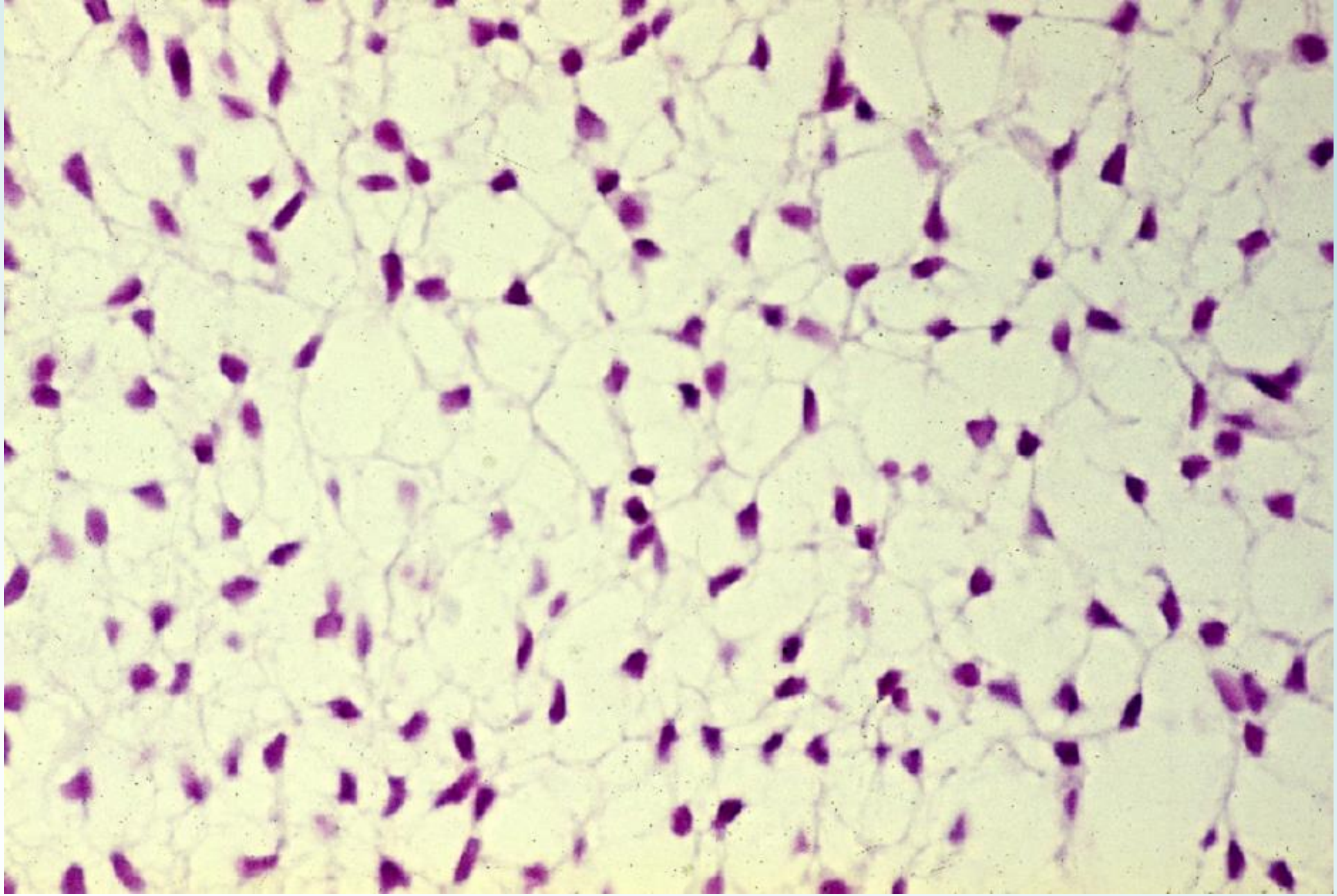
03-00
Supporting Tissue

03 Supporting Tissue
Menu 1/2

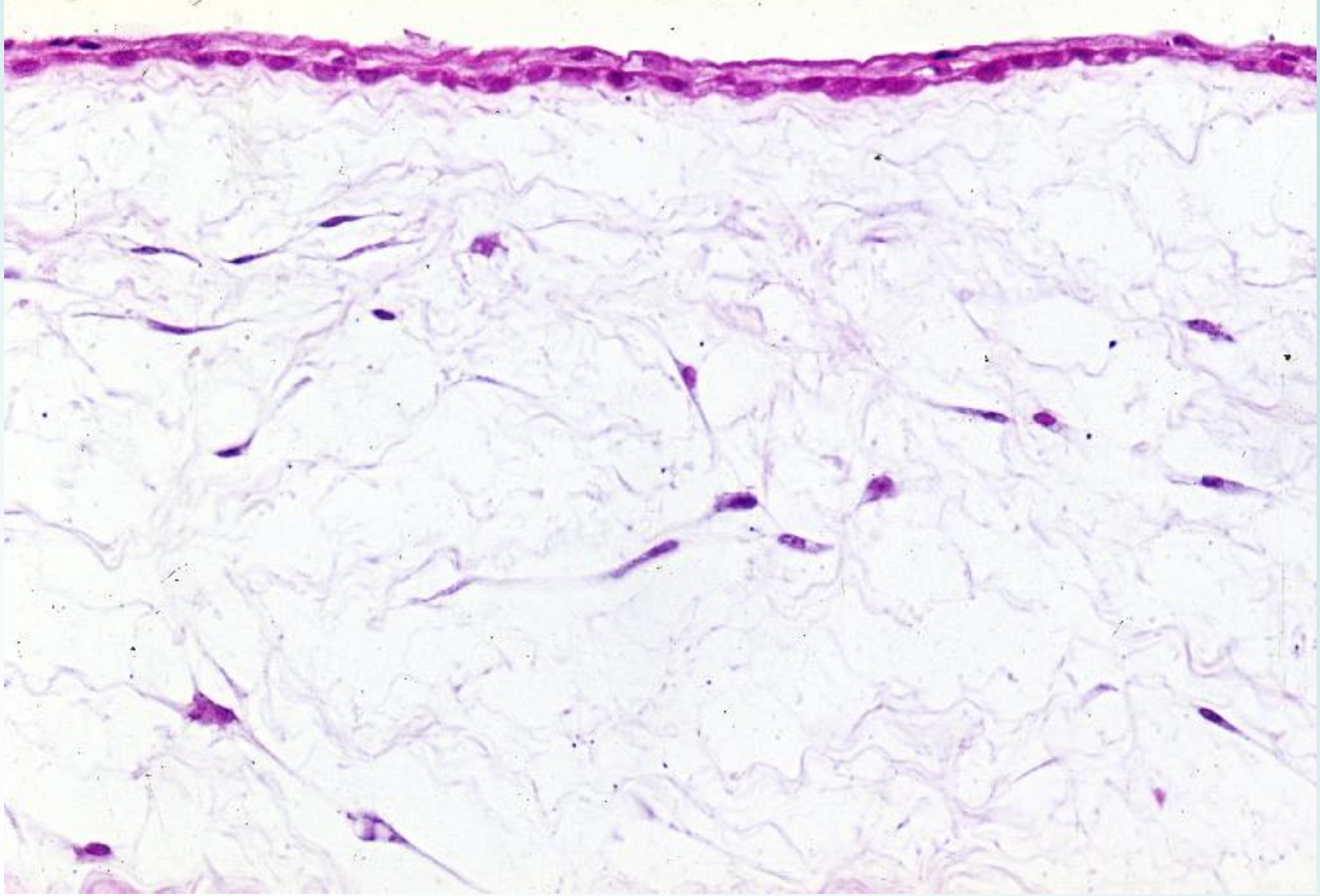
03 Supporting Tissue
Menu 2/2

03-34. Fibrocartilage 2. Meniscus of knee joint, monkey, H-E stain, x 160.
03-35. Fibrocartilage 3. Symphysis pubis, monkey H-E stain, x 160.
03-36. Fibrocartilage 4. Intervertebral disc, human, H-E stain, x 2.0.
03-37. Fibrocartilage 5. Intervertebral disc, human, H-E stain, x 64.
03-38. Fibrocartilage 6. Intervertebral disc, human, H-E stain, x 160.
03-39. Fibrocartilage 7. Intervertebral disc, human, H-E stain, x 64.
03-003. Bone
03-40. Transverse section of femur 1. Monkey, decalcified and H-E stain, x 4.0.
03-41. Transvers section of femur 2. Monkey, decalcified, H-E stain, x 64.
03-42. Haversian systems 1. Monkey femur, decalcified, Schmorl' stain, x 64.
03-43. Haversian system 2. Monkey femur, decalcified, Schmorl' stain, x 160.
03-44. Herversian systems 3. Human, ground section, not stained, x 64.
03-45. Haversian system 4. Human, ground section, not stained, x 64.
03-004. Blood
03-46. Small lymphocyte 1. Human, Giemsa stain, x 640.
03-47. Small lymphocyte 2. Human, Giemsa stain, x 640.
03-48. Large lymphocyte 1. Human, Giemsa stain, x 640.
03-49. Large lymphocyte 2. Human, Giemsa stain, x 640.
03-50. Monocyte 1. Human, Giemsa stain, x 640.
03-51. Monocyte 2. Human, Giemsa stain, x 640.
03-52. Eosinophilic leucocyte 1. Human, Giemsa stain, x 640.
03-53. Eosinophilic leucocyte 2. Human, Giemsa stain, x 640.
03-54. Bosophilic leukocyte 1. Human, Giemsa stain, x 640.
03-55. Bosophilic leukocyte 2. Human, Giemsa stain, x 640.
03-56. Neutrophilic leukocyte 1. Rod-shape nucleus. Human, Giemsa stain, x 640.
03-57. Neutrophilic leukocyte 2. 2-segmented nucleus. Human, Giemsa stain, x 640.
03-58. Neutrophilic leukocyte 3. 3-segmented nucleus. Human, Giemsa stain, x 640.
03-59. Neutrophilic leukocyte 4. 4-segmented nucleus. Human, Giemsa stain, x 640.
03-60. Neutrophilic leukocyte 5. Human female, Giemsa stain, x 640.
03-61. Blood platelets 1. Human, Giemsa stain, x 640.
03-62. Blood platelets 2. Human, Giemsa stain, x 640.
03-005. Bone marrow
03-63. Bone marrow in the femur. Monkey, H-E stain, x 4.0.
03-64. The red bone marrow 1. Monkey, H-E stain, x 25.
03-65. The red bone marrow 2. Monkey, H-E stain, x 64.
03-66. Hemopoietic center 1. Monkey, H-E stain, x 160.
03-67. Hemopoietic center 2. Monkey, H-E stain, x 250.

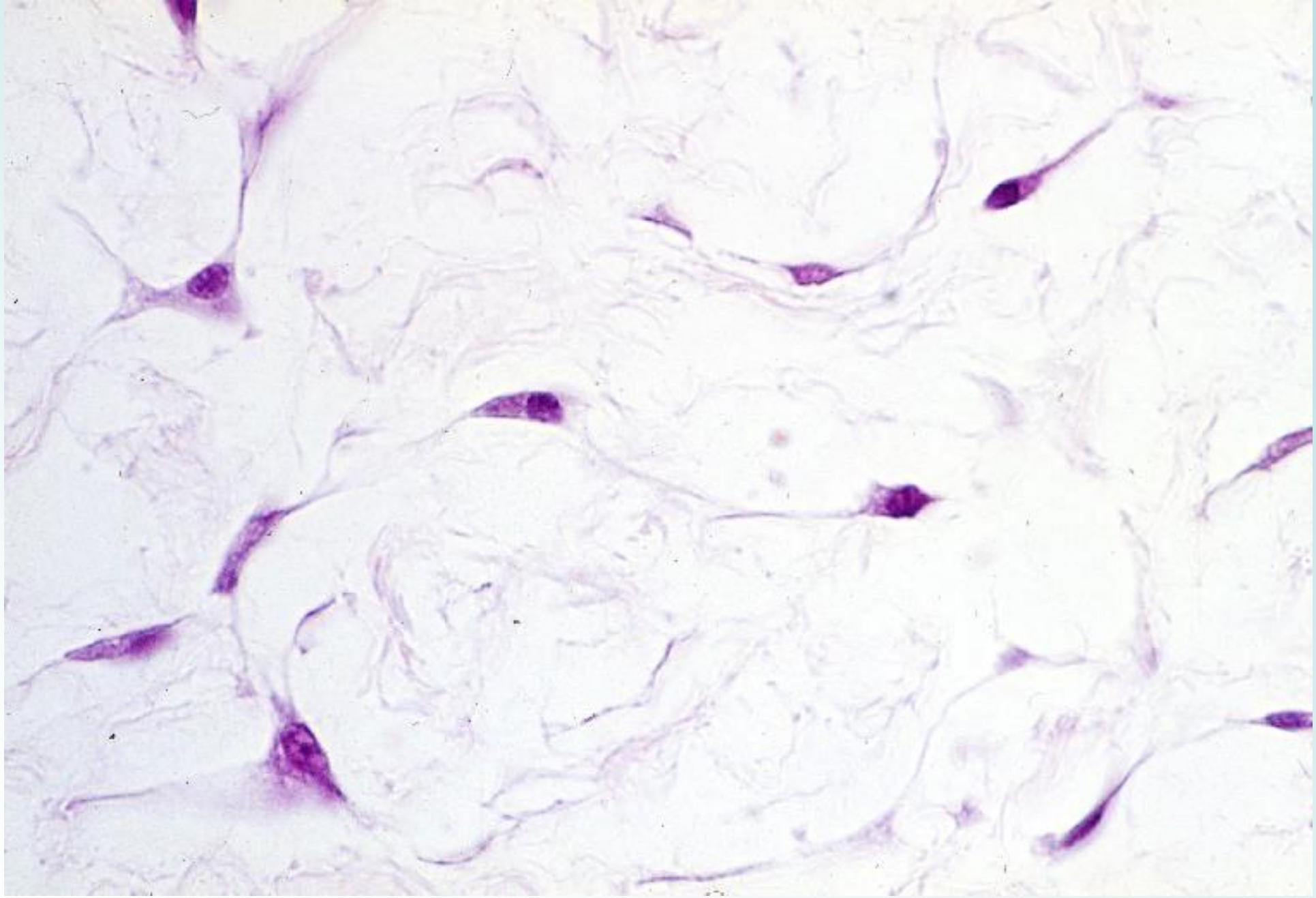
03-001
Connective tissue



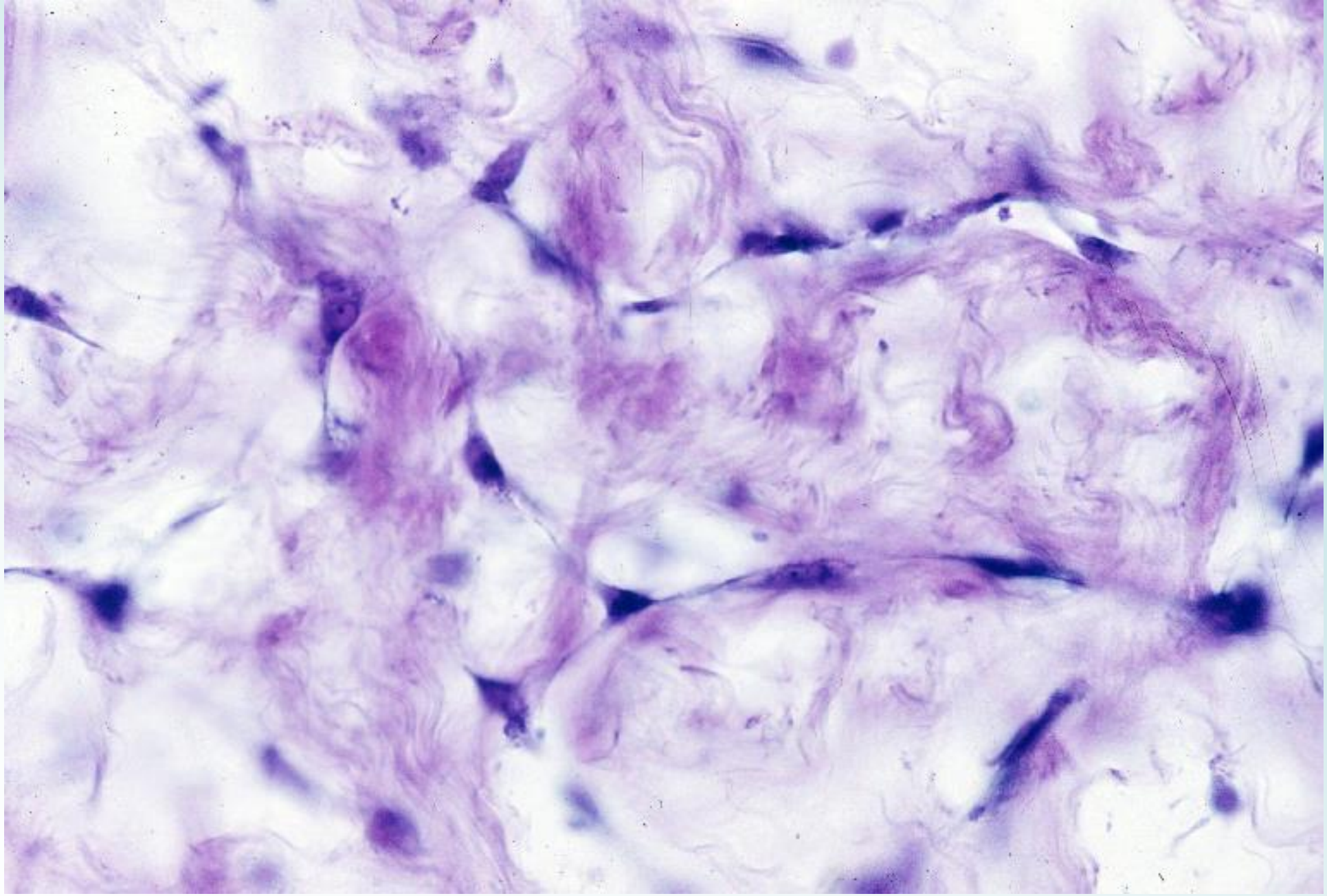
03-01 Mesenchyme. Human embryo, H-E stain, x 160.



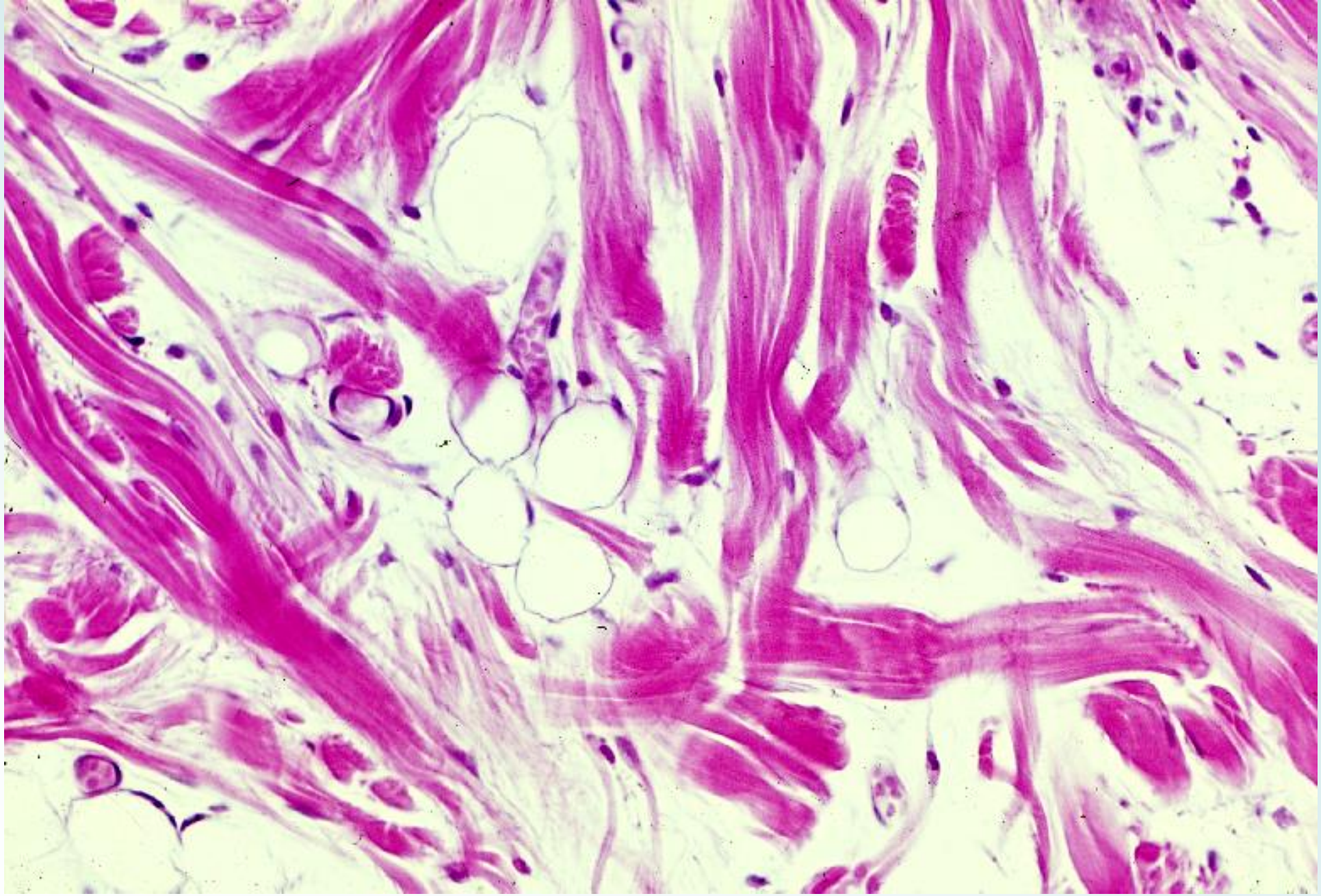
03-02 Wharton' jelly 1. Human umbilical cord, H-E stain, x 80.



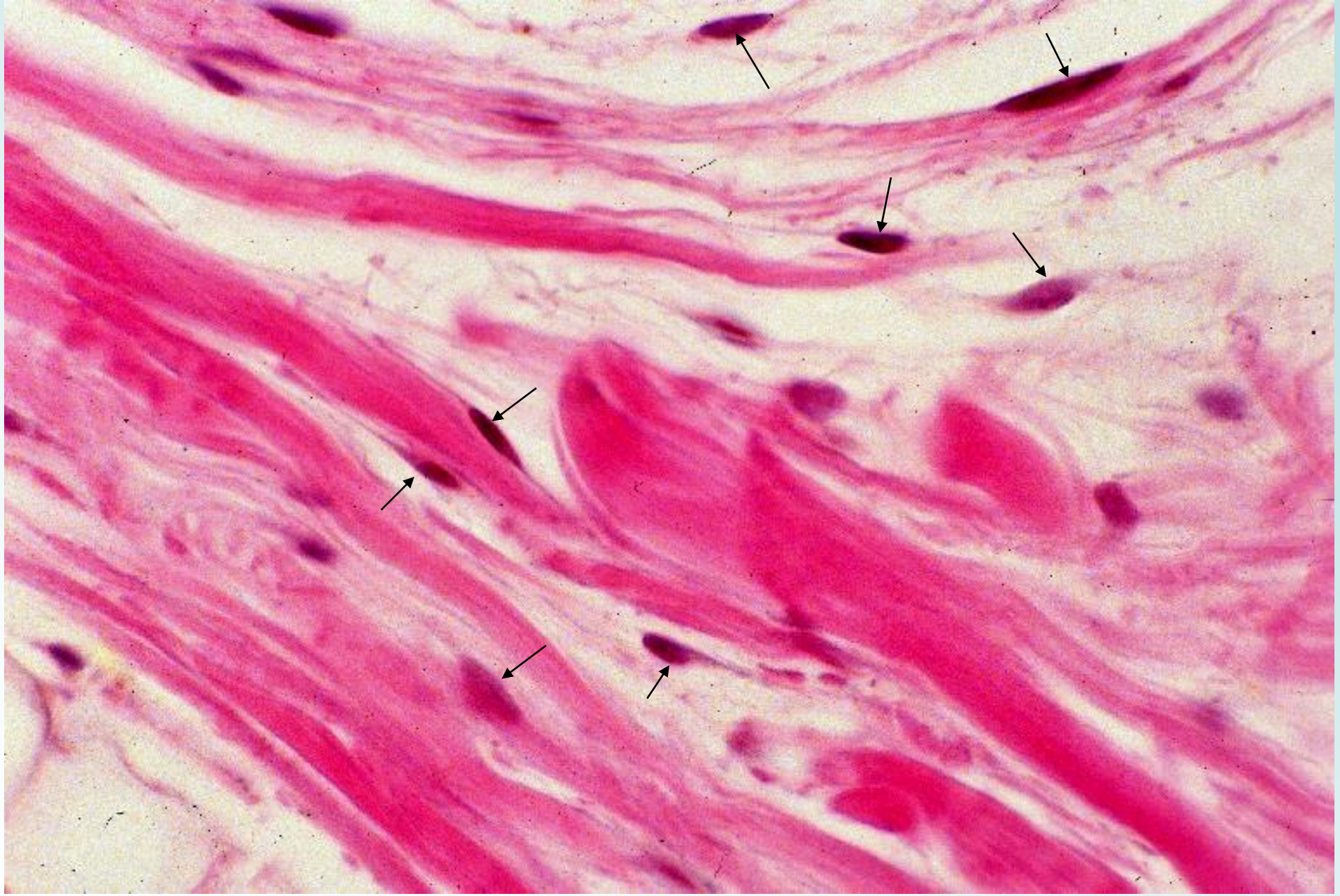
03-03 Wharton' jelly 2. Human umbilical cord, H-E stain, x 160.



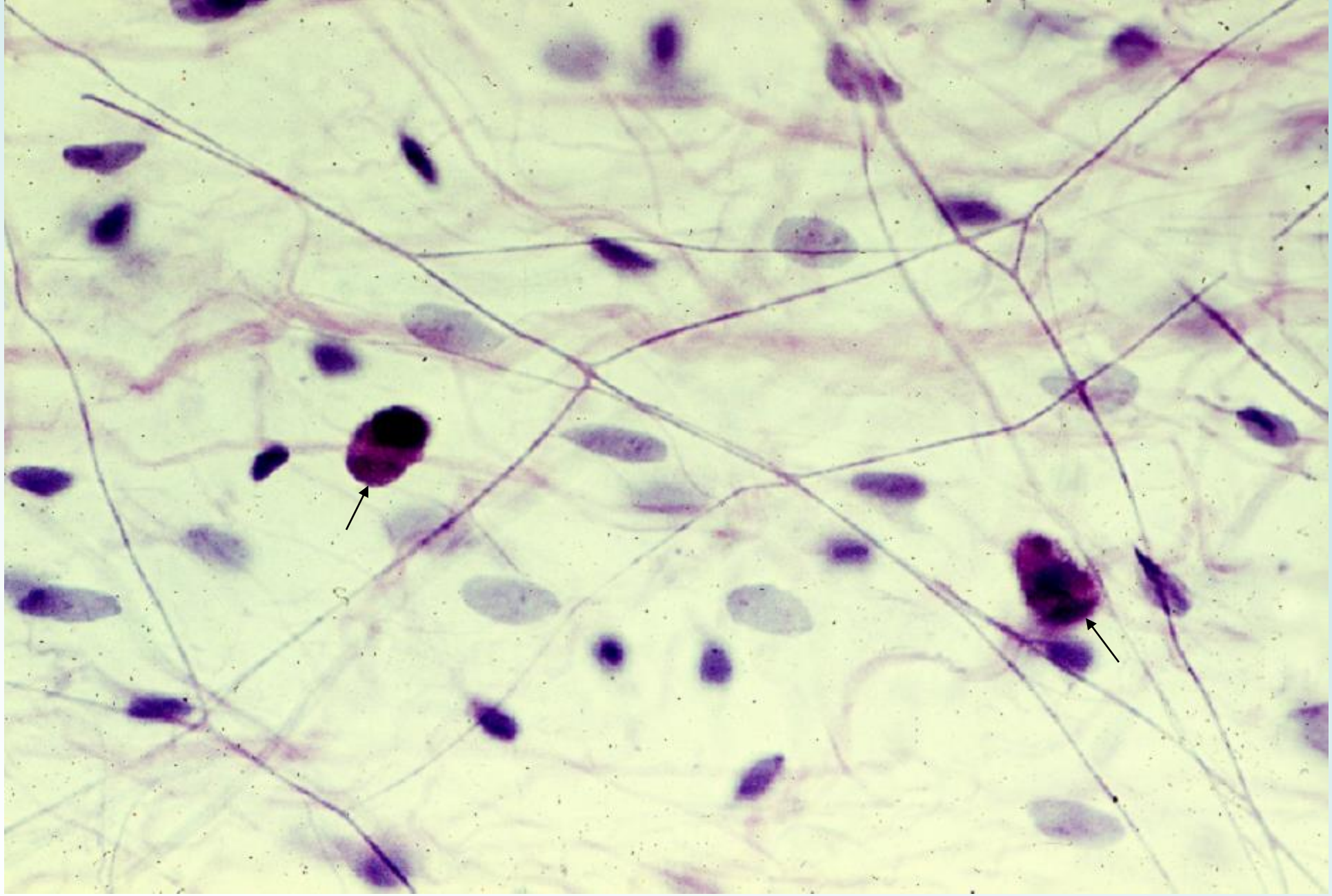
03-04 Wharton' jelly 3. Human umbilical cord, tolouidinblue stain, x 80.



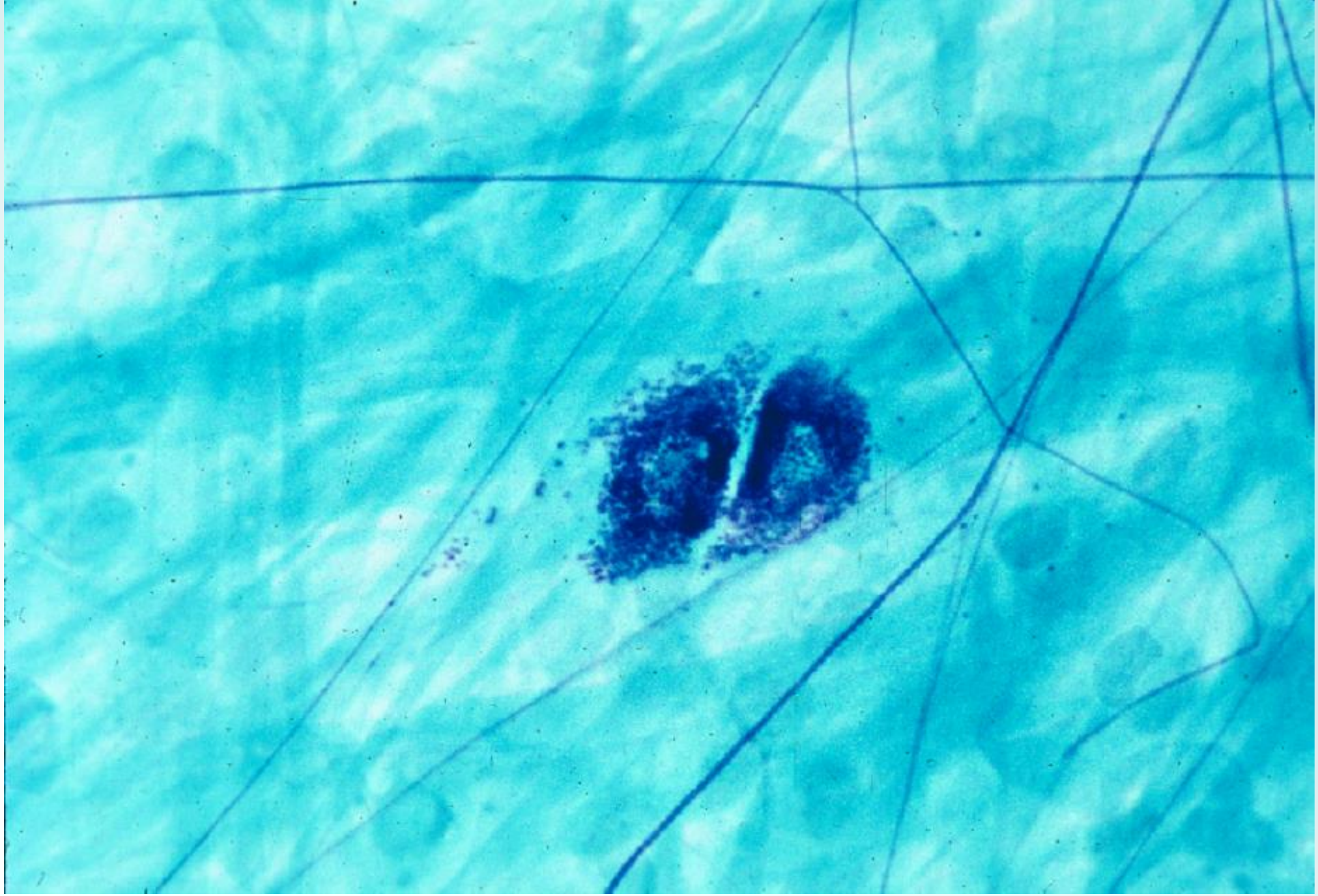
03-05 Loose connective tissue. Human scalp, H-E stain, x 160.



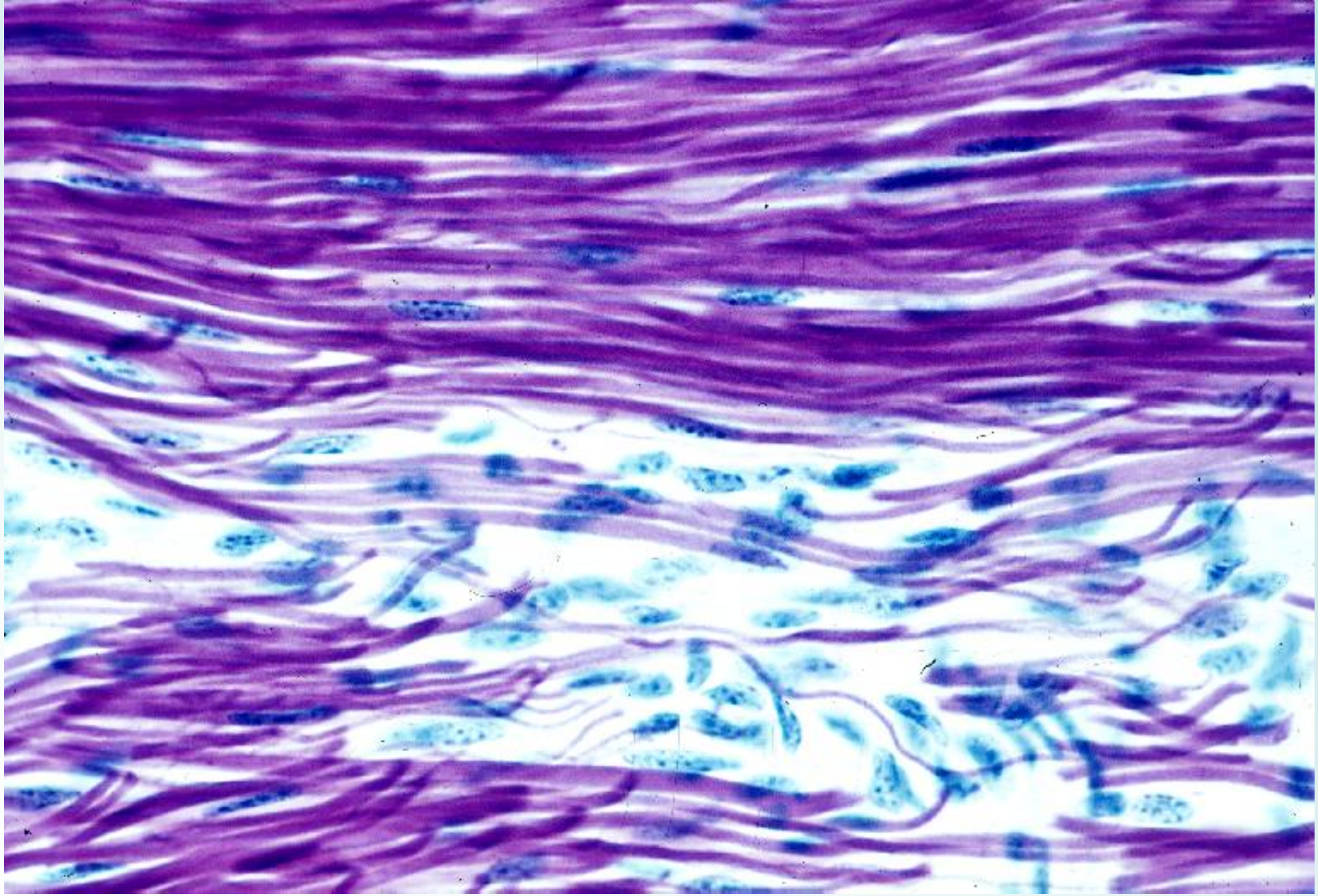
03-06 Fibroblasts. Human subcutaneous tissue, H-E stain, x 250.



