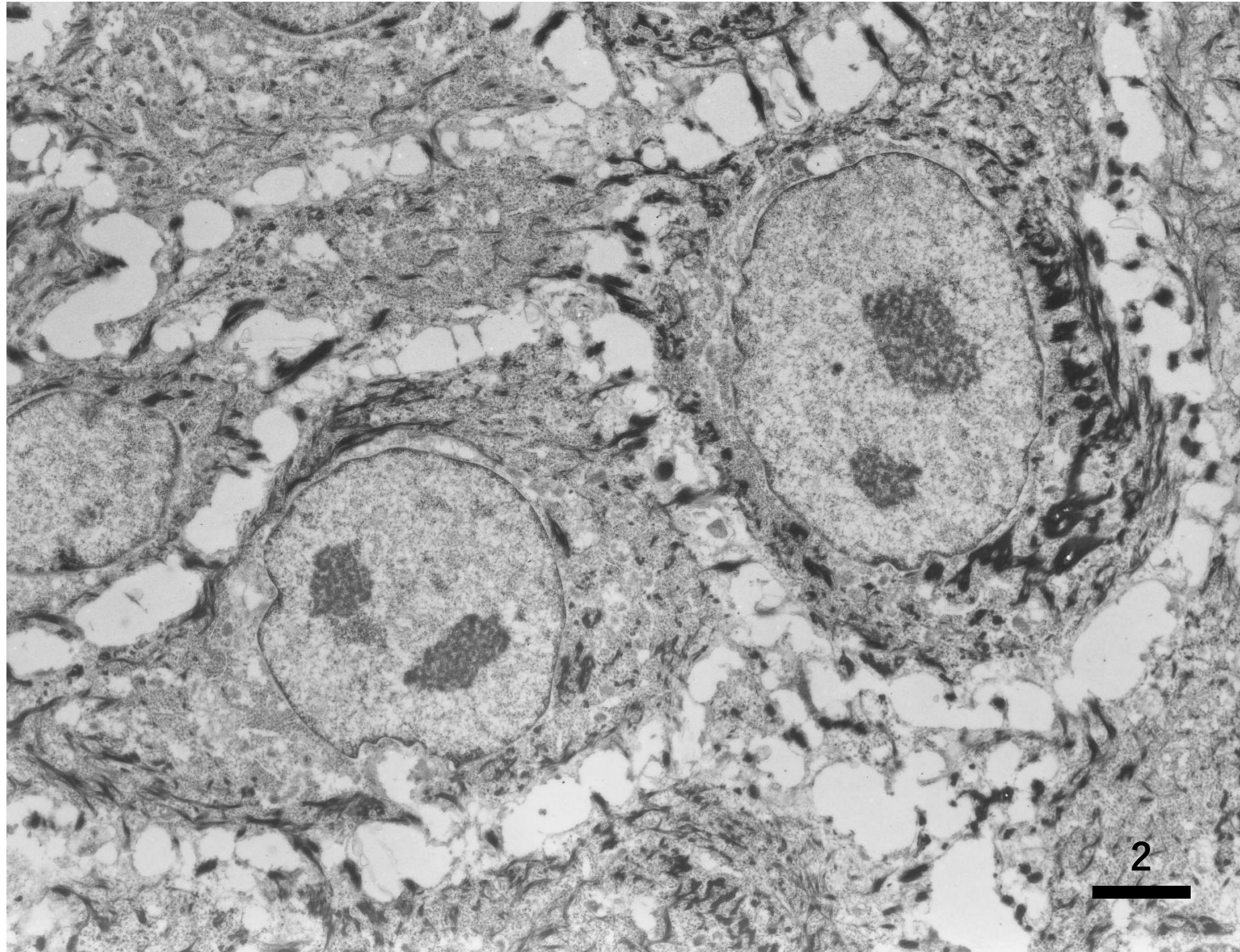
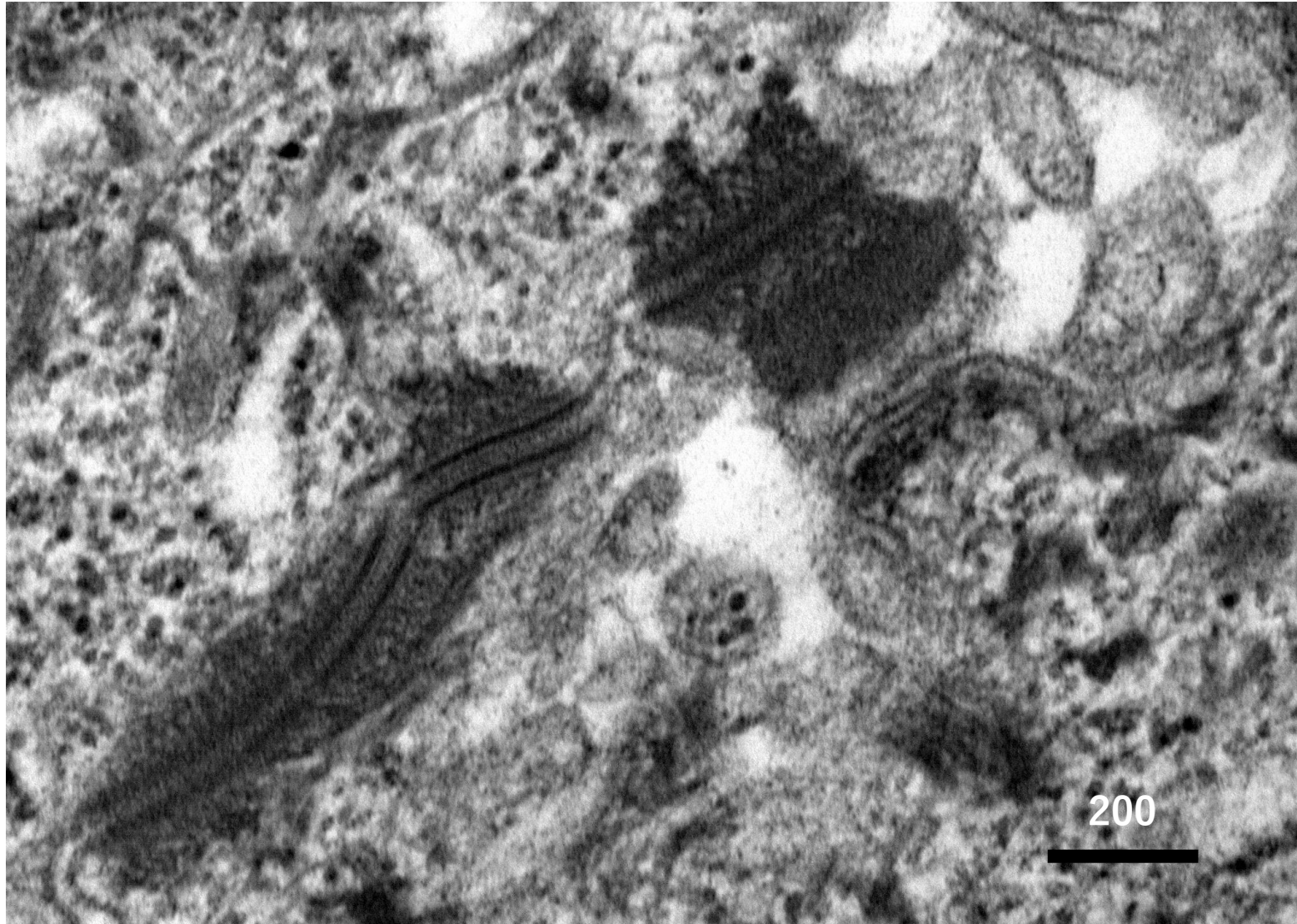


Fine structures of cells and lesions 100

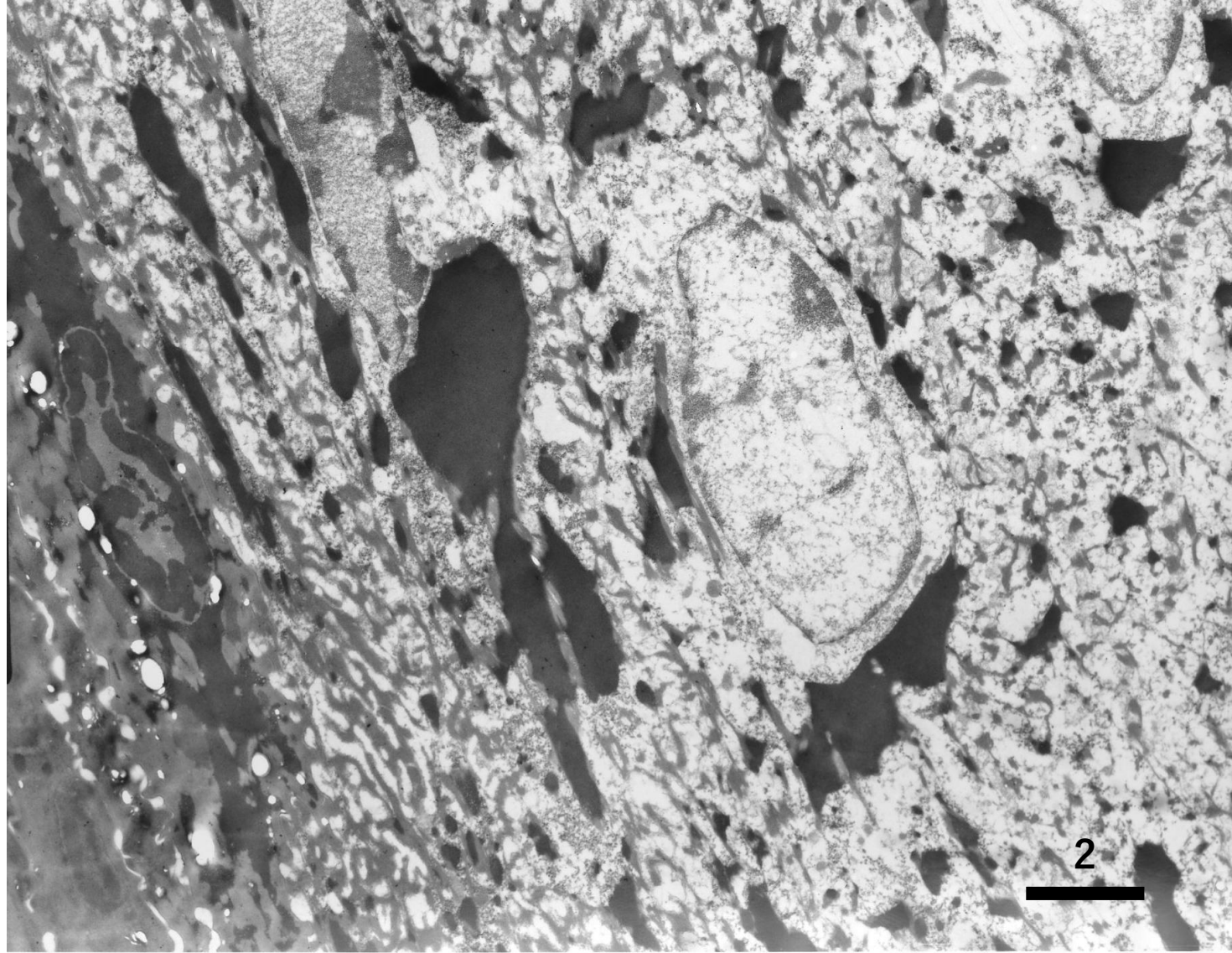
A total of 100 ultrastructural pictures of a variety of normal and diseased cells and tissues are demonstrated. The black and white features are often quite artistic. The fine structures of neoplastic cells fundamentally represent those of normal counterparts. Ultrastructural morphology may assist at understanding the light microscopic changes and the function of the cells and tissues. Enjoy the electron microscopic journey.



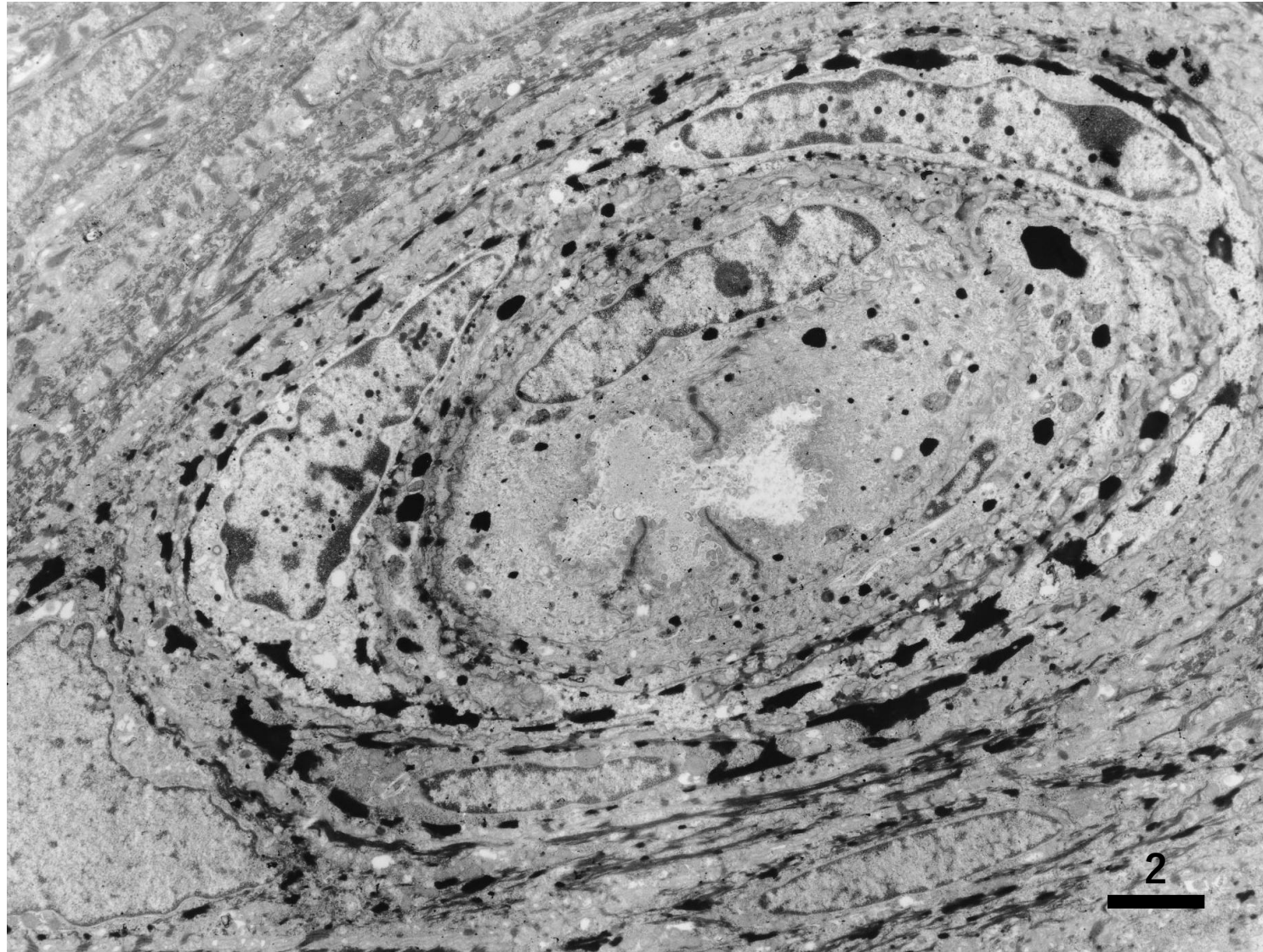
Ultrastructure of **normal epidermal keratinocytes**. Intercellular junctions are tightly connected with desmosomes. Tonofilaments are rich in the cytoplasm.



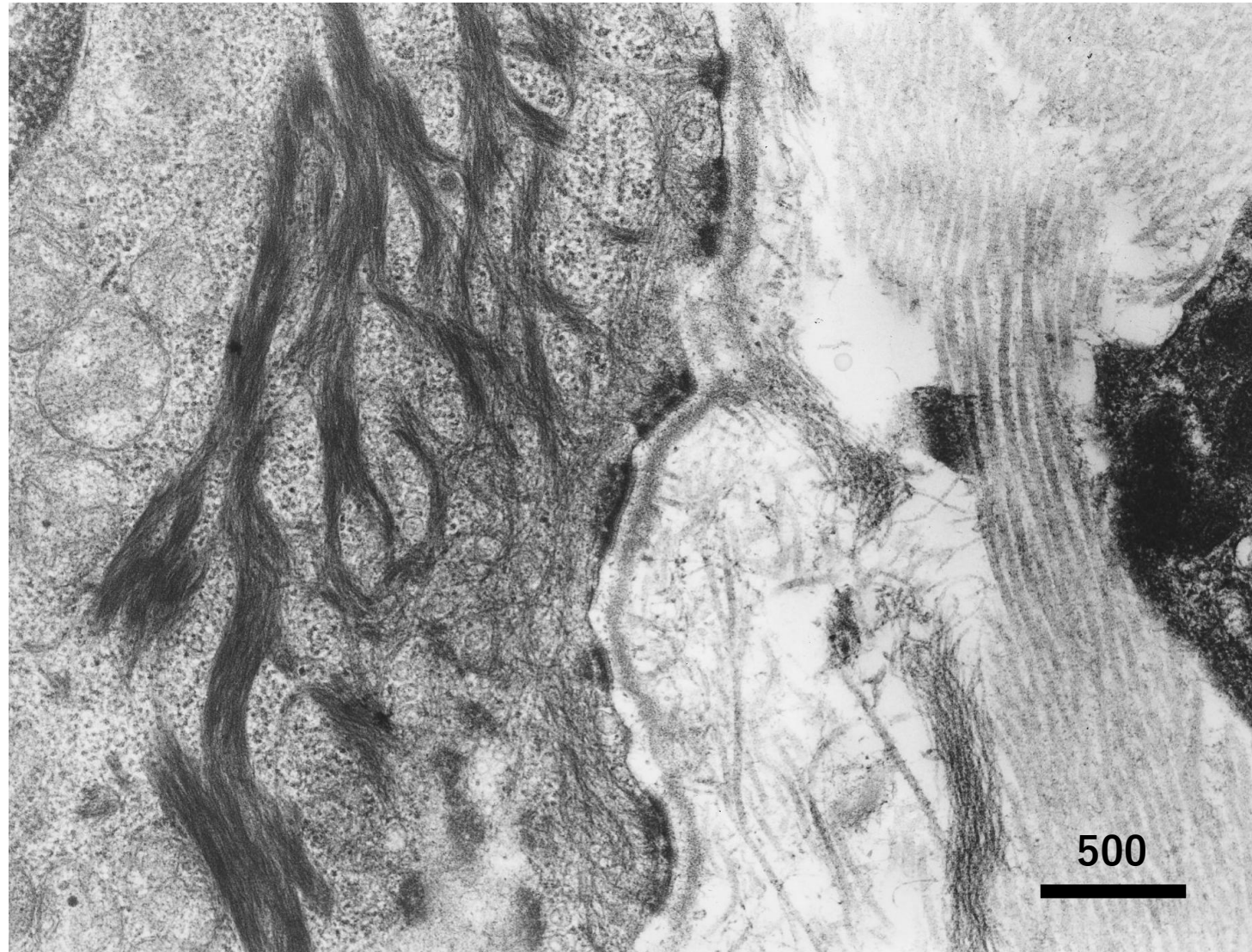
Ultrastructure of **normal epidermal keratinocytes**. **Desmosomal junctions** are well developed. Tonofilaments connect to the desmosomes.



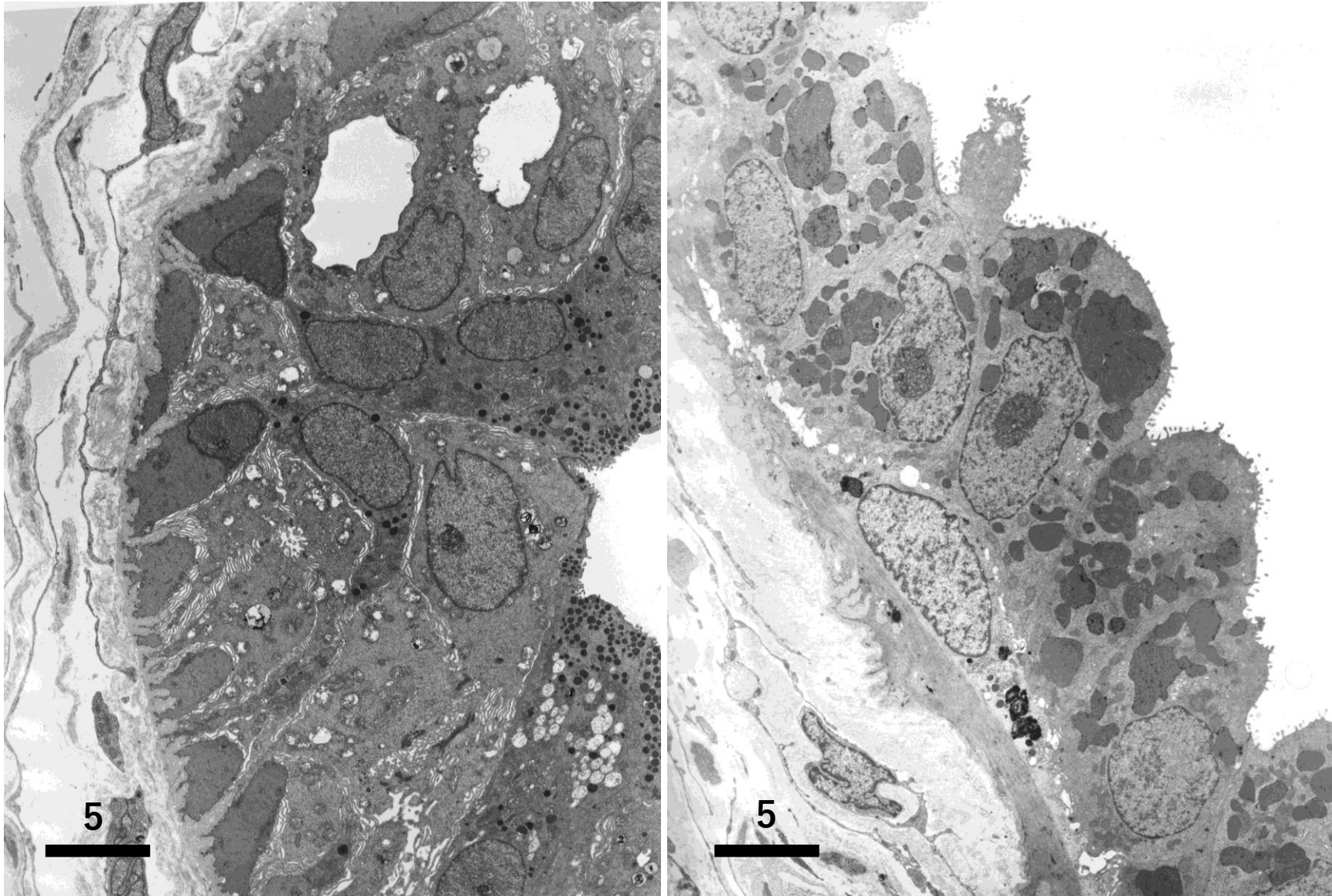
Ultrastructure of **normal epidermal keratinocytes**. The **granular layer** keratinocytes contain irregular-shaped, electron-dense keratohyaline granules. The granular layer cells are seen just adjacent to the horny layer.



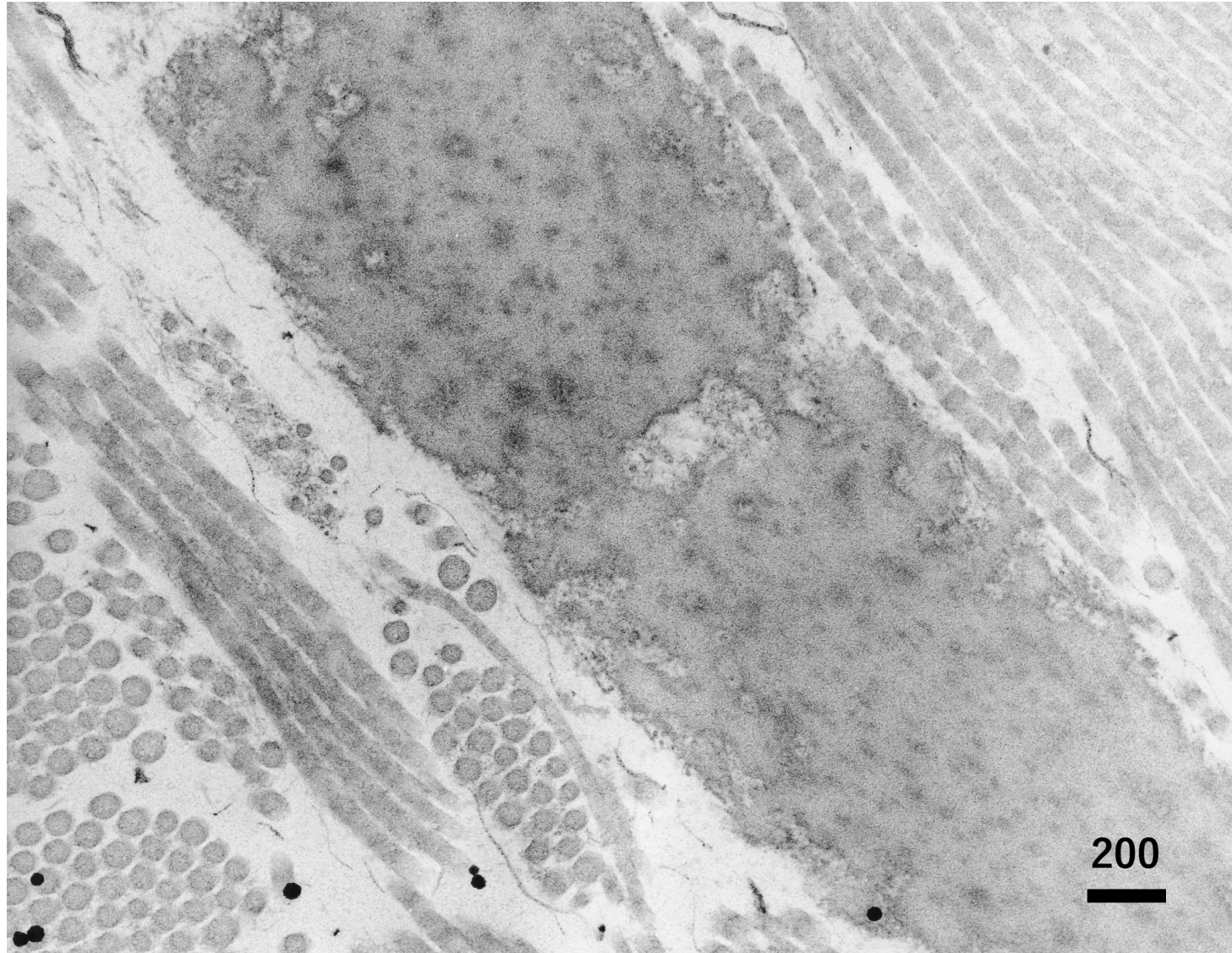
Ultrastructure of **intraepidermal spiral duct (acrosyringium)**. The acrosyringium, opening out through the sweat pore, is lined by cuboidal cells, and surrounded by concentrically arranged keratinocytes rich in tonofilaments.



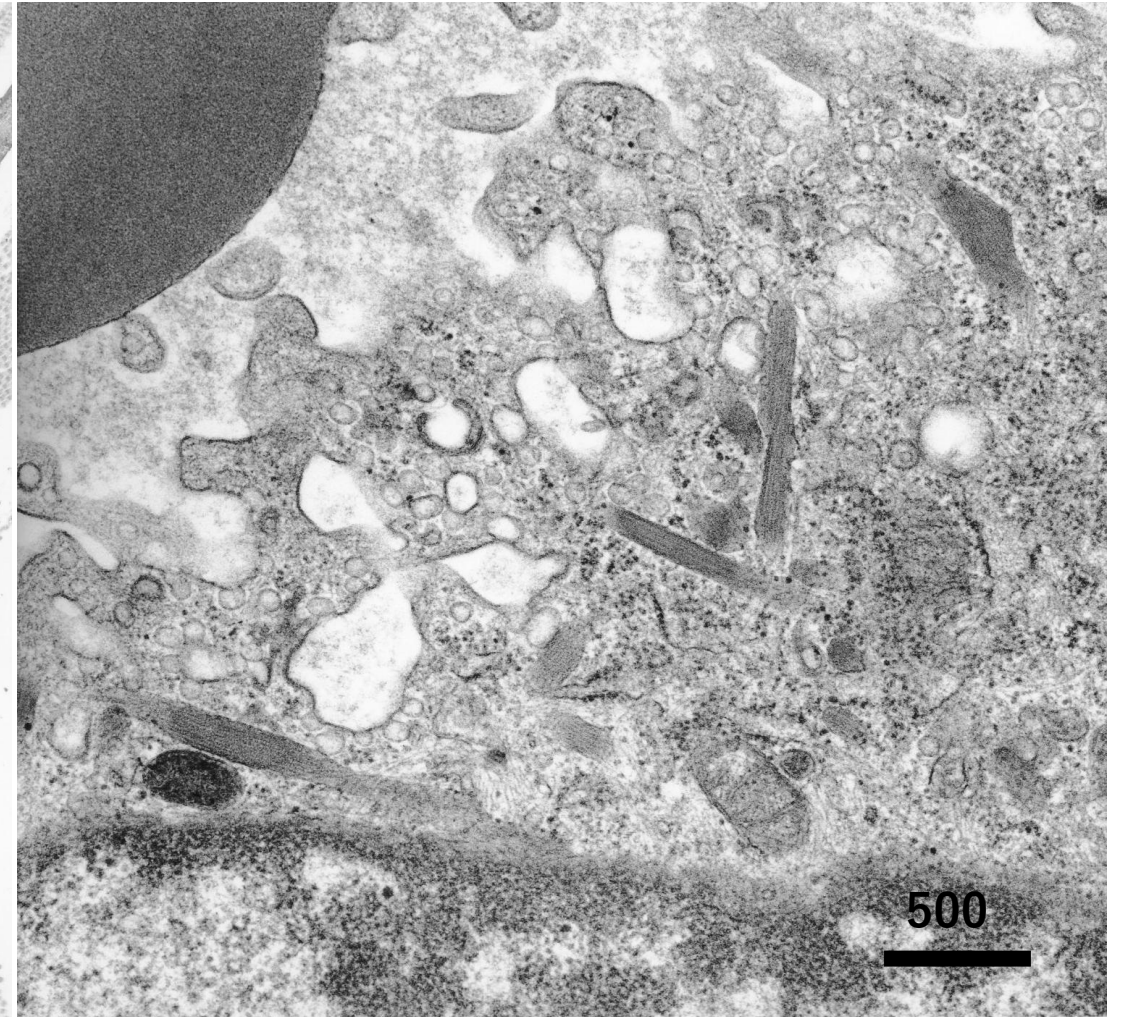
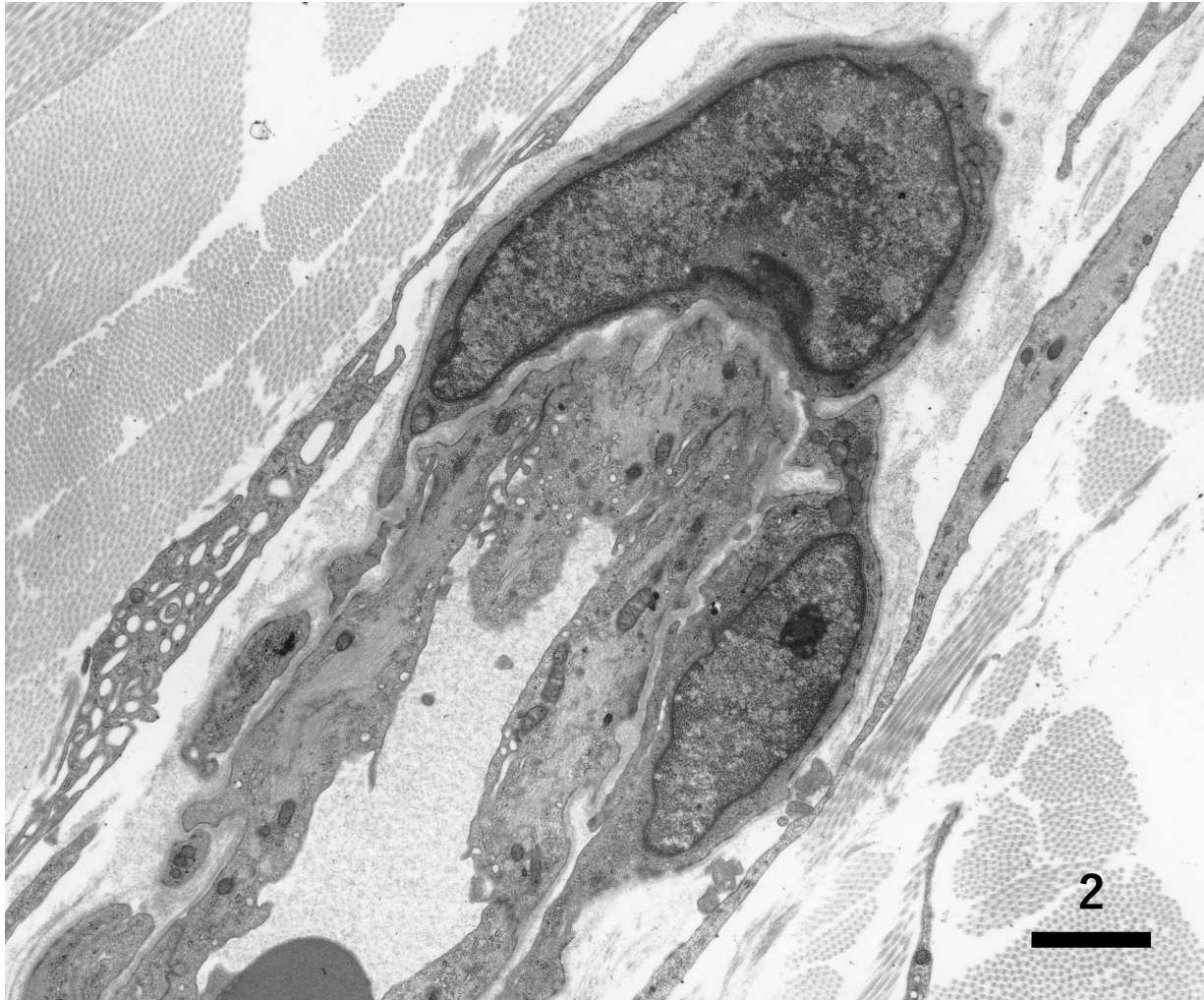
Ultrastructure of **normal epidermal keratinocytes**. The **basal layer** keratinocytes rich in tonofilaments form hemidesmosomes just above the basal lamina. Anchoring fine collagen fibrils connect to the basal lamina.



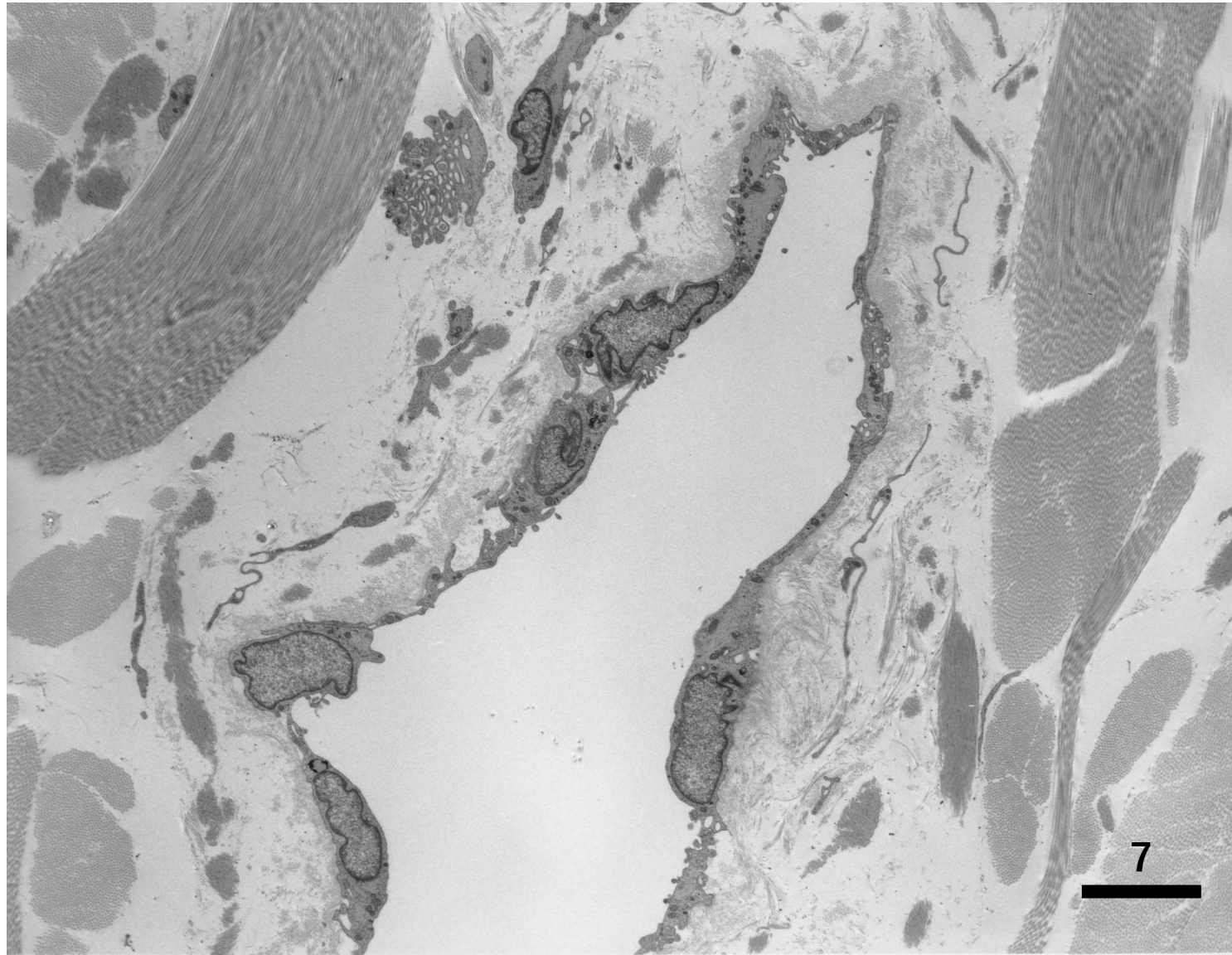
Ultrastructure of **normal sweat glands** (left: **eccrine gland**, right: **apocrine gland**). Fine secretory granules are seen in the eccrine gland, while the apocrine gland contain irregular-shaped large apocrine-type granules. Myoepithelial cells lie at the base of the epithelial layer of both types.



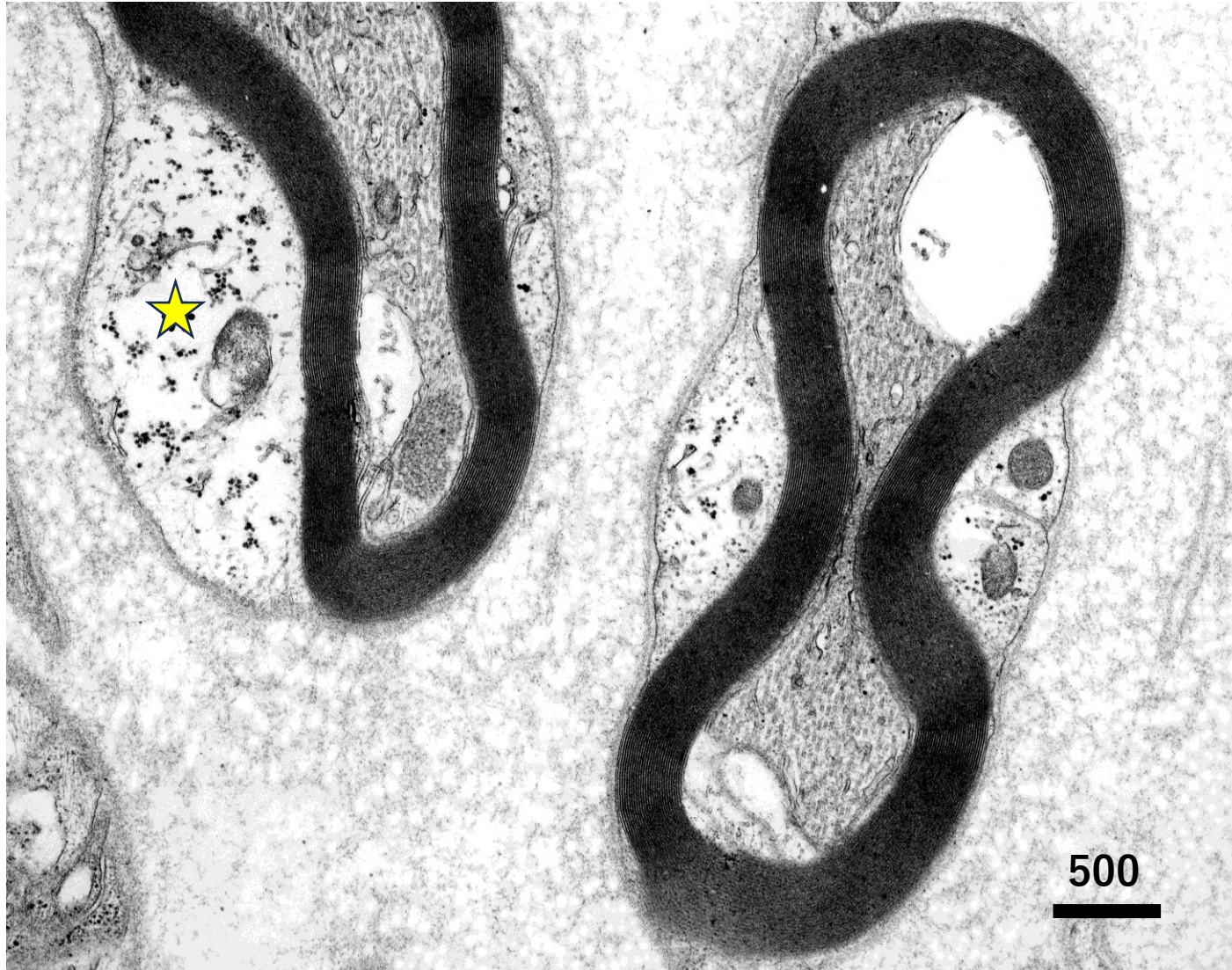
Ultrastructure of **normal dermis**. A thick **elastic fiber** is embedded among bundles of the **collagen fibers**. The amorphous component of the elastic fiber consists of cross-linked (polymerized) elastin. Electron-dense clusters of microfibrils are scattered in the matrix.



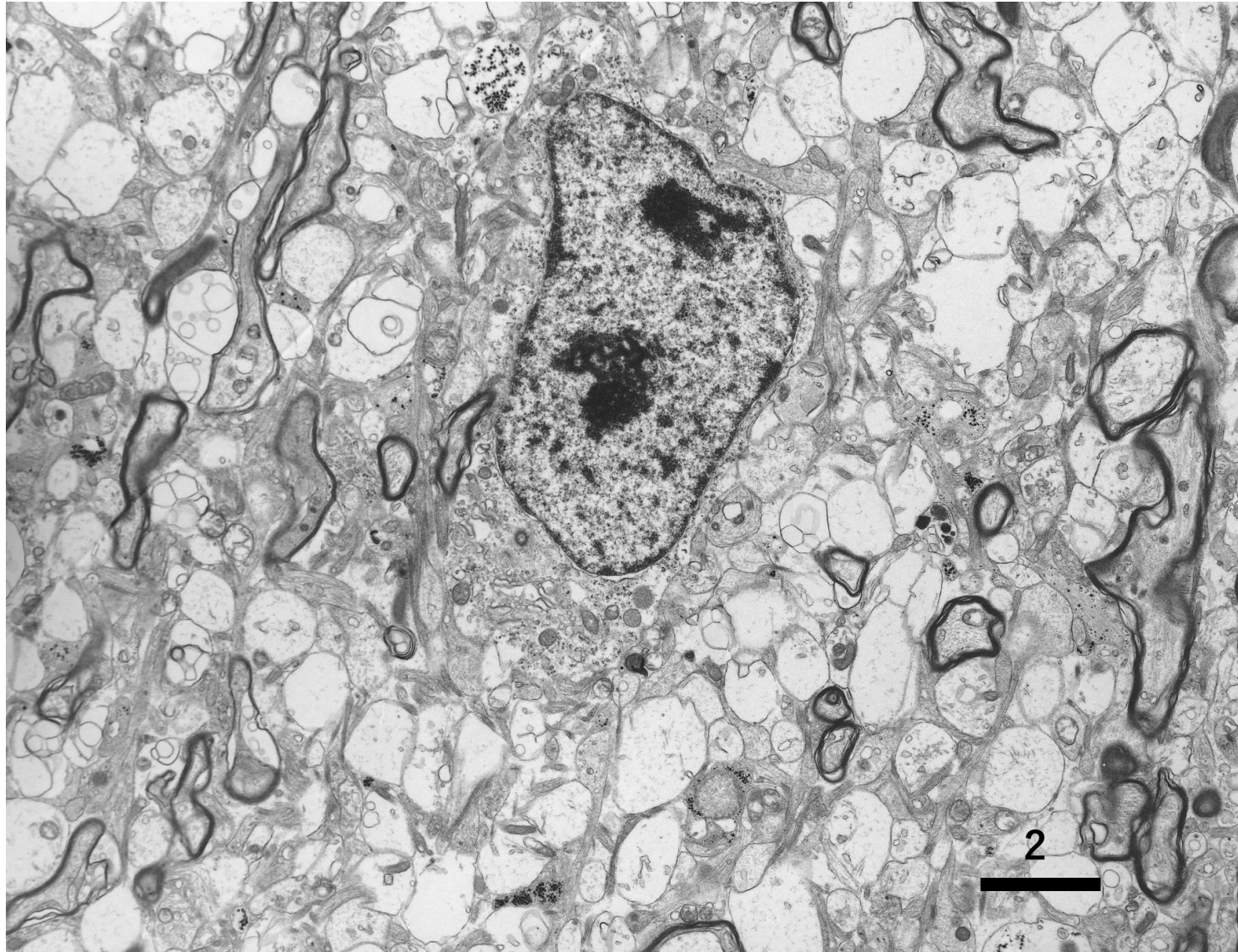
Ultrastructure of a **normal capillary vessel** in the dermis. The capillary vessel consists of endothelial cells and perithelial cells. Weibel-Palade bodies (long rod-like inclusions) seen in the right-half panel are a characteristic structure of endothelial cells.



