Southampton NHS
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Don't know your amyloid from your epithelium?

You need our.........

Basic Renal Electron Microscopy Training Day

Presented by Bart Wagner
Chief Biomedical Scientist
at Sheffield Northern General Hospital

Biomedical Imaging Unit

http://www.som.soton.ac.uk/research/sites/biu

Where: Southampton General Hospital, UK
When: Friday 30th September 2011
How much: £40.00 (£30.00 IBMS)
Contact: a.page@soton.ac.uk
IBMS accredited

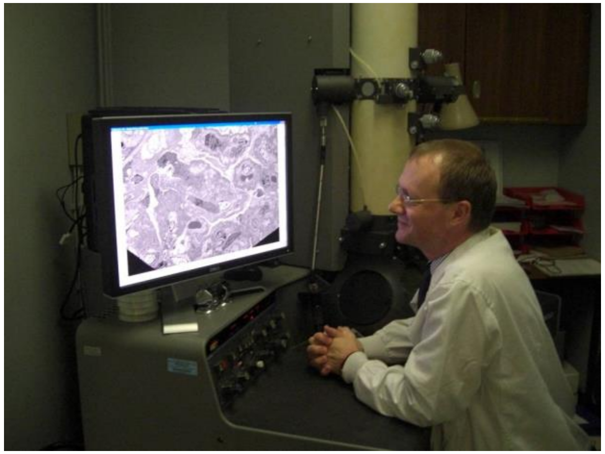
UNIVERSITY OF Southampton

Basic Renal EM workshop

Southampton

September 30th 2011

Renal Ultrastructure Normal



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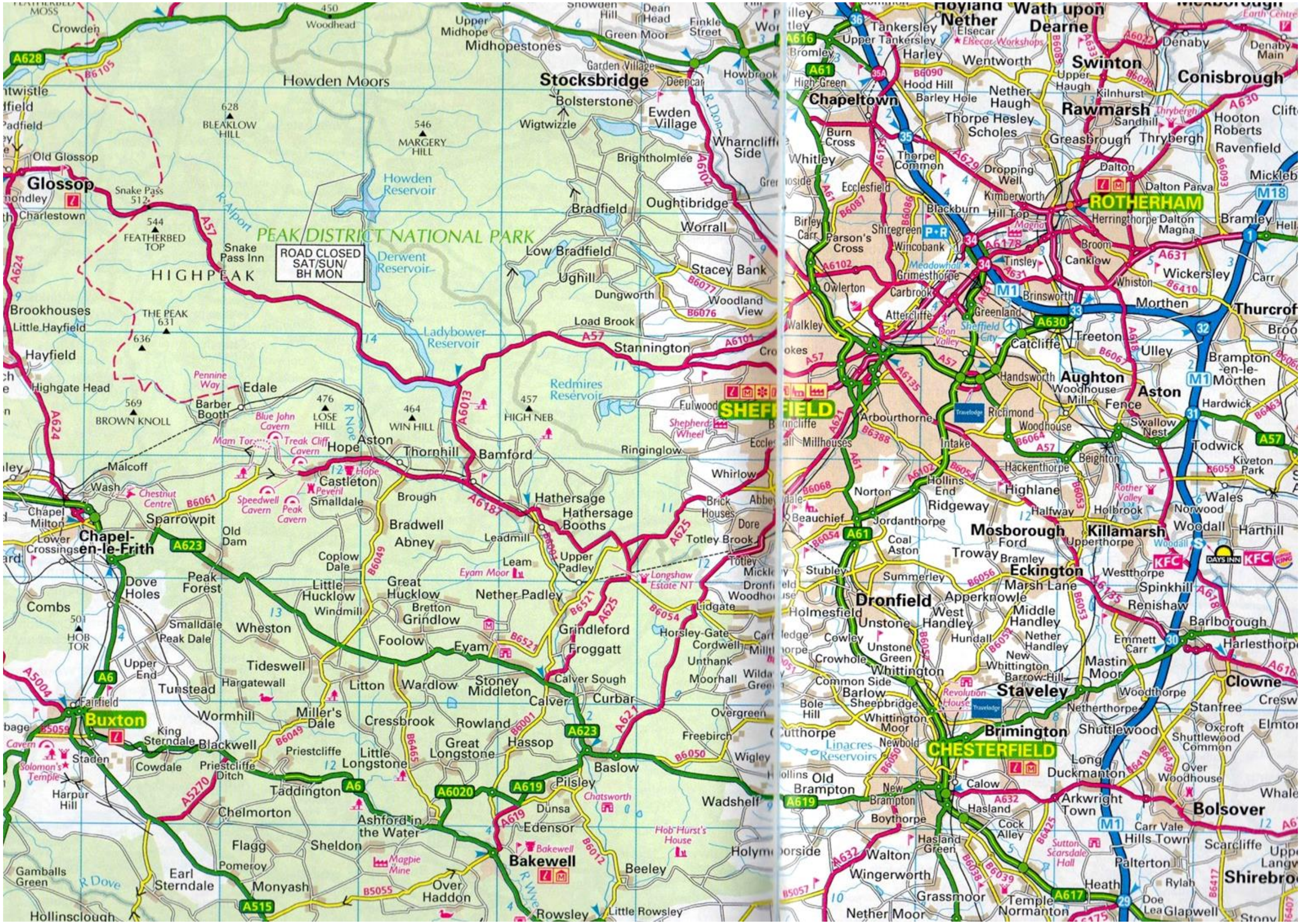
Sheffield

- In the centre of England, in South Yorkshire.
- A post-industrial city.
- Population of half a million.
- Two large universities & hospitals.
- Built on 7 hills.
- Manchester, Leeds, Nottingham - all nearby.
- But immediately adjacent to the Peak District

Sheffield is very close to the Peak District National Park



Near where I live… The Peak District National Park

Burbage moor

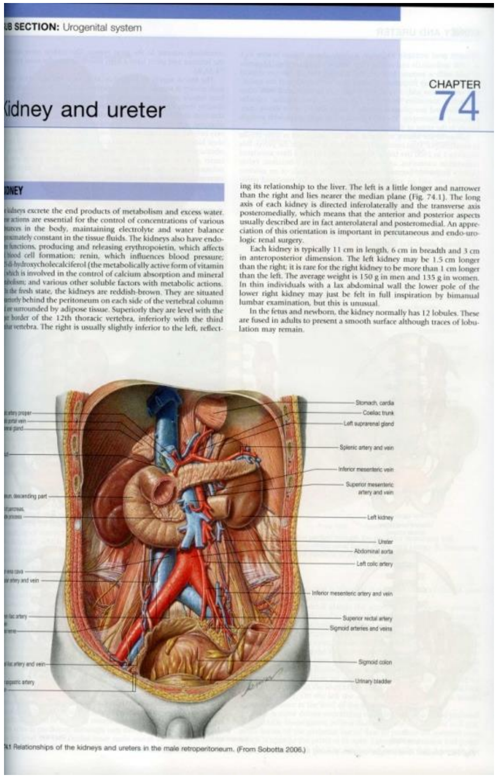

Bakewell

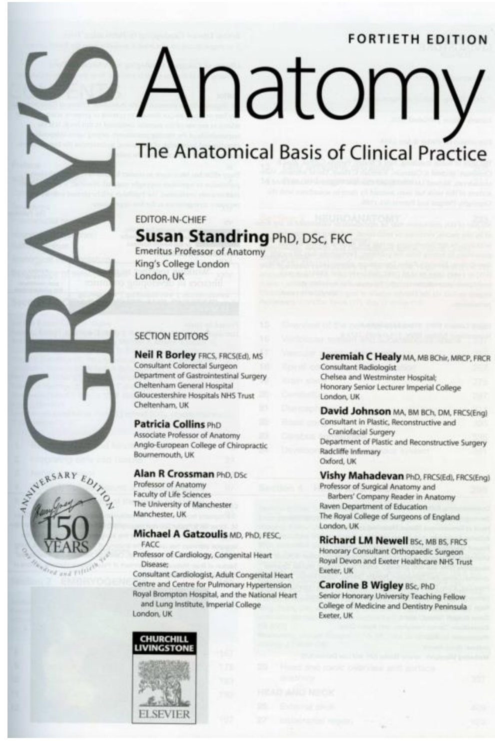

Near Calver


Calver

If you are visiting Sheffield

Chatsworth House. Near Sheffield - built circa 1560




FORTIETH EDITION

GRAY'S Anatomy

The Anatomical Basis of Clinical Practice

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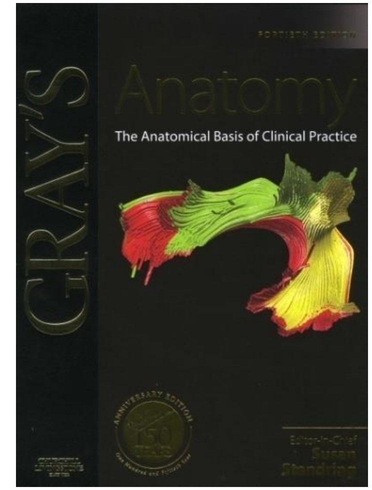


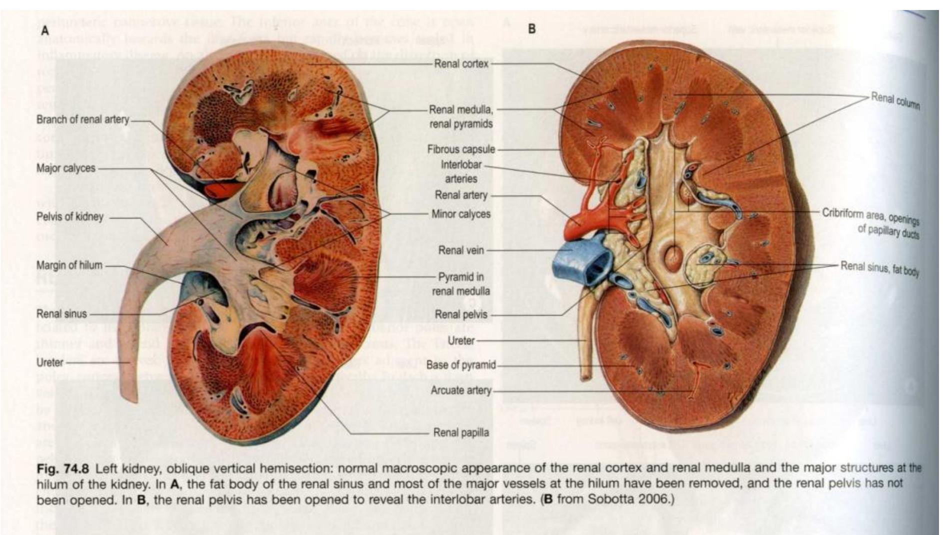
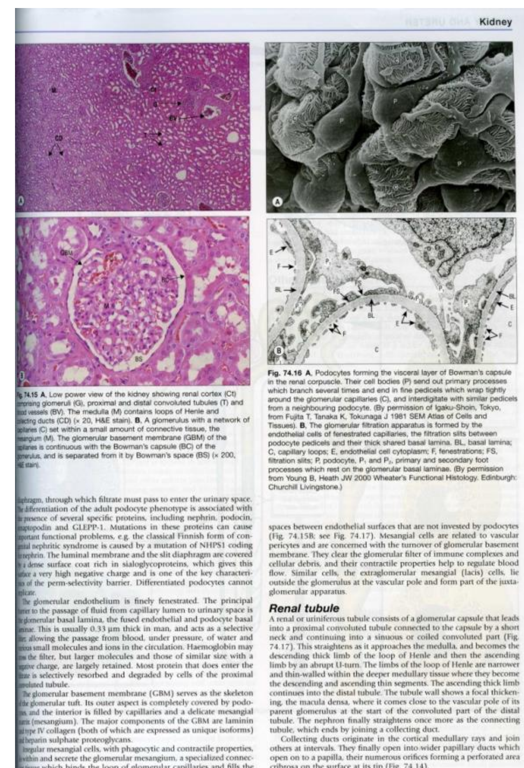


Fig. 74.8 Left kidney, oblique vertical hemisection: normal macroscopic appearance of the renal cortex and renal medulla and the major structures at the hilum of the kidney. In **A**, the fat body of the renal sinus and most of the major vessels at the hilum have been removed, and the renal pelvis has not been opened. In **B**, the renal pelvis has been opened to reveal the interlobar arteries. (**B** from Sobotta 2006.)

Ultrastructure is an extension of histology and anatomy



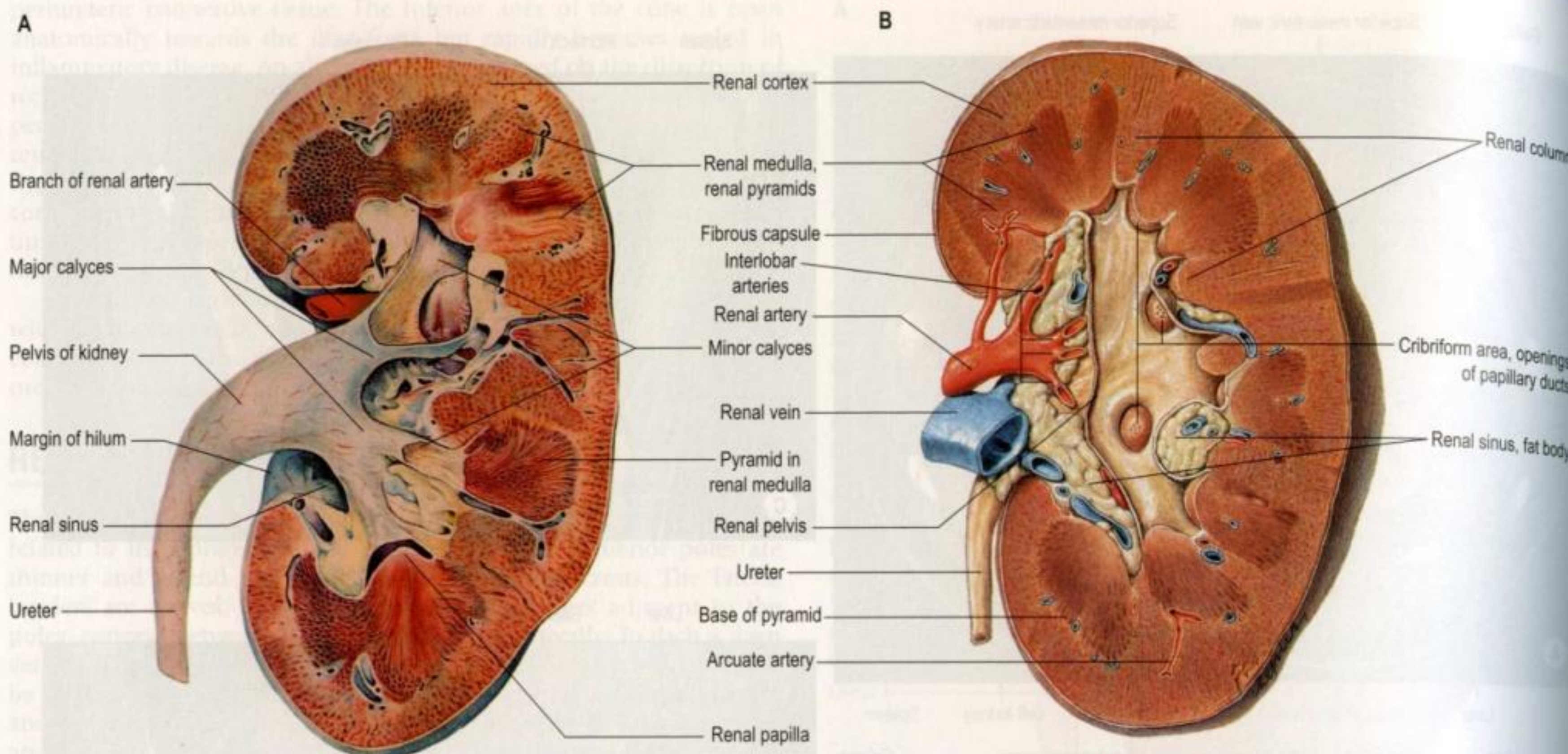
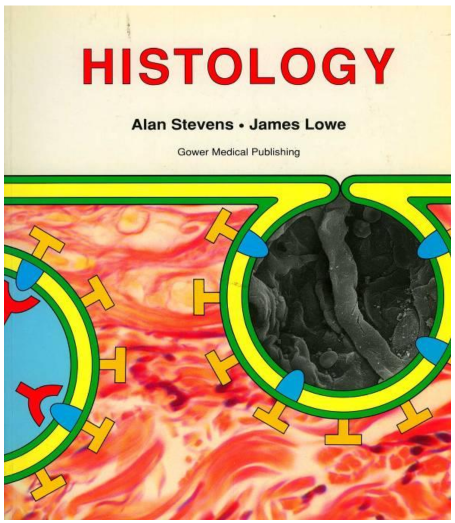


Fig. 74.8 Left kidney, oblique vertical hemisection: normal macroscopic appearance of the renal cortex and renal medulla and the major structures at the hilum of the kidney. In **A**, the fat body of the renal sinus and most of the major vessels at the hilum have been removed, and the renal pelvis has not been opened. In **B**, the renal pelvis has been opened to reveal the interlobar arteries. (**B** from Sobotta 2006.)



Stevens and Lowe
1992

Page 296

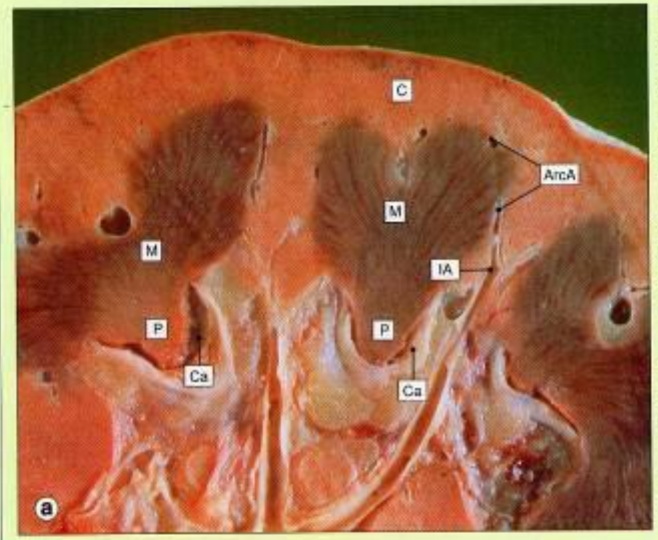


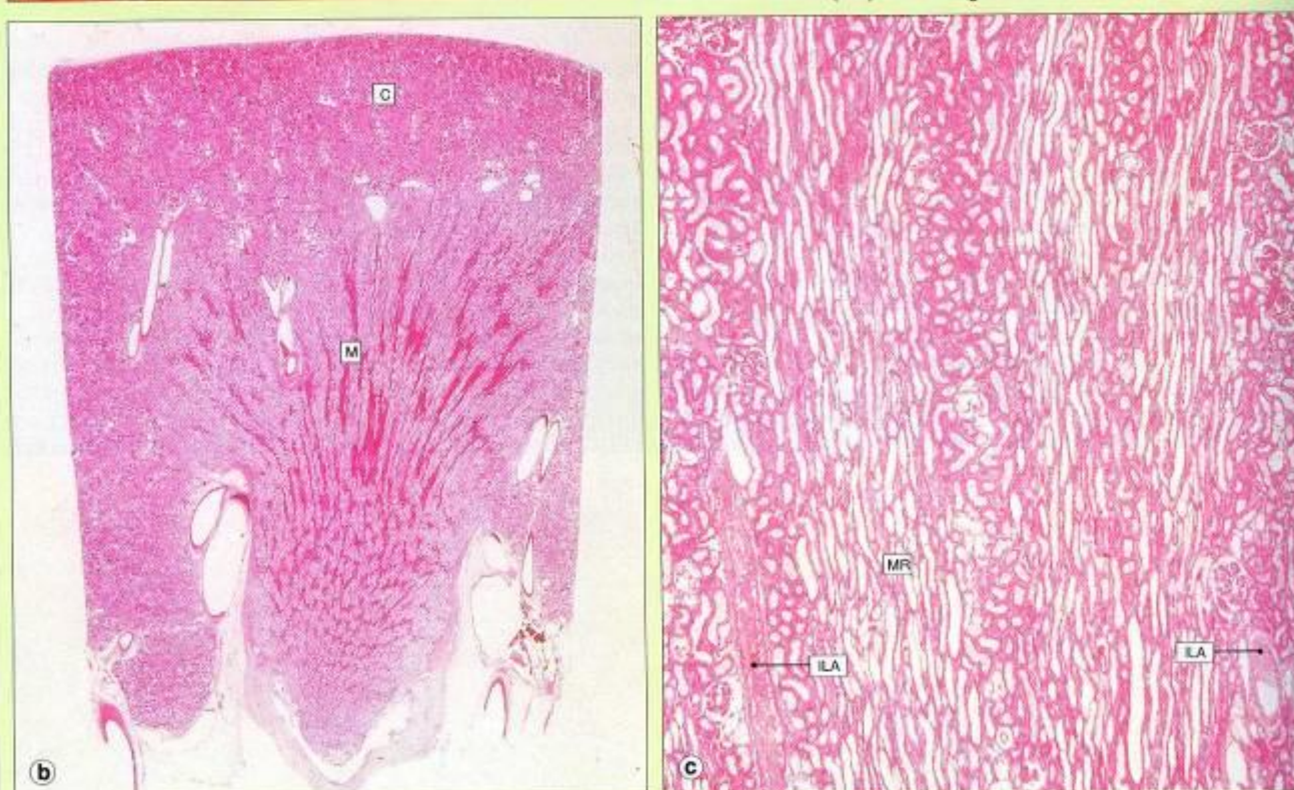
Fig. 16.30 Anatomy of adult kidney.

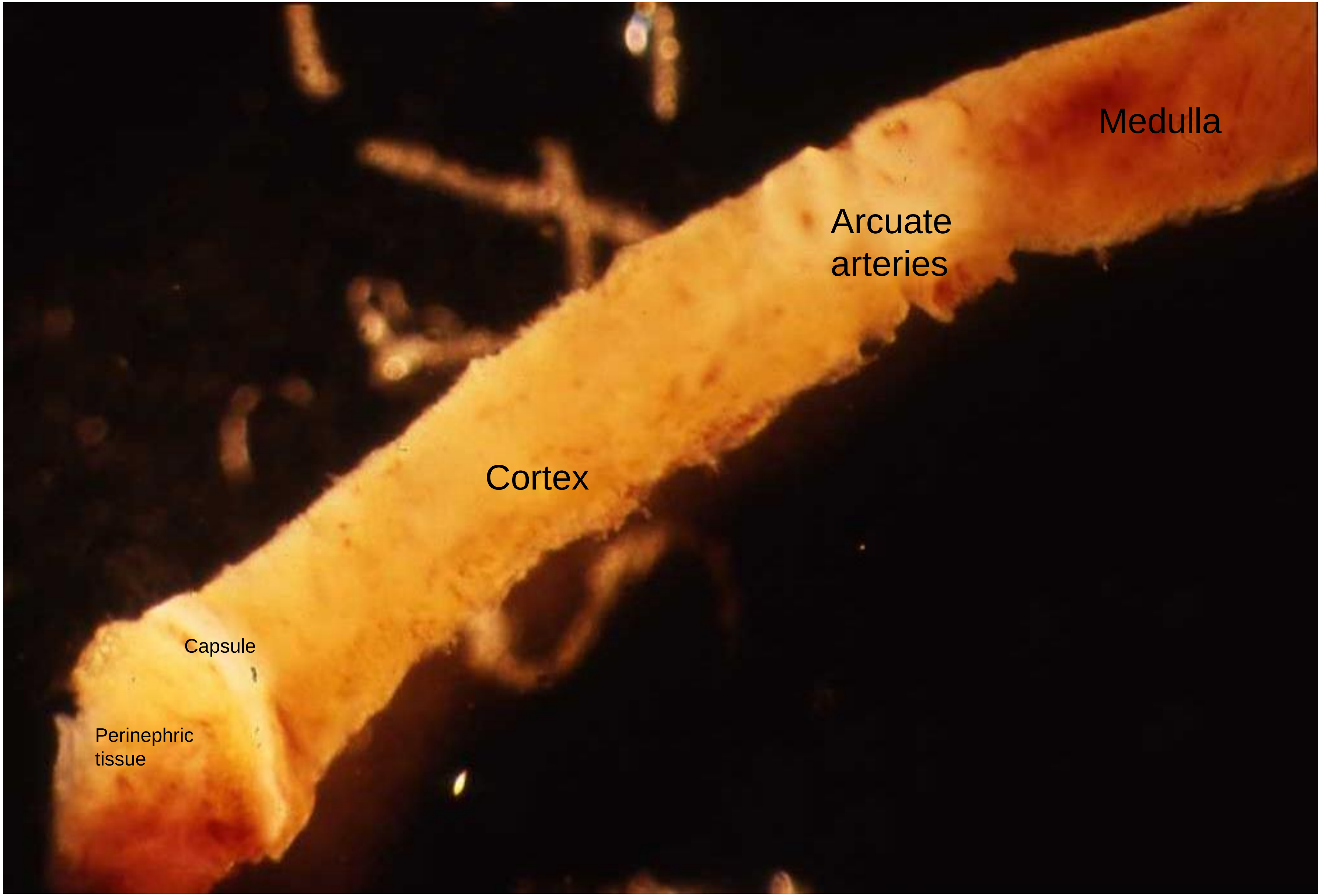
a Photograph of sectioned adult kidney, which has been fixed in formalin and the near natural colour restored in alcohol. Note the cortex (C), the medullary pyramid (M) culminating in the papillary tip (P), which protrudes into the lumen of a calyx (Ca). Interlobar arteries (IA) and arcuate arteries (ArcA) can also be seen. Little detail of cortical structure is visible with the naked eye, but the vertical linearity of the components of the medulla is highlighted by clusters of prominent blood vessels (vasa recta).

b In this H&E stained paraffin section prepared from the tissue block shown in **a**; the distinction between cortex (C) and medulla (M) can be easily seen. This section also shows the vertical linearity of the components of the medulla, both tubules and vessels.

At this low magnification, glomeruli can be seen as small dots in the cortex. Note that some areas of the cortex are free of glomeruli, but contain vertically running duct systems; these areas are known as medullary rays and represent the sites where cortical tubules drain into the collecting ducts.

