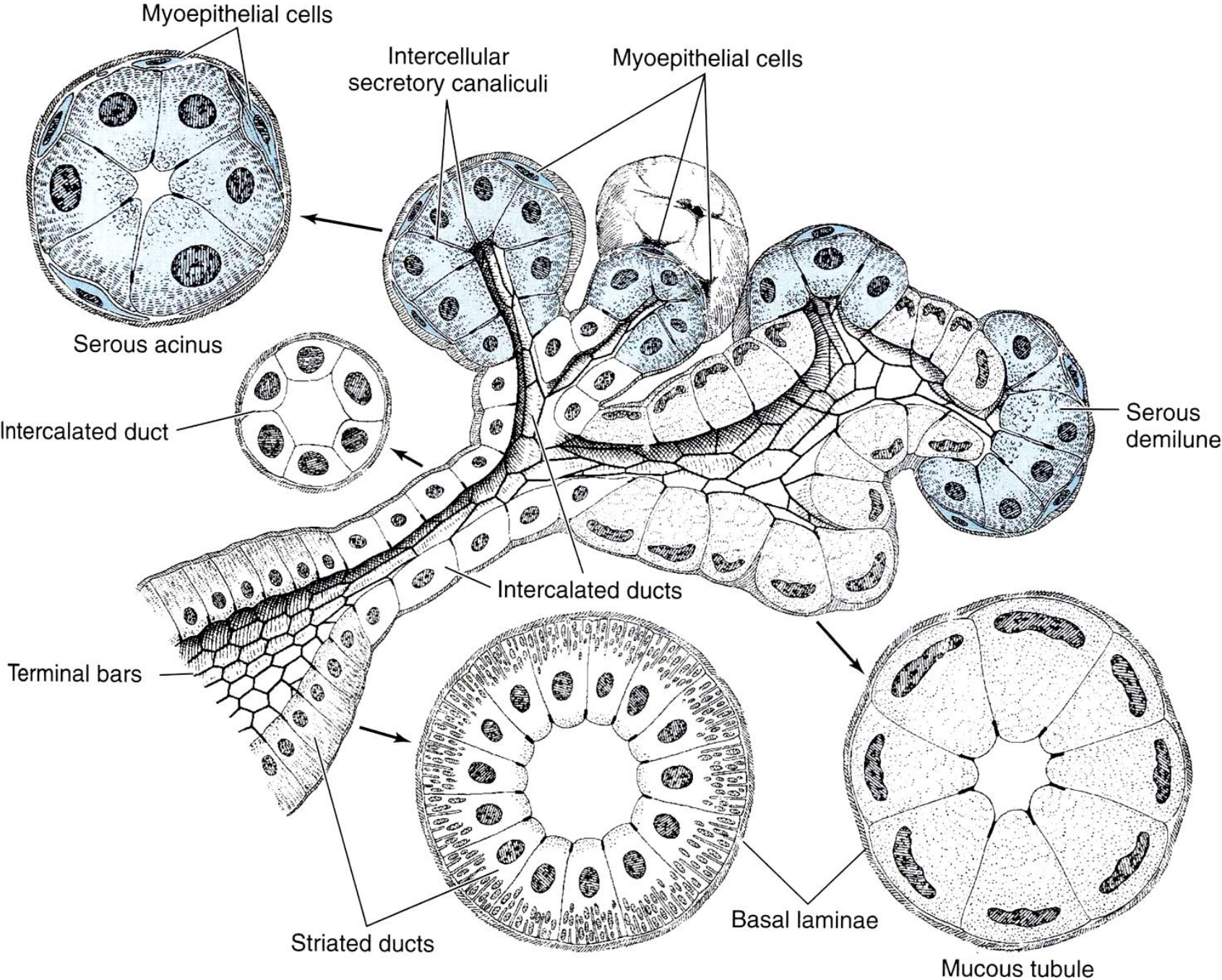
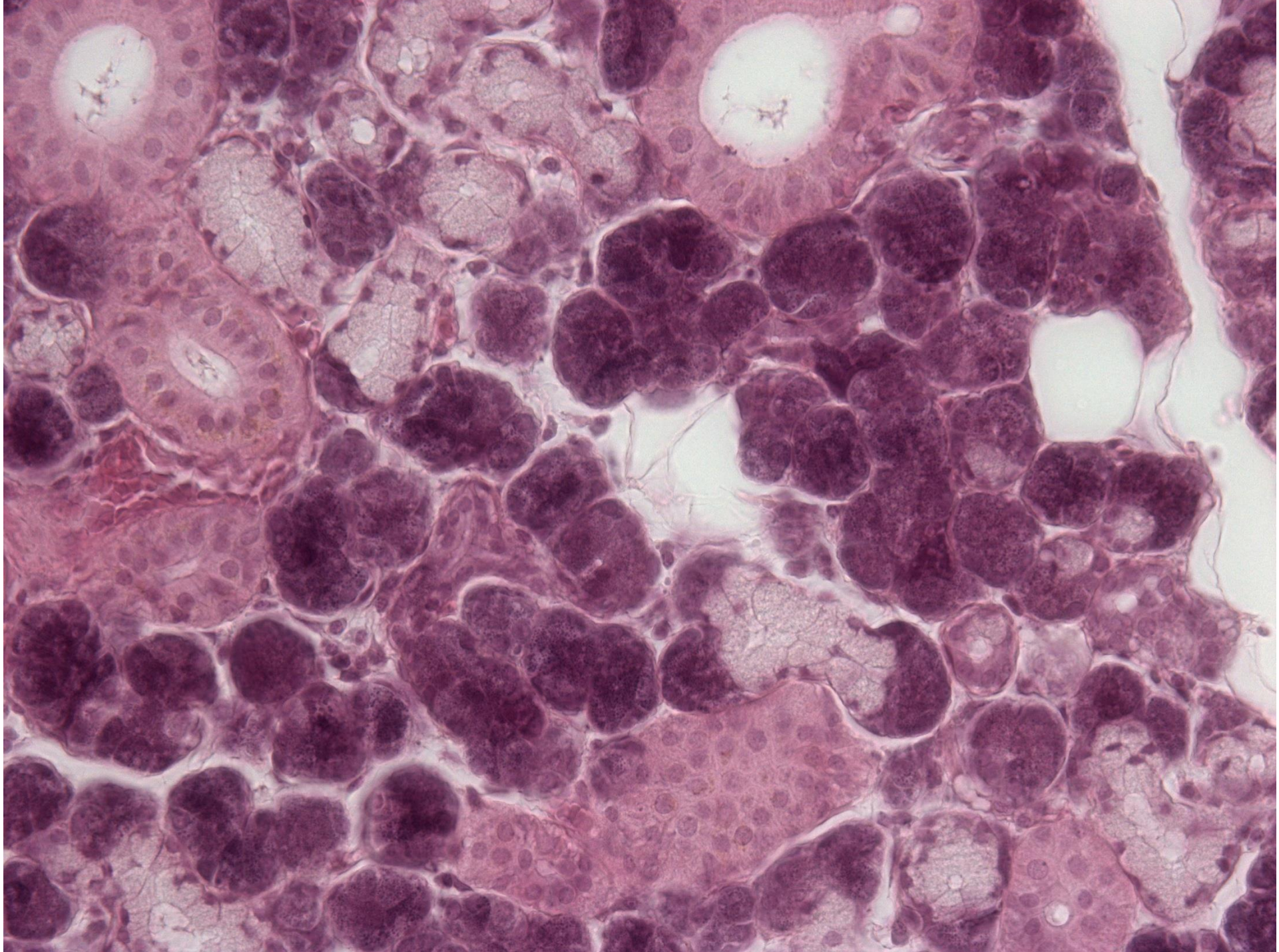


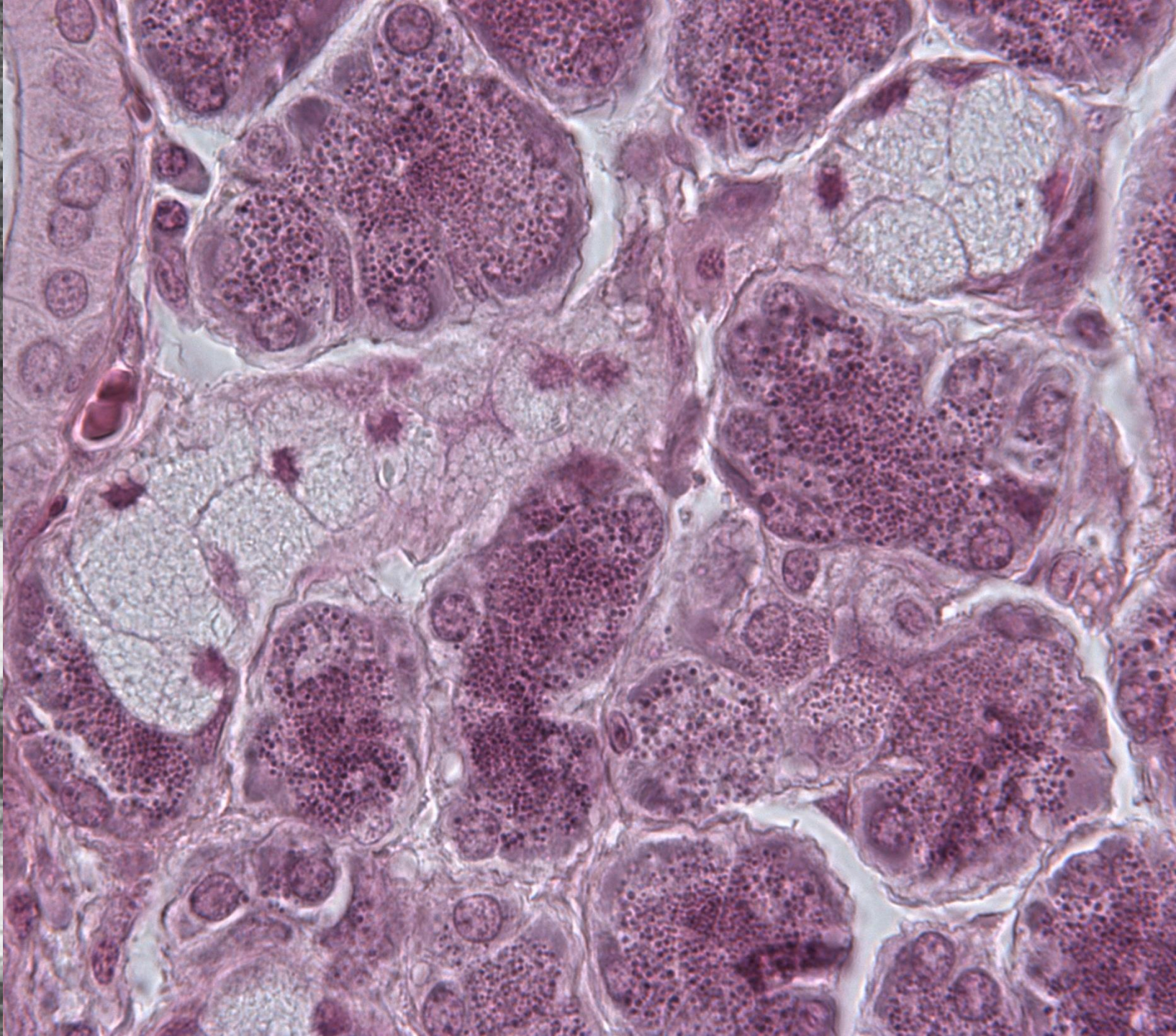
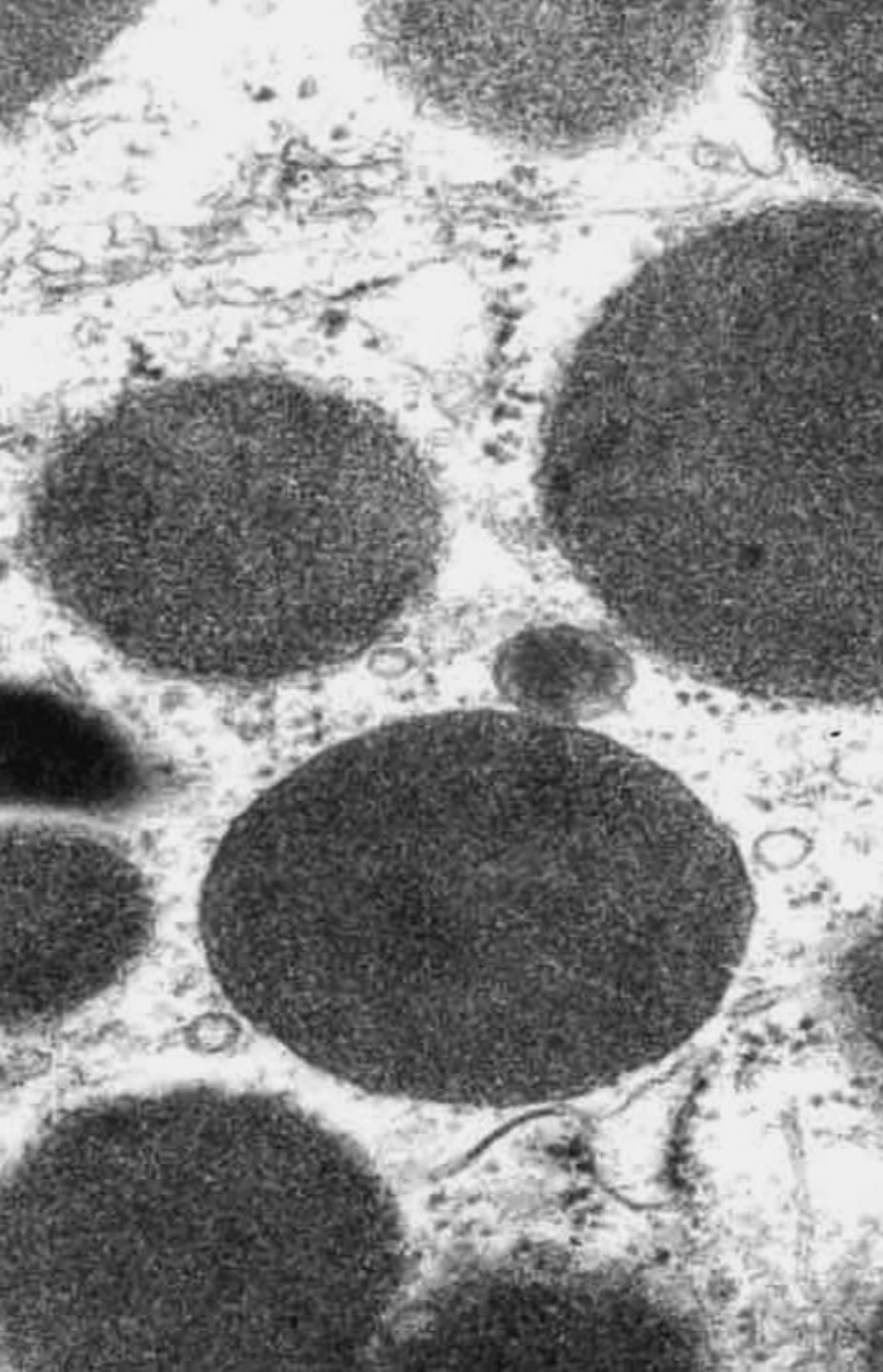
Salivary glands, pancreas, liver, gallbladder

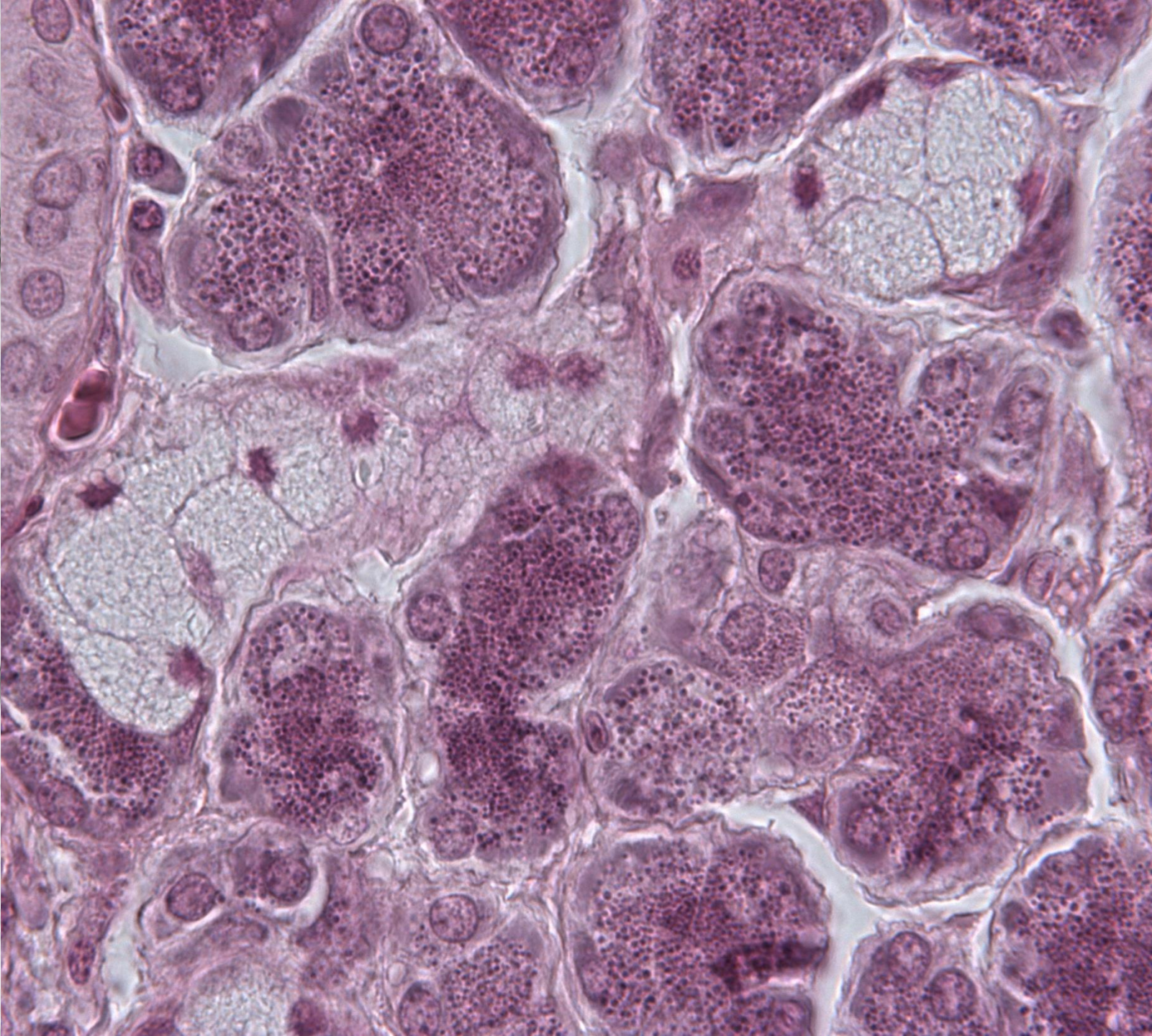
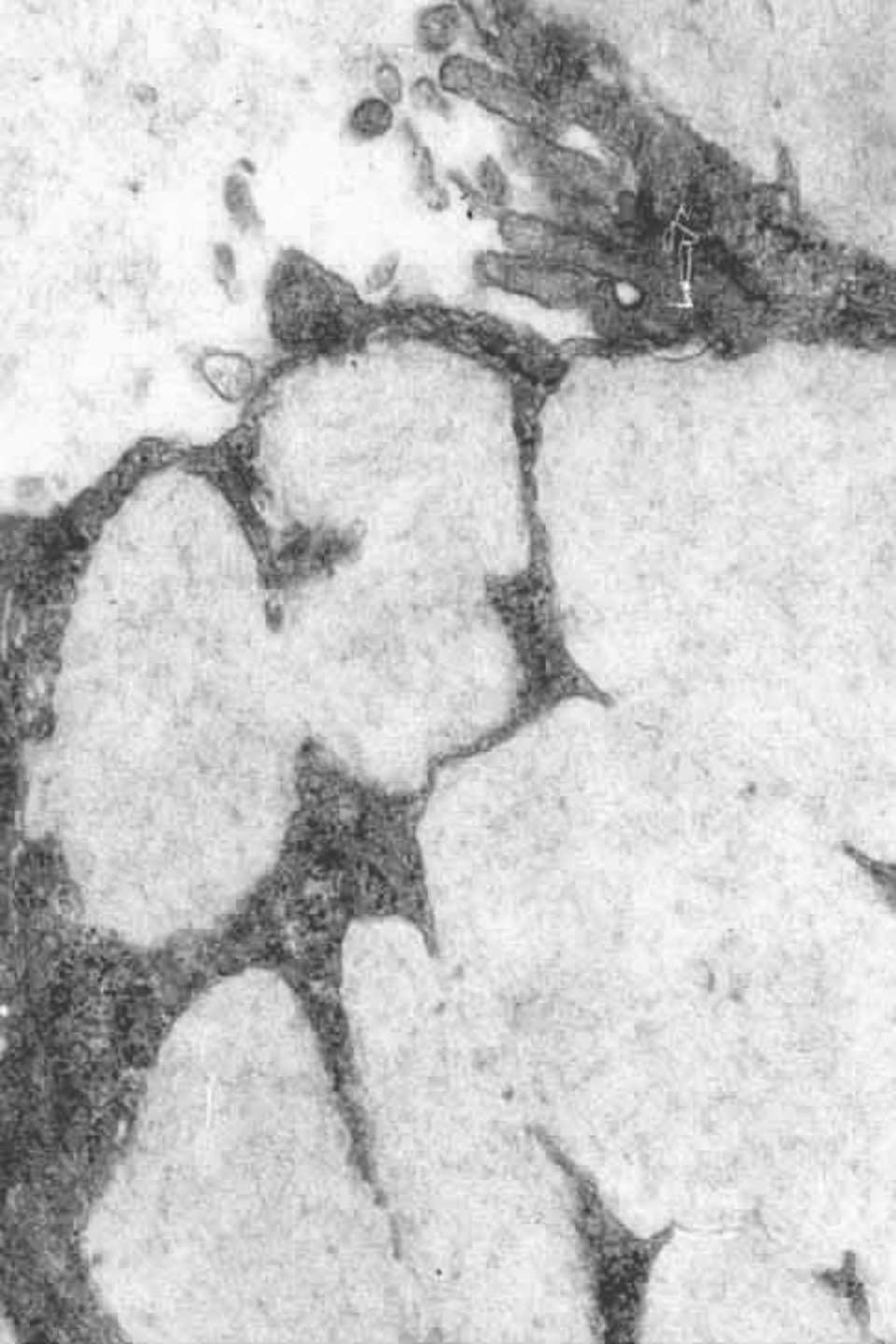
MUDr. Pavel Rořtok

Salivary glands









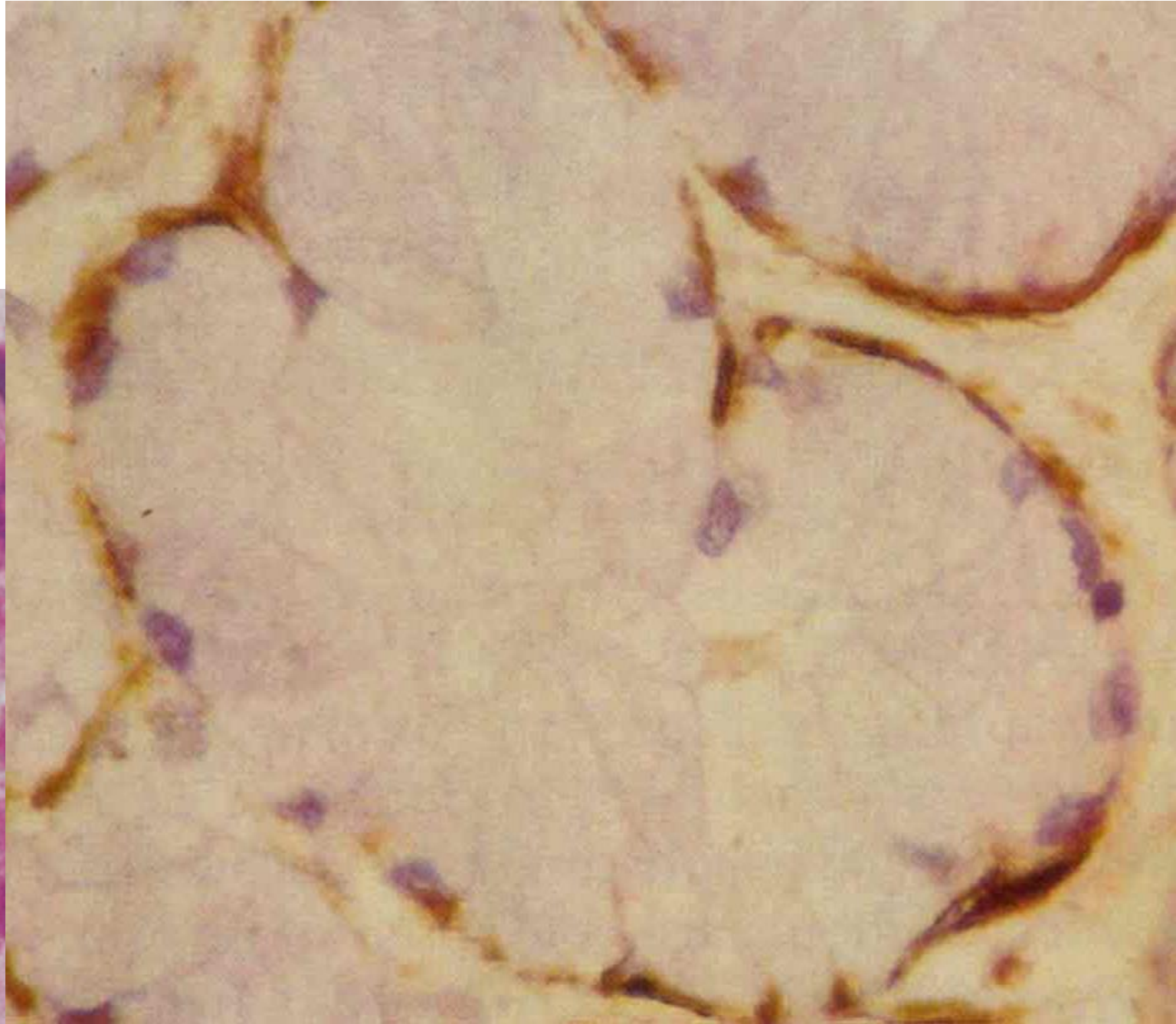
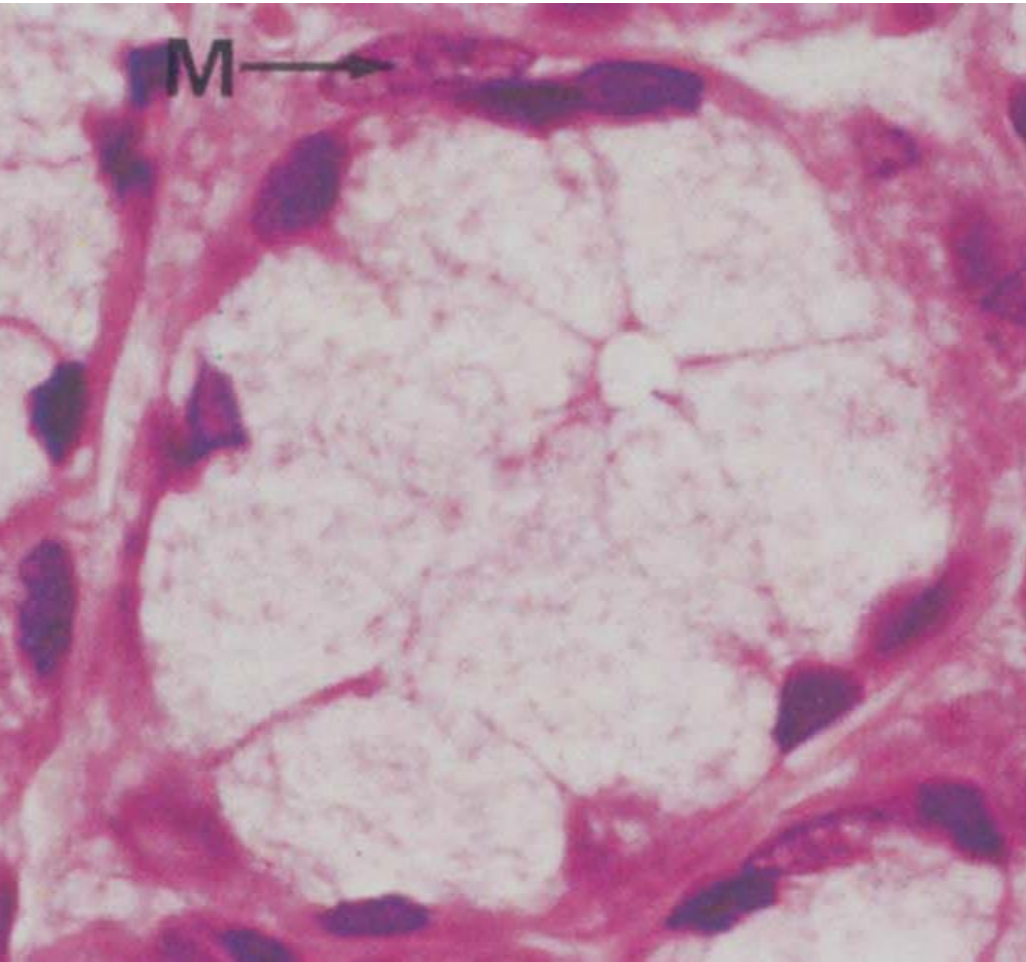
Rapid freezing

Conventional fixation



Yamashina S, Tamaki H, Katsumata O. The serous demilune of rat sublingual gland is an artificial structure produced by conventional fixation. *Arch Histol Cytol.* 1999 Oct;62(4):347-54. doi: 10.1679/aohc.62.347. PMID: 10596945.

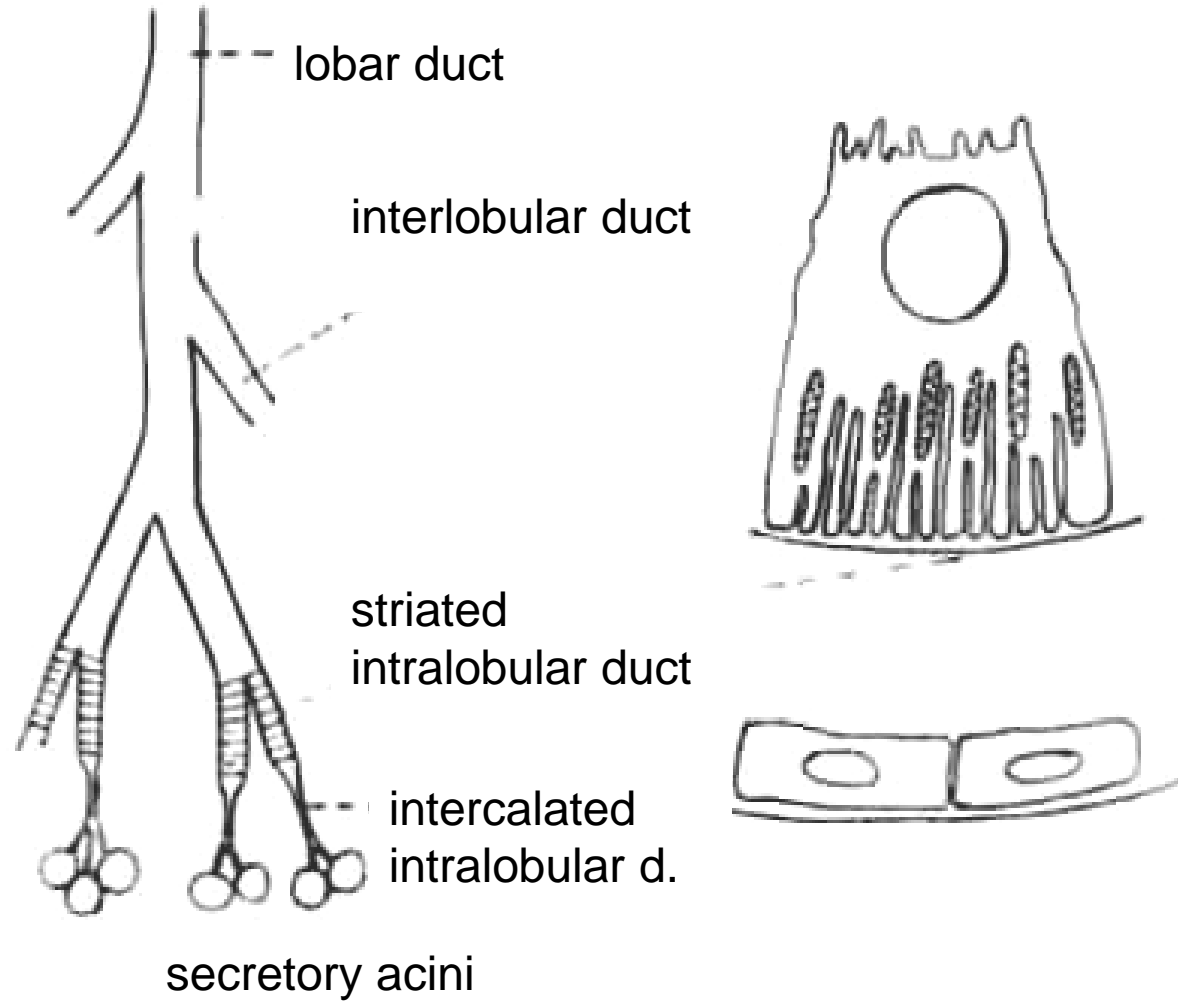
Myoepithelial cells (HE, IHC - actin)



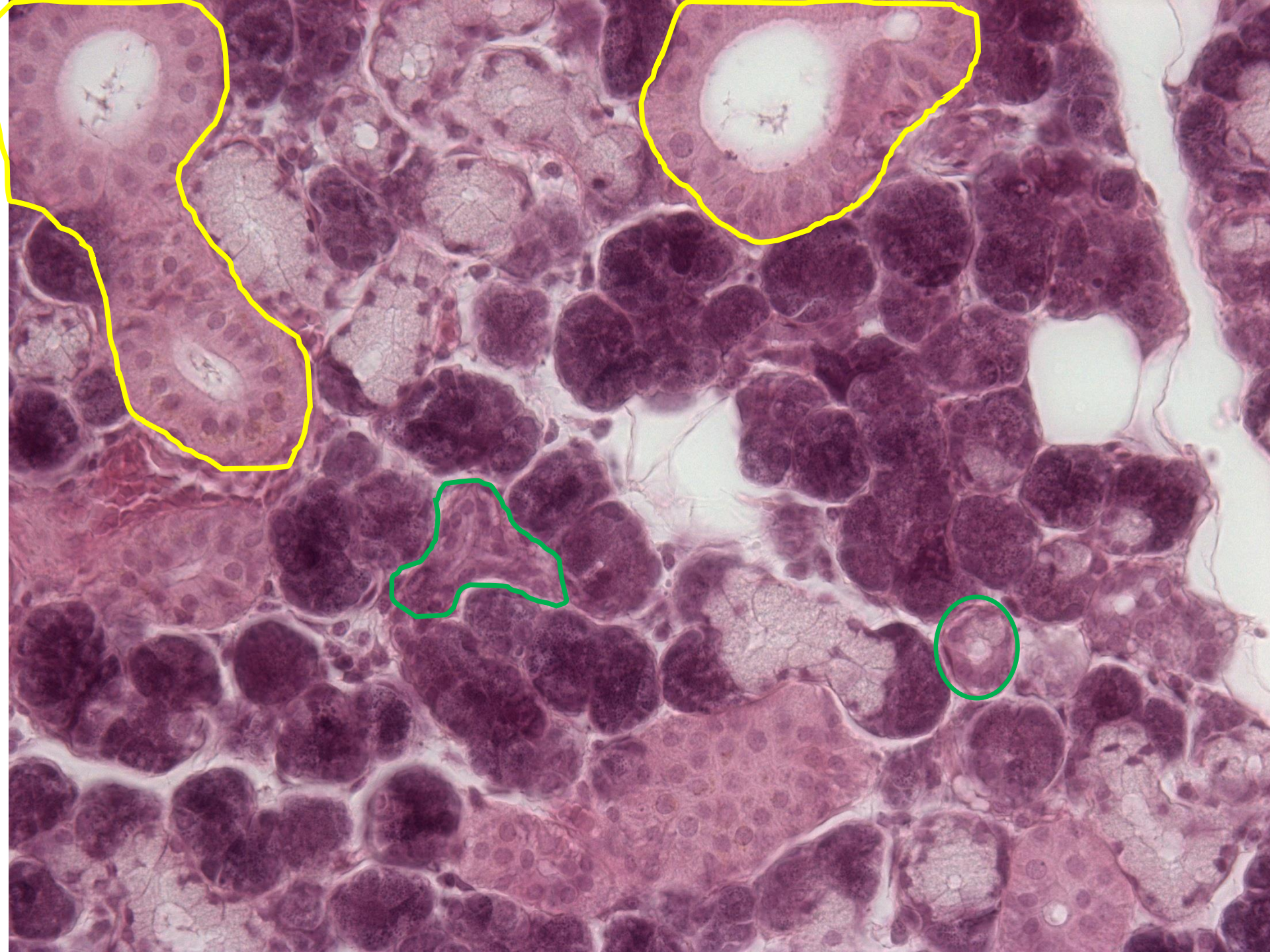
Salivary glands – secretory portion

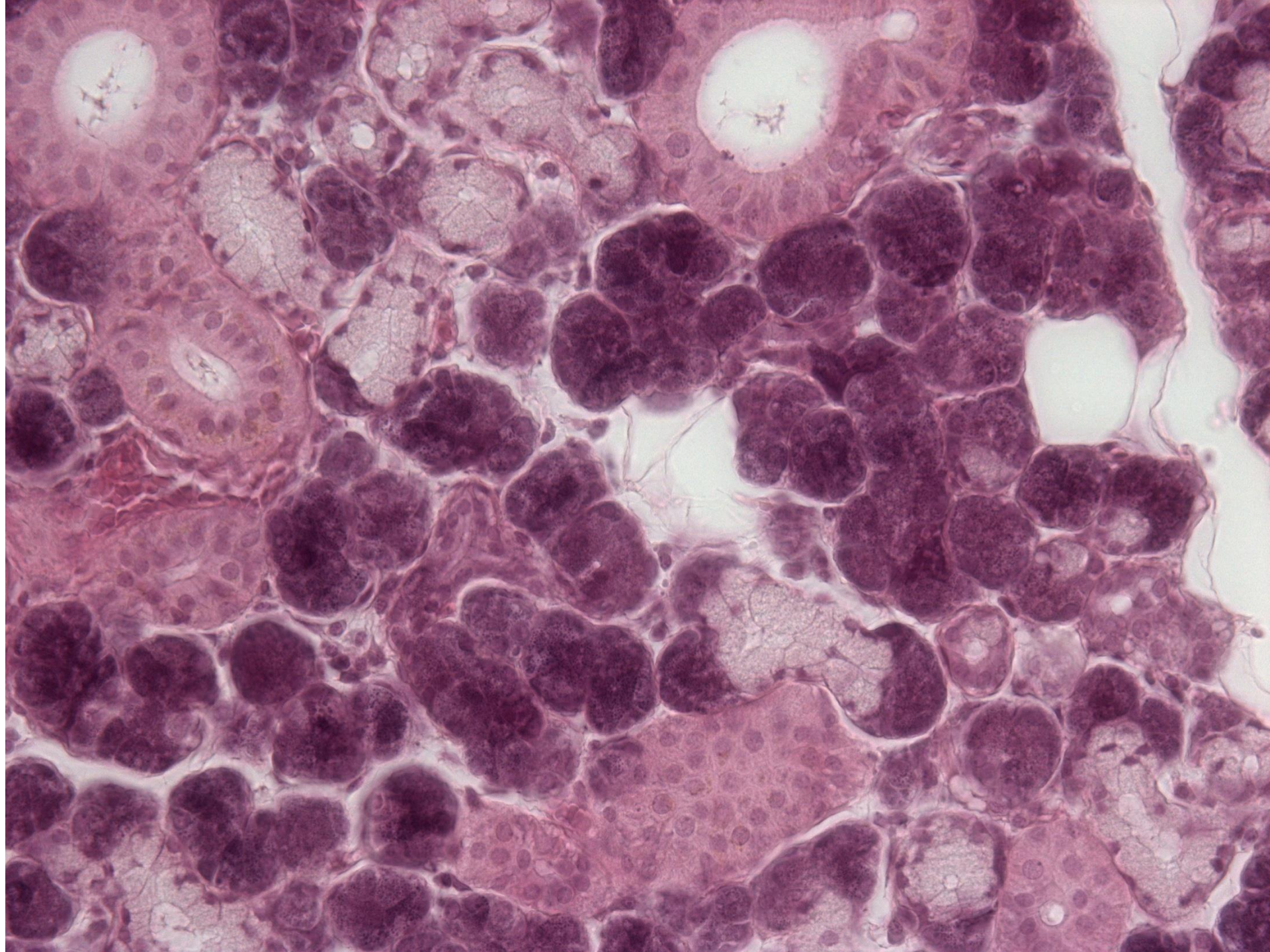
- Secretory portion (acini, tubules, demilunes)
- Produces protein (zymogen granules in serous cells), mucin (special glycoprotein in mucous cells)
- Myoepithelial cells are contractile