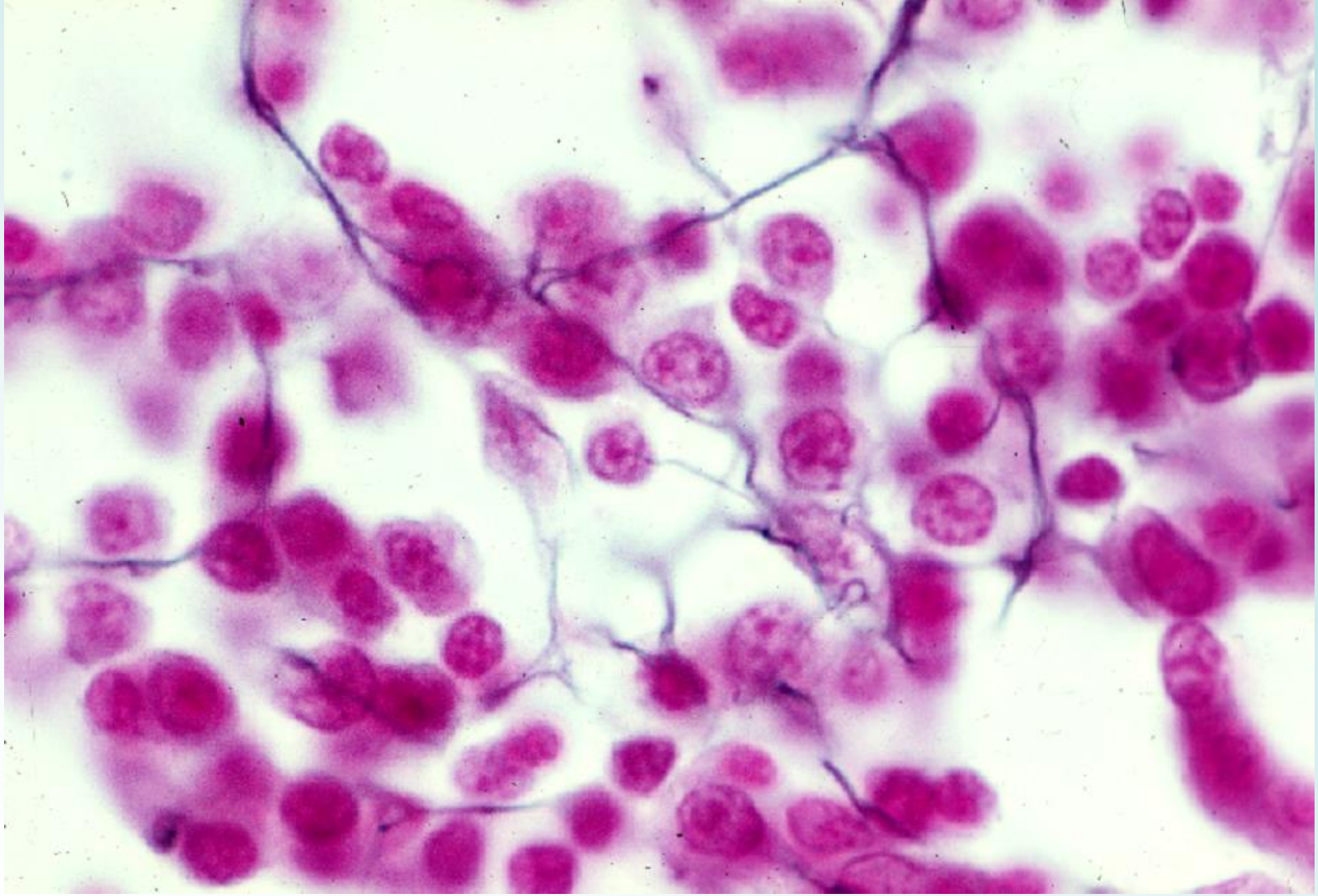
03-07 Collagenous and elastic fibers. Cat mesenterium, orcein and H-E stain, x 160.



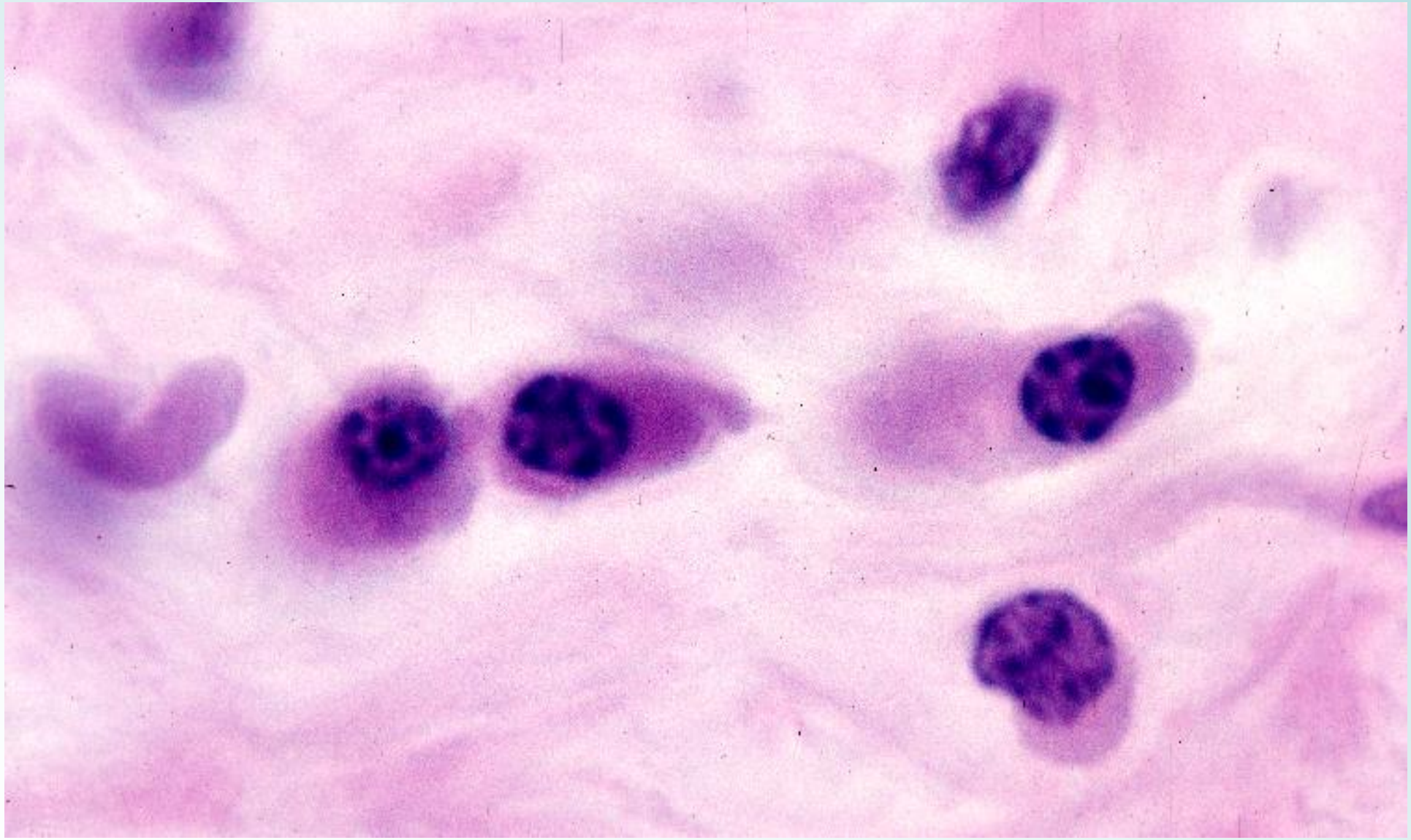
03-08 Collagenous and elastic fibers 2. Rat subcutaneous tissue, aldehyde fuchsin and right green stain, x 200.



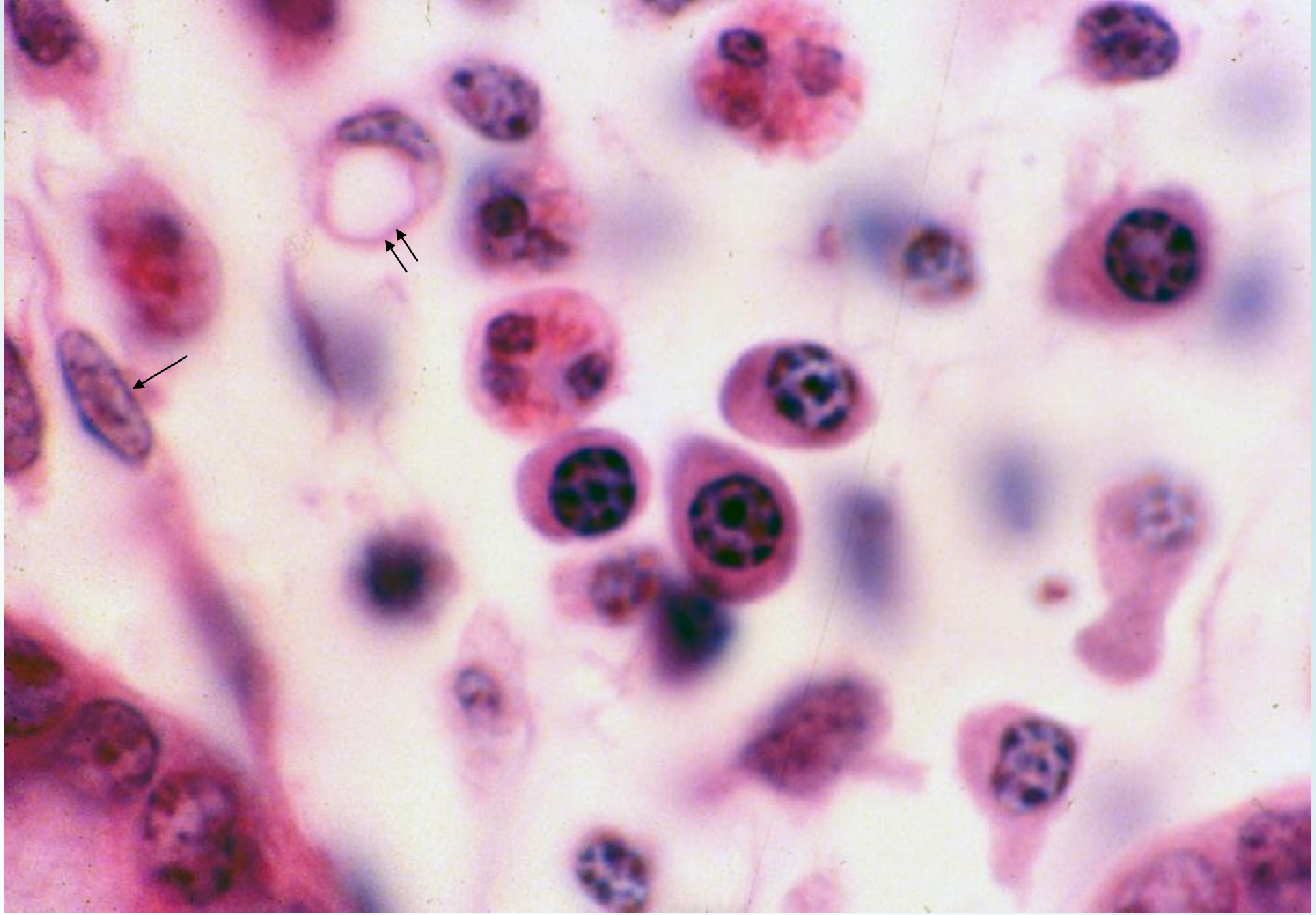
03-09 Elastic fibers. Bovine Lig. nuchae, resorcin-fuchsin stain, x 160.



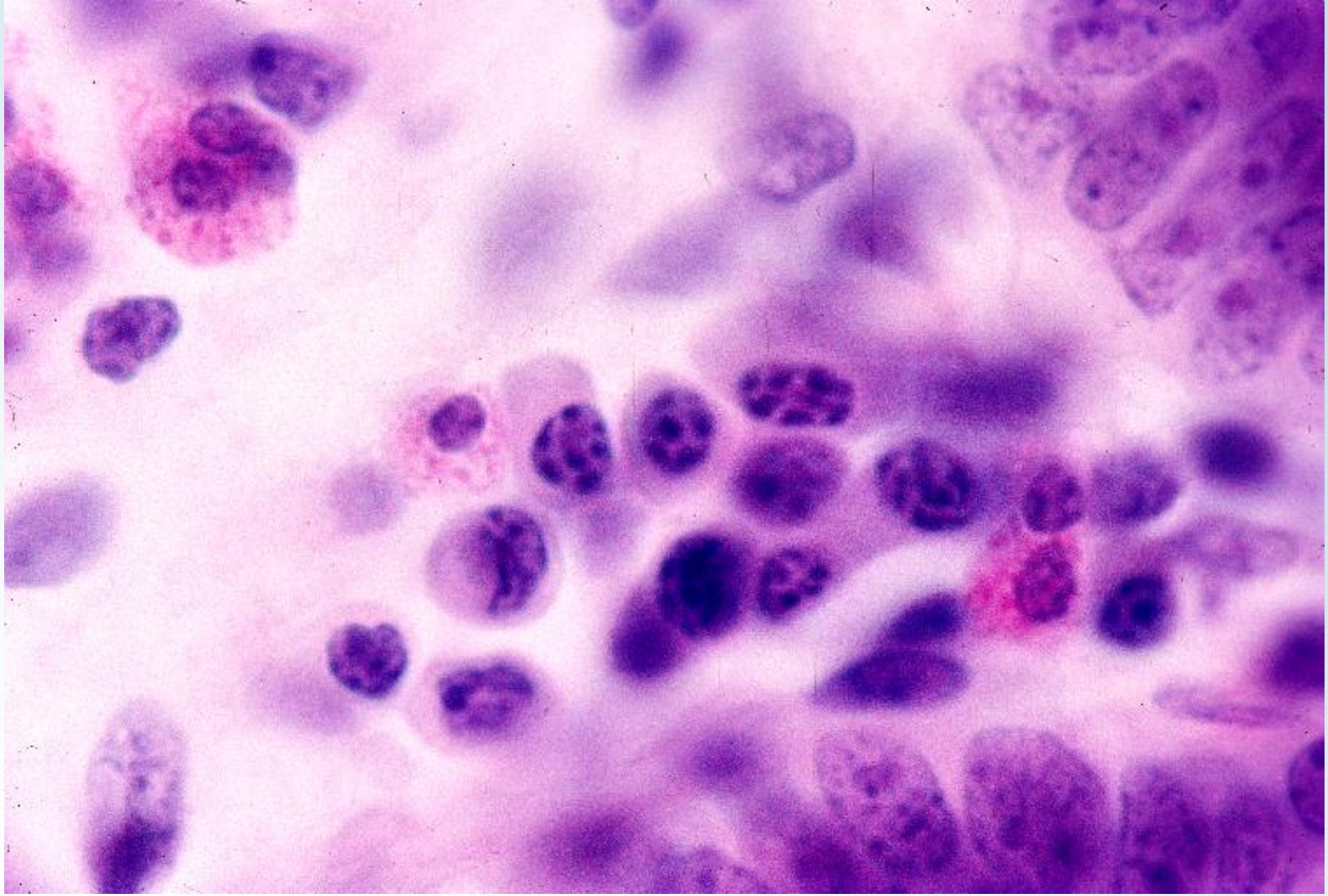
03-10 Reticular fibers. Monkey, Silver impregnation and Kernechtrot stain, x 400.



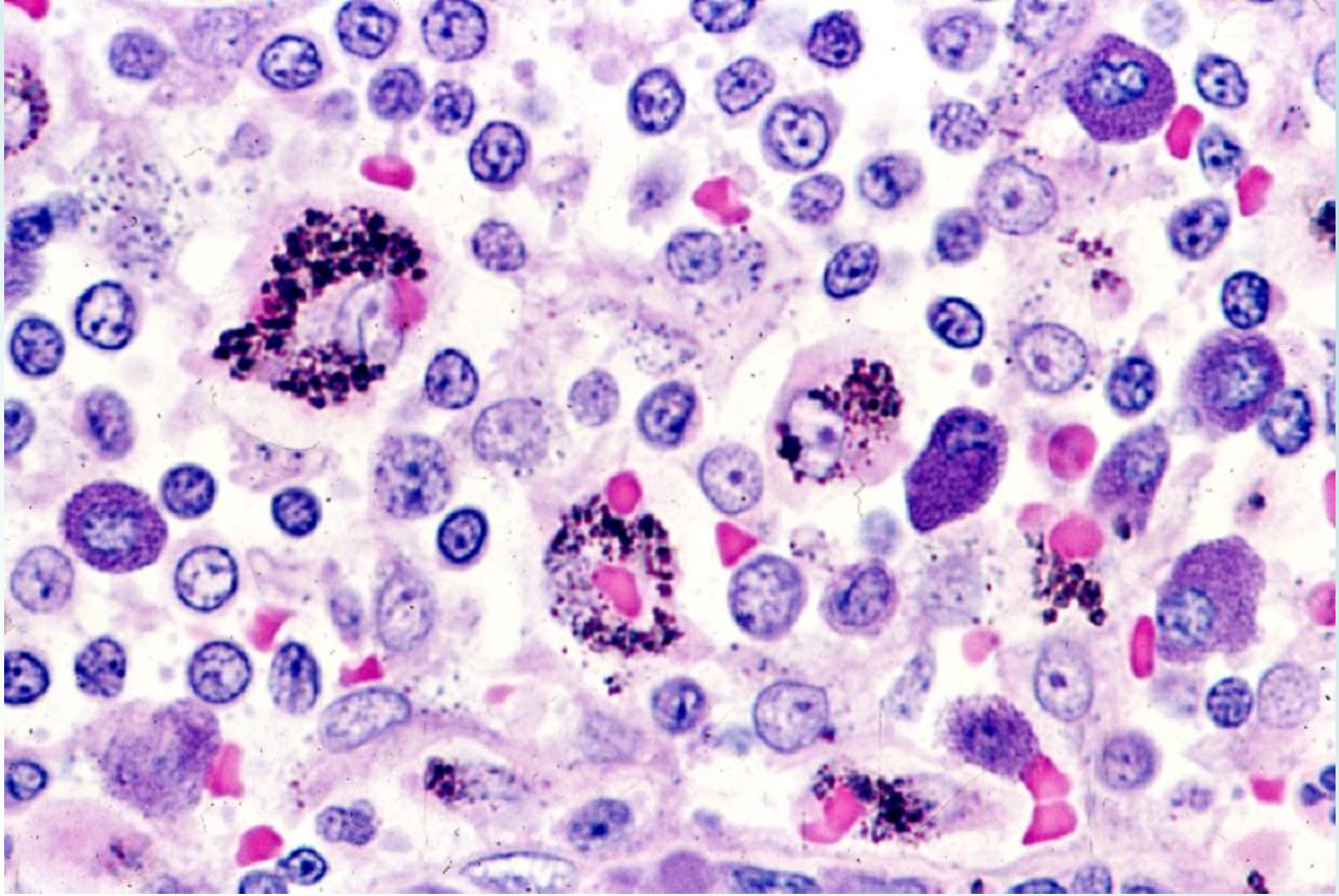
03-11 Plasma cells 1. Monkey. H-E stain, x 640.



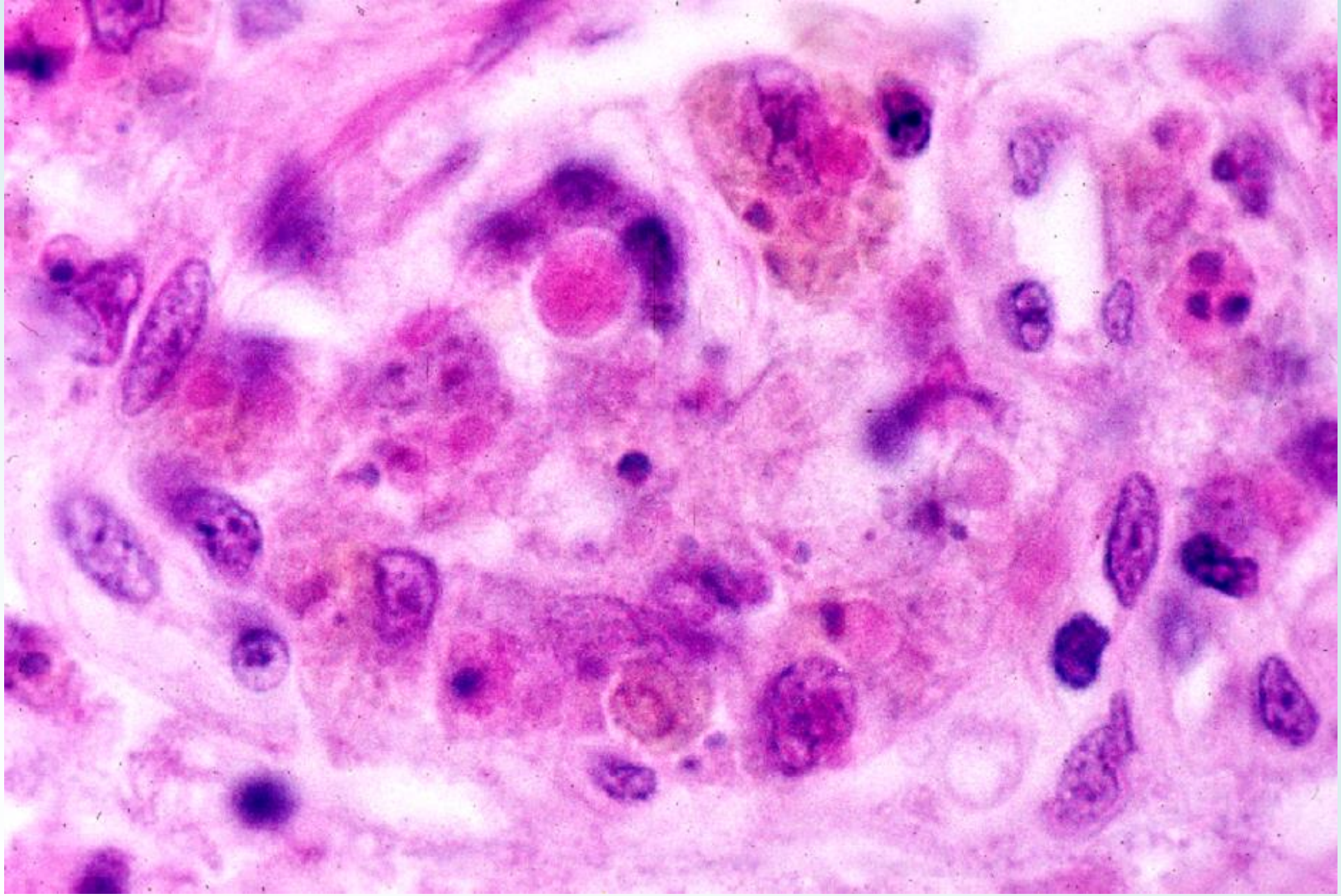
03-12 Plasma cells 2. Lamina propria of monkey intestine, H-E stain, x 400.



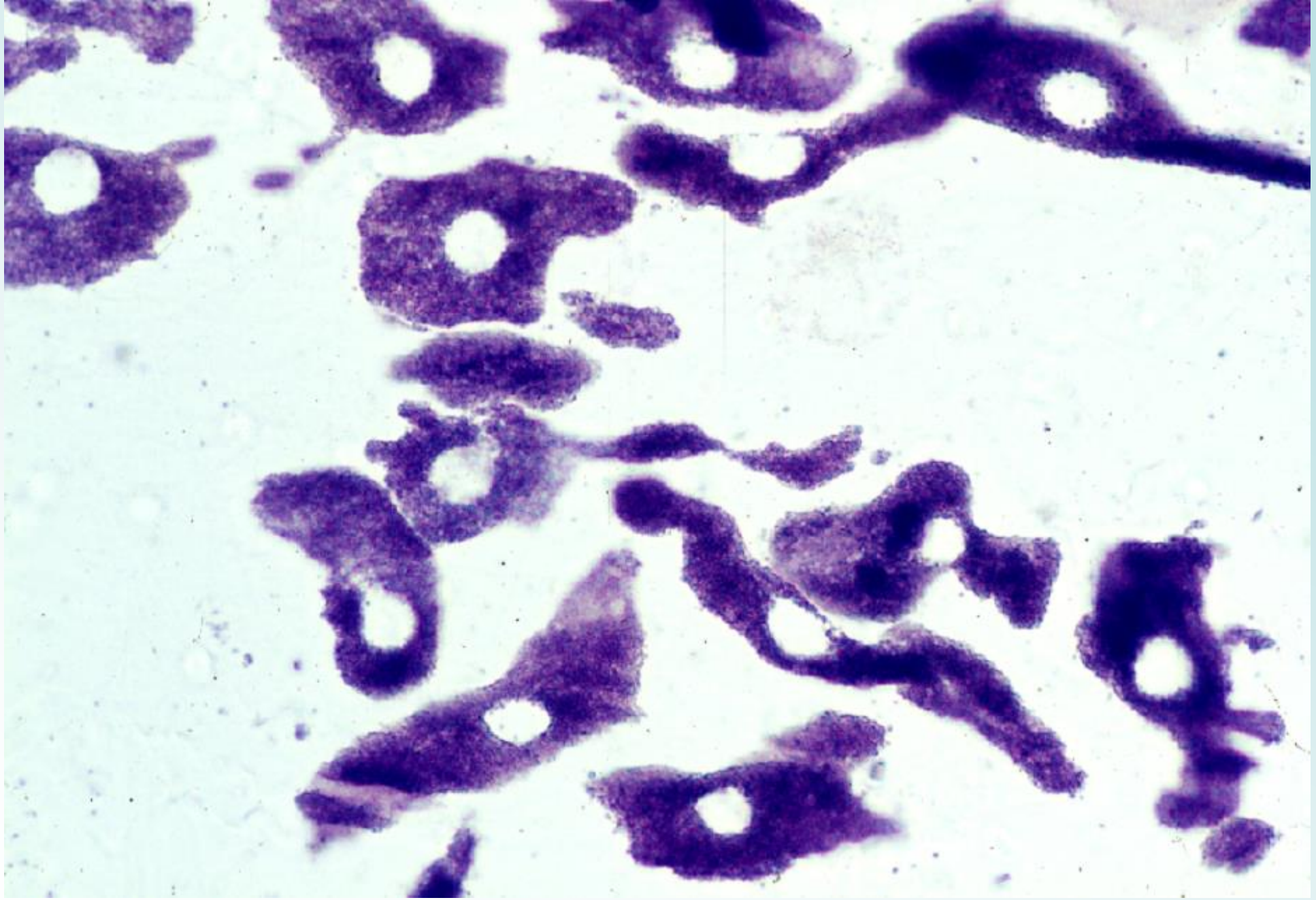
03-13 Plasma cells 3. Lamina propria of monkey intestine, H-E stain, x 500.



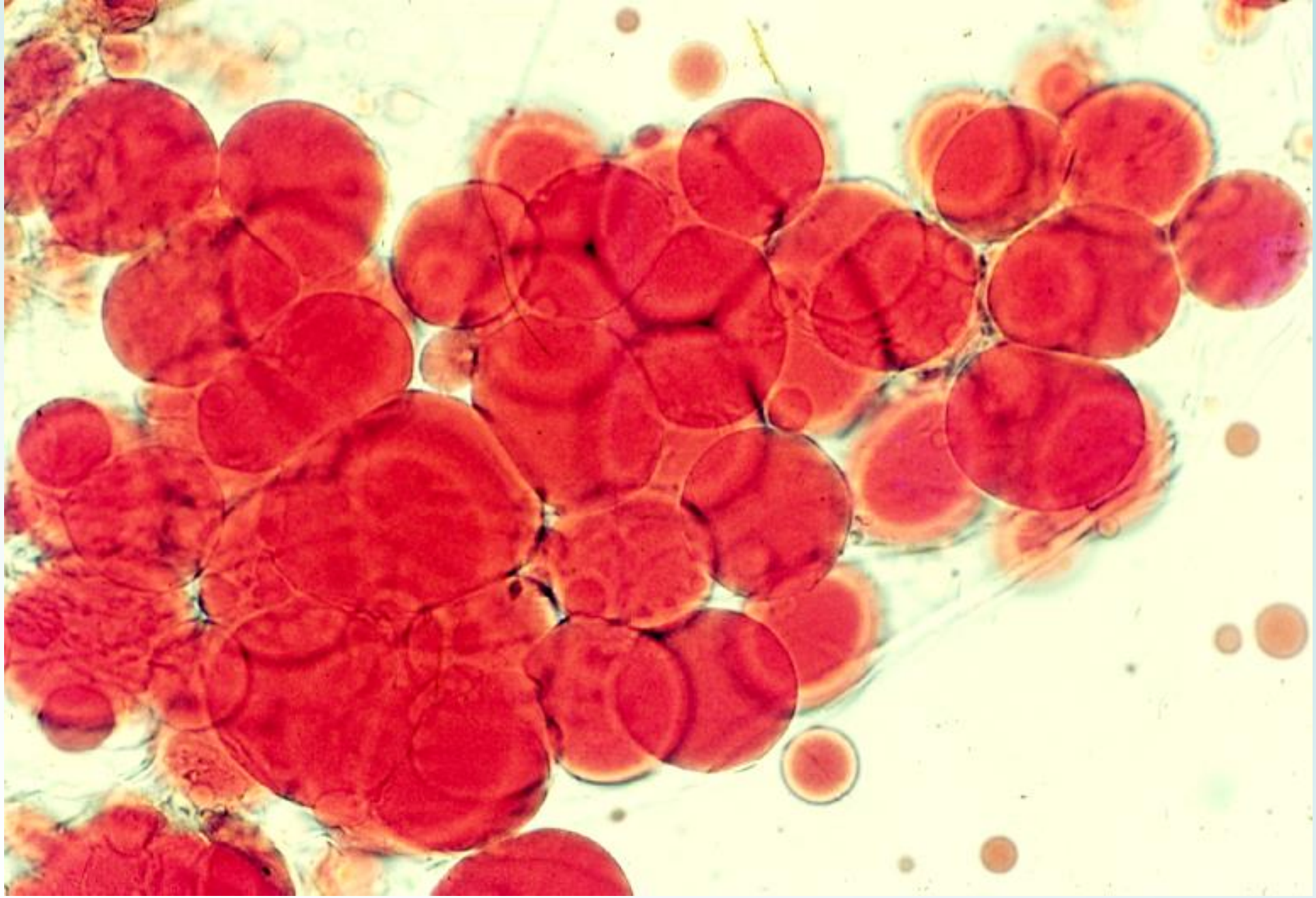
03-14 Macrophages 1. Lymph node of rabbit, vital stain with India ink, toluidin blue and eosin stain, x 250.



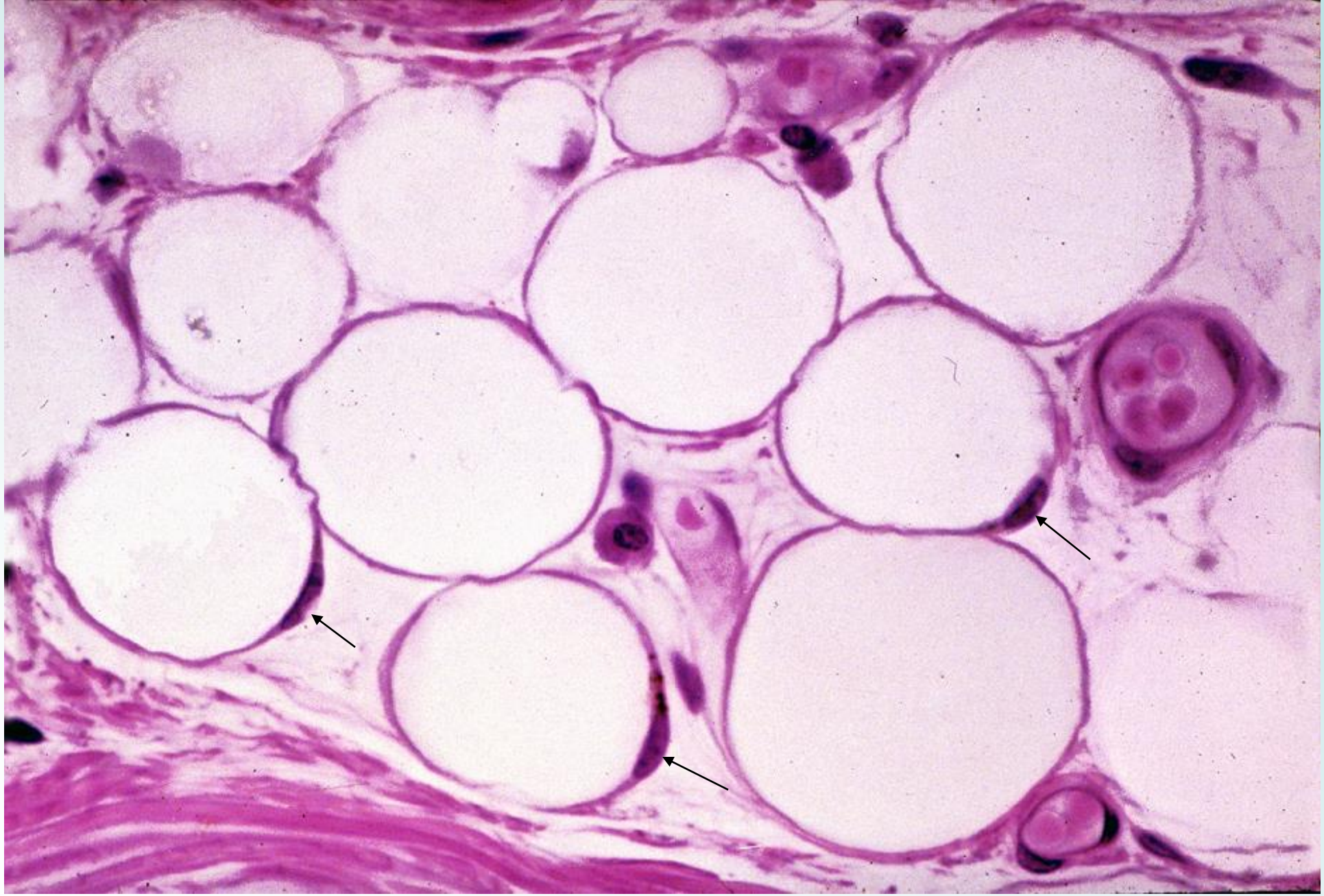
03-15 Macrophages 2. Lamina propria at the tip of intestinal vilus, monkey, H-E stain, x 400.