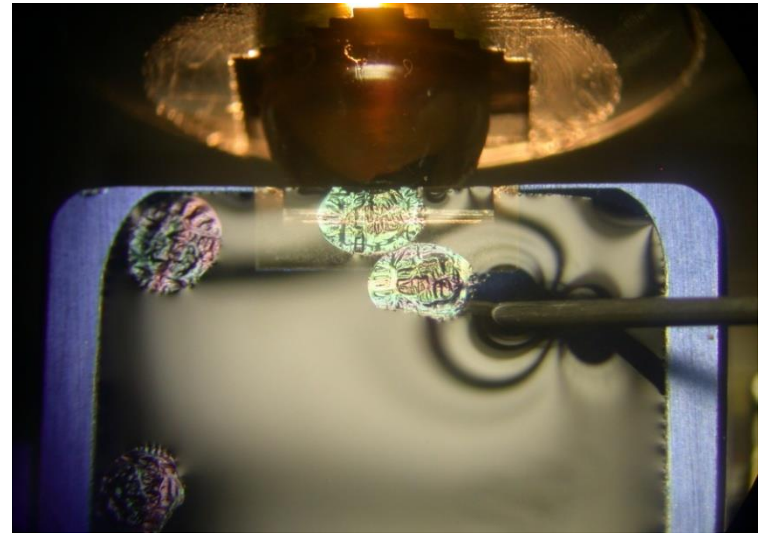
c In this micrograph of cortex at a higher magnification than in **b** it can be seen that the medullary ray (MR) area is devoid of glomeruli and that the interlobular arteries (ILA) run in the glomeruli-rich area.



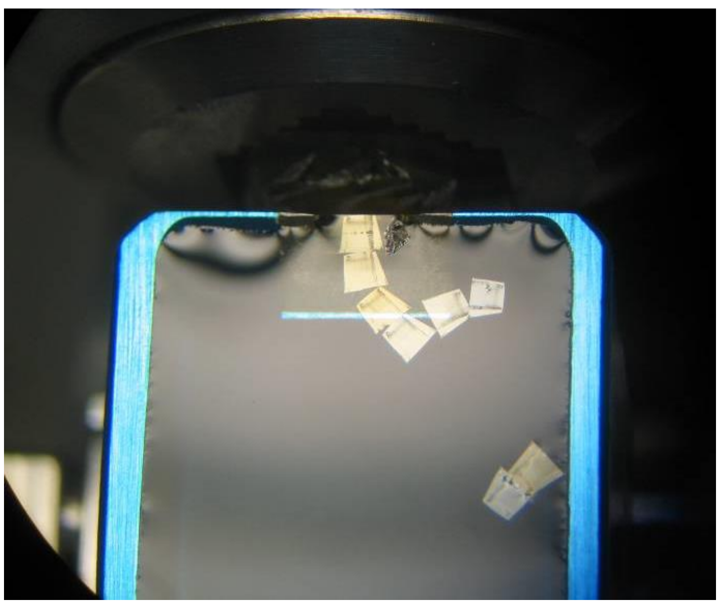


View of renal biopsy core as seen using stereo microscope

Resin blocks and their moulds



Picking up semi-thin sections

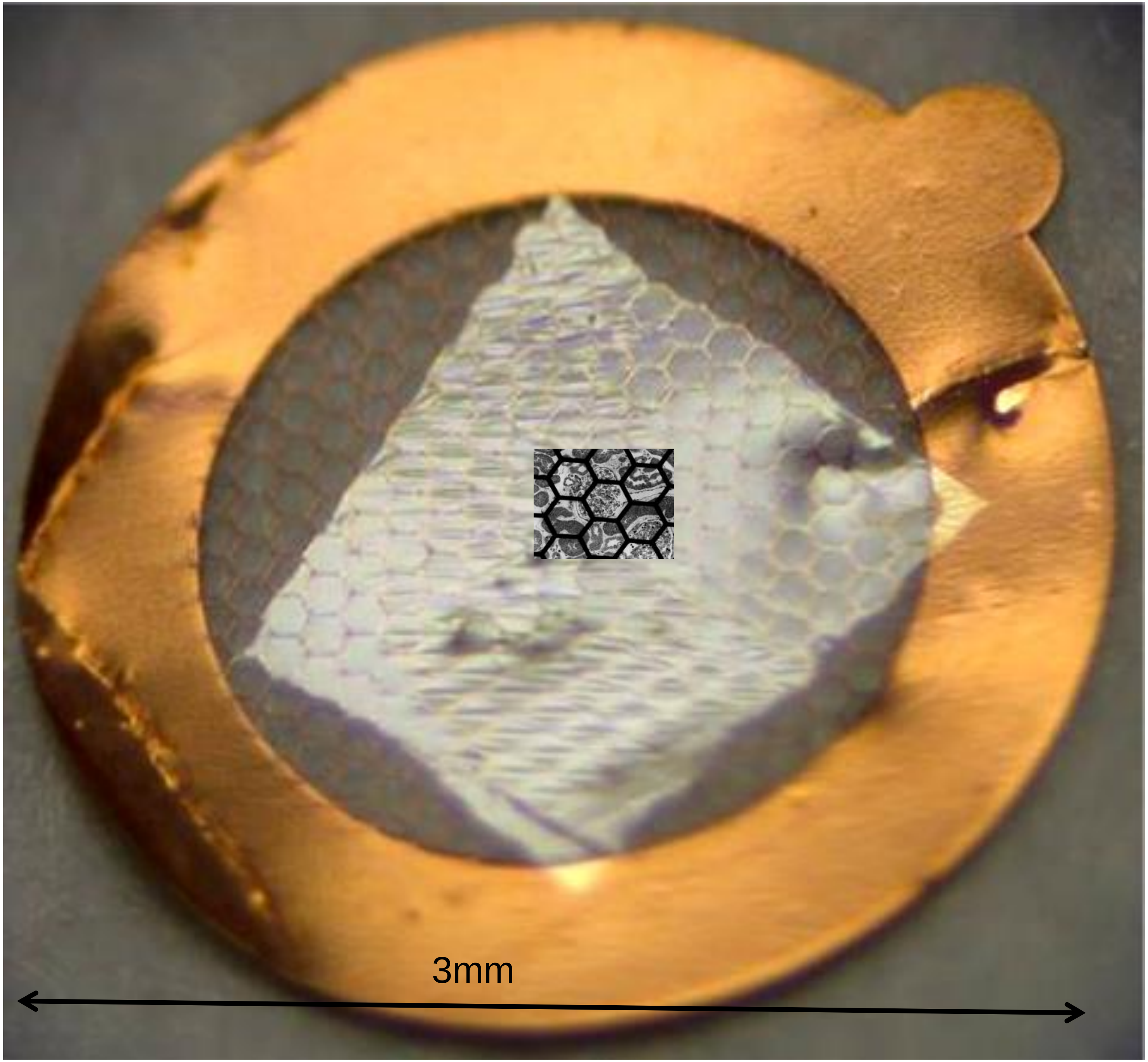


Cutting thin sections

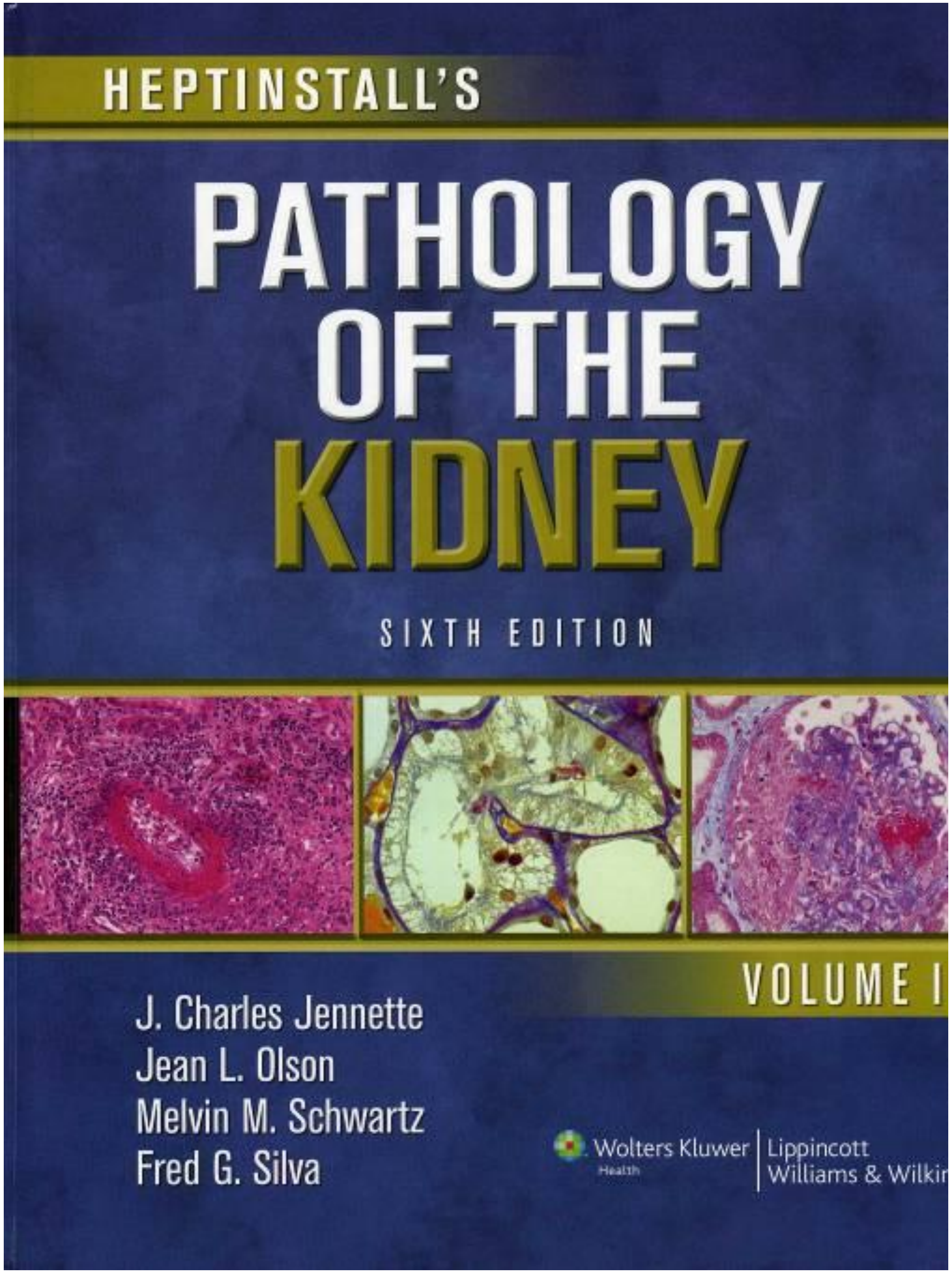
Picking up thin sections onto copper grids

Thin section on 200 mesh hexagonal high transmission copper grid

Section should have as many glomeruli as possible

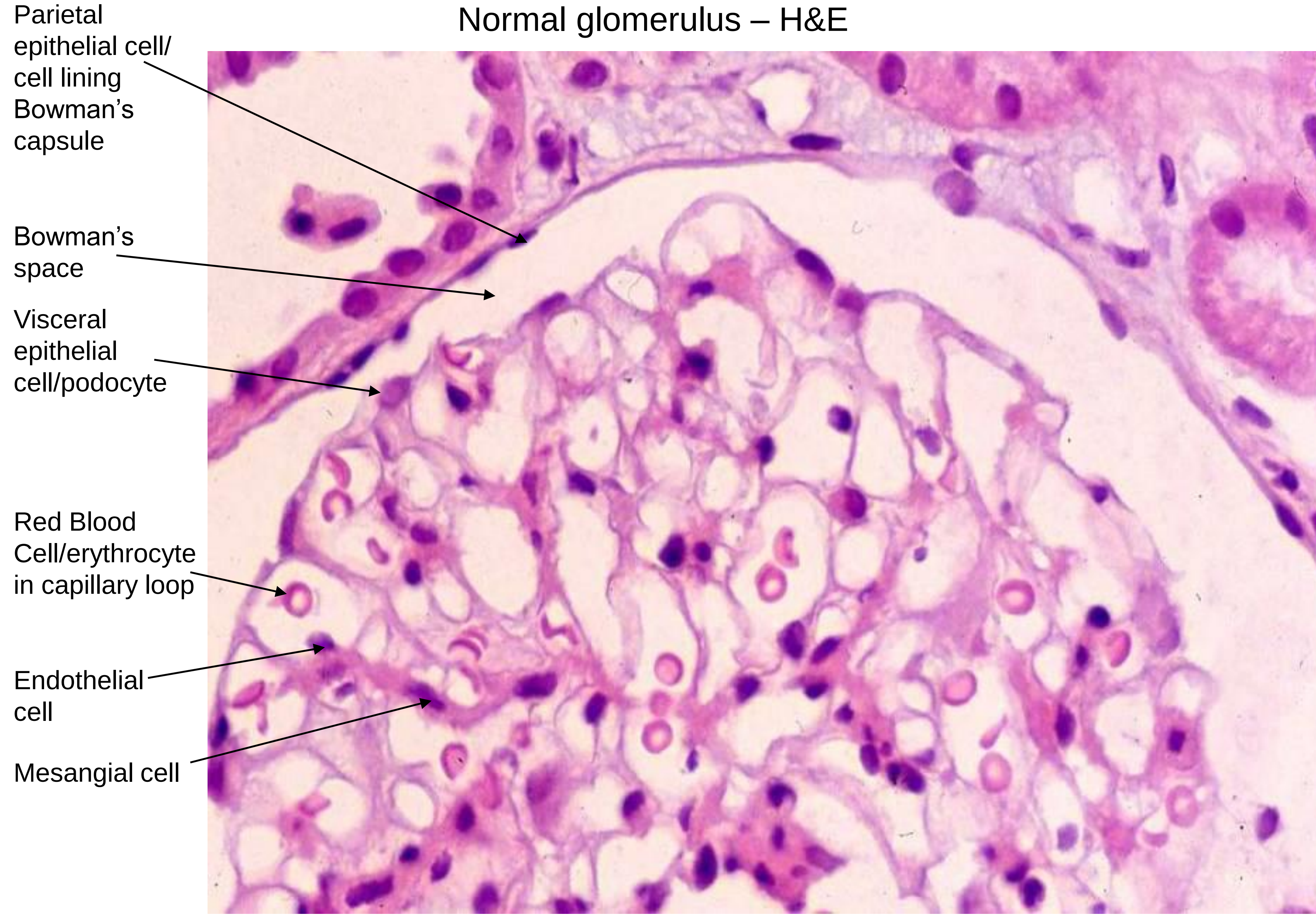


First chapter
on renal
anatomy and
histology

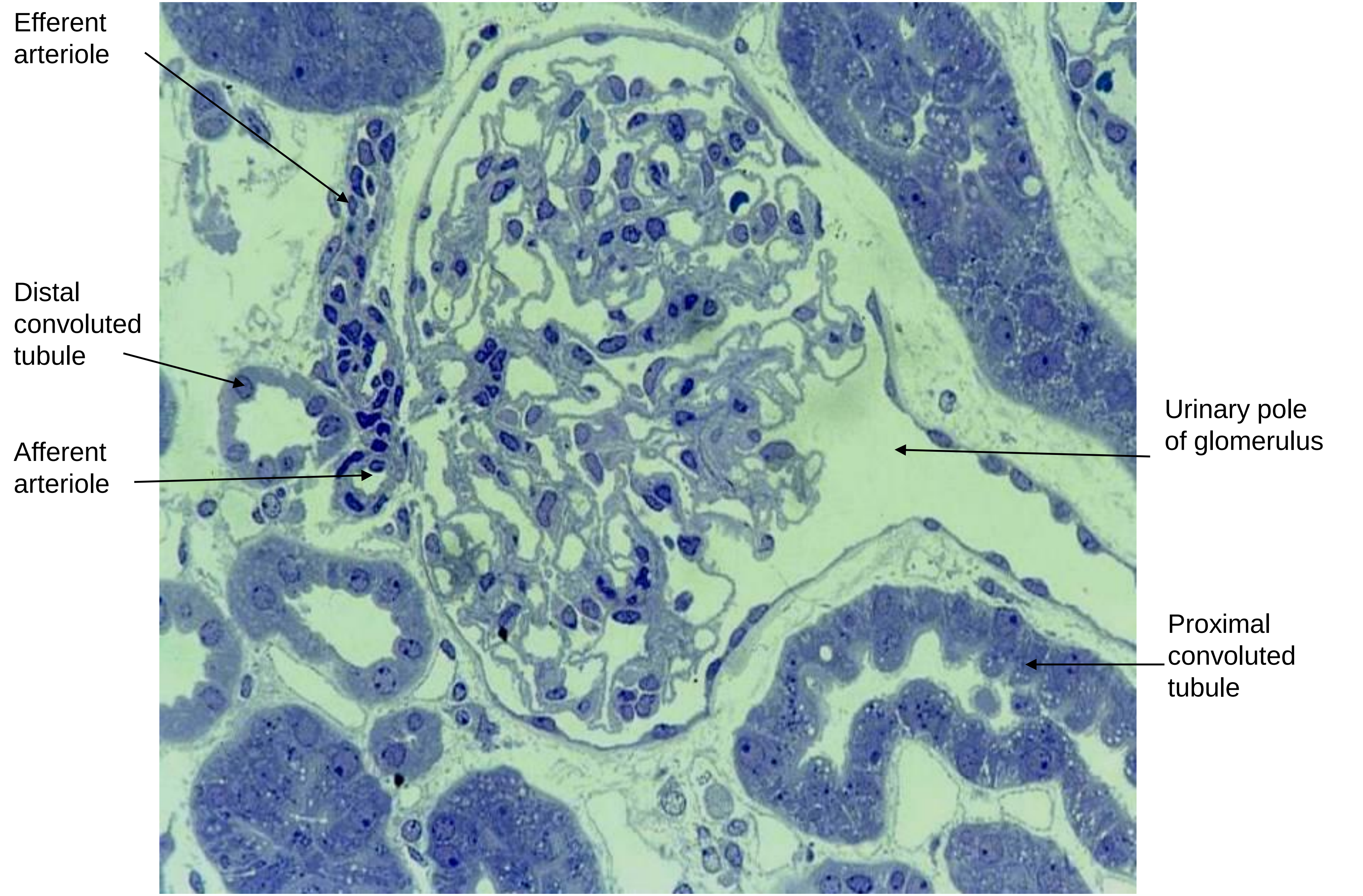


2007

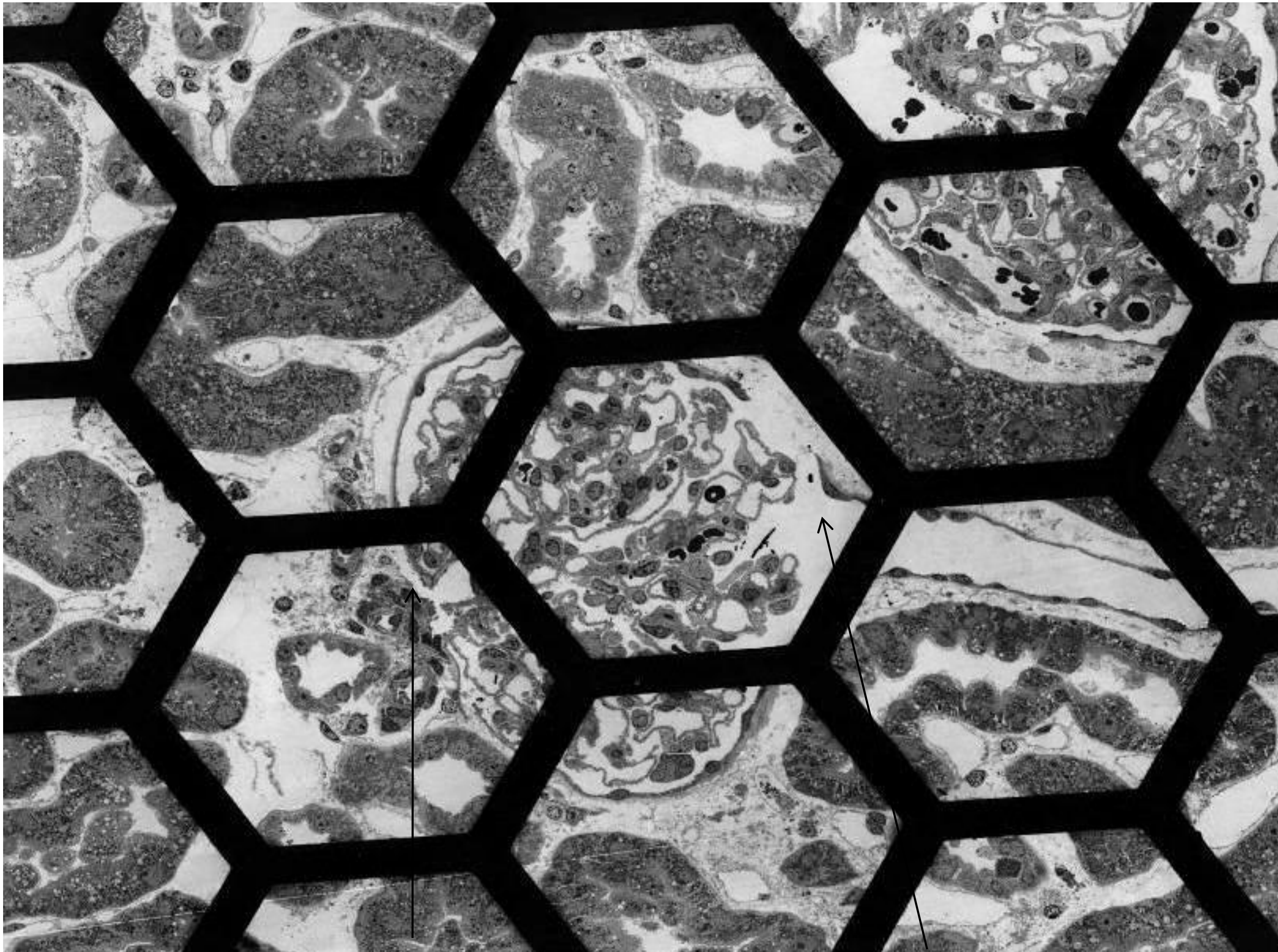
Normal glomerulus – H&E



Normal glomerulus – Toluidine Blue stained plastic section



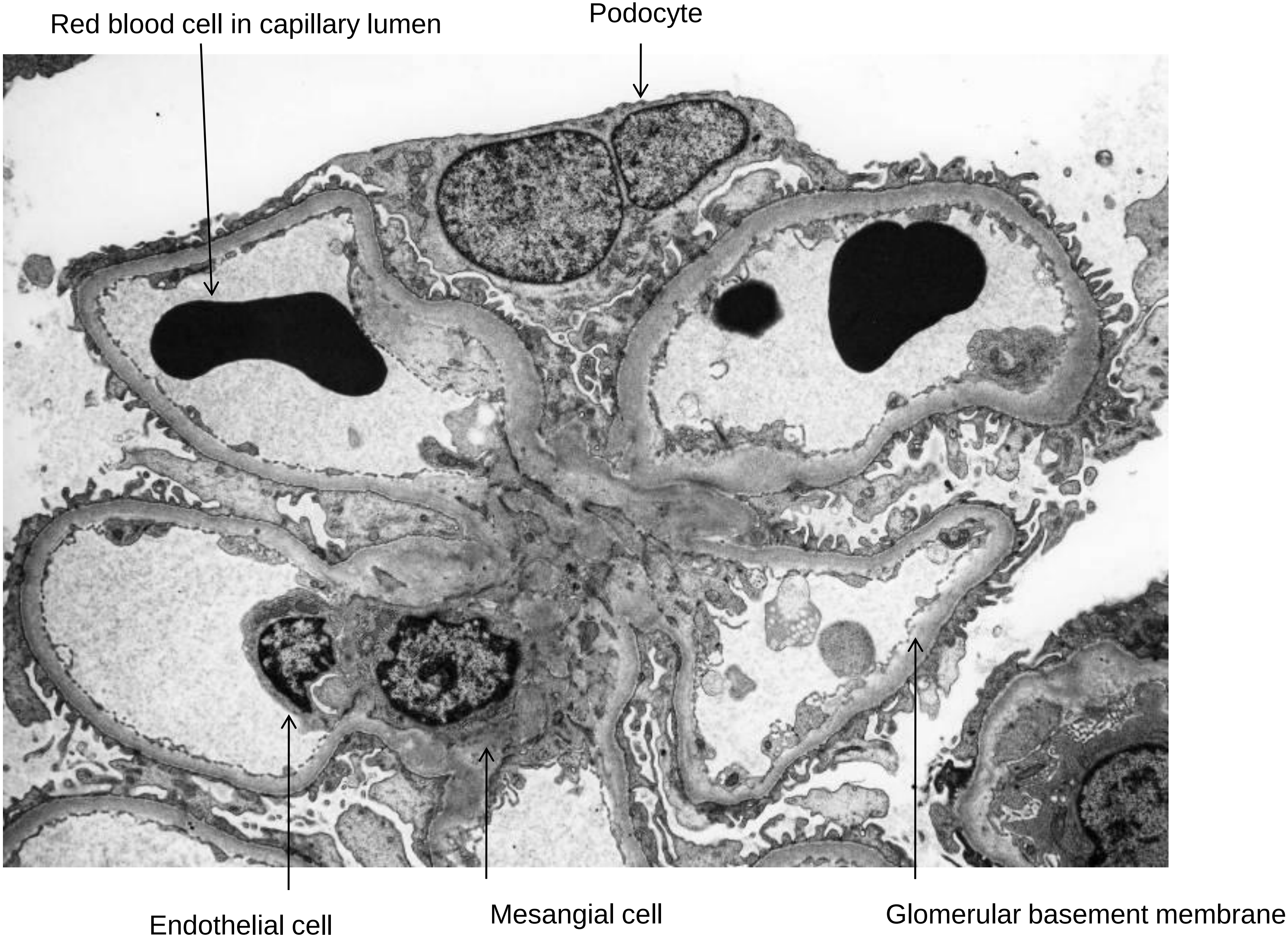
Thin-section electron micrograph of same block as previous slide