VÝVODY VELKÝCH SLINNÝCH ŽLÁZ



Striated
ducts
(yellow) and
intercalated
ducts
(green)

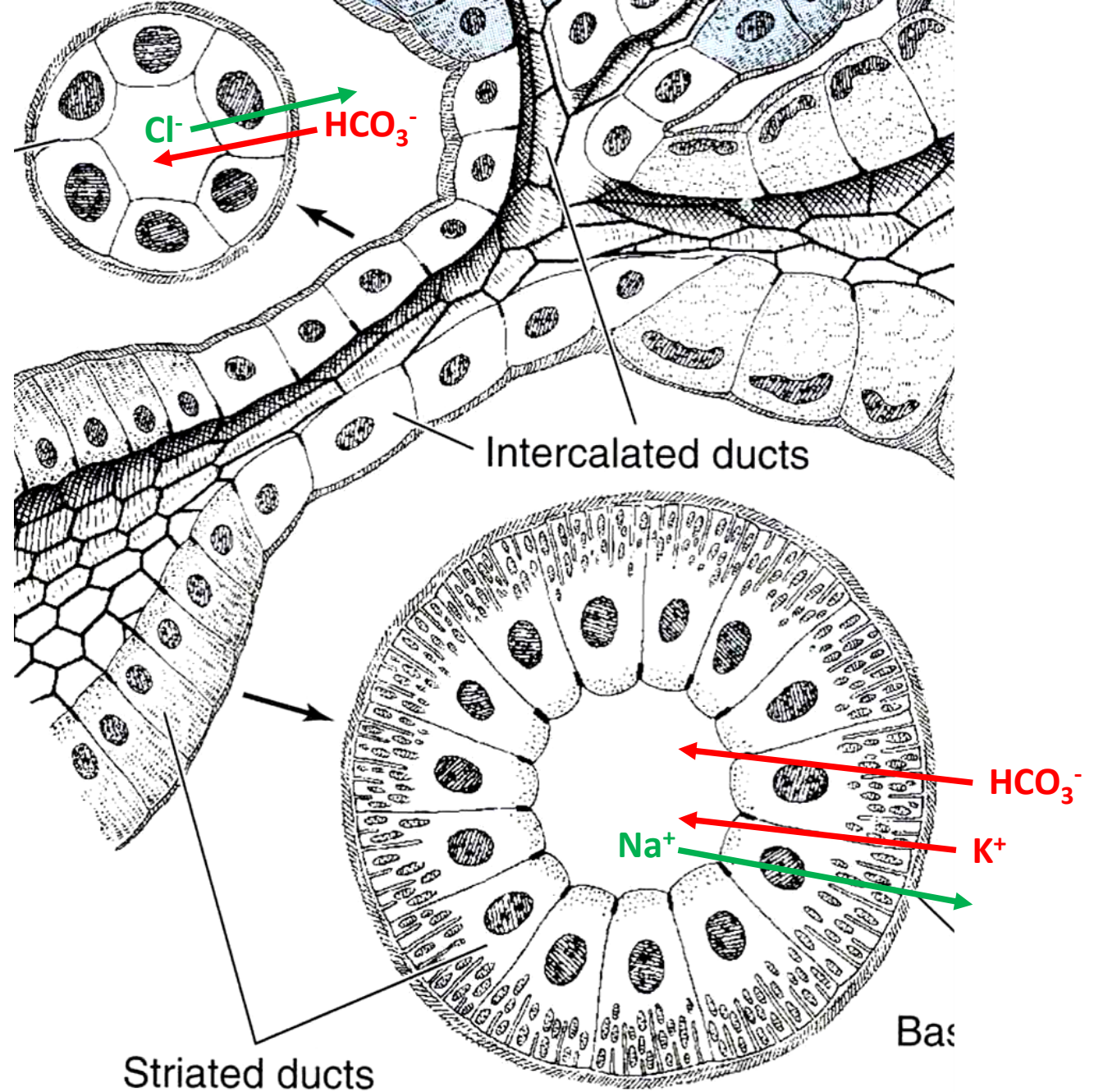




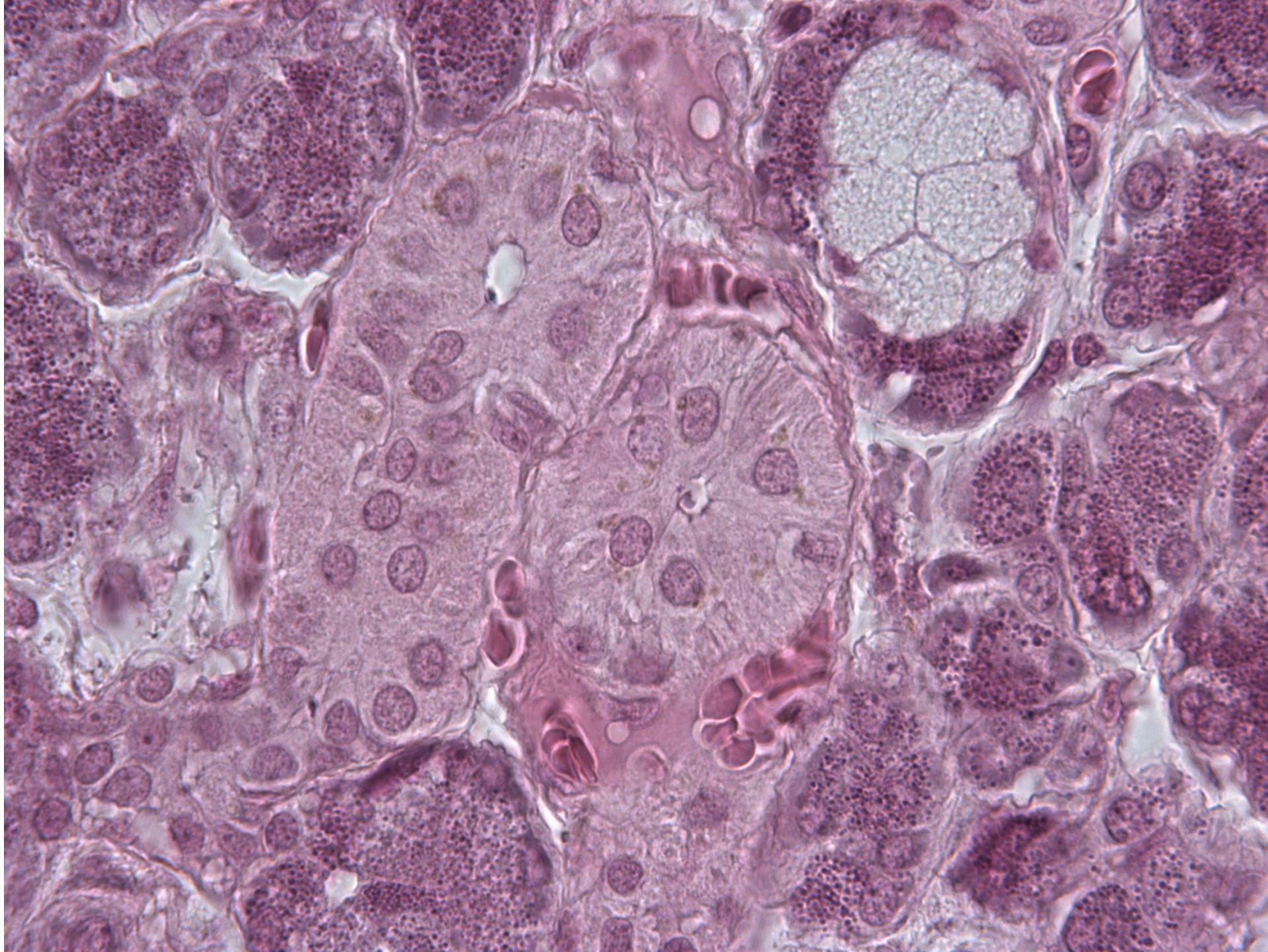
What happens in the intralobular portion of the duct system?

Reabsorption of ions causes the saliva to be hypotonic.

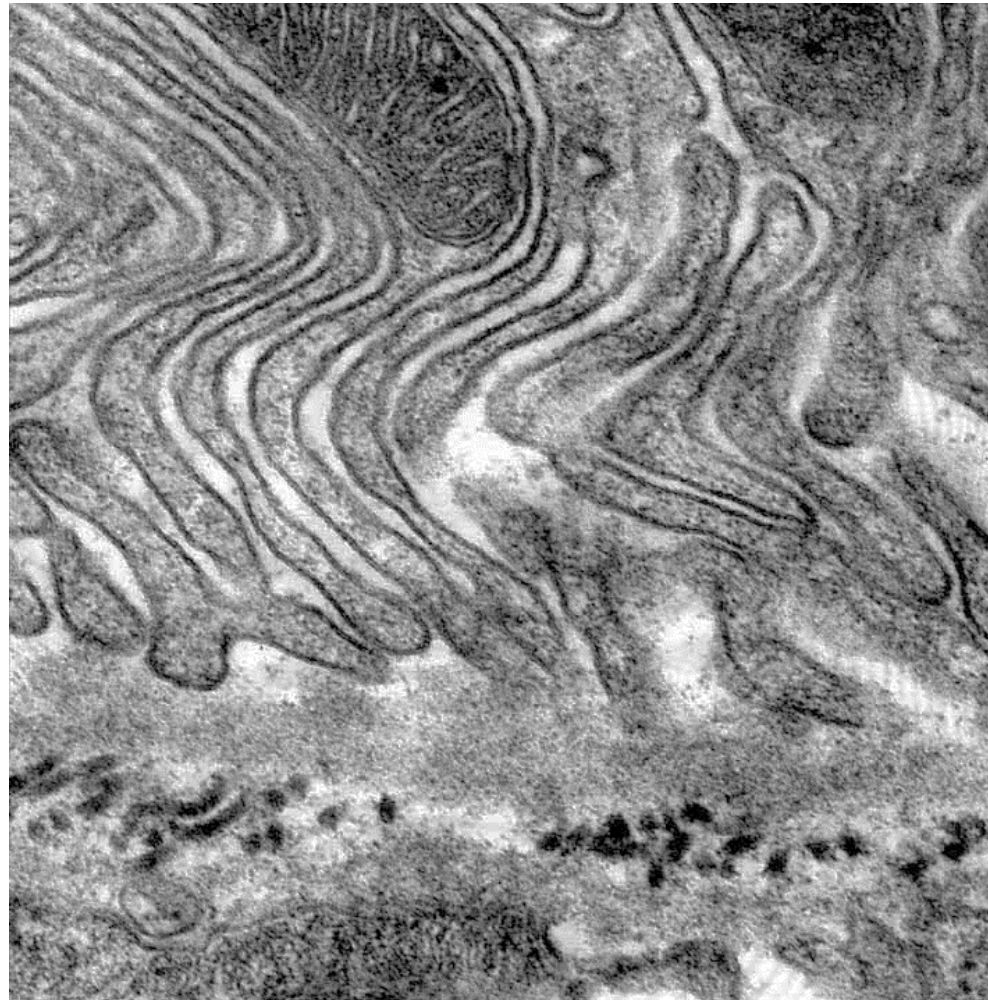
„The final saliva that enters the mouth, on average, contains 2-5 mEq/L of NaCl and 2-5 mg/ml protein“



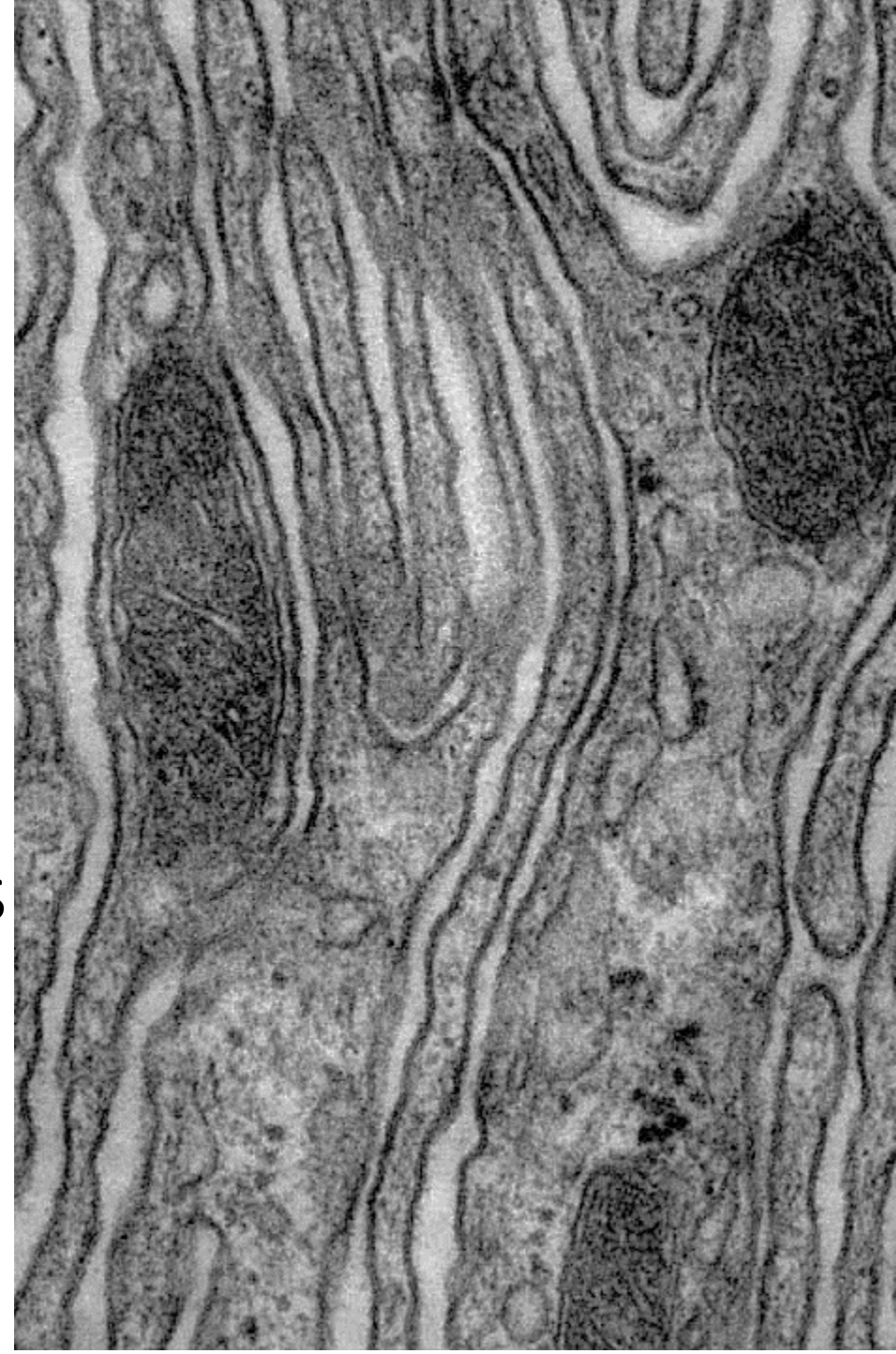
Striated
duct



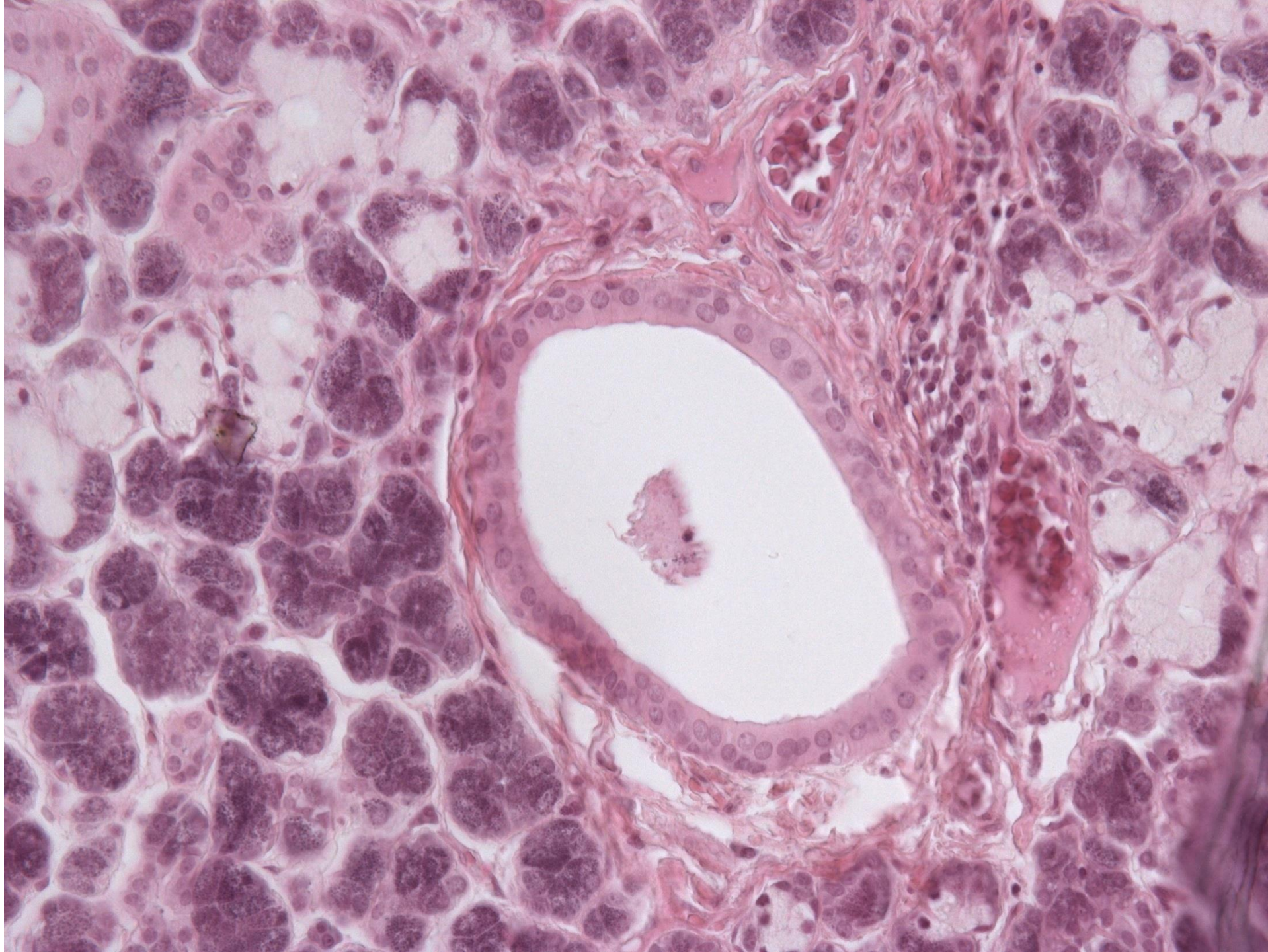
Striated duct – basal infoldings (a.k.a. basal labyrinth)



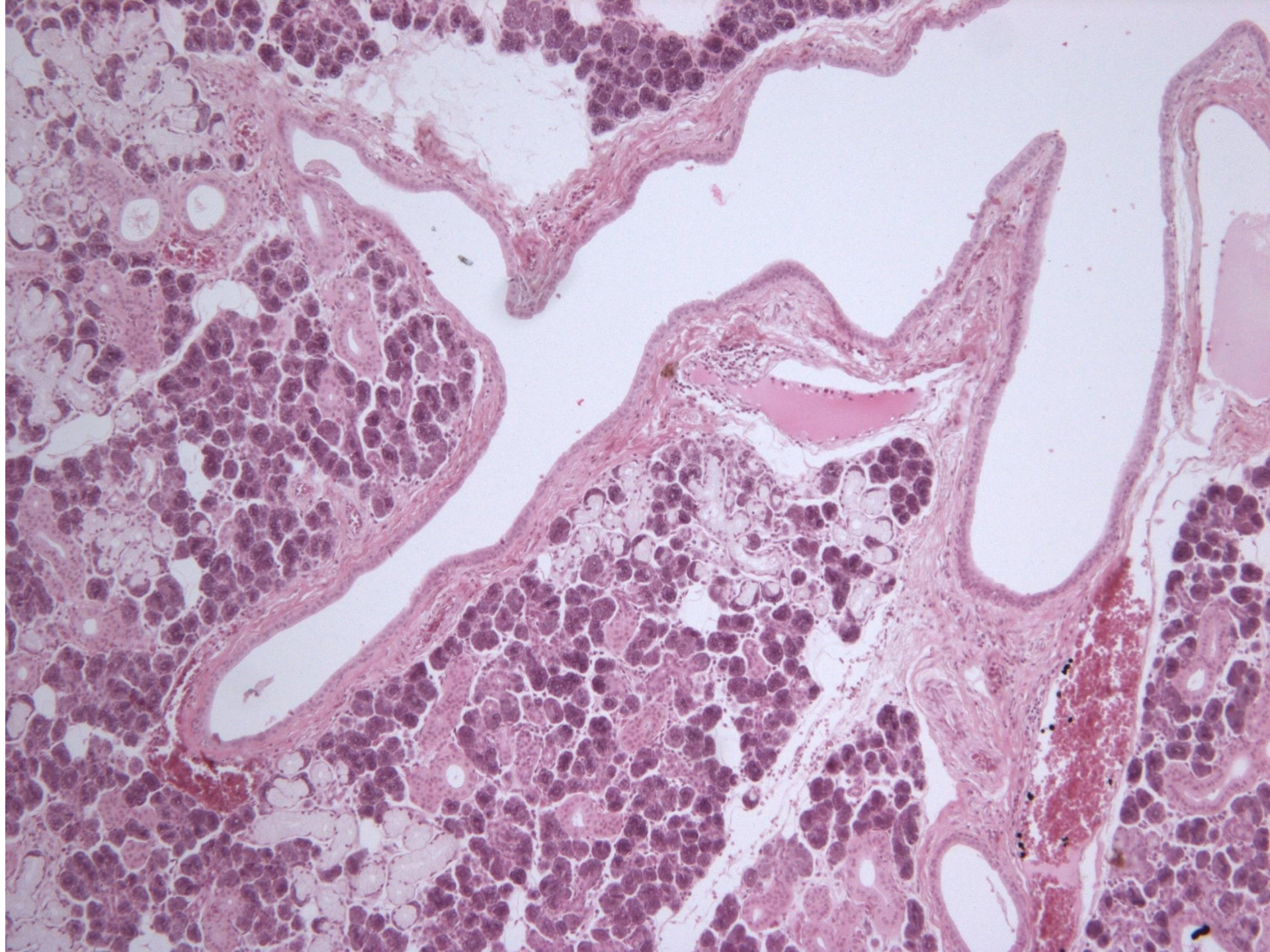
Mitochondria
are inclosed in
these infoldings

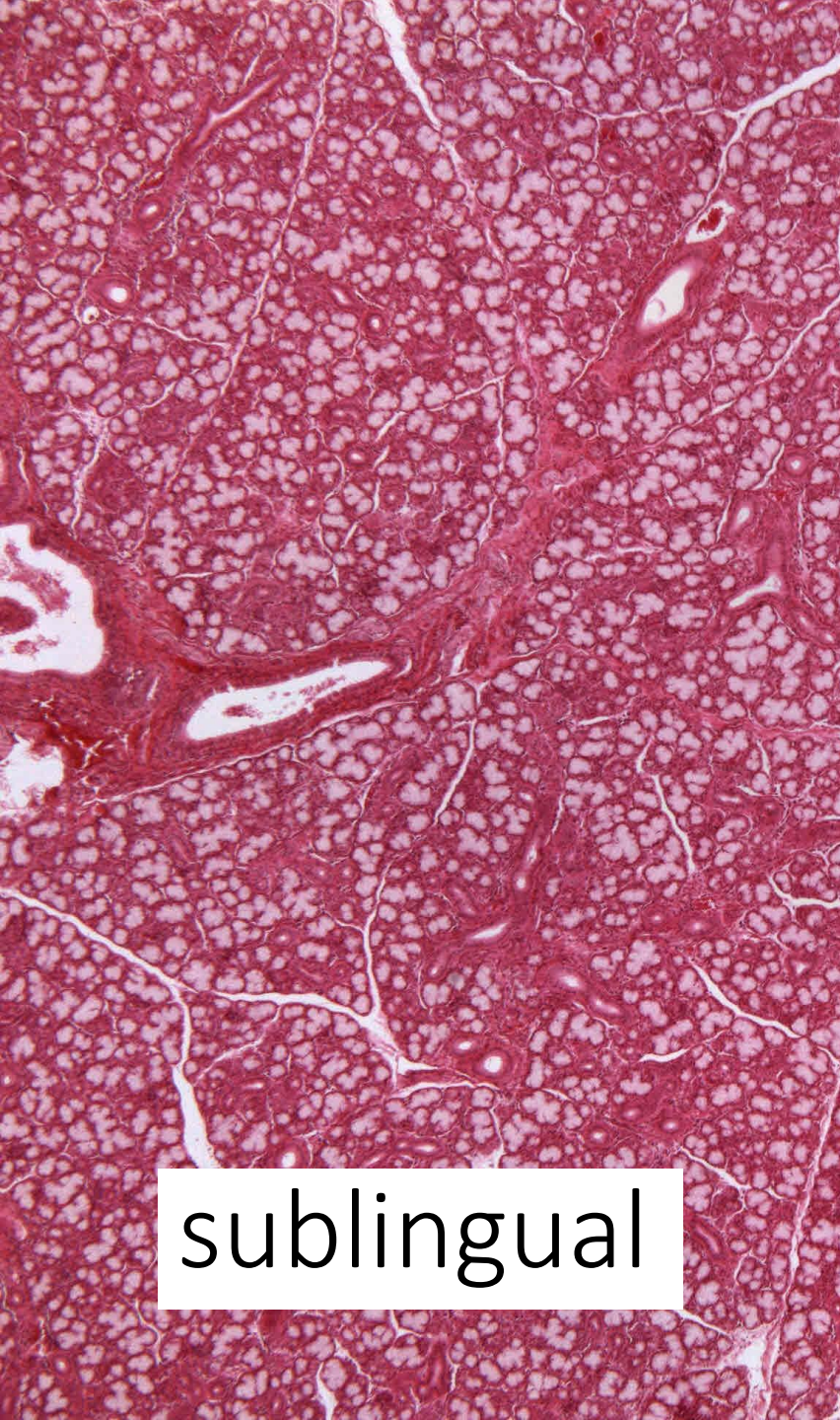


Interlobular
duct

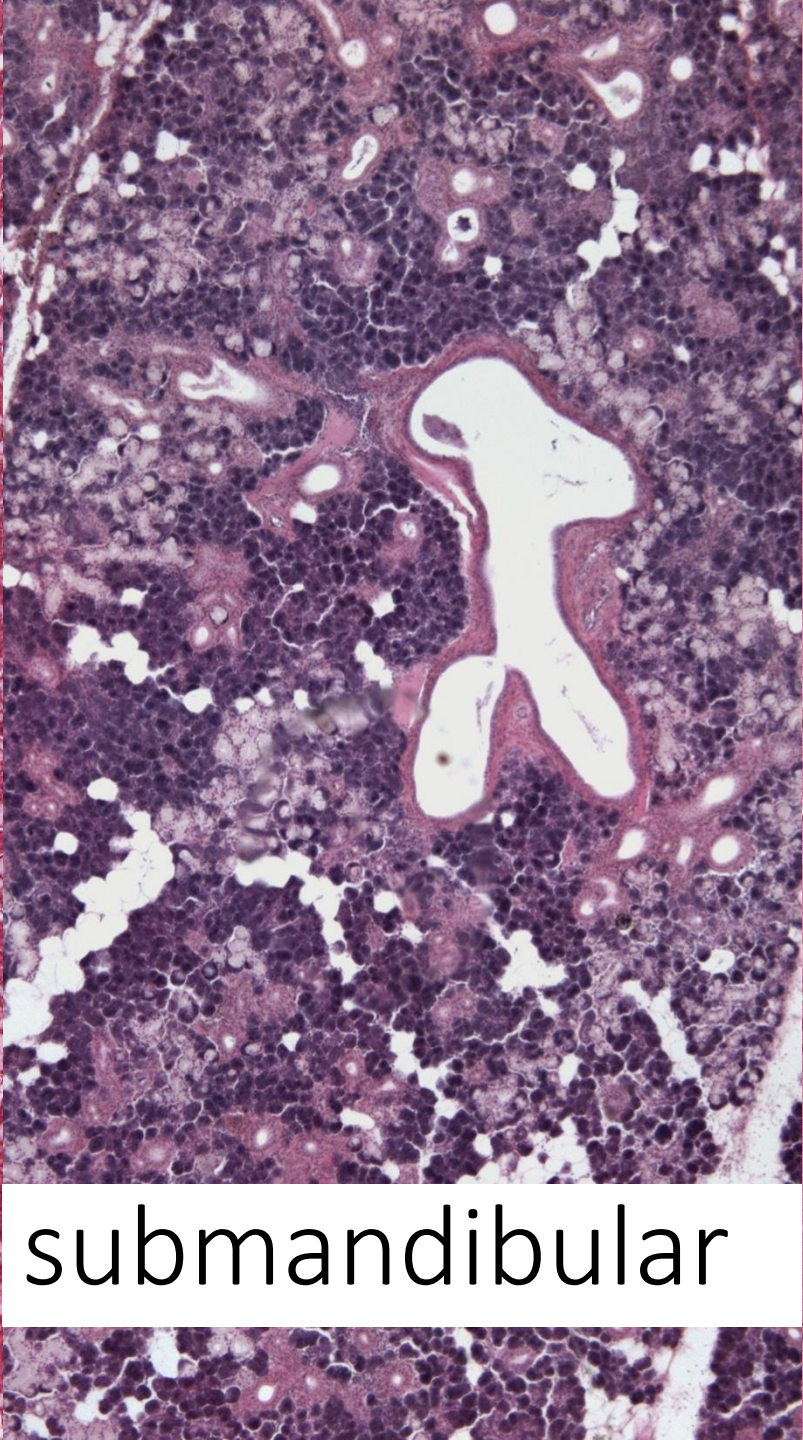


Lobar
duct

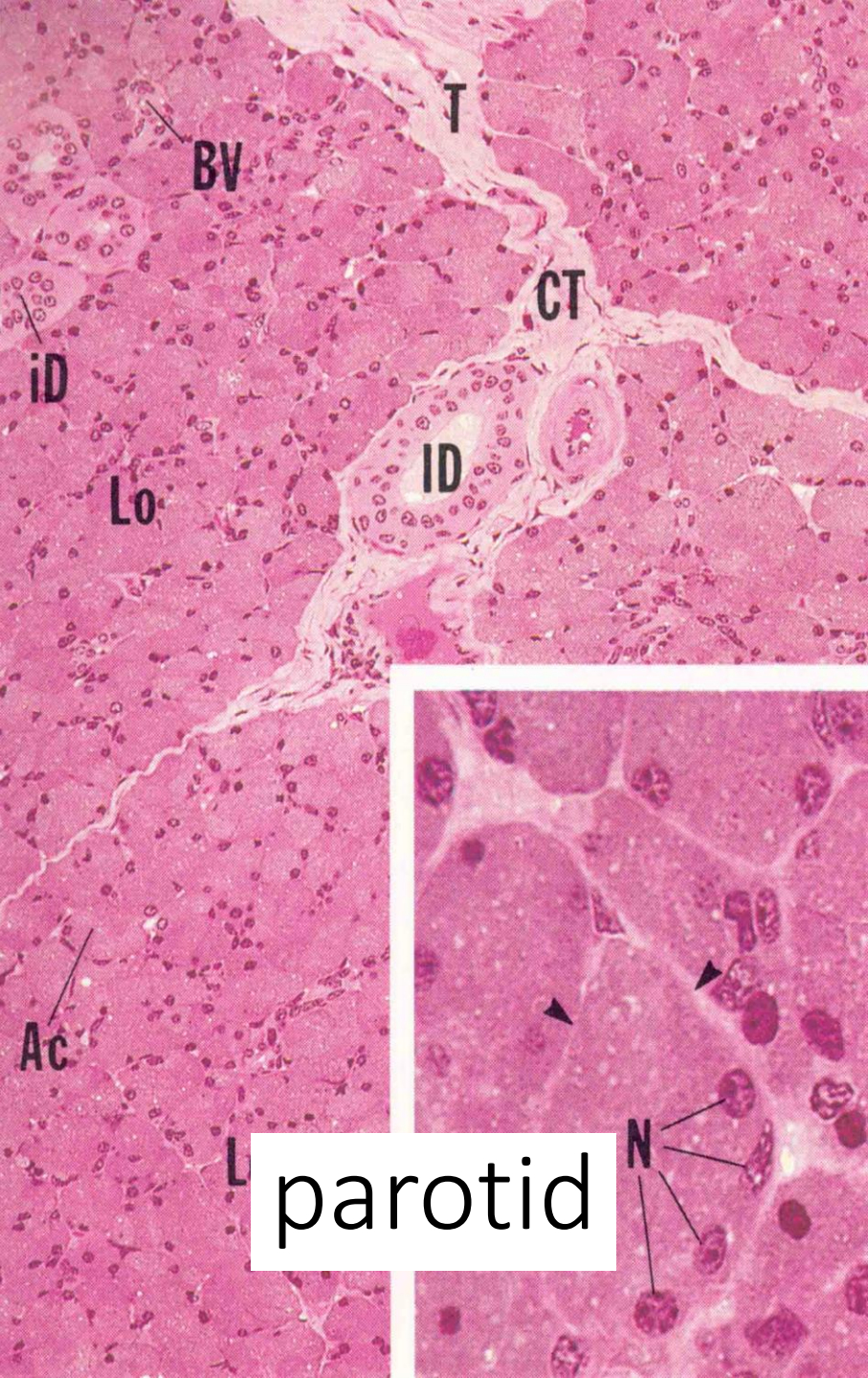




sublingual

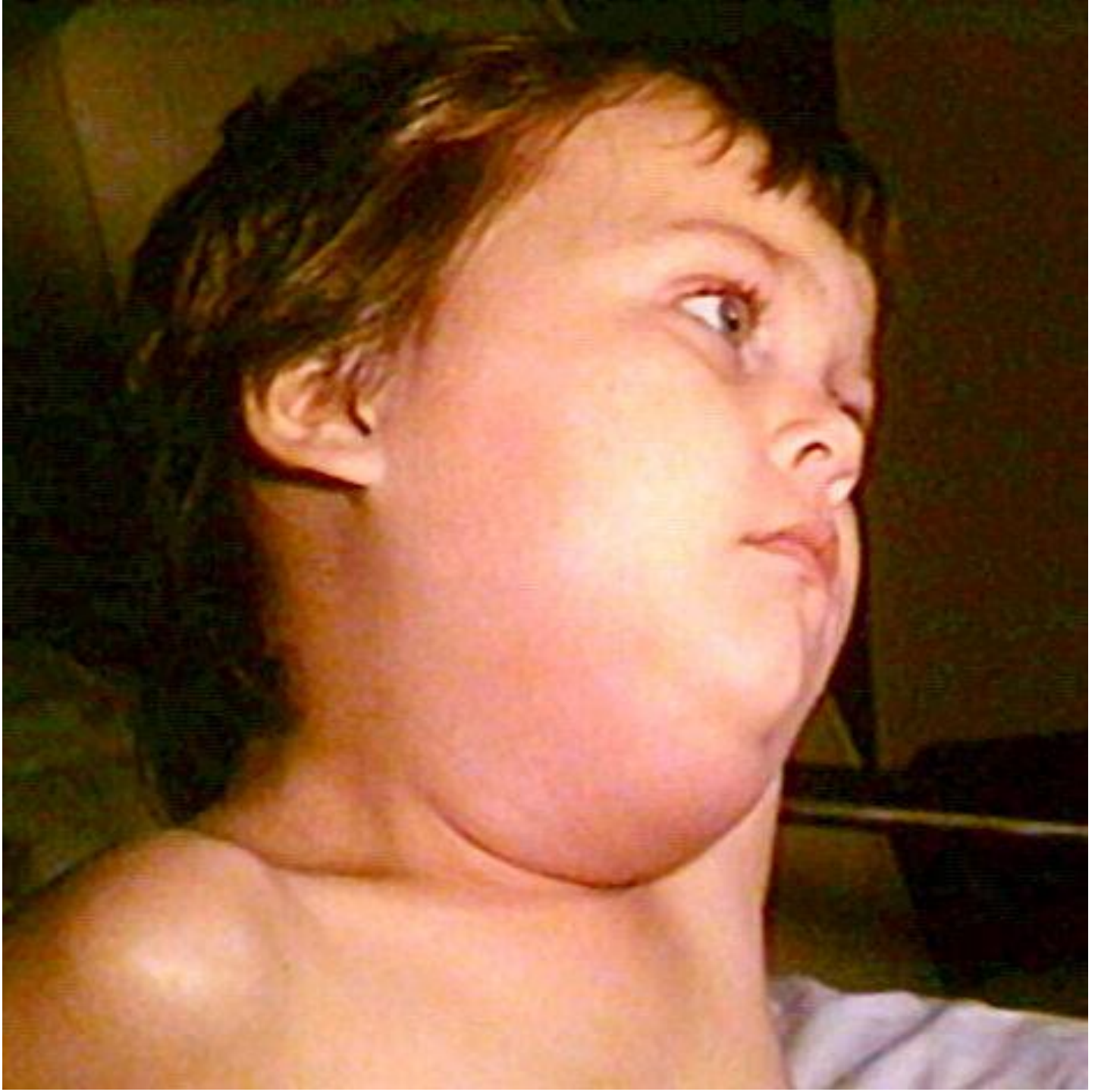


submandibular



parotid

Disease?

