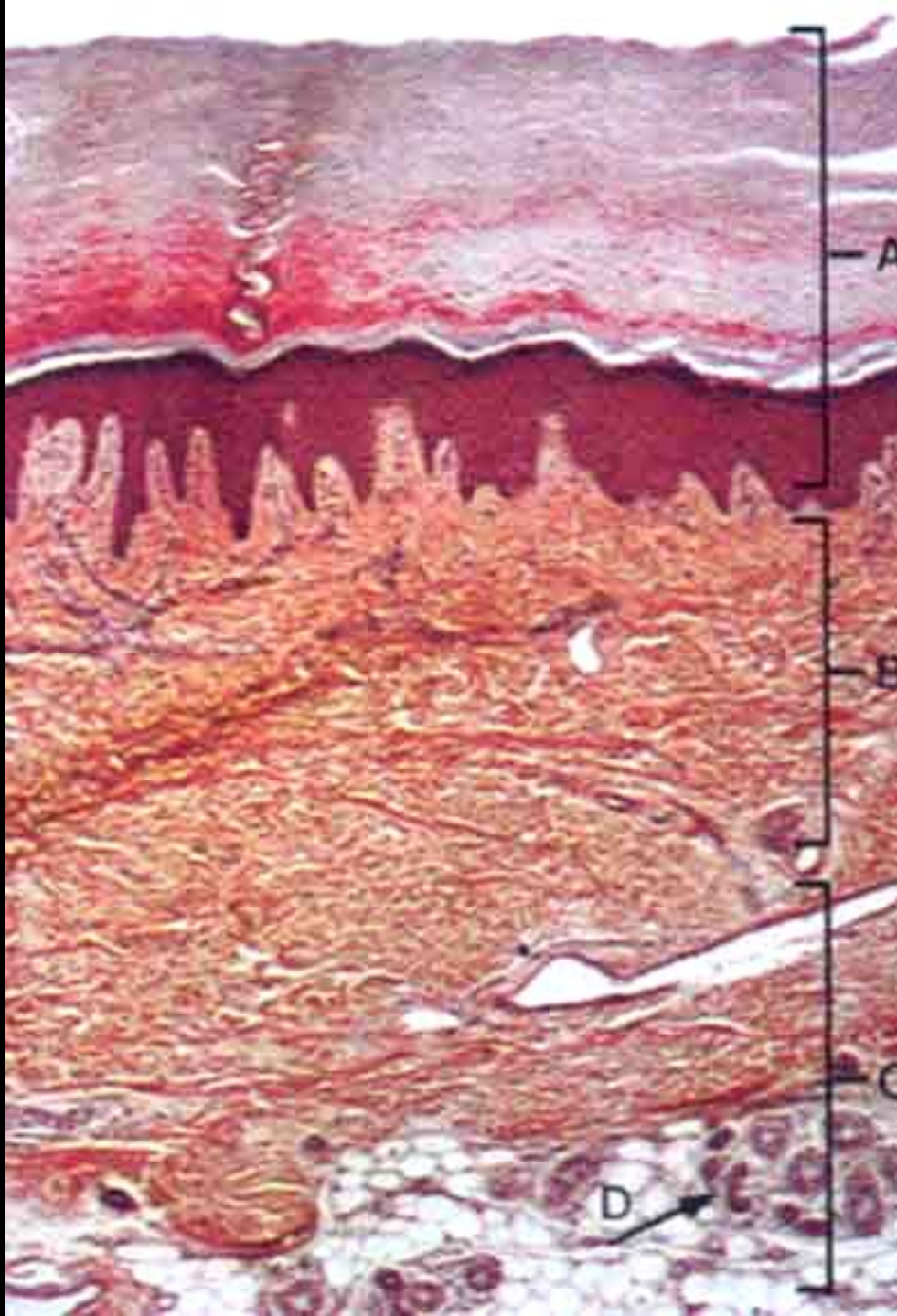


# Integumentary system

# Skin

- The biggest organ of the body
- Protection (barrier)
- Thermoregulation
  - Sweat glands
  - Regulation of blood flow
- Excretion
- Drug absorption
- Immune function
- Metabolism (ergosterol → vitamin D)



# Skin

## epidermis

keratinized stratified  
squamous epithelium

## dermis (corium)

loose and dense irregular  
connective tissue

## hypodermis

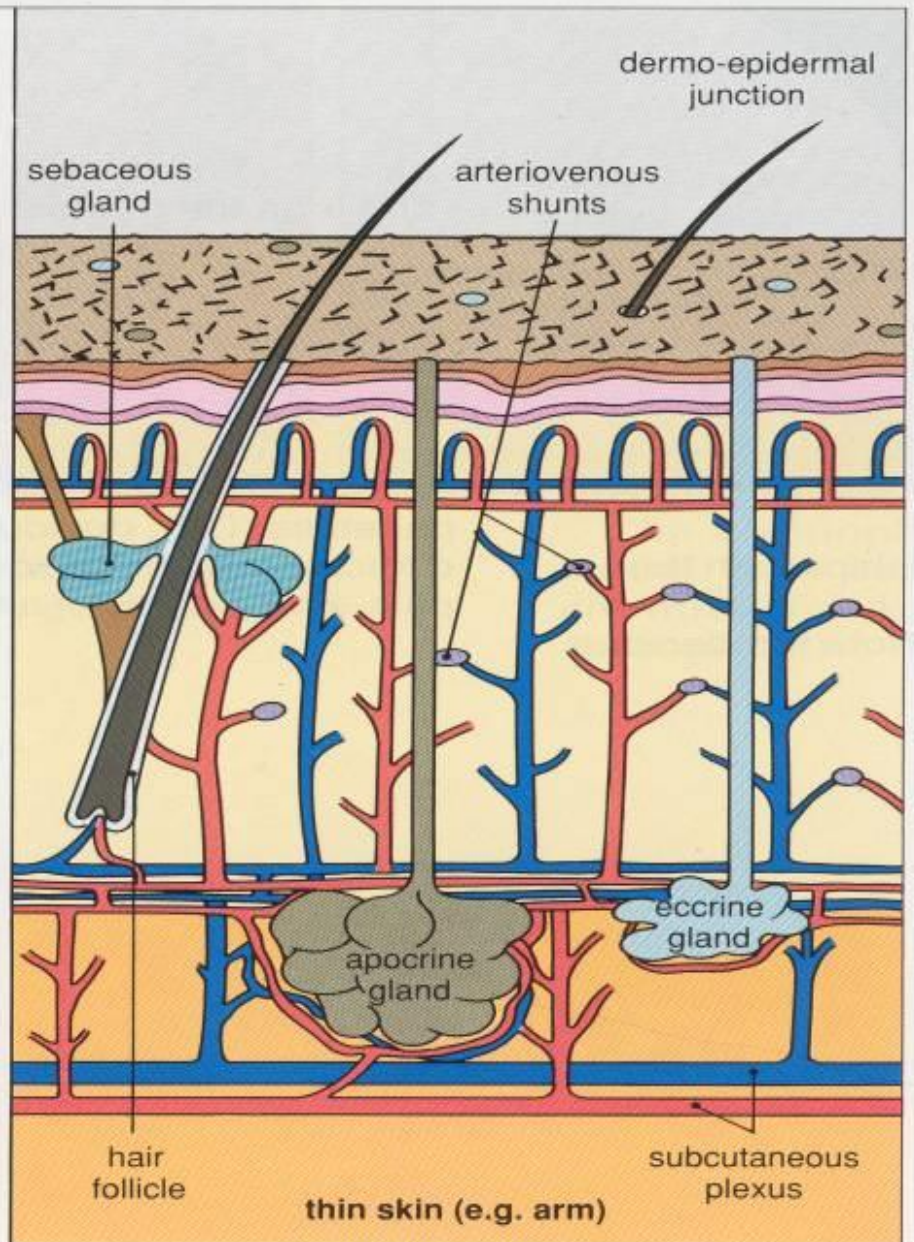
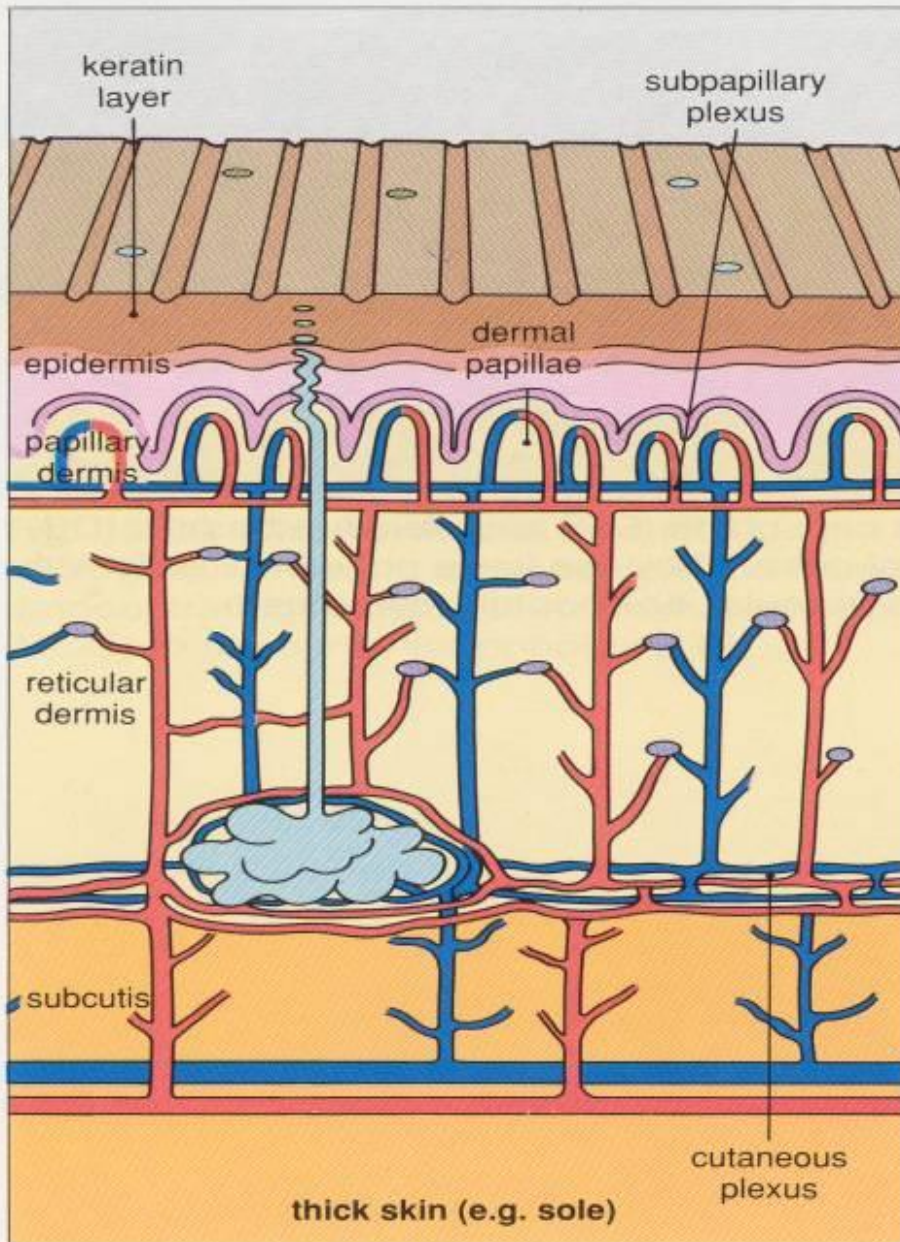
## (subcutaneous tissue)

adipous, loose and dense  
irregular connective tissue

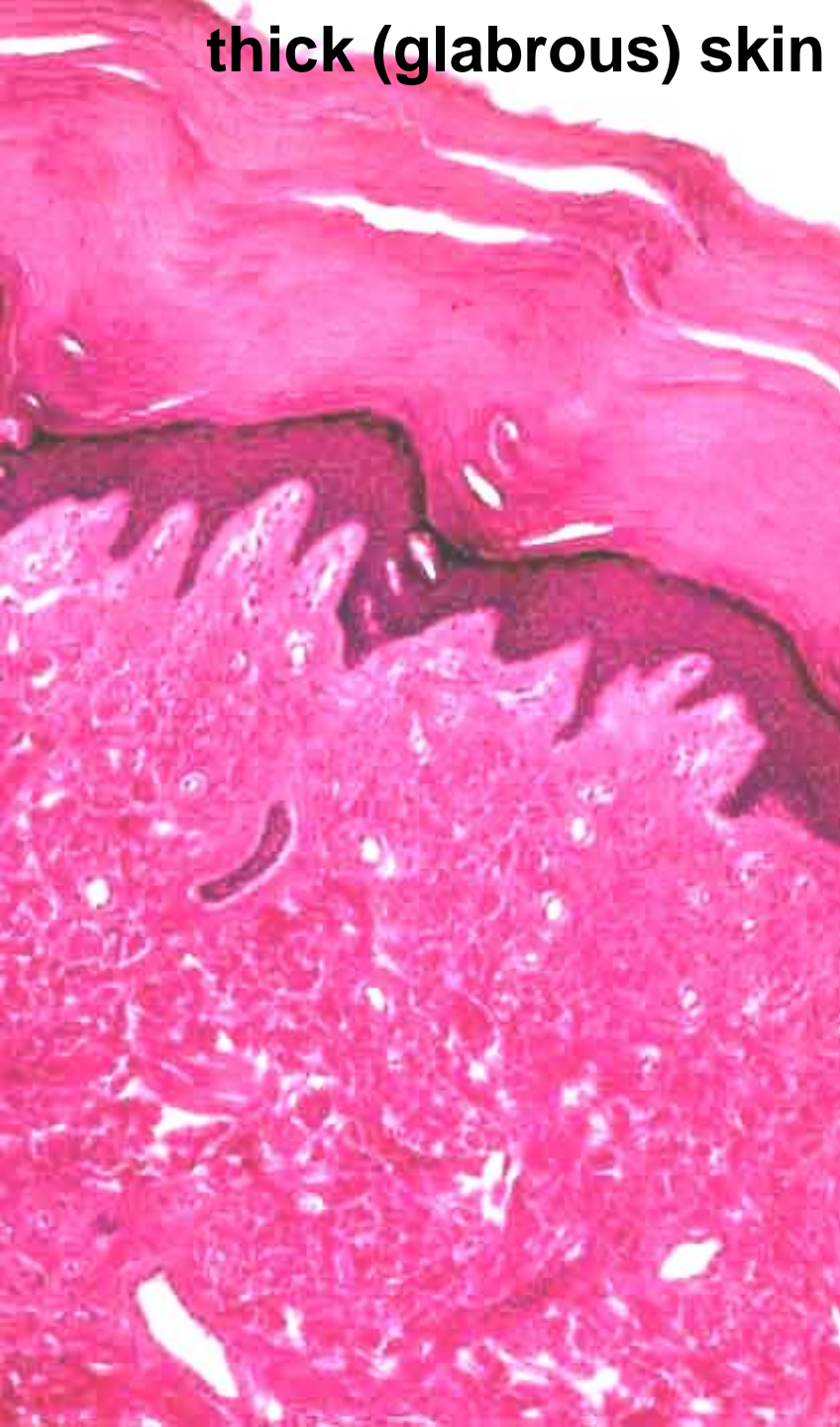
# architecture of the skin

thick - epidermis 400-600  $\mu\text{m}$

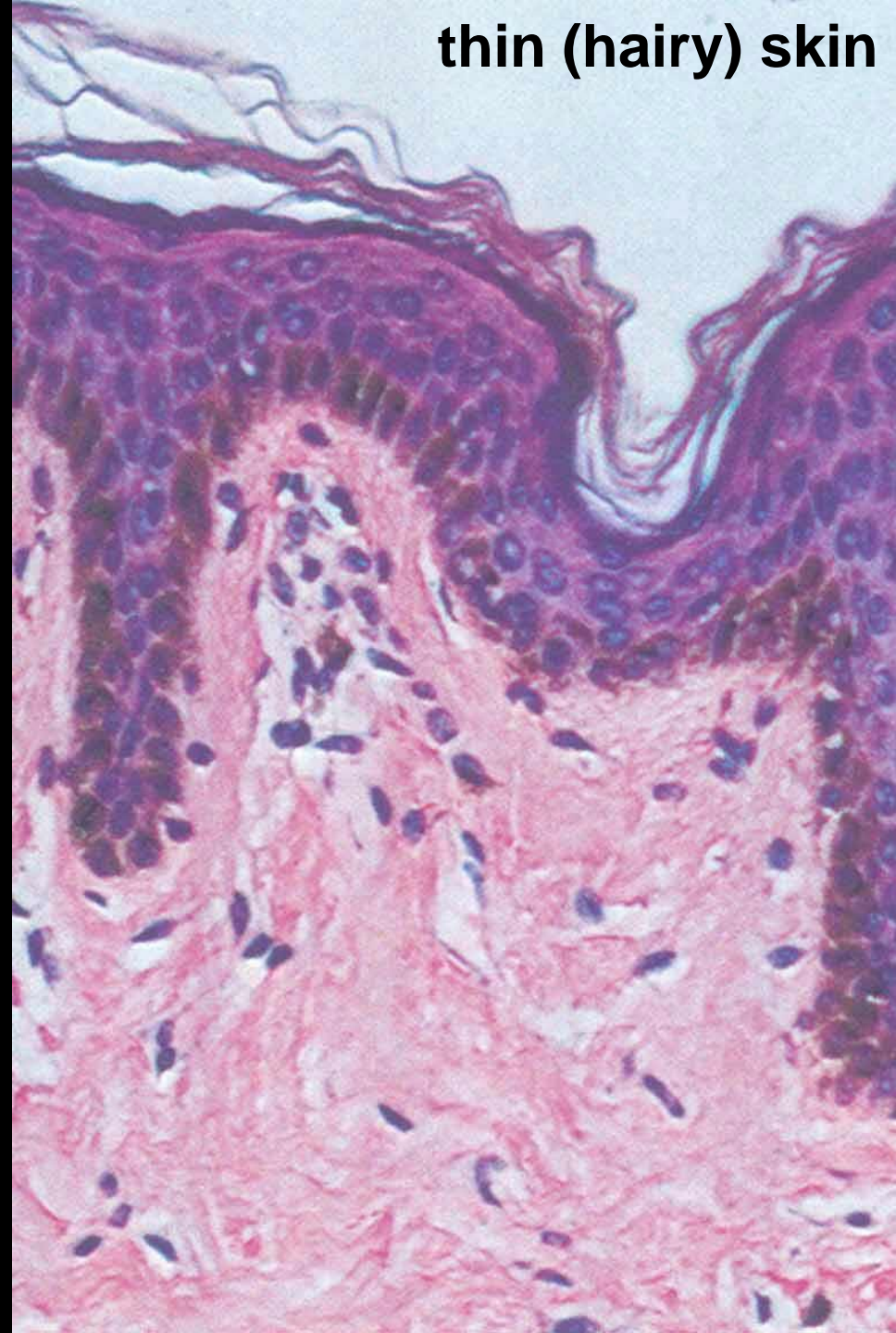
thin - epidermis 75-150  $\mu\text{m}$



**thick (glabrous) skin**



**thin (hairy) skin**



# Epidermis

stratum corneum

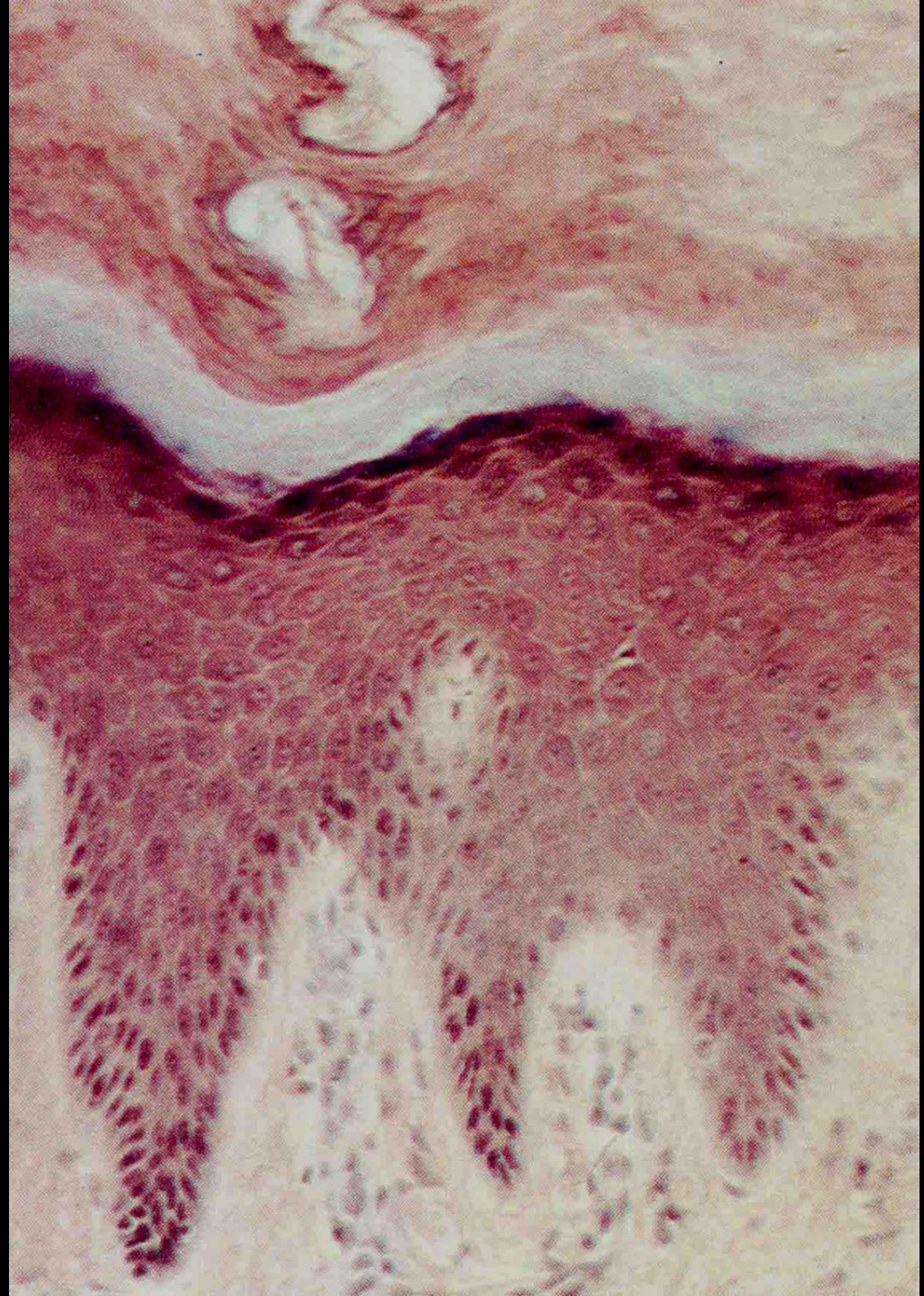
(stratum lucidum)