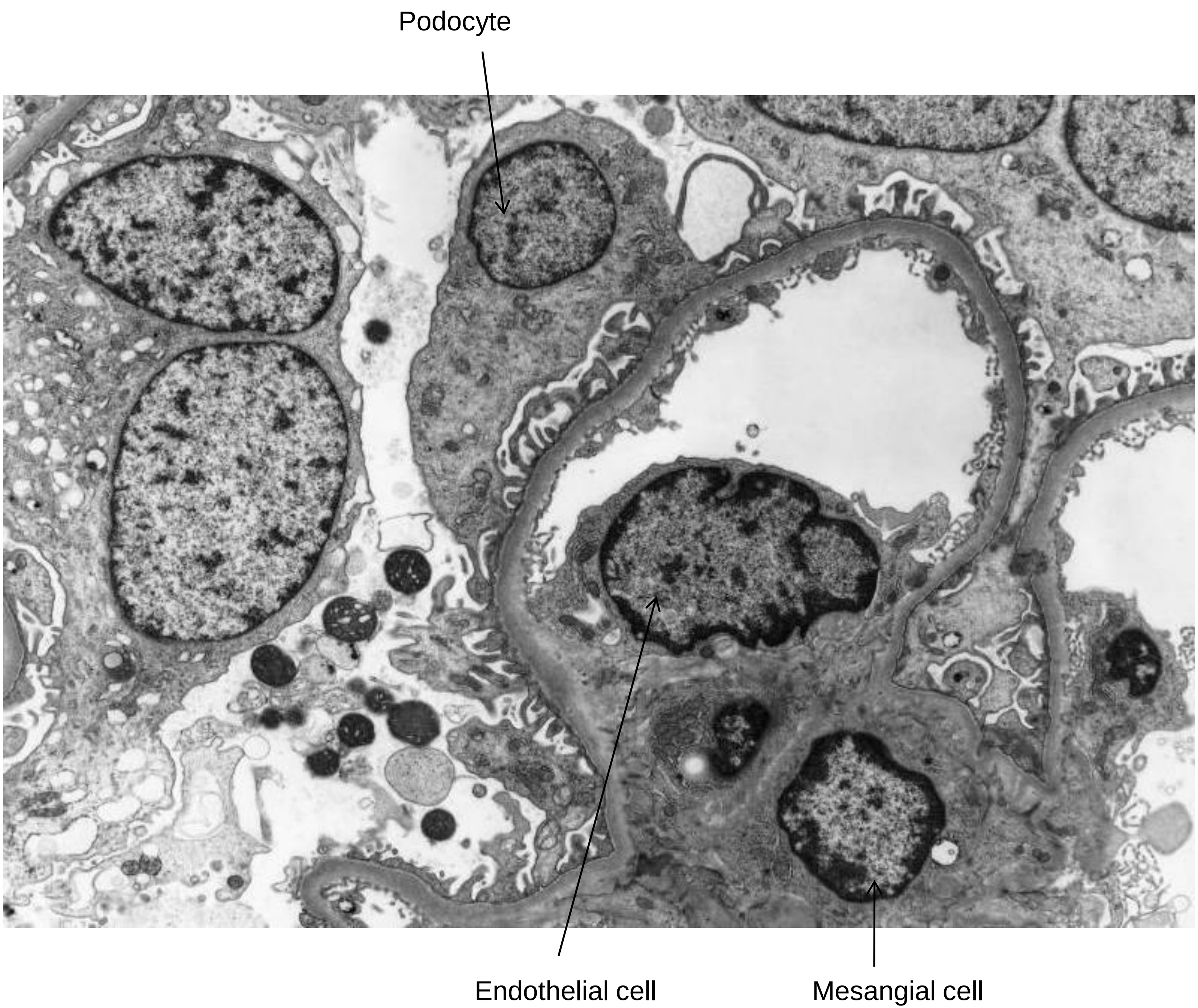


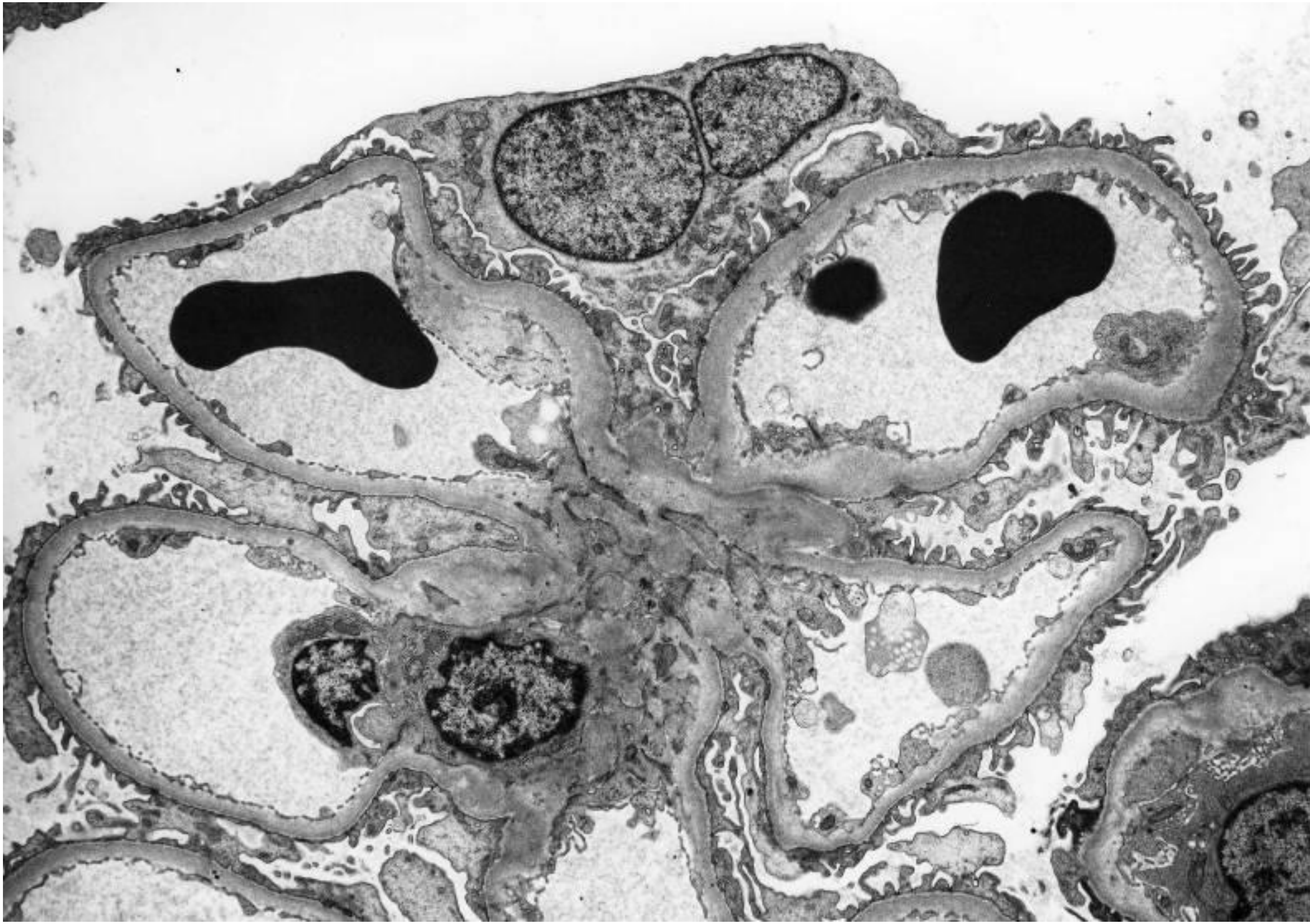
Vascular pole of glomerulus

Urinary pole of glomerulus

Mesangial cell surrounded by 5 capillary loops




Podocyte
Endothelial cell
Mesangial cell



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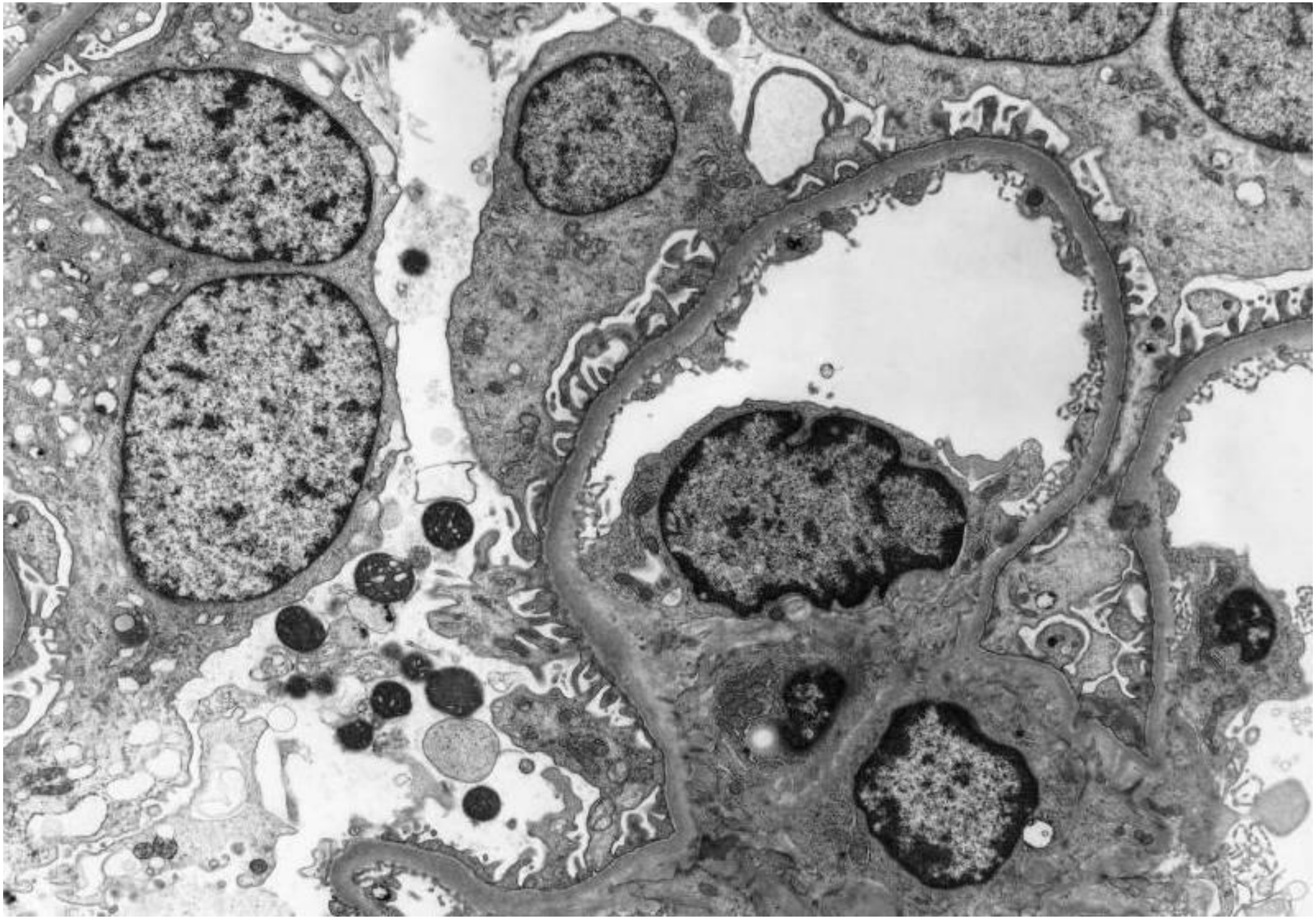

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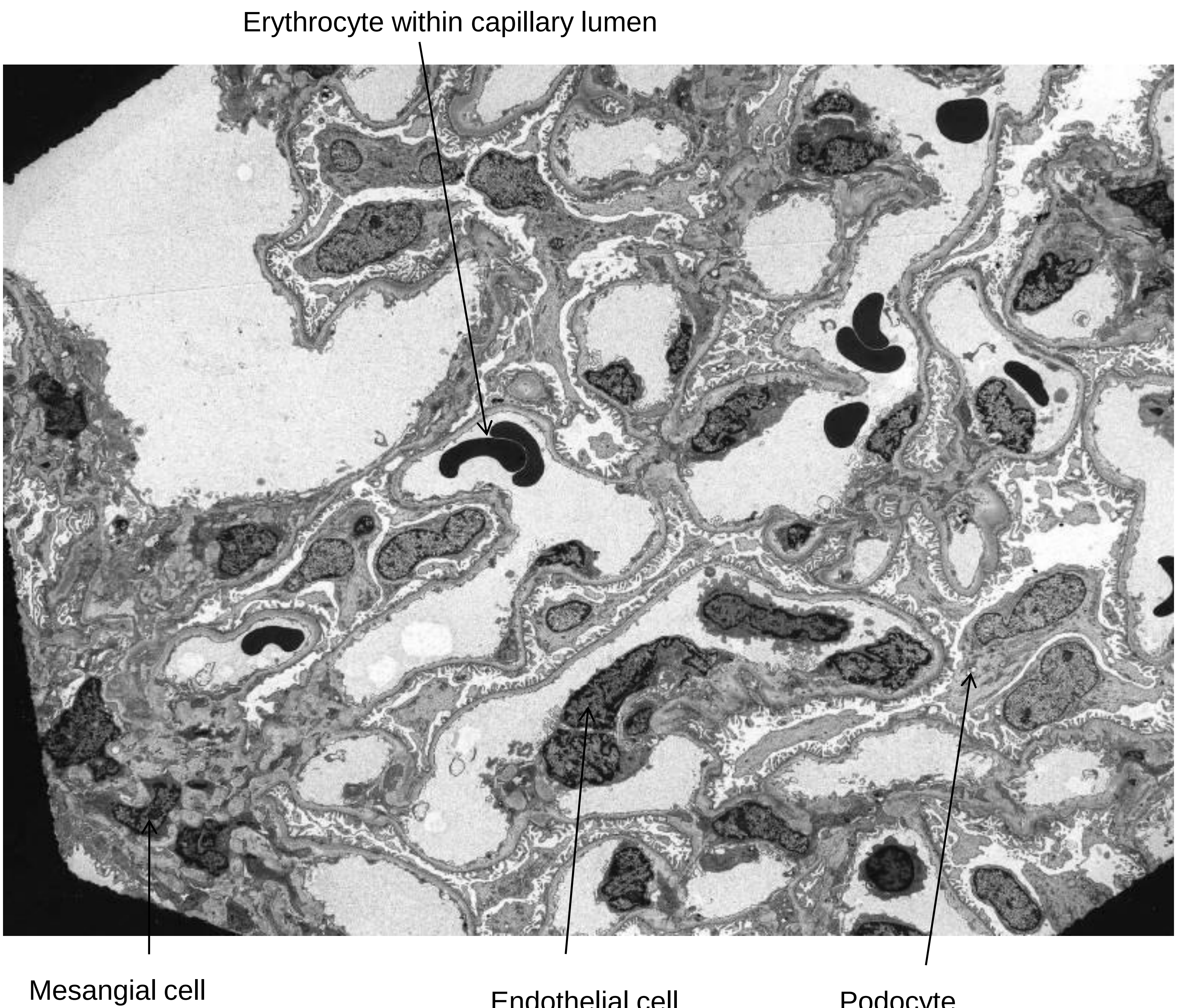
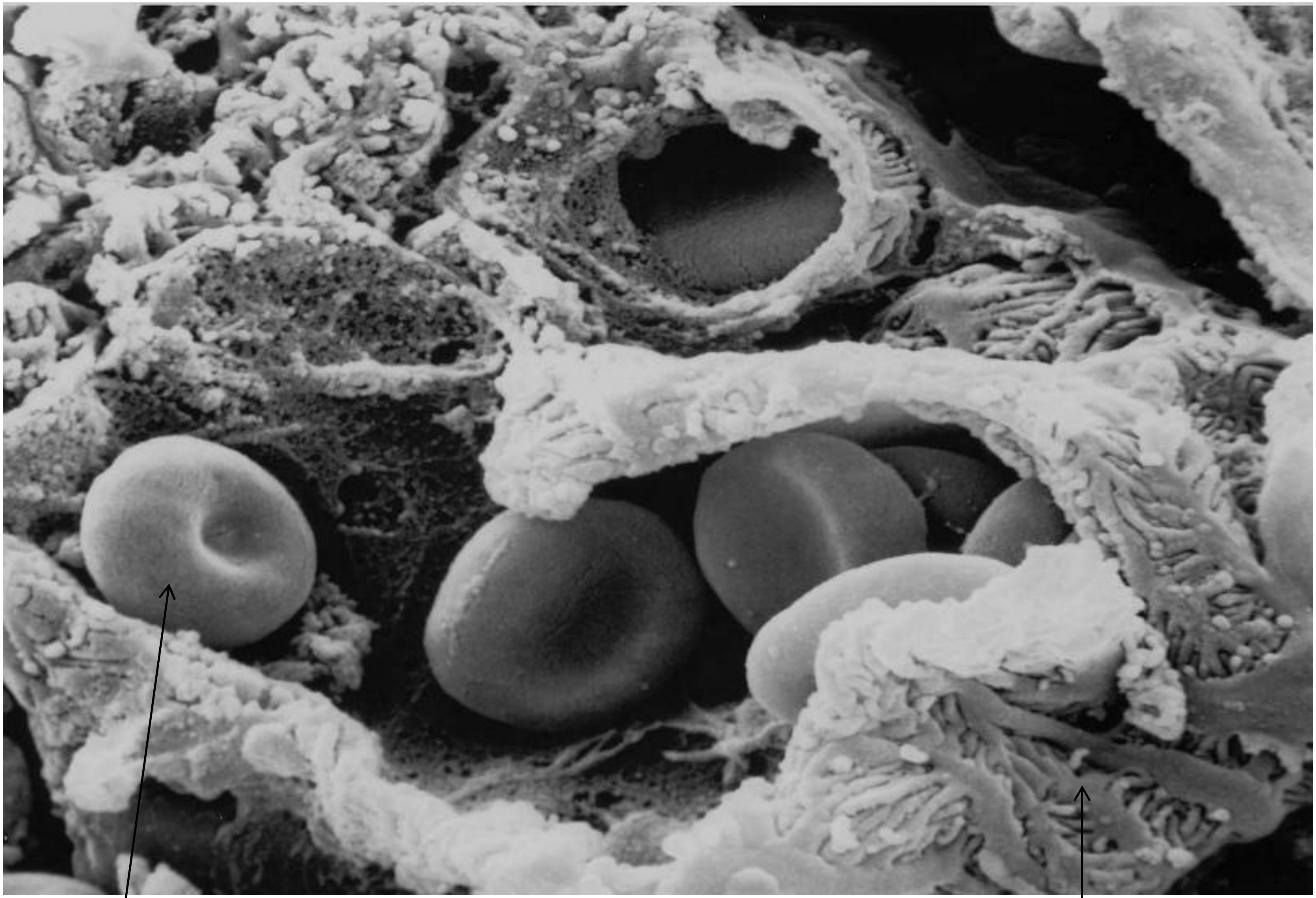

Erythrocyte within capillary lumen
Mesangial cell
Endothelial cell
Podocyte

Scanning electron microscopy of exterior of whole rat glomerulus

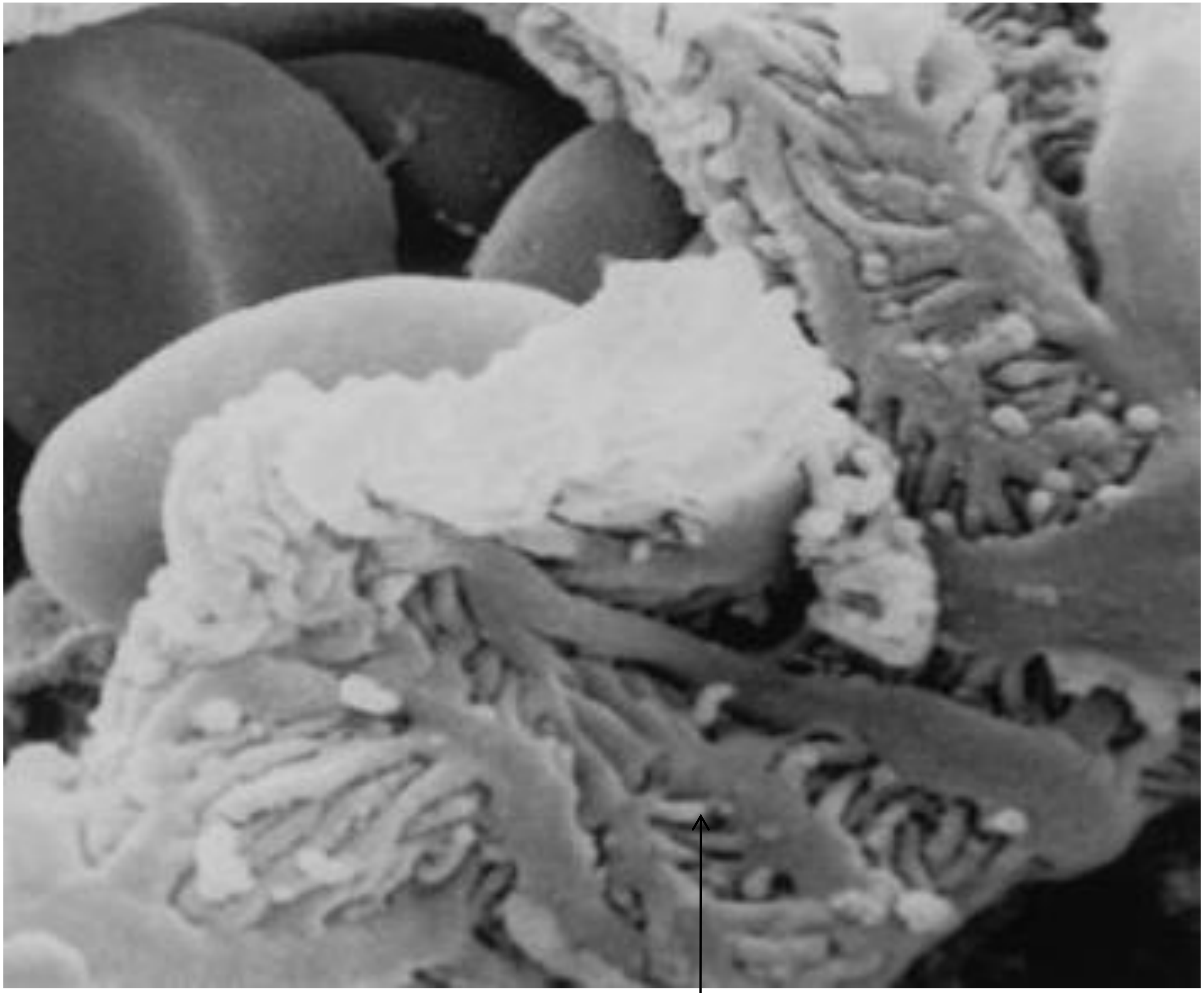
Scanning electron microscopy of rat glomerulus cut in half



