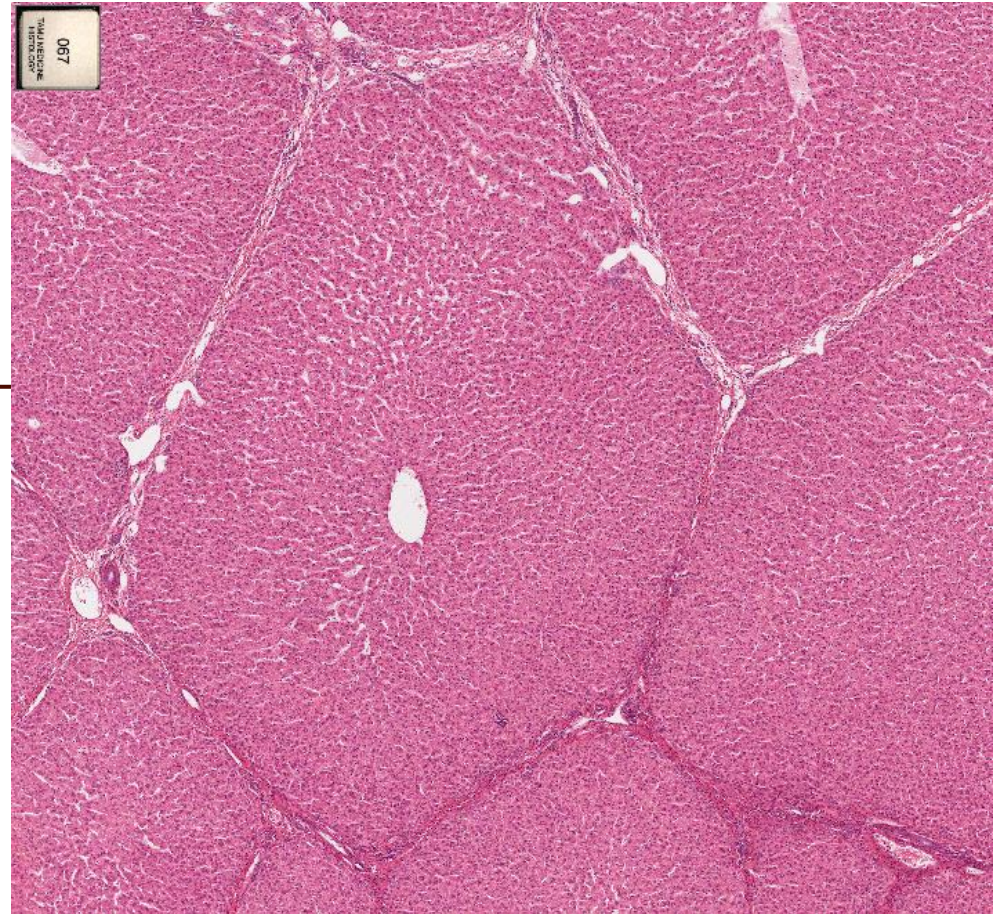
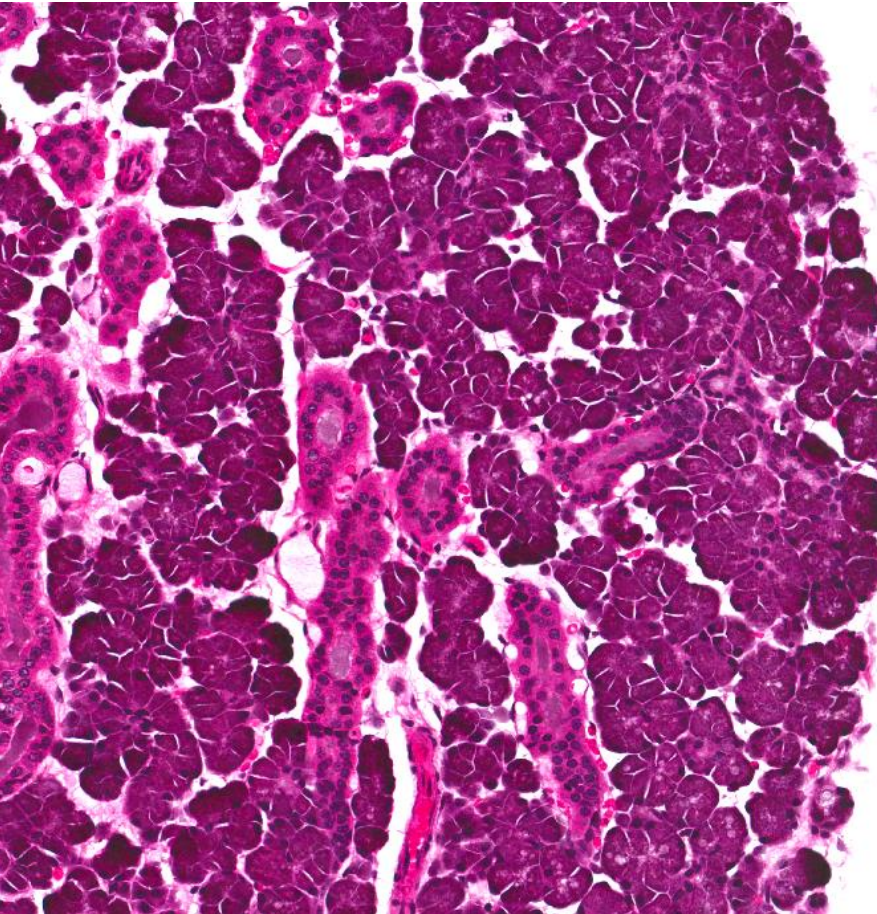


# DIGESTIVE SYSTEM II

## ACCESSORY DIGESTIVE ORGANS



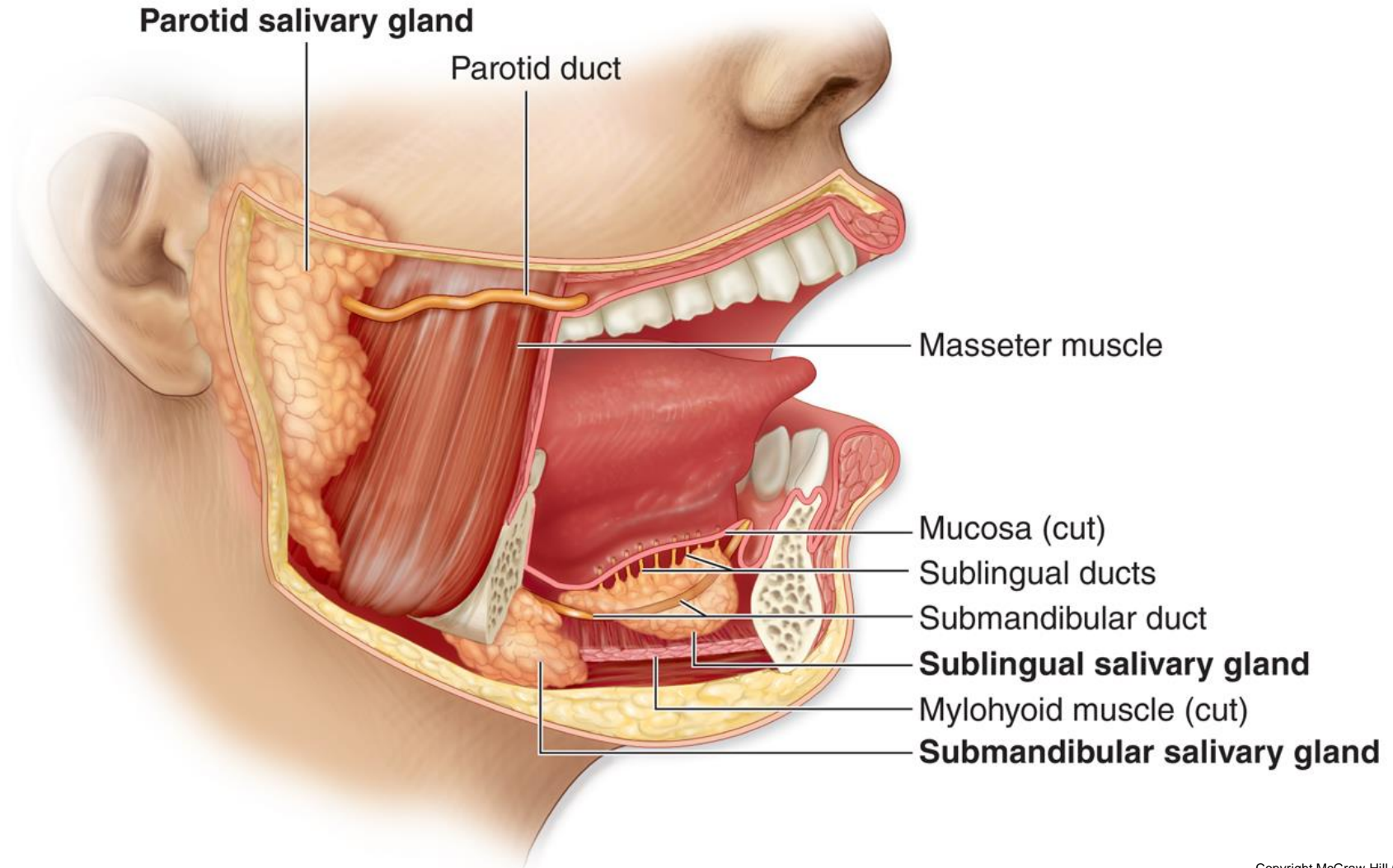
Dr. Larry Johnson

Texas A& M University

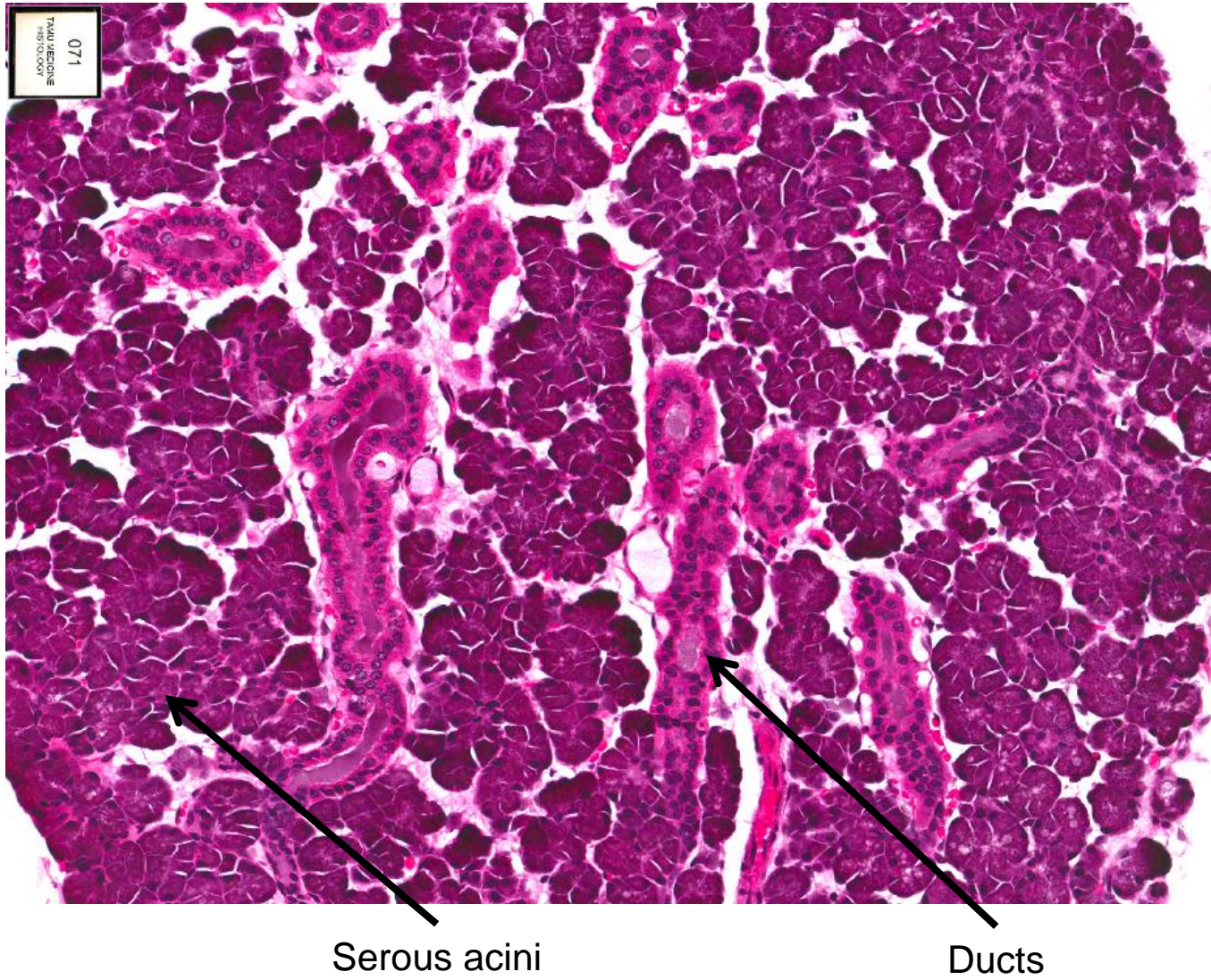
# Objectives

- Distinguish between the parotid and submandibular salivary glands.
- Understand and identify the structural organization of the pancreas.
- Characterize the structural organization of the liver and relate it to a classical lobule, portal lobule and hepatic acinus.
- Identify the gall bladder and describe its function.

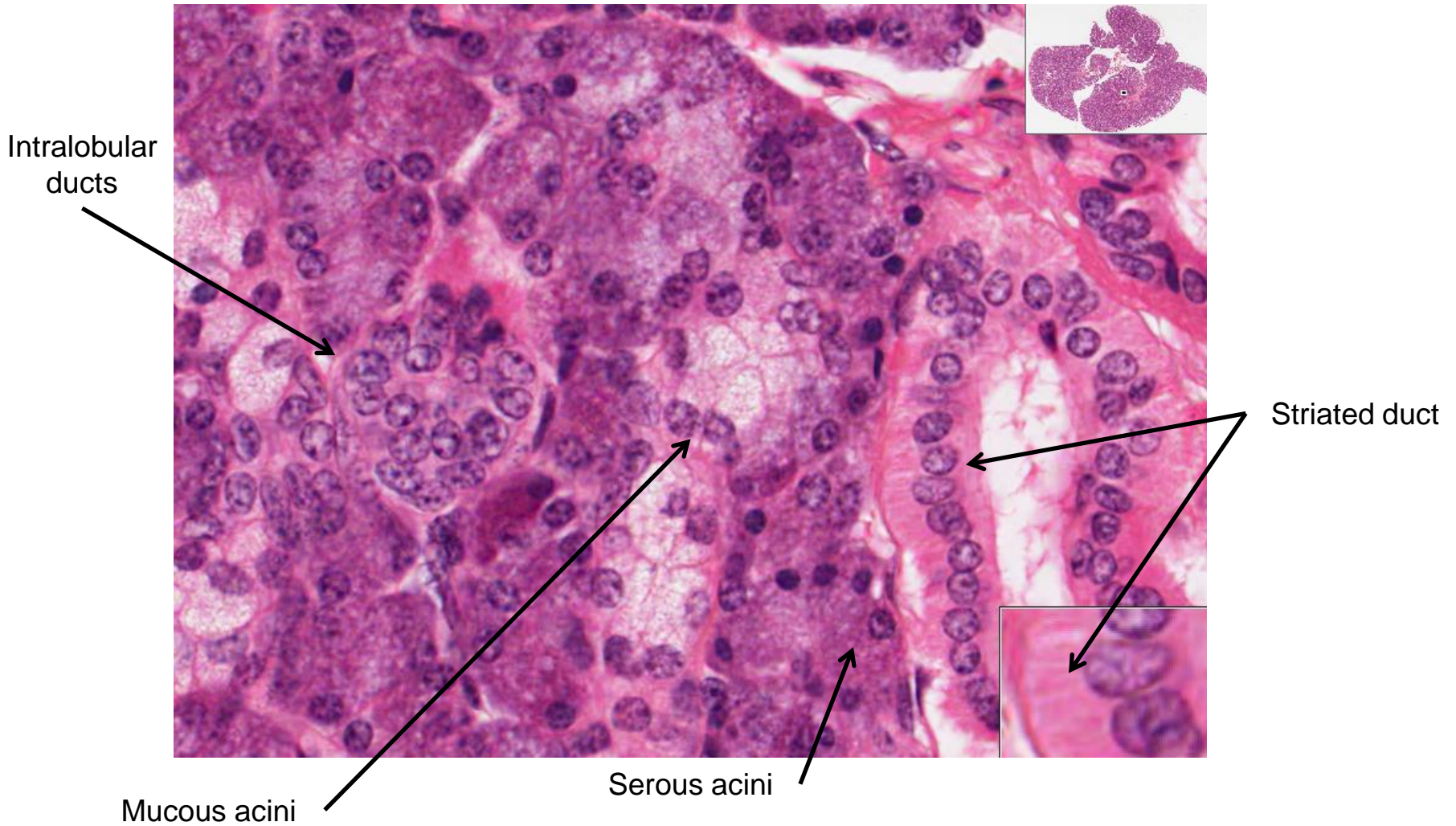
# Major salivary glands



# Slide 71: Parotid gland



# Slide 72: Submandibular gland



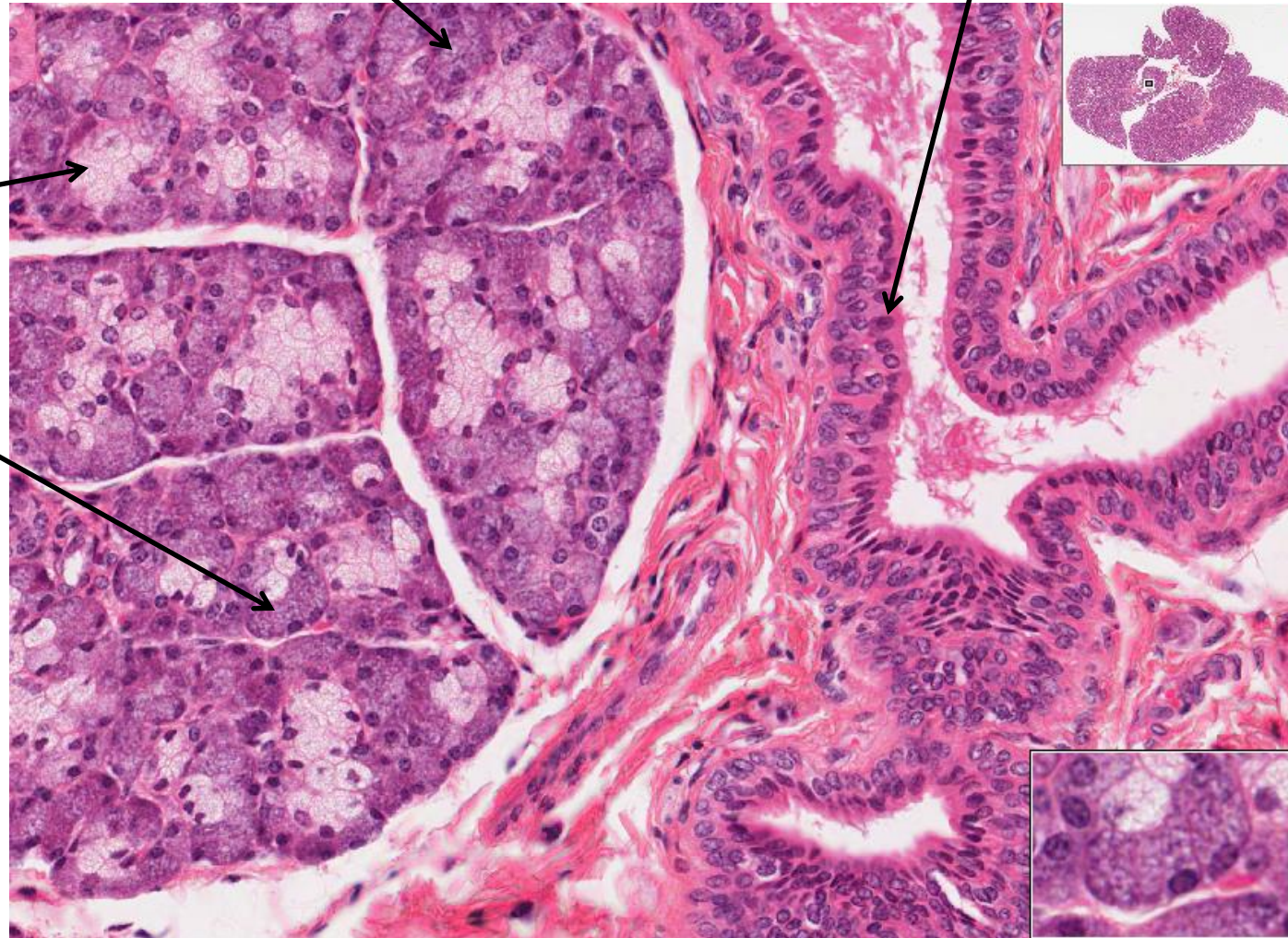
# Slide 72: Submandibular gland

Serous acini

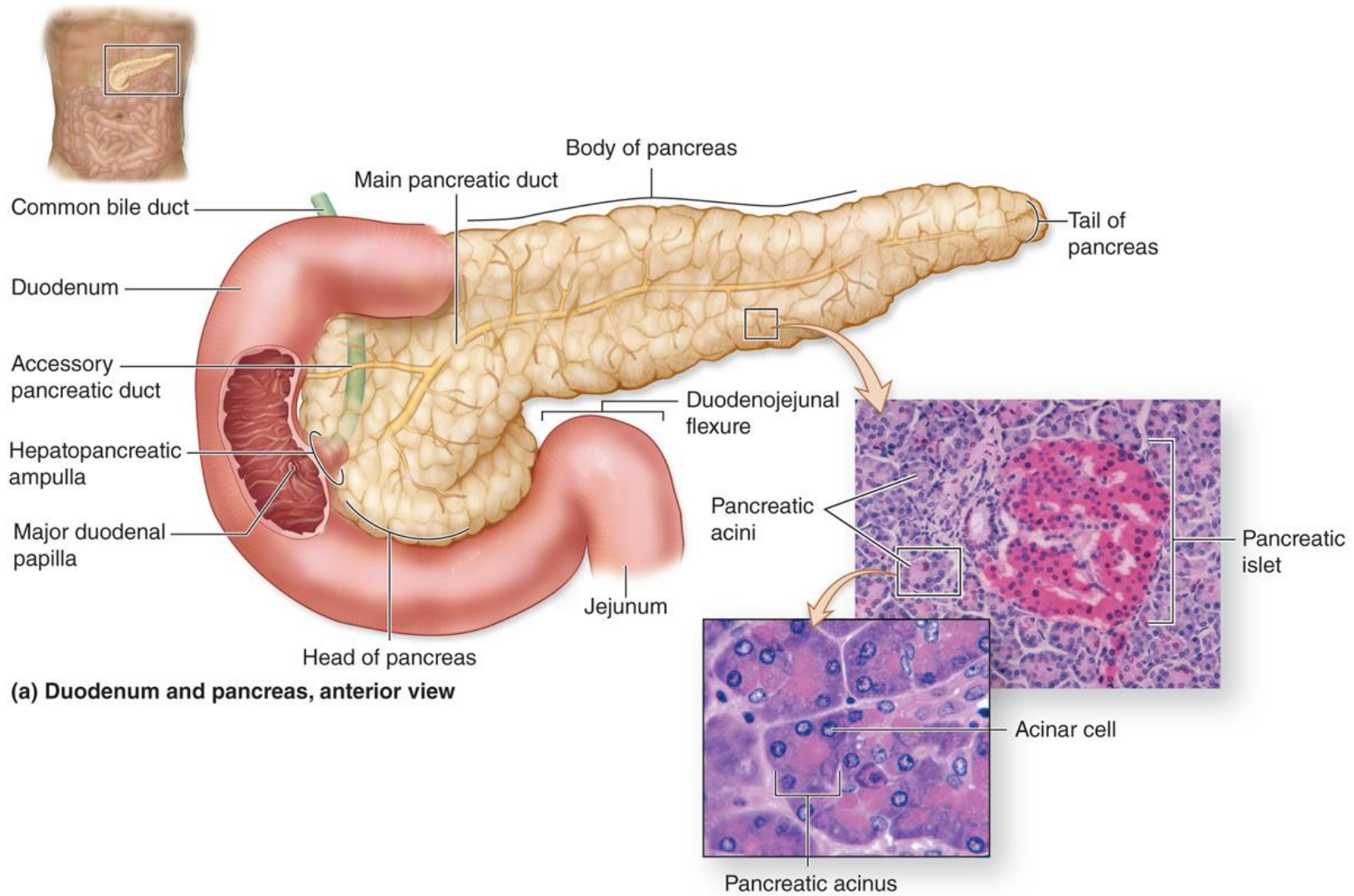
Stratified cuboidal/  
columnar epithelium of  
larger interlobular duct

Mucous acini

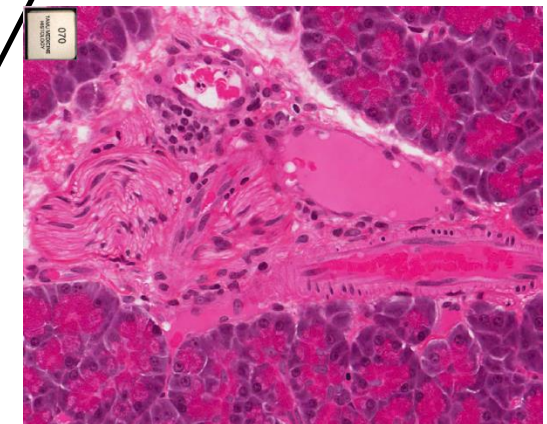
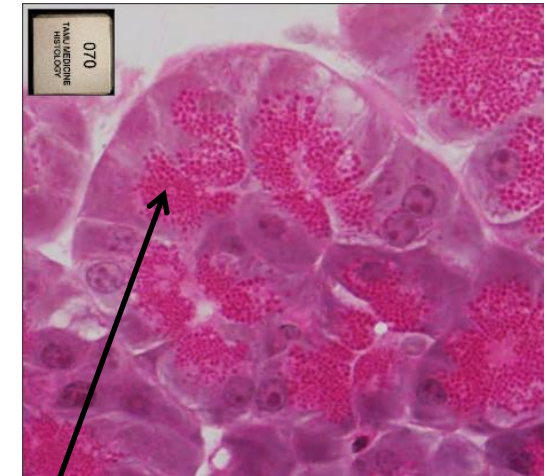
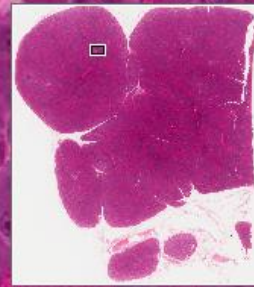
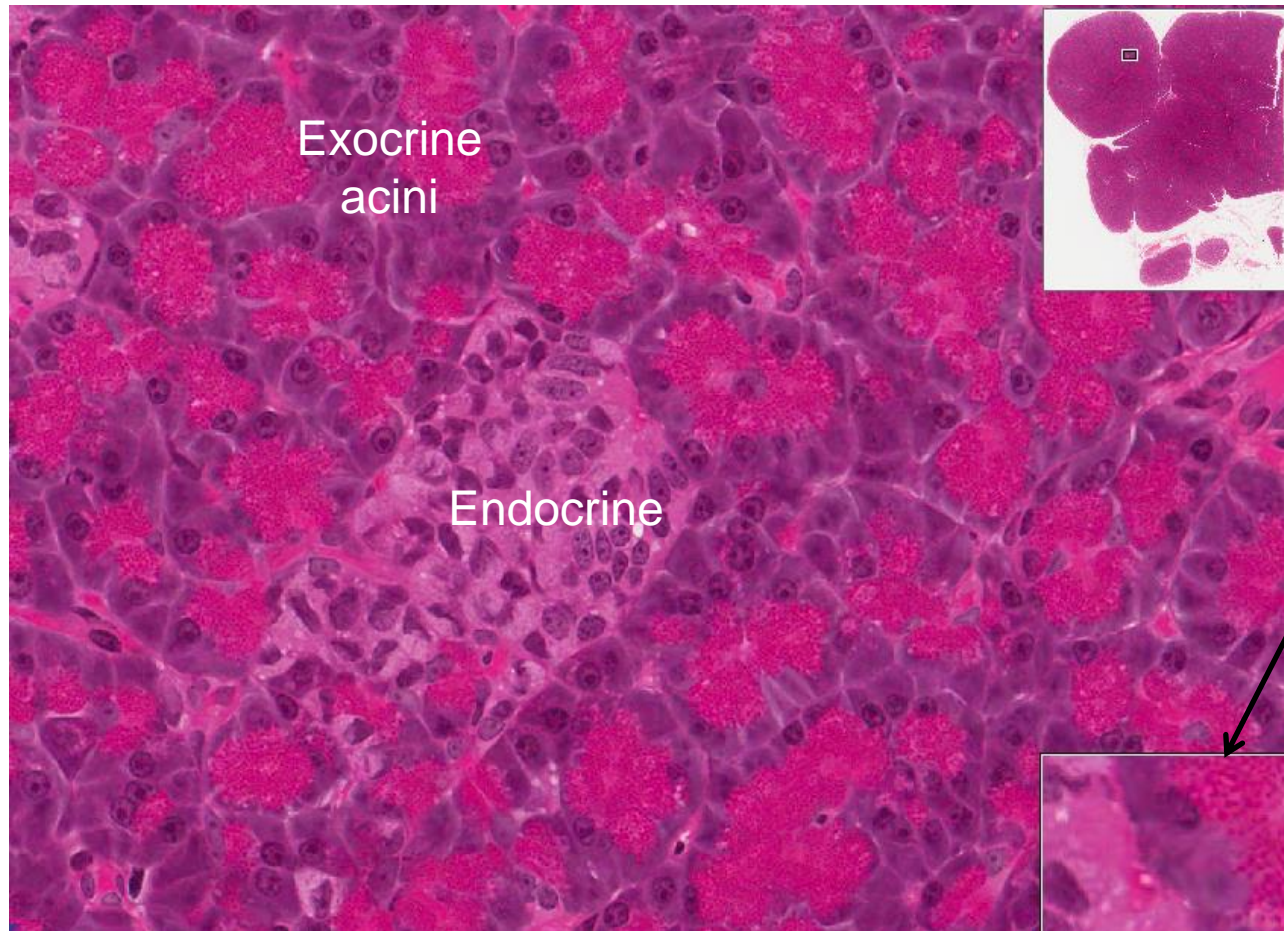
Serous demilune



# Pancreas and duodenum



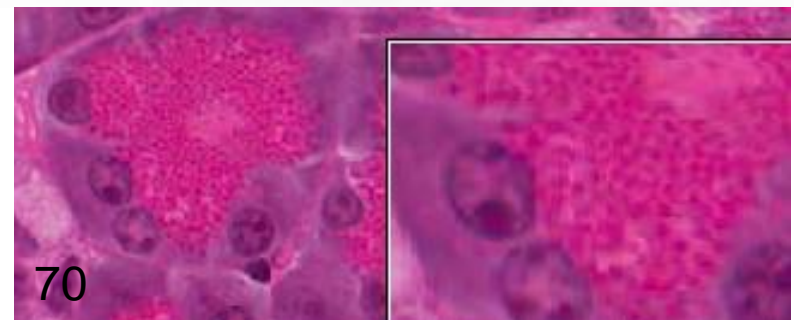
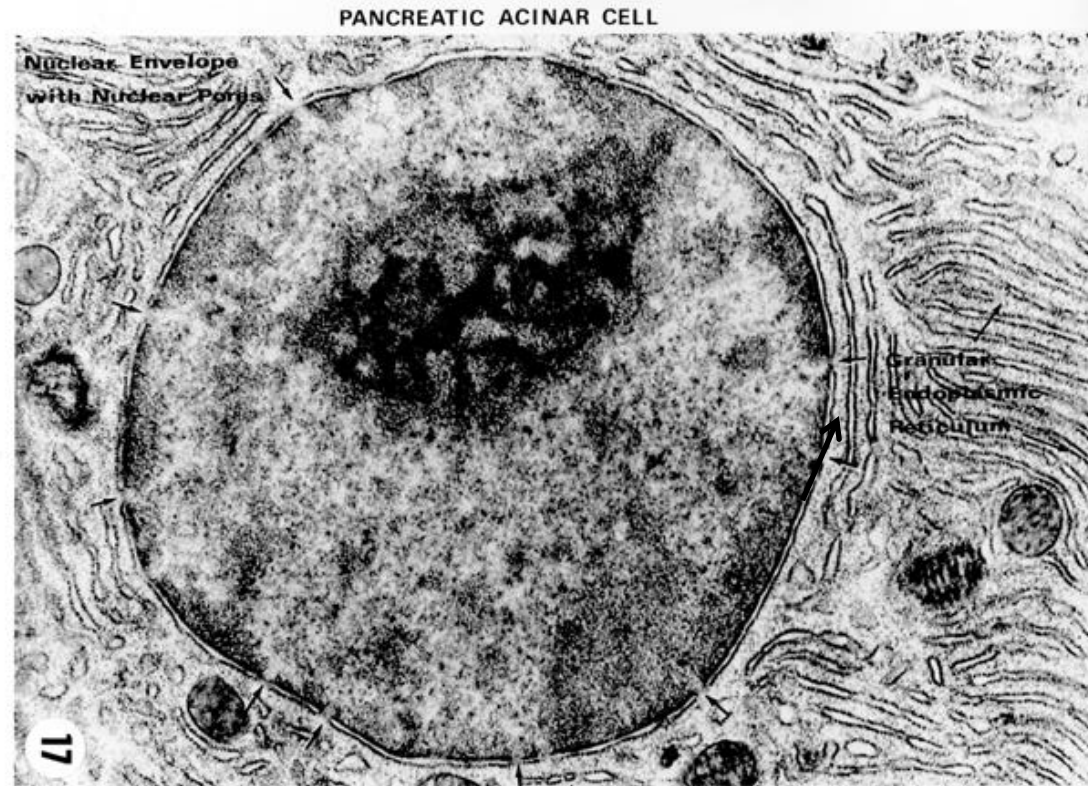
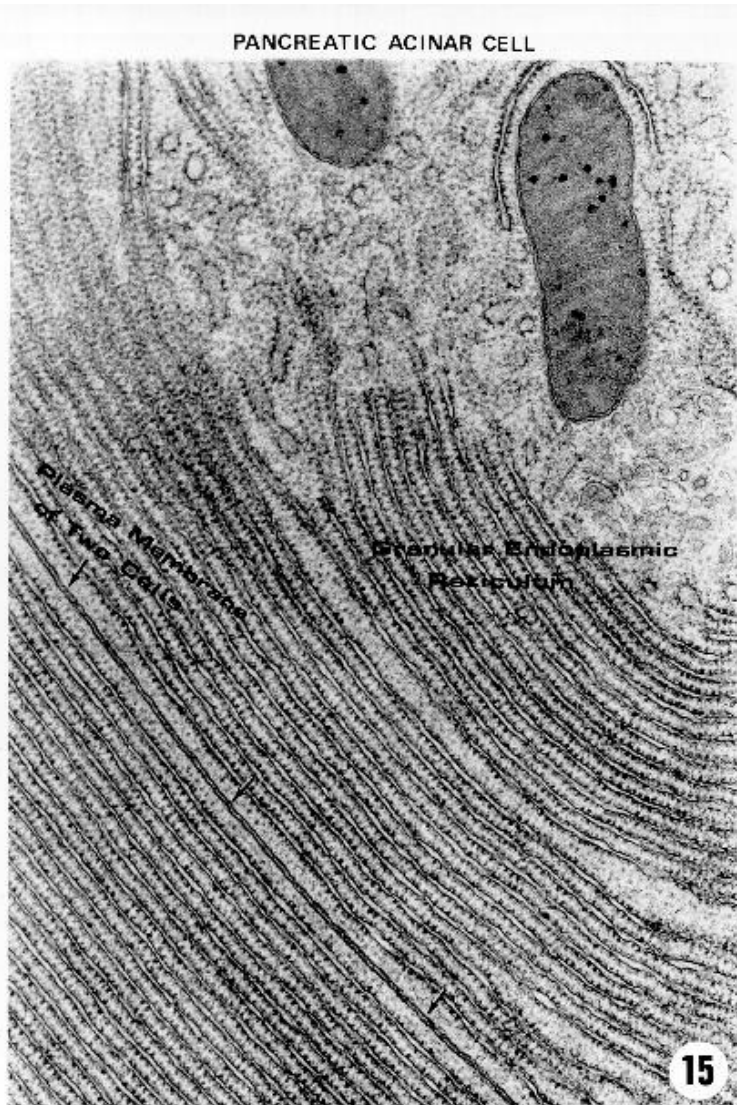
# Slide 70: Pancreas (plastic-embedded)



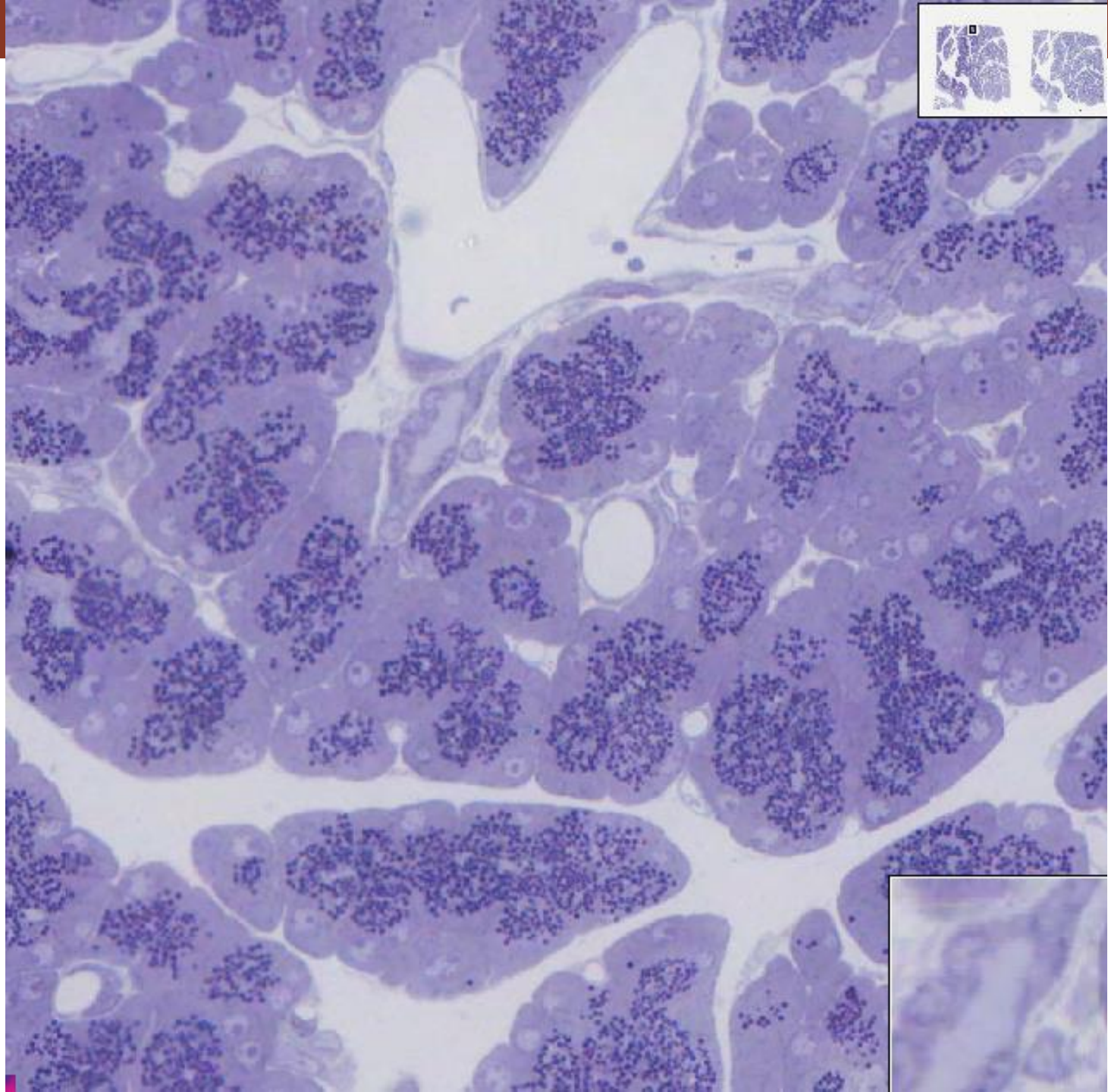
Identify these features



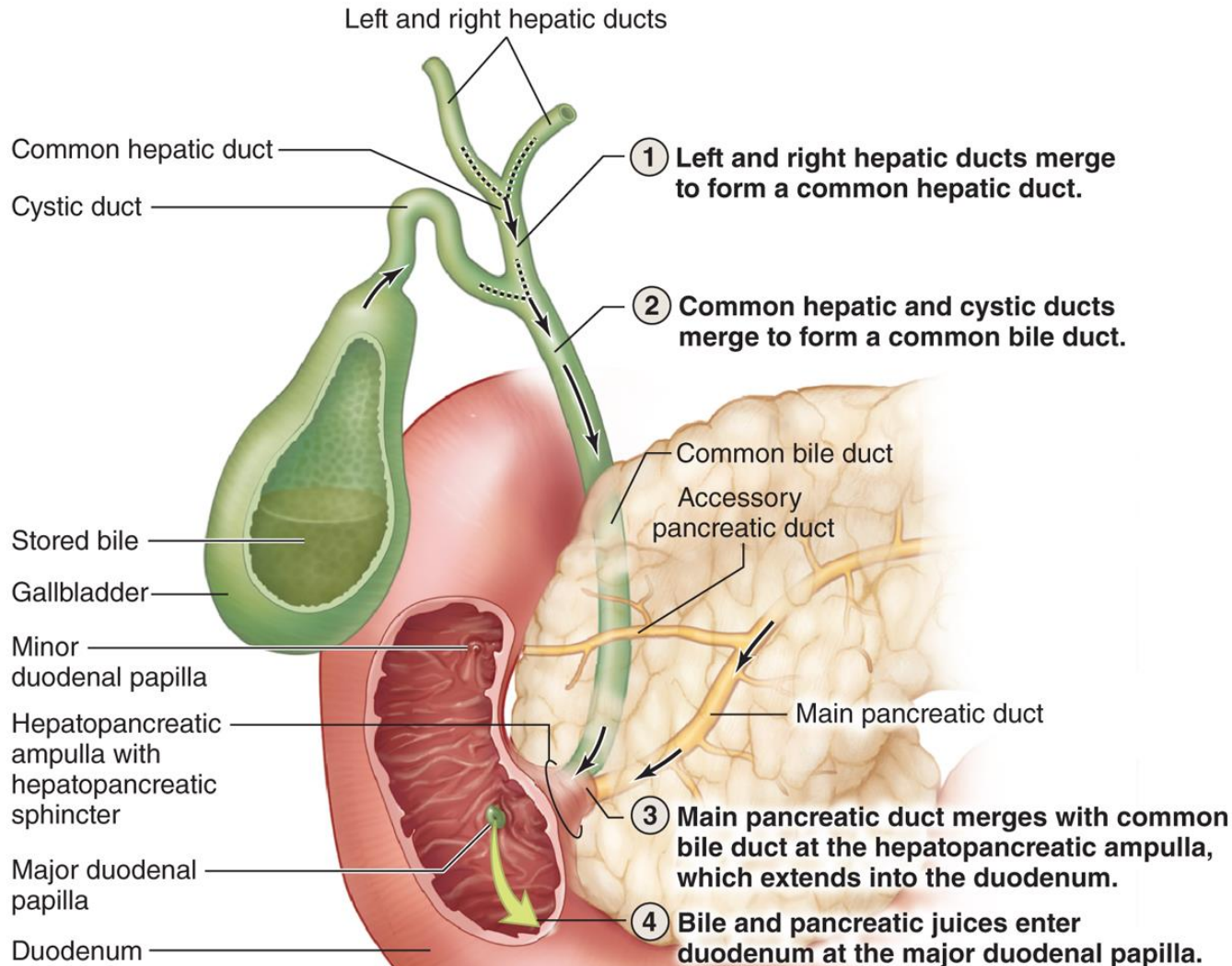
# EM 15: Pancreatic acinar cells



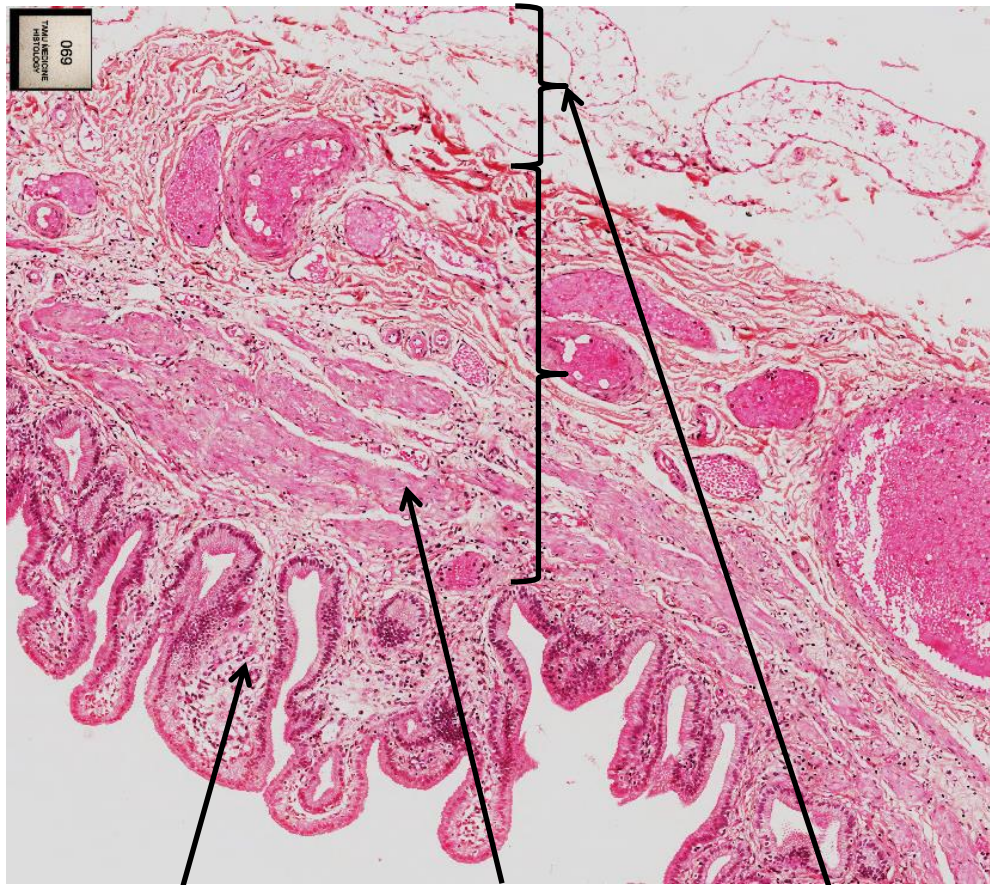
34218



# Biliary tract and gallbladder



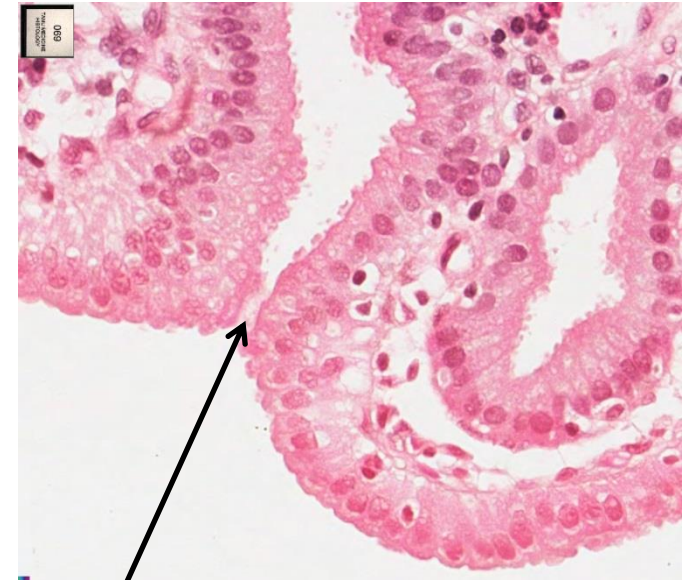
# Slide 69: Gall bladder



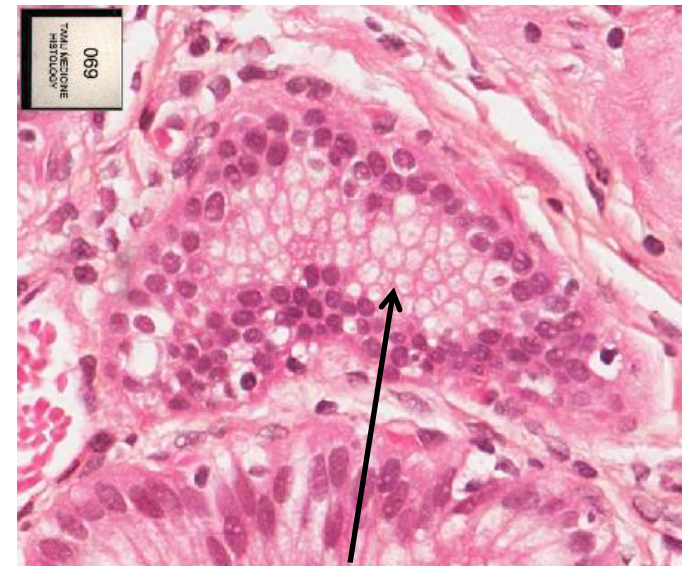
Lamina propria

Irregular smooth muscle of muscularis externa

Adventitia/Serosa

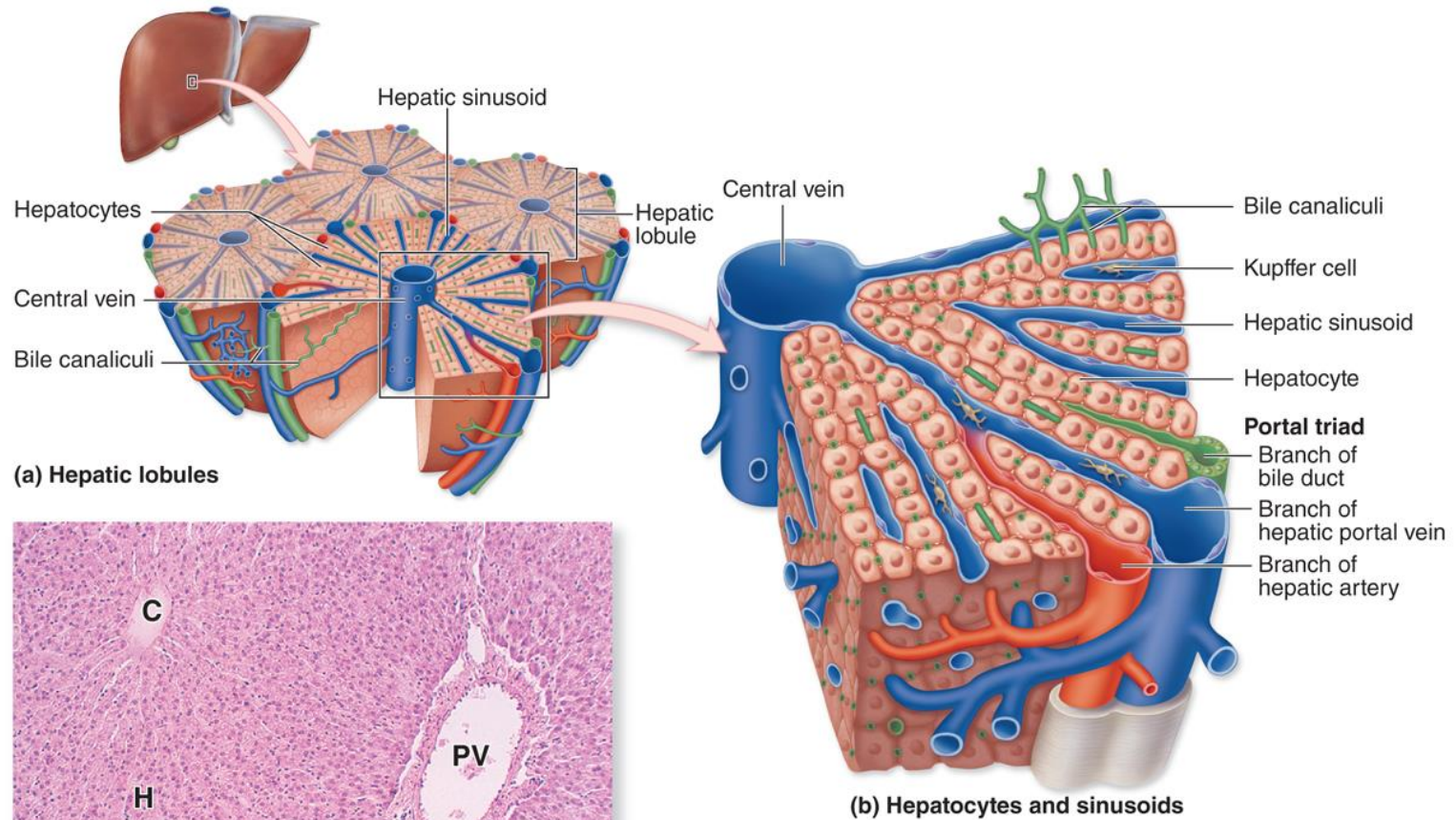


Brush border of simple columnar epithelium



Mucous glands

# Liver

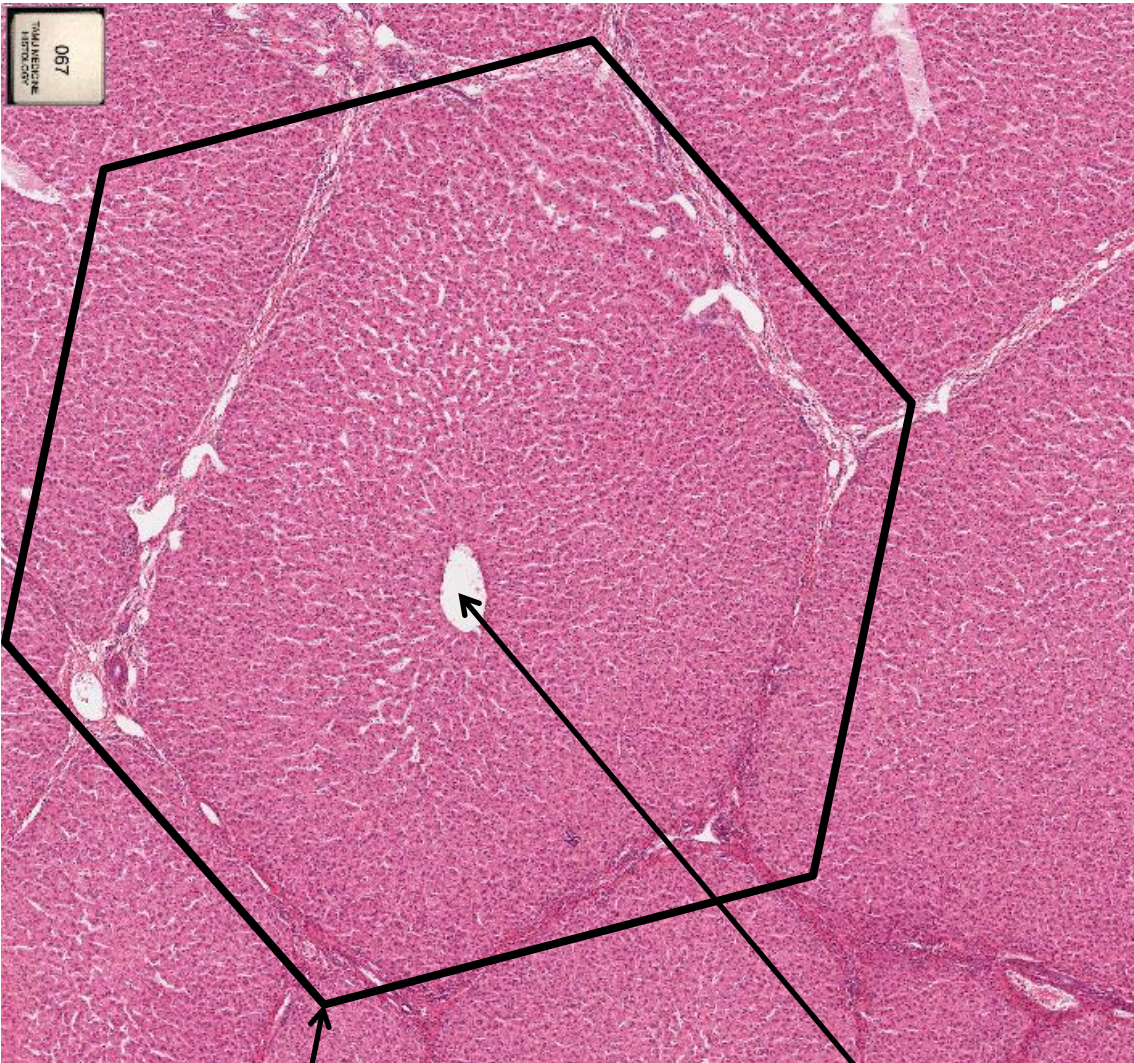


(a) Hepatic lobules

(b) Hepatocytes and sinusoids

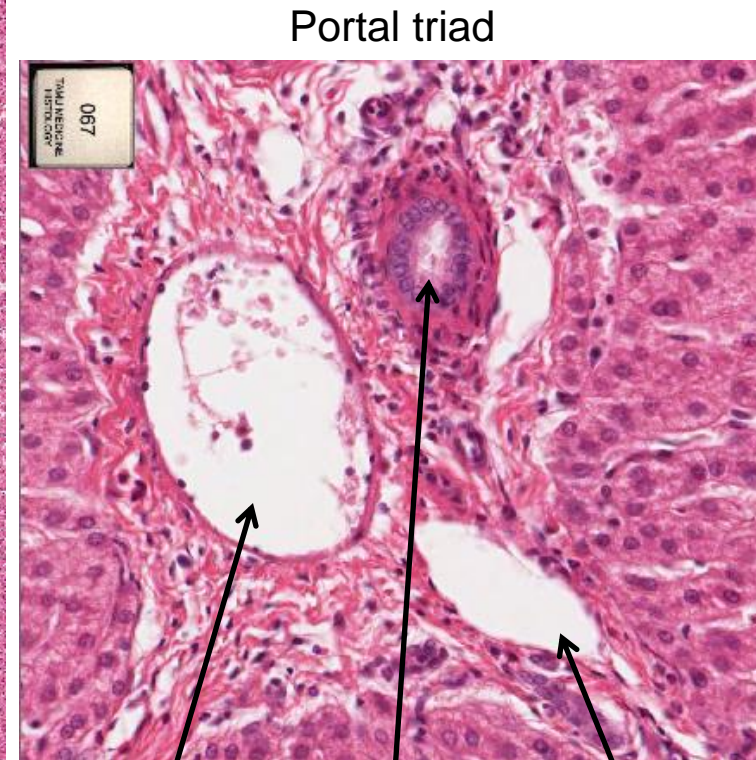
(c) Portal triad and hepatic lobule

# Slide 67: Pig liver



Classic lobule

Central vein



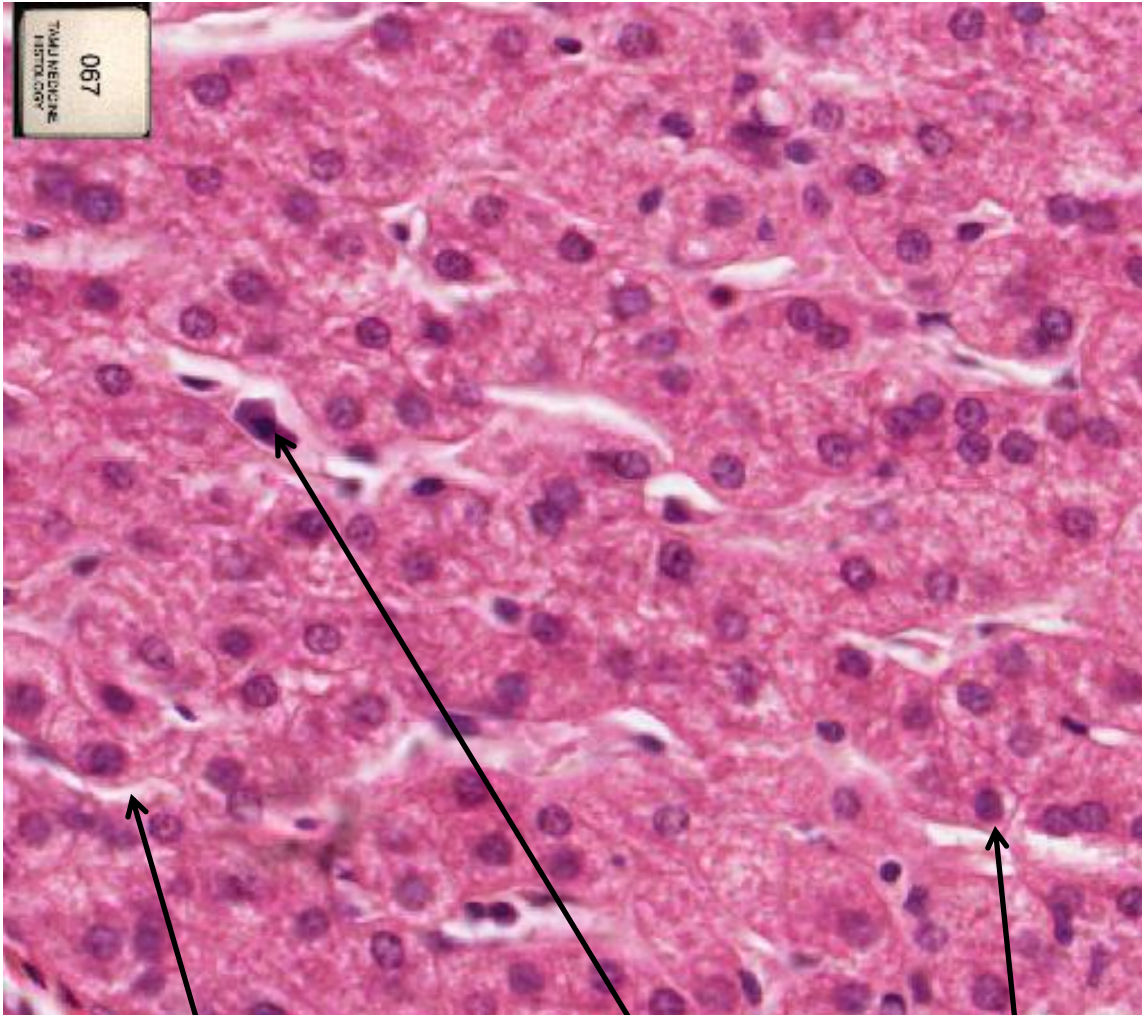
Portal triad

Hepatic artery

Bile duct

Portal vein

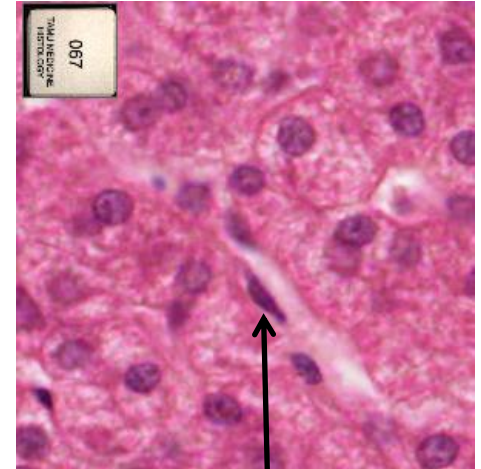
# Slide 67 : Pig liver



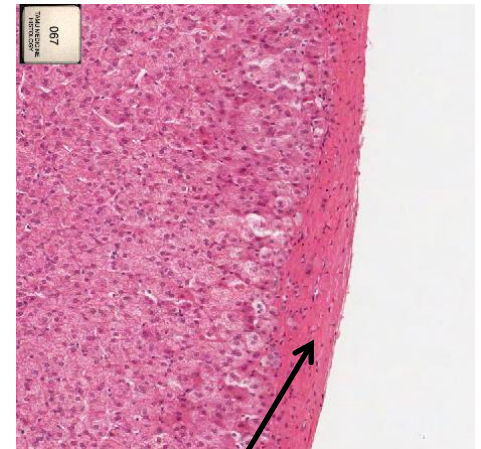
Hepatic sinusoids

Hepatic macrophage  
(Kupffer cell)

Hepatocytes



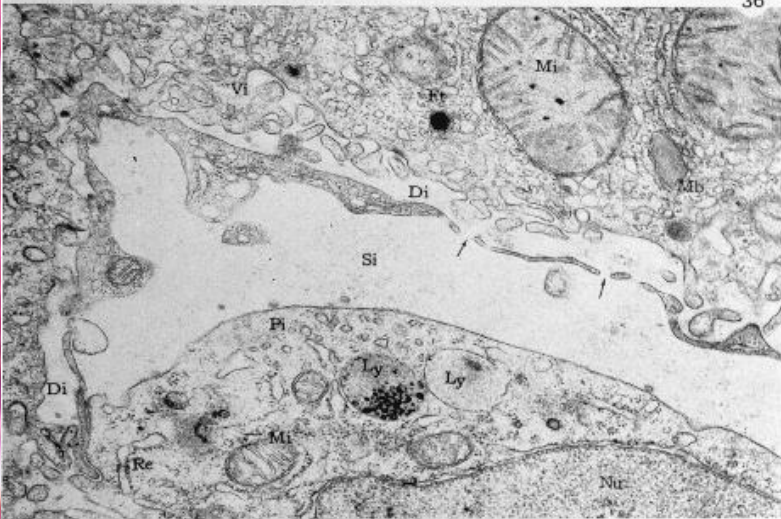
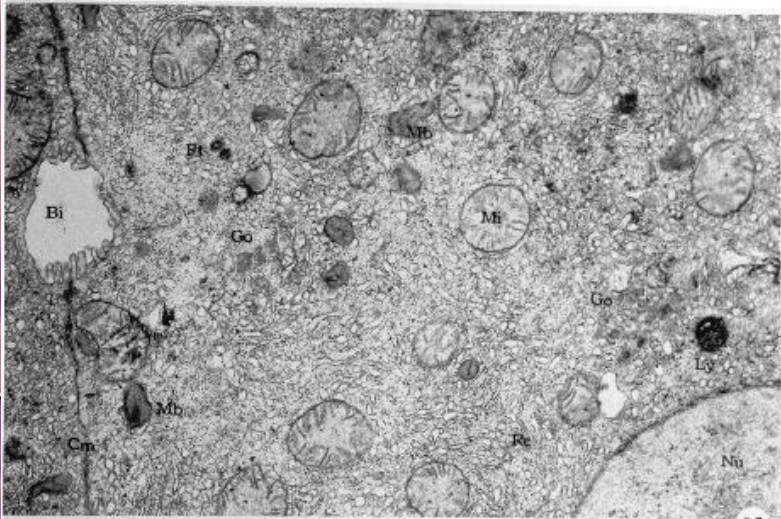
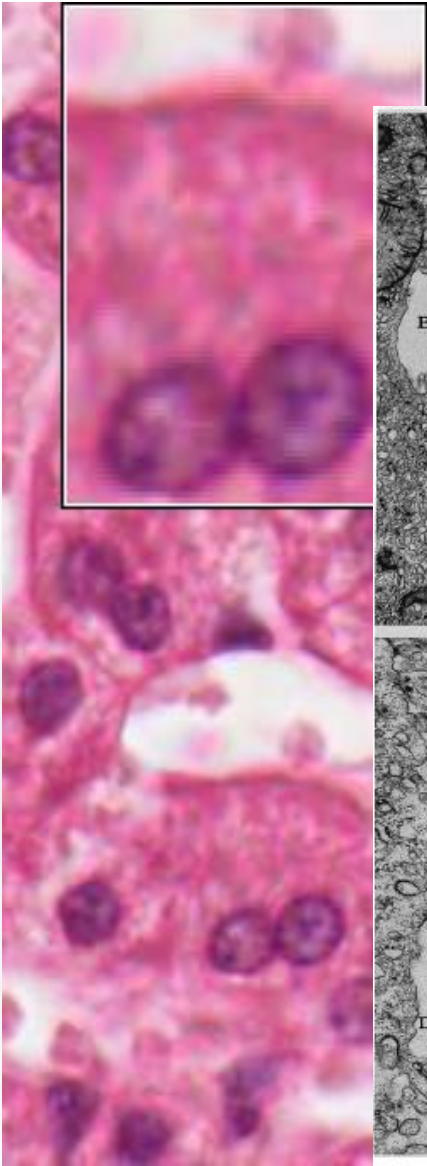
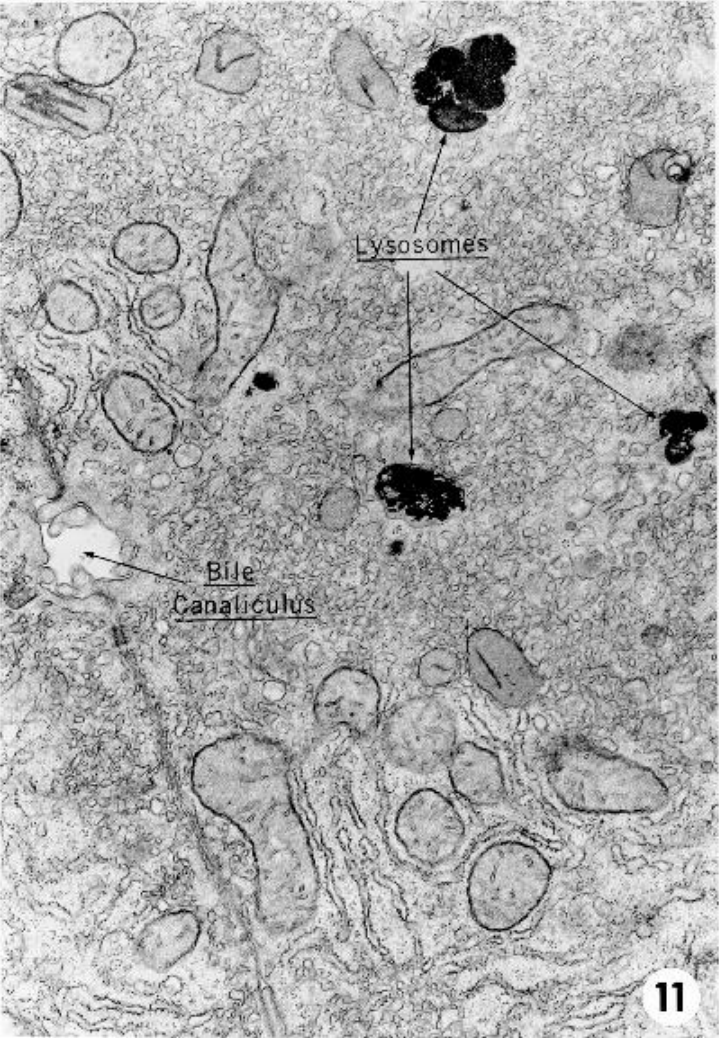
Space of Disse beneath  
endothelial cell



Hepatic capsule  
(Glisson's)

# EM 11 and 36

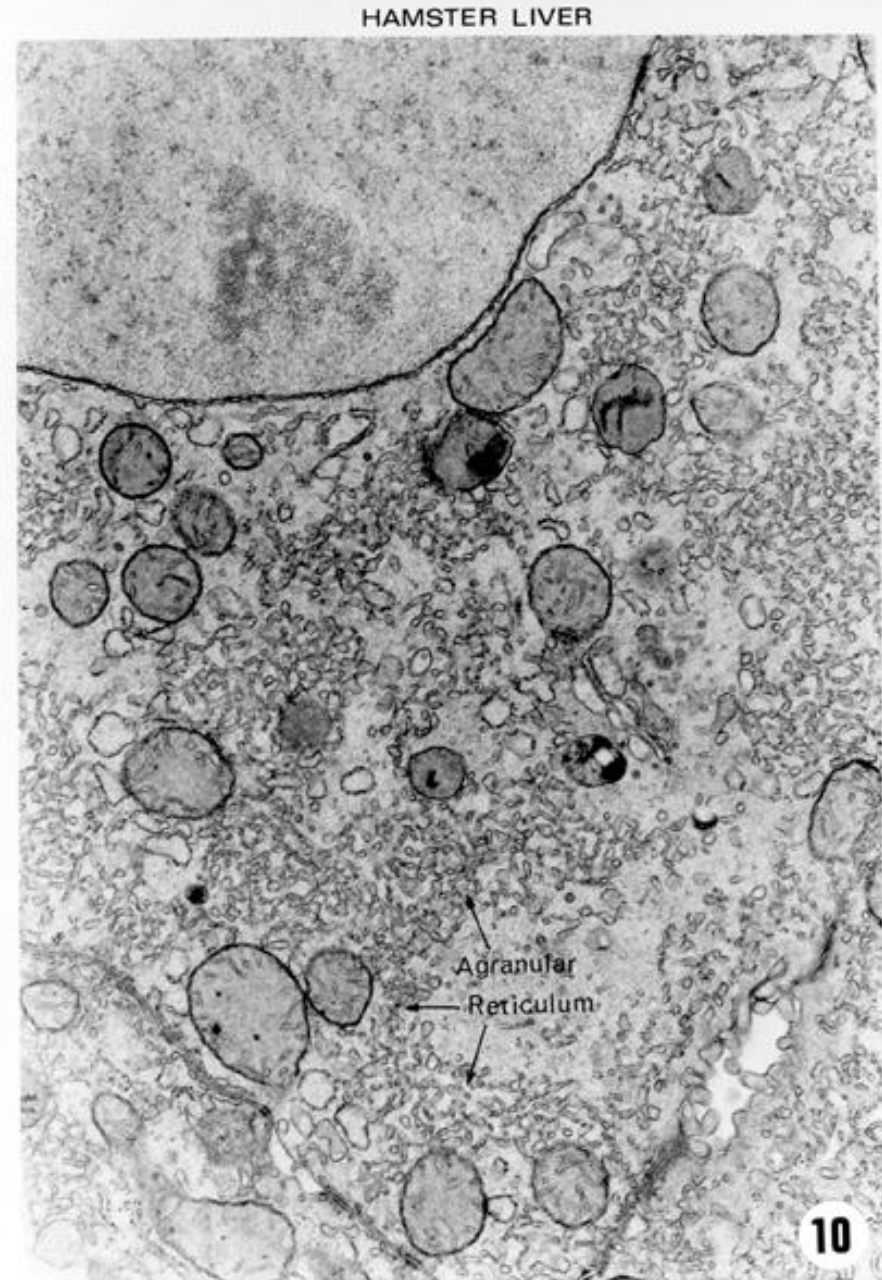
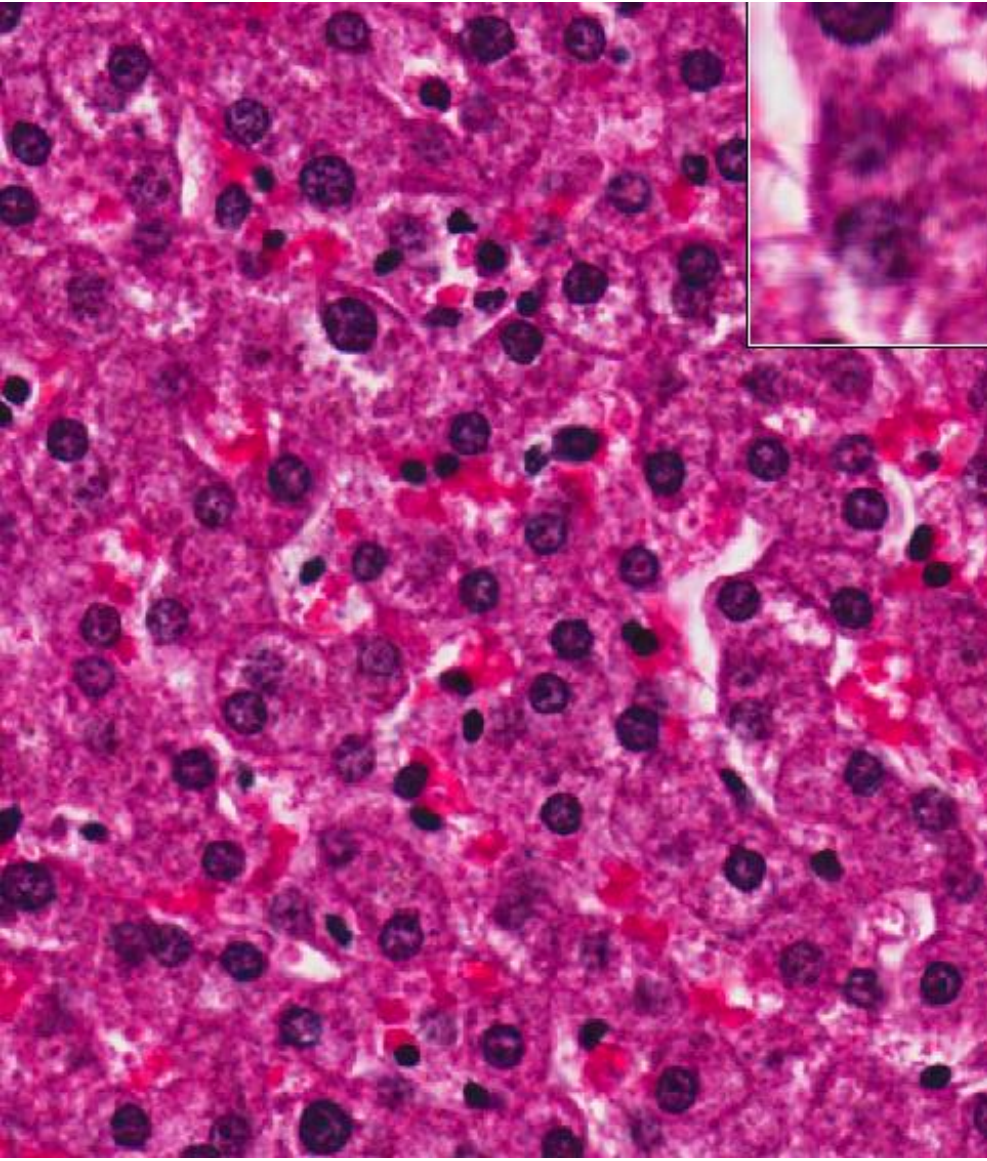
HAMSTER LIVER



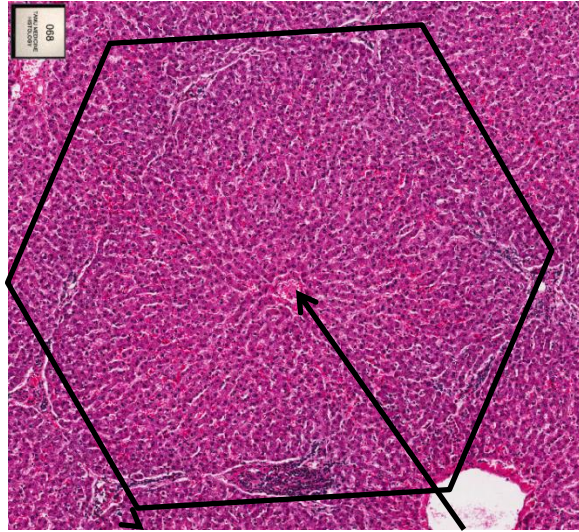


# EM 10

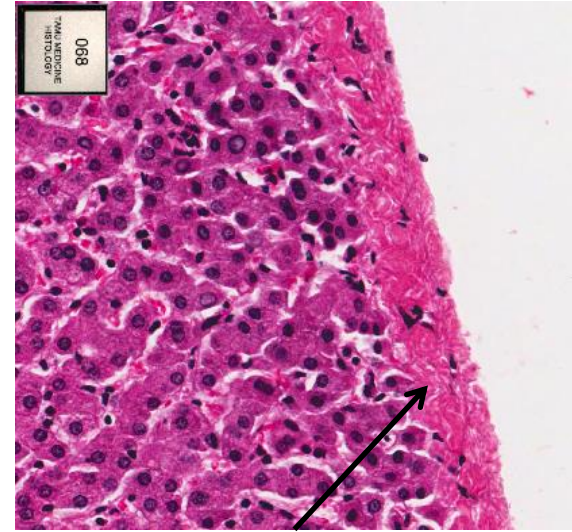
68



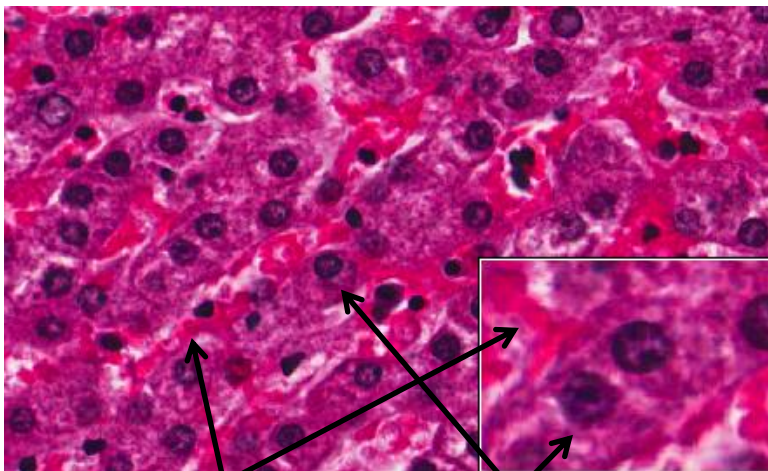
# Slide 68: Human Liver



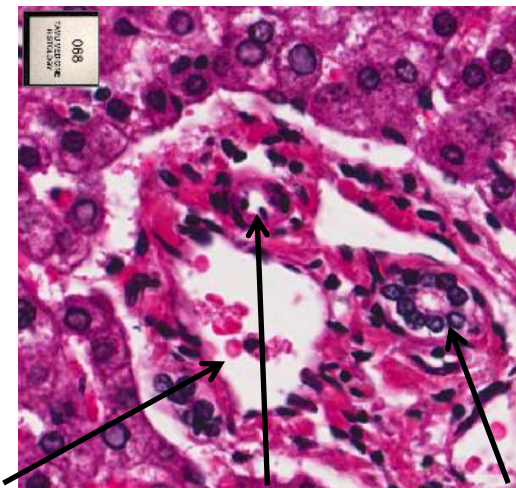
Hepatic lobule      Central vein



Hepatic capsule



Hepatic sinusoids      Hepatic cords



Portal vein      Hepatic artery      Bile duct

# Clinical Correlation

*The most common cause of liver cirrhosis is chronic alcoholism.*

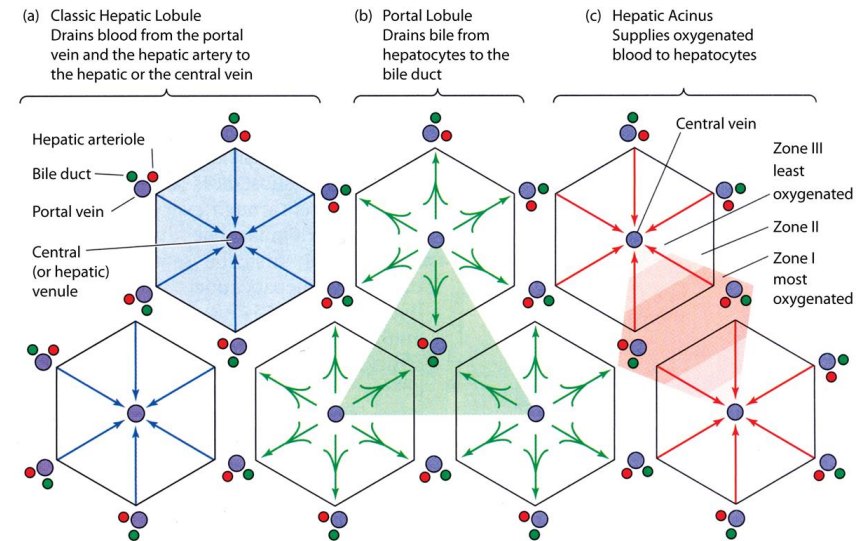
Which zone of the liver acinus would be most severely affected by alcohol?

What would a biopsy of liver tissue from a patient with alcoholic cirrhosis look like?

- Read “Exploring Alcohol’s Effects on Liver Function” by JACQUELYN J. MAHER, M.D.
- <http://pubs.niaaa.nih.gov/publications/arh21-1/05.pdf>



<http://www.cswfi.org/wp-content/uploads/2012/01/Depression-and-Alcoholism.jpg>



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# Clinical Correlation

*The most common cause of liver cirrhosis is chronic alcoholism.*

Which zone of the liver acinus would be most severely affected by alcohol?

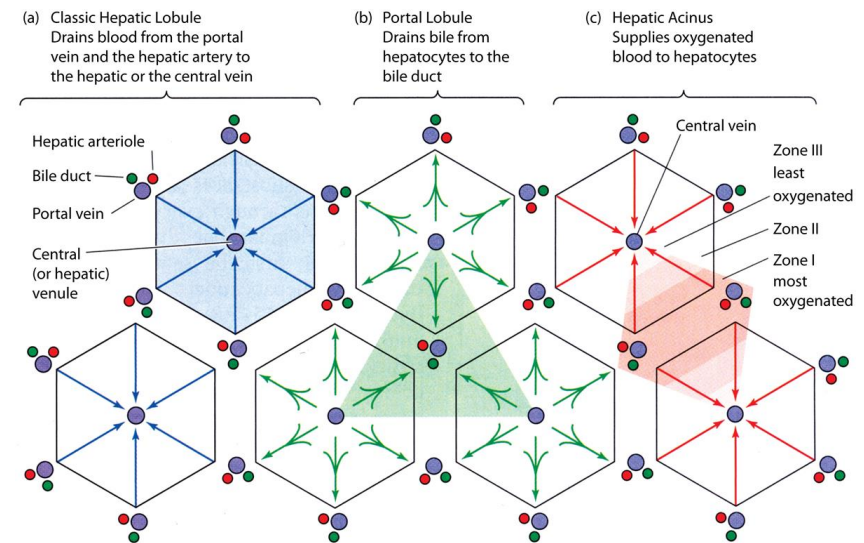
- Alcohol metabolism requires increased oxygen utilization, thereby reducing the availability of oxygen (hypoxia) for cells in zone III of the liver.
- The relative lack of oxygen (hypoxia) in zone III encourages fibrosis in cirrhotic livers.

What would a biopsy of liver tissue from a patient with alcoholic cirrhosis look like?

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- <http://pubs.niaaa.nih.gov/publications/arh21-1/05.pdf>



<http://www.cswfw.org/wp-content/uploads/2012/01/Depression-and-Alcoholism.jpg>



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# Clinical Correlation

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Which zone of the liver acinus would be most severely affected by alcohol?

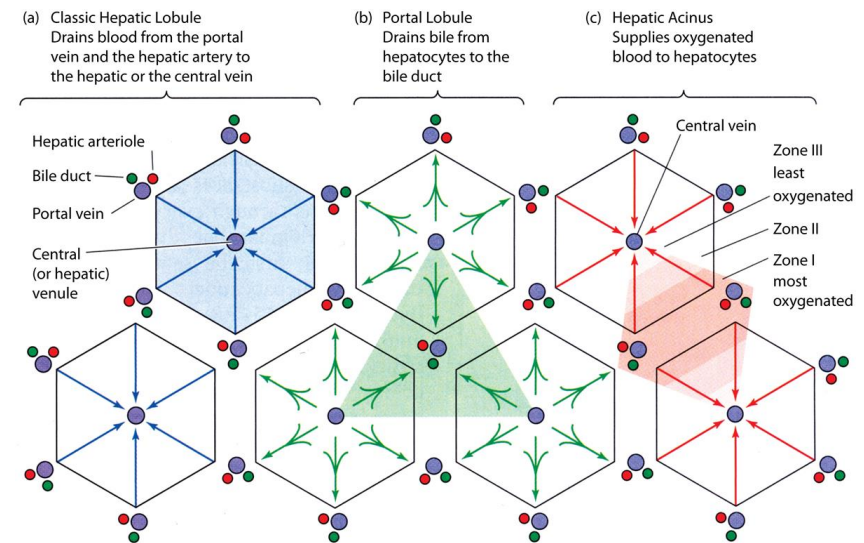
- Alcohol metabolism requires increased oxygen utilization, thereby reducing the availability of oxygen (hypoxia) for cells in zone III of the liver.
- The relative lack of oxygen (hypoxia) in zone III encourages fibrosis in cirrhotic livers.

What would a biopsy of liver tissue from a patient with alcoholic cirrhosis look like?

- The liver tissue from a patient with alcoholic cirrhosis would demonstrate extensive fibrosis that distorts the liver structure.
- Read "Exploring Alcohol's Effects on Liver Function" by JACQUELYN J. MAHER, M.D.  
<http://pubs.niaaa.nih.gov/publications/arh21-1/05.pdf>



<http://www.cswfw.org/wp-content/uploads/2012/01/Depression-and-Alcoholism.jpg>



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# The End!

## 2013 NATIONAL SENIOR GAMES BADMINTON PARTICIPANT REPORT Singles



\*\*\*Changes after June 10, 2013 will not be reflected in this report\*\*\*



Age Group	Last Name	First Name	State/Country	Gender	Sport	Singles
55-59	TIERNEY	RICHARD	HI	Male	Badminton	Yes
55-59	TREHAN	RAJEEV	KS	Male	Badminton	Yes
55-59	WILSON	JOHN	TX	Male	Badminton	Yes
55-59	ZHOU	JIANPING	MD	Male	Badminton	Yes
60-64	FABRITIUS	MICHAEL	KY	Male	Badminton	Yes
60-64	HILLIARD	MICHAEL	AZ	Male	Badminton	Yes
60-64	JOHNSON	LARRY	TX	Male	Badminton	Yes

# Answers to questions in lab manual

1. Identify an important enzyme produced by the parotid gland.
  - Serous cells of parotid glands secrete abundant alpha-amylase, that initiates hydrolysis of carbohydrates, and proline-rich proteins with antimicrobial and other protective properties.
2. Identify an enzyme secreted by the cells forming the demilune and its function.
  - Lysozyme, functions in bacterial wall hydrolysis.
3. What is the functional significance of these infoldings?
  - The infoldings of the basal cell membrane seen in striated ducts contain numerous elongated mitochondria. These structures are characteristic feature of cells that transport fluids and electrolytes across cell membranes.
  - These mitochondria within the folds supply energy for rapid ion uptake from saliva.
4. What is the significance of this (lactoferrin secretion by some submandibular glands)?
  - Lactoferrin binds iron, thereby preventing bacterial growth (which requires iron).
5. What is the function of the rough endoplasmic reticulum?
  - Modifies, transports, and stores proteins produced by attached ribosomes; these proteins are secreted, become components of the plasma membrane, or serve as enzymes of lysosomes.
6. What are zymogen granules?
  - Secretory granules with dense contents of inactive precursors of digestive enzymes

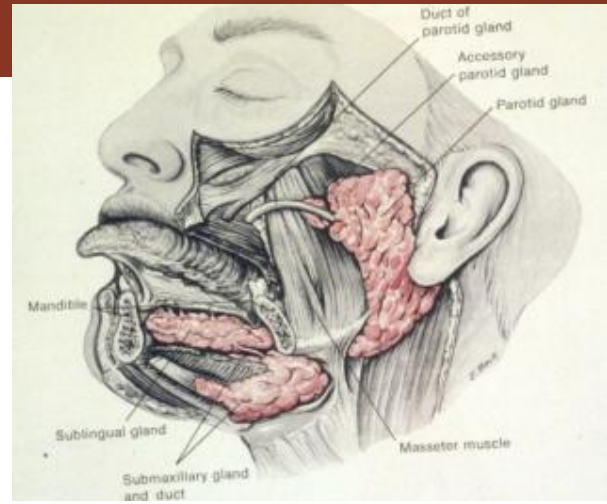
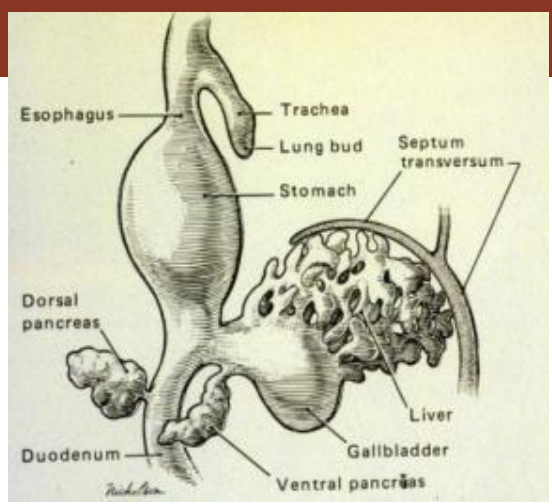
# Answers to questions in lab manual

7. What hormone causes contraction of the smooth muscle layer and where is that hormone produced?
  - Cholecystokinin (CCK) causes contraction of the smooth muscle layer.
  - CCK is produced by enteroendocrine cells of the small intestine and is stimulated by the presence of ingested fats.
8. What is the difference between a serosa and an adventitia?
  - Serosa: Thin layer of loose connective tissue with a simple squamous mesothelium. The serosa is continuous with mesenteries, which are continuous with the peritoneum, which lines the abdominal cavity.
    - Surrounds digestive organs that are suspended within the abdominal cavity.
  - Adventitia: Thick connective tissue layer that merges with surrounding tissues and lacks mesothelium.
    - Surrounds digestive organs that are not suspended within the abdominal cavity, but rather are bound directly to adjacent structures.
9. Identify the function of the gall bladder.
  - The function of the gallbladder is to store bile.
10. Is the hepatic capsule (Glisson's) present?
  - Yes.
11. What is found in the Space of Disse?
  - Irregular microvilli projecting from the hepatocytes fill the Space of Disse.
  - This direct contact between hepatocytes and plasma facilitates most key hepatocyte functions that involve uptake and release of nutrients, proteins, and potential toxins.



# Answers to questions in lab manual

12. Are lymphatics part of the portal triad? Where are they found in the liver?
  - Not part of the portal triad per se (portal vein, hepatic artery, bile duct), but most peripheral portal areas do contain lymphatics.
  
13. Which zone of the liver acinus would be most severely affected by alcohol?
  - Alcohol metabolism requires increased oxygen utilization, thereby reducing the availability of oxygen (hypoxia) for cells in zone III of the liver.
  - The relative lack of oxygen (hypoxia) in zone III encourages fibrosis in cirrhotic livers.
  
14. What would a biopsy of liver tissue from a patient with alcoholic cirrhosis look like?
  - The liver tissue from a patient with alcoholic cirrhosis would demonstrate extensive fibrosis that distorts the liver structure.



# LIVER, GALLBLADDER, PANCREAS, AND SALIVARY GLANDS

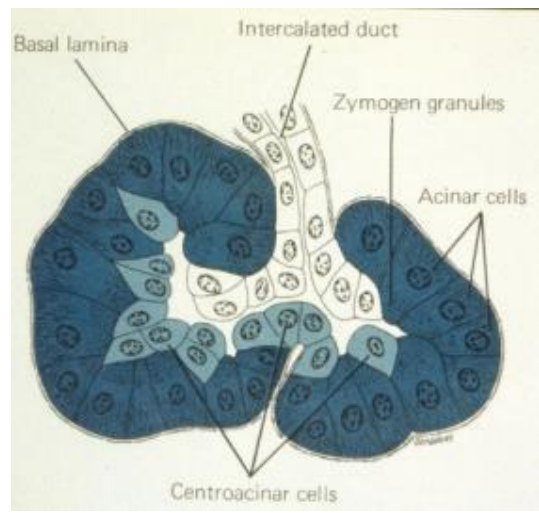
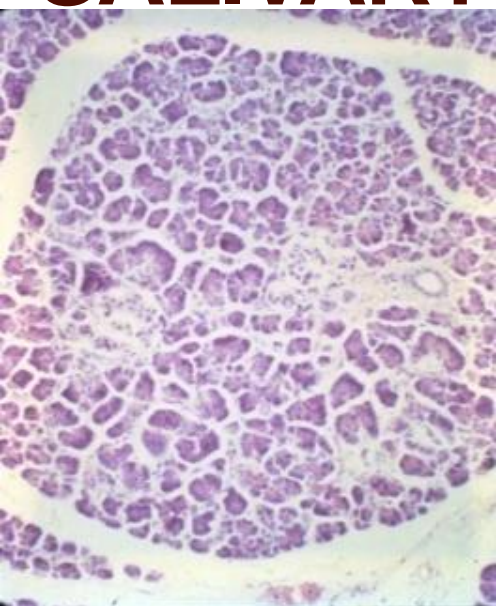
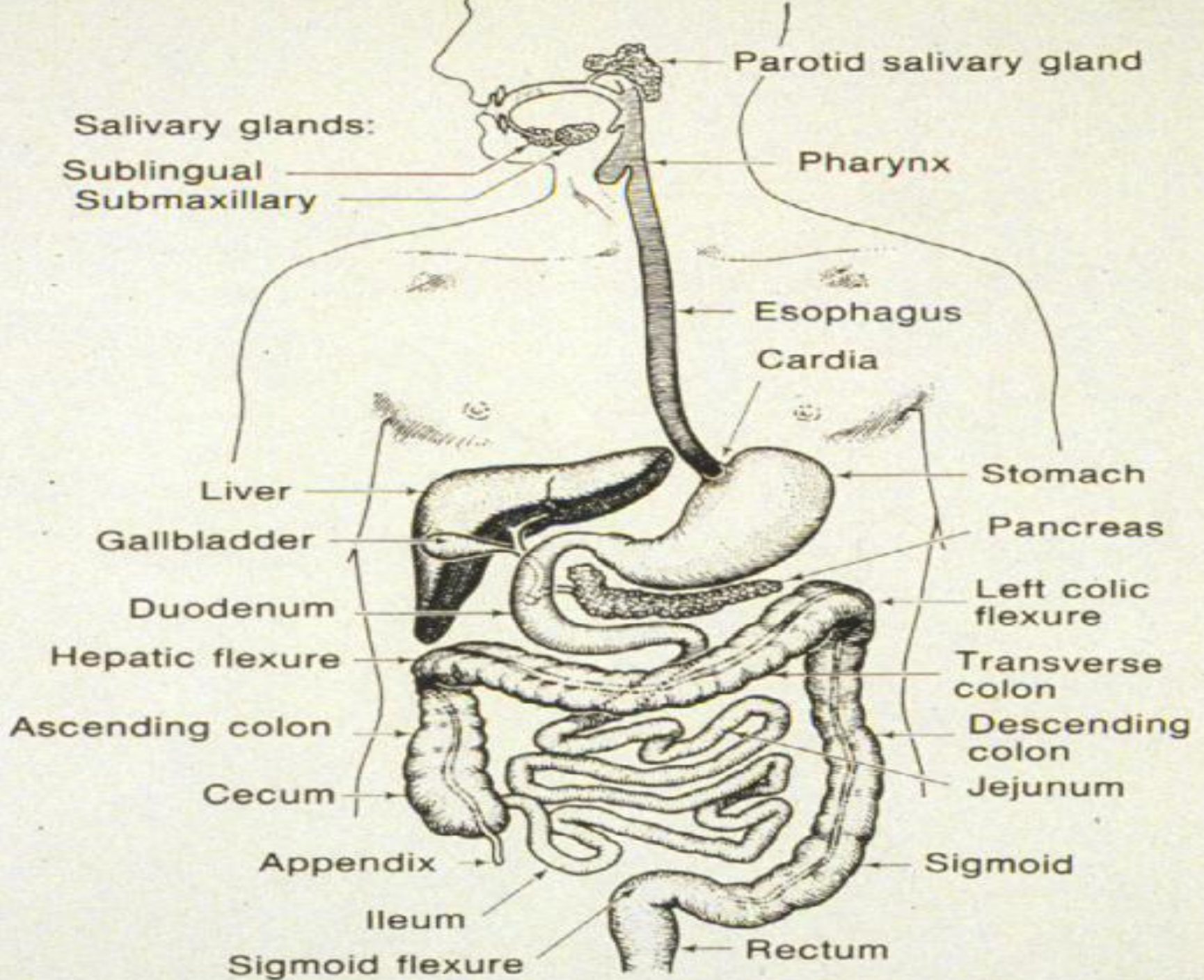
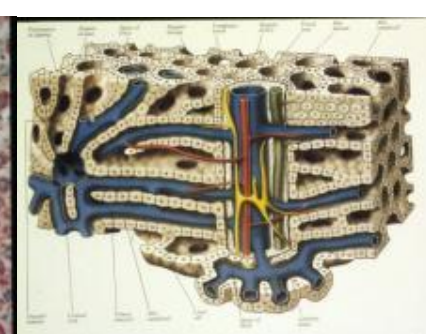
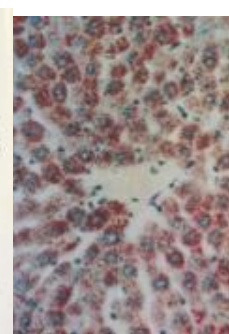
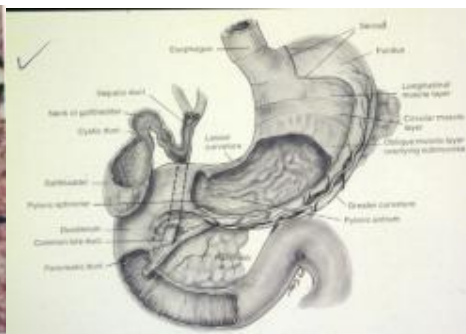
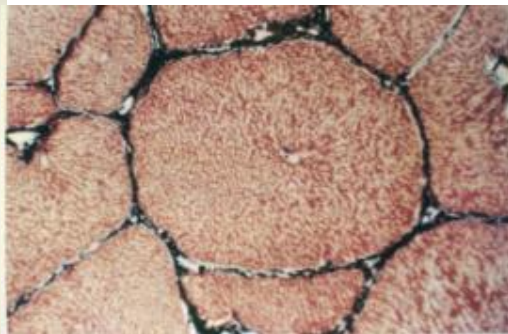


Fig. 9.22: Jawbone prosthesis



# OBJECTIVES

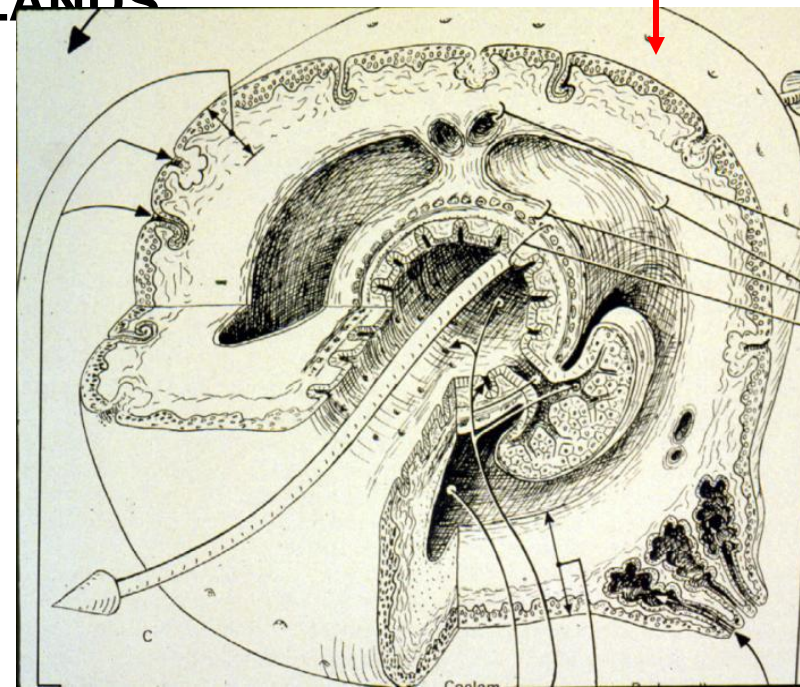
***Learn of the GENERAL AND UNIQUE STRUCTURAL FEATURES OF GLANDS ASSOCIATED WITH DIGESTIVE TRACT***



***ORIGIN OF THESE GLANDS AND HOW STRUCTURAL FEATURES OF THESE GLANDS CONTRIBUTE TO THEIR FUNCTION IN DIGESTION AND ABSORPTION OF FOOD STUFFS***

# ORIGIN AND DISTRIBUTION OF EPITHELIUM

**ECTODERM** - EPIDERMIS OF SKIN AND EPITHELIUM OF CORNEA TOGETHER COVERS THE ENTIRE SURFACE OF THE BODY; SEBACEOUS AND MAMMARY GLANDS

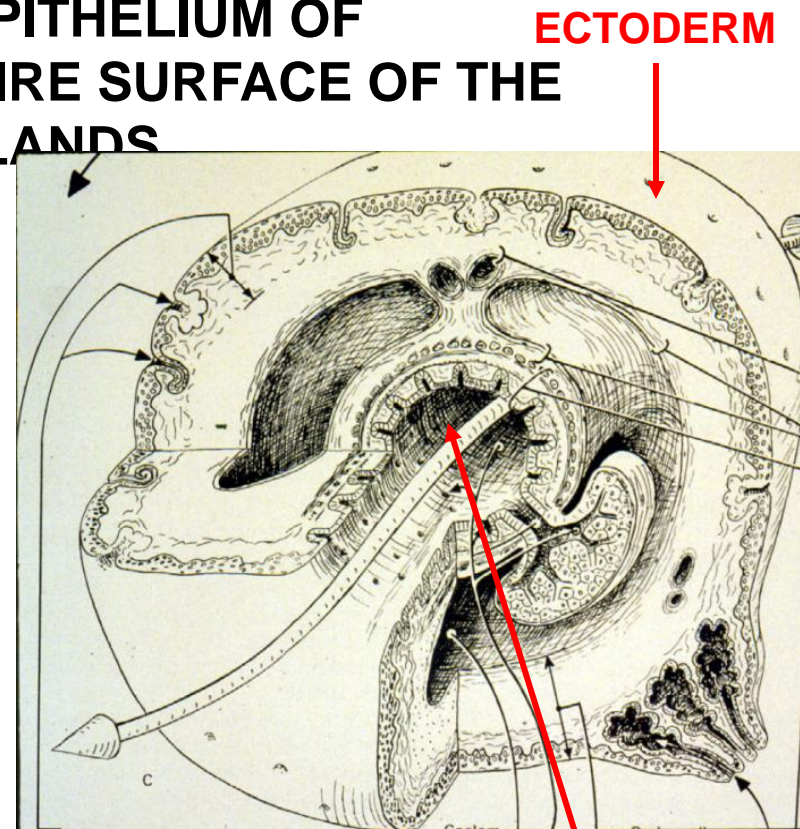


# ORIGIN AND DISTRIBUTION OF EPITHELIUM

**ECTODERM** - EPIDERMIS OF SKIN AND EPITHELIUM OF CORNEA TOGETHER COVERS THE ENTIRE SURFACE OF THE BODY; SEBACEOUS AND MAMMARY GLANDS

**ENDODERM** - ALIMENTARY TRACT, LIVER, PANCREAS, GASTRIC GLANDS, INTESTINAL GLANDS

- ENDOCRINE GLANDS - LOSE CONNECTION WITH SURFACE



**ENDODERM**

# ORIGIN AND DISTRIBUTION OF EPITHELIUM

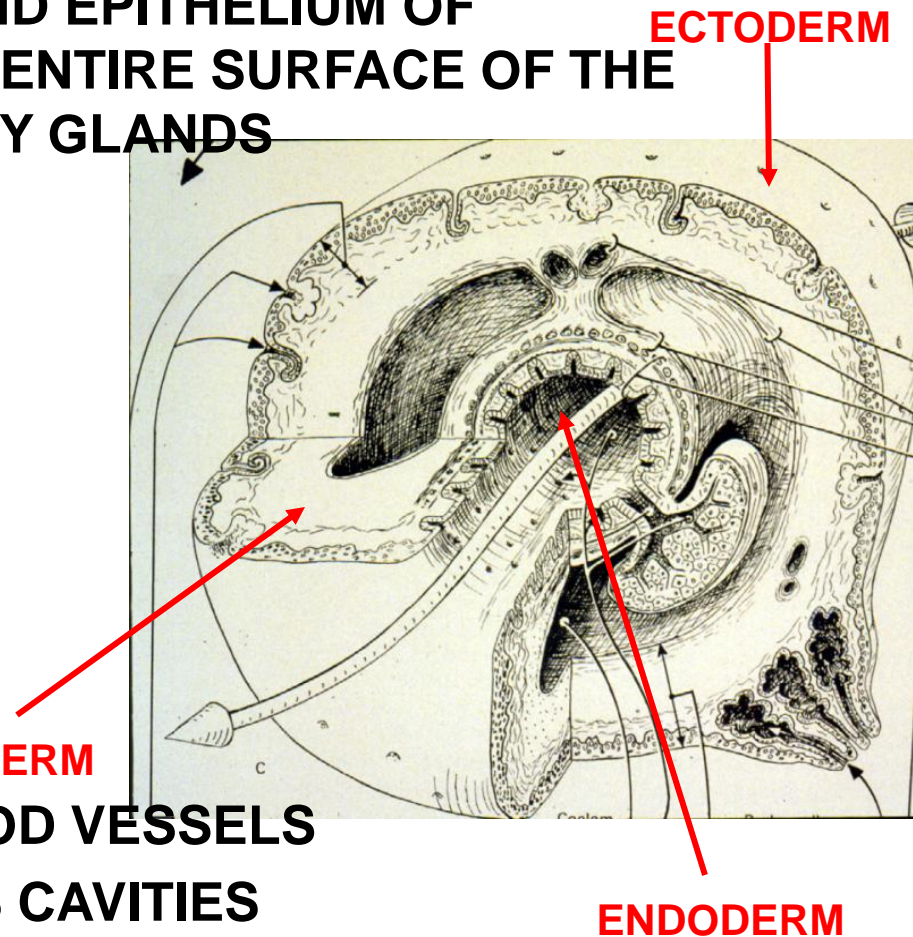
**ECTODERM** - EPIDERMIS OF SKIN AND EPITHELIUM OF CORNEA TOGETHER COVERS THE ENTIRE SURFACE OF THE BODY; SEBACEOUS AND MAMMARY GLANDS

**ENDODERM** - ALIMENTARY TRACT, LIVER, PANCREAS, GASTRIC GLANDS, INTESTINAL GLANDS

- ENDOCRINE GLANDS - LOSE CONNECTION WITH SURFACE

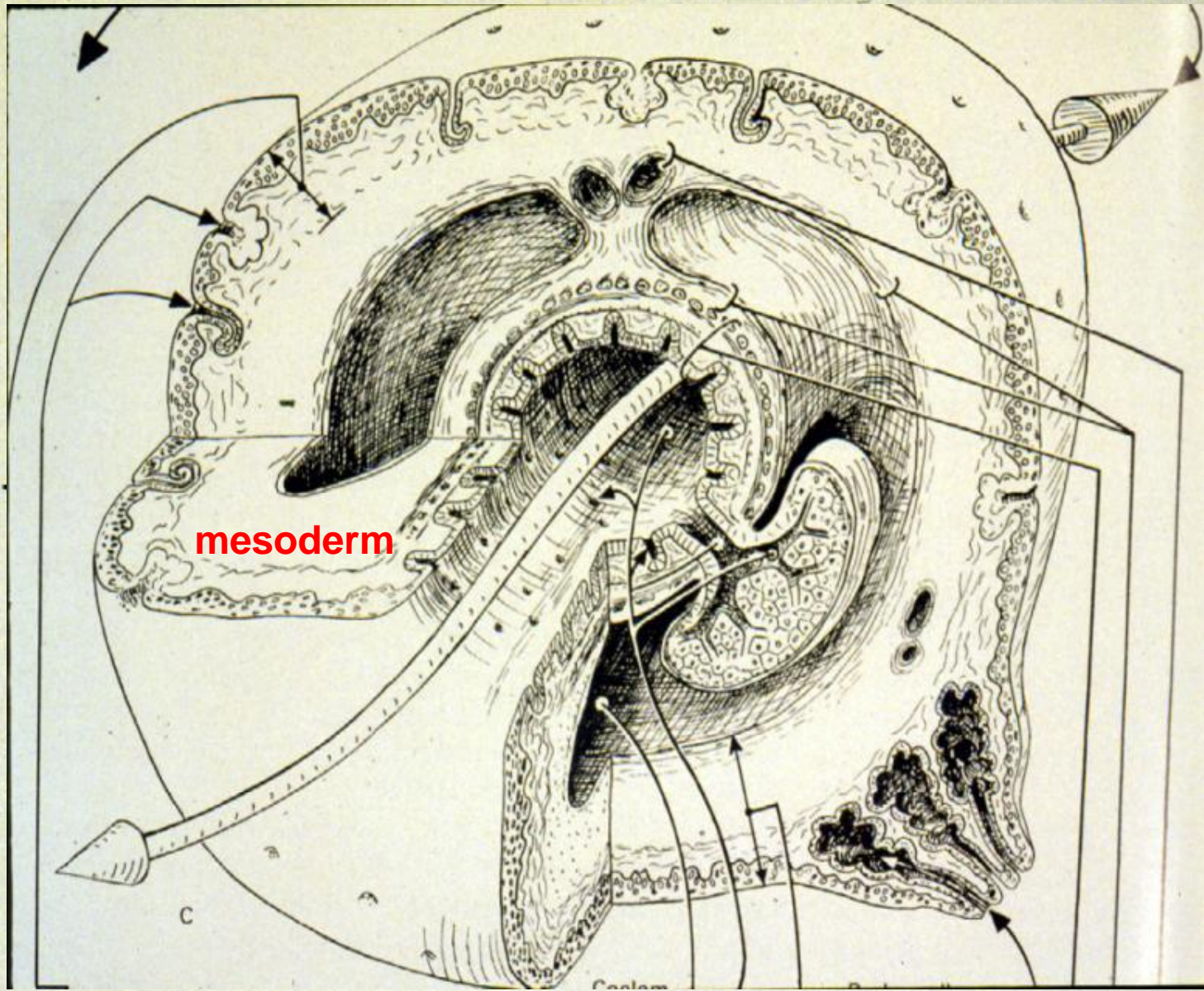
**MESODERM**

- ENDOTHELIUM - LINING OF BLOOD VESSELS
- MESOTHELIUM - LINING SEROUS CAVITIES



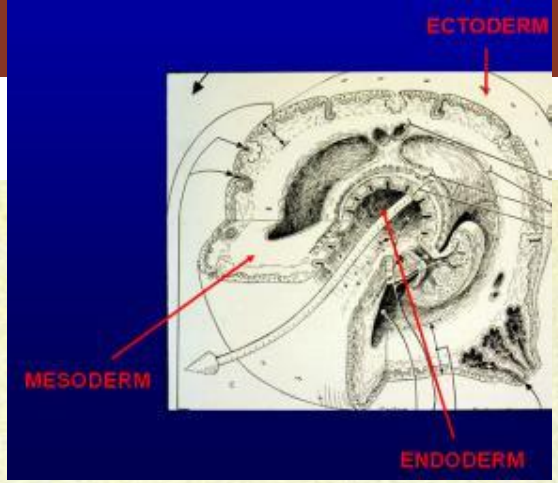
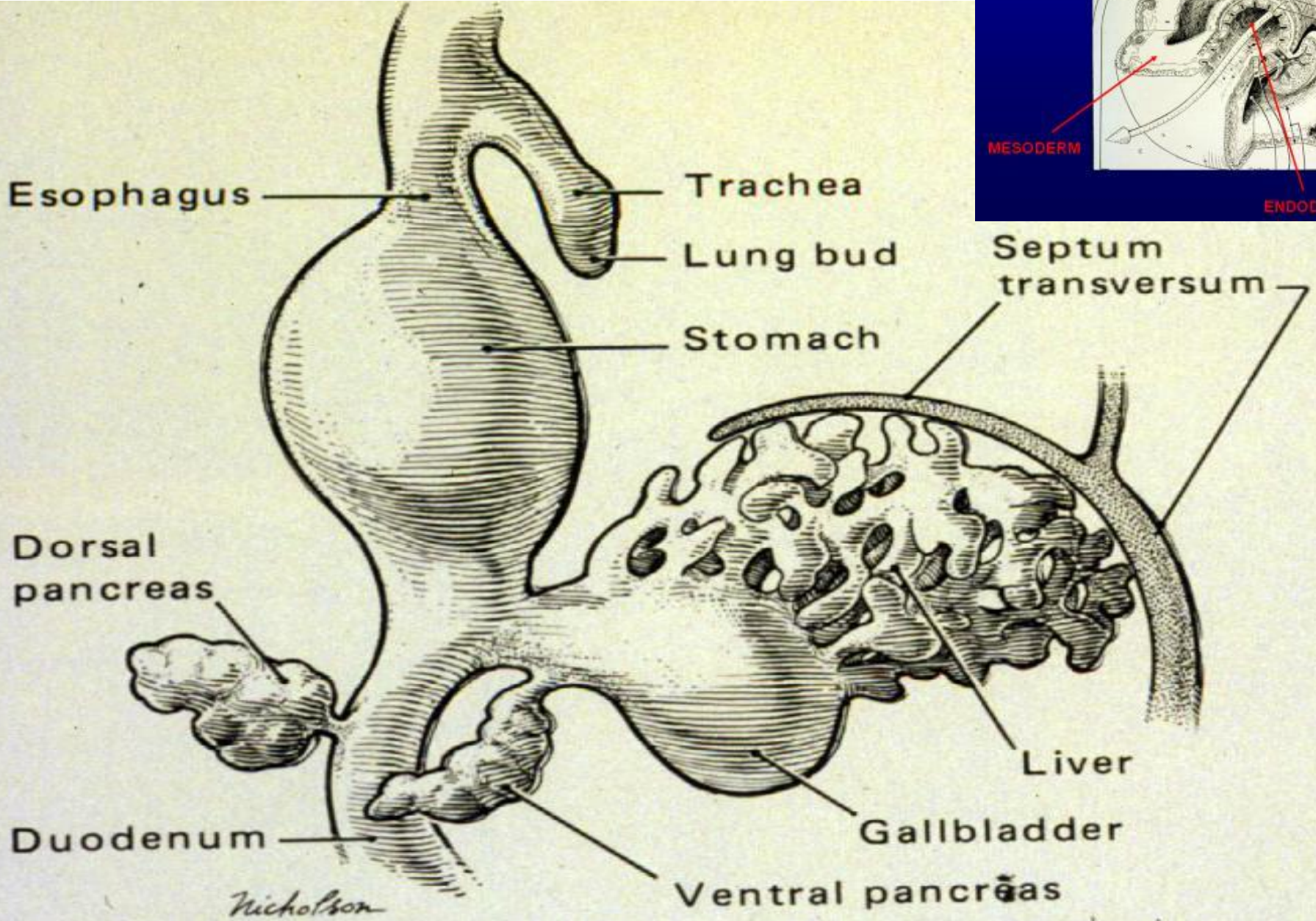
# CONNECTIVE TISSUE OF ASSOCIATION

Connective tissue  
from the  
mesoderm





# Origin of glands

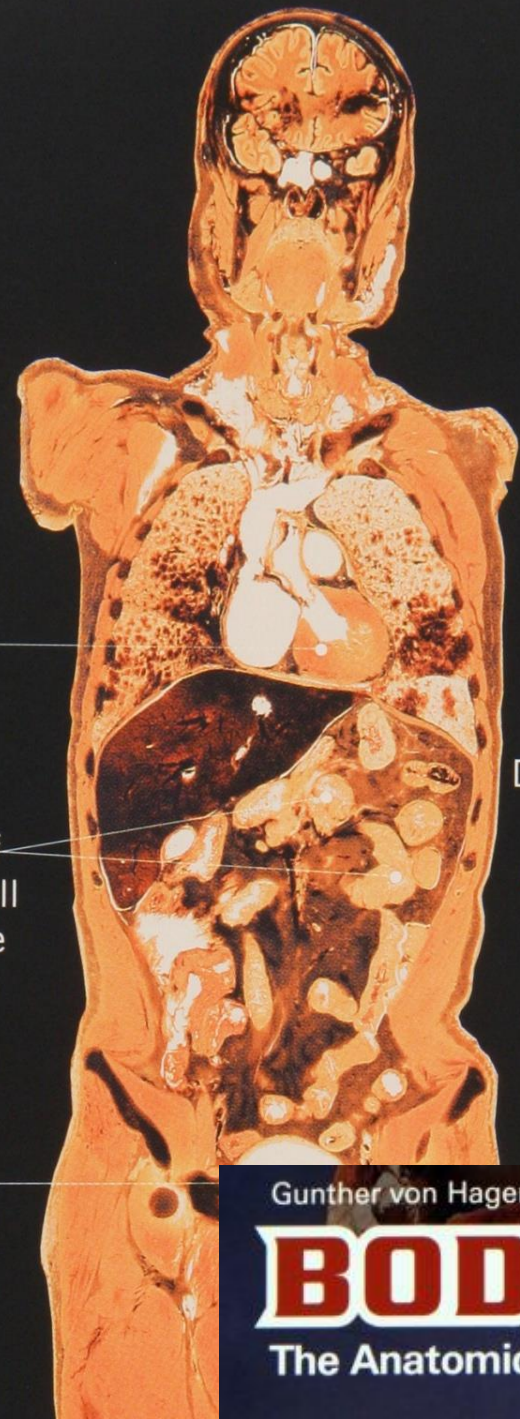




Heart

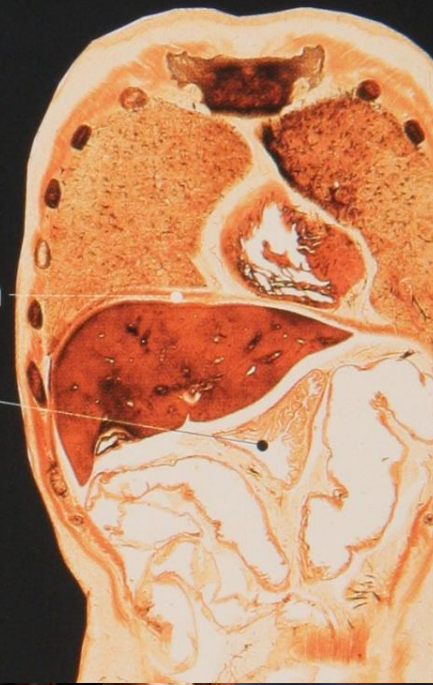
Loops of the Small Intestine

Bladder



Diaphragm

Stomach



Gunther von Hagens'

# BODY WORLD

The Anatomical Exhibition of Real Human Bo



Liver

Duodenum

Superior Vena Cava

Common Iliac Artery

Diaphragm

Pancreas

Aorta

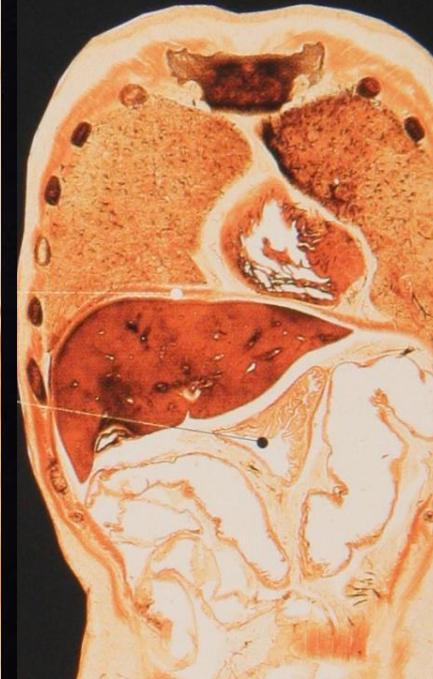
Left Ureter

the internal abdominal organs. The large and small intestines, stomach, and spleen are completely removed from the abdominal cavity.

Gunther von Hagens'

# BODY WORLD

The Anatomical Exhibition of Real Human Bodies

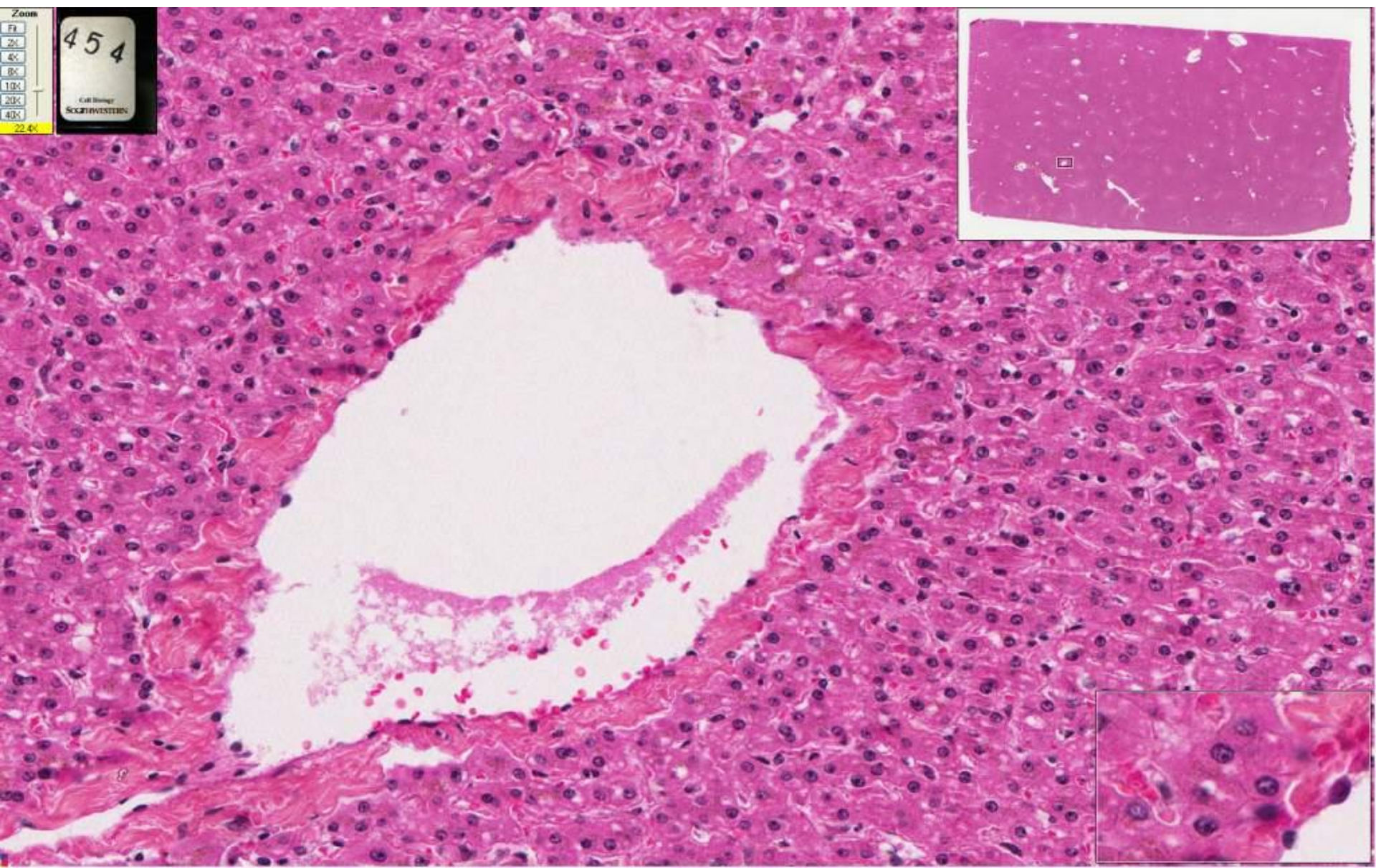


Gunther von Hagens'

# **BODY WORLD**

The Anatomical Exhibition of Real Human Bodies

# Liver - vein



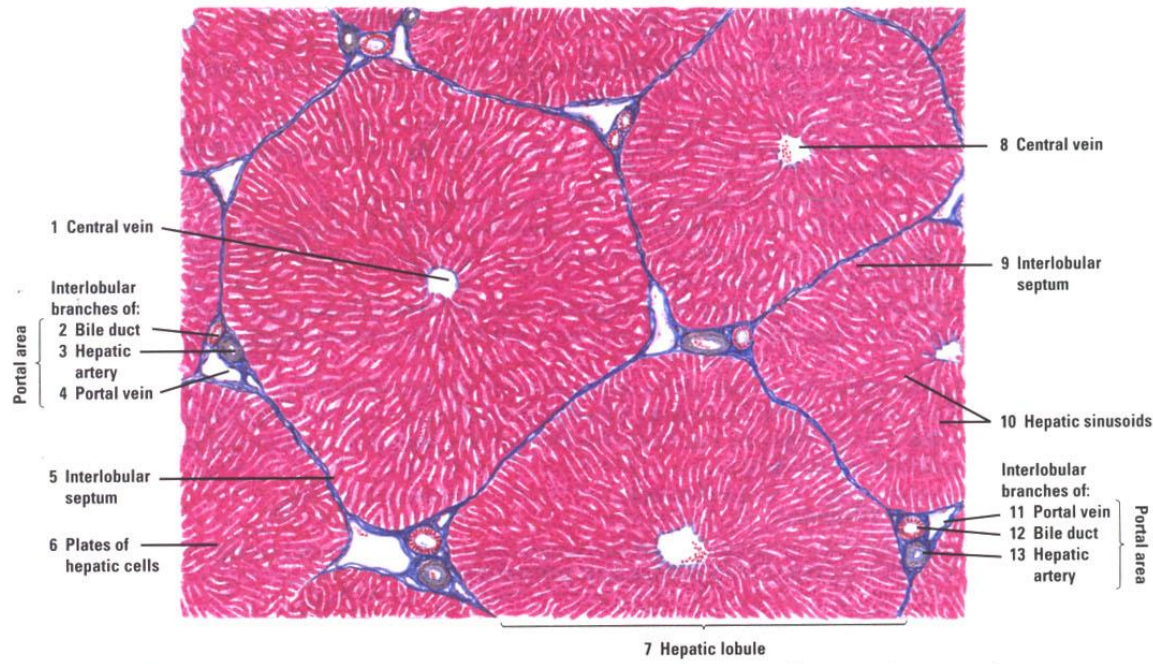
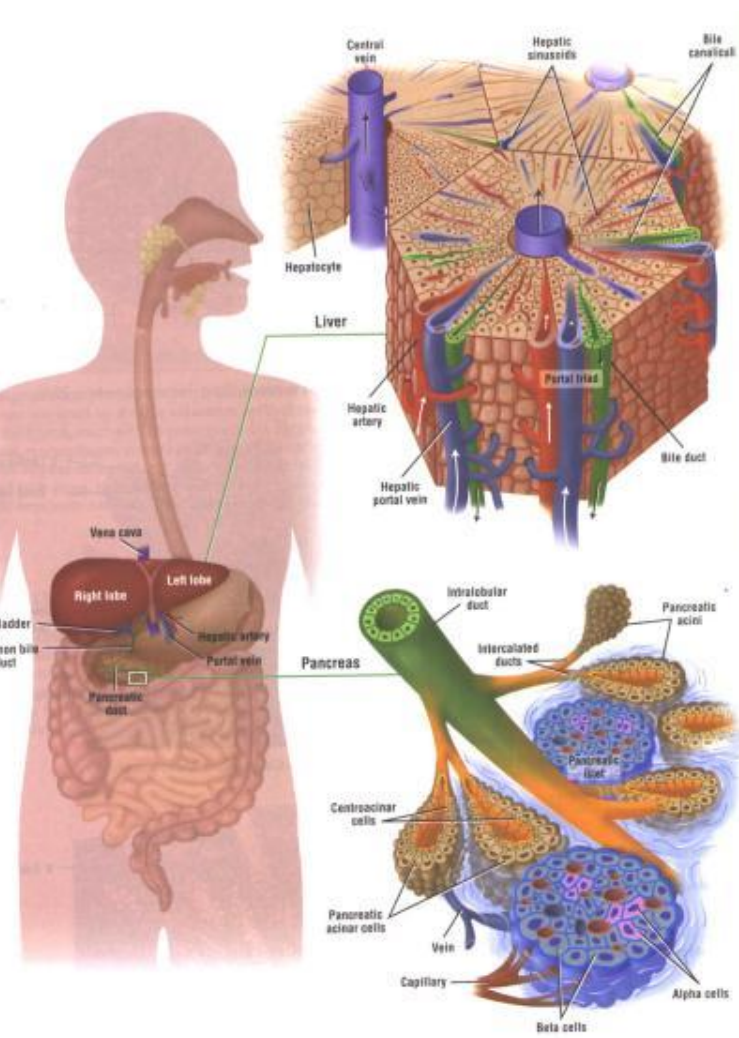
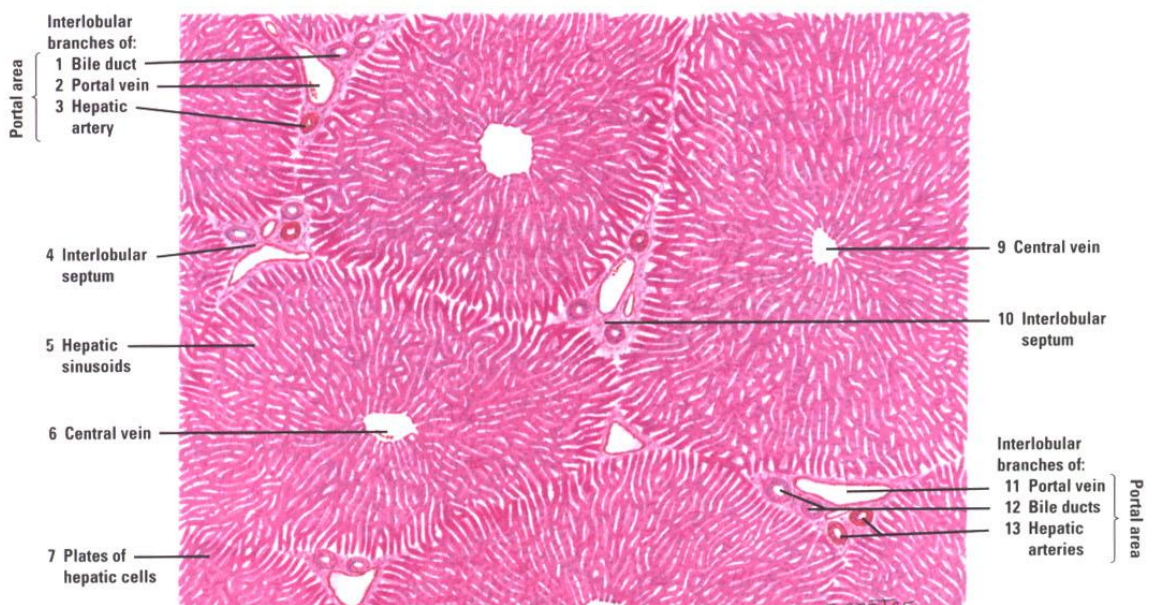
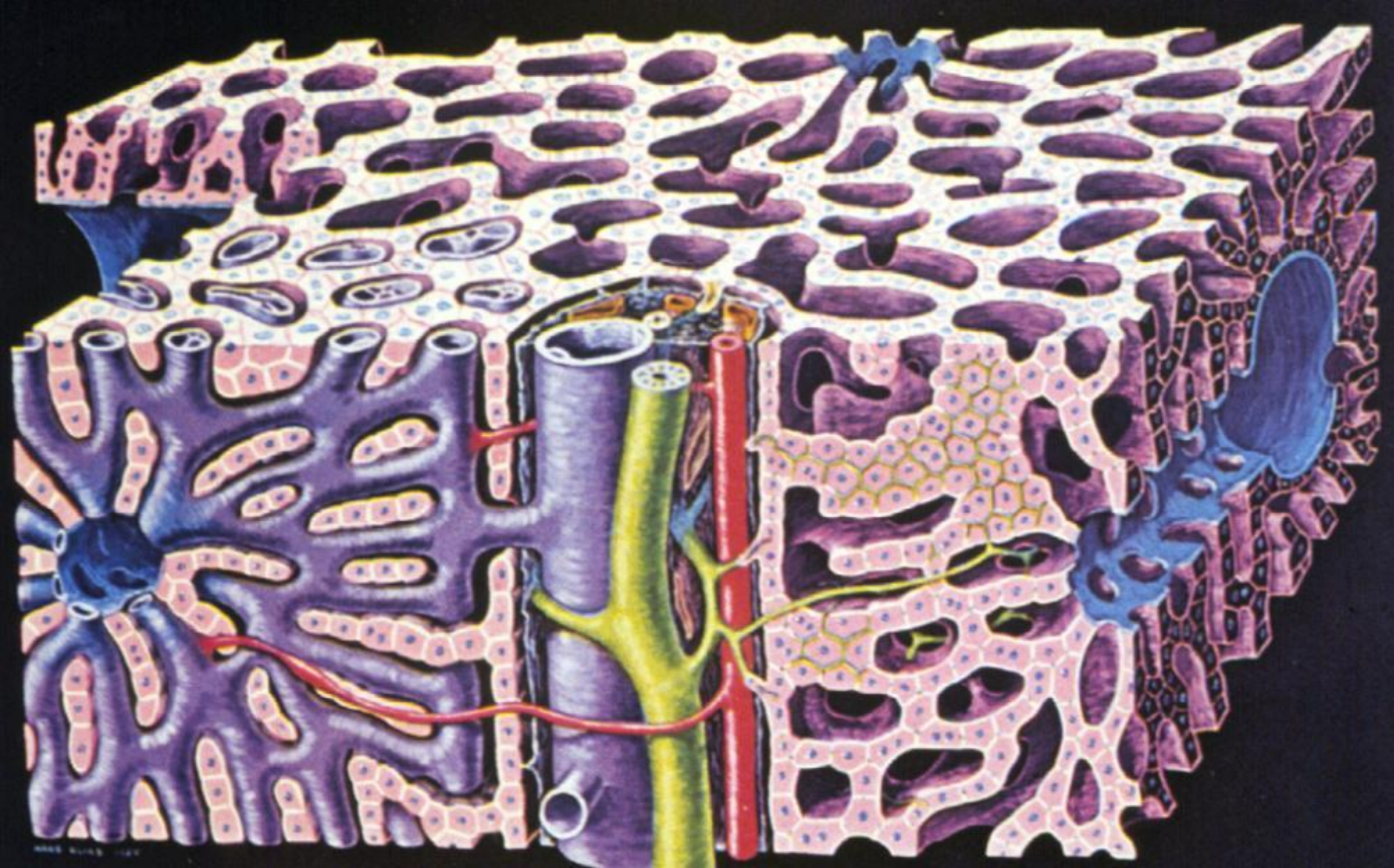


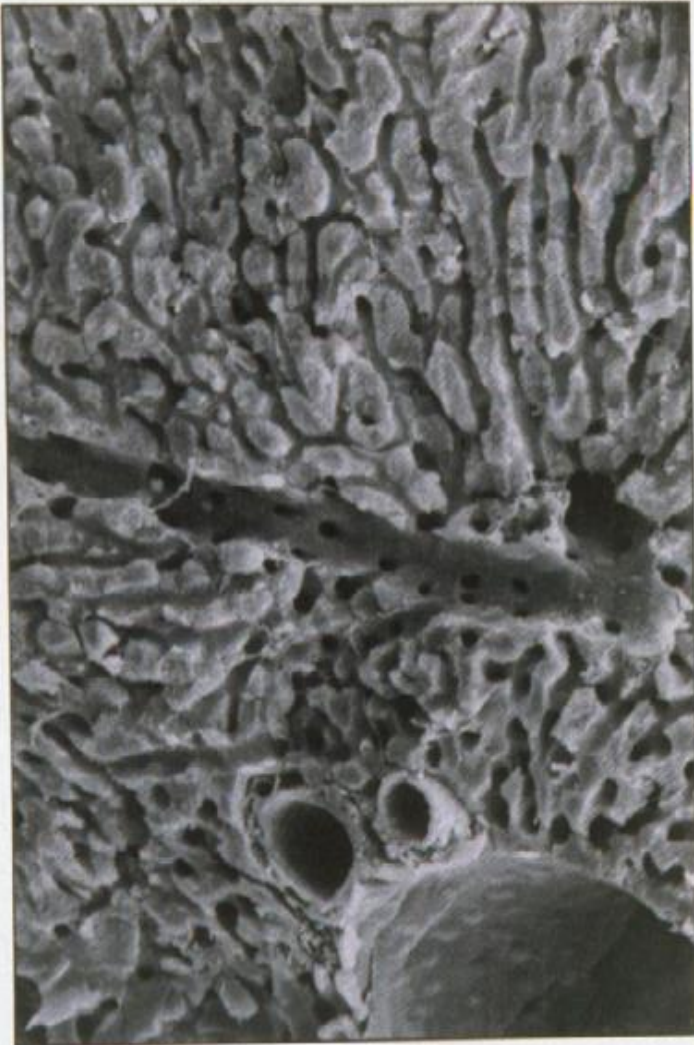
Fig. 13-1 Pig's Liver (panoramic view, transverse section). Stain: Mallory-azan. Low magnification.



liver

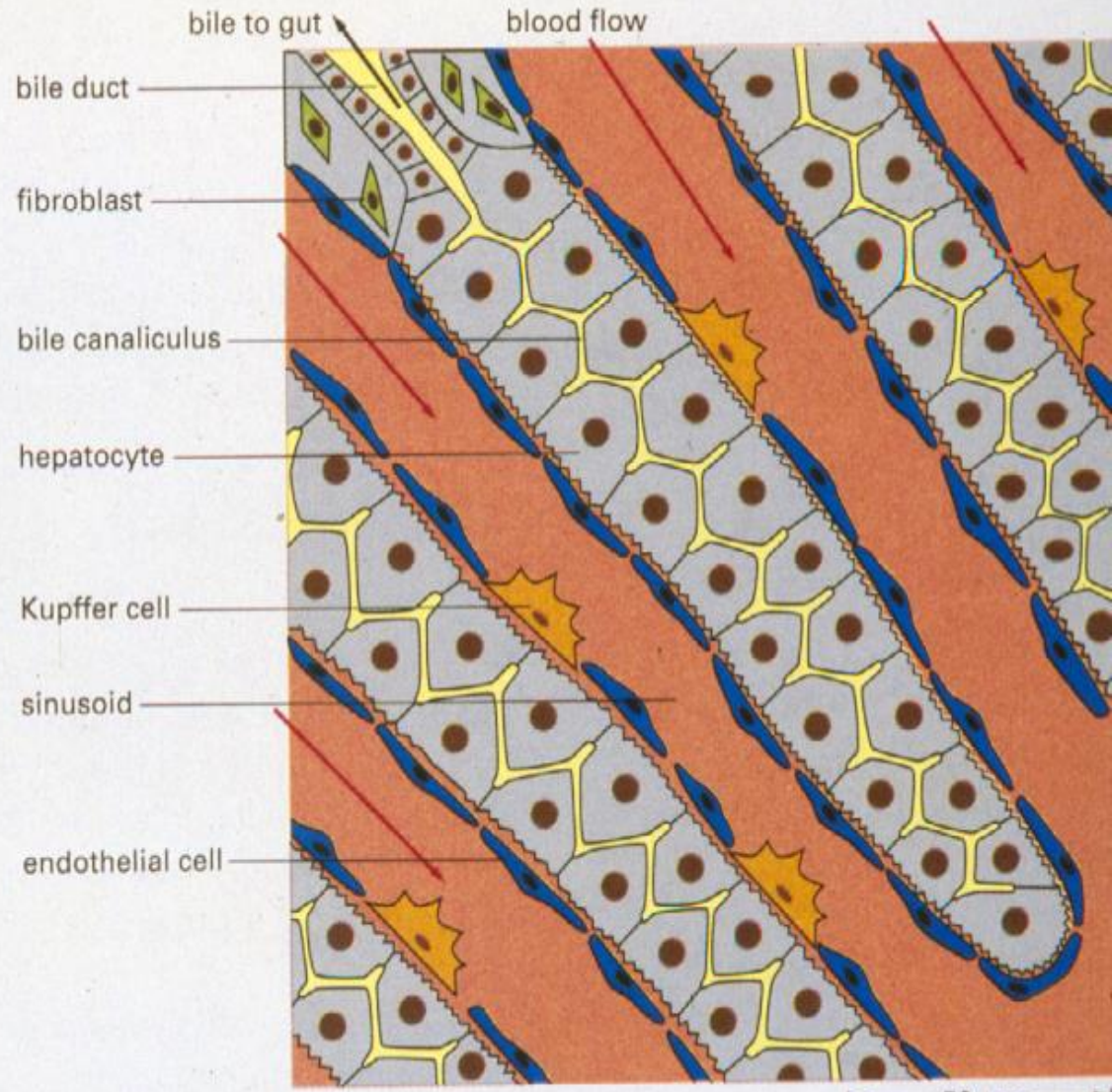


# Liver



(A)

100  $\mu\text{m}$



(B)

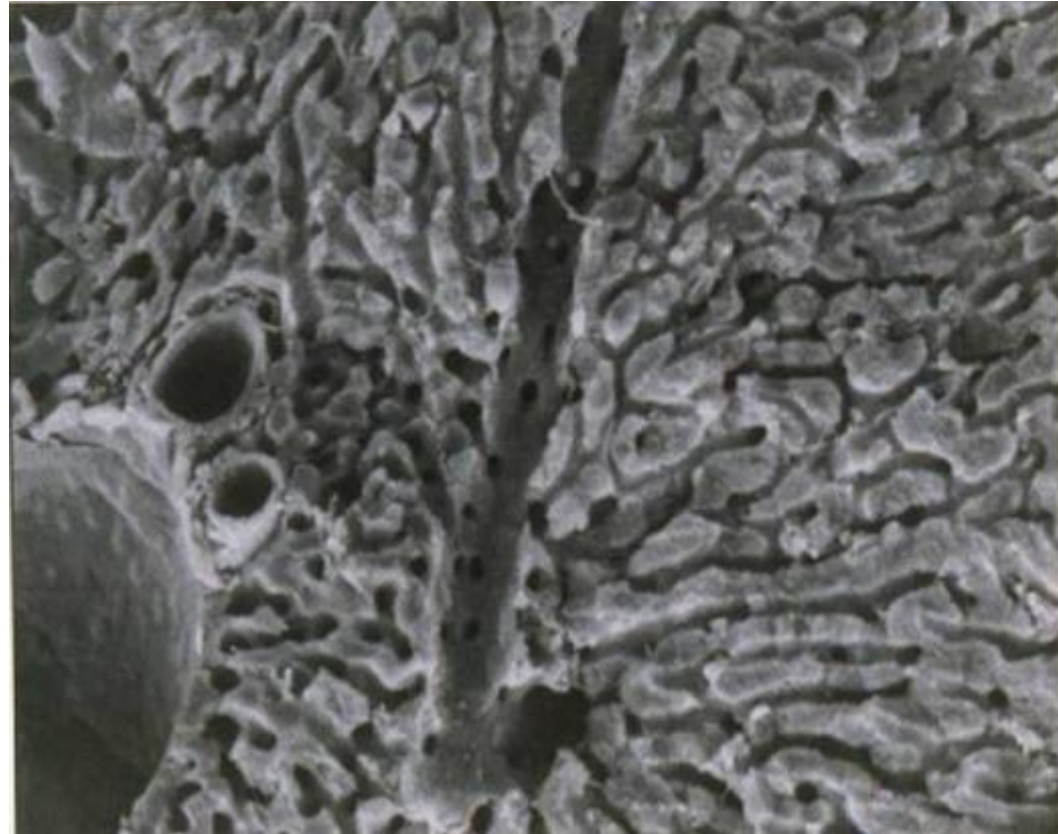
50  $\mu\text{m}$



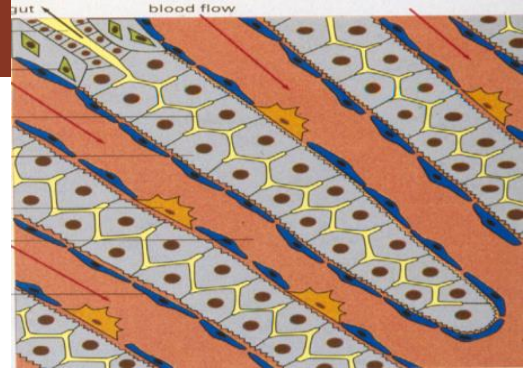
# LIVER FUNCTION - LARGEST GLAND

**EXOCRINE - BILE  
ACIDS, BILIRUBIN**

**ENDOCRINE -  
ALBUMIN,  
FIBRINOGEN, ETC.**



# LIVER FUNCTIONS



**BLOOD FILTRATION  $1.2 \times 10^7$  KUPFFER CELLS/G**

**BLOOD STORAGE - LIVER SIZE AND SINUSOIDS EXPAND**

**MAINTAIN NORMAL BLOOD GLUCOSE CONCENTRATIONS**

**METABOLISM AND TRANSPORT OF LIPIDS**

**SECRETE PLASMA PROTEINS - BLOOD CLOTTING**

**NUTRITIONAL METABOLISM AND BILE SECRETION**

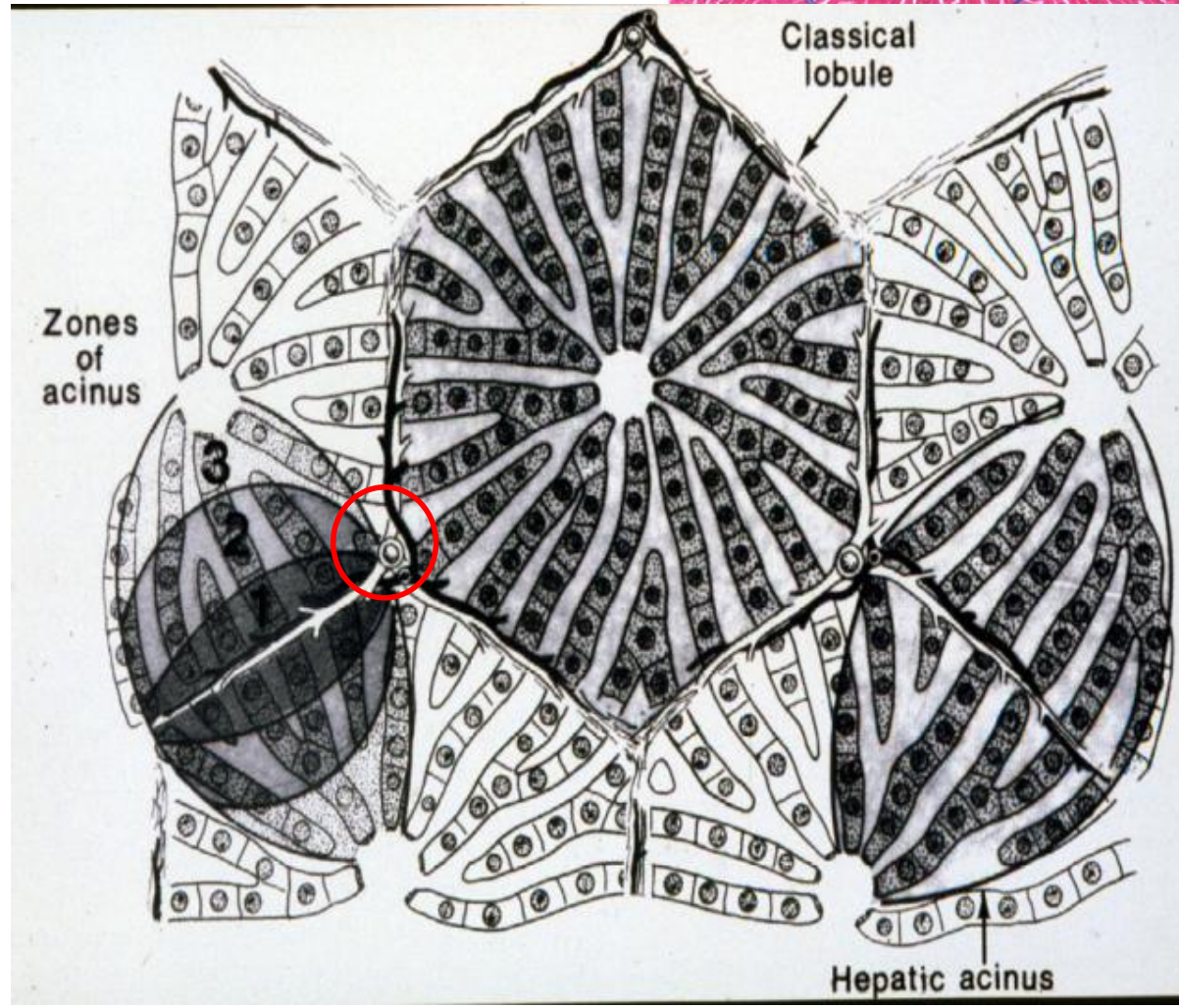
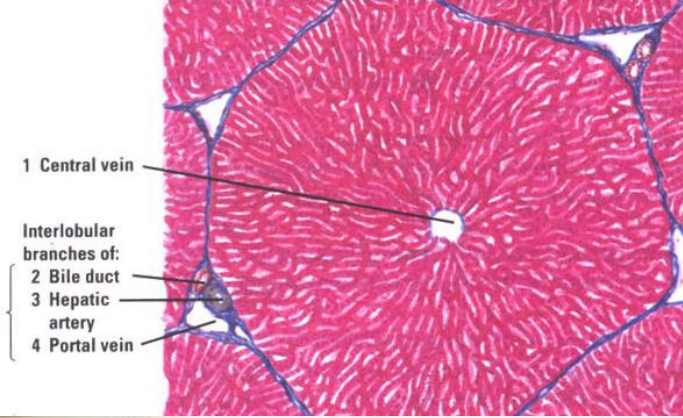
**DRUG METABOLISM - SER DRUG TOLERANCE**

**EXCRETION OF BILIRUBIN - JAUNDICE**

**SECRETE BILE - EMULSIFYING FATS**

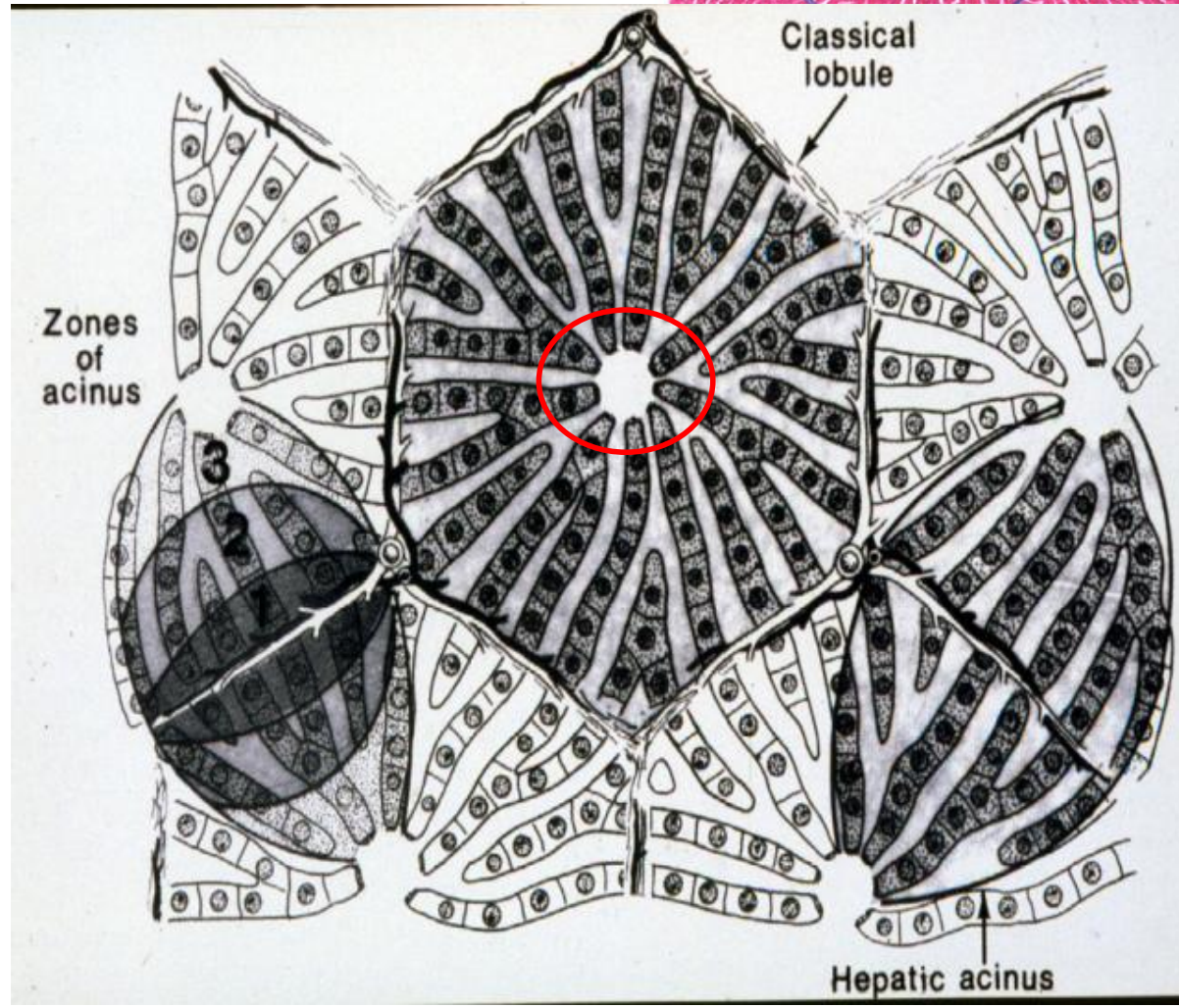
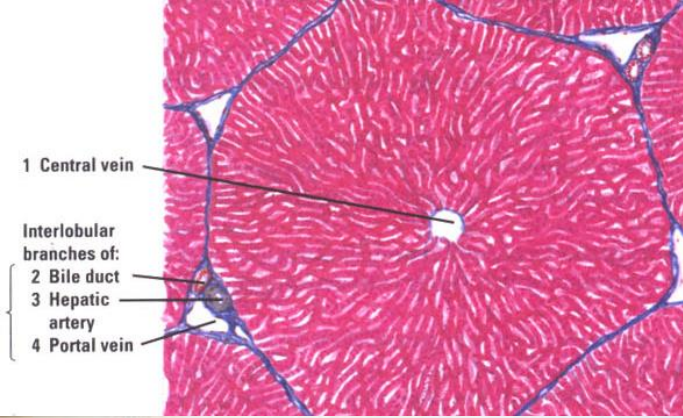
# LIVER LOBULE

## PORTAL TRIAD BLOOD SUPPLY



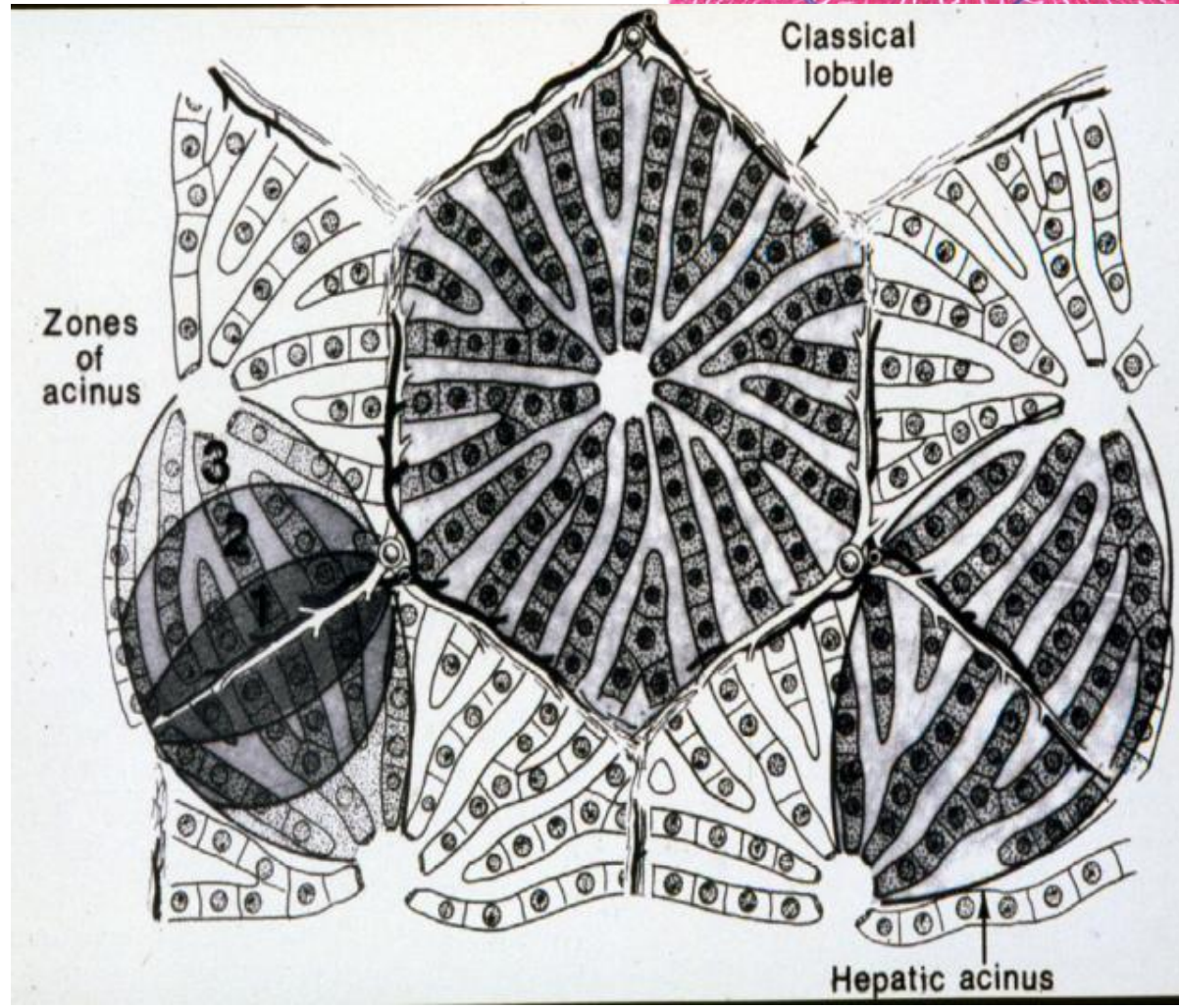
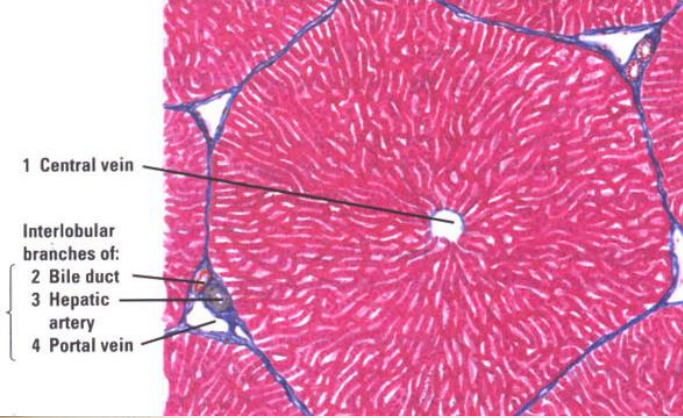
# LIVER LOBULE

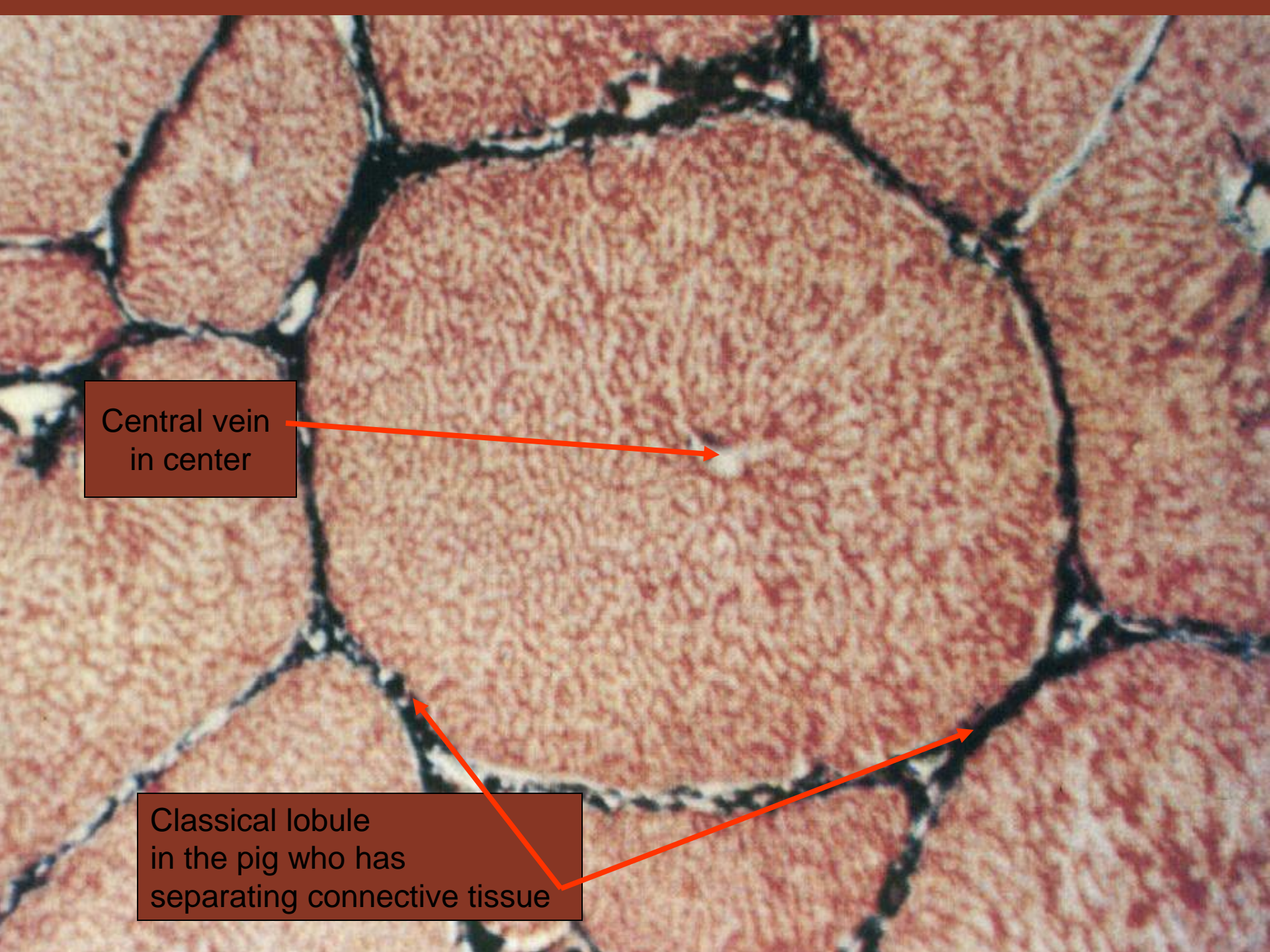
PORTAL TRIAD  
BLOOD SUPPLY  
CENTRAL VEIN  
HEPATIC  
SINUSOIDES



# LIVER LOBULE

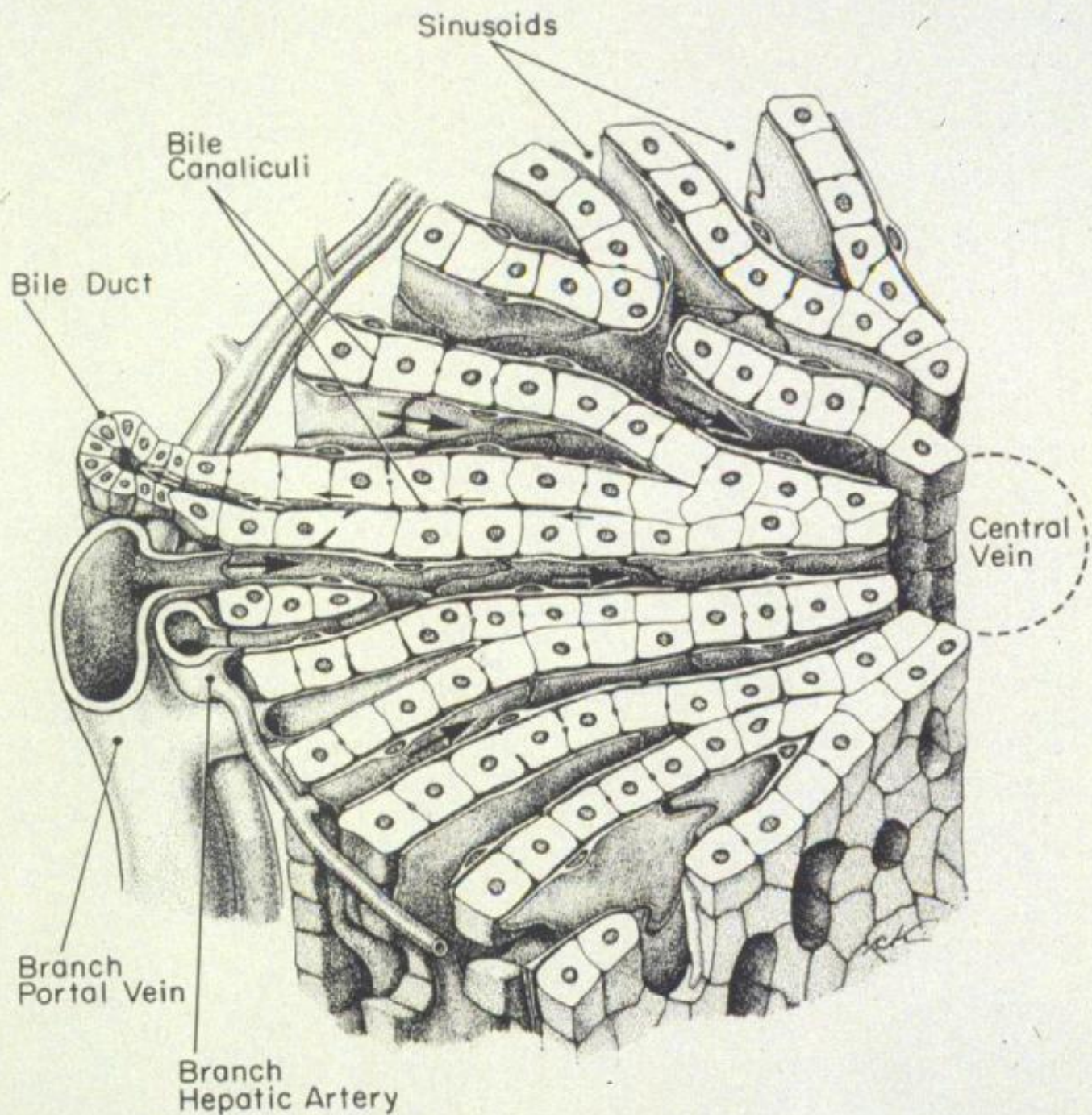
PORTAL TRIAD  
BLOOD SUPPLY  
CENTRAL VEIN  
HEPATIC  
SINUSOIDES  
ZONATION OF  
THE LIVER

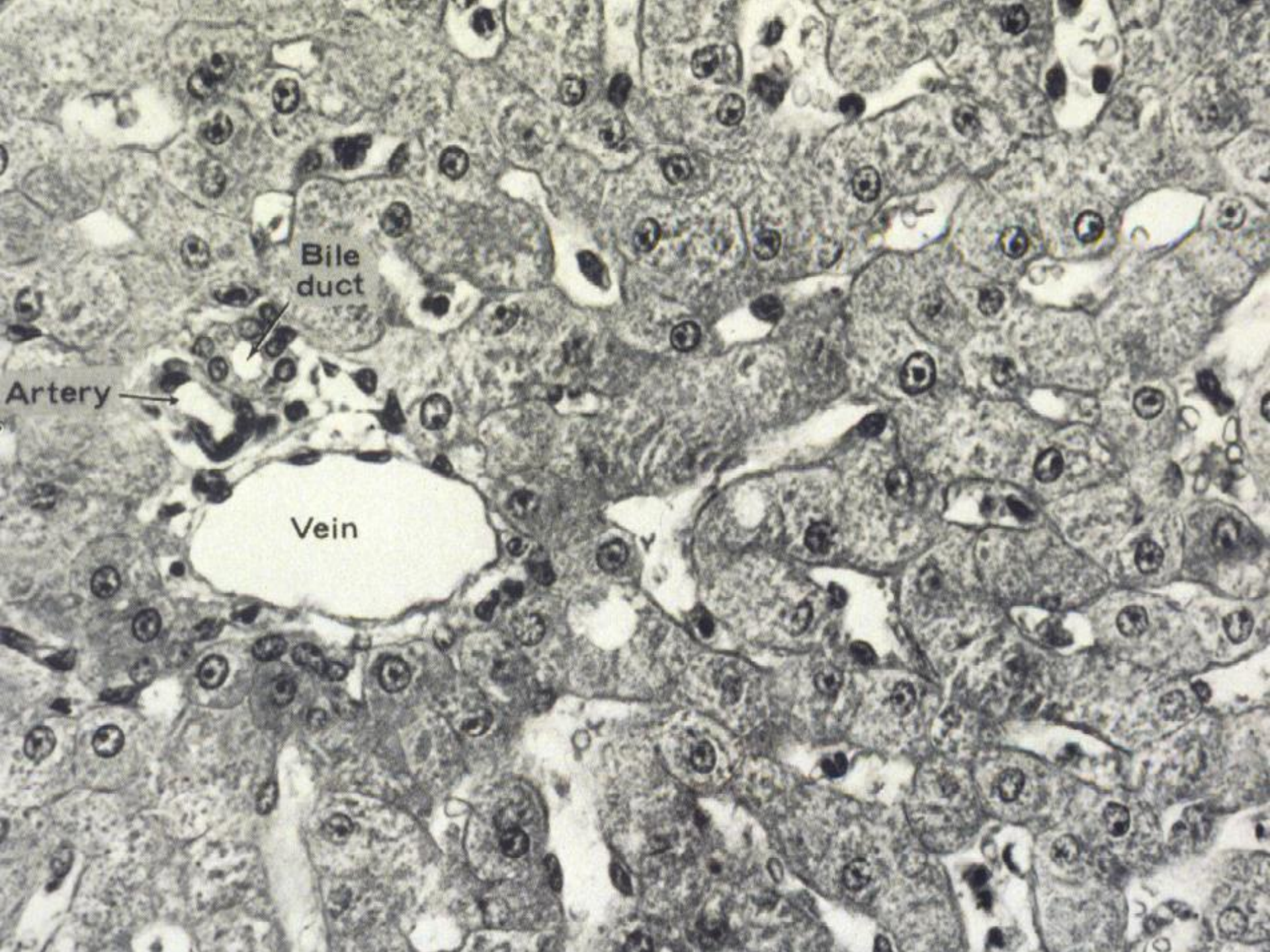




Central vein  
in center

Classical lobule  
in the pig who has  
separating connective tissue



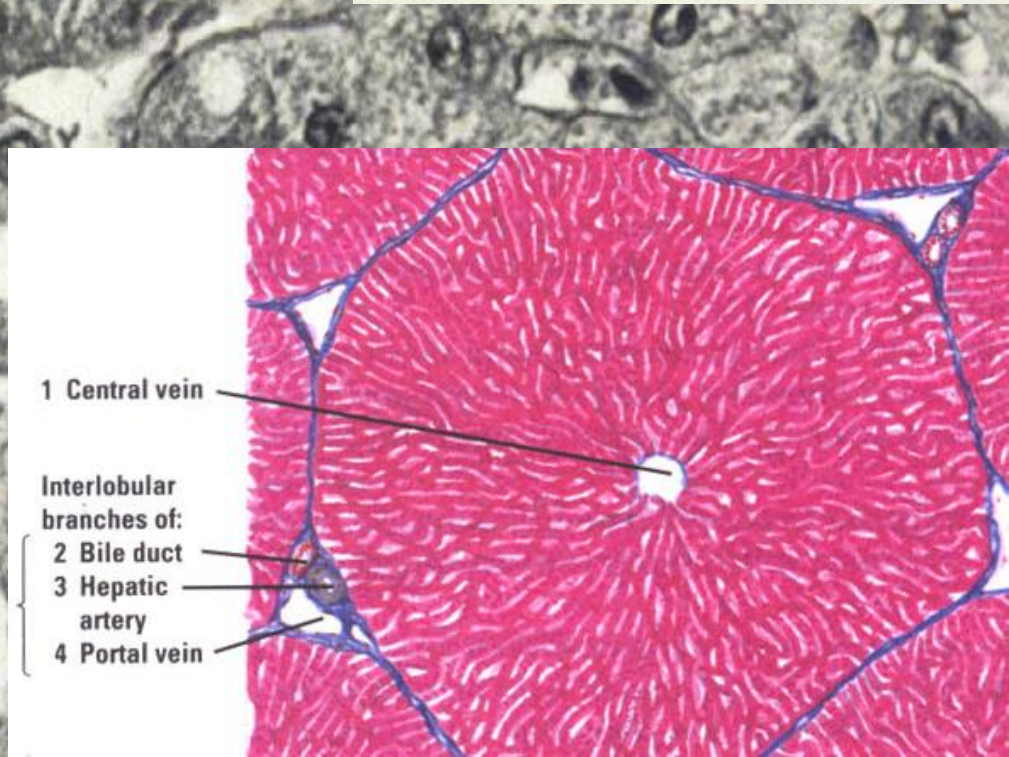
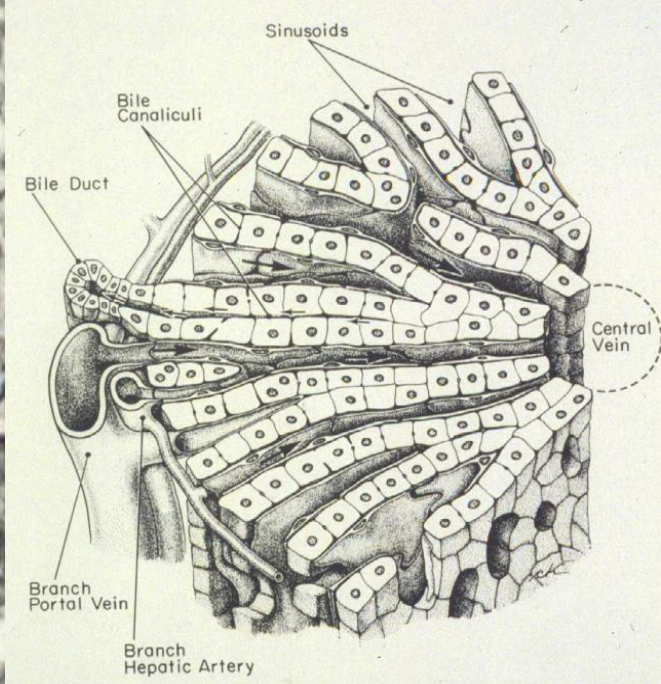
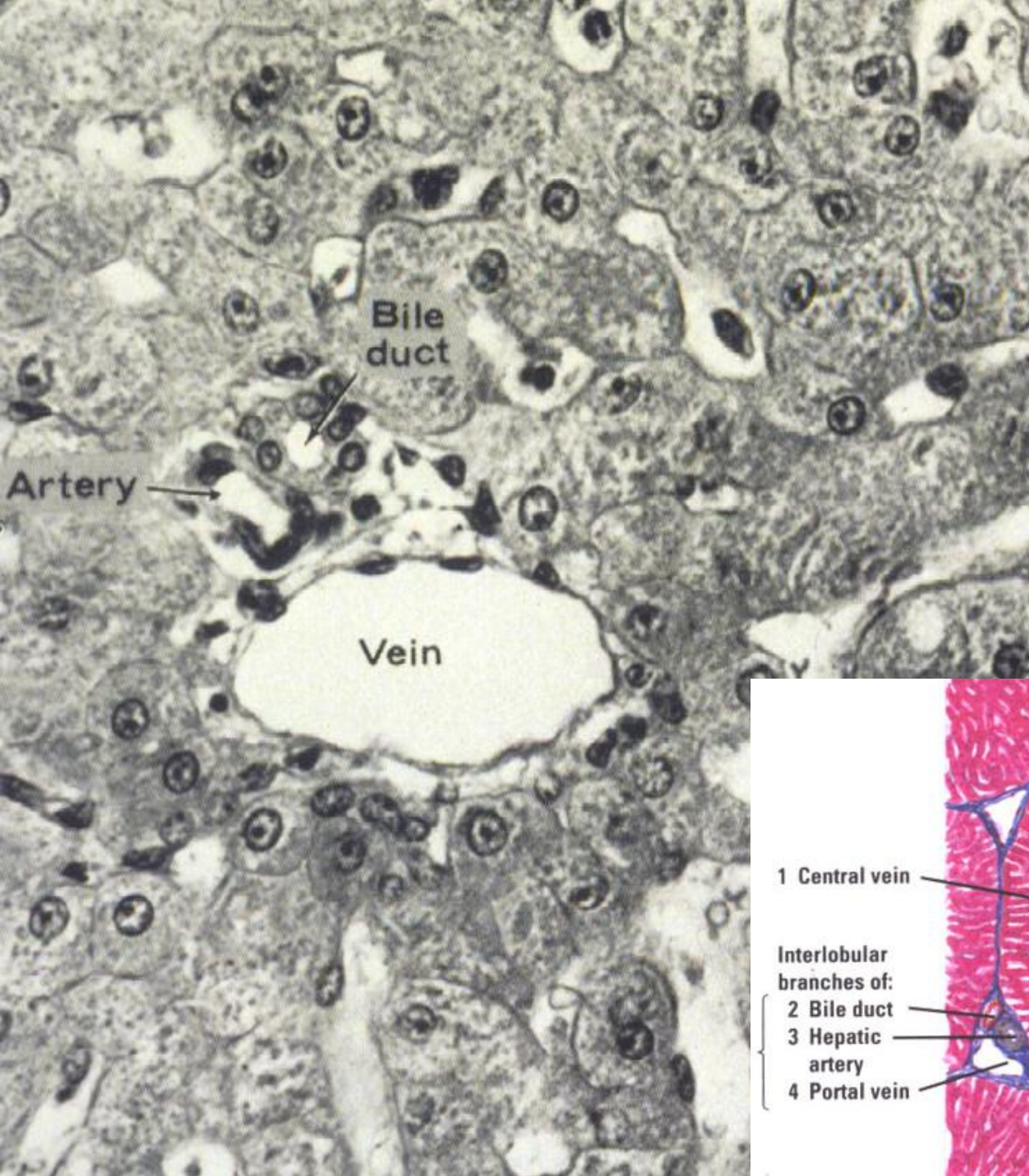


Bile duct

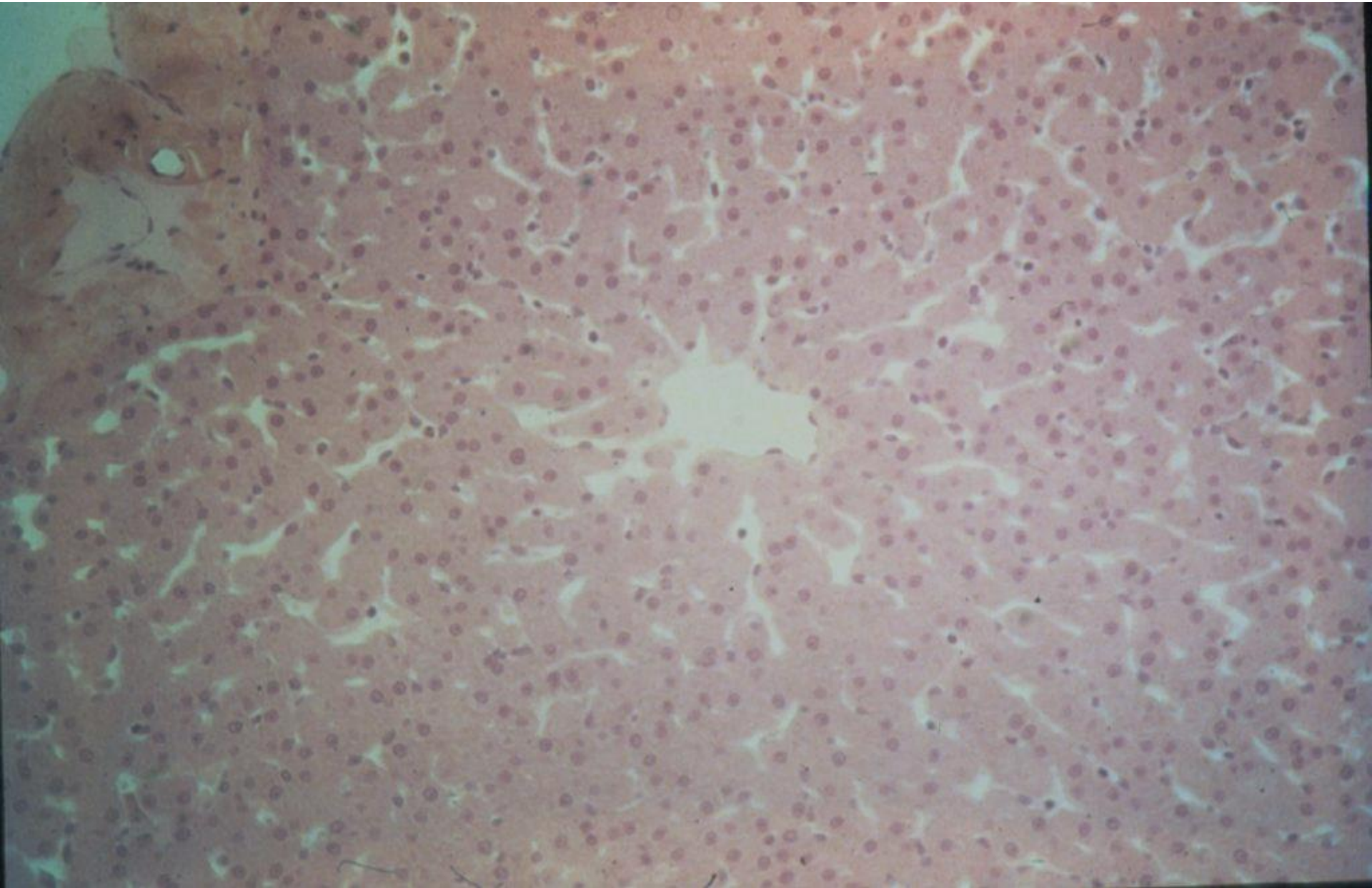
Artery

Vein

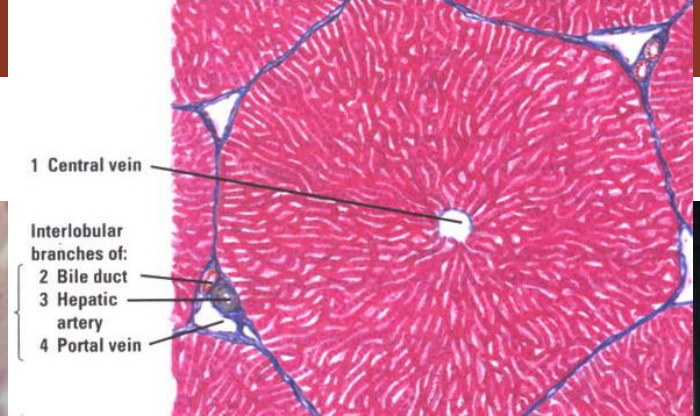
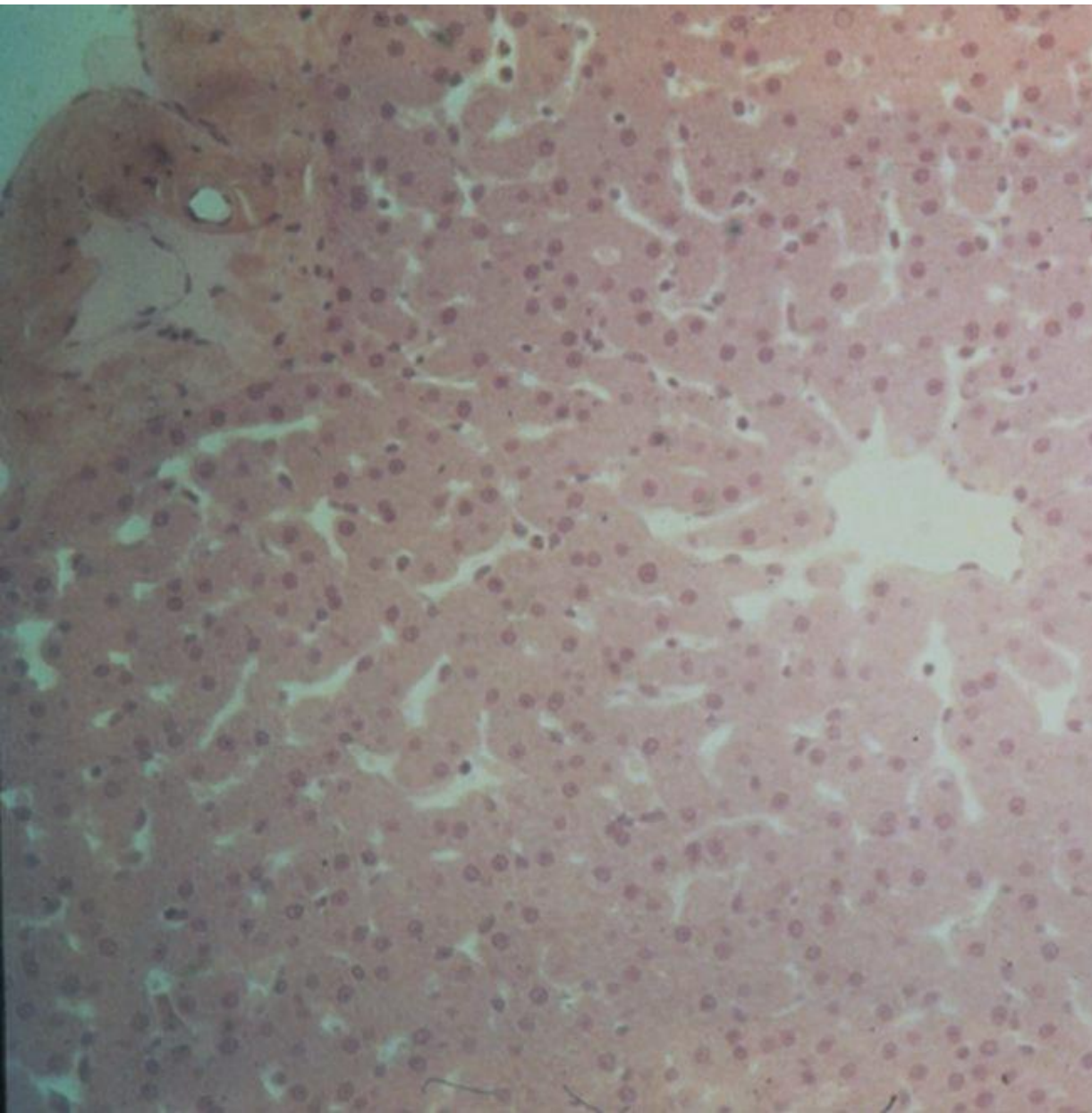




liver



# liver

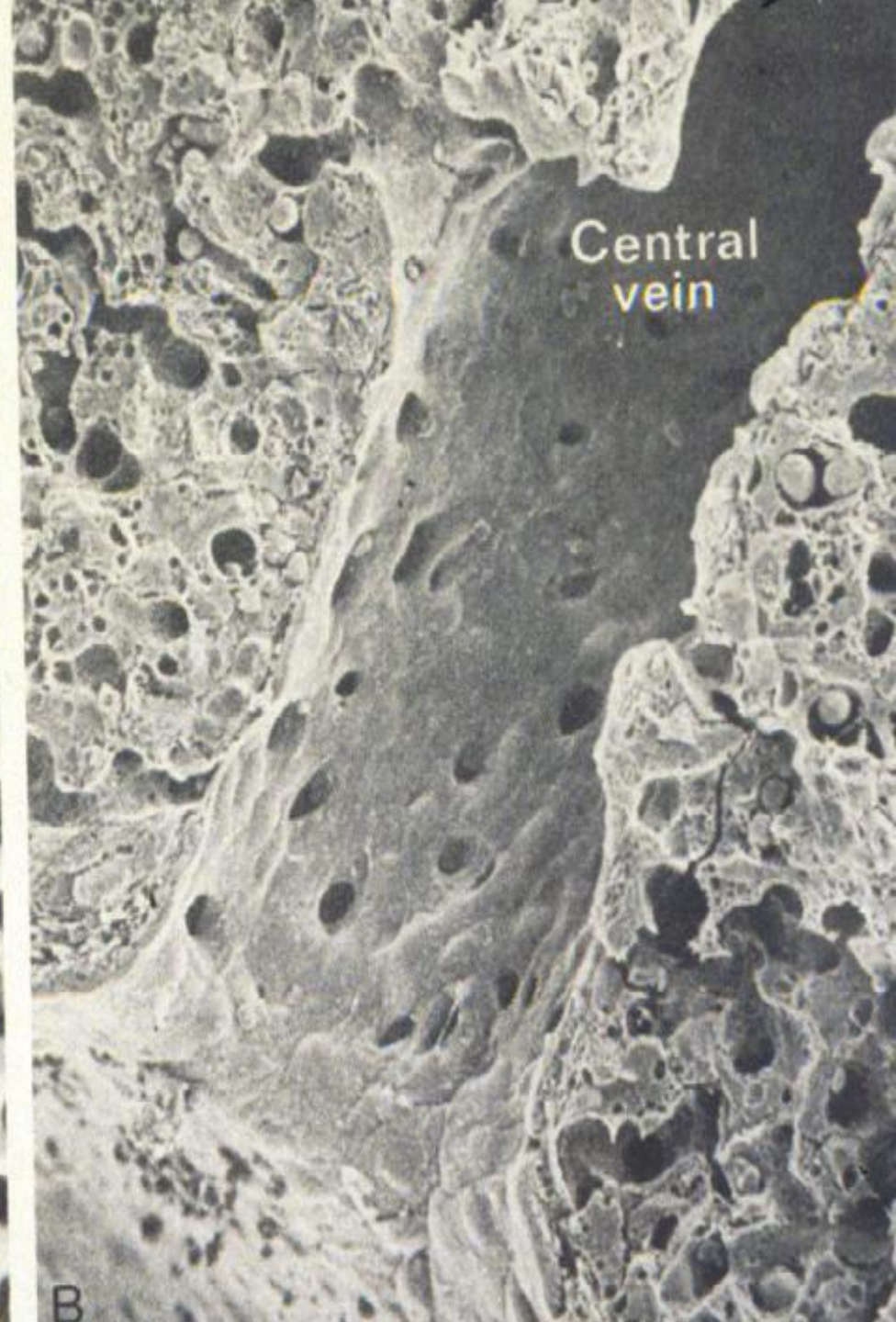
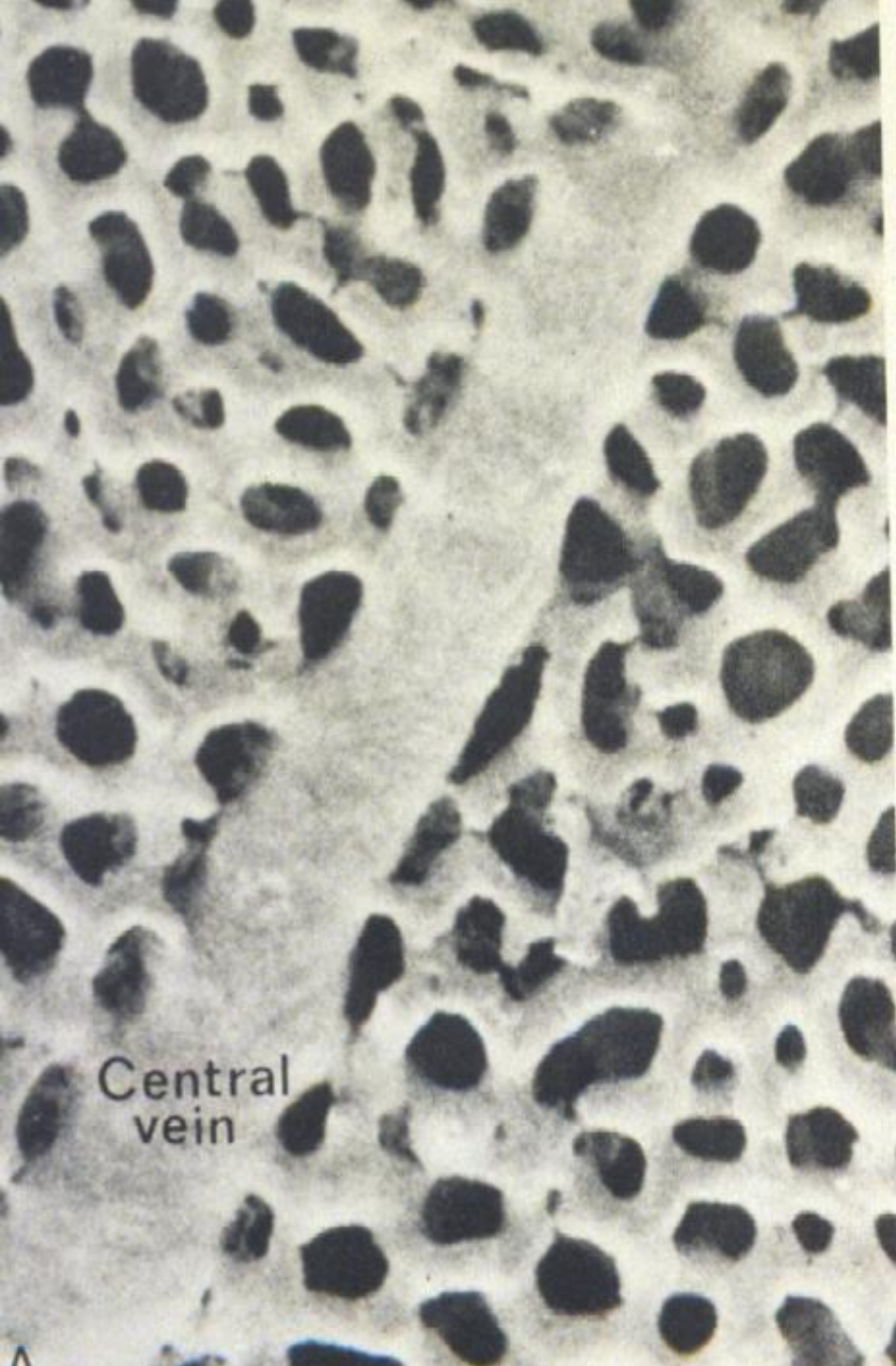




Artery

Vein

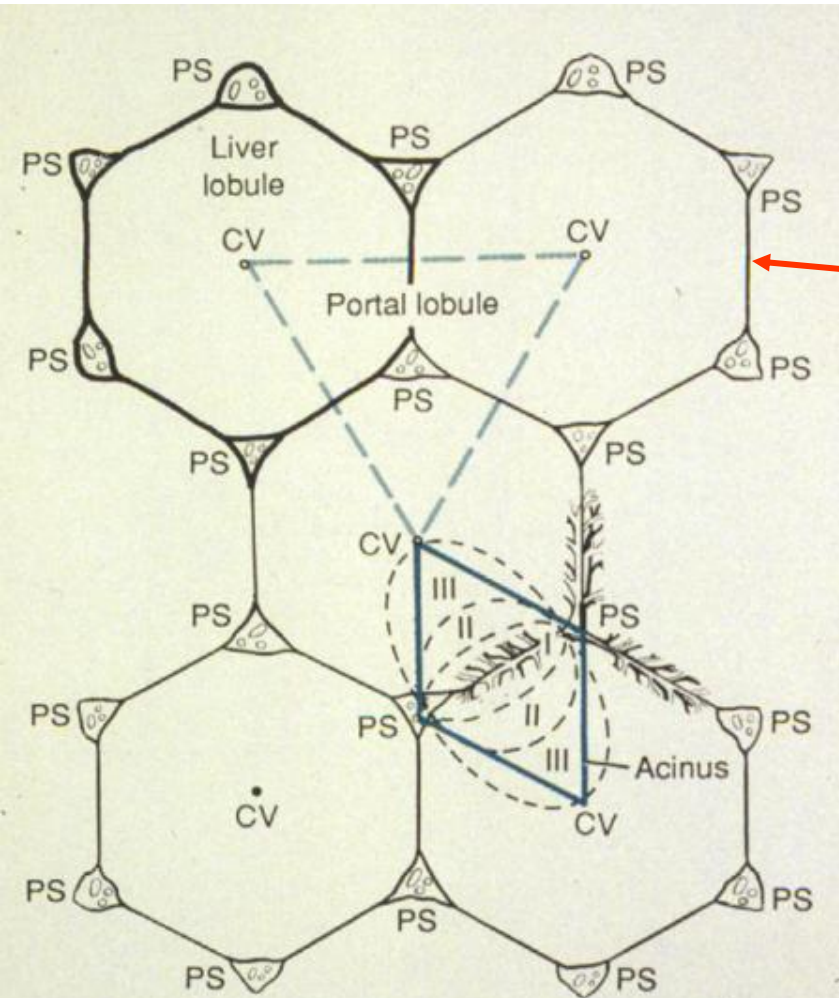
Sinusoids



# Acinus with portal vein and artery in center

## ZONATION OF THE LIVER

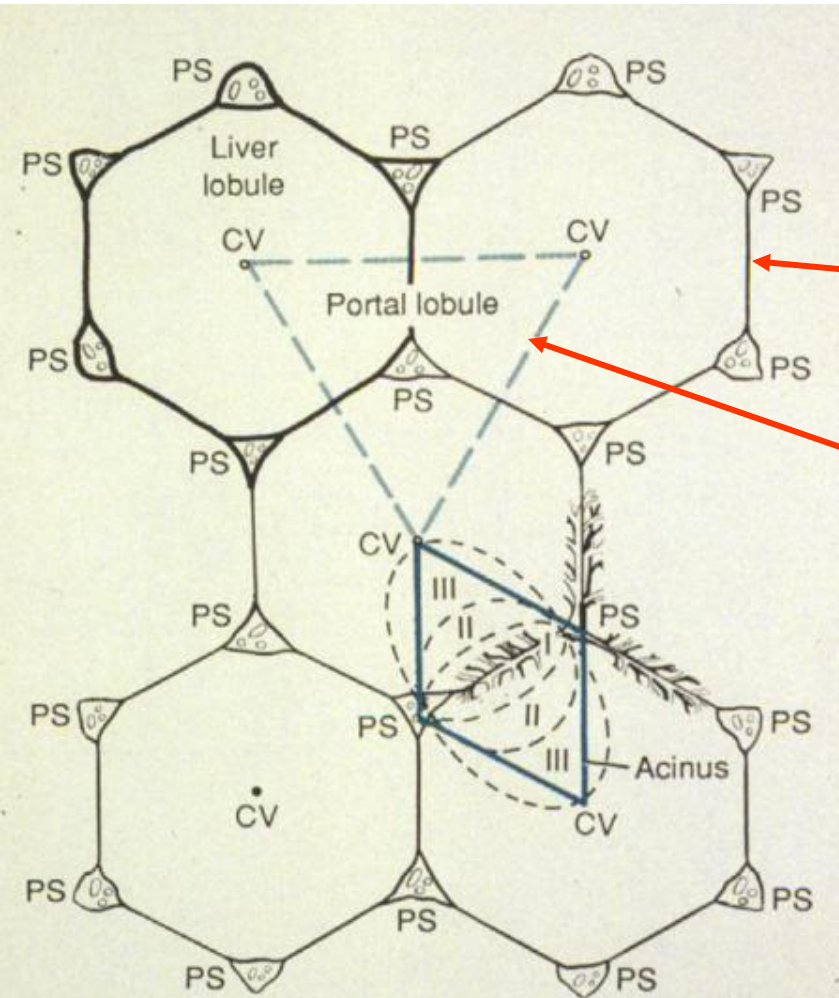
Classical lobule



**Figure 16-16.** Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces

# Acinus with portal vein and artery in center

## ZONATION OF THE LIVER



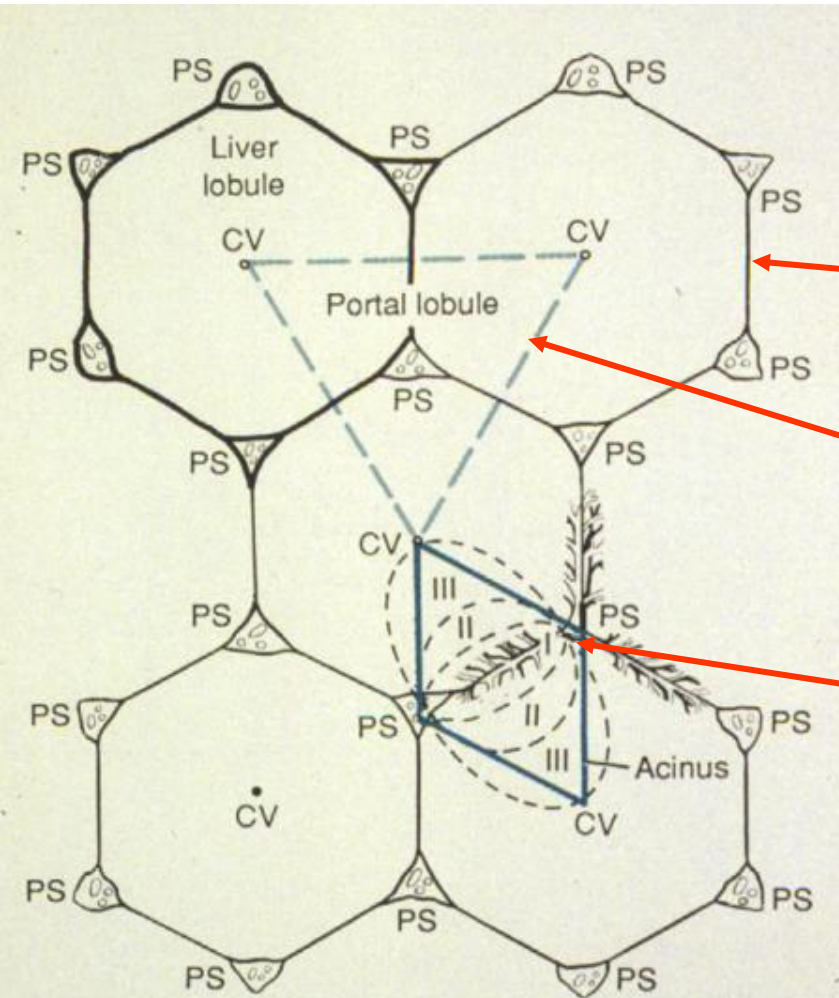
Classical lobule

Portal lobule with triad in center

**Figure 16-16.** Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces

# Acinus with portal vein and artery in center

## ZONATION OF THE LIVER



Classical lobule

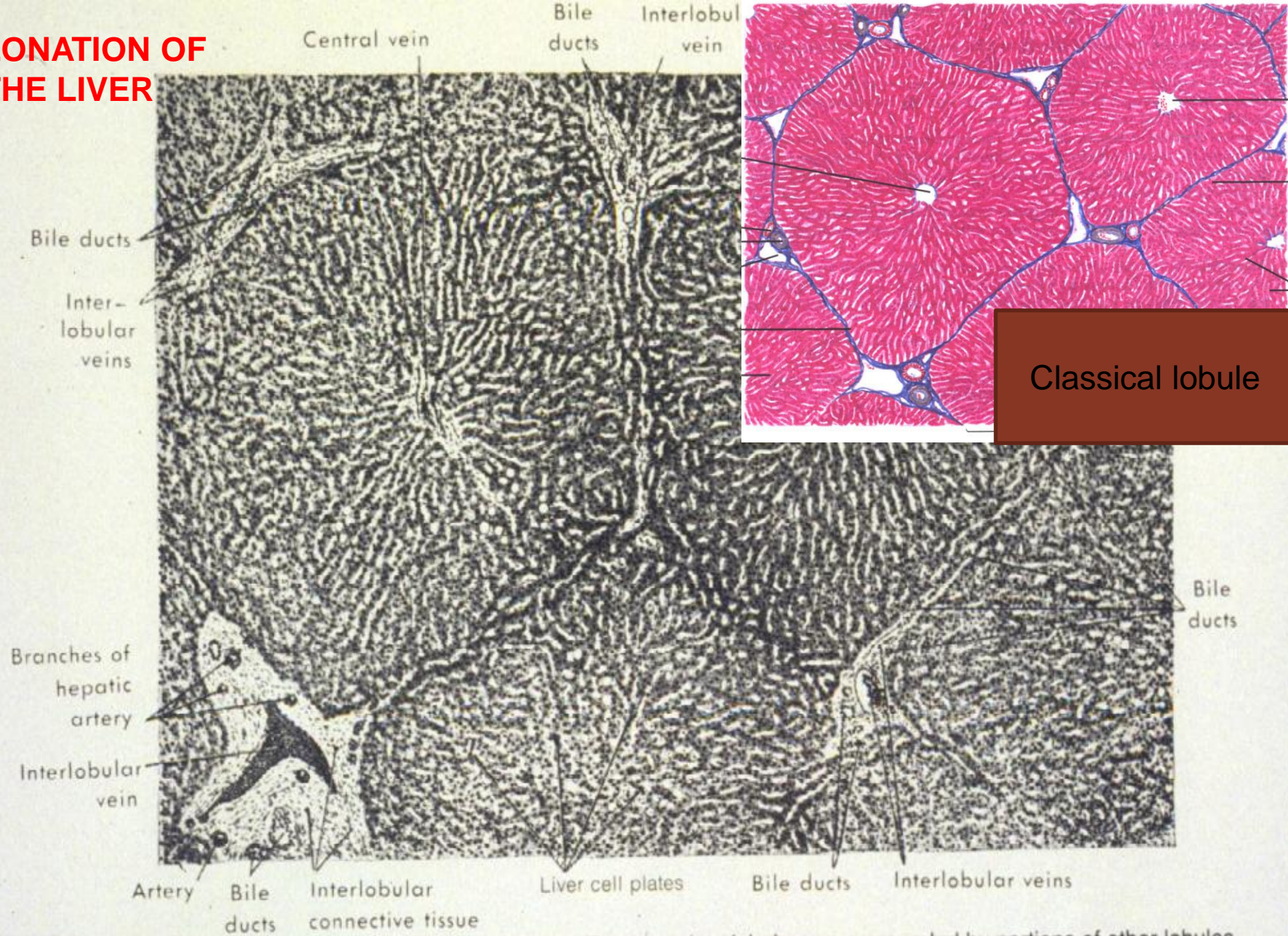
Portal lobule with triad  
in center

Acinus layers between  
two central veins

**Figure 16-16.** Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces

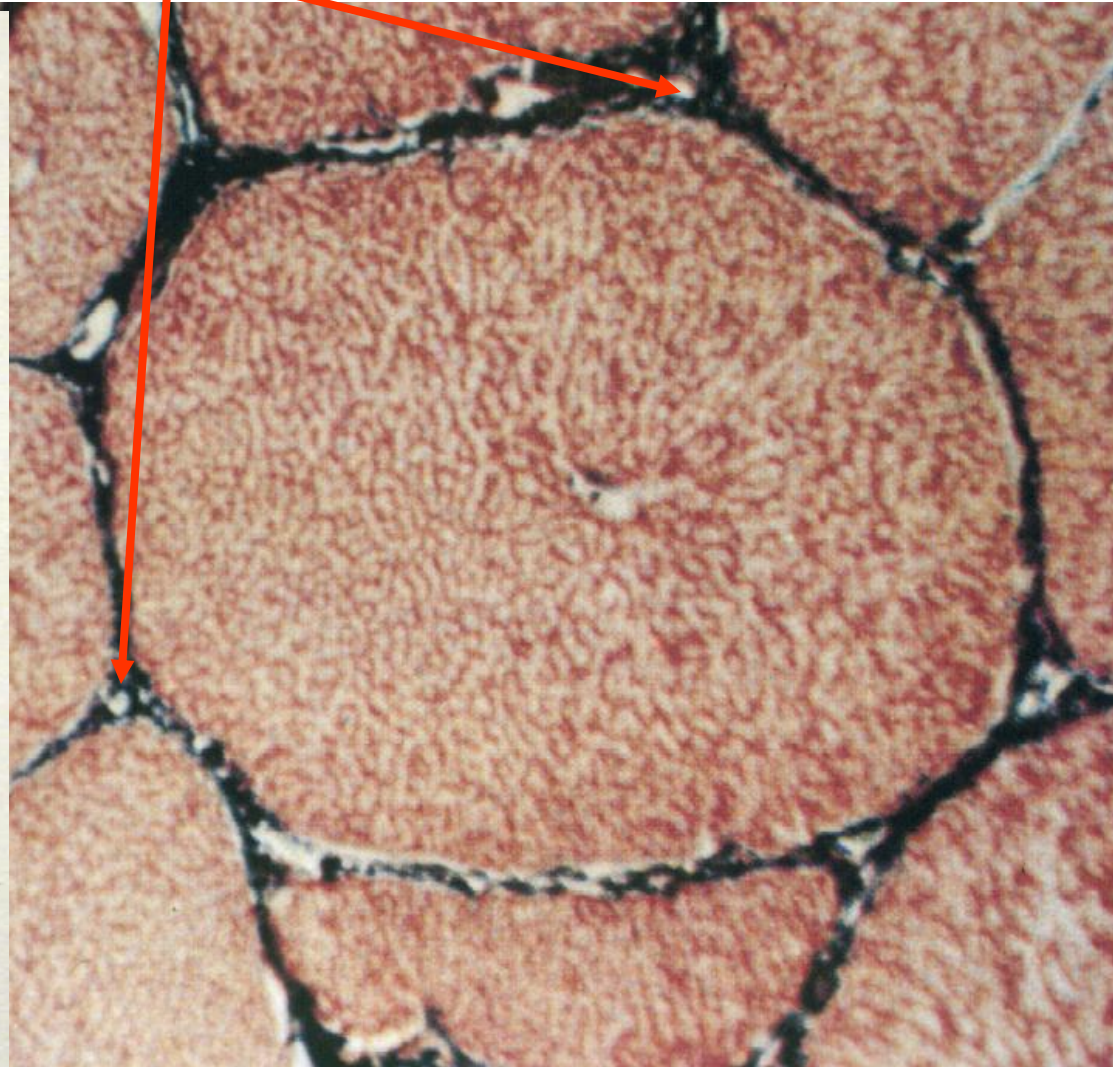
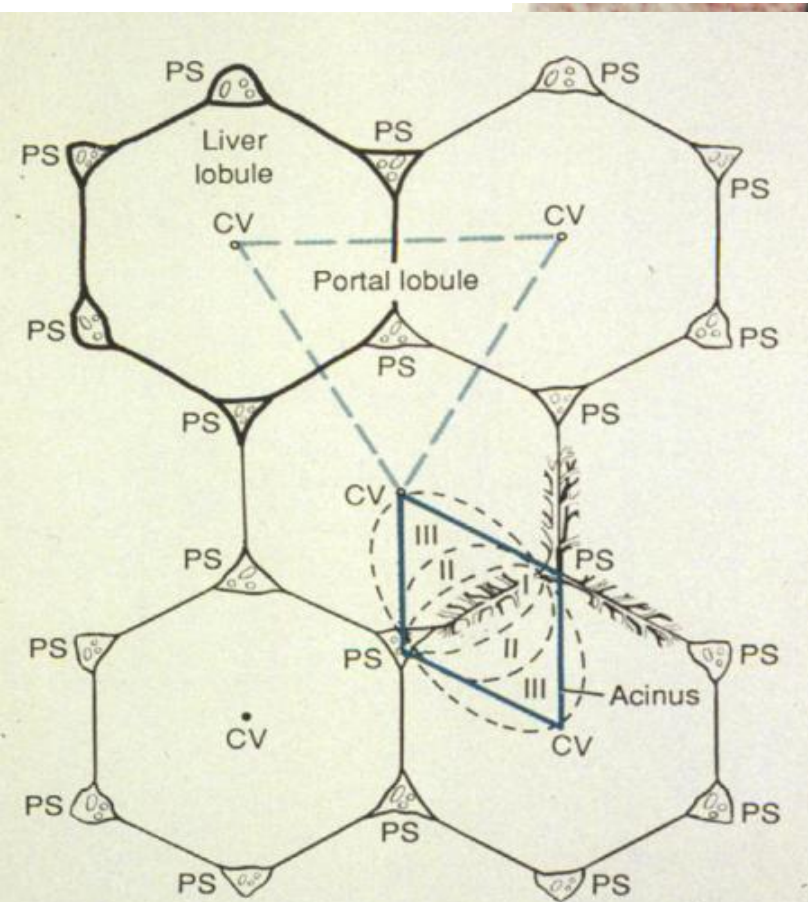


# ZONATION OF THE LIVER



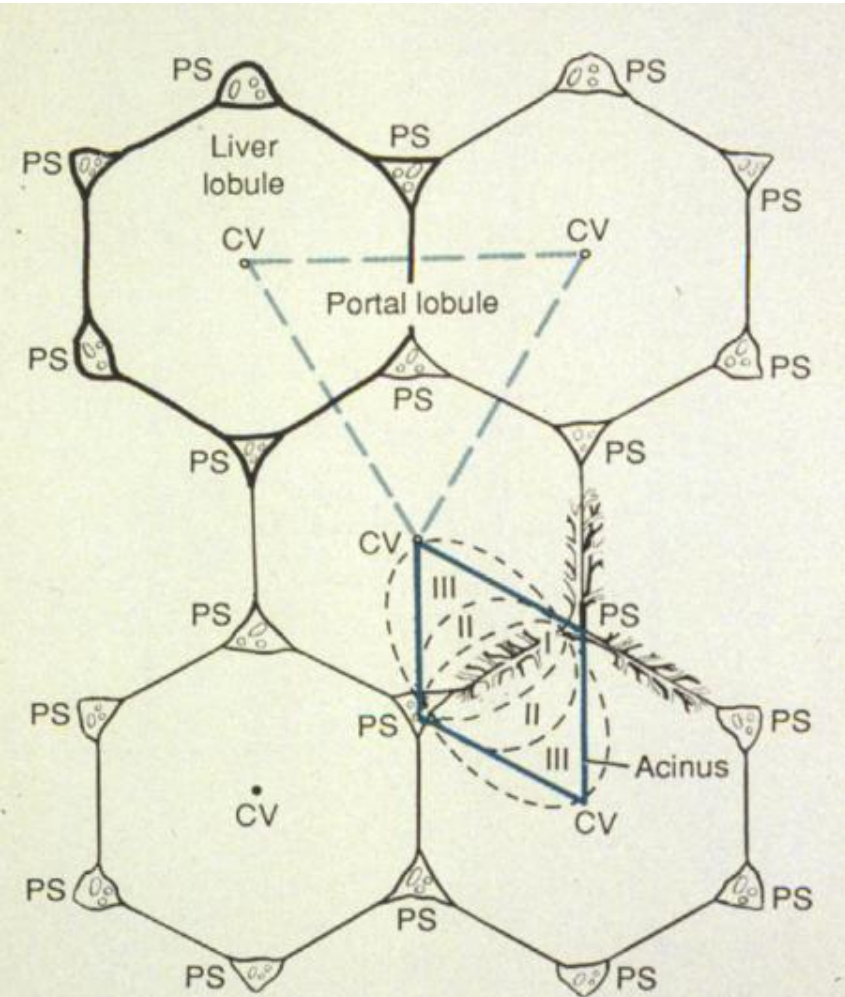
**Figure 27-2.** Portion of liver from a 22-year-old man. Two complete lobules are surrounded by portions of other lobules.  $\times 70$ . (After Sobotta.)

# Portal lobule with triad in center

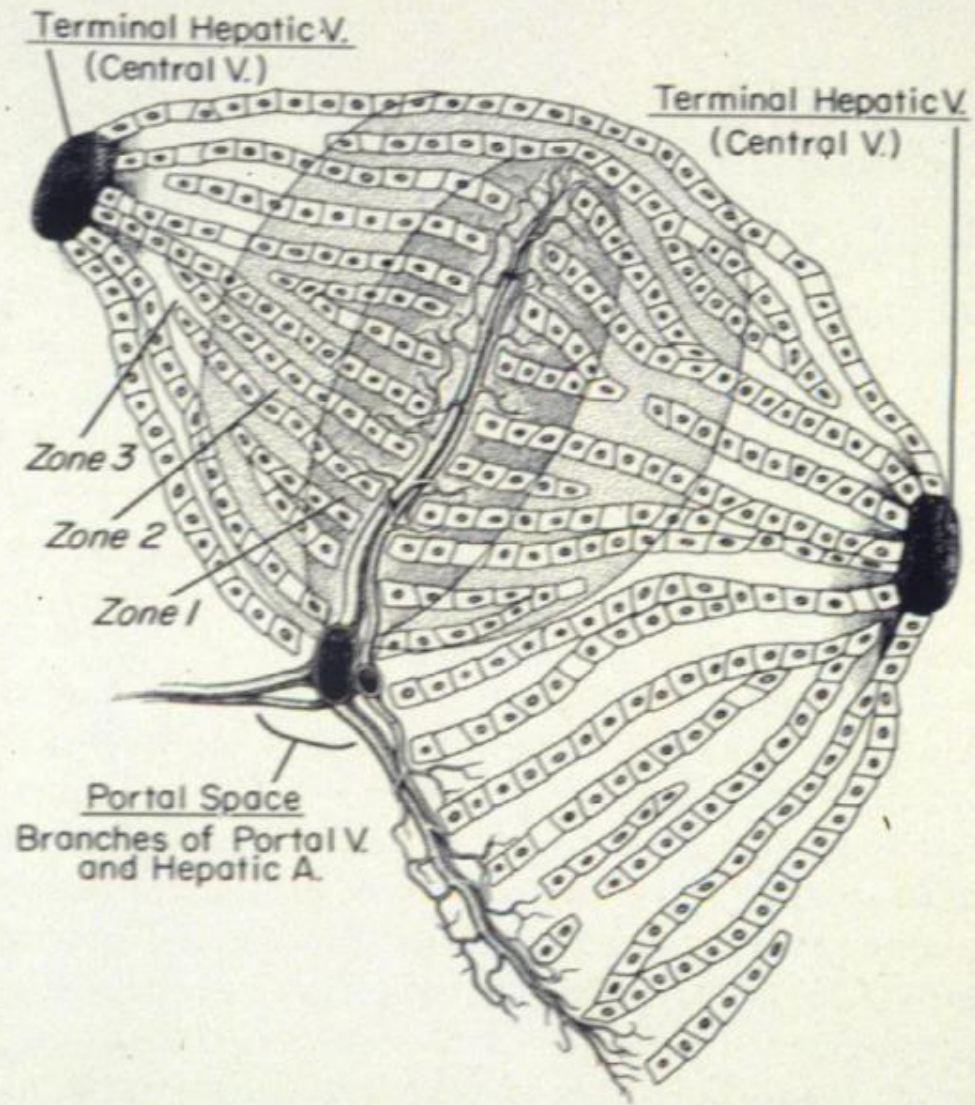


**Figure 16-16.** Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces (PS). The portal lobule (lighter color) has the central vein (CV) and is outlined by the dashed lines. The hepatic acinus (dotted line) is the smallest unit of the liver and is outlined by the solid line.

# Acinus with portal vein and artery in center



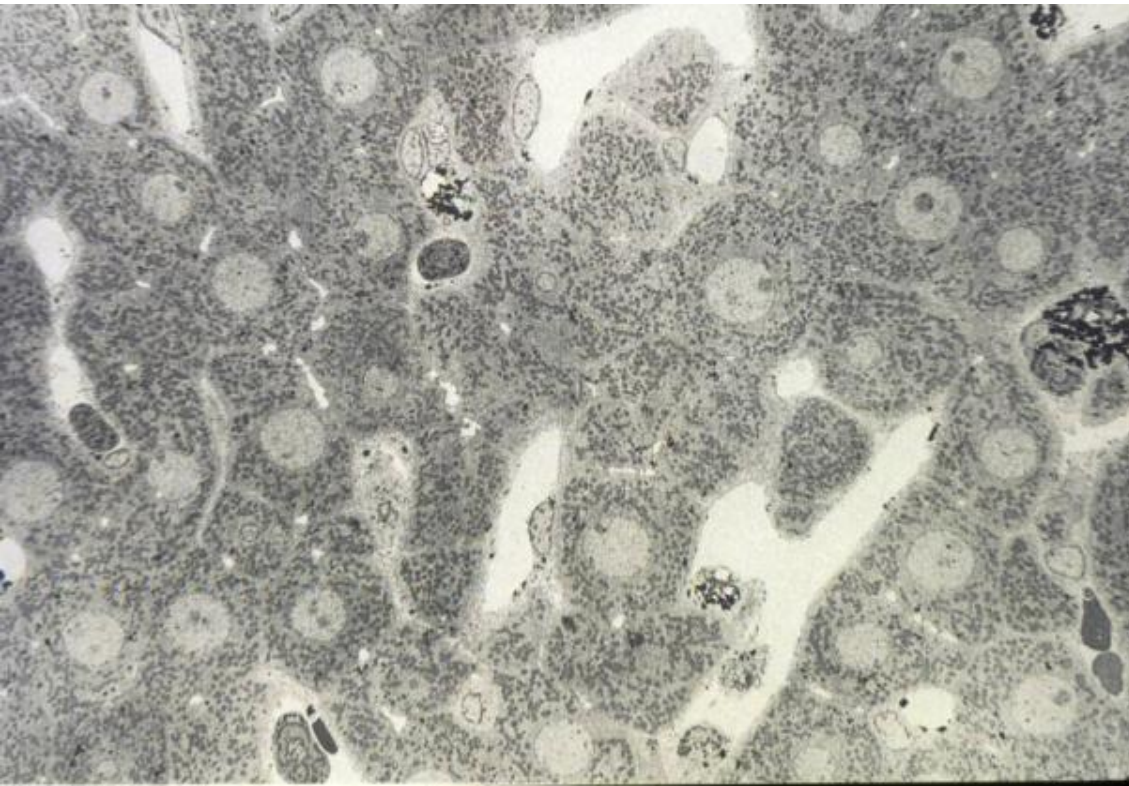
**Figure 16-16.** Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces



**Figure 27-13.** Diagram of the acinus, consisting of parenchyma centered around the terminal branches of the hepatic artery and portal vein. The cells in zone-1 have first call on the incoming oxygen and nutrients. The cells of zone-2 are less favored, and those of zone-3 are least favorably situated. (Redrawn after Rappaport, A.M. et al. 1954. *Anat. Rec.* 119:11.)

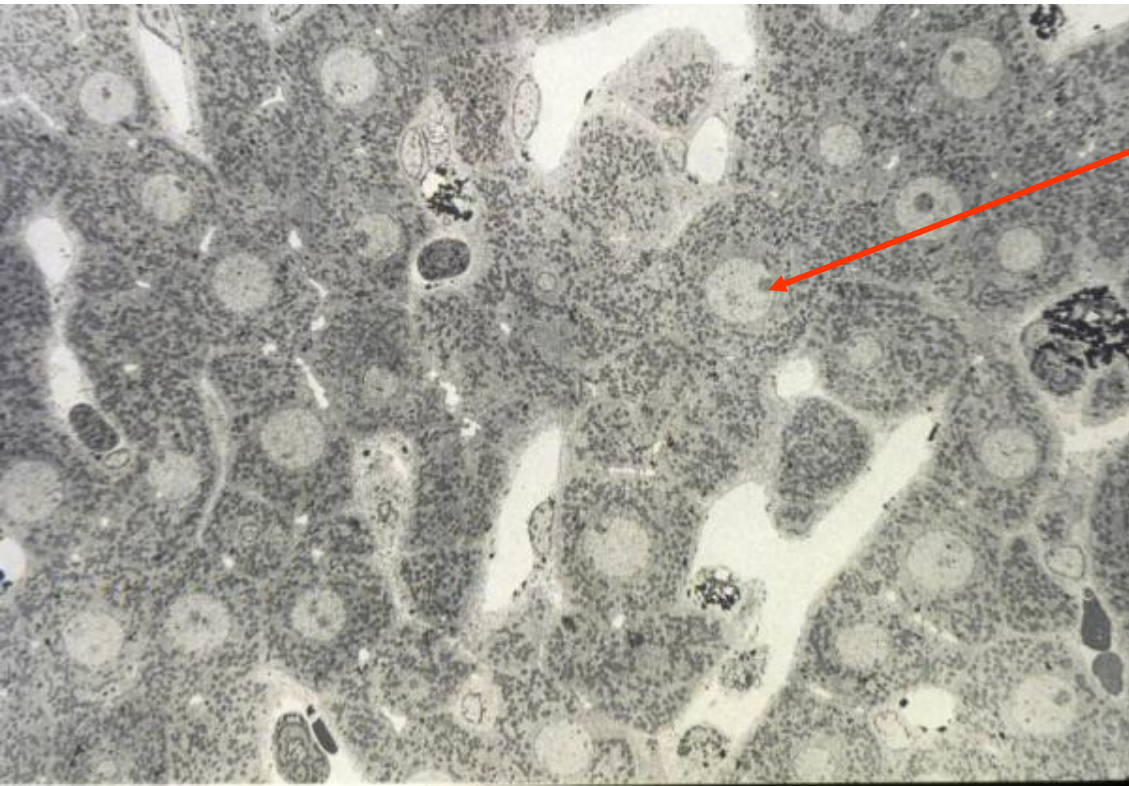
# CELLS OF THE LIVER LOBULE

- A. HEPATOCYTE
- B. KUPFFER AND FAT-STORING CELLS
- C. ENDOTHELIAL CELL



# CELLS OF THE LIVER LOBULE

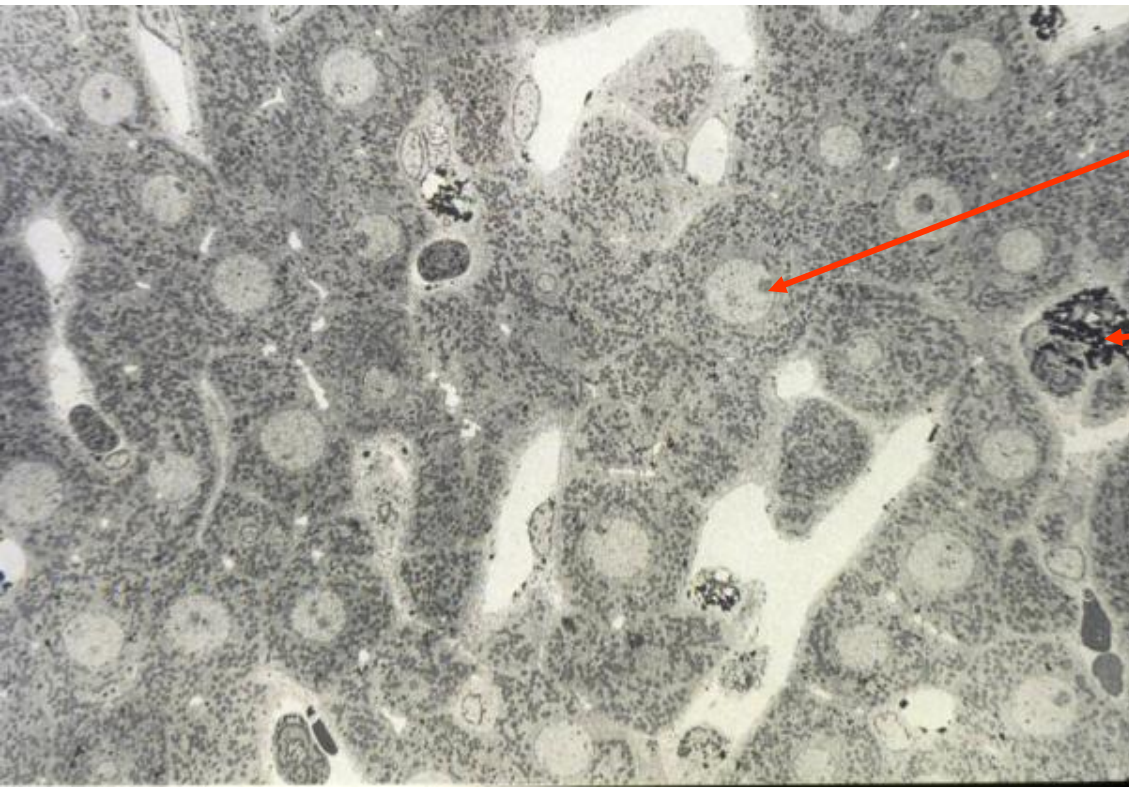
- A. HEPATOCYTE
- B. KUPFFER AND FAT-STORING CELLS
- C. ENDOTHELIAL CELL



HEPATOCYTE

# CELLS OF THE LIVER LOBULE

- A. HEPATOCYTE
- B. KUPFFER AND FAT-STORING CELLS
- C. ENDOTHELIAL CELL

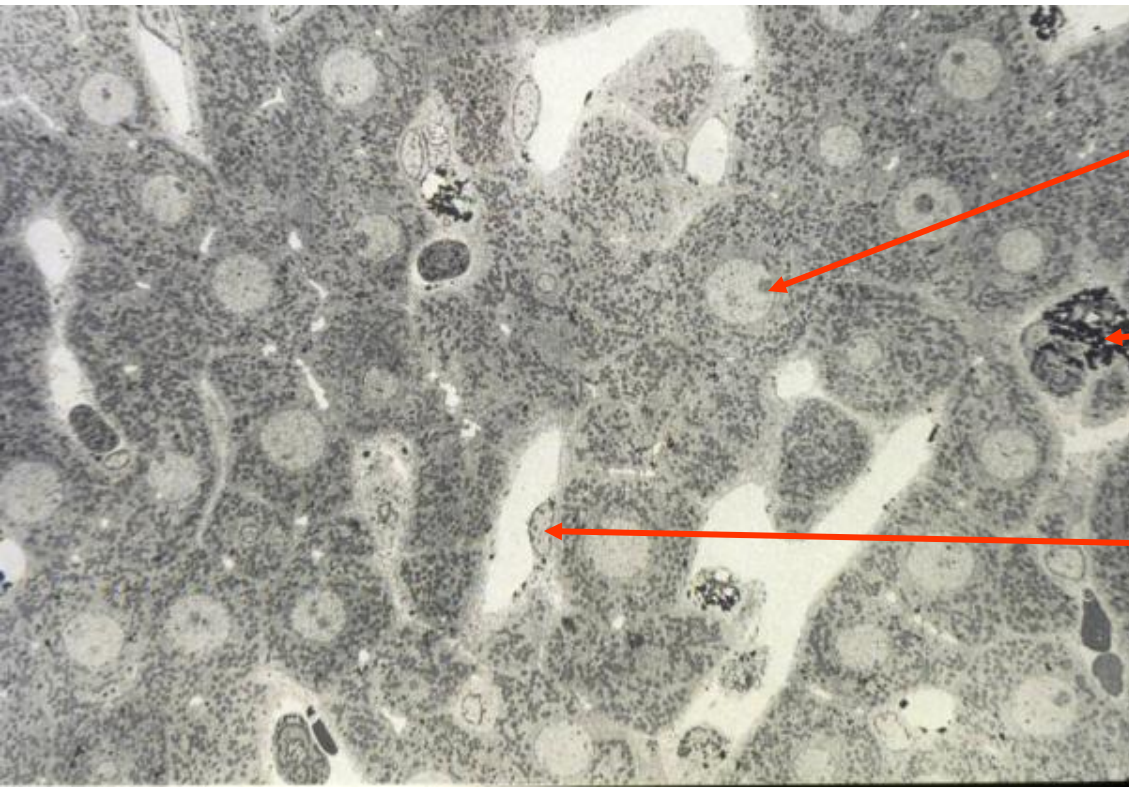


HEPATOCYTE

KUPFFER CELLS

# CELLS OF THE LIVER LOBULE

- A. HEPATOCYTE
- B. KUPFFER AND FAT-STORING CELLS
- C. ENDOTHELIAL CELL



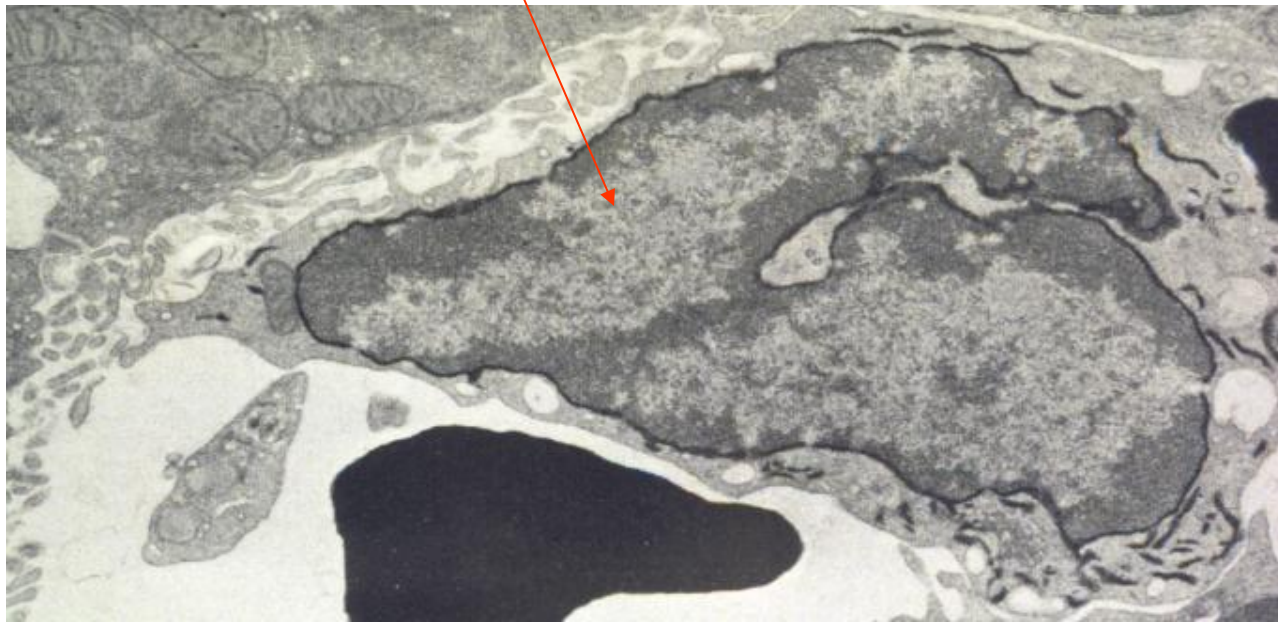
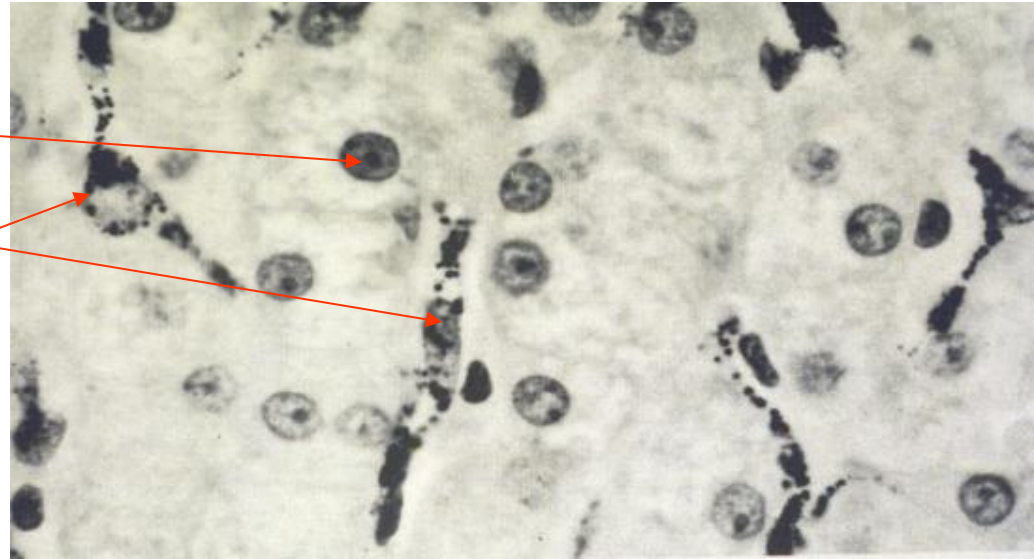
HEPATOCYTE

KUPFFER CELLS

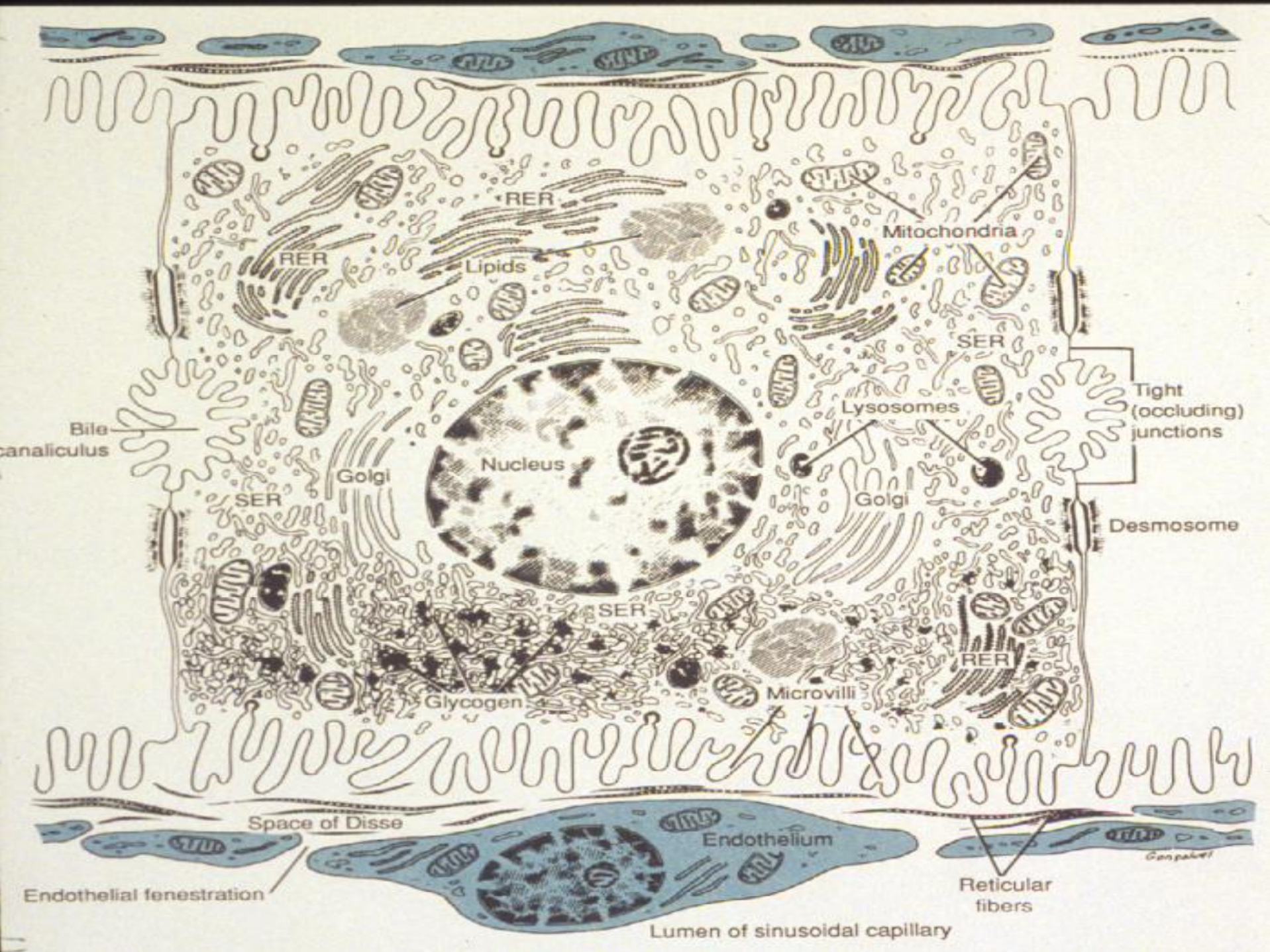
ENDOTHELIAL CELL

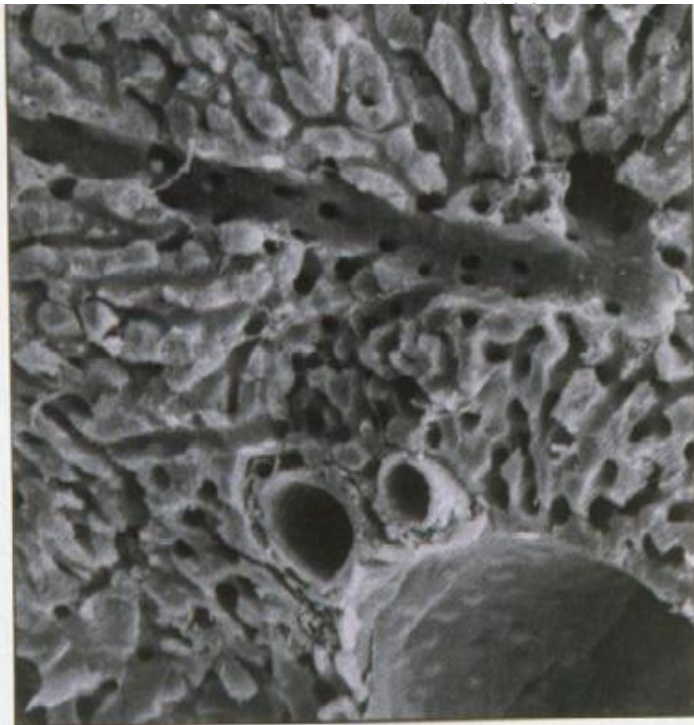
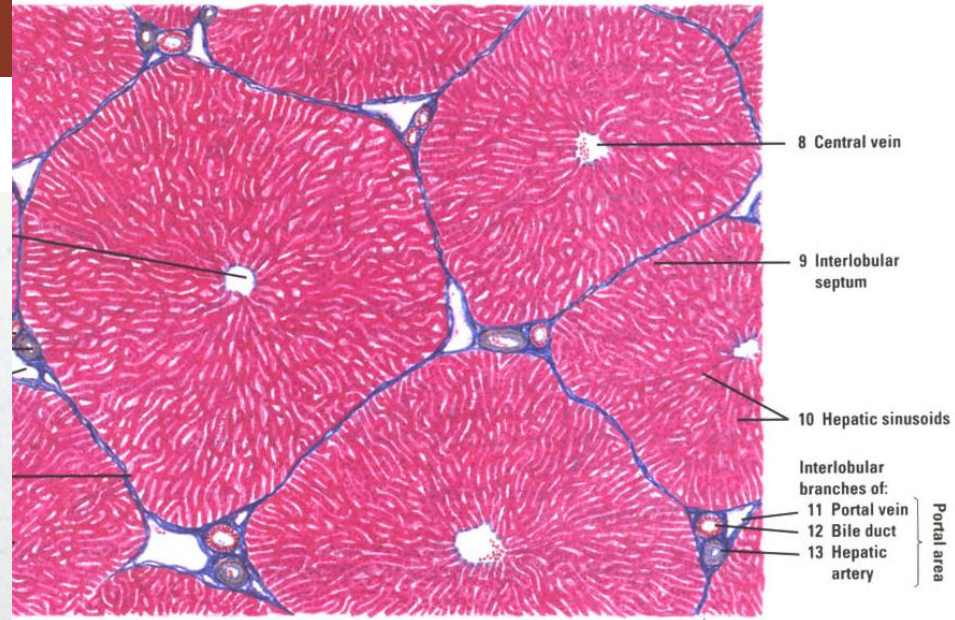
# CELLS OF THE LIVER LOBULE

- A. HEPATOCYTE
- B. KUPFFER CELLS
- C. ENDOTHELIAL CELL



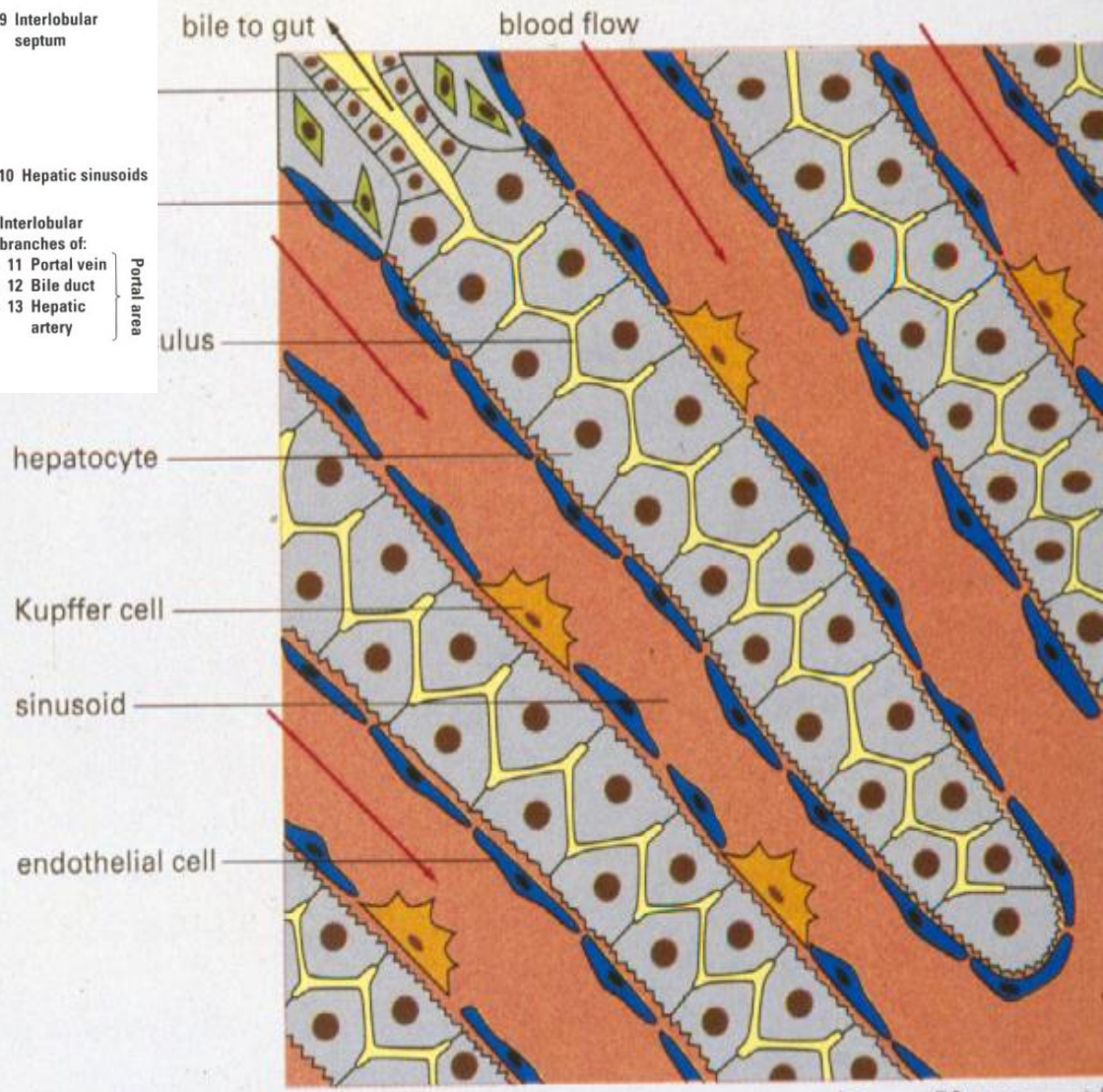






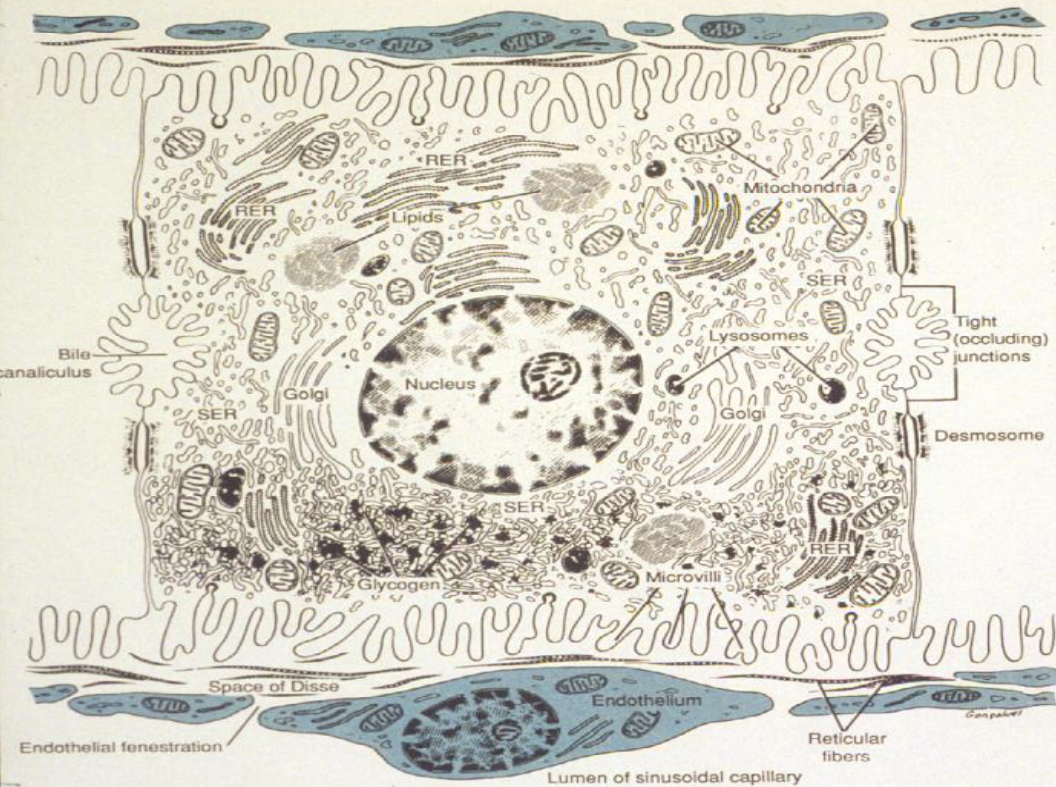
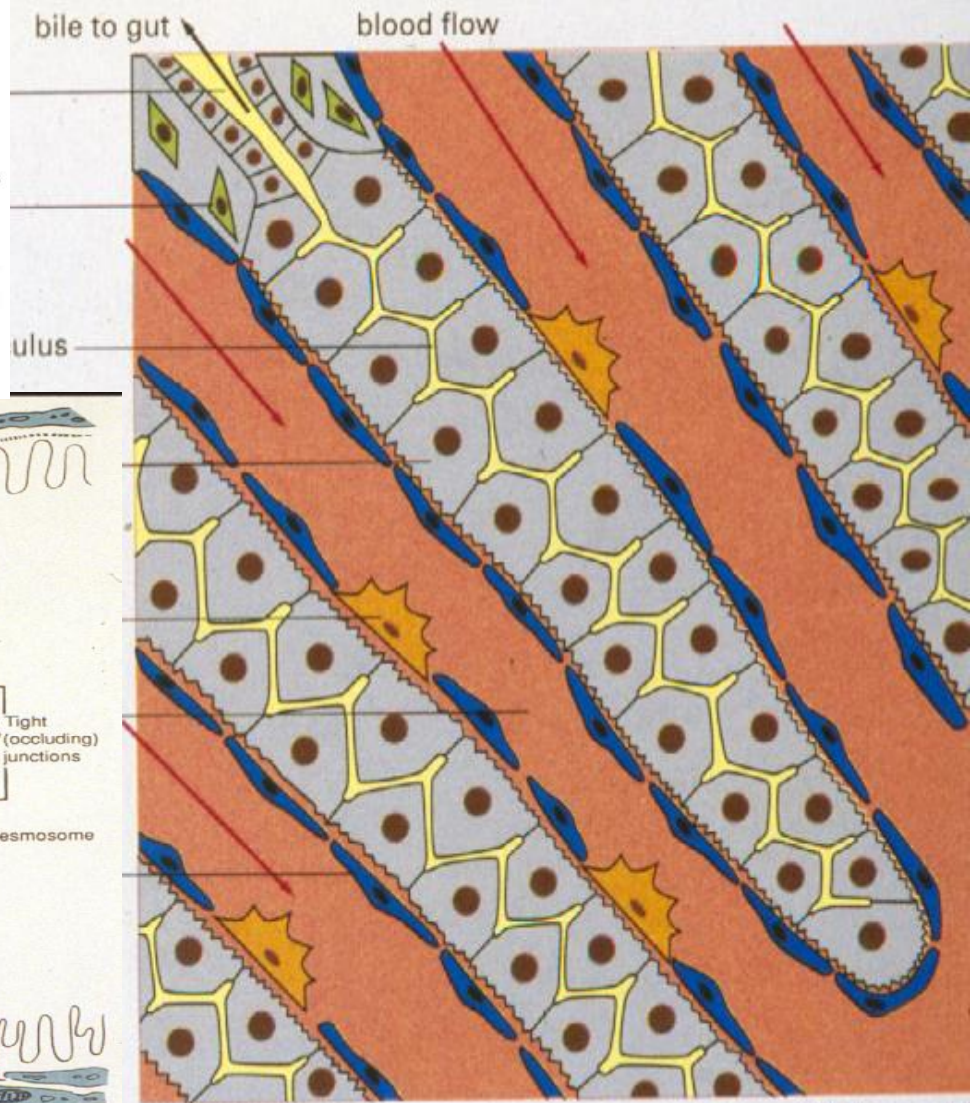
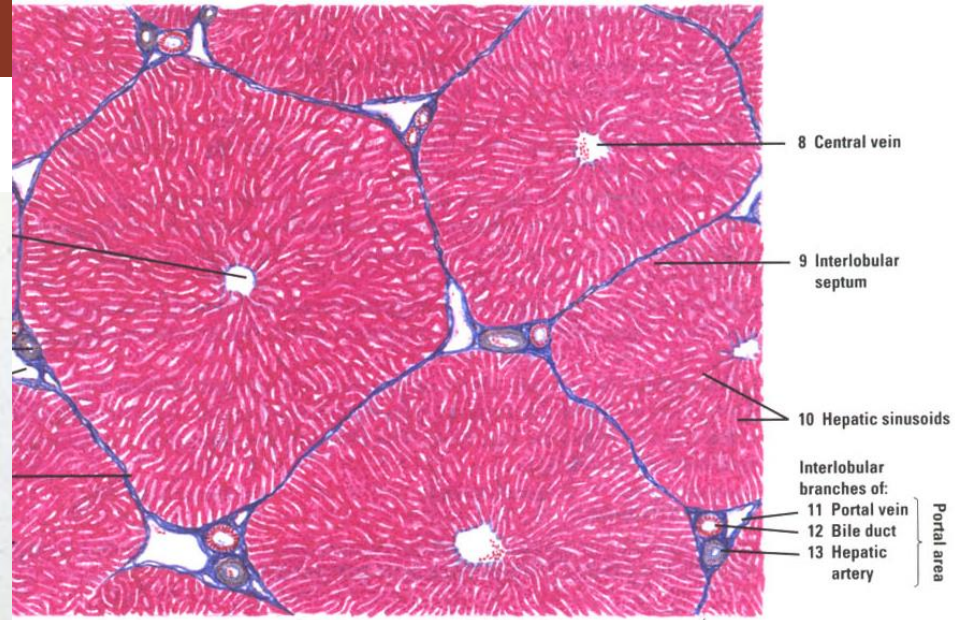
(A)

100  $\mu\text{m}$

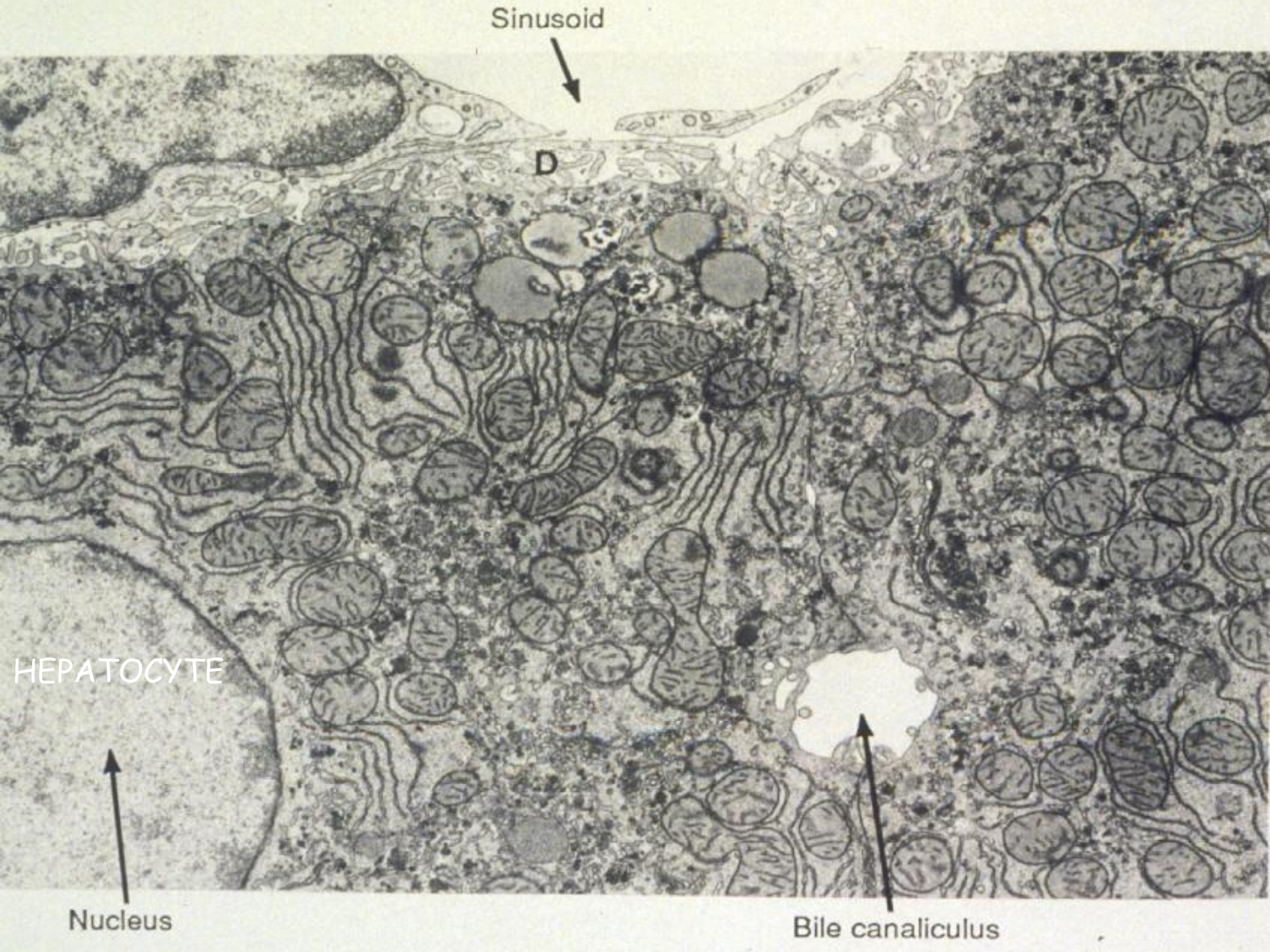


(B)

50  $\mu\text{m}$



(B)



Sinusoid

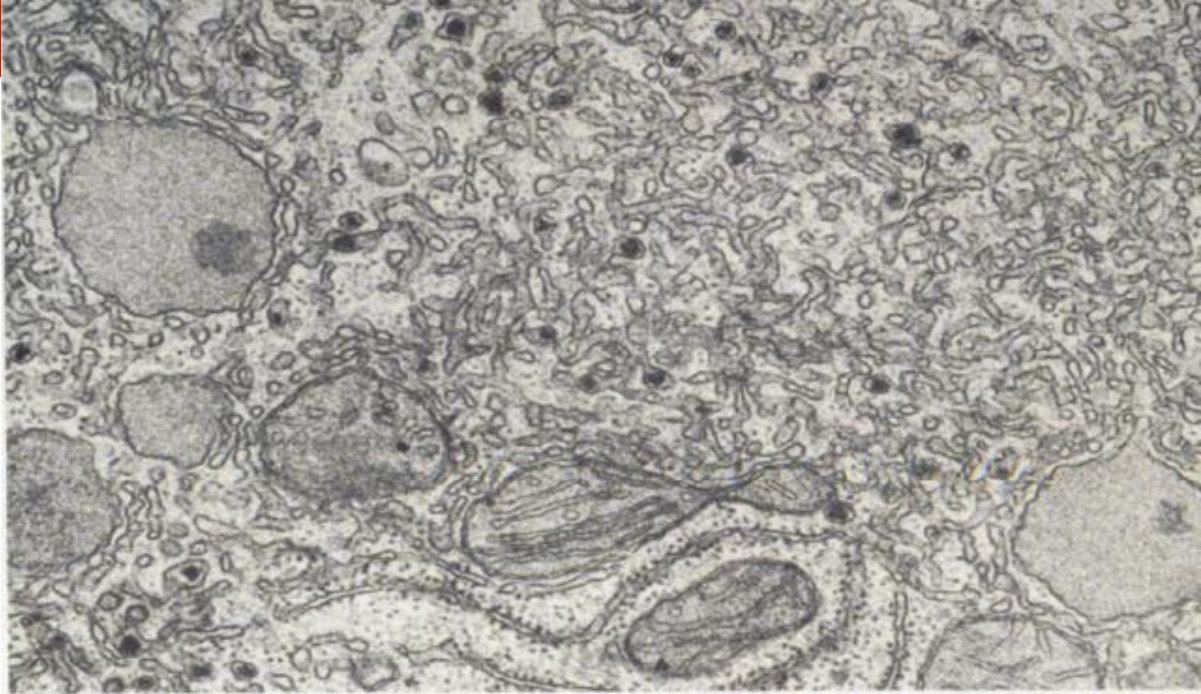
D

HEPATOCTYTE

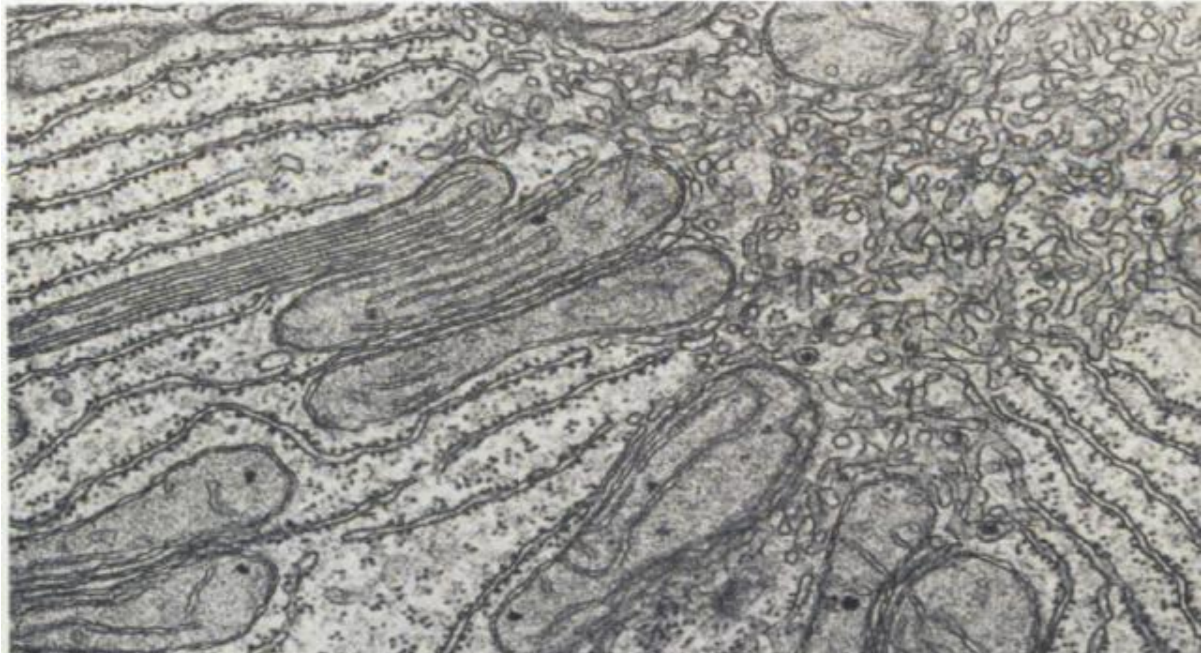
Nucleus

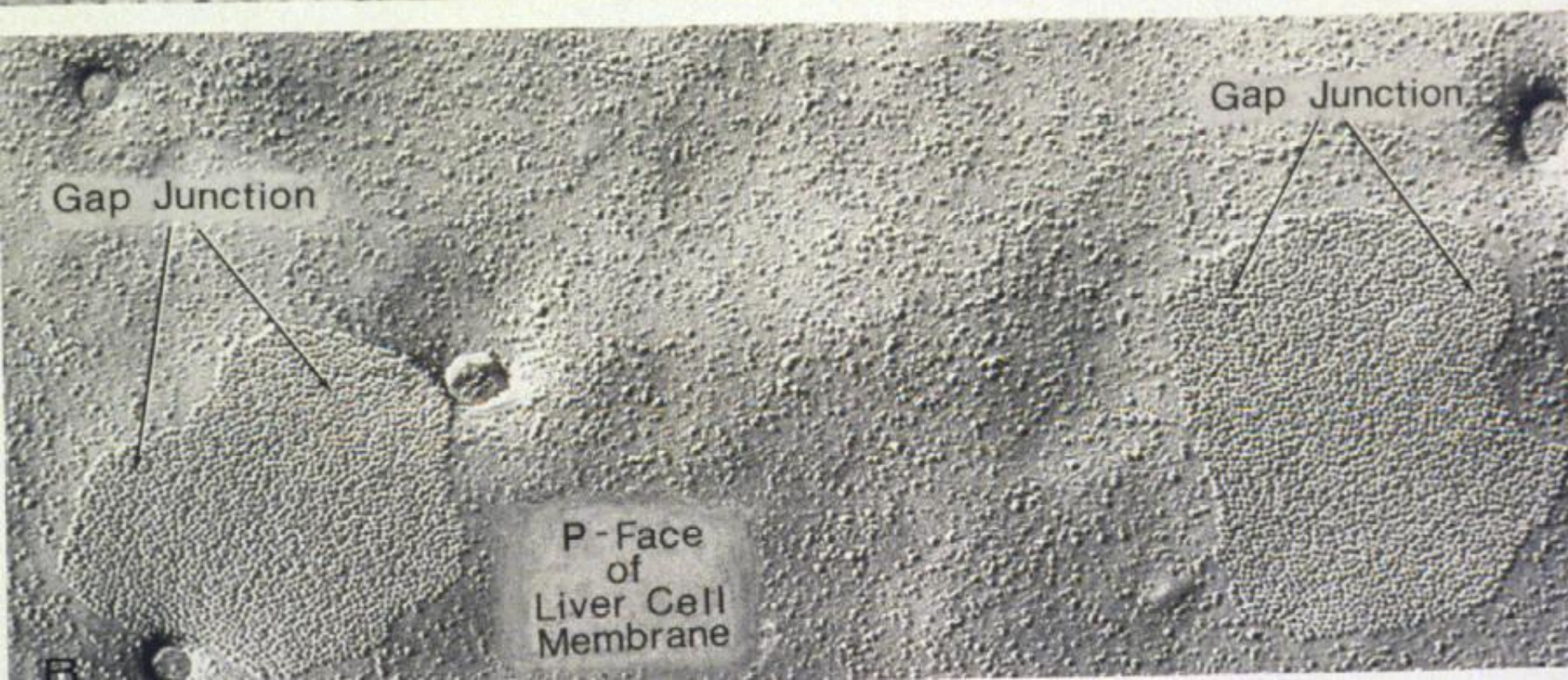
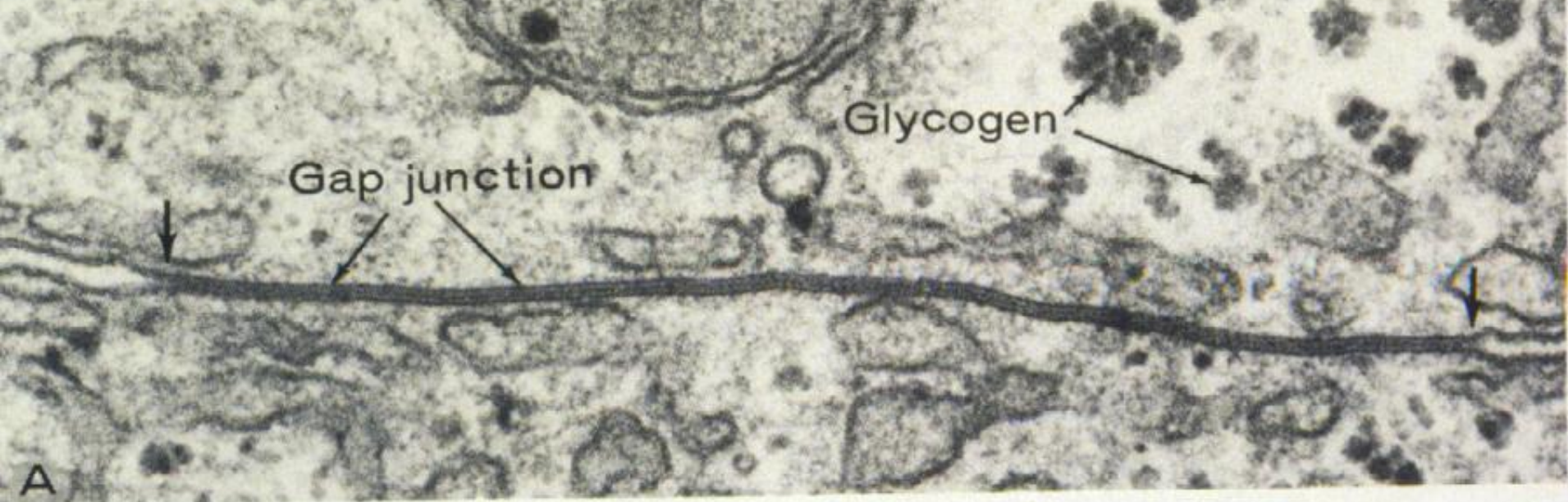
Bile canaliculus

# HEPATOCTYTE



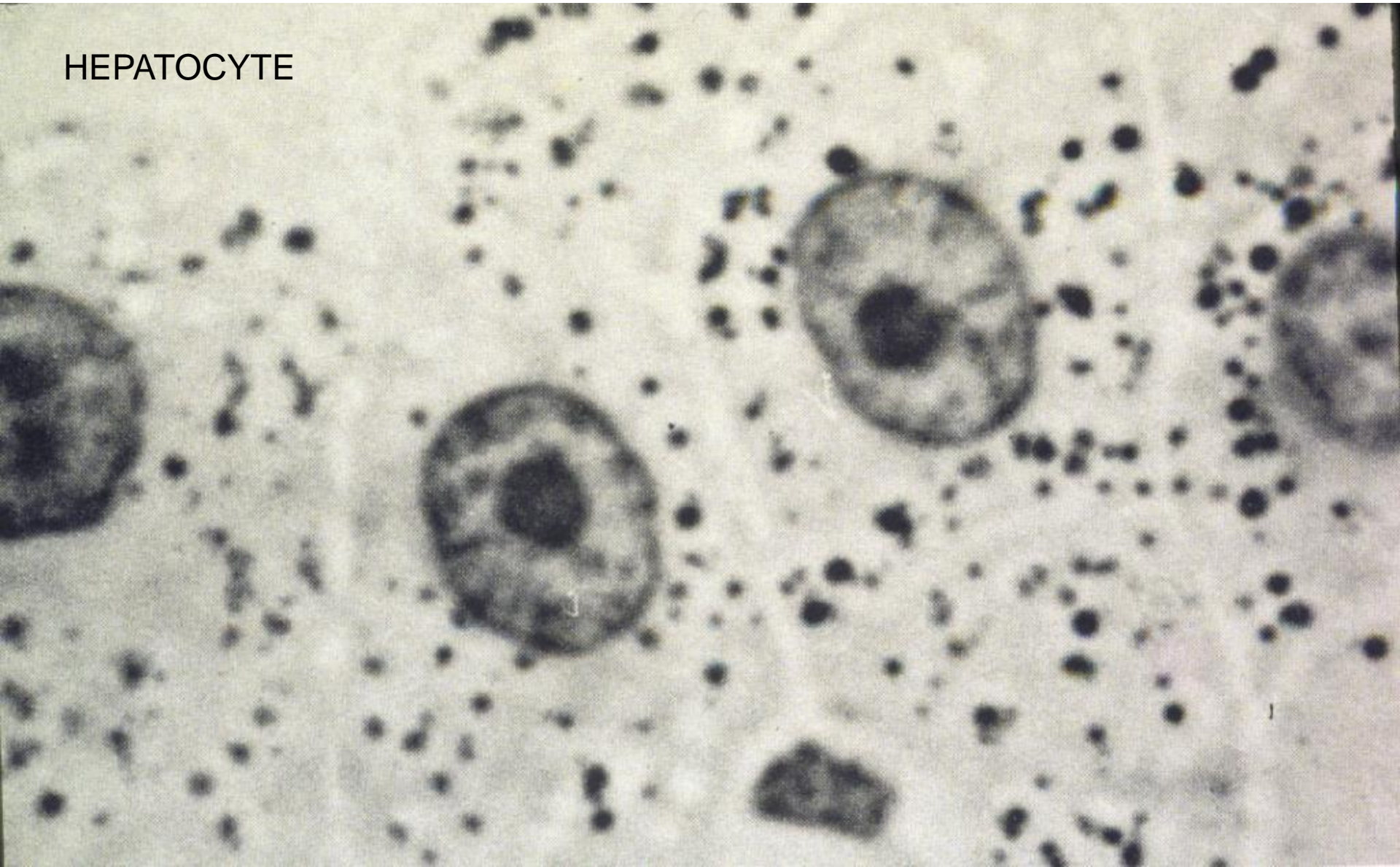
**Figure 27-23.** Electron micrograph of hepatocyte cytoplasm showing smooth-surfaced reticulum containing spherical dense particles representing newly synthesized, very-low-density serum lipoprotein. Also present are mitochondria and microbodies or peroxisomes with eccentrically placed nucleoids. (Micrograph by R. Bolender.)





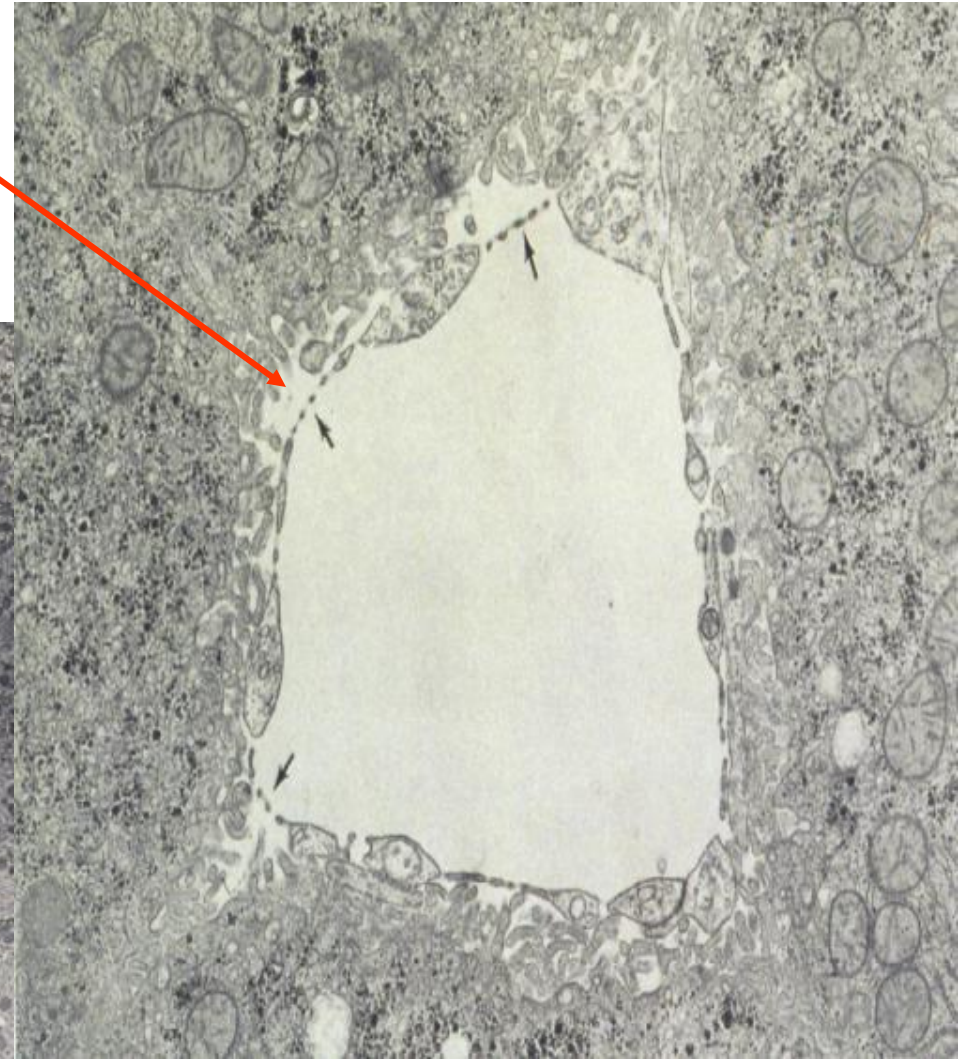
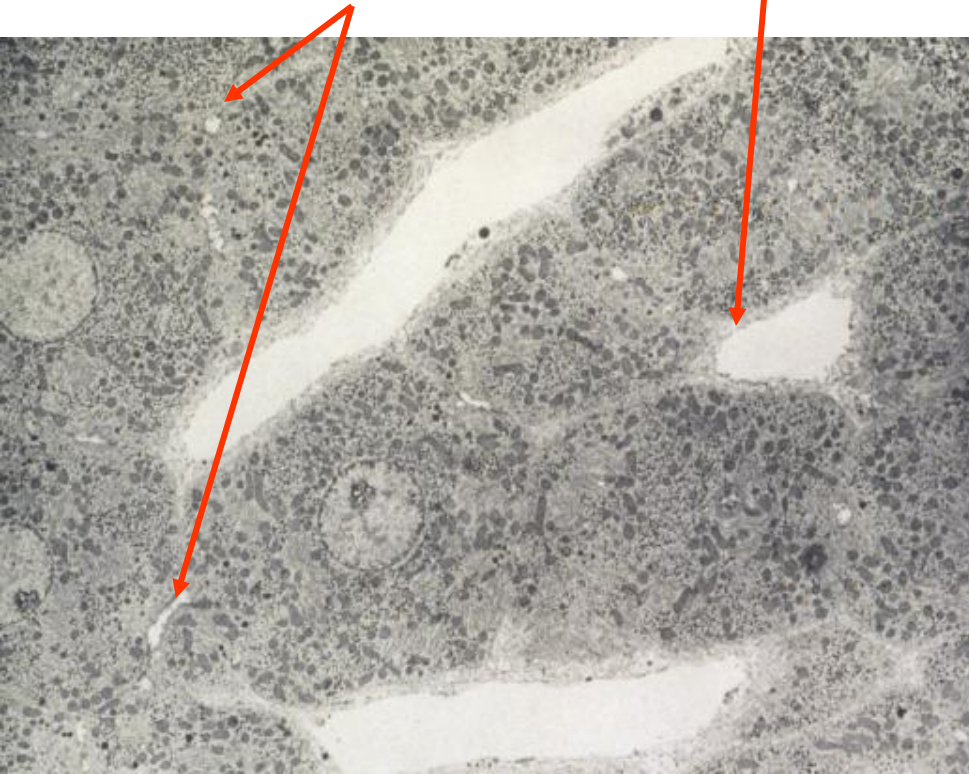
# Histological reaction for peroxidase

HEPATOCYTE



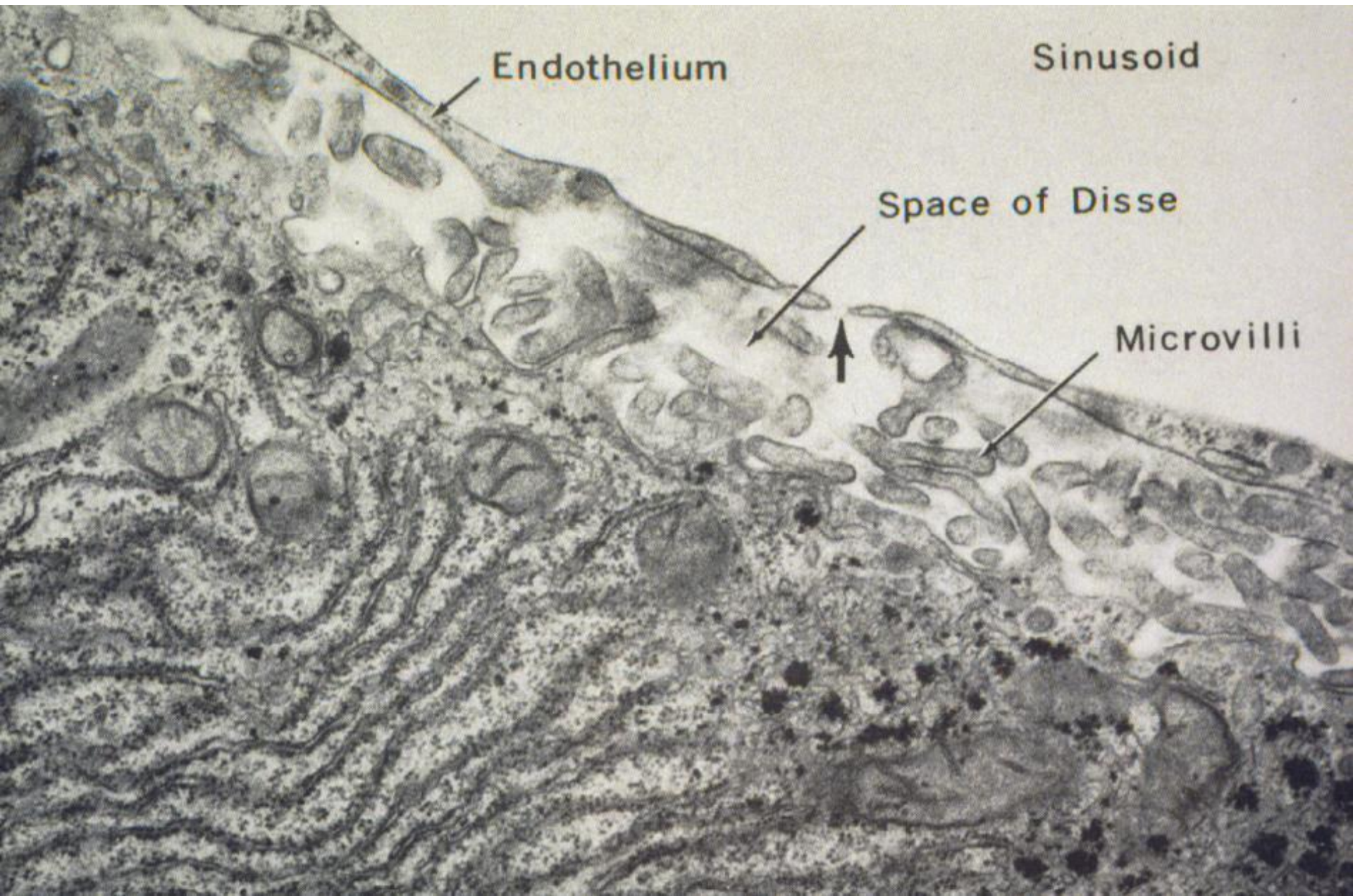
# HEPATOCTYTE

**SPACE OF DISSE**  
**BILE**  
**CANALICULI**

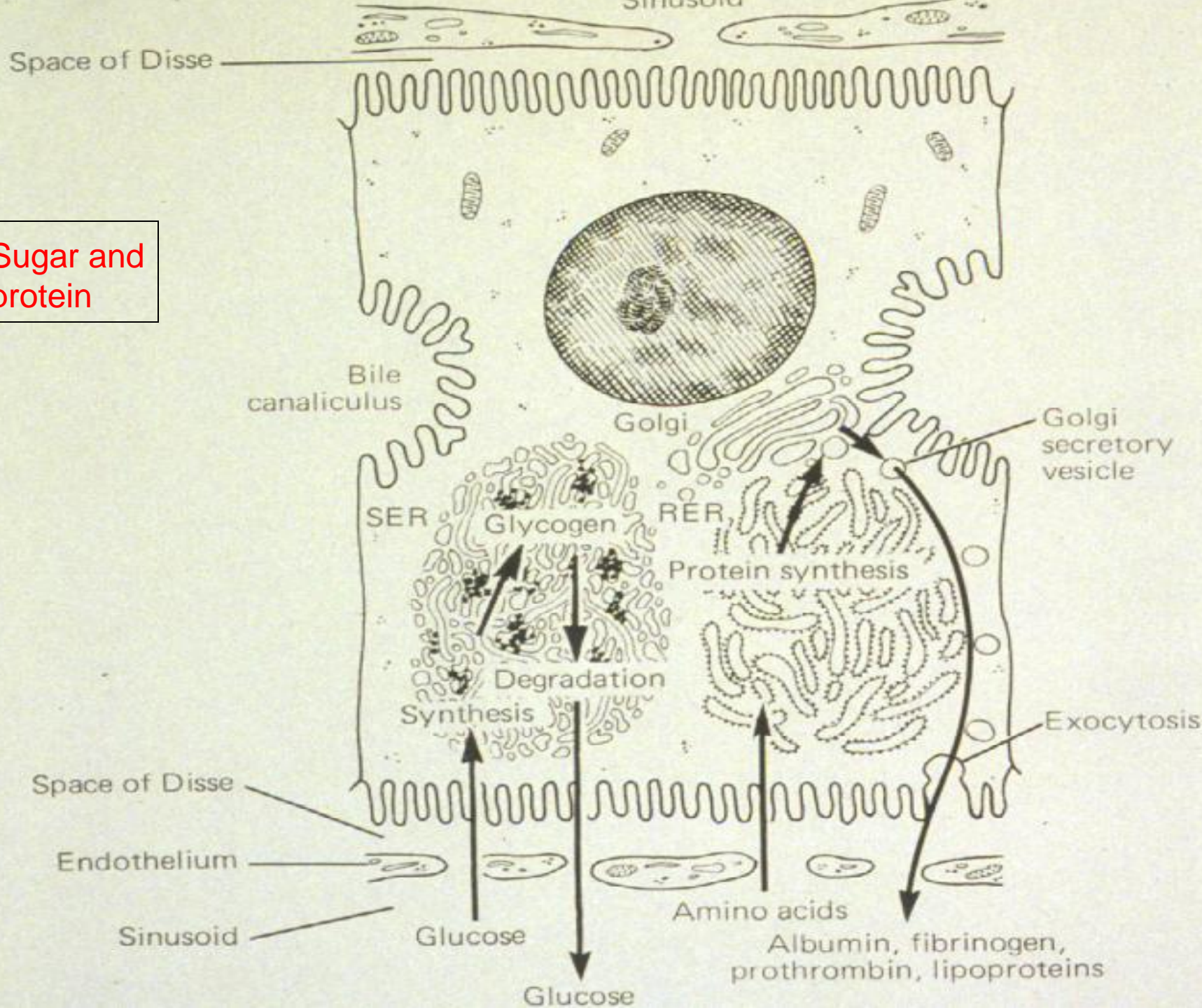




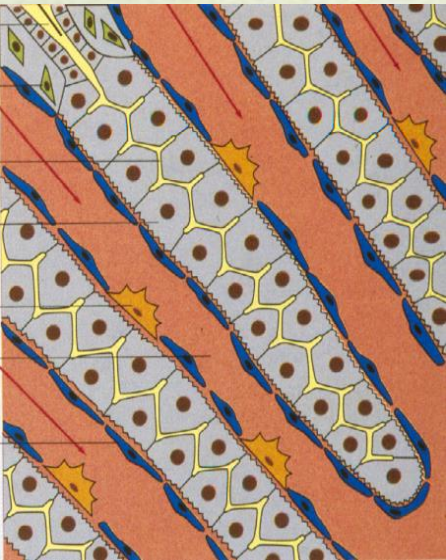
# SPACE OF DISSE



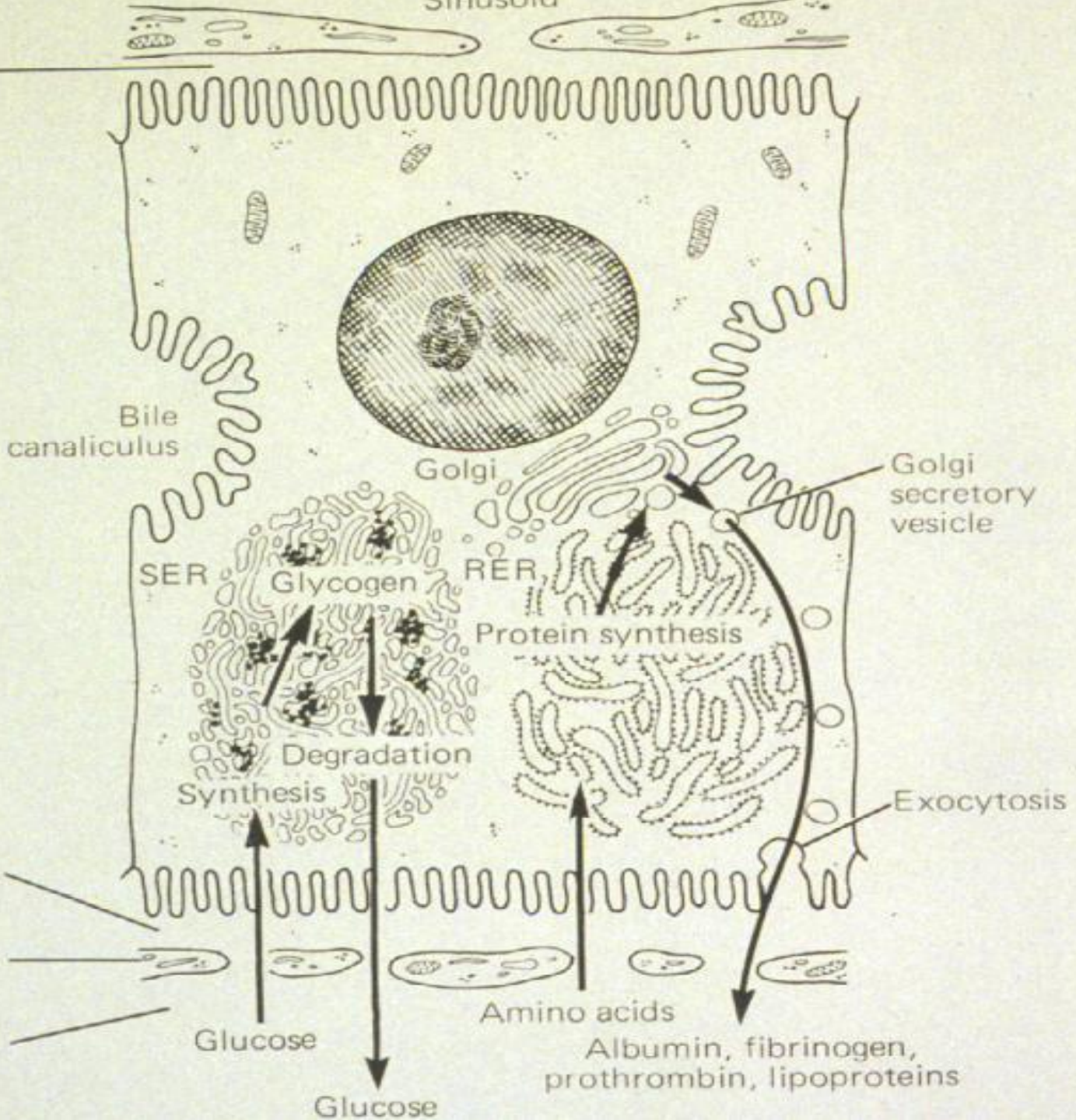
Sugar and protein



Sugar and protein



Space of Disse



Space of Disse

Endothelium

Sinusoid

Glucose

Glucose

Amino acids

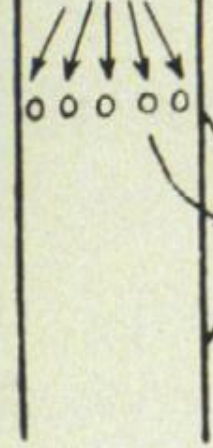
Albumin, fibrinogen, prothrombin, lipoproteins

Alimentary canal

Liver

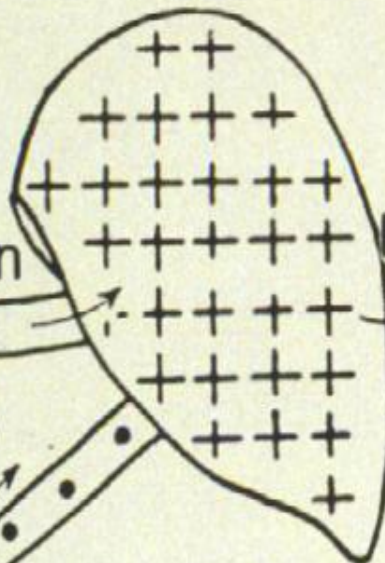
Systemic circulation

Starch



Portal vein

0.15%



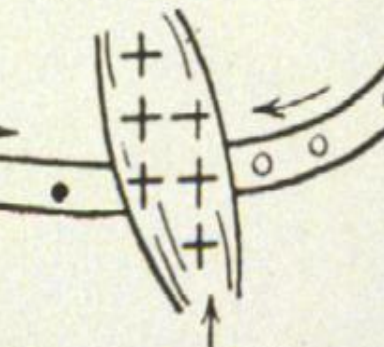
Hepatic vein

0.1%

Pancreas



Muscle



Sugar utilized

Normal sugar

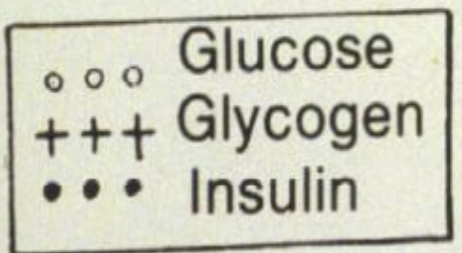
0.1%

Renal artery

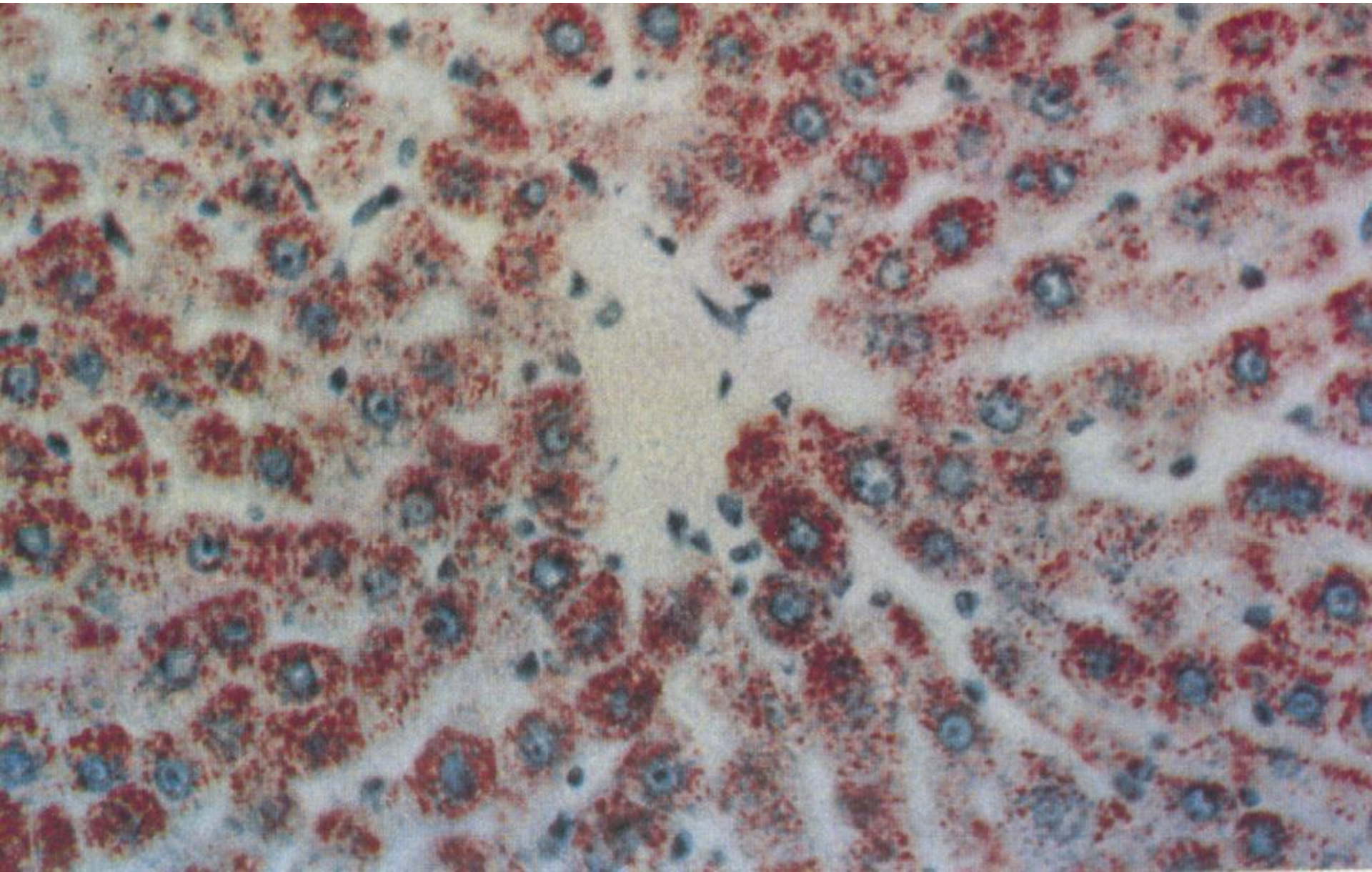
Ureter

Kidney

No sugar in urine



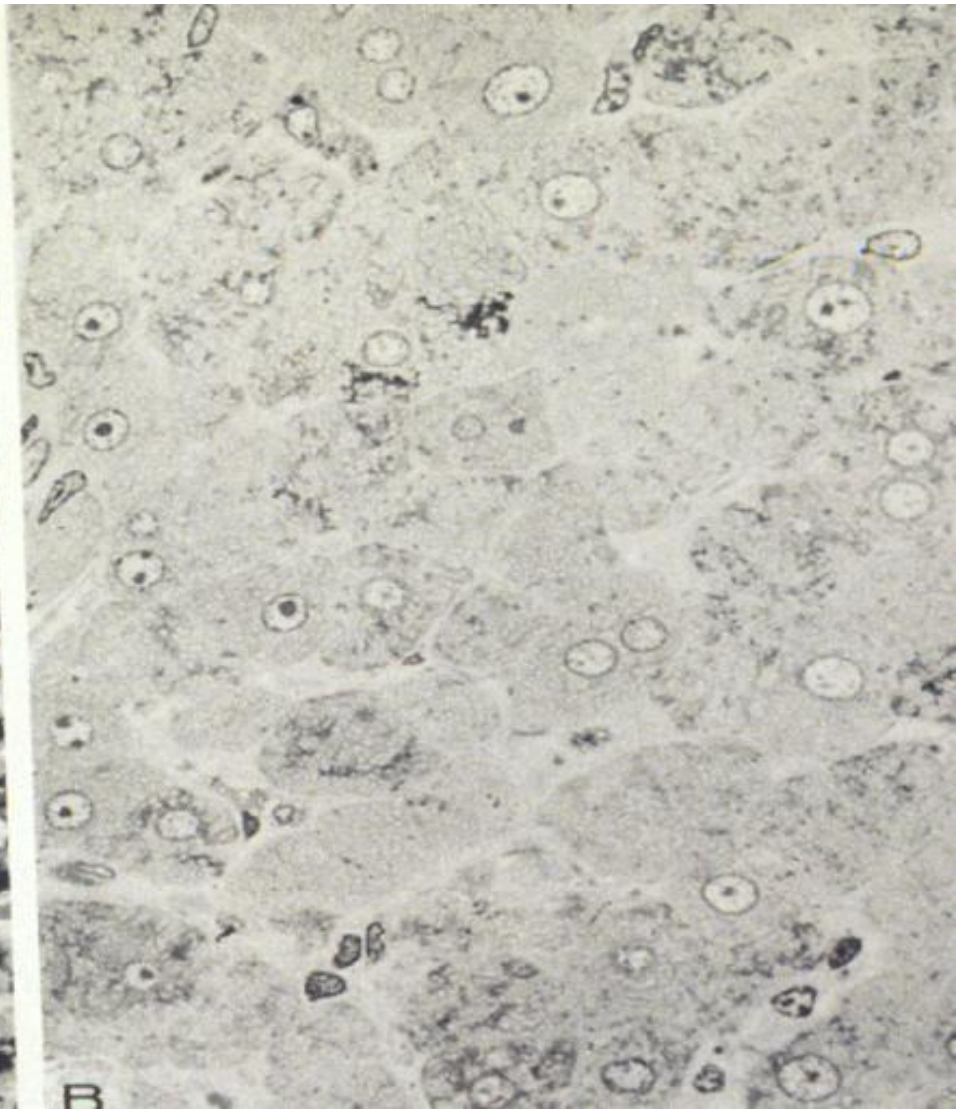
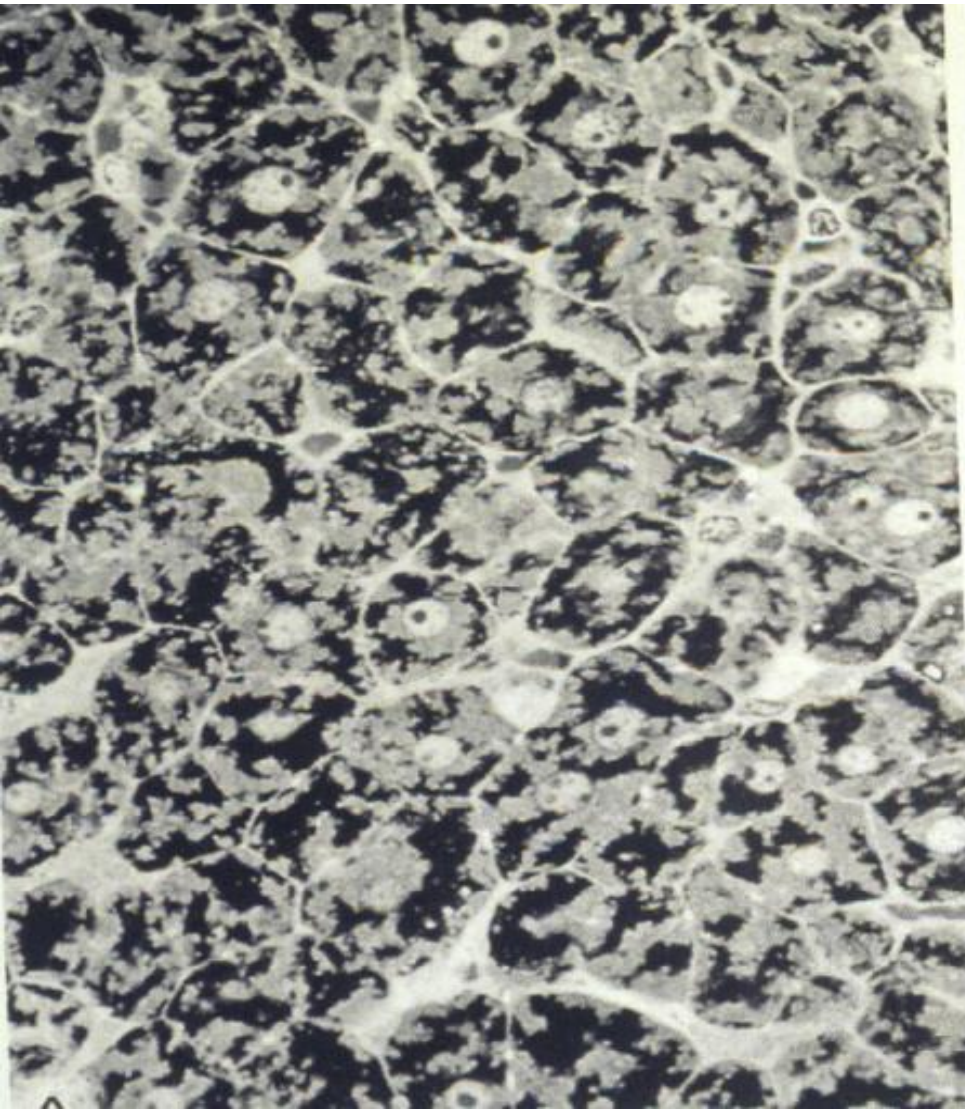
# Glycogen in hepatocytes



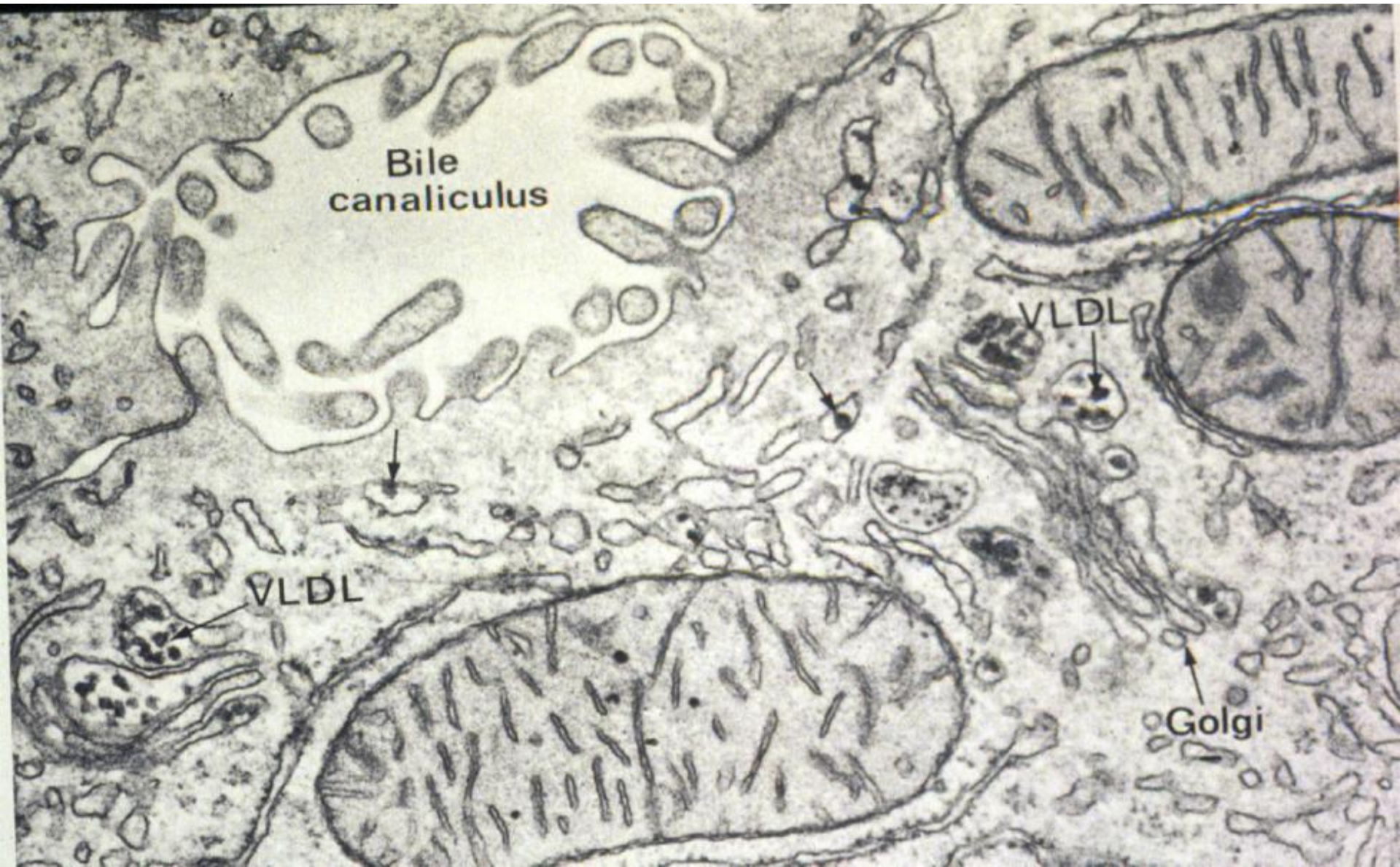
# Dietary differences in amount of glycogen in hepatocytes

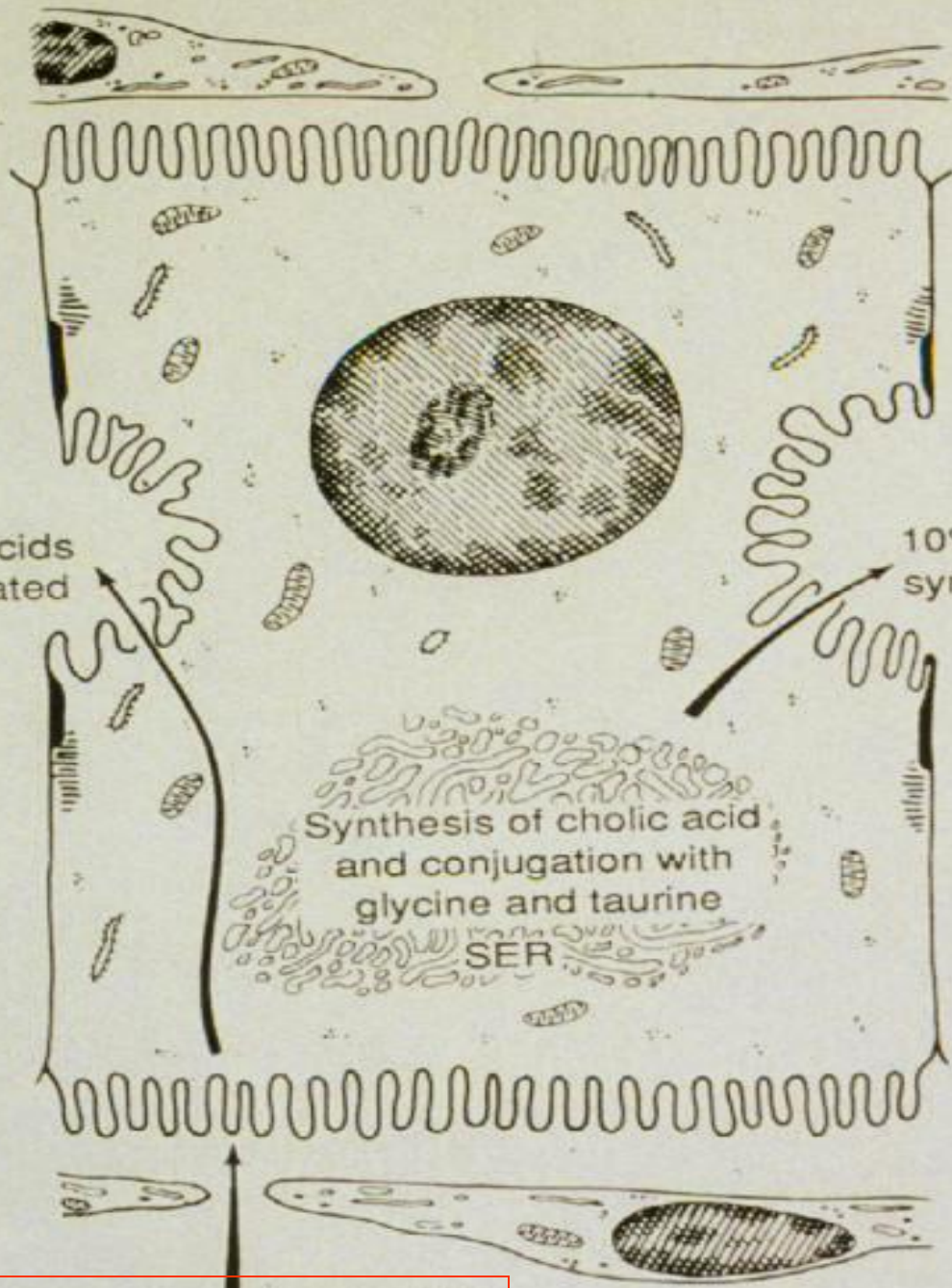
2-hour fast (8.2% glycogen)

24-hour fast (0.9% glycogen)



# BILE CANALICULI





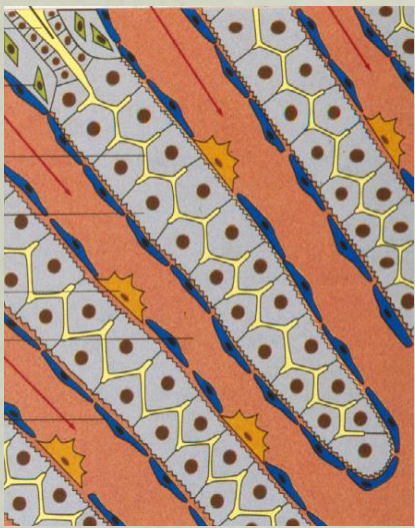
90% of bile acids are recirculated

10% of bile acids are synthesized de novo

Synthesis of cholic acid and conjugation with glycine and taurine

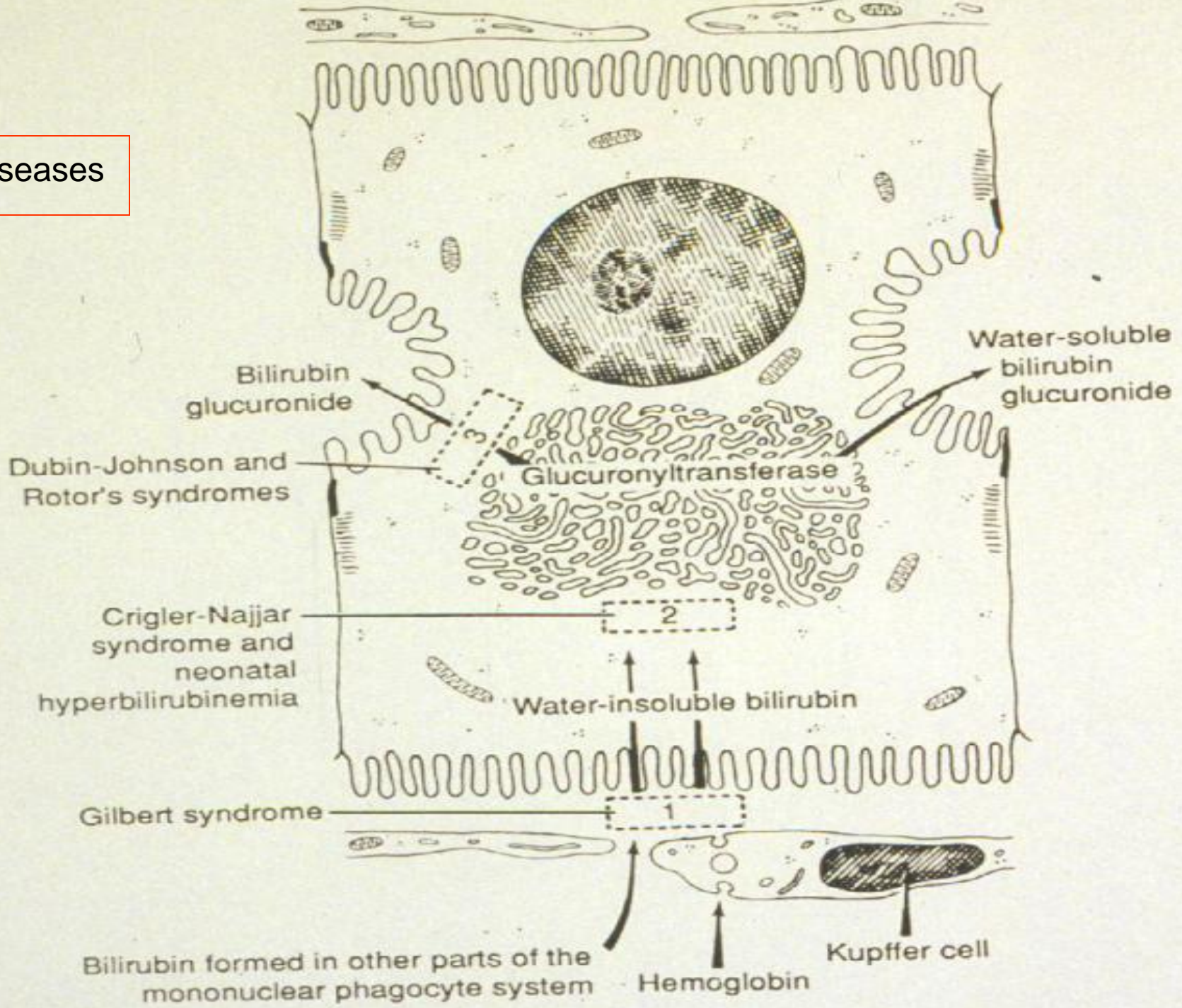
SER

Bile acids reabsorbed in the intestines

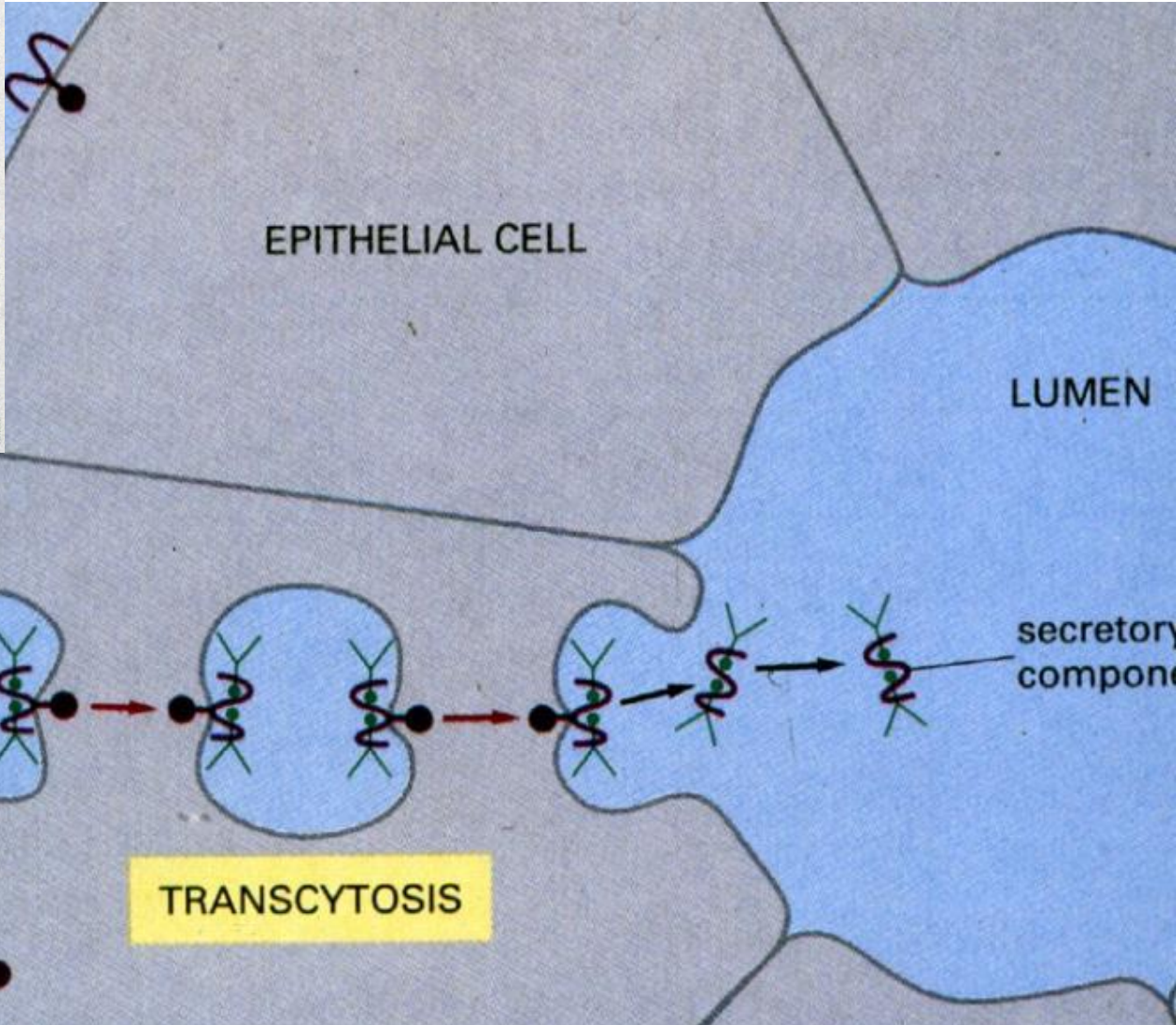
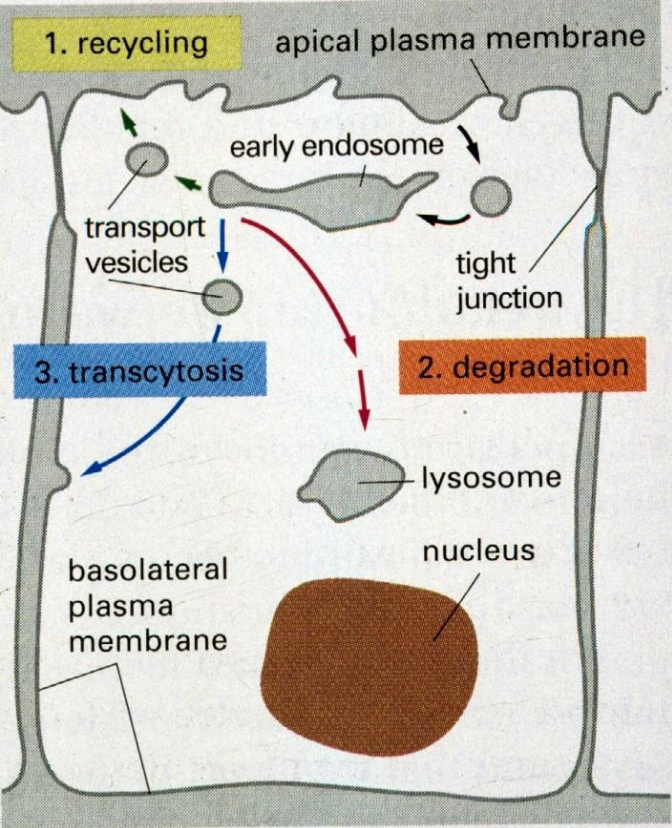




diseases



# SURFACE SPECIALIZATIONS OF EPITHELIA



# Bile canaliculus

Four + compounds that are deposited/secreted into this space.

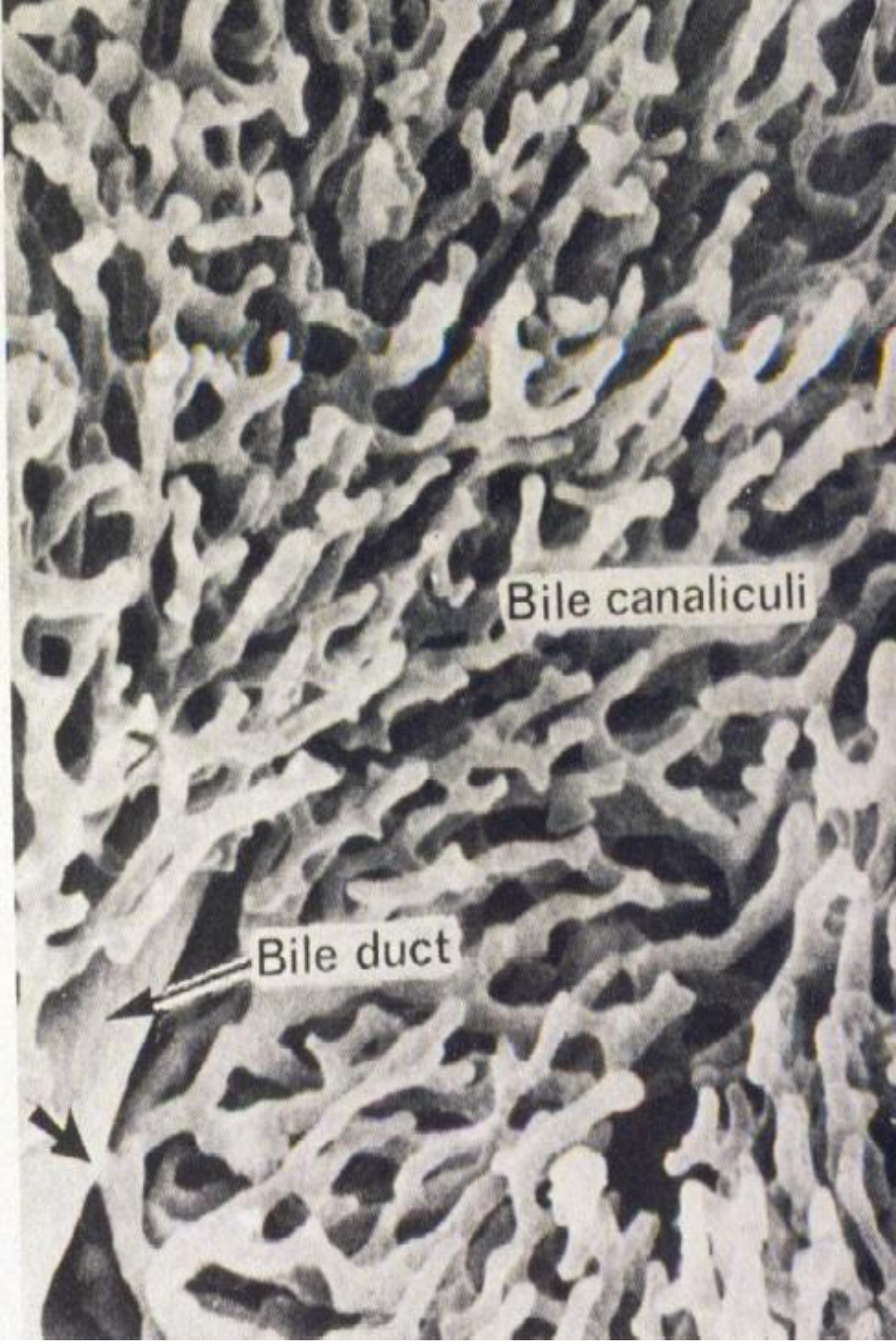
**a. Cholesterol**

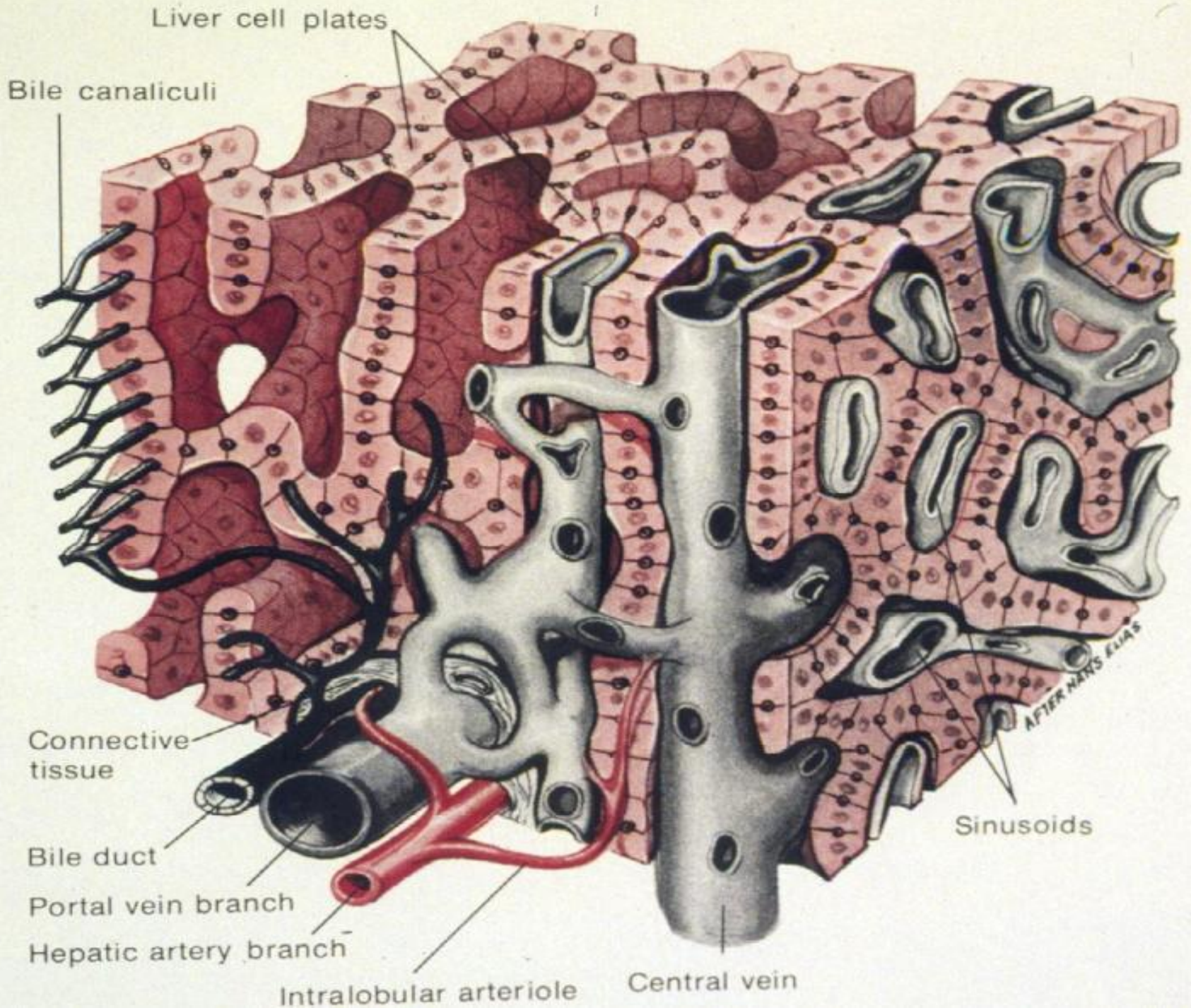
**b. EGF**

**c. insulin**

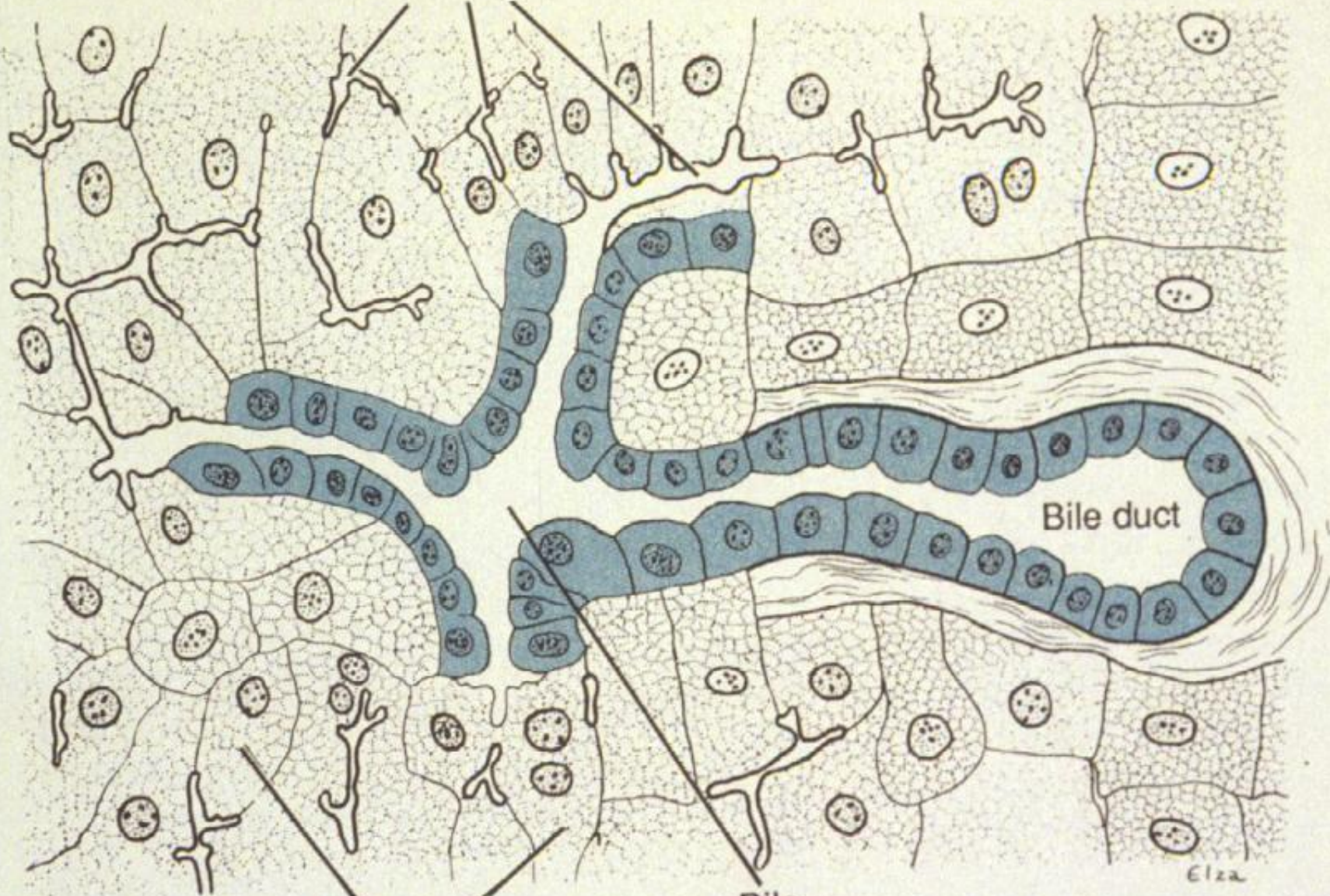
**d. IgA**

**also bile salts and BILIRUBIN**





Bile  
canaliculi



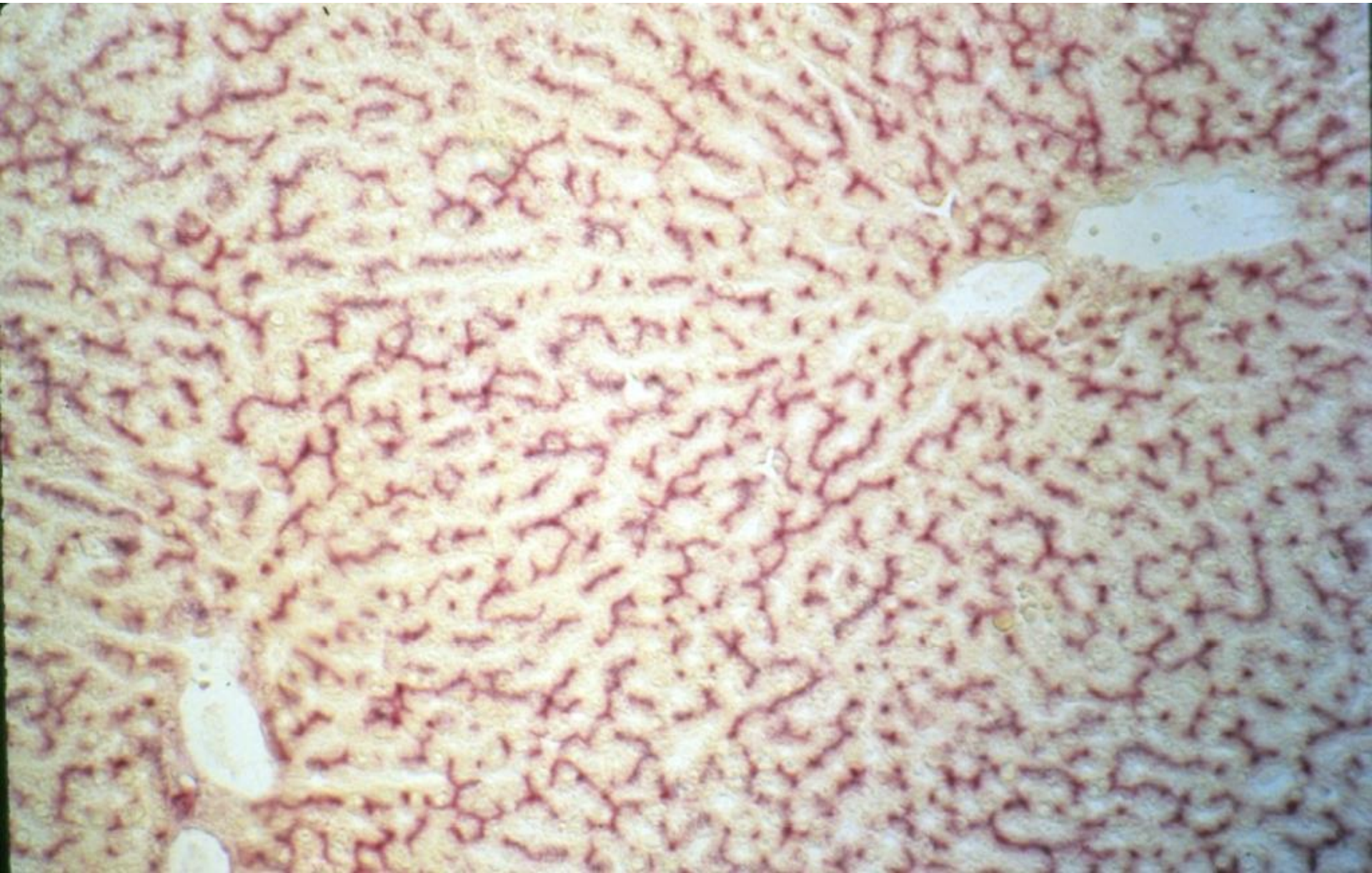
Bile duct

Hepatocytes

Bile  
ductule

Eiza

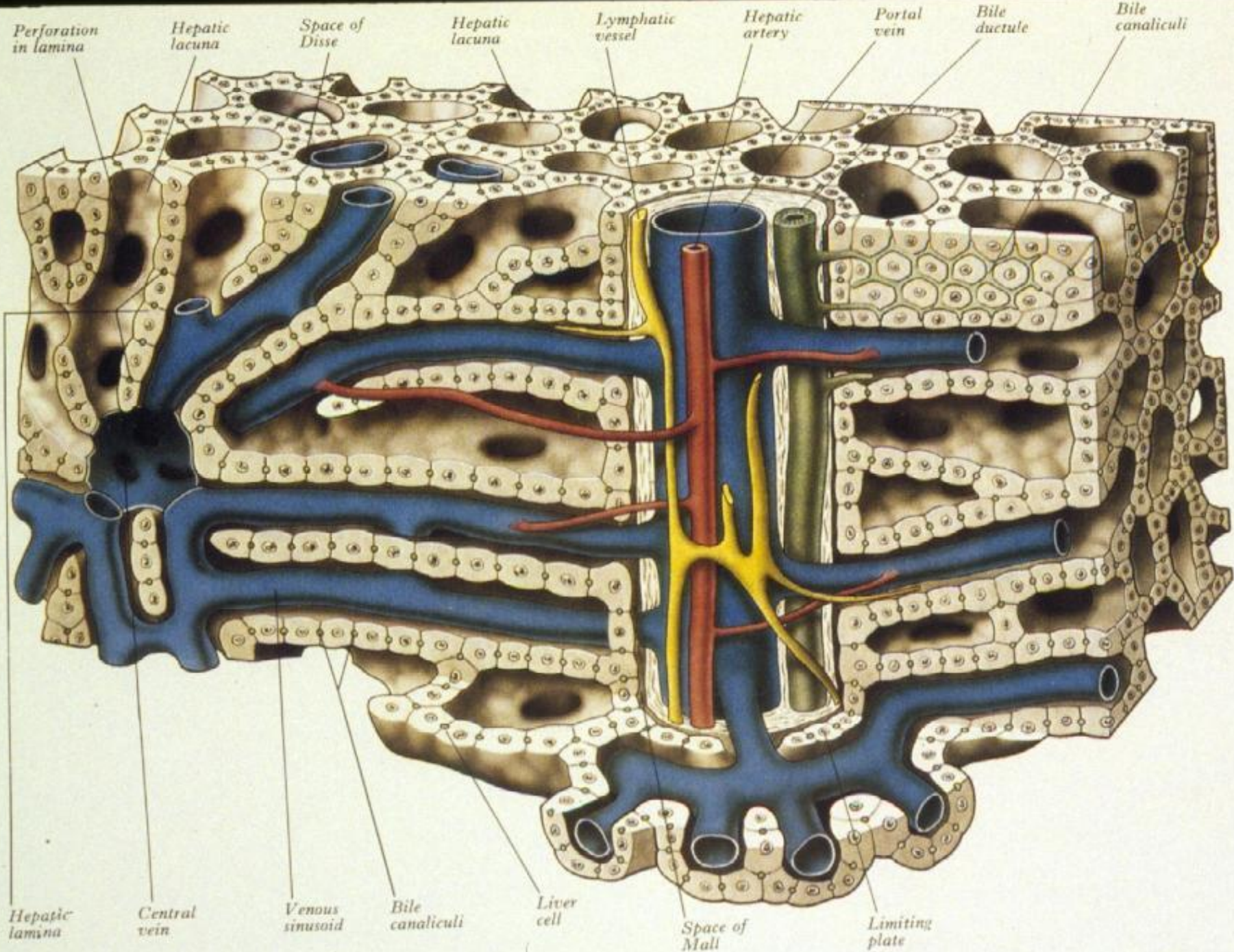
# BILE CANALICULI



# BILE duct







Perforation in lamina

Hepatic lacuna

Space of Disse

Hepatic lacuna

Lymphatic vessel

Hepatic artery

Portal vein

Bile ductule

Bile canaliculi

Hepatic lamina

Central vein

Venous sinusoid

Bile canaliculi

Liver cell

Space of Mall

Limiting plate

# GALLBLADDER & BILE DUCTS

FUNCTION

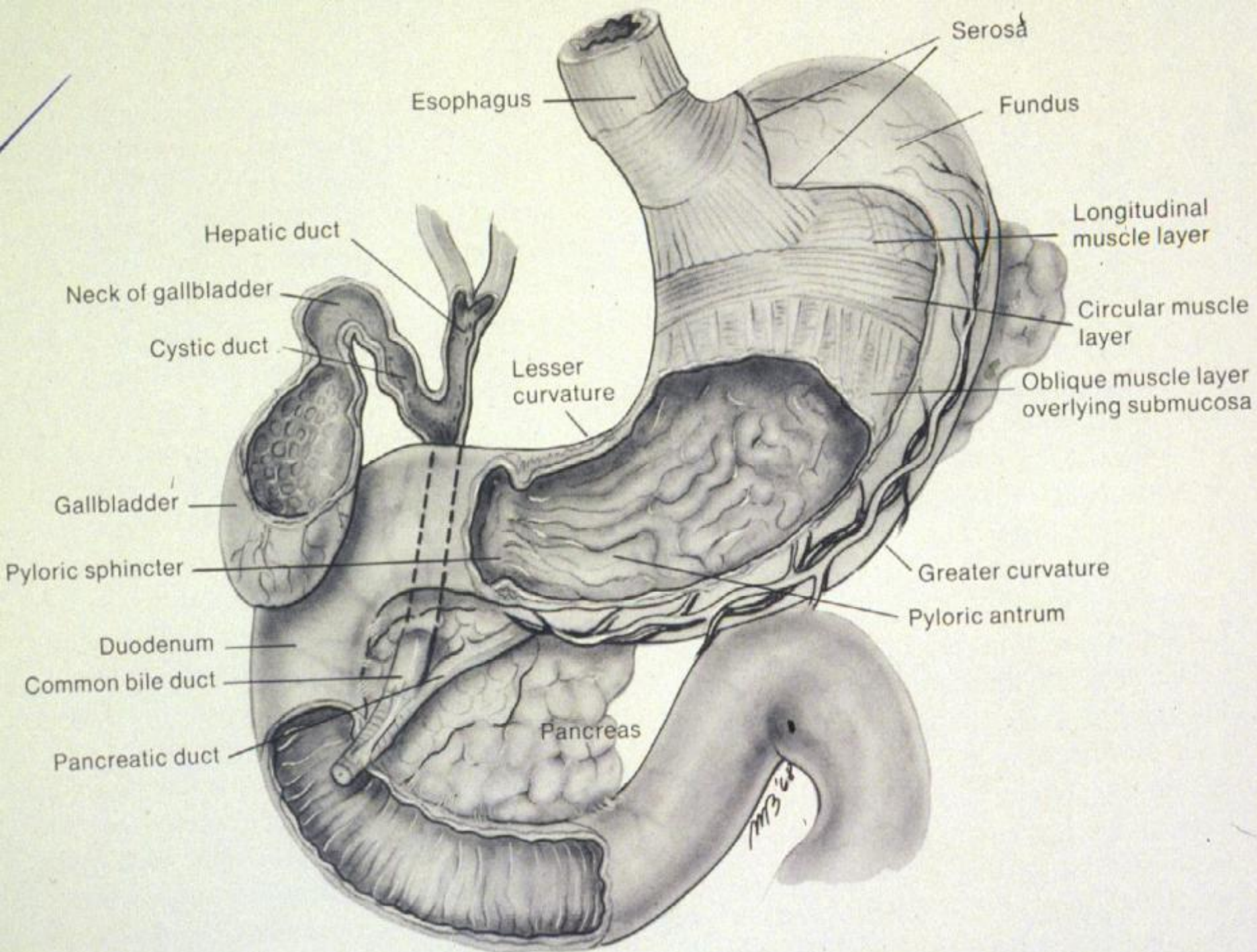
BILIARY TRACT

ORGANIZATION OF GALLBLADDER

    EPITHELIUM

    CONNECTIVE TISSUE

HISTOPHYSIOLOGY



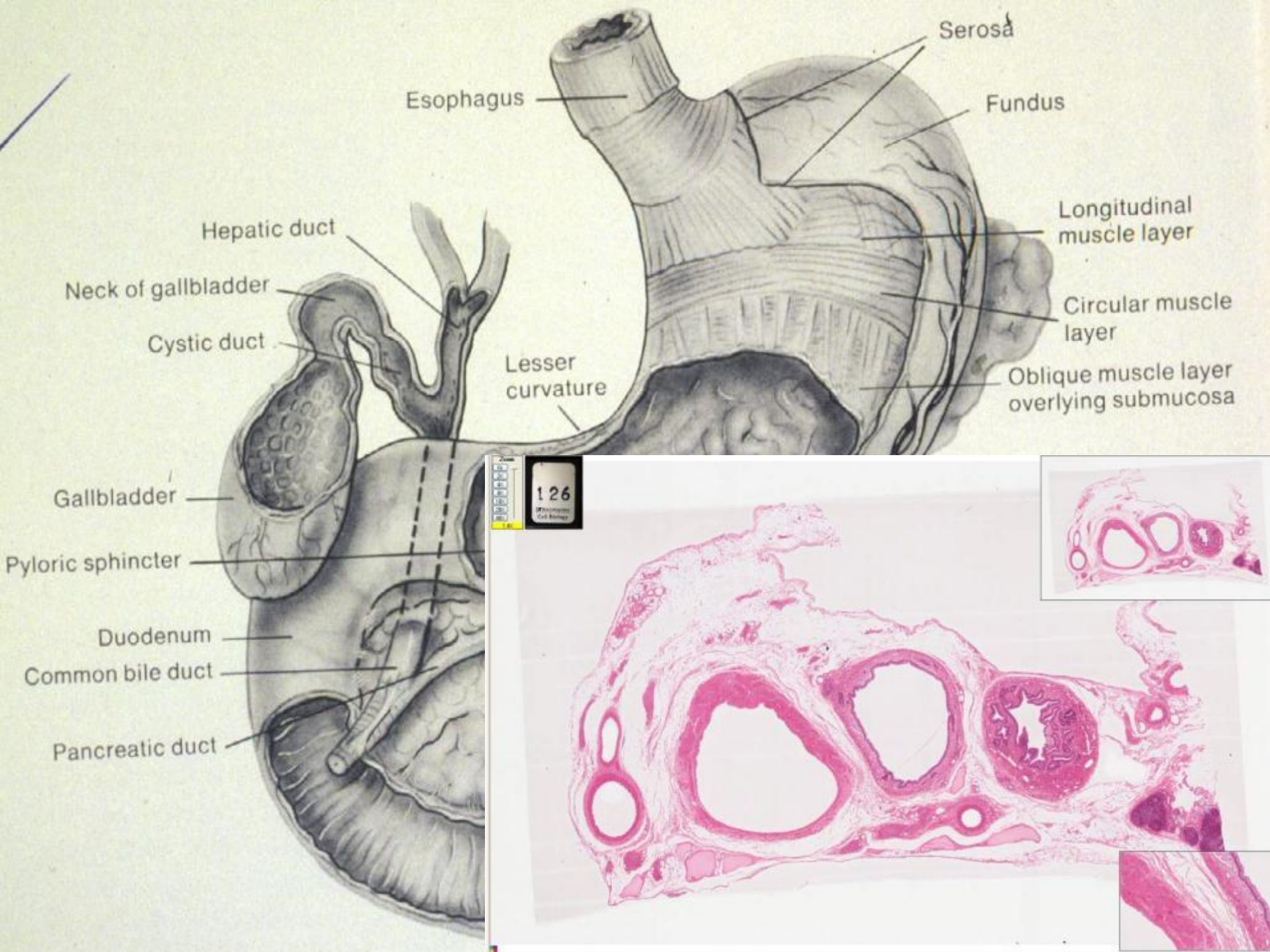
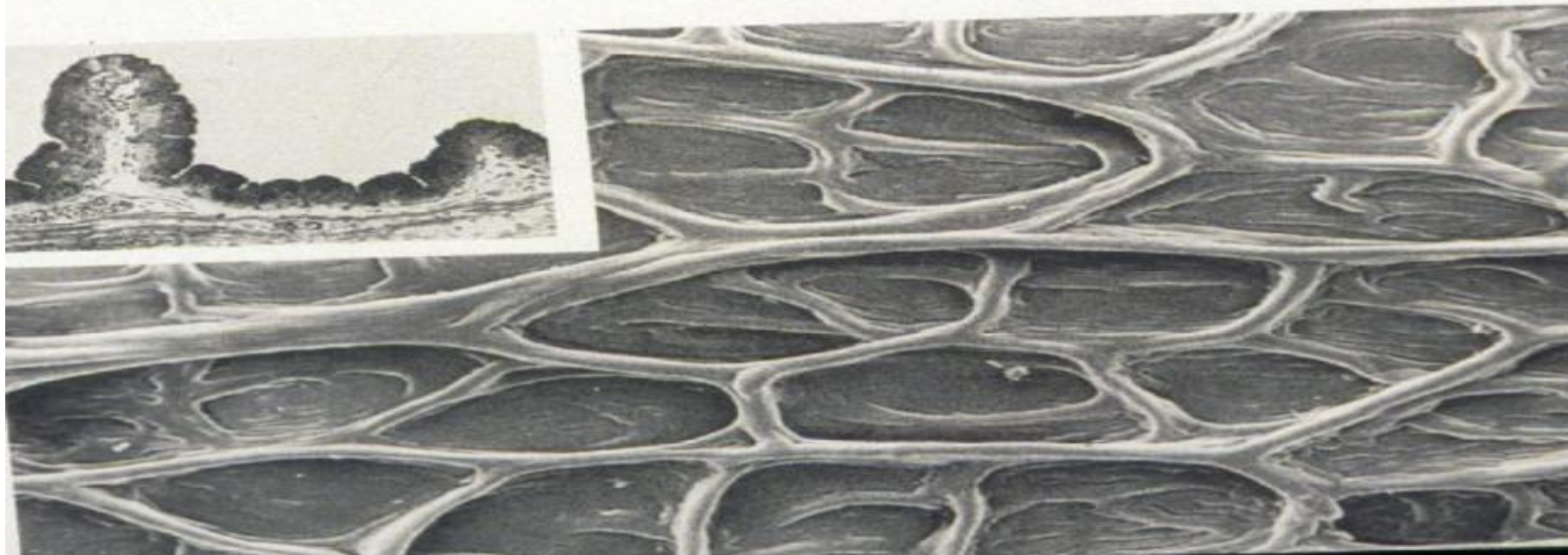
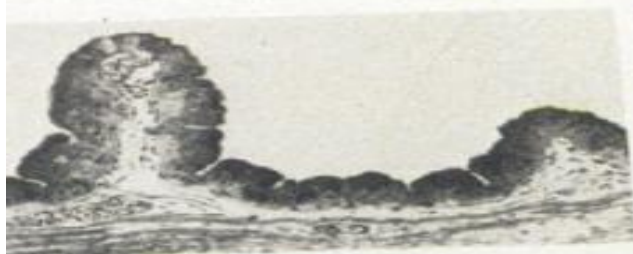


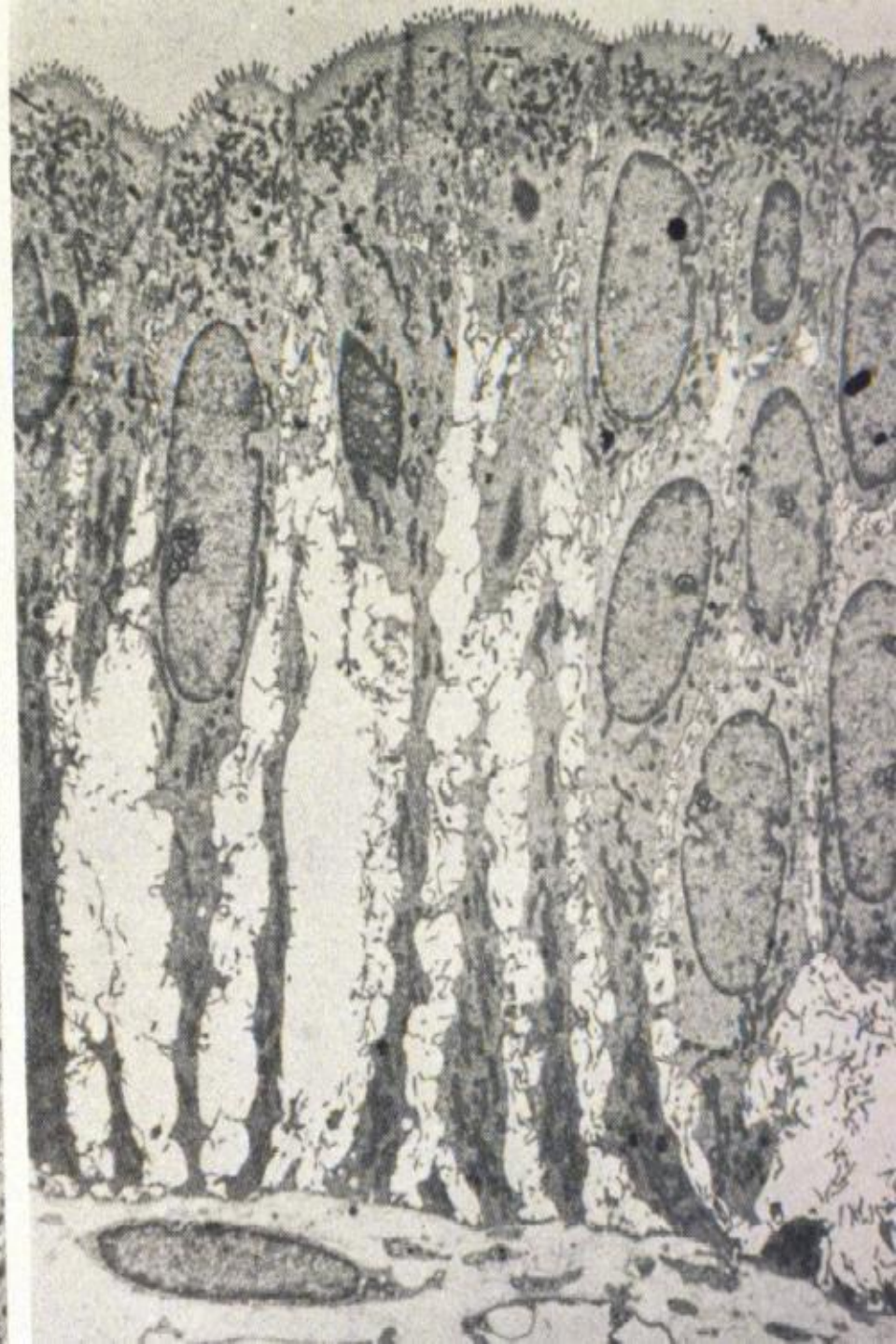
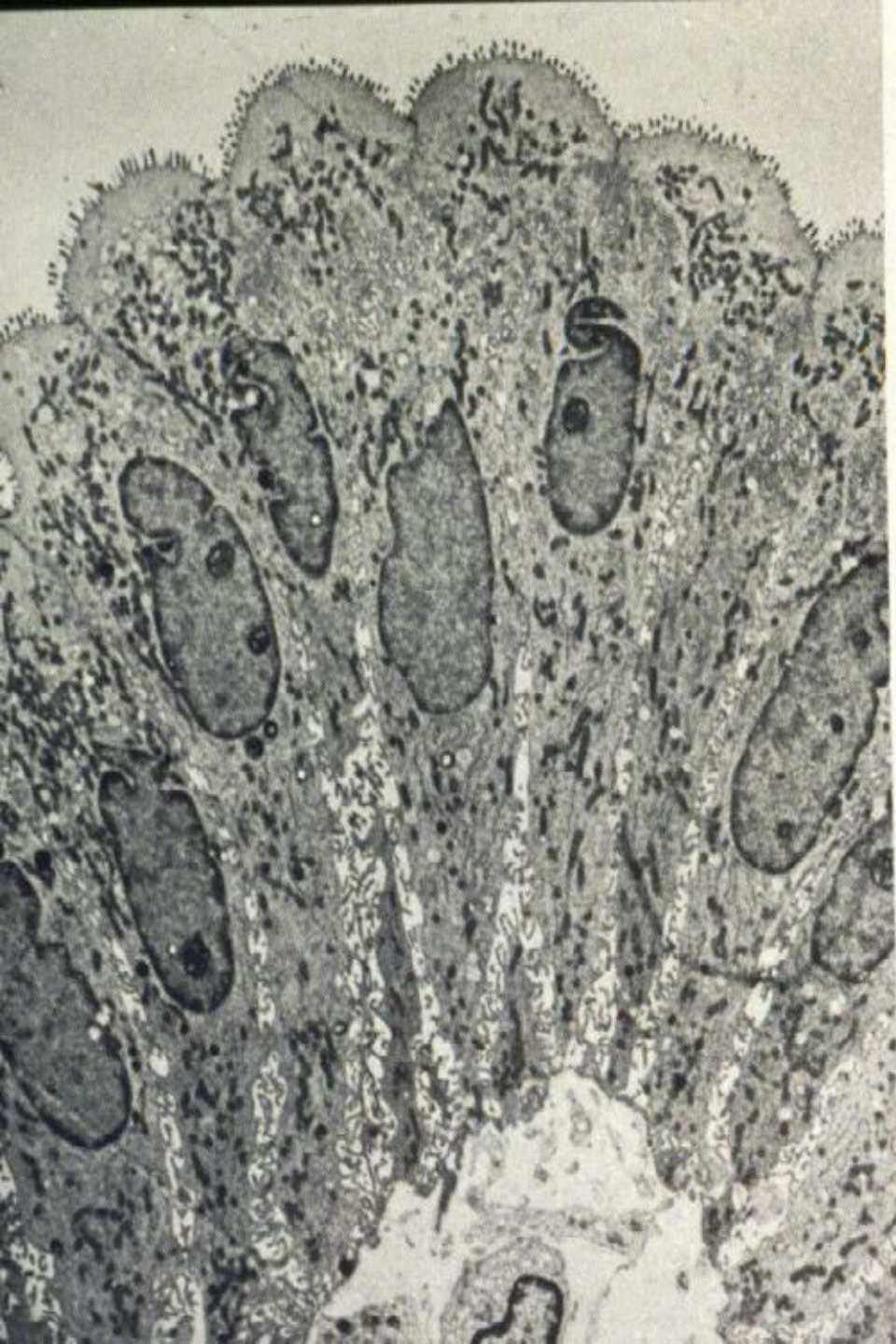


Figure 27-36. Scanning micrograph of the contracted gallbladder. The mucosa is thrown up into folds. A histological section through these has the appearance shown in the inset. Compare with scanning micrographs from Castellucci, M. J. *Submicrosc. Cytol.* 12:375, 1980.)

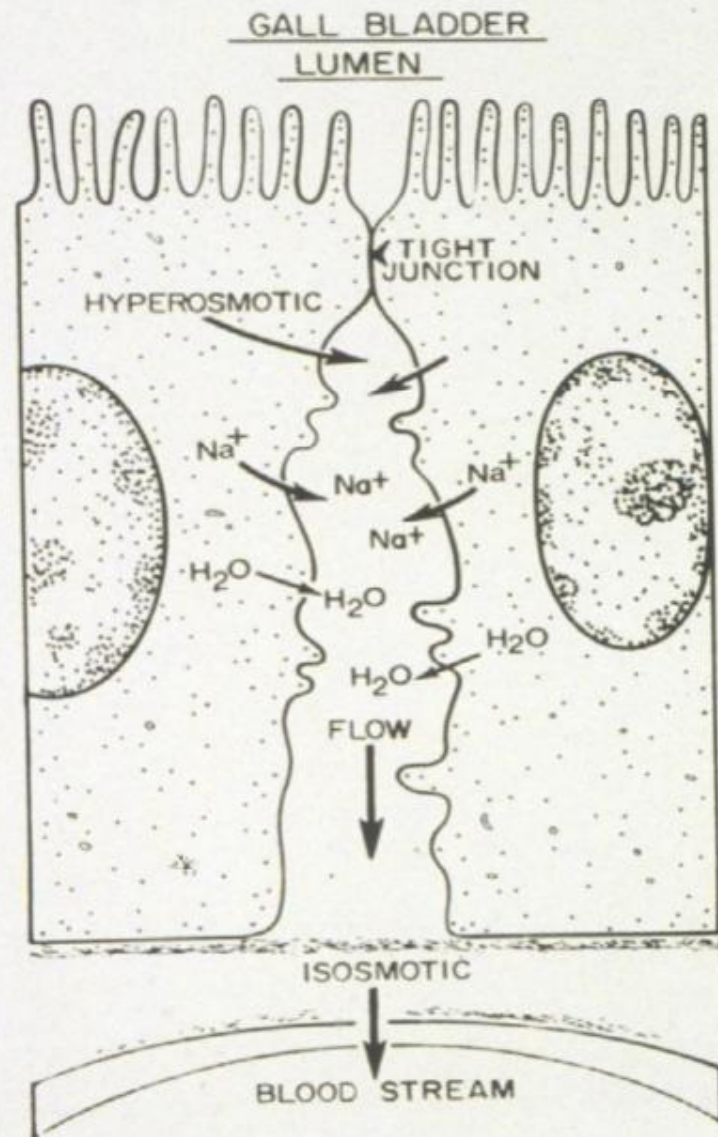
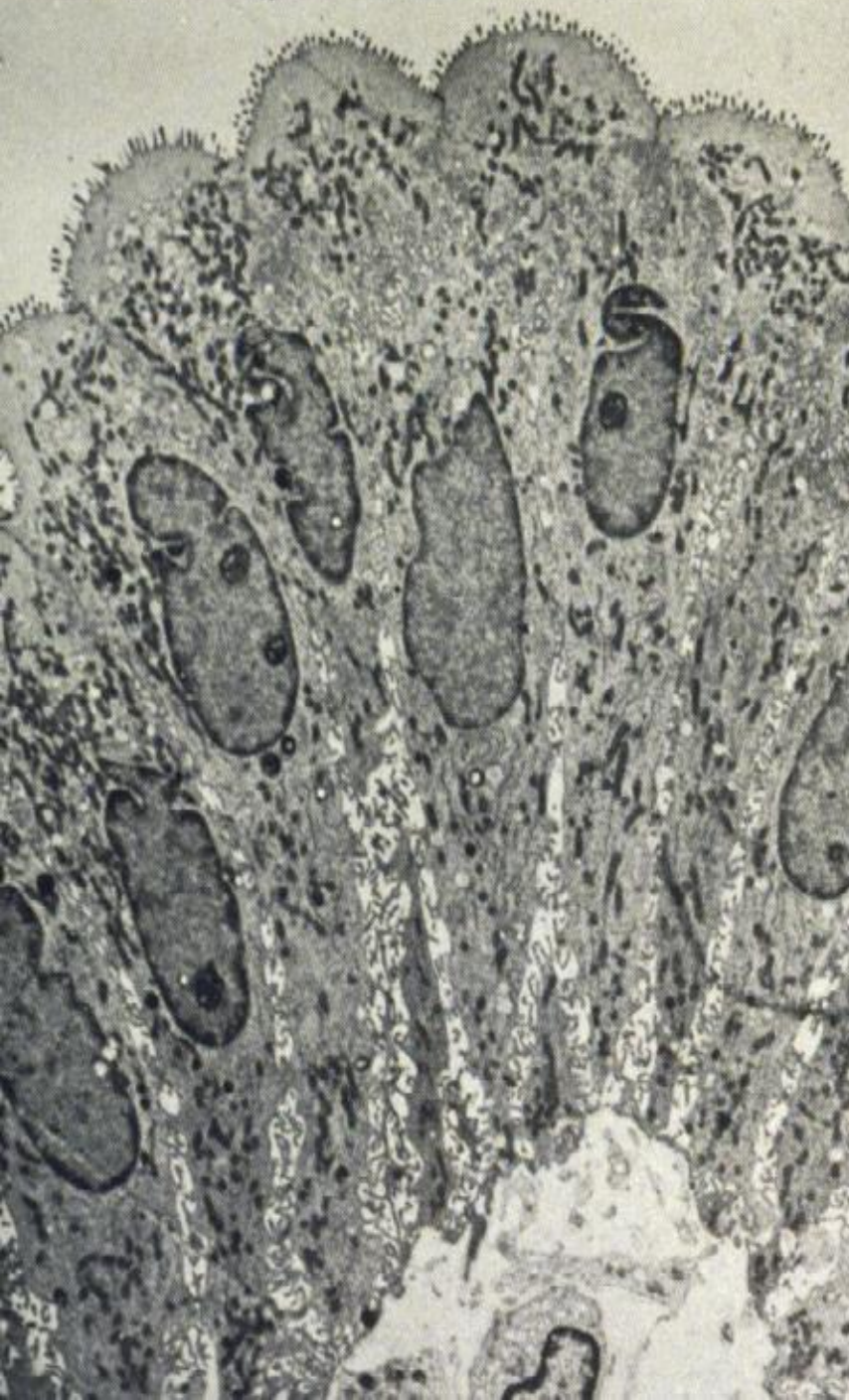












**Figure 27-37.** Diagram illustrating the mechanism of concentration of the bile. Sodium is actively pumped into the intercellular cleft below the occluding junction, creating a standing gradient that moves water from the lumen to blood vessels in the lamina propria.

# SALIVARY GLANDS

**FUNCTION**

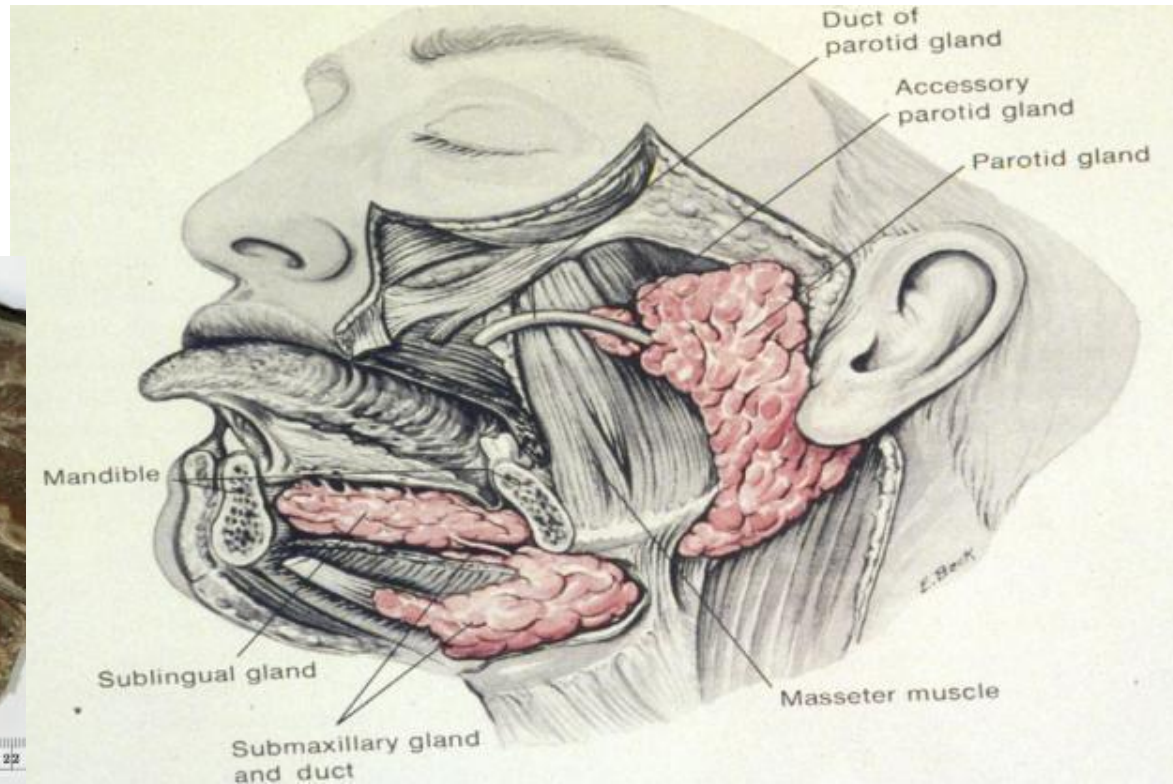
**HISTOLOGICAL ORGANIZATION**

**ACINUS = FUNCTIONAL UNIT**

**SEROUS**

**MUCOUS**

**MIXED**



Gunther von Hagens'

# BODY WORLD

The Anatomical Exhibition of Real Human B

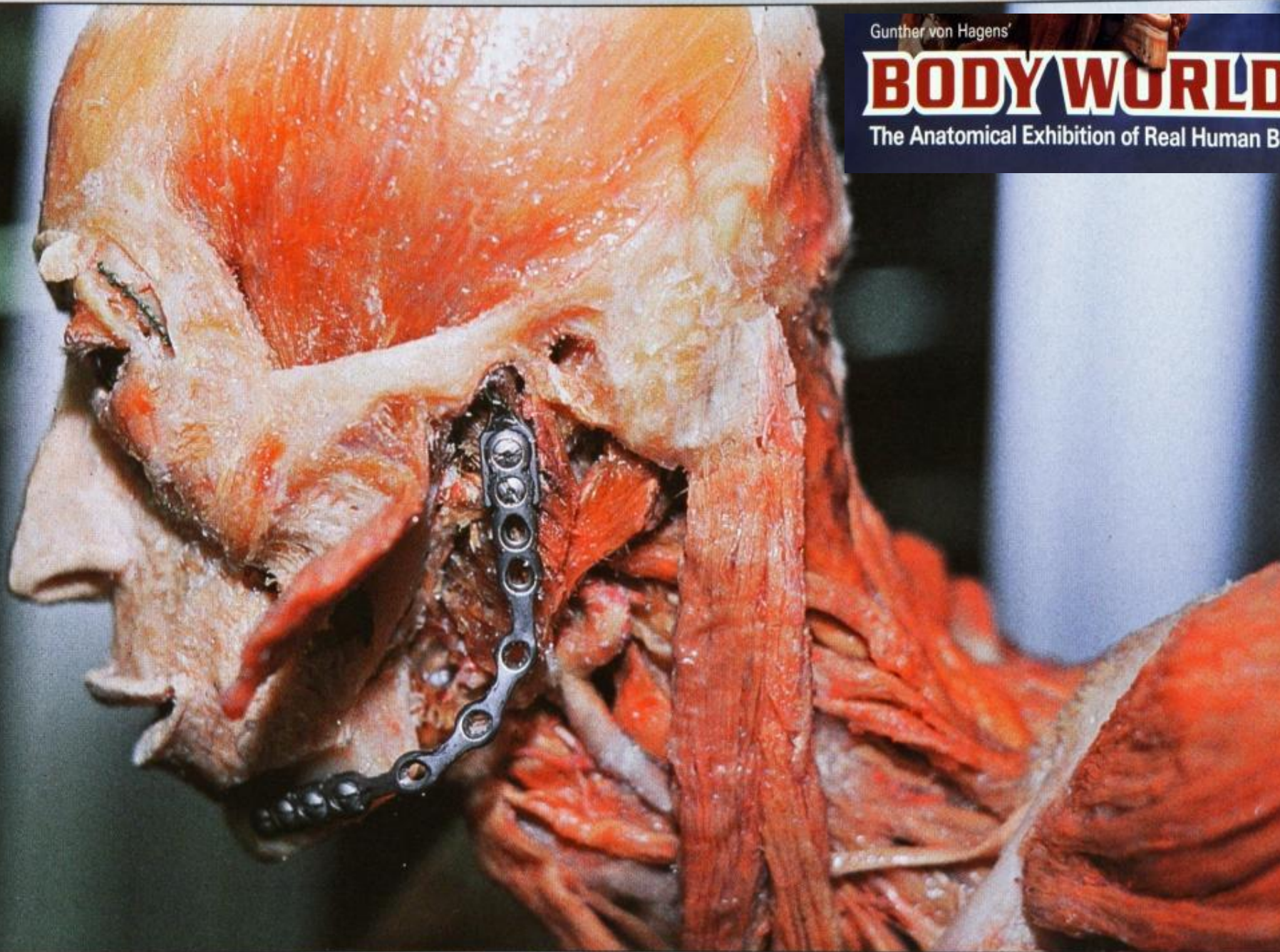
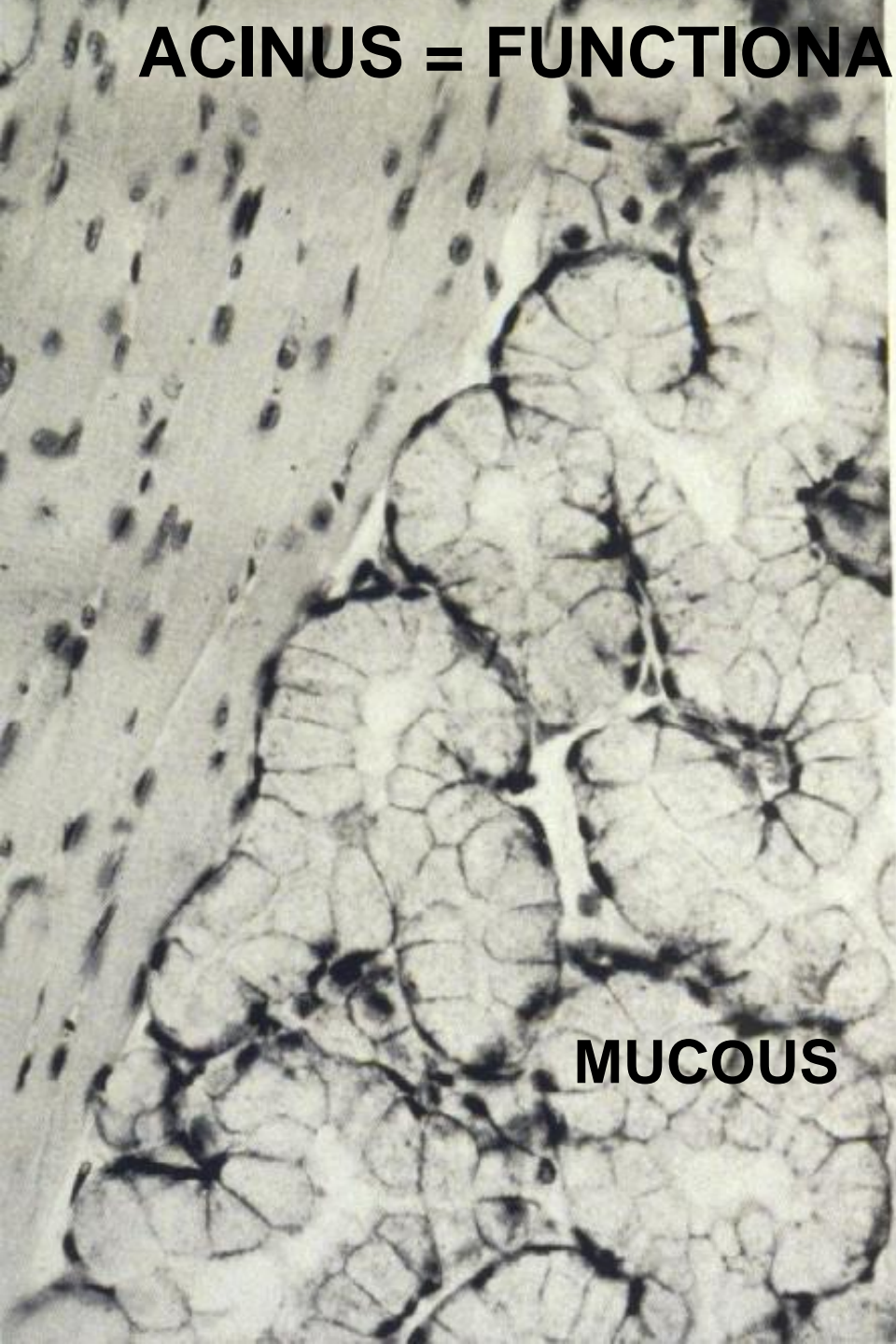
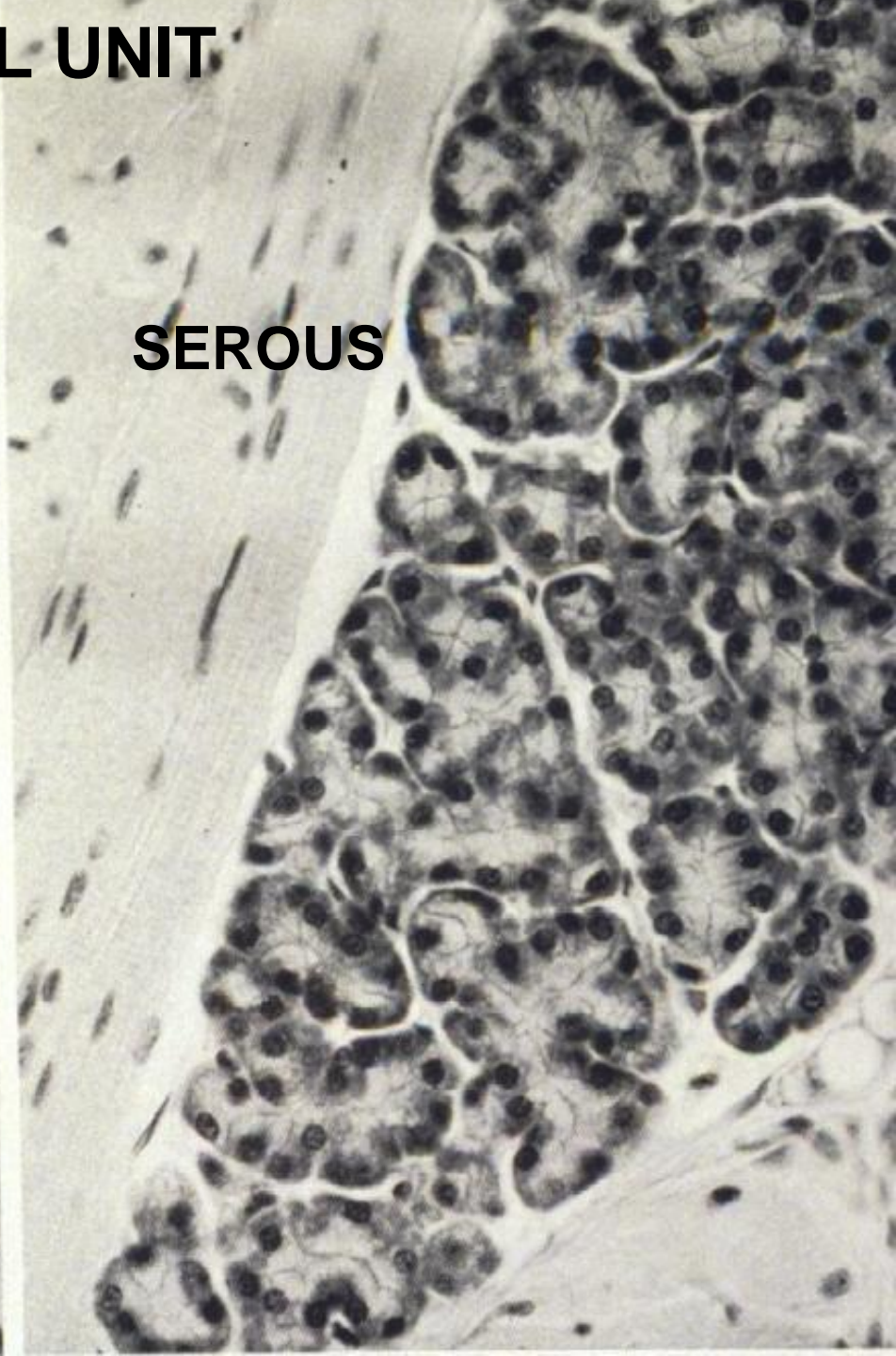


Fig. 9.22: Jawbone prosthesis after partial resection of the jawbone.

**ACINUS = FUNCTIONAL UNIT**



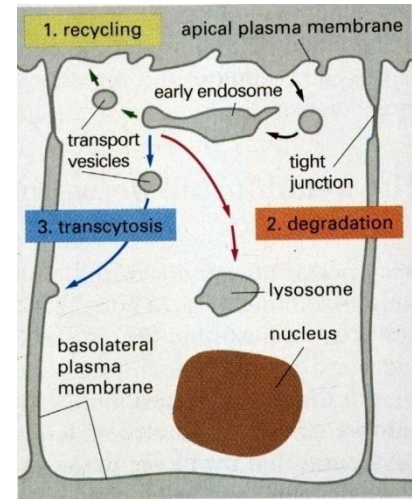
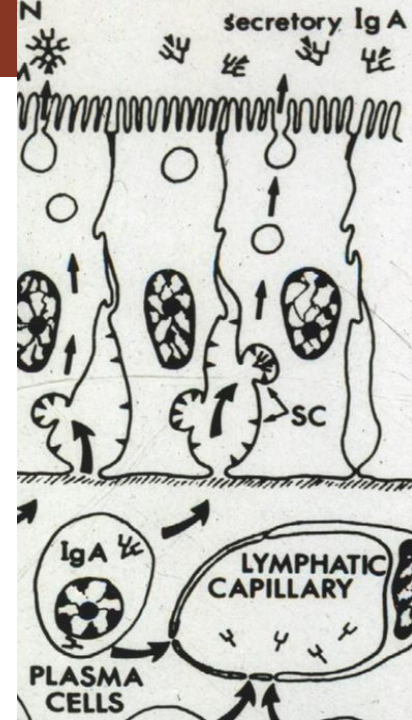
**MUCOUS**



**SEROUS**

# SALIVA HELPS PREVENTS INFECTIONS

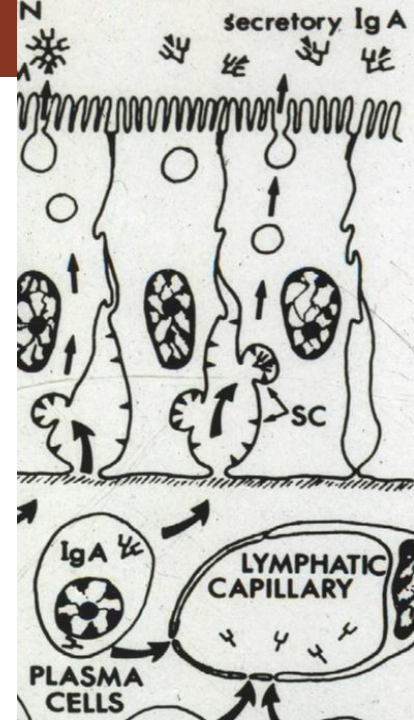
CONTAINS SECRETED IGA



# SALIVA HELPS PREVENTS INFECTIONS

CONTAINS SECRETED IGA

CONTAINS LACTOFERIN - BIND UP IRON  
NEEDED FOR BACTERIA DIVISION

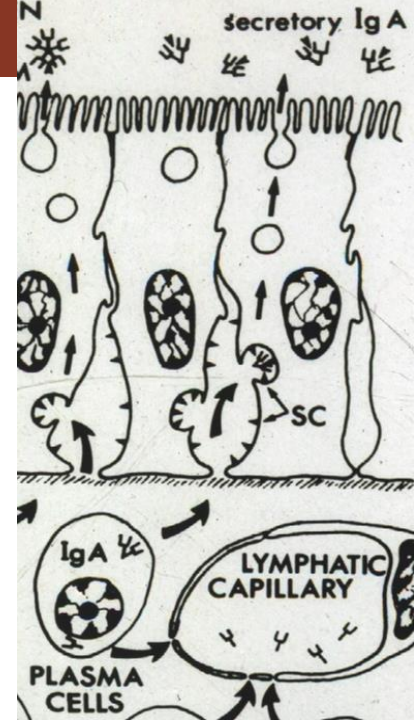


# SALIVA HELPS PREVENTS INFECTIONS

CONTAINS SECRETED IGA

CONTAINS LACTOFERIN - BIND UP IRON  
NEEDED FOR BACTERIA DIVISION

CONTAINS LYSOSOME THAT KILLS  
BACTERIA



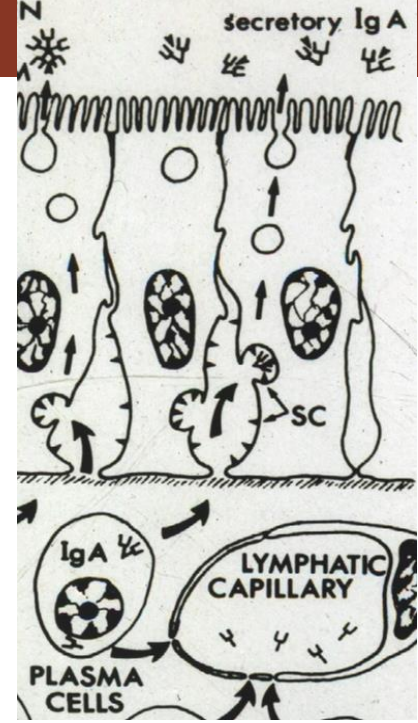
# SALIVA HELPS PREVENTS INFECTIONS

CONTAINS SECRETED IGA

CONTAINS LACTOFERIN - BIND UP IRON  
NEEDED FOR BACTERIA DIVISION

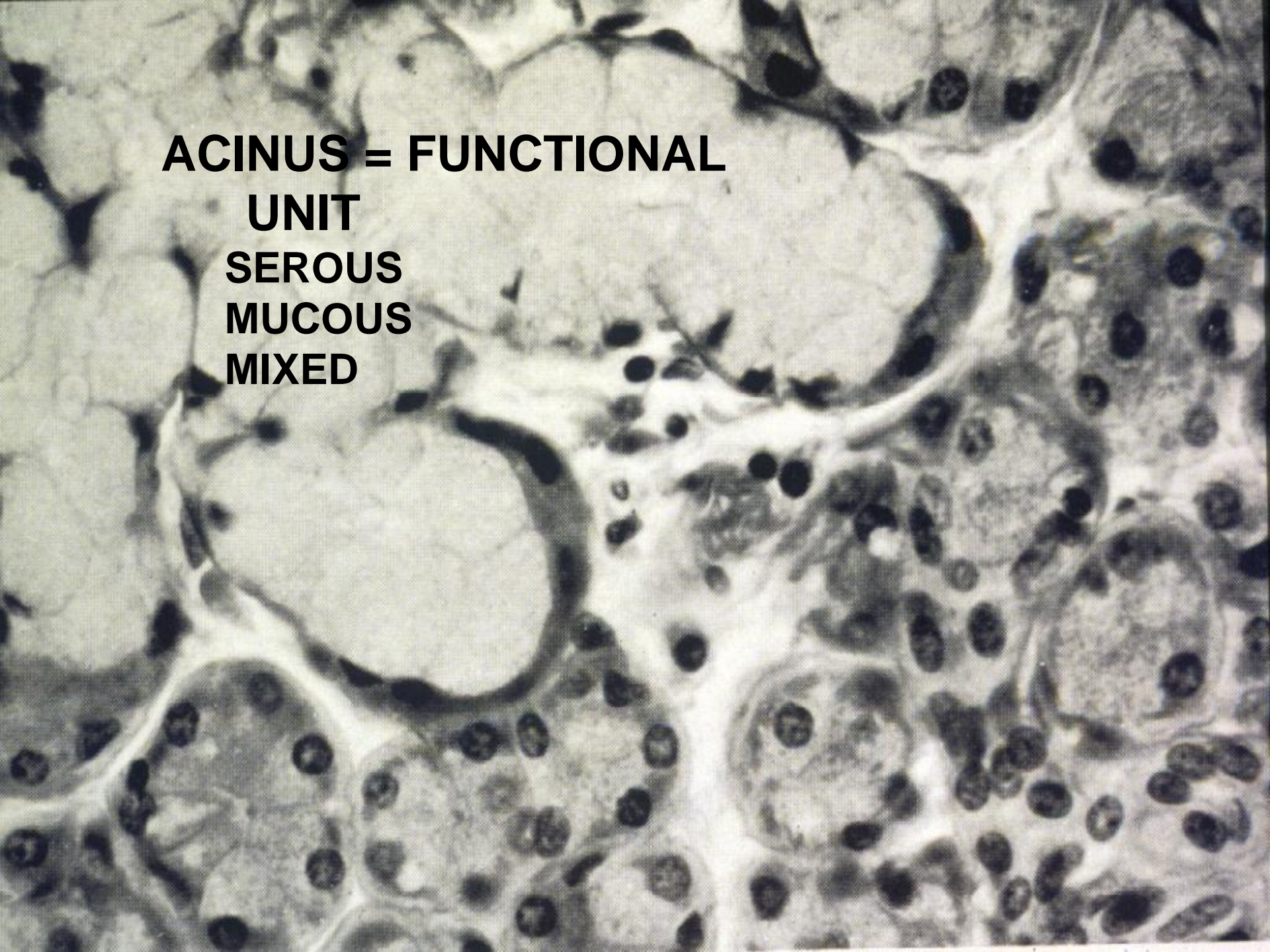
CONTAINS LYSOSOME THAT KILLS  
BACTERIA

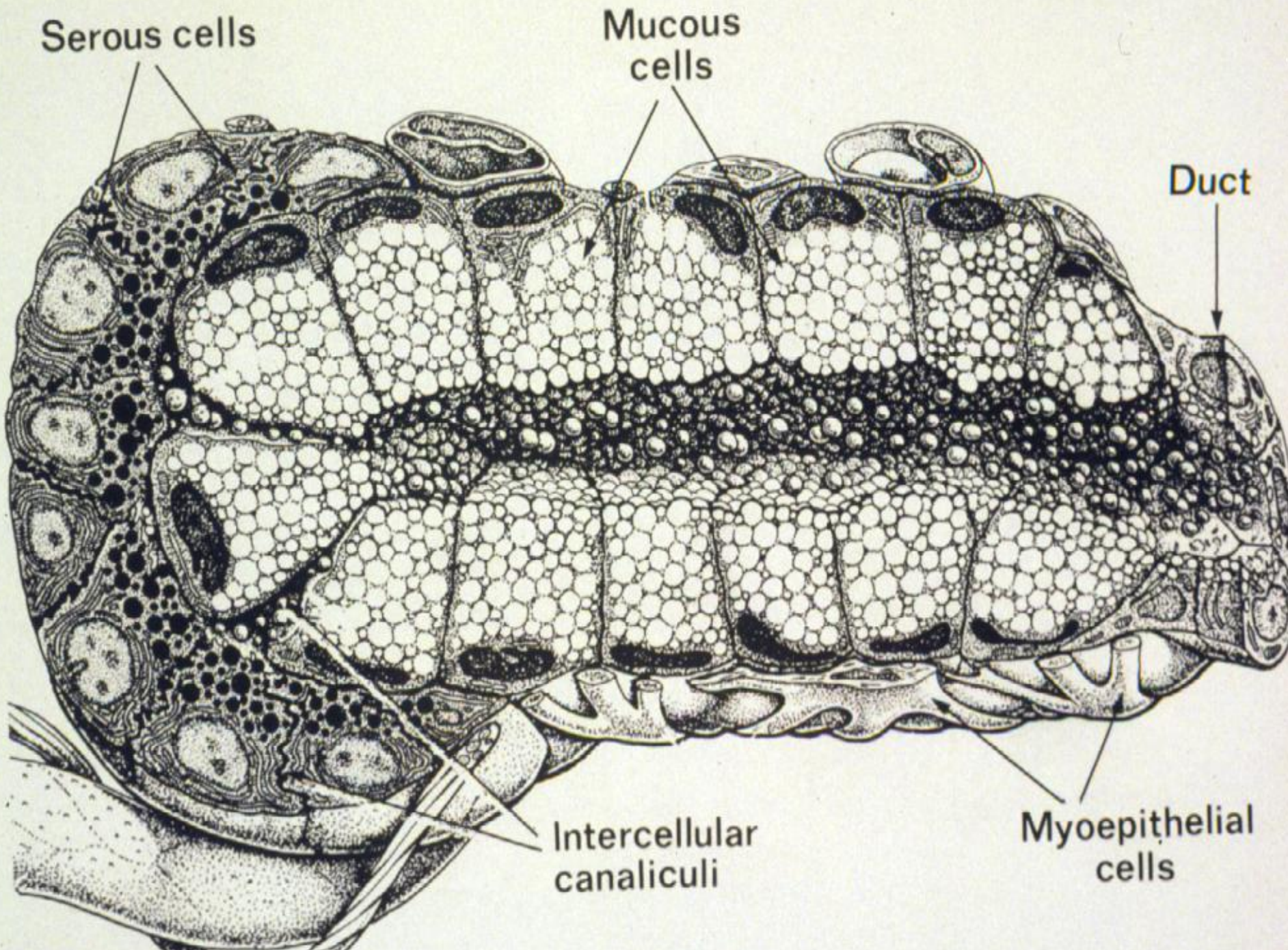
CONSTANTLY WASHES MOUTH TO  
DISLODGE AND SWEEP BACTERIA DOWN  
GI TRACT





**ACINUS = FUNCTIONAL  
UNIT  
SEROUS  
MUCOUS  
MIXED**





Serous cells

Mucous cells

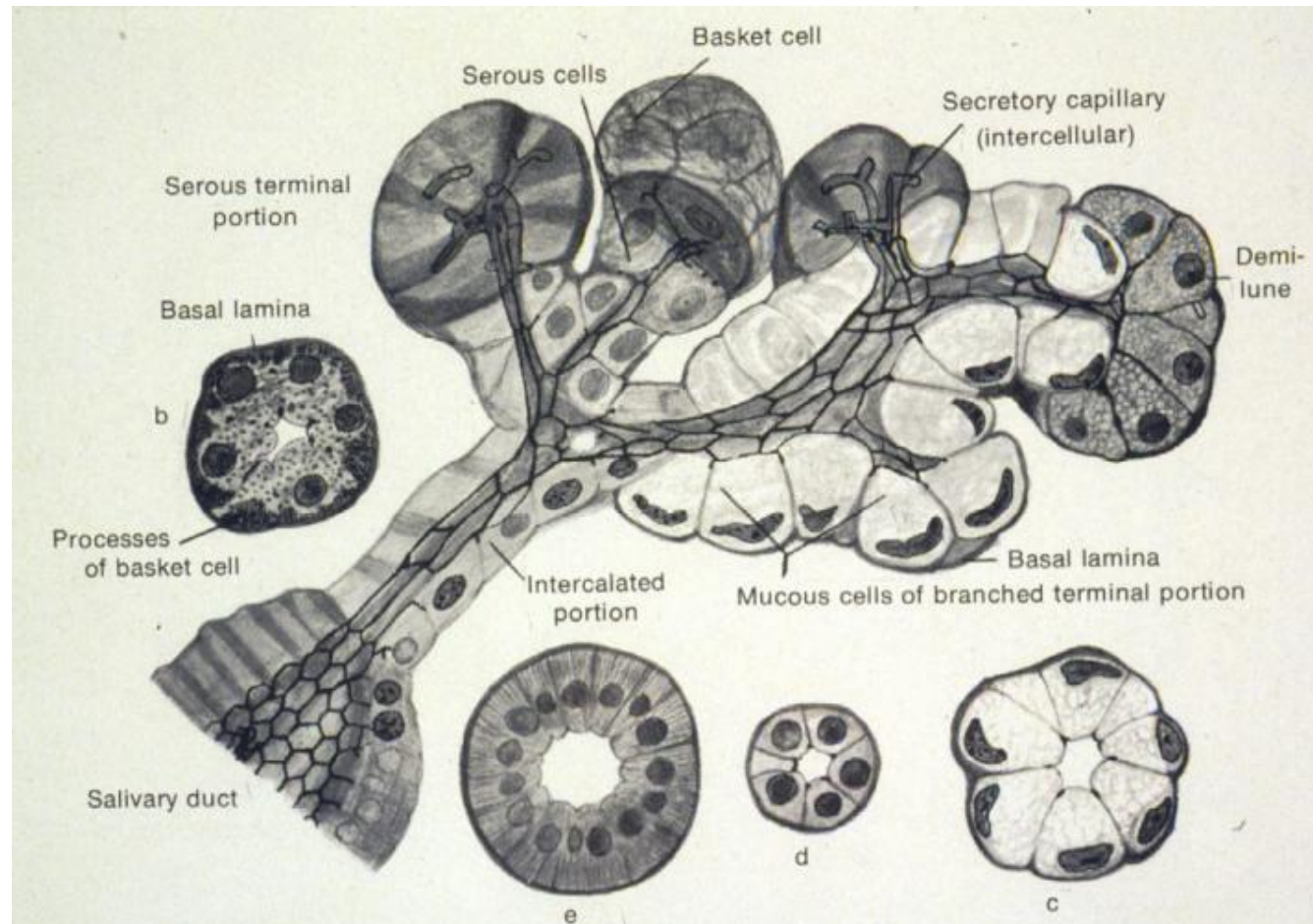
Duct

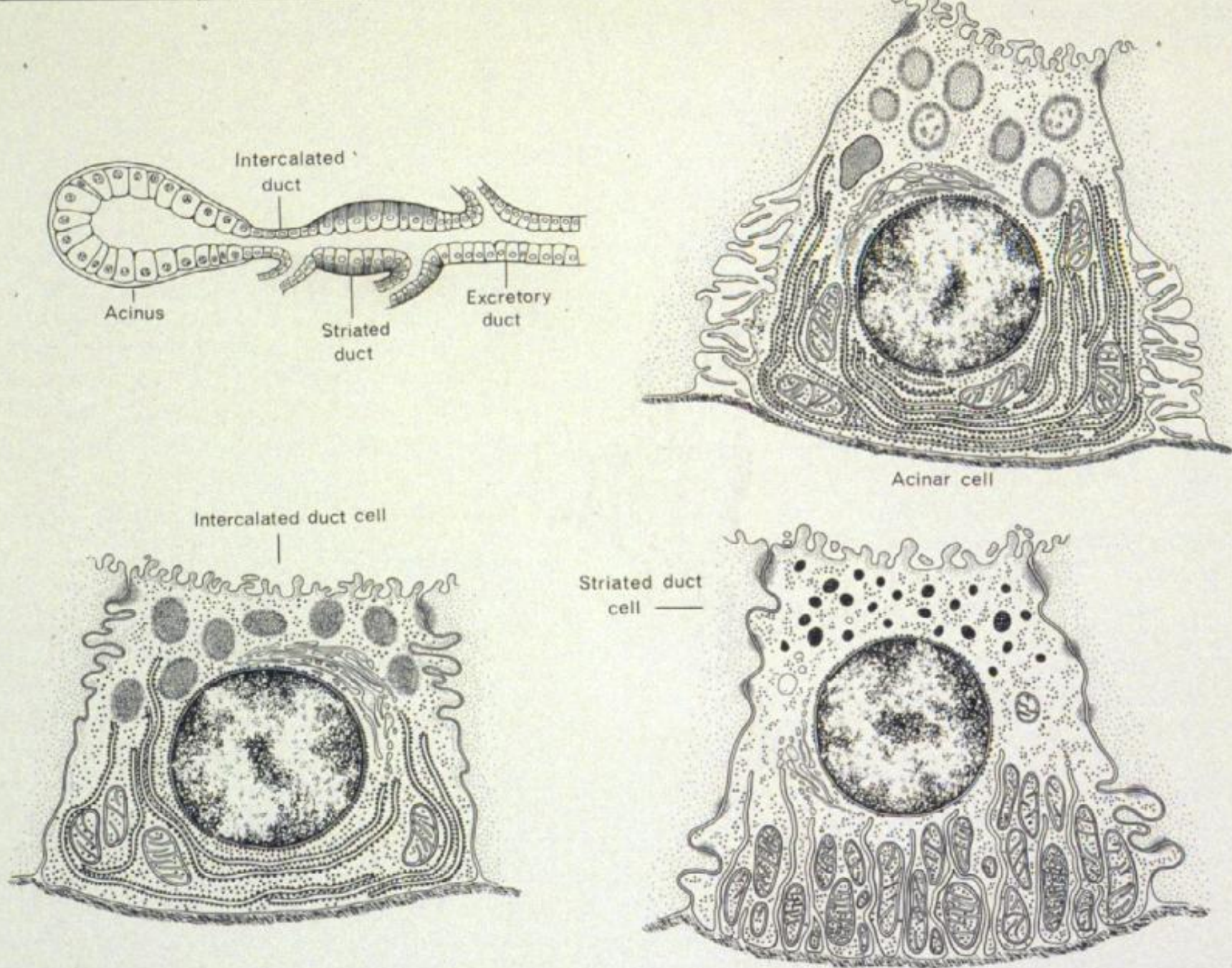
Intercellular canaliculi

Myoepithelial cells

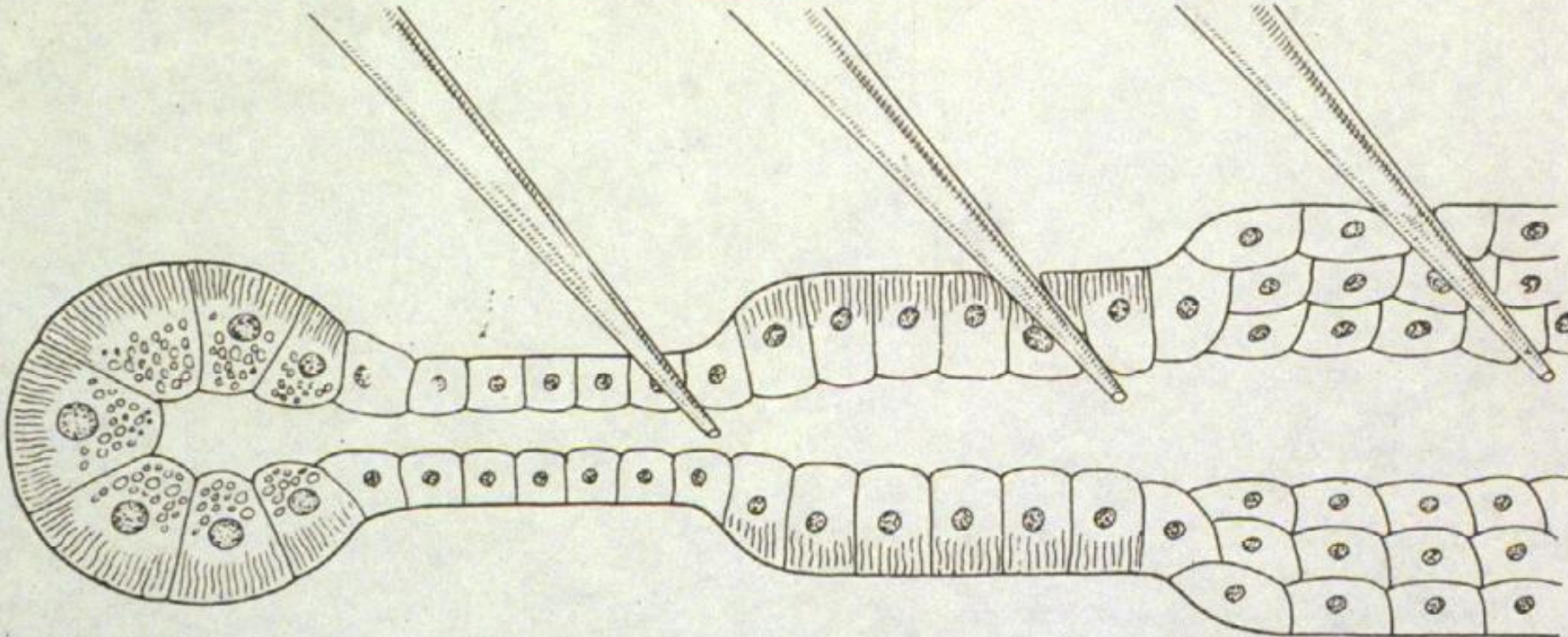
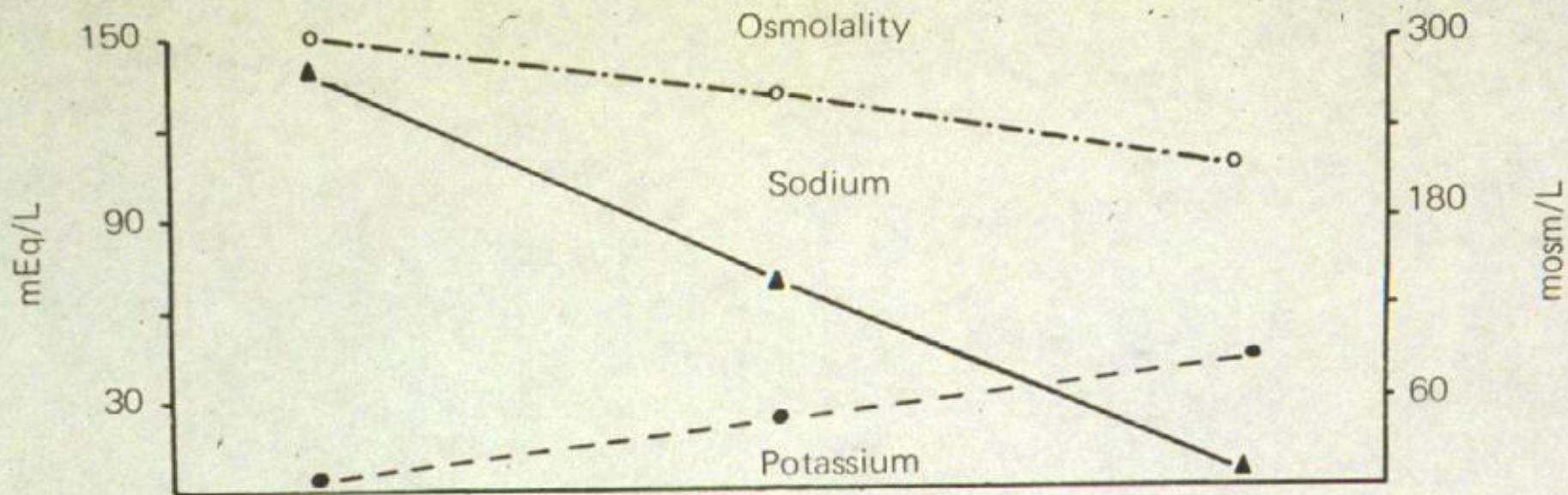
# DUCTS OF SALIVARY GLANDS

## INTERCALATED STRIATED



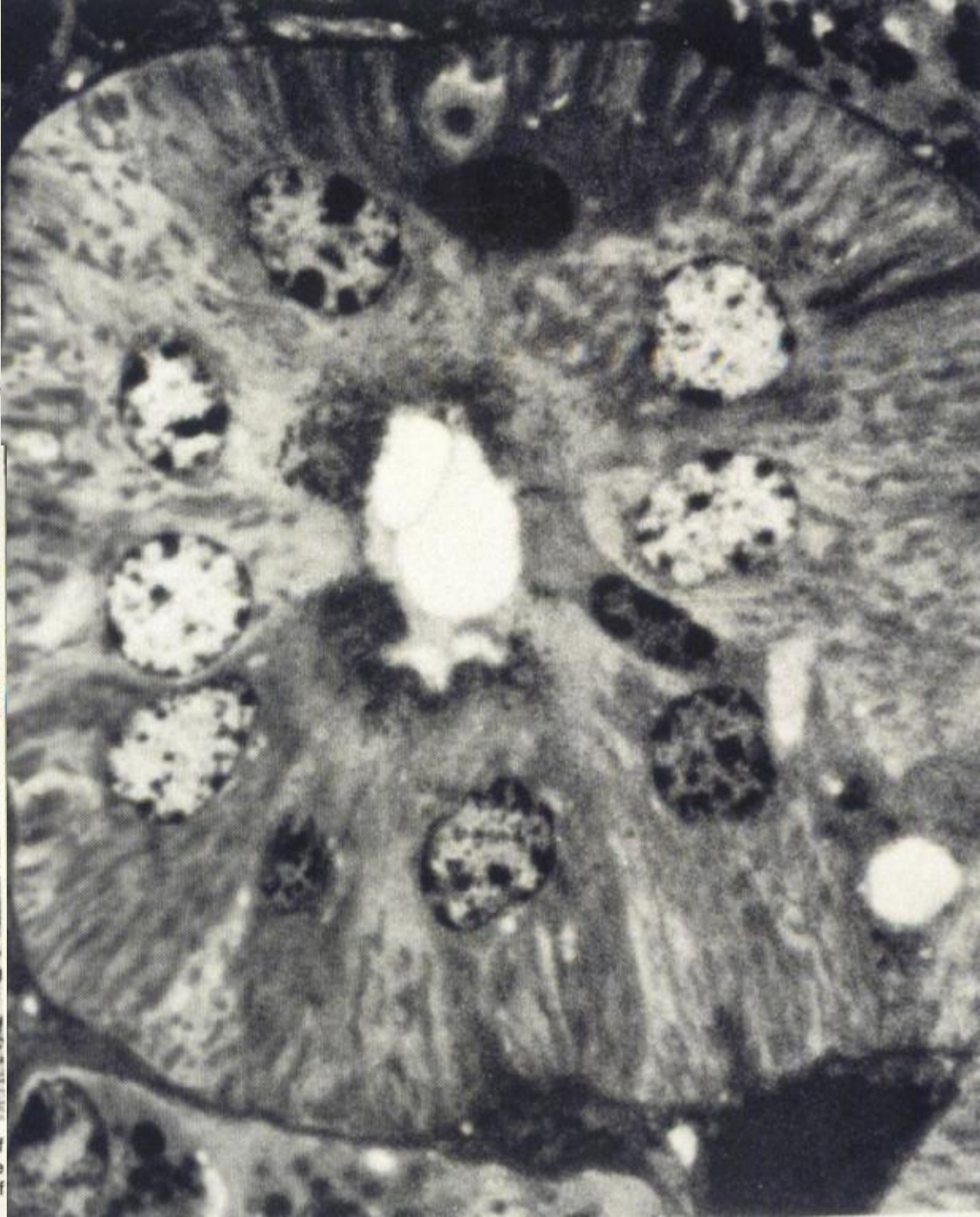
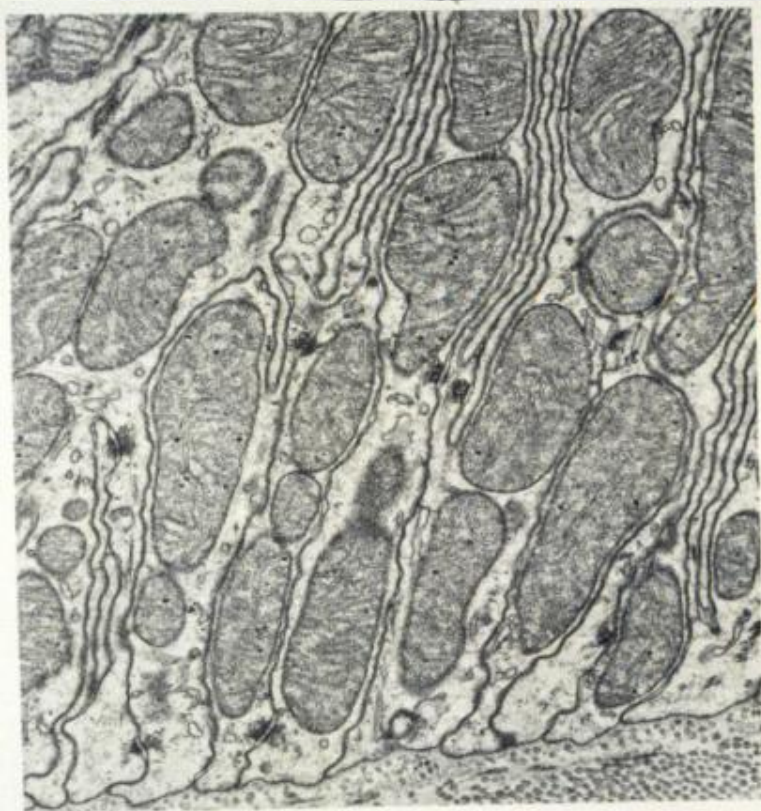
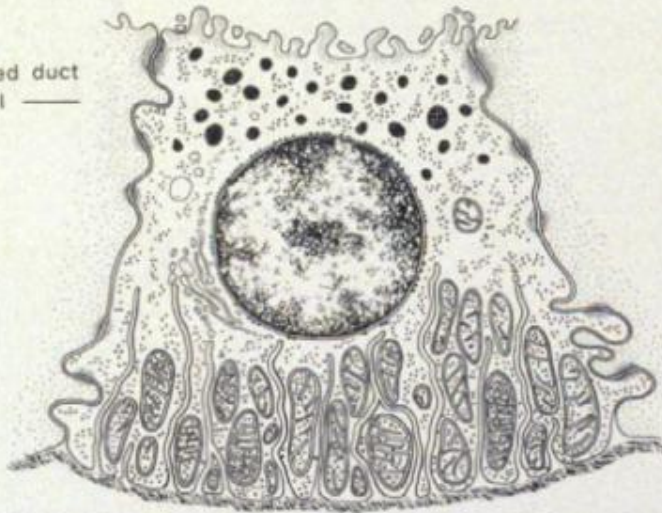


**Figure 23-19.** Diagrammatic representation of the fine structural characteristics of the various cell types in the mouse submandibular gland. (Redrawn after U. Rutberg.)



Acinus      Intercalated duct      Striated duct      Interlobular duct

Striated duct  
cell —



**Figure 23-21.** Electron micrograph of basal region of striated duct cells from cat submandibular gland. Notice the desmosomes joining the interdigitating processes of adjacent cells. (Micrograph courtesy of B. Tandler.)

# PANCREAS

## FUNCTION

1. EXOCRINE
2. ENDOCRINE

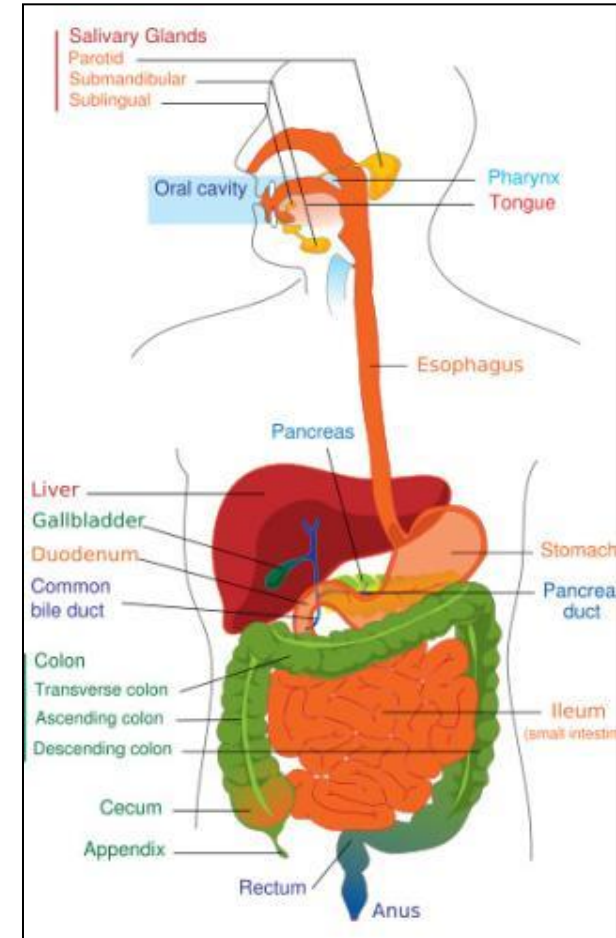
## HISTOLOGICAL ORGANIZATION, EXOCRINE PORTION

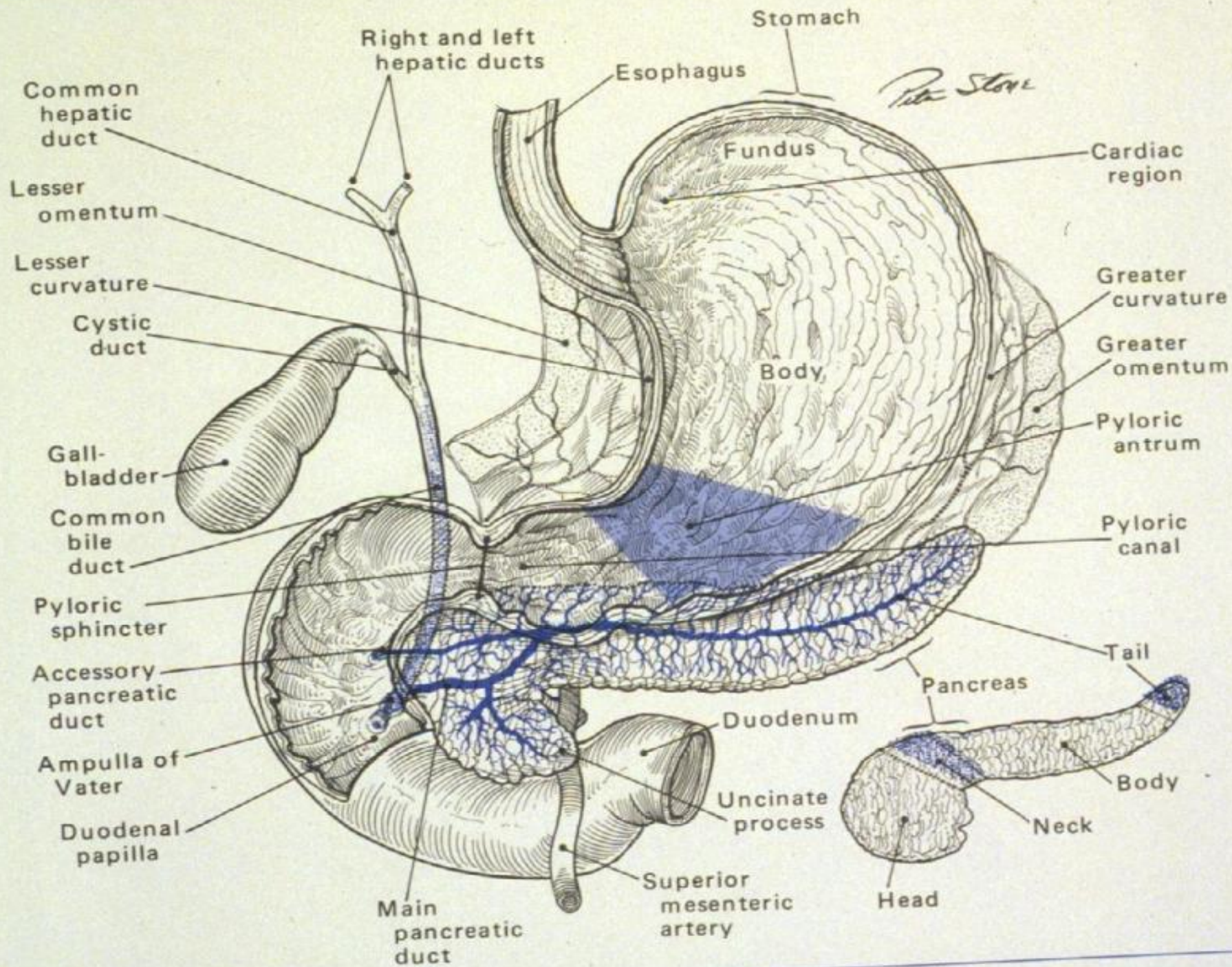
1. ACINI
2. DUCTS

## ENDOCRINE PORTION

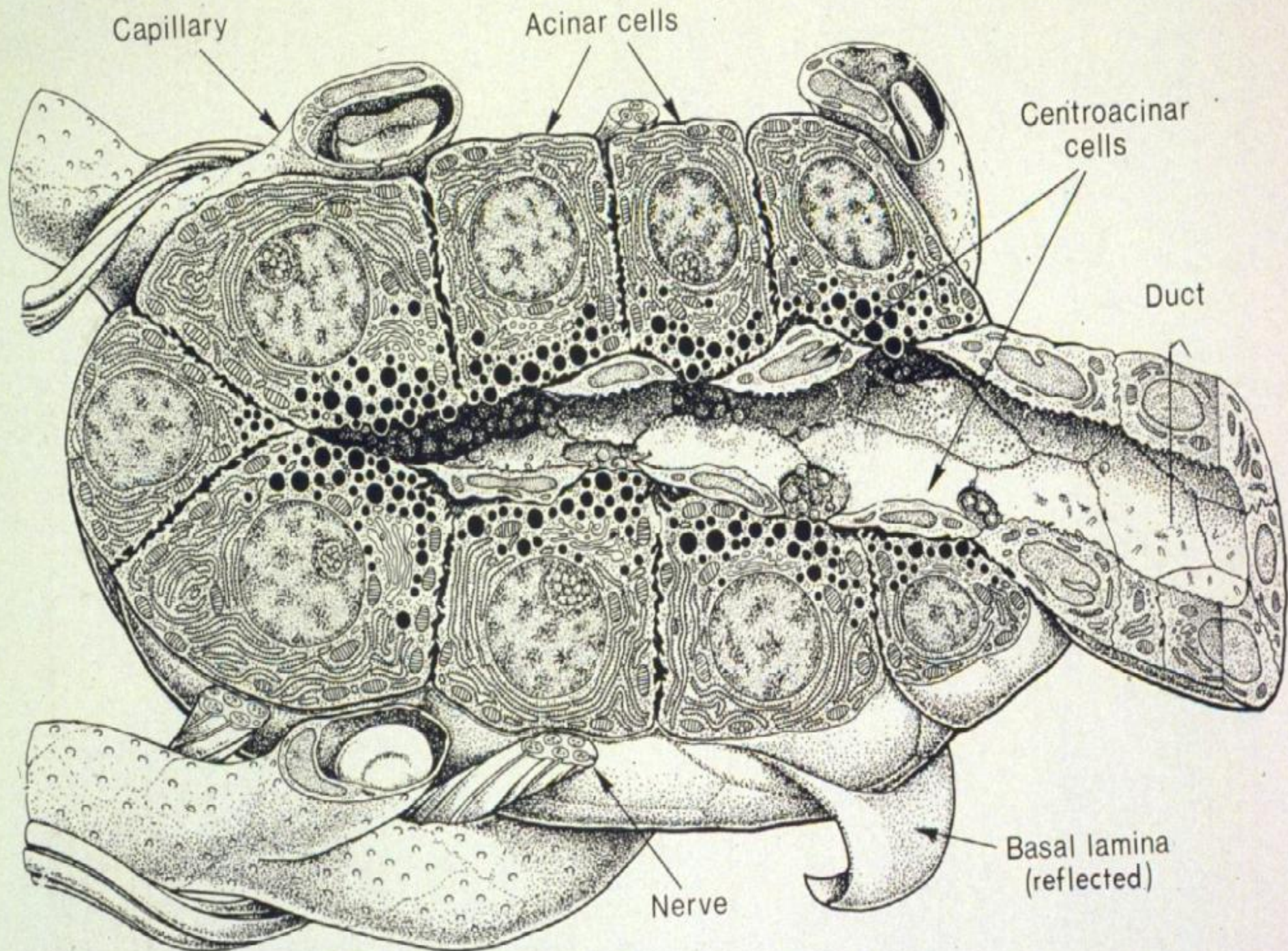
- ISLETS OF LANGERHANS

## HISTOPHYSIOLOGY









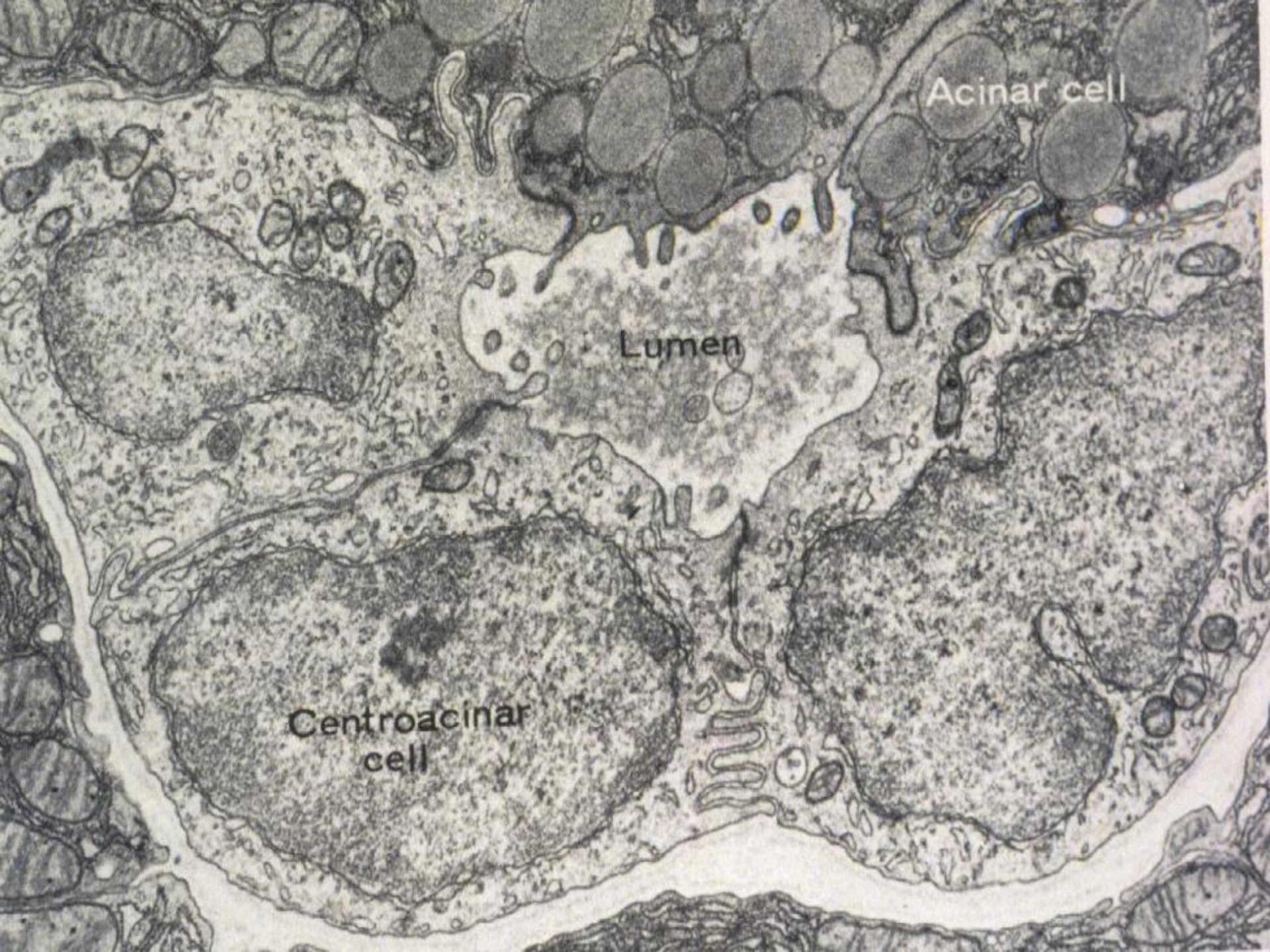


Ergastoplasm

Centroacinar cells

Zymogen granules

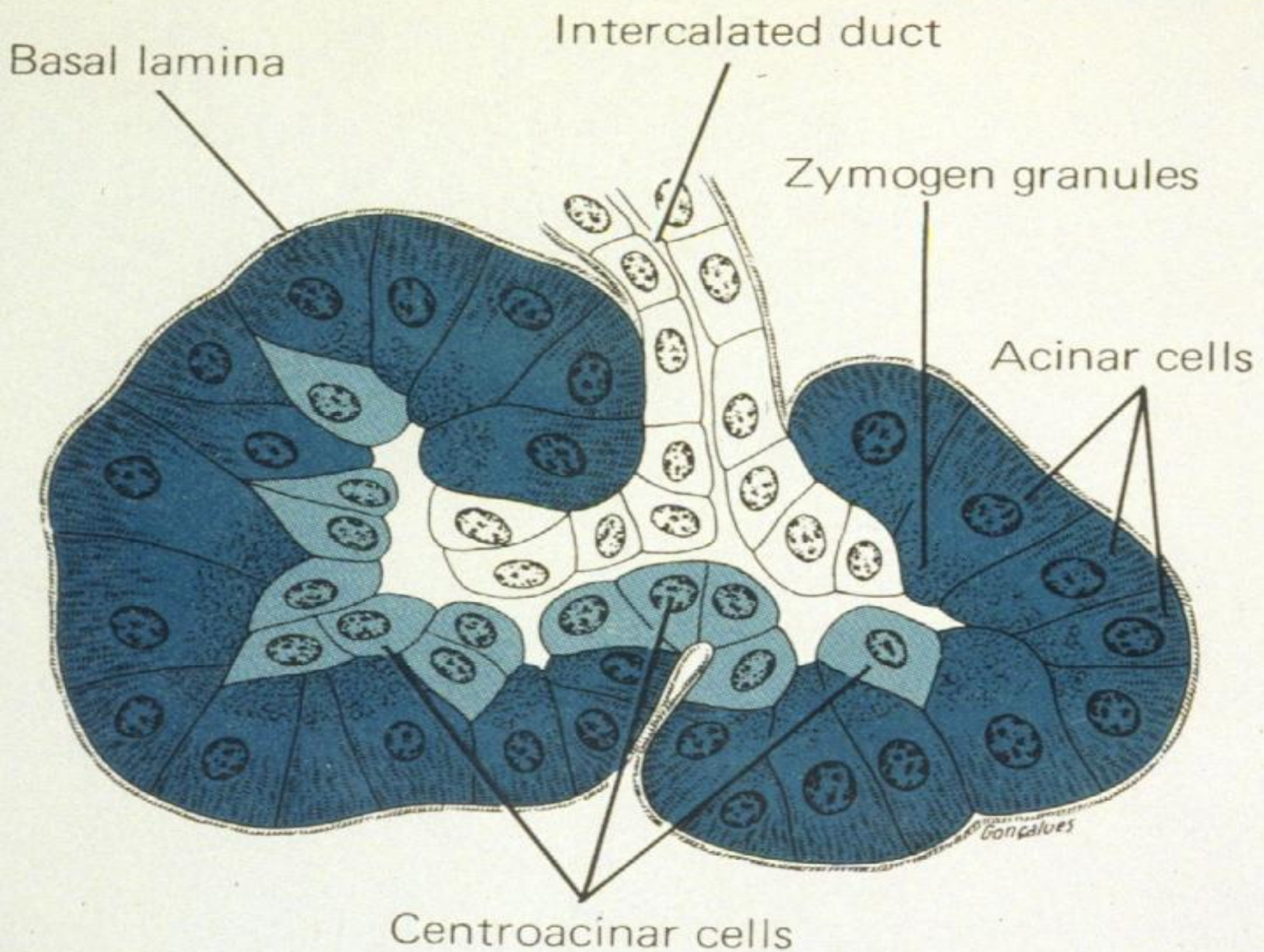
Golgi complex

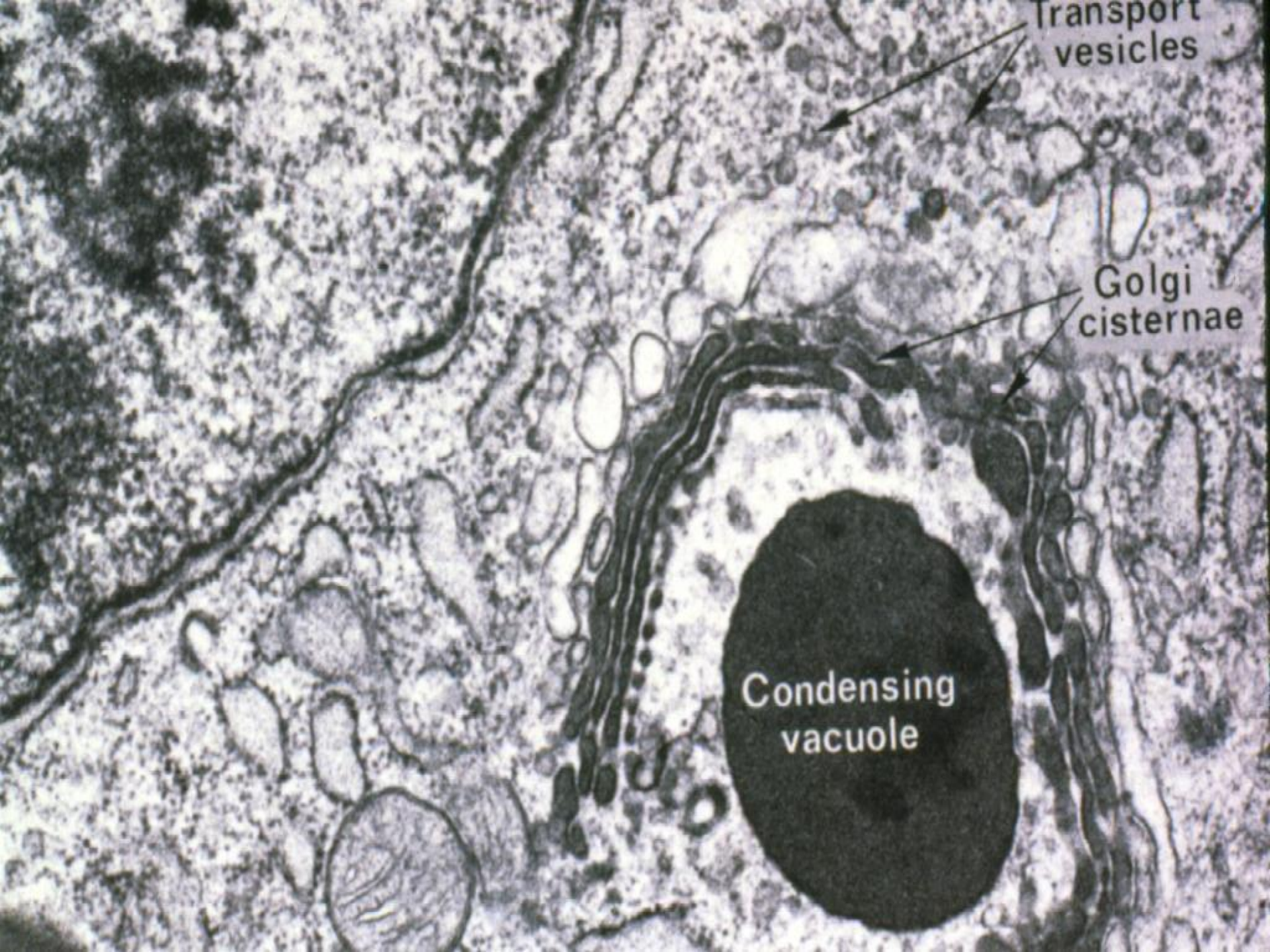


Acinar cell

Lumen

Centroacinar cell

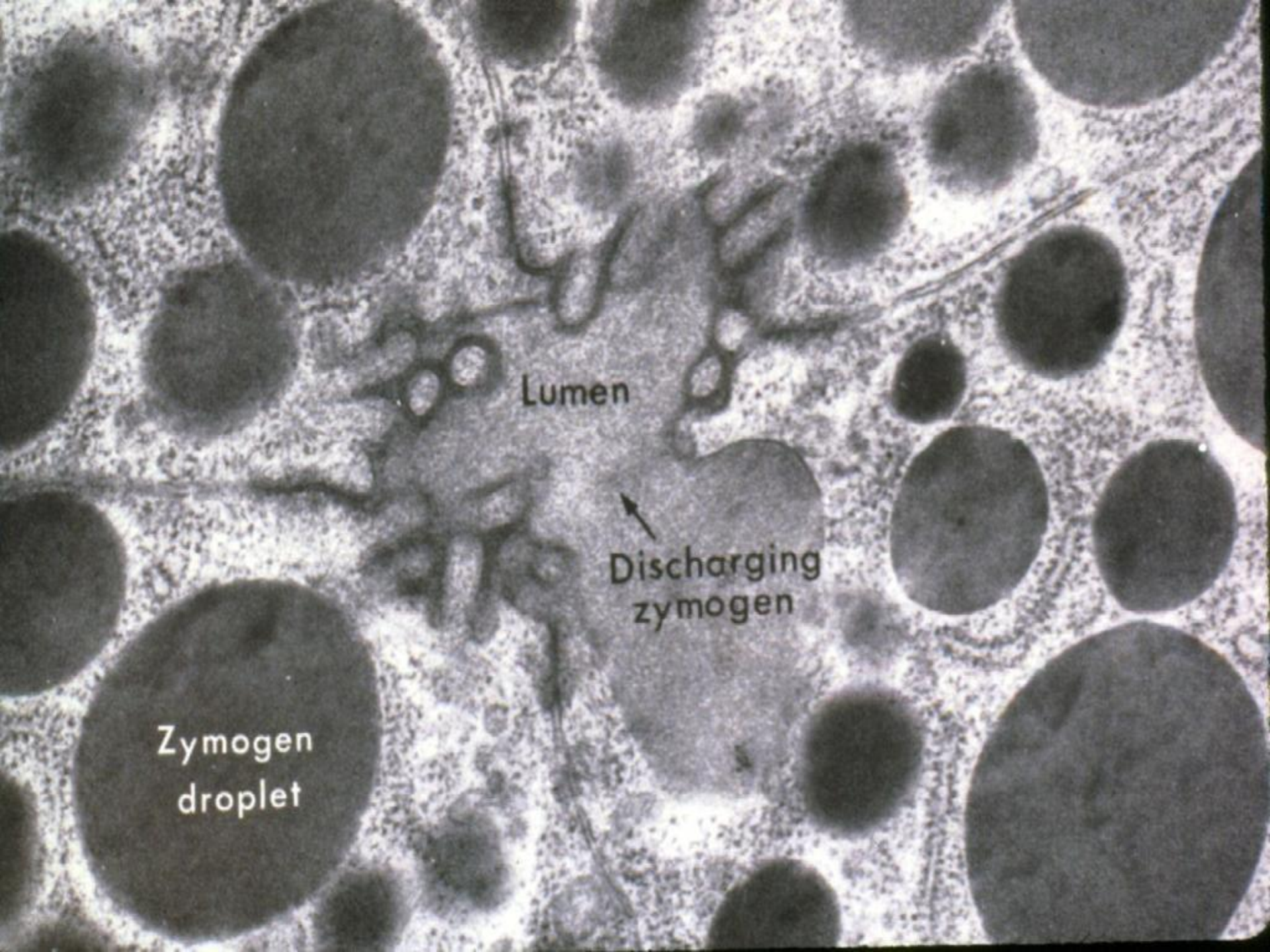




Transport vesicles

Golgi cisternae

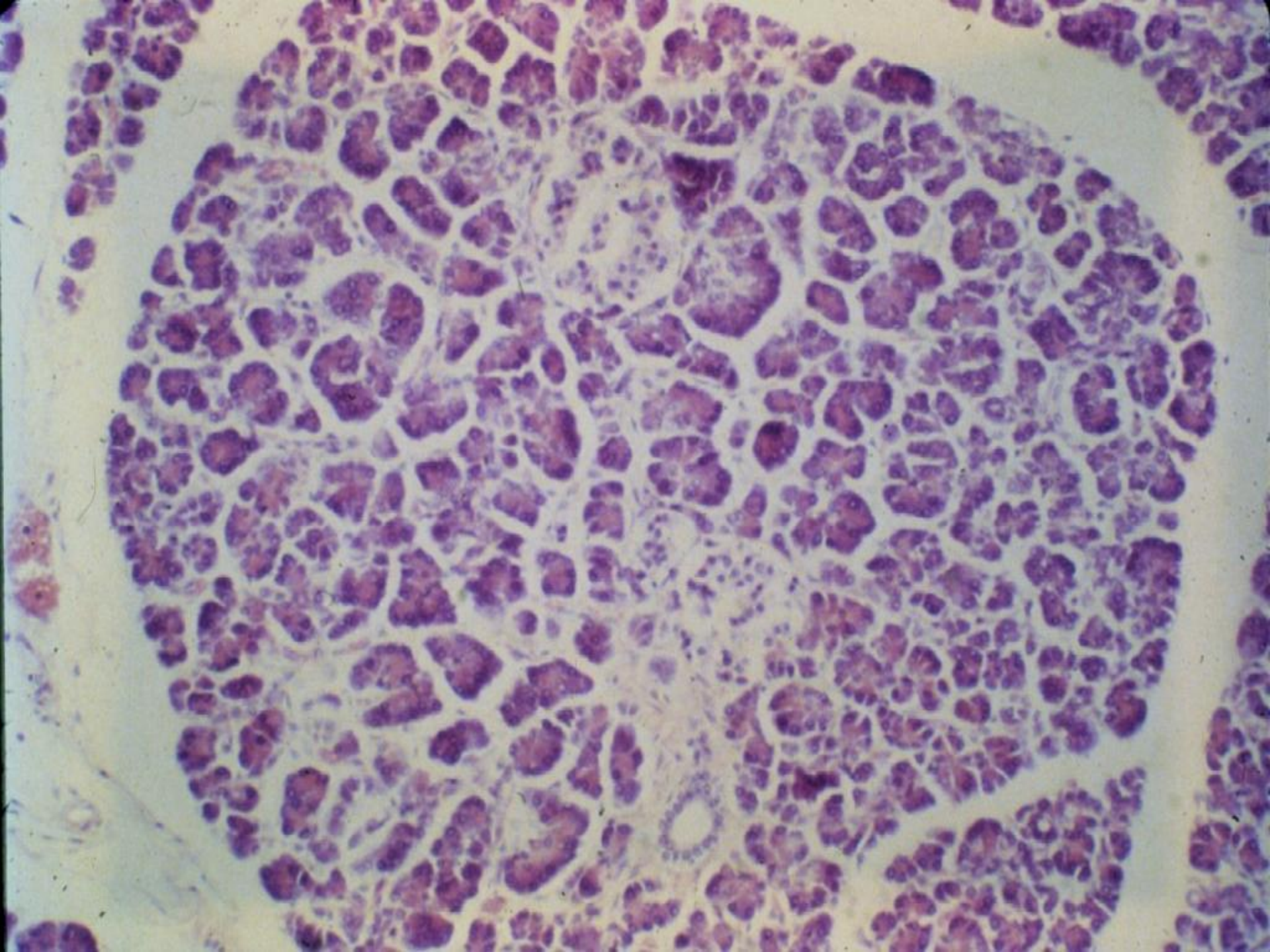
Condensing vacuole

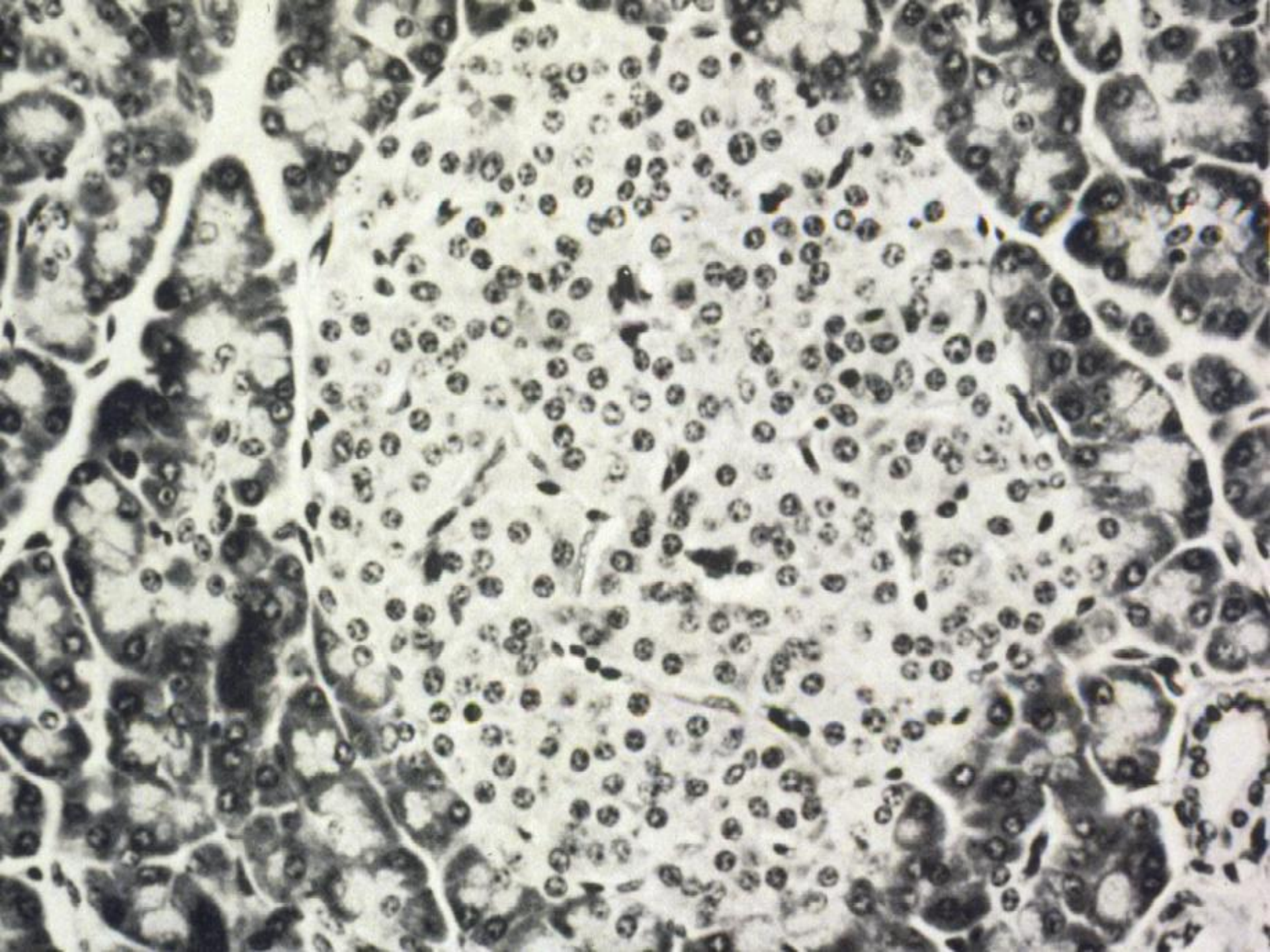


Lumen

Discharging  
zymogen

Zymogen  
droplet







34218

