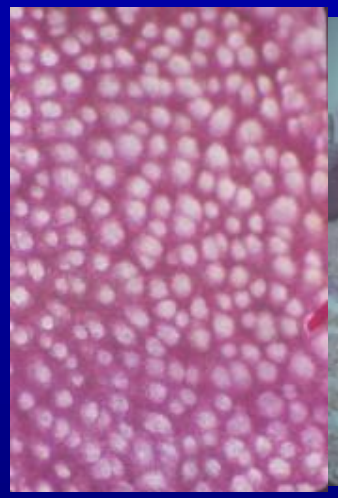
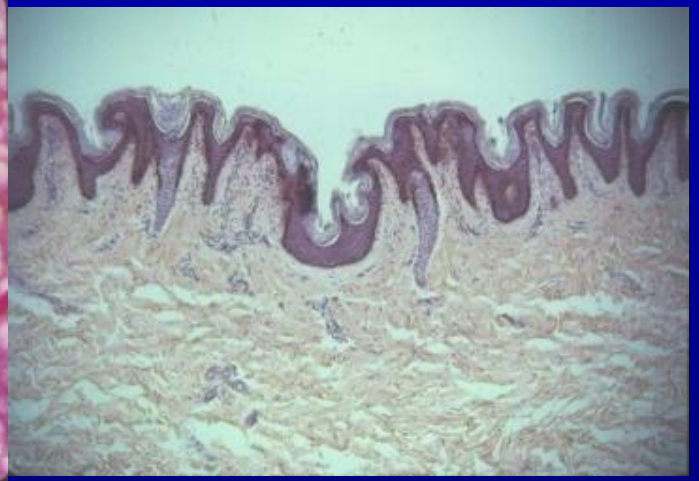
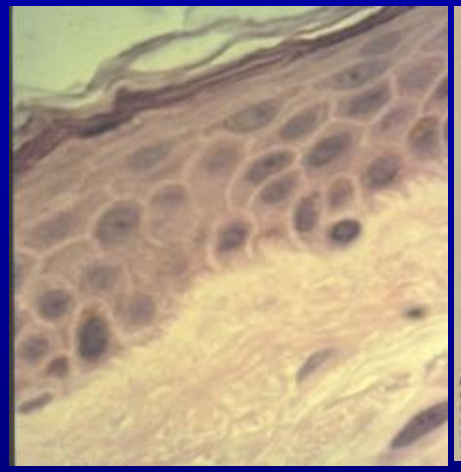
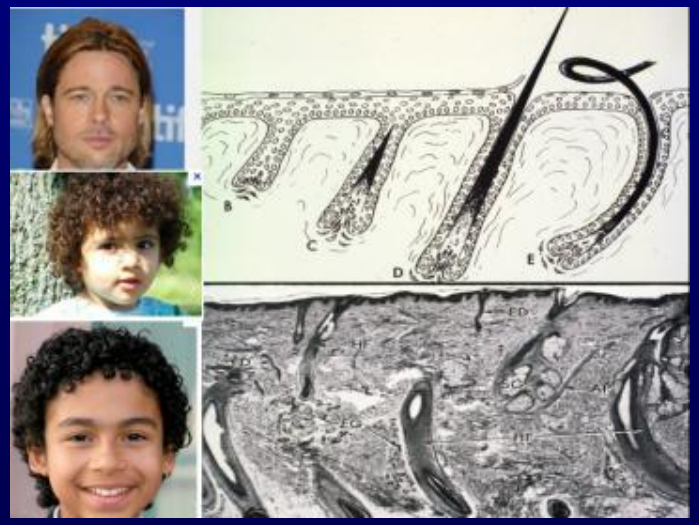
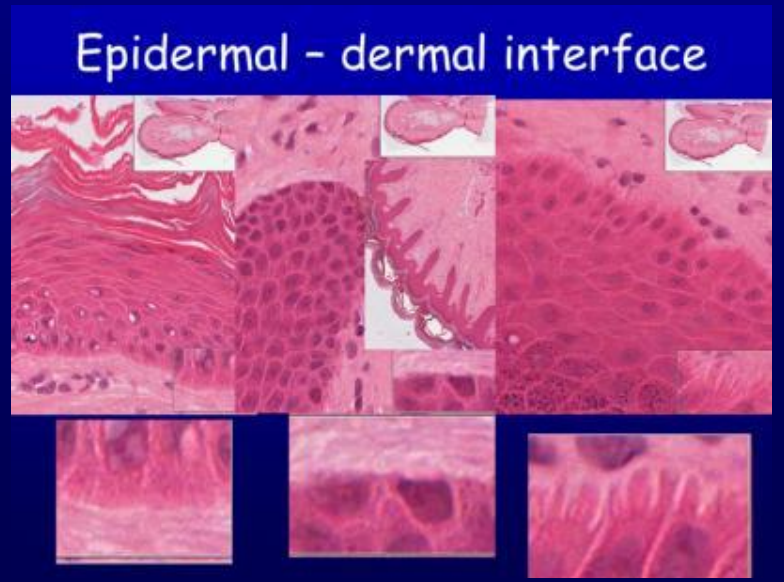
Skin
Integument





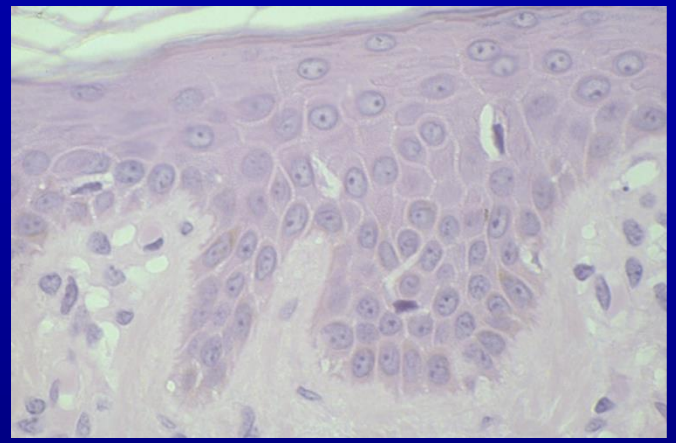


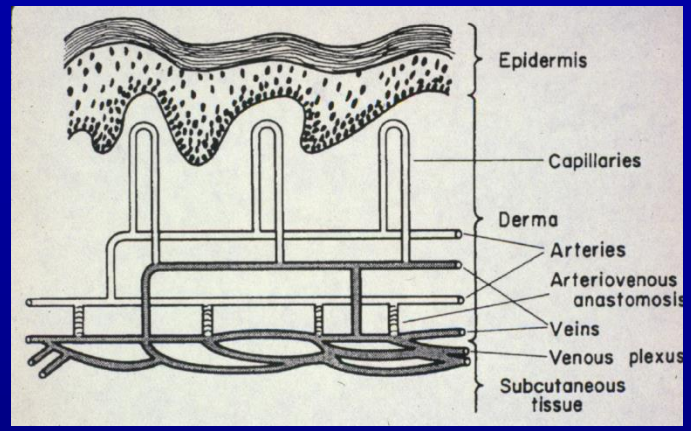


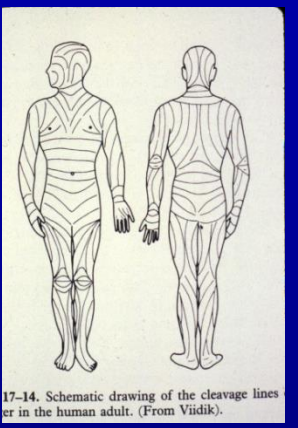


Objectives

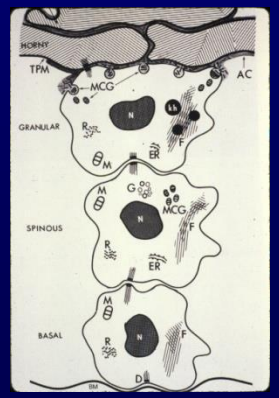
To gain a greater appreciation of the diversity of functions of skin

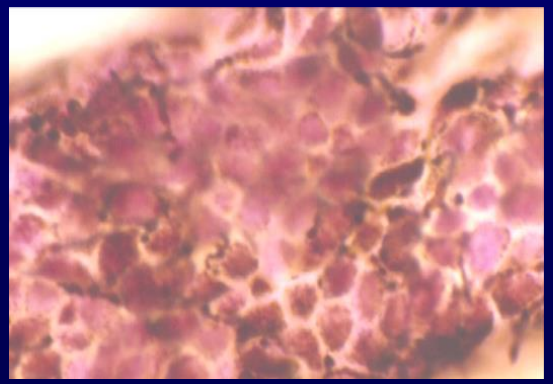





17–14. Schematic drawing of the cleavage lines er in the human adult. (From Viidik).

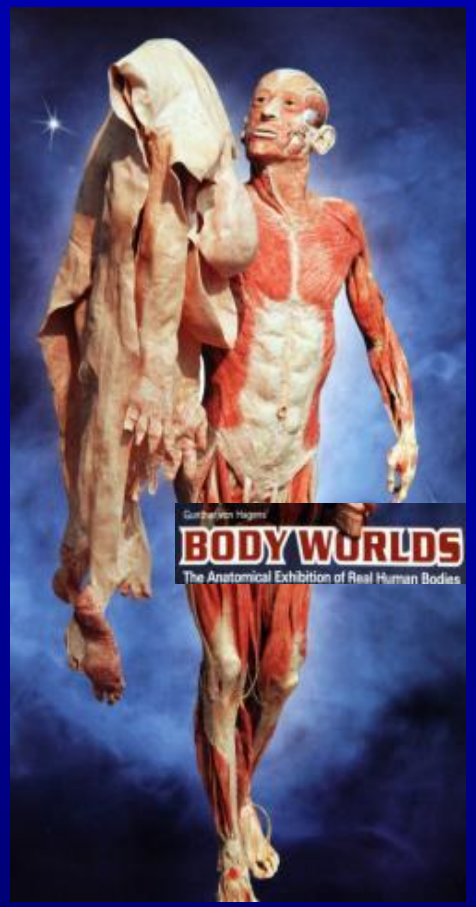
To recognize the different cell types and structures of the skin which make possible this functional diversity

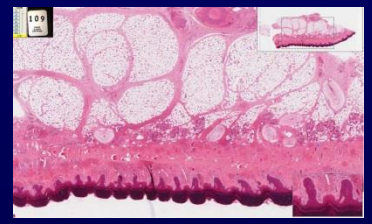




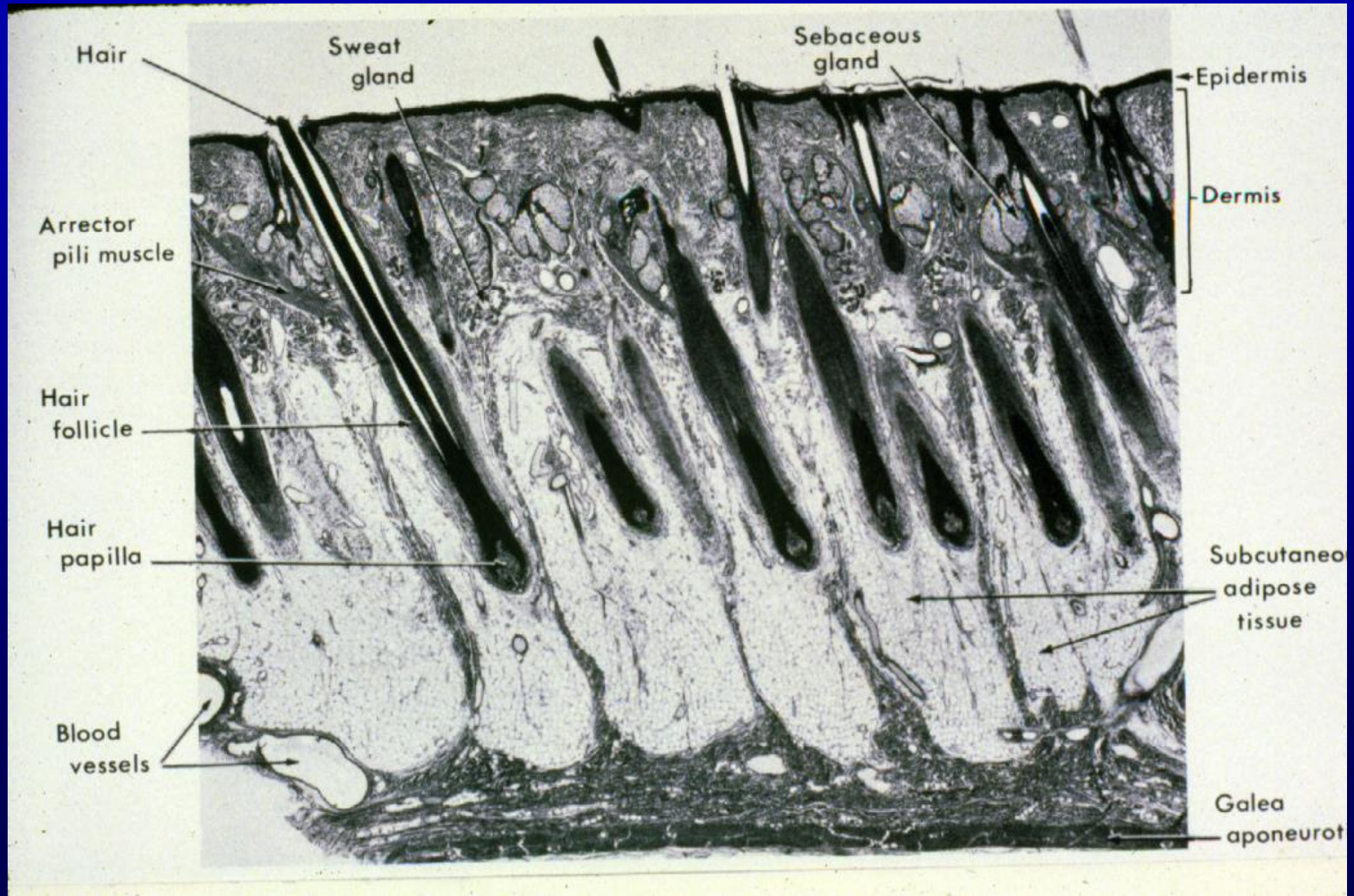
Functions of Skin: Functional Diversity of Skin

- Protects against injury and desiccation
- Maintenance of water balance
- Excretes/secretes various substances
- Thermoregulation
- Receives stimuli
  - Temperature
  - Pain
  - Pressure
- Basis of recognition and yields clues to one's well being
- Fat metabolism in the subcutaneous layer

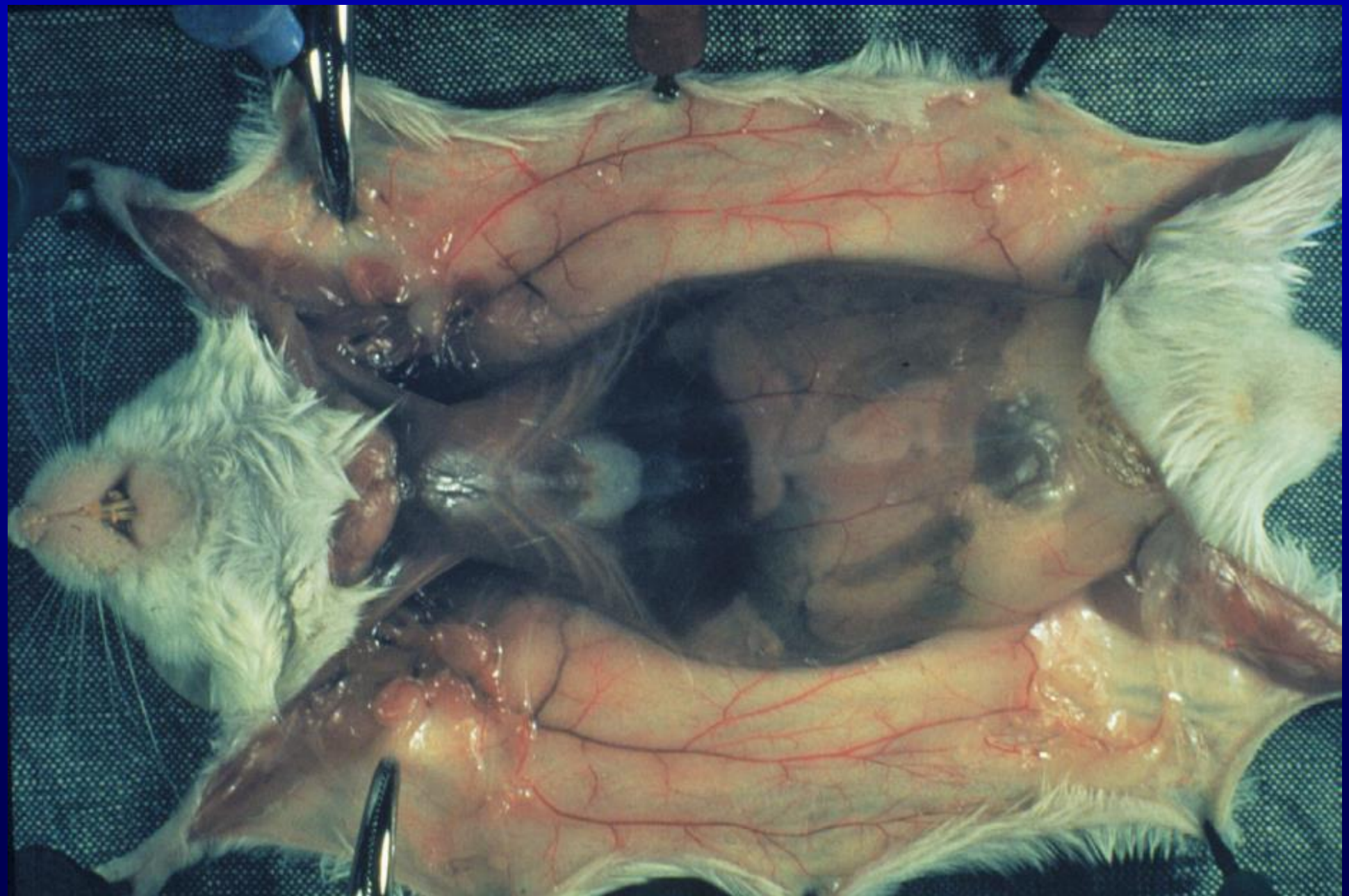


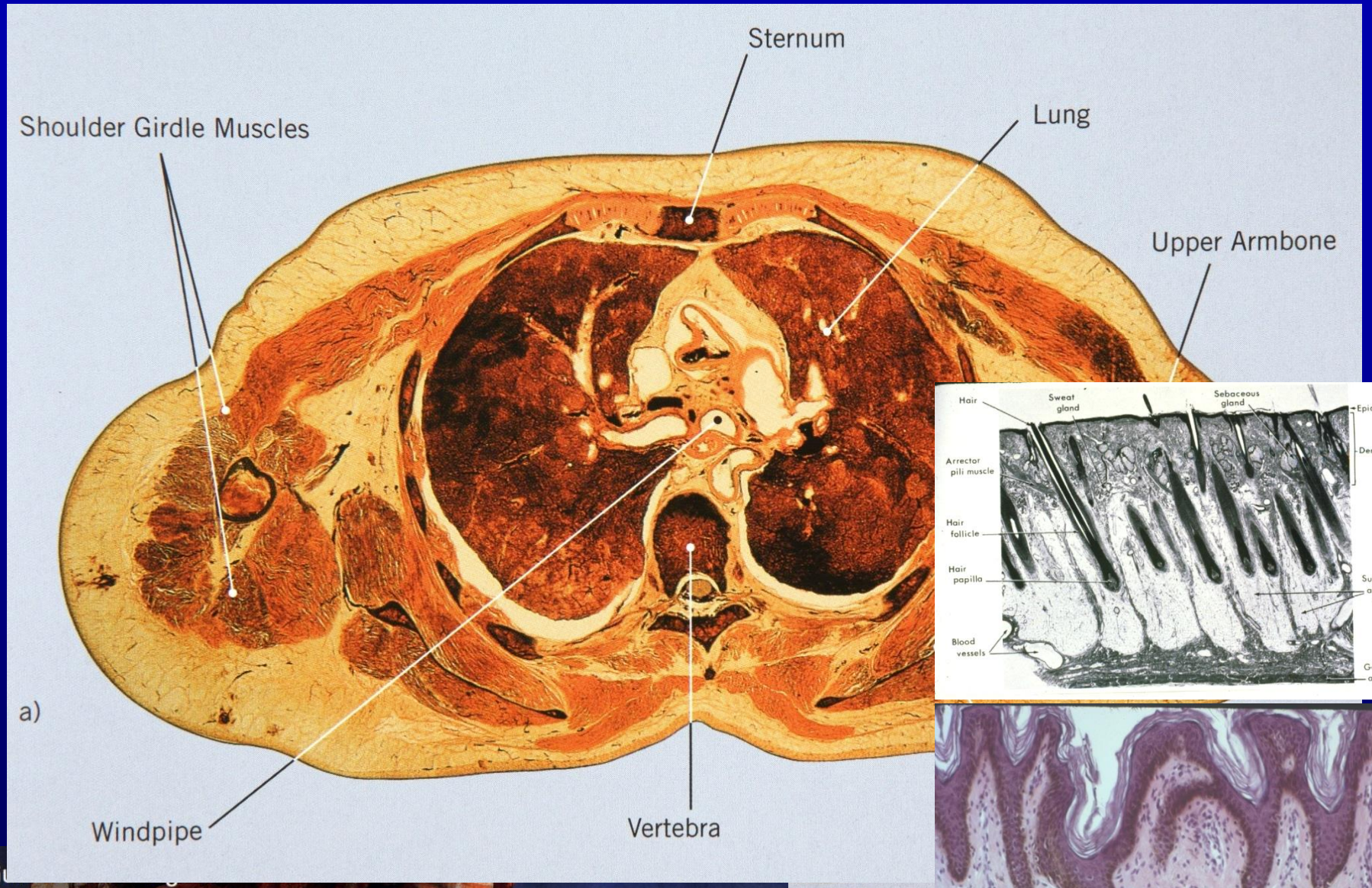


Fat Metabolism in the Subcutaneous Layer

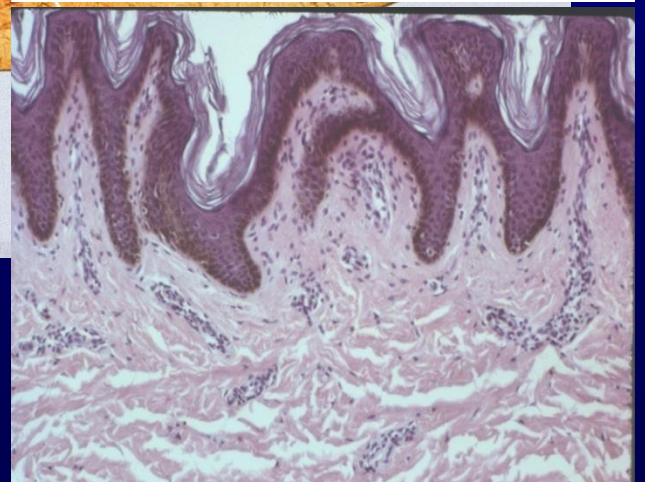


Fat Metabolism in the Subcutaneous Layer




Sternum
Shoulder Girdle Muscles
Lung
Upper Armbone
a)
Windpipe
Vertebra

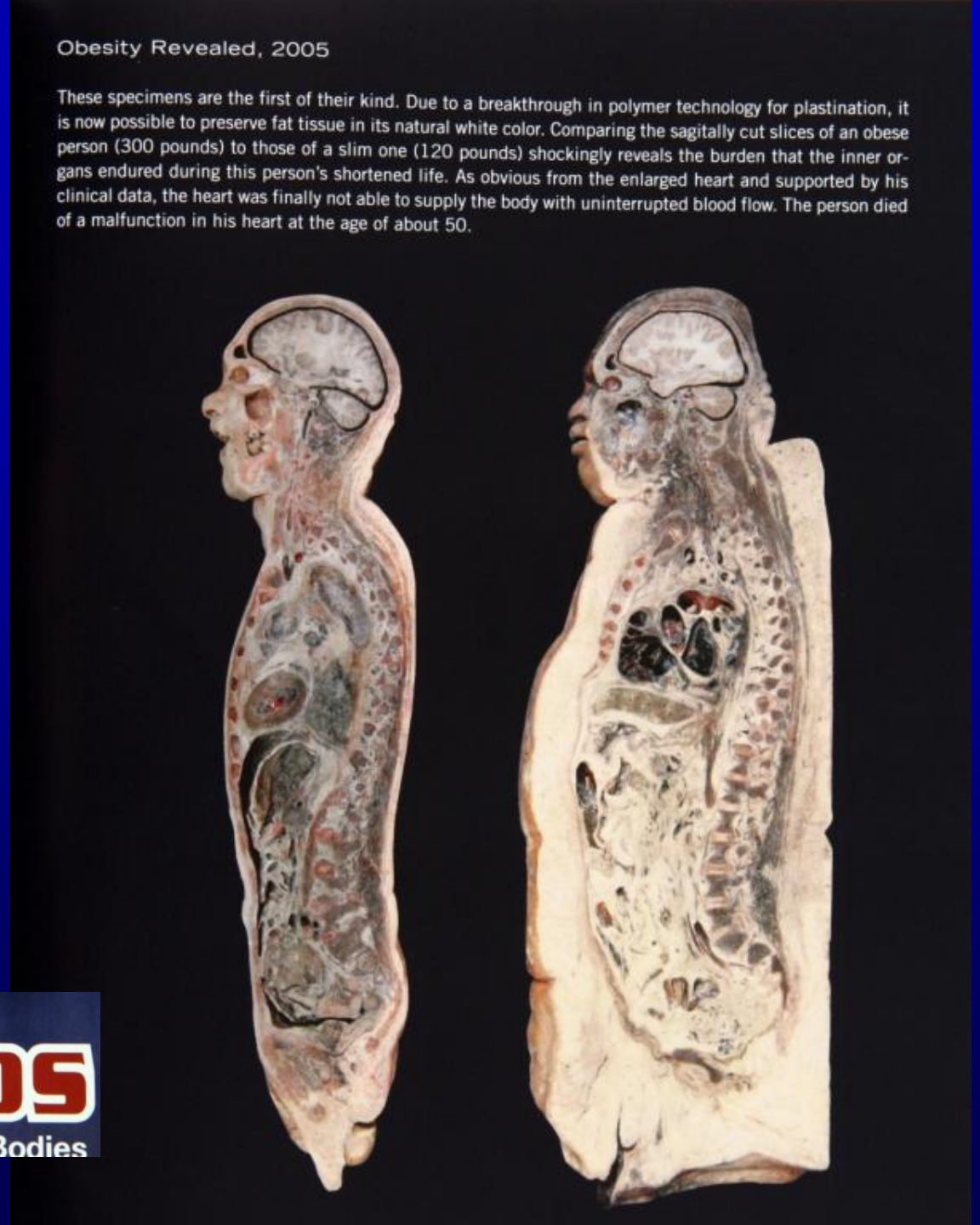
Hair
Sweat gland
Sebaceous gland
Epidermis
Dermis
Arrector pili muscle
Hair follicle
Hair papilla
Blood vessels
Subcutaneous adipose tissue
Galea aponeurotica




BODY WORLDS
The Anatomical Exhibition of Real Human Bodies

Obesity =

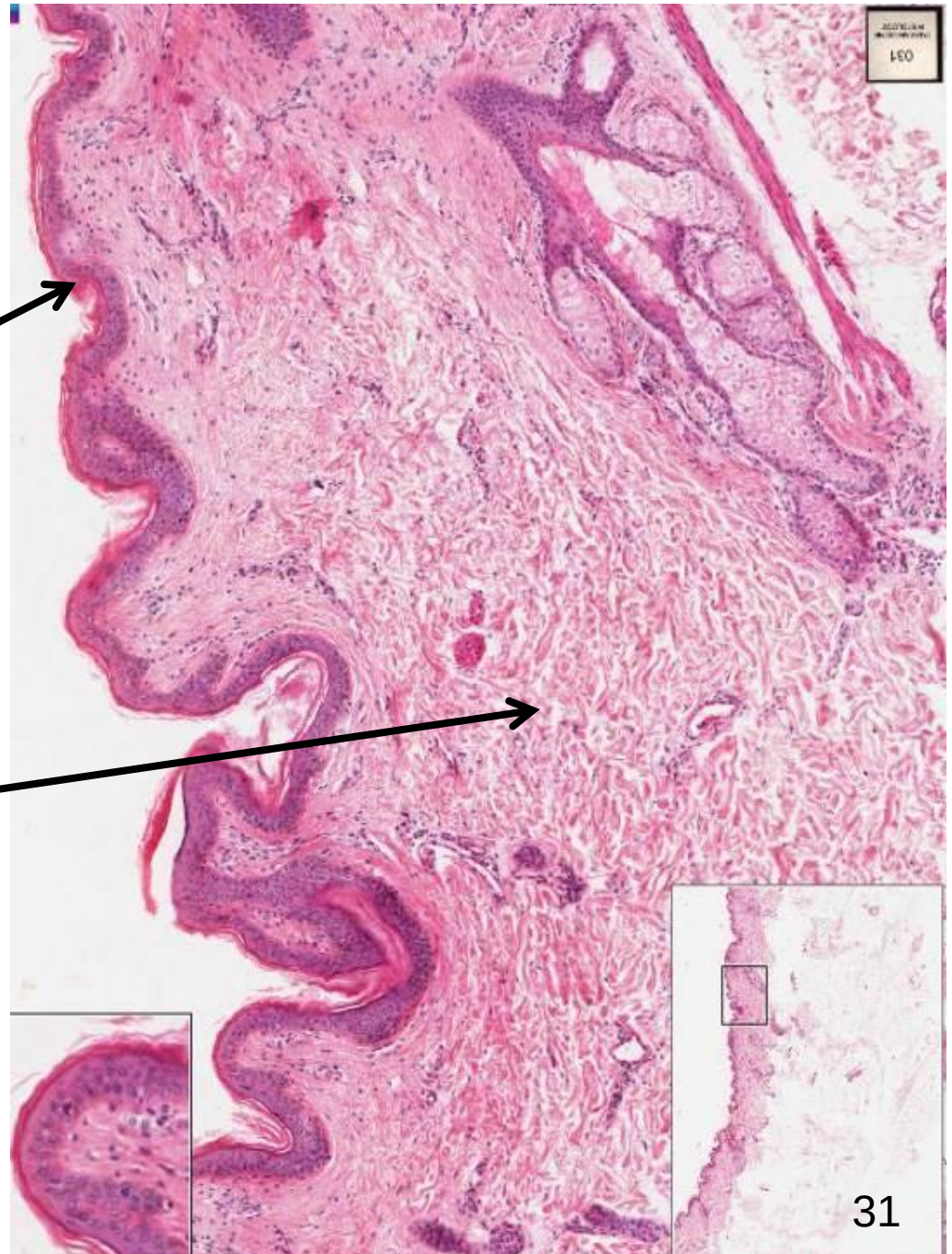
Too much fat in the Subcutaneous Layer



BINARY ORIGIN OF SKIN

EPIDERMIS – ECTODERM

DERMIS - MESODERM



Skin Overview and Introduction

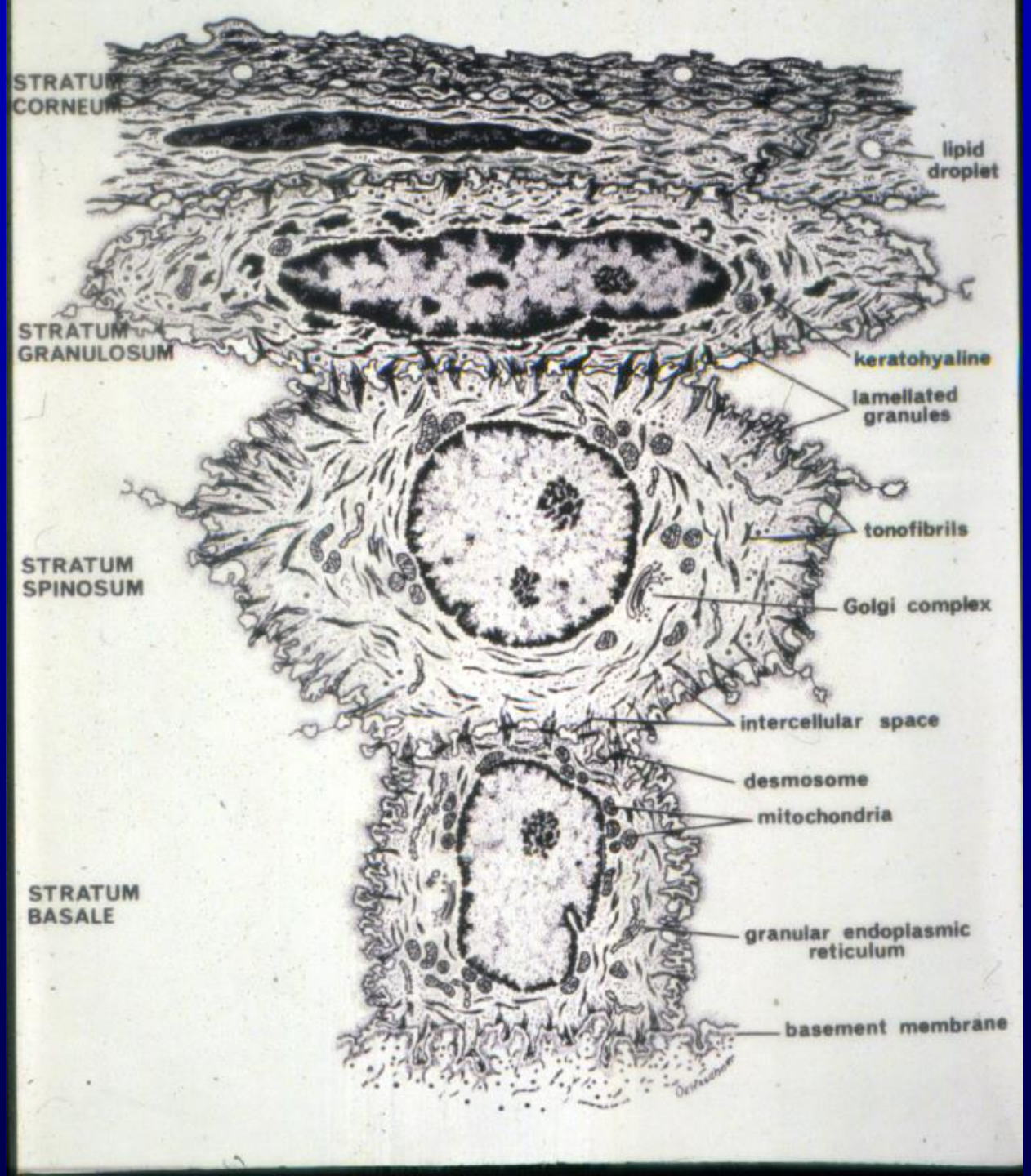
- http://www.youtube.com/watch?v=yKAzVC0WcmI

