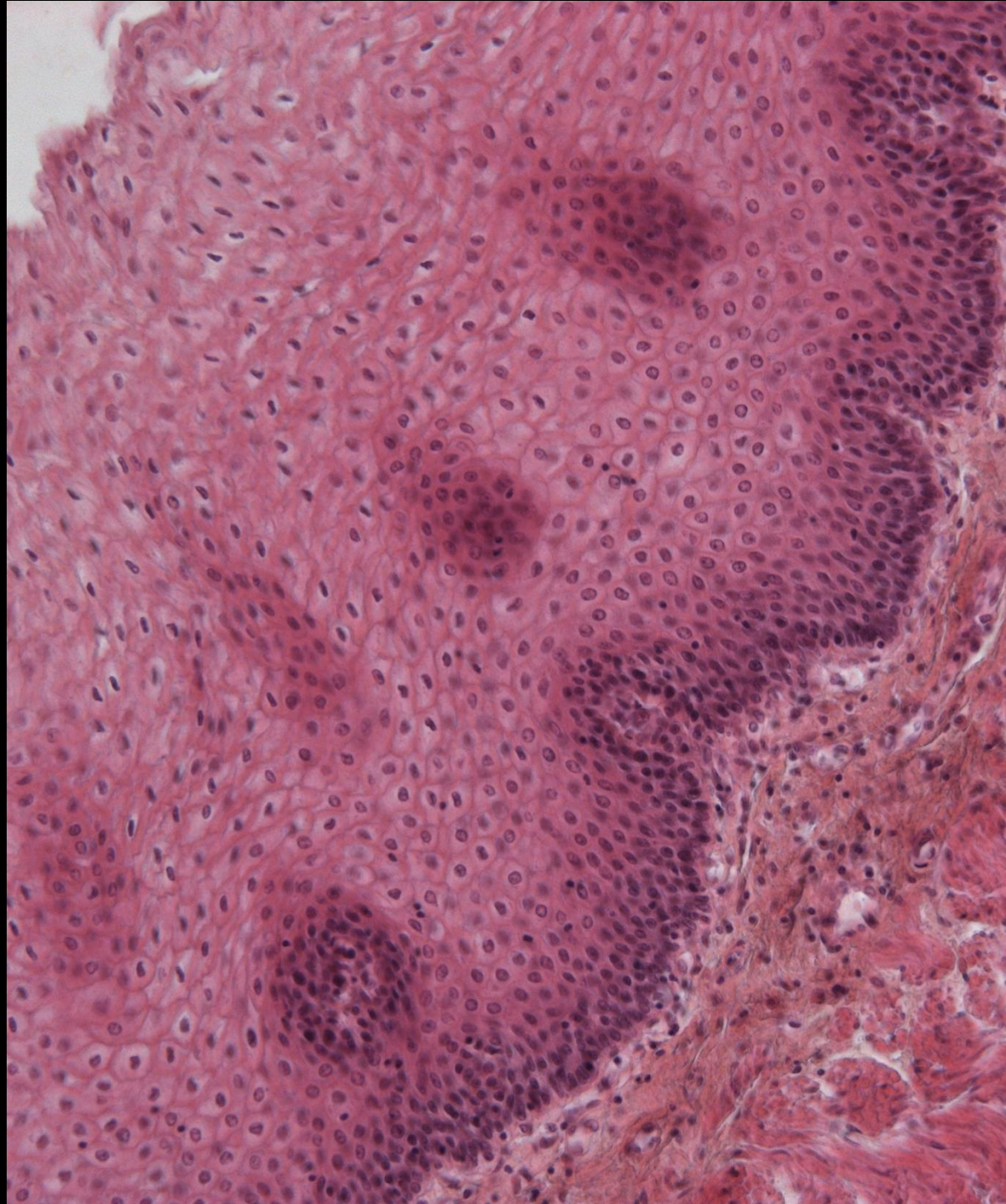
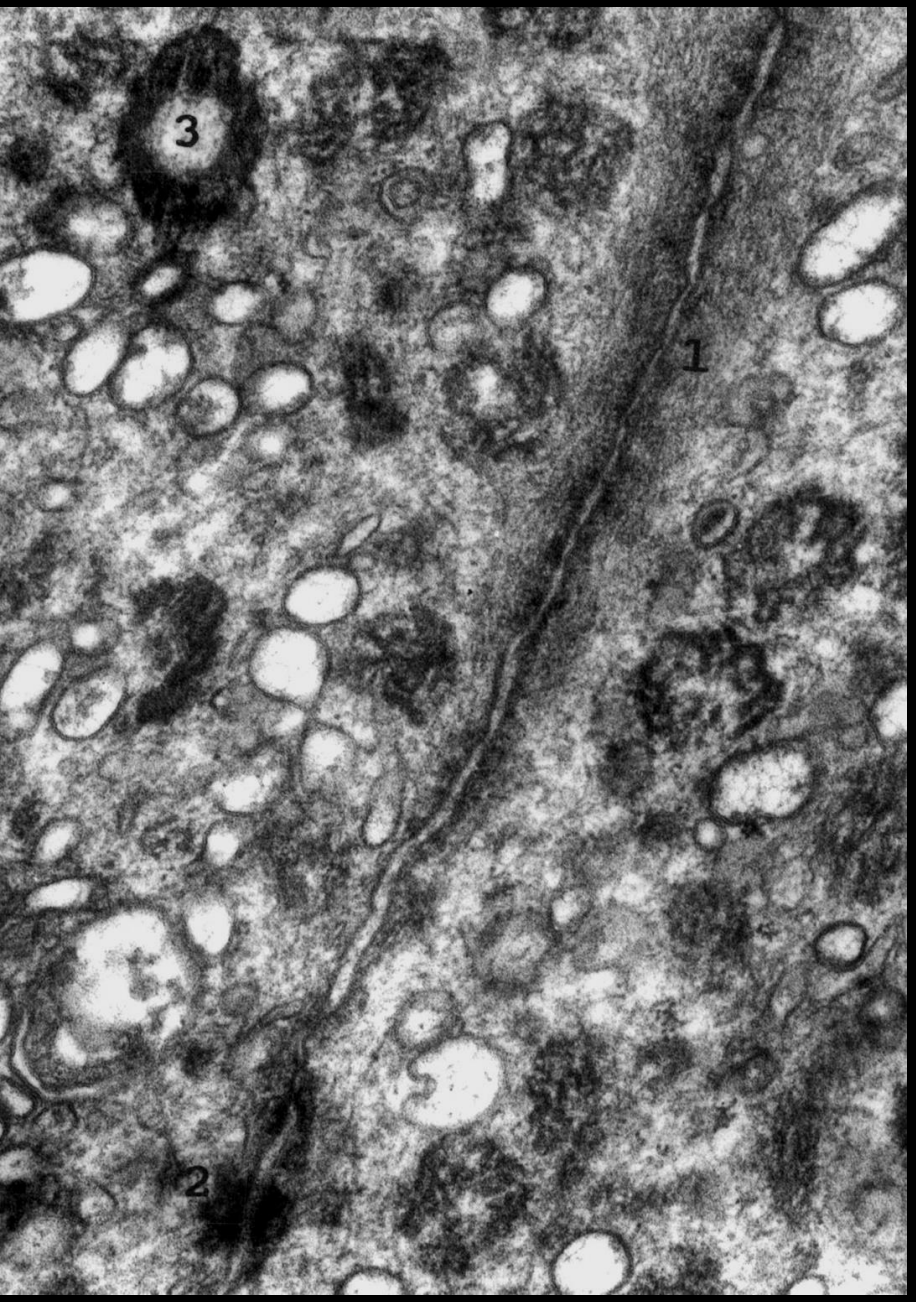
Epithelial tissue

