Digestive glands

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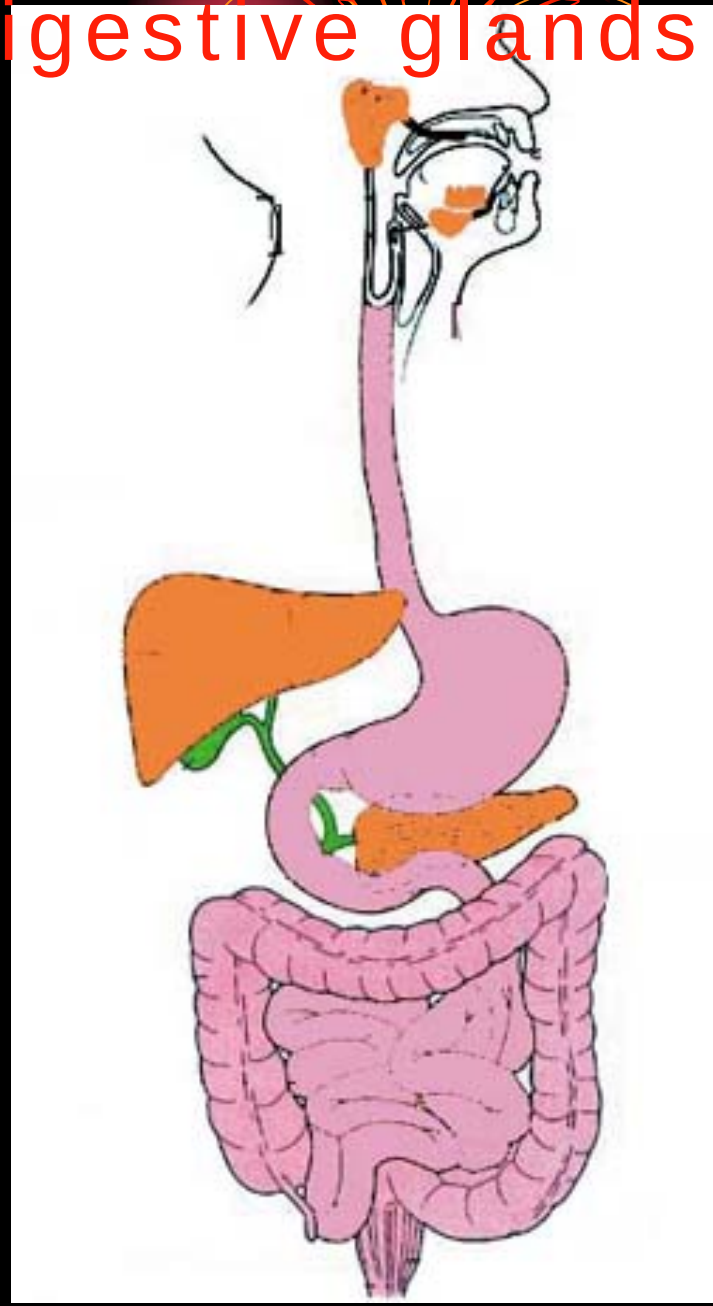
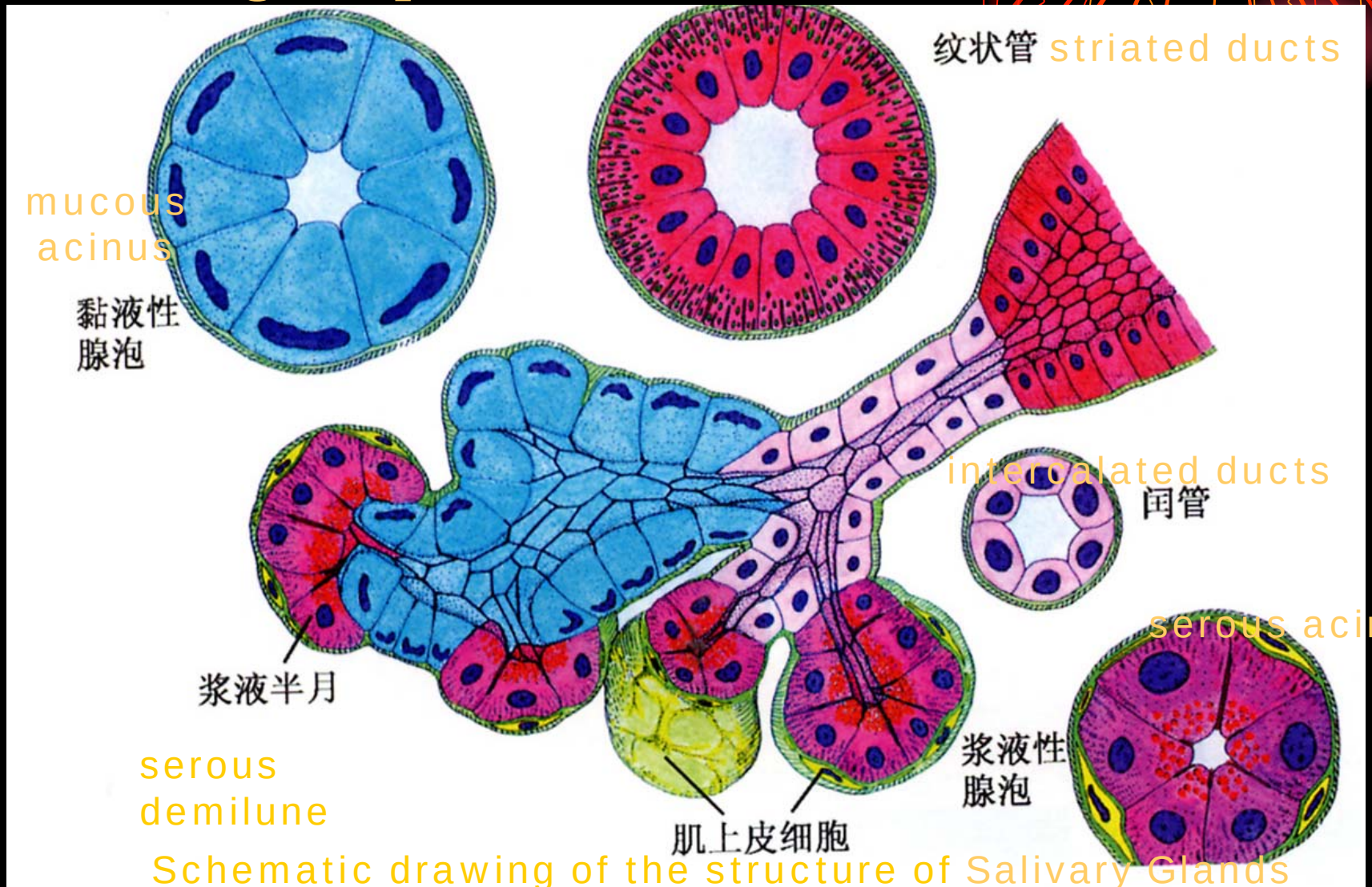
1.general description of digestive glands

- Small digestive glands
  - oesophageal glands
  - gastric glands
  - pyloric glands
  - intestinal glands
- large digestive glands
  - salivary glands
  - pancreas
  - liver
- Function:
  - excretion digestive juice
  - incretion



2 salivary glands

2.1.The General Structure of Salivary Glands being composed of acinus and duct



Schematic drawing of the structure of Salivary Glands

2.1.1 acinus

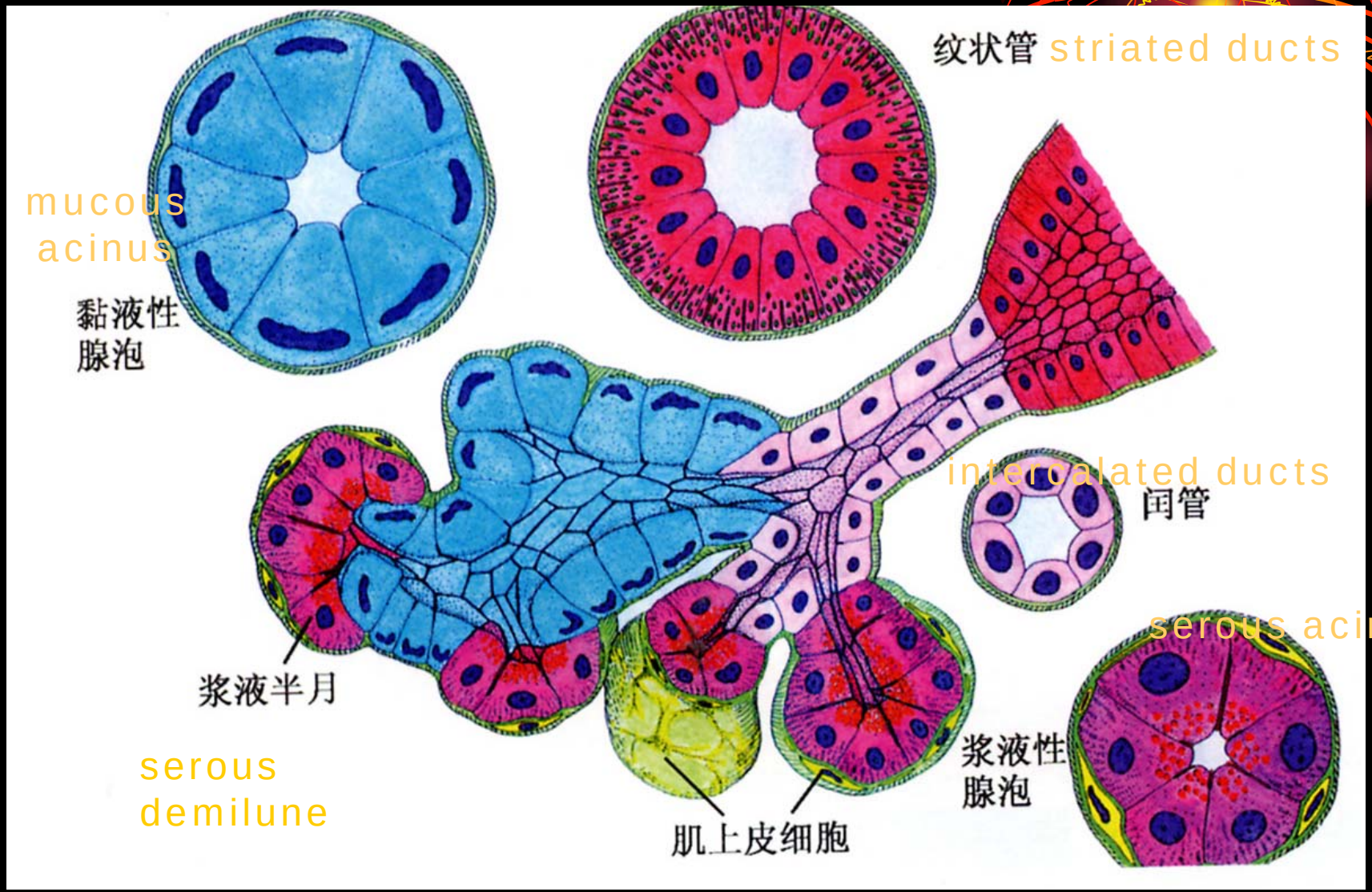
(1) serous acinus

(2) mucous acinus

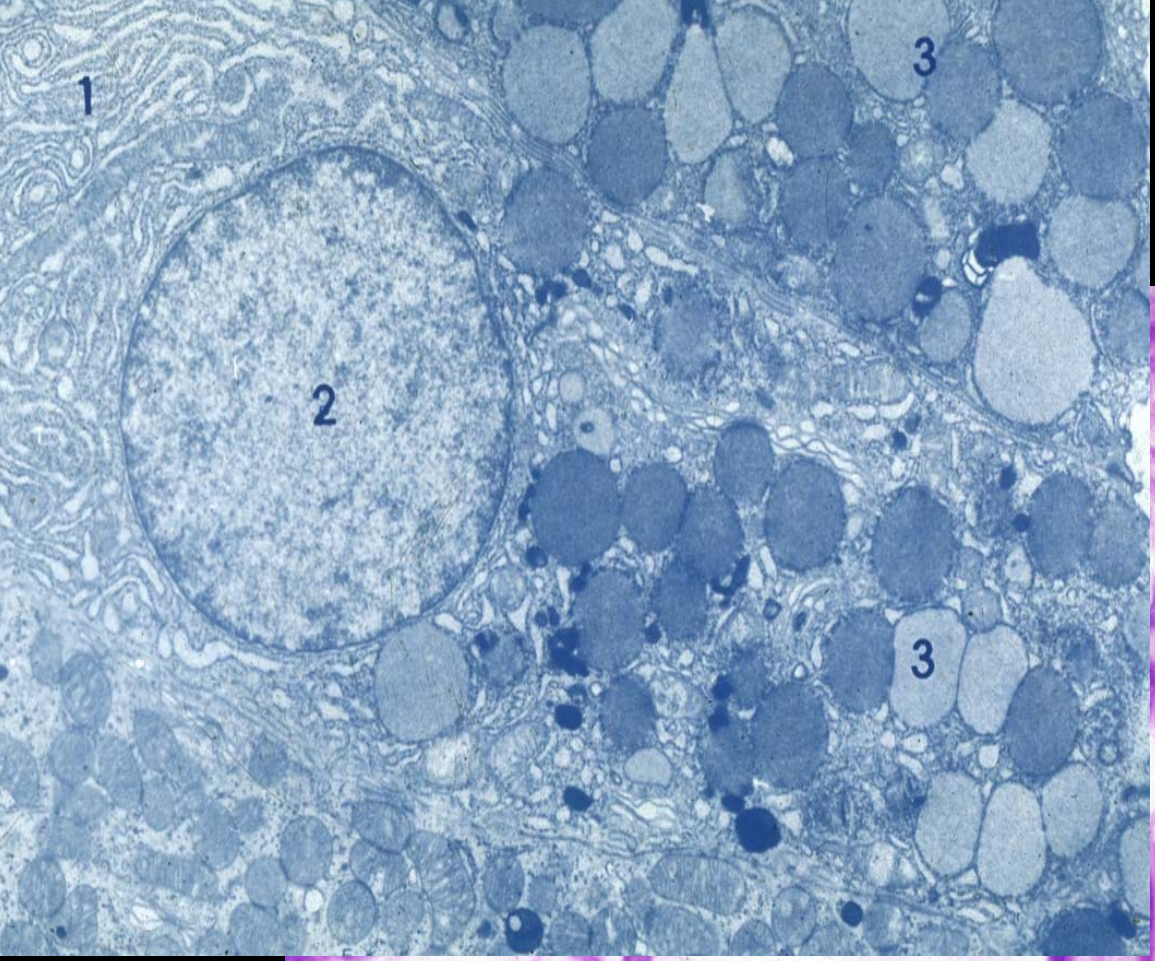
(3) mixed acinus

serous acinus

- Serous cells are usually pyramidal in shape, with a broad base and a narrow apical surface .They exhibit characteristics of protein-secreting cells. Adjacent secretory cells are joined together and usually form a spherical mass of cells called acinus, with a lumen in the center .



Schematic drawing of the structure of Salivary Glands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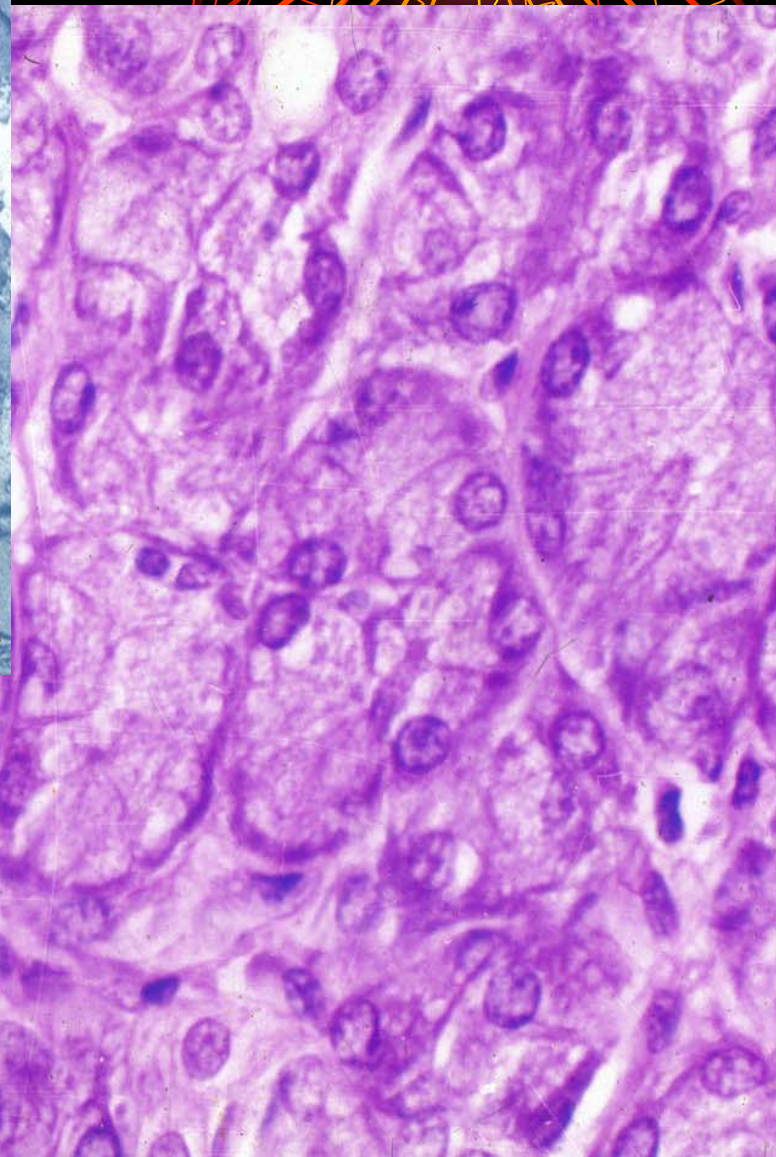
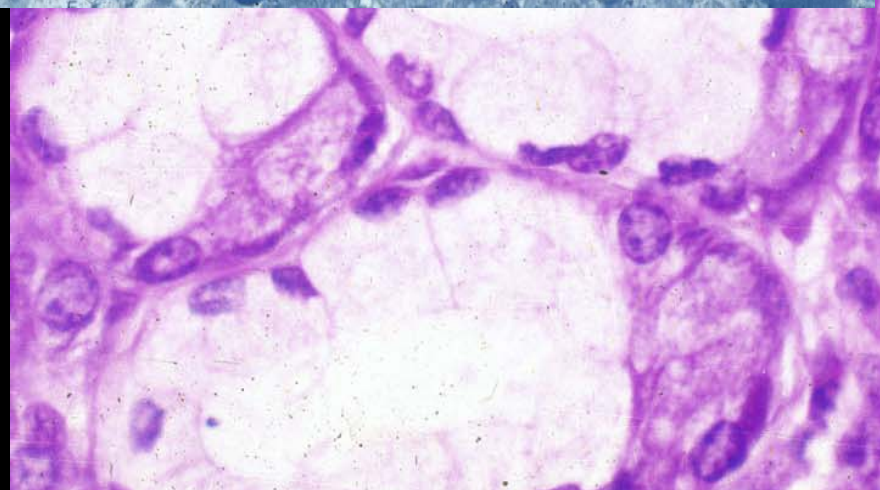
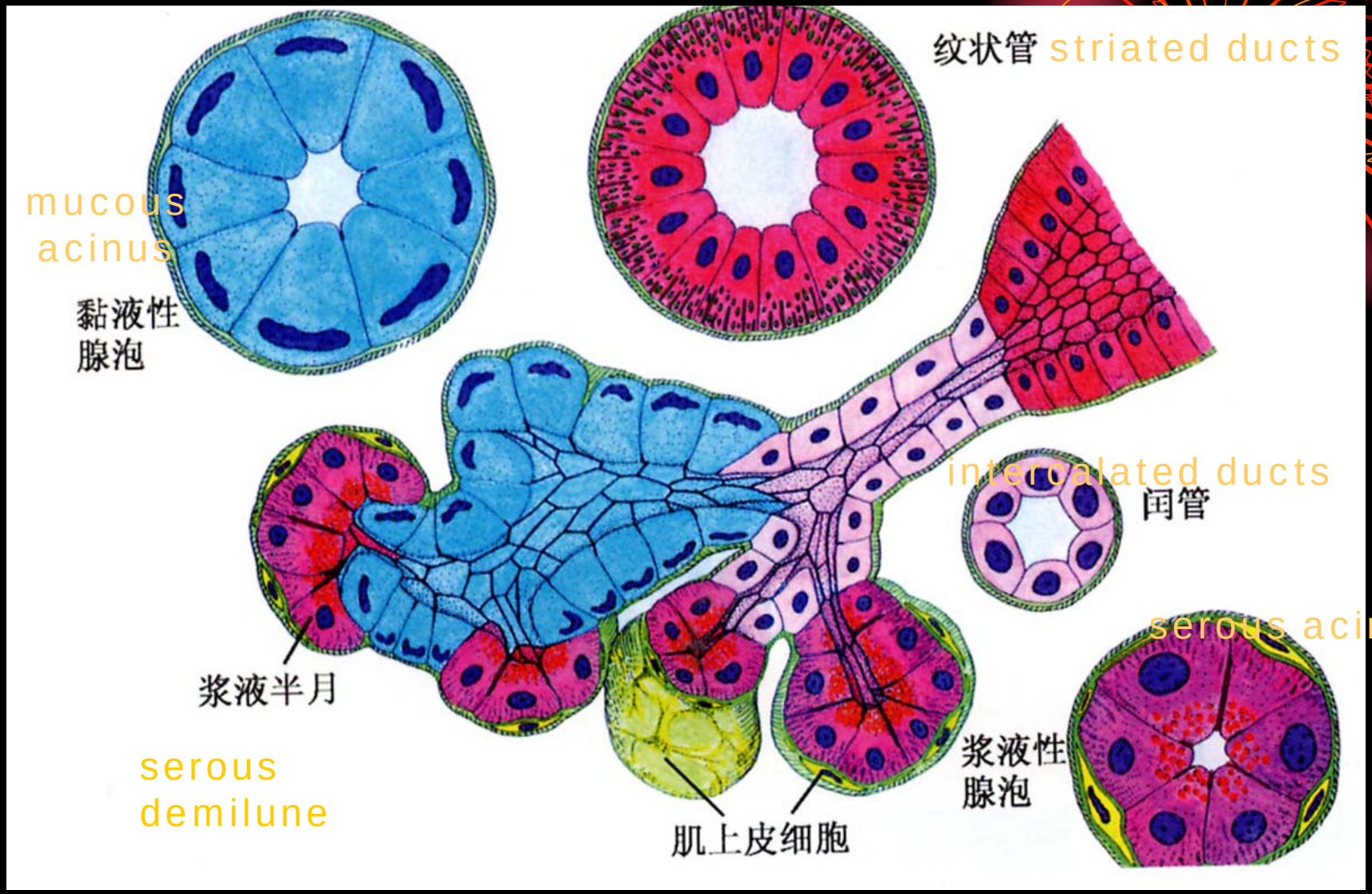


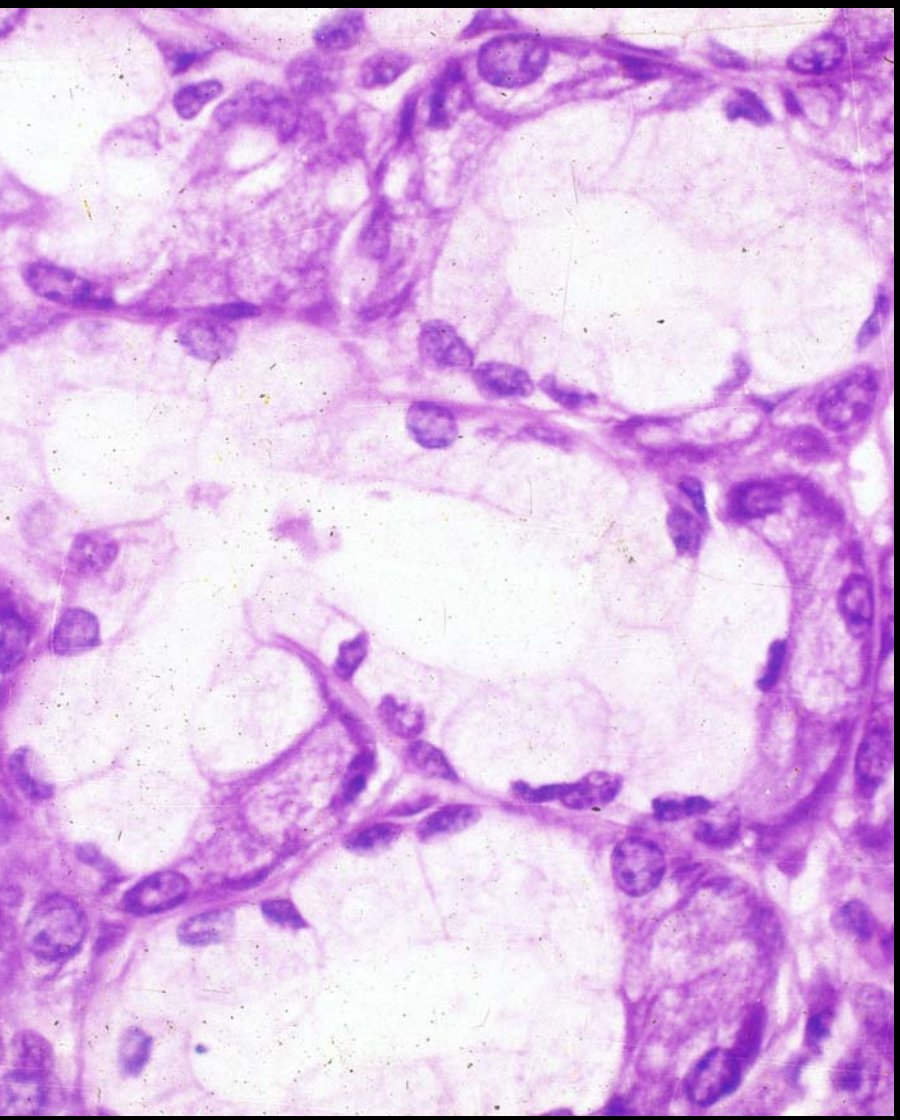


mucous cells

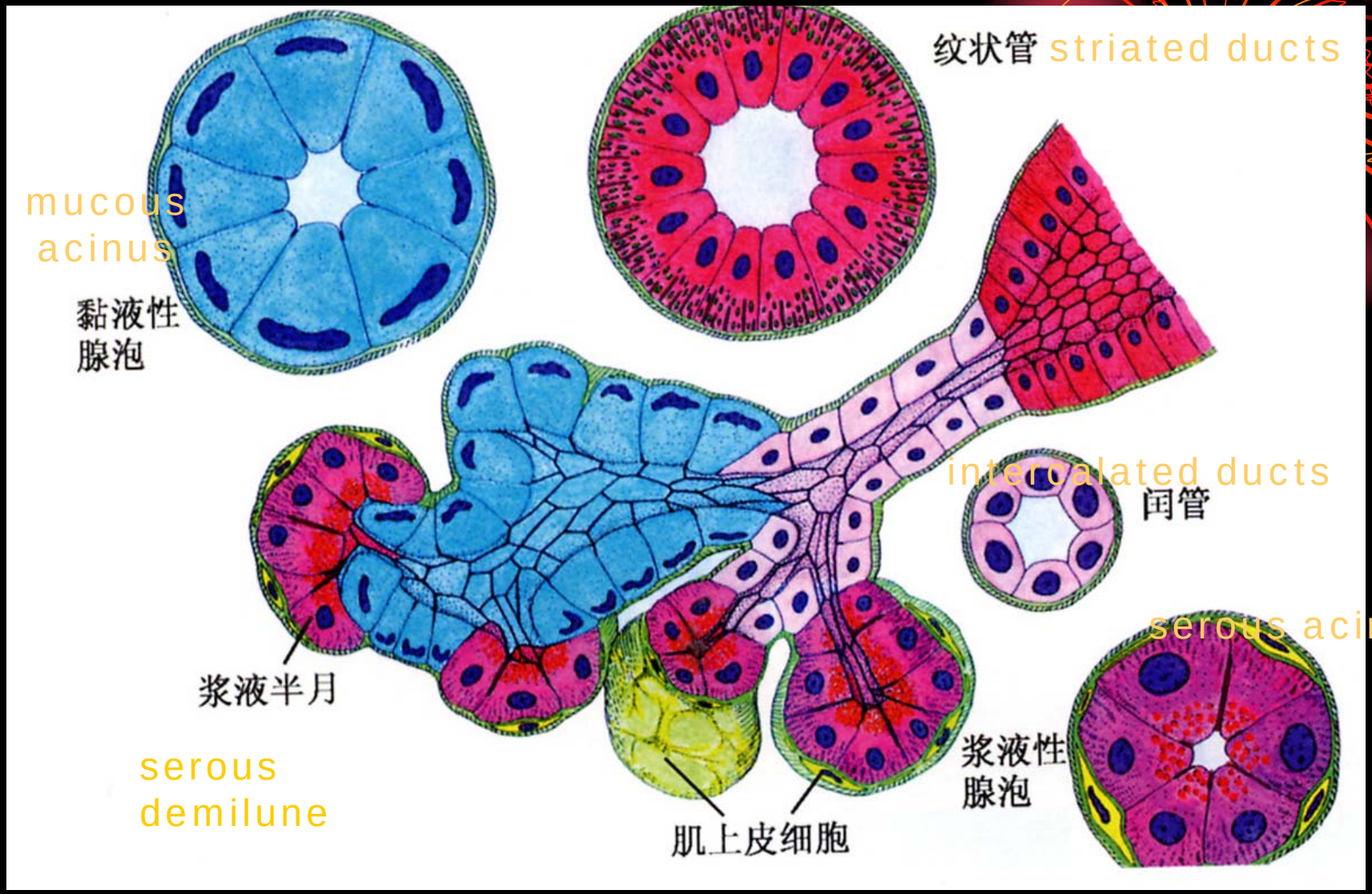
Mucous cells are usually cuboidal to columnar in shape; their nuclei are oval and pressed toward the bases of the cells. They exhibit the characteristics of mucus-secreting cells , containing glycoproteins important for the moistening and lubricating functions of the saliva.



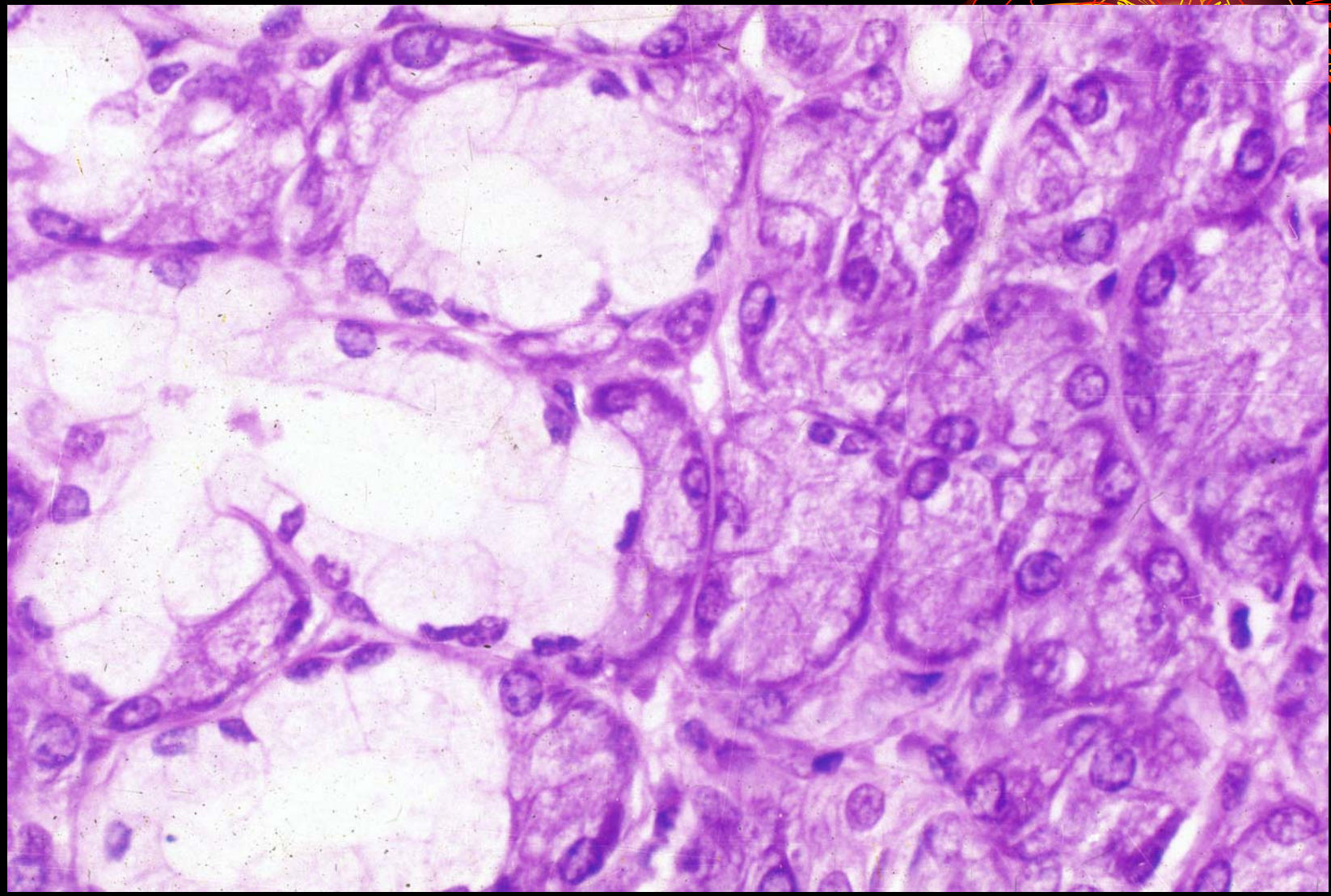
Schematic drawing of the structure of Salivary Glands



The cytoplasm stains lighter in an H and E preparation.large mucigen granules are present in the apical cytoplasm,since the mucigen granules are not well preserved in routine preparations.the cytoplasm has a foamy pattern under a light microscope.