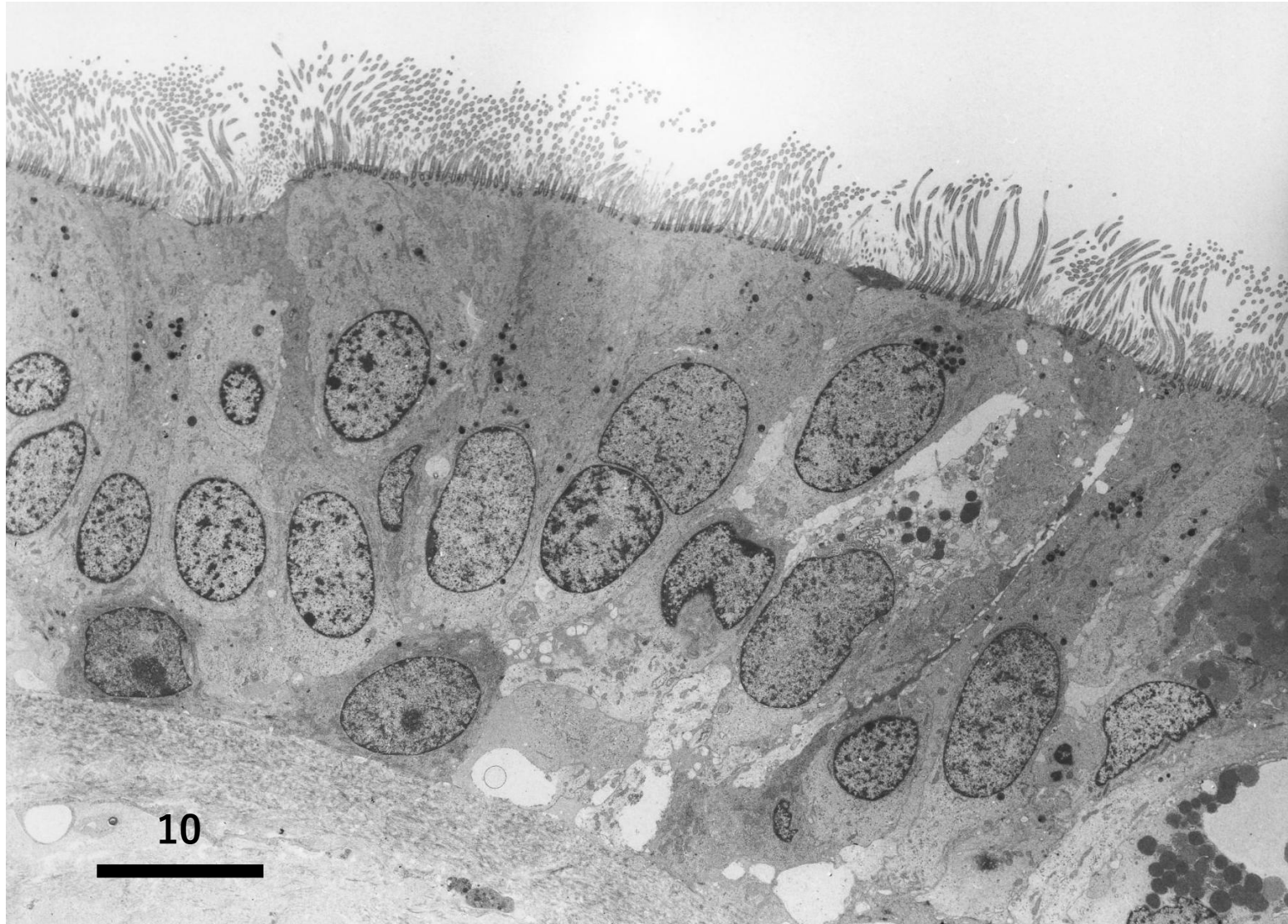
Ultrastructure of a **normal lymphatic vessel** in the dermis. The lymphatic vessel consists of a single layer of endothelial cells. No perithelial lining is discerned. Collagen and elastic fibers are distributed in the surrounding dermal tissue.



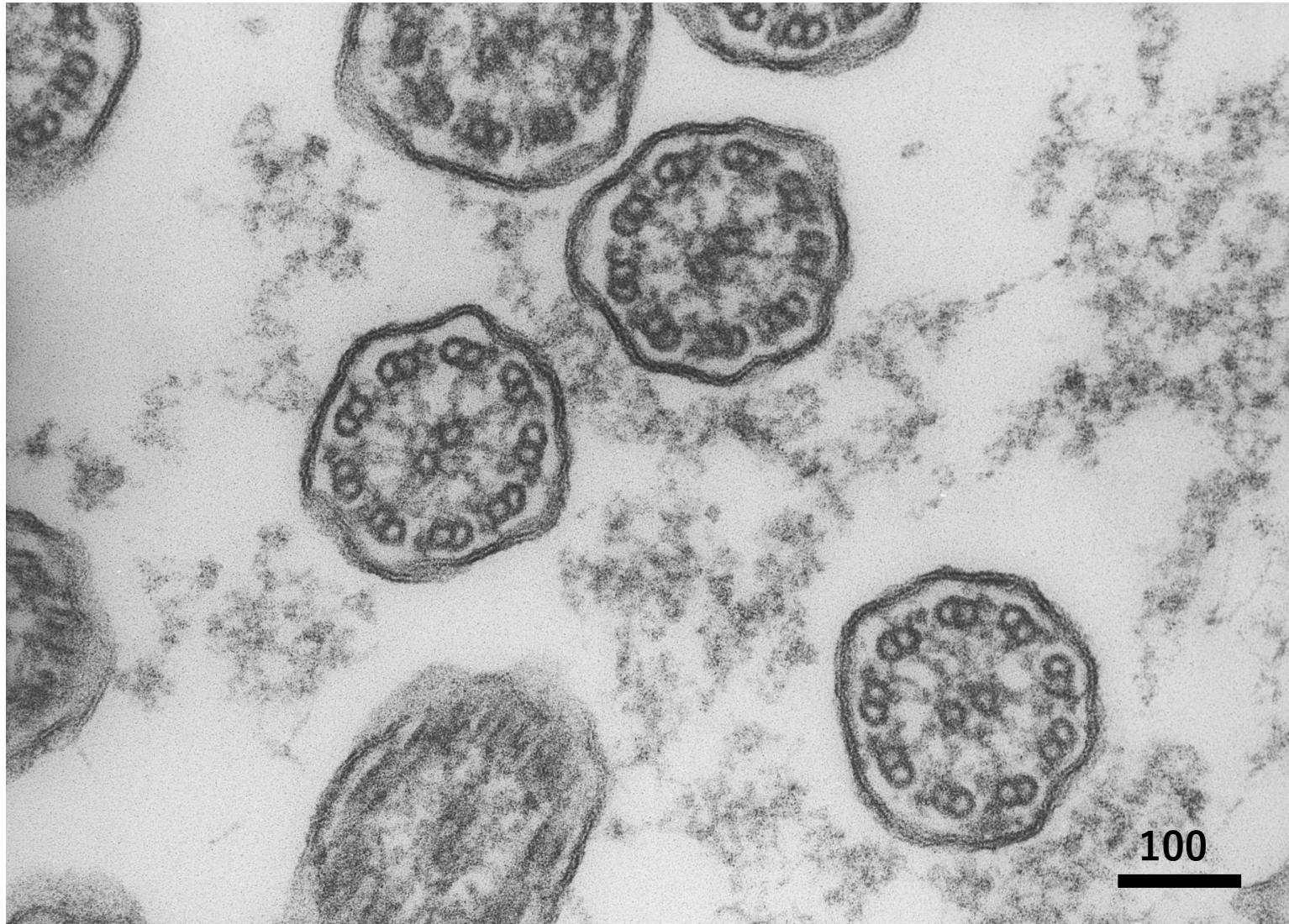
Ultrastructure of **normal myelinated nerve fibers** in the dermis. Electron-dense laminated myelin sheath surrounds the axons. The myelin sheath is formed by Schwann cells (asterisk) demarcated by the basal lamina.



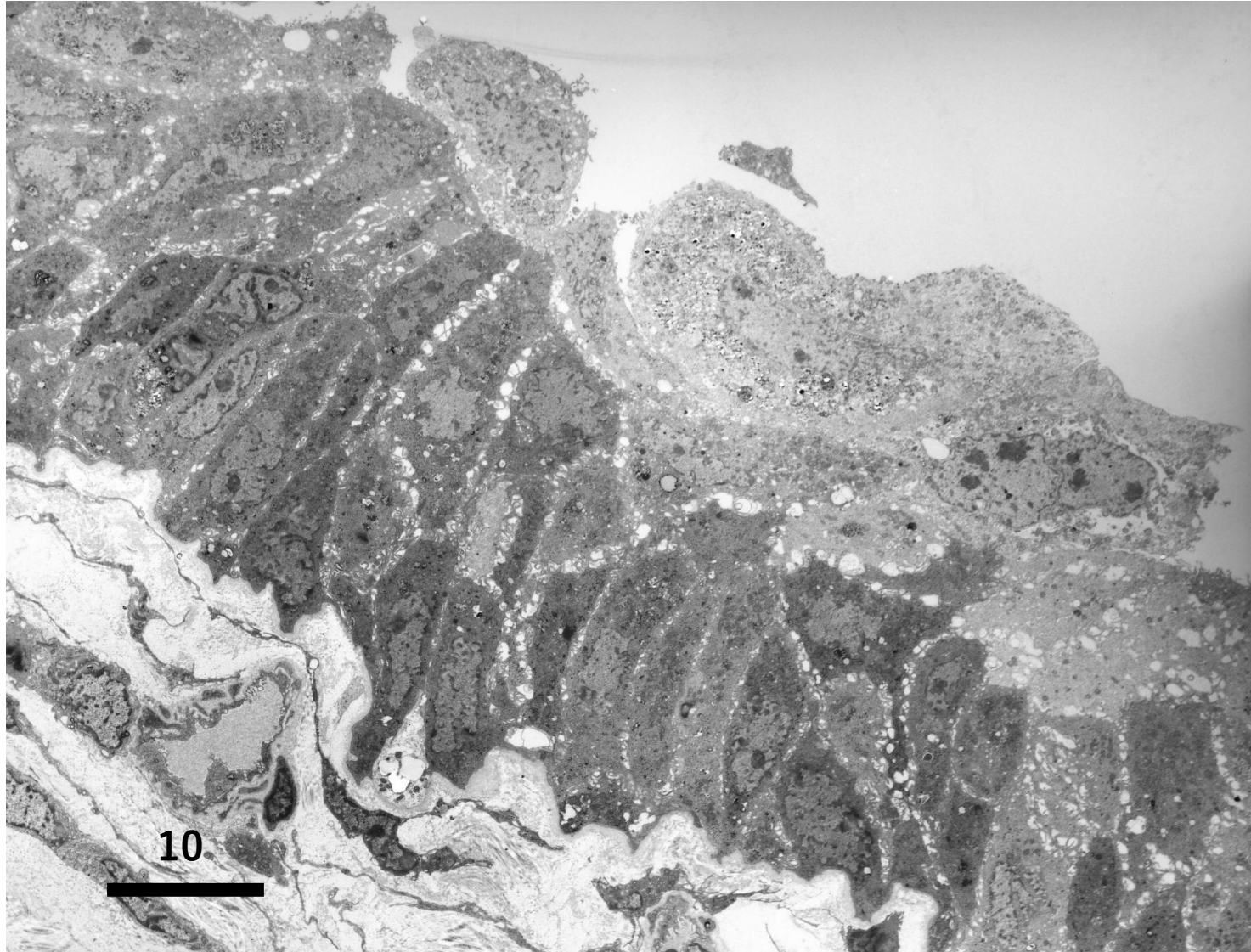
Ultrastructure of **normal cerebral cortex**. A neuron is embedded in the neuropil consisting of numbers of dendrites and axons. Myelinated fibers are dispersed.



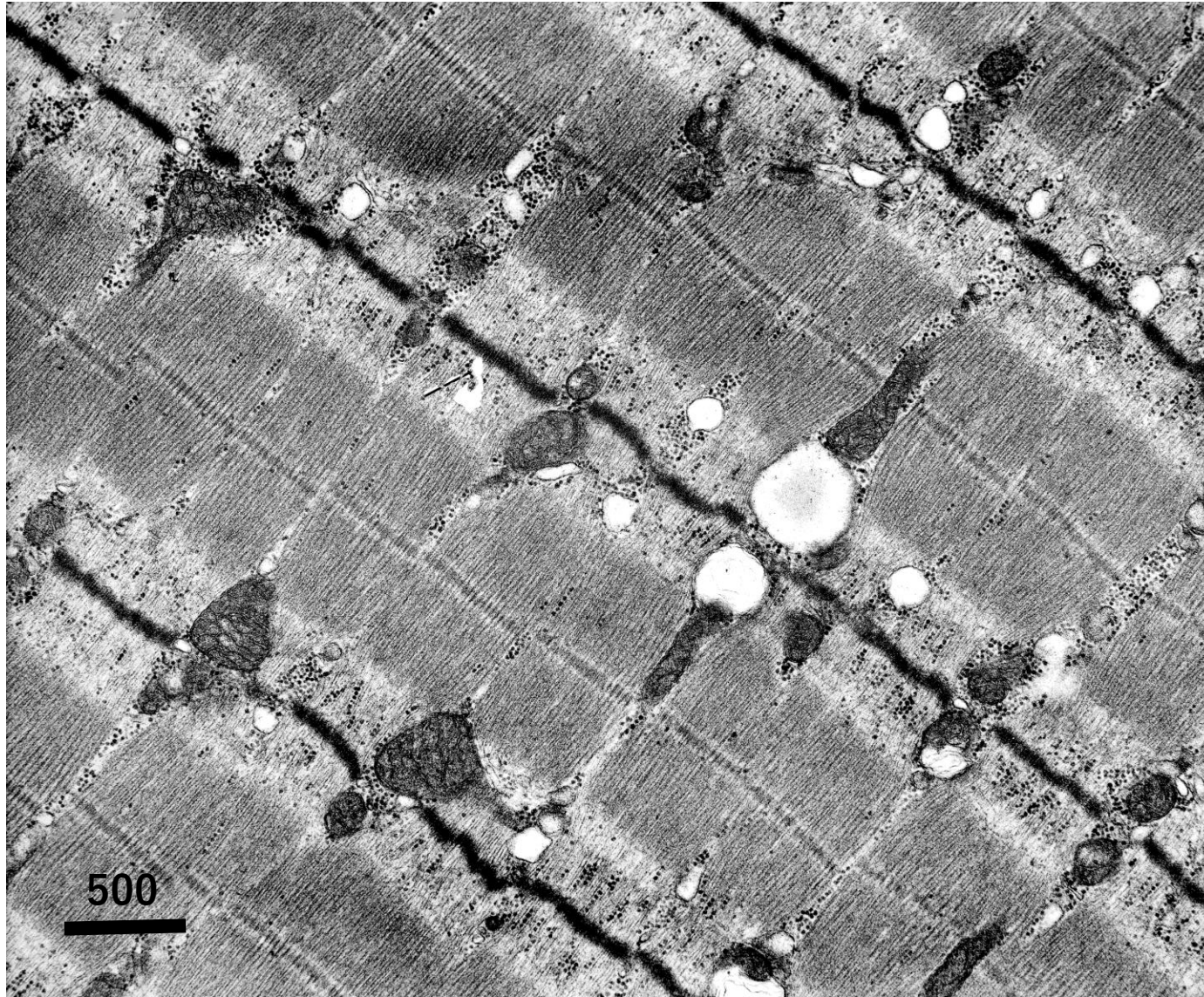
Ultrastructure of **normal bronchial mucosa**. Ciliated surface is evident. The cilia are connected with the pseudostratified columnar cells by the basal bodies. Basal cells are distributed on the basal lamina.



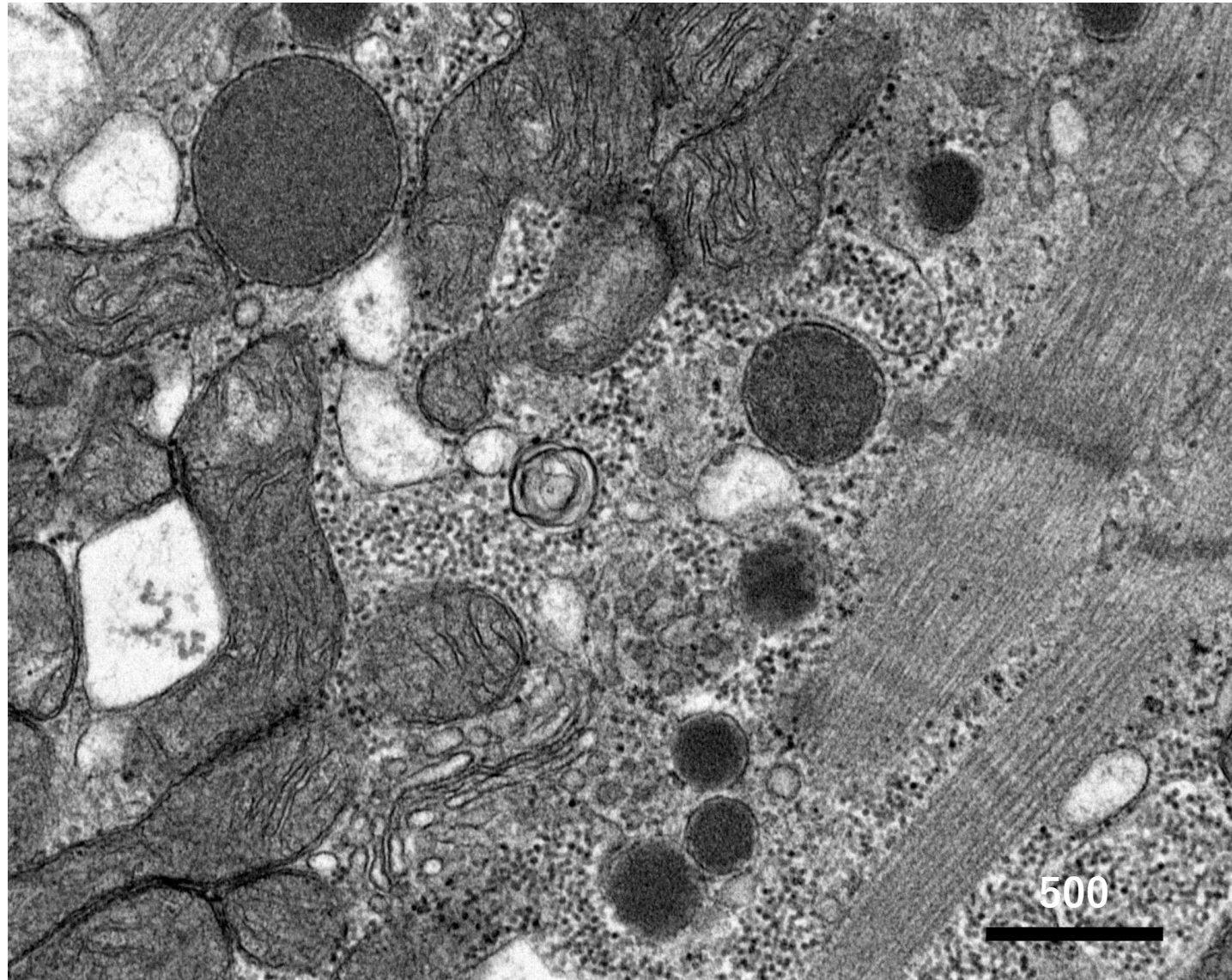
Ultrastructure of **normal cilia** on the bronchial mucosa. Cut surfaces reveal a paired central singlets and nine pairs of peripheral doublets. Both inner and outer dynein arms are observed.



Ultrastructure of **normal urothelial mucosa** of the renal pelvis. Large-sized umbrella cells cover the entire urothelial mucosa. It should be noted that all the urothelial epithelial cells, including the umbrella cells, have connection with the basal lamina.



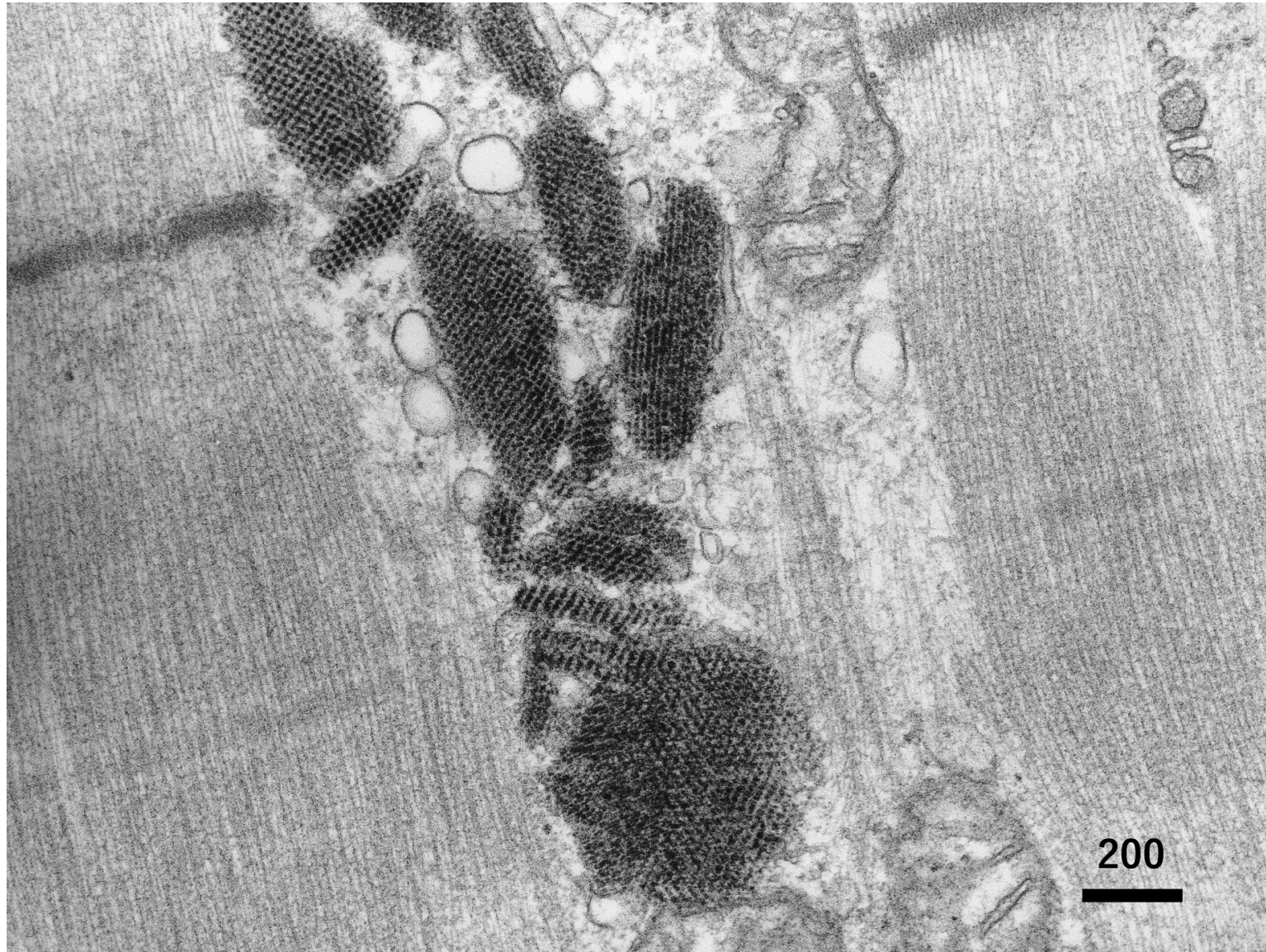
Ultrastructure of **normal striated muscle cell**. Electron-dense Z-discs and actomyosin filamentous layers (A-bands) with central M-lines are regularly and alternately distributed. The layers around the Z-discs are called I-bands. Mitochondria, glycogen particles and fat droplets are seen in the I-bands.



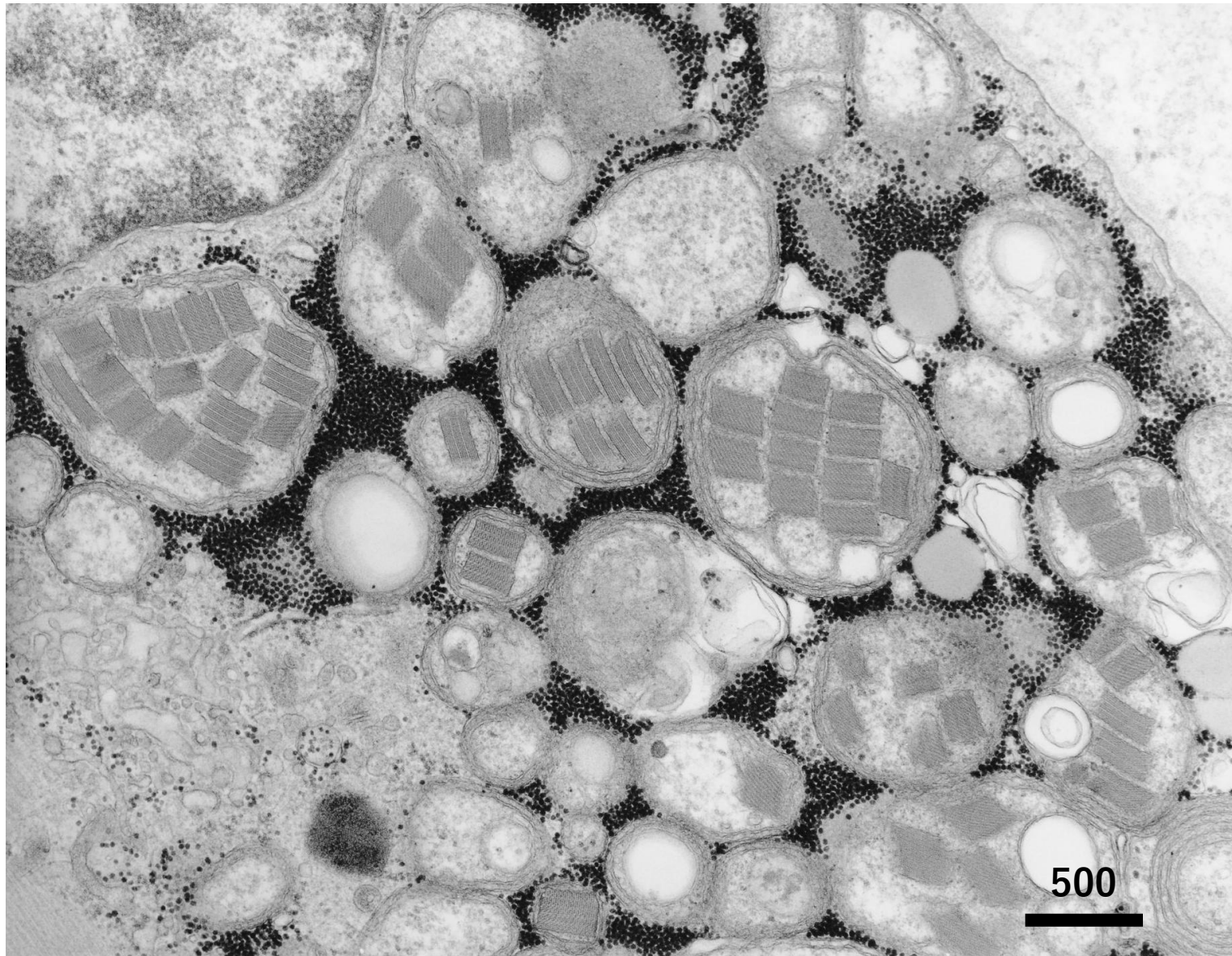
Ultrastructure of a **normal atrial muscle cell** of the heart. In addition to Z-disc-associated actomyosin fascicles and richly distributed mitochondria, large-sized cored and electron-dense neuroendocrine granules secreting atrial natriuretic peptide (ANP) are characteristically observed.



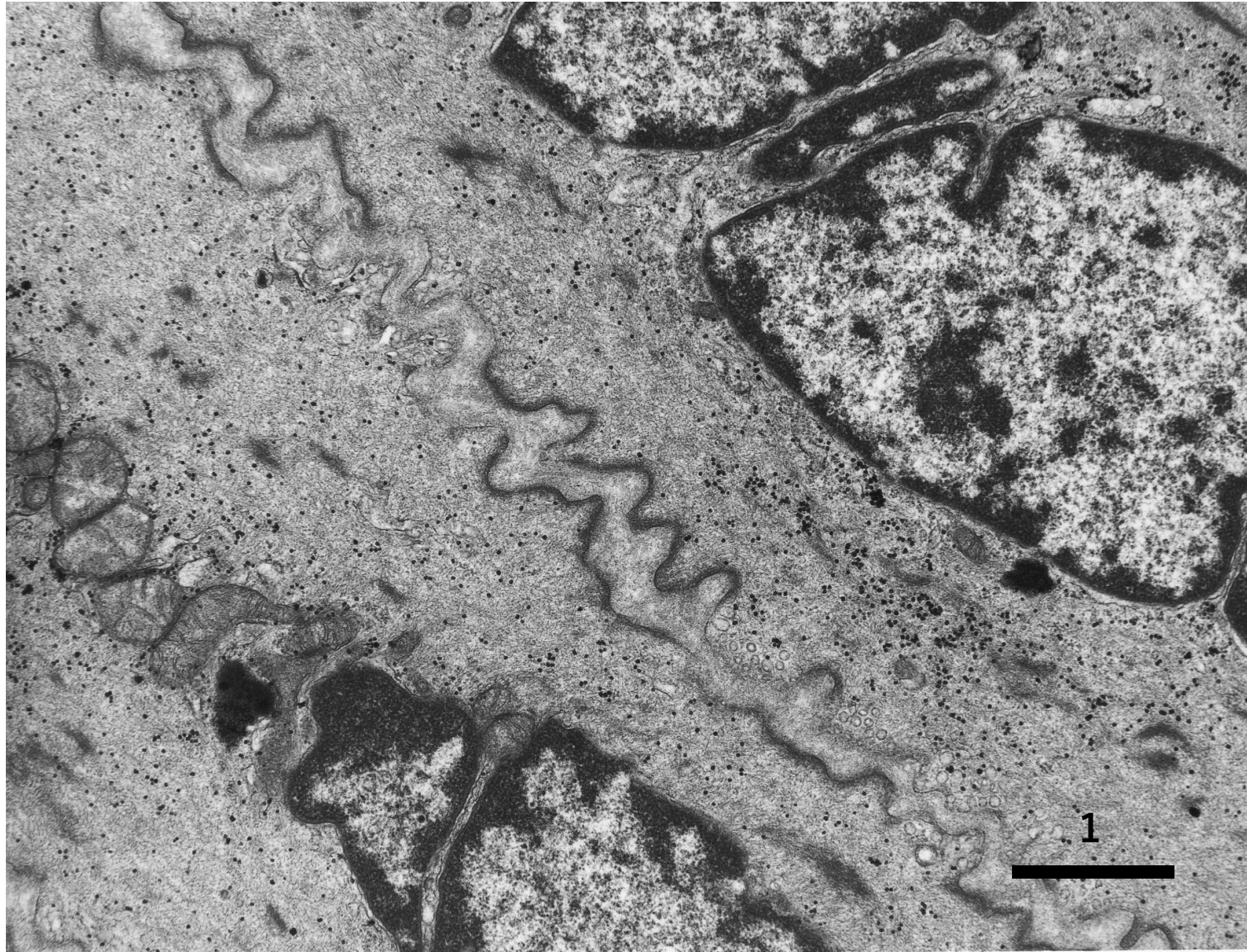
Ultrastructure of a **caterpillar cell (Anitschkow cell)** in the stroma of **rheumatic carditis**. Chromatin is condensed in the center of the nucleus with a wavy rod-like (caterpillar) pattern. The Anitschkow cell belongs to the macrophage often forming Aschoff nodules.



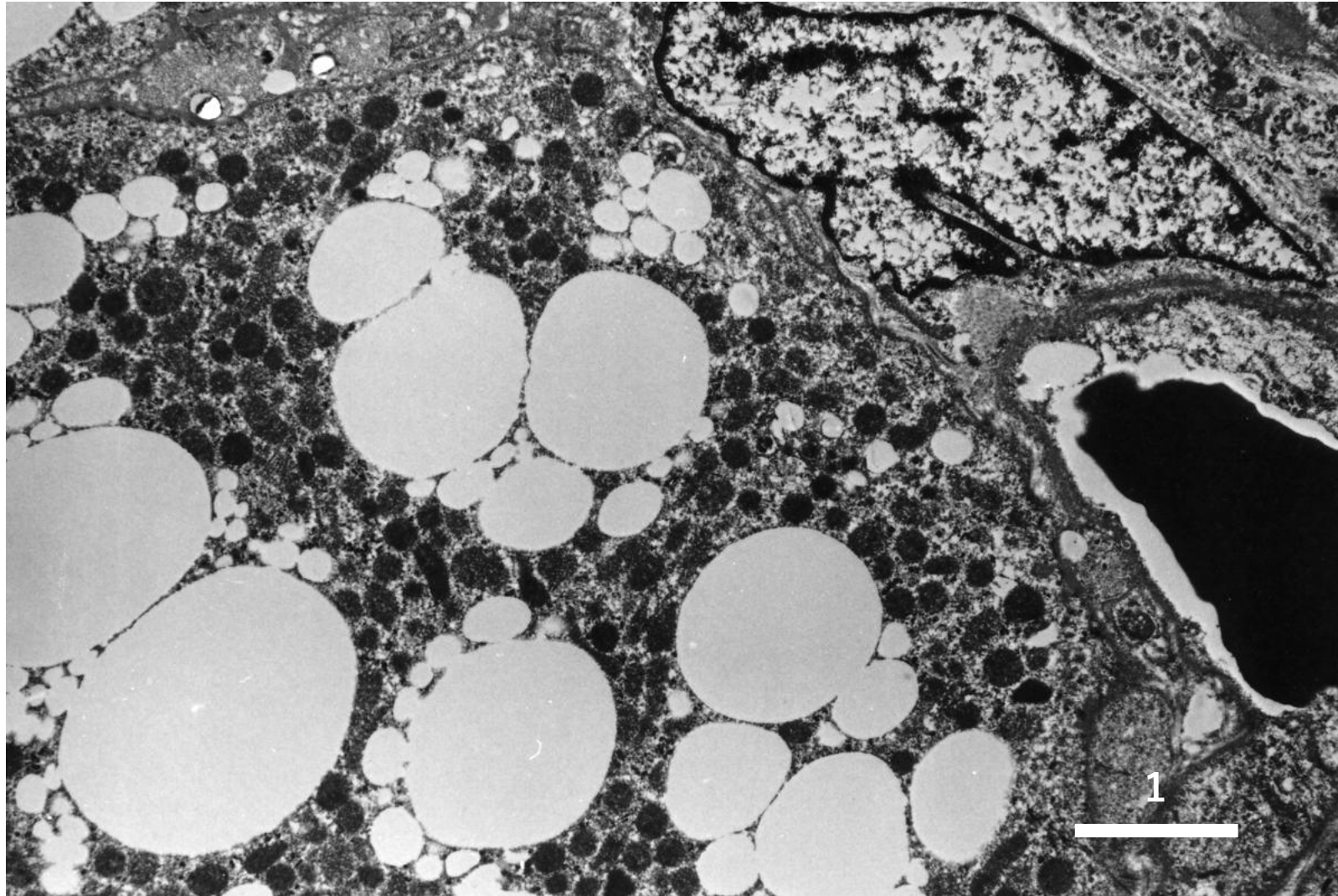
Nemaline myopathy is a hereditary myopathy manifesting muscle weakness, hypoventilation, swallowing dysfunction and impaired speech ability. The formation of nemaline rods with latticed structures is pathognomonic. The nemaline rods are derived from the degraded Z-disc.



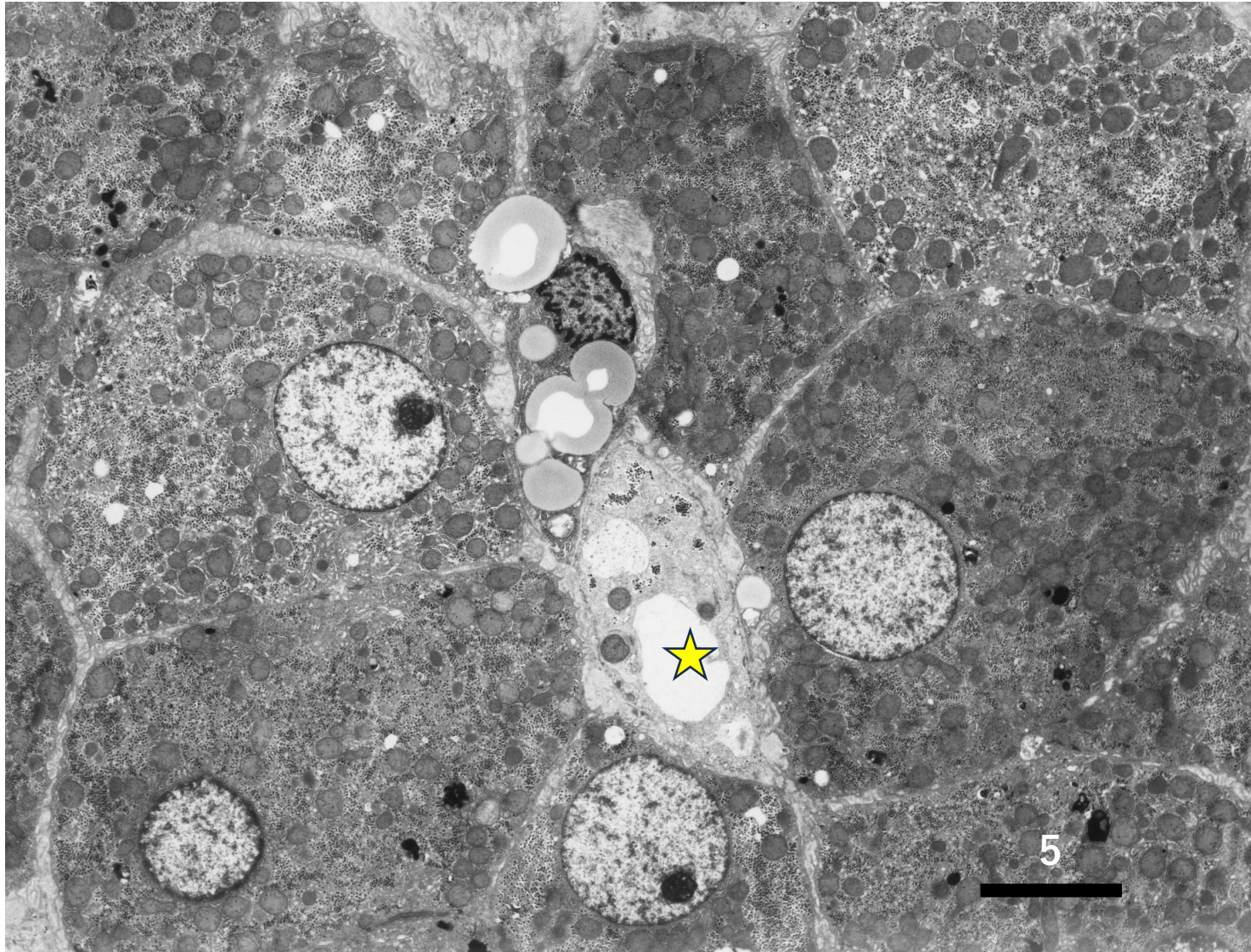
Ultrastructure of **mitochondrial myopathy** caused by **MELAS** (mitochondrial myopathy, encephalopathy, lactic acidosis, stroke-like episodes). The mitochondria in the involved striated muscle cell are enlarged and possess peculiar rod-shaped paracrystalline inclusions.



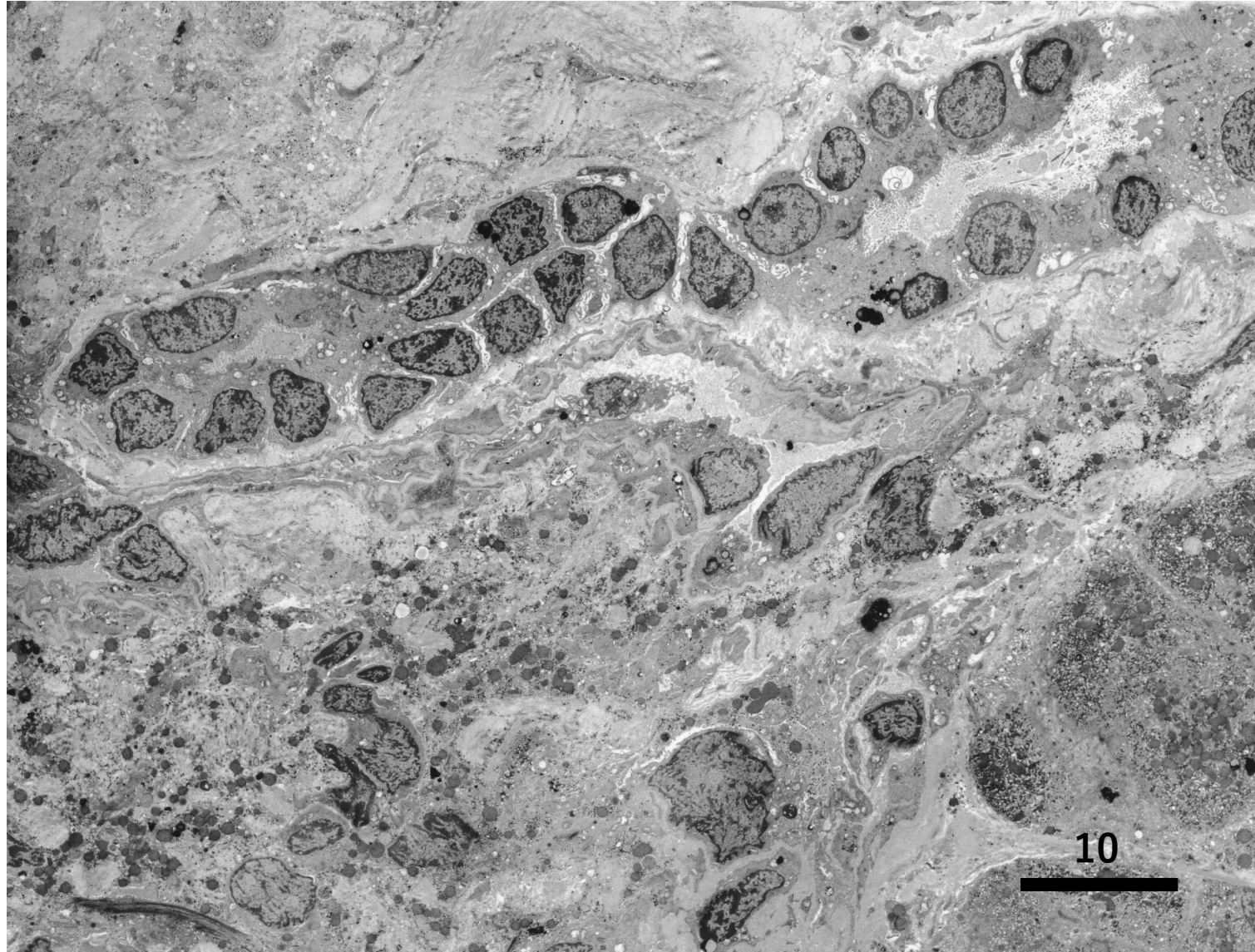
Ultrastructure of **normal smooth muscle cells** of the urinary bladder. The cytoplasm is filled with intermediate filaments with dense patch formation. Actin microfilaments are clustered just along the inner surface of the plasma membrane.



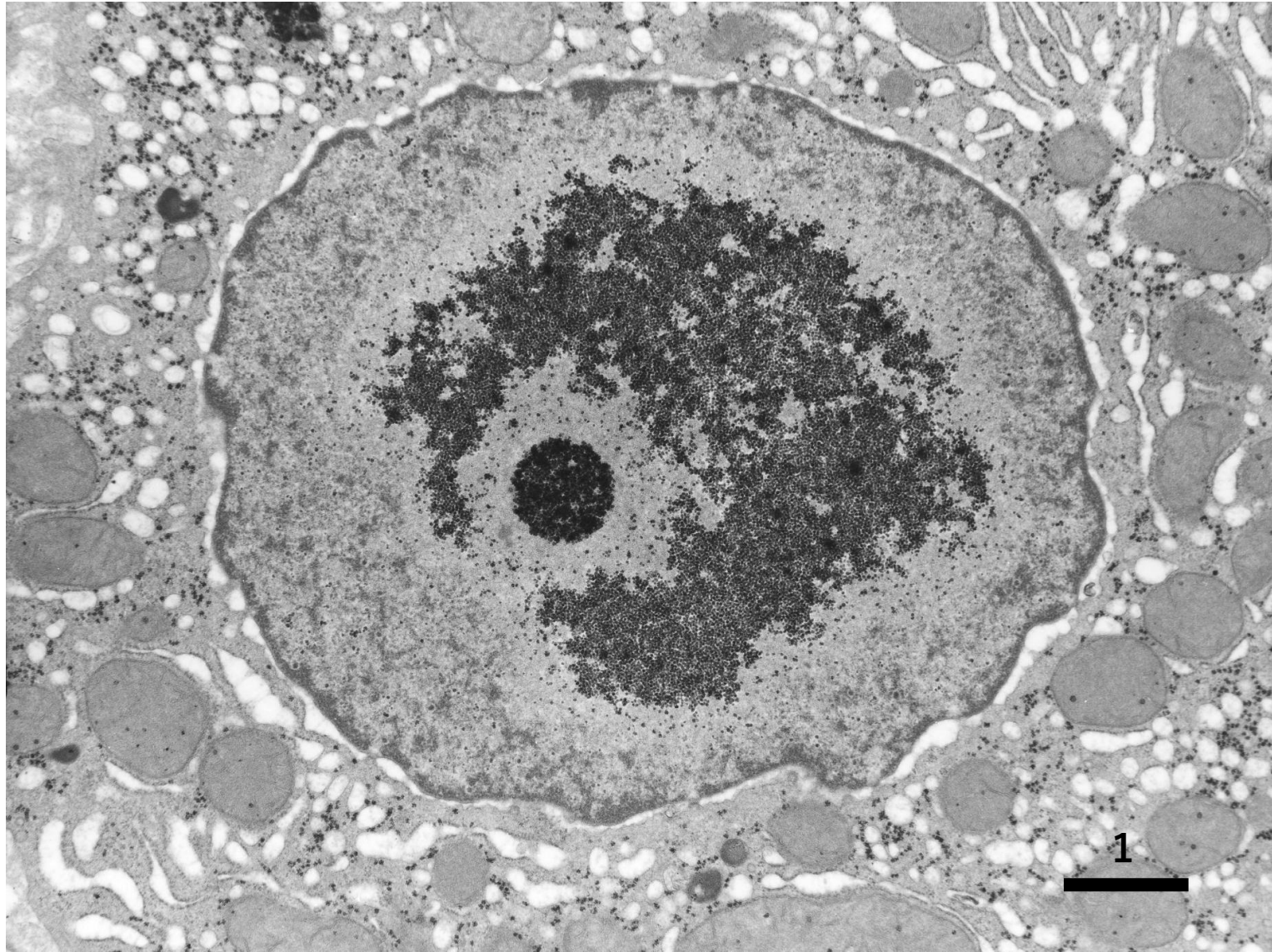
Ultrastructure of **brown fat cell**. The brown or beige adipocyte is thermogenic. It is specialized in dissipating chemical energy in the form of heat. The cytoplasm contains numbers of mitochondria and small fat droplets. The brownish color is due to the abundance of heme protein cytochrome in mitochondria.