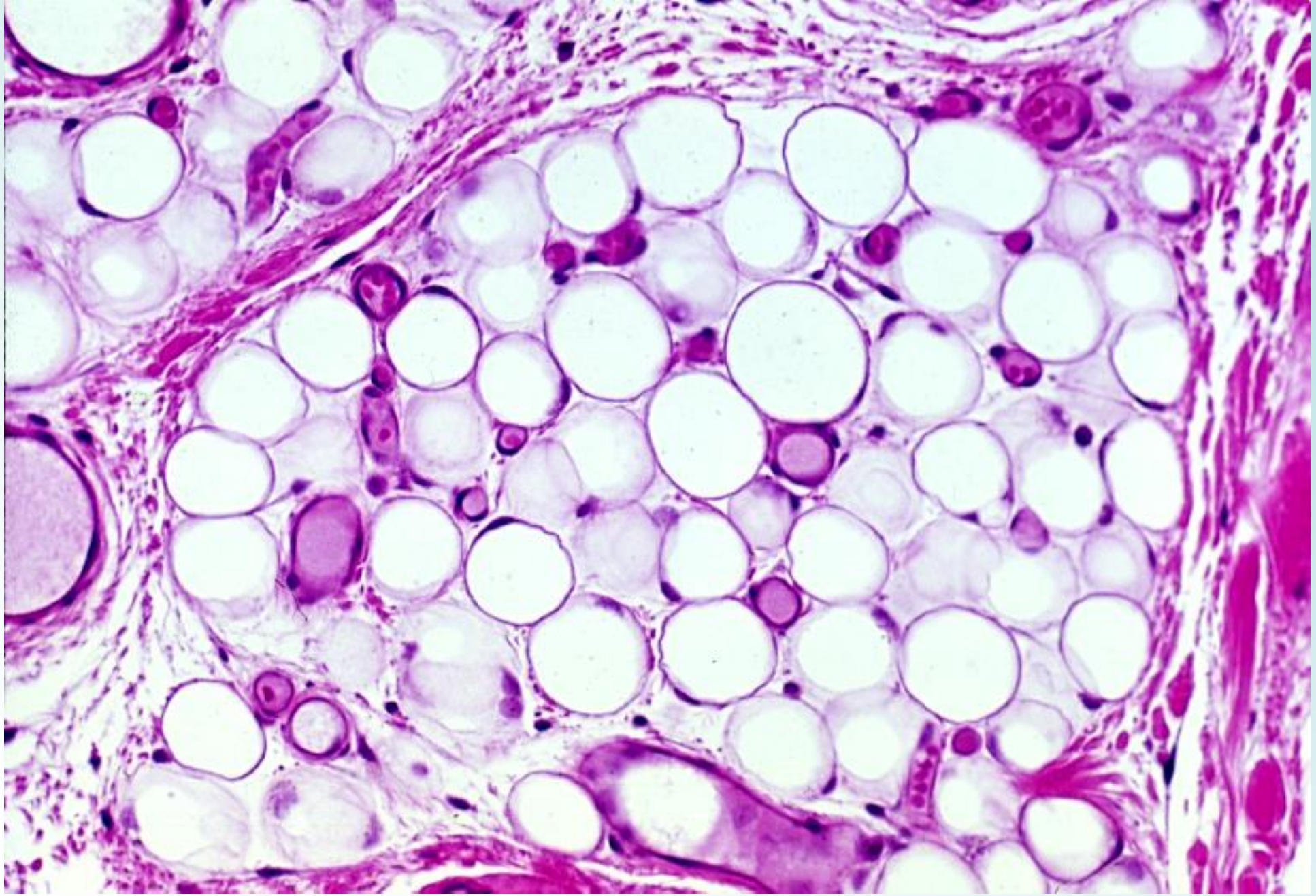
03-16 Pigment cells. Bovine chorioidea, not stained, x 400.



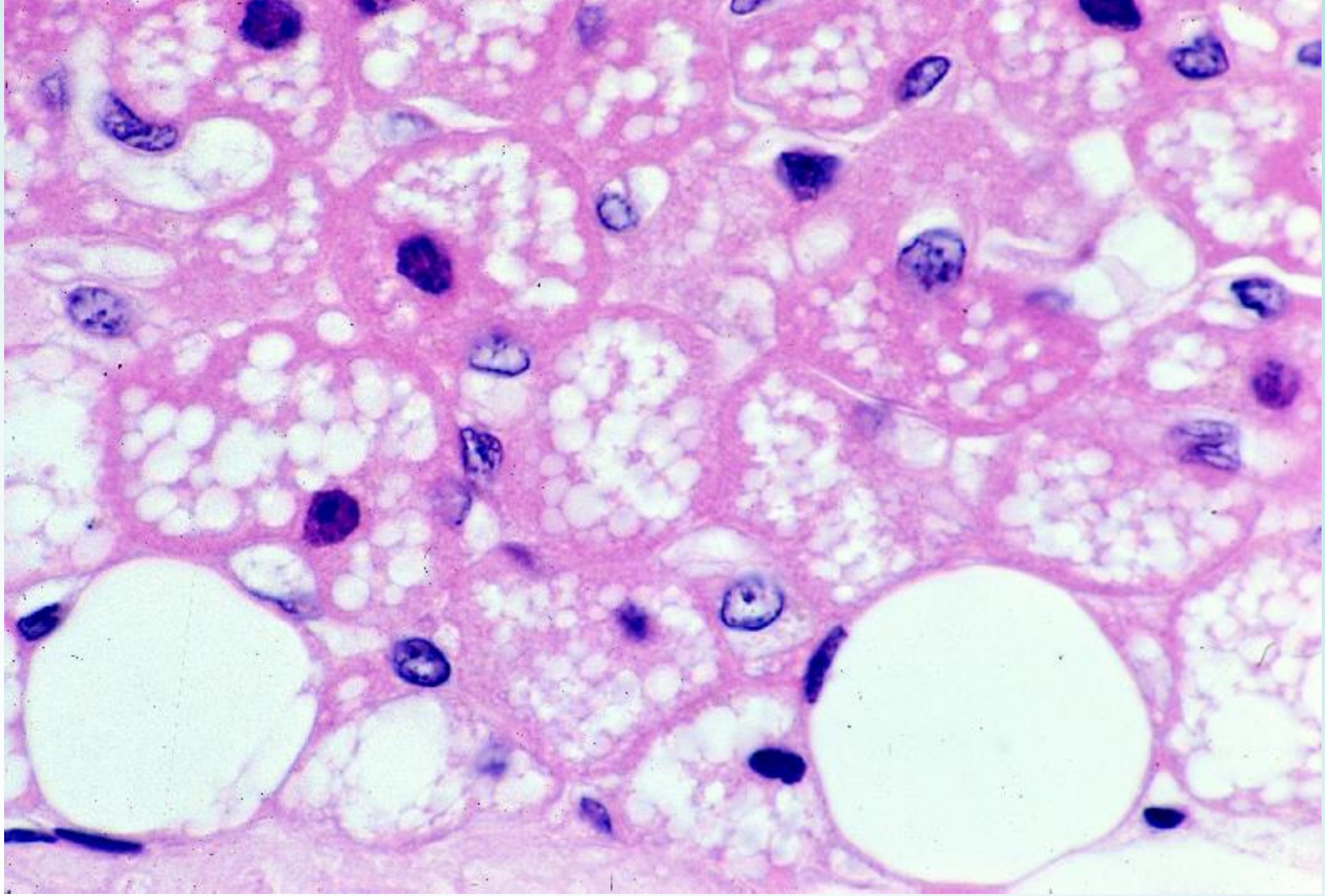
03-17 Fat cells 1. Subcutaneous fat, guinea pig, Sudan III stain, x 64.



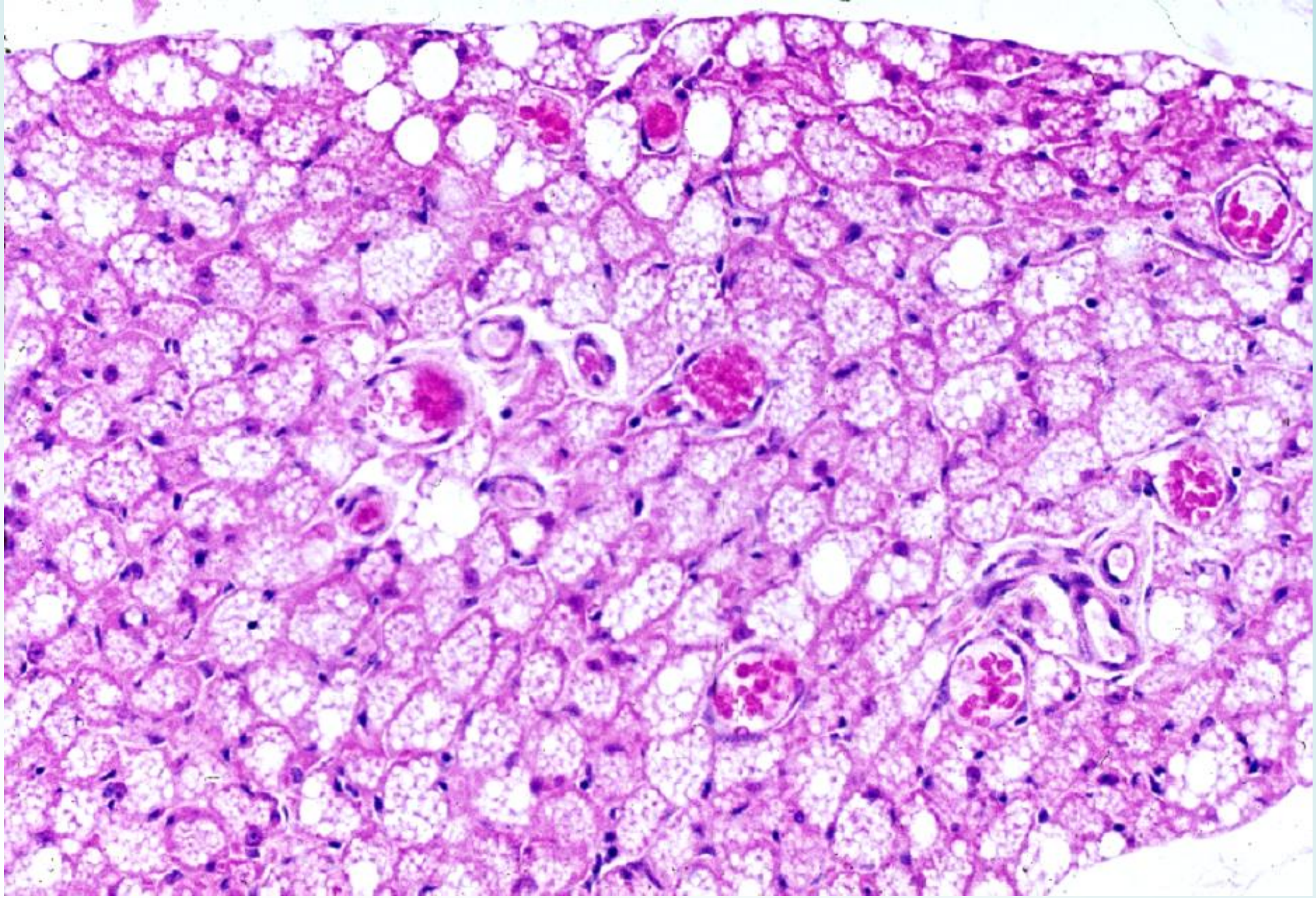
03-18 Fat cells 2. Human subcutaneous fat tissue, H-E stain, x 160.



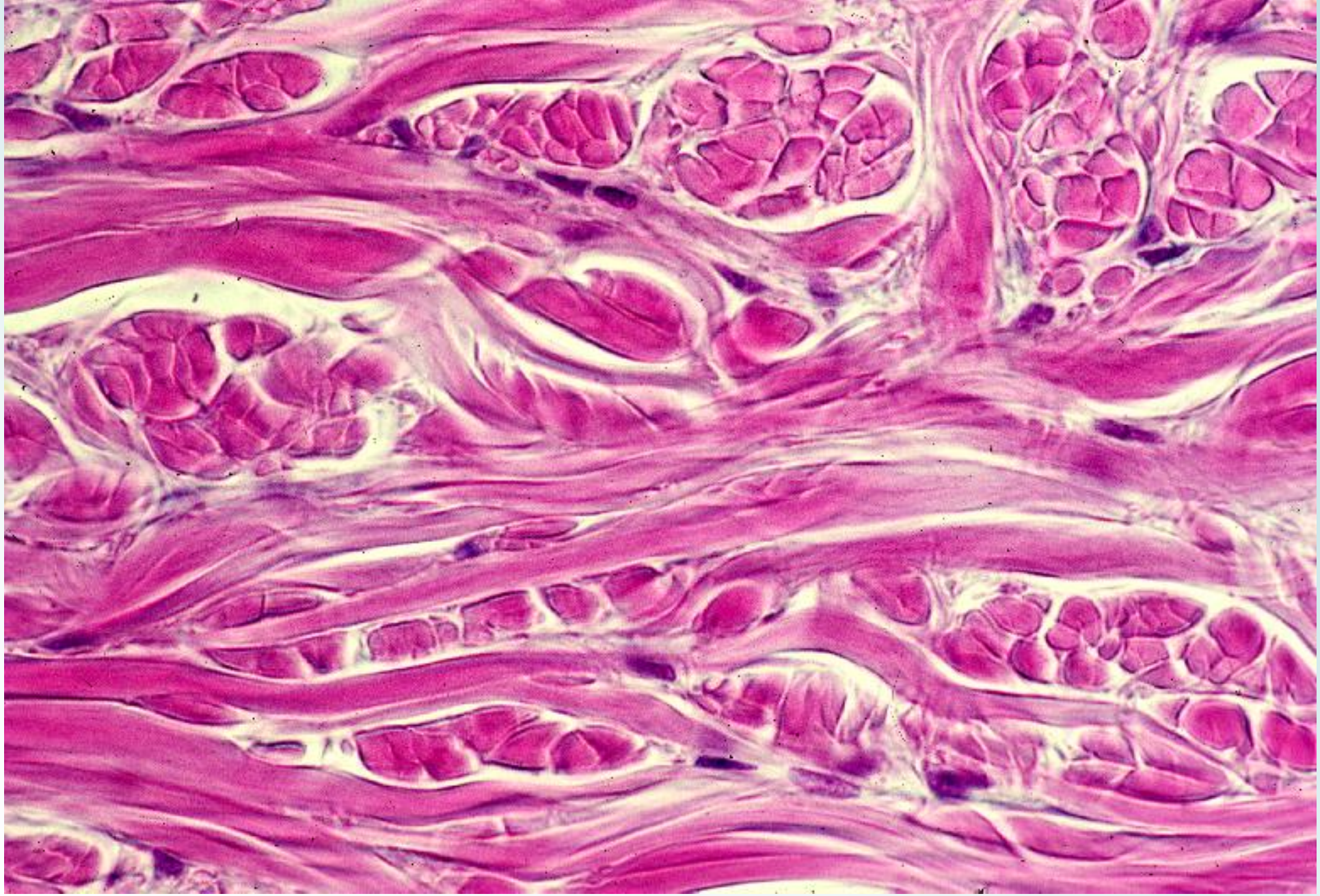
03-19 Fat tissue. Human scalp, H-E stain, x 64.



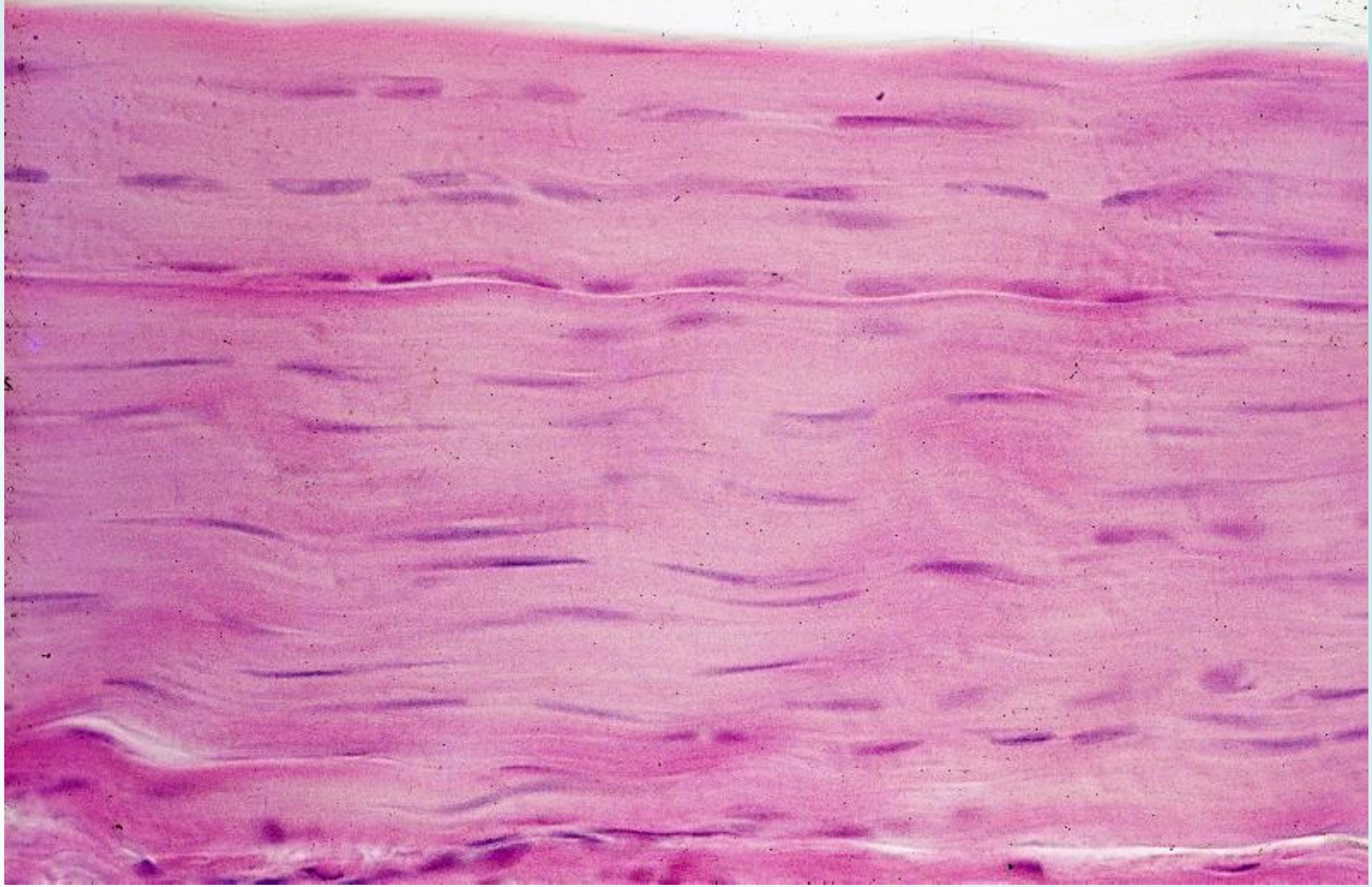
03-20 Young developing fat tissue. Human, H-E stain, x 160.



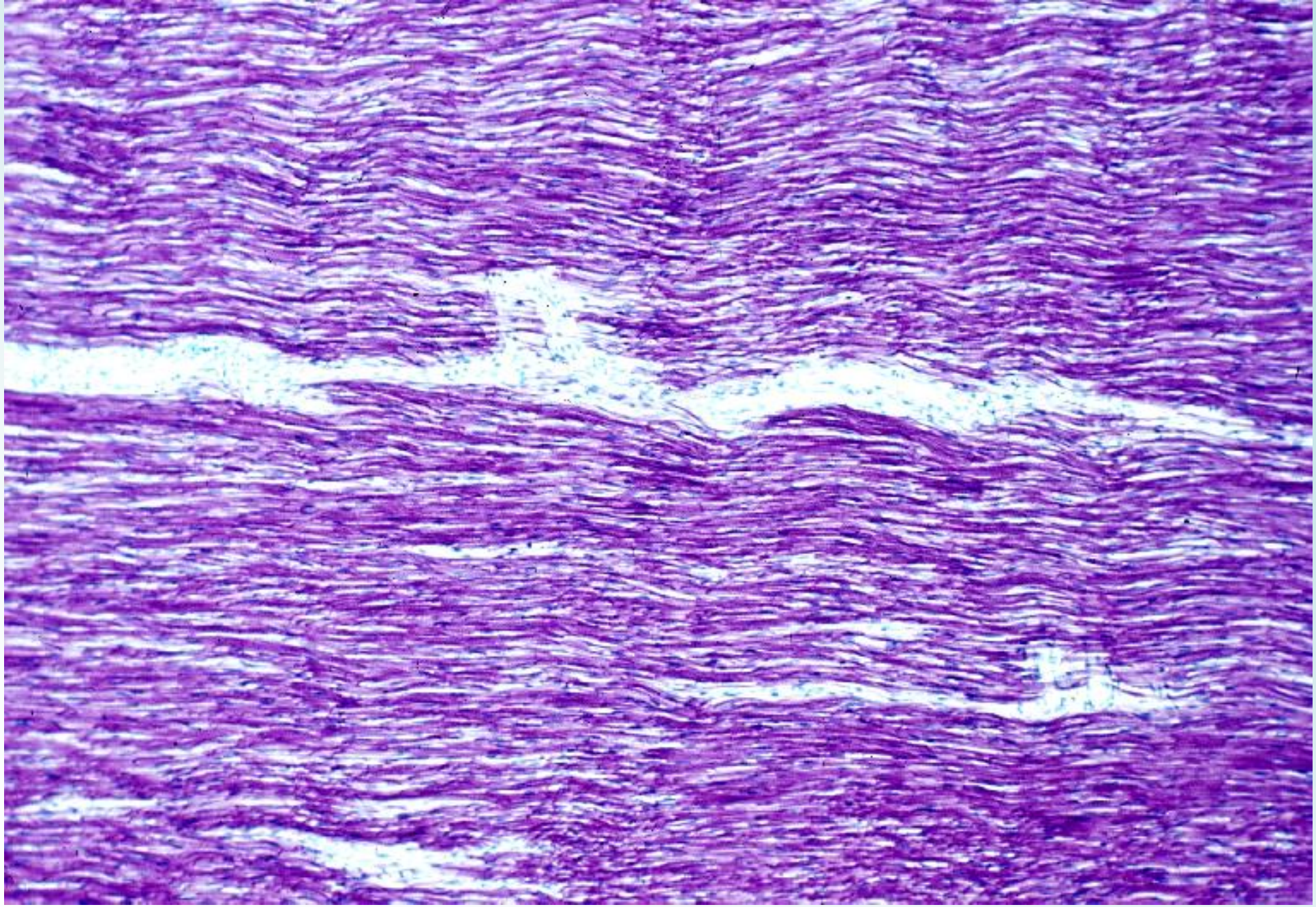
03-21 Brown fat tissue. Monkey, H-E stain, x 64.



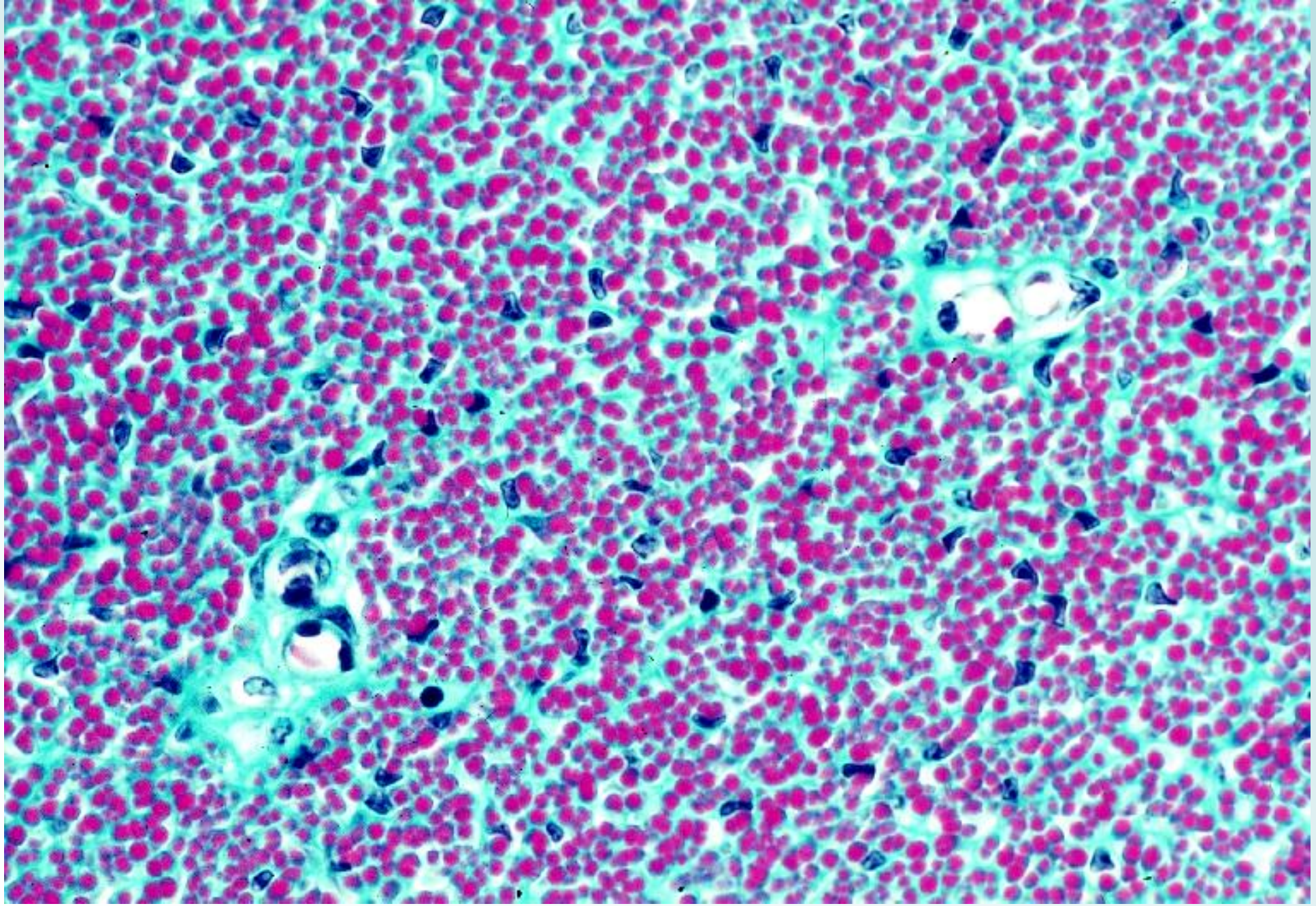
03-22 Densely woven connective tissue 1. Human dermis, H-E stain, x 160.



03-23 Dense regular connective tissue, Achillis tendon. Human, H-E stain, x 100.



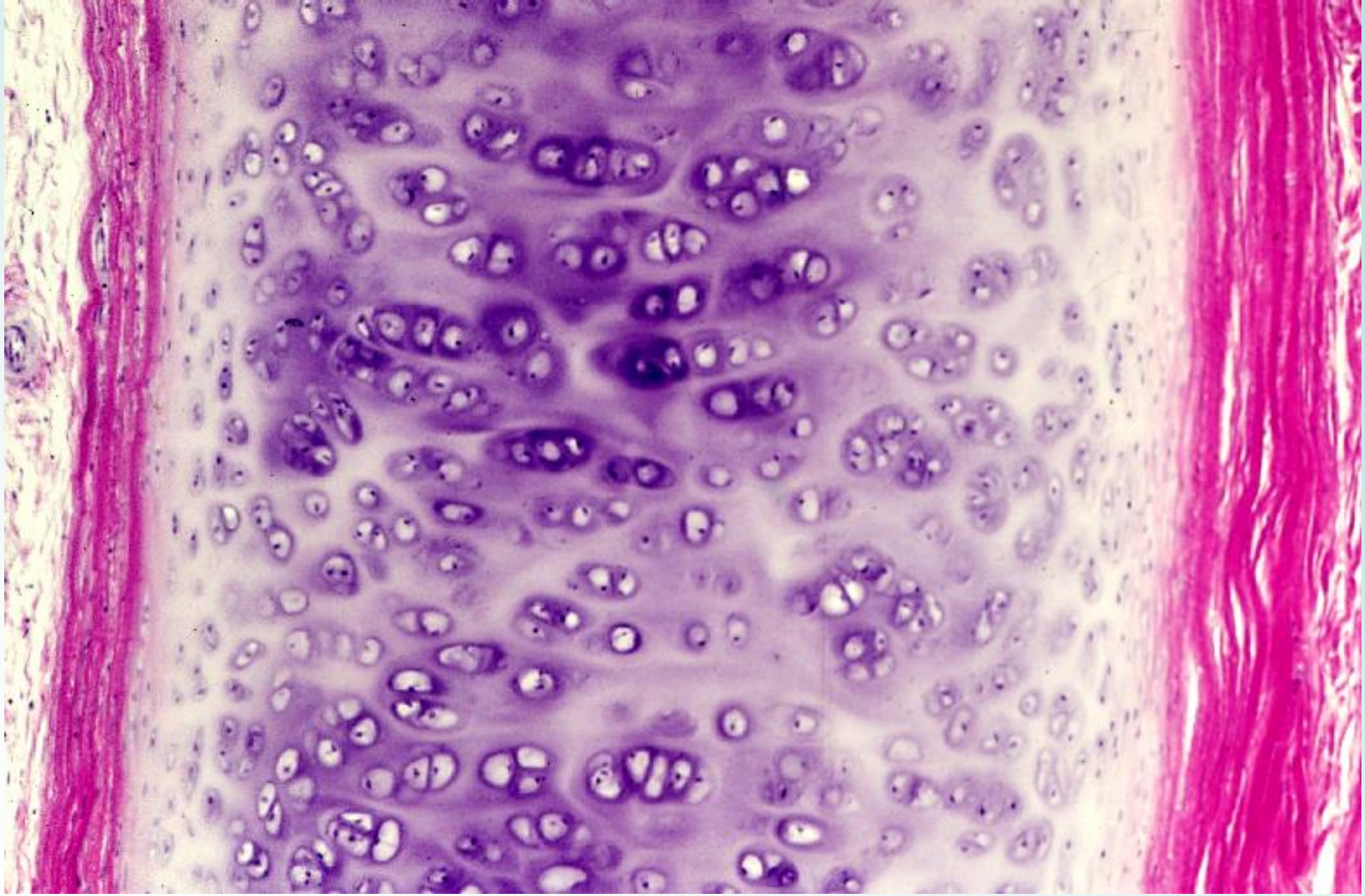
03-24 Ligamentum nuchae. Bovine, resorcin-fuchsin stain, x 64.



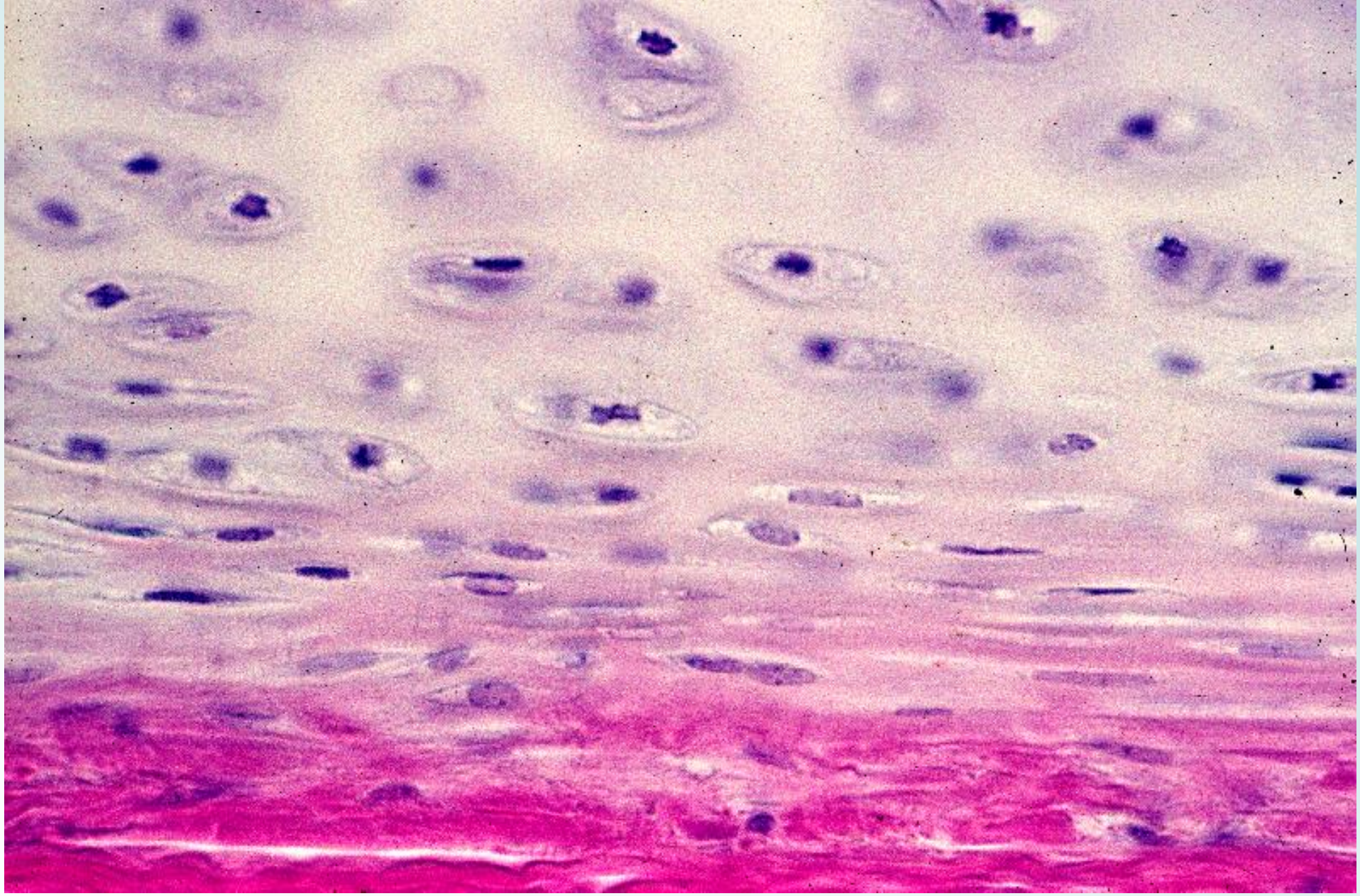
03-25 Ligamentum nuchae, transverse section. Bivine, M-G stain, x 160.

03-002
Cartilage

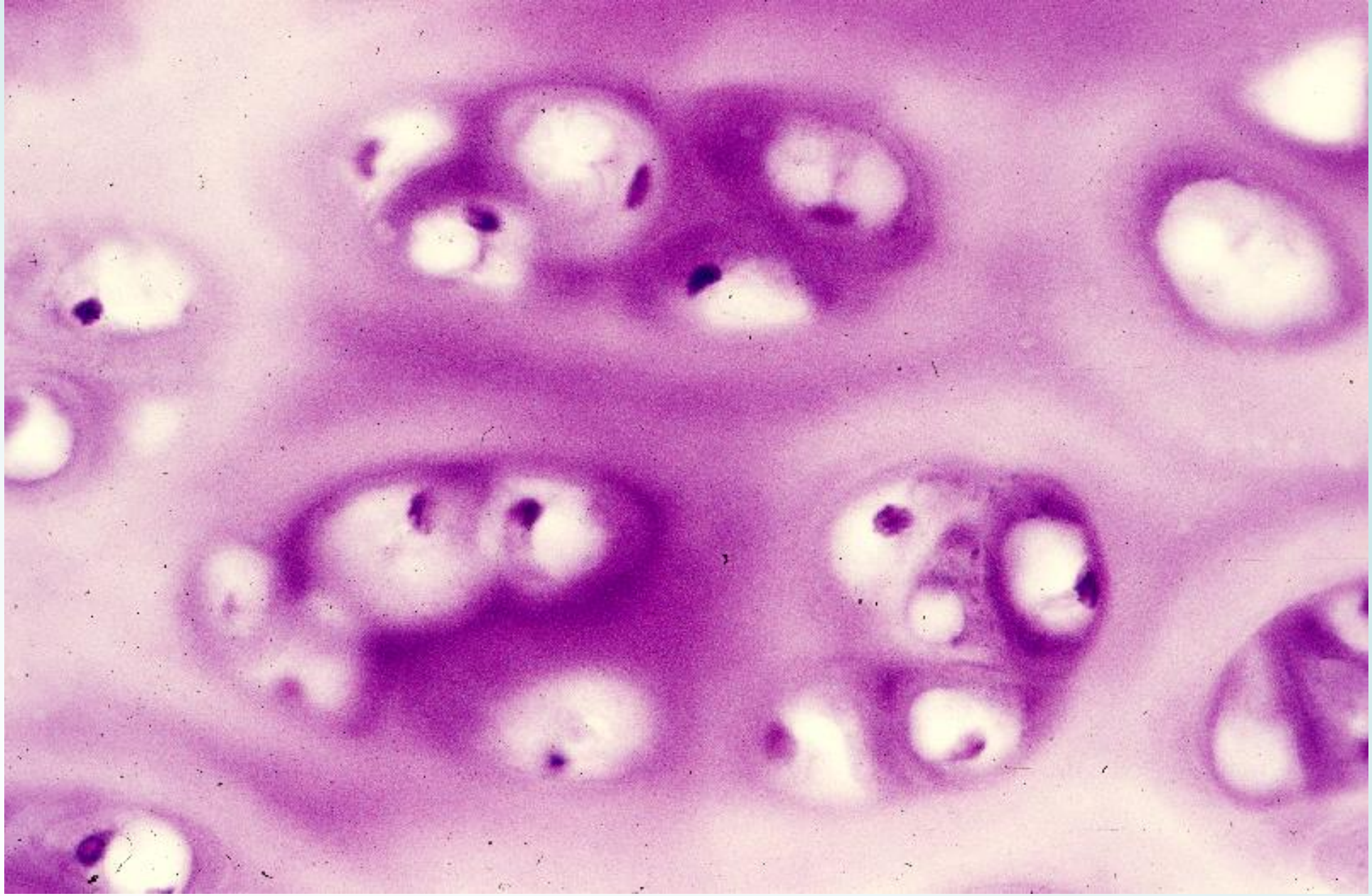
03-26 Hyaline cartilage 1. Human trachea, H-E stain, x 3.0.



