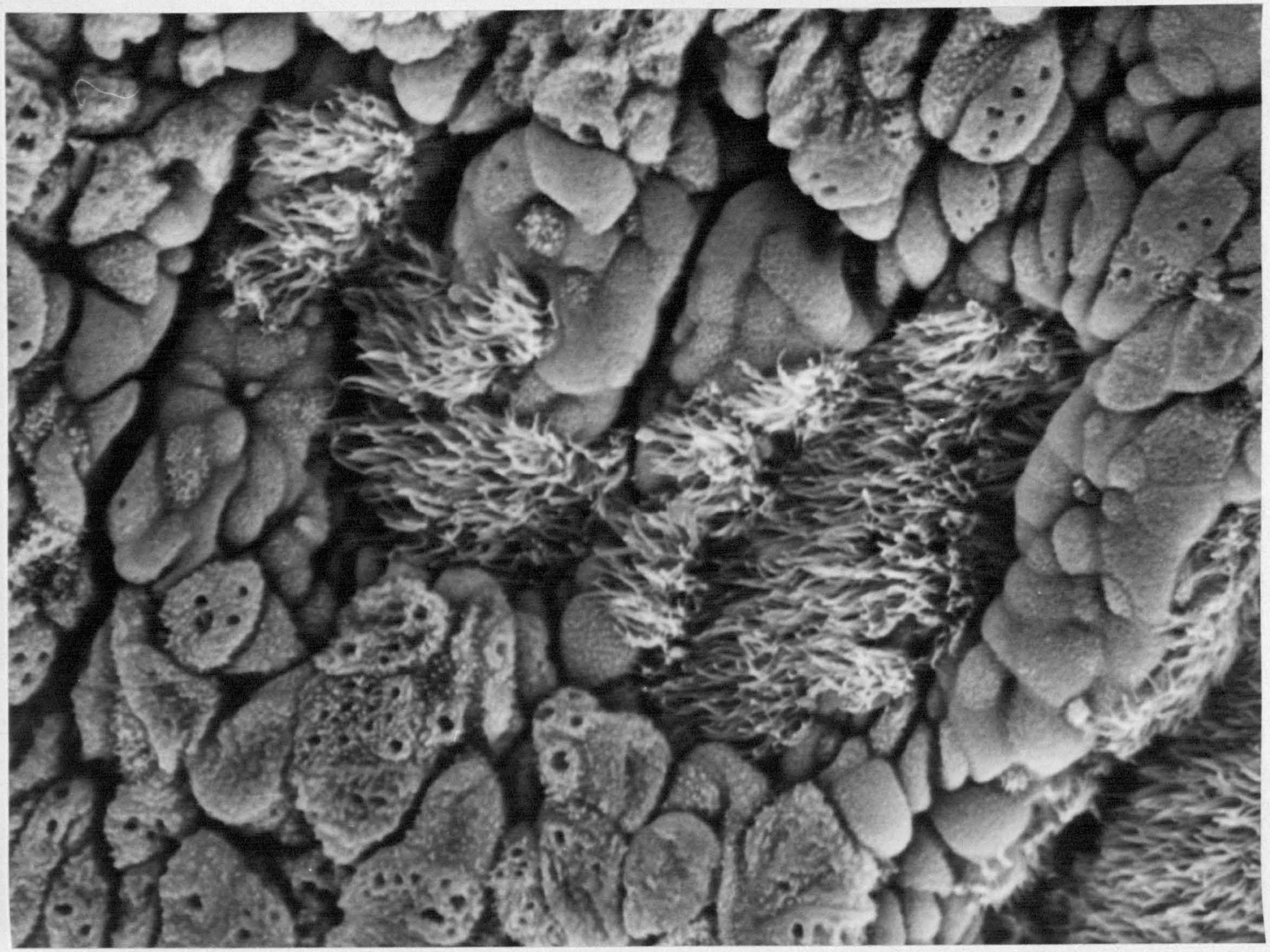


Fig. 3.70 Ventral larynx. A junctional zone showing sparsely-ciliated epithelial cells. Note the irregular surface cells with their numerous stubby microvillous processes.
SEM x 7,500.

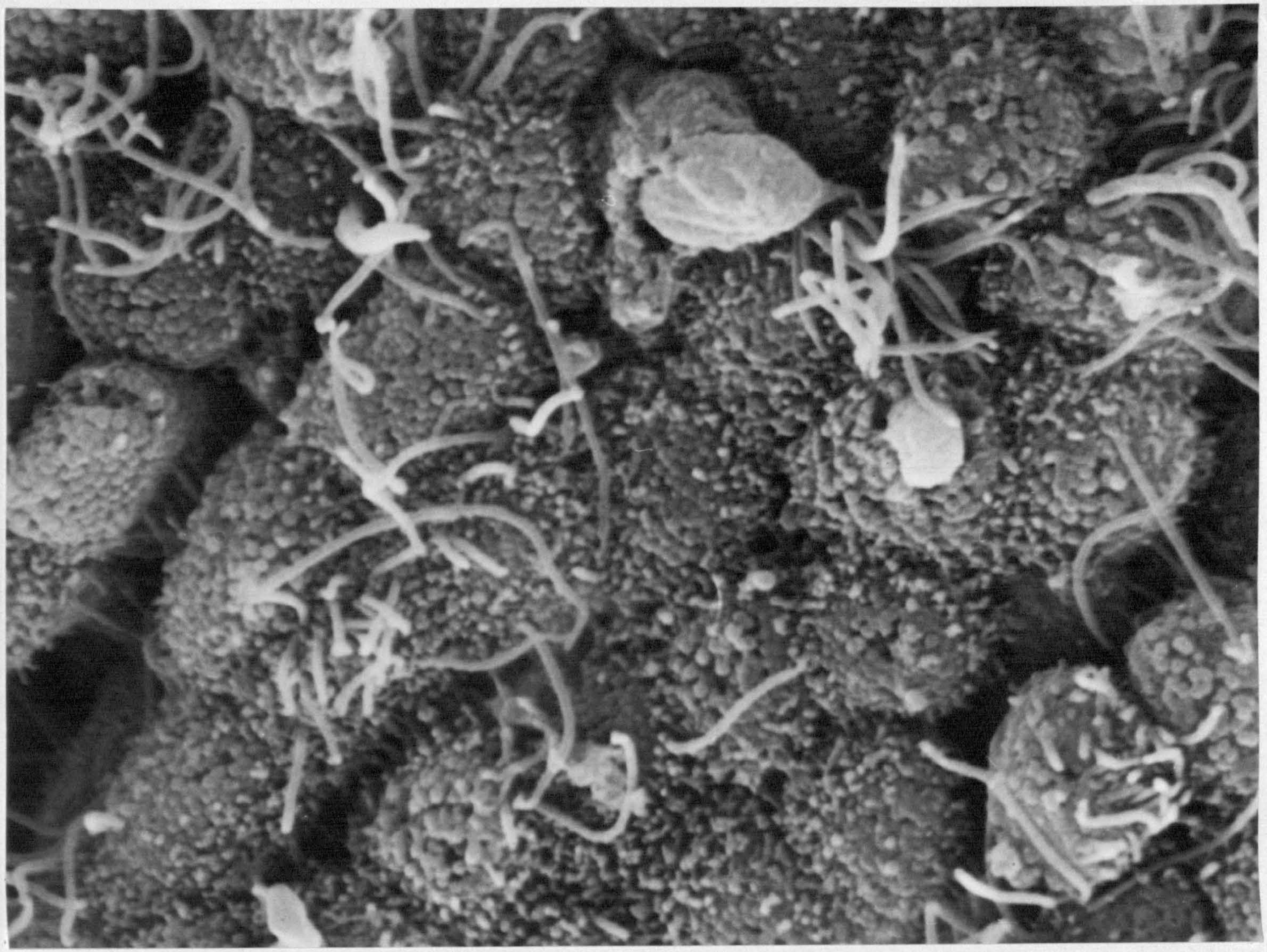


Fig. 3.71 Trachea. A low power view showing the longitudinal folds of the mucosa.
SEM x 240.

Fig. 3.72 Trachea. Note the folded appearance of the ciliated surface.
SEM x 960.

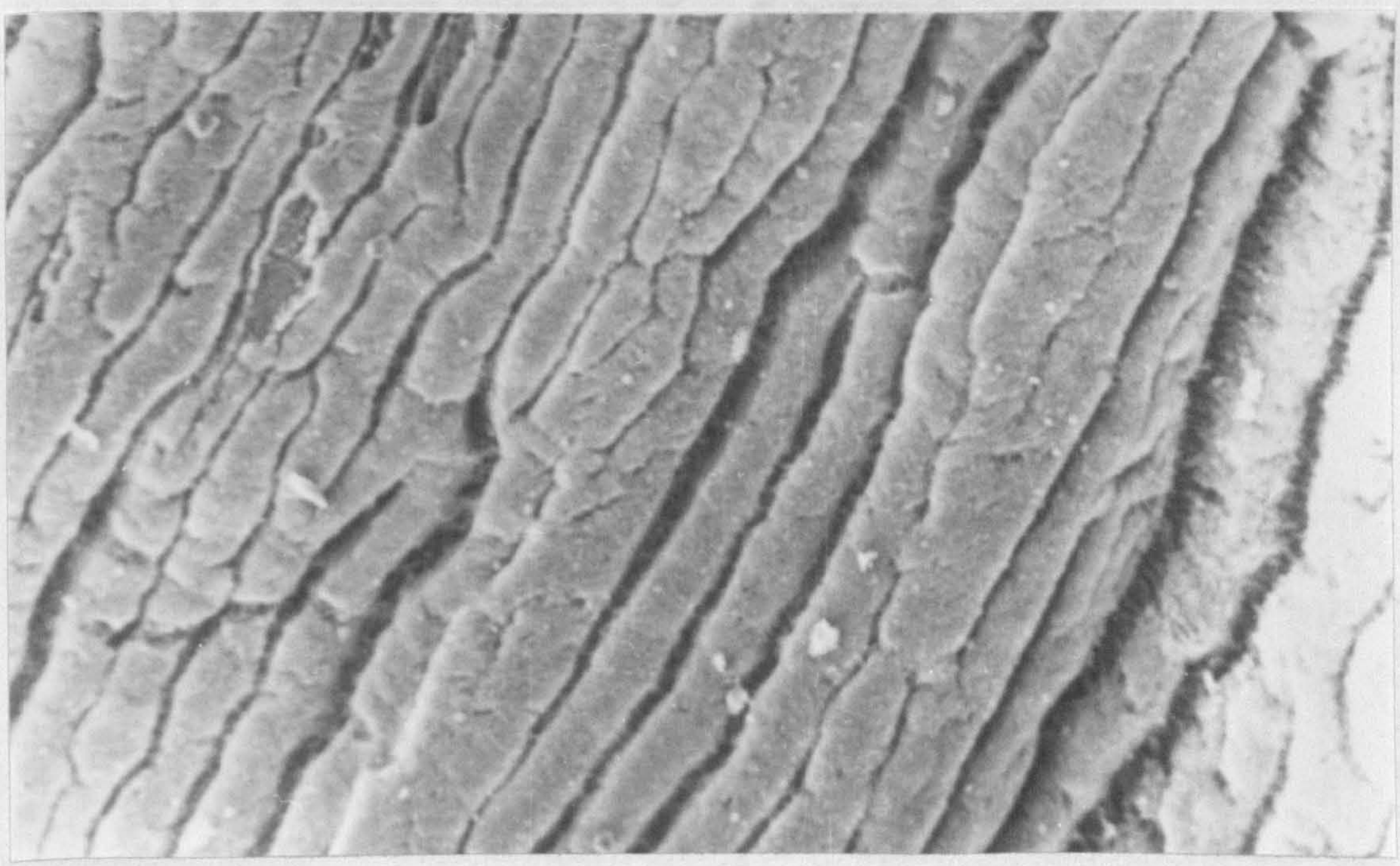




Fig. 3.73 Trachea. Note the dense carpet of cilia. SEM x 7,500.

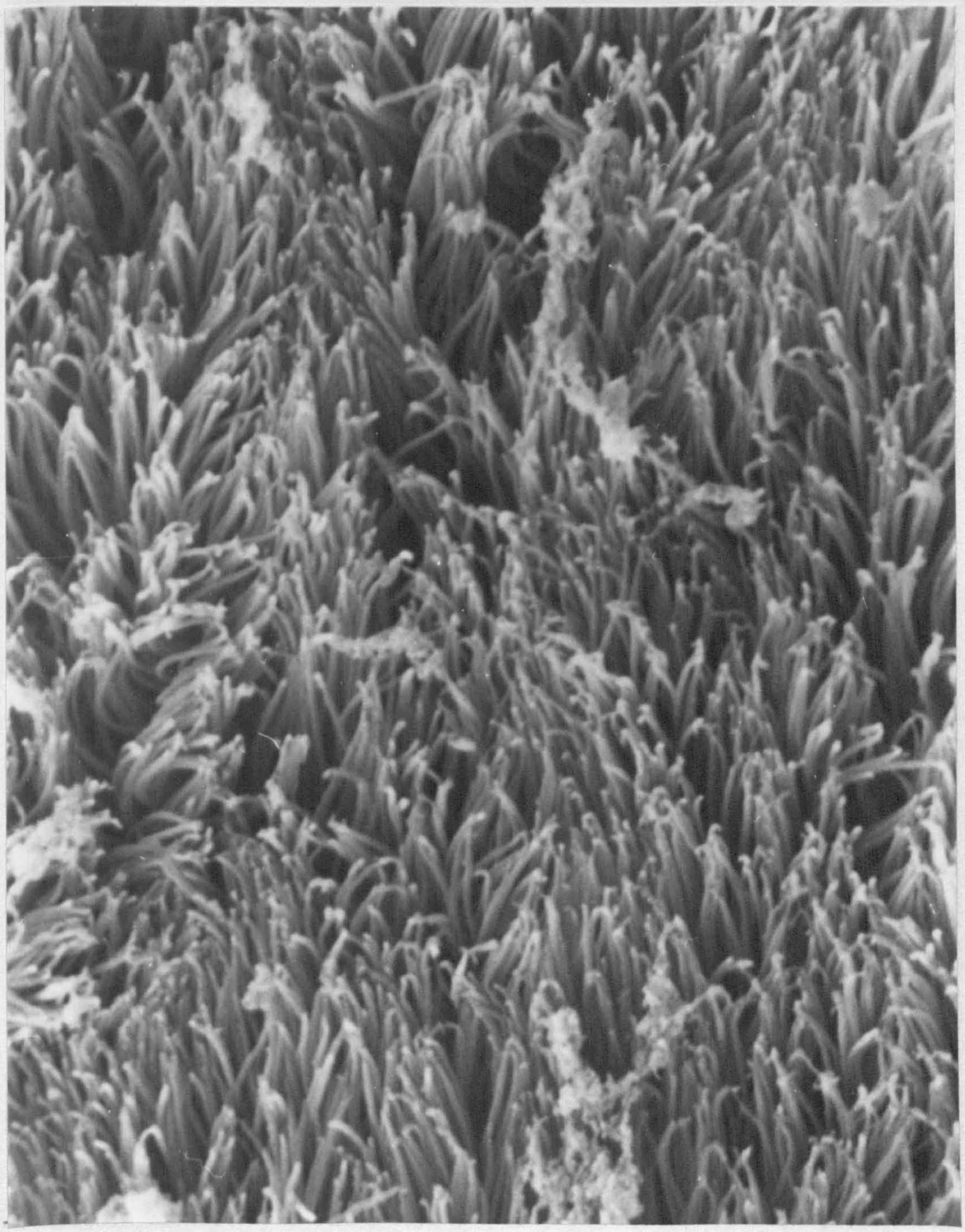


Fig. 3.74 Trachea. In this dog (WA 15), a few scattered patches of non-ciliated cells were found. Note the irregular surface of these cells due to the presence of numerous stubby microvillous processes. SEM x 3,750.

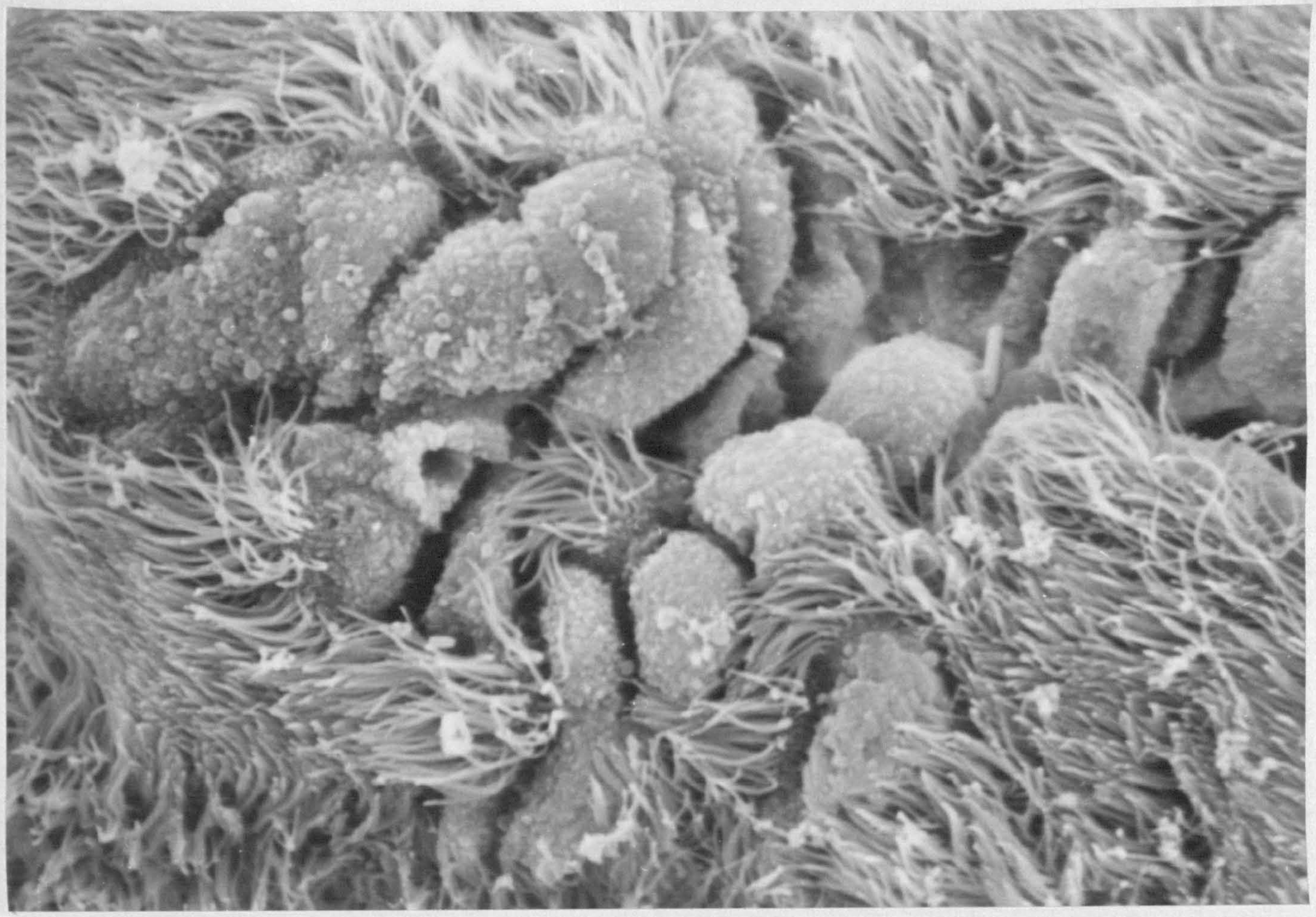


Fig. 3.75 Trachea. A number of goblet cells can be seen protruding between the cilia.
SEM x 3,750.

Fig. 3.76 Trachea. In this fractured specimen, a number of goblet cells (G) and ciliated cells (C) can be seen.
SEM x 7,500.

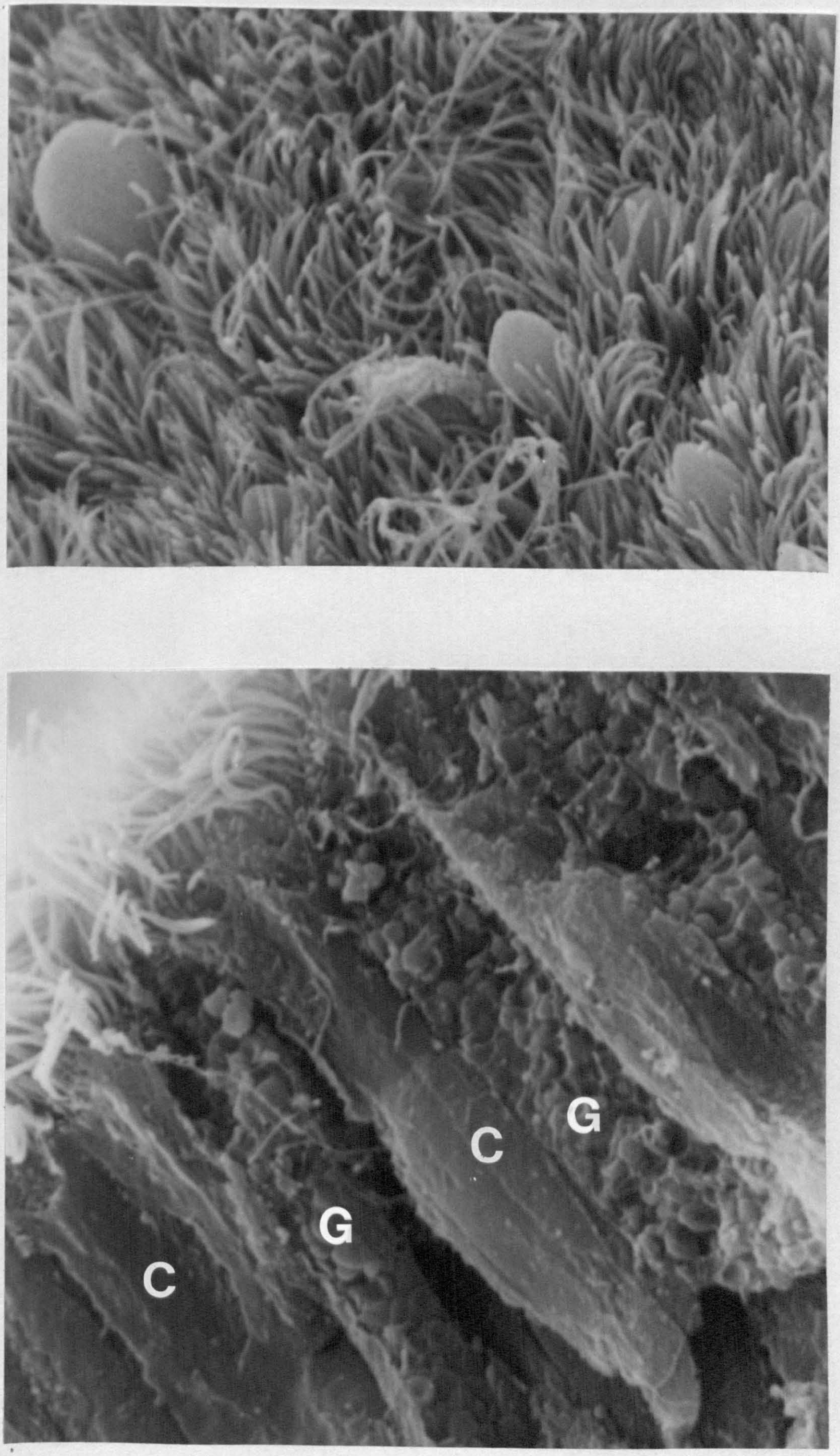
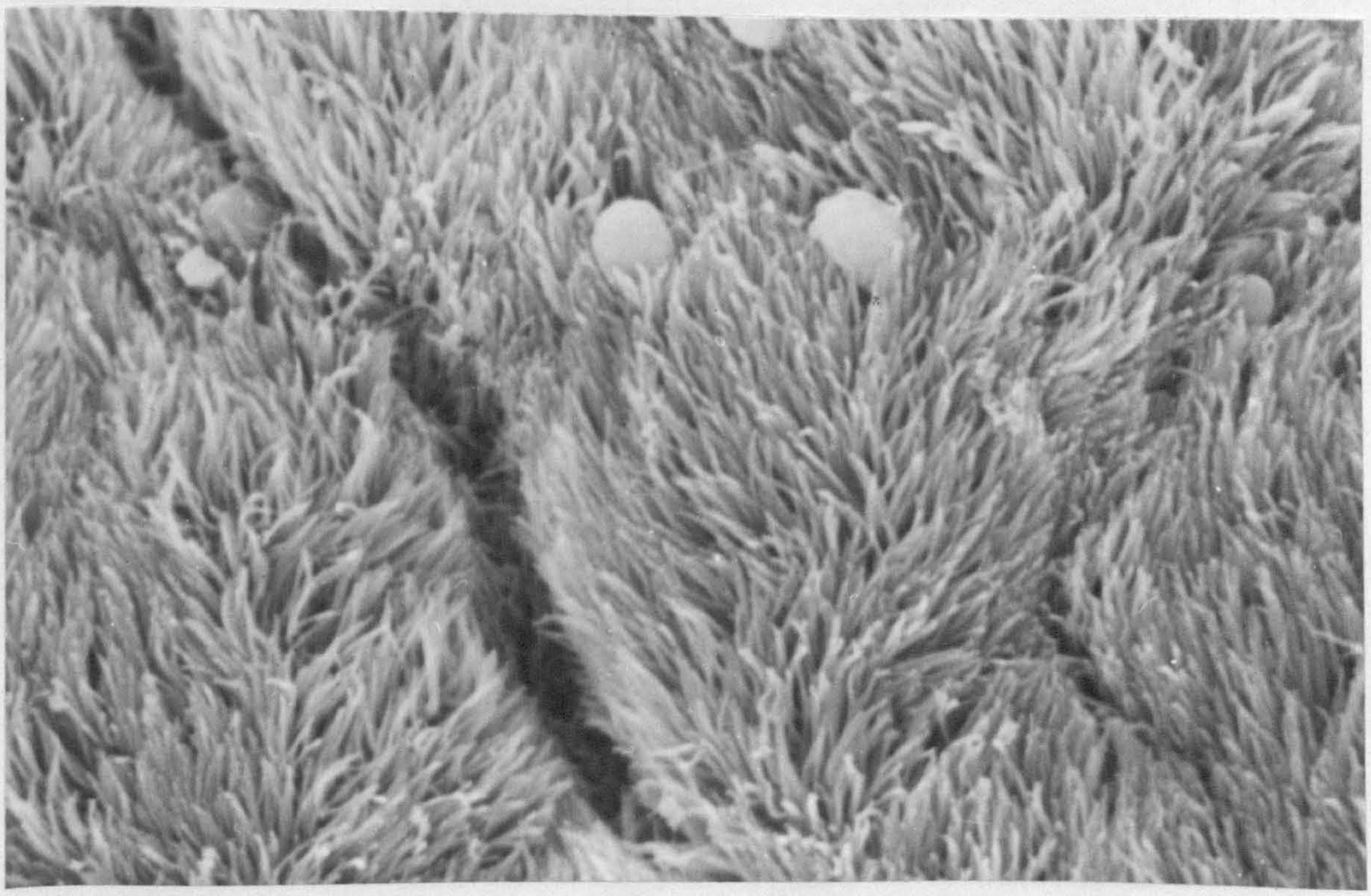

C
G
C
G
C
G

Fig. 3.77 Extrapulmonary bronchus.
A number of goblet cells can be seen.
SEM x 3,750.

Fig. 3.78 Extrapulmonary bronchus.
Note the orifice of a bronchial gland.
SEM x 1920.



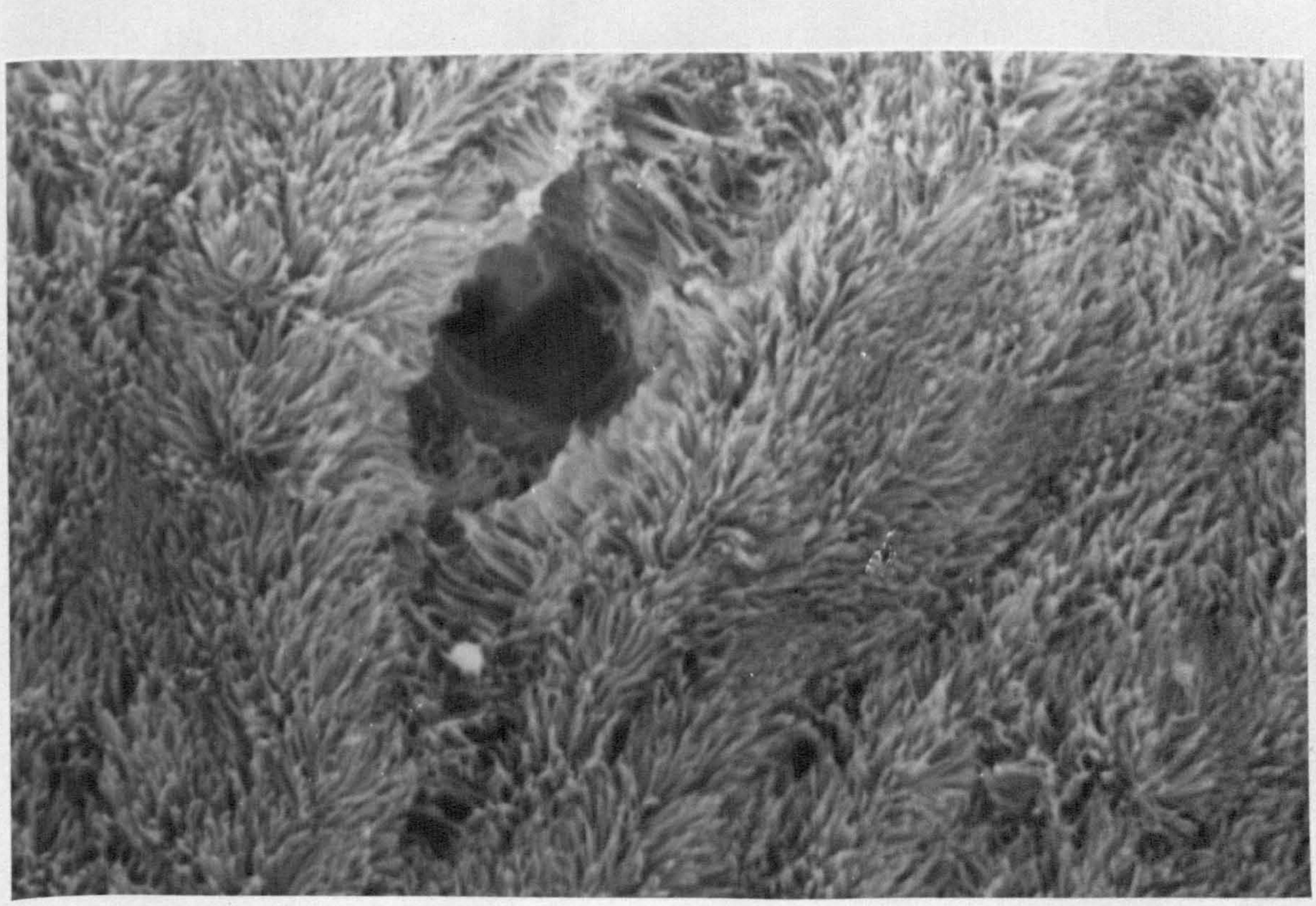


Fig. 3.79 Bronchus. A section through a large bronchus (B) illustrates the longitudinal mucosal folds. SEM x 120.

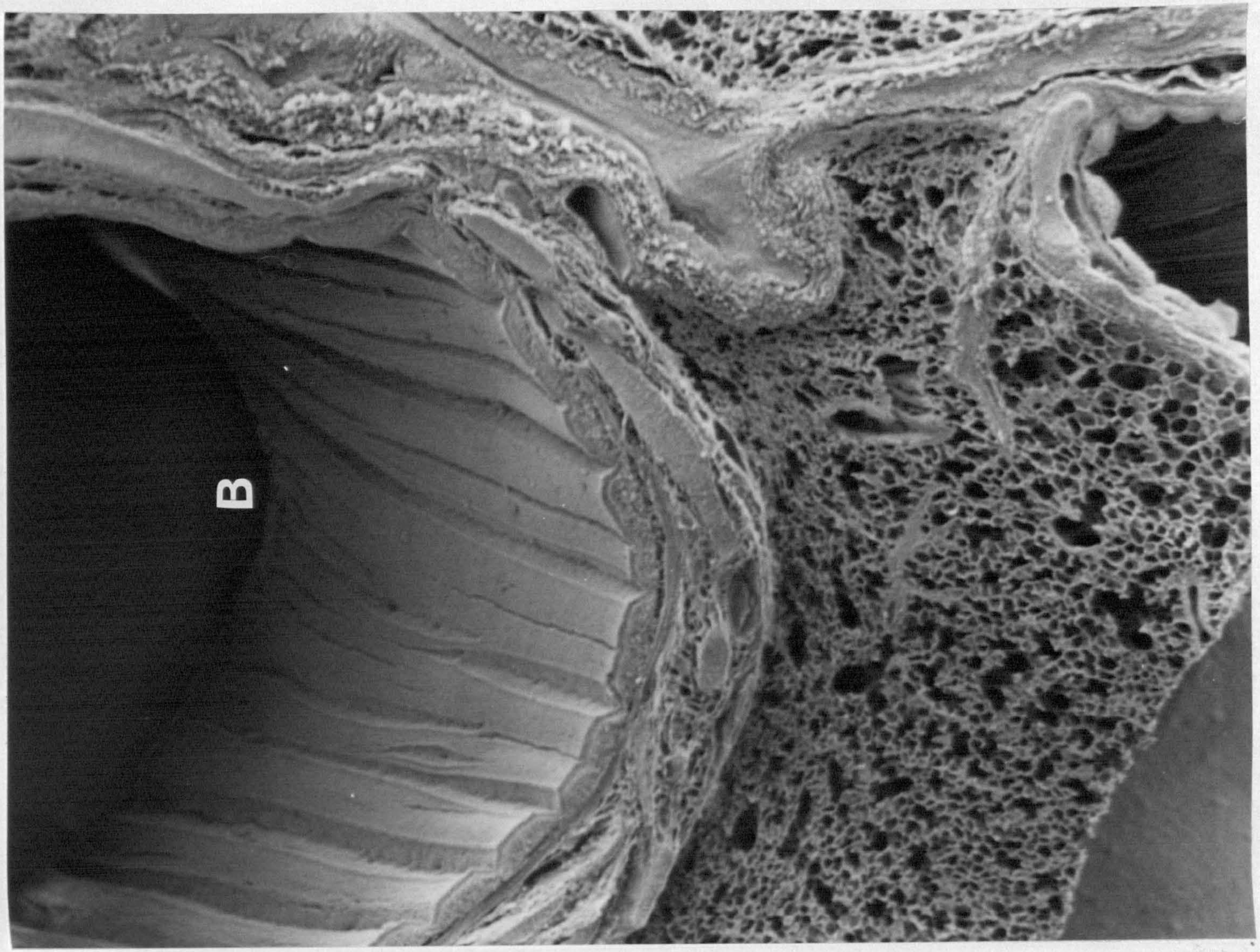

B

Fig. 3.80 Bronchus. The surface is completely ciliated. SEM x 3,750.

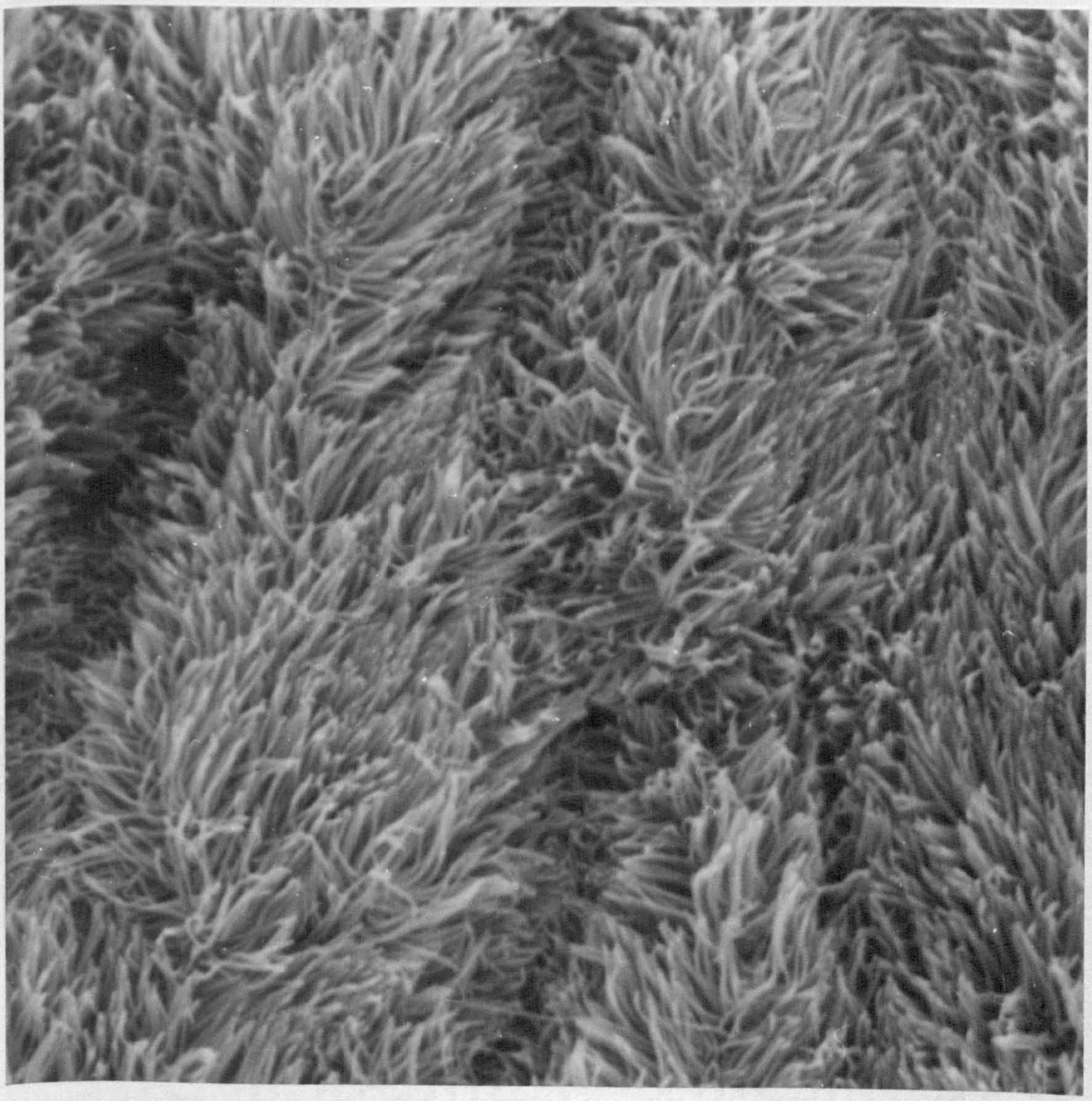


Fig. 3.81 Bronchiole. A section of lung, showing a large (LB) and small (SB) bronchiole.
SEM x 240.

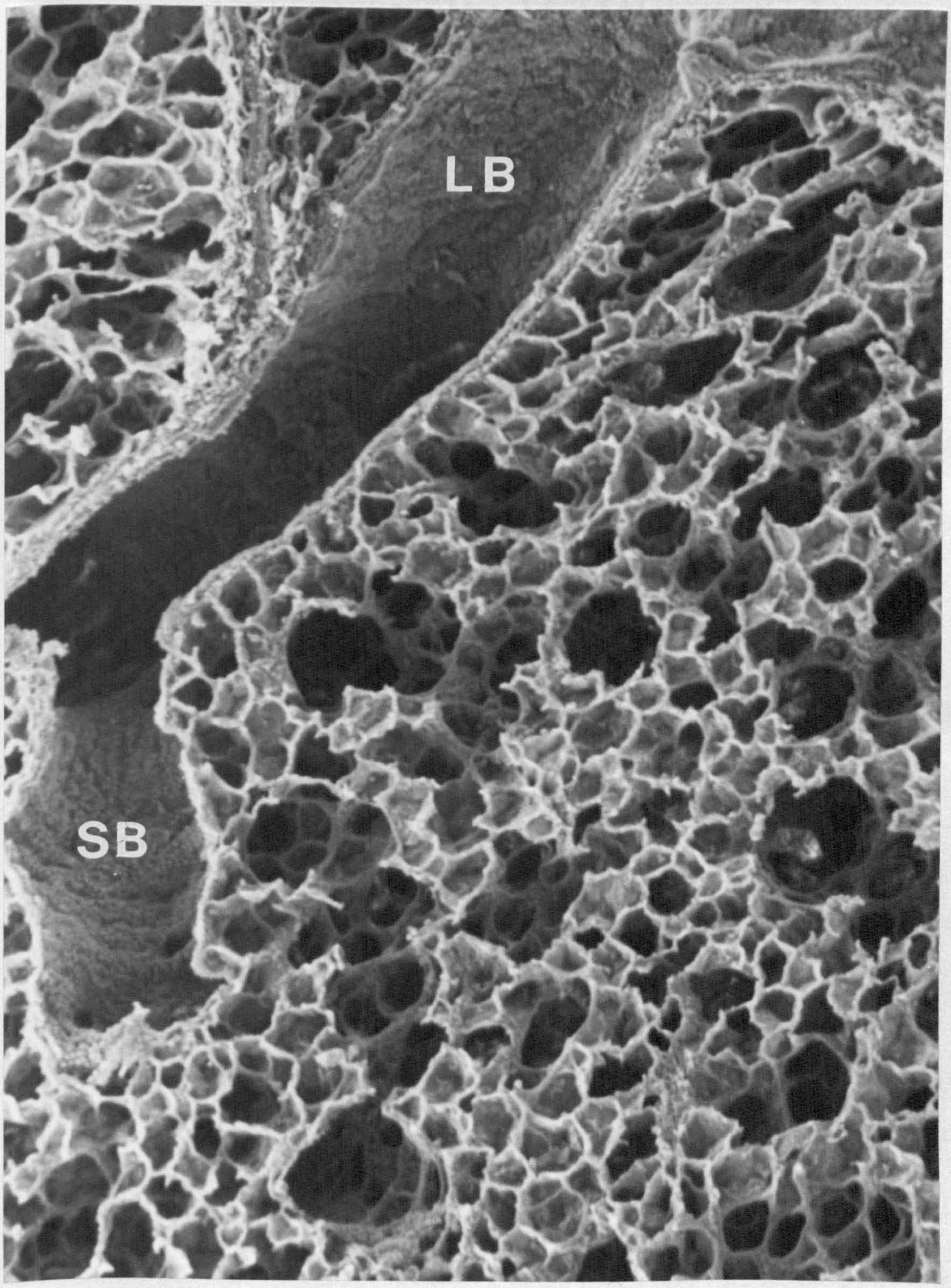
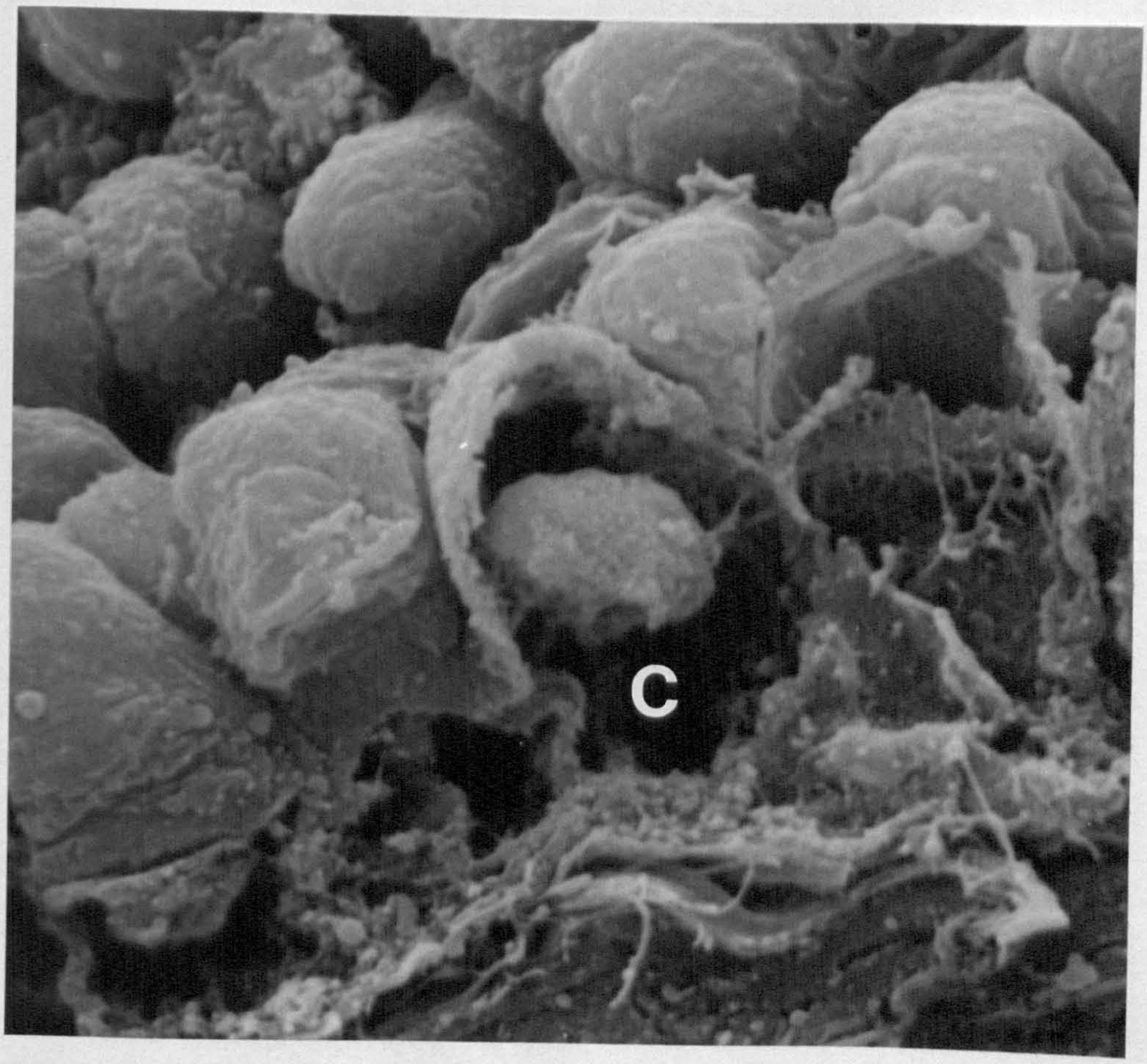

LB
SB

Fig. 3.82 Bronchiole. Note the dome-shaped non-ciliated bronchiolar secretory (Clara) cell. One of these cells has been sectioned (C) exposing the nucleus.
SEM x 7,500.

Fig. 3.83 Bronchiole. This specimen shows a mixture of Clara cells and ciliated cells.
SEM x 7,500.


