

# 21-00 Skin and its Accessories

# 21 Skin and its Accessories

## Menu 1 / 2

- [21-00.](#) Skin and its Accessories
- [21-001.](#) Skin
- [21-01.](#) Skin of the palm 1. General view. Human, H-E stain, x 3.3.
- [21-02.](#) Skin of the palm 2. Human, H-E stain, x 25.
- [21-03.](#) Skin of the palm 3. Dermis. Human, H-E stain, x 64.
- [21-04.](#) Skin of thumb tip 1. Human, H-E stain, x 1.7.
- [21-05.](#) Skin of thumb tip 2. Human, H-E stain, x 5.0.
- [21-06.](#) Skin of thumb tip 3. Stratum spinosum. Human, H-E stain, x 400.
- [21-07.](#) Skin of the thumb tip 4. Stratum germinativum and melanocytes. Human, H-E stain, x 160.
- [21-08.](#) Skin of auricula. Melanocytes and Langerhans cells. Human, H-E stain, x 250.
- [21-09.](#) Sweat gland 1. General view. Human, H-E stain, x 10.
- [21-10.](#) Sweat gland 2. Secretory portions and ducts. Human, H-E stain, x 64.
- [21-11.](#) Sweat gland 3. Secretory portion and duct, longitudinal section 1. Human, H-E stain, x 130.
- [21-12.](#) Sweat gland 4. Secretory portion and duct, longitudinal section 2. Human, H-E stain, x 100.
- [21-13.](#) Sweat gland 5. Secretory portion and duct, longitudinal section 3. Human, H-E stain, x 160.
- [21-14.](#) Sweat gland 6. Transverse section of acinus and duct. Human, H-E stain, x 250.
- [21-15.](#) Duct of sweat gland 1. Transverse section. Human, H-E stain, x 160.
- [21-16.](#) Duct of sweat gland 2. Passing through the epidermis 1. Human, H-E stain, x 100.
- [21-17.](#) Duct of sweat gland 3. Passing through the epidermis 2. Human, H-E stain, x 160.
- [21-18.](#) Dermal papilla, containing a Meissner's corpuscle. Human, H-E stain, x 160.
- [21-19.](#) Meissner's corpuscle. Silver impregnation. Human, x 100.
- [21-20.](#) Pacinian corpuscle 1. Transverse section. Human, H-E stain, x 25.
- [21-21.](#) Pacinian corpuscle 2. Longitudinal section, Human, H-E stain, x 25.
- [21-22.](#) Organ of Hoyer-Grosser 1. Human, H-E stain, x 66.
- [21-23.](#) Organ of Hoyer-Grosser 2. Human, H-E stain, x 160.
- [21-24.](#) Skin of abdomen 1. Human, H-E stain, x 25.
- [21-25.](#) Skin of abdomen 2. Human, H-E stain, x 160.
- [21-26.](#) Skin of axilla 1. Human, H-E stain, x 10.
- [21-27.](#) Apocrine sweat gland 1. Human axilla, H-E stain, x 66.
- [21-28.](#) Apocrine sweat gland 2. Gl. cerminosa. Human, H-E stain, x 64.
- [21-002.](#) Scalp
- [21-29.](#) Scalp. Vertical section. Human, H-E stain, x 3.0.
- [21-30.](#) Hair follicle. Longitudinal section. Human, H-E stain, x 25.



# 21 Skin and its Accessories

## Menu 2/2

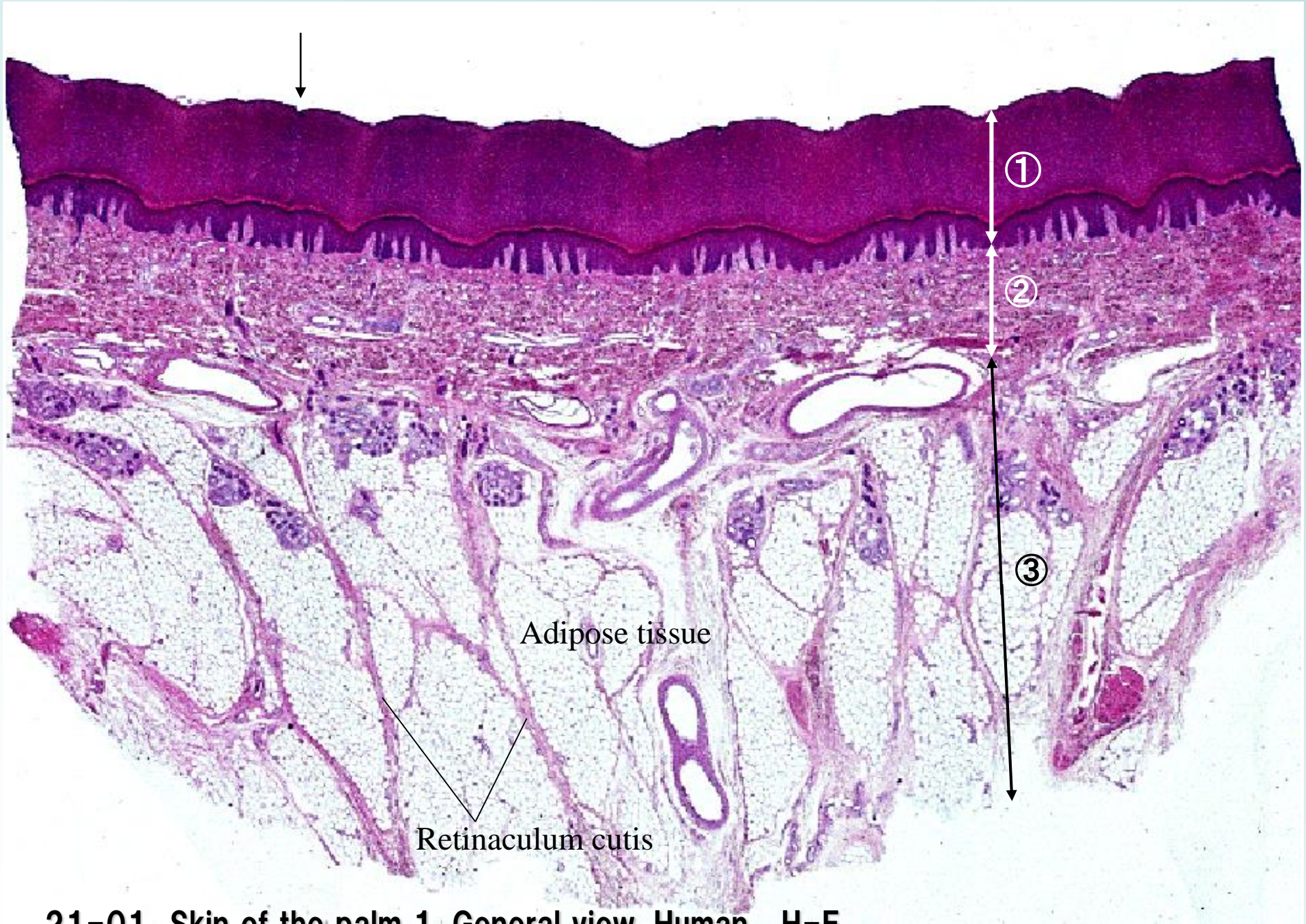
- [21-31.](#) Longitudinal section of hair and hair follicle. Human, H-E stain, x 160.
- [21-32.](#) Glandulae sebaceae and arrector pili muscle 1. Human, H-E stain, x 25.
- [21-33.](#) Glandulae sebaceae and arrector pili muscle 2. Human, H-E stain, x 30.
- [21-34.](#) Tangential section of scalp 1. Level of the sebaceous glands. Human, H-E stain x 25.
- [21-35.](#) Tangential section of scalp 2. Level of the sweat glands. Human, H-E stain, x 25.
- [21-36.](#) Tangential section of scalp 3. Level of the deeper portion of hair follicle. Human, H-E stain x 25.
- [21-37.](#) Tangential section of scalp 4. Level of the hair papilla. Human, H-E stain, x 25.
- [21-38.](#) Transverse section of hair follicle 1. Human, x 64.
- [21-39.](#) Transverse section of hair follicle 2. Human, x 64.
- [21-40.](#) Transverse section of hair follicle 3. Human, x 64.
- [21-41.](#) Transverse section of hair follicle 4. Human, x 64.
- [21-42.](#) Tangential section of scalp 2-1. Human, H-E stain, x 3.0.
- [21-43.](#) Tangential section of scalp 2-2. Human, H-E stain, x 3.0.
- [21-44.](#) Tangential section of scalp 2-3. Human, H-E stain, x 3.0.
- [21-45.](#) Tangential section of scalp 2-4. Human, H-E stain, x 3.0.
- [21-46.](#) Tangential section of scalp 2-5. Human, H-E stain, x 3.0.
- [21-47.](#) Tangential section of scalp 2-6. Human, H-E stain, x 3.0.

- [21-003.](#) Nail
- [21-48.](#) Longitudinal section of nail. Human, H-E stain, x 1.6.
- [21-49.](#) Transverse section of nail 1. Human, H-E stain, x 2.75.
- [21-50.](#) Transverse section of nail 2. Human, H-E stain, x 10.
- [21-51.](#) Transverse section of nail 3. Human, H-E stain, x 25.
- [21-004.](#) Mammary Gland
- [21-52.](#) Nipple and mammary gland. General view. Human, H-E stain, x 0.7.
- [21-53.](#) Nipple. Longitudinal section. Human, H-E stain, x 4.0.
- [21-54.](#) Mammary gland on resting stage. Human, H-E stain, x 25.
- [21-55.](#) Mammary gland at term, 1. Human, H-E stain, x 2.5.
- [21-56.](#) Mammary gland at term, 2. Human, H-E stain, x 25.
- [21-57.](#) Mammary gland at term, 3. Human, H-E stain, x 100.

# 21-001

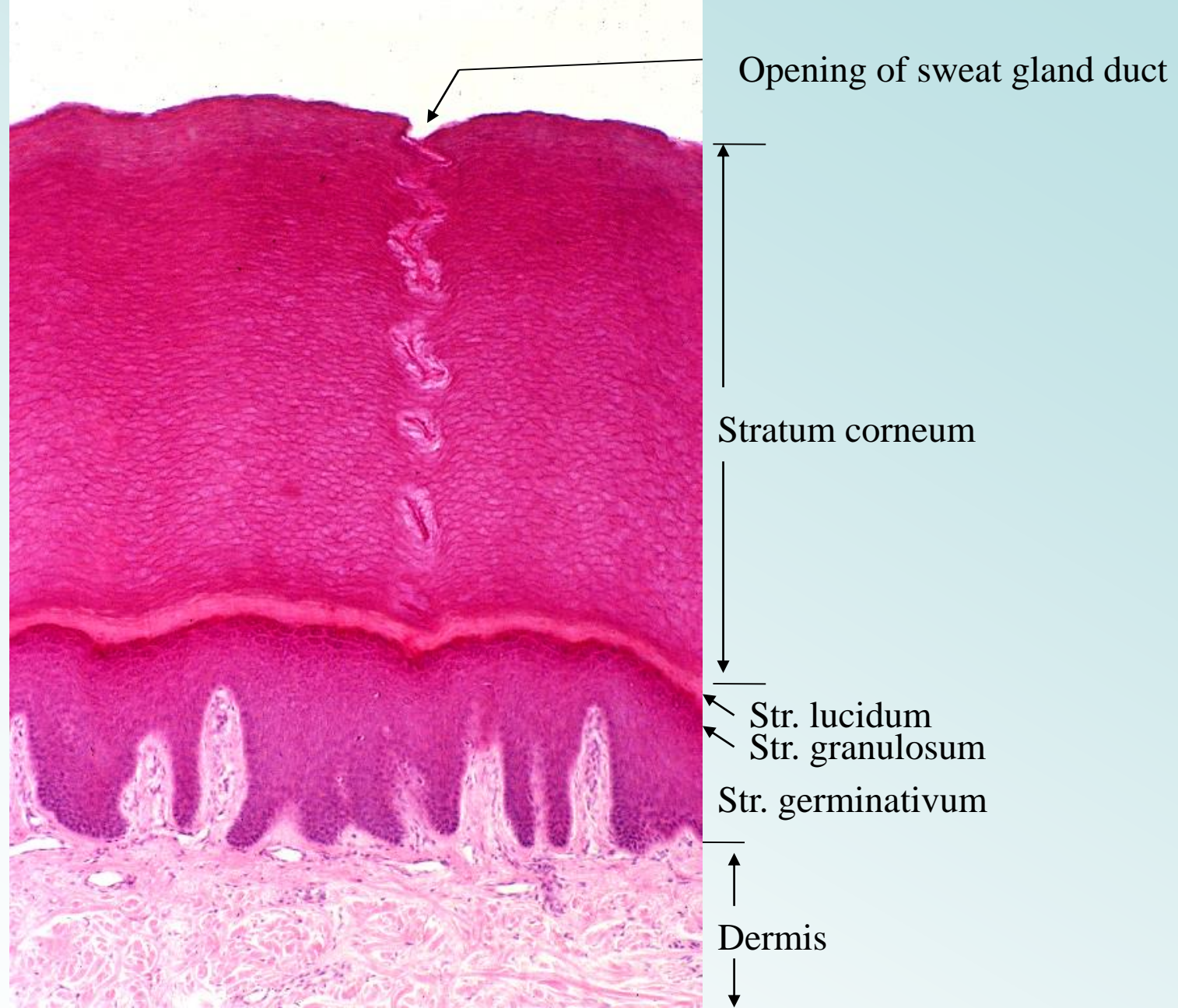
# Skin





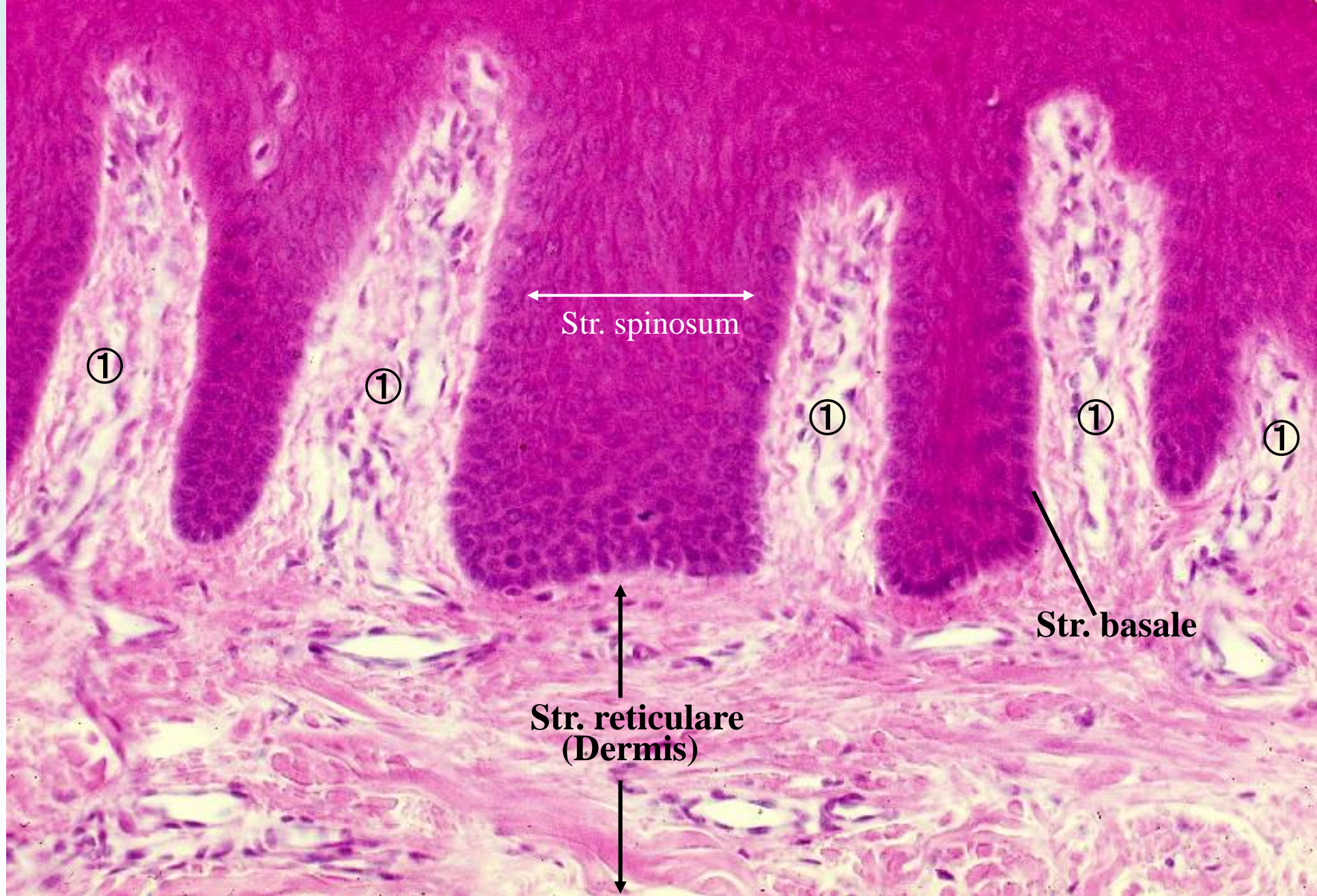
21-01 Skin of the palm 1. General view. Human, H-E stain, x 3.3.





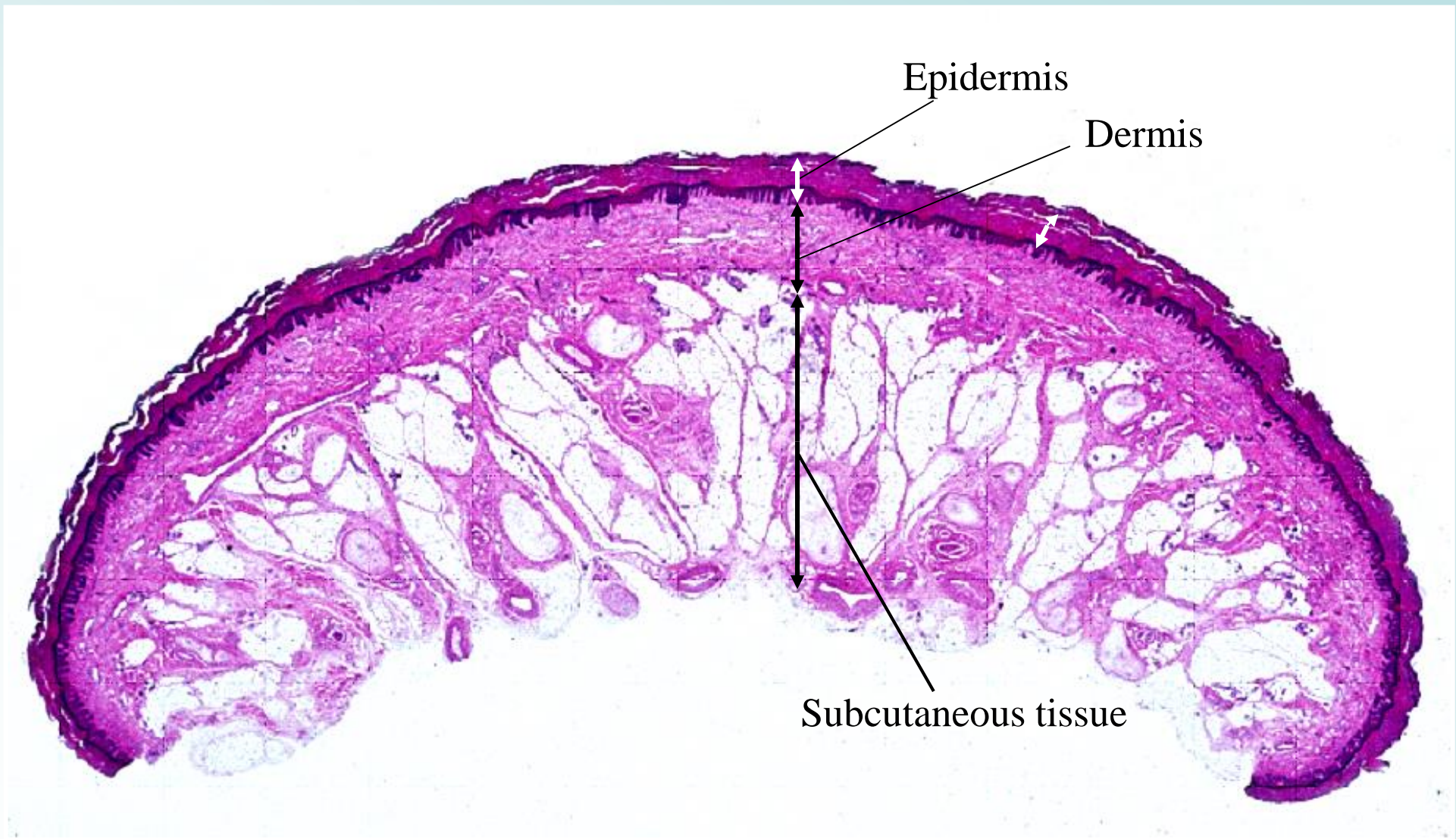
21-02 Skin of the palm 2. Human, H-E stain, x 25.





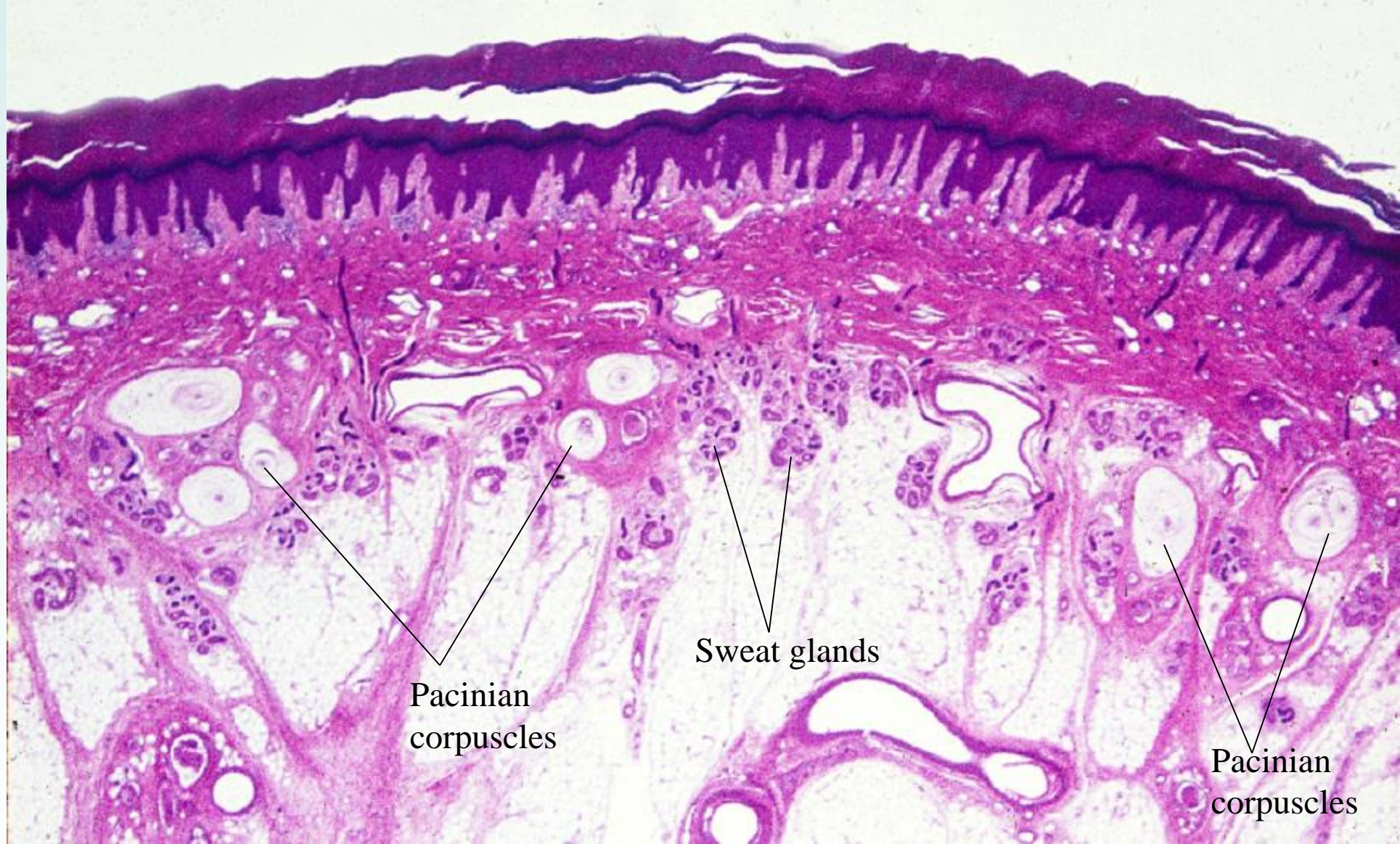
21-03 Skin of the palm 3. Dermis. Human, H-E stain, x 64.





21-04 Skin of thumb tip 1. Human, H-E stain, x 1.7.





Pacinian  
corpuscles

Sweat glands

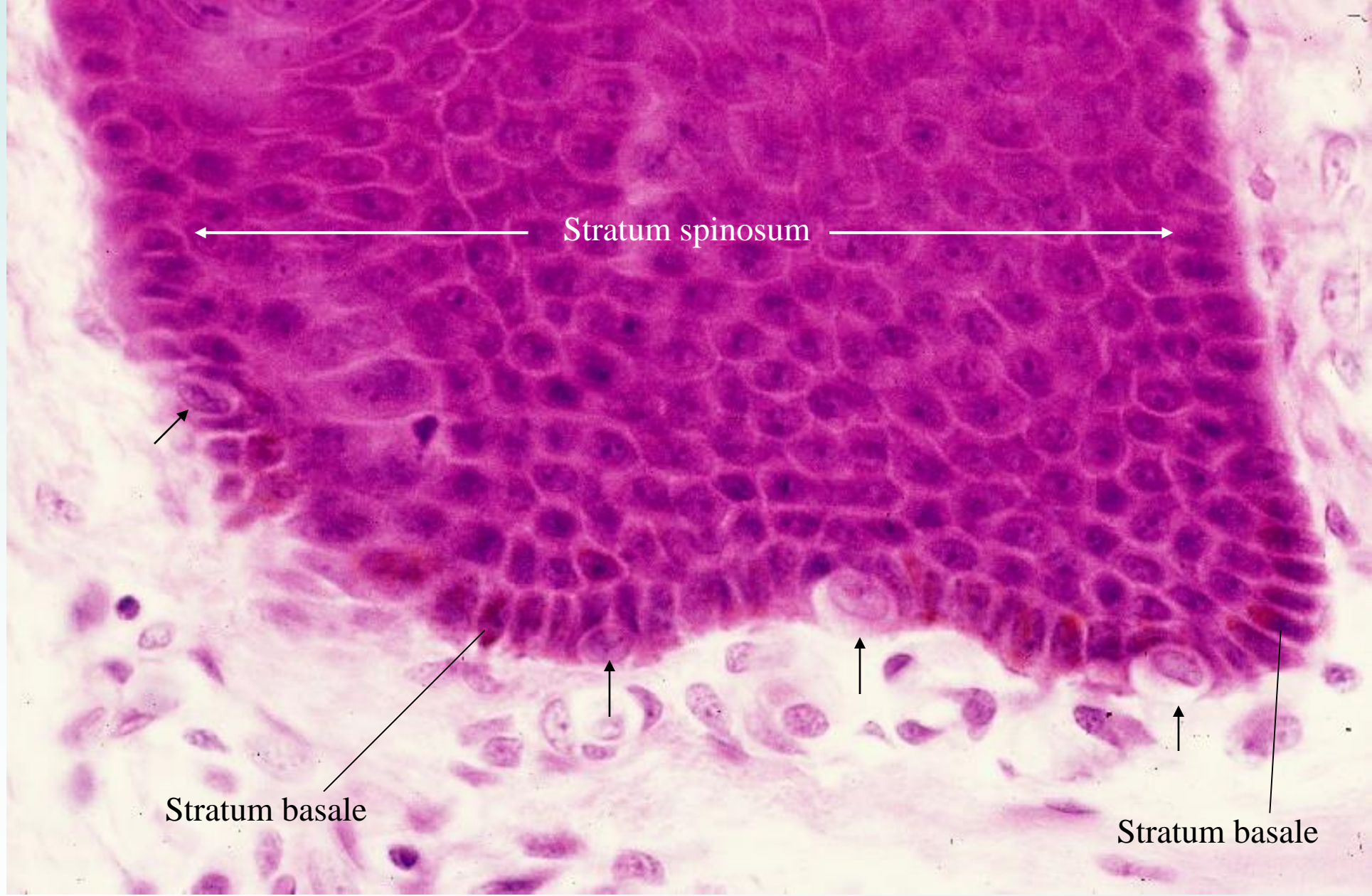
Pacinian  
corpuscles





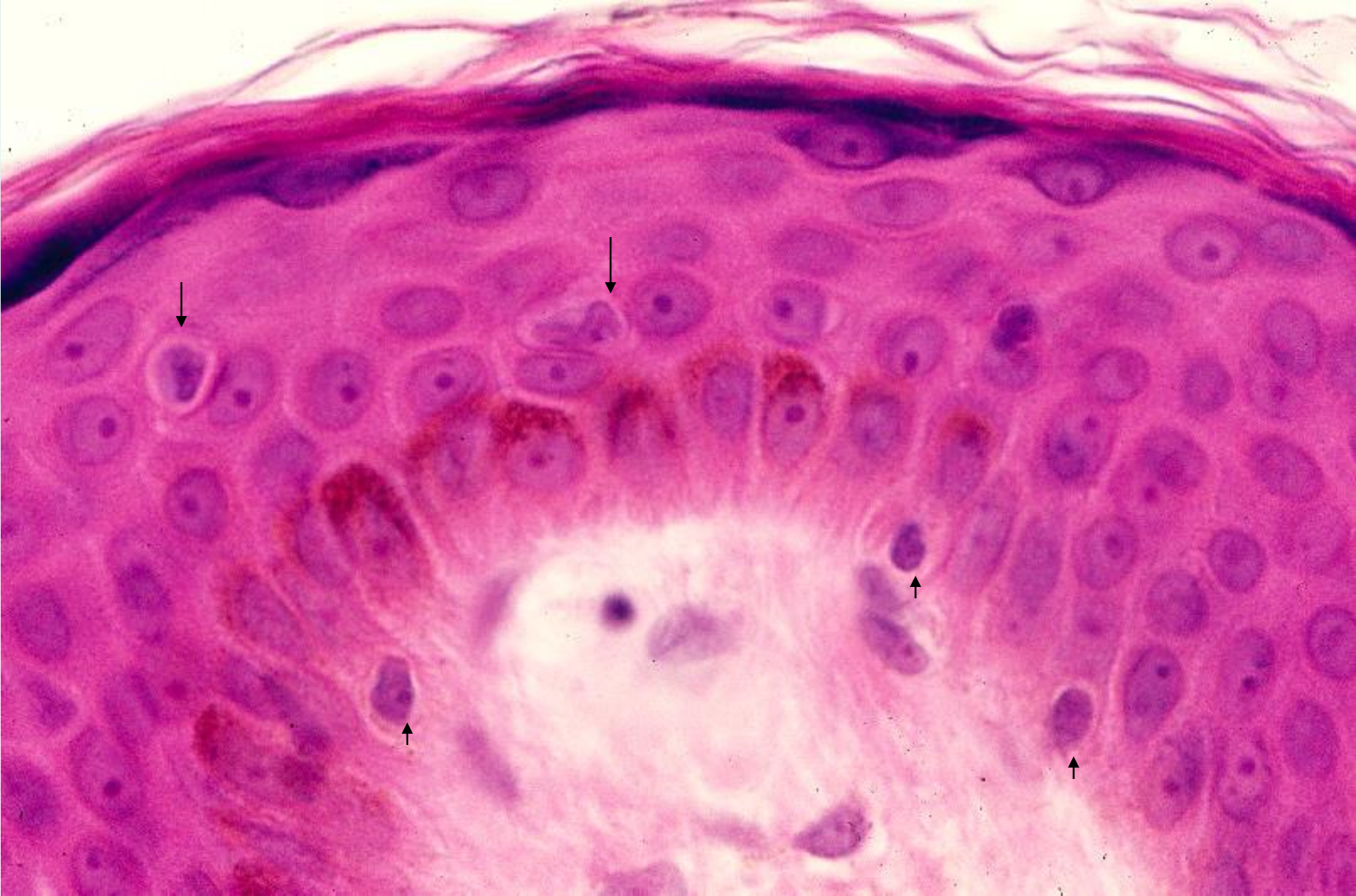
**21-06 Skin of thumb tip 3. Stratum spinosum. Human, H-E stain, x 400.**