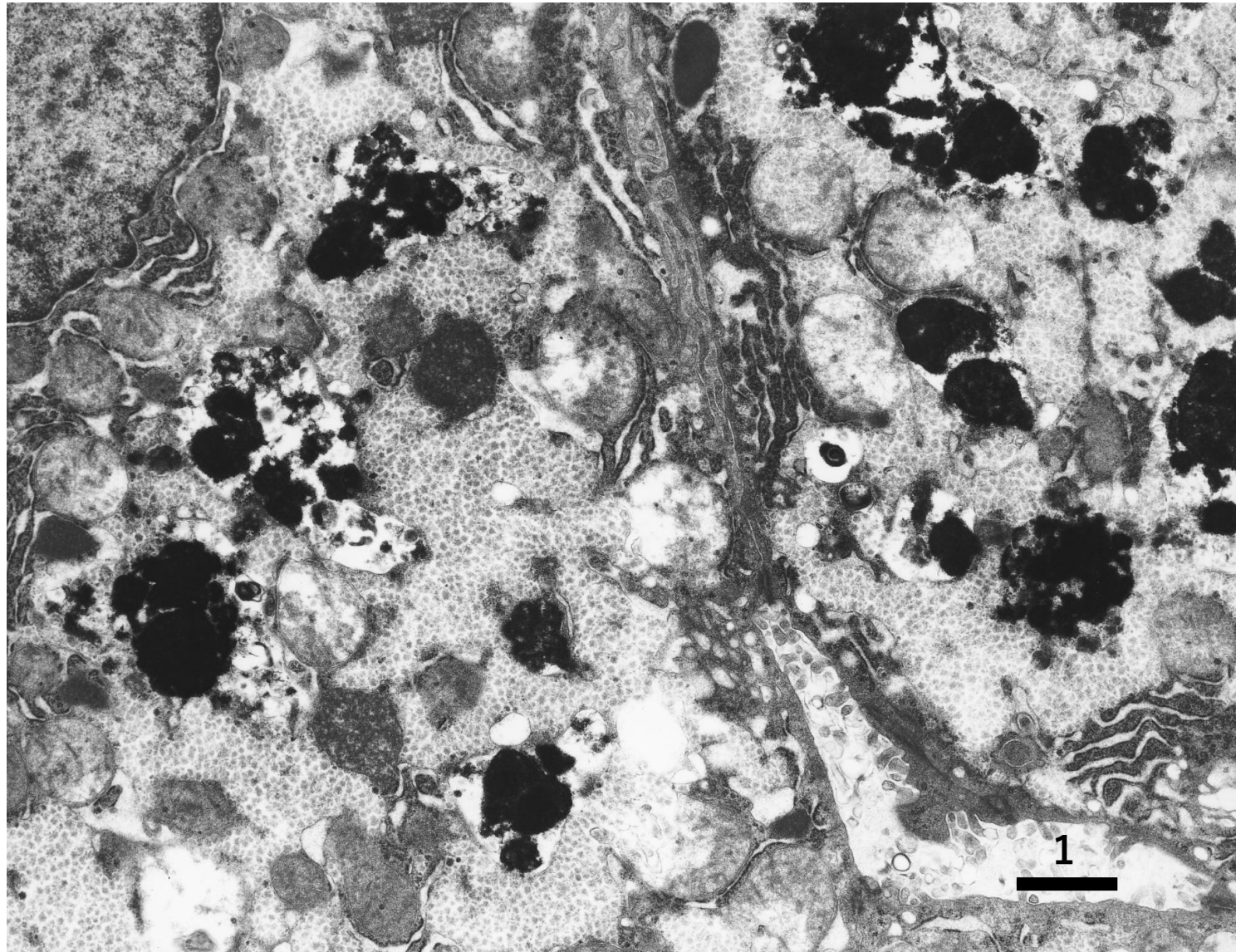
Ultrastructure of **normal liver**. The liver cell cord is separated by the sinusoid. A **Kupffer cell** (asterisk) and a lipid-storing **Ito cell** are observed in the sinusoid. Ito cells are known to store vitamin A. The hepatocytes are rich in mitochondria.



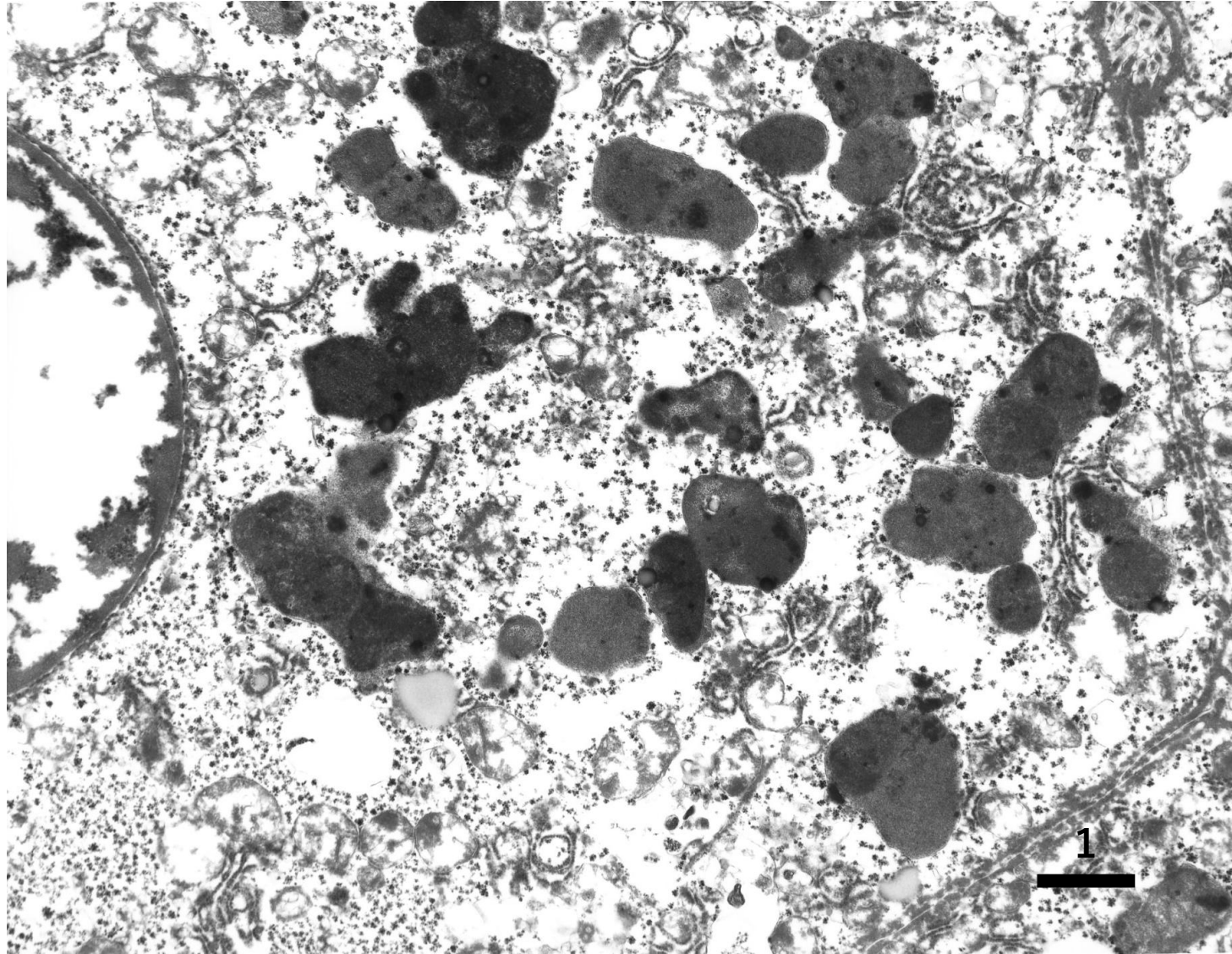
Ultrastructure of a **normal portal tract of the liver**. An intrahepatic bile duct lined by single-layered cuboidal epithelial cells is observed. The hepatocytes form a limiting membrane against the portal tract.



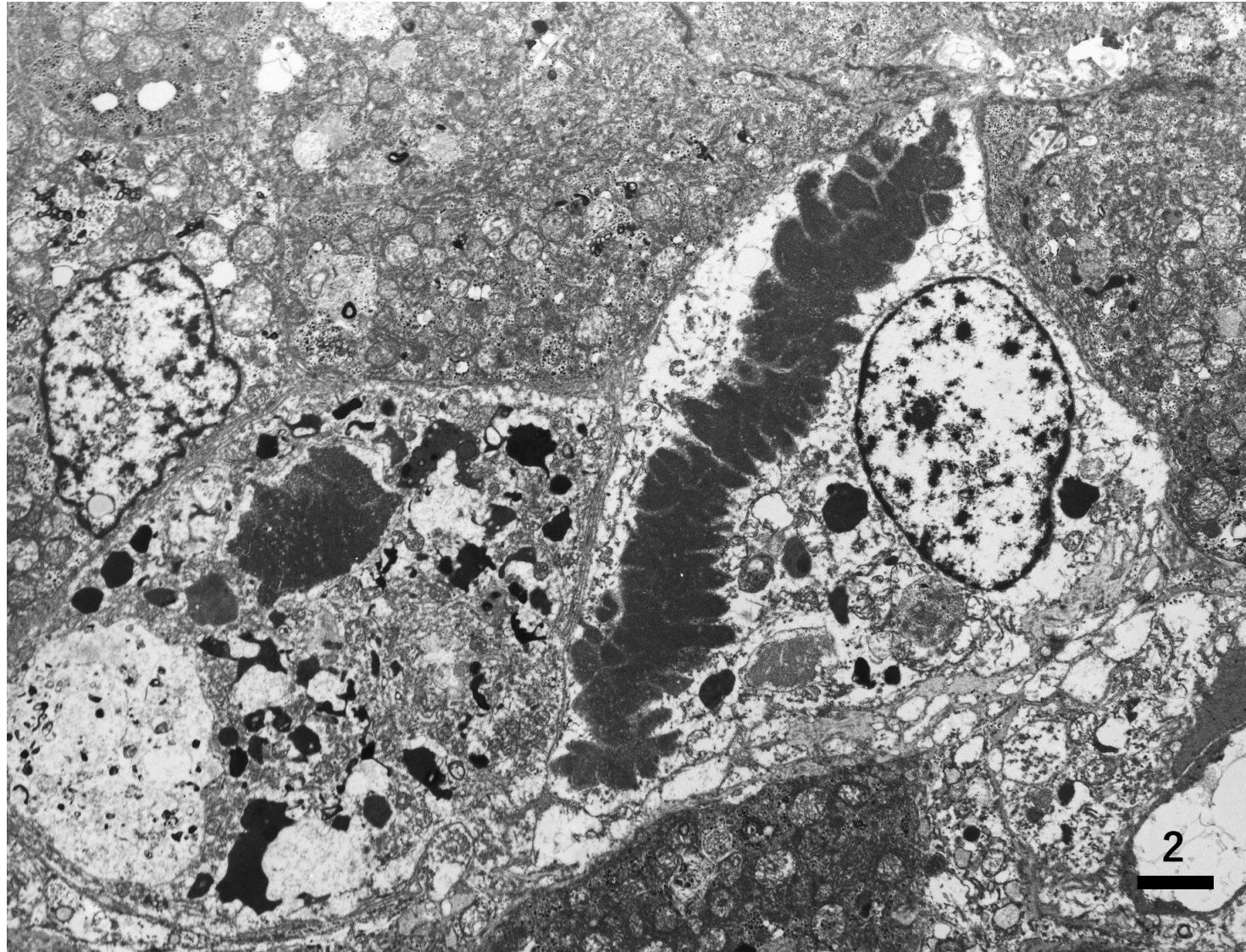
Ultrastructure of the hepatocyte with **intranuclear glycogen deposition**. This phenomenon may be physiological, but accelerated by certain disease states such as congestion and cholestasis.



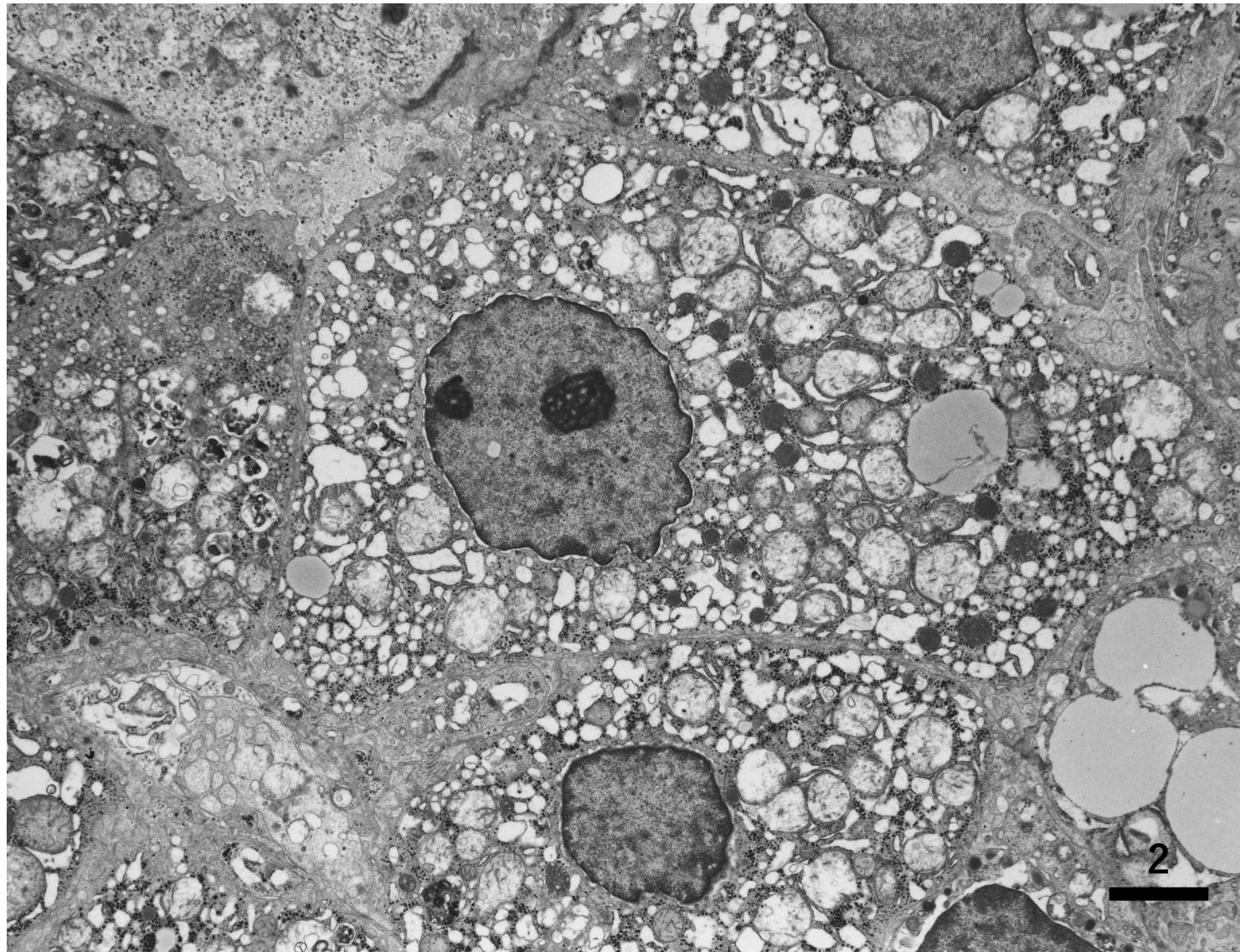
Ultrastructure of **hemosiderosis** of the hepatocyte. Hemosiderin particles represent irregular-shaped and electron-dense materials deposited in lysosomes. Hemosiderosis was caused by repeated transfusion.



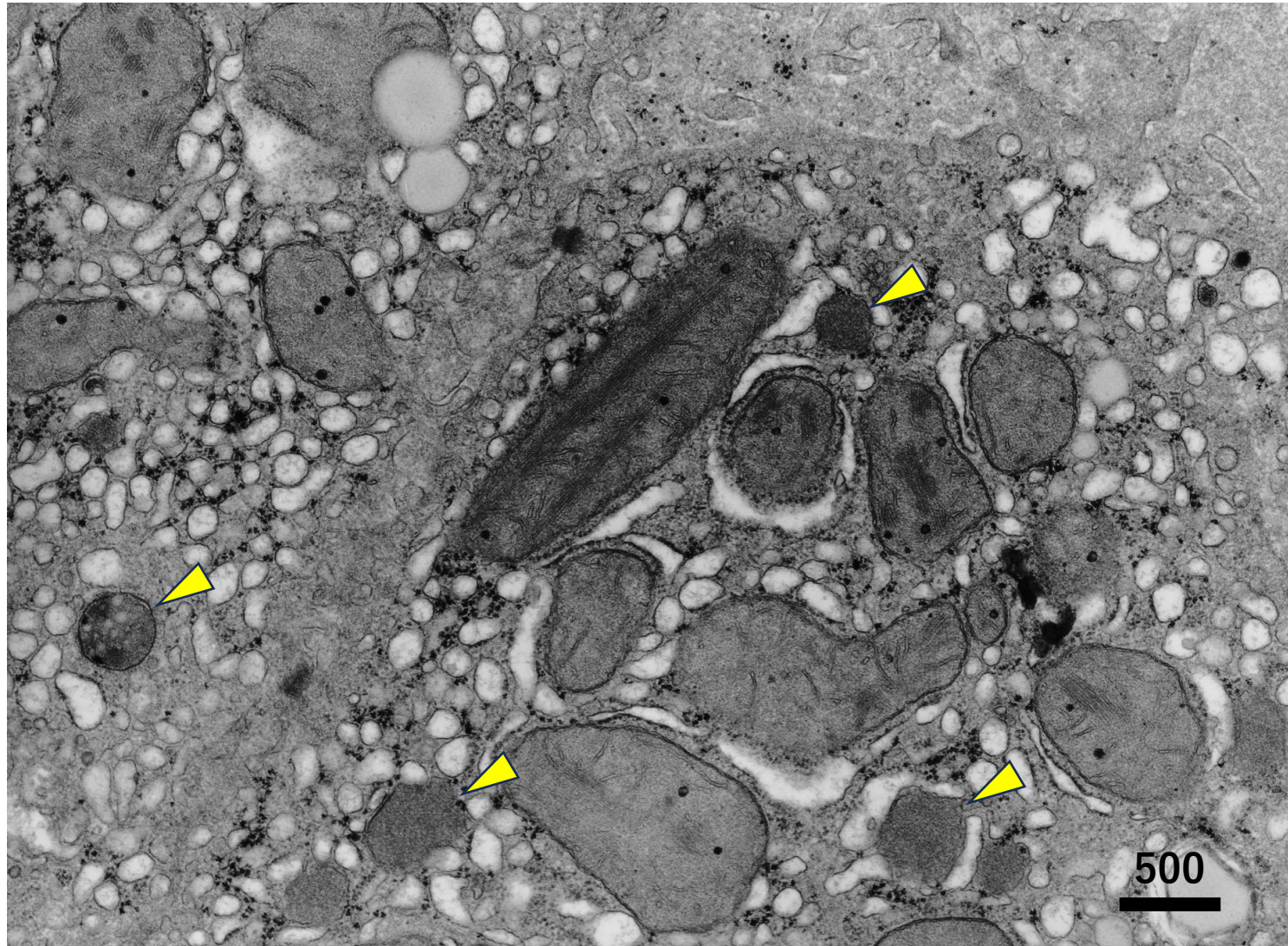
Ultrastructure of the hepatocyte in **Dubin-Johnson syndrome**. Lipofuscin-like electron-dense deposits are seen in the cytoplasm of the hepatocyte, causing a black color of the liver.



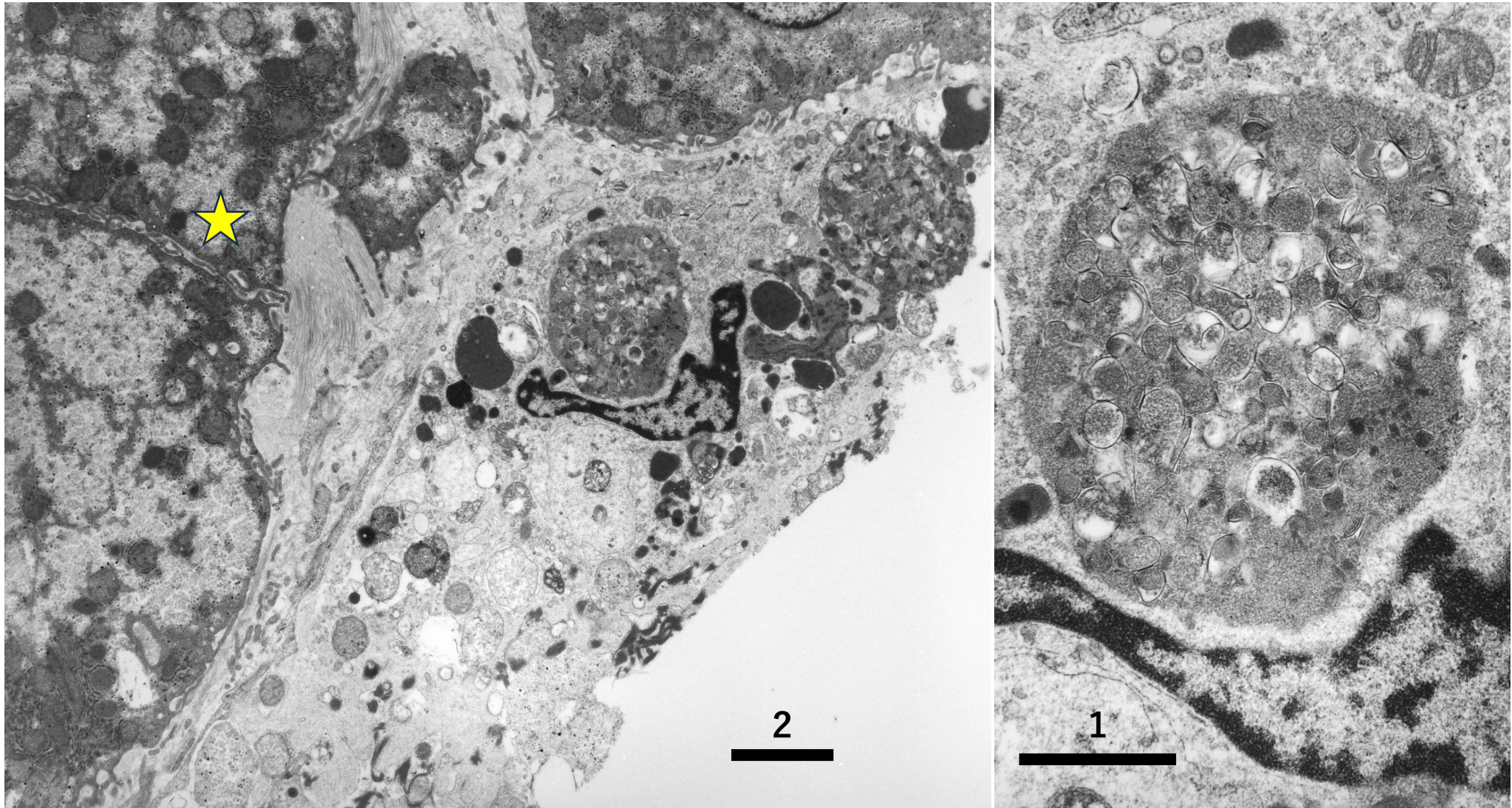
Ultrastructure of **Mallory bodies** in the hepatocyte in giant cell hepatitis seen in a 5 months-old boy. Mallory bodies represent ubiquitinated aggregations of cytokeratin filaments, occasionally seen in alcoholic hepatitis or cholestatic liver disorders.



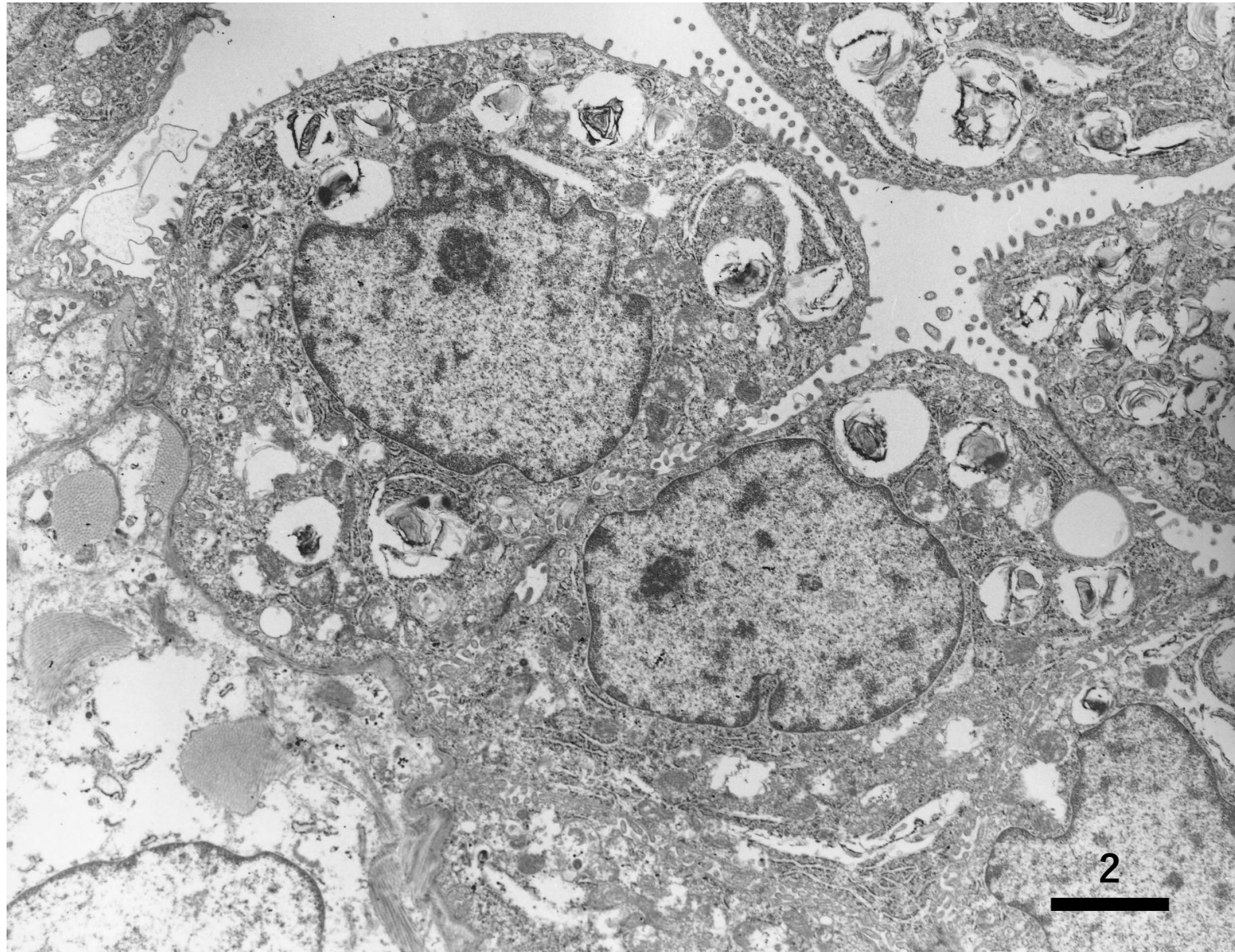
Ultrastructure of the hepatocyte in **Reye syndrome** seen in a 6 months-old girl. Reye syndrome represents pediatric acute encephalopathy typically caused by Aspirin intake against a febrile state. Loss of cristae of mitochondria indicates a state of mitochondriopathy. Deposition of fine droplets of fat (microvesicular steatosis) is complicated.



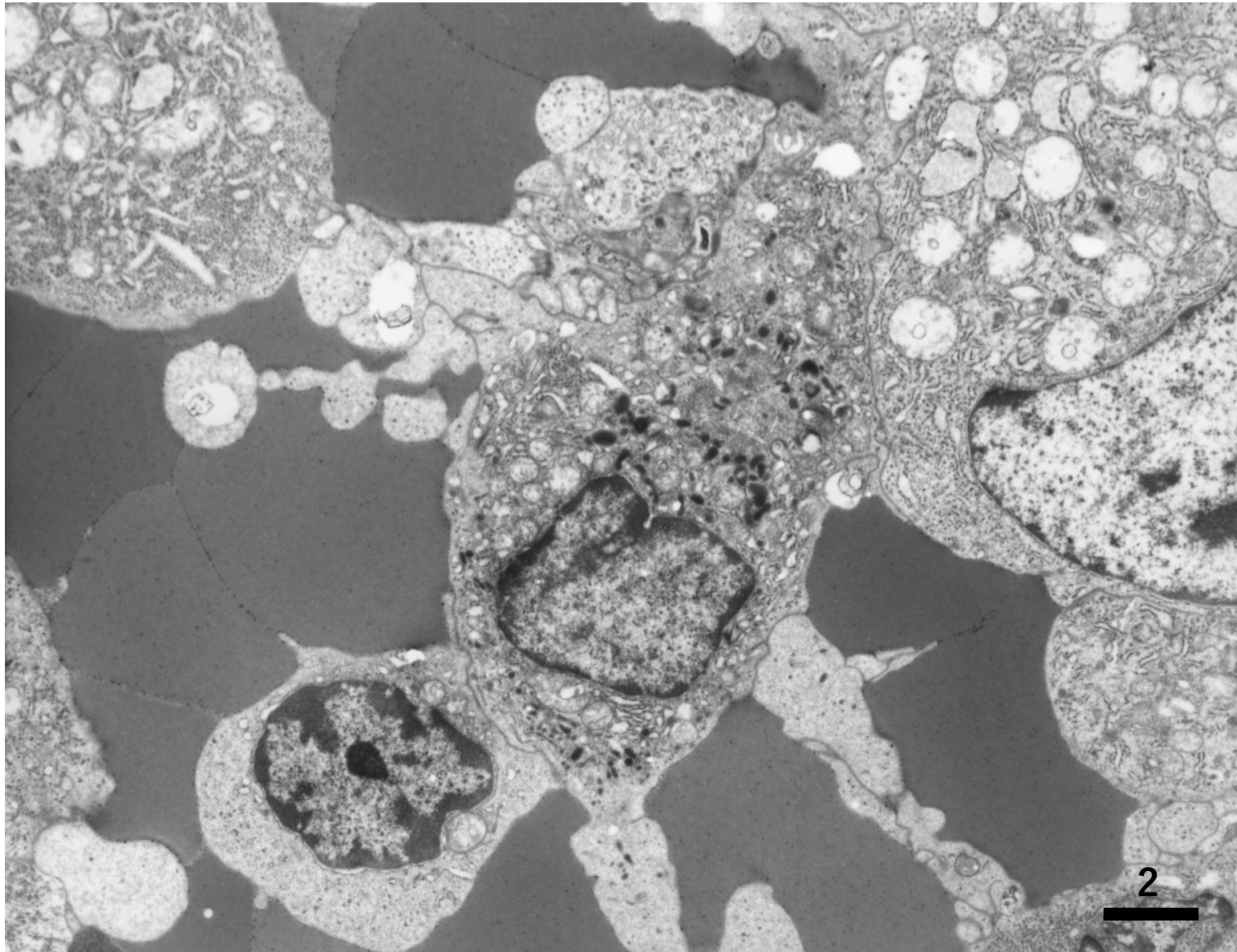
Ultrastructure of **peroxisomes** in the hepatocyte. The liver biopsy from a 4 y-o boy. Mitochondria are mildly enlarged and contain longitudinally arranged tubular cristae. The round-shaped peroxisomes with mildly elevated electron density are increased (arrowheads). Peroxisomes seen in every nucleated cell contain catalase converting hydrogen peroxide to water and oxygen, and also contribute to the biosynthesis of membrane ether lipids known as plasmalogens.



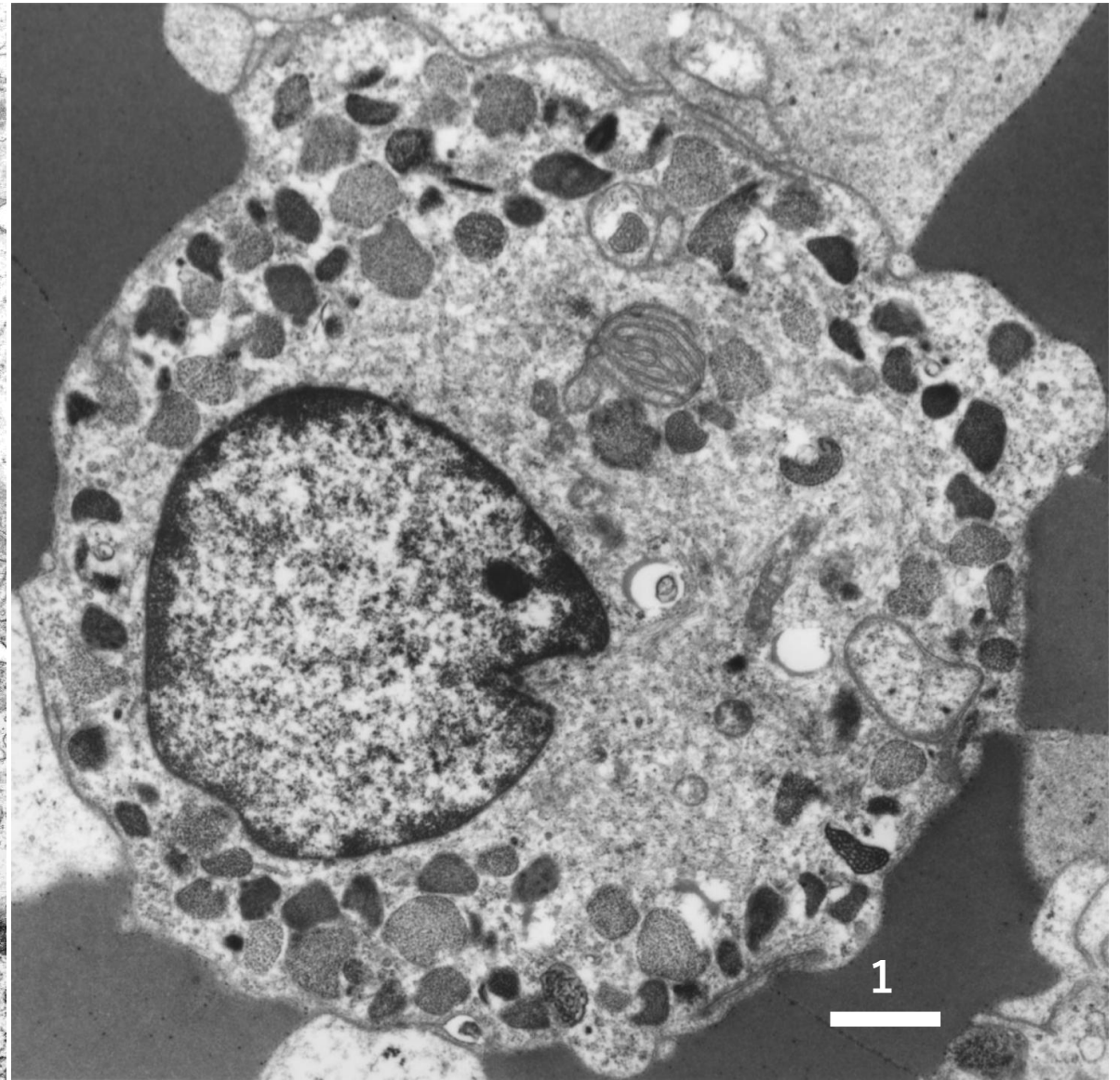
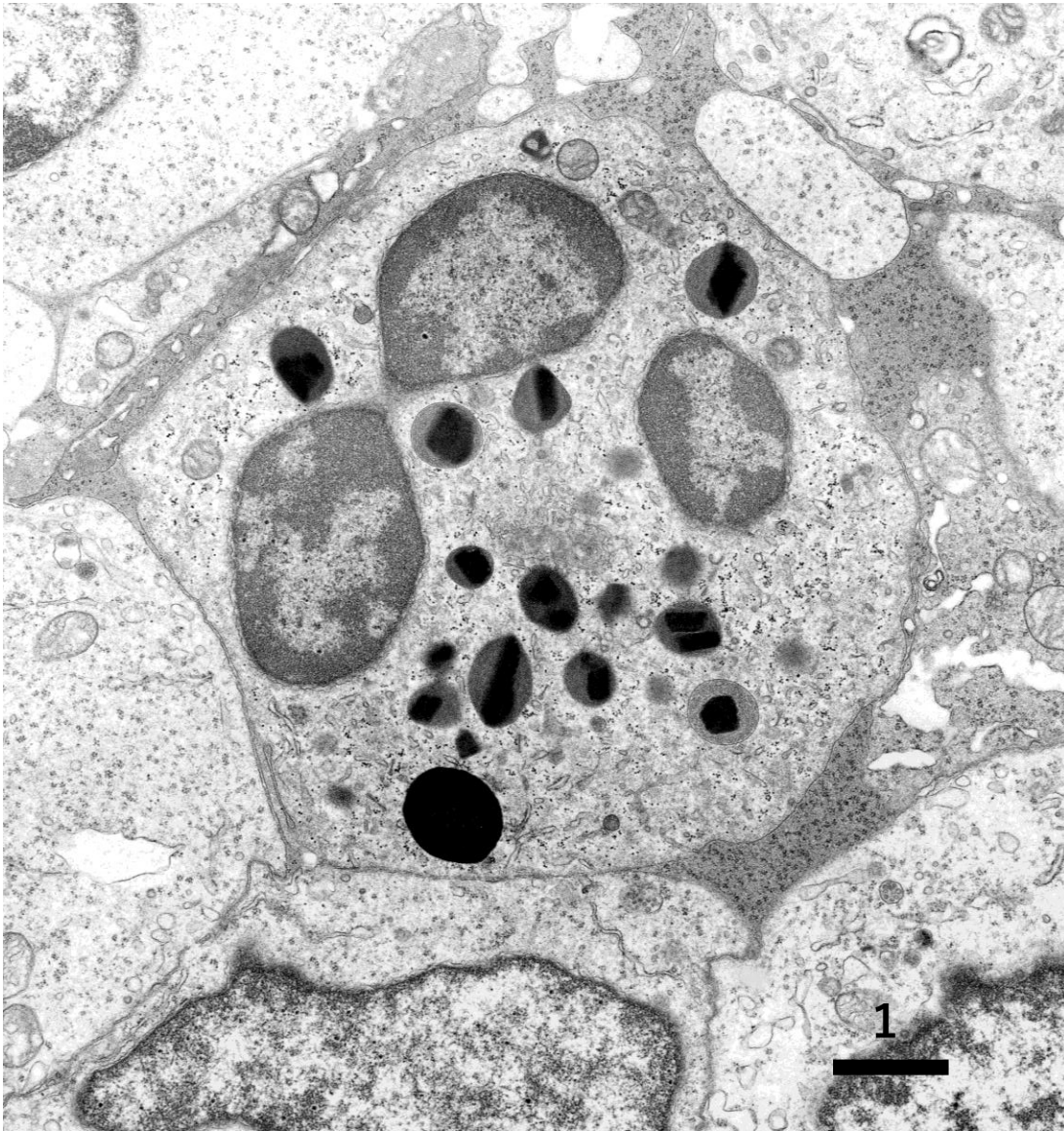
Ultrastructure of **autophagosomes** in an activated **Kupffer cell** in a 3 y-o boy with veno-occlusive disease of the liver. Lysosomes of the phagocyte are activated to phagocytize own organelles. Asterisk indicates the hepatocyte.



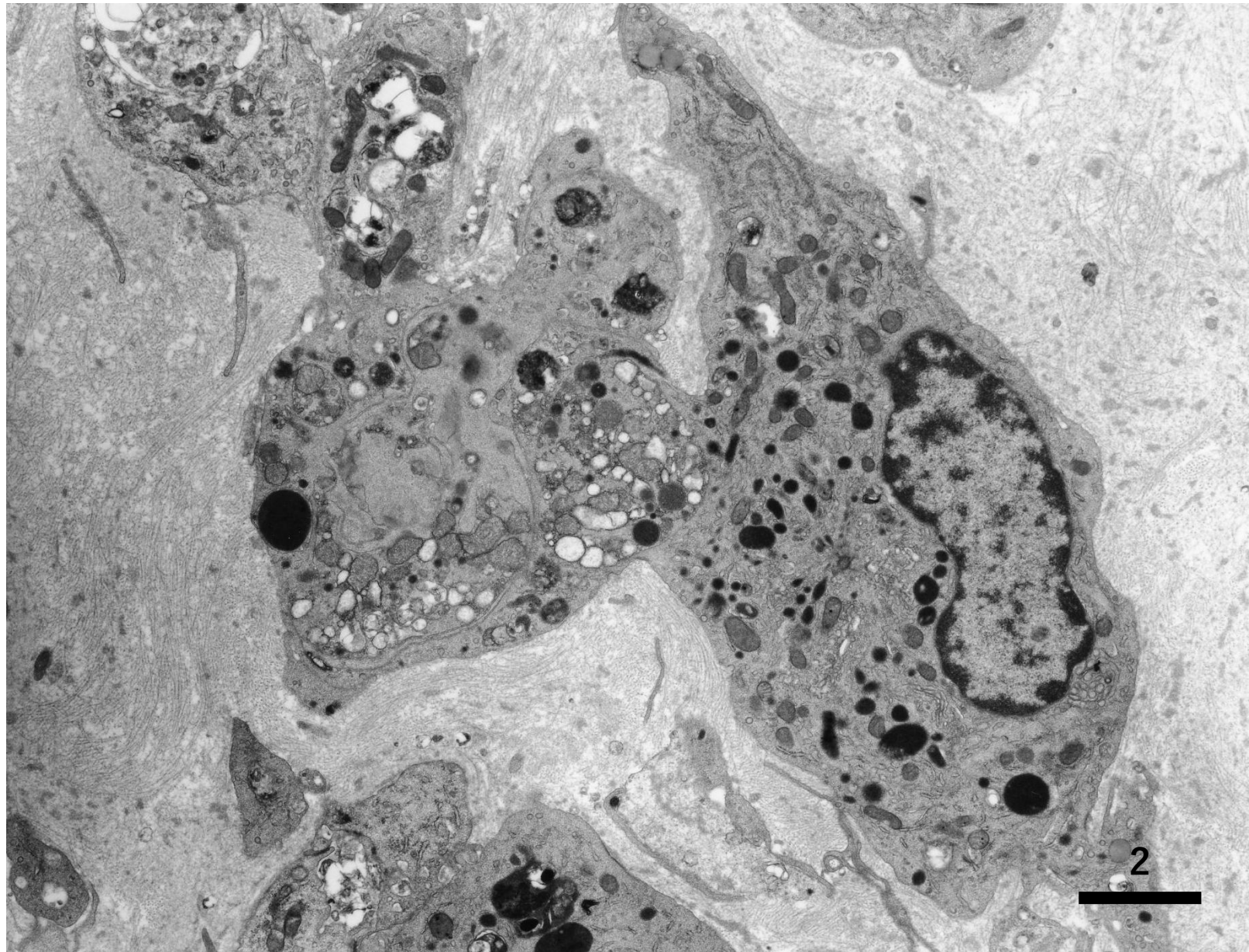
Ultrastructure of **type II pneumocytes**. Cuboidal-shaped epithelial cells with microvillous surface contain lamellar bodies, secreting surface-active substances (surfactants). They are often activated by interstitial lung diseases.



Ultrastructure of a **neutrophil** and a **lymphocyte** stagnated in a dilated capillary vessel. The neutrophil with an indented nucleus and fine granules attaches the capillary endothelial cell for migrating outside the vessel. The lymphocyte is smaller than the neutrophil, and lacks granules.



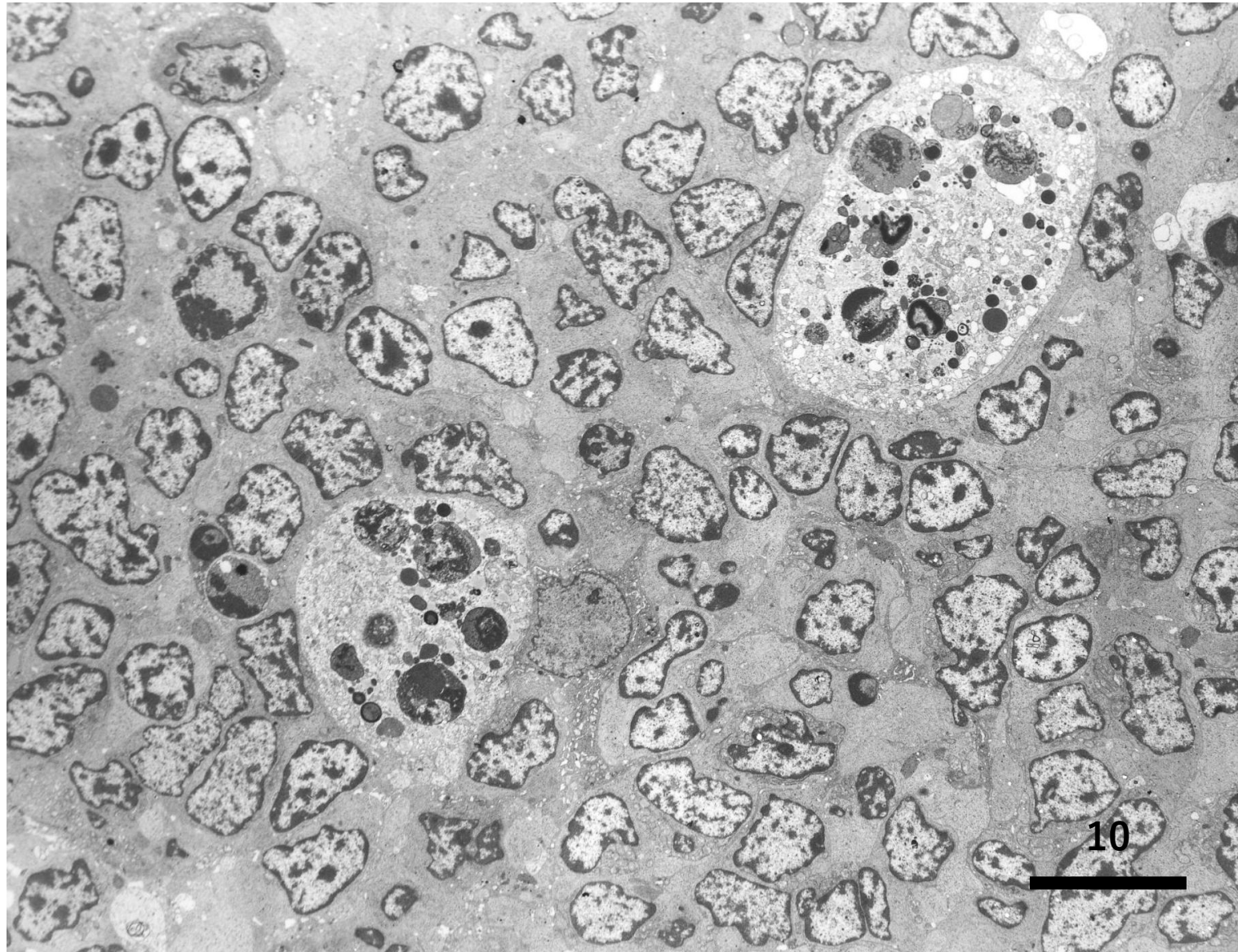
Ultrastructure of an **eosinophil** (left) and a **basophil** (right). Both of the granulocytes contain large-sized specific granules. The eosinophil contains crystallized granules, while the basophil granules are less electron density with fingerprint-like configurations.



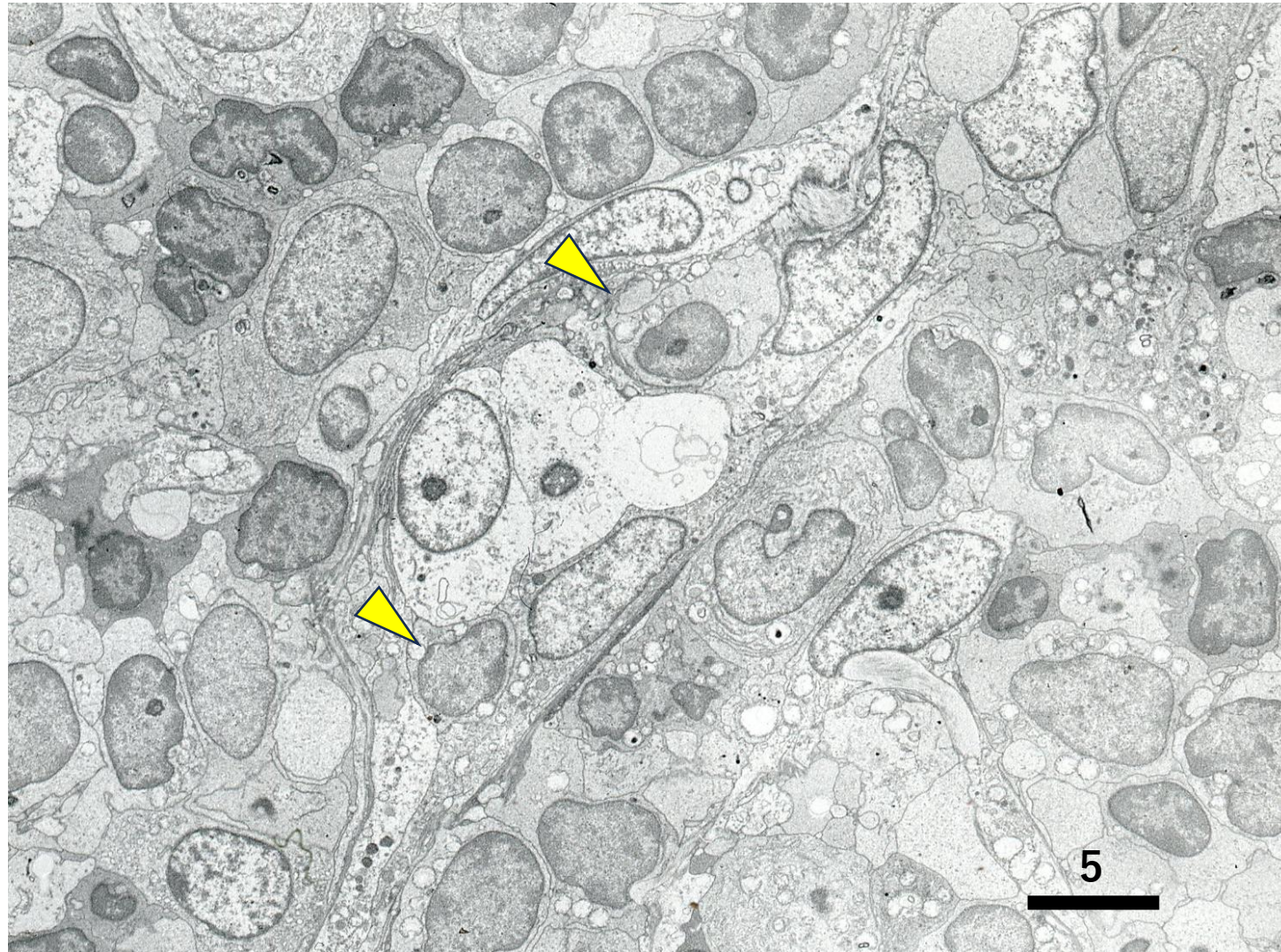
Ultrastructure of a **normal macrophage**. The macrophage contains plump ameboid-shaped cytoplasm with numbers of lysosomes.