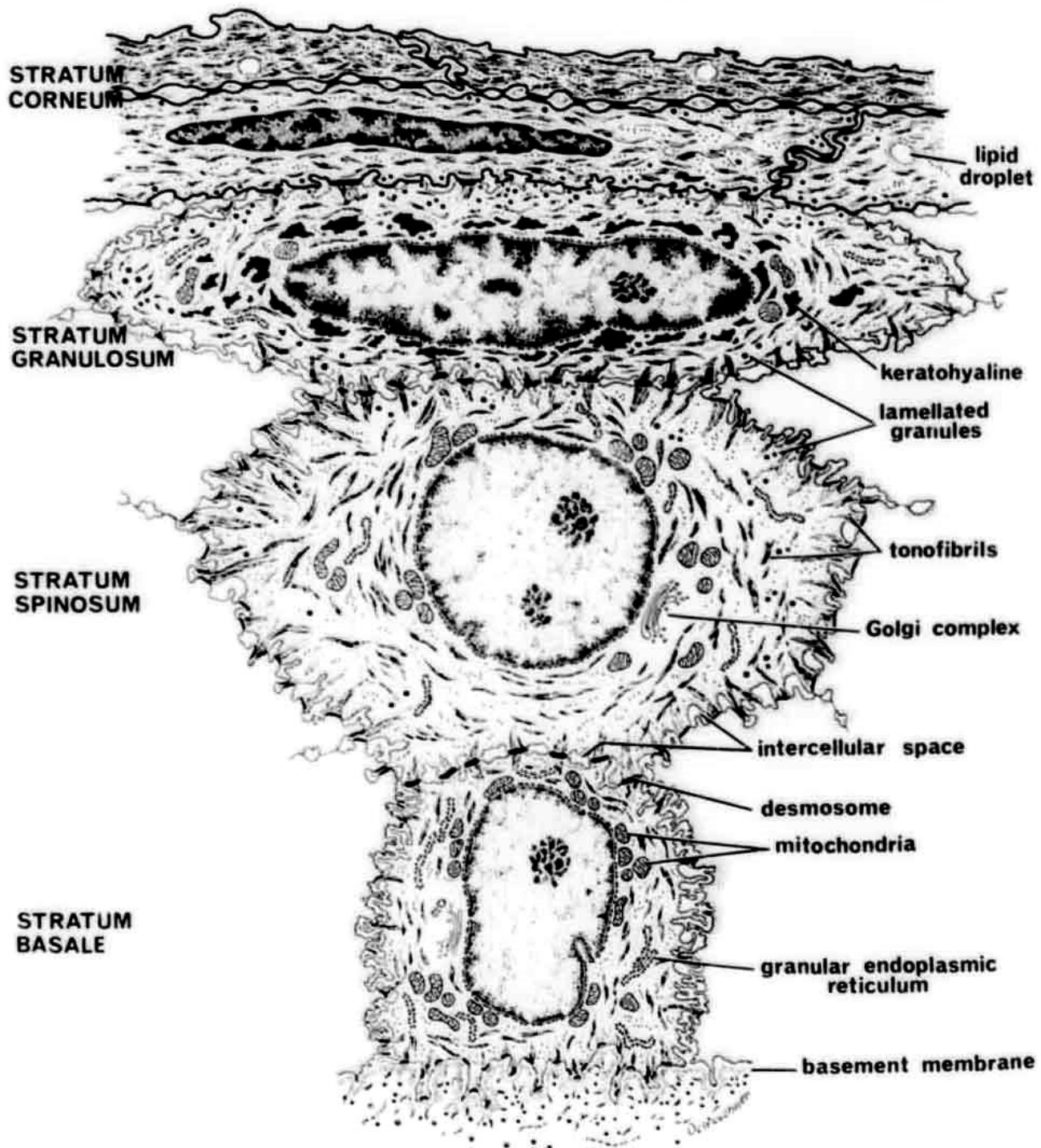
stratum granulosum

stratum spinosum

stratum basale

- keratinocytes
- melanocytes
- Langerhans cells (dendritic)
- Merkel cells





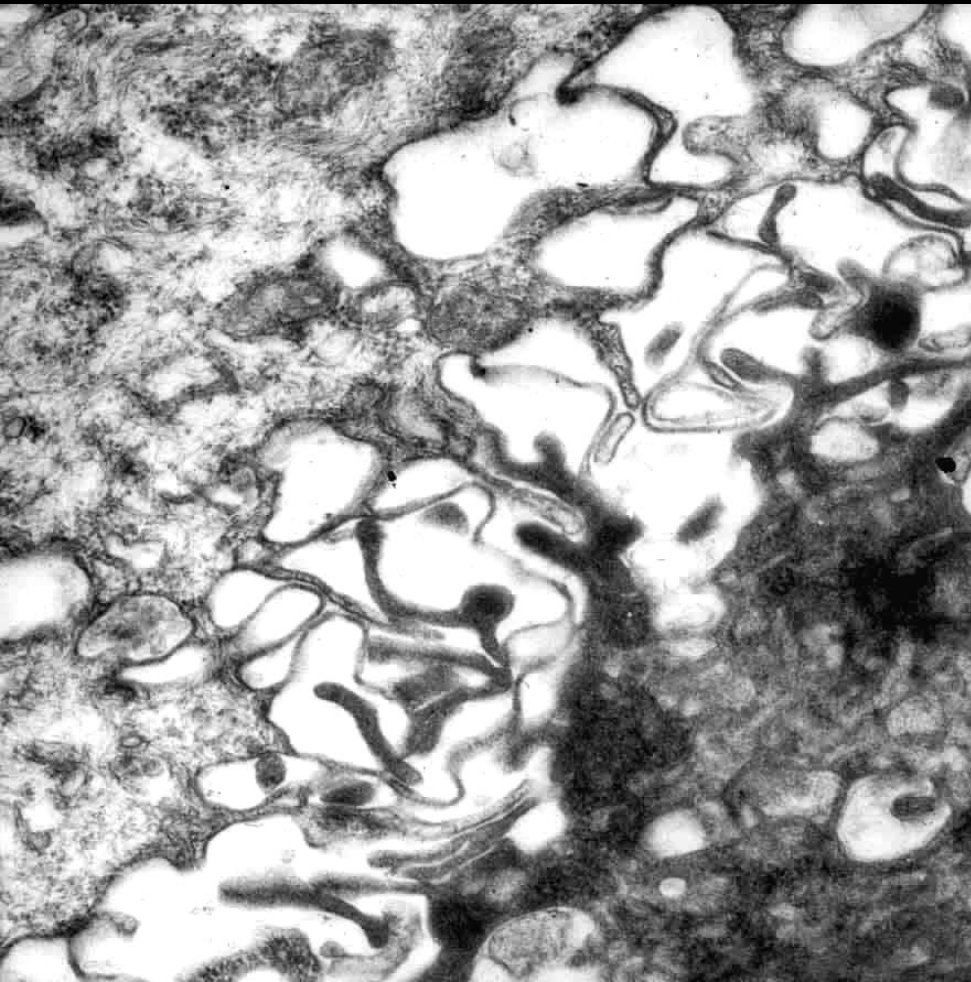
# stratum spinosum

Str. basale + str. spinosum  
= str. germinativum Malpighi

# stratum basale







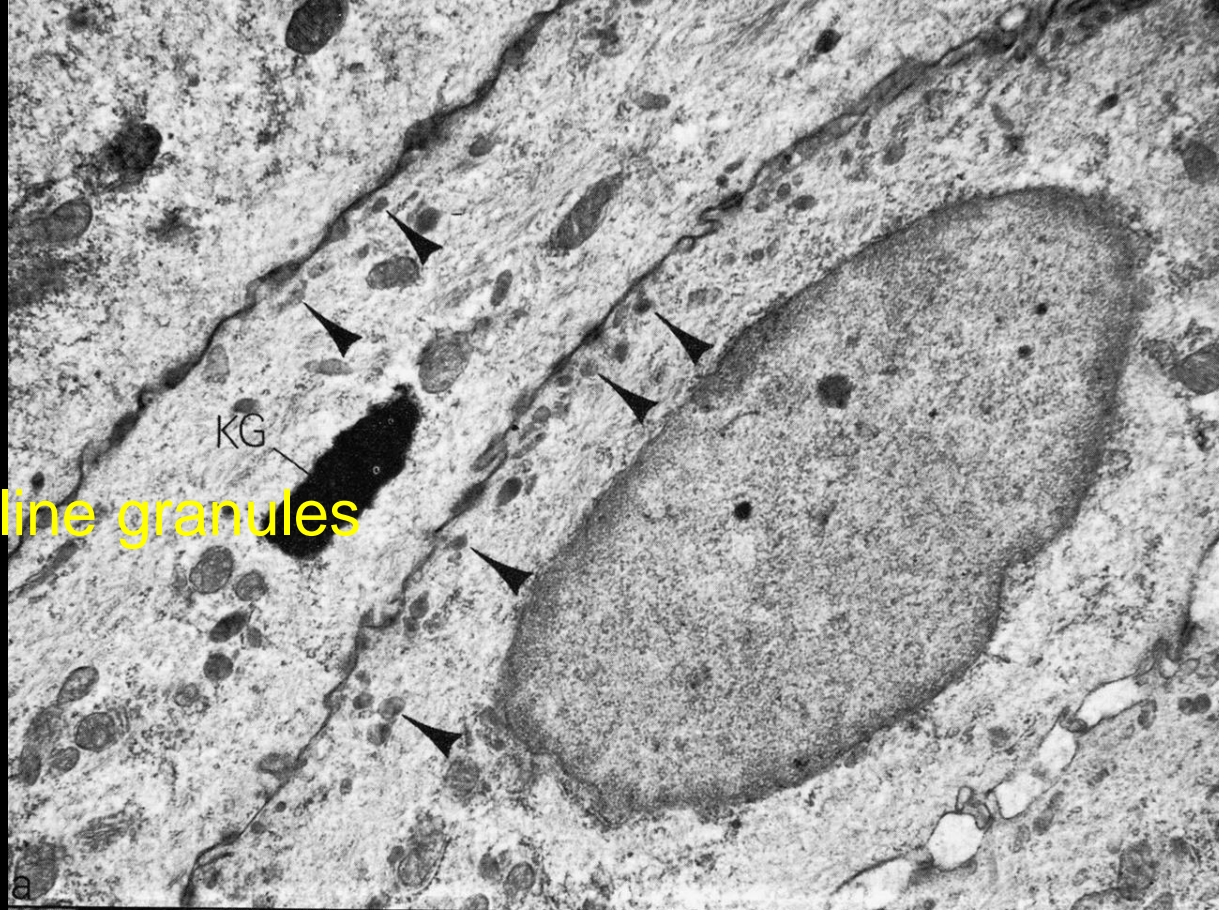
**nodes of Bizzozero EM**

**desmosomes**

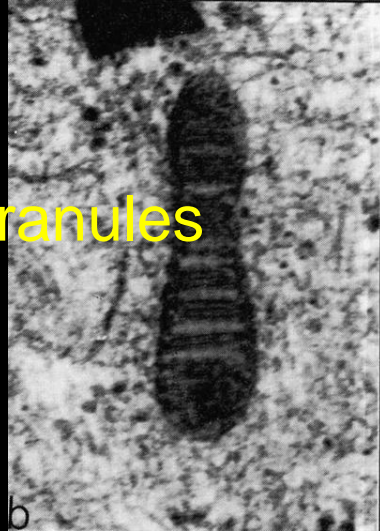


stratum granulosum

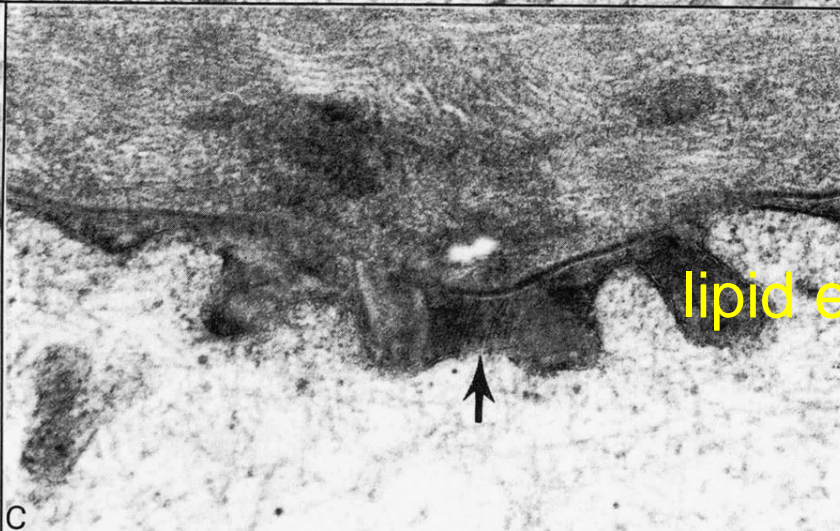




keratohyaline granules

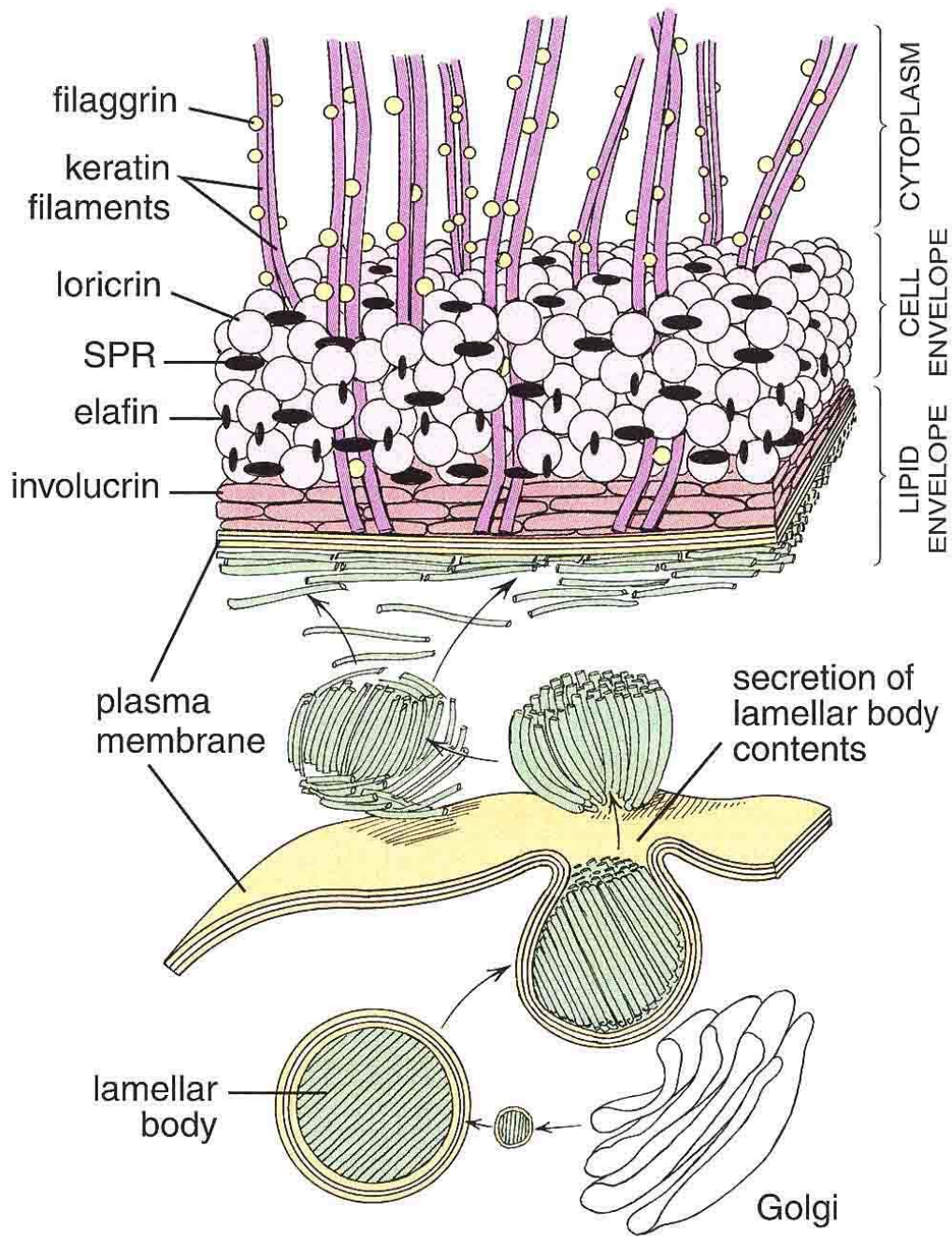


lamellar granules



lipid envelope

# lipid envelope



C

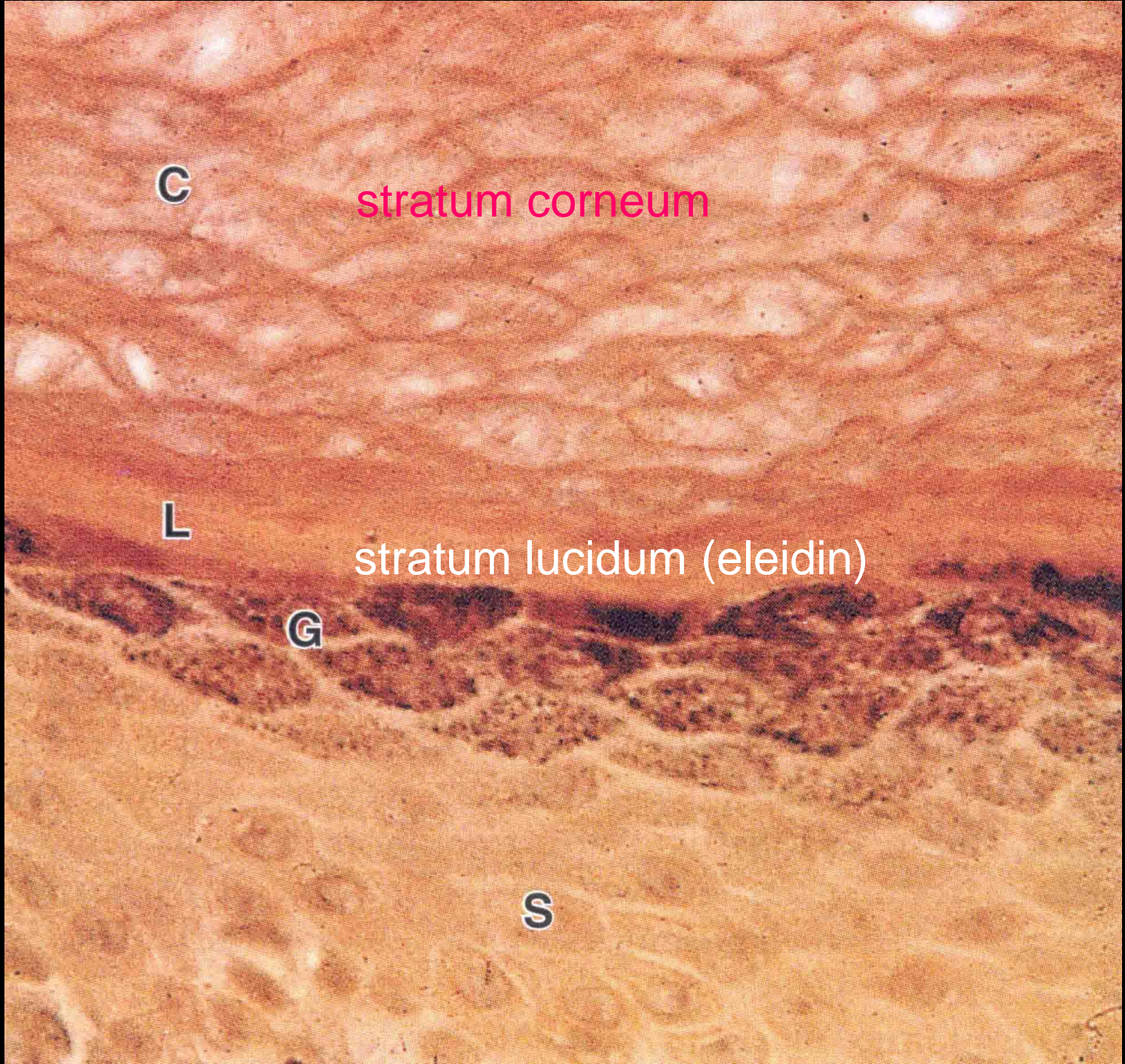
stratum corneum

L

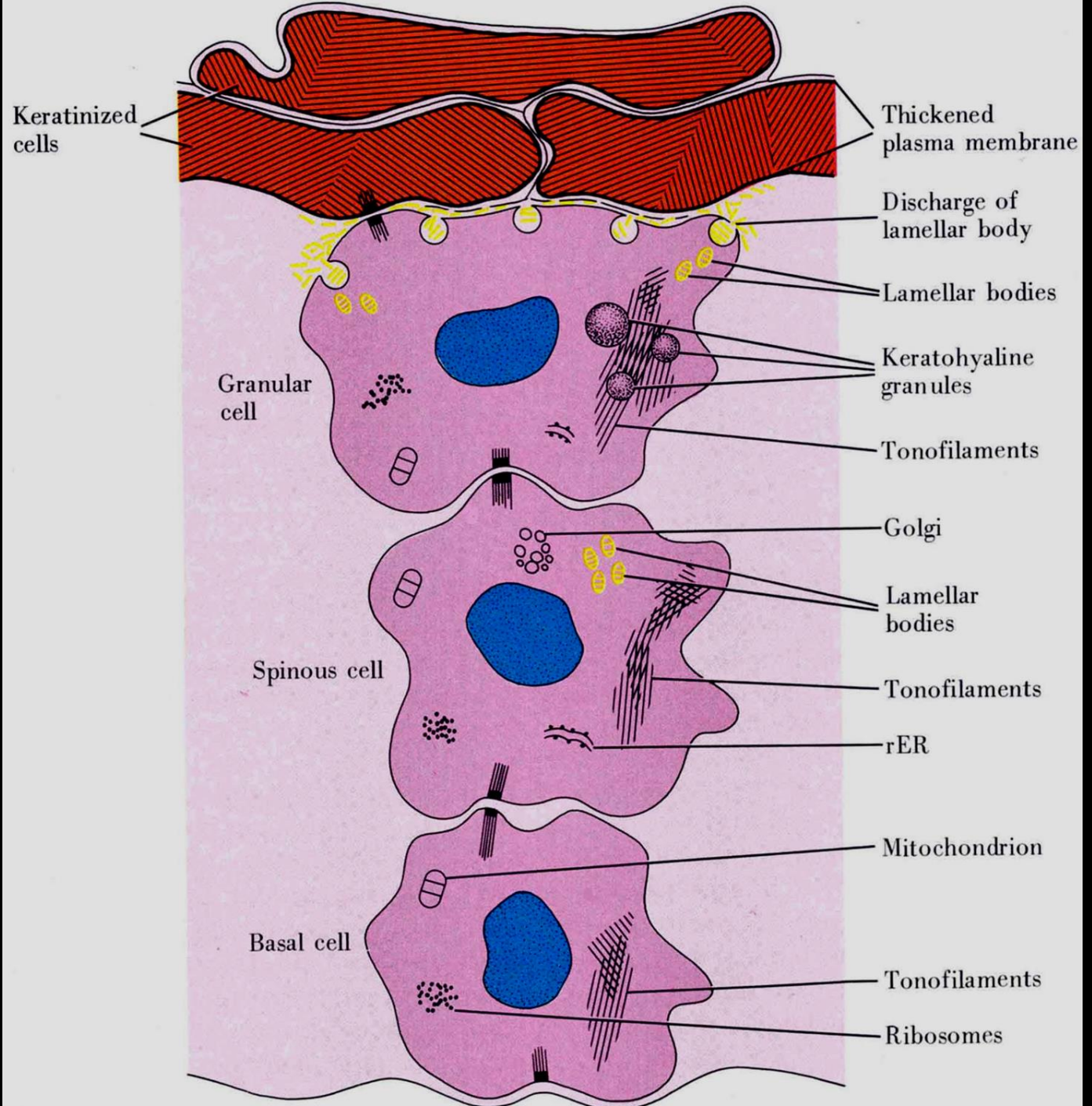
stratum lucidum (eleidin)

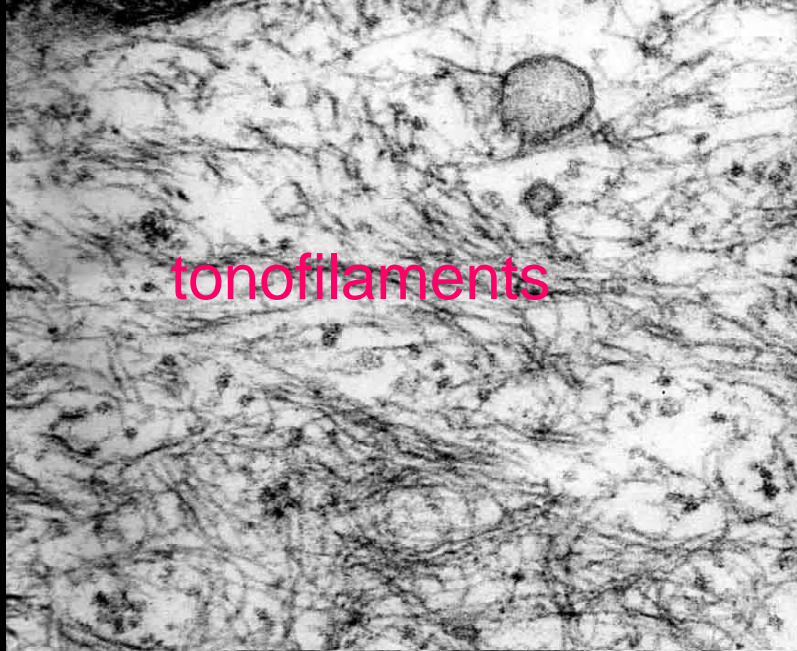
G

S

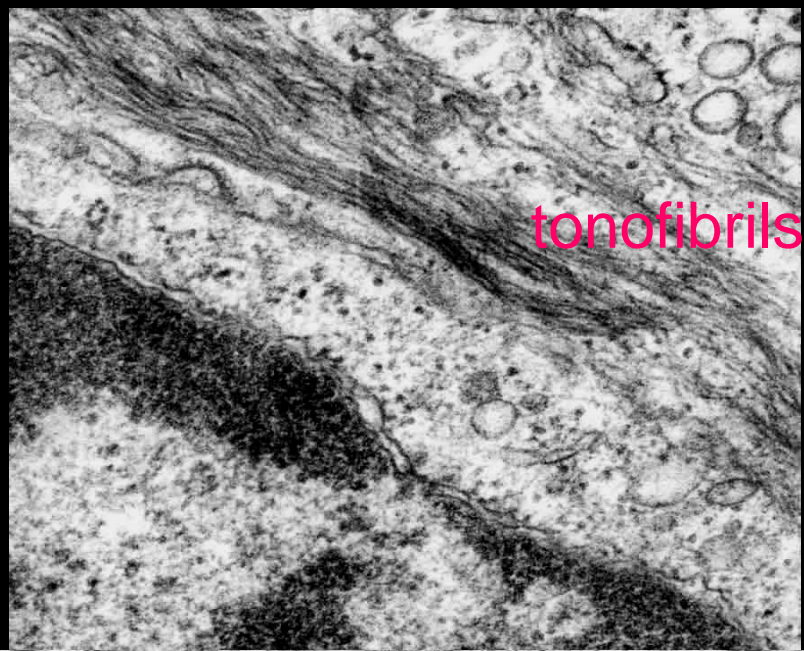


# Keratinization

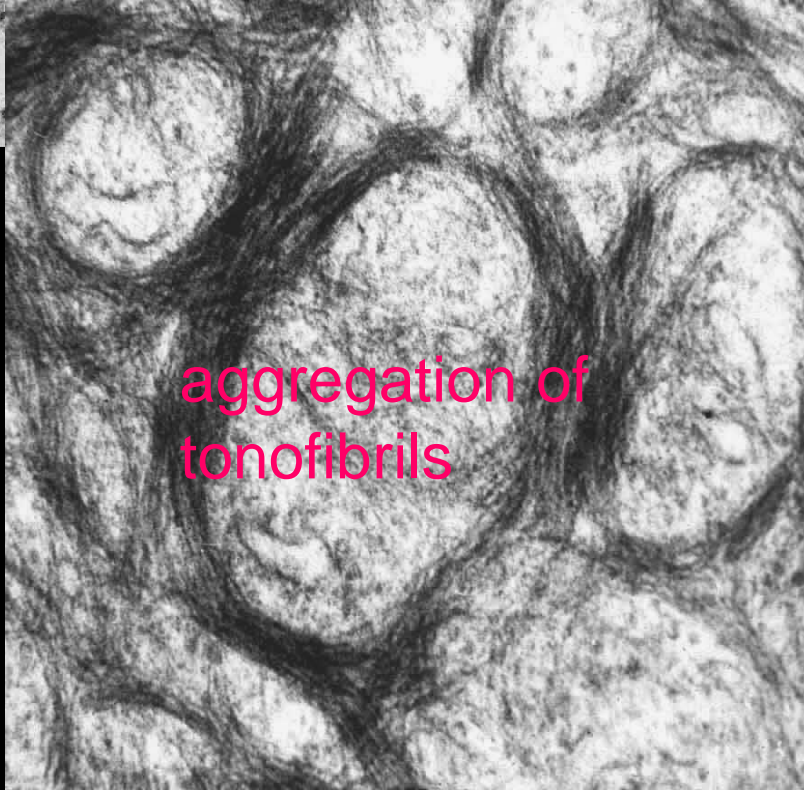




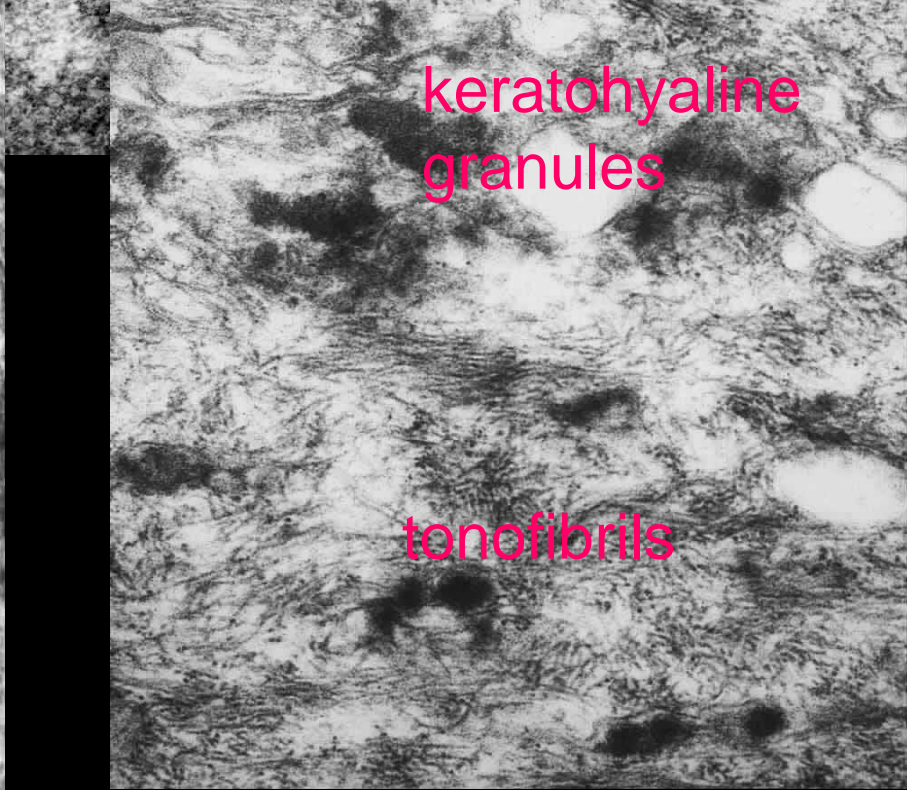
tonofilaments



tonofibrils



aggregation of tonofibrils

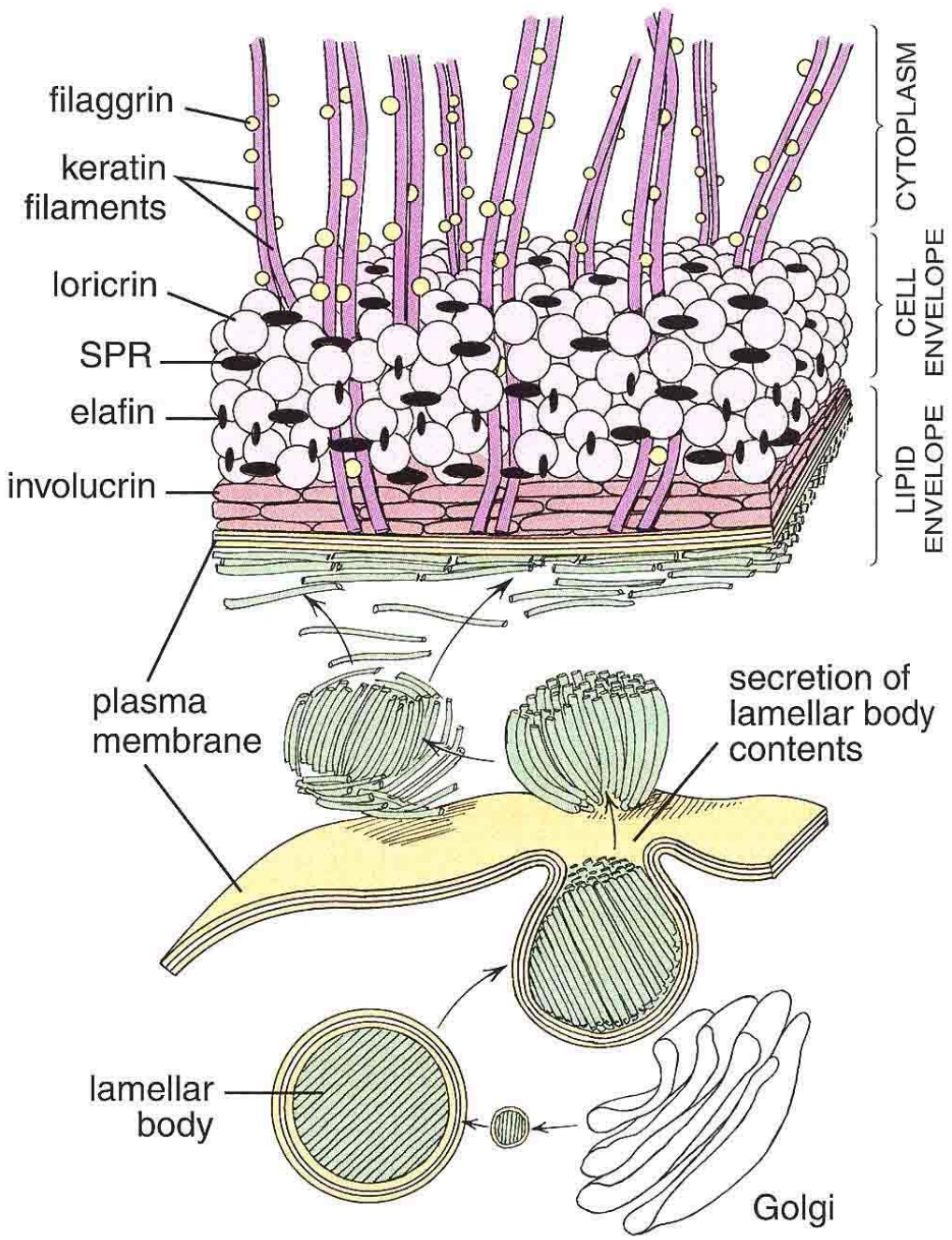


keratohyaline granules

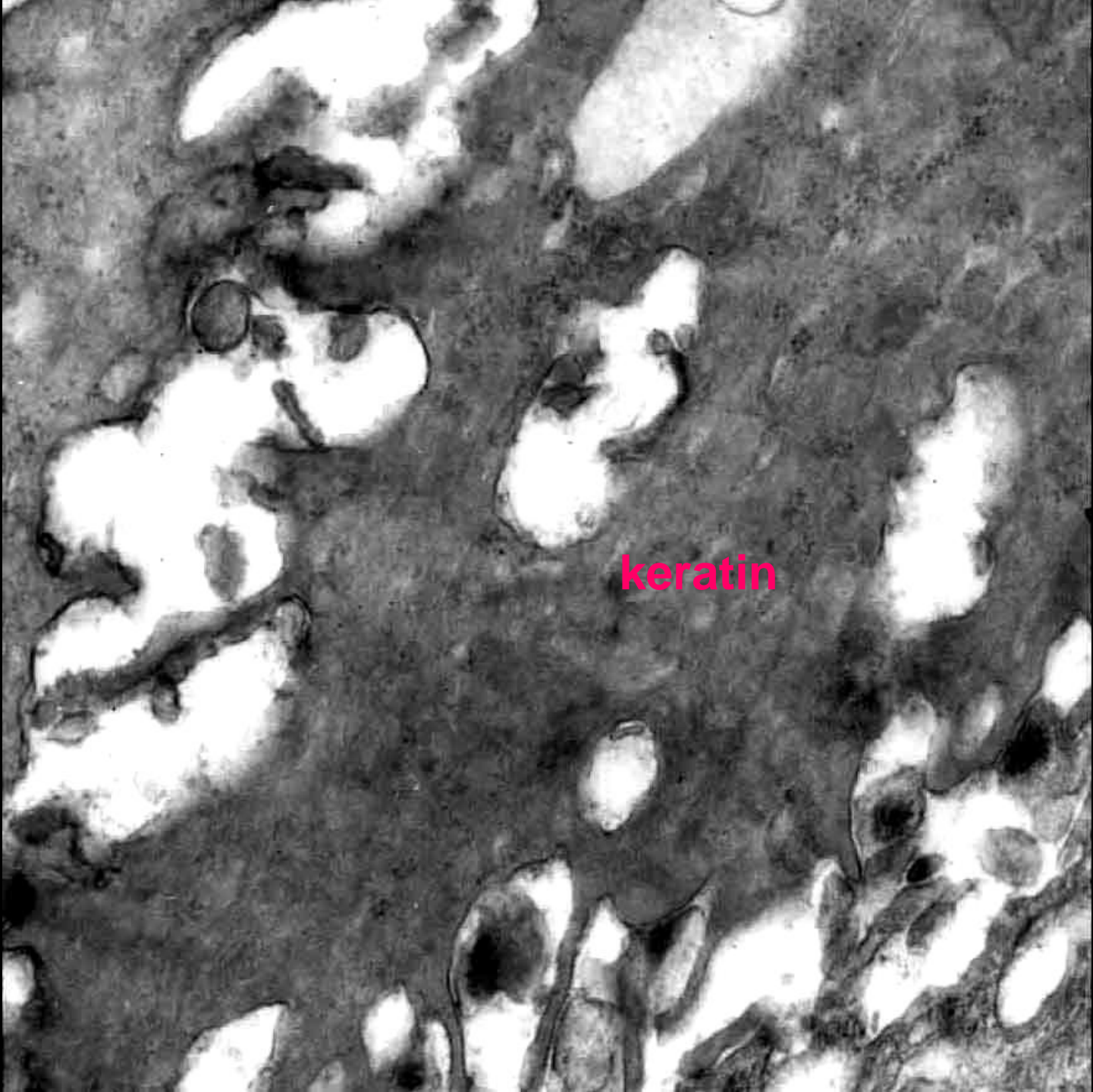
tonofibrils

keratin

cell envelope

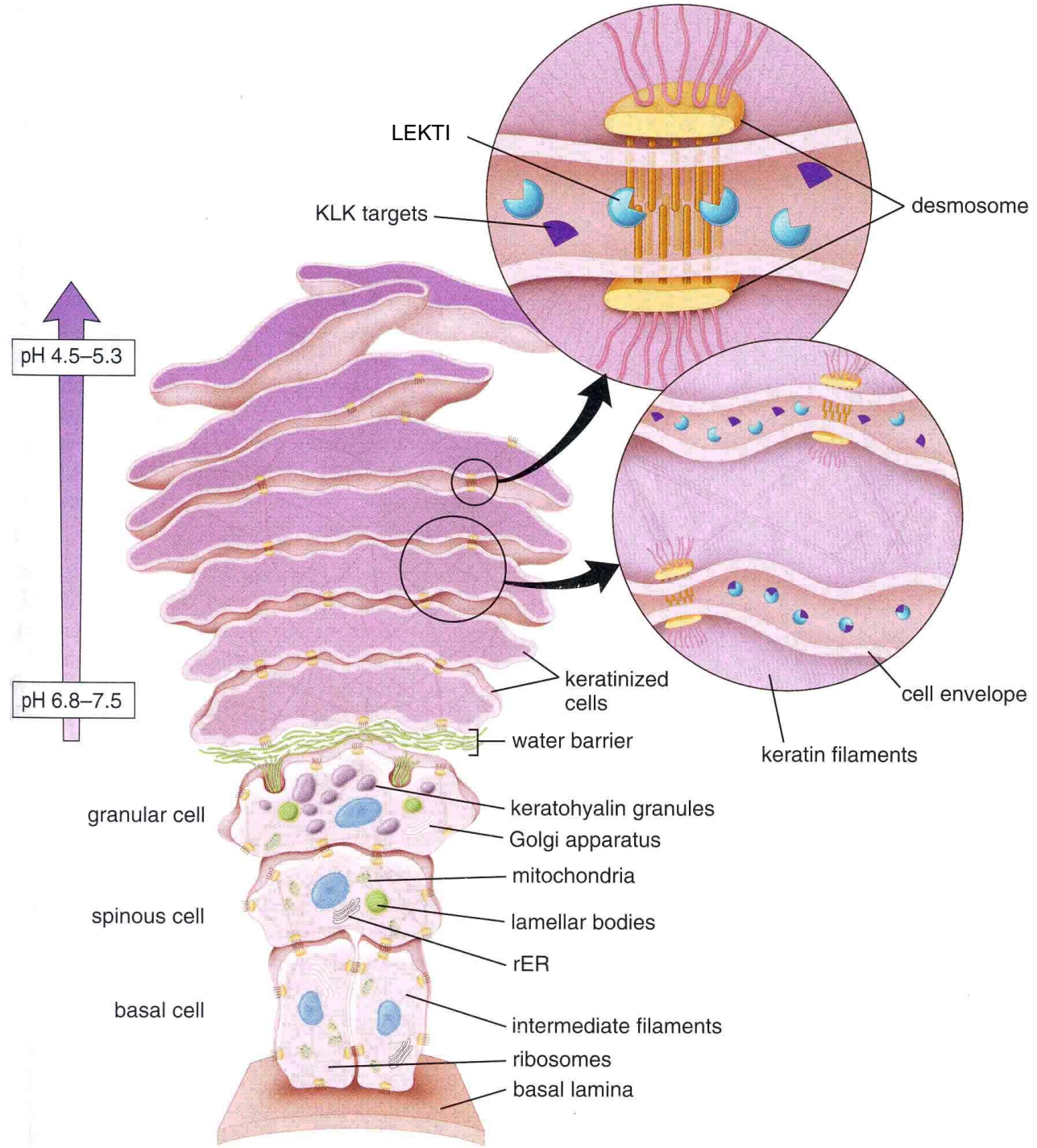






keratin

# desquamation

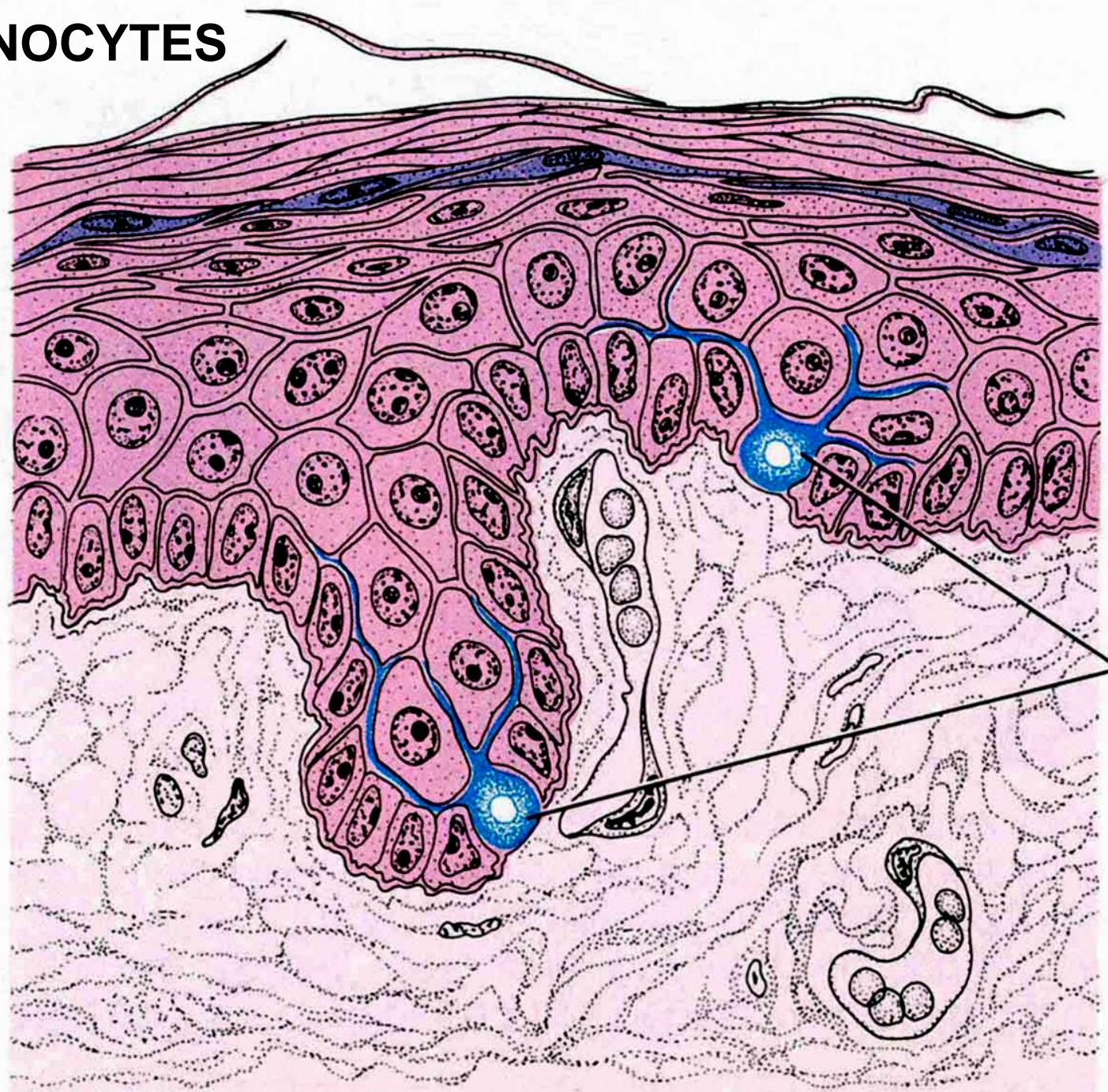


# MELANOCYTES

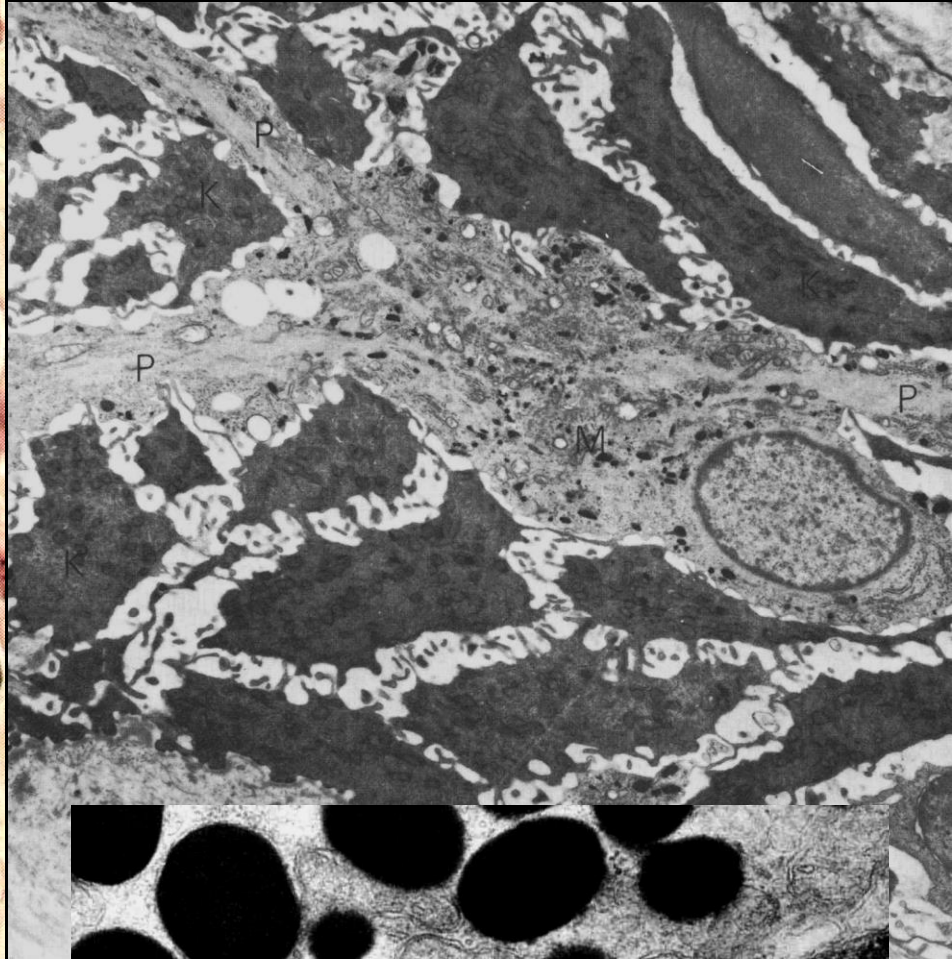
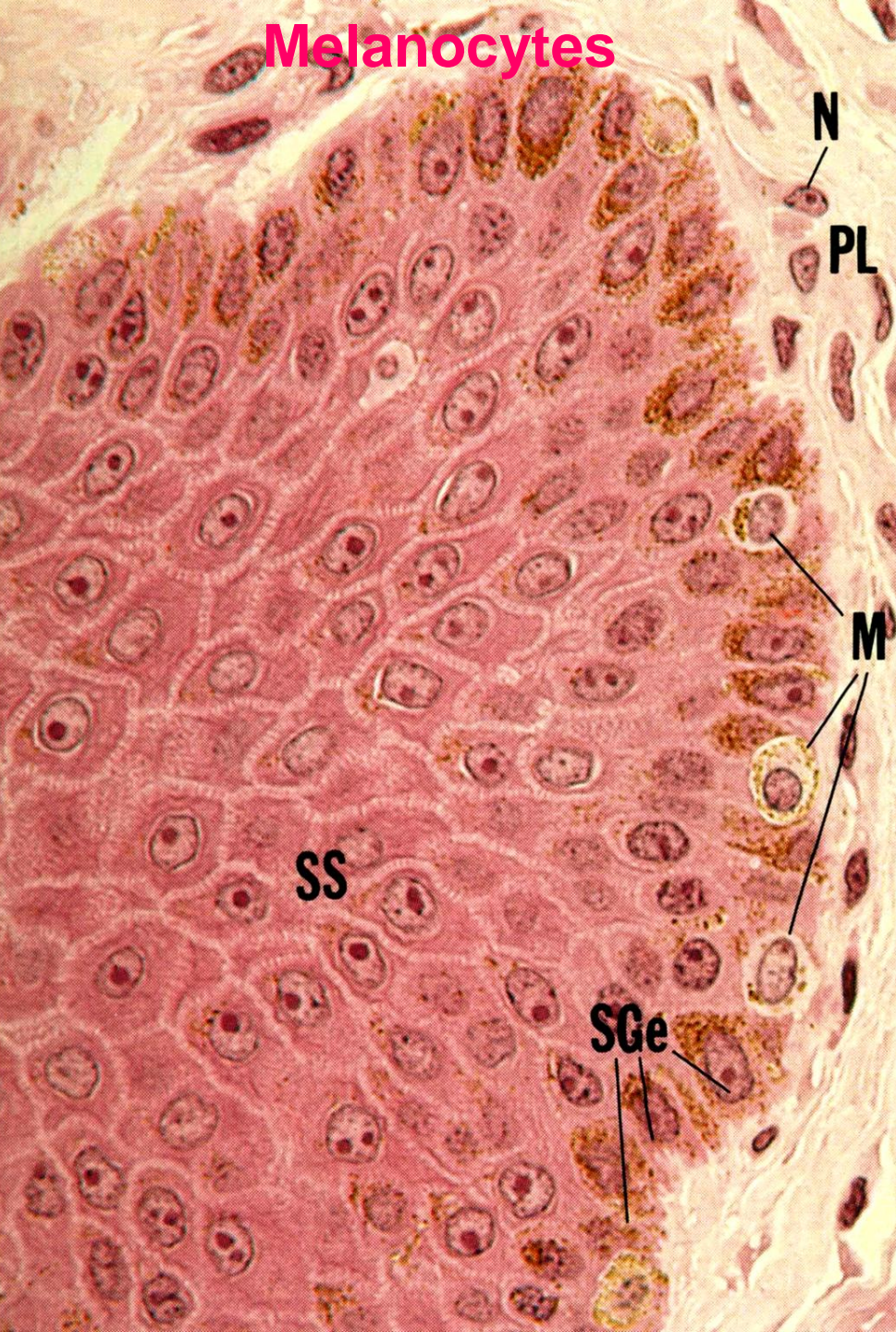
Epidermis