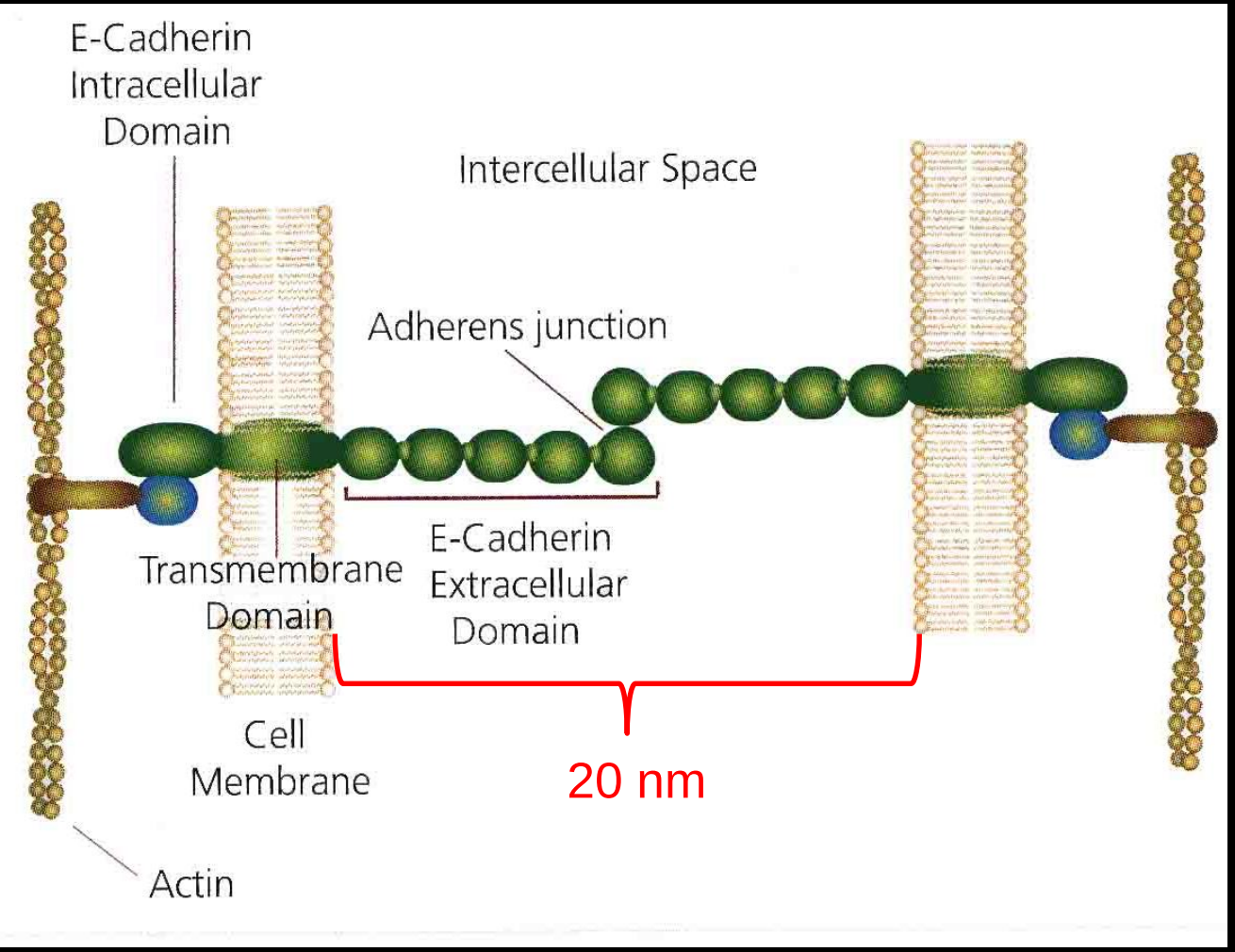
- tightly arranged cells
- small amount of extracellular matrix
- high coherence
- polarized cells
- surface specializations
- avascular tissue
- rich innervation
- fast cell renewal
- high ability of regeneration