Stratum Corneum

Stratum Granulosum

Stratum Spinosum

Stratum Basale



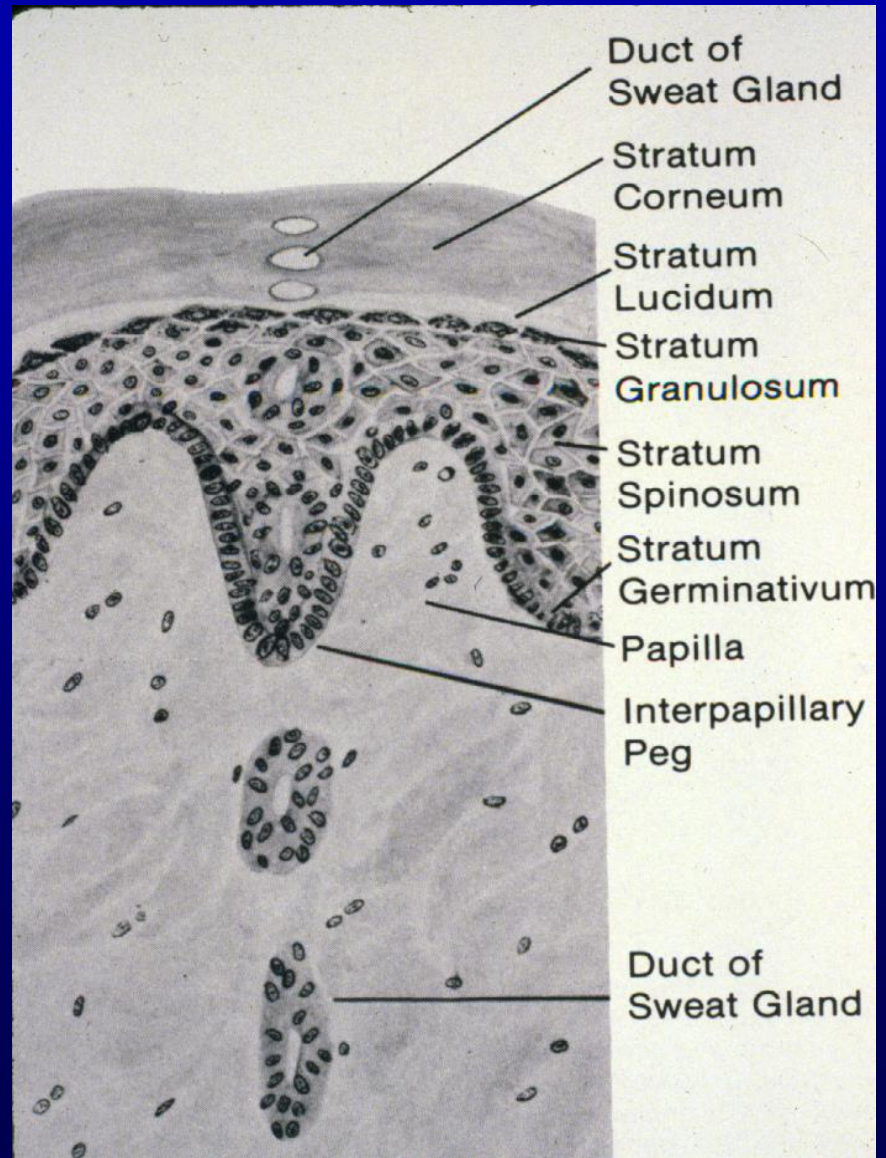
Layers of the Epidermis: palms and soles of feet

Stratum Corneum
- Keratinized flattened, denucleated, dead cells

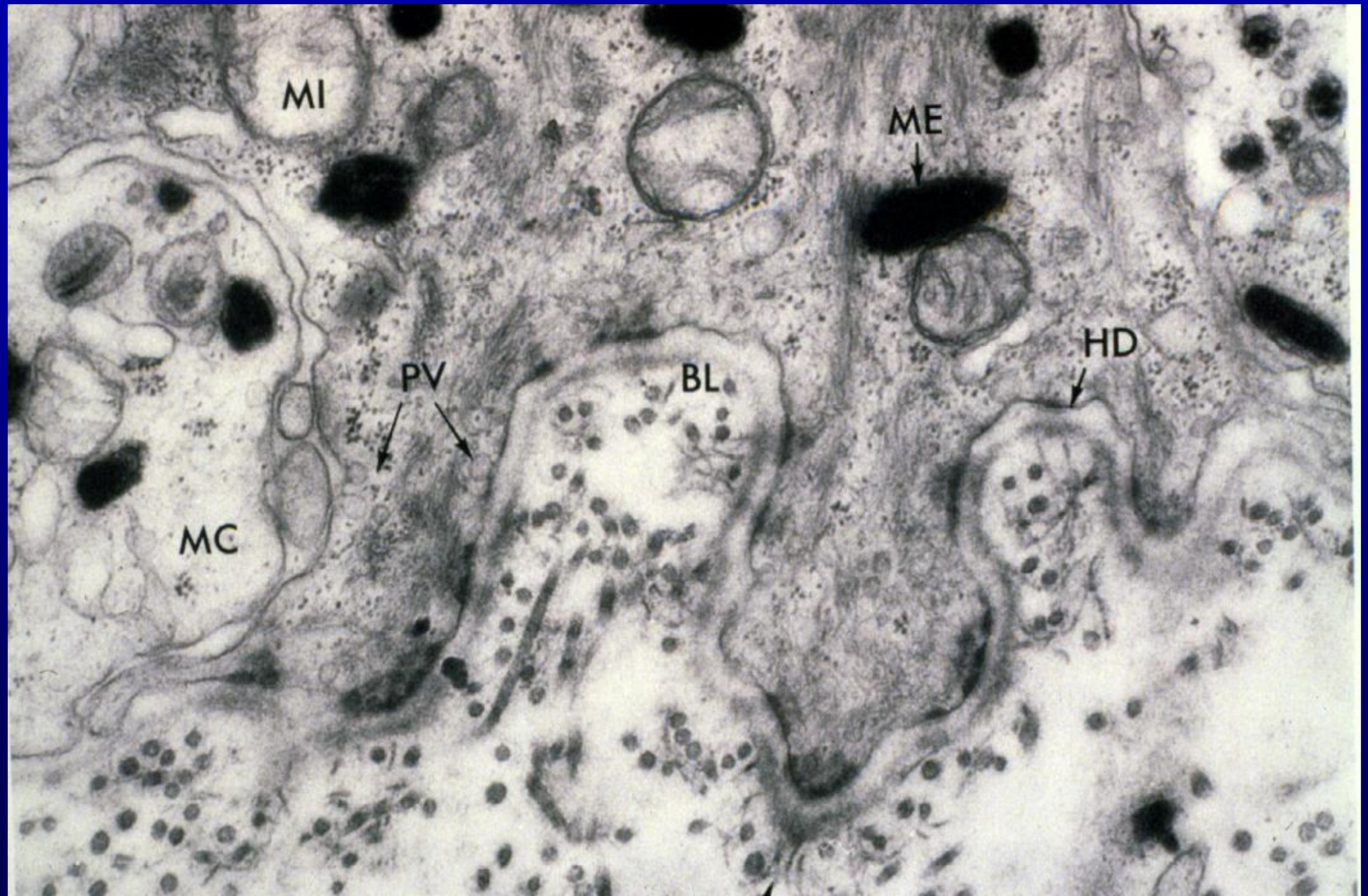
Stratum Granulosum
- Keratohyalin granules

Stratum Spinosum
- Tonofibrils – desmosomes

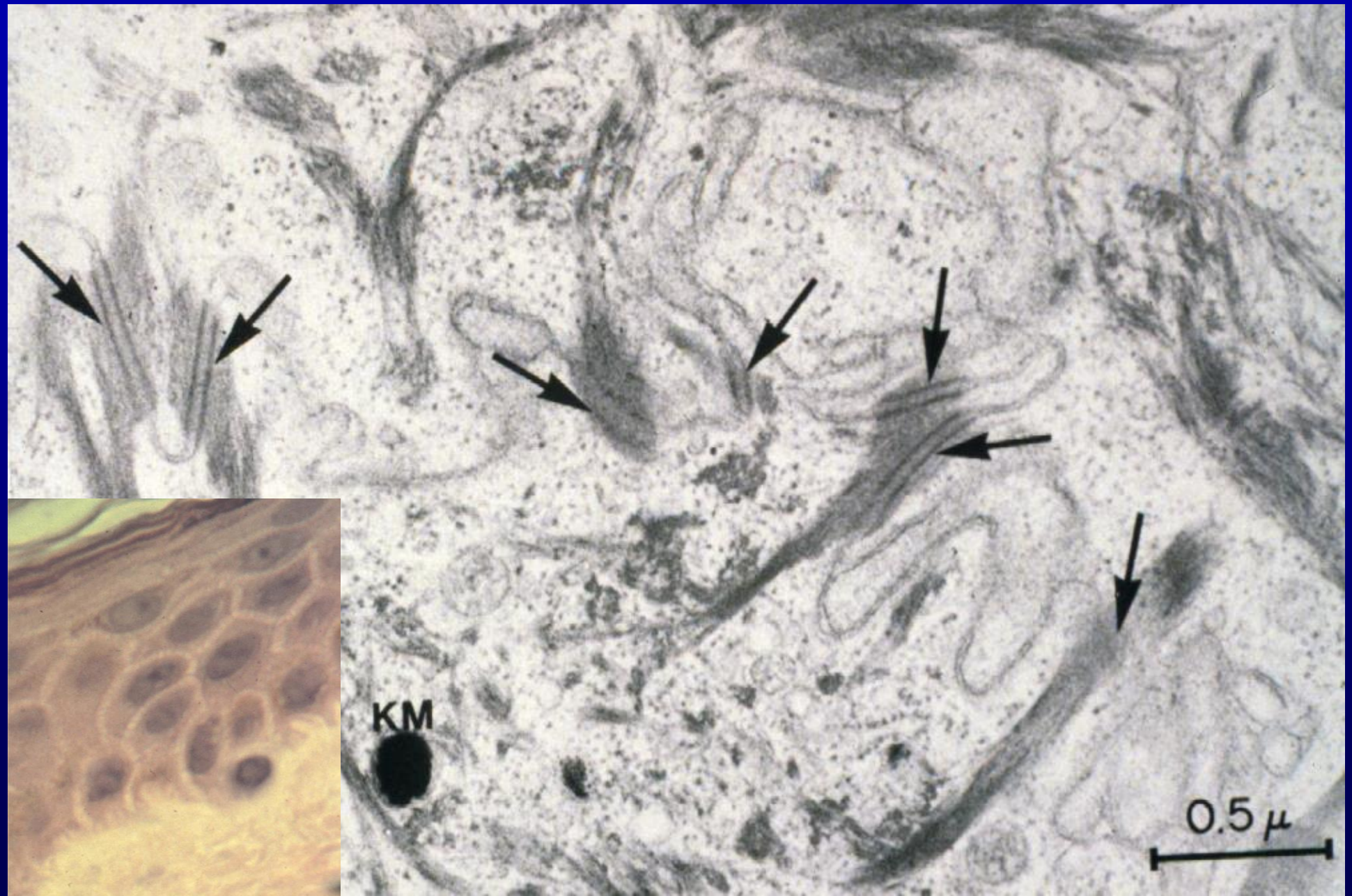
Stratum Basale
- Continual renewal of epidermis



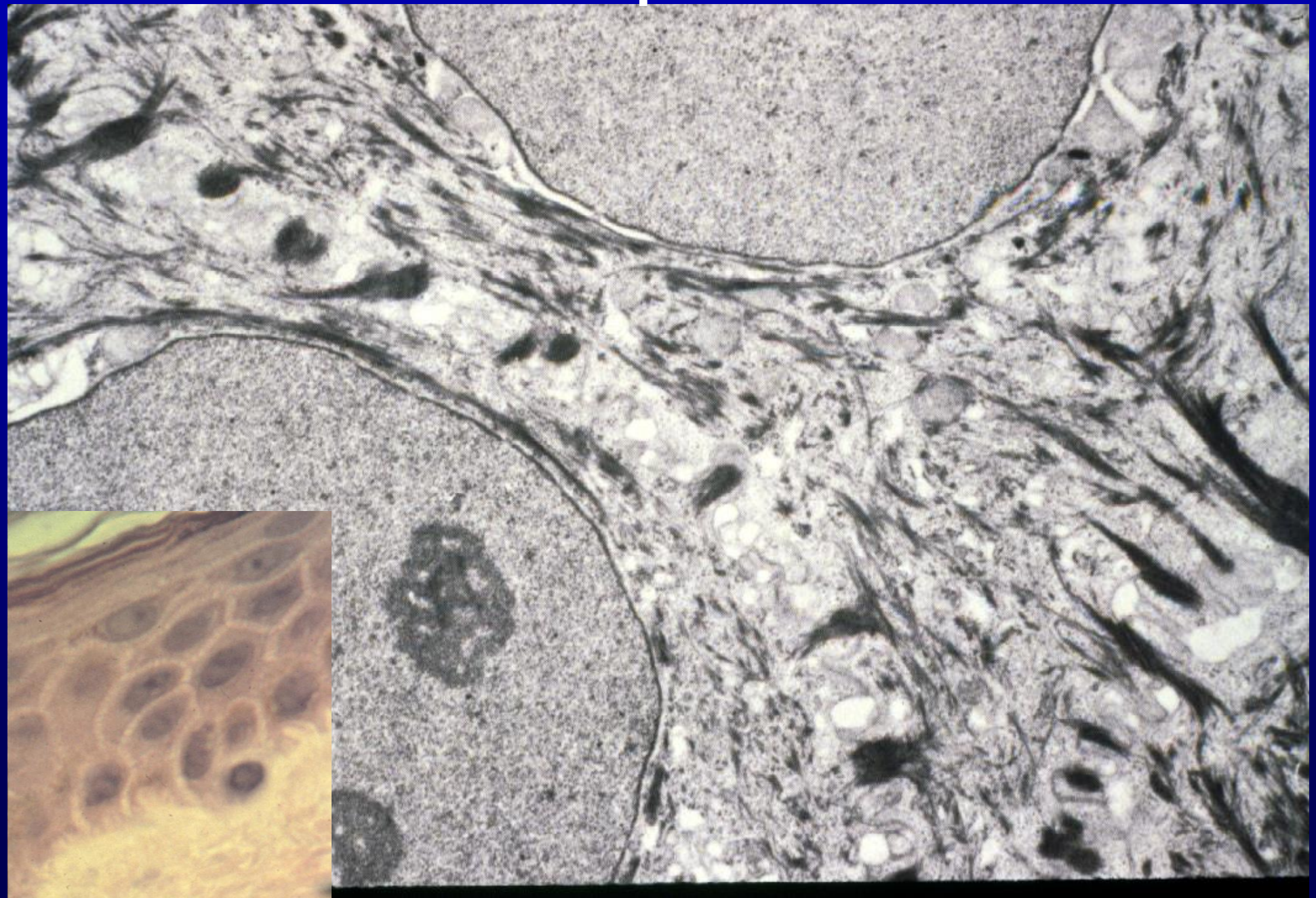
Stratum Basale



Stratum Spinosum

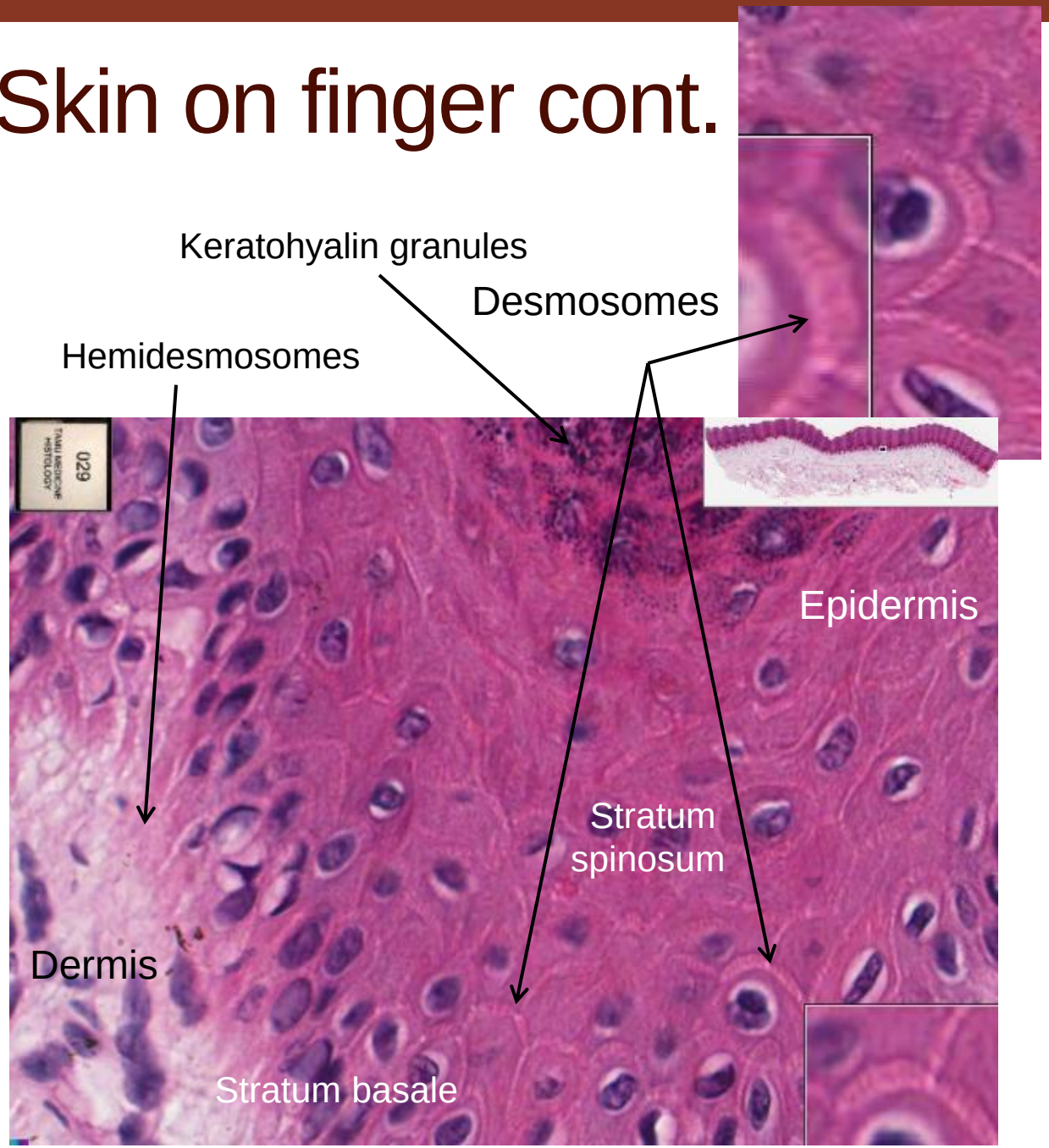


Stratum Spinosum



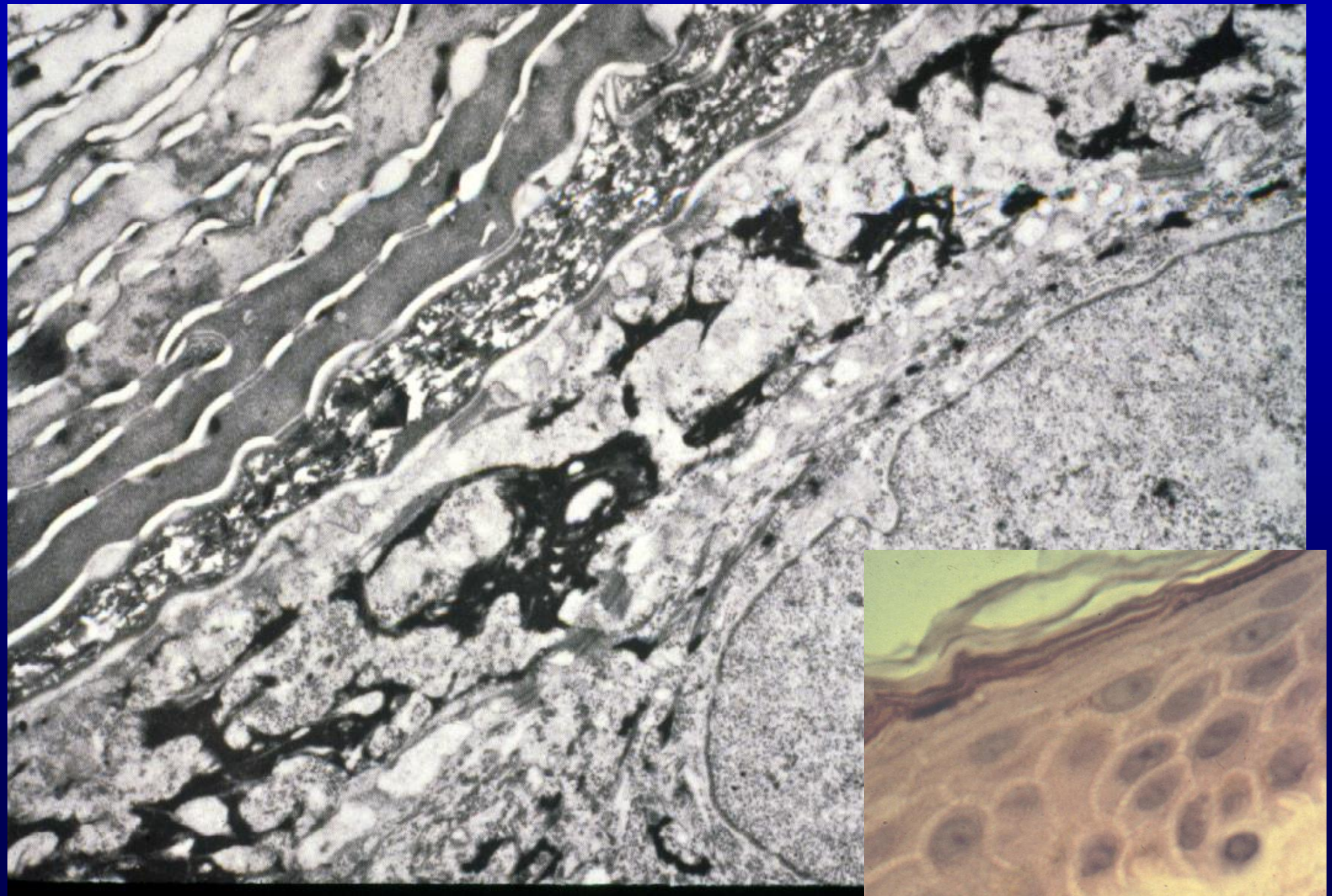
Slide 29: Thick Skin on finger cont.

The epidermis of thick skin is subject to continuous[1] friction and pressure so the abundant desmosomes (and tonofibrils) withstand this and hold the cell layers together.