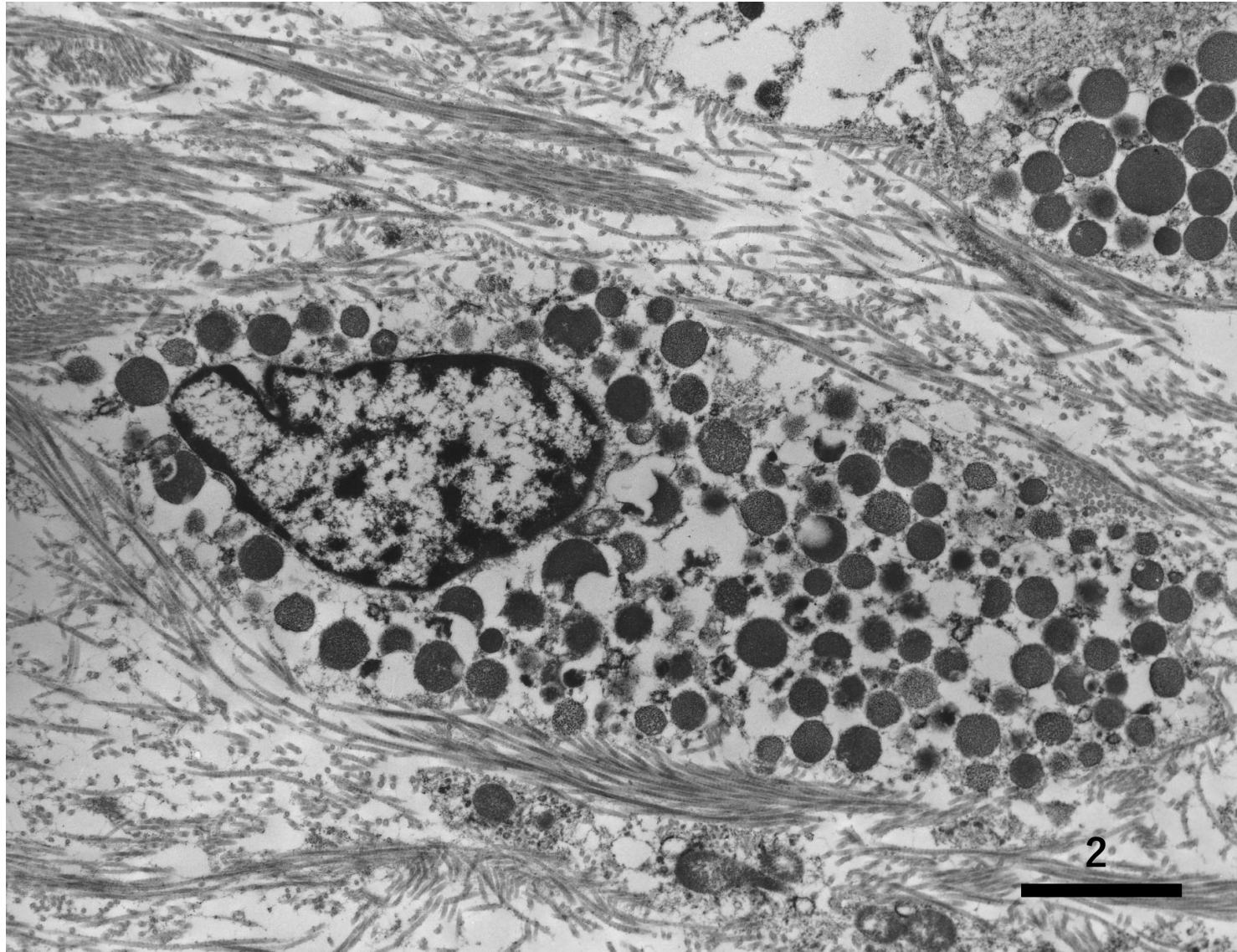
Erythrophagocytosis by a macrophage. The phagocytized red blood cell is indicated by the asterisk. An rhombus indicates an activated lysosome. A hypercytotoxic state is indicated.



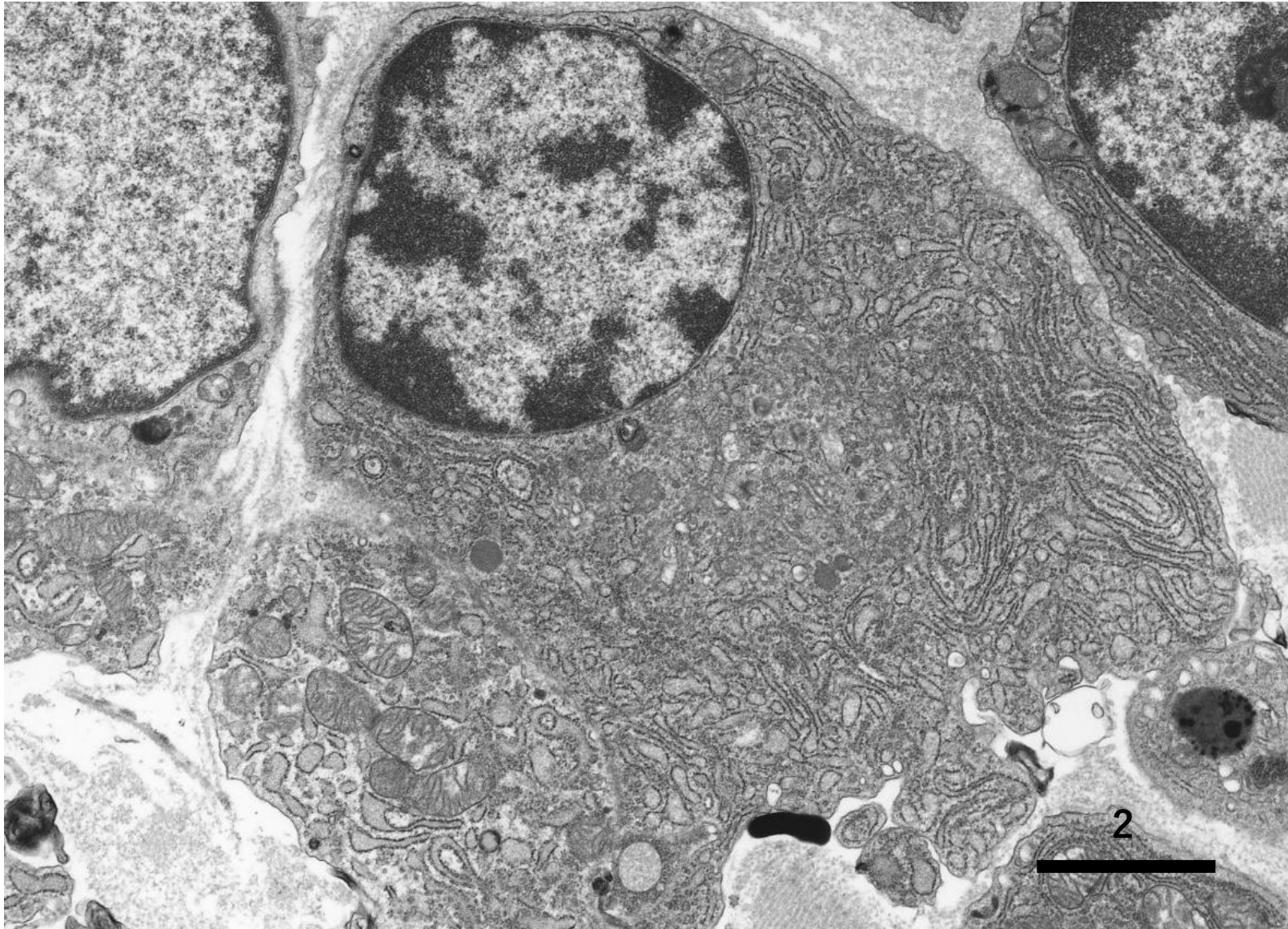
Ultrastructure of the **germinal center of the reactive lymphadenopathy**. **Tingible body macrophages** actively phagocytize apoptotic lymphocytes. Activated B-lymphocytes in the germinal center possess indented (cleaved) nuclei.



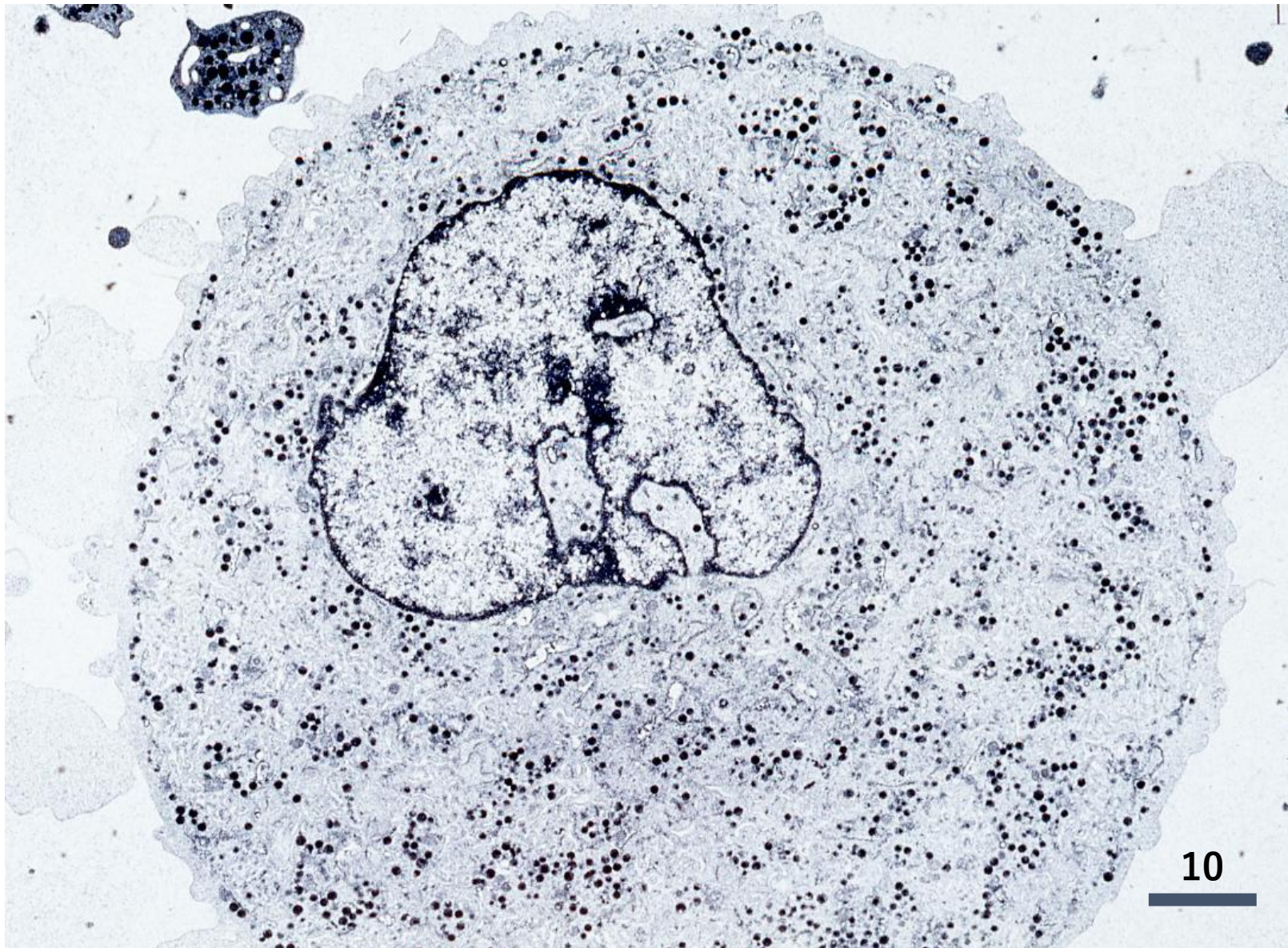
Ultrastructure of the **post-capillary venule** (PCV) in the paracortex of reactive lymphadenopathy. High endothelial cells line the PCV, and lymphocytes penetrate through the endothelial cells, representing lymphocytic homing (arrowheads). The surrounding parenchyma is rich in T-lymphocytes.



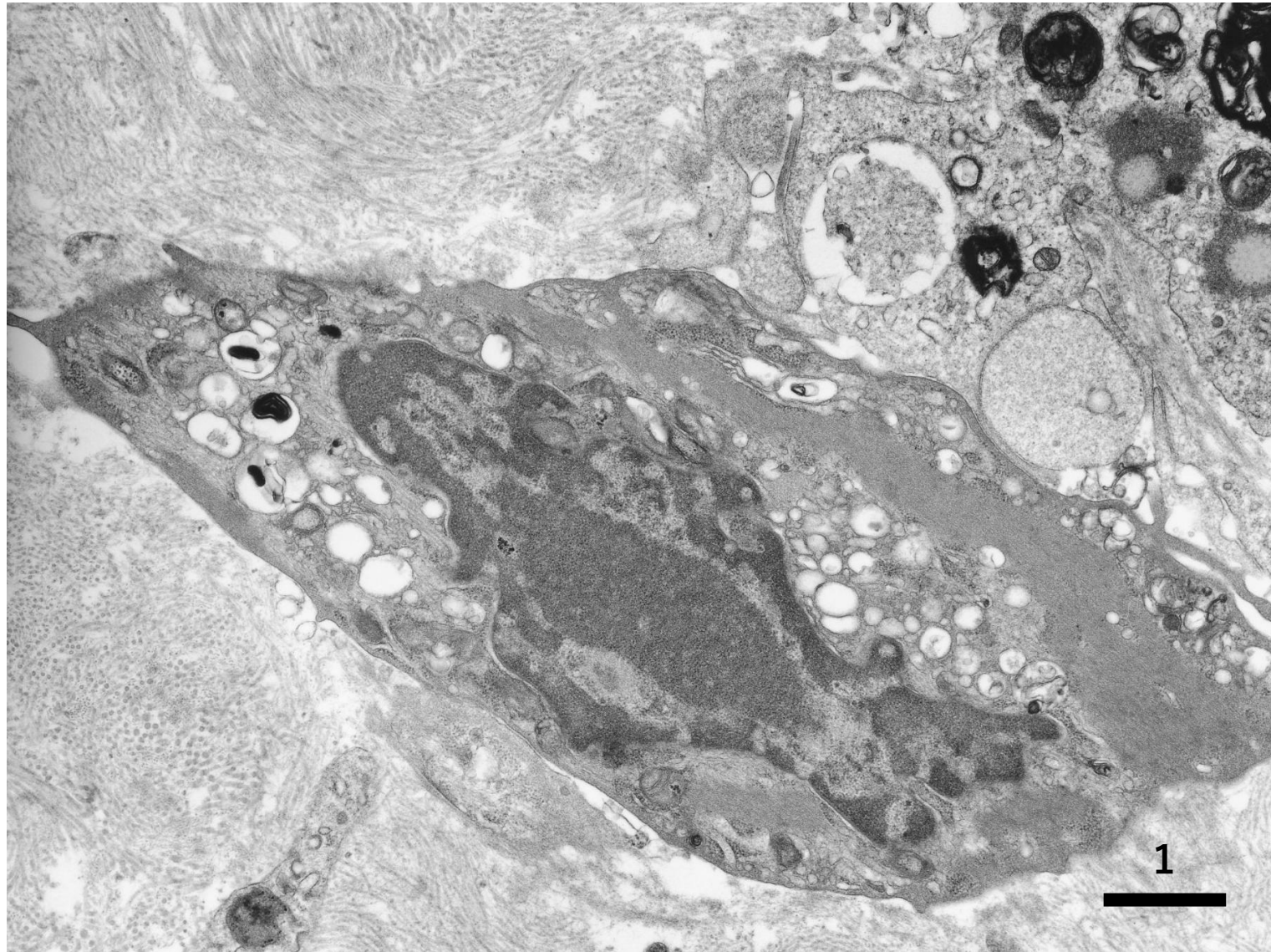
Mast cells seen in the soft tissue. The cytoplasm is filled with rounded electron-dense granules rich in histamine.



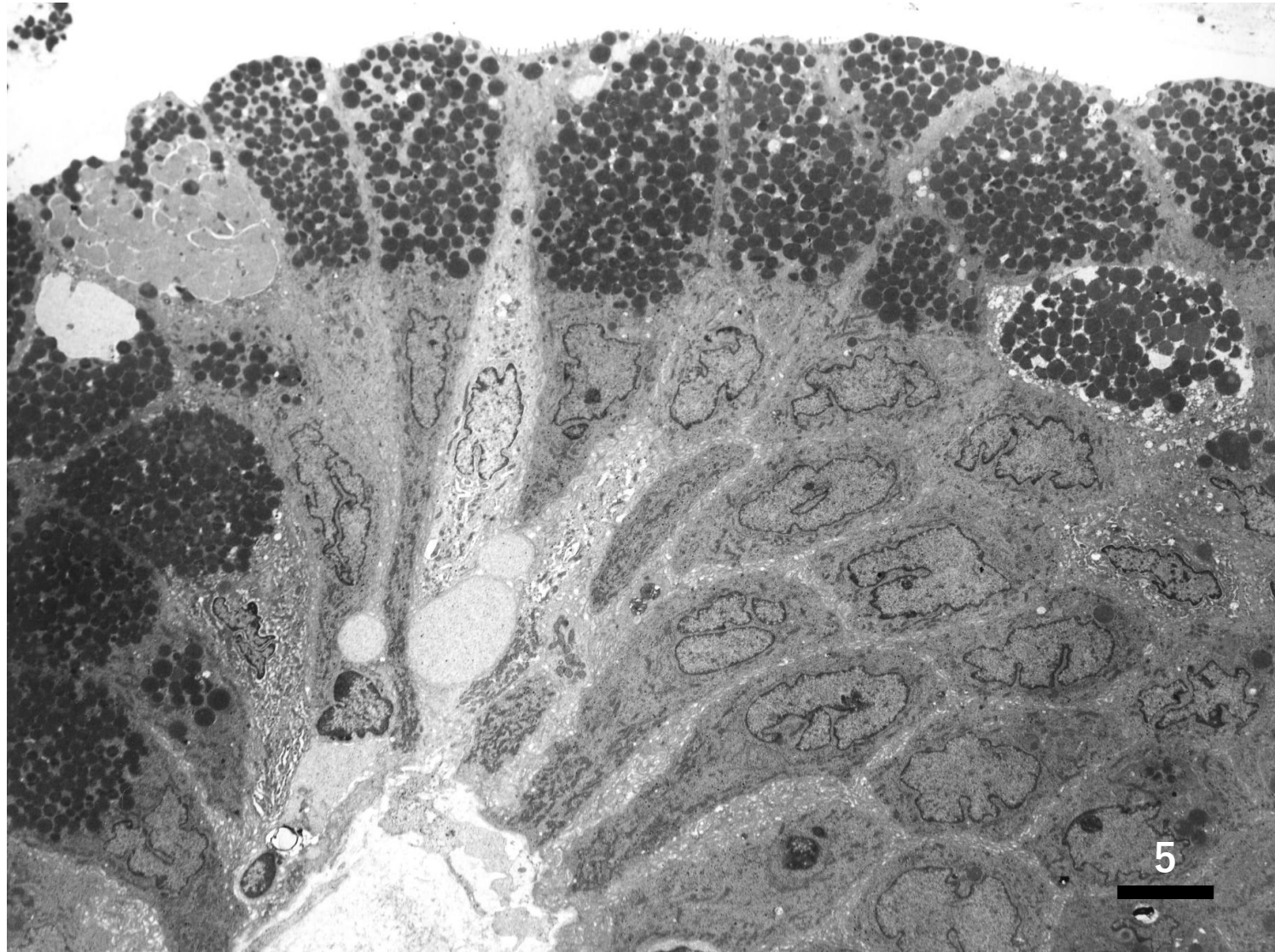
Plasma cell possesses eccentrically located nucleus with aggregated heterochromatin at the periphery and wide cytoplasm rich in rough endoplasmic reticulum producing immunoglobulins. Golgi apparatus is also well developed.



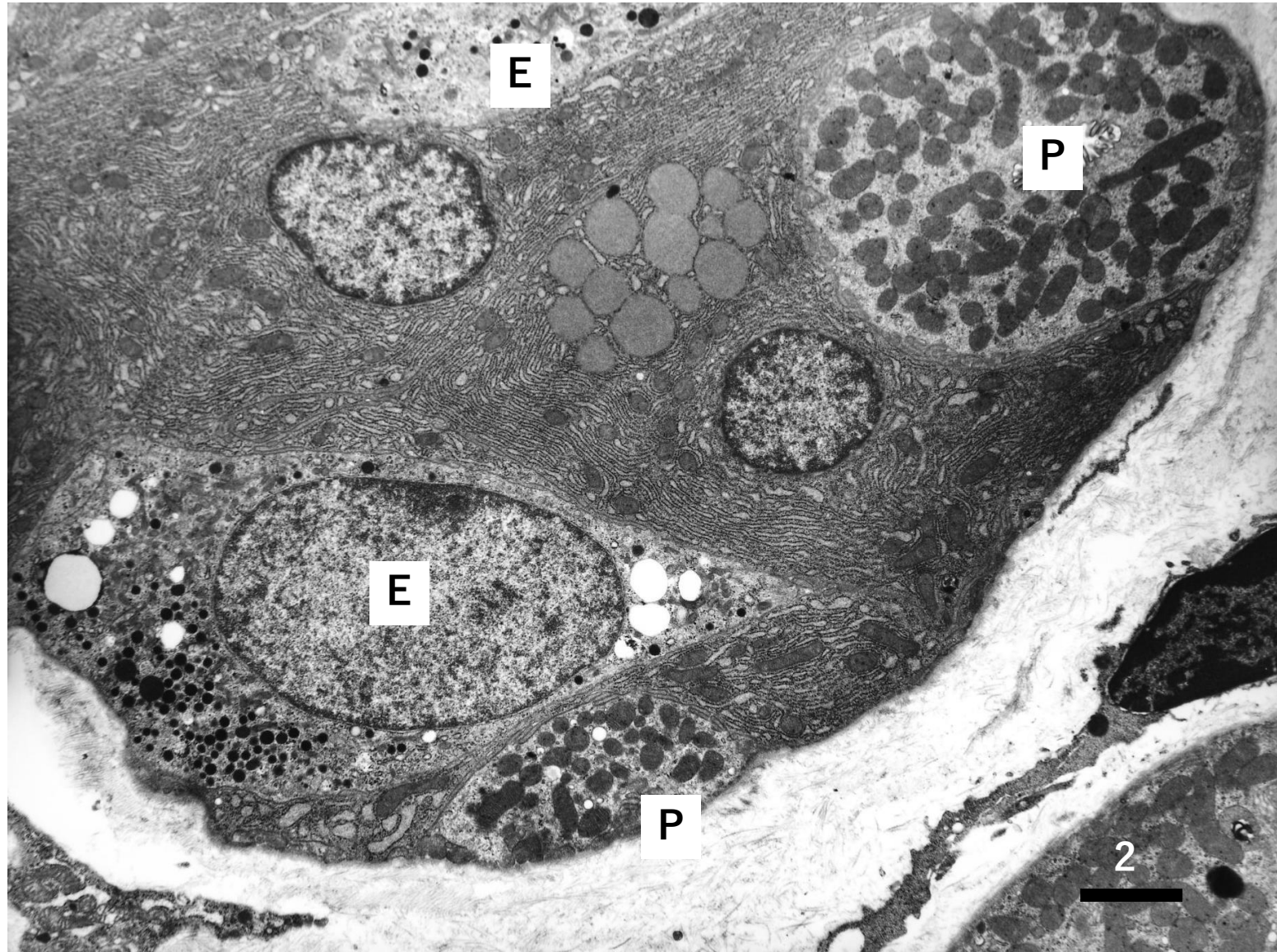
Ultrastructure of a **megakaryocyte** in the bone marrow. The largest hematopoietic cell contains large lobulated nuclei and plump cytoplasm rich in electron-dense alpha-granules. Demarcation membranes occasionally with projections of pseudopods are seen at the periphery of the cell. Platelet segregation is focally associated.



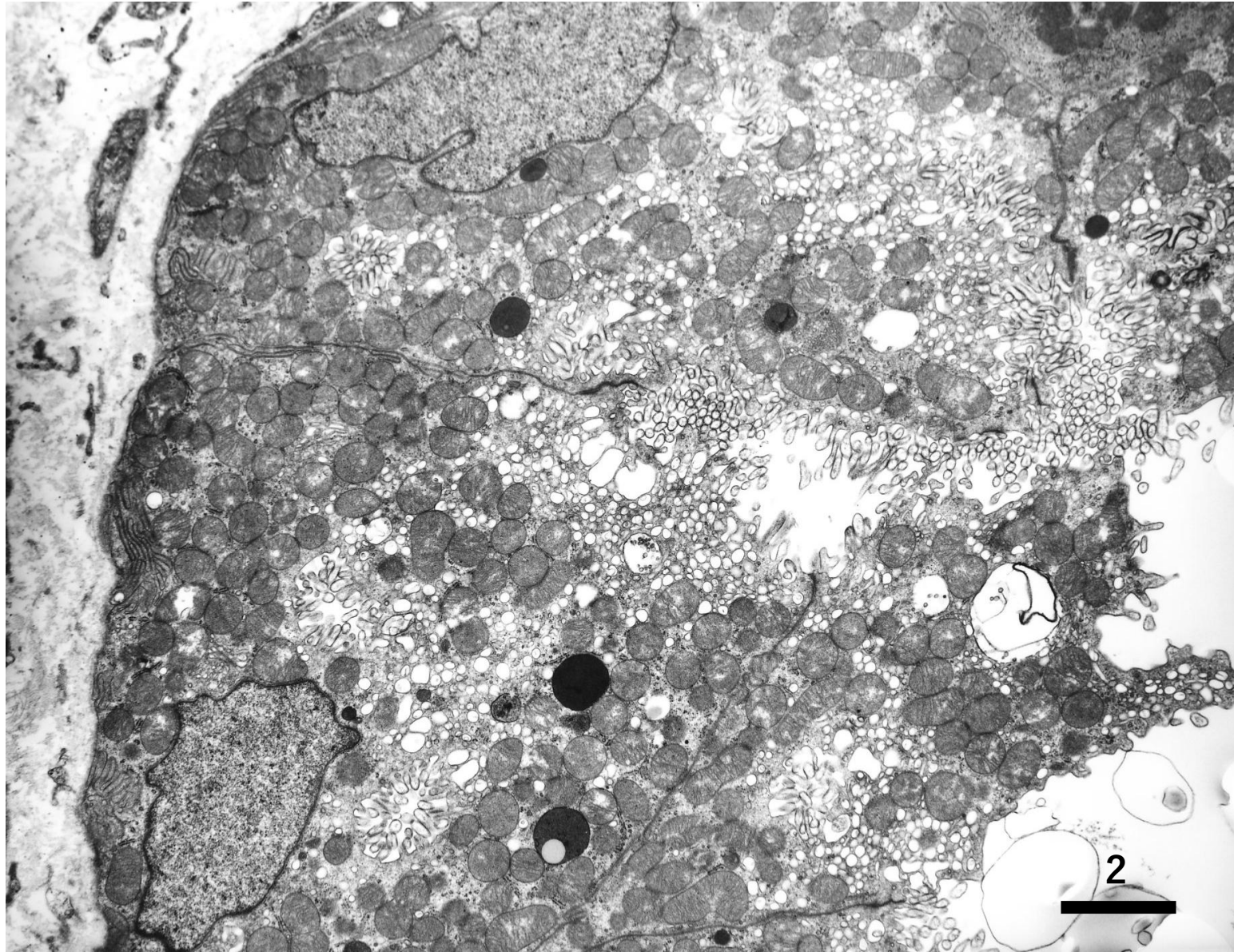
Ultrastructure of a **myofibroblast** seen in a fibrotic bone lesion. The spindled cell embedded in collagenous matrix possesses well-developed rough endoplasmic reticula and bundles of actin filaments. An activated macrophage is seen adjacent to the myofibroblast.



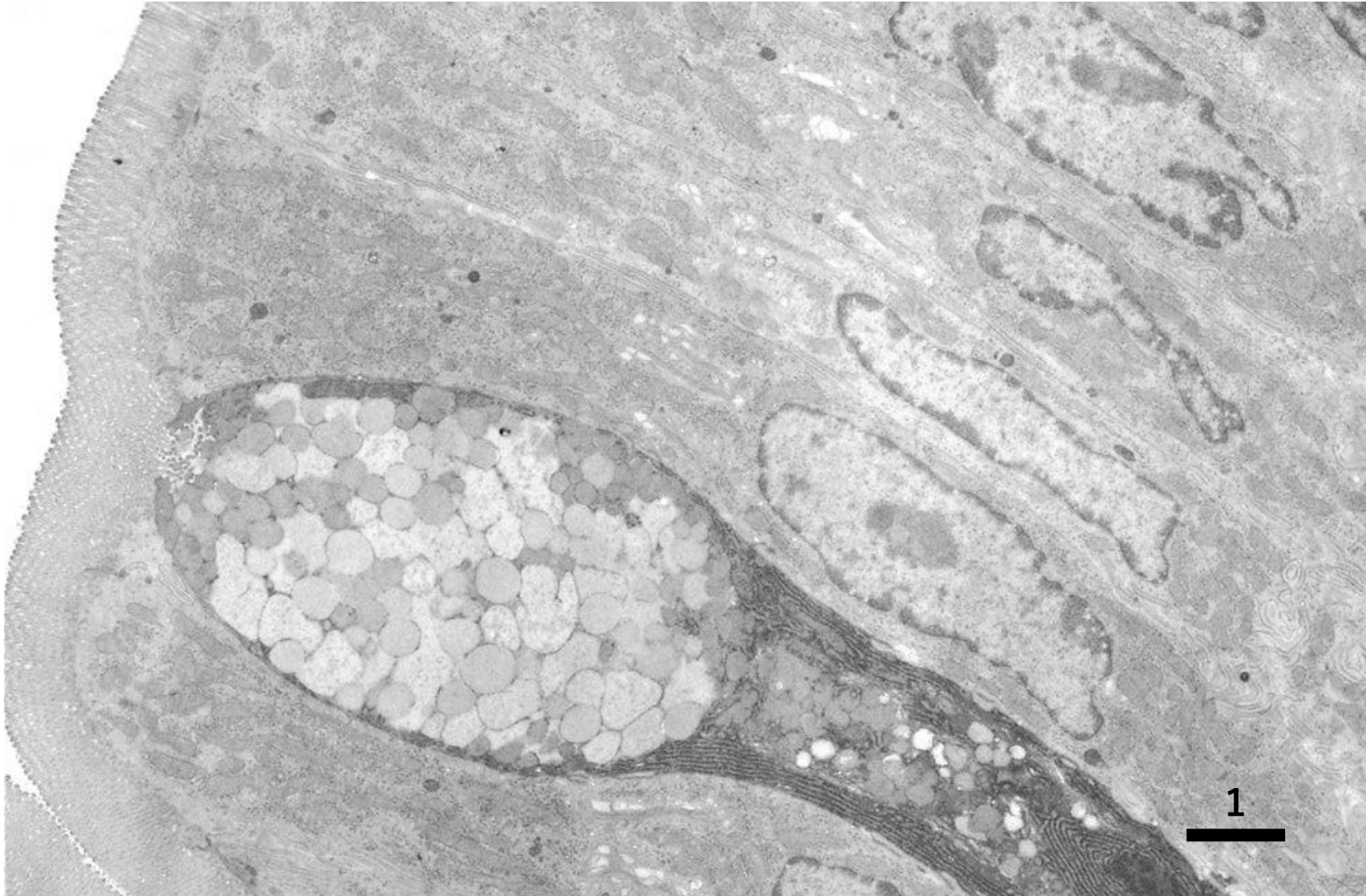
Ultrastructure of **gastric surface mucous cells**. The supranuclear cytoplasm is filled with electron-dense mucin (excretory) granules.



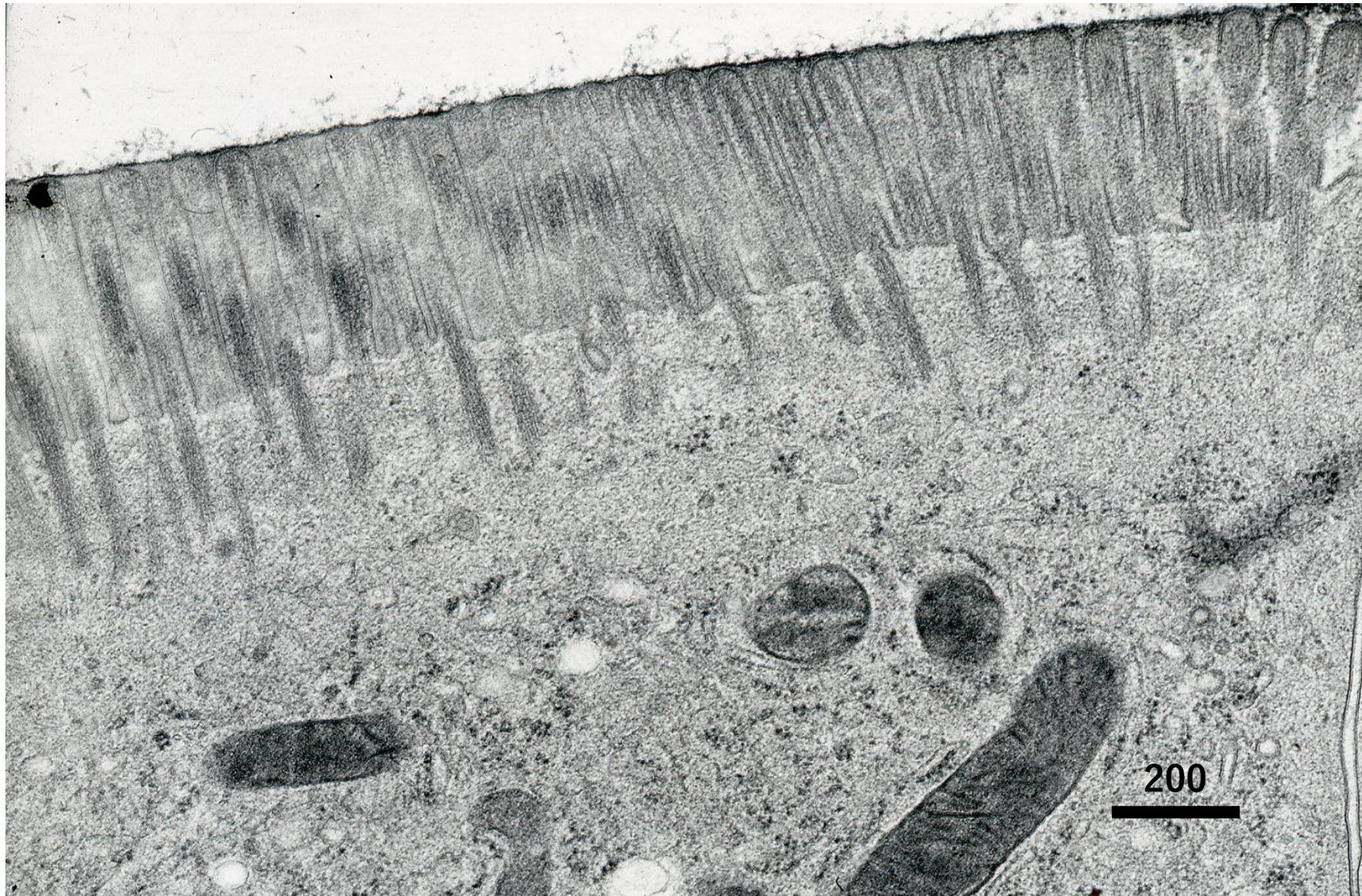
Ultrastructure of the **fundic gland of the stomach**. A chief cell possesses well-developed rough endoplasmic reticula and round-shaped excretory granules. Parietal cells (P) are rich in mitochondria. Neuroendocrine cells (E) contain small neurosecretory granules in the infranuclear cytoplasm.



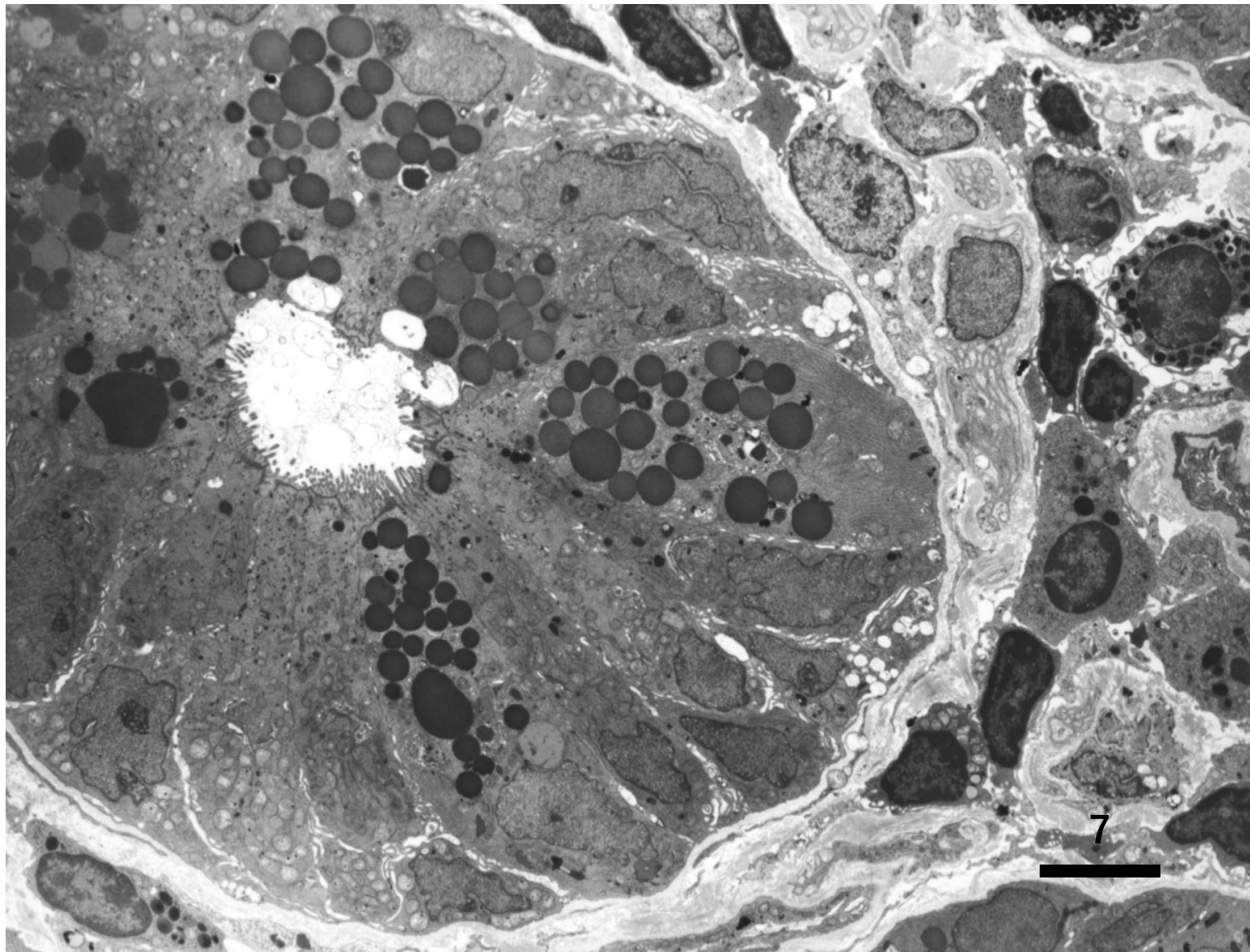
Ultrastructure of a **parietal cell** in the oxyntic gastric mucosa. The cytoplasm is rich in mitochondria, and intracytoplasmic secretory canaliculi, a specific structure for acid secretion, are lined by microvillous surface.



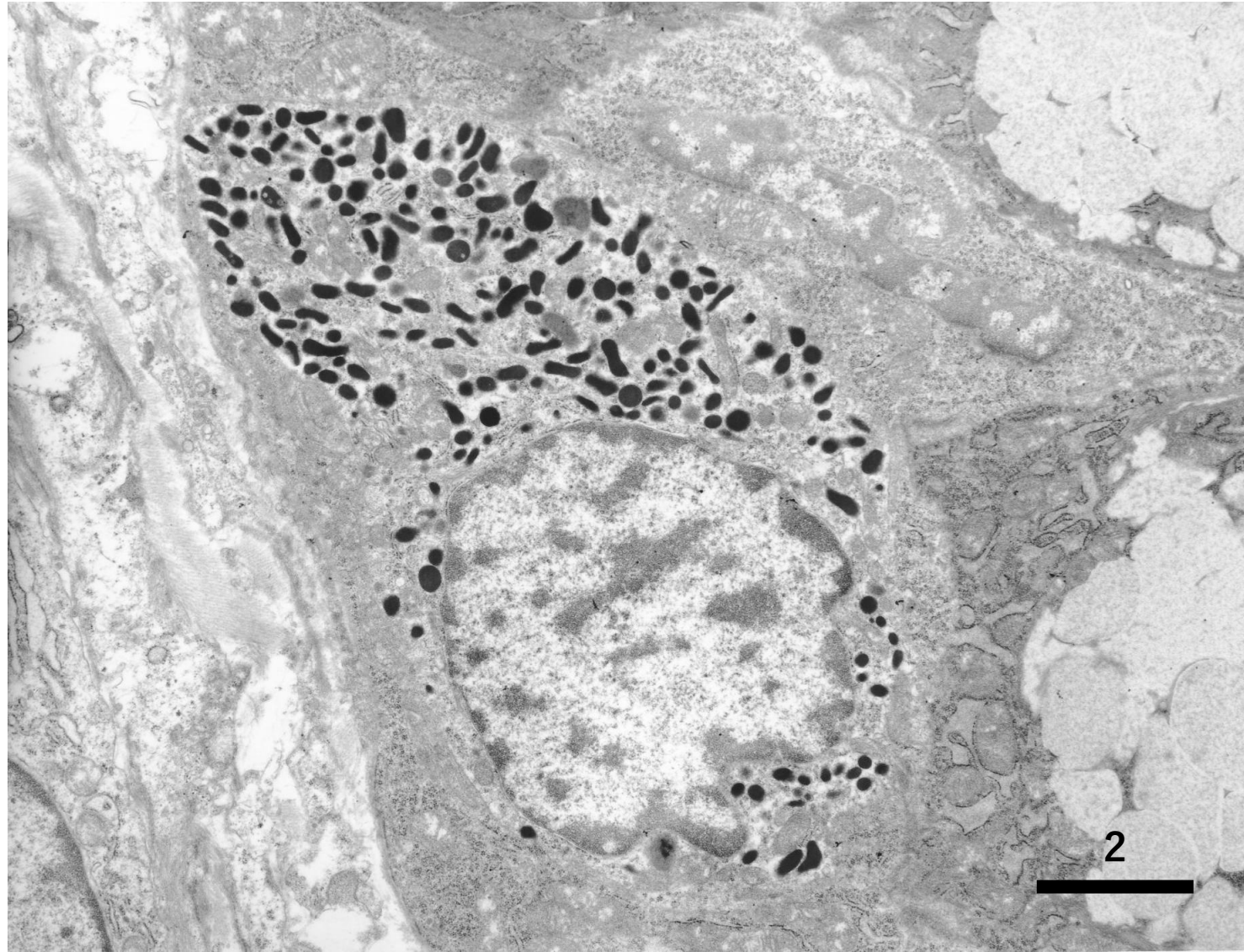
Ultrastructure of **the villus of the small bowel mucosa**. A goblet cell possesses mucin granules-filled plump cytoplasm with well-developed rough endoplasmic reticula. The apical surface of the non-mucous columnar cells is covered with densely packed microvilli.



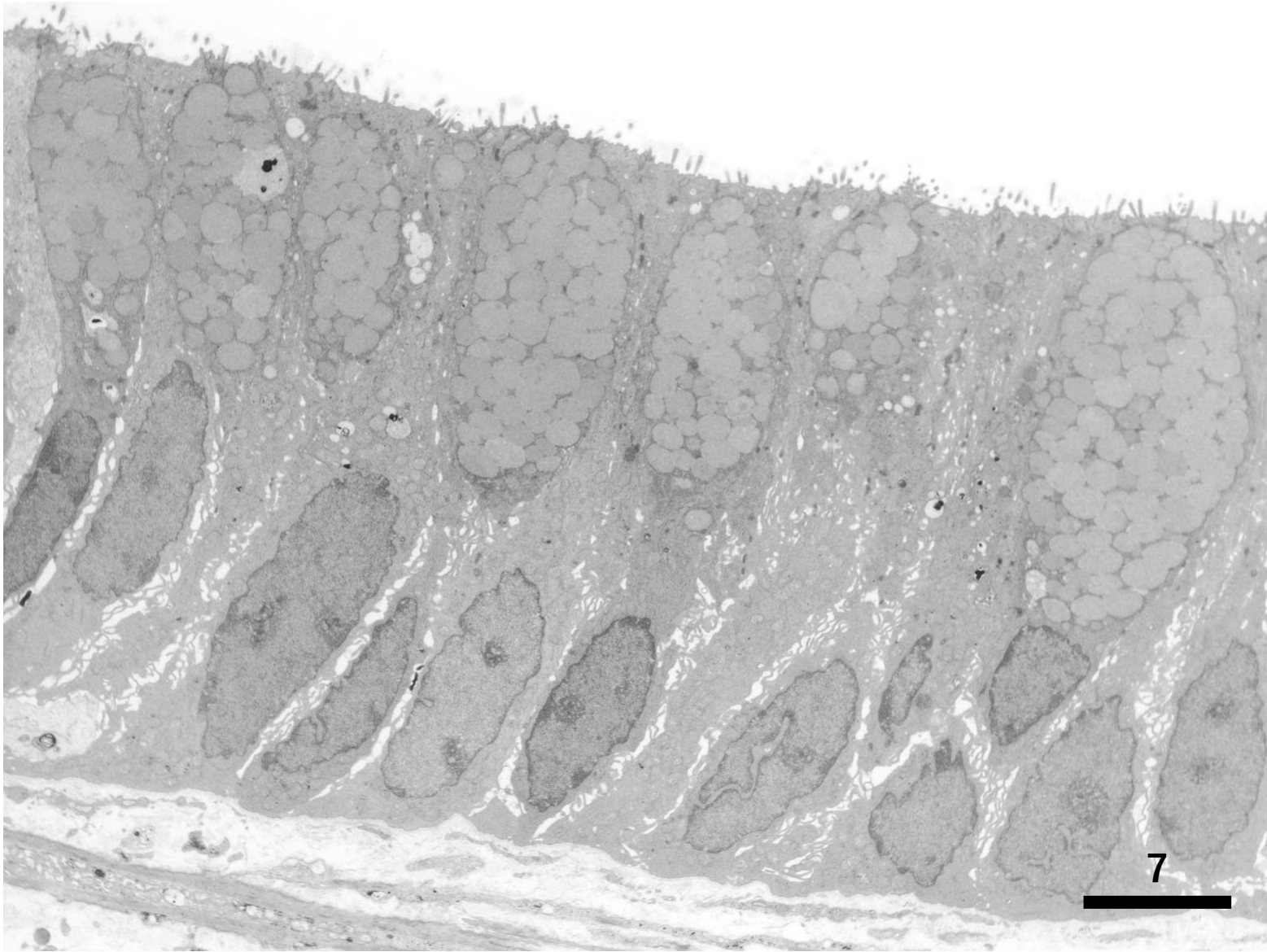
Ultrastructure of the **microvilli** on the small bowel columnar cell. The apical surface of the non-mucous columnar cells is covered with densely packed microvilli. The terminal villi are connected to the cell body by the terminal web.