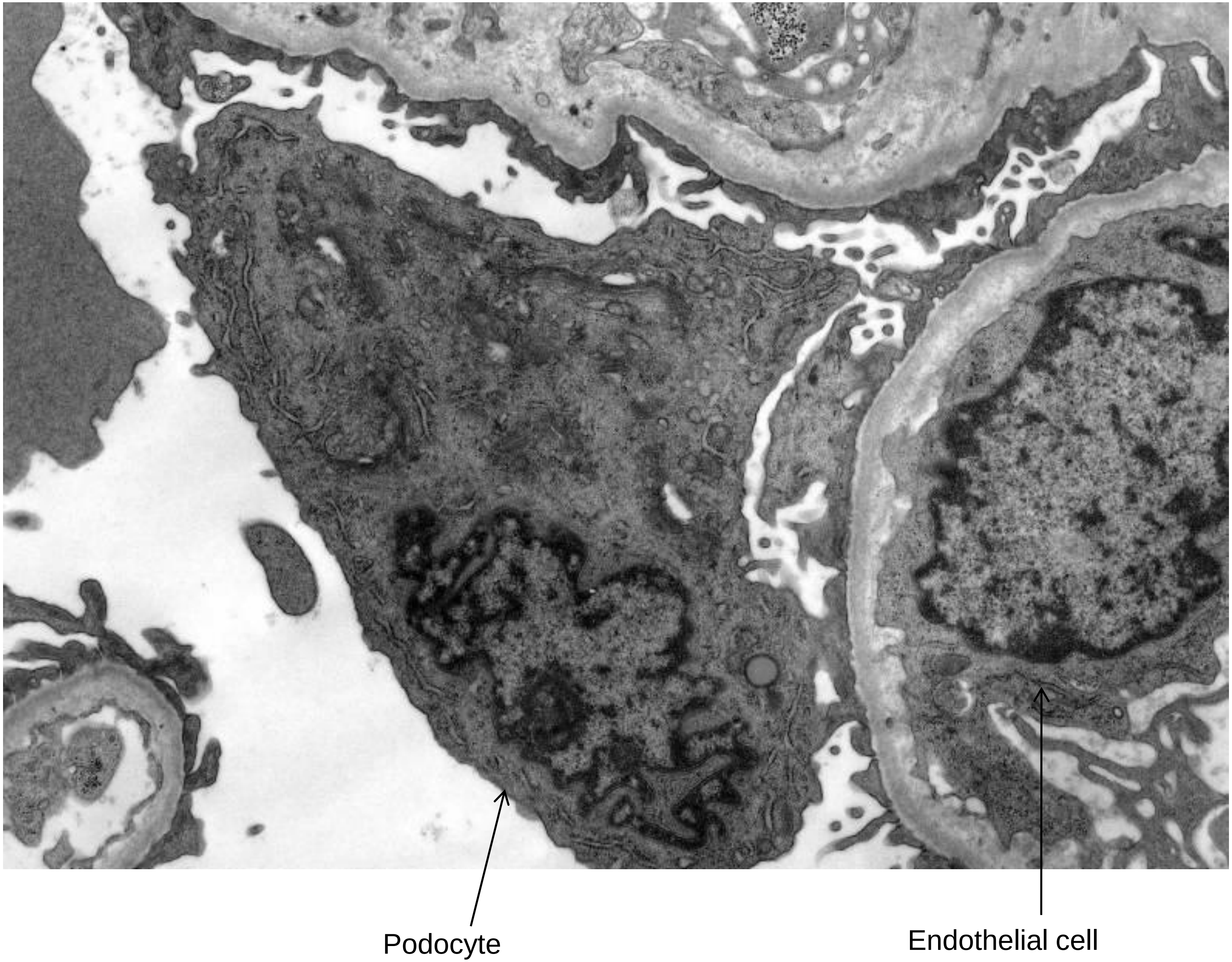
Erythrocyte

Podocyte

Higher magnification of previous slide

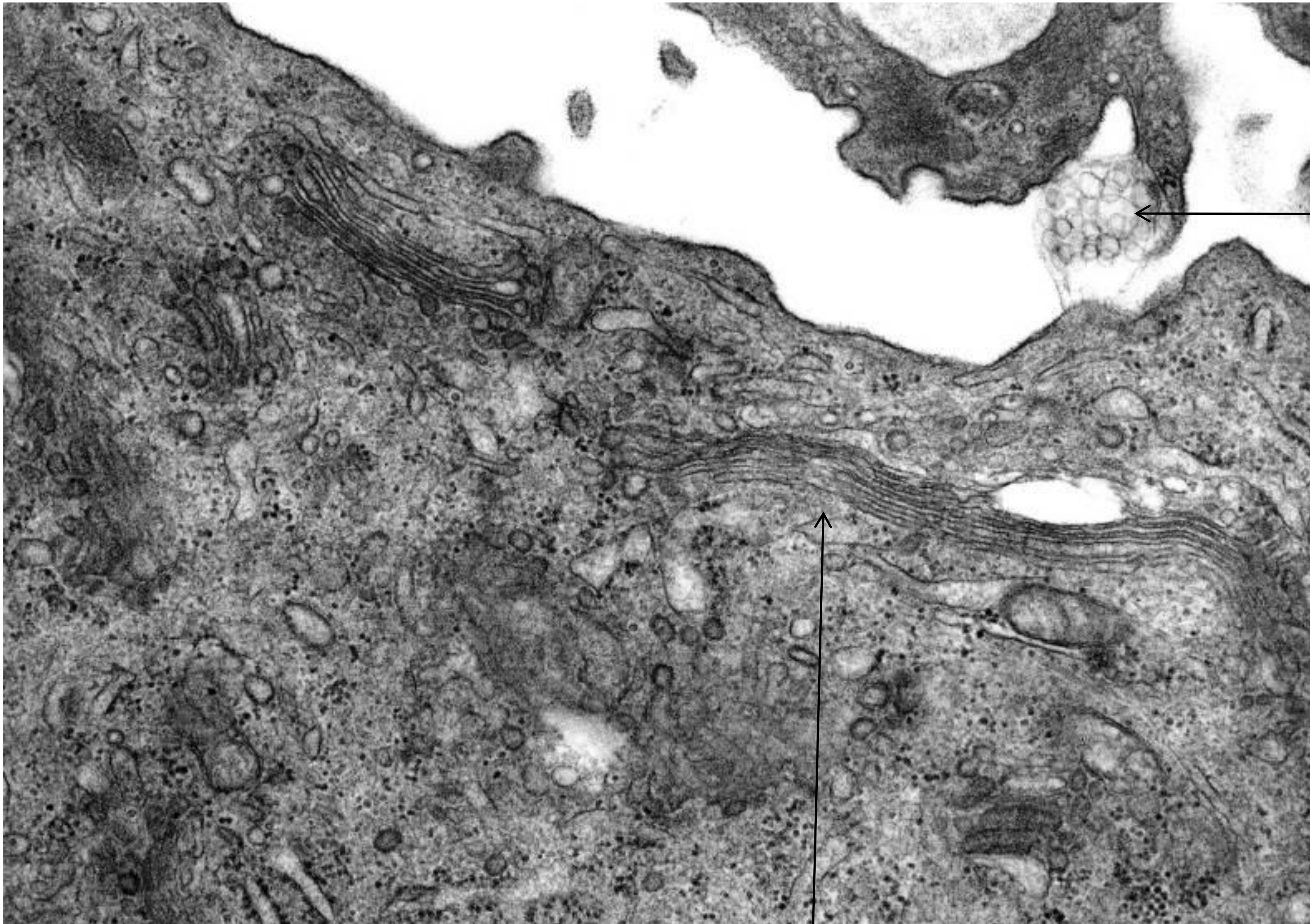


Interdigitating foot processes



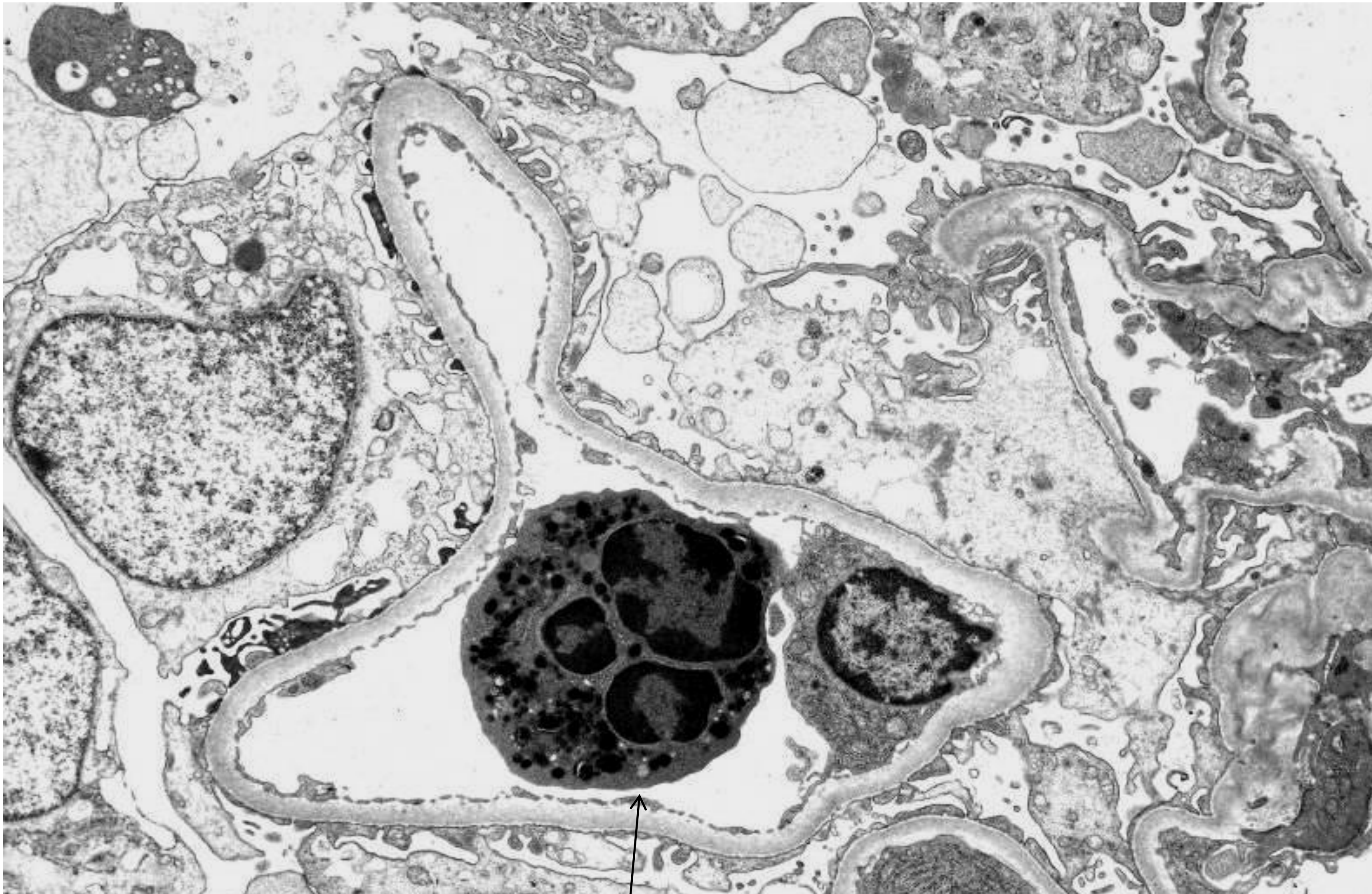
Podocyte
Endothelial cell

Higher magnification of previous image



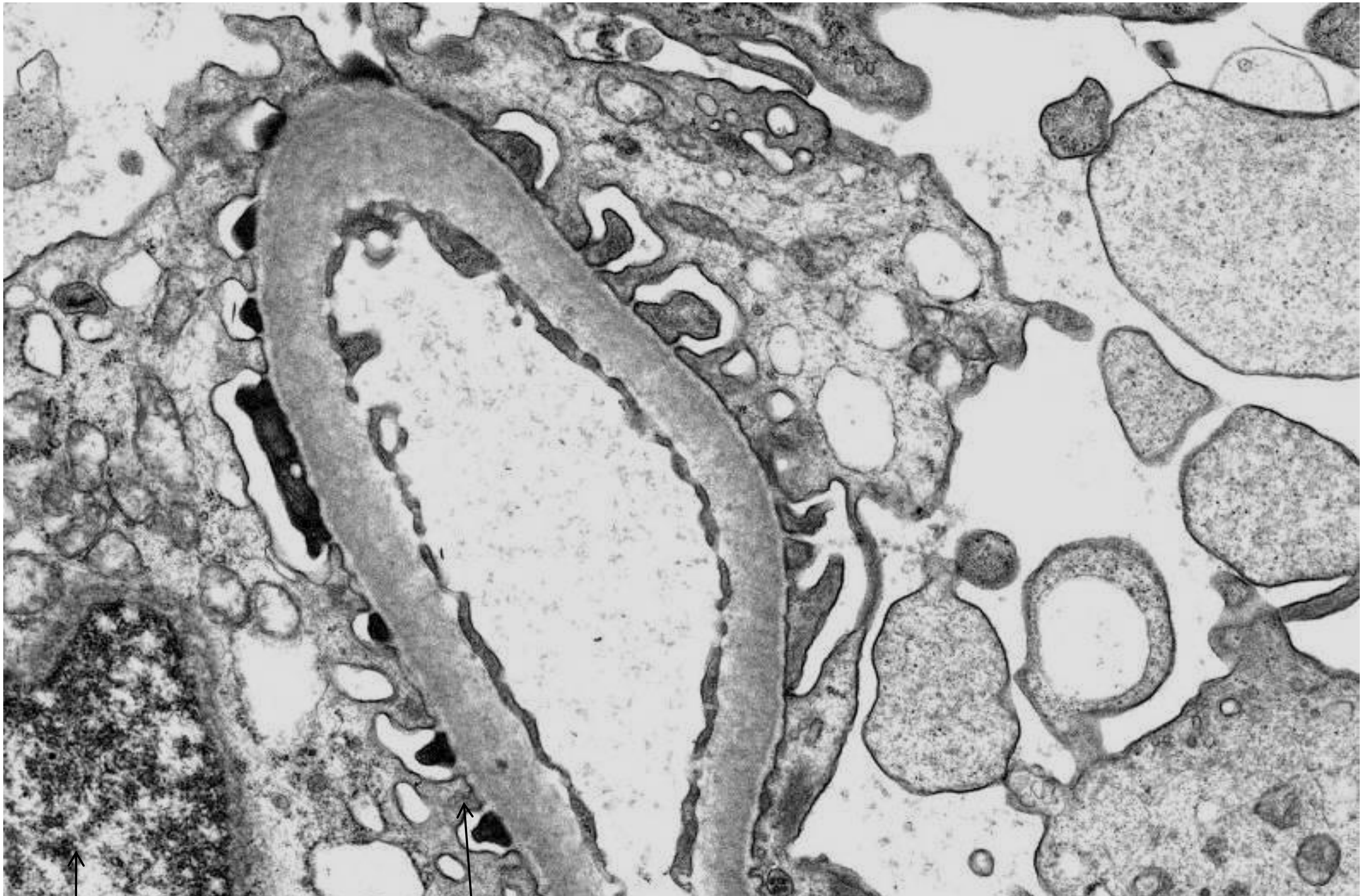
Podocyte cytoplasm

Podocyte – light cell dark cell artefact caused by hypoxia



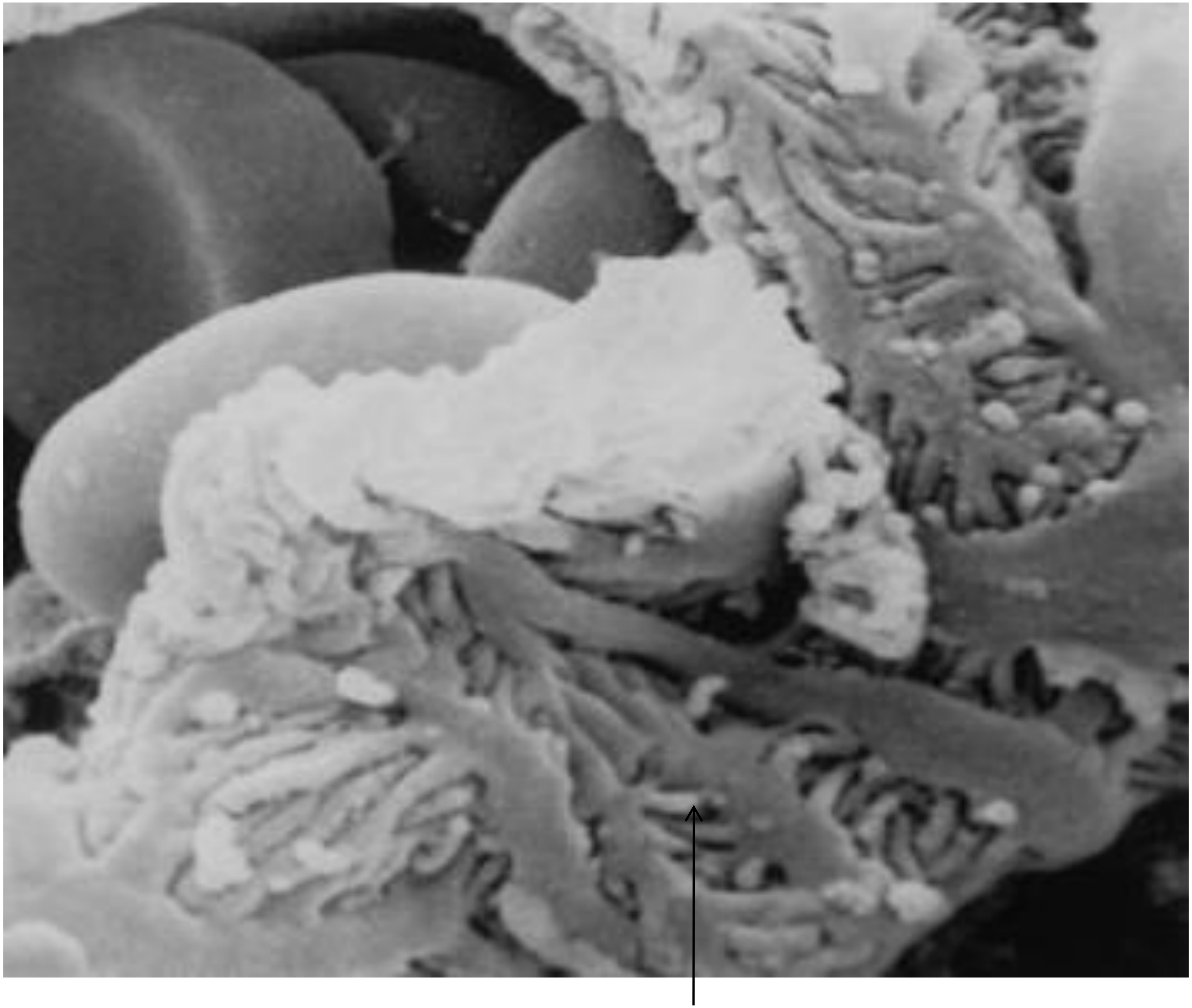
Neutrophil polymorphonuclear leukocyte

Higher magnification of previous image

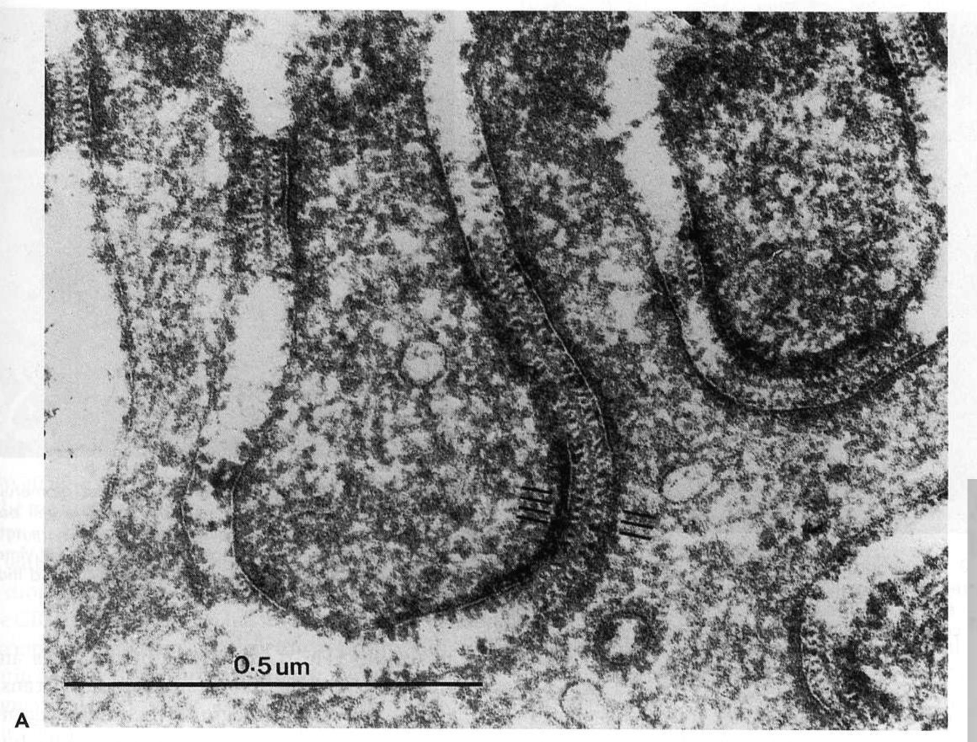


Podocyte

Interdigitation of foot processes

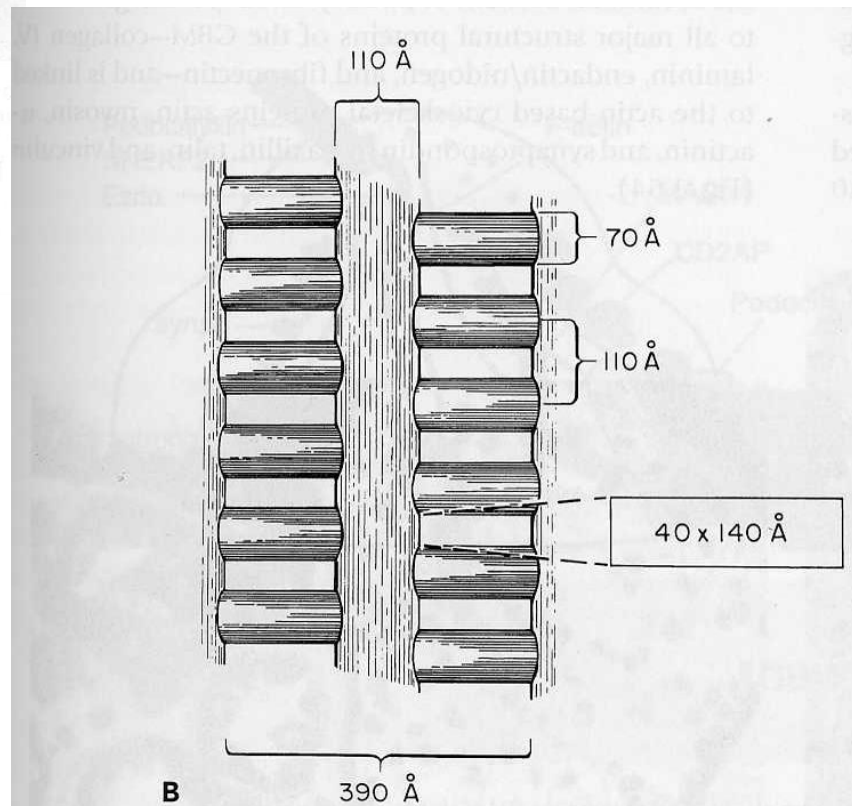

Interdigitating foot processes

Chapter 1: Renal Anatomy and Histology

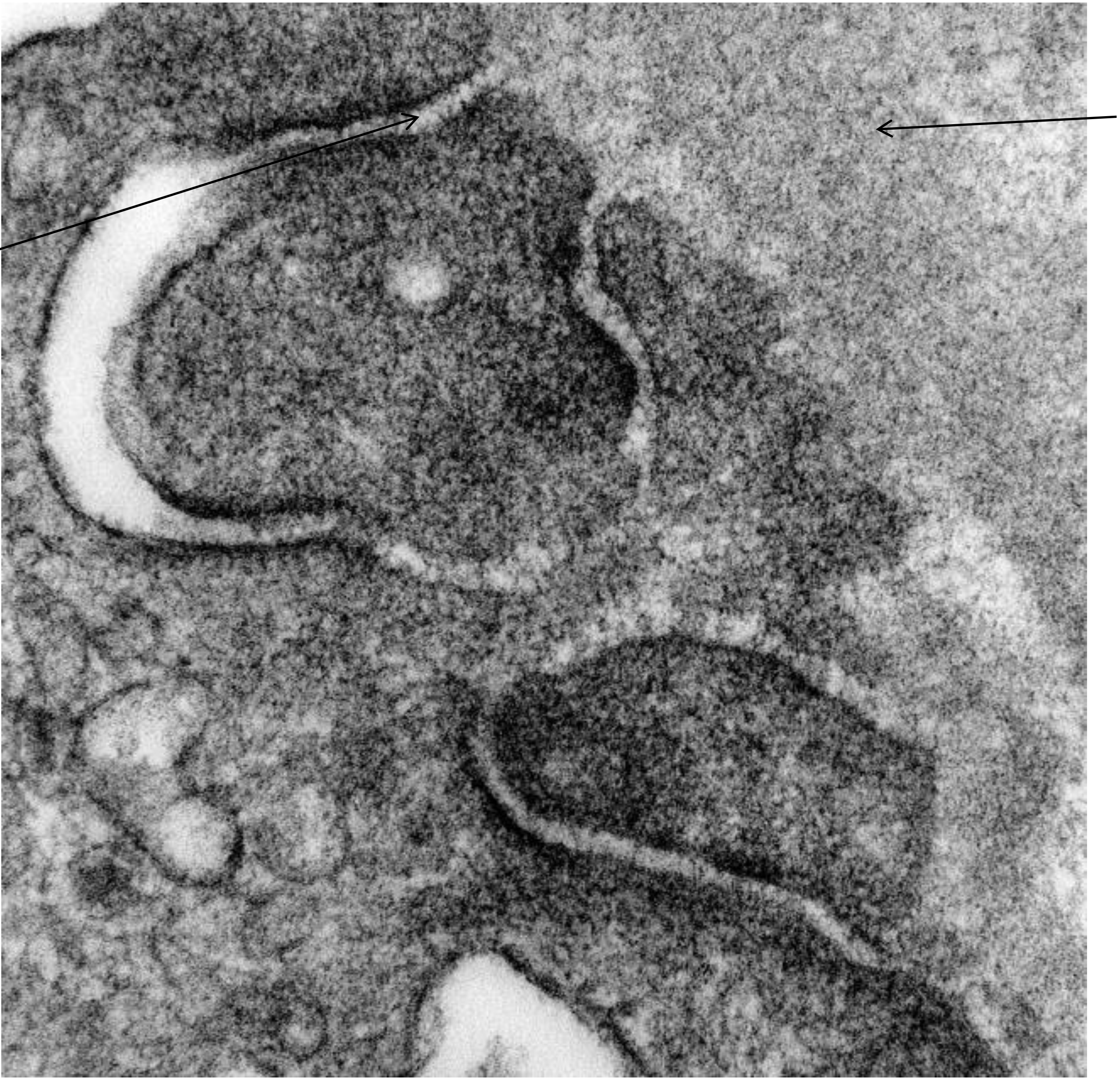


Slit diaphragm viewed *en face*
Rat glomerulus

Ladder shaped diaphragm with central band



Heptinstall's Pathology of the kidney 6th edition page 29



Note: no central band

Glomerular capillary wall

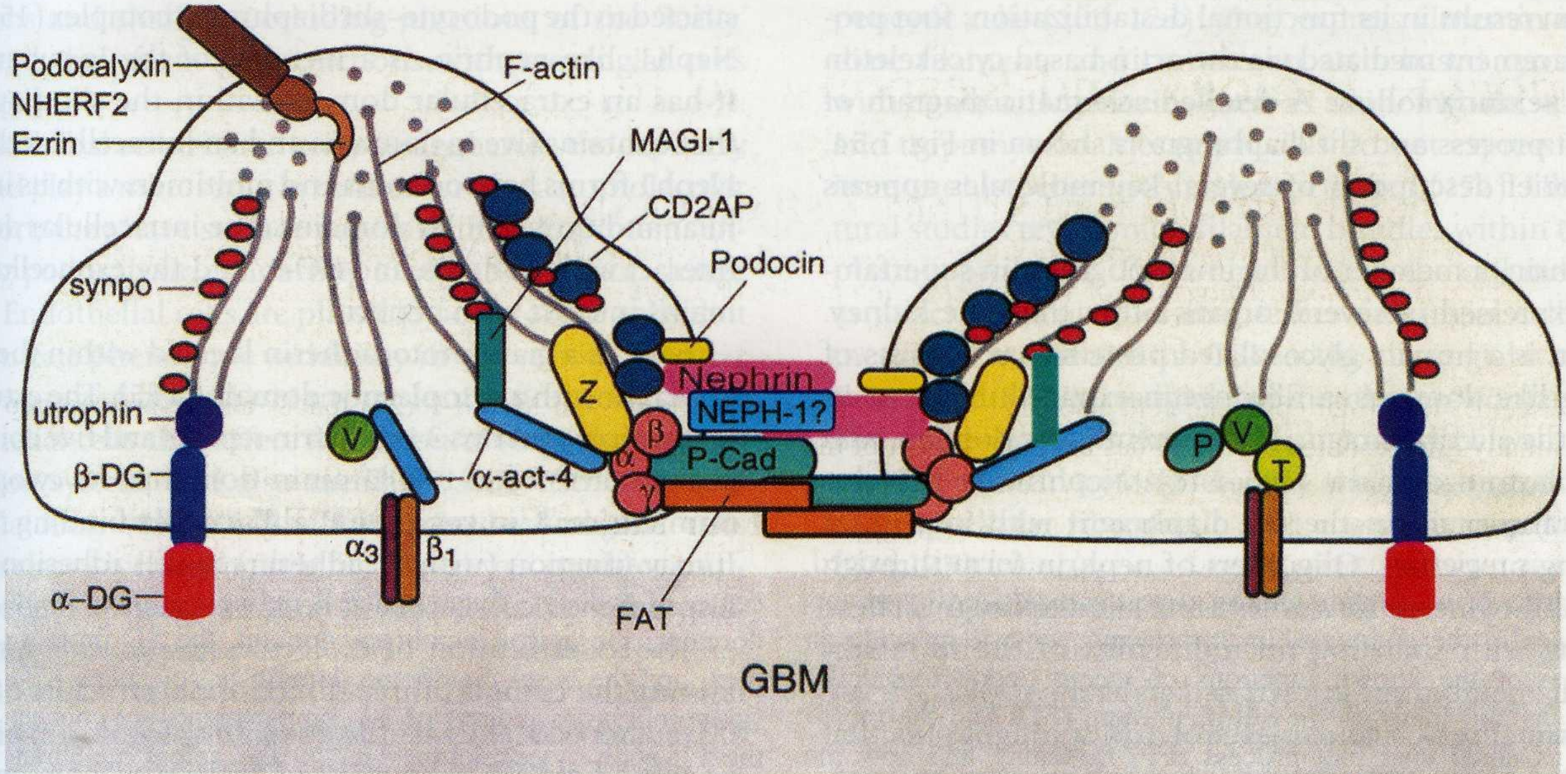
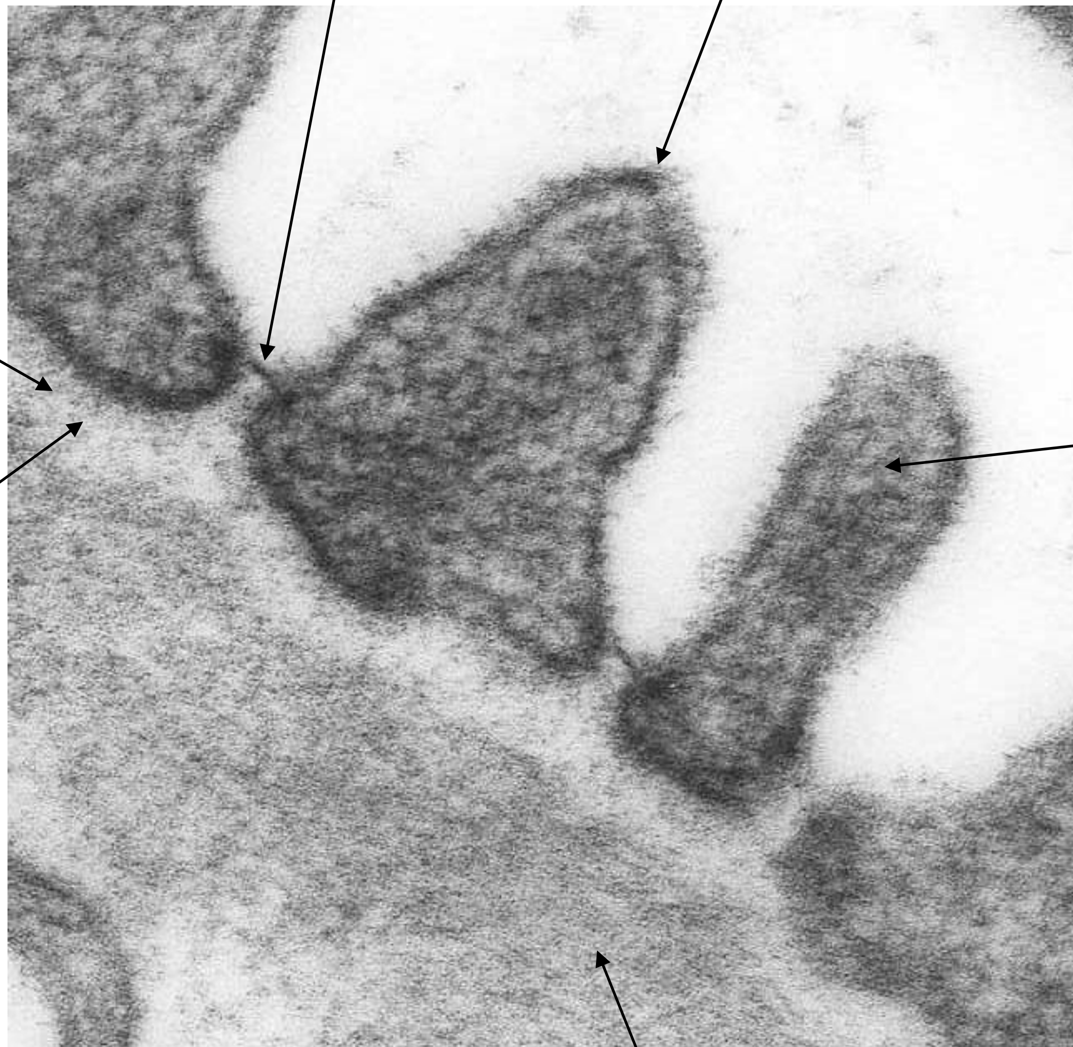
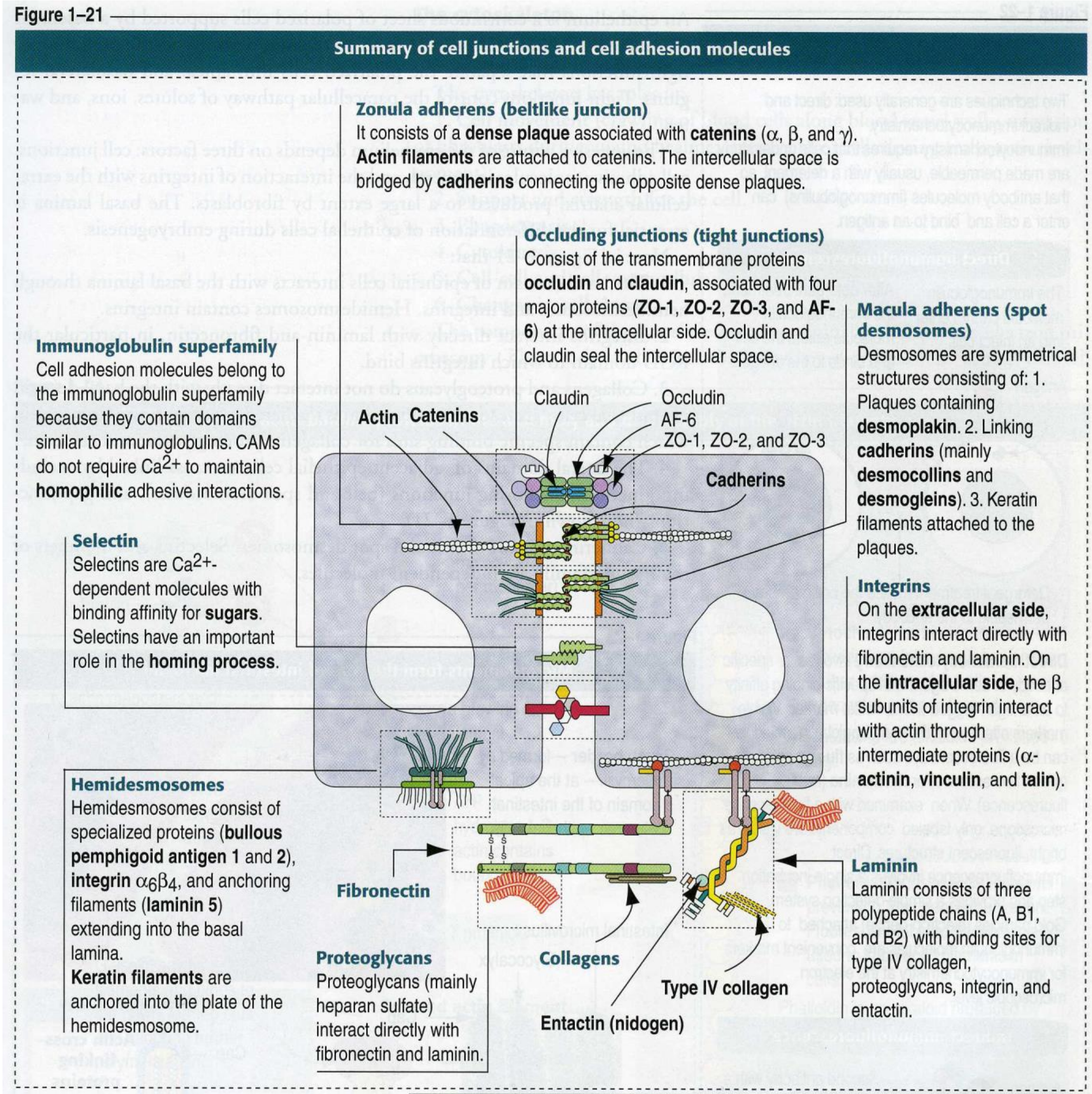


Figure 1.54 Molecular anatomy of the podocyte foot process (FP) and actin cytoskeleton. This schematic shows two adjacent podocyte FPs with the interposed slit diaphragm (SD) complex. The localization of NEPH-1 at the SD and its heterophilic interaction with nephrin remain to be established. The