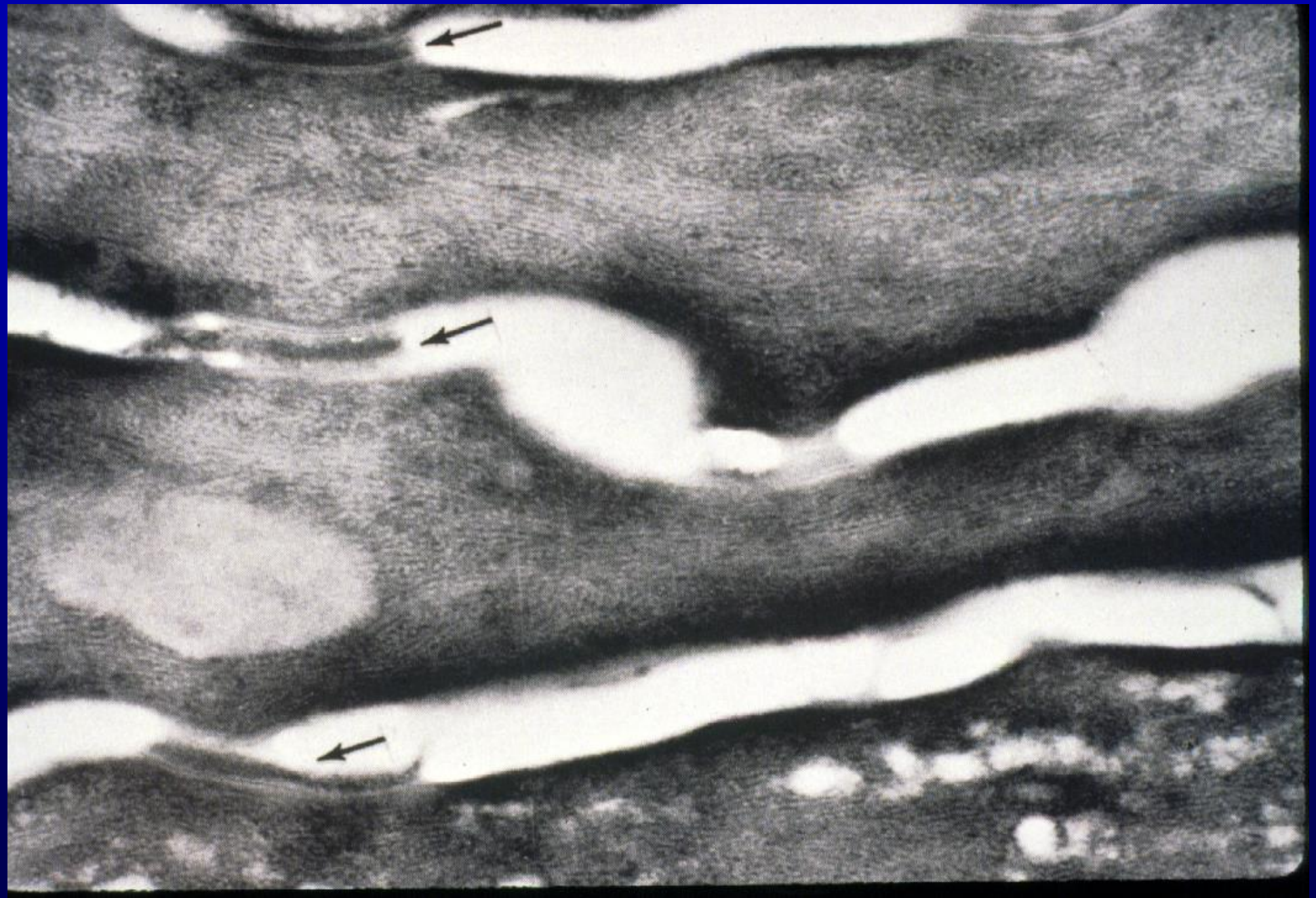


Stratum Corneum

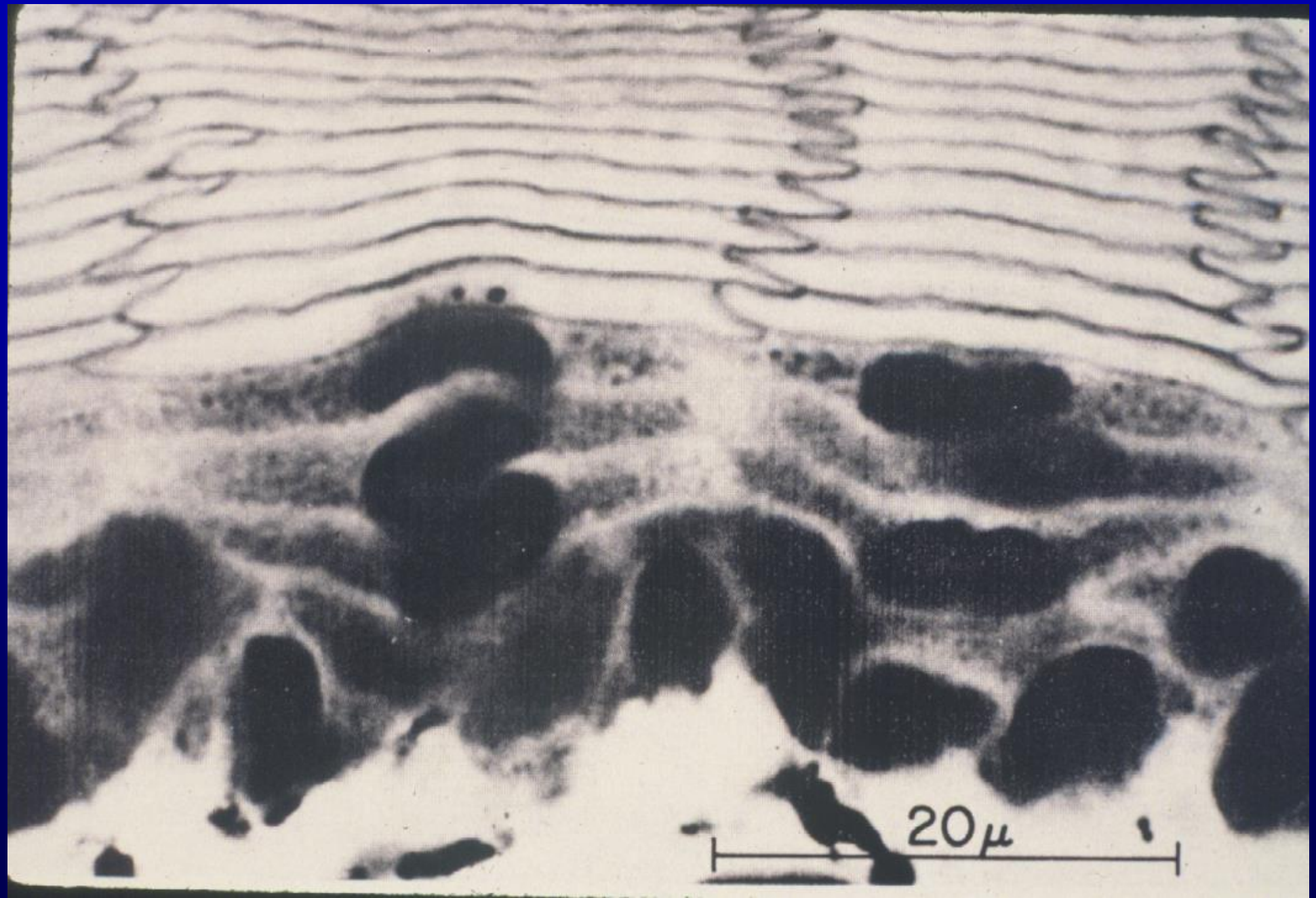
Stratum Granulosum



Stratum Corneum



Stratum Corneum



Three Types of Granules in Keratinocytes

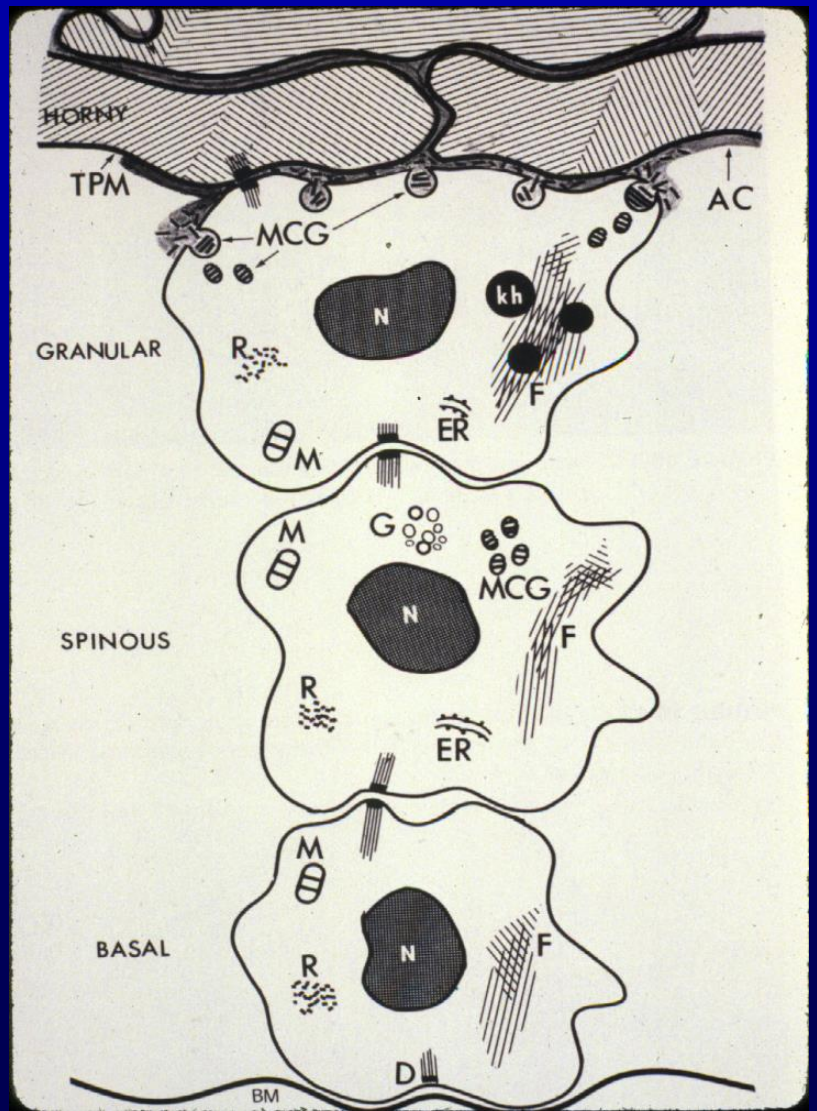
Melanin

- **Skin pigment**
- **Produced by melanocytes and passed by cytocrine secretion to keratinocytes**

Membrane coating granules (lamellated granules)

- **Water proofing function**
- **Produced by keratinocytes**

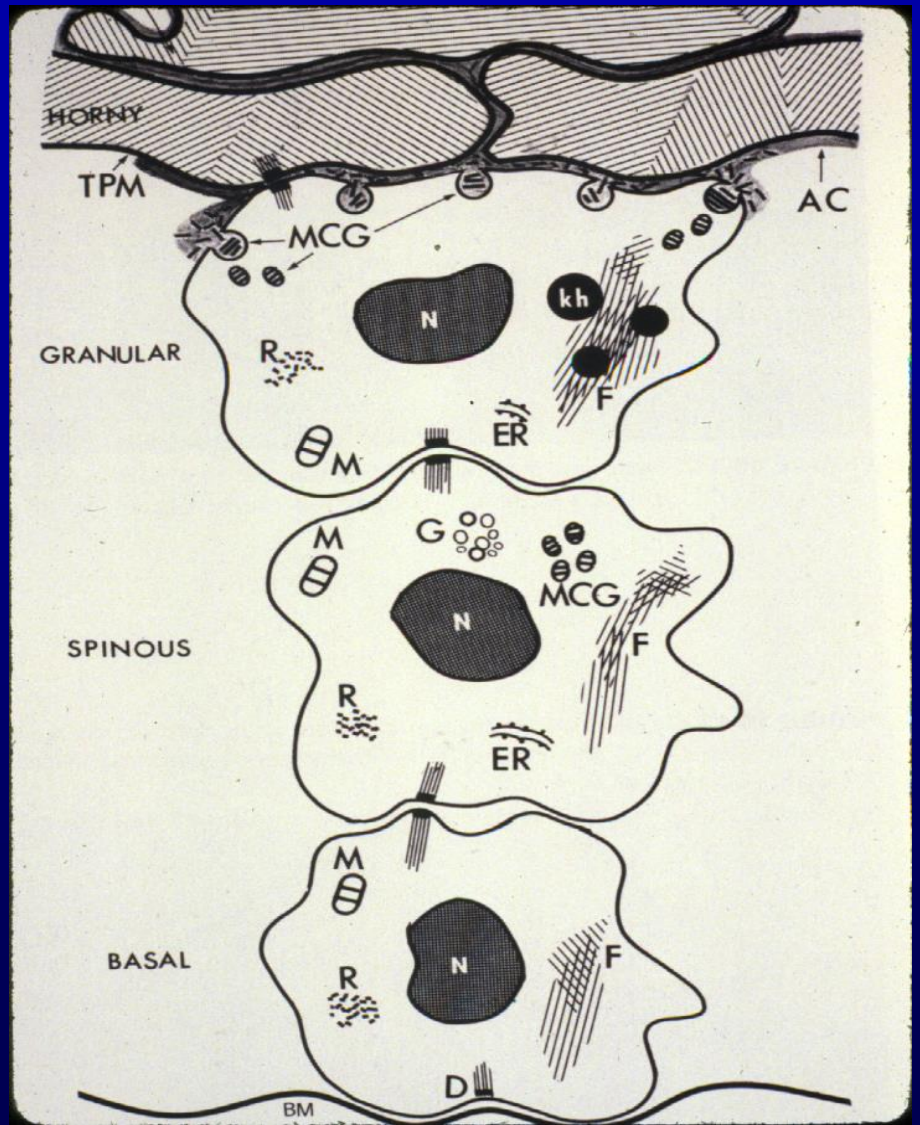
Keratinohyalin granules



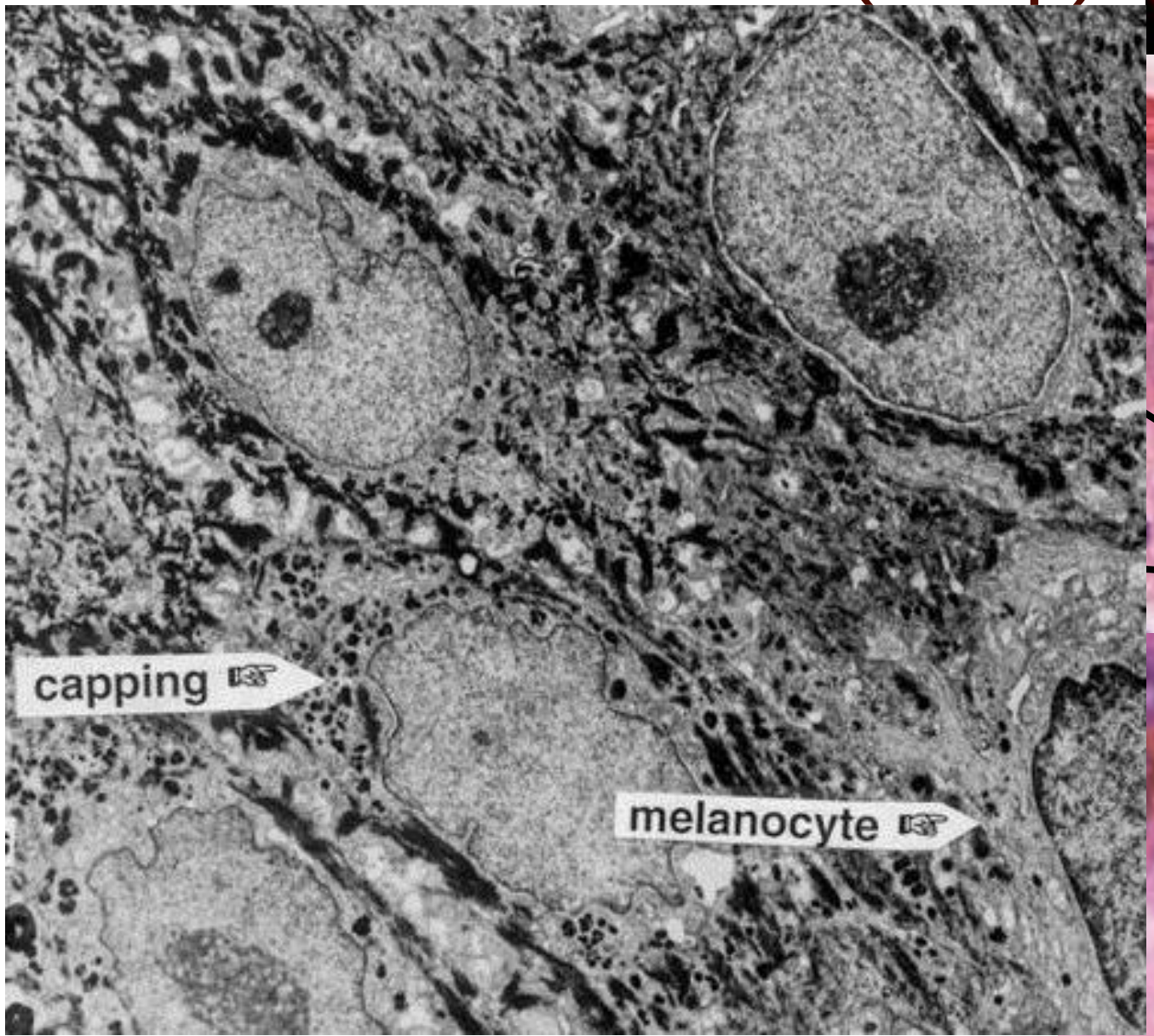
Three Types of Granules in Keratinocytes

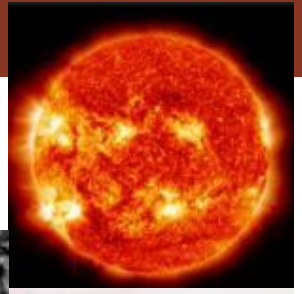
Keratinohyalin granules

- **Chemical nature not clearly established**
- **Rich in histodine forms**
- **Matrix of cells in stratum corneum, stability due to disulfide bonds**
- **Absent in hair and nails**



Slide 31: Thin Skin (scalp)

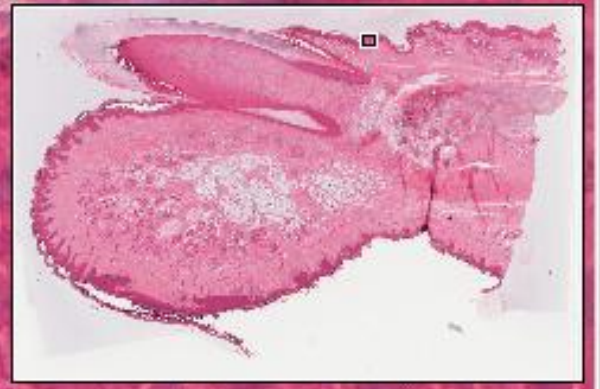




Sun from NASA

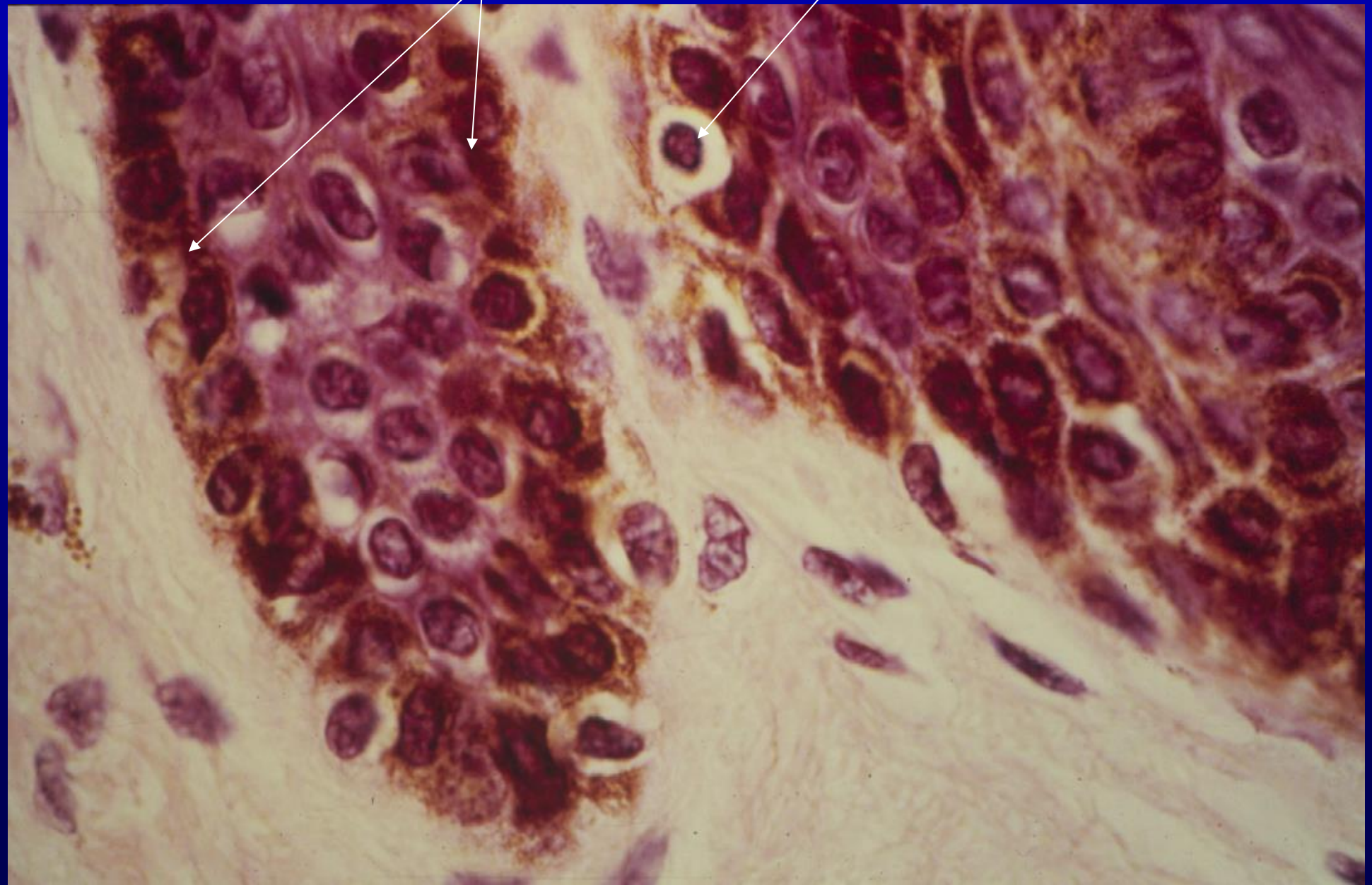
Melanin capping of nuclei

Capping of Melanin Granules in Keratinocytes in Stratum Basale

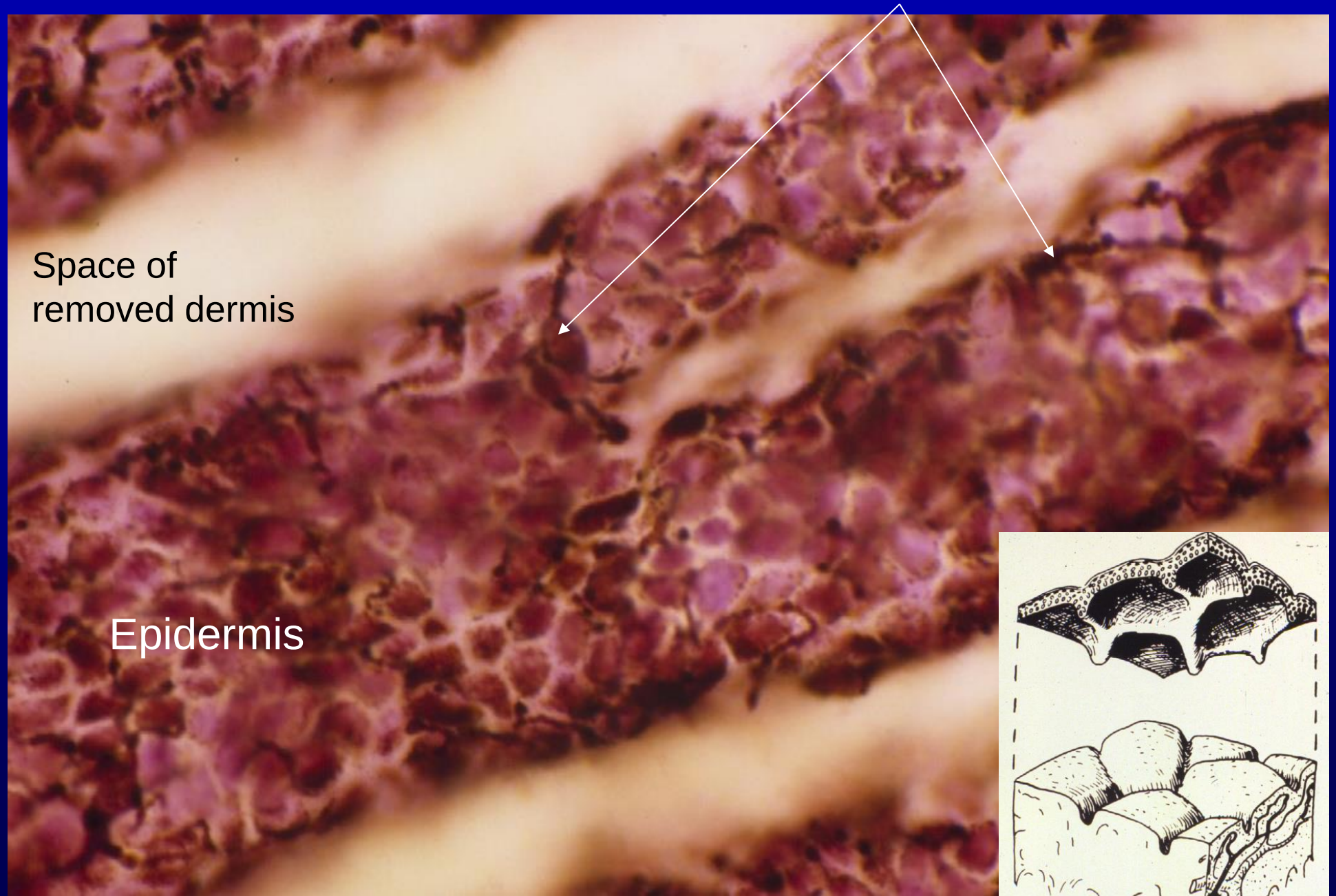


Capping

Melanin is produced by Melanocytes



Melanin-producing enzymes in Melanocytes



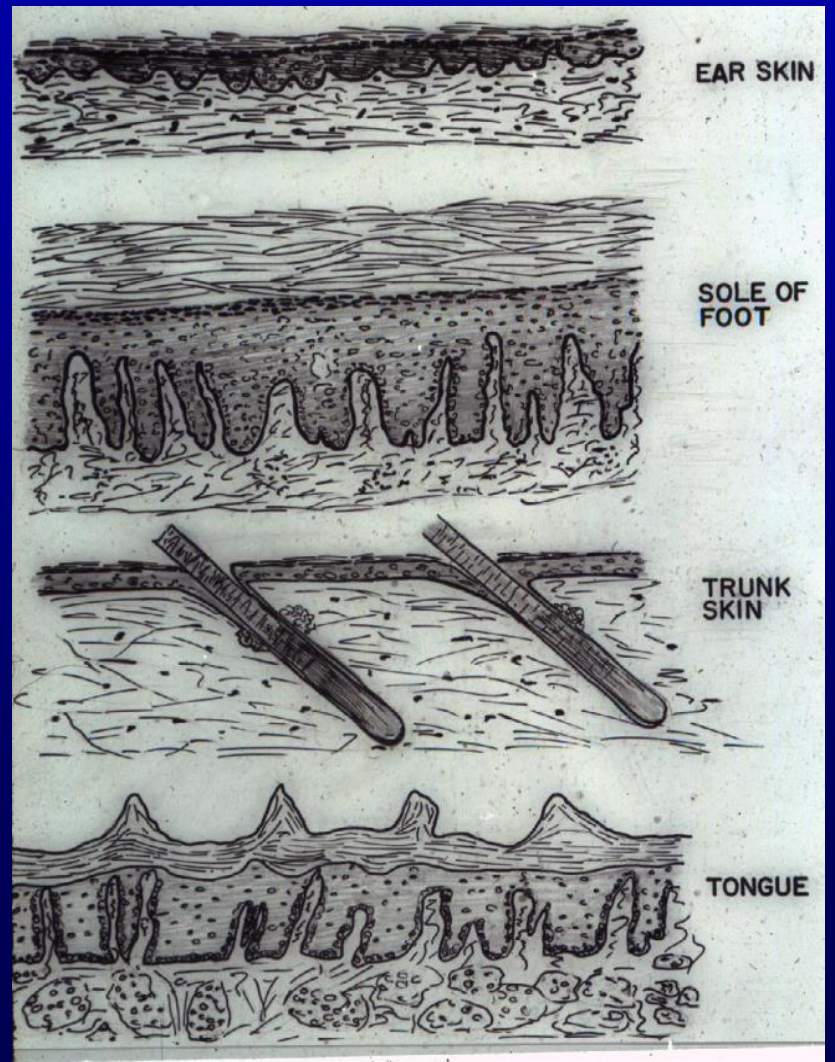
Regional Variation of the Epidermis

Thick skin - sole of foot (1.4 mm thick)

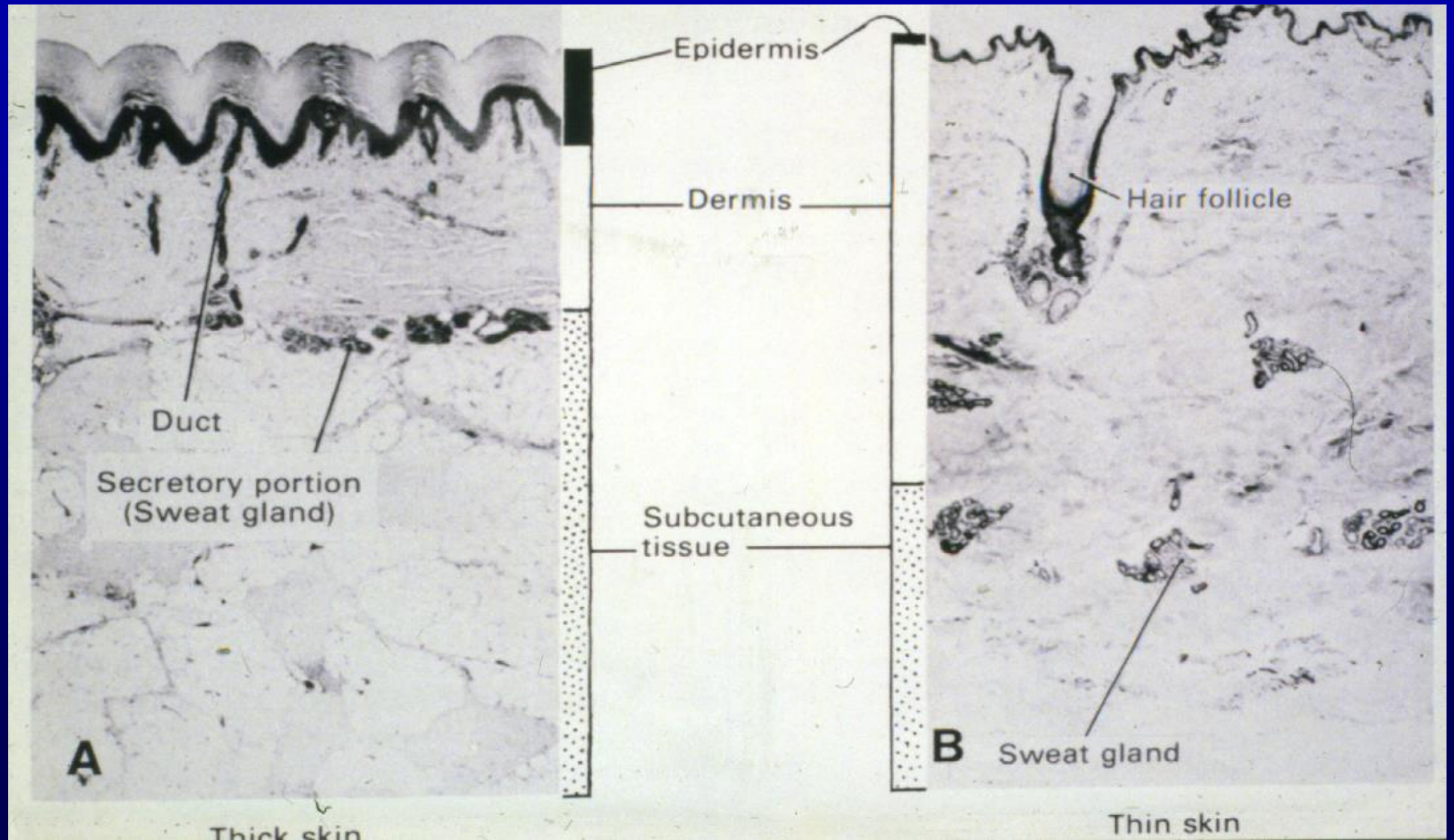
Thin skin - eyelid and most of body (0.07 to 0.12 mm)

Cornea of eye - transparent

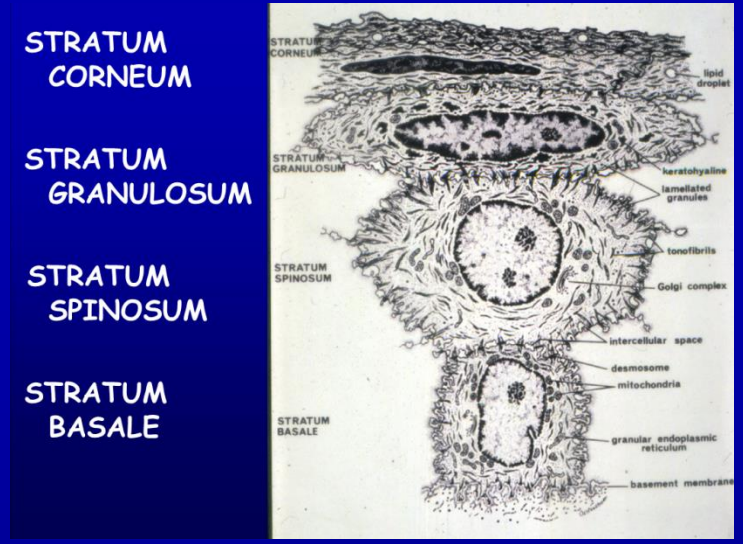
Appendages - hair follicles, nails, glands



Regional Variation of the Epidermis



Cells in Epidermis

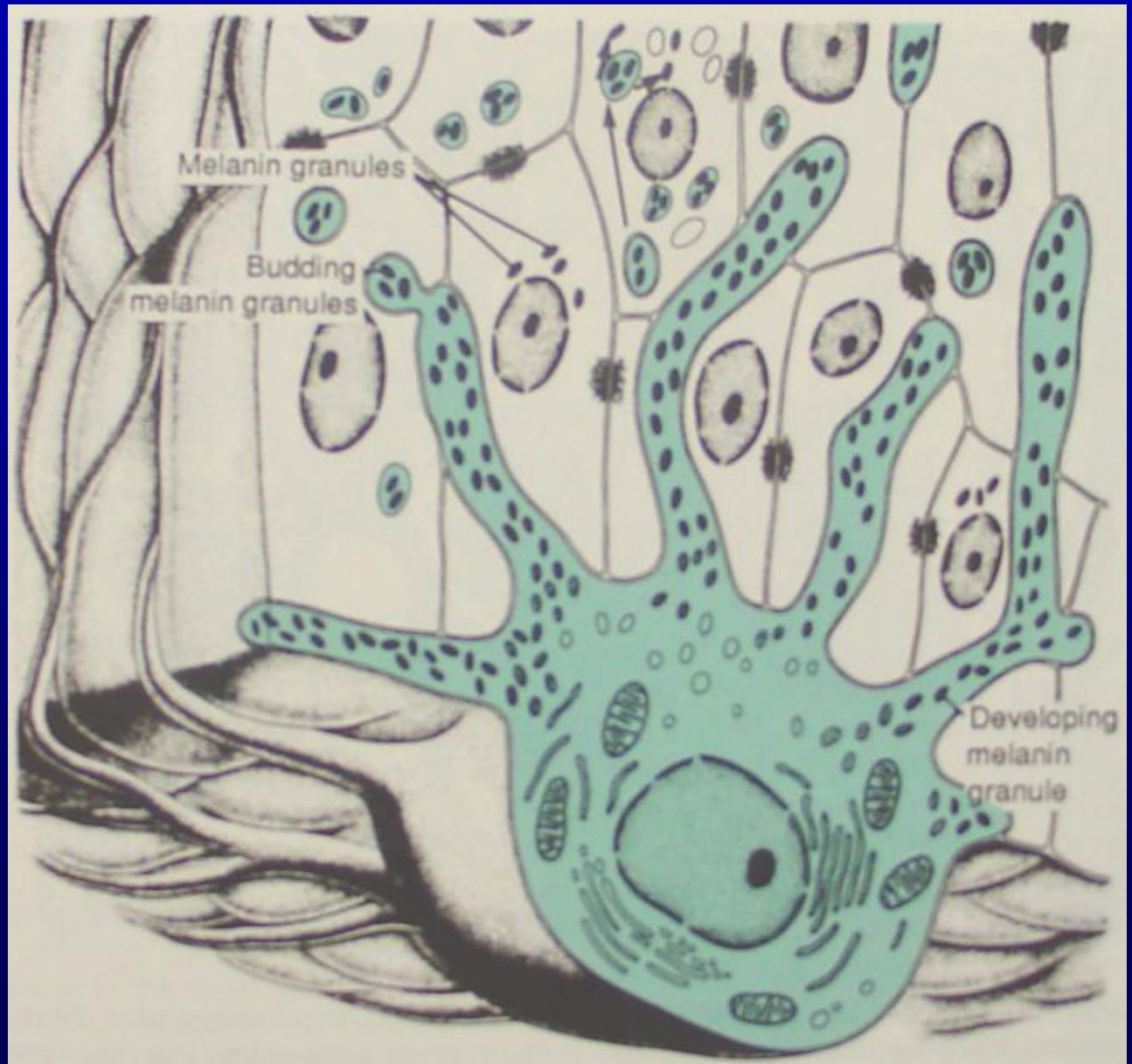


Stratified squamous - cell types include:

- **Keratinocytes - main cell type – ectoderm**
- **Melanocytes - pigmentation - neural crest**
- **Langerhans cell - immunologic role**
- **Merkel cells - associated with nerve endings**

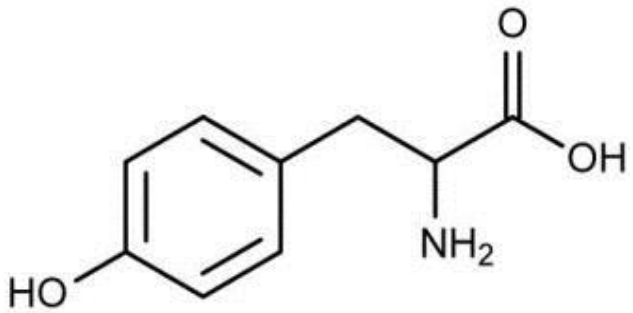
= Renewal of skin by cell division and differentiation

CYTOCRINE SECRETION - PASS MELANIN GRANULES FROM MELANOCYTES TO KERATINOCYTES



Clinical Correlation

Albinism can be caused by a hereditary defect in tyrosinase activity or the inability of cells to take up tyrosine.