Schematic drawing of the structure of Salivary Glands



2.1.2 ducts

(1) intercalated ducts

squamous to low cuboidal epithelium

(2) secretory ducts (striated ducts)

columnar epithelium

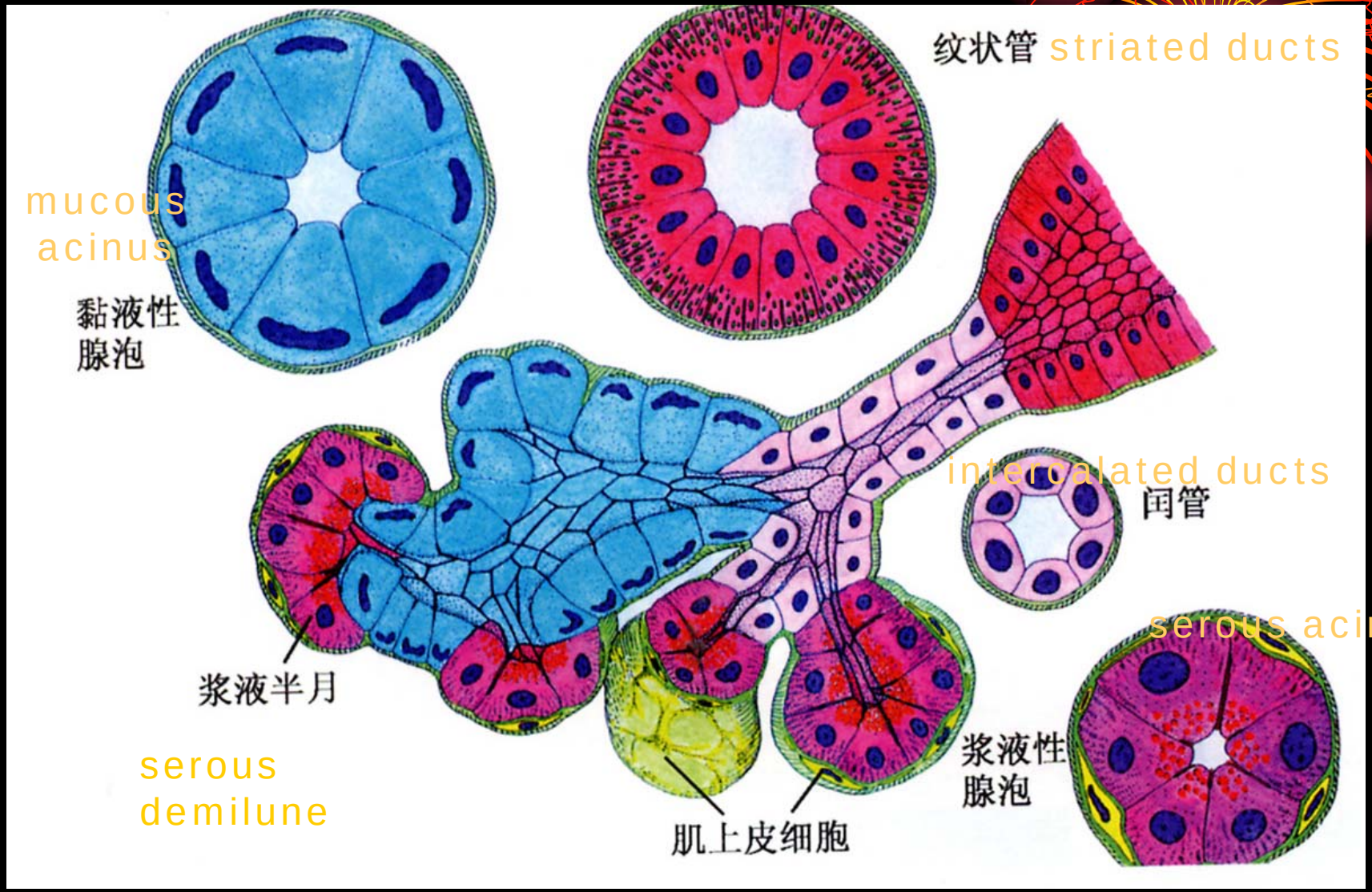
intralobular ducts

function: ion-transporting

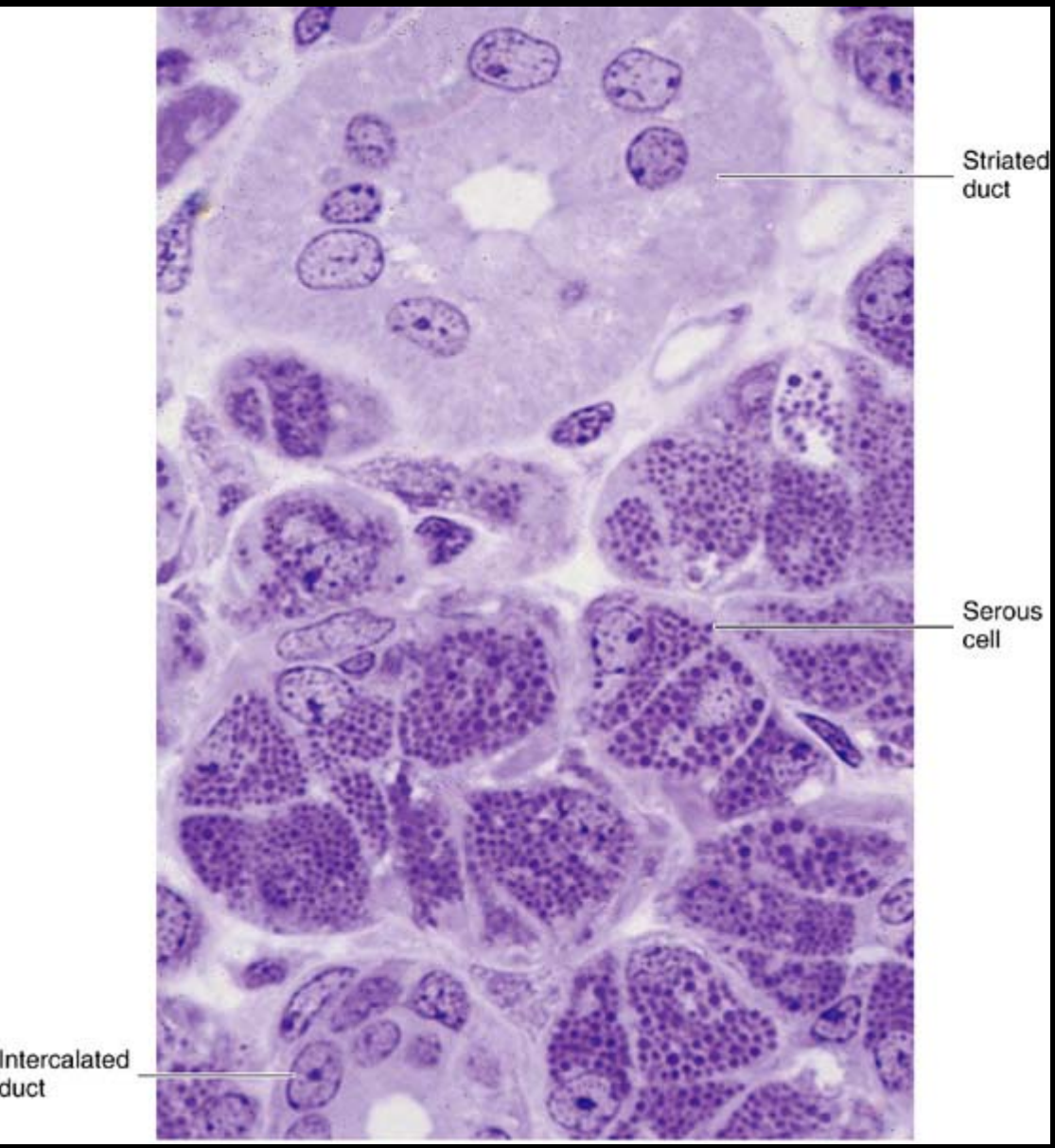
(3) interlobar ducts

stratified cuboidal to columnar epithelium

(4) main ducts empties into the oral cavity ,lined with nonkeratinized-stratified squamous epithelium

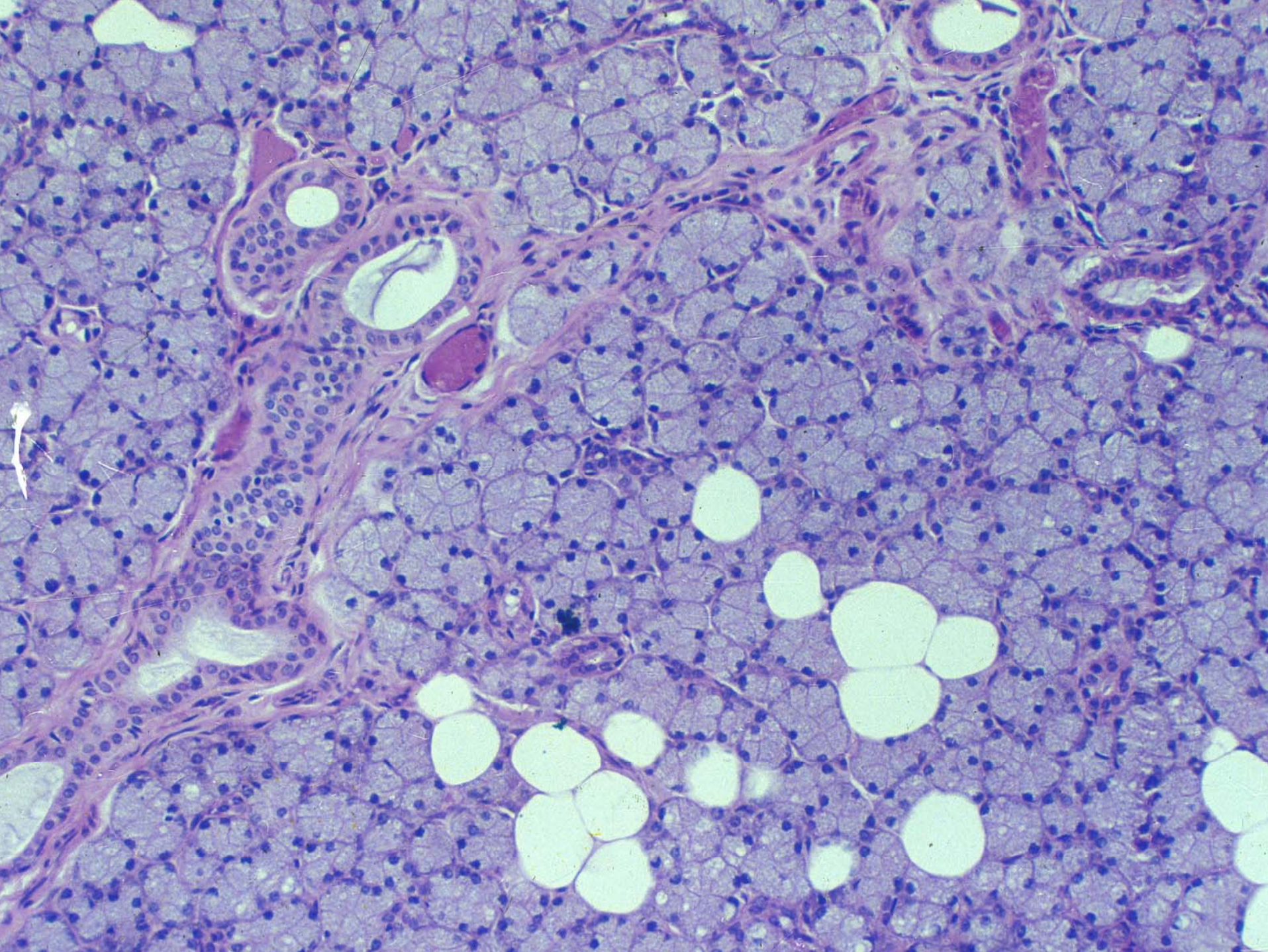


Schematic drawing of the structure of Salivary Glands



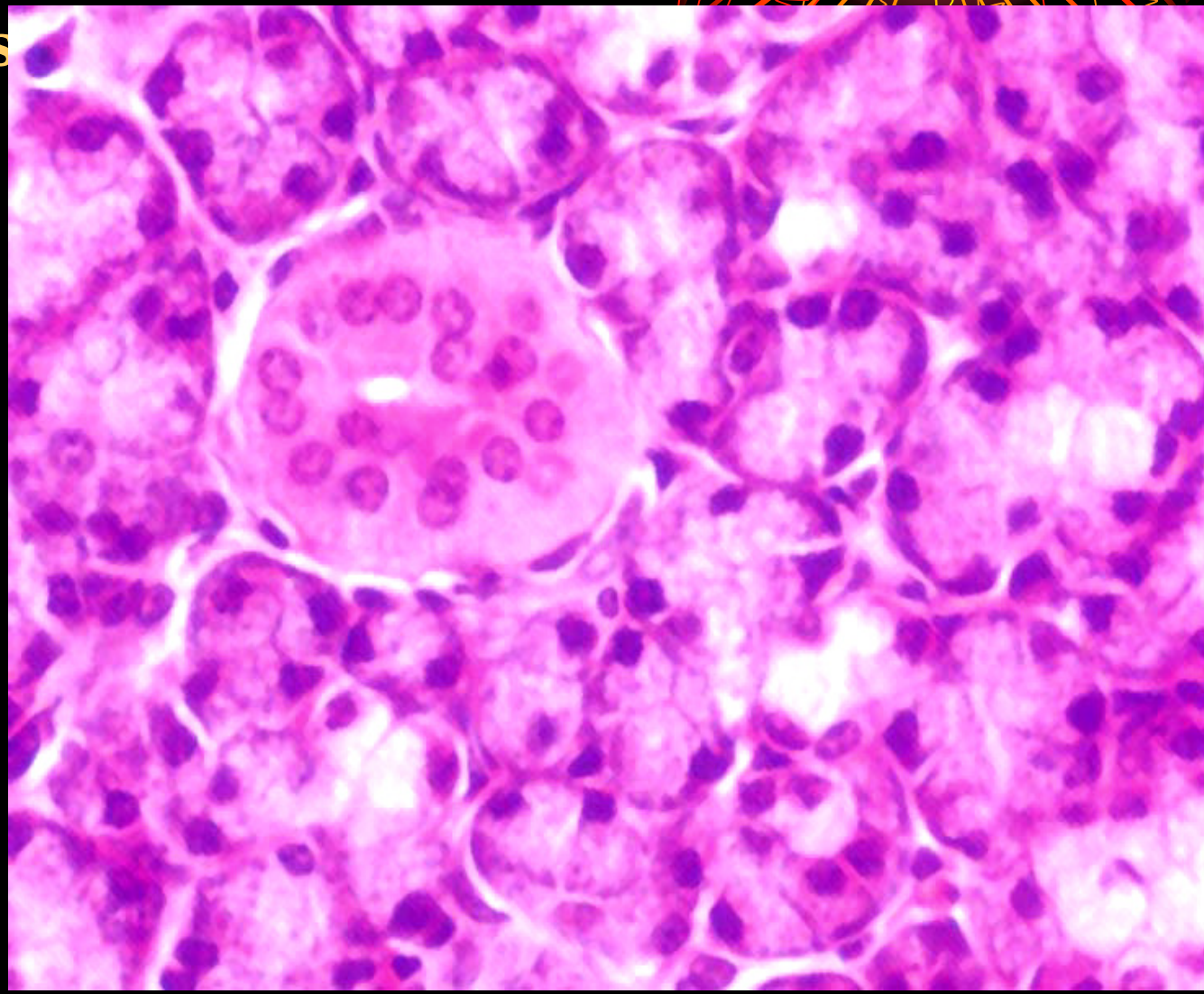
The striated ducts, which are continuous with the intercalated ducts, are lined with a simple columnar epithelium.as the secretion from the acini passes through the striated ducts, the epithelium can re-absorb sodium and water from the lumen to the interstitium ,and transport potassium into the saliva, thus changing the consistency of the saliva

Photomicrograph of a parotid gland
Intralobular (intercalated and striated) ducts are also present.



2. Structure Characteristics of Three pair of Salivaries

2.1 Parotid glands serous acinus



Secretion:Ptyalin

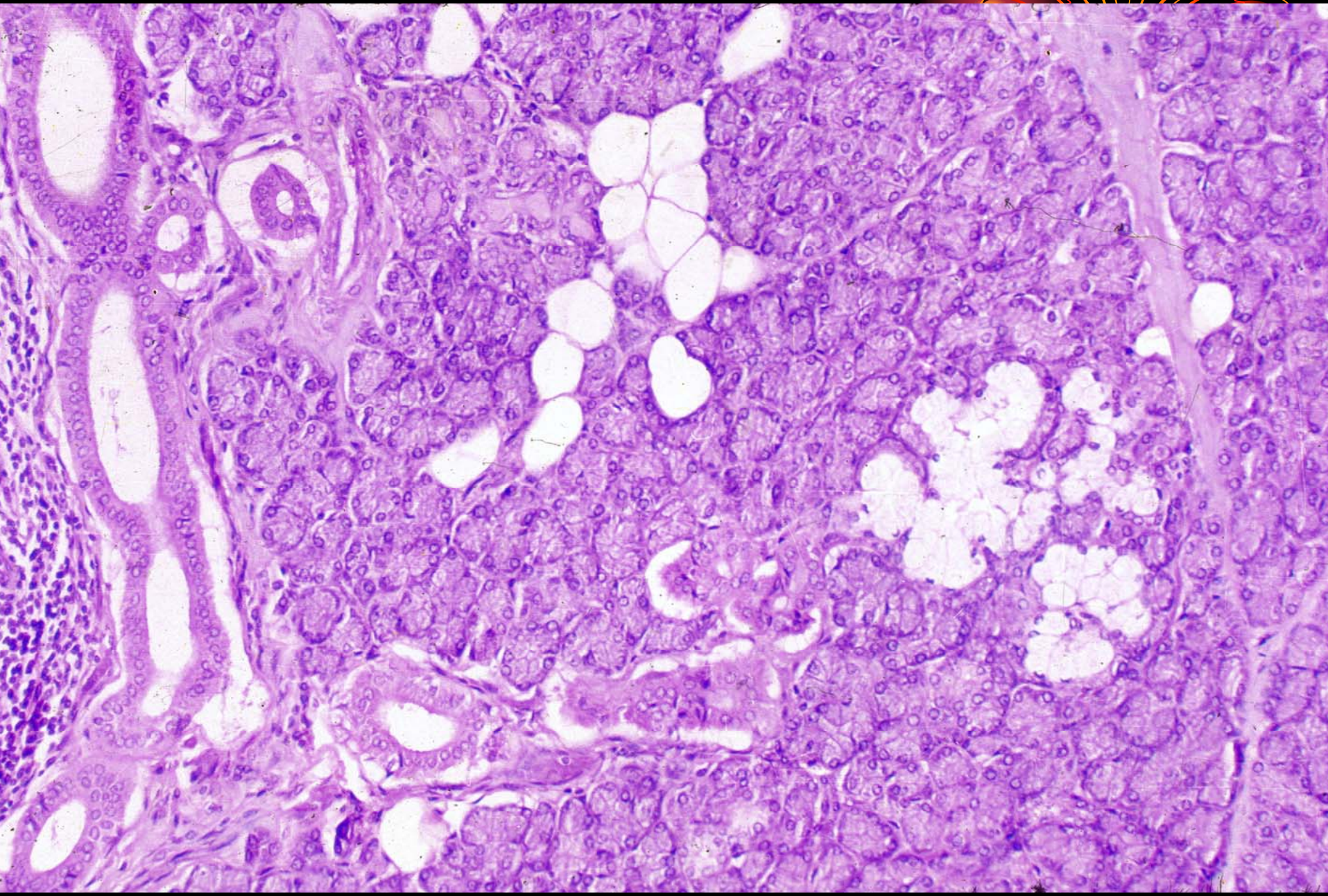
- The parotid gland is a branched acinar gland; its secretory portion is composed exclusively of serous cells containing secretory granules that are rich in proteins and have a high amylase activity. This activity is responsible for most of the hydrolysis of ingested carbohydrates.

- As in other large salivary glands, the connective tissue contains many plasma cells and lymphocytes. The plasma cells secrete IgA, which forms a complex with a secretory component synthesized by the serous acinar, intercalated duct, and striated duct cells. The IgA-rich secretory complex released into the saliva is resistant to enzymatic digestion and constitutes an immunologic defense mechanism against pathogens in the oral cavity.

2.2 submandibular glands :

- The submandibular gland is a branched tubuloacinar gland ; its secretory portion contains both mucous and serous cells. The serous cells are the main component of this gland and are easily distinguished from mucous cells by their rounded nuclei and basophilic cytoplasm. In humans, 90% of the endpieces of the submandibular gland are serous acinar, whereas 10% consist of mucous tubules with serous demilunes.

- Serous cells are responsible for the weak amylolytic activity present in this gland and its saliva. The cells that form the demilunes in the submandibular gland secrete the enzyme lysozyme, whose main activity is to hydrolyze the walls of certain bacteria.



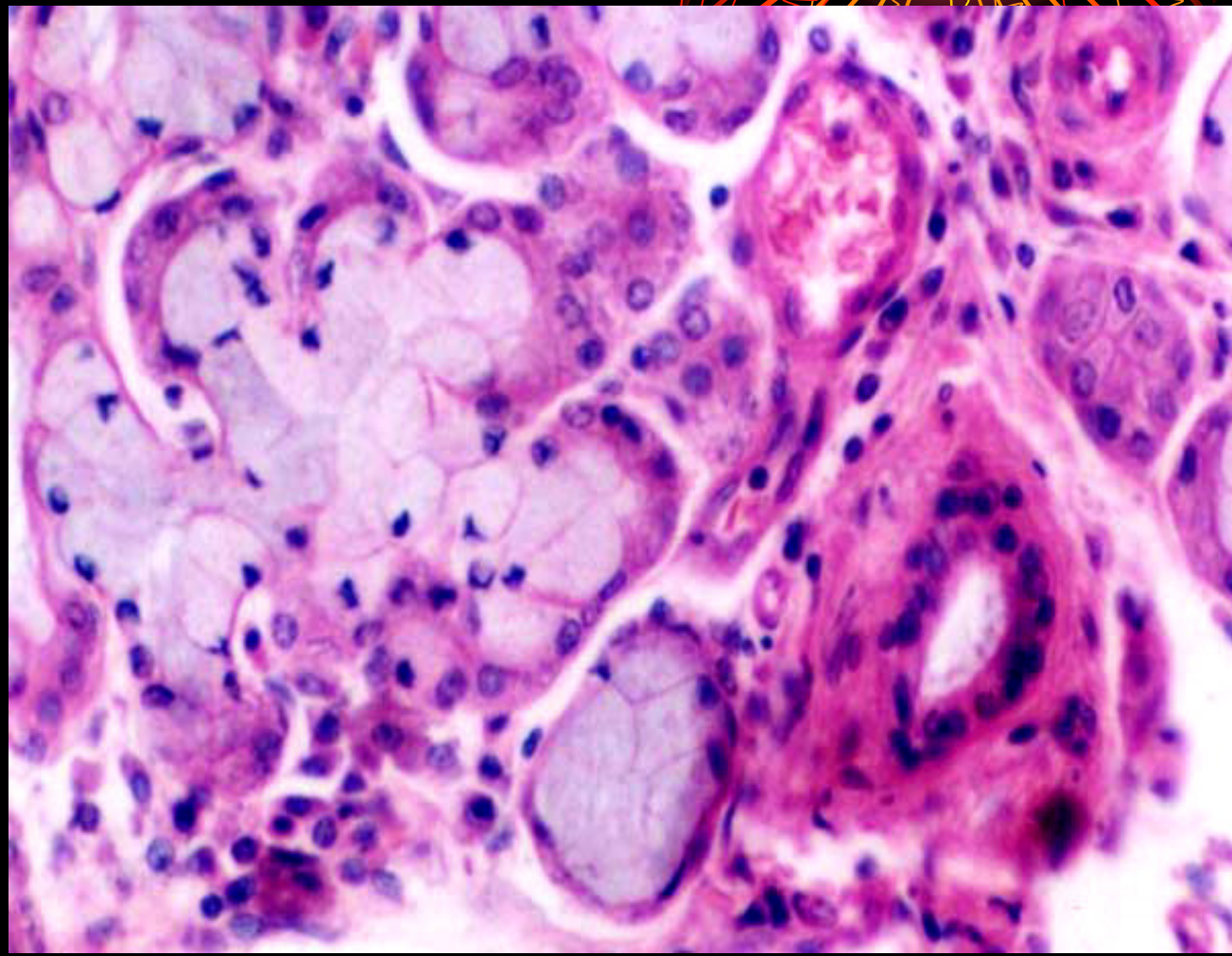
2.3 Sublingual glands

main mucous type

and mixed type

Secretion:

mainly mucous



- The sublingual gland, like the submandibular gland, is a branched tubuloacinar gland formed of serous and mucous cells. Mucous cells predominate in this gland; serous cells are present exclusively on demilunes of mucous tubules . As in the submandibular gland, cells that form the demilunes in this gland secrete lysozyme.

saliva

Saliva is a complex fluid that secreted by salivary glands. It contain much ingredient

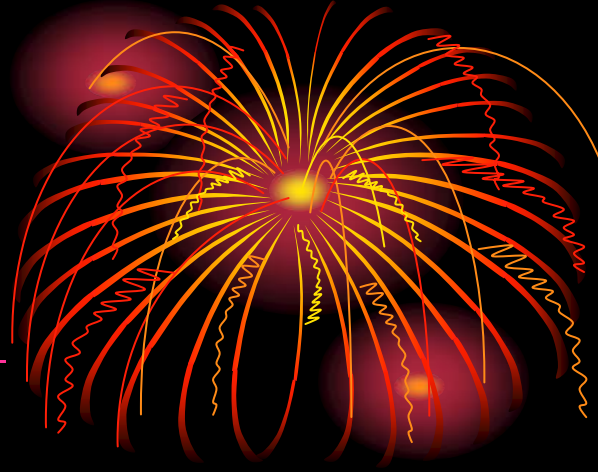
Water of mucous--to lubricate cavity

Salivary amylase --to hydrolyze starch or carbohydrate

Lysozyme--to hydrolyze the bacteria

it has digestive, lubricating and protective function

3 pancreas



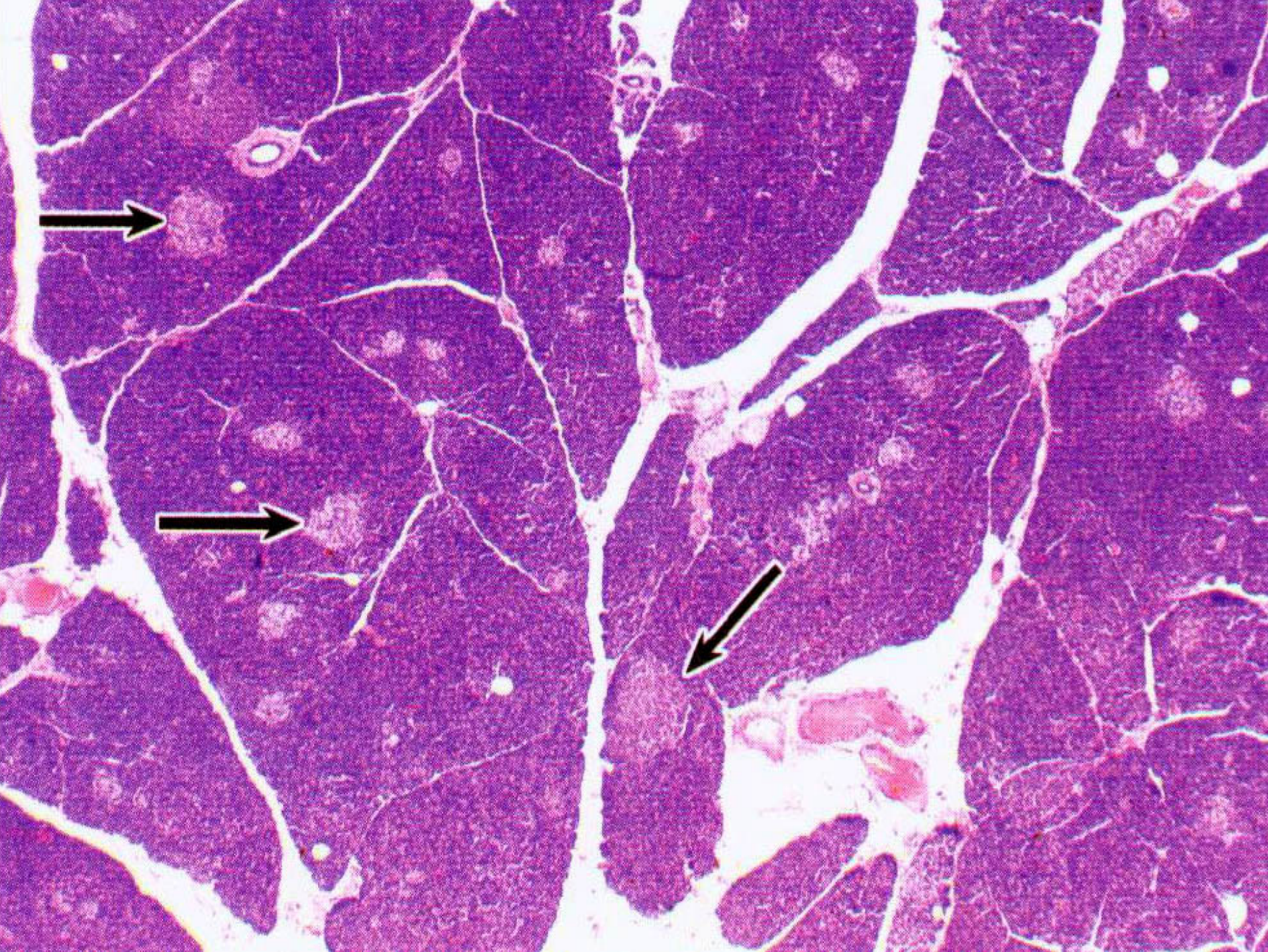
1.The general structure of pancreas

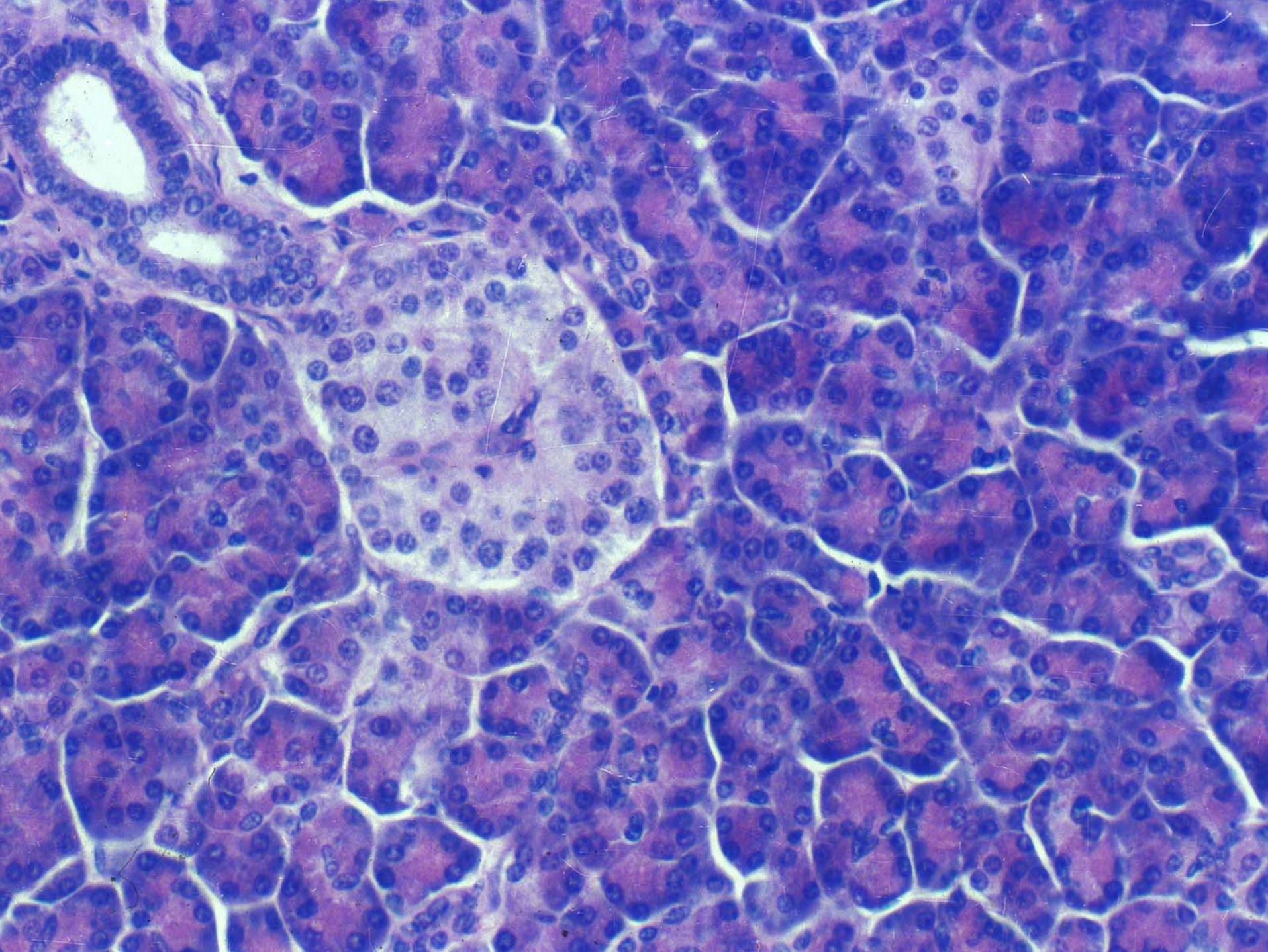
capsule : lamellar connective tissue

lobules:

Parenchyma : exocrine portion { Acini / ducts

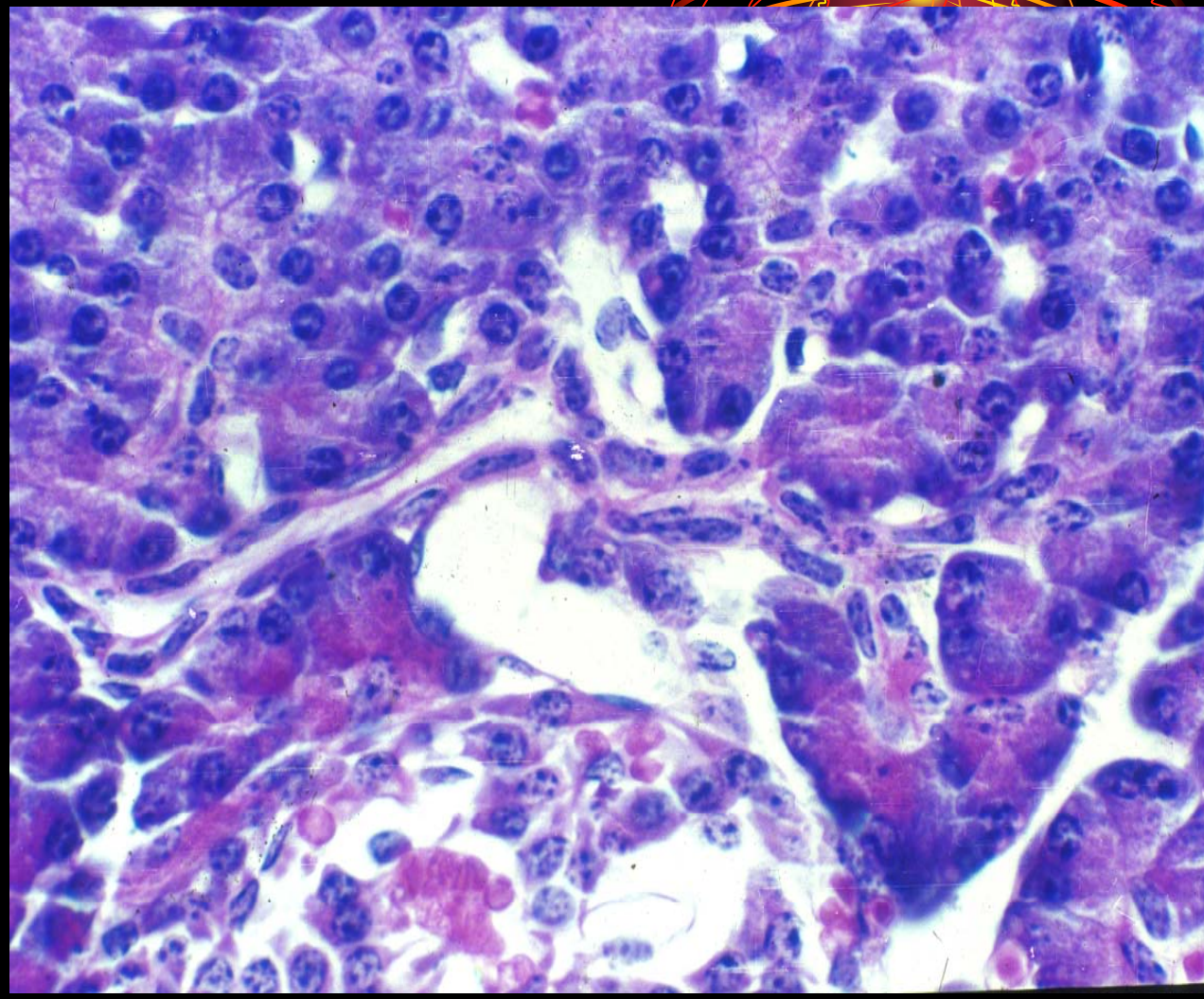
endocrine portion (pancreatic islets)





3.1exocrine portion of the pancreas

The exocrine portion of the pancreas is a compound acinar gland composed of secretory acini and ducts.