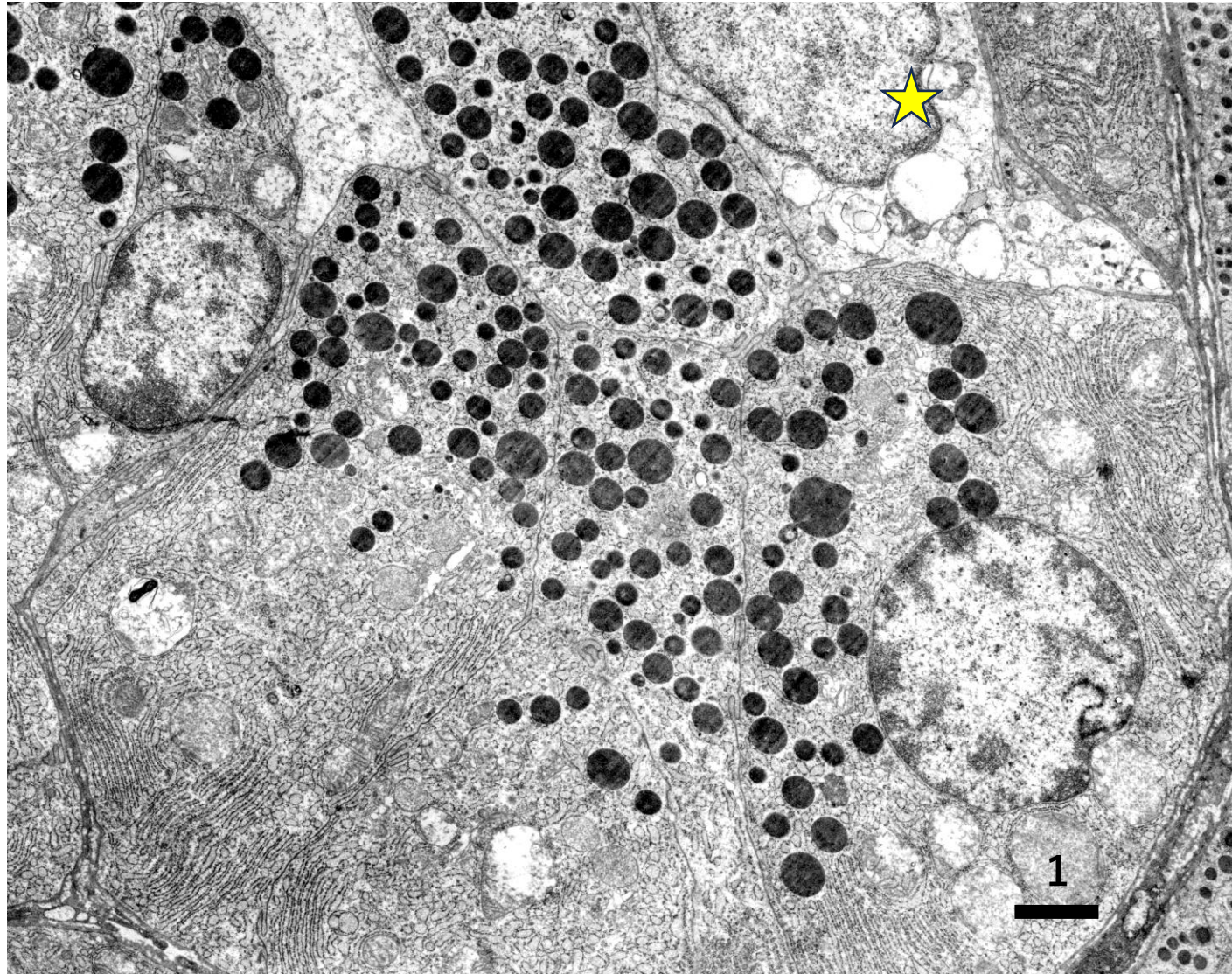
Ultrastructure of the **crypt of the small bowel mucosa**. **Paneth cells** possesses large-sized electron-dense excretory granules in the supranuclear cytoplasm. Sparsely microvillous apical surface is observed. The lamina propria mucosae contains small lymphocytes and plasma cells.



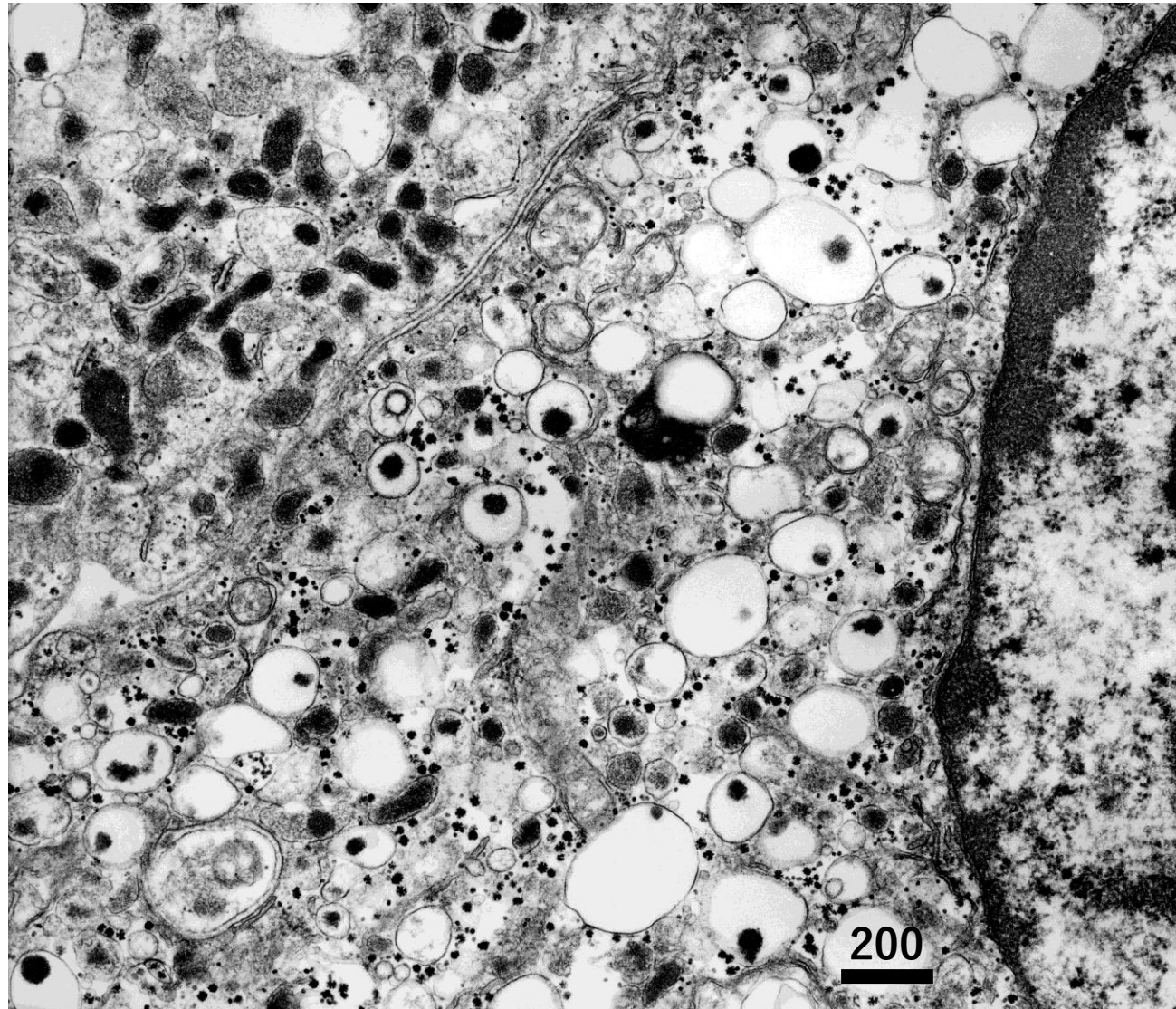
An **enterochromaffin (EC) cell** in normal rectal mucosa. Elongated or curved neuroendocrine granules in the infranuclear cytoplasm of the EC cell contain serotonin.



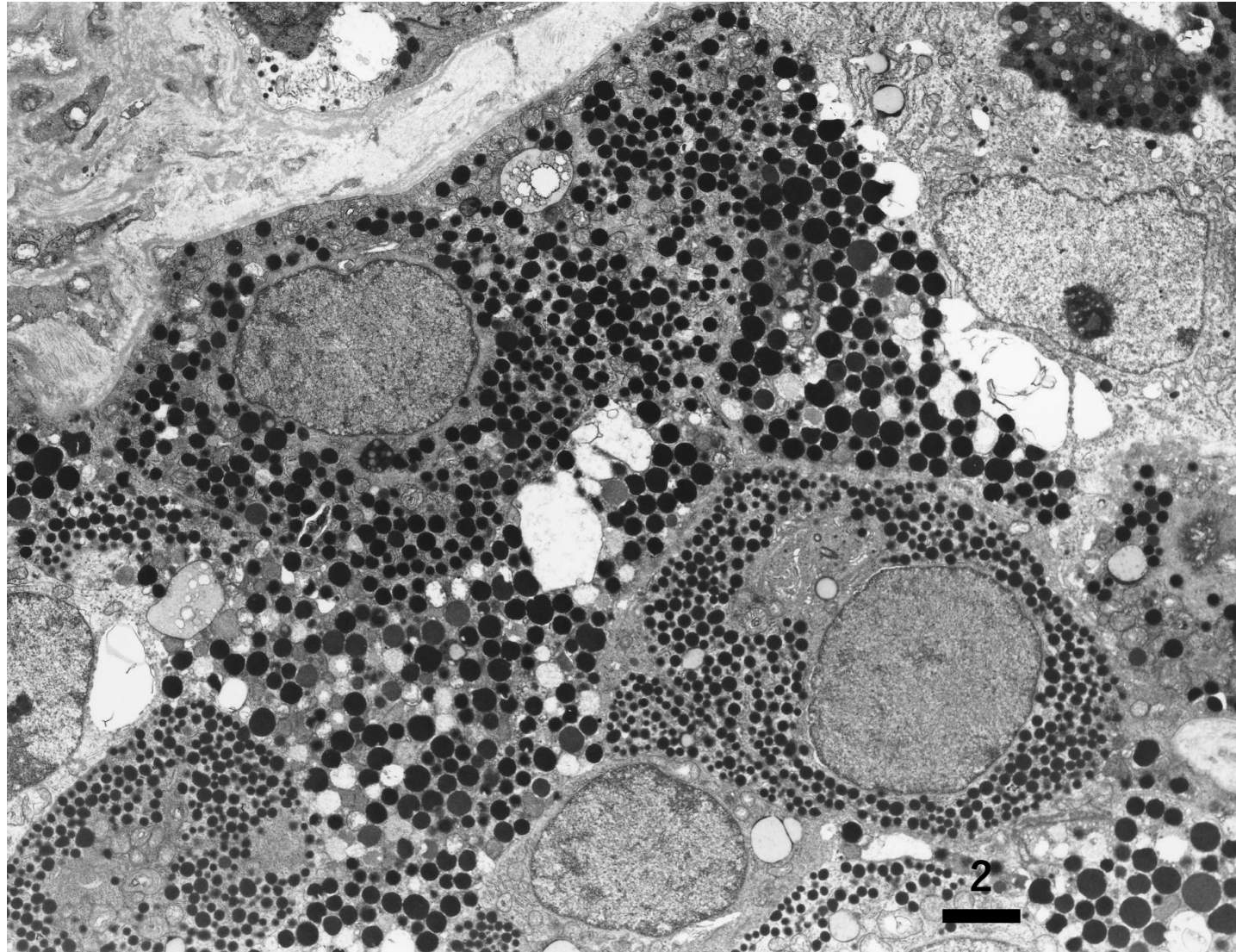
Ultrastructure of **normal colonic mucosa**. Numbers of goblet cells are distributed. Microvilli on the absorptive (non-goblet) columnar epithelial cells are poorly developed.



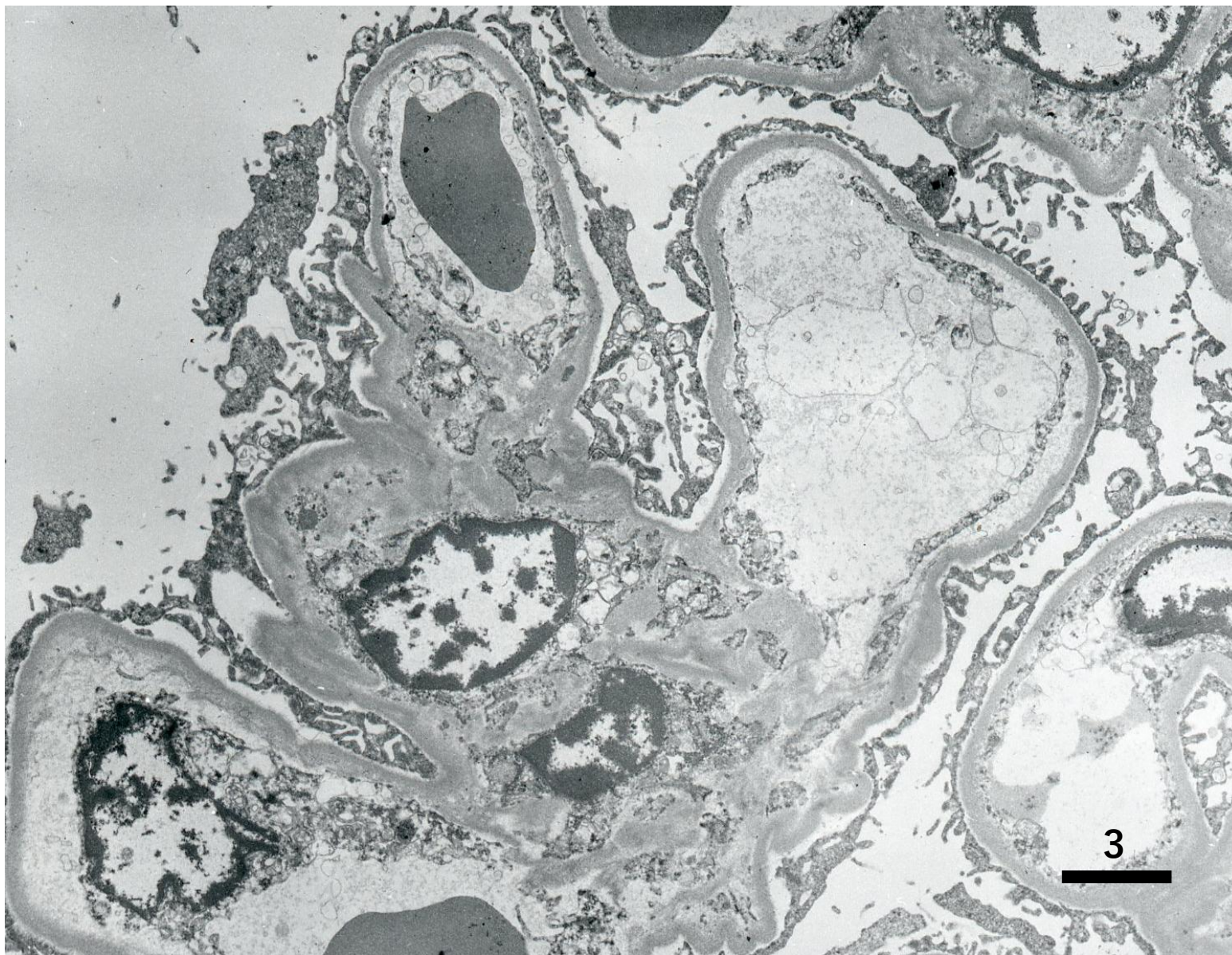
Ultrastructure of **acinar cells** of the normal pancreas. Large-sized, electron-dense excretory granules are seen in the supranuclear cytoplasm. Asterisk indicates a centroacinar cell without granule formation.



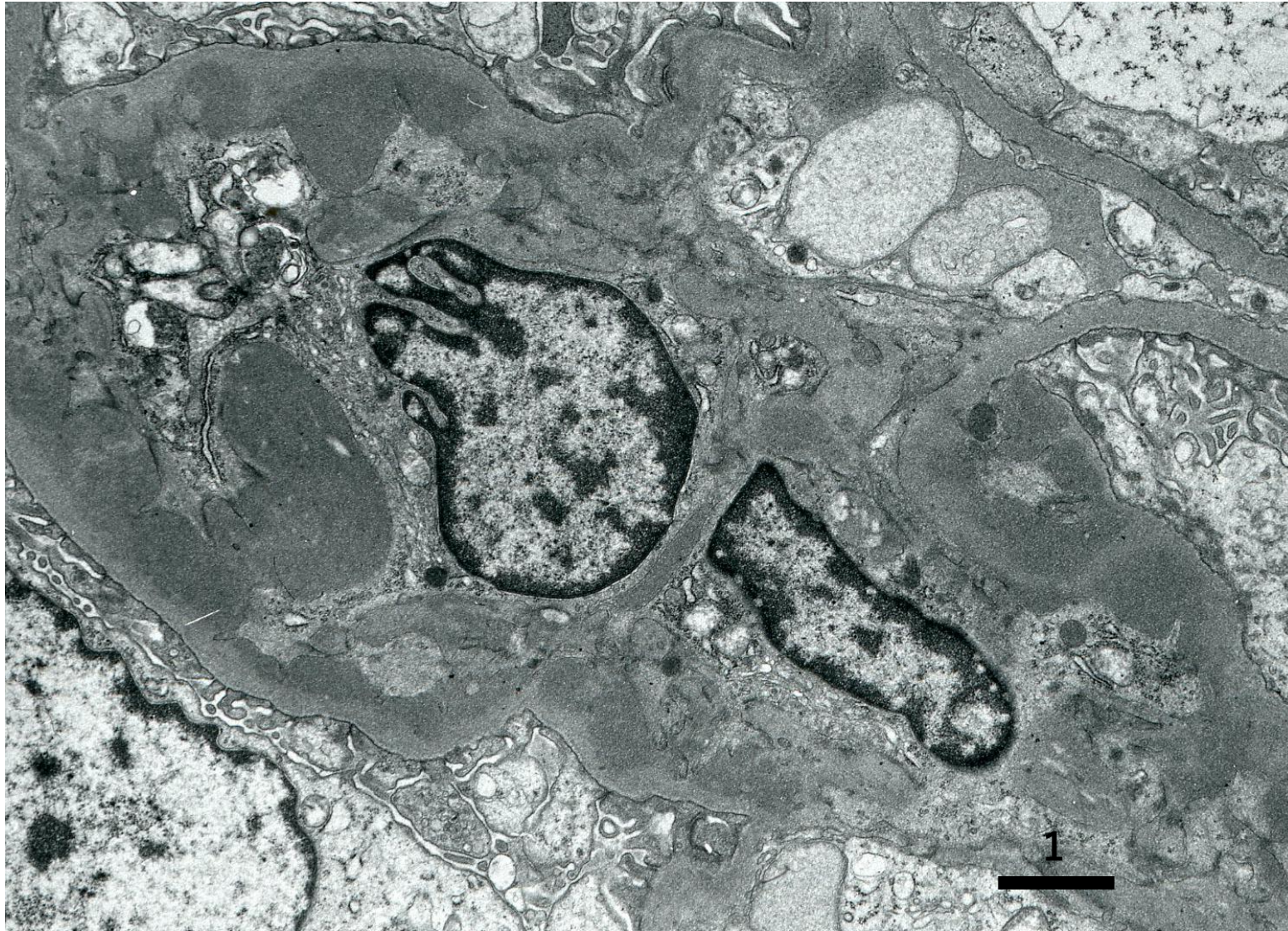
Ultrastructure of **Langerhans' islets**. The insulin-secreting beta-cell located in the right side contain large neuroendocrine granules with wide haloes around the electron-dense core. The glucagon-secreting alpha cell located in the left upper corner possess round to oval-shaped electron-dense neuroendocrine granules with sparse haloes.



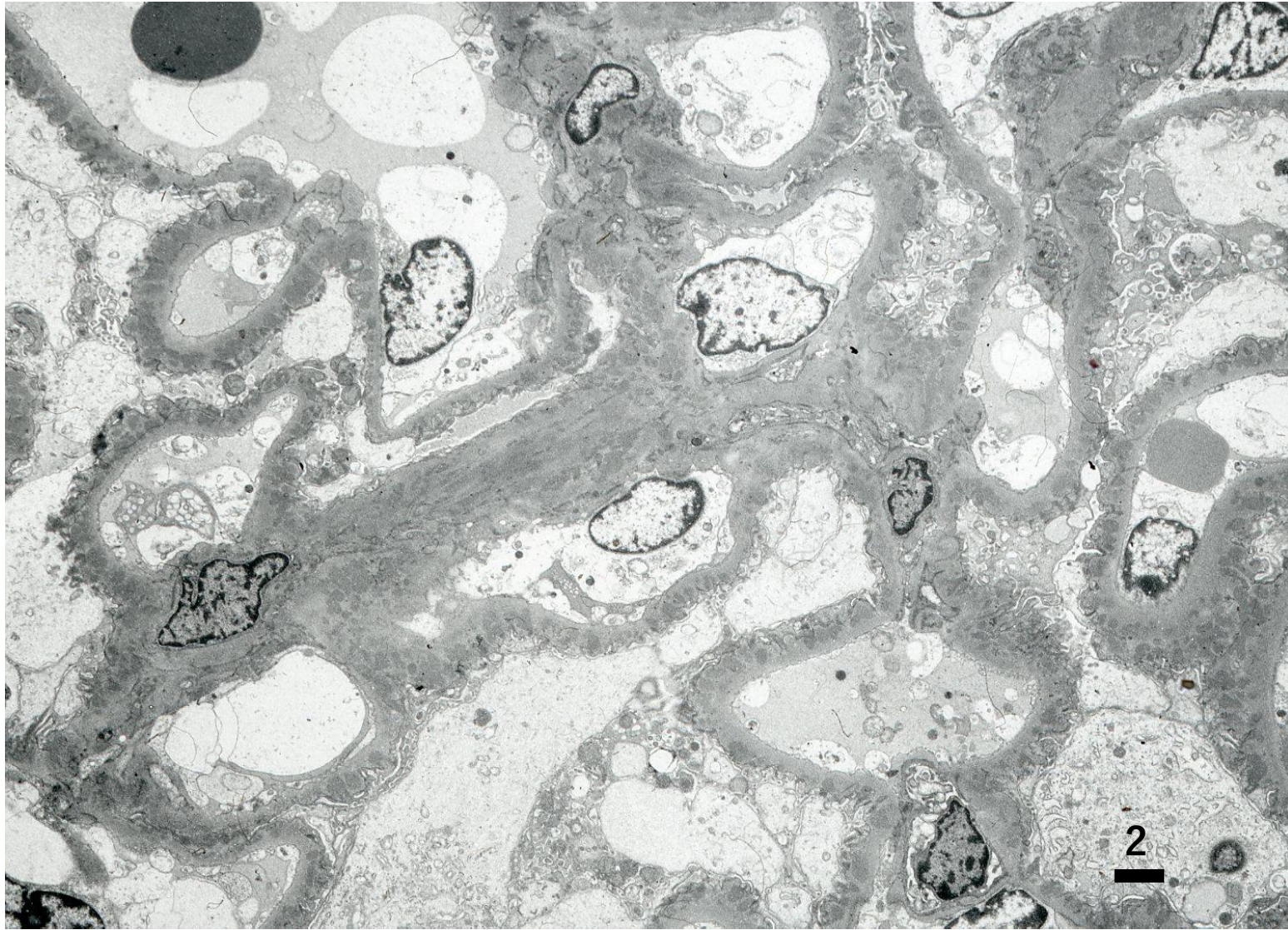
Ultrastructure of the **anterior lobe of the normal pituitary gland**. Cells with larger-sized neuroendocrine granules secrete growth hormone, while cells with smaller-sized granules and well-developed Gogi apparatus produce prolactin.



Minimal change nephrotic syndrome. Ultrastructurally, fusion of foot processes is diffusely observed. Neither mesangiocellular growth nor immune deposition is seen.



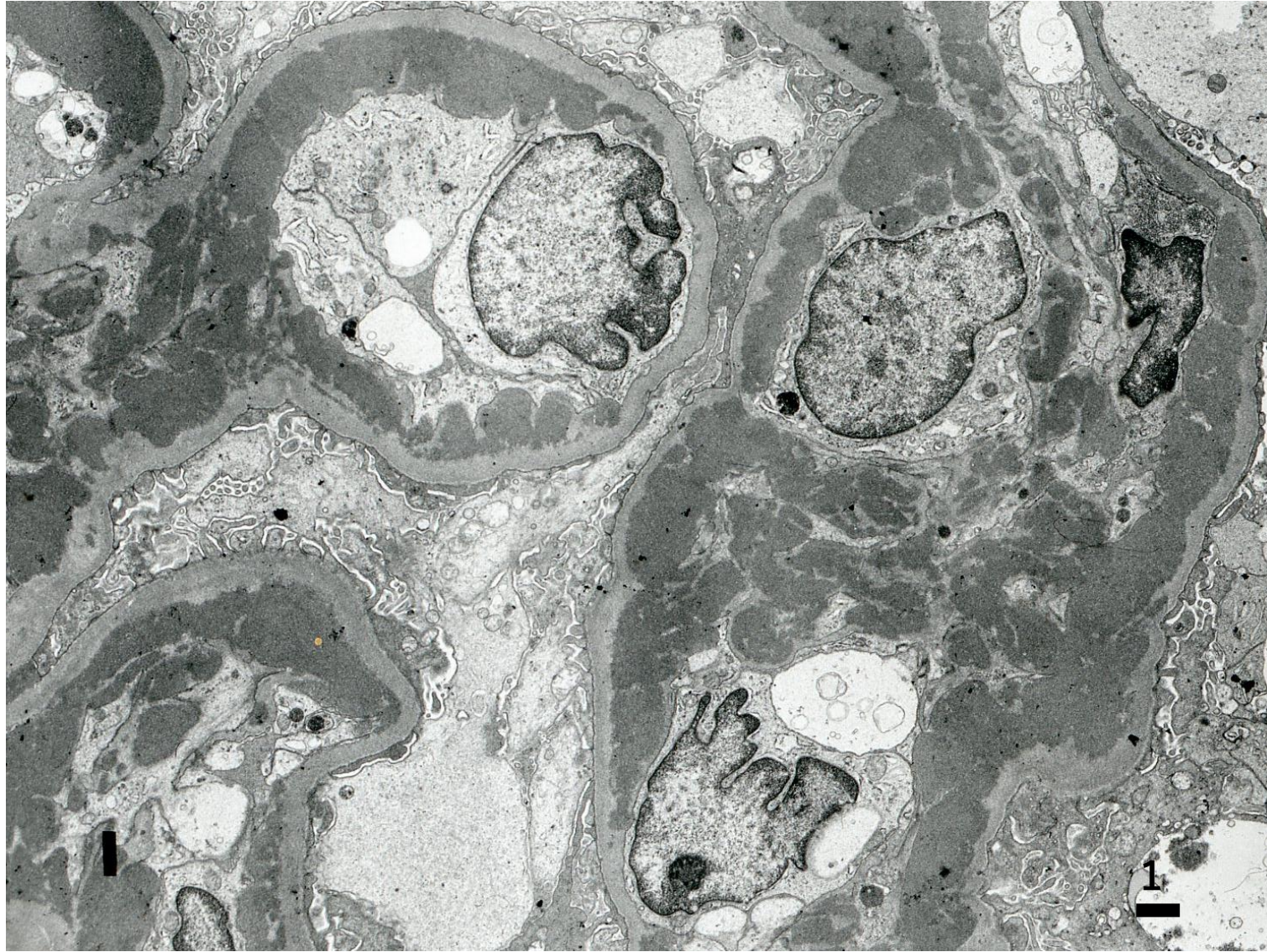
IgA nephropathy. Ultrastructurally, paramesangial deposition of electron-dense immune complexes is characteristic. Mesangial cells are mildly increased. The fusion of foot processes is associated.



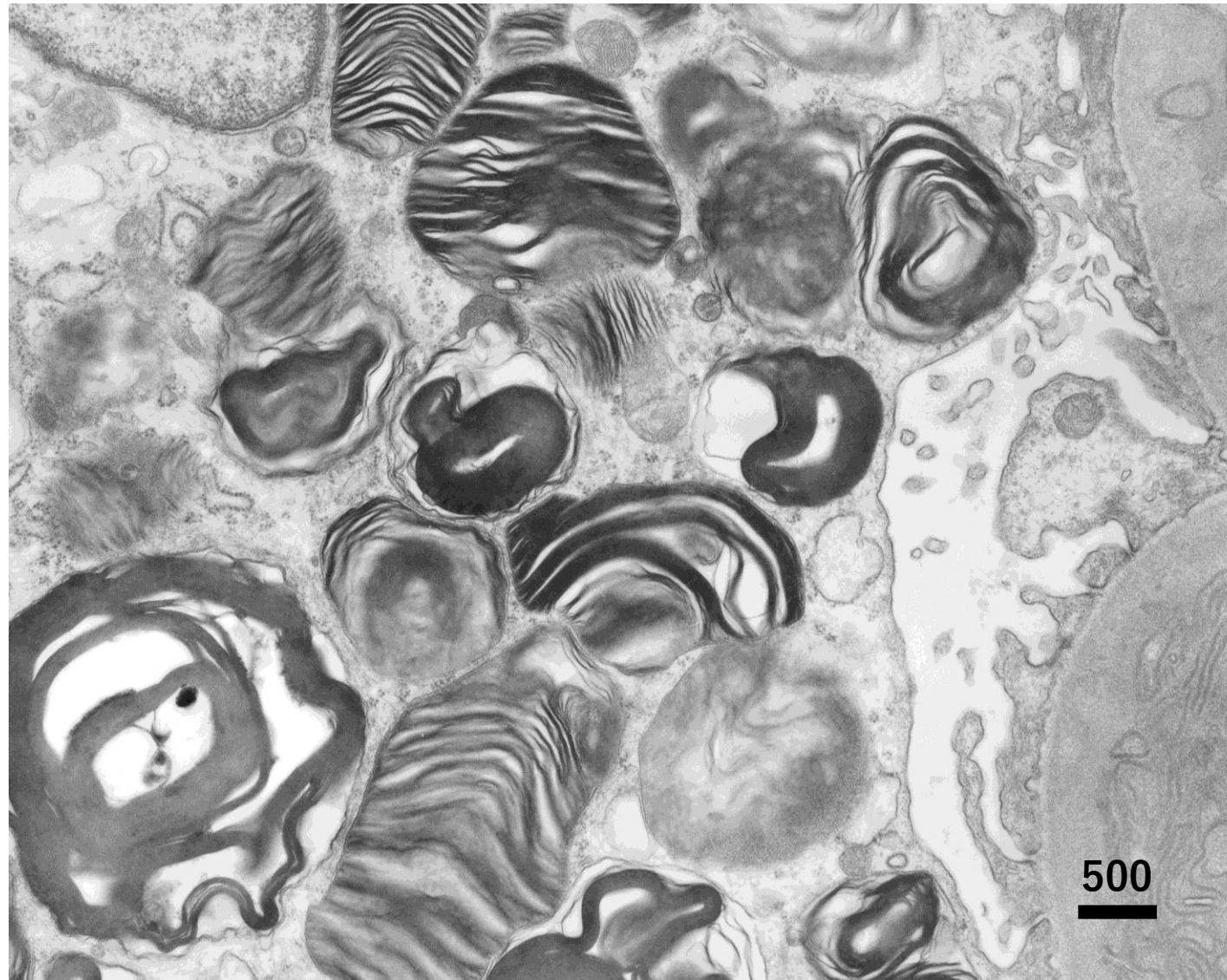
Membranous nephropathy. Ultrastructurally, subepithelial deposition of electron-dense immune complexes is characteristic. No mesangial cell growth is noted. The fusion of foot processes is associated.



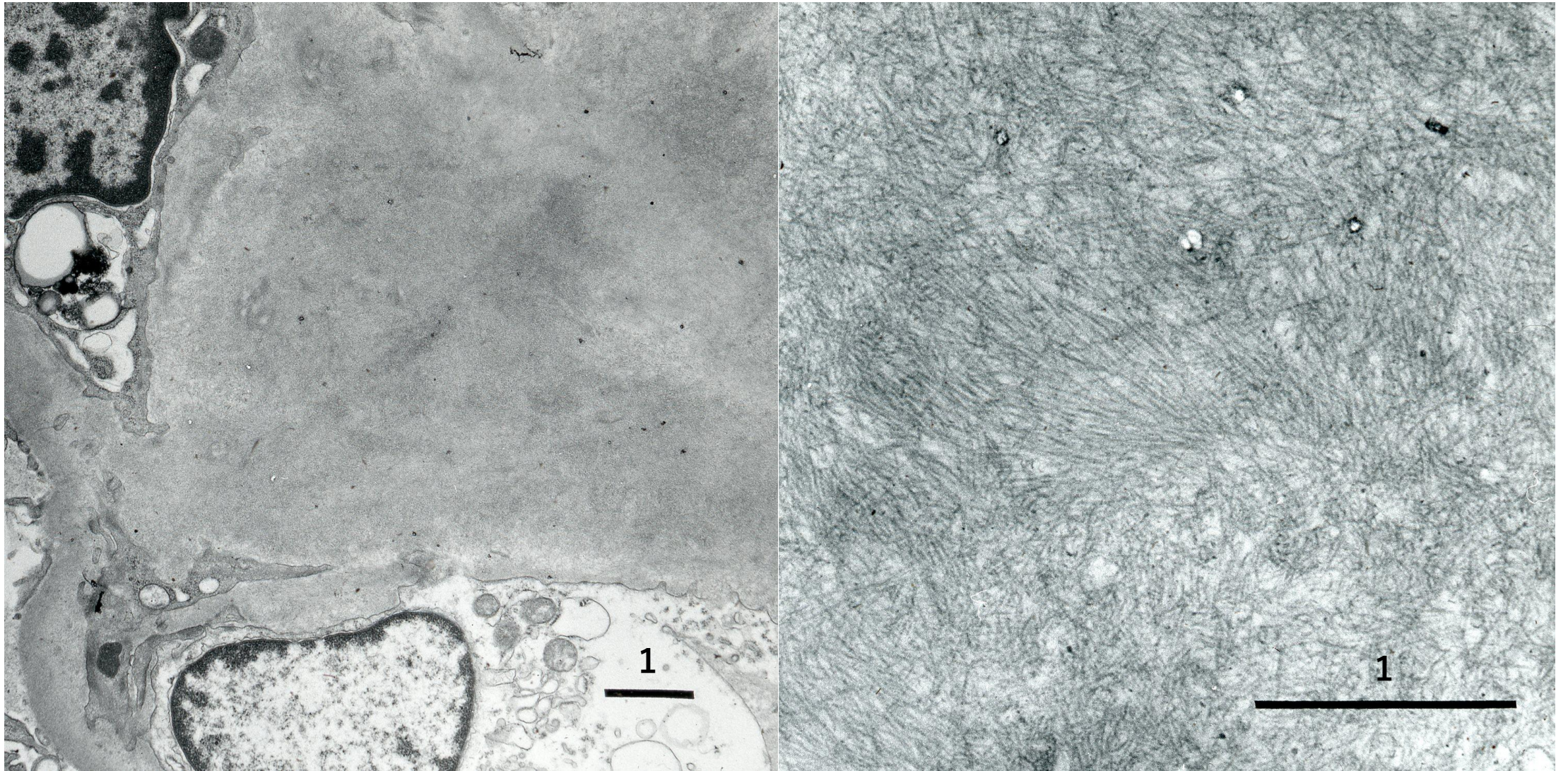
Membranoproliferative glomerulonephritis. Ultrastructurally, subendothelial deposition of electron-dense immune complexes is associated with mesangial interposition. The fusion of foot processes is associated. A neutrophil is seen in the capillary lumen.



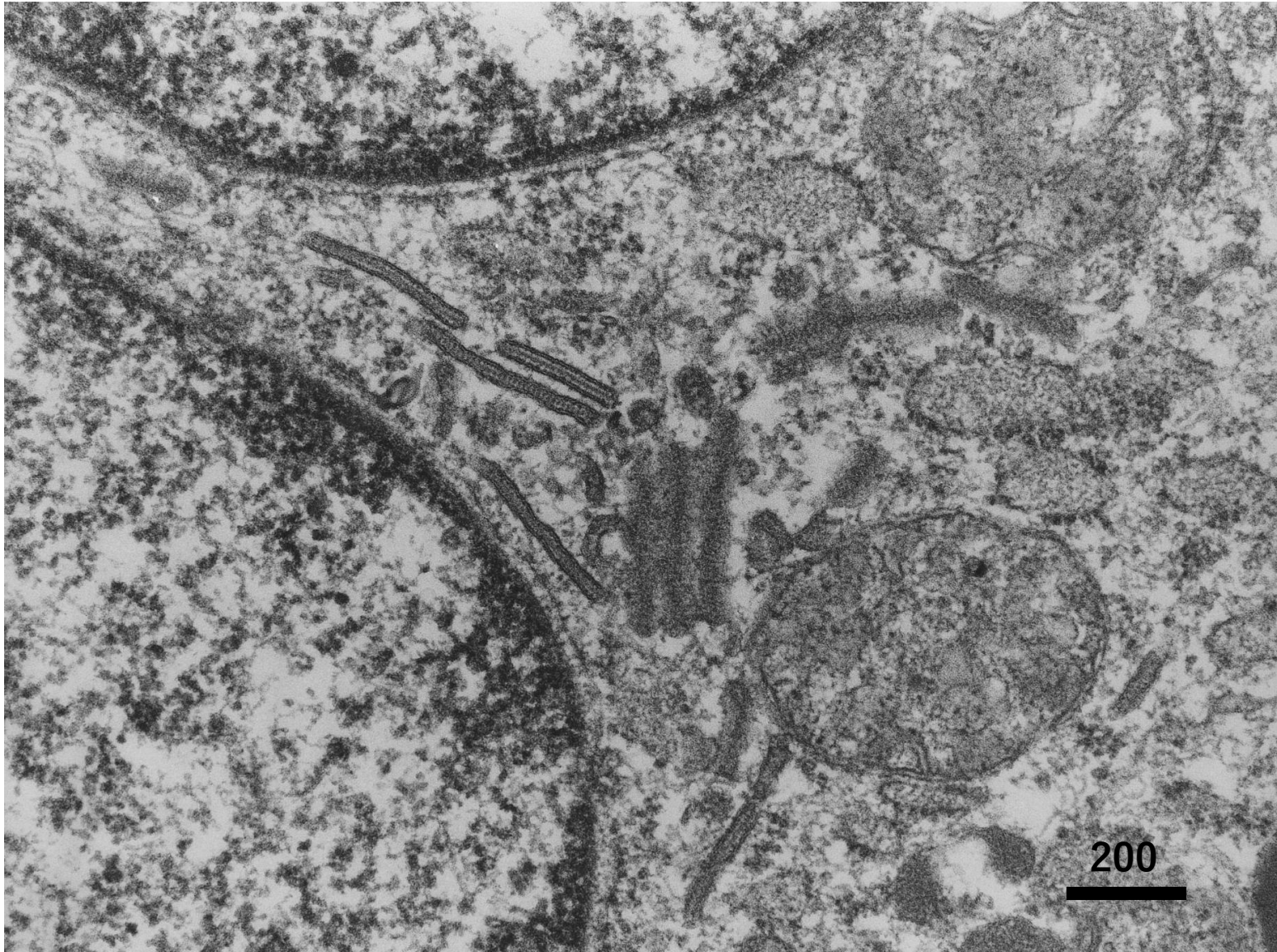
Lupus nephritis with wire loop lesion in a case of systemic lupus erythematosus. Ultrastructurally, massive subepithelial deposition of electron-dense immune complexes is characteristic. Mesangial cell growth and the fusion of foot processes are associated.



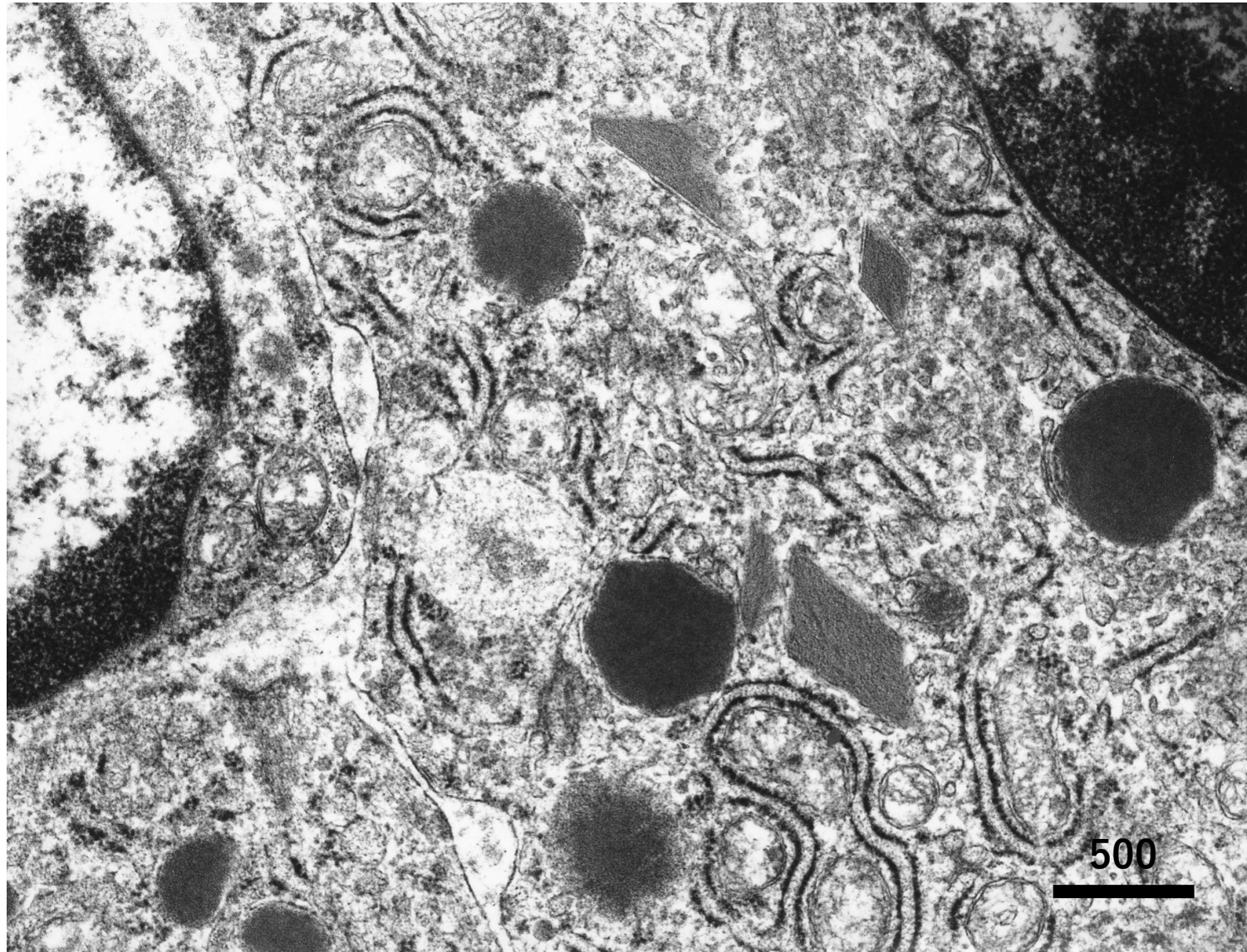
Fabry's disease. Ultrastructurally, the cytoplasm of the glomerular epithelial cell shows massive deposition of zebra bodies (lamellated inclusion bodies). Fabry's disease is an X-linked genetic disorder, involving the kidney, heart, brain and skin. Deficiency of alpha-galactosidase causes deposition of sphingolipids. Chronic renal failure may be associated.



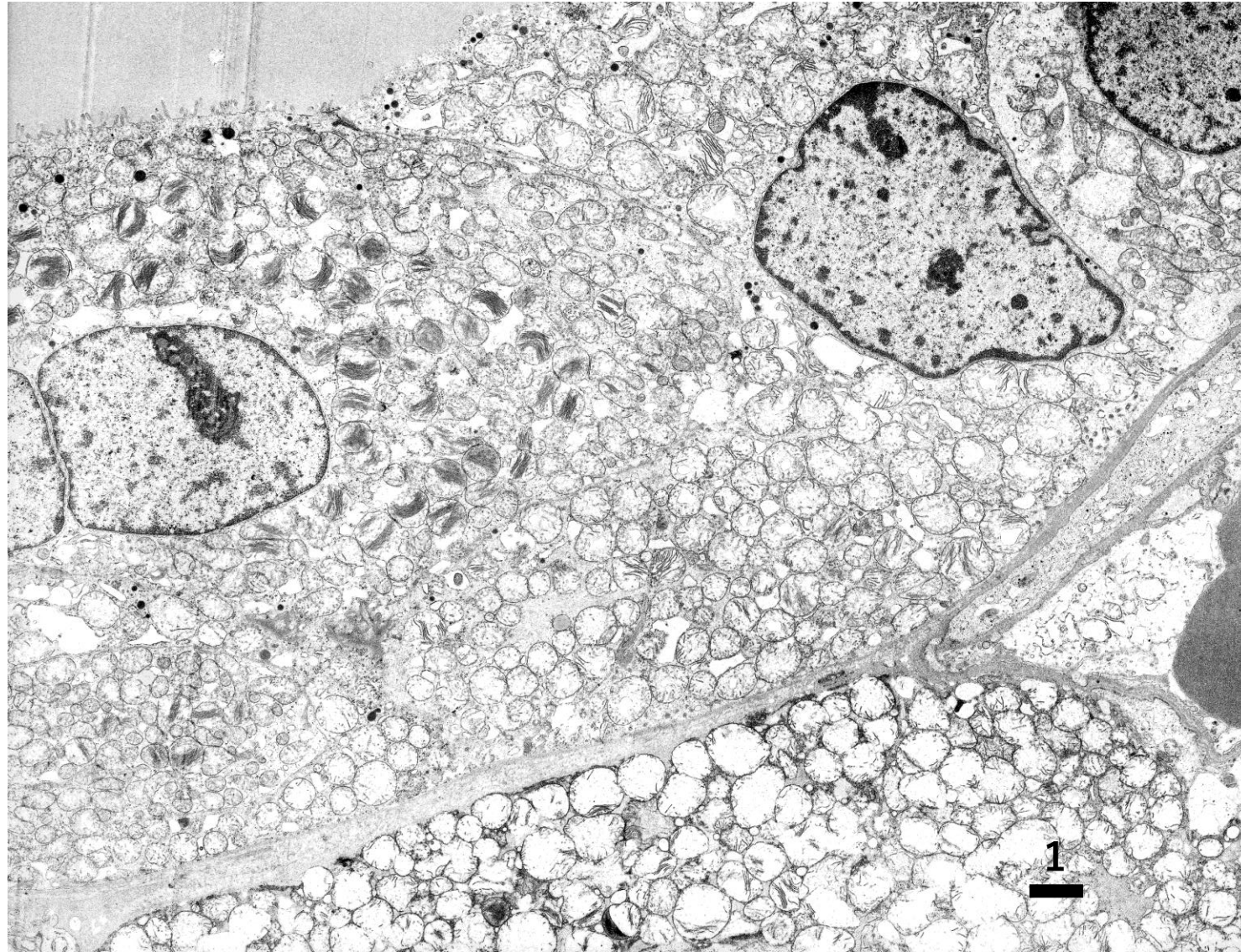
Amyloid nephropathy in **systemic amyloidosis**. Ultrastructurally, amyloid fibrils deposit mainly in the mesangial matrix, causing nephrotic syndrome and chronic renal failure. Amyloid fibrils represent non-branching, water-insoluble thin filamentous materials.