Tyrosine amino acid figure

chemistry.about.com.

Patient with albinism would be more at risk for the development of **basal and squamous cell carcinomas** as albinism produces skin hypopigmentation so fewer melanin granules to protect nuclear DNA from the ionizing, mutagenic effects of UV radiation.

Albino peacock

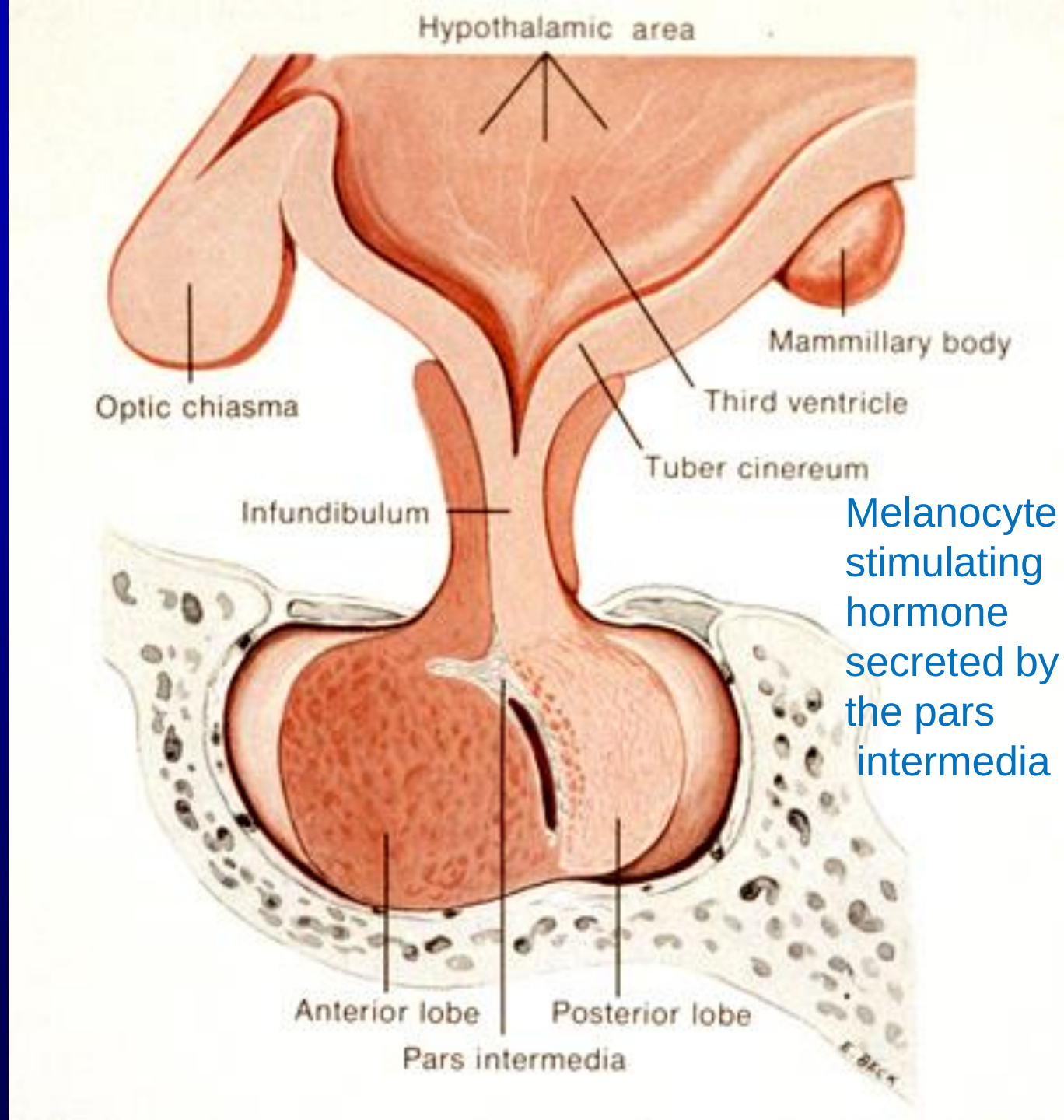
http://www.duskyswondersite.com/animals/albino-animals/

Melanocyte - pigment synthesis

Freckles - melanin distributed in patches

Melanocyte - pigment synthesis

Freeze branding in cattle



Melanocyte stimulating hormone secreted by the pars intermedia

Melanocyte – disease states

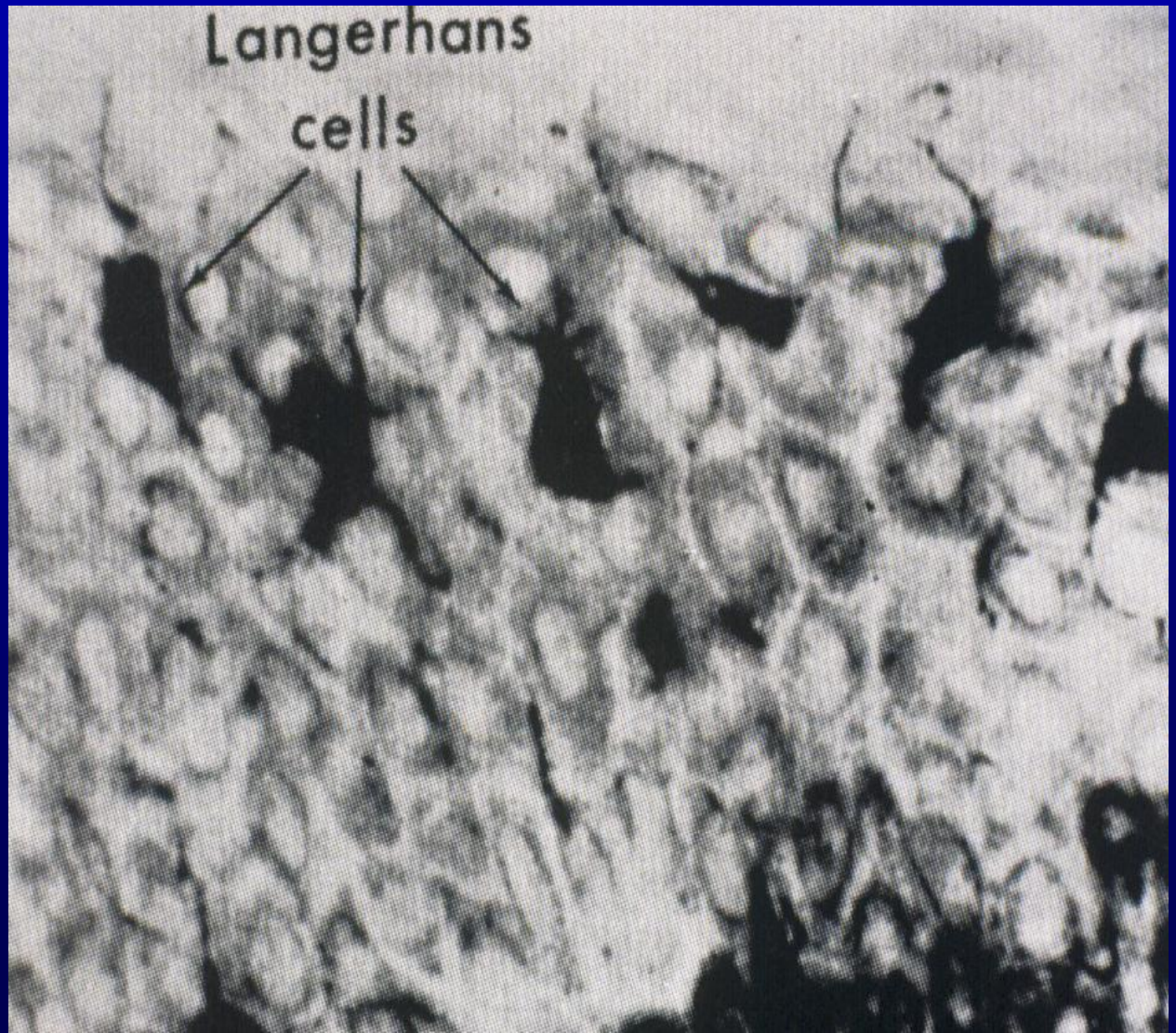
Albinism - failure to produce melanin

Malignant melanomas - cancer

Addison’s disease - pigment deposition in skin due to adrenocortical insufficiency

Langerhans cells

- Bone marrow origin
- Located in stratum spinosum - gold chloride stain
- Clear cell - no desmosomes
- Dendritic cell



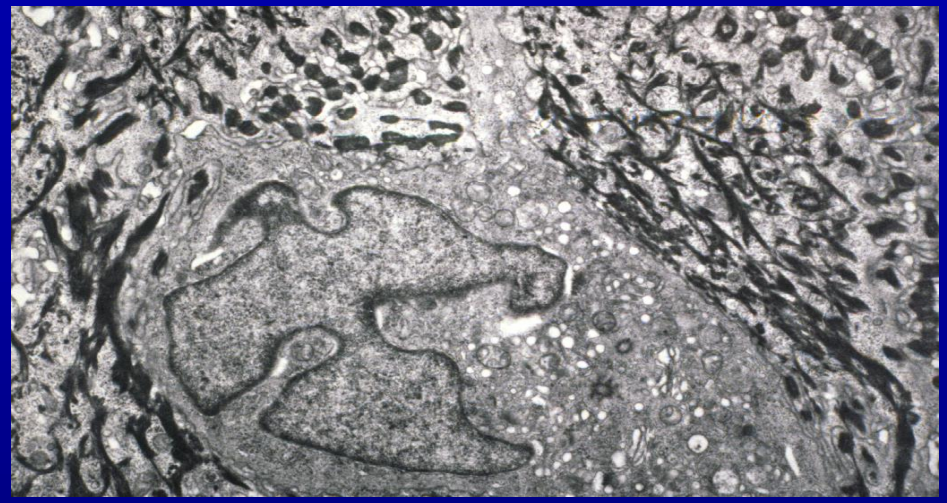
Langerhans cells

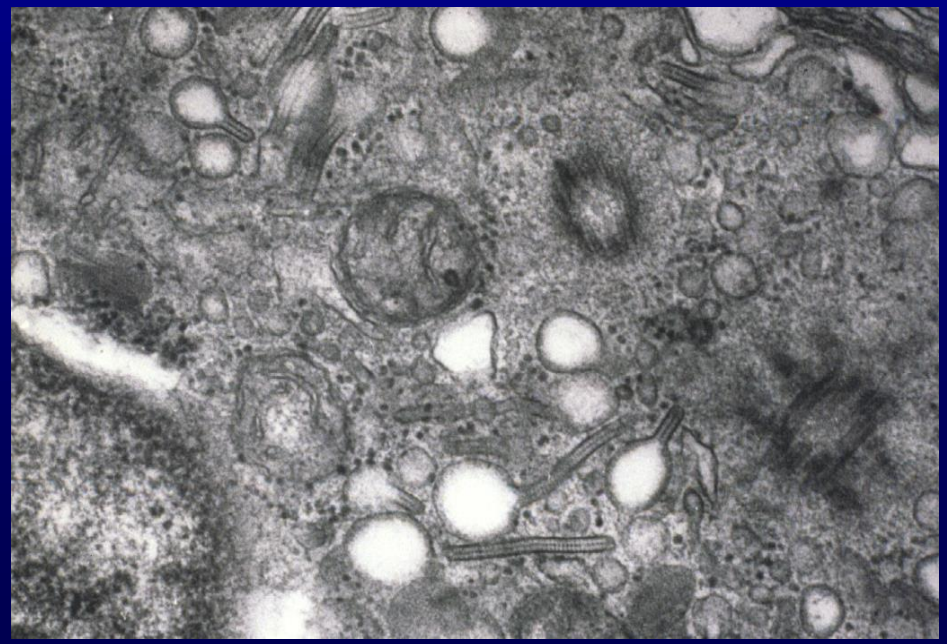
Dendritic cell

Rod or racket shaped granules

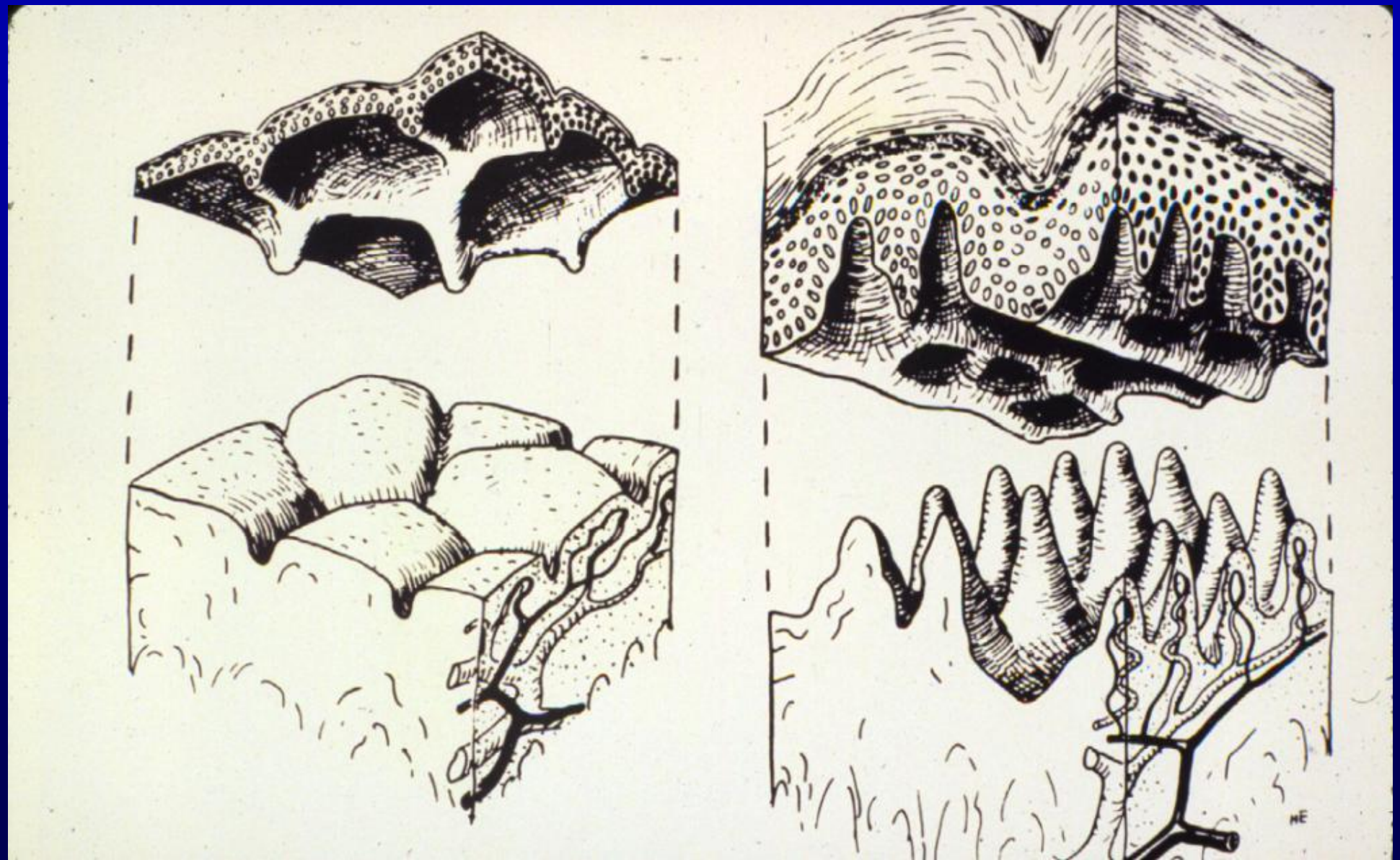
Function - immunologic role as an antigen-presenting cell