C

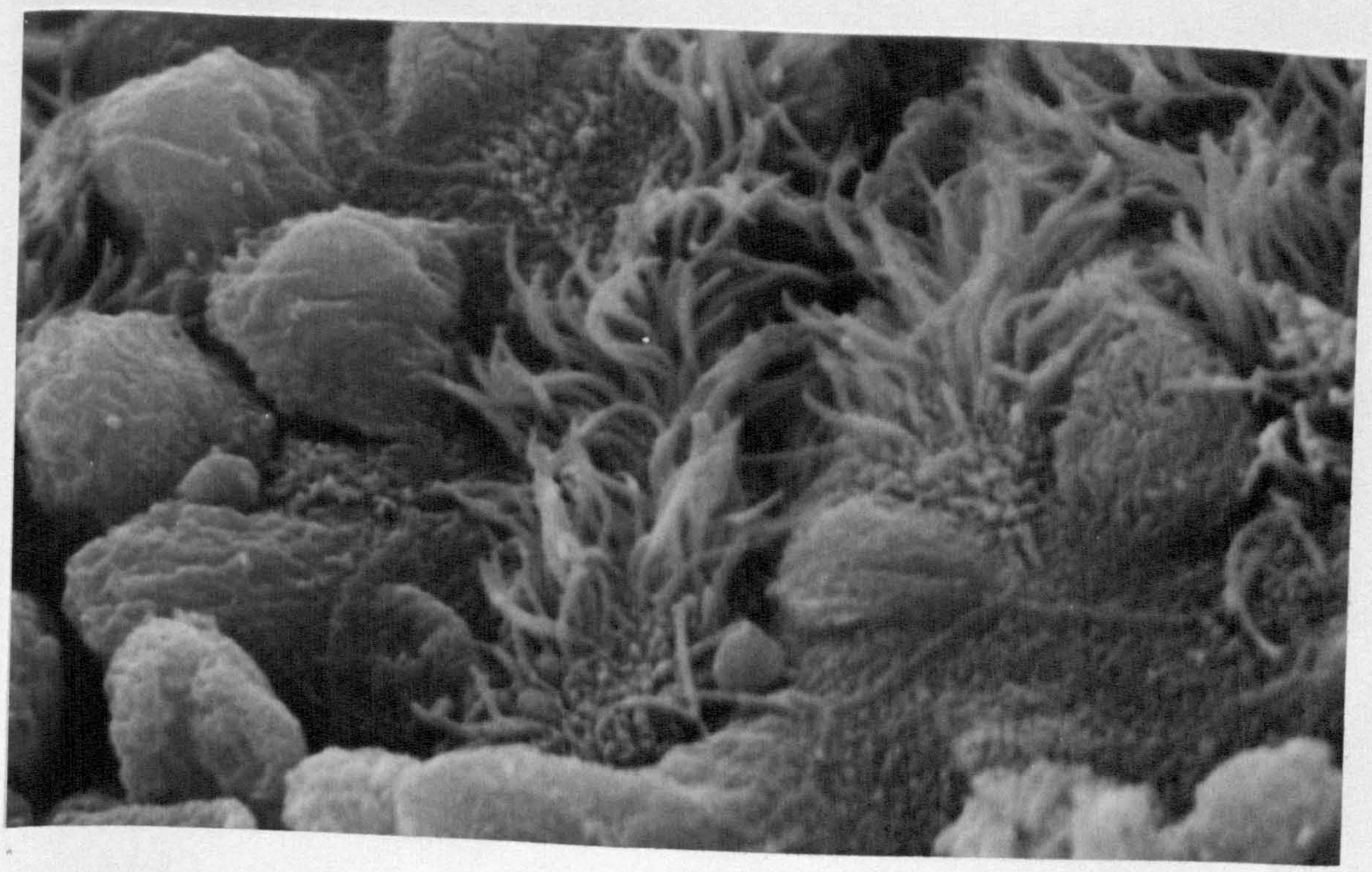


Fig. 3.84 Terminal bronchiole. At this level only a few sparsely ciliated cells persisted; the majority of cells are Clara cells.
SEM x 7,500.

Fig. 3.85 Respiratory bronchiole. Note the mural alveoli (*). No ciliated cells are present at this level. SEM x 960.

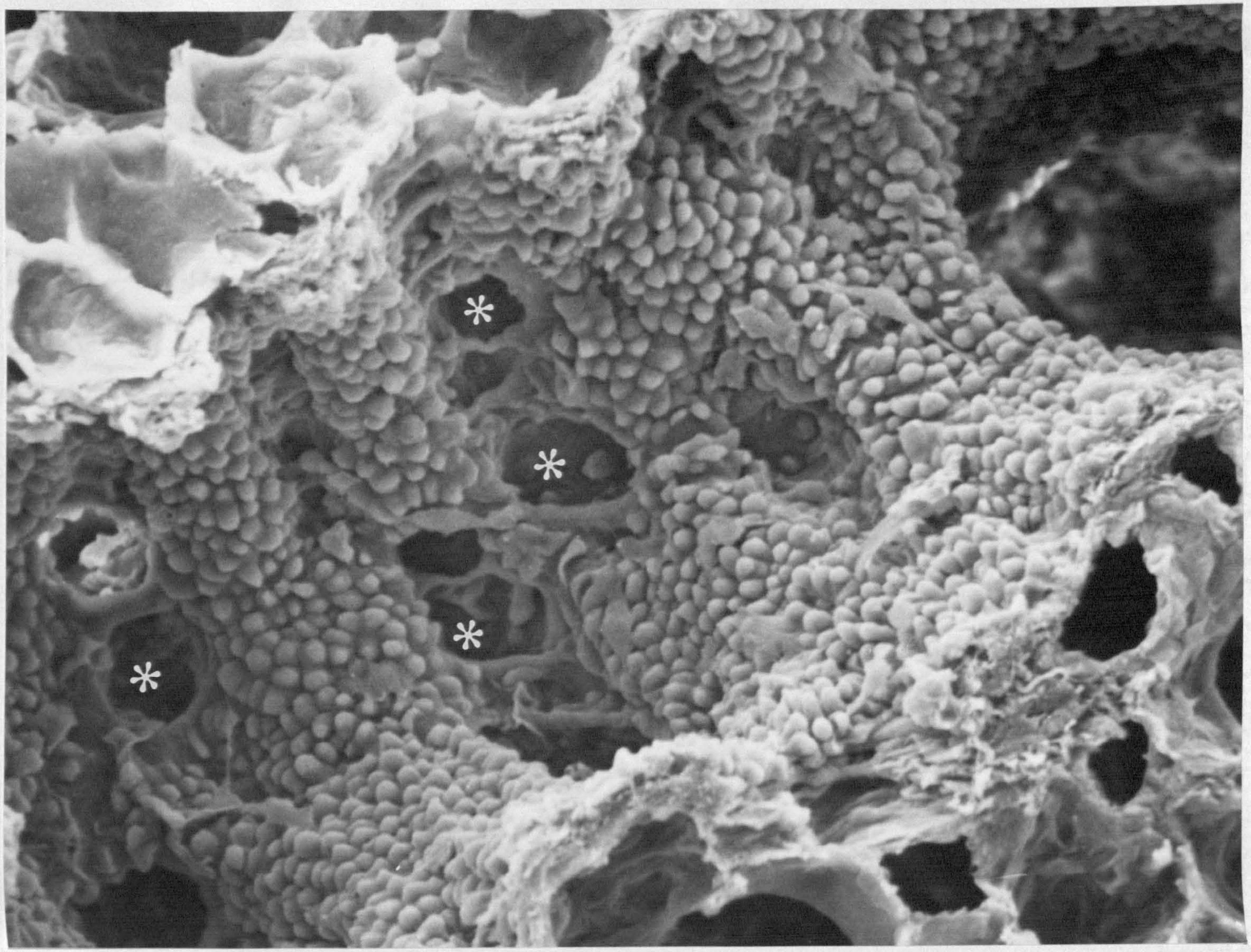


Fig. 3.86 Respiratory bronchiole. Note the non-ciliated, dome-shaped Clara cells. SEM x 7,500.

Fig. 3.87 Lung. Note the exposed alveolar walls and thin alveolar septa. SEM x 960.

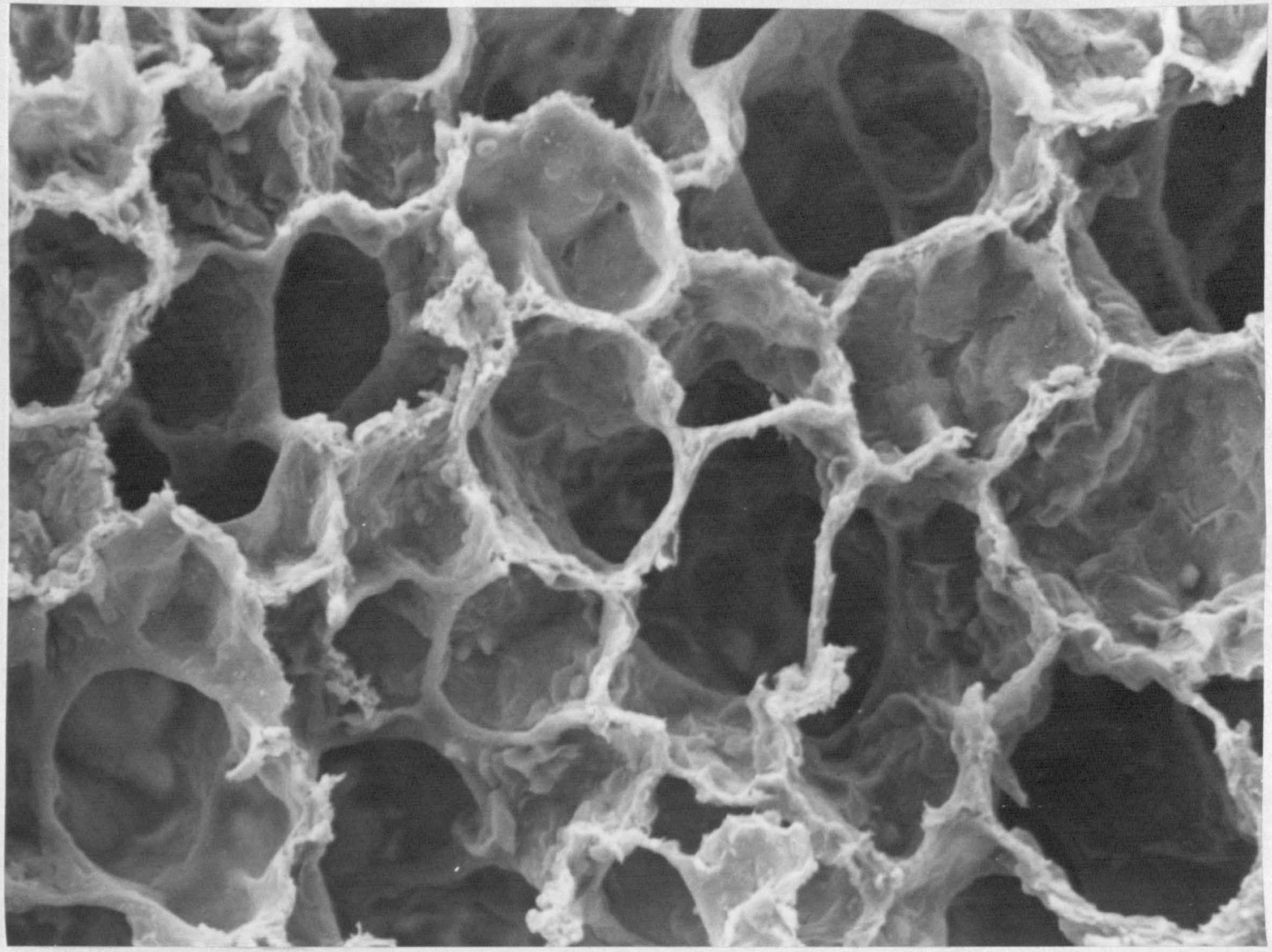


Fig. 3.88 Lung. A higher power view of the alveolar wall showing an underlying capillary (C). Note also Type I pneumonocytes (1) and Type II pneumonocytes (2).
SEM x 15,000.

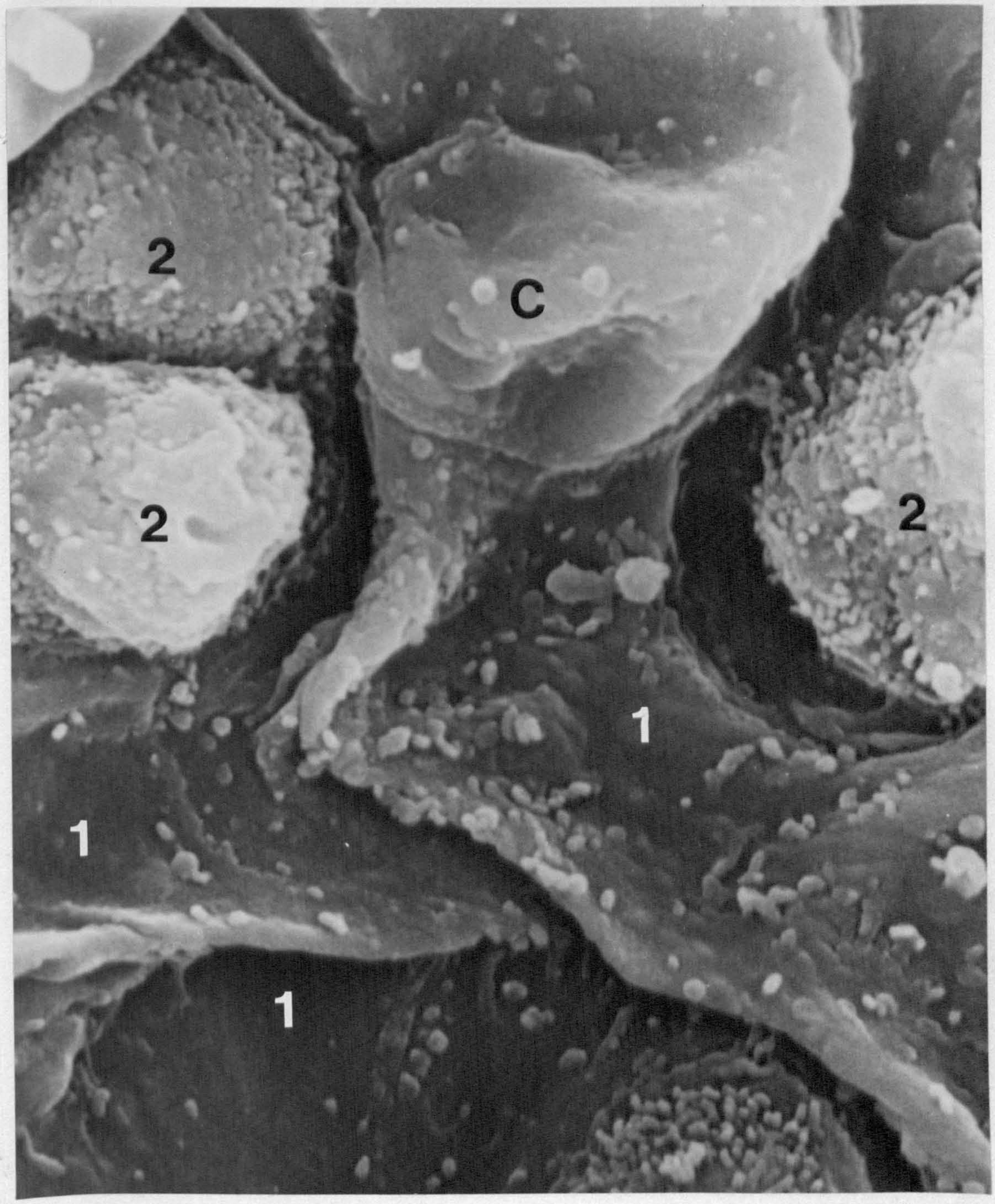

2
C
2
2
1
1

Fig. 3.89 Lung. A high power view of the alveolar wall, showing an alveolar pore (of Kohn). SEM x 15,000.

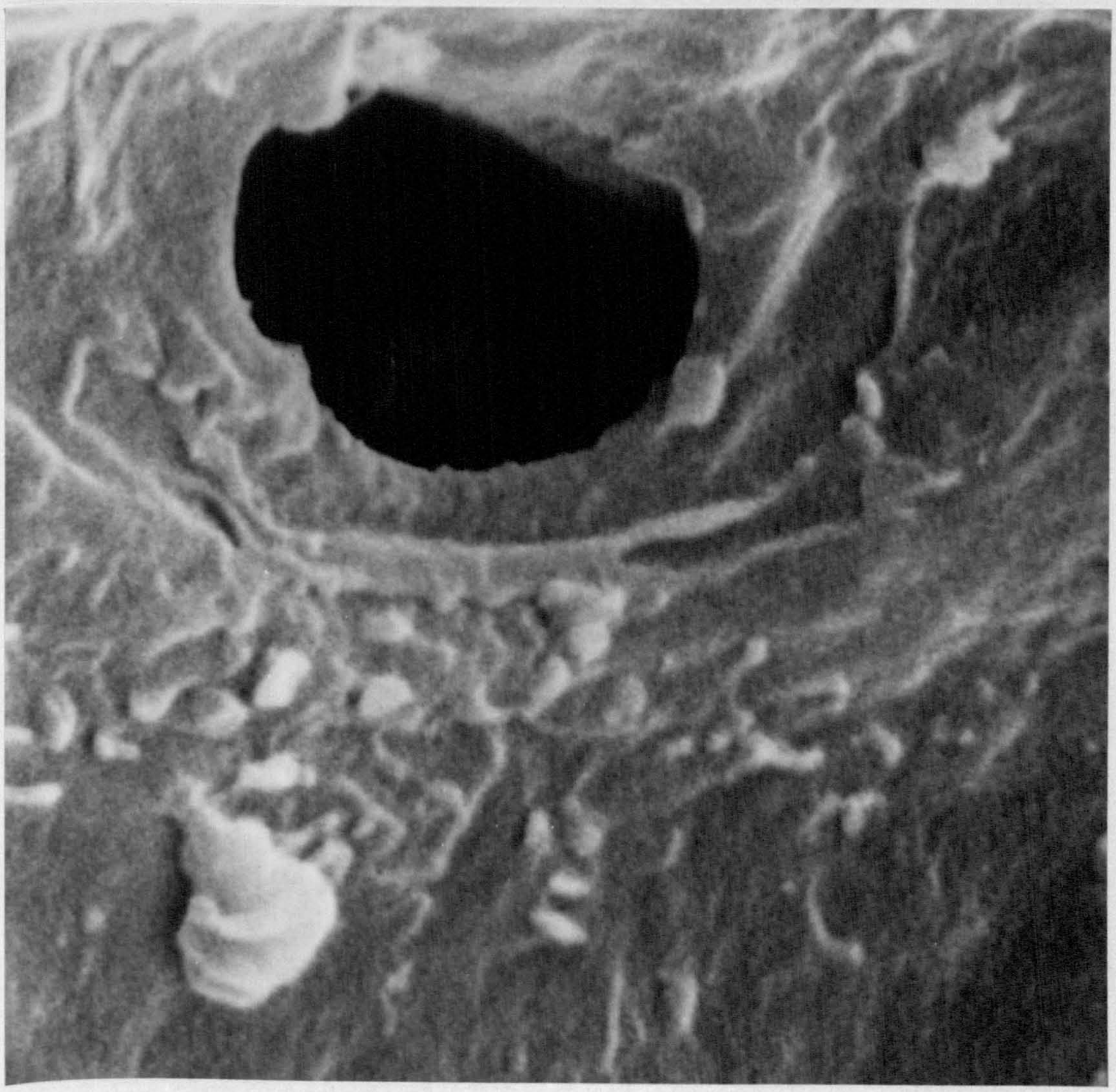


Fig. 3.90 Lung. This photomicrograph illustrates Type I and Type II pneumonocytes. The surface of the former (1) shows many stubby projections; the cell boundary between two adjacent cells can clearly be seen (arrows). The surface of the prominent Type II cells (2) shows numerous microvilli. SEM x 15,000.

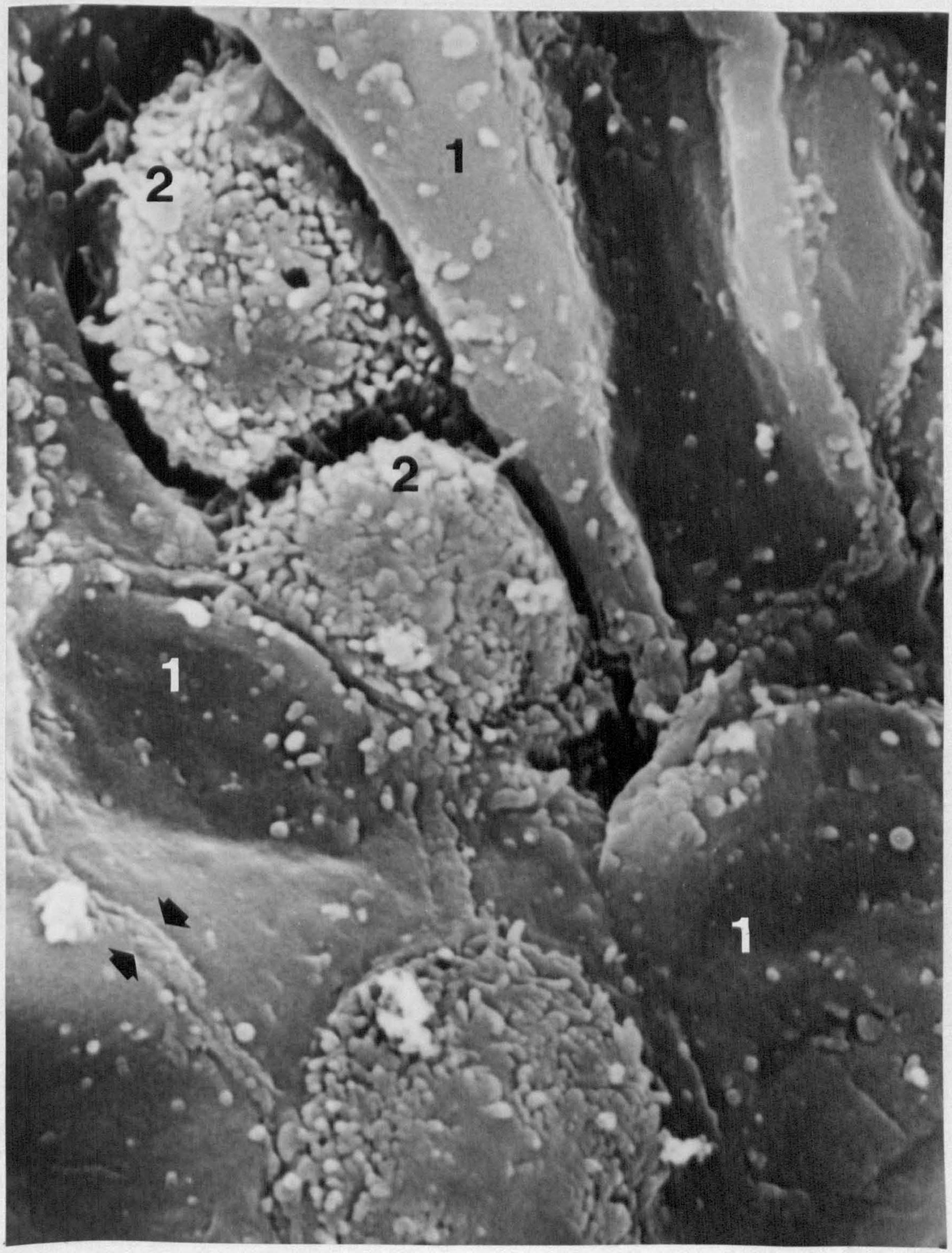

2
1
2
1
1

Fig. 3.91 Lung. Note the "Pores" on the surface of a Type II pneumonocyte (arrows).
SEM x 15,000.

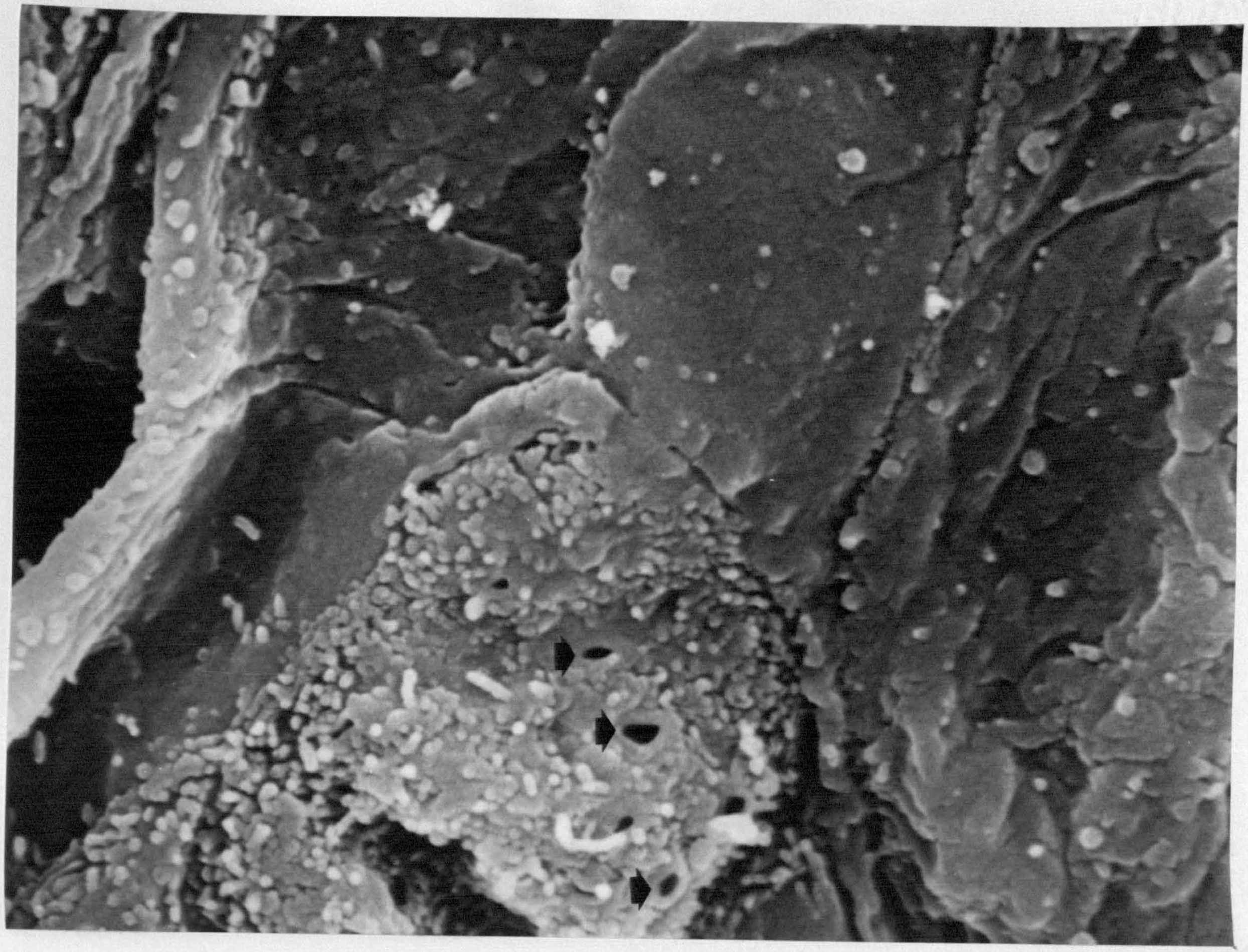
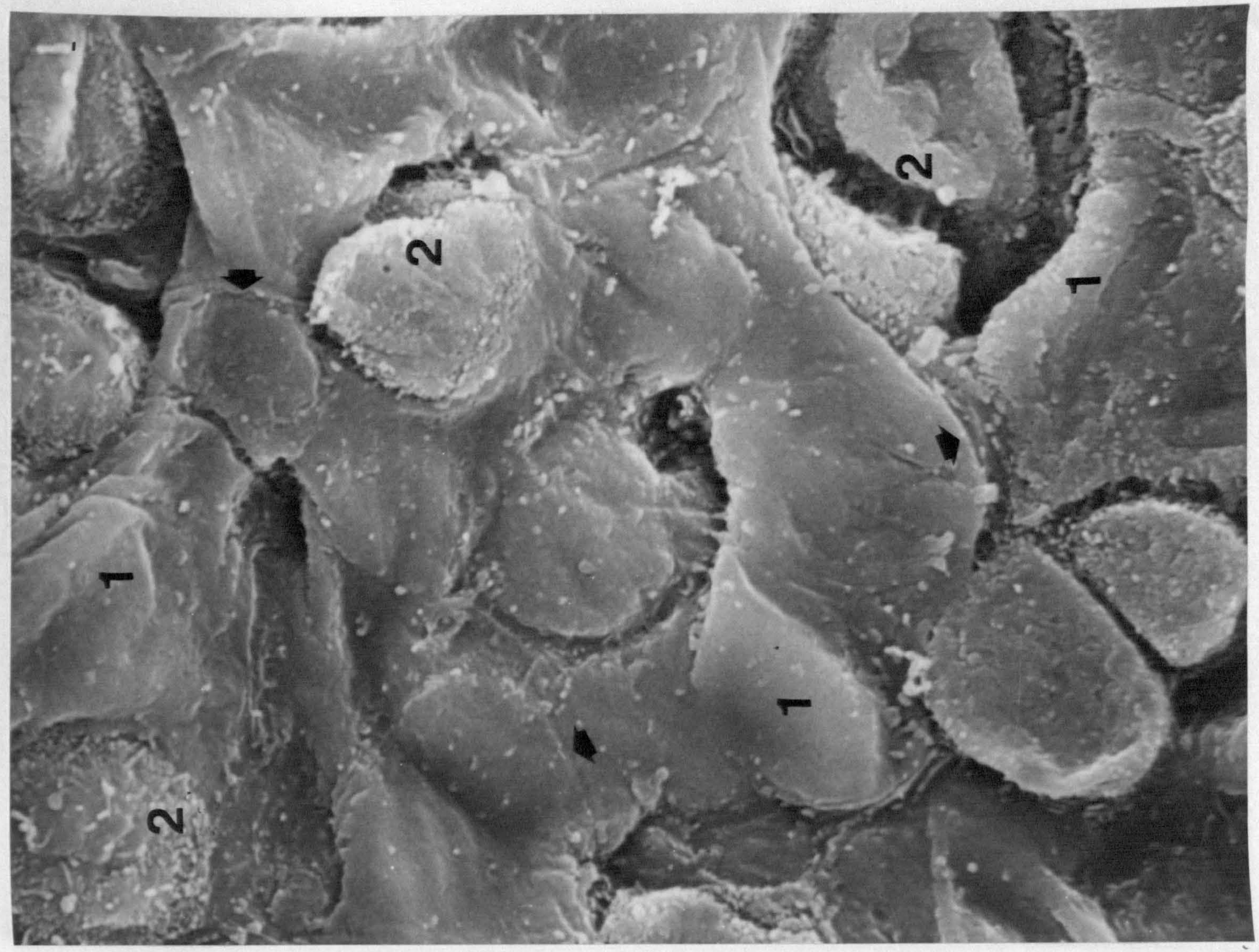


Fig. 3.92 Lung, alveolar duct. This photomicrograph shows numerous Type II pneumonocytes (2). The cell boundaries of adjacent Type I pneumonocytes (1) can be clearly distinguished (arrows).
SEM x 7,500.


2
2
1
1
1
2

CHAPTER 4

Fig. 4.1 Diagram of the canine larynx to show the areas sampled for histological examination.

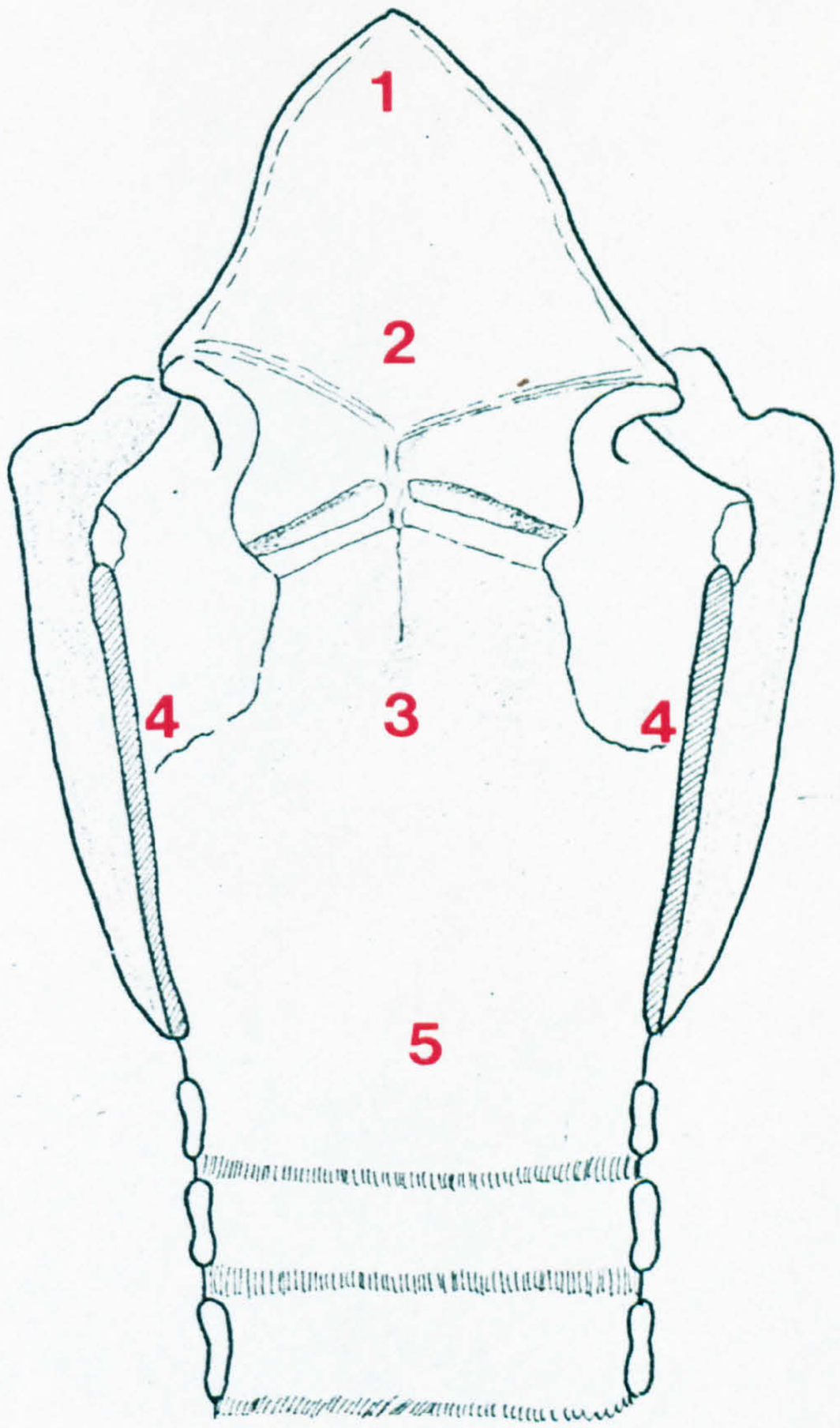

1
2
4
3
4
5

Fig. 4.2 Canine larynx, stained with Alcian blue. Respiratory mucosa (blue stained regions) is confined to the caudal region of the larynx.

Fig. 4.3 Canine larynx, stained with Alcian blue and phloxine B. Again, respiratory epithelium is confined mainly to the caudal larynx.



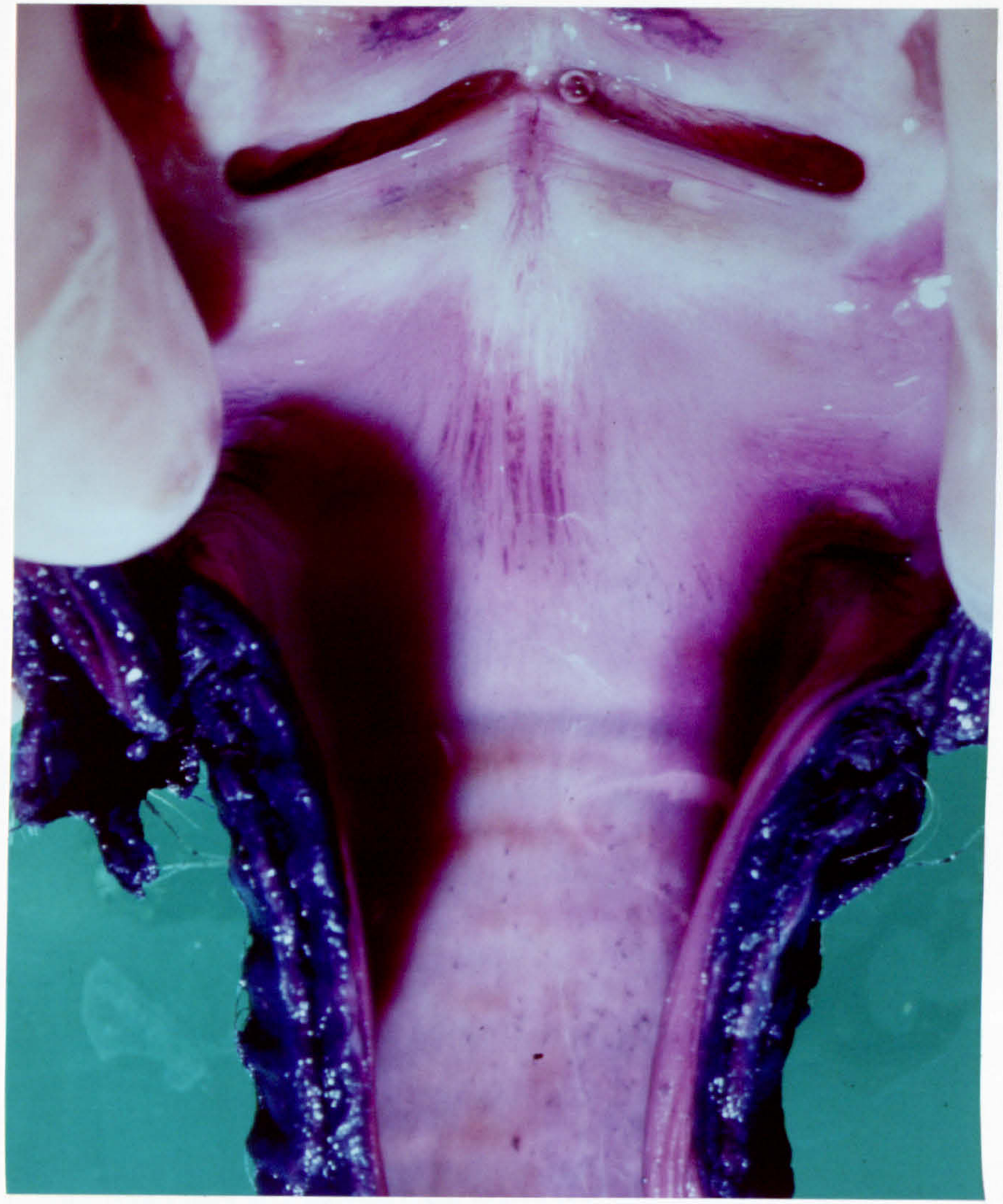
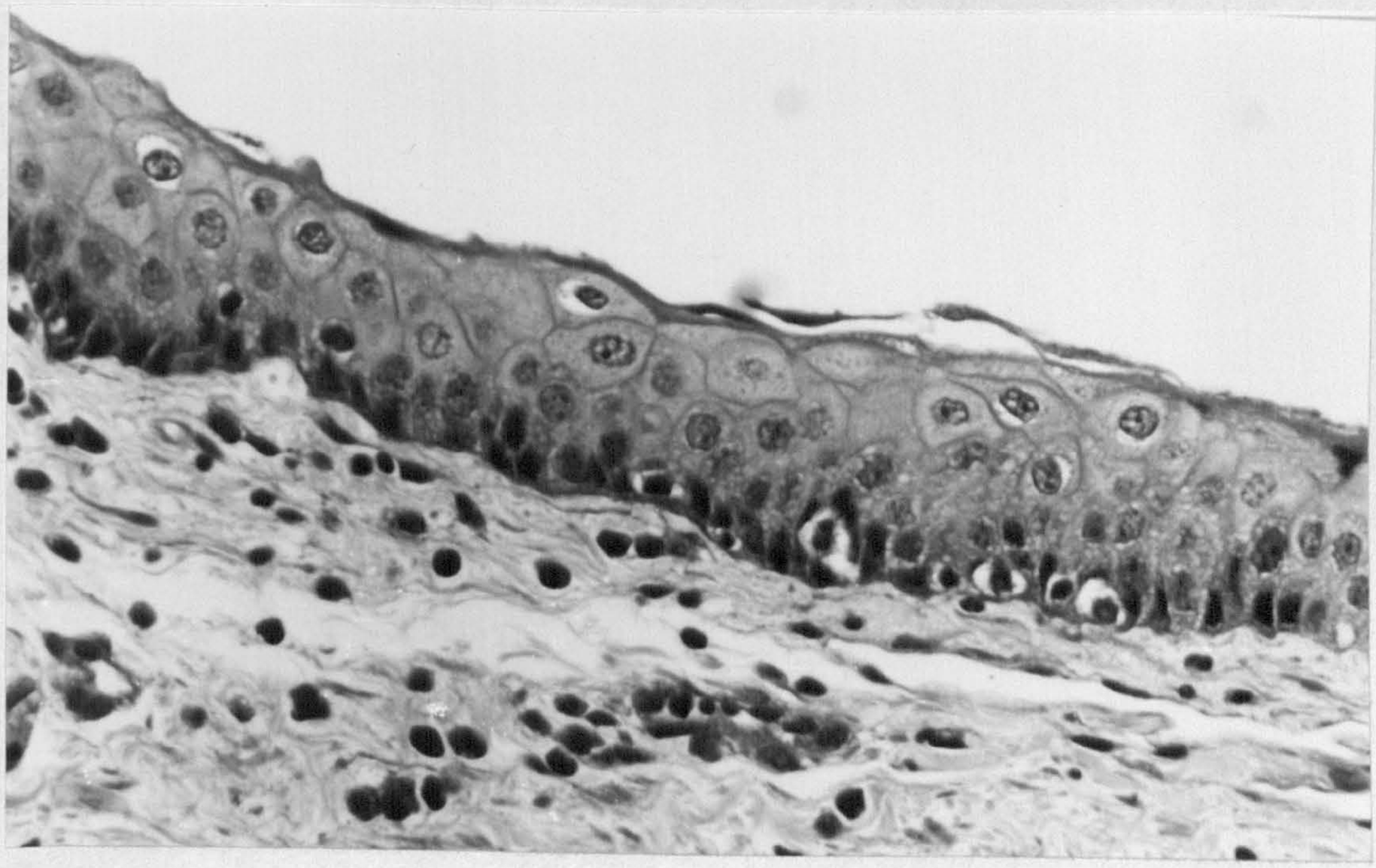
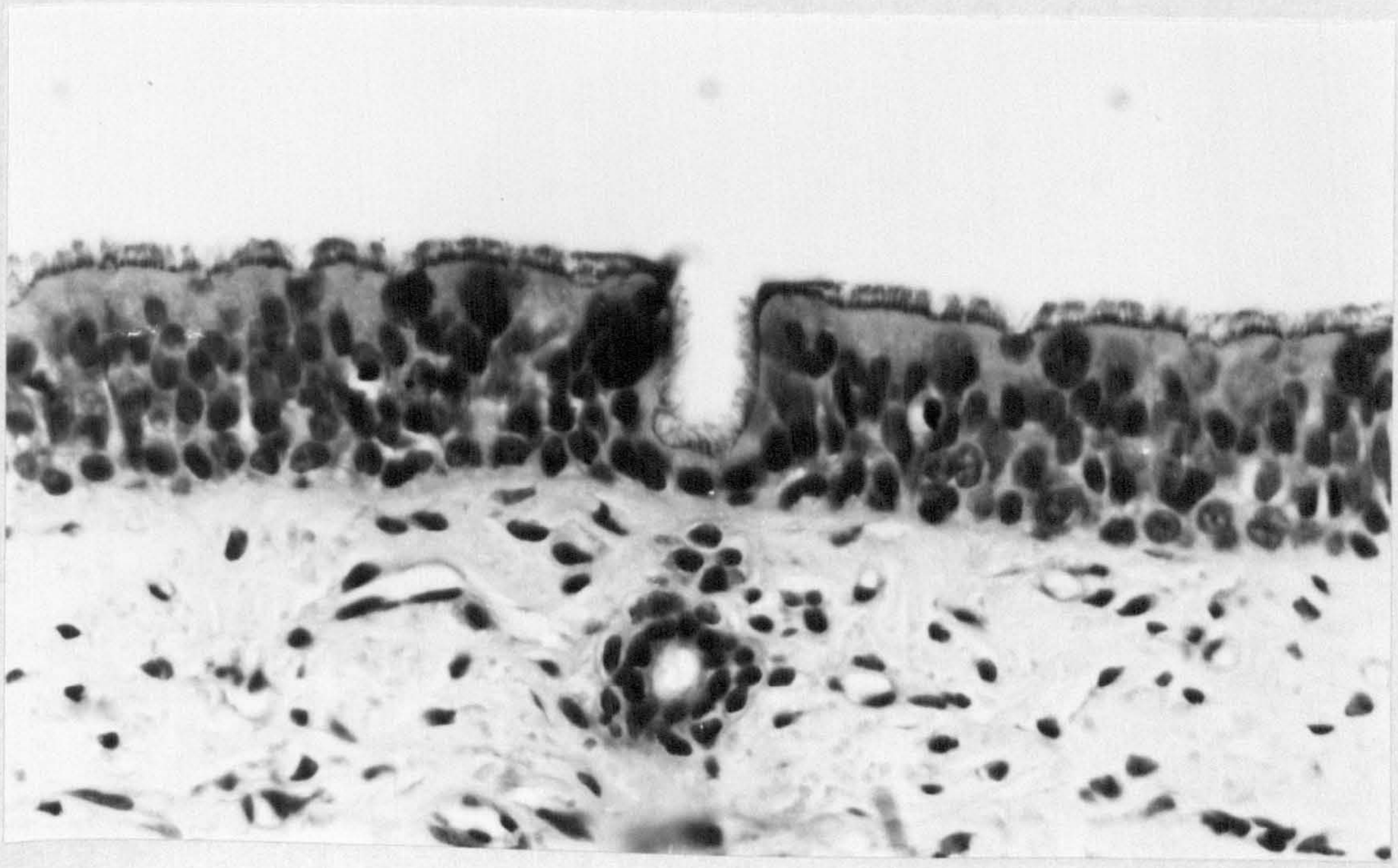


Fig. 4.4 Canine larynx. In this specimen, the epithelium is of the stratified squamous non-keratinising type. HE x 400.

Fig. 4.5 Canine larynx. Note the pseudostratified columnar ciliated epithelium with goblet cells. AB-PAS x 300.