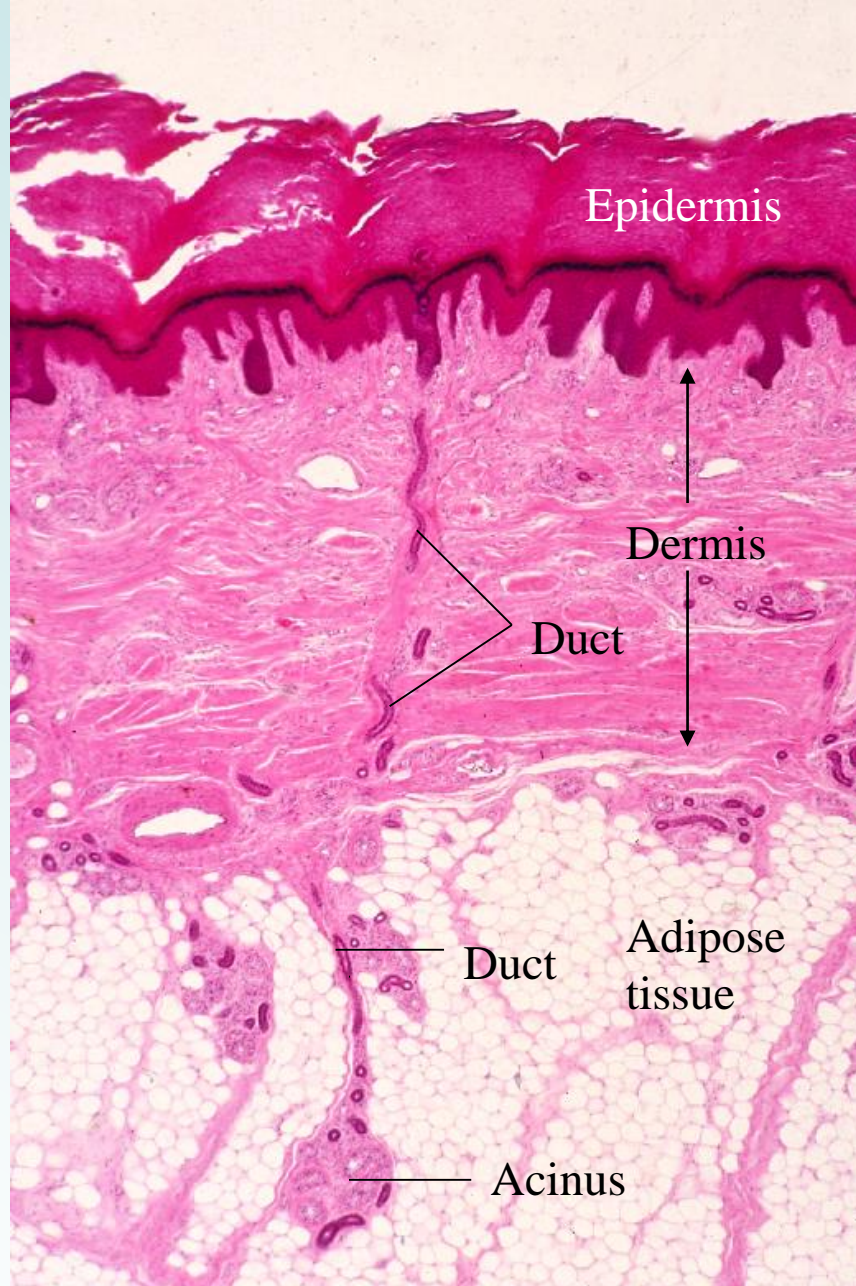
**21-07 Skin of the thumb tip 4. Stratum germinativum and melanocytes. Human, H-E stain, x 160.**





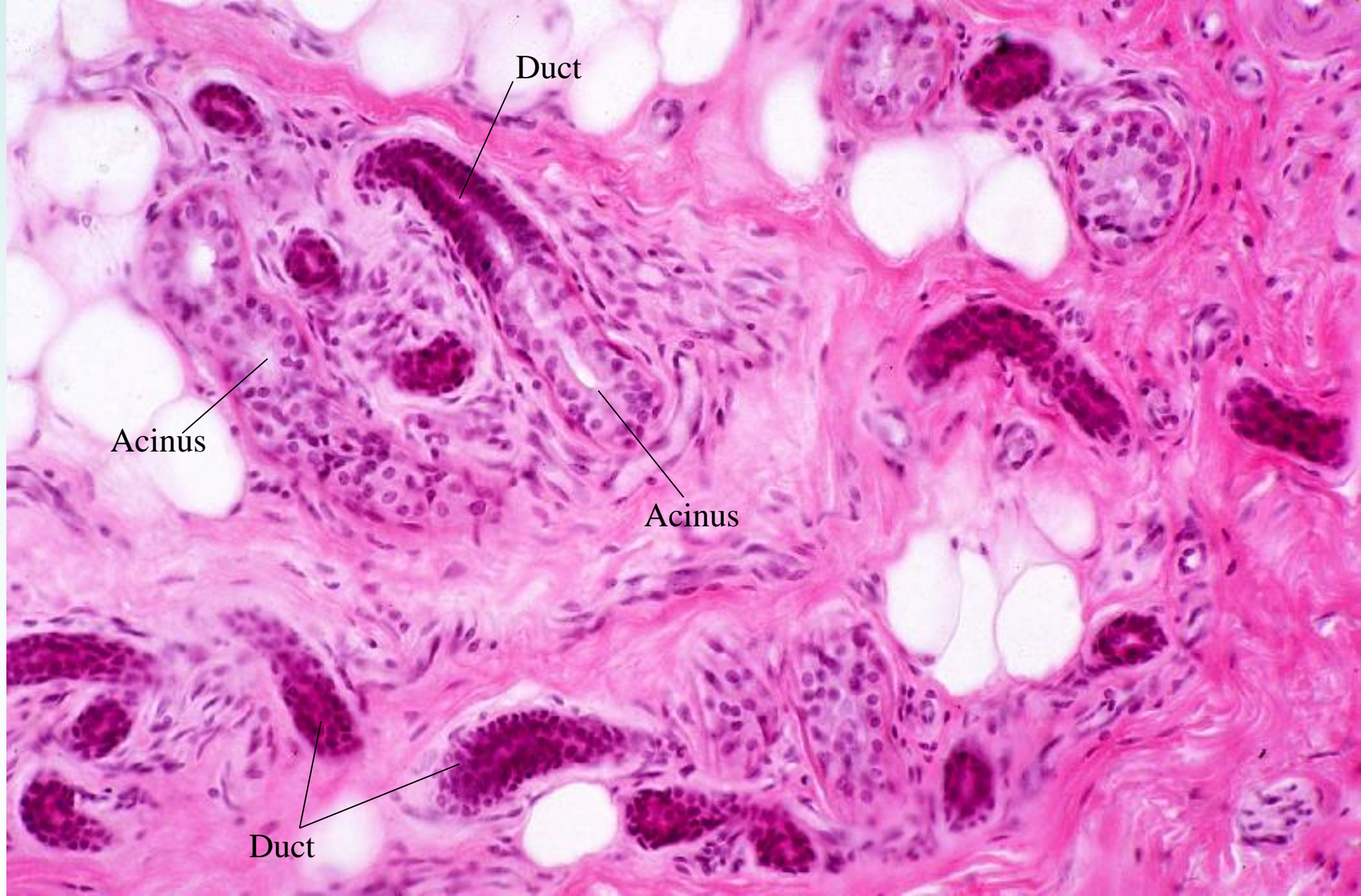
21-08 Skin of auricula. Melanocytes and Langerhans cells. Human, H-E stain, x 250.





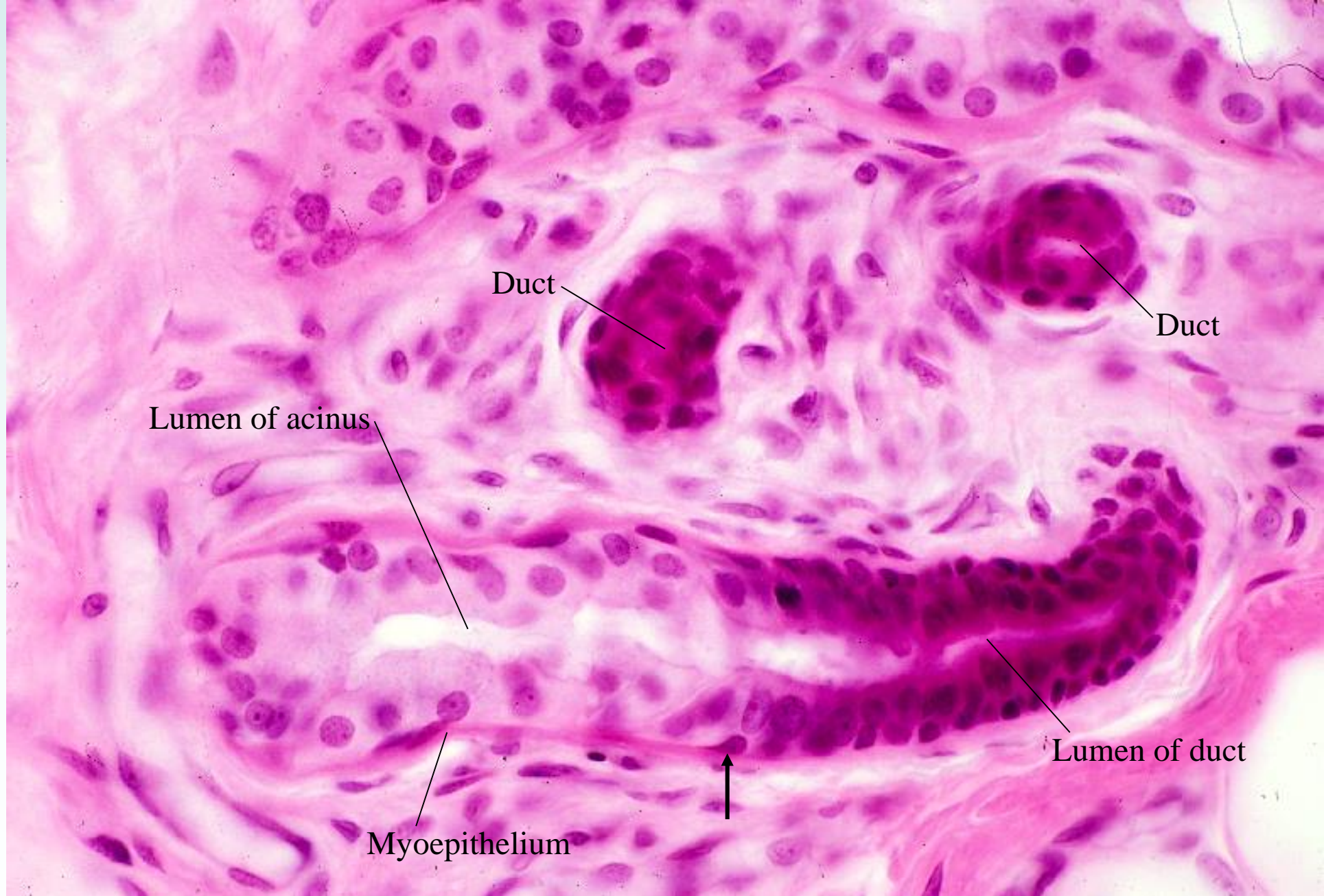
21-09 Sweat gland 1. General view. Human, H-E stain, x 10.





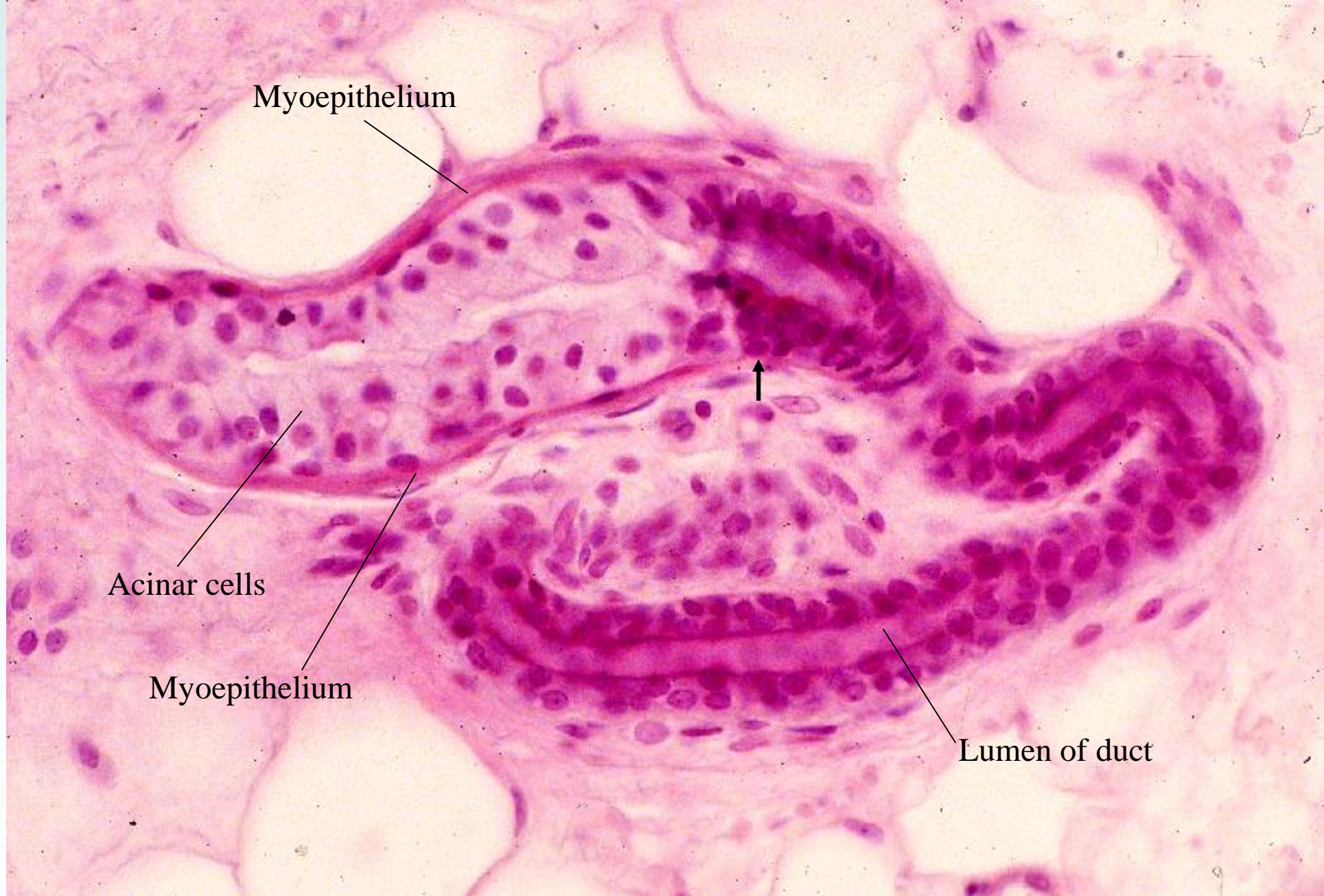
**21-10 Sweat gland 2. Secretory portions and ducts.**  
**Human, H-E stain, x 64.**





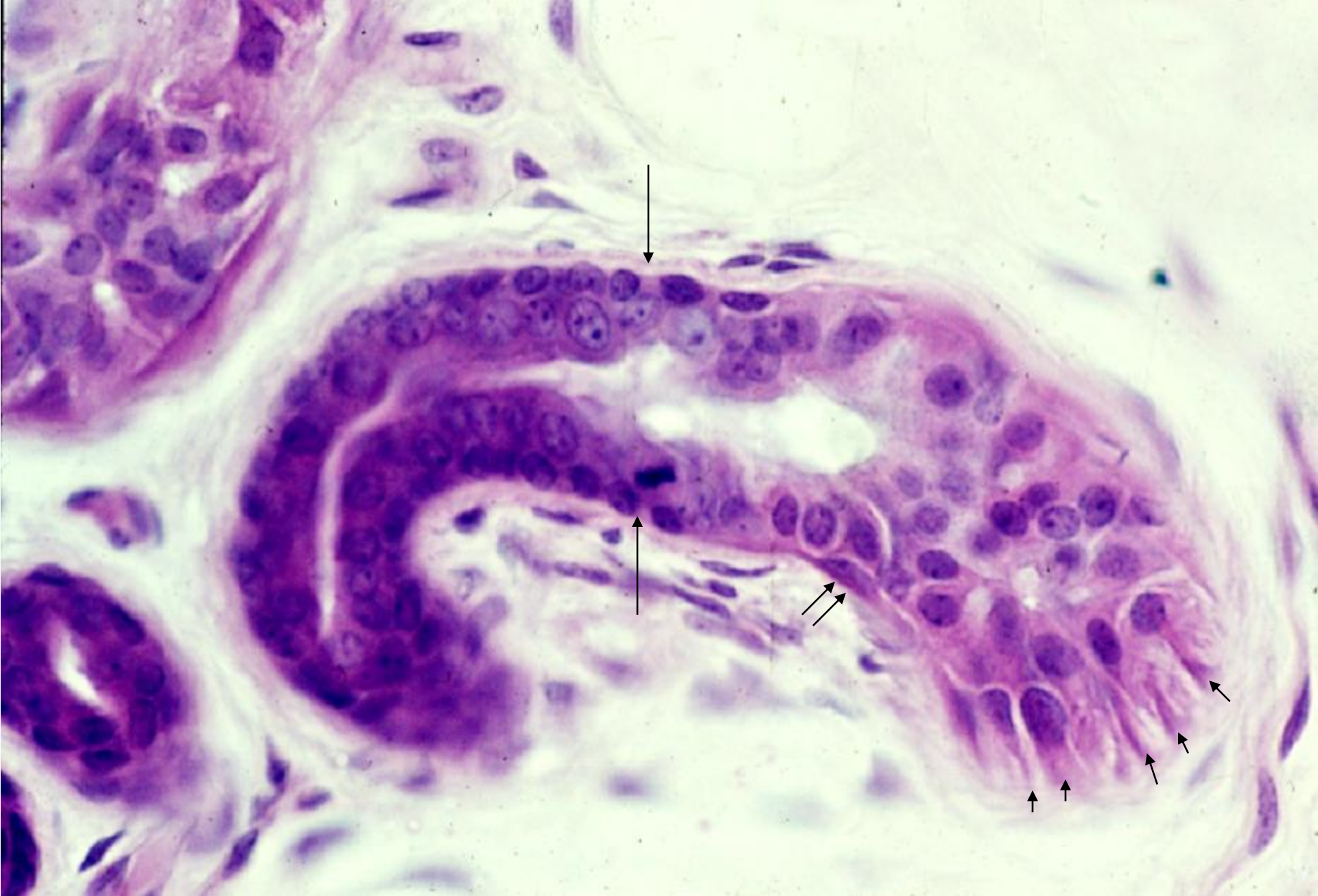
**21-11 Sweat gland 3. Secretory portion and duct, longitudinal section 1. Human, H-E stain, x 130.**





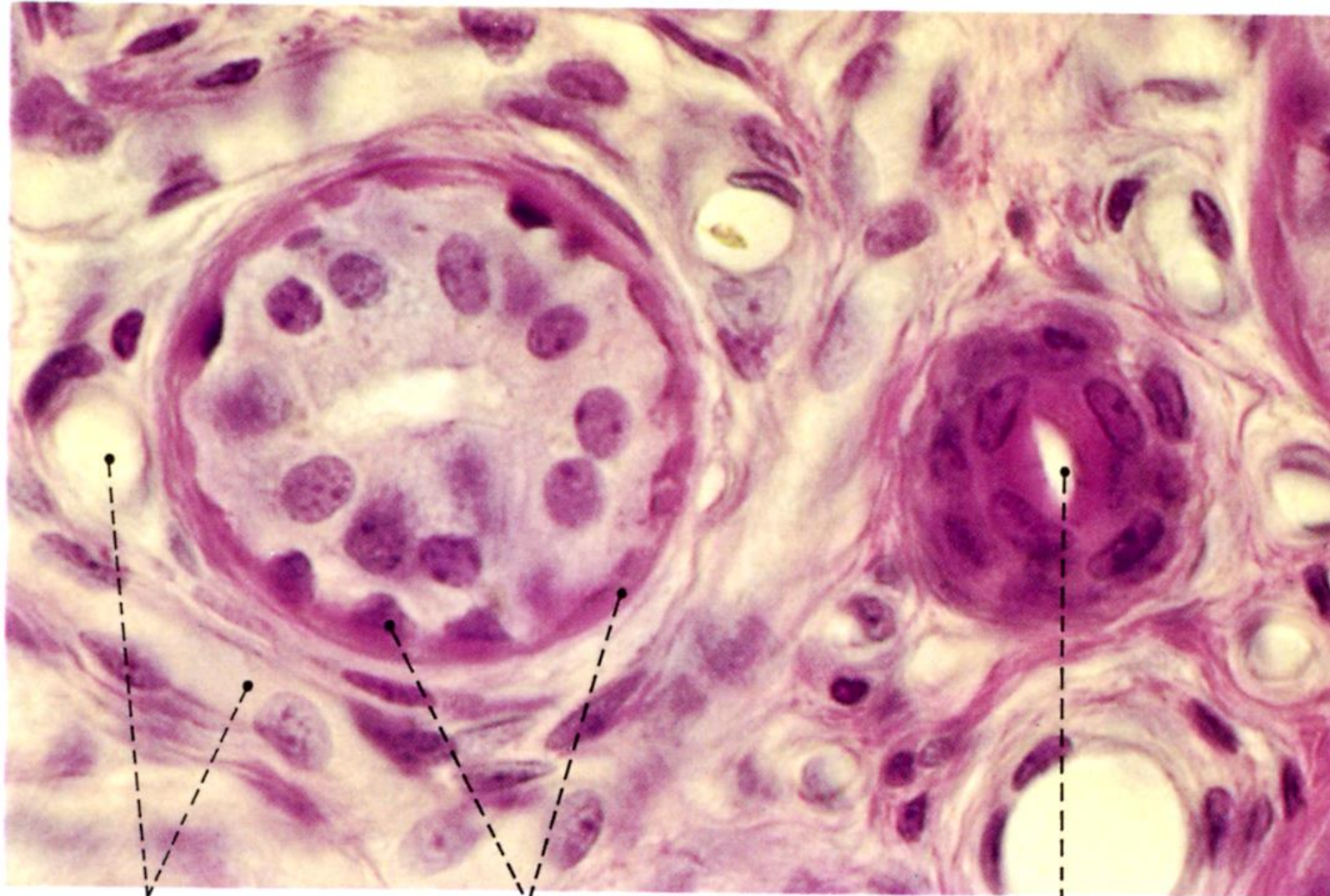
**21-12 Sweat gland 4. Secretory portion and duct, longitudinal section 2. Human, H-E stain, x 100.**





**21-13 Sweat gland 5. Secretory portion and duct, longitudinal section 3. Human, H-E stain, x 160.**





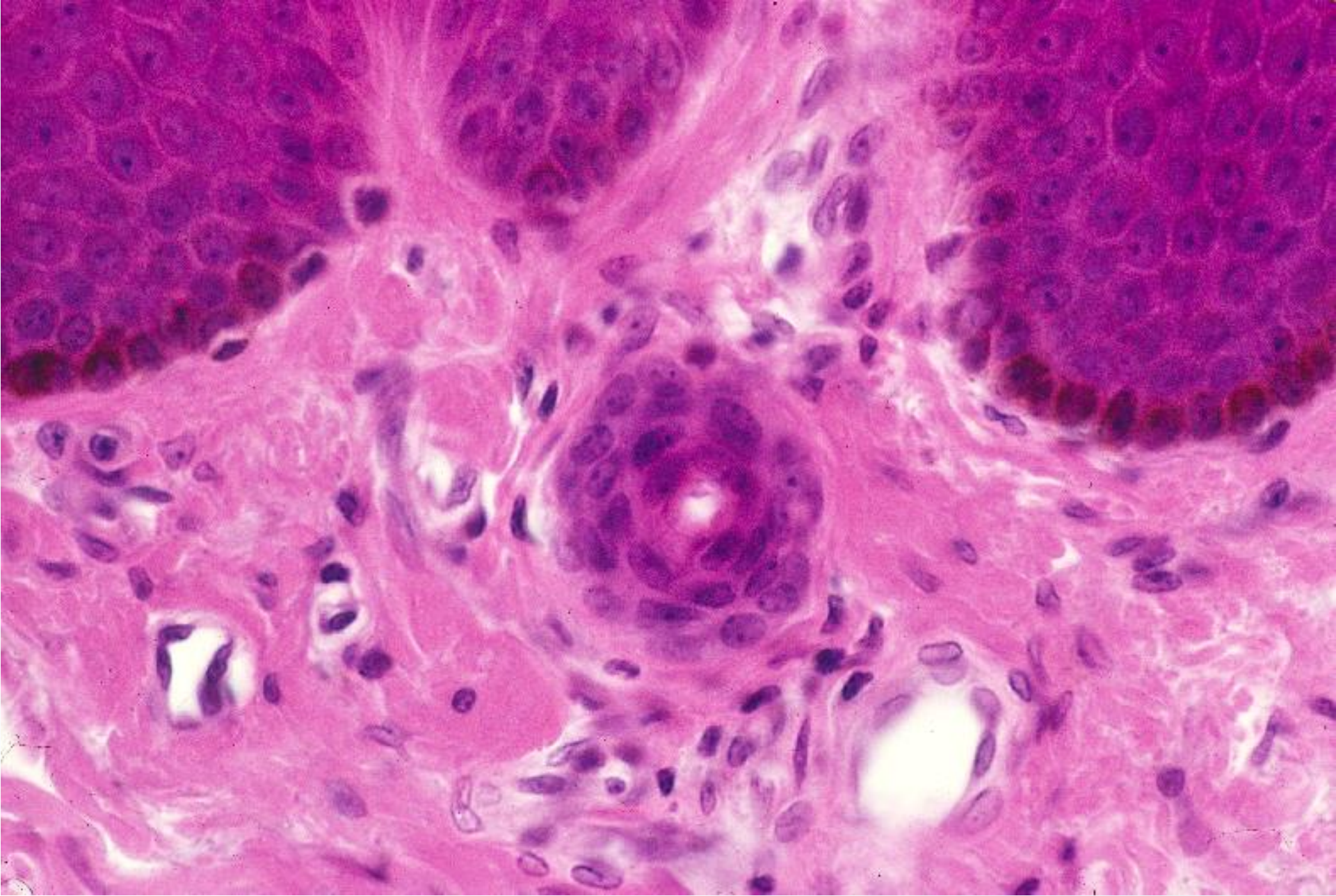
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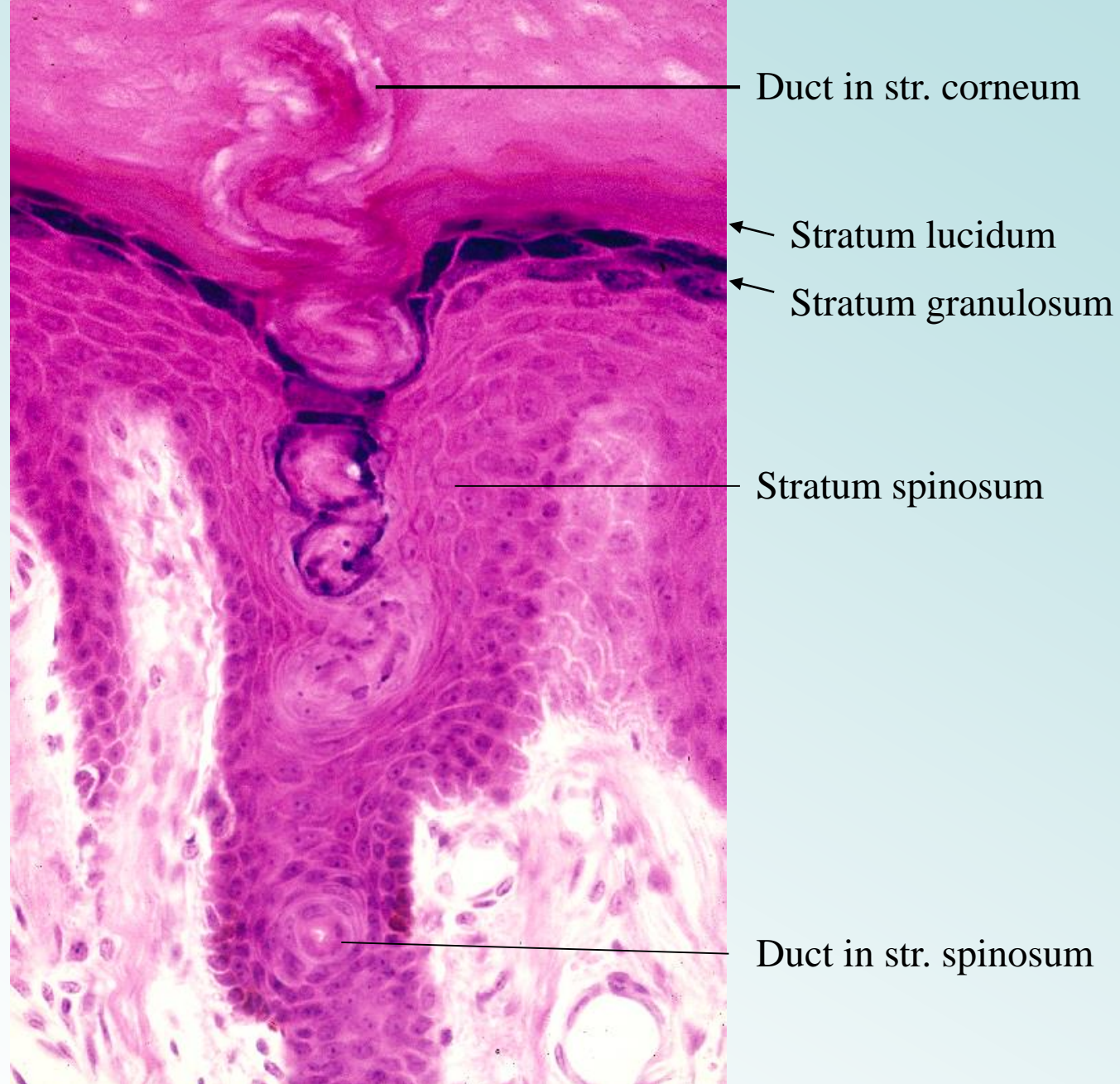
21-14 Sweat gland 6. Transverse section of acinus and duct. Human, H-E stain, x 250.