Dermis

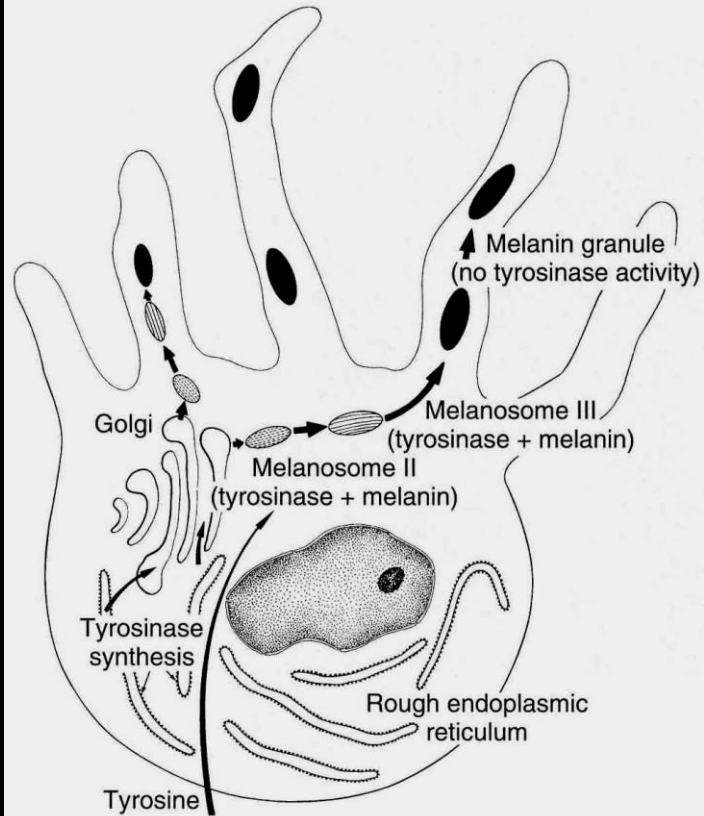
Melanocytes



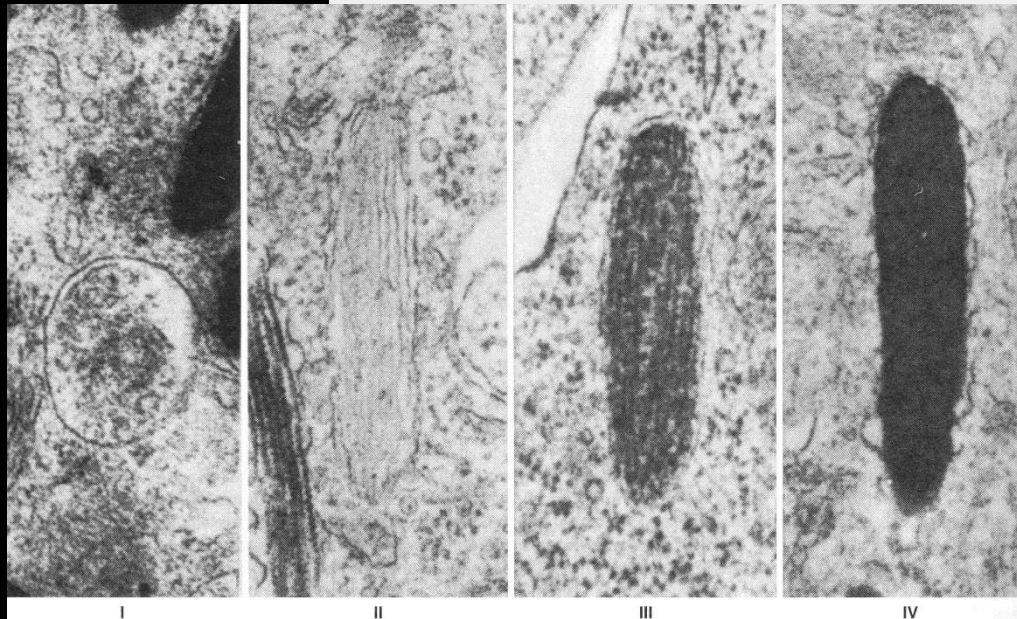
# Melanocytes



production of melanin



maturation of melanosomes

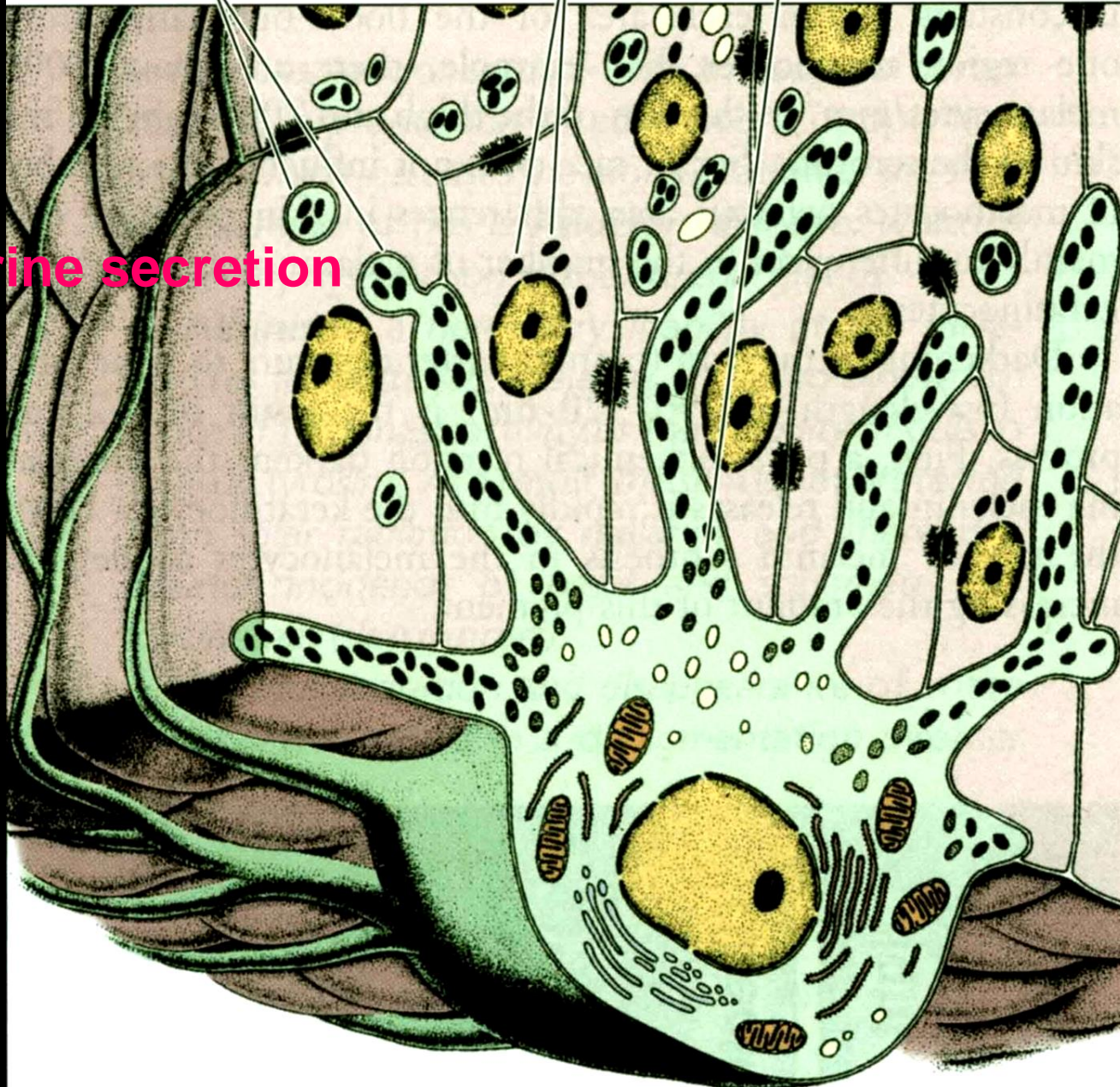


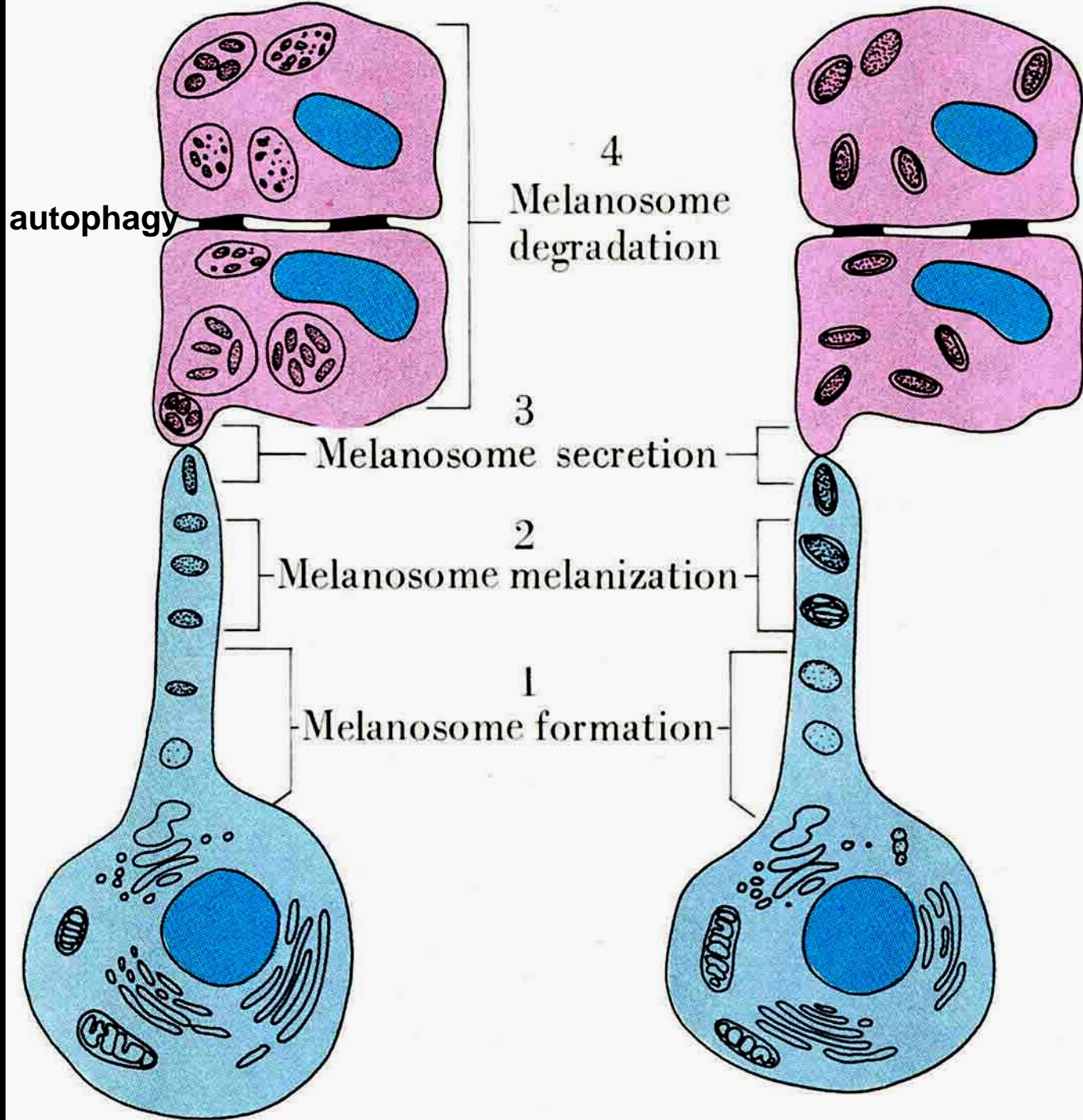
Budding melanin granules

Melanin granules

Developing melanin granule

cytokrine secretion





autophagy

4

Melanosome degradation

3

Melanosome secretion

2

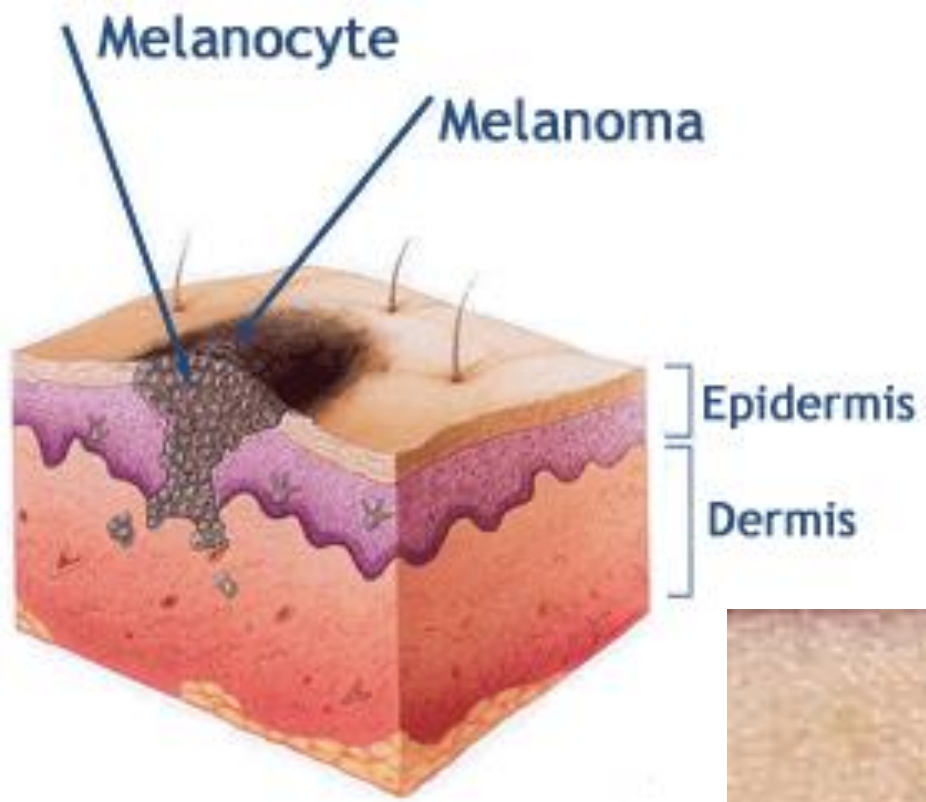
Melanosome melanization

1

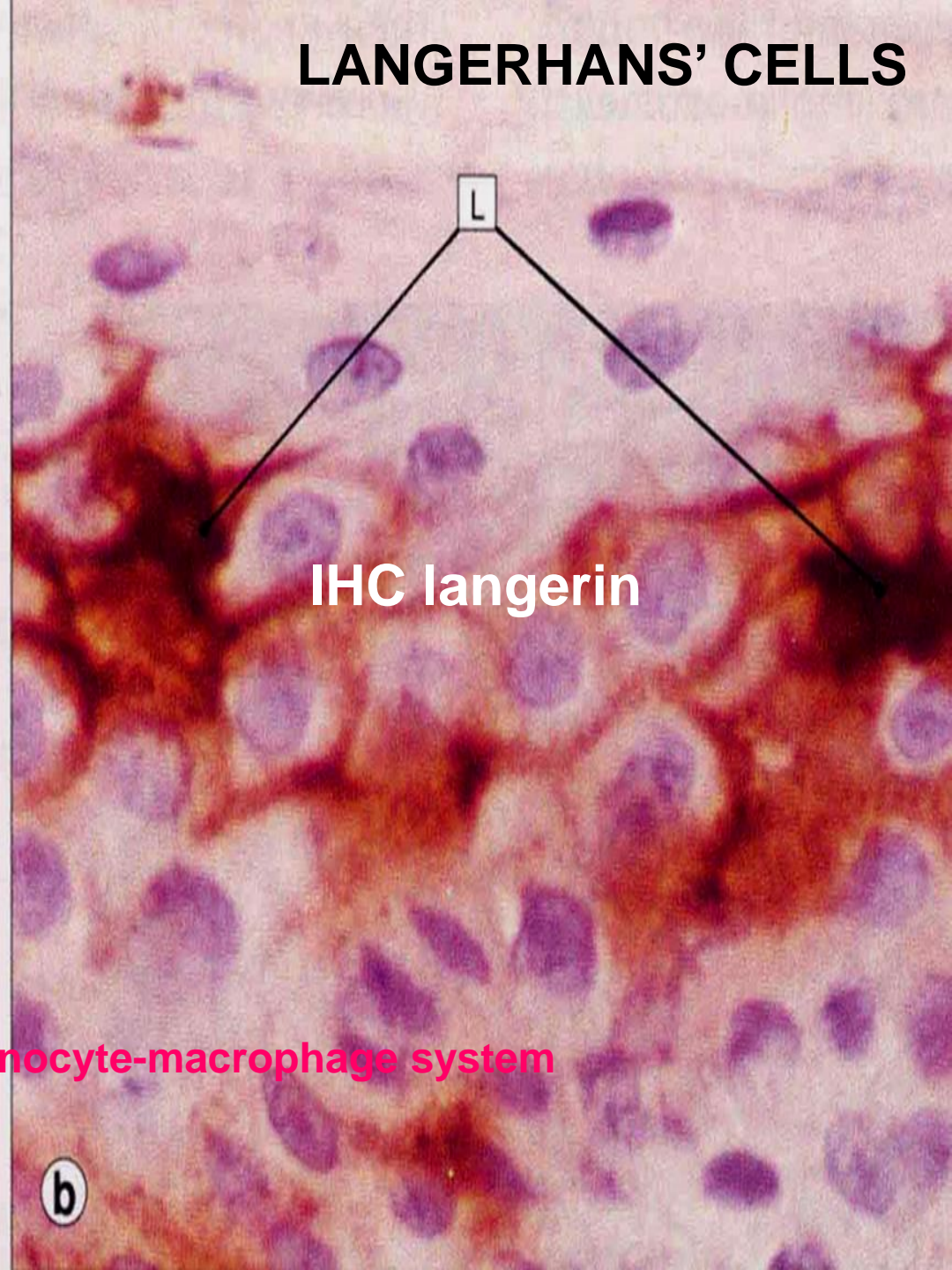
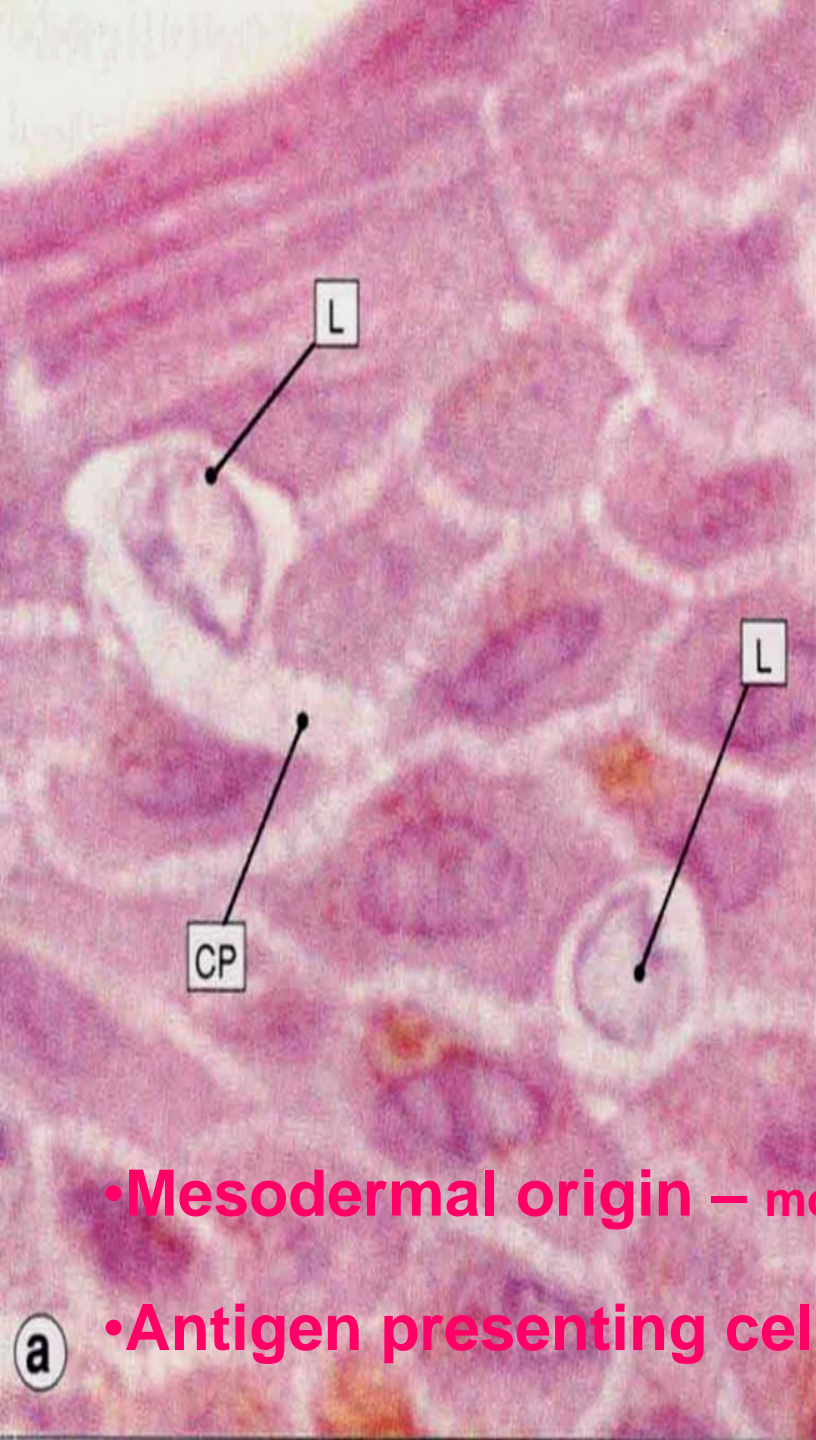
Melanosome formation

Caucasian

Negroid







• Mesodermal origin – monocyte-macrophage system

• Antigen presenting cell

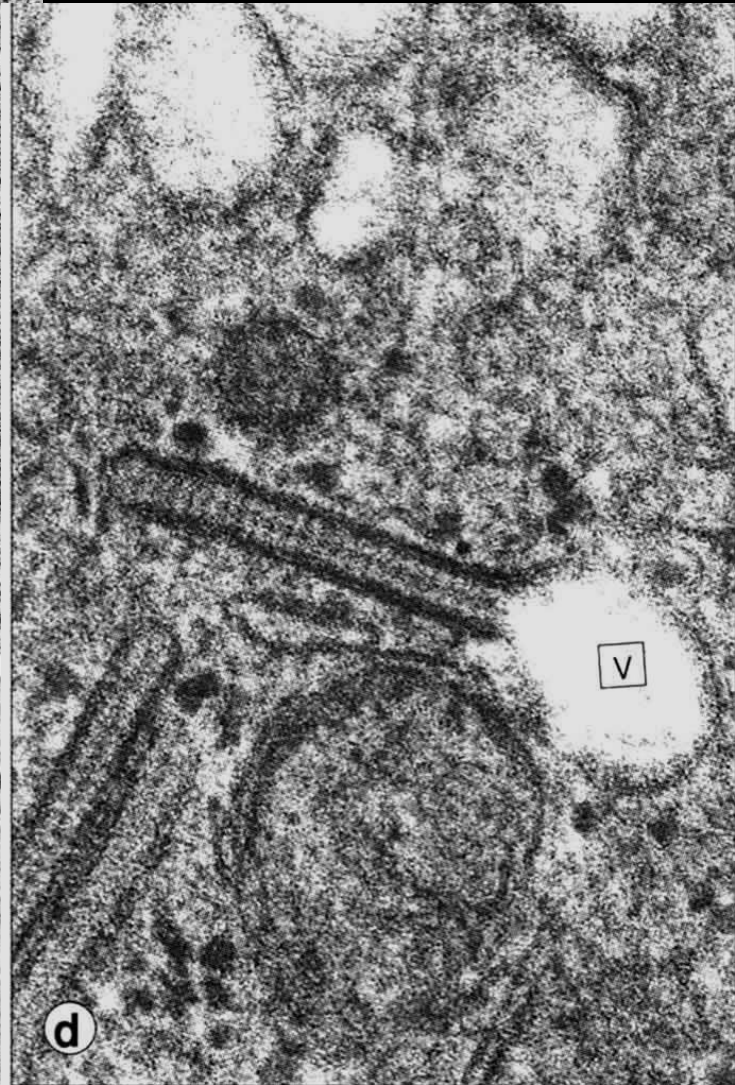
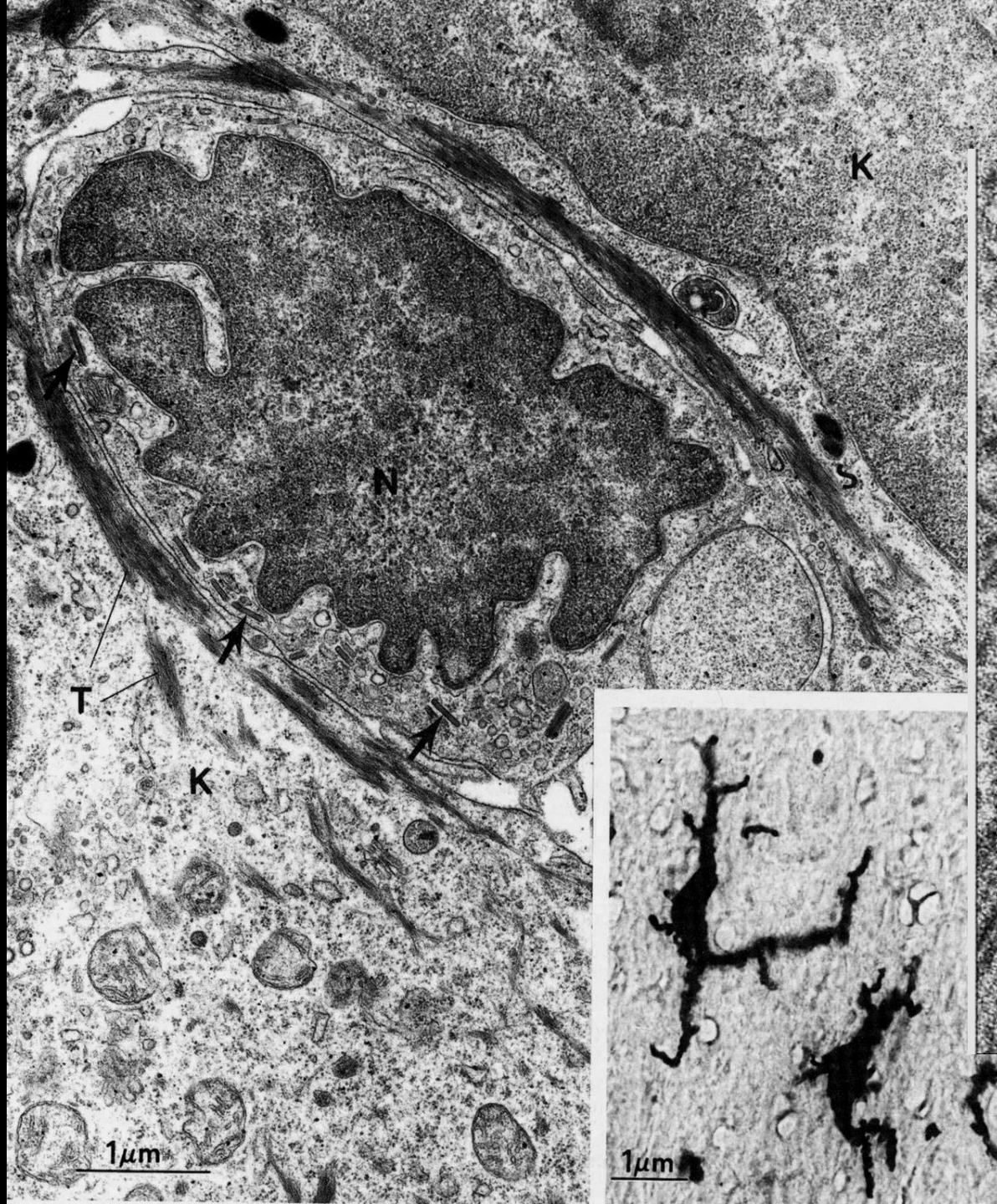
## LANGERHANS' CELLS

IHC langerin

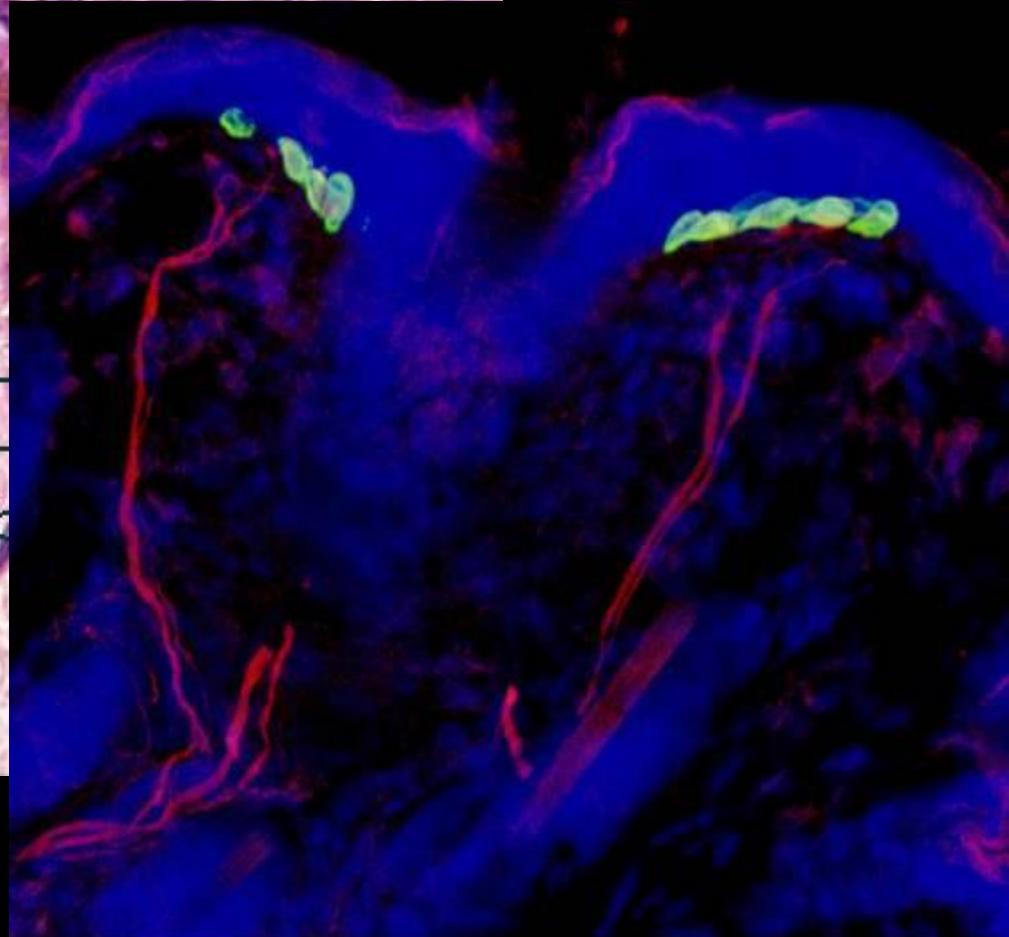
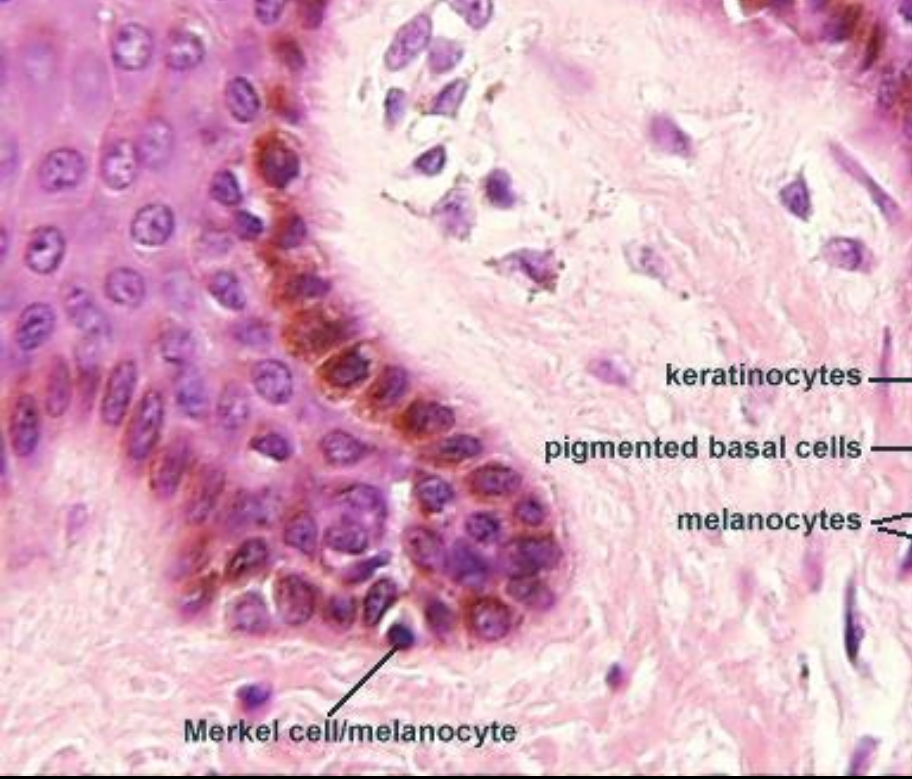
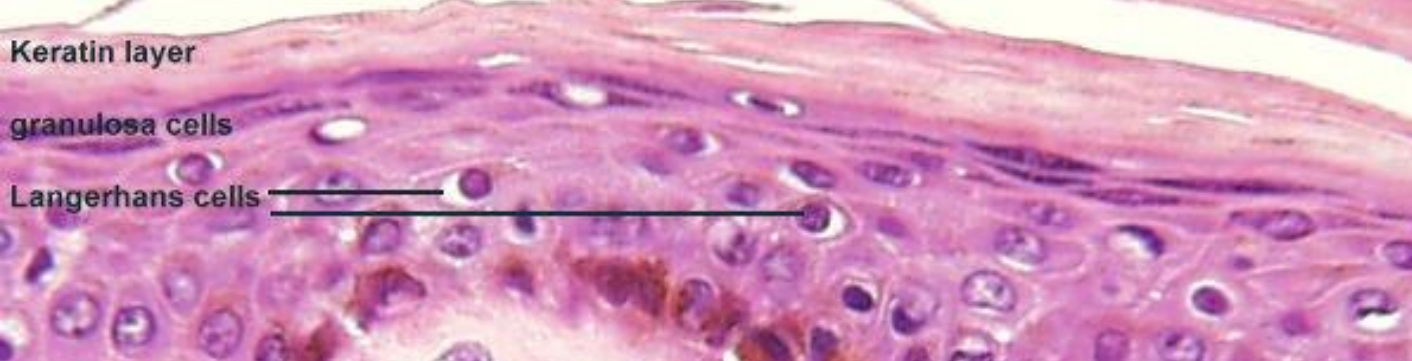
a

b

# Birbeck granules

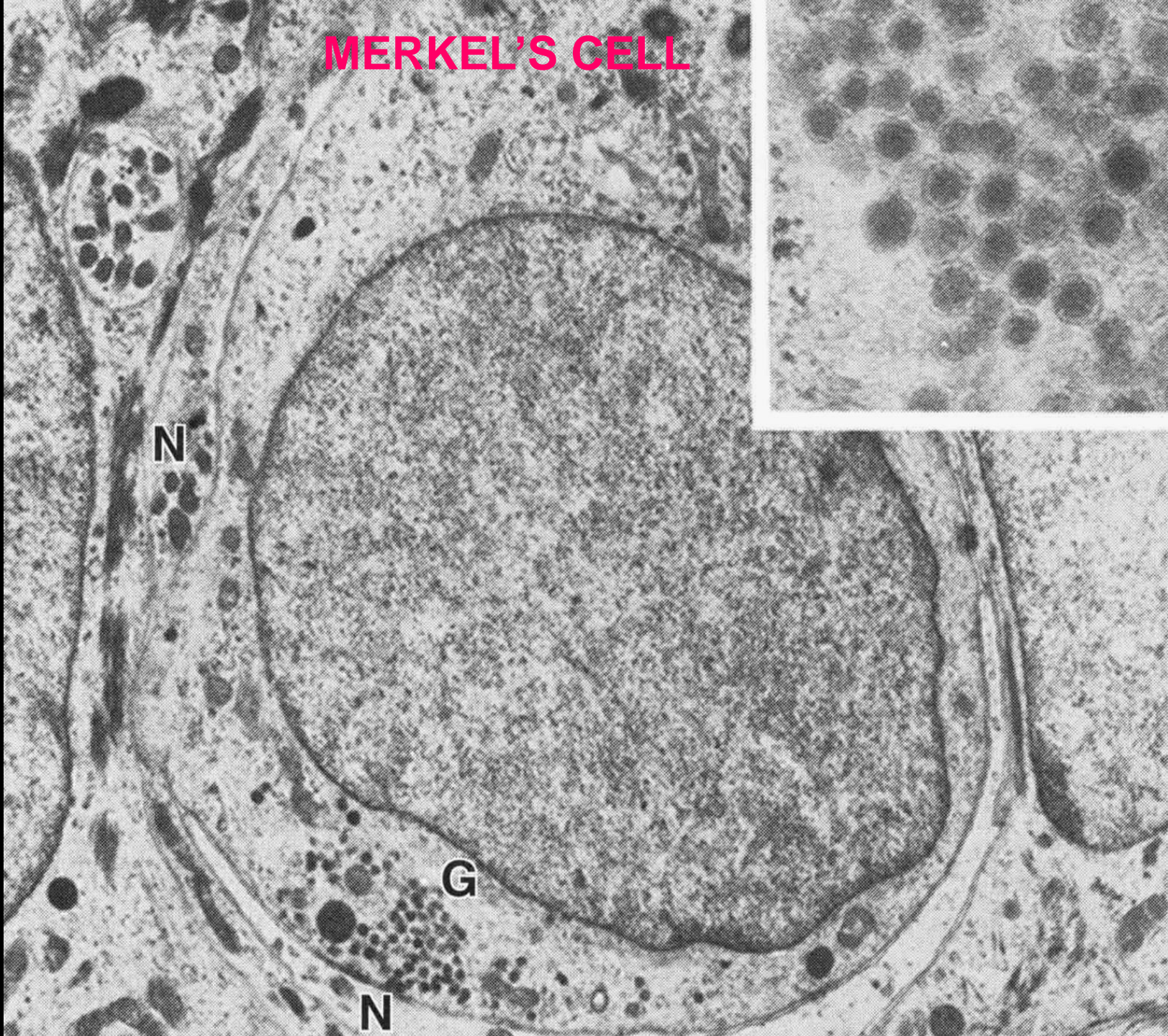


# MERKEL'S CELLS

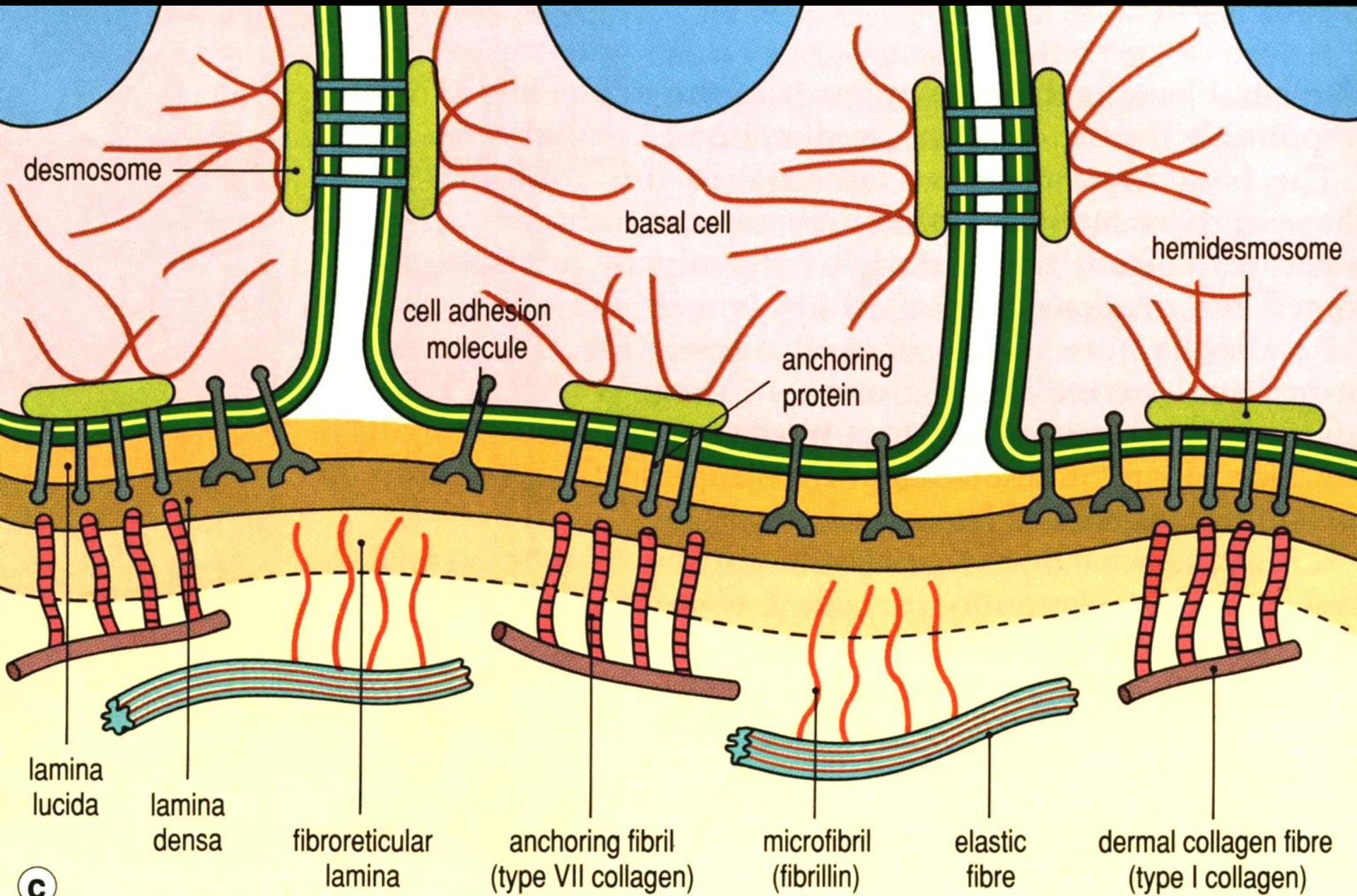


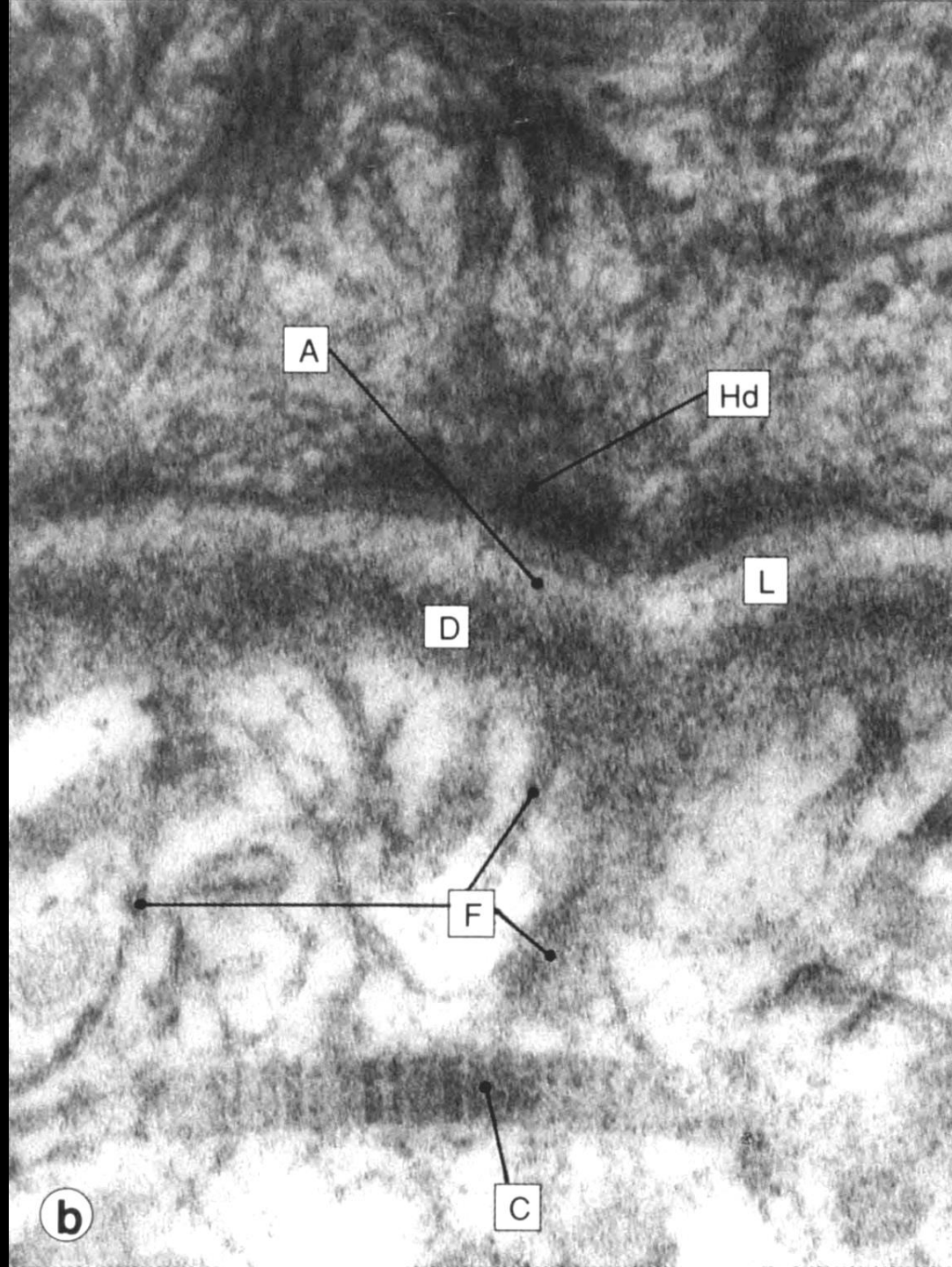
Skin touch dome with Merkel cells and innervating neurites