actin cytoskeleton is the common downstream pathway and receives input from three podocyte domains: the apical domain, the lateral SD-containing domain, and the basal domain of the FP sole plate, which links the podocyte to the GBM. Interference with any of the three domains will ultimately cause FP effacement and proteinuria/nephrotic syndrome. α-act-4, α-actinin-4; α3β1, α3β1 integrin; α-DG, α-dystroglycan, β-DG, β-dystroglycan; NHERF2, Na^{+}/H^{+} exchanger regulatory factor 2; P, paxillin; P-cad, P-cadherin; synpo, synaptopodin; T, talin; V, vinculin. (From Mundel P, Shankland SJ. Podocyte biology and response to injury. J Am Soc Nephrol 2002;13:3005.)

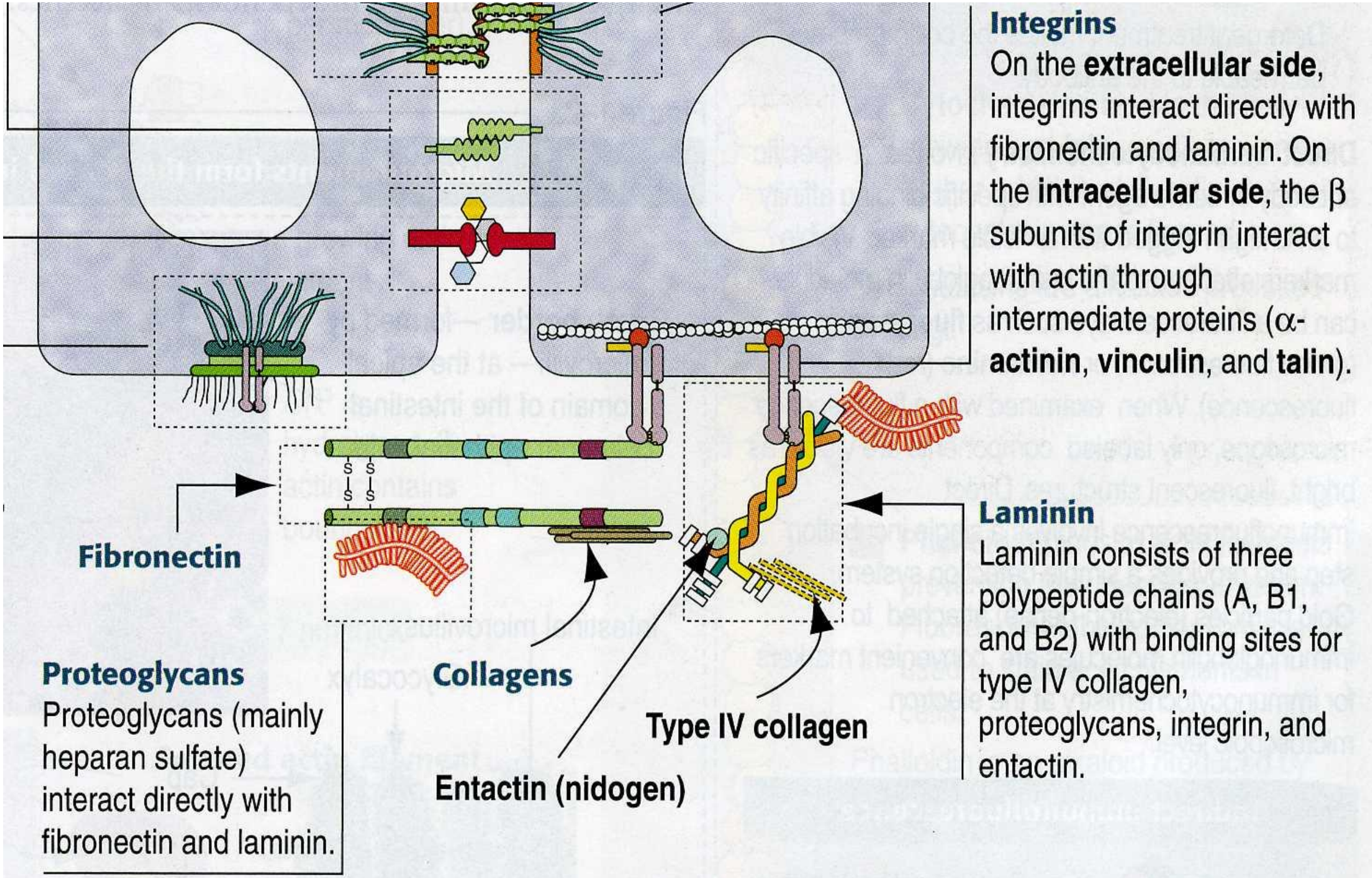


Nephrin & p Cadherin
Podocalyxin
Alpha & Beta
Dystroglycan
Alpha3 Beta1
integrin
Actin
Collagen IV & Laminin



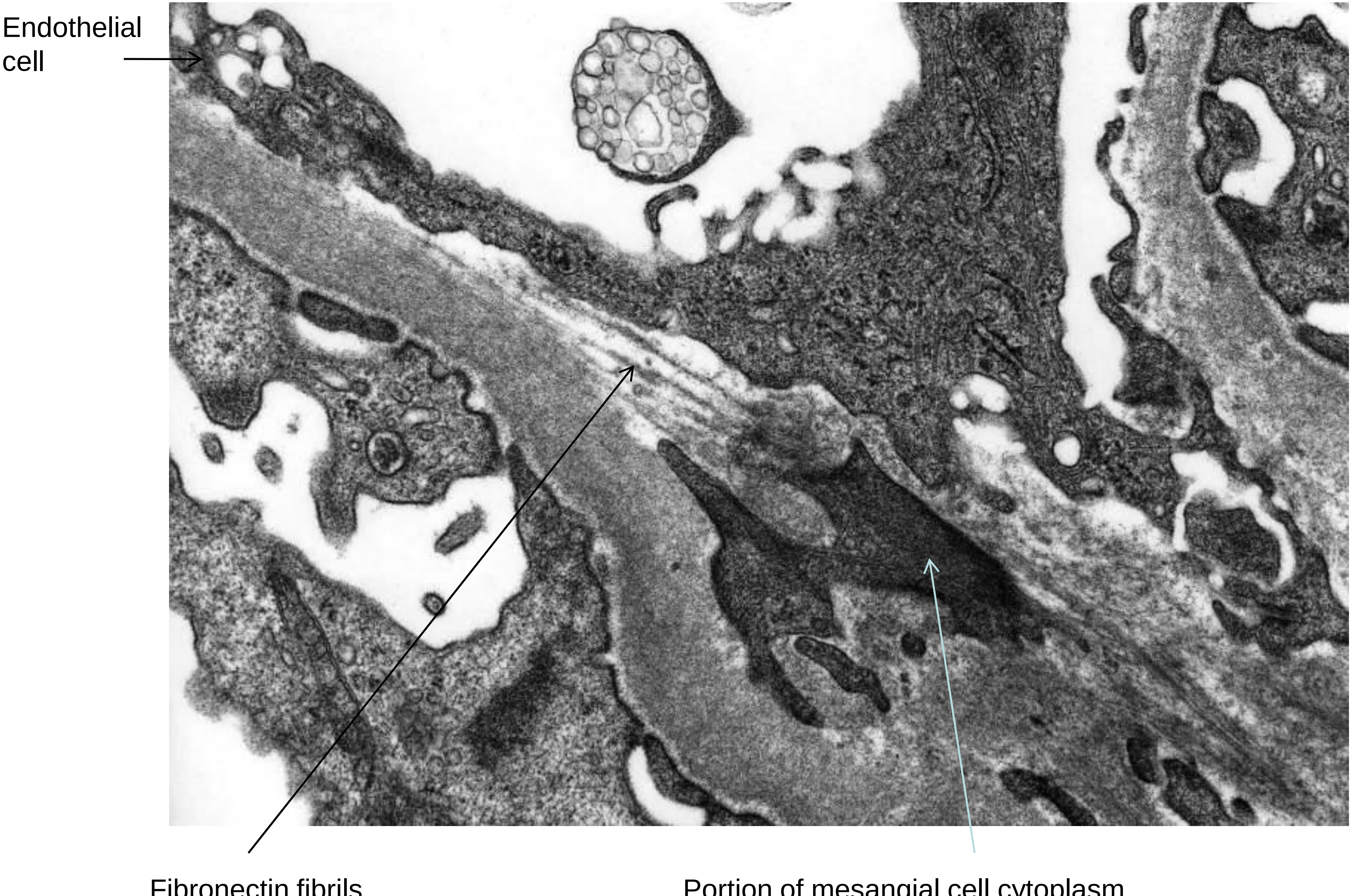
Histology and Cell Biology

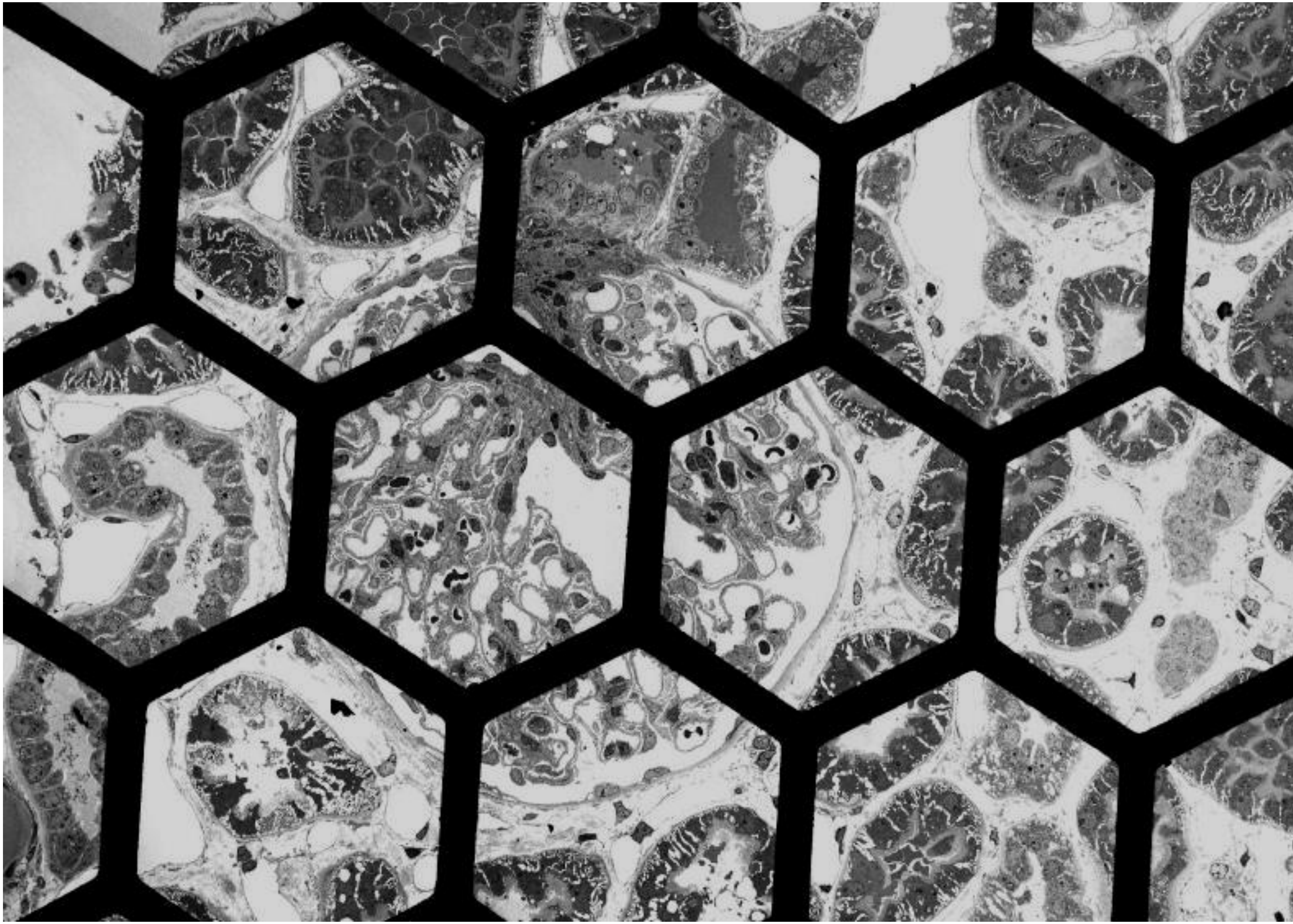
AL Kierszenbaum 2002



Histology and Cell Biology AL Kierszenbaum 2002

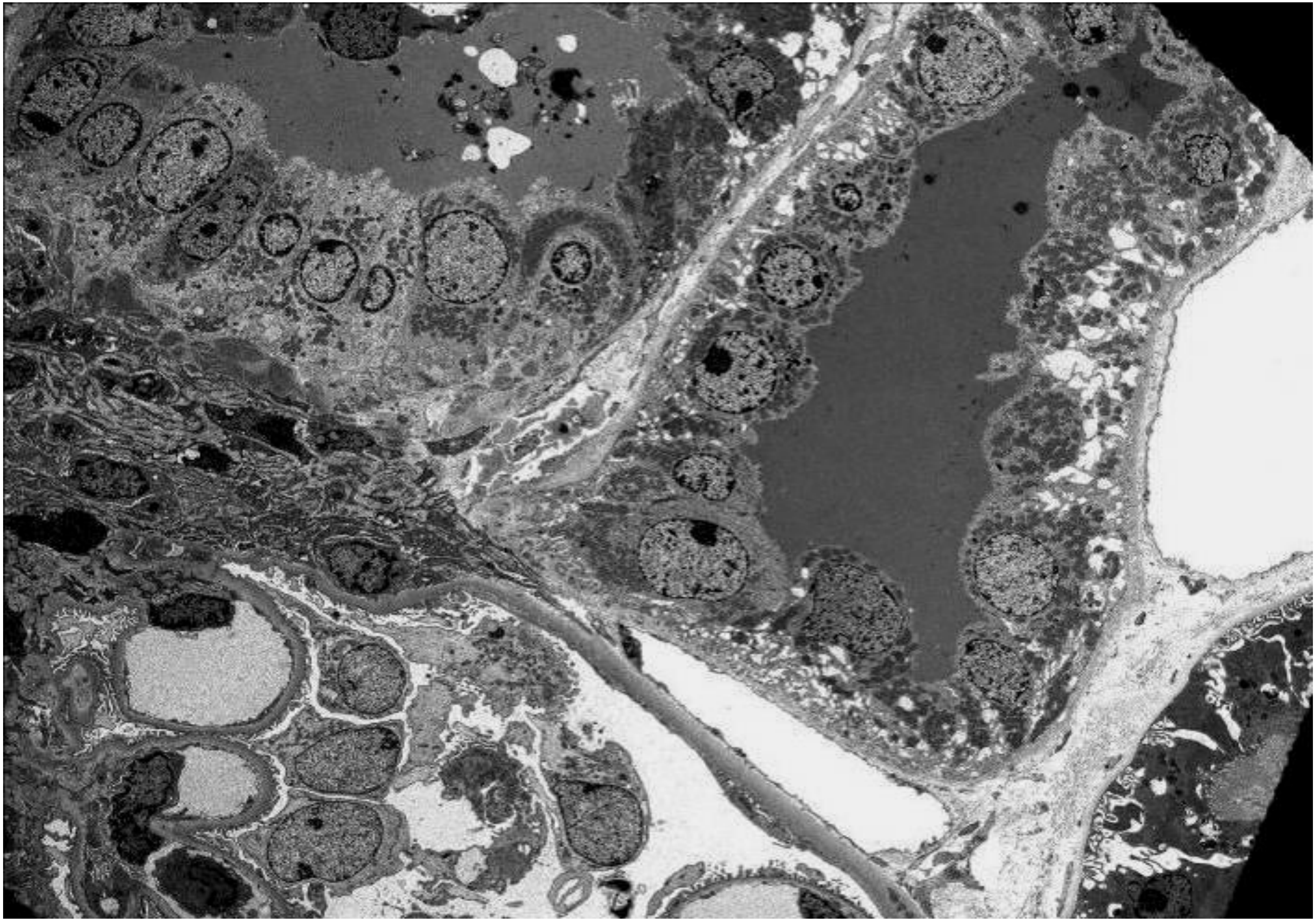
Paramesangial region





Juxtaglomerular apparatus

Macula densa at end of thick ascending part of loop of Henle and beginning of distal convoluted tubule



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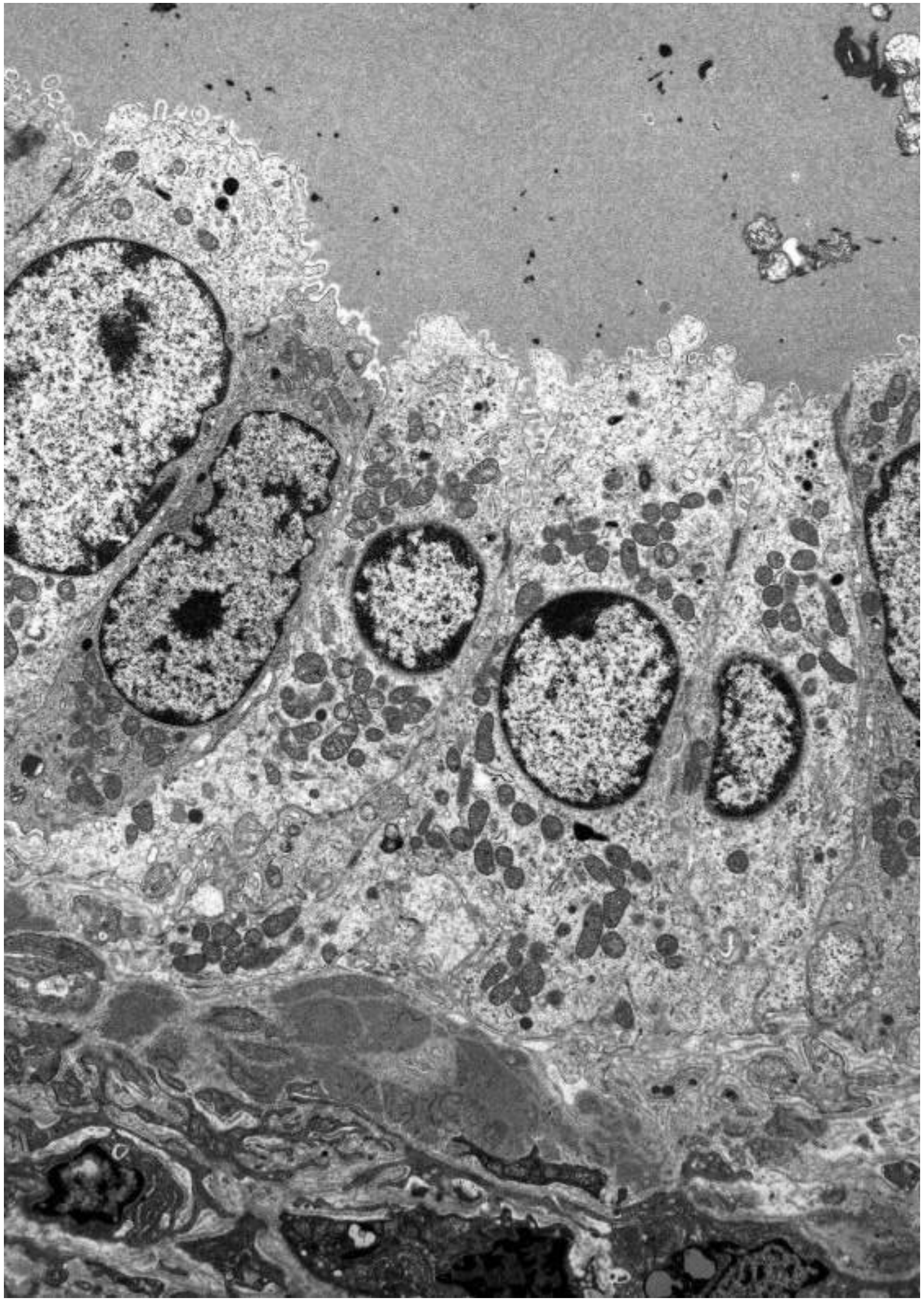
Macula densa part of distal convoluted tubule adjacent to extraglomerular mesangial/lacis cells