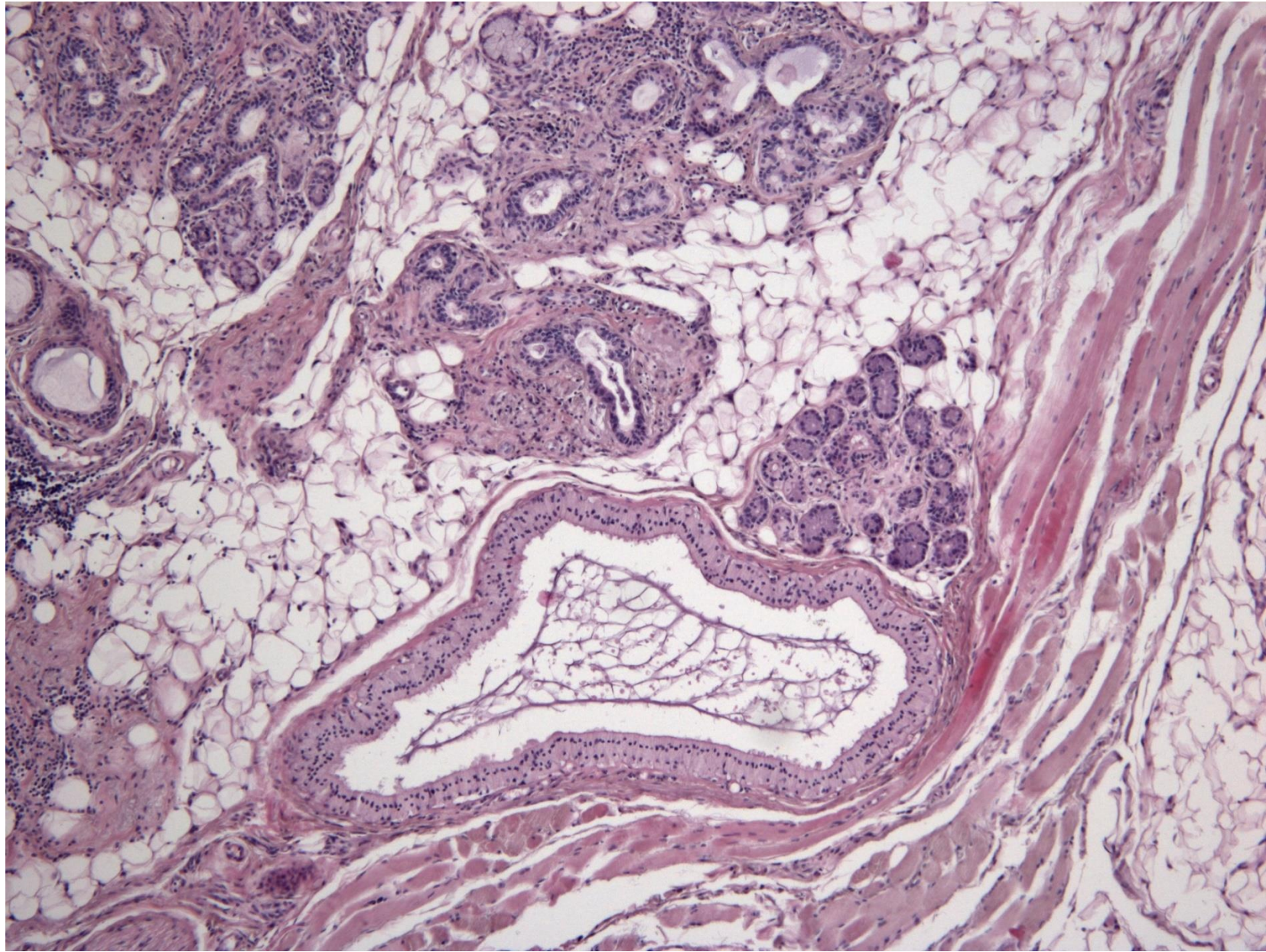


Major salivary glands

- Parotis
 - Completely serous, largest, adipose tissue
- Submandibularis
 - Predominantly serous, not so many intercalated ducts
- Sublingual
 - Predominantly mucous, multiple excretory ducts

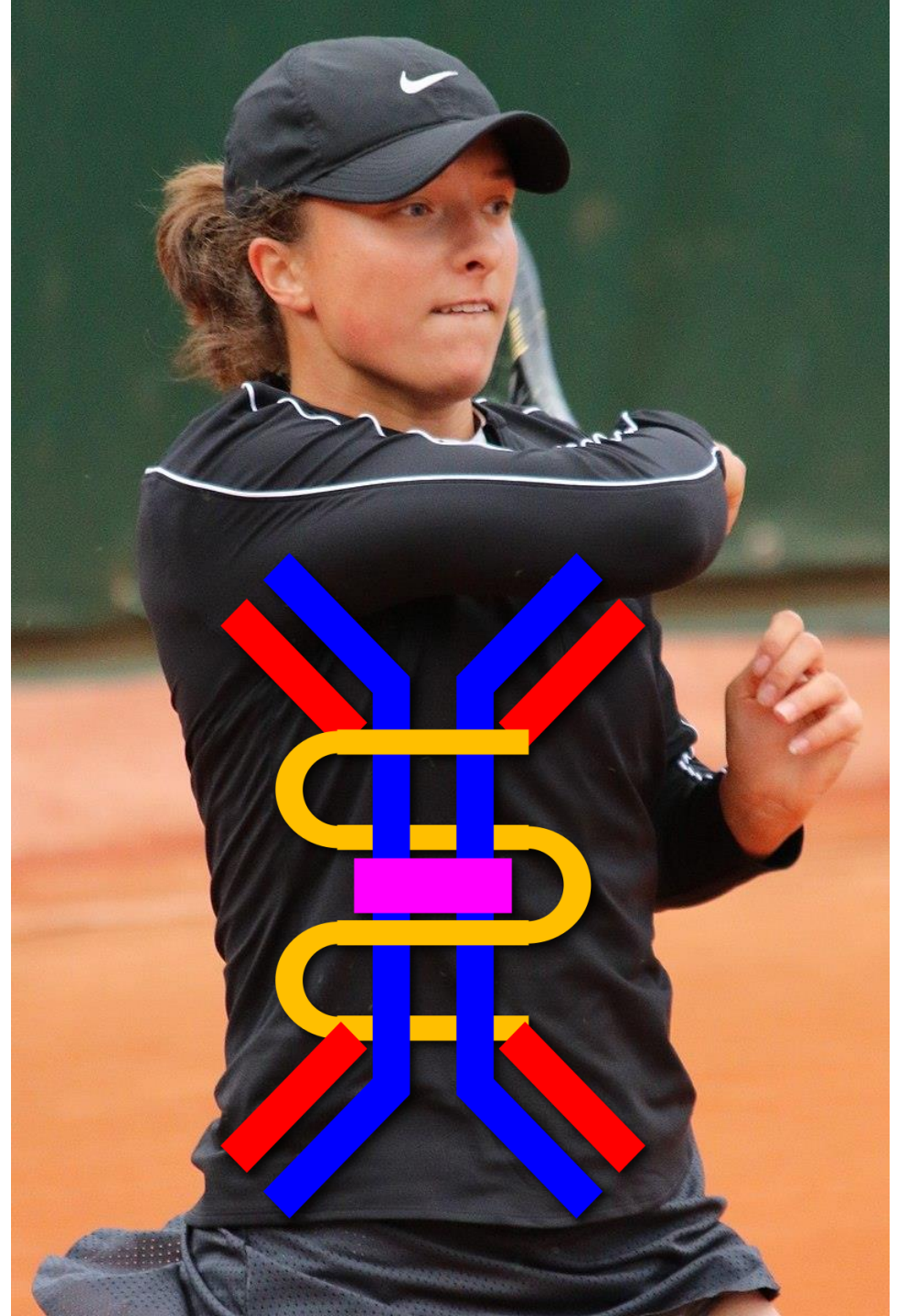
Minor salivary glands

- Seromucous
 - Labial, buccal...
- Mucous
 - Palatine, Weber glands of the tongue
- Serous
 - Von Ebner glands of the tongue



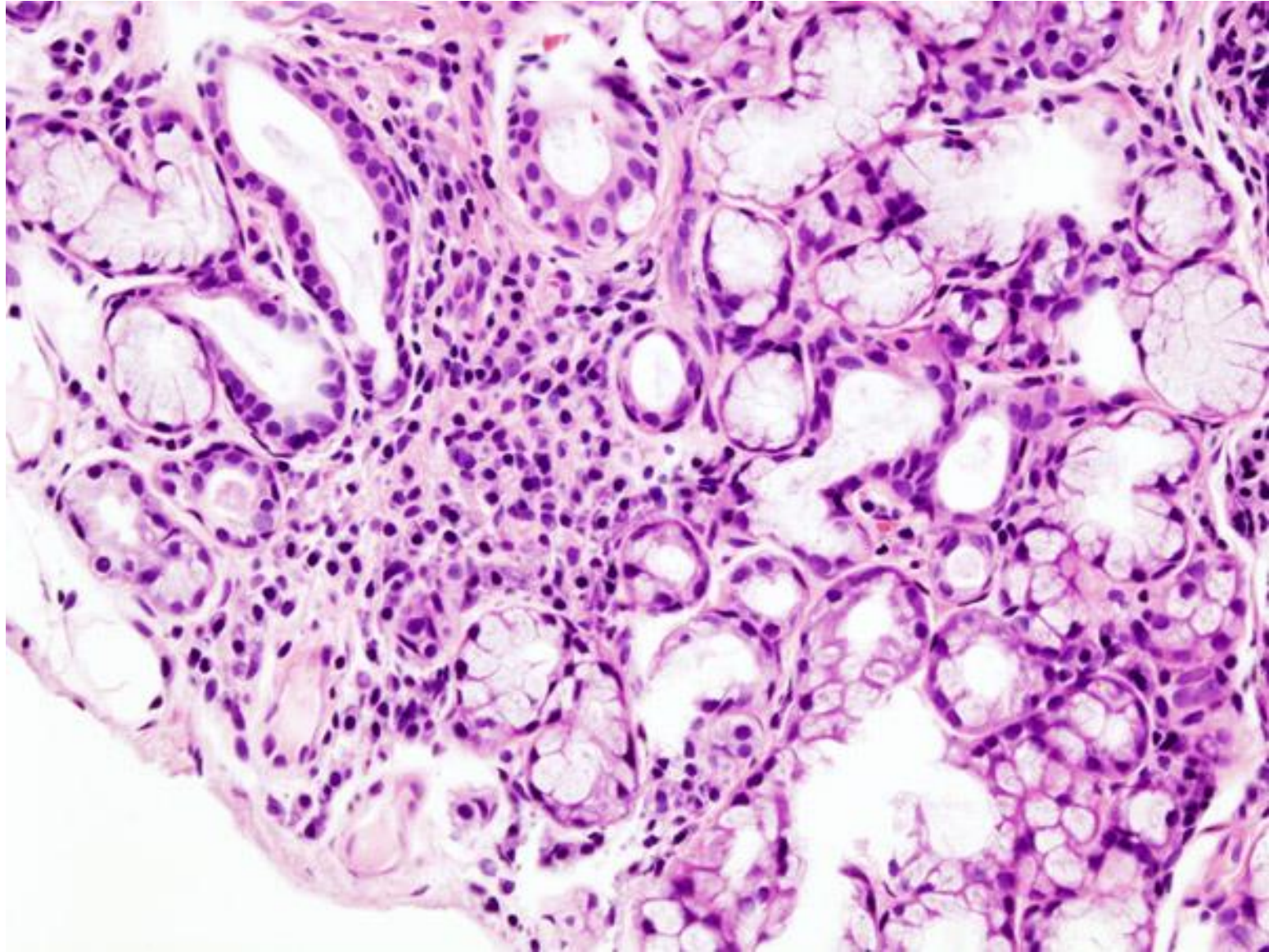
Saliva - function

- Moisture
- Taste
- Buffering pH
- Immunity (IgA, lysozyme, lactoferrin)
- Digestion (amylase, lipase)

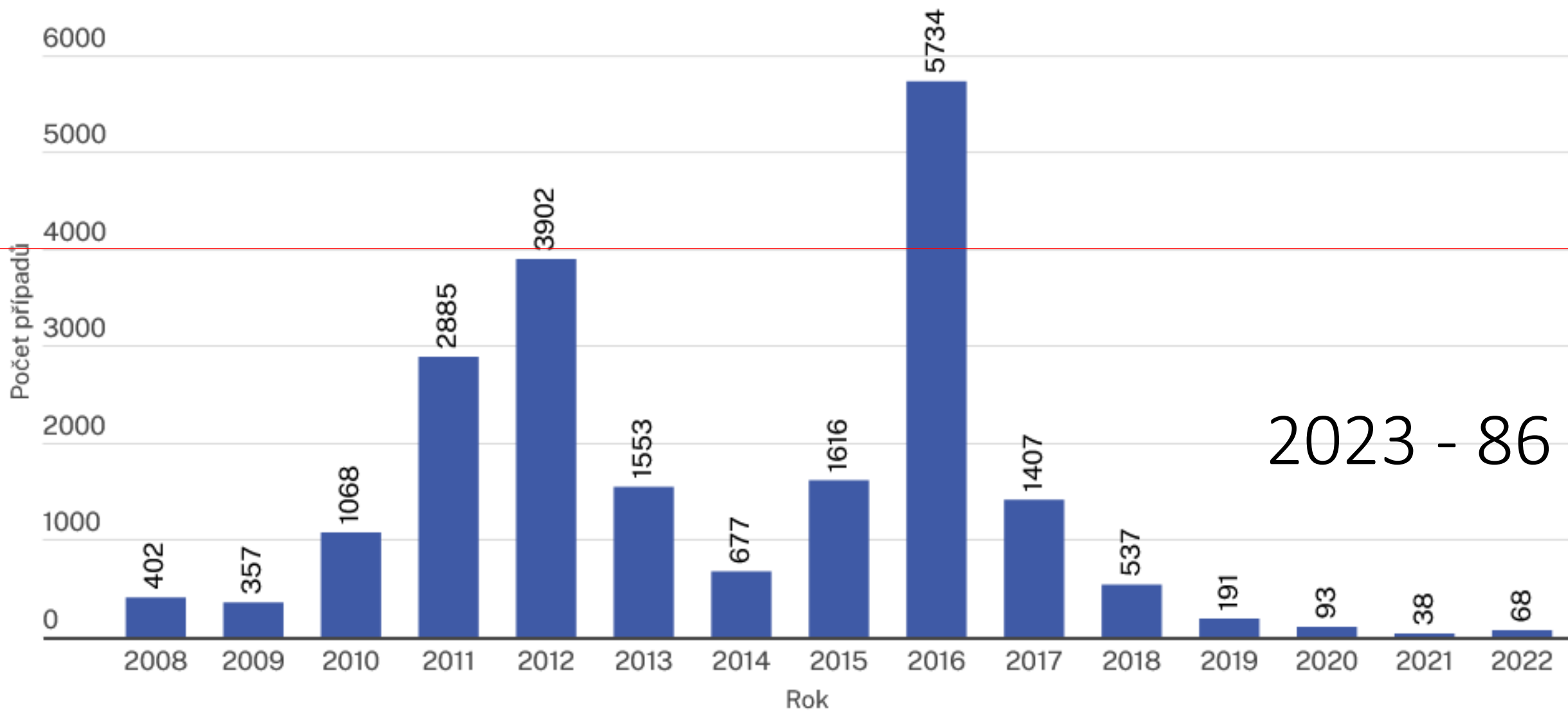


Sjögren syndrome

- Autoimmune disease
- Lymphocytic infiltrate
- Prevalence 40 - 100 per 100,000 people (uptodate.com)
- Symptoms?

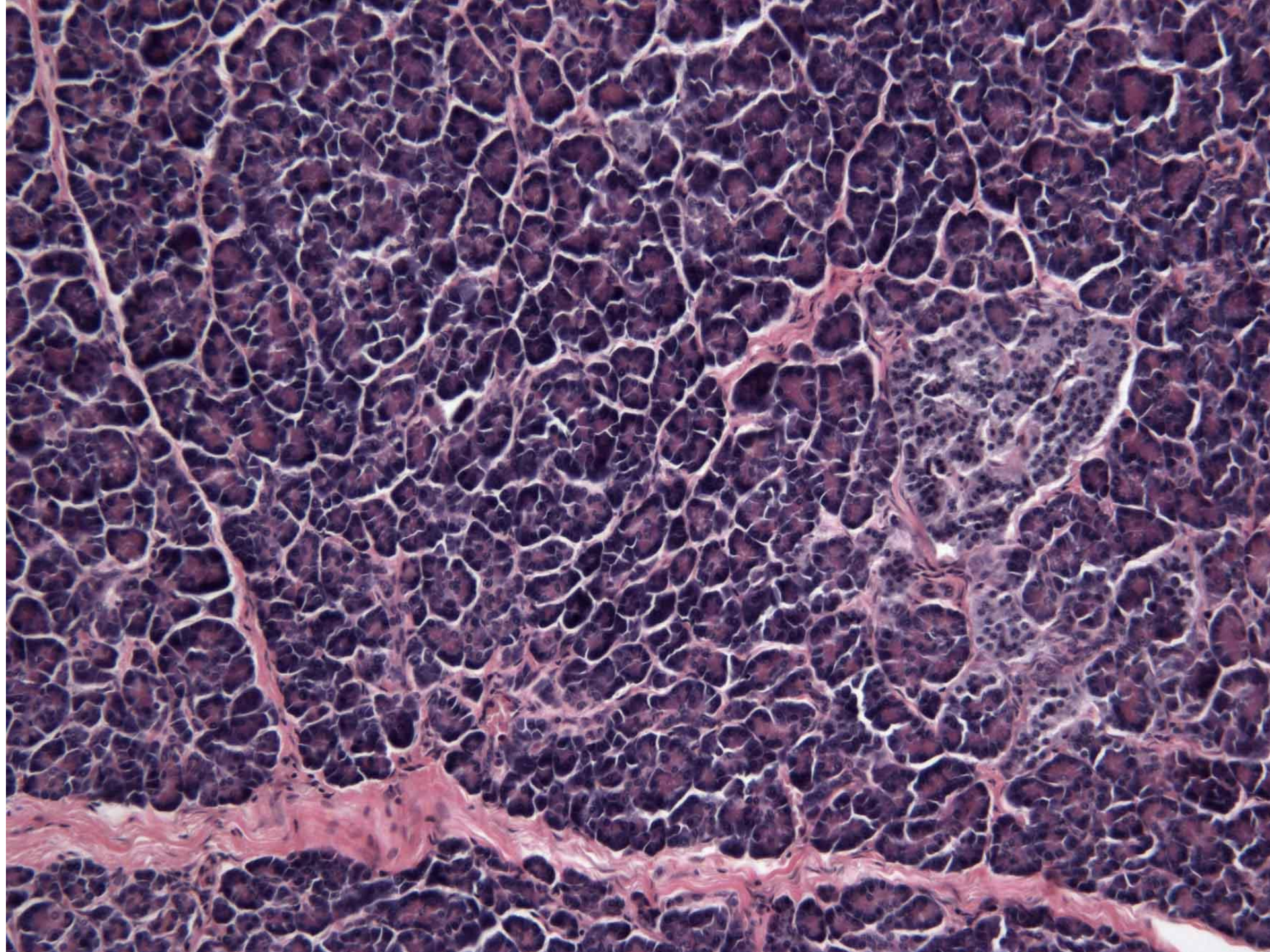


Počet případů průušnic v ČR

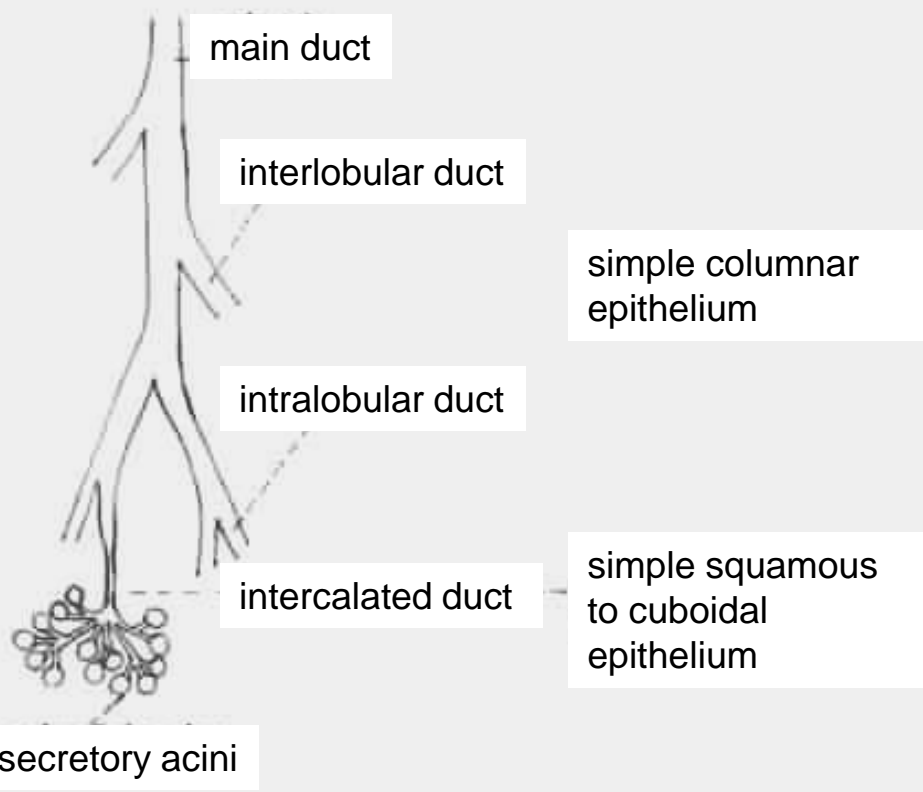
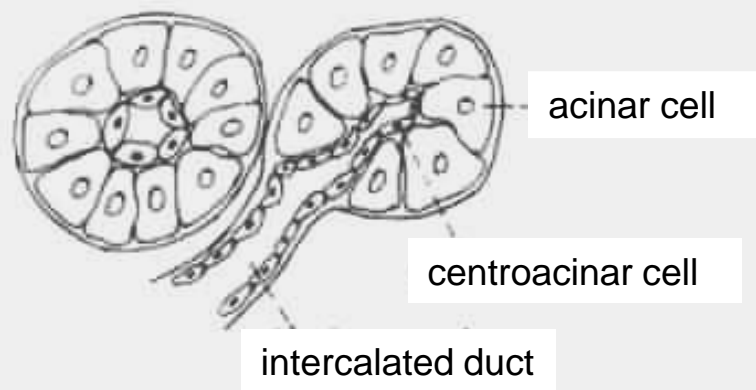


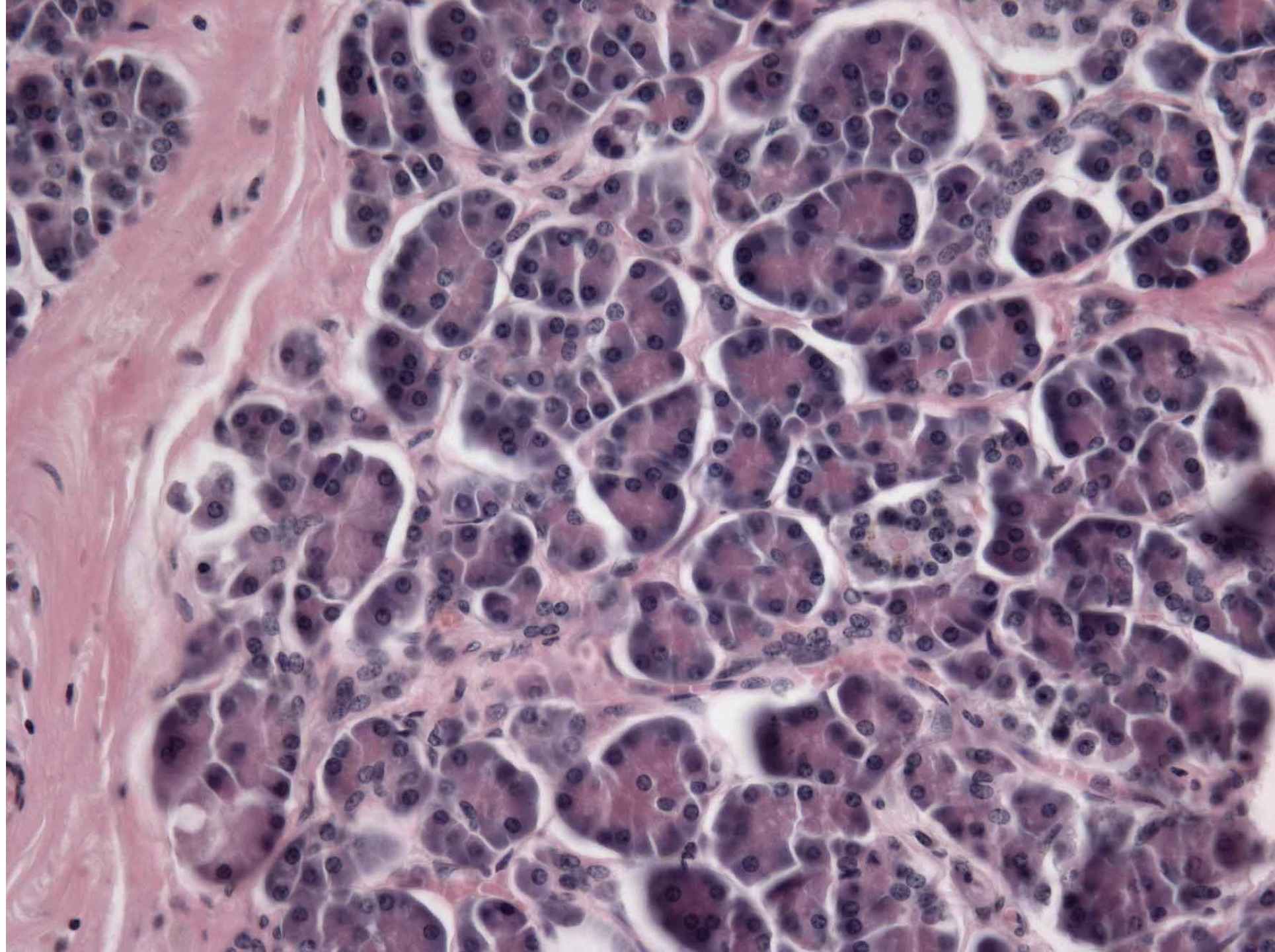
Iga, Japan

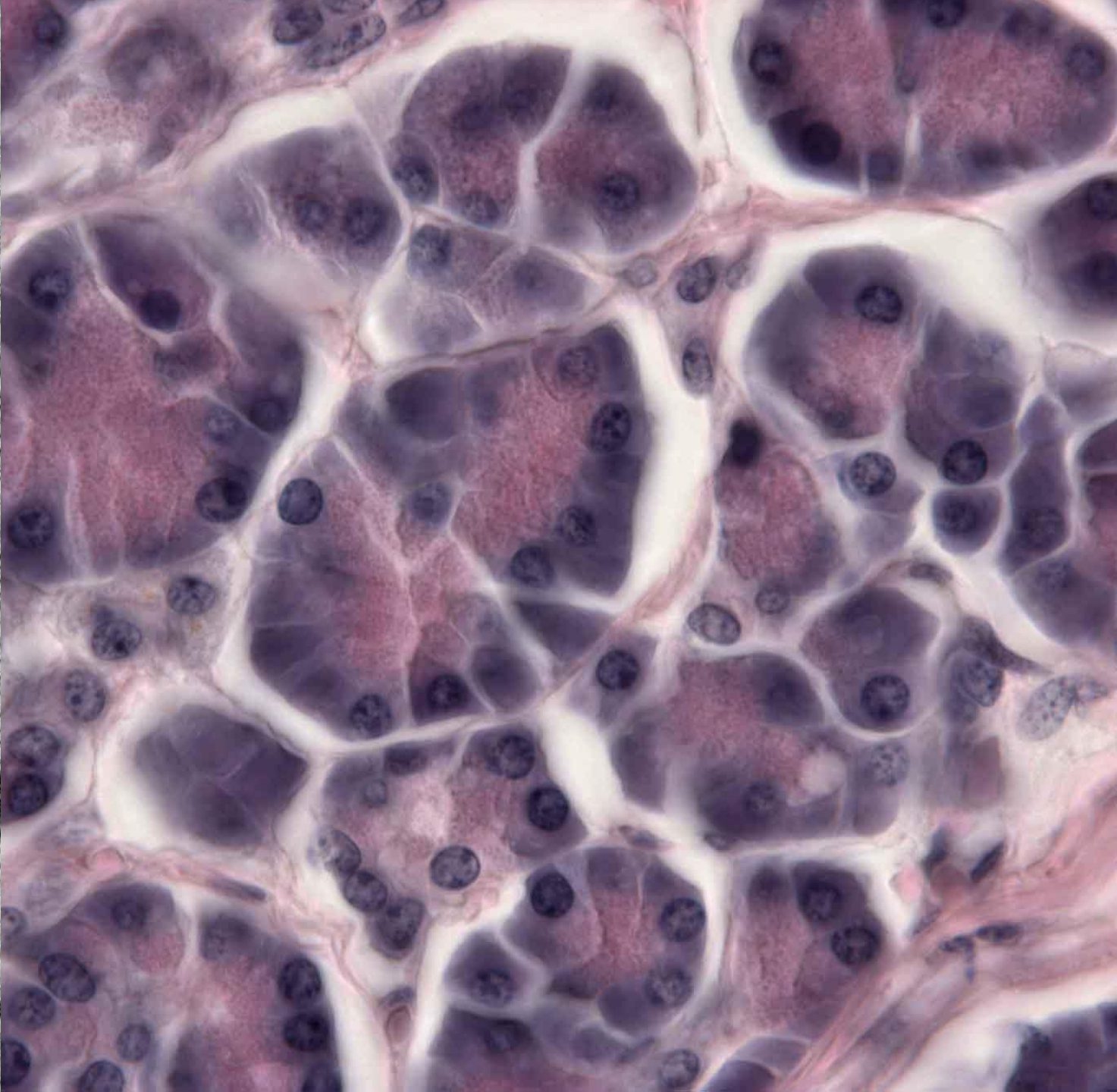
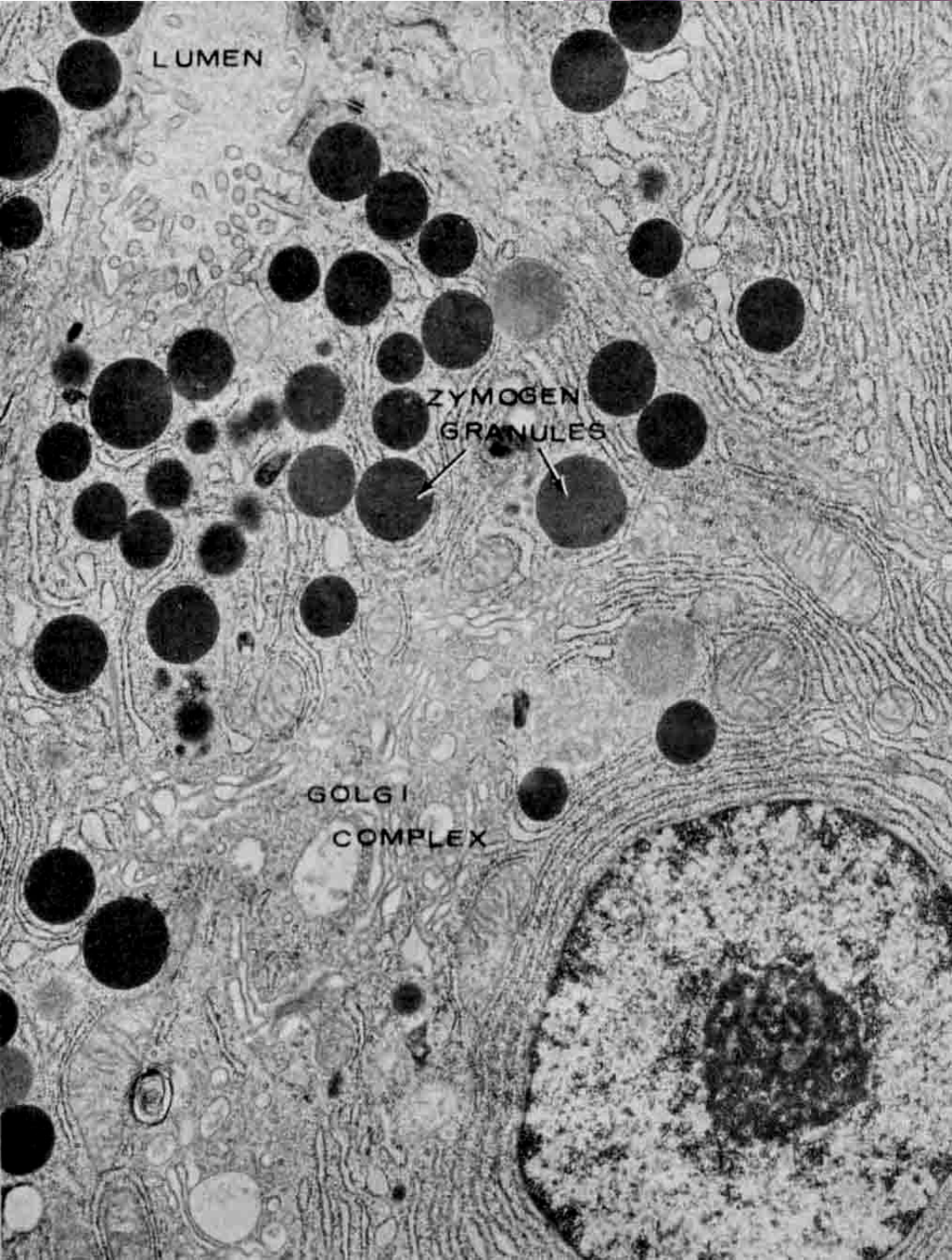