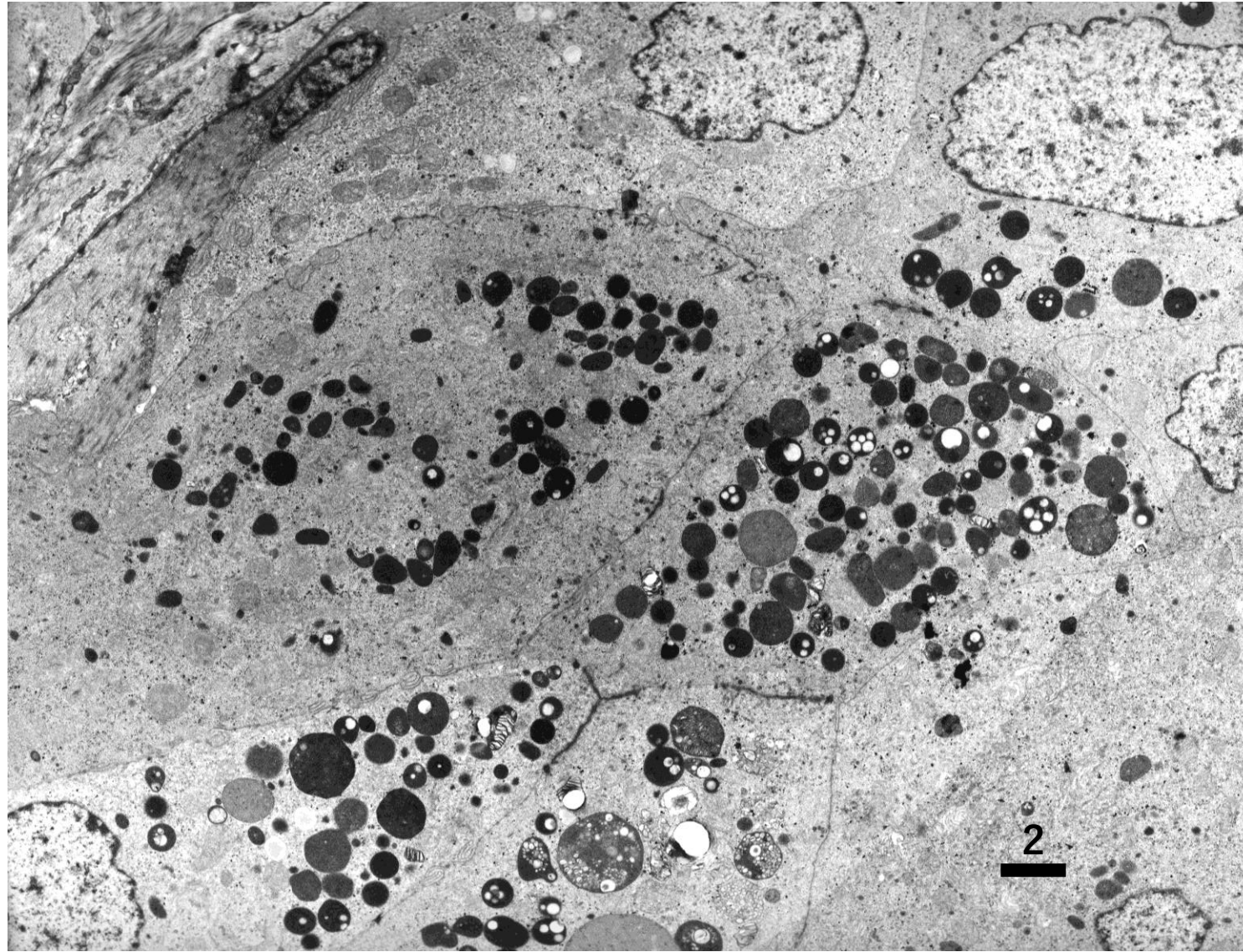
Ultrastructure of **Langerhans cell histiocytosis**. Clonal growth of Langerhans cells is seen unifocally or multifocally in the lymph node, bone, lung or other organs. Ultrastructurally, the formation of **Birbeck granules**, elongated inclusions with zipper-like appearance, is pathognomonic. They may be tennis racquet-shaped.



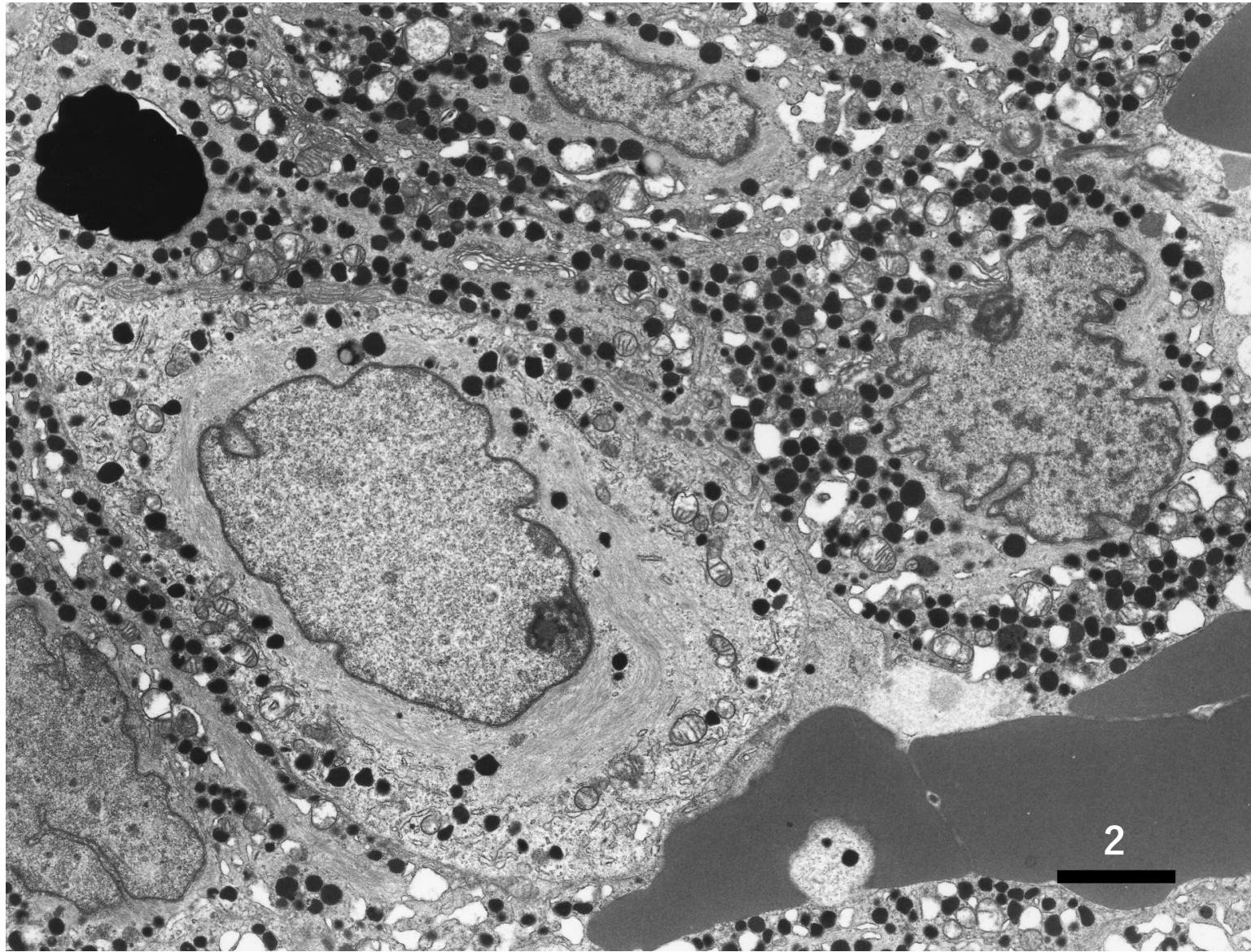
Ultrastructure of renin-producing **juxtaglomerular cell tumor** of the kidney, 3 cm in size, seen in a 17 y-o female patient. In addition to rounded granules, rhomboid **renin-granules** with striated structure are observed.



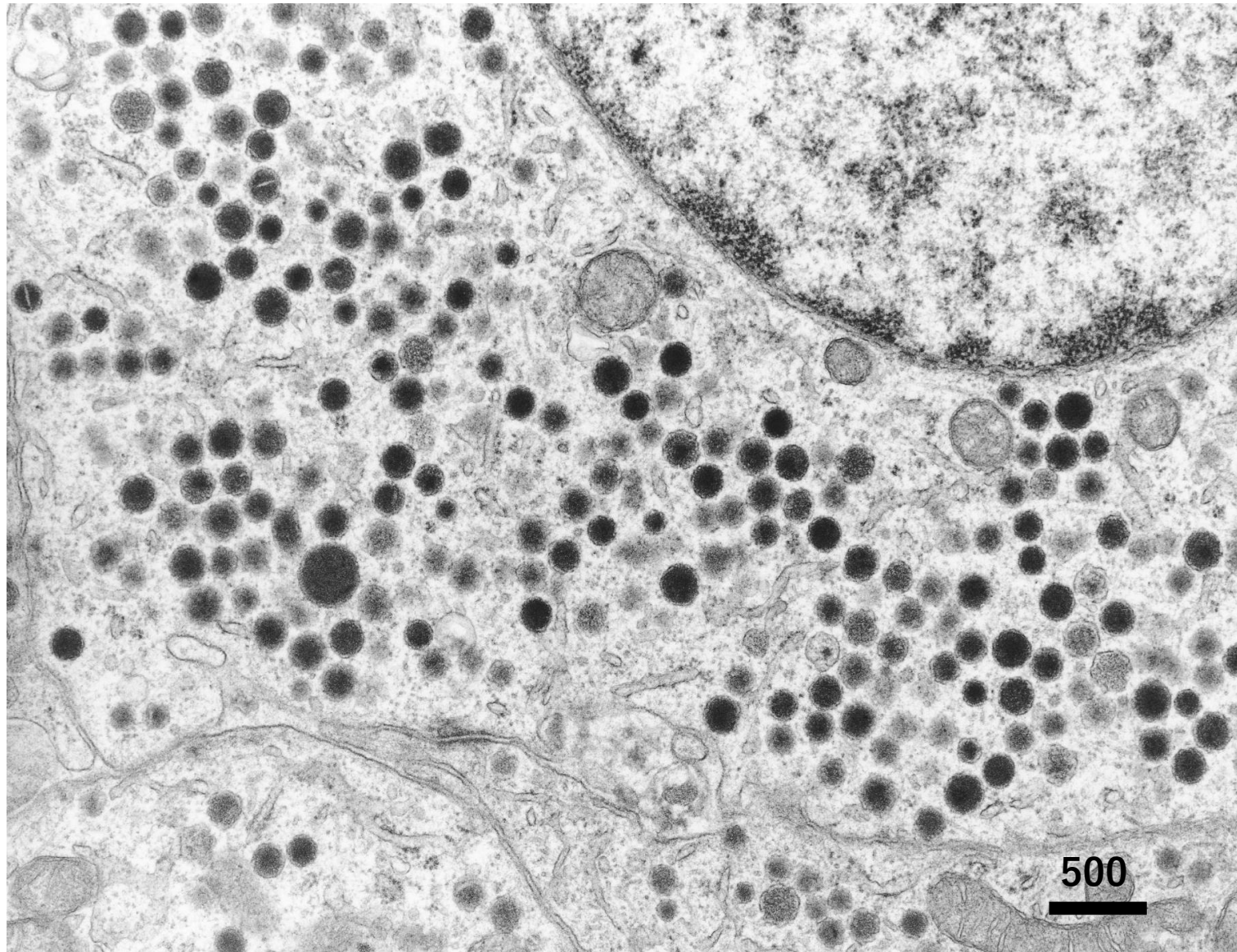
Ultrastructure of **oncocytoma** of the thyroid gland. The plump eosinophilic cytoplasm of the tumor cells is filled with mitochondria. The oncocytoma is nicknamed as mitochondrioma.



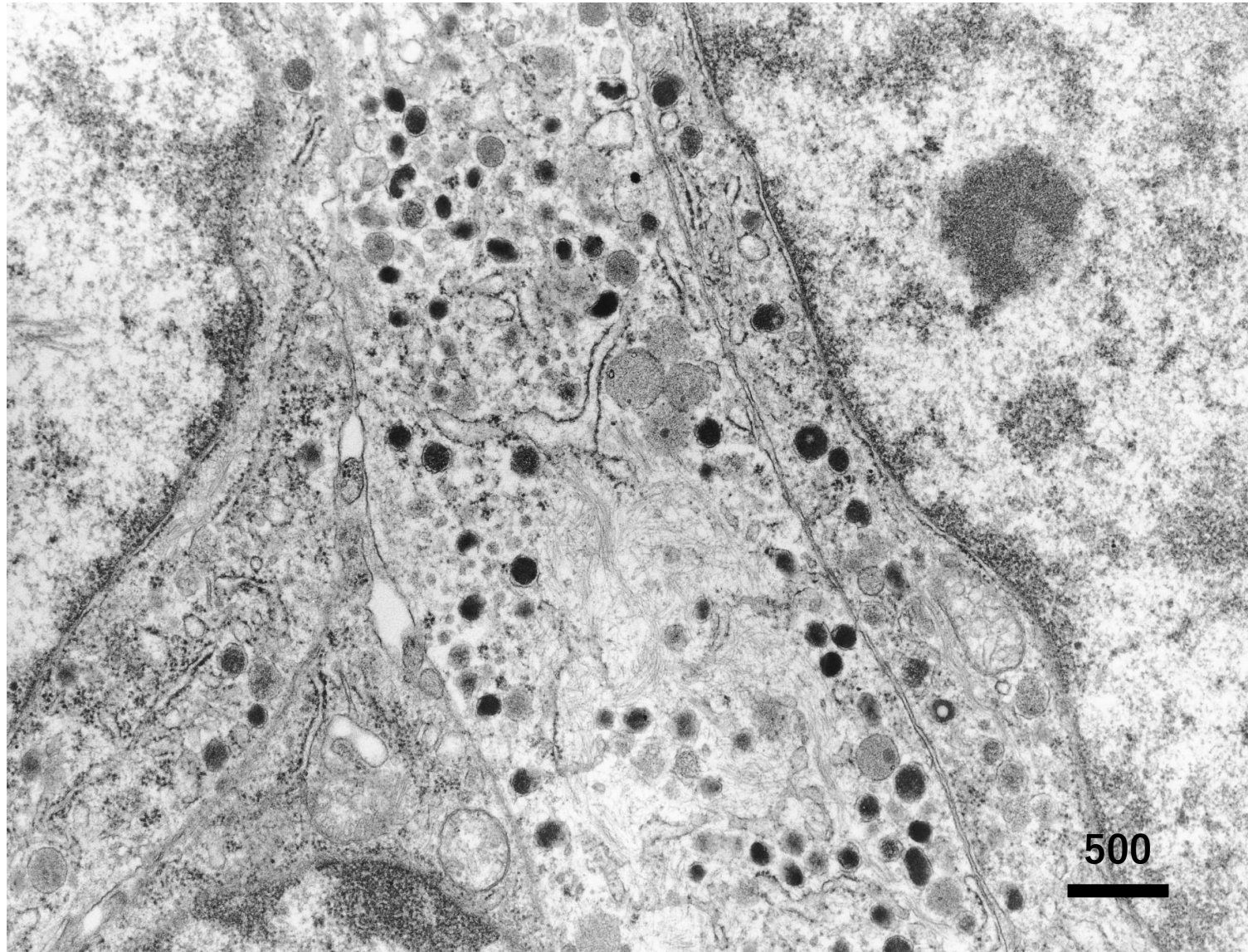
Ultrastructure of **apocrine carcinoma of the breast**. The plump, eosinophilic granular cytoplasm of apocrine carcinoma is filled with electron-dense apocrine excretory granules. The cancer cells are positive for AR, but negative for ER and PgR.



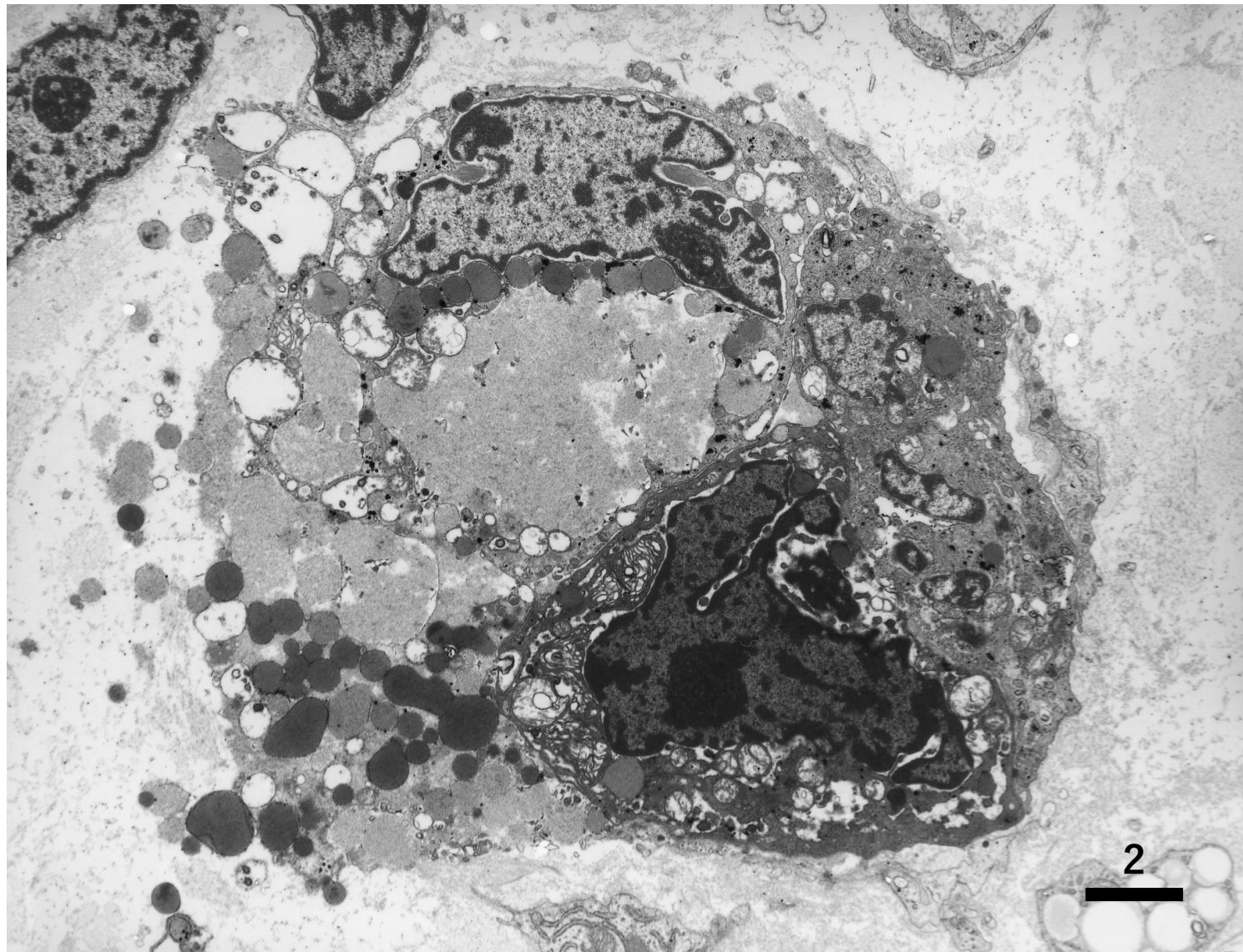
Ultrastructure of ACTH-producing **basophilic adenoma of adenohypophysis**. Numbers of electron-dense neurosecretory granules are dispersed in the cytoplasm. Accumulation of intermediate filaments around the nucleus represents “Crooke’s degeneration”, characteristic appearance of Cushing’s adenoma.



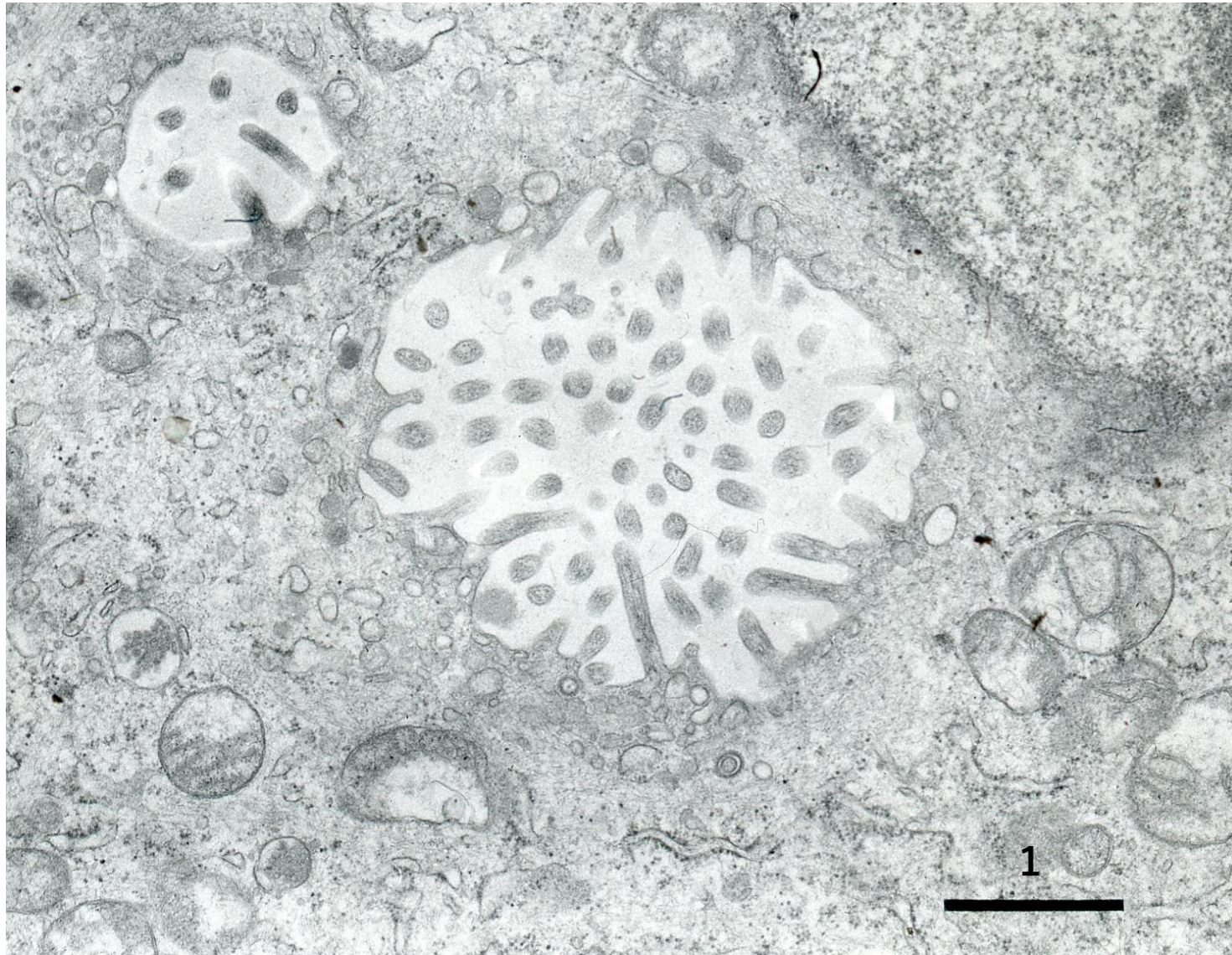
Ultrastructure of **bronchial carcinoid tumor**. The plump cytoplasm contains numbers of cored neuroendocrine-type granules larger than the granules in small cell lung carcinoma.



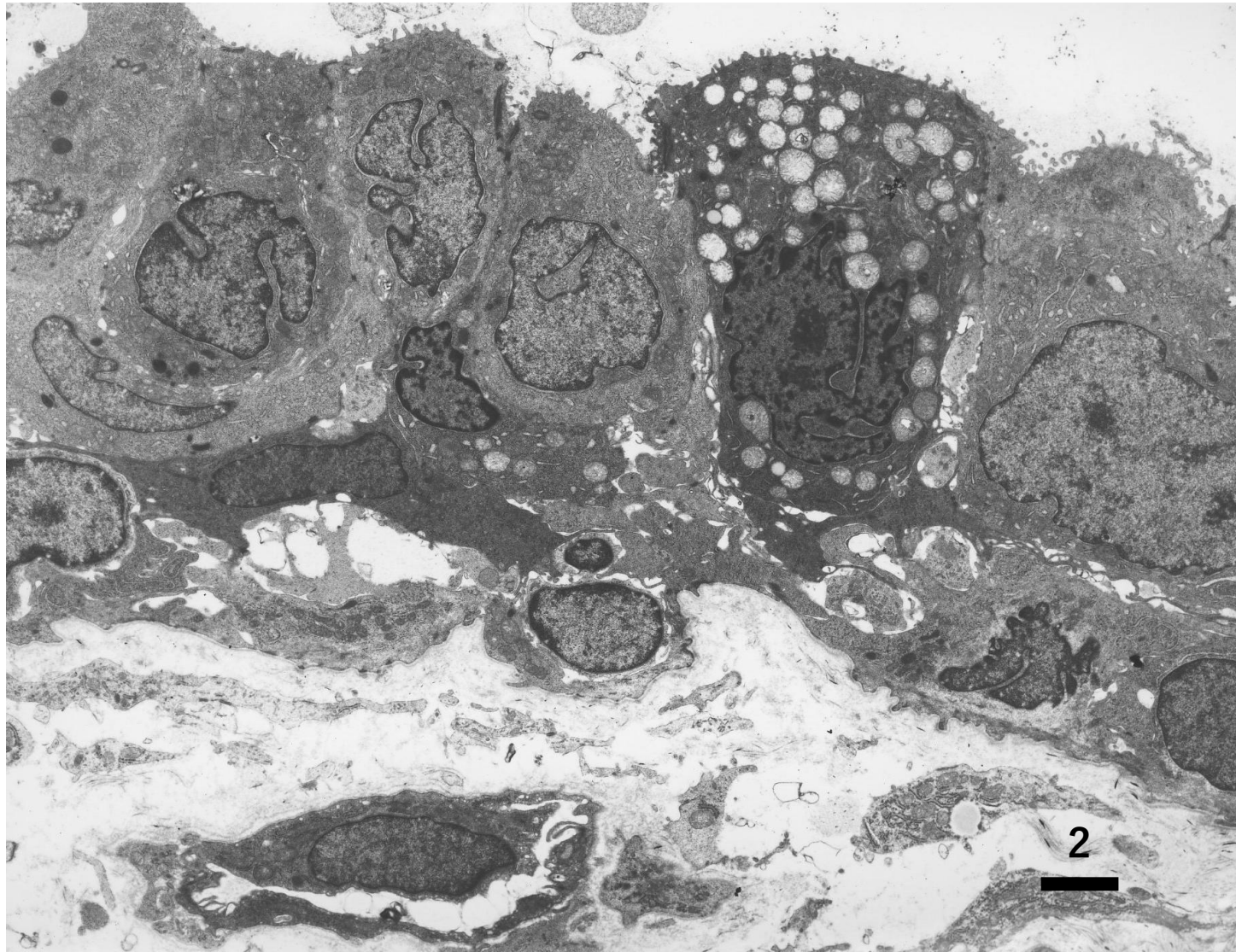
Ultrastructure of **small cell lung carcinoma**. Small-sized cored neuroendocrine granules are dispersed in the narrow cytoplasm.



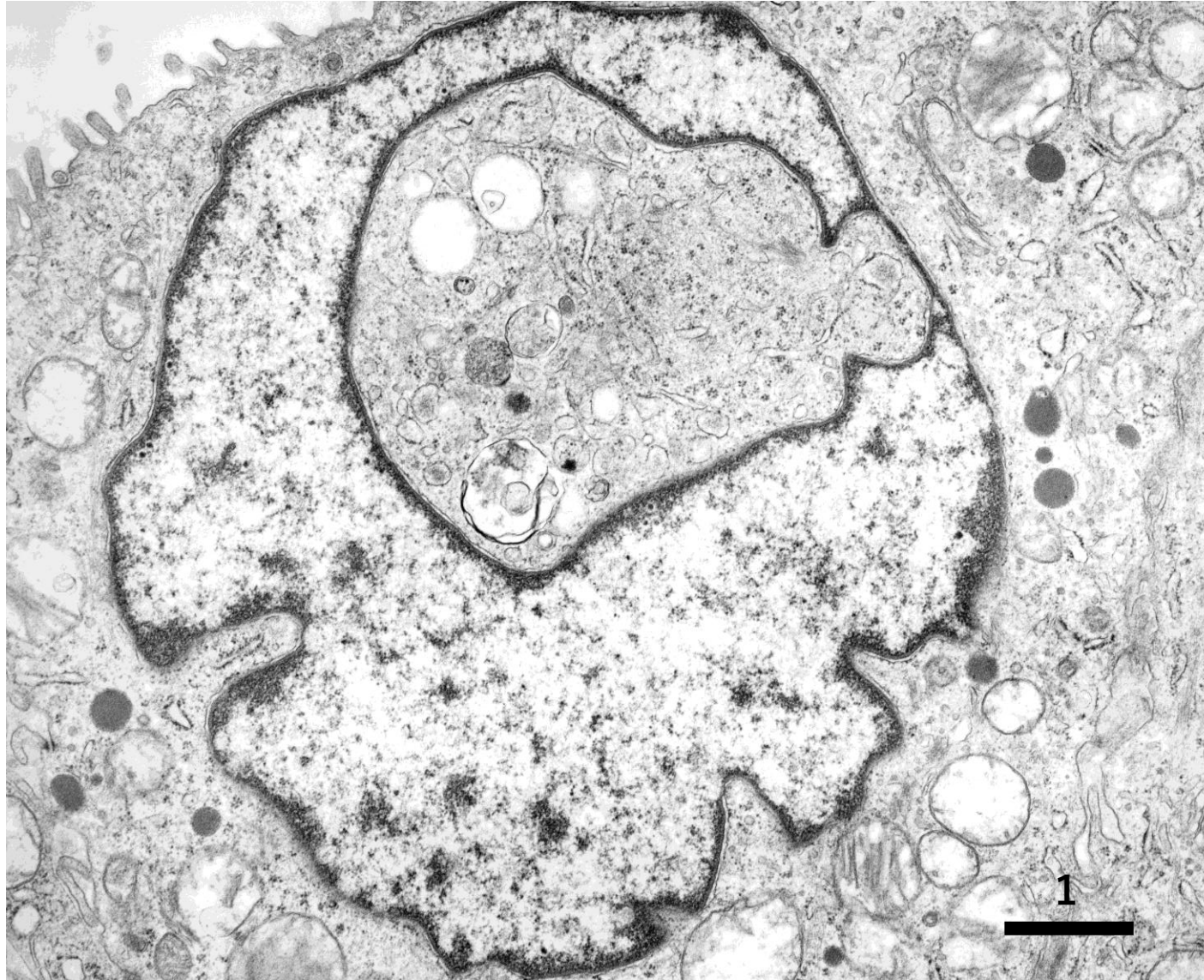
Ultrastructure of a **signet ring carcinoma** cell metastatic to the ovary (Krukenberg tumor). Intracytoplasmic mucin retention and eccentric location of the nucleus are observed in the signet ring cancer cells of gastric origin. Both electron-lucent (probably of pyloric gland type) and electron-dense (probably of surface foveolar cell type) mucin granules are co-localized in the cytoplasm.



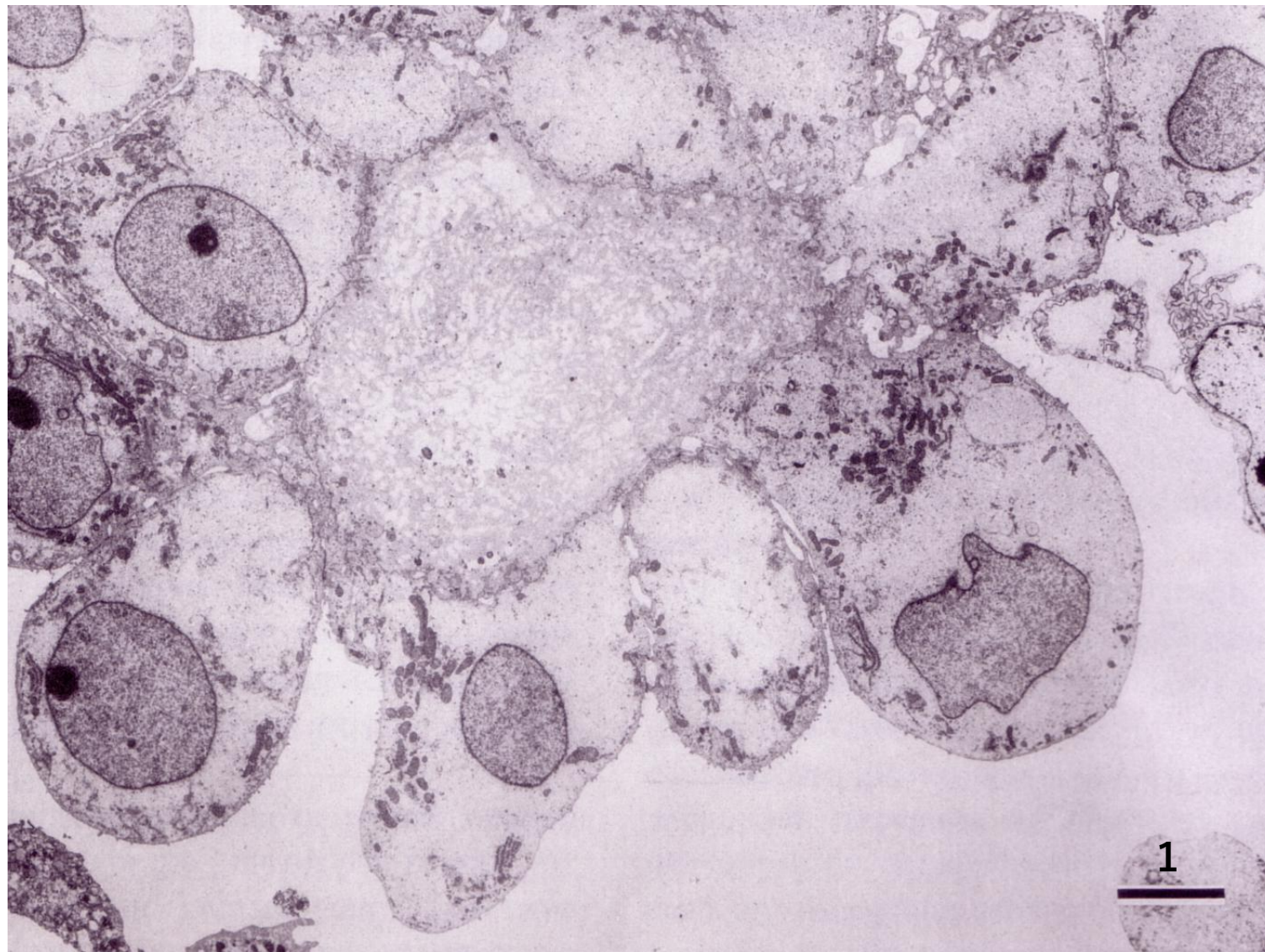
Ultrastructure of **invasive ductal carcinoma of the breast**.
Formation of intracytoplasmic lumina lined by microvilli is often
seen in the adenocarcinoma, particularly in breast cancer.



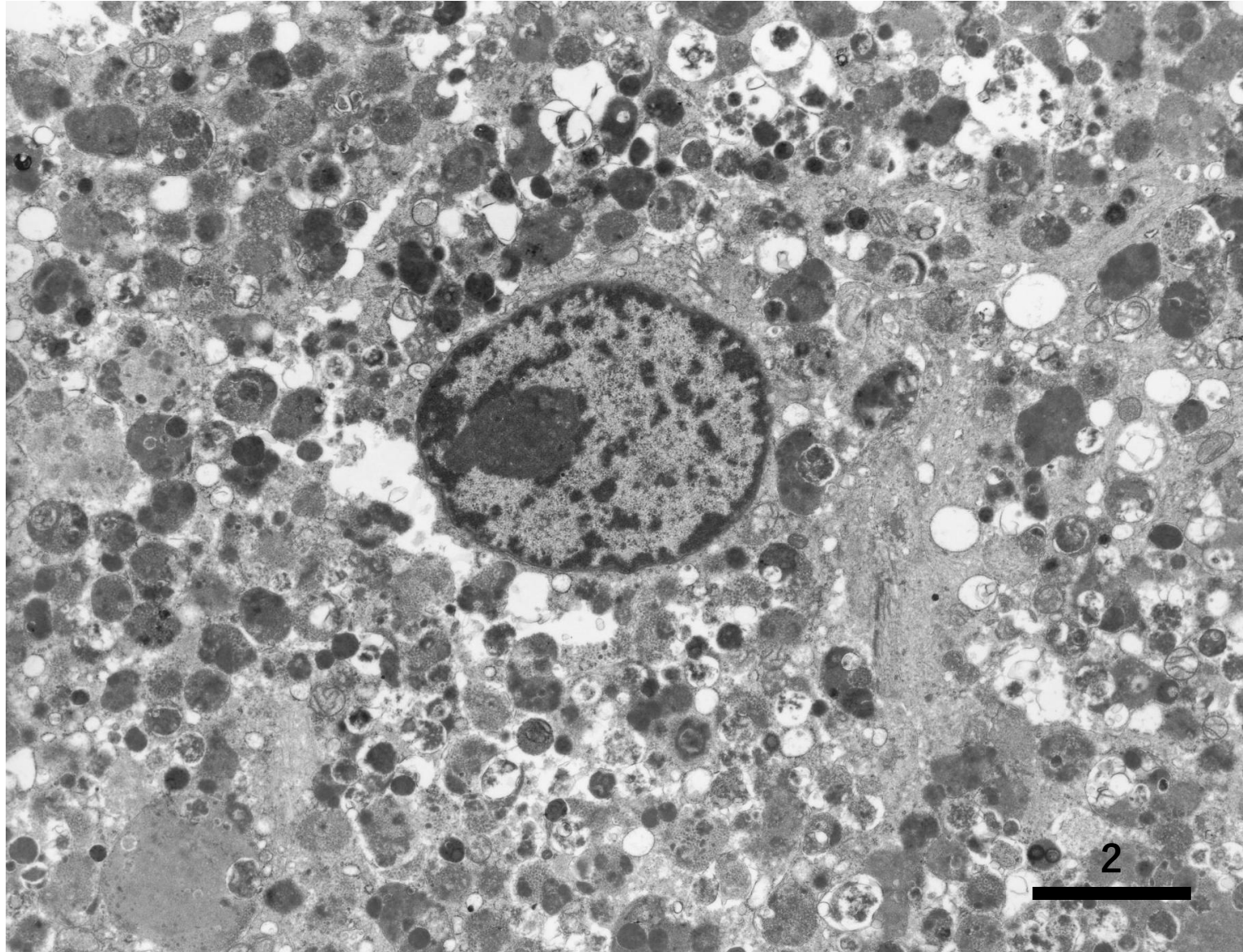
Ultrastructure of **fibroadenoma of the breast**. In benign breast lesions such as fibroadenoma, sclerosing adenosis and intraductal papilloma, the two-celled pattern is retained. Namely, myoepithelial cells are seen in the duct-forming structure.



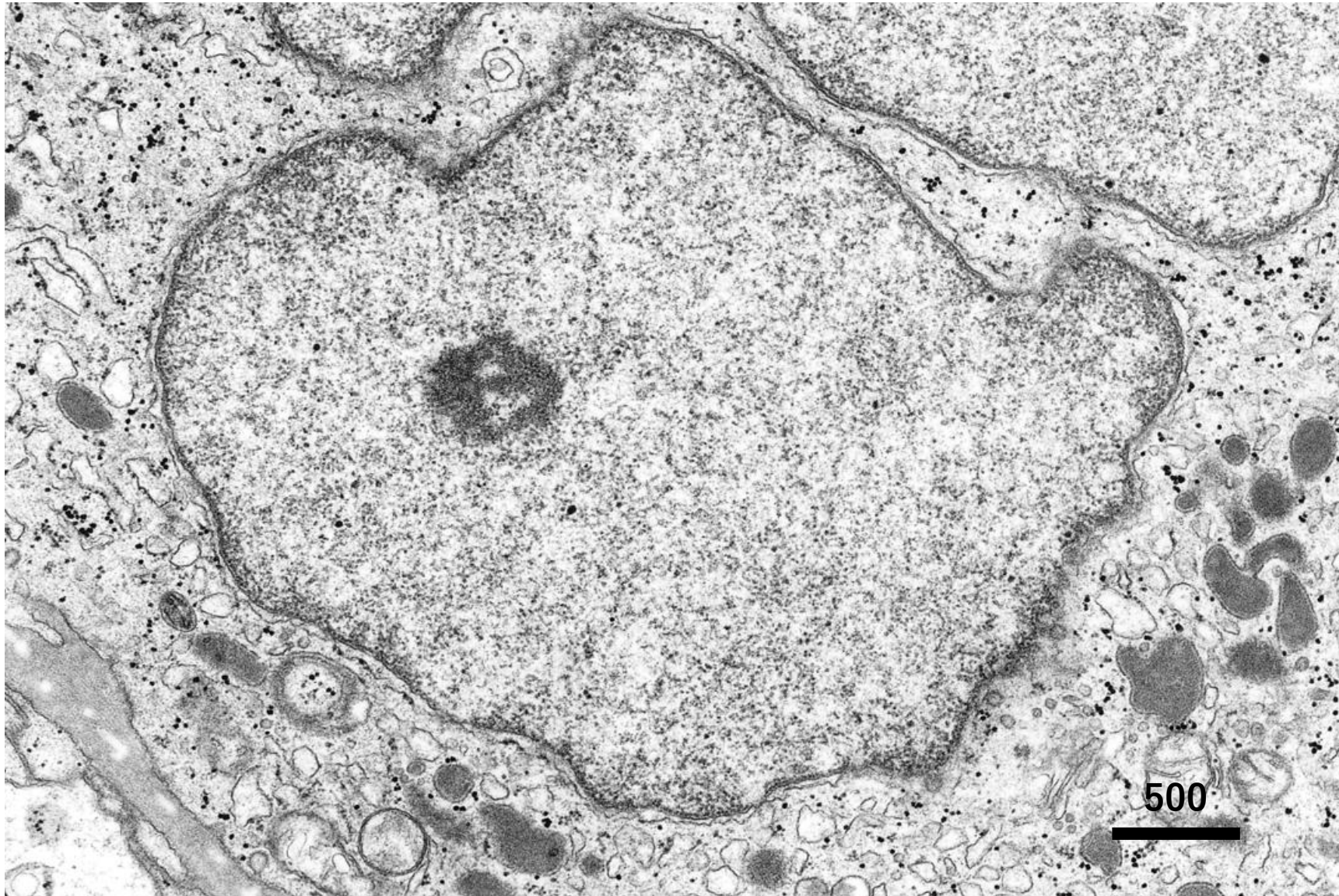
Ultrastructure of **papillary thyroid carcinoma**. **Intranuclear cytoplasmic inclusion** is diagnostically useful. Degraded organelles are seen within the inclusion.