Macula densa cells



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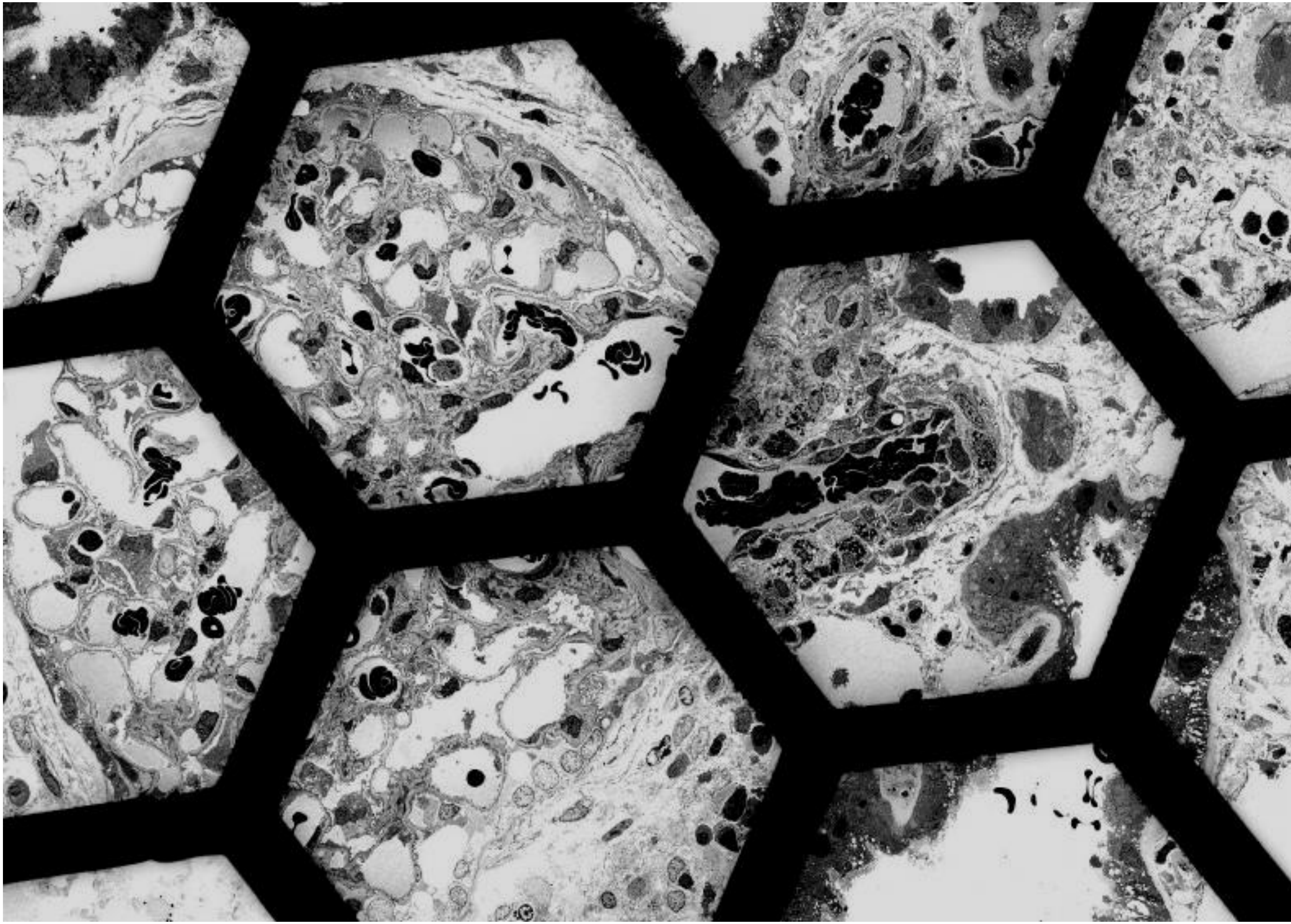
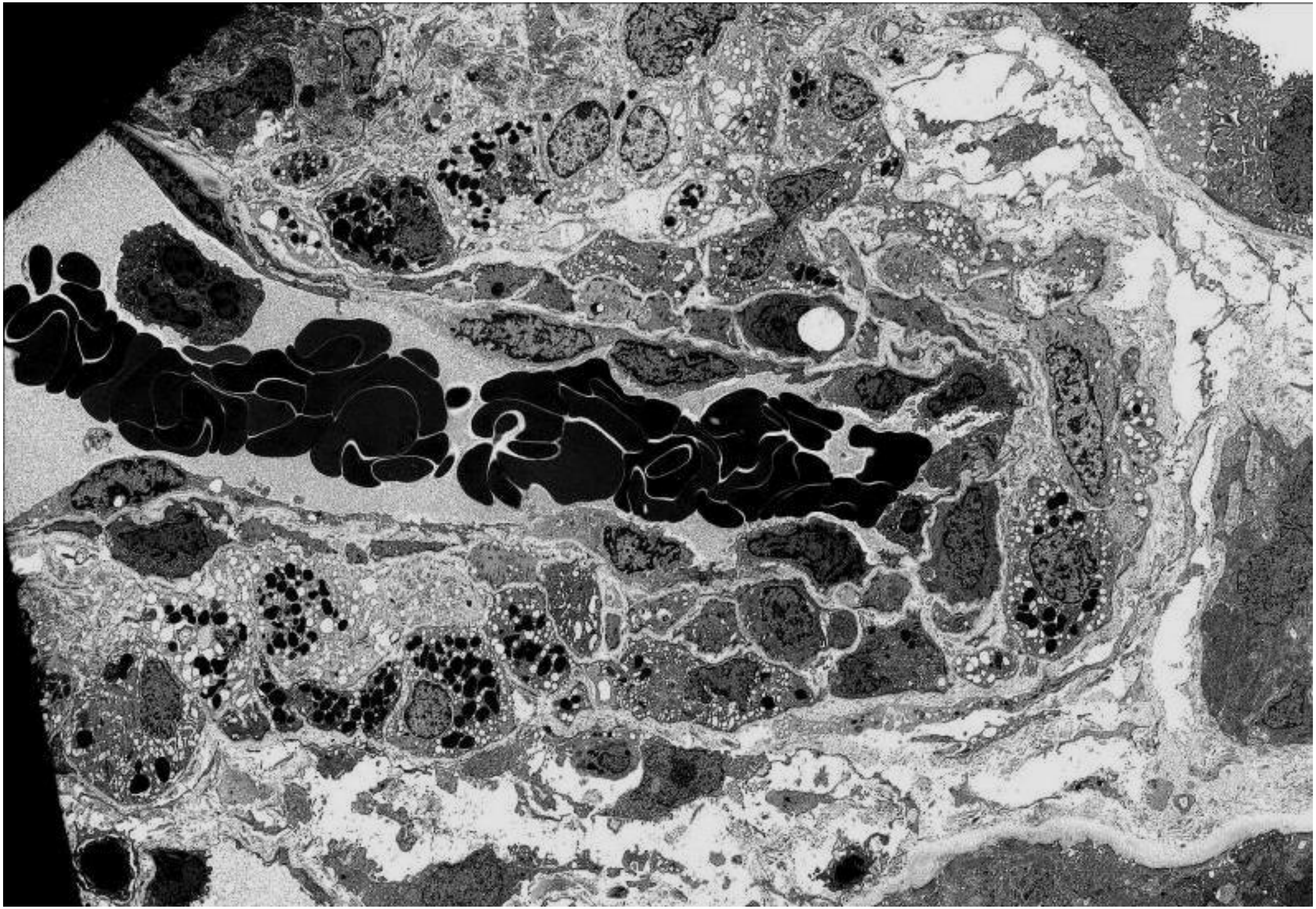


Afferent arteriolar cells at point of juxtaglomerular apparatus contain renin and angiotensin II granules



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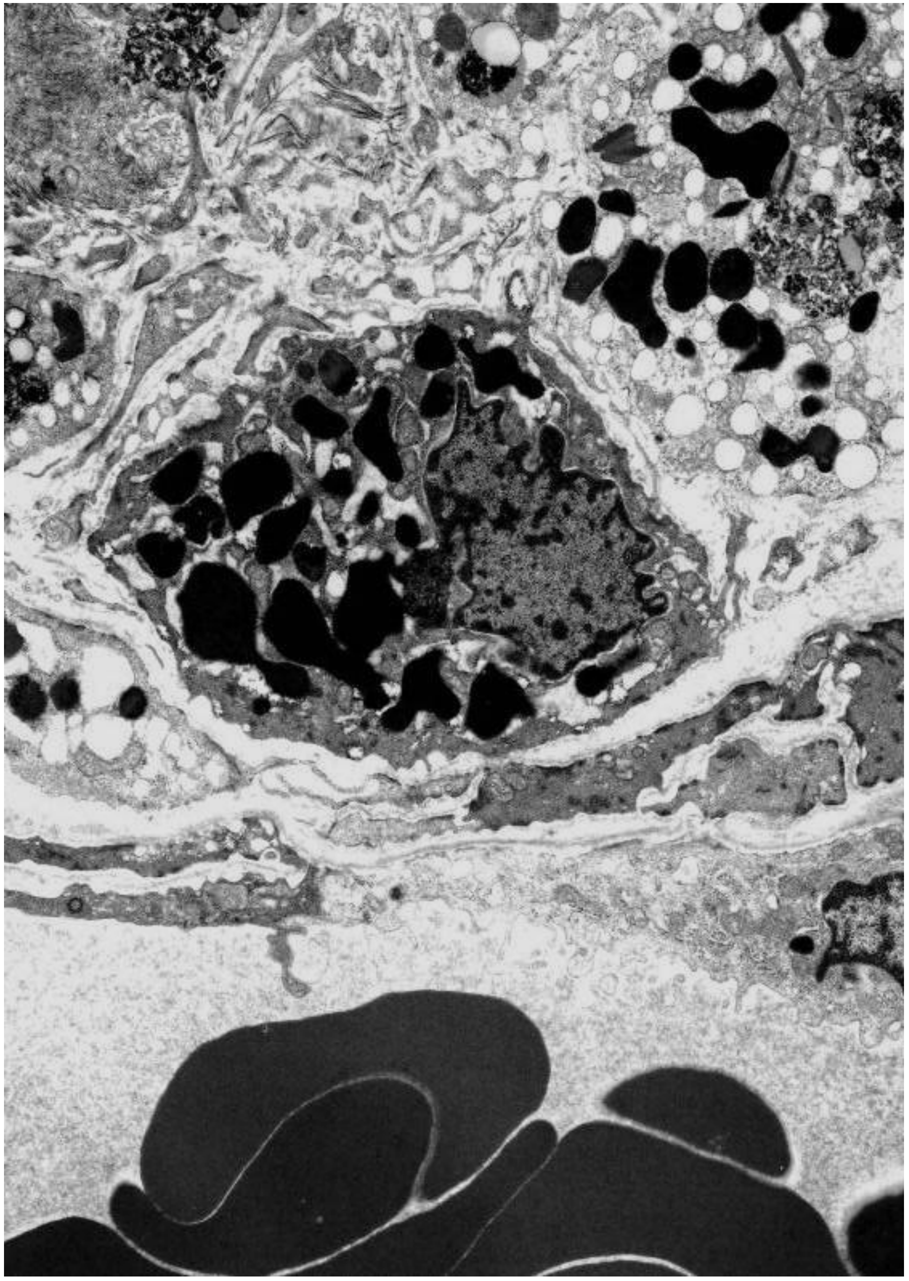
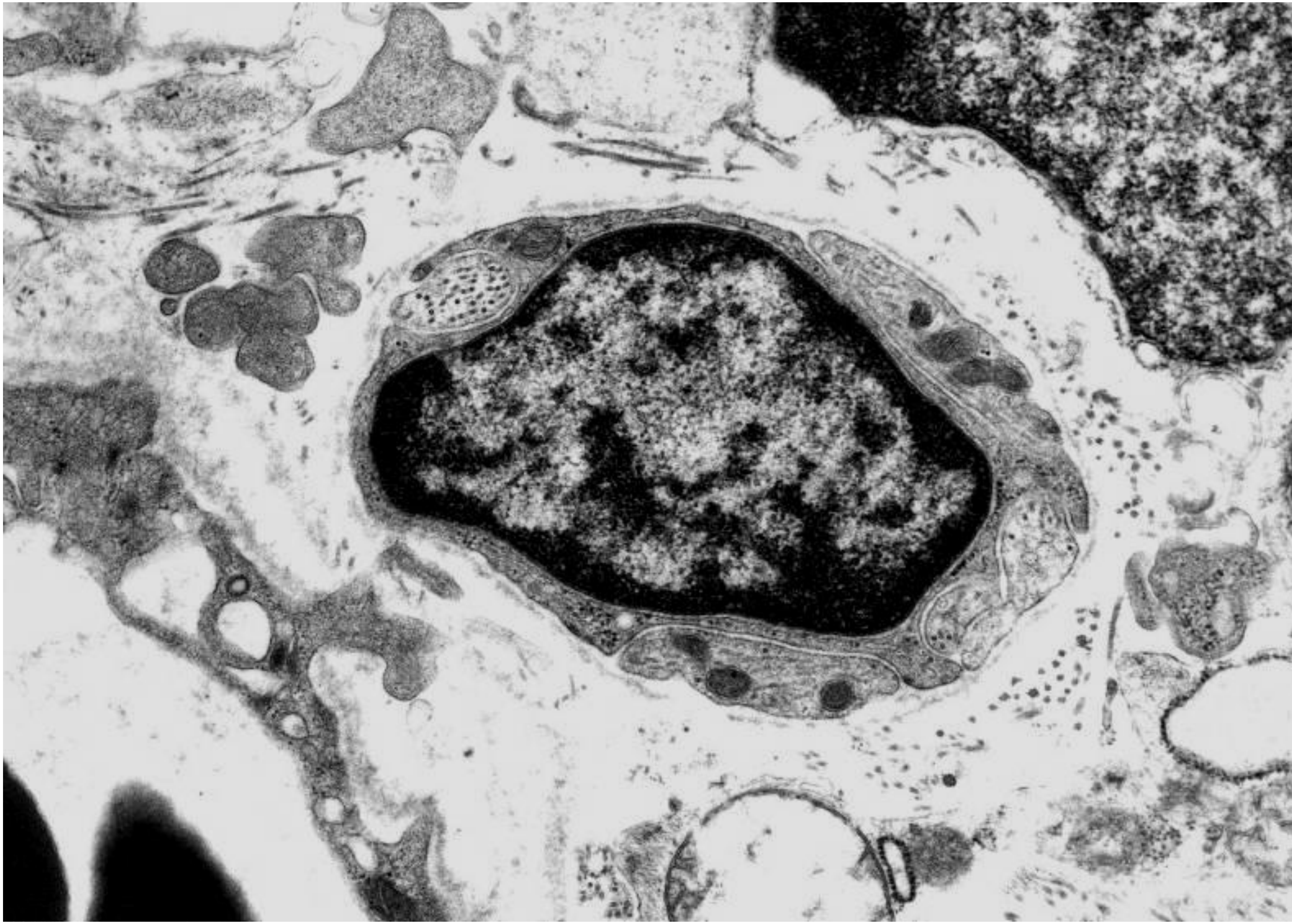
Afferent arteriole

Granular
myoepithelial
cells



Granules contain renin

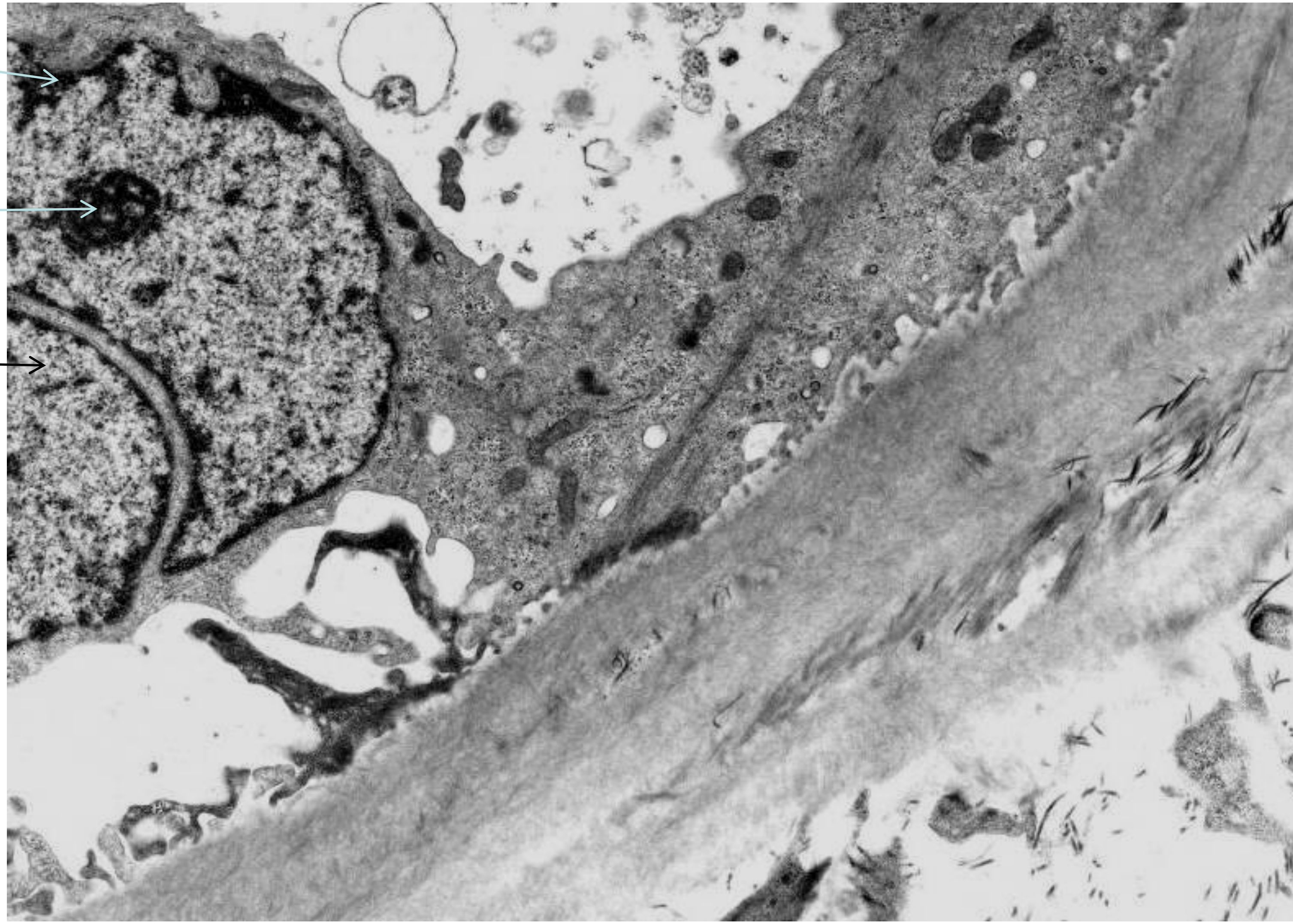


Schwann cell partly wrapping around neuronal cell processes

Non-myelinated nerve in renal cortical interstitium

Innervation of smooth muscle cells of afferent and efferent arterioles

Cells lining Bowman's space/parietal epithelial cell sitting on Bowman's capsule



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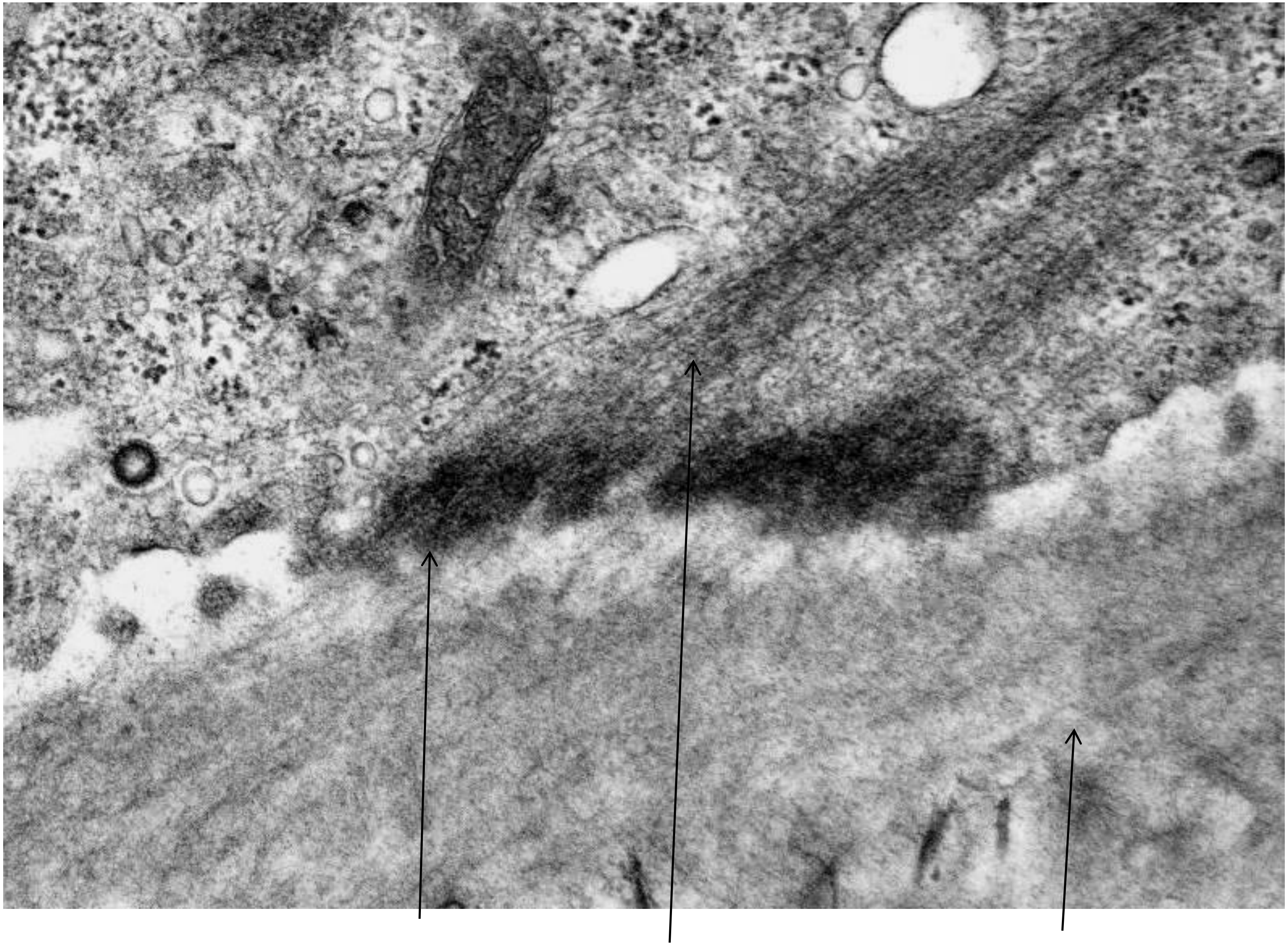
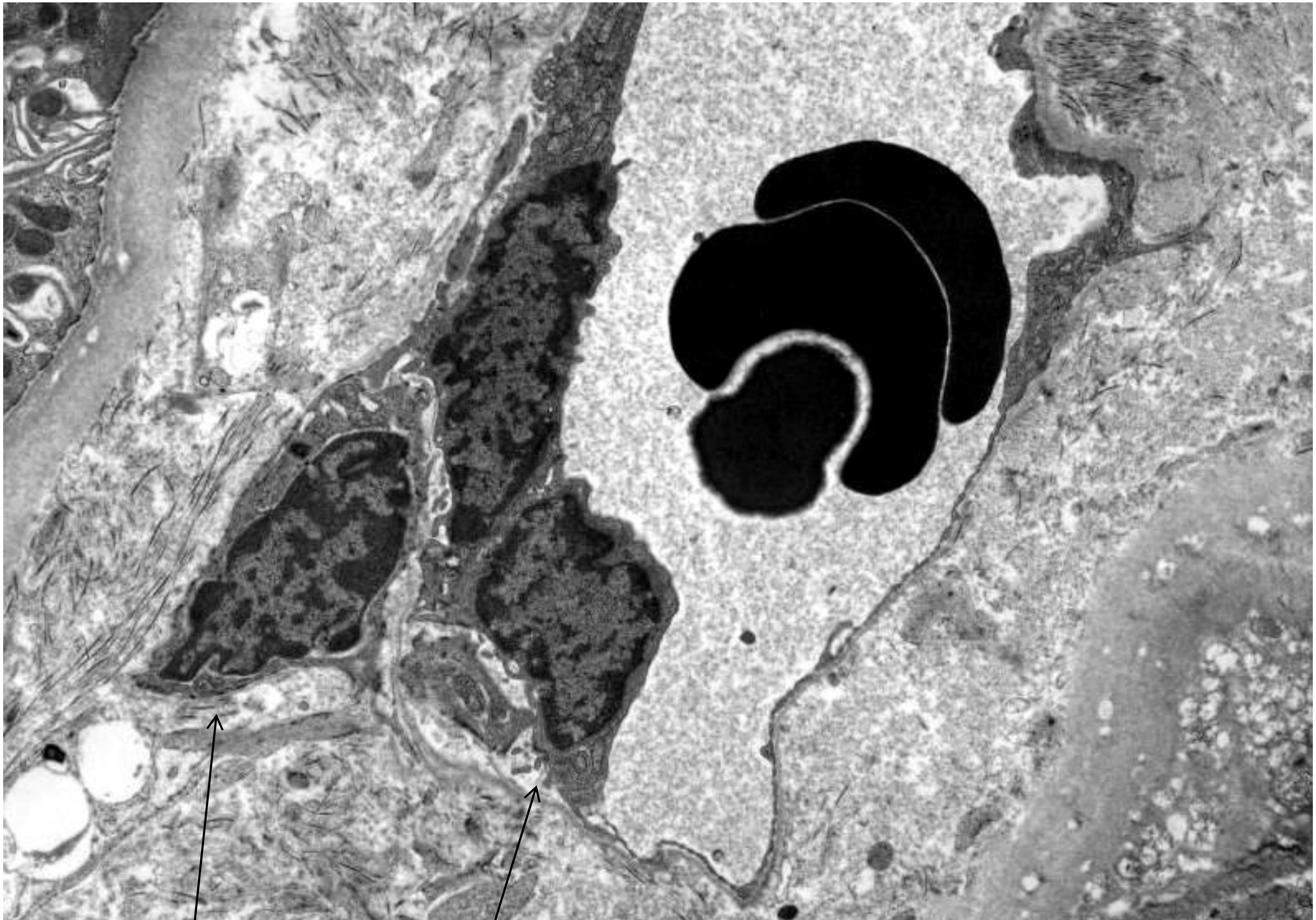
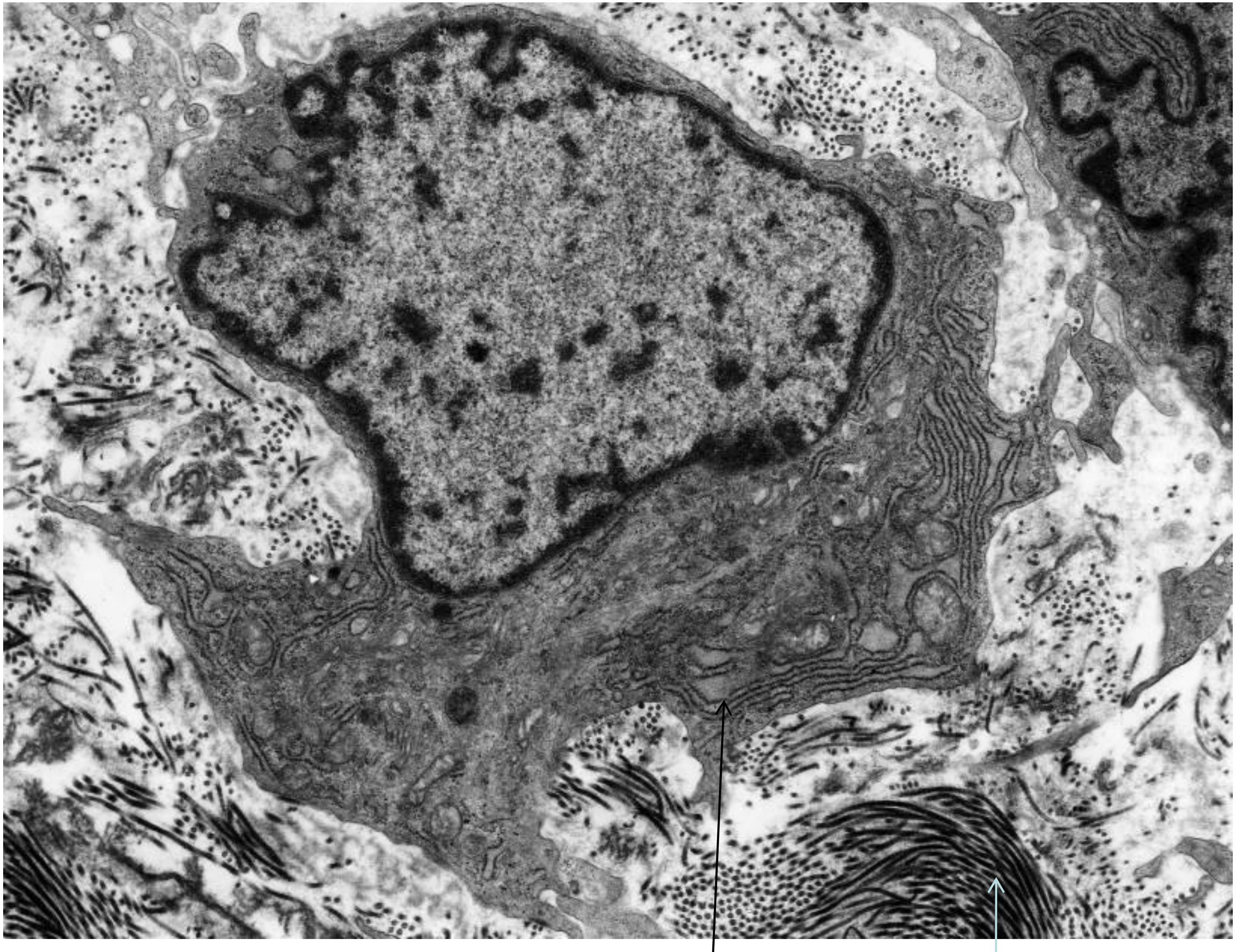