Contact allergic responses and other cell mediated reaction of the skin





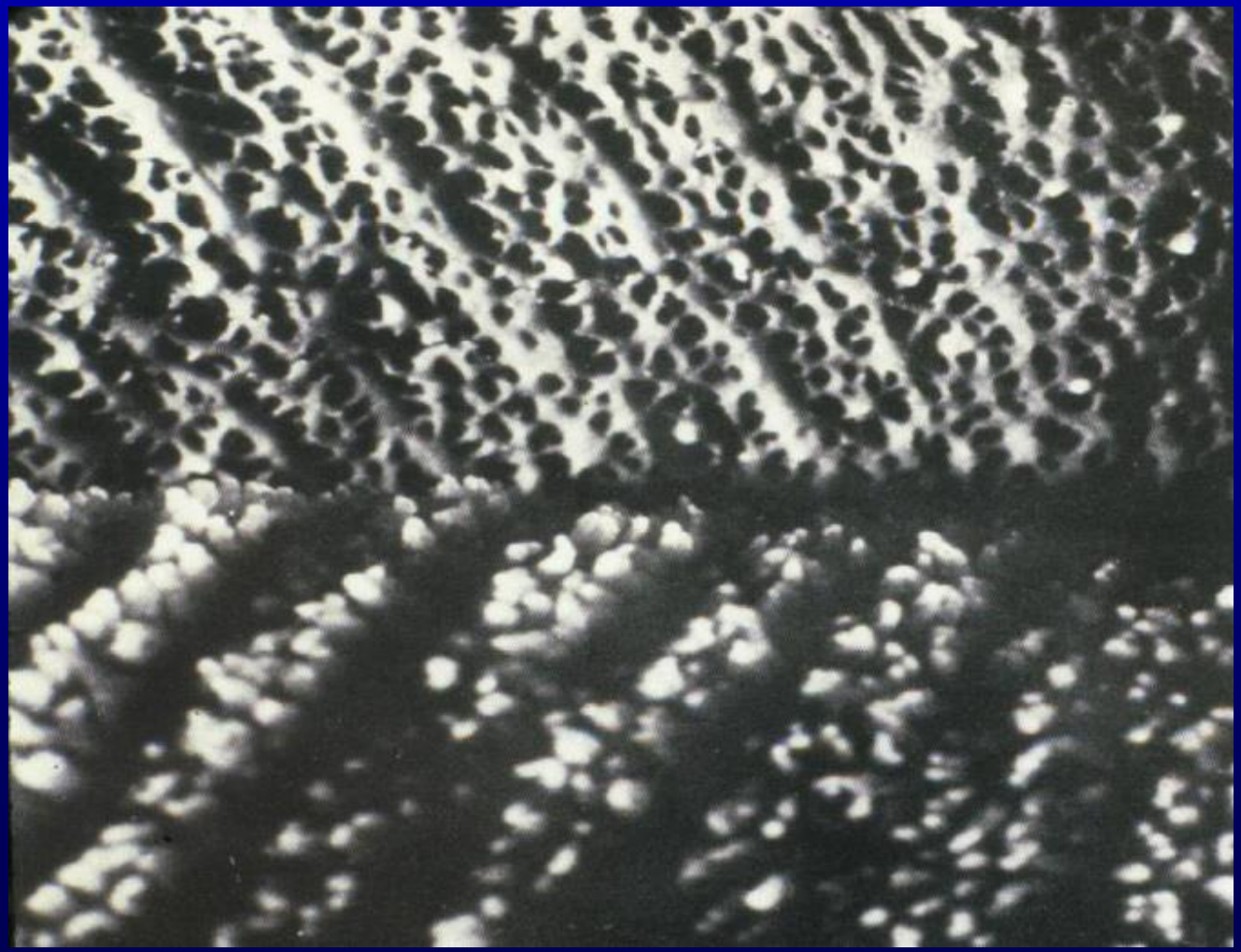
Epidermal – dermal interface



Epidermal – dermal interface

Epidermis

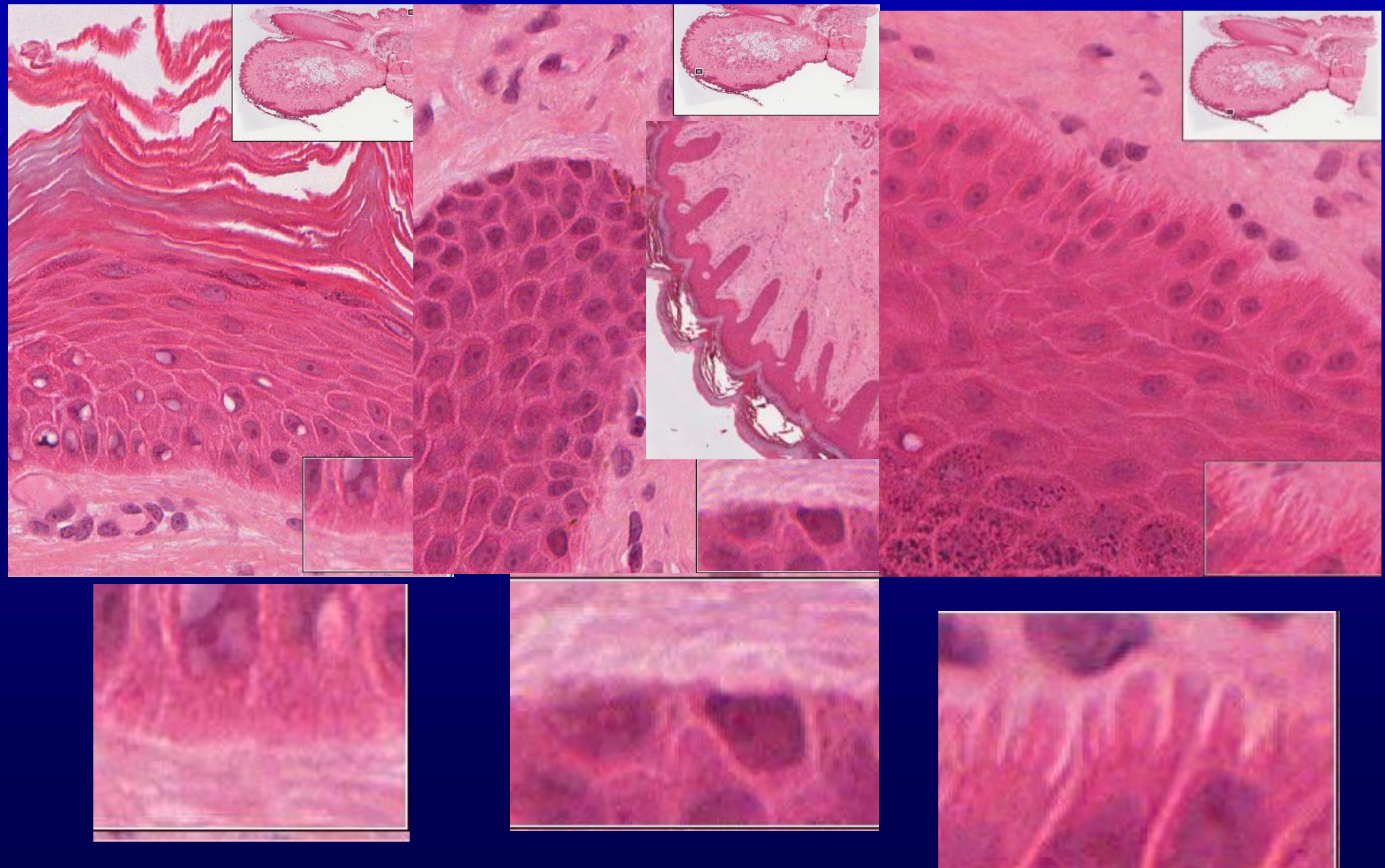
Rete pegs
of epidermis



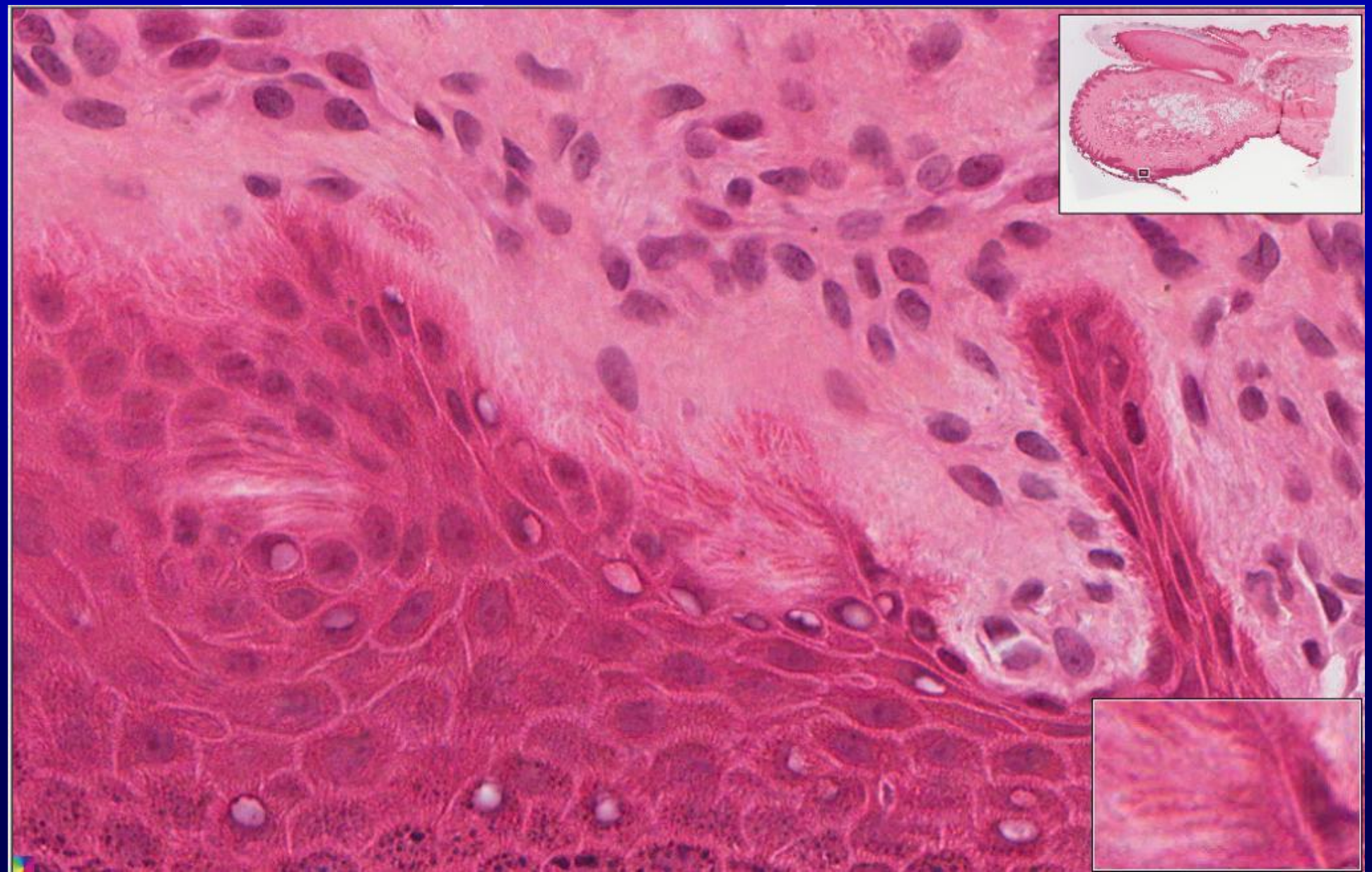
Dermal papillae

Dermis

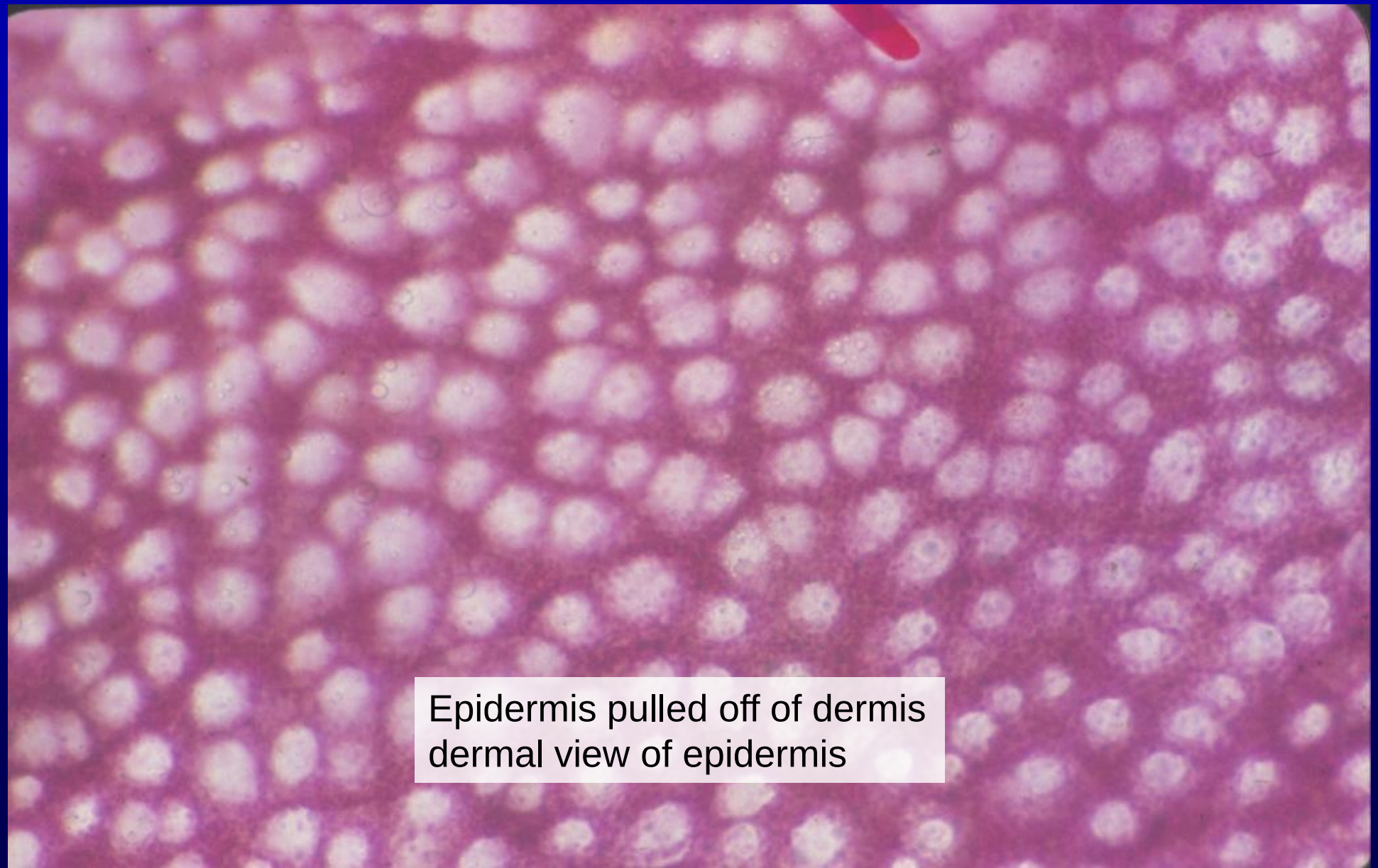
Epidermal – dermal interface



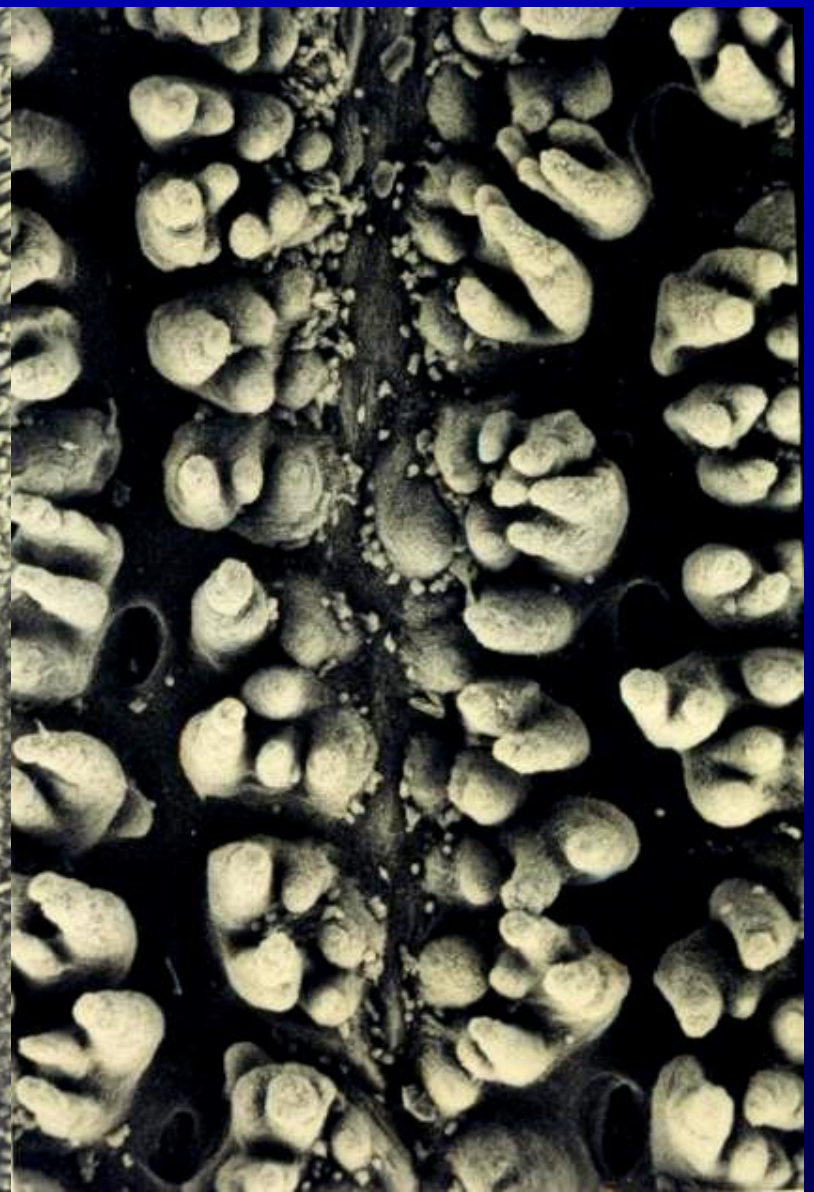
Epidermal – dermal interface



Epidermal – dermal interface

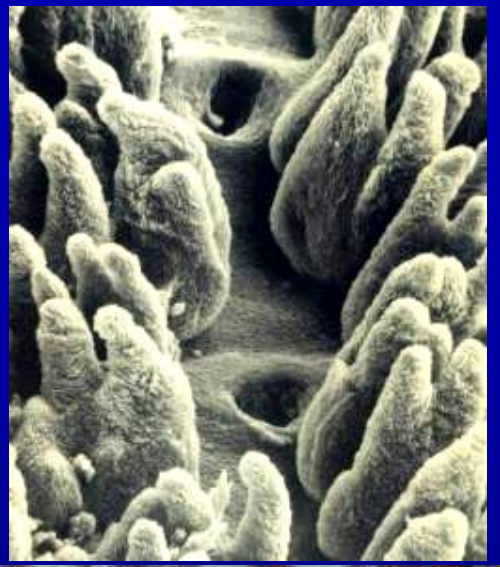


Epidermal – dermal interface - finger pad



Dermis

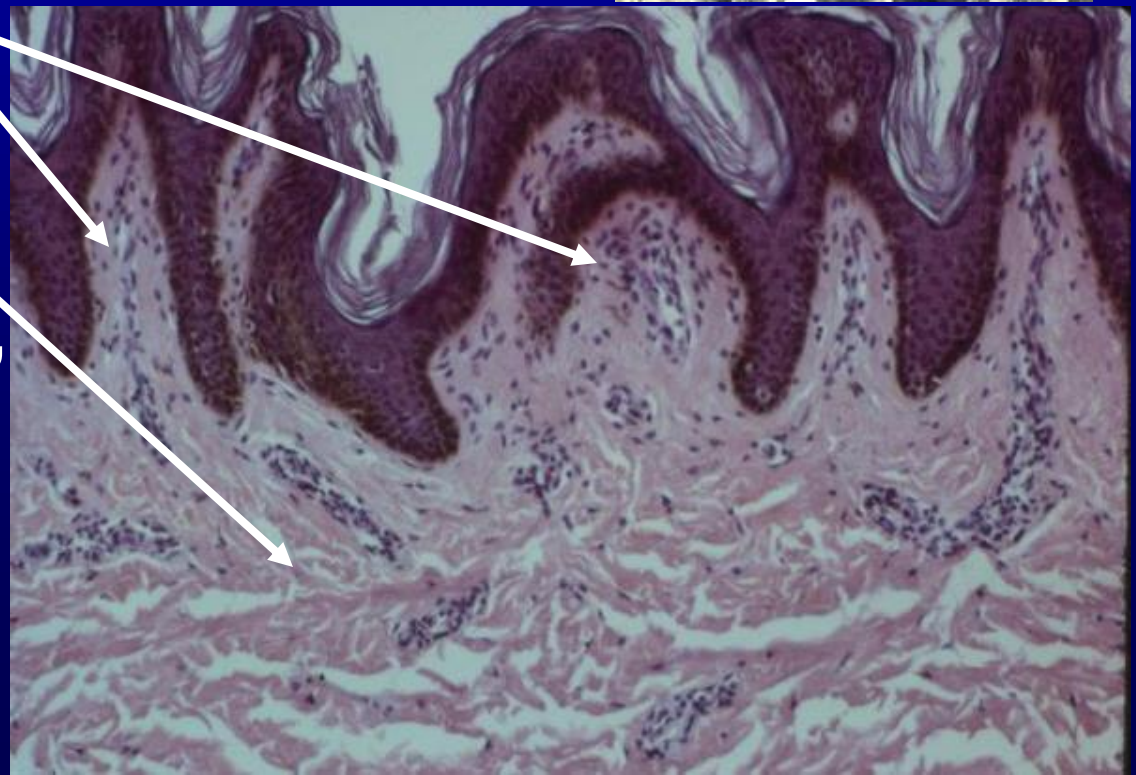
PAPILLARY LAYER



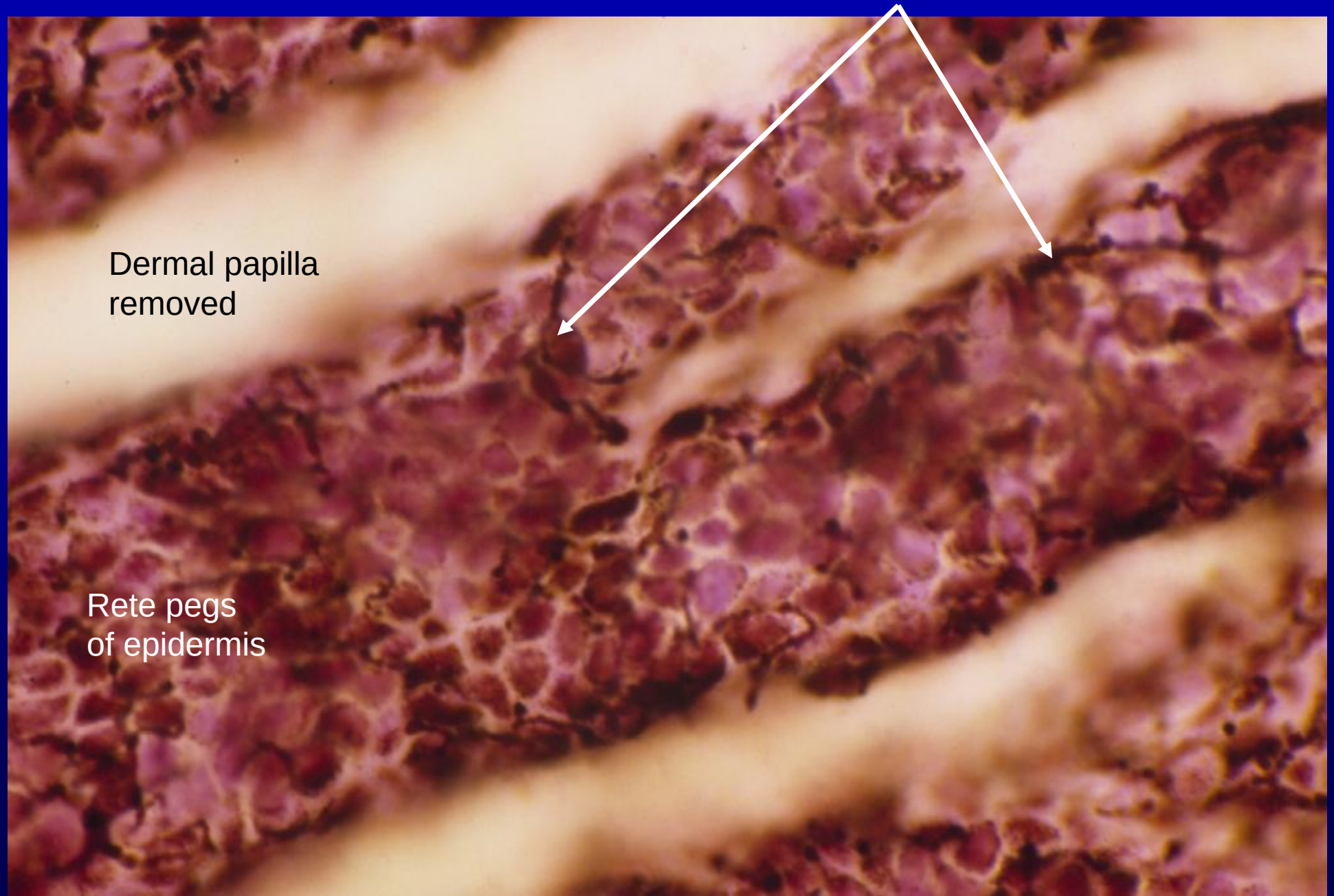
Two layers”

Papillary layer - sculptured layer of dermis

Reticular layer - deeper main portion of dermis, rather dense irregular CT



Melanin-producing enzymes in Melanocytes

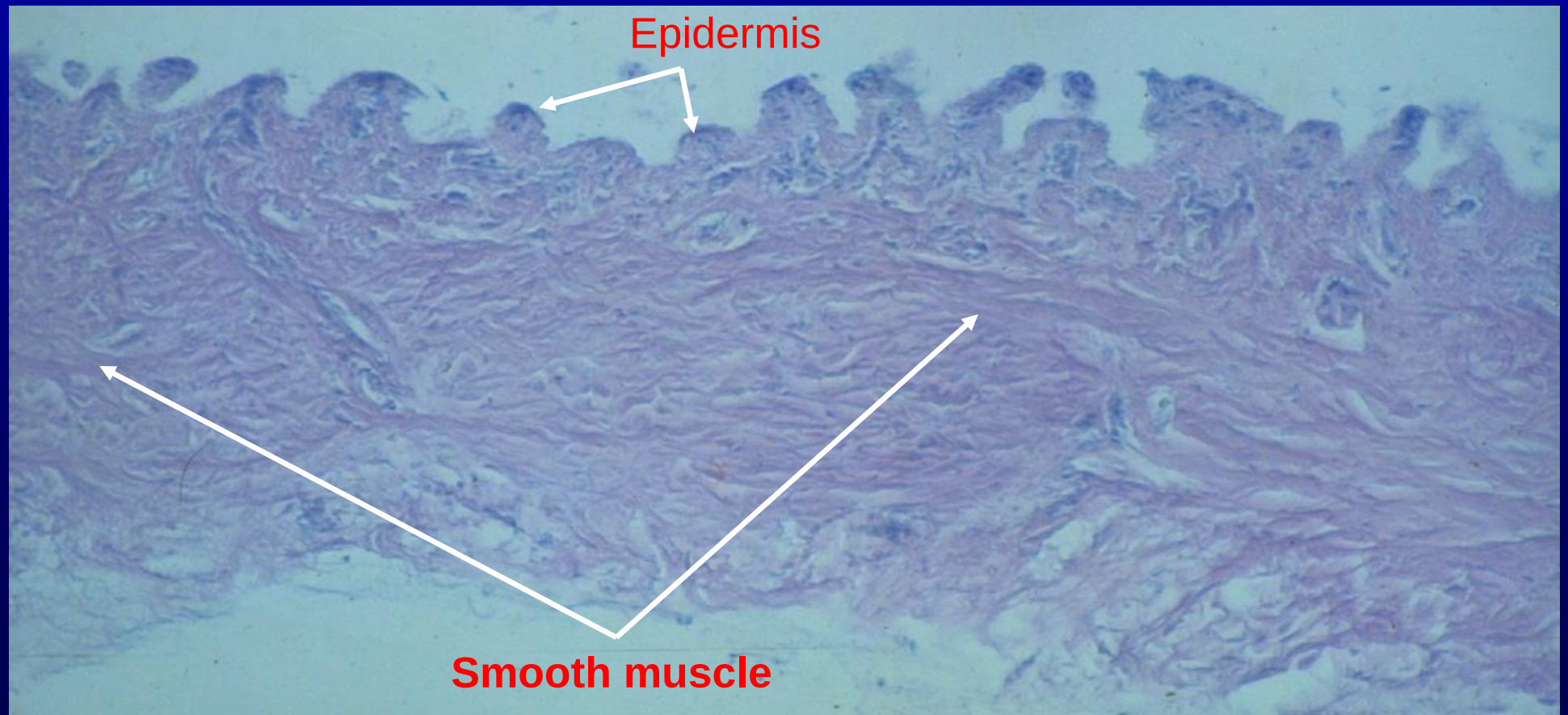


Dermis

Elastic fibers

- Network between collagen bundles muscle

Smooth muscle - loose plexus in reticular layer in areolae, penis, perineum, and scrotum



Dermis

Muscle

Skeletal muscle - terminated in the dermis

- Facial expression

Dermis

Muscle

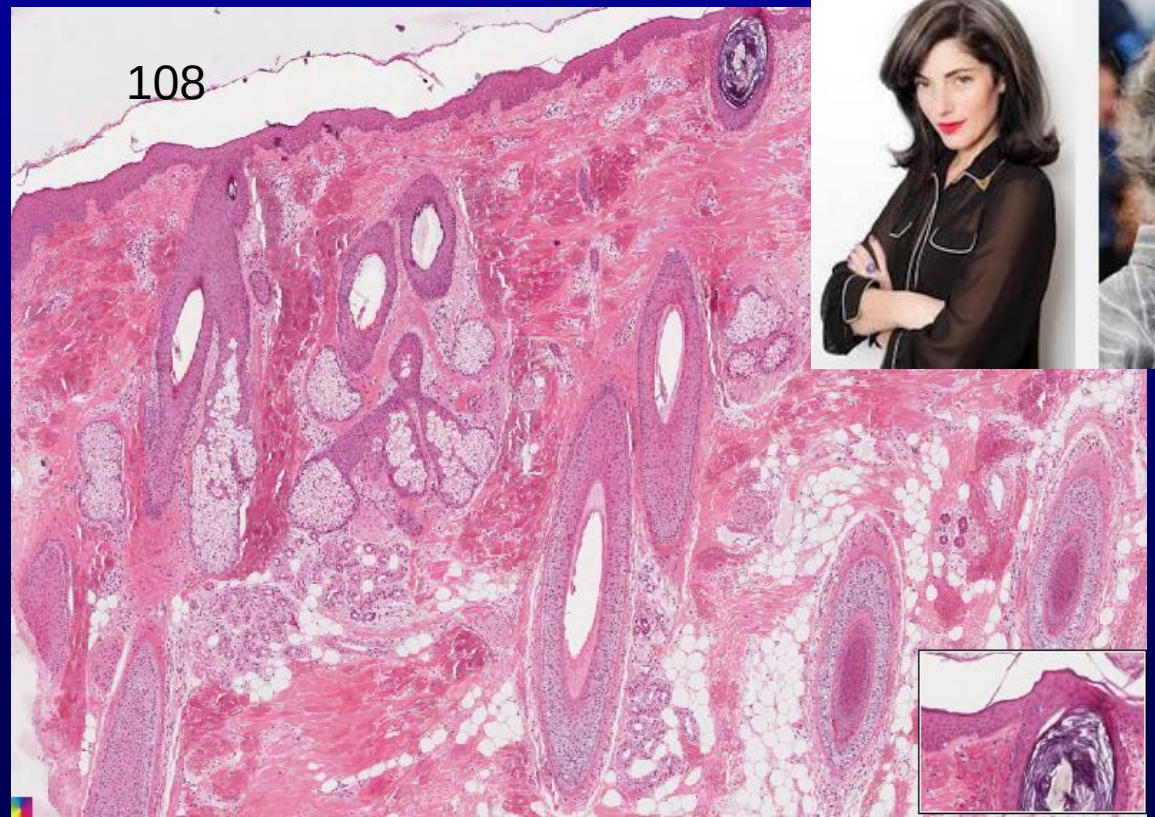
Skeletal muscle - terminated in the dermis

- Facial expression

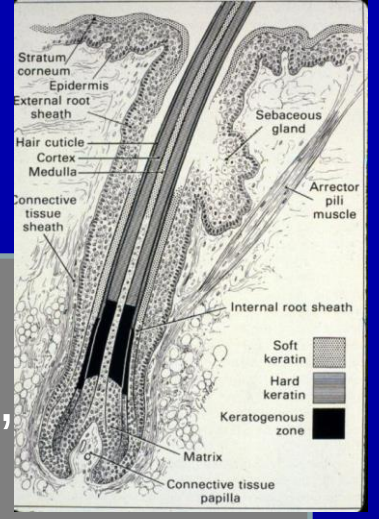
Cutaneous appendages

Hair

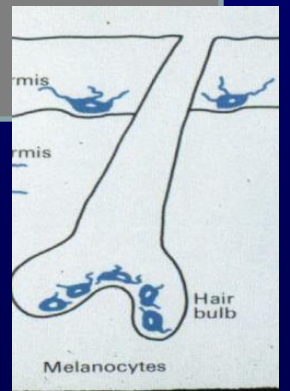
- **Follicles**
- **Pigmentation**
- **Graying**



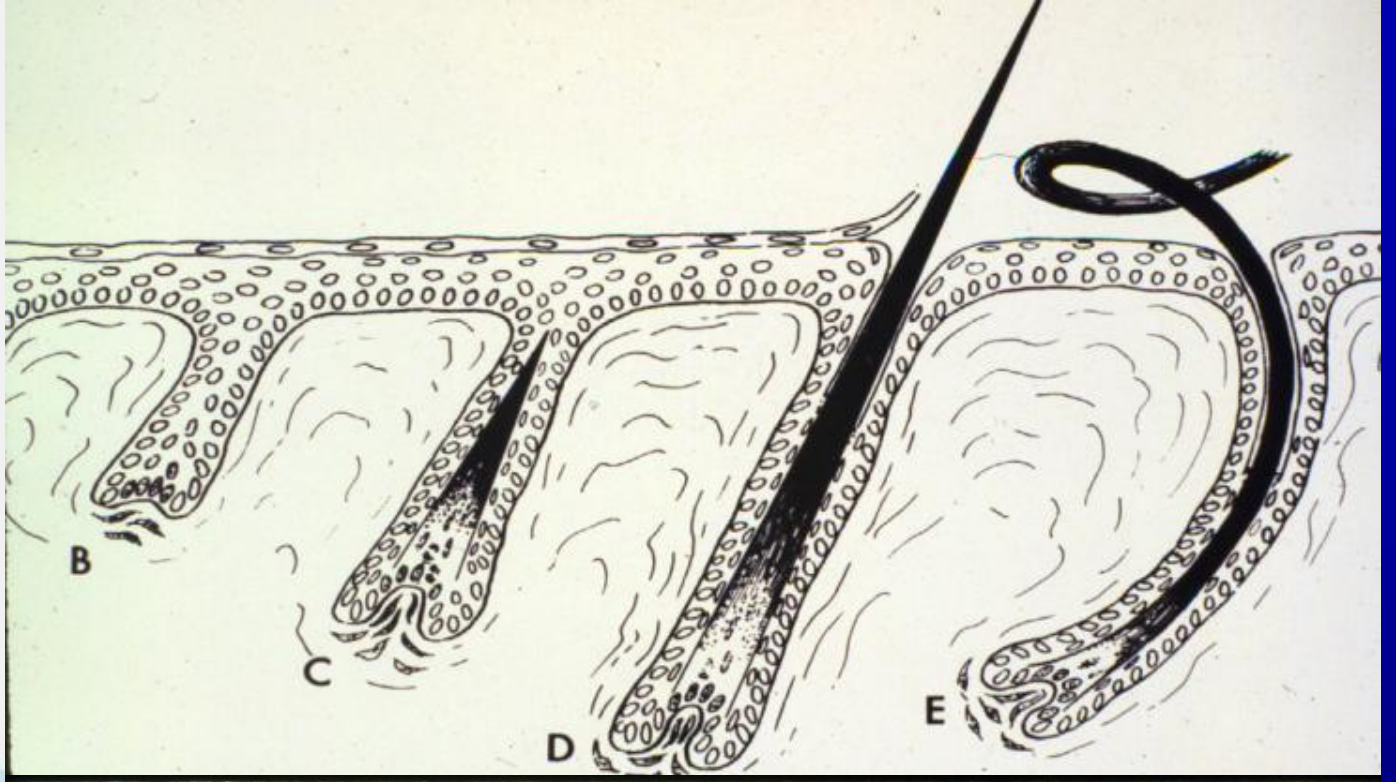
Hair Graying with age



Every hair follicle contains pigment cells called melanocytes. The melanocytes produce eumelanin, which is black or dark brown, and pheomelanin, which is reddish-yellow, and pass the melanin to the cells which produce keratin, the chief protein in hair. When the keratin-producing cells (keratinocytes) die, they retain the coloring from the melanin. When you first start to go gray, the melanocytes are still present, but they become less active. Less pigment is deposited into the hair so it appears lighter. As graying progresses, the melanocytes die off until there aren't any cells left to produce the color.



Http://chemistry.About.Com/od/howthingsworkfaqs/f/why-does-hair-turn-gray.Htm


B
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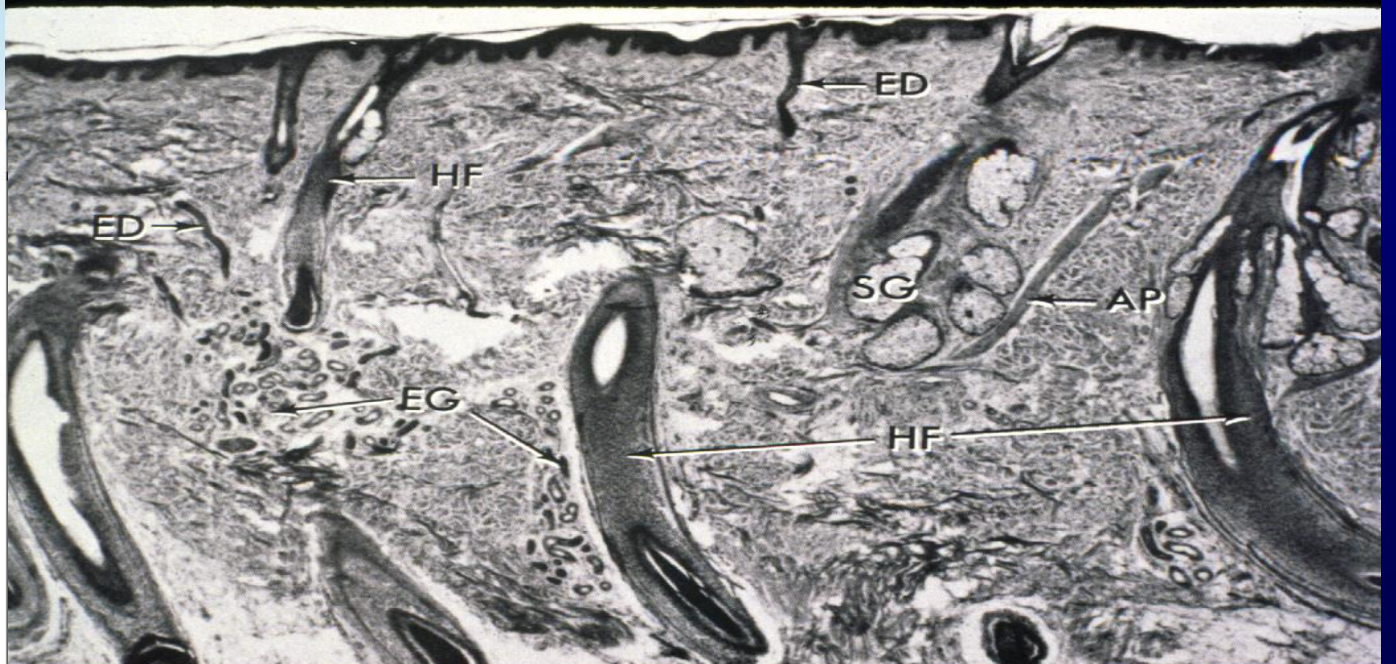
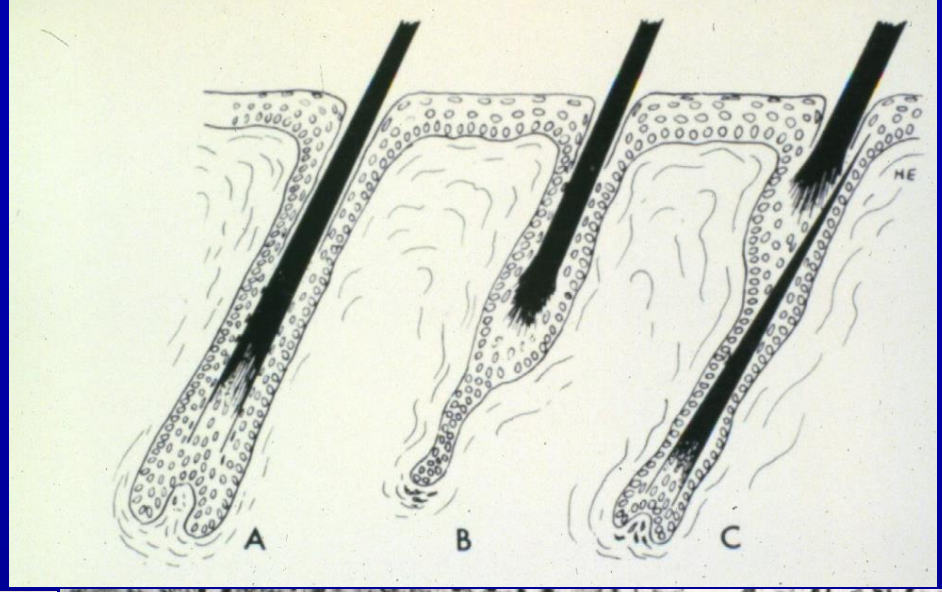
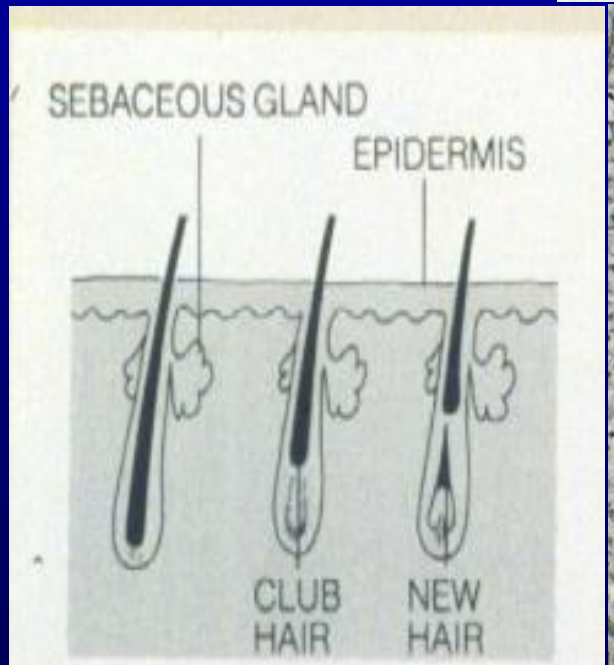
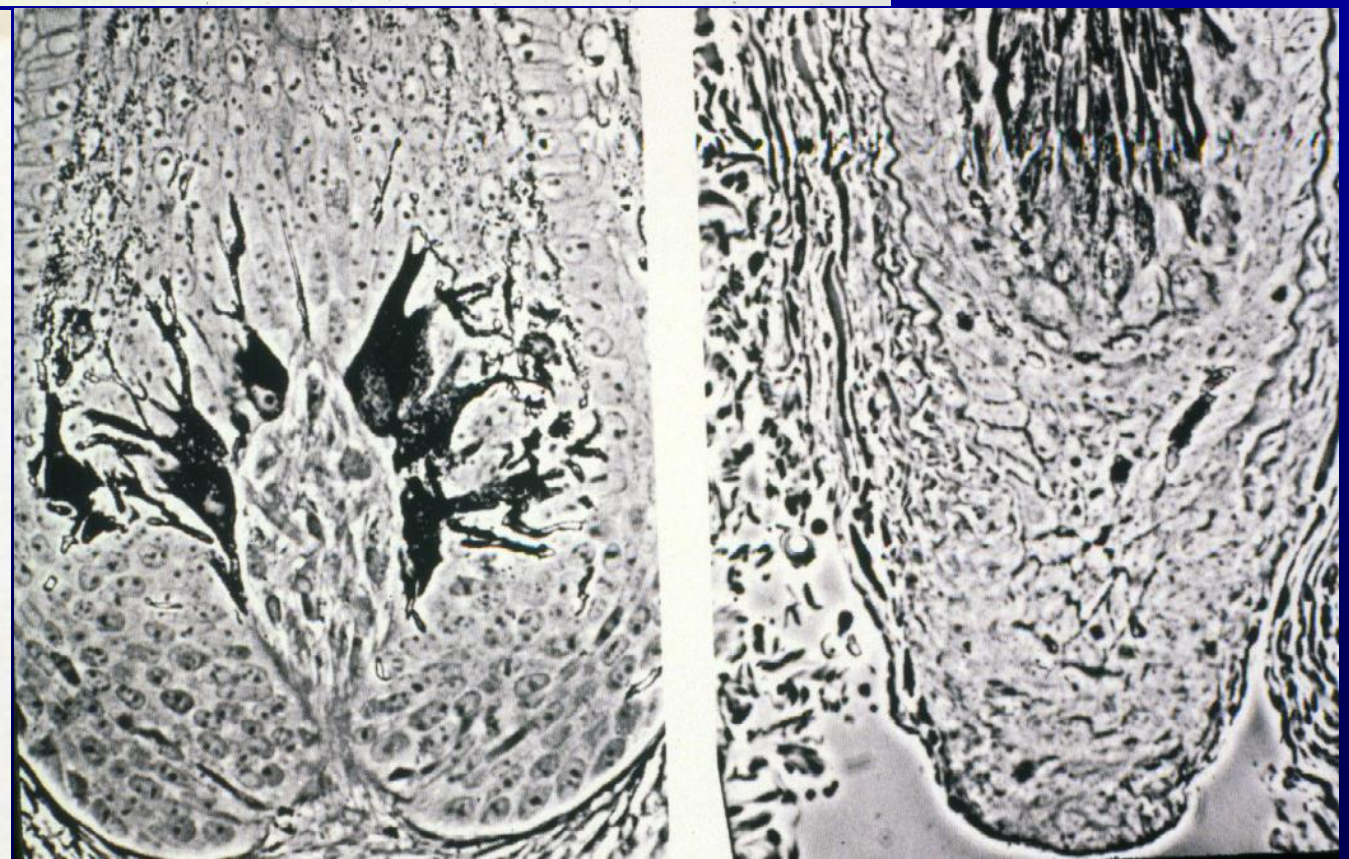