**MERKEL'S CELL**



# Dermo-epidermal junction



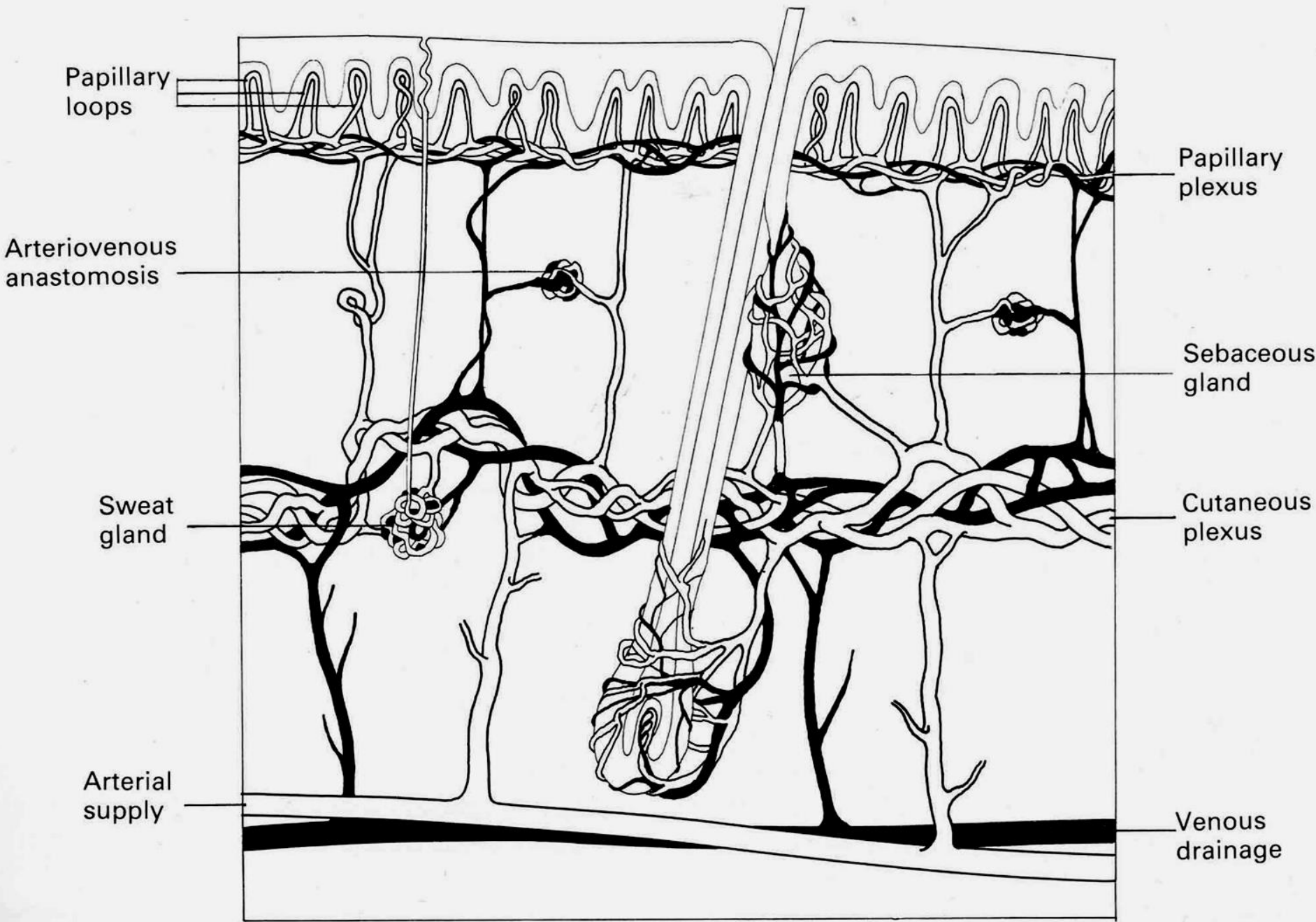


# Dermis



**stratum papillare**  
**papillary layer**  
loose connective tissue

**stratum reticulare**  
**reticular layer**  
dense irregular CT



Papillary loops

Arteriovenous anastomosis

Sweat gland

Arterial supply

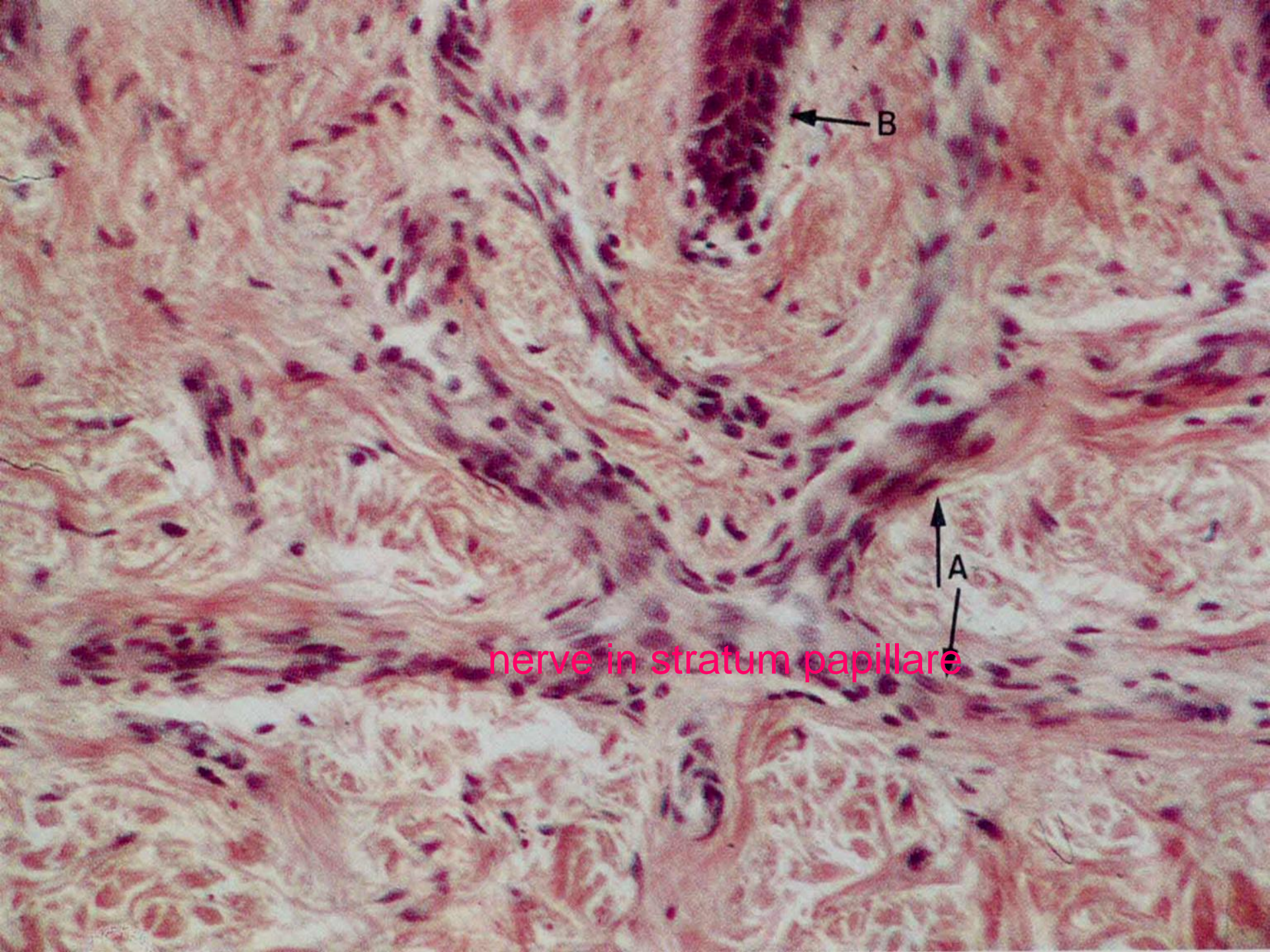
Papillary plexus

Sebaceous gland

Cutaneous plexus

Venous drainage





B

A

nerve in stratum papillare

# **Skin adnexa (appendages, derivatives)**

- **Hairs (piles, barbs, eyelashes)**
- **Nails**
- **Glands**
  - **sebaceous**
  - **sweat**
    - **eccrine**
    - **aromatic**
  - **mammary**

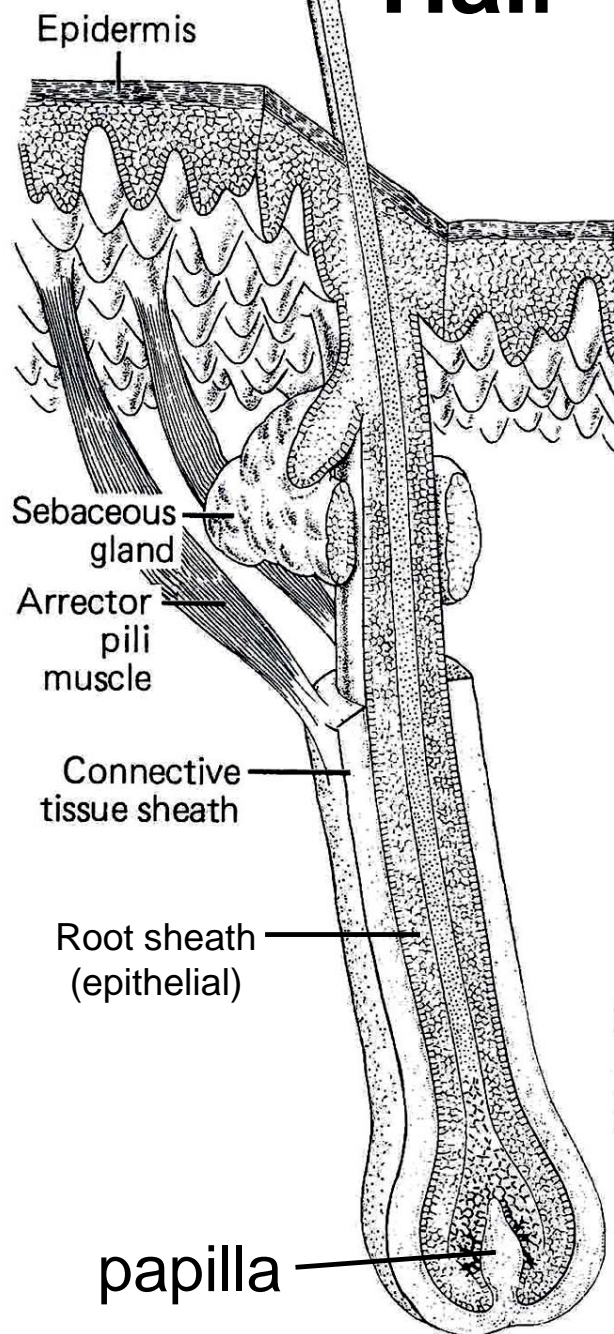
shaft

# Hair

neck

root

bulb



CT sheath

external root sheath

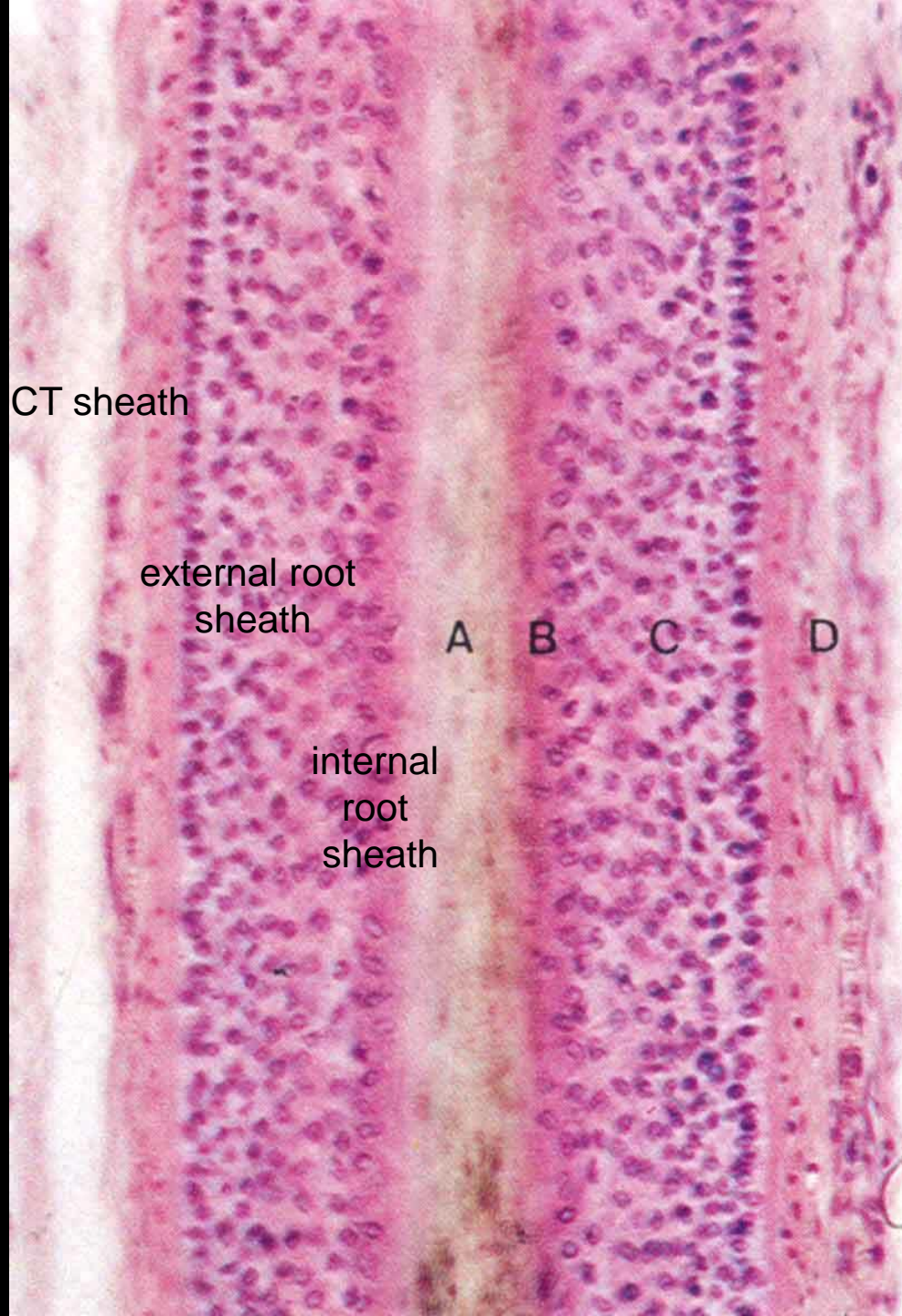
A

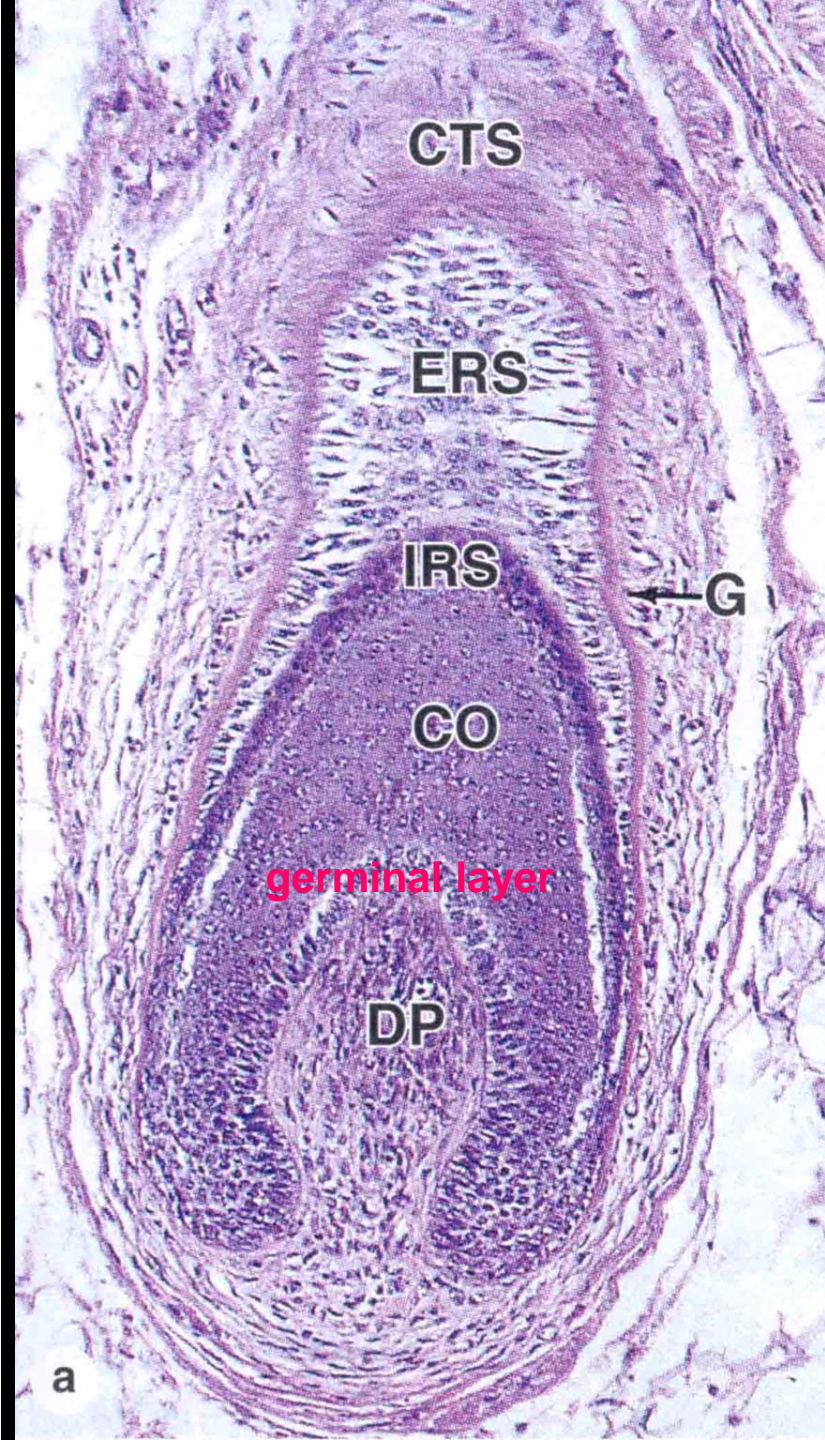
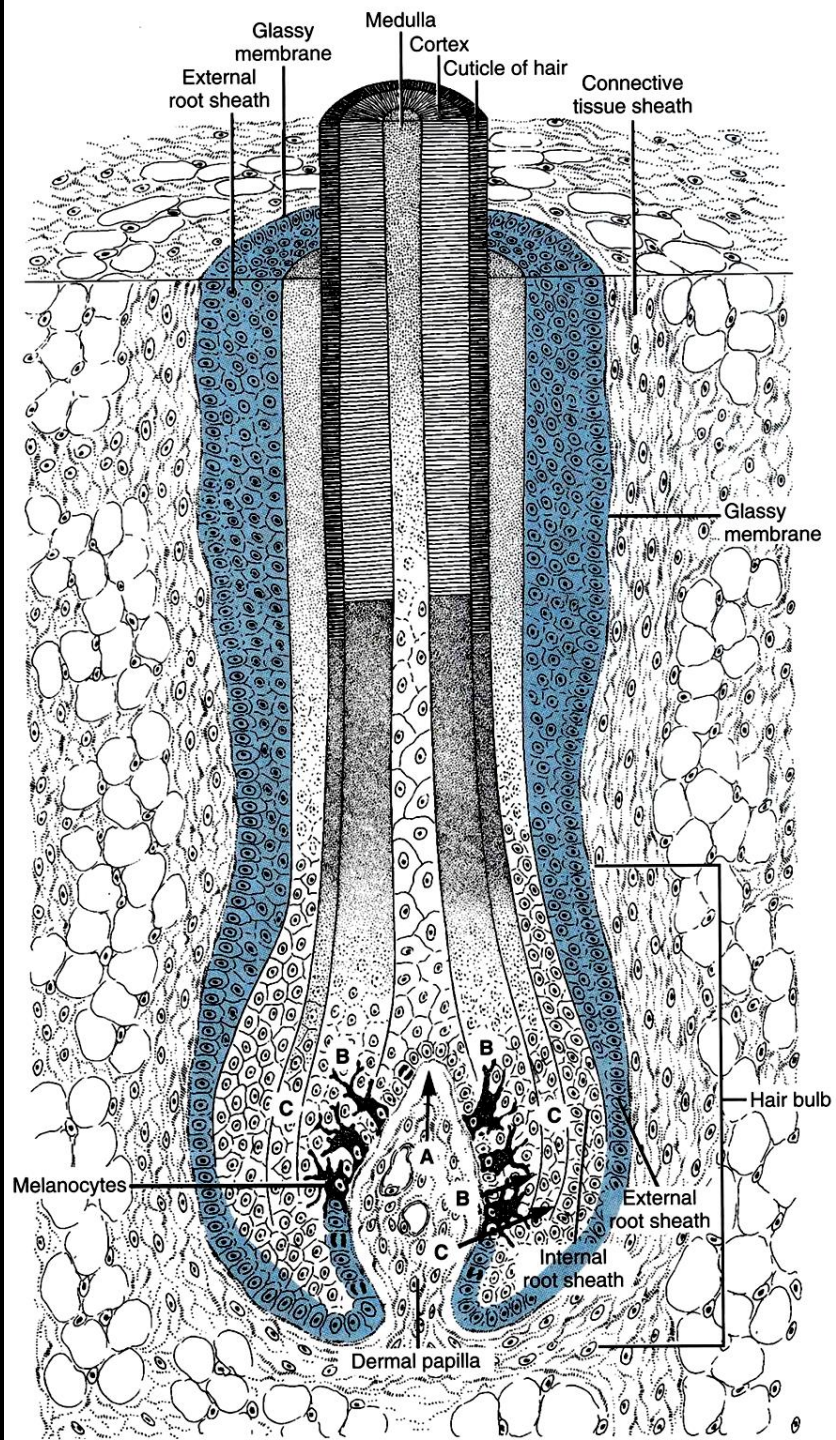
B

C

D

internal root sheath







hair  
cuticle

hair cortex

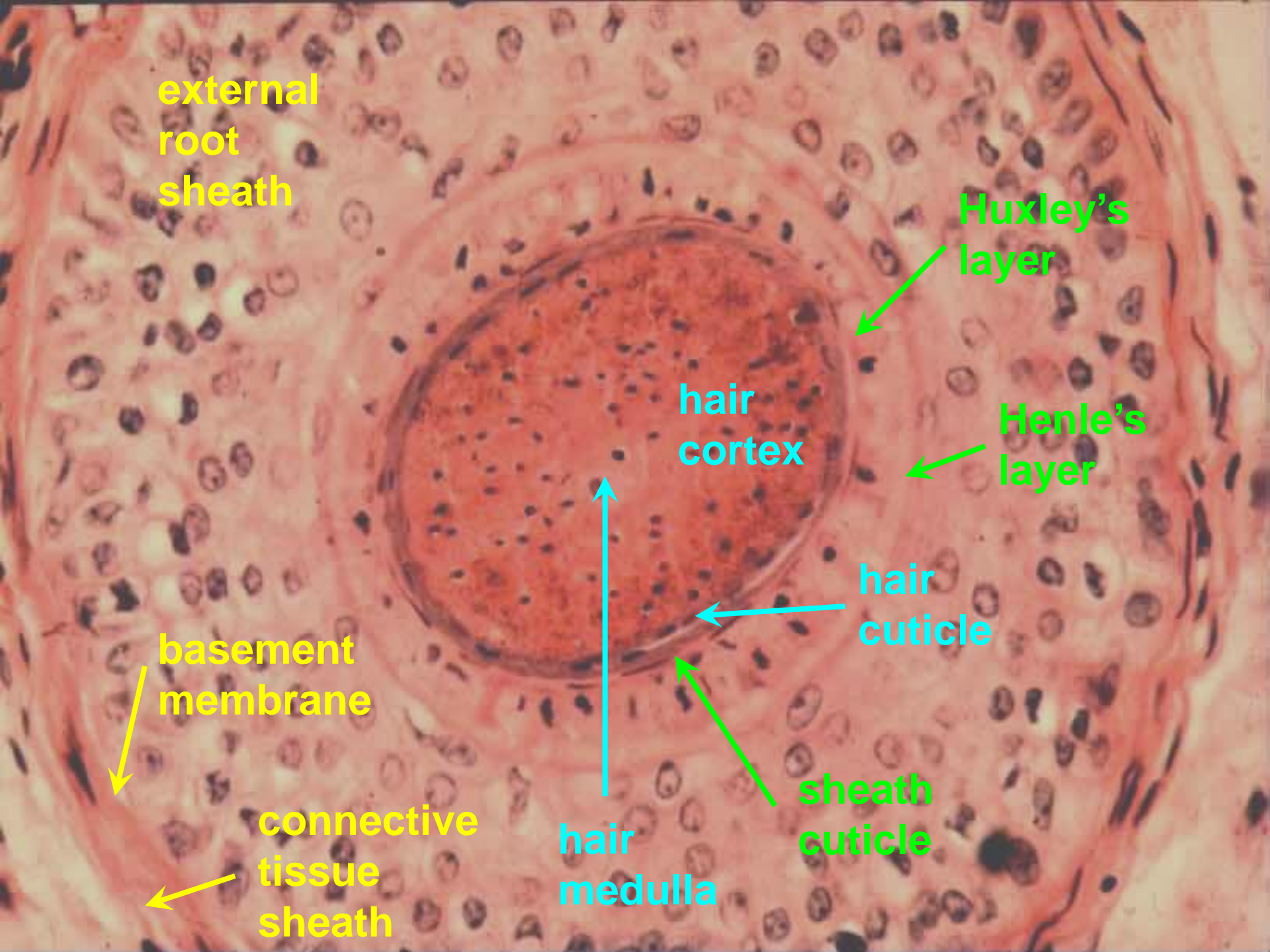
hair medulla



hair cortex

hair cuticle

hair medulla



external  
root  
sheath

Huxley's  
layer

Henle's  
layer

hair  
cortex

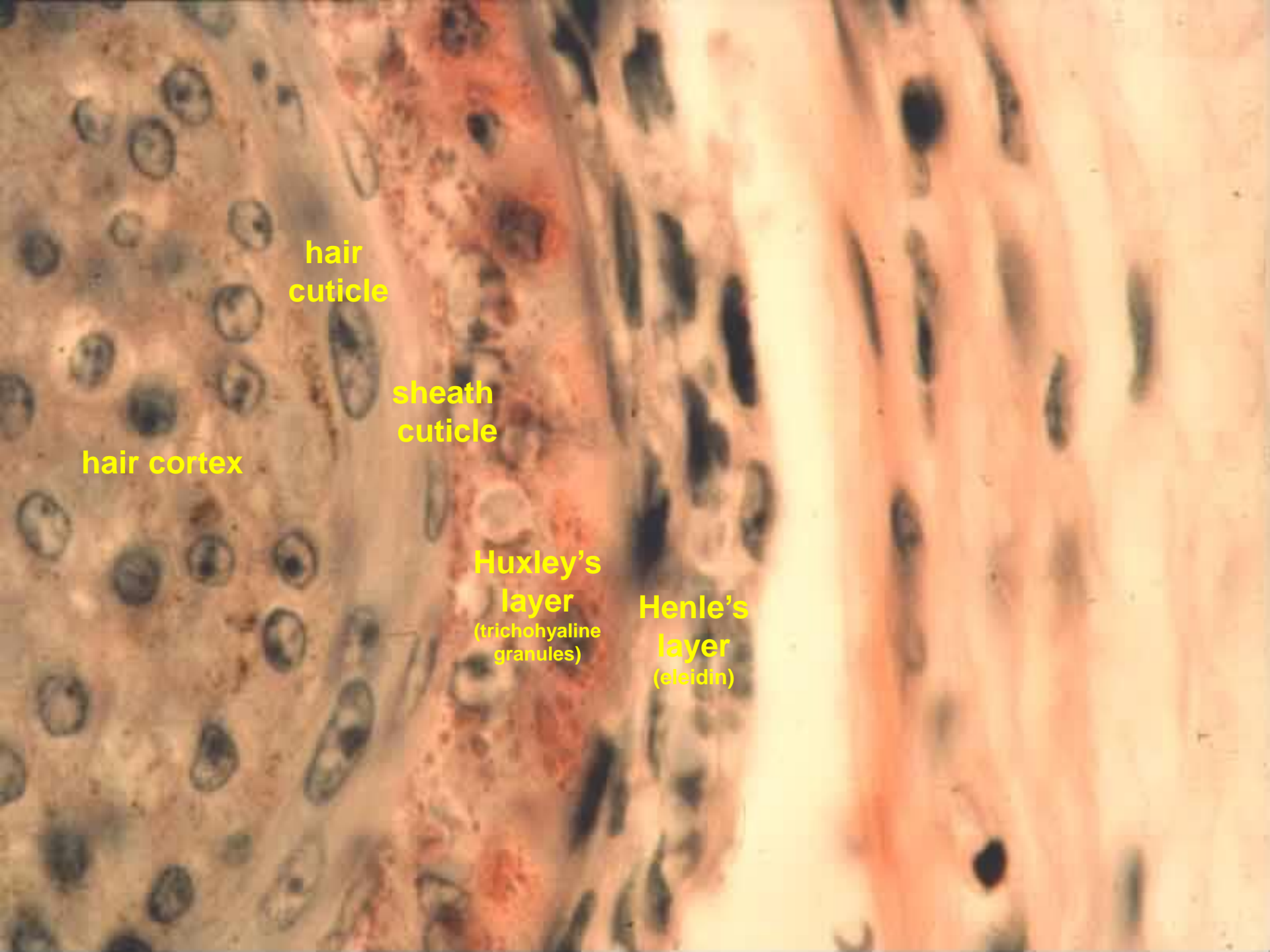
hair  
cuticle

basement  
membrane

sheath  
cuticle

connective  
tissue  
sheath

hair  
medulla



hair  
cuticle

sheath  
cuticle

hair cortex

Huxley's  
layer  
(trichohyaline  
granules)

Henle's  
layer  
(eleidin)

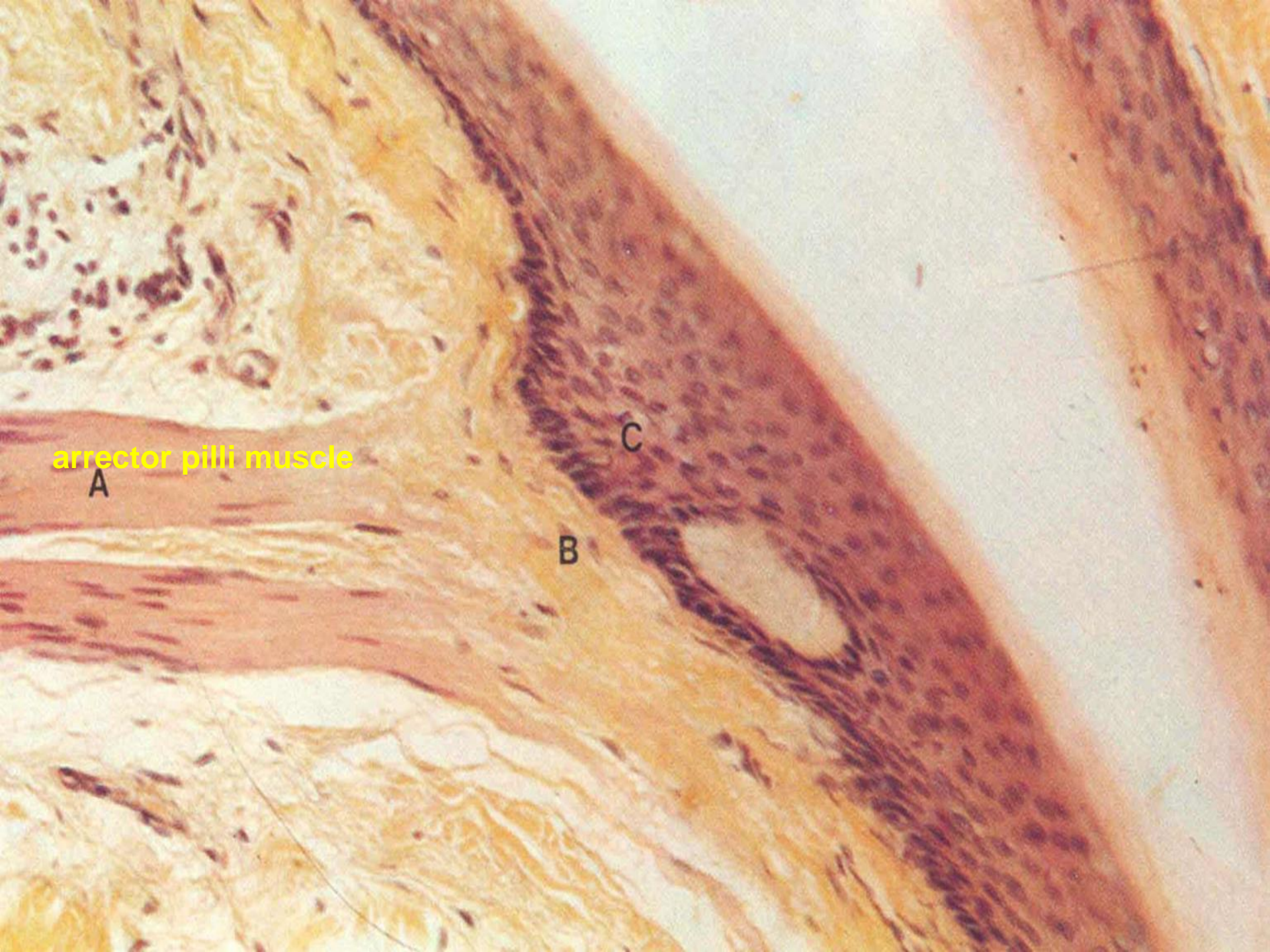


arrector pili muscle

A

B

C



- Downy / Primary hair - lanugo

- Secondary hair

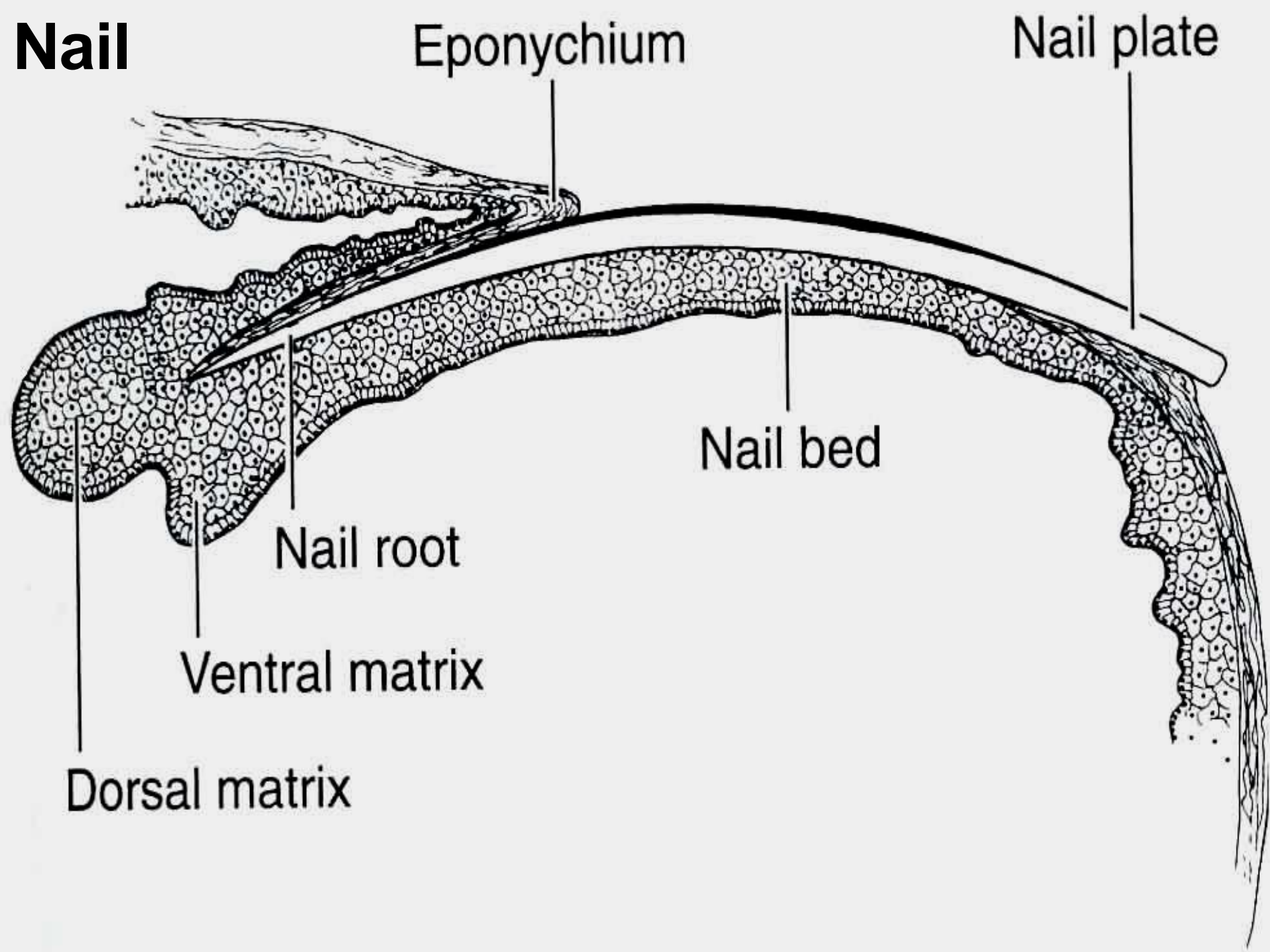
- hair – *pilli, capilli*
- eyebrows - *supercilia*
- eyelashes - *cilia*