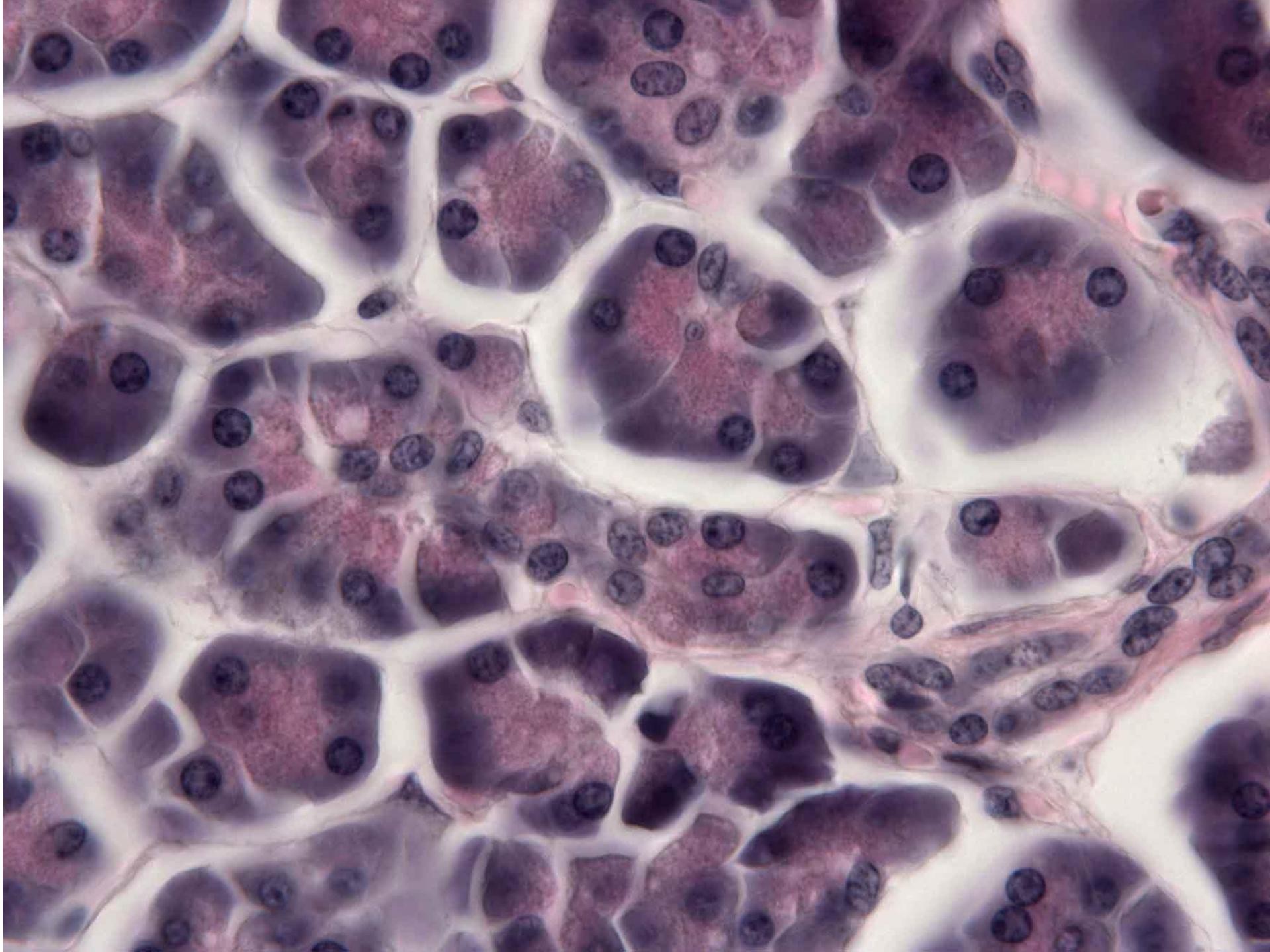
Ductal system

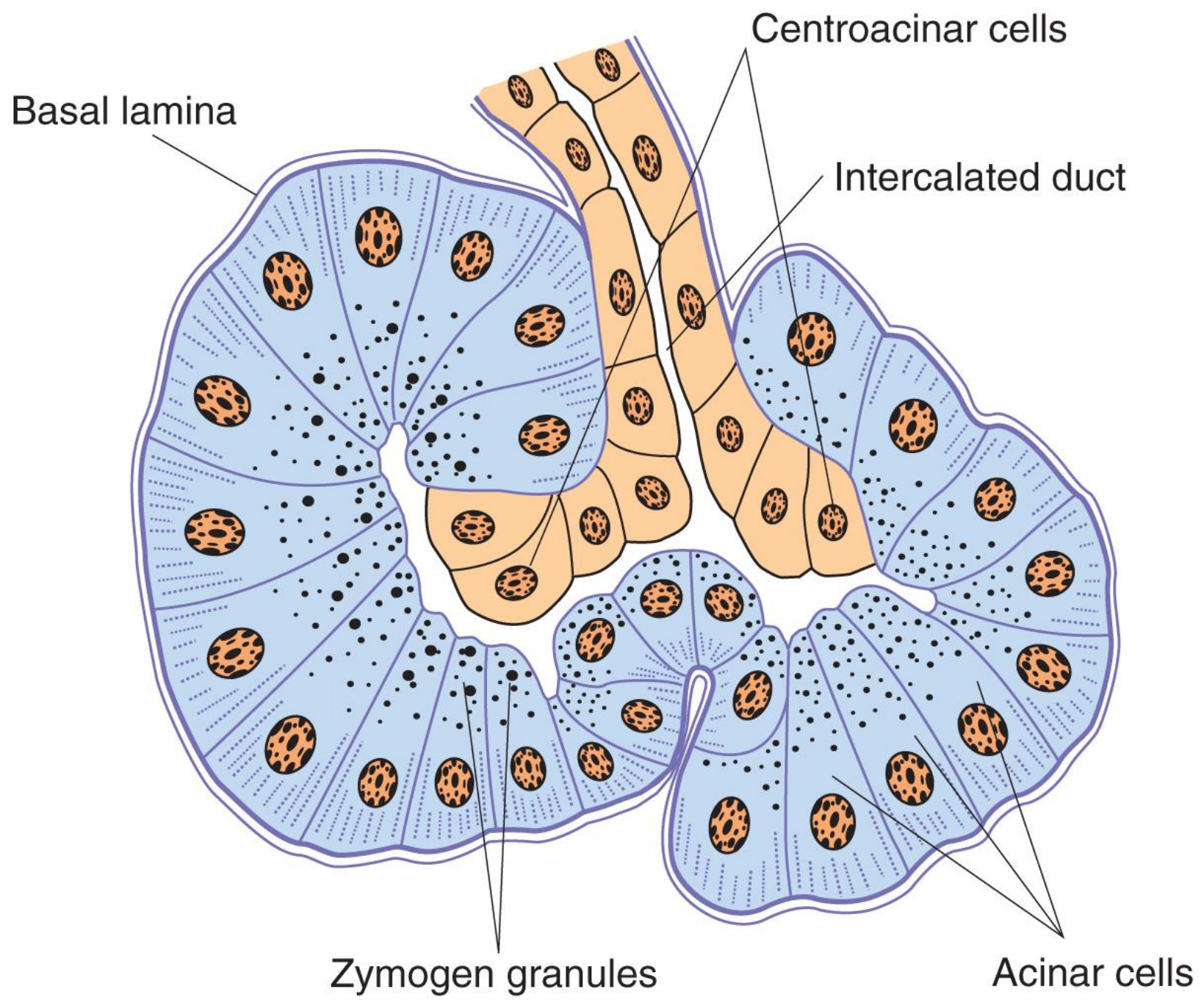






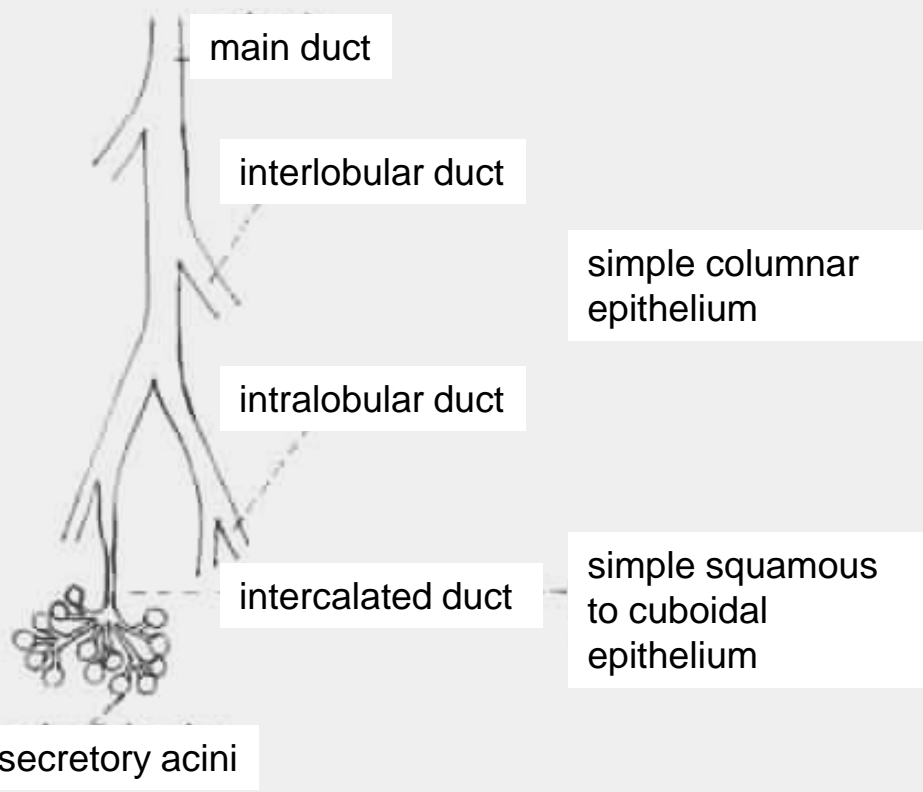
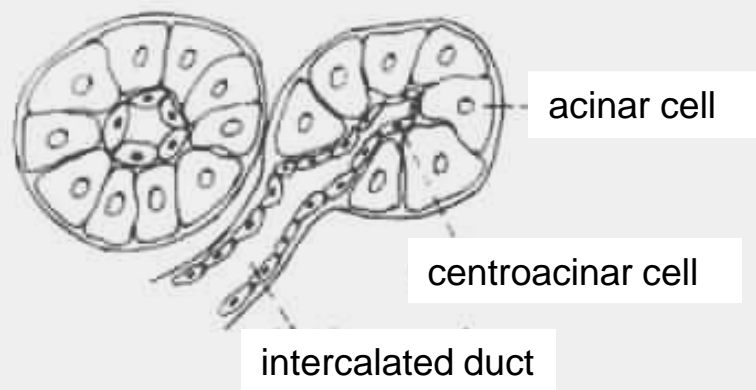
Centroacinar
cells

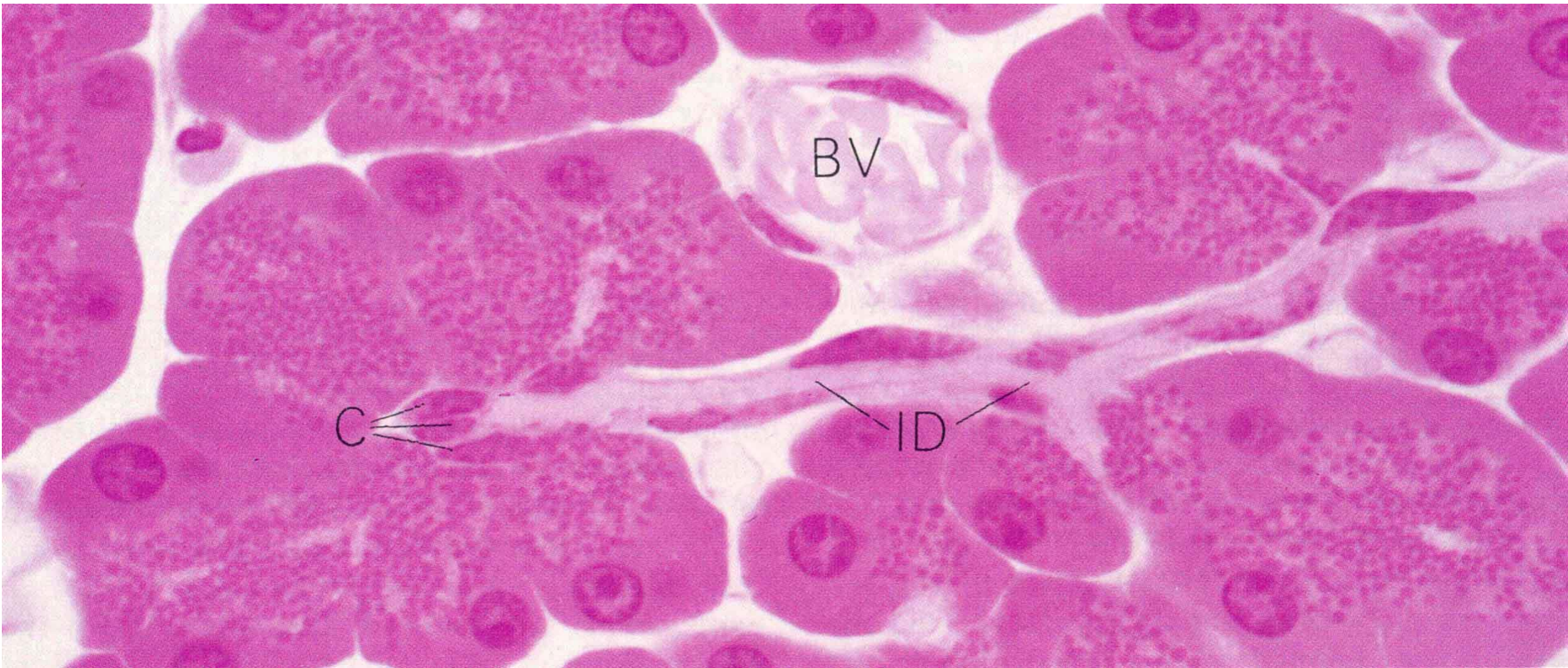




b

Ductal system



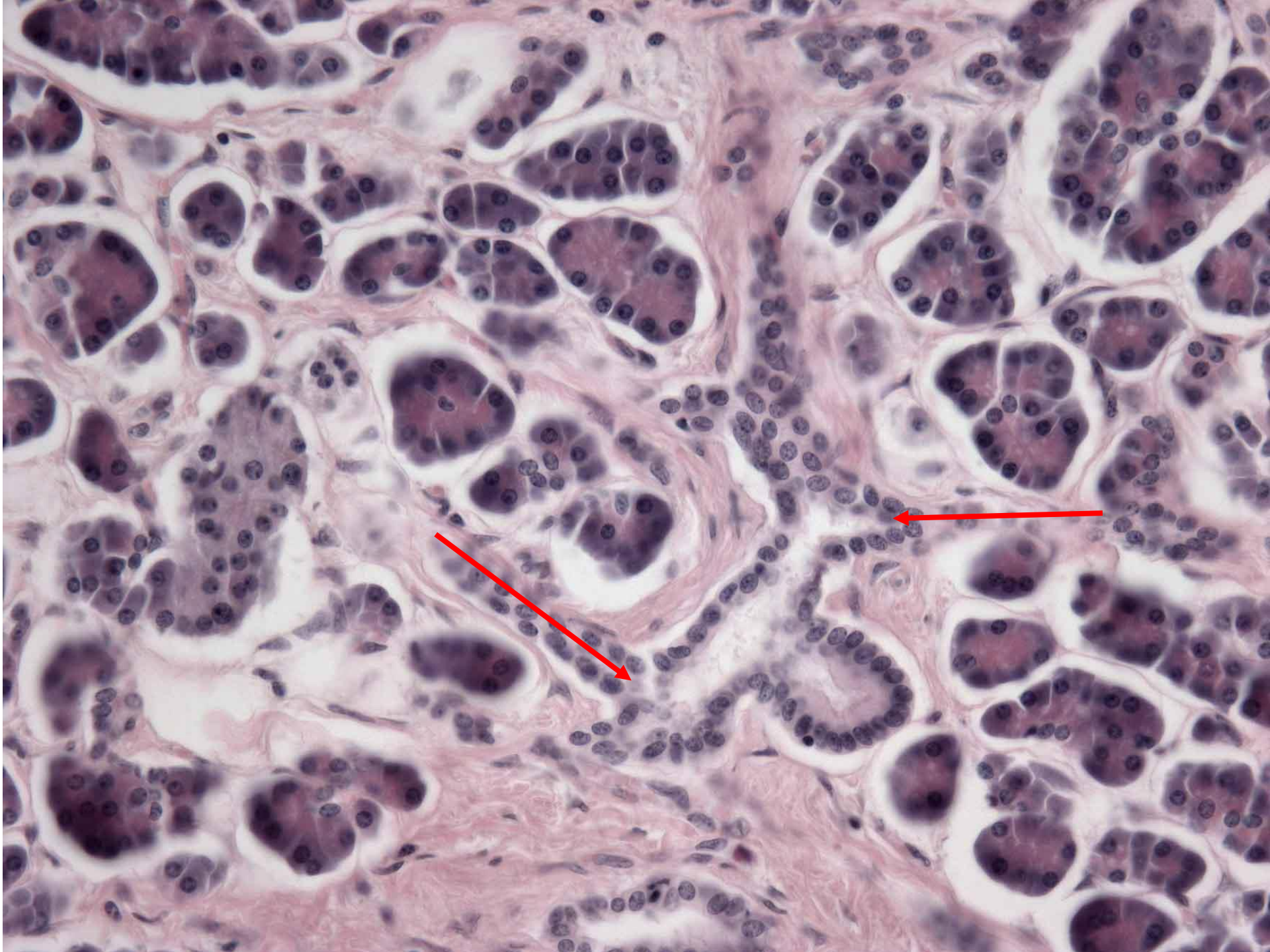


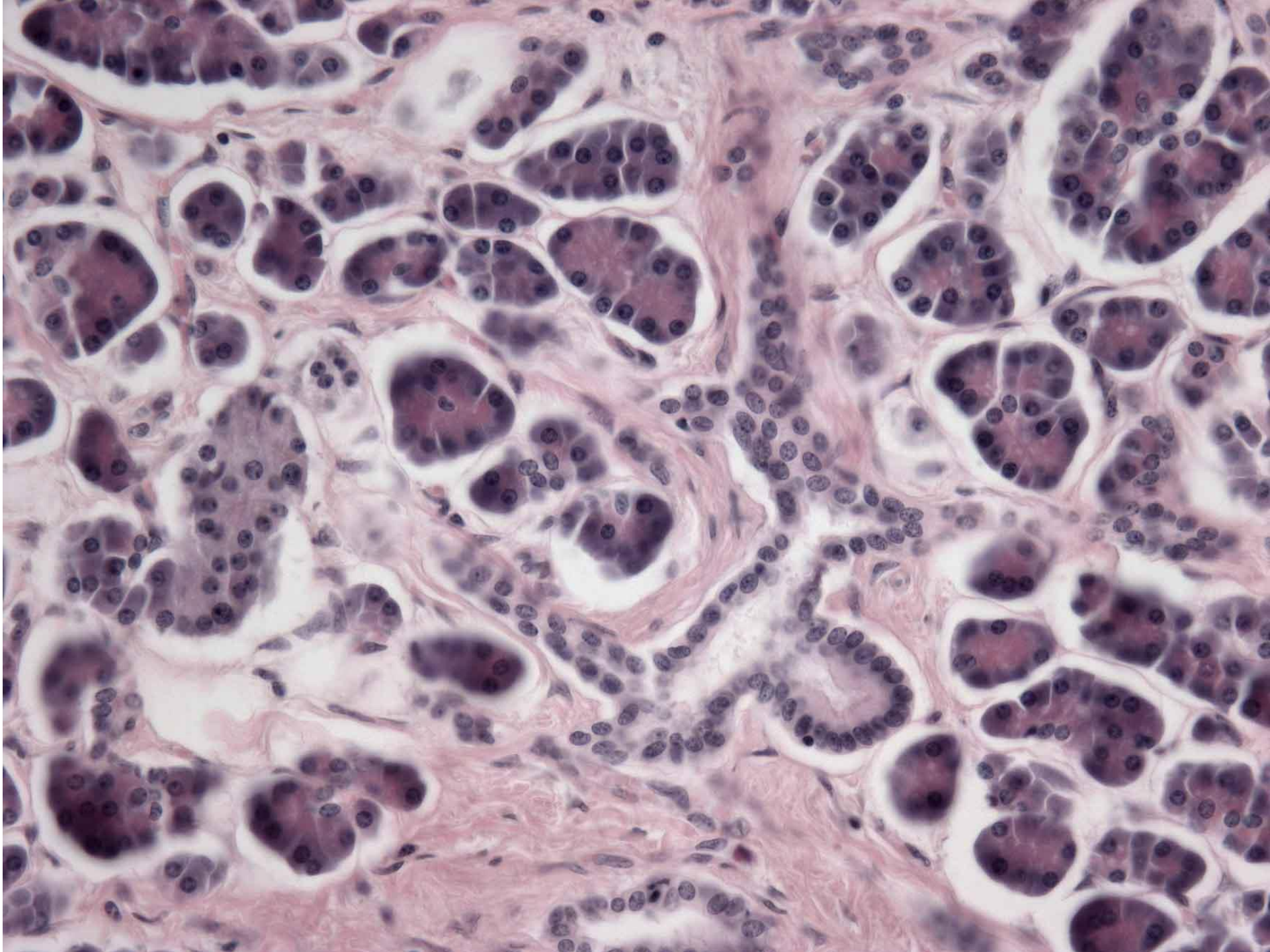
BV

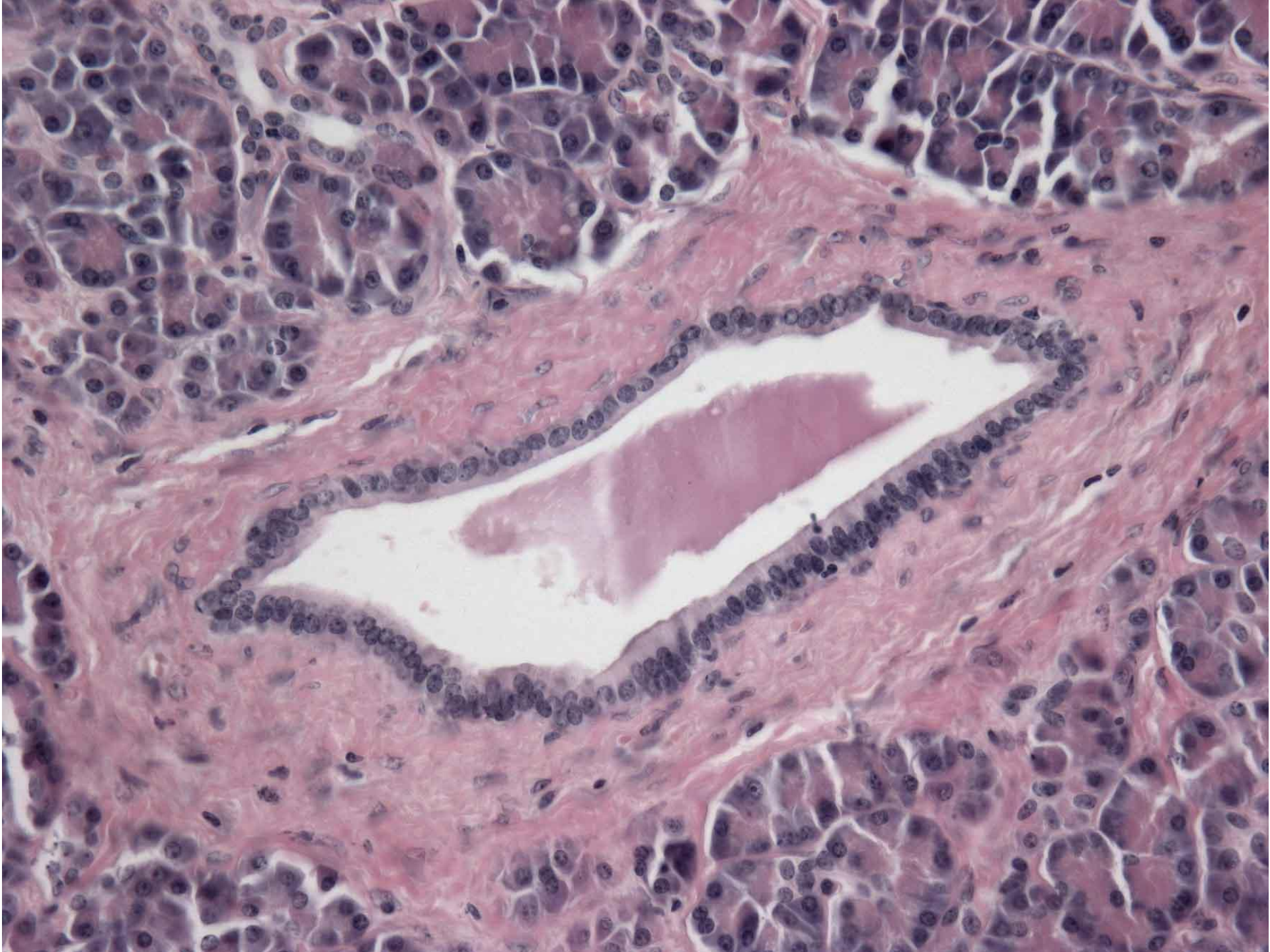
C

ID

Intralobular ducts feeding into an interlobular duct.







Exocrine pancreas

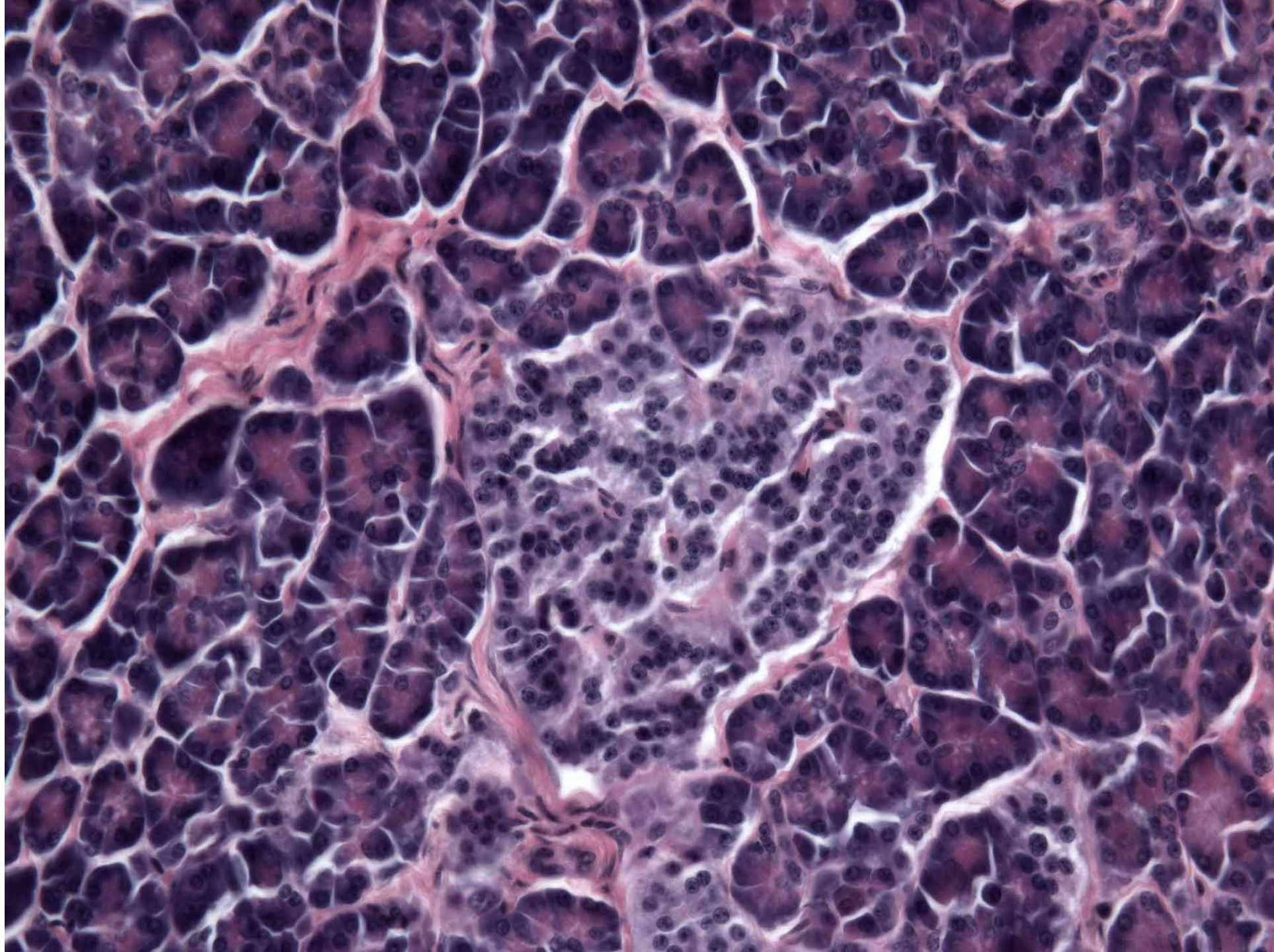
- Similar structure to the parotid, but with some differences:
 - Centroacinar cells, no striated ducts
 - Minimal connective tissue and adipose tissue
 - Controlled by secretin and cholecystokinin
- Zymogen granules contain a wide variety of enzymogens, that are activated in the intestine
 - Trypsinogen (becomes trypsin and activates other enzymes), chymotrypsinogen, carboxypeptidase, aminopeptidase, elastase
 - Ribonuclease, deoxyribonuclease
 - Amylase
 - Lipases, phospholipases
 - Bicarbonate

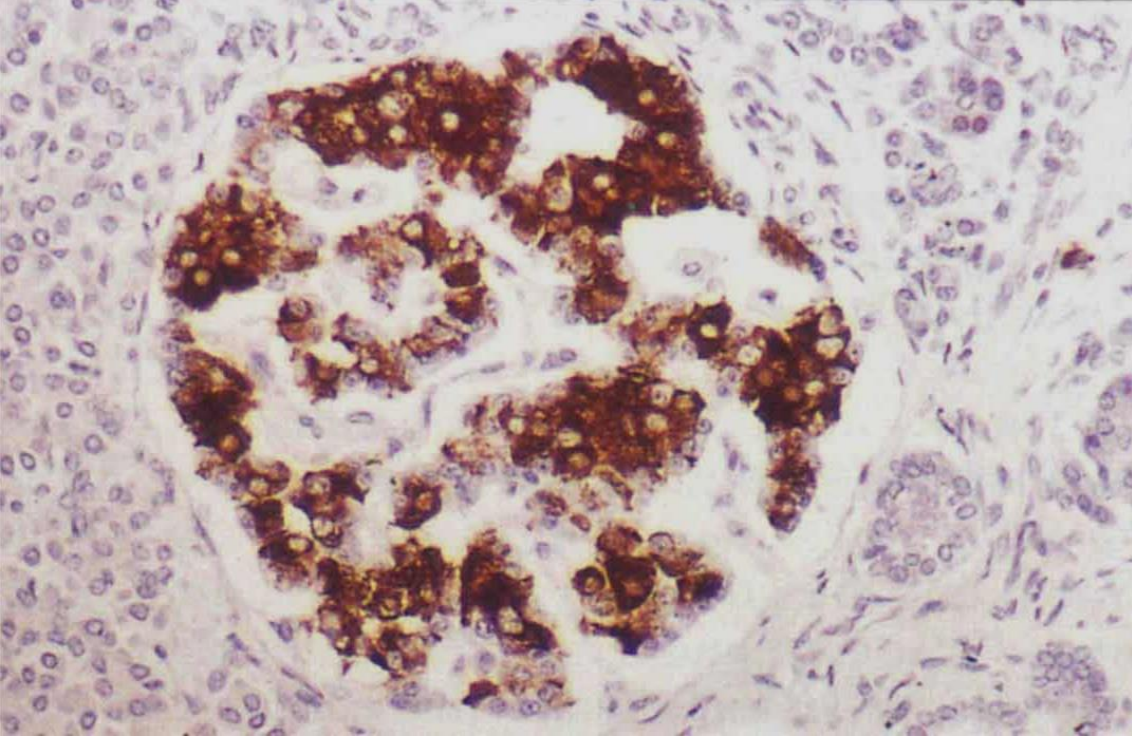
Beef pancreas and thymus are called the sweetbreads.

Even among nose-to-tail eating enthusiasts, beef pancreas often gets overlooked. (<https://www.doctorkiltz.com/beef-pancreas/>)

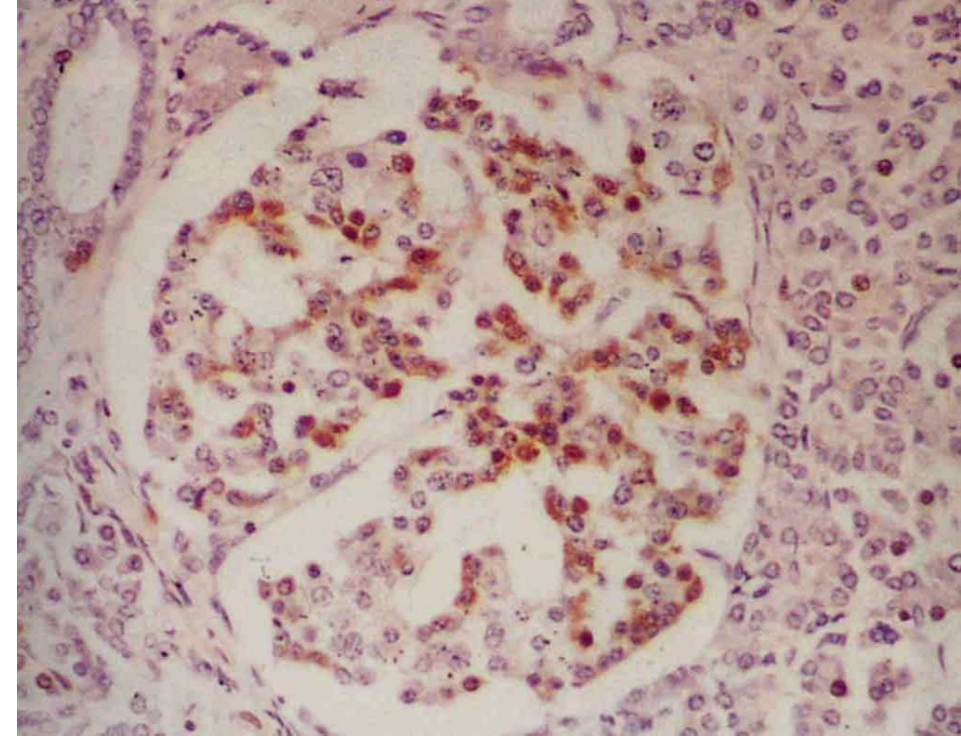


Endocrine
pancreas –
the islets of
Langerhans

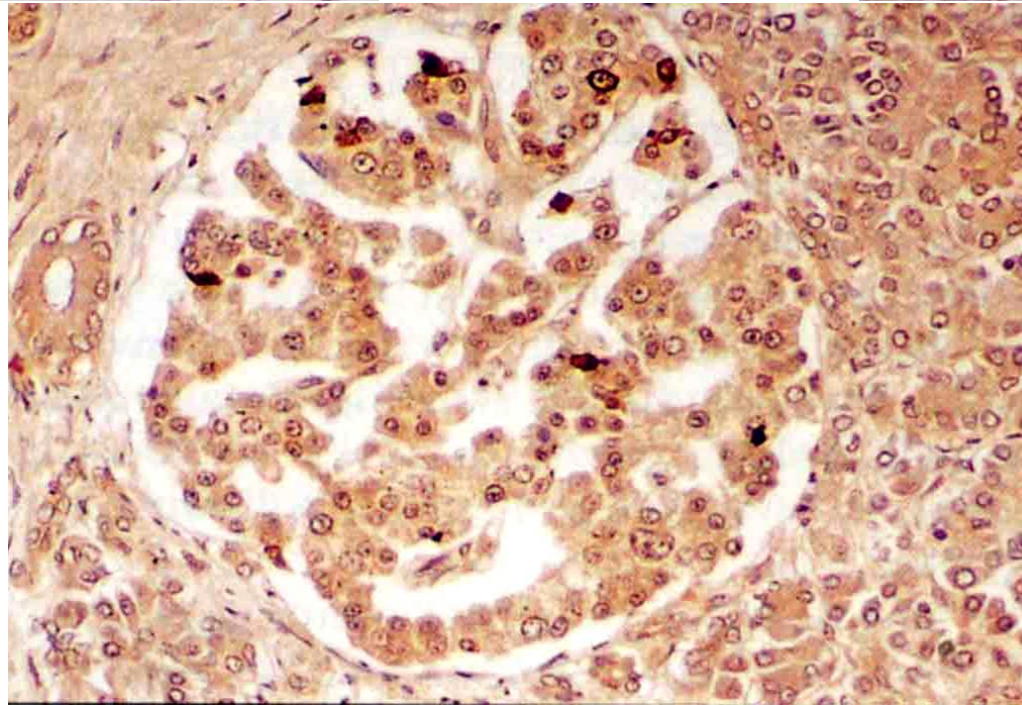




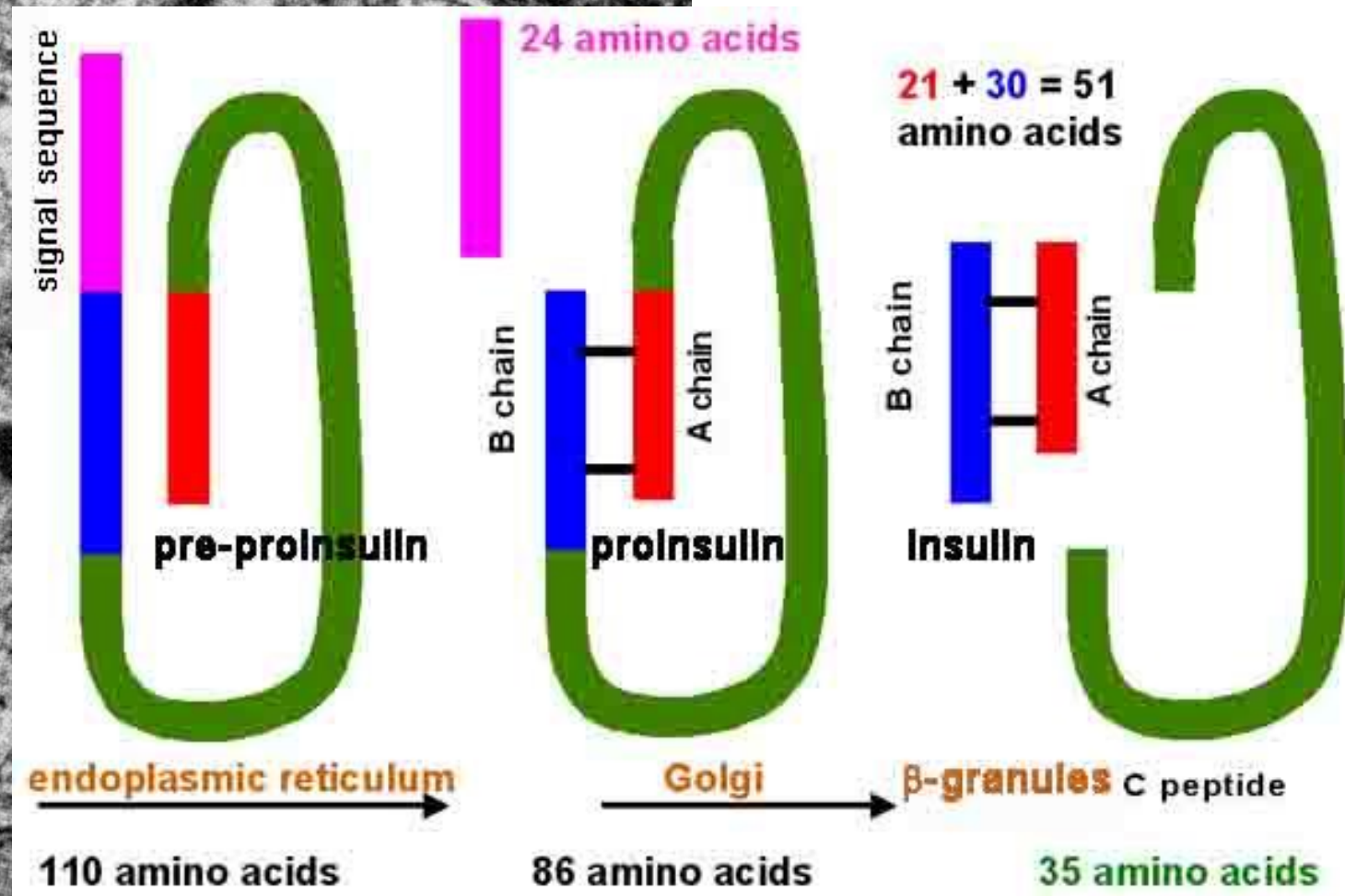
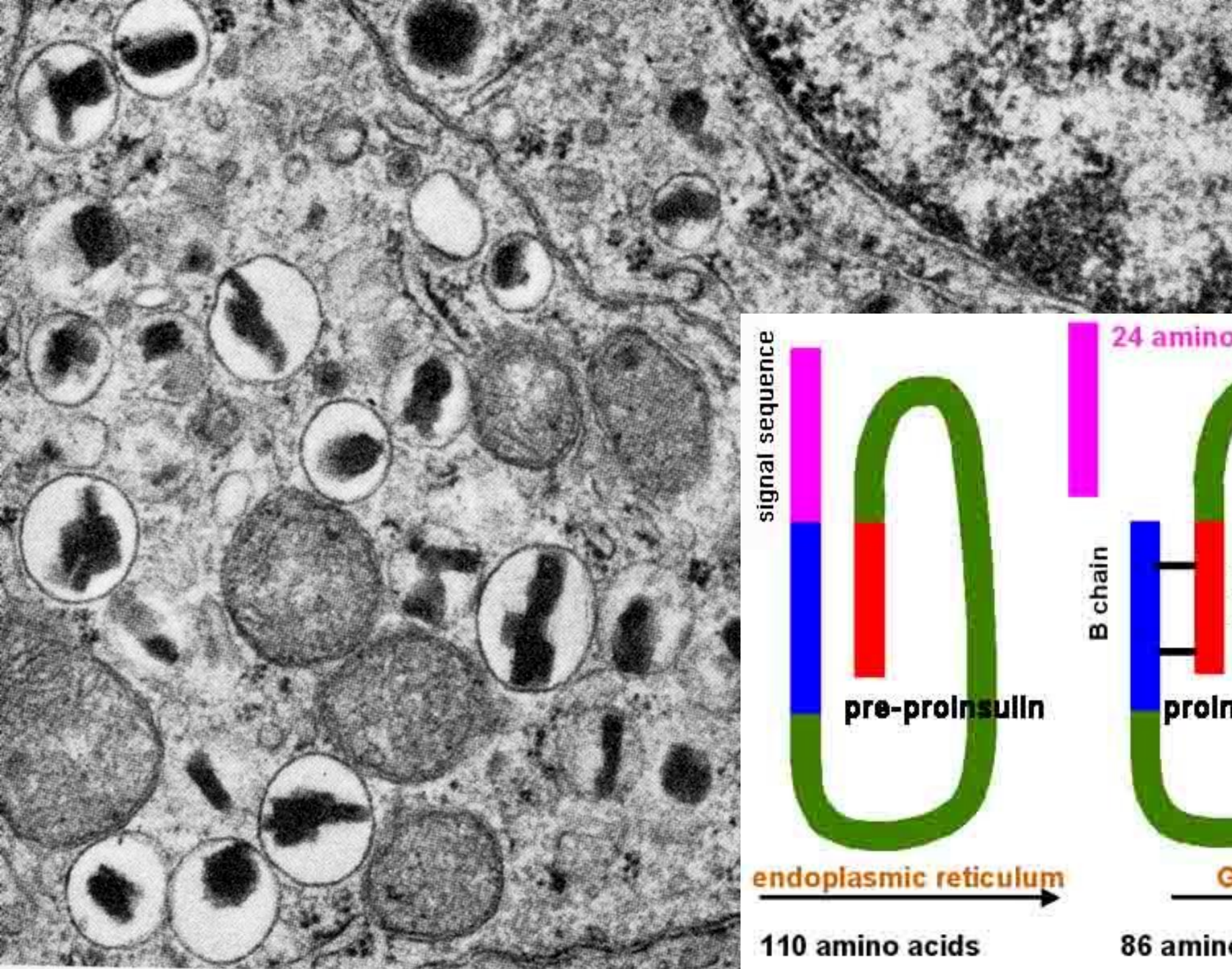
**B cells
approx. 70 %
centrum, clusters**