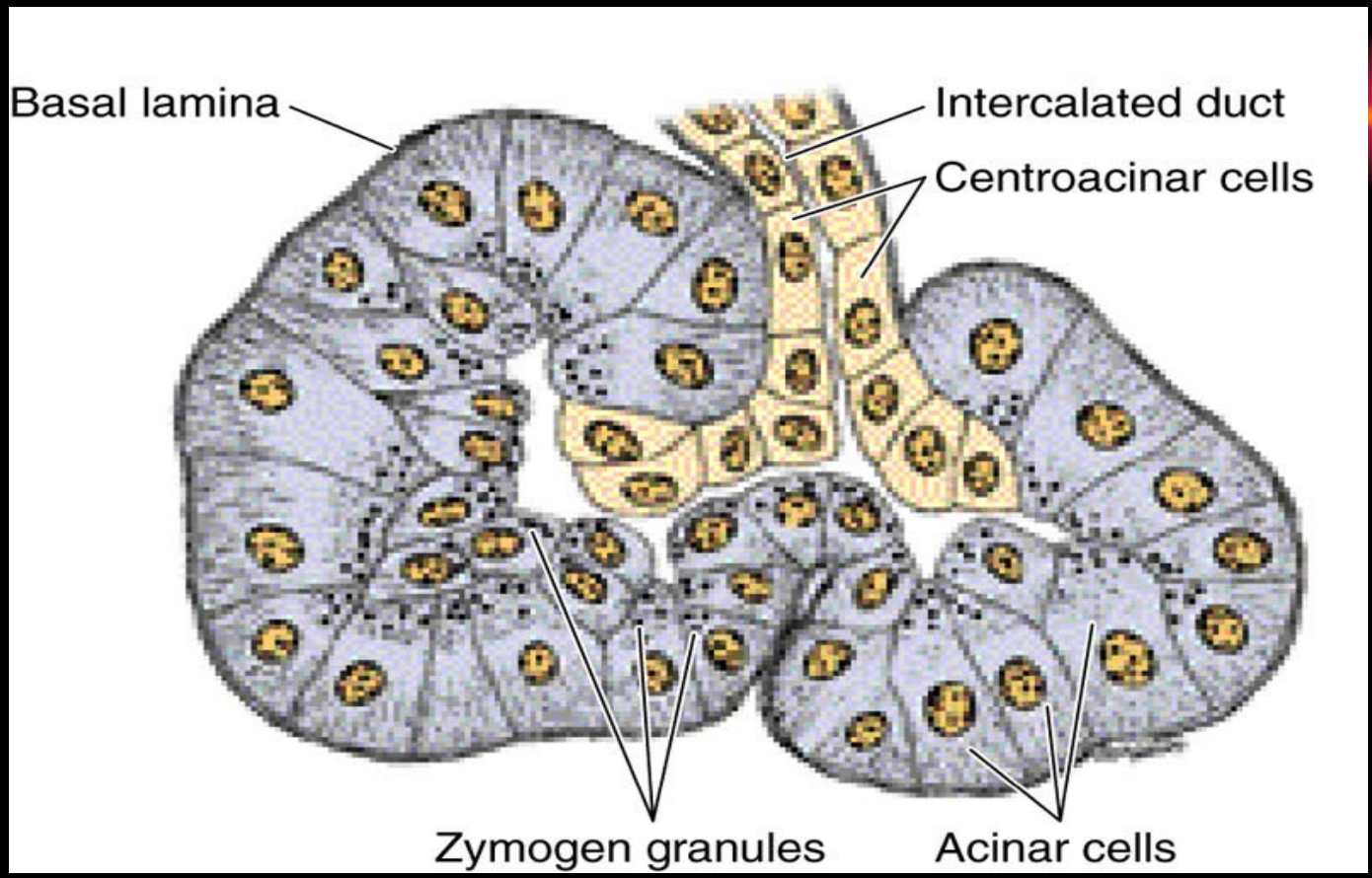


3.1.1 acini

Structure: serous cells

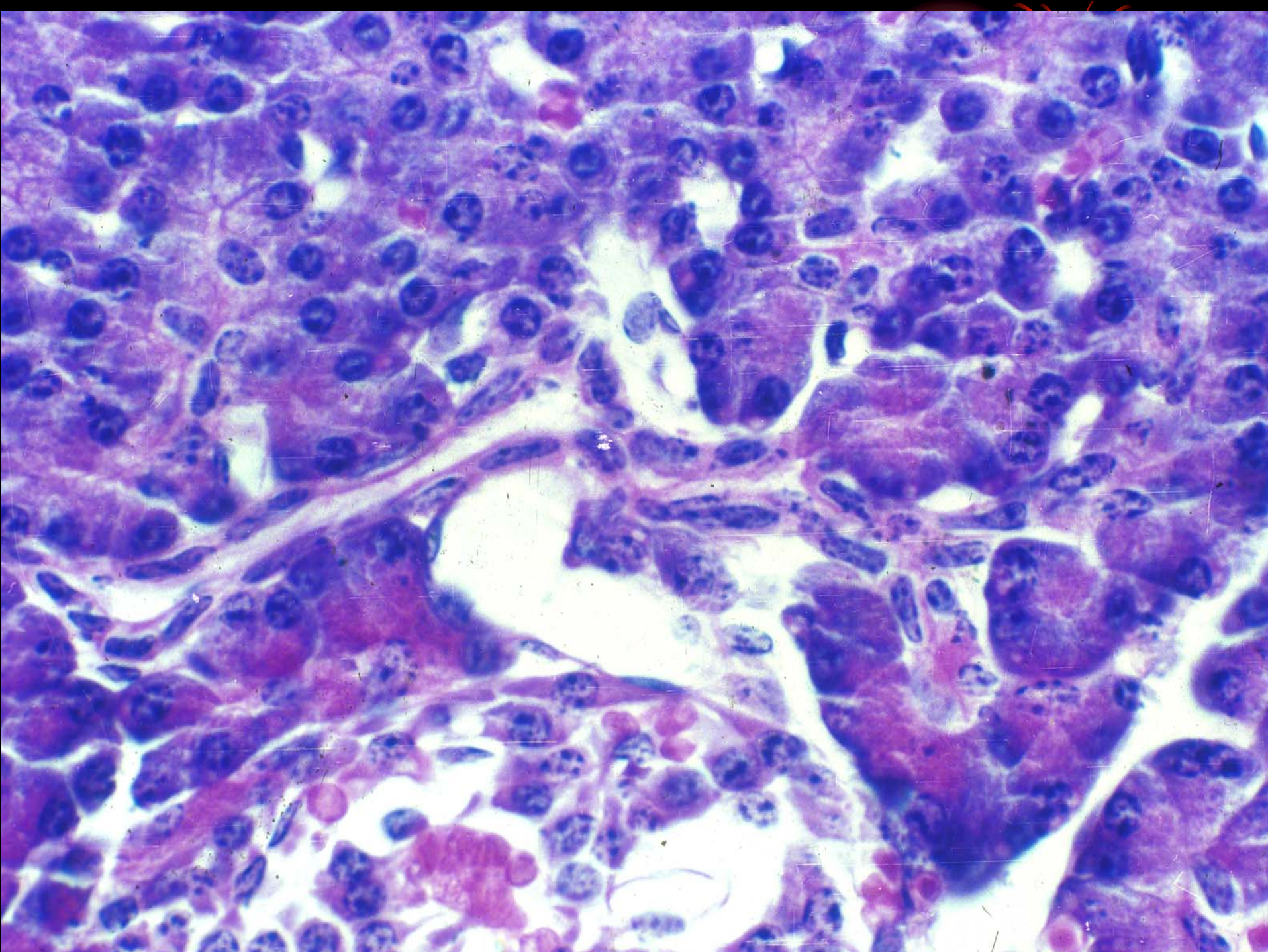
typical protein-secreting cells

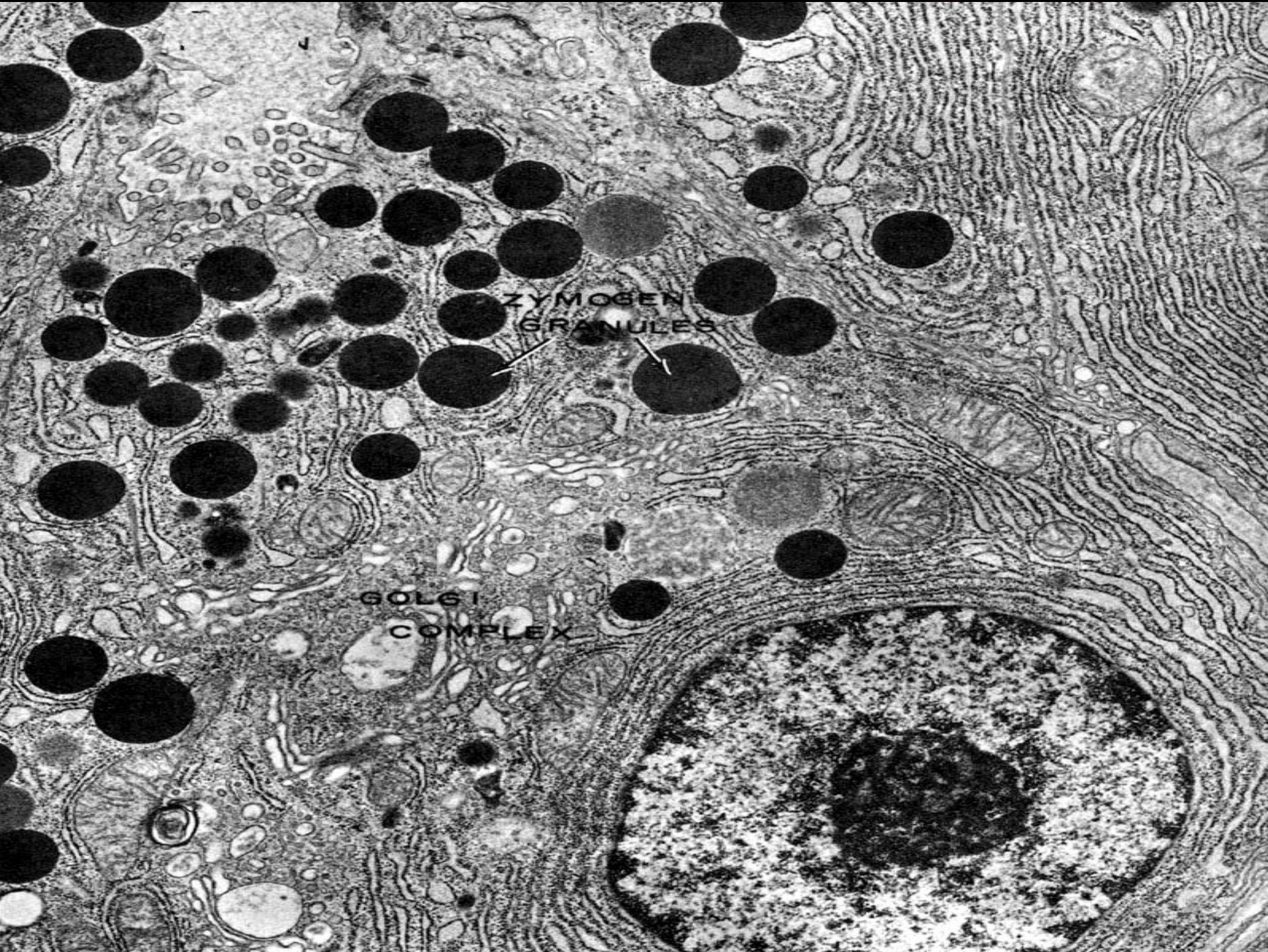
Function: Producing digestive enzymes (trypsin, amylase, lipase ,ribonuclease,



Schematic drawing of the structure of pancreatic acini

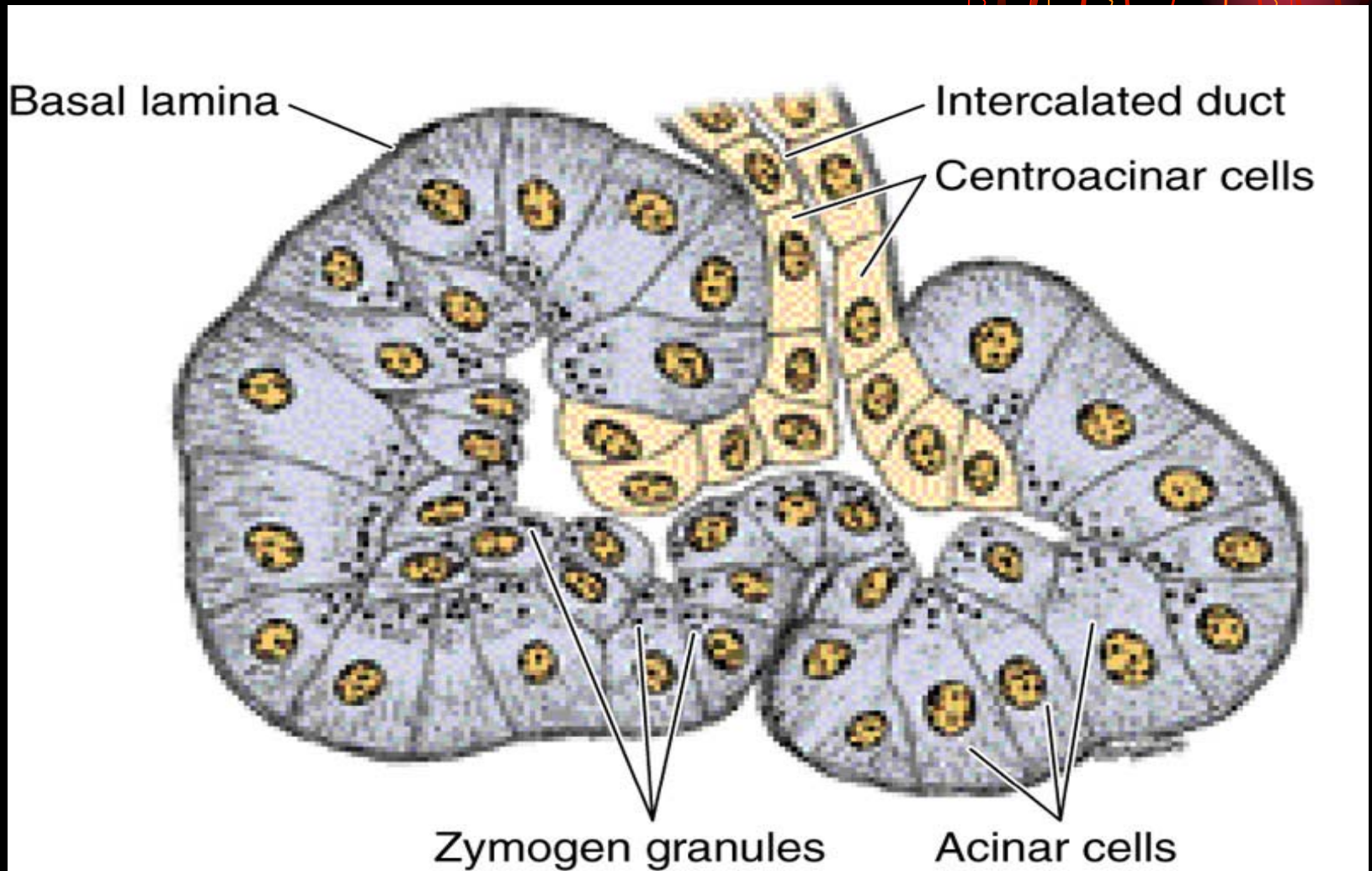
- The exocrine pancreatic acinus is composed of several serous cells surrounding a lumen . These cells are highly polarized, with a spherical nucleus, and are typical protein-secreting cells.



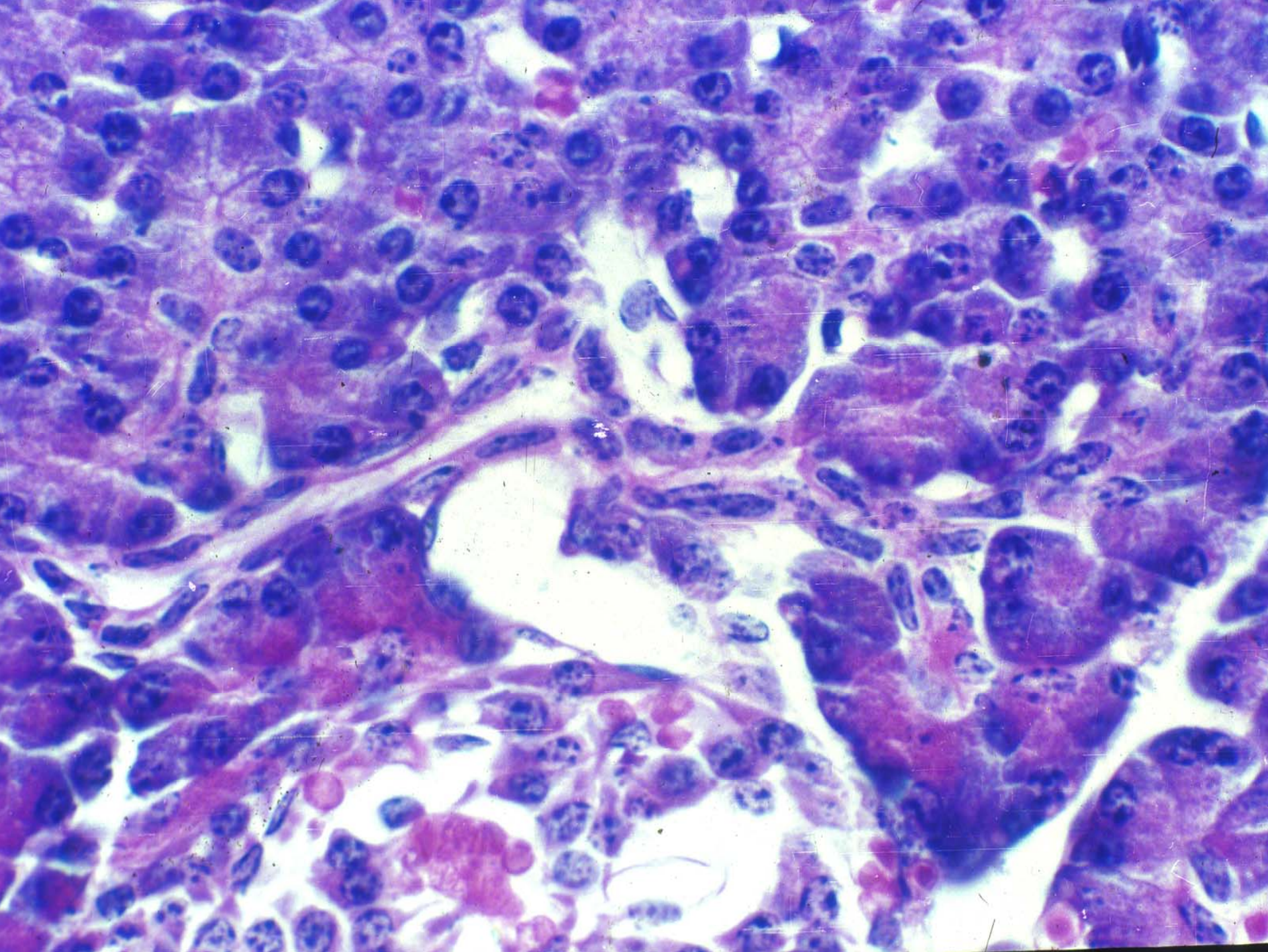

ZYMOGEN
GRANULES
GOLGI
COMPLEX

centroacinar cells

The beginnings of intercalated ducts, the characteristics of pancreatic acini



- The characteristic detail is that in the pancreas the initial portions of intercalated ducts penetrate the lumens of the acini. The cells surrounded by a pale cytoplasm. These cells are found only in pancreatic acini.



3.1.2 ducts

intercalated ducts (a simple squamous or cuboidal epithelium)

↓

intralobular ducts (a simple cuboidal epithelium)

↓

interlobular ducts (a simple columnar epithelium)

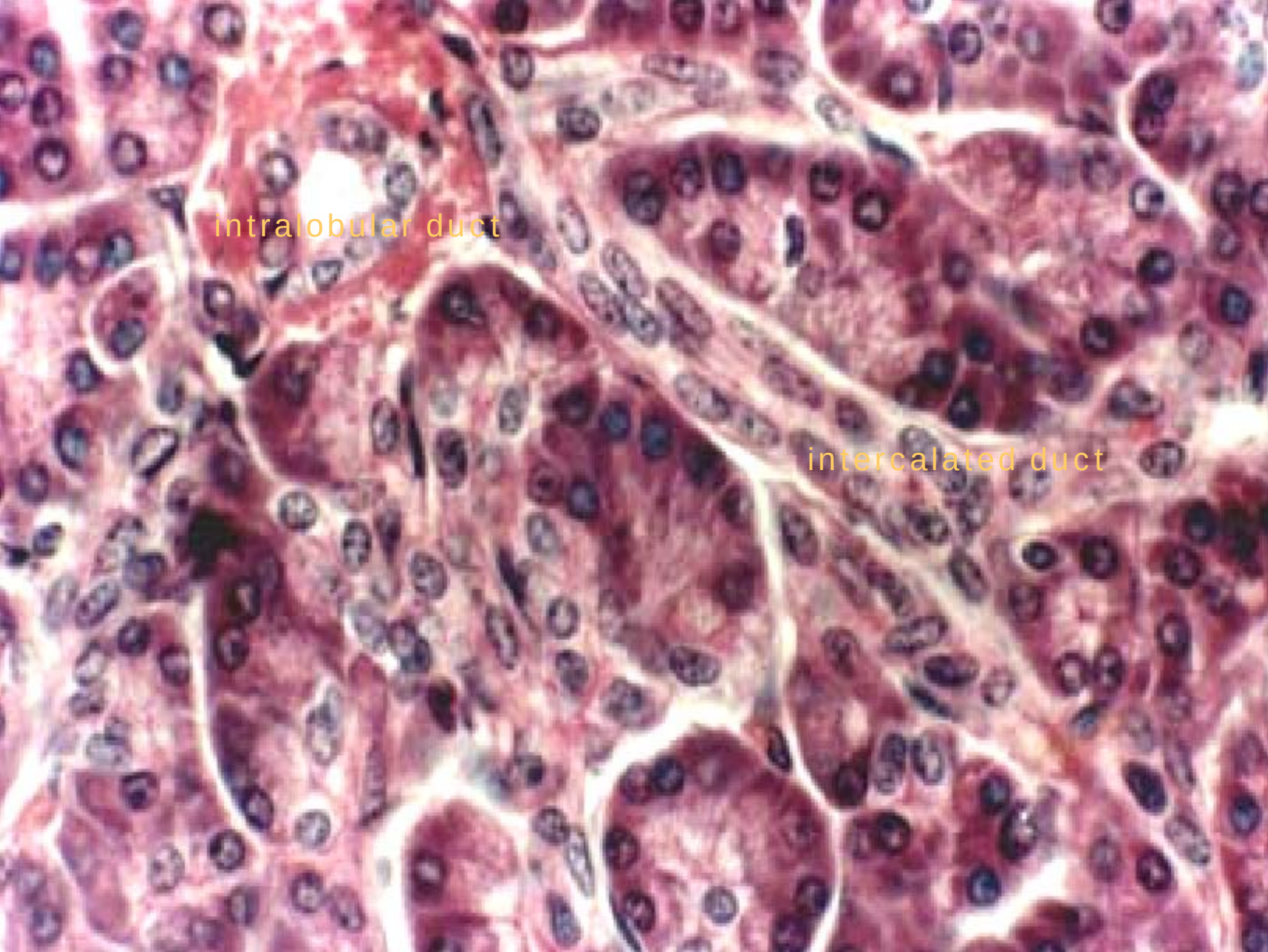
↓

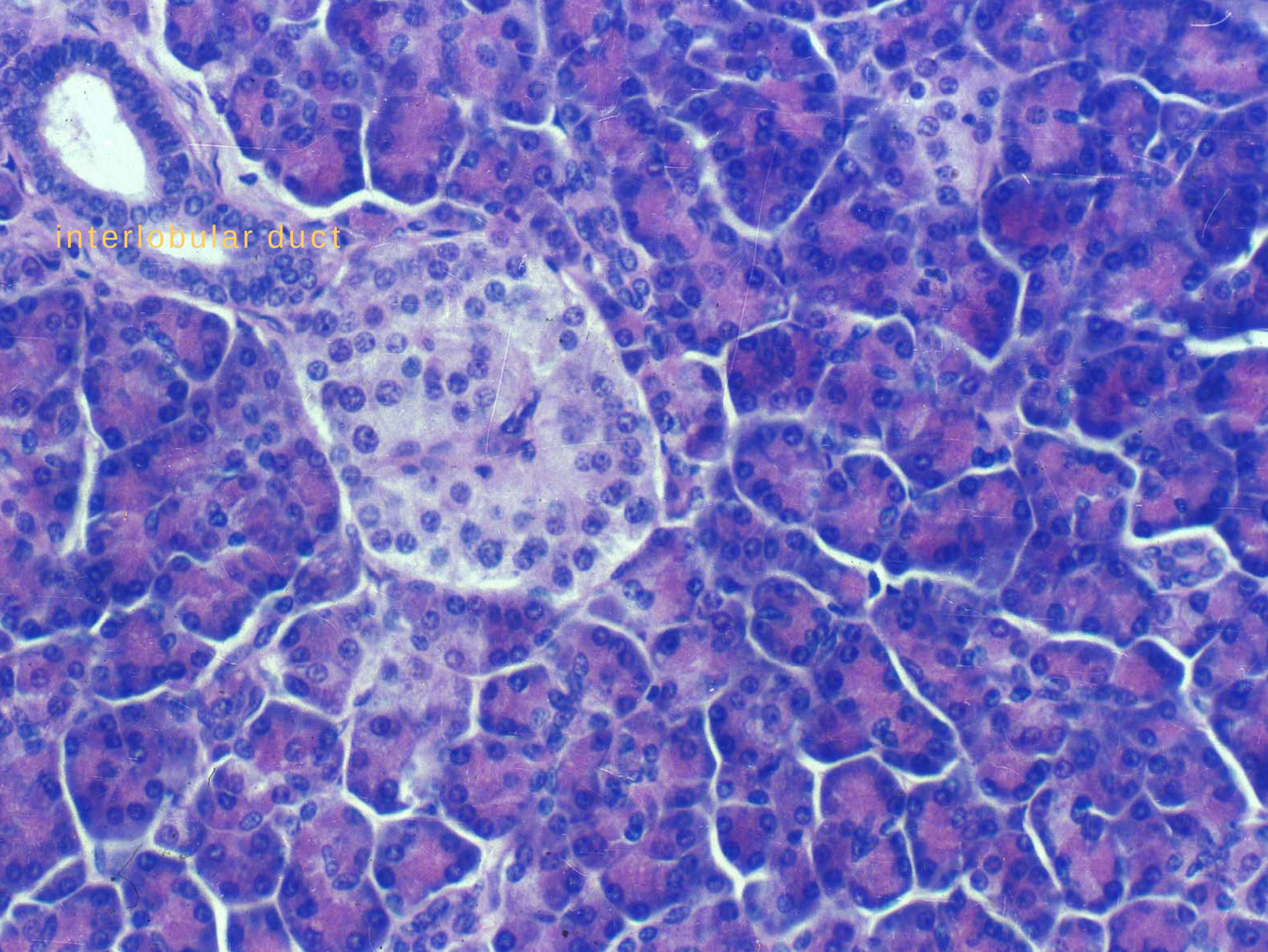
The pancreatic duct(a simple high columnar epithelium and goblet cells)

↓

The pancreatic duct opens into a recess of the duodenal lumen

Function: excrete water and electrolytes


intralobular duct
intercalated duct


interlobular duct

Function of the exocrine pancreas

- water and electrolytes
- several proteases ,amylase, lipases and so on. The majority of the enzymes are stored as proenzymes in the secretory granules of acinar cells, being activated in the lumen of the small intestine after secretion. This is very important for the protection of the pancreas.

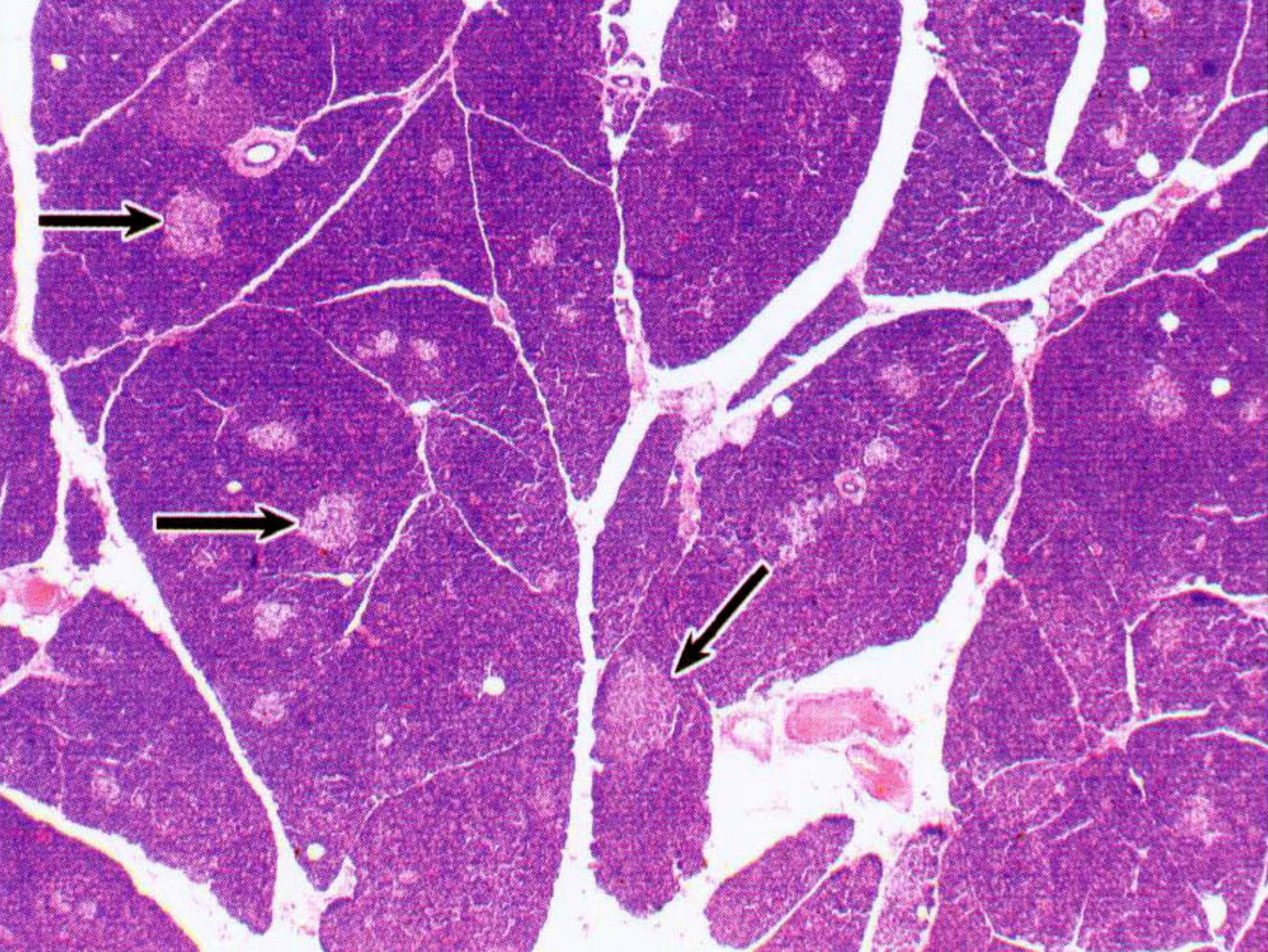
- *Medical Application*
- In acute pancreatitis, the proenzymes may be activated and digest the whole pancreas, leading to very serious complications.