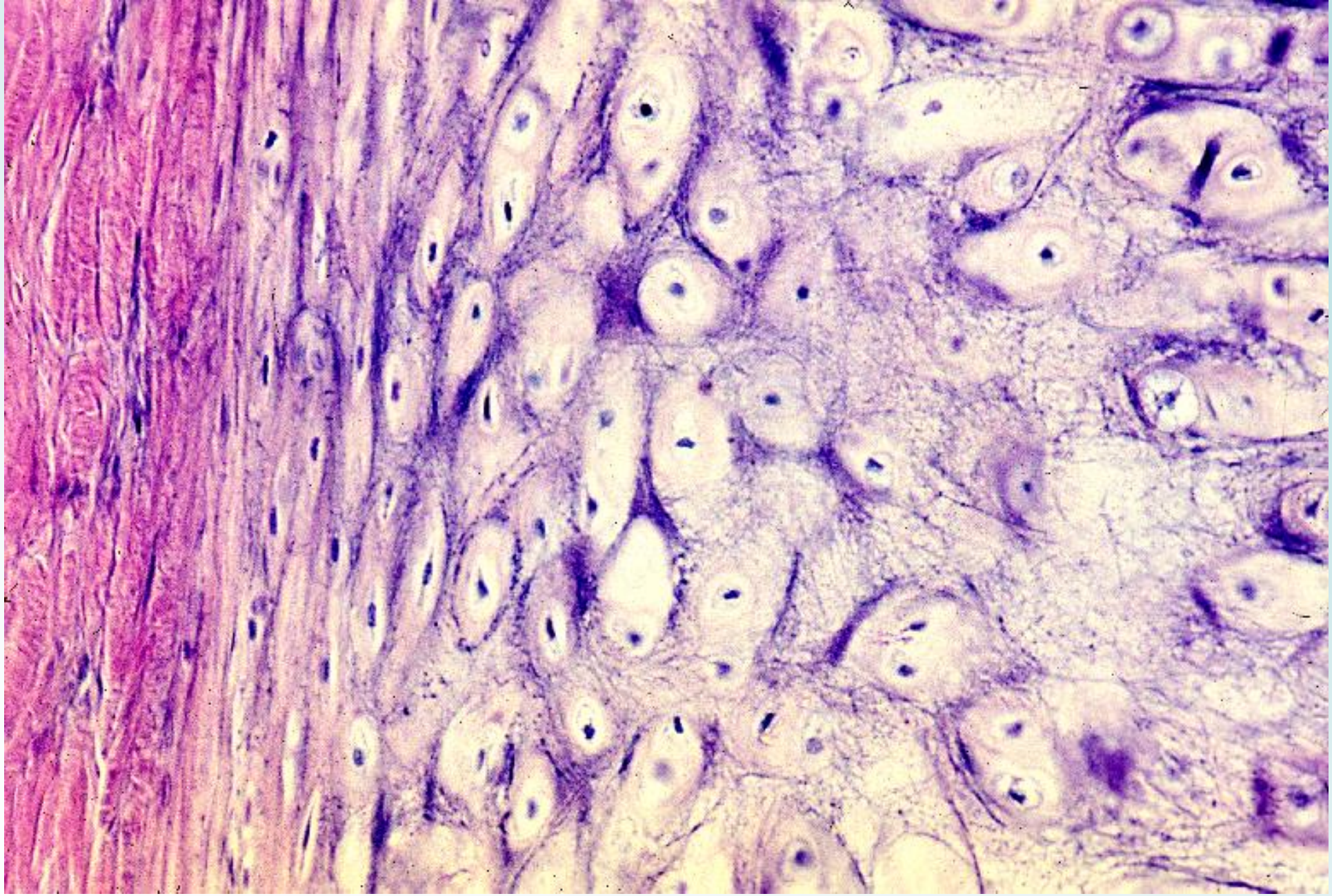
03-27 Hyaline cartilage 2. Human trachea, H-E stain, x 64.



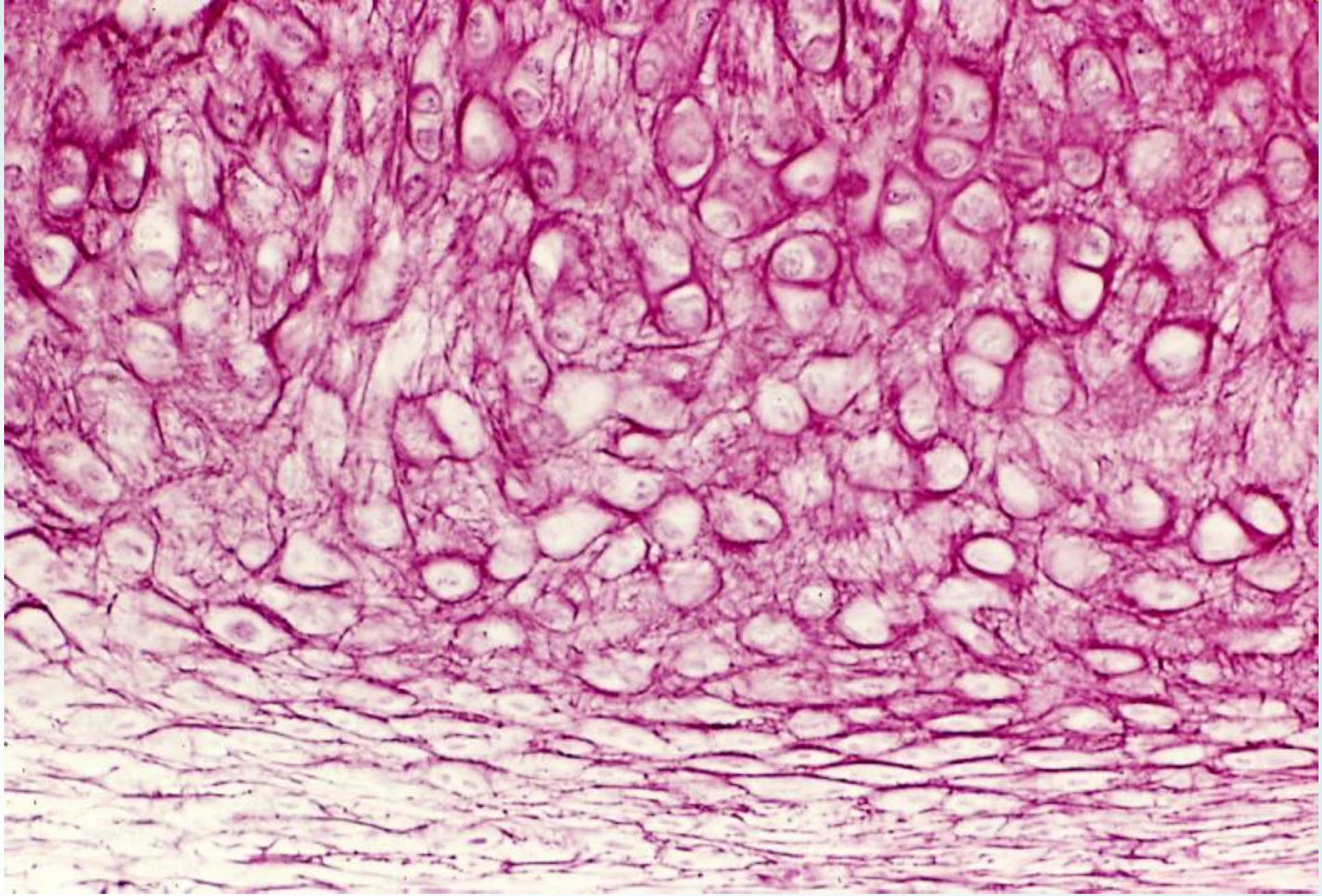
03-28 Hyaline cartilage 3. Perichondrium, human trachea, x 160.



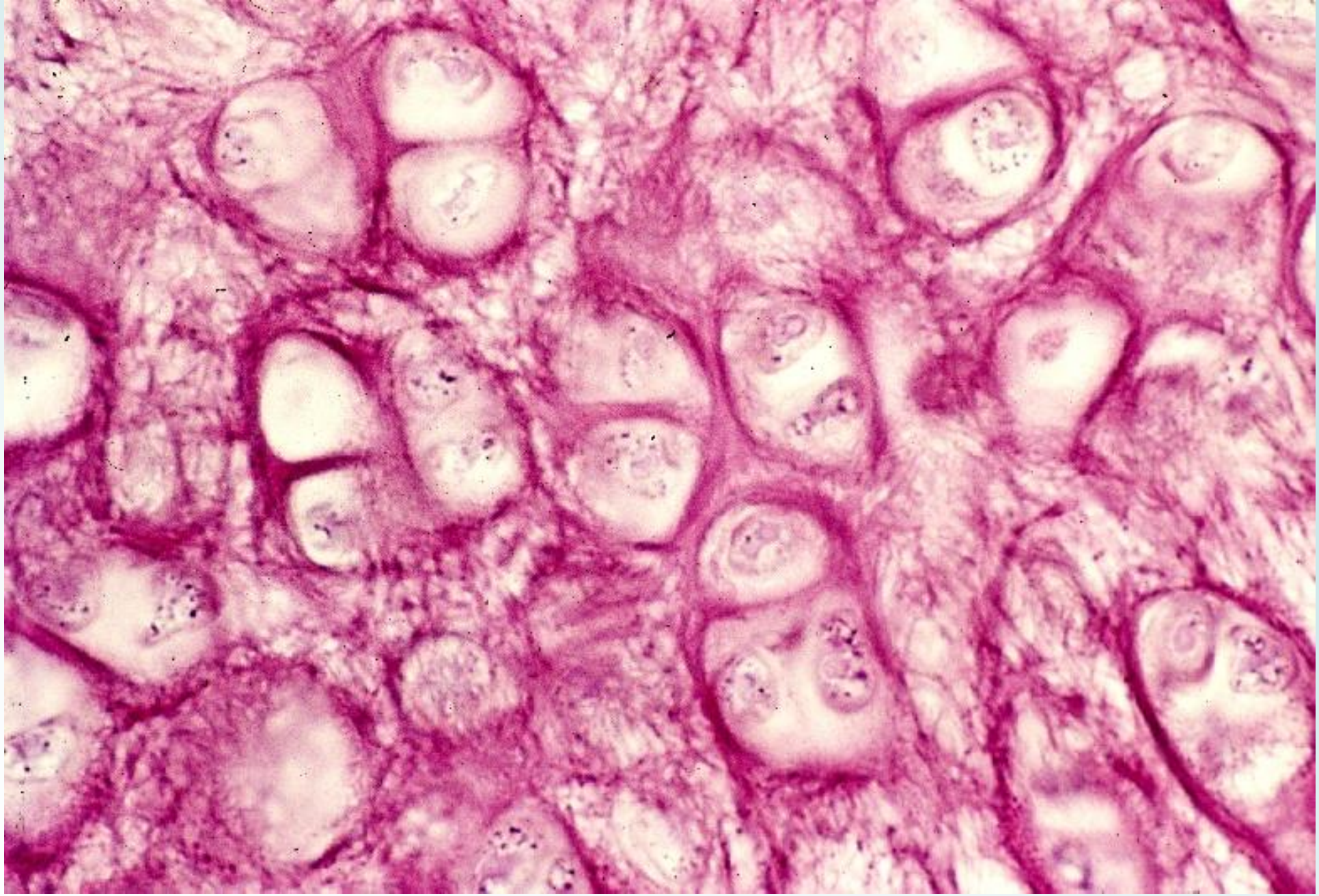
03-29 Hyaline cartilage 4. Human trachea, H-E stain, x 160.



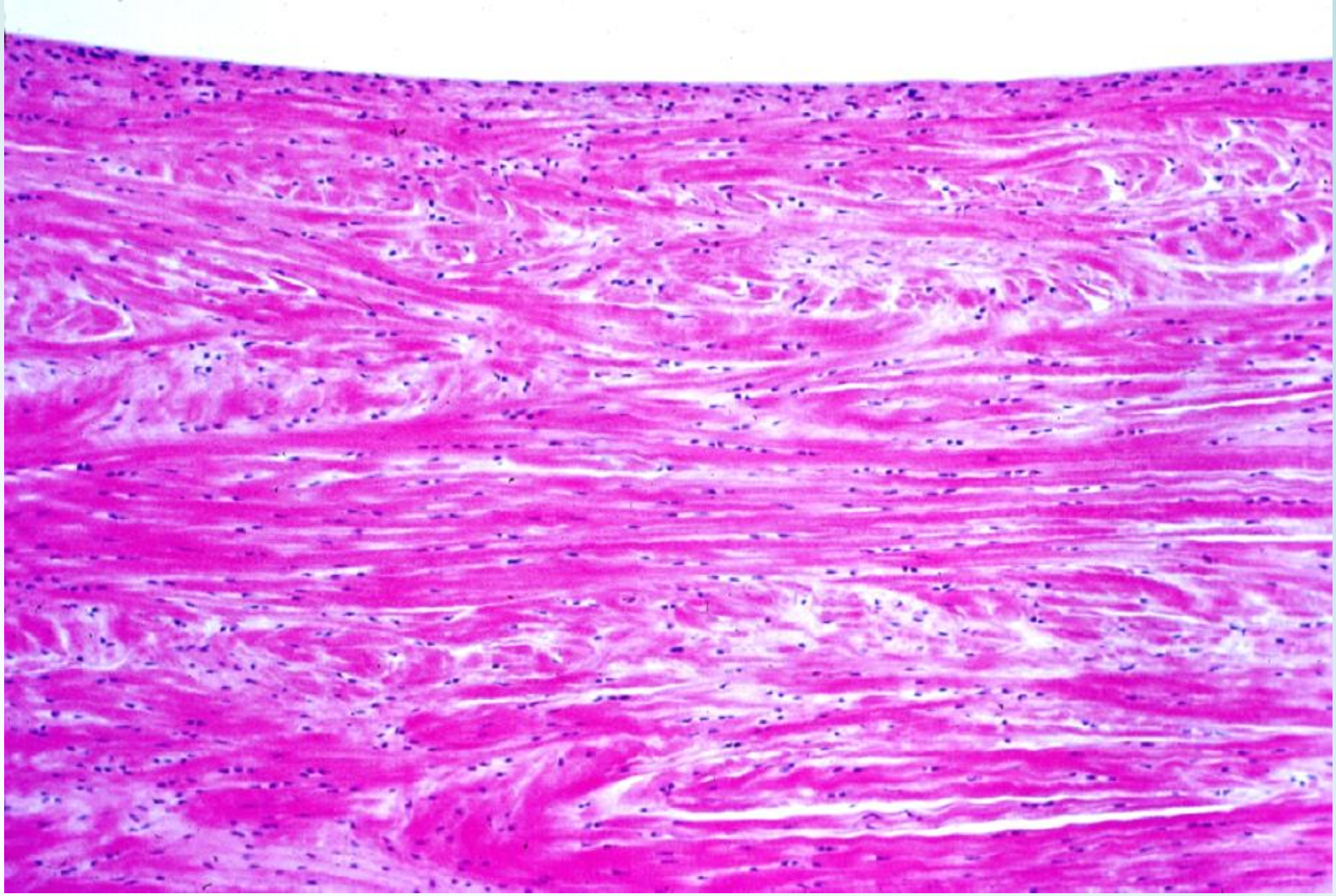
03-30 Elastic cartilage 1. Human auricula, H-E stain, x 160.



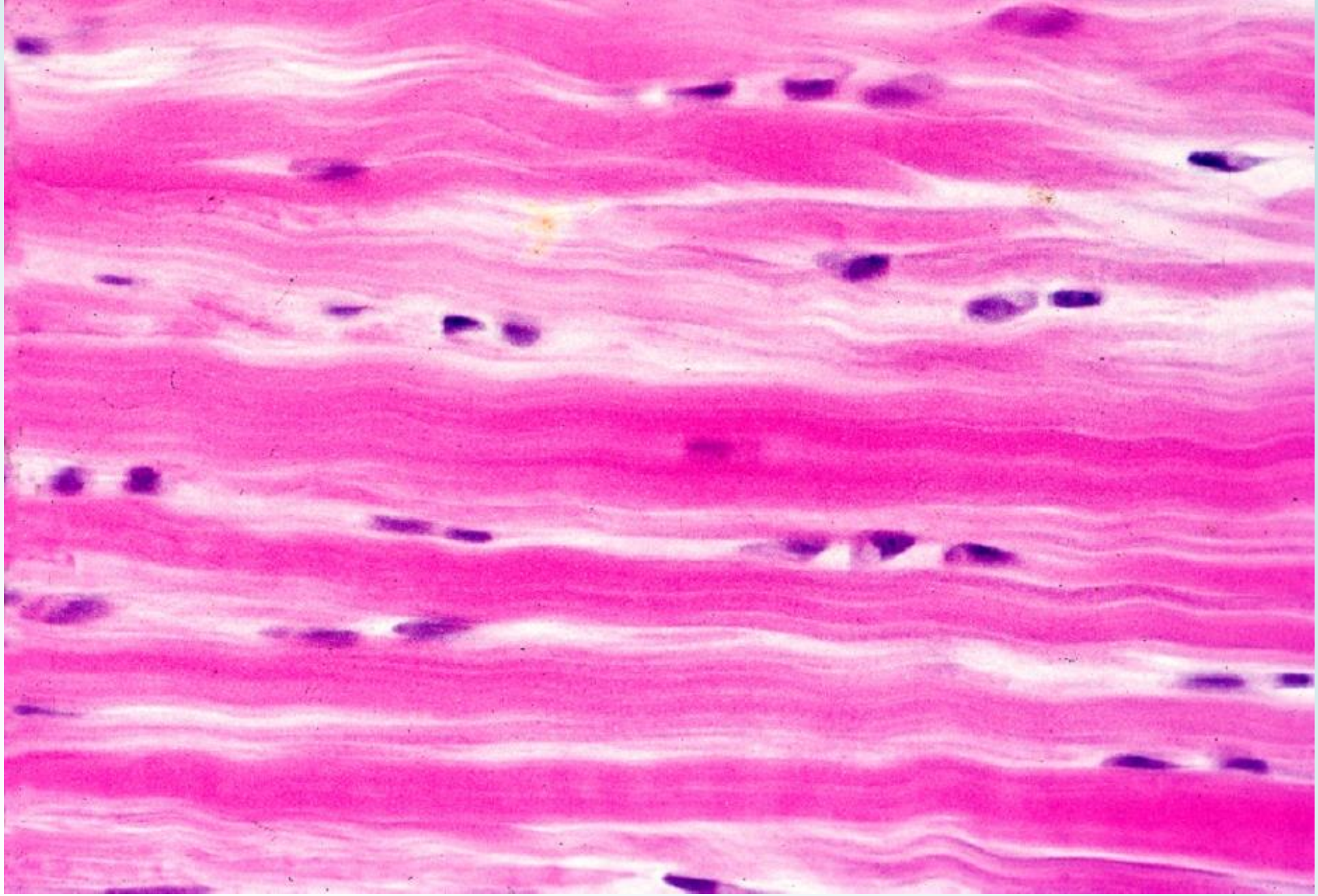
03-31 Elastic cartilage 2. Human auricula, resorcin-fuchsin stain, x 64.



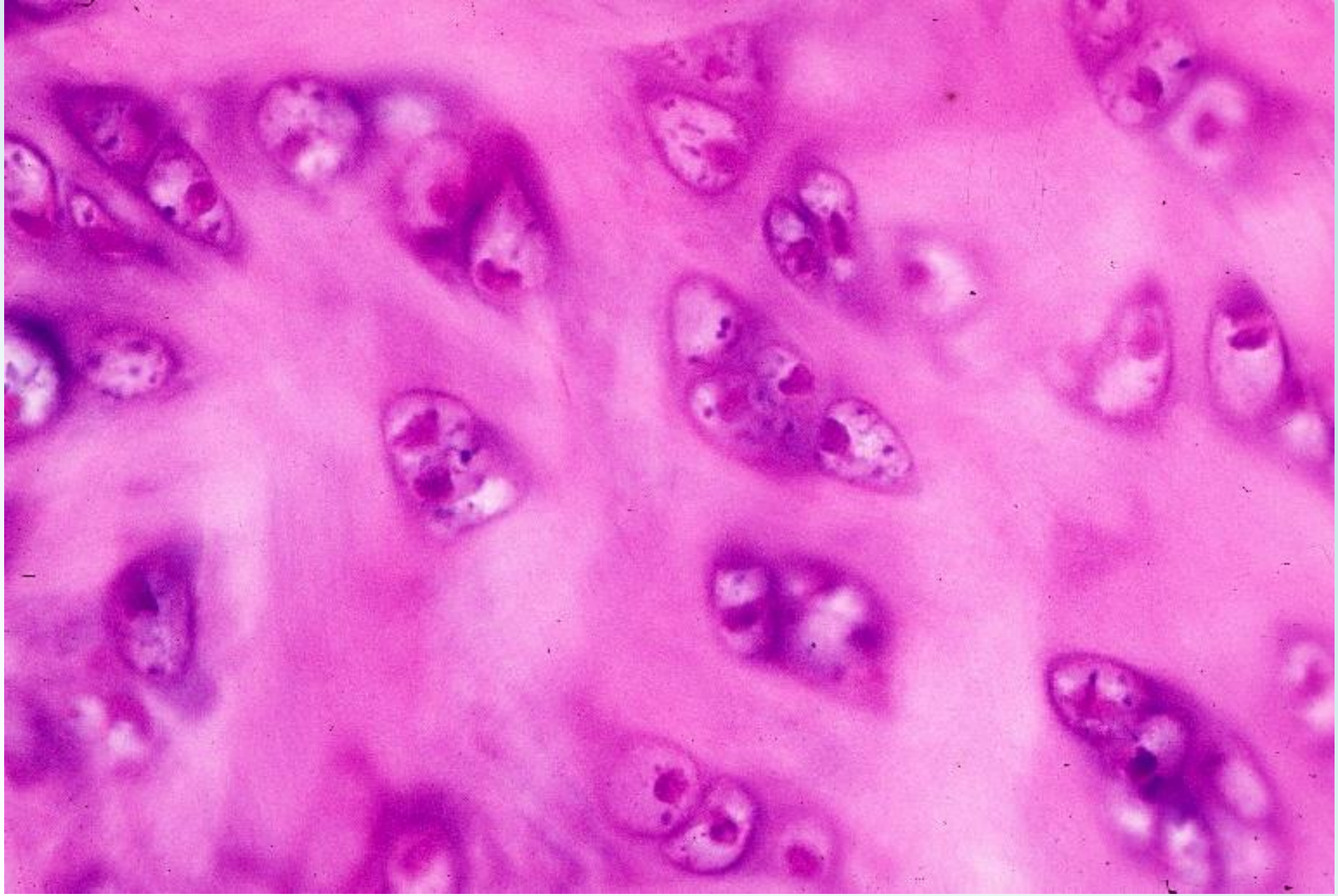
03-32 Elastic cartilage 3. Human auricula, resorcin-fuchsin stain, x 160.



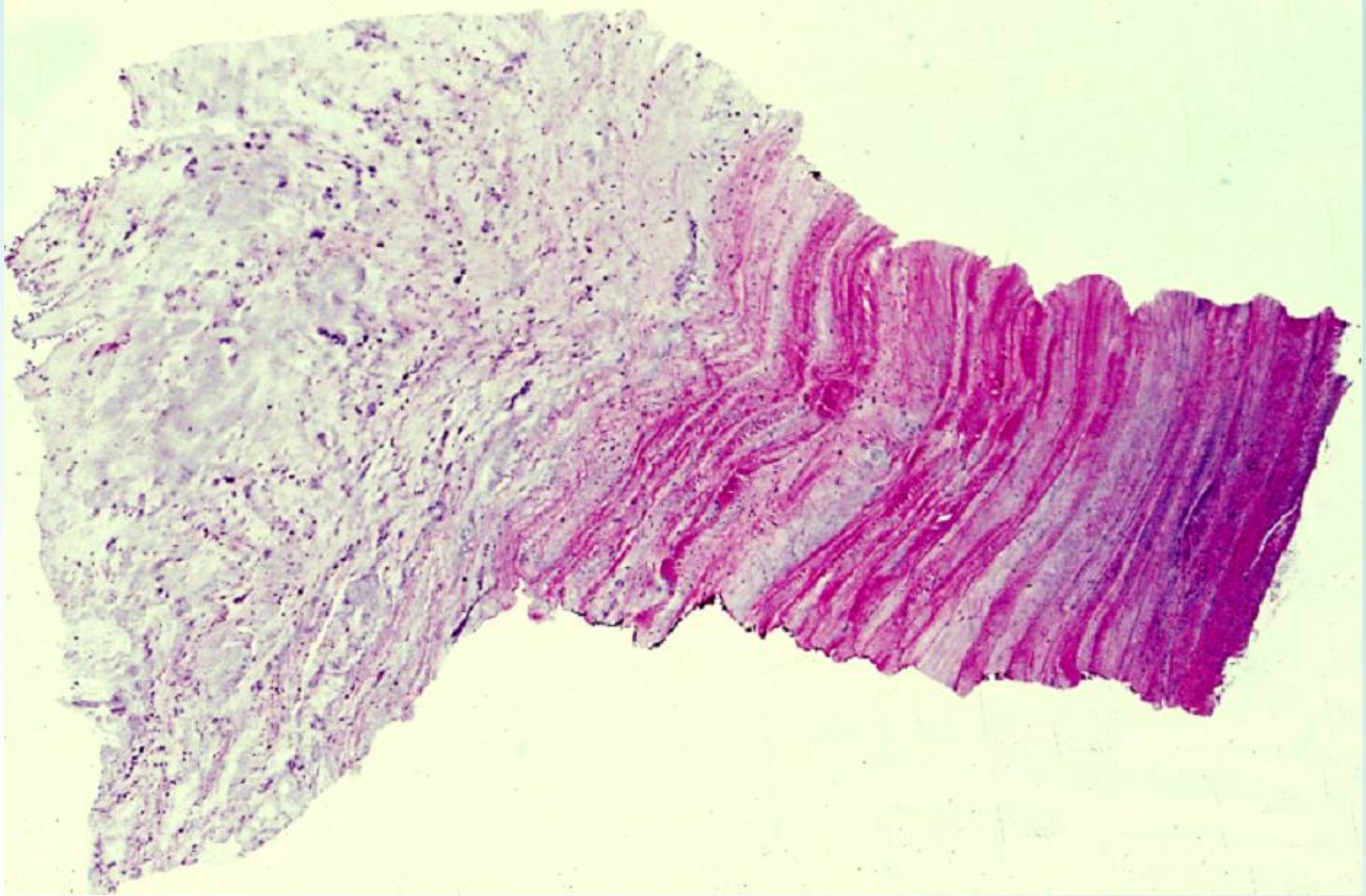
03-33 Fibrocartilage 1. Meniscus of knee joint, monkey, H-E stain, x 64.



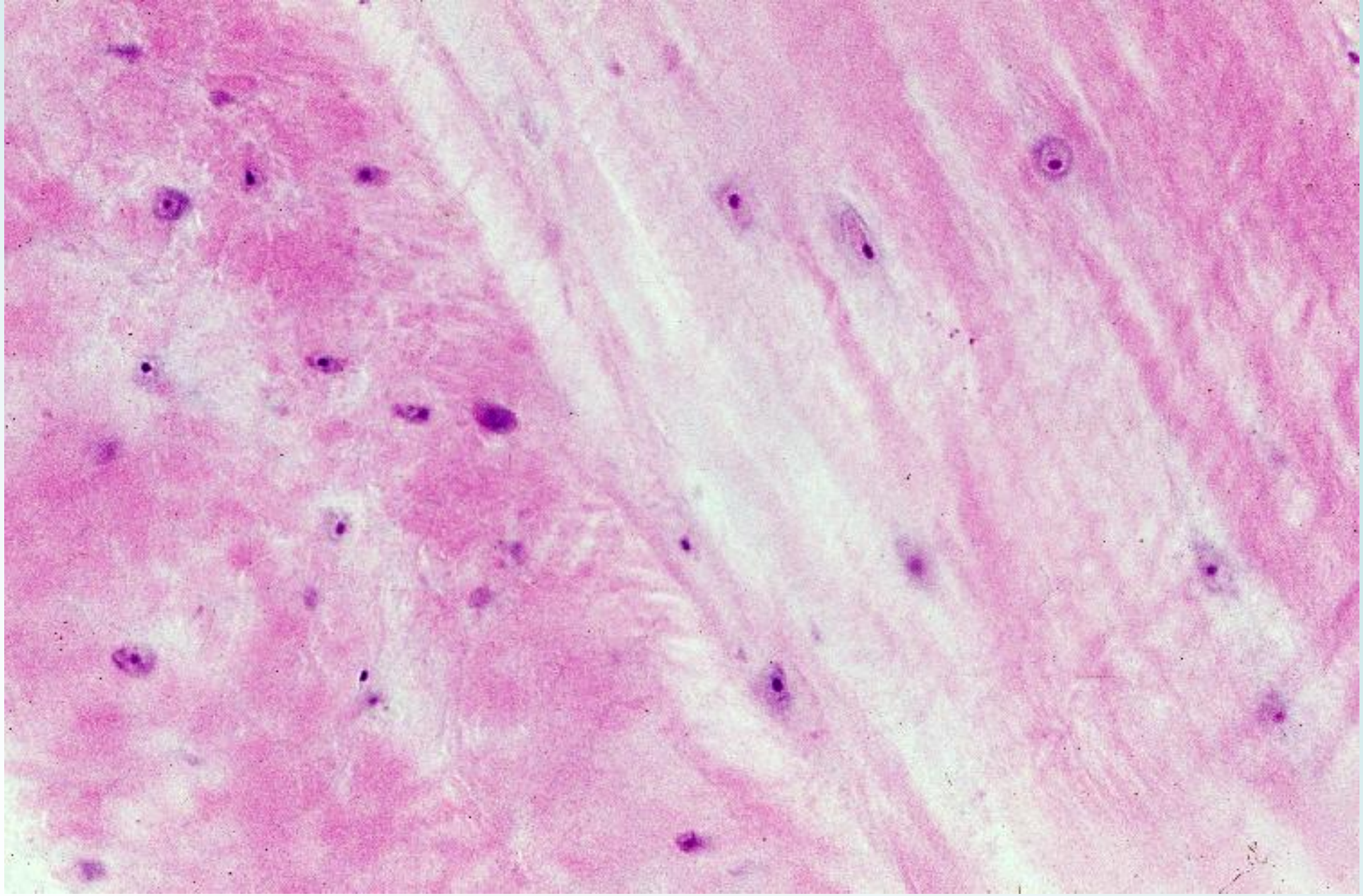
03-34 Fibrocartilage 2. Meniscus of knee joint, monkey, H-E stain, x 160.



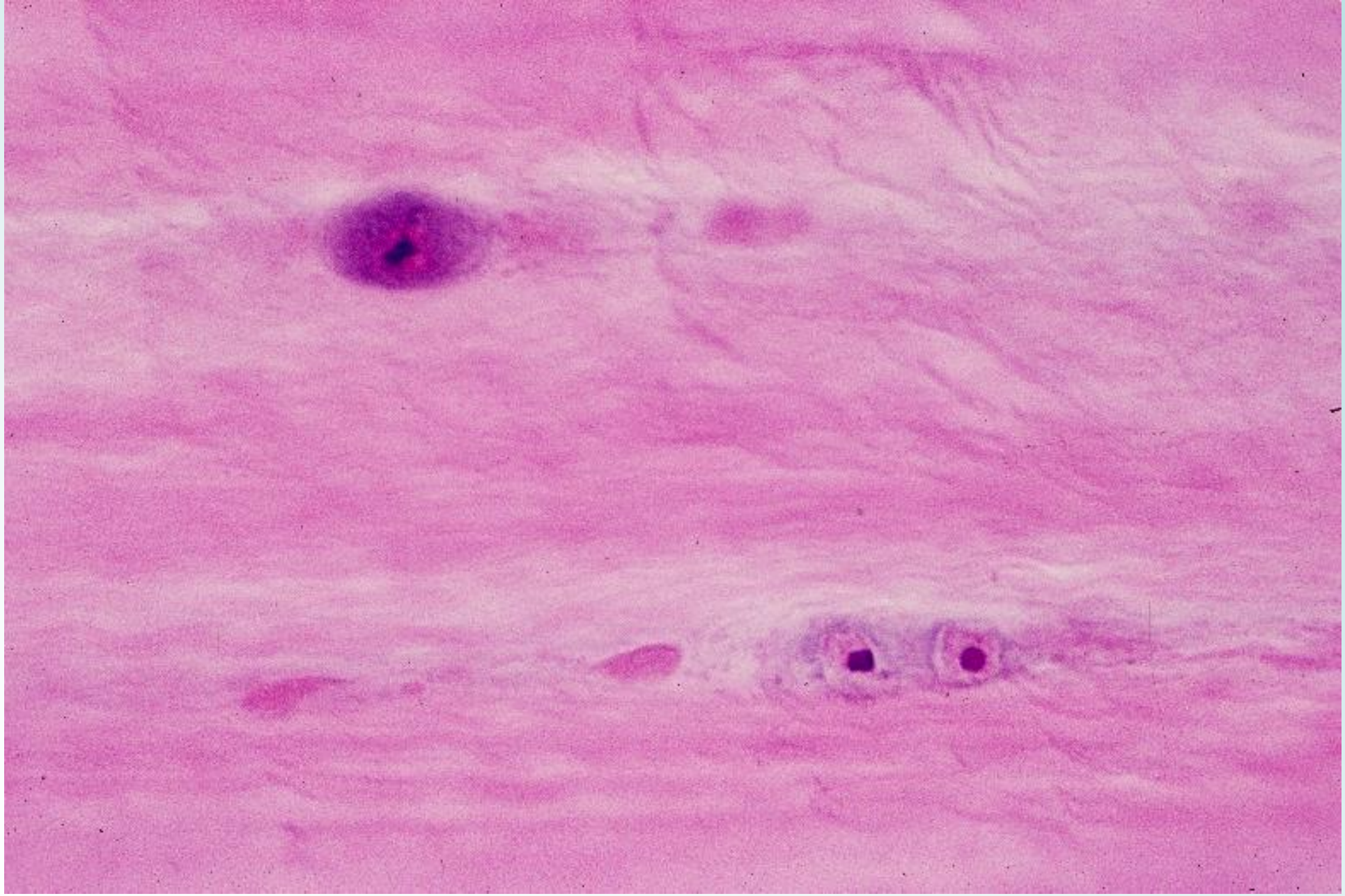
03-35 Fibrocartilage 3. Symphysis pubis, monkey H-E stain, x 160.