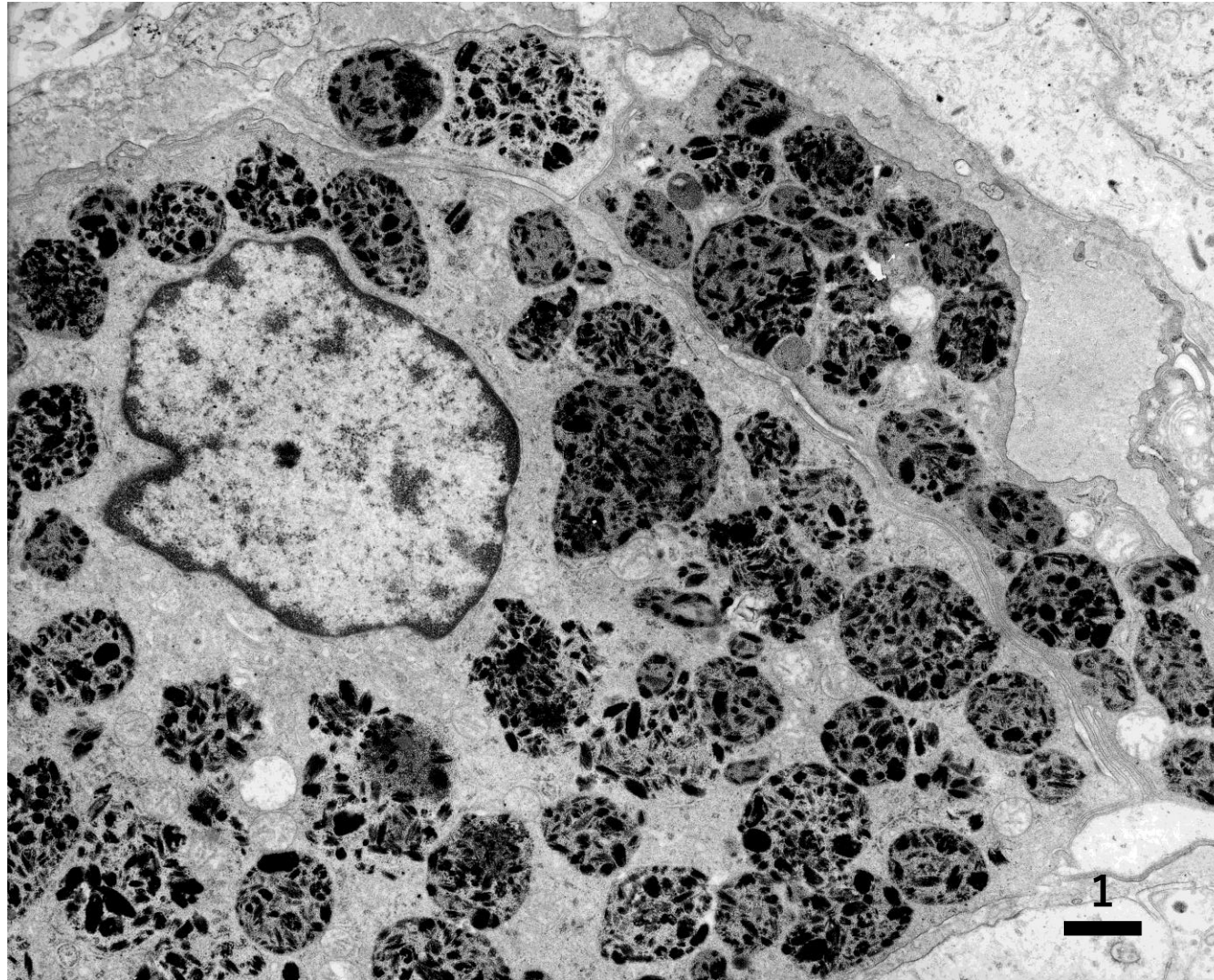
Ultrastructure of **clear cell carcinoma of the ovary** disseminated to the ascites. Hobnailed clear cells form a so-called raspberry body in the body fluid. Basal lamina-like substances characteristically accumulate in the center of the cell cluster. **Ref.** Ito H, et al. Excessive formation of basement membrane substance in clear-cell carcinoma of the ovary: Diagnostic value of the “raspberry body” in ascites cytology. *Diagnost Cytopathol* 1997; 16(6): 500-504. doi: 10.1002/(SICI)1097-0339(199706)16:6<500::AID-DC6>3.0.CO;2-D



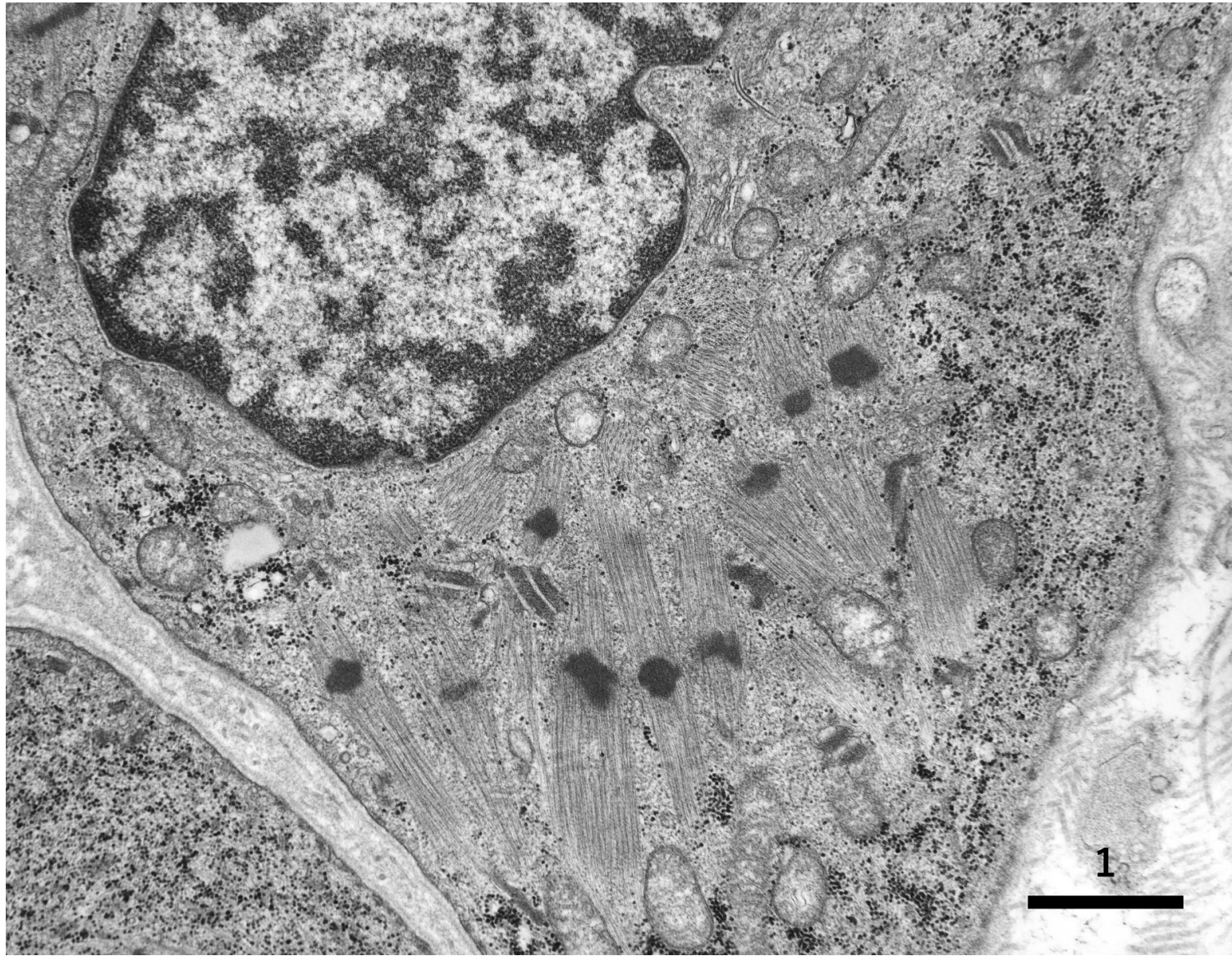
Ultrastructure of **granular cell tumor** seen in the upper arm of a 52 y-o female patient. The benign tumor cells of Schwann cell origin contain numbers of coarse degradation granules with uneven electron density, resembling ceroid pigment



Ultrastructure of **malignant melanoma**. Melanosomes of varying shapes are clustered in the cytoplasm of melanoma cells. Granular electron-dense material (mature melanin pigment) is focally seen in the granules.



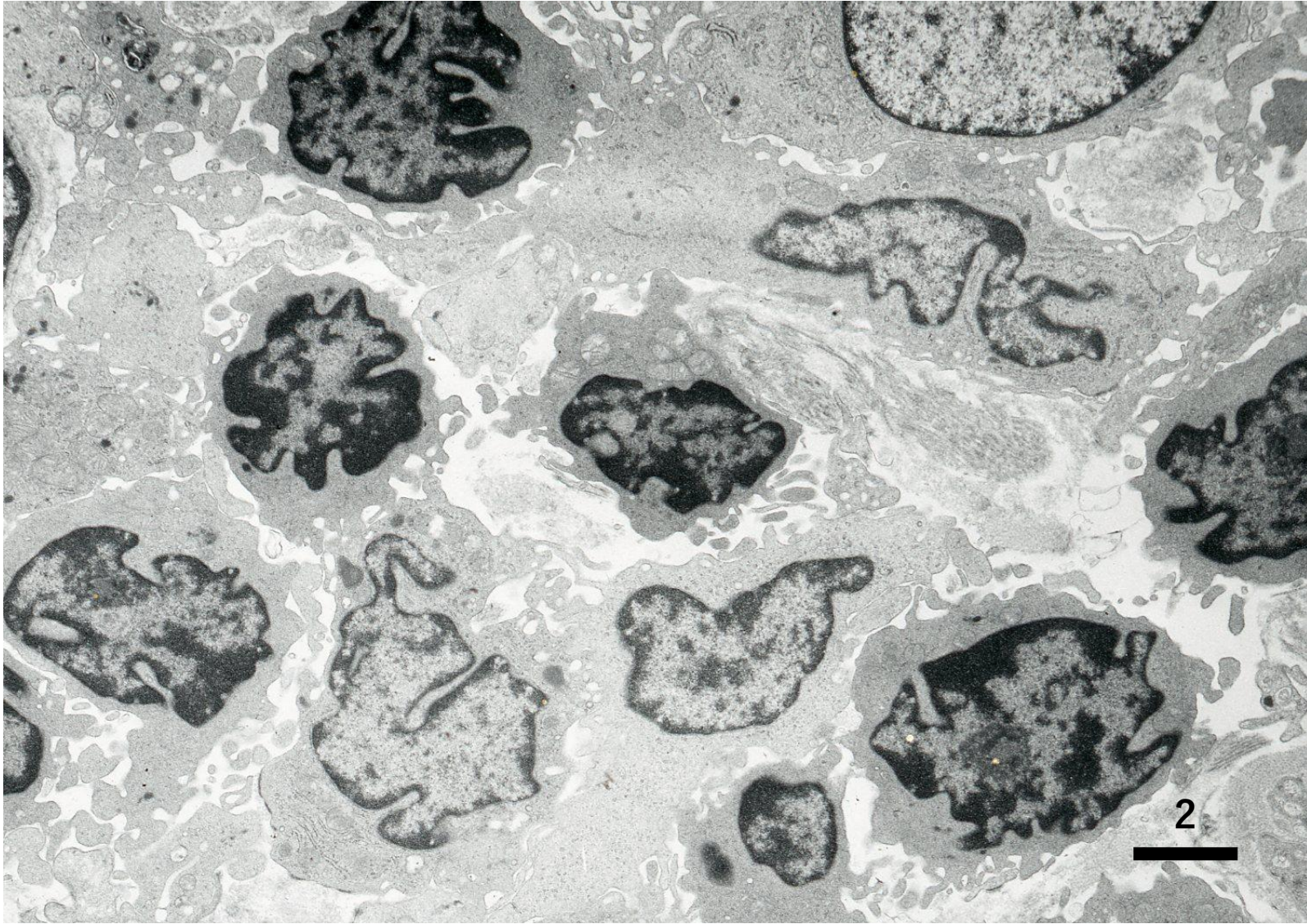
Ultrastructure of a **melanophagocyte**. Mature melanin pigment is phagocytized by macrophages (melanophages), located just adjacent to melanin-producing lesions (nevus or melanoma). Lysosomes are filled with the melanin pigment.



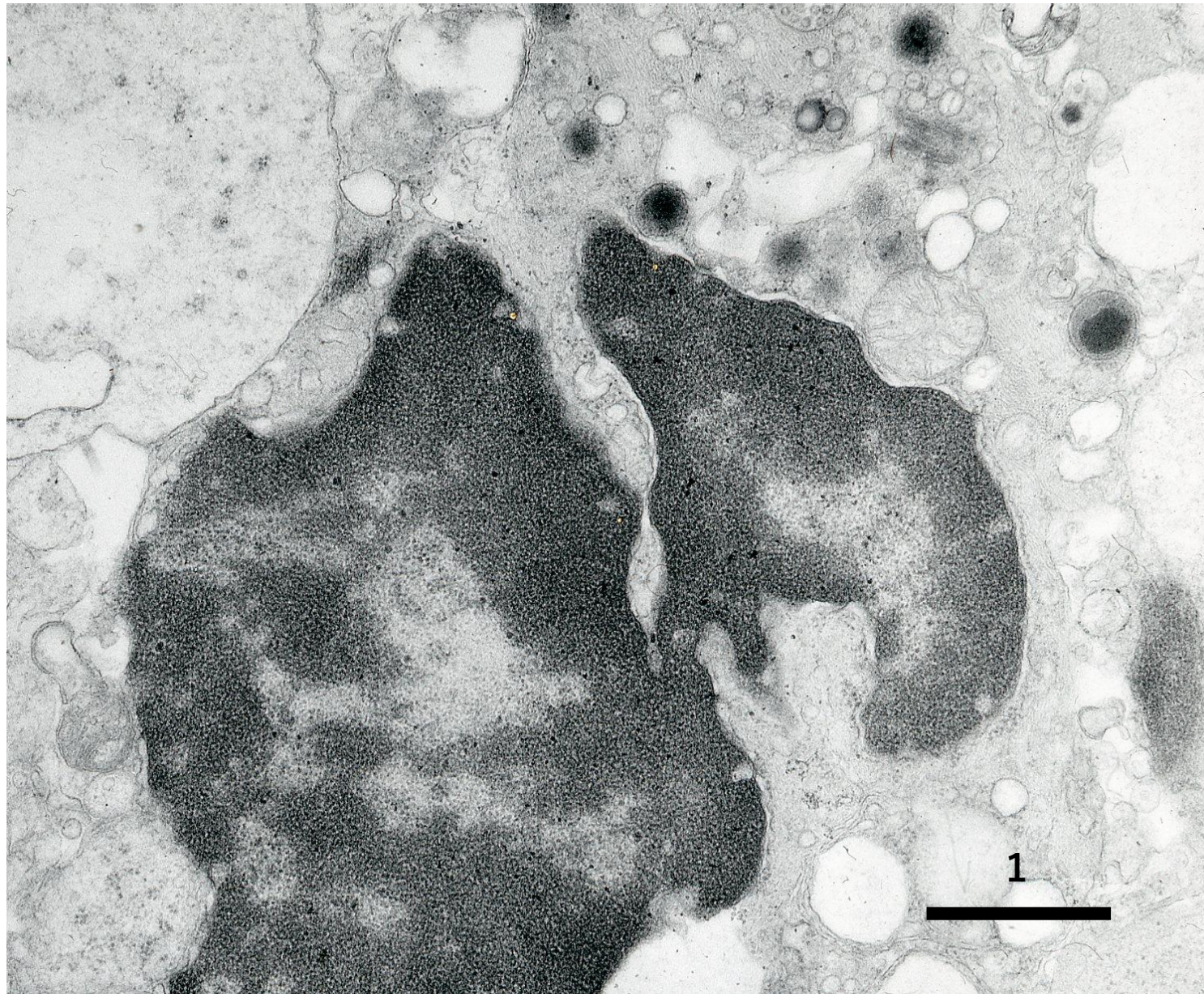
Ultrastructure of **rhabdomyosarcoma, botryoid type**, seen in the ureter of a 5 y-o girl. The isolated sarcoma cell reveals bundles of actomyosin filaments with Z-disc formation. The basal lamina surrounds the rhabdomyoblast.



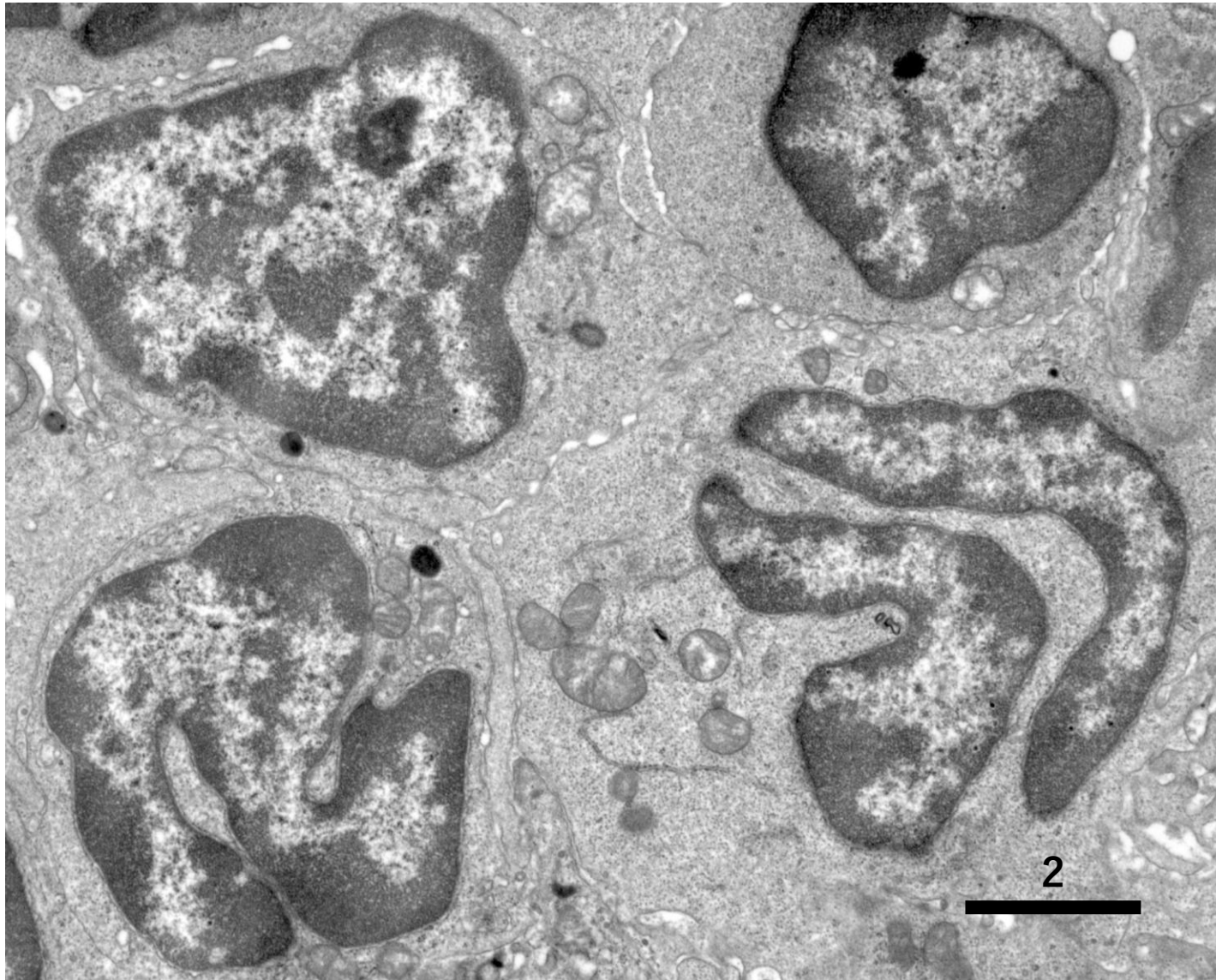
Ultrastructure of **mycosis fungoides**, a specific indolent form of cutaneous T-cell lymphoma. The convoluted nucleus with petal-like deep indentations is characteristic of the neoplastic T-cells.



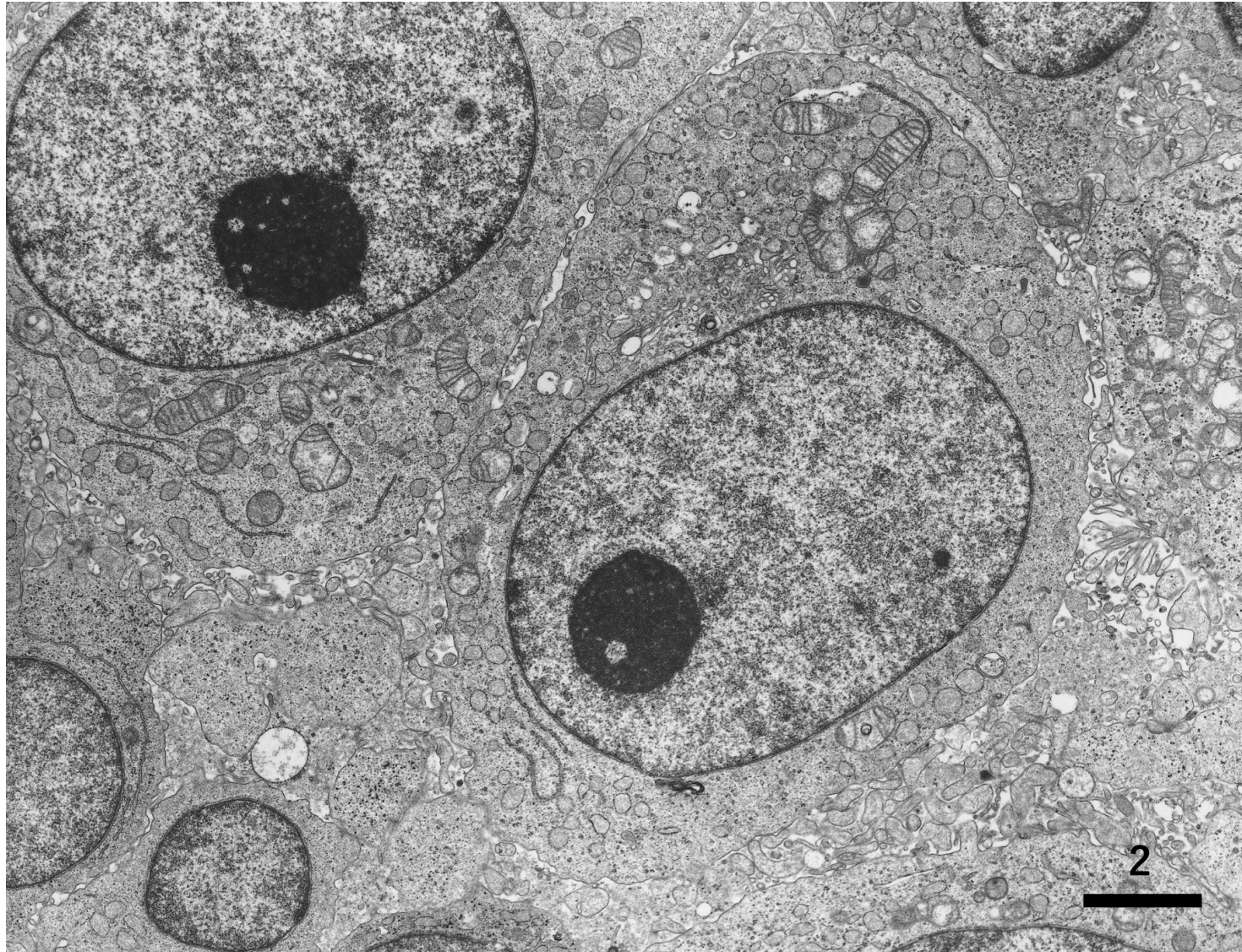
Ultrastructure of **adult T-cell leukemia** (ATL) infiltrating into the skin. Convoluted or cerebriform nuclei are quite characteristic of ATL cells.



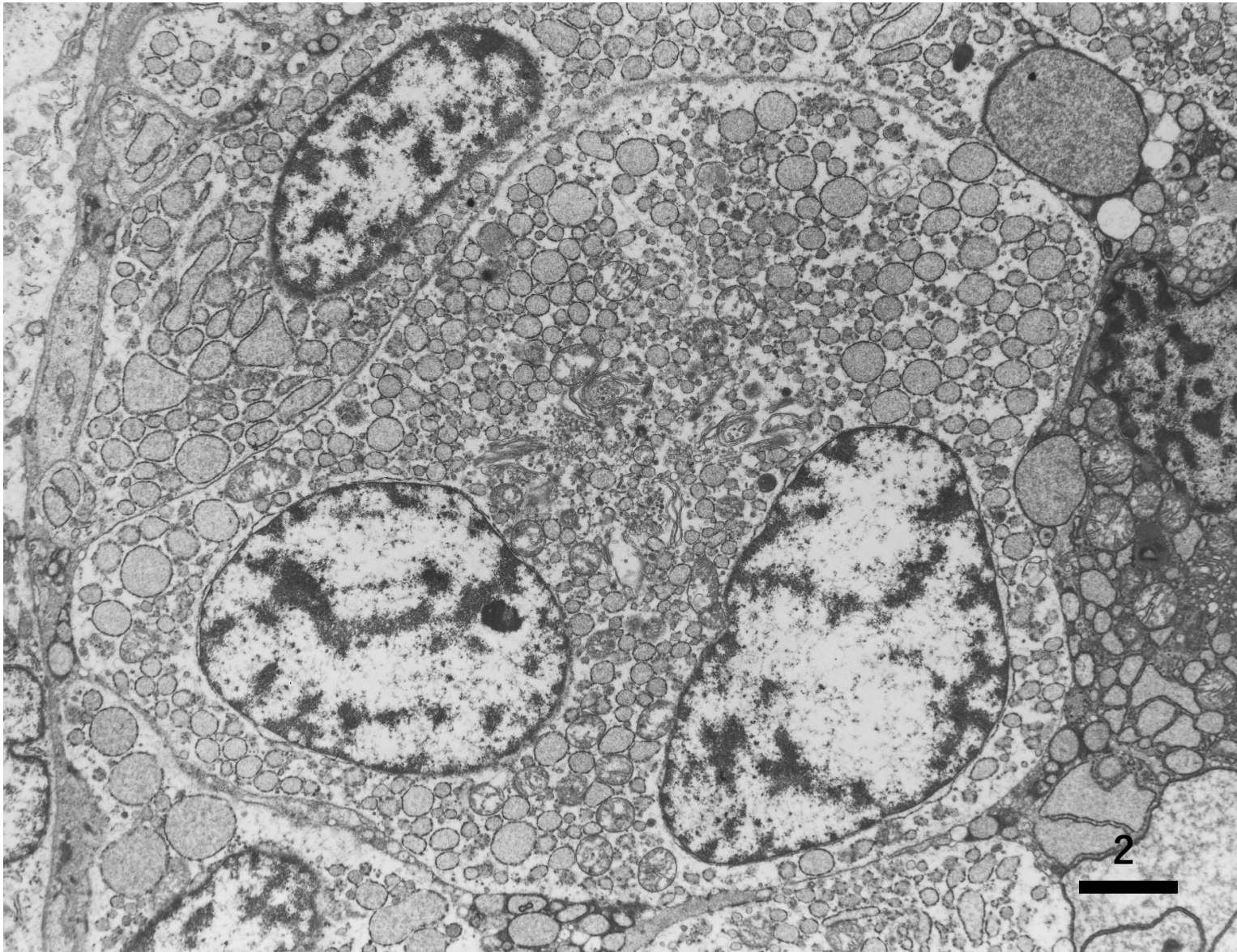
Ultrastructure of EBV-related **nasal NK cell lymphoma**. The cytoplasmic granules contain killer substances such as perforin and granzyme B.



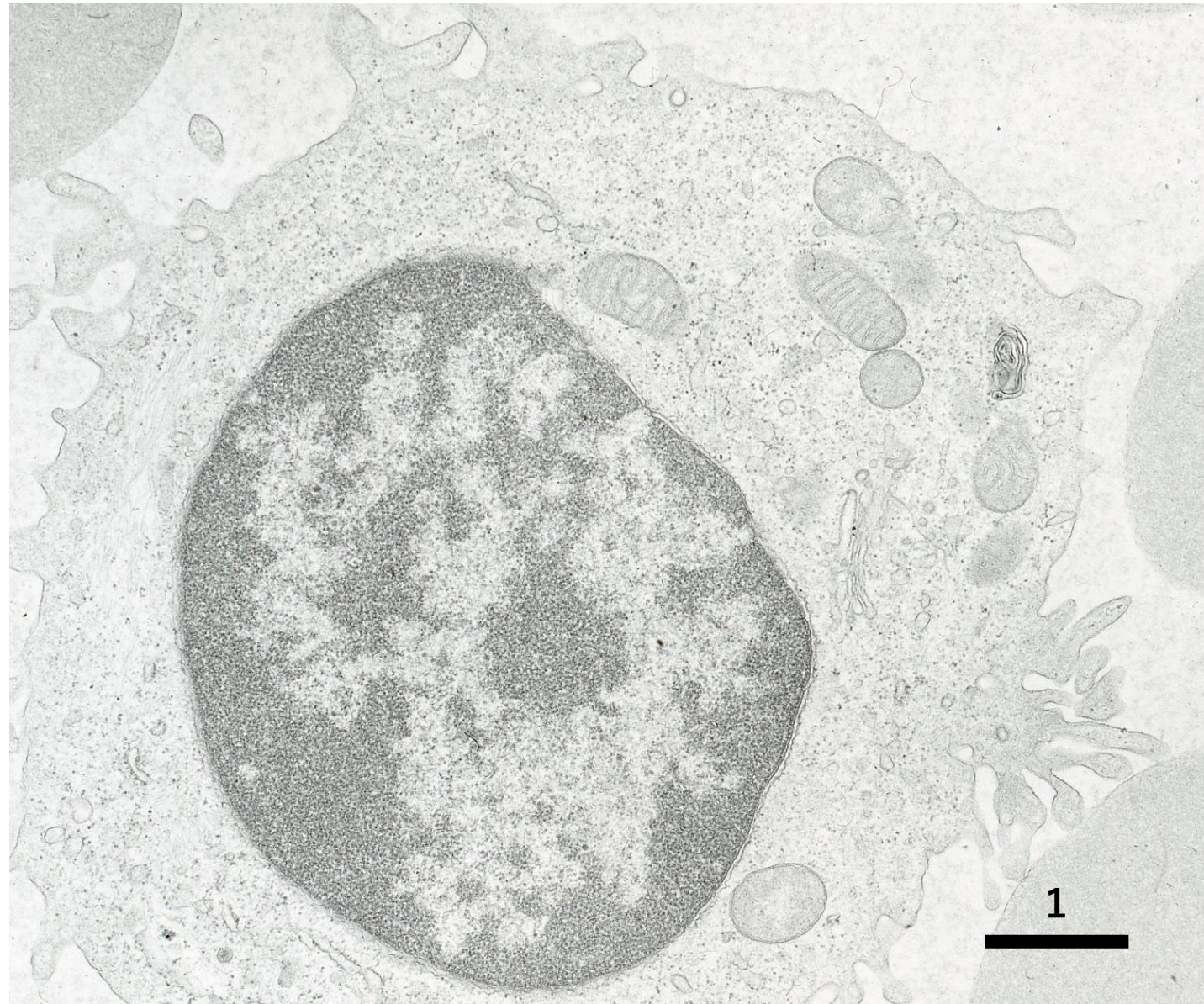
Ultrastructure of **large B-cell lymphoma of germinoblastic type**.
The large-sized lymphoma cells possess indented (cleaved) nuclei.



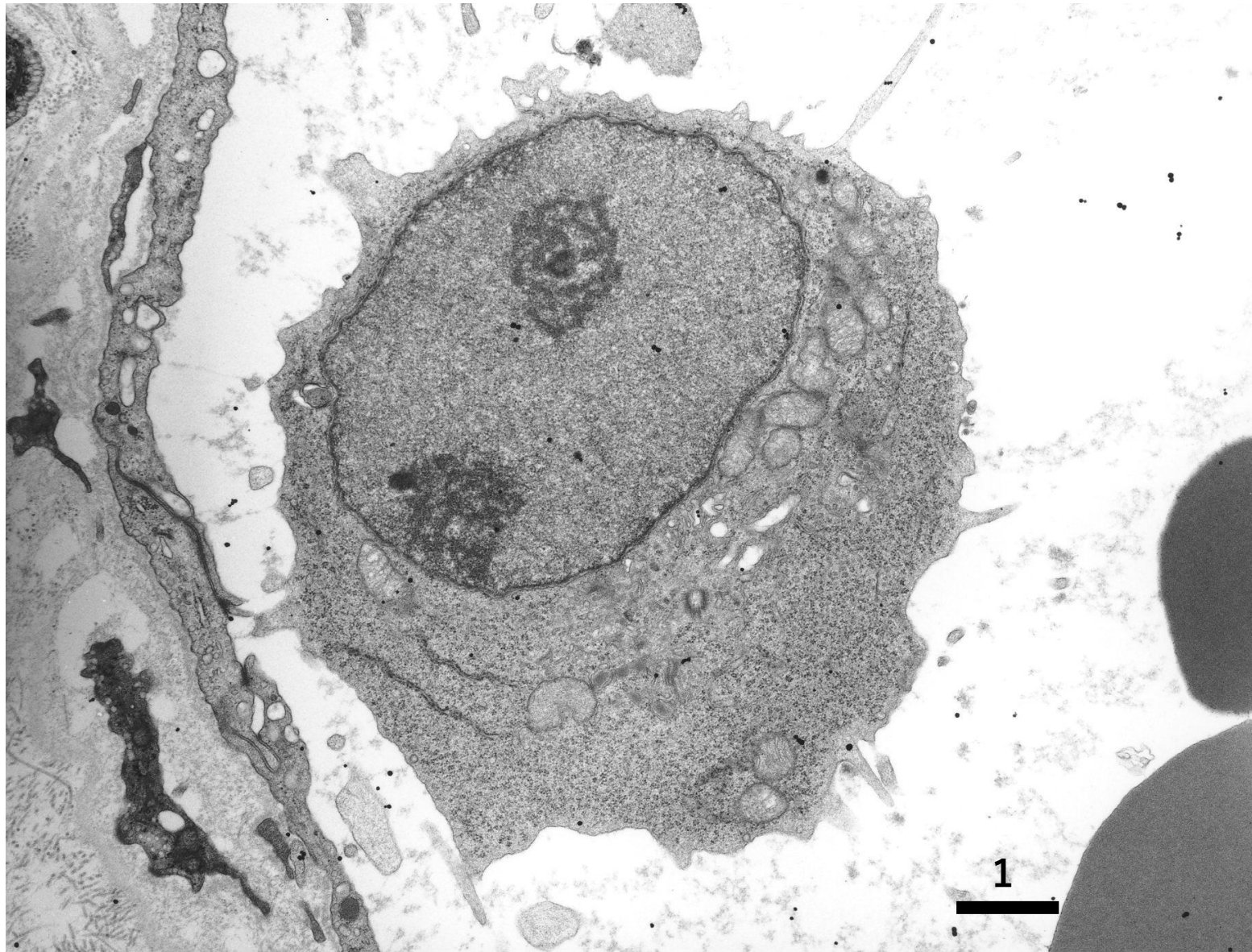
Ultrastructure of **large B-cell lymphoma of immunoblastic type**. The large-sized lymphoma cells possess round nuclei with prominent nucleoli. Rough endoplasmic reticula are dispersed in the plump cytoplasm.



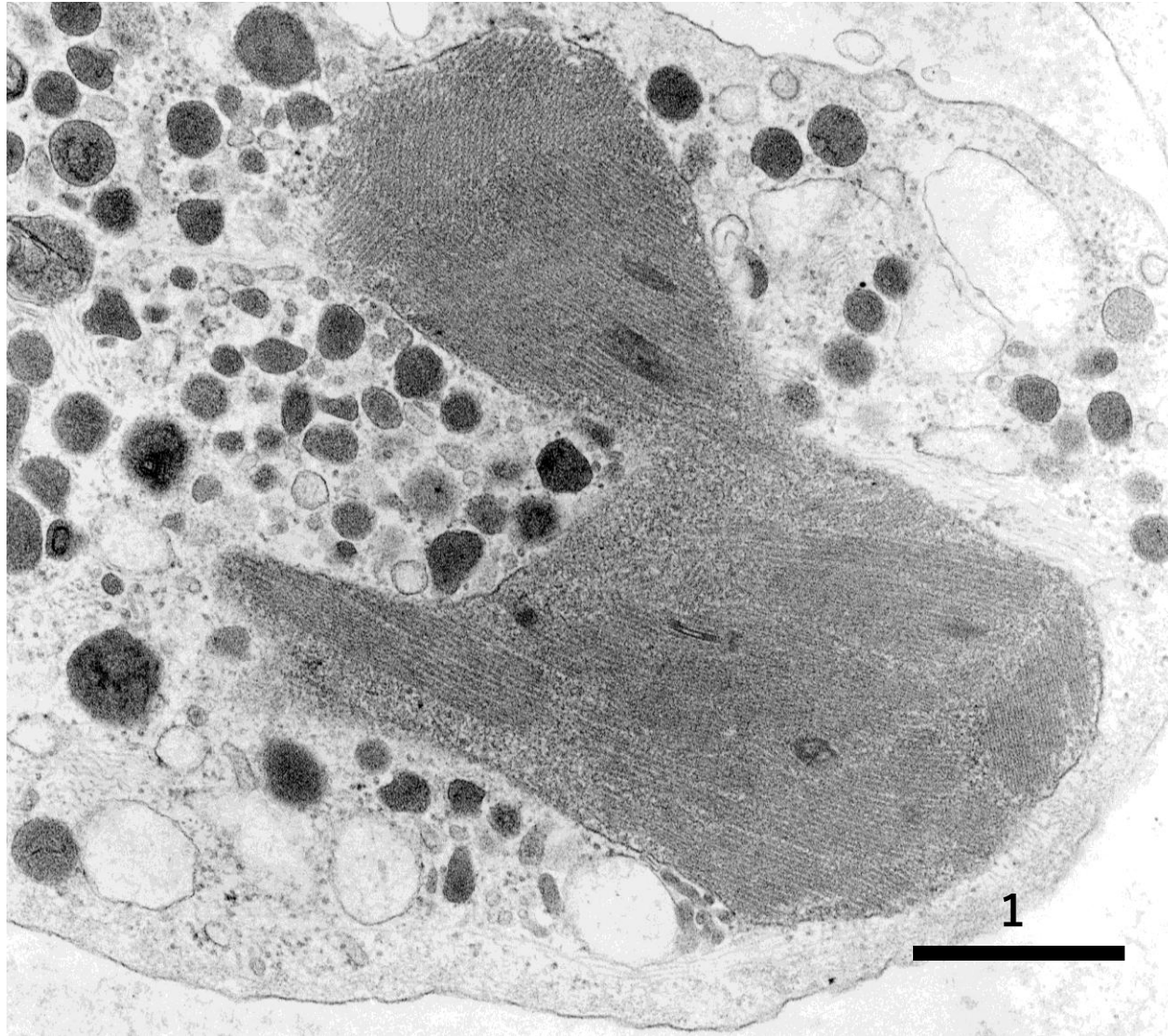
Ultrastructure of **multiple myeloma (plasmacytoma)**. The binucleated cell contains well-developed rough endoplasmic reticulum (rER) and Golgi apparatus. The cisterna of the rER is mildly dilated.



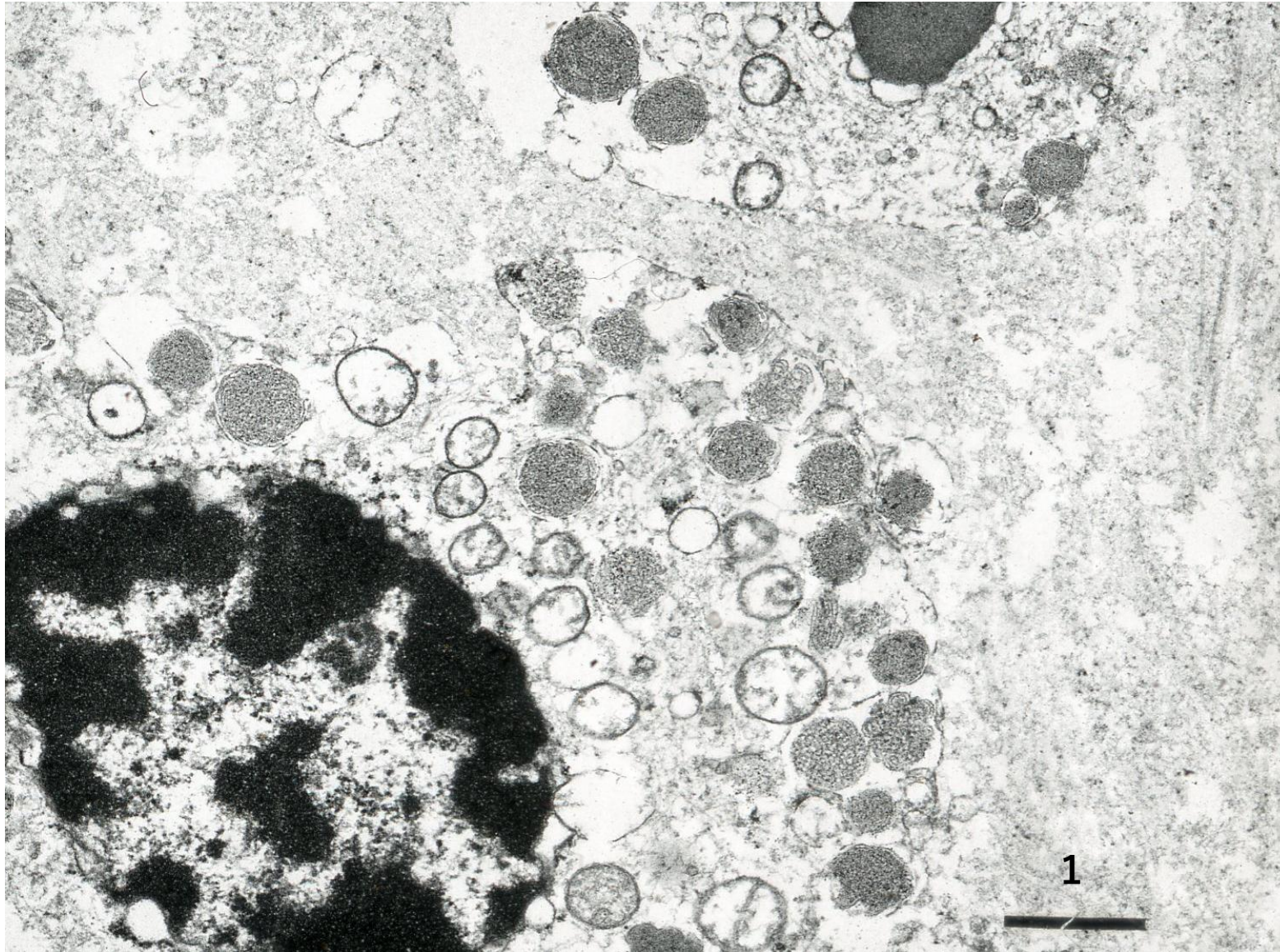
Ultrastructure of **hairy cell leukemia** in the peripheral blood. The leukemic lymphocyte with a prominent nucleolus possesses hairy projections from the plasma membrane.



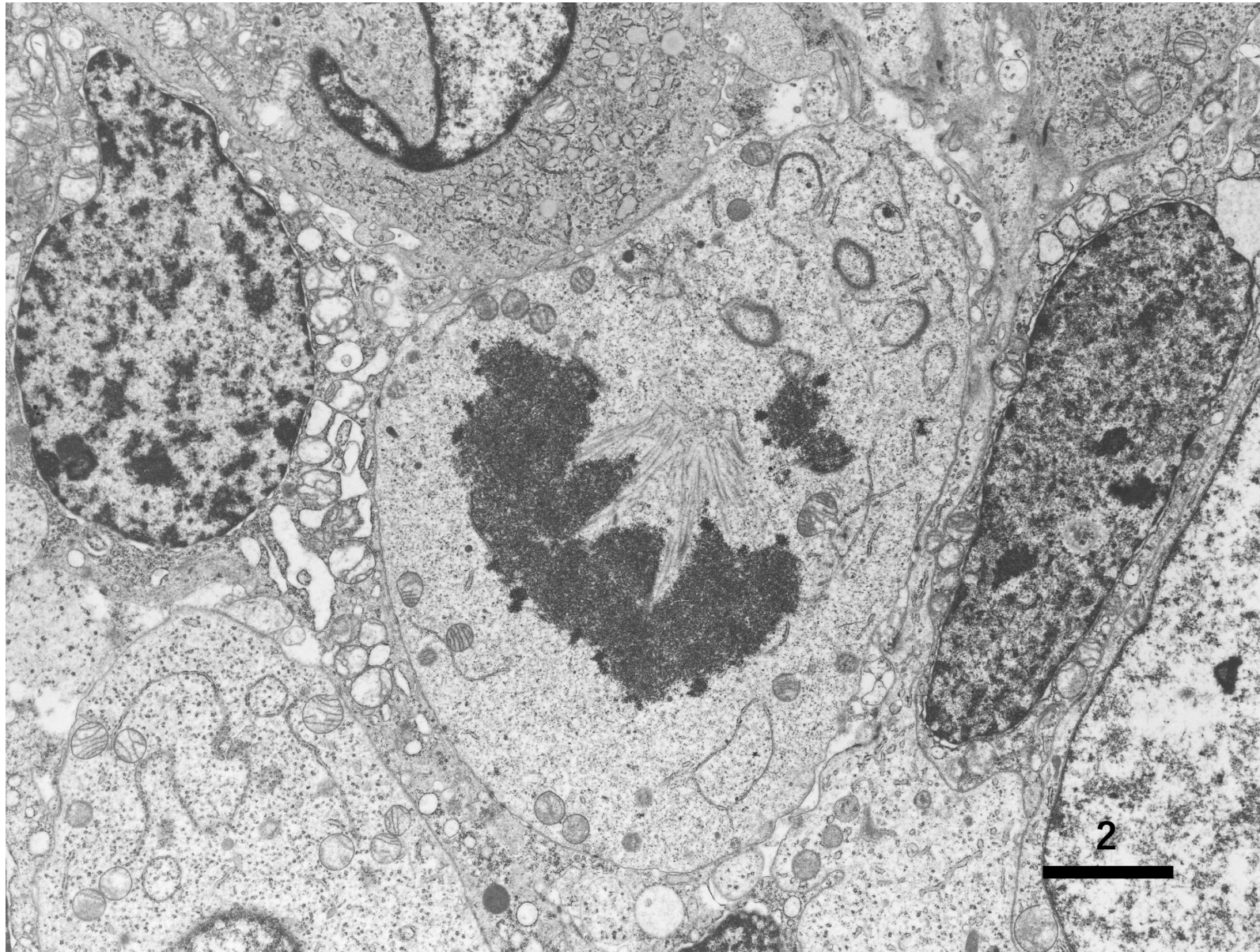
Ultrastructure of **intravascular lymphoma** of the skin. The neoplastic B-lymphoma cell grows in the vascular lumen. The connection to the vascular endothelial cell is observed.



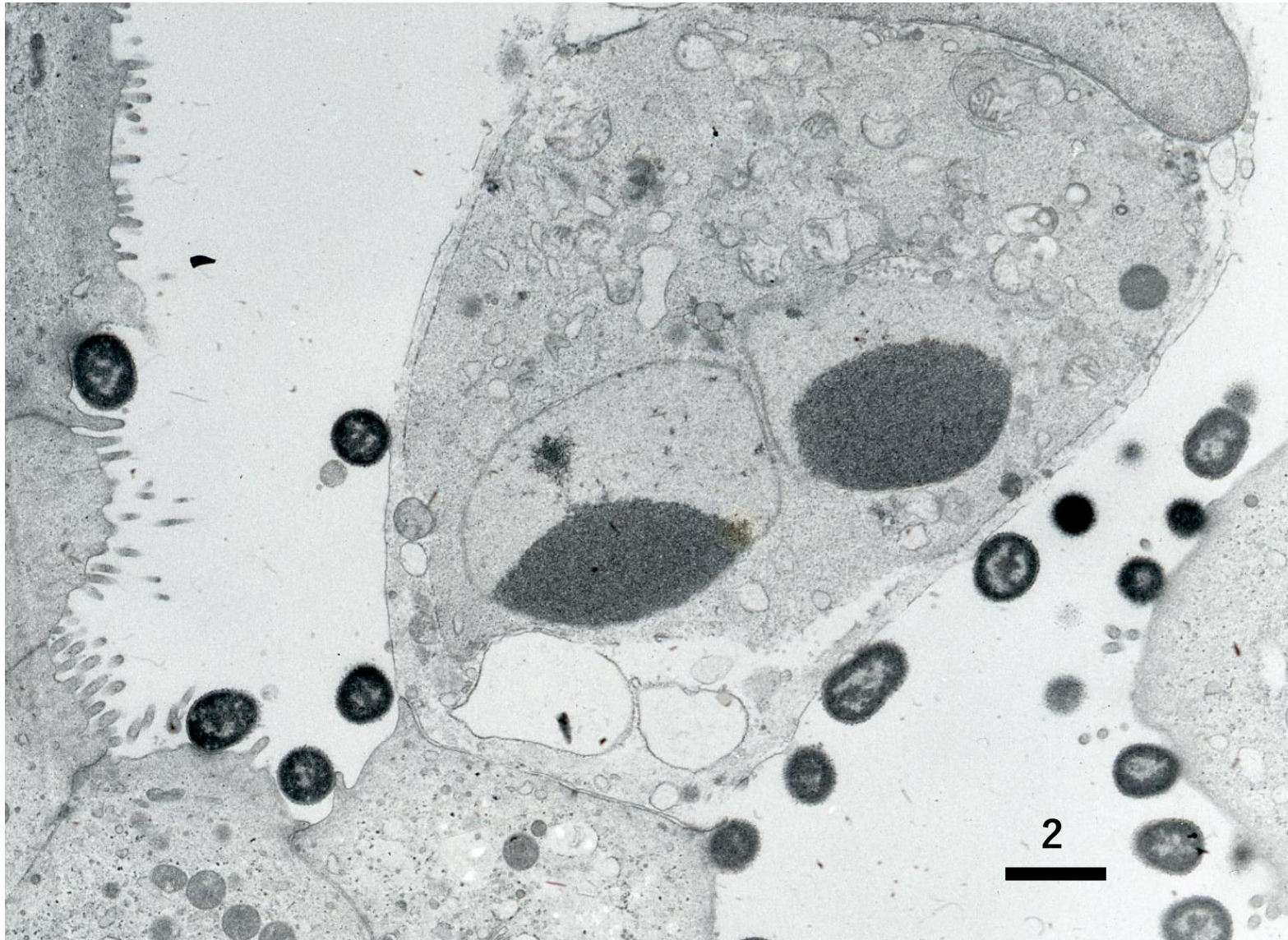
Ultrastructure of **acute promyelocytic leukemia** (APL). The neoplastic APL cell (AML, M3) contains numbers of Azur granules and a large **Auer body** consisting of paralleling filamentous materials.