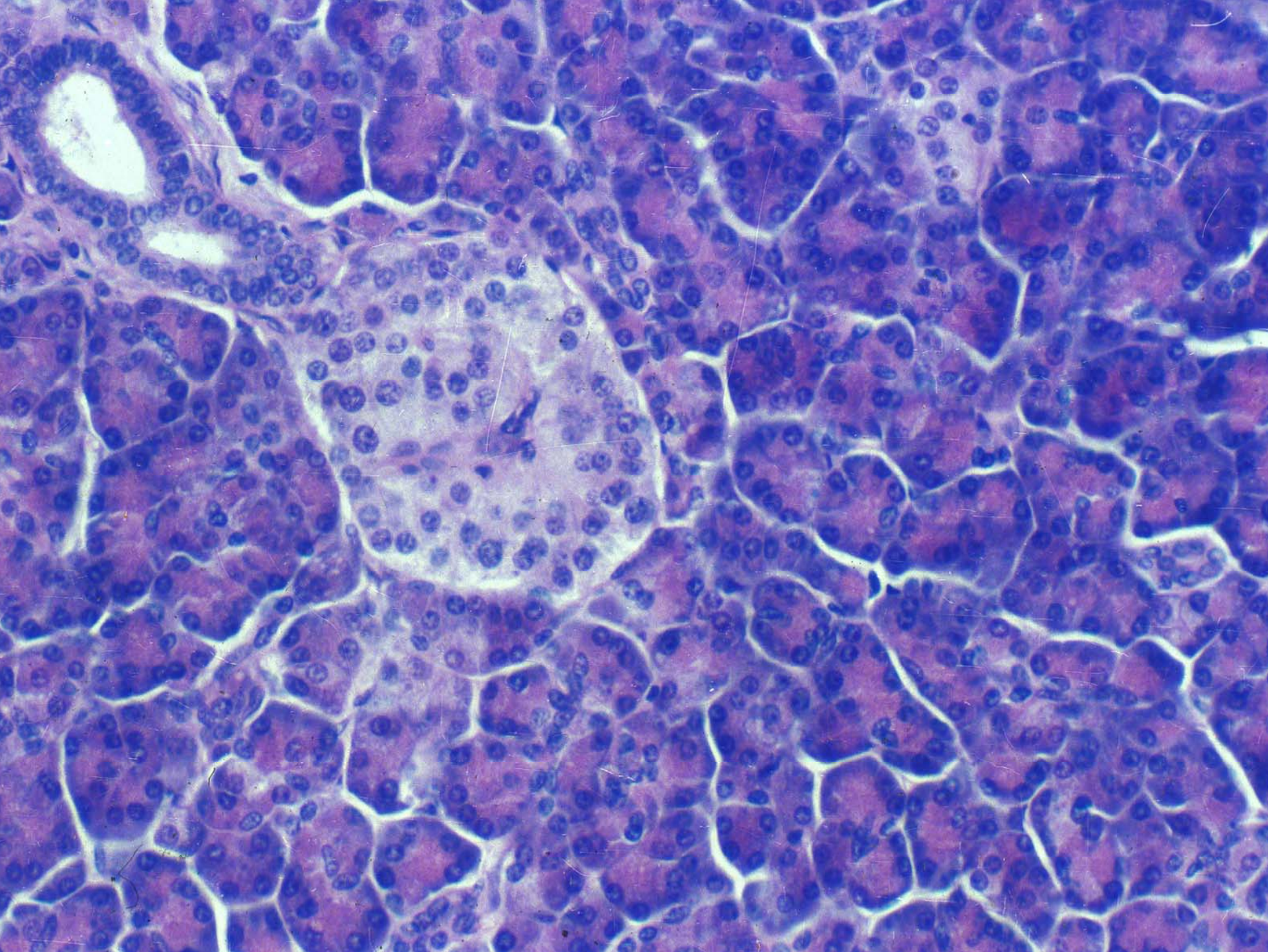
3.2 endocrine portion of the pancreas

pancreatic islets

- appear as rounded clusters of cells
- scattered among the exocrine acini
- vary in size according to the number of cells
- abundant fenestrated capillaries
- three different cell-types by Mallory staining

Function: secrete multihormones





3.2.1 A-cells

Constitute 20% of the islet cell population

Large in size

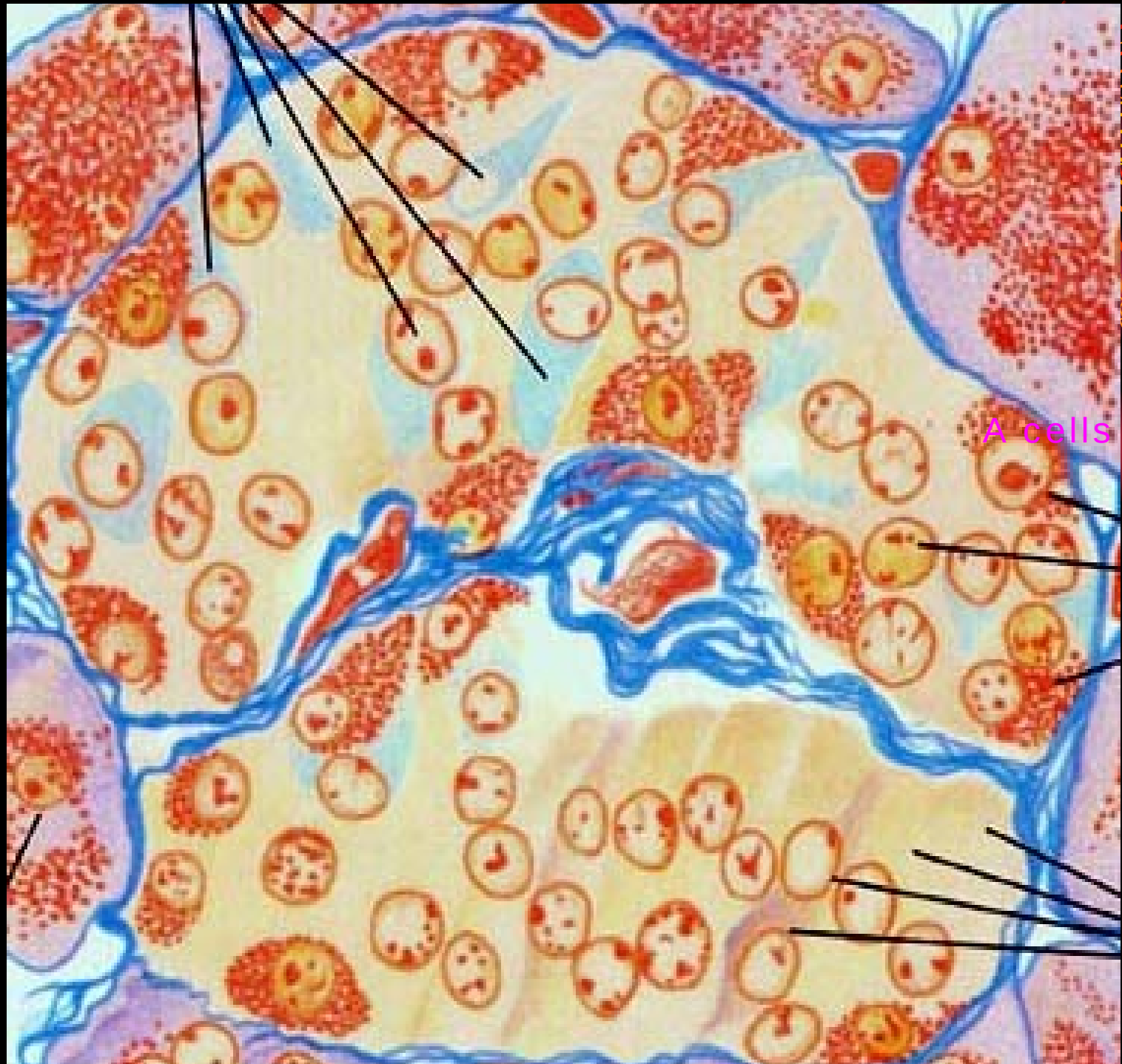
located at the periphery of an Islet

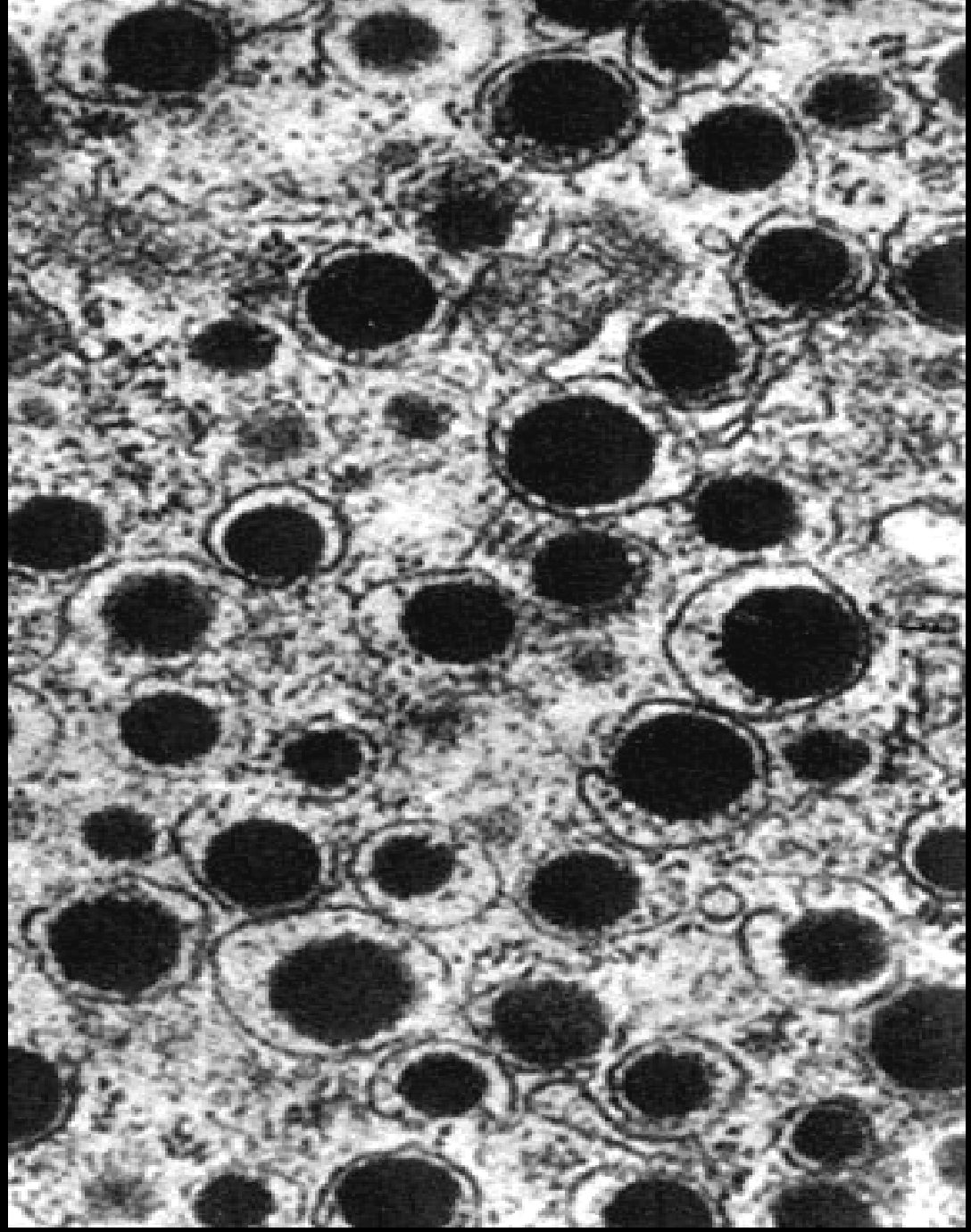
Function : secrete glucagon, which

increases the rate of conversion

of liver glycogen to glucose,

raises blood sugar levels


A cells



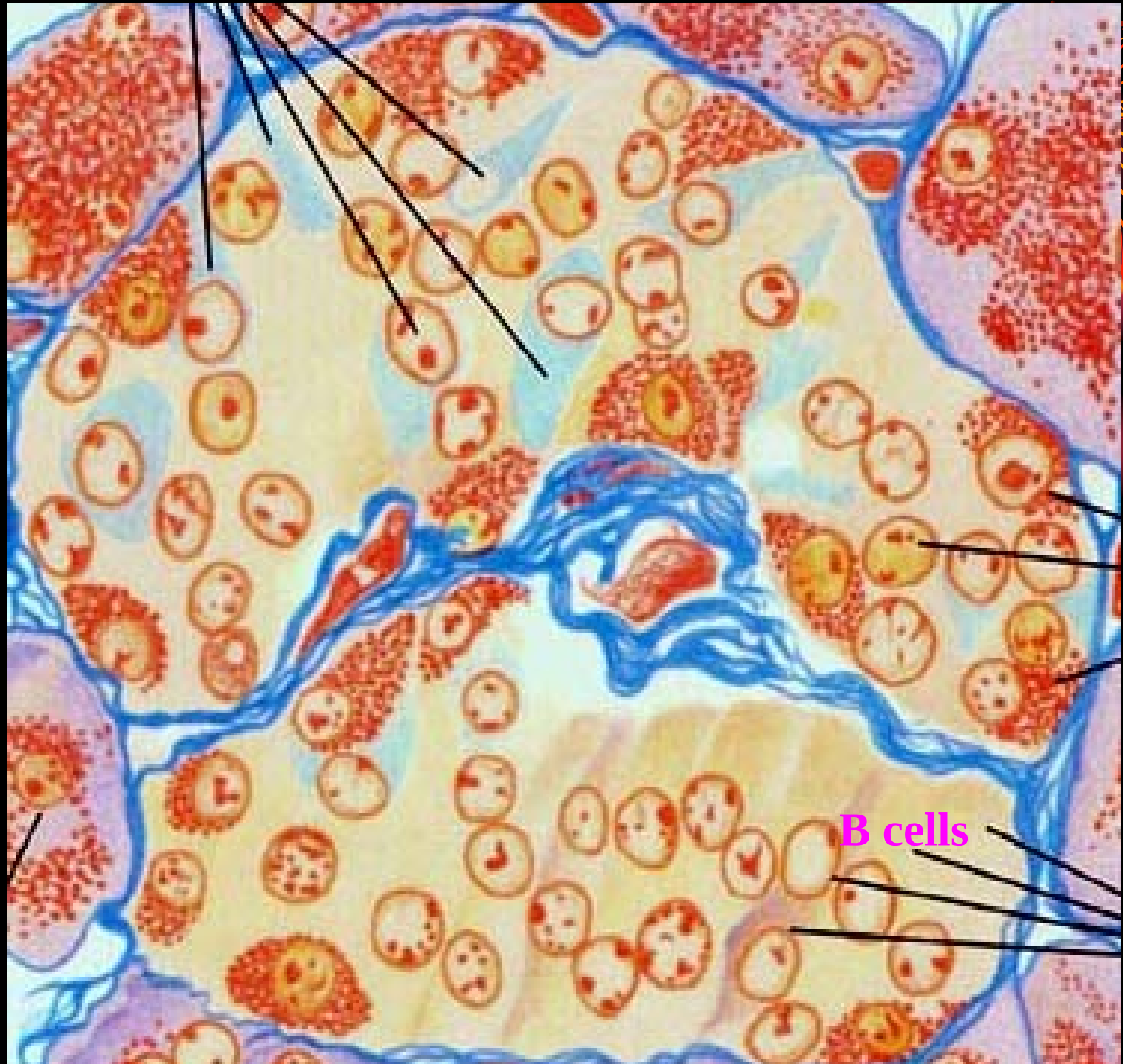
These granules are shown to be membrane-bound, with a highly electron-dense core

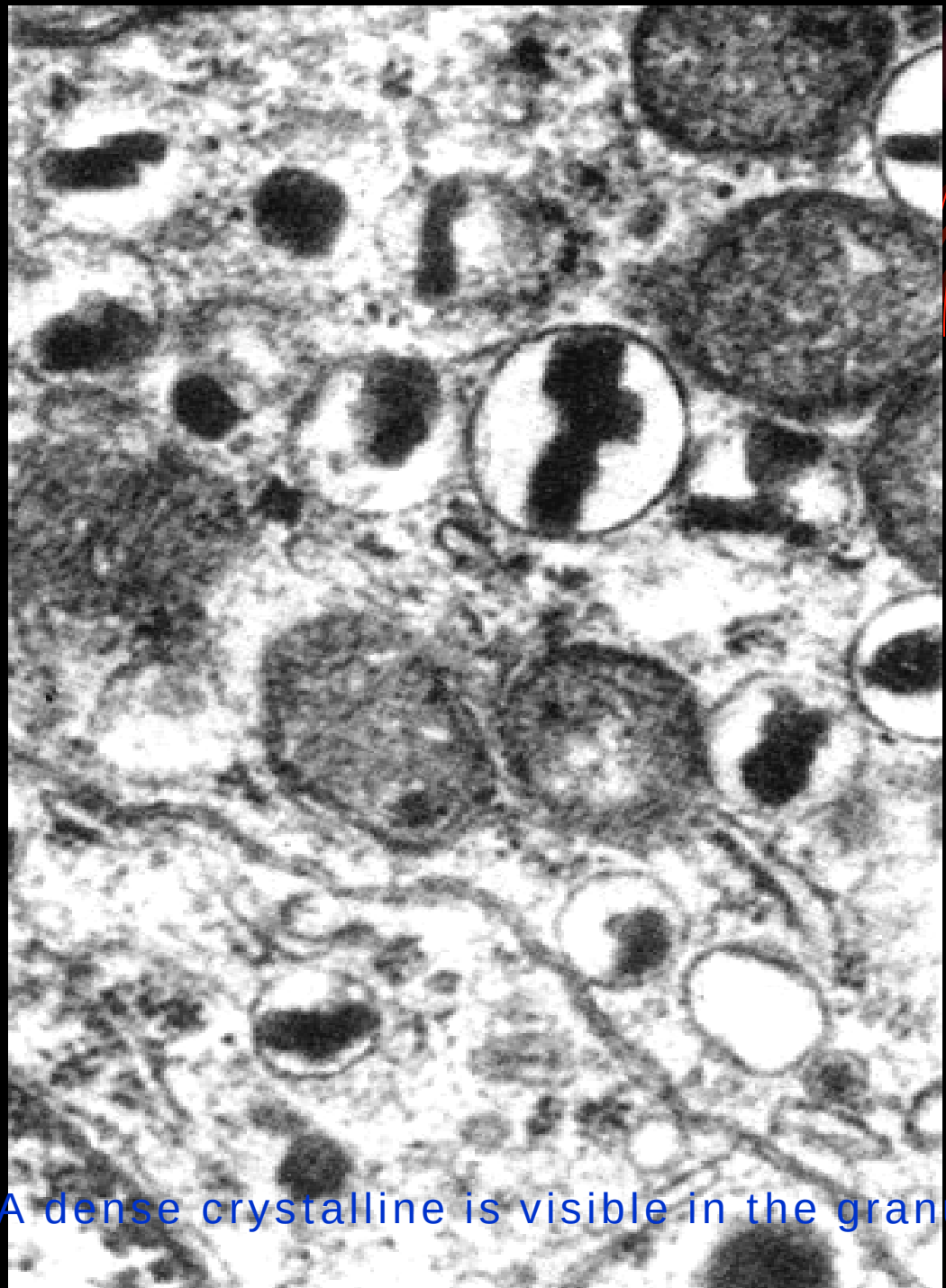
3.2.2 B-cells

Constitute 70% of the islet cell population

located at the centre of an Islet

Function: secrete insulin which acts antagonistically to glucagon and facilitates the utilization of glucose by increasing glucose oxidation and glycogenesis, thus lowering blood sugar levels


B cells



A dense crystalline is visible in the granules

3.2.3 D-cells

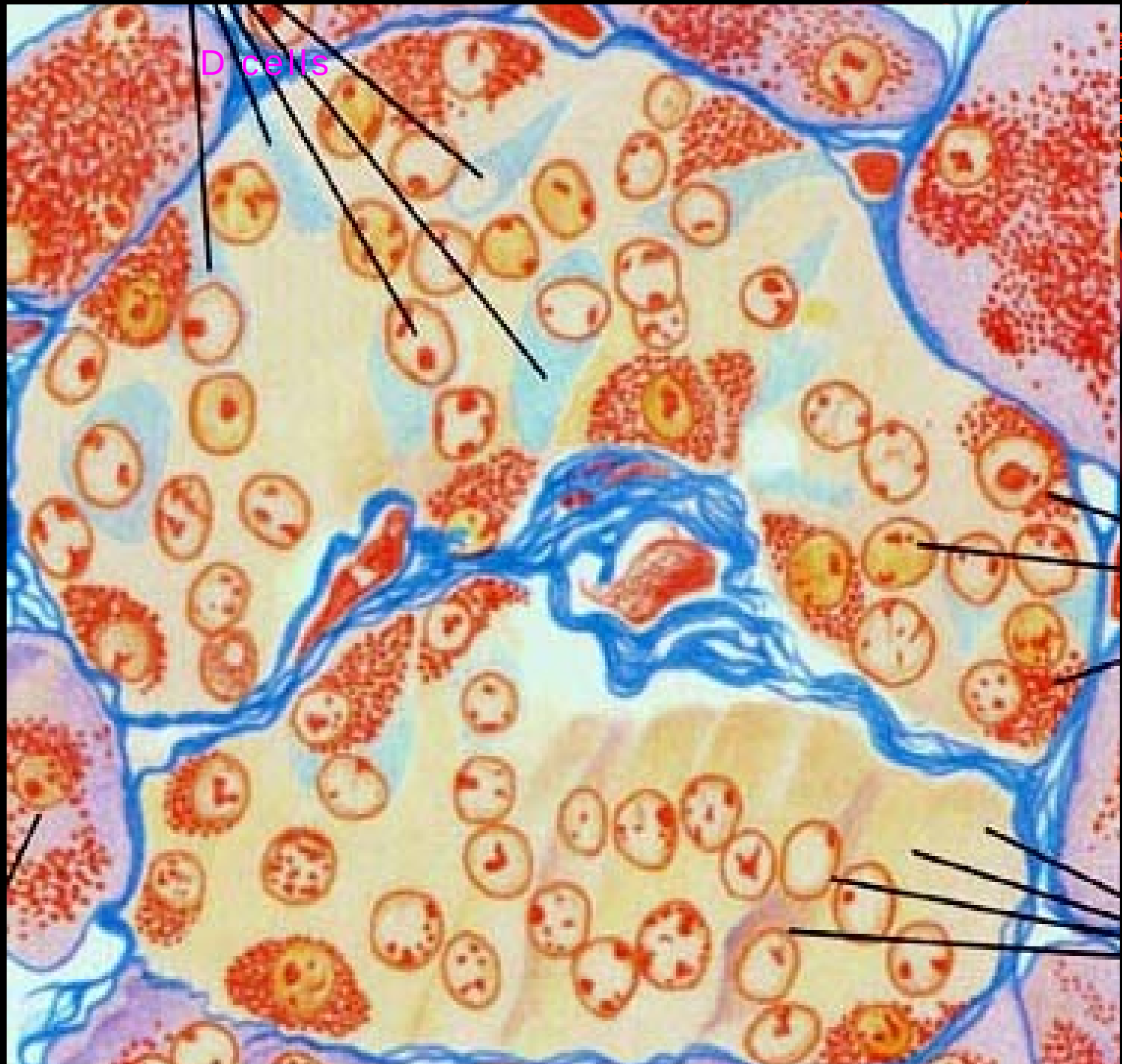
Constitute 5% of the islet cell population

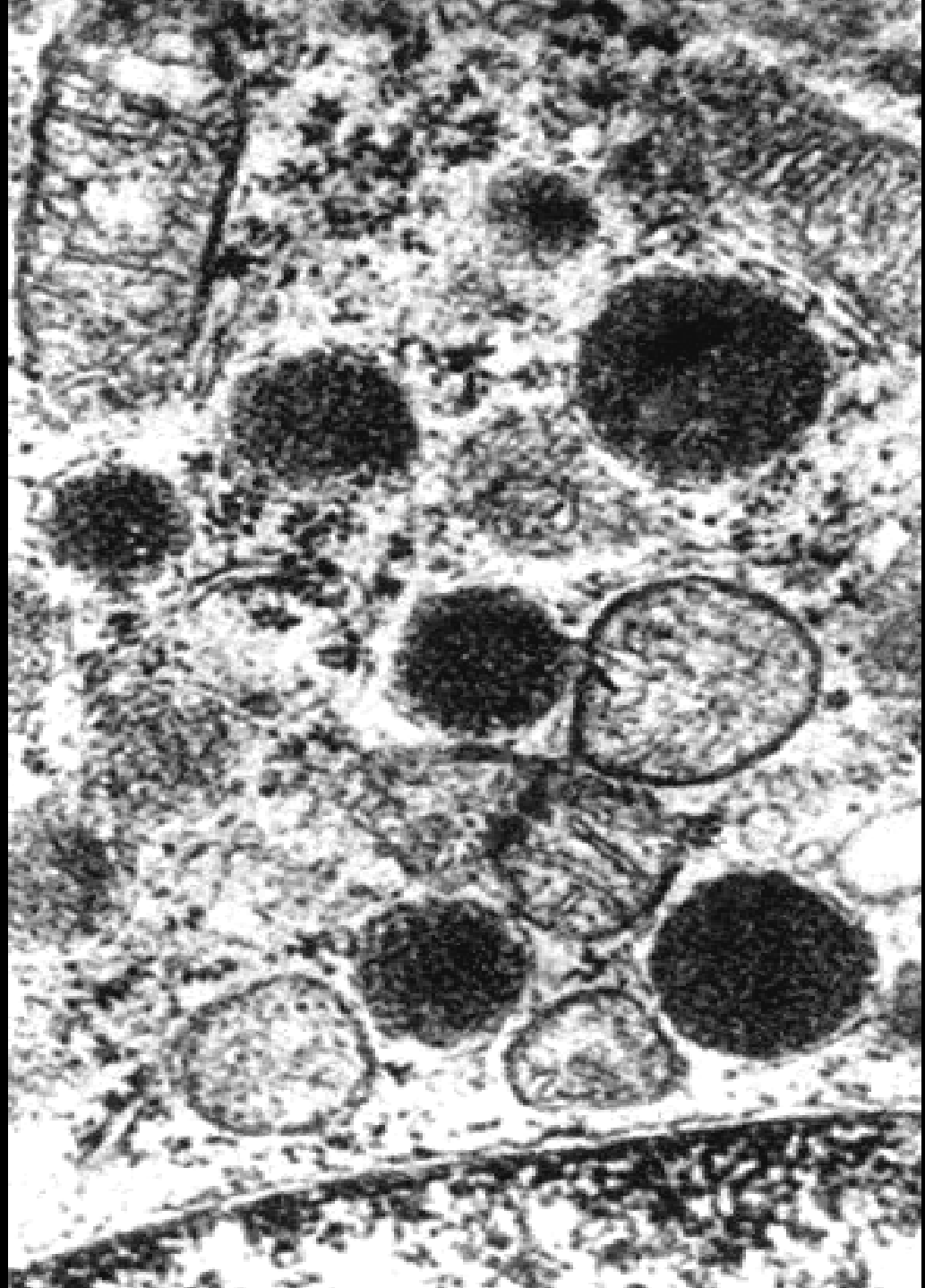
scattered in an Islet

Function: secrete somatostatin which

inhibits the release of glucagon

and insulin


D cells

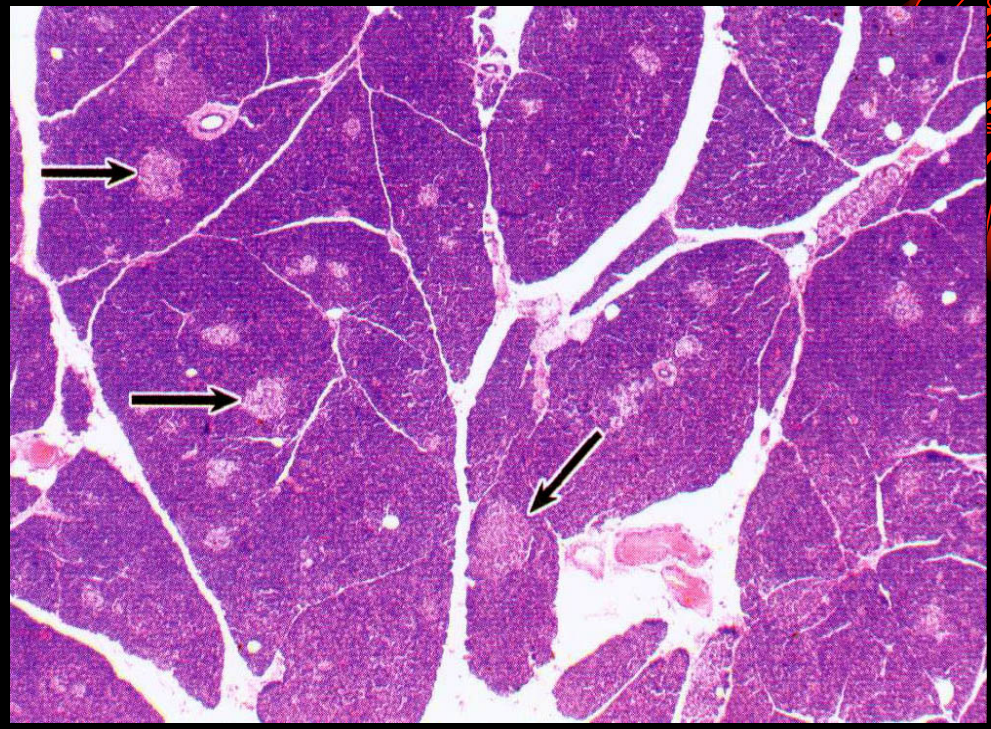


These granules appear less electron-dense than those of the A-cells

In addition to the above cell-types, the pancreatic islets also contain PP-cells and D1 cells.

PP-cells which secrete pancreatic polypeptide, to promote the secretion of gastric acid and pepsinogen.

D1 cells which secrete vasoactive intestinal peptide which to stimulate the secretion of glucagon and insulin. to inhibit the secretion of gastric acid



exocrine portion: water and electrolytes,

several proteases ,amylase, lipases and so on.

endocrine portion

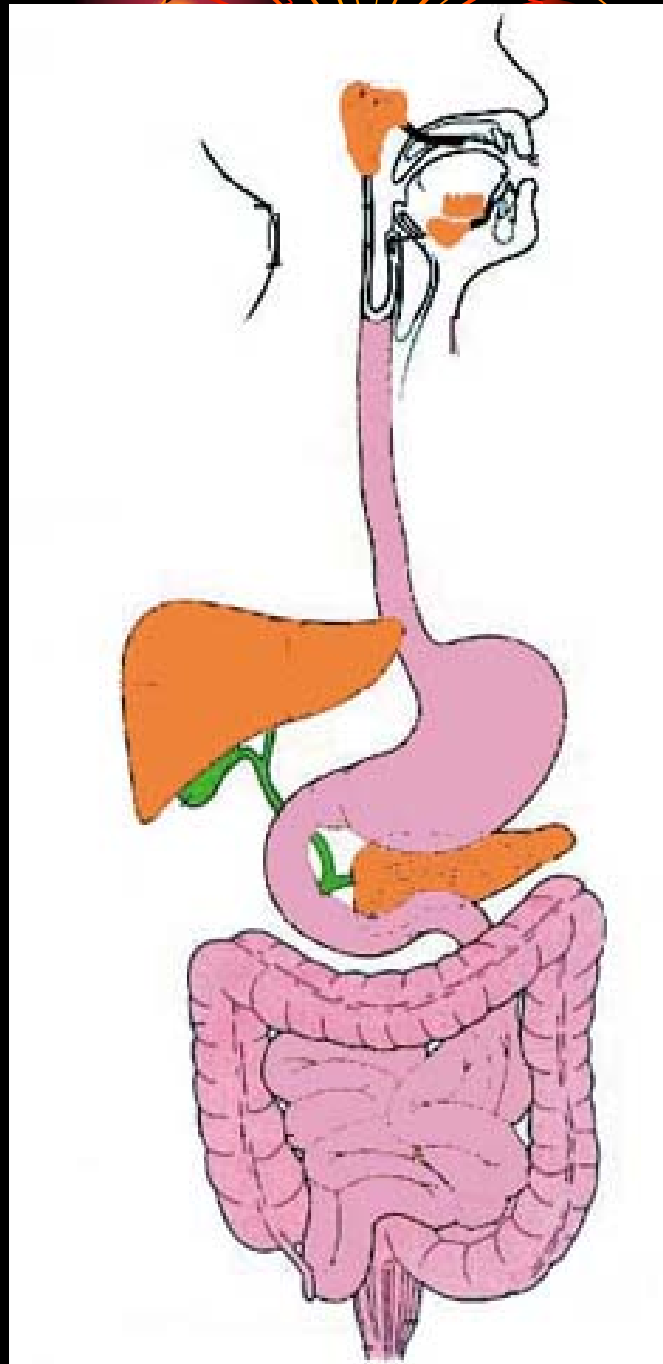
(pancreaticislets):Acells(glycogen),Bcells(insulin),

Dcells(somatostatin)

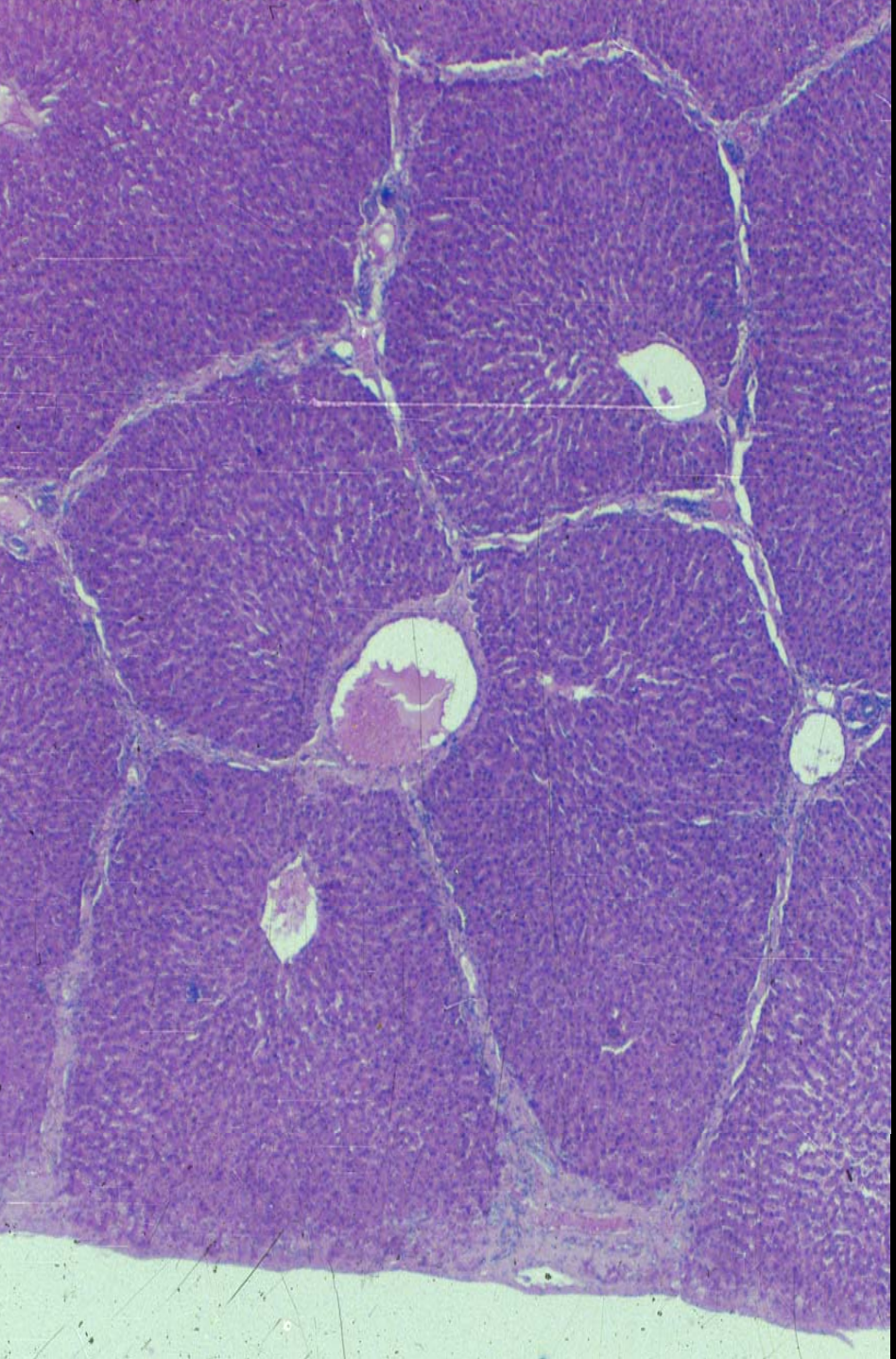
4.liver

The general structure of liver

Capsule
hepatic lobules
portal area: the lobules are demarcated by connective tissue containing bile ducts, lymphatics, nerves,and blood vessels, these regions, named portal area.