Peritubular capillary



Pericyte and endothelial cells

Renal cortical interstitial fibroblast



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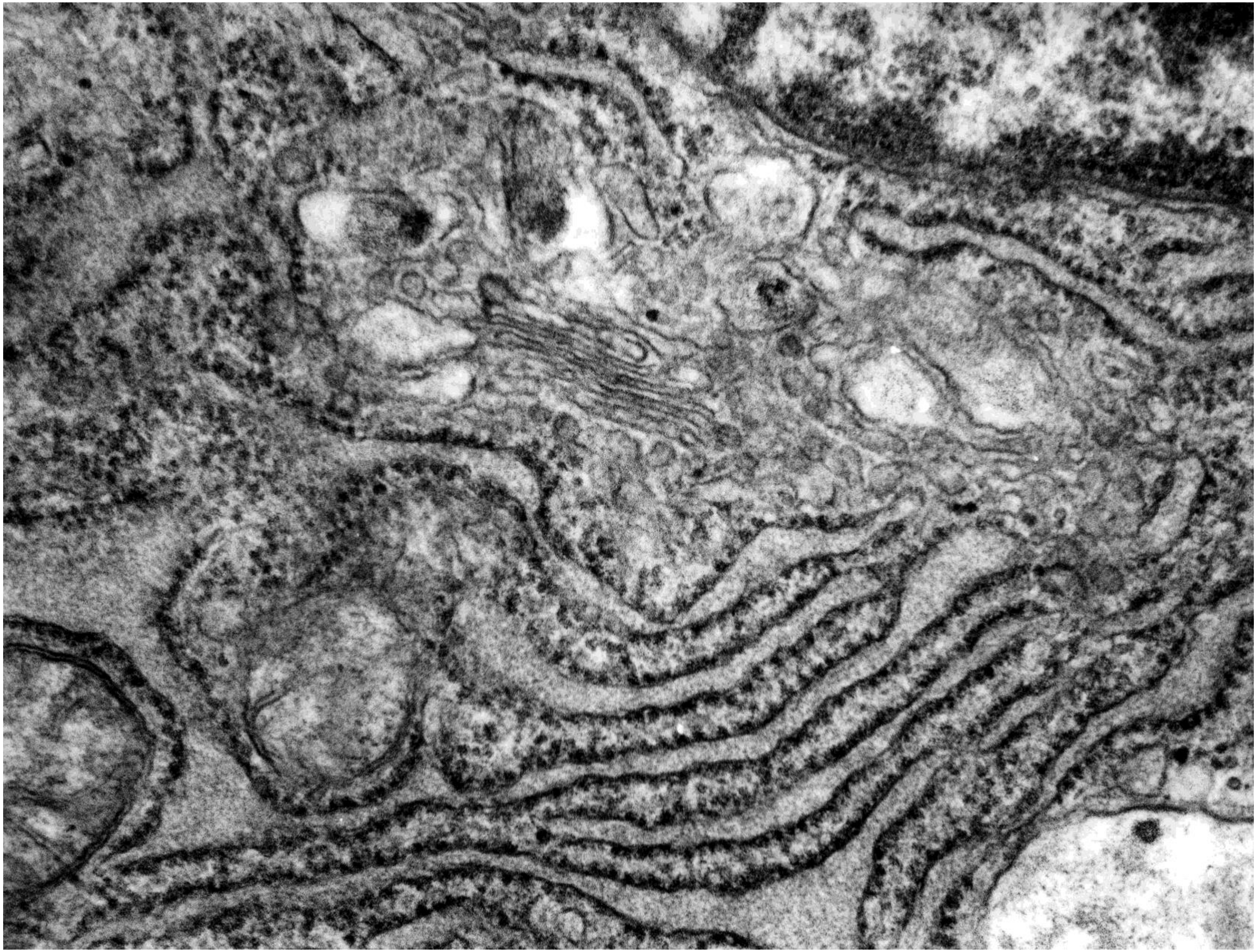


Renal interstitial fibroblast

Toluidine blue stained plastic section of renal cortical tubules

Distal convoluted tubule

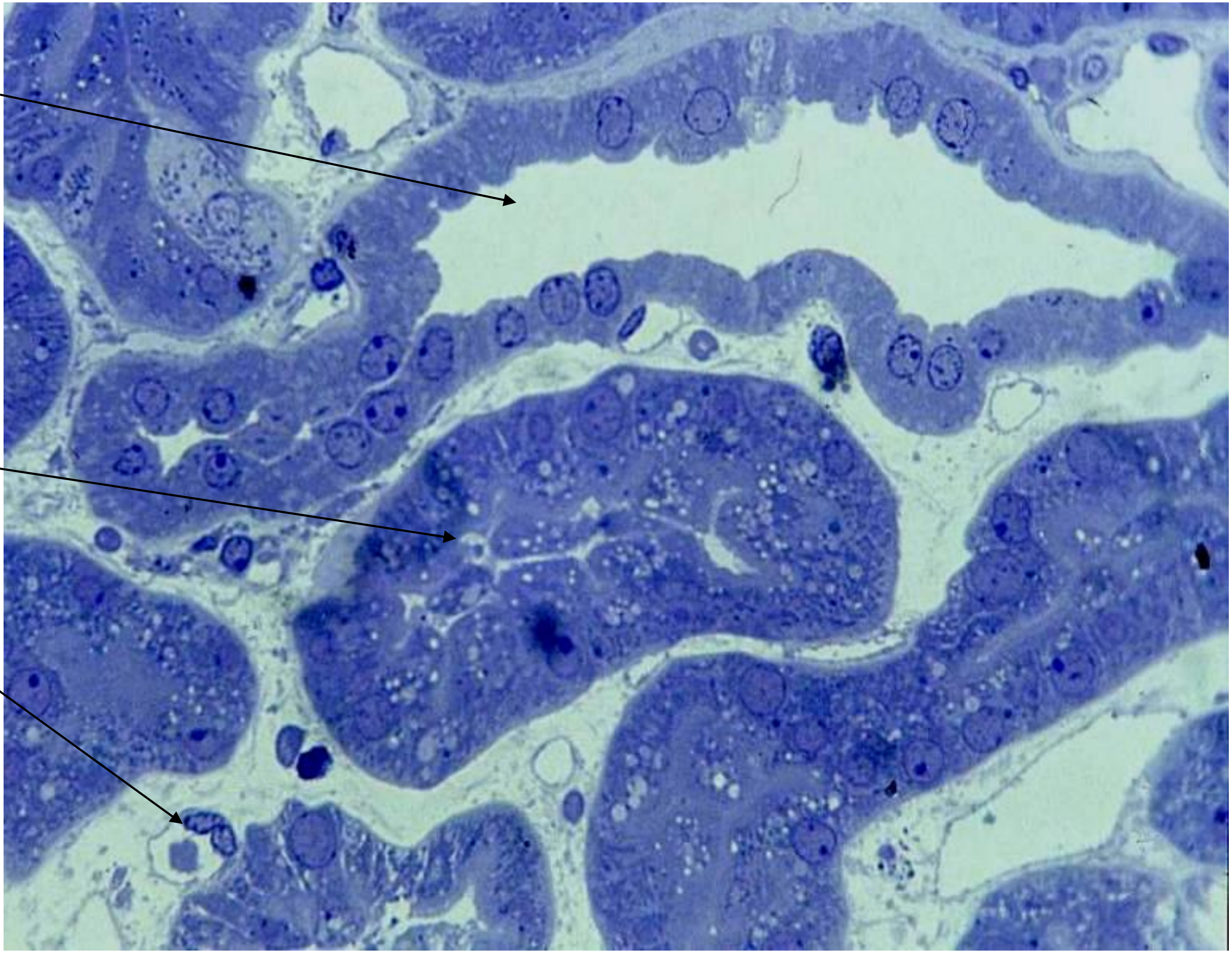
DCT

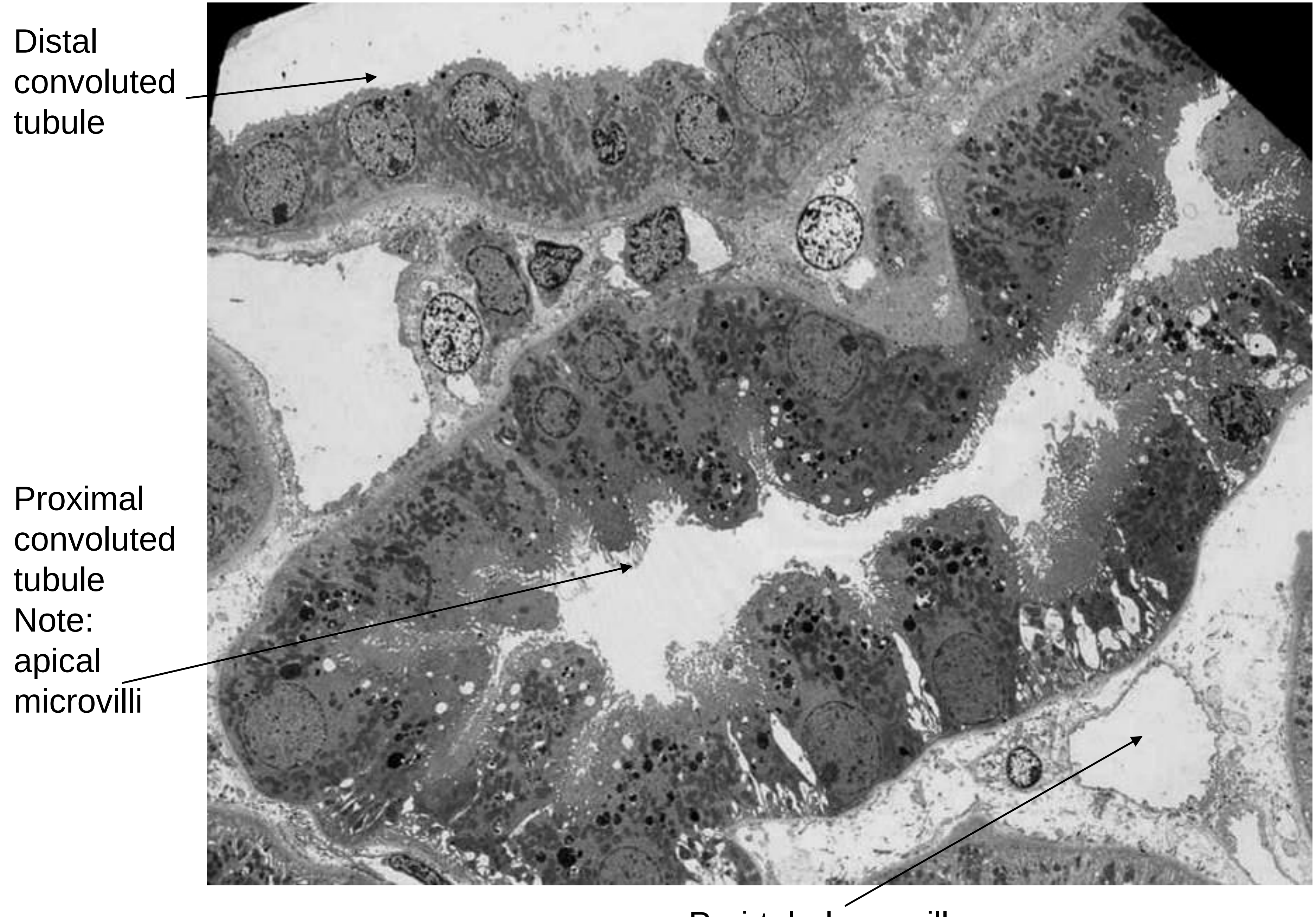
Proximal convoluted tubule

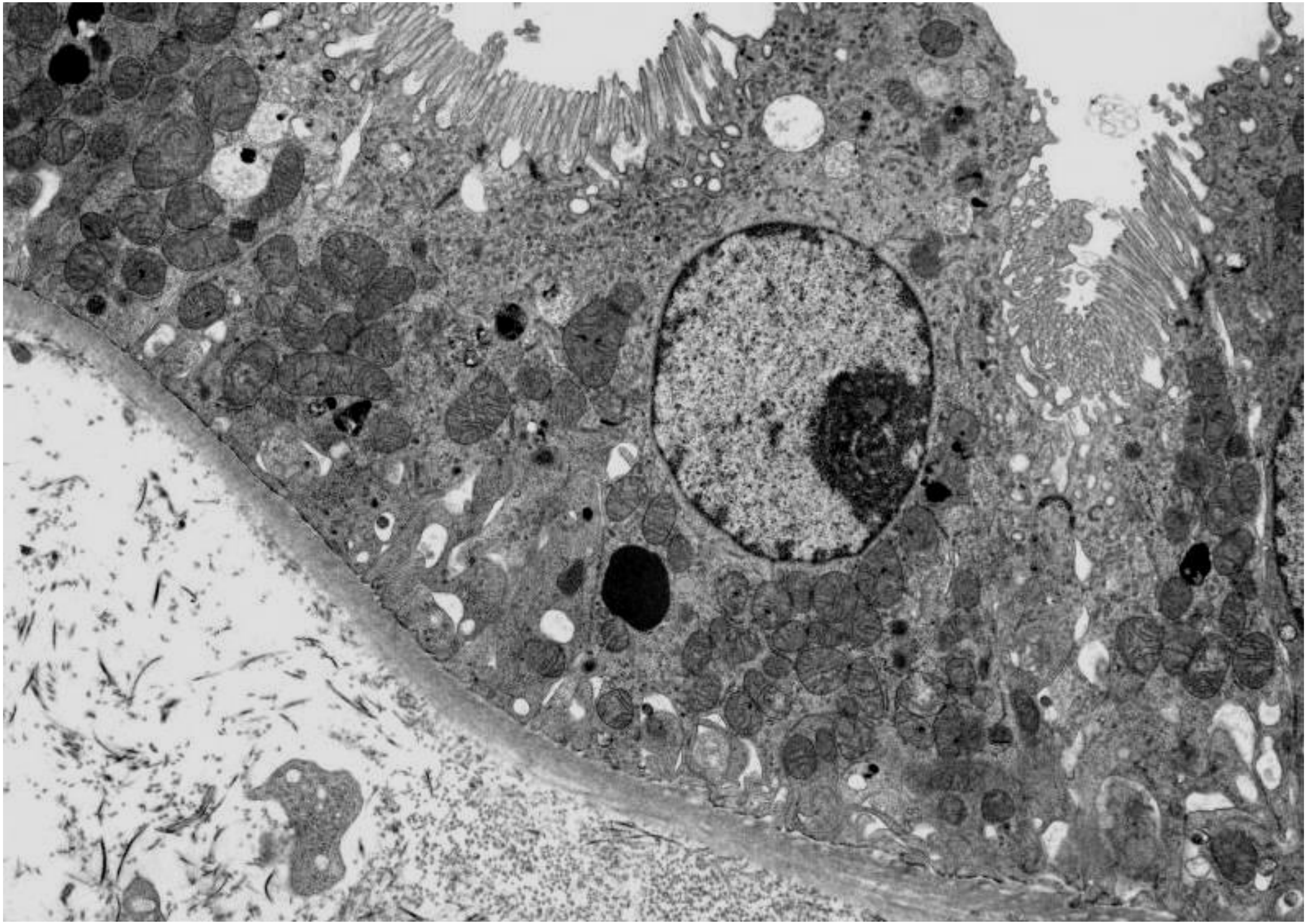
PCT

Peritubular capillaries

PTC

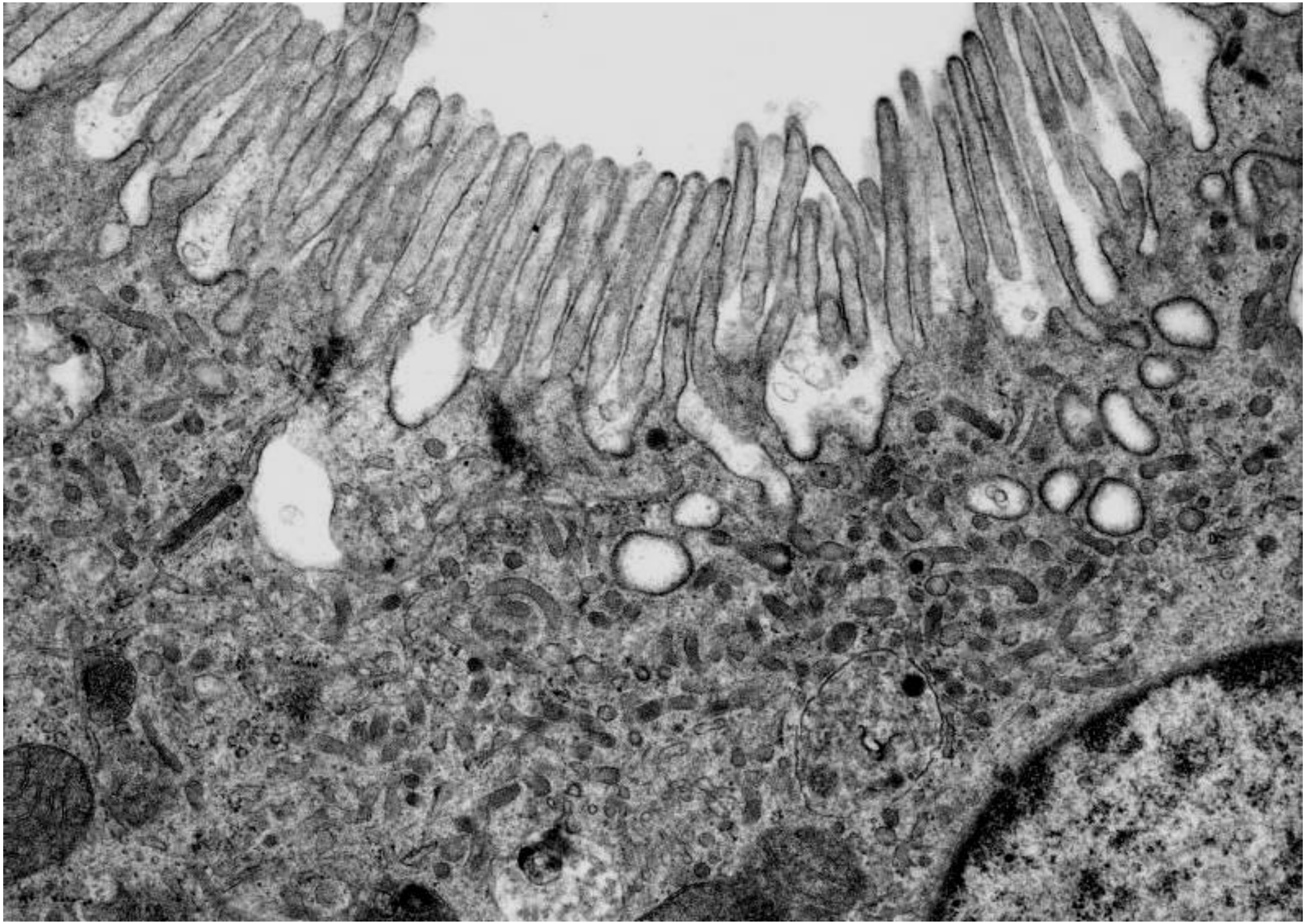



Distal convoluted tubule
Proximal convoluted tubule Note: apical microvilli
Peri-tubular capillary



Proximal convoluted epithelial cell

Apex of proximal convoluted epithelial cell



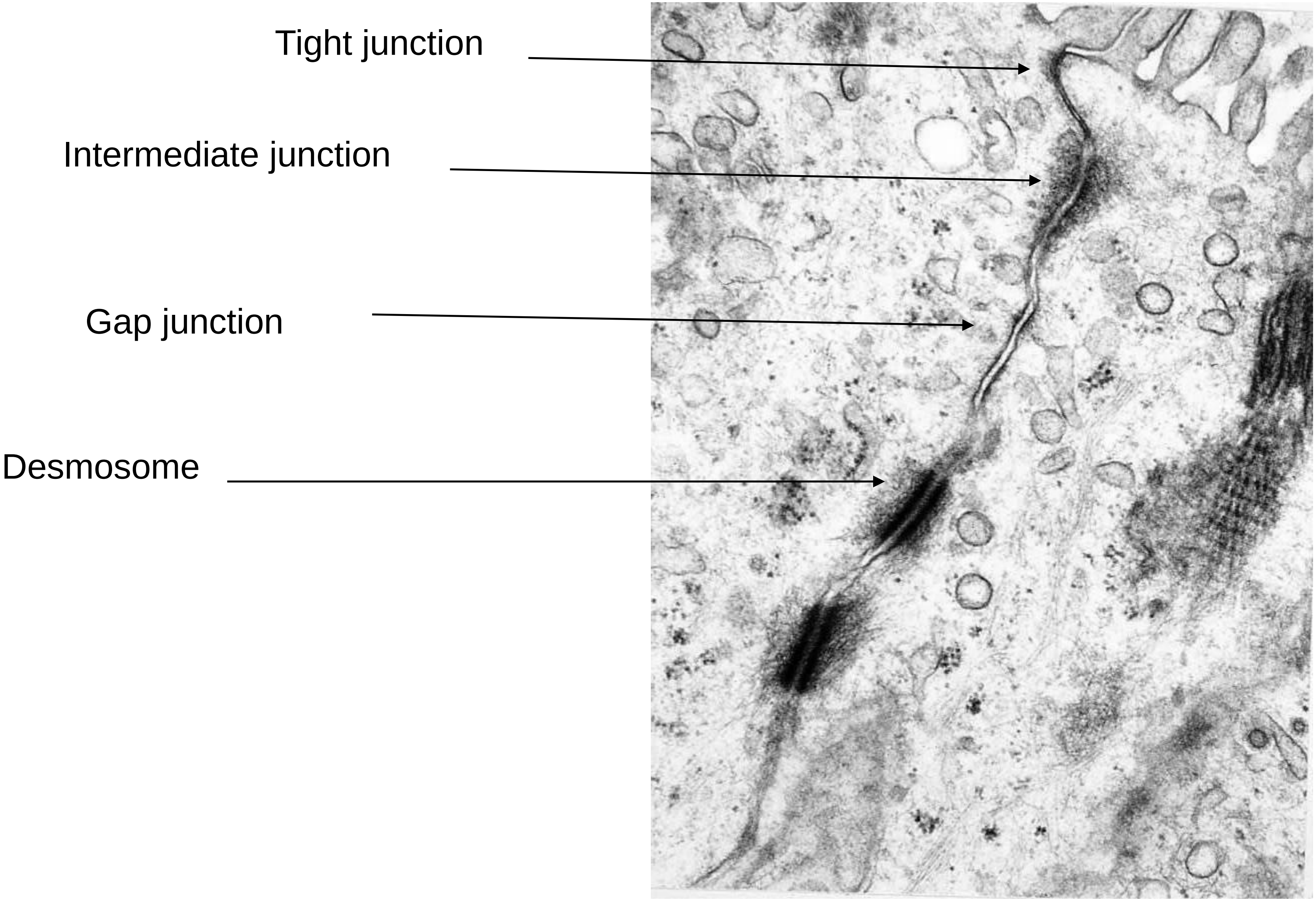
Microvilli to resorb water via aquaporins, apical vesicles to resorb and transport peptides, smooth endoplasmic reticulum to replace cell membrane.