Tightly arranged cells, small amount of extracellular matrix

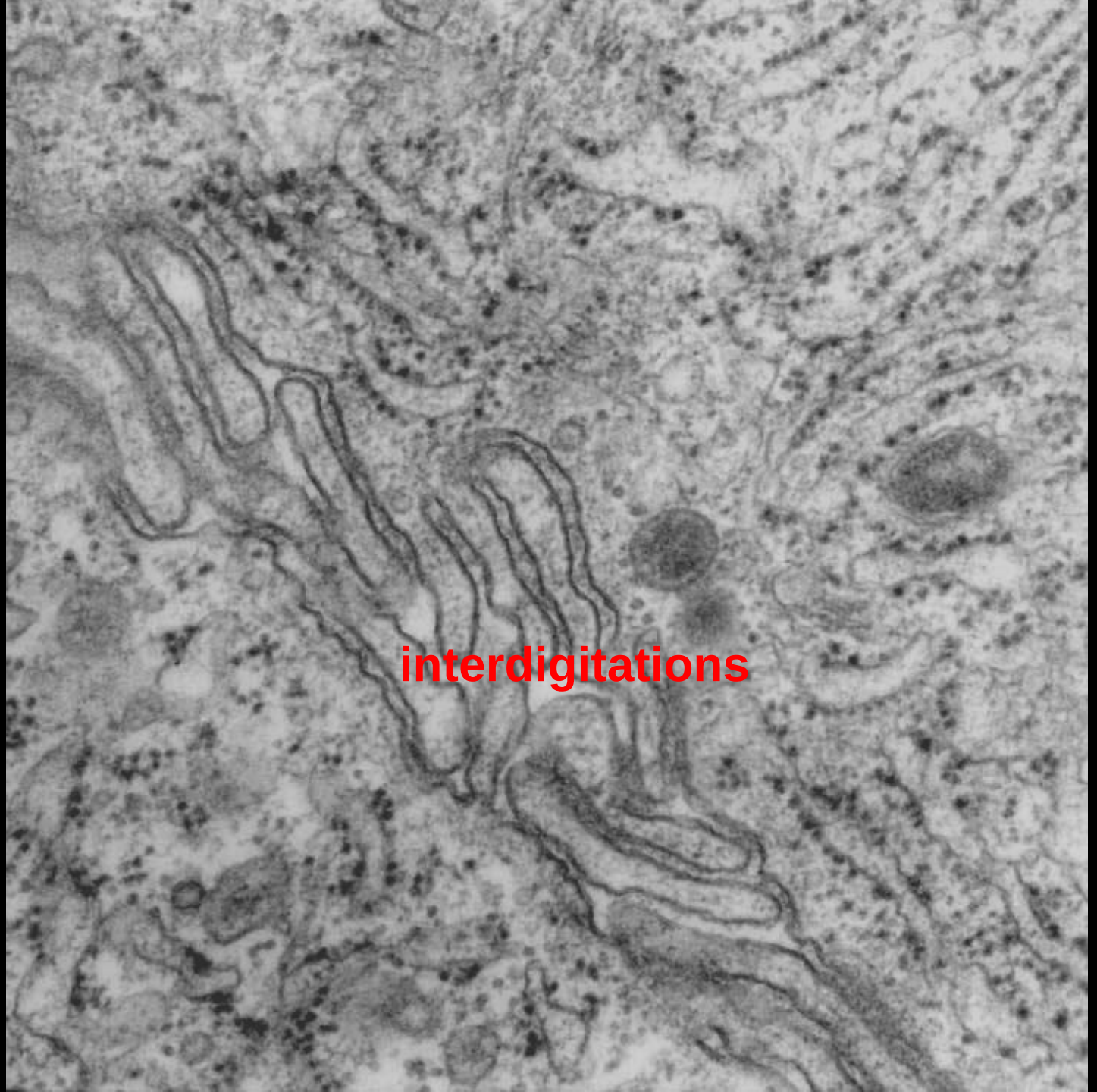


High coherence

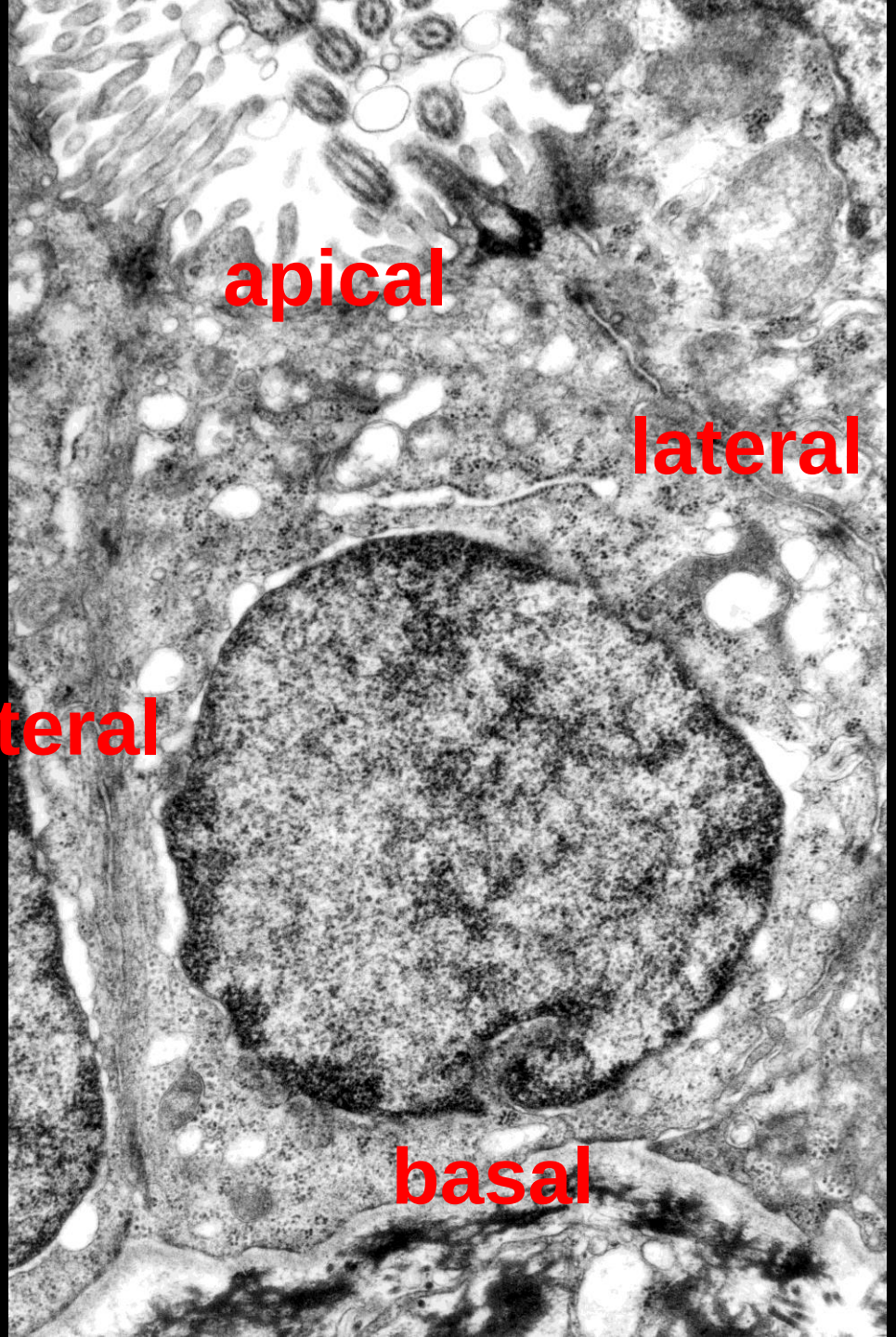


Cell adhesion molecules (CAM)

cell-to-cell adhesion
CADHERINS
(Ca^{2+} co-operation)
E-cadherin - uvomorulin


interdigitations

Polarity, surface specializations



SPECIALIZATIONS OF LATERAL SURFACES OF EPITHELIAL CELLS

1) zonula occludens (tight junction)