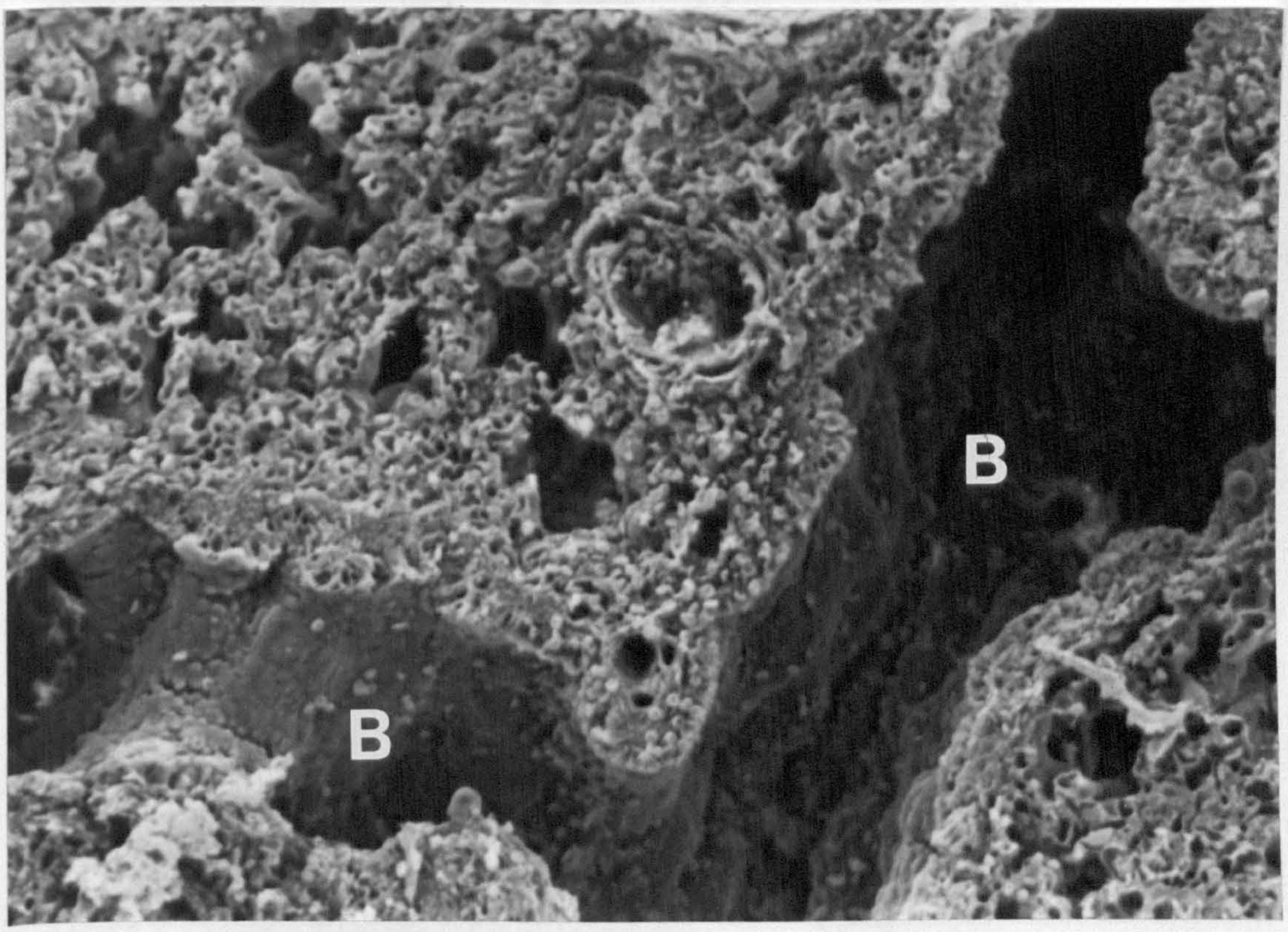




CHAPTER 5

Fig. 5.1 Lung. The alveoli are poorly inflated. Note the bronchiole (B). SEM x 320.

Fig. 5.2 Lung. Note the distension of the pulmonary vessels (V). A small bronchus (B) can also be seen. SEM x 320.


B
B

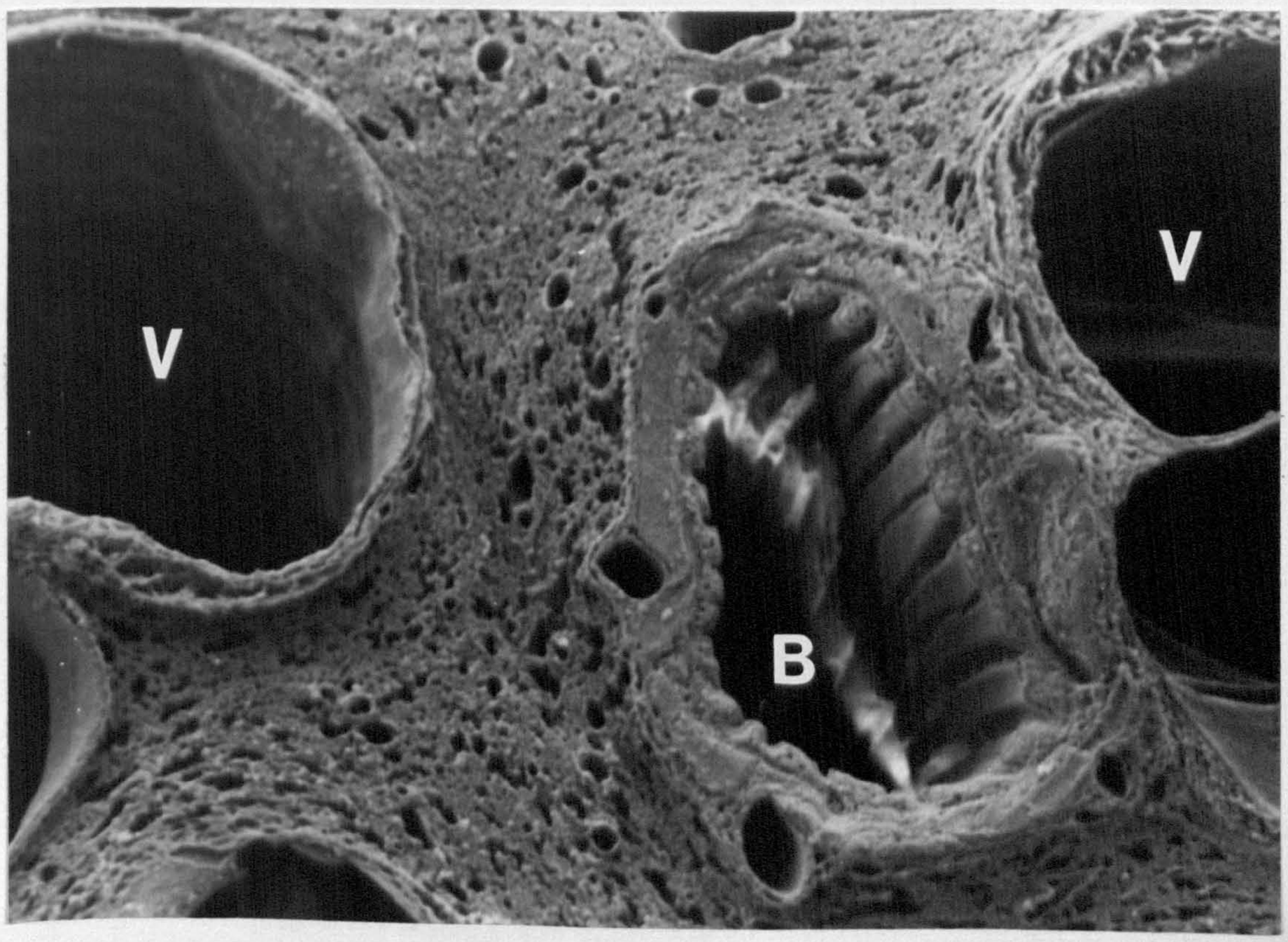
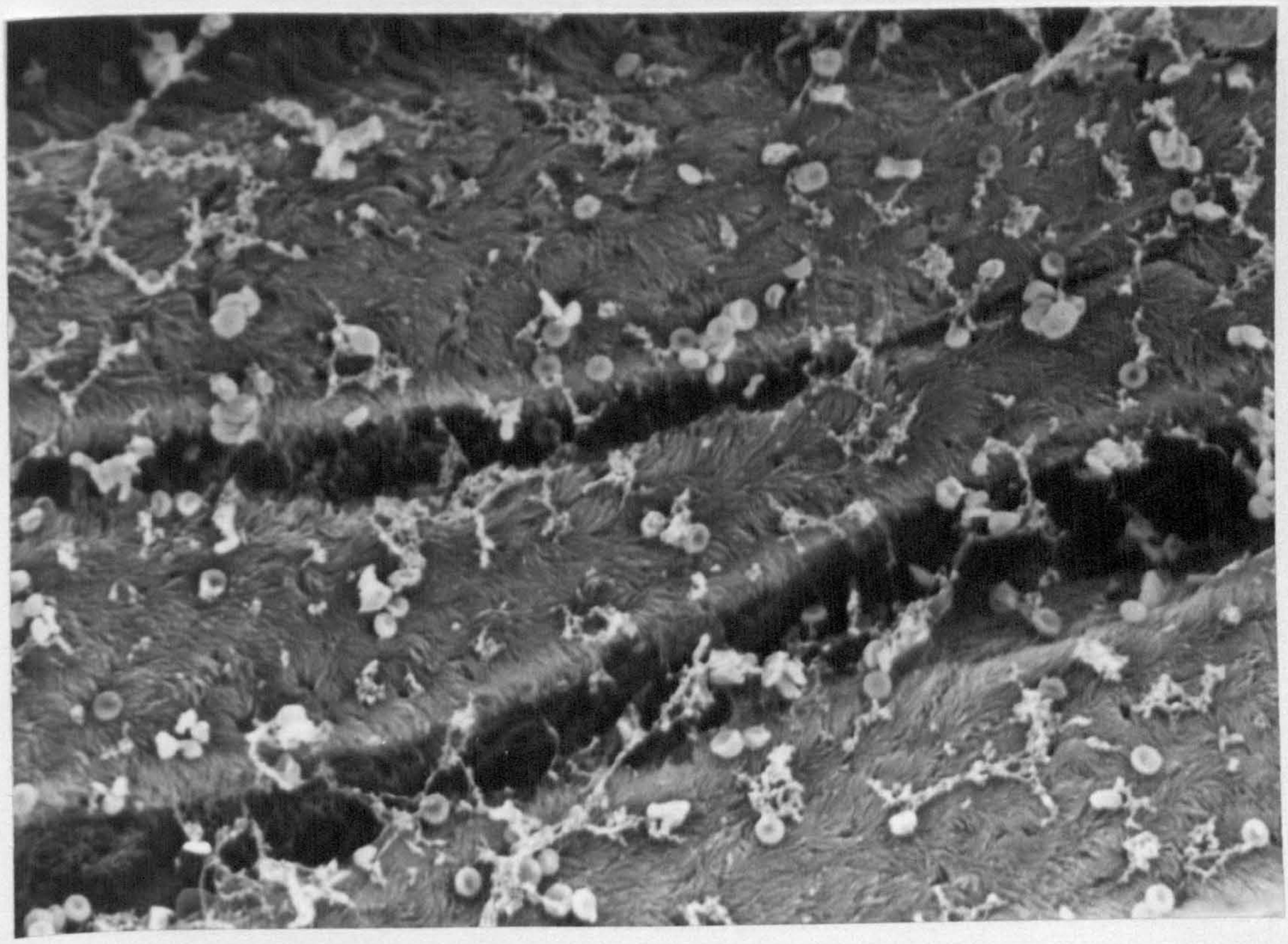

V
V
B

Fig. 5.3 Small bronchus. Note the surface debris and red blood cells. SEM x 640.

Fig. 5.4 Small bronchus. A fractured portion of respiratory epithelium, showing ciliated (C) and goblet (G) cells. SEM x 5,000.



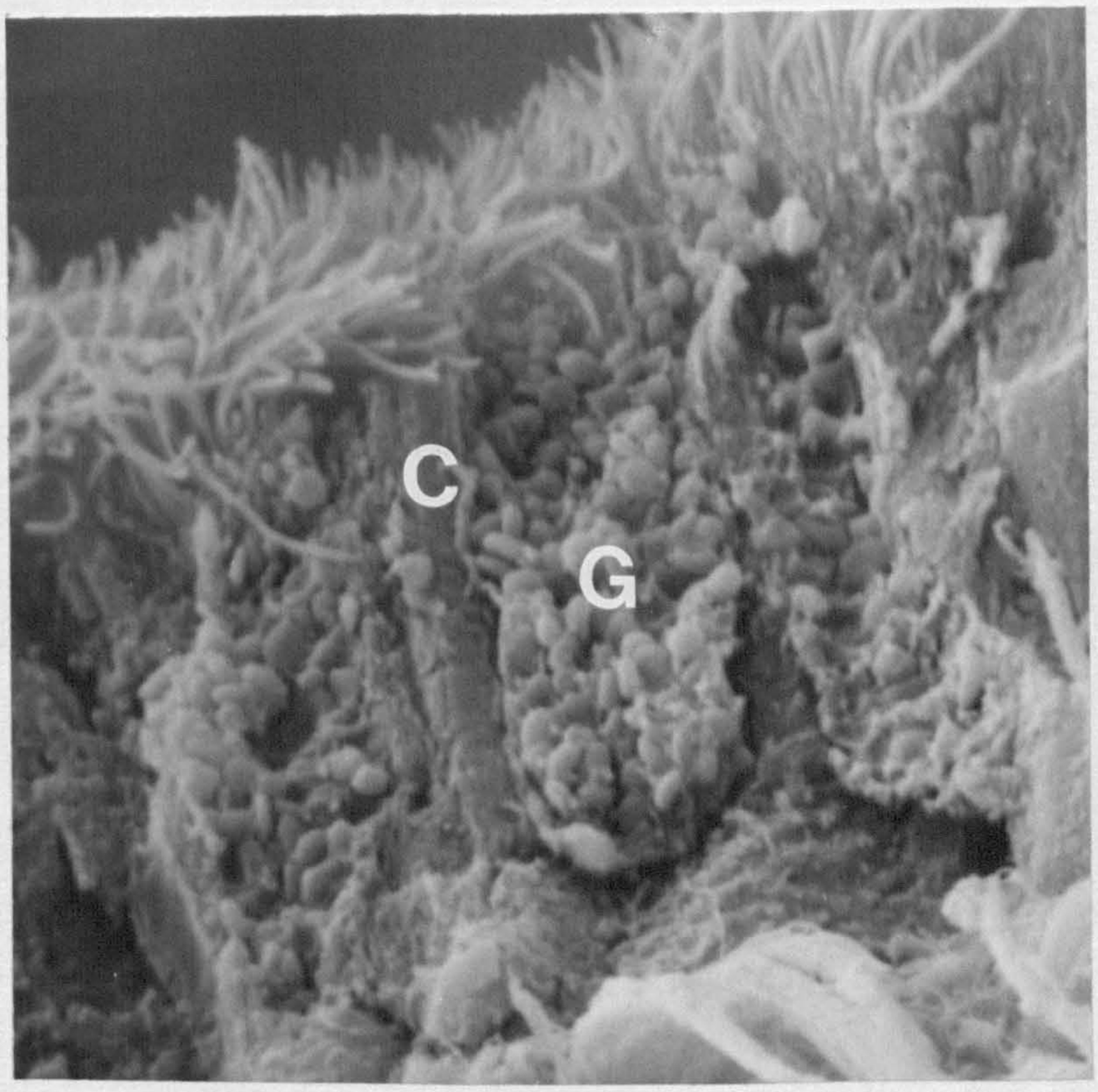
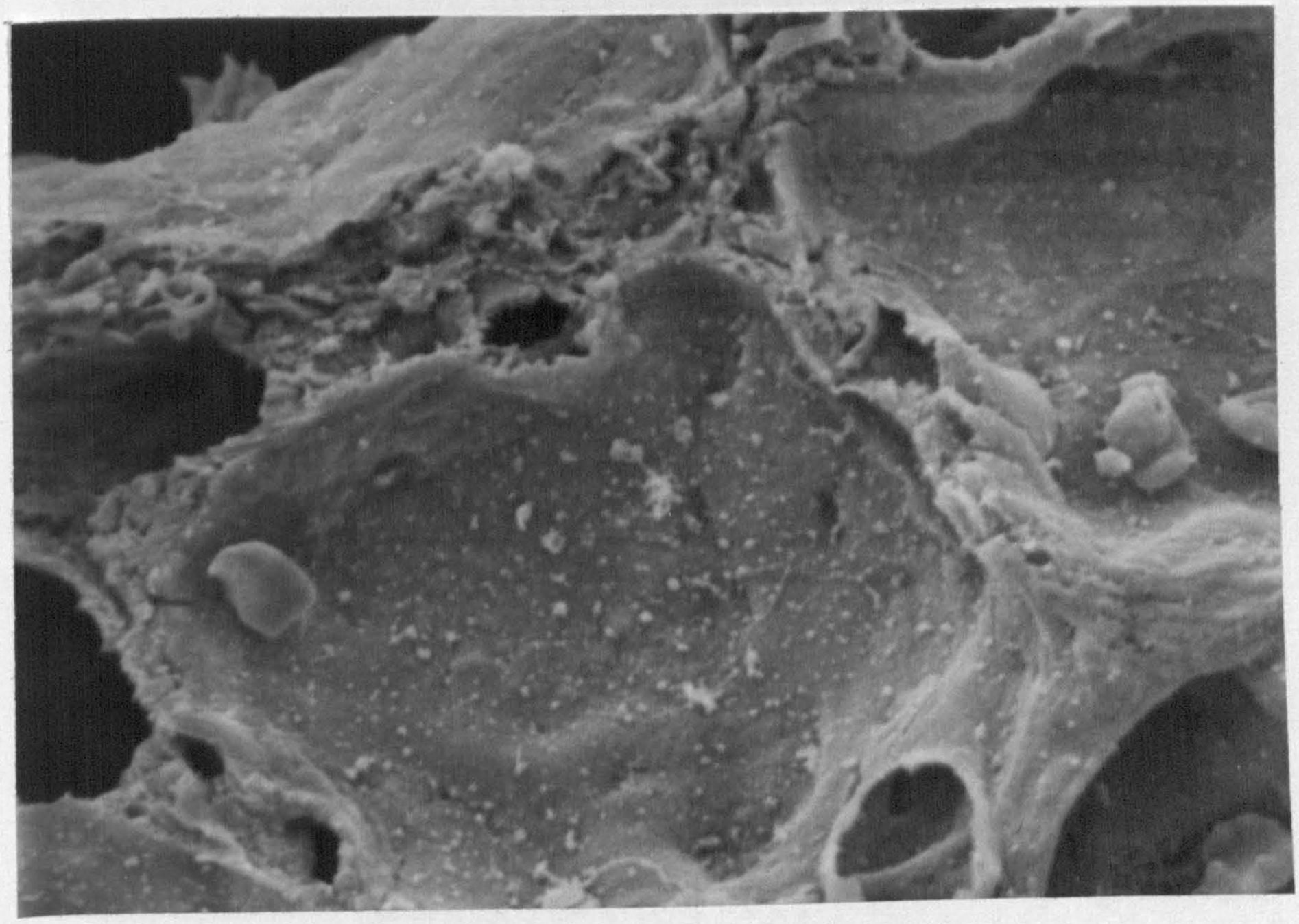

C
G

Fig. 5.5 Lung. Note the debris scattered over the alveolar surface.
SEM x 2,500.

Fig. 5.6 Lung, alveolar wall. Type II pneumonocytes (2) are difficult to distinguish from Type I pneumonocytes (1).
SEM x 5,000.



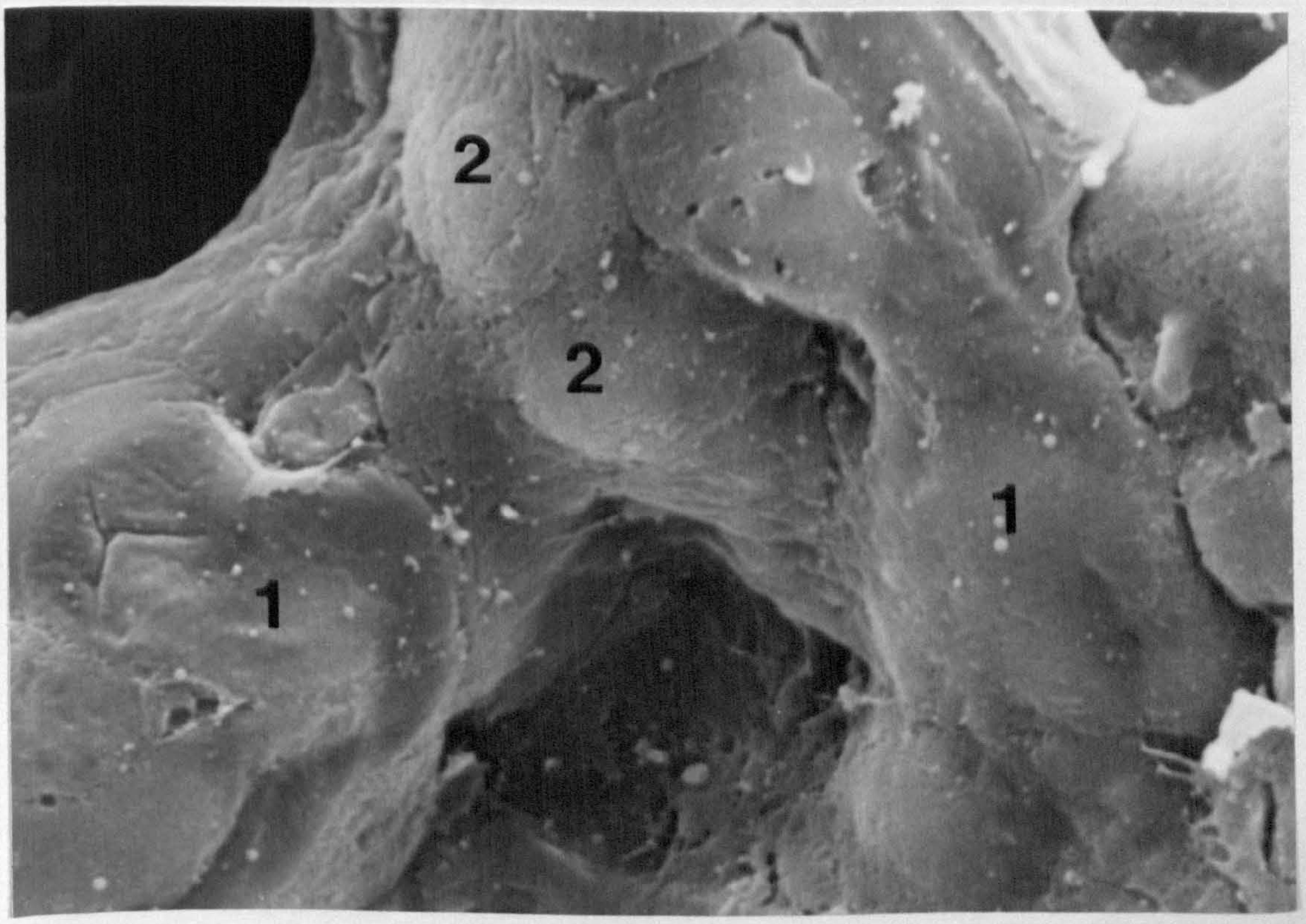

2
2
1
1

Fig. 5.7 Lung. Three pores of Kohn (*) can be seen. SEM x 5,000.

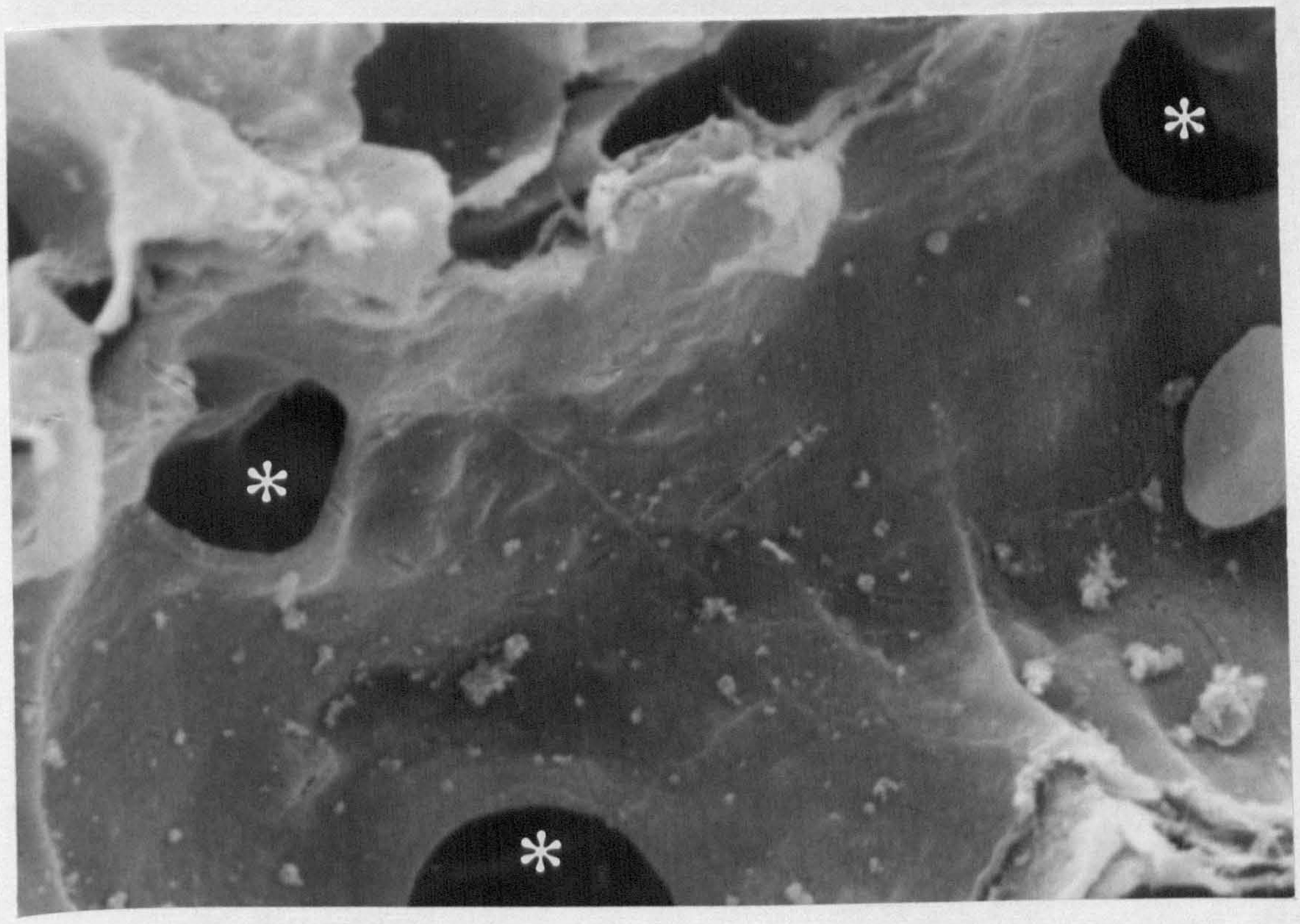
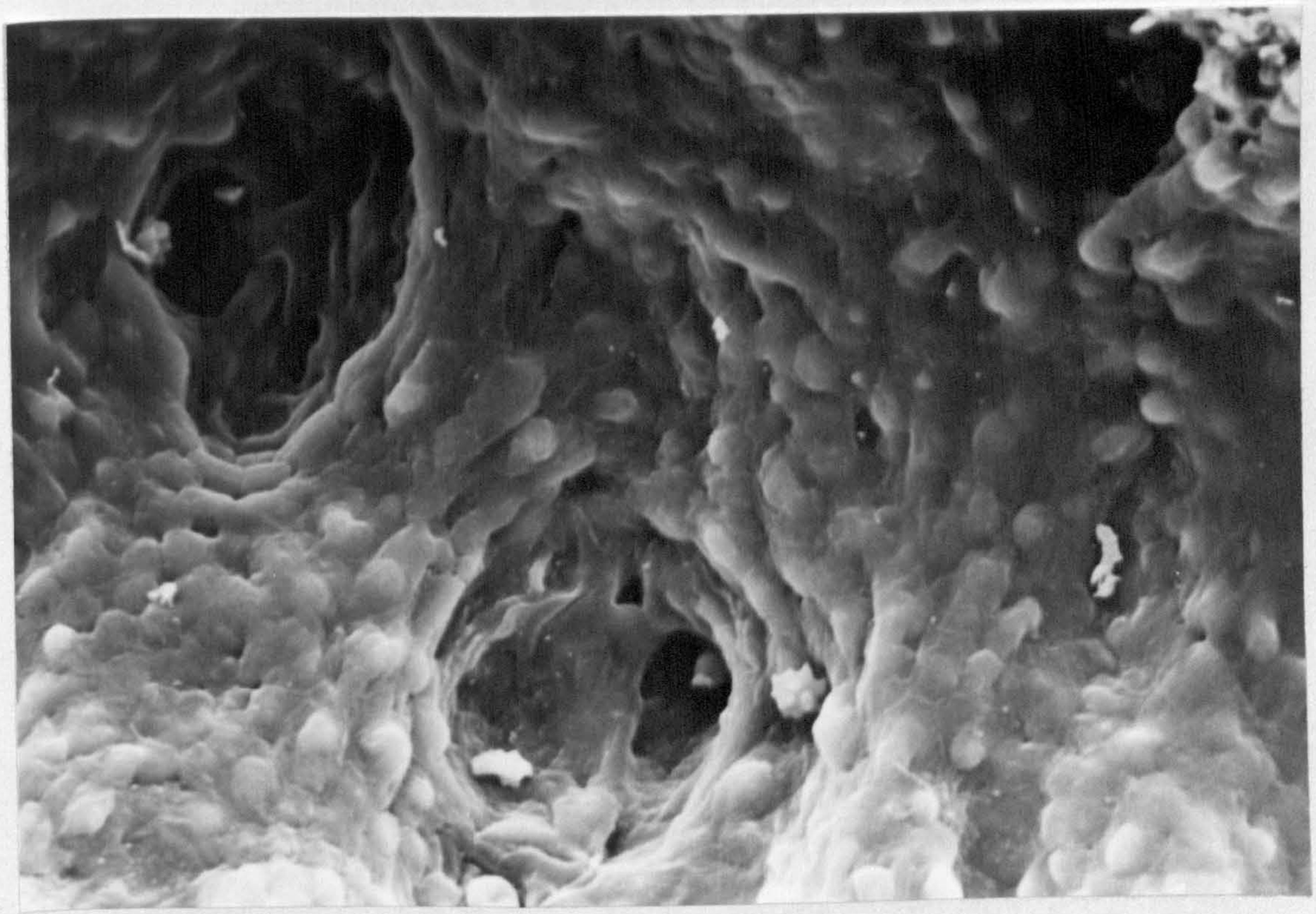


Fig. 5.8 Respiratory bronchiole. Note the smooth surface of the Clara cells.
SEM x 1280.

Fig. 5.9 Respiratory bronchiole. Note the surface debris and the indistinct outline of the Clara cells.
SEM x 5,000.



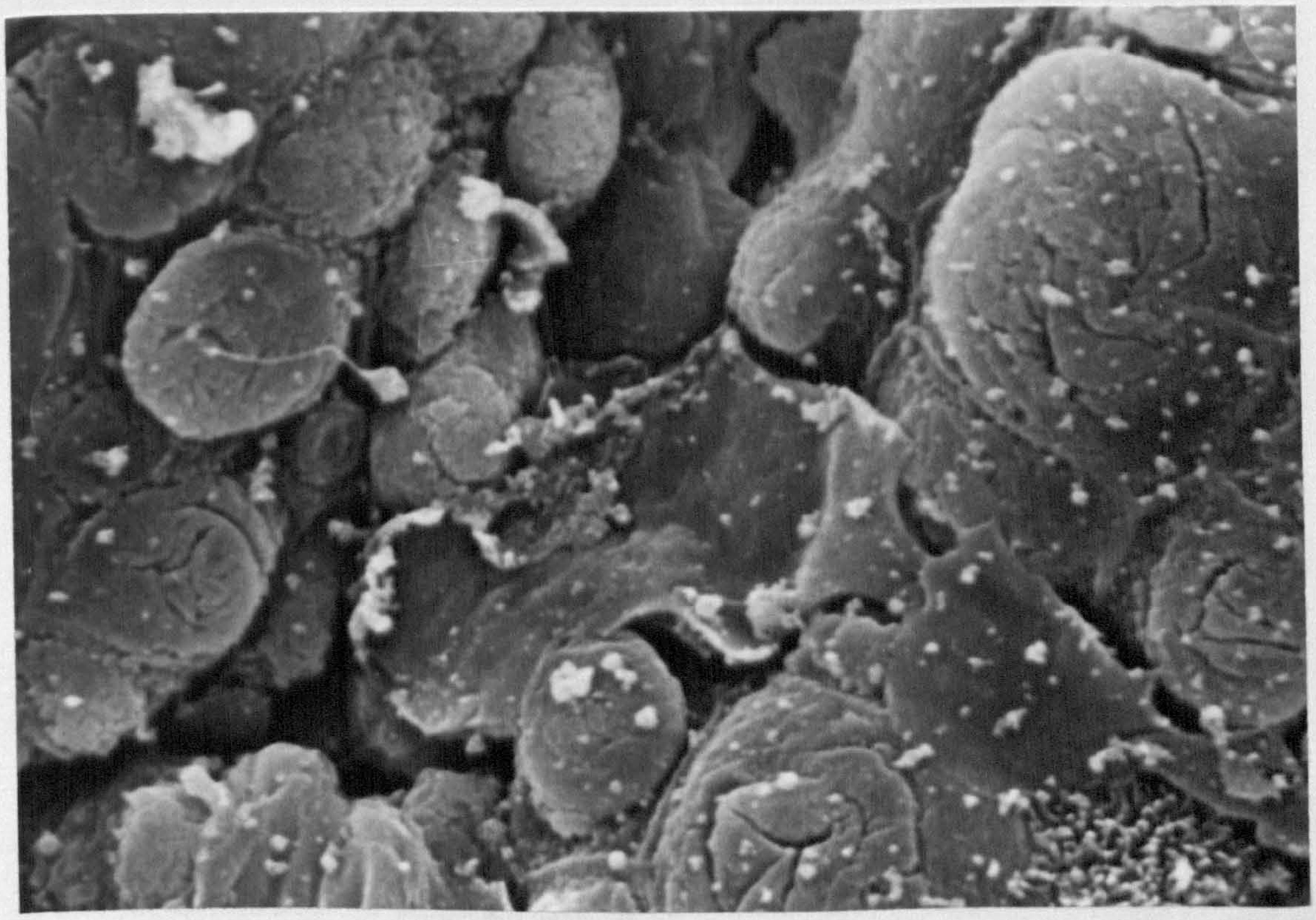


Fig. 5.10 Large bronchiole. This surface epithelial cell is ciliated and also shows many microvilli.
TEM x 7,500.

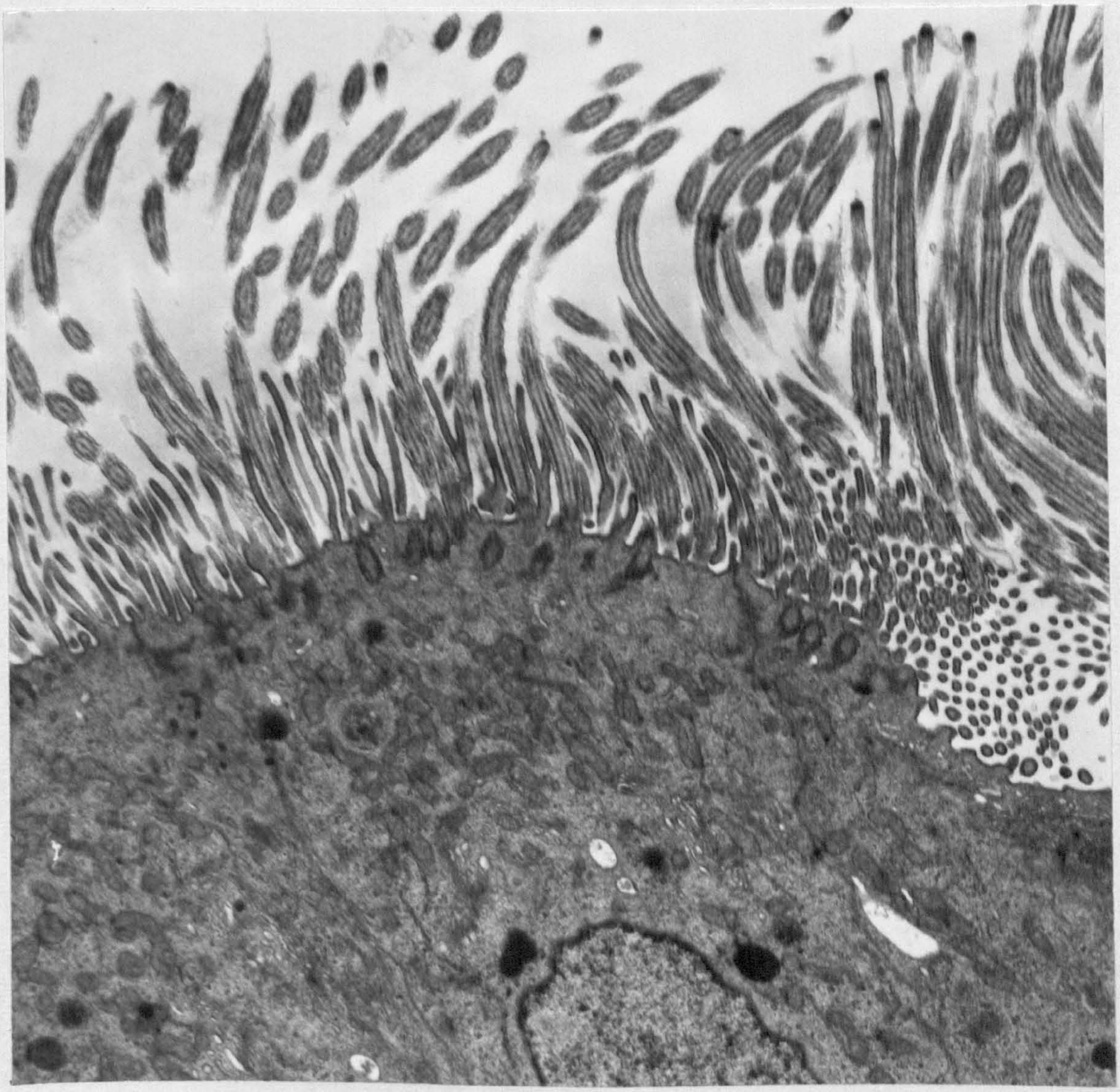


Fig. 5.11 Large bronchiole. A basal cell (B) is sandwiched between two ciliated cells (1,2).
TEM x 7,500

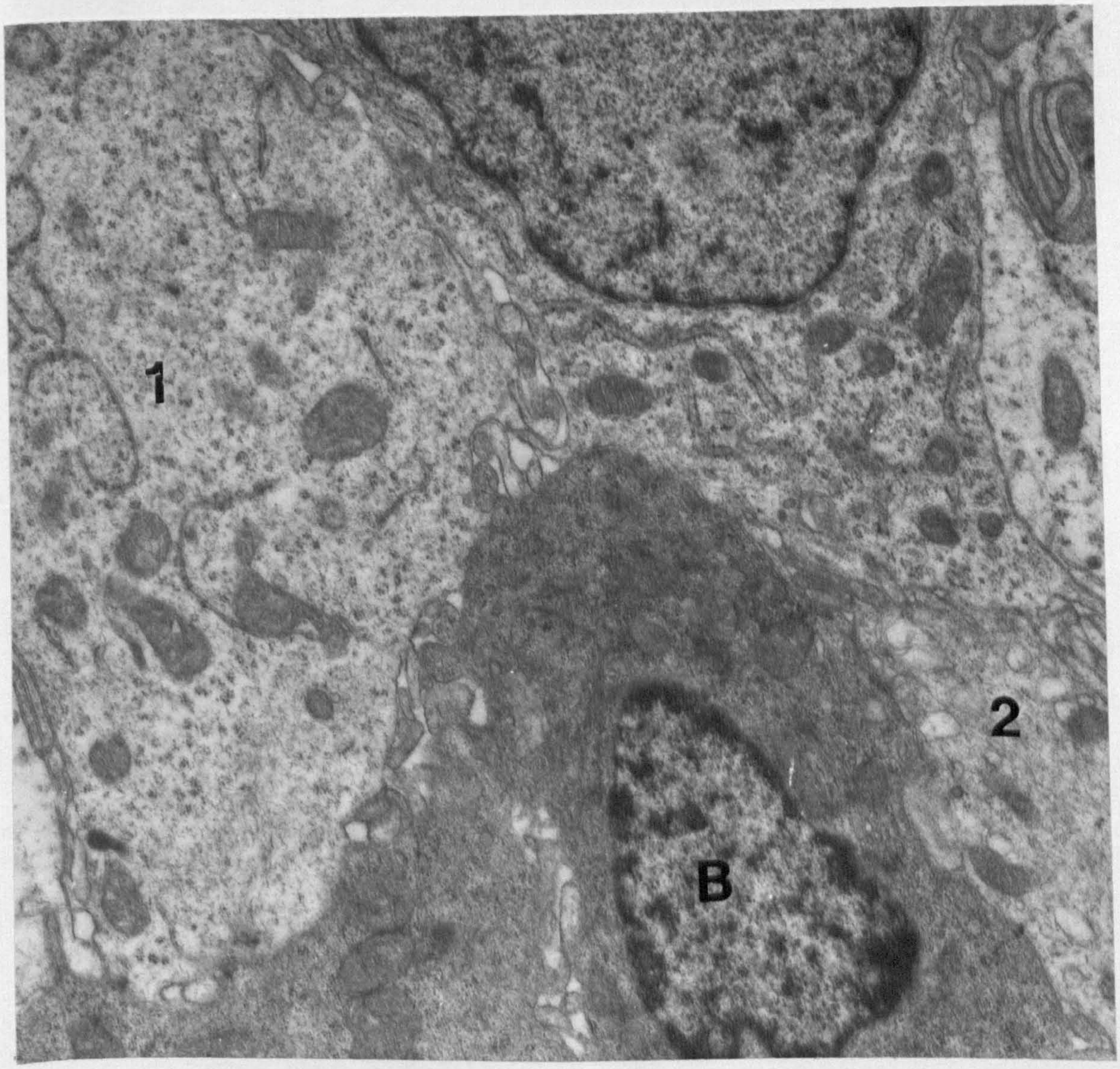

1
2
B

Fig. 5.12 Large bronchiole. The apical portion of a goblet cell (arrow) protrudes between the cilia of adjacent ciliated cells.
TEM x 7,500.



Fig. 5.13 Large bronchiole. An electron dense cell (arrows) with apical granules is sandwiched between adjacent ciliated cells.
TEM x 7,500.

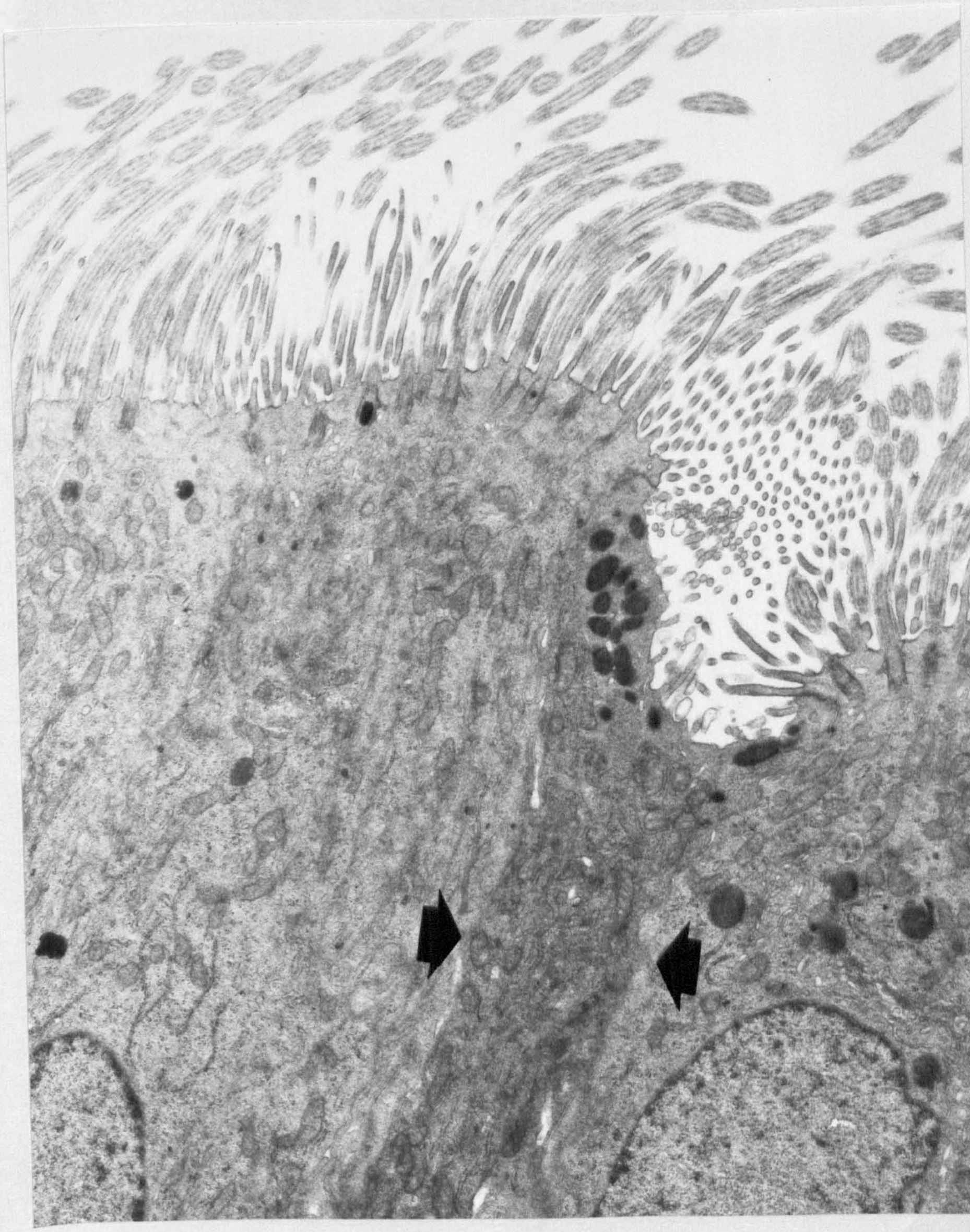


Fig. 5.14 Small bronchiole. In this photomicrograph, a sparsely ciliated cell (1) is contiguous with a Clara cell (2).
TEM x 7,500.