ED
HF
ED
SG
AP
EG
HF

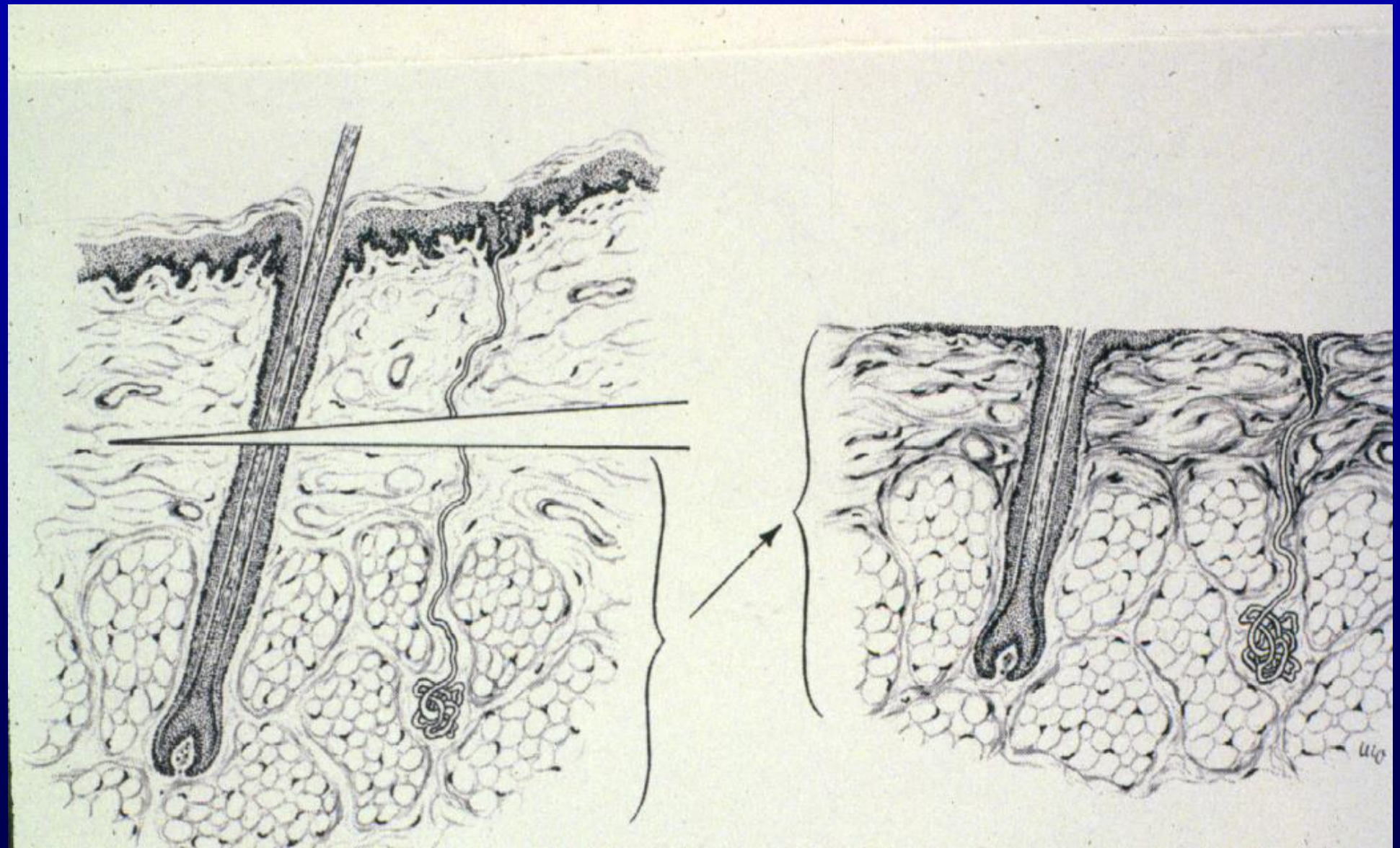




A hair lives for several years. The follicle rests for months, then produces another hair.



Regeneration of epidermis



Degrees of Burn, Methods of Treatment

The three burn categories correspond to the three layers of skin. A first-degree burn damages only the outer layer, the epidermis. A second-degree burn penetrates deeper, into the dermis. Capillaries may be damaged, and plasma may escape to produce blistering—and great pain. In third-degree burns, the damage reaches the subcutaneous layer. This kind of burn is dangerous because the slow-healing underskin is vulnerable to bacterial attack. Loss of blood may impede circulation and cause dehydration.

First-degree burns, such as scalds, affect the outer skin and heal by themselves. Cold water gives relief.

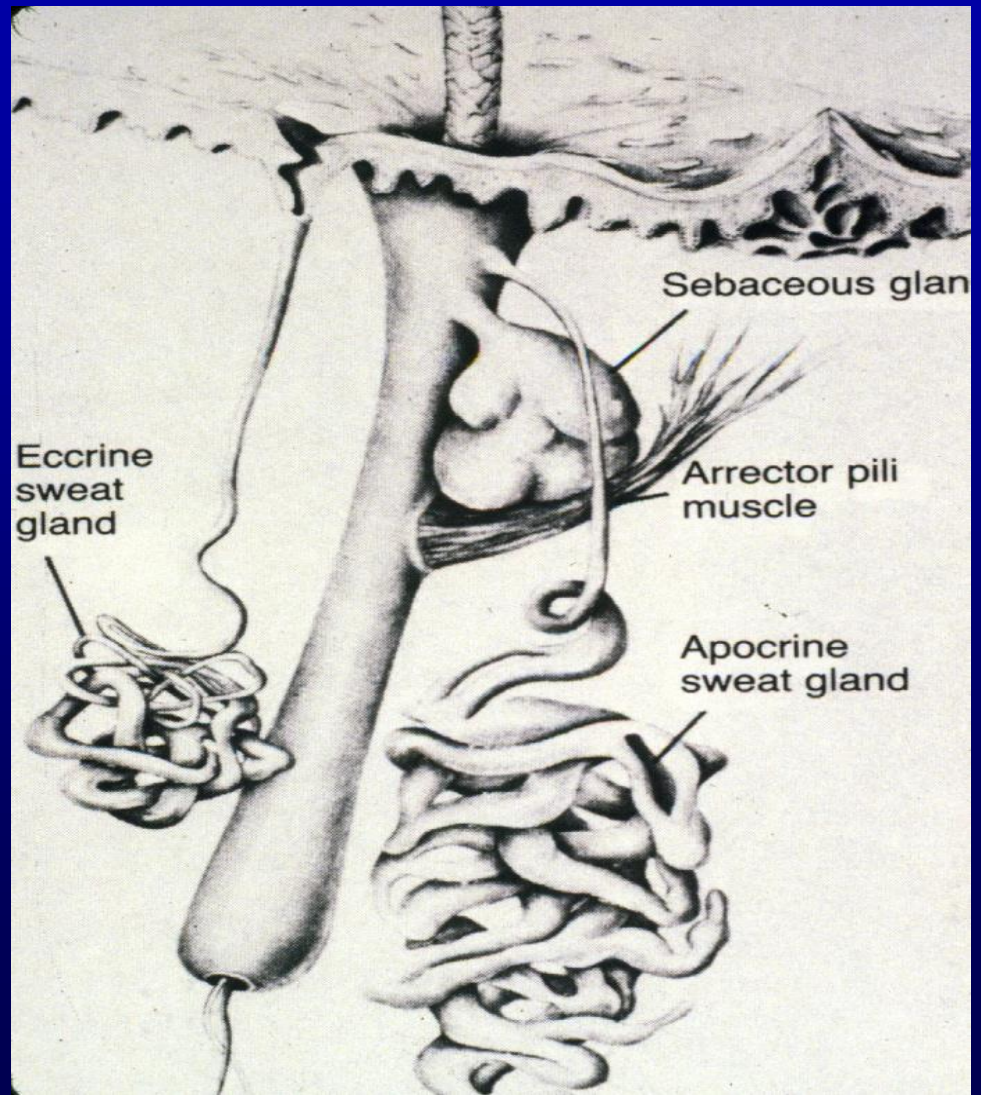
Second-degree burns damage the lower layer. If blisters are unbroken, they protect the injured area.

Third-degree burns, which go into the subcutaneous layer, should receive immediate medical attention.

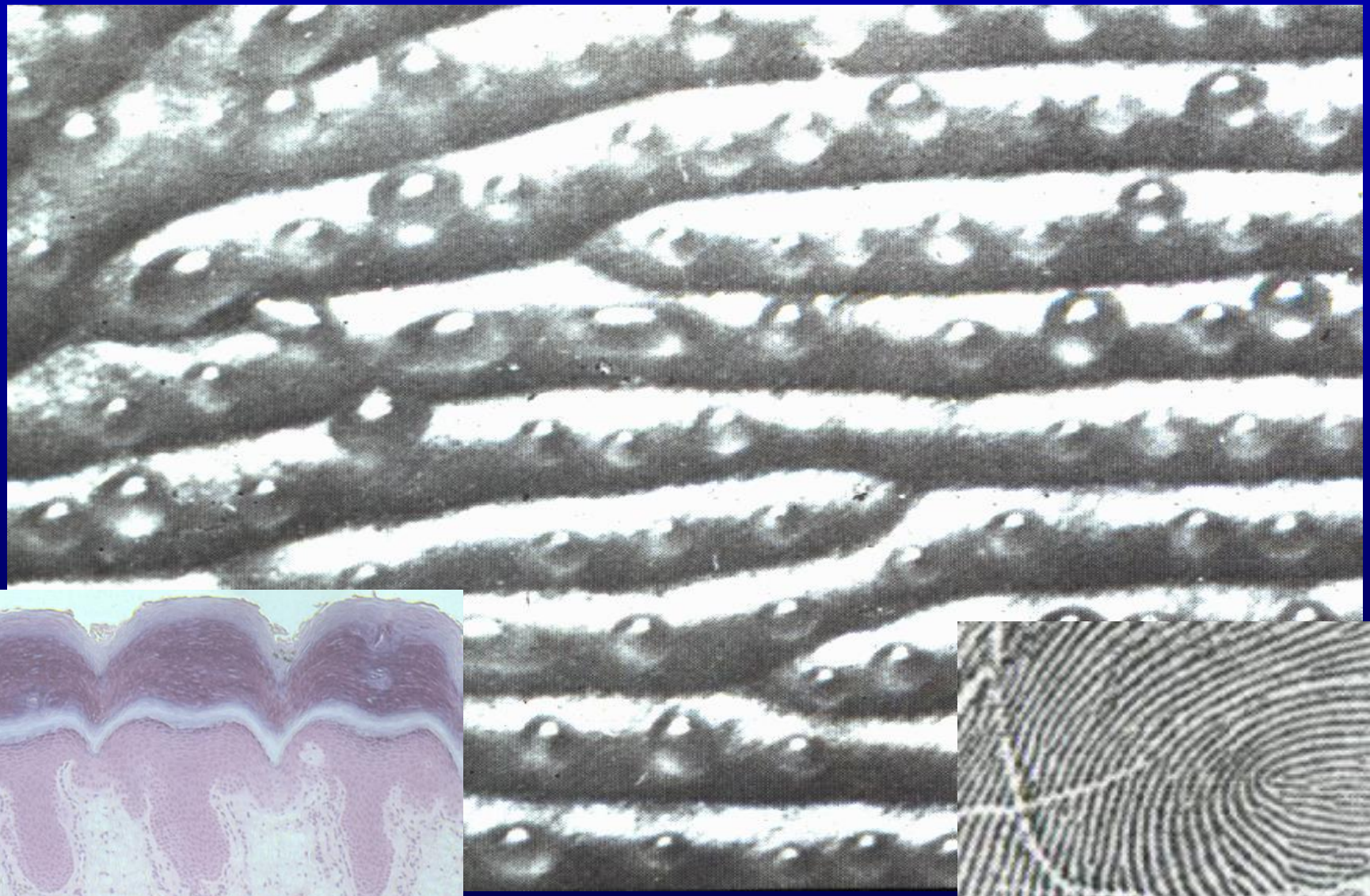
Glands of epidermal origin

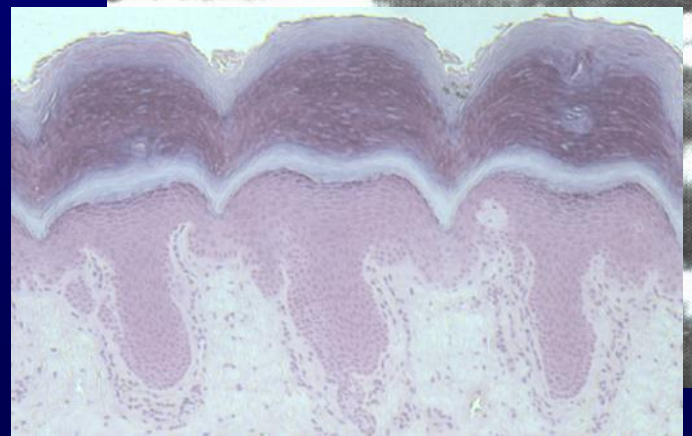
Sweat glands

- **Eccrine: common sweat gland - local cooling**
- **Apocrine axillary region: function in animals**



Sweat Gland Secretions

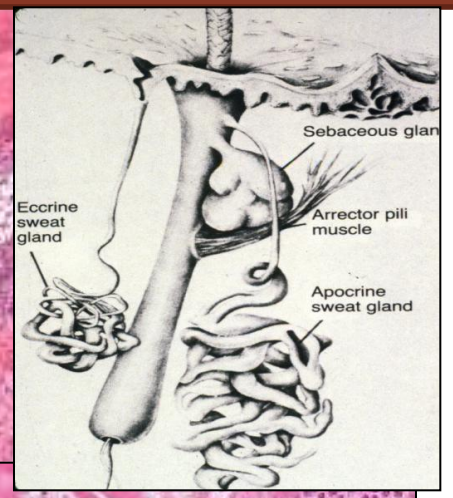




Human Skin, scalp 108

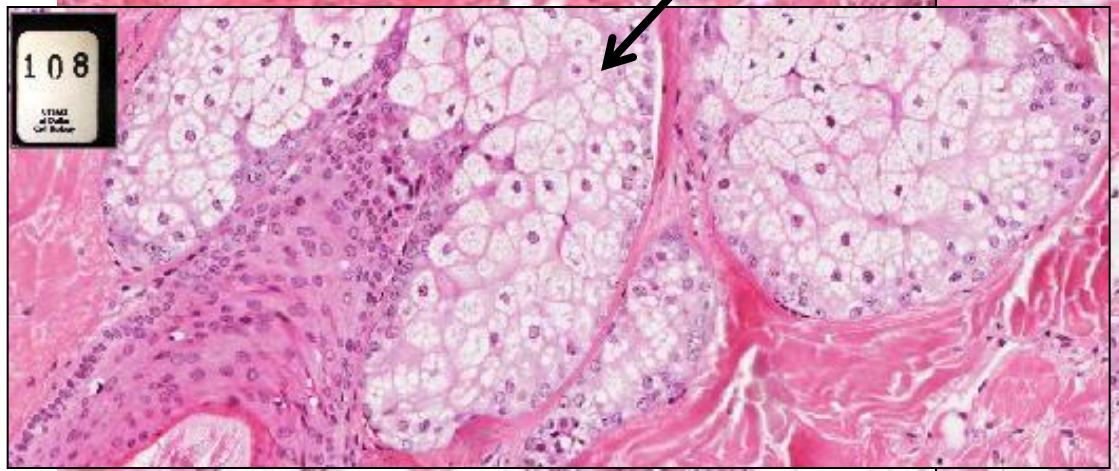
Skin, scalp

Mode of secretion of the sebaceous glands is holocrine where by the sebum is released when cells burst.

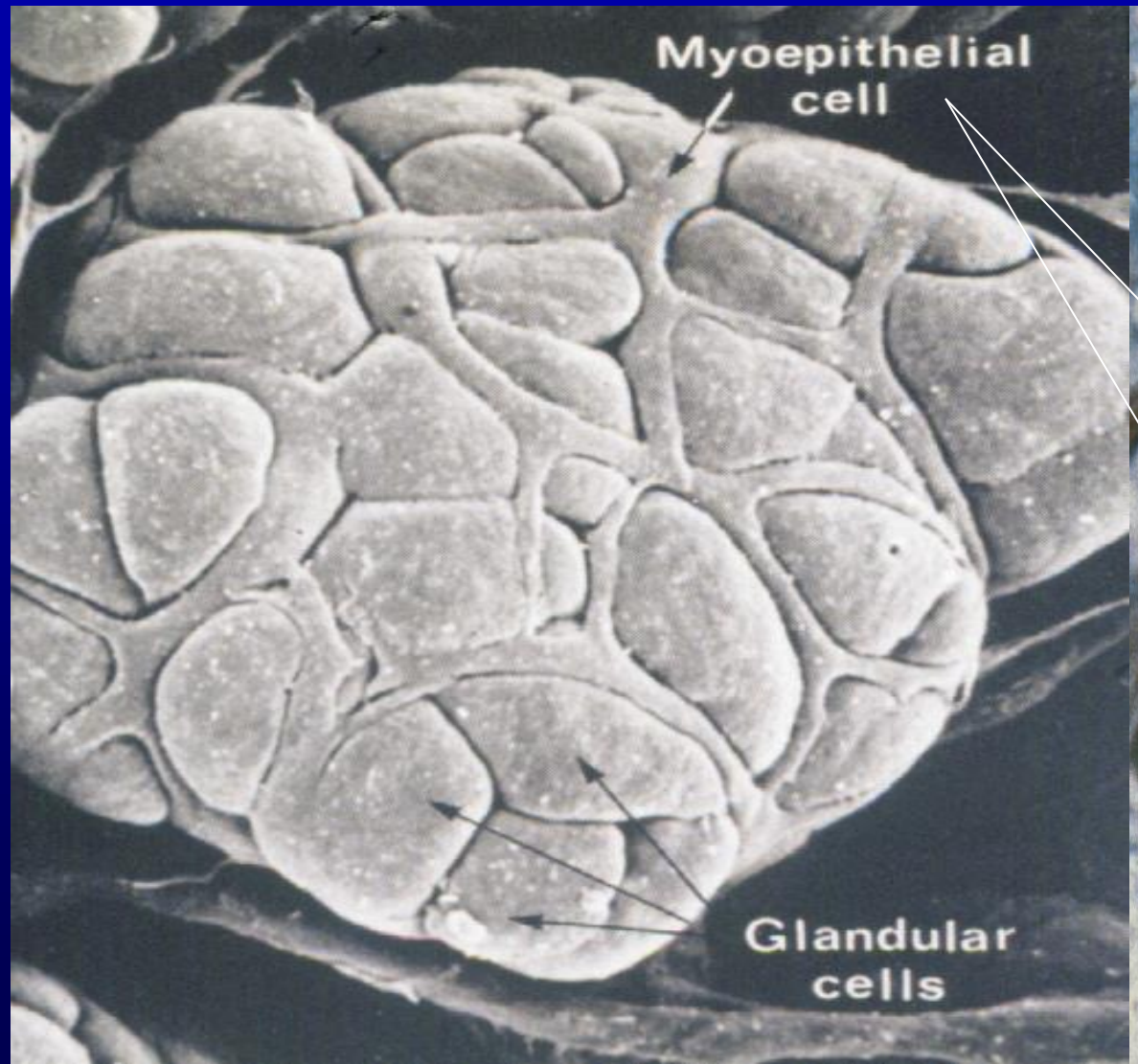


sebaceous glands

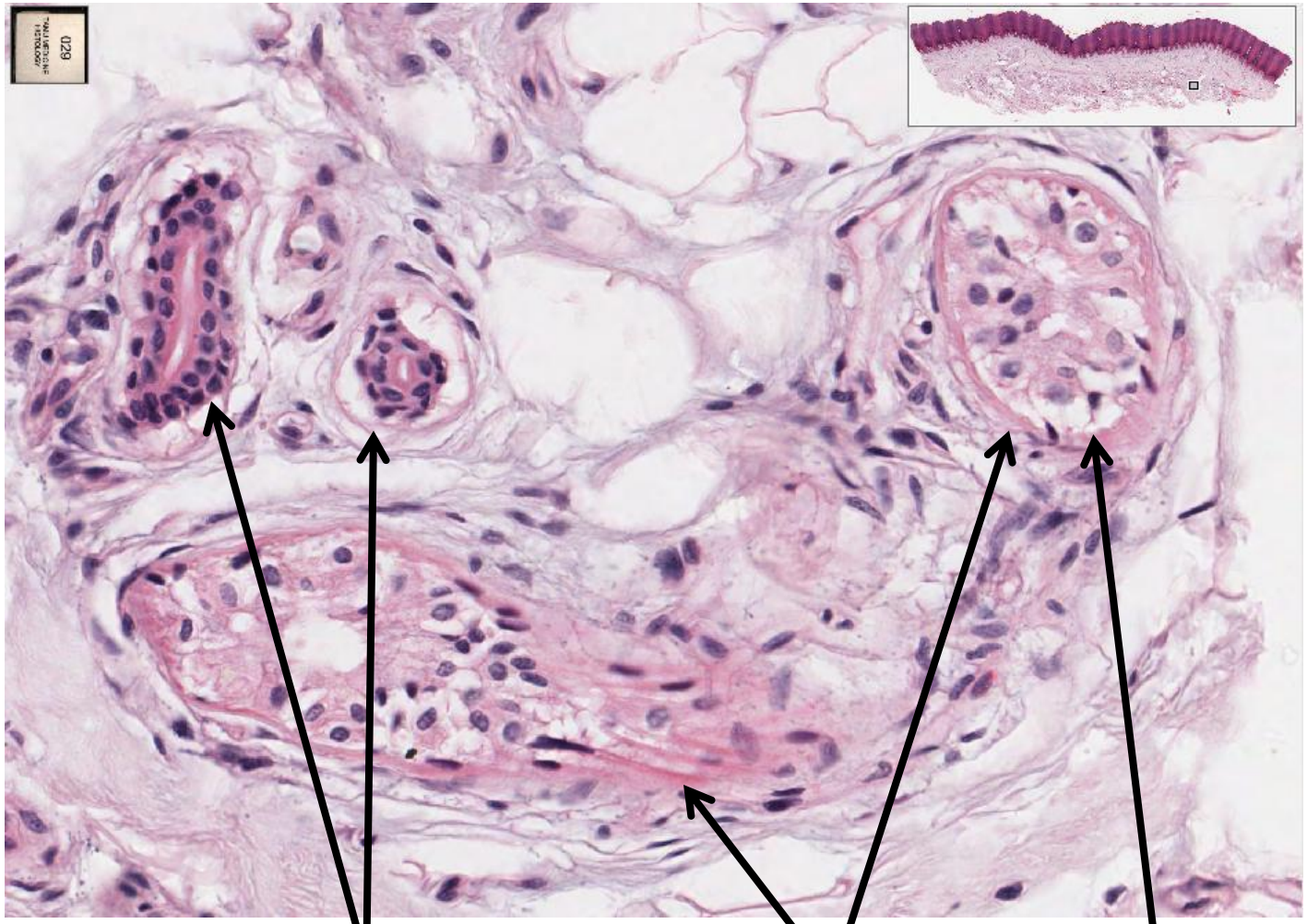
Eccrine sweat glands



Sweat Glands

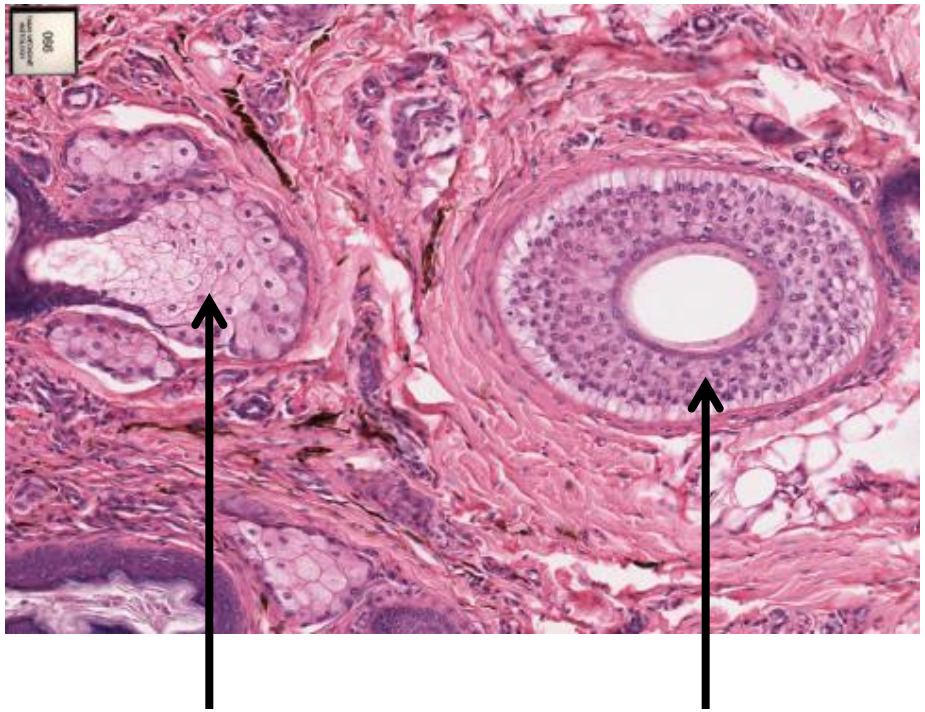


Slide 29: Thick Skin (ventral surface of finger)



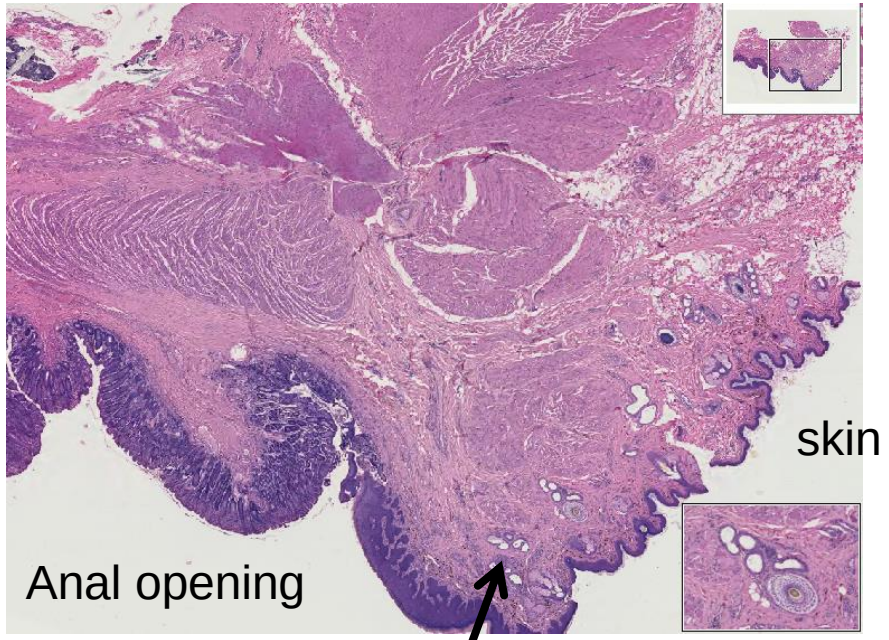
Myoepithelial cells are eosinophilic because of the presence of muscle contractile proteins, which contract to expel sweat when needed.