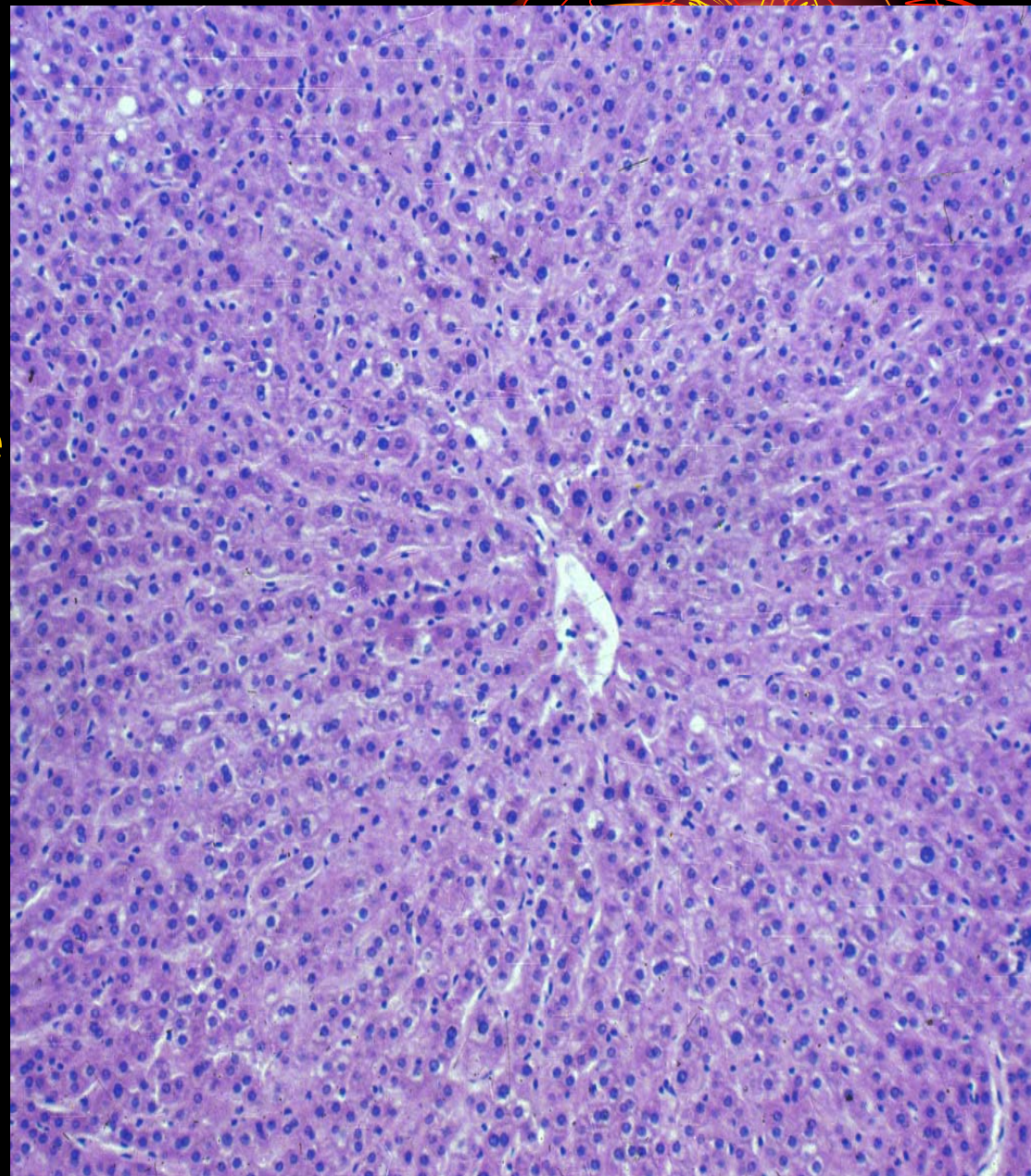


- The liver is the largest gland of the body, weighing about 1.5kg.which is about 2% of the body weight of an adult, The liver is covered by a capsule of dense connective tissue rich in elastic fibers. Thin connetive tissue septa enter the parenchyma of the liver at the hilum, together with the portal vein, hepatic artery, hepatic ducts to divide the liver into lobules

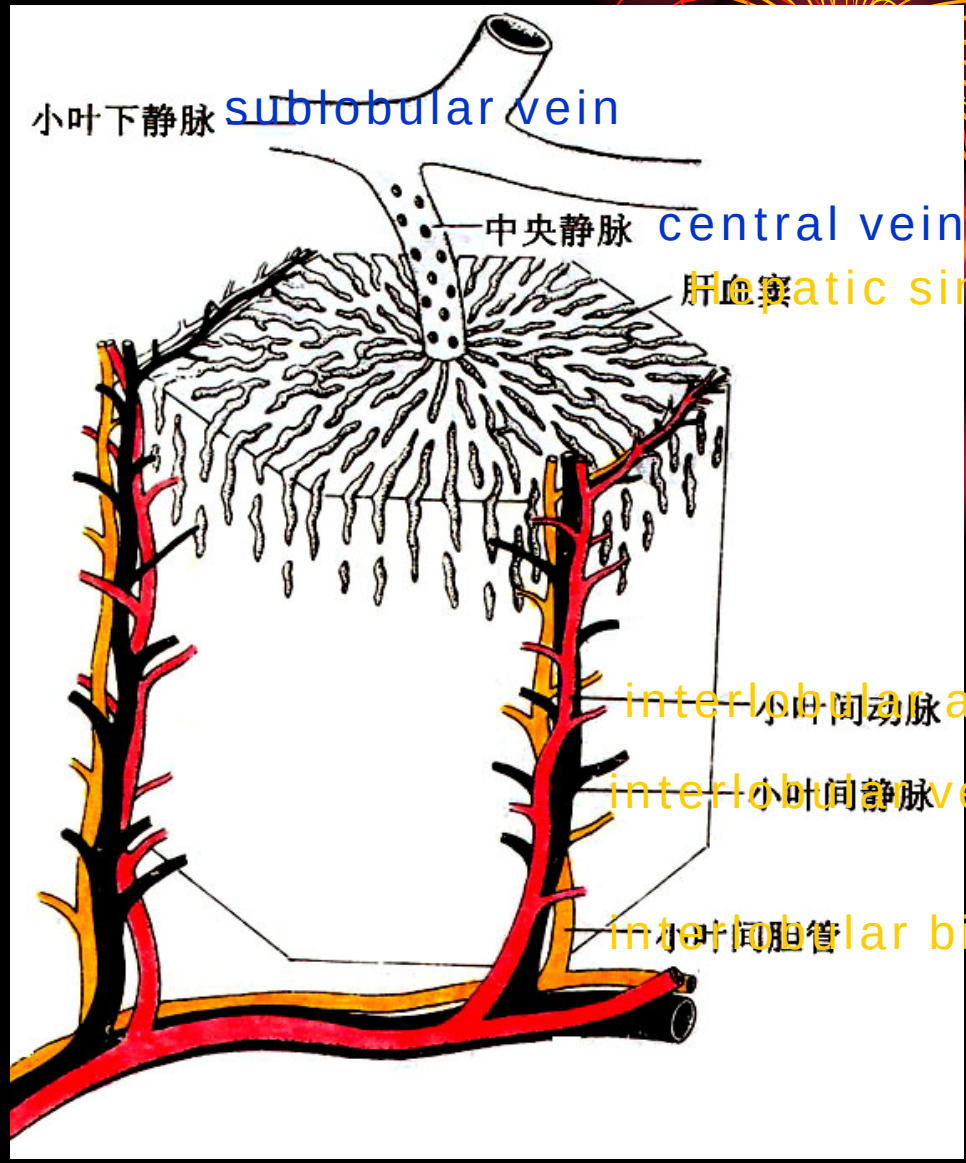


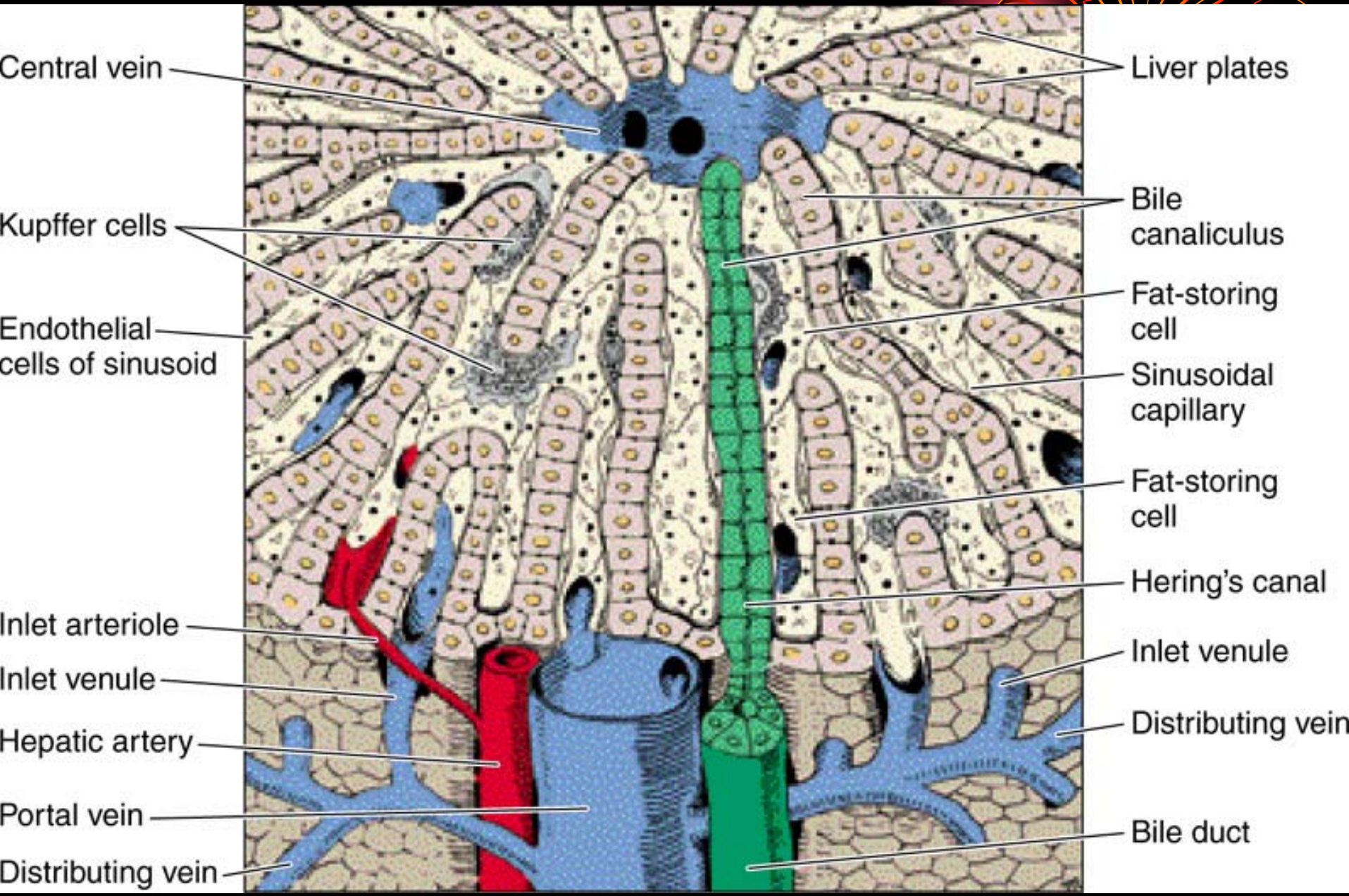
4.1 Hepatic Lobules

- There is a central vein at the centre of the hepatic lobule
- The hepatocytes are radially disposed and are arranged like the bricks of a wall named hepatic plate
- sinusoid

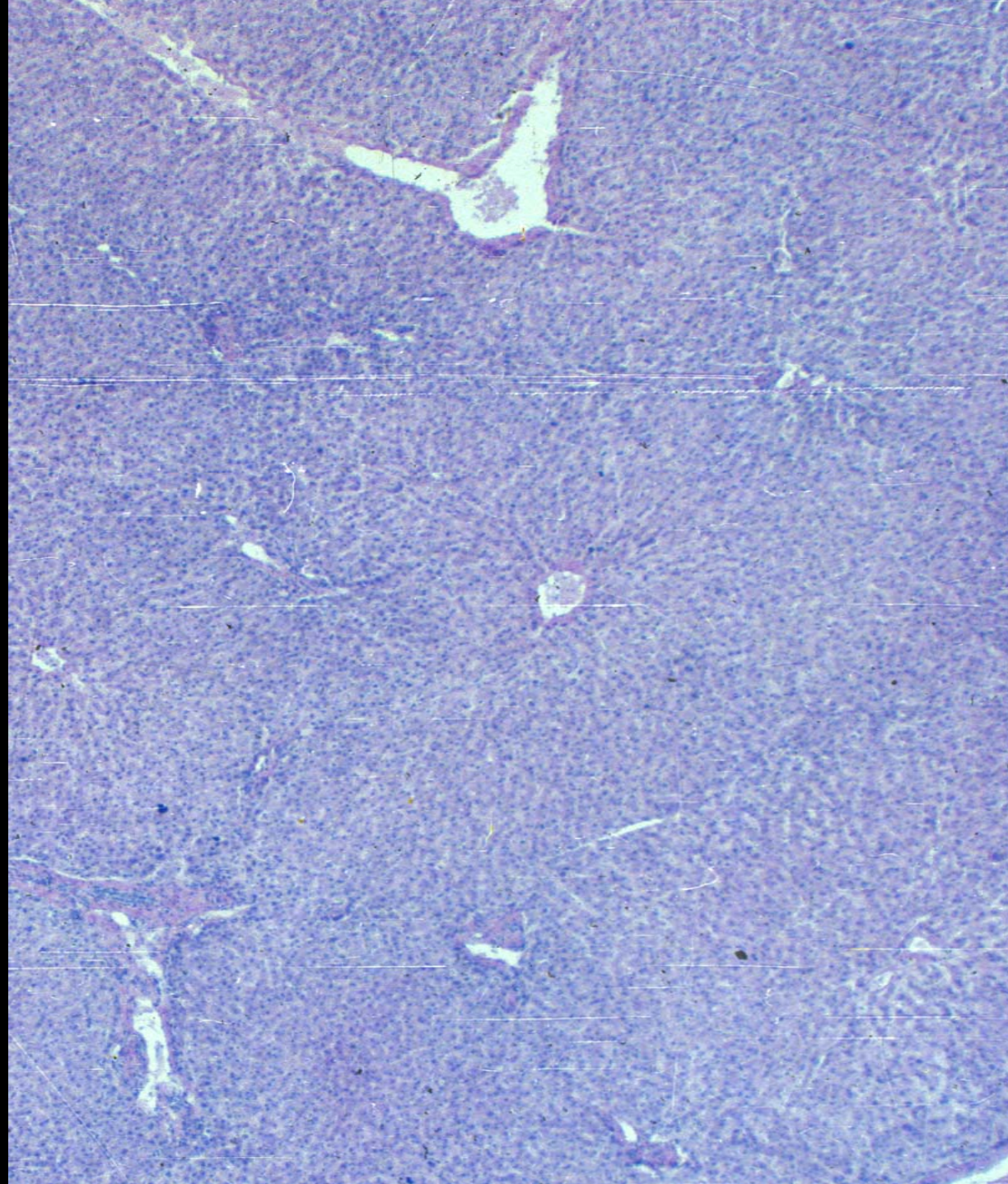


The hepatic lobule is the basic structural unit of the liver. there are about a half to one million in an adult liver. The liver lobule is formed of a polygonal mass of tissue .



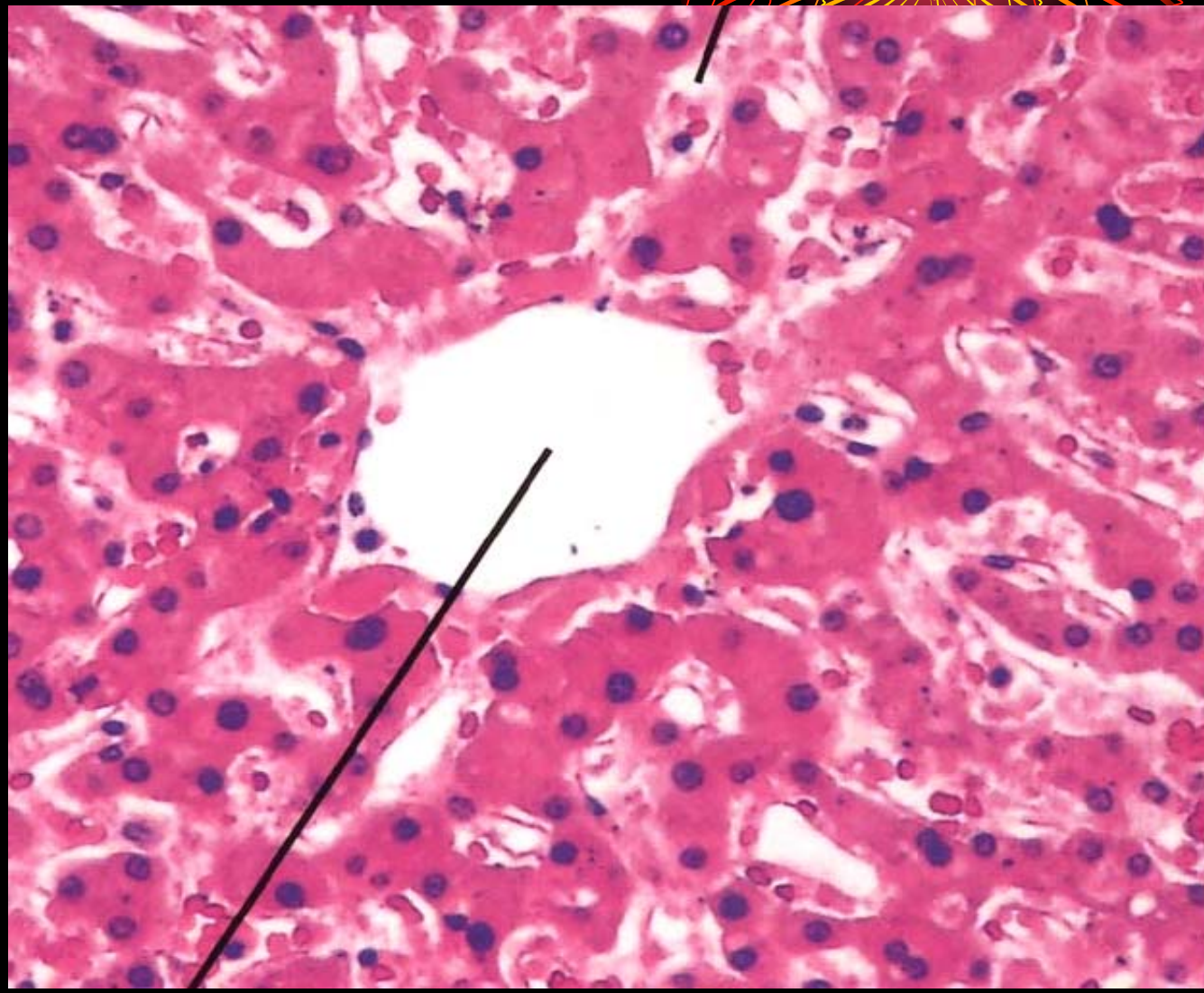

Central vein
Kupffer cells
Endothelial cells of sinusoid
Inlet arteriole
Inlet venule
Hepatic artery
Portal vein
Distributing vein
Liver plates
Bile canaliculus
Fat-storing cell
Sinusoidal capillary
Fat-storing cell
Hering's canal
Inlet venule
Distributing vein
Bile duct

the lobules are in close contact along most of their length, making it difficult to establish the exact limits between different lobules.



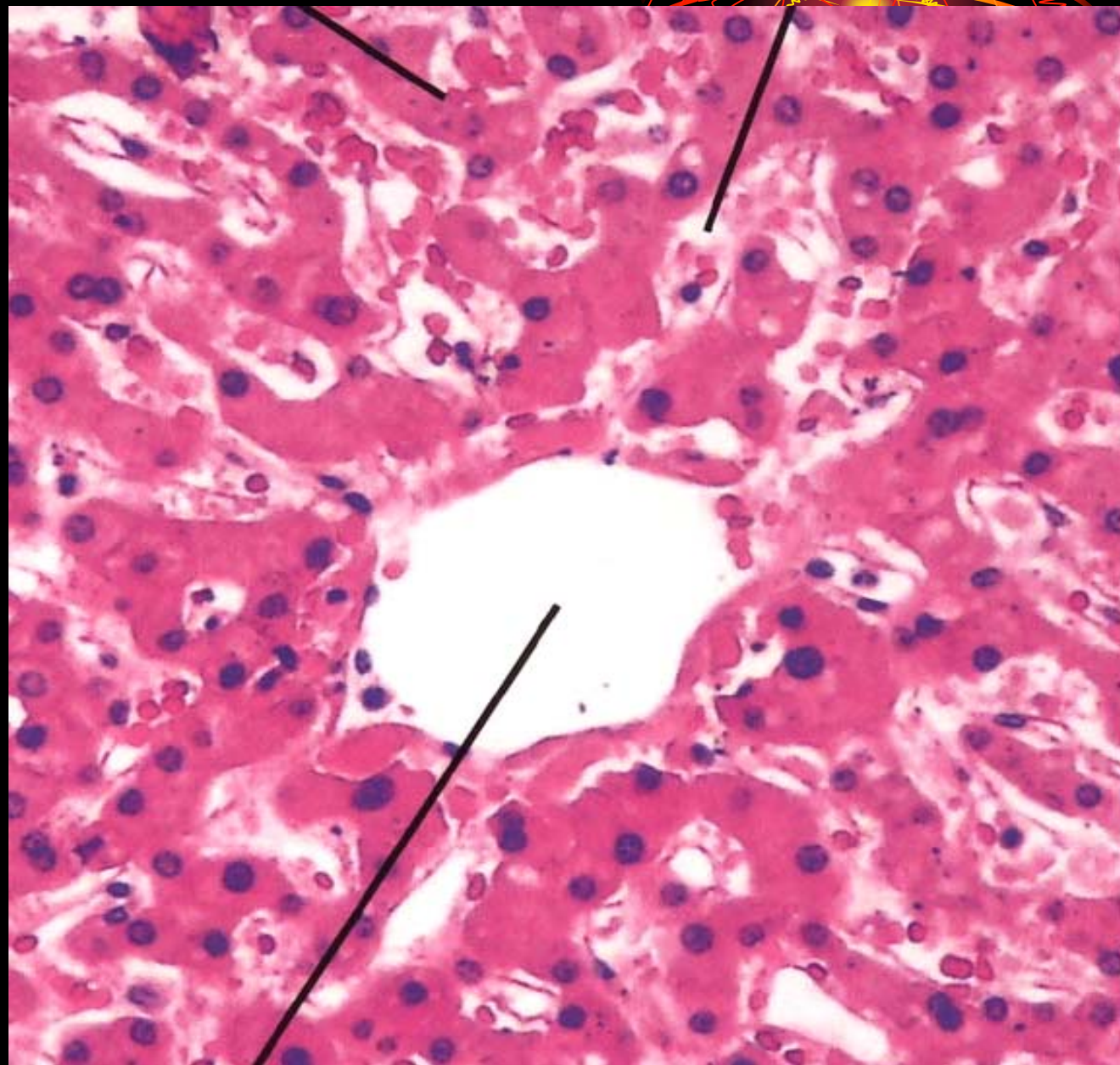
4.1.1 central vein

- this is the smallest tributary of the portal vein
- Is very thin-walled consisting of only endothelial cells supported by a sparse population of collagen fibers



4.1.2 hepatic plates

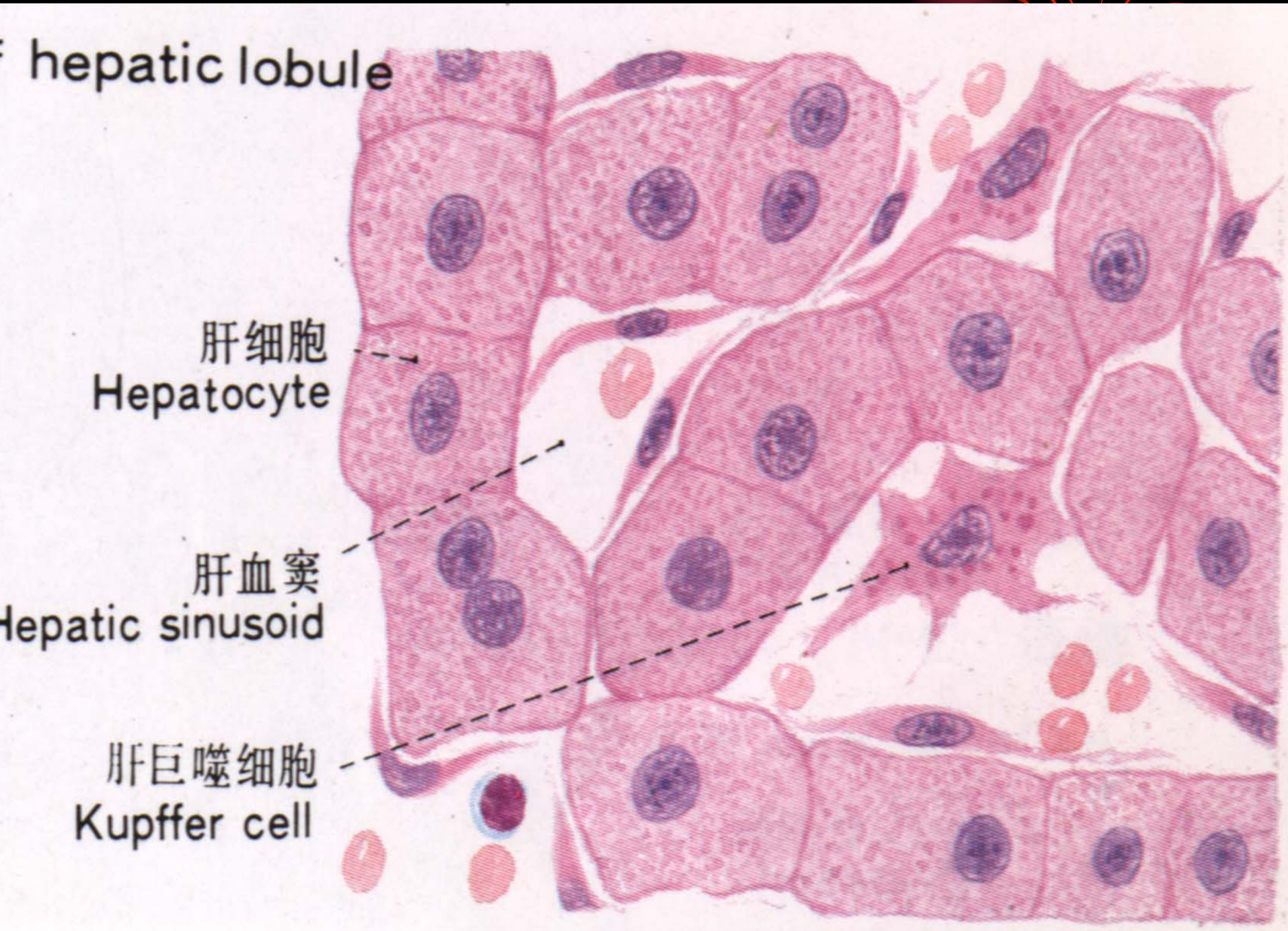
- The hepatocytes are radially disposed and are arranged like the bricks of a wall named hepatic plate , These cellular plates are directed from the periphery of the lobule to its center and anastomose freely, forming a labyrinthine and spongelike structure

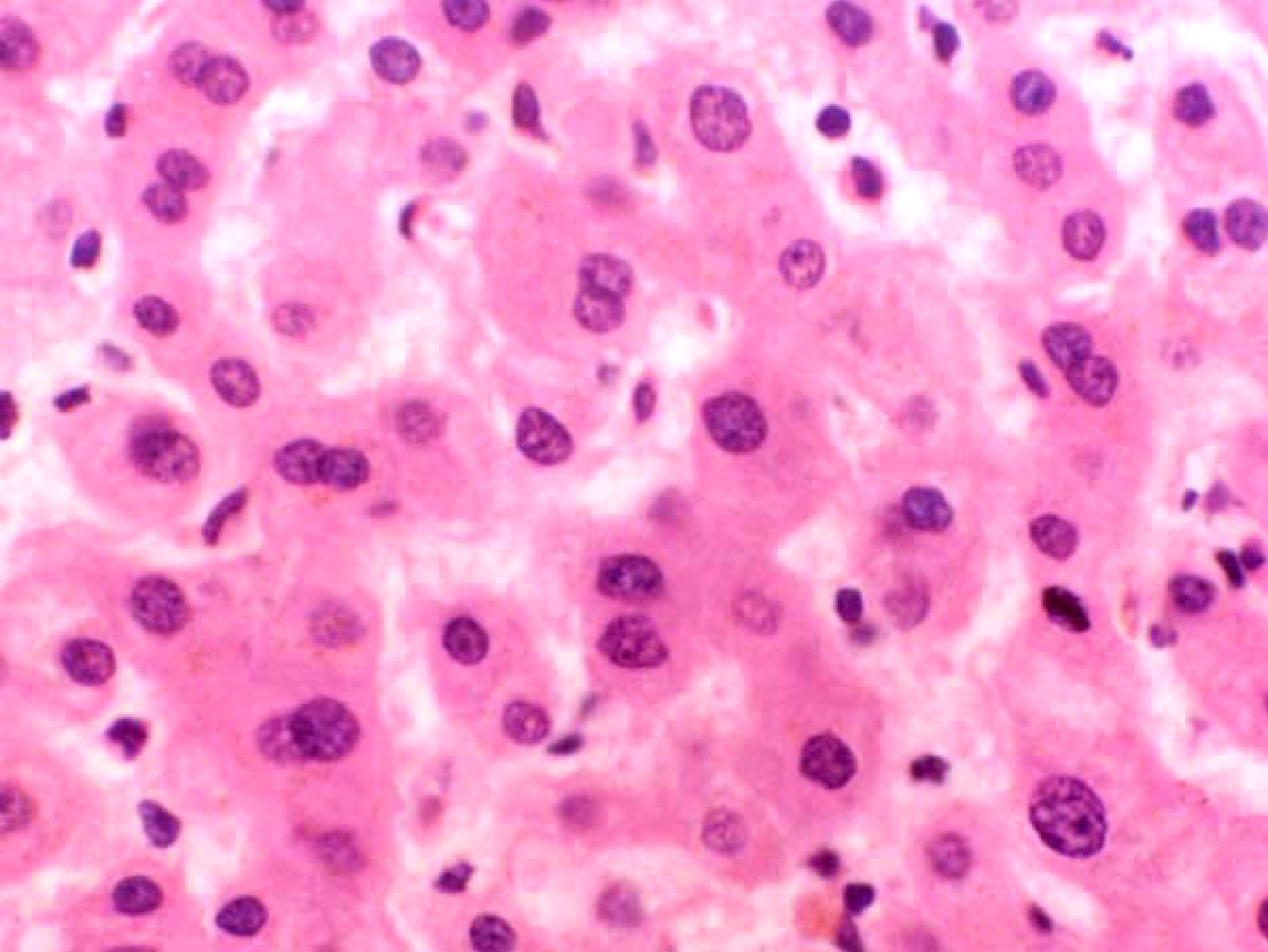


hepatocytes

Structure

LM: Hepatocytes are polyhedral, with 6 or more surfaces , the cytoplasm of the hepatocyte is eosinophilic, mainly because of the large number of mitochondria and some smooth endoplasmic reticulum. basophilic granules in it, single nucleus or double nuclei, which is spherical ,located in the centre of the cells.with a prominent nucleolus and scattered chromatin granules

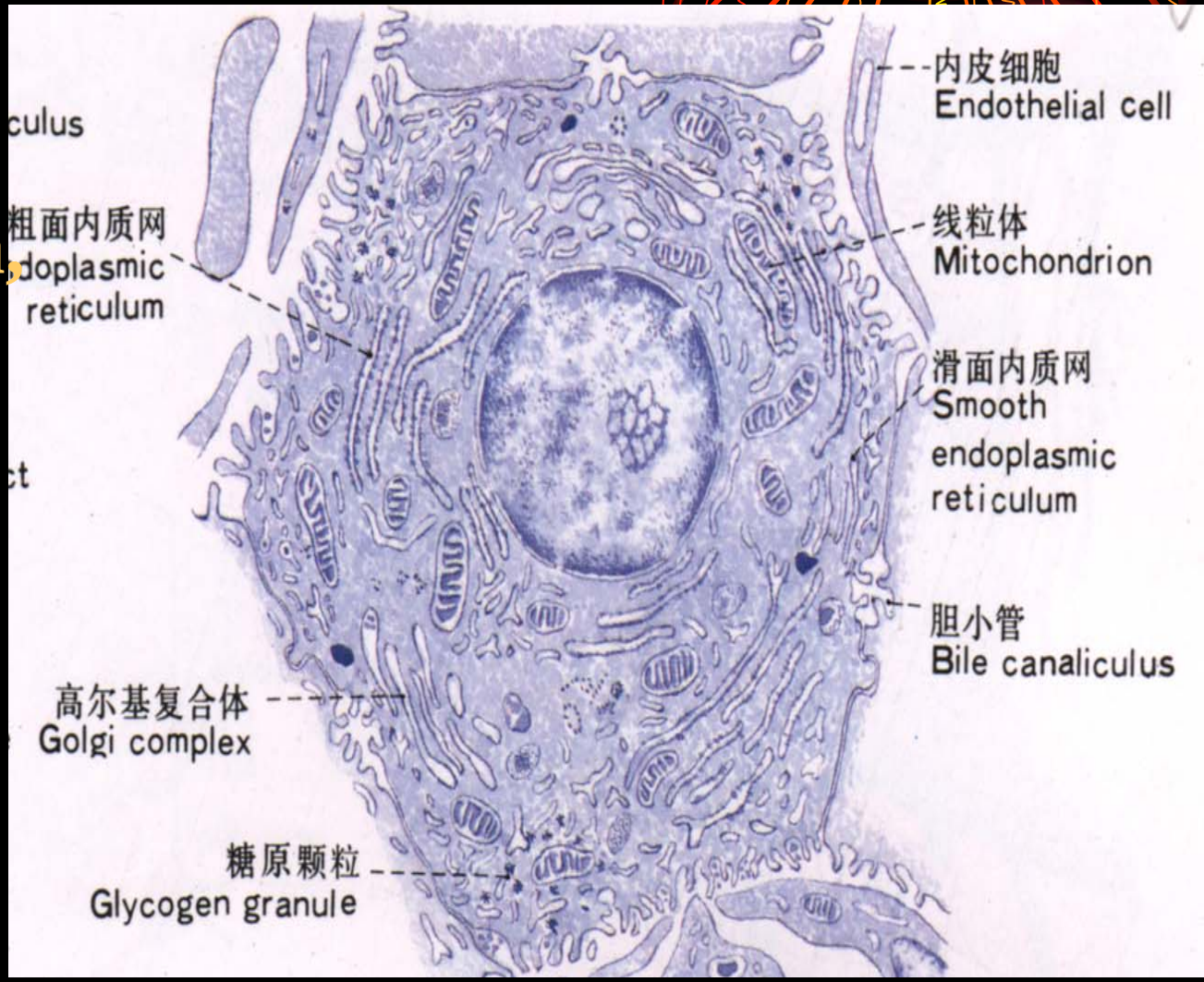

f hepatic lobule
肝细胞
Hepatocyte
肝血窦
Hepatic sinusoid
肝巨噬细胞
Kupffer cell



EM structure of hepatocyte

organelle:

large numbers of mitochondria, SER, RER, Golgi complex, lysosome, microbody inclusions

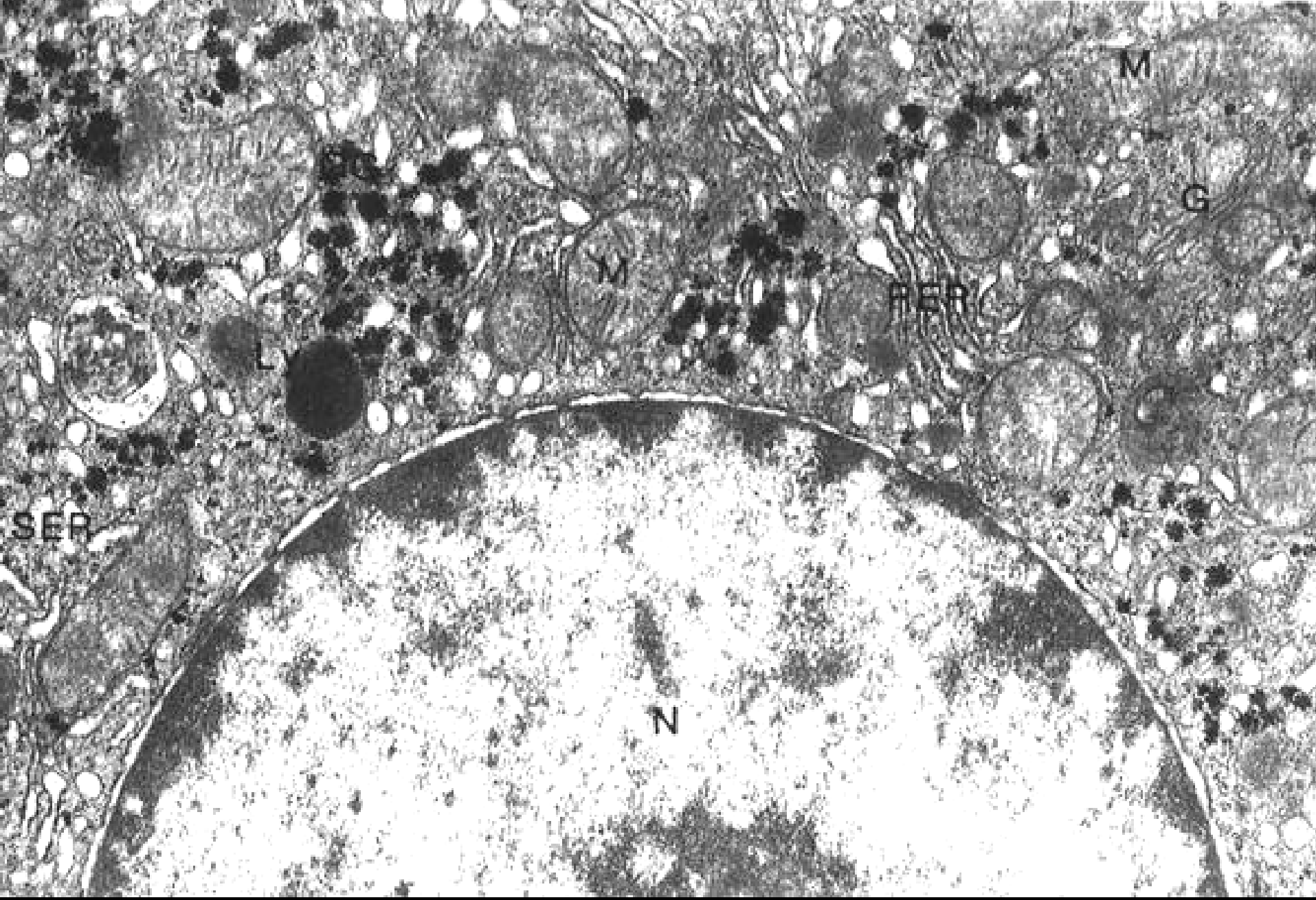


- **Mitochondria: supply energy to cells**
- **RER: several protein-eg, blood albumin, fibrinogen lipoprotein and transferrin**
- **SER：synthesizing and secreting bile, metabolism of lipids and hormones and detoxifcation , the proceses of oxidation,methylation,conjugation of various substances**
- **Golgi complex: formation of lysosomes and the secretion of plasma proteins, glycoproteins ,lipoproteins**
- **Lysosome: in the normal replacement of cellular components and organelles,as well as in cellular defense mechanisms**

- Microbody(peroxisomes): contain catalase and oxidative enzymes, oxidation of excess fatty acids, break down of the hydrogen peroxide ,break down of excess purines to uric acid, participation in the synthesis of cholesterol, bile acids, and some lipids used to make myelin