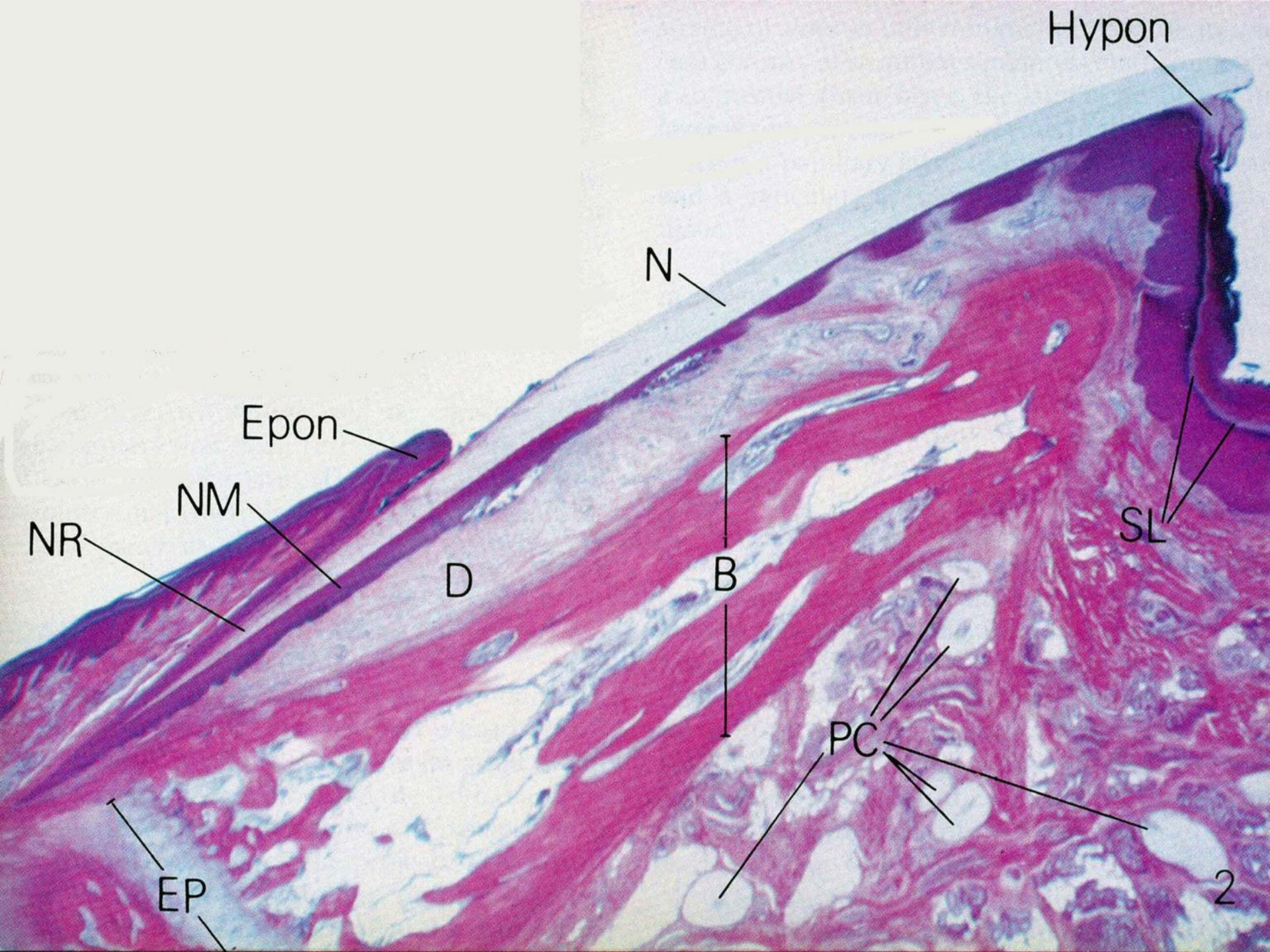
- Tertiary hair

- beard – *barba*
- axial hair - *hirci*
- pubic hair - *pubes*
- vestibulum nasi – *vibrissae*
- external auditory meatus - *tragi*



# Nail

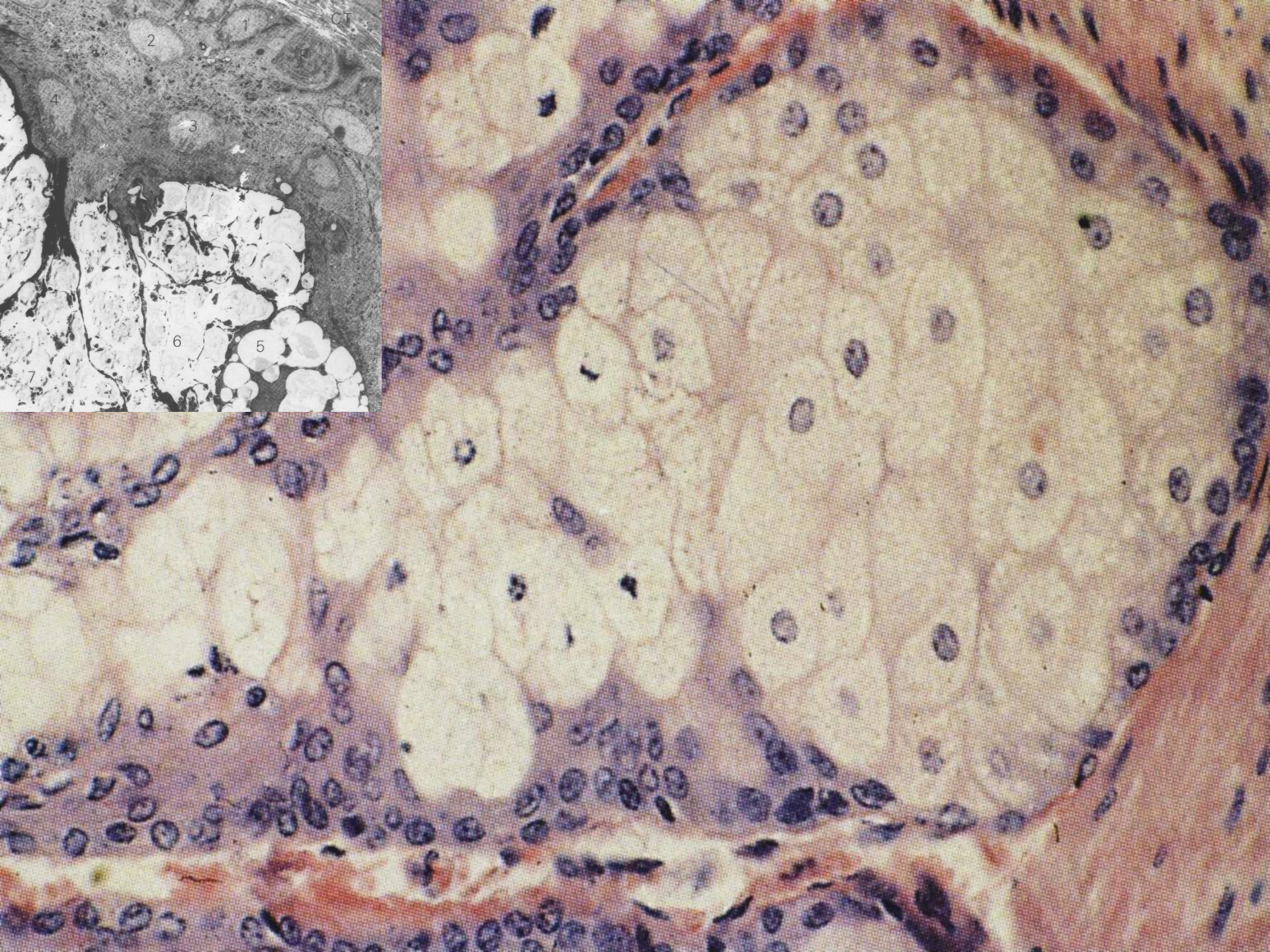
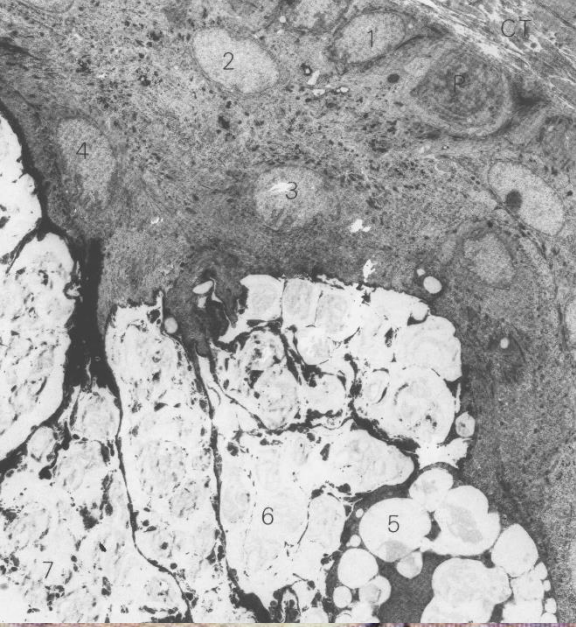




# Sebaceous glands

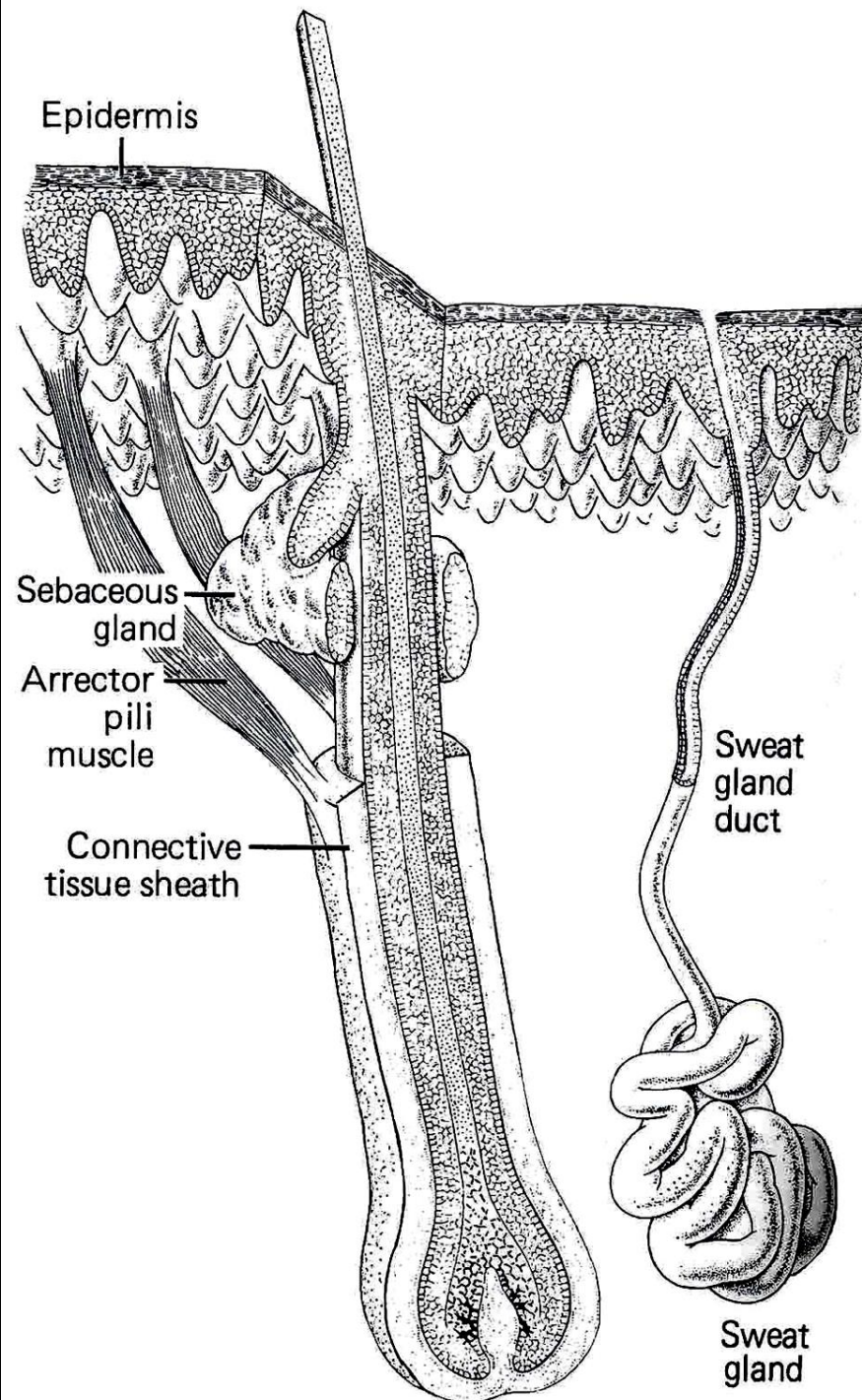
branched alveolar  
holocrine secretion

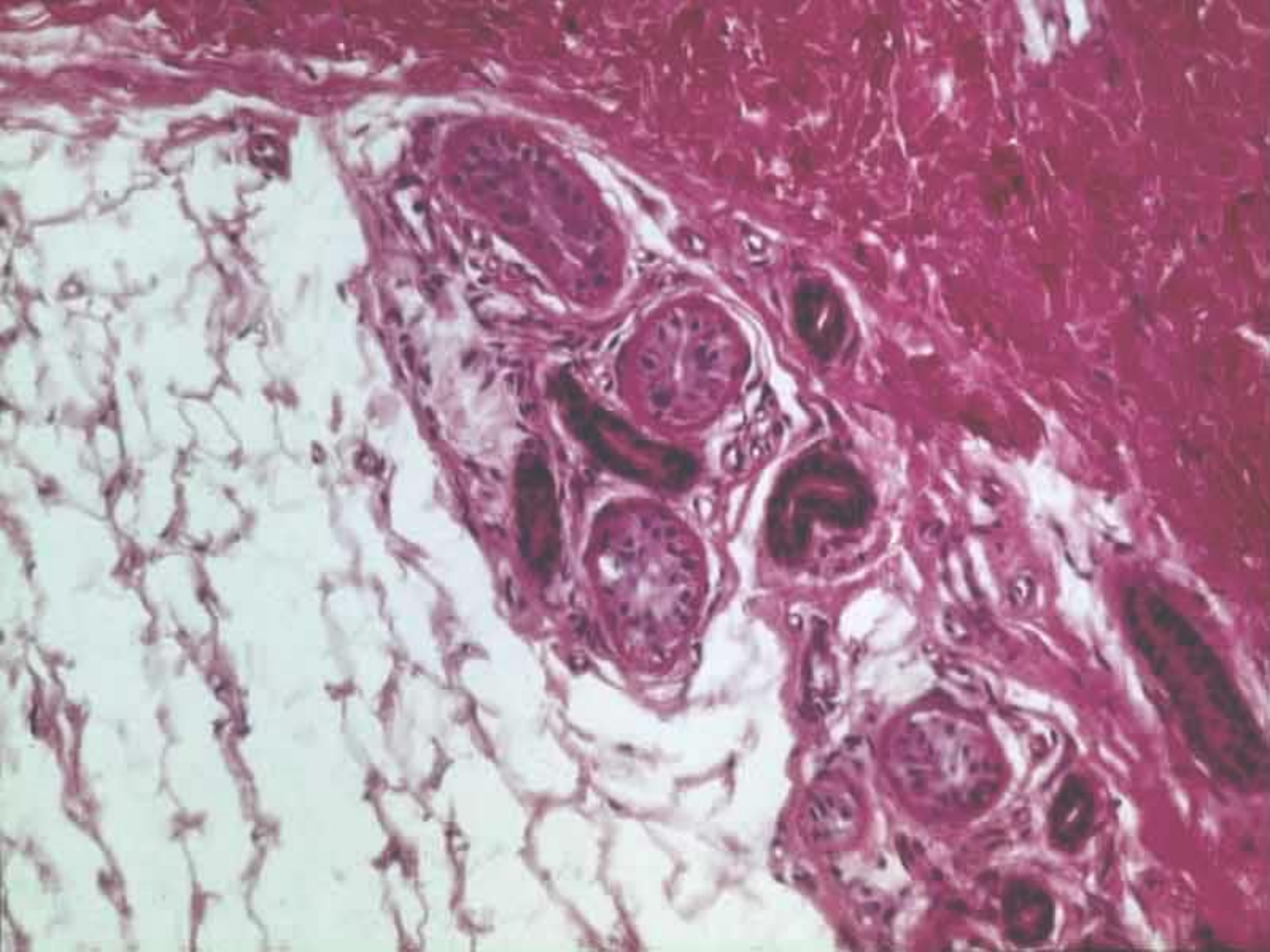




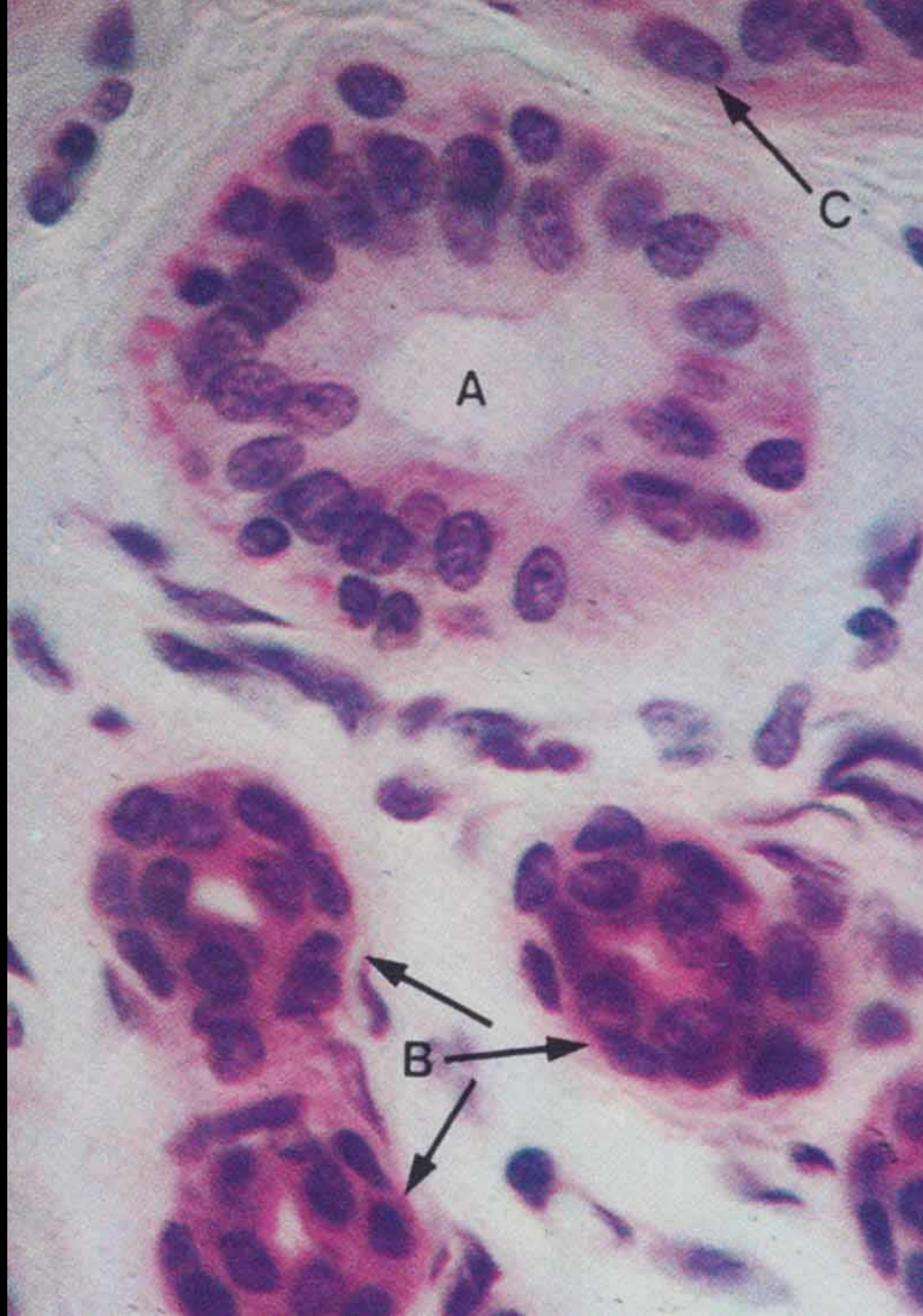
# Eccrine sweat glands

simple tubular coiled  
merocrine secretion



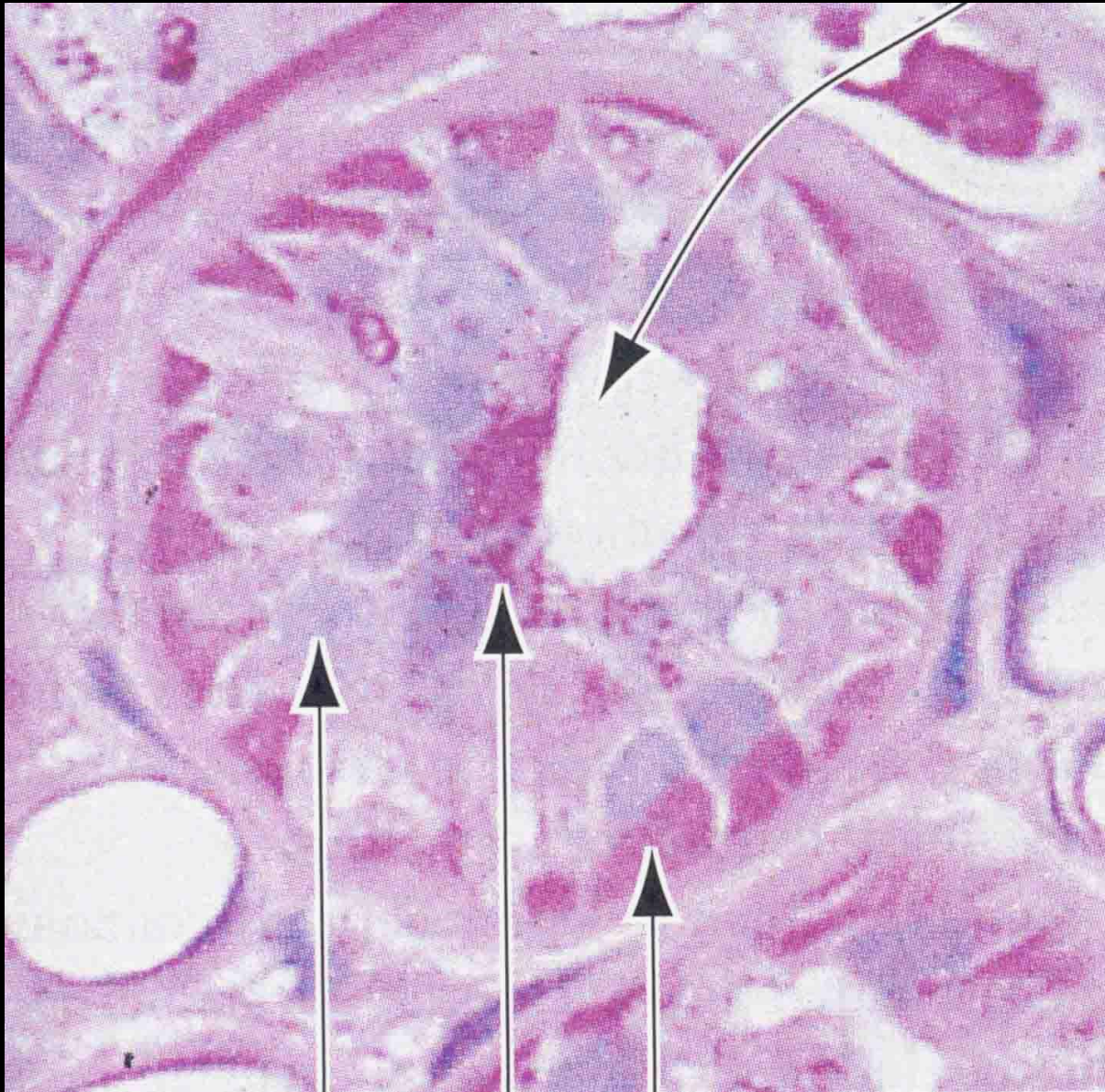






# PAS reaction

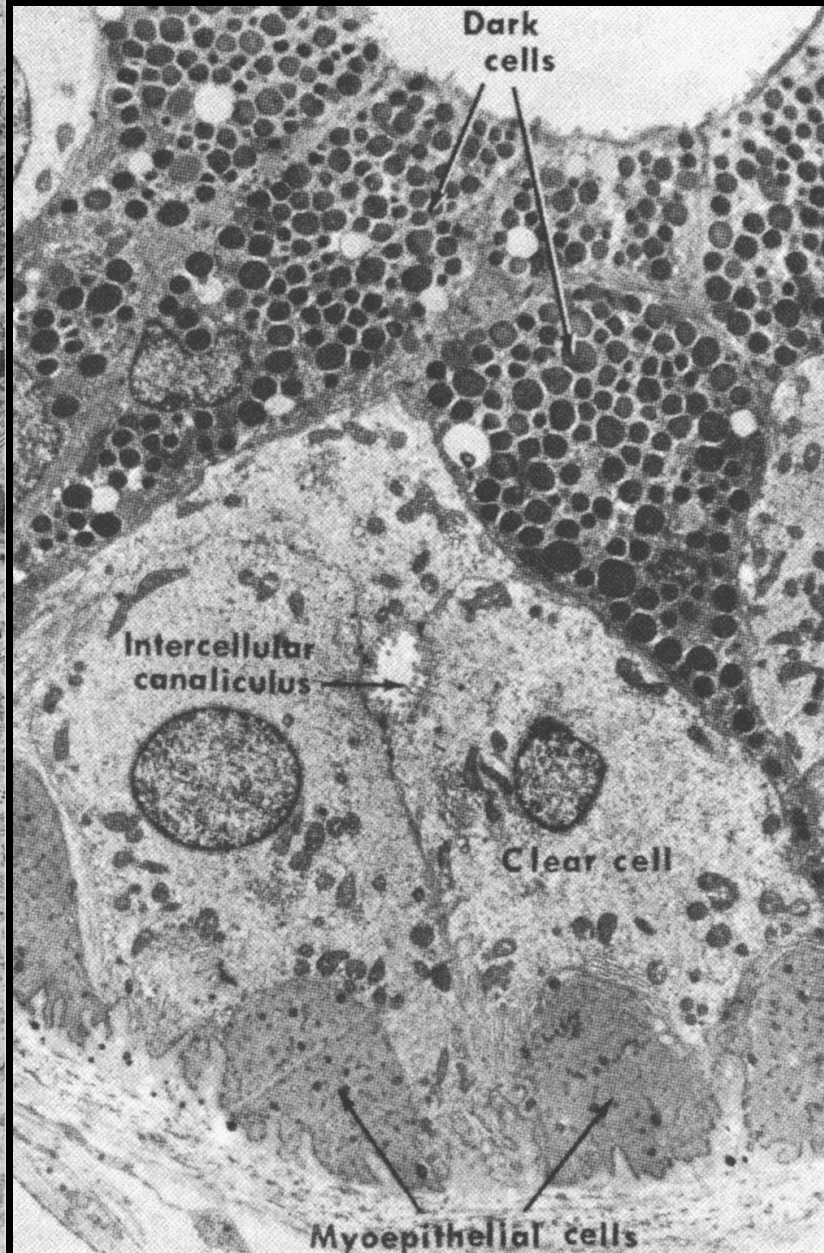
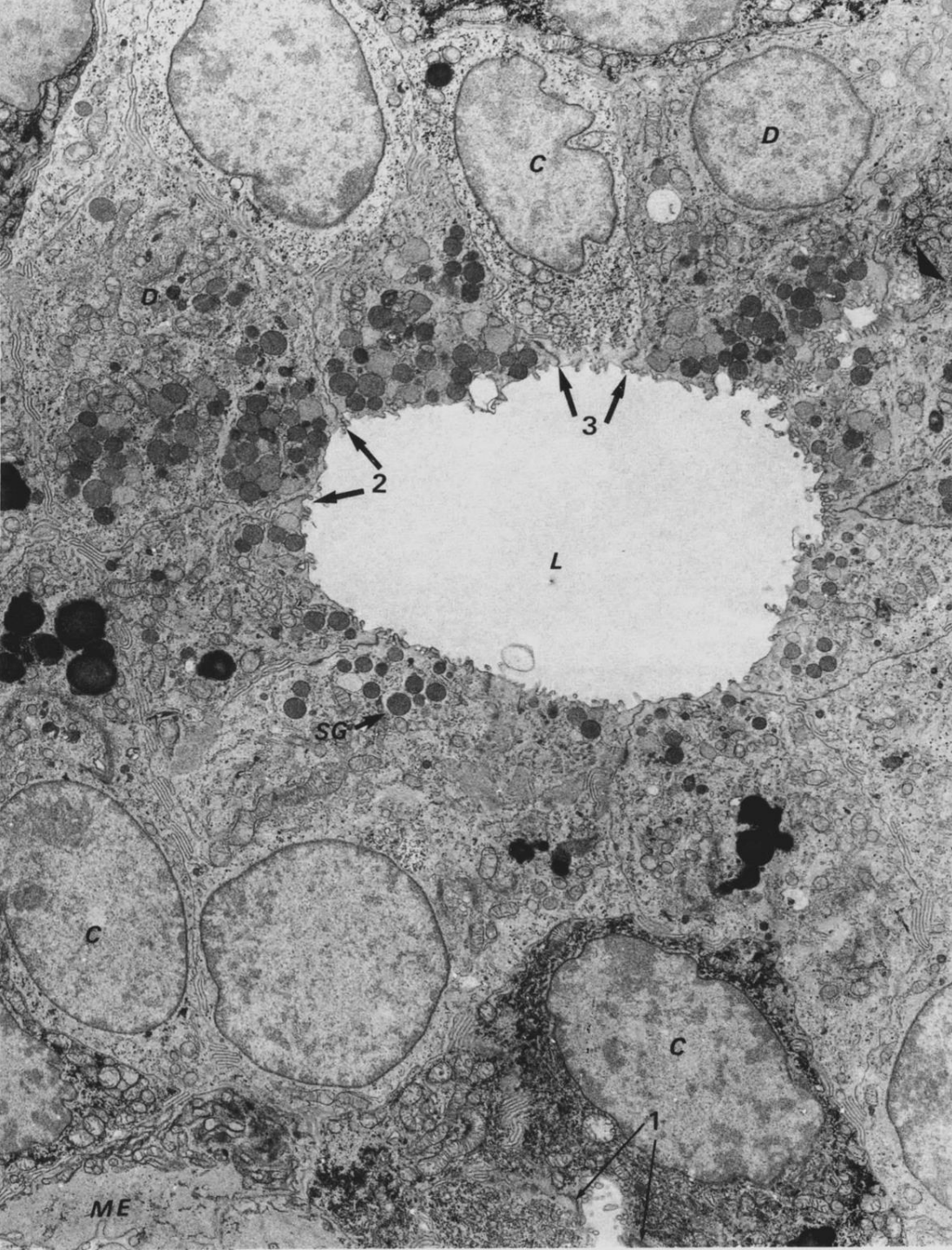
lumen



clear  
cell

dark  
cell

myoepithelial  
cell





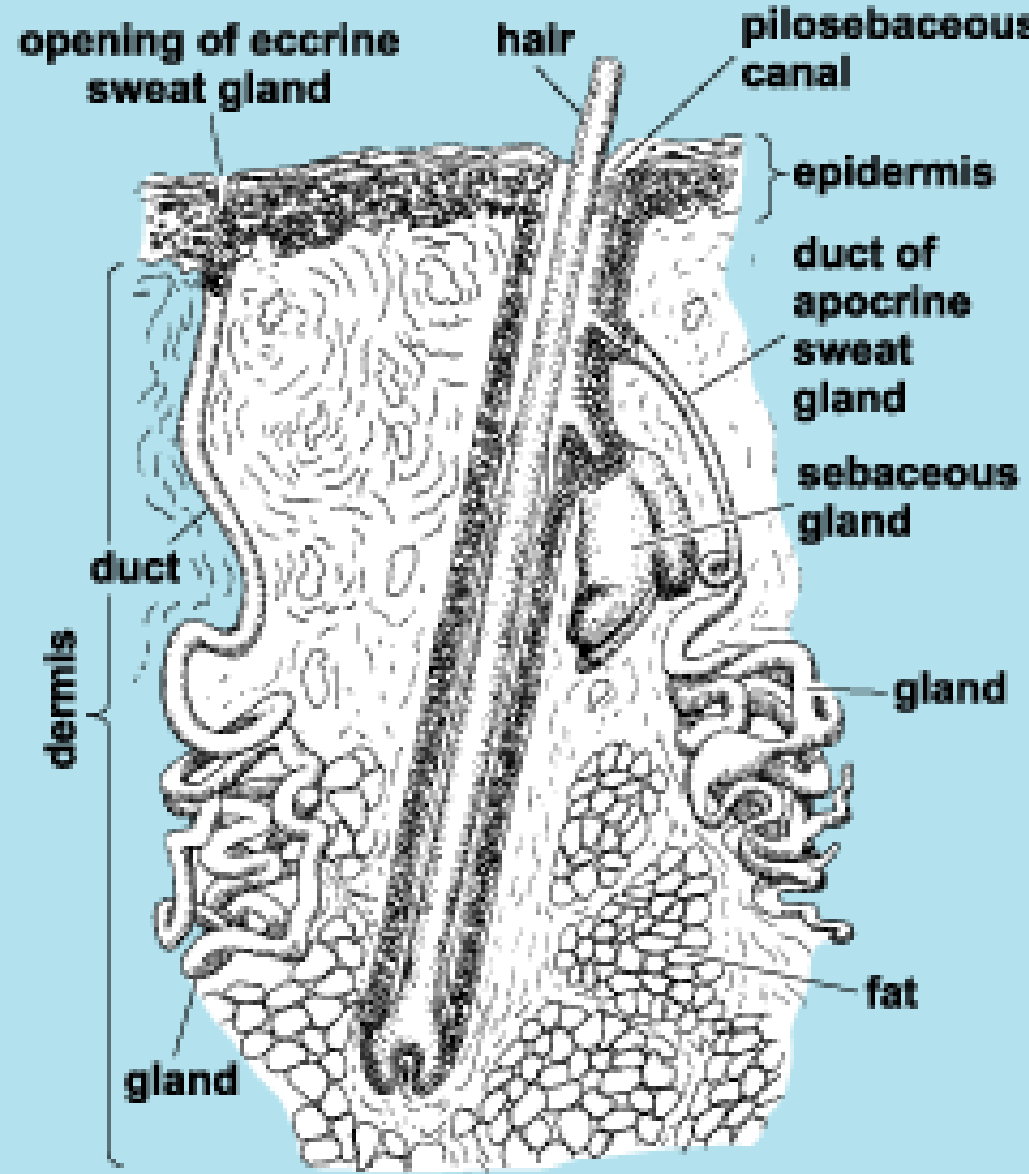
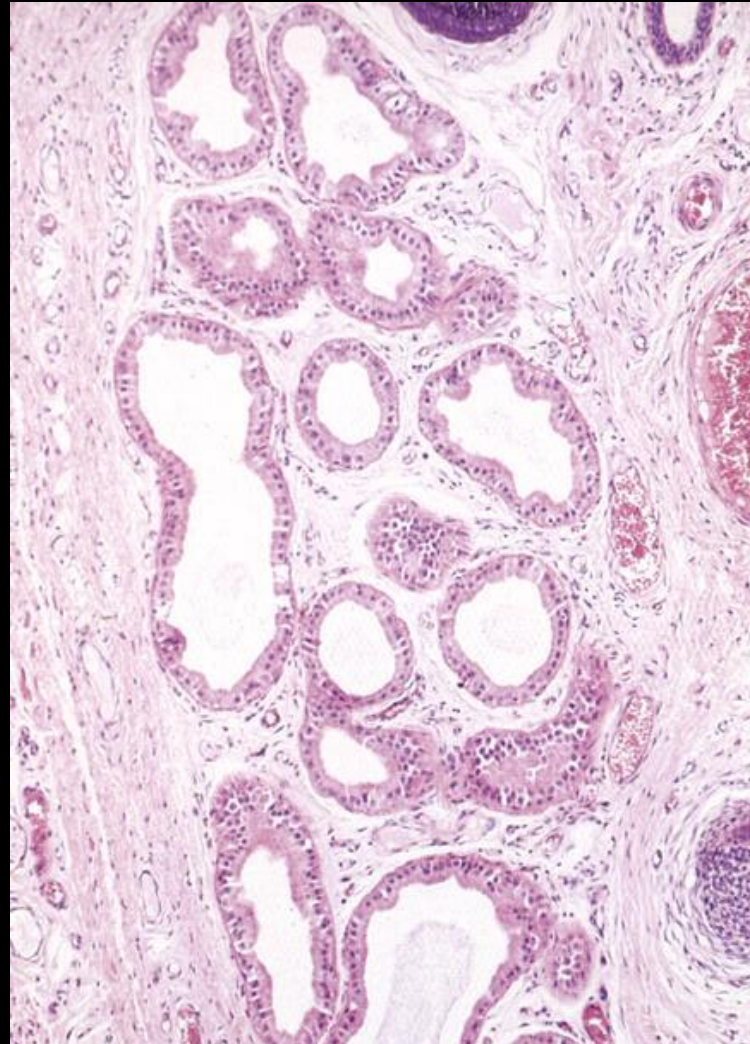
pore