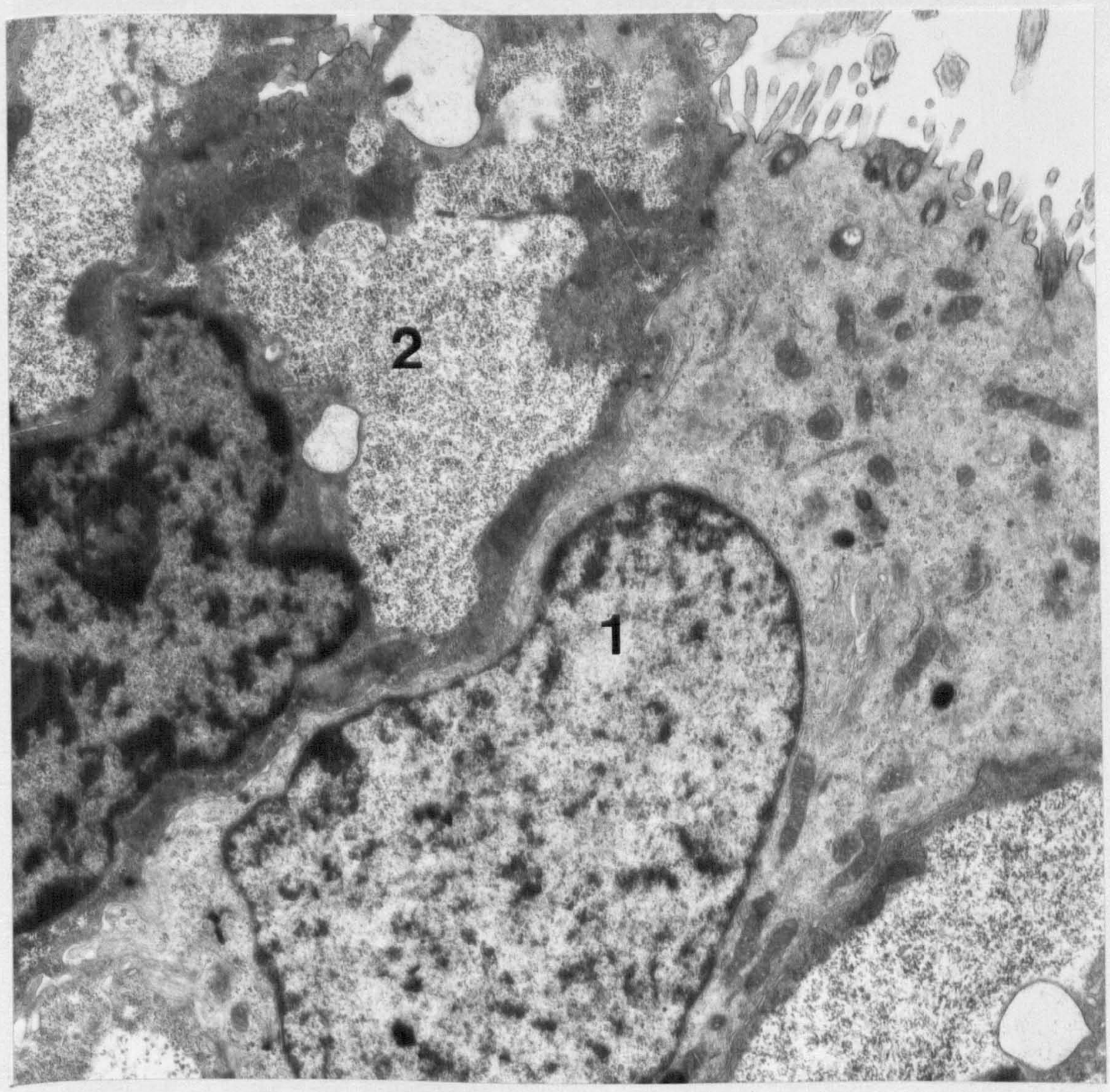

2
1

Fig. 5.15 Small bronchiole. Two Clara cells (1) bulge over a sparsely ciliated cell (2). The latter cell, in this plane of section, shows no cilia (only basal bodies) but numerous microvilli.
TEM x 7,500.

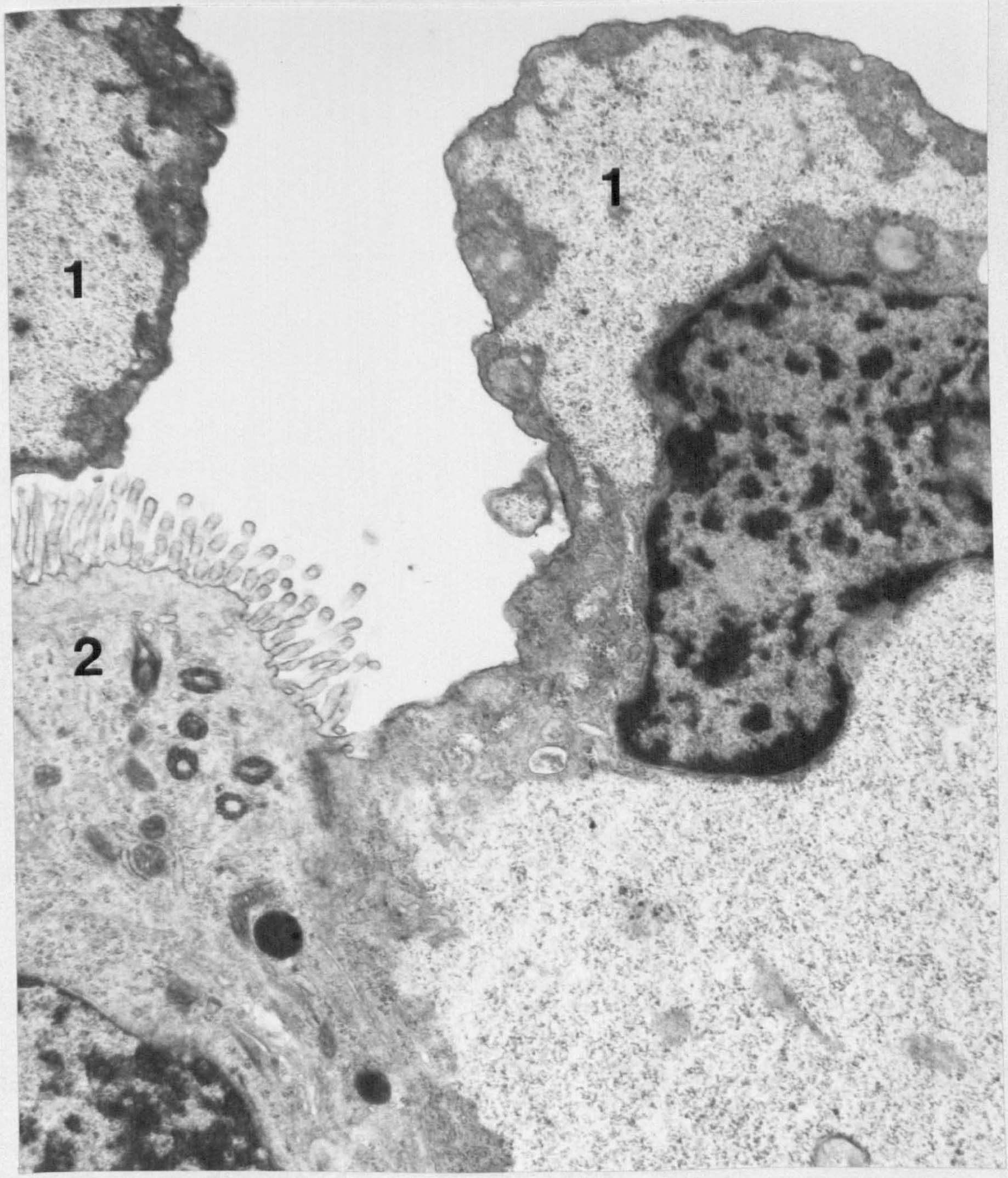

1
1
2

Fig. 5.16 Terminal bronchiole. Note the bulging apical portions of three Clara cells. Most of the cytoplasm is occupied by glycogen deposits (G). TEM x 7,500.

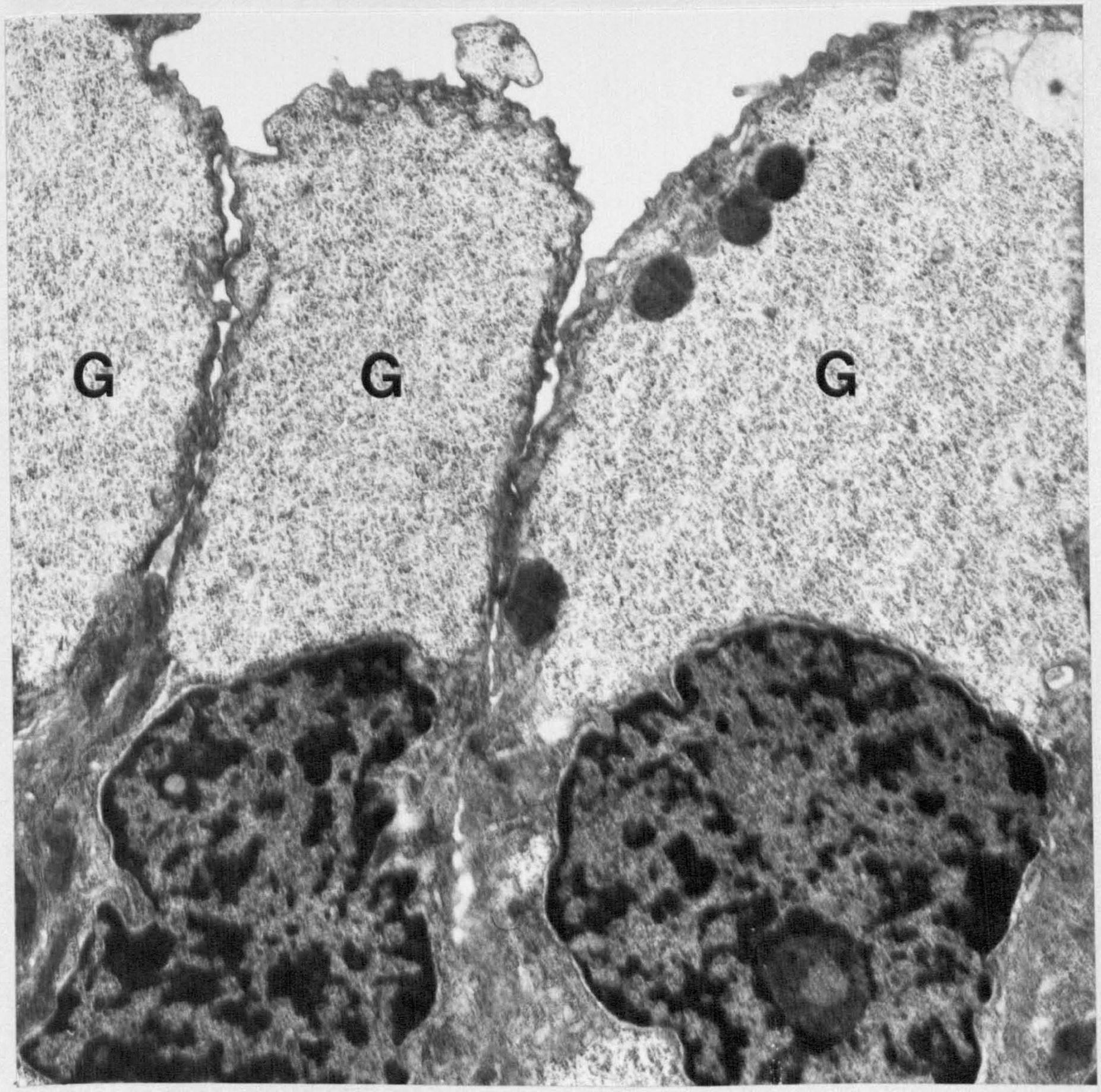

G
G
G

Fig. 5.17 Terminal bronchiole. In these Clara cells, the nuclei are located towards the apex of the cell. Note how the cytoplasmic organelles are distributed around the nucleus and immediately below the cell membrane.
TEM x 7,500.

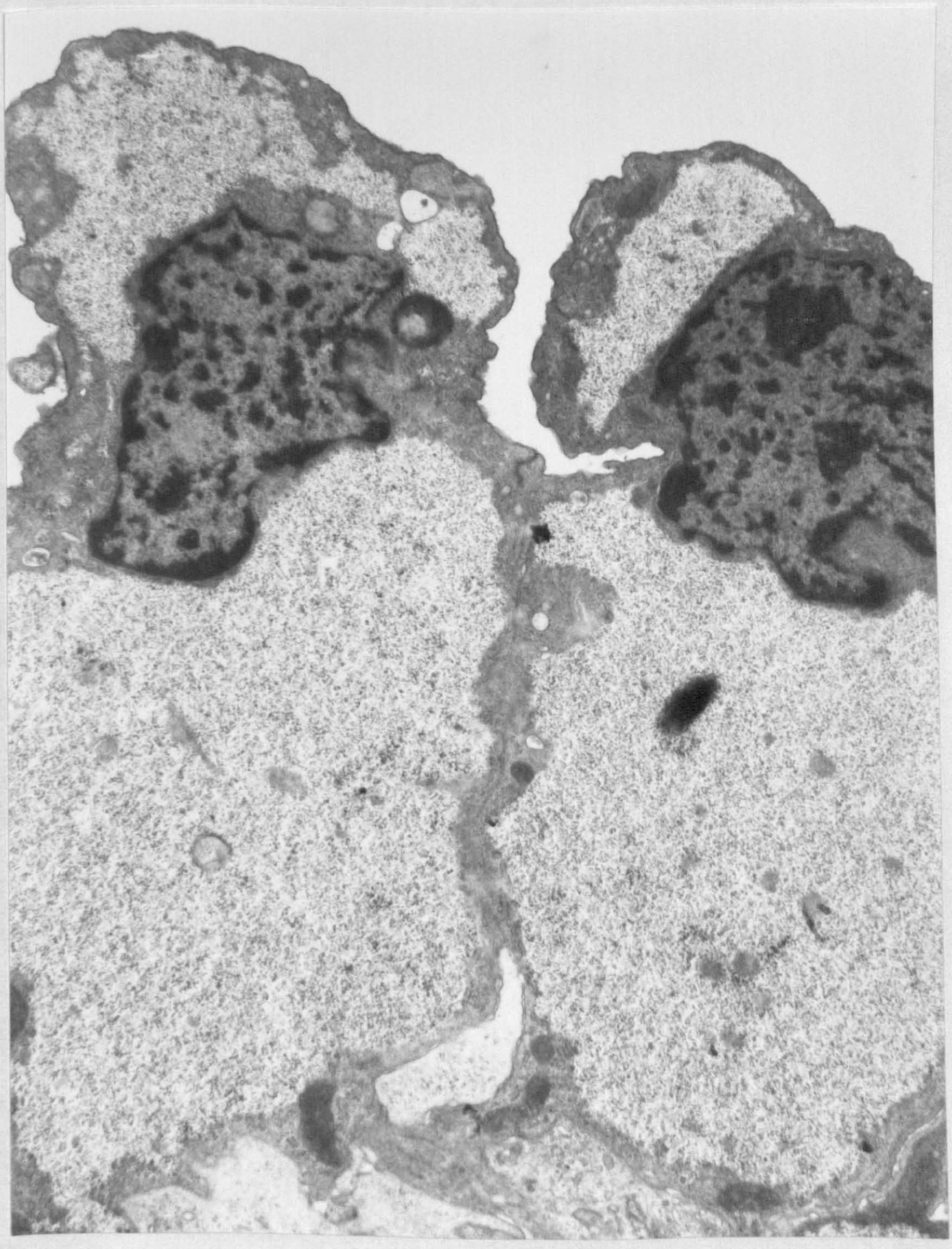


Fig. 5.18 Junction of a respiratory bronchiole with an alveolar duct. A Clara cell (1) is contiguous with a Type II pneumonocyte (2).
TEM x 7,500.

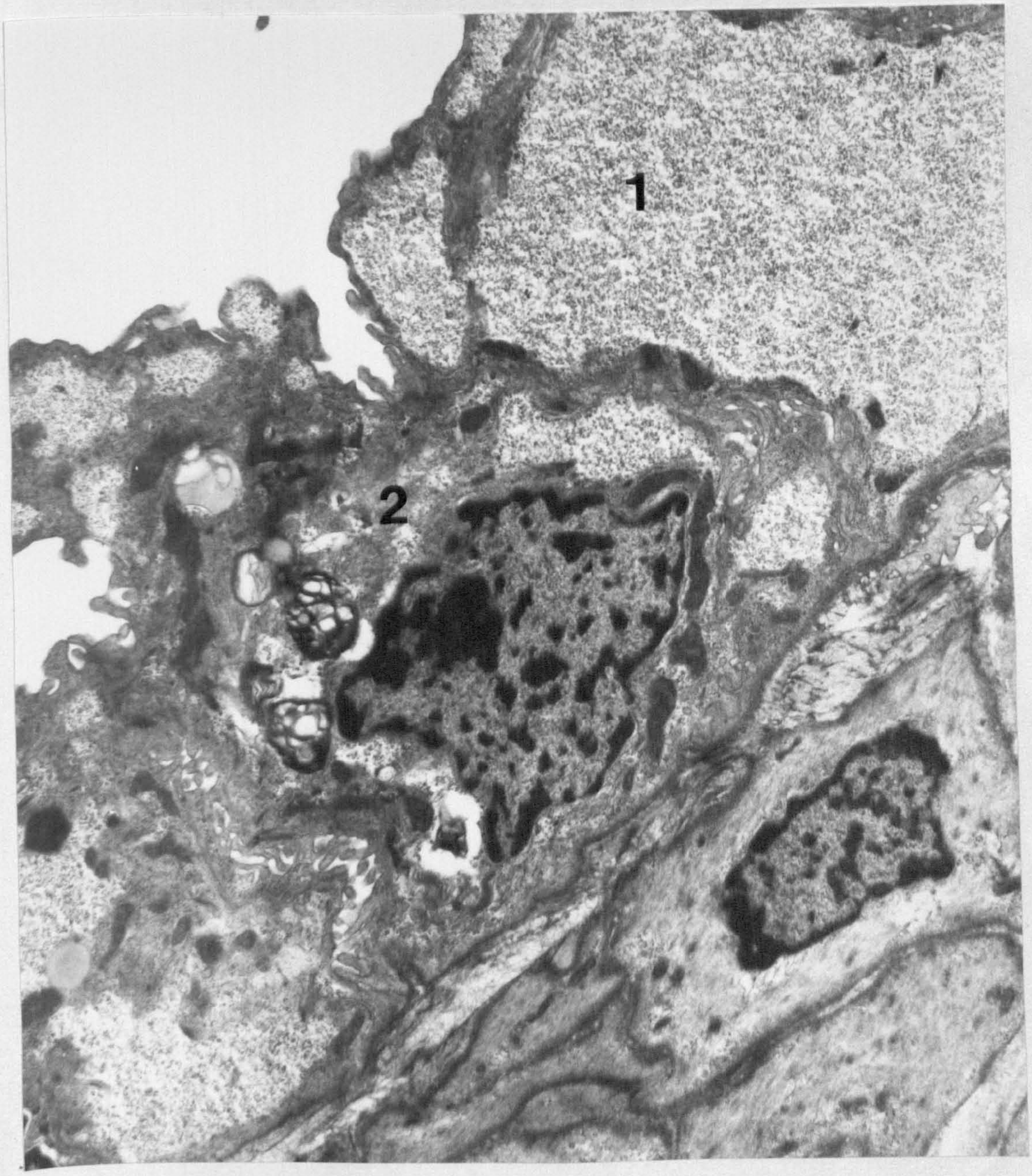
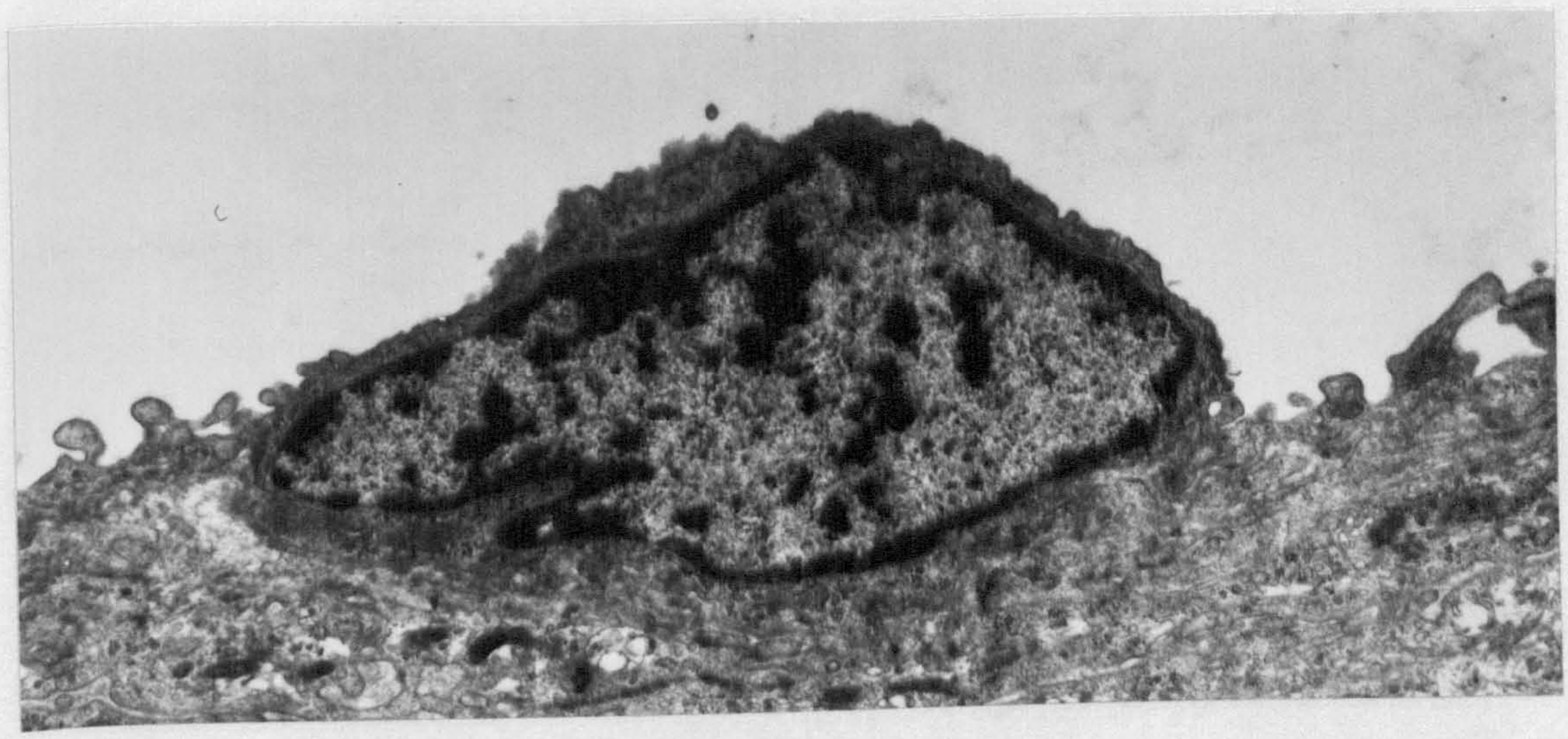

1
2

Fig. 5.19 Type I pneumonocyte. Part of the alveolar membrane showing the cell body.
TEM x 7,500.

Fig. 5.20 Alveolar septum, showing the thin attenuated cytoplasm of the Type I pneumonocyte (arrows). Note the underlying capillary endothelial cell.
TEM x 7,500.



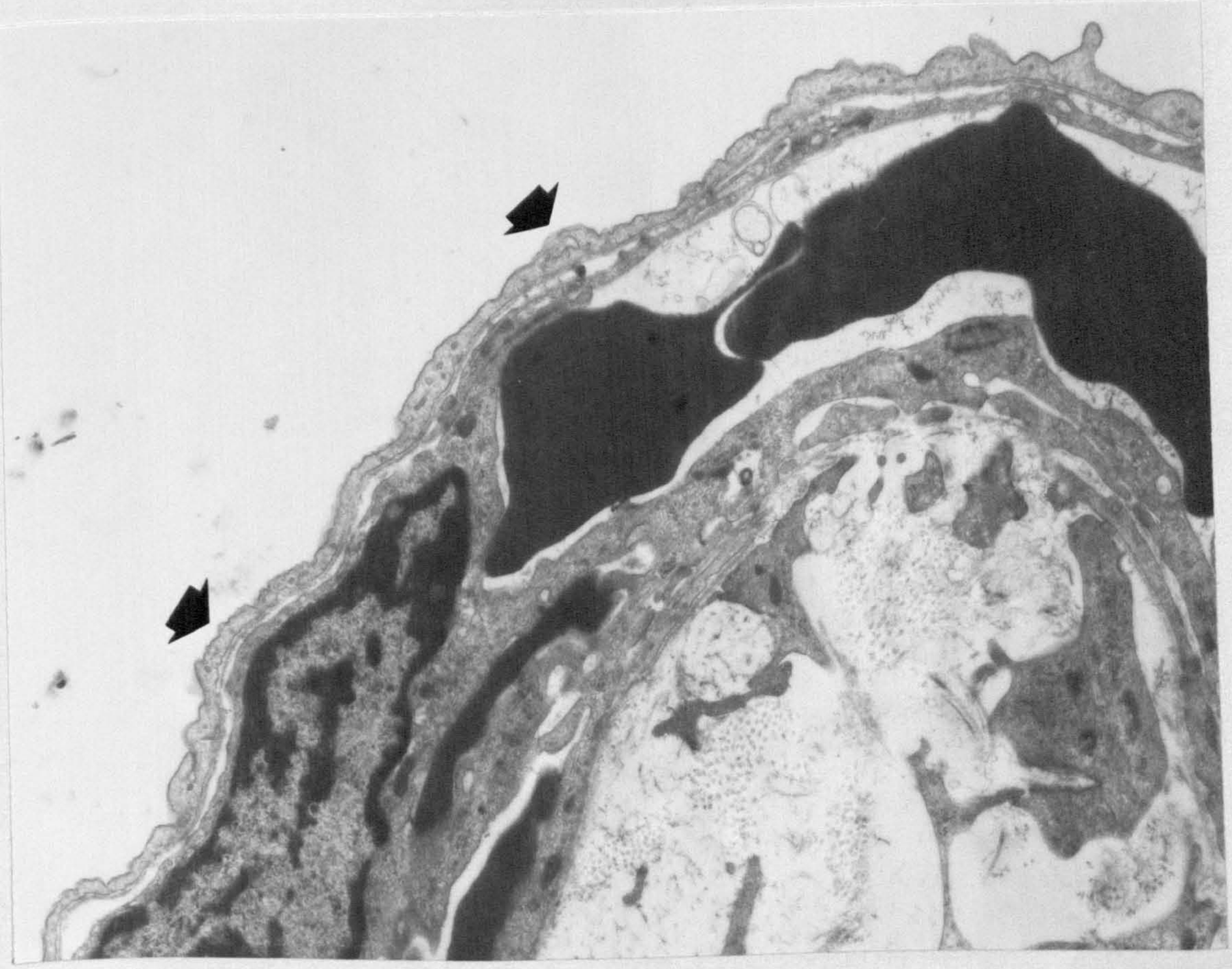


Fig. 5.21 Type II pneumonocyte. Note the electron dense lamellar inclusion bodies.
TEM x 7,500.

Fig. 5.22 In this photomicrograph, an alveolar macrophage (arrow) is seen in close contact with a Type I pneumonocyte. TEM x 7,500.

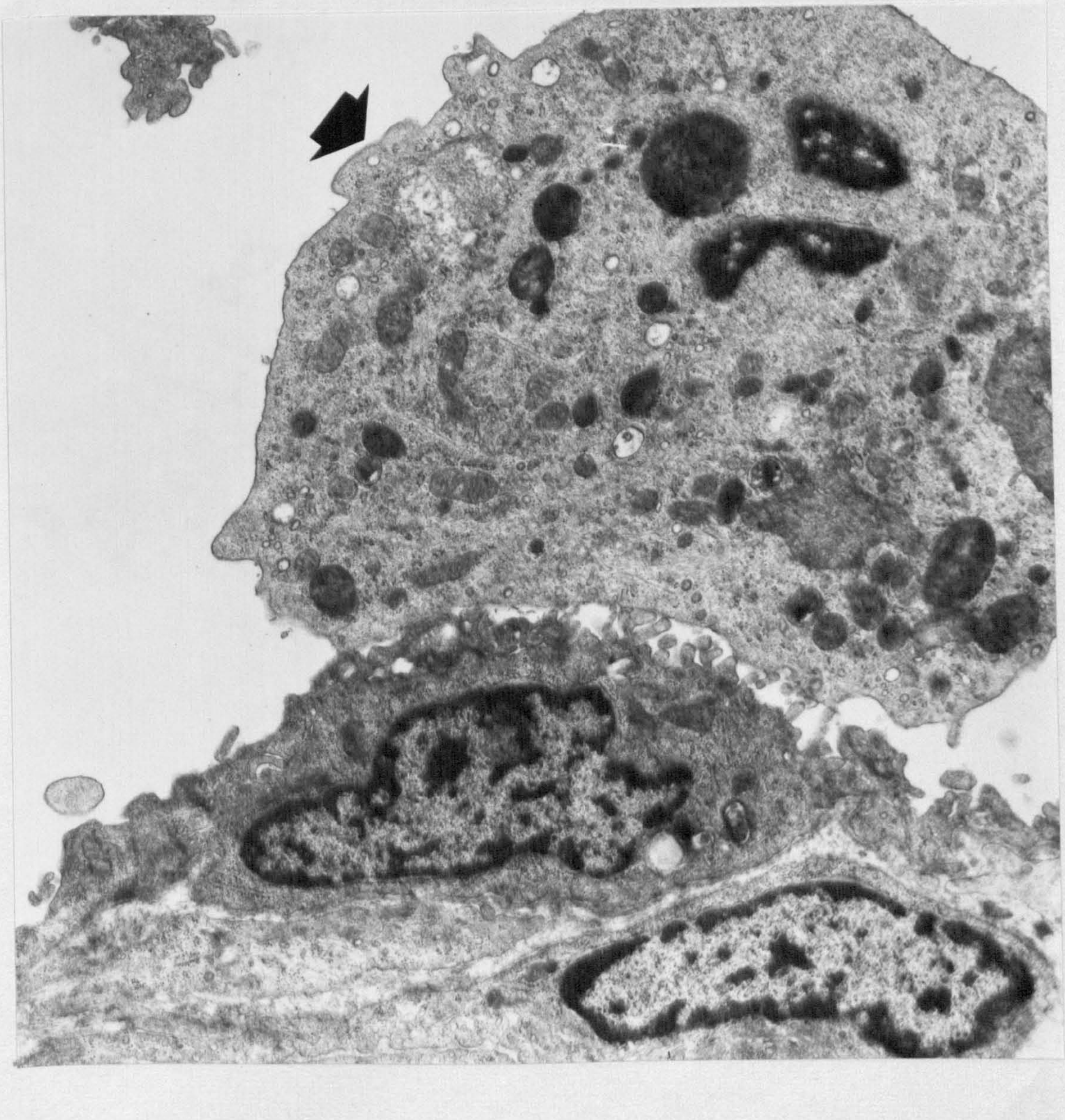
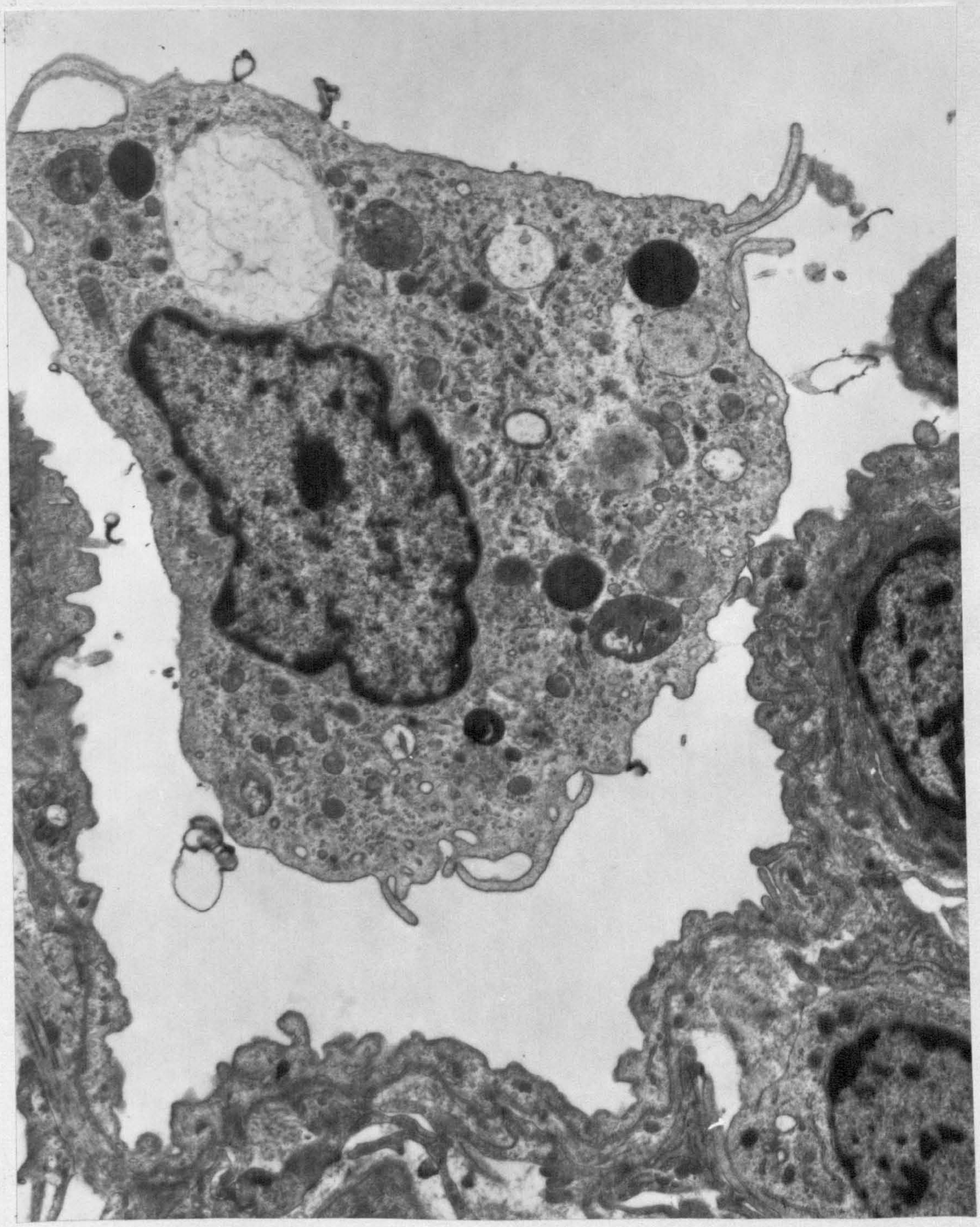


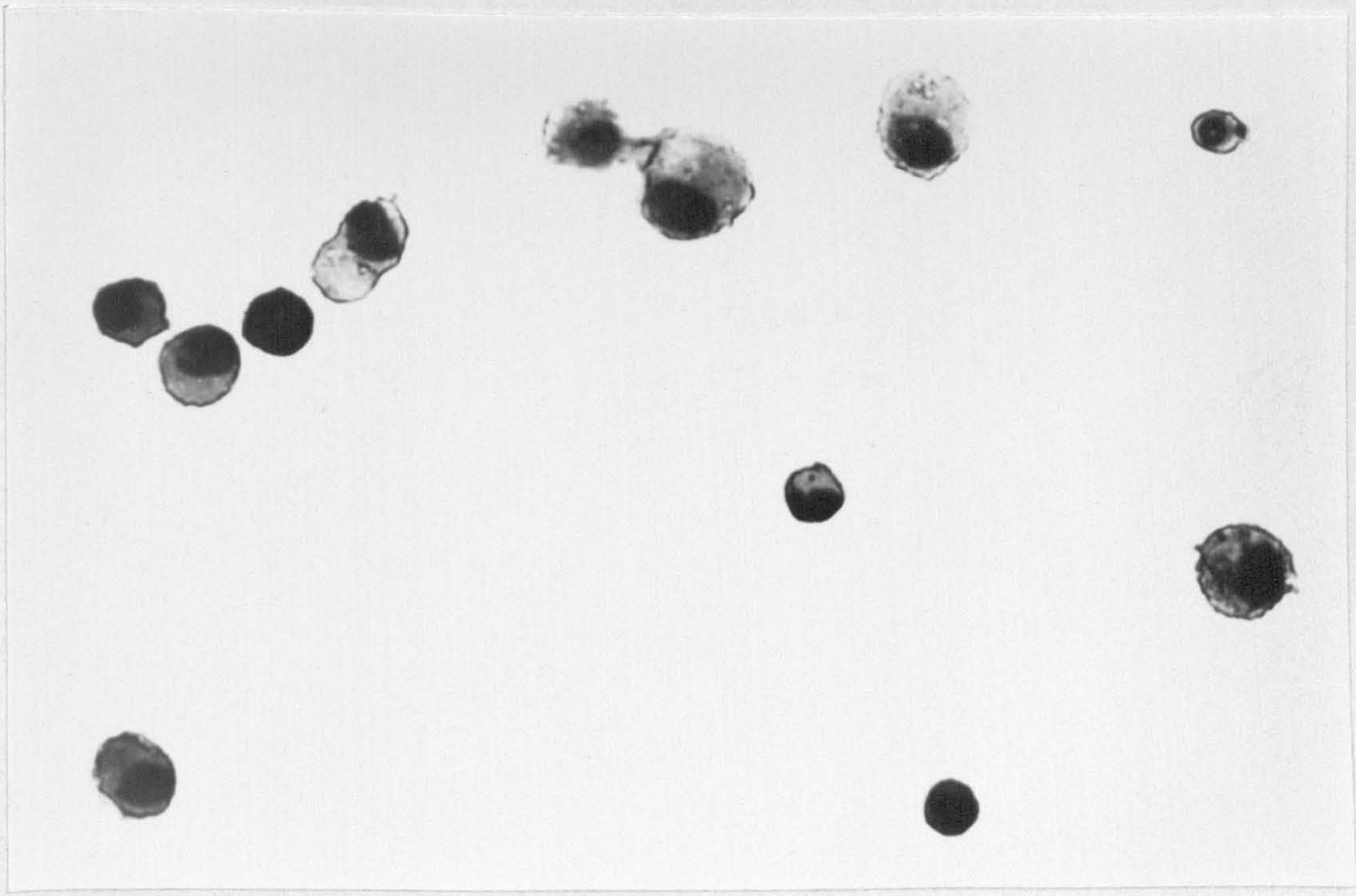
Fig. 5.23 An alveolar macrophage is seen lying free in the alveolar cavity. TEM x 7,500.



CHAPTER 6

Fig. 6.1 Smear of lung washings, stained with the May-Grunwald-Giemsa method. Although most of the cells are macrophages, a few small lymphocytes are also present.
x 200.

Fig. 6.2 Plastic section (1 μm) stained with Toluidine blue. Note the foamy appearance of the alveolar macrophages.
x 1200.



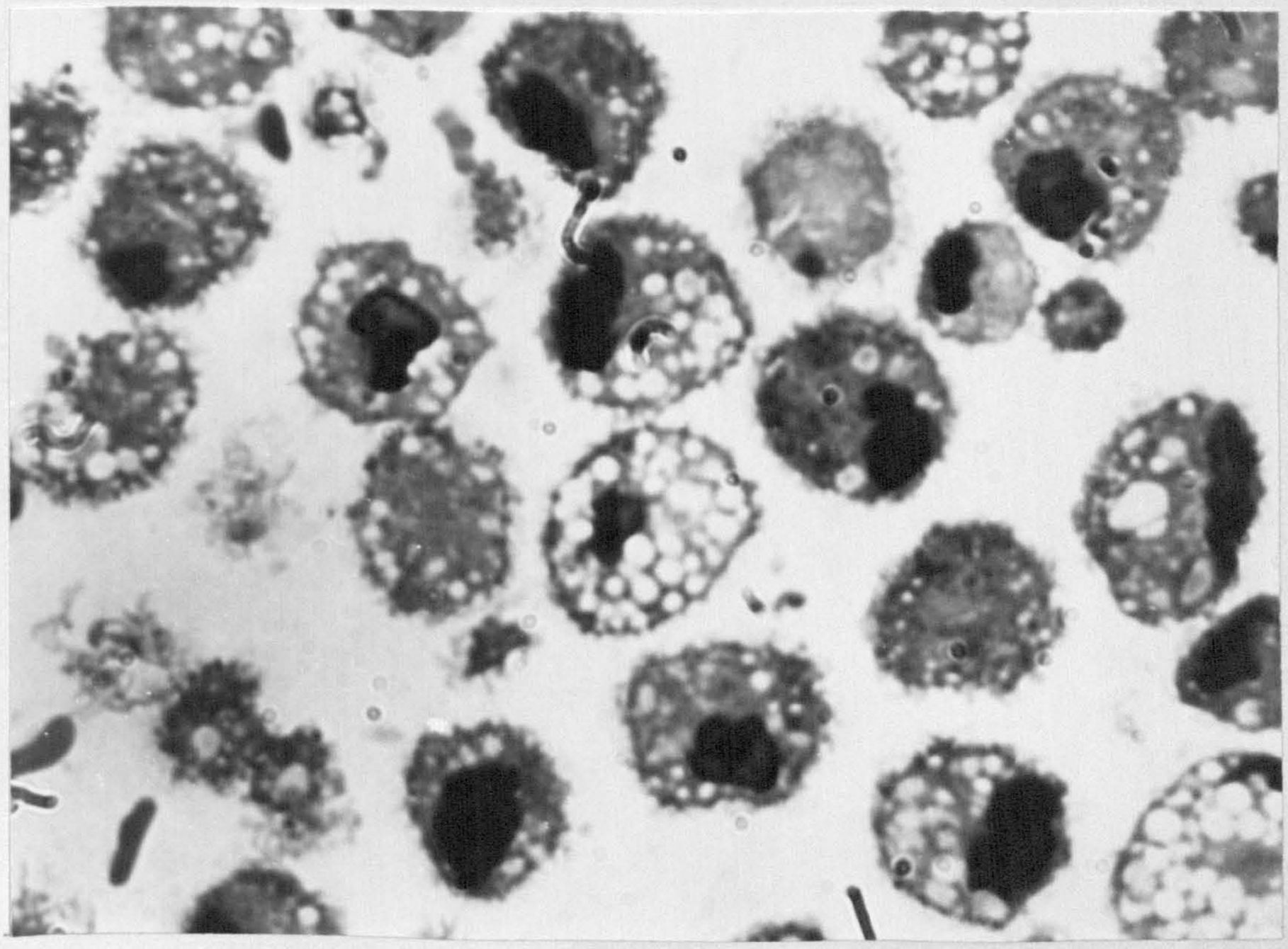
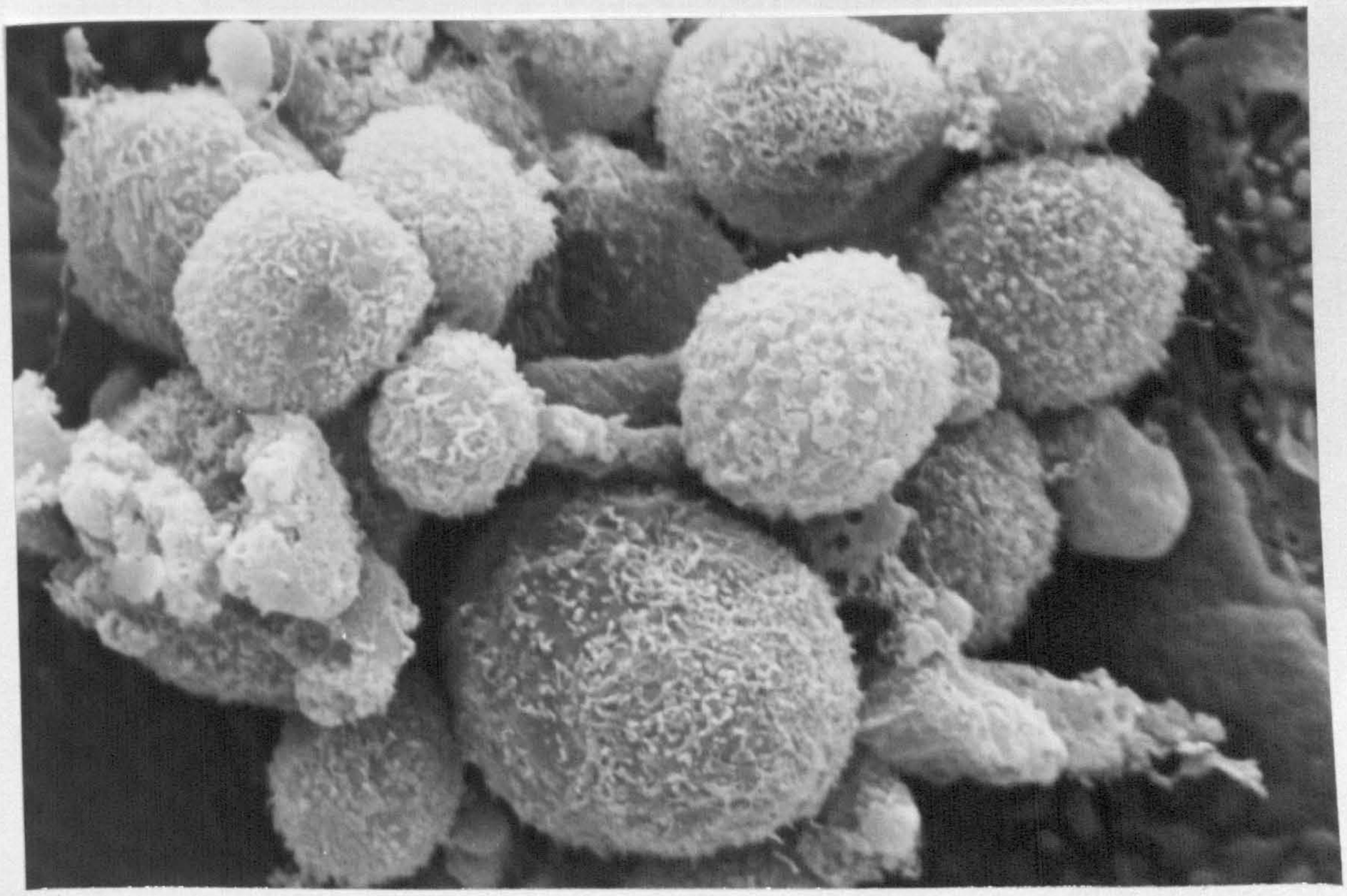


Fig. 6.3 A cluster of cells obtained from the lung washings. Note the range in size of the cells, all of which have a frilly surface outline.
SEM x 3,750.

Fig. 6.4 A higher power view of two alveolar macrophages. Note the complicated array of surface projections.
SEM x 7,250.