2) zonula adhaerens

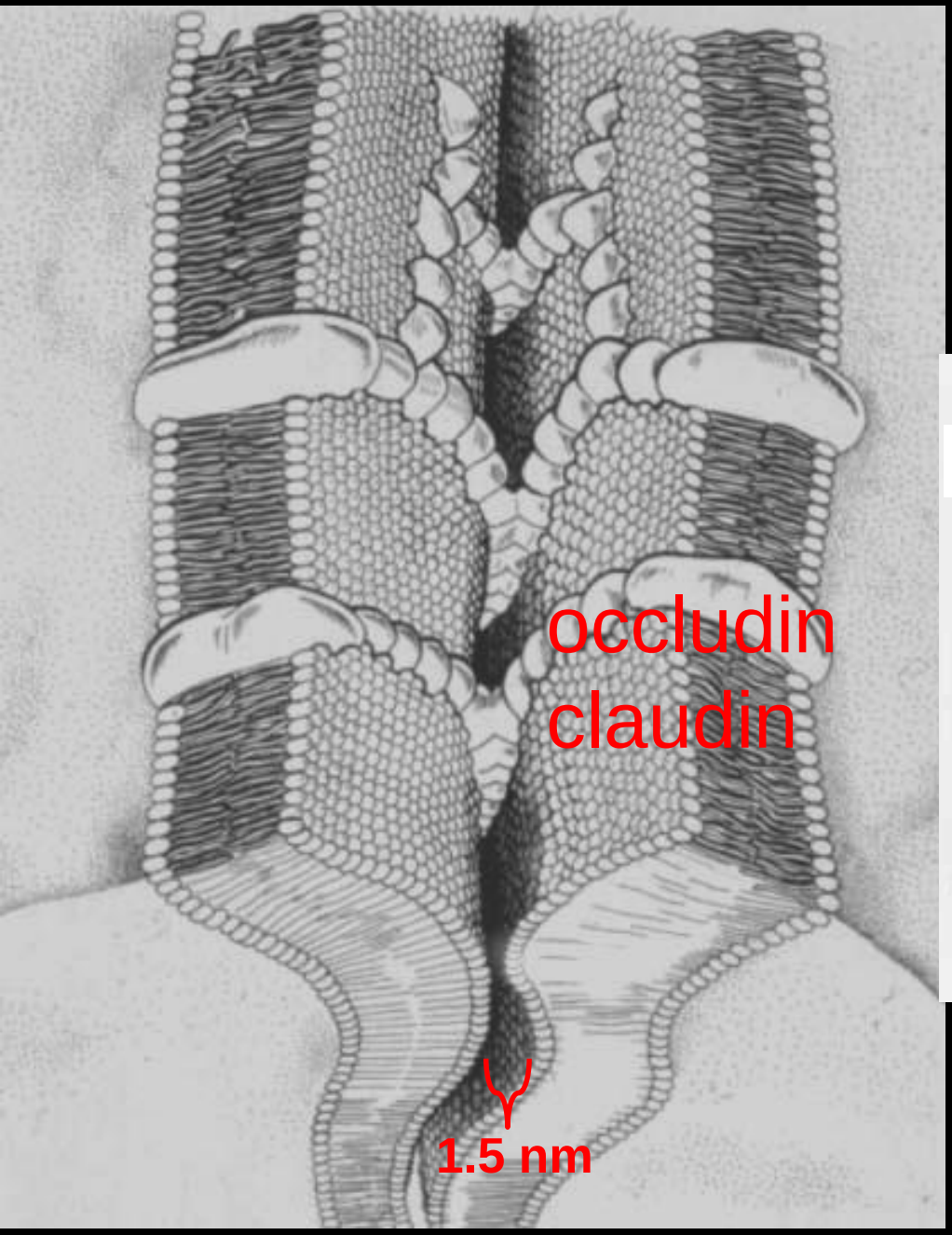
3) macula adhaerens (desmosome)

terminal bar (1+2)

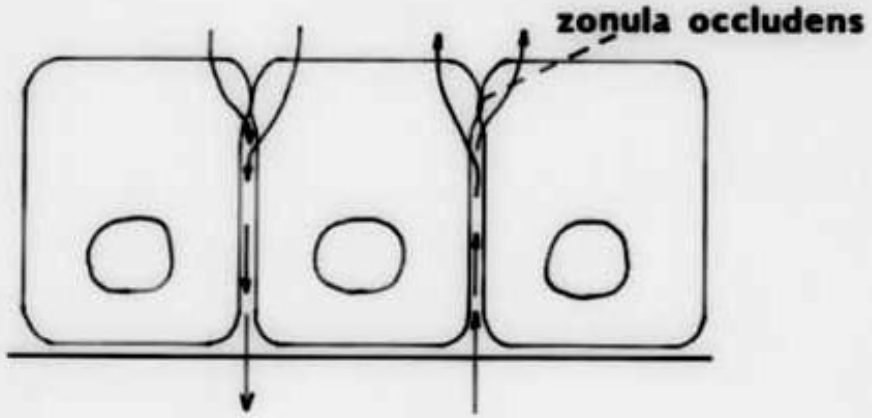
apical junctional complex (1+2+3)

4) nexus (gap junction)