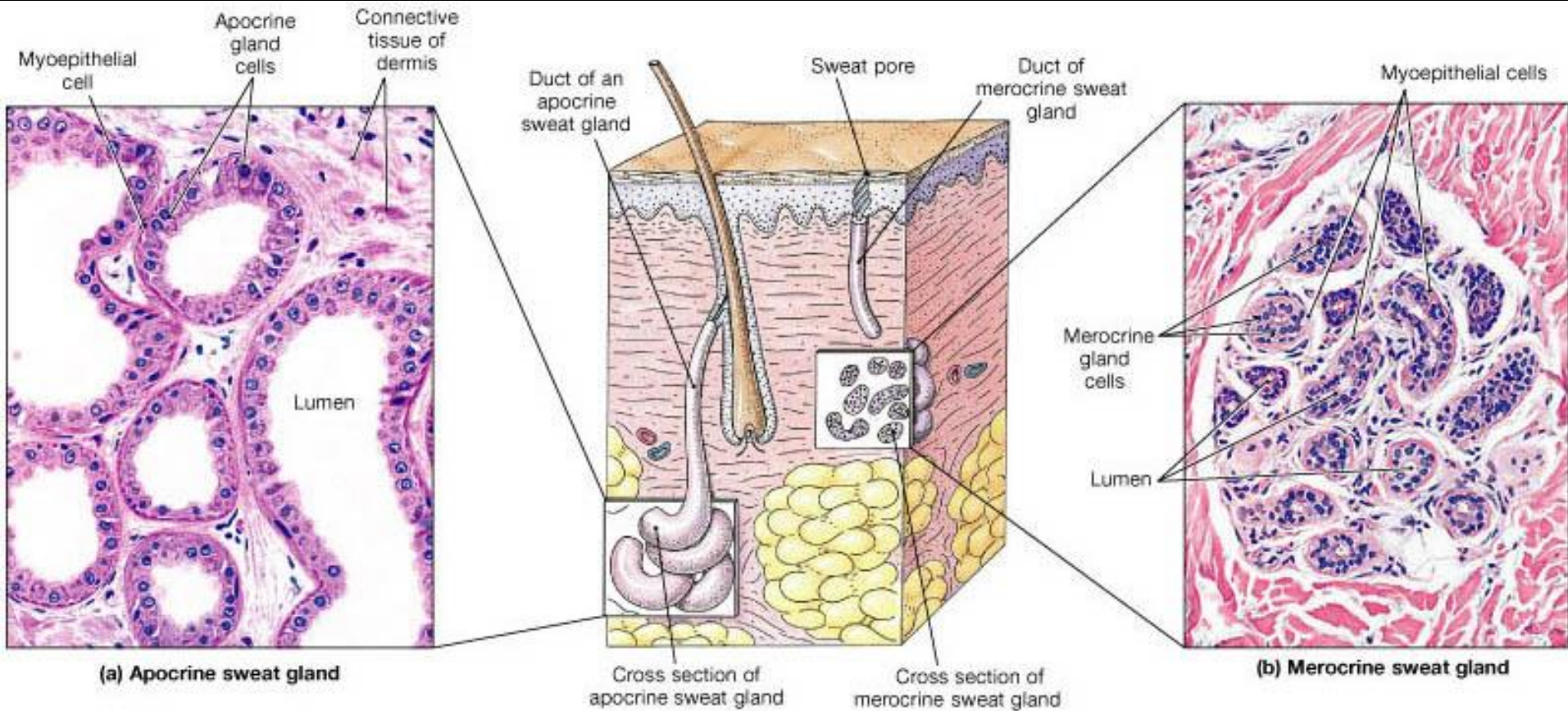
duct

duct

# Aromatic sweat glands

branched tubular coiled  
merocrine (not apocrine)  
secretion



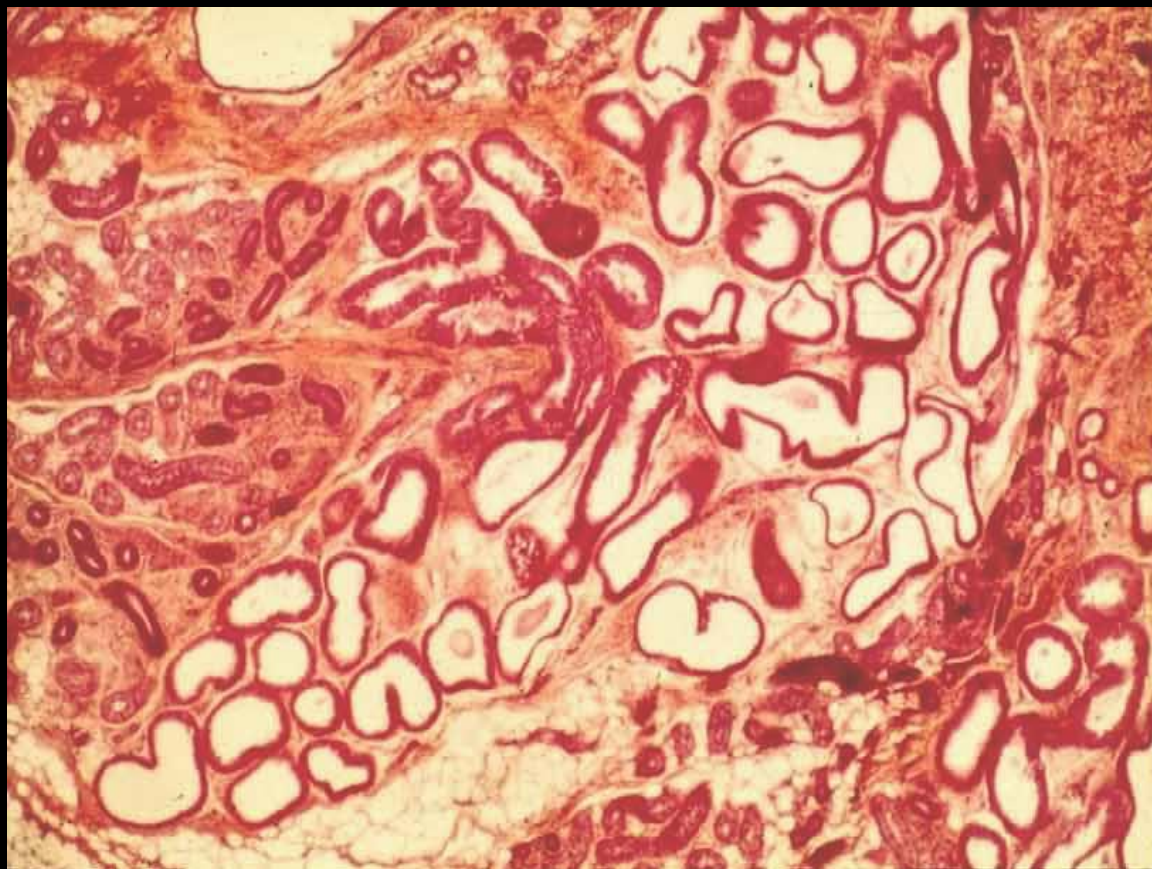


**(a) Apocrine sweat gland**

**Cross section of apocrine sweat gland**

**Cross section of merocrine sweat gland**

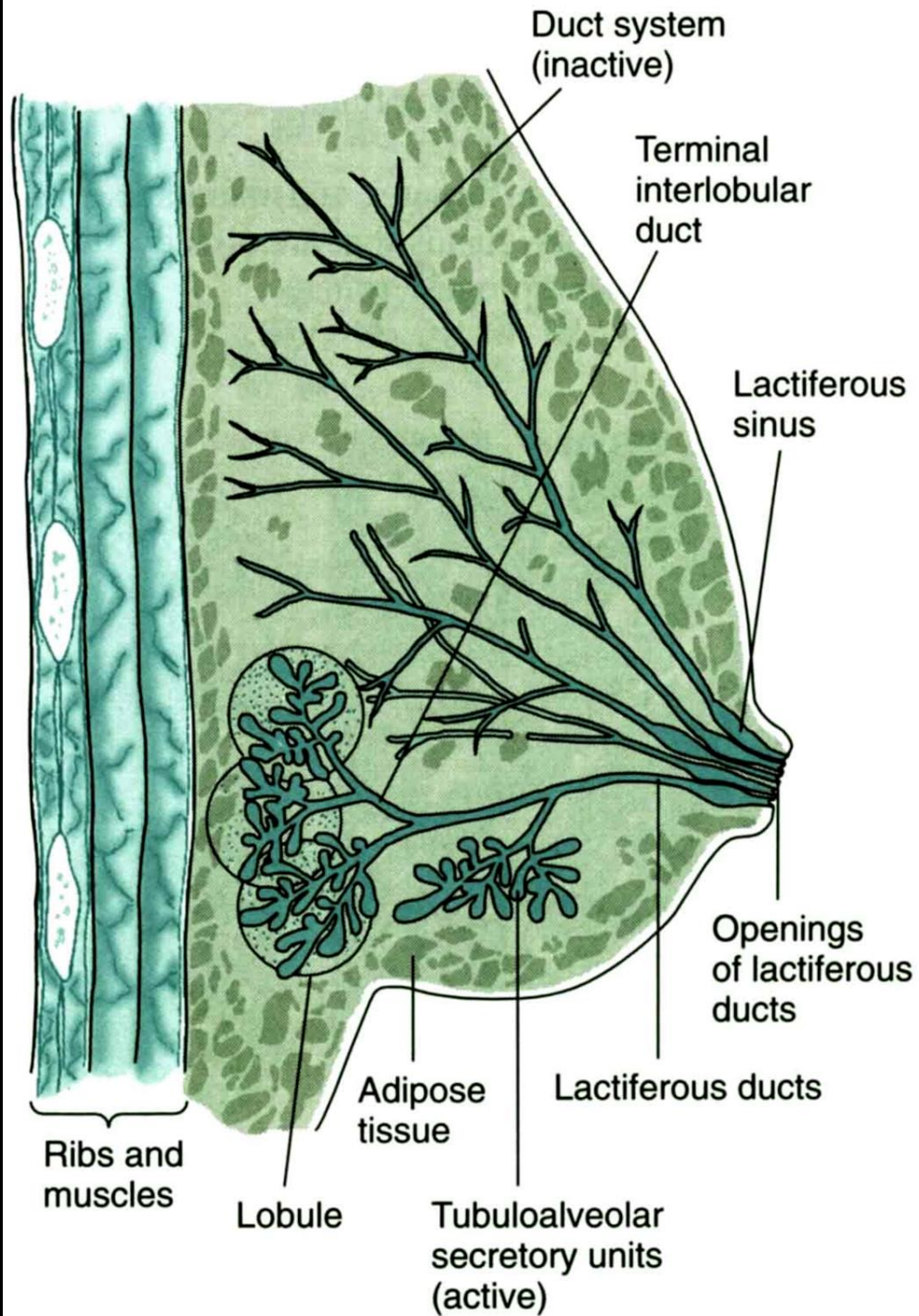
**(b) Merocrine sweat gland**



- axilla**
- circumanal**
- perigenital**
- areola mammae (Montgomery)**
- nasal vestibule**
- eyelid (Moll)**
- external auditory meatus (ceruminous)**

# Mammary gland

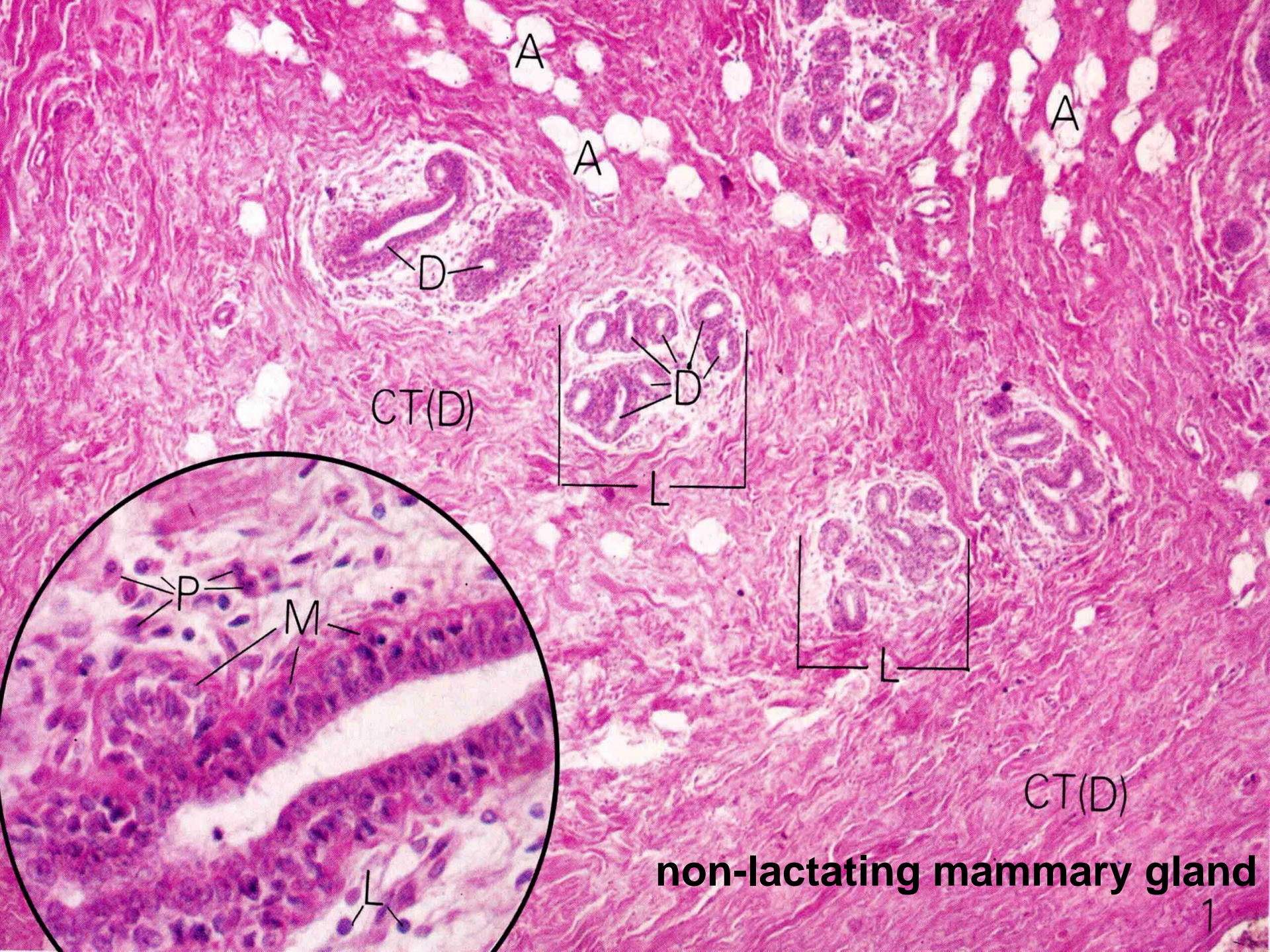
15-20 compound tuboalveolar glands





A histological micrograph of a prepubertal mammary gland. The image shows several cross-sections of mammary ducts. Each duct is lined by a single layer of cuboidal epithelial cells, which are arranged in a circular pattern. The ducts are embedded within a dense, fibrous connective tissue stroma. The overall appearance is that of a developing ductal system with no secretory activity.

**prepubertal mammary gland**



A

A

A

D

D

CT(D)

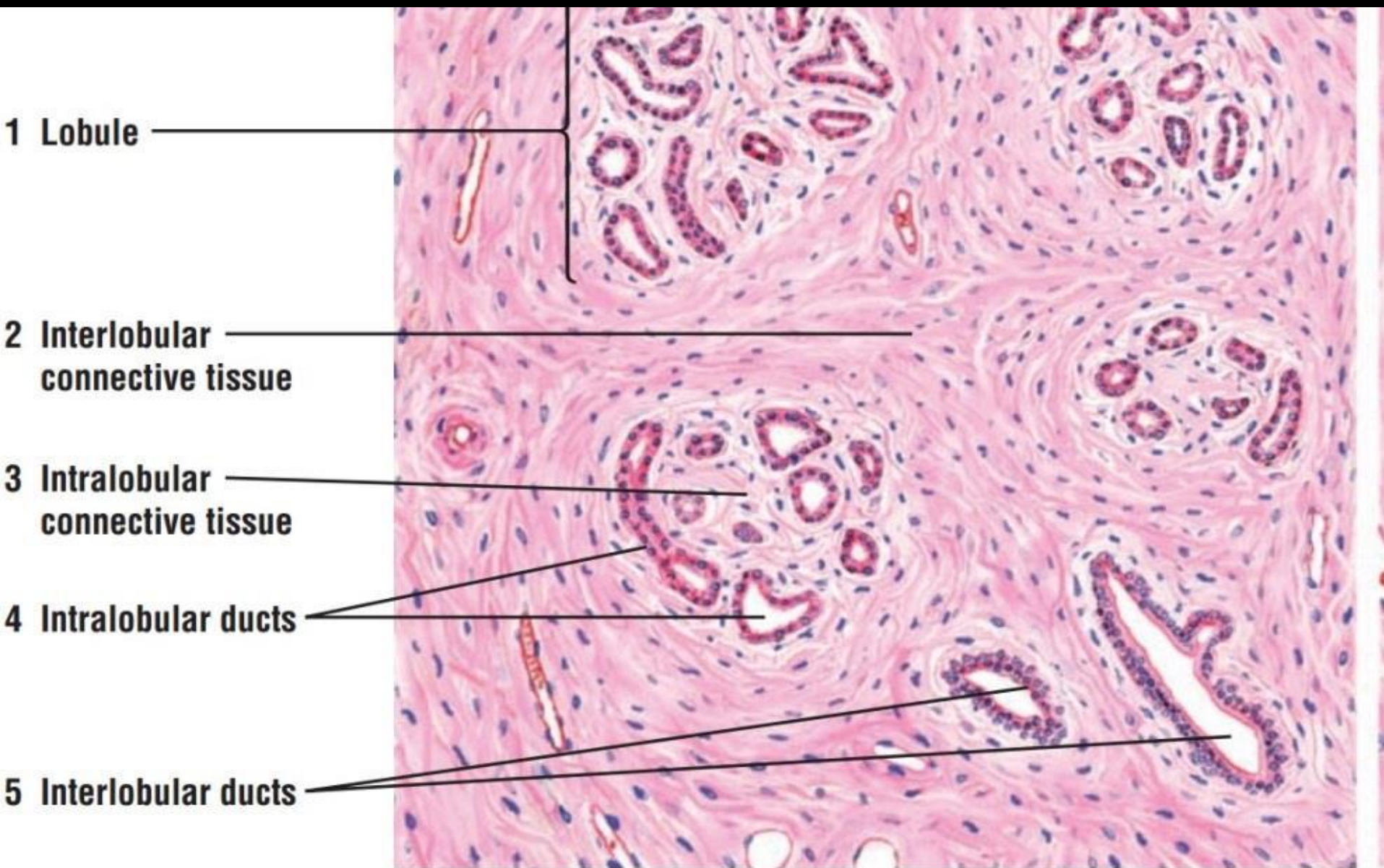
D

CT(D)

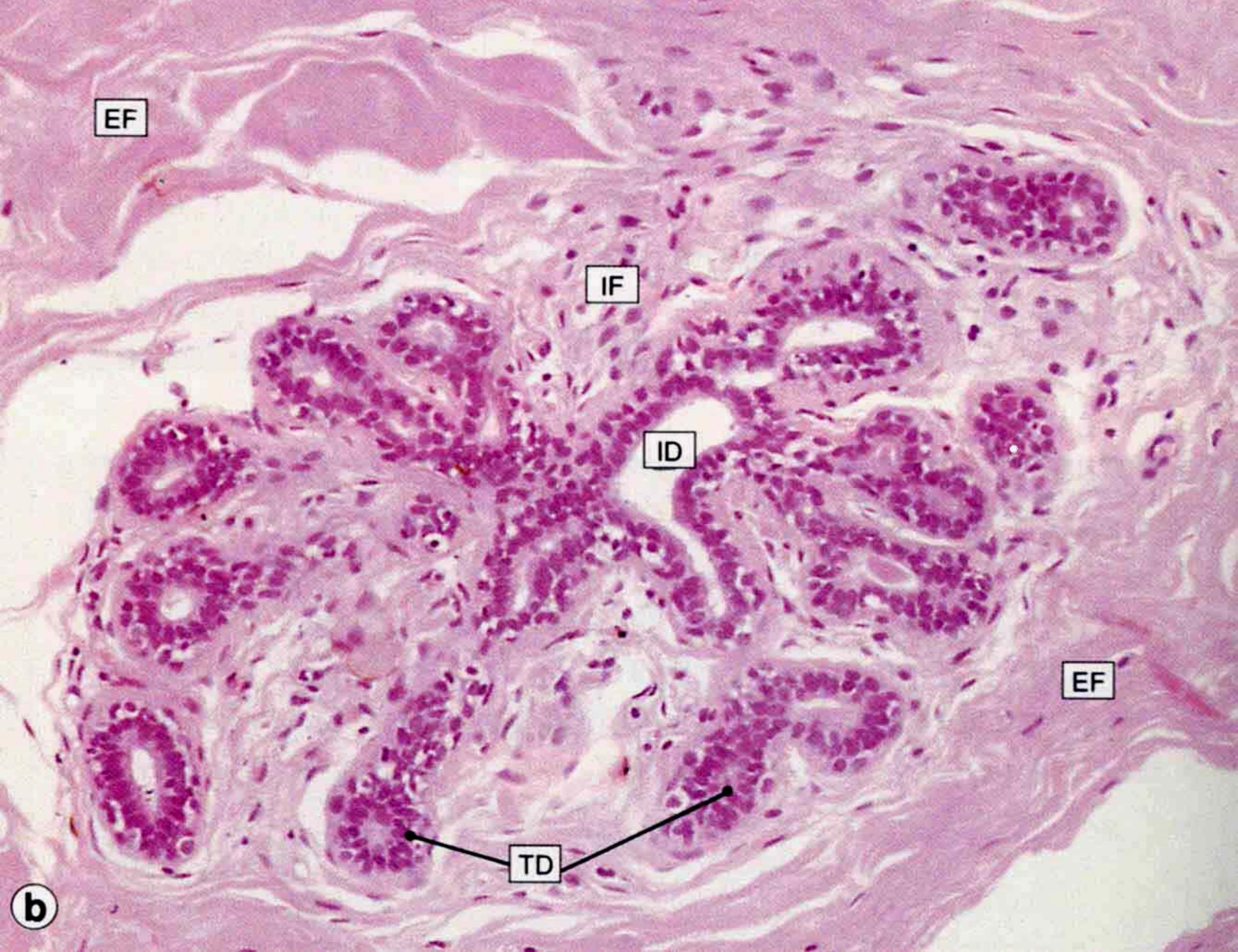
P

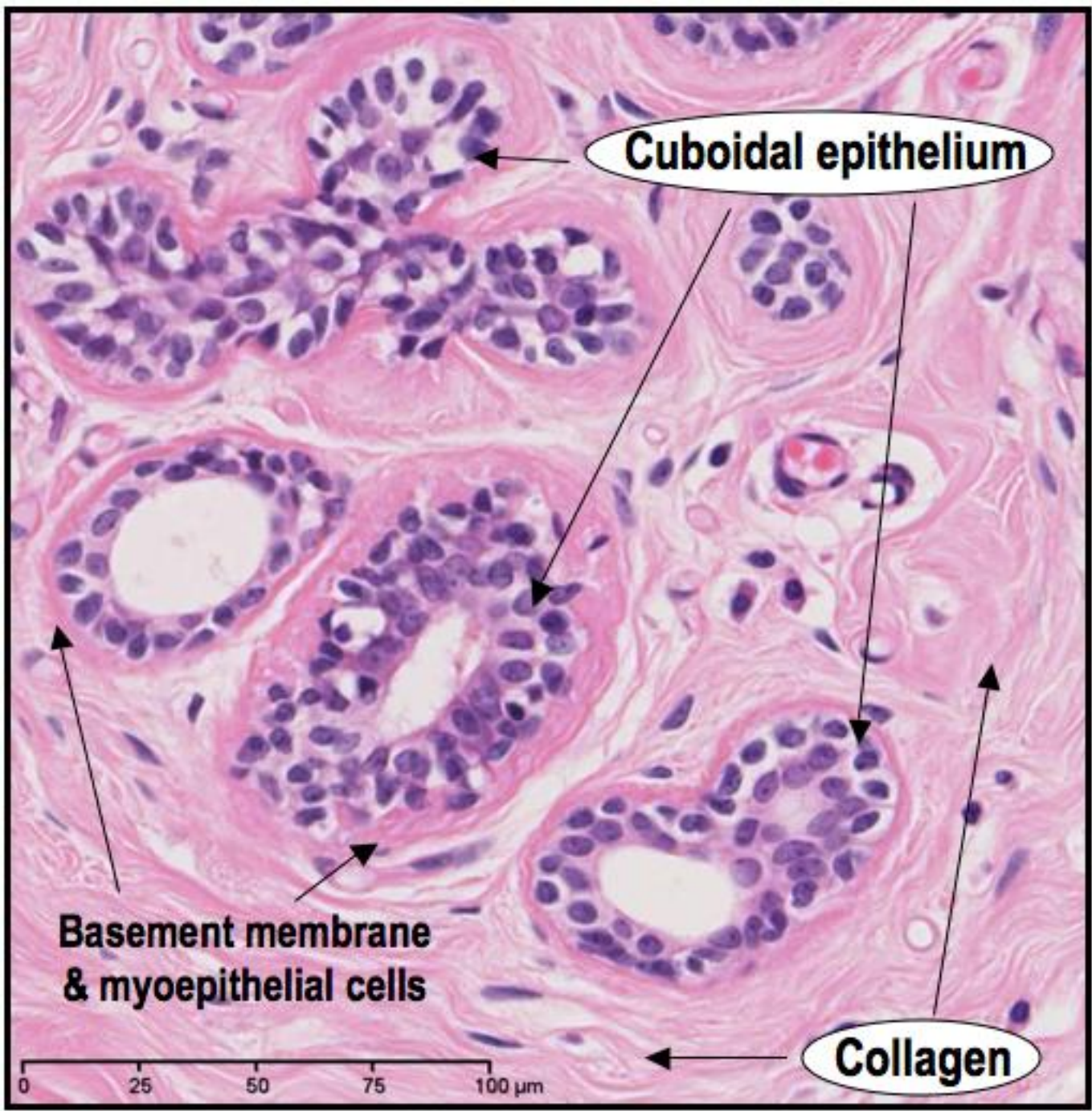
M

**non-lactating mammary gland**

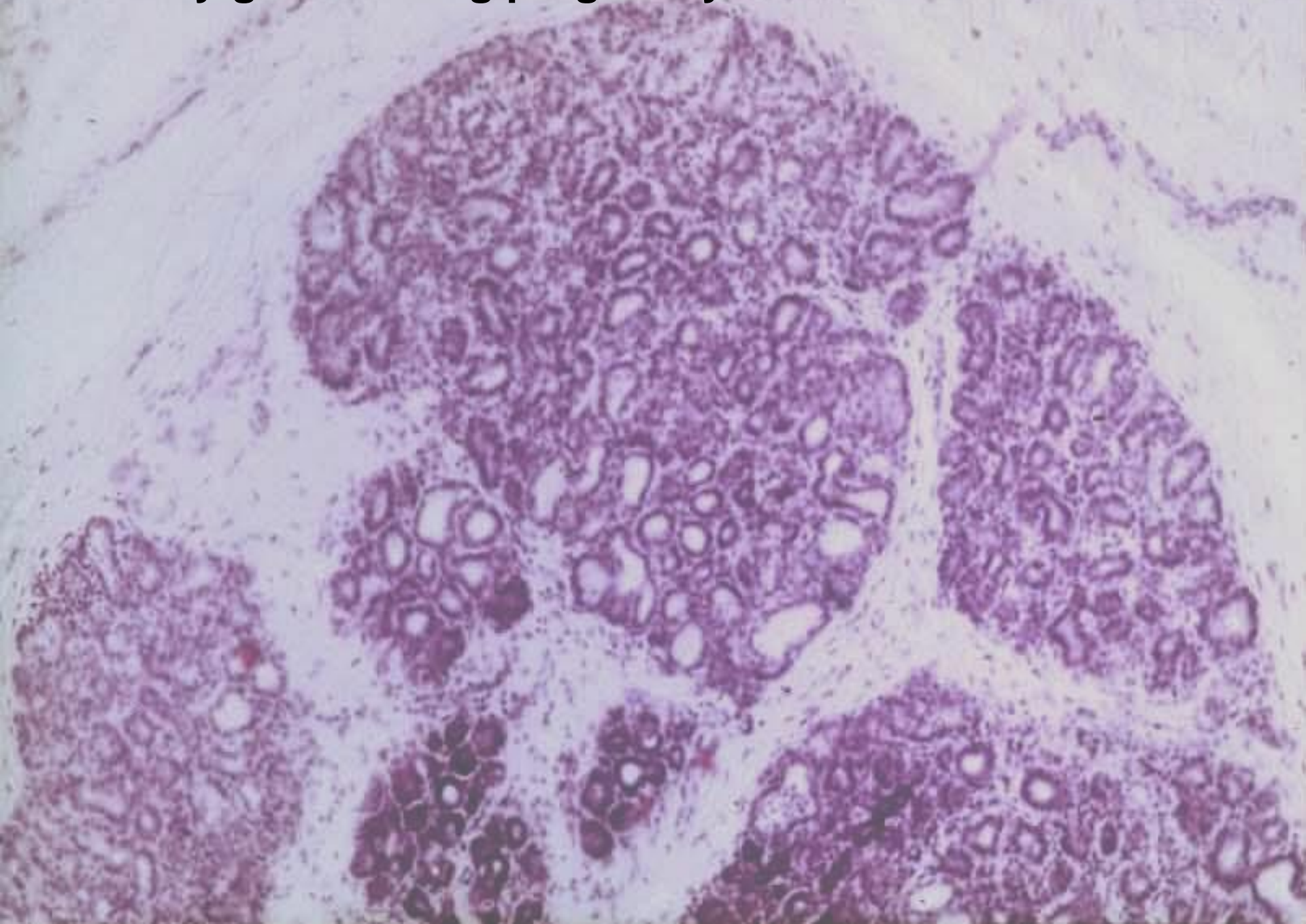


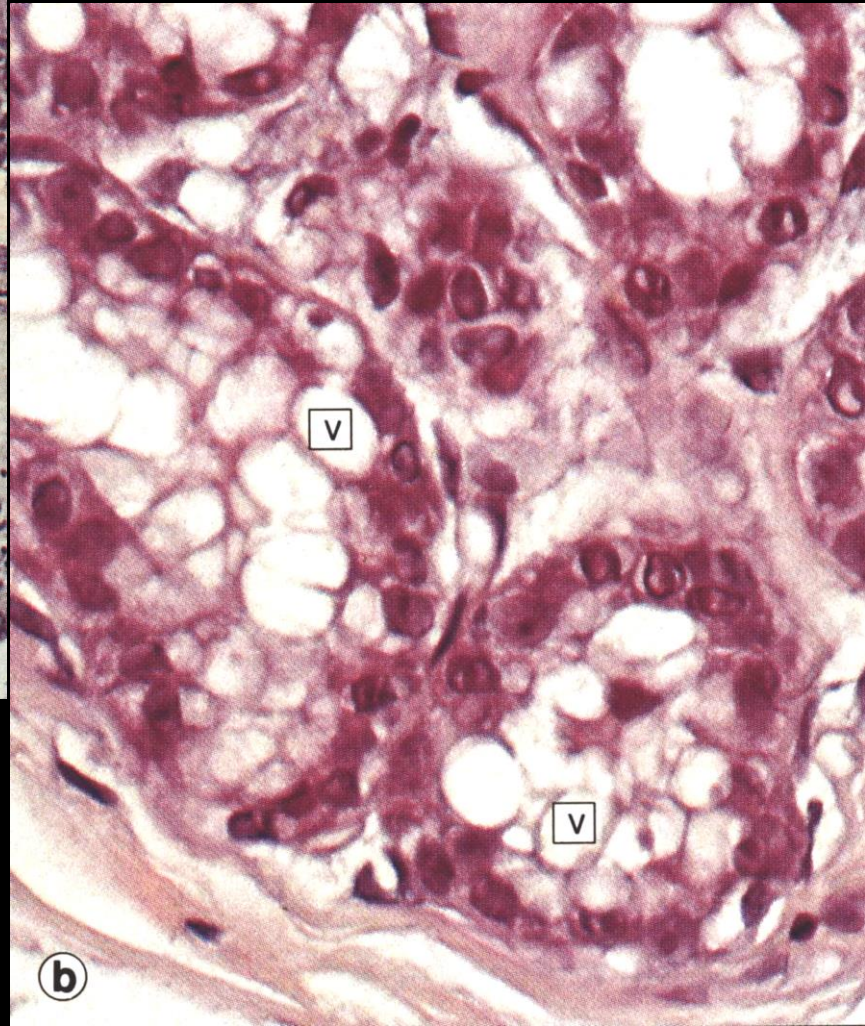
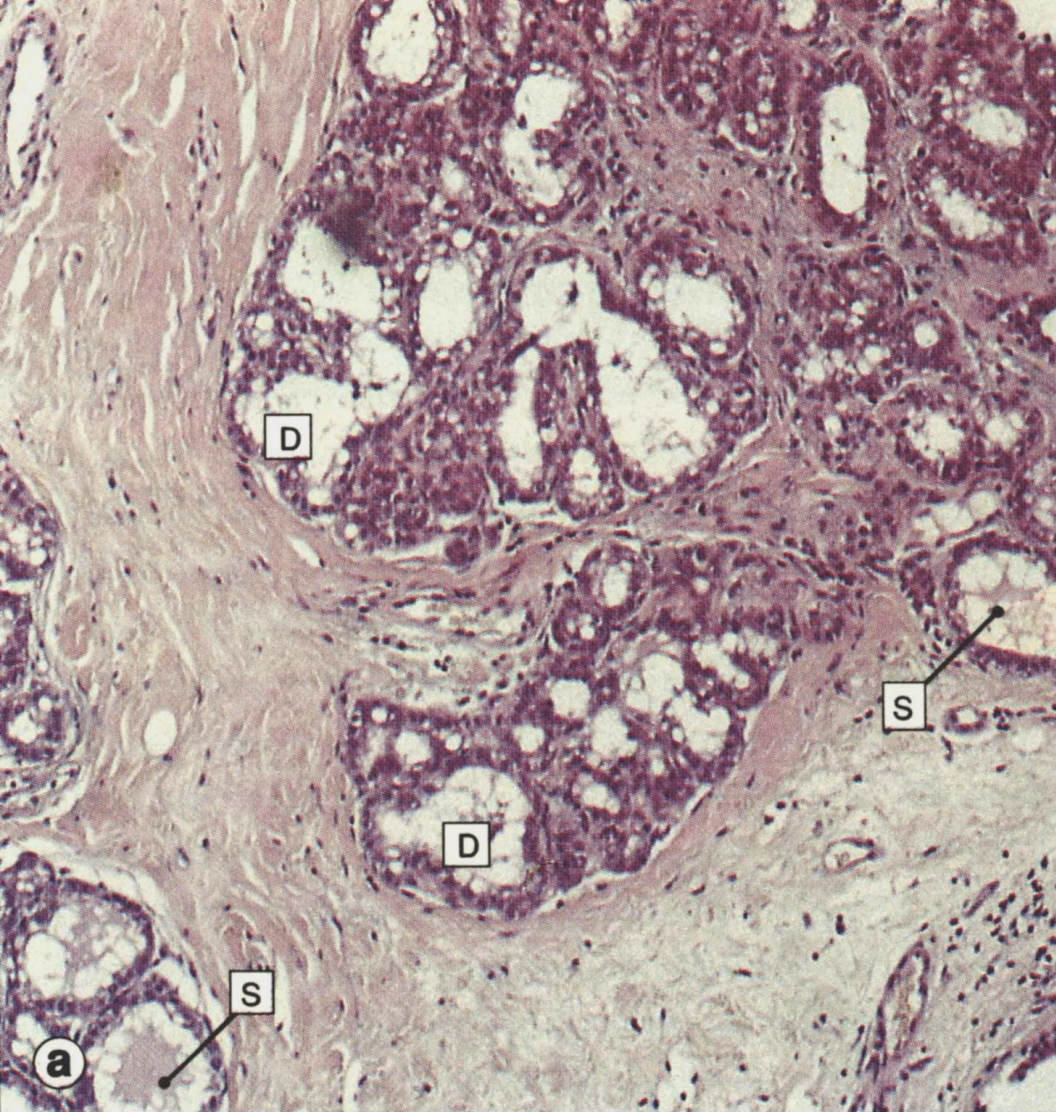
**FIGURE 19.24** ■ Inactive mammary gland. Stain: hematoxylin and eosin.