Apex of tubular epithelial cell

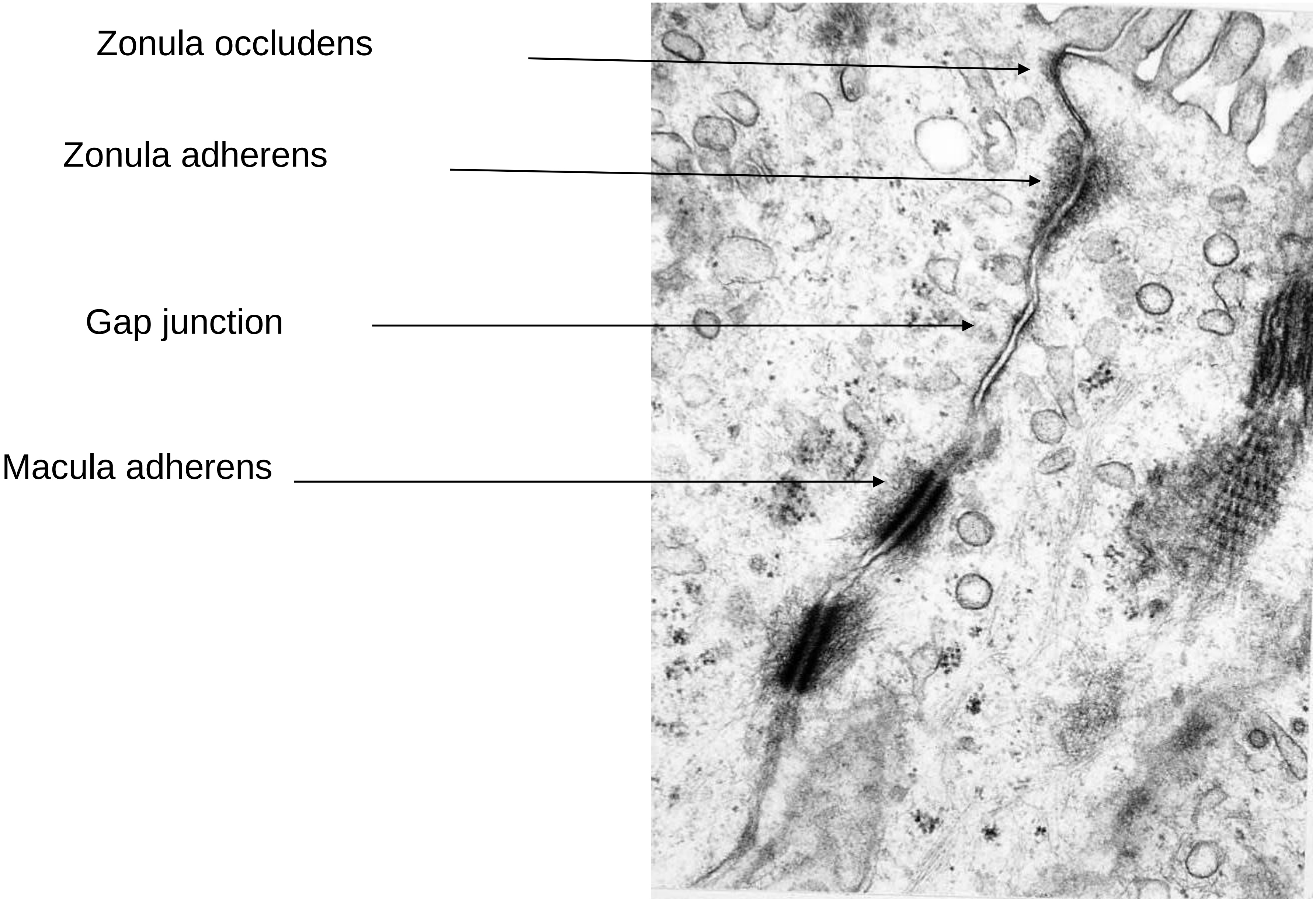
Junctional complex

Tight, intermediate, desmosome junctions

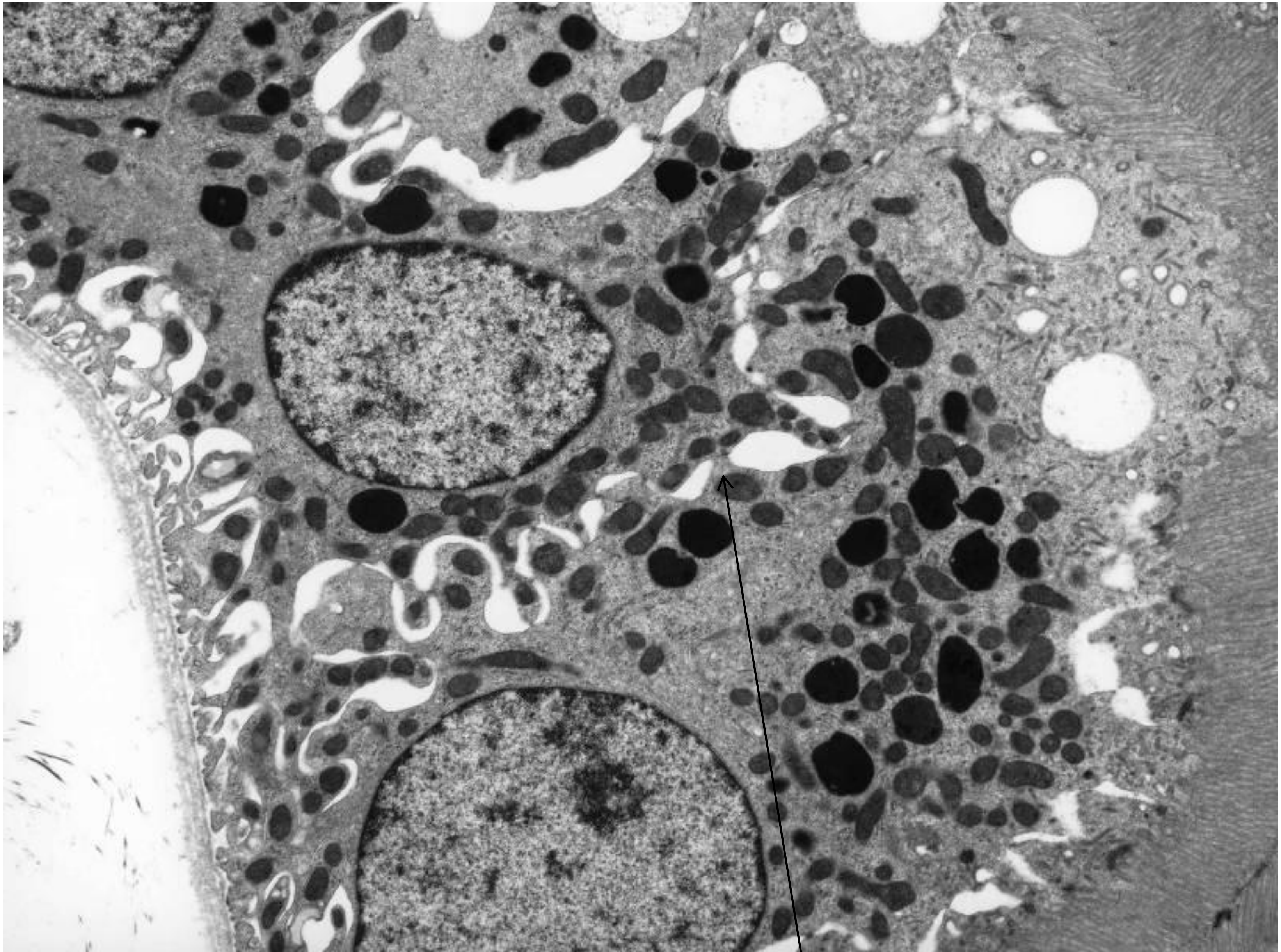
Zonula occludens, zonula adherens, macula adherens



Junctional complex - endocervix



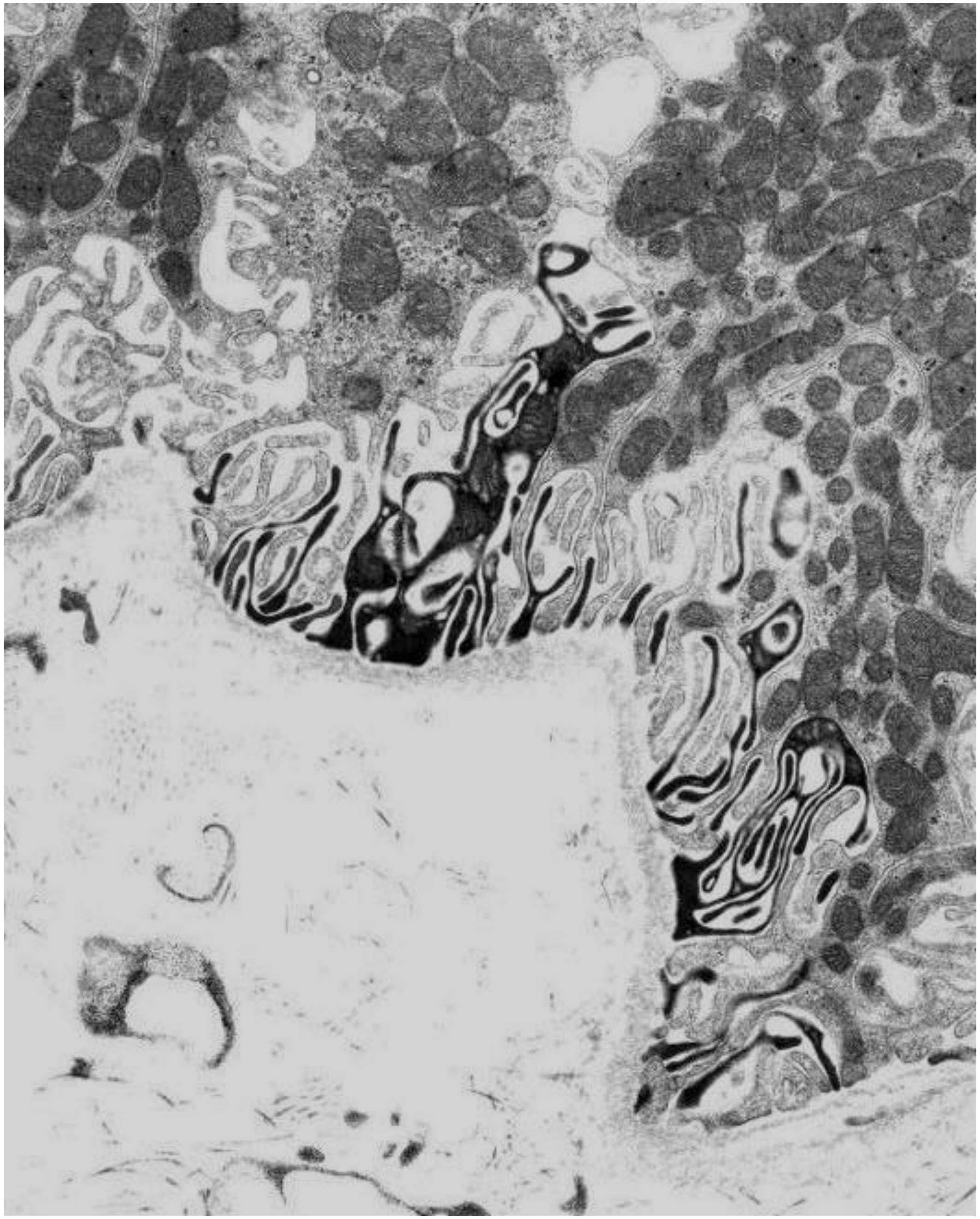
Junctional complex - endocervix



Proximal convoluted tubular epithelial cell

Cell shrinkage demonstrating lateral border attachment points

Base of tubular epithelial cell, folding and interdigitating with neighbour

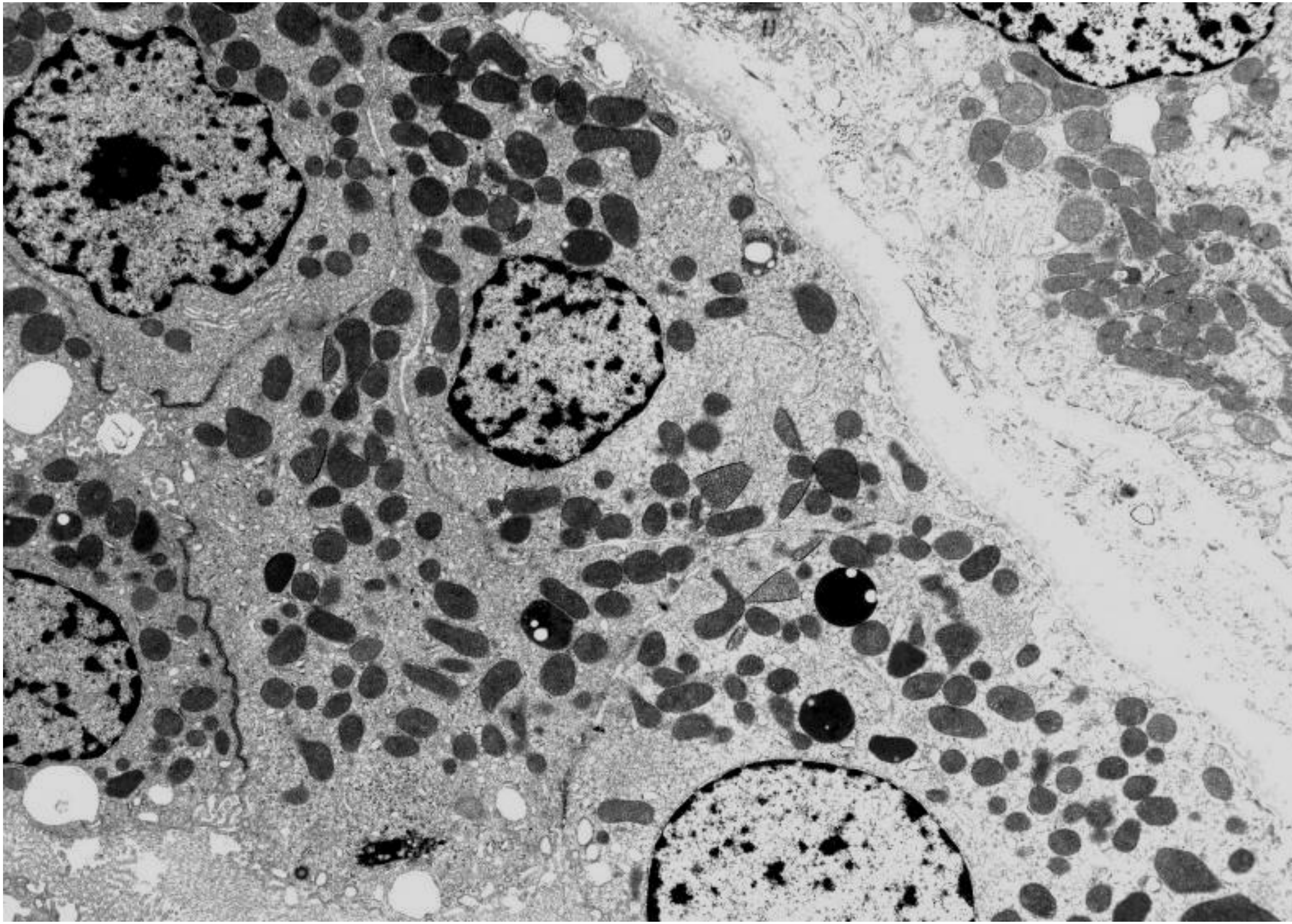


Light cell dark cell phenomenon

Base of tubular epithelial cell

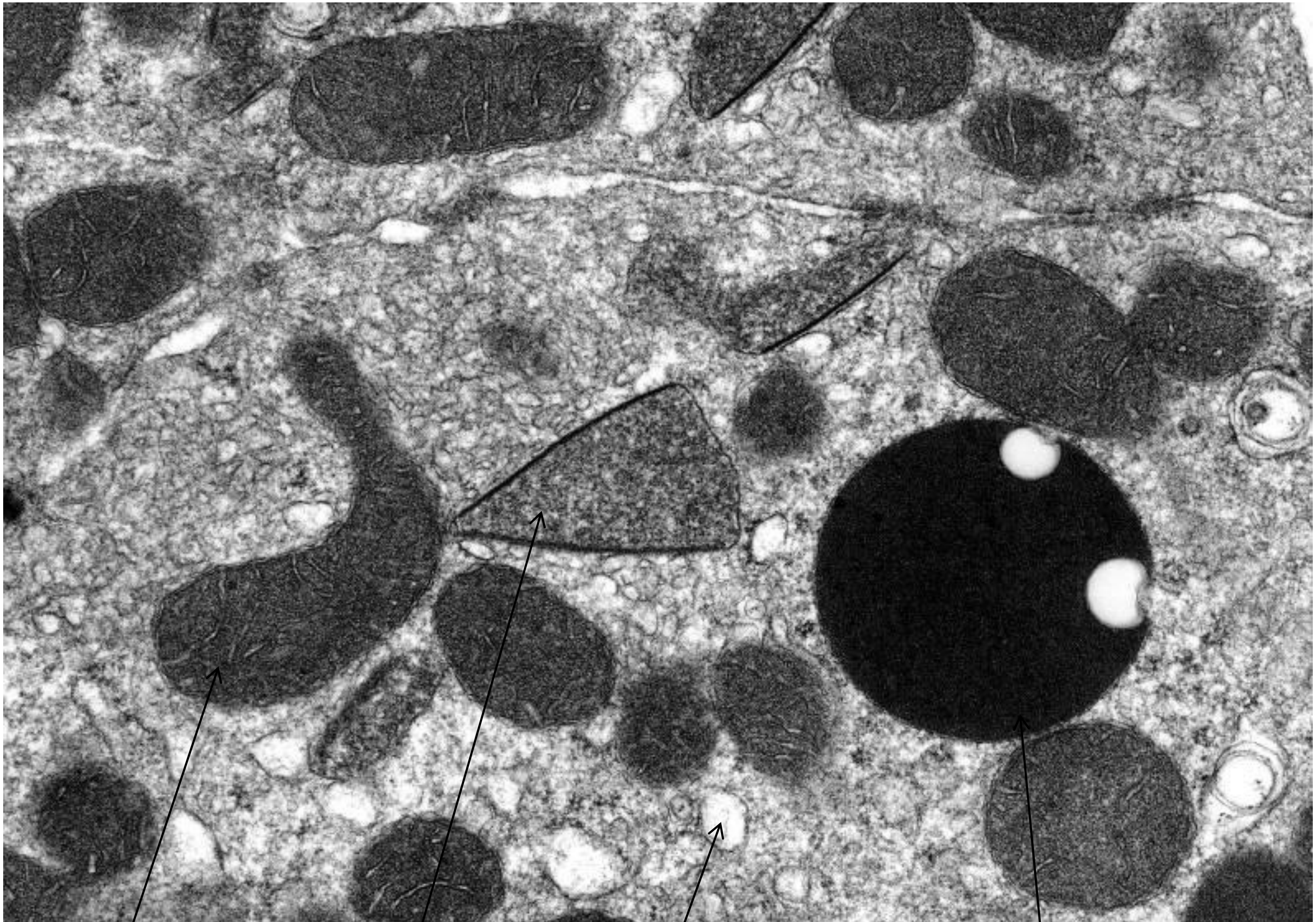
Numerous mitochondria

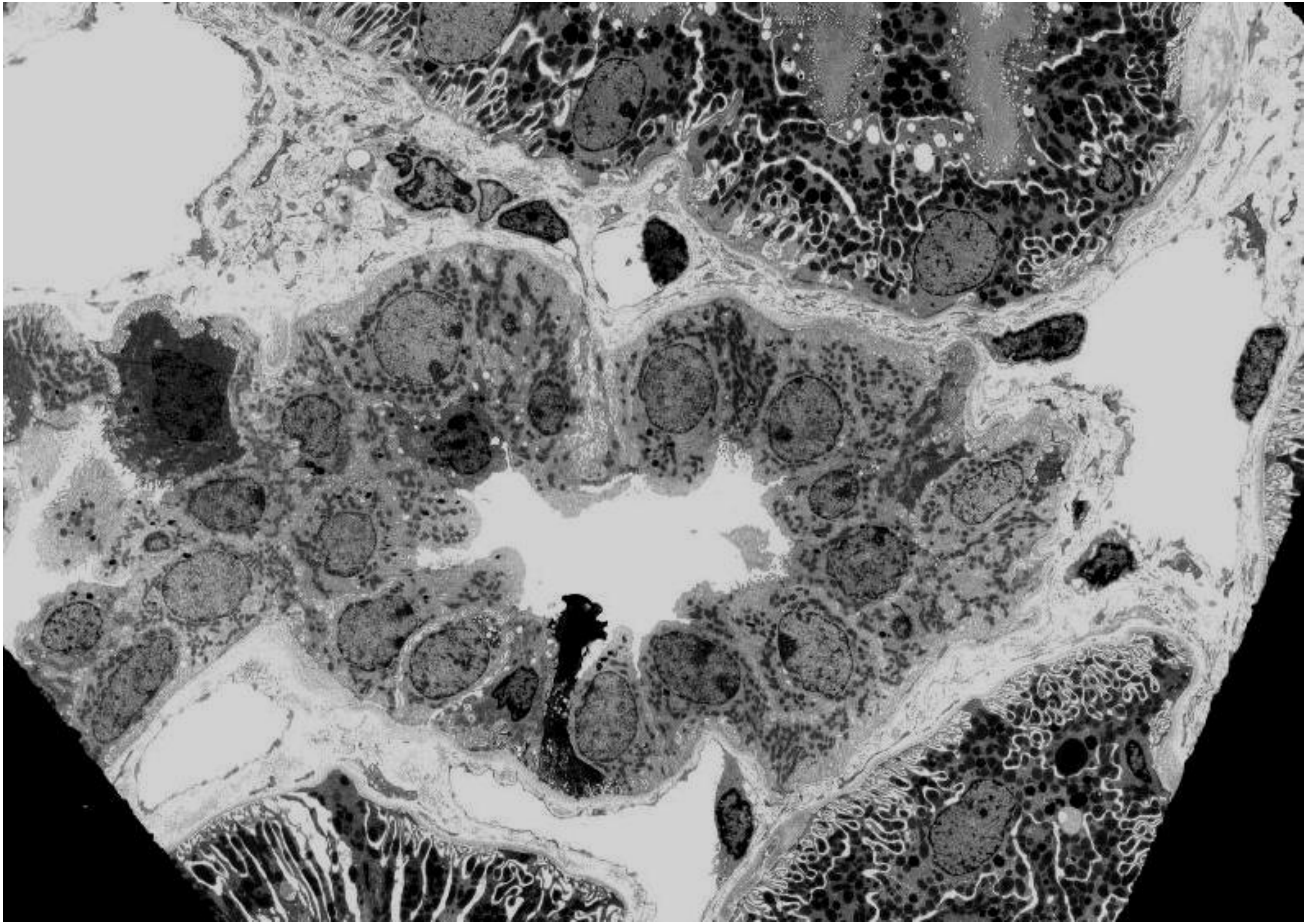
Proximal convoluted tubular epithelial cell



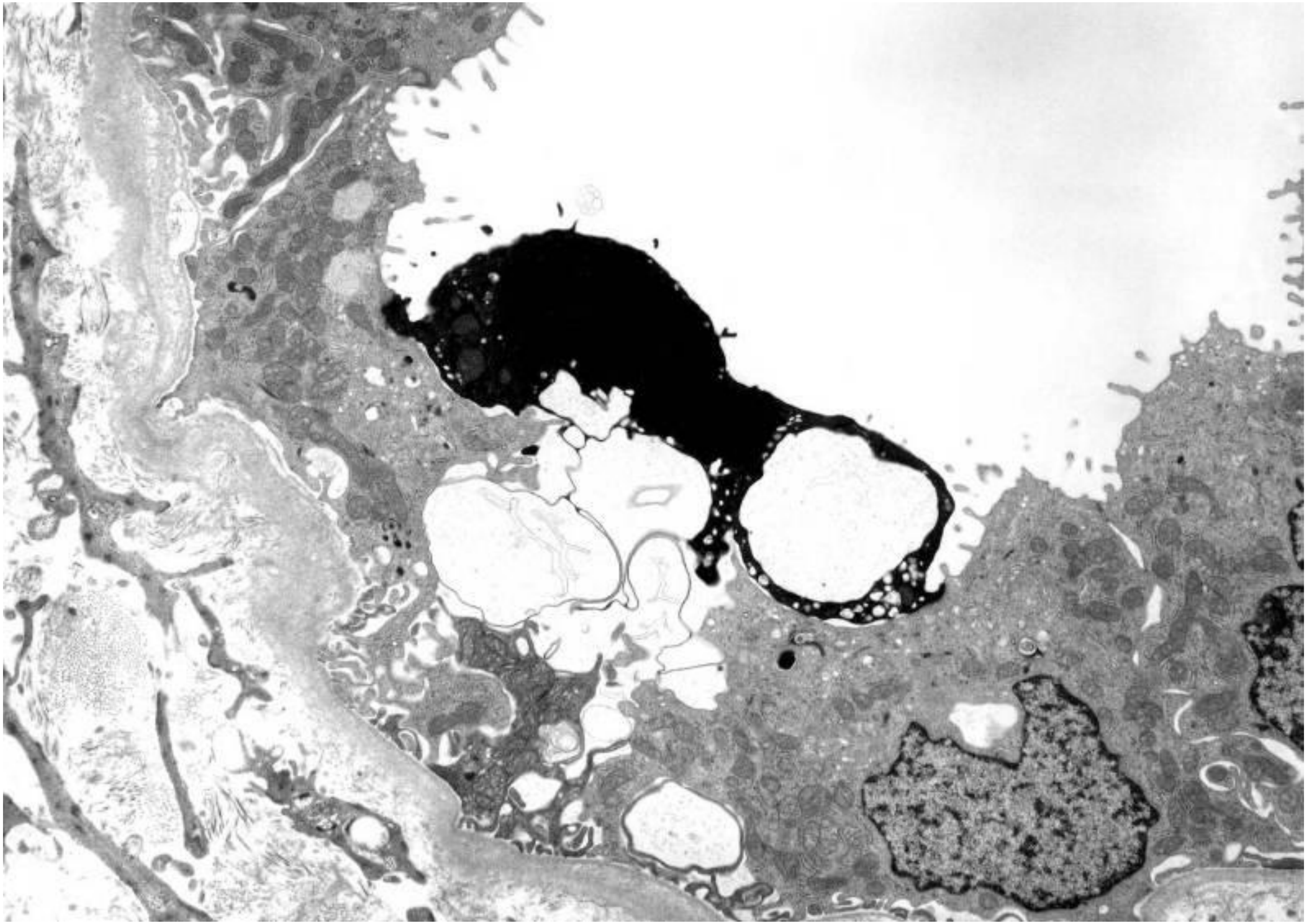
Proximal tubular epithelial cell

Higher magnification of previous slide





Distal convoluted tubule



Distal convoluted tubule cell possibly having undergone apoptosis

Time for a quick break?

‘The mind cannot absorb what the backside cannot endure’

Prince Philip ,The Duke of Edinburgh.