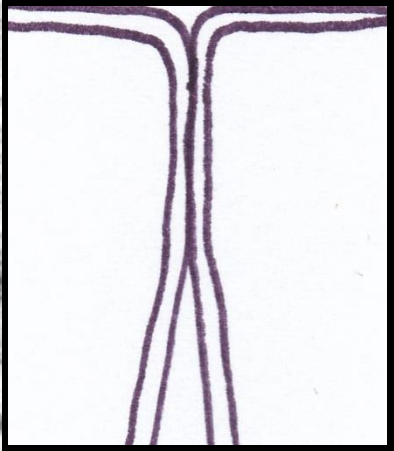
Zonula occludens



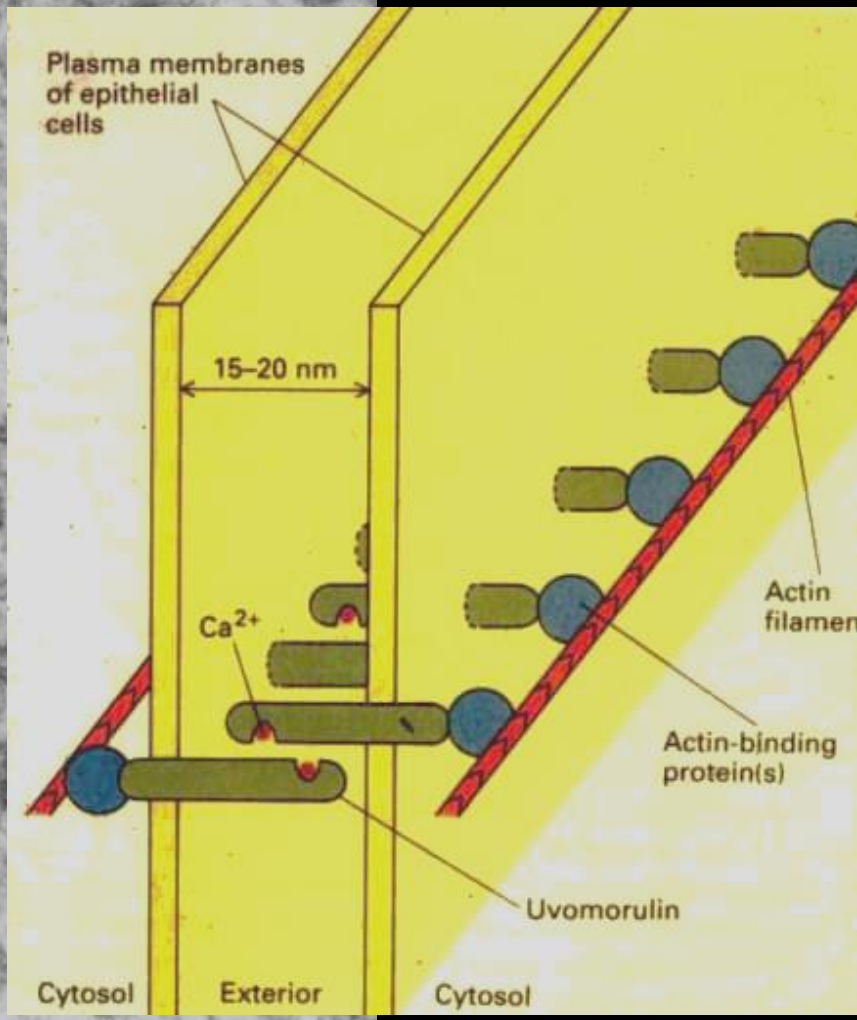