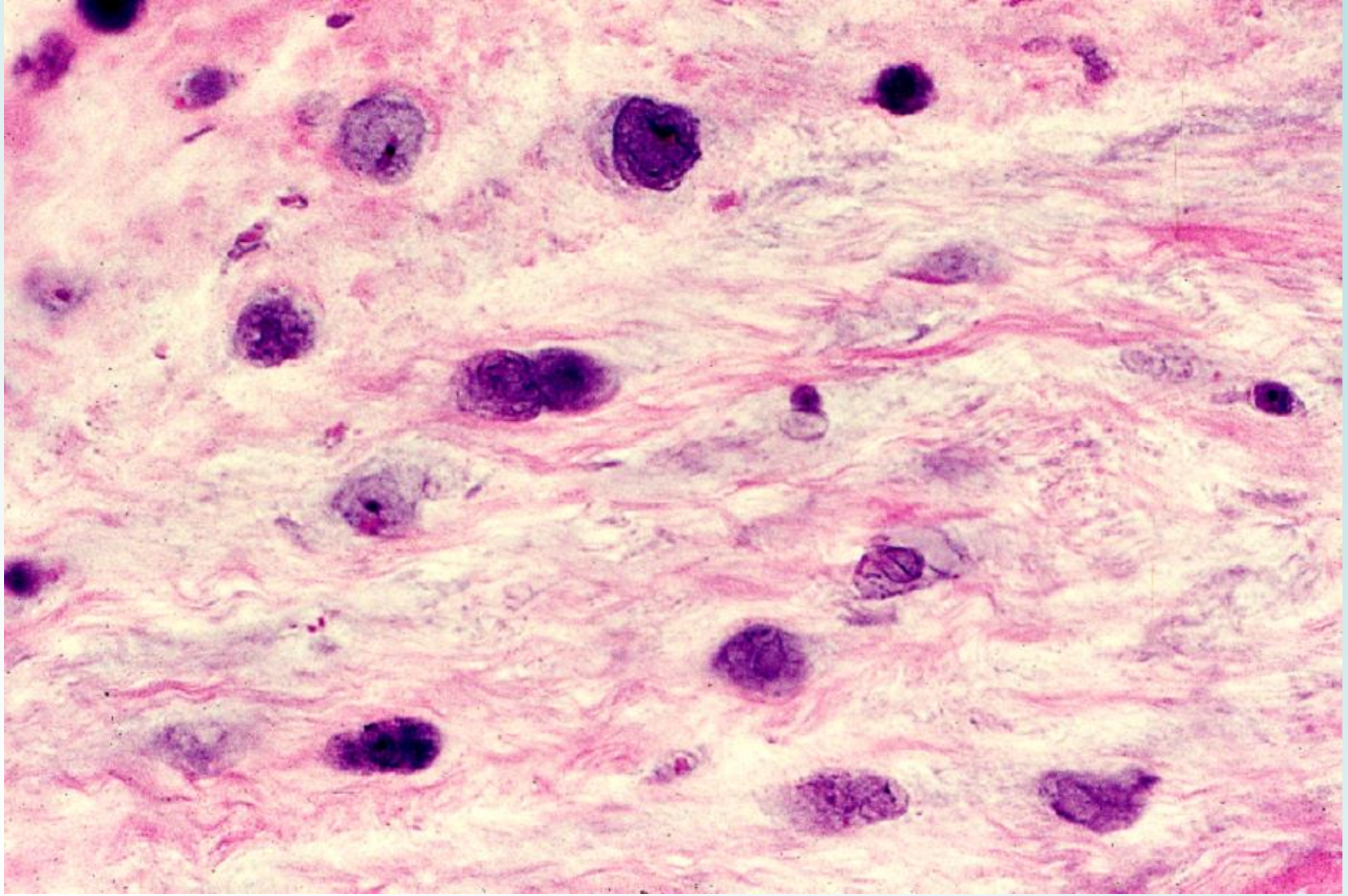
03-36 Fibrocartilage 4. Intervertebral disc, human, H-E stain, x 2.0.



03-37 Fibrocartilage 5. Intervertebral disc, human, H-E stain, x 64.



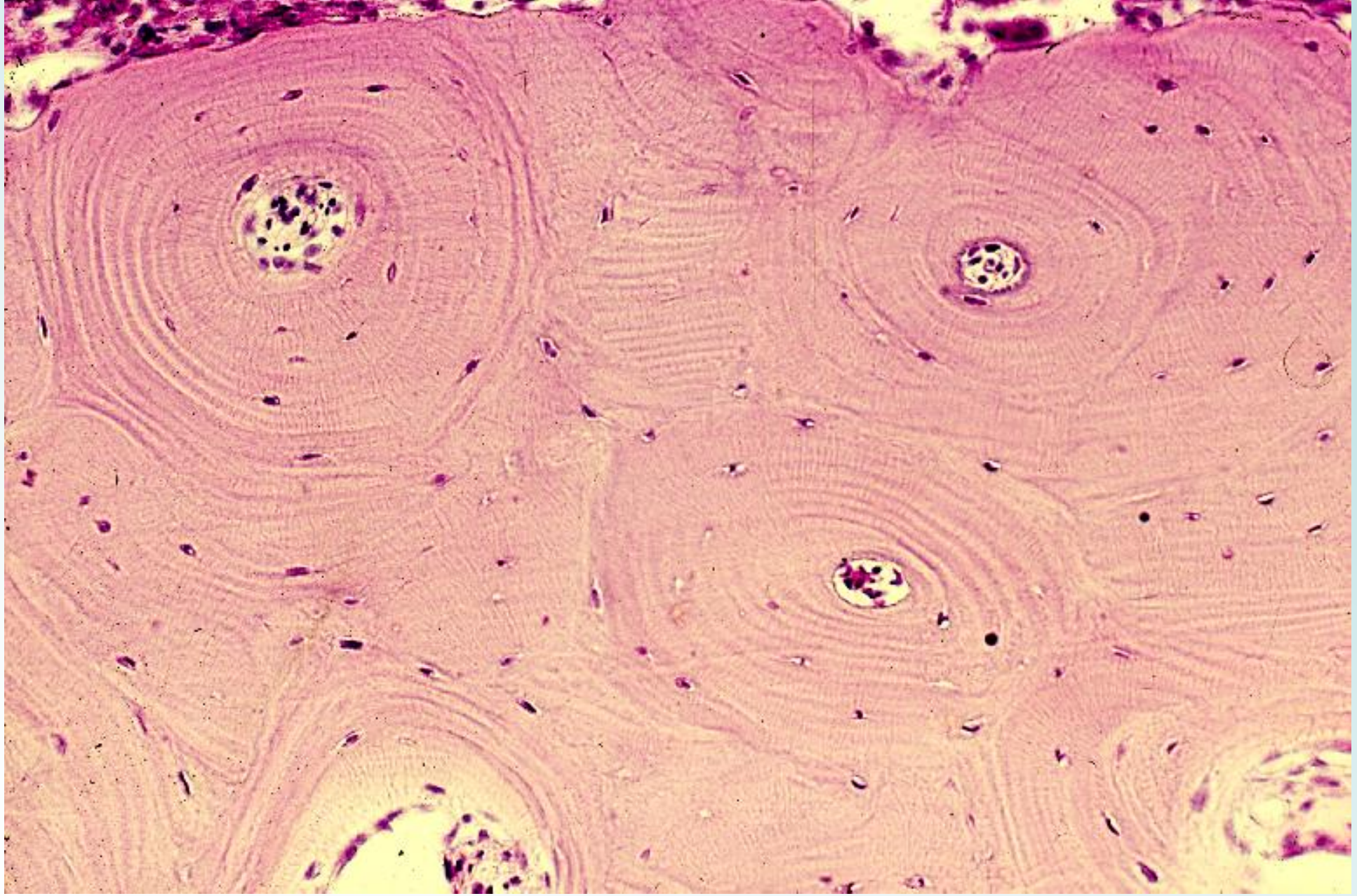
03-38 Fibrocartilage 6. Intervertebral disc, human, H-E stain, x 160.



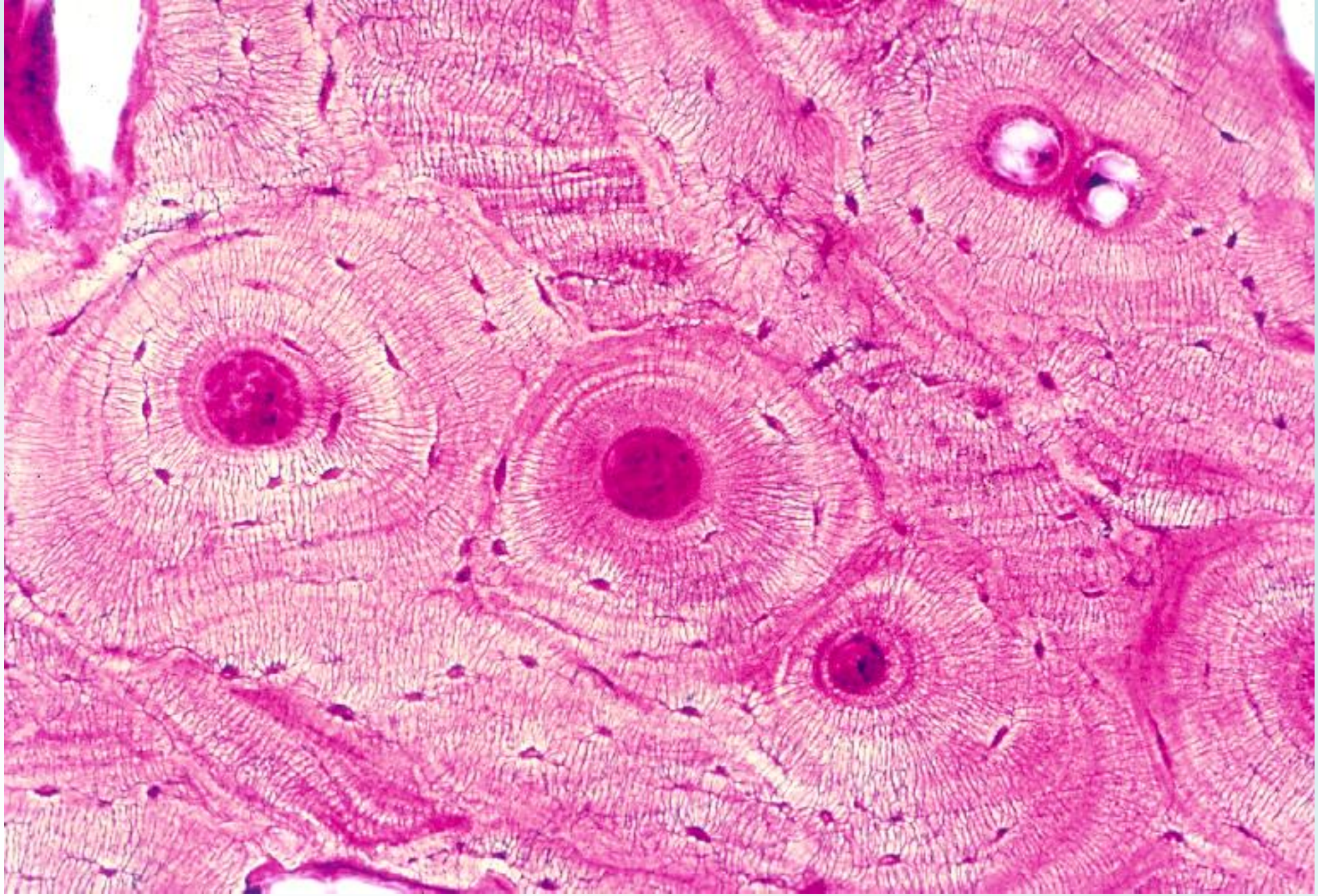
03-39 Fibrocartilage 7. Intervertebral disc, human, H-E stain, x 64.

03-003
Bone

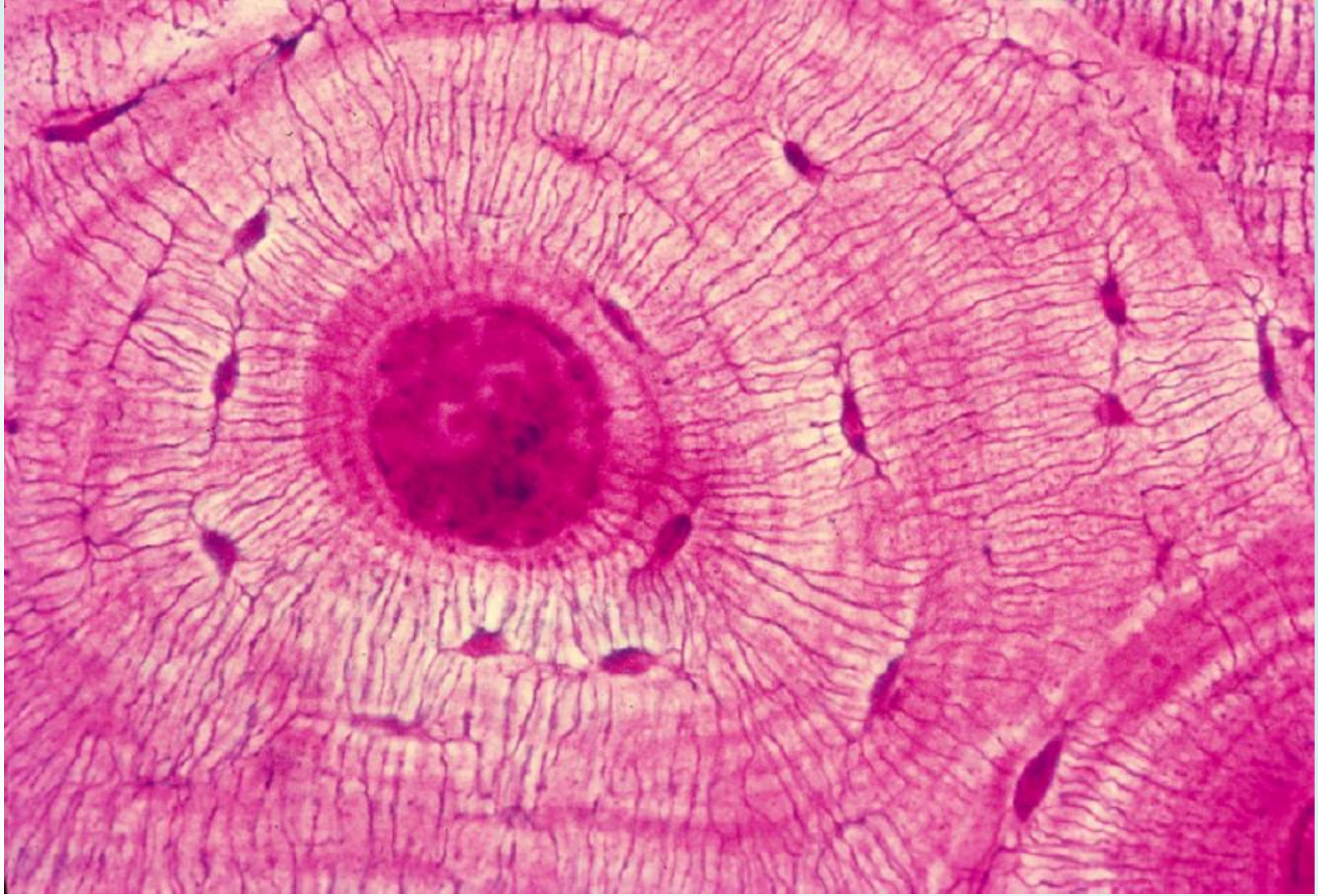
03-40 Transverse section of femur 1. Monkey, decalcified and H-E stain, x 4.0.



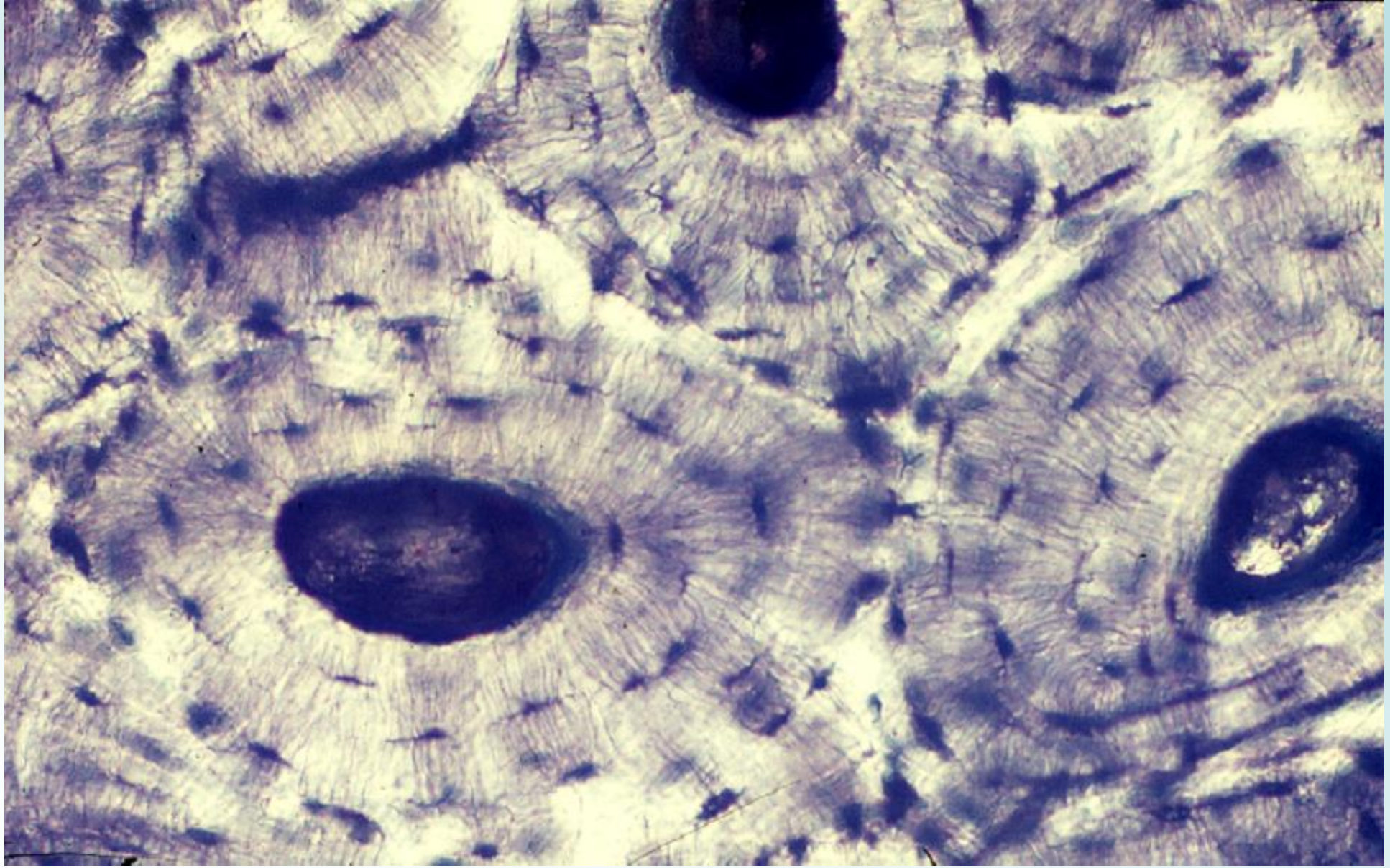
03-41 Transvers section of femur 2. Monkey, decalcified, H-E stain, x 64.



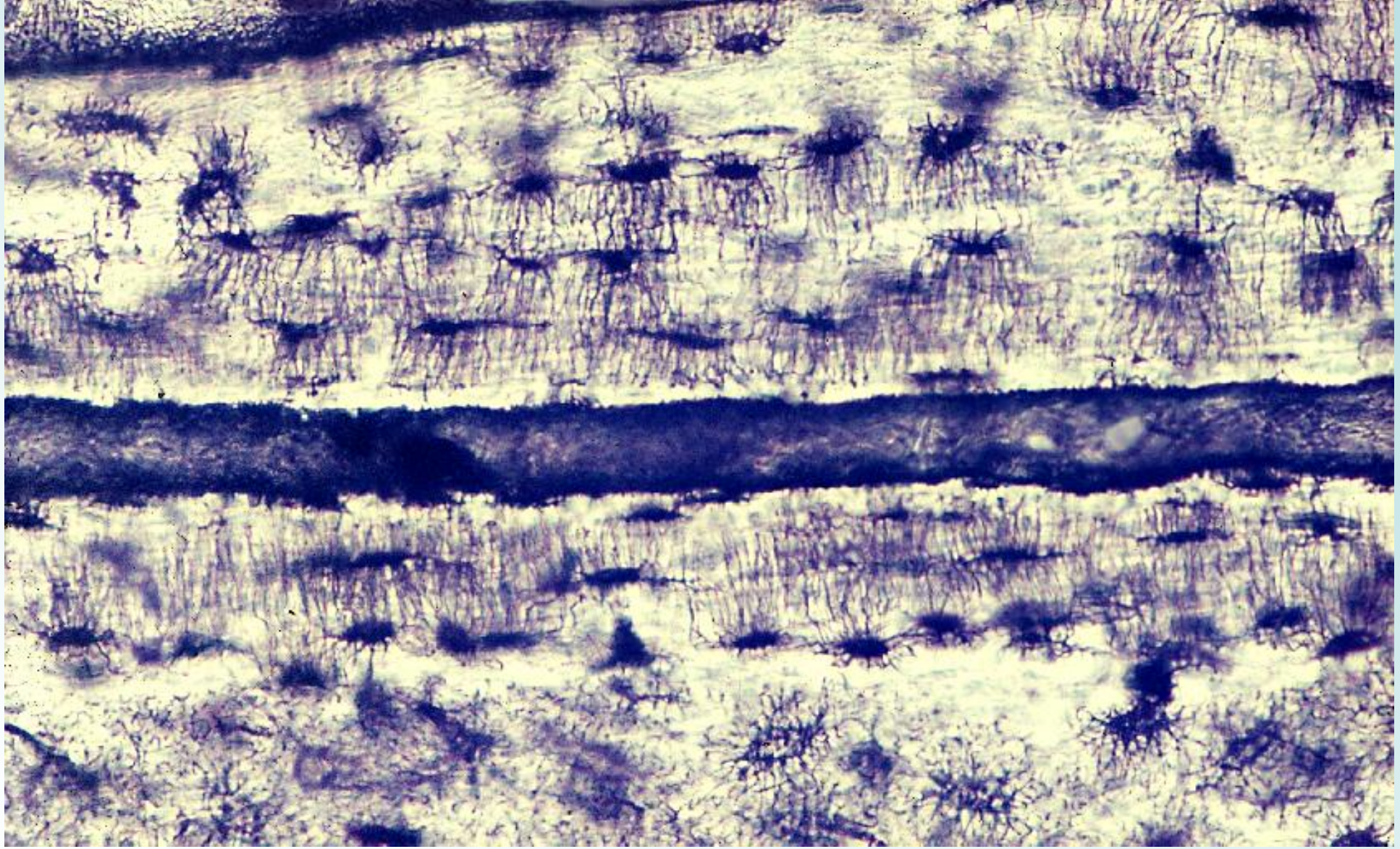
03-42 Haversian systems 1. Monkey femur, decalcified, Schmorl' stain, x 64.



03-43 Haversian system 2. Monkey femur, decalcified, Schmorl' stain, x 160.



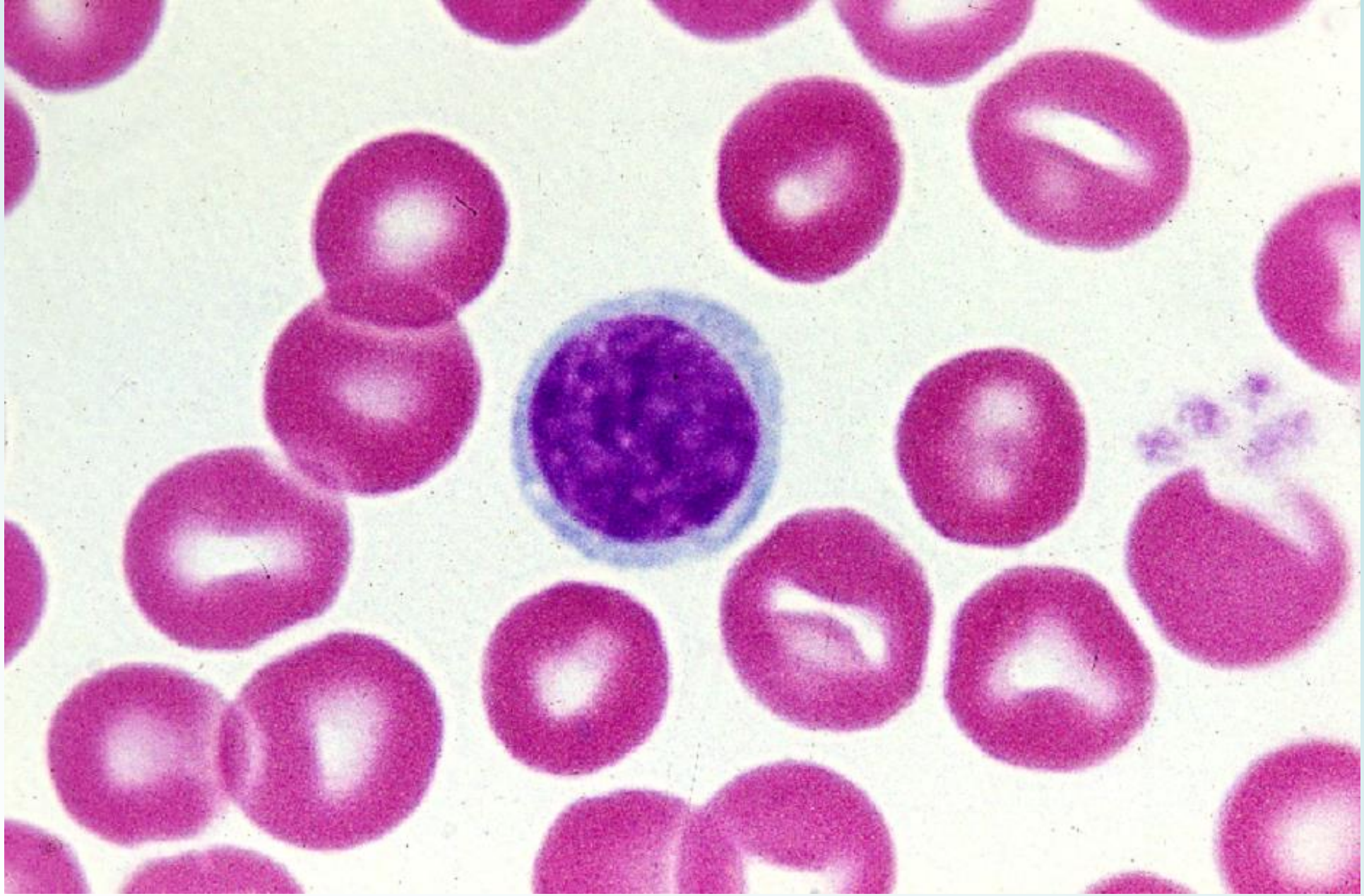
03-44 Herversian systems 3. Human, ground section, not stained, x 64.



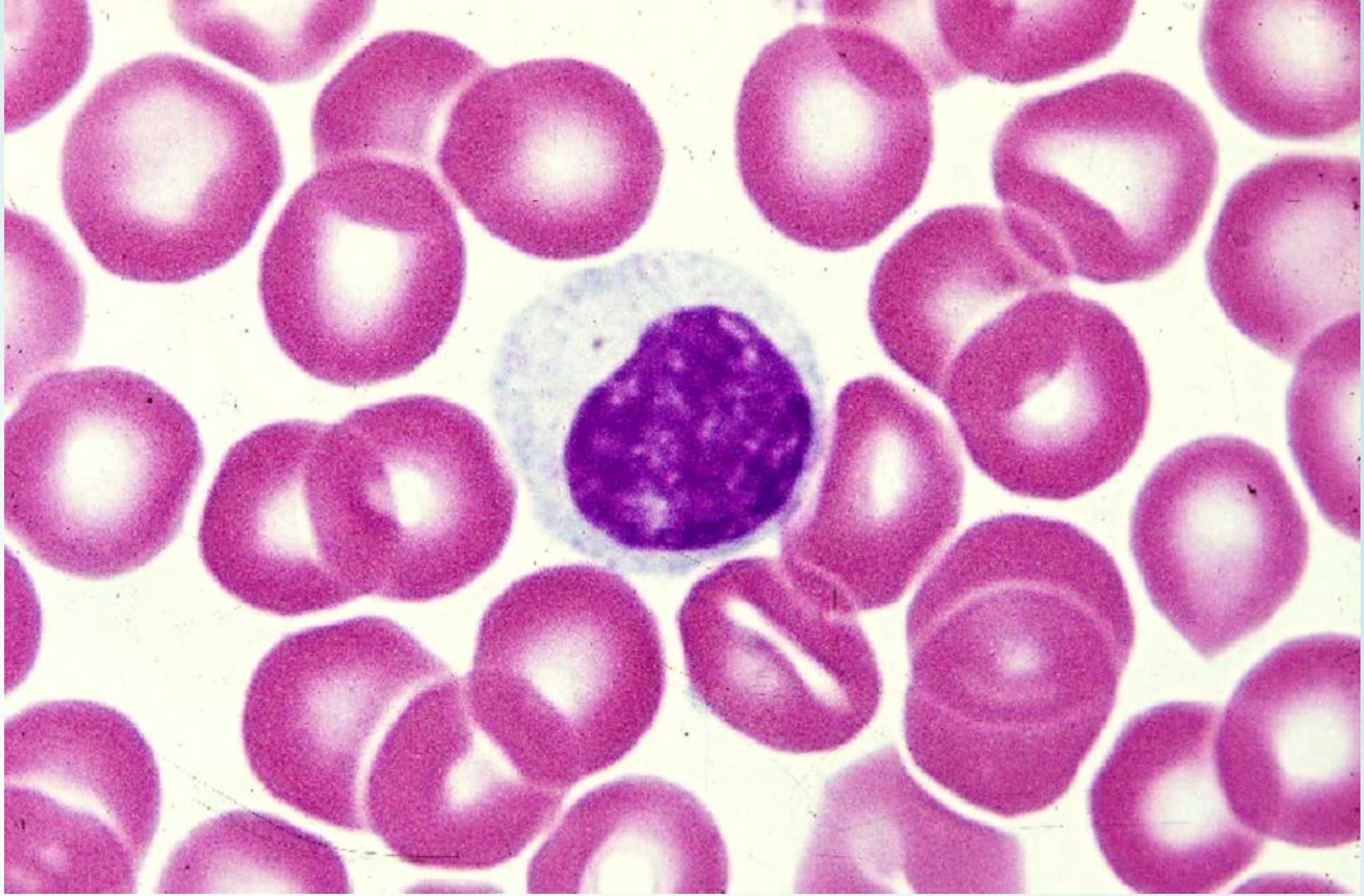
03-45 Haversian system 4. Human, ground section, not stained, x 64.

03-004
Blood

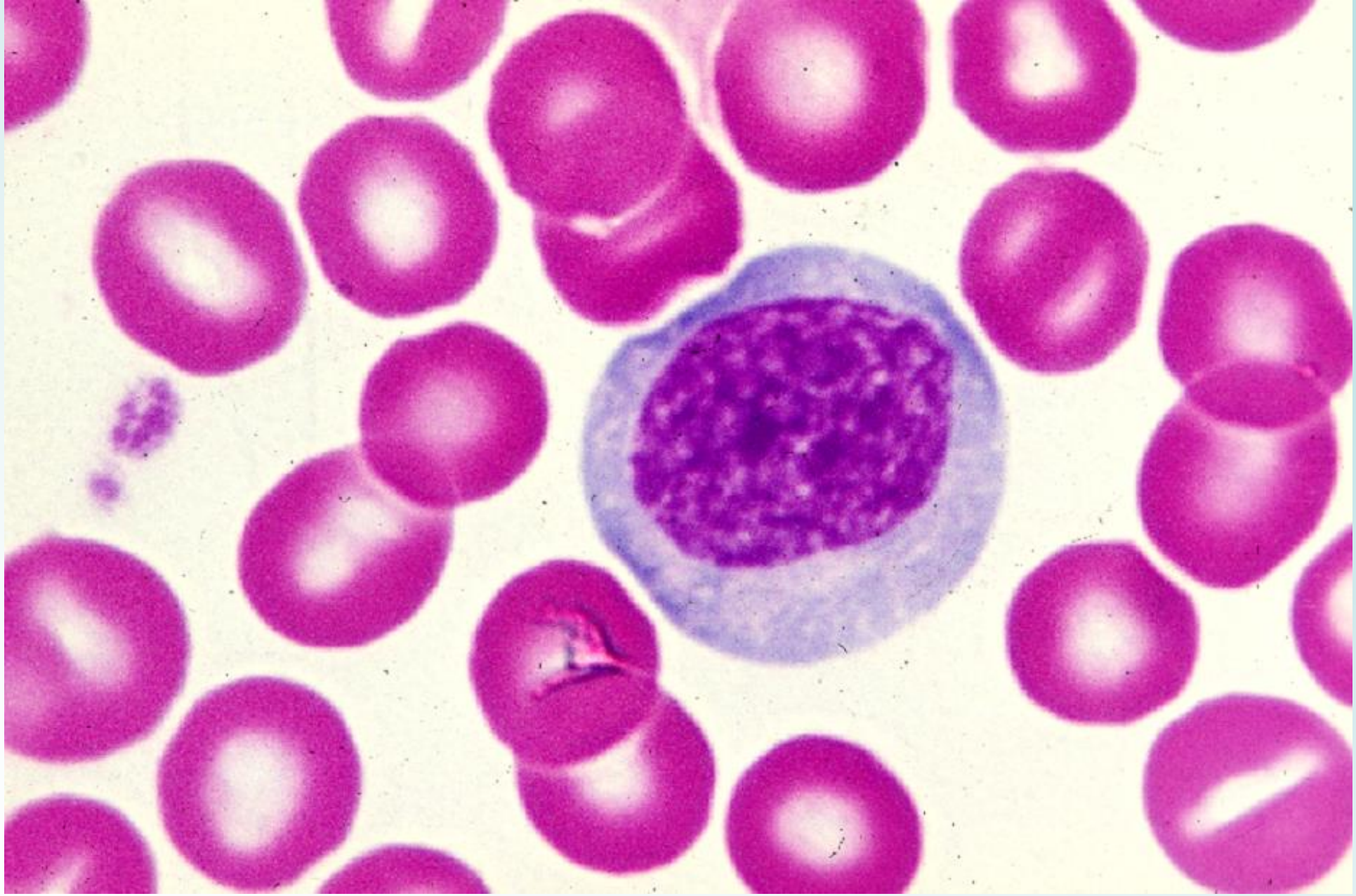
03-46 Small lymphocyte 1. Human, Giemsa stain, x 640.