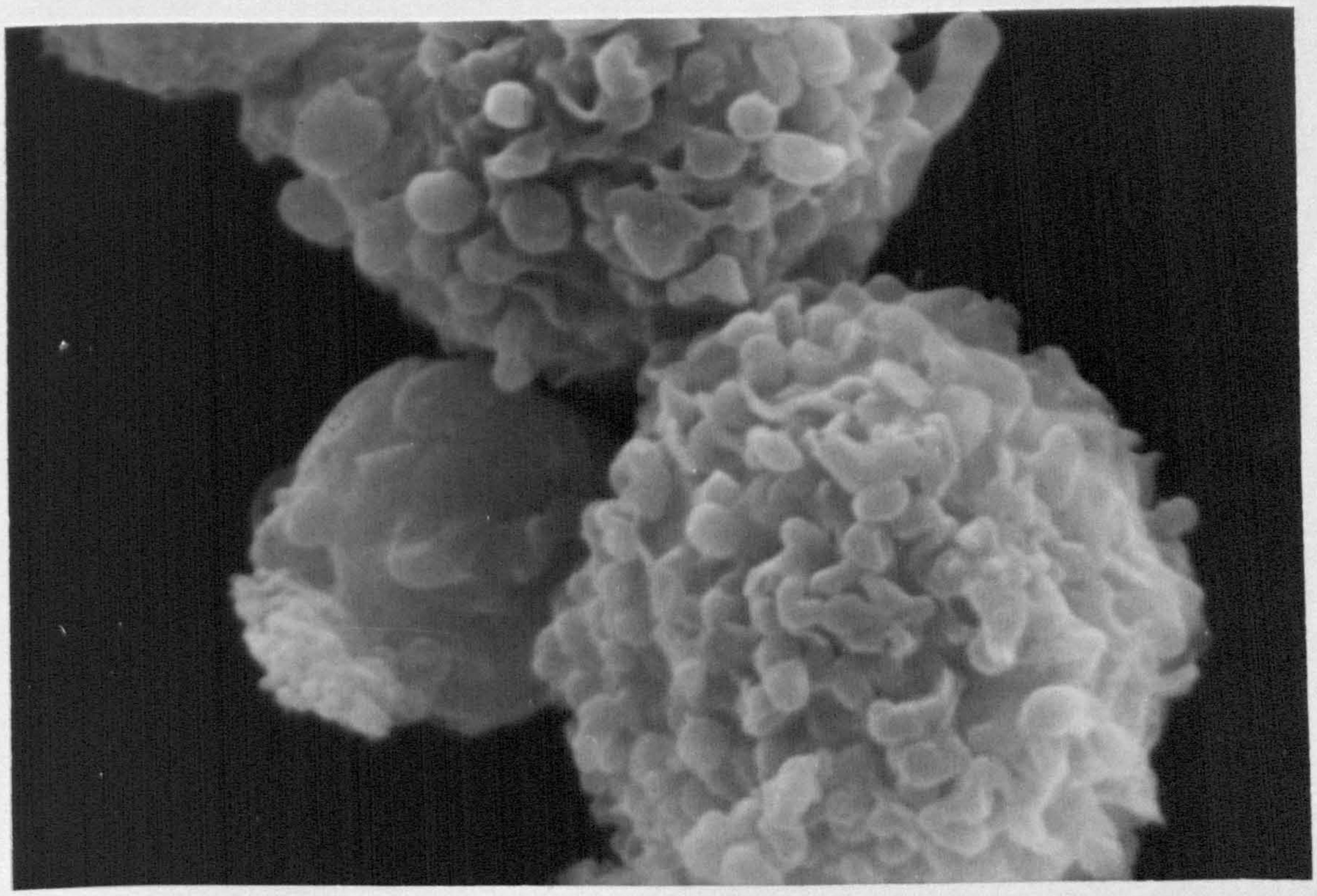
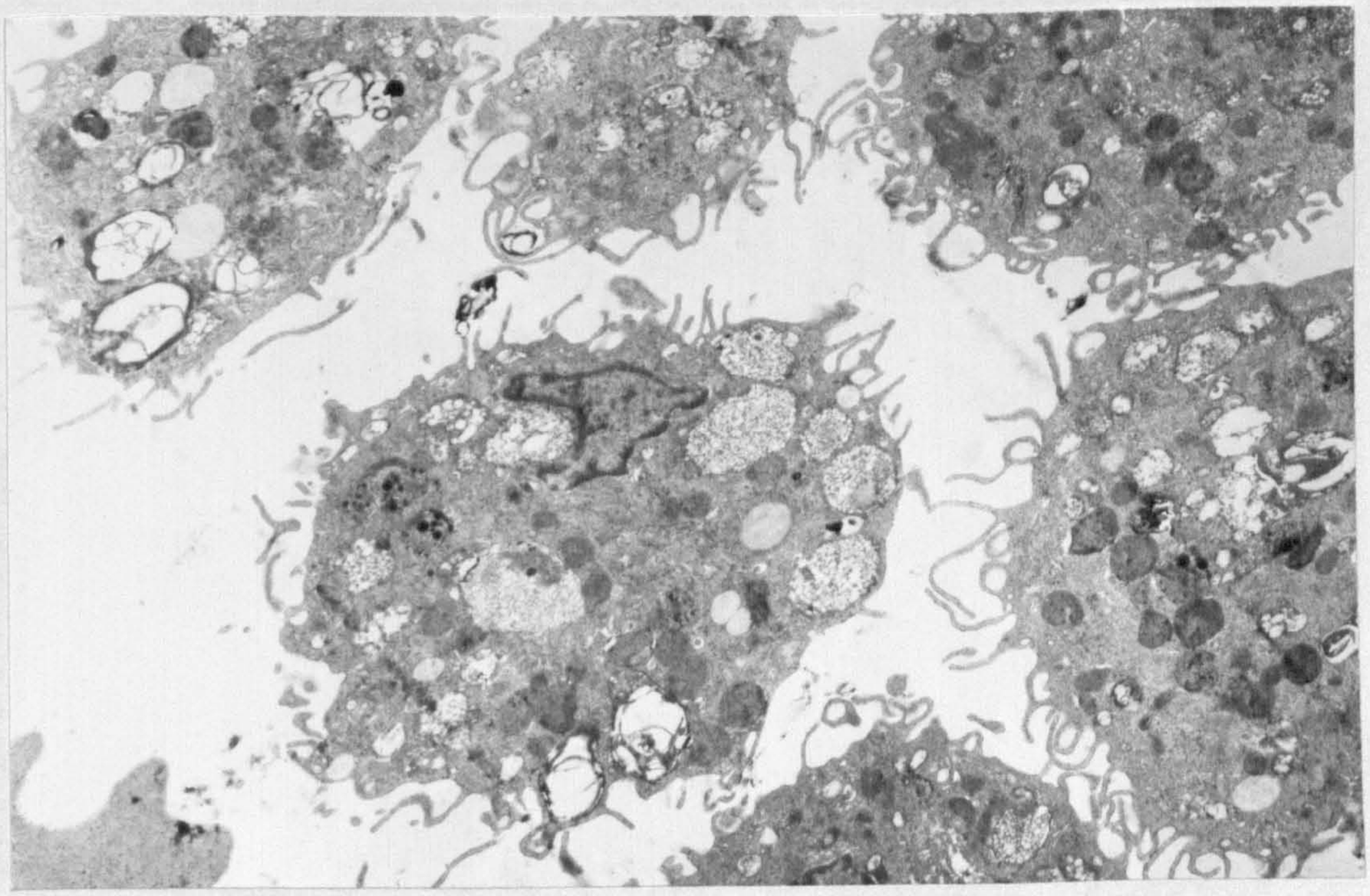


Fig. 6.5 A group of alveolar macrophages. Note the numerous cytoplasmic vacuoles and surface projections. TEM x 2,500.

Fig. 6.6 An alveolar macrophage, showing the characteristic indented nucleus, cytoplasmic extensions and intracytoplasmic vacuoles. TEM x 4,800.



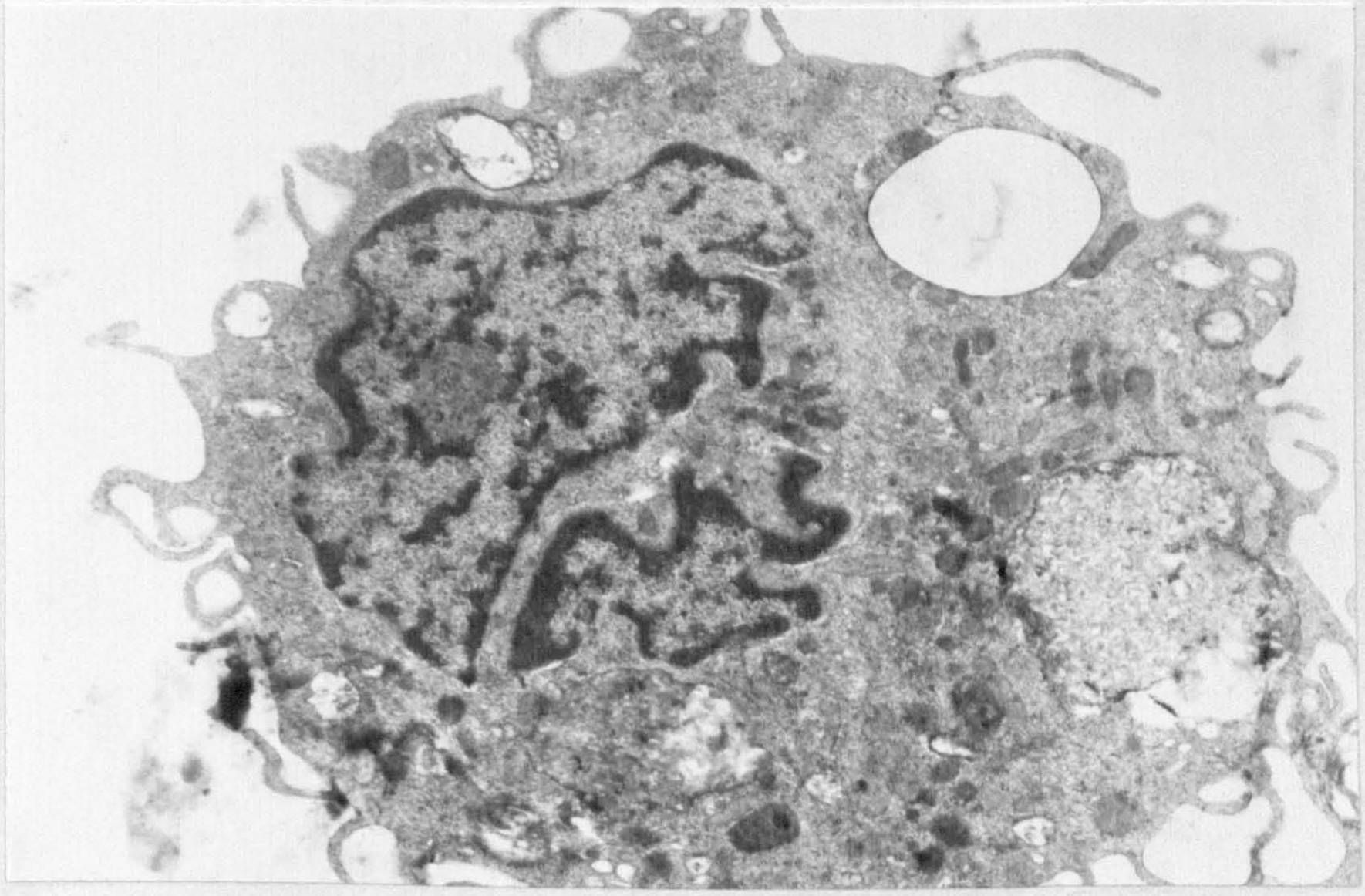


Fig. 7.1 Culture smear of Bordetella bronchiseptica.
Gram x 1500.

Fig. 7.2 Culture smear of Bordetella bronchiseptica.
SEM x 30,000.



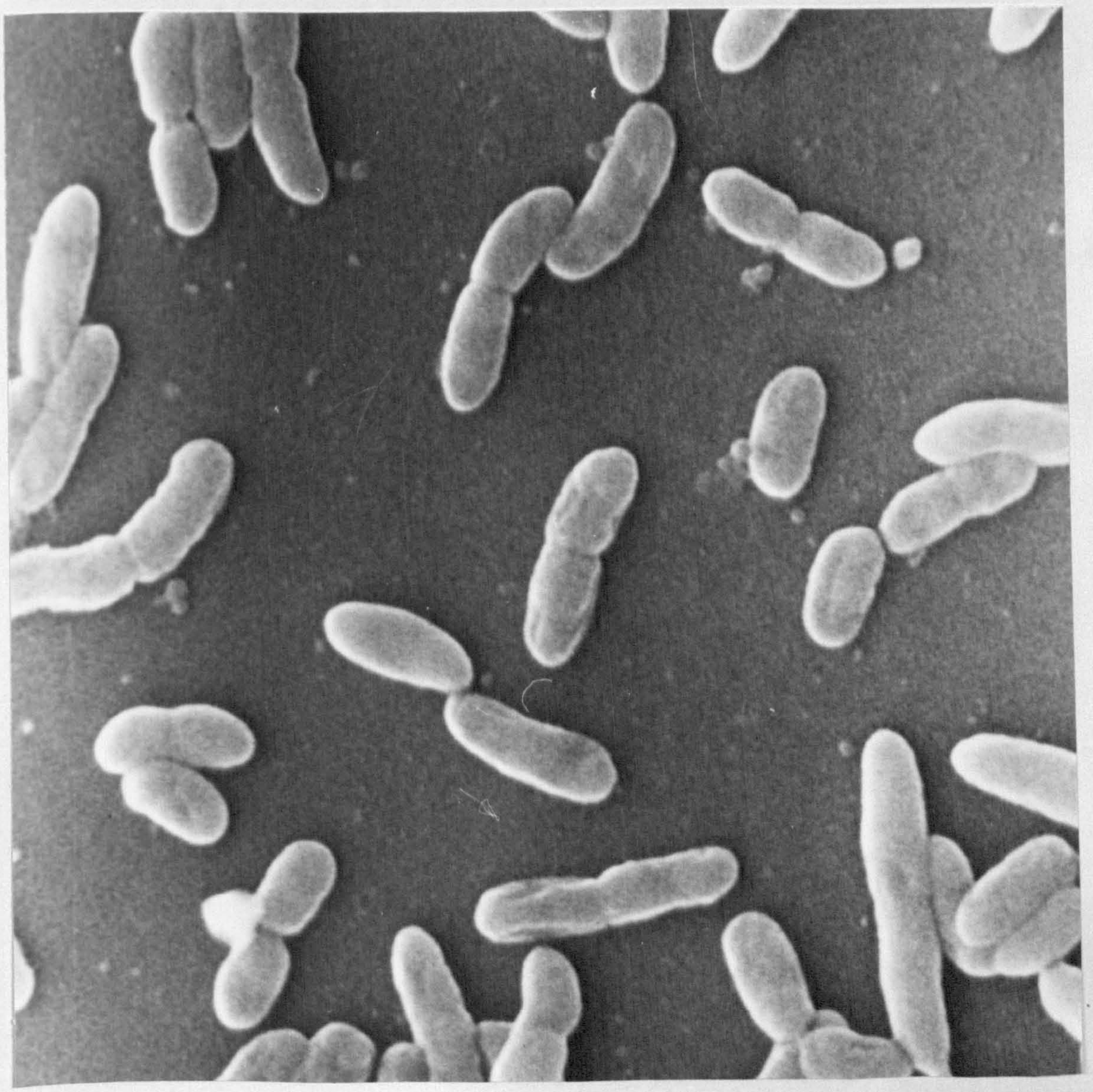
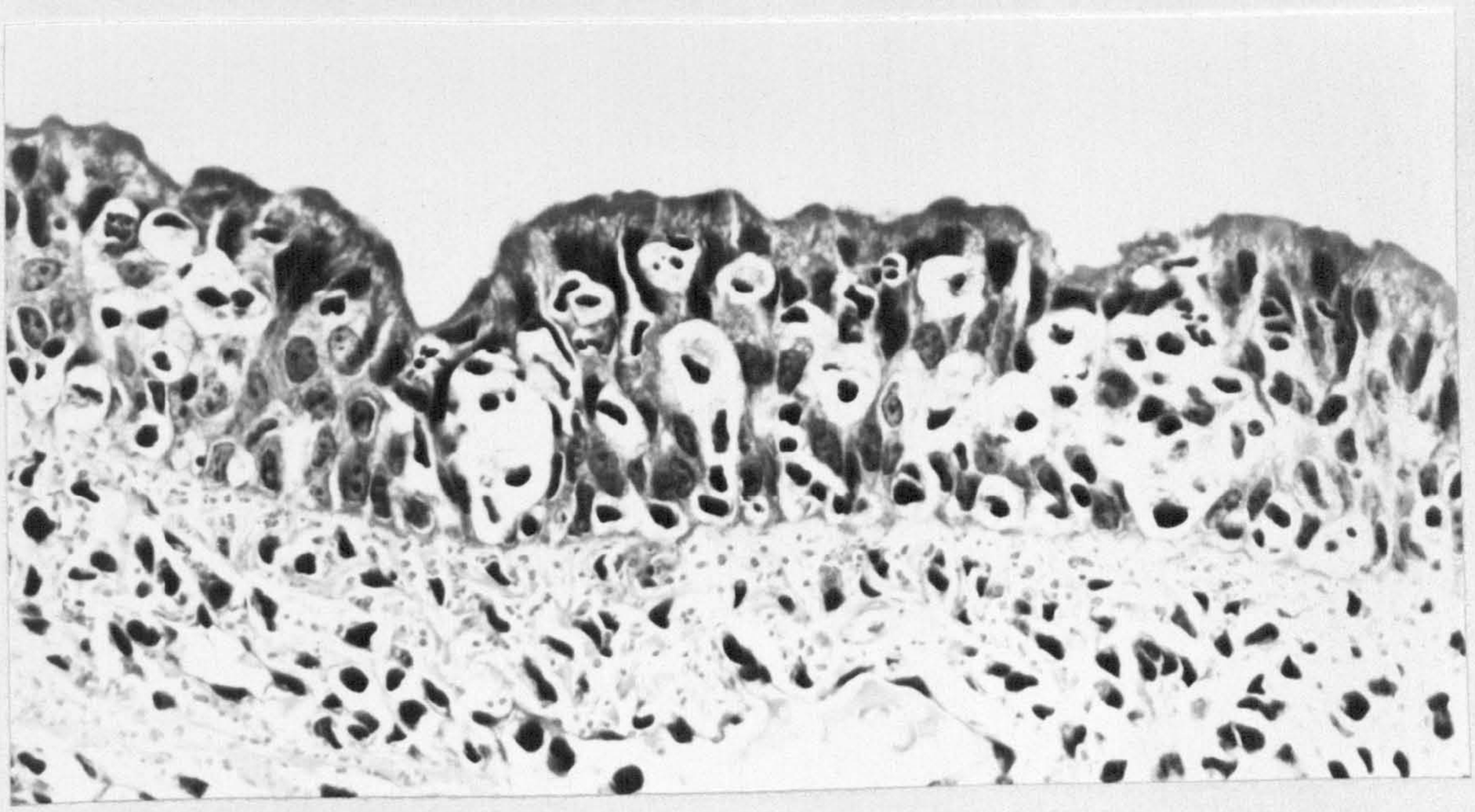


Fig. 7.3 Extrapulmonary bronchus, four days post aerosolisation. Many polymorphonuclear leucocytes are migrating through the pseudostratified epithelium.
HE x 400.

Fig. 7.4 Nasopharynx, four days post aerosolisation. Note the focal area of epithelial degeneration (arrow).
HE x 400.



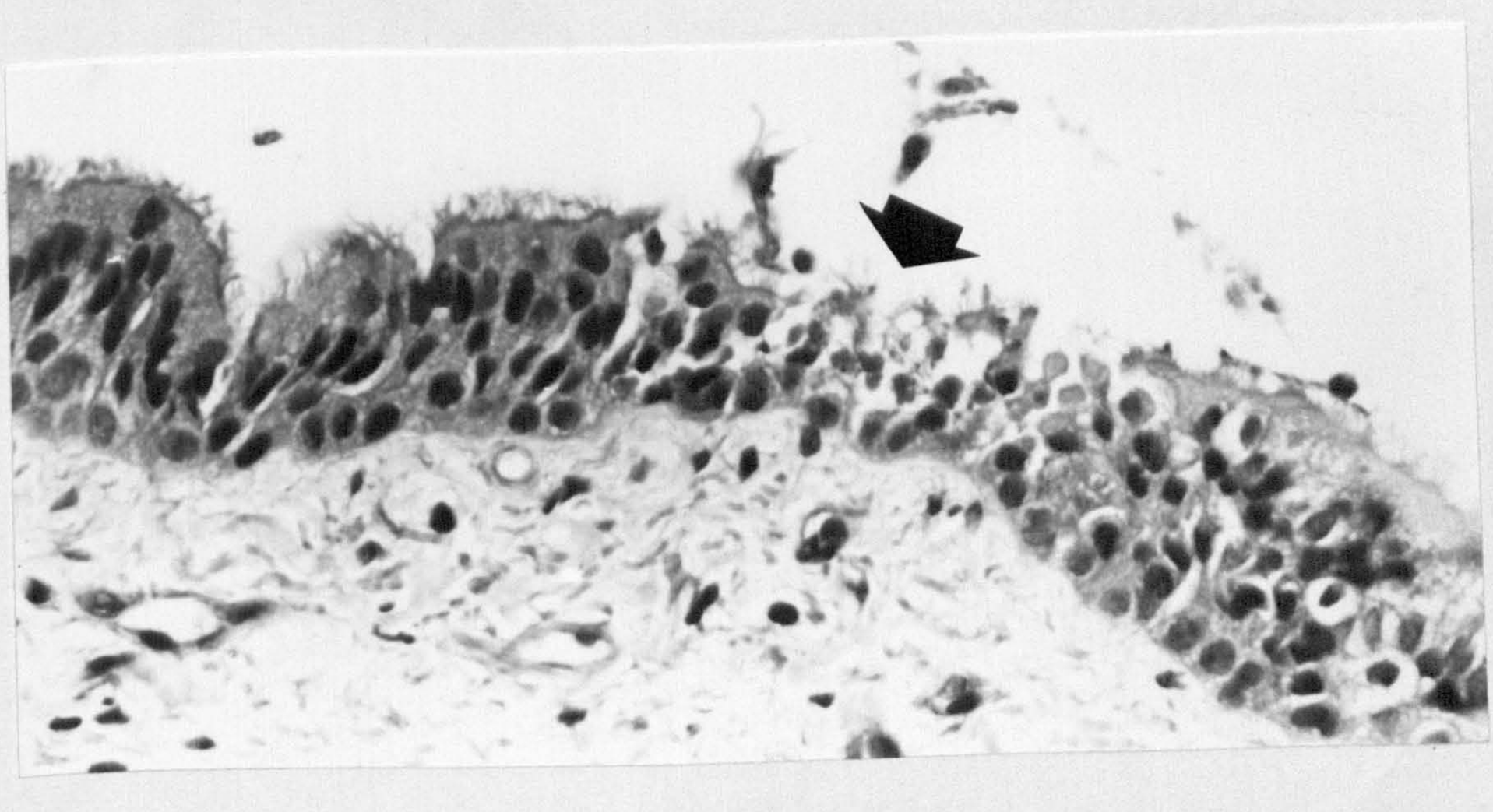
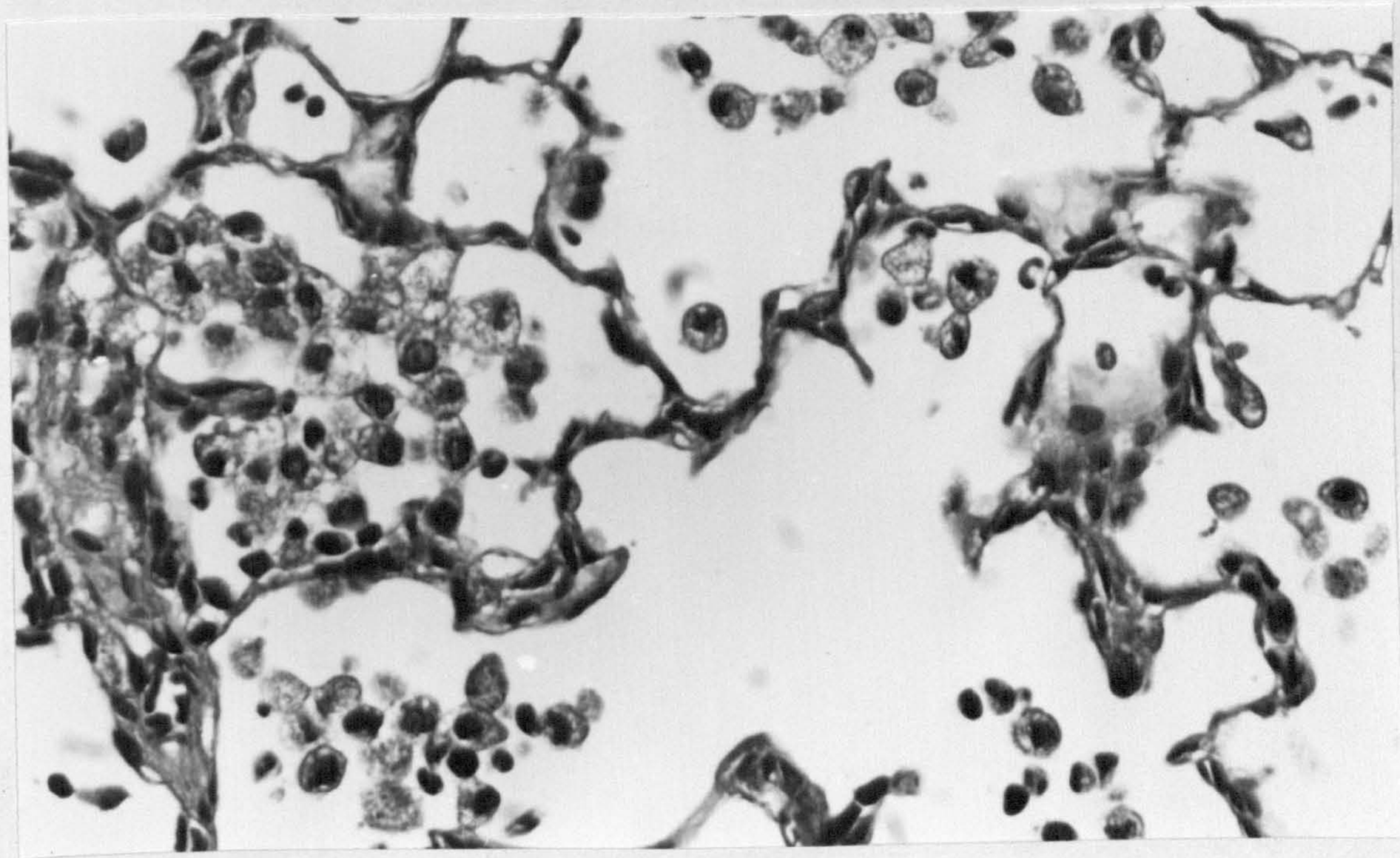


Fig. 7.5 Lung, four days post aerosolisation. Many vacuolated alveolar macrophages are present. HE x 400.

Fig. 7.6 Nasopharynx, four days post aerosolisation. Dense masses of bacteria can be seen trapped in the cilia. Gram-Twort x 400.



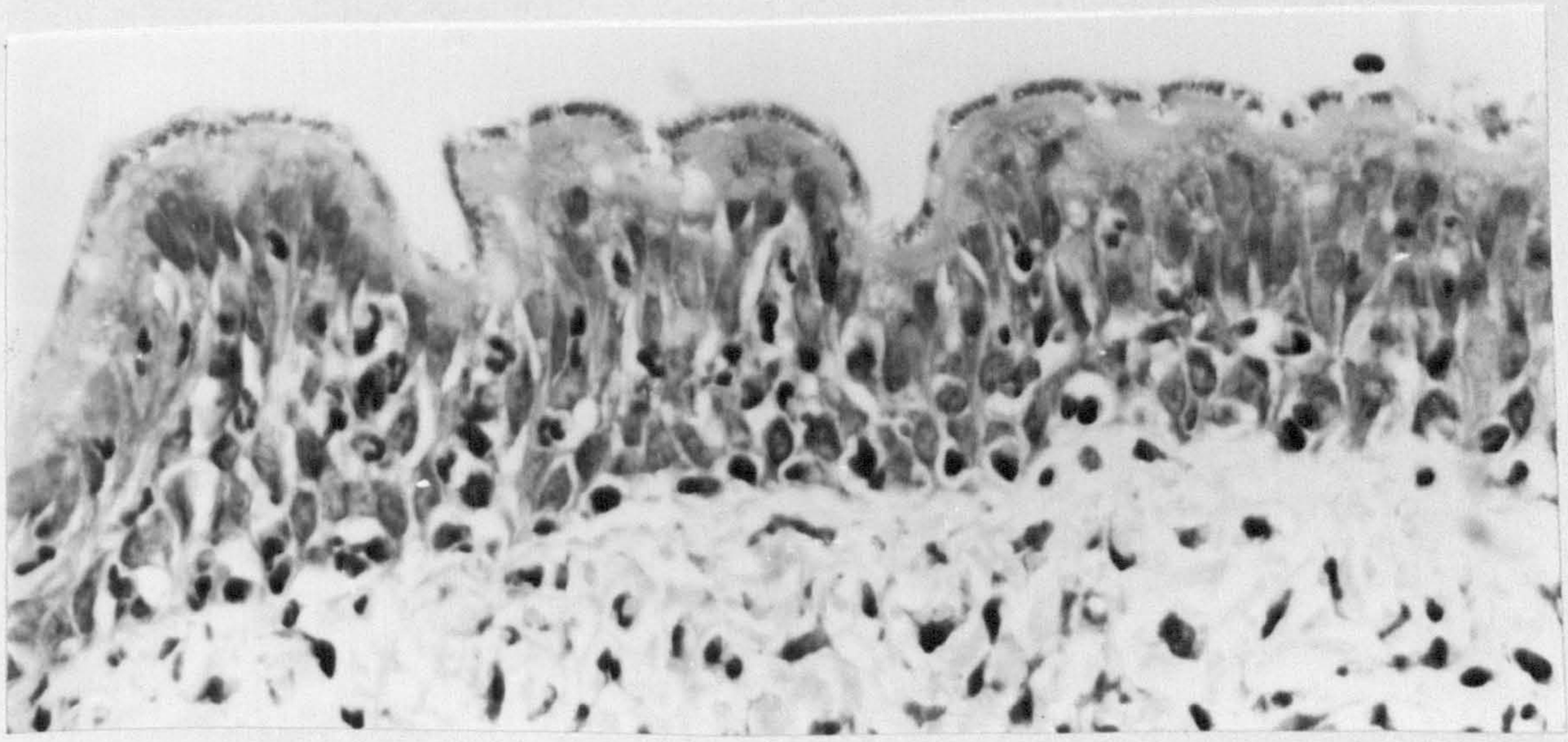
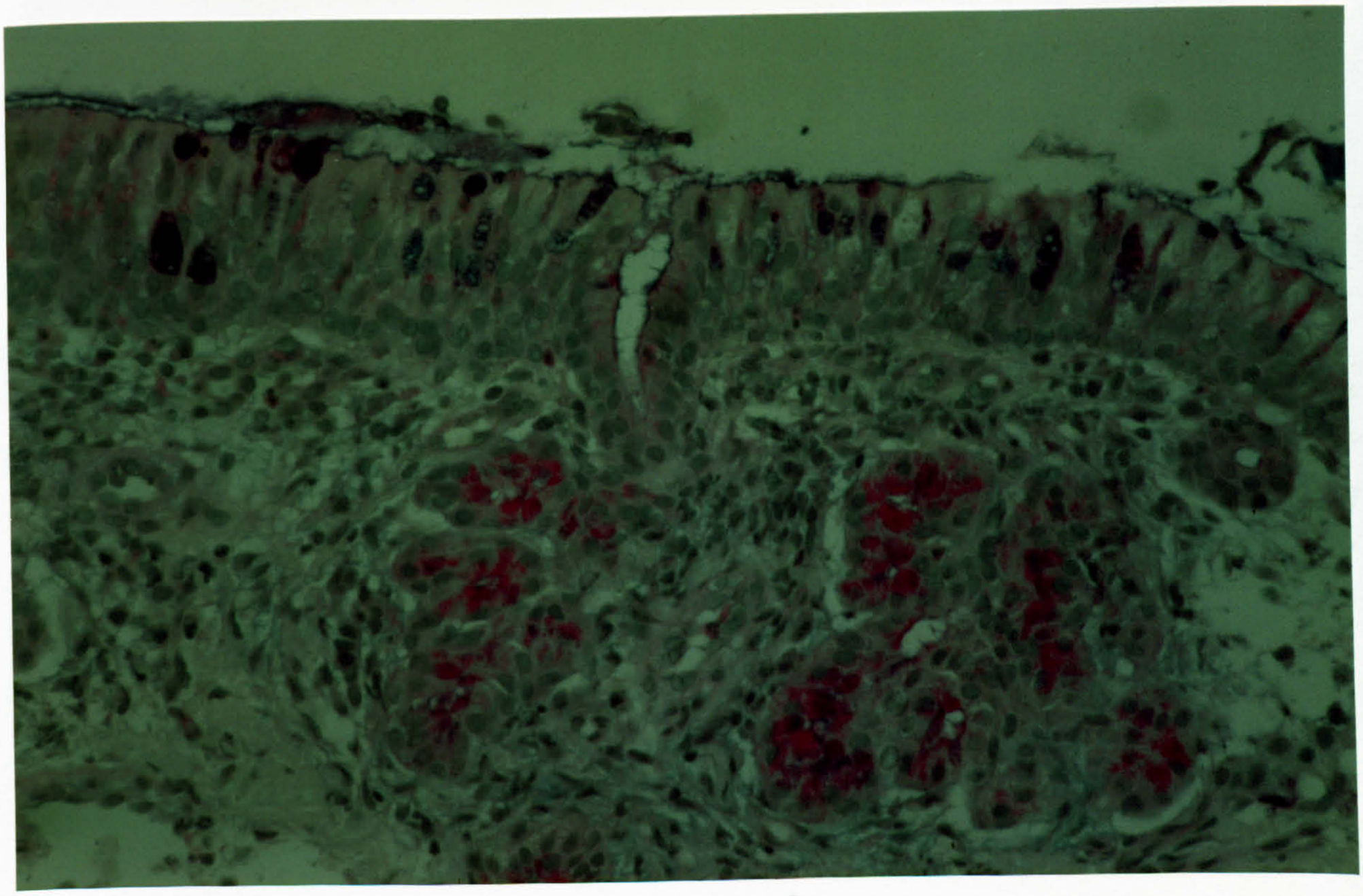


Fig. 7.7 Ventral concha, four days post aerosolisation. A number of poorly-stained goblet cells, containing mainly mixed mucosubstances, can be seen. Some neutral staining glands are also present.
AB-PAS x 250.

Fig. 7.8 Septum, four days post aerosolisation. The type of mucosubstance in these poorly-filled goblet cells is mainly acidic.
AB-PAS x 350.



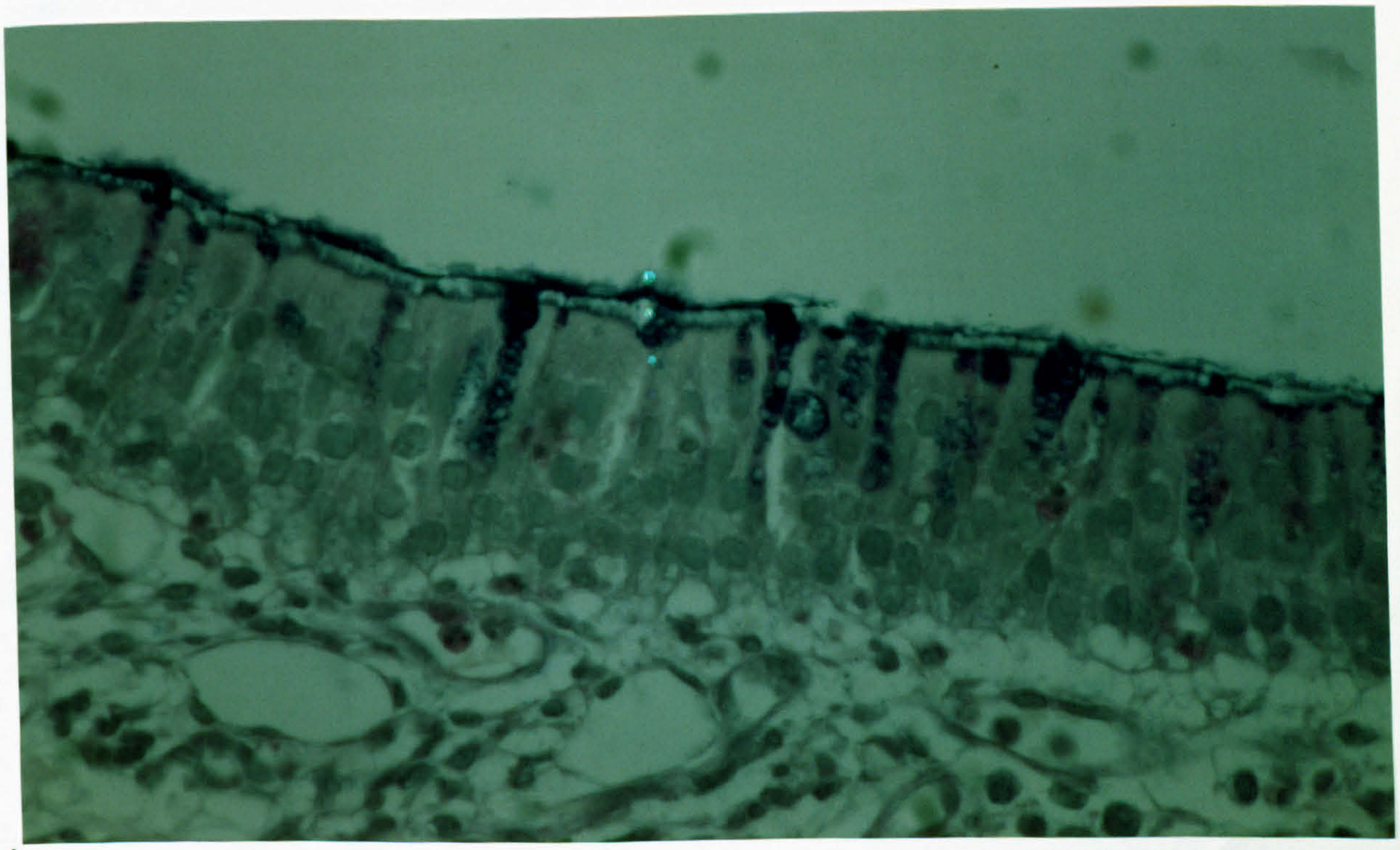
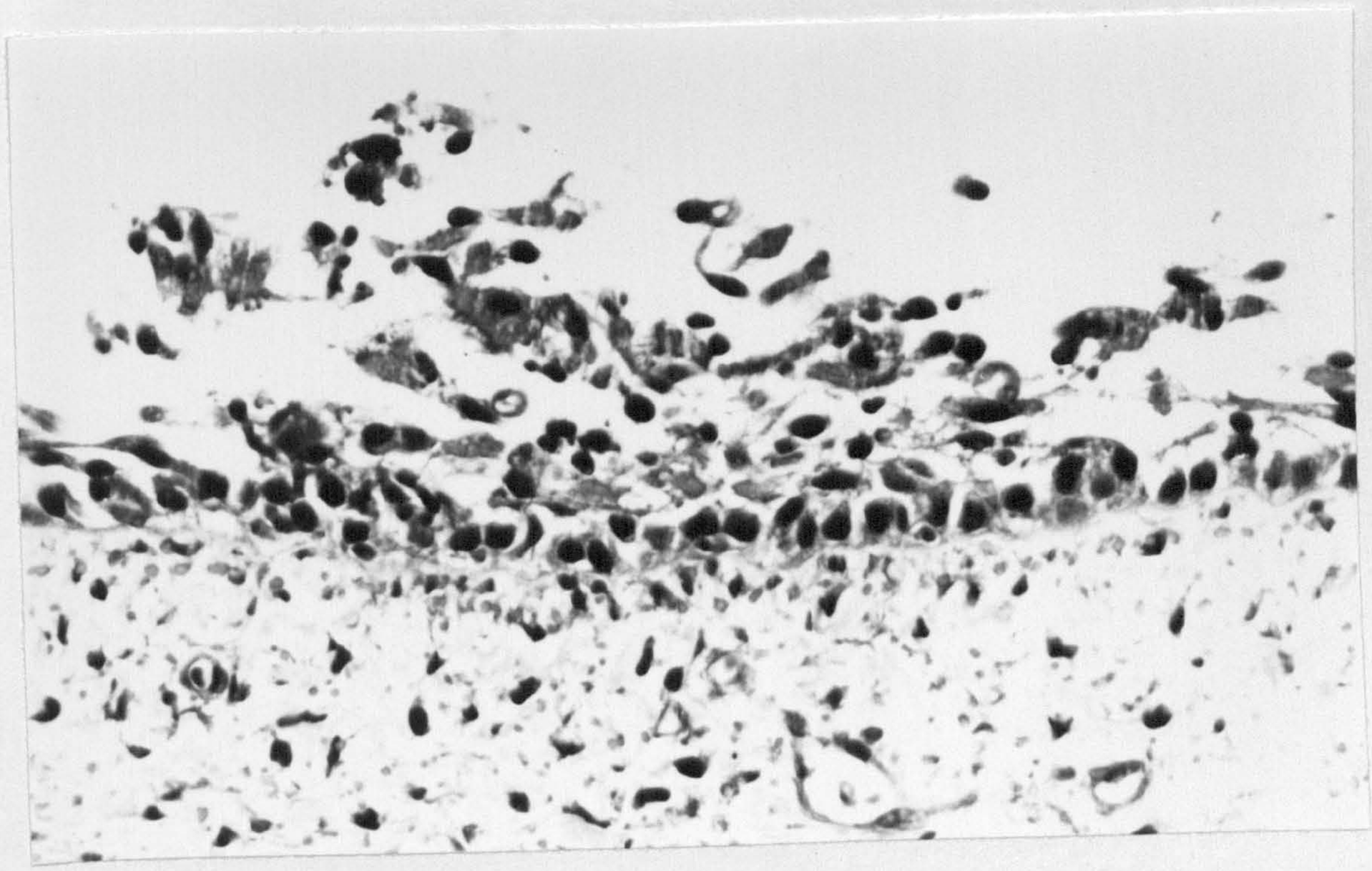


Fig. 7.9 Septum, six days post aerosolisation. There is severe epithelial necrosis. Only the basal cells are still attached to the basal lamina. HE x 350.

Fig. 7.10 Extrapulmonary bronchus, six days post aerosolisation. The lamina propria is heavily infiltrated with lymphocytes, macrophages and plasma cells. Note the partial detachment of the overlying epithelial cells. HE x 350.



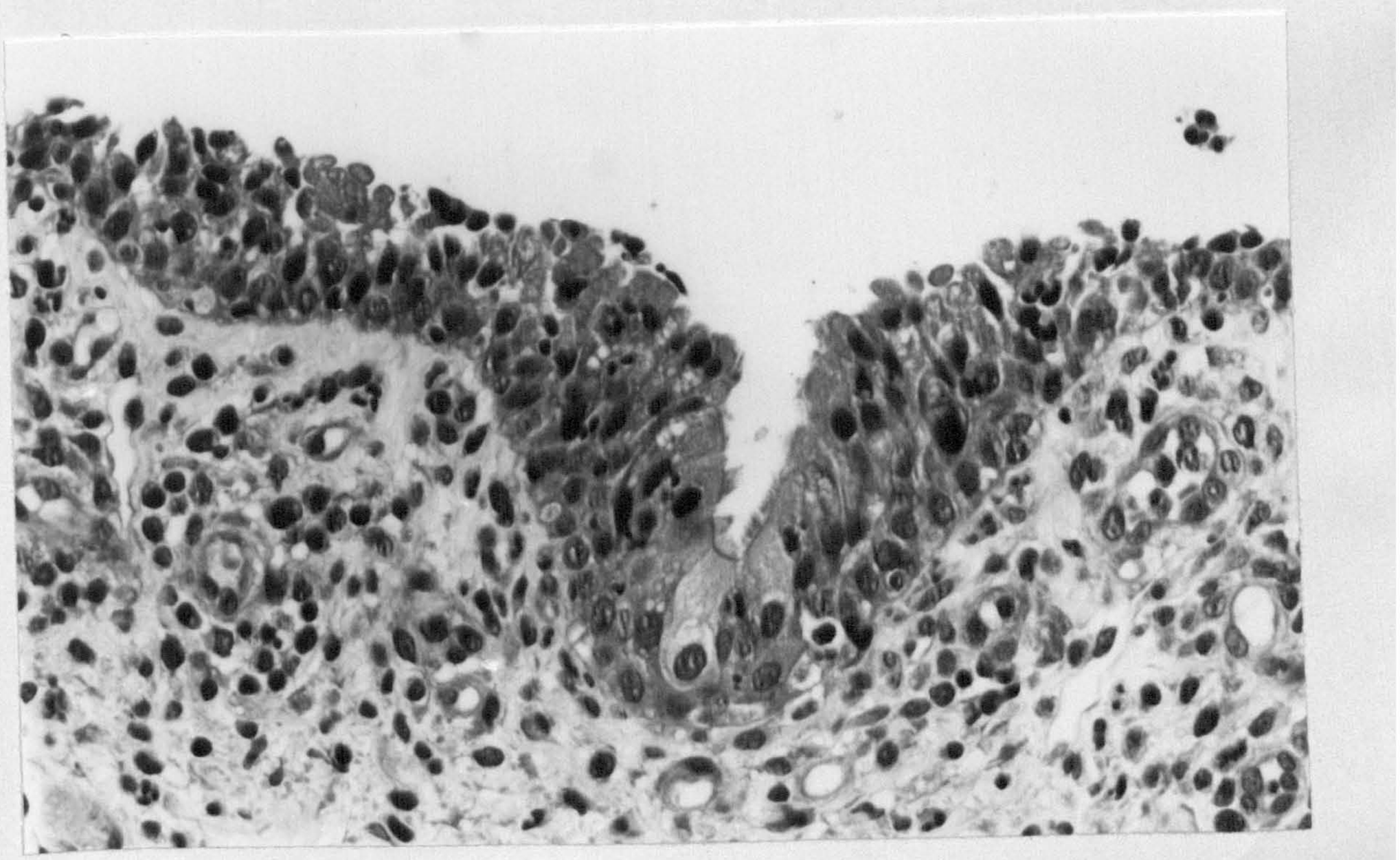
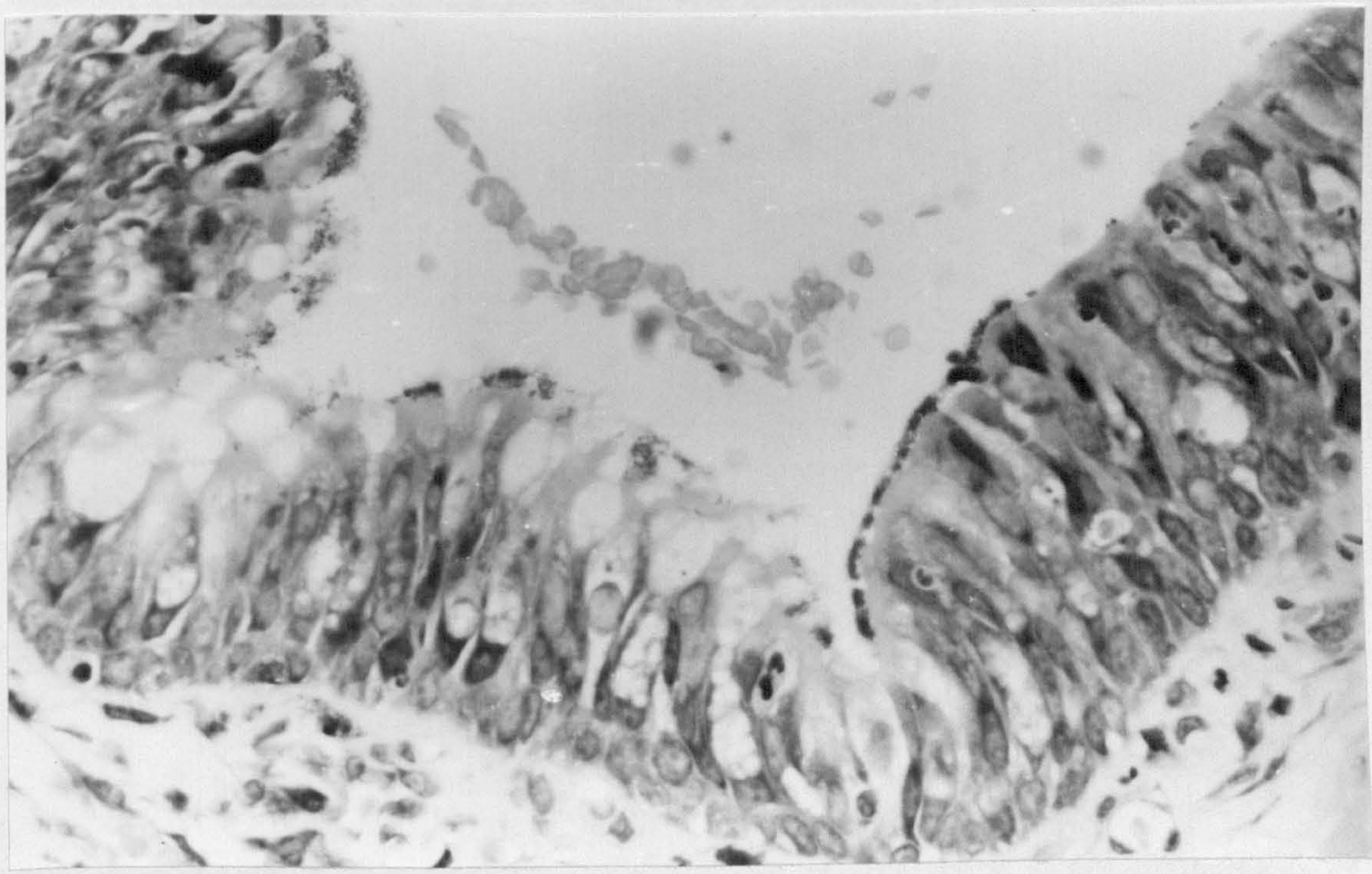


Fig. 7.11 Small bronchus, six days post aerosolisation. Many bacteria are to be seen trapped in the cilia.
Gram-Twort x 350.