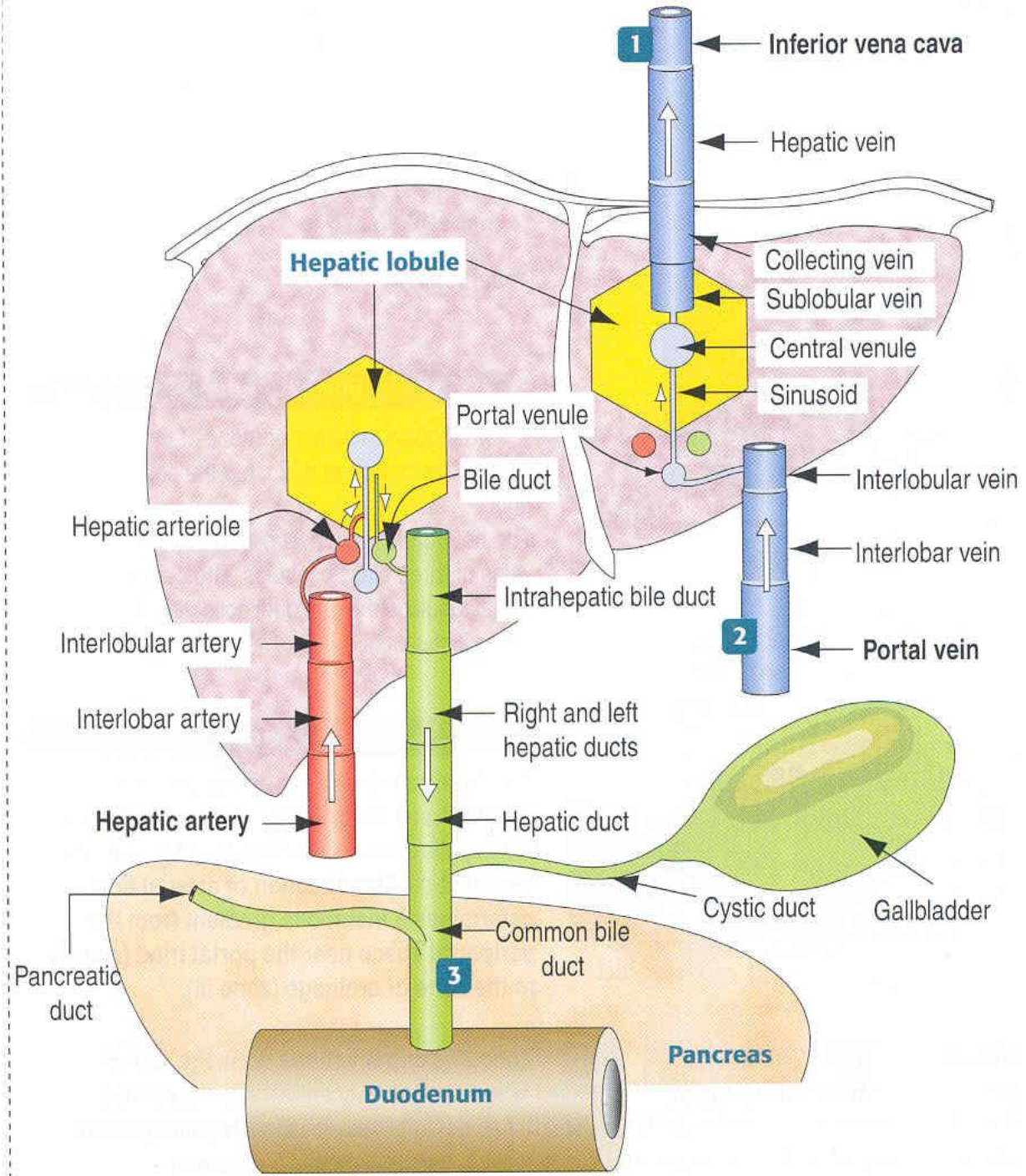


**A cells
to 20 %
periphery,
sheets**



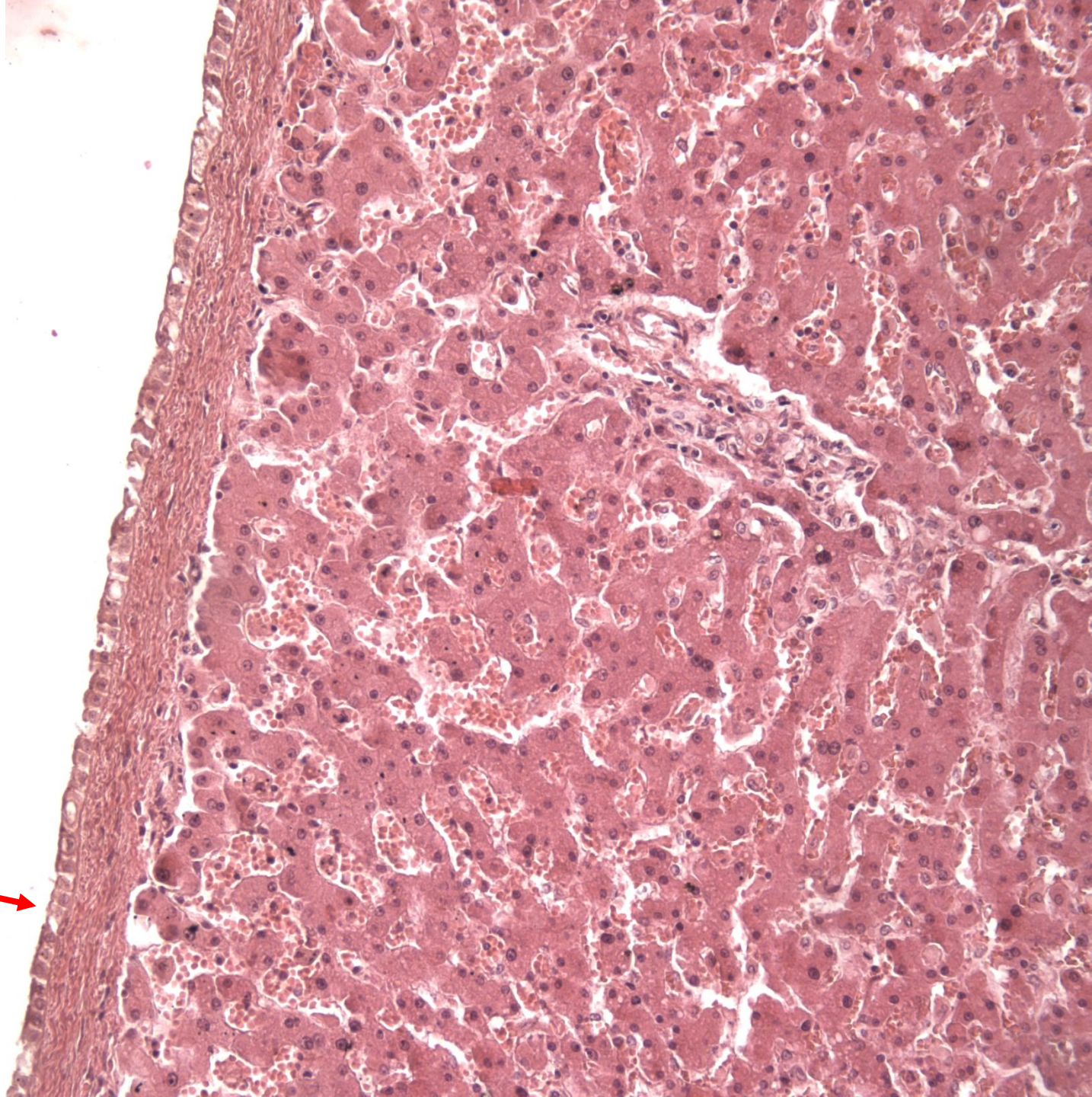
**D cells
to 5 %
scattered**

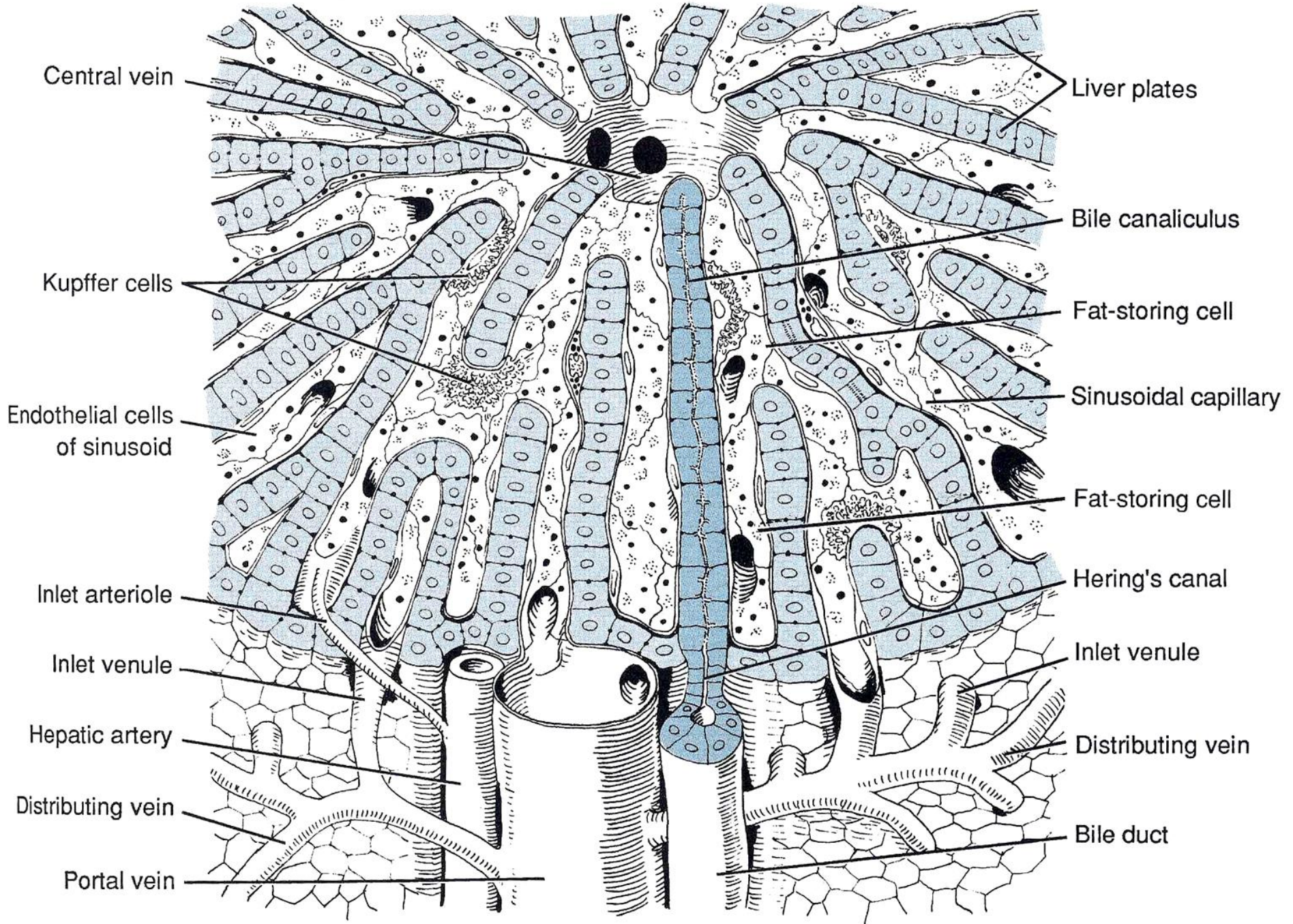




Liver (capsule,
trabecular
epithelium)

What's this?





Central vein

Liver plates

Bile canaliculus

Kupffer cells

Fat-storing cell

Sinusoidal capillary

Endothelial cells of sinusoid

Fat-storing cell

Hering's canal

Inlet arteriole

Inlet venule

Inlet venule

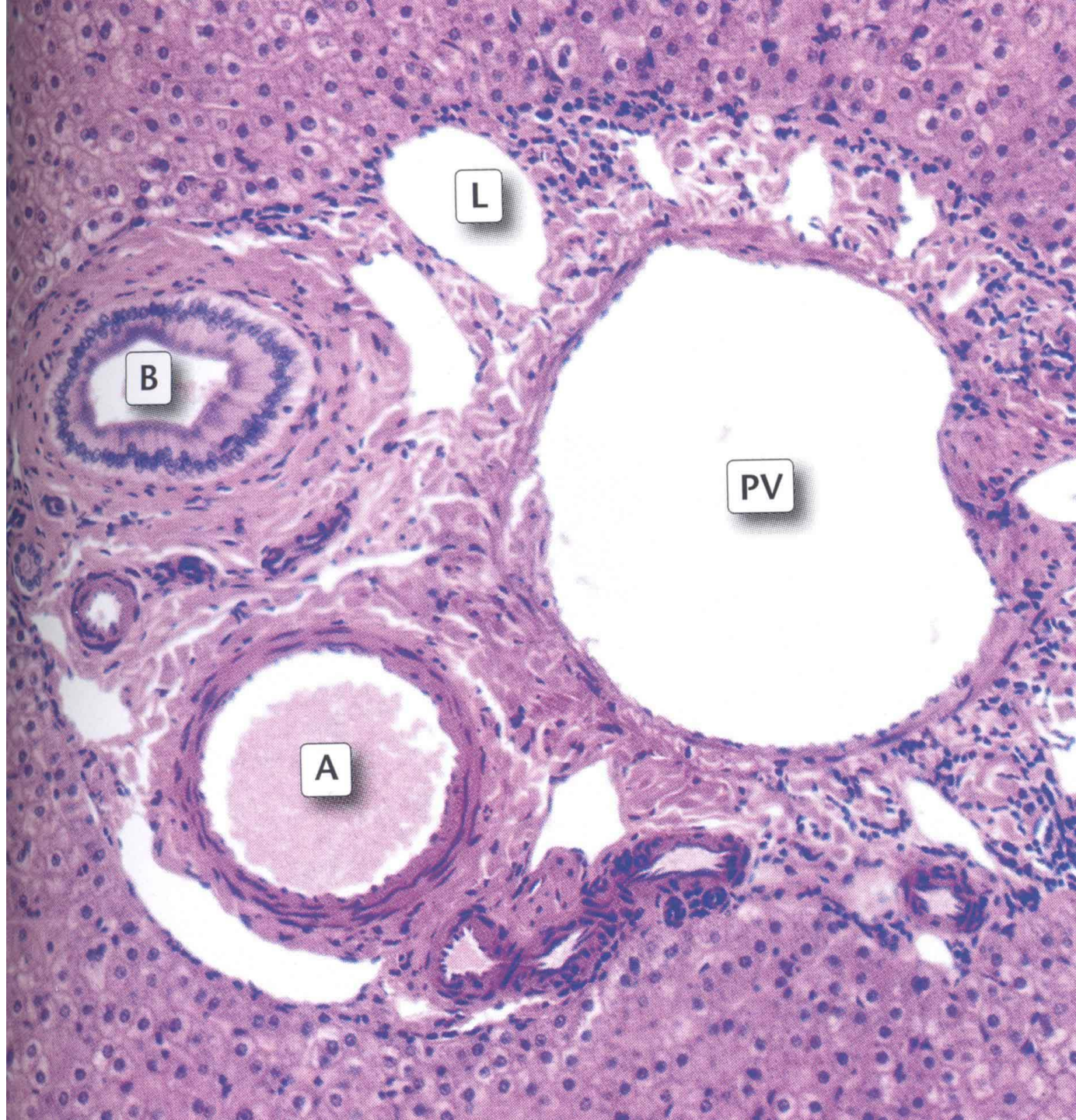
Distributing vein

Hepatic artery

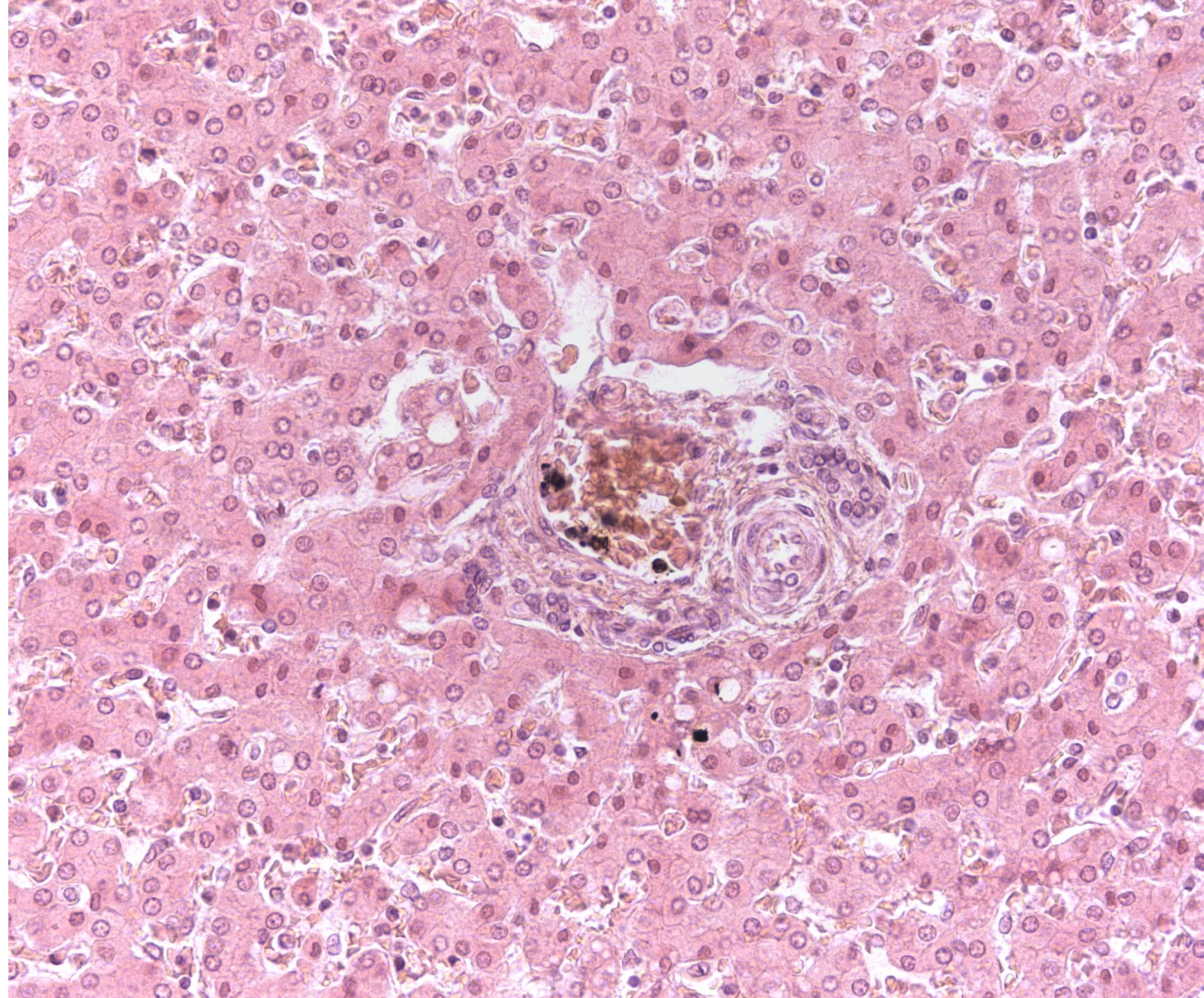
Bile duct

Distributing vein

Portal vein



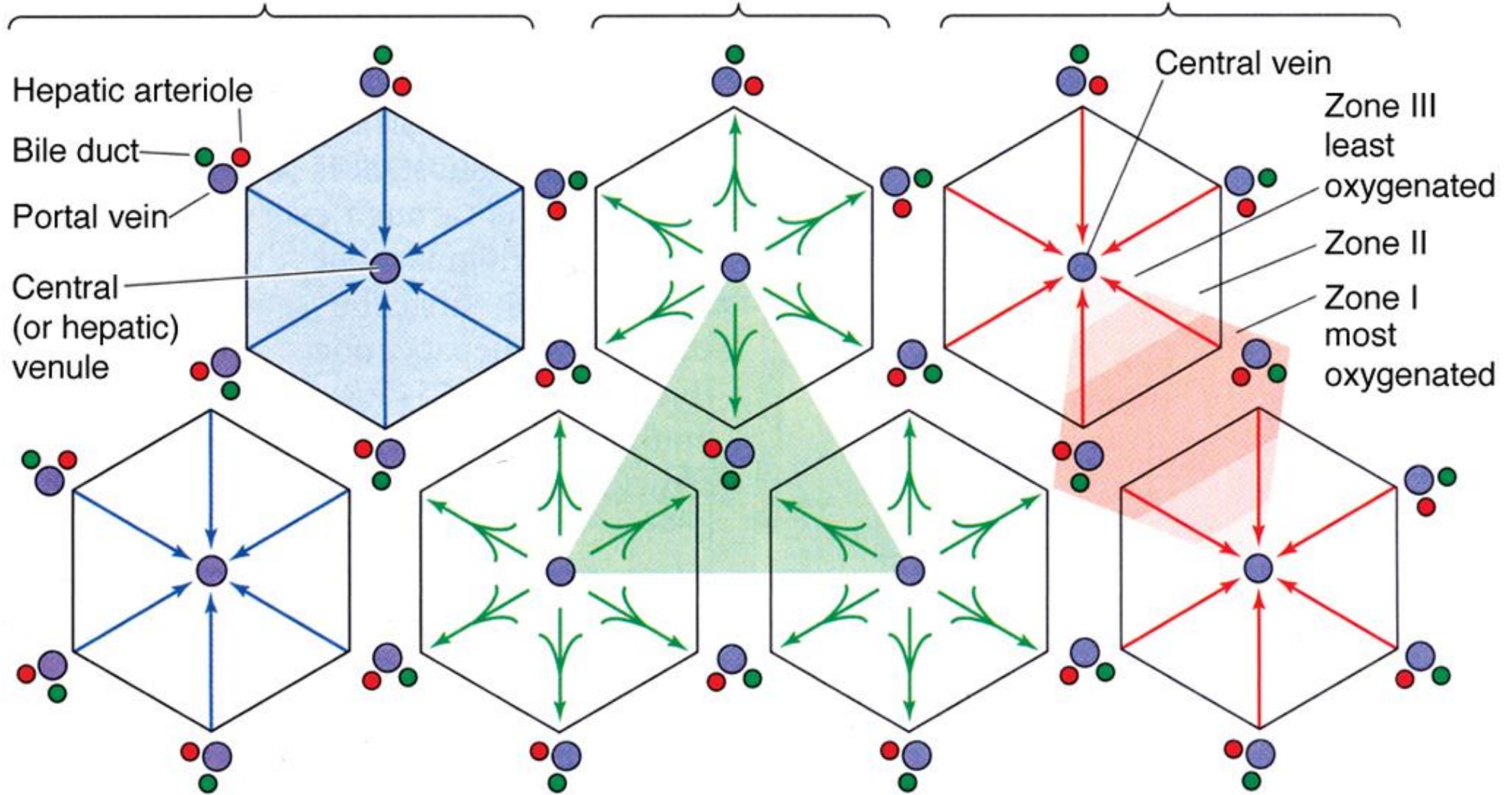
Portobiliary
space, portal
triad



a CLASSIC HEPATIC LOBULE
Drains blood from the portal vein and the hepatic artery to the hepatic or the central vein

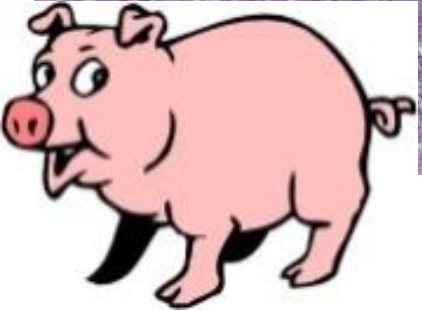
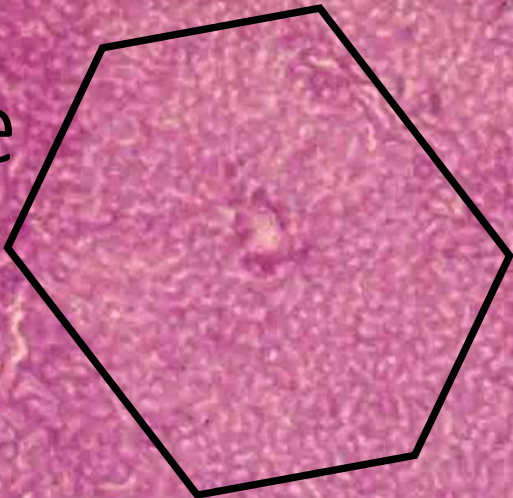
b PORTAL LOBULE
Drains bile from hepatocytes to the bile duct

c PORTAL ACINUS
Supplies oxygenated blood to hepatocytes

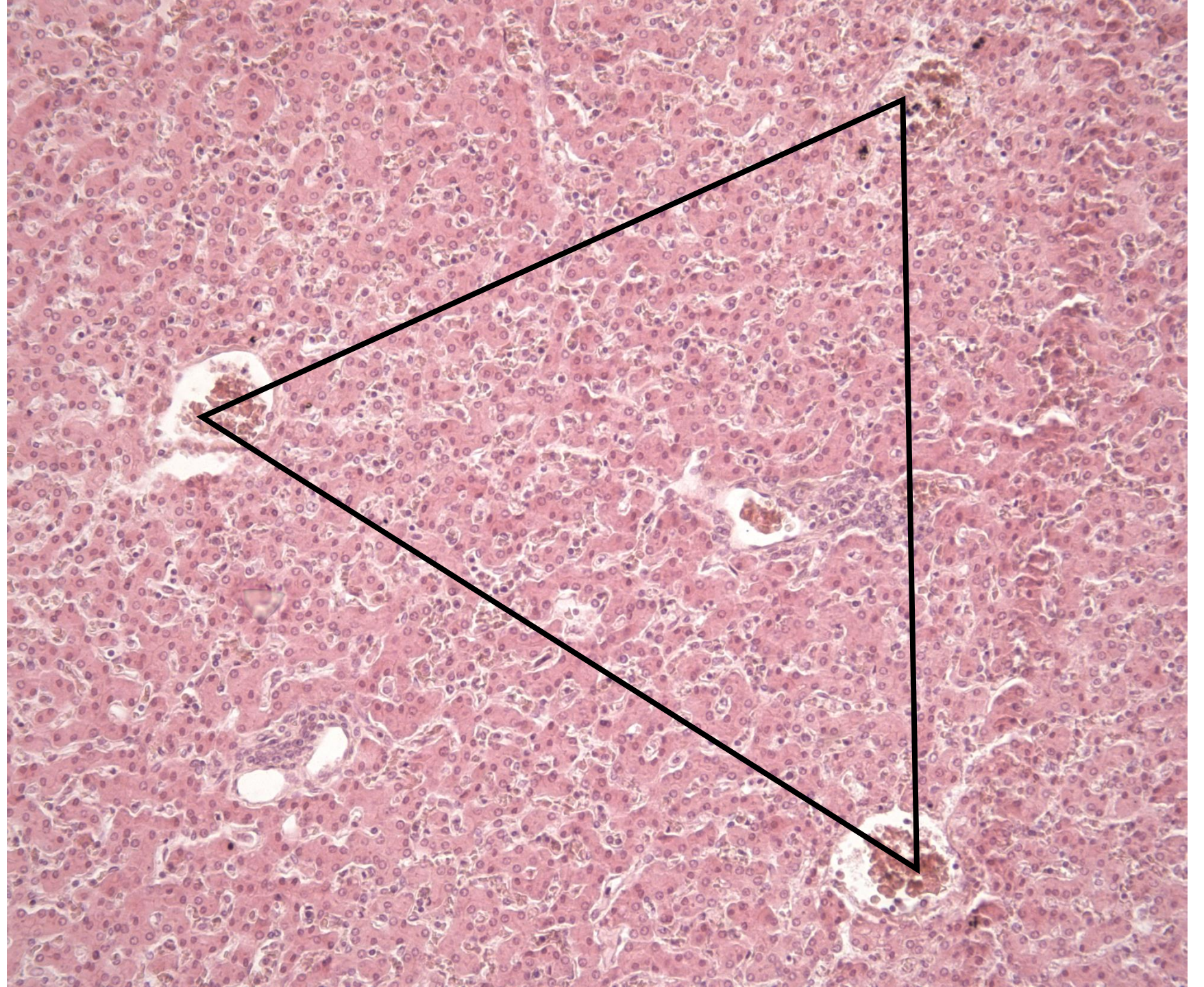




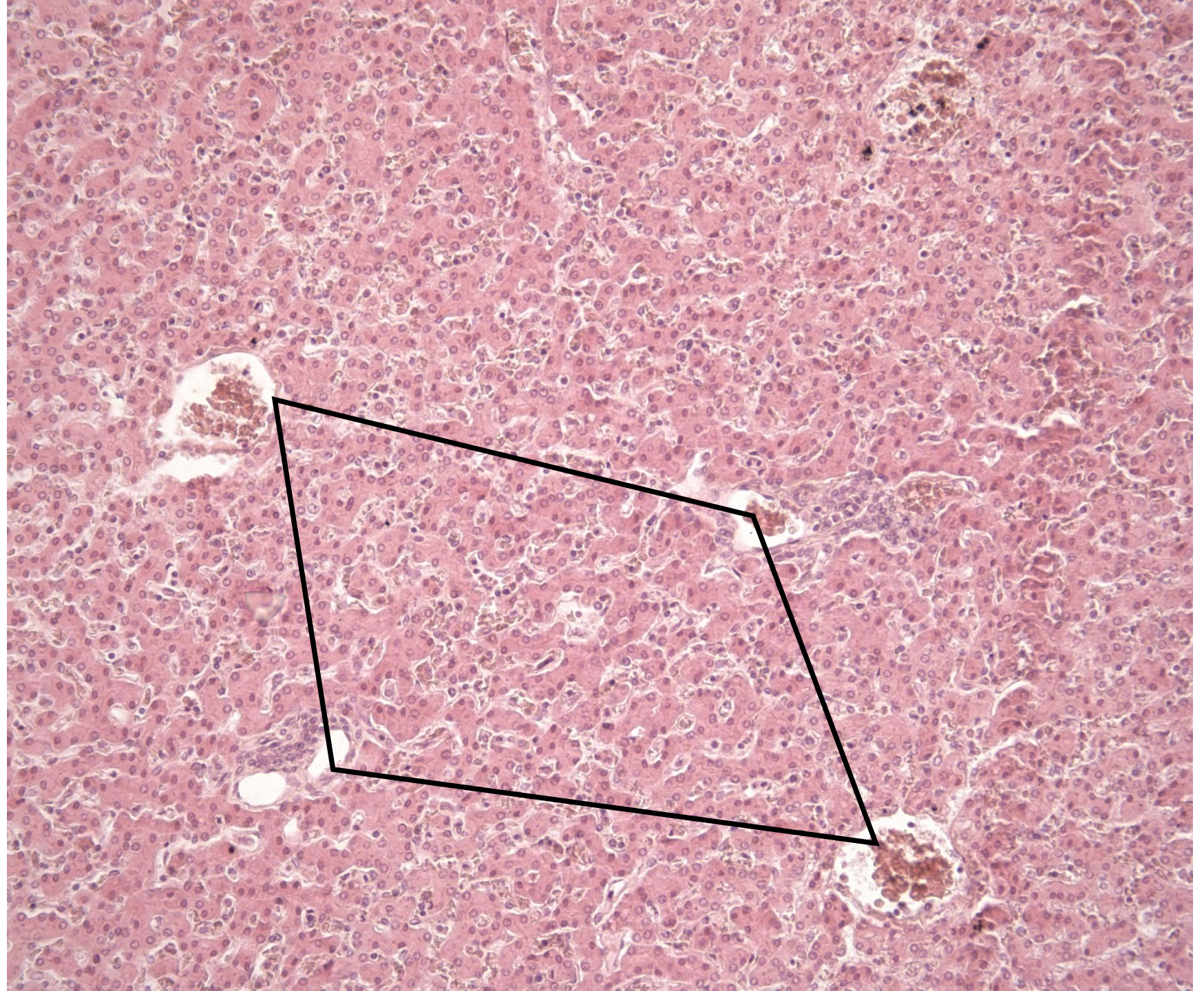
Hepatic lobule



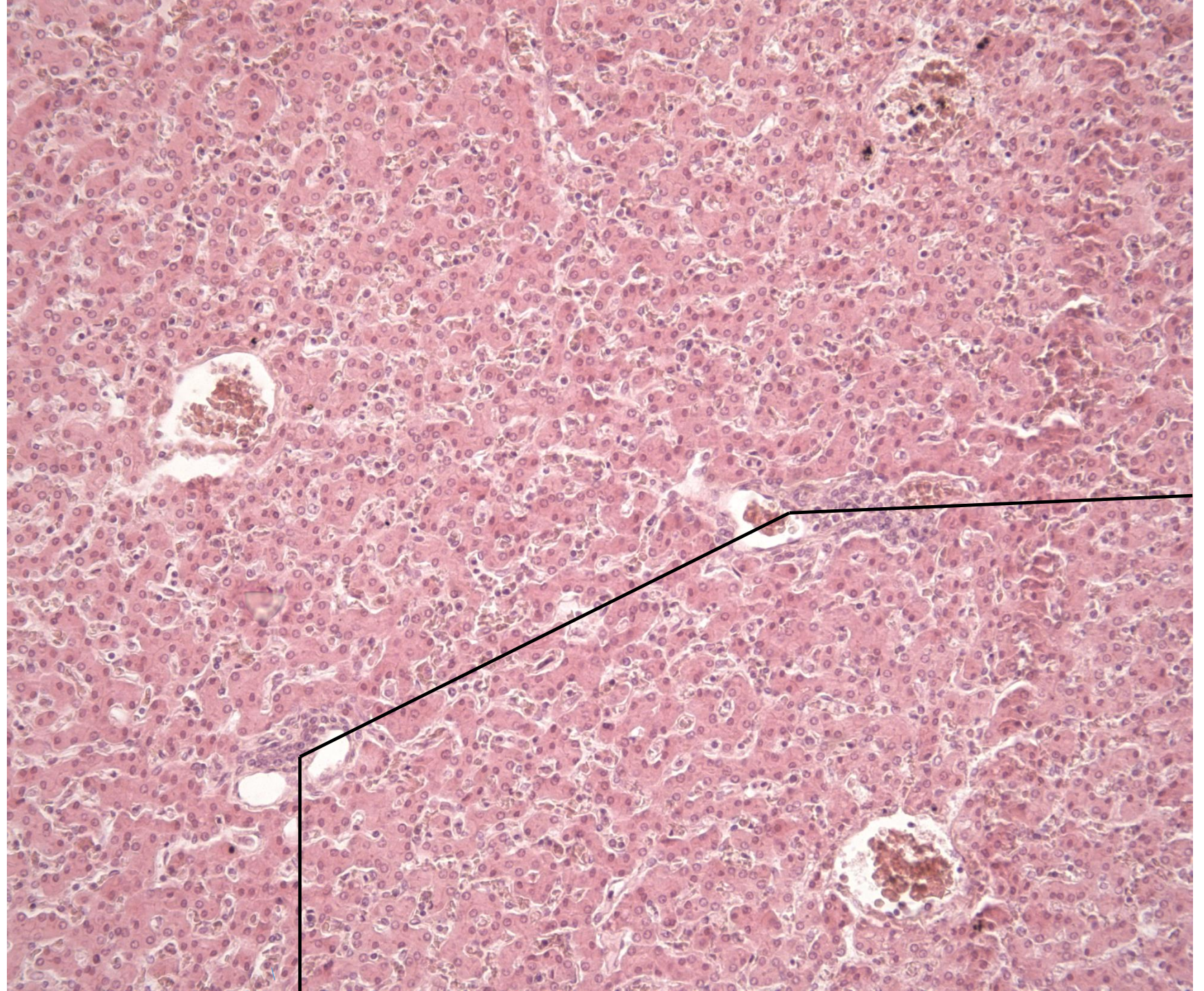
Portal
lobule



Portal
acinus

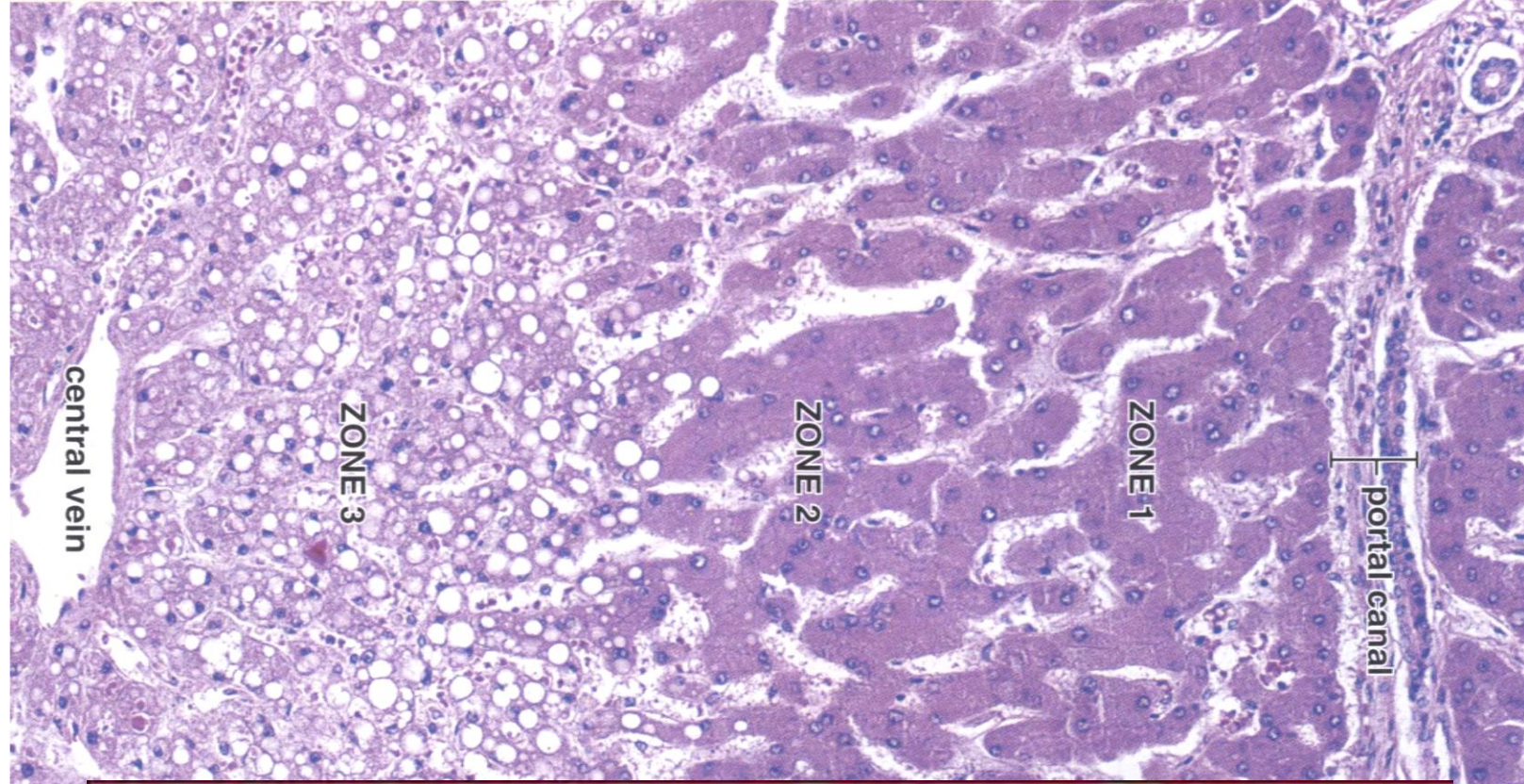


Classic
hepatic
lobule



hypoxic damage to classic hepatic lobule

Pawlina, W.: Histology. A Text and Atlas, Wolters Kluwer 2016.