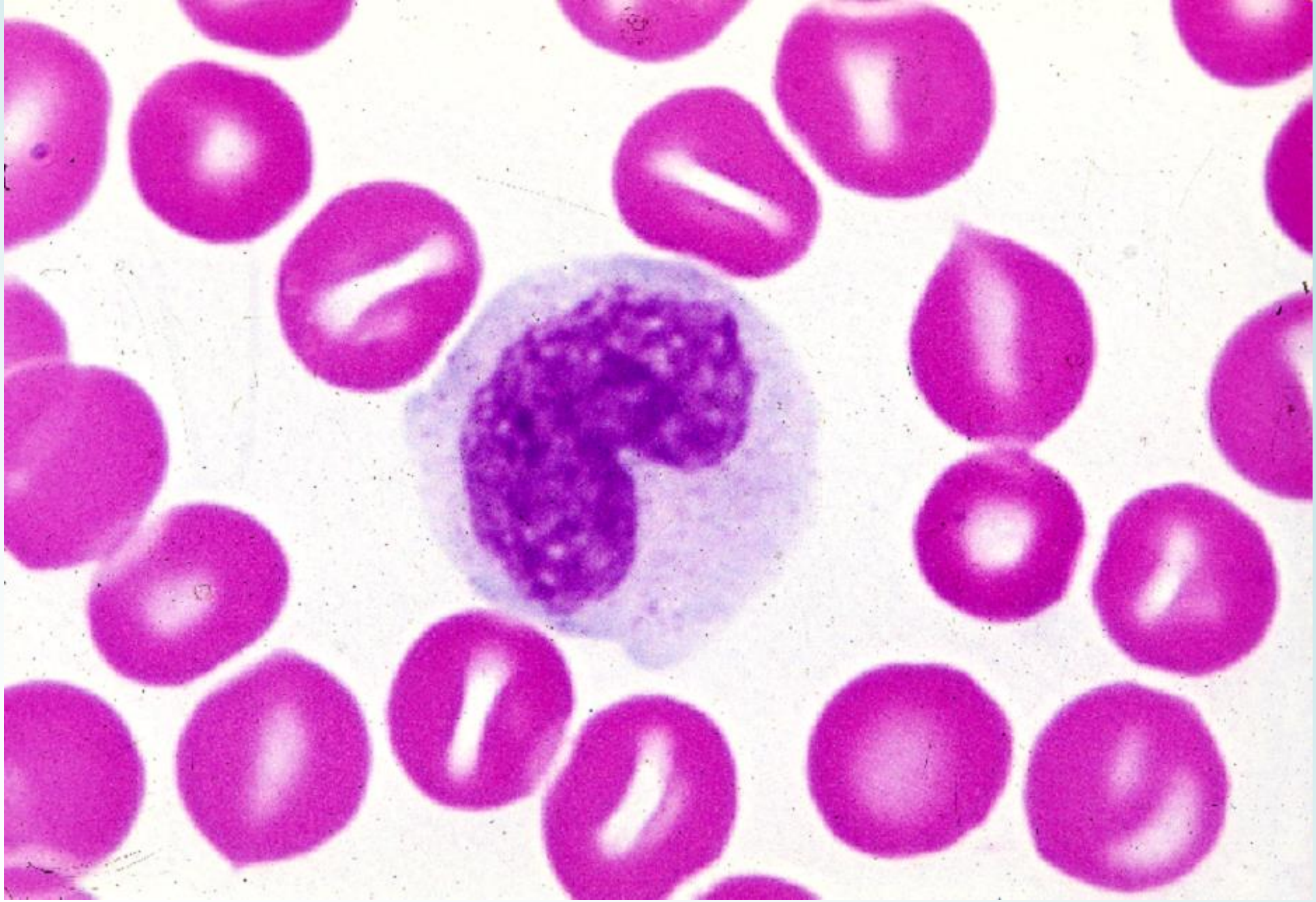
03-47 Small lymphocyte 2. Human, Giemsa stain, x 640.



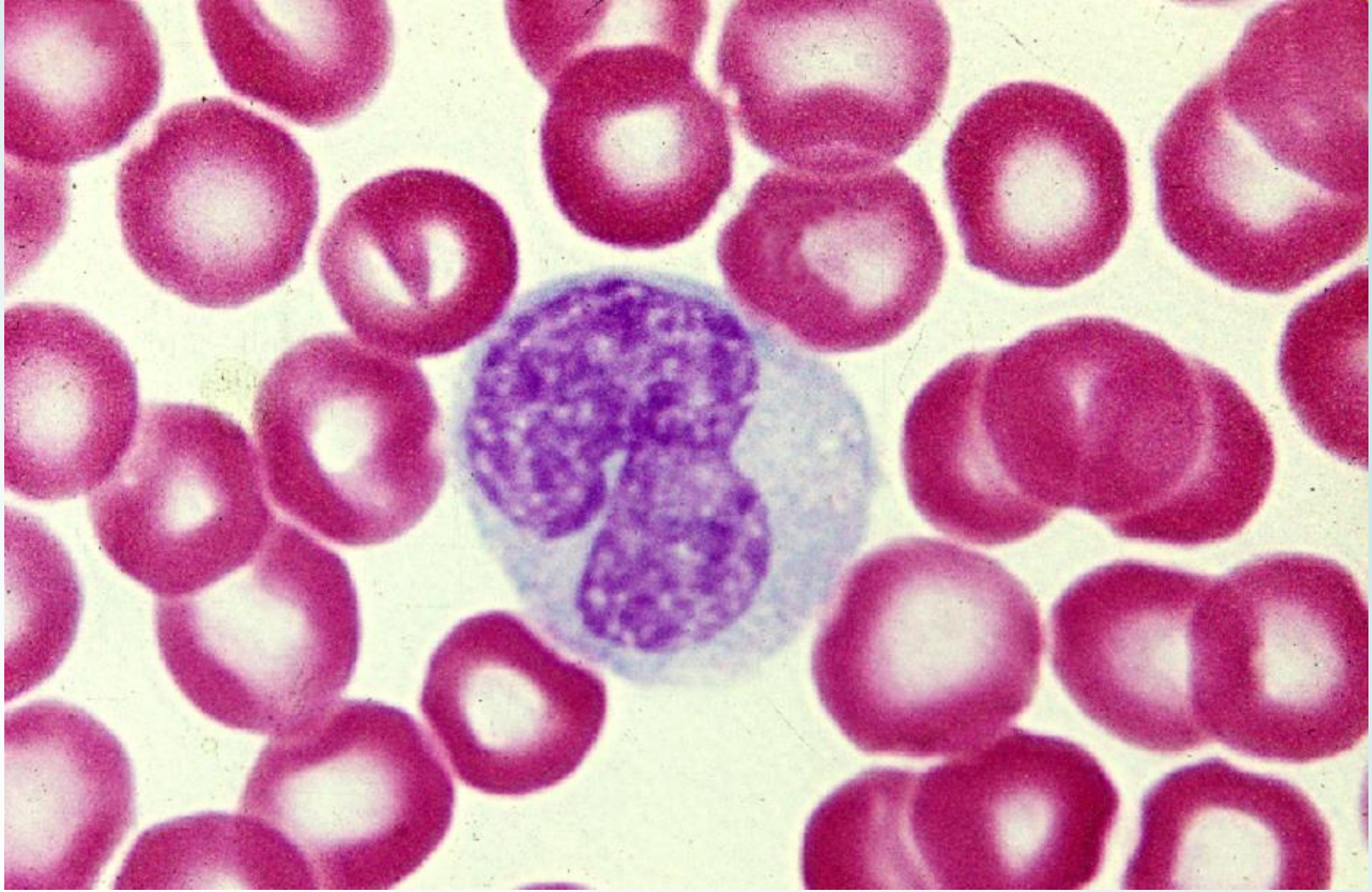
03-48 Large lymphocyte 1. Human, Giemsa stain, x 640.



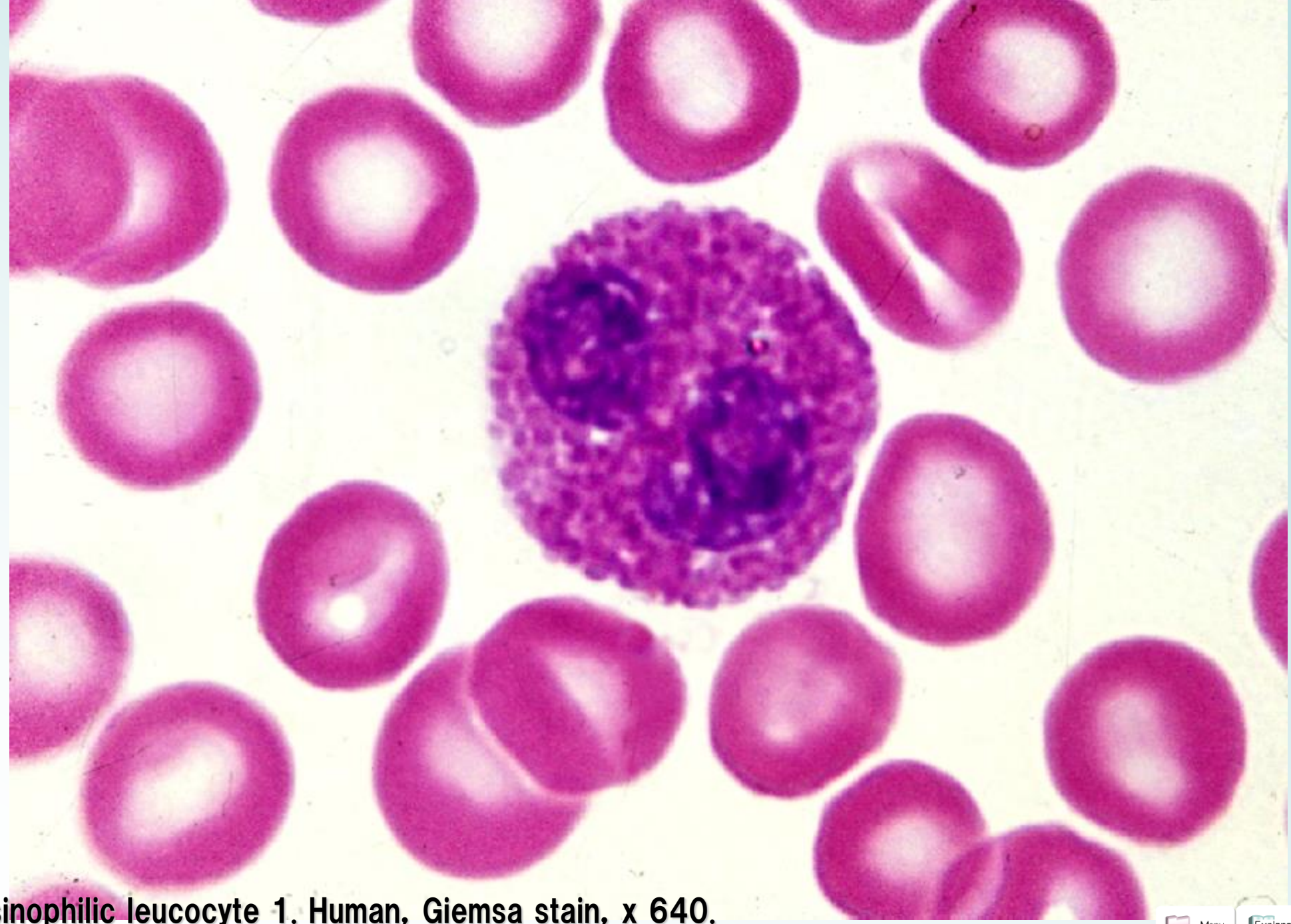
03-49 Large lymphocyte 2. Human, Giemsa stain, x 640.



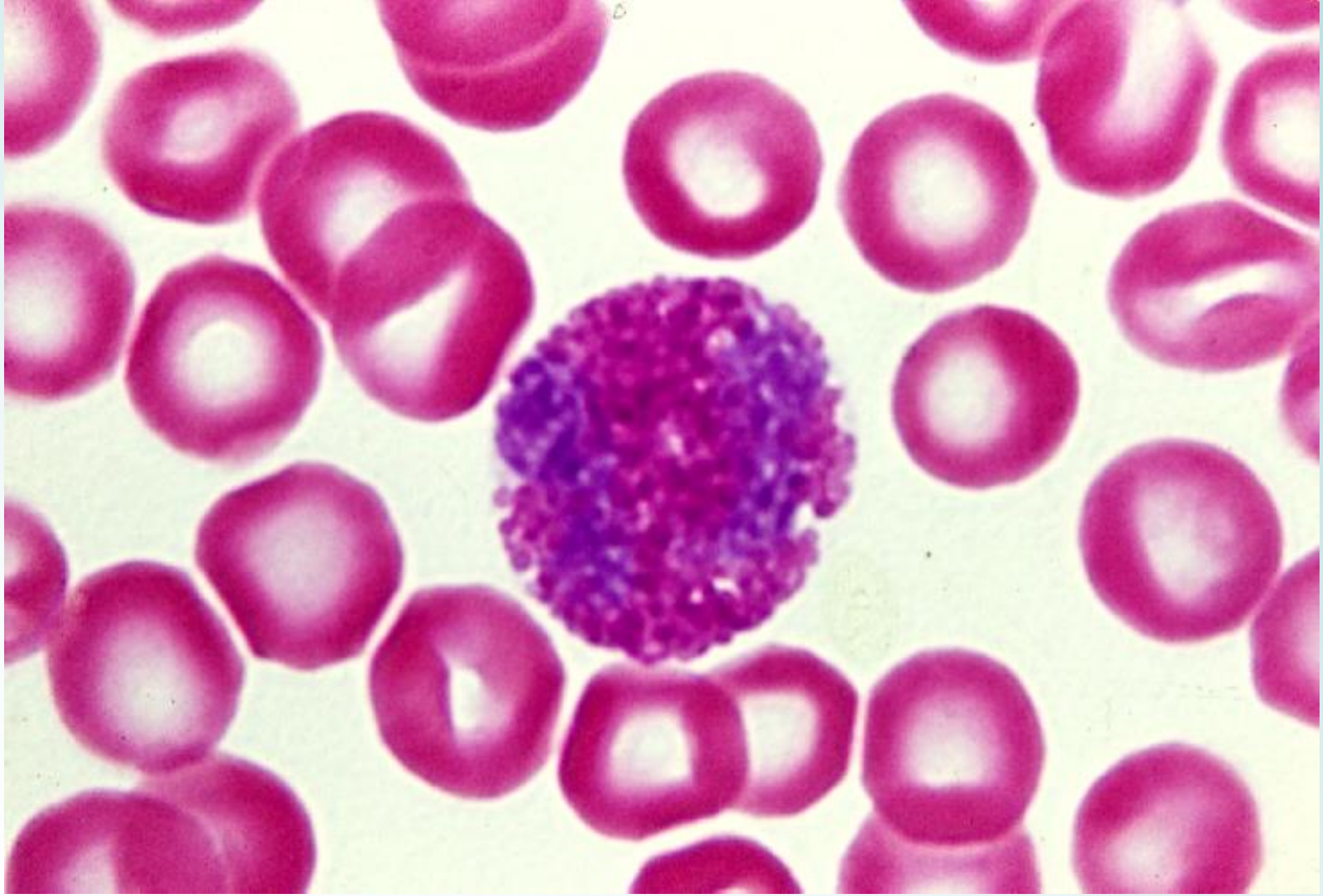
03-50 Monocyte 1. Human, Giemsa stain, x 640.



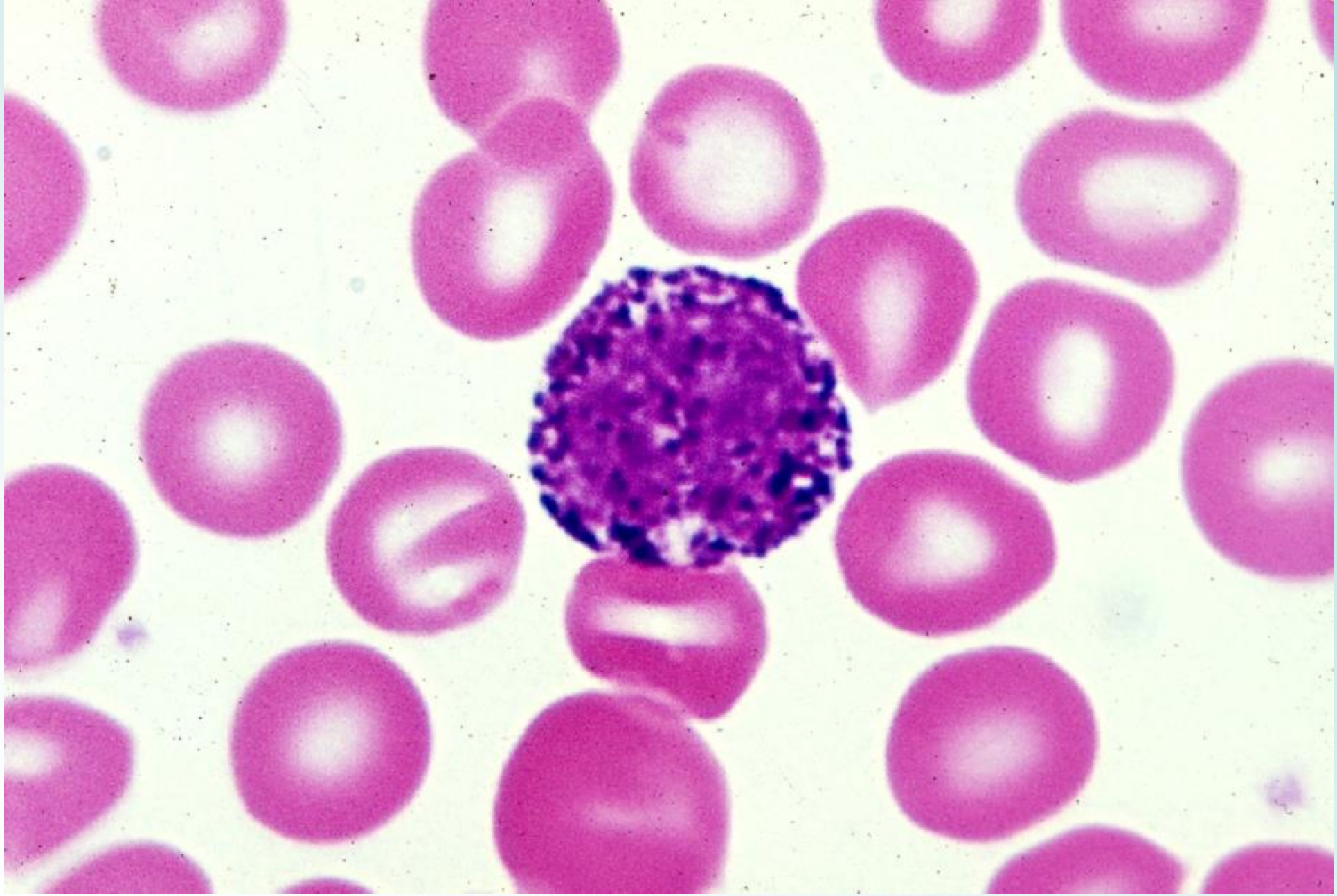
03-51 Monocyte 2. Human, Giemsa stain, x 640.



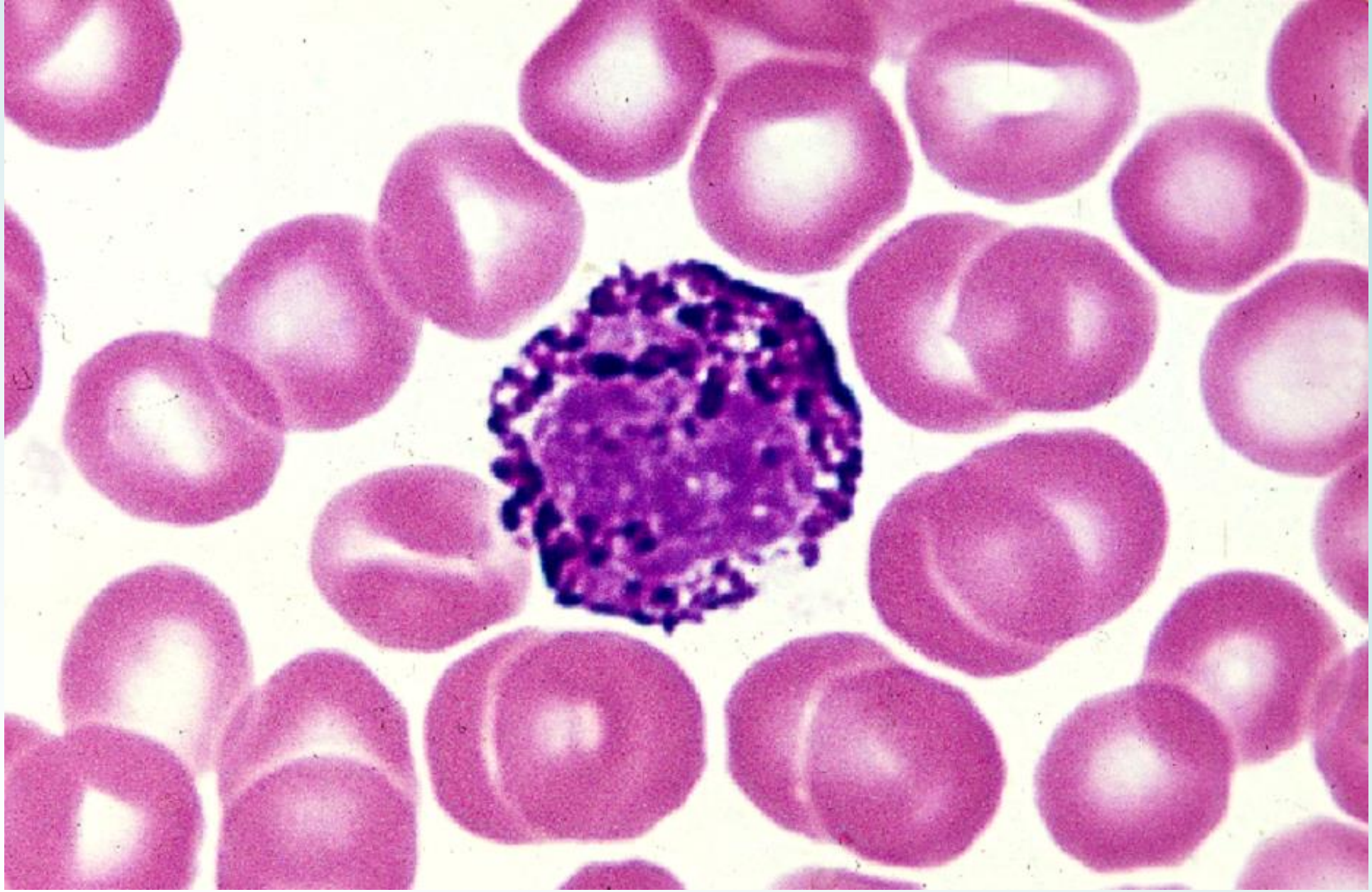
03-52 Eosinophilic leucocyte 1. Human, Giemsa stain, x 640.



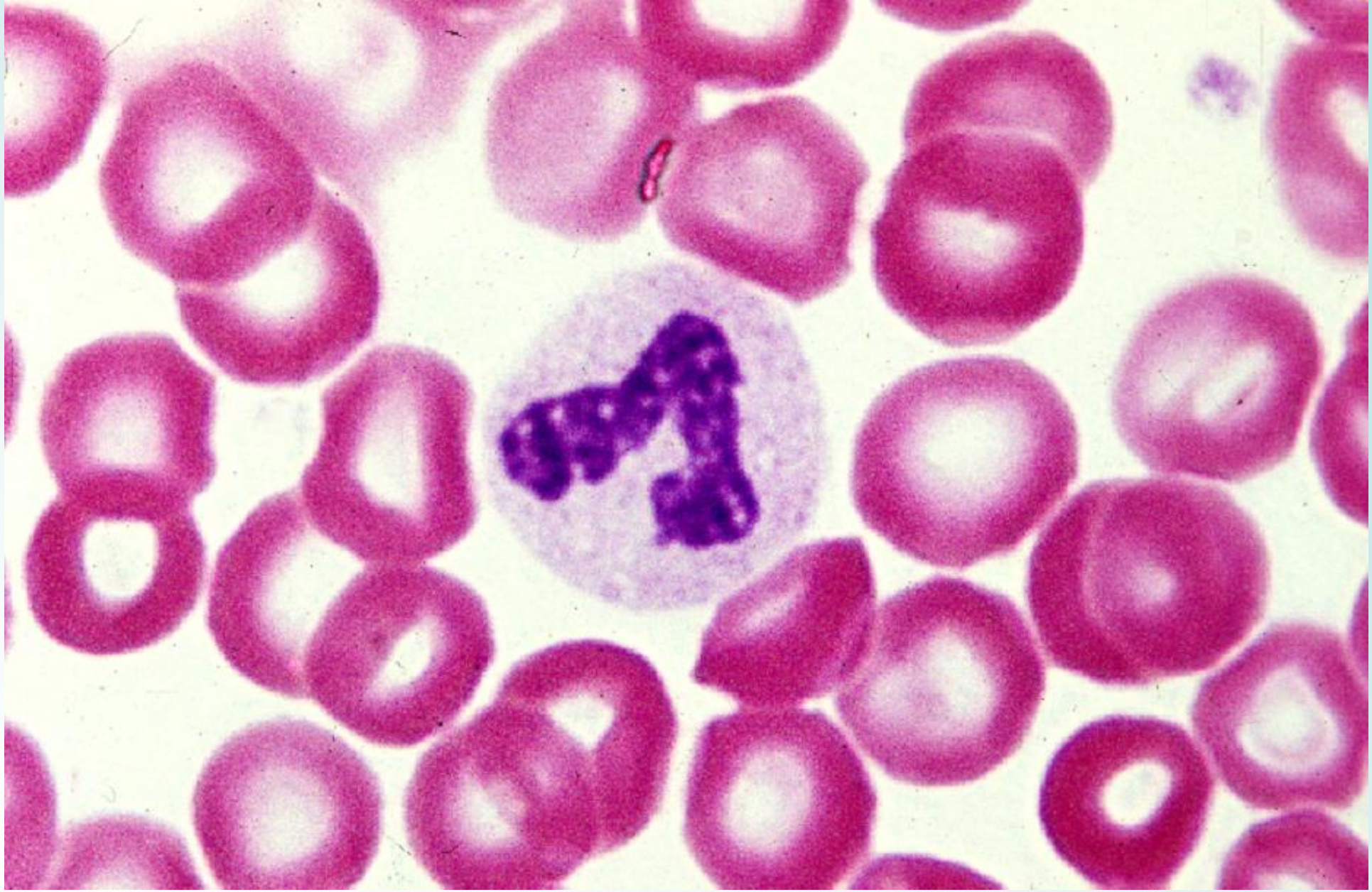
03-53 Eosinophilic leucocyte 2. Human, Giemsa stain, x 640.



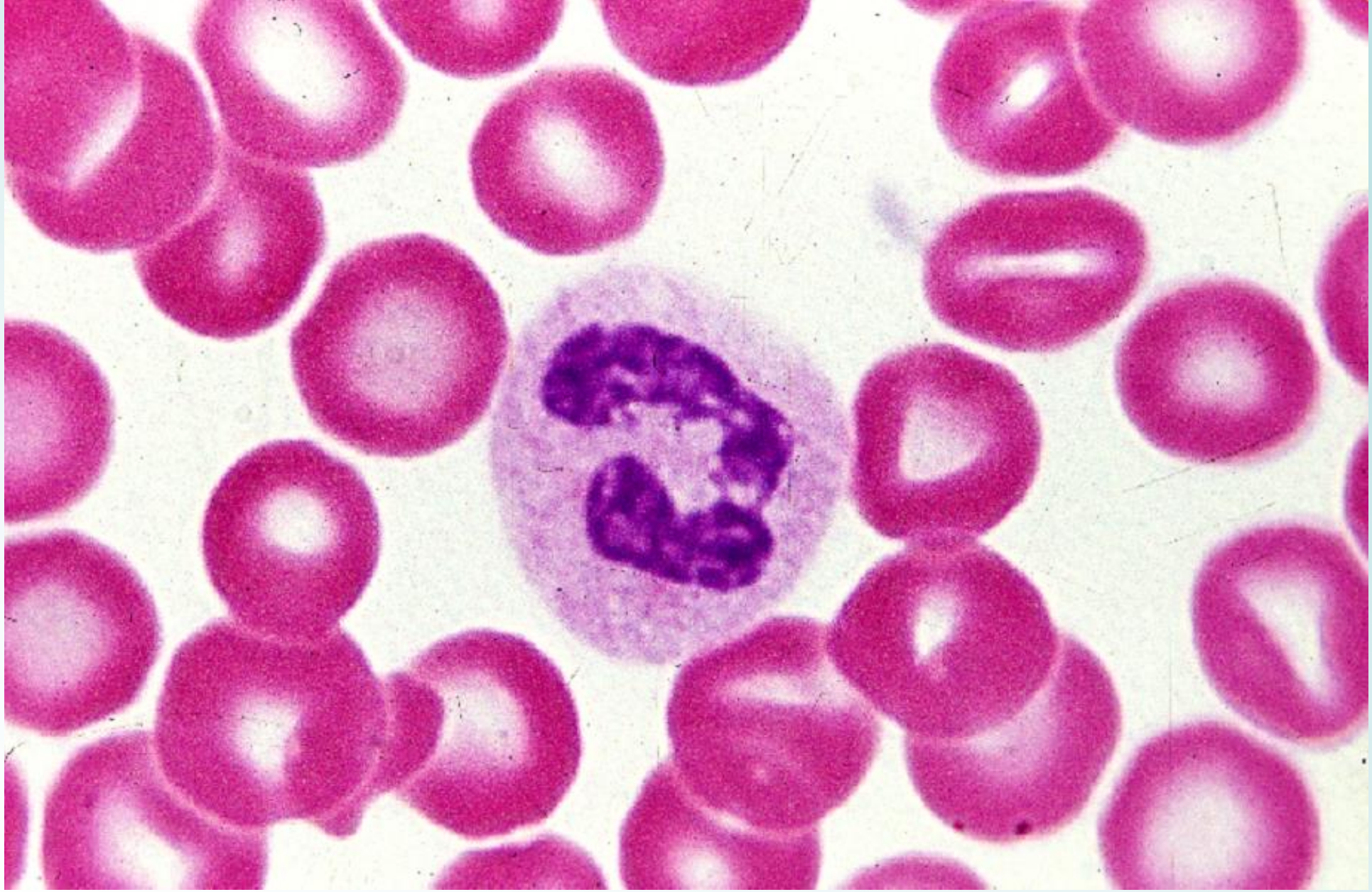
03-54 Bosophilic leukocyte 1. Human, Giemsa stain, x 640.



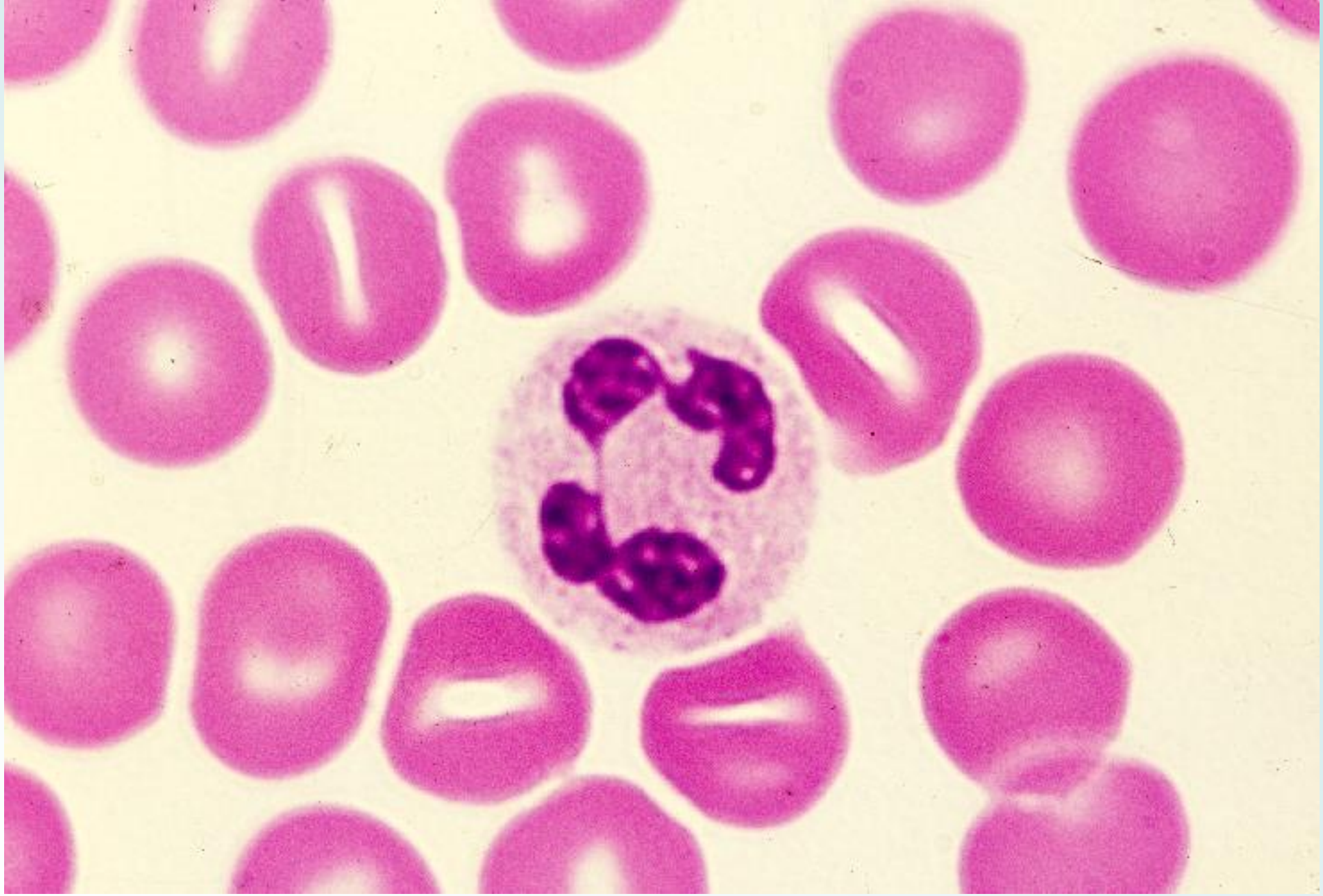
03-55 Bosophilic leukocyte 2. Human, Giemsa stain, x 640.



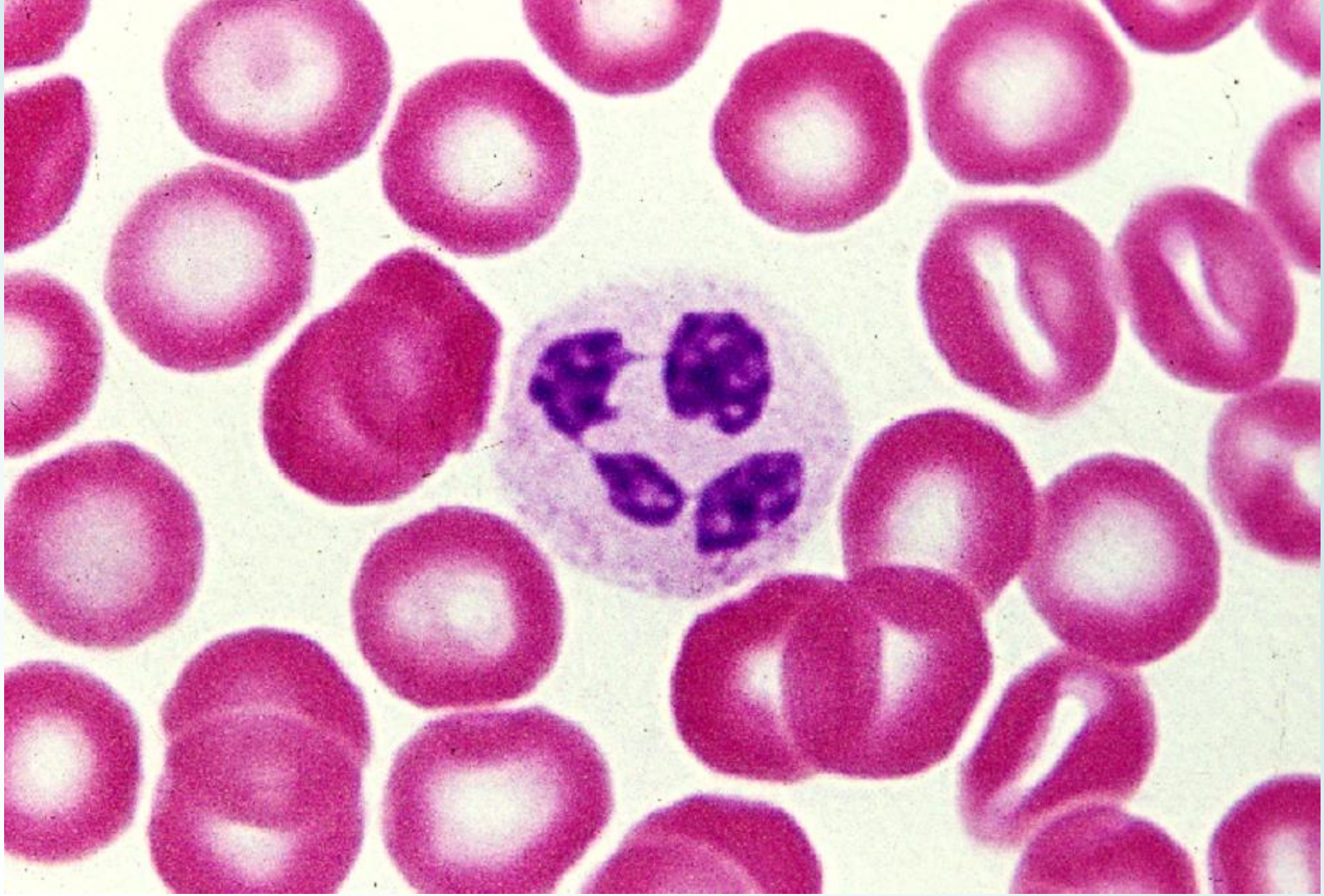
03-56 Neutrophilic leukocyte 1. Rod-shape nucleus. Human, Giemsa stain, x 640.