Fig. 7.12 Lung, six days post aerosolisation. This small bronchiole (B) shows loss of lining epithelium while the surrounding alveoli contain many neutrophils and macrophages.
HE x 250.



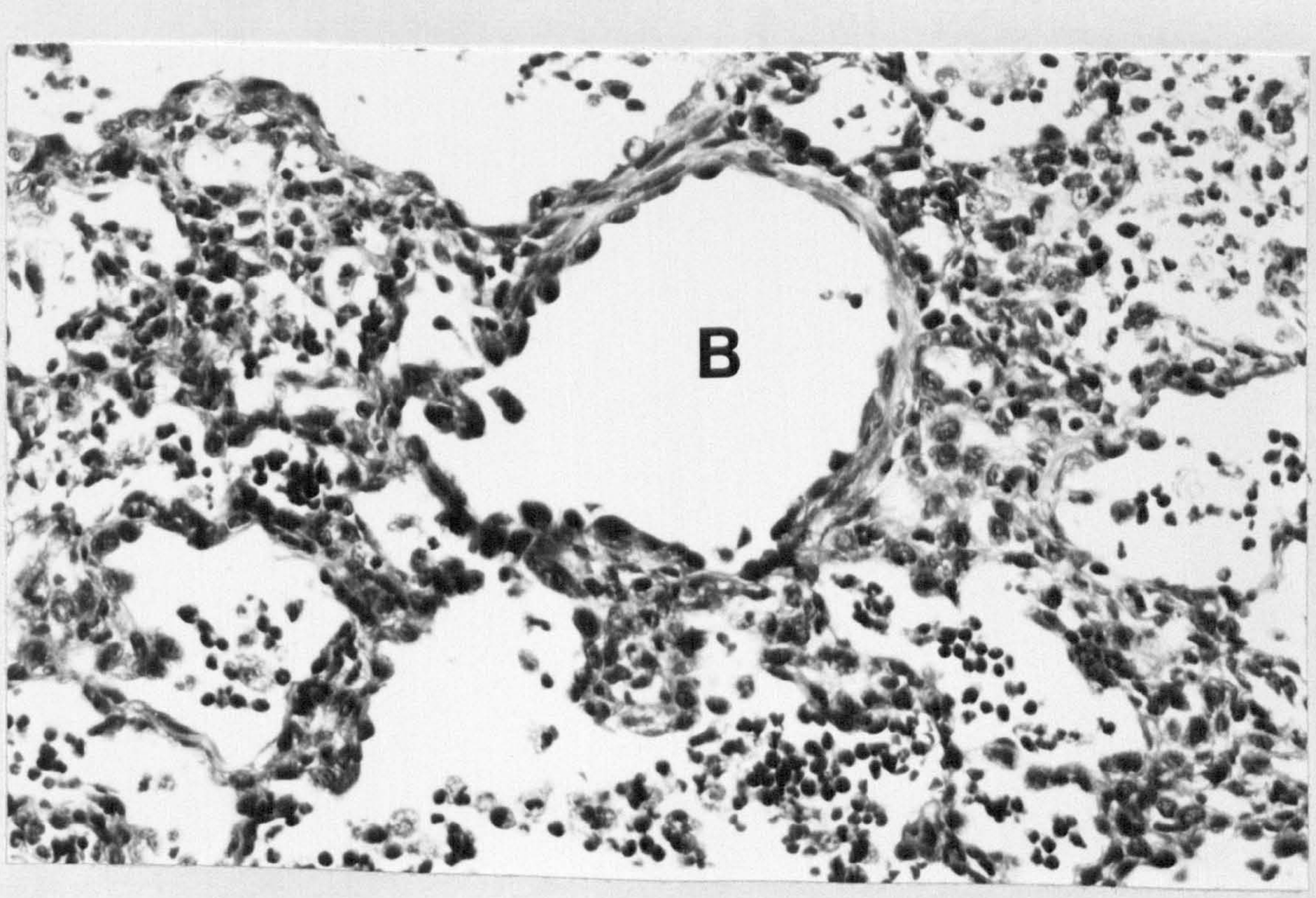
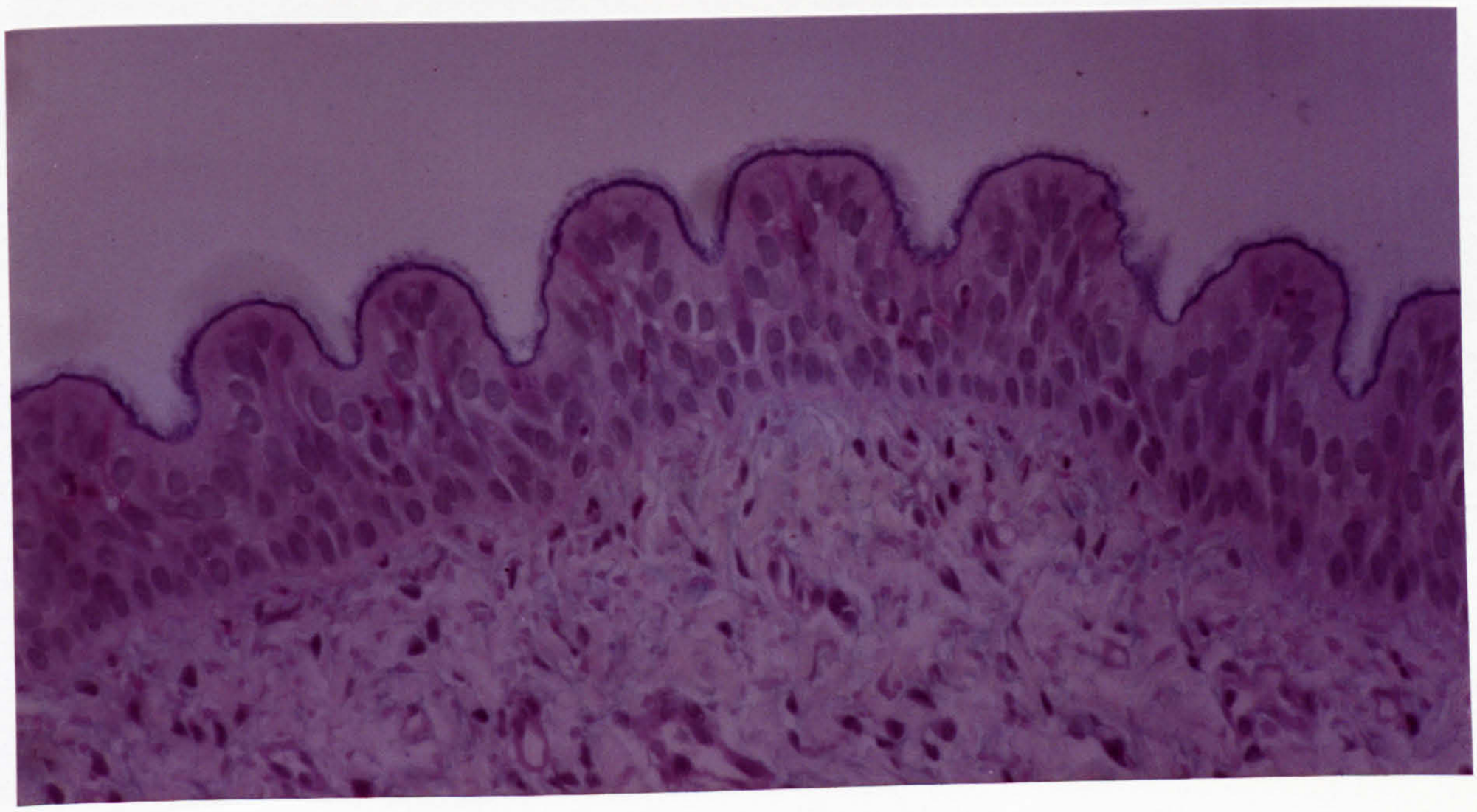

B

Fig. 7.13 Trachea, six days post aerosolisation. No well developed goblet cells can be seen in this area.
AB-PAS x 350.

Fig. 7.14 Ventral larynx, six days post aerosolisation. The glands here contain only a few granules of neutral mucosubstance.
AB-PAS x 350.



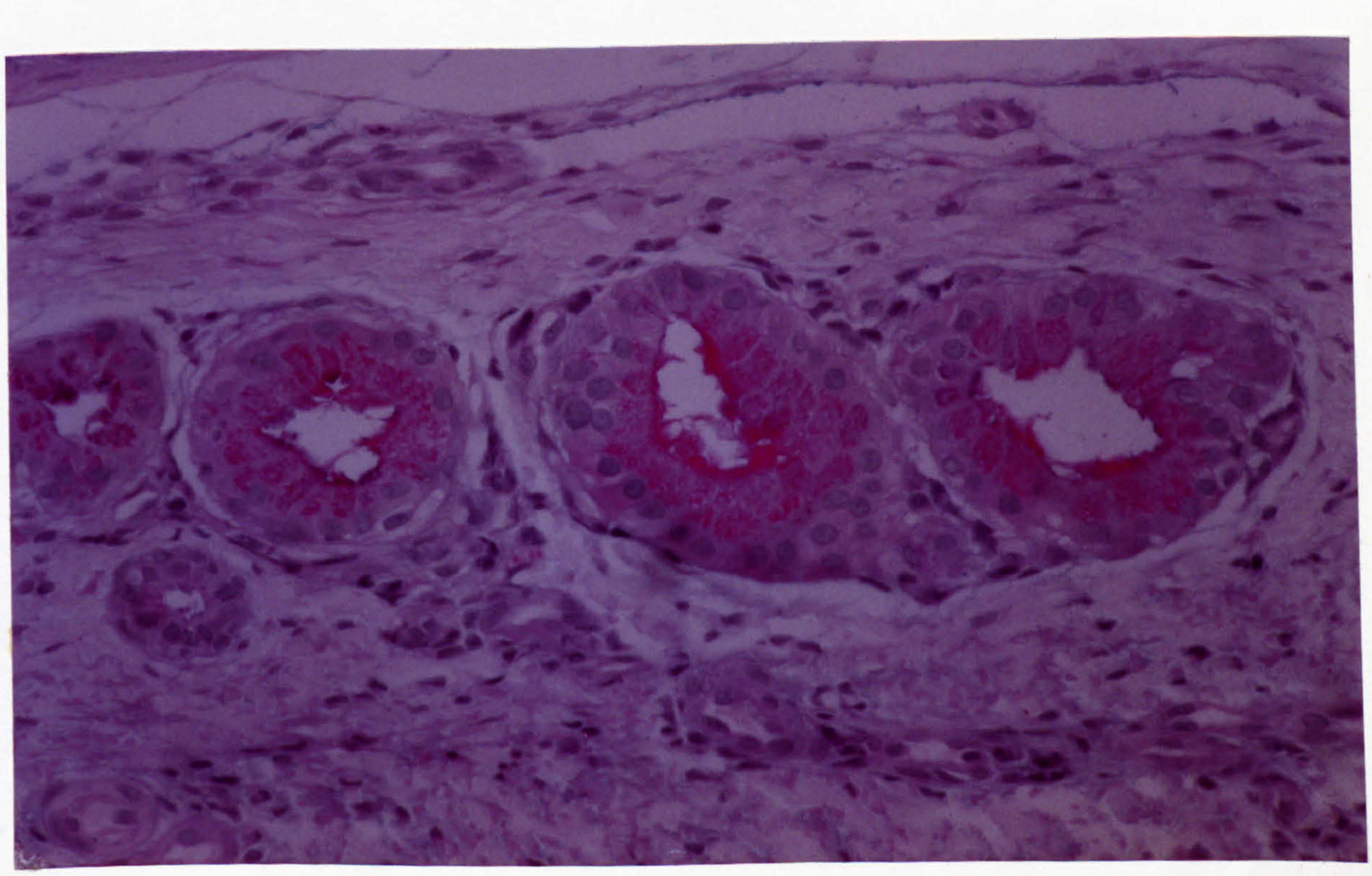
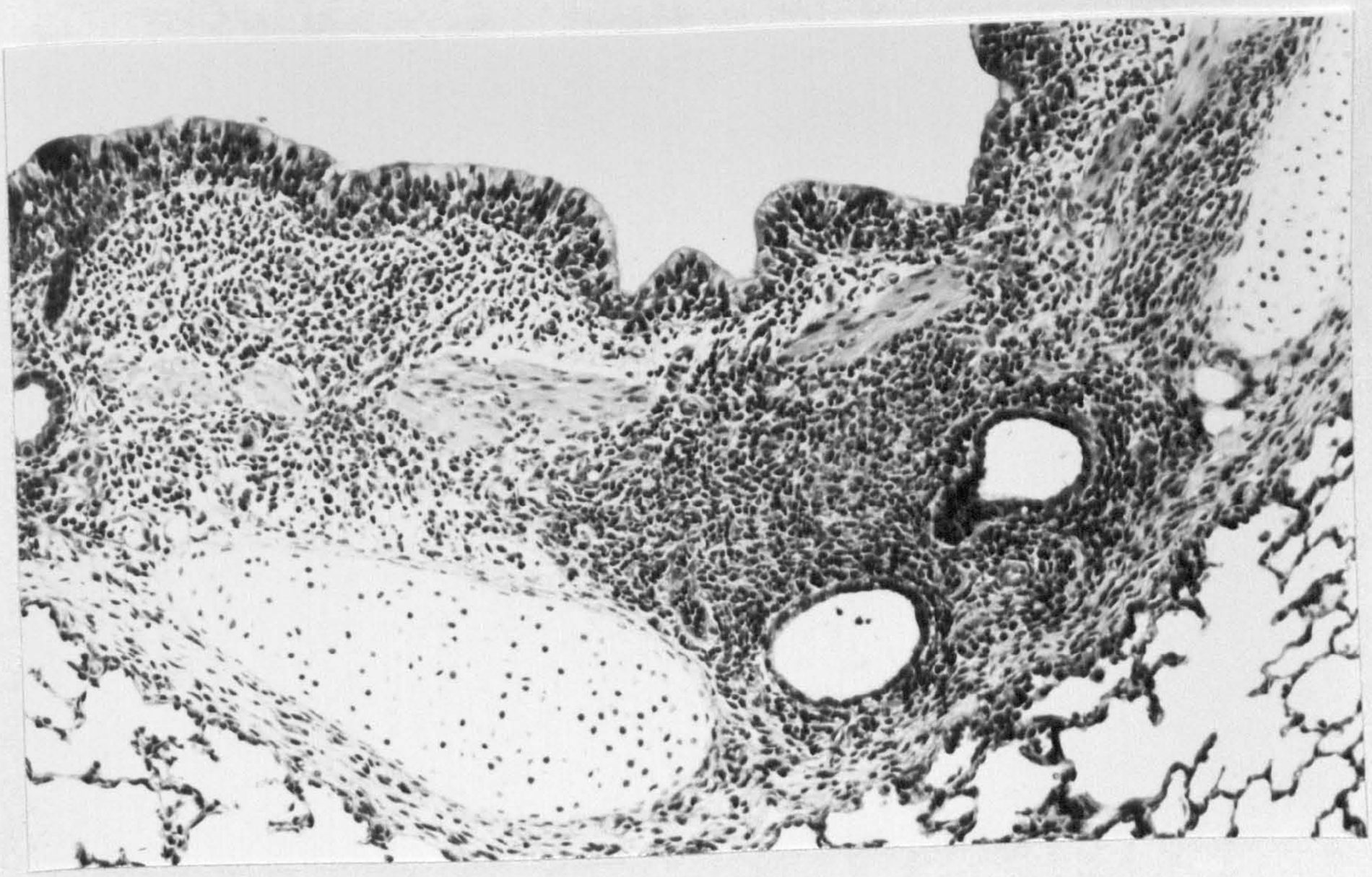


Fig. 7.15 Large bronchus, eight days post aerosolisation. Note the dense accumulation of cells in the lamina propria and submucosa. HE x 180.

Fig. 7.16 Bronchiolitis, eight days post aerosolisation. A purulent exudate can be seen in the lumen of a small bronchiole (B). HE x 180.



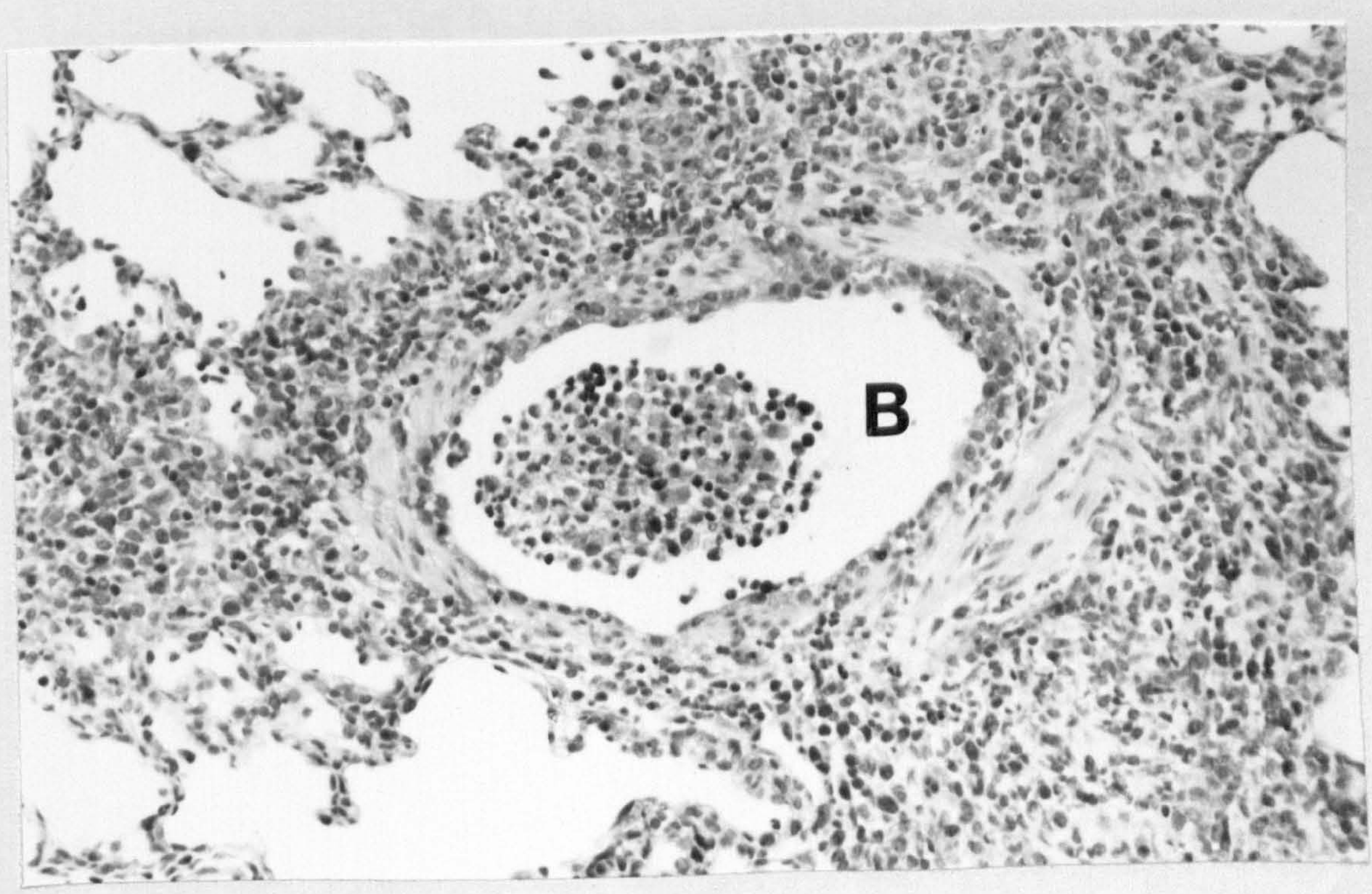
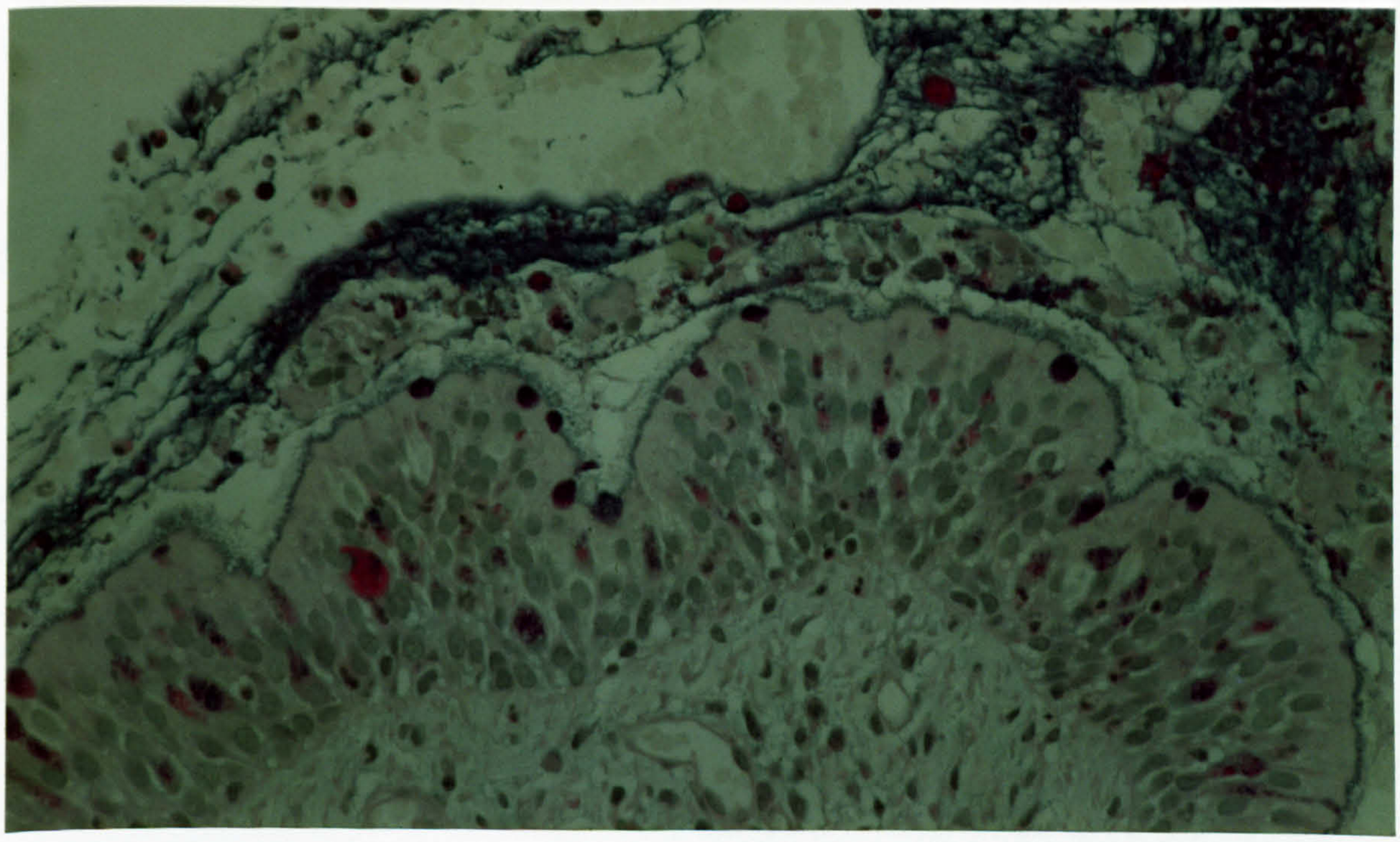

B

Fig. 7.17 Extrapulmonary bronchus, eight days post aerosolisation. Note the paucity of goblet cells and the strands of mucus on the mucosal surface.
AB-PAS x 350.

Fig. 7.18 Trachea, ten days post aerosolisation. There is an abundant purulent exudate in the tracheal lumen.
HE x 180.



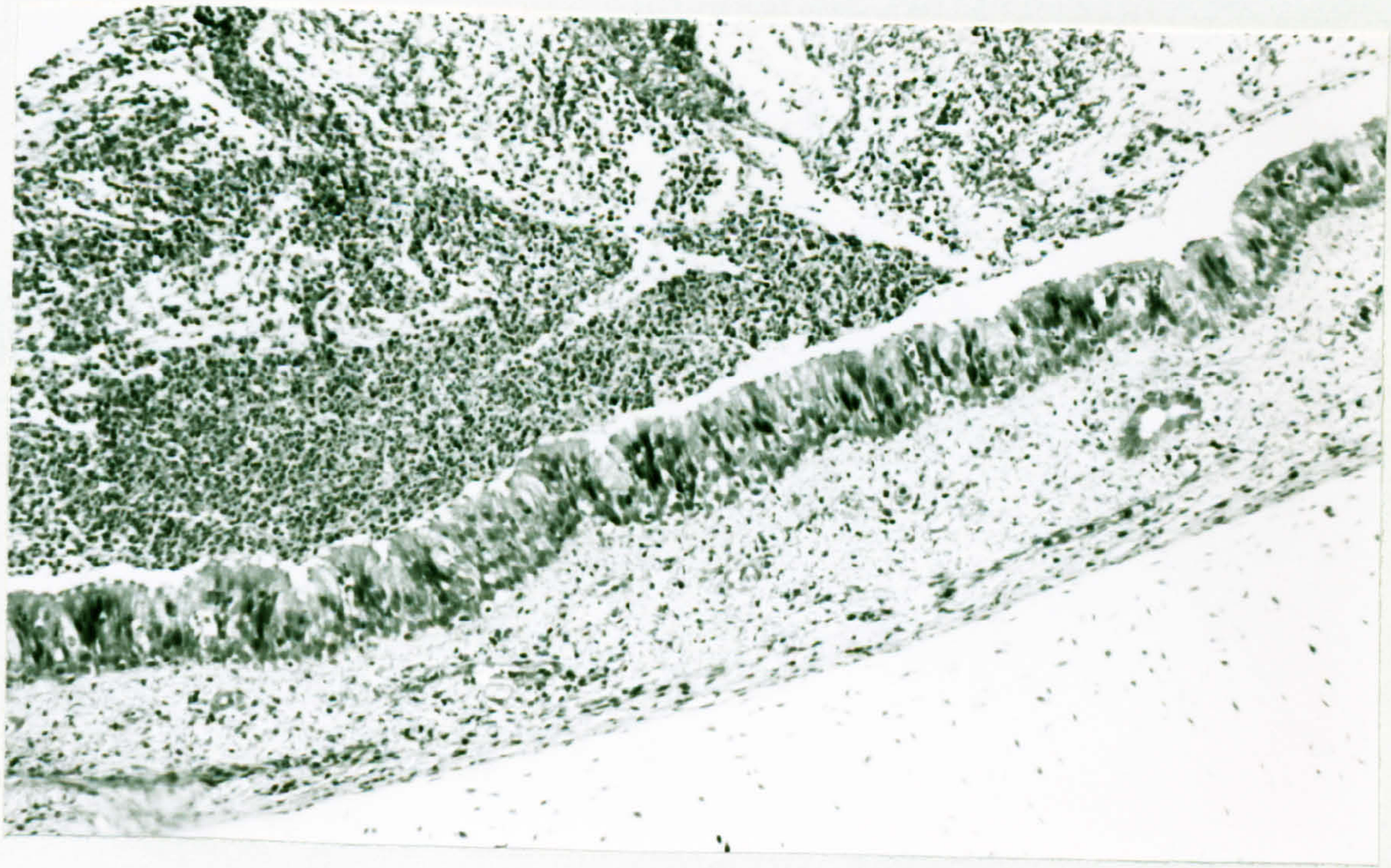
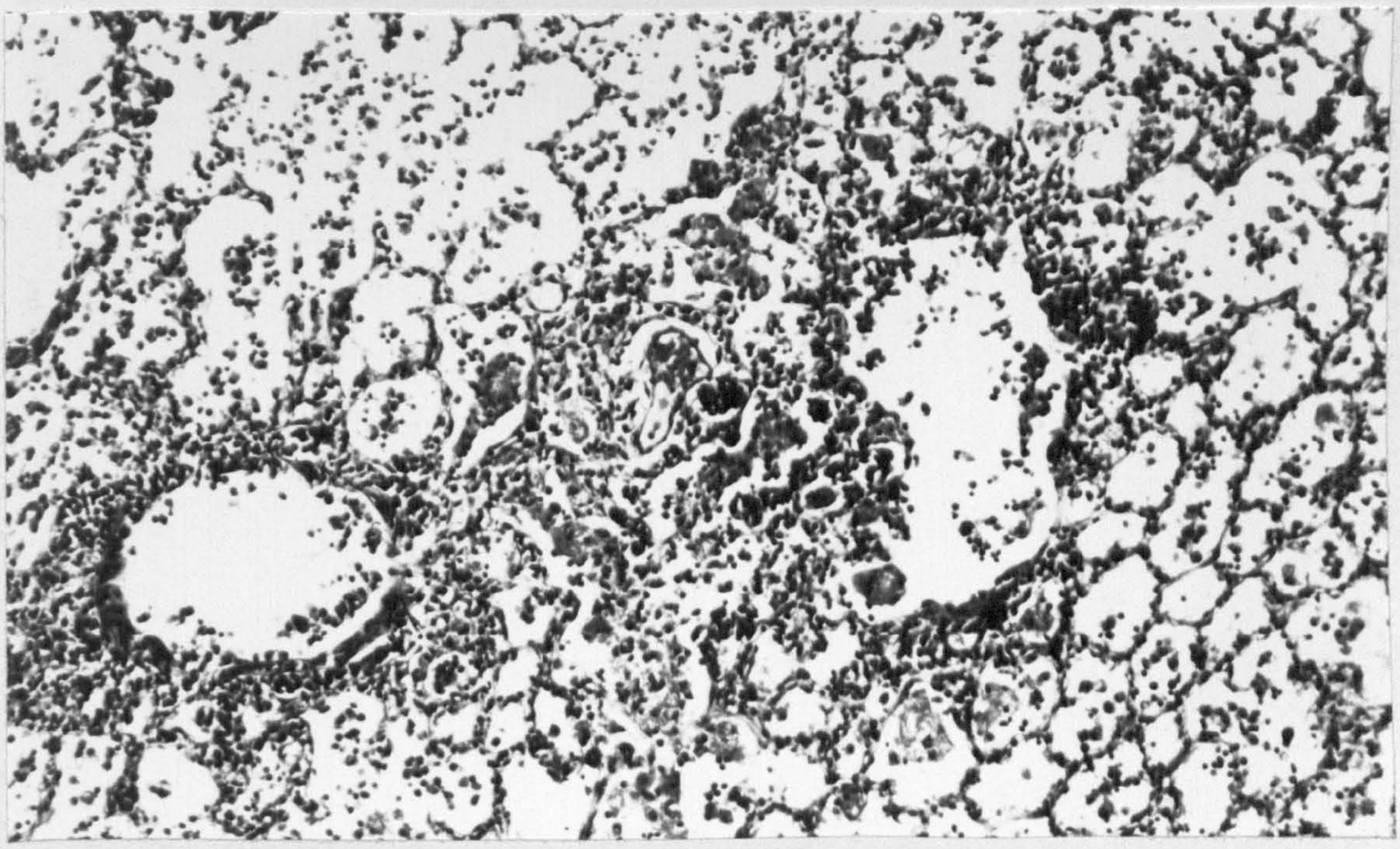


Fig. 7.19 Bronchiolitis, ten days post aerosolisation. Two bronchioles have lost their epithelium and the surrounding alveoli are flooded with inflammatory cells.
HE x 180.

Fig. 7.20 Large bronchus, ten days post aerosolisation. Note the flattened squamous-like epithelium.
HE x 350.



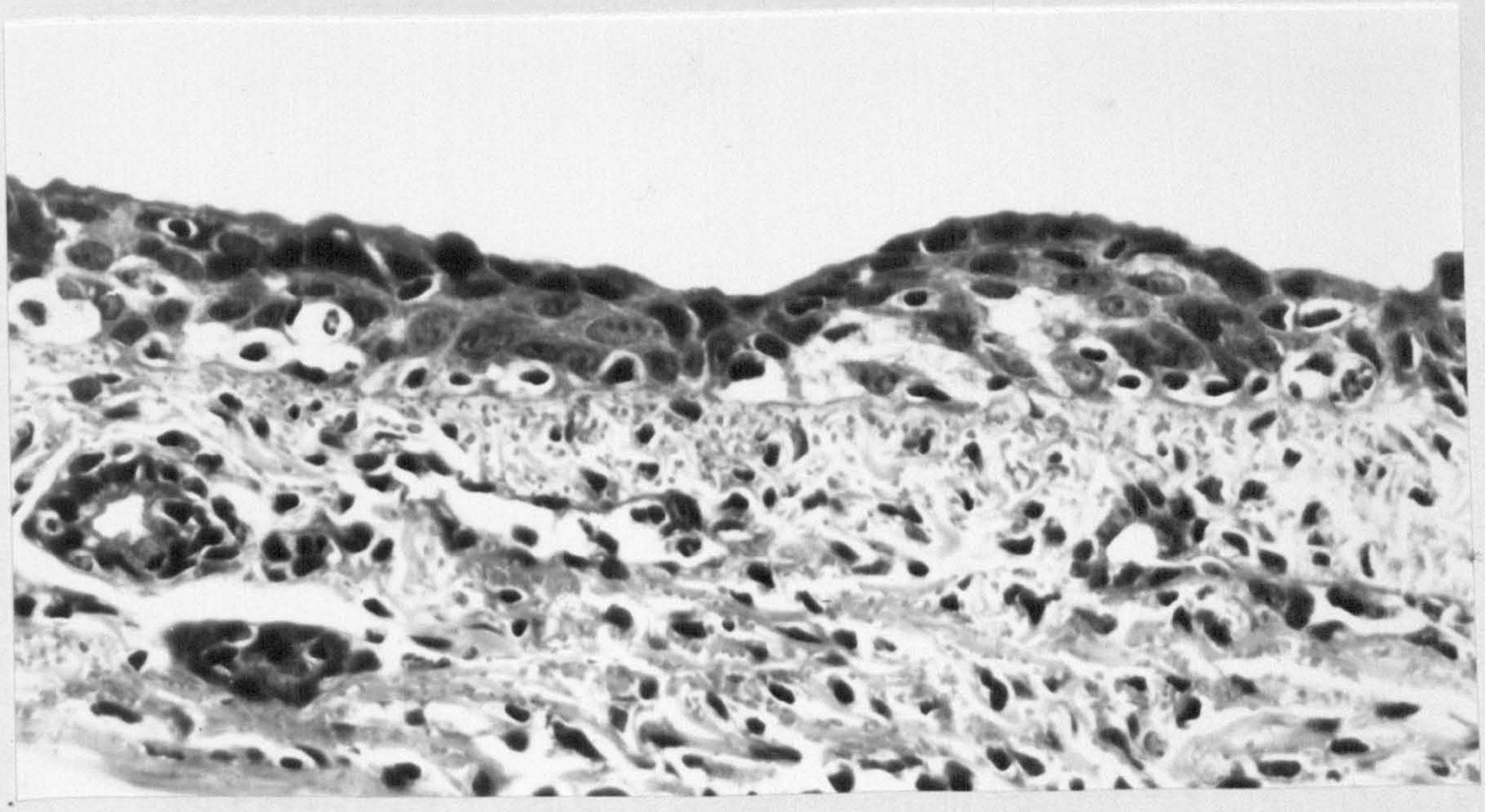


Fig. 7.21 Ventral concha, 20 days post aerosolisation. Note the mixed inflammatory infiltrate in the lamina propria.
HE x 350.

Fig. 7.22 Ventral concha, 20 days post aerosolisation. Some neutral-staining goblet cells can be seen.
AB-PAS x 350.

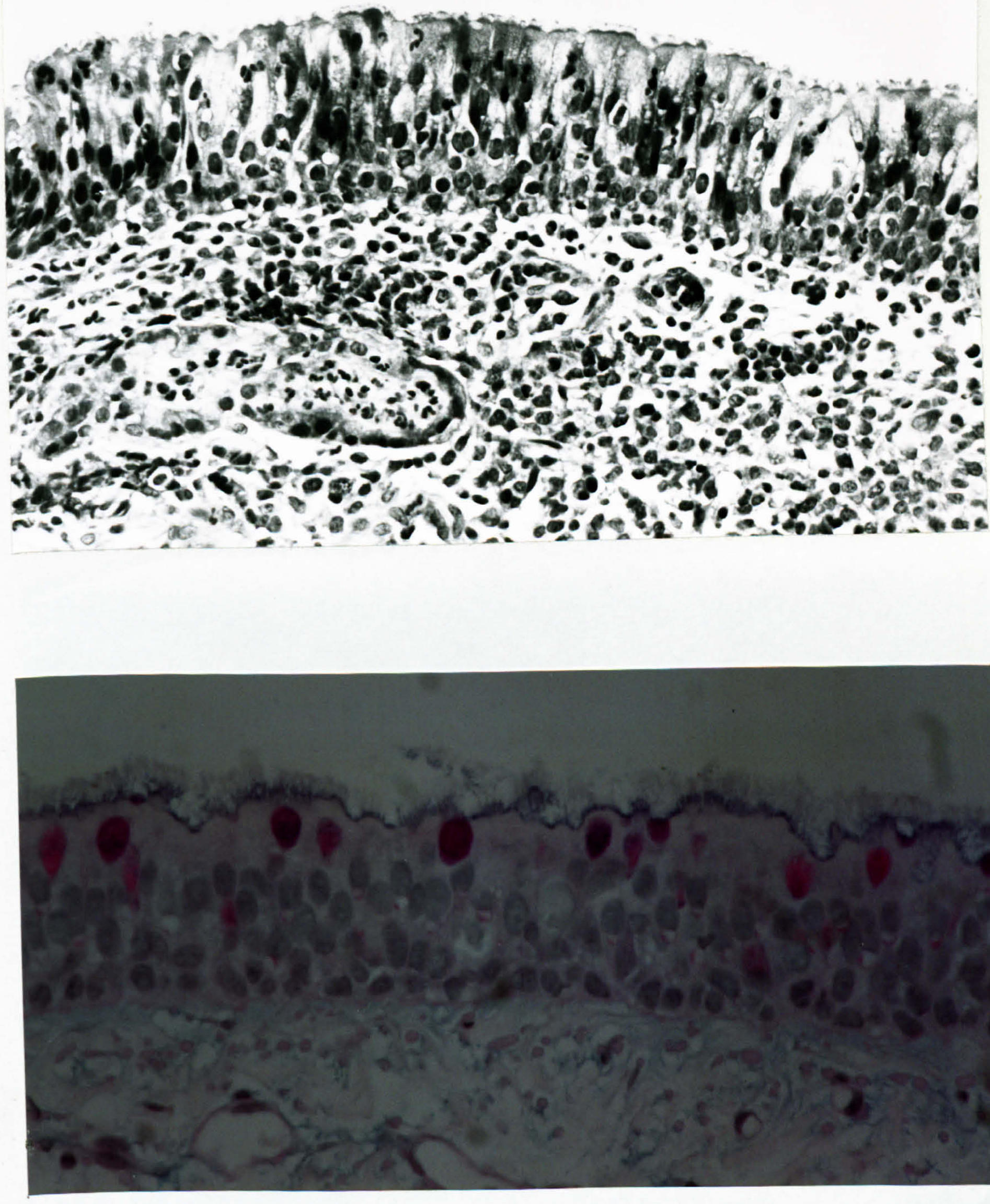
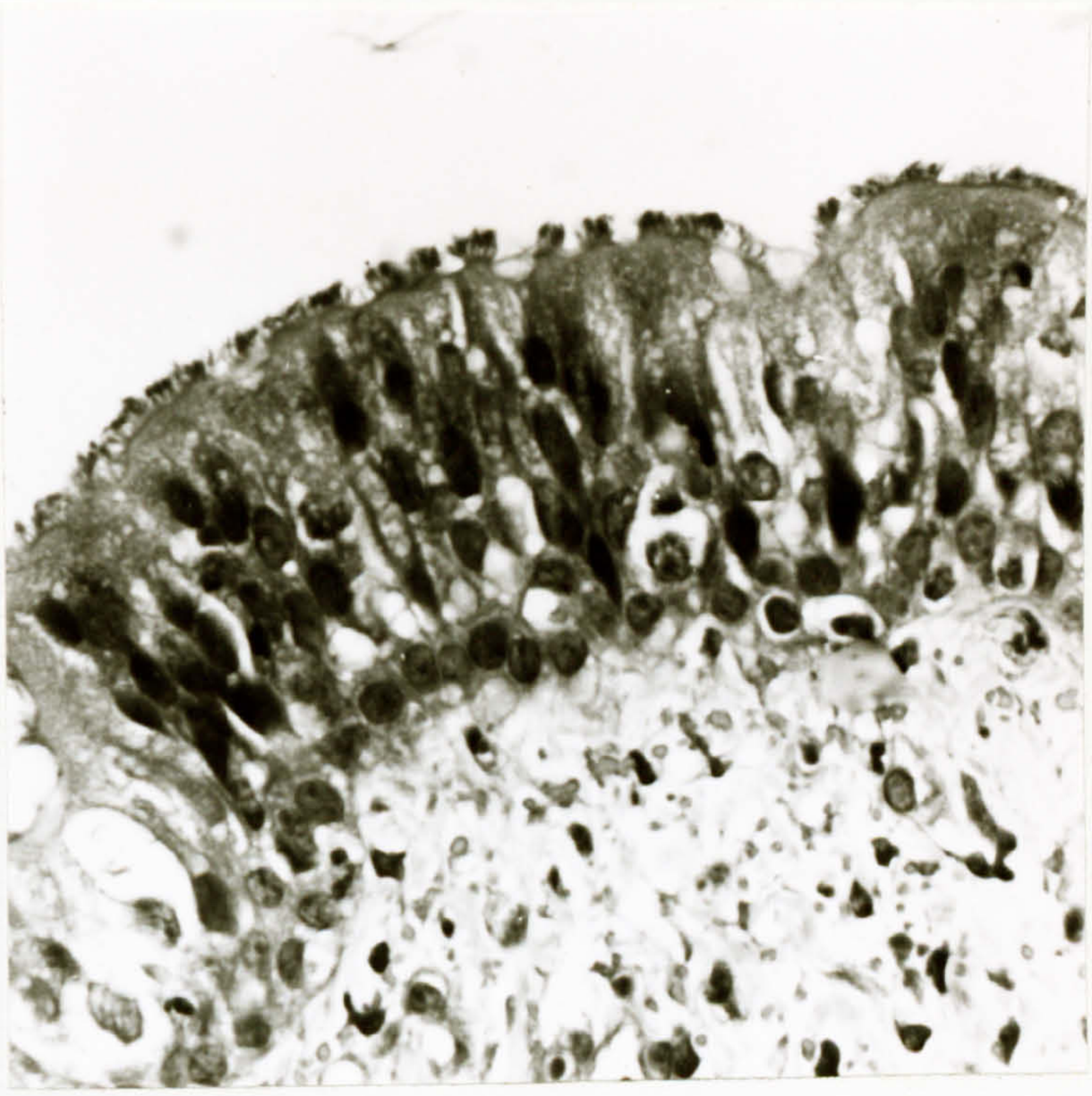


Fig. 7.23 Ventral larynx, 28 days post aerosolisation. Clumps of bacteria can be seen trapped in cilia.
HE x 350.

Fig. 7.24 Large bronchus, 28 days post aerosolisation. Many goblet cells can be seen.
AB-PAS x 180.