FUNCTION OF THE TIGHT JUNCTION

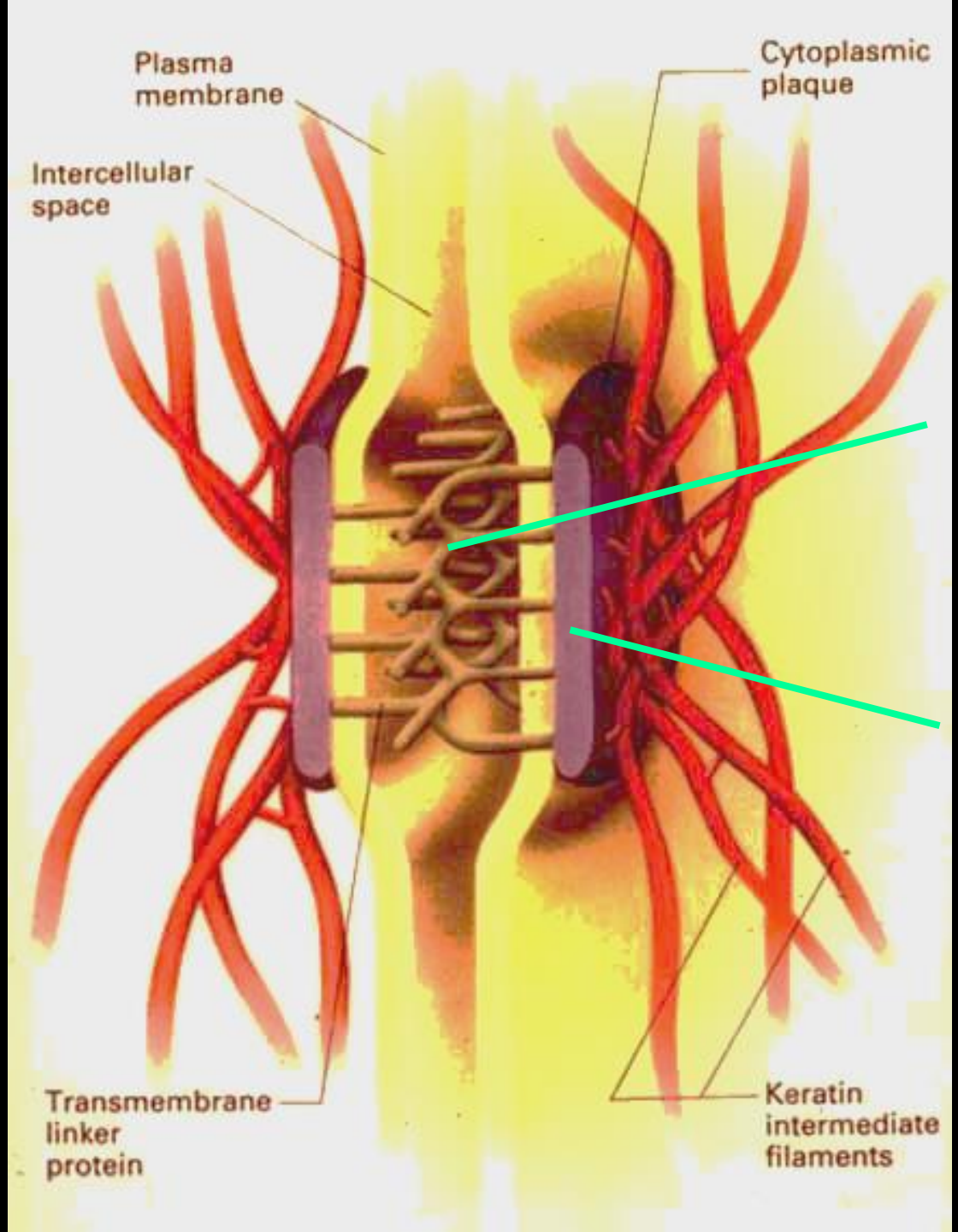


pentalaminar structure