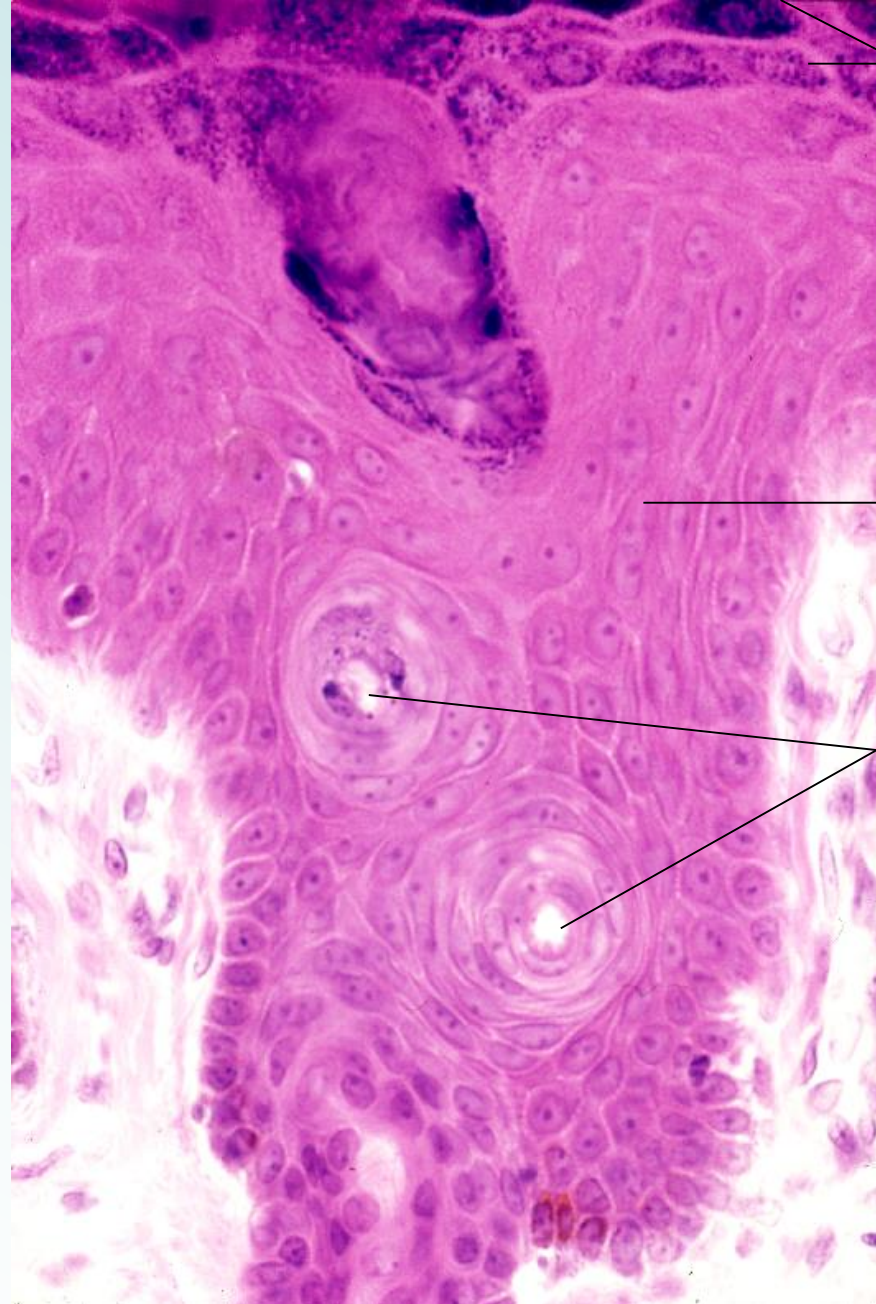


**21-15 Duct of sweat gland 1. Transverse section.  
Human, H-E stain, x 160.**





**21-16 Duct of sweat gland 2. Passing through the epidermis 1. Human, H-E stain, x 100.**



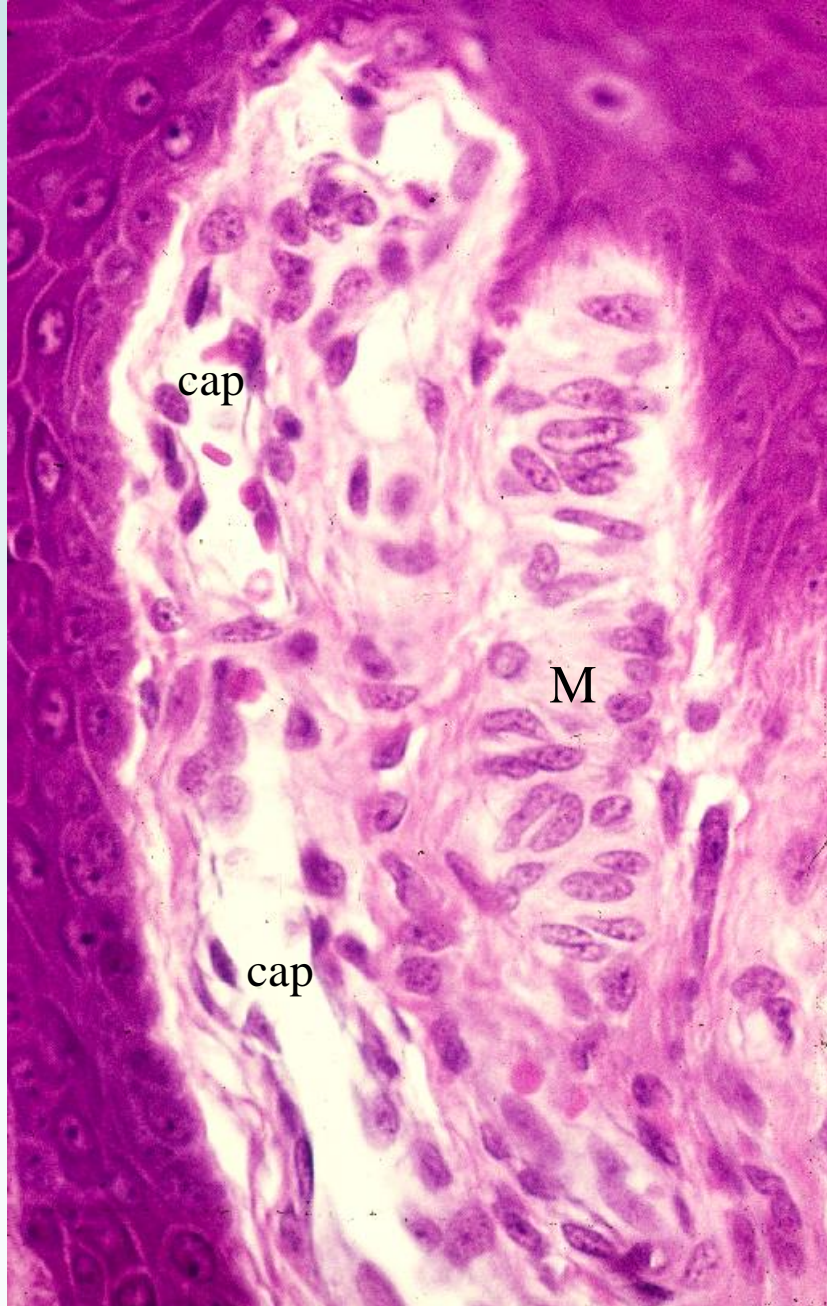
Stratum granulosum

Stratum spinosum

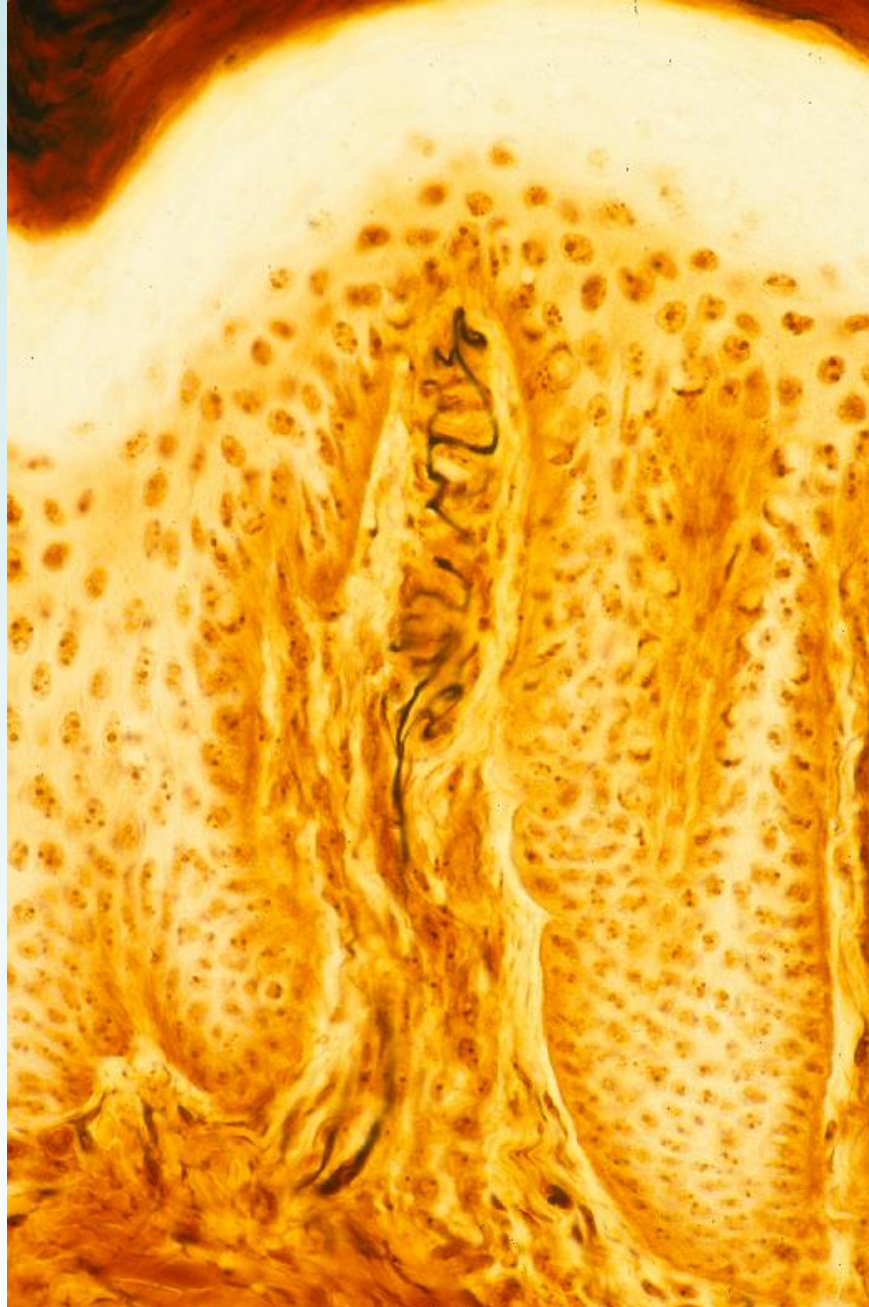
Duct

**21-17 Duct of sweat gland 3. Passing through the epidermis 2. Human, H-E stain, x 160.**



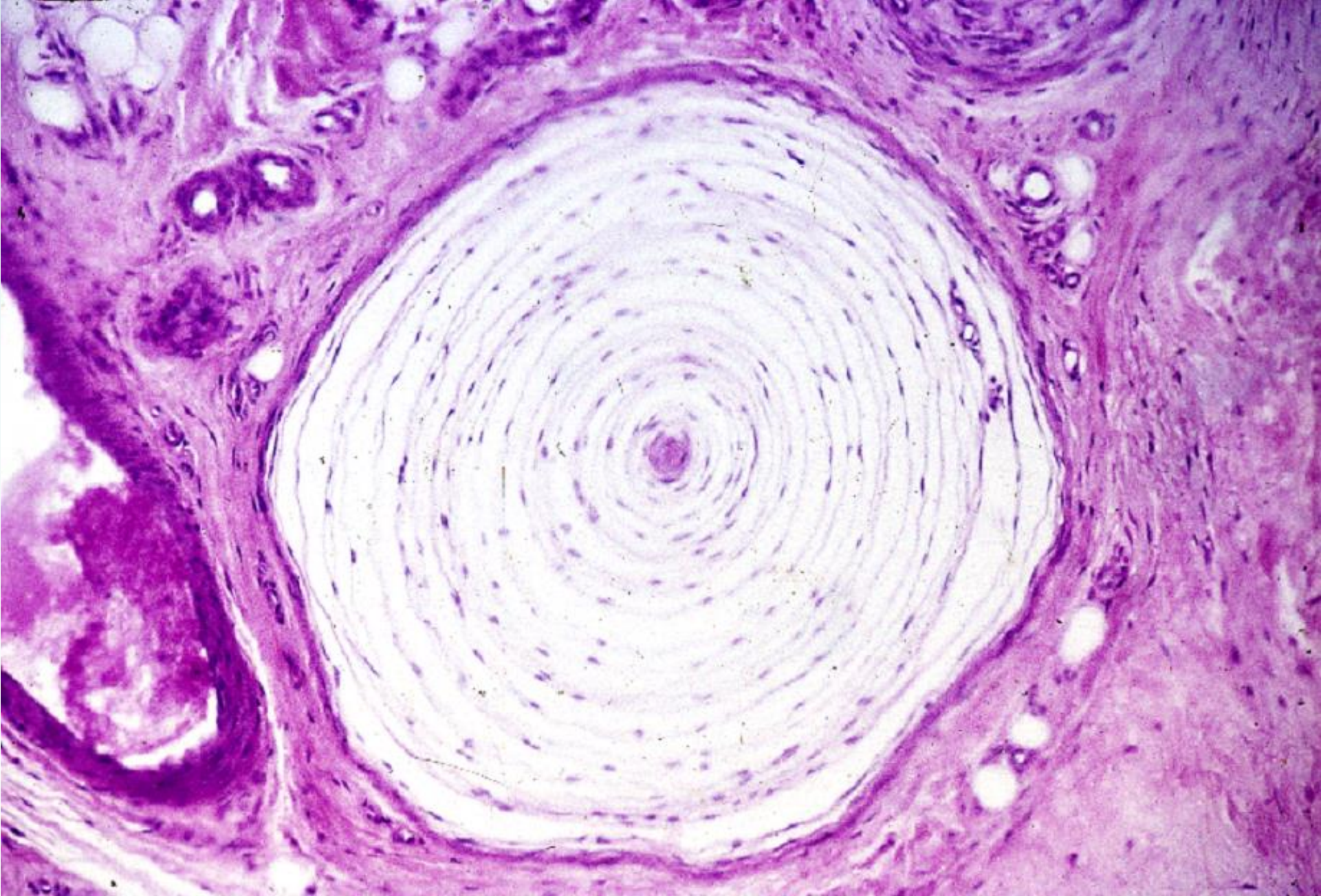


**21-18 Dermal papilla, containing a Meissner's corpuscle. Human, H-E stain, x 160.**



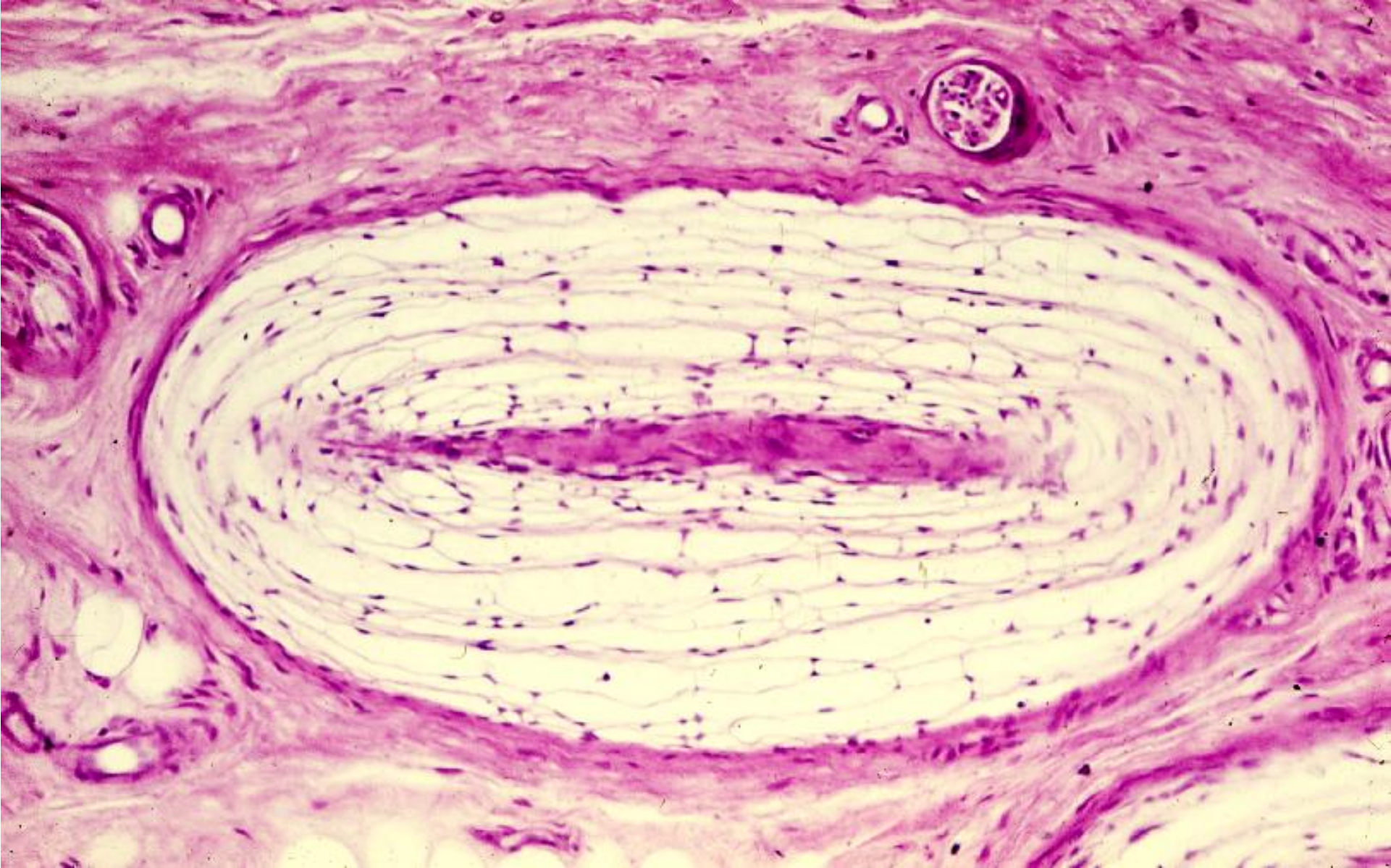
**21-19 Meissner's corpuscle. Silver impregnation.  
Human, x 100.**





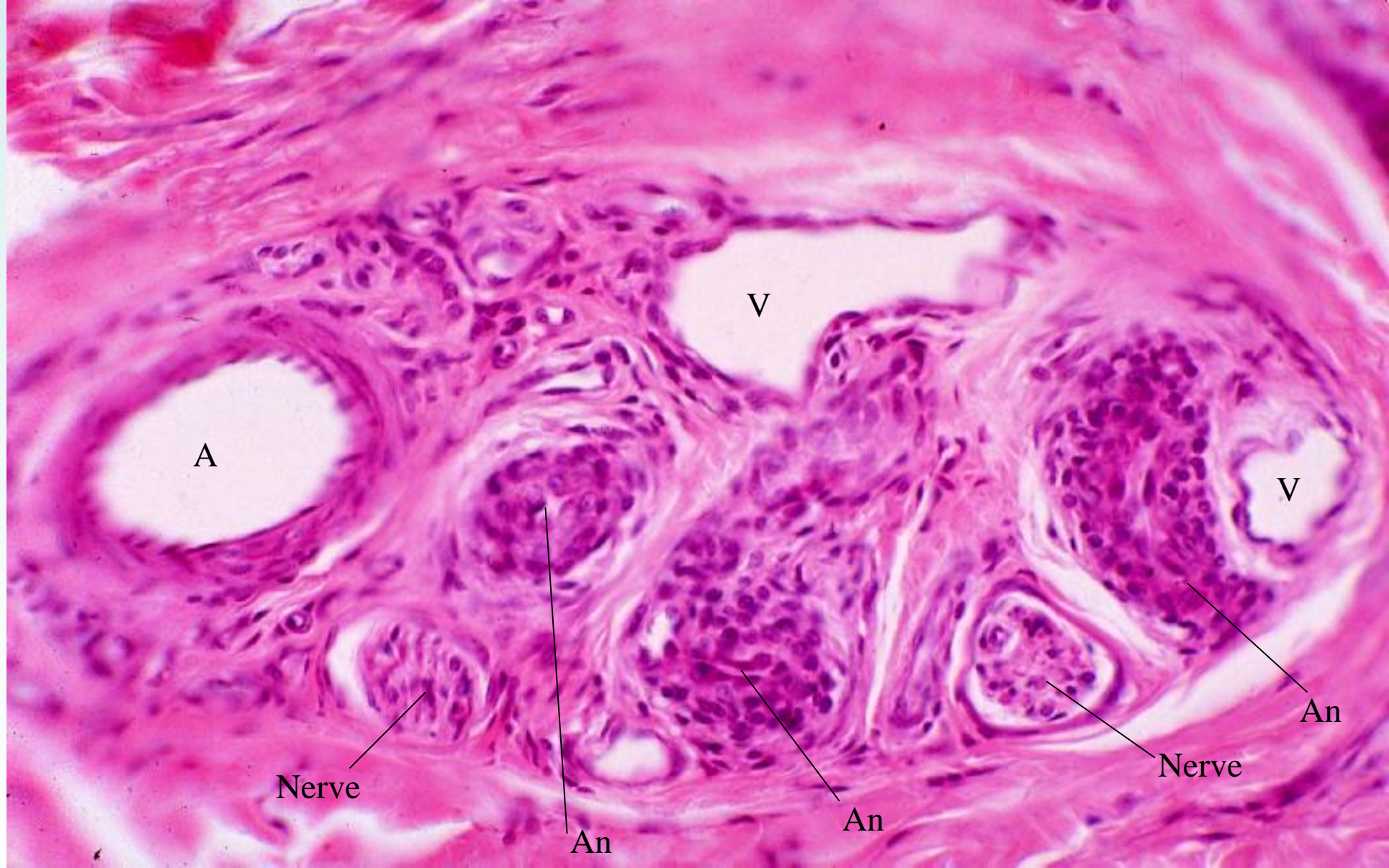
21-20 Pacinian corpuscle 1. Transverse section. Human, H-E stain, x 25.





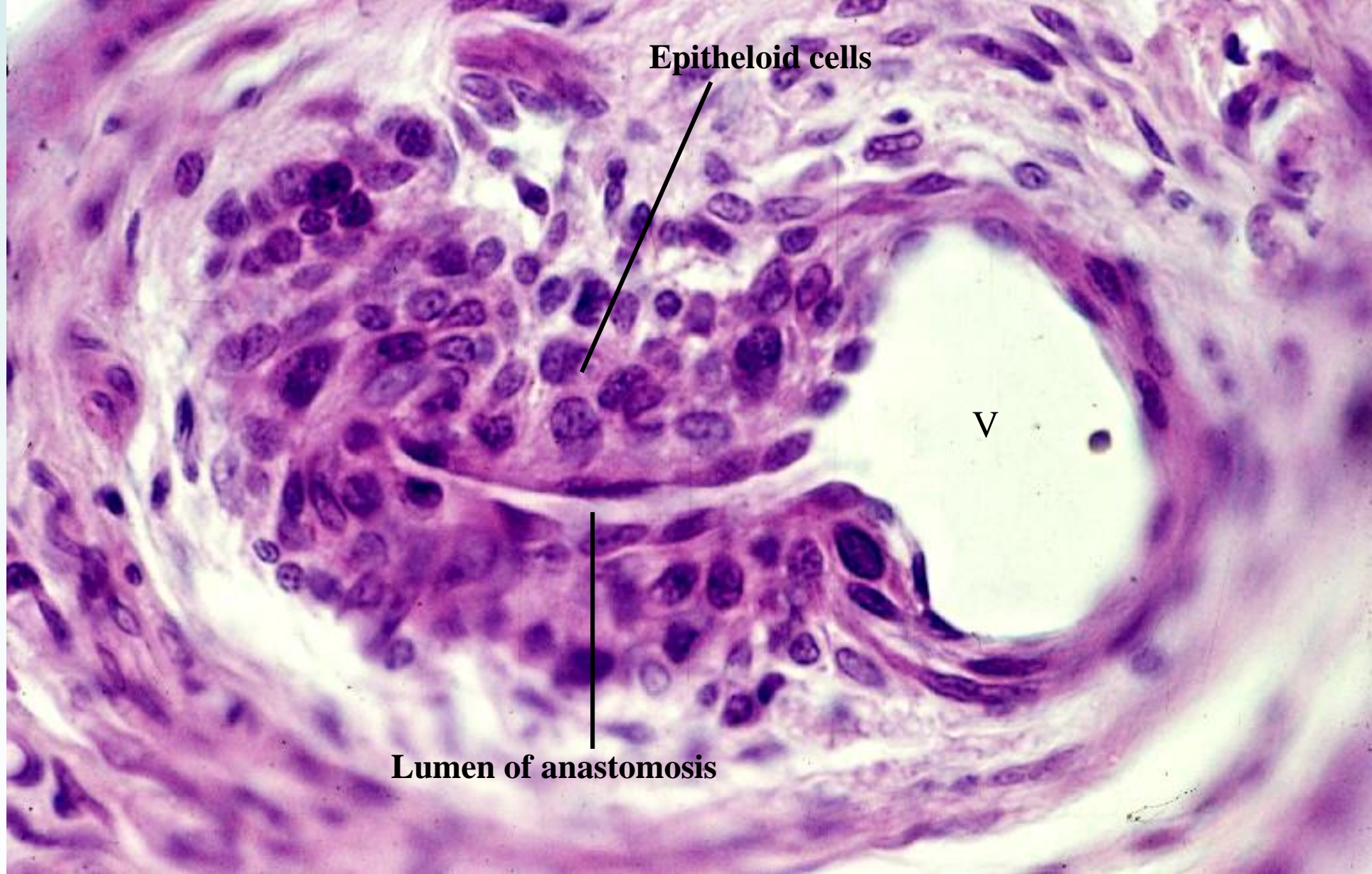
**21-21 Pacinian corpuscle 2. Longitudinal section,  
Human, H-E stsin, x 25.**





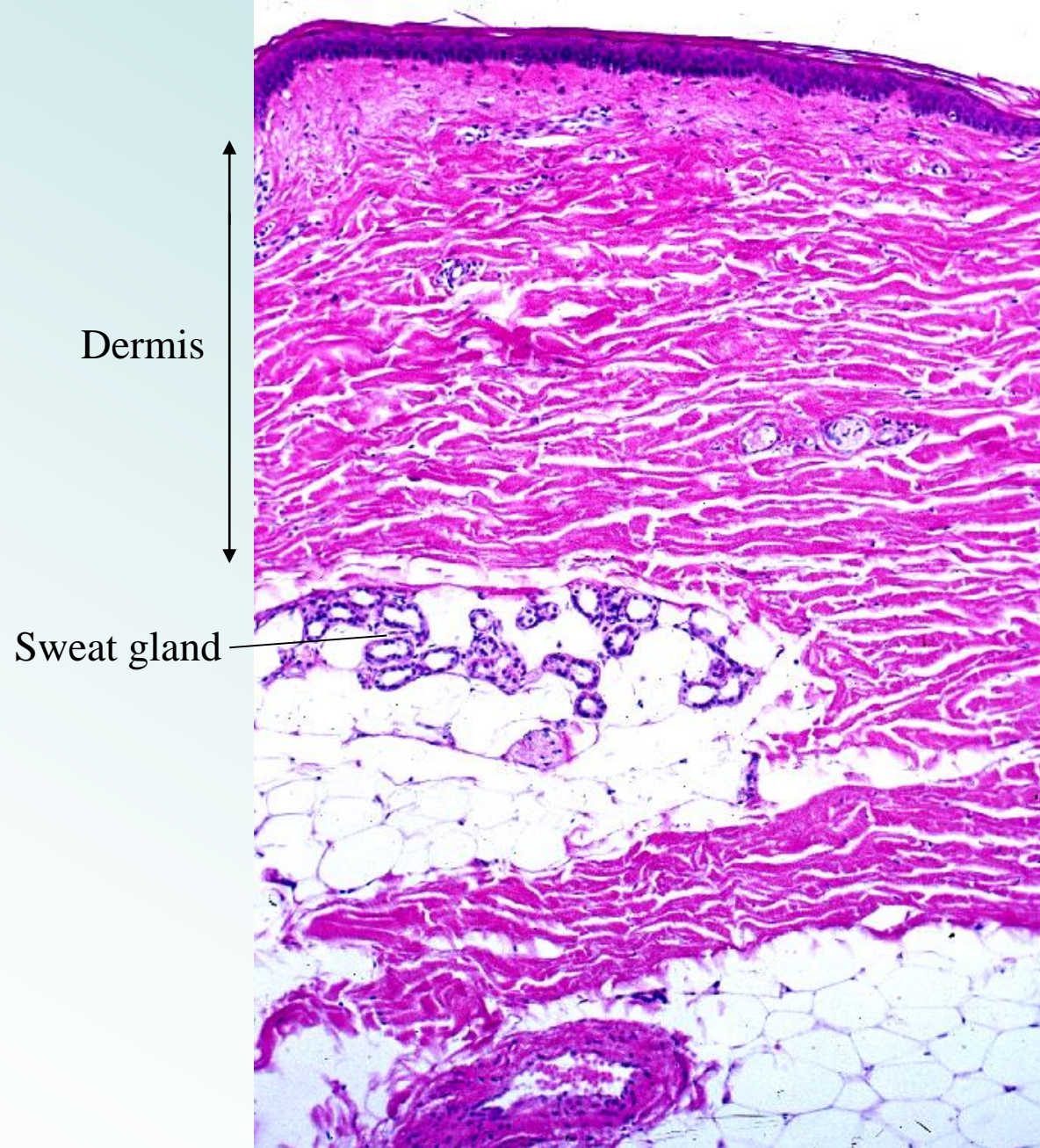
21-22 Organ of Hoyer-Grosser 1. Human, H-E stain, x 66.