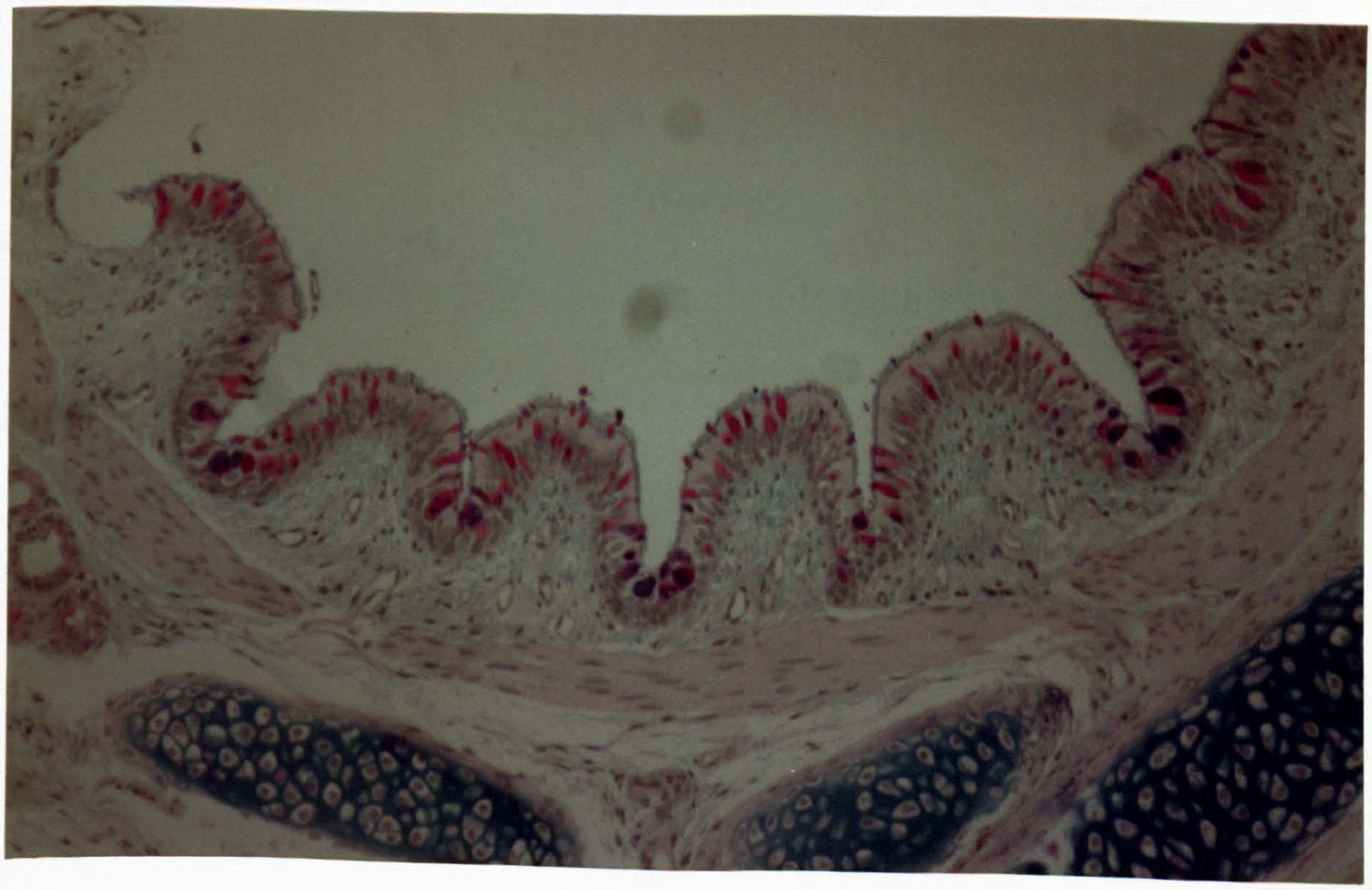
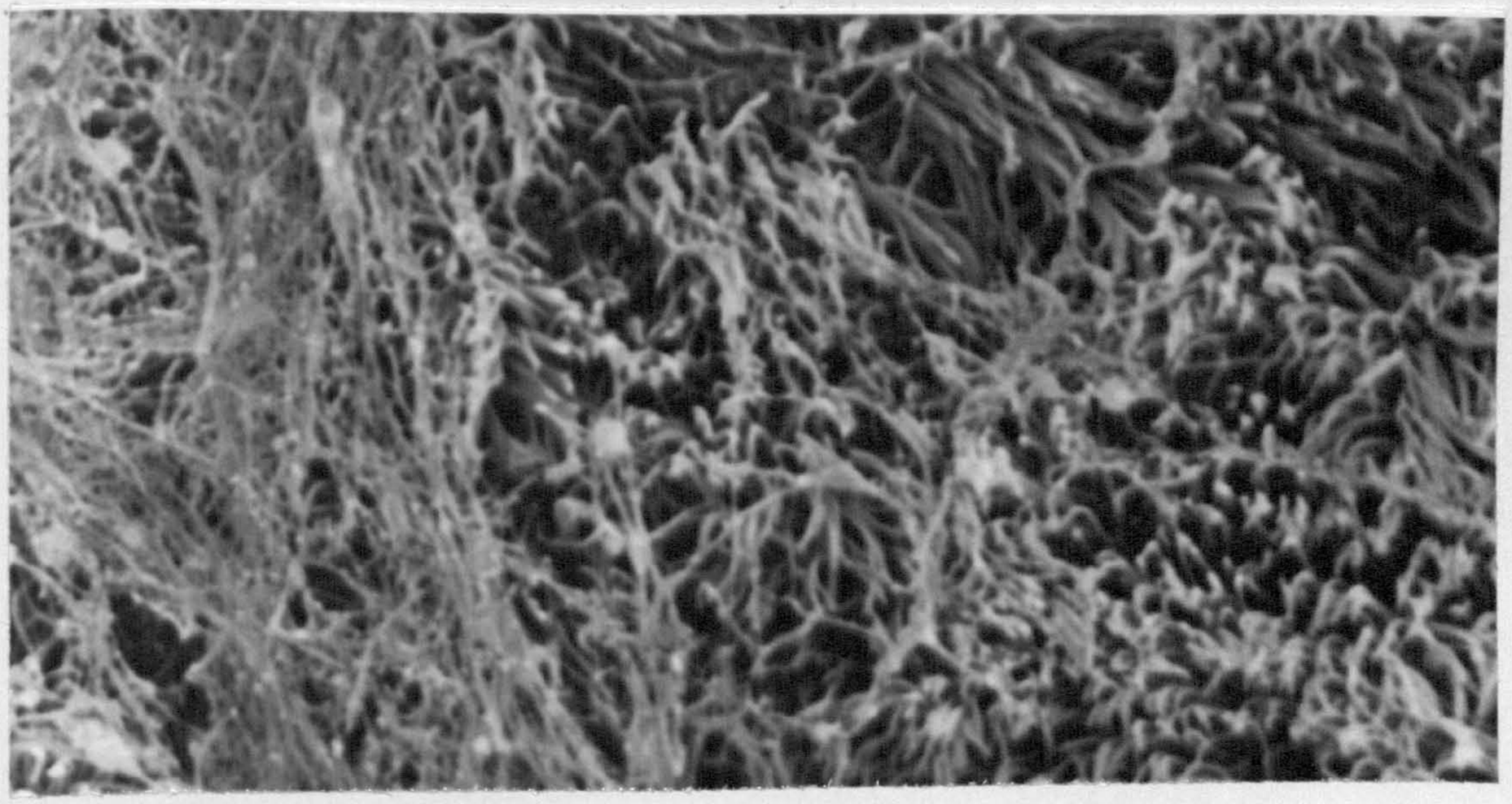


Fig. 7.25 Ventral larynx, four days post aerosolisation. The ciliated surface is covered with strands of mucus.
SEM x 3,750.

Fig. 7.26 Trachea, four days post aerosolisation. Two bacteria can be seen (arrows).
SEM x 30,000.



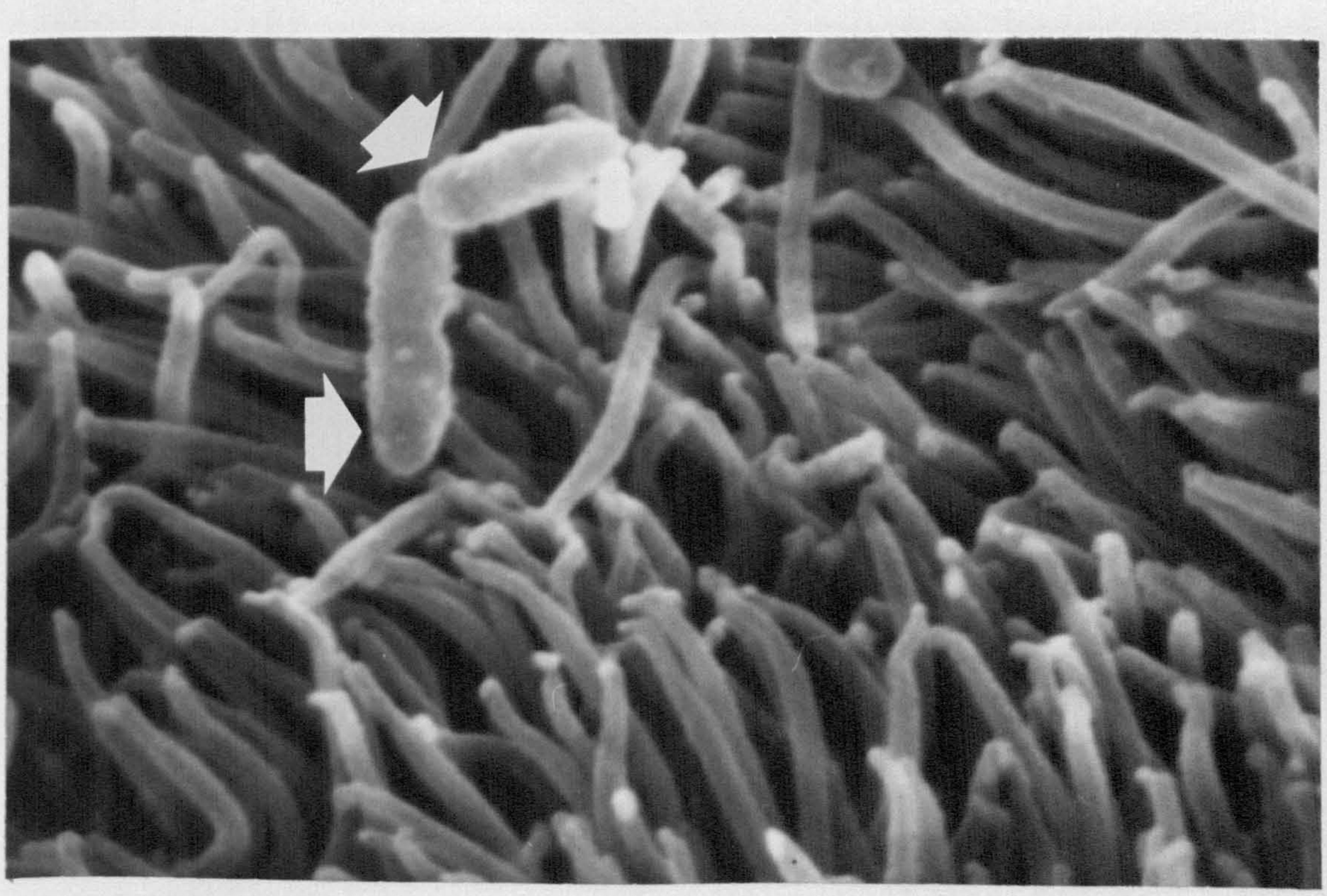
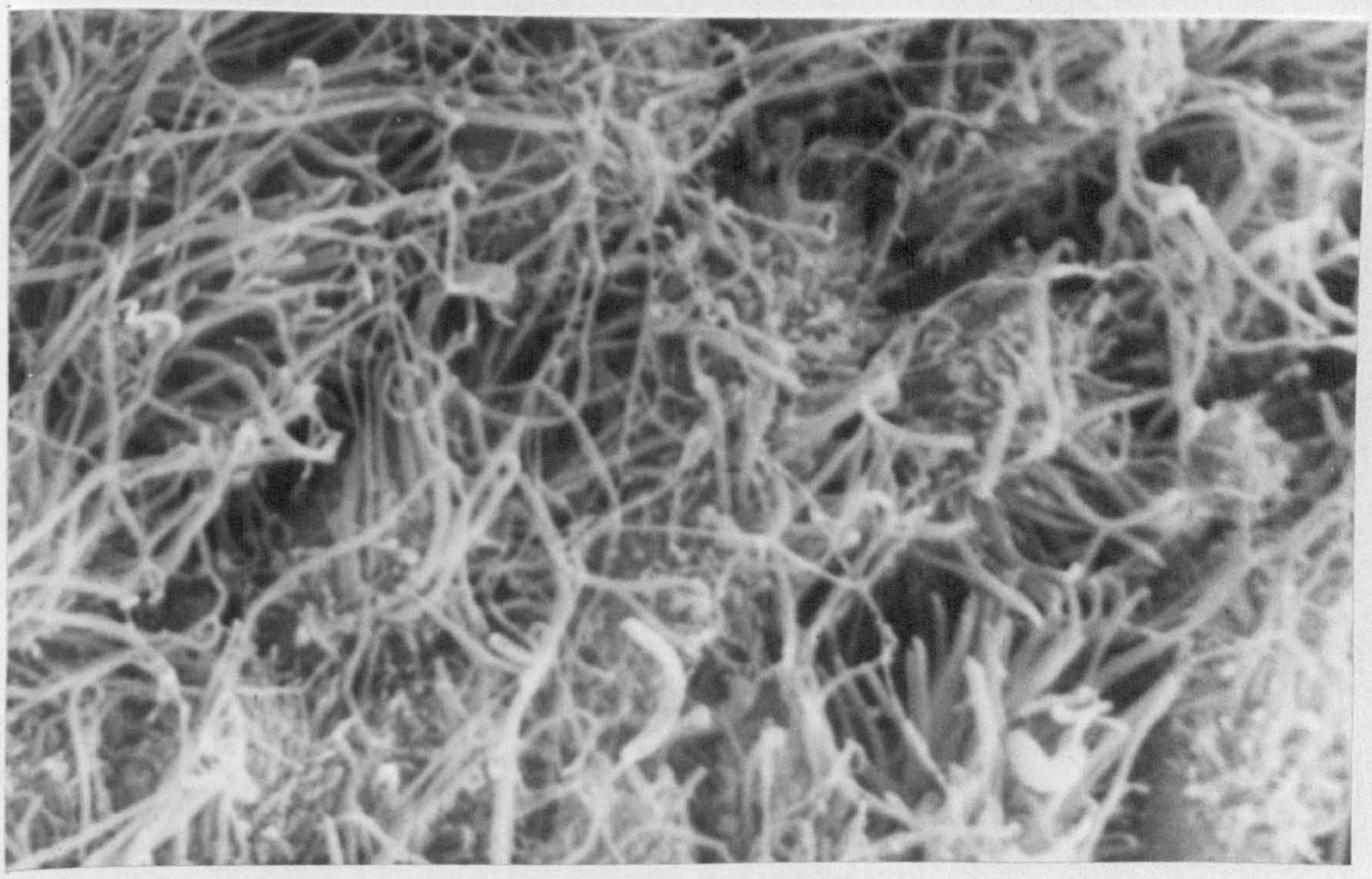


Fig. 7.27 Nasopharynx, four days post aerosolisation. Note the irregular tangled appearance of the cilia.
SEM x 7,500.

Fig. 7.28 Extrapulmonary bronchus, four days post aerosolisation.
In this region, there is almost complete loss of cilia.
SEM x 7,500.



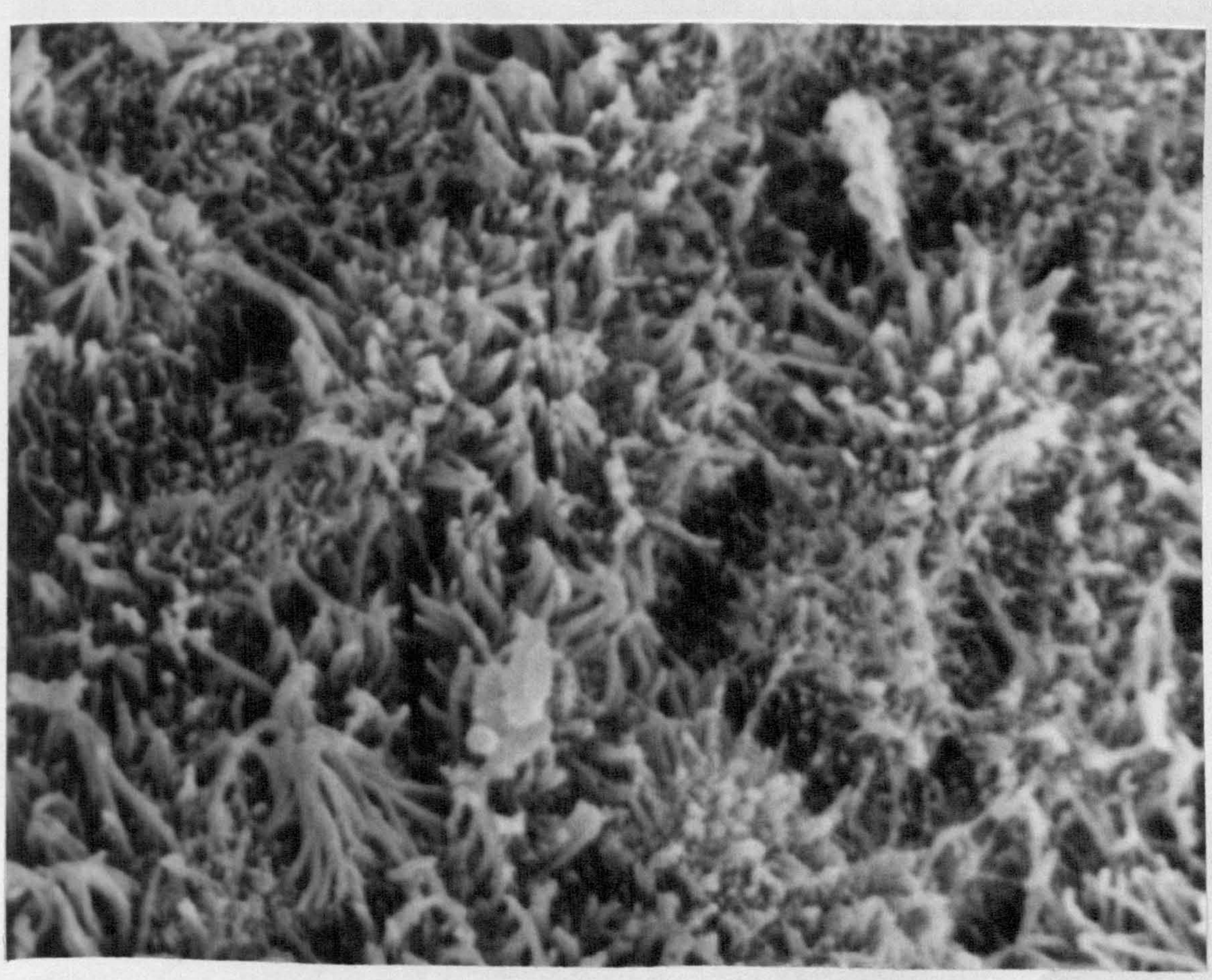


Fig. 7.29 Alveolus, four days post aerosolisation. Note the large alveolar macrophage (M) with its irregular cytoplasmic outline. SEM x 15,000.

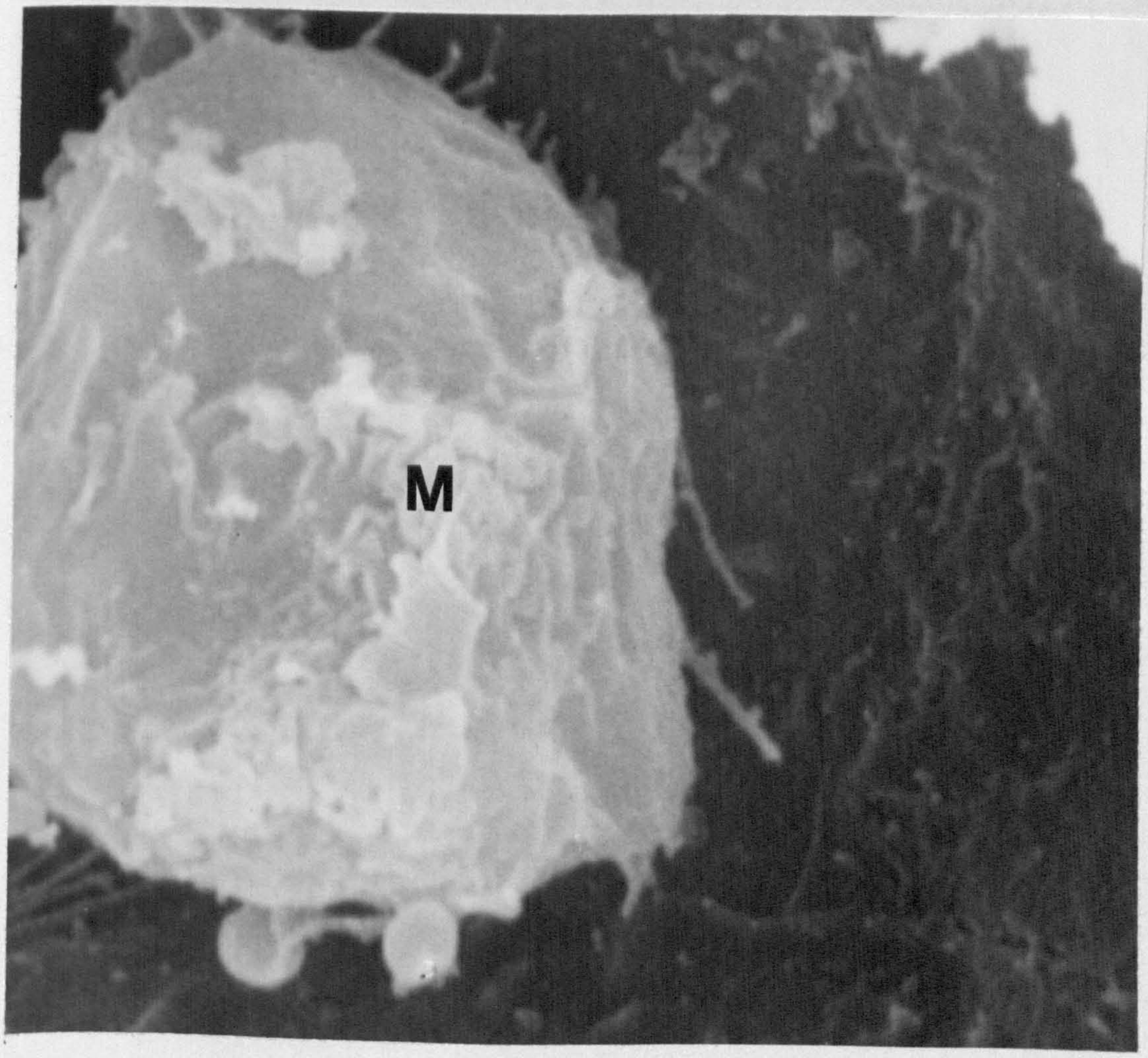

M

Fig. 7.30 Extrapulmonary bronchus, six days post aerosolisation. Many Bordetella bronchiseptica organisms are present. Fine filaments (arrow) can be seen apparently anchoring some bacteria to neighbouring cilia. SEM x 30,000.

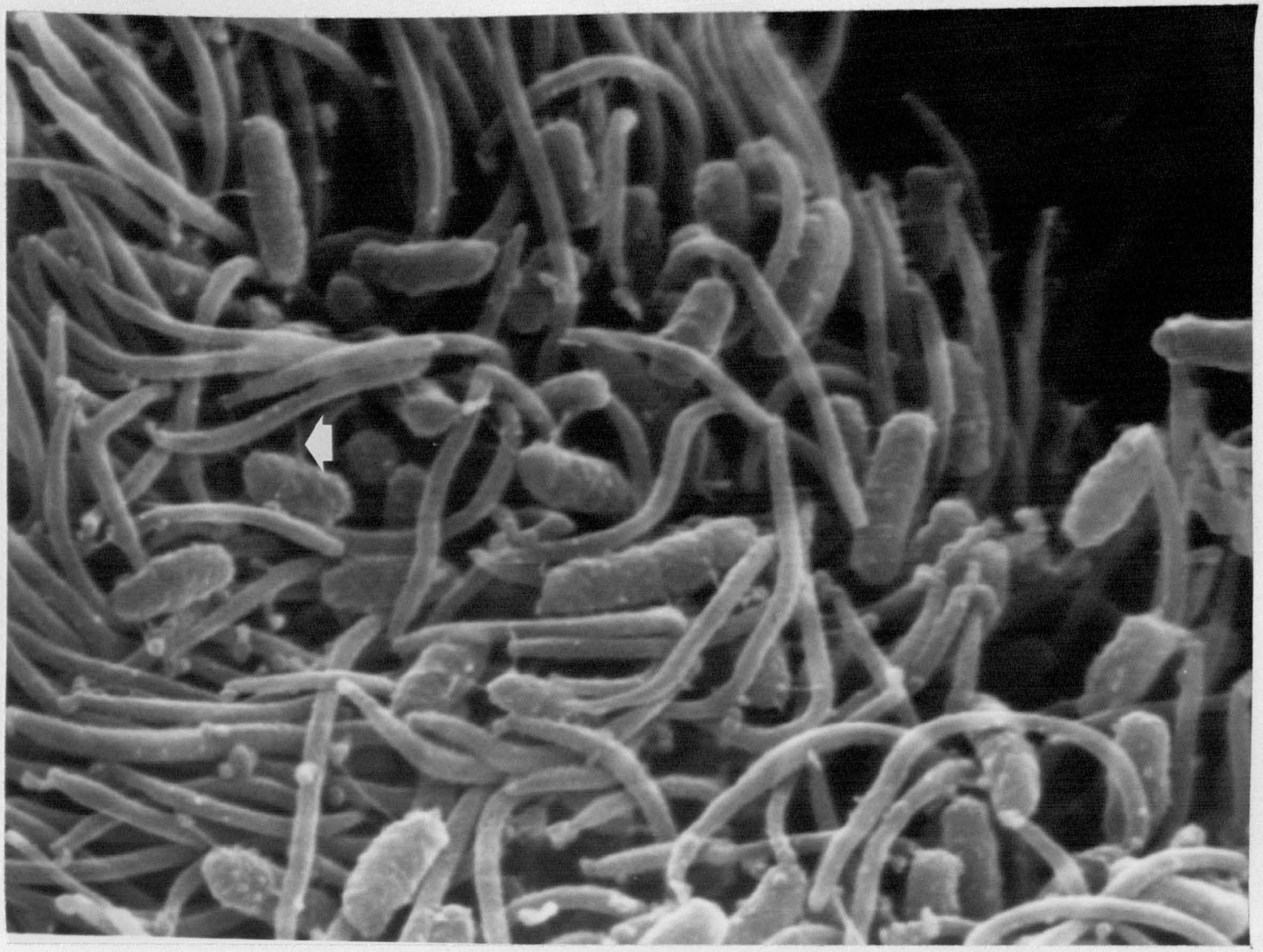


Fig. 7.31 Septum, six days post aerosolisation. In this field, there is complete ciliary necrosis and epithelial cell disruption.
SEM x 7,500.

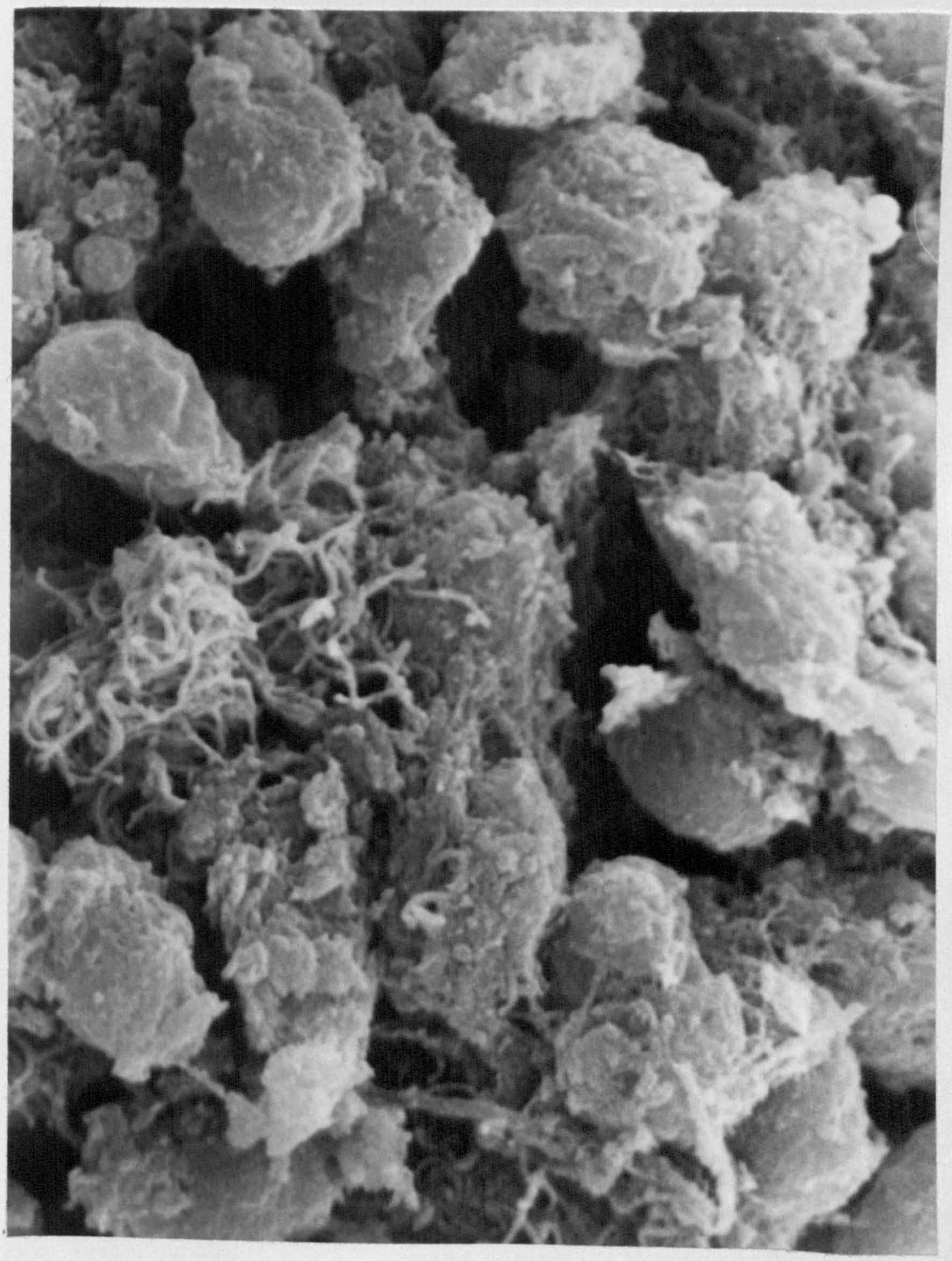


Fig. 7.32 Trachea, six days post aerosolisation. Note the patch of non-ciliated or poorly-ciliated epithelial cells. SEM x 960.

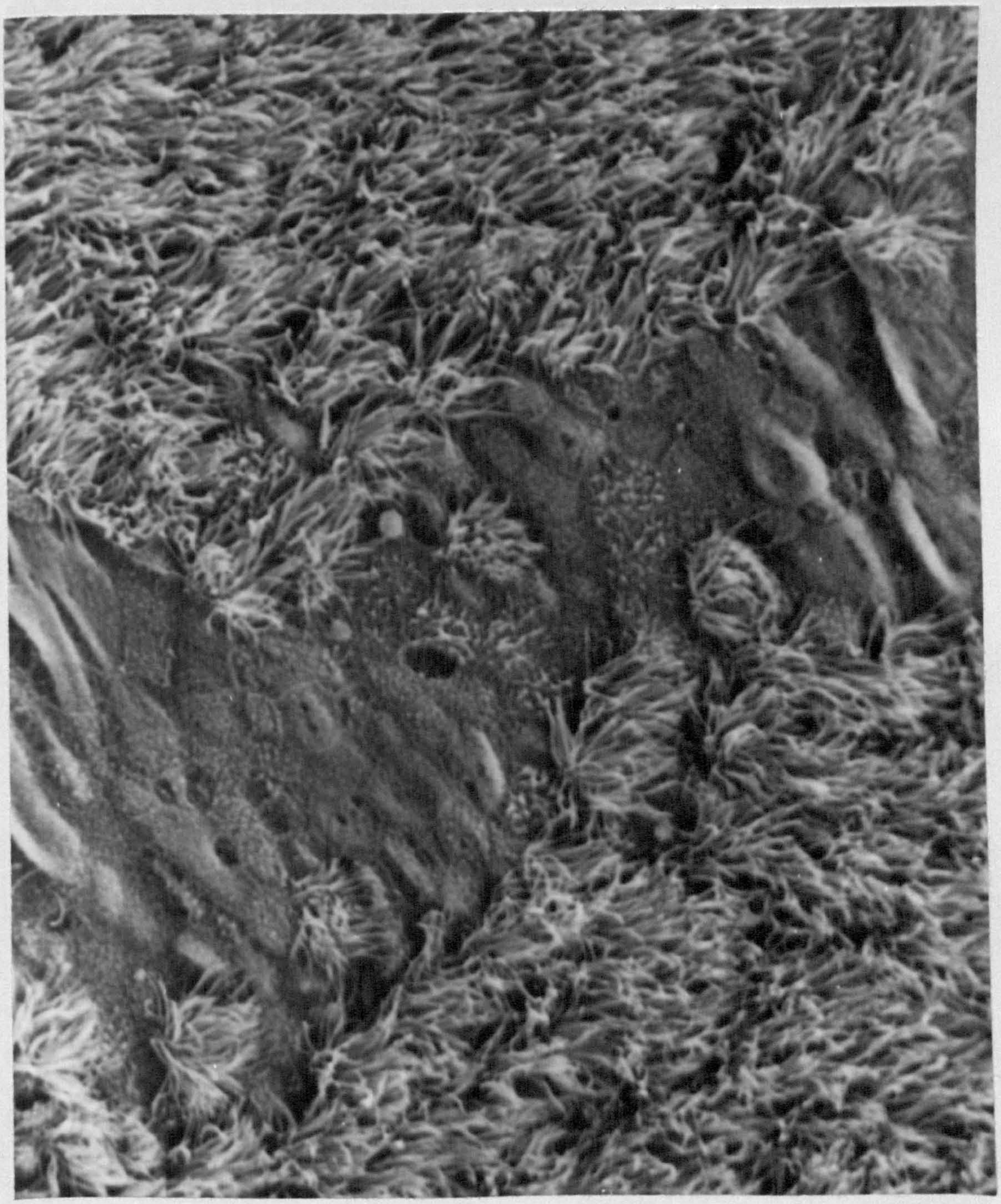


Fig. 7.33 Extrapulmonary bronchus, six days post aerosolisation. Note some sparsely-ciliated cells; others have no cilia and are covered with microvillous processes. SEM x 7,500.



Fig. 7.34 Trachea, six days post aerosolisation. Two polymorphonuclear leucocytes (P) can be seen. Note their irregularly folded surface.
SEM x 15,000.

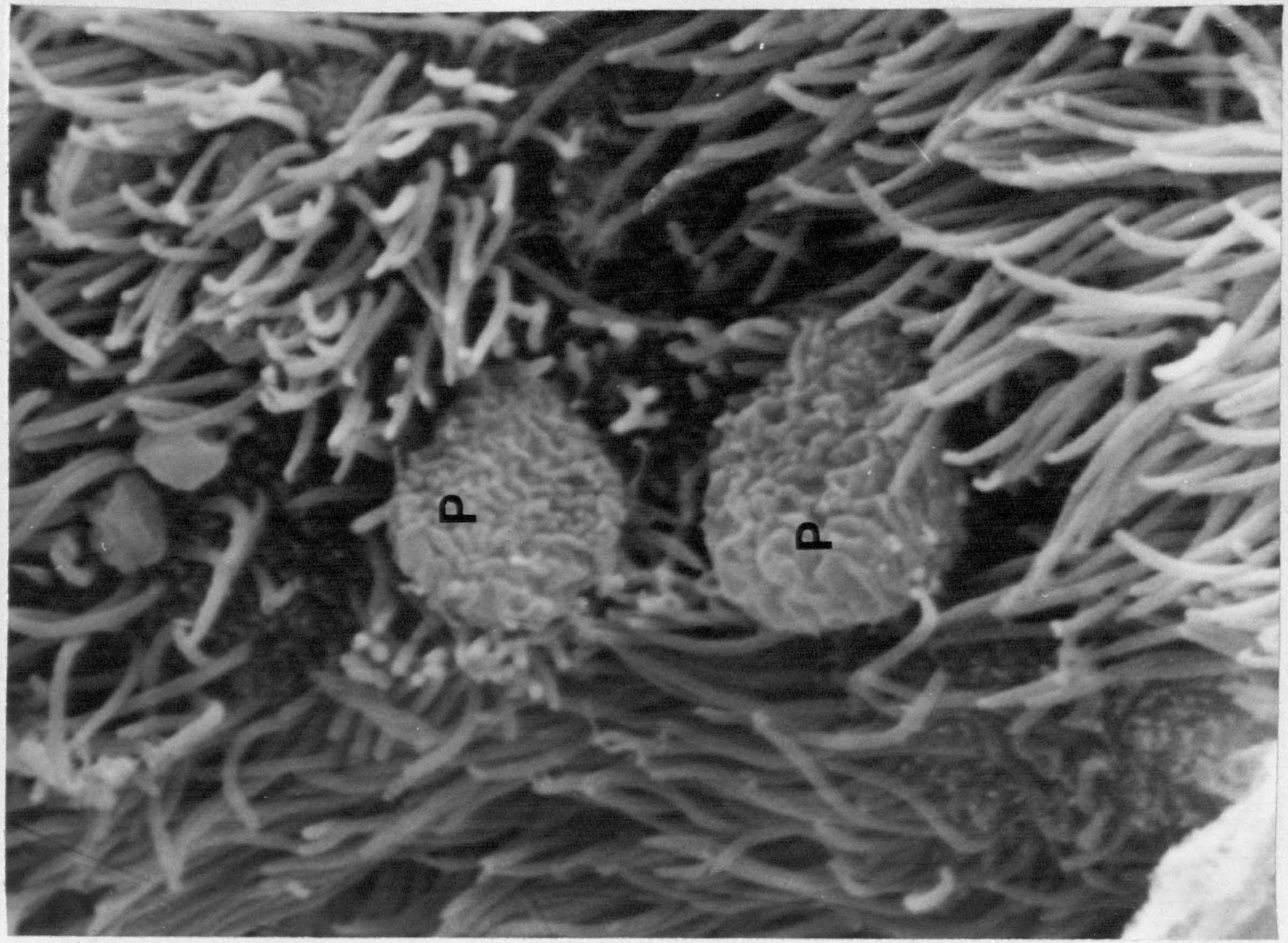

P
P

Fig. 7.35 Nasopharynx, eight days post aerosolisation. There is complete ciliary disorganisation; many cilia appear clumped together. SEM x 7,500.

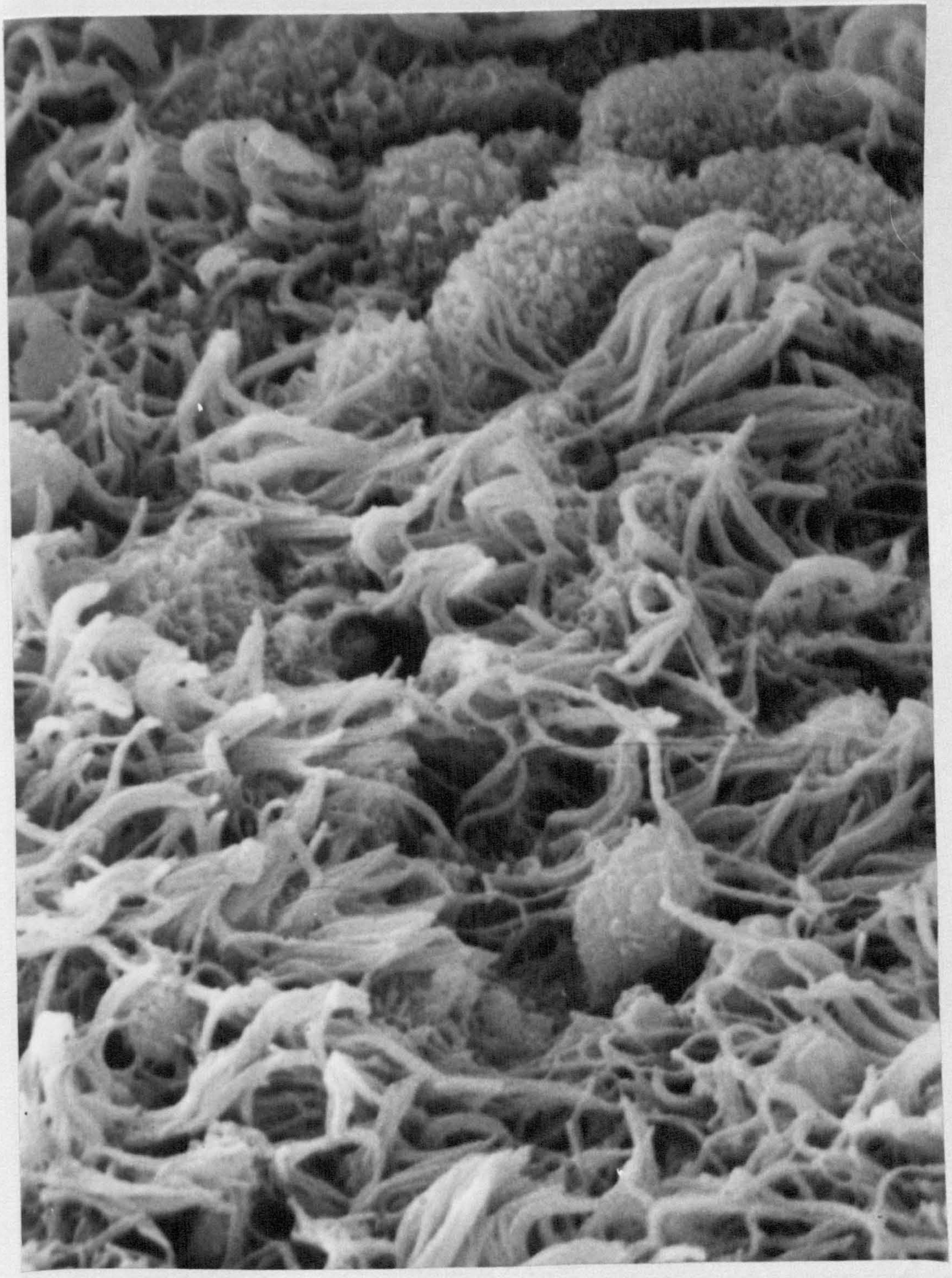


Fig. 7.36 Large bronchus, eight days post aerosolisation. Note the clump of inflammatory debris (D) on the folded mucosal surface. SEM x 640.

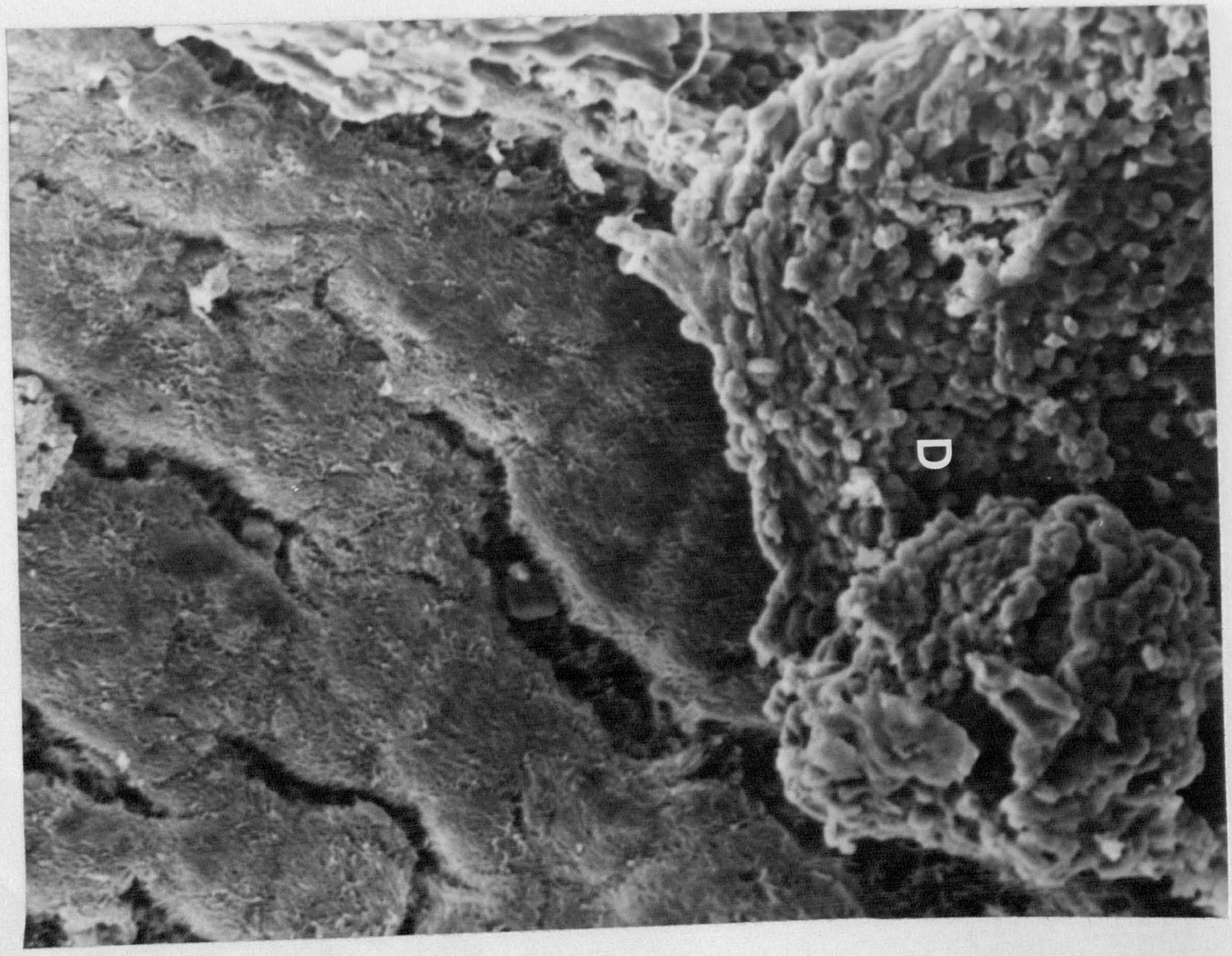

D

Fig. 7.37 Large bronchiole, eight days post aerosolisation. The lumen contains clumps of inflammatory exudate.

SEM x 640.

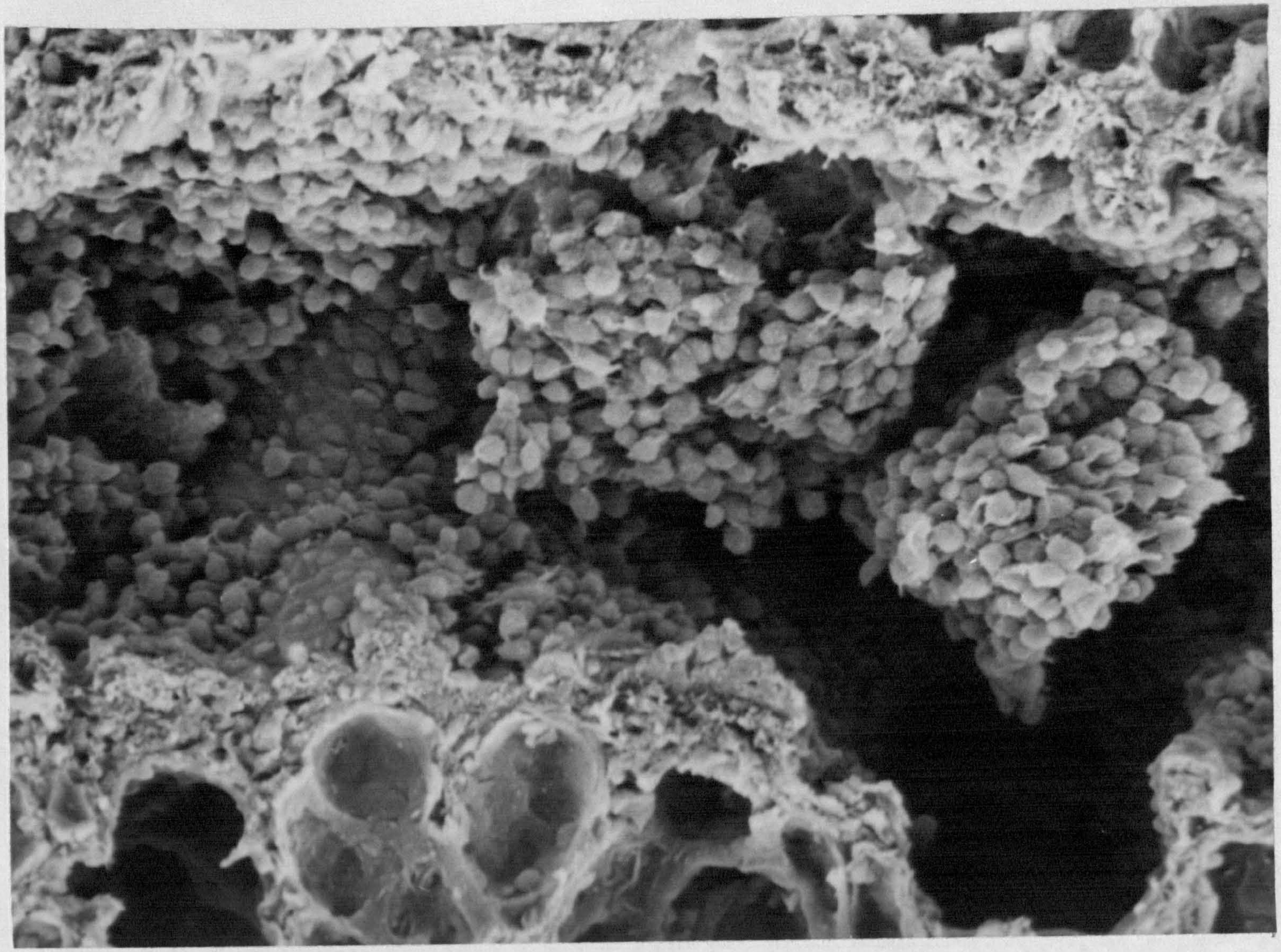


Fig. 7.38 Alveolus, eight days post aerosolisation. An alveolar macrophage (M) is apparently anchored to underlying Type I pneumonocytes by many slender cytoplasmic processes (arrows). SEM x 15,000.