Inclusions

- **The hepatocyte frequently contains glycogen. This polysaccharide appears in the electron microscope as coarse, electron-dense granules that frequently collect in the cytosol close to the smooth endoplasmic reticulum . The amount of glycogen present in the liver conforms to a diurnal rhythm; it also depends on the nutritional state of the individual. Liver glycogen is a depot for glucose and is mobilized if the blood glucose level falls below normal. In this way, hepatocytes maintain a steady level of blood glucose, one of the main sources of energy for use by the body.**
  lipid droplets
- **pigment**


M
G
M
RER
L
SER
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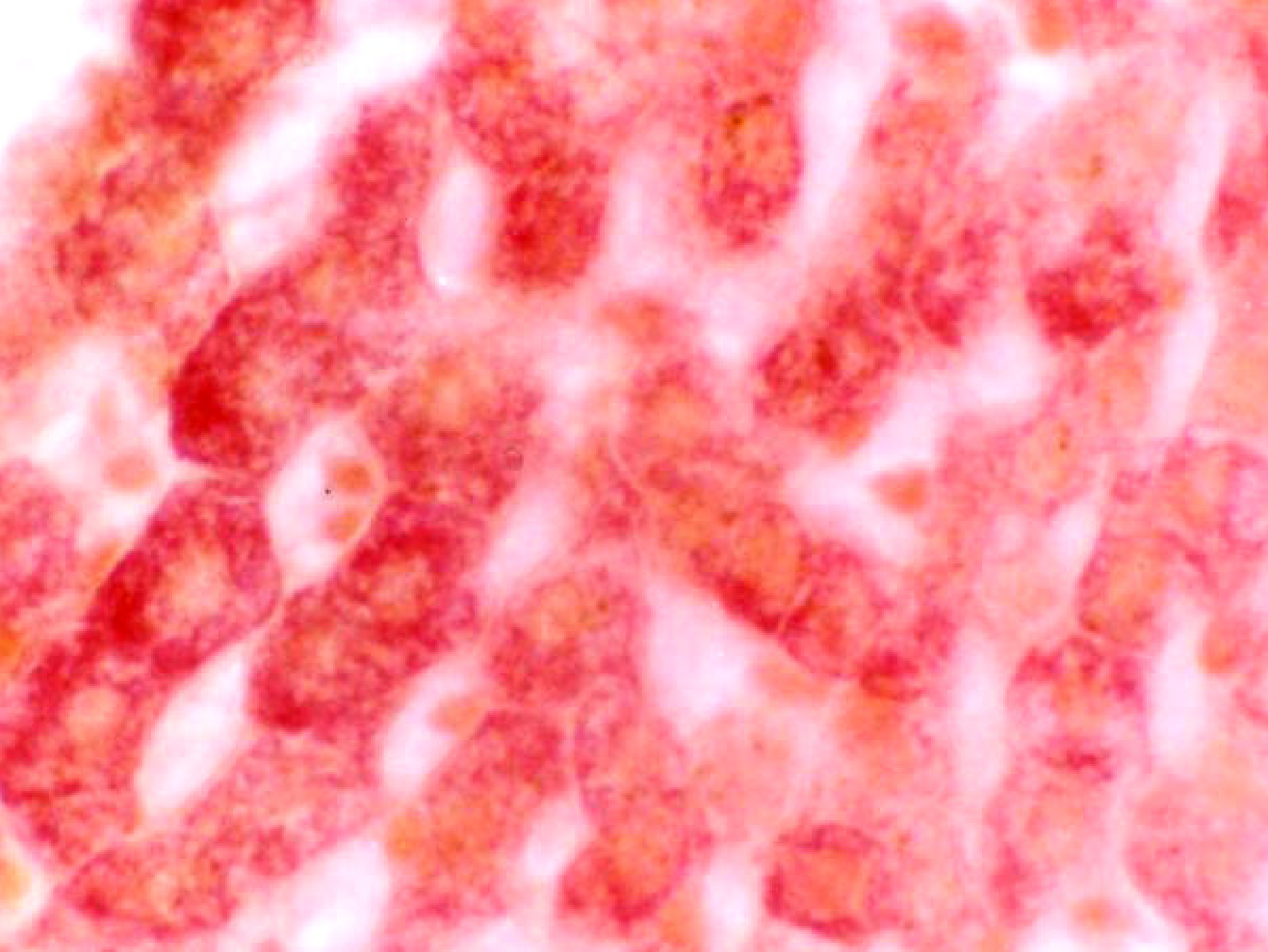
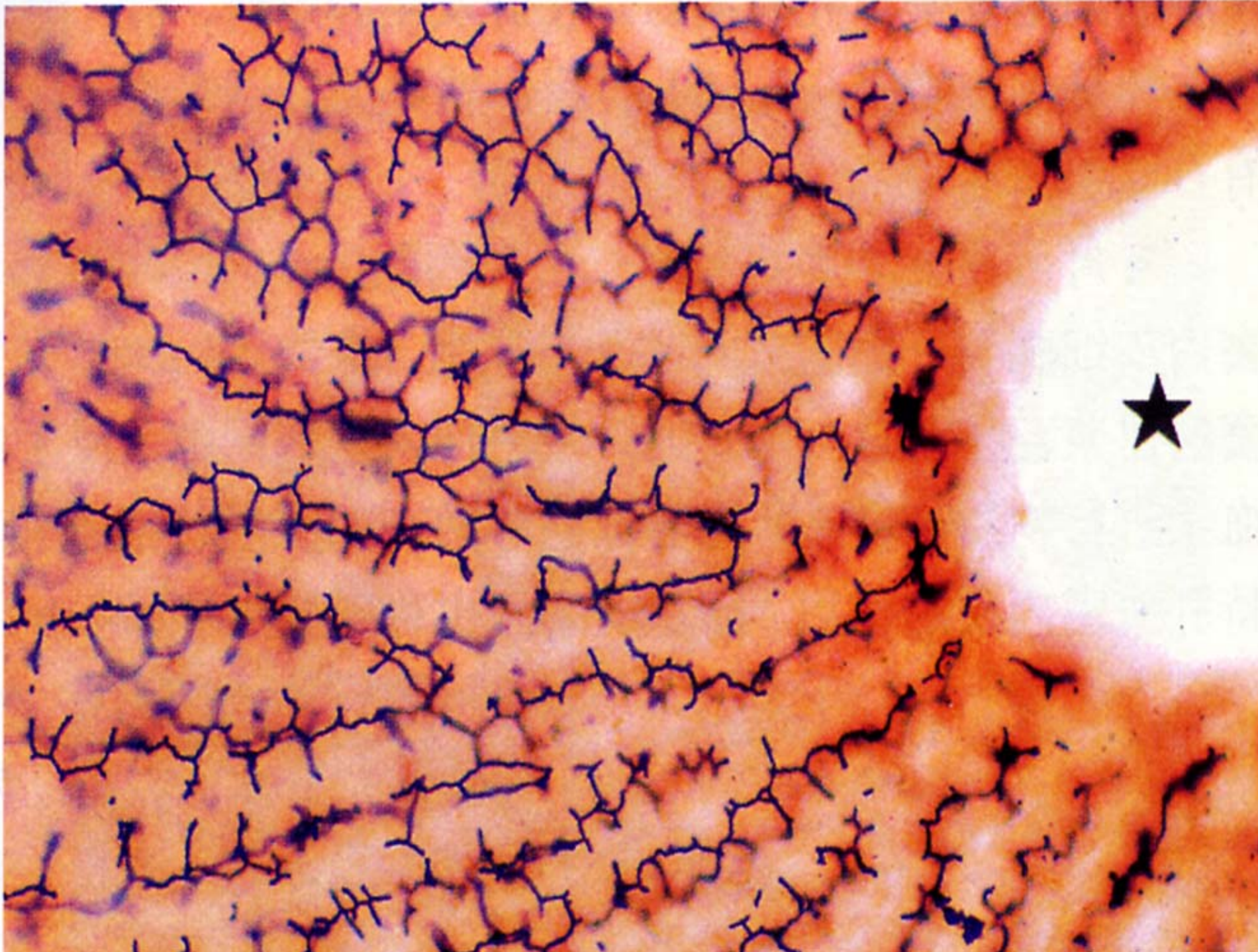


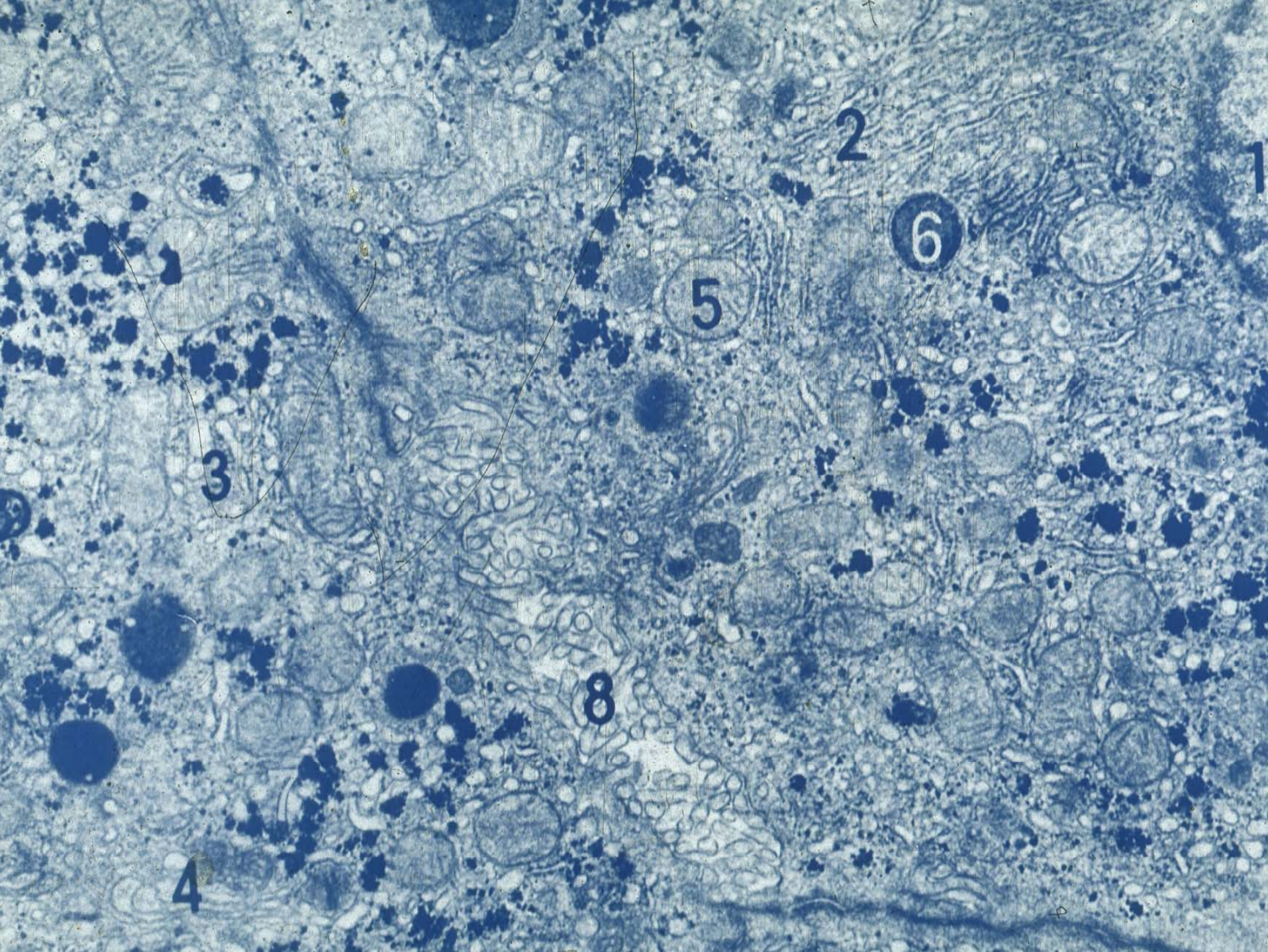
bile canaliculi

2 hepatocytes abut, they delimit a tubular space between them known as bile canaliculus

in which have a small number of microvilli.

The cell membranes near these canaliculi are firmly bound by tight junction, desmosomes and gap junction.

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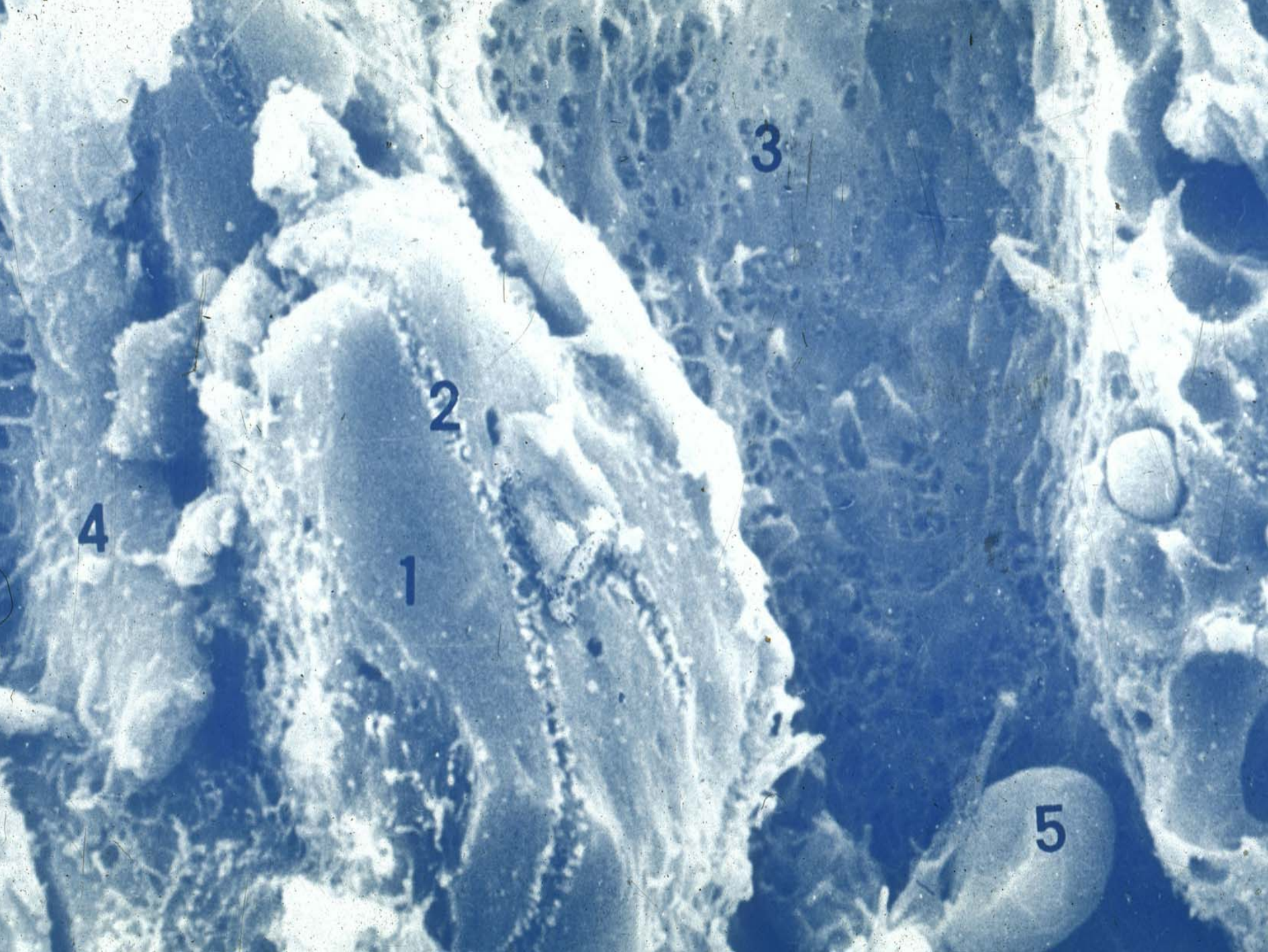
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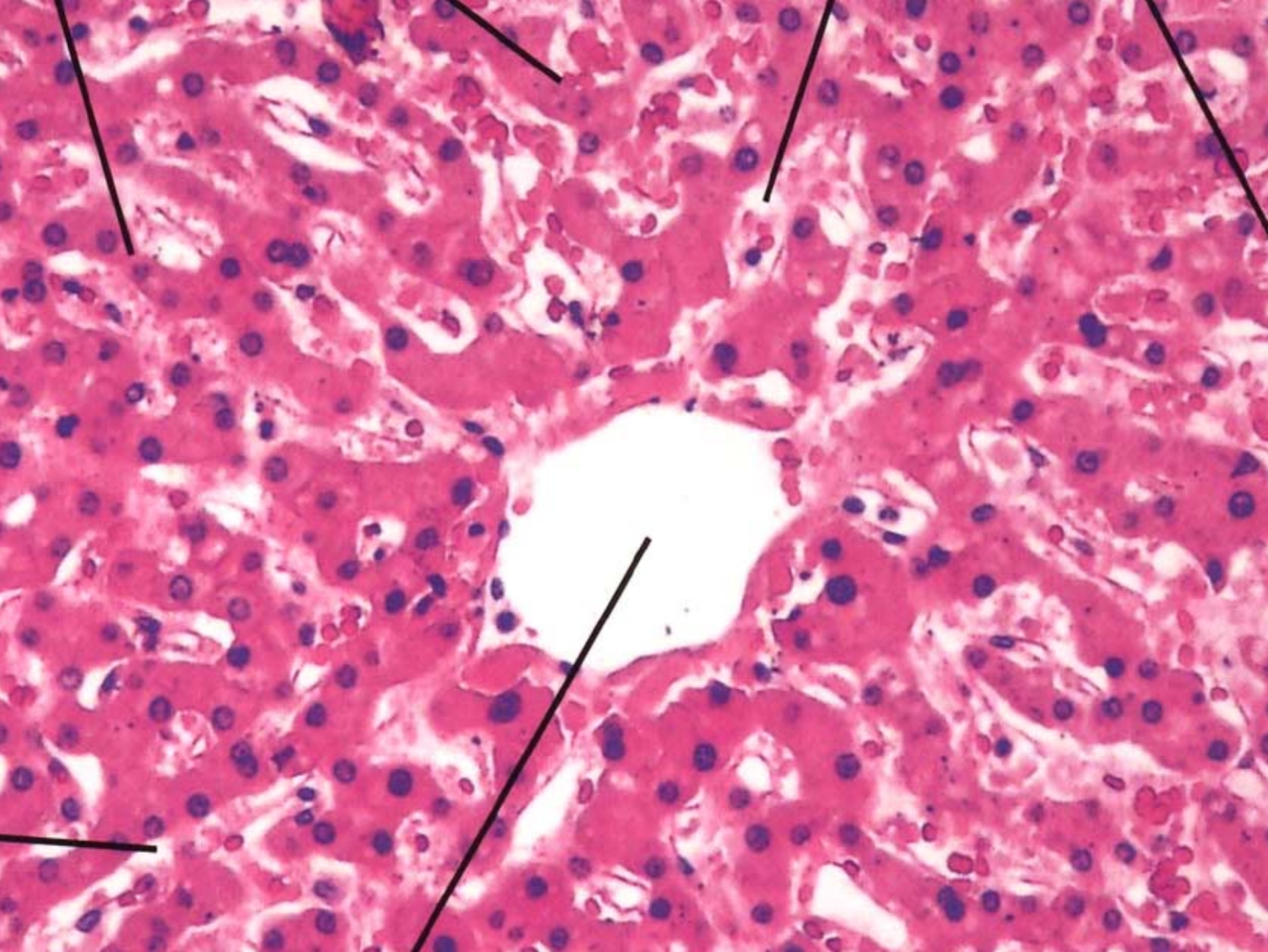
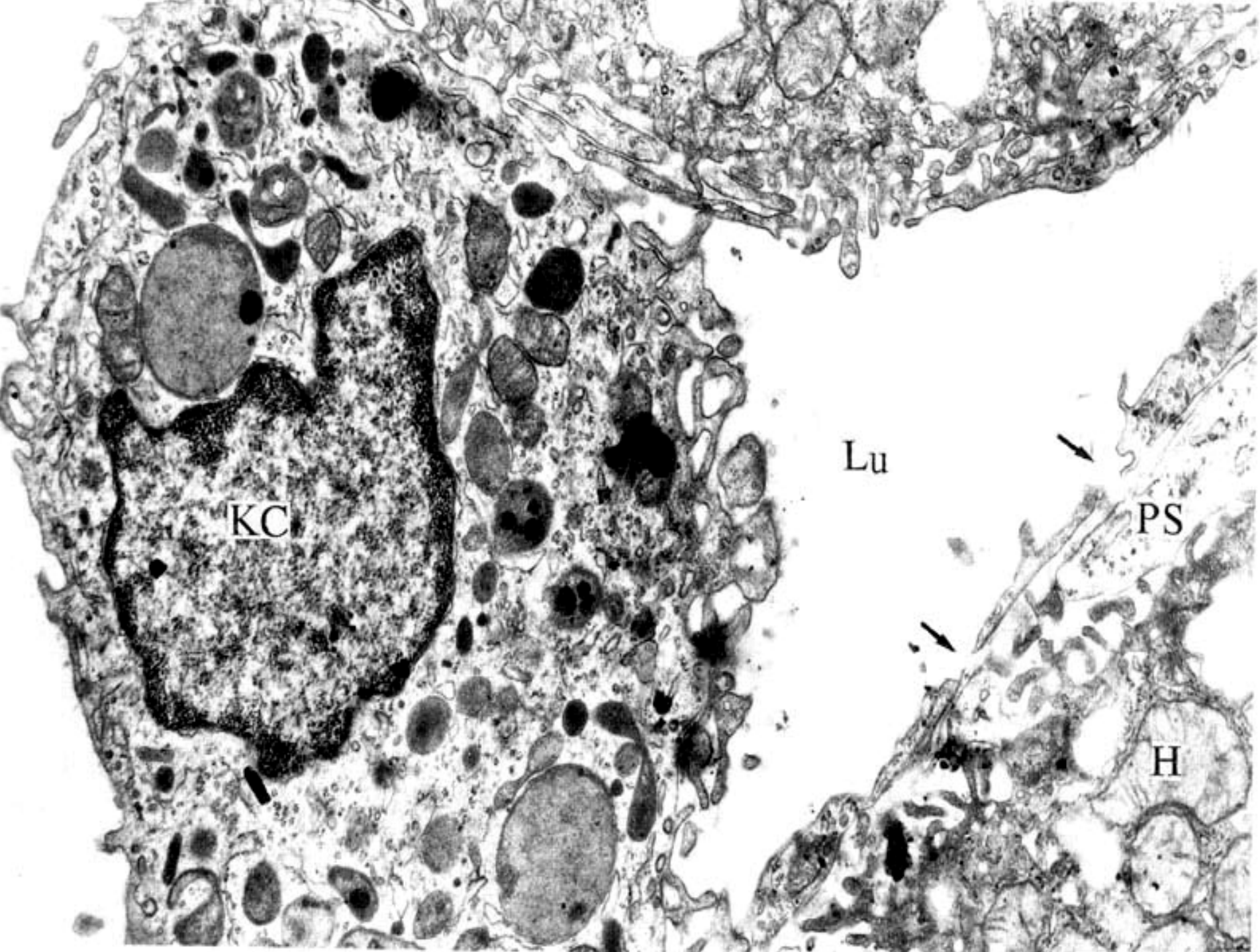
hepatic sinusoid

between hepatic plates sponge work

Wall of sinusoid: fenestrated endothelium，no basement membrane，macrophages(Kupffer cells) and large granules cells in lumen of sinusiod




KC
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PS
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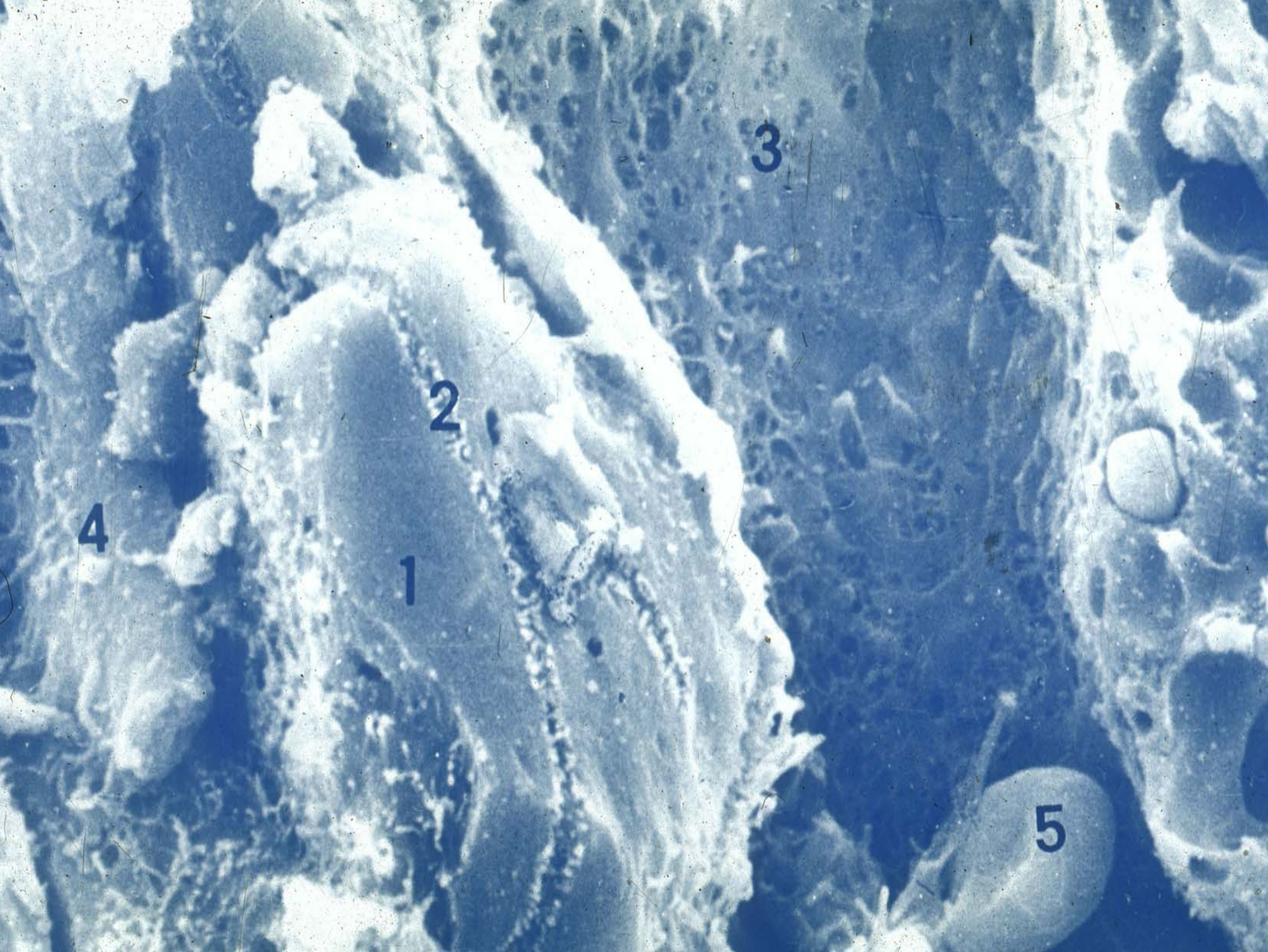
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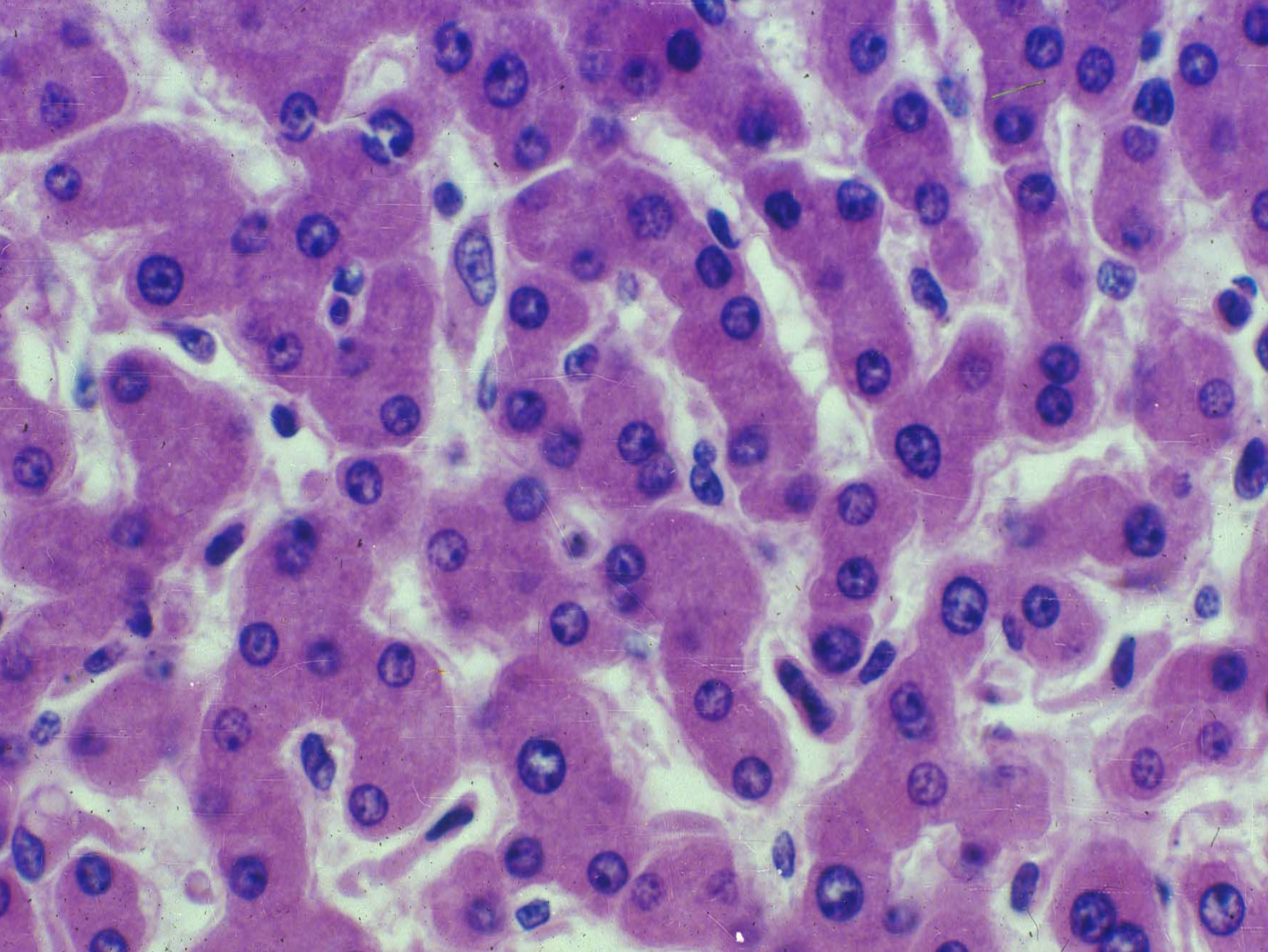
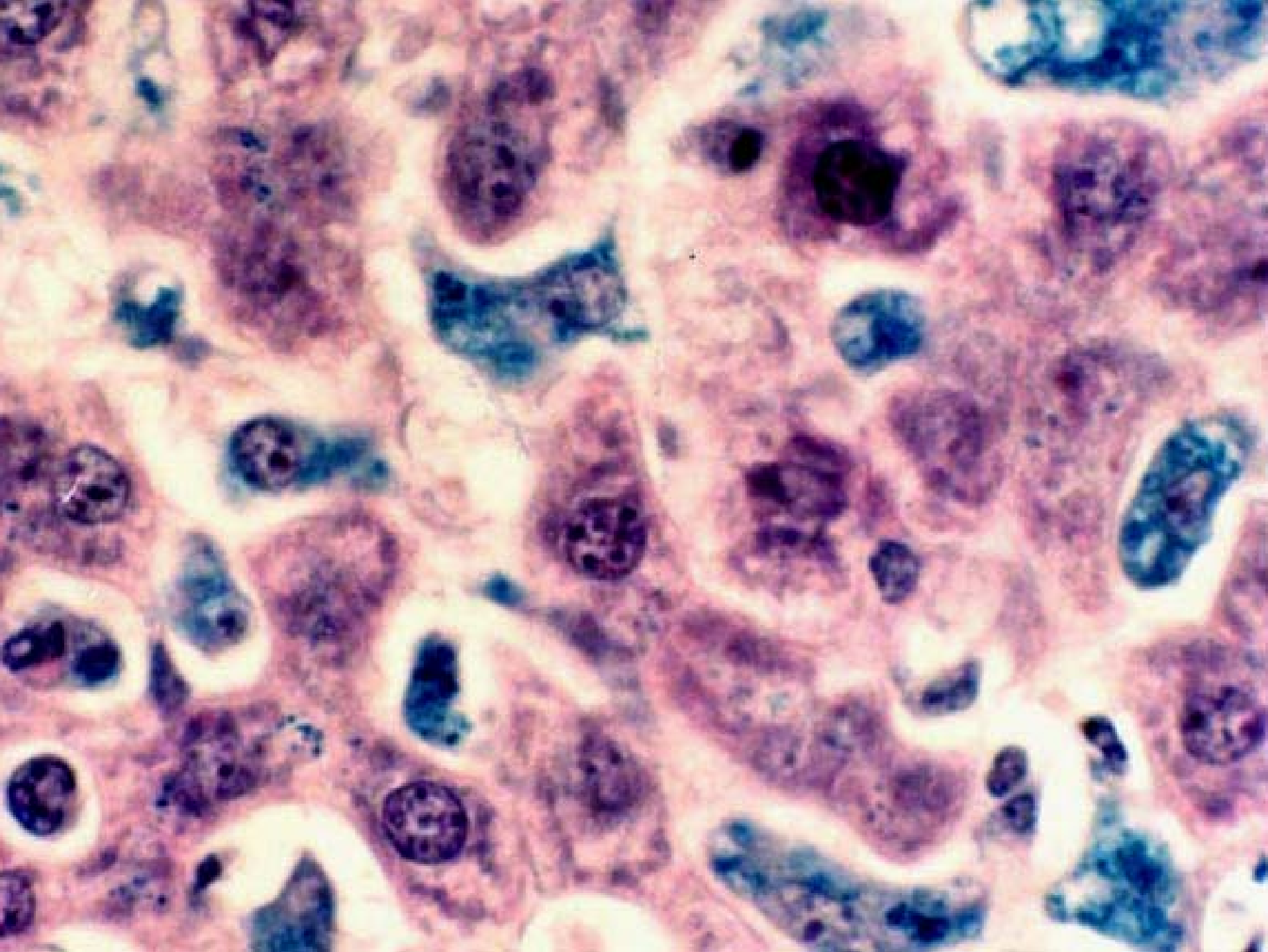
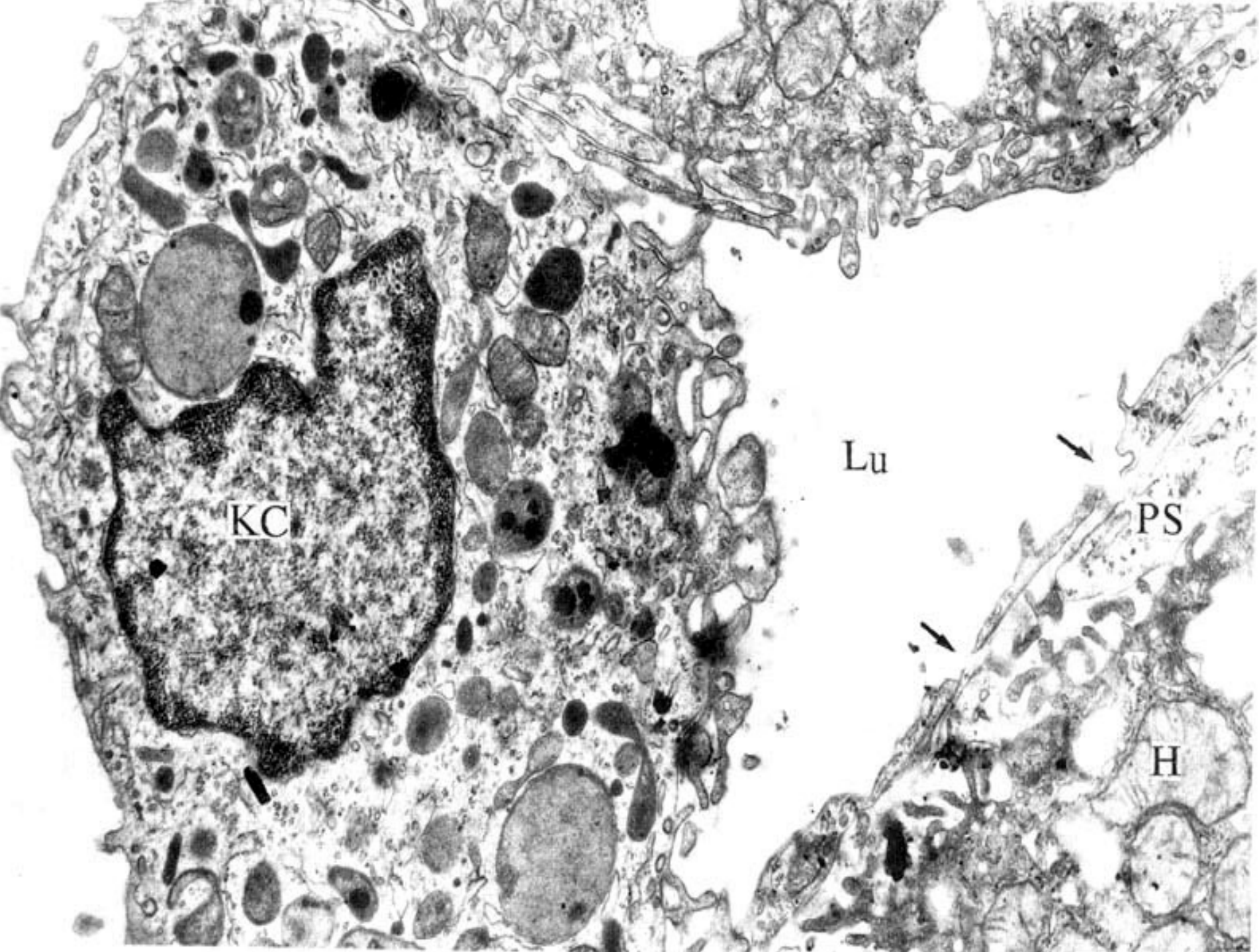
Hepatic macrophages

so called Kupffer cells， the cells with processes，location on the luminal surface of the endothelial cells or between them. In electron micrographs, Kupffer cells can be identified by the presence of large numbers of lysosomes in the cytoplasm. They phagocytose remnants of degenerating red cells and are involved in the metabolism of haemoglobin.