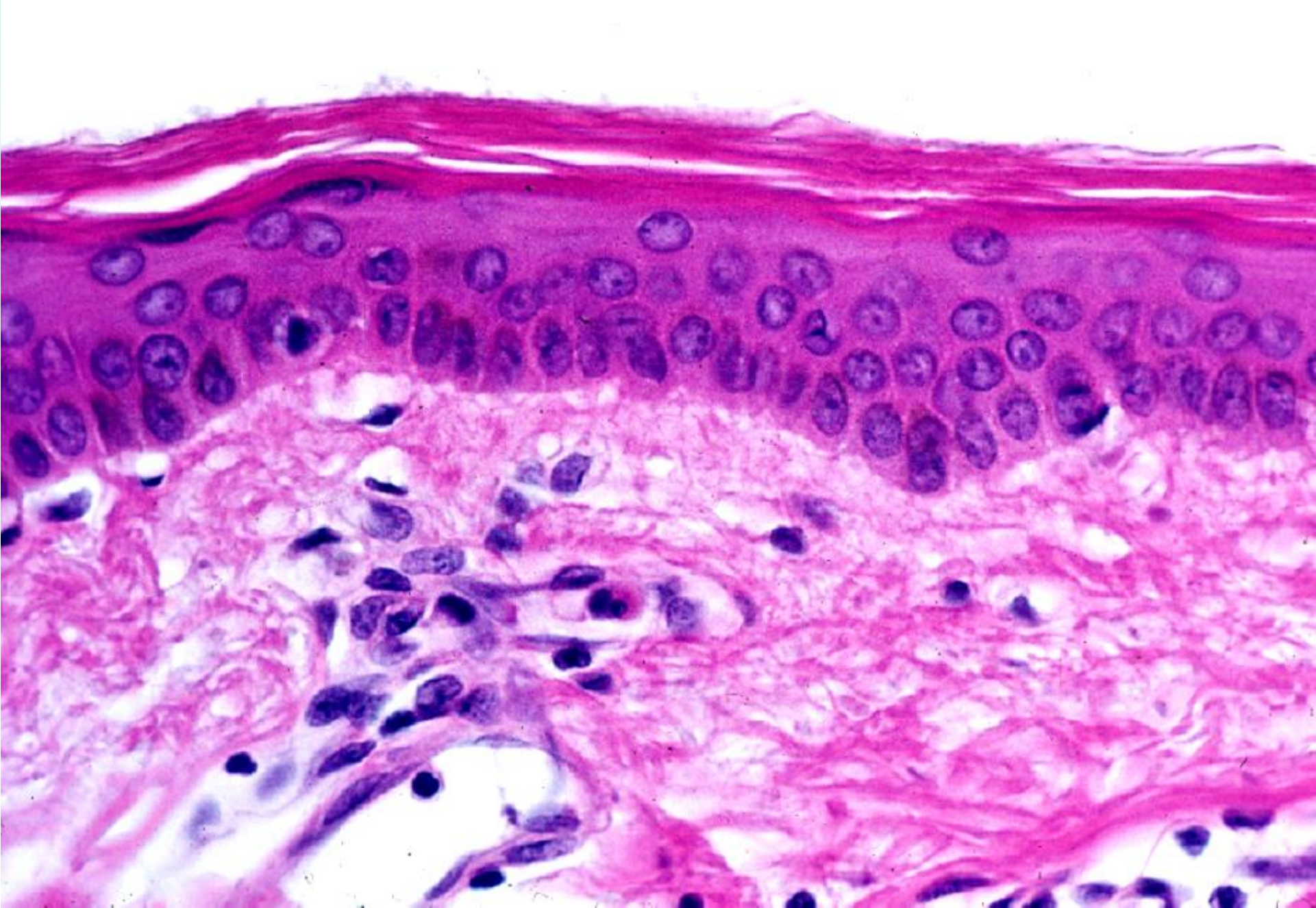
21-23 Organ of Hoyer-Grosser 2. Human, H-E stain, x160.





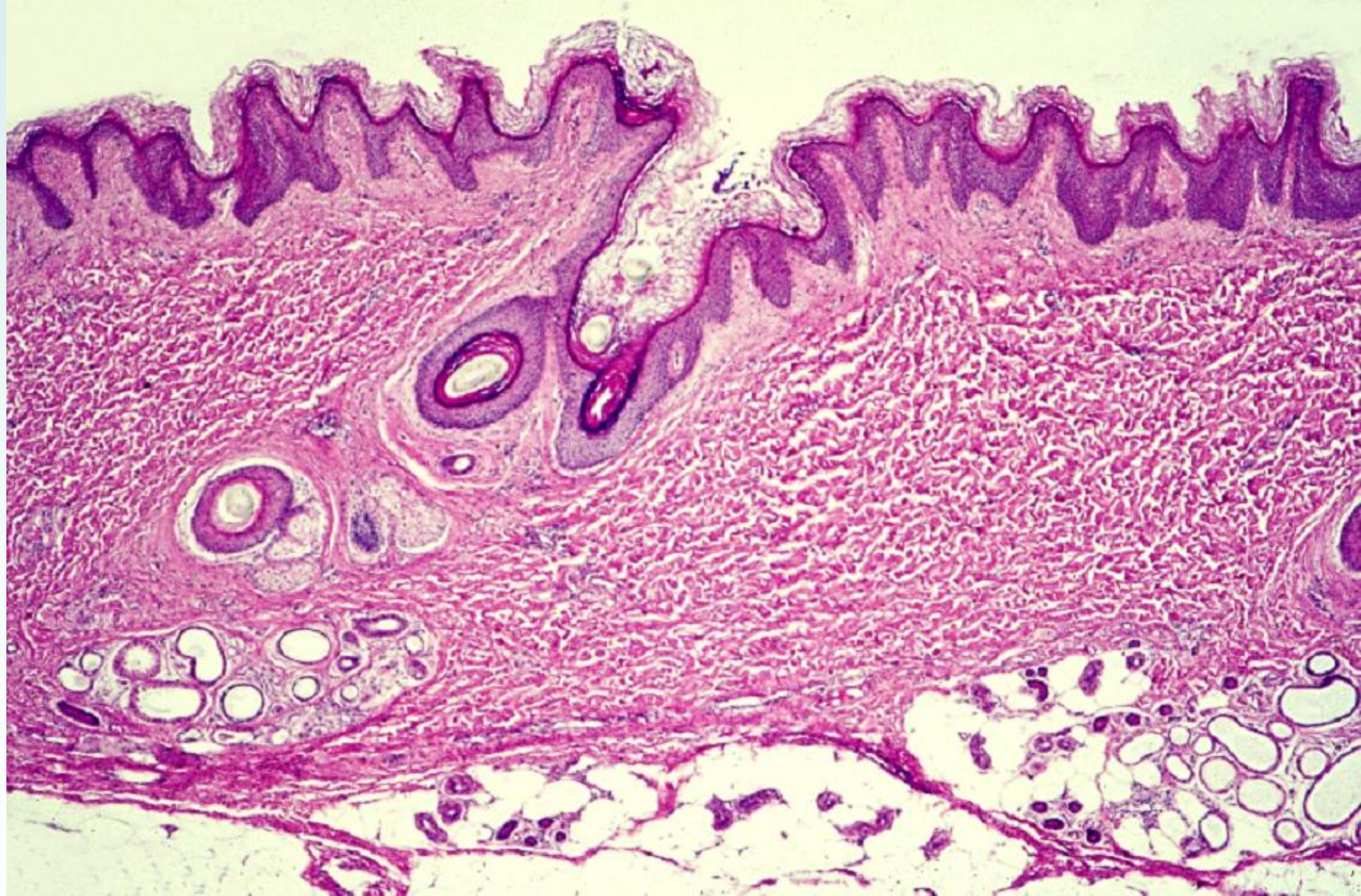
21-24 Skin of abdomen 1. Human, H-E stain, x 25.





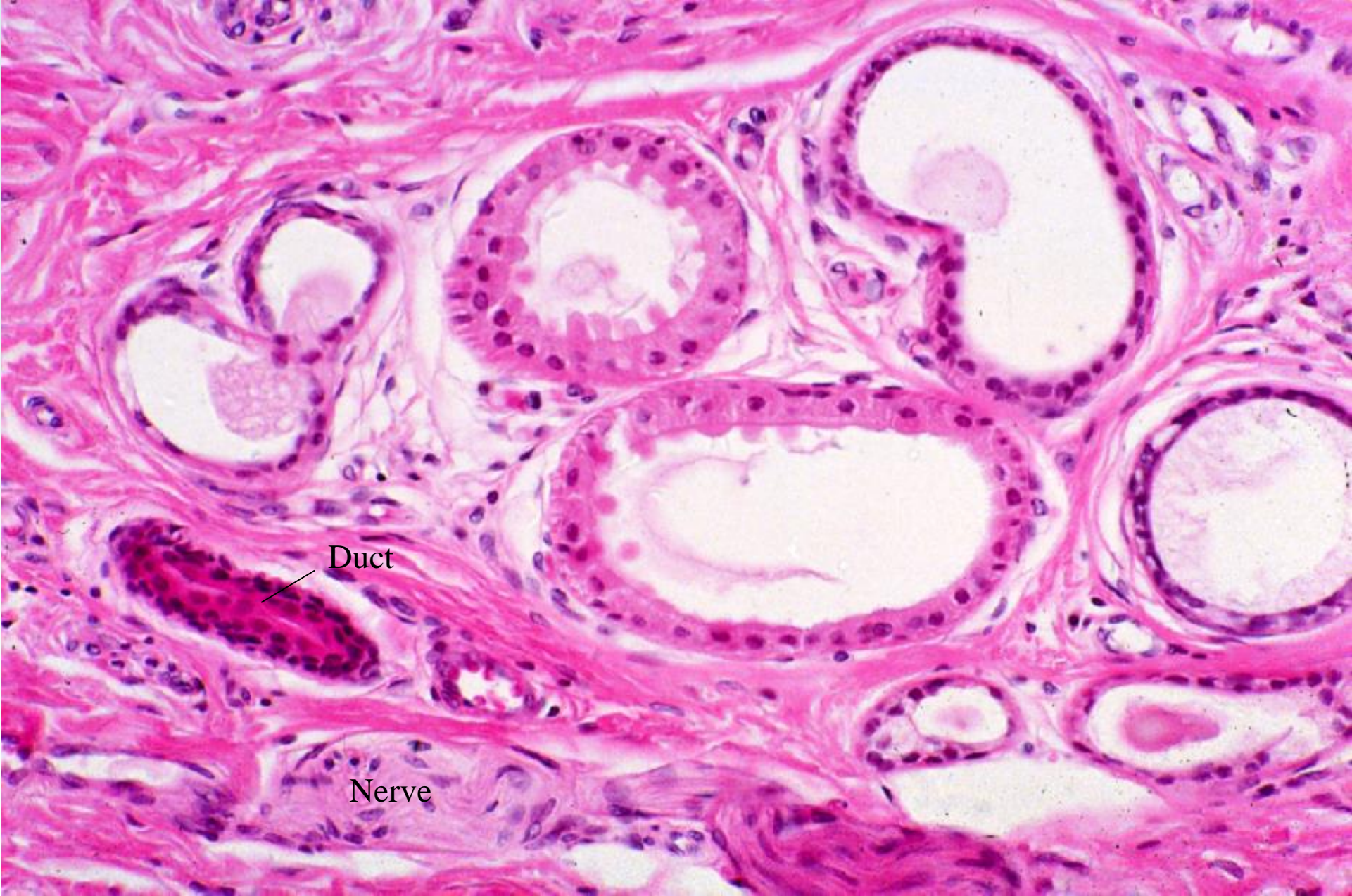
21-25 Skin of abdomen 2. Human, H-E stain, x 160.





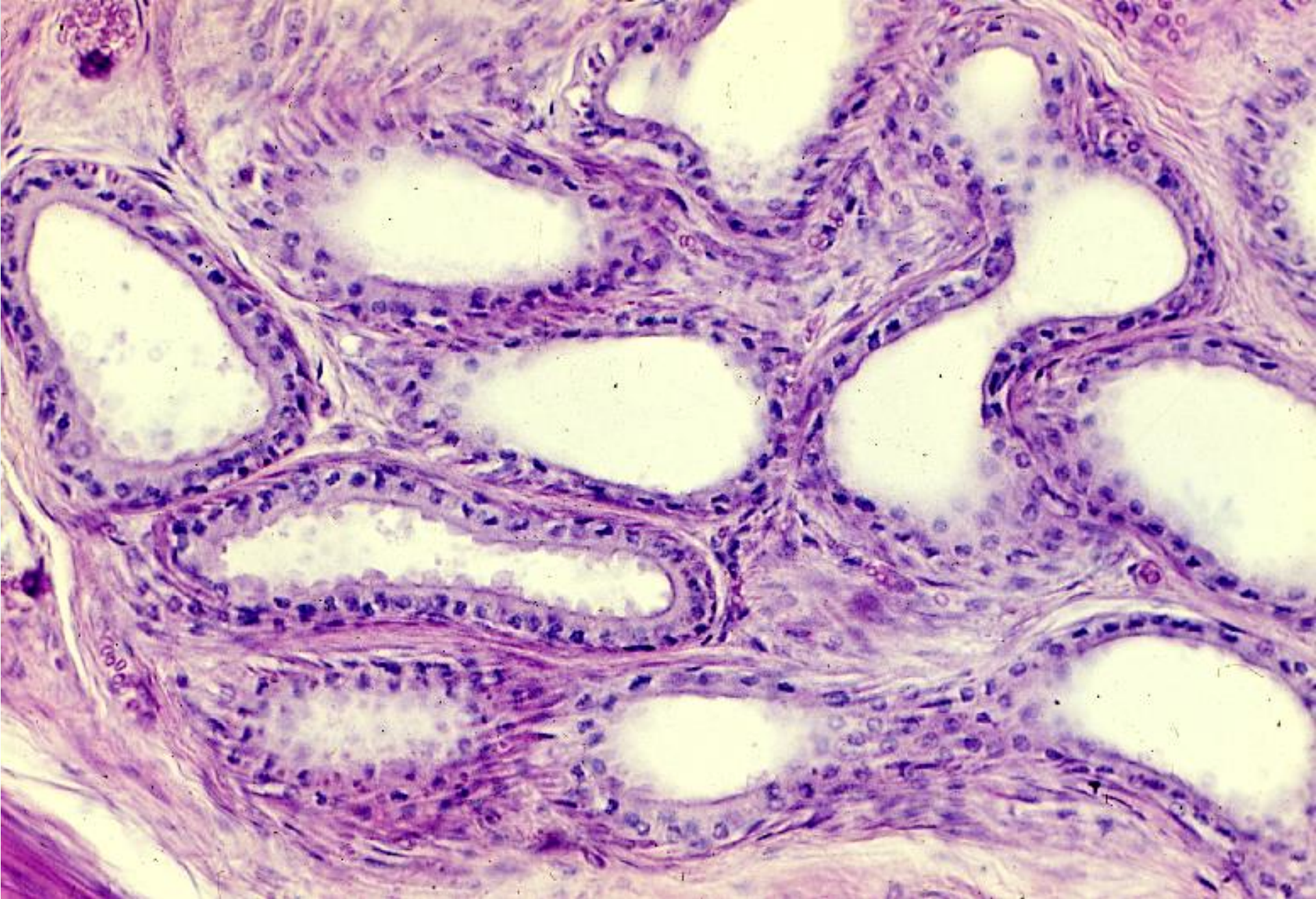
21-26 Skin of axilla 1. Human, H-E stain, x 10.





21-27 Apocrine sweat gland 1. Human axilla, H-E stain, x 66.



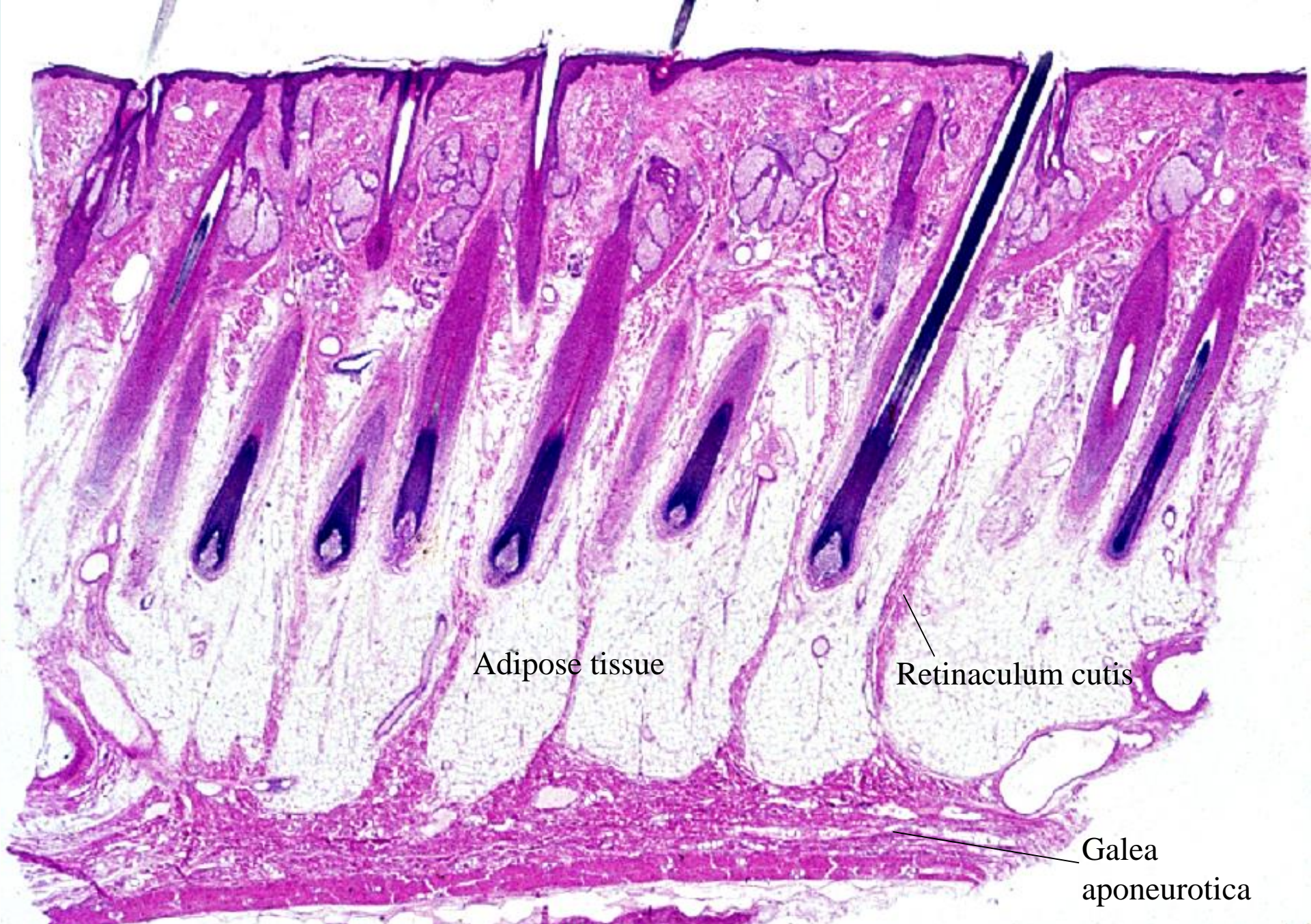


**21-28 Apocrine sweat gland 2. Gl. cerminosa. Human,  
H-E stain, x 64.**



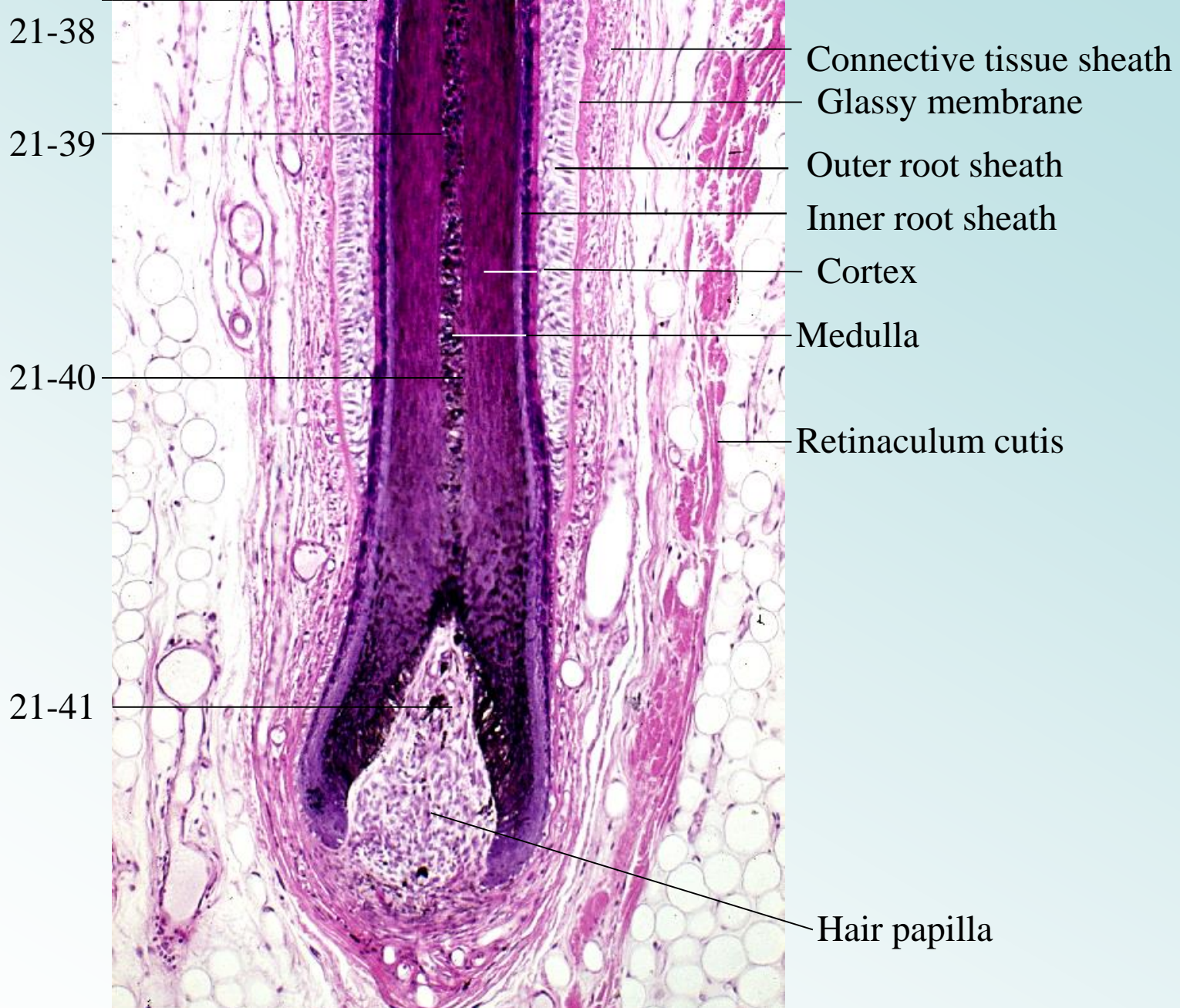
# 21-002

# Scalp



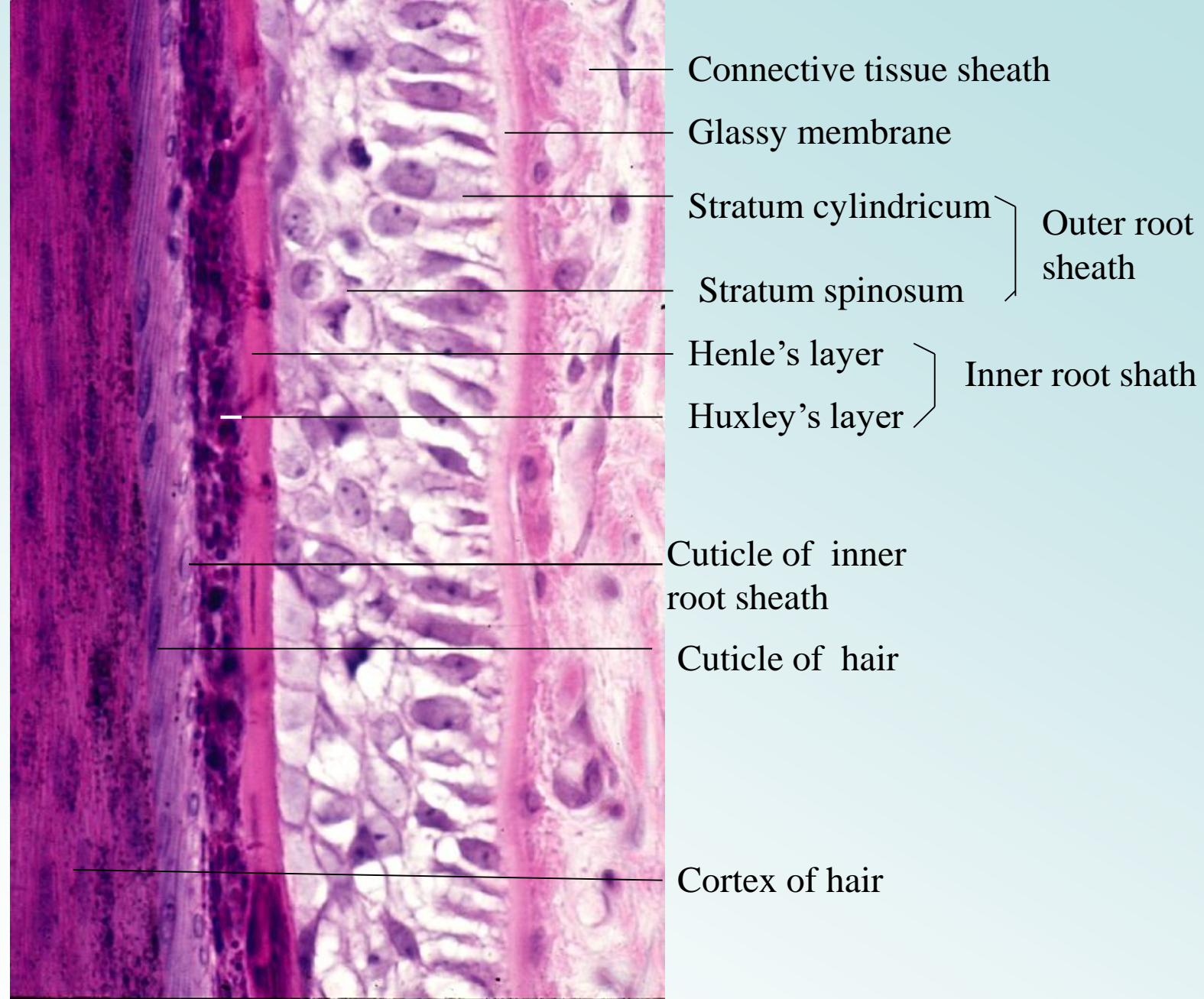
21-29 Scalp. Vertical section. Human, H-E stain, x 3.0.





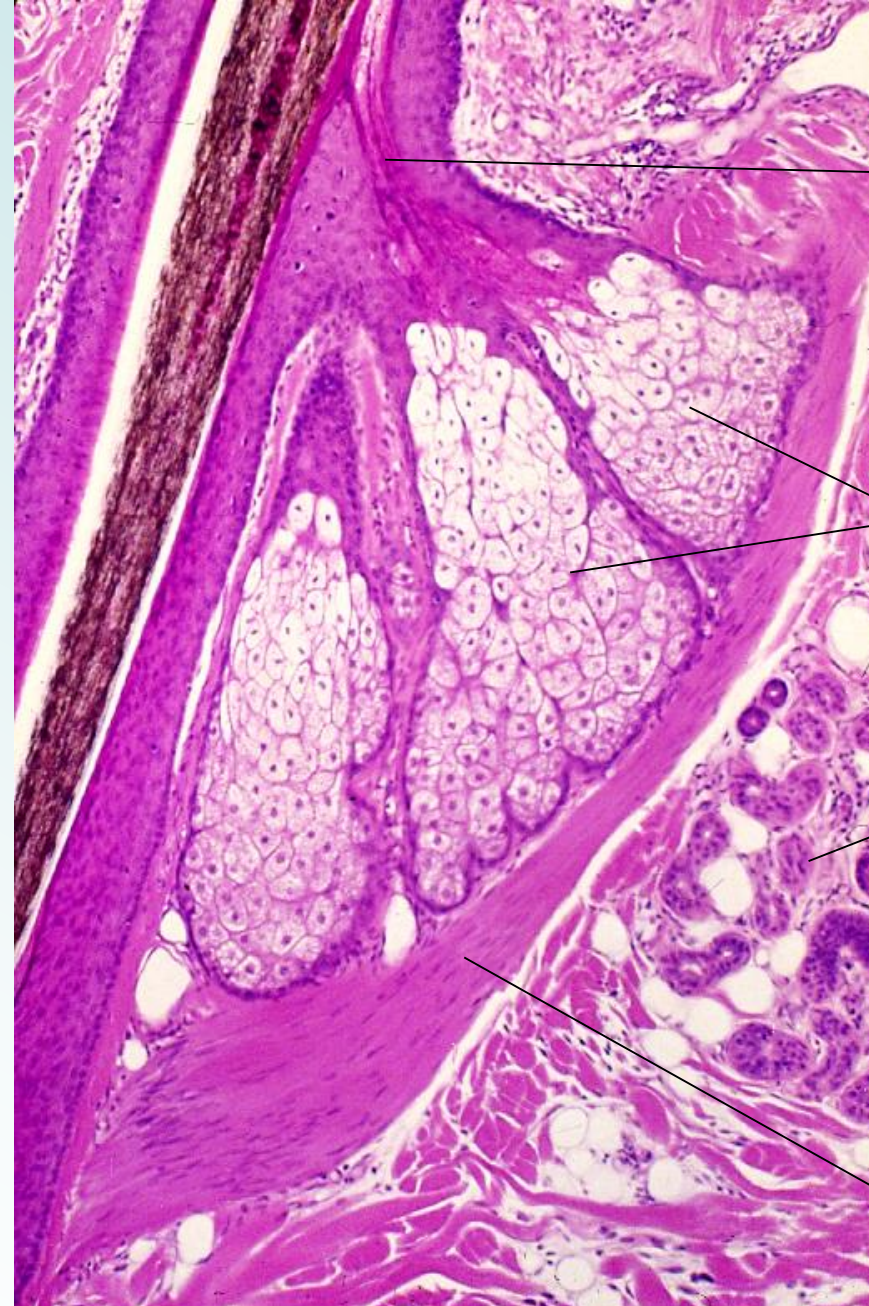
**21-30** Hair follicle. Longitudinal section. Human, H-E stain, x 25.