Slide 66: Recto-anal junction



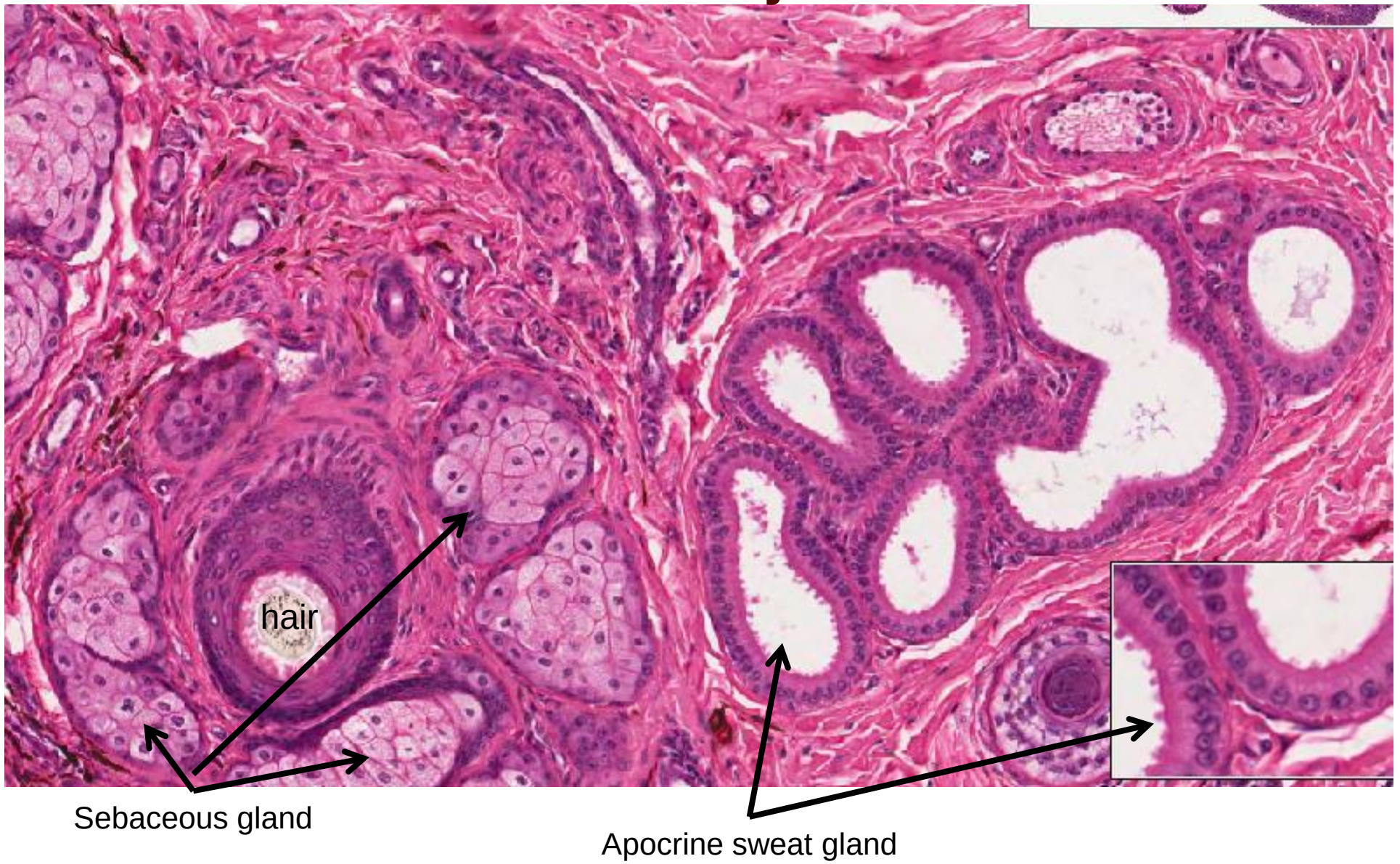
Sebaceous gland

Hair follicle



Apocrine sweat gland

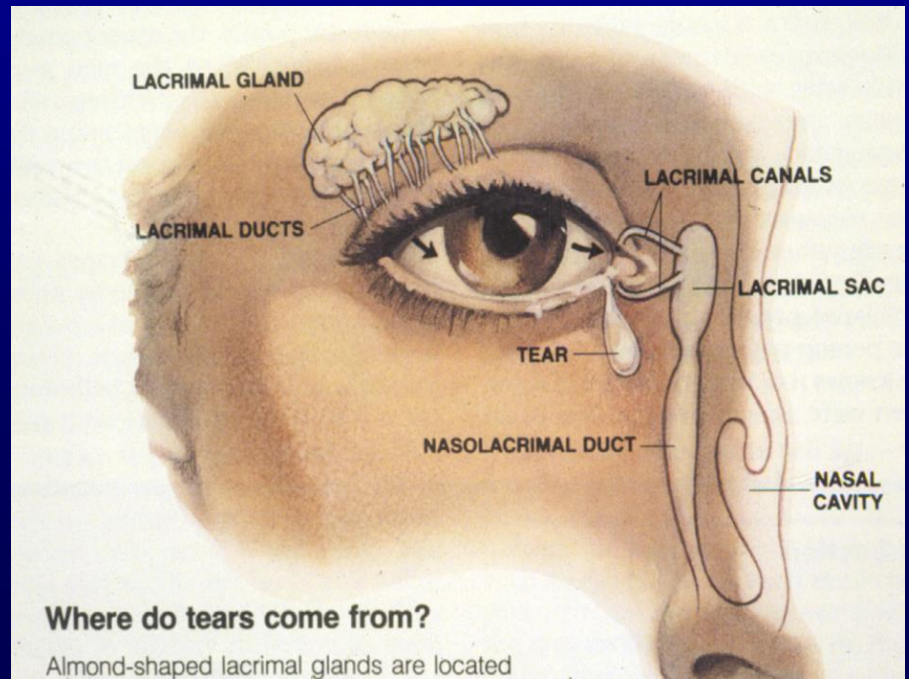
Slide 66: Recto-anal junction



Other Glands of Epidermal Origin

Cerumenous glands - produce wax (cerumen) in the ear for waterproofing and discourage entry of insects

Tarsal lacrimal glands - tears of the eye



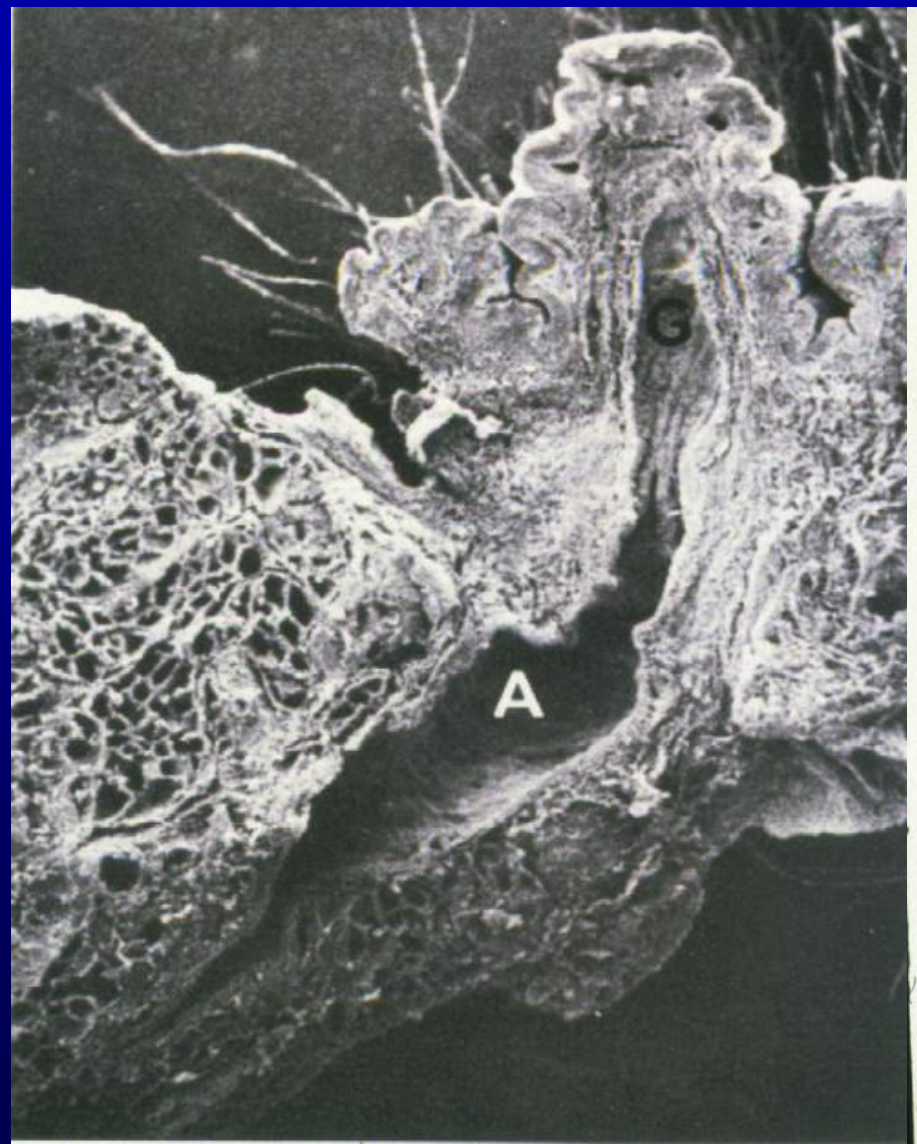
Other Glands of Epidermal Origin

Cerumenous glands - produce wax (cerumen) in the ear for waterproofing and discourage entry of insects

Tarsal lacrimal glands - tears of the eye

Tarsal gland of meibomian – wax-like secretion that holds in tears

Other Glands of Epidermal Origin – mammary gland



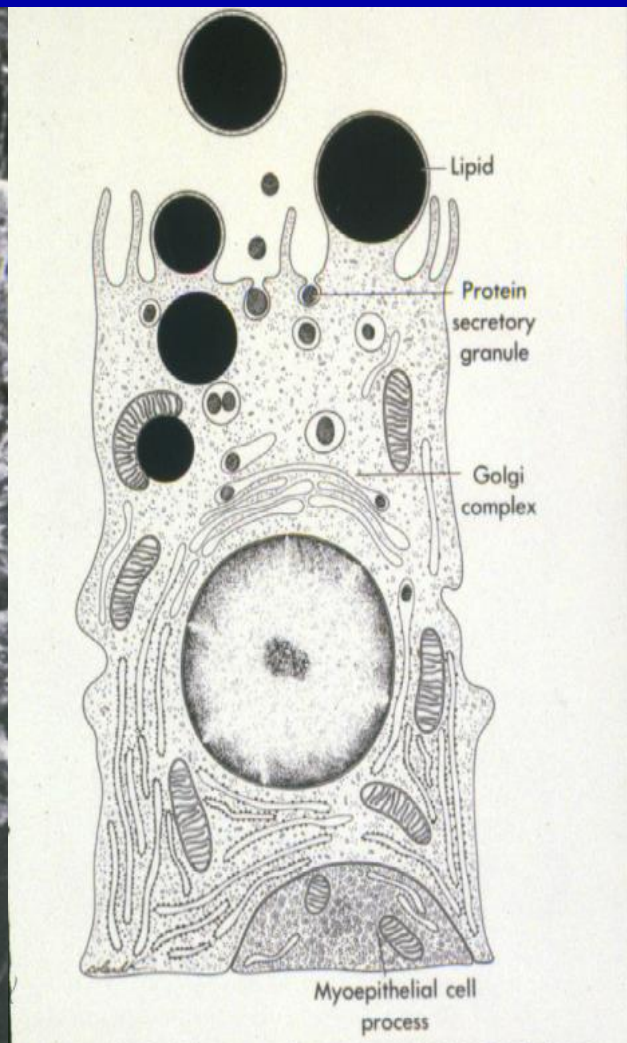


Figure 33–8. Diagrammatic representation of a cell from a lactating mammary gland, showing large lipid droplets being cast off enclosed in a layer of cytoplasm, and small

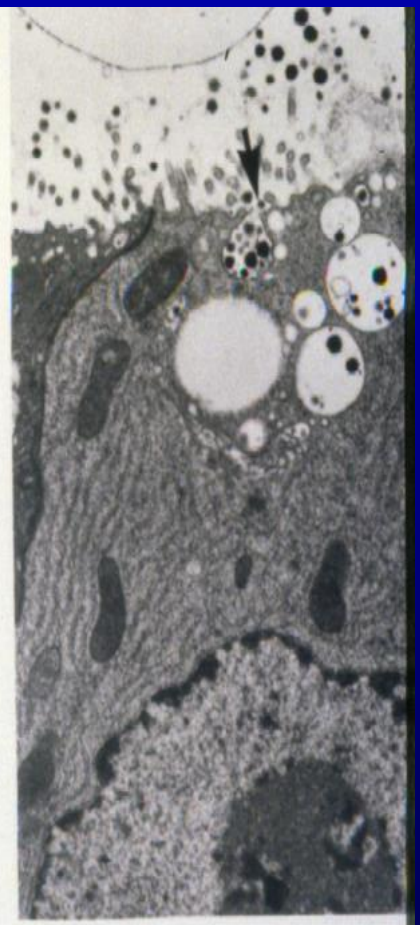


Figure 33–9. Electron micrograph of a r
lial cell, showing several vacuoles conta
milk protein. One *(at arrow)* is in proce
(Micrograph courtesy of A. Ichikawa.)

Other Glands of Epidermal Origin – Mammary Gland

Gland for which our class, mammalia, was named. Mammals are characterized by hair on skin, special ear bones, and milk-producing mammary glands in females for nourishment of young.

Variations in the Microvasculature

Common Arteriole

⬇

Capillary

⬇

Venule

Shunts Arteriole

⬇

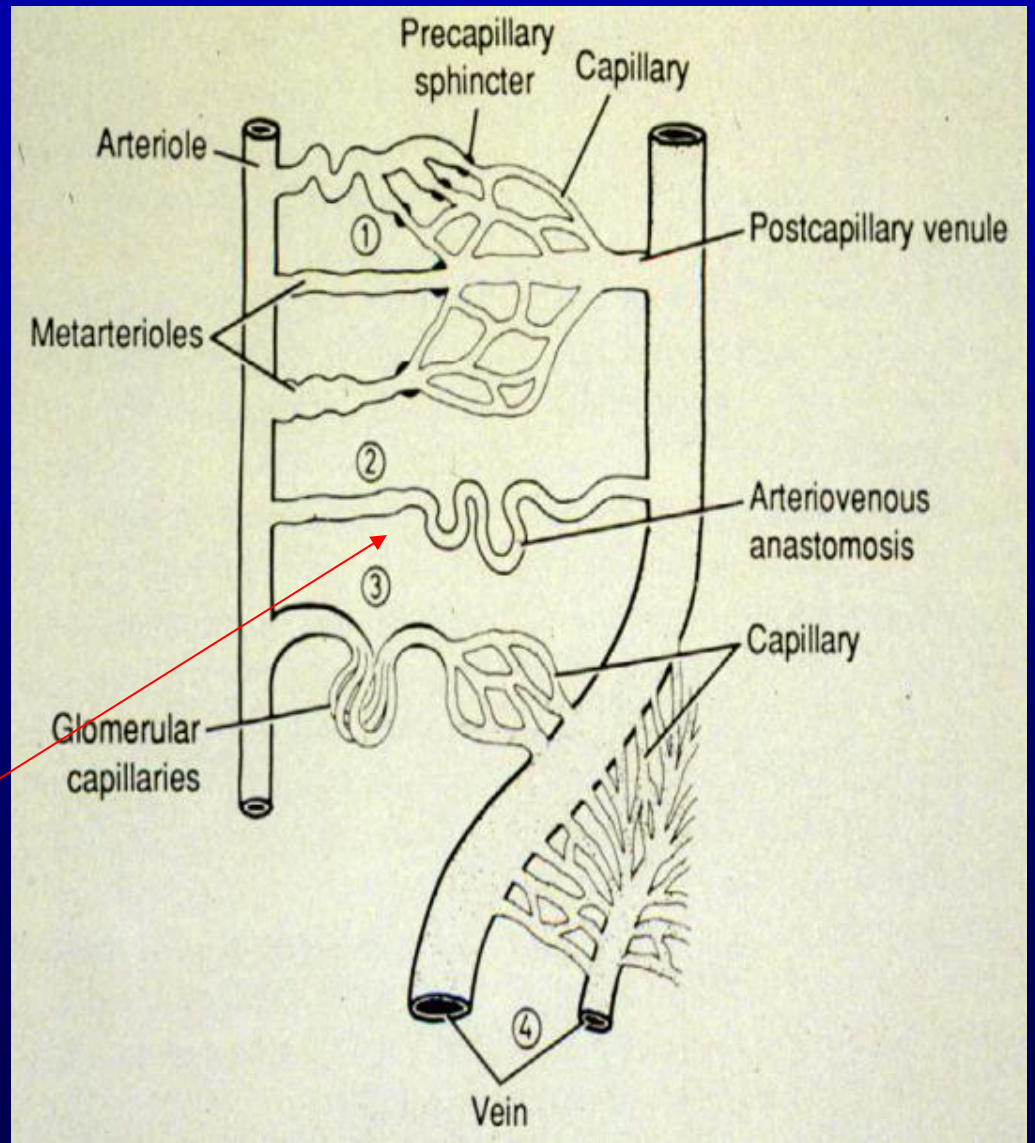
Metarteriole

⬇

Venule

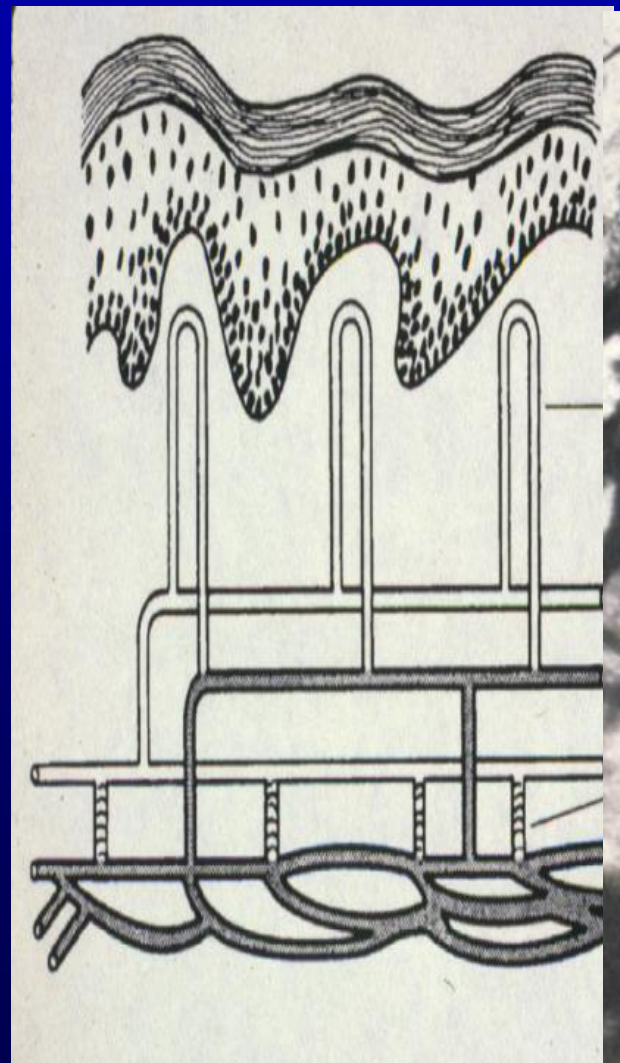
arteries ⇨ av

shunt ⇨ venules



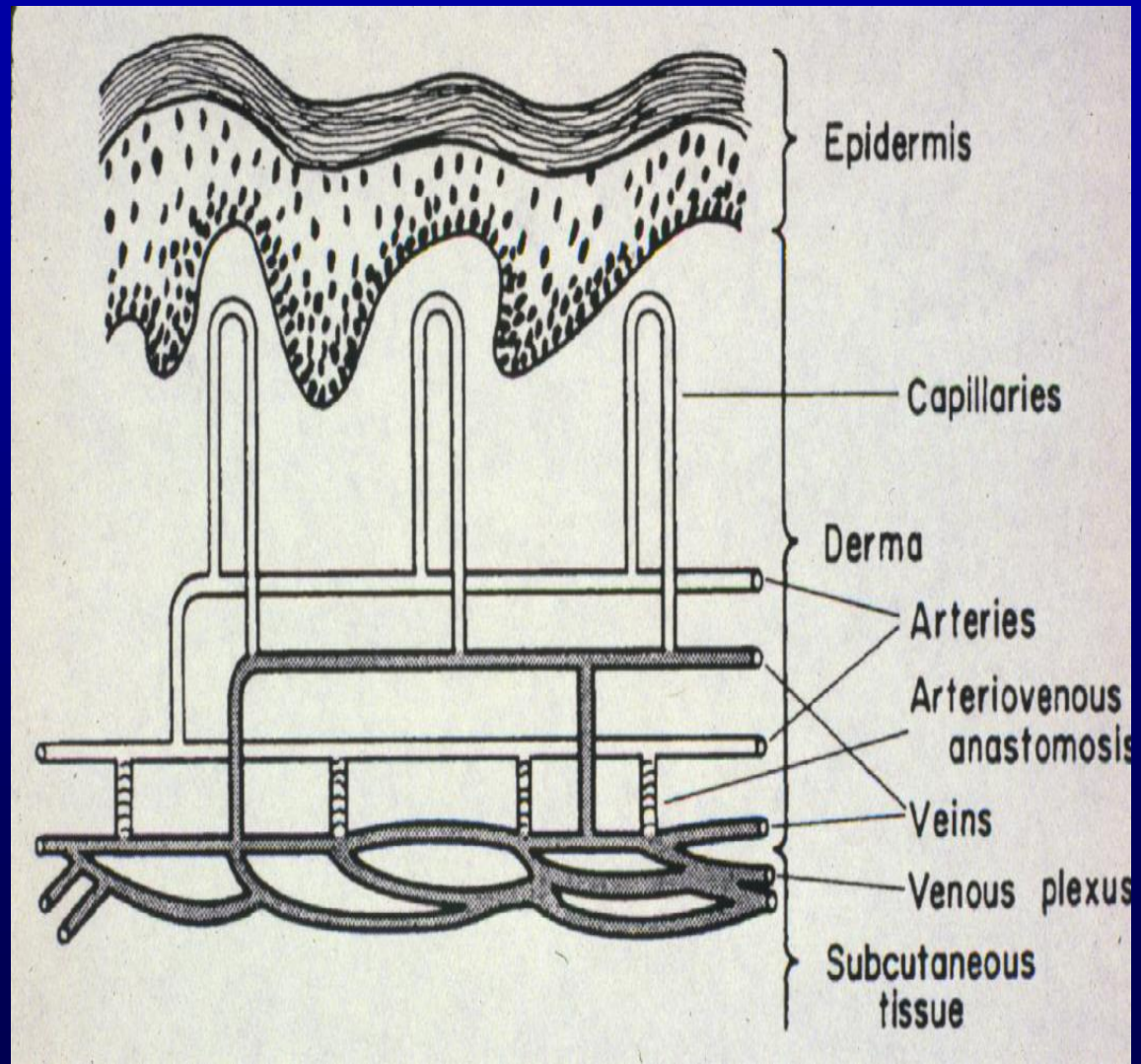
Circulation of Blood Through Skin:

Blushing?

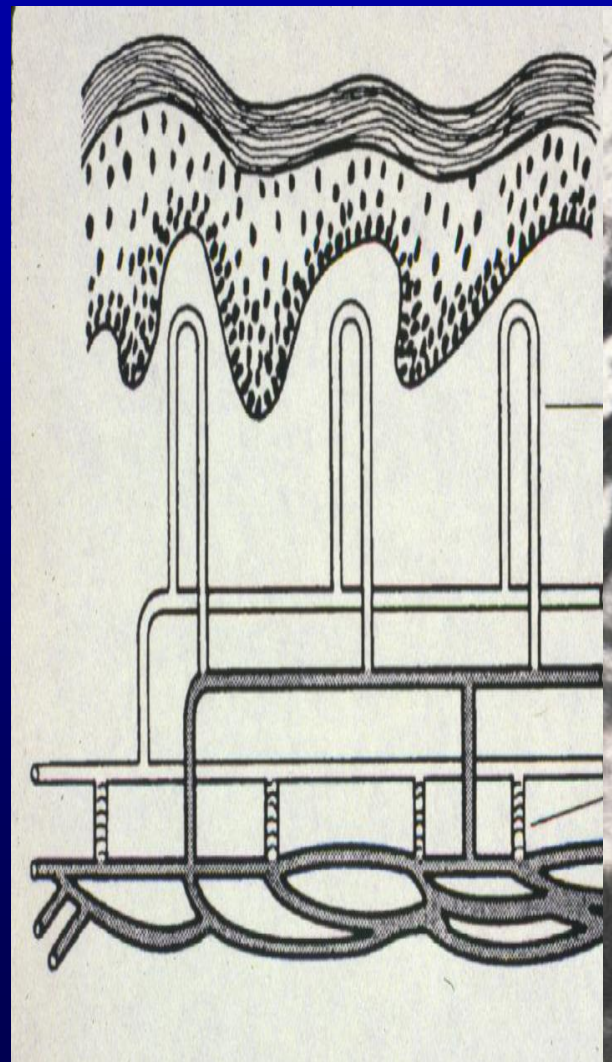


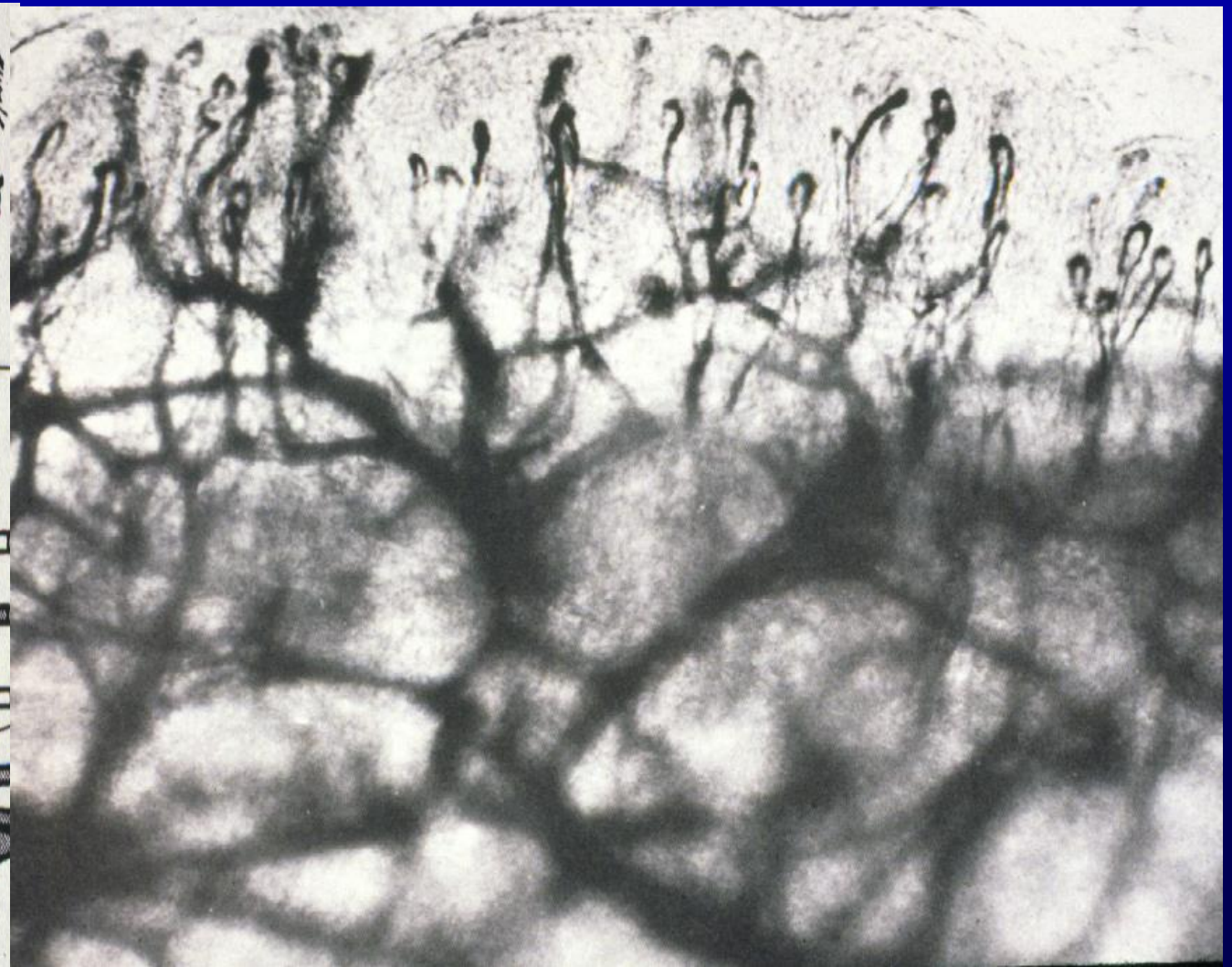
Circulation of Blood Through Skin

- Function and structure
  - Nutrition - capillaries
  - Heat conduction from body
    - Subcutaneous venous plexus (holds large quantities of blood to heat skin)
    - Arterio-venous anastomoses