KC
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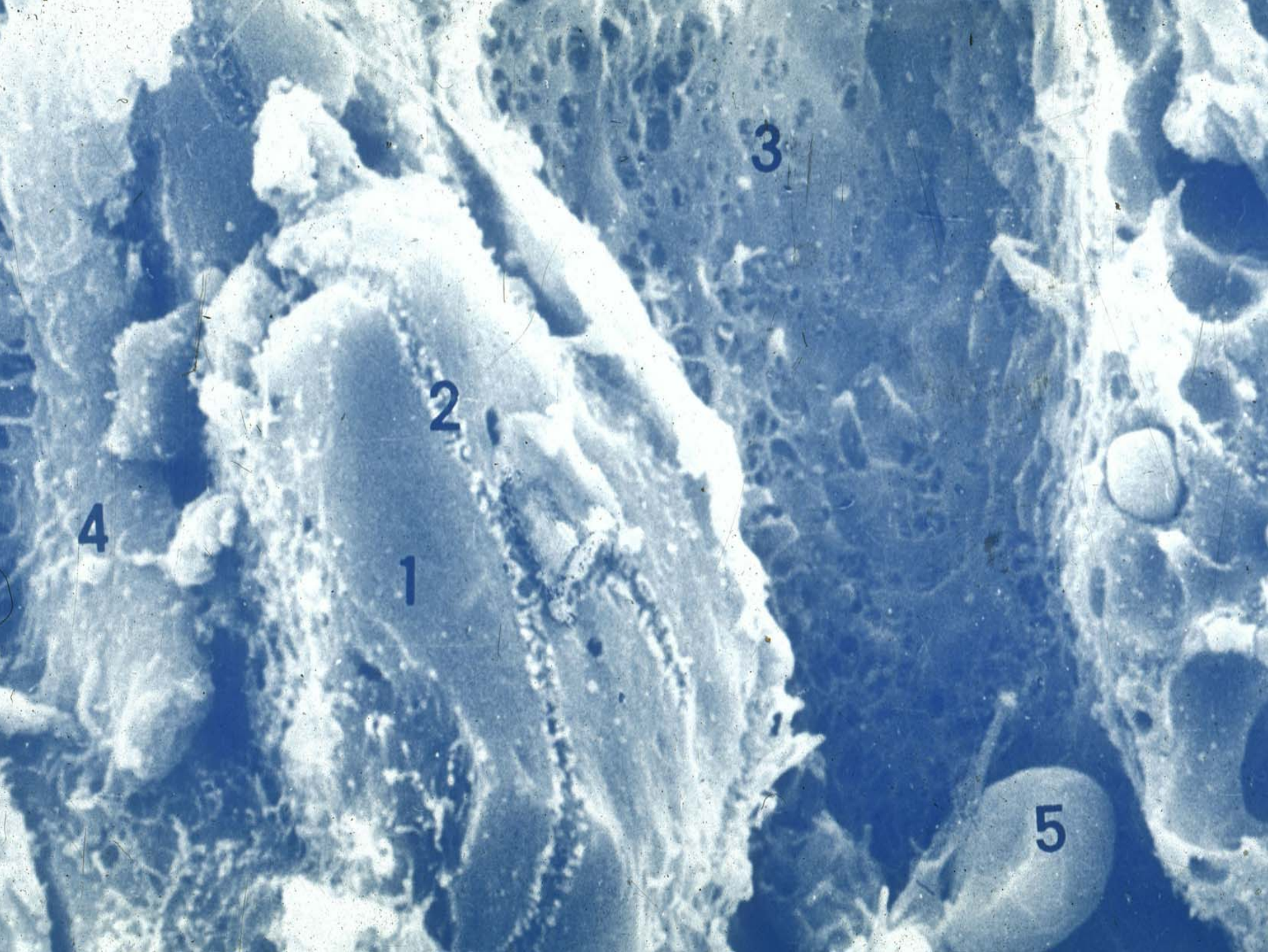
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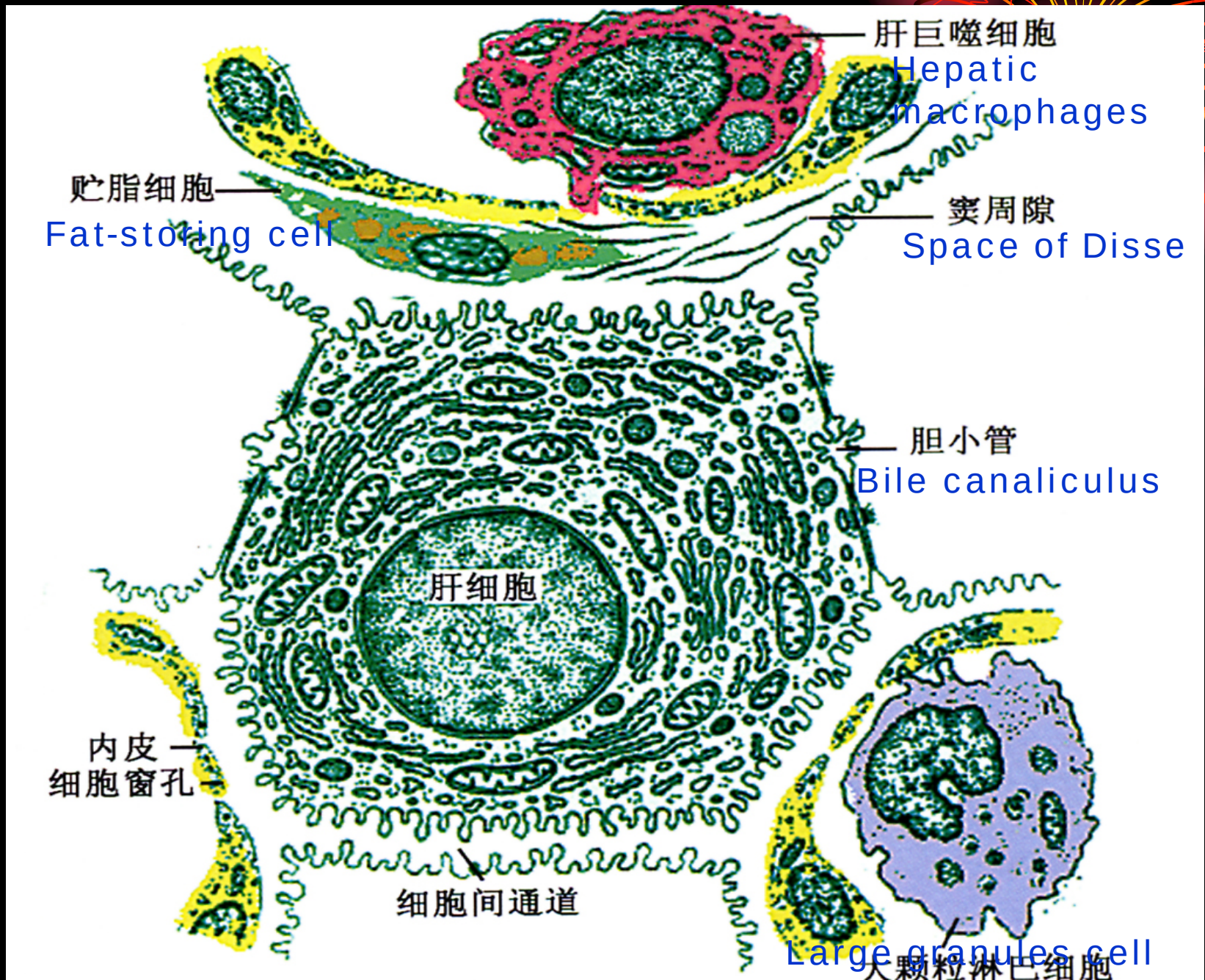
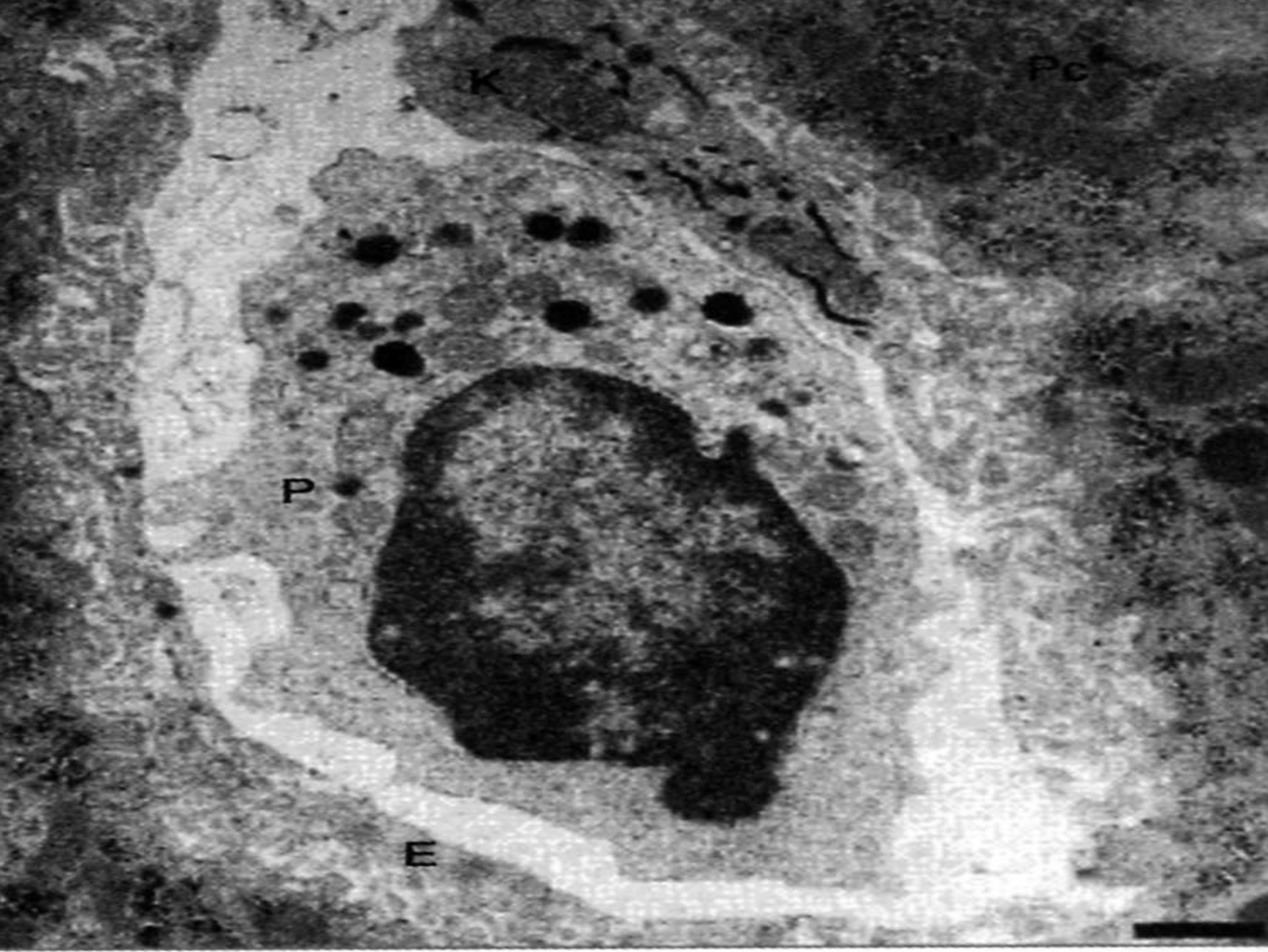
large granules cells




K
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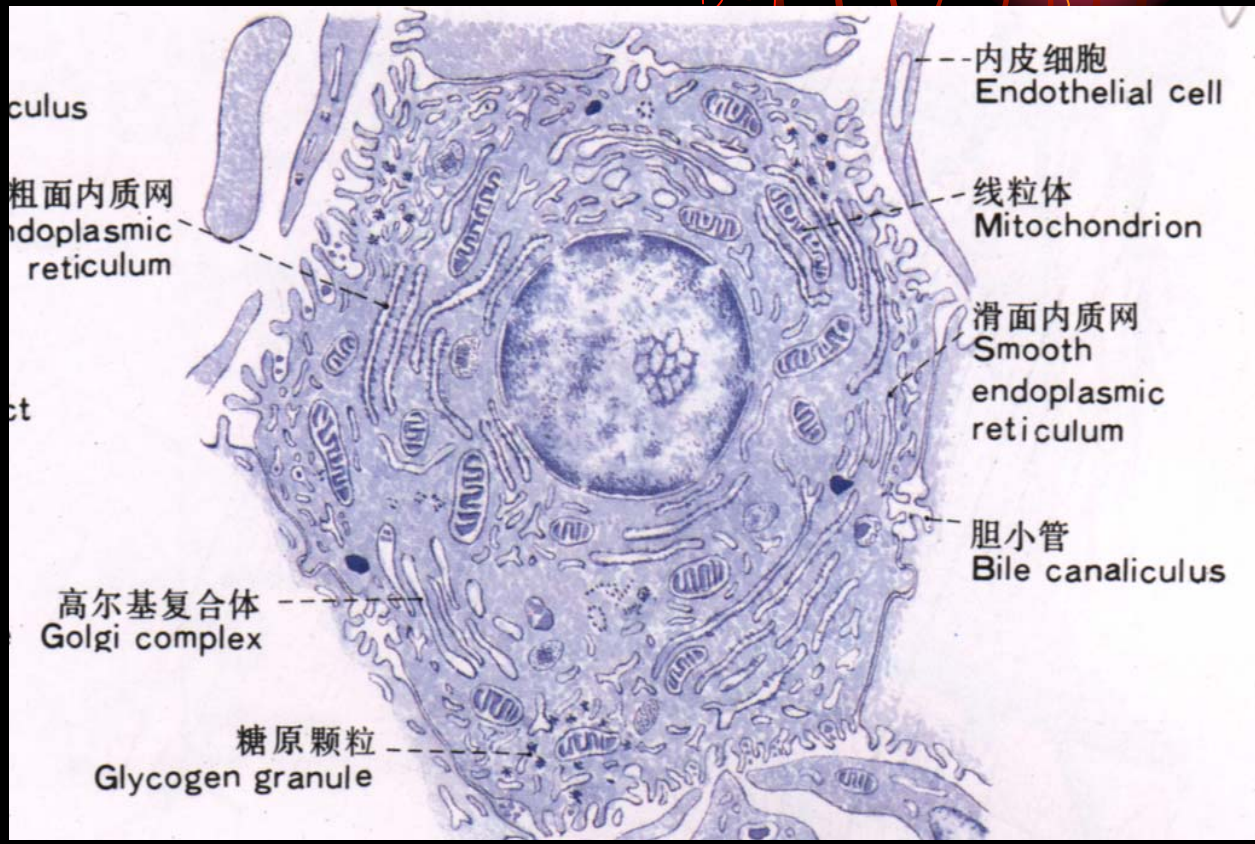
E

Three function surfaces of the hepatocytes

Facing the sinusoids

Contacting with adjacent cells

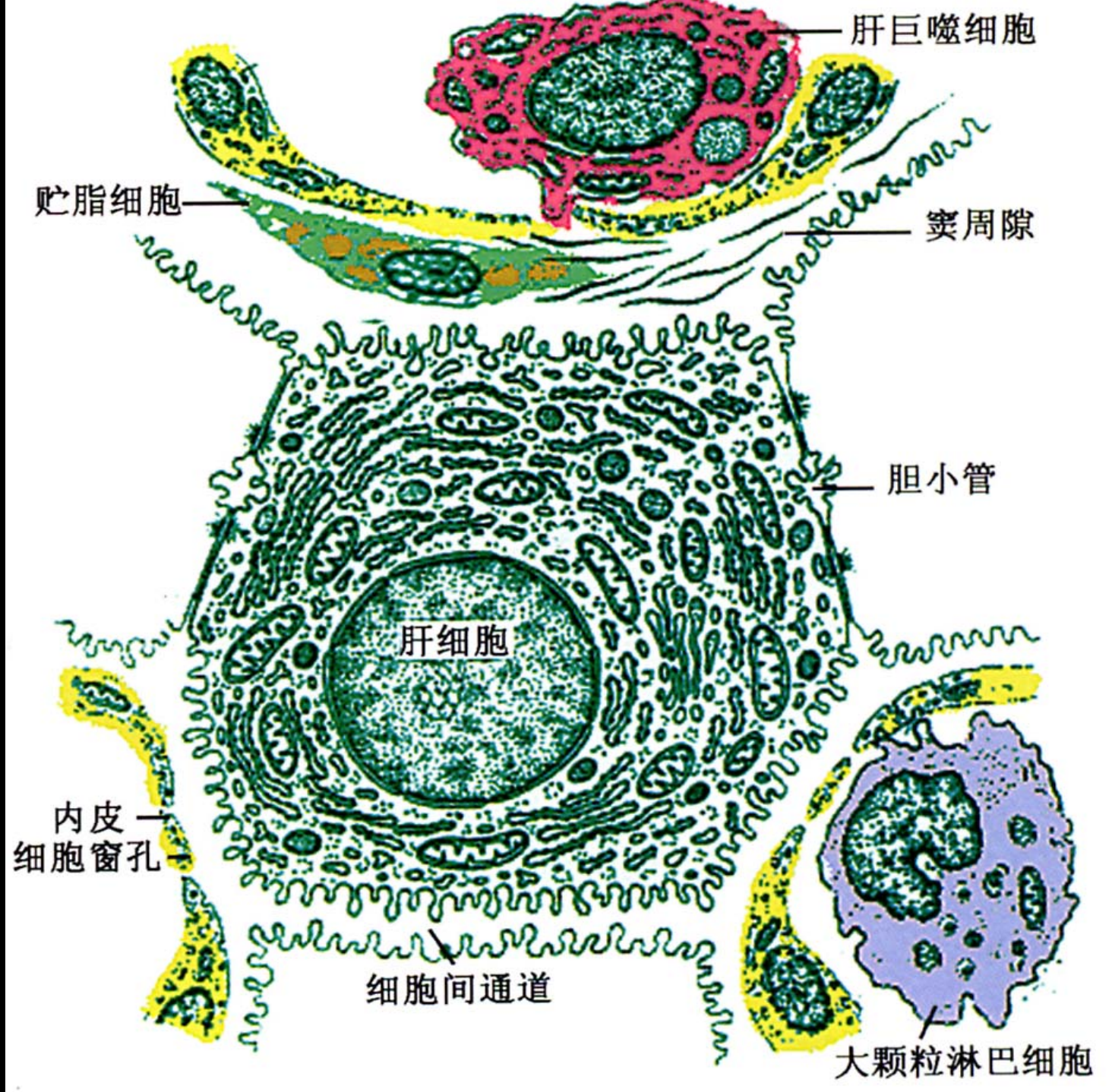
Facing a bile canaliculus

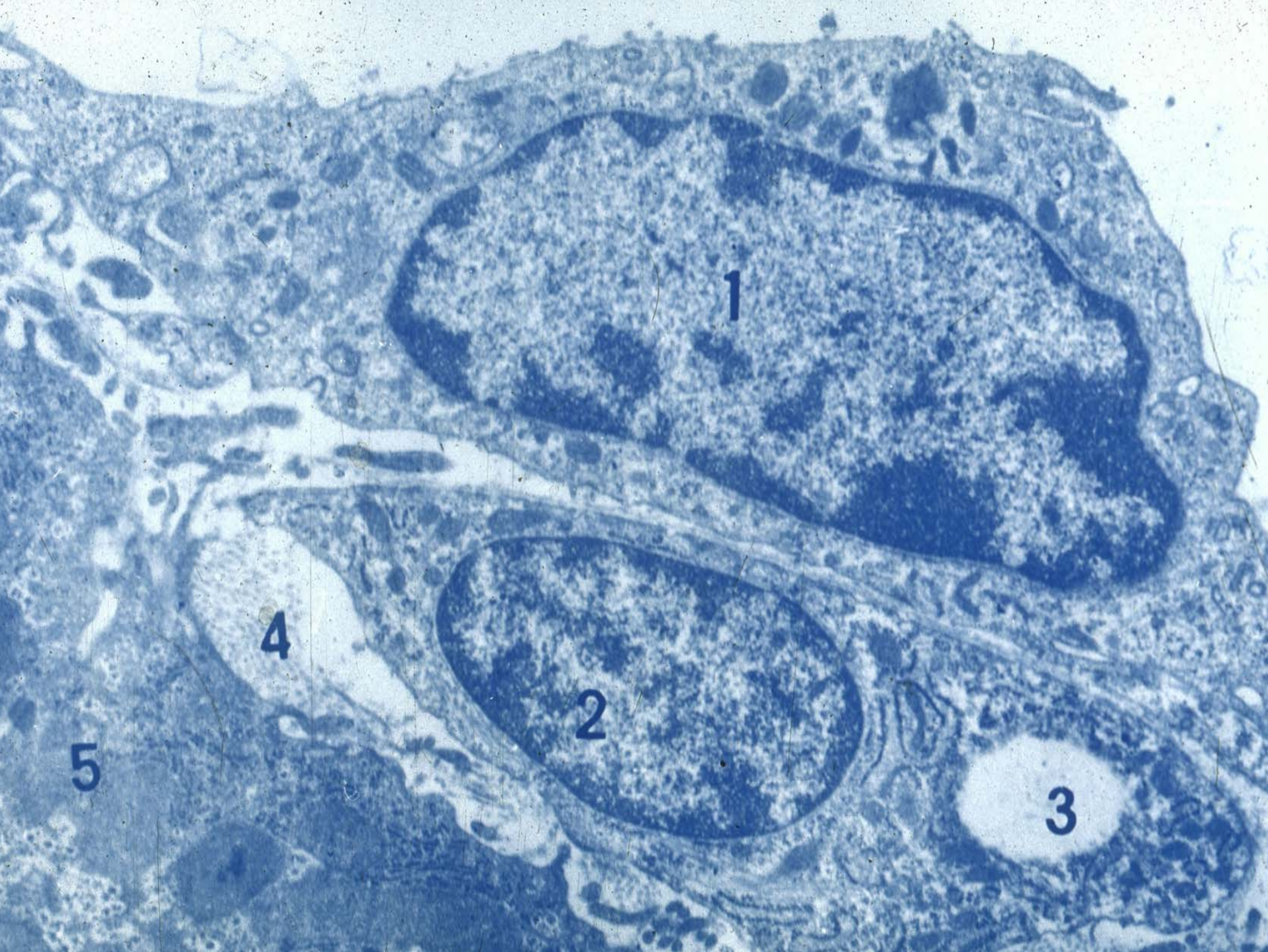


perisinusoidal space(space of Disse)

- The perisinusoidal space is an interstitial space between the endothelial cells of sinusoids and the hepatocytes

- allowing active metabolic exchange between the liver and the plasma.small numbers of fat-storing cells (lipocyte) are found in the perisinusoidal space .They contain fat droplets and store vitamin A


肝巨噬细胞
贮脂细胞
窦周隙
胆小管
肝细胞
内皮
细胞窗孔
细胞间通道
大颗粒淋巴细胞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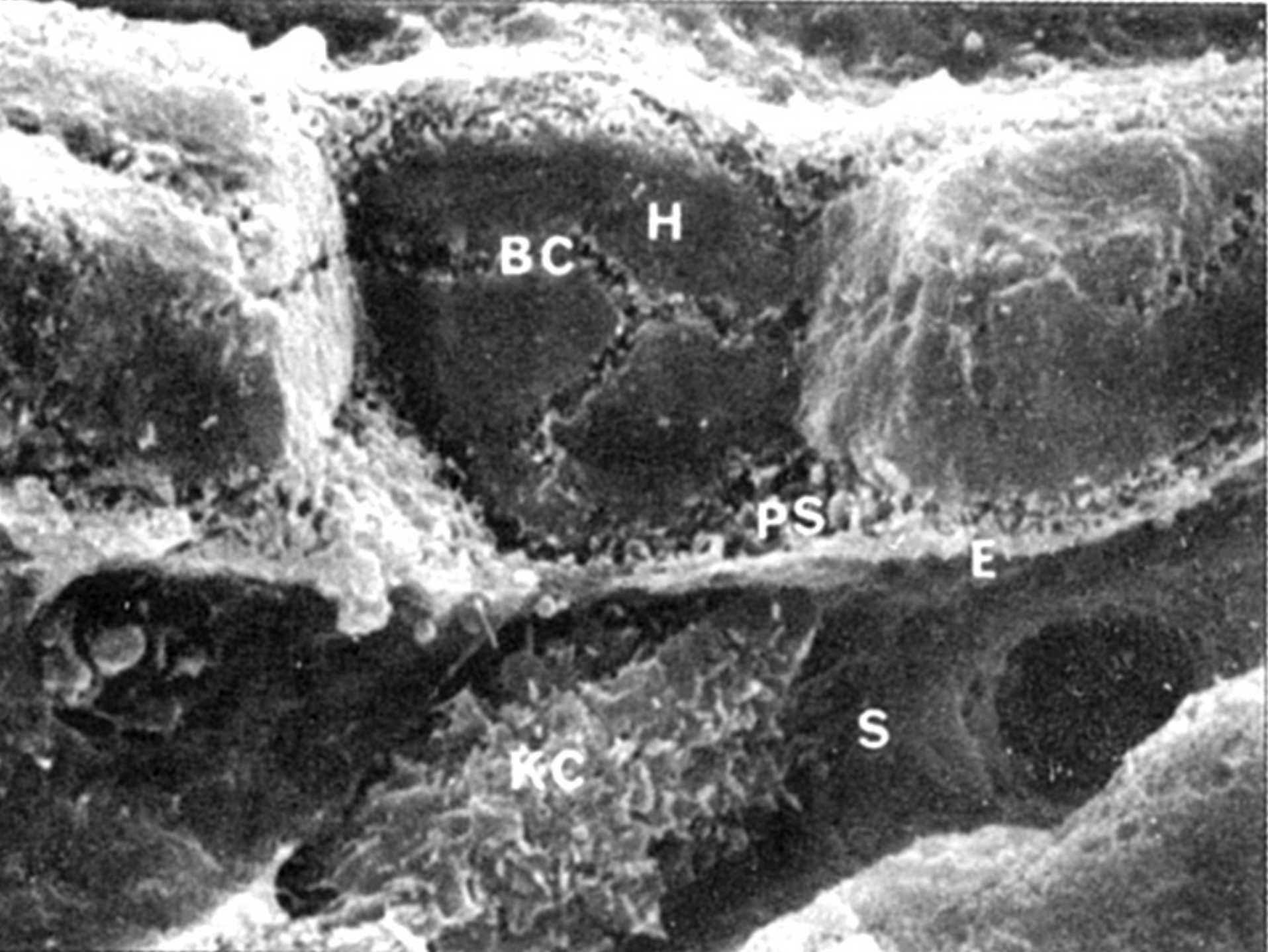
BC
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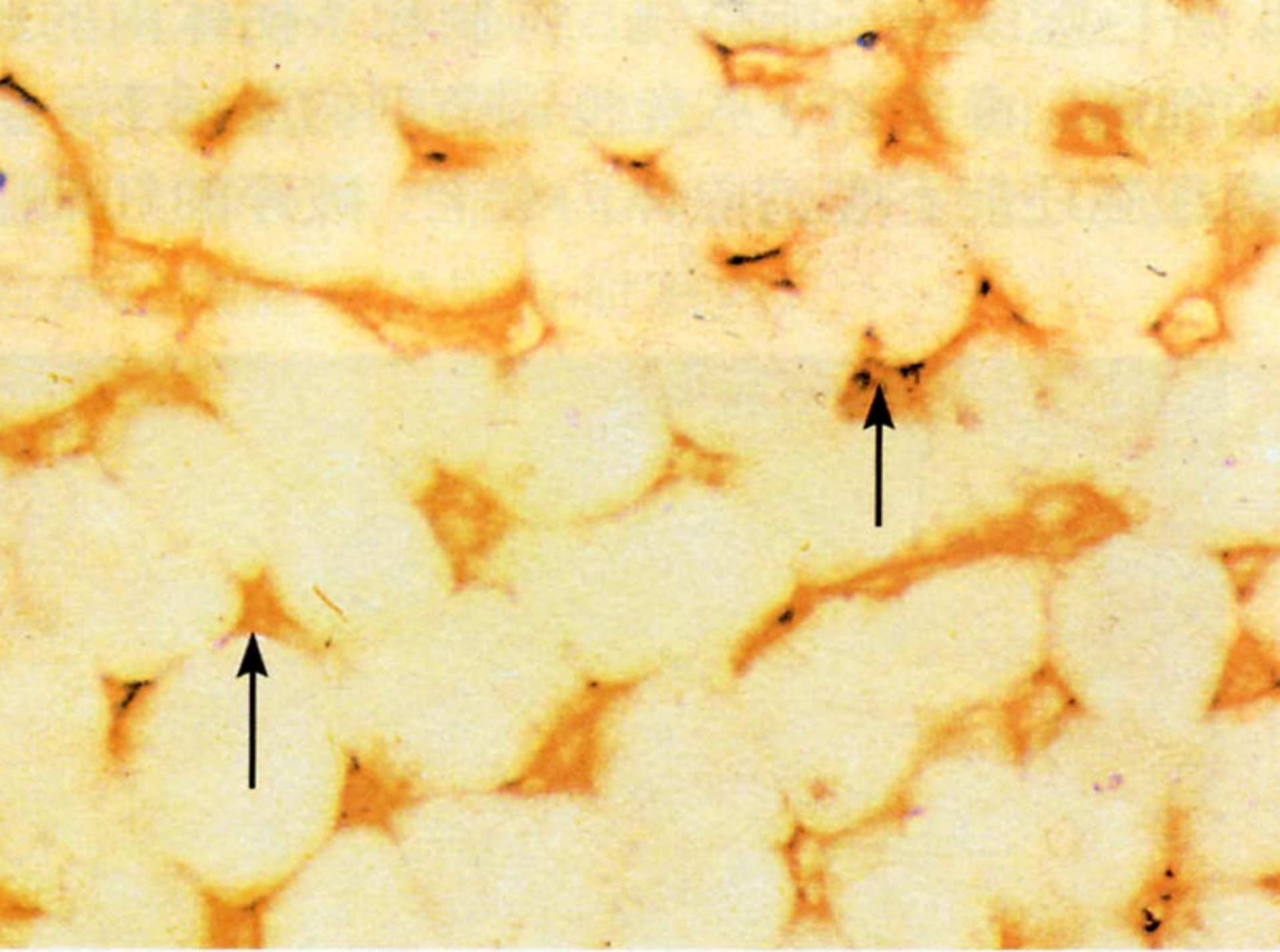