**21-31** Longitudinal section of hair and hair follicle.  
Human, H-E stain, x 160.





Duct of sweat gland

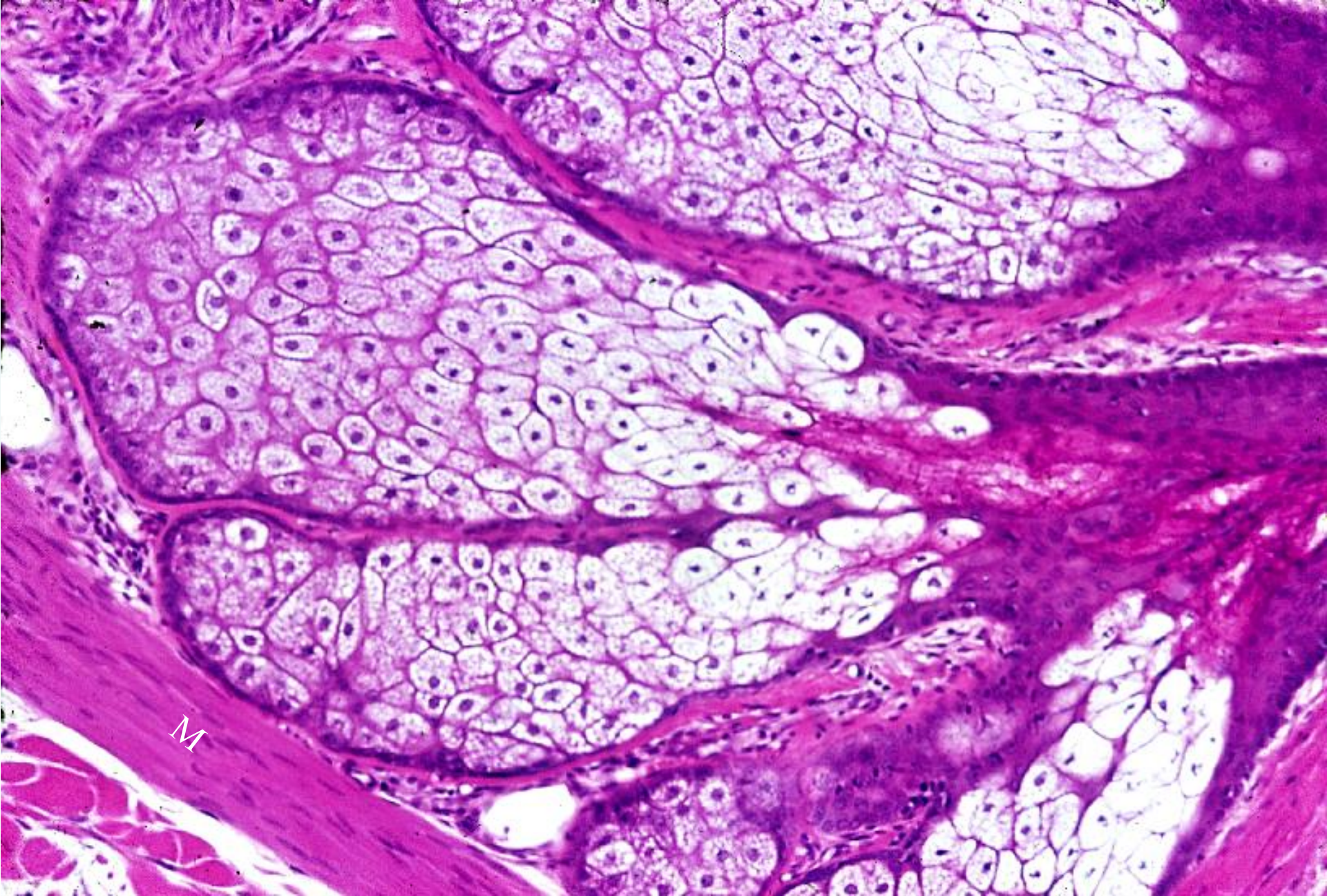
Sebaceous glands

Sweat gland

Arrector pili muscle

**21-32 Glandulae sebaceae and arrector pili muscle 1.**  
**Human, H-E stain, x 25.**





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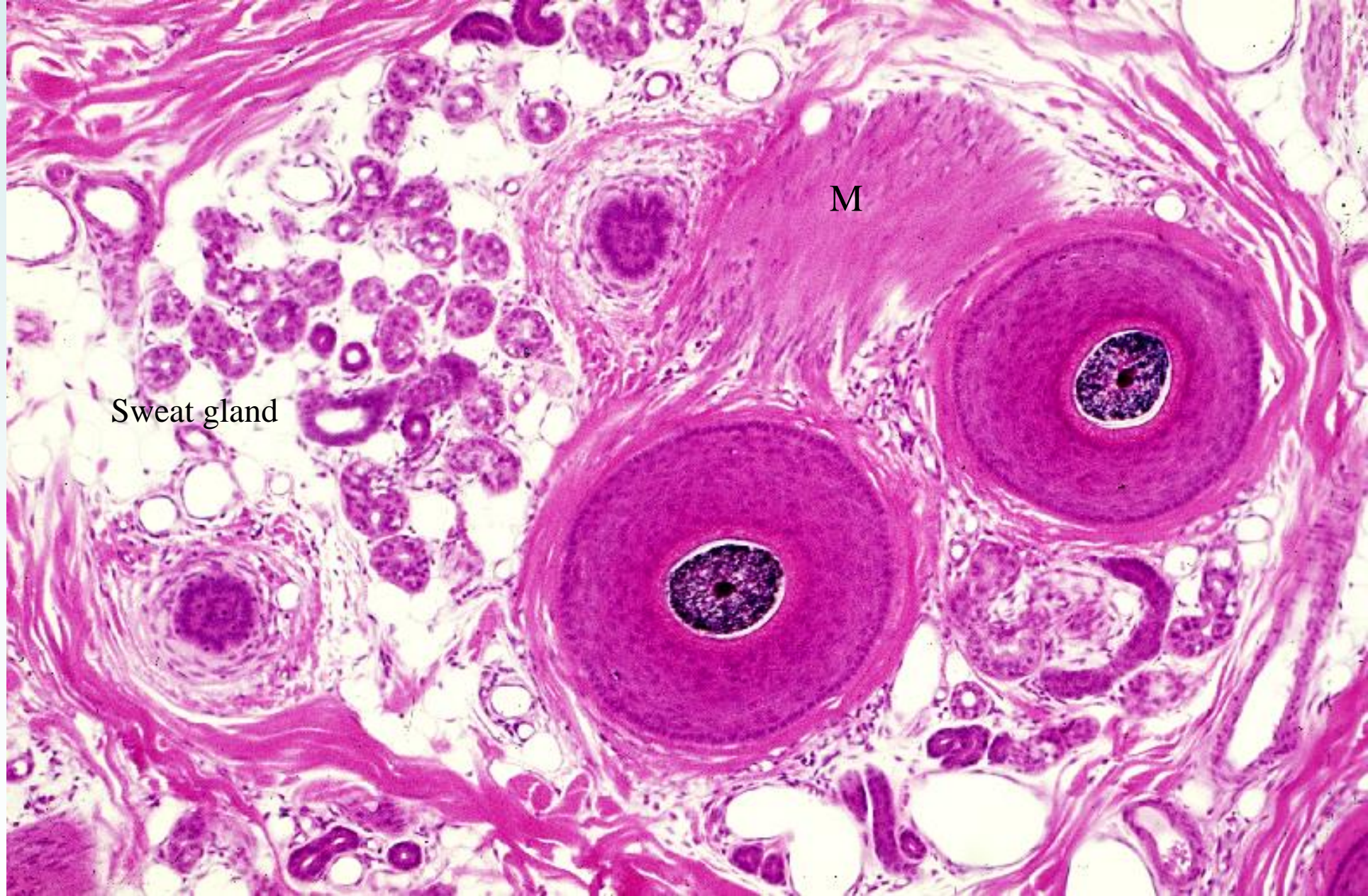
21-33 Glandulae sebaceae and arrector pili muscle 2.  
Human, H-E stain, x 30.





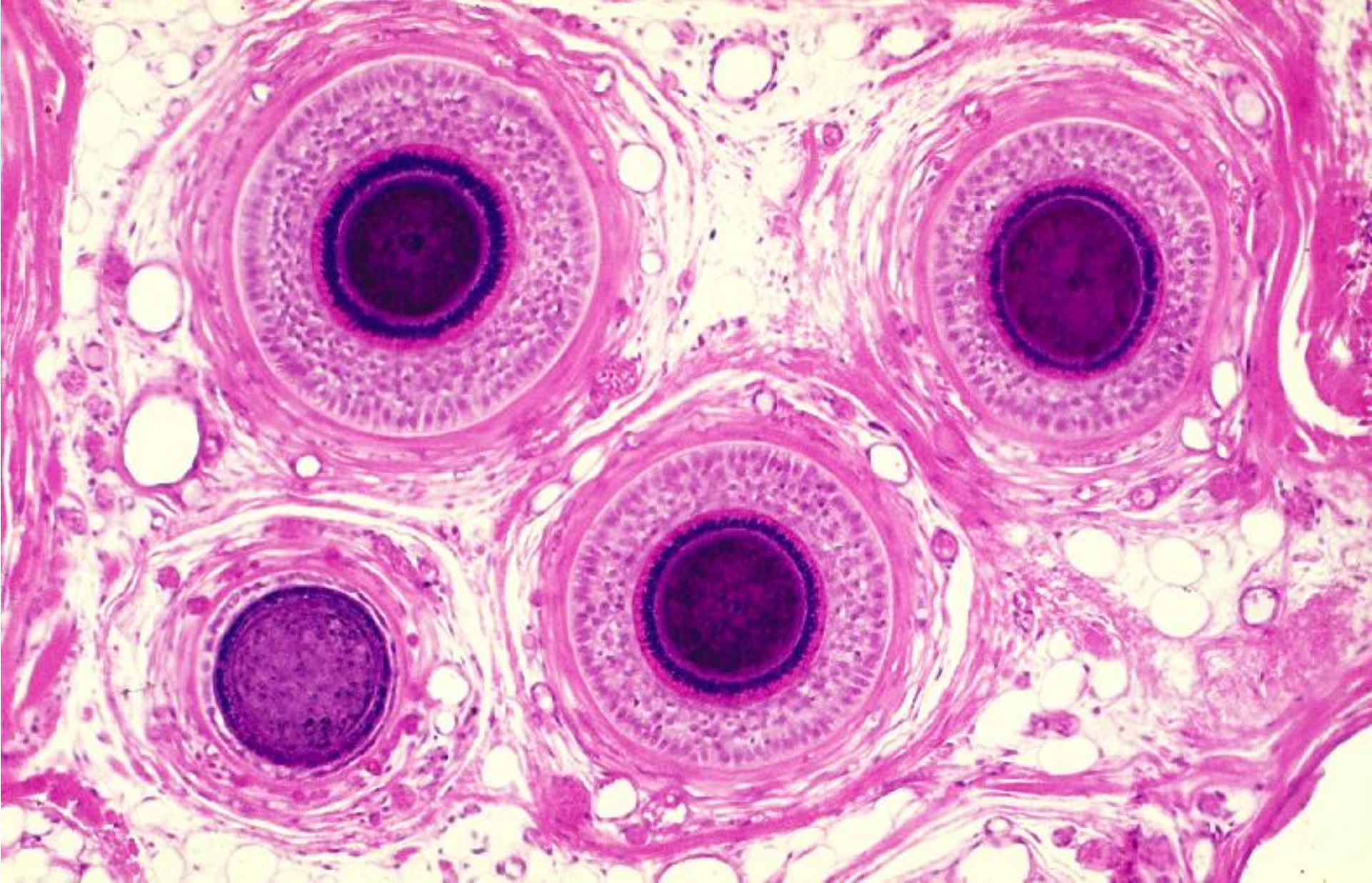
**21-34 Tangential section of scalp 1. Level of the sebaceous glands. Human, H-E stain x 25.**





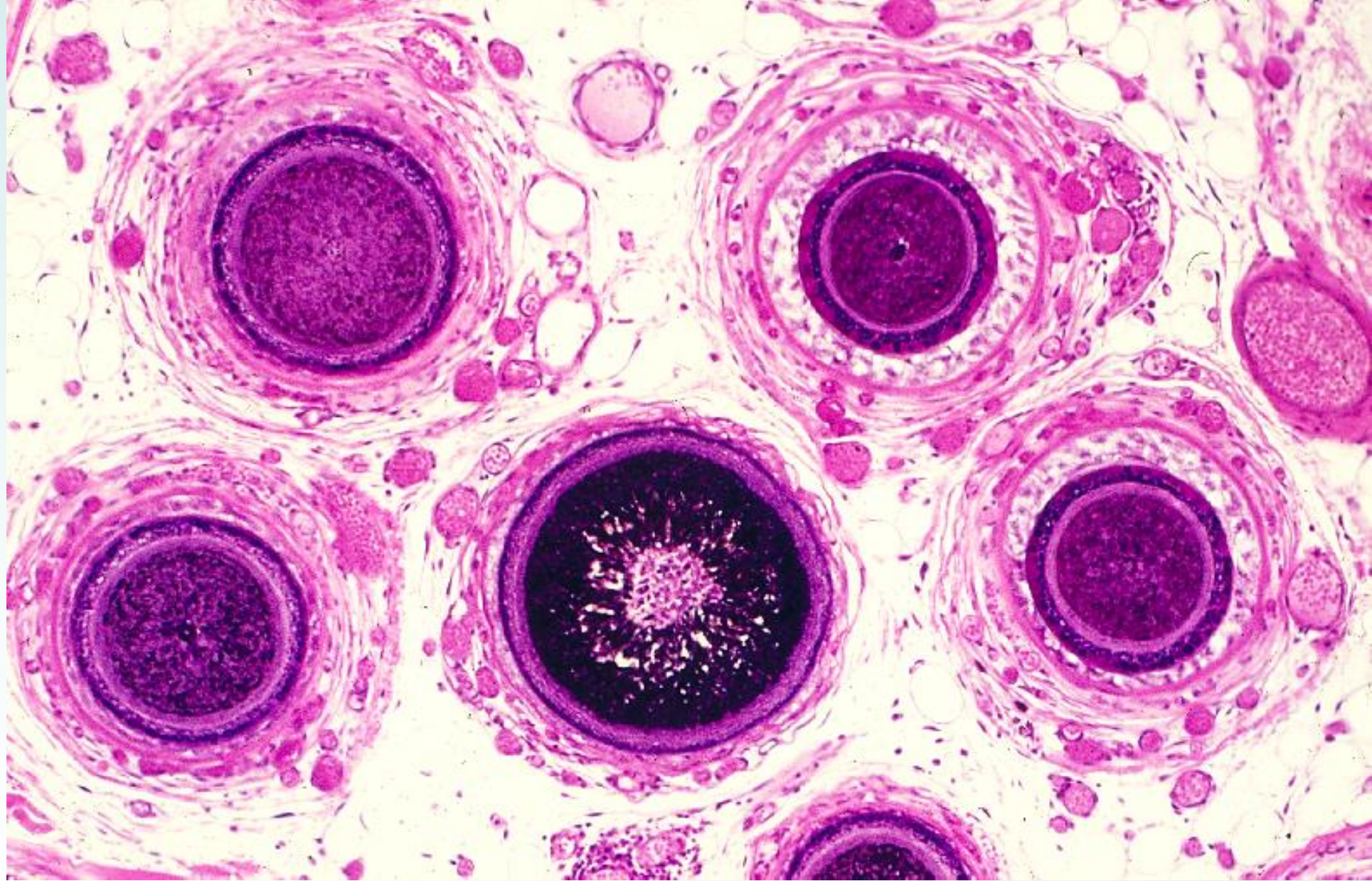
**21-35 Tangential section of scalp 2. Level of the sweat glands. Human, H-E stain, x 25.**





**21-36 Tangential section of scalp 3. Level of the deeper portion of hair follicle. Human, H-E stain x 25.**





**21-37 Tangential section of scalp 4. Level of the hair papilla. Human, H-E stain, x 25.**





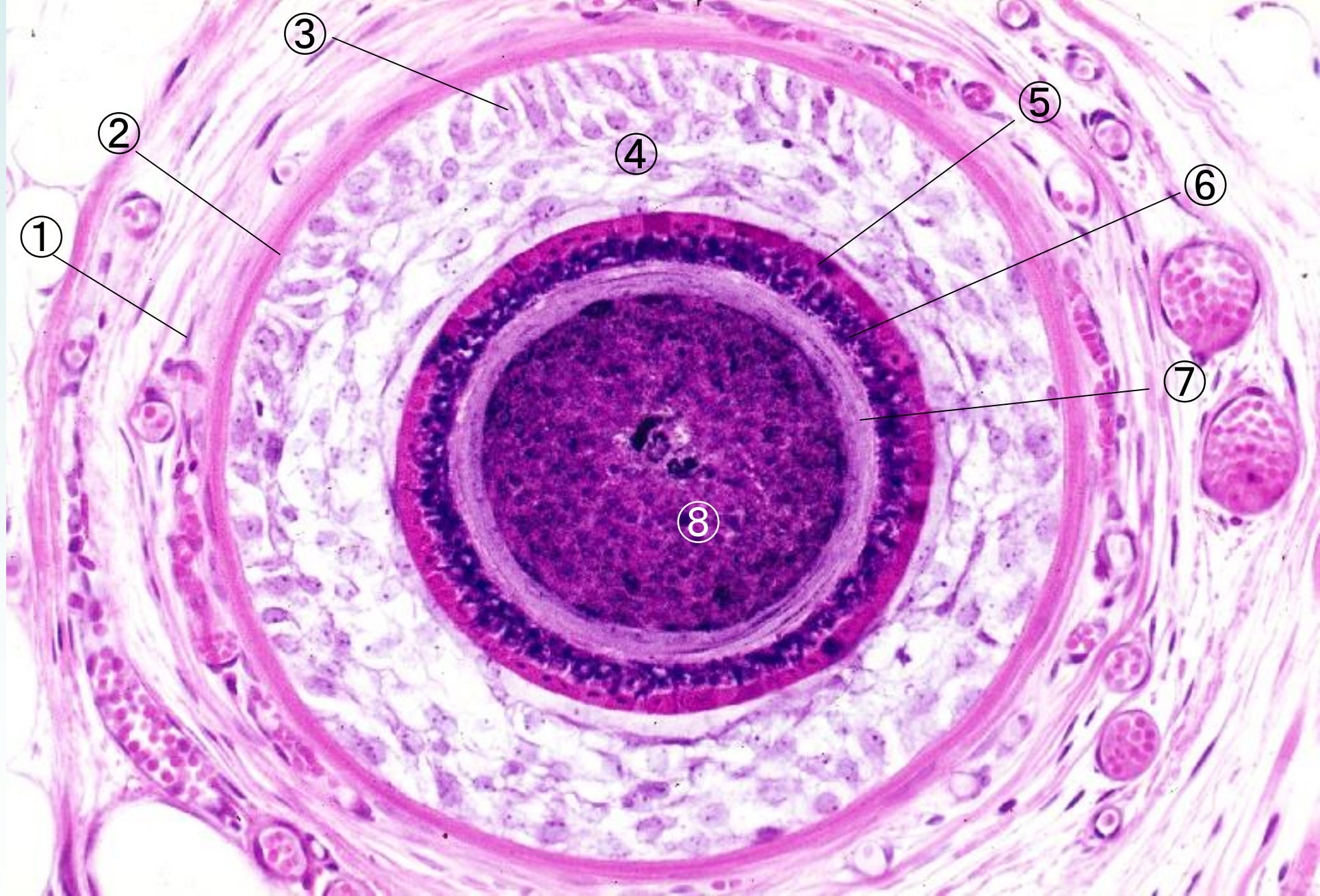
21-38 Transverse section of hair follicle 1. Human, x 64.





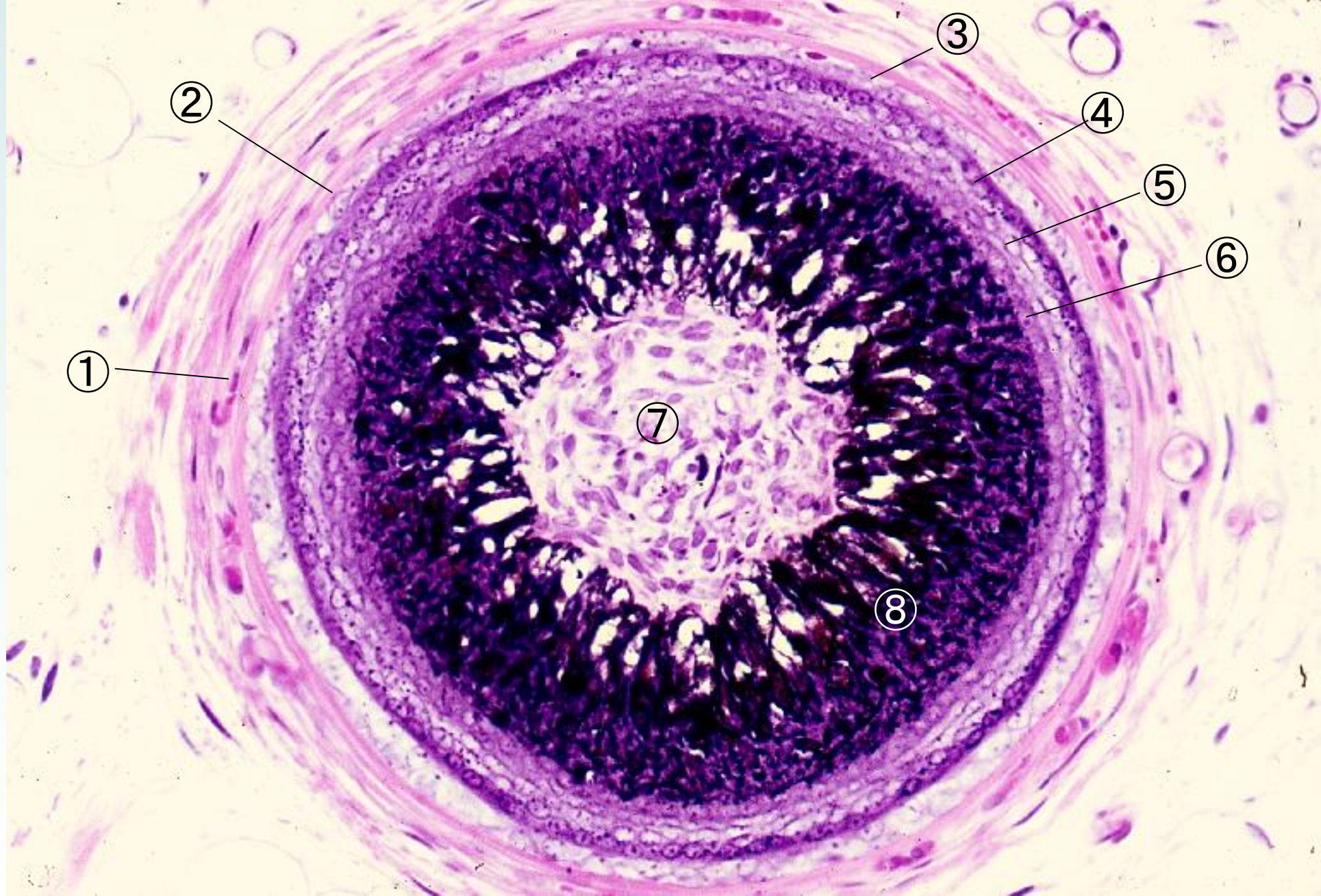
21-39 Transverse section of hair follicle 2. Human, x 64.





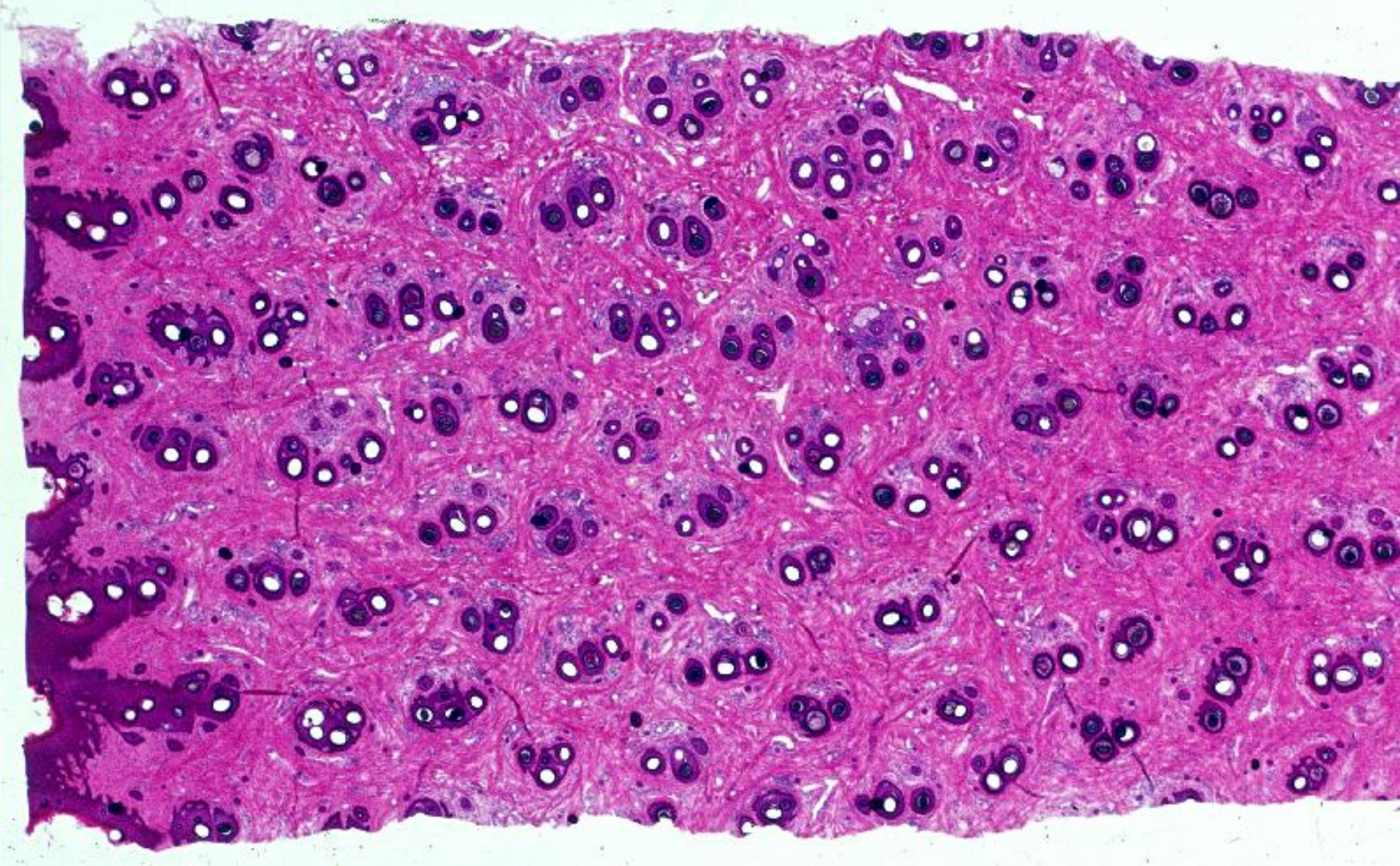
21-40 Transverse section of hair follicle 3. Human, x 64.





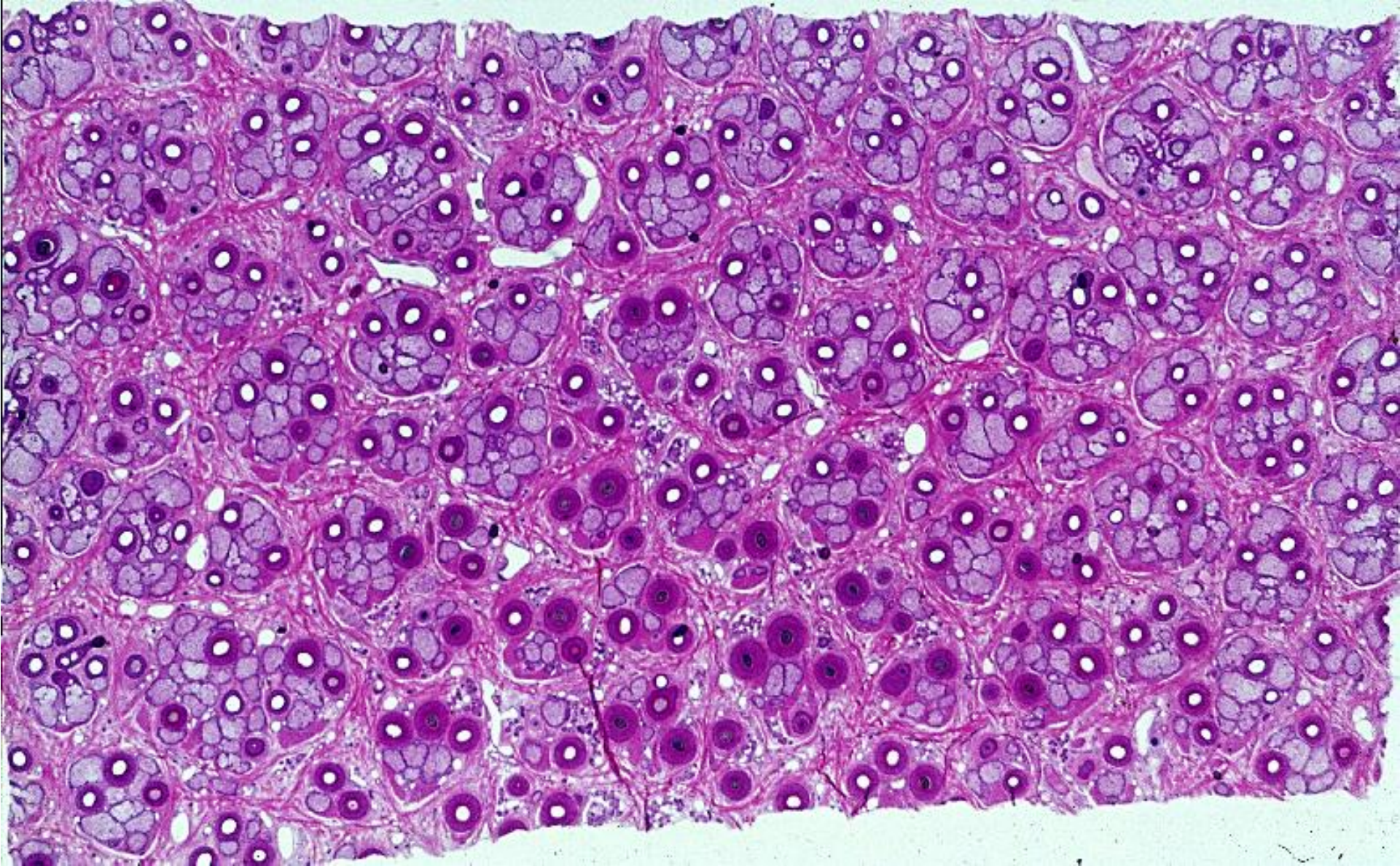
21-41 Transverse section of hair follicle 4. Human, x 64.





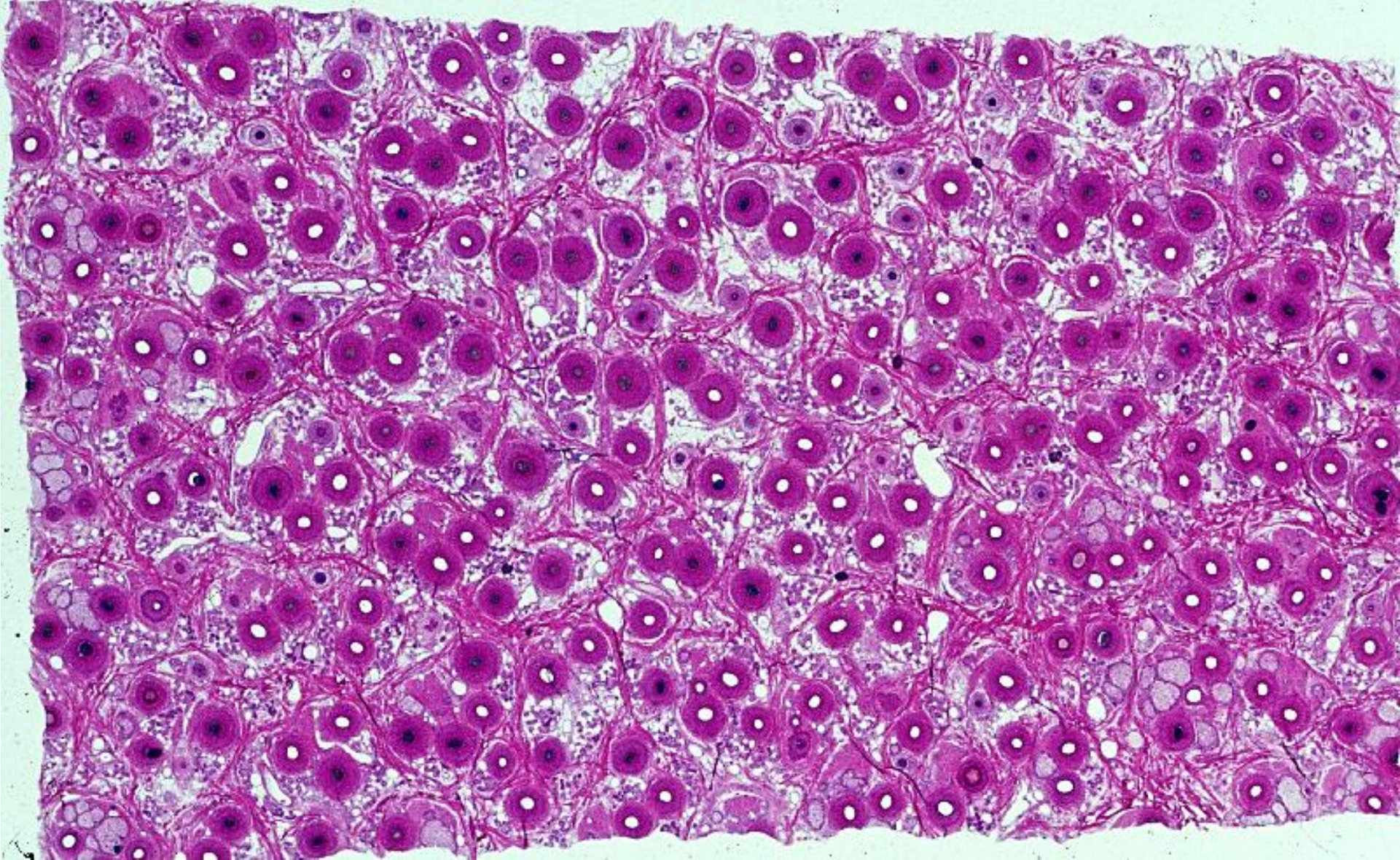
21-42 Tangential section of scalp 2-1. Human, H-E stain, x 3.0.