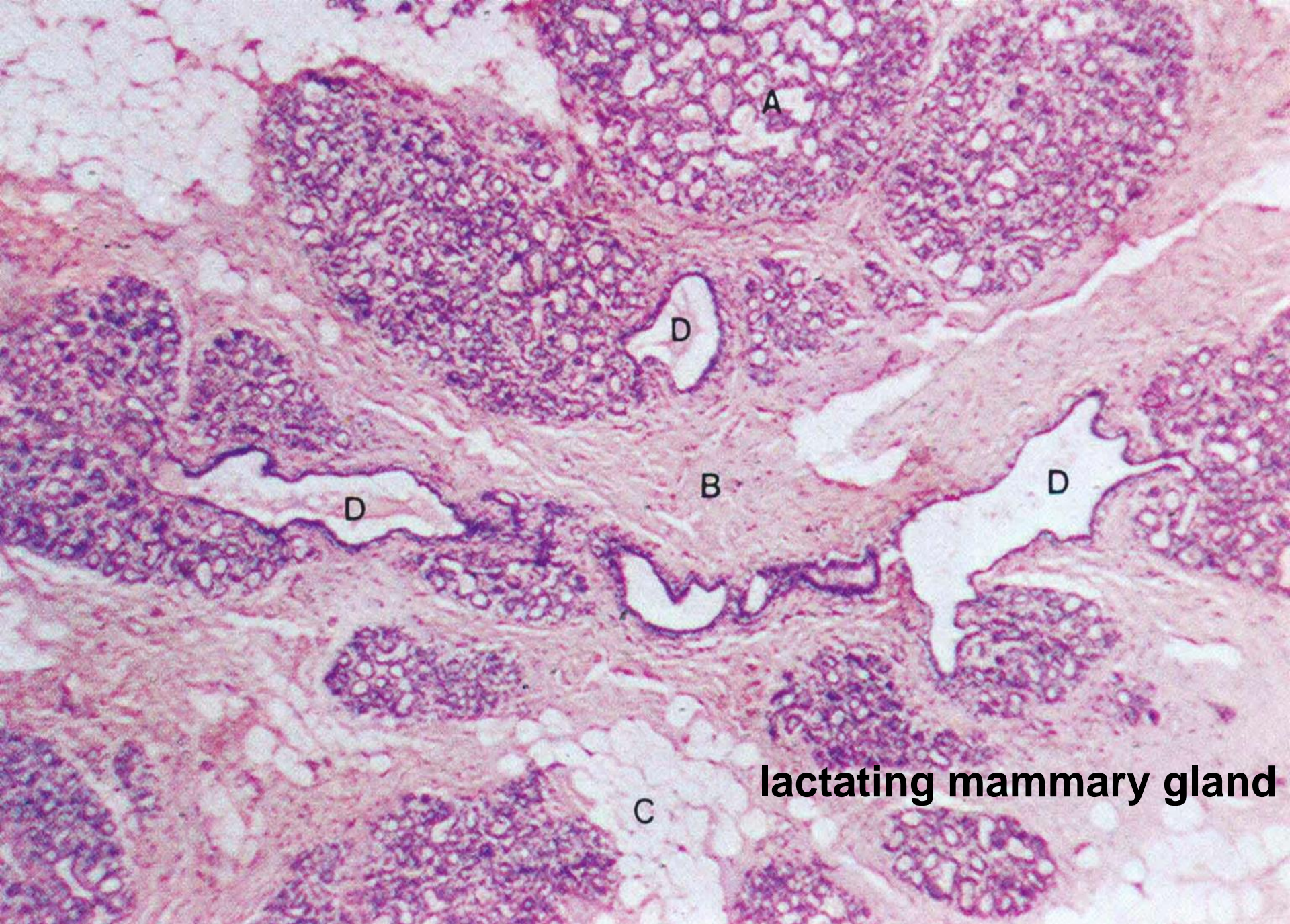
**mammary gland during pregnancy**





**dilatation of terminal ductules  
formation of secretory alveoli  
accumulation of lipid droplets**

**(b)**



**lactating mammary gland**



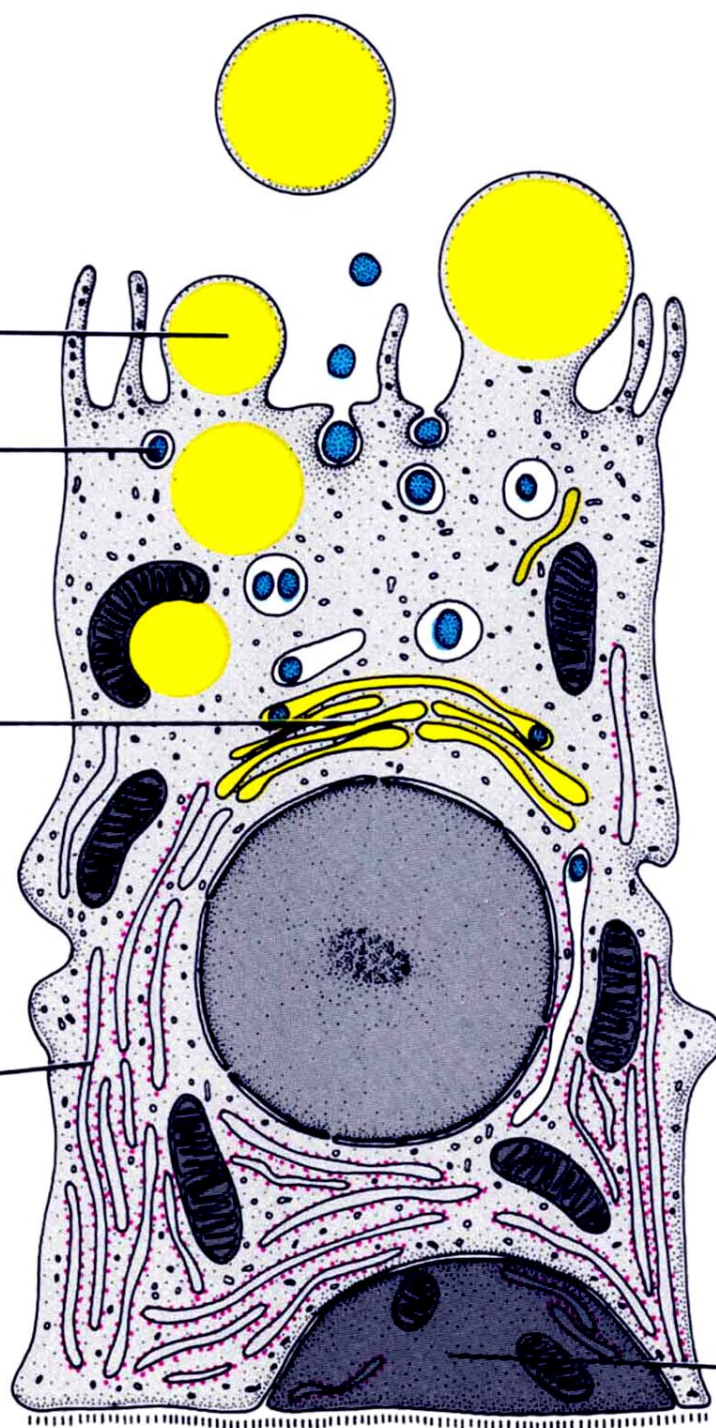
Lipid

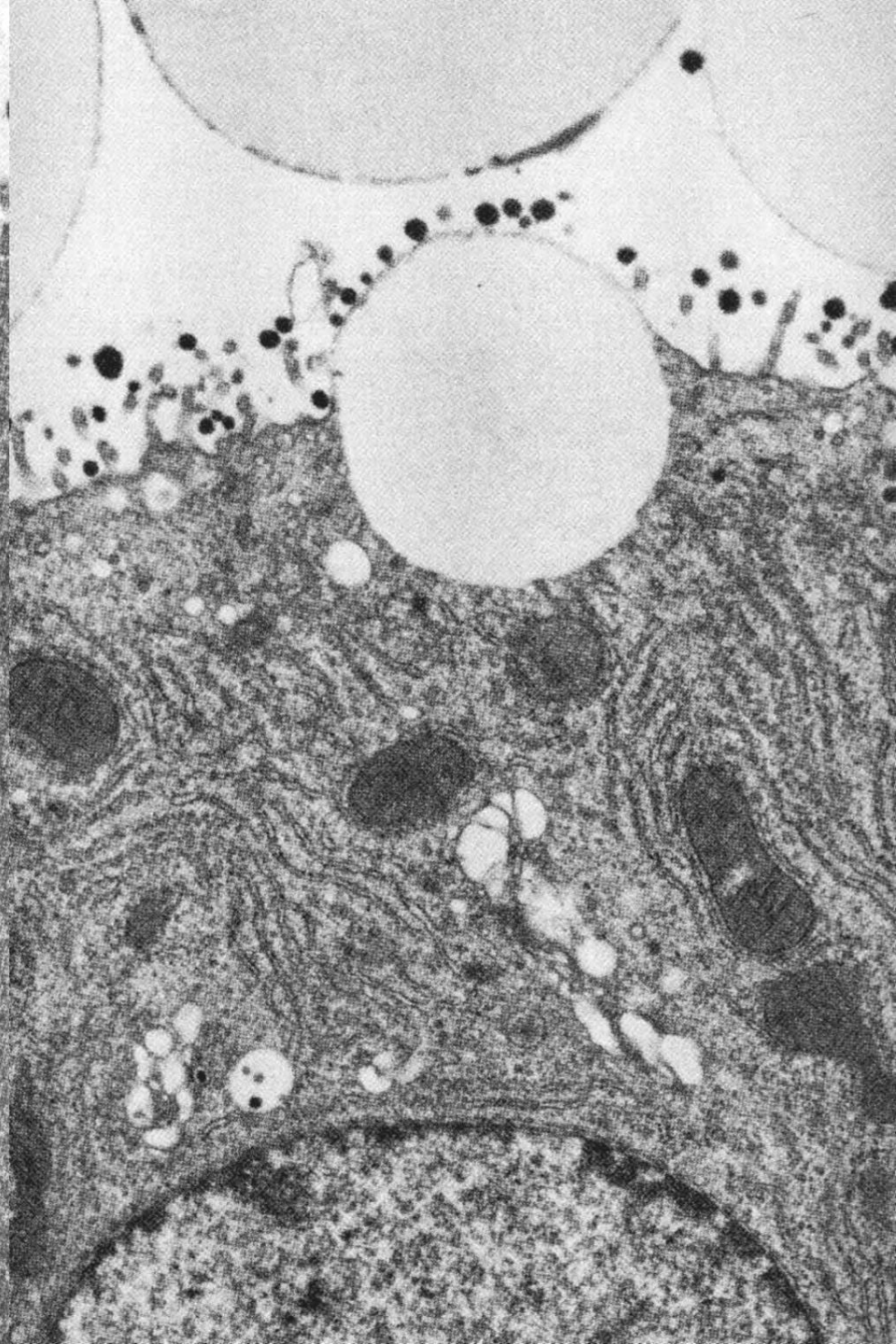
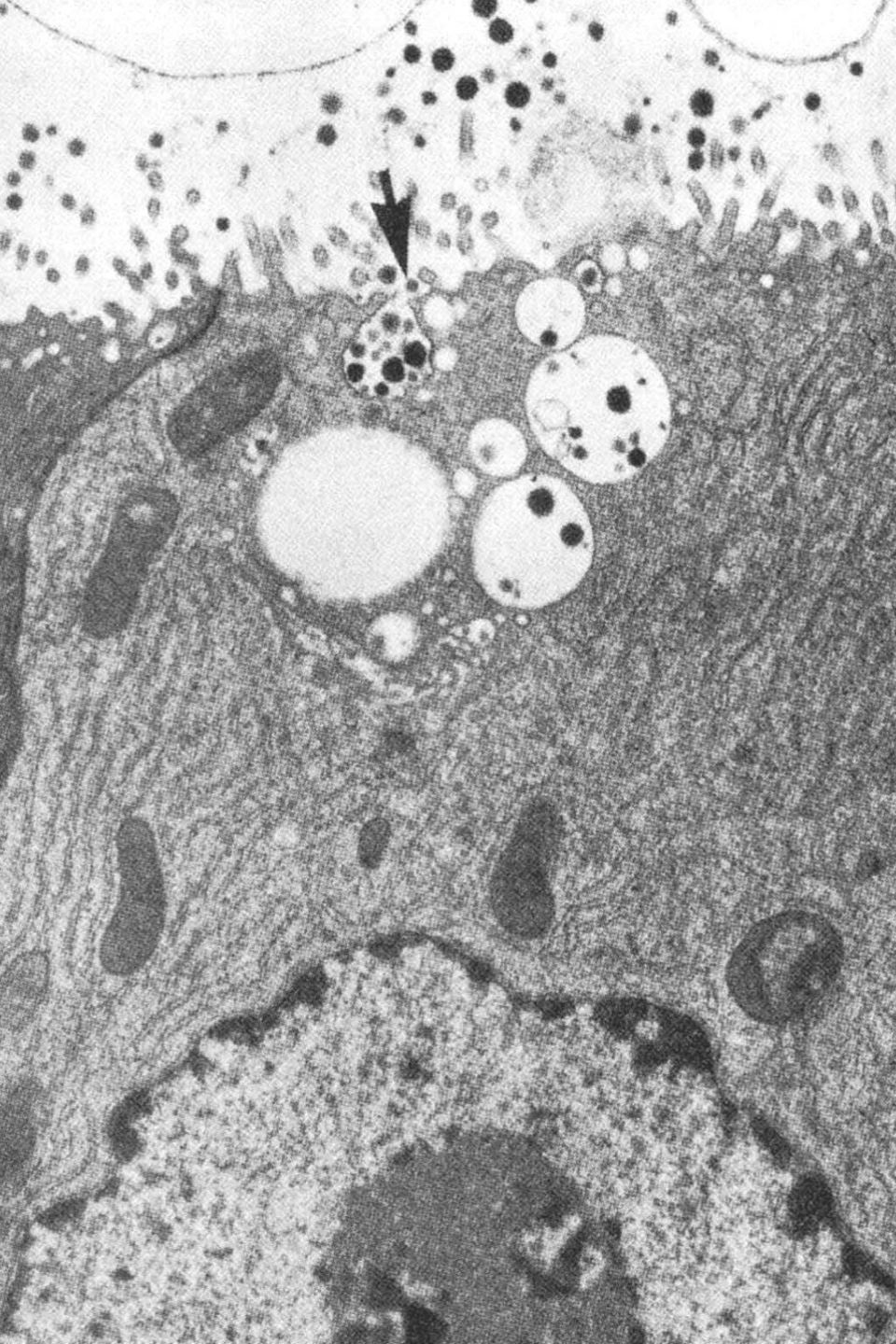
Protein

Golgi complex

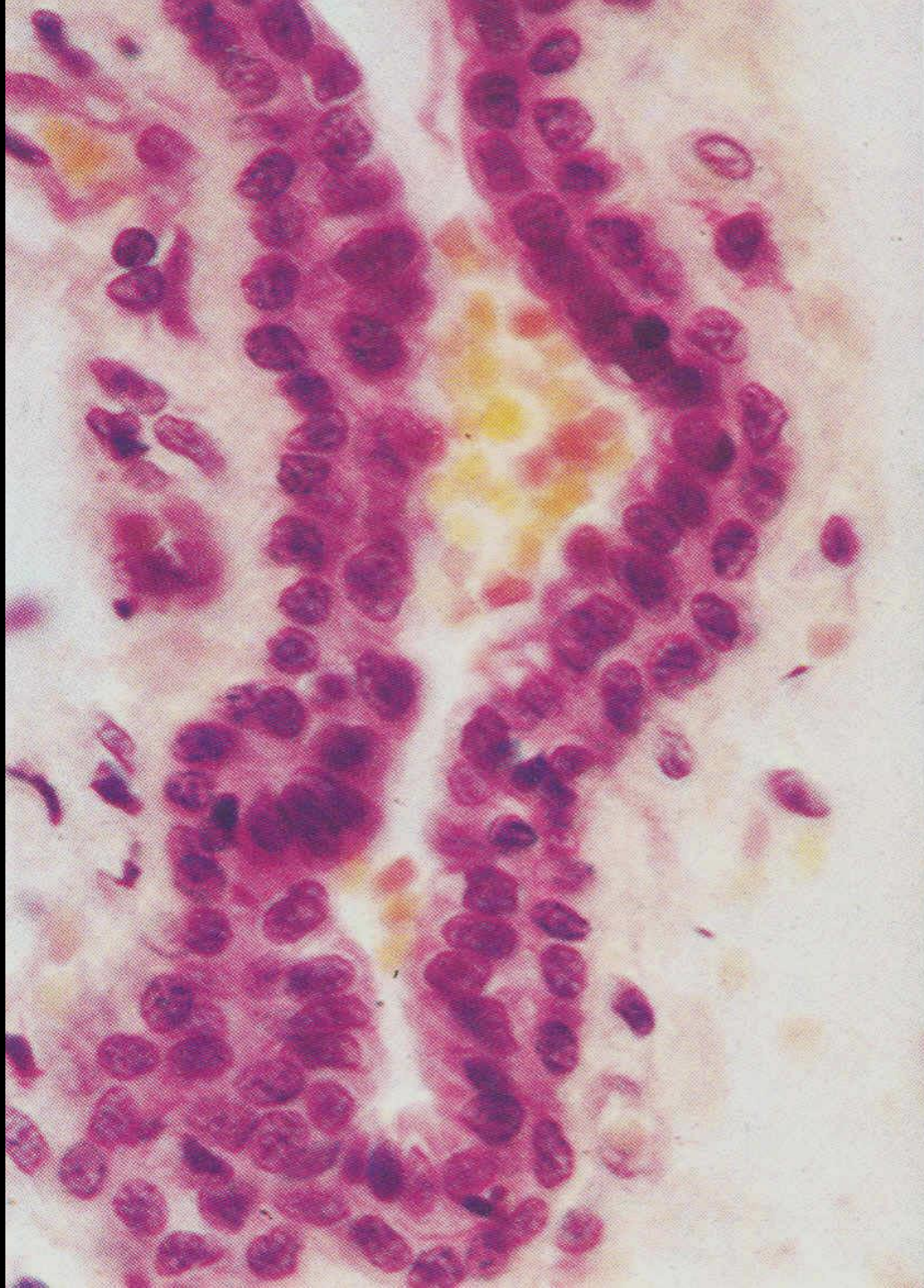
Granular endoplasmic reticulum

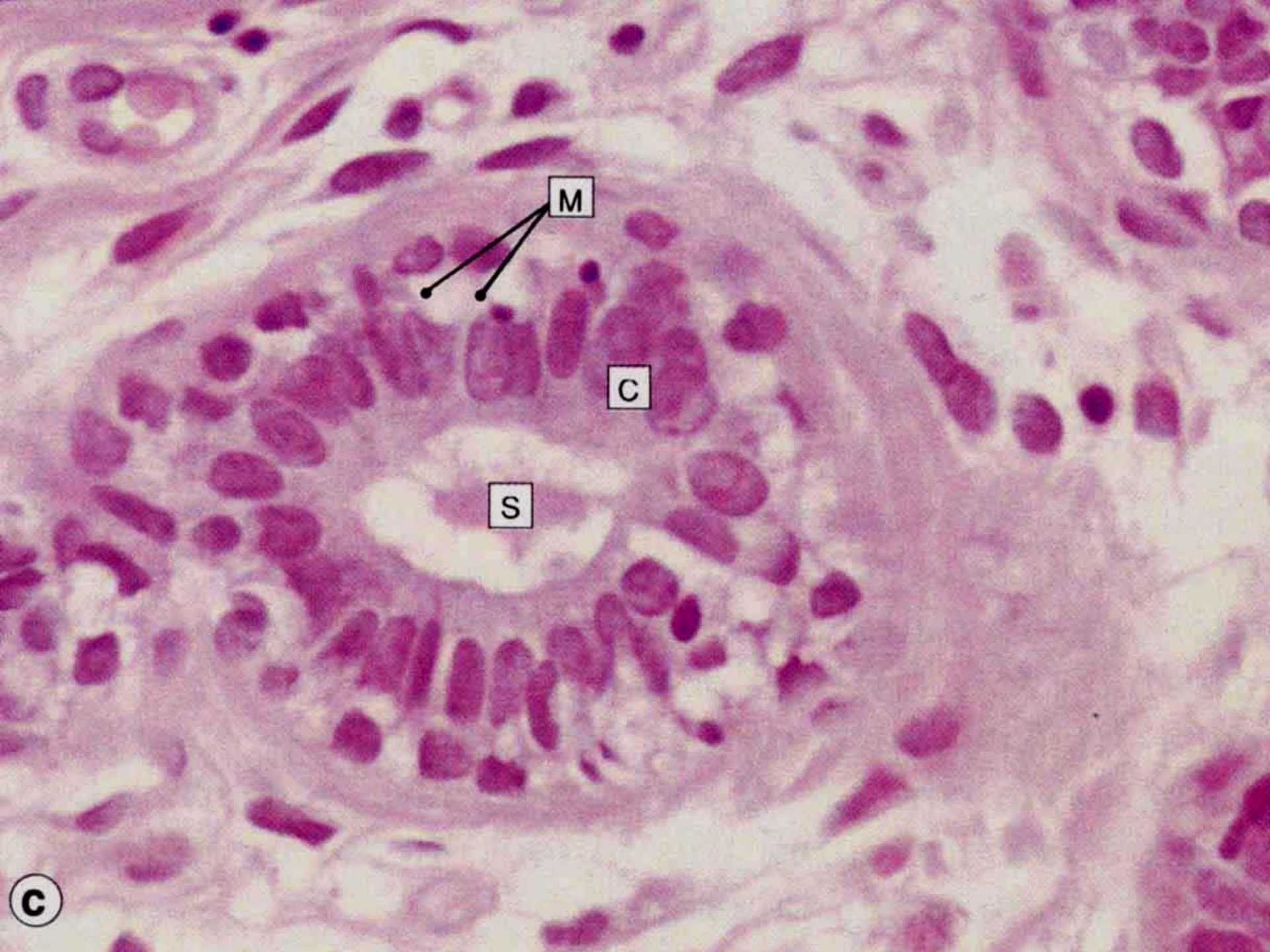
Process of a myoepithelial cell





**Lactiferous  
duct**



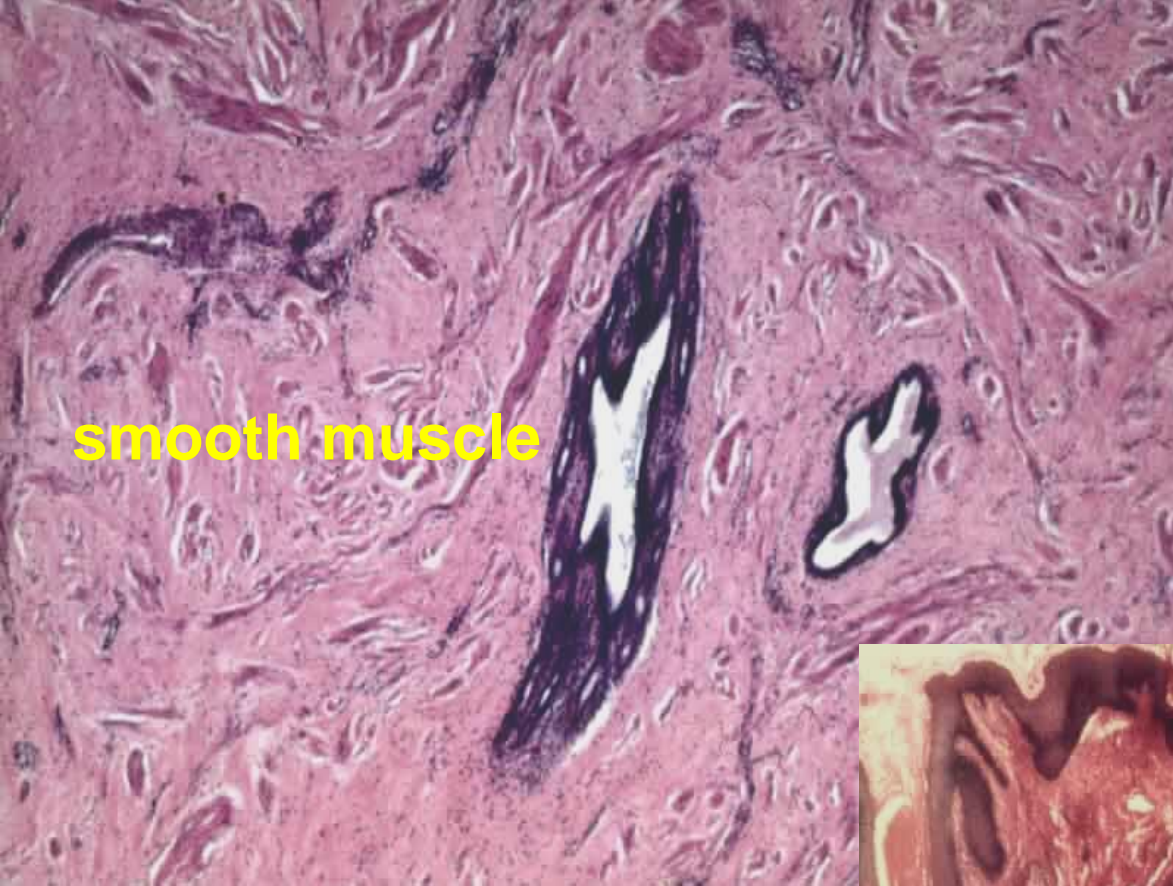


M

C

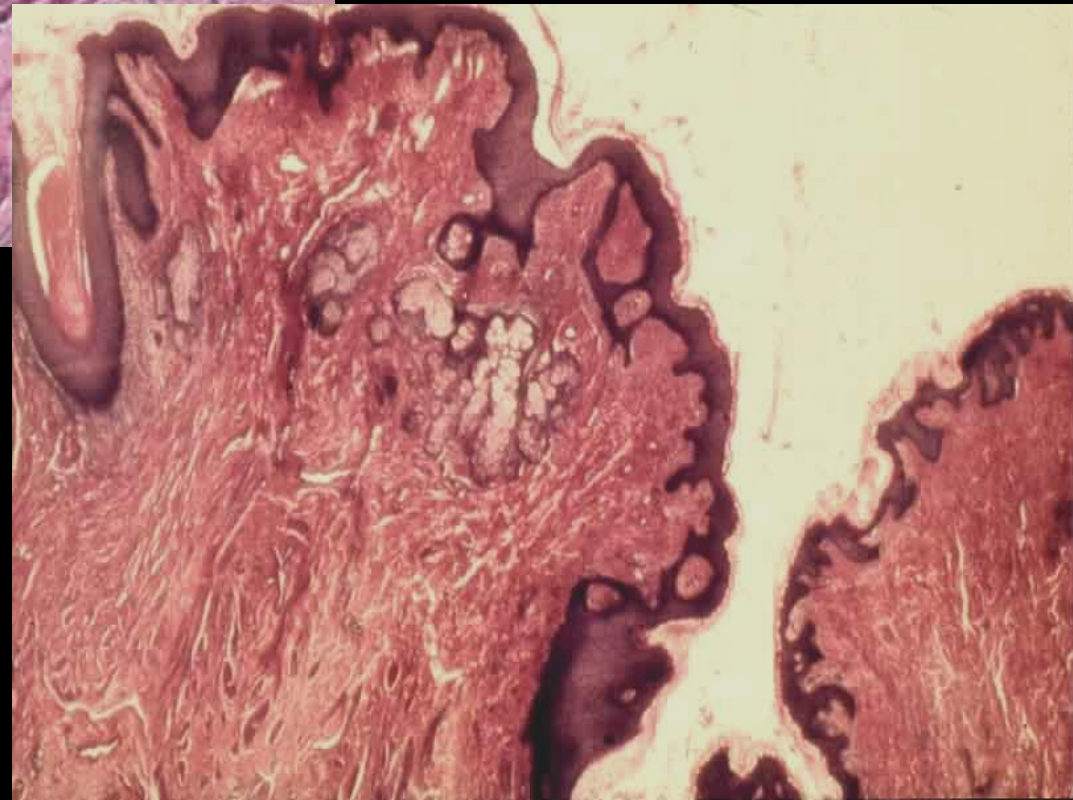
S

C

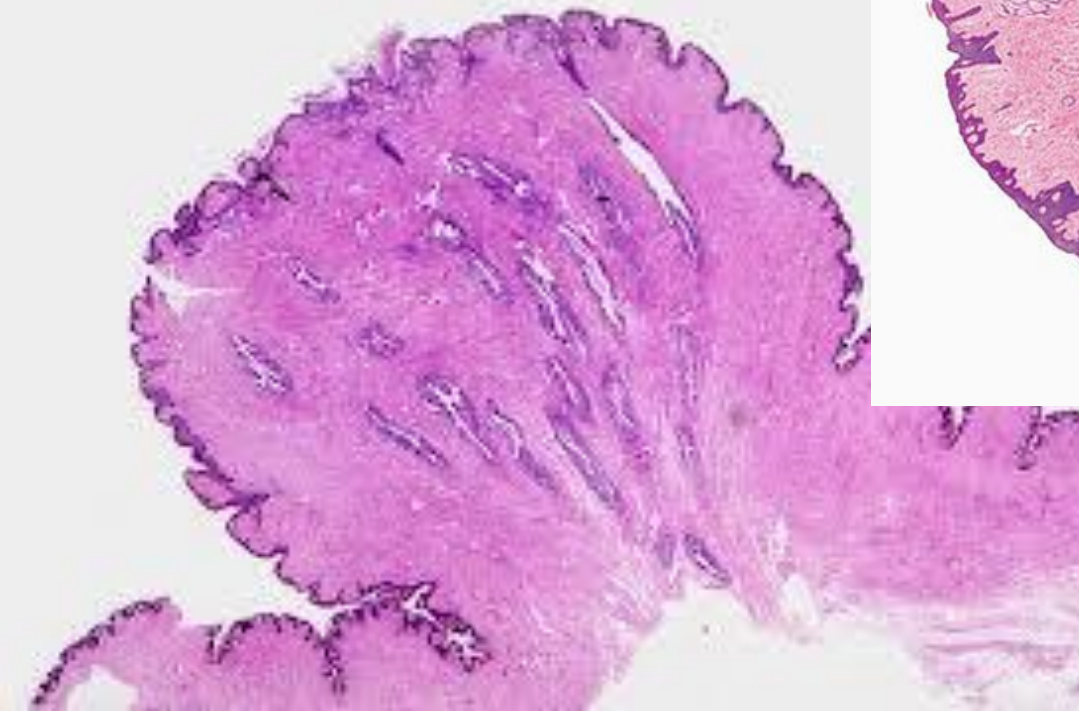


smooth muscle

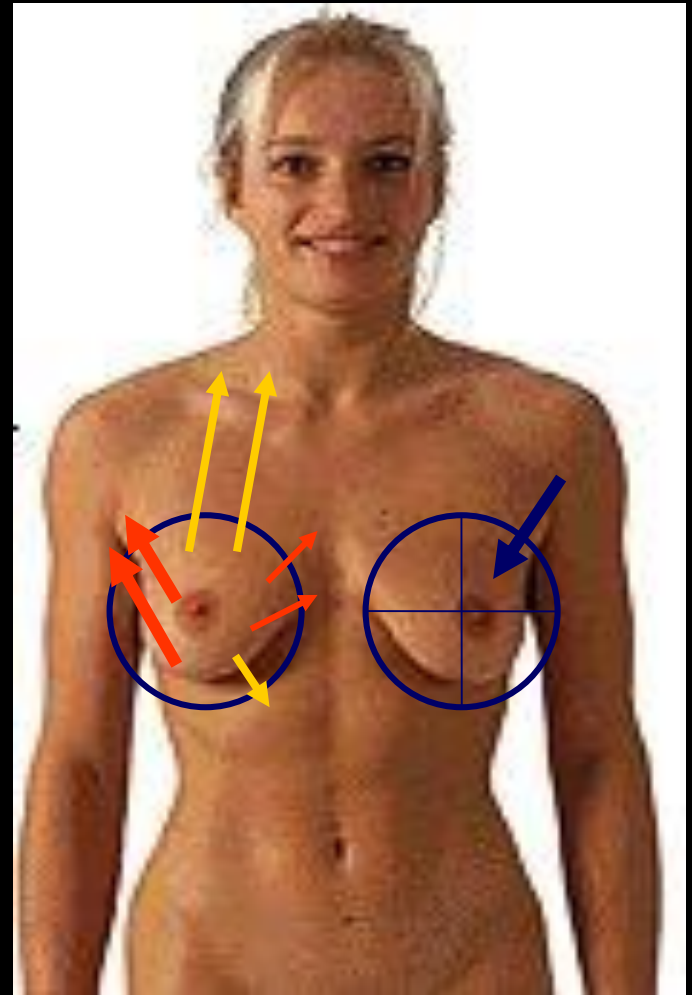
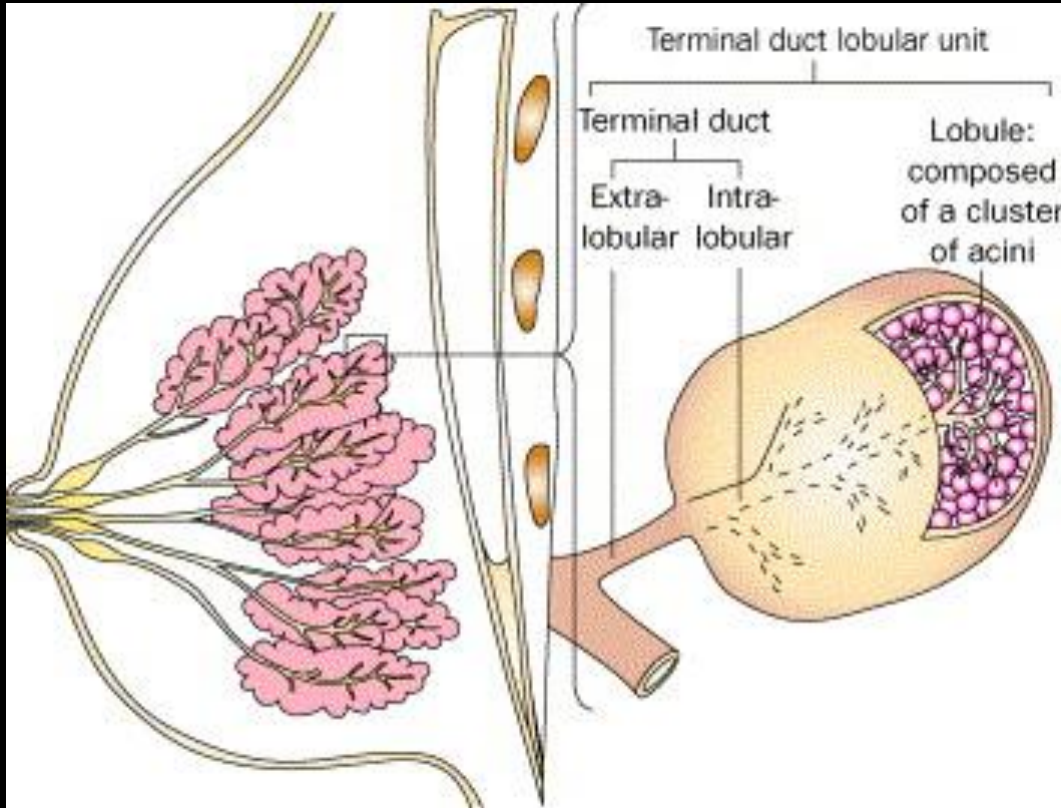
lactiferous pore



# Papilla mammae



# TDLU

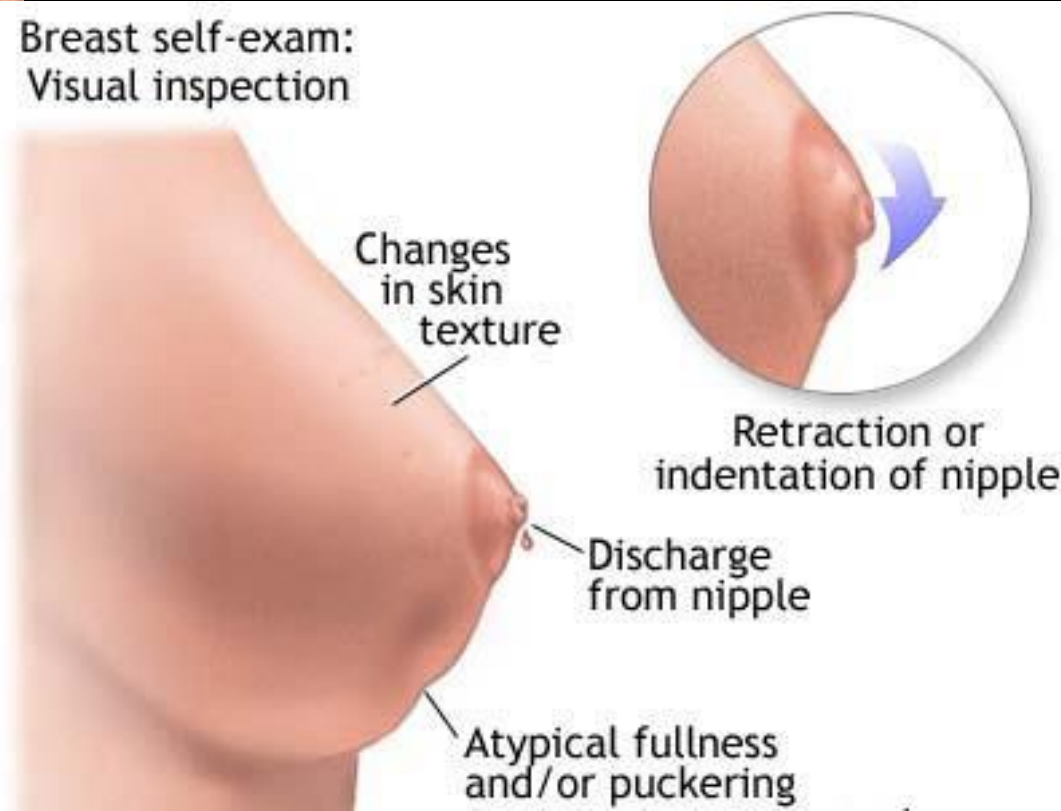


lymphatic drainage  
Sorgius node

# Breast carcinoma



Breast self-exam:  
Visual inspection



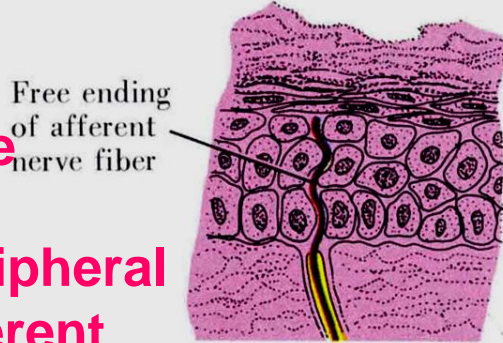


# **Skin receptors**

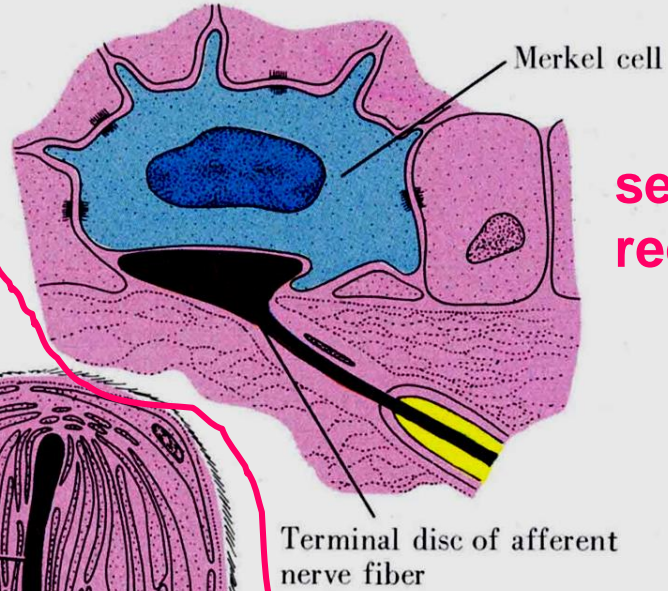
**mechanoreceptors, thermoreceptors, nociceptors**

free  
|  
peripheral  
afferent  
nerve terminals  
|  
encapsulated

### A. FREE EPIDERMAL NERVE ENDING



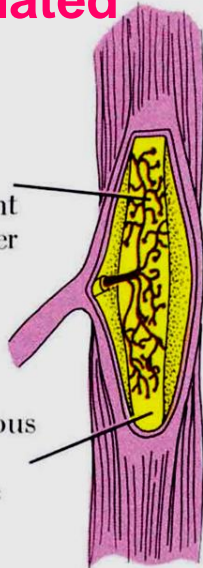
### B. MERKEL ENDING



secondary  
receptor cell

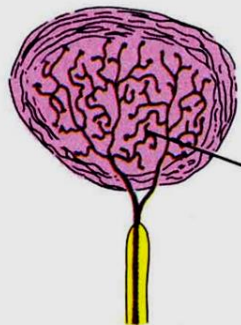
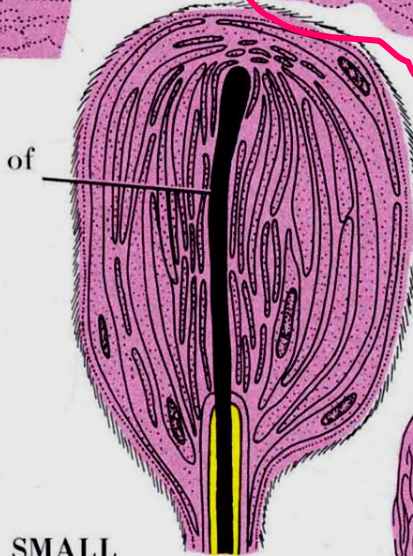
Terminal extremity of afferent nerve fiber