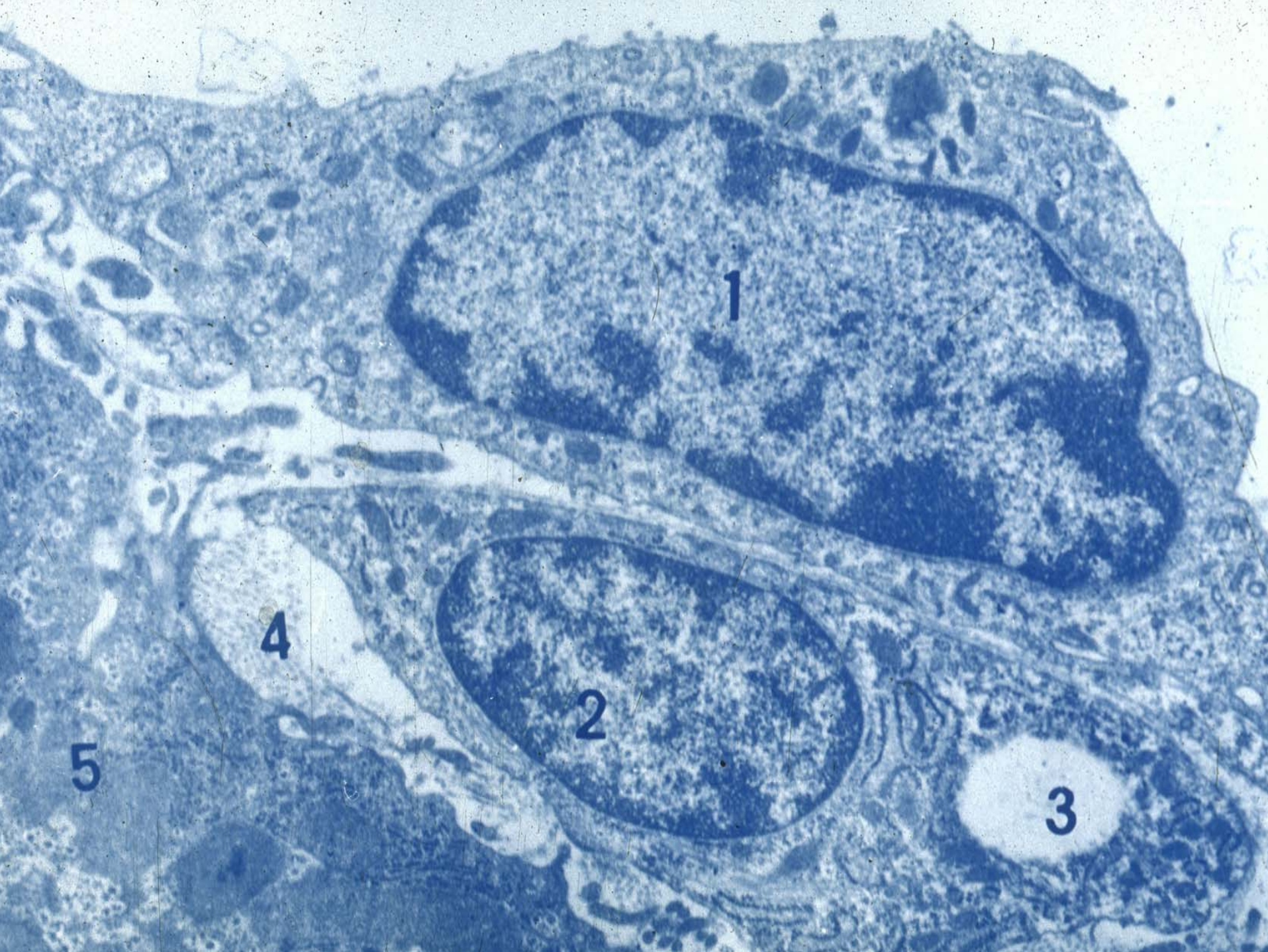
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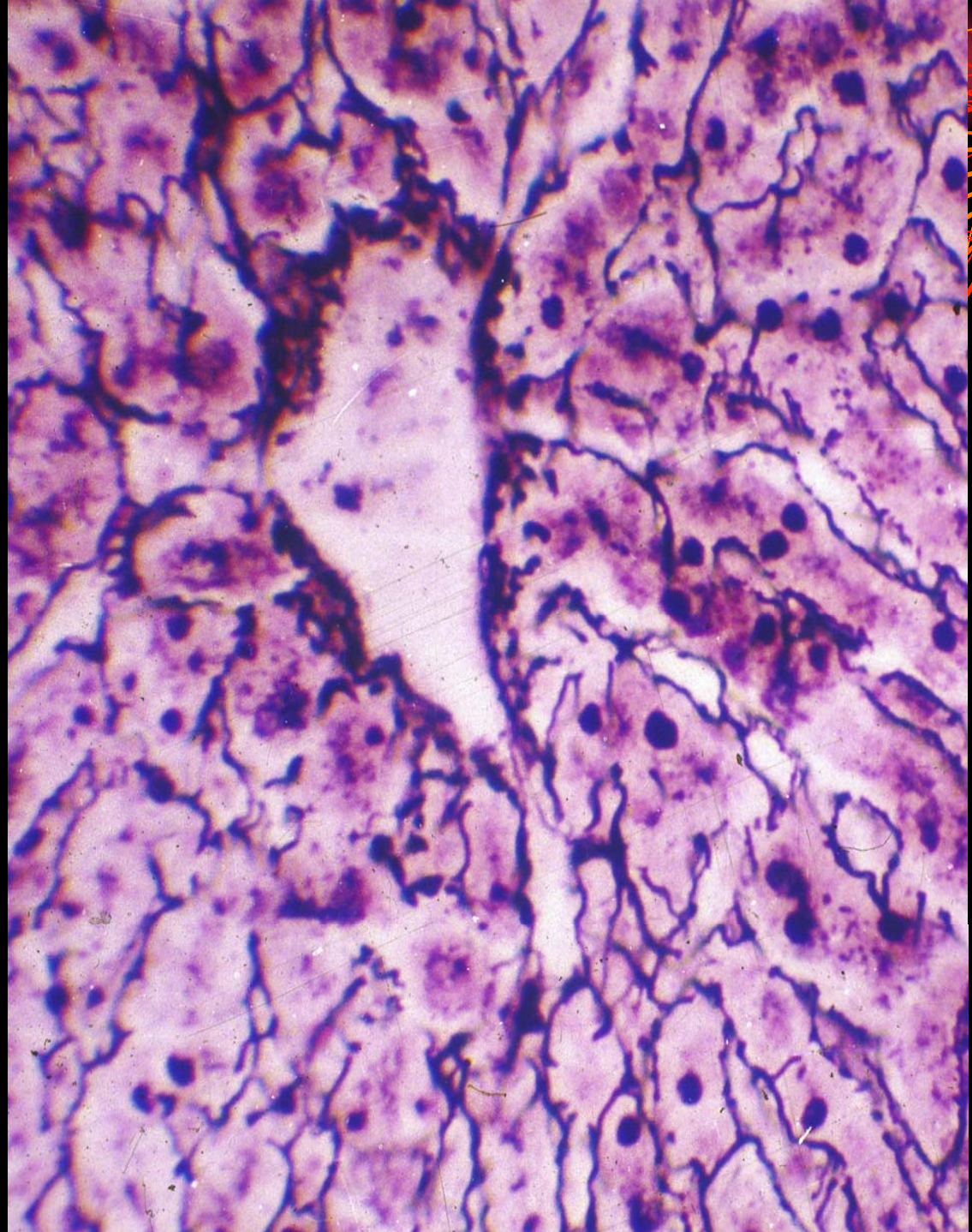


4.2 port areas

Are found in the angles where adjacent hepatic lobules meet

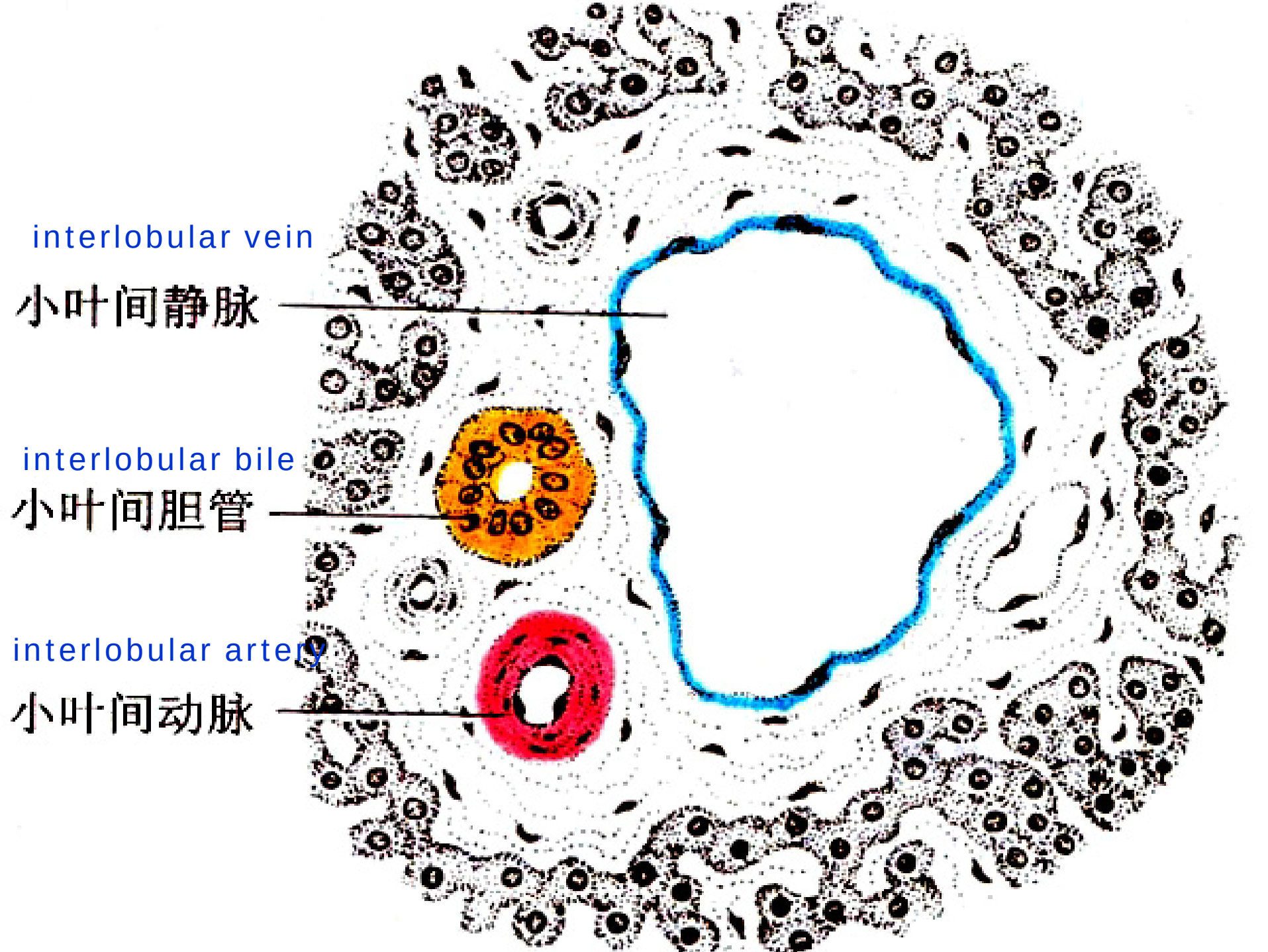
are surrounded by amounts of fibroconnective tissue

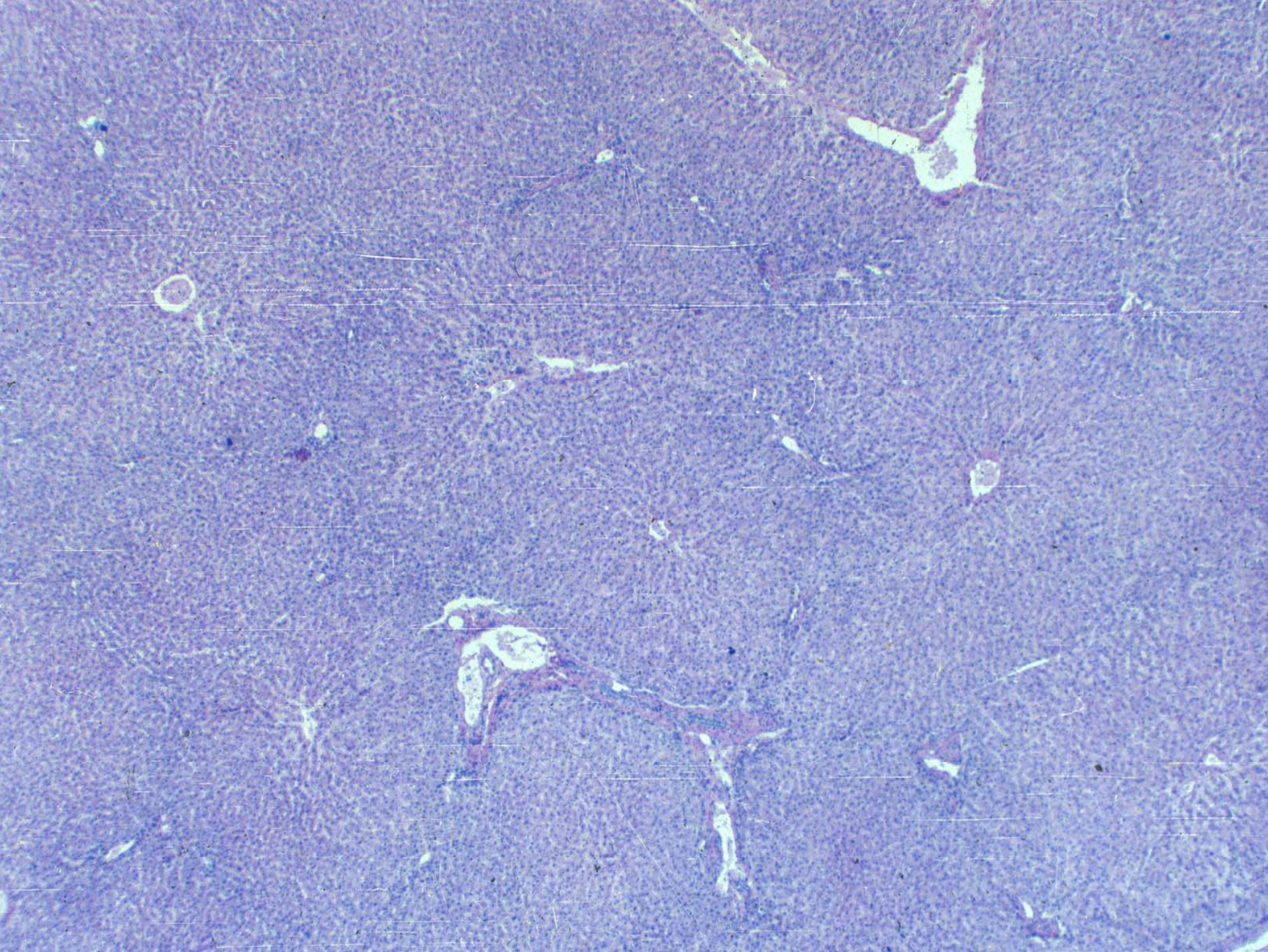
Comprises interlobular arteries: the branches of hepatic artery

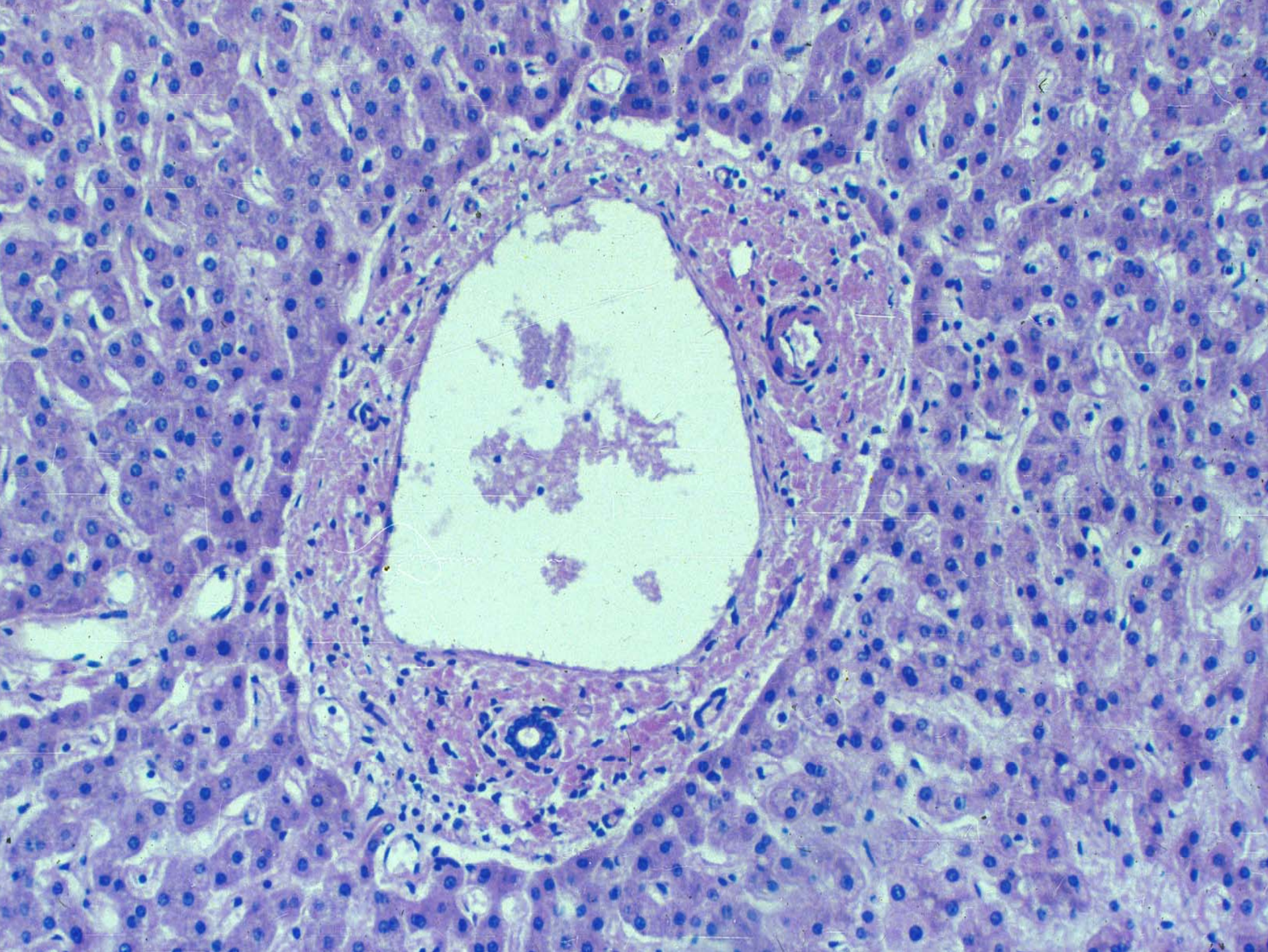
interlobular veins: the branches ofportal vein

interlobular bile duct: the branches of hepatic duct,

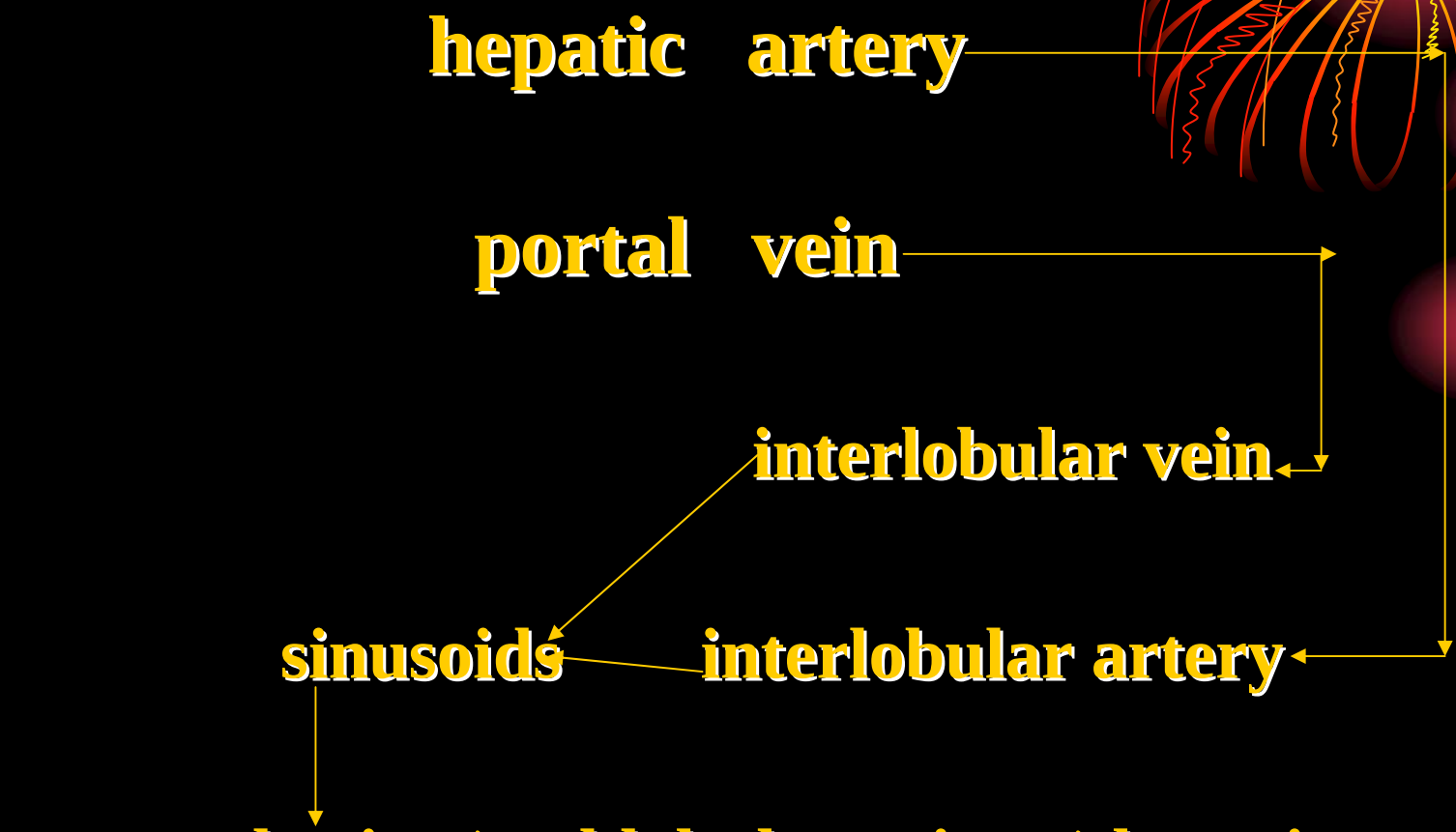
it makes up of simple cuboidal epithelium


interlobular vein
小叶间静脉
interlobular bile
小叶间胆管
interlobular artery
小叶间动脉

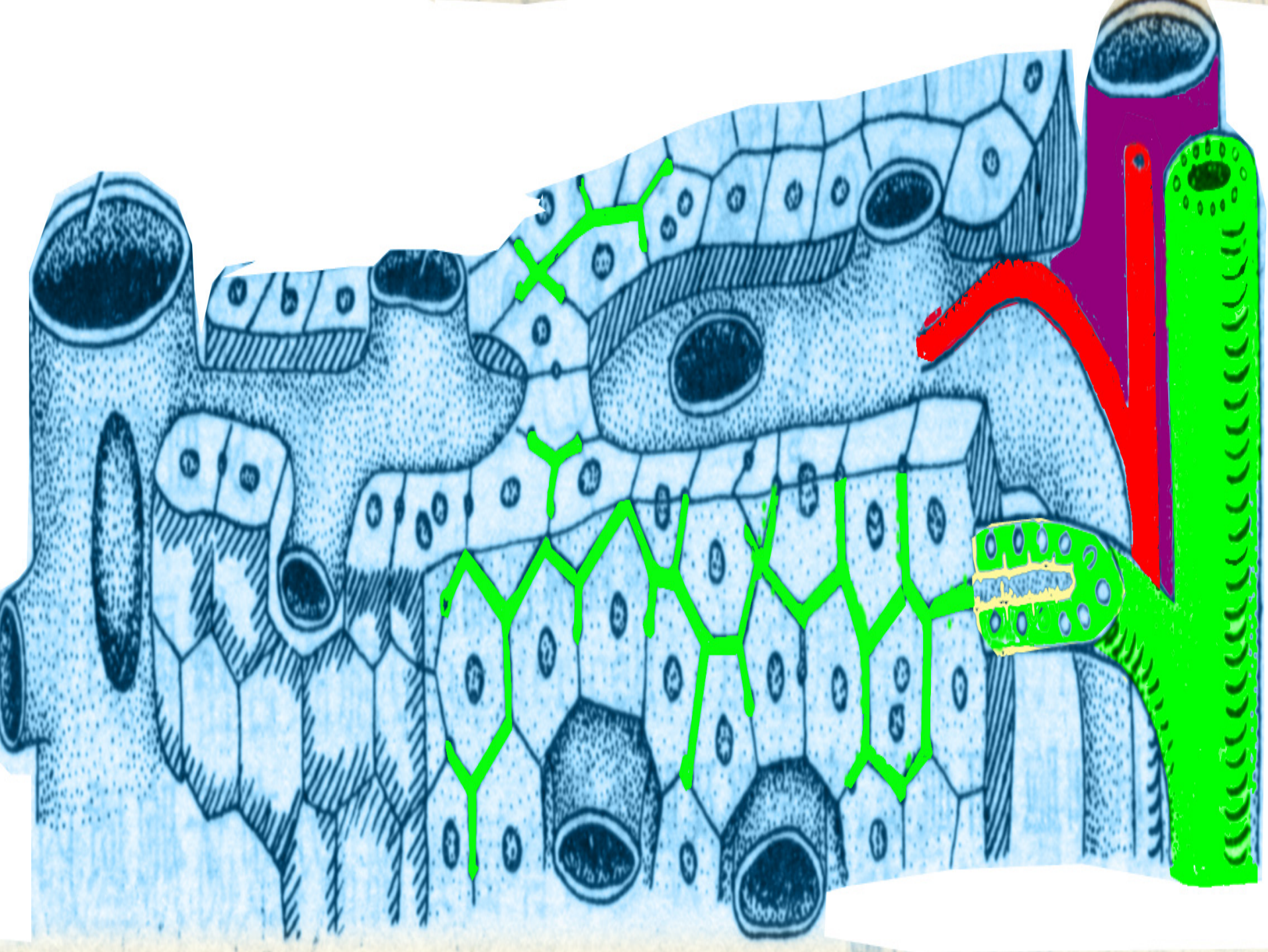


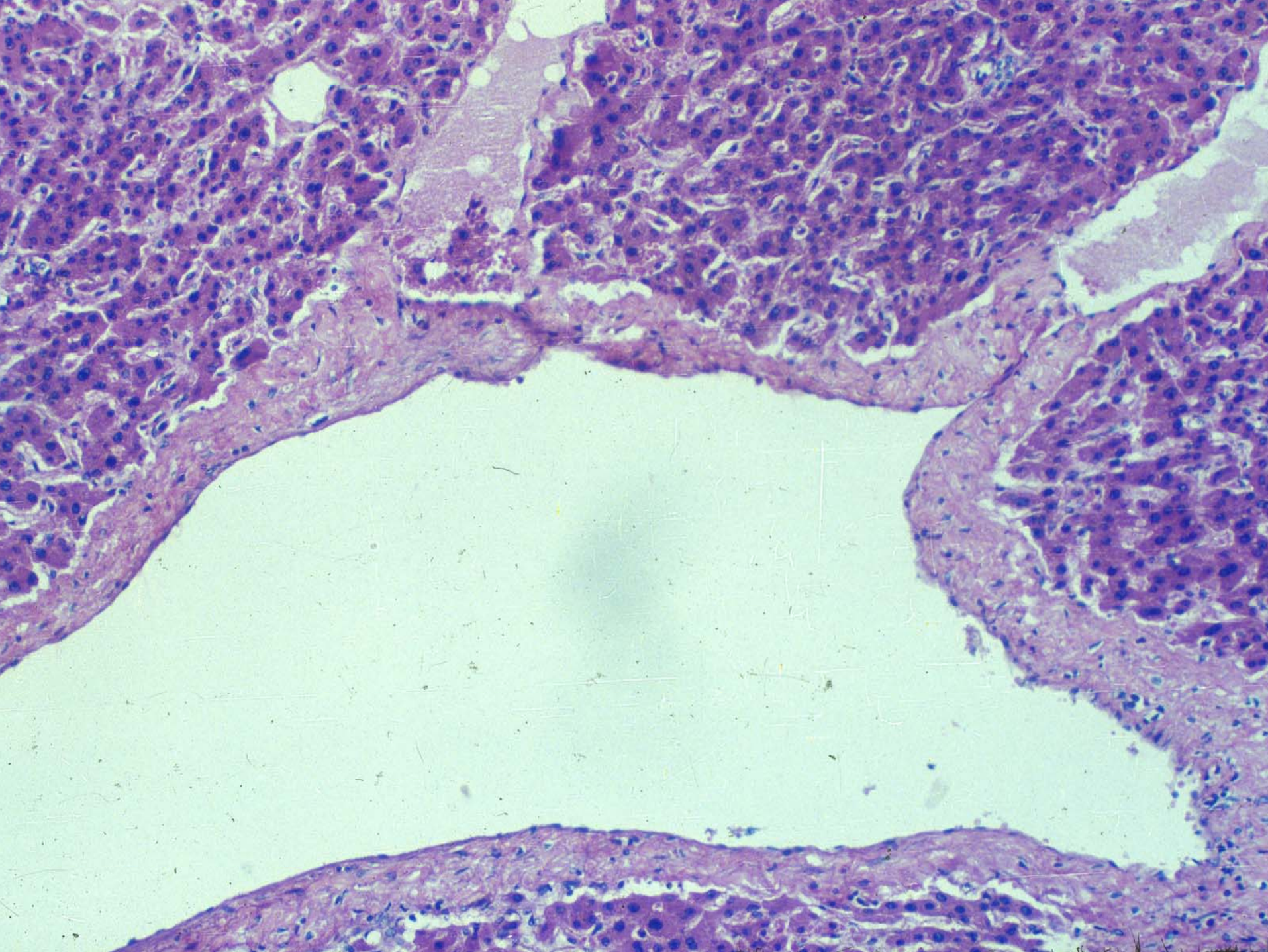


4.3 Blood supply of Liver



- The liver is unusual in that it receives blood from 2 sources:80% of the blood derives from the portal vein, which carries oxygen-poor, nutrient-rich blood from the abdominal viscera, and 20% derives from the hepatic artery, which supplies oxygen-rich blood. Blood flow is directed from the periphery through the sinusoids between plates of hepatocytes to the central vein, blood is thereafter conveyed through sublobular veins, eventually drawing into the inferior vena cava

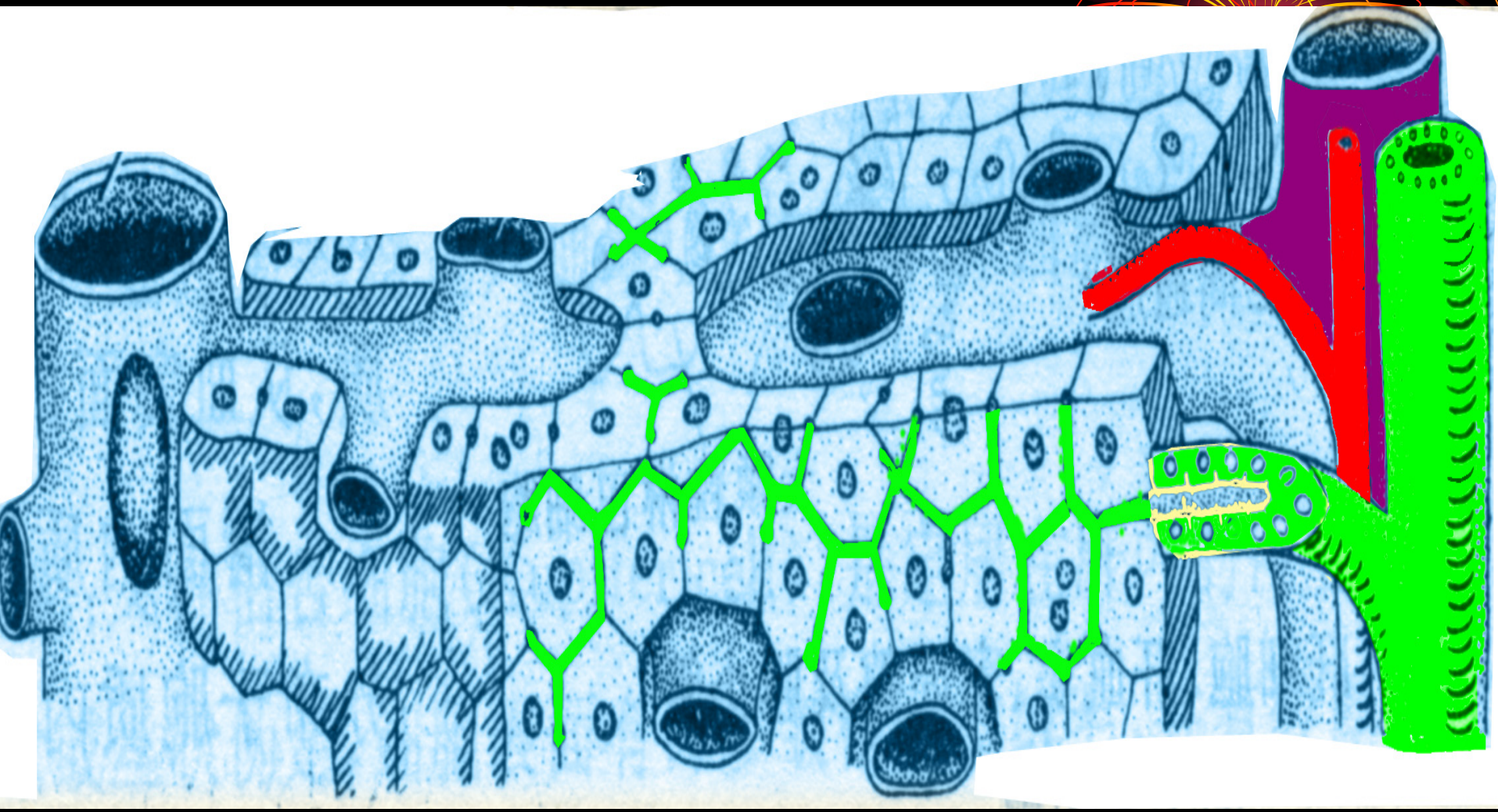


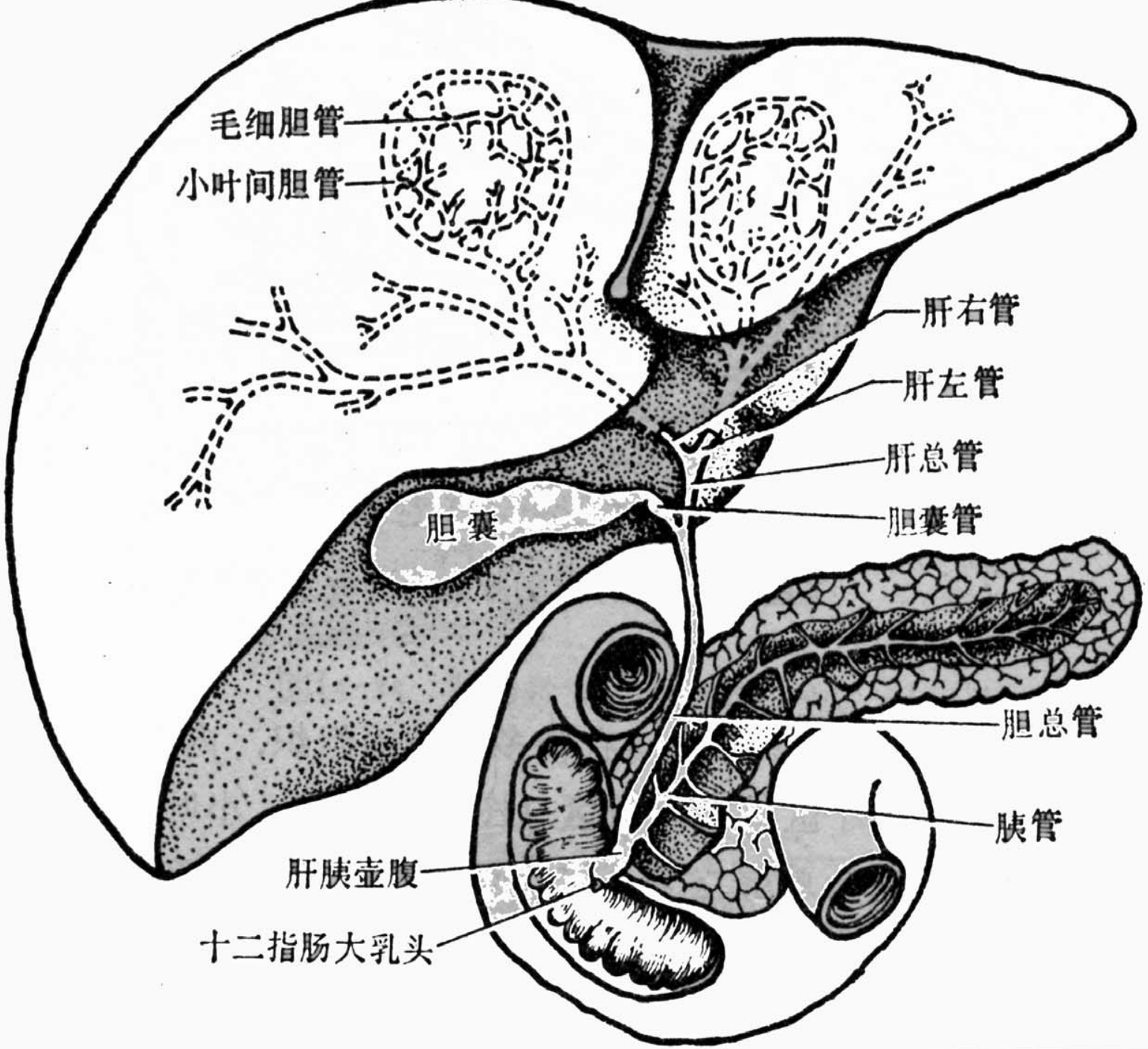


4.5 passage of bile

hepatocytes → bile canaliculi →cholangioles（at the periphery of the lobule）→ interlobular bile duct（in the portal area）→left and right hepatic duct →the common hepatic duct →the common bile duct(ductus choledochus) which continues to the duodenum

- The bile produced by the hepatocyte flows through the bile canaliculi, bile ductules, and bile ducts. These structures gradually merge,forming a network that converges to form the hepatic duct,the hepatic duct,after receiving the cystic duct from the gallbladder, continues to the duodenum as the commomn bile duct




毛细胆管
小叶间胆管
肝右管
肝左管
肝总管
胆囊管
胆囊
胆总管
胰管
肝胰壶腹
十二指肠大乳头

Emphasis of this chapter

- The general structure of pancreas, the structure and function of acini and pancreactic islets
- The general structure of the liver and the lobular liver
- the structure and function of hepatocyte, the Kupffer cells, the fat-storing cells
- The blood supply and the passage of bile