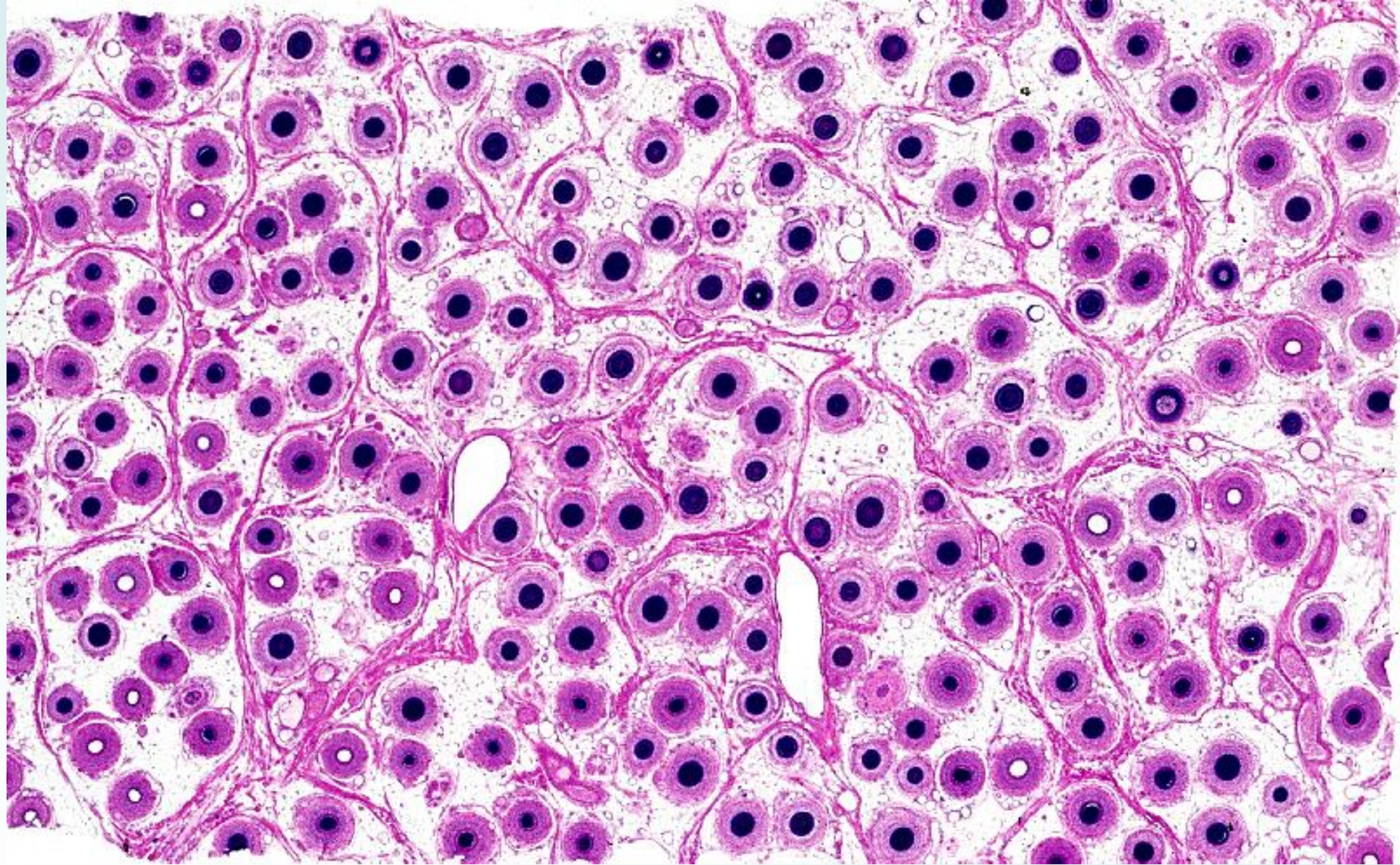
21-43 Tangential section of scalp 2-2. Human, H-E stain, x 3.0.





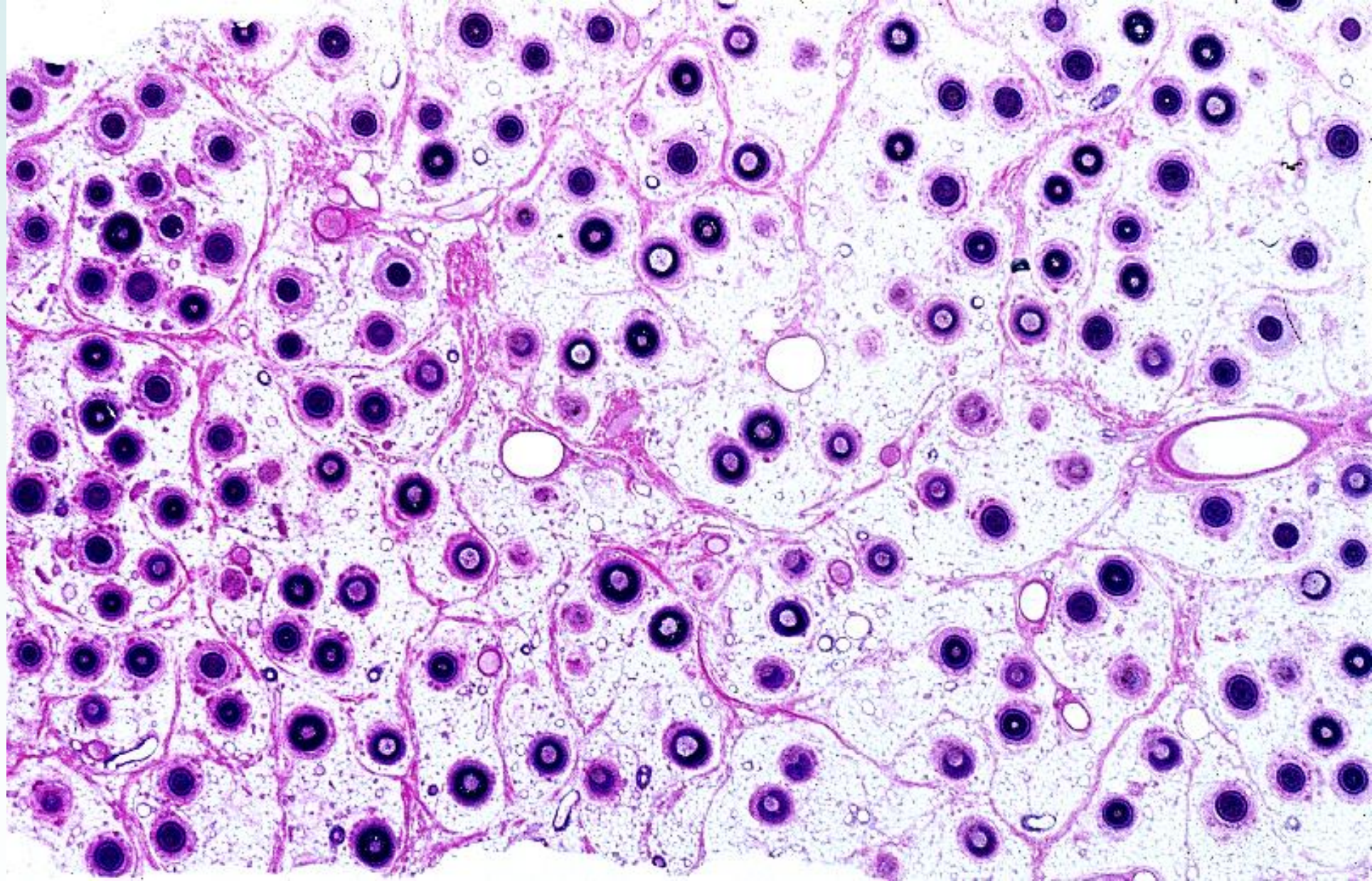
21-44 Tangential section of scalp 2-3. Human, H-E stain, x 3.0.





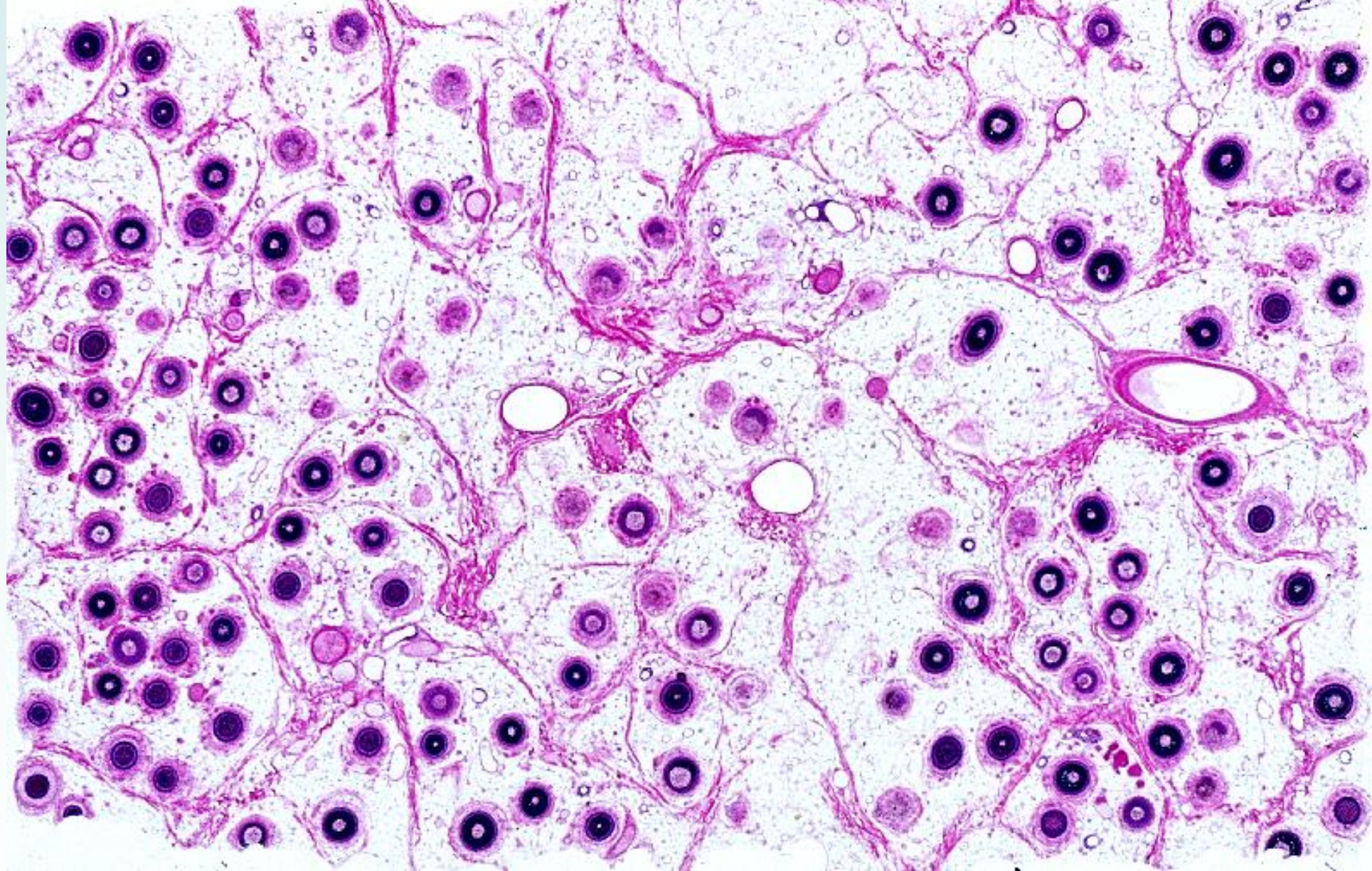
21-45 Tangential section of scalp 2-4. Human, H-E stain, x 3.0.





21-46 Tangential section of scalp 2-5. Human, H-E stain, x 3.0.





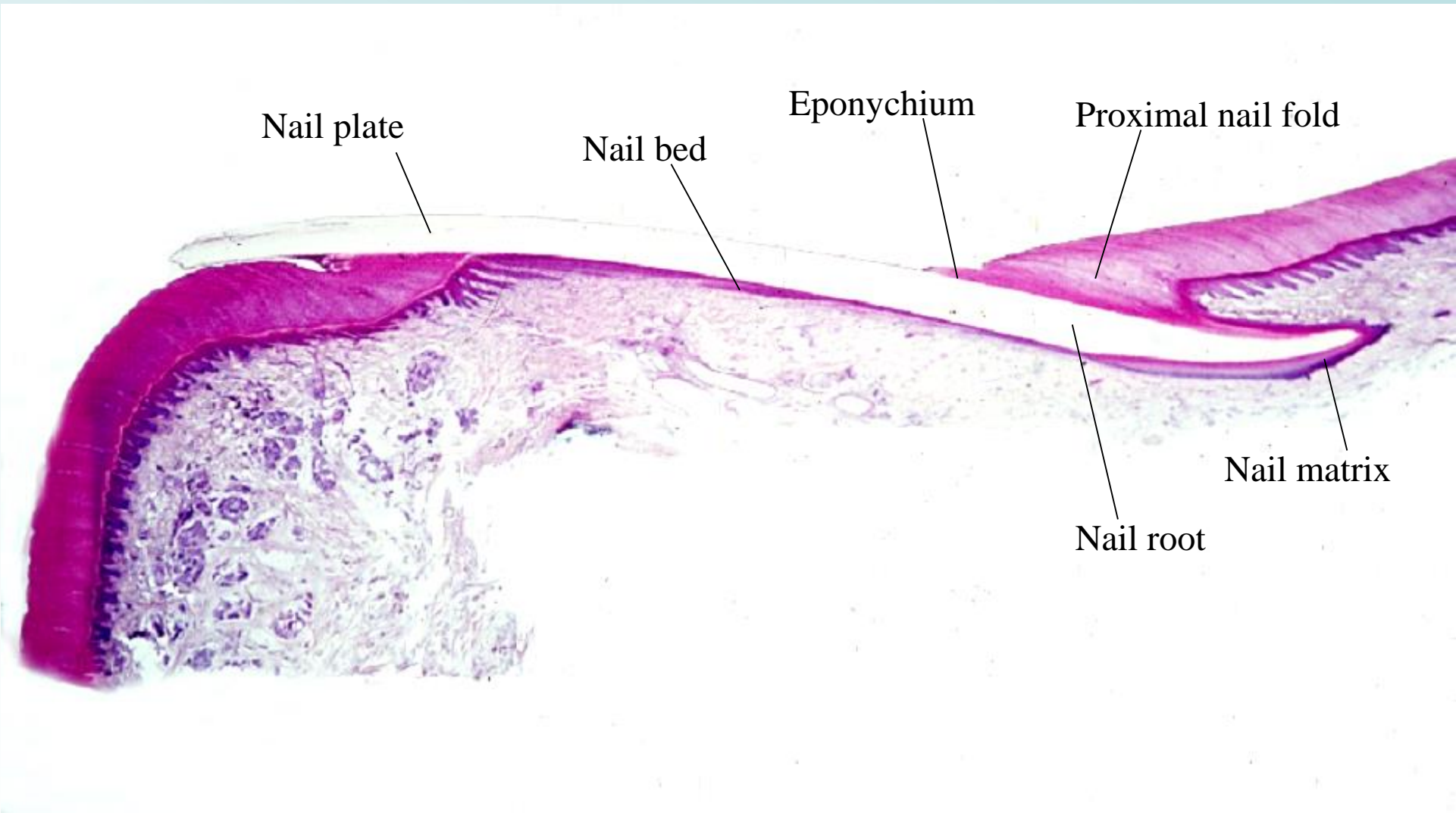
21-47 Tangential section of scalp 2-6. Human, H-E stain, x 3.0.



# 21-003

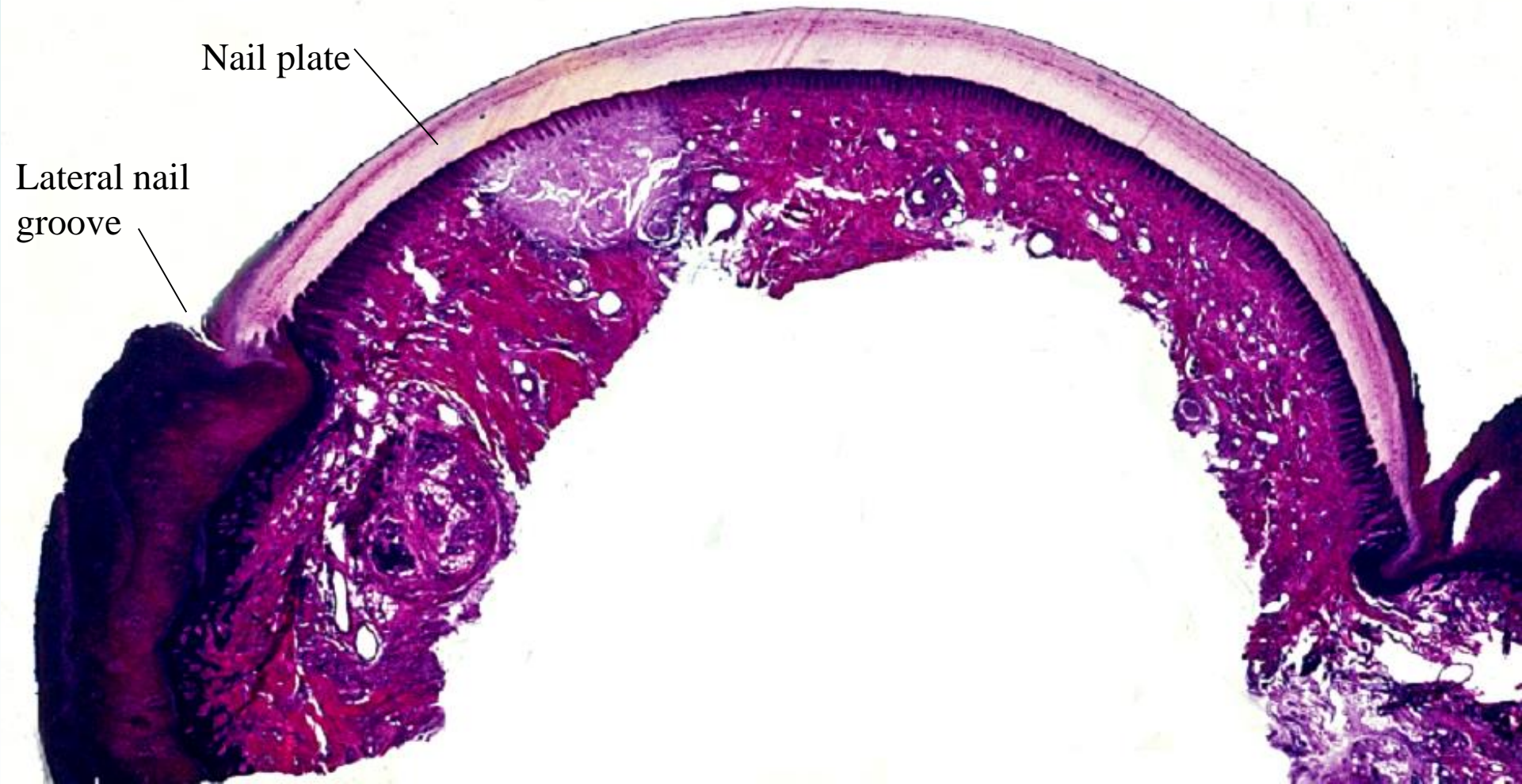
# Nail





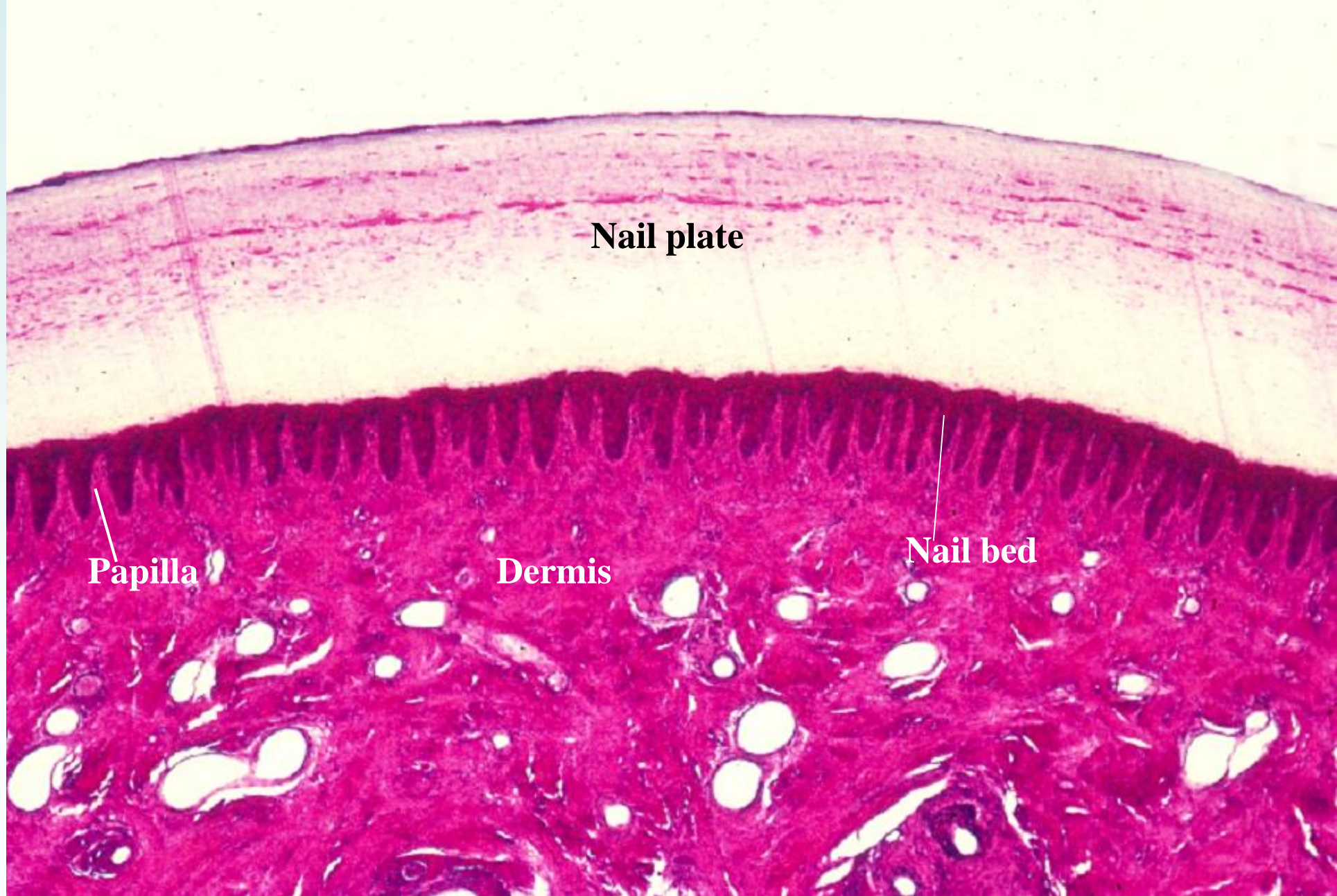
**21-48** Longitudinal section of nail. Human, H-E stain, x 1.6.





**21-49** Transverse section of nail 1. Human, H-E stain, x 2.75.





**Nail plate**

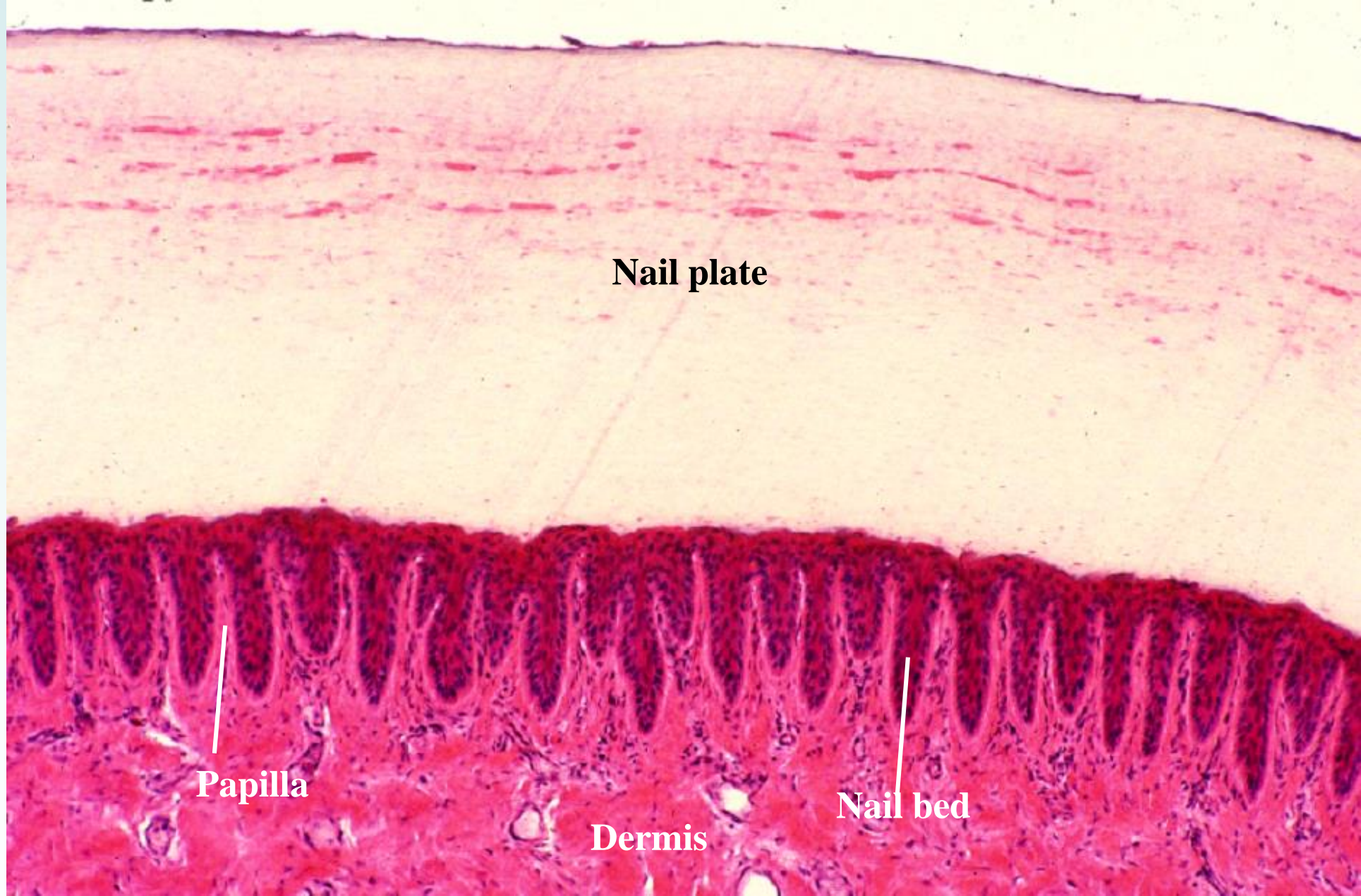
**Papilla**

**Dermis**

**Nail bed**

**21-50 Transverse section of nail 2. Human, H-E stain, x 10.**





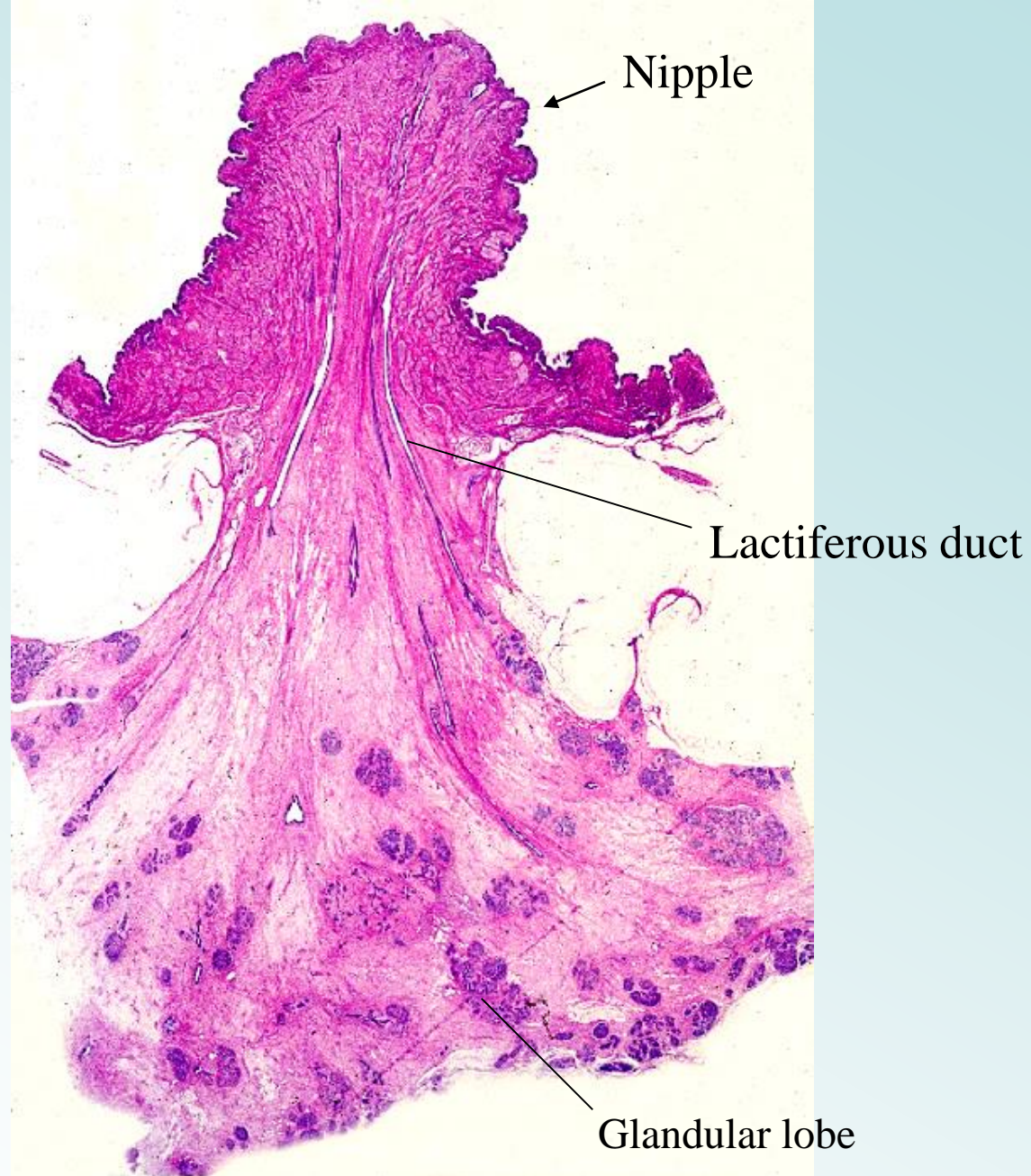
**21-51** Transverse section of nail 3. Human, H-E stain, x 25.