Terminal branches of afferent nerve fiber

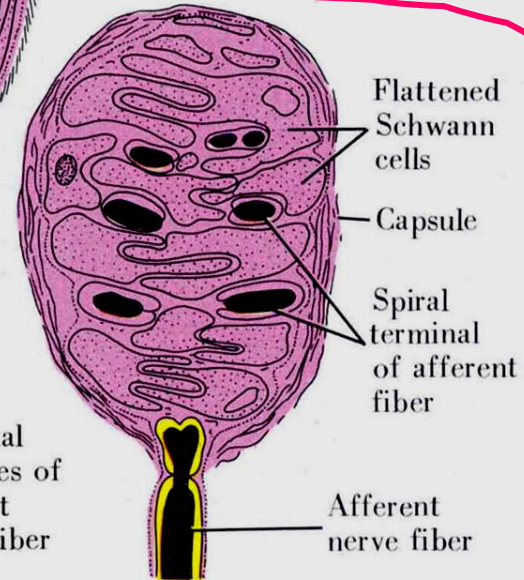


### D. RUFFINI CORPUSCLE

### C. SMALL PACINIAN CORPUSCLE

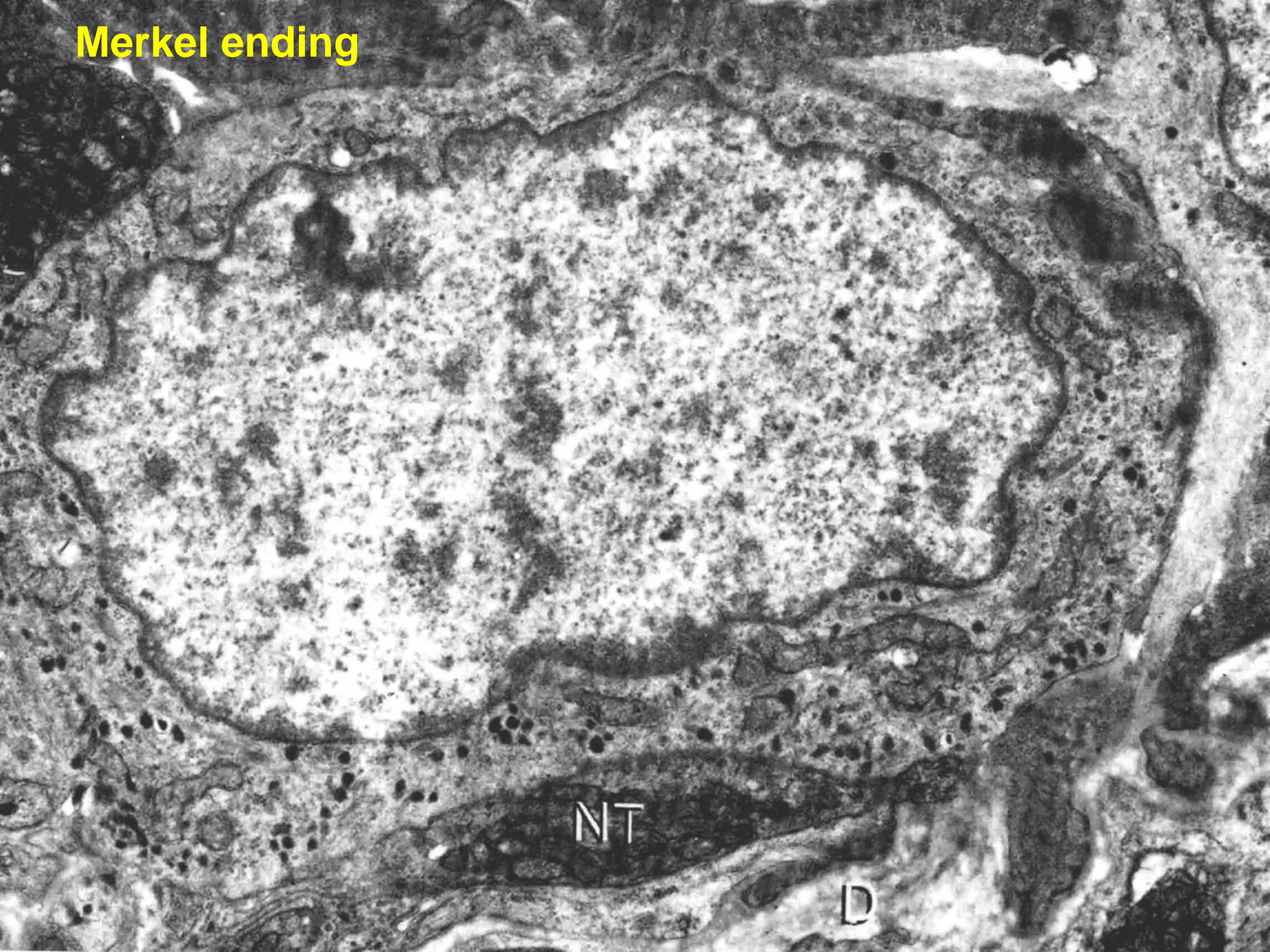


### E. KRAUSE END BULB



### F. MEISSNER'S CORPUSCLE

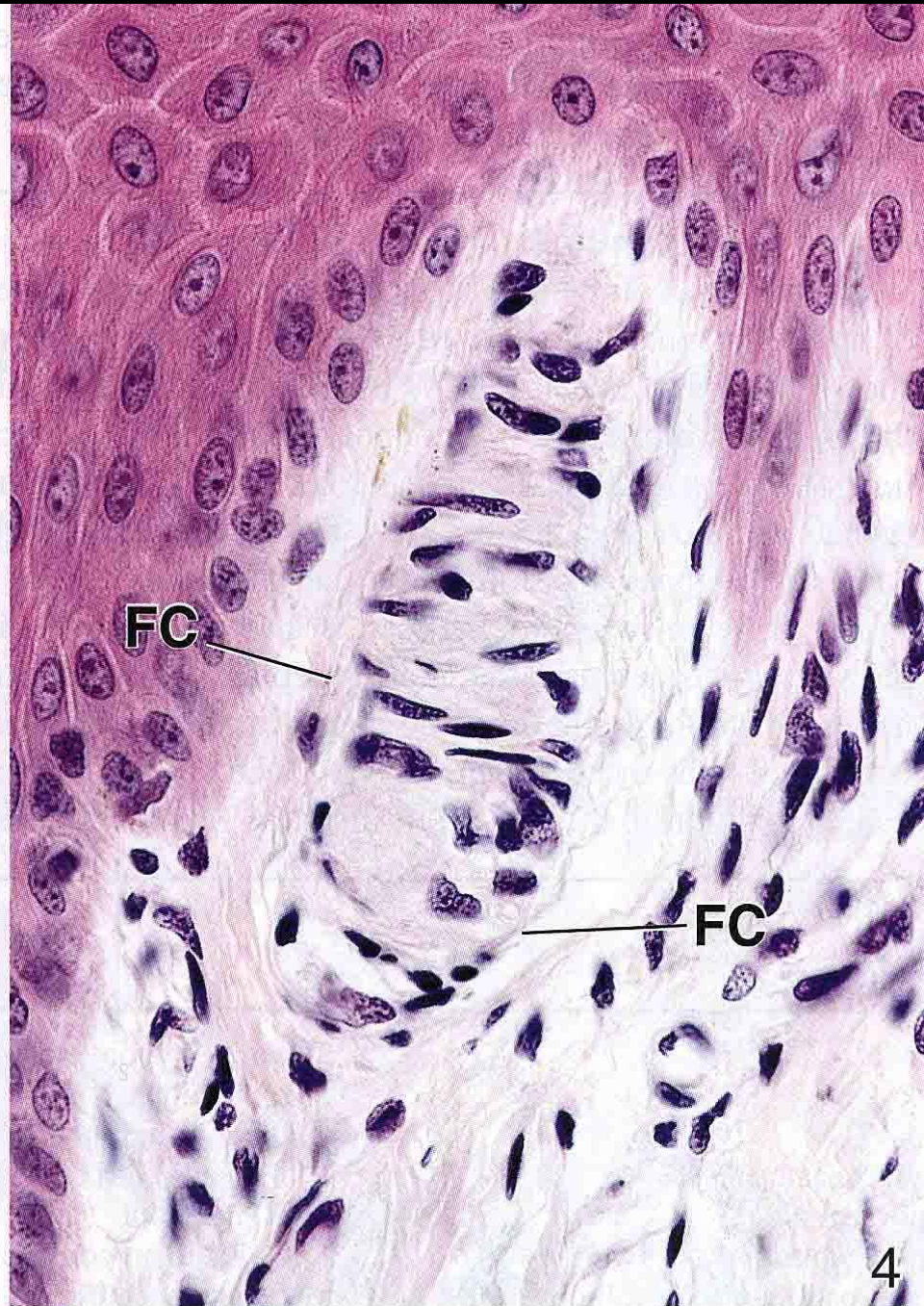
**Merkel ending**

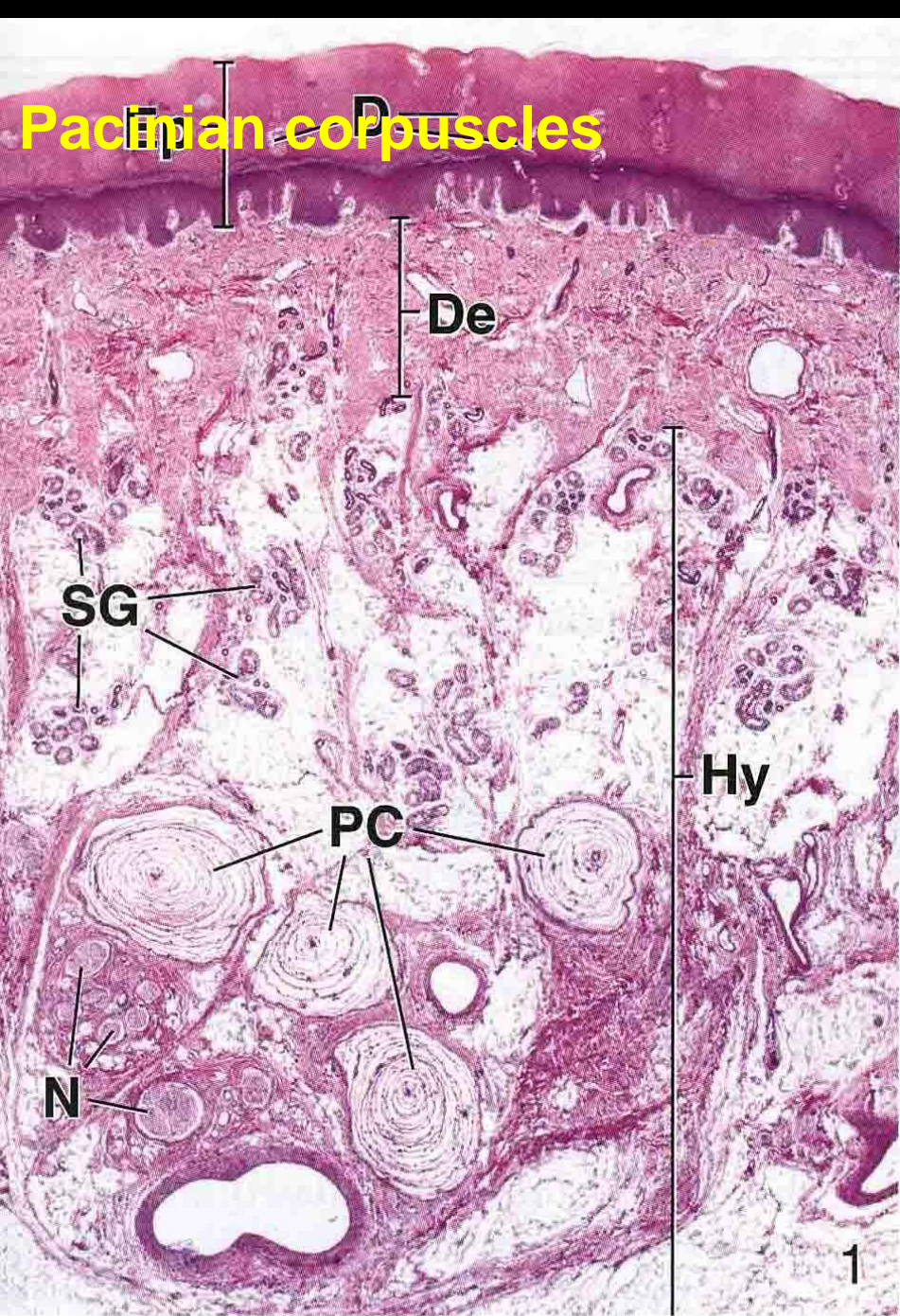


NT

D

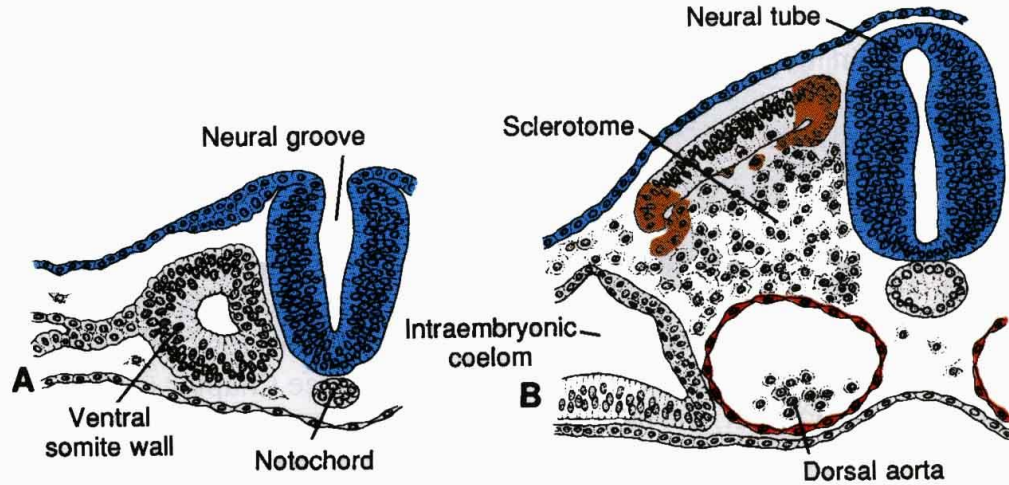
# Meissner's corpuscles



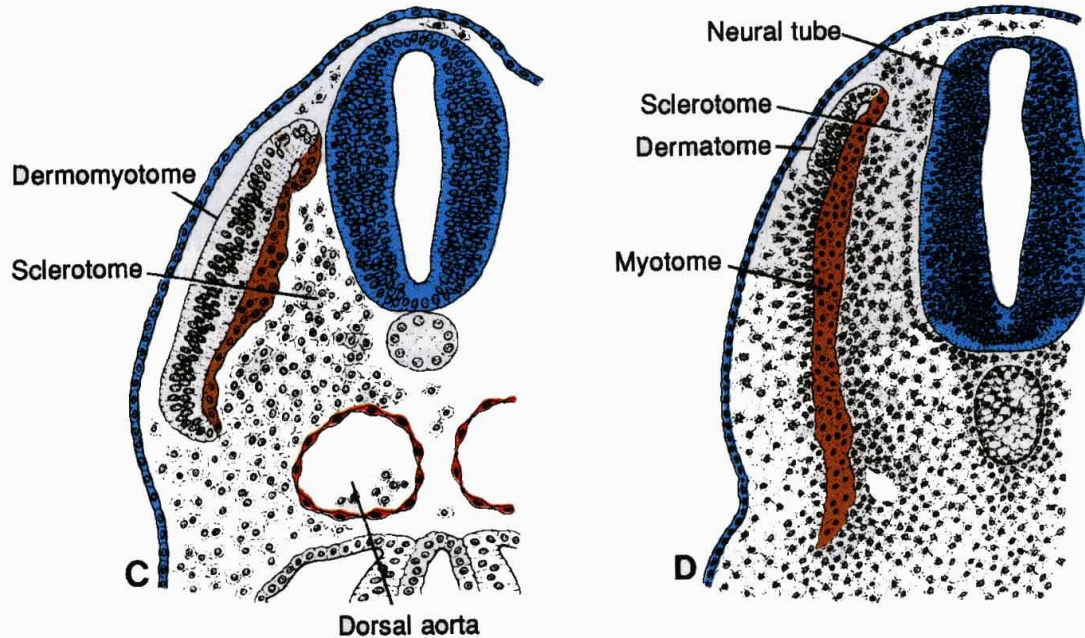


# DEVELOPMENT OF THE SKIN

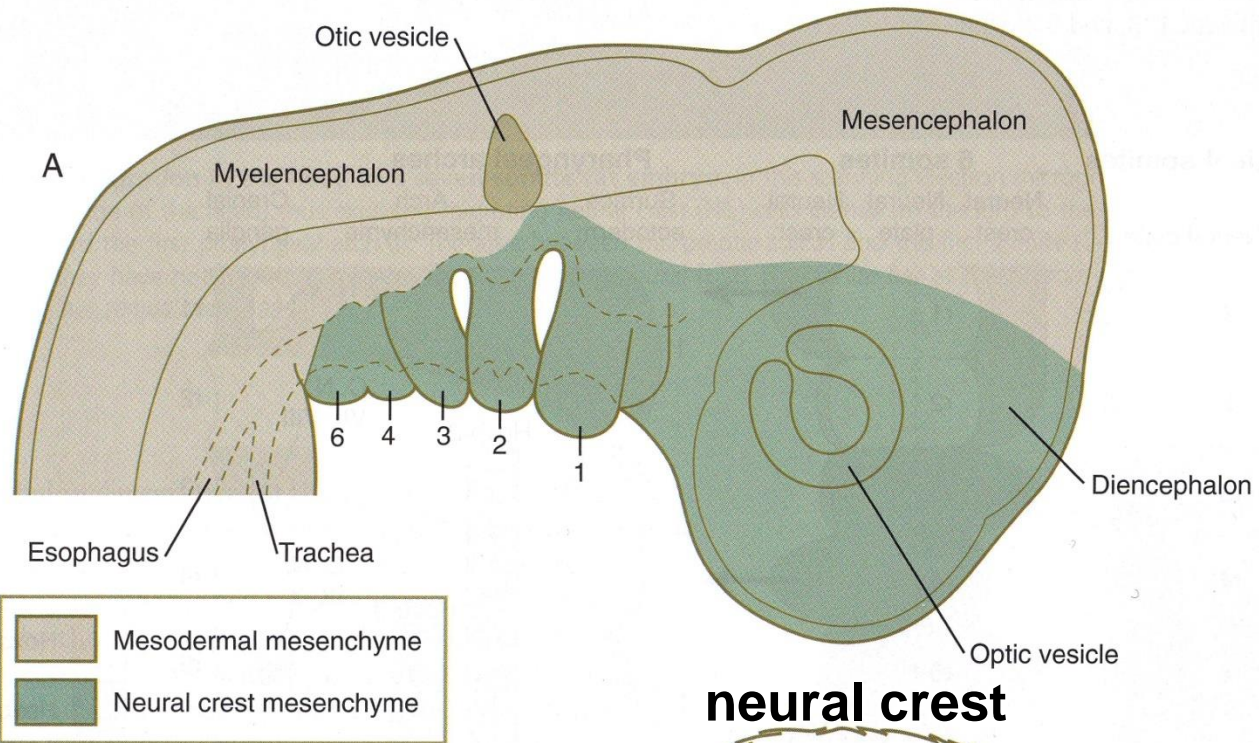
surface ectoderm



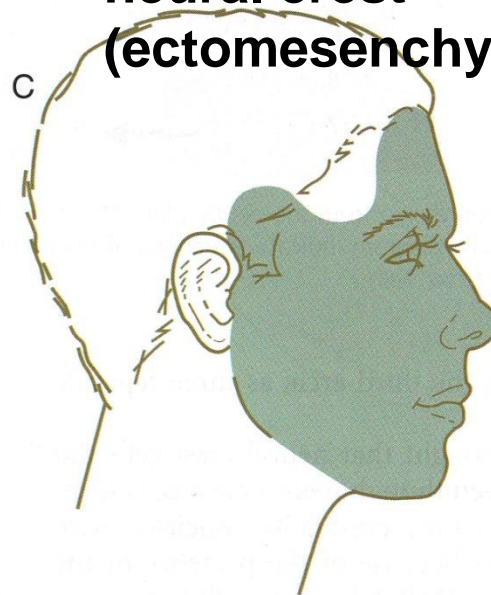
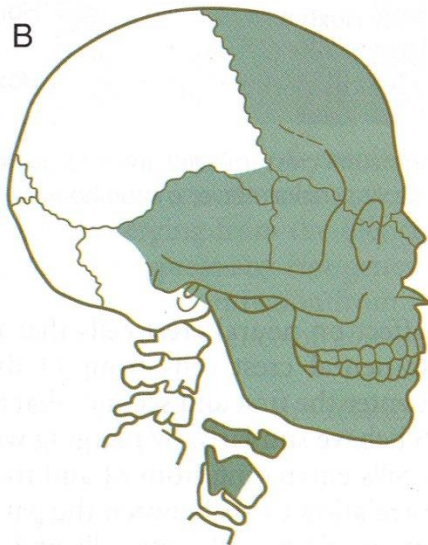
paraxial mesoderm

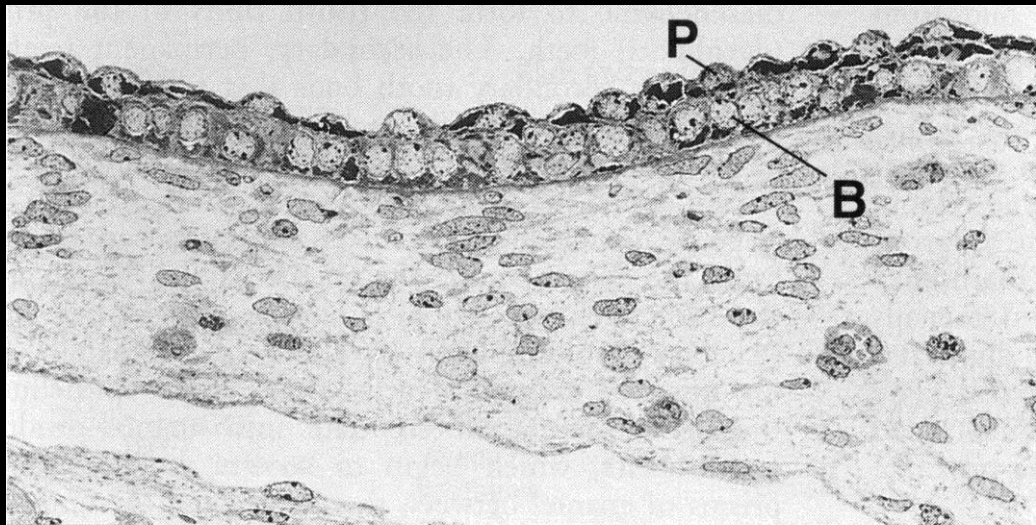
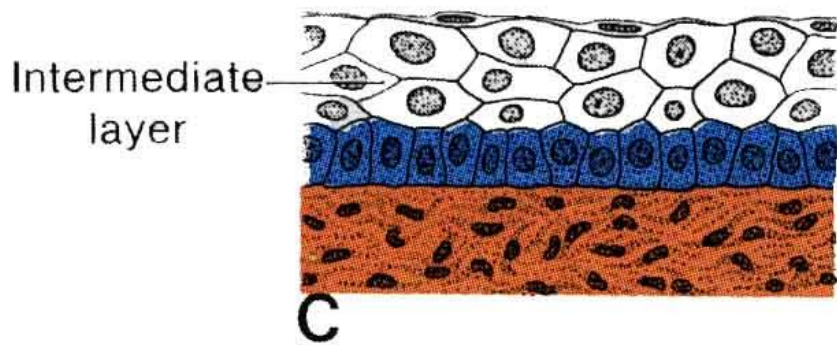
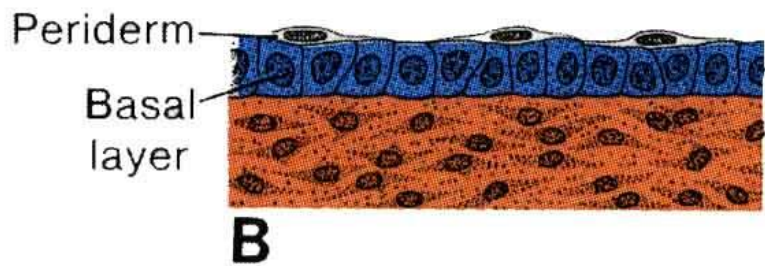
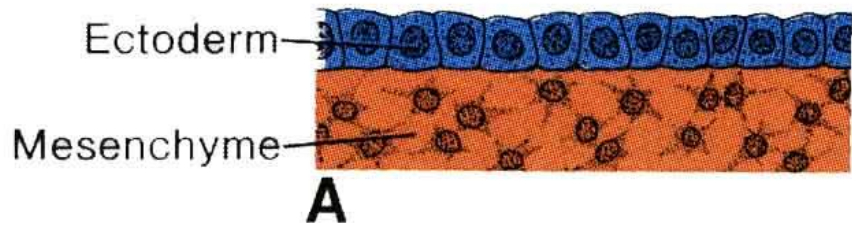


lateral mesoderm

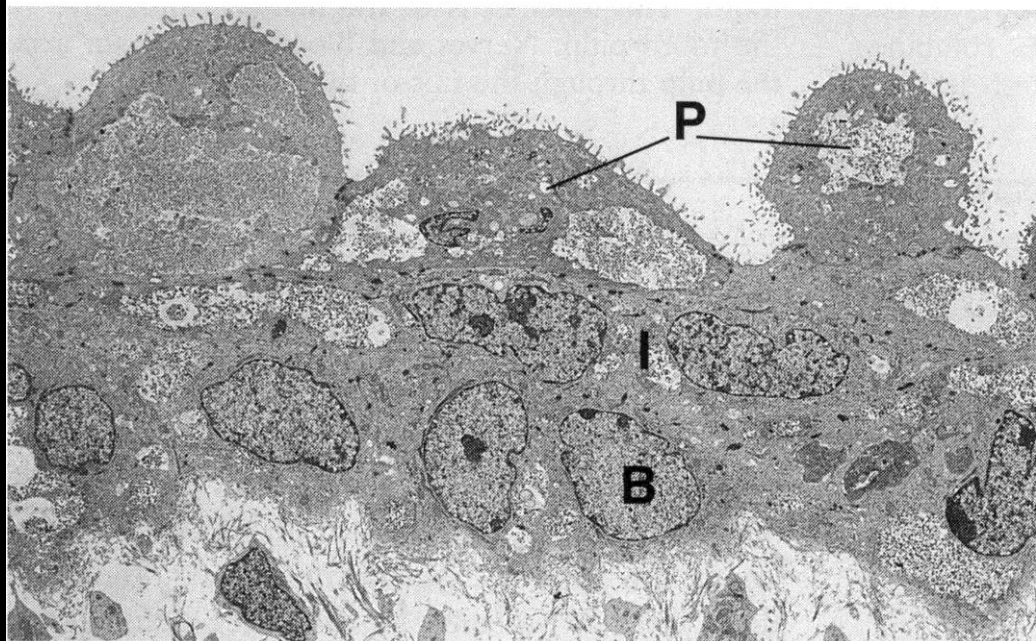


**neural crest  
(ectomesenchyme)**





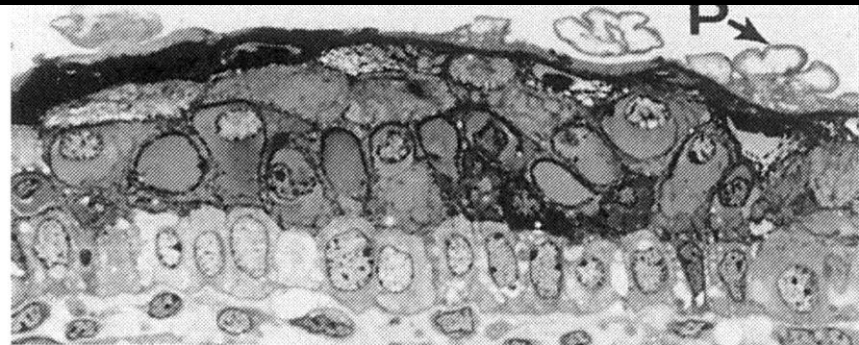
8 weeks



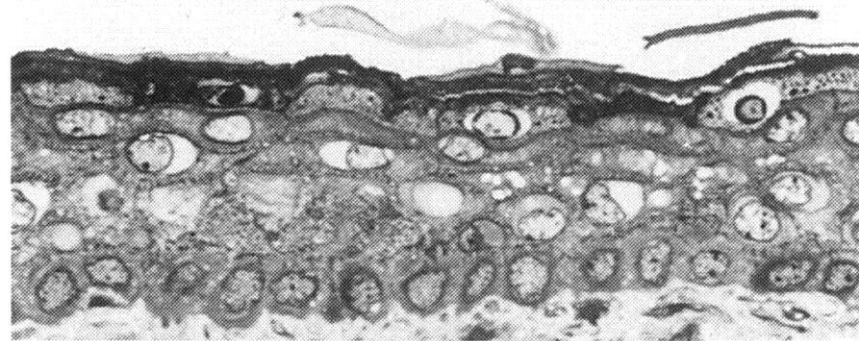
11 weeks



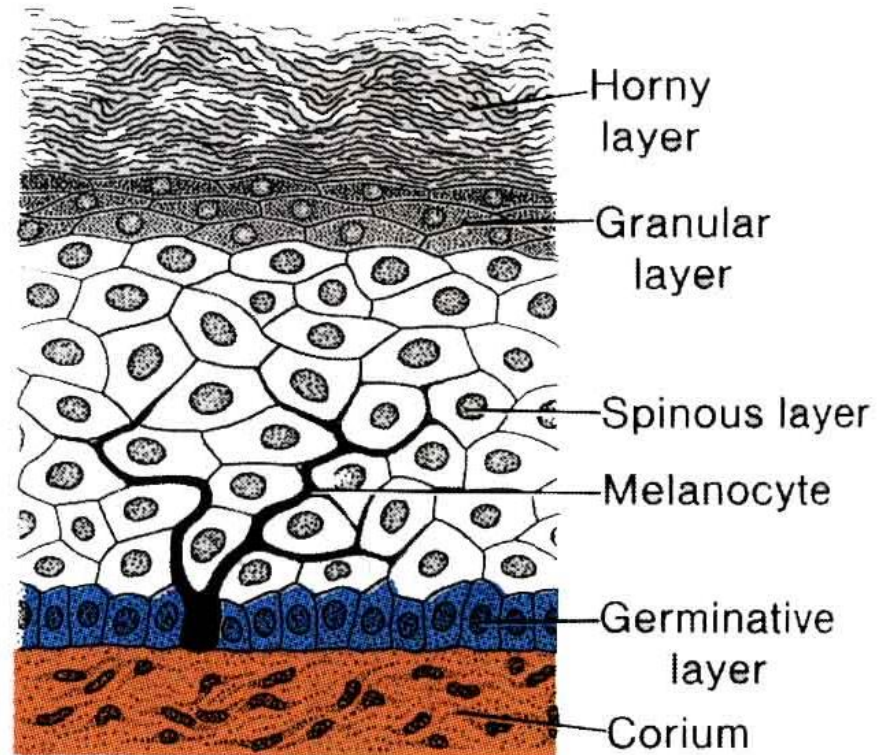
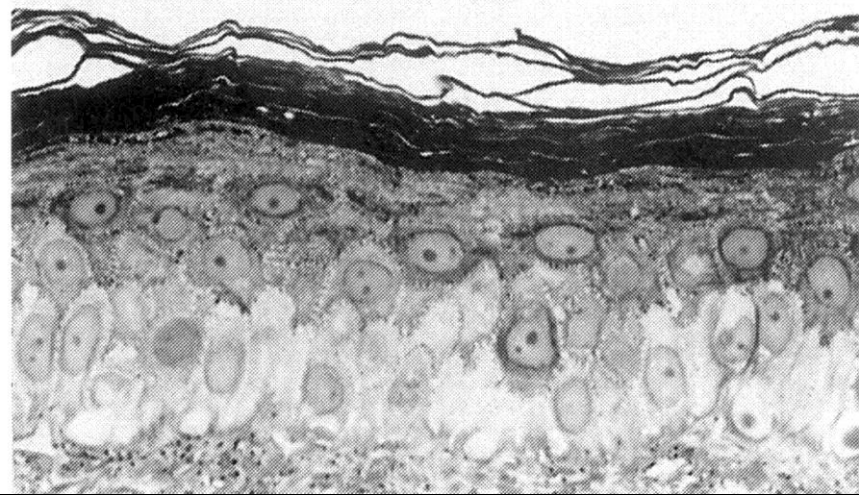
17 weeks



24 weeks

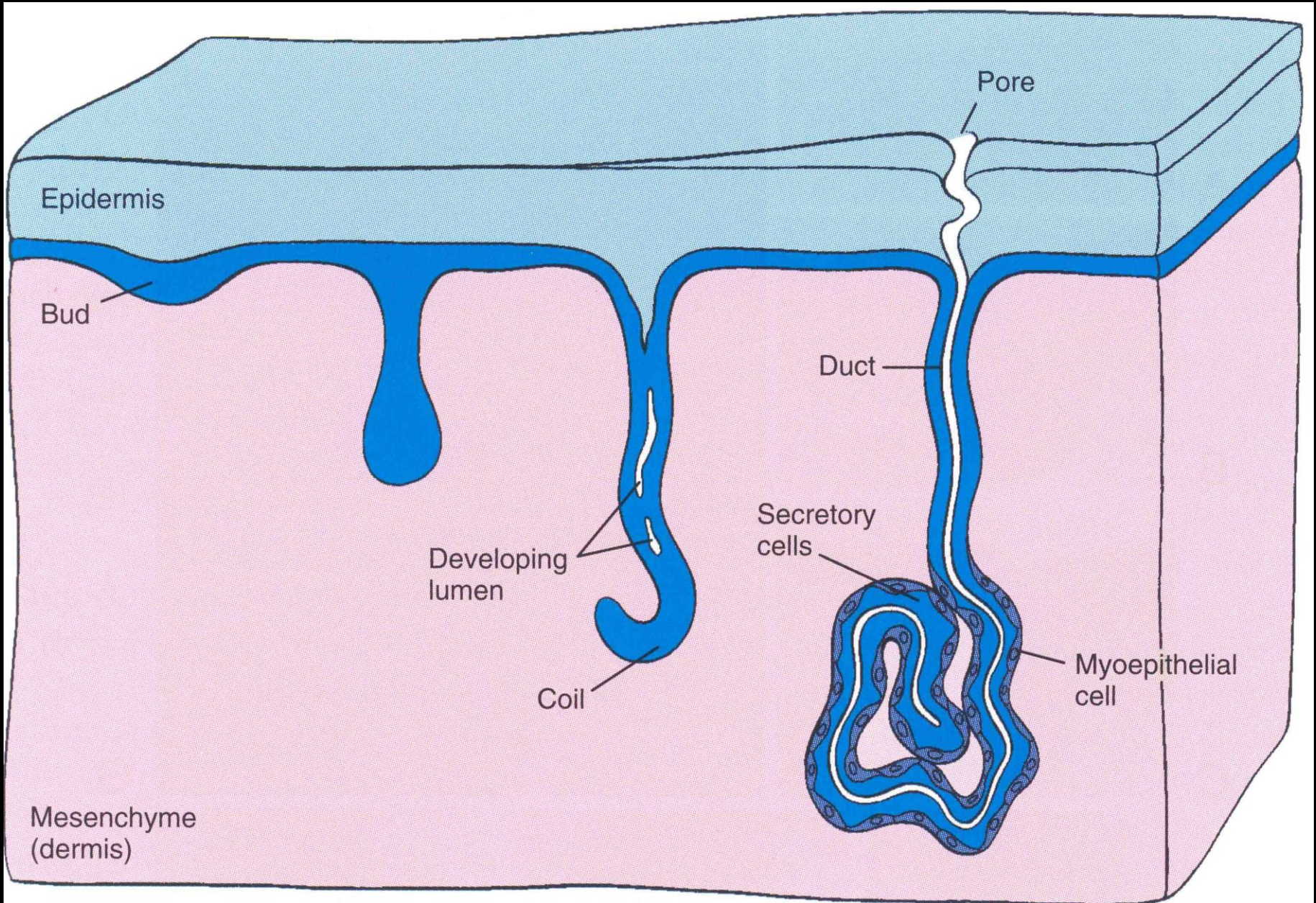


Adult

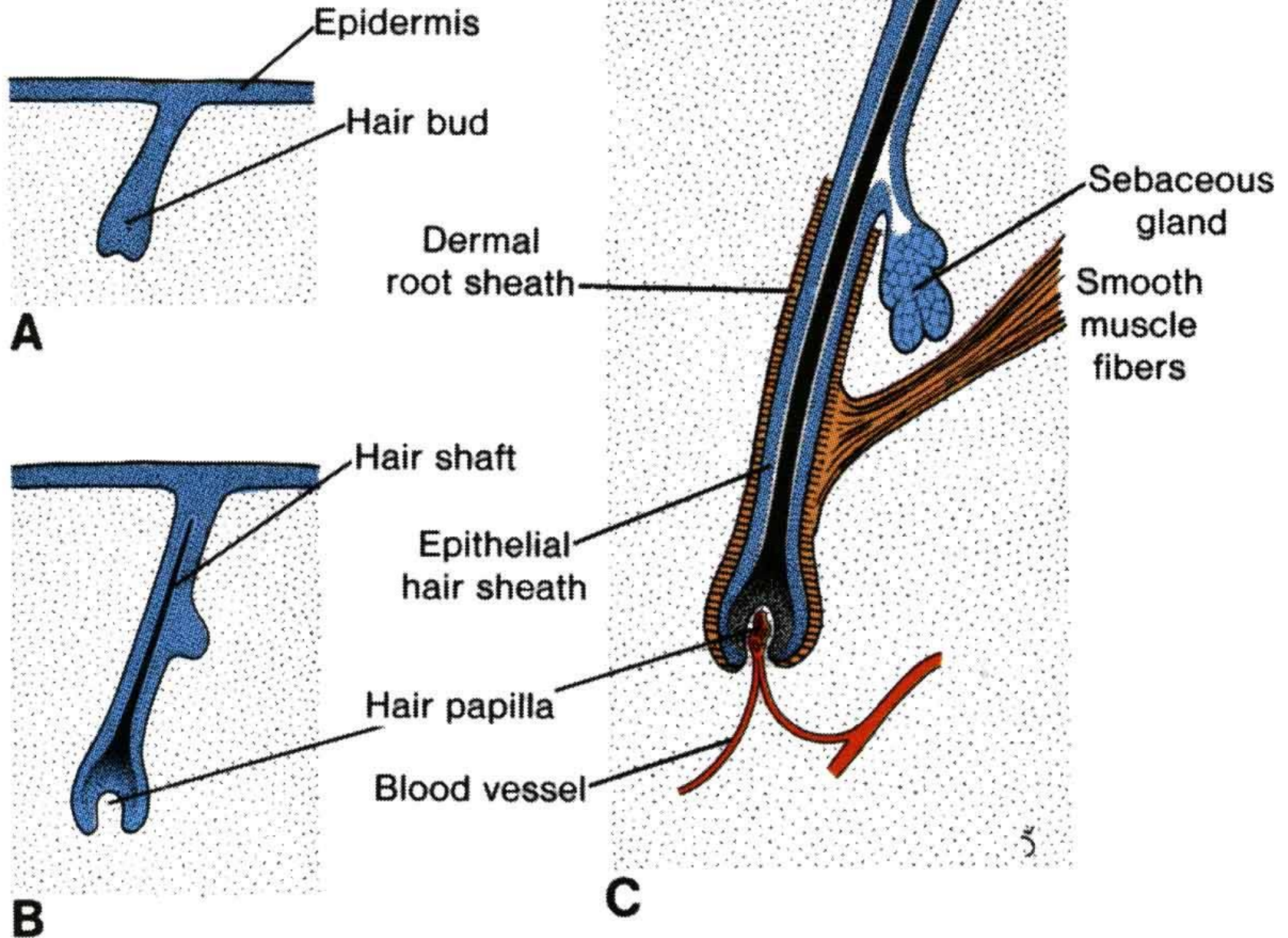


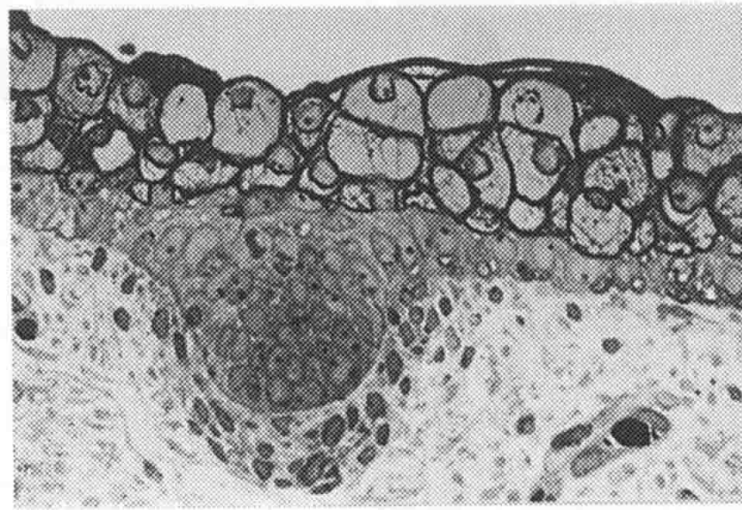
D

# Development of sweat glands

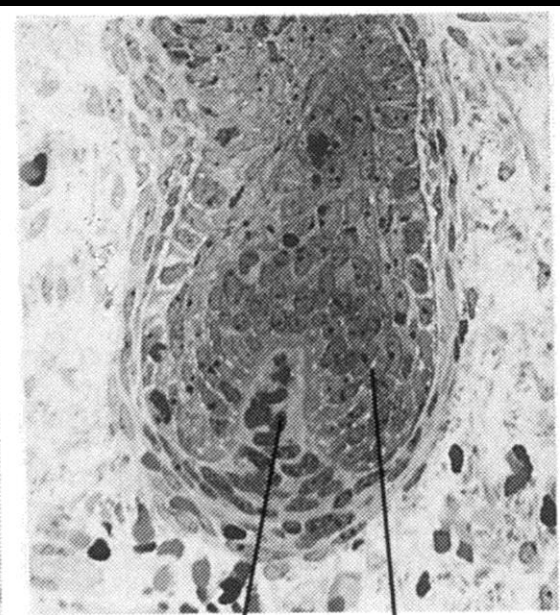


# Development of hairs and sebaceous glands



**A****B****C****D**

GM

**E**

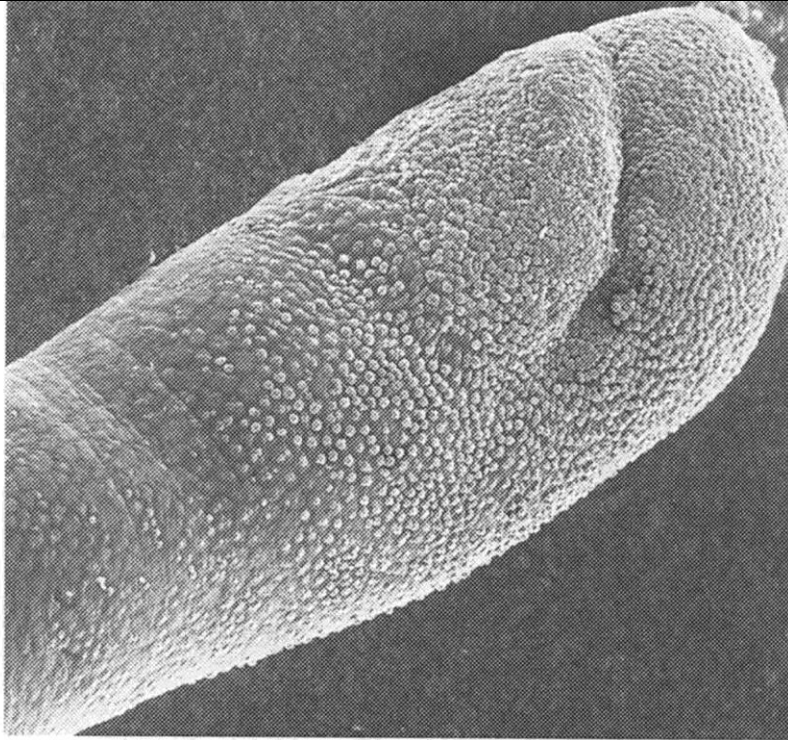
DP

GM

# Development of nails

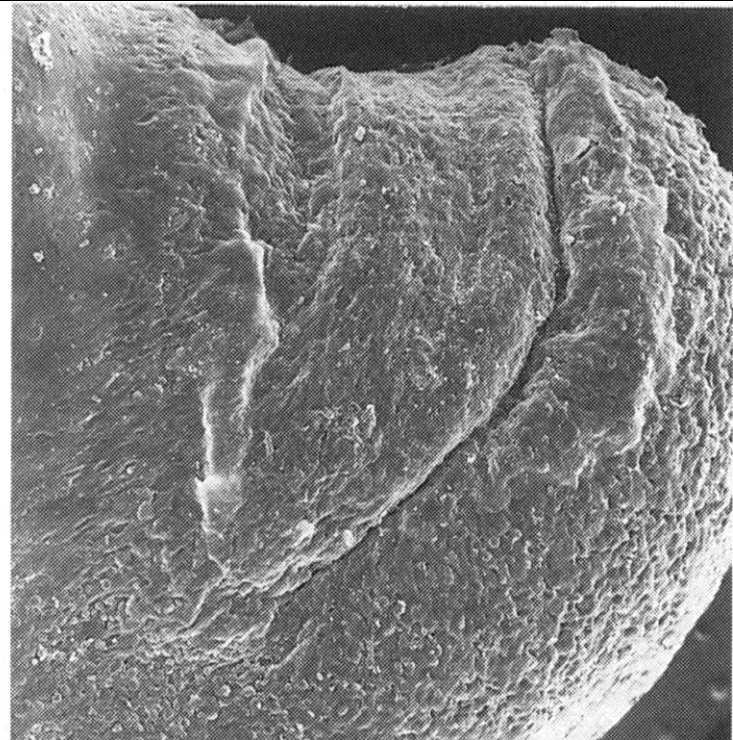
**A**

12 weeks



**C**

16 weeks



# Development of mammary glands