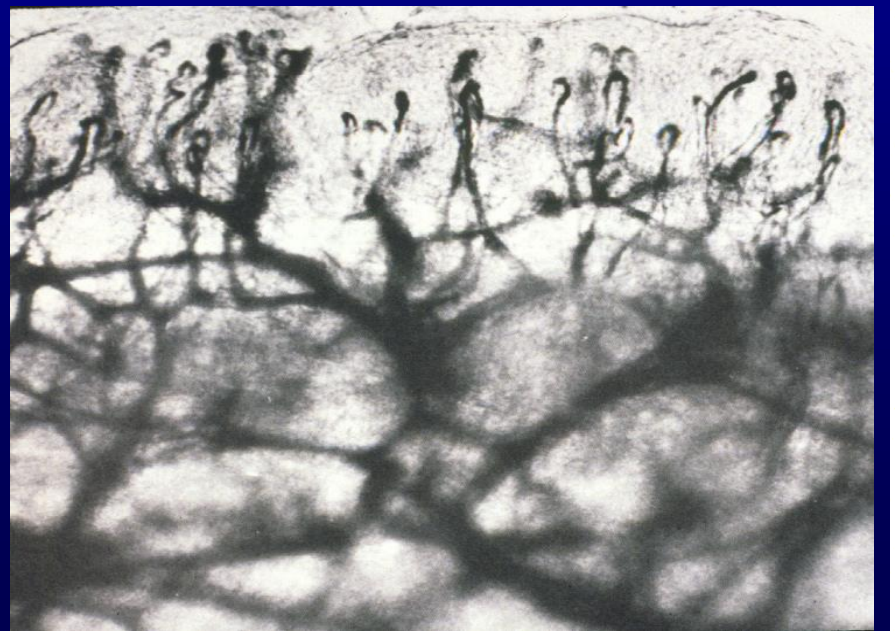
Circulation of Blood Through Skin

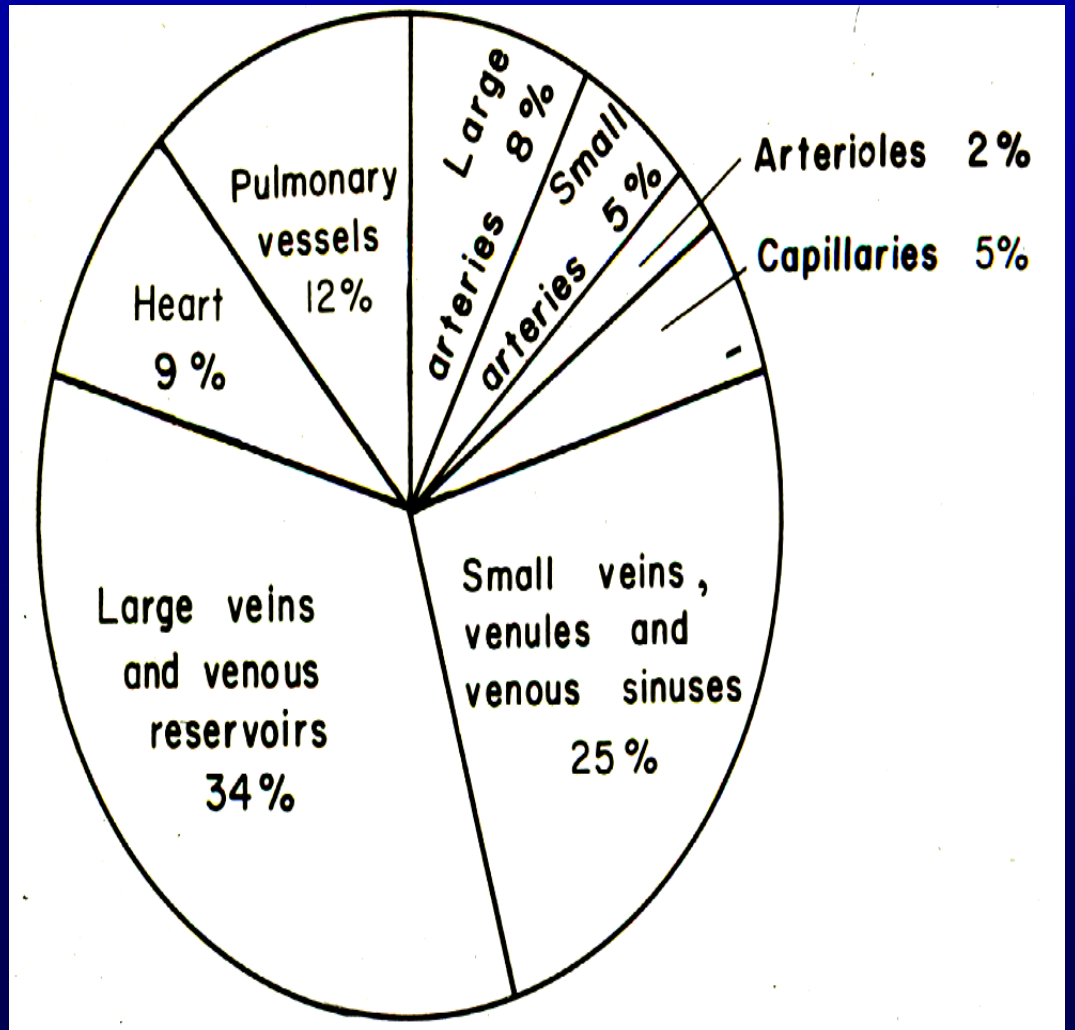




Circulation of Blood Through Skin

Blood volume capacity of skin is 4.5% of total blood volume





Circulation of Blood Through Skin

Blood flow through skin in an average adult

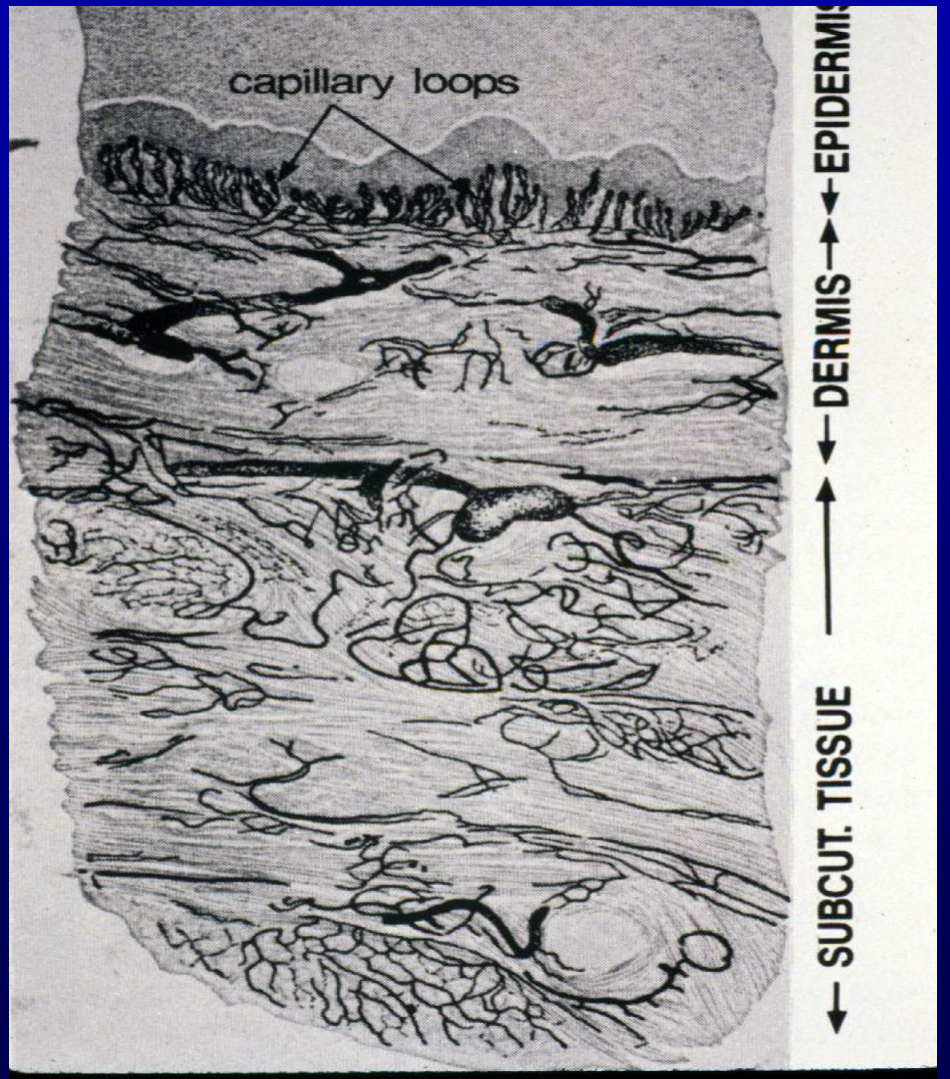
- **Normal conditions - 400 mL/min.**
- **Hot conditions - 2.8 liters/min**

(Volume 5-6 L = 12-13 pints/person)

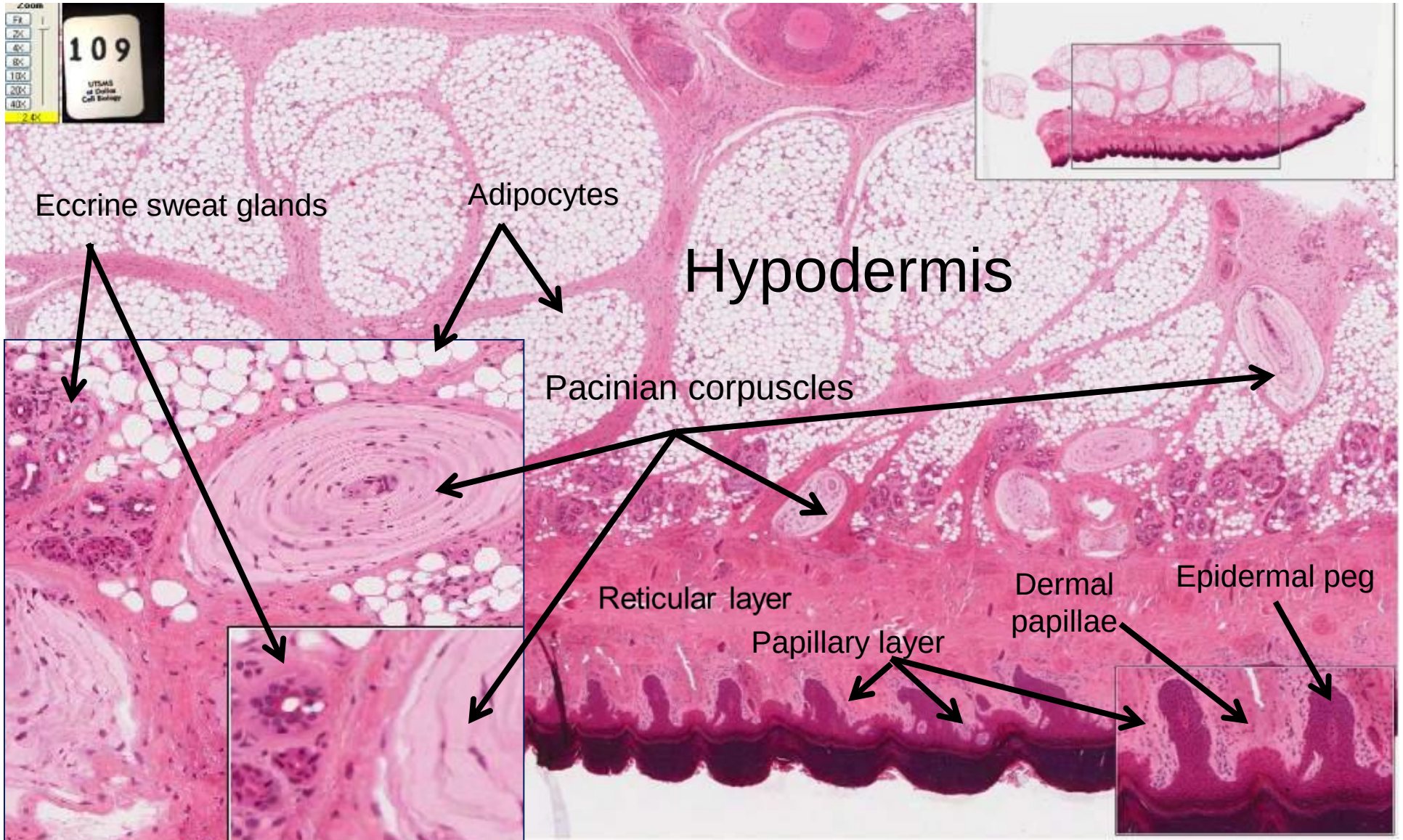
Circulation of Blood Through Skin

Blood vessels in different layers

Of skin to accommodate variation in flow rate.

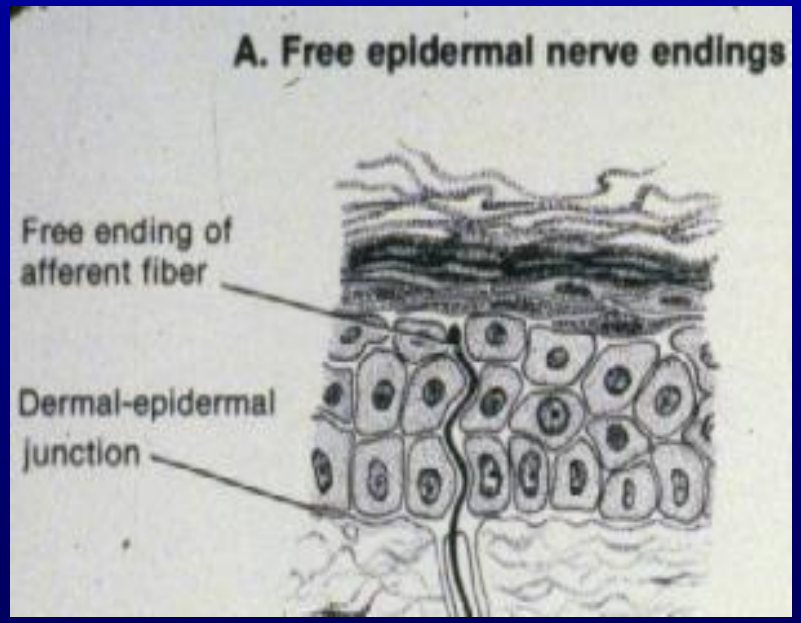


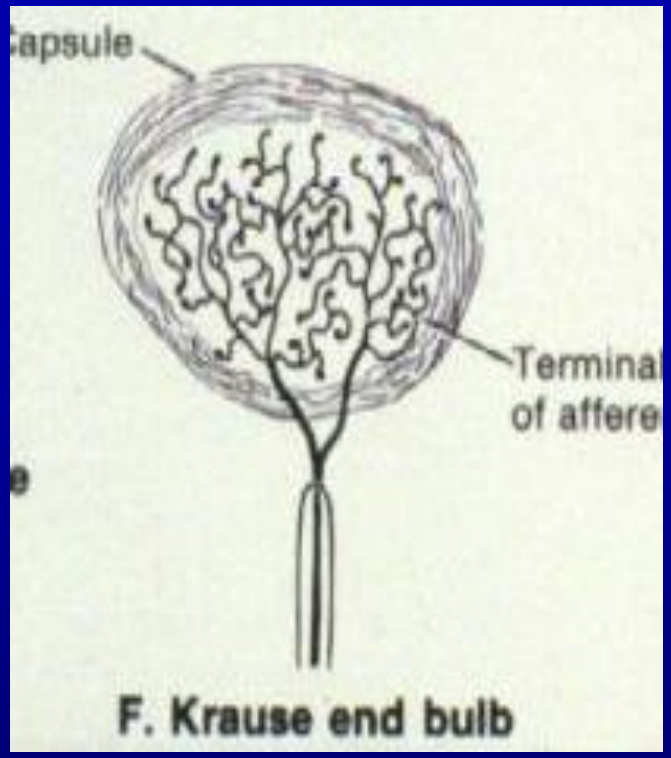
109 Skin hand monkey



Epidermal and dermal – nerve interfaces

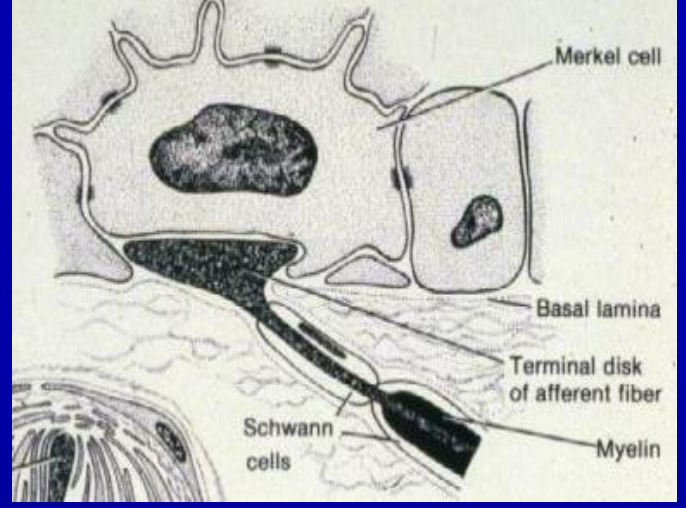
The End bulb of Krause is a thermoreceptor that picks up on the sensation of cold temperatures.





Pain receptors are found on free nerve endings located in many tissues throughout the body. This includes skin, muscles, joints, connective tissues, and internal organs. Pain receptors are activated in response to a painful stimulus, usually involving tissue damage.

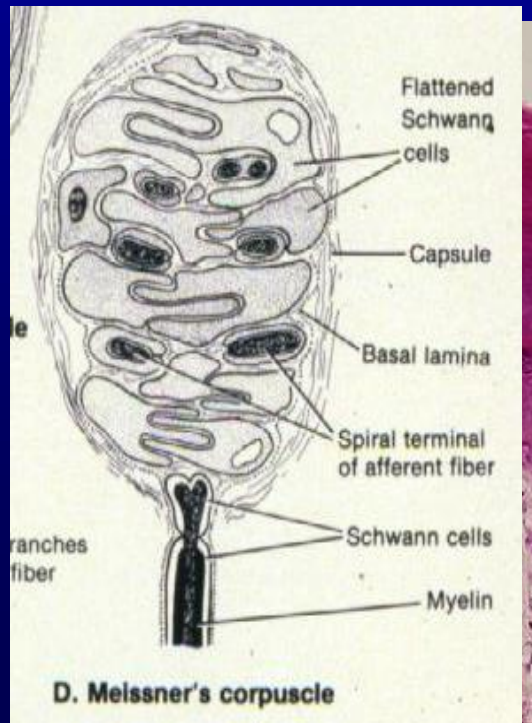
Epidermal and dermal–nerve interfaces

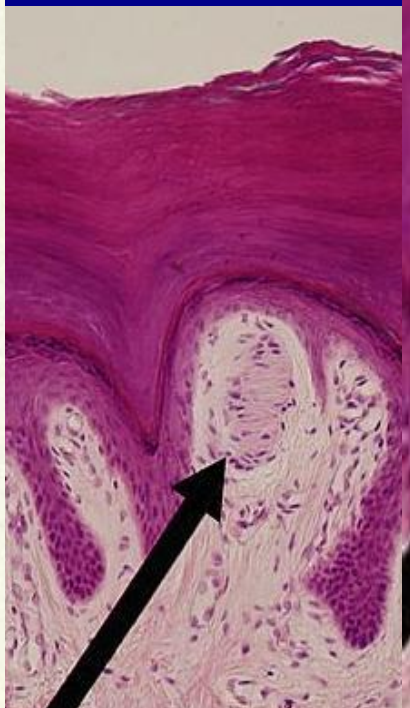


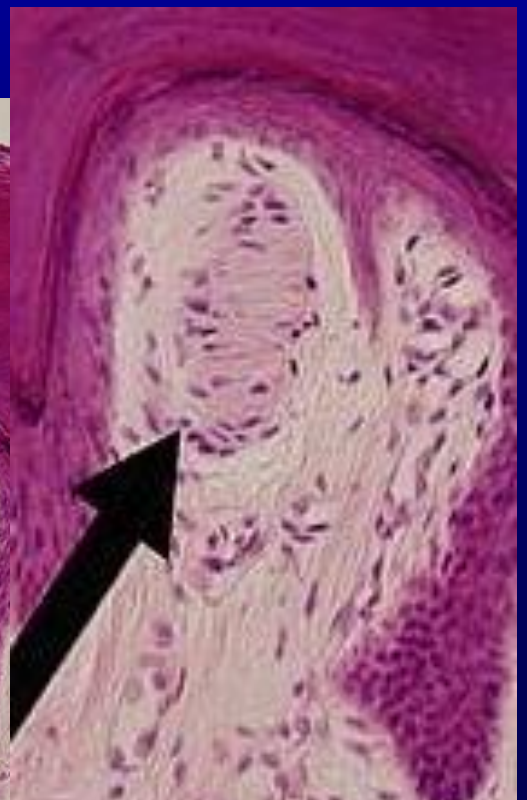
Merkel cells or Merkel-Ranvier cells are oval receptor cells found in the skin of vertebrates that have synaptic contacts with somatosensory afferents. They are associated with the sense of light touch discrimination of shapes and textures. Genetic knockout mice have recently shown that Merkel cells are essential for the specialized coding by which afferent nerves resolve fine spatial details.

Meissner's corpuscles (or tactile corpuscles) are a type of nerve ending in the skin that is responsible for sensitivity to light touch. In particular, they have highest sensitivity (lowest threshold) when sensing vibrations lower than 50 Hertz. They are rapidly adaptive receptors. Any physical deformation in the corpuscle will cause an action potential in the nerve. Since they are rapidly adapting or phasic, the action potentials generated quickly decrease and eventually cease (this is the reason one stops "feeling" one's clothes).

Epidermal and dermal – nerve interfaces

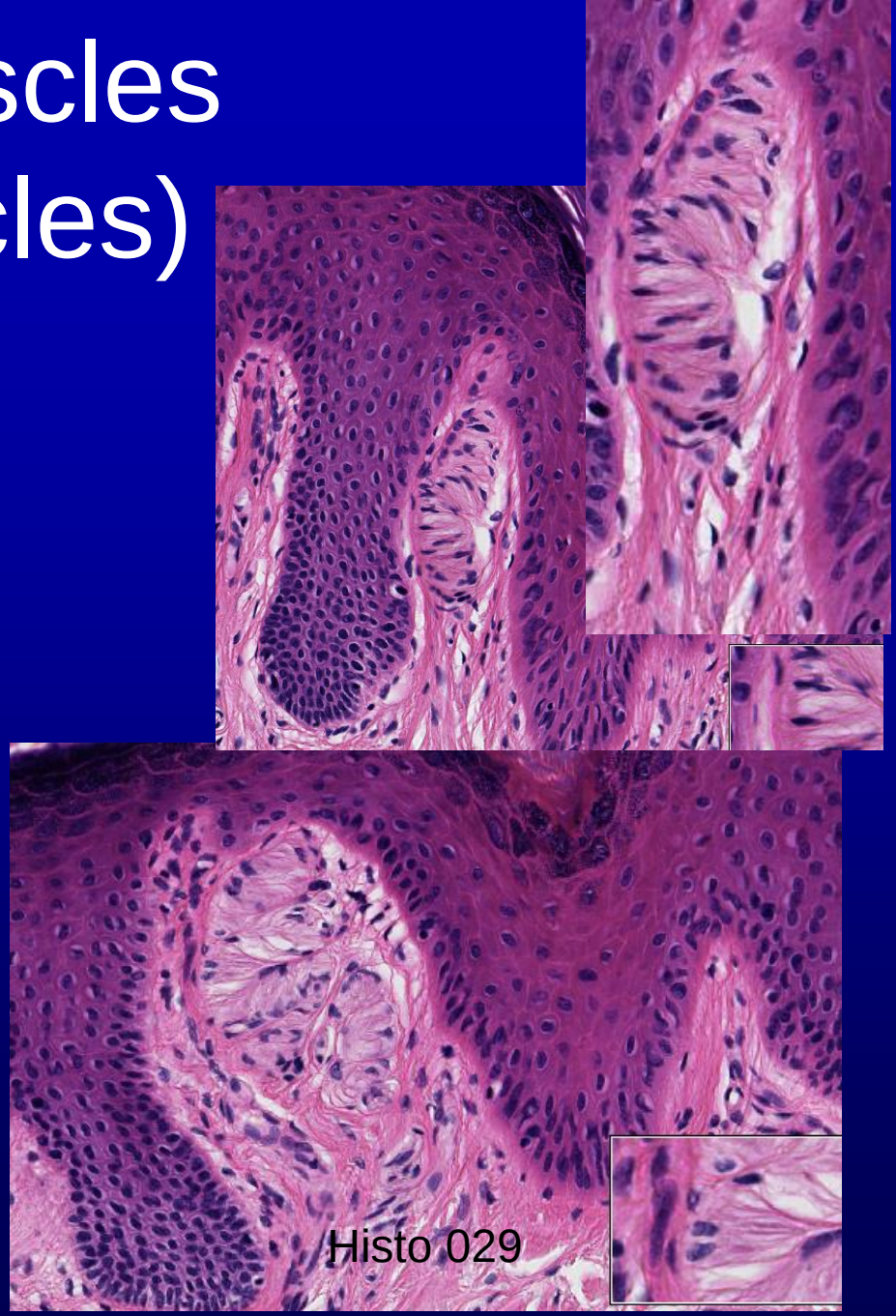






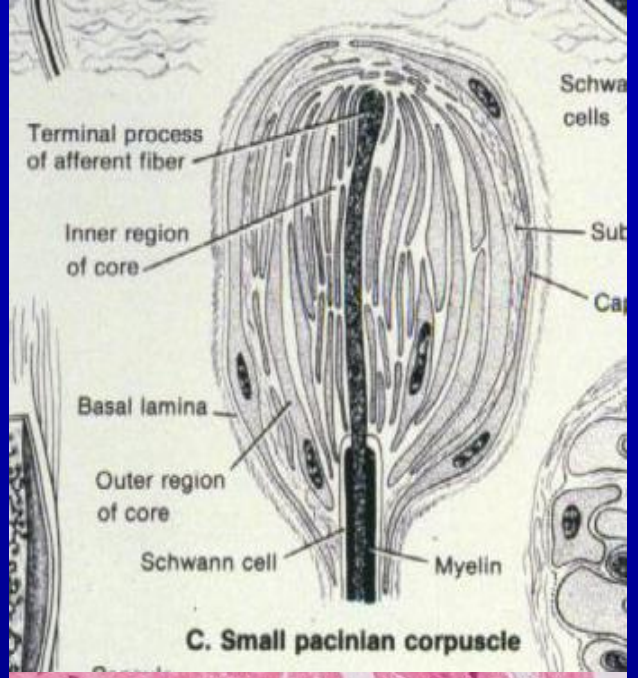
Meissner's Corpuscles (or tactile corpuscles)

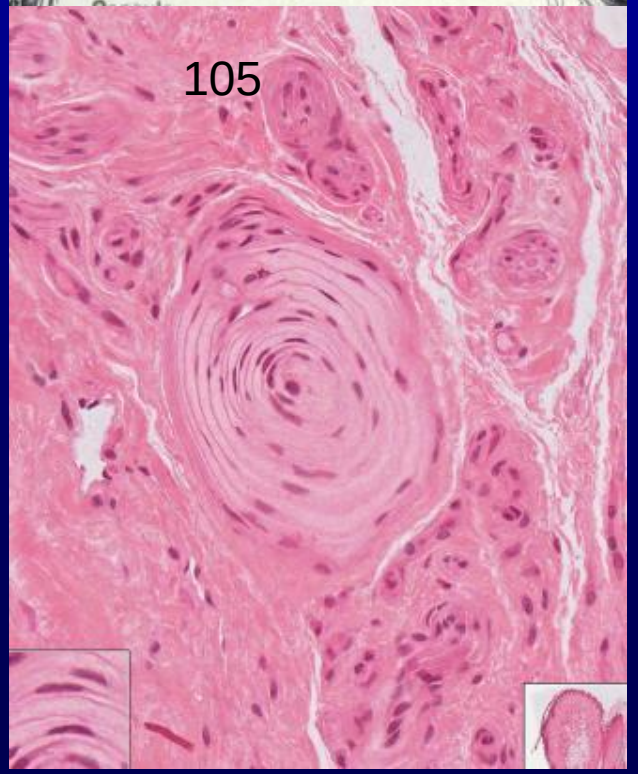
- The number of Meissner's corpuscles per square millimeter of human skin on the fingertips drops four fold between the ages of 12 and 50. The rate at which they are lost correlates well with the age-related loss in touch sensitivity for small probes (Thornbury and Mistretta, 1981).



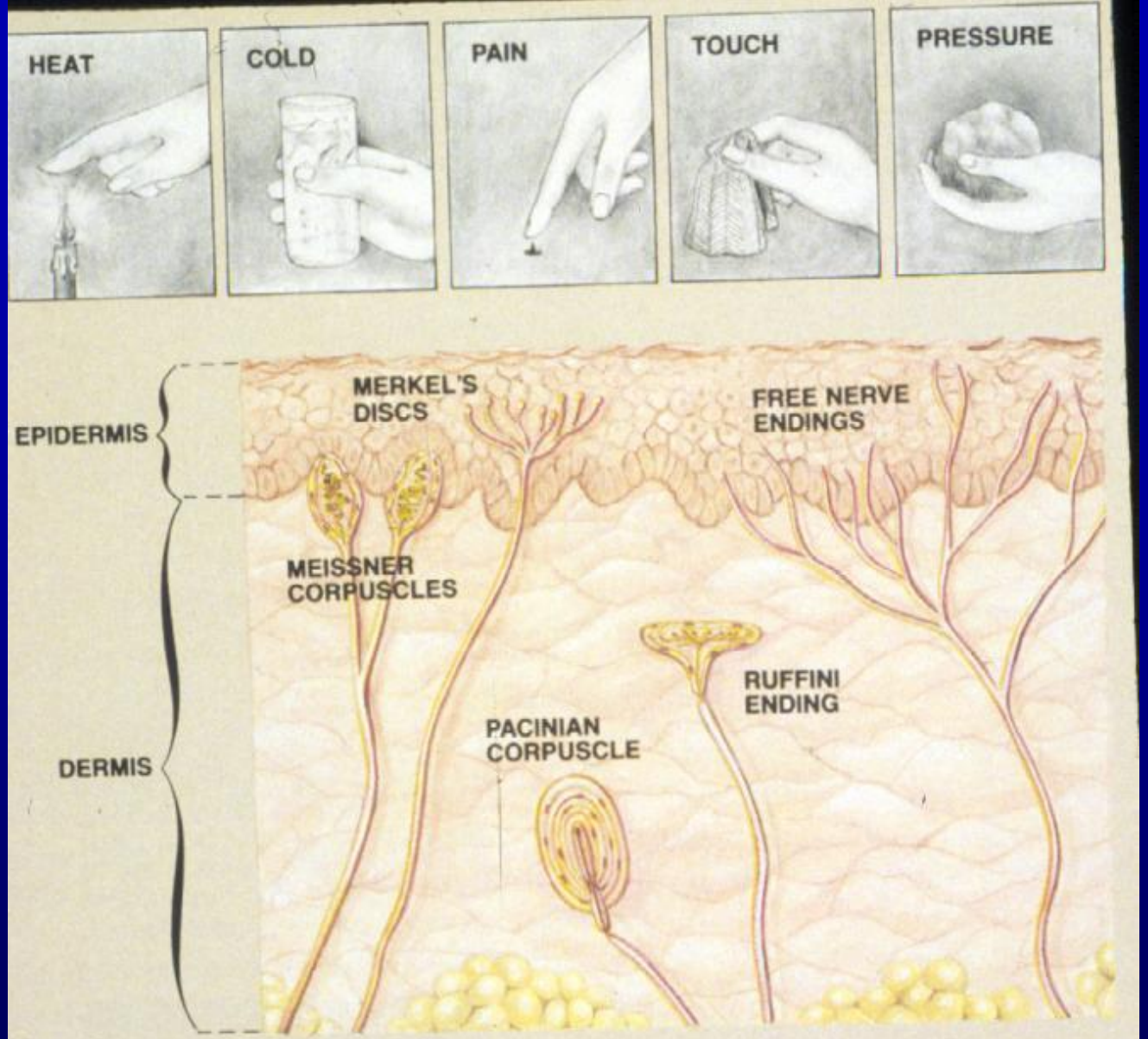
Epidermal and Dermal – Nerve Interfaces

A Pacinian corpuscle is a type of touch receptor located in the skin. It is classed as a mechanoreceptor, meaning it is part of the group of sensory receptors that respond to touch and pressure. Pacinian corpuscles are especially suited to feeling rough surfaces and detecting vibration. They respond to transient touches rather than sustained pressure. This is because a Pacinian corpuscle is able to quickly adapt to pressure so that it no longer acts as a stimulus.





Epidermal and Dermal – nerve Interfaces



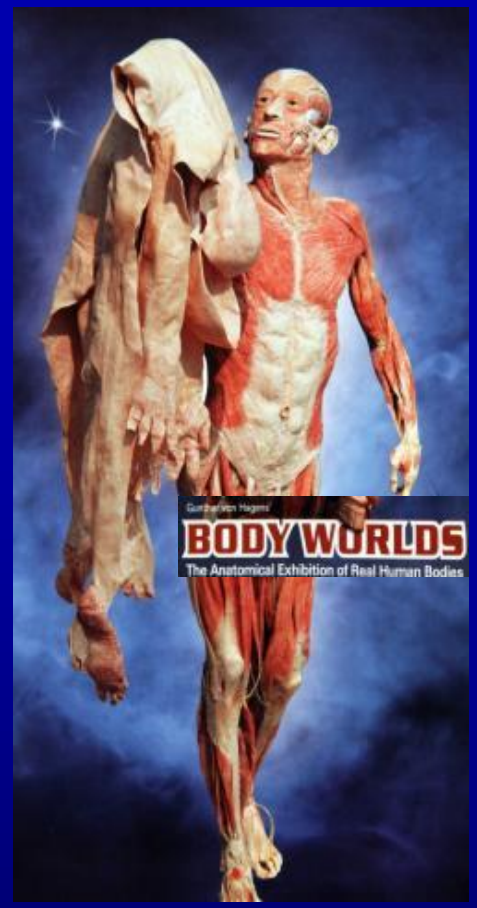
Free nerve endings, which are scattered throughout the body, and which are grouped around the bases of hairs, can register pain and pressure. Other, larger, specialized receptors are also present (see above). These occur in clusters, the more numerous, the more sensitive the area. The tips of the fingers have many

Mucocutaneous Junctions

Lips,
Nares,
Eyelids,
Vulva or
Prepuce
Anal Canal


DREAM
DRESSER

Functional Diversity of Skin



- Protects against injury and desiccation
- Maintenance of water balance
- Excretes/secretes various substances
- Thermoregulation
- Receives stimuli
  - Temperature
  - Pain
  - Pressure
- Basis of recognition and yields clues to one's well being
- Fat metabolism in the subcutaneous layer