21-004

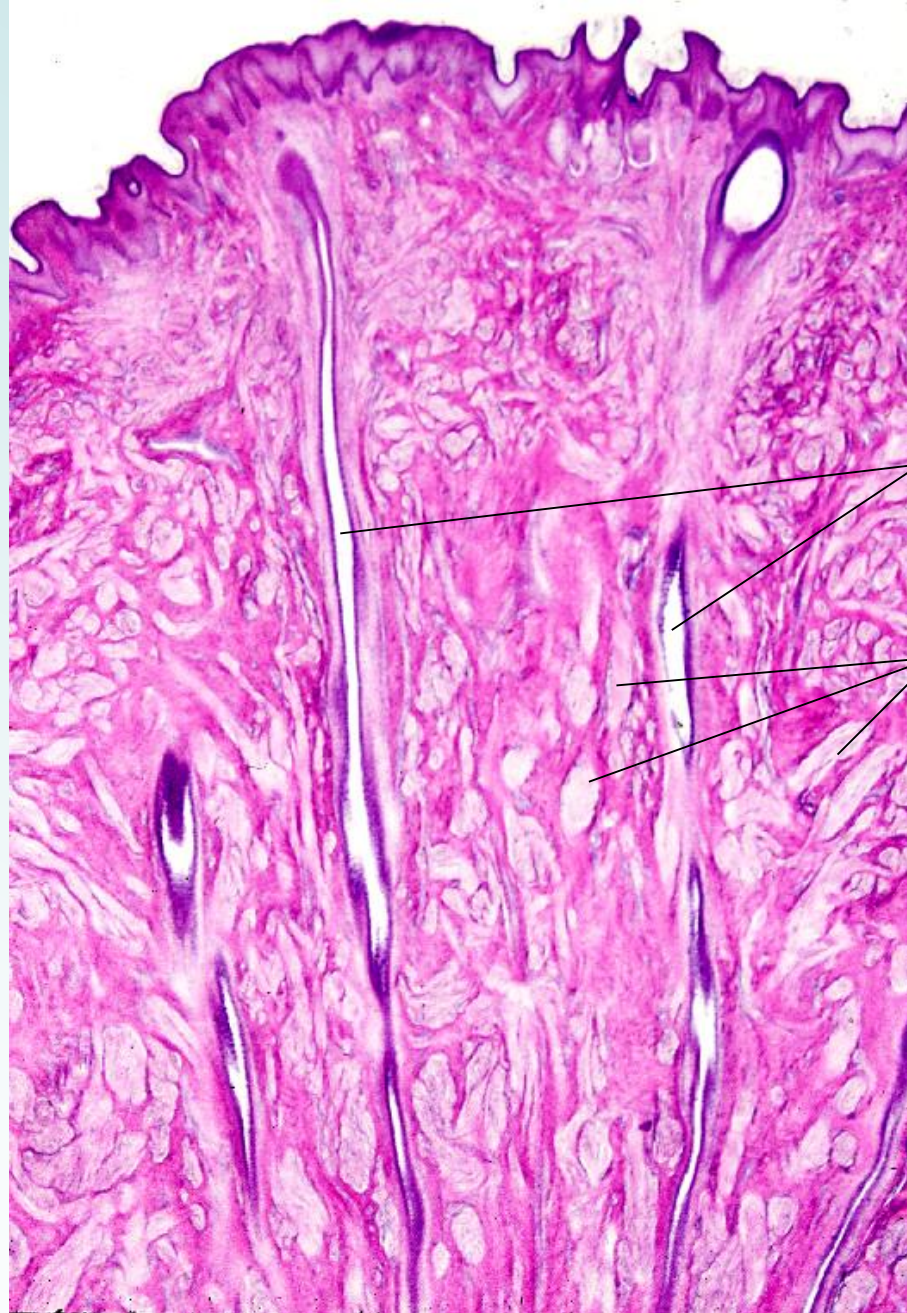
# Mammary Gland





**21-52 Nipple and mammary gland. General view. Human, H-E stain, x 0.7.**



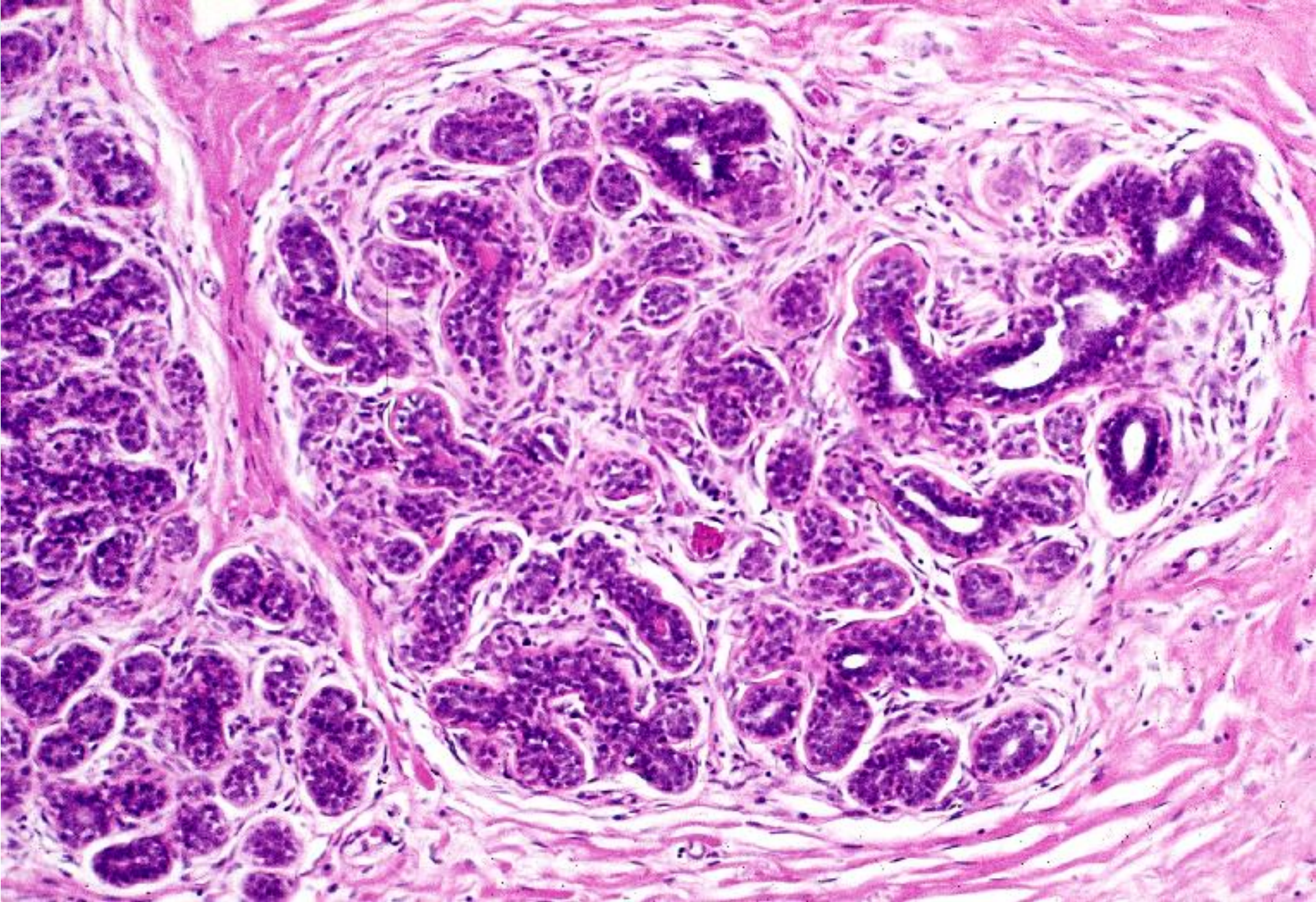


Lactiferous sinus

Smooth muscle  
fiber bundles

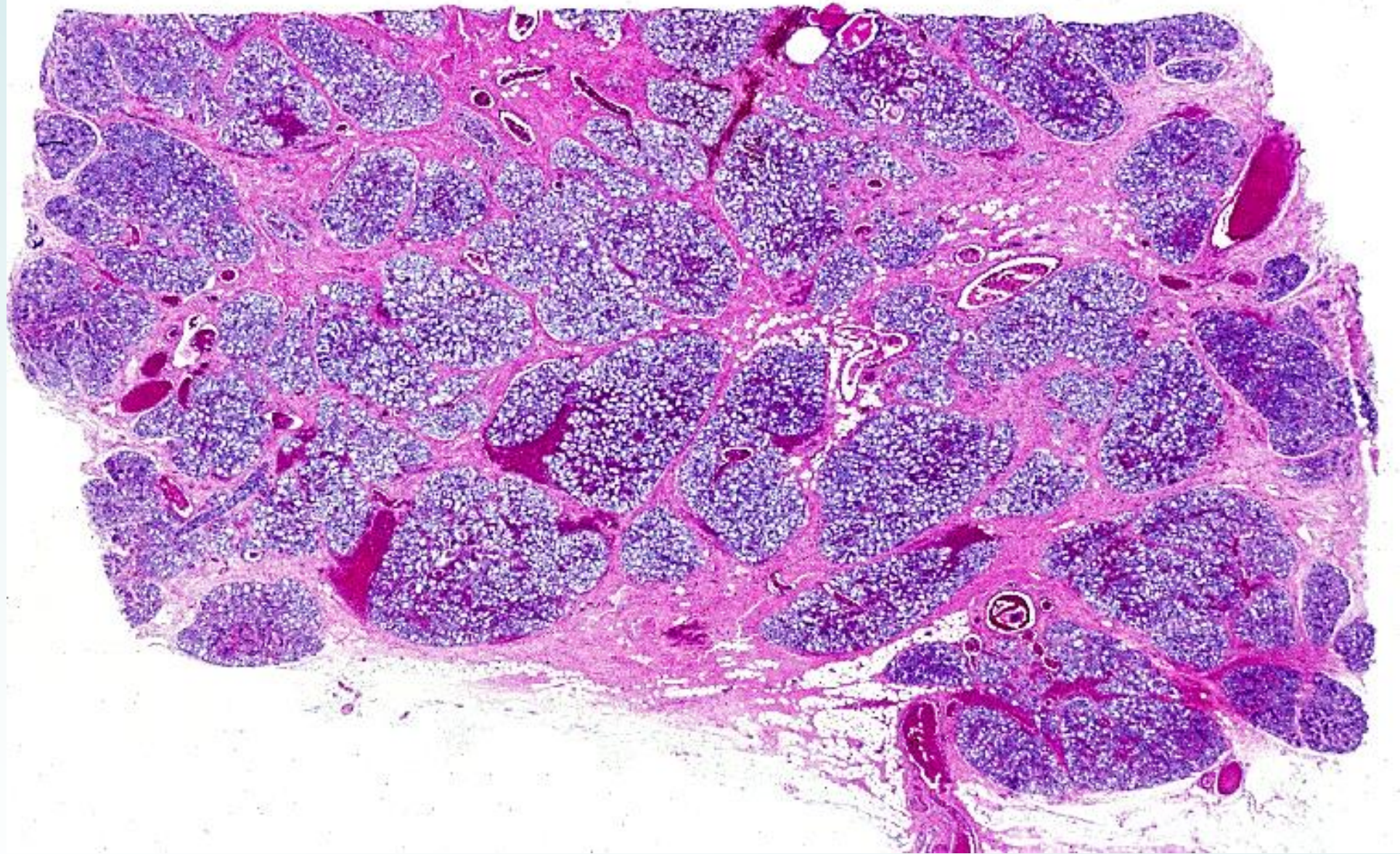
21-53 Nipple. Longitudinal section. Human, H-E stain,  
x 4.0.





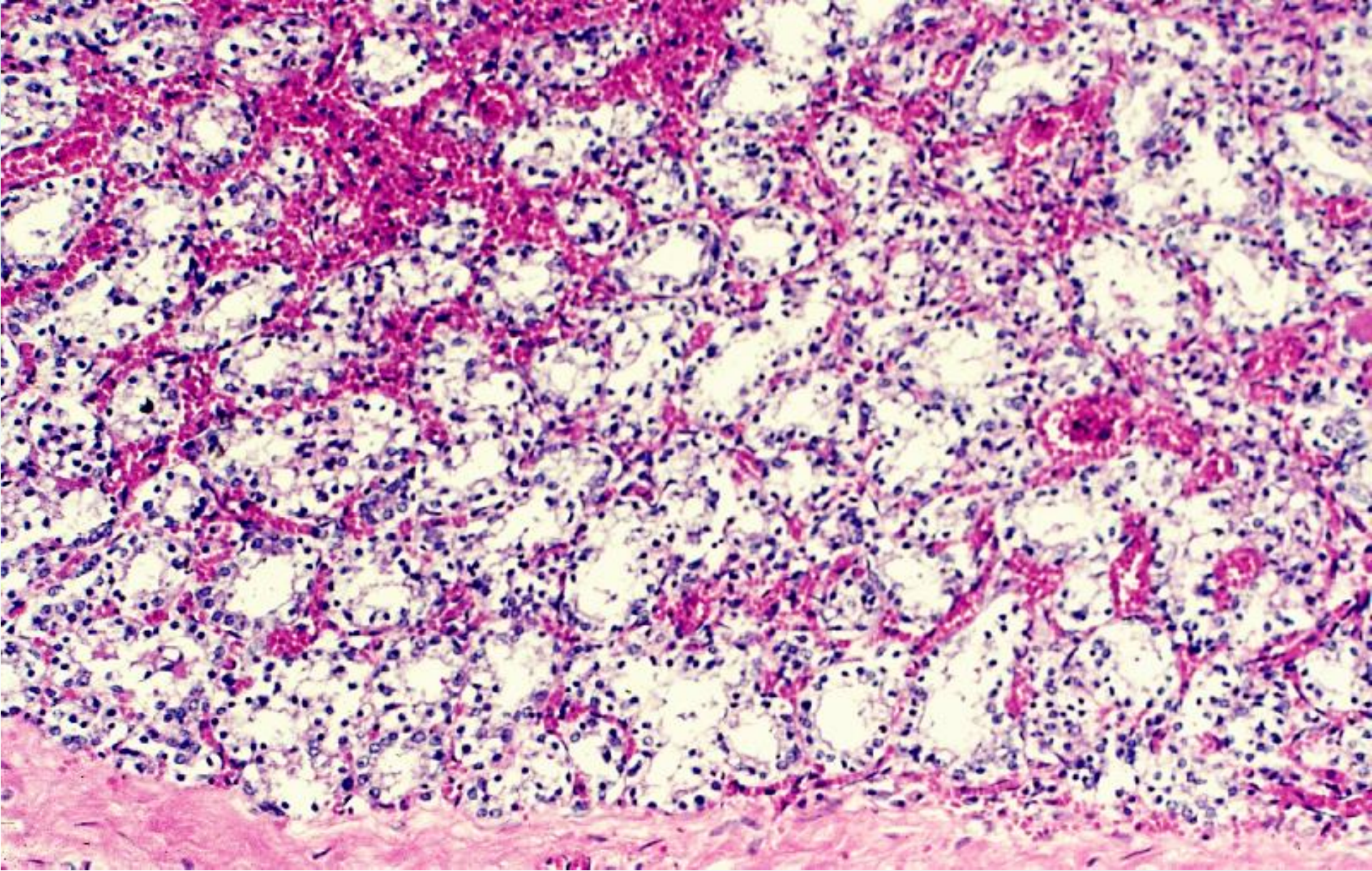
**21-54 Mammary gland on resting stage. Human, H-E stain, x 25.**





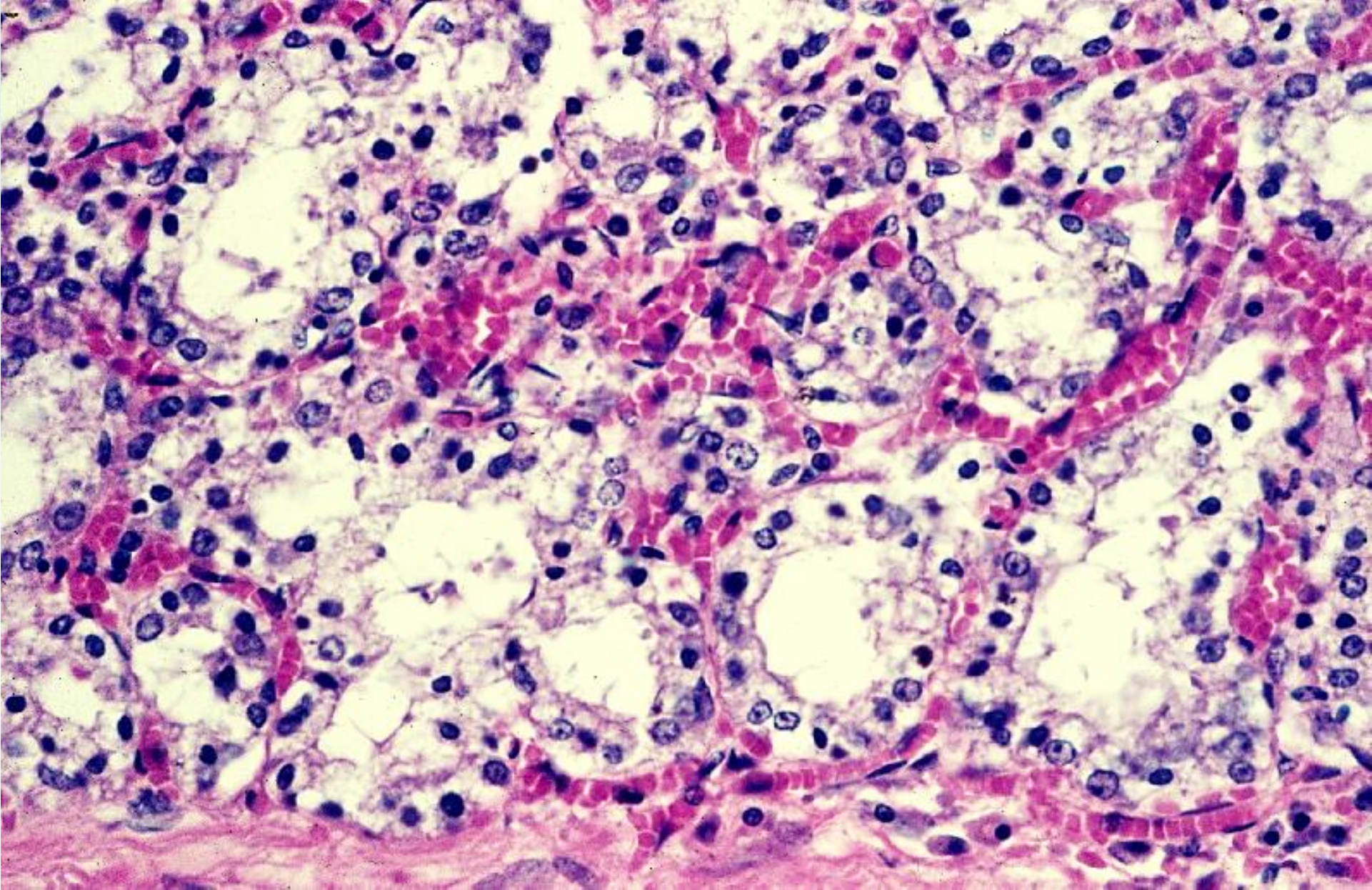
**21-55 Mammary gland at term, 1. Human, H-E stain, x 2.5.**





21-56 Mammary gland at term, 2. Human, H-E stain, x 25.





**21-57 Mammary gland at term, 3. Human, H-E stain, x100.**



## 21. Skin and its Accessories

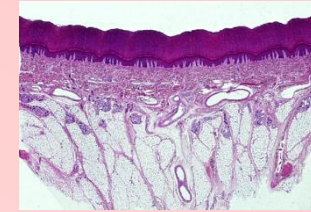
- The skin is the organ, which covers the whole surface of the body and accounts for some 16% of the body weight. The skin consists of ectodermal epithelium, epidermis, and underlying mesodermal dense connective tissue, dermis. Beneath it follows very loose connective tissue, hypodermis or subcutaneous tissue, which connects the skin loosely with the deeper structures, namely, fascia, peritendineum, and periosteum. In many places the subcutaneous tissue contains a lot of fat cells ( adipose tissue ), which protect the interior from the influence of the mechanical power and thermal change of the environment. In the skin distribute a number of nerve fibers and many terminal apparatuses of various senses, tactile, pain, temperature, etc. In this meaning, the skin is one of the important sense organs.
- The epidermis forms an uninterrupted investment over the entire surface of the body and is locally specialized for the production of the skin appendages, hair and nails. It gives rise to two kinds of glands, namely, sweat glands and sebaceous glands.
- The interface between the epidermis and dermis is highly irregular. An intricate pattern of ridges and grooves on the under side of the epidermis fits into a conforming pattern of grooves and ridges on the underlying dermis. The projections of the dermis are called dermal papillae.



# 21. Skin



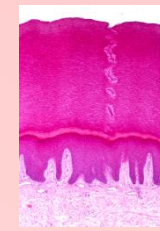
## 21-02 Skin of the palm 1. General view. Human, H-E stain, x 3.3.



- This is a section of the palm, perpendicular to the surface. Here the skin is very thick and consists of epidermis ( ① ), dermis ( ② ), and subcutaneous tissue ( ③ ). The epidermis is a thick stratified squamous epithelium, which shows keratinization typically ( see 21-02 ). Into its basal layer project a number of finger-shaped papillae from the dermis. The substance of the dermis consists of thick collagen fiber bundles running mostly parallel to the skin surface and tightly woven with each other. Beneath the dermis follows a very loose connective tissue, called hypodermis or subcutaneous tissue, containing a lot of fat cells ( adipose tissue ). From the lower surface of the dermis a number of thin strings of the collagen fiber bundles connecting the skin with the deeper structures as fascia and peritoneum. They are called retinaculum cutis. In the superficial area of the subcutaneous tissue there are numerous sweat glands. An arrow indicates the opening of a duct of the sweat gland.
- In the dermis and subcutaneous tissue there are numerous blood vessels of larger and smaller calibers.



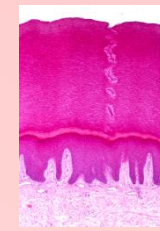
## 21-02 Skin of the palm 2. Human, H-E stain, x 25. (1/2)



- Higher magnification of 21-01.
- The epidermis consists of following cell layers from the base to the surface: ① Stratum basale, ② Stratum spinosum, ③ Stratum granulosum, ④ Stratum lucidum, and ⑤ Stratum corneum. ① and ② are called stratum germinativum, ③ and ④, stratum intermedium.
- The cells of the epidermis are continually renewed by mitosis of the cells in the basal layer, and as new cells are formed they are slowly displaced toward the surface of the epithelium by the proliferation of the cells in the basal layer. In their transit, they differentiate, enlarging and accumulating increasing amounts of keratin filaments in their cytoplasm. As they approach the surface, they die and their flake-like lifeless cell bodies are continually shed. Their transit time from the base of the epithelium to the surface is 20 to 30 days. Their changing appearance at different levels in the epithelium makes it possible to distinguish above described zones in histological sections, perpendicular to the skin surface.
- **Stratum basale** is the undermost layer of the epidermis and consists of a single layer of cylindrical or cuboidal cells supported by a typical basal membrane. These cells are densely arranged with each other and perpendicular to the junction line between the epidermis and dermis. Their cytoplasm is intensely basophilic. Mitotic figures are common in this layer.
- **Stratum spinosum.** The cells of this layer are polyhedral of flat polyhedral and have basophilic cytoplasm. They radiate a number of tiny projections ( spines ) from the surface that unite tightly with those of the neighboring cells with the desmosome at about the middle portion of the intercellular spaces ( see 21-06 ). They were called the intercellular bridges in the light microscopic histology. The thickness of this layer varies largely according to the place of the body. The dermal papillae invade deeply into this layer.



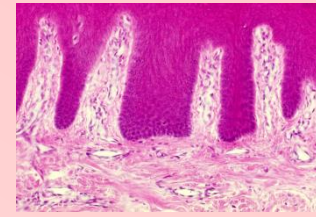
## 21-02 Skin of the palm 2. Human, H-E stain, x 25. (2/2)



- **Stratum granulosum** consists of three to five layers of cells that are somewhat more flattened than those of the stratum spinosum. The most distinguishing feature of the cells is the presence of the coarse granules, deeply dark blue stained, in the cytoplasm; they are called keratohyalin granules. They are believed to be precursors of the keratin. The keratohyalin granules are more numerous and densely packed, as the cells go upward.
- **Stratum lucidum** is a layer of thin, lightly staining, refractile cells locating between the stratum granulosum and stratum corneum in thick skin, but this is not identifiable in the thinner skin. This layer consists of 4 to 6 rows of very flat cells. The nuclei are usually not identified. The keratin filaments in the cytoplasm are closely arranged and very flattened cytoplasm is densely layered parallel to the skin surface.
- **Stratum corneum** consists of many layers of very flat, heavily keratinized cells containing no nucleus or cytoplasmic organelles. As is here seen, stratum corneum is very thick at the palm and sole and occupies more than three fourths of the epidermis. The cells of the lower layers of the stratum corneum are still closely adherent with each other, but in the outer layers, the fully keratinized, lifeless cells loosen and ultimately desquamate. In this figure a duct of sweat gland penetrates the stratum corneum with a spiral course.
- Beneath the epidermis is the dermis, from which numerous dermal papillae deeply invade into the stratum germinativum.



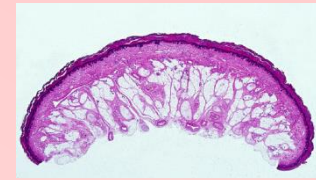
### 21-03 Skin of the palm 3. Dermis. Human, H-E stain, x 64.



- Higher magnification of 20-02. The upper half of this figure consists of epidermis (②, stratum basale and stratum spinosum) and the lower half, the dermis, which is composed of mostly thick collagen fiber bundles running parallel to the skin surface and being densely woven with each other. This layer is called stratum reticulare of dermis. The dermis sends numerous finger-like projections deep into the stratum germinativum; they are called dermal papillae (①). The papillae consist of thinner collagen fibers, running perpendicular to the skin surface and contain the roops of blood capillaries. The dermal papillae are called as a whole statum papillare of dermis. The dermal papillae are the base from which the nutrients of epidermis are supplied.



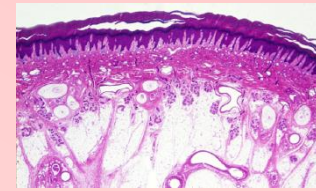
## 21. Skin of thumb tip 1. Human, H-E stain, x 1.7.



- This is a transverse section of the thumb tip. The skin of the thumb tip is similar to that of the palm, consisting of thick epidermis, also thick dermis and very loose subcutaneous tissue, rich in adipose tissue.



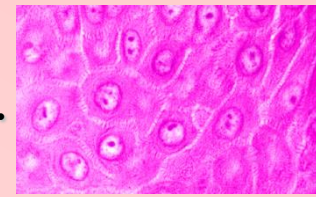
## 21-04. Skin of thumb tip 2. Human, H-E stain, x 5.0.



- Higher magnification of 21-04. General histological features of the thumb tip are well identified. The epidermis is thick and the basophilia of the stratum germinativum is evident. The dermis is also thick consisting of densely woven collagen fiber bundles, which projects numerous finger-shape papillae deeply into the stratum germinativum of epidermis. In the deeper area of the dermis there are several Pachinian corpuscles, the terminal apparatuses of the sense of pressure. In the uppermost area of the sub-cutaneous tissue numerous sweat glands are distributed, whose ducts penetrating the dermis are encountered here and there.



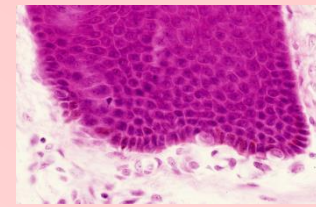
21. Skin of thumb tip 3. Stratum spinosum. Human, H-E stain, x 400.



- The cells constituting the stratum spinosum are polyhedral in shape and arranged with a narrow intercellular space apposing to one another. Each cell projects a number of tiny processes from the cell surface, which unite tightly with those of the neighboring cells at about the middle of the intercellular space with desmosomes. They are called, as a whole, intercellular bridges. The nutrients, exuded from the capillary loops in the dermal papillae, go through the intercellular spaces toward the surface, feeding the epithelial cells, and finally evaporate from the skin surface.
- Here, the intercellular spaces and intercellular bridges are evident.



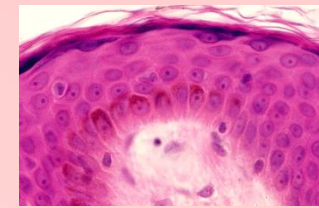
21. Skin of the thumb tip 4. Stratum germinativum and melanocytes.  
H&E stain, x 160.



- This is the stratum germinativum surrounded by dermis and dermal papillae. On its surface line columnar or cylindrical cells, the stratum basale. Surrounded by them, polyhedral cells are densely packed, the stratum spinosum. The cells of stratum basale contain melanin granules in the apical cytoplasm. Among these cells intermingle several large lucent cells with a large nucleus ( indicated with arrows ). They are the melanocytes, but they contain no melanin granules. They synthesize the melanin granules and give them to the cells of the stratum basale. They may appear in the dermis a little apart from the stratum basale.



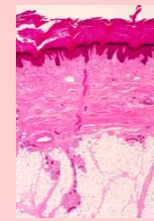
21. Skin of auricula. Melanocytes and Langerhans cells. Human, H-E stain 50.



- The skin of the auricula is thin; although the stratum germinativum is well identified; stratum granulosum and stratum corneum are both very thin and no stratum lucidum is perceived. Among the cylindrical cells of stratum basale intermingle three melanocytes ( upward arrows ). The melanin granules in the apical cytoplasm of the cells of stratum basale are here conspicuous. Among the cells of the stratum spinosum two Langerhans cells are perceived ( downward arrows ).



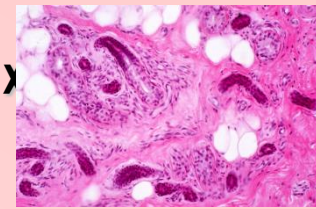
21. **Sweat gland 1. General view. Human, H-E stain, x 10.**



- The whole view of a sweat gland is shown, namely, the secretory portion in the subcutaneous adipose tissue, spiral course of the duct in the dermis and epidermis are seen.



21. Sweat gland 2. Secretory portions and ducts. Human, H-E stain, x  
64.



- Groups of the secretory portions ( acini ) and ducts of the sweat gland are shown. The wall of ducts with narrow lumen consists of two layers of cuboidal cells whose cytoplasm stains dark reddish violet. The acinus consists of two layers of cells; the inner, surrounding a relatively large lumen, have a round nucleus and lightly violet staining cytoplasm; the outer, long slender deep red staining cells containing a long spindle shaped nucleus, the myoepithelium, Both acini and ducts wind up and make balls, and are densely surrounded by the capillary network. In the middle of this figure an acinus continuing with a duct is seen ( see 21-11 ).



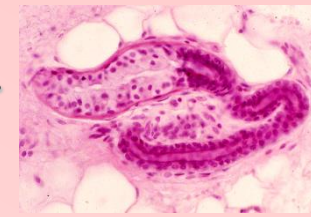
21-10. Human sweat gland 3. Secretory portion and duct, longitudinal section 1.  
H&E stain, x 130.