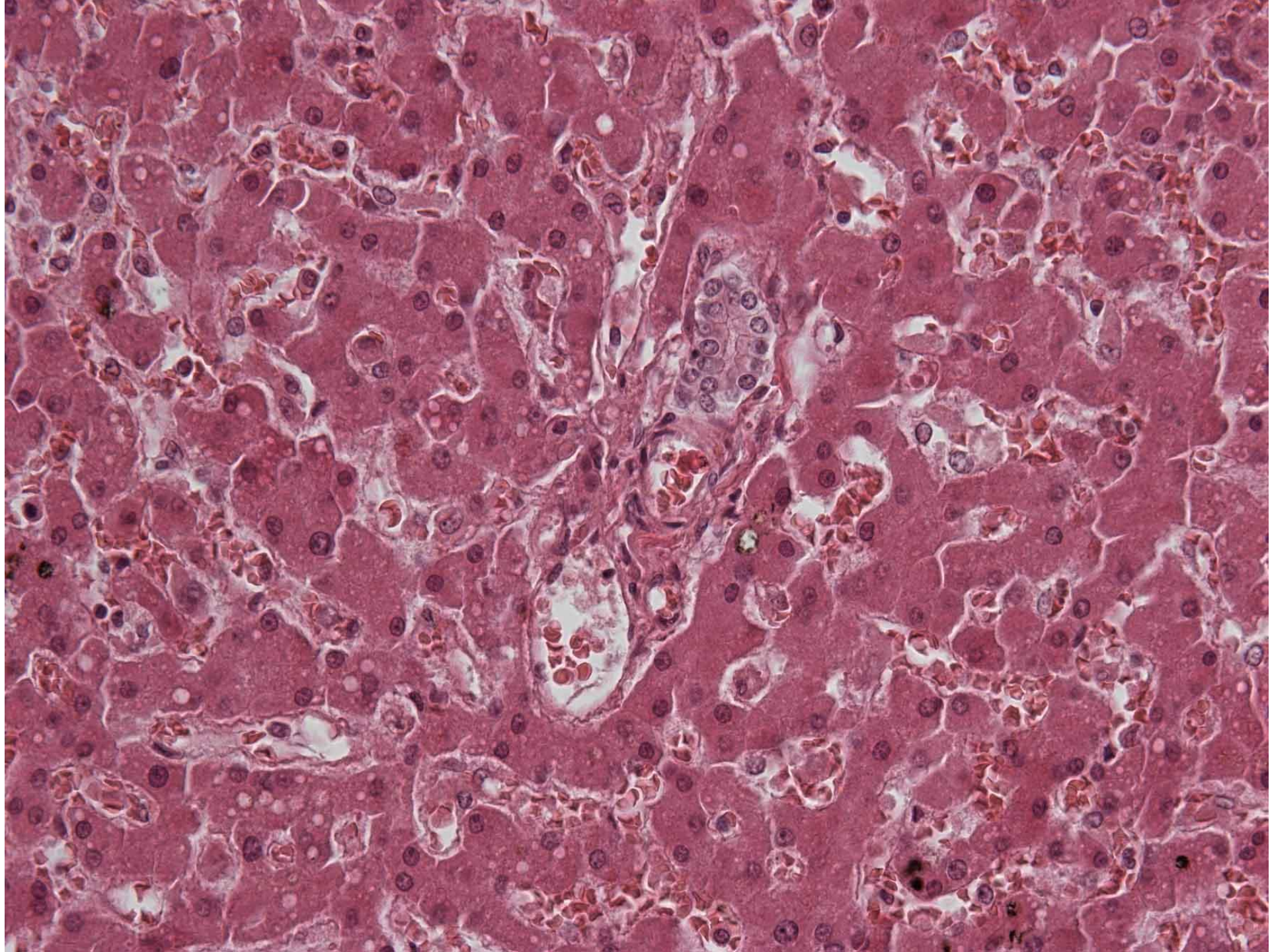
Sarma, V., Janmeda, P.: Protective assessment of Euphorbia neriifolia and its isolated flavonoid against N-nitrosodiethylamine-induced hepatic carcinogenesis in male mice: A histopathological analysis. Toxicology International 21 (1), 2014: 37-43.

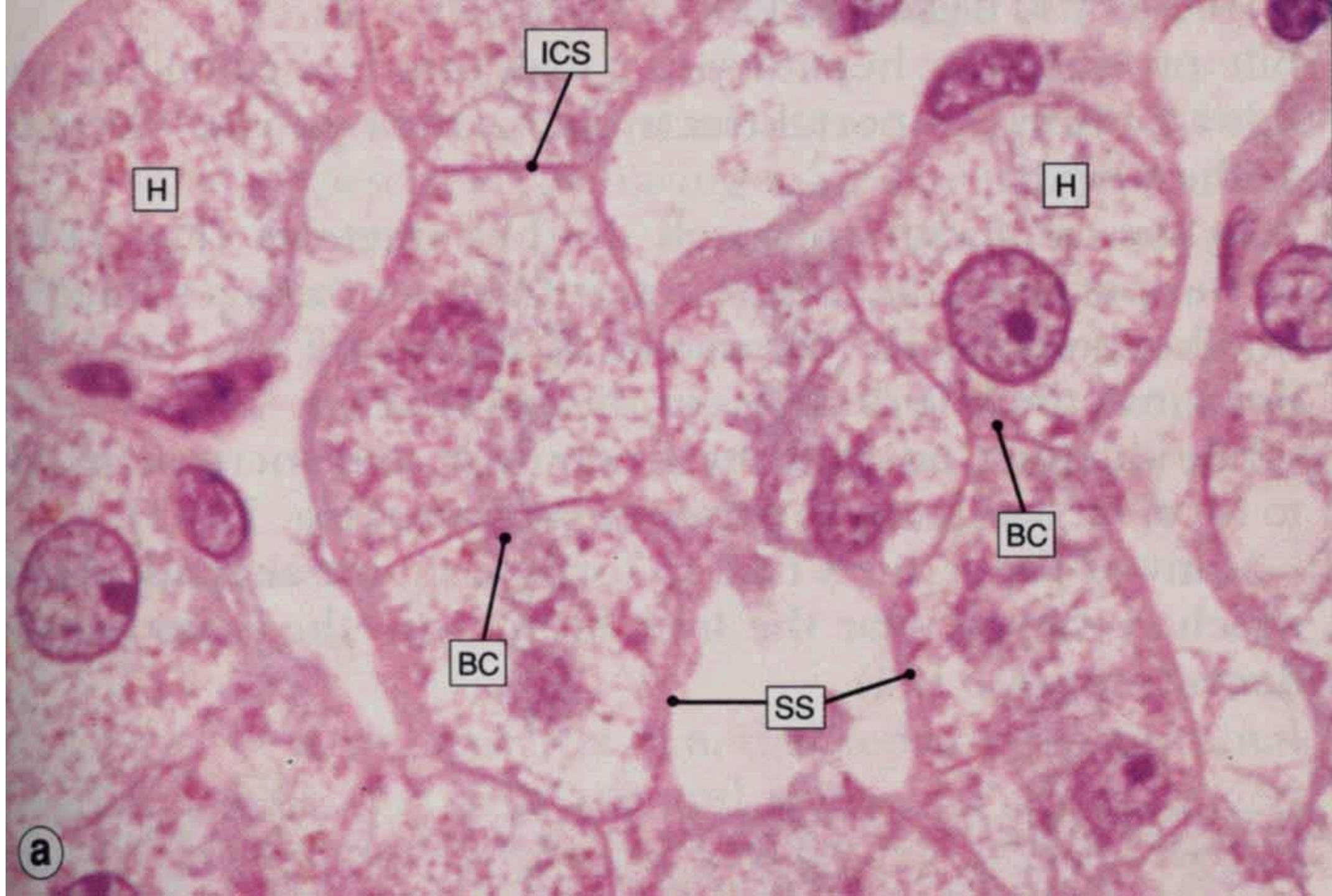
toxic damage to classic hepatic lobule

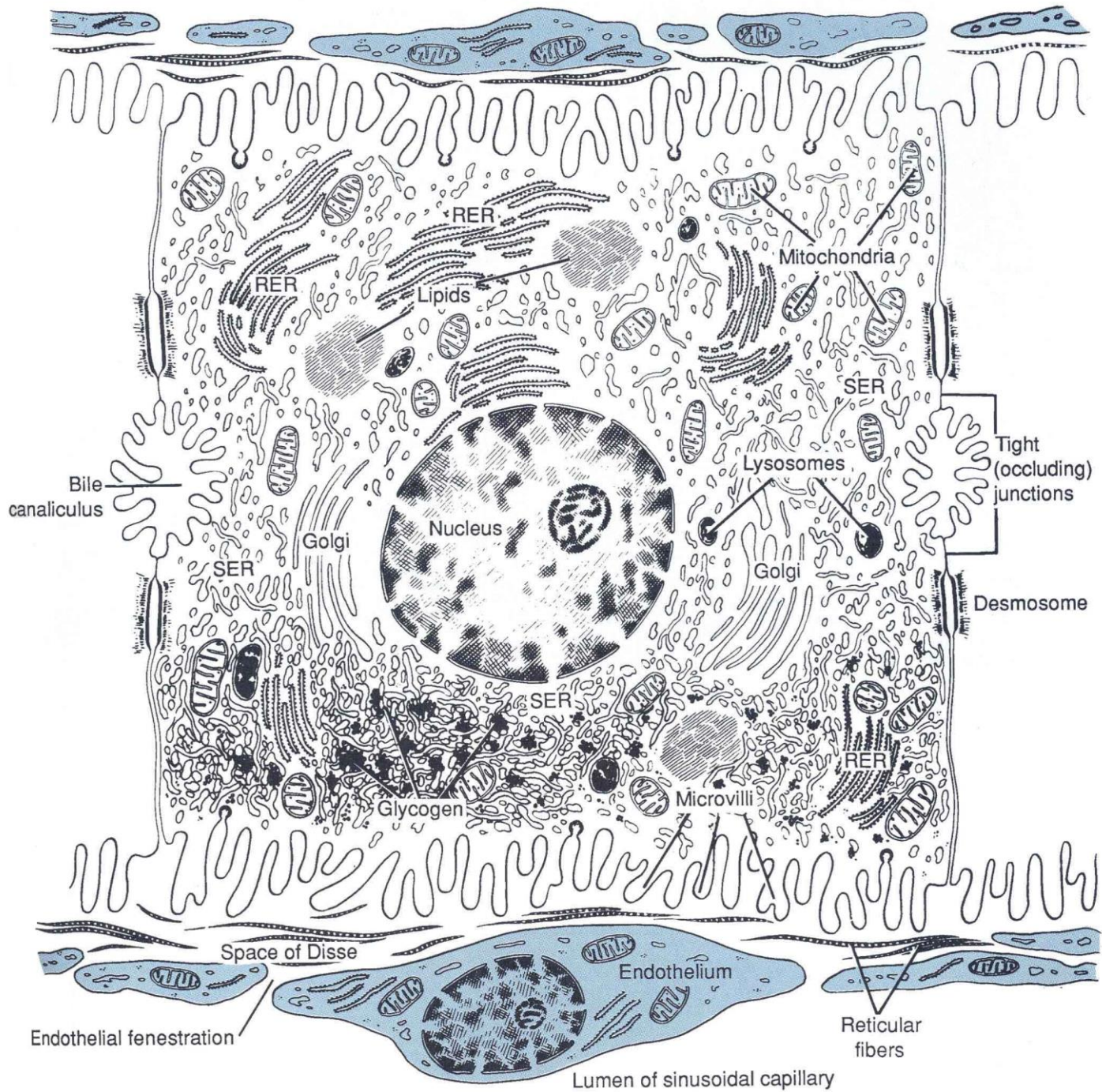
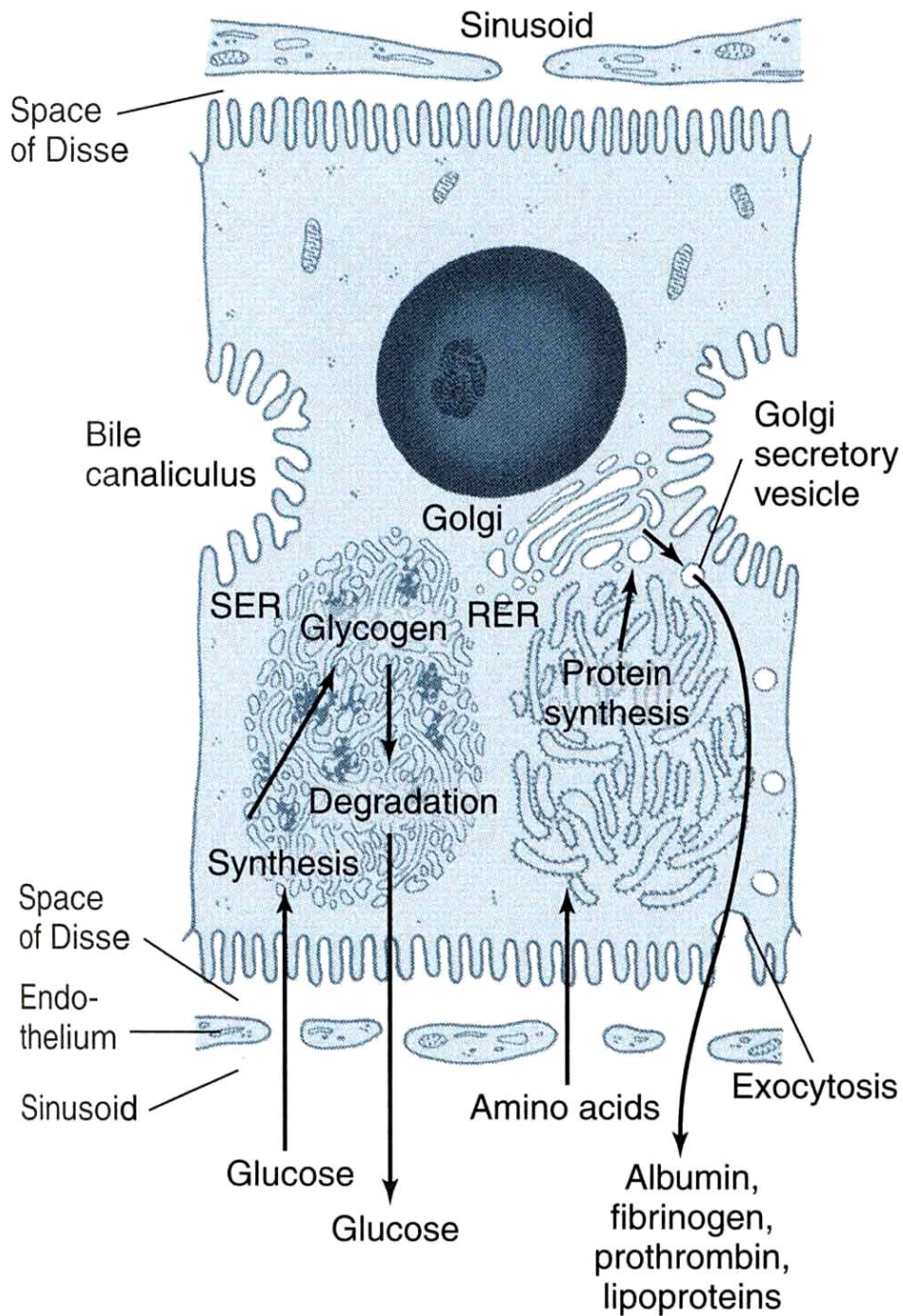


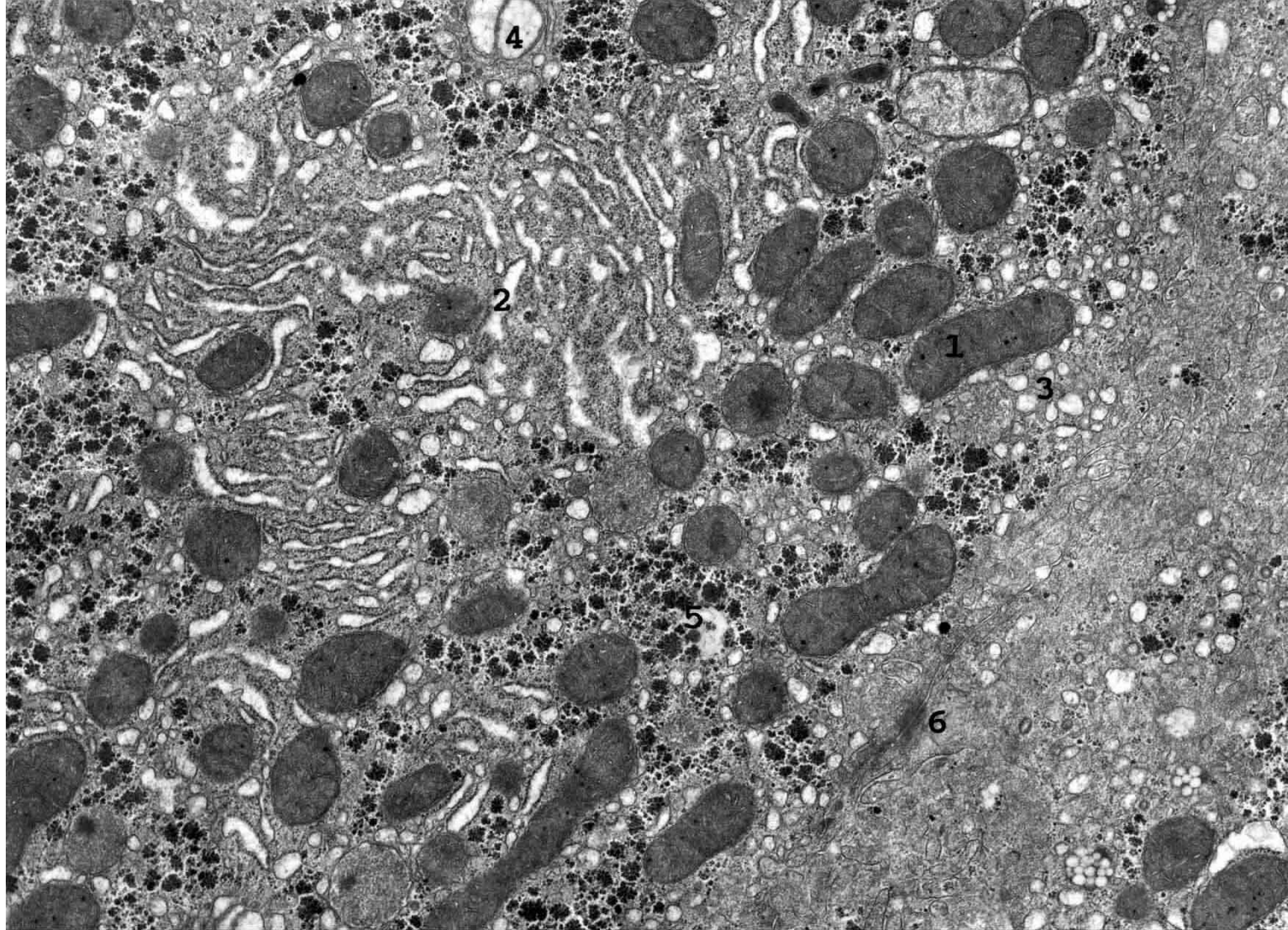
Liver

- Parenchyma of the liver is formed by trabecular epithelium (hepatocytes), between the trabecules there are sinusoids
- The liver has a functional (v. portae) and nutritional (a. hepatica propria) blood supply, branches of these travel in the portal spaces and blood finally mixes in the sinusoids
- Vessels of the portal space with a bile duct make up the portal triad (however, lymphatic vessels are traveling along as well)
- Classic liver lobule (6 portal triads surrounding a central vein), portal lobule (3 central veins surrounding a portal triad), portal acinus (2 adjacent portal triads and their 2 shared central veins)

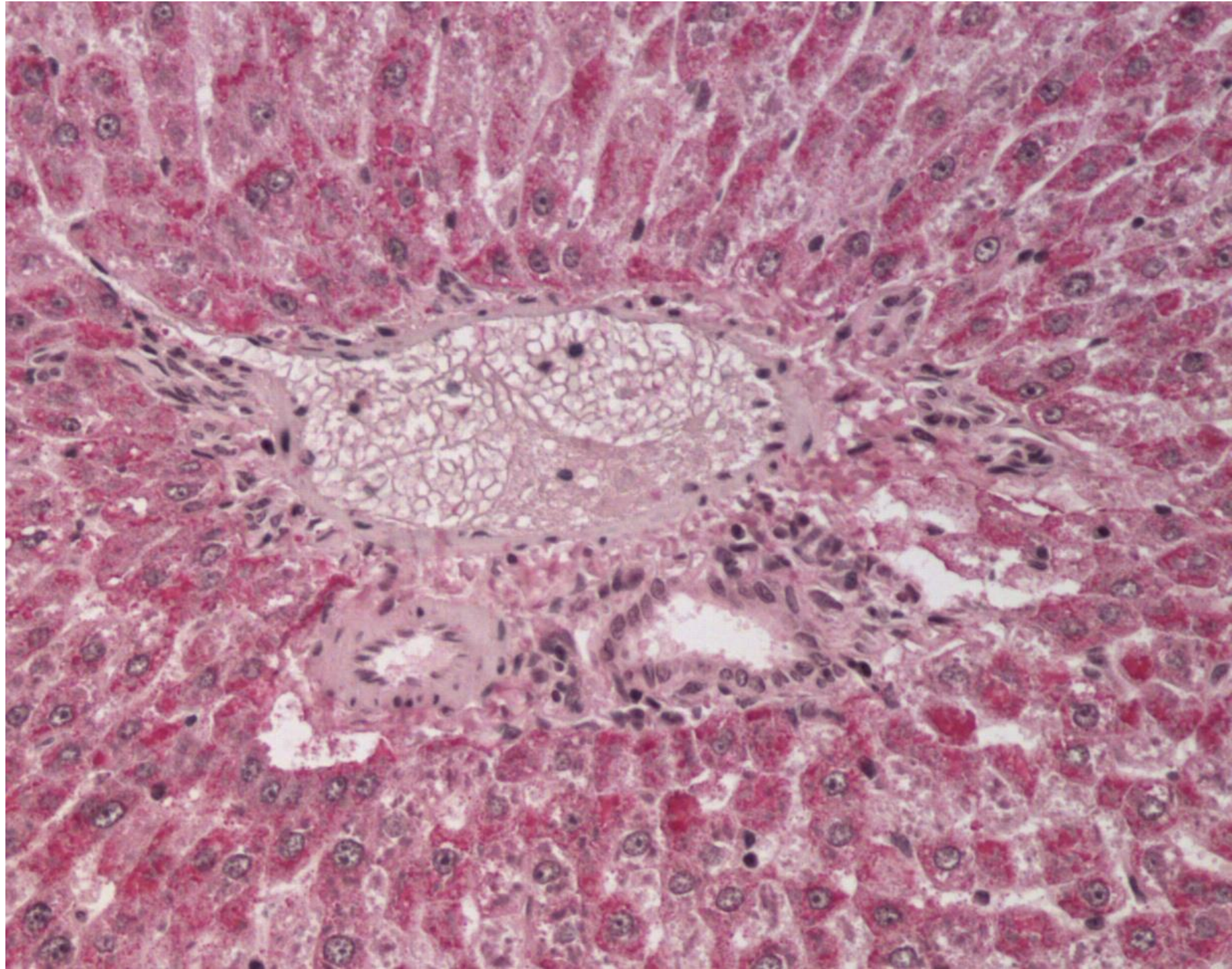








Best's
carmine for
glycogen

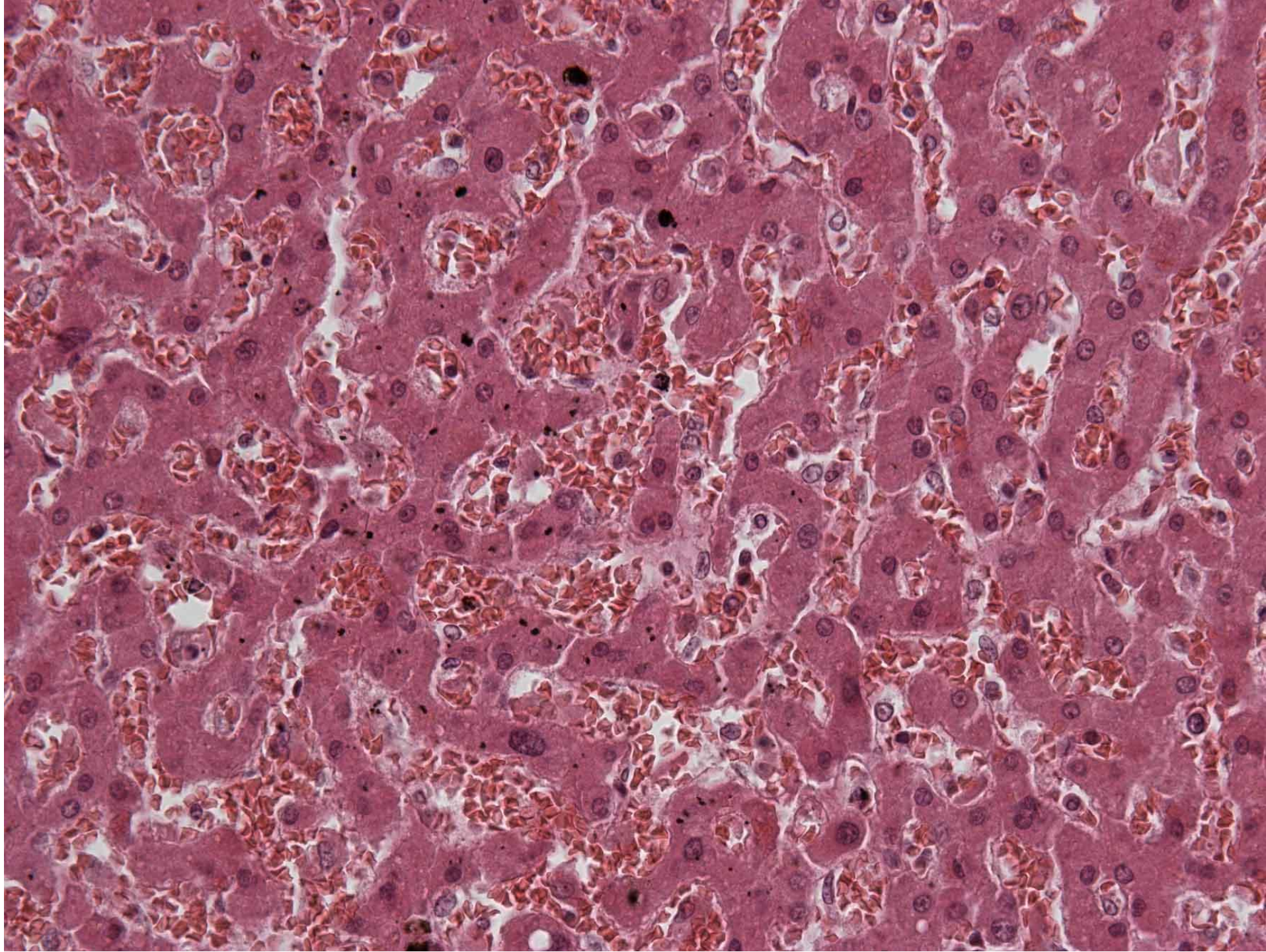


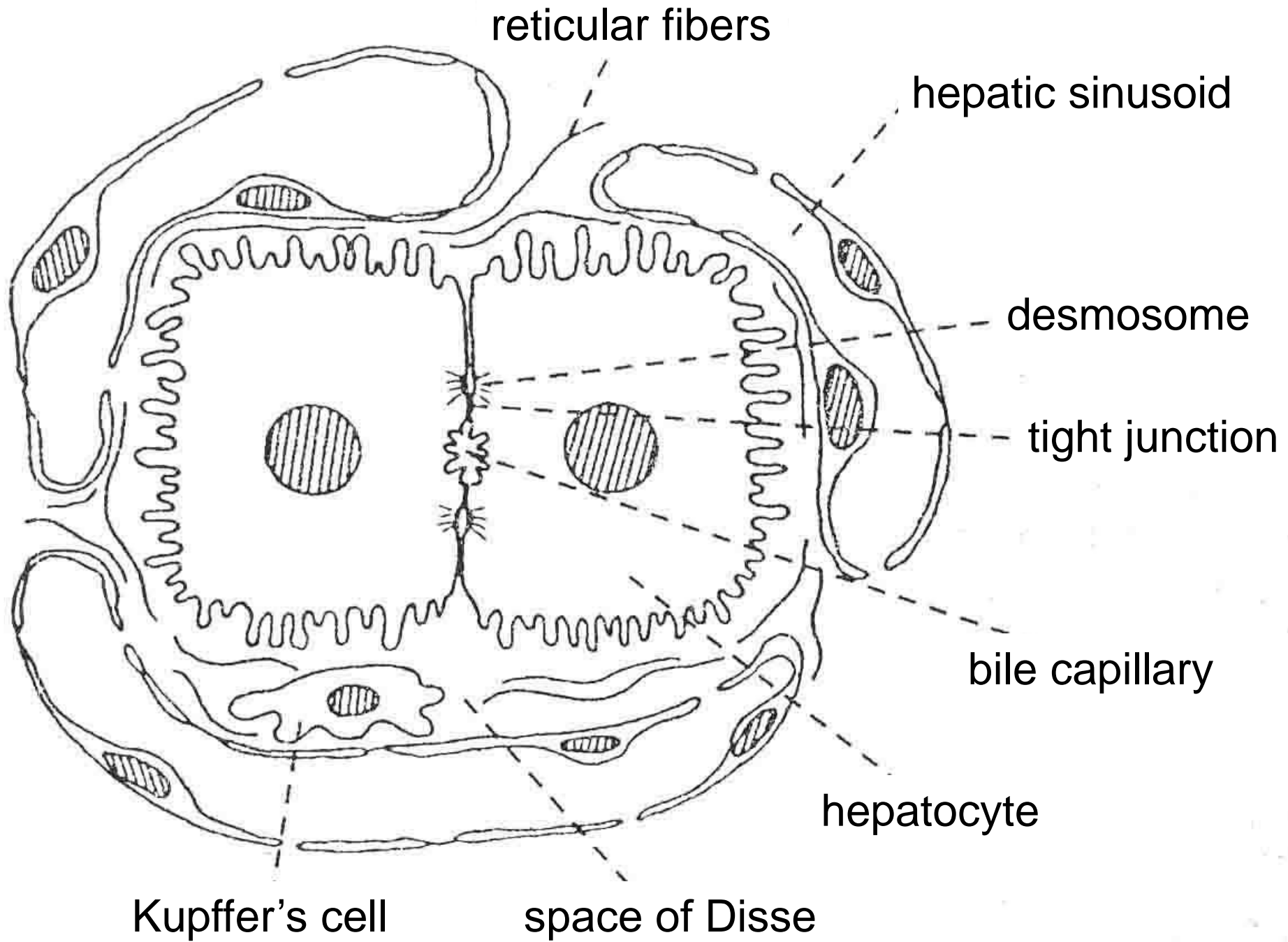
Hepatocytes

- Metabolic activity (extensive)
 - Synthesis (plasma proteins, glucose, lipoproteins, ketone bodies, bile)
 - Storage (vitamins A, D, K, E, iron, glycogen)
 - Degradation and excretion (billirubin, proteins to urea, xenobiotics)
- Well developed organelles and cellular junctions
- Microvilli on both apical (bile canaliculus) and basal (space of Disse towards the sinusoids) surfaces

Hepatic sinusoids

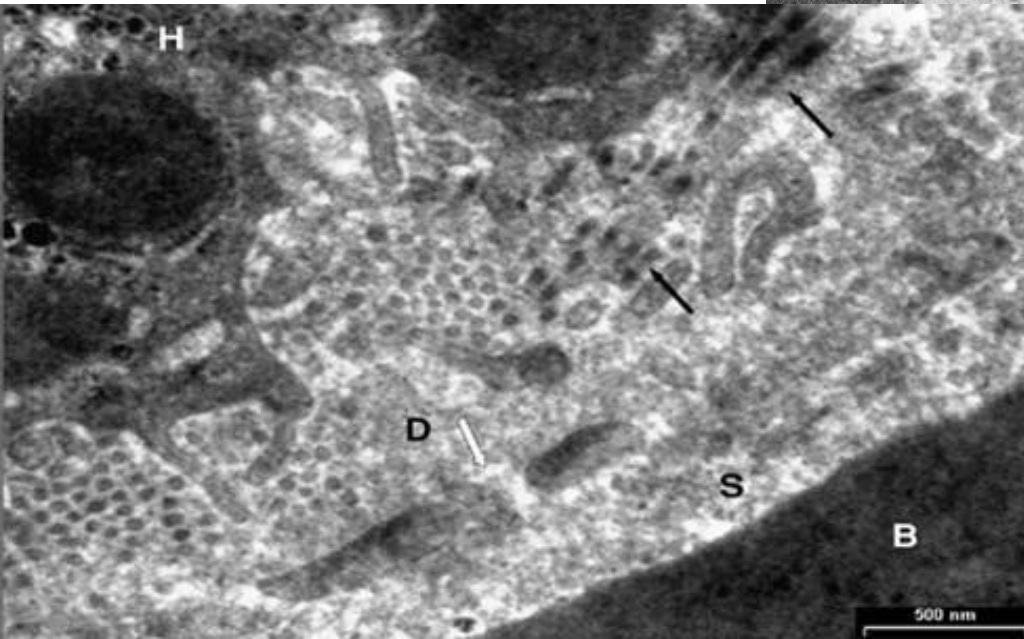
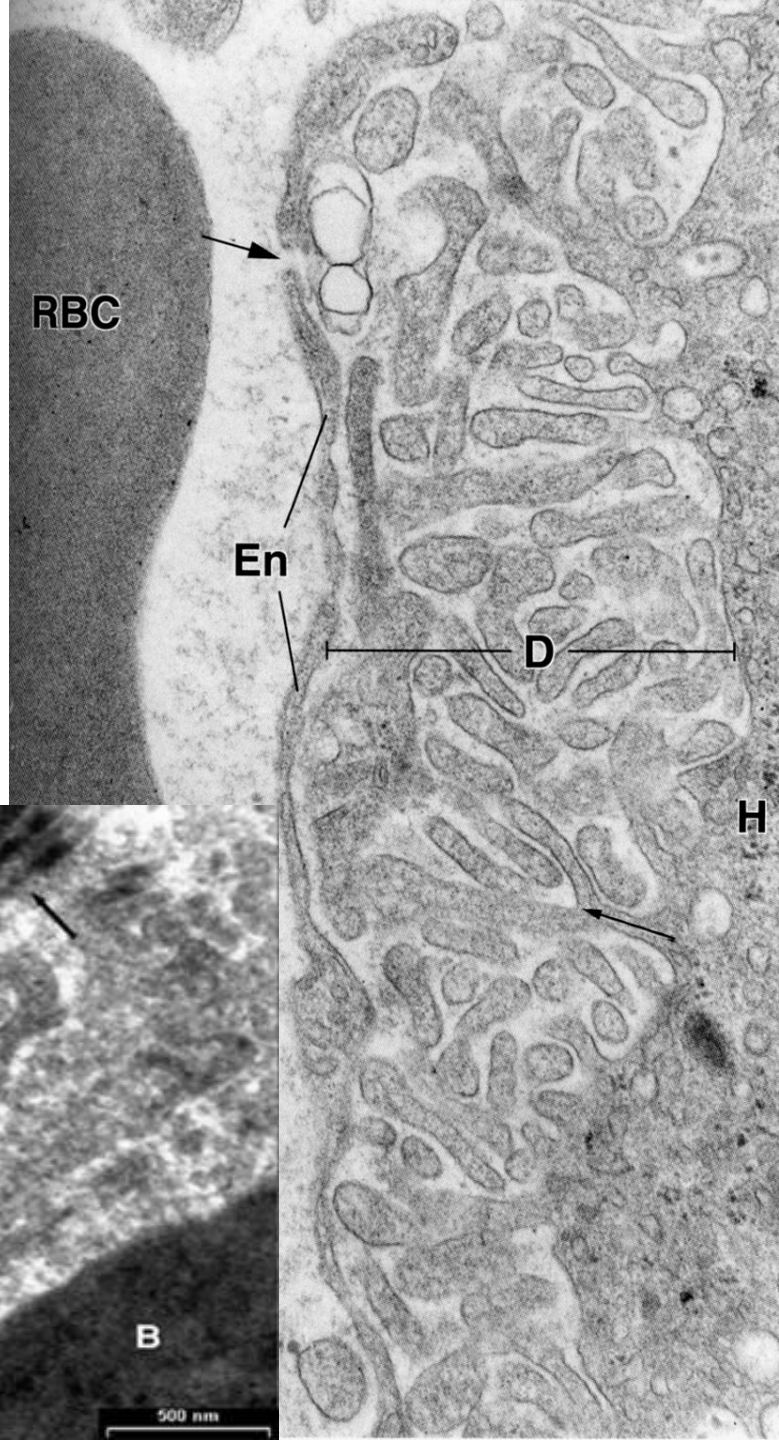
What are the most important characteristics of a sinusoid?