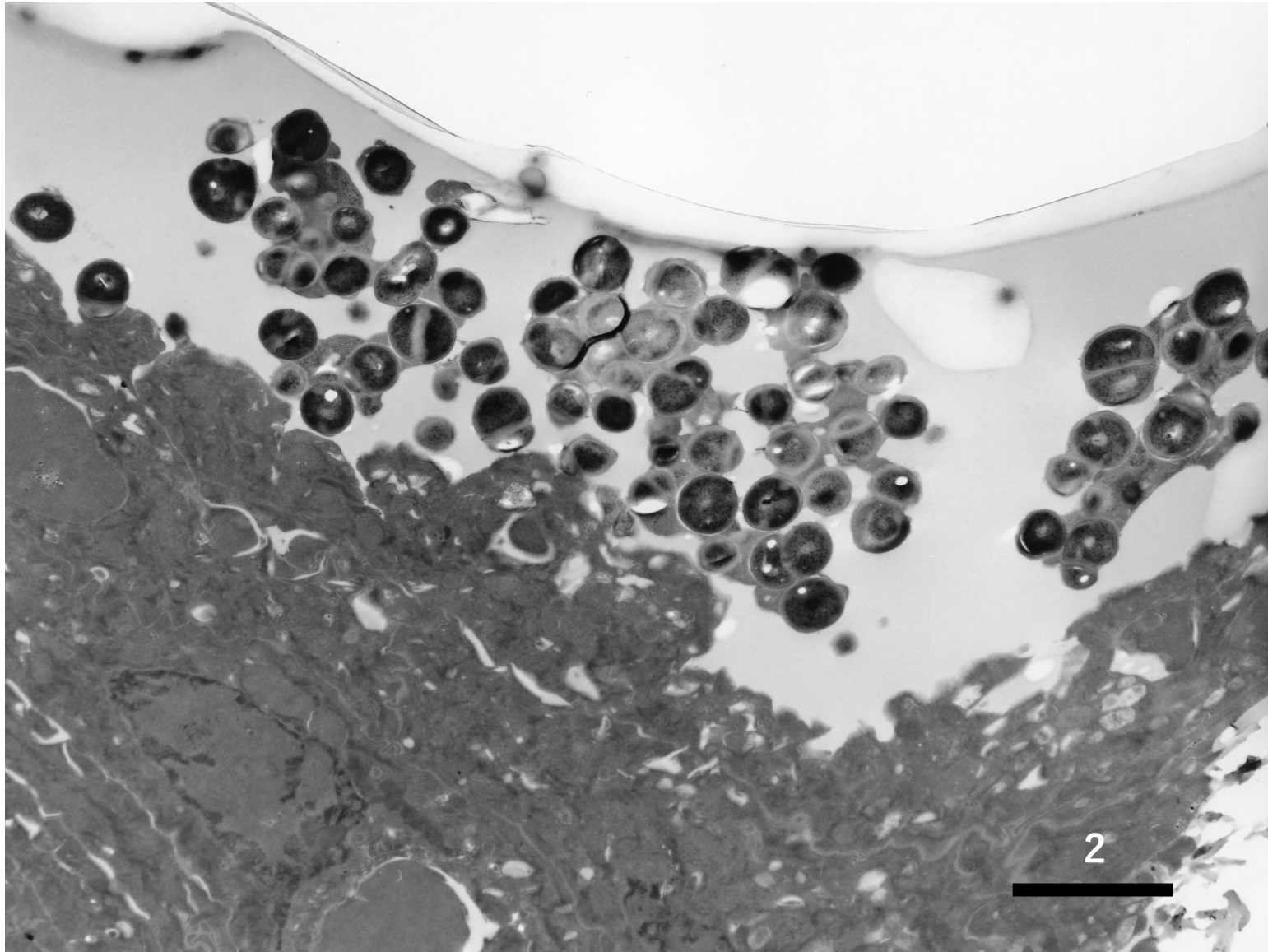
Ultrastructure of lethal **systemic mastocytosis**. Large-sized mast cell granules with finger print-like configurations are filled in the cytoplasm.



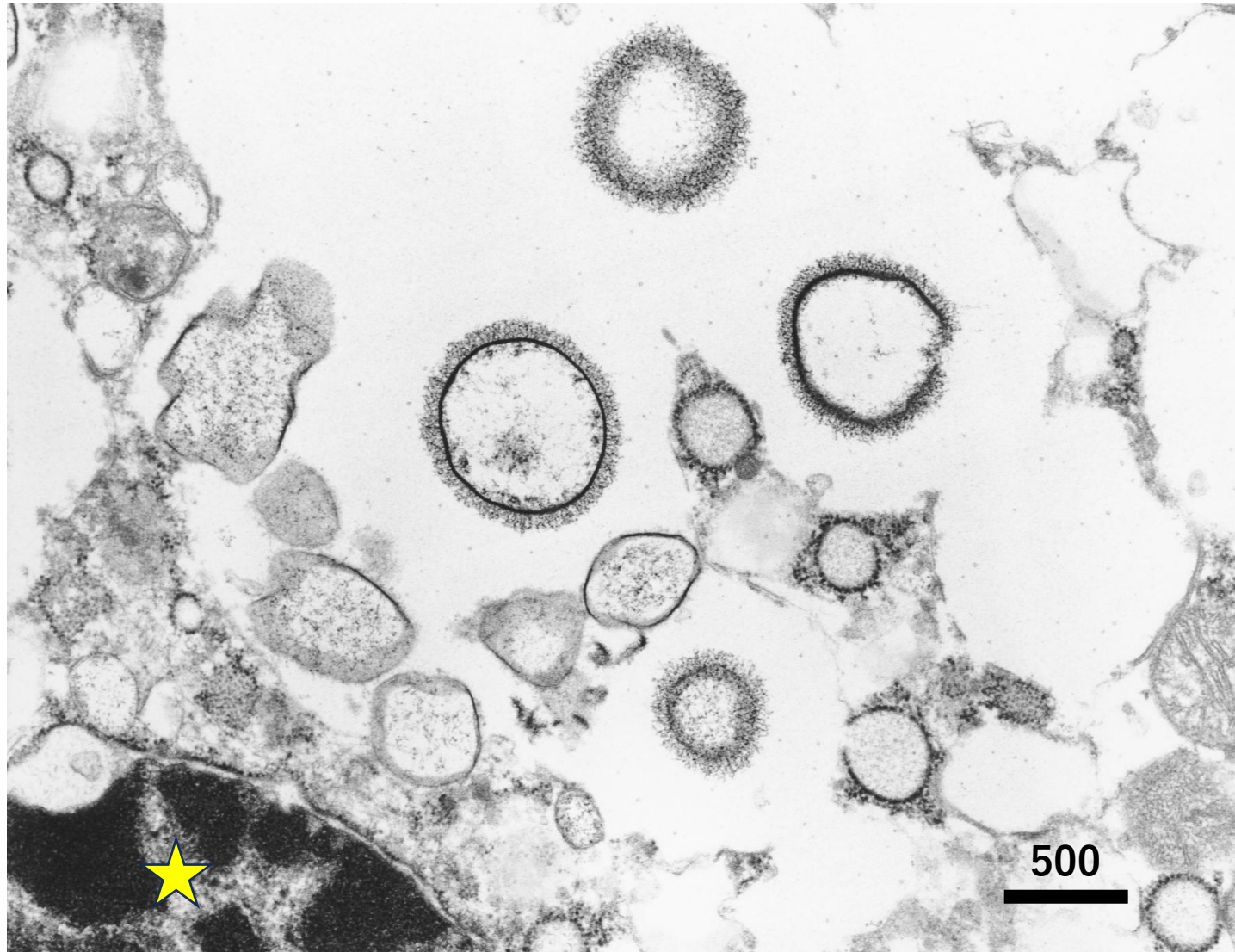
Ultrastructure of **mitosis** seen in poorly differentiated adenocarcinoma of the uterine cervix. Mitotic spindles in the metaphase are observed.



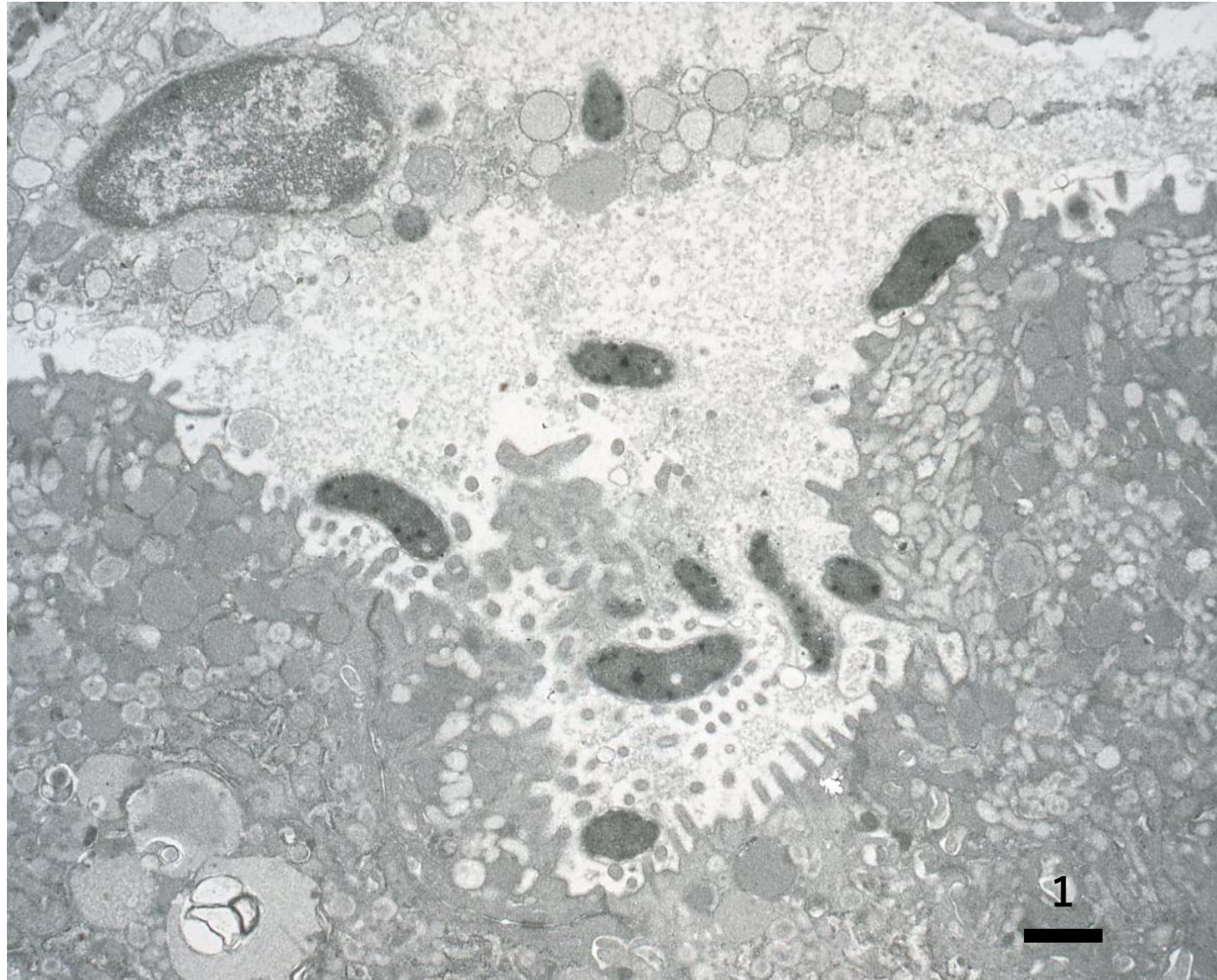
Ultrastructure of **apoptosis** seen in the colonic columnar epithelial cell with experimental **enteroadhesive *E. coli* O-5 infection** in the rabbit. Apoptotic epithelial cells showing chromatin margination and loss of microvilli protrude into the lumen.



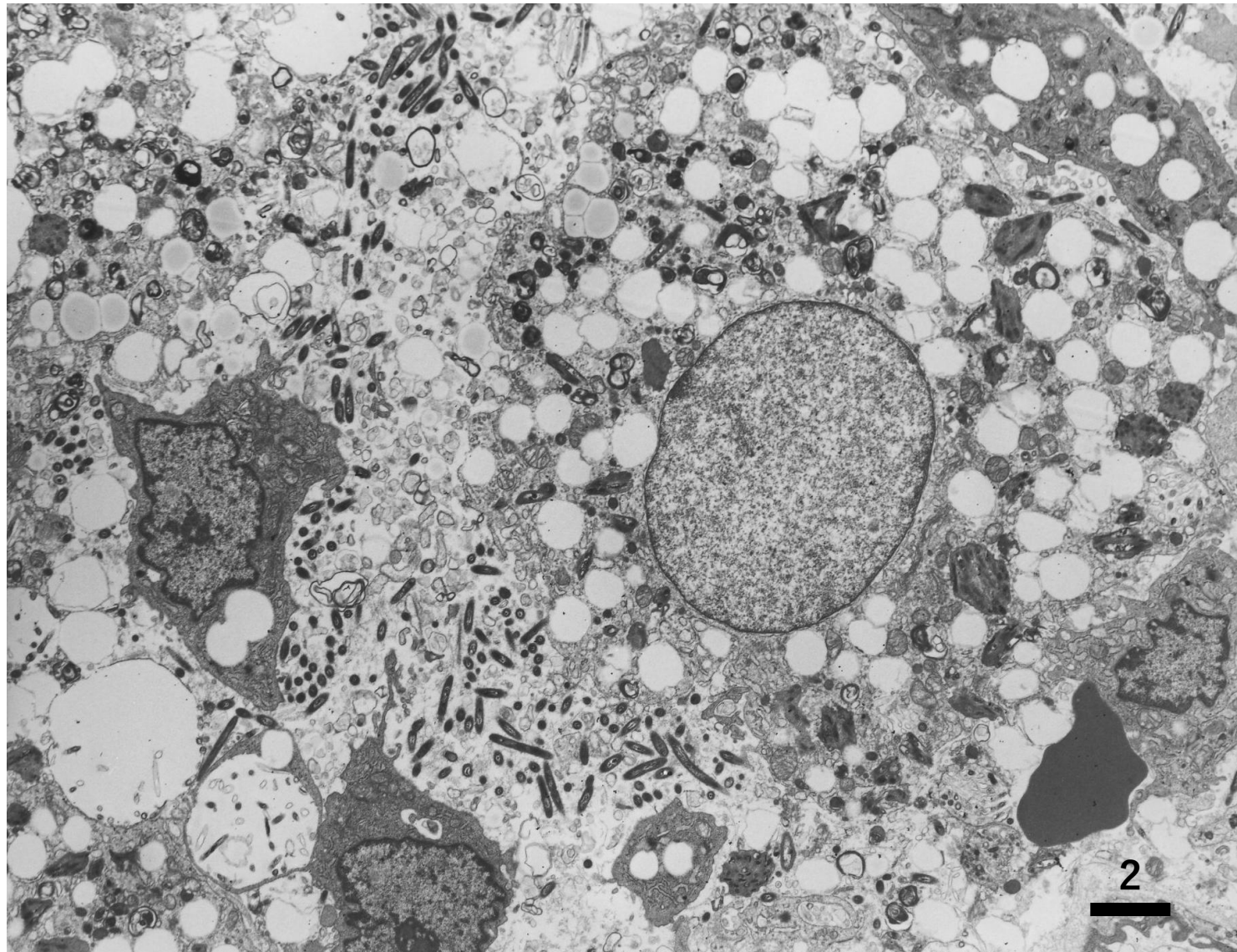
Ultrastructure of **staphylococcal infection** on the epidermis. Secondary colonization of *Staphylococcus aureus* on the skin is demonstrated. Binary fission of the cocci is discerned.



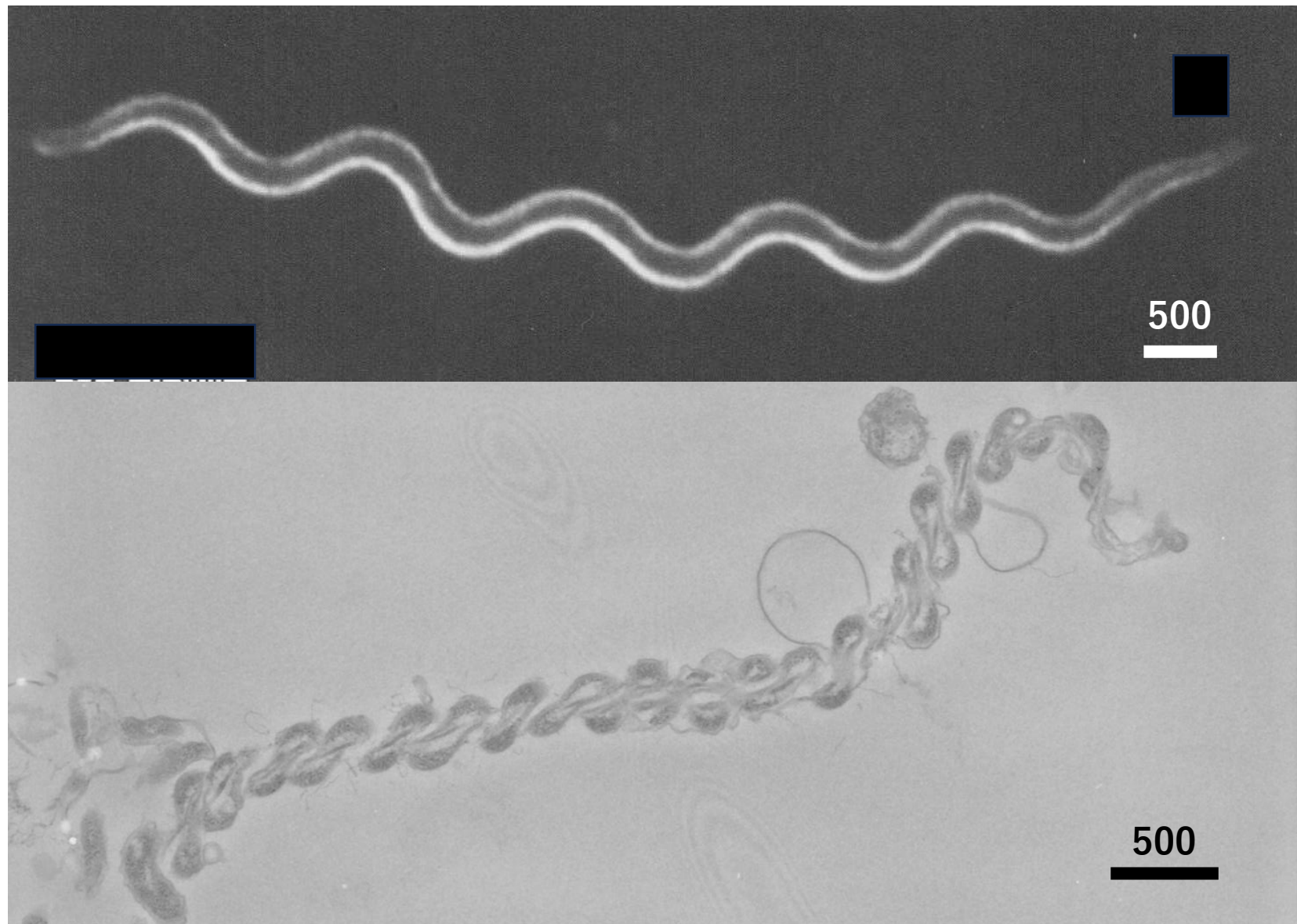
Ultrastructure of **pneumococcal lobar pneumonia**. In the alveolar lumen, *Streptococcus pneumoniae* with distinct capsule formation is floating, and the cocci escape from phagocytosis by the neutrophil (asterisk).



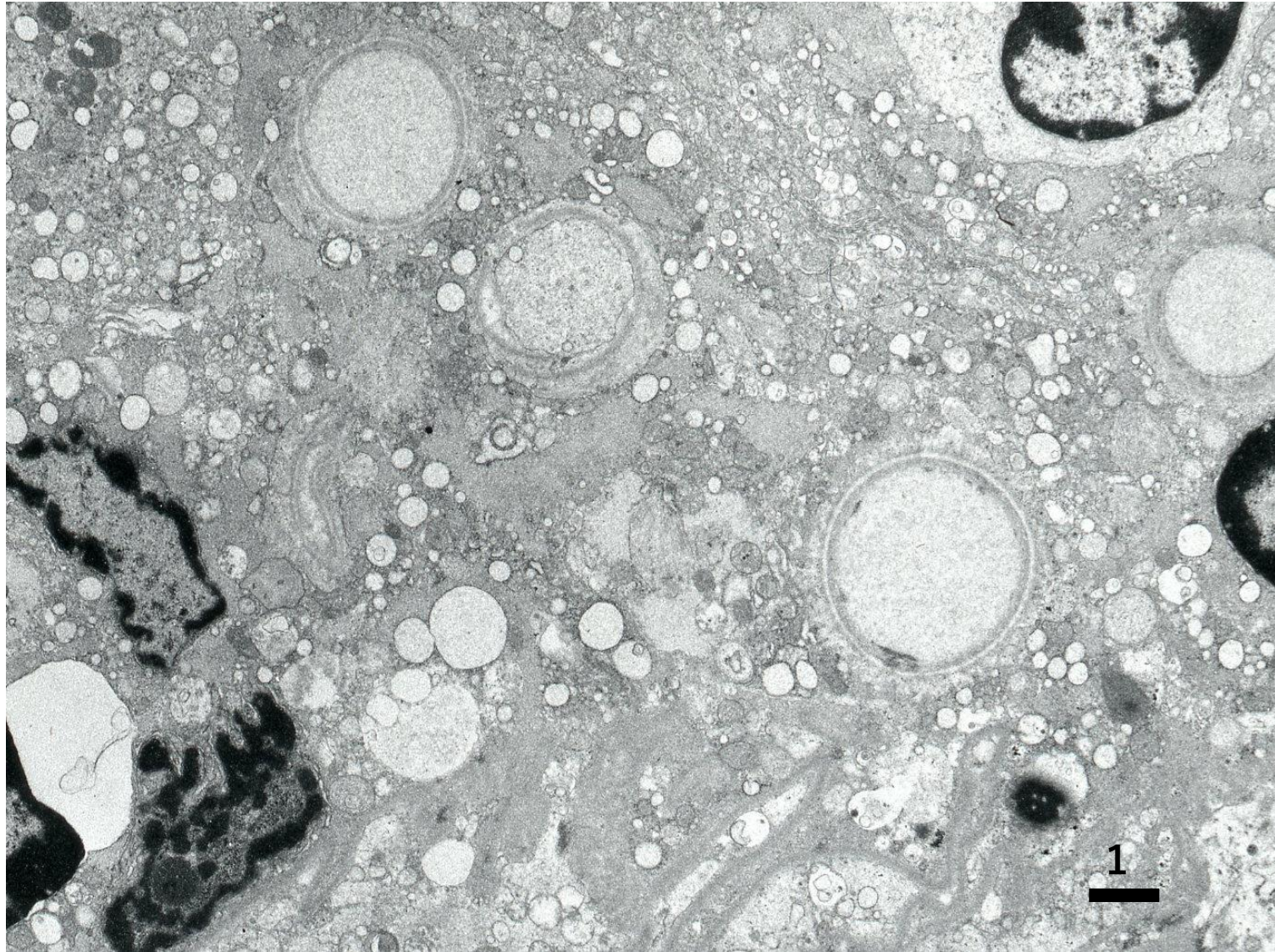
Ultrastructure of ***Helicobacter pylori* infection** on the gastric mucosa. The spiral bacteria attach the microvillous surface of the mucin-secreting gastric foveolar epithelial cells.



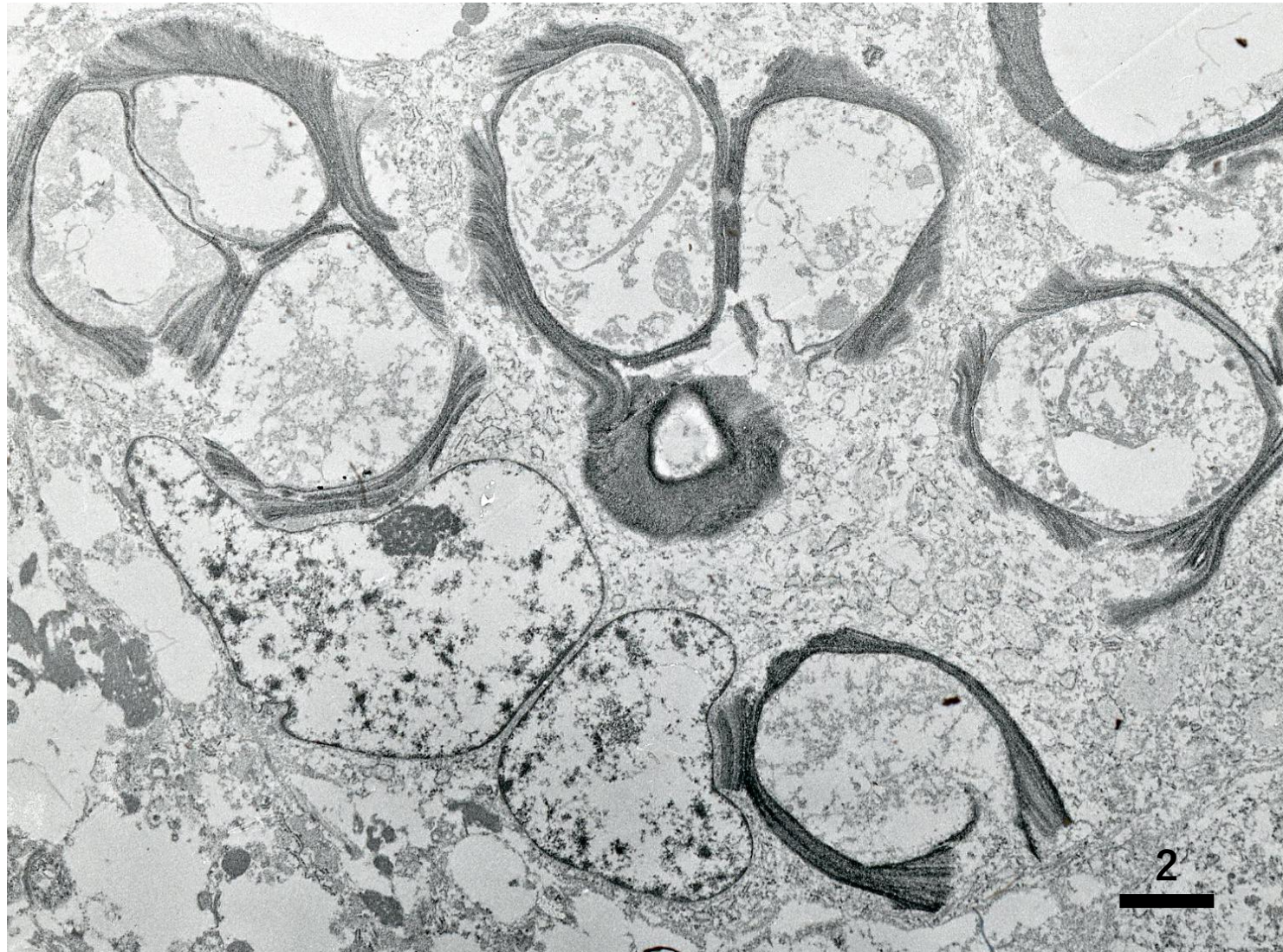
Ultrastructure of **Whipple's disease**. The ileal biopsy reveals infection of long rods both inside and outside of macrophages in the lamina propria mucosae. Microbial culture of the causative pathogen *Tropheryma whippelii* is difficult, and thus ultrastructural demonstration of the pathogen in biopsy specimens is of diagnostic significance.



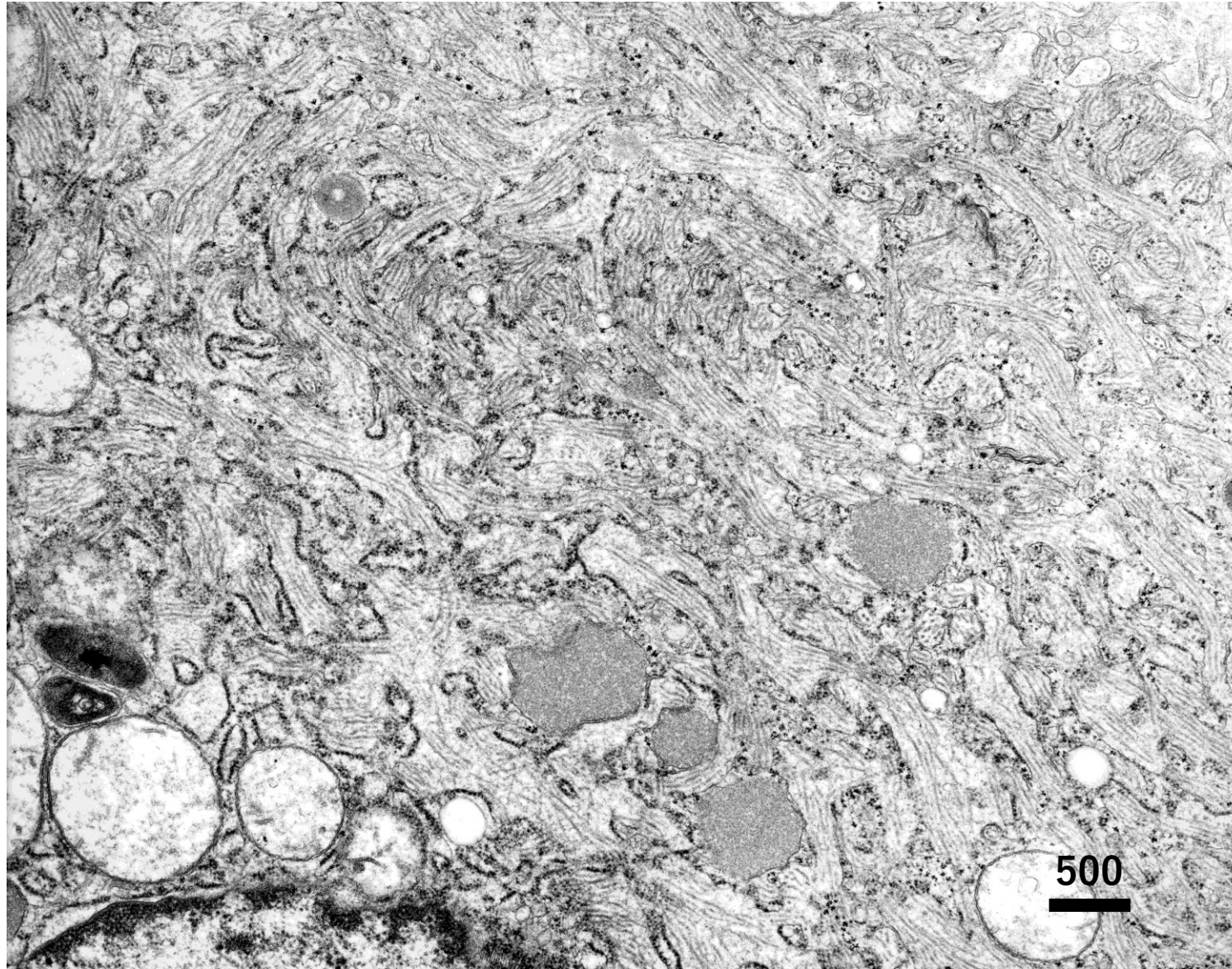
Ultrastructure of isolated **Spirochaeta**: *Treponema pallidum* (top) vs. *Leptospira interrogans* (bottom). *T. pallidum* is loosely coiled, while *L. interrogans* is highly coiled around the centrally located periplasmic flagella. The body of *L. interrogans* is hooked at both ends.



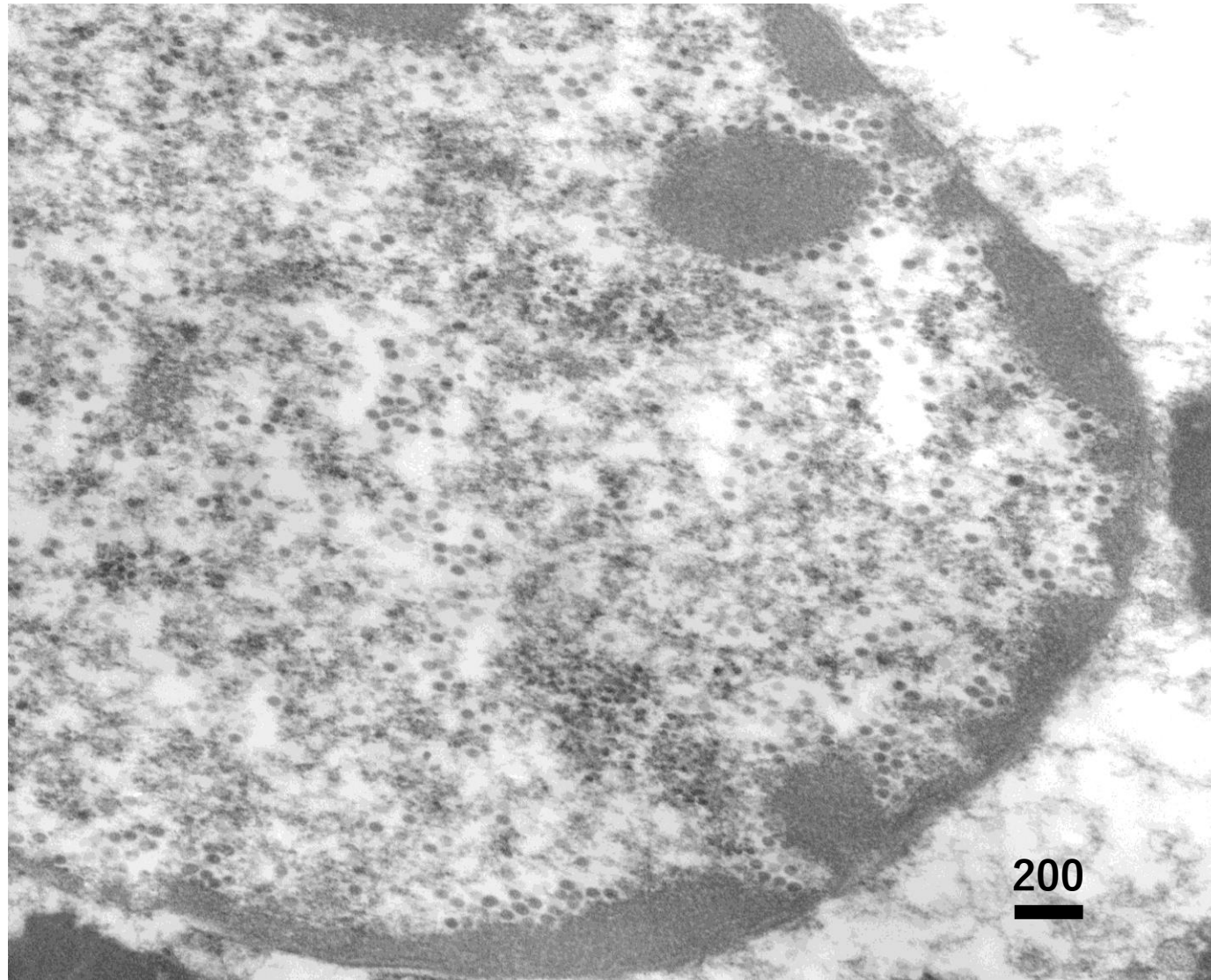
Ultrastructure of pulmonary **cryptococcal granuloma**. Infection of round-shaped yeast-form fungi is observed in the cytoplasm of epithelioid macrophages.



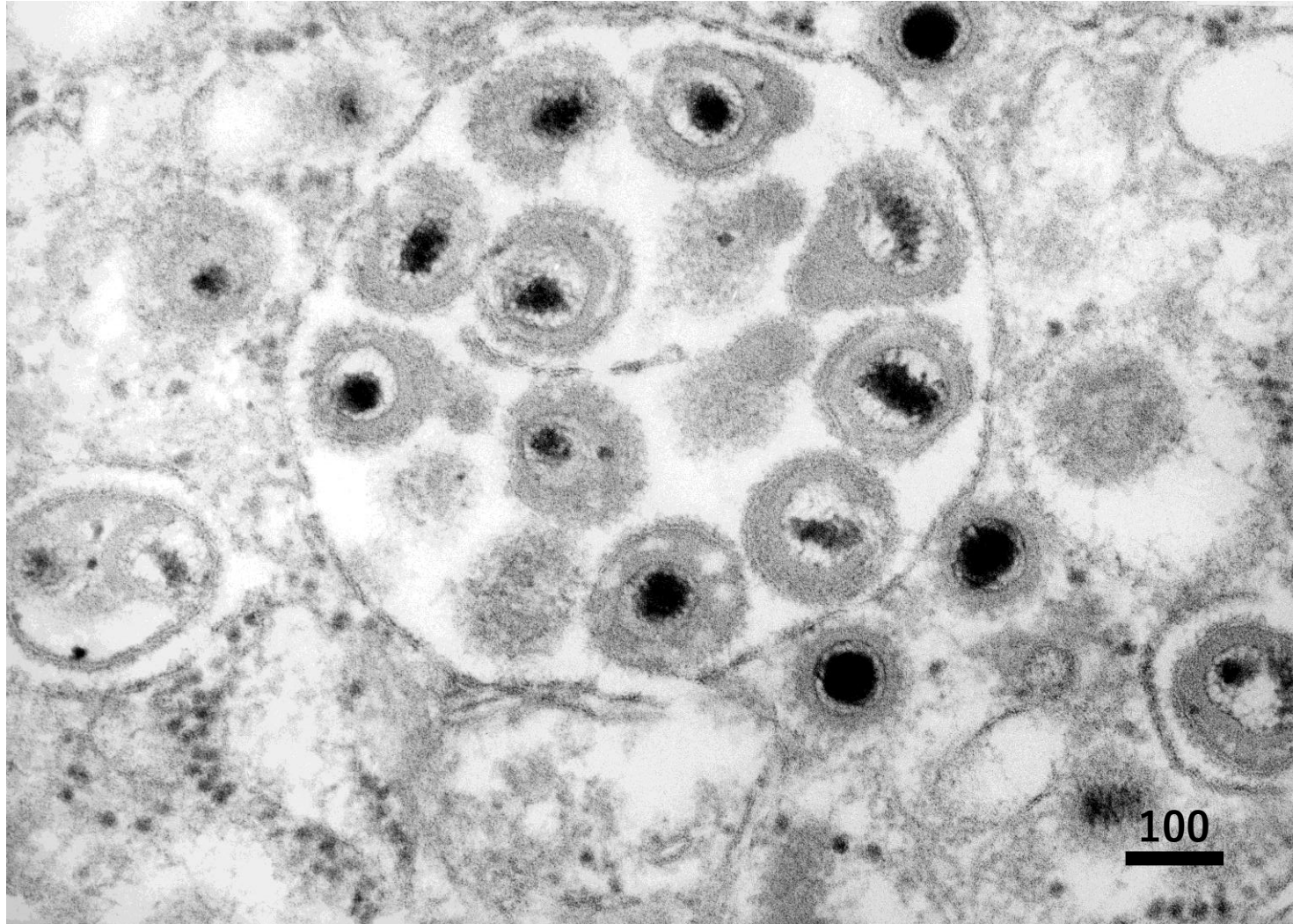
Ultrastructure of **chromomycosis** of the skin. Sclerotic cells, melanin-coated yeast-form fungi, grow in the cytoplasm of the multinucleated macrophage. Electron-dense lamellated cell walls are characteristic of the environmental colored fungal cells, *Fonsecaea pedrosoi*. Organelles are observed in the fungal cell.



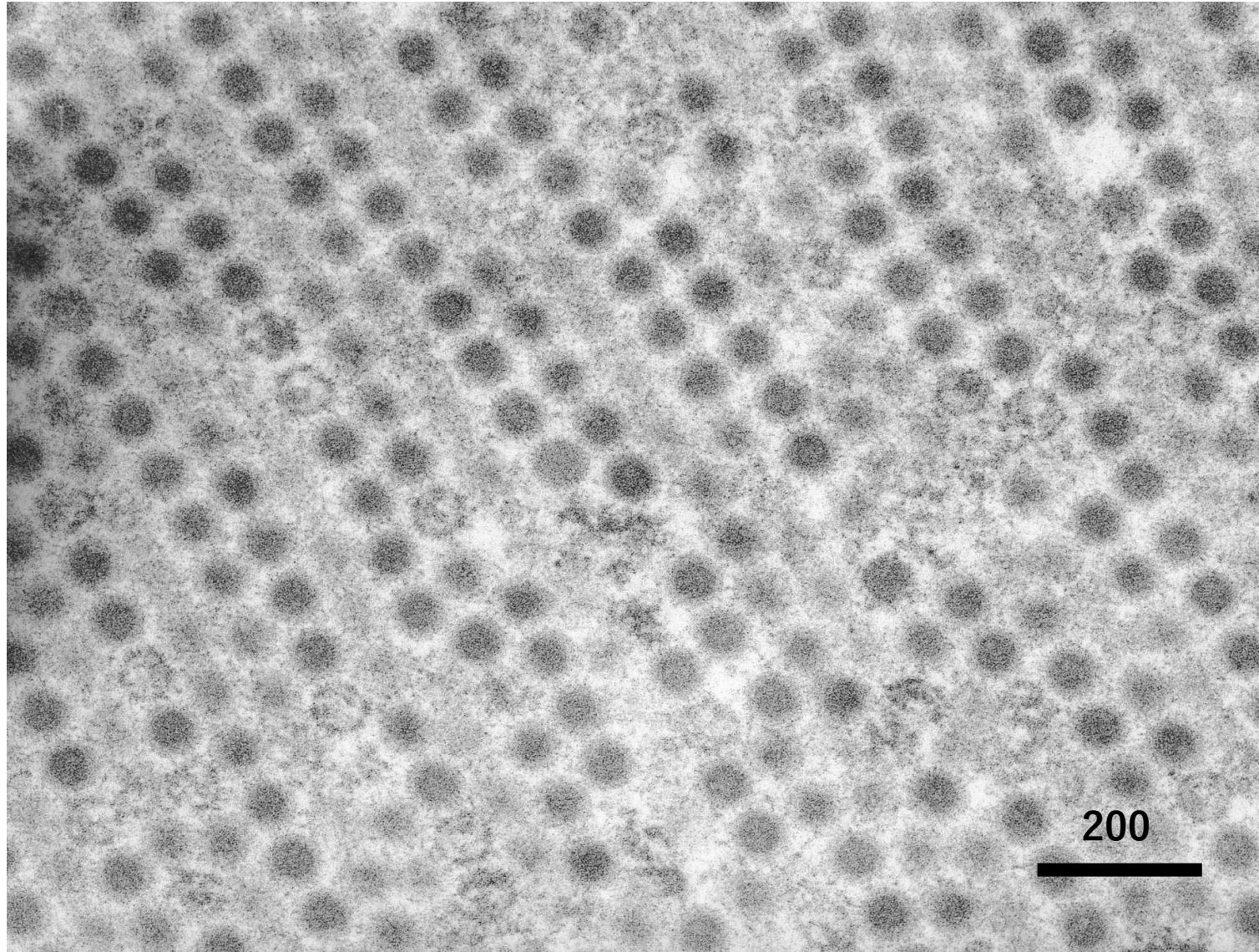
Ultrastructure of the **HBs antigen-positive ground-glass hepatocyte** in a healthy carrier of hepatitis B virus. Filamentous substances are seen in the cisterna of rough endoplasmic reticula. They represent abnormal accumulation of non-secretory HBs antigen molecules.



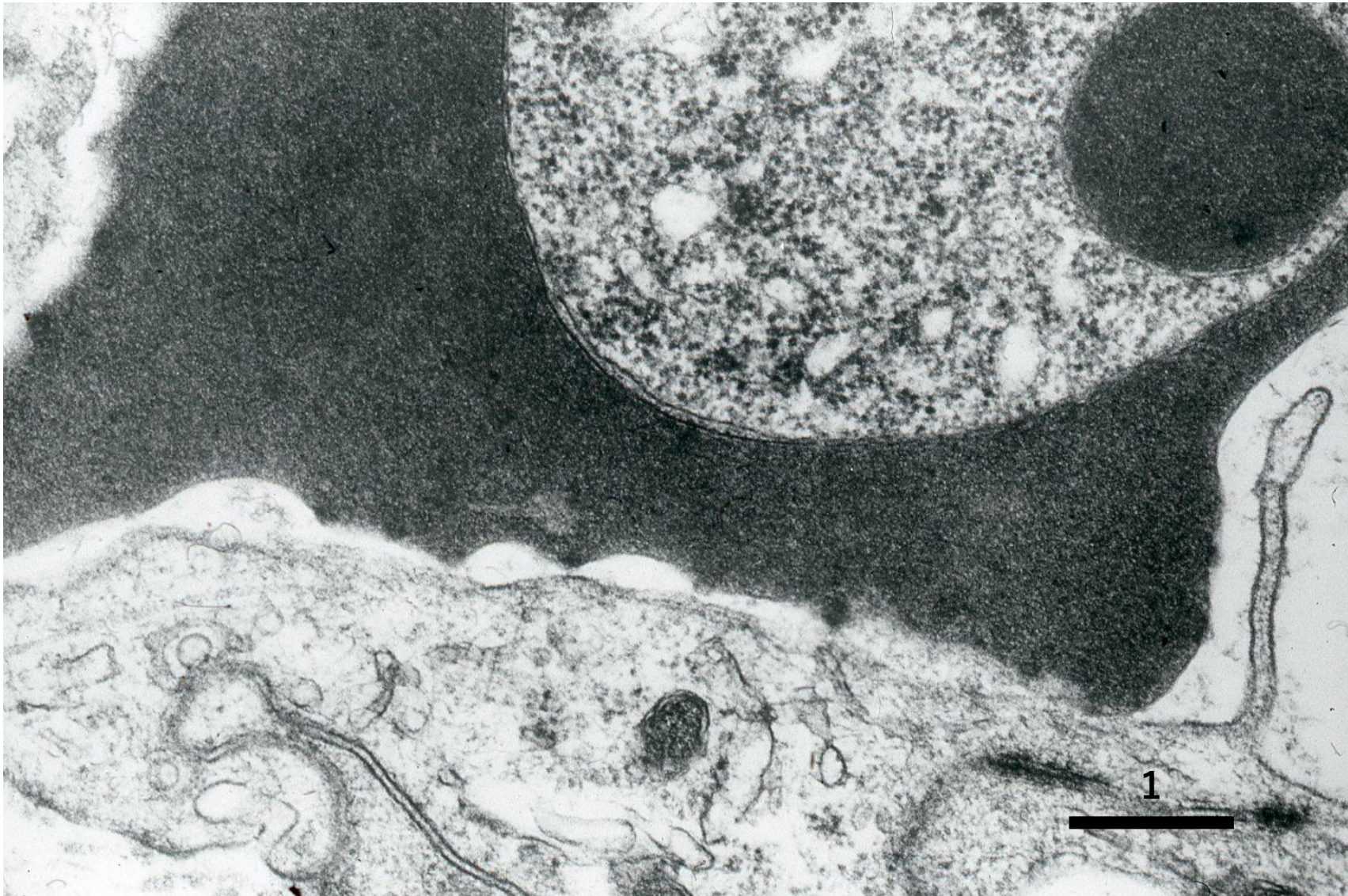
Ultrastructure of **verruca vulgaris** of the skin. The intranuclear inclusion body is formed in the keratinocyte in the granular layer. Very small viral particles around 50 nm are packed in the nucleus.



Ultrastructure of a **cytomegalovirus**-infected type II alveolar cell of the lung. In and outside the cisterna of rough endoplasmic reticula, enveloped viral capsids with electron-dense cores (virions) measuring about 180 nm are clustered.



Ultrastructure of **adenovirus infection** of the liver. Hexagonal-shaped adenoviral particles about 70 nm in diameter are geometrically arranged in the hepatocellular nucleus. Some particles lack the electron-dense core (virions).



Ultrastructure of **cerebral malaria**. The red blood cell in a capillary vessel is infected with an ameboid form (trophozoite) of *Plasmodium falciparum*. Knob formation is seen on the infected red blood cell, and adhesion molecules are accumulated on the spiculated structure. This is the mechanism of red cell adhesion onto the capillary endothelial cell in cerebral (malignant) malaria.



Ultrastructure of amastigotes of *Leishmania major* growing in a cutaneous macrophage in a case of **cutaneous leishmaniasis** of Indian type. The peripherally and centrally condensed chromatin, microtubular lining just beneath the plasma membrane, kinetoplast formation and mitochondria around the nucleus are noted in the 3 μm -sized and oval-shaped intracellular protozoan body.