- Higher magnification of 21-10. In the lower half of this figure a secretory portion and a duct are continuously observed. The duct consists of two layers of epithelial cells; the inner cells are cuboidal in shape and contain a round nucleus and their apical cytoplasm stains dark red, called cuticle; the outer cells are low cuboidal and contain an elliptic nucleus. At the transition from the duct to the acinus, the inner cells of the duct become the secretory cells, having the lightly violet stained cytoplasm and a round nucleus; and the outer cells of the duct change into the myoepithelium (indicated by an arrow). Around the acini and ducts very dense capillary networks are developed. Along the upper edge of this figure traverses a longitudinal section of an acinus.



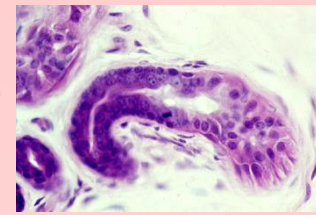
21. Sweat gland 4. Secretory portion and duct, longitudinal section 2.  
H&E stain, x 100.



- This is also a longitudinal section of an acinus and excretory duct of the sweat gland. Of the duct the cuticle encircling the lumen is evident. In the acinus the acinar cells surrounding a narrow lumen have lightly violet stained cytoplasm and a round nucleus. The myoepithelium consisting of thin long smooth muscle fibers wraps the acinus longitudinally ( spirally ). The transition from the duct to the acinus is indicated by an arrow.



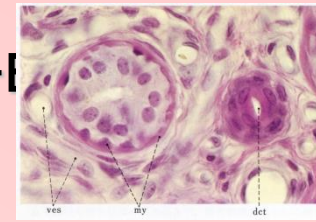
21. Sweat gland 5. Secretory portion and duct, longitudinal section 3.  
H&E stain, x 160.



- This figure shows also the transition from the duct to the acinus of the sweat gland. The transition is indicated by two long arrows. The acinus is sectioned obliquely, so that the arrangement of the smooth muscle fibers ( myoepithelium ) is very conspicuous ( arrow heads ).



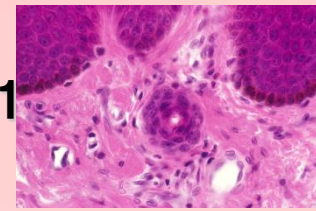
21. Sweat gland 6. Transverse section of acinus and duct. Human, H-E stain 50.



- The histological features of the acinus and duct are evident in this figure. In the acinus light violet stained cytoplasm and round nucleus, and intercellular secretory canaliculi are clearly observed. The smooth muscle fibers of myoepithelium are cut transversely and their nucleus are fit into the base of the acinar cells. In the duct the dense apical cytoplasm ( cuticle )of the inner cells encircling the lumen is conspicuous.
- dct: duct; my: myoepithelium; ves: blood capillaries;



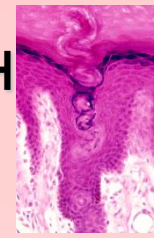
## 21. Duct of sweat gland 1. Transverse section. Human, H-E stain, x 1



- This is a transversely sectioned duct, in the dermis just beneath the epidermis. Approaching the epidermis the duct of the sweat gland is encircled by the cells of the epidermis extending downward, so that it consists of several layers of the epithelial cells.



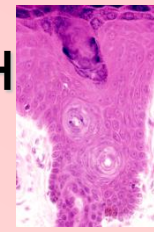
21. Histology of sweat gland 2. Passing through the epidermis 1. Human, H  
stain 00.



- Entering into the epidermis the duct of the sweat gland is encircled by the cells of the stratum spinosum and penetrates it with highly spiral course, and nearing the stratum granulosum cells containing the keratohyalin granules extend downward and encircle the duct. Entering into the stratum corneum the duct loses the structure as a duct and as a highly tortuous spiral gap extends to the skin surface ( see 21-02 ).



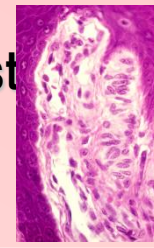
21. Histology of sweat gland 3. Passing through the epidermis 2. Human, H  
stain 60.



- At bottom center of this figure a duct enters into the stratum germinativum. Above it two sections of the duct showing the concentric arrangement of the cells around the lumen, that shift to the cells of stratum spinosum without any boundary. Further above is a part of longitudinally sectioned duct, which is enveloped by keratohyalin granule containing cells.



21. Dermal papilla, containing a Meissner's corpuscle. Human, H-E stain  
x 1



- The dermal papillae are finger shaped projections of dermis extending deeply into the stratum germinativum of the epidermis, consisting of fine collagen fibers running mostly perpendicular to the skin surface. They contain loops of blood capillaries. Some of them contain moreover the terminal apparatus of tactile sense, Meissner's corpuscle, They are called the papillae nervosae and others, papillae vasculares. In this figure there is a papilla containing capillary loop ( left side, cap ) and a Meissner's corpuscle ( right side, M ).
- The Meissner's corpuscles are long elliptic structures, about  $150 \mu\text{m}$  in length, locating in dermal papillae of palms, soles nipples, lips, and external genitalia, perpendicular to the skin surface and consisting of numerous cells with elliptic nuclei arranged parallel to one another and perpendicular to the long axis of the corpuscles. The corpuscle has a moderately thick capsule. Myelinated nerve fibers reach the lower pole of the corpuscle and enter into it as non-myelinated fibers. They proceed within it to the upper extremity with a course of many bendings, among flattened cells that are probably modified Schwann cells ( see 21-19 ). The Meissner's corpuscles are believed as mechanoreceptors.



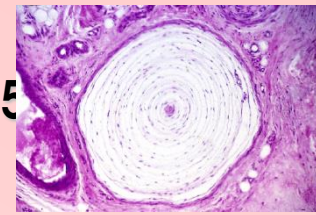
21. **Meissner's corpuscle. Silver impregnation. Human, x 100.**



- In this specimen nerve fibers are demonstrated by the silver impregnation. The course of the axons of many bendings is evident. . . .



## 21-05 Pacinian corpuscle 1. Transverse section. Human, H-E stain, x 25



- As they are seen in 21-05, the Pacinian corpuscles are large ovoid structures up to one mm in diameter. They are found in the dermis and hypodermis of the skin, in the periosteum of bone, and connective tissue stroma of some organs. A myelinated nerve enters one pole, loses the myelin sheath, and its axon continues in the core of the corpuscle ending as a somewhat thickened club, which is surrounded by 20 to 60 concentric lamellae consisting of very thin flat cells separated by narrow space filled with gel-like material of low viscosity. The nerve and its surrounding lamellae are enclosed in a thin connective tissue capsule.
- This figure shows a transverse section of a Pacinian corpuscle, in the thumb tip skin.



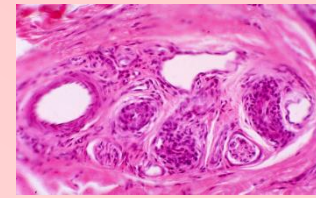
21. Pacinian corpuscle 2. Longitudinal section, Human, H-E stain, x 200



- This is a longitudinal section of a Pacinian corpuscle, also in the thumb tip skin.



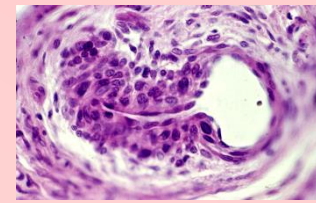
## 21-22 Organ of Hoyer-Grosser 1. Human, H-E stain, x 66.



- This is an arterio-venous anastomosis, seen in the dermis of the thumb tip skin, called the organ of Hoyer-Grosser. In the dermis of palms, soles, and finger tips, there are numerous such arterio-venous anastomosis. Under certain circumstances, these open, shunting blood directly from arteries to veins without an intervening capillary meshwork. Thus, they play an important role in the thermoregulation. The organ of Hoyer-Grosser consists of arteries, veins and connecting anastomoses, that are composed of densely concentrically arranged thin and small cells, surrounding a very narrow lumen. These cells are modified smooth muscle cells, called the epithelioid cells. Artery ( A ), veins ( V ) and anastomoses ( An ) are enclosed together by the connective tissue capsule, in which several small nerves are observed.



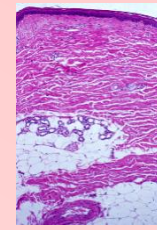
**21-23 Organ of Hoyer-Grosser 2. Human, H-E stain,  
x 160.**



- This shows the opening from an anastomose into a vein ( V ). The lumen of the anastomose is very narrow and lined by the endothelium. Around it surround the epithelioid cells very densely.



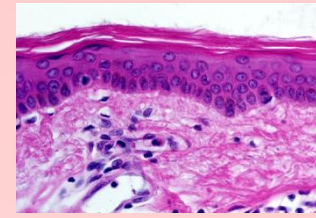
## 21. Skin of abdomen 1. Human, H-E stain, x 25.



- The skin of abdomen consists of thin epidermis and thick dermis. The epidermis is very thin and so that the dermal papillae are not conspicuous ( see 21–25 ), but the dermis is thick consisting of dense collagen fiber bundles. Beneath the dermis follows the subcutaneous adipose tissue, in which some sweat glands are recognized.

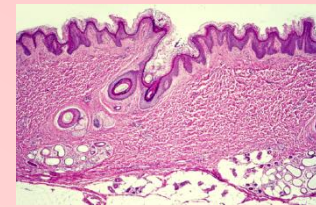


## 21. Skin of abdomen 2. Human, H-E stain, x 160.



- Here, in the epidermis, stratum basale is well identified as a layer of cylindrical cells; stratum spinosum consists of only three or four layers of polyhedral cells; stratum granulosum is very poor and only three flat cells are perceived at upper left corner. Stratum lucidum is not identified and stratum corneum is also very thin. Beneath the stratum basale follows loose connective tissue of fine collagen fibers, among that numerous blood vessels are seen. This layer corresponds to the stratum papillare in the thick skin.

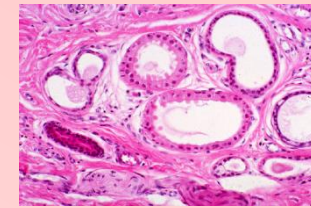
## 21. Skin of axilla 1. Human, H-E stain, x 10.



- The skin of axilla consists of thin epidermis and thick dermis. In the epidermis stratum germinativum is well identified whereas stratum granulosum is poorly developed and stratum corneum is thin and loosely constituted. Beneath the epidermis follow the loose connective tissue and then dermis consisting of densely woven thick collagen fiber bundles. In the deeper region of dermis and in the subcutaneous adipose tissue there are apocrine sweat glands, glandulae axillares, and also eccrine sweat glands. At the top center of this figure there is a deep hollow, which is the opening of the follicle of an axillary hair.

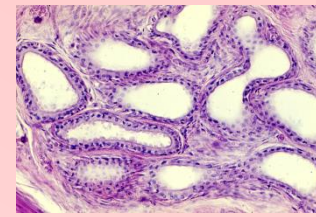


21. Apocrine sweat gland 1. Human axilla, H-E stain, x 66.



- Higher magnification of 21–26. At center two sections of the acinus show the typical secretory process of apocrine secretion. The apocrine gland has a large lumen surrounded by a layer of cuboidal cells. During the secretion, numerous secretory droplets, enveloped by plasma membrane, protrude into the lumen from the apical surface of the acinar cells, then leave from the cell surface and drop into the lumen as secretory substance. The other sections of acini, consisting of low cuboidal acinar cells, have no secretory droplets, that means, just after the secretion. At the lower left corner there is a longitudinally sectioned duct and a nerve fiber bundle.

21. Apocrine sweat gland 2. Gl. ceruminosa. Human, H-E stain, x 64.



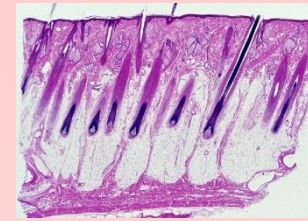
- The Gl. ceruminosa in the outer acoustic meatus is also the apocrine sweat gland. At the lower left corner apocrine droplets protruding from the apical surface of the acinar cells are evident. In this figure the myoepithelial cells spirally wrapping the acini are evident.



## 21. Scalp

- The scalp is the skin of the head, from which grow numberless thick hairs. The scalp consists of relatively thin epidermis, thick dermis, and thick subcutaneous adipose tissue. In the dermis there are a number of sebaceous glands attaching to the hair follicles. In the superficial area of the subcutaneous tissue sweat glands are distributed numerous, whose ducts open independently on the scalp surface. From the inferior surface of the dermis extend numerous thin collagen fiber bundles, retinaculum cutis, uniting the scalp with the galea aponeurotica.

21. Scalp. Vertical section. Human, H-E stain, x 3.0.



- The general view of the scalp is well demonstrated. Numerous hairs and hair follicles deeply extend obliquely from the surface to the subcutaneous adipose tissue. In the thick dermis *M. arrector pili*, attaching obliquely to the hair follicle is recognized, here and there. Sebaceous gland and sweat gland are evident. From the inferior surface of the dermis extends the retinaculum cutis, uniting the dermis with galea aponeurotica.

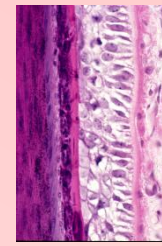


## 21. Hair follicle. Longitudinal section. Human, H-E stain, x 25.



- The hairs are slender keratinous filaments that develop from the matrix cells of follicular invaginations of the epidermal epithelium. Each hair arises in a tubular invagination of the epidermis, the **hair follicle**, which extends down into the dermis where it is surrounded by connective tissue ( see 21-29 ). The follicle has a bulbous terminal with a concavity in its bottom occupied by a connective tissue **papilla**. The papilla is covered by epithelial matrix cells of hair and root sheath. The cells of dome of the convexity form the hair **root** which develops into the hair **shaft**. The free end of the shaft protrudes beyond the surface of the skin.
- The epithelial cells around the papilla ( the matrix ) differentiate into several types. (1) The central matrix cells on the top of the convexity of the papilla develop into the **medulla** of the hair shaft. The cells are large and vacuolated and eventually keratinize. (2) The next concentric layer of matrix cells keratinizes and develops into the **cortex** of the hair, the main constituent of the shaft. Its cells are heavily keratinized and tightly compacted, and they carry most of the pigment of the hair. (3) Peripheral to the matrix cells of the cortex lie those of the **cuticle** of the hair. These cells of the outermost layer are the most heavily keratinized.
- The more peripheral concentric rows of matrix cells produce the internal root sheath, a transient structure surrounding the hair shaft below the level of the sebaceous glands. It consists of three layers. The **cuticle of the internal root sheath**, like the cuticle of the hair, consists of overlapping thin scales with their free margins directed toward the bottom of the follicle. **Huxley's layer** consists of one to three layers of cornified cells. **Henle's layer** is a single layer of elongated cells closely adherent to the external sheath.
- The outermost layer of the follicle, the **external root sheath**, is basically similar to the unspecialized epidermal epithelium and is continuous with it above.
- This figure shows a longitudinal section of a hair passing through the medulla, so that the concentric arrangement of the cells constituting the hair and hair follicle is evidently recognized. The transverse sections indicated by 21-38 ~ 21-41 are shown in the respective figures.

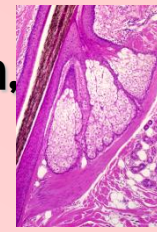
21-160 Longitudinal section of hair and hair follicle. Human, H-E stain, x 160



- Higher magnification of 21–30. The concentric arrangement of the cells constituting the hair and hair follicle is evidently recognized. Here the outer root sheath consists of stratum cylindricum and stratum spinosum, the same as the stratum germinativum of the epidermis.

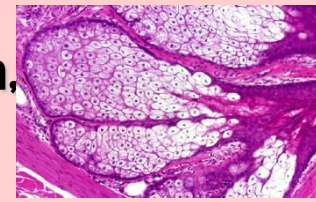


21. **andullae sebaceae and arrector pili muscle 1. Human, H-E stain,**  
25.



- Along the left edge of this figure runs a hair shaft with its follicle obliquely from bottom upward. Right to it there are three lobes of the sebaceous gland that are limited right side by an arrector pili muscle. The ducts of the sebaceous glands unite together and open into the gap between the hair shaft and outer root sheath. At lower right corner there is a group of sweat glands. The arrector pili muscle is a thick bundle of smooth muscle fibers which originates at the middle portion of hair follicle and terminates at the superficial portion of the dermis. Its contraction pulls up the hair and makes it perpendicular to the skin surface.

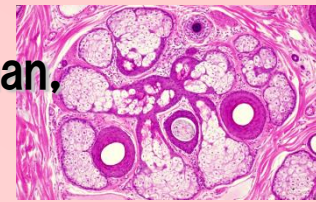
21. **andullae sebaceae and arrector pili muscle 2. Human, H-E stain,**  
30.



- Four lobes of sebaceous gland occupy the figure, uniting their ducts at right edge of the figure. In each lobule, the process of the holocrine secretion is evidently observed. At the lower left corner runs a thick bundle of the arrector pili muscle ( M ) obliquely.

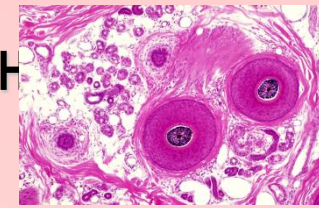


21-34 Tangential section of scalp 1. Level of the sebaceous glands. Human.  
H-I 25.



- Figures 21-34 to 21-37 are tangential sections passing through the plane roughly perpendicular to the slant of the hairs, arranged from superficial level to downward. . Magnification of them is x 25.
- 21-34 is the section through the most superficial level passing through the sebaceous glands. In the scalp hairs and sebaceous glands are grouped and loosely encircled by loose connective tissue. Here three thick hairs and one thin hair ( long arrow ) and surrounding eight lobes of sebaceous gland are grouped. At the upper periphery two ducts of sweat gland are recognized ( short arrows ).

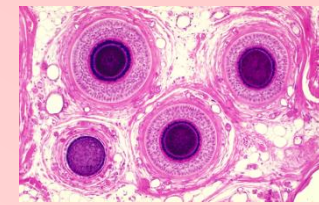
21. Longitudinal section of scalp 2. Level of the sweat glands. Human, H  
stain 5.



- This section passes through the level of the sweat glands. Two thick hair follicles and two thin hair follicles are grouped, together with the sweat gland. They are encircled loosely by collagen fiber bundles. The originating portion of arrector pili muscle ( M ) is encountered. Around the thick hair, the external root sheath is very thick and surrounded by connective tissue follicle. A narrow gap between the hair and internal root sheath is conspicuous. Follicles of thin hairs show the bottom level figures.

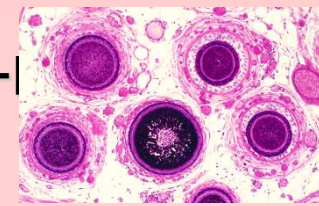


21. Histological section of scalp 3. Level of the deeper portion of hair follicles, H-E stain x 25.



- This section shows most beautifully the concentric arrangement of cells of hairs and hair follicles. In the upper three follicles concentric arrangement of the cells is evidently shown, namely, medulla and cortex of hair, hair cuticle and internal sheath cuticles, Huxley's layer, Henle's layer, stratum spinosum and stratum cylindricum, glassy membrane, and connective tissue follicle are all definitely demonstrated. Around and in the connective tissue follicle there are numerous blood vessels. The lower left one is a section at deeper level, a little above the top of the papilla. As the outer epithelial root sheath only one layer of cylindrical cells is recognized and no internal root sheath is perceivable.

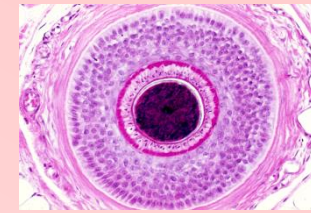
21. Longitudinal section of scalp 4. Level of the hair papilla. Human, H-  
stain 5.



- This is a section at the deepest level of the hair follicle. At lower center is a section passing through the hair papilla; around the papilla heavily melanin loaded matrix cells are densely packed. Around the matrix cellular elements of the hair cuticle and Henle's layer are recognized. Other four hair follicles in this figure are sectioned at a little higher level. Each follicle is surrounded by numerous blood vessels.



## 21-38 Transverse section of hair follicle 1. Human, x 64.



- From 21-38 to 21-41 are transverse sections of hair follicle at different levels, arranged from upper to downward. These levels are shown in 21-30.
- 21-38 is a section at the level, where the external root sheath is the thickest. Concentric arrangement of layers are as follows: ① is the connective tissue root sheath, in which numerous blood vessels are distributed. ② is the glassy membrane. ③ is the stratum cylindricum of the external root sheath. ④ is the stratum spinosum of the external root sheath. ③ and ④ correspond to the respective layers of dermis. ⑤ is the Henle's layer, already cornified. ⑥ is the Huxley's layer. ⑦ is the gap between the internal root sheath and the hair. ⑧ is the hair.

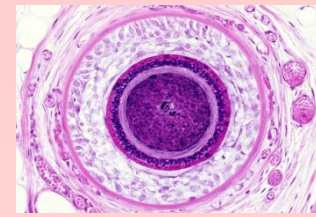
## 21-39 Transverse section of hair follicle 2. Human, x 64.



- The level of this section is indicated in 21-30. ①~⑥ are the same as in 21-38. ⑦ indicates the united root sheath cuticle and hair cuticle. ⑧ is the hair.

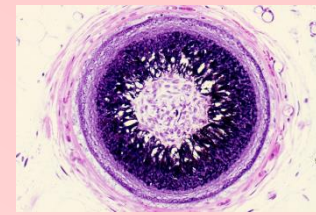


## 21-40 Transverse section of hair follicle 3. Human, x 64.



- The level of this section is indicated in 21-30. ①~⑤ are the same as in 21-39. ⑦ is the inner root sheath cuticle, ⑧, the hair cuticle, and ⑨ cortex and ⑩ medulla of hair.

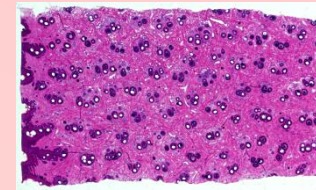
## 21-41 Transverse section of hair follicle 4. Human, x 64.



- The level of this section is indicated in 21-30. ① and ② are the same as in 21-40. ③ is the external root sheath, ④ the Henle's layer, ⑤ the cuticle of inner root sheath and ⑥ cuticle of hair. ⑦ is the hair matrix and ⑧ is the hair papilla.

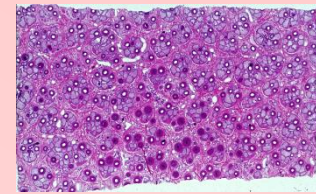


## 21-42 Longitudinal section of scalp 2-1. Human, H-E stain, x 3.0.



- 21-42 ~ 21-47 are transverse sections of human scalp at different levels, shown with very low magnification. They are arranged from upper to downward. To understand these figures, it is necessary to refer to the figure 21-29.
- 21-42 is the section of the most superficial level, namely the level of the dermis. In this section hairs are left off. Three to five hair follicles are grouped and each group is separated one another by collagen fiber bundles, running mostly parallel to the skin surface, and densely woven around the hair groups.

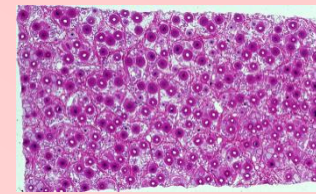
21. Longitudinal section of scalp 2-2. Human, H-E stain, x 3.0.



- This is the section of the level of sebaceous glands. In this section hairs are also fallen out. Hair follicles are grouped together with sebaceous glands. Collagen fiber bundles separating these groups are woven somewhat looser than those in 21-42.

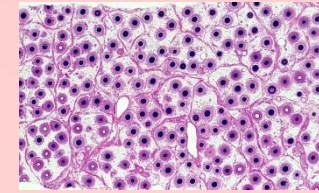


21. Longitudinal section of scalp 2-3. Human, H-E stain, x 3.0.



- This is the section of the level of the sweat glands, that means the level of the uppermost area of subcutaneous adipose tissue. Each follicle shows the thick external root sheath.

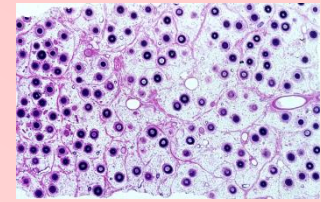
21. Longitudinal section of scalp 2-4. Human, H-E stain, x 3.0.



- This is the level of deeper portion of the hair follicles. Hair follicles are in the subcutaneous adipose tissue. The epithelial root sheath is here the thickest. Thick collagen fiber bundles separating the groups of the hair follicles are the retinaculum cutis.

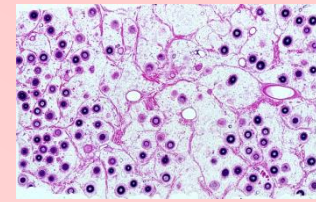


21. Longitudinal section of scalp 2-5. Human, H-E stain, x 3.0.



- This is the level of the hair papilla.

21.  ingential section of scalp 2-6. Human, H-E stain, x 3.0.

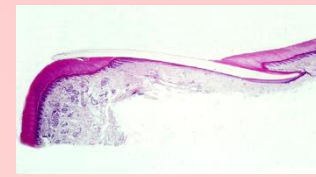


- This is the level of the bottom of the hair follicles.



21. Jail

**21-48 Longitudinal section of nail. Human, H-E stain,  
x 1.6.**



- The nails are plates of closely compacted hard corneous substance covering the dorsal surface of the finger tip as well as toe tip. The exposed portion of the nail is called nail plate and its proximal portion embedded in the epidermis, proximal nail fold, is named the nail root. The epidermis of the proximal nail fold covers the dorsal surface of the nail root and turns inward enclosing its proximal end of the nail root, and continues with the epithelial cell layer of the inferior surface of the nail plate, the nail bed. The epidermis enclosing the nail root is called the nail matrix.
- The nail plate is formed by proliferation and keratinization of epithelial cells in the nail matrix. The stratum corneum of the epidermis of the proximal nail fold extends for a short distance onto the upper surface of the nail, forming a thin covering of its proximal 0.5 to 1.0 mm, that is called the eponychium.
- The nail bed consists only of the stratum germinativum adhering to the inferior surface of the nail plate, but it has no function to form the nail plate. Distal end of the nail bed continues with the thick epidermis attaching to the inferior surface of the distal end of the nail plate, that is epidermis of the finger tip.

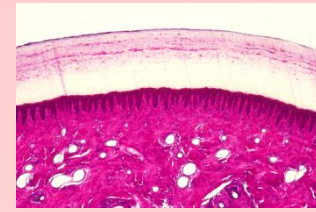


21. **ansverse section of nail 1. Human, H-E stain, x 2.75.**



- The nail plate is limited laterally by the lateral nail grooves where the nail plate continues with the epidermis of the lateral nail folds. Here the epidermis of the lateral nail fold loses its stratum corneum and continues beneath the body of the nail plate as the nail bed. There the epidermis consists only of the stratum germinativum. Growth of the nail is occurred by the cell proliferation in the nail matrix and the nail slides over the thin epidermis of the nail bed which makes no contribution to its formation.

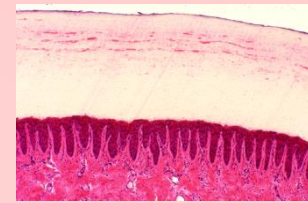
**21-50 Transverse section of nail 2. Human, H-E stain, x 10.**



- Higher magnification of 21-49.
- The thick nail plate is underlain by the nail bed consisting only of the stratum germinativum. The dermis of the nail bed is highly vascular and this is reflected in the pale pink color transmitted through the translucent nail.



**21. Transverse section of nail 3. Human, H-E stain, x 25.**



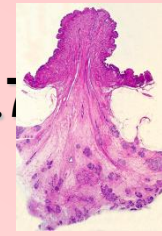
- Higher magnification of 21–50.
- Dermis sends numerous narrow papillae deeply into the stratum germinativum, oriented parallel to the long axis of finger, that give comb-teeth like appearance to the nail bed of the transverse section.

## 21. Mammary Gland

- The mammary glands are specialized accessory glands, to provide for the nourishment of the offspring. In the human there are paired mammary glands on the thorax. The mammary glands undergo extensive structural changes associated with puberty, pregnancy and menopause.
- The mammary glands are large spherical in form and with a nipple on their top. Around the base of nipple there is a circular pigmented area of the skin, called areola. Fifteen to twenty lactiferous ducts ( ductus lactiferi ) penetrate through the nipple and open onto its tip, that are excretory ducts of the separate lobes of the mammary gland.

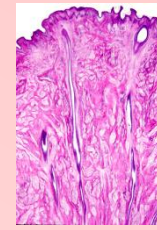


## 21. Nipple and mammary gland. General view. Human, H-E stain, x 0.7



- The mammary gland is a compound tubuloalveolar gland consisting of 15 to 20 lobes drained by the same number of lactiferous ducts that open on the tip of the nipple. The lobes are separated by connective tissue and adipose tissue. The lactiferous duct of each lobe goes through several orders of branching, to drain multiple small lobules, each consisting of a group of alveoli around one of the terminal branches of that lactiferous duct. The mammary gland does not have a capsule. Interlobular connective tissue septa extend inward from the subcutaneous tissue surrounding the gland.
- This is a longitudinal section of a human nipple and mammary glands on resting stage. Several lactiferous ducts penetrate through the nipple, that extend deeply inward and attain to the glandular lobes. At the level of the base of the nipple, lactiferous ducts are slightly dilated to form lactiferous sinus. As this specimen was on resting stage, the glandular lobes are small and poorly developed.

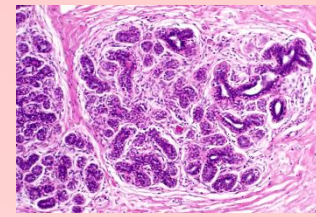
21. Nipple. Longitudinal section. Human, H-E stain, x 4.0.



- In this figure, several lactiferous ducts are seen penetrating the nipple; around each of them encircle a number of smooth muscle fiber bundles.

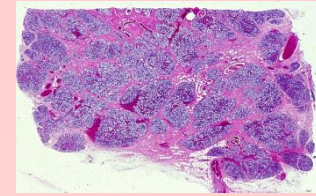


21. Mammary gland on resting stage. Human, H-E stain, x 25.



- On the resting stage there are no secretory portions at the distal end of the lactiferous duct. This is a lobule of tortuous tubule consisting of two layered cuboidal epithelial cells.

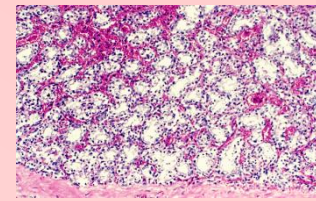
**21-55 Mammary gland at term, 1. Human, H-E stain,  
x 2.5.**



- In pregnancy, the elevated levels of circulating estrogens and progesterone bring about major changes in the mammary glands. There is a rapid growth in length and branching of the duct system and proliferation of alveoli, caused by the vigorous cell divisions at their distal ends. The paired mammary glands protrude massively on the thorax at the expense of the adipose tissue among the alveoli. The acini develop highly and have the wide lumen, but until the delivery no secretion is observed in the lumen.
- This specimen shows the mammary gland at term, consisting of numerous alveoli, but no adipose tissue among them..

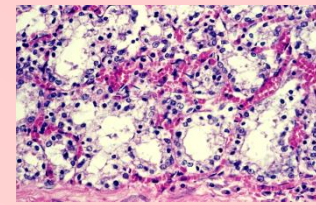


**21-56 Mammary gland at term, 2. Human, H-E stain,  
x 25.**



- This figure is throughout filled by the aveoli consisting of one layer of cuboidal epithelial cells encircling a wide lumen. Interalveolar stroma is densely filled by capillaries containing a lot of erythrocytes.

**21-57 Mammary gland at term, 3. Human, H-E stain,  
x 100.**



- Higher magnification of 21-56. The epithelial cells encircling the alveolar lumen are tall cuboidal and have basophilic cytoplasm. The wide lumen is empty and contains still no secretion. Around the alveoli encircles a capillary network very densely.