03-57 Neutrophilic leukocyte 2. 2-segmented nucleus. Human, Giemsa stain, x 640.

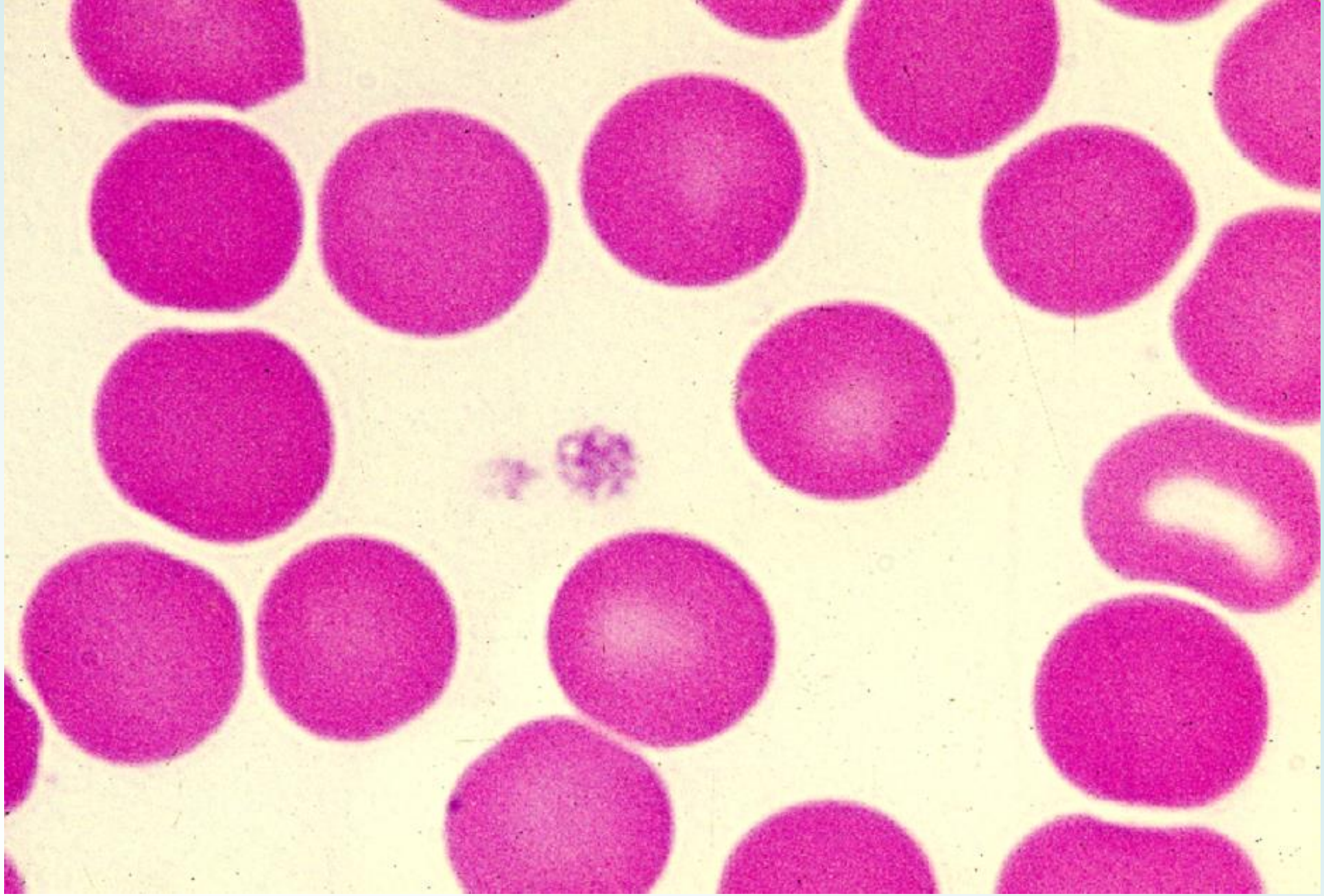


03-58 Neutrophilic leukocyte 3. 3-segmented nucleus. Human, Giemsa stain, x 640.

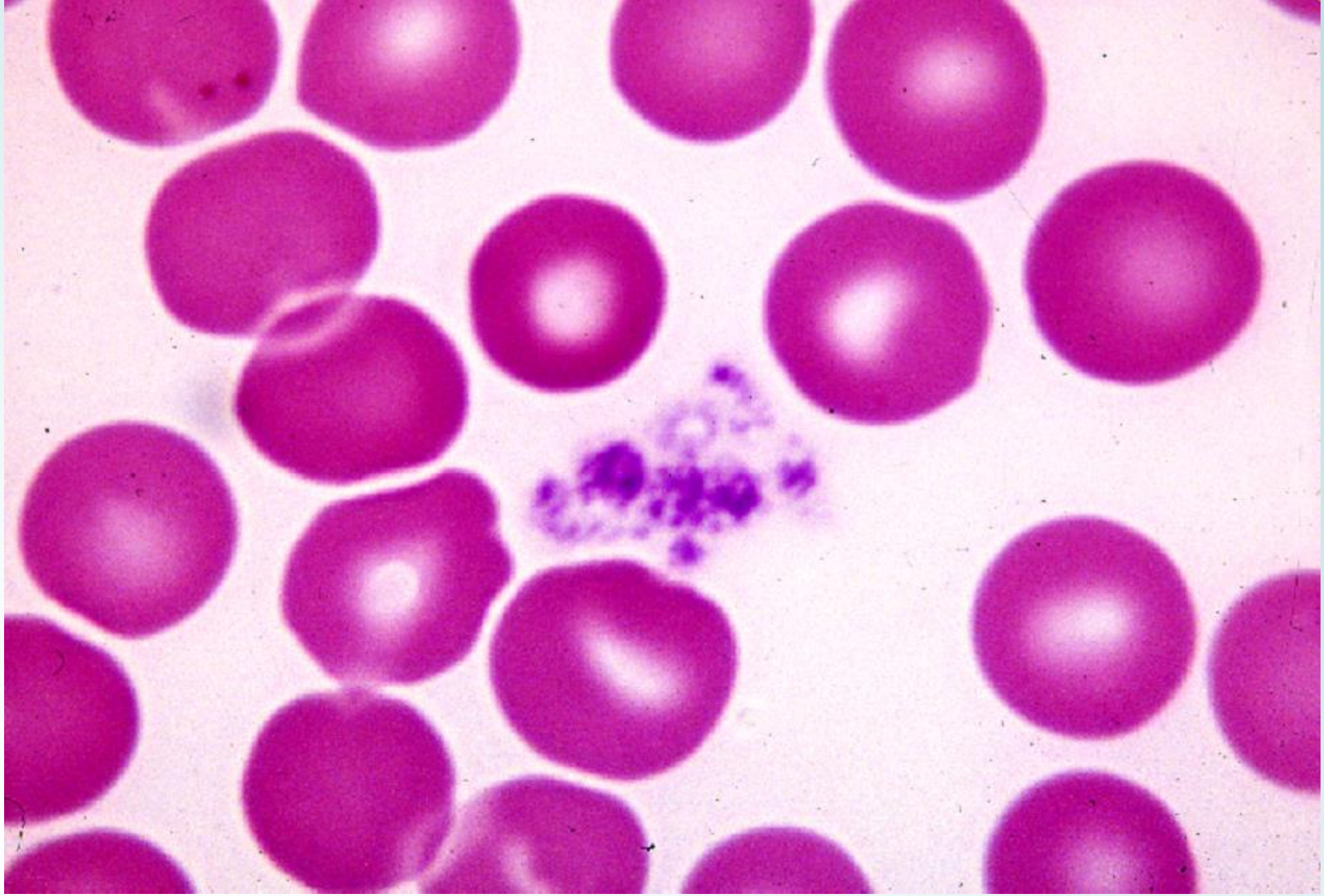


03-59 Neutrophilic leukocyte 4. 4-segmented nucleus. Human, Giemsa stain, x 640.

03-60 Neutrophilic leukocyte 5. Human female, Giemsa stain, x 640.



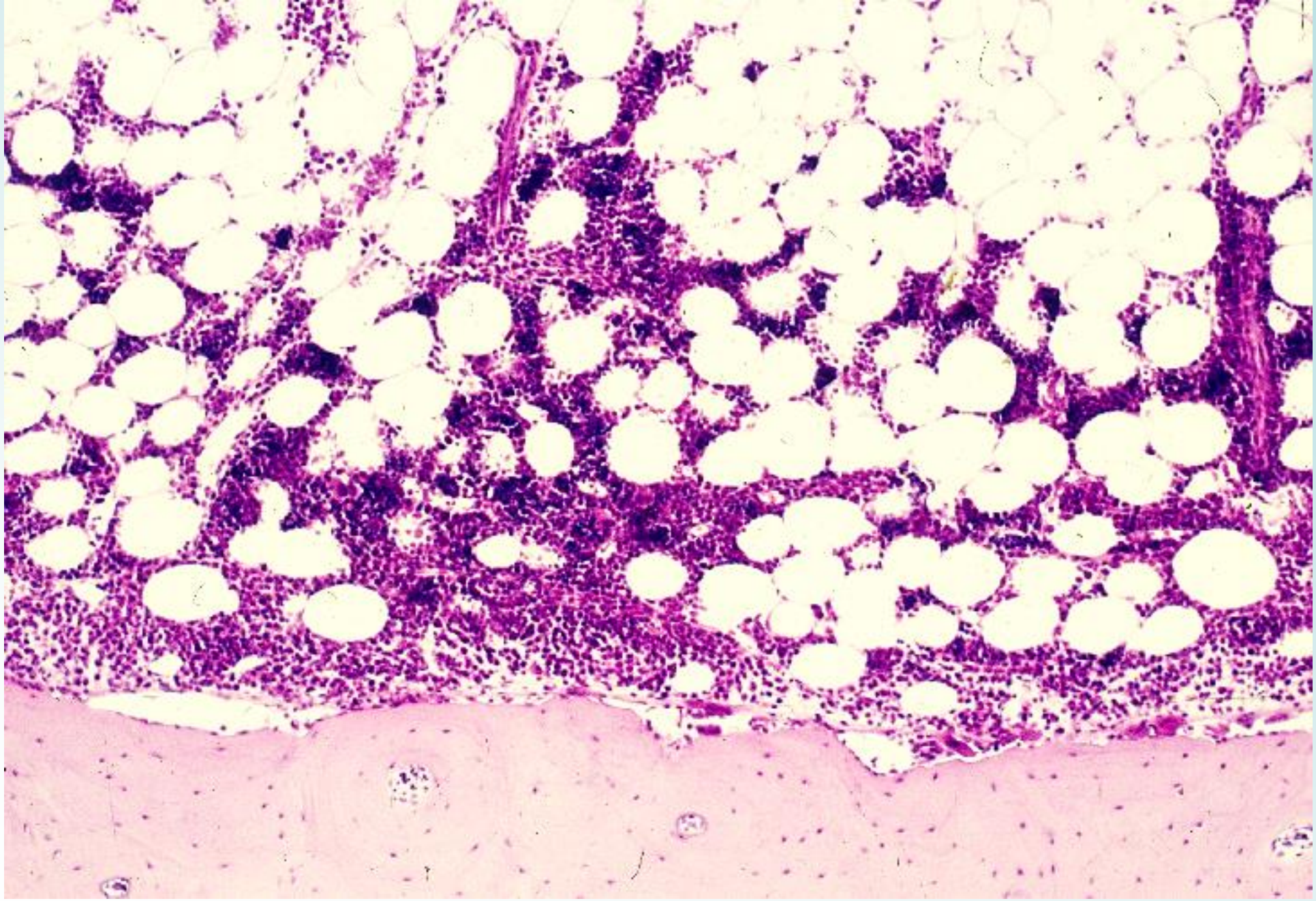
03-61 Blood platelets 1. Human, Giemsa stain, x 640.



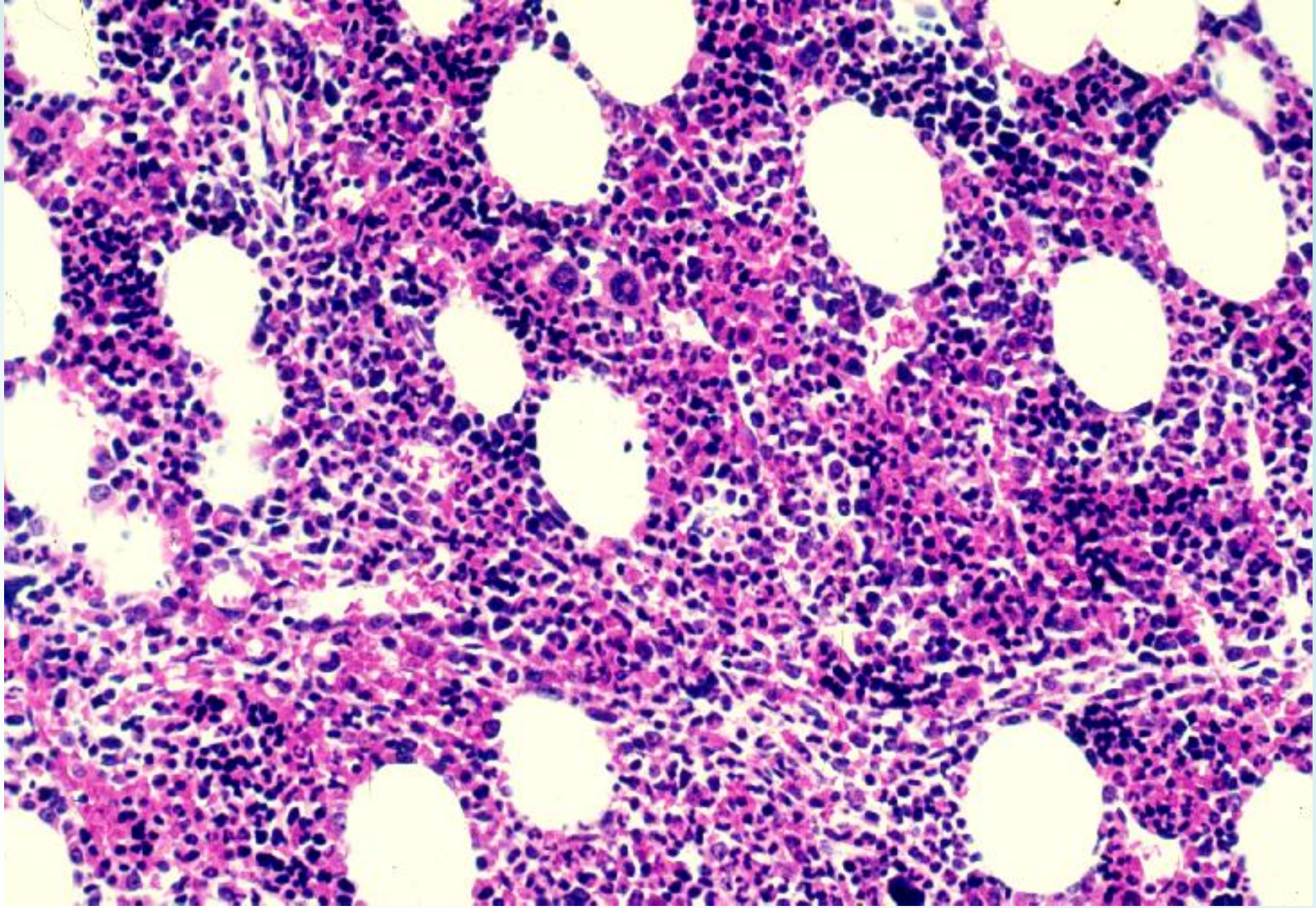
03-62 Blood platelets 2. Human, Giemsa stain, x 640.

03-005
Bone Marrow

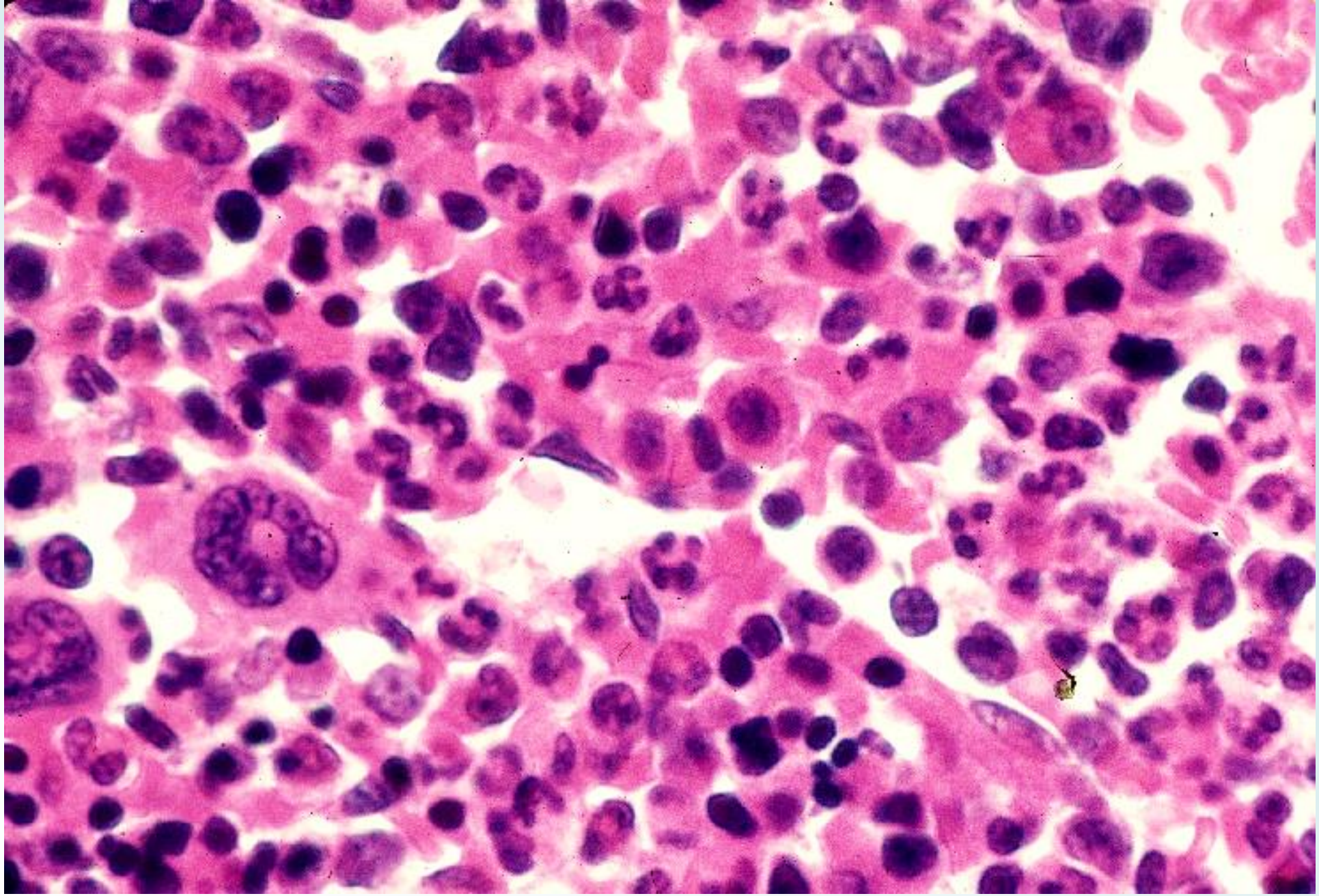
03-63 Bone marrow in the femur. Monkey, H-E stain, x 4.0.



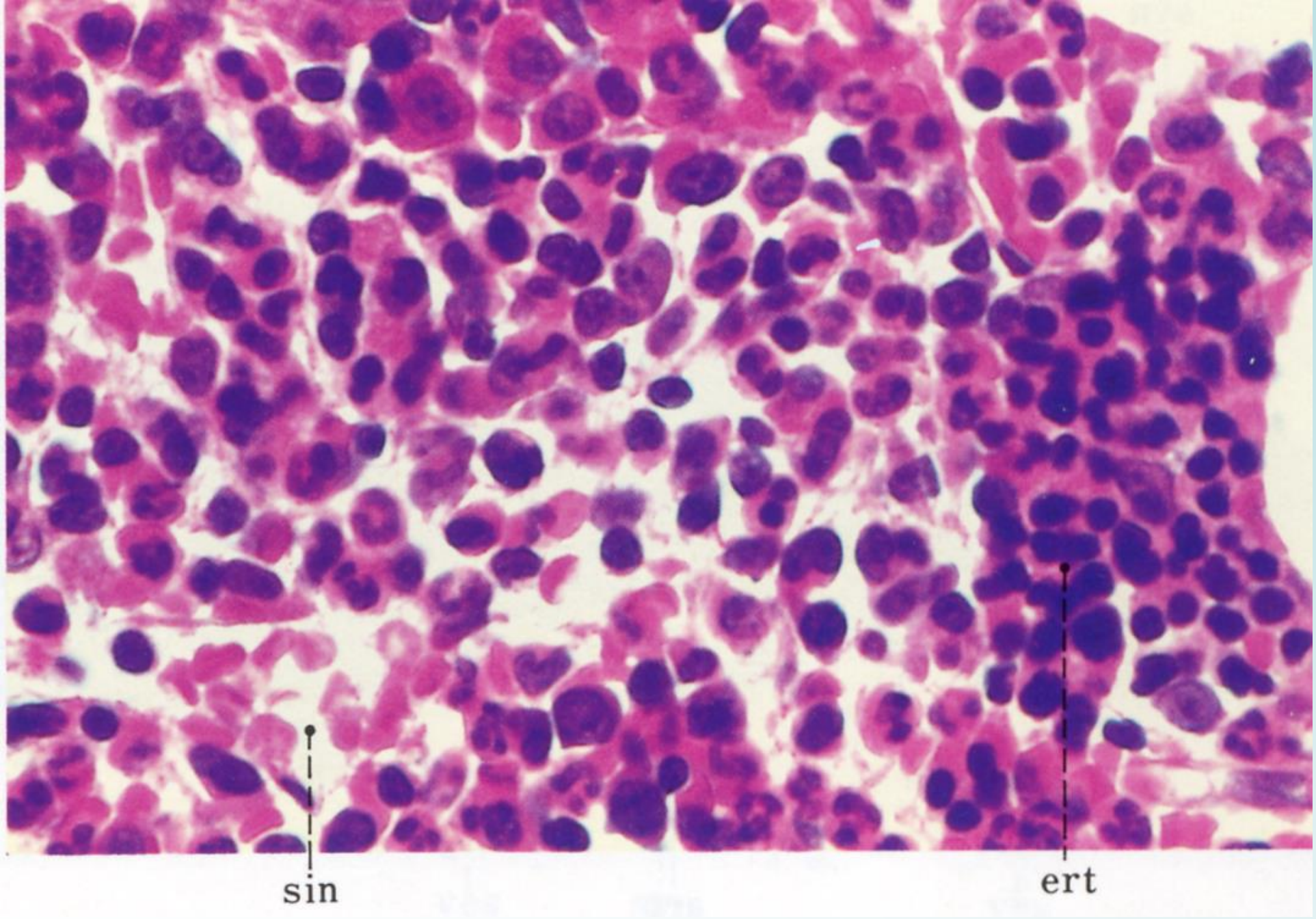
03-64 The red bone marrow 1. Monkey, H-E stain, x 25.



03-65 The red bone marrow 2. Monkey, H-E stain, x 64.



03-66 Hemopoietic center 1. Monkey, H-E stain, x 160.



03-67 Hemopoietic center 2. Monkey, H-E stain, x 250.

03-00 Supporting Tissue

- The Connective tissue, Cartilage, Bone and Blood are collectively called the supporting tissue. They differentiate all from the embryonic mesenchyme. They consist, on the contrary to the epithelium, of a few number of cells and a large quantity of intercellular substance, i.e. fibers and amorphous matrix. According the difference of the matrix these four tissues show each respective character. Matrix of the blood is liquid and contains no fibers.

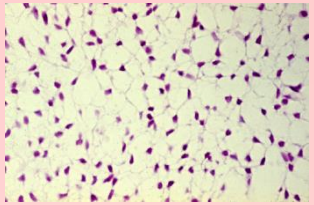
03-001 Connective tissue (1/2)

- The connective tissue exists almost of all the regions of the body and supports the cells, tissues and organs by enveloping and connecting, and further, by being the component of the organs it gives them some fixed form and fastens them at fixed place.
- The connective tissue consists of cellular elements, fibrous elements and amorphous matrix. As the cellular elements fibroblasts are common. The fibrous elements are collagenous fibers, reticular fibers and elastic fibers.
- ① Collagenous fibers are present in all types of connective tissue but vary greatly in their abundance. In the fresh condition they appear as colorless strands 1 to 12 μ m in thickness and of indefinite length, and run in all directions with a slightly wavy course. They are flexible but offer great resistance to a pulling force.
  By H-E stain they appear intensely reddish-pink hue and in the larger fibers faint longitudinal striation is perceived, suggesting that they consist of smaller fibrils. Collagenous fibers (collagen fibers) are easily dissolved by boiling in the thin neutral salt solution or diluted acid.
- ② Elastic fibers are thin refractile fibers consisting of elastin. As they are not demonstrated by H-E stain, so it is necessary special stain methods for them, using orcein or Weigert's resorcin-fuchsin. They stretch easily to about 150% of their original length and when released after stretching they return almost completely to their original length. Elastic fibers are not made up of visible fibrilar subunit but appear homogeneous. When present sufficient numbers, elastic fibers impart a yellowish color to the tissue, such as ligamenta flava. Elastic fibers are highly resistant to boiling and to dilute acids and alkalis.

03-001 Connective tissue (2/2)

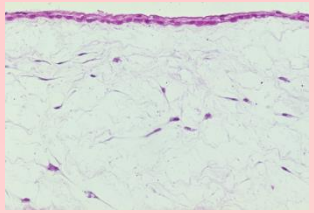
- ③ Reticular fibers are minute fibers and tend to form delicate networks rather than coarse bundles. They stain more intensively with silver impregnation than do typical collagenous fibers. They are not apparent in ordinary histological preparations but can be demonstrated by silver impregnation. Reticlar fibers are found in delicate networks surrounding adipose tissue, supporting the endothelium of capillaries, the sarcolemma of muscle and the endoneurium of nerves. The basement membrane of the epithelium is also constituted mainly of reticular fibers. Reticular fibers appear by silver impregnation intensely black, whereas collagenous fibers dark braun. As to the stain- ability for dyes, reticular fibers and collagenous fibers are almost the same.
- ④ Ground substance. The formed elements of connective tissue are embedded in a matrix of amorphous ground substance, having the properties of a very viscous solution or thin gel, being optically homogeneous and transparent.
- ⑤ Fibroblasts are the common fixed cells of the connective tissue that elaborate the precursors of the extracellular fibrous and amorphous components. They are usually deployed along bundles of collagen fibers and appear in sections as fusiform elements with long tapering processes. In other conditions they appear as flattened, stellate cells with several slender processes. Their cytoplasm stain very faintly with eosin so that difficult to perceive. Elongated elliptic nuclei, stained dark blue , locate in the middle of the cytoplasm.

03-01 Mesenchyme. Human embryo, H-E stain, x 160.



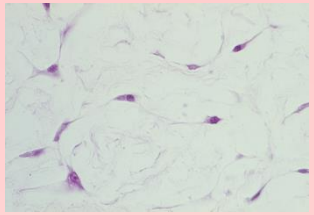
- The mesenchyme is the least differentiated embryonic connective tissue. It consists of the mesenchymal cells and liquid matrix, and contains no fibers. The mesenchymal cells are triangular or spindle in shape and provides several long protoplasmic processes, with that they connects each other forming a loose meshwork. In the mesenchyme any kinds of fibers are still not developed.
- This is the mesenchyme in the head region of a human embryo of 10 mm C-R length.

03-02 Wharton’ jelly 1. Human umbilical cord, H-E stain, x 80.



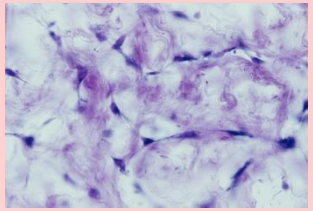
- This is the substance of the umbilical cord, consisting of a very large amount of amorphous ground substance, unusually rich in hyaluronic acid, . and only a few collagenous fibers. The cellular elements are fusiform or stellate fibroblasts, scattered widely spaced.
- In this figure, the uppermost cell line is the amniotic epithelium.

03-03 Wharton’ jelly 2. Human umbilical cord, H-E stain, x 160.



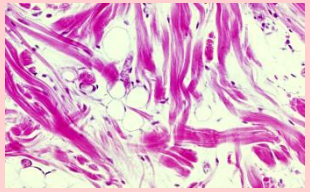
- This is higher magnification of 03-02. A small number of the fusiform or stellate fibroblasts are scattered at wide interval. A few fibers are seen in the matrix.

03-04 Wharton’ jelly 3. Human umbilical cord, tolouidinblue stain, x 80.



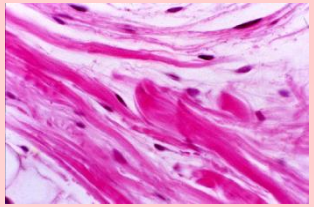
- In the Wharton’ jelly collagenous fibers are coated with substance which shows distinct metachromasia. In spite of the staining with toluidinblue, of dark blue, this coating substance appears reddish violet. This phenomenon is called metachromasia. In this figure nuclei of the fibroblasts stain dark blue but the coating substance of collagenous fibers appears reddish violet, i.e. typical metachromasia.

03-05 Loose connective tissue. Human scalp, H-E stain, x 160.



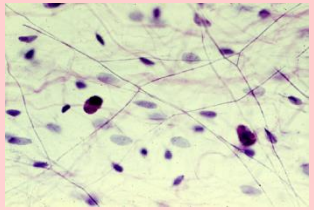
- This is the most common connective tissue existing everywhere in the body, without any fixed form.
- In this H-E stained specimen, intensely red stained collagenous fibers, making thin and thick bundles, are seen, running randomly to form a loose meshwork. The spindle- shaped fibroblasts are scattered in the interspace among the fibers. The small circles in this figure are fat cells. The loose connective tissue provides the path to the blood vessels and nerves.

03-06 Fibroblasts. Human subcutaneous tissue, H-E stain, x 250.



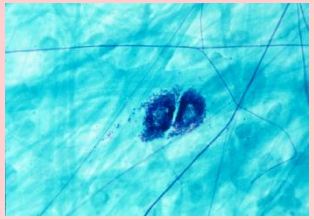
- In this specimen the fibroblasts mostly show the long spindle-shape, and in the middle of the faintly stained cytoplasm locates an intensely stained elongated elliptic nucleus. They attach by side to the collagenous fibers. It is clear that collagenous fibers consist of minute fibrils.

03-07 Collagenous and elastic fibers. Cat mesenterium, orcein and H-E stain, x 160.



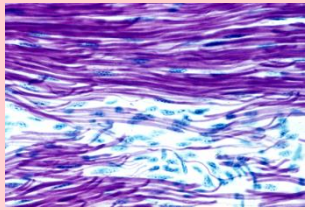
- A small piece of distended mesenterium stained first with orcein then H-E. The deep stained thin fibers are elastic fibers and faintly pink stained thick and thin tortuous fibers are collagenous fibers. The deep blue stained elliptic nuclei are of fobroblasts and light blue stained larger nuclei are the nuclei of mesenterial epithelium. Two large cells filled with coarse granules (arrows) are mstcells.

03-08 Collagenous and elastic fibers 2. Rat subcutaneous tissue, aldehyde fuchsin and right green stain, x 200.



- This is the spread subcutaneous tissue, stained first with aldehyde fuchsin then with light green. The elastic fibers are straight thin fibers stained deep blue and the collagenous fibers are, on the centrally, faintly blue-green stained thicker fibers. Two big cells filled with coarse granules are the mast cells.
- Mast cells are found widely distributed in the connective tissues. Their cytoplasm is filled with granules being metachromatic when stained with certain basic aniline dyes. Stained with methylene blue or thionine the granules assume a purple hue. Mast cells contain at least heparin and histamine.

03-09 Elastic fibers. Bovine Lig. nuchae, resorcin-fuchsin stain, x 160.

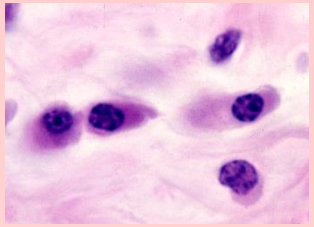


- This is the longitudinal section of bovine lig. nuchae consisting of elastic fibers. stained by resorcin-fuchsin elastic fibers assume deep violet homogeneously and no minute subunit fibrils are perceivable. Because the lig. nuchae is composed so densely of elastic fibers, it assumes the yellowish hue. The lightly blue stained nuclei are of fibroblasts.

03-10 Reticular fibers. Monkey, Silver impregnation and Kernechtrot stain, x 400.

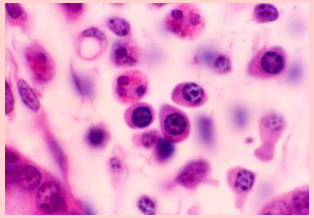
- Reticular fibers are minute fibers to form delicate networks in connective tissue, basement membrane and reticular tissues in lymph nodes and spleen. They show very intense affinity with silver impregnation. This figure shows reticular fiber network in the lymph node of a monkey. Reticular fibers forming network appear deep black; nuclei of various kinds of cells are stained red by Kernechtrot.

03-11 Plasma cells 1. Monkey. H-E stain, x 640.



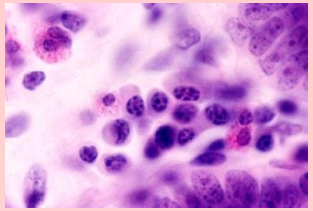
- The plasma cells are the principal producer of antibodies. They are 2 or 3 times larger than lymphocytes and ovoid in shape, containing round or ovoid nucleus slightly eccentric in the intensely basophilic cytoplasm. The nuclear chromatin is distributed in unusually coarse clumps or blocks that tend to be spaced around the periphery of the nucleus so as to produce a radial pattern that is identical to these cells.
- This figure shows four plasma cells in the interlobular connective tissue of monkey submandibular gland. The eccentric location of nuclei and intense basophilia of cytoplasm are conspicuous. The basophilia is based on the highly developed rER.

03-12 Plasma cells 2. Lamina propria of monkey intestine, H-E stain, x 400.