Zonula adhaerens

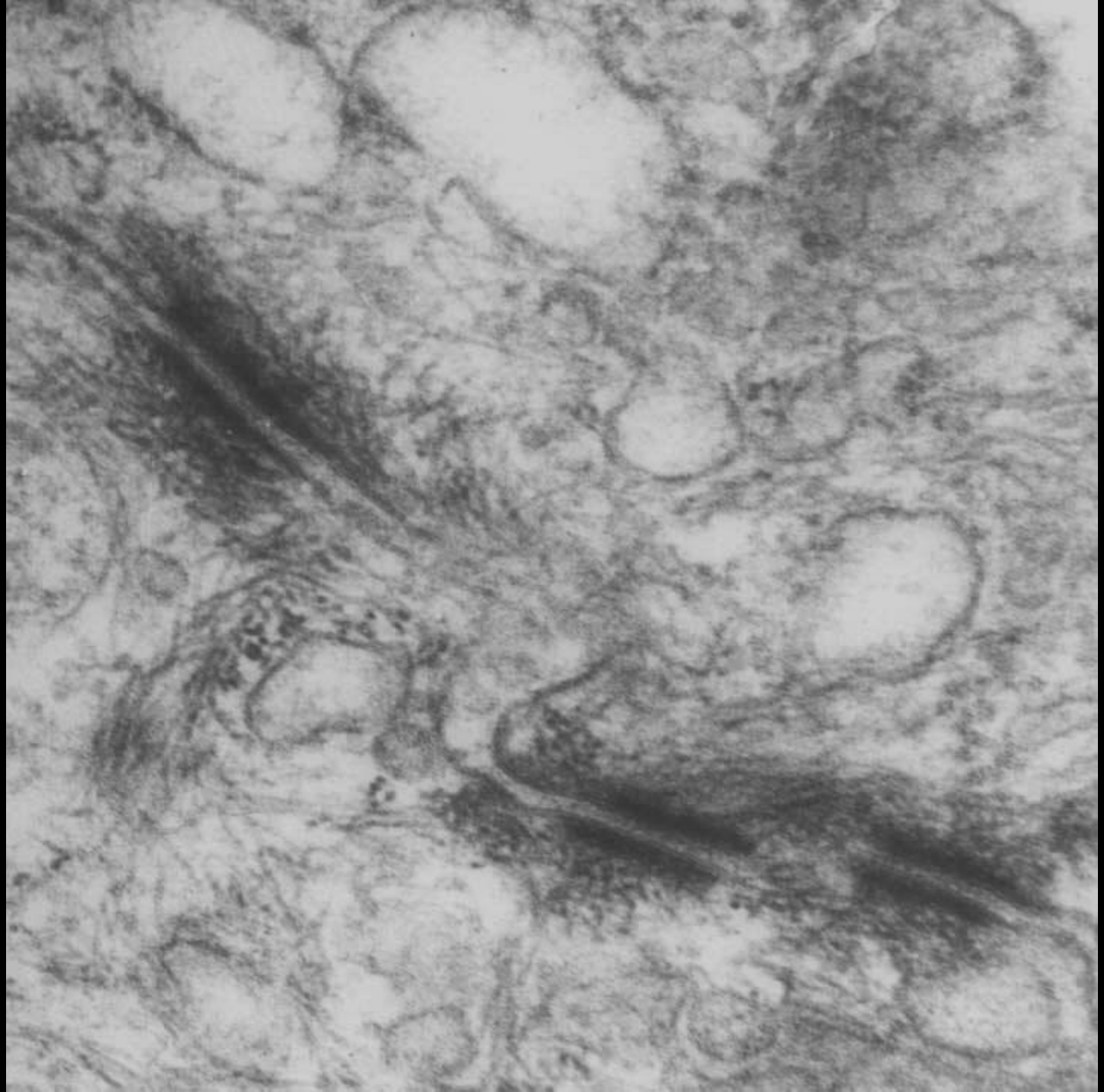


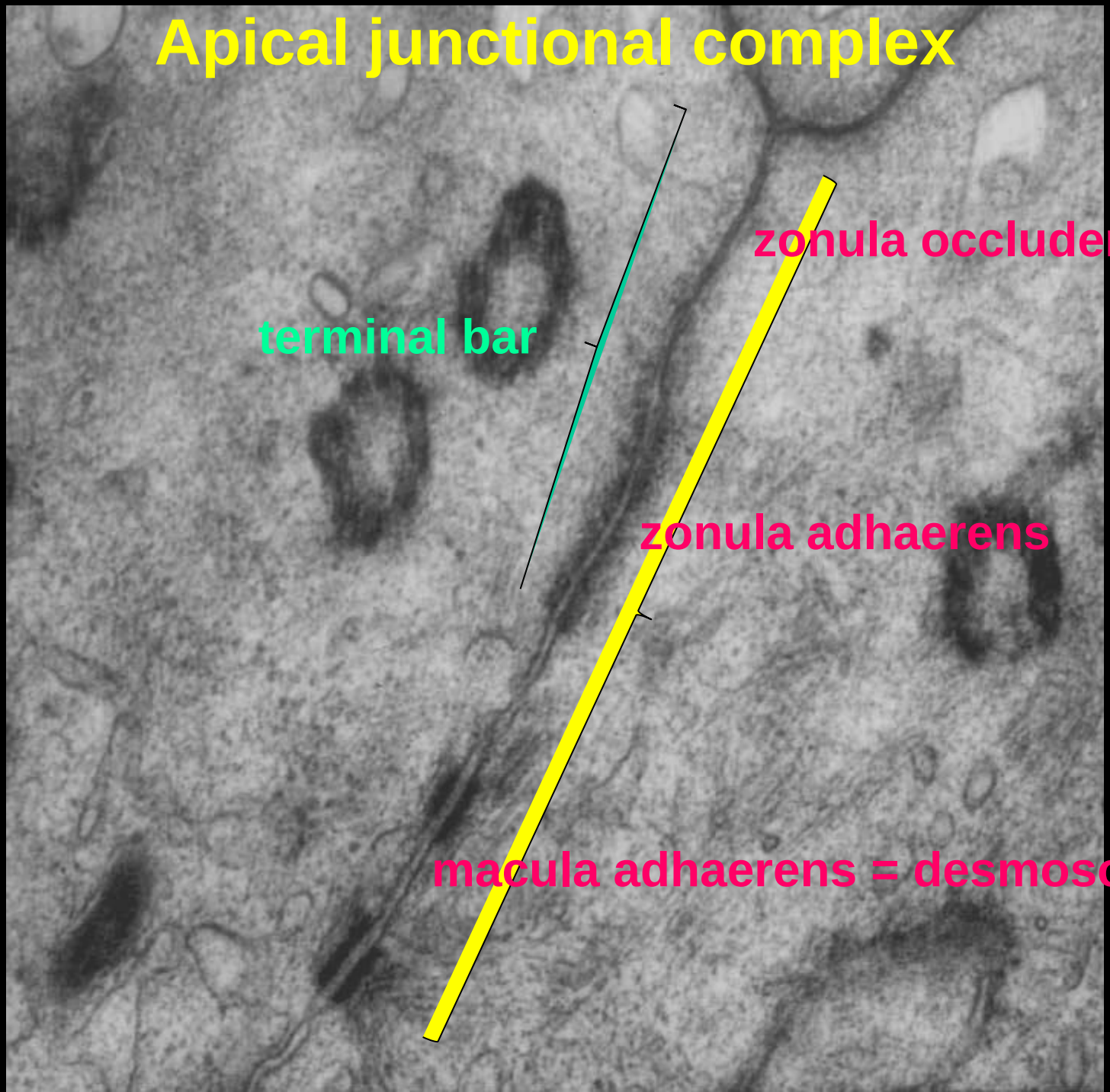


Desmosome