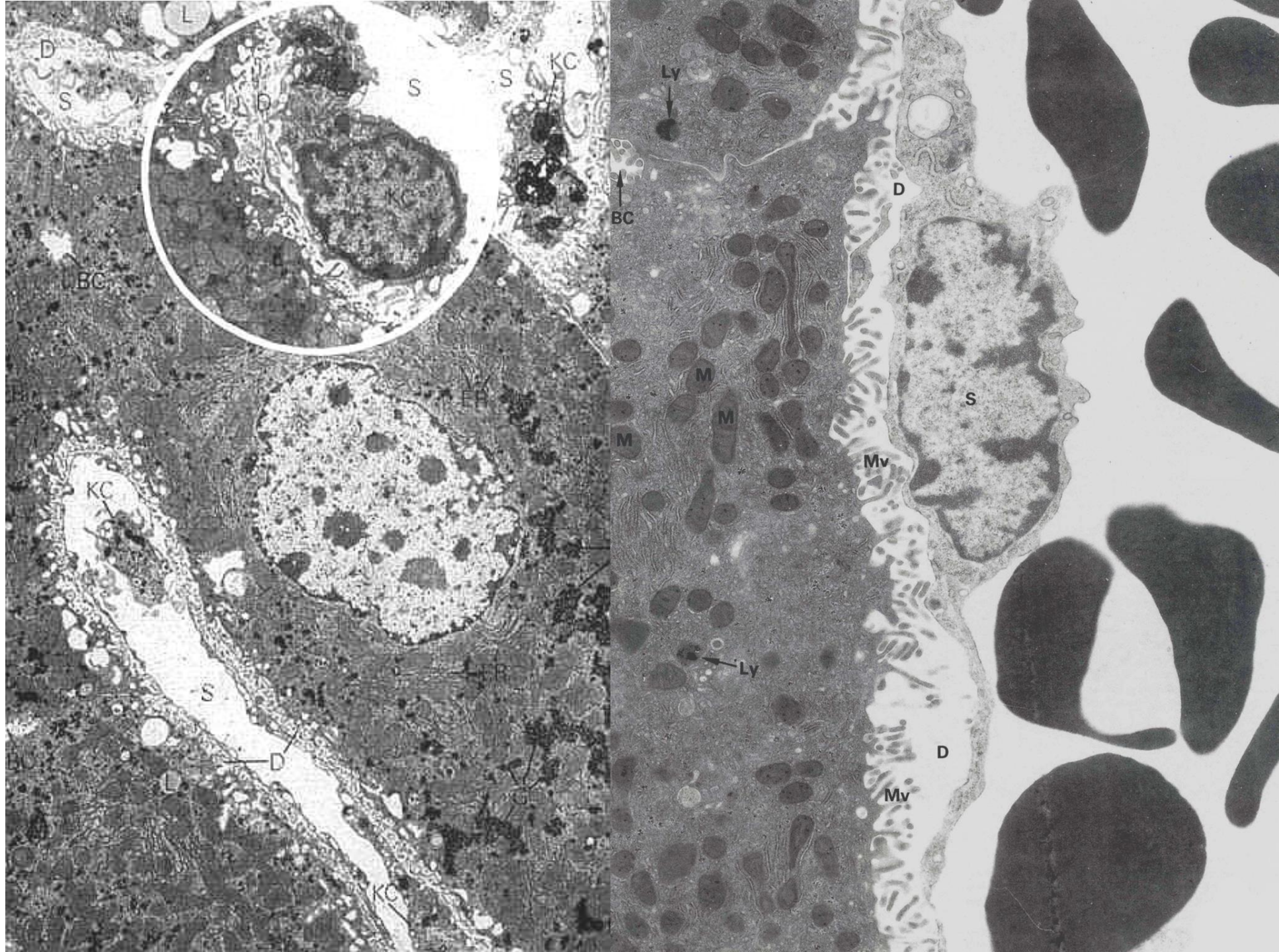
Reticular fibers in the space of Disse

Soheir S. Mansy et al., (2010) Hepatic Stellate Cells and Fibrogenesis in Hepatitis C Virus Infection: An Ultrastructural Insight, Ultrastructural Pathology

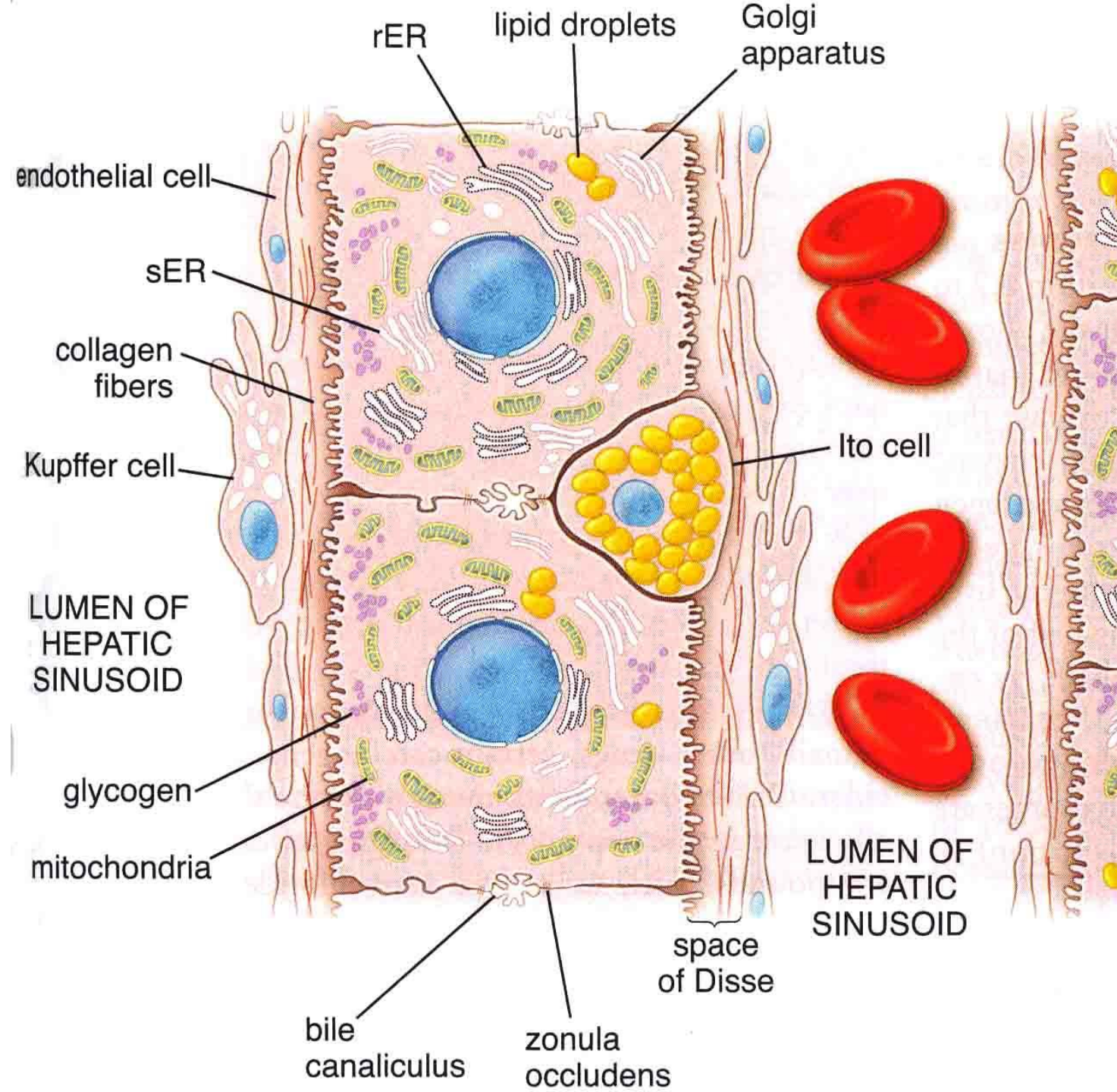


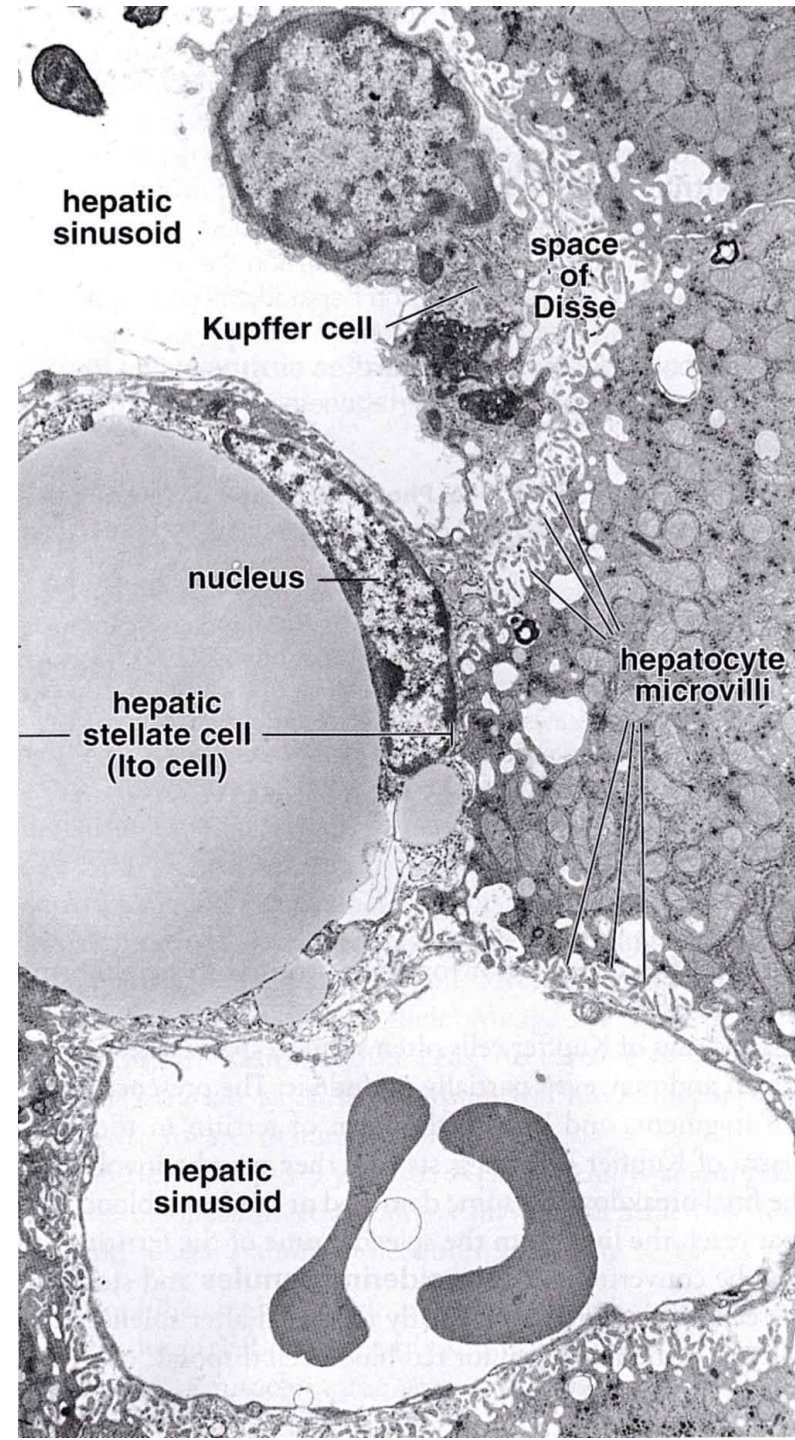
Spaces of Disse

What are the functions of the cells found in the space of Disse?



Ito cells (hepatic stellate cells) store vitamin A and fat and can participate in ECM production and inflammation. They probably play a role in liver cirrhosis, where they differentiate into myofibroblasts.





hepatic sinusoid

space of Disse

Kupffer cell

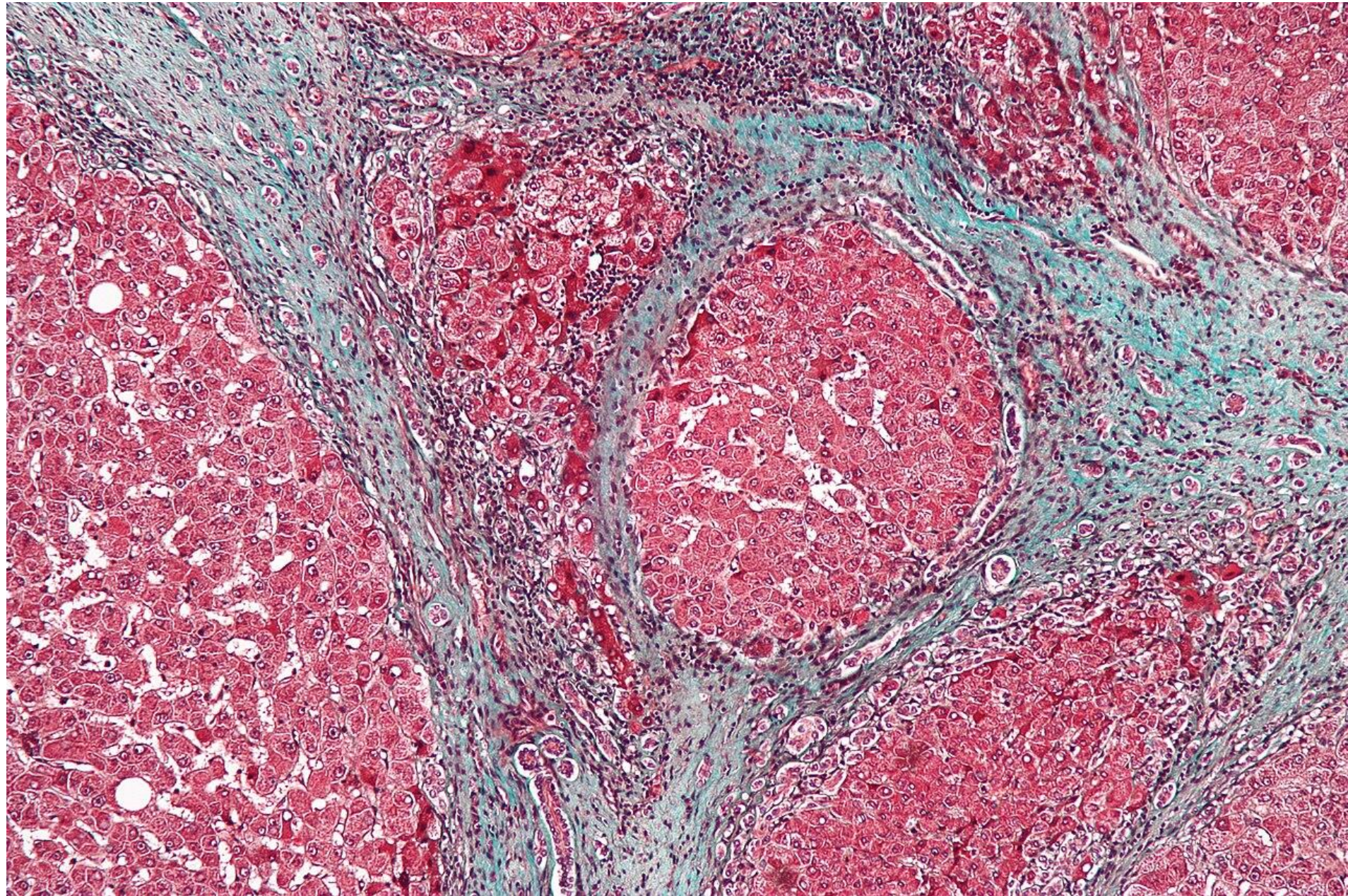
nucleus

hepatocyte microvilli

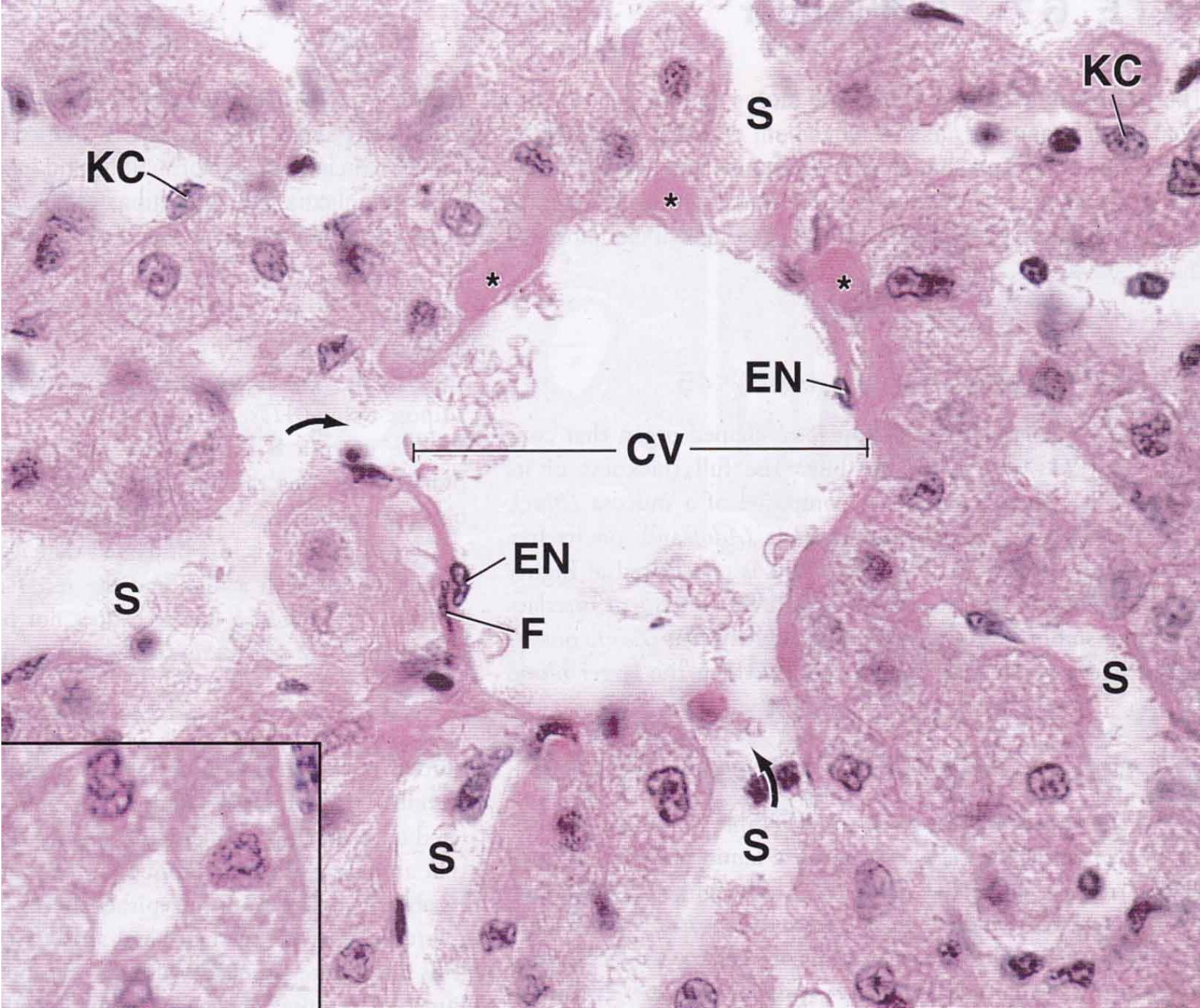
hepatic stellate cell (Ito cell)

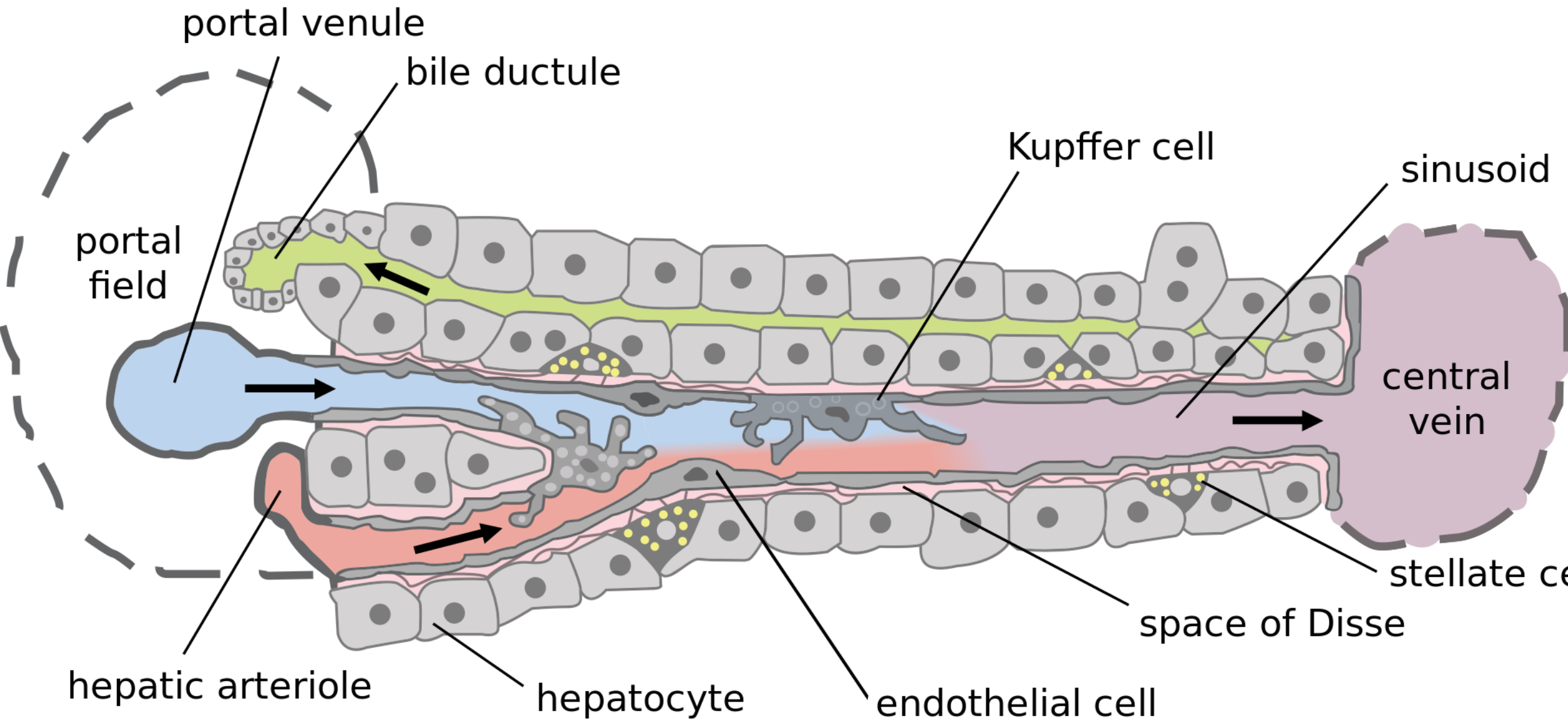
hepatic sinusoid

Liver cirrhosis is a disease caused by prolonged exposure to harmful factors (e.g. hepatitis viruses B and C, alcohol). In response, the connective tissue of liver proliferates and nodules form.



Kupffer cells are liver macrophages. They line the sinusoids (but don't form cell junctions) and send their processes into the sinusoid lumen.

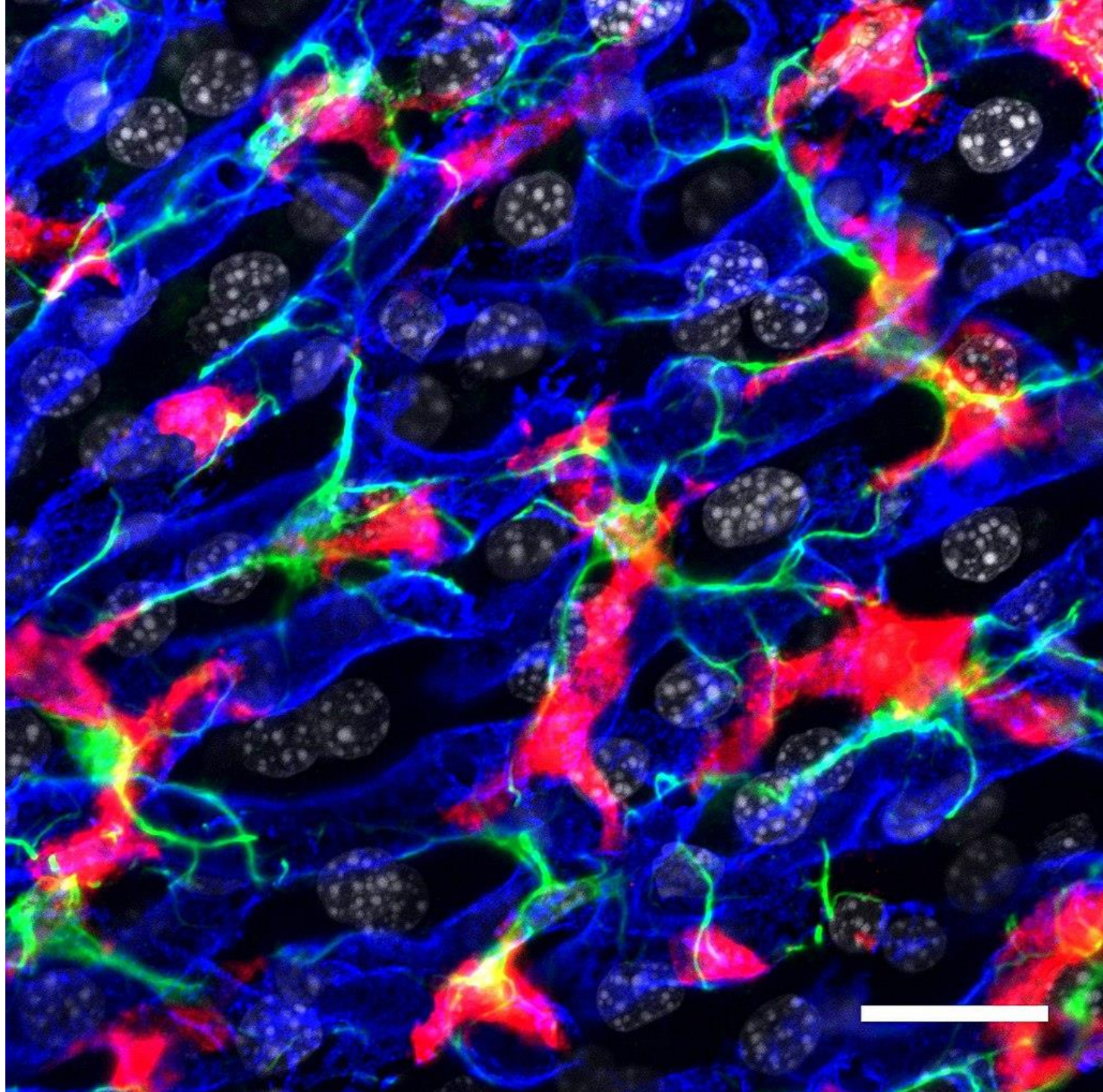


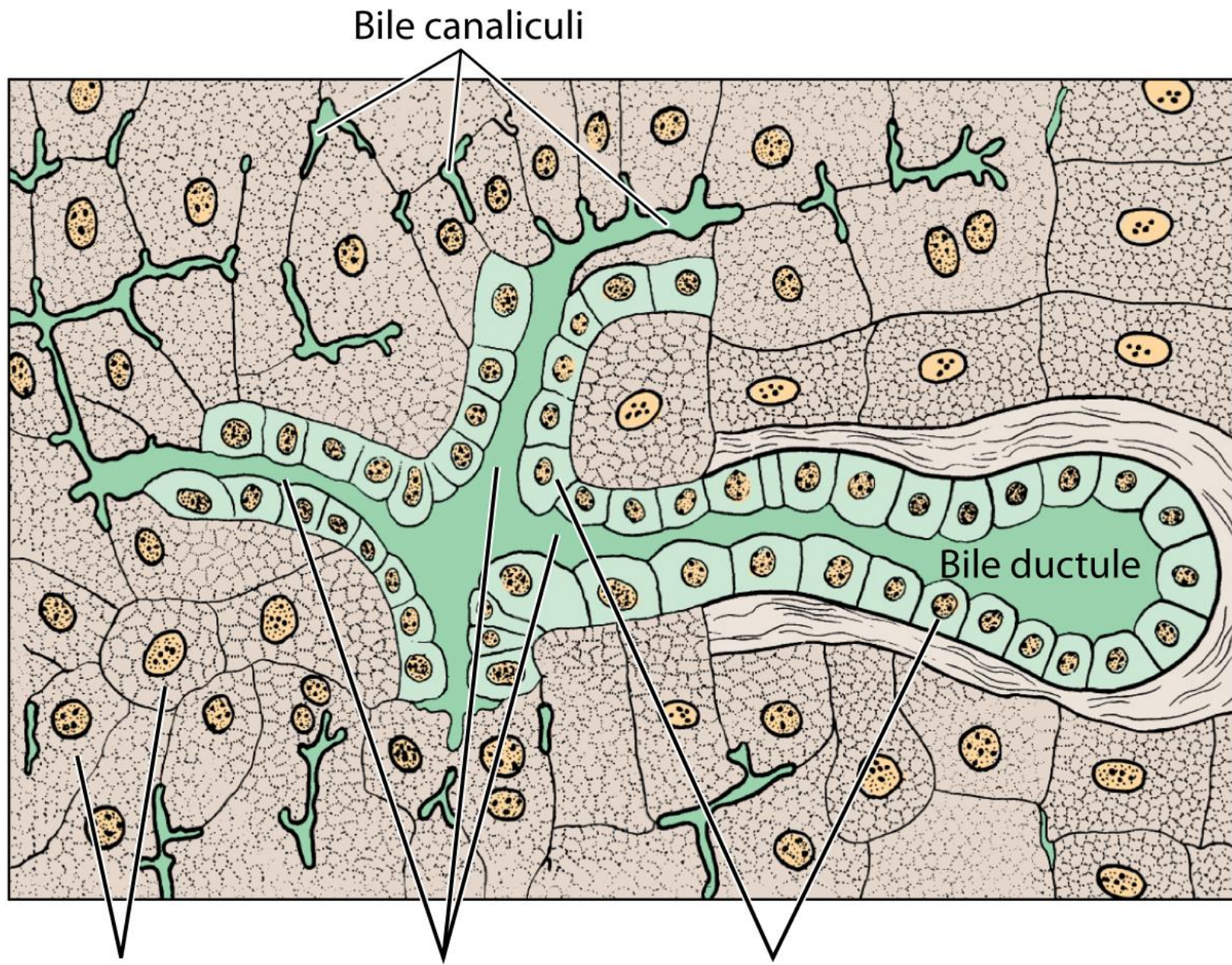


https://en.wikipedia.org/wiki/Kupffer_cell#/media/File:Hepatic_structure2.svg

Ito cells – green
Kupffer cells – red
Endothelia – blue
Nuclei – white

https://en.wikipedia.org/wiki/Kupffer_cell#/media/File:Interaction_between_Kupffer_cells,_Stellate_cells_and_endothelial_cells.jpg





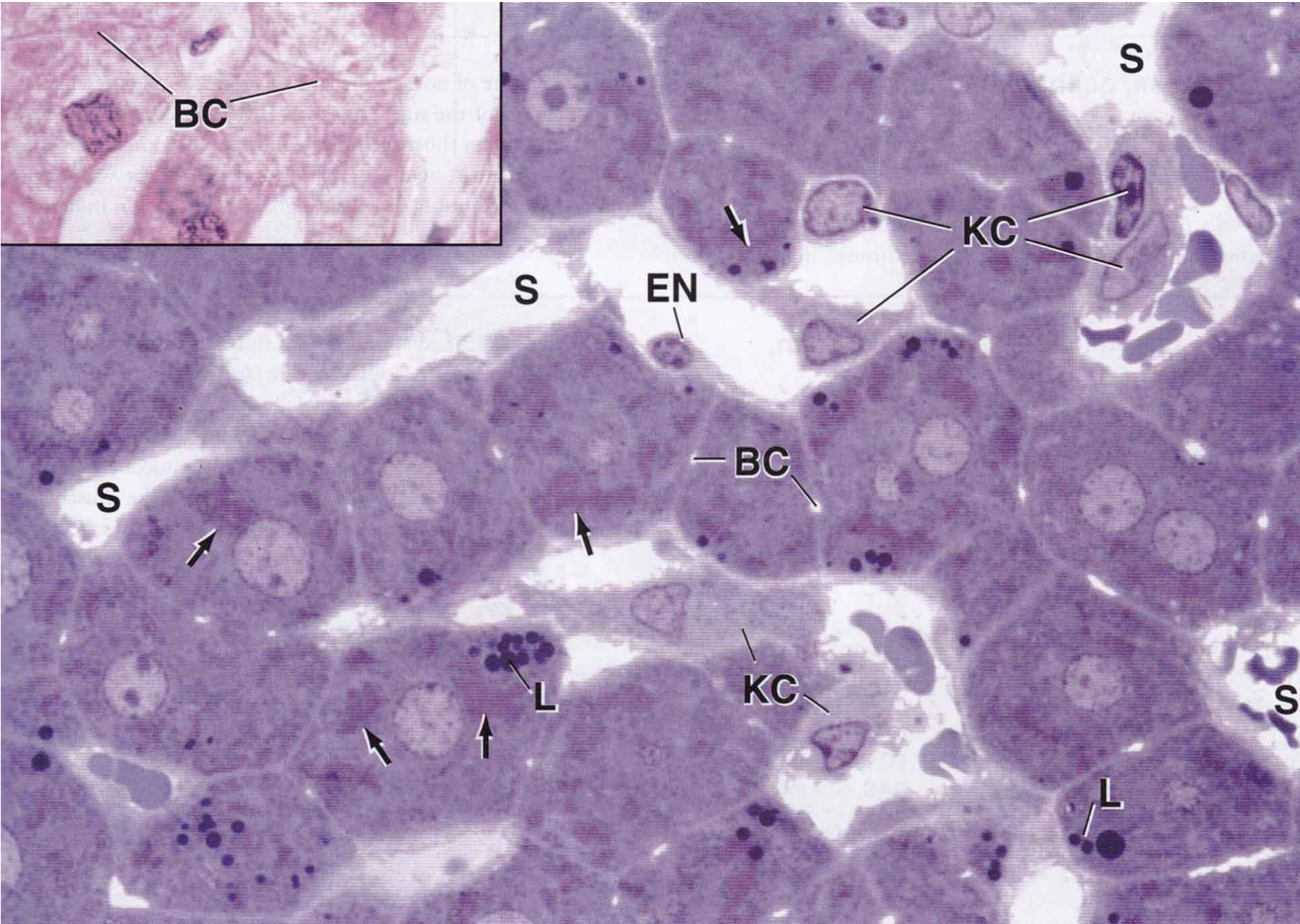
Bile canaliculi

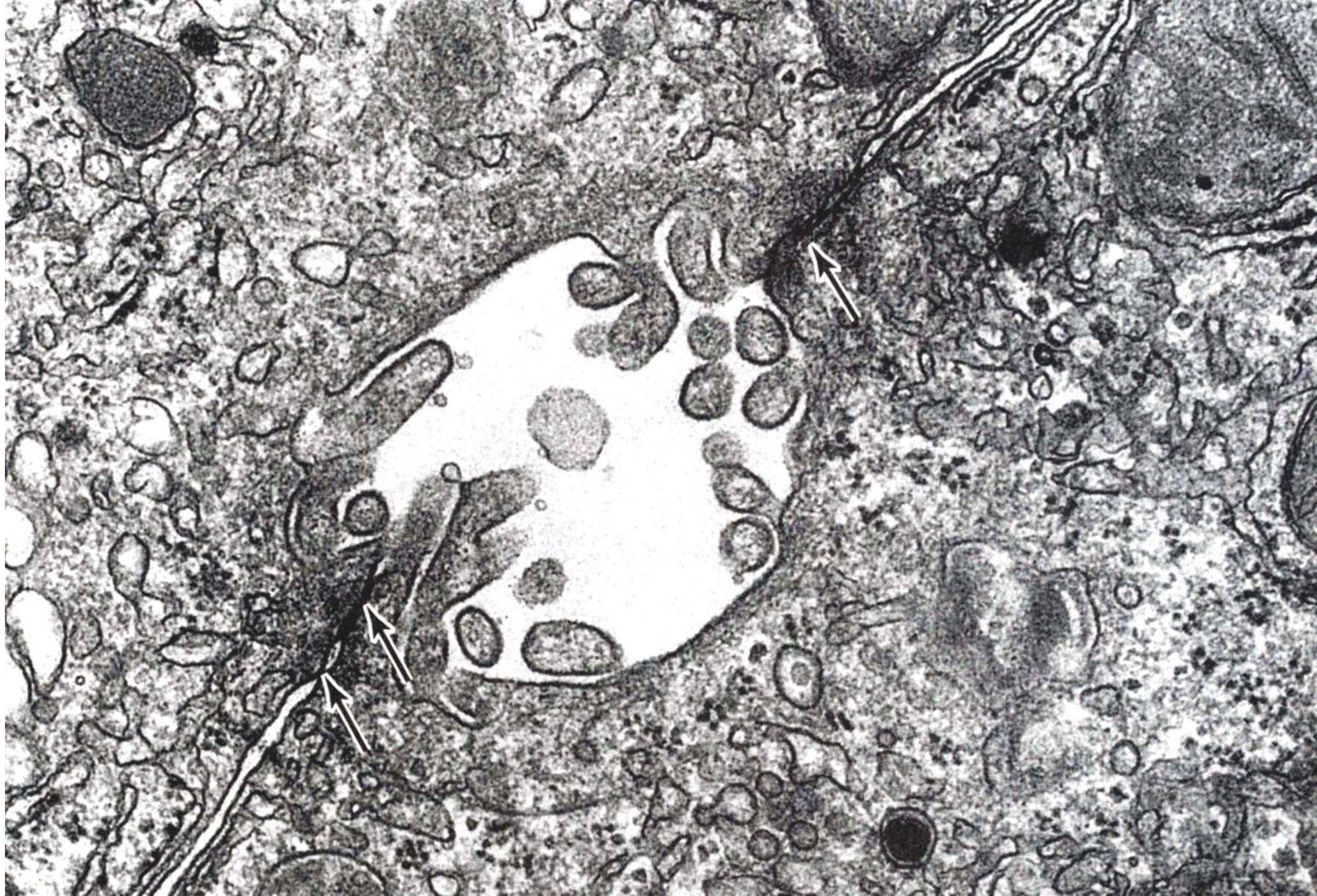
Bile ductule

Hepatocytes

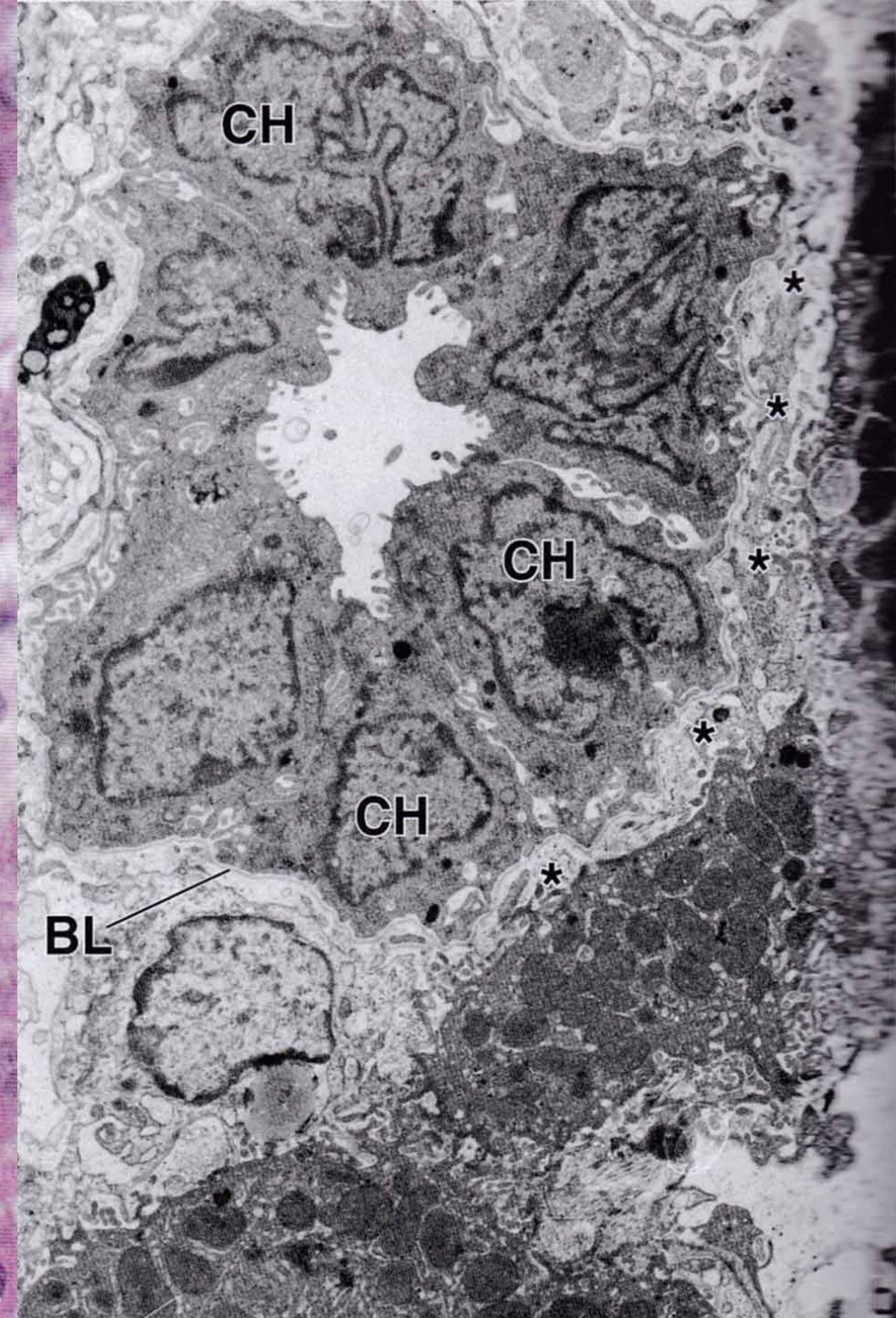
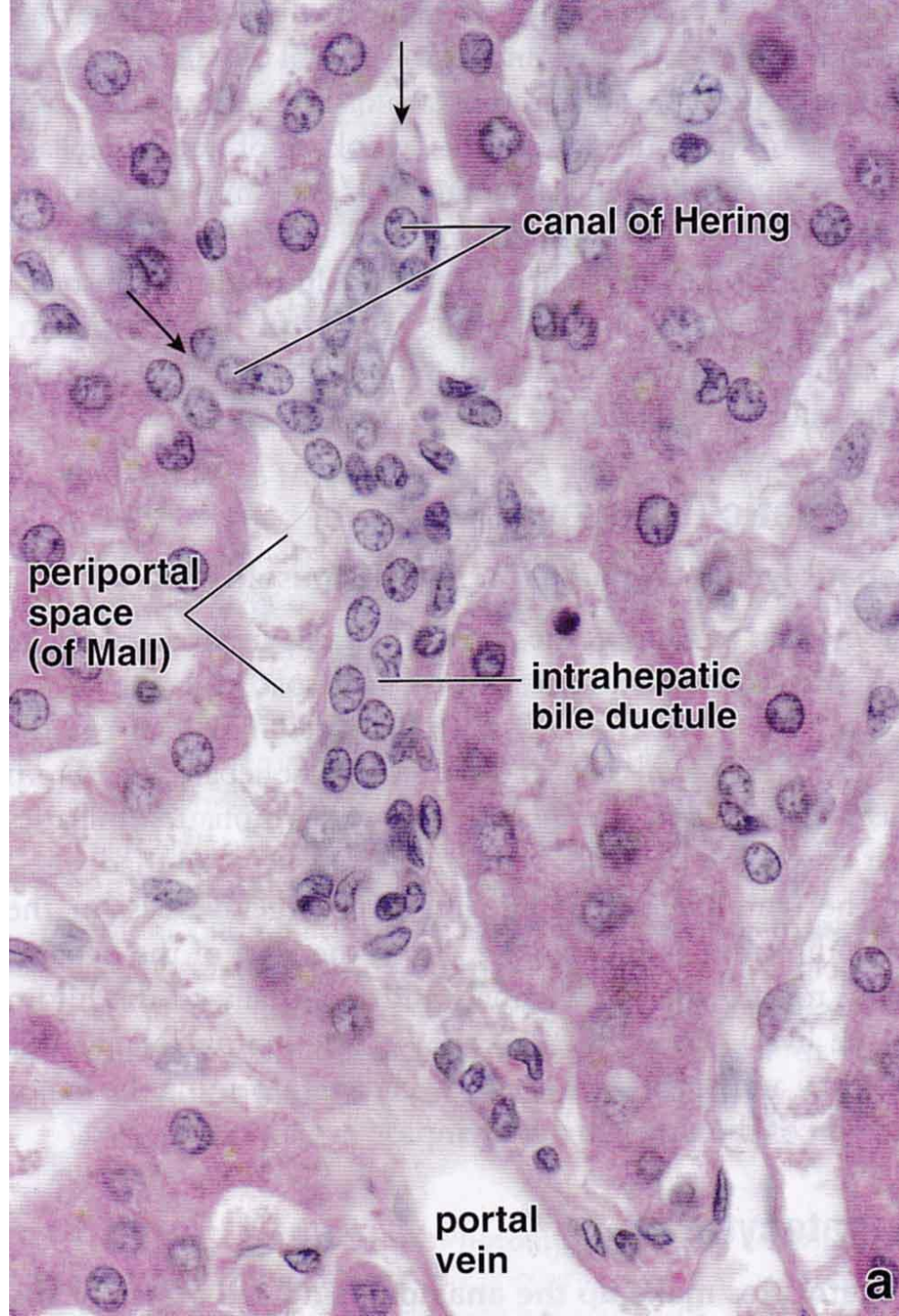
Bile canals
of Hering