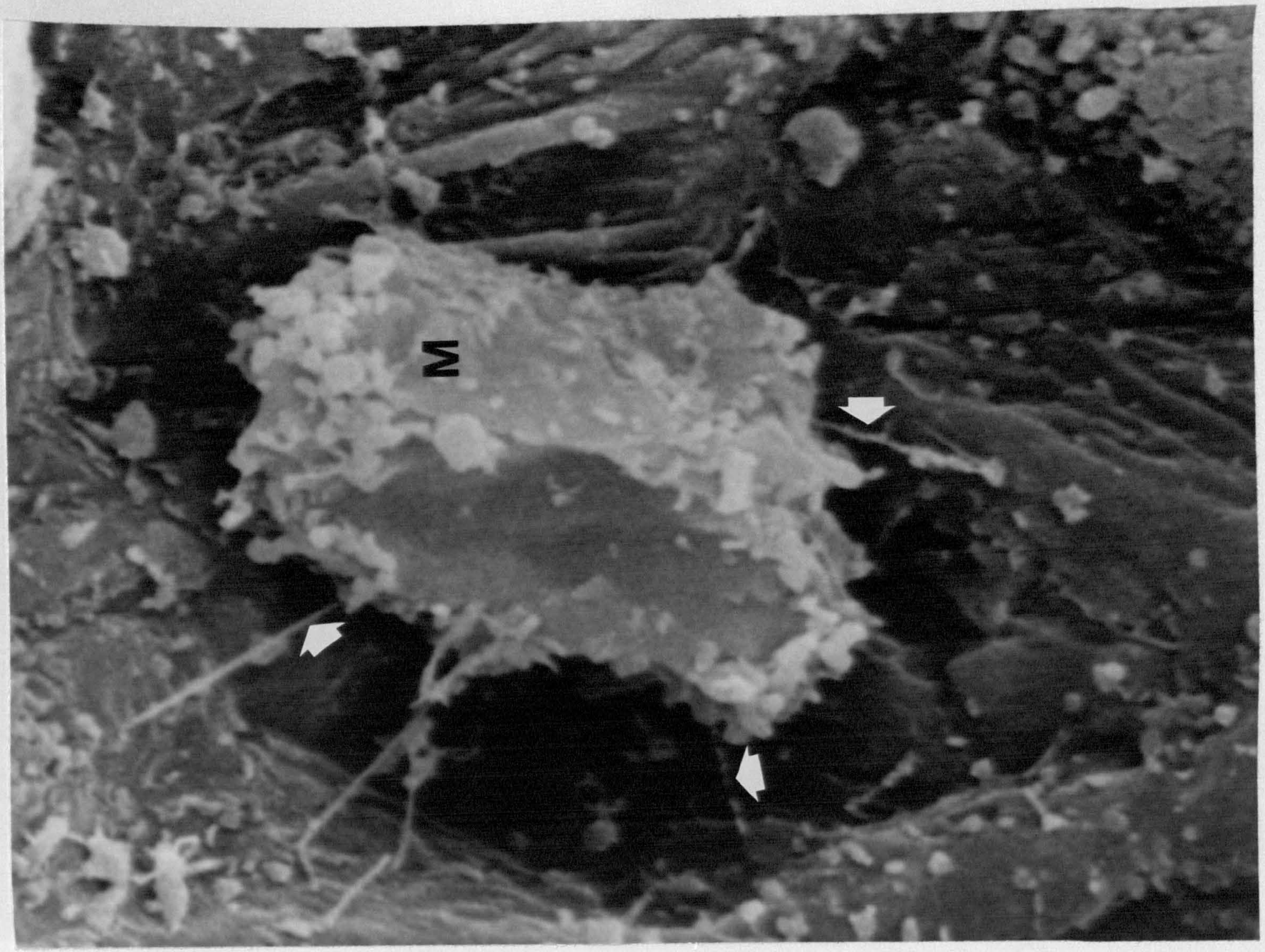

M

Fig. 7.39 Ventral larynx, ten days post aerosolisation. Note the tangled appearance of the cilia. SEM x 7,500.

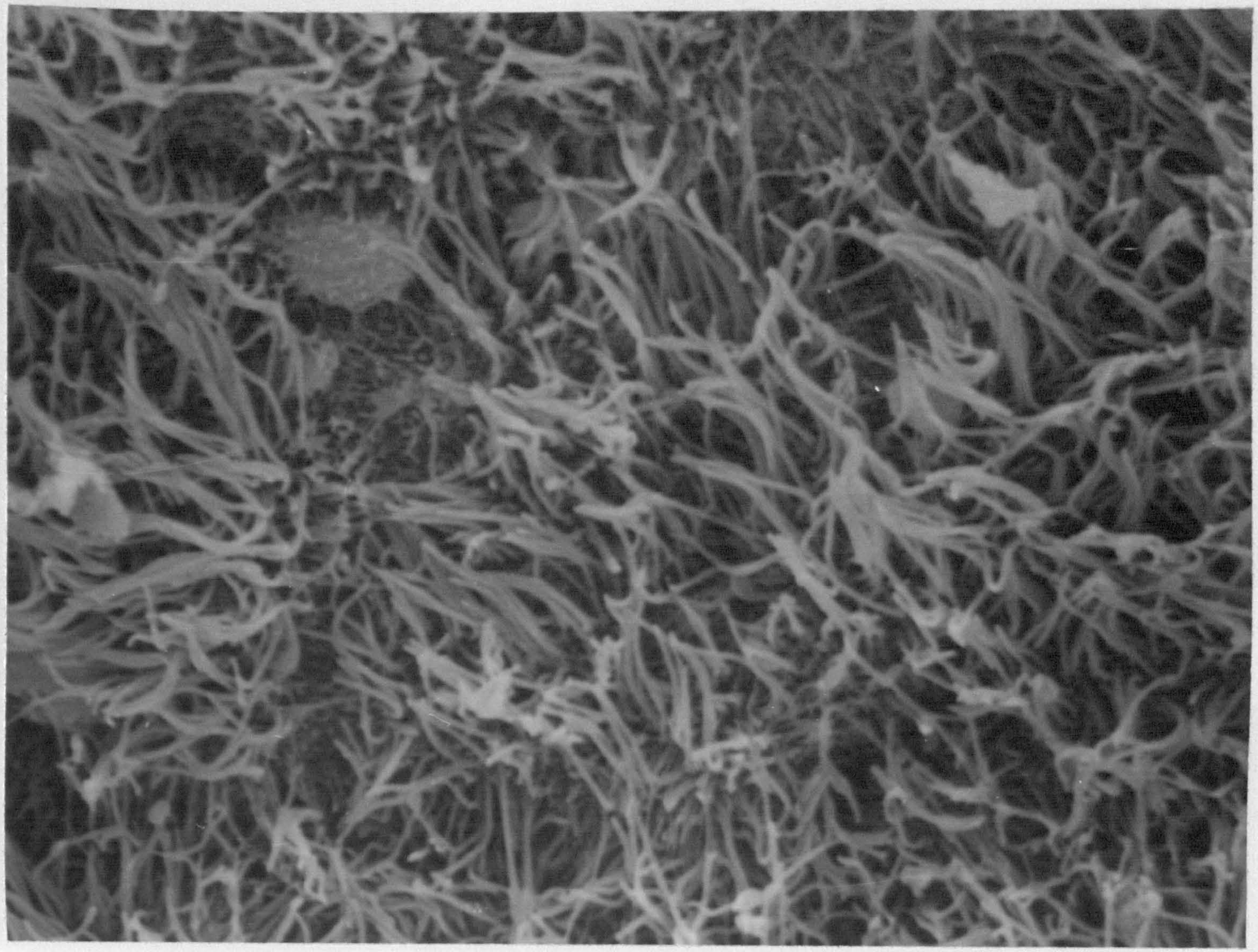


Fig. 7.40 Large bronchus, ten days post aerosolisation. Some cells are devoid of cilia; others have short stunted cilia.
SEM x 7,500.

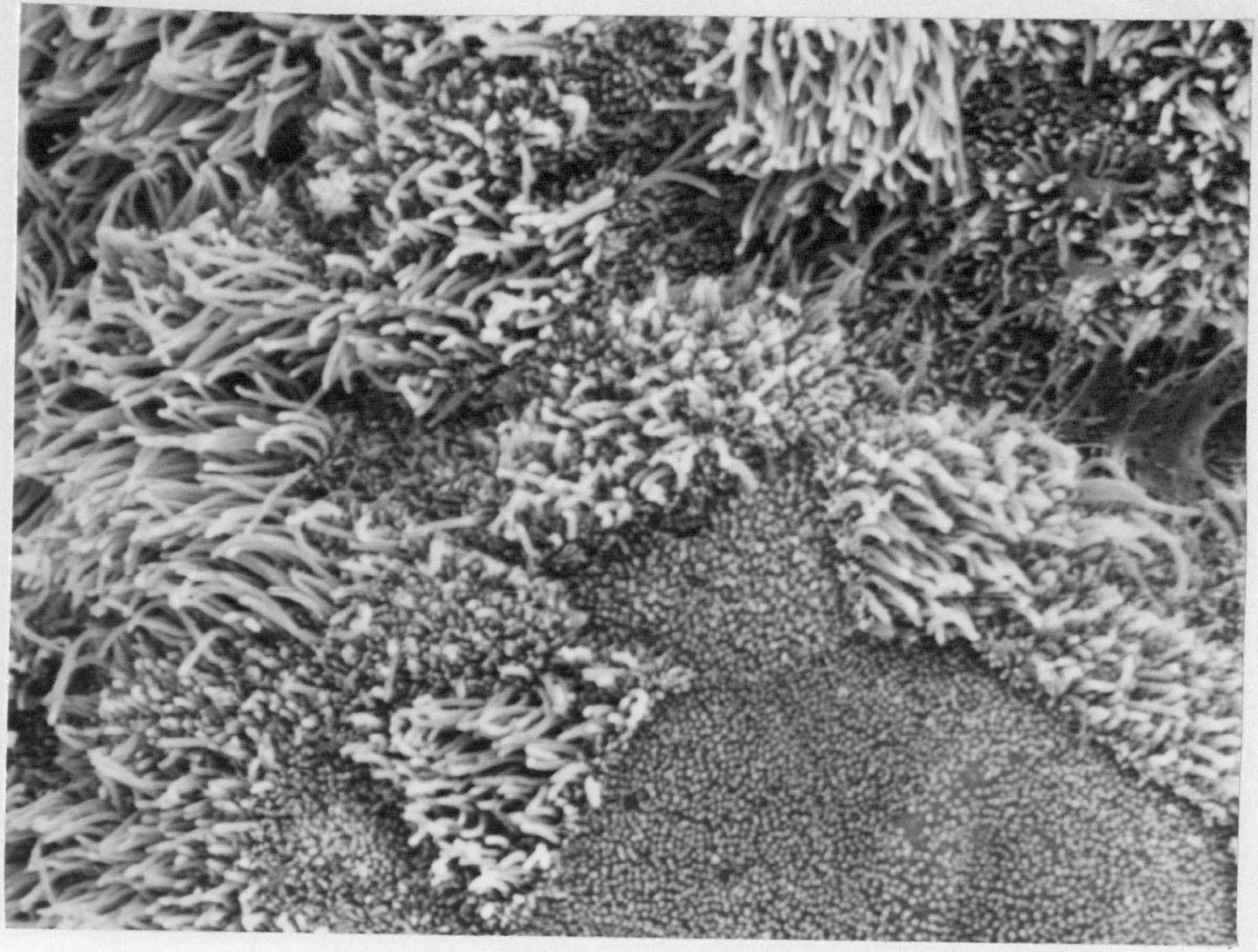


Fig. 7.41 Lung, ten days post aerosolisation. Many cells, mainly alveolar macrophages, are present in the alveoli.
SEM x 1920.

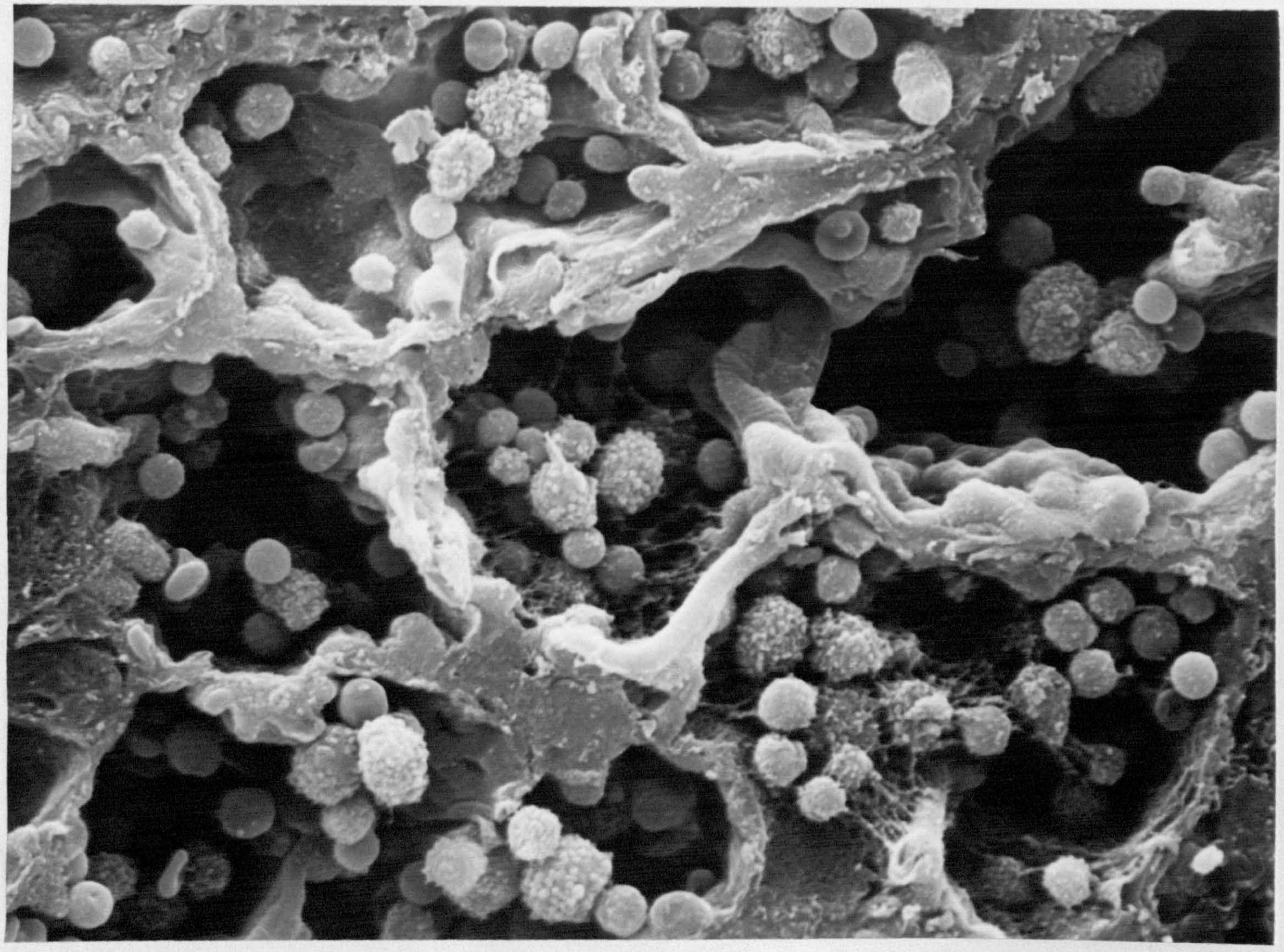


Fig. 7.42 Trachea, ten days post aerosolisation. A focal patch of non-ciliated microvillous cells. SEM x 1920.

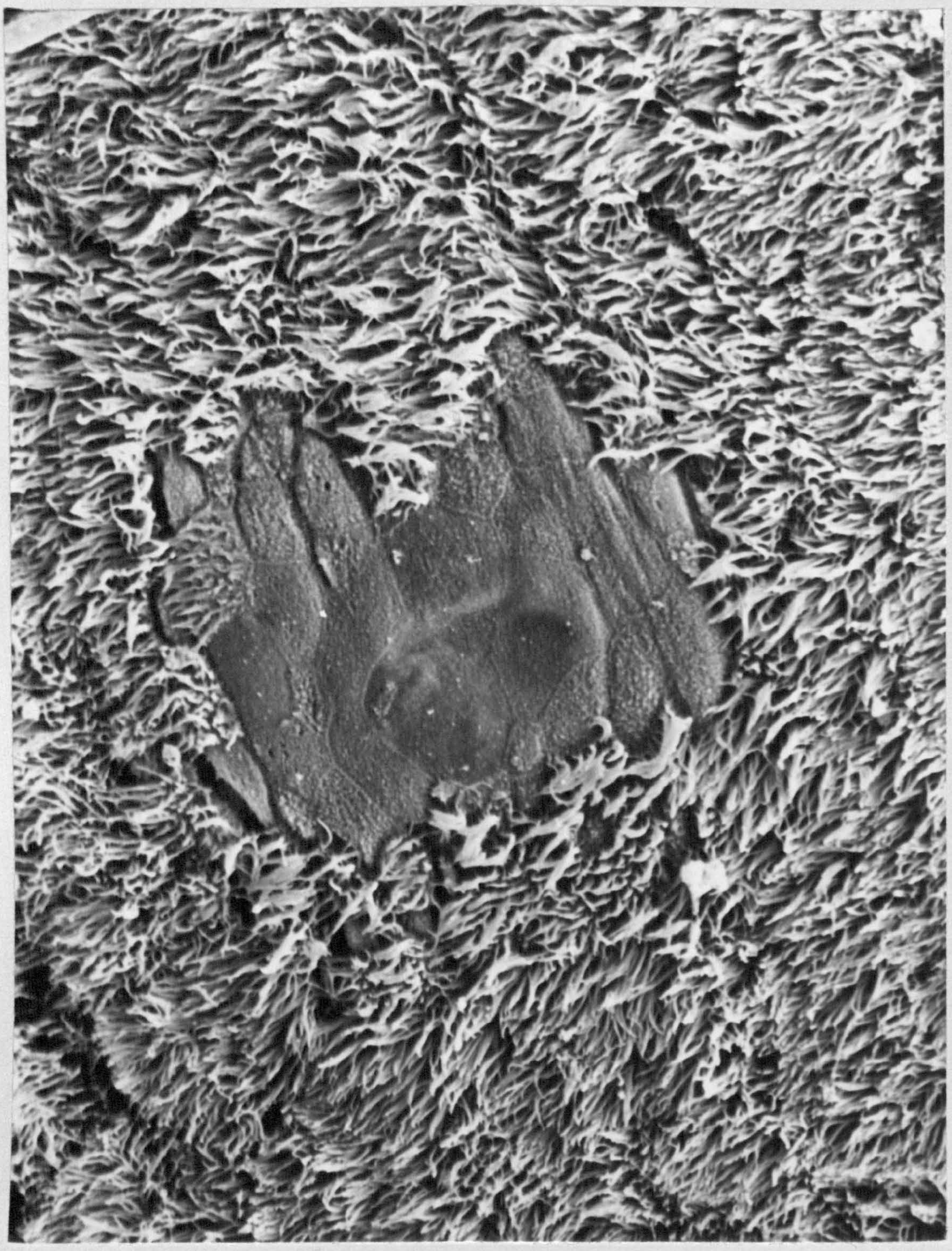


Fig. 7.43 Extrapulmonary bronchus, ten days post aerosolisation. A patch of non-ciliated microvillous cells. A few bacteria (arrows) can be seen.
SEM x 7,500.

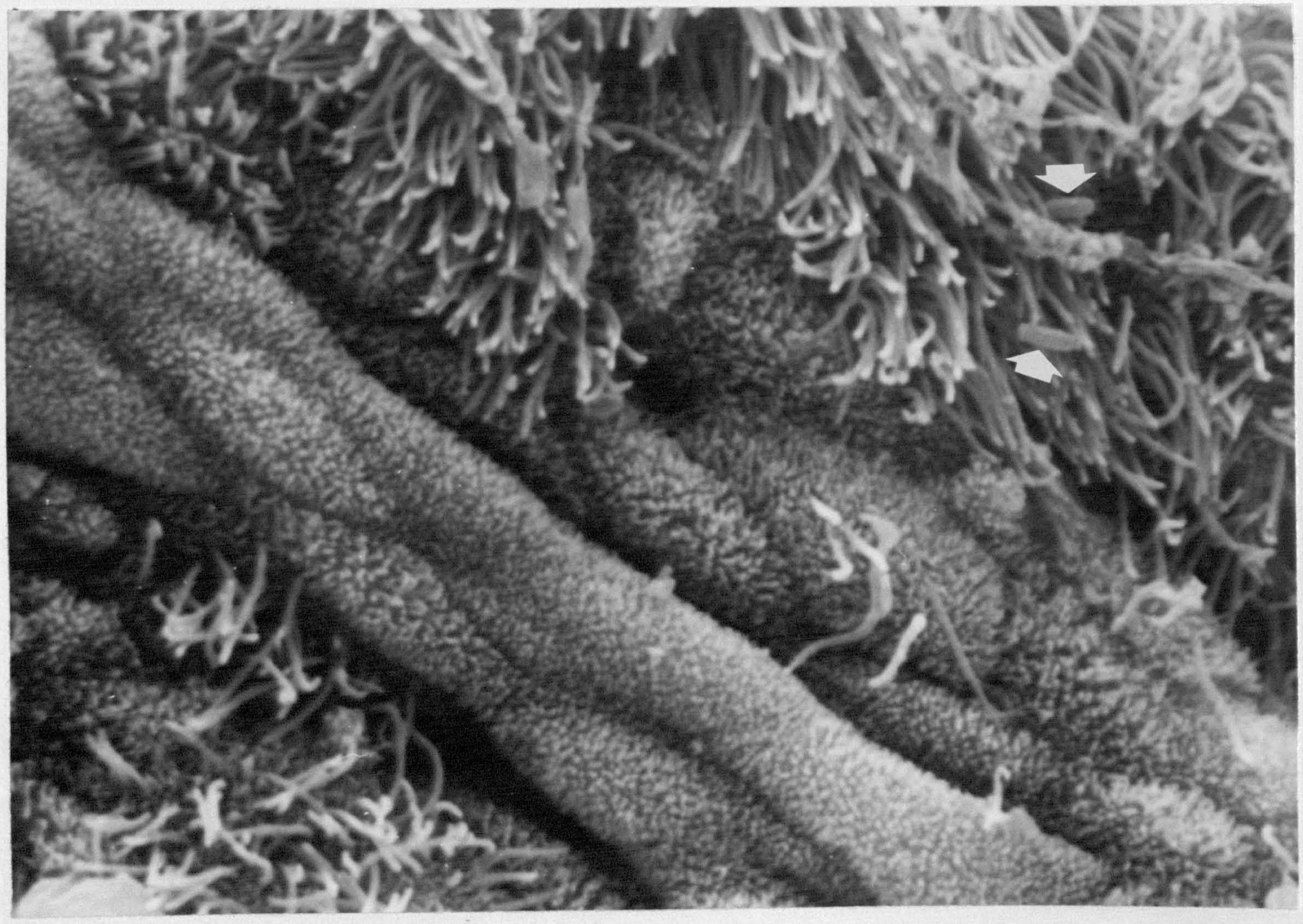


Fig. 7.44 Nasopharynx, ten days post aerosolisation. Many Bordetella bronchiseptica organisms can be seen.
SEM x 7,500.

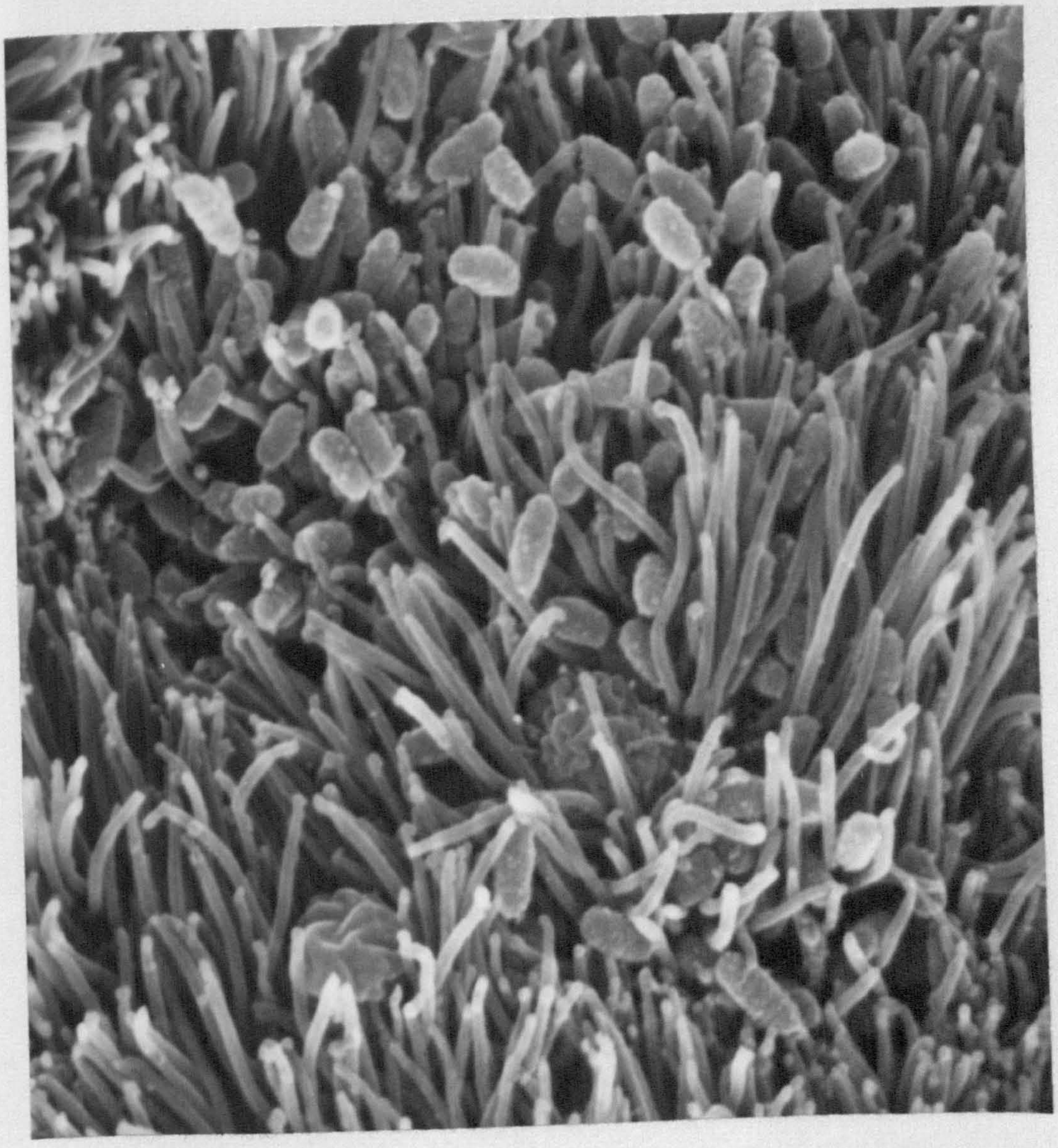


Fig. 7.45 Trachea, 20 days post aerosolisation. Note the patchy distribution of ciliated cells. A tracheal gland orifice exuding mucus can be seen. SEM x 960.

Fig. 7.46 Extrapulmonary bronchus, 20 days post aerosolisation. A patch of non-ciliated squamous-like epithelium can be seen. SEM x 480.

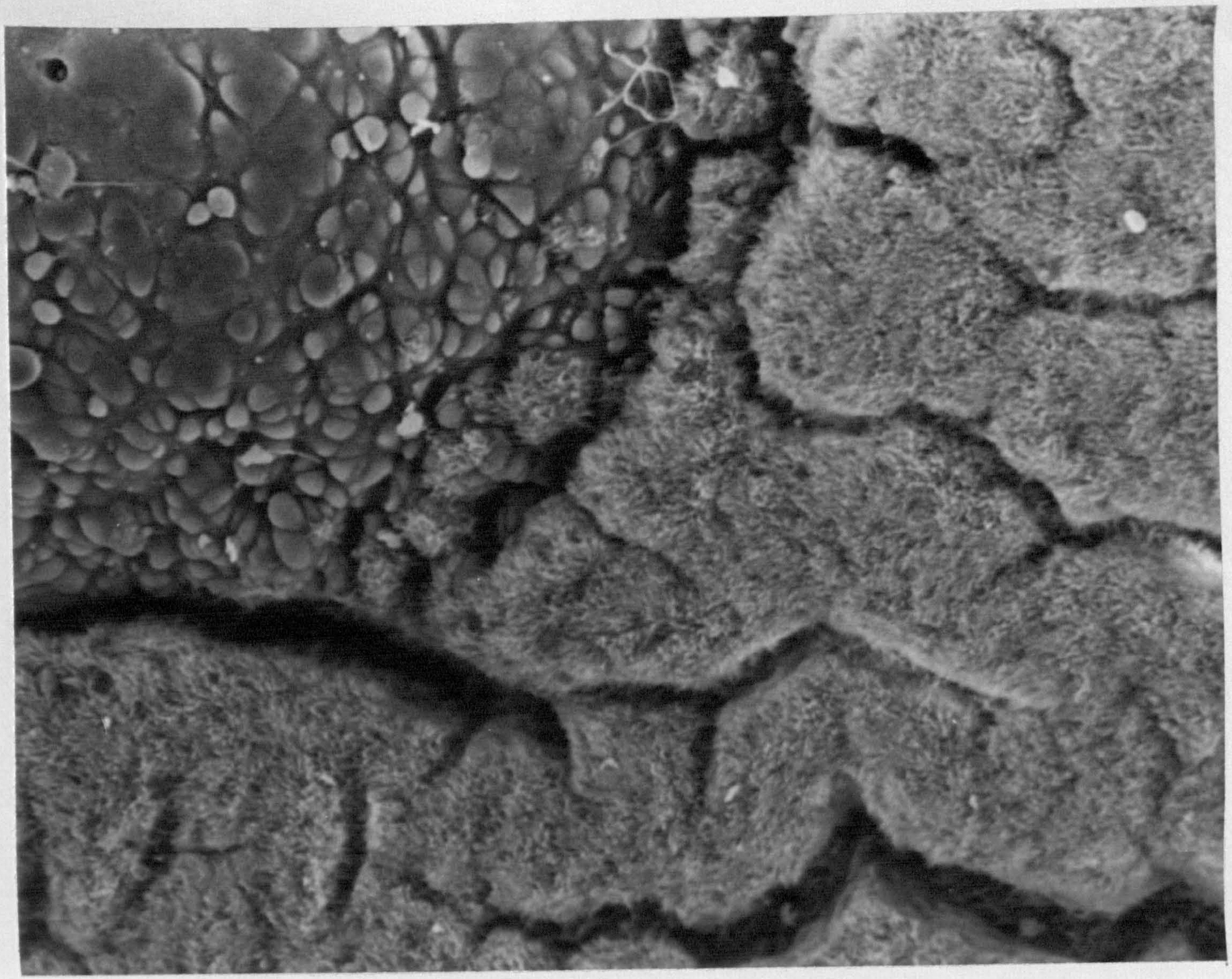


Fig. 7.47 Lung, 20 days post aerosolisation. Note the thickened alveolar septa (arrows). SEM x 1920.

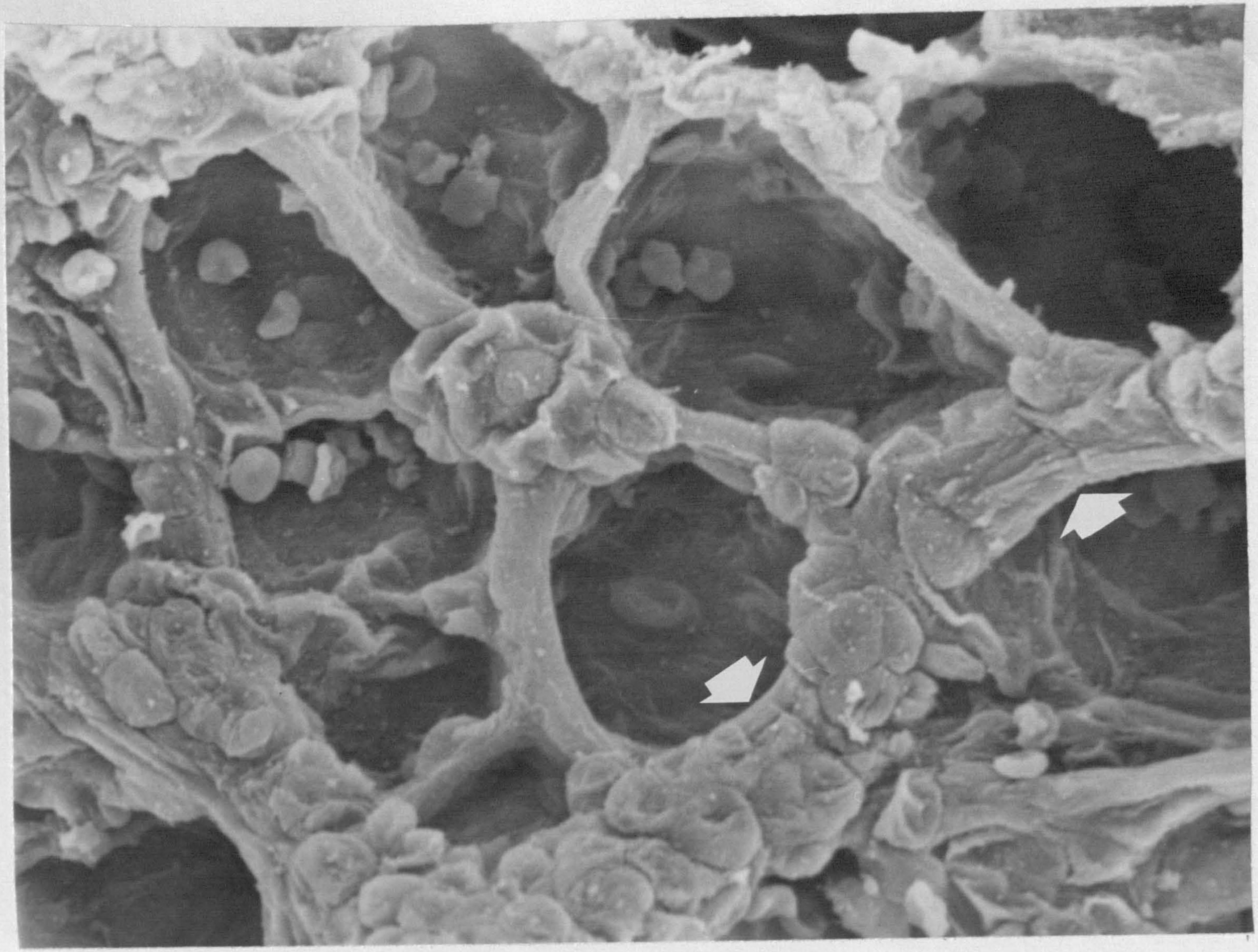


Fig. 7.48 Septum, 20 days post aerosolisation.
Note the numerous goblet cells.
SEM x 3,750.



Fig. 7.49 Trachea, 20 days post aerosolisation. The epithelium is normal but a few organisms are present (arrow). SEM x 7,500.

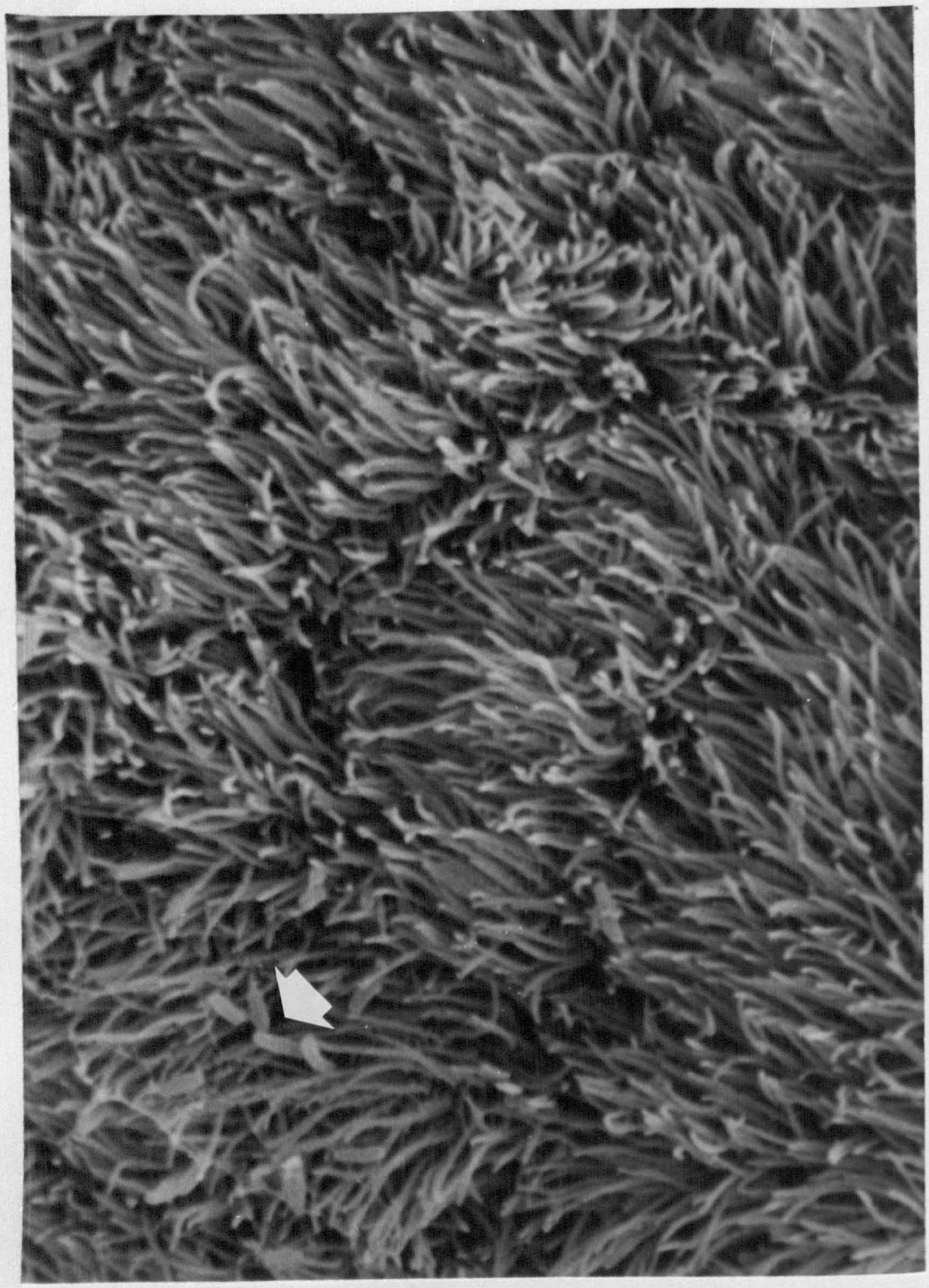


Fig. 7.50 Extrapulmonary bronchus, 28 days post aerosolisation. Many non-ciliated microvillous cells can be seen.
SEM x 7,500.

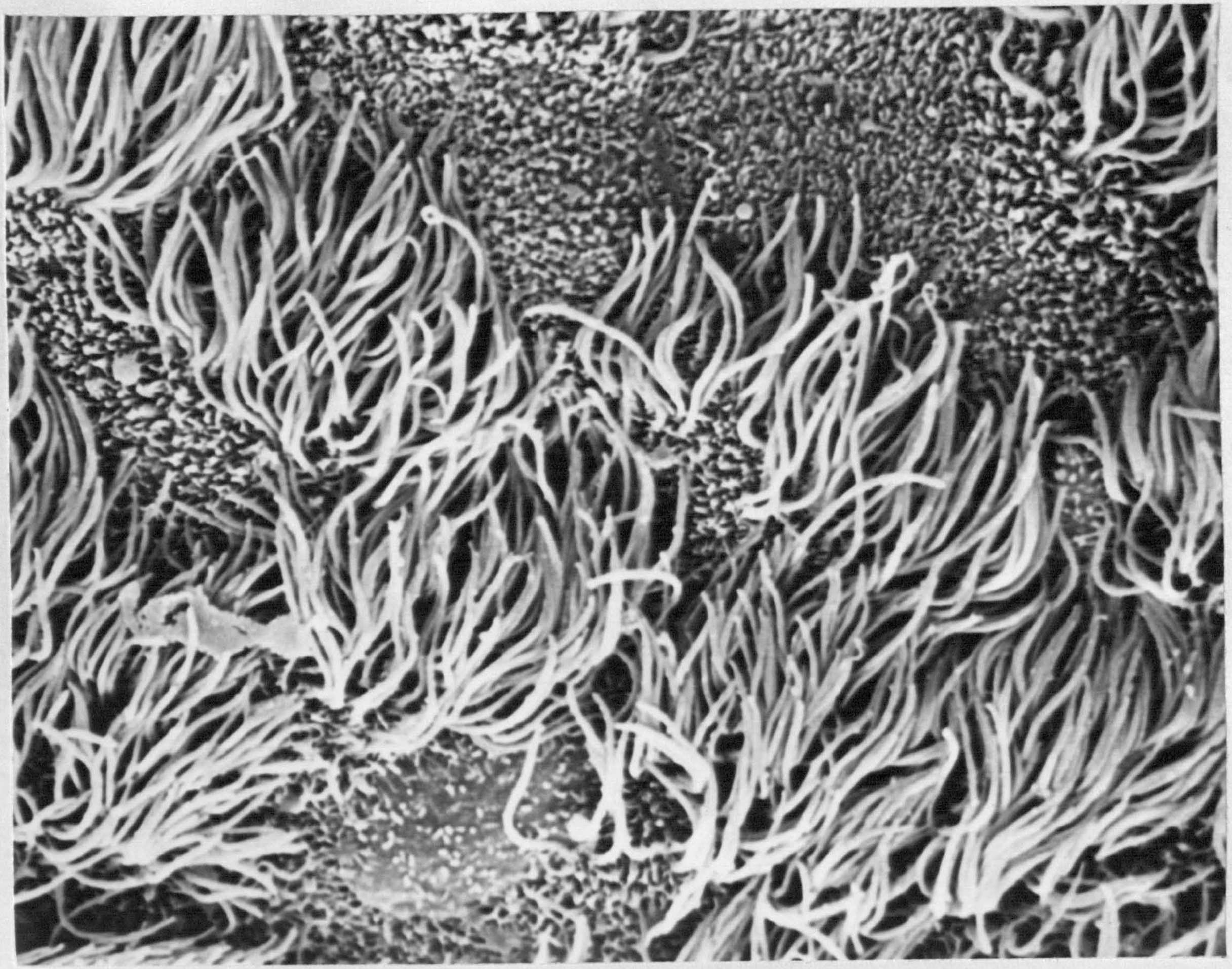
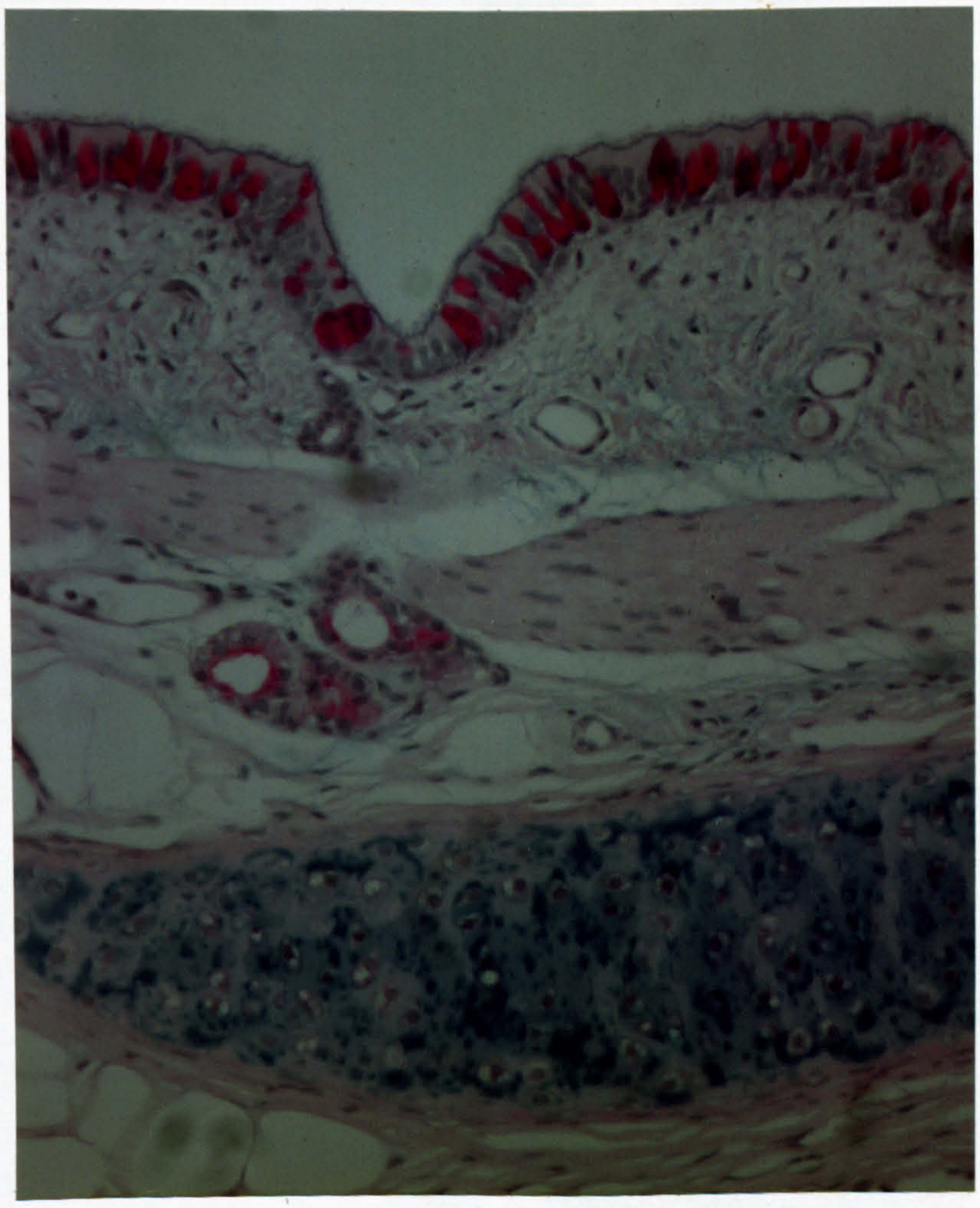


Fig. 7.51 Extrapulmonary bronchus, control dog killed at 20 days post aerosolisation. Many neutral-staining goblet cells can be seen. AB-PAS x 180.



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