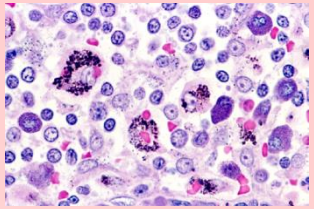
- In the center three plasma cells of the characteristic features are seen. Above them there are two eosinophilic leucocytes. The long arrow indicates a fibroblast and the short one a young fat cell. In the right one fourth of the figure there are four more plasma cells.

03-13 Plasma cells 3. Lamina propria of monkey intestine, H-E stain, x 500.



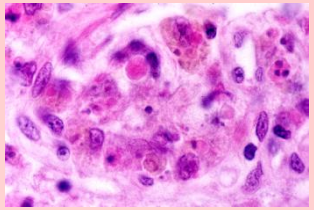
- This is the lamina propria surrounding the bottom of the intestinal glands. In the center there is a group of plasma cells and on the periphery of this group 2 eosinophilic leucocytes and upper left corner of this figure one more eosinophilic leucocyte are seen. The upper right and lower right corner there are bottom of the intestinal glands.

03-14 Macrophages 1. Lymph node of rabbit, vital stain with India ink, toluidinblue and eosin stain, x 250.



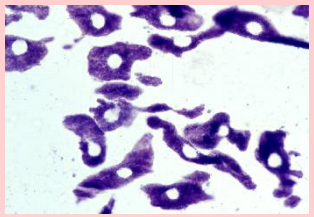
- When induced the non-toxic colloidal dyes suspended in the physiological salt solution into the vein, the macrophages take up the particles of dye by phagocytosis and concentrate them within cytoplasmic vacuoles so that they assume the color of the dye. This procedure is called the vital staining.
- This figure shows the vital stain with India ink; macrophages take up the India ink particles so that they assume black color. Some of them take up also erythrocytes. There are several mast cells with coarse granules exhibiting the clear metachromasia.

03-15 Macrophages 2. Lamina propria at the tip of intestinal vilus, monkey, H-E stain, x 400.



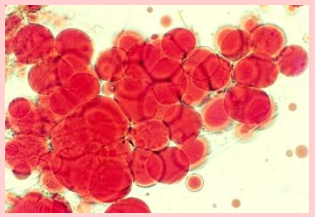
- This is a group of macrophages in the lamina propria at the tip of an intestinal vilus of monkey. Macrophages containing large nuclei are big in size and their cytoplasm filled with phagosomes assumes dirty brownish hue. Some of them take up erythrocytes. Macrophages storing fully with phagosomes come together here, in the lamina propria at the tip of the intestinal vili, and release themselves with the intestinal epitheliar cells at the tip of the vili into the intestinal cavity. This is a way to eliminate extrinsic and intrinsic substances that cannot be thrown away by other means.

03-16 Pigment cells. Bovine chorioidea, not stained, x 400.



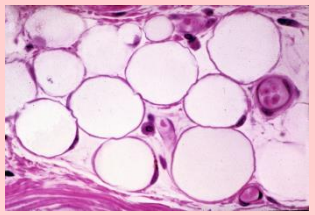
- The fibroblasts whose cytoplasm is filled with melanin granules are named pigment cells. This figure shows pigment cells constituting the chorioidea of the eye ball. Their cytoplasm is filled with melanin granules and the light circle in the middle of cells is the nucleus.

03-17 Fat cells 1. Subcutaneous fat, guinea pig, Sudan III stain, x 64.



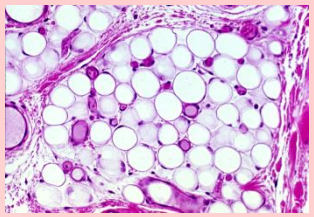
- The cells which store lipid fully in the cytoplasm are called fat cells or adipose cells. When fresh fat cells are soaked in an alcoholic solution of Sudan III, this dye moves from alcohol to lipid so that the lipid assumes yellowish orange hue. This figure shows a group of fat cells treated with alcoholic Sudan III solution. Each fat cell is stained homogeneously yellowish orange by Sudan III.

03-18 Fat cells 2. Human subcutaneous fat tissue, H-E stain, x 160.



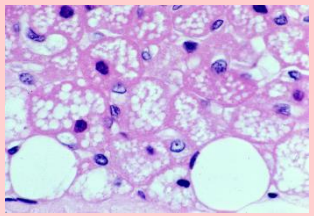
- Fat cells accumulate lipid to an extent that the nucleus is flattened and displaced to one side, and the cytoplasm becomes so thinned out that it is resolved as a thin rim of the single large lipid droplet. In the usual histological specimen the lipid droplets of the fat cells are completely dissolved out during dehydration, and only the outline of the cytoplasm and nucleus attached to the cell surface are seen. This figure shows a group of fat cells, in three of them nucleus (arrows) attaches to the cell surface, but in others only the outline surrounding the fat droplet is seen.

03-19 Fat tissue. Human scalp, H-E stain, x 64.



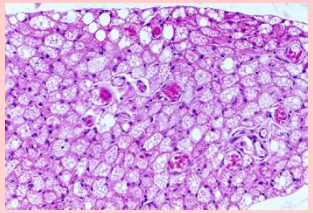
- A number of fat cells, grouped and enclosed with collagenous fibers, constitutes the fat or adipose tissue. The adipose tissue is abundant and universal in our body, as subcutaneous adipose tissue, that acts as storage of fuel and also as buffers against the mechanical power and thermal influence. This figure shows a small lobule of adipose tissue enclosed with collagenous fibers. Adipose tissues contain numerous blood vessels and act also as a storage of water.

03-20 Young developing fat tissue. Human, H-E stain, x 160.



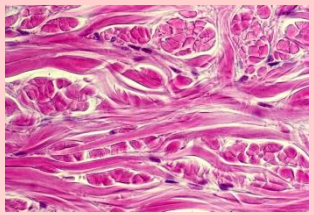
- The fat cells differentiate from mesenchymal cells. First appear in the cytoplasm small fat droplets then they coalesce with each other forming larger droplets and finally a single droplet of fat occupies most of the volume of the cell, displacing the nucleus to the cell surface. The fat cells containing numerous small droplets of fat are called multilocular. This figure shows all steps of developing fat cells.

03-21 Brown fat tissue. Monkey, H-E stain, x 64.



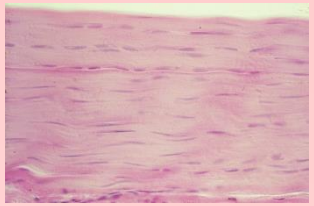
- This is the brown fat tissue found around the thyroid gland. Almost of all the cells are multilocular. Brown fat tissue occurs around the endocrine glands such as thyroid and adrenal gland, and should not be viewed as undifferentiated young adipose tissue. Brown adipose tissue is especially rich in blood vessels.

03-22 Densely woven connective tissue 1. Human dermis, H-E stain, x 160.



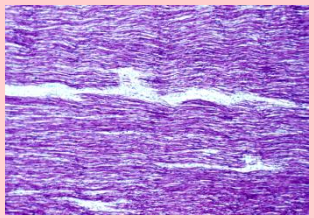
- Dense connective tissue differs from the loose form mainly in the great preponde- rance of the fibers over the cellular and amorphous components. Where the fiber bundles are randomly oriented the tissue is described as dense irregular connective tissue, and where the fibers are oriented in a consistent pattern it is called dense regular connective tissue.
- This figure shows the dermis of human palm, typical dense irregular connective tissue. As seen in this figure thick collagenous fiber bundles are very densely woven alternately. Among fiber bundles a few number of nuclei of the fibroblasts are scattered.

03-23 Dense regular connective tissue, Achillis tendon. Human, H-E stain, x 100.



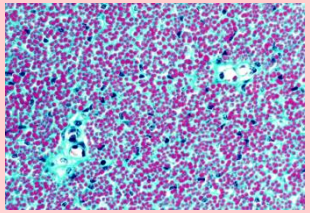
- Where the pulling force acts constantly fiber bundles densely arrange coincidently with the direction of force and form tendons and ligaments. This is a longitudinal section of the Achilis tendon, consisting of thick collagenous fiber bundles very densely. Nuclei of the fibroblasts are scattered in the interspace between the collagenous fiber bundles.

03-24 Ligamentum nuchae. Bovine, resorcin-fuchsin stain, x 64.



- Ligamentum nuchae consists of elastic fibers very densely, arranged parallel coincidently with cranio-caudal direction. This is a longitudinal section of bovine Lig. nuchae, showing the great density of elastic fibers. Nuclei of fibroblasts are stained blue by hematoxylin. Compare with 03-09.

03-25 Ligamentum nuchae, transverse section. Bivine, M-G stain, x 160.



- In the Lig. nuchae all elastic fibers arrange densely parallel in the cranio-caudal direction. In the transverse section all fibers are cut transversely and appear as round dot of various diameter. In M-G stain, elastic fibers stain red and surrounding collagenous or reticular fibers green.

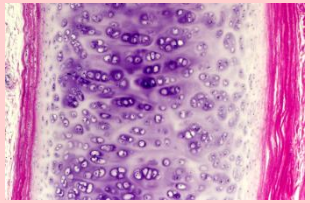
03-002 Cartilage

- Cartilage is a hard tissue to be cut with a razor and constitutes with bone the skeleton and serves as strut of body and as a part of locomotive organs.
- Cartilage consists of cells, chondrocytes, and extracellular fibers embedded in an amorphous matrix. The intercellular components predominate over the cells, which are isolated in small cavities, lacunae, within the matrix. Cartilage has no nerves nor blood vessels of its own. Except where it is exposed to the synovial fluid in joints, cartilage is enclosed in a dense fibrous connective tissue covering, perichondrium.
- Three kinds of cartilage, hyaline, elastic, and fibrocartilage, are distinguished on the basis of the amount of amorphous matrix and the relative abundance of the collagenous and elastic fibers embedded in it. Hyaline cartilage is the most common and characteristic type and the others can be regarded as modifications of it.

03-26 Hyaline cartilage 1. Human trachea, H-E stain, x 3.0.

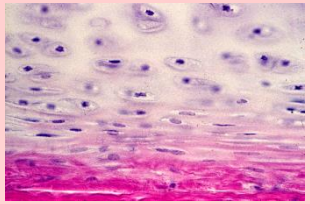
- This is a transverse section of a part of the human trachea, the core of which is an arch of hyaline cartilage staining deep violet blue. The upper surface is the mucous membrane of the trachea and lower covering is perichondrium stained deep red.

03-27 Hyaline cartilage 2. Human trachea, H-E stain, x 64.



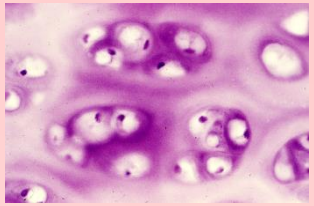
- Hyaline cartilage of trachea is covered both inside (left) and outside (right) by a dense connective tissue, perichondrium. The outside perichondrium is much thicker and more densely composed. The outermost region of the cartilage adjacent to the peri-chondrium stains faintly but the central region of it stains with basic dye deeply, and metachrmotically.

03-28 Hyaline cartilage 3. Perichondrium, human trachea, x 160.



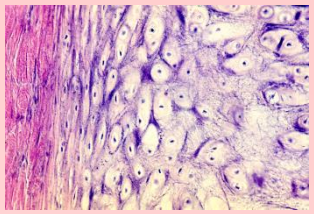
- The perichondrium (bottom) consisting of collagenous fibers stains deep red, and superficial portion of the cartilage (directly adjacent to the perichondrium) loses the red hue suddenly. The cells immediately above the perichondrium recently added in appositional growth are single, small and elongated. As going to the central portion (above), cells are larger, rounded and form groups of two to three cells enclosed by deeply stained matrix. These groups are of isogenous cells.

03-29 Hyaline cartilage 4. Human trachea, H-E stain, x 160.



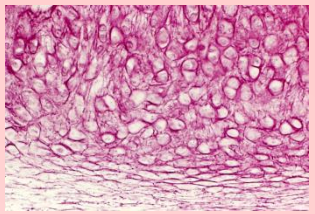
- This is a central portion of hyaline cartilage of trachea. The matrix immediately surrounding the groups of isogenous cells stains deep metachromatically but that of interterritorial region stains not so deep.

03-30 Elastic cartilage 1. Human auricula, H-E stain, x 160.



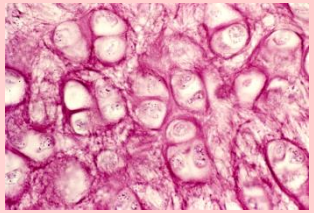
- In mammals elastic cartilage is found in the auricula, tuba auditiva, epiglottis, etc. It differs from hyaline cartilage in its yellowish color and its opacity, flexibility and elasticity. Its cells are similar to those of hyaline cartilage. They are of the rounded shape, surrounded by capsule, and scattered singly or in isogenous groups of two or three cells. The interstitial substance differs from that of hyaline cartilage by being permeated by frequently branching elastic fibers. They form a network that is often so dense that the ground substance is obscured.
- This figure shows a superficial portion of elastic cartilage of human auricula. The red stained left margin of this figure is the perichondrium and in the layers directly adjacent to it, the cartilage cells are single, small, fusiform and arrange parallel to inner surface of the perichondrium. As going rightwards cartilage cells become larger and rounded and arranged at intervals. Fibers enclosing the cells are elastic fibers making dense network in the intercellular spaces.

03-31 Elastic cartilage 2. Human auricula, resorcin-fuchsin stain, x 64.



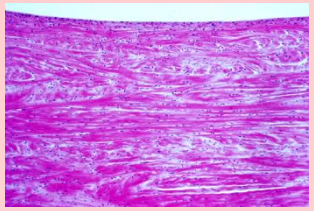
- The undermost layer, containing few elastic fibers, is the perichondrium; in the layers adjacent to this cartilage cells are small and fusiform, and elastic fibers are not so dense. In the upper two thirds of this figure, the central portion of the cartilage, cells are large and rounded and the elastic fibers surrounding them form a very dense network.

03-32 Elastic cartilage 3. Human auricula, resorcin-fuchsin stain, x 160.



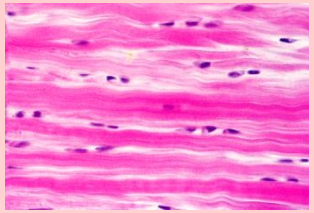
- Higher magnification of 03-31. This figure shows the central portion of the elastic cartilage of auricula. The cartilage cells are large and rounded and make groups of two to four isogenous cells. Elastic fibers directly surrounding these cells constitute a very dense network.

03-33 Fibrocartilage 1. Meniscus of knee joint, monkey, H-E stain, x 64.



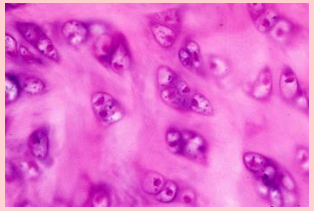
- Fibrocartilage occurs in the intervertebral discs, certain articular cartilage, in the symphysis pubis, etc. The encapsulated cartilage cells lie singly or in pair or sometimes aligned in row between collagen fiber bundles. The ground substance is quite inconspicuous..
- This figure shows the meniscus of the knee joint. It consists of thick collagen fiber bundles very densely woven alternately. Because the ground substance is very few that each fiber bundle stains deep red. A few number of cartilage cells are scattered among the fiber bundles.

03-34 Fibrocartilage 2. Meniscus of knee joint, monkey, H-E stain, x 160.



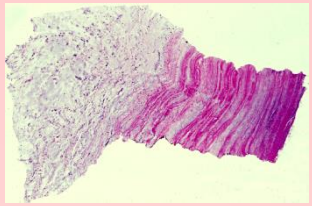
- Higher magnification of 03-33. Between the thick fiber bundles, deeply red stained, align the isogenous cartilage cells. They are fusiform and at the side of nuclei small amount of the cytoplasm is recognizable.

03-35 Fibrocartilage 3. Symphysis pubis, monkey H-E stain, x 160.



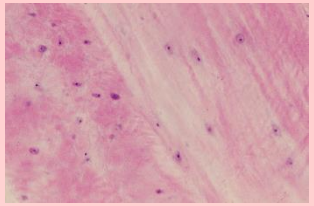
- This is the central portion of the symphysis pubis. The groups of isogenous cartilage cells are embedded in the matrix, where the fiber bundles are obscure.

03-36 Fibrocartilage 4. Intervertebral disc, human, H-E stain, x 2.0.



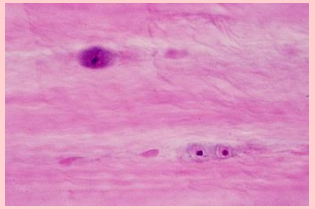
- This is a cranio-caudal section of a human intervertebral disc. The right half, consisting of dense fiber bundles, is the superficial portion and the left half, consisting of thin connective tissue fibers, is the central portion.

03-37 Fibrocartilage 5. Intervertebral disc, human, H-E stain, x 64.



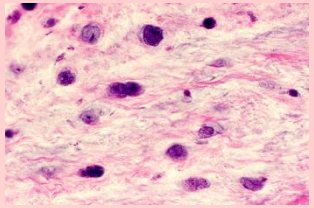
- This is a superficial portion of the disc. Among the thick collagen fiber bundles, very densely woven alternately, a few number of cartilage cells are scattered, whose cytoplasm is recognized at the side of nucleus.

03-38 Fibrocartilage 6. Intervertebral disc, human, H-E stain, x 160.



- This is also a superficial portion of the disc. Collagen fibers bundles are very thick and dense. Upper a big round cartilage cell and lower two isogenous cells are seen

03-39 Fibrocartilage 7. Intervertebral disc, human, H-E stain, x 64.



- This is a central portion of the disc. The collagen fiber bundles are thin and woven loosely. Cartilage cells are big and rounded.

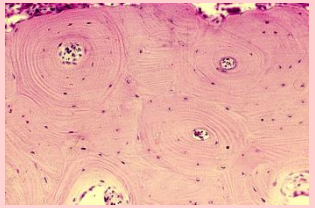
03-003 Bone

- Bone is the hardest tissue in the body except for the enamelum of teeth. Bone consists of cells, osteocytes, collagen fibers and ground substance. As its extracellular components are calcified, bone is hard and unyielding and suitable for its supportive and protective functions in the skeleton. It provides for the internal support of the body and for the attachment of the muscles and tendons essential for locomotion. It protects the vital organs of the cranial and thoracic cavities, and it encloses the blood forming elements of the bone marrow. Bone plays an important role as a mobilizable store of calcium.
- The osteocytes are flat lenticular in shape and provide numerous thin, long and branching protoplasmic processes, with which they connect with each other three dimensionally. They are involved in the small cavities (lacunae) and their processes in the thin canaliculi.
- The matrix consists of collagen fibers and amorphous substance, consisting, in turn, of a small amount of mucopolysaccaride and a lot of inorganic calcium, in the form of apatite and hydroxyapatite.
- Because of its hardnes, bone is unable to be sectioned with razar, and it is necessary two methods for histological studies: ① decalcified sections and ② ground sections.

03-40 Transverse section of femur 1. Monkey, decalcified and H-E stain, x 4.0.

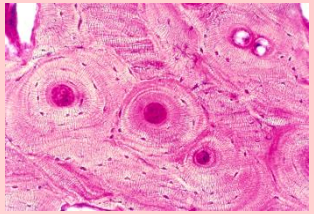
- This is a transverse section of femur, a typical long tubular bone; the deeply red stained thick ring is the shaft (diaphysis) of femur, which encloses the bone marrow. In the center of bone marrow an artery and a vein penetrate longitudinally. The surface of diaphysis is covered by a thin layer of dense connective tissue, periosteum, only a part of which is remained in this specimen (arrow). The substance of diaphysis, conpact bone, is penetrated by numerous thin canals, Haversian canals.
- As to the bone marrow peripheral portion stains deep violet blue; this is called red bone marrow, the active hemopoietic area. The central portion is, on the contrary, filled with fat tissue; this is the yellow bone marrow, the inactive hemopoietic area.

03-41 Transvers section of femur 2. Monkey, decalcified, H-E stain, x 64.



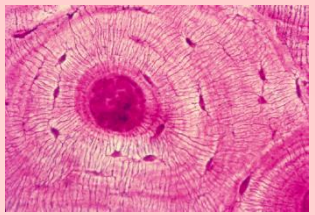
- This is a part of a transverse section of diaphysis. Three Haversian canals and their surrounding lamellae are seen. One Haversian canal and concentrically surrounding lamellae are together called a Haversian system or oswteon.. Between Haversian systems there are interstitial lamellar systems.

03-42 Haversian systems 1. Monkey femur, decalcified, Schmorl' stain, x 64.



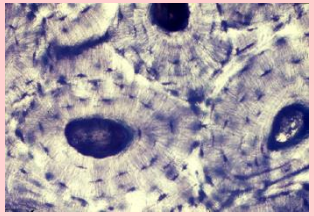
- This is a part of transverse section of femur stained by Schmorl's thyonin-picric acid method. Using this method osteocytes and their processes are very clearly demon- strated. In the middle of this figure three Haversian systems align from left to right. Beside these, i.e. lower left and upper right, there are interstitial lamellar systems.

03-43 Haversian system 2. Monkey femur, decalcified, Schmorl' stain, x 160.



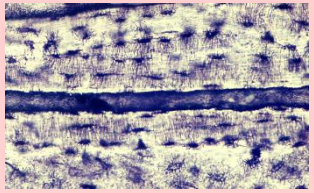
- Higher magnification of 03-42. A packed Haversian canal in the center and concentric arrangement of lamellae are conspicuous. The osteocytes connect with each other with thin protoplasmic processes crossing the lamellae.

03-44 Herversian systems 3. Human, ground section, not stained, x 64.



- This is a transversely ground section of human femur. Three Haversian system are shown. The concentric arrangement of lacunae and canaliculi connecting the lacunae are distinct. A light line between the Haversian systems is called cementing line.

03-45 Haversian system 4. Human, ground section, not stained, x 64.

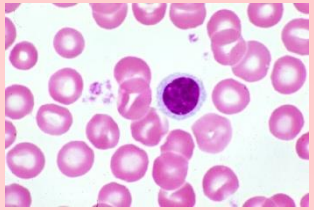


- This is a longitudinally ground section of human femur. One Haversian canal runs horizontally in the center of this figure. Parallel to this lacunae run top and bottom each in three rows, These all constitute together one Haversian system, under which one cementing line is distinct. In the undermost region of this figure lacunae and canaliculi present superficial view..

03-004 Blood

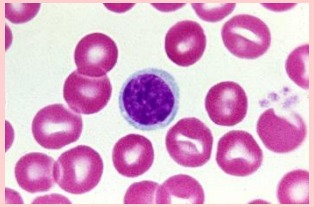
- The blood is a red liquid, which circulates in a closed system of tubes, the blood vessels. Its quantity in man is estimated as about 7% of the body weight.
- The blood consists of the amorphous liquid component, the plasma, and several kinds of formed elements, suspended in the plasma: the red corpuscles (erythrocytes), colorless corpuscles (leukocytes), and the blood platelets. The plasma is colorless and red color comes from the erythrocytes suspended in the plasma
- The **erythrocytes** are non motile, highly differentiated cells, which have lost their nucleus, Golgi-complex, RNA, mitochondria, and centrioles during maturation.
- The normal measure of the erythrocytes averages 5.2 million per ml. for men and 4.5 million per ml. for women. The size of the erythrocytes is remarkably uniform; in man the diameter averages 8 μ m and the thickness at the edge 2 μ m and in the center about 1 μ m. They are biconcave disc in form and pale greenish yellow in color. In dense masses of them, however, the color is a distinct red.
- The erythrocytes are filled with a special kind of protein, hemoglobin, which gives them their color. The erythrocytes are extremely soft and flexible and sensitive to the osmotic pressure. A solution of 0.9% of NaCl is isotonic and therefore does not difer the size or form of the erythrocytes. In a solution of lower osmotic pressure, water comes from out side into the erythrocytes and the hemoglobin is easily separated from them; this is called hemolysis. After hemolysis remains the colorless contour of them, ghost. If the osmotic pressure of the plasma increased, the interior of the erythrocyte gives up water to the plasma and becomes irregular in outline.
- The blood contains a number of colorless (white) cells, **leukocytes.** Their number is far smaller than that of the erythrocytes, averaging 7000 per ml. The leukocytes are true cells with a nucleus and cytoplasm. Among them several types are distinguished: agranular leukocytes, that are lymphocytes and monocytes, and granular leukocytes, that are neutrophilic leukocytes, eosinophilic leukocytes, and basophilic leukocytes
- To study the formed elements of the blood, in detail, it is widely used the dry smear preparations stained with Right or Giemsa method. In these preparations the erythrocytes appear as homogeneously deep red stained disc. The leukocytes appear each respective figures.

03-46 Small lymphocyte 1. Human, Giemsa stain, x 640.



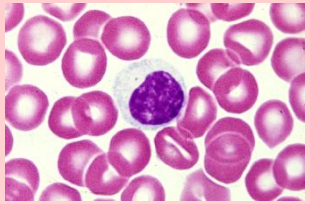
- The lymphocytes have no granules in the cytoplasm. They are divides in two groups, i.e. smaller one of 6 to 8 μm in diameter and larger one of 10 to 15 μm in diameter. They occupy 20 to 25% of total leukocyte count.
- This figure shows a small lymphocyte, having a large round nucleus and surrounding narrow cytoplasm showing distinct basophilia. This basophilia is caused by abundant free ribosomes.
- Around the lymphocyte there are numerous erythrcytes.

03-47 Small lymphocyte 2. Human, Giemsa stain, x 640.



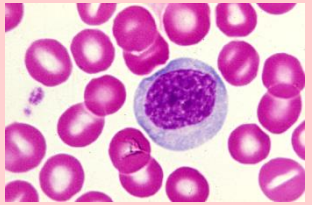
- This is also a small lymphocyte. Basophilic cytoplasm is more conspicuous.

03-48 Large lymphocyte 1. Human, Giemsa stain, x 640.



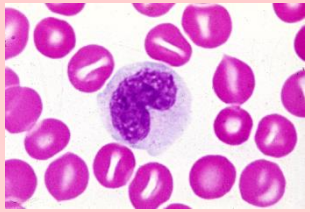
- This is a large lymphocyte, of 12 μm in diameter. The nucleus locates eccentrically and in the broad cytoplasm an azurophilic granule is seen.

03-49 Large lymphocyte 2. Human, Giemsa stain, x 640.



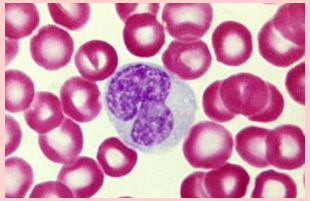
- This is a large lymphocytes of 15 μ m in diameter. Cytoplasmic basophilia is predominant.

03-50 Monocyte 1. Human, Giemsa stain, x 640.



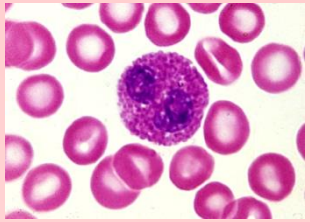
- The monocytes are the largest leukocytes of 12 to 20 μ m in diameter and occupy 3 to 10% of total leukocyte count. The nucleus locates eccentric and its side facing the broad cytoplasm becomes hollow. Basophilia of the cytoplasm is less dense than the lymphcytes.

03-51 Monocyte 2. Human, Giemsa stain, x 640.



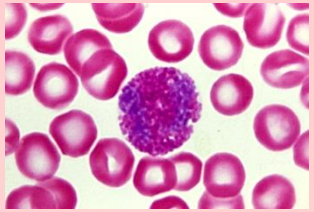
- This is also a monocyte, whose nucleus shows a distinct hollow.

03-52 Eosinophilic leucocyte 1. Human, Giemsa stain, x 640.



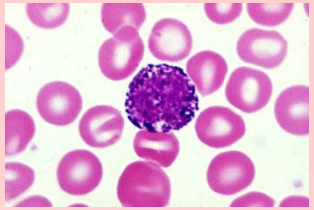
- Among the granulated leukocytes according to the stainability of the granules they are divided into three groups: ① Acidophilic(eosinophilic), ② Basophilic, and ③ Neutrophilic leukocytes.
- The eosinophilic leucocytes are the second largest leucocytes of 12 to 15 μ m in diameter and occupy 2 to 4% of total leucocyte count. Their cytoplasm is densely packed with coarse spherical granules of about the same size stained deeply with acid dyes, for example eosin. The nucleus has usually two lobes connected by a thin chromatin thread
- This figure shows an eosinophilic leucocyte. Coarse and spherical granules stains with eosin brilliantly deep red.

03-53 Eosinophilic leucocyte 2. Human, Giemsa stain, x 640.



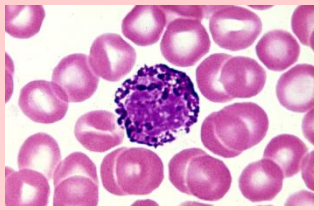
- This is also an eosinophilic leukocyte. In this cell the contour of the nucleus is not clear, because the coarse granules overlap the nucleus.

03-54 Bosophilic leukocyte 1. Human, Giemsa stain, x 640.



- The basophilic leukocytes are difficult to find in human blood because they form only about 0.5% of the total number of leukocytes. Their size is about 10 μ m in diameter, about the same as that of the neutrophilic leukocytes.
- The coarse granules of different sizes in the cytoplasm stain with basic dyes deeply. Because they overlap the nucleus, the contour of the nucleus is not clearly discerned. The substance of the granules is soluble in water; so that in the preparations stained with the usual watery dye solutions, the granules are partly dissolved and disfigured.

03-55 Bosophilic leukocyte 2. Human, Giemsa stain, x 640.

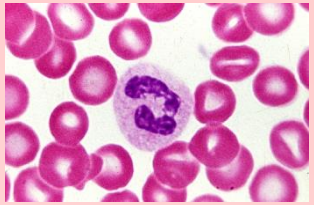


- This is also a basophilic leukocyte. The contour of the nucleus is difficult to discern.

03-56 Neutrophilic leukocyte 1. Rod-shape nucleus. Human, Giemsa stain, x 640.

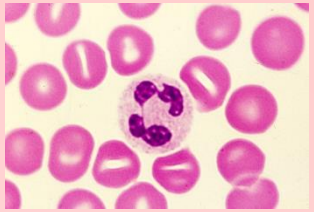
- This type of leukocyte is the most numerous in the blood and constitutes 65 to 75% of the total number of leukocytes. They are 10 to 12 μm in diameter and contain fine granules that are beyond the resolving power of the light microscope and stained with neutral dyes. The nucleus is highly polymorphous. It is an elongated, bent or twisted body consisting of several lobes connected by thin chromatin threads. The number of lobes usually varies from 3 to five and increases with the age of the cell.
- This is a neutrophic leukocyte of rod-shaped nucleus.

03-57 Neutrophilic leukocyte 2. 2-segmented nucleus. Human, Giemsa stain, x 640.



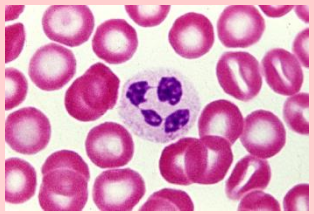
- This is a neutrophilic leukocyte of 2-segmented nucleus.

03-58 Neutrophilic leukocyte 3. 3-segmented nucleus. Human, Giemsa stain, x 640.



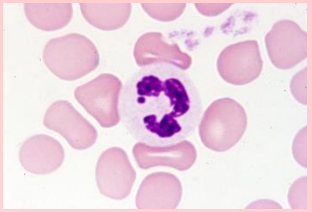
- This is a neutrophilic leukocyte of 3-segmented nucleus.

03-59 Neutrophilic leukocyte 4. 4-segmented nucleus. Human, Giemsa stain, x 640.



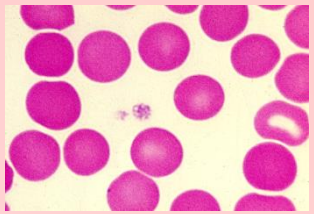
- This is a neutrophilic leukocyte of 4-segmented nucleus.

03-60 Neutrophilic leukocyte 5. Human female, Giemsa stain, x 640.



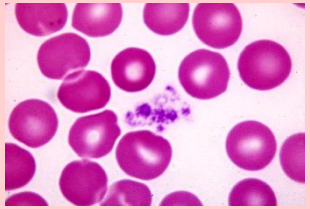
- This is a neutrophilic leukocyte of a Japanese woman, having a drumstick appendix at the end of the nucleus (arrow).

03-61 Blood platelets 1. Human, Giemsa stain, x 640.



- The blood platelete are small, round or oval, biconvex disks. Their size is not uniform, the average being 3 μ m. The number varies considerably and usually given as 250, 000 per cu mm of blood, but it is difficult to determine the real number, because as soon as the blood leaves the vessel, the platelets adhere to one another and to all surfaces with which they come in contact.
- At the center of this figure there are two platelets. They show in the dry smear preparations no clear contour, as seen here. The erythrocytes surrounding them stain homogeneously deep red and their contour is clear.

03-62 Blood platelets 2. Human, Giemsa stain, x 640.



- At the center of this figure several platelets are seen. They coalesce with each other and their contour is not clearly seen.

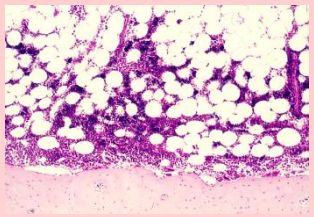
03-005 Bone marrow

- The bone marrow is one of the blood cell forming organs (hemopoietic organs) and produces the erythrocytes, granular leukocytes and platelets, myeloid elements. The other hemopoietic organs are lymphatic organs producing lymphocytes and probably monocytes, lymphoid elements. The lymphatic tissues and organs are described in the Holder 07-00.
- The fundamental structure of the bone marrow is the loose meshwork of reticular (argyrophilic) fibers and primitive and phagocytic reticular cells and the meshes are filled with large number of hemopoietic cells. The marrow performing active hemo- poiesis is seen macroscopically fresh red, so that it is called red marrow. When hemo- poietic procedure becomes inactive, blood cell forming cells are replaced by fat cells and the marrow itself appears yellowish; that is called yellow marrow. In the normal adult, vertebrae, ribs, sternum, diplo ë , and proximal epiphysis of femur and humerus contain red marrow.
- The bone marrow is characterized by the presence of many wide vessels, sinusoids, whose walls are lined by flattened fixed macrophages (littoral cells), and through these walls innumerable cells pass into the bloodstream. The marrow is encapsulated and protected by bone.

03-63 Bone marrow in the femur. Monkey, H-E stain, x 4.0.

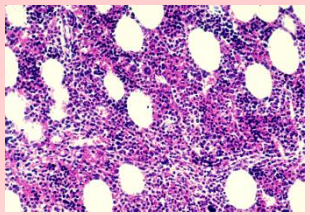
- This is the transverse section of femur. The space enclosed by thick and deep red stained diaphysis is filled by the bone marrow, The peripheral portion appearing deep violet is the red marrow and central portion consisting of mainly fat cells is the yellow marrow.

03-64 The red bone marrow 1. Monkey, H-E stain, x 25.



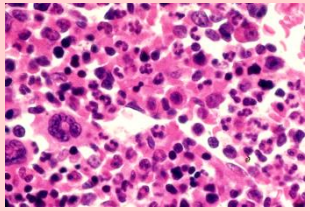
- The bottom of this figure is bone and above adjacent to the bone is the red marrow. In the upper portion increase the fat cells and gradually begins the yellow marrow.

03-65 The red bone marrow 2. Monkey, H-E stain, x 64.



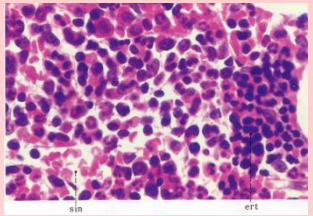
- The stroma of the marrow is filled with a lot of hemopoietic cells.

03-66 Hemopoietic center 1. Monkey, H-E stain, x 160.



- Higher magnification of 03-63. The granular leukocytes forming center is shown. At lower left there are two megakaryocytes.

03-67 Hemopoietic center 2. Monkey, H-E stain, x 250.



- Higher magnification of 03-63. The erythrocytes forming center (ert) is shown and sin indicates sinusoid.