Cholangiocytes

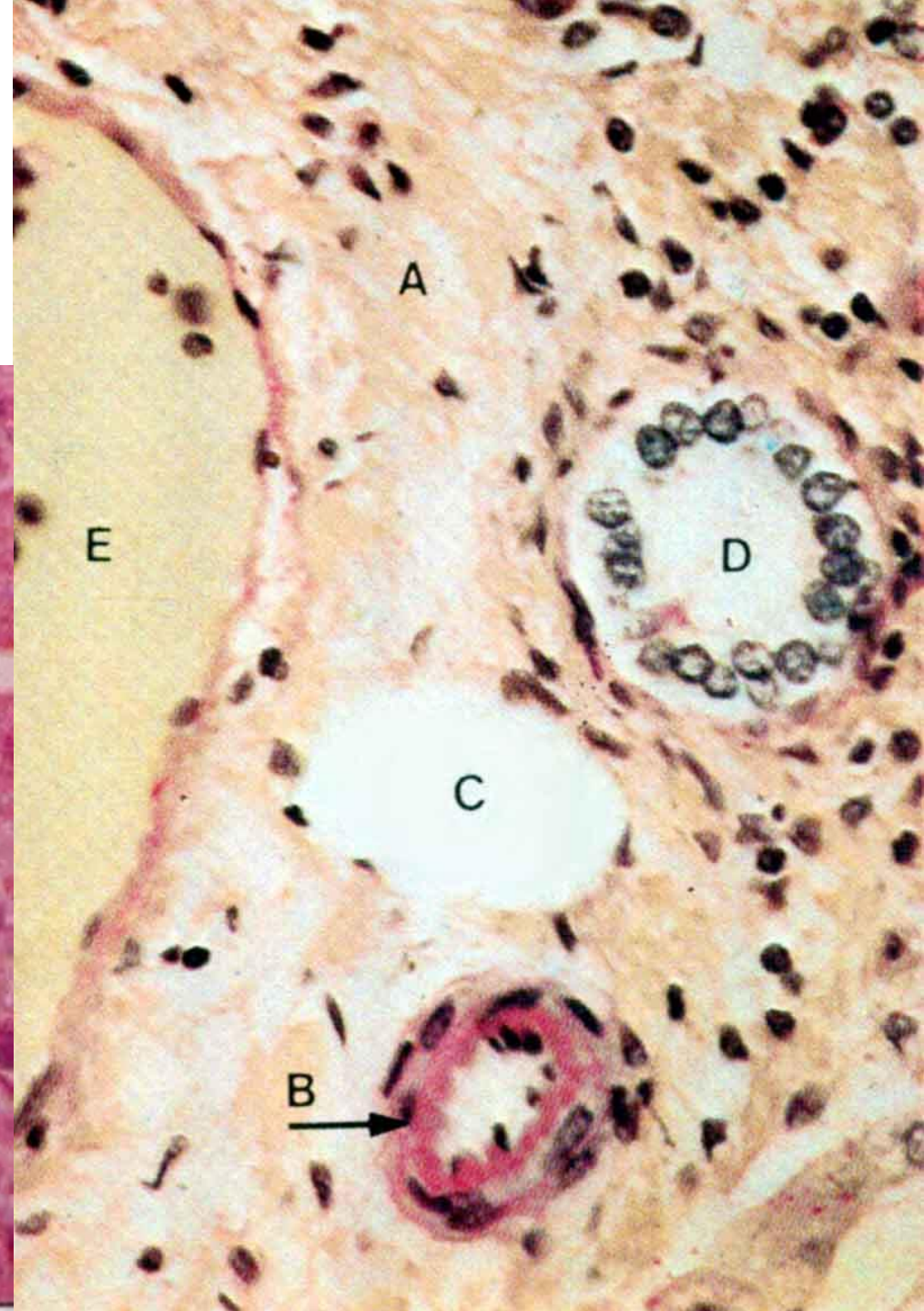
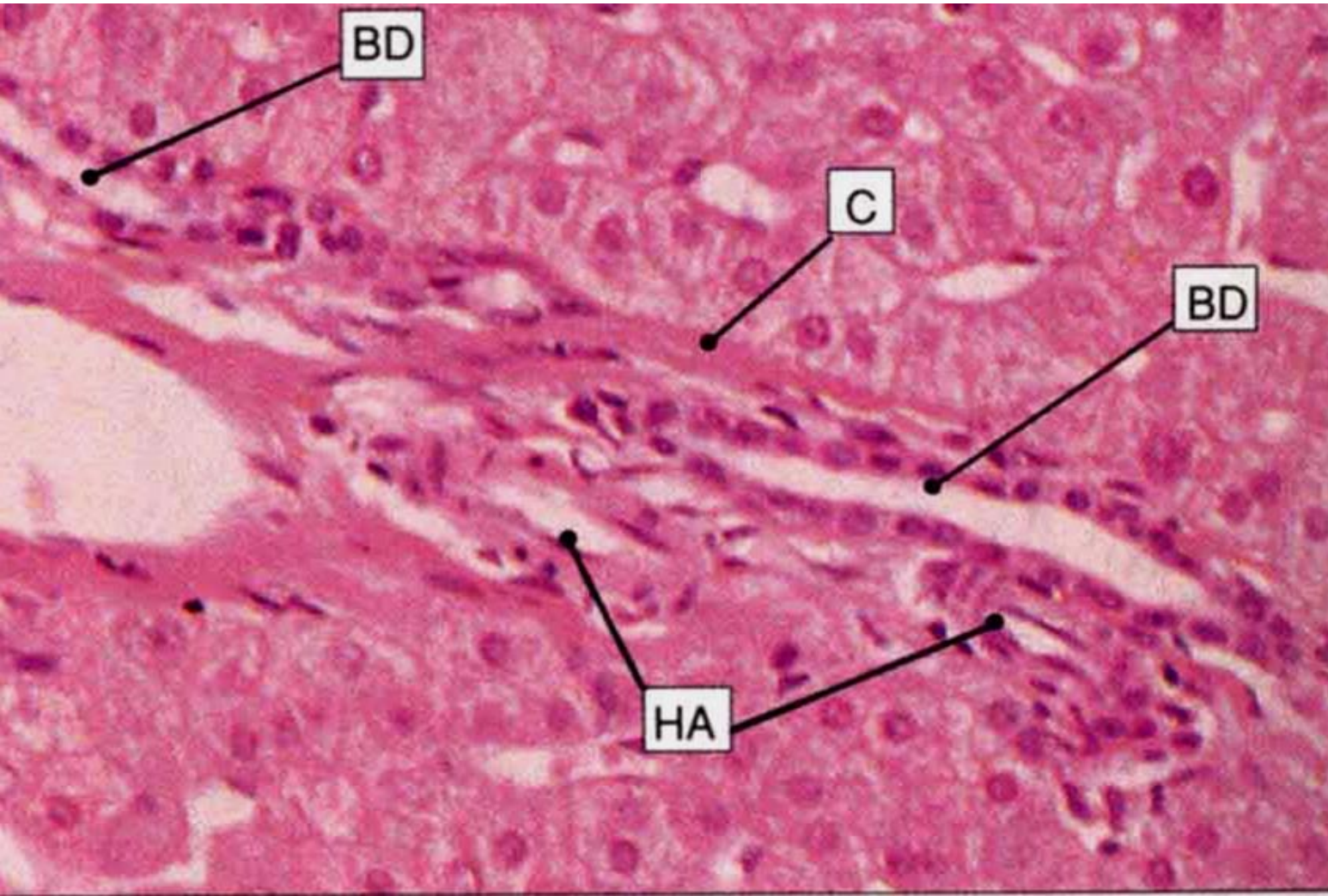




Canals of Hering are partially lined by cholangiocytes (simple cuboidal epithelium). They feed into intrahepatic bile ductules (completely lined by cholangiocytes).



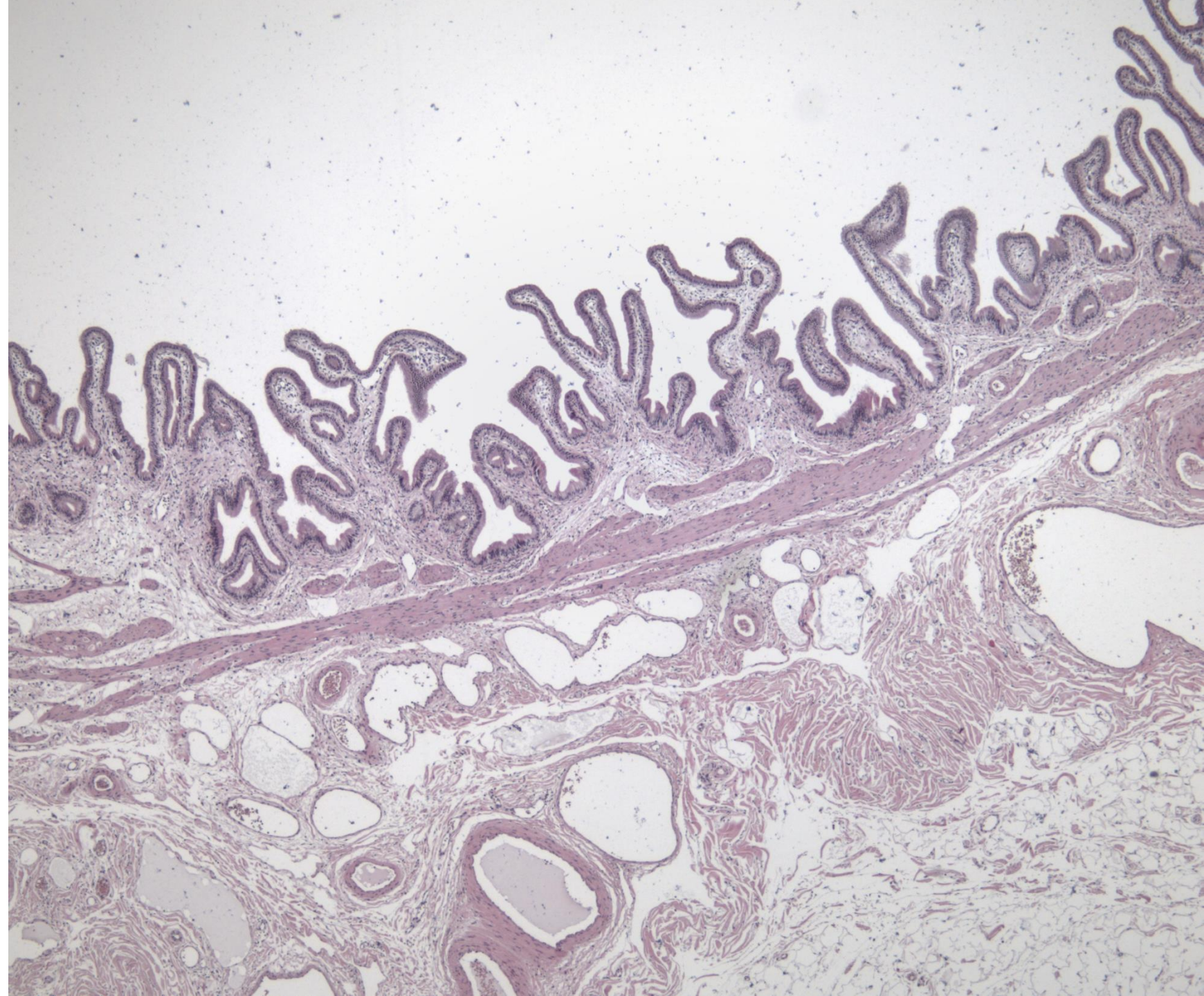
Interlobular bile ducts are a part of the portal triad.



In larger bile ducts the epithelium becomes columnar

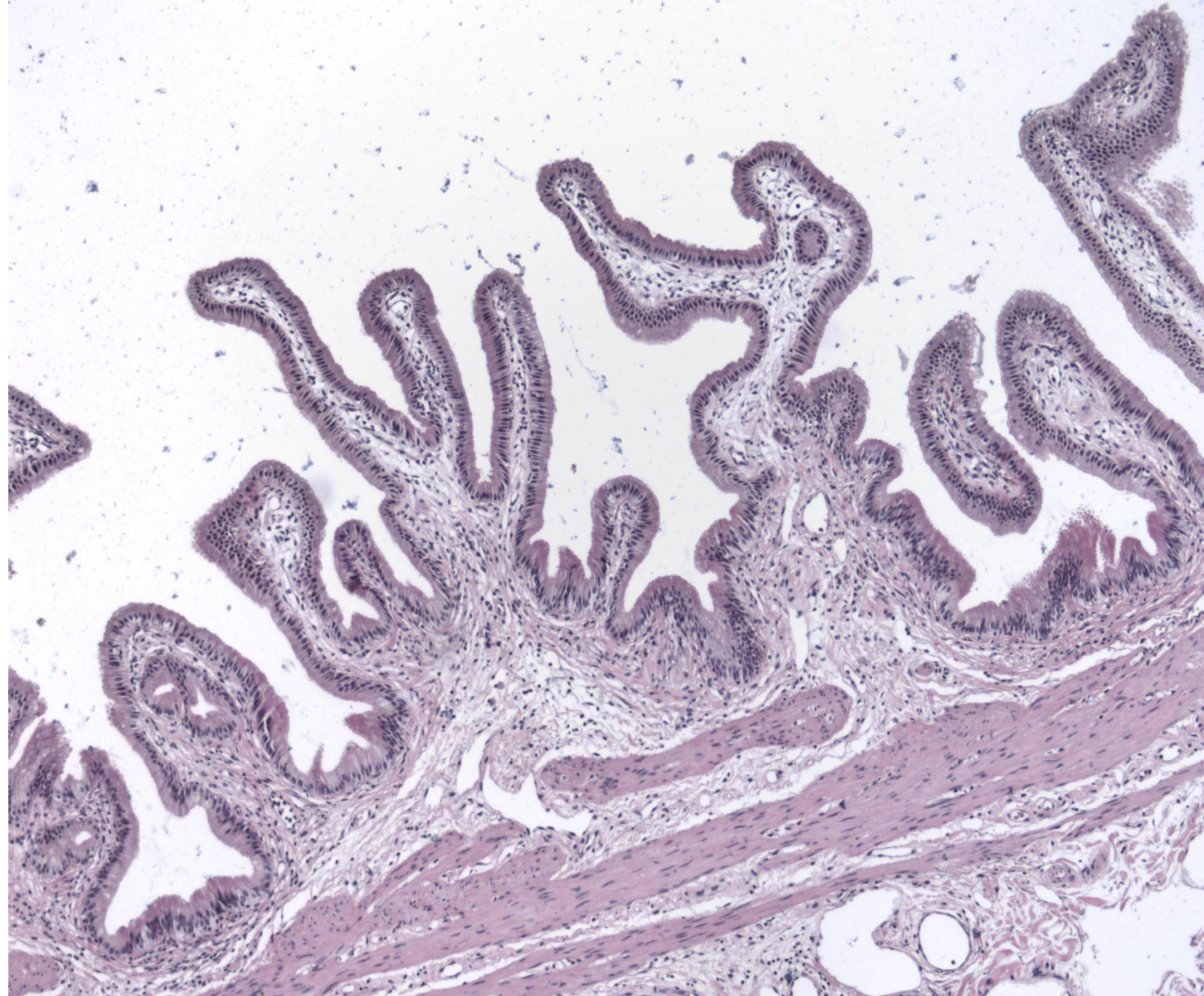


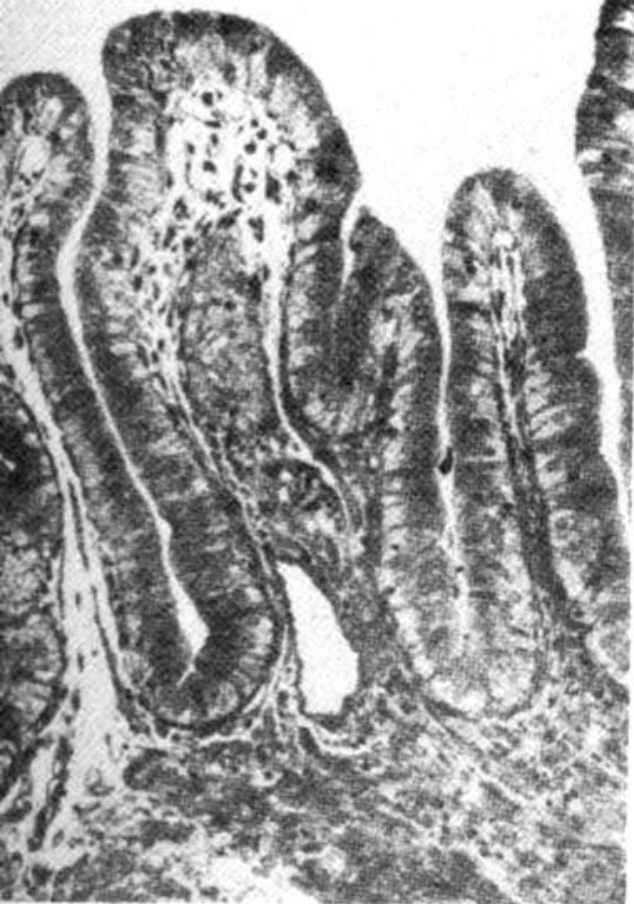
Gallbladder contains mucosa with folds, muscularis externa and thick adventitia or serosa.



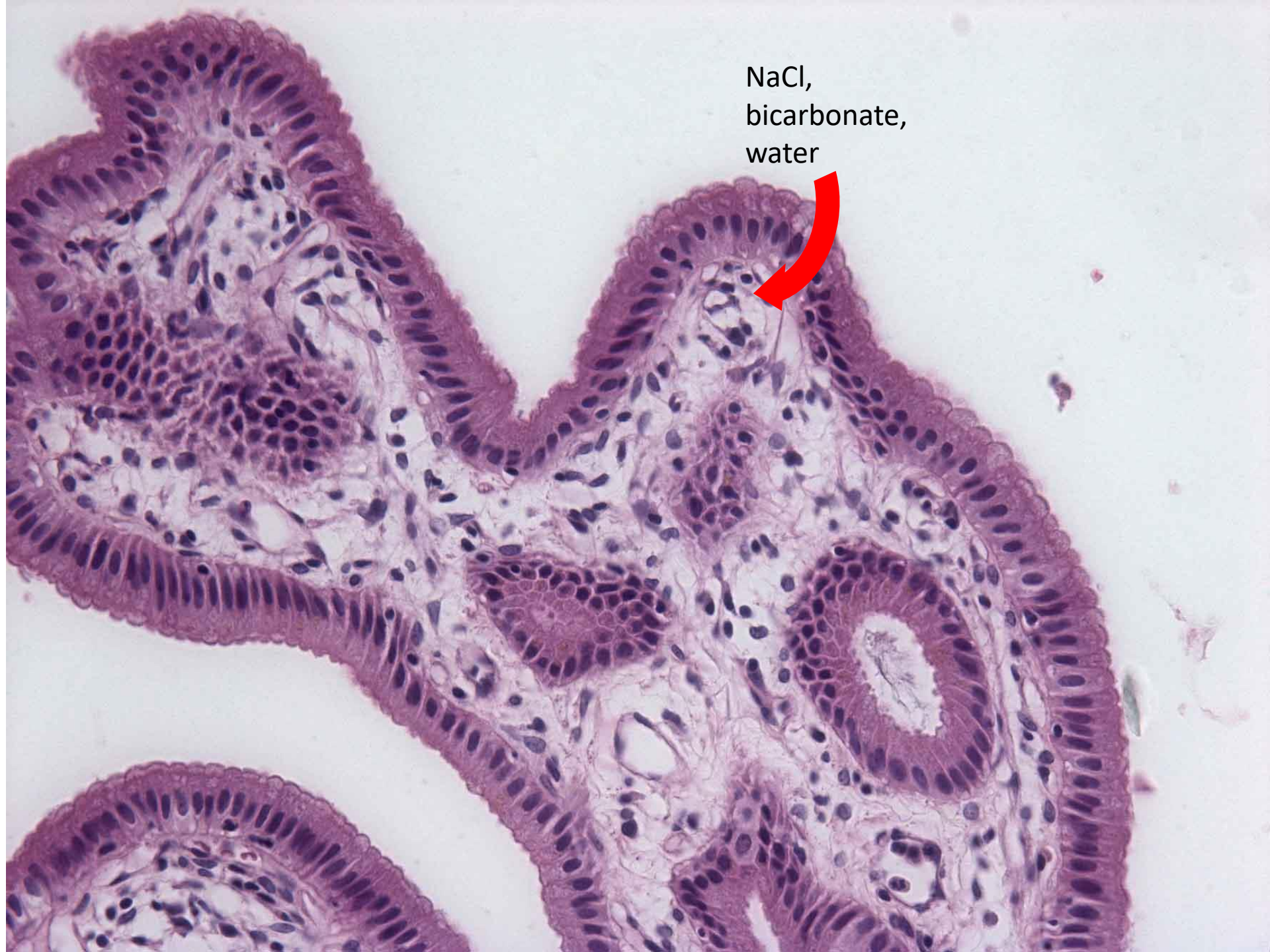
There is no
muscularis
mucosae.

The smooth
muscle you see
is muscularis
externa.



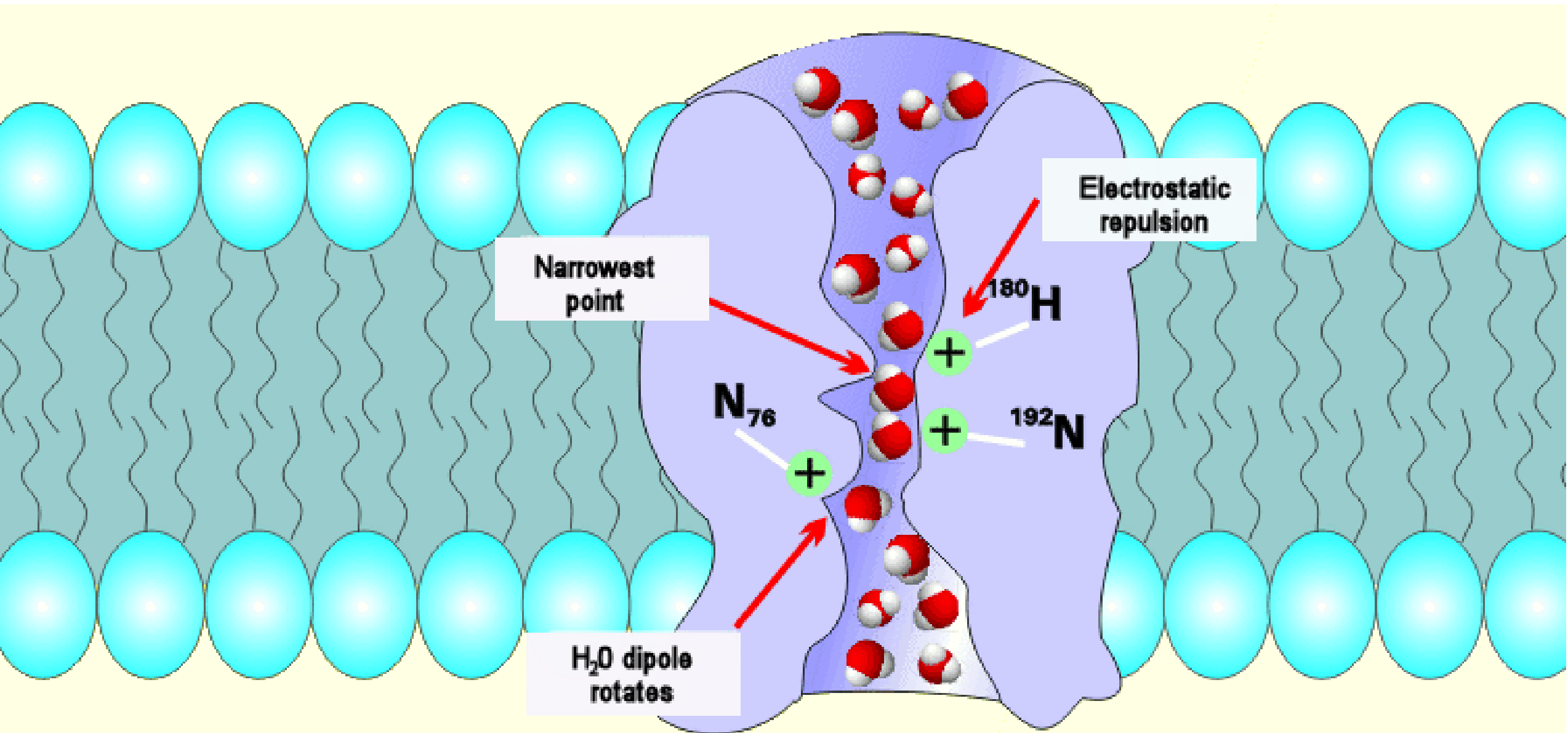


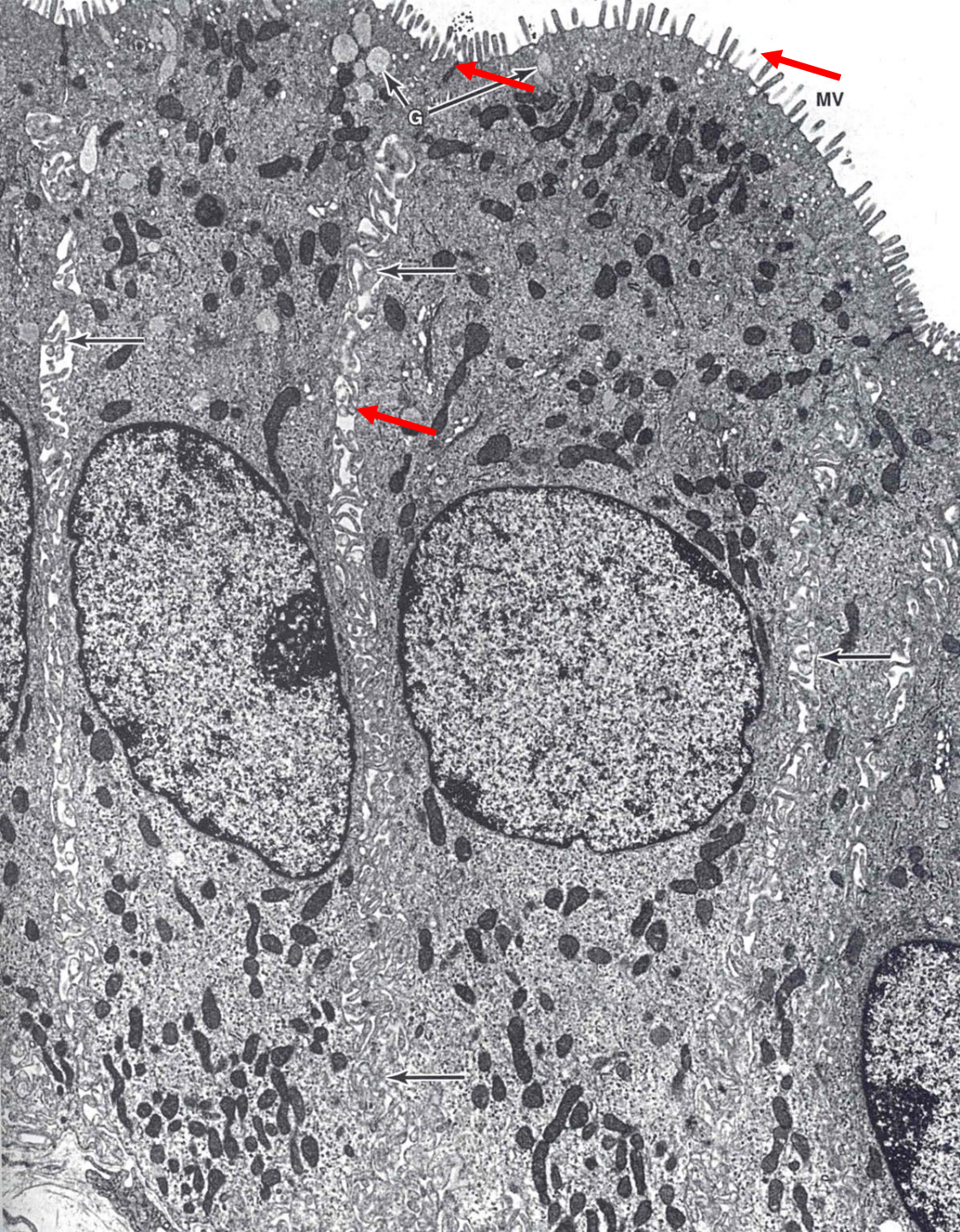
The epithelial cells actively transport electrolytes and contain aquaporins (about 90% of water can be absorbed). Note well developed capillary network.



NaCl,
bicarbonate,
water

Aquaporin



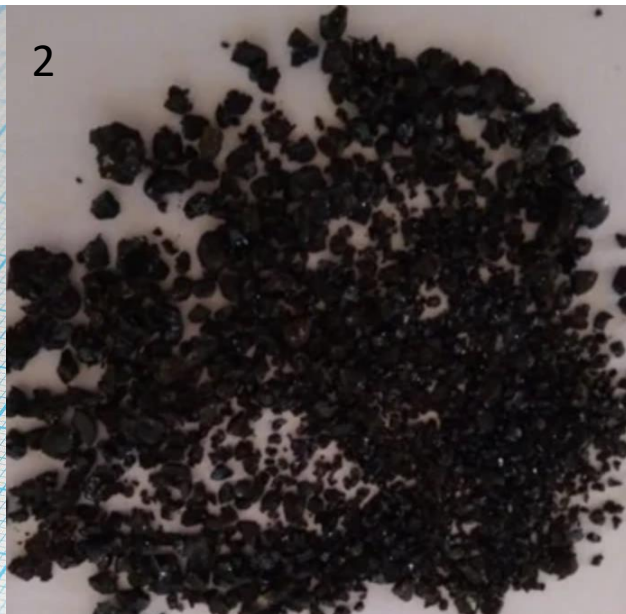


What are these made of?

1



2



3



4



5



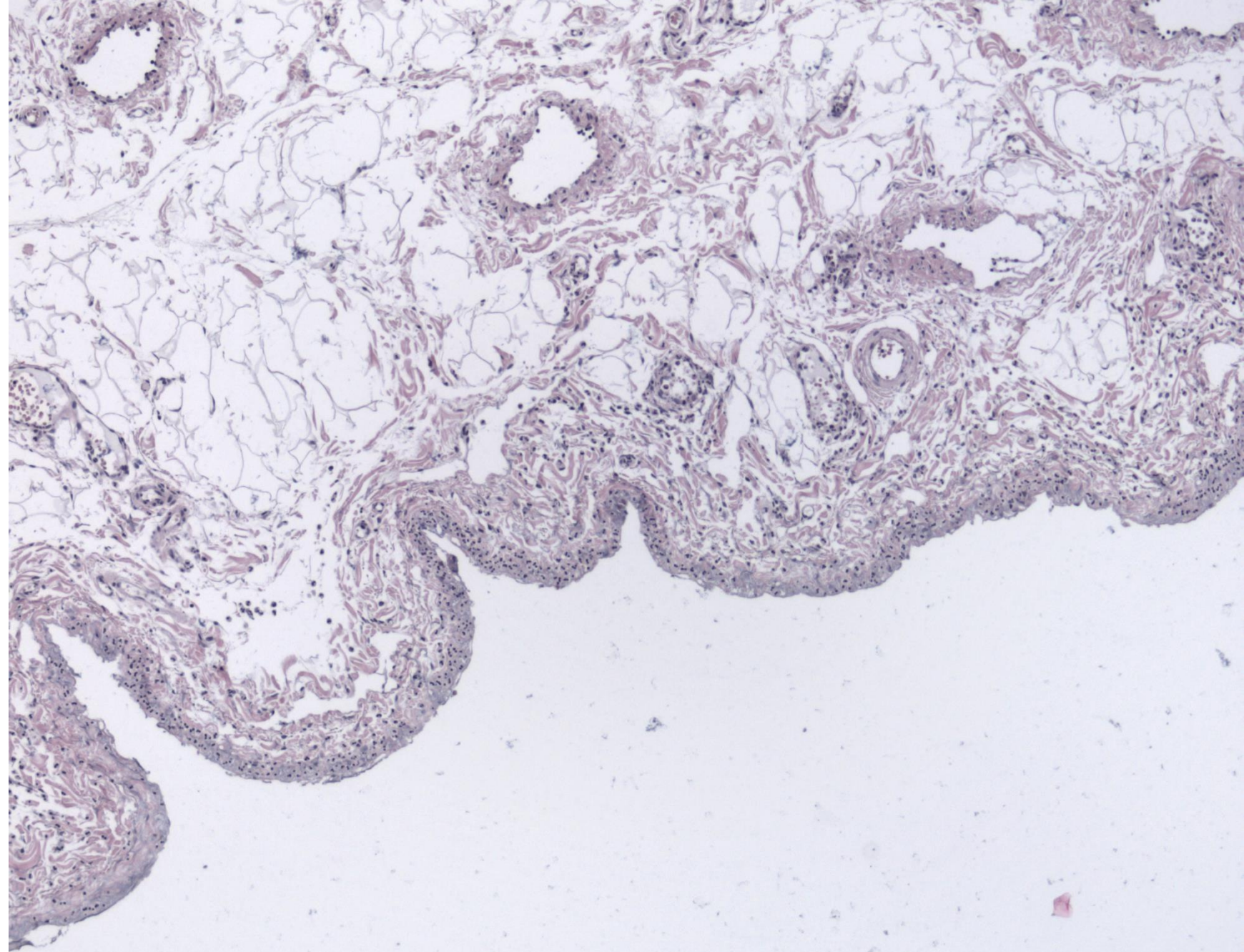
6



Rokitansky-Aschoff sinuses are sometimes considered pathologic structures (result of chronic cholecystitis or damage caused by gallstones).



Is there
adventitia or
serosa on the
gallbladder?



Gallbladder

- Three layers (mucosa, muscularis, adventitia/serosa)
- Mucosa contains simple columnar epithelium (cholangiocytes) provisioned with microvilli, junctional complexes and complex lateral plications and lamina propria containing a rich capillary network
- The principal function of the gallbladder is bile storage and concentration, epithelial cells are able to transport water and electrolytes into lamina propria, where the fluid is taken up by the capillaries