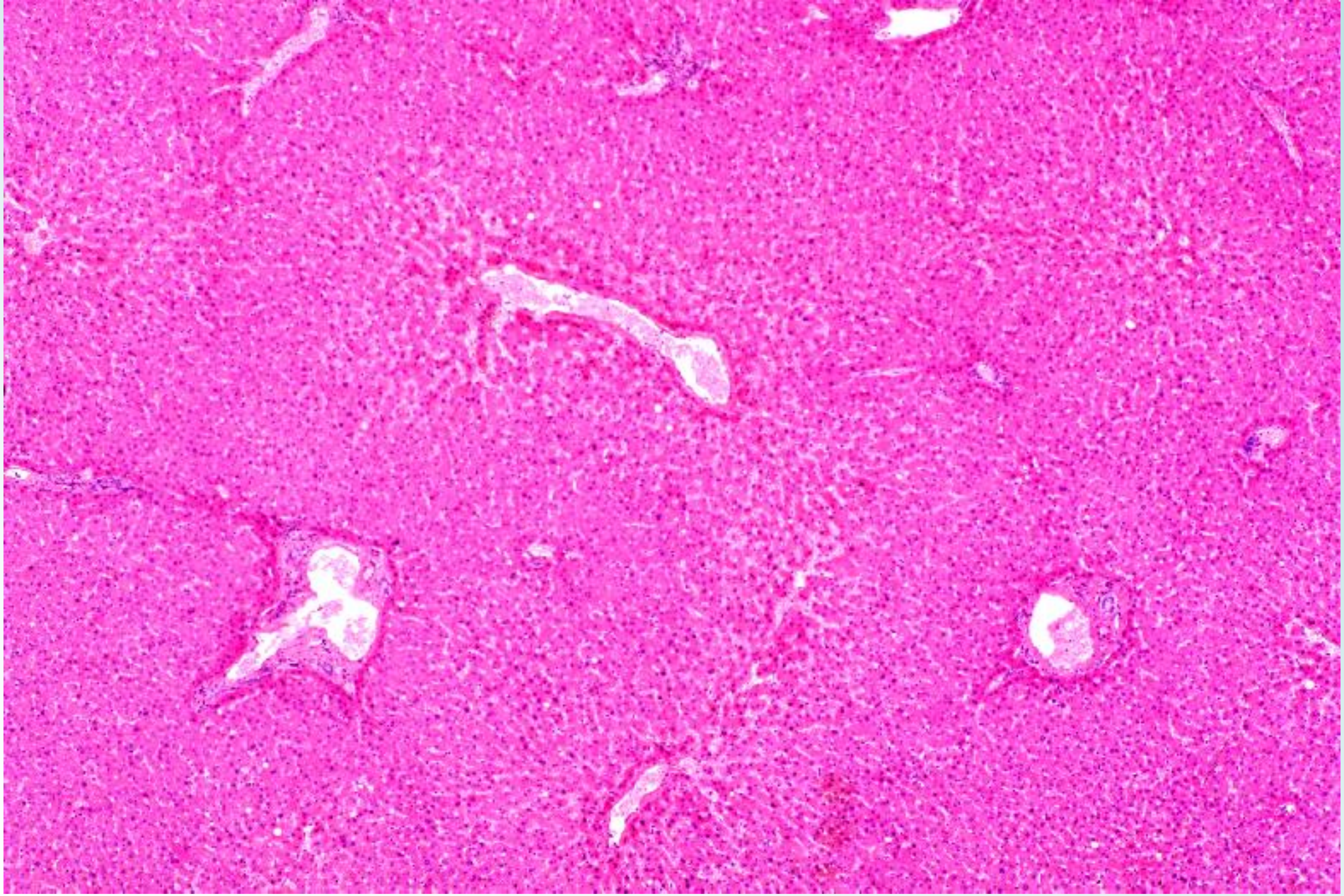
12-000
Digestive system
4
Liver and Pancreas

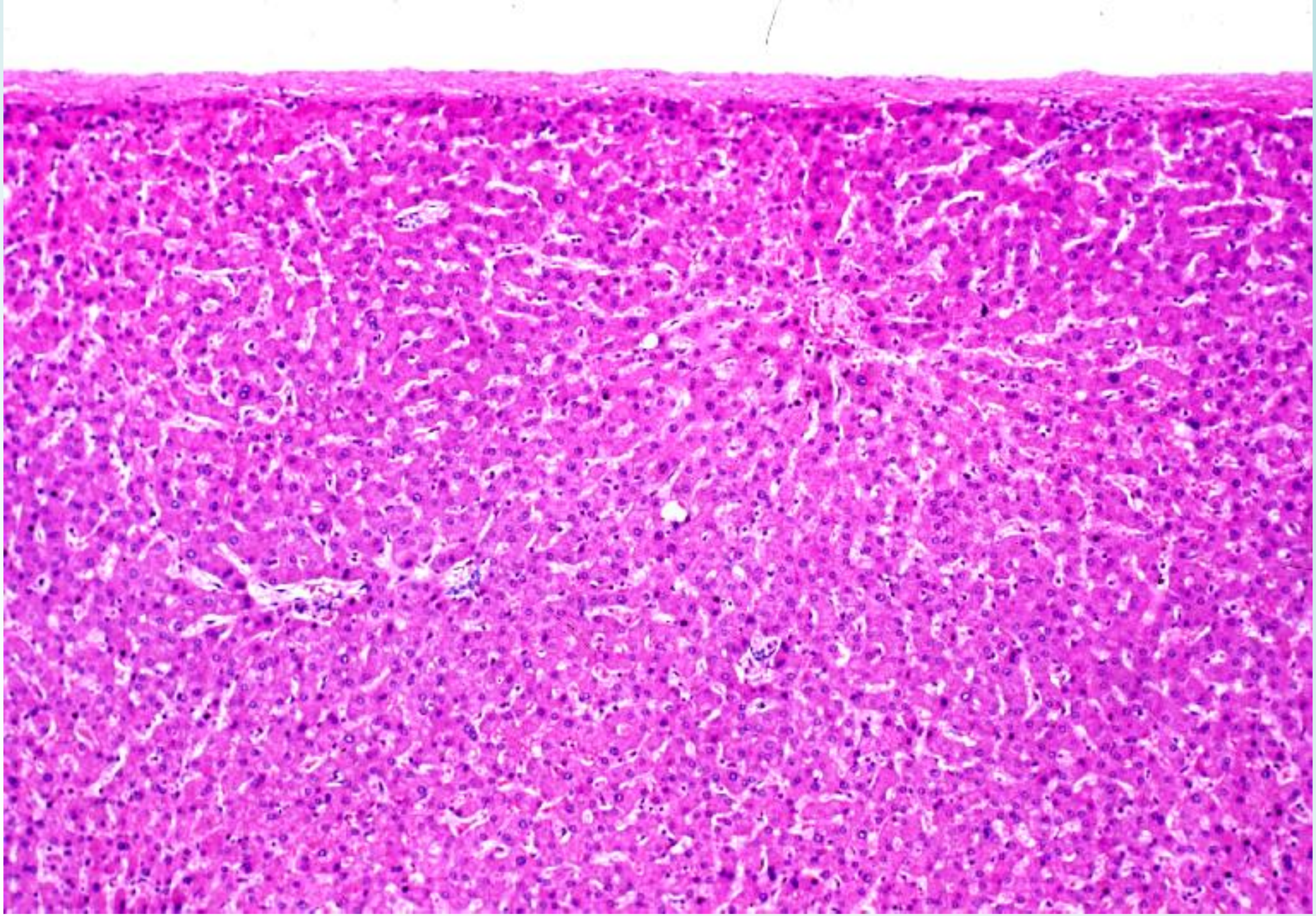
12 Digestive system 4
Menu 1/2

12 Digestive system 4
Menu 2/2

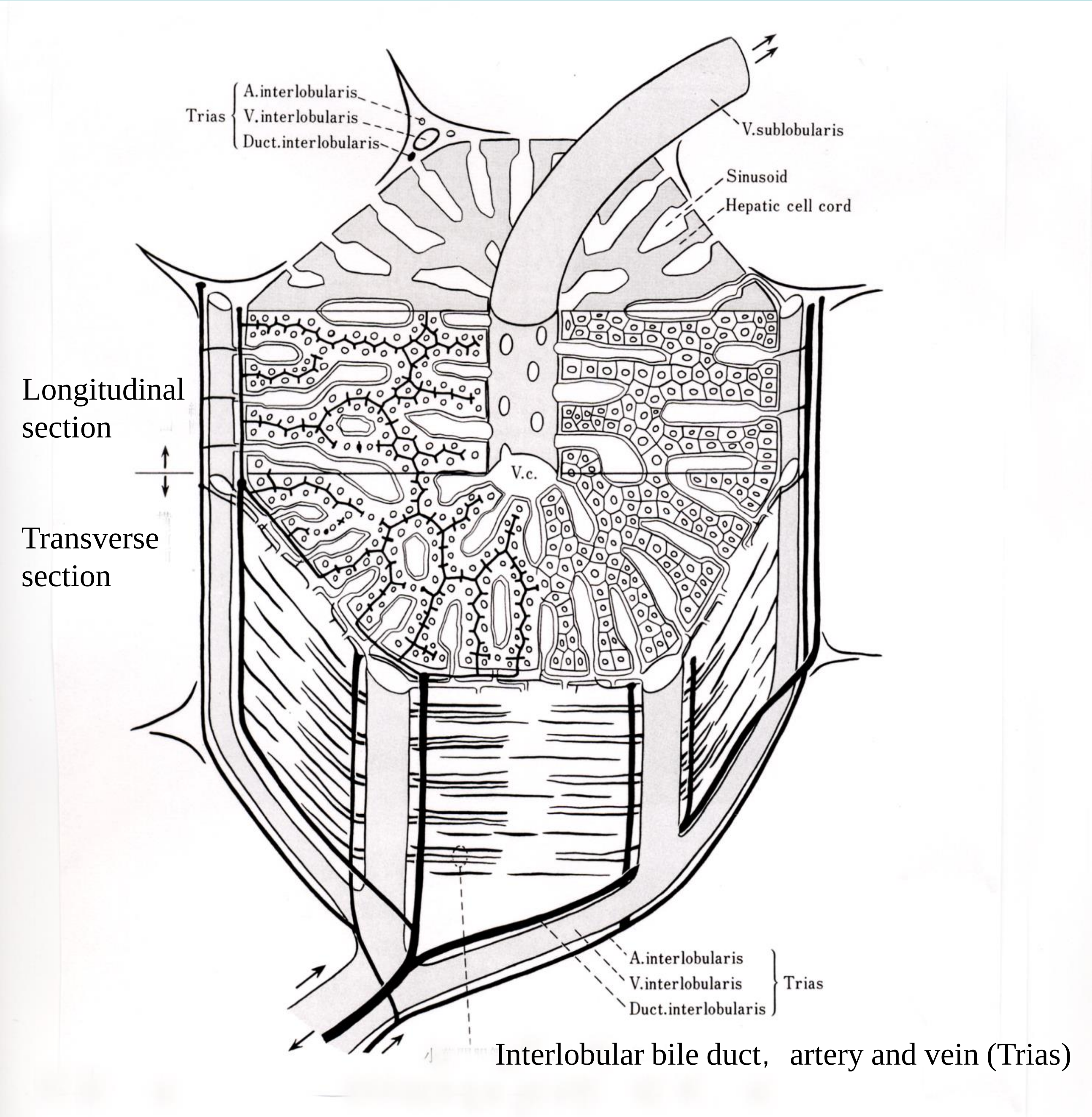
12-001
Liver



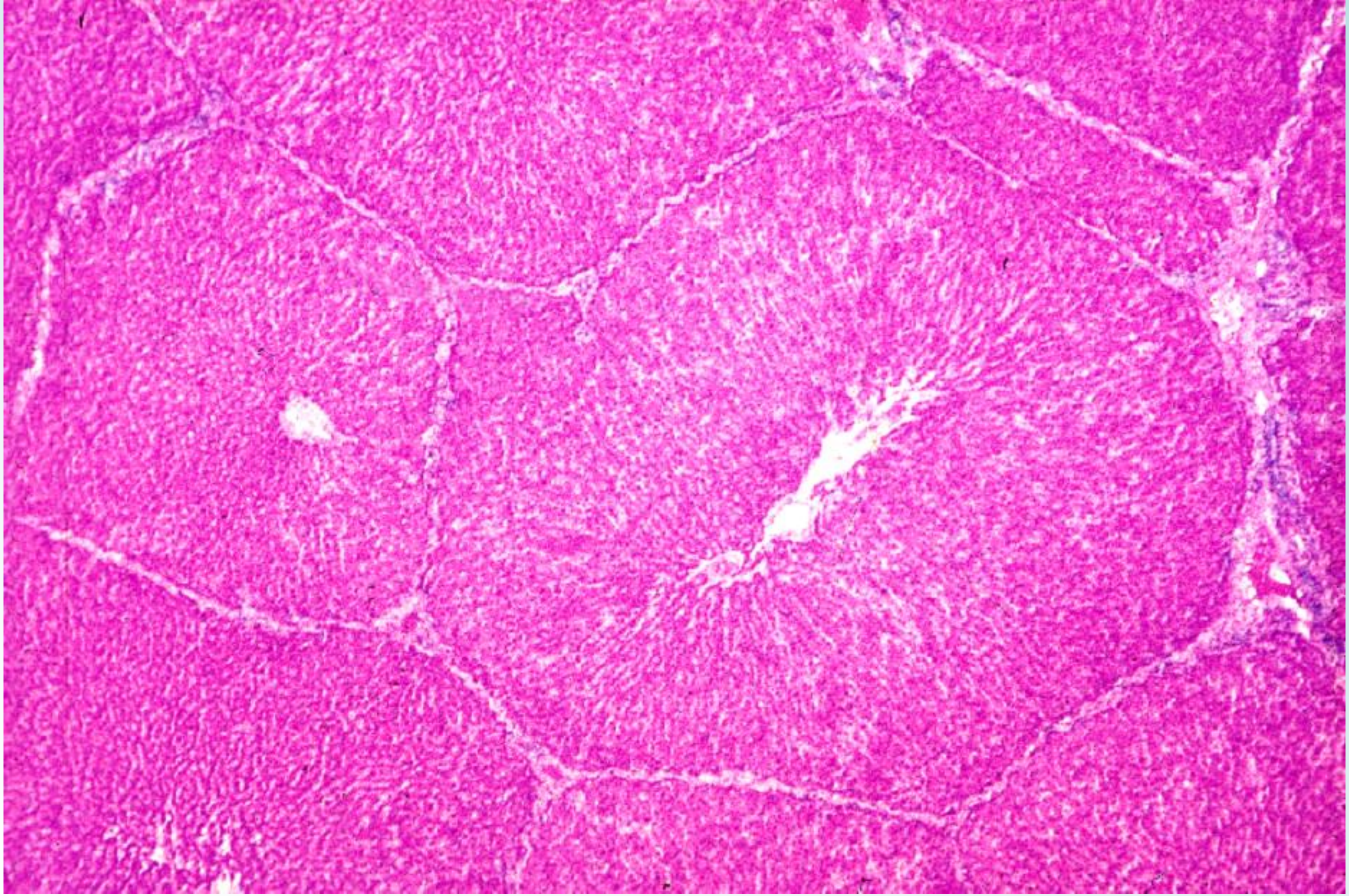
12-01 Liver, general view, 1. Human, H-E stain, x 13.



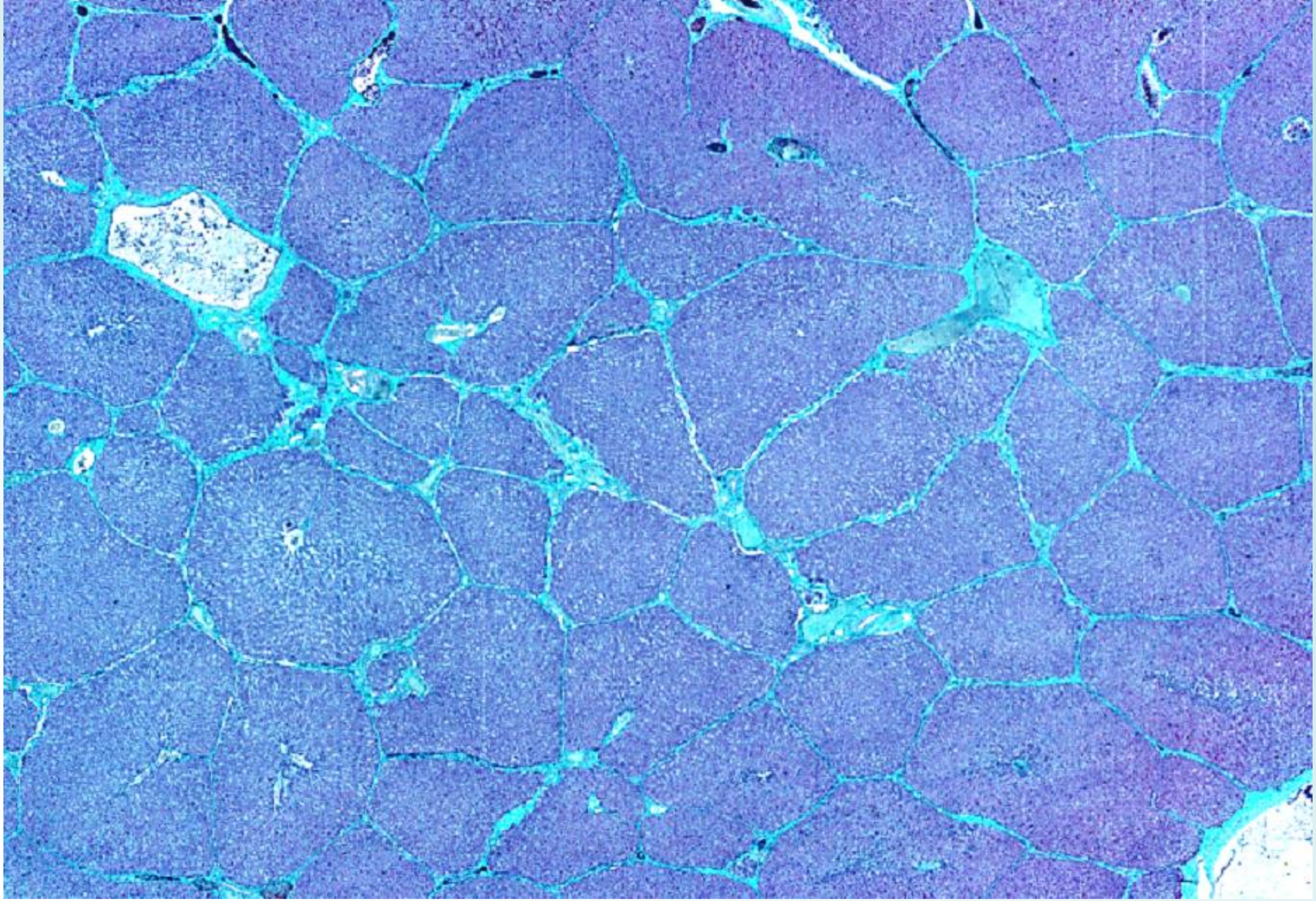
12-02 Liver, general view, 2. Human, H-E stain, x 25



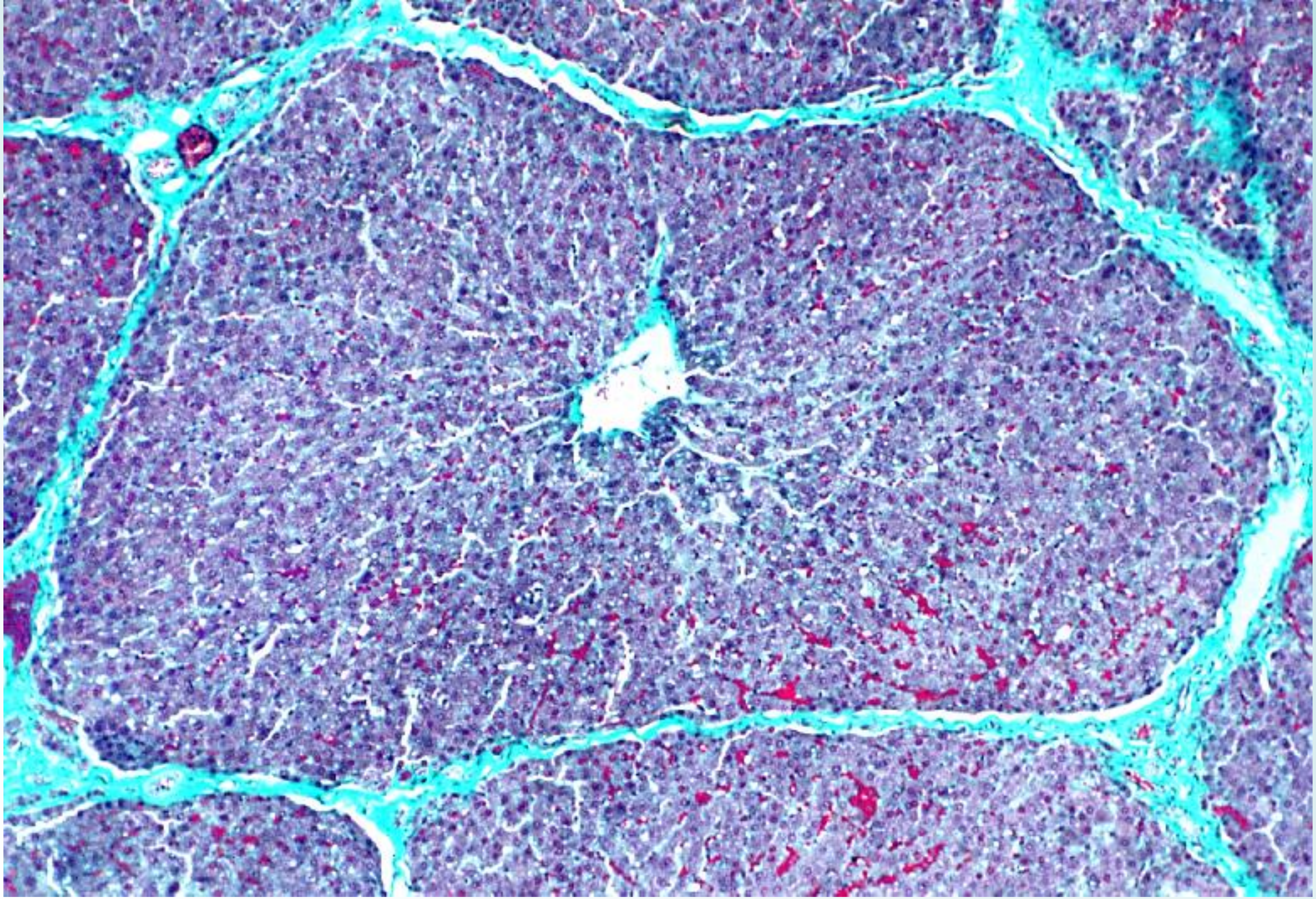
12-03 Scheme showing the three-dimensional structure of a hepatic lobule (Original).



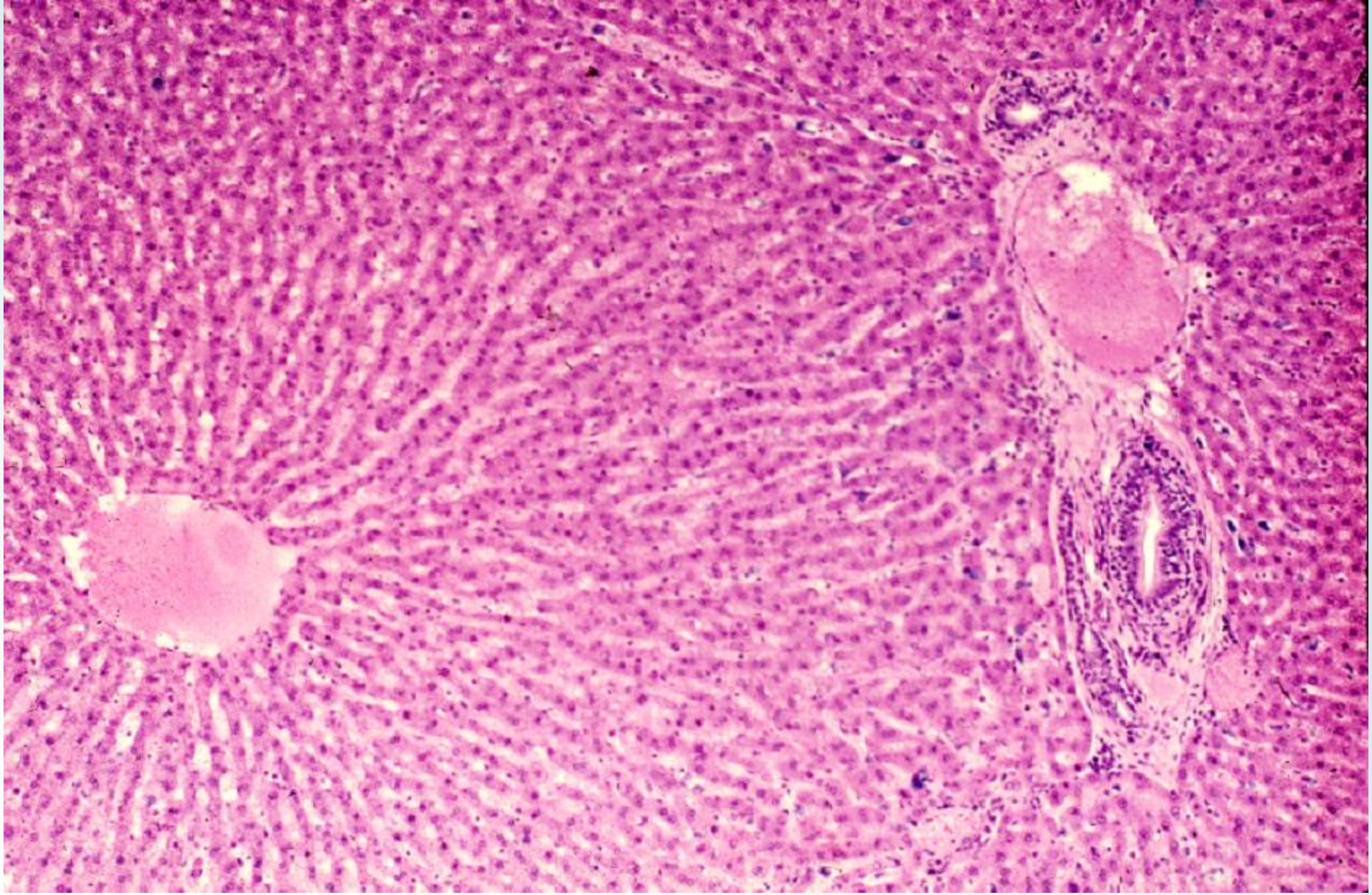
12-04 Liver, general view, 3. Pig, H-E stain, x 10.



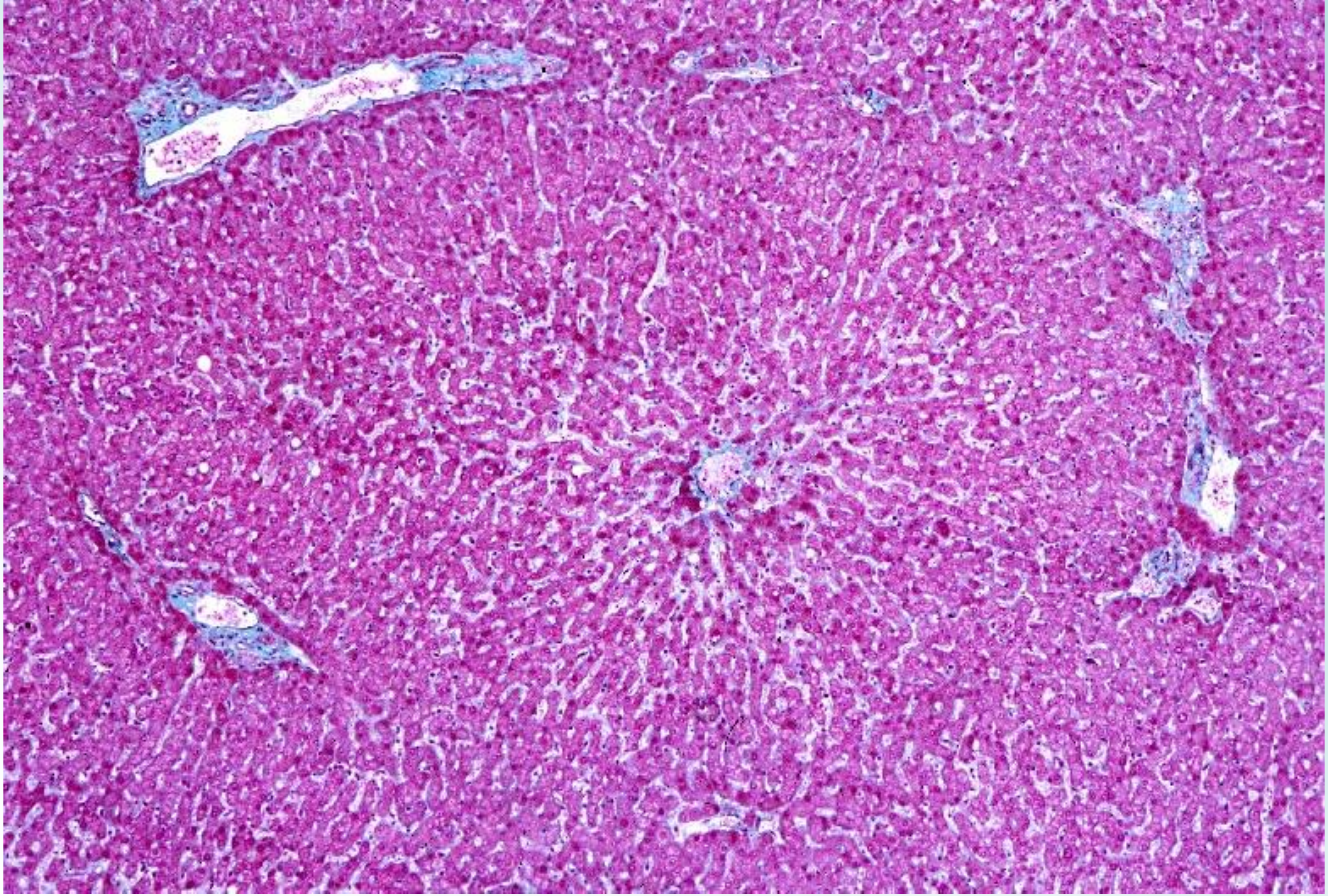
12-05 Liver, general view, 4. Pig, M-G stain, x 4.0.



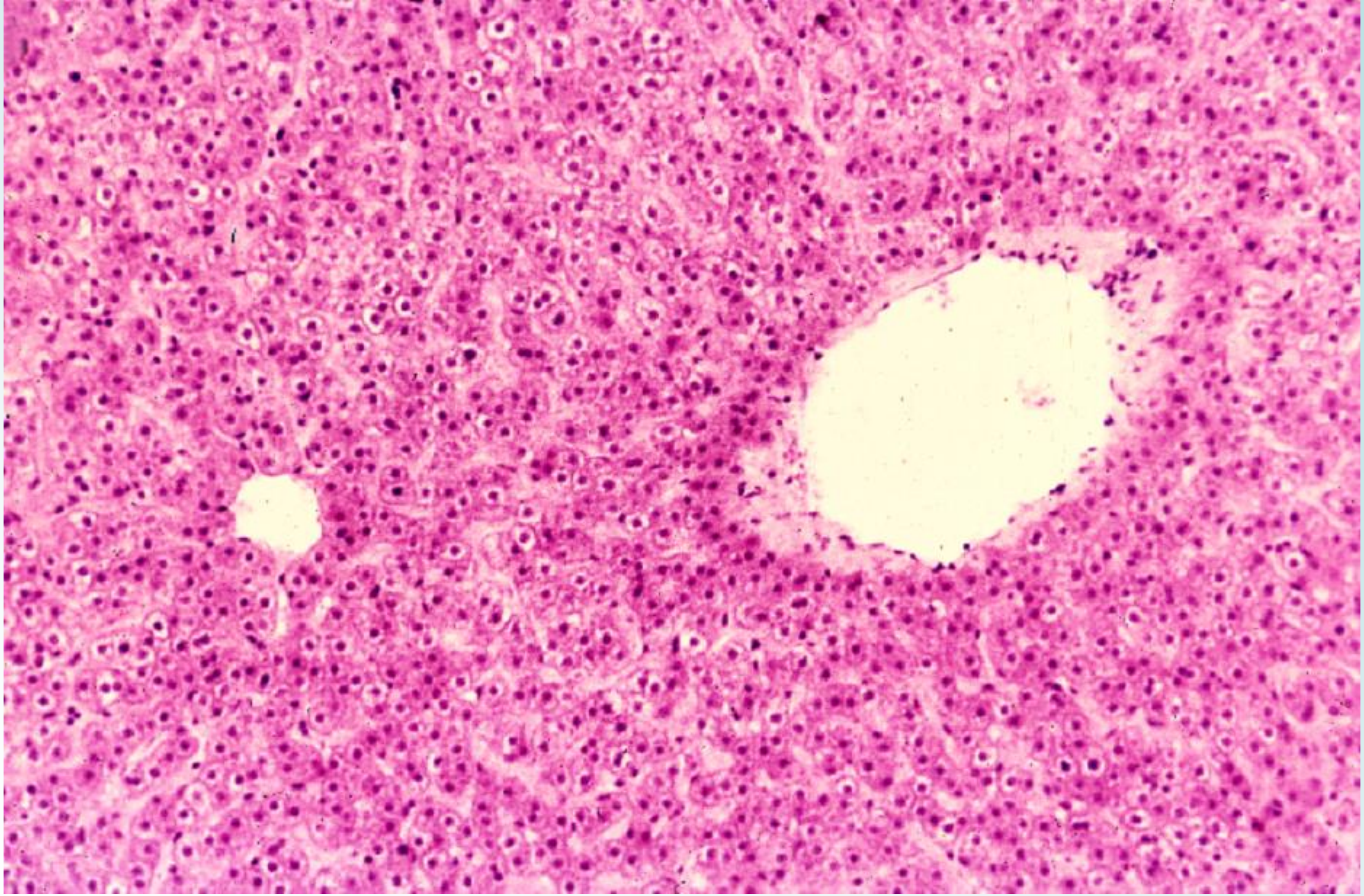
12-06 Hepatic lobule, general view 1. Pig, M-G stain, x 25.



12-07 Hepatic lobule, general view 2. Rabbit, H-E stain, x 25.

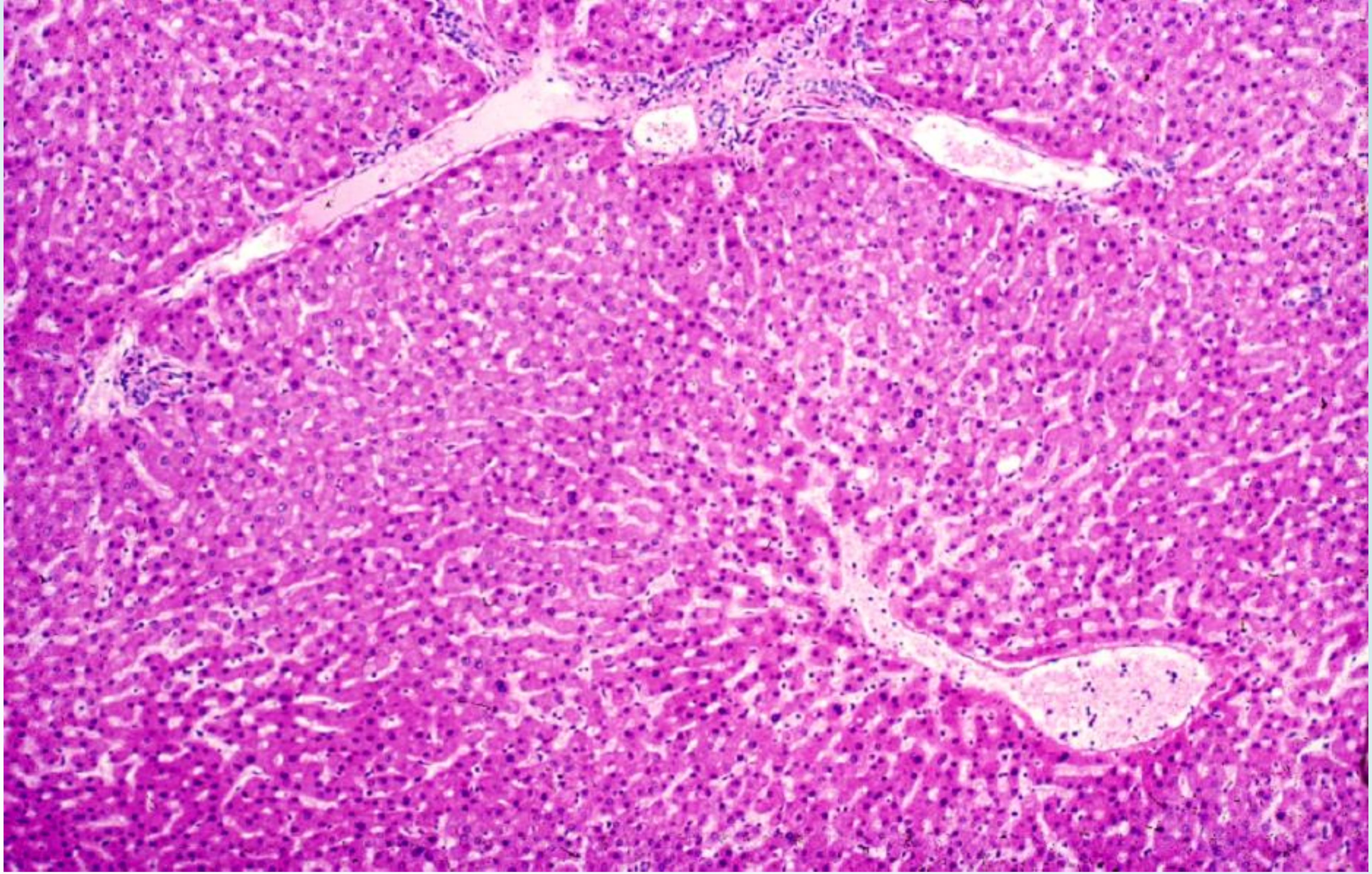


12-08 Hepatic lobule, general view 3. Human, M-G stain, x 16.

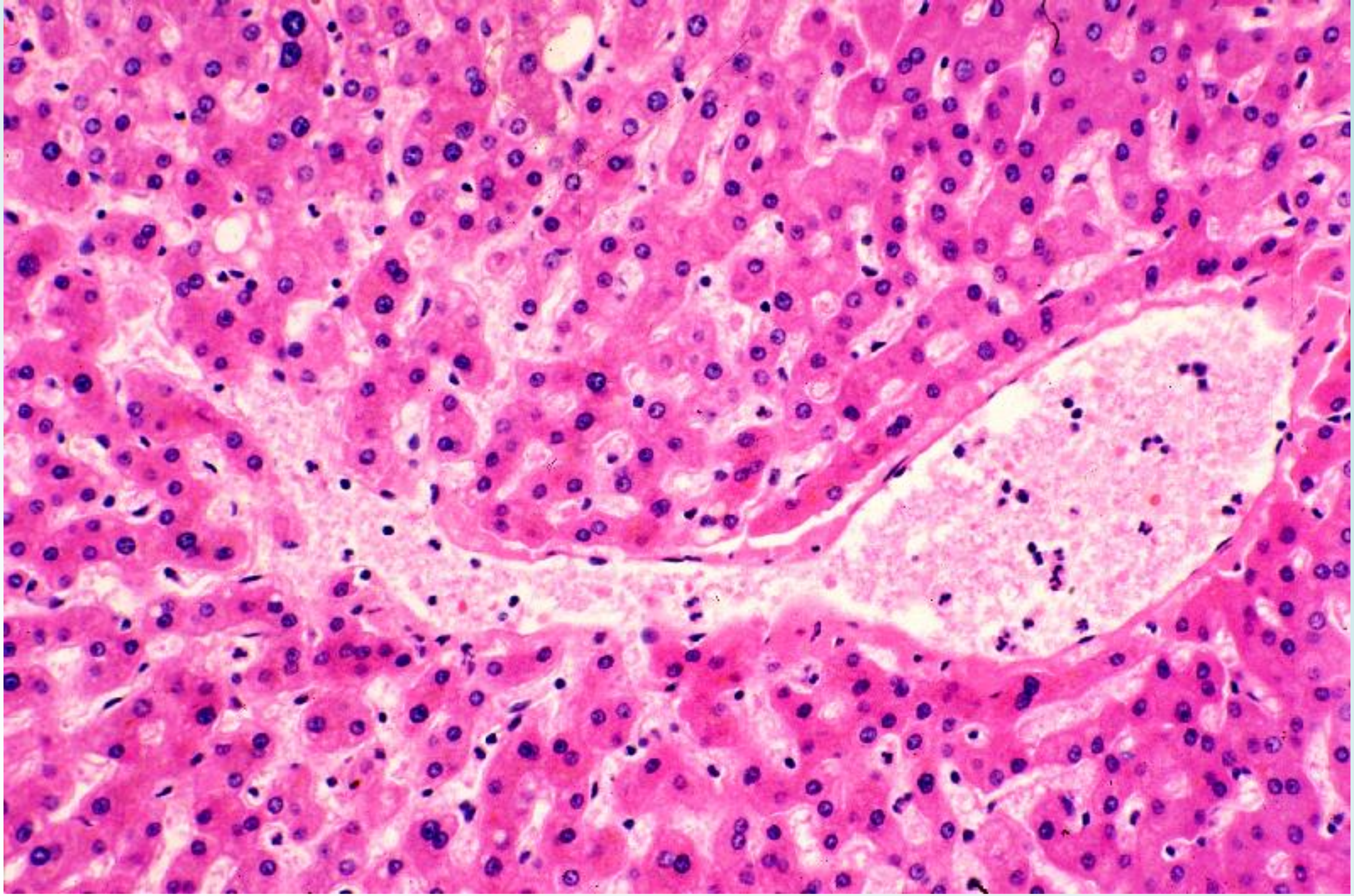


12-09 V. centralis and V. sublobularis 1. Monkey, H-E stain, x 40.

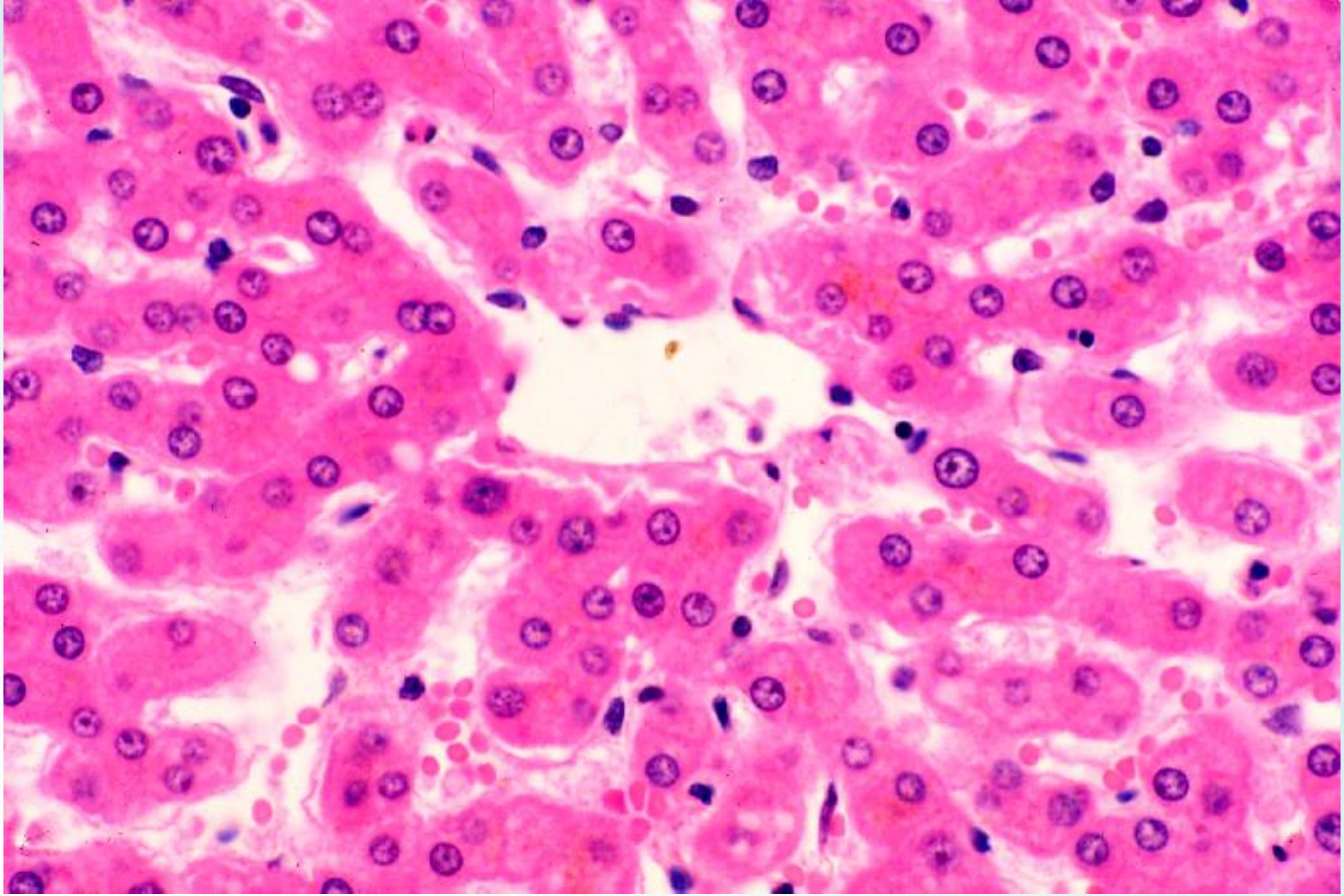
12-10 Sinusoids, central vein and sublobular vein. Human, H-E stain, x 33.



12-11 Hepatic lobule, general view 4. Human, H-E stain, x 25.



12-12 Sinusoids, V. centralis and V. sublobularis. Human, H-E stain, x 66.



12-13 Sinusoids and V. centralis. Human H-E stain, x 130.

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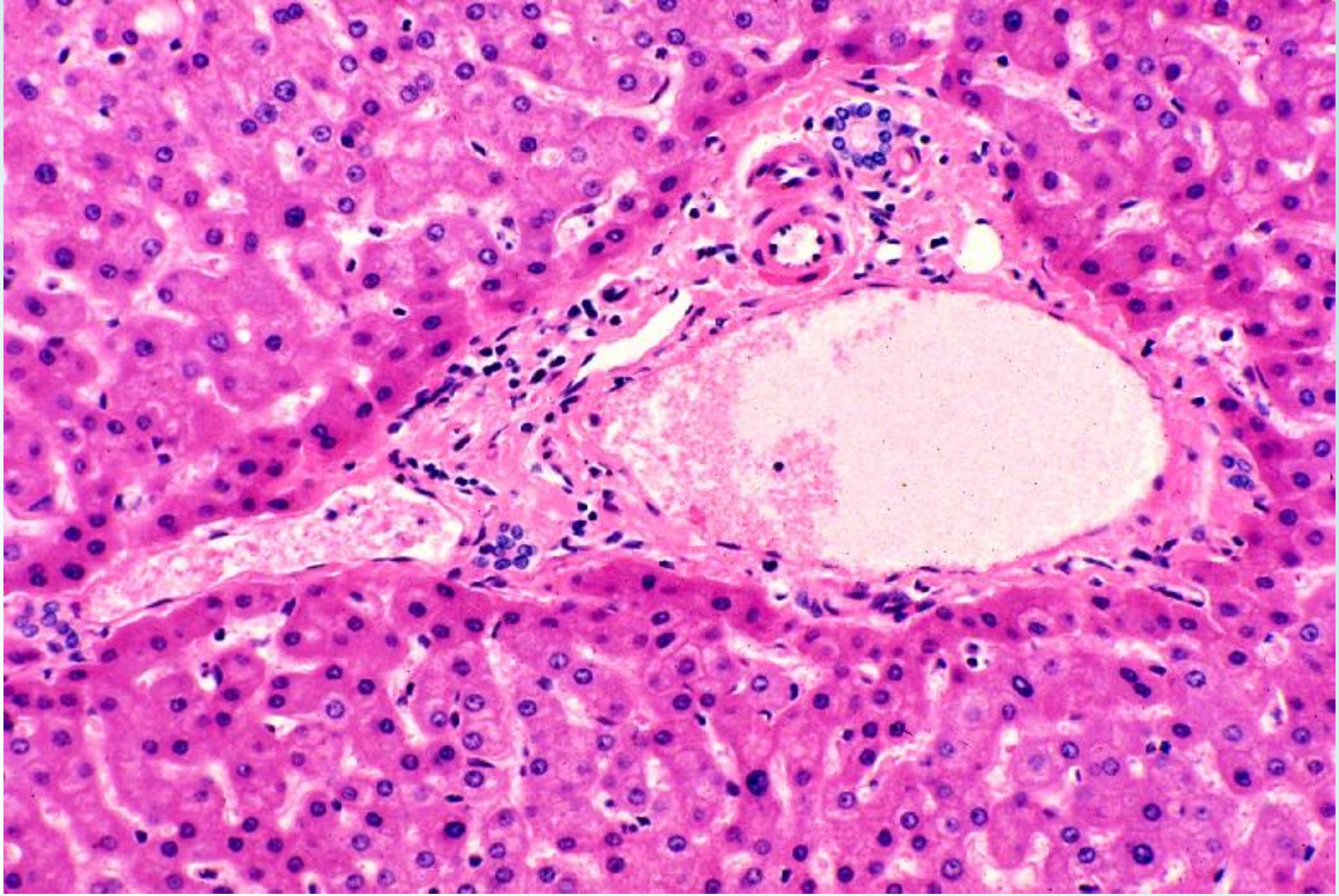
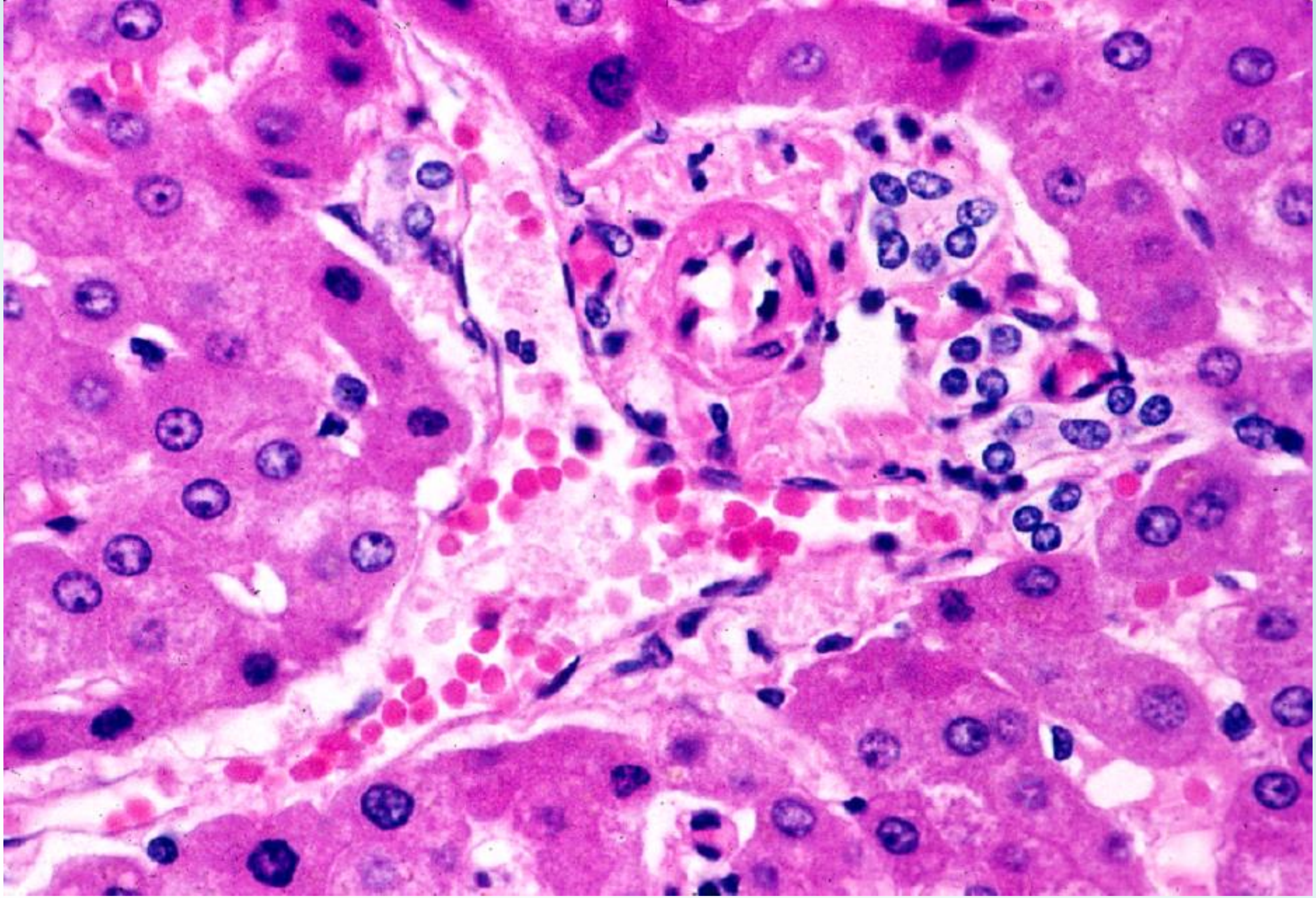
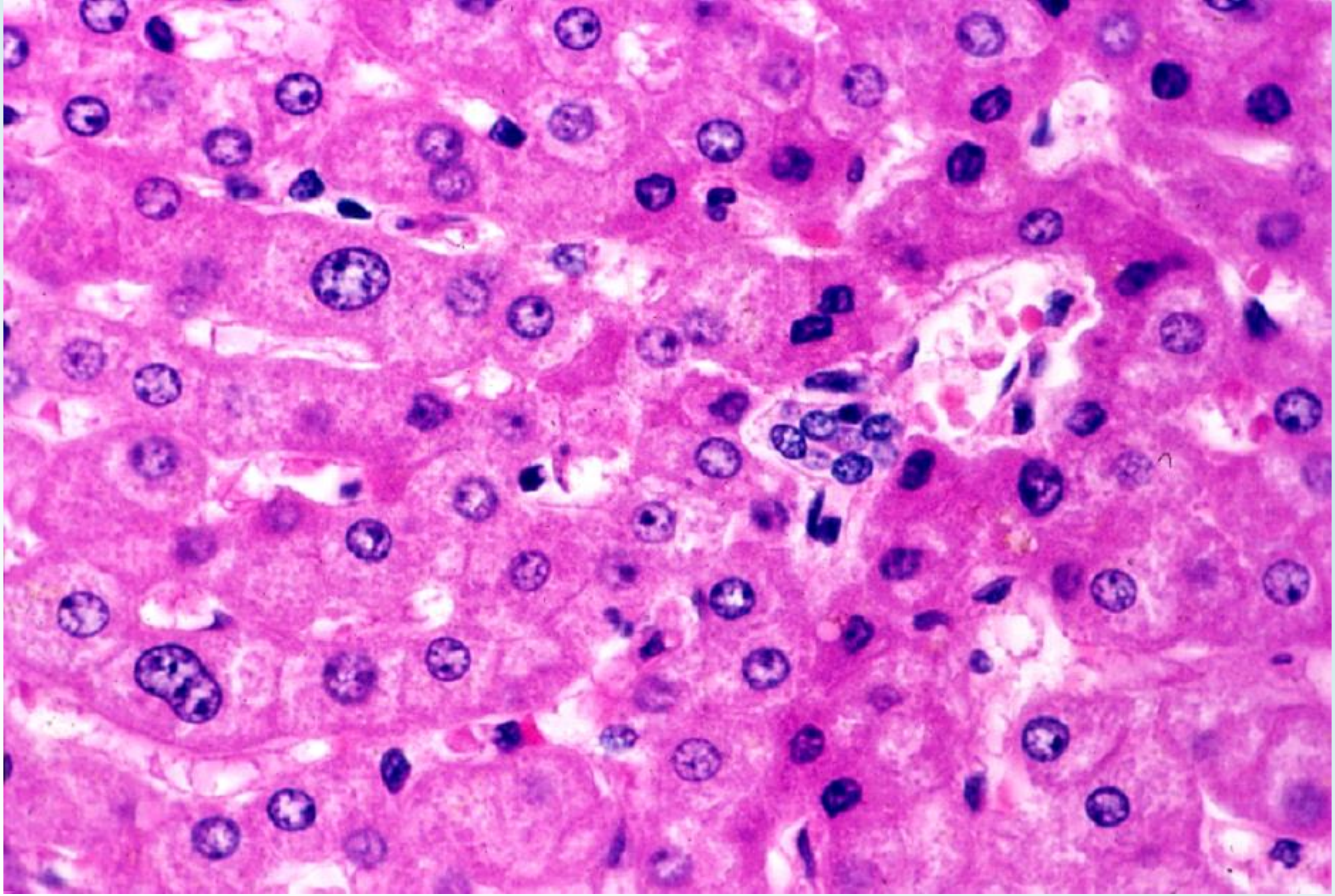


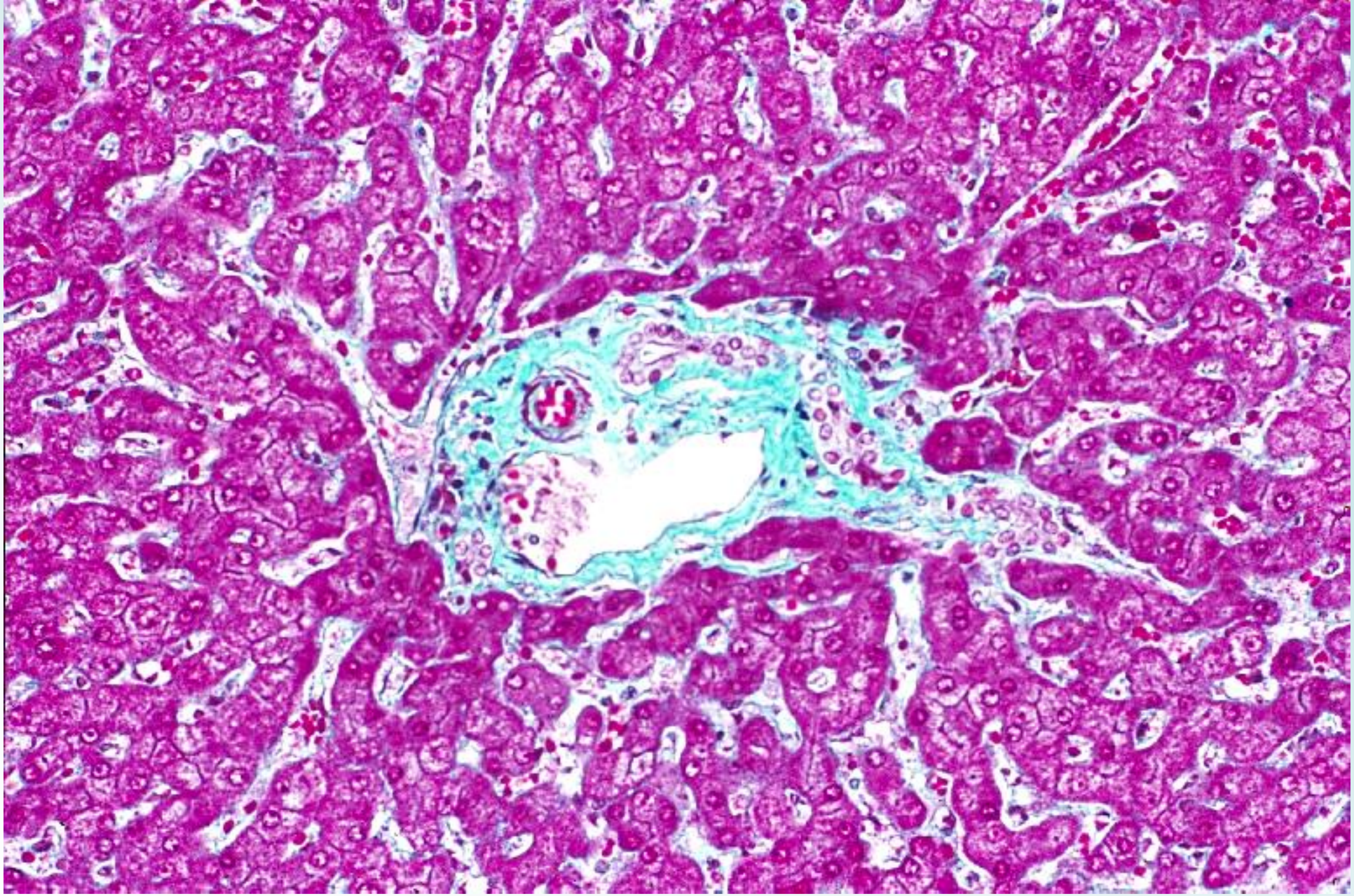
12-14 Interlobular connective tissue (Glisson's sheath) 1. Human, H-E stain, x 66.



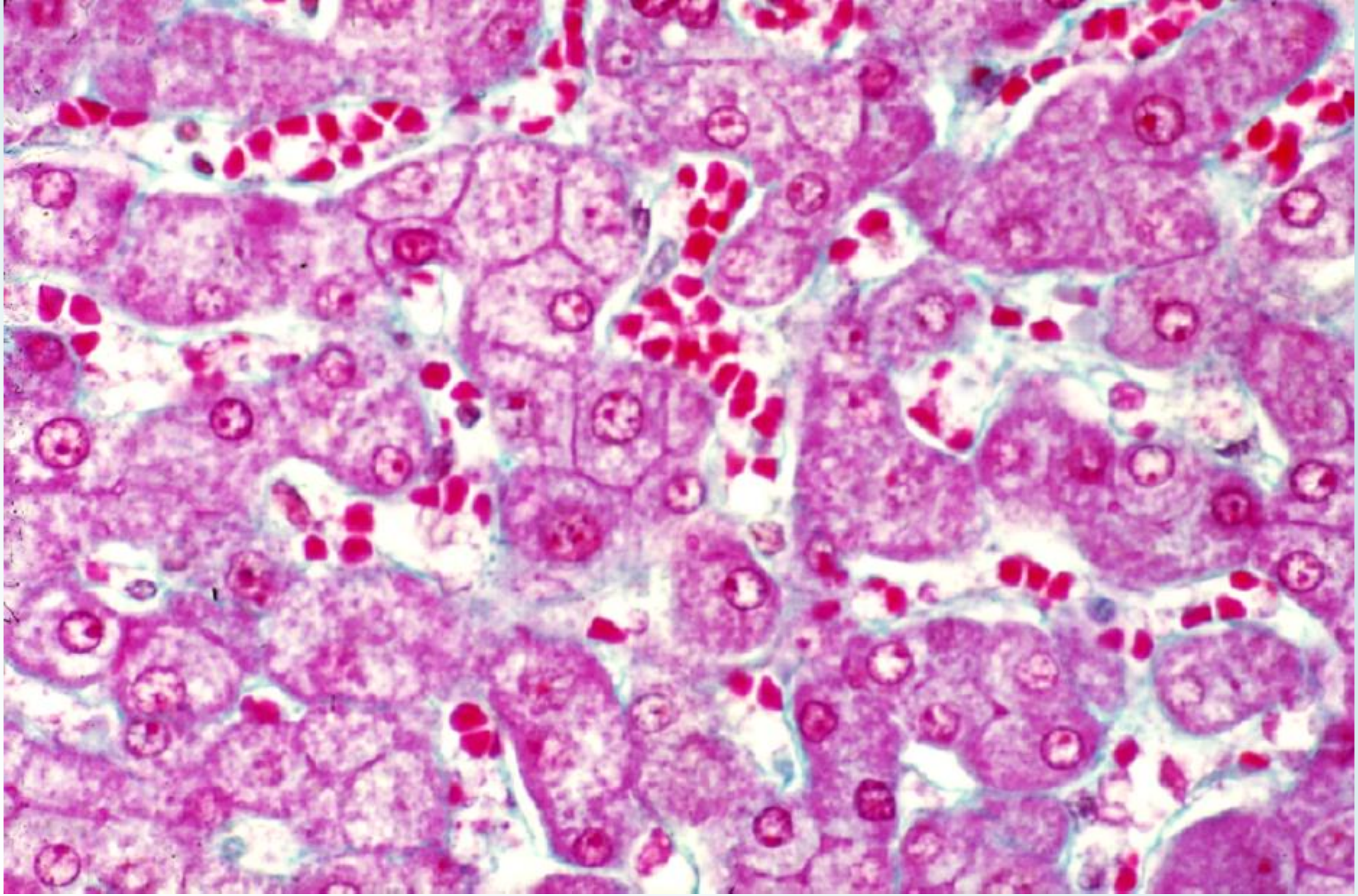
12-15 Interlobular connective tissue 2. Human, H-E stain, x 160.



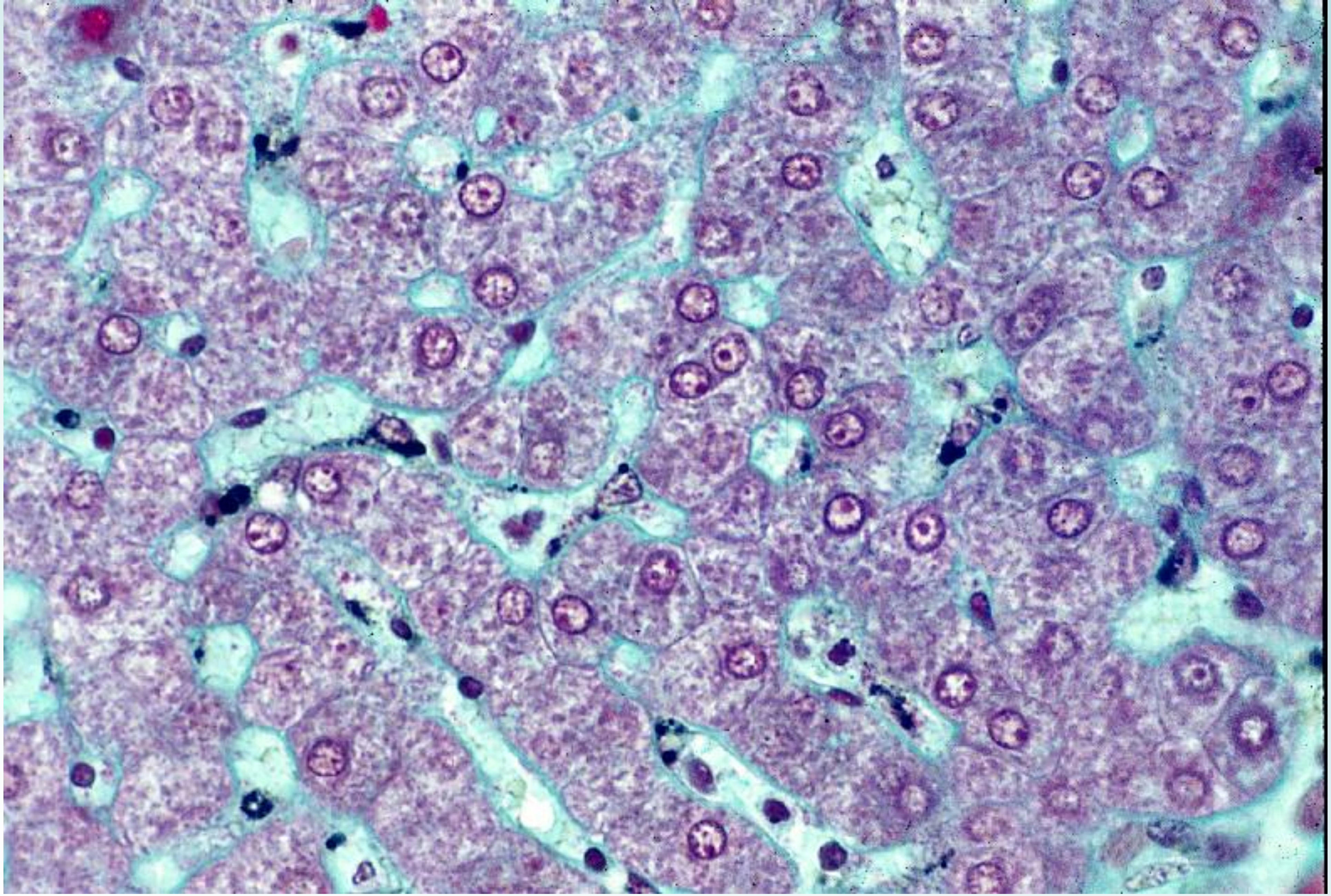
12-16 Interlobular connective tissue 3. Human, H-E stain, x 160.



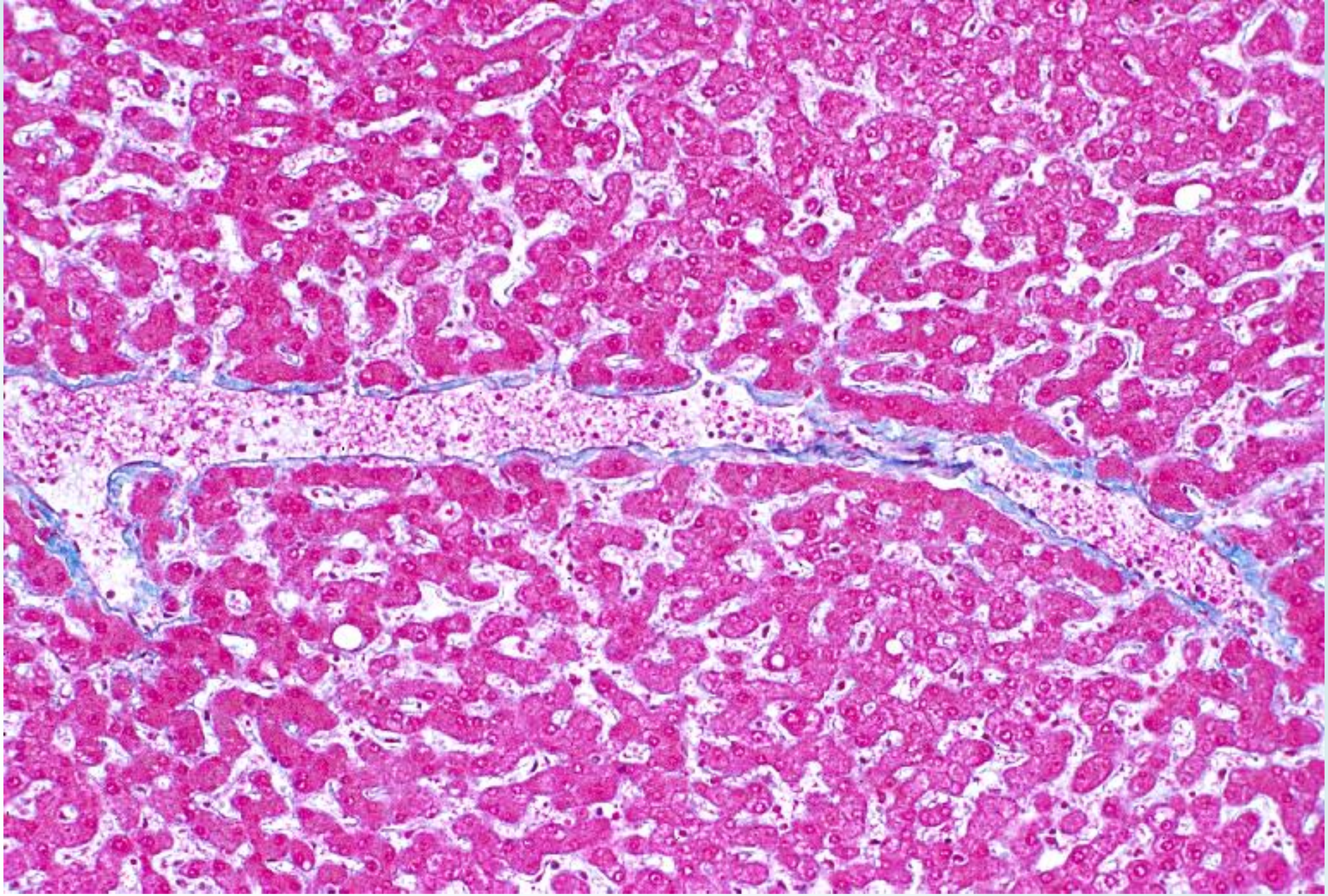
12-17 Interlobular connective tissue4. Human, M-G stain, x 64.



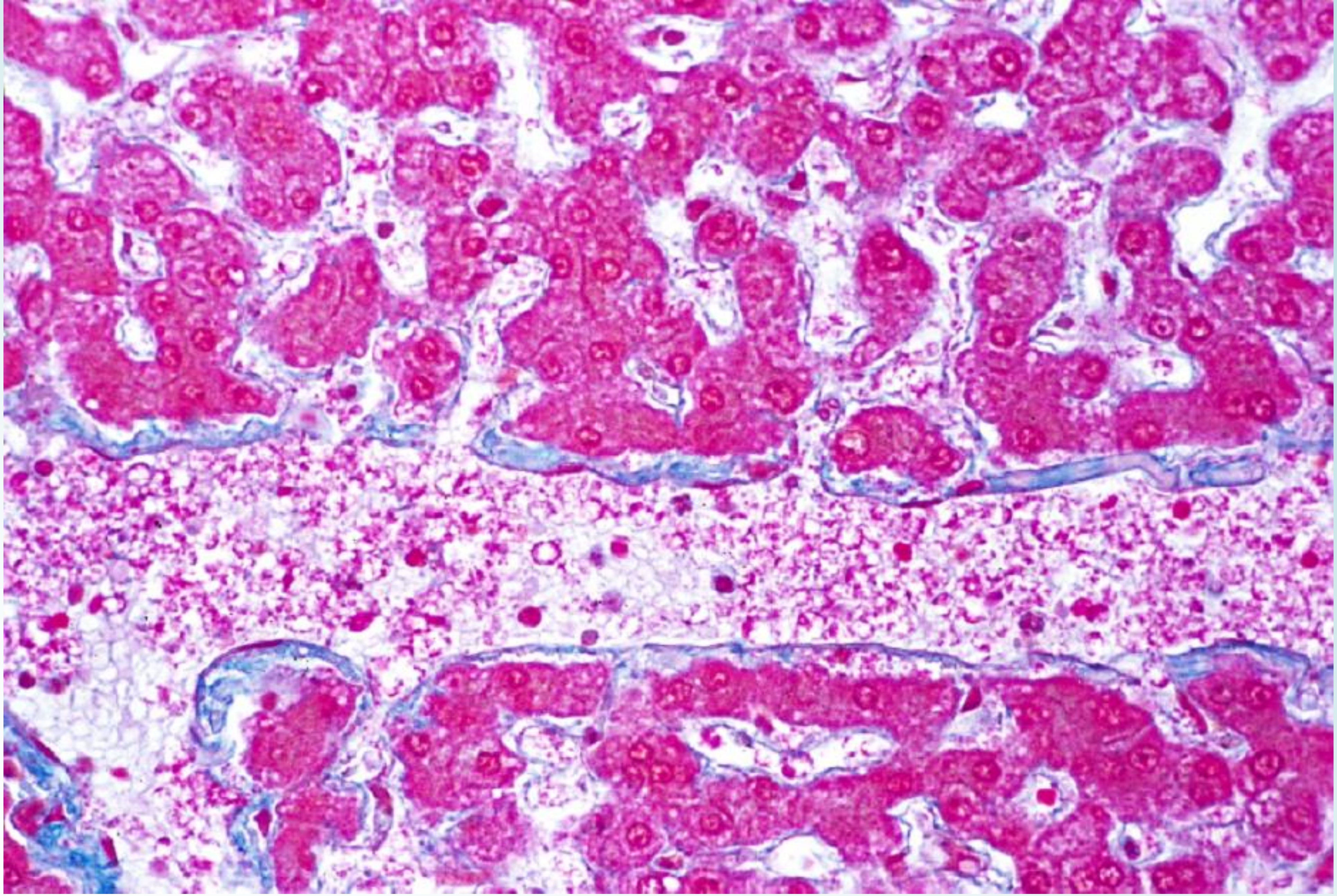
12-18 Hepatic cell cords and sinusoids 1. Human, M-G stain, x 160.



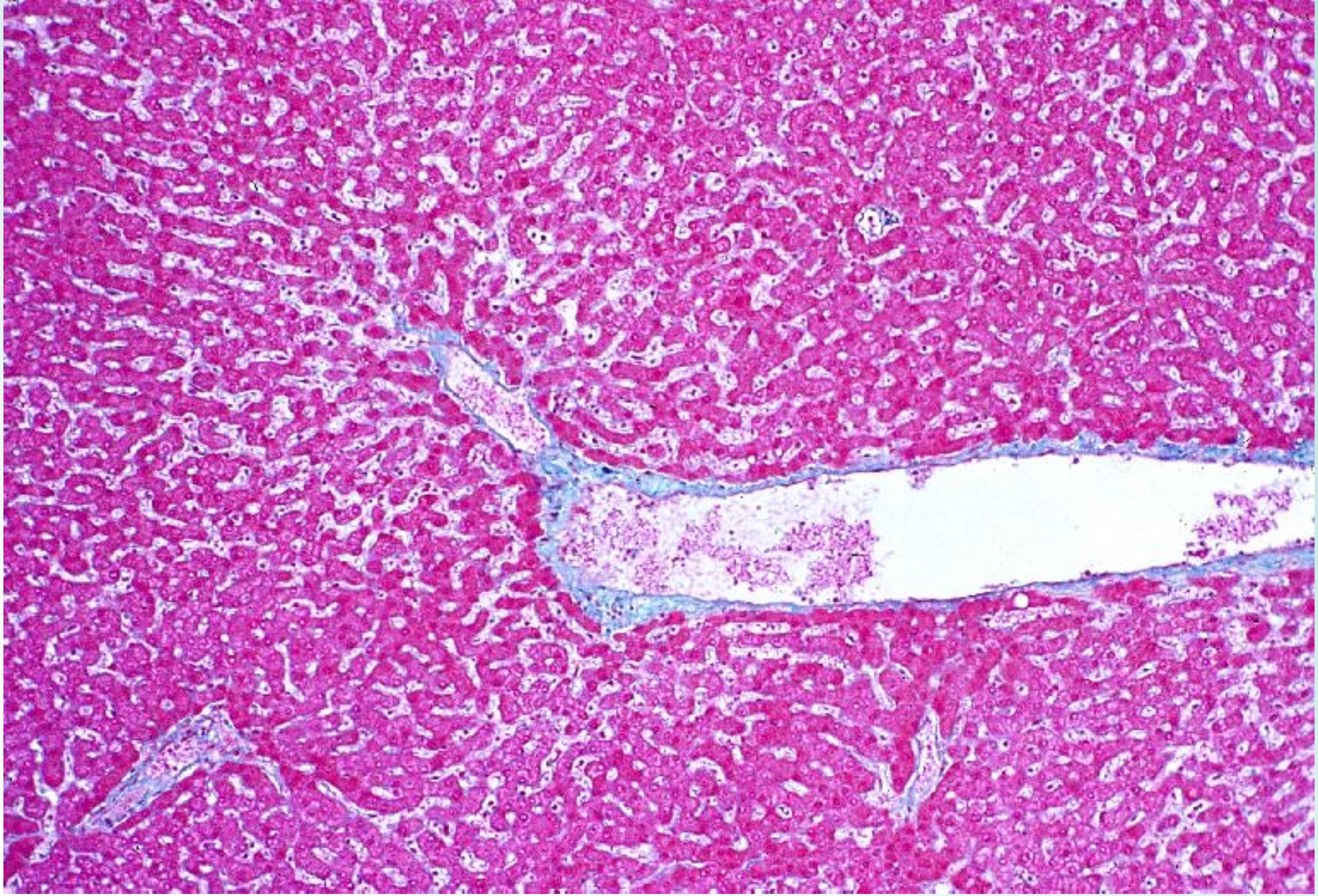
12-19 Hepatic cell cords and sinusoids 2. Pig, M-G stain, x 160.



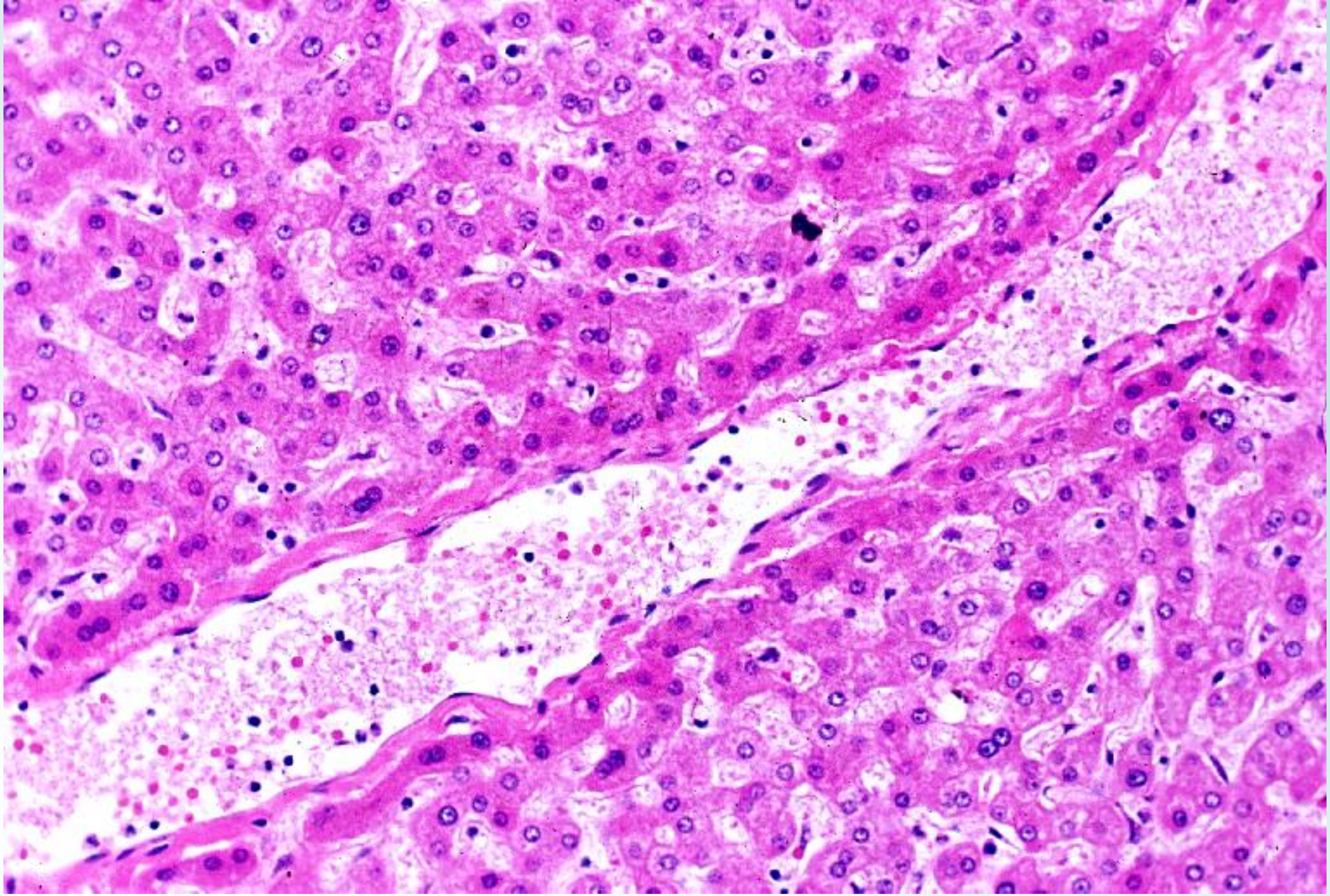
12-20 V. centralis, longitudinal section 1. Human, M-G stain, x 40.



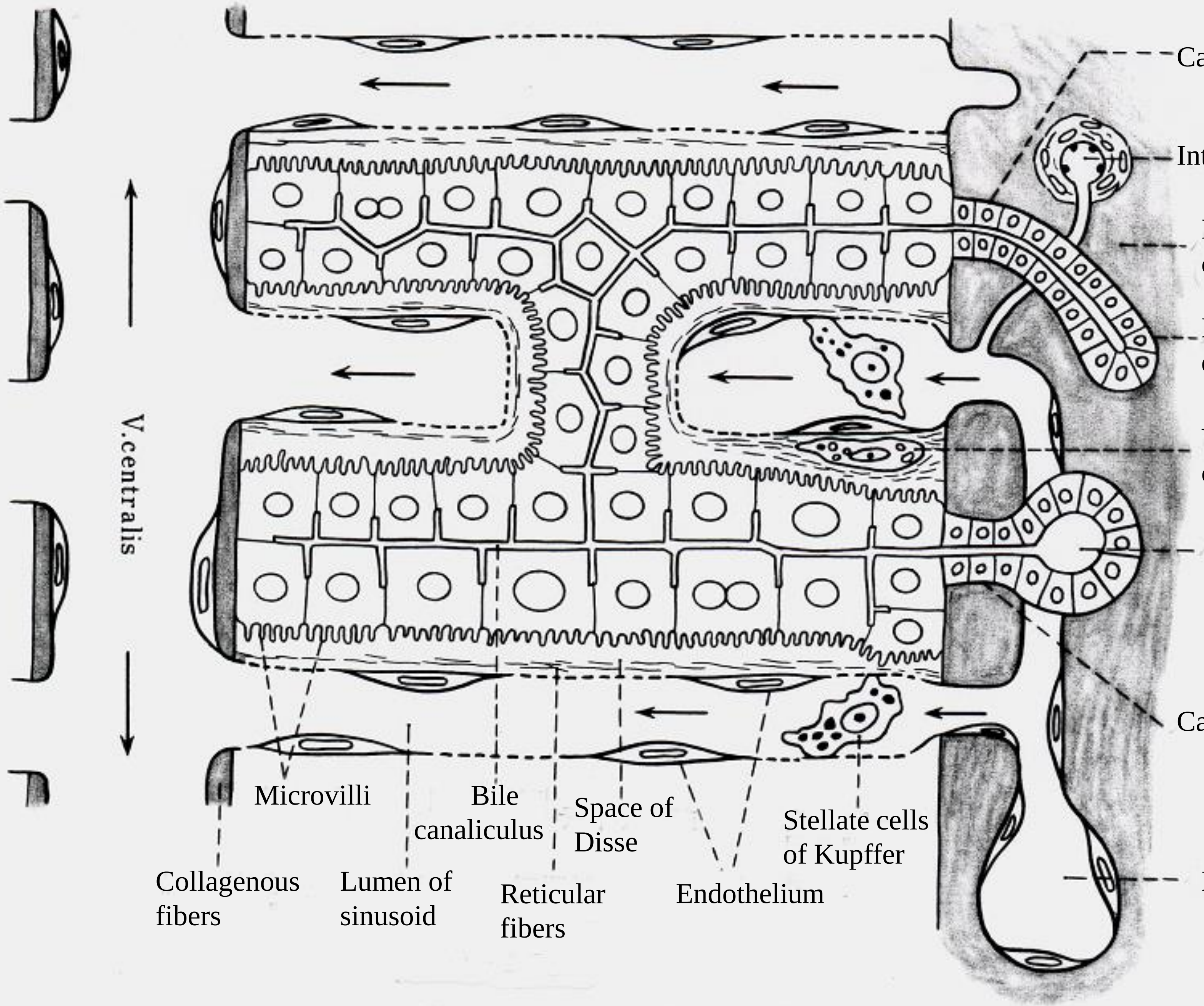
12-21 V. centralis, longitudinal section 1. Human, M-G stain, x 100.



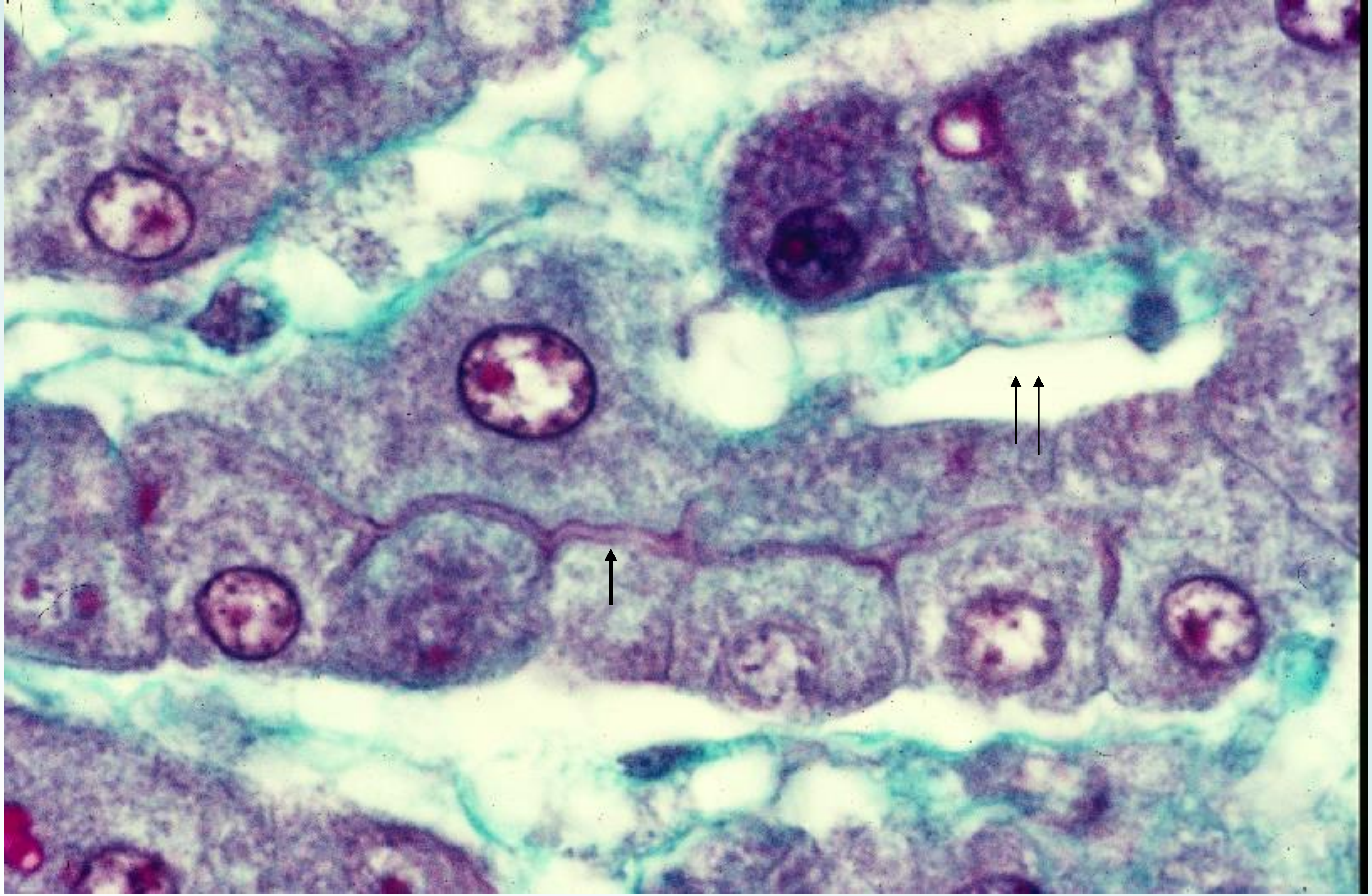
12-22 V. centralis and V. sublobularis, longitudinal section. Human, M-G stain, x 25.



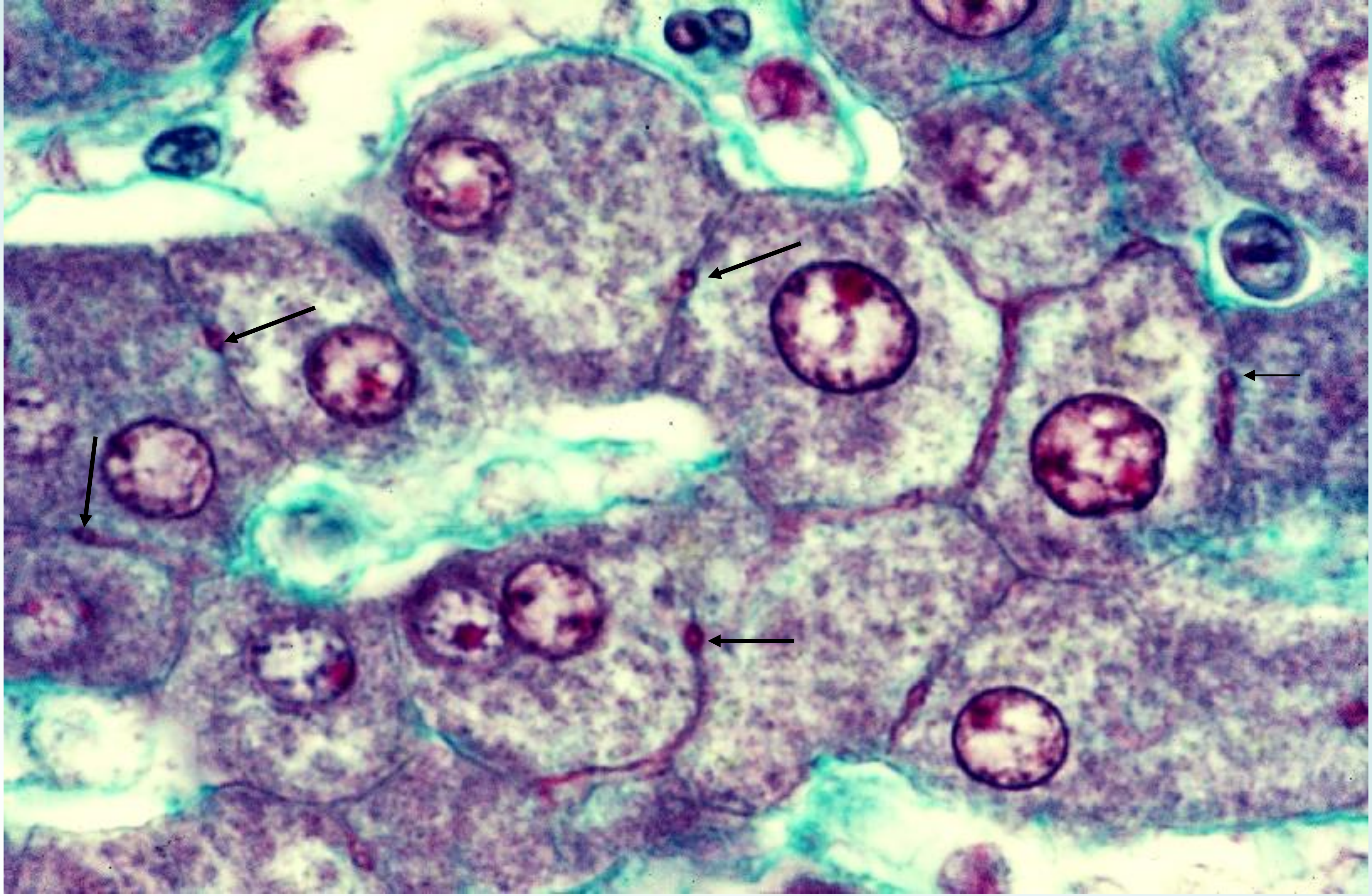
12-23 V. sublobularis, longitudinal section. Human, H-E stain, x 64.



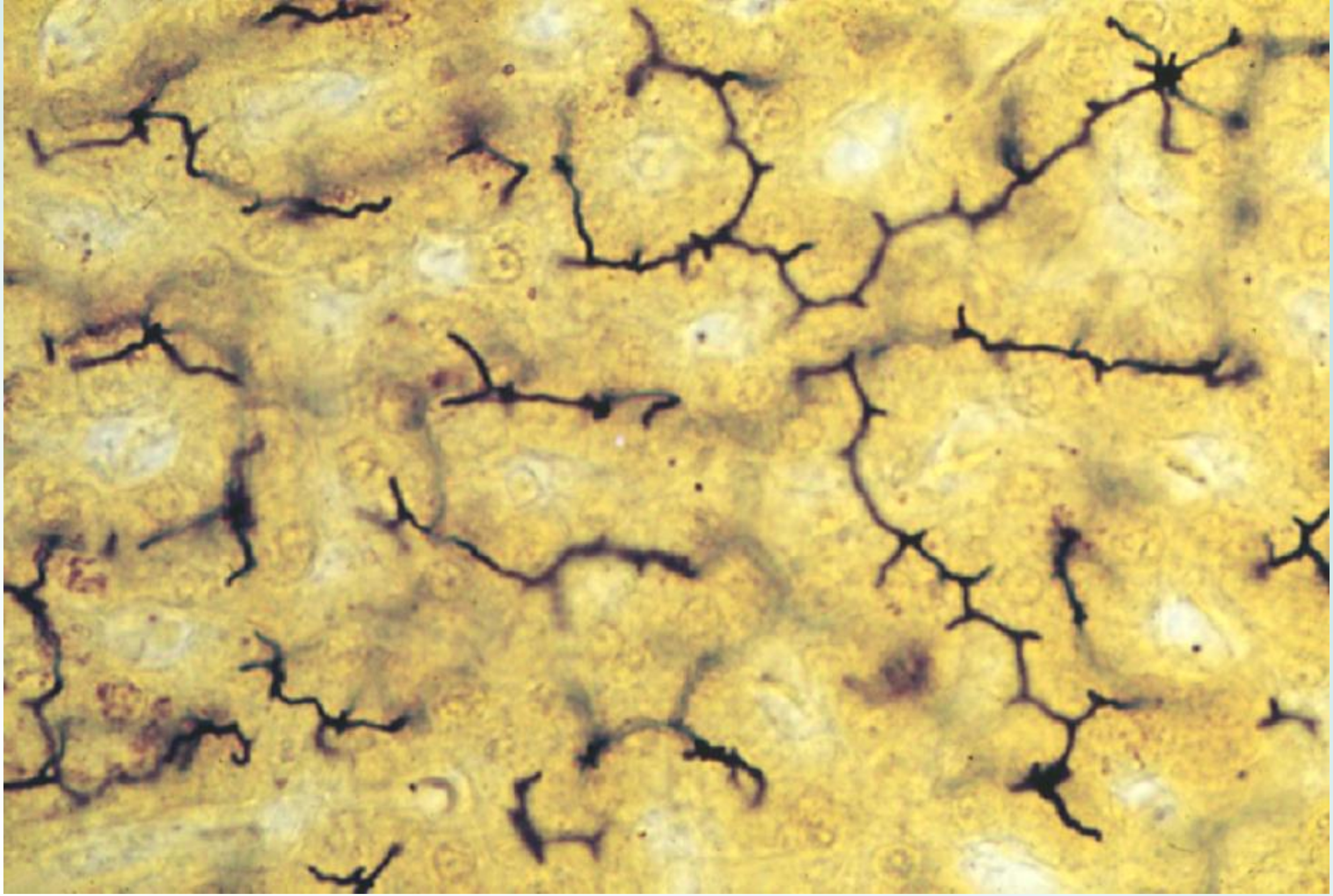
12-24 Hepatic cell cords, bile canaliculi and sinusoids. (Original scheme).



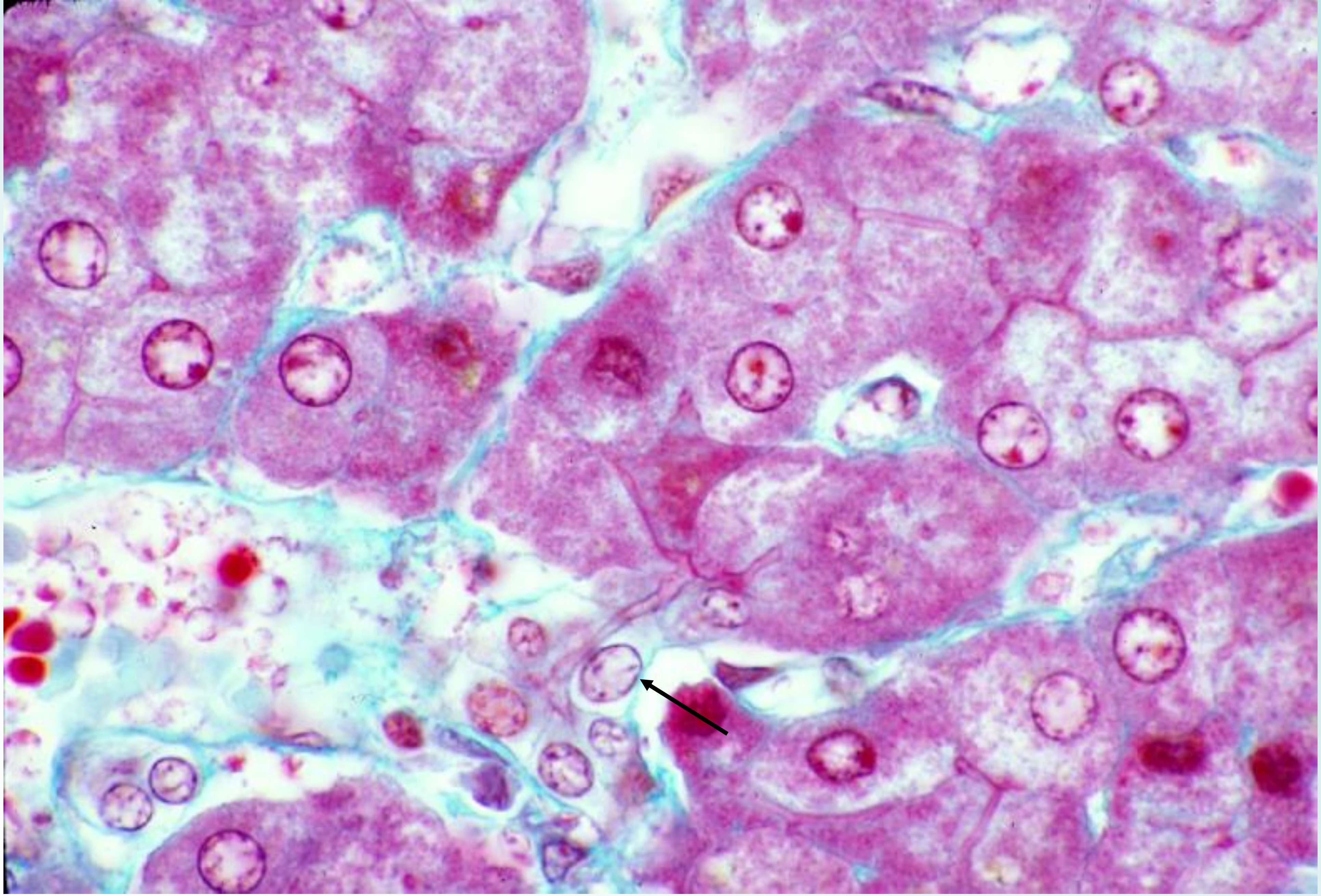
12-25 Hepatic cell cords and bile canaliculus 1. Human, M-G stain, x 400.



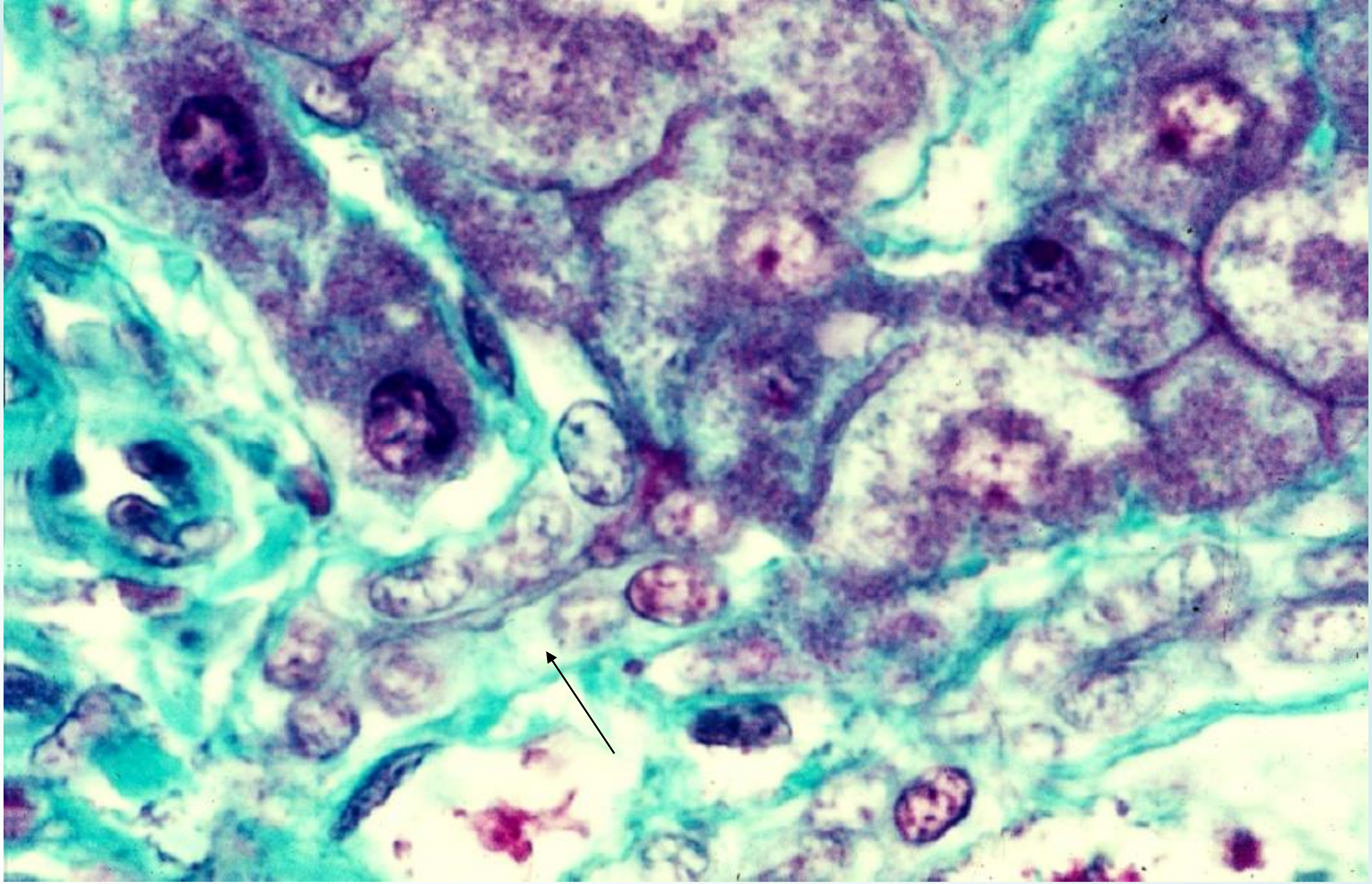
12-26 Hepatic cell cords and bile canaliculi 2. Human, M-G stain, x 400.



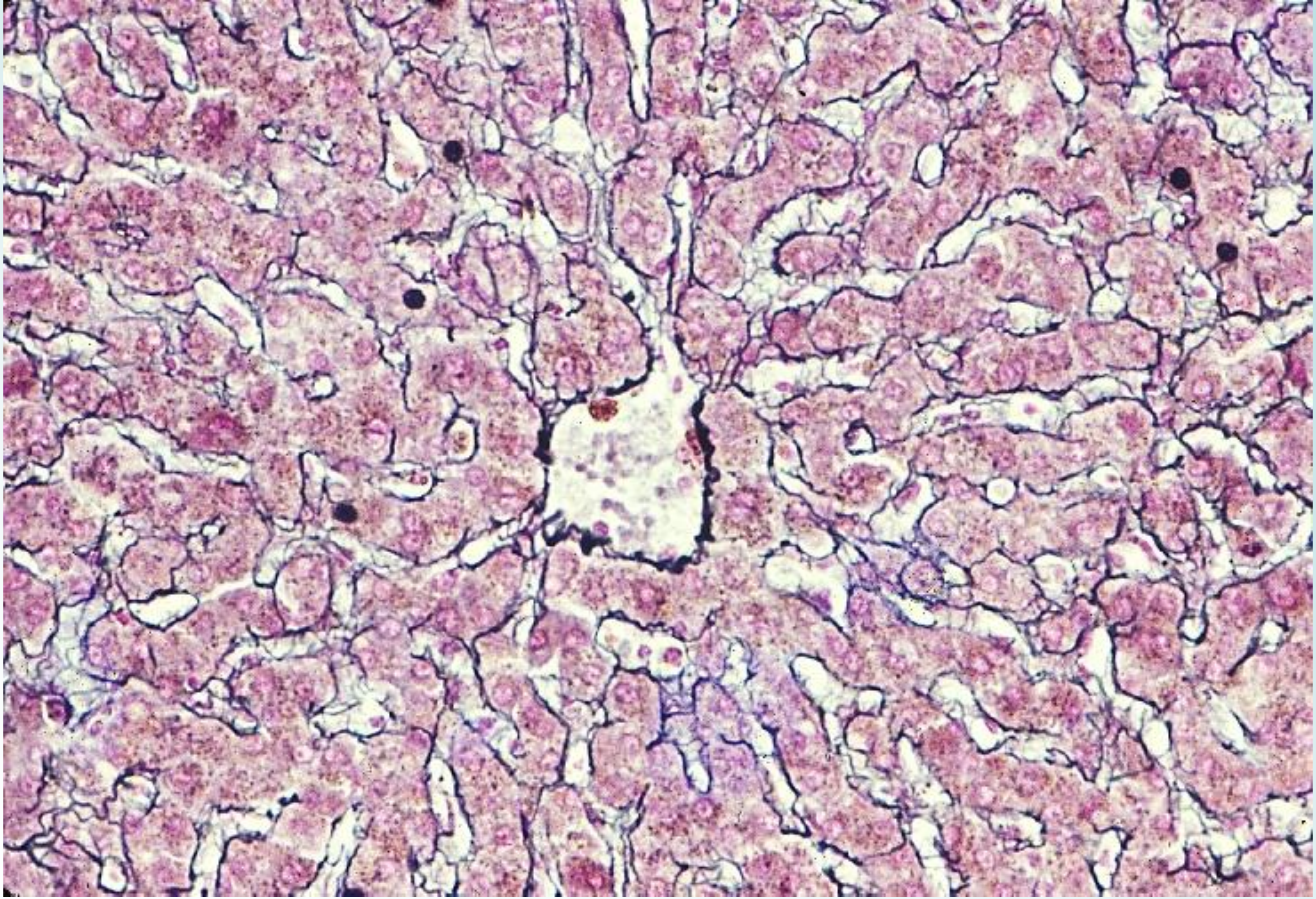
12-27 Bile canaliculi. Human, Golgi's silver impregnation, x 160.



12-28 Bile canaliculi and canal of Hering 1. Human, M-G stain, x 330.



12-29 Bile canaliculi and canal of Hering 2. Human, M-G stain, x 400.



12-30 V. centralis and sinusouds 1. Monkey, silver impregnation and Kernechtrot stain, x 64.

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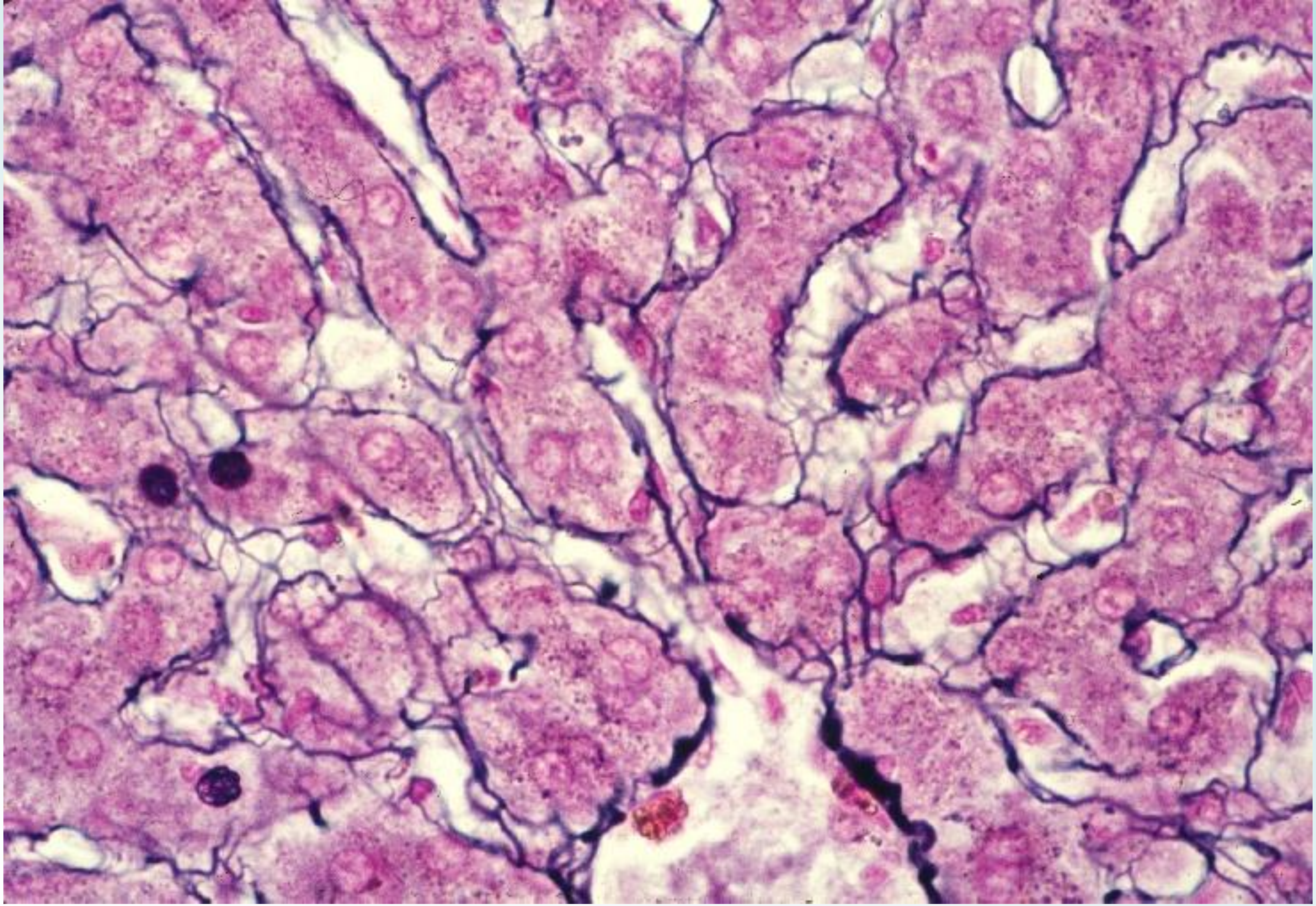
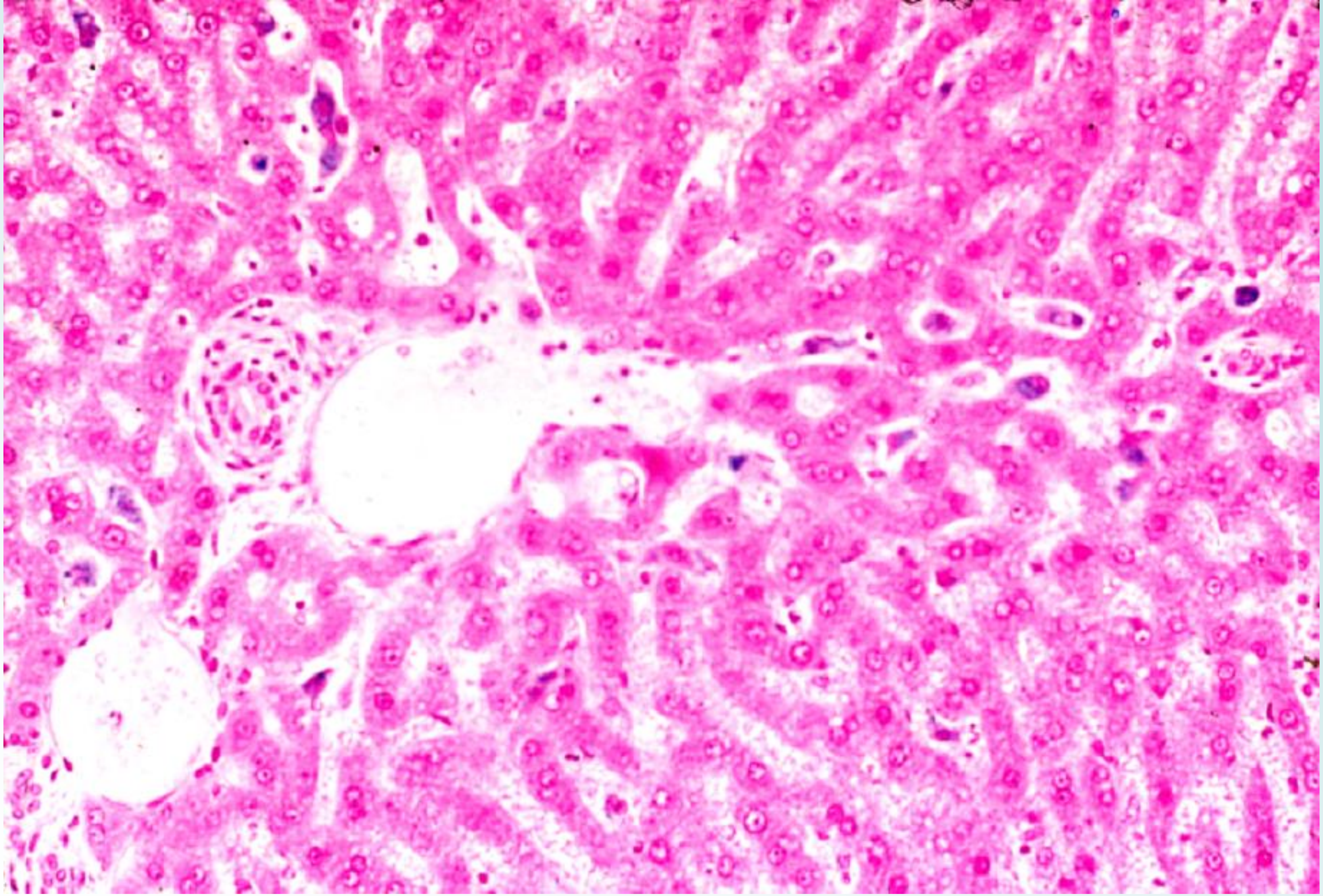


12-31 V. centralis and sinusouds 2. Monkey, silver impregnation and Kernechtrot stain, x 160.



12-32 Kupffer cells 1. Rabbit, vital stain with tripan blue and counter-stained with Kernechtrot, x 64.

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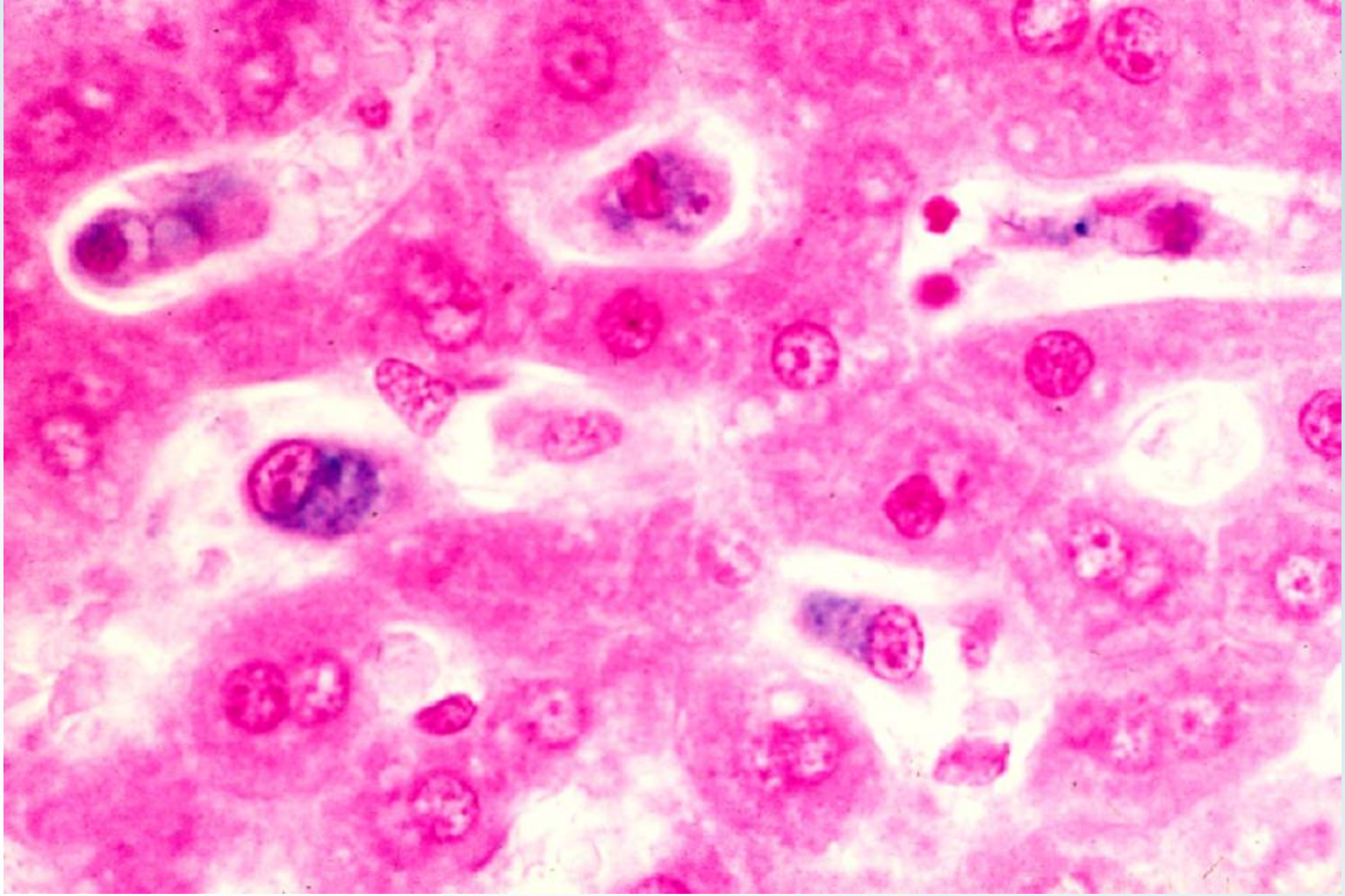
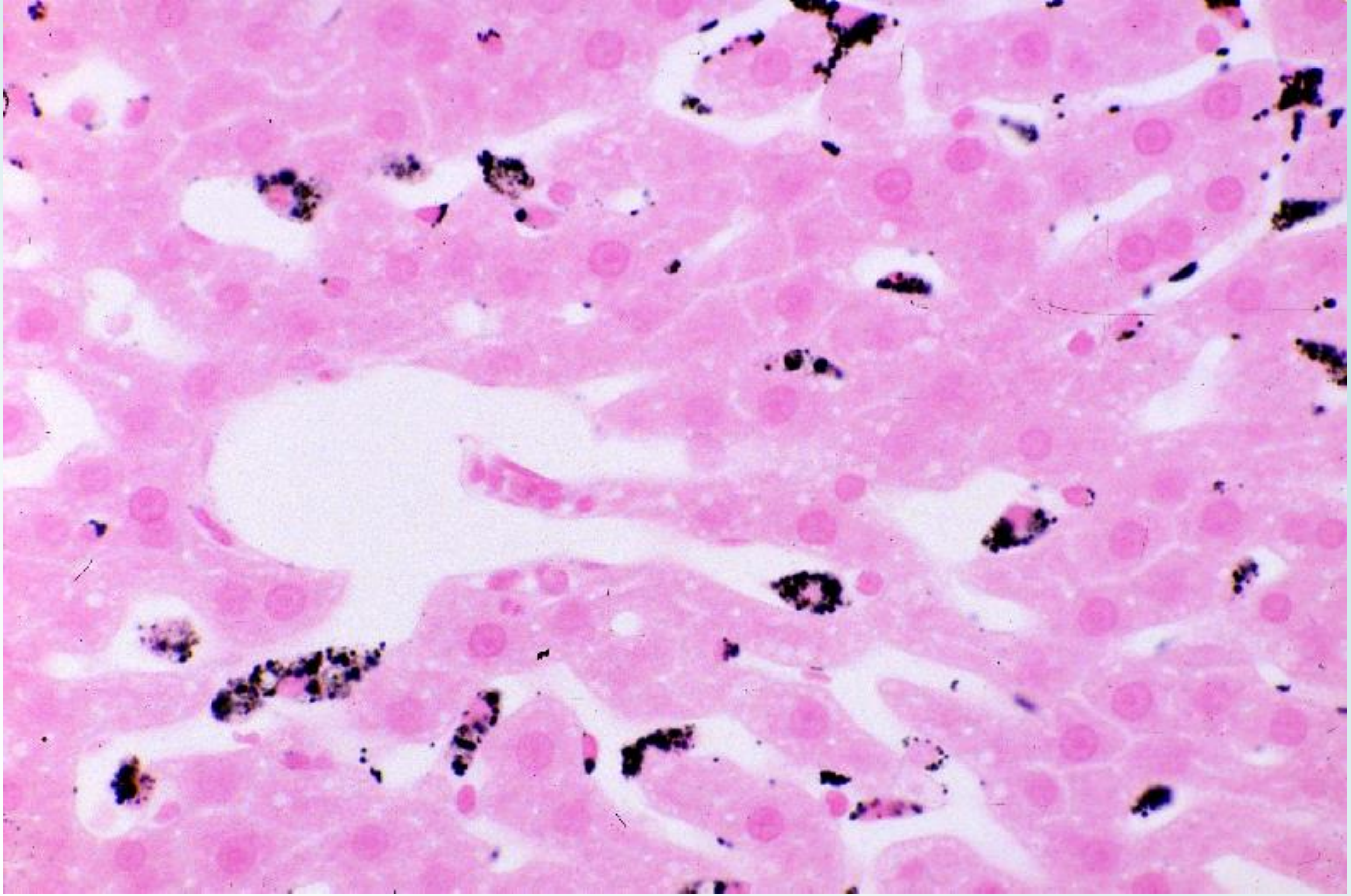
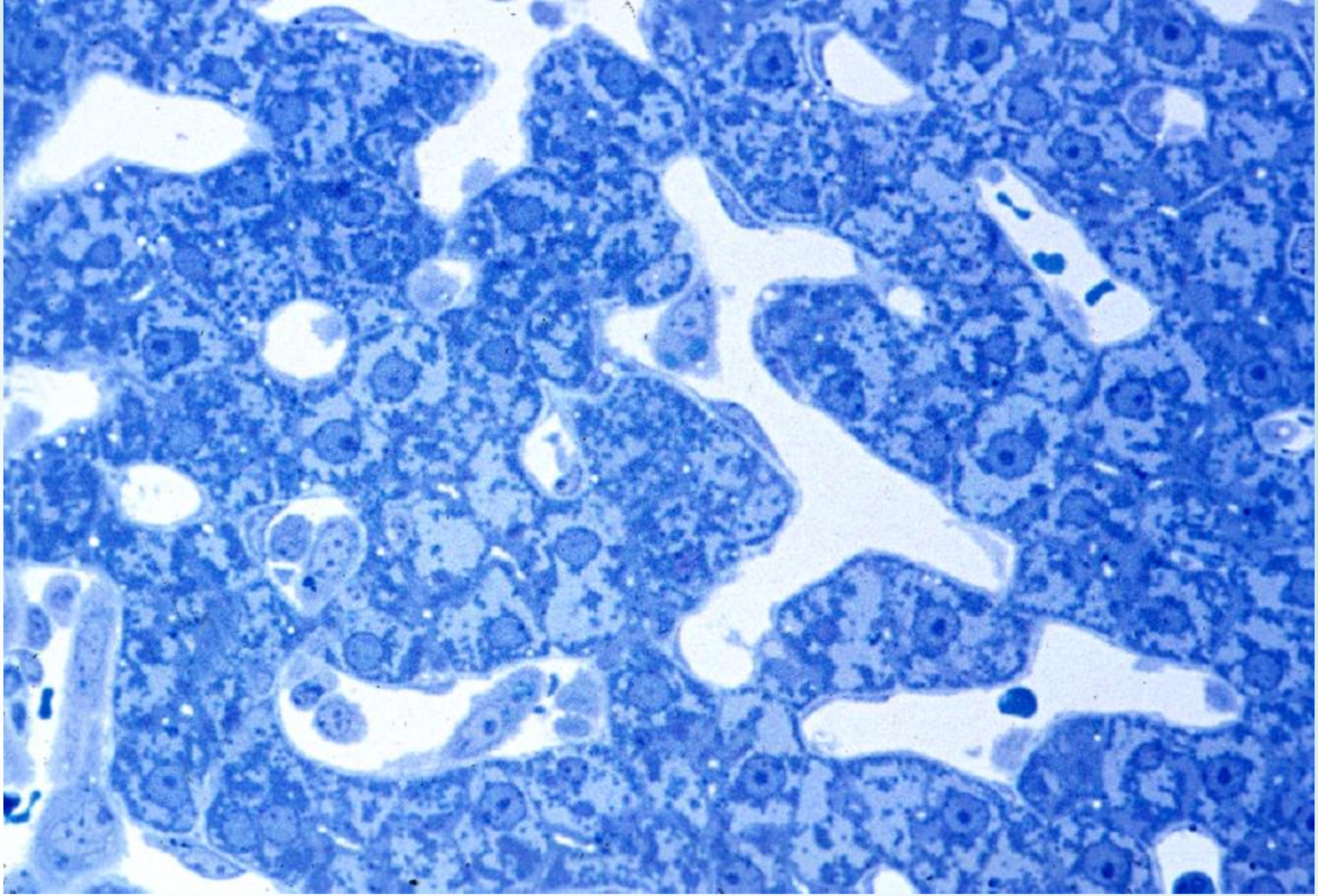


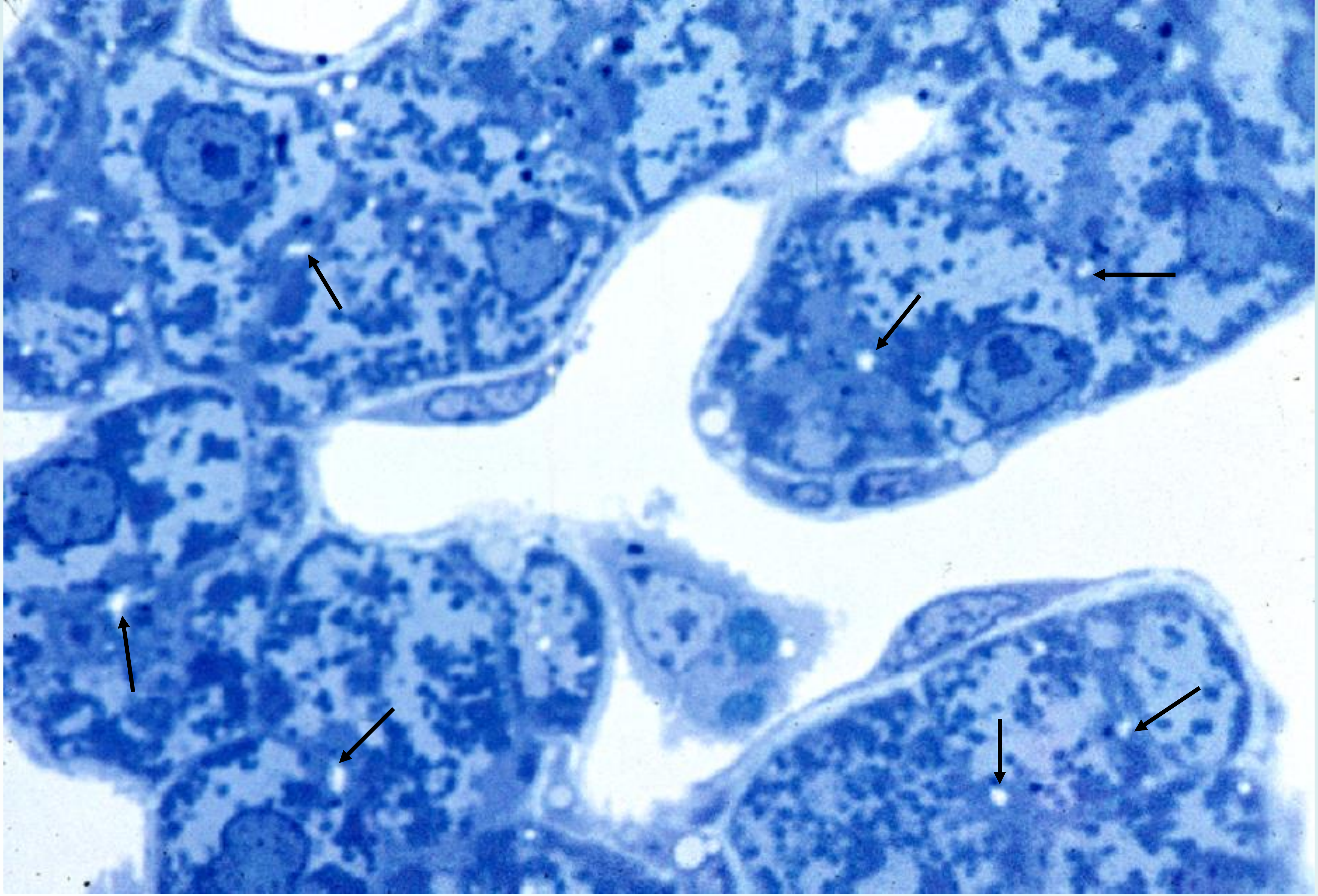
12-33 Kupffer cells 2. Rabbit, vital stain with tripan blue and counter-stained with Kernechtrot, x 250.



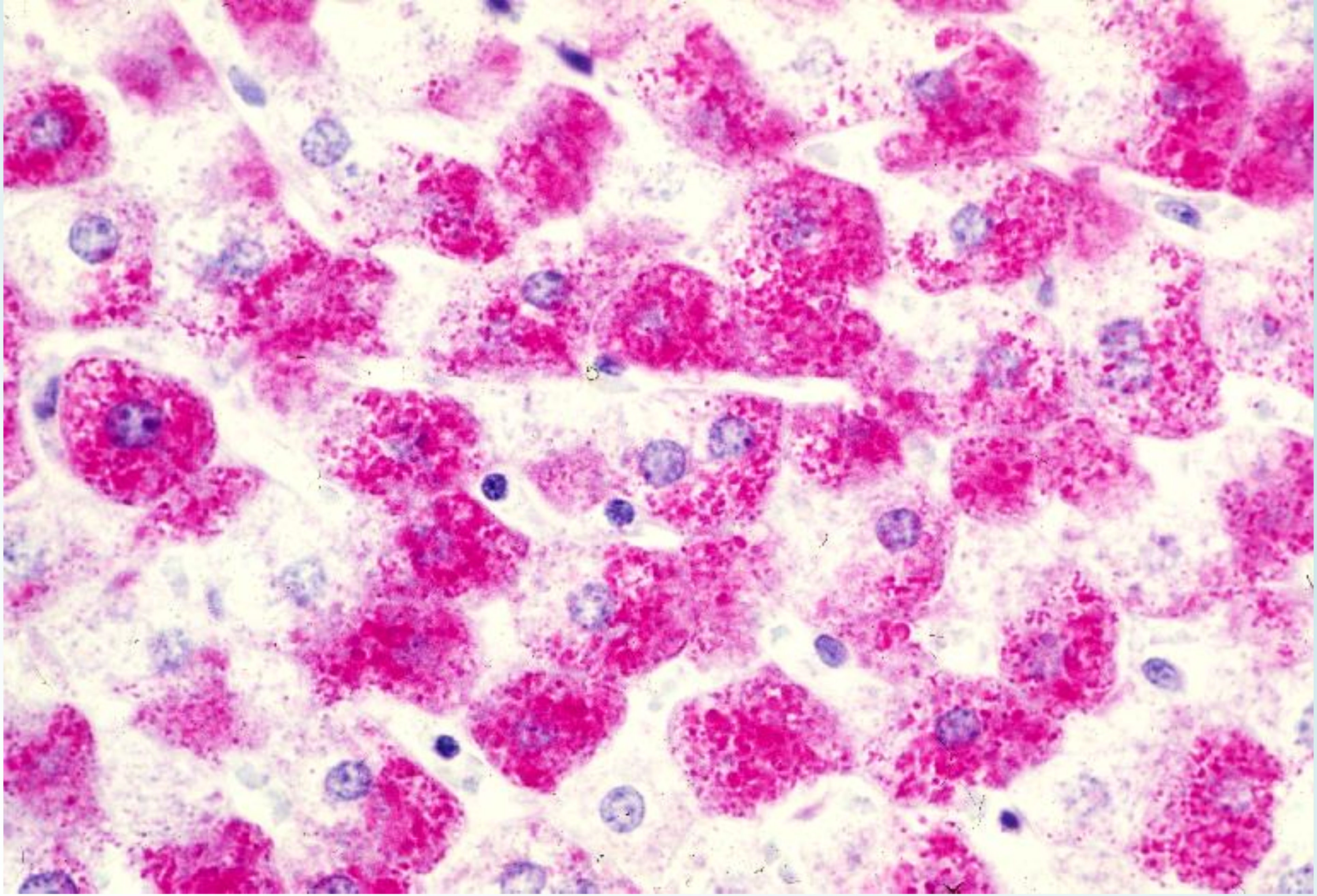
12-34 Kupffer cells 3. Rabbit, vital stain with India ink and counter-stain with carmine, x 130.



12-35 Hepatic cell cords and sinusoids 3. Rat, epon section, toluidin blue stain, x 160.



12-36 Hepatic cell cords and sinusoids 4. Rat, epon section, toluidin blue stain, x 400.



12-37 Glycogen granules in hepatic cells. Rabbit, Best's carmine stain, x 160.

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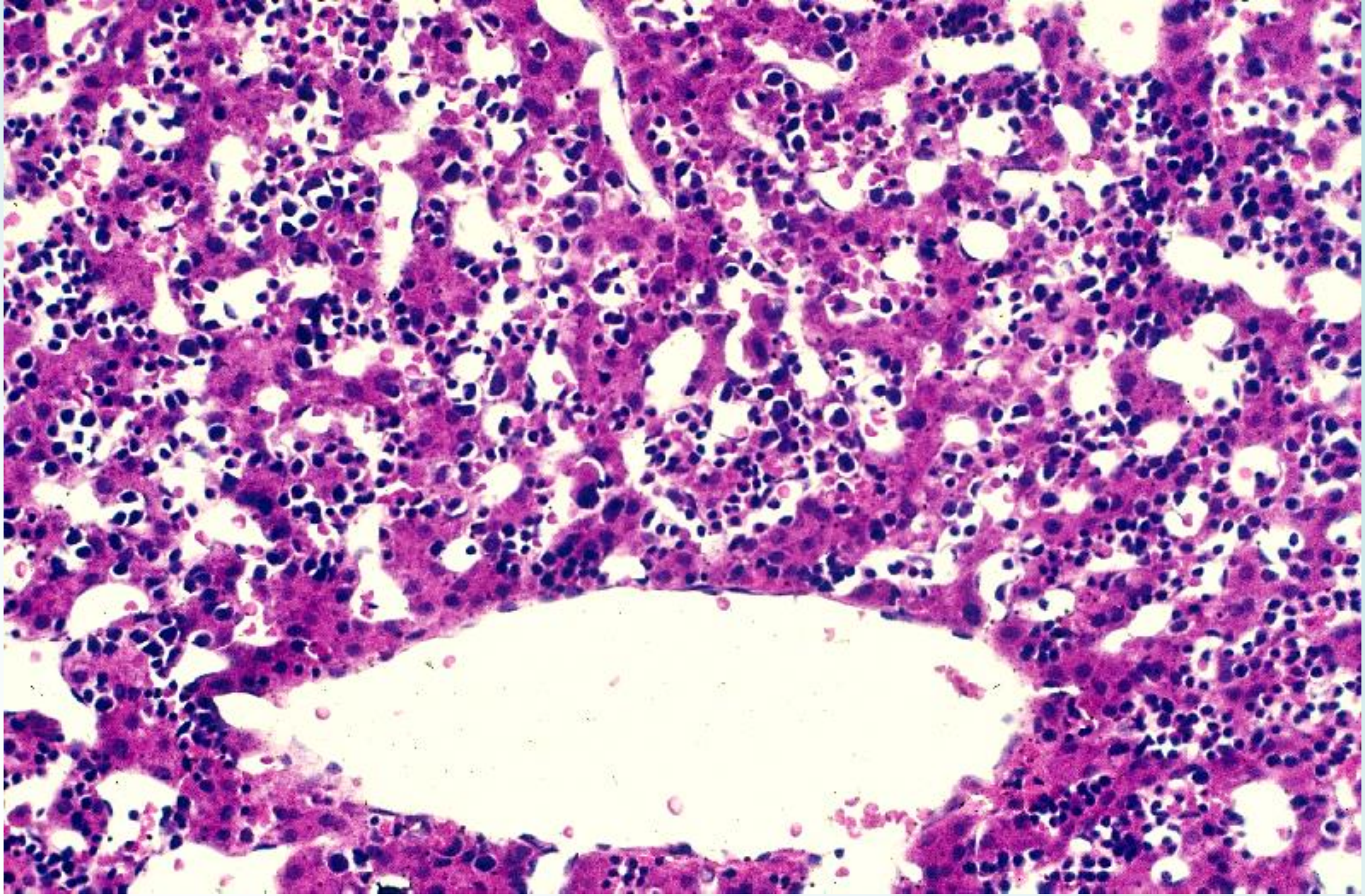

12-38 Liver of 6-month human embryo 1. H-E stain, x 64.

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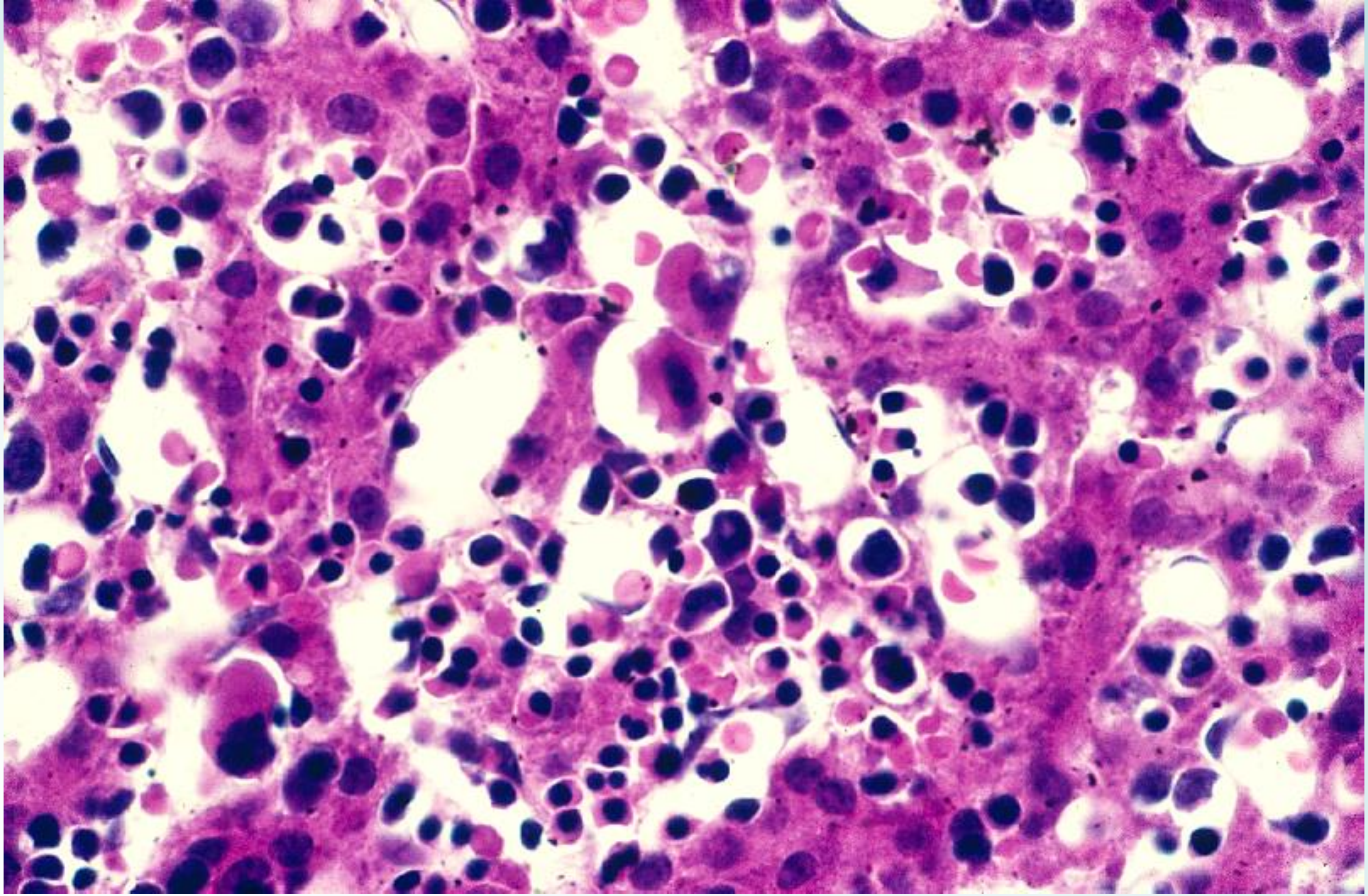
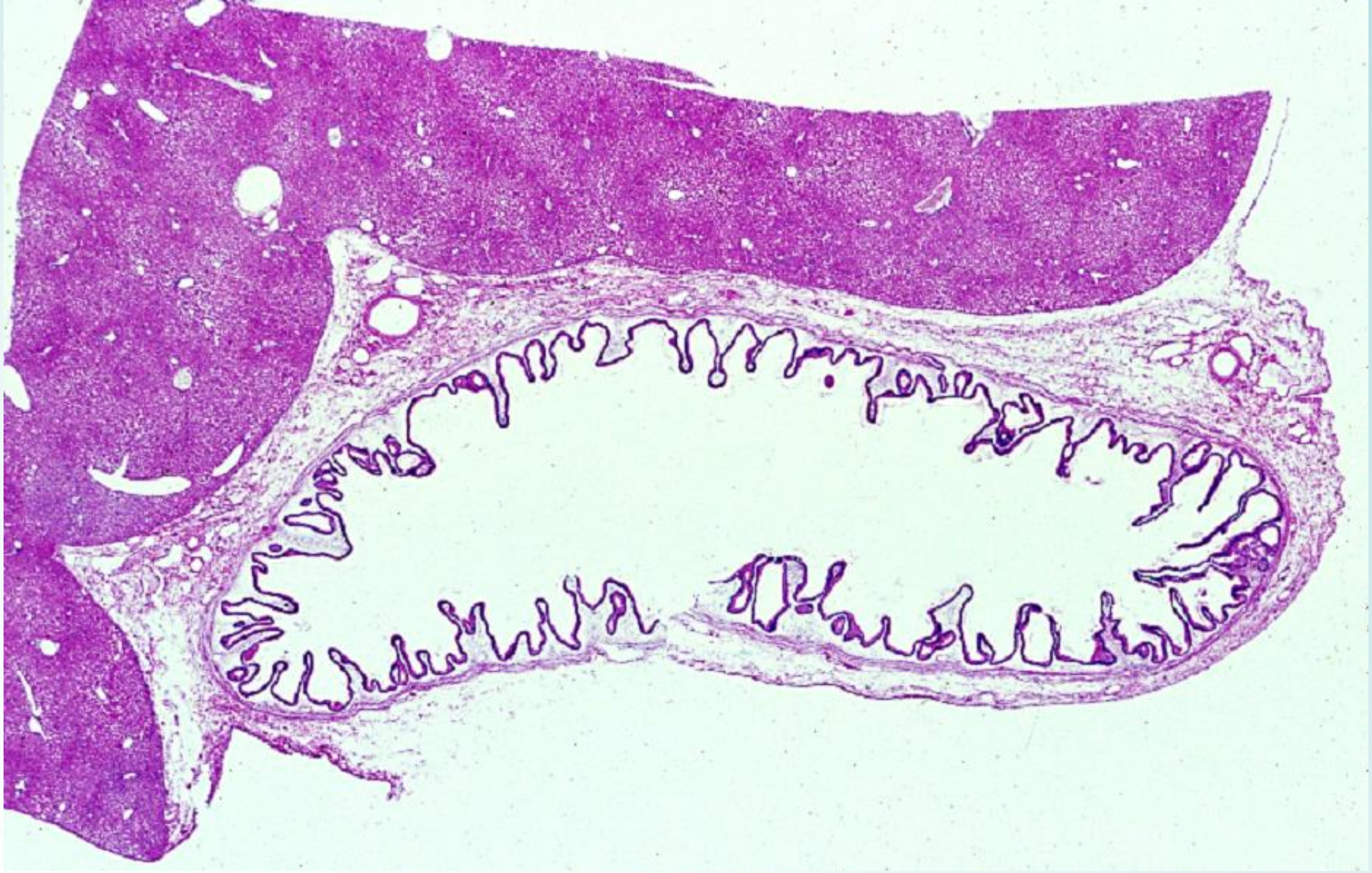
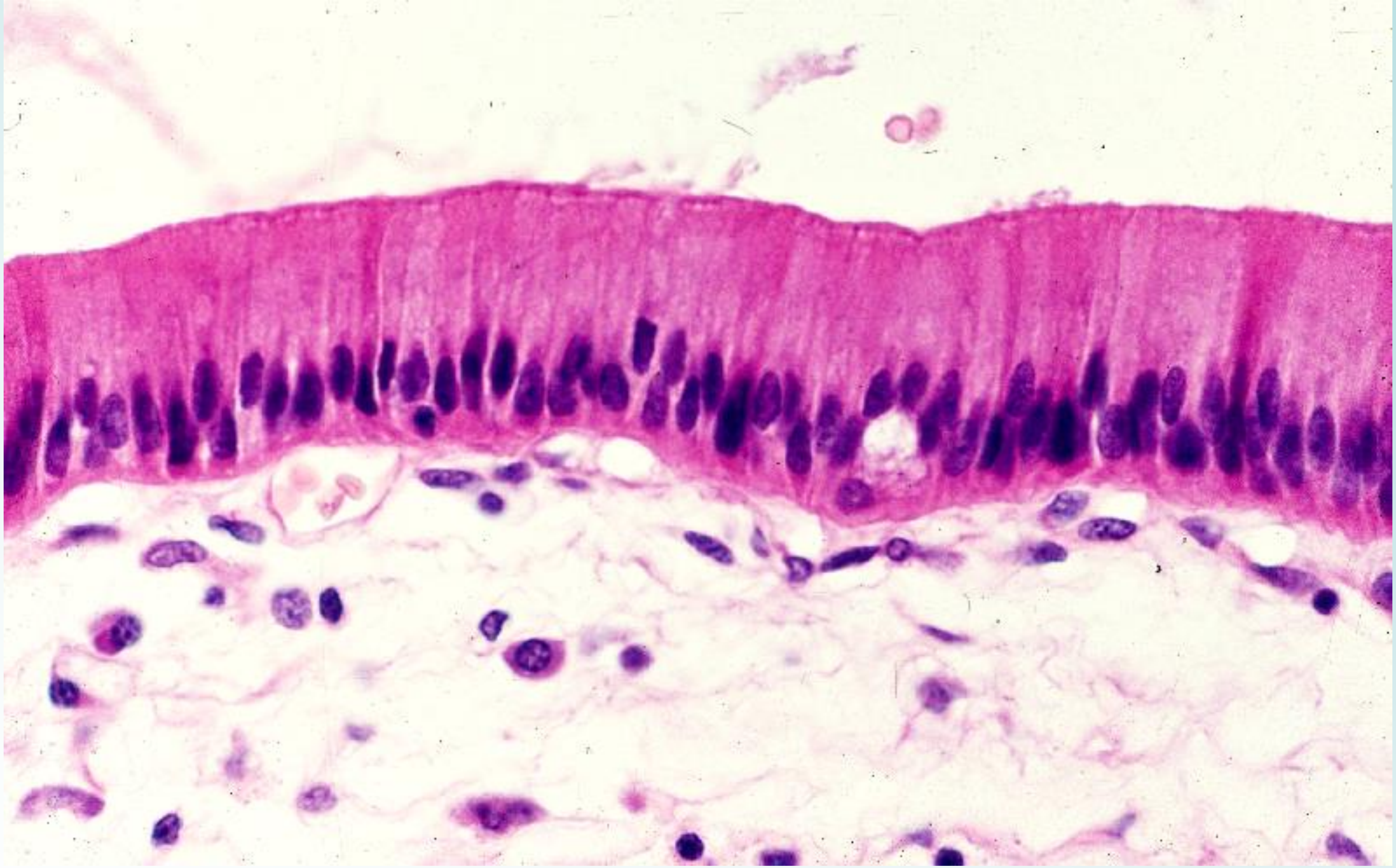


12-39 Liver of 6-month human embryo 2. H-E stain, x 160.

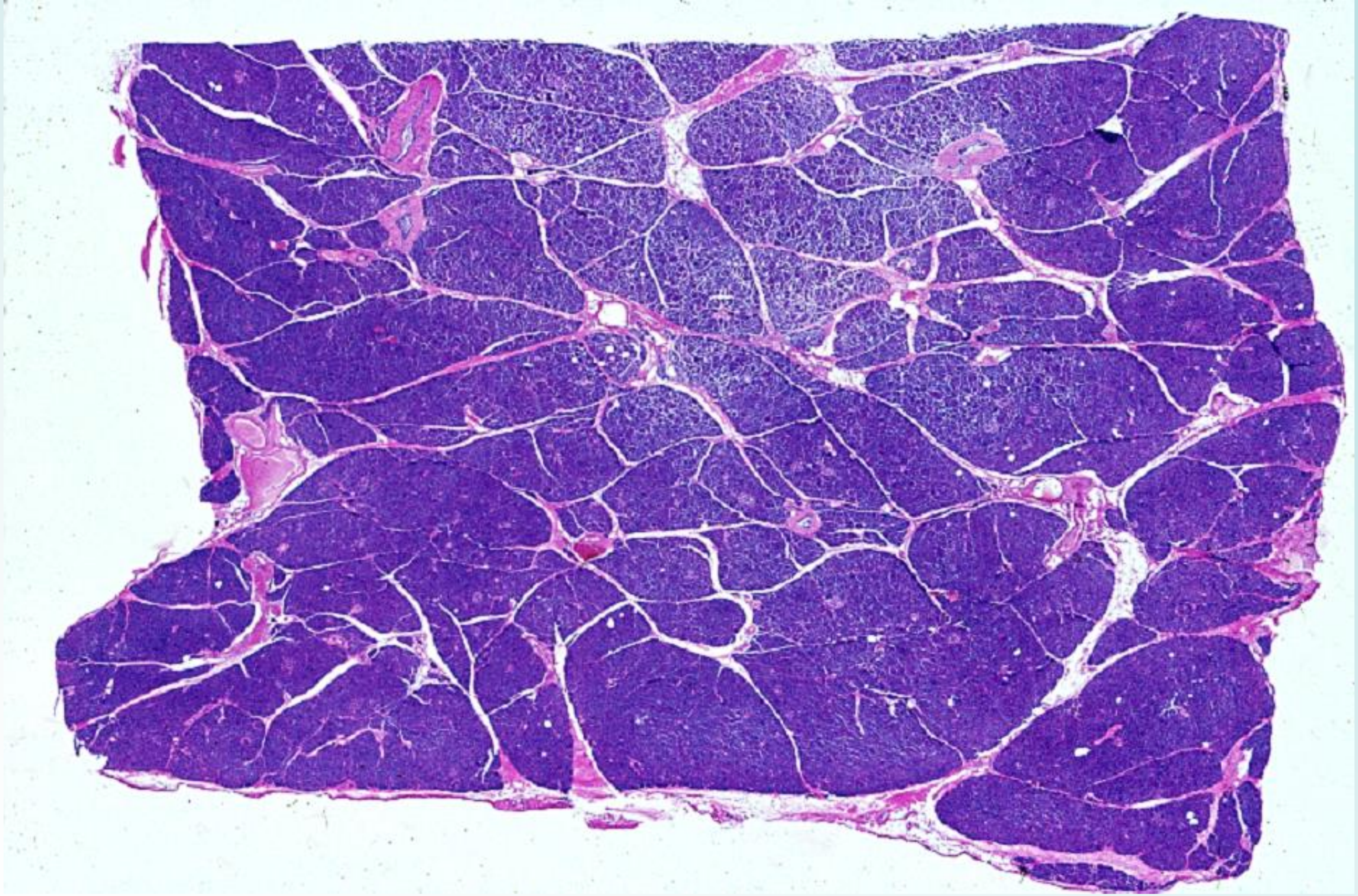


12-40 Gallbladder, transverse section. Monkey, H-E stain, x 2.2.

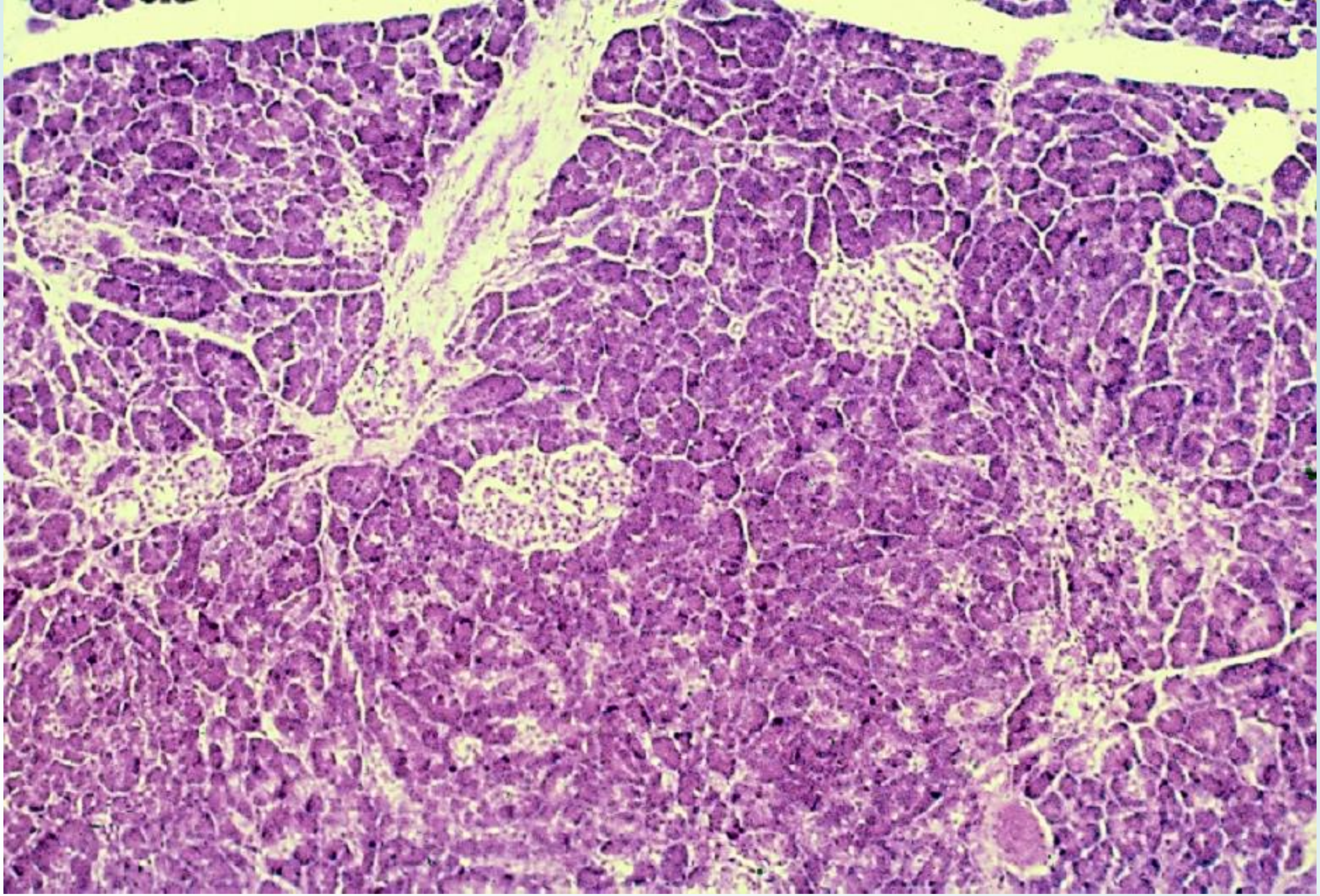


12-41 Epithelium of gallbladder. Monkey, H-E stain, x 40.

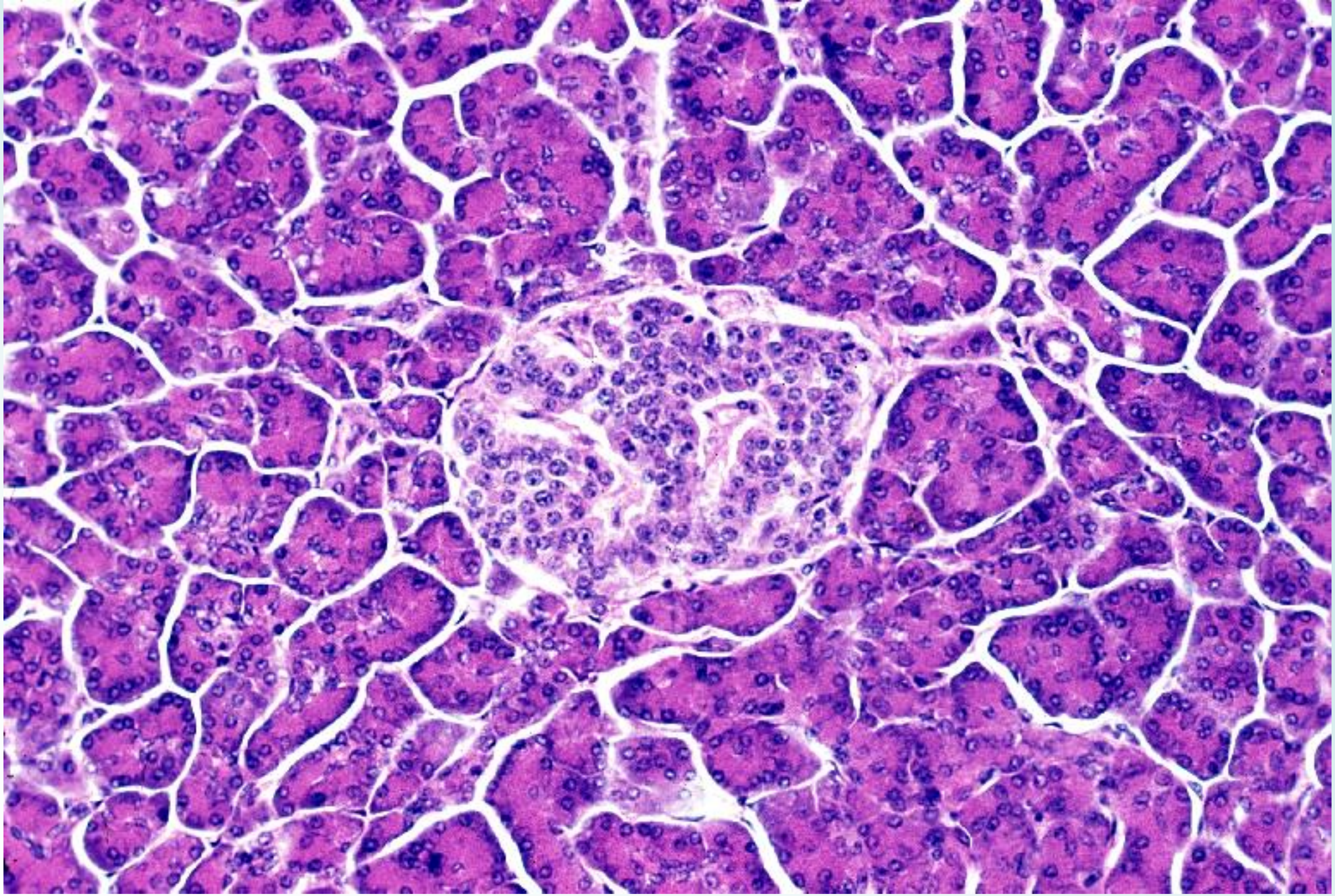
12-002
Pancreas



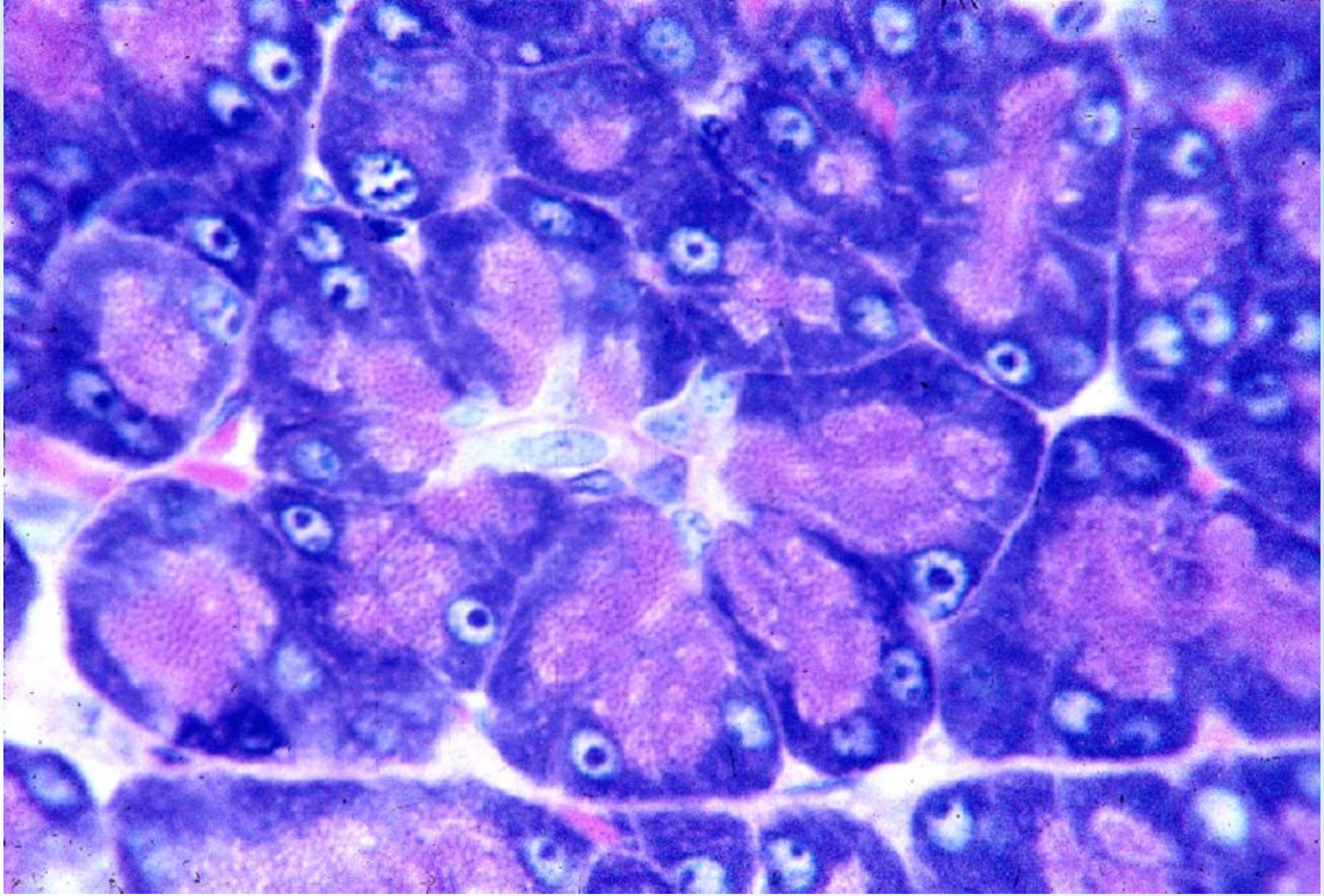
12-42 Pancreas, general view 1. Human, H-E stain, x 2.2.



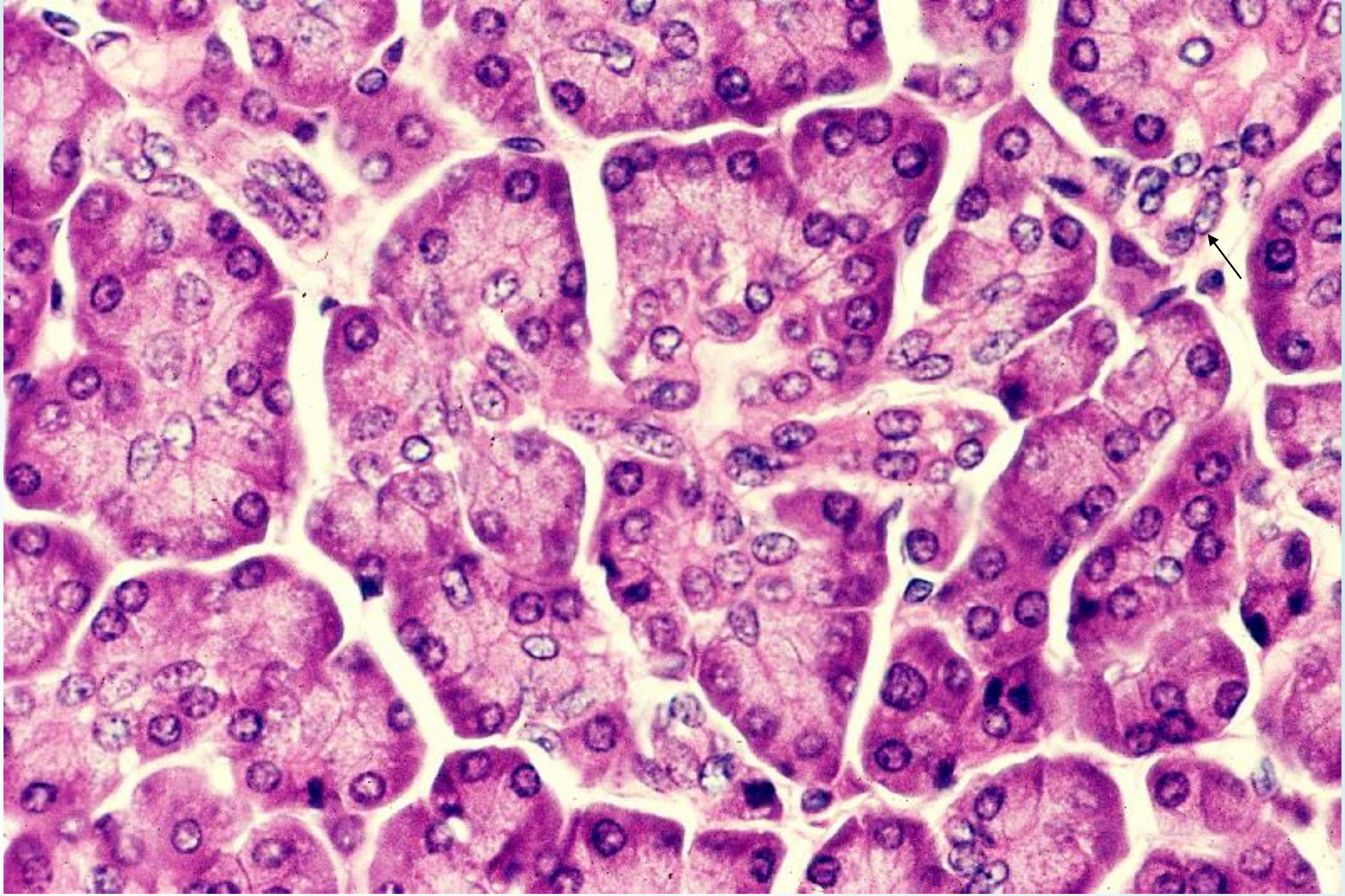
12-43 Pancreas, general view 2. Human, H-E stain, x 25.



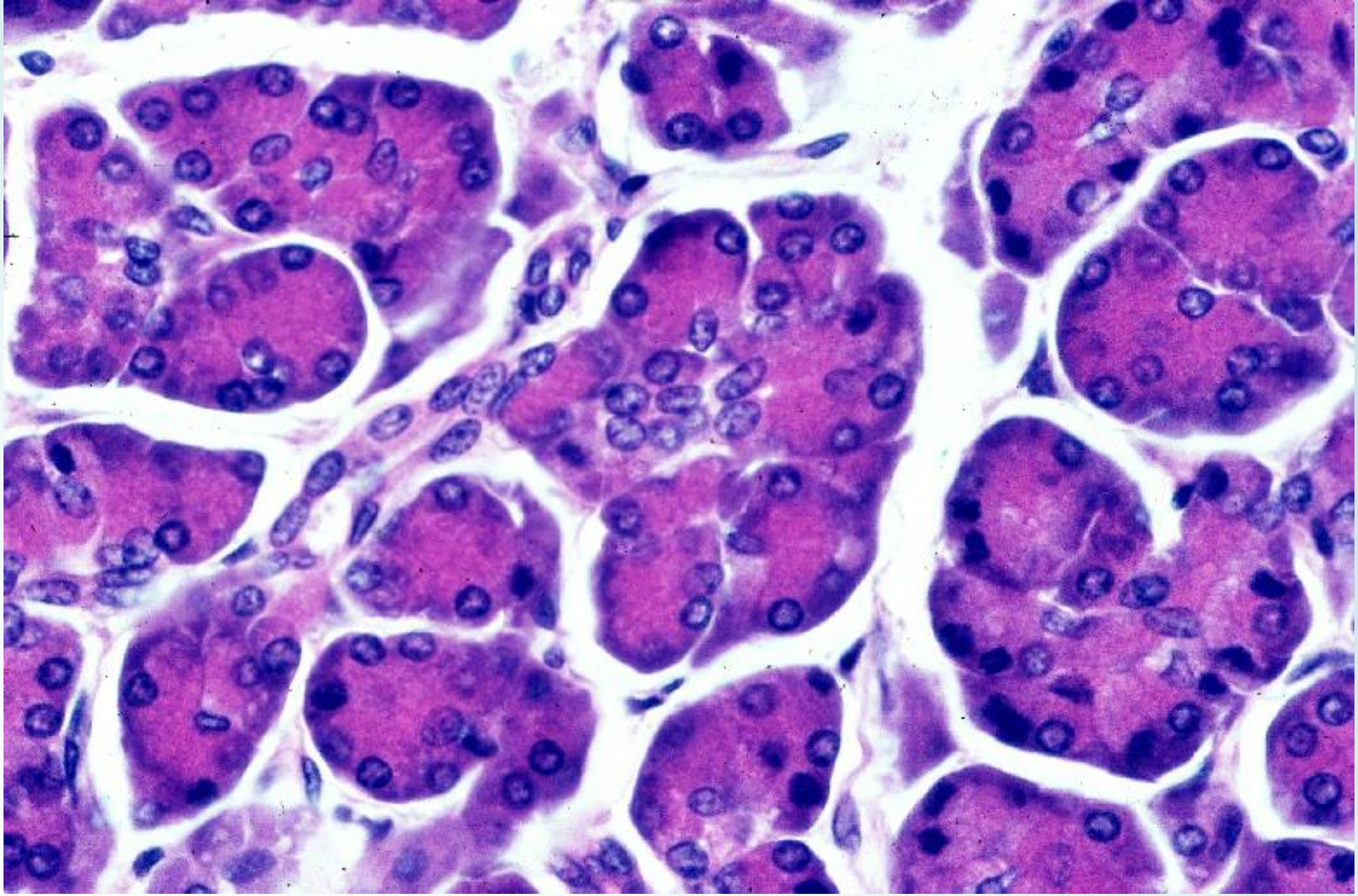
12-44 Pancreatic islet and exocrine acini. Human, H-E stain, x64.



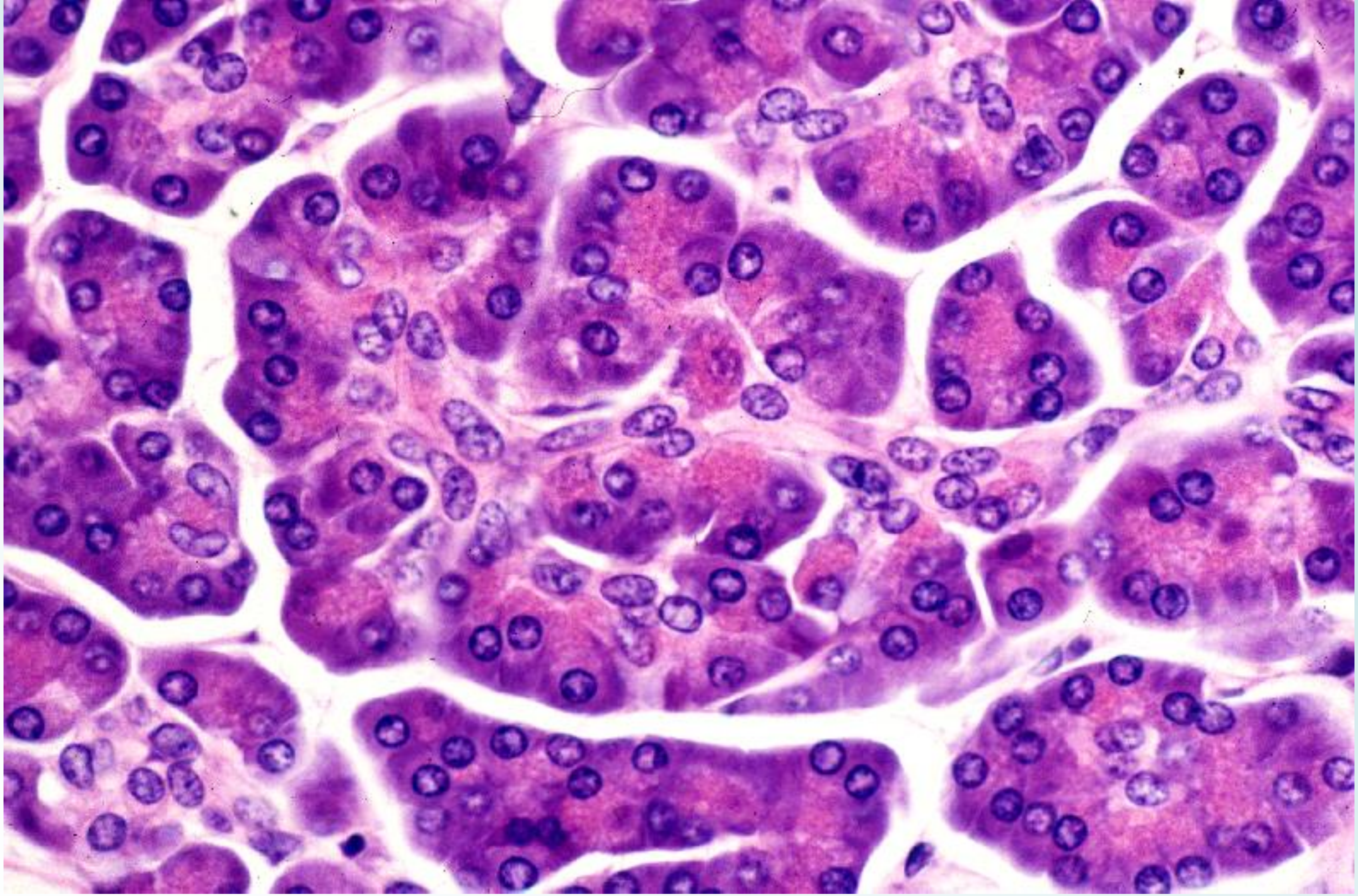
12-45 Pancreatic acini and zymogen granules. Rat, toluidine blue and eosin stain, x 225.



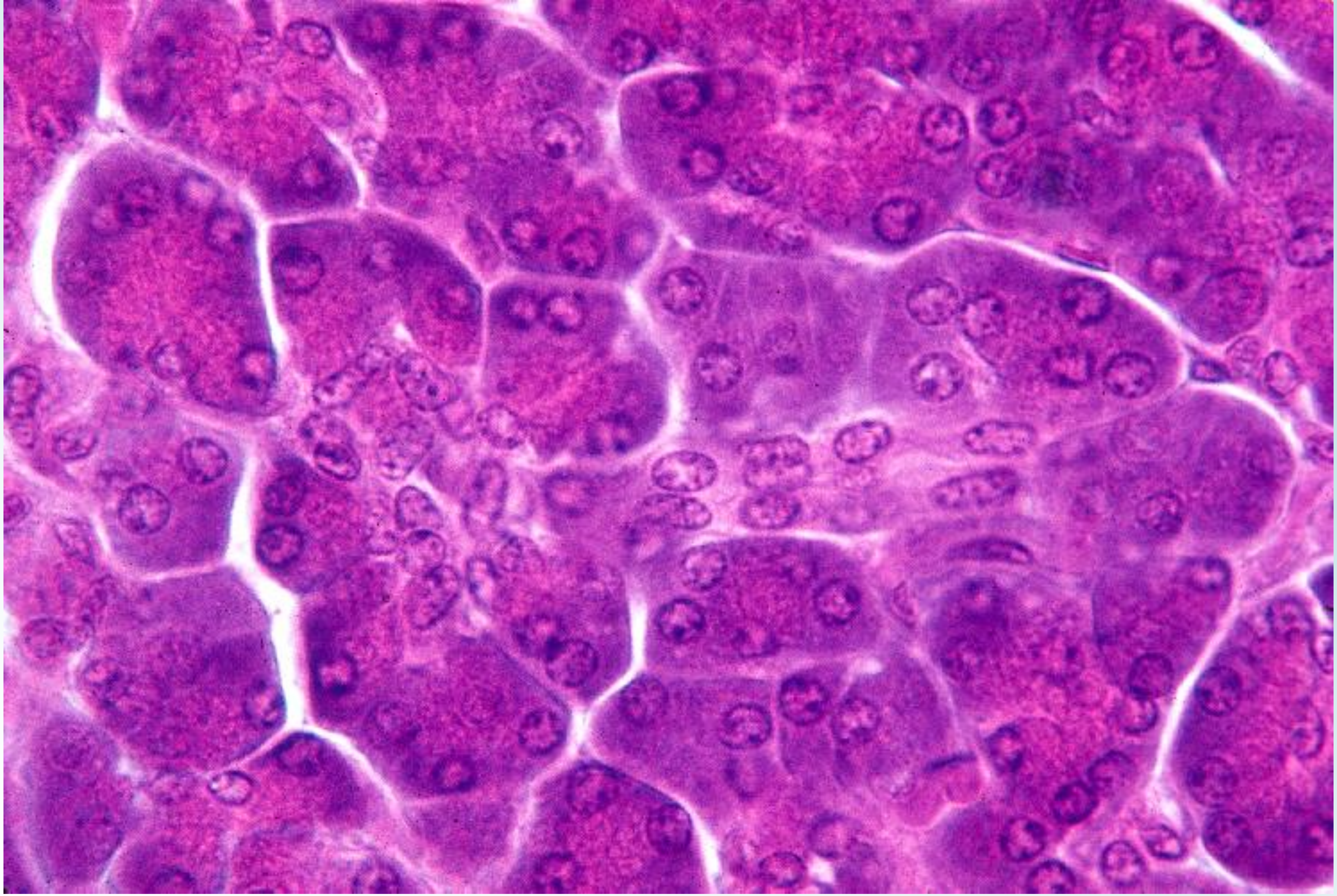
12-46 Acini and intercalated duct 1 . Human, H-E stain, x 160.



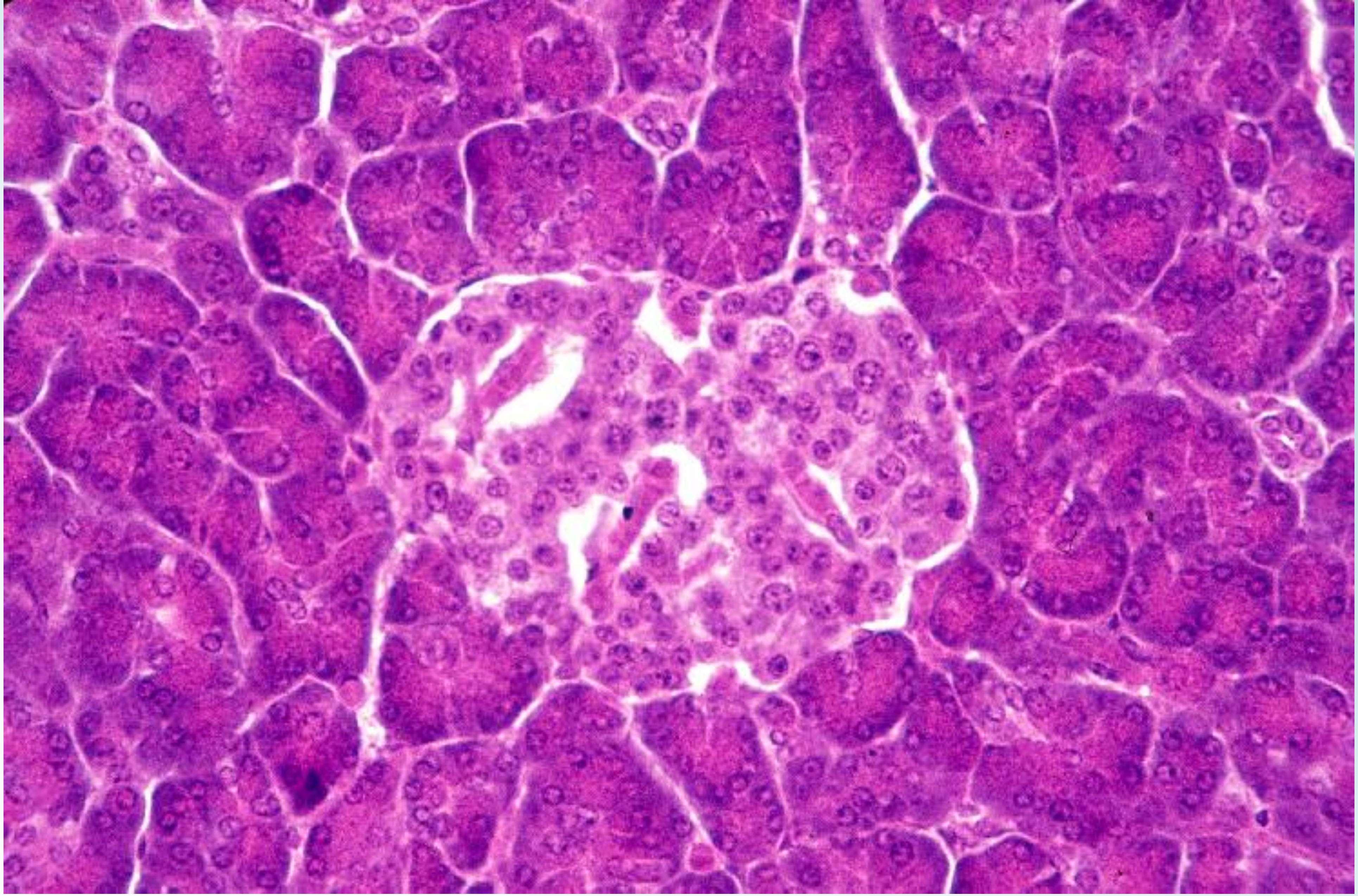
12-47 Acini and intercalated duct 2. Human, H-E stain, x 160.



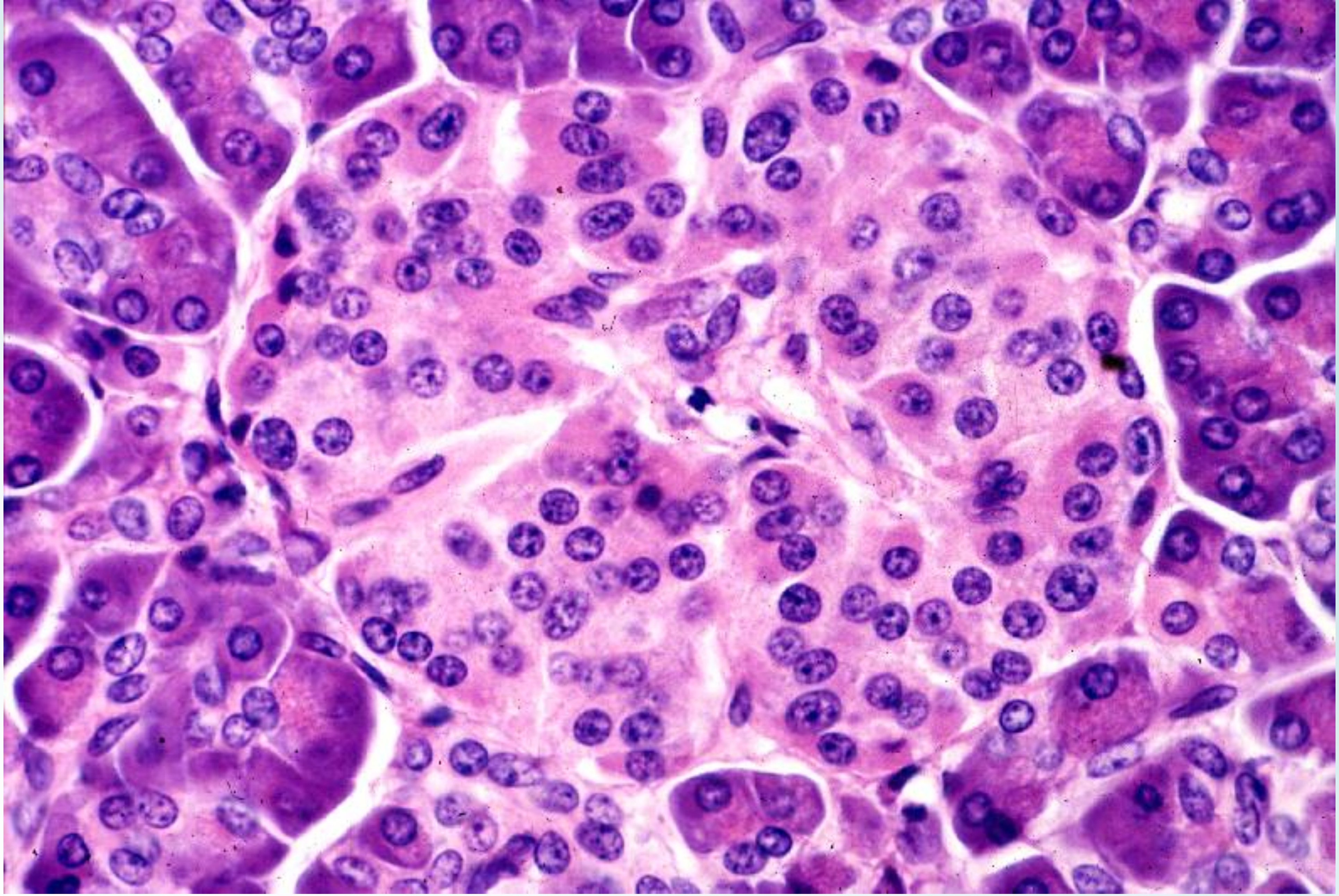
12-48 Acini and intercalated duct 3 . Human, H-E stain, x 160.



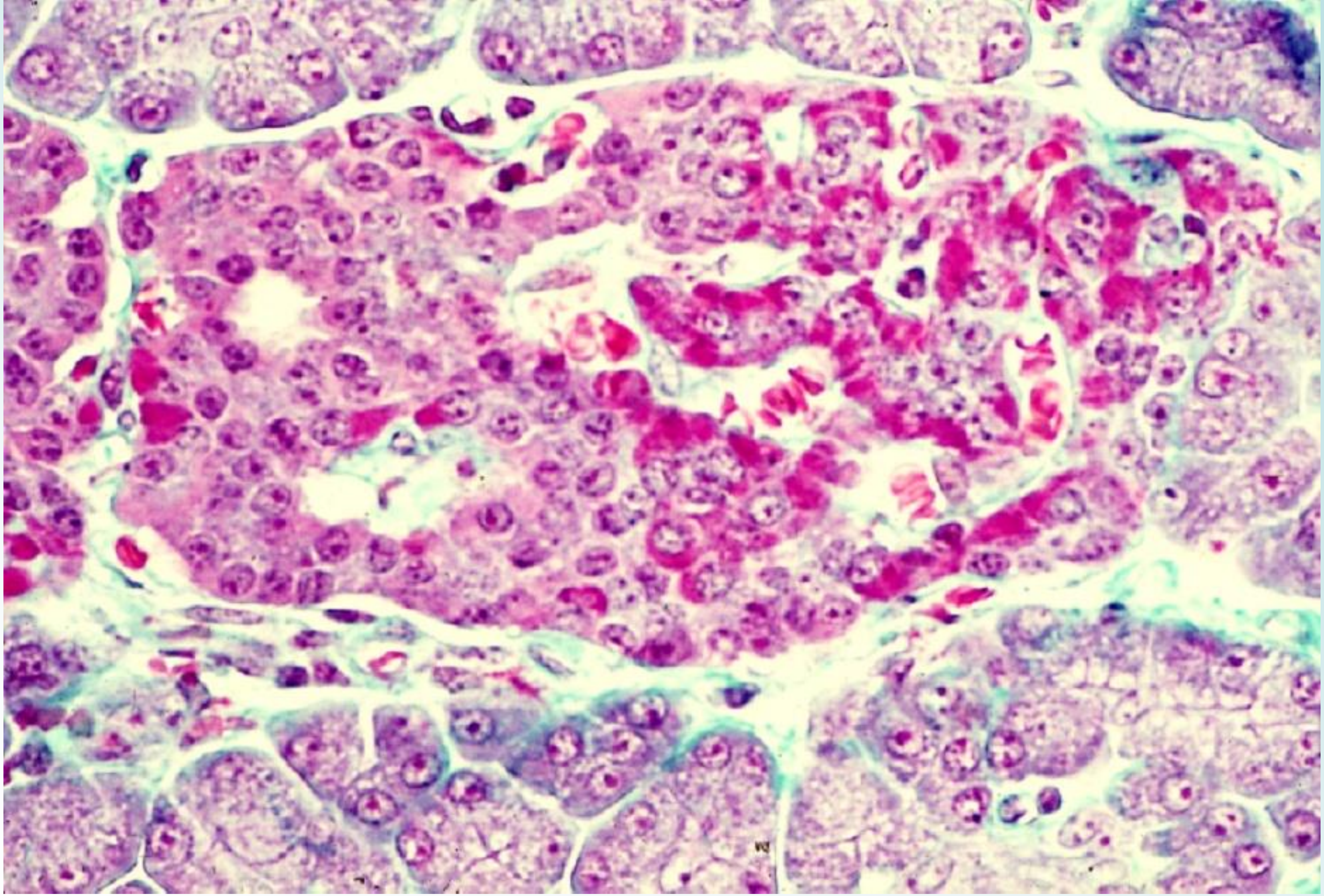
12-49 Acini and intercalated duct 4 . Human, H-E stain, x 225.



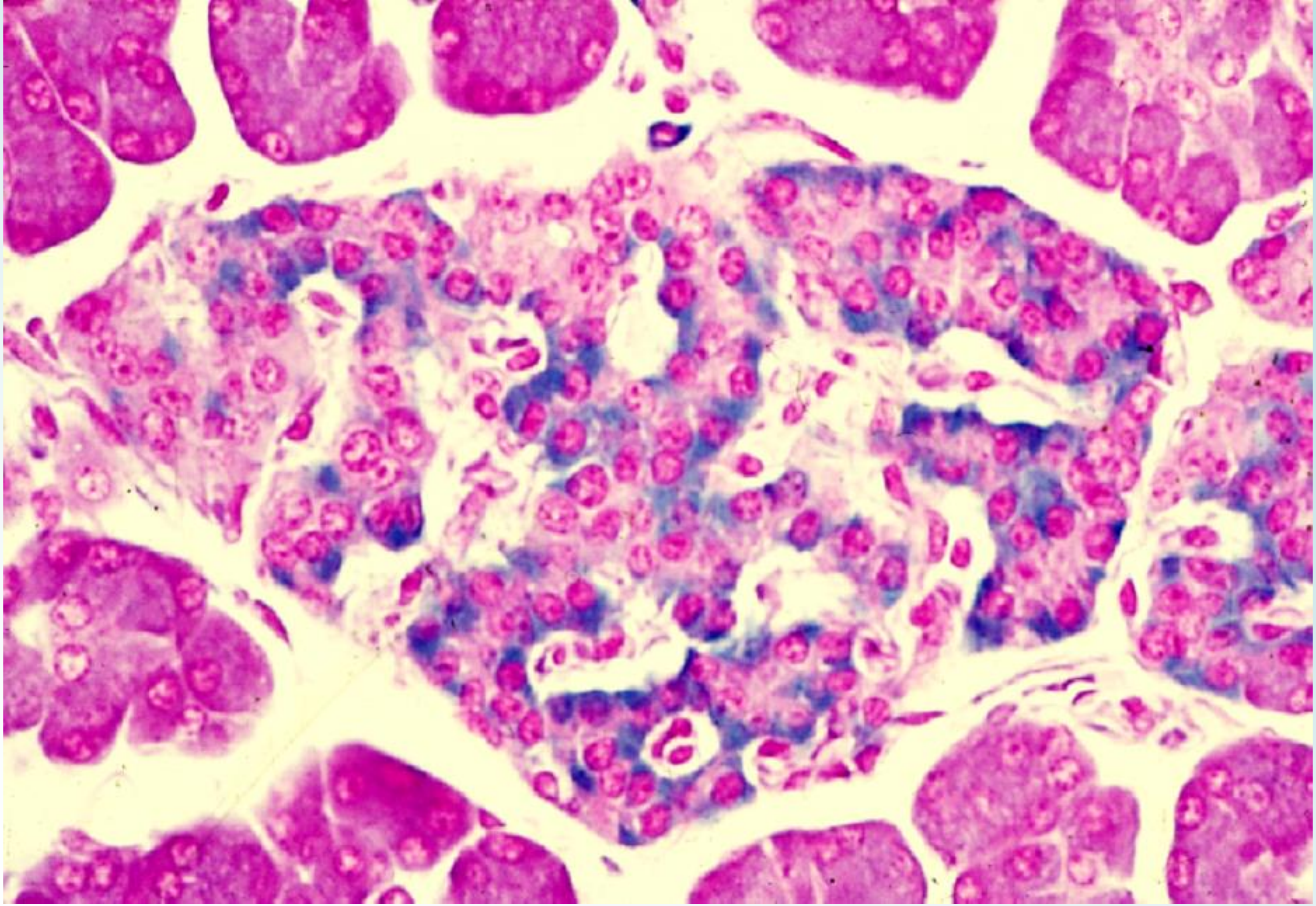
12-50 Pancreatic islet 1. Human, H-E stain, x 100.



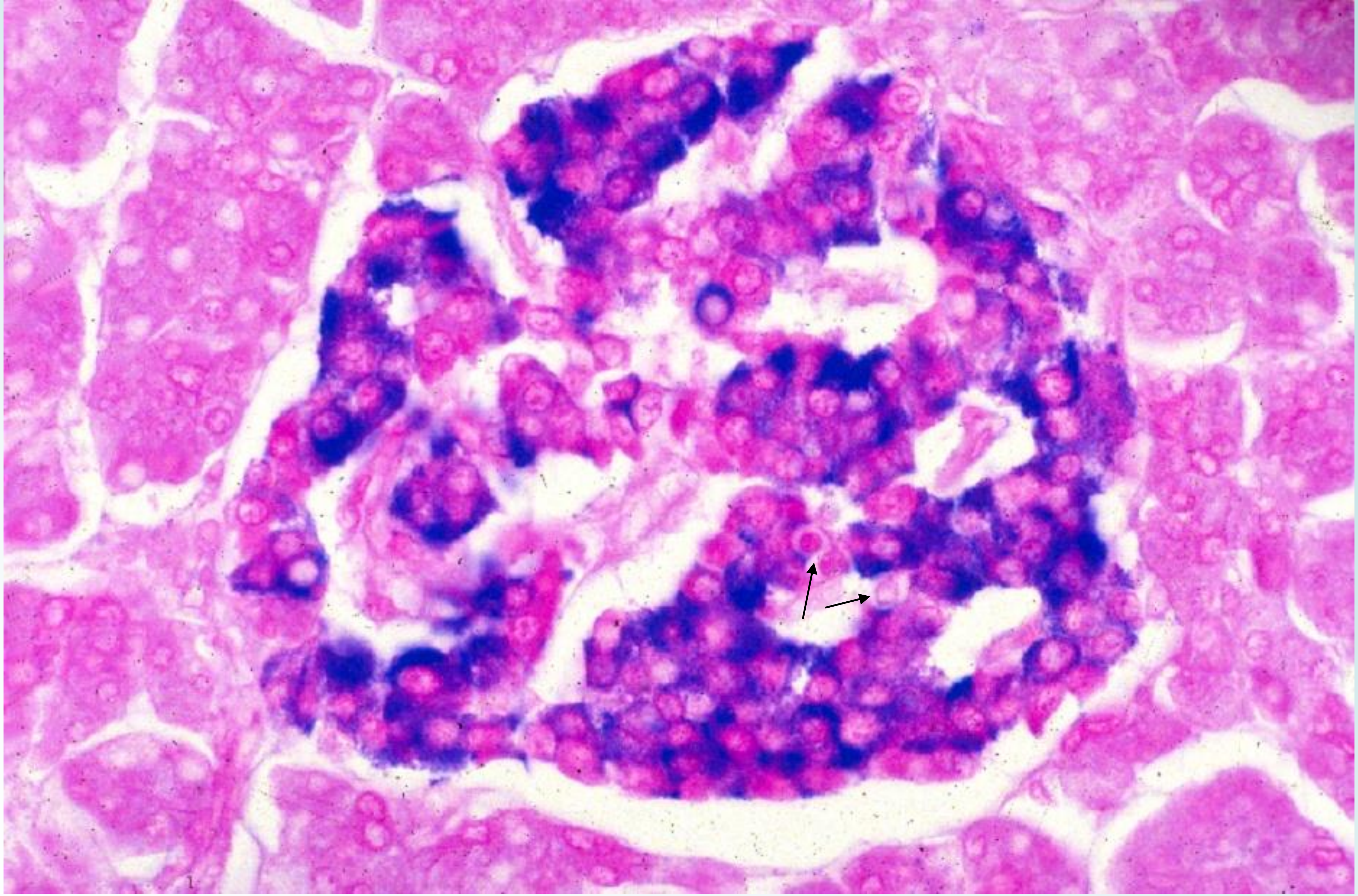
12-51 Pancreatic islet 2. Human, H-E stain, x 160.



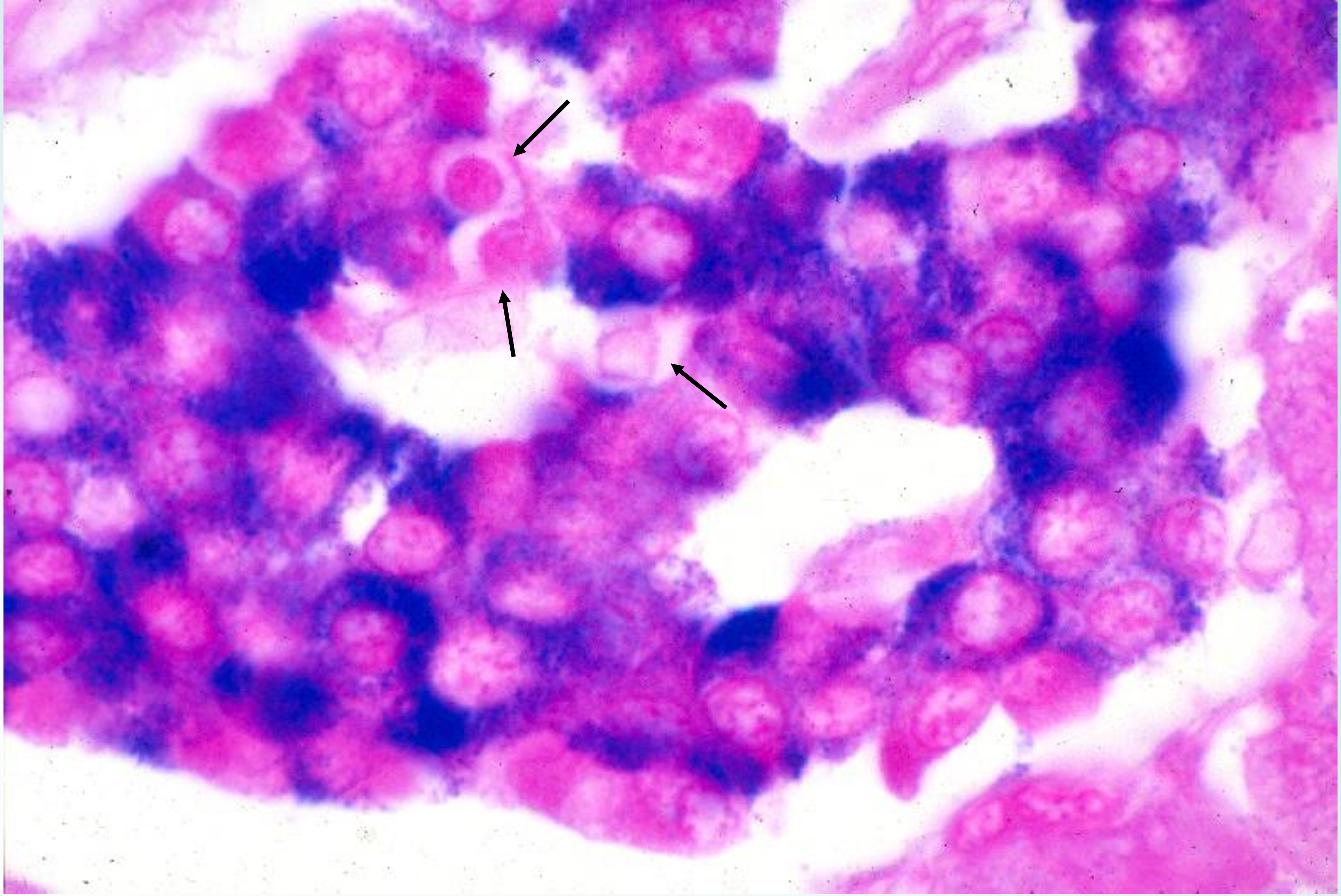
12-52 Pancreatic islet 3. Human, M-G stain, x 160.



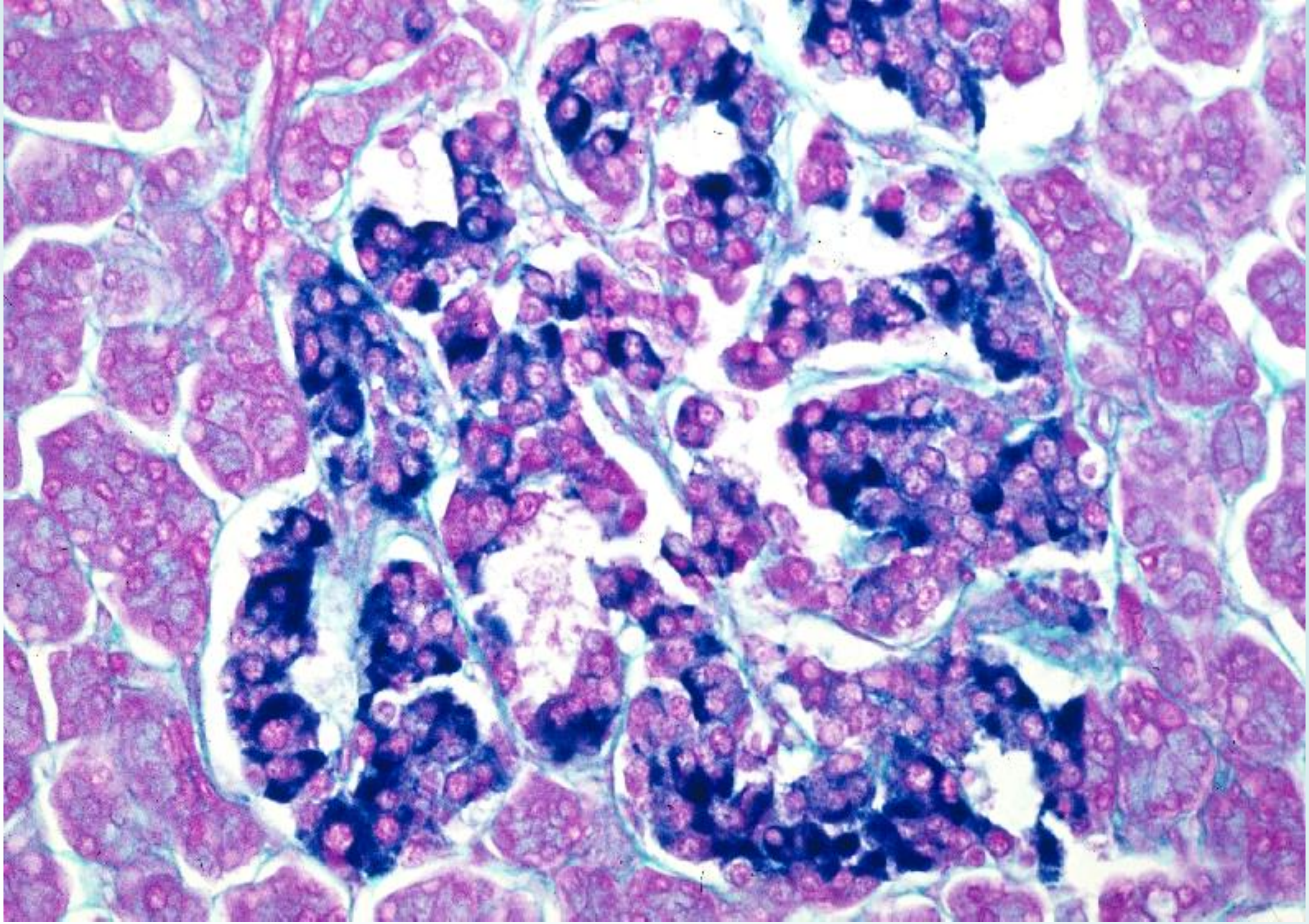
12-53 Pancreatic islet 4. Human, Victoria blue and Kernechtrot stain, x 160.



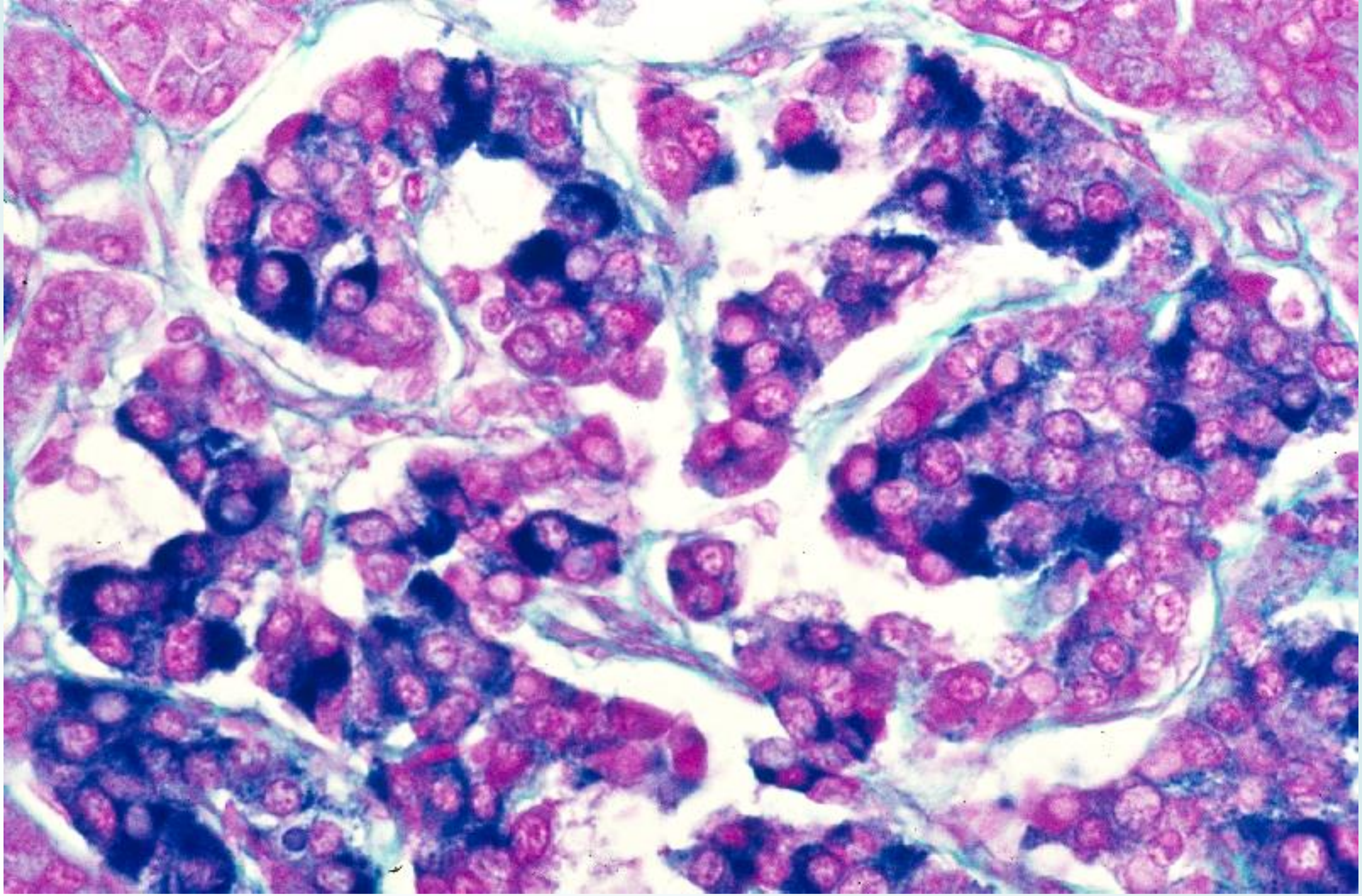
12-54 Pancreatic islet 5. Human, Victoria blue and phloxin stain, x 130.



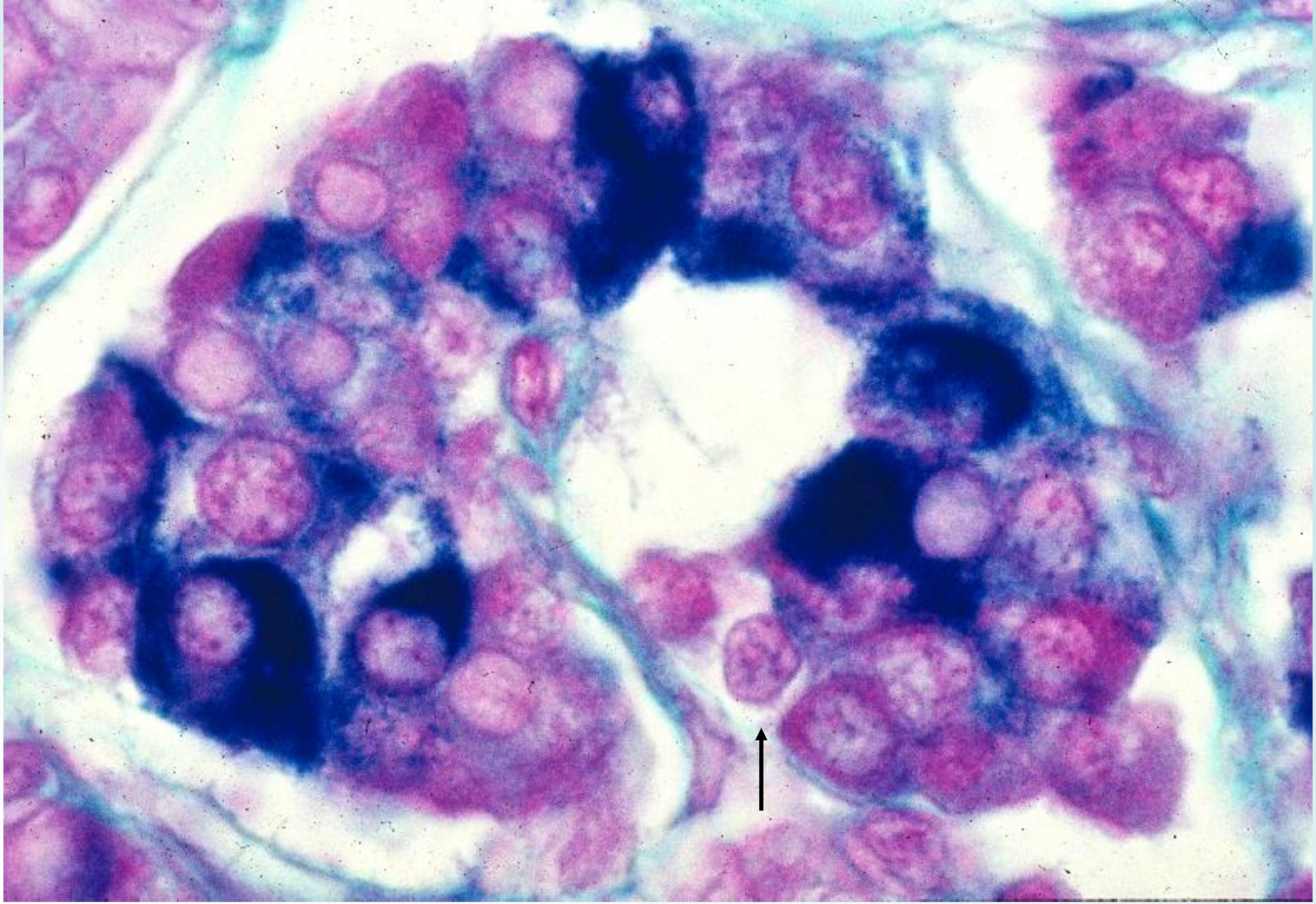
12-55 Pancreatic islet 6. Human, Victoria blue and phloxin stain, x 330.



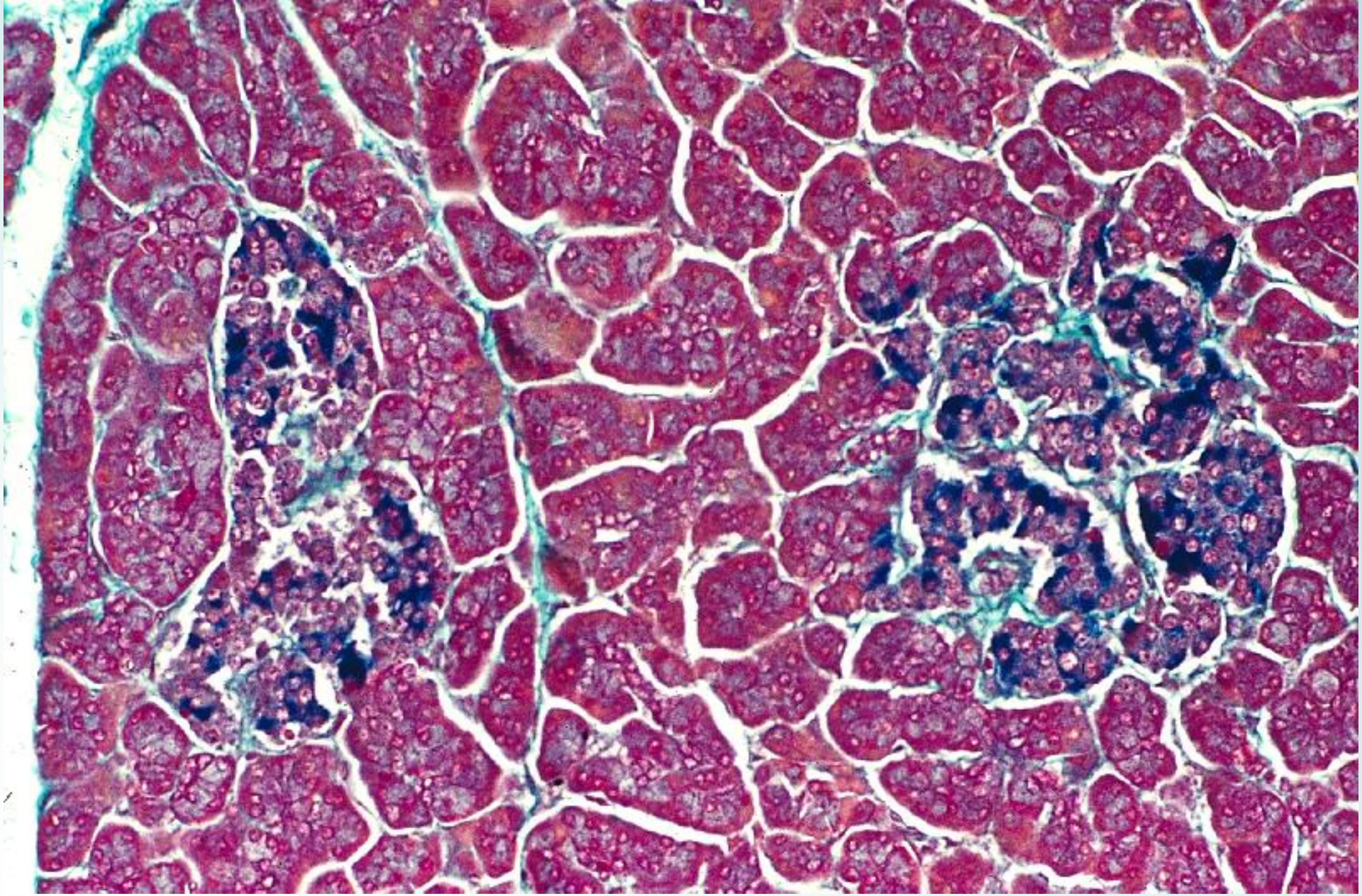
12-56 Pancreatic islet 7. Human, Victoria blue, phloxin and light green stain, x 100.



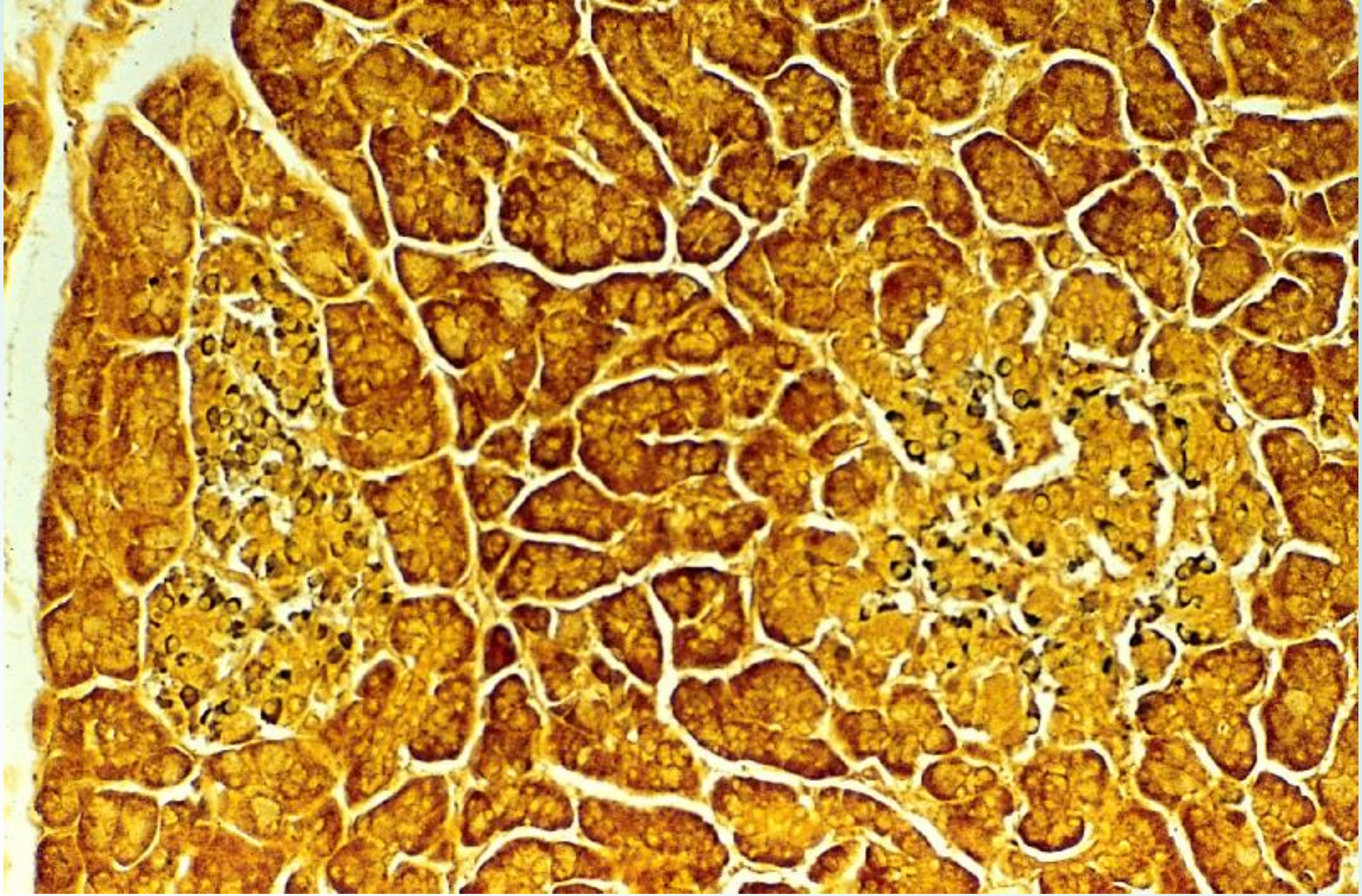
12-57 Pancreatic islet 8. Human, Victoria blue, phloxin and light green stain, x 160.



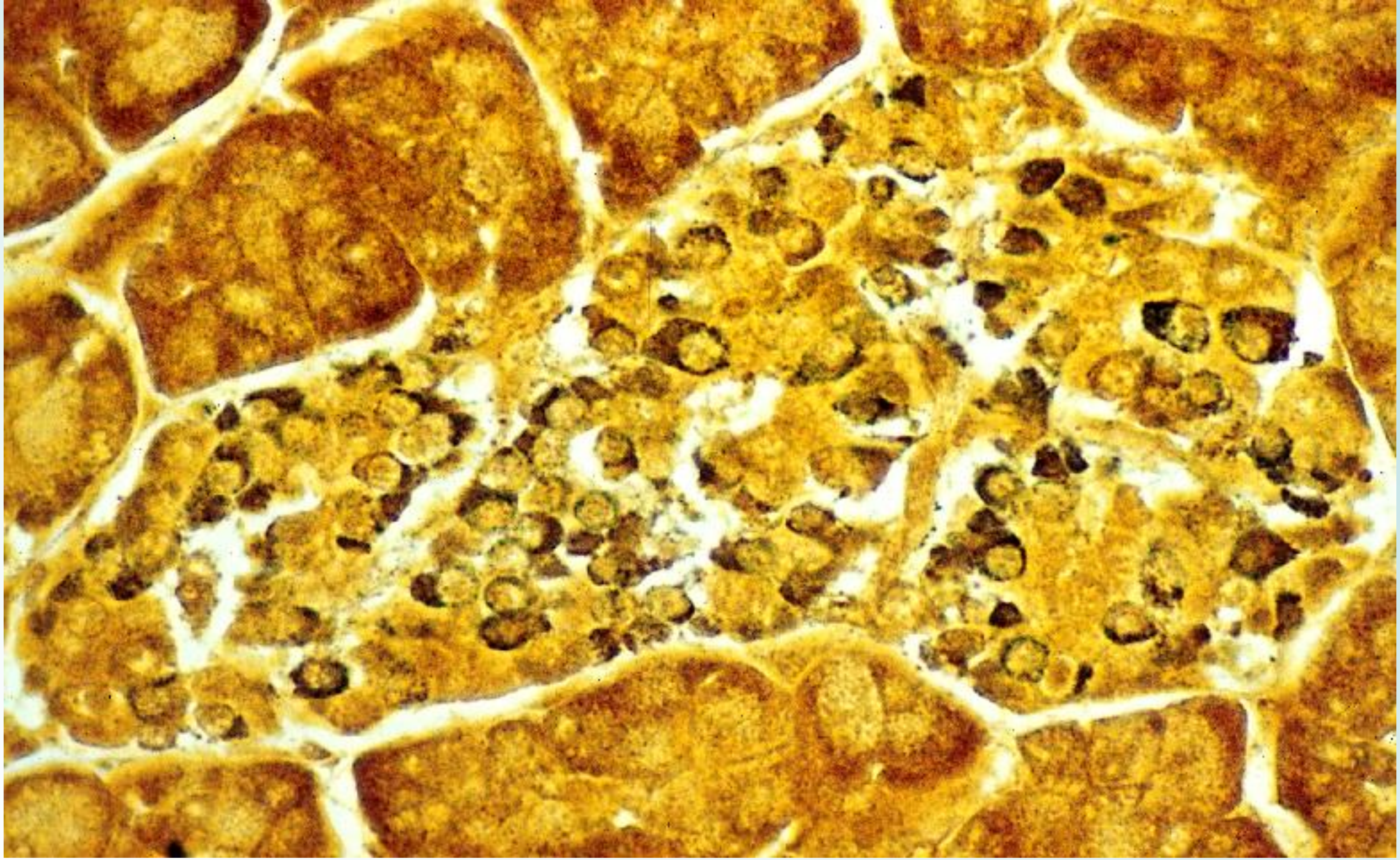
12-58 Pancreatic islet 9. Human, Victoria blue, phloxin and light green stain, x 250.



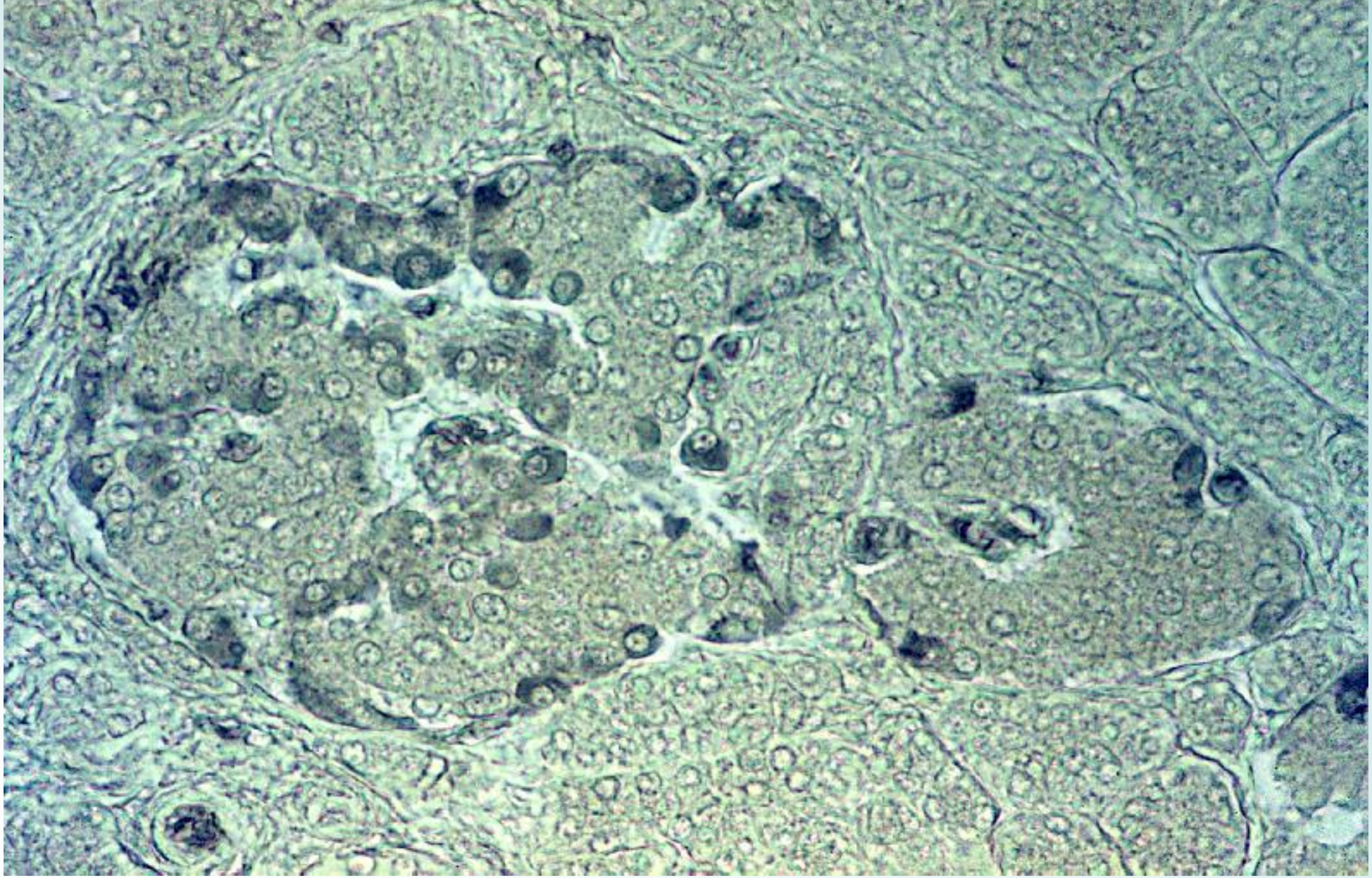
12-59 Pancreatic islet 10. Human, Victoria blue, phloxin and light green stain, x 64.



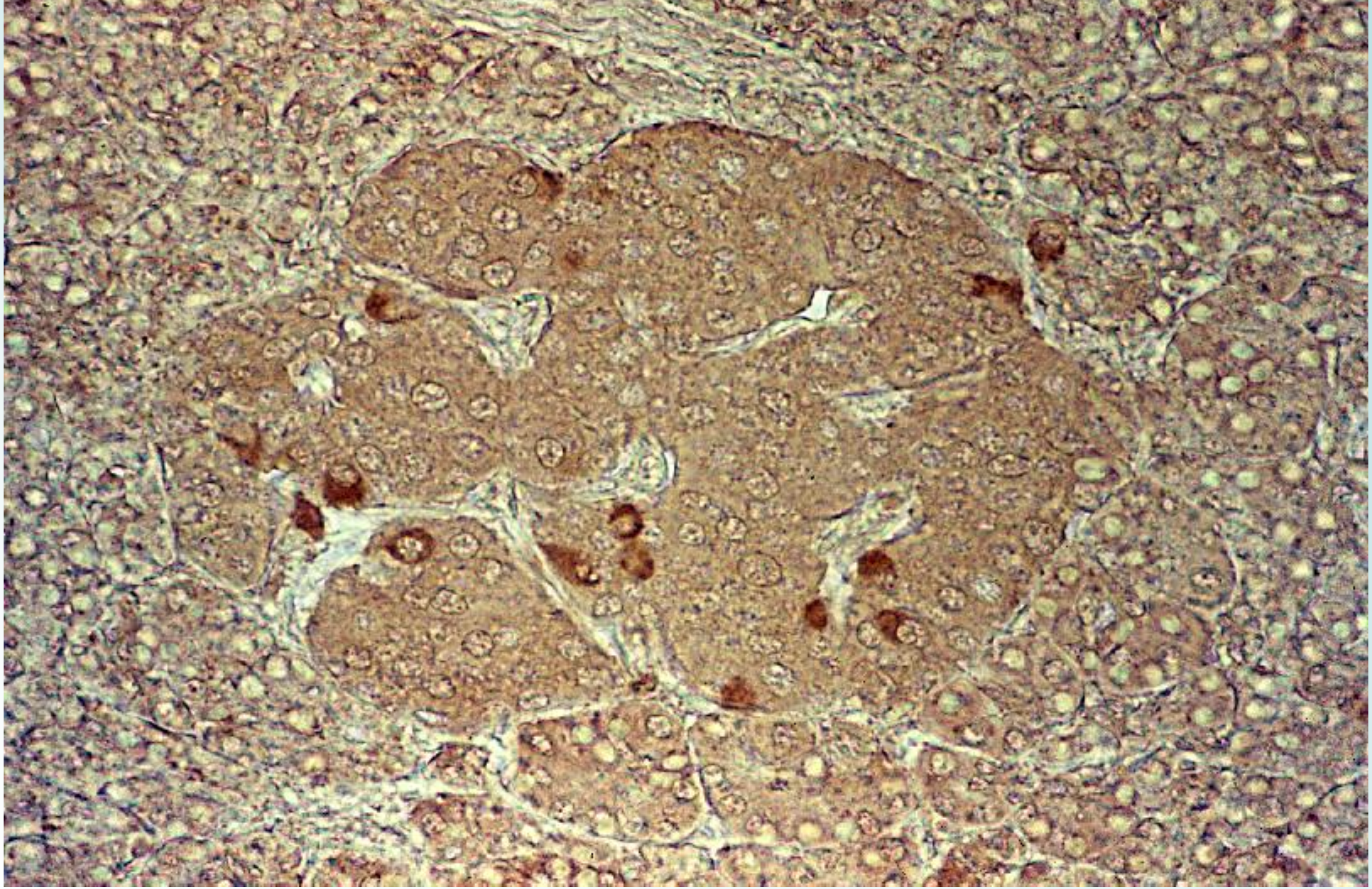
12-60 Pancreatic islet 11. Human, Hellman's silver impregnation method, x 64.



12-61 Pancreatic islet 12. Human, Hellman's silver impregnation method, x 160.



12-62 Pancreatic islet 13. Human embryo, antiglucagon reaction. x 160.



12-63 Pancreatic islet 14. Human embryo, antisomatostatin reaction, x 160.

12-000 Digestive system 4 Liver and Pancreas

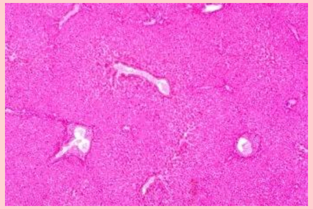
12-001 Liver (1/2)

- The liver is an accessory gland of the gastro-intestinal tract but it has a remarkable diversity of other functions unrelated to alimentation. The liver is the largest gland in the body, weighing about 1500 g in the adult. It is situated in the right upper quadrant of the abdominal cavity with its rounded upper surface conforming to the dome of the diaphragm. Its thin investment of connective tissue, Glisson's capsule, is covered over most of its surface by peritoneal mesothelium. On its under side, blood vessels enter, and the right and left hepatic ducts leave the organ at its hilus, the porta hepatis.
- The liver has an indispensable role in the metabolism of absorbed nutrients that depends on its unique relationship to the two major subdivisions of the vascular system. It has a dual blood supply, receiving well-oxygenated blood from the general circulation via the hepatic artery (25%) and a larger volume of poorly oxygenated blood coming from the intestinal tract via portal vein (75%). Blood from these two sources mingles in the hepatic sinusoids, where its solutes have direct access to the hepatic cells. The blood leaving the organ is carried via the hepatic veins to the inferior vena cava. Thus, interposed between the intestinal tract and the general circulation, the liver receives absorbed nutrients and stores or degrades them to smaller molecules that are released into the systemic circulation for distribution to the other tissues and organs of the body.
- The liver continuously produces bile, a fluid that is ultimately secreted into the duodenum via the common bile duct. As much as 1 liter is produced daily, but the greater portion is diverted to the gall bladder where it is concentrated up to 10-fold and stored until released in response to the ingestion of food. Bile facilitates digestion by emulsifying dietary fats and reducing them to micelles that are more readily absorbed by the intestinal epithelium. In addition to its exocrine function, the liver synthesizes plasma proteins and delivers them directly into the blood. It also exercises considerable control over the general metabolism of the body through its ability to store carbohydrate in the form of glycogen and release glucose as needed to maintain the normal concentration of this important energy source in the blood. The liver also takes up drugs and other potentially harmful substances absorbed by the intestines and degrades them by oxidation or forms harmless conjugates that are excreted back into the intestines in the bile.

12-001 Liver (2/2)

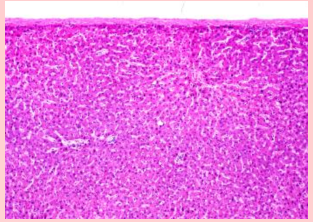
- The organization of the liver is quite different from that of the majority of the exocrine glands. The epithelial cells constituting the liver present a remarkably uniform appearance throughout the organ and structural subunits are not easy to identify. The liver consists of innumerable roughly hexagonal cylinders, about 0.7 mm in diameter and 2 mm in height, called the hepatic lobules, which are enveloped by a thin coat of connective tissue fibers. In the hepatic lobules the parenchymal (hepatic) cells form two-cell-thick cell-cords, which branch and anastomose one another repeatedly and are arranged radially around the central vein and form fenestrated plates. These plates are piled up on top of one another at one-cell-thick intervals, and arranged perpendicular to the longitudinal axis of the lobule. The hepatic cell cords constituting these plates anastomose freely with those of the neighboring plates, so that the hepatic cells constitute three dimensional complex networks. The meshes are filled by thin-walled blood vessels, hepatic sinusoids.
- At three corners of these hexagonal areas there is a small triangular area of connective tissue, interlobular connective tissue, enclosing a small bile duct, a branch of the hepatic artery, and a branch of the portal vein. This complex is called the portal triad or portal area. Lateral branches of these vessels, occurring at short intervals along their length, confluent with hepatic sinusoids and drain into the central vein. The fenestrated plates of hepatic cells are, thus, exposed to a large volume of blood flowing centripetally in the labyrinthine system into a network of sinusoids. Bile is continuously secreted into a network of intercellular bile canaliculi within the cell plates and flows outward to bile ductules in the portal areas at the periphery.

12-01 Liver, general view, 1. Human, H-E stain, x 13.



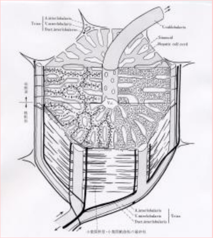
- This is a general view of human liver; hepatic cells are stained uniformly deep red. At center of this figure one central vein, and at lower right and lower left interlobular connective tissues, portal areas, are seen. In human, interlobular connective tissues are poorly developed so that hexagonal contour of the hepatic tubules is difficult to perceive.

12-02 Liver, general view, 2. Human, H-E stain, x 25



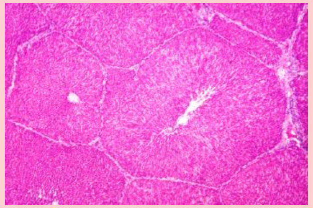
- The upper edge is the connective tissue of the hepatic capsule, beneath it is the parenchyma of the liver consisting of uniformly red stained hepatic cell cords. The meshes of the networks of the hepatic cell cords are filled by hepatic sinusoids. They appear as rents between the cell cords. In this figure, no hepatic lobule is identified.

12-03 Scheme showing the three-dimensional structure of a hepatic lobul (Original).



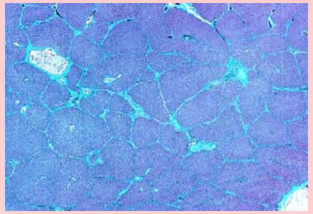
- This is to show the three-dimensional structure of a hepatic lobule. The red line divides the lower transverse (horizontal) section and the upper longitudinal (vertical) section. In the horizontal section, at each corner there is the portal triad, interlobular bile duct, interlobular artery and interlobular vein; the interlobular artery and interlobular vein flow into the hepatic sinusoids which drain into the central vein. The intercellular bile canaliculi running centrifugally throughout the axial portion of the hepatic cell cords empty into the interlobular bile ducts at the periphery of the hepatic lobule. These interrelationship is also recognized in the vertical section. The central vein becomes sublobular vein after leaving the lobule.

12-04 Liver, general view, 3. Pig, H-E stain, x 10.



- In the pig liver, as the interlobular connective tissue is very well developed, the boundary of each lobule is conspicuously recognized. In this figure the boundary of the hepatic lobules is distinct. The large lobule locating at center right is sectioned oblique longitudinally. At the right edge of this lobule the portal triad is conspicuous.

12-05 Liver, general view, 4. Pig, M-G stain, x 4.0.



- Masson-Goldner (M-G) stain stains the connective tissue fibers deep green. Therefore in this specimen the boundary of each hepatic lobule is evident.

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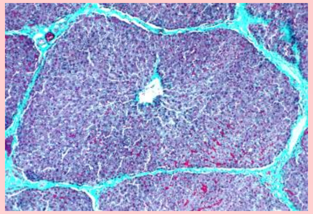
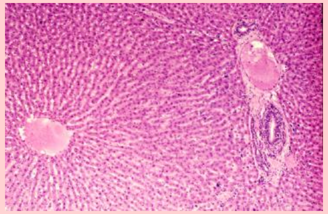
12-06 Hepatic lobule, general view 1. Pig, M-G stain, x 25.



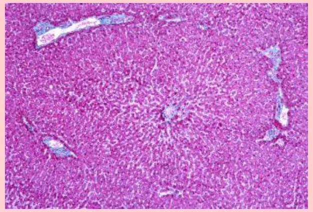
- This figure shows one hepatic lobule, distinctly enclosed by the interlobular connective tissue. At center opens a central vein. The hepatic sinusoids appear as fissures among the hepatic cell cords. The red stained small substances are erythrocytes in the sinusoids.

12-07 Hepatic lobule, general view 2. Rabbit, H-E stain, x 25.



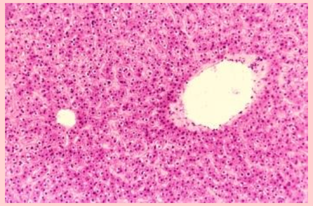
- At center left opens a central vein (CV), from which radiate the hepatic cell cords and hepatic sinuses. At the right edge is the portal area, containing an interlobular vein (IV) and interlobular bile ducts. The interlobular artery is not perceived in this figure.

12-08 Hepatic lobule, general view 3. Human, M-G stain, x 16.



- At center opens a central vein, around which the radial arrangement of the hepatic cell cords and sinusoids is evident. Interlobular connective tissues at the right, upper left and lower left indicate the boundary of this lobule.

12-09 V. centralis and V. sublobularis 1. Monkey, H-E stain, x 40.

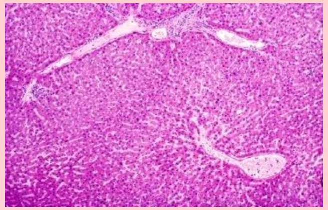


- In this figure, the central vein (Vc) and sublobular vein (Vs) are shown. Into the Vc opens the sinusoids whereas Vs has a connective tissue covering and no direct connection with sinusoids.

12-10 Sinusoids, central vein and sublobular vein. Human, H-E stain, x 

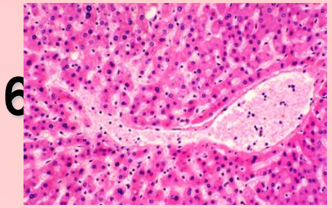
- At center traverses a central vein, opening at its right end into the sublobular vein. At the left end of this central vein open several sinusoids. The hepatic cell cords stains homogeneously deep red.

12-11 Hepatic lobule, general view 4. Human, H-E stain, x 25.



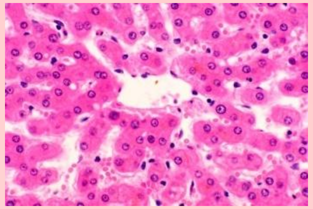
- At upper right and upper left the interlobular connective tissues limit the lobule. At lower right is a central vein opening into the sublobular vein.
- Higher magnification of this vein is shown in 12-12.

12-12 Sinusoids, V. centralis and V. sublobularis. Human, H-E stain, x 6



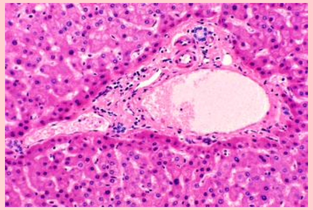
- At center a short central vein (Vc) traverses and opens into the sublobular vein (Vs) at the right end. Into this central vein flow several hepatic sinusouds at the left end. The networks of the hepatic cell cords are clearly recognized.

12-13 Sinusoids and V. centralis. Human H-E stain, x 130.



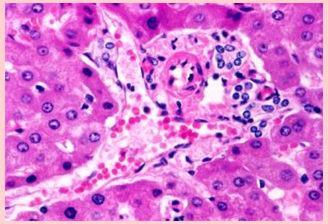
- At center is a transverse section of the central vein, into which opens a hepatic sinusoid (arrow). The relationship of the hepatic cell cords and hepatic sinusoids is clearly recognized. In the sinusoids erythrocytes are scattered.

12-14 Interlobular connective tissue (Glisson's sheath) 1. Human, H-E stain, x 66.



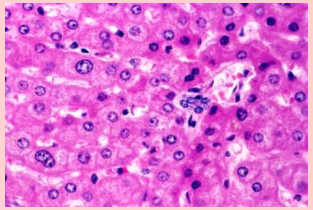
- In the middle of this figure is a triangular interlobular connective tissue, staining light pink, in which a large and slender interlobular veins (Vi1 and Vi2) are seen. Above Vi1 there are two interlobular arteries, appearing as deep red circles, and two lymphatics (arrows) are recognized. Right to the artery is an interlobular bile duct. The hepatic cells surrounding the interlobular connective tissue are smaller and deeper red stained than the other hepatic cells.

12-15 Interlobular connective tissue 2. Human, H-E stain, x 160.



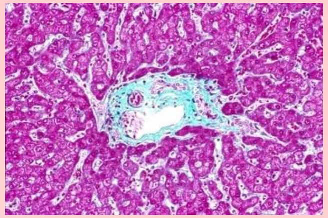
- Higher magnification of an interlobular connective tissue. In the middle an Y formed interlobular vein (Vi) is evident; right to this there are an interlobular artery (A), a lymphatic (L) and a thick (double arrows) and several thin (arrows) interlobular bile ducts. The thin ducts may be the canals of Hering. The hepatic cells surrounding this connective tissue are smaller and deeper red stained than the other hepatic cells.

12-16 Interlobular connective tissue 3. Human, H-E stain, x 160.



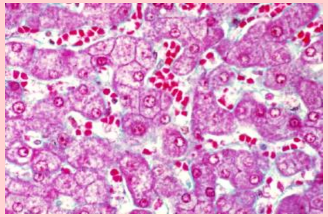
- This is to show the smallest interlobular connective tissue, containing only a small interlobular vein and a small interlobular bile duct. Among the hepatic cells there are cells of two nuclei and also cells of tetraploid nuclei (arrows).

12-17 Interlobular connective tissue4. Human, M-G stain, x 64.



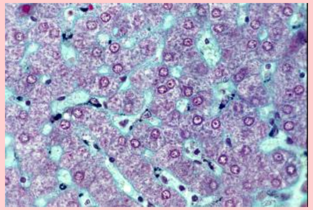
- As in this specimen collagen fibers stain green, the interlobular connective tissue and sinusoids, encircled by reticular fibers, are easily discerned. In the interlobular connective tissue an interlobular vein (Vi), an interlobular artery (arrow) and several interlobular bile ducts are seen.

12-18 Hepatic cell cords and sinusoids 1. Human, M-G stain, x 160.



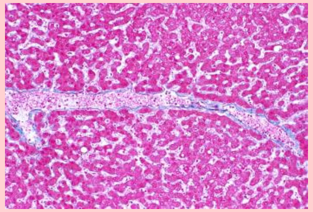
- In this specimen hepatic cells stain red, reticular fibers encircling the sinusoids, green and erythrocytes in the sinusoids, deep reddish orange. The relationship of hepatic cell cord and the sinusoids is very clear. The cell boundary of the hepatic cells is indicated by the bile canaliculi.

12-19 Hepatic cell cords and sinusoids 2. Pig, M-G stain, x 160.



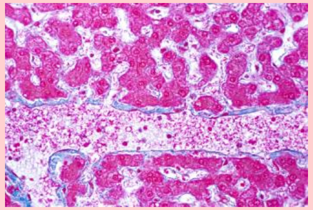
- As this specimen was freshly fixed, the space of Disse is not widened. The reticular fibers encircling the sinusoids attach to the hepatic cell cords.

12-20 V. centralis, longitudinal section 1. Human, M-G stain, x 40.



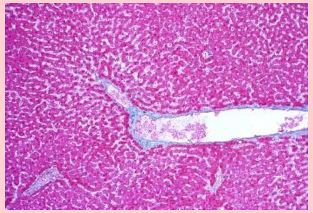
- In the middle one central vein traverses throughout the field. Into this vein flow numerous sinusoids from upper and lower sides.

12-21 V. centralis, longitudinal section 1. Human, M-G stain, x 100.



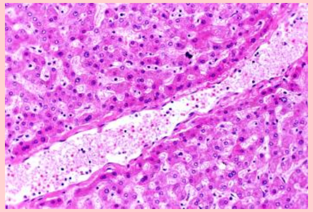
- Higher magnification of 12-20. Confluences of sinusoids into the central vein (arrows) are clearly recognized.

12-22 V. centralis and V. sublobularis, longitudinal section. Human, M-G stain, x 25.



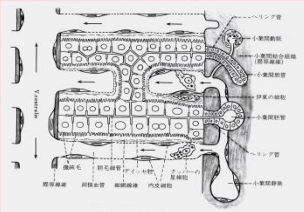
- At middle right a sublobular vein traverses rightward, whose wall consists of collagenous fibers without any discontinuation. Into its left end flows a central vein lower right wards. Around these the network of the hepatic cell cords and sinusoids are clearly recognized.

12-23 V. sublobularis, longitudinal section. Human, H-E stain, x 64.



- This is a longitudinally sectioned sublobular vein (Vs), whose lumen is bordered by endothelium und underlying collagenous fibers. No sinusoid flows directly into the sublobular vein.

12-24 Hepatic cell cords, bile canaliculi and sinusoids. (Original scheme



- This is to show the fine structures of the hepatic cell cords and sinusoids, based on the electron microscopic finding
- Hepatic cells constitute the two-cell-thick cell cords. A bile canaliculus is a minute channel, 0.5 ～1.5 μm in diameter, located midway along the interface between adjoining hepatic cells. This starts at the central portion of the hepatic lobule and runs to its periphery where it drains into the interlobular bile duct, via a thin short ductile, called canal of Hering. As the hepatic cell cords form three-dimensional networks, this canaliculus also forms a network within the plates of hepatic cells. Owing to the branching and anastomosis of the cell plates the network of the canaliculus is continuous throughout the lobule.
- The basal surface of the hepatic cells facing the sinusoids is provided with numerous microvilli. The hepatic sinusoids are wider than capillaries and their walls conform to the surface of the plates of hepatic cells on either side but are separated from them by a narrow space, called space of Disse. The endothelium of the sinusoids is extremely thin and perforated by innumerable minute pores of variable size and underlay with reticular fibers.
- The blood coming into the sinusoids from interlobular veins and from interlobular arteries flows centripetal and drains into the central vein and during the flow the exchange of substances between blood and hepatic cells takes place.
- Within the sinusoids there are Kupffer cells, which show the active phagocytosis. They are situated on the surface of the endothelial cells but without desmosomes or other specializations for cell-to-cell attachment. One more type of cells is found in the perisinusoidal space, i.e. space of Disse. These cells show no phagocytosis but store lipid droplets in the cytoplasm. They are called fat-storing cells of vitamin A-storing cells.

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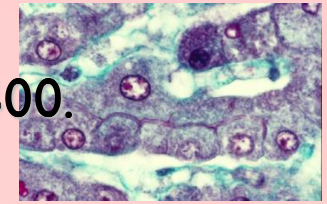
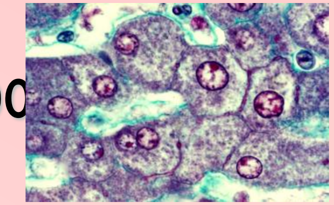
12-25 Hepatic cell cords and bile canaliculus 1. Human, M-G stain, x 400.



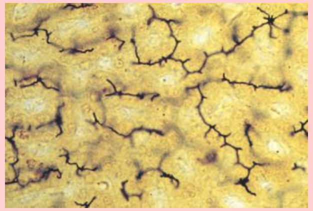
- In the middle traverses one hepatic cell cord and at its axial portion the minute canaliculus runs longiludinally (arrow). In this specimen the space of Disse is widened as post mortem artifact (double arrows).

12-26 Hepatic cell cords and bile canaliculi 2. Human, M-G stain, x 400



- In this figure hepatic cell cords form a network. Transverse sections of bile canaliculi are evidently recognizable (white arrows).

12-27 Bile canaliculi. Human, Golgi's silver impregnation, x 160.



- In this soecimen bile canaliculi are visualized by Golgi's silver impregnation. The zig-zag course of the bile canaliculi and their branchings and anastomosis are evident.

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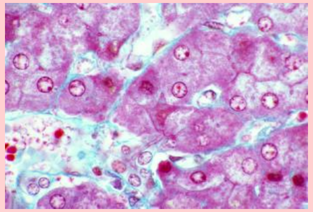
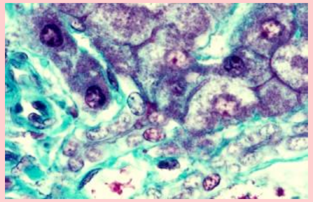
12-28 Bile canaliculi and canal of Hering 1. Human, M-G stain, x 330.



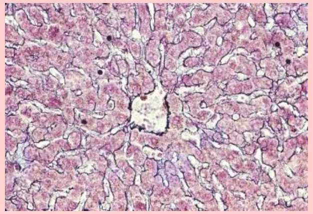
- At lower left portion of this figure there is the interlobular connective tissue. In the hepatic cell cords surrounding this bile canaliculi, appeared longitudinally and transversely, are evidently recognized. At lower center a canal of Hering (arrow) attaches to the hepatic cell cord where the lumen of the canal continues with bile canaliculus. At lower left corner one more canal of Hering is seen.

12-29 Bile canaliculi and canal of Hering 2. Human, M-G stain, x 400.



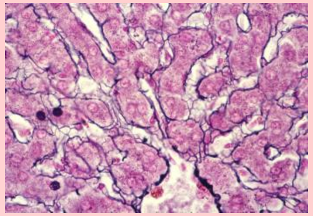
- At center the lumen of the canal of Hering (arrow) continues with a bile canaliculus of the hepatic cell cord. At lower right corner a longitudinally sectioned canal of Hering is seen.

12-30 V. centralis and sinusouds 1. Monkey, silver impregnation and Kernechtrot stain, x 64.



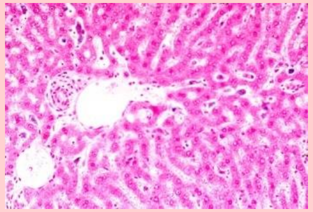
- In this specimen reticular fibers are visualized by Suzuki's silver impregnation method and thereafter counter-stained with Kernechtrot. As the reticular fibers underlie the endothelium of sinusoids, the relationship between hepatic cell cords and sinusoids is clearly understood. The radial arrangement of hepatic cell cords and sinusoids around the central vein is evident.

12-31 V. centralis and sinusouds 2. Monkey, silver impregnation and Kernechtrot stain, x 160.



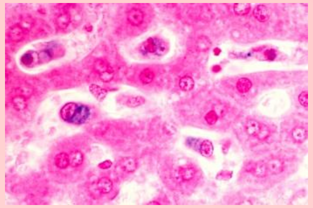
- Higher magnification of 12-30. At lower center is the central vein, into which four sinusoids open. As this monkey was freshly fixed, the space of Disse is not recognized.

12-32 Kupffer cells 1. Rabbit, vital stain with tripan blue and counter-stained with Kernechtrot, x 64.



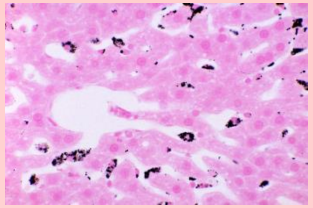
- When an animal is infused suspension of tripan blue into the vein, cells of phagocytotic function incorporate the tripan blue and thereby they are visualized. This method is called “vital stain”. In the liver the Kupffer cells are visualized by this method. In upper left, lower left and middle right areas of this figure large cells containing the substances of dark blue color are seen in the sinusoids; they are the Kupffer cells.

12-33 Kupffer cells 2. Rabbit, vital stain with tripan blue and counter-stained with Kernechtrot, x 250.



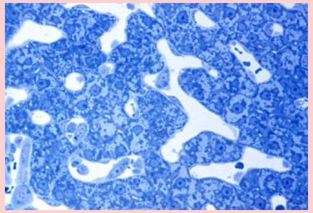
- Higher magnification of 12-32. The large cells containing the substances of dark blue color in the sinusoids are the Kupffer cells.

12-34 Kupffer cells 3. Rabbit, vital stain with India ink and counter-stain with carmine, x 130.



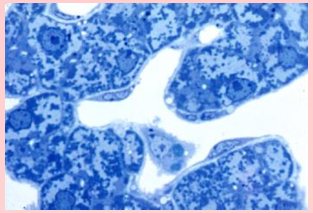
- In this specimen vital stain was performed with India ink. The Kupffer cells incorporate particles of India ink and more conspicuous than in 12-32 and 12-33.

12-35 Hepatic cell cords and sinusoids 3. Rat, epon section, toluidin blue stain, x 160.



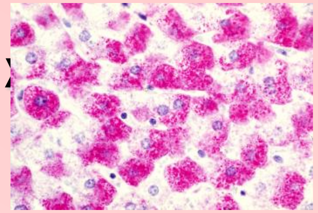
- Because of thinness of the section, about 0.5 μm thick, relation between hepatic cell cords and sinusoids is clear.

12-36 Hepatic cell cords and sinusoids 4. Rat, epon section, toluidin blue stain, x 400.



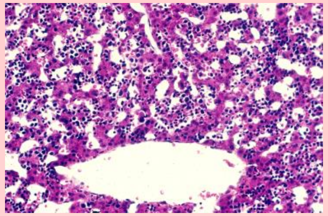
- Higher magnification of 12-35. In this figure bile canaliculi are indicated with white arrows. The endothelium is extremely thin and the narrow space of Disse is clearly recognized (black arrow). In the sinusoid there is a Kupffer cell containing phagosomes (double arrows).

12-37 Glycogen granules in hepatic cells. Rabbit, Best's carmine stain, x 160.



- Hepatic cells densely contain the glycogen granules but in usual specimens they are dissolved and disappeared. This specimen was fixed with 100% alcohol so that they are well preserved and deep red stained.

12-38 Liver of 6-month human embryo 1. H-E stain, x 64.



- In embryo the liver is a hemopoietic organ rather than an alimentary organ. The space between the hepatic cells and sinusoids, later space of Disse, is filled by mesenchymal cells, which proliferate actively and produce all kinds of blood cells.
- This figure shows a part of the hemopoietic liver. At lower middle is the central vein, from which hepatic cell cords, deep red stained, and sinusoids radiate. The hepatic cell cords are relatively slender whereas the sinusoids are wide. Around the hepatic cell cords crowd small round nuclei, darkly blue stained, they are the hemopoietic cells.

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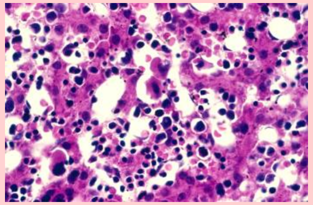
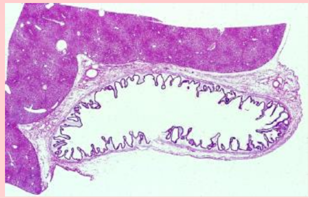
12-39 Liver of 6-month human embryo 2. H-E stain, x 160.



- Higher magnification of 12-38. Around the hepatic cell cords, stained deep red, crowd the hemopoietic cells of variable sizes and stainabilities. Mainly they are in the space of Disse, but some are in the sinuoids. The erythrocytes generate here also.

12-40 Gallbladder, transverse section. Monkey, H-E stain, x 2.2.



- The gallbladder is a pear-shaped, hollow sack closely attached to the posterior surface of the liver. It consists of a blindly ending fundus, a body, and a neck, which continues into the cystic duct. It measures normally approximately 10 by 4 cm in adult man. The upper surface attaches to the liver with connective tissue whereas the lower surface faces to the abdominal cavity and covered by peritoneum.
- The wall consists of a mucous layer consisting of a surface epithelium and a lamina propria, a layer of smooth muscles and a perimuscular connective tissue. The mucous layer is thrown into frequent folds.
- As this animal was treated by perfusion fixation, structures of the gallbladder is well preserved. Numerous folds of the mucous membrane thrown into the cavity are evident.

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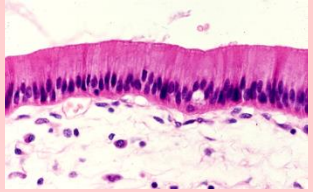
12-41 Epithelium of gallbladder. Monkey, H-E stain, x 40.

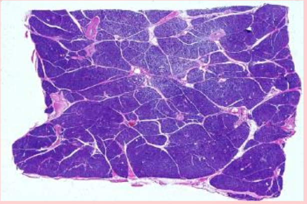


- The epithelium consists of a single layer of tall columnar cells, with oval nuclei located toward the base of the cells, which are underlain by a distinct basement membrane. The lamina propria consists of a very loose connective tissue.

12-002 Pancreas

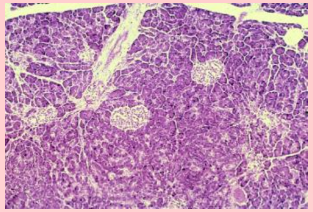
- The pancreas consists of an exocrine gland and an endocrine gland; the former elaborates about 1200 ml of digestive juice containing all kinds of digestive enzymes, and the latter secretes hormones which control the carbohydrate metabolism of the body.
- The pancreas is a compound acinous gland whose lobule are bound together by loose connective tissue, through which run blood vessels, nerves, lymphatics, and excretory ducts. The pancreatic acini consists of a single row of pyramidal epithelial cells conversing toward a central lumen and resting upon a basal lamina supported by delicate reticular fibers. The acinar cells show striking differences in the various stages of secretion. In usual sections stained with H-E stain, the basal parts of the acinar cells stain dark blue-violet, while the secretory granules, zymogen granules, in the apical part of the cells appear bright orange-red. After releasing the secretory granules, after taking meal, secretory granules disappear and area staining dark violet widens to the apical part of the cells and nuclei locate more centrally.
- The duct system of the pancreas consists of the intercalated ducts and the simple ducts. The lumen of each acinus is continuous with the lumen of small duct bounded by the centroacinar cells. They are easily distinguished by their pale staining in histological sections. Proximally they drain into the thin duct, called intercalated duct, consisting of simple cboidal or flat cuboidal epitheliar cells with pale blue staining cytoplasm. They are turned into the interlobular duct consisting of simple cuboidal epithelial cells. They repeatedly join one another and become thicker and finally as the ductus pancreaticus confluents with the ductus hepaticus forming the ductus choledocus and drains into the duodenum.

12-42 Pancreas, general view 1. Human, H-E stain, x 2.2.



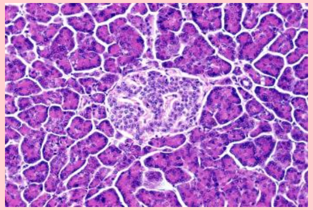
- This is to show the general structural features of the pancreas. The pancreas is as a whole enveloped by a thin layer of loose connective tissue which enters into the organ dividing the parenchyma numerous lobes and lobules. These connective tissues are called interlobar and interlobular connective tissue, through which run blood vessels, nerves, lymphtics and excretory ducts. The pancreatic parenchyma stains dark blue-violet uniformly and at such low power magnification the endocrine units are not perceivable.

12-43 Pancreas, general view 2. Human, H-E stain, x 25.



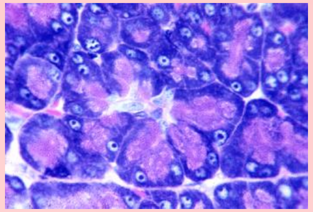
- At this magnification the endocrine units, pancreatic islets, are recognized. Among the exocrine acini three islets are scattered.

12-44 Pancreatic islet and exocrine acini. Human, H-E stain, x64.



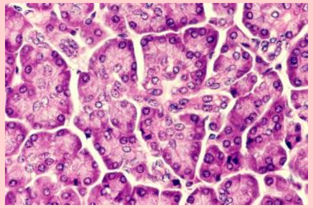
- At center locates one pancreatic islet, surrounded by a number of exocrine acini. The epithelial cells of the islets small polyhedral in shape and constitute cell cords branching and anastomosing one another to form three dimensional networks. Their cytoplasm stains usually faint pink. The exocrine acini surrounding the islet show typical features of staining. In this specimen acini contain a lot of zymogen granules.

12-45 Pancreatic acini and zymogen granules. Rat, toluidine blue and eosin stain, x 225.



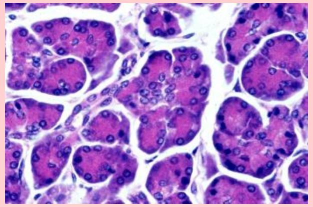
- Stained with basic dye, toluidine blue the basal cytoplasm of the acinar cells stains intensely, owing to the presence of high concentrations of ribonucleoprotein in this part of the cell. The nuclei locate near the basement membrane and supranuclear cytoplasm is densely filled by the coarse secretory granules stained deep red. At center in the middle of several acini there are several long elliptic nuclei stained faint blue; they are called centroacinar cells.

12-46 Acini and intercalated duct 1 . Human, H-E stain, x 160.



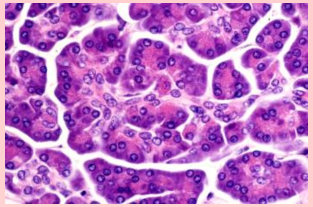
- In this specimen zymogen granules are all released so that the structures of acini are well observed. At center two large acini are penetrated by one intercalated duct, which is thin duct consisting of simple low cuboidal or flat epithelial cells with faintly staining cytoplasm. In the middle of figure an intercalated duct enters the acinus and opens into the acinar lumen, then goes further leftward and penetrates the second acinus. The epithelial cells of intercalated duct are turned into the centroacinar cells enclosing the lumen. The basal portion of each acinar cell stains deep violet and contains a round nucleus, whereas the supranuclear portion stains faint violet and cell boundary is distinct because of the absence of the zymogen granules. At upper right corner a trans- verse section of the intercalated duct is seen (arrow).

12-47 Acini and intercalated duct 2. Human, H-E stain, x 160.



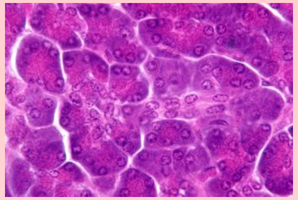
- In this specimen the supranuclear portion of the acinar cells is densely filled by zymogen granules staining deep red. At center is one large acinus with centroacinar cells. To its left side attaches one thin intercalated duct consisting of flat cuboidal epithelial cells.

12-48 Acini and intercalated duct 3 . Human, H-E stain, x 160.



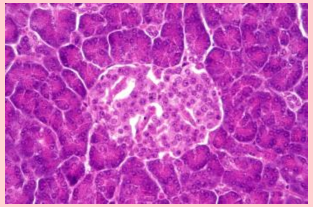
- An intercalated duct traverses from right to left and enters the large complex of acini, locating at center. During the penetrating epitheliar cells are turned into the centro- acinar cells and at its left end it divides into two and ends as the centroacinar cells at the acinar lumen. As this specimen is about 5 μm thick such microscopic features are well recognized. Compare with 12-49.

12-49 Acini and intercalated duct 4 . Human, H-E stain, x 225.



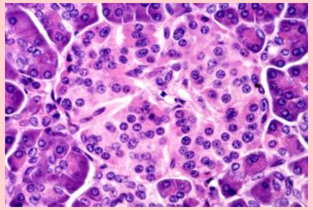
- One intercalated duct runs transversely from right to left and end in one acinus as centroacinar cells. As this specimen is about 30 μm thick, microscopic features are not so well observed as in 12-48. But the intensely basophilic basal cytoplasm and zymogen granules filling the supranuclear cytoplasm and staining deep red are conspicuous.

12-50 Pancreatic islet 1. Human, H-E stain, x 100.



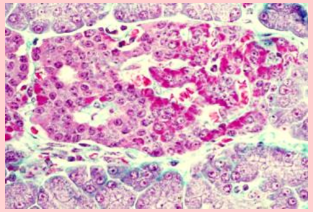
- The pancreatic islets, also called islets of Langterhans, contain three principal types of cells, each secreting a different hormone: α-cells (A-cells) secreting glucagons; β-cells (B-cells) secreting insulin; and δ-cells (D-cells) secreting somatostatin. These cannot be distinguished in routine H-E stained preparations. Methods have been devised for selectively staining these cell types. The α-cells contain acidophilic granules; the β-cells, basophilic granules; and D-cells, granules demonstrated by Hellman's silver impregnation method. Because the granules in the β-cells are glyco- protein and watersoluble, their preservation is not easy using the routine fixatives. Specimens from 12-53 to12-61 were fixed with Bouin's fluid, which is effective for the fixation of glycoprotein.
- In this figure an islet is shown at center. The islet cells are arranged in irregular cords forming a network, intermingled with capillary network, and are stained paler than surrounding acinar tissue. No secretion granules can be seen within them in this routine H-E preparations. The islets are more or less completely demarcated from the surrounding acinar tissue by a thin layer of reticular fibers.

12-51 Pancreatic islet 2. Human, H-E stain, x 160.



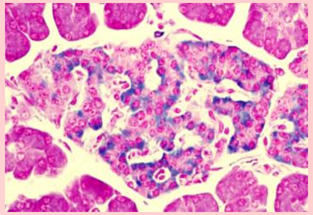
- This specimen was freshly taken and fixed with Bouin' fluid, so that the microscopic features are well preserved; however the identification of the islet cells is not possible.

12-52 Pancreatic islet 3. Human, M-G stain, x 160.



- In this section α-cells stain selectively red and connective tissue fibers appear green.

12-53 Pancreatic islet 4. Human, Victoria blue and Kernechtrot stain, x 160.



- In this specimen β-cells are selectively dark blue stained.

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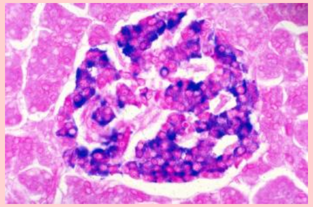
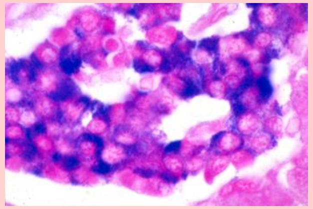
12-54 Pancreatic islet 5. Human, Victoria blue and phloxin stain, x 130.



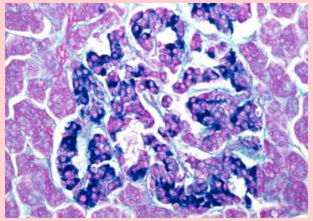
- In this specimen β-cells are stained selectively dark blue with Victoria blue and α-cells, red with phloxin. Two arrows indicate the colorless cells; they are D-cells.

12-55 Pancreatic islet 6. Human, Victoria blue and phloxin stain, x 330.



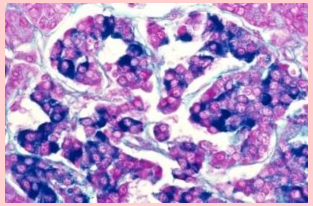
- Higher magnification of 12-54. Arrows indicate three cells with color less cytoplasm, that are D-cells. As in the previous specimen, α-cells stain red with phloxin and β-cells, dark blue with Victoria blue.

12-56 Pancreatic islet 7. Human, Victoria blue, phloxin and light green stain, x 100.



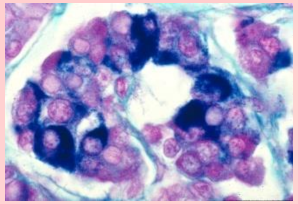
- This section was stained first with Victoria blue and phloxin and thereafter with light green to visualize the connective tissue fibers. Higher magnification of the small portion at top center is shown in 12-57 and 12-58.

12-57 Pancreatic islet 8. Human, Victoria blue, phloxin and light green stain, x 160.



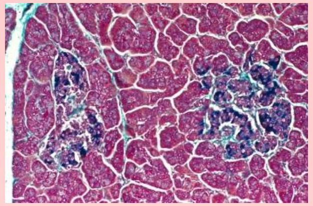
- At this magnification, α-cells and β-cells are well distinguished. An arrow indicates a cell with colorless cytoplasm.

12-58 Pancreatic islet 9. Human, Victoria blue, phloxin and light green stain, x 250.



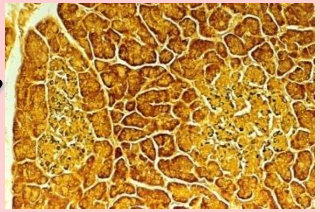
- Higher magnification of 12-57. An arrow indicates a cell with colorless cytoplasm. The identification between the α-cells and the β-cells is clear.

12-59 Pancreatic islet 10. Human, Victoria blue, phloxin and light green stain, x 64.



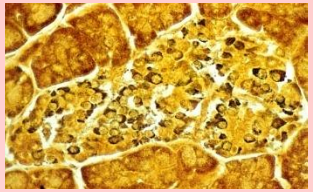
- In this section two islets of Langerhans are shown. The neighboring section with this was treated with Hellman's silver impregnation method, which visualizes the D-cells selectively. Compare these two sections.

12-60 Pancreatic islet 11. Human, Hellman's silver impregnation method, 64.



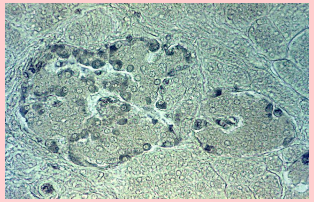
- In this specimen D-cells are all blackened. The distribution of the D-cells in each islet varies largely. Higher magnification of the left islet is shown in 12-62.

12-61 Pancreatic islet 12. Human, Hellman's silver impregnation method, x 160.



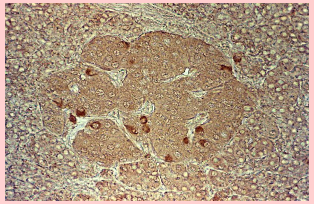
- Higher magnification of 12-60. The cytoplasm of the D-cells are filled with coarse granules, blackened by this method. Distribution of D-cells is quite random.

12-62 Pancreatic islet 13. Human embryo, antiglucagon reaction. x 160.



- In this preparation α-cell are demonstrated by antiglucagon reaction after Nakane. This specimen was made by Dr. S. Fujii.

12-63 Pancreatic islet 14. Human embryo, antisomatostatin reaction, x 160.



- In this specimen D-cells are demonstrated by antisomstostatin reaction after Nakane. This specimen was made by Dr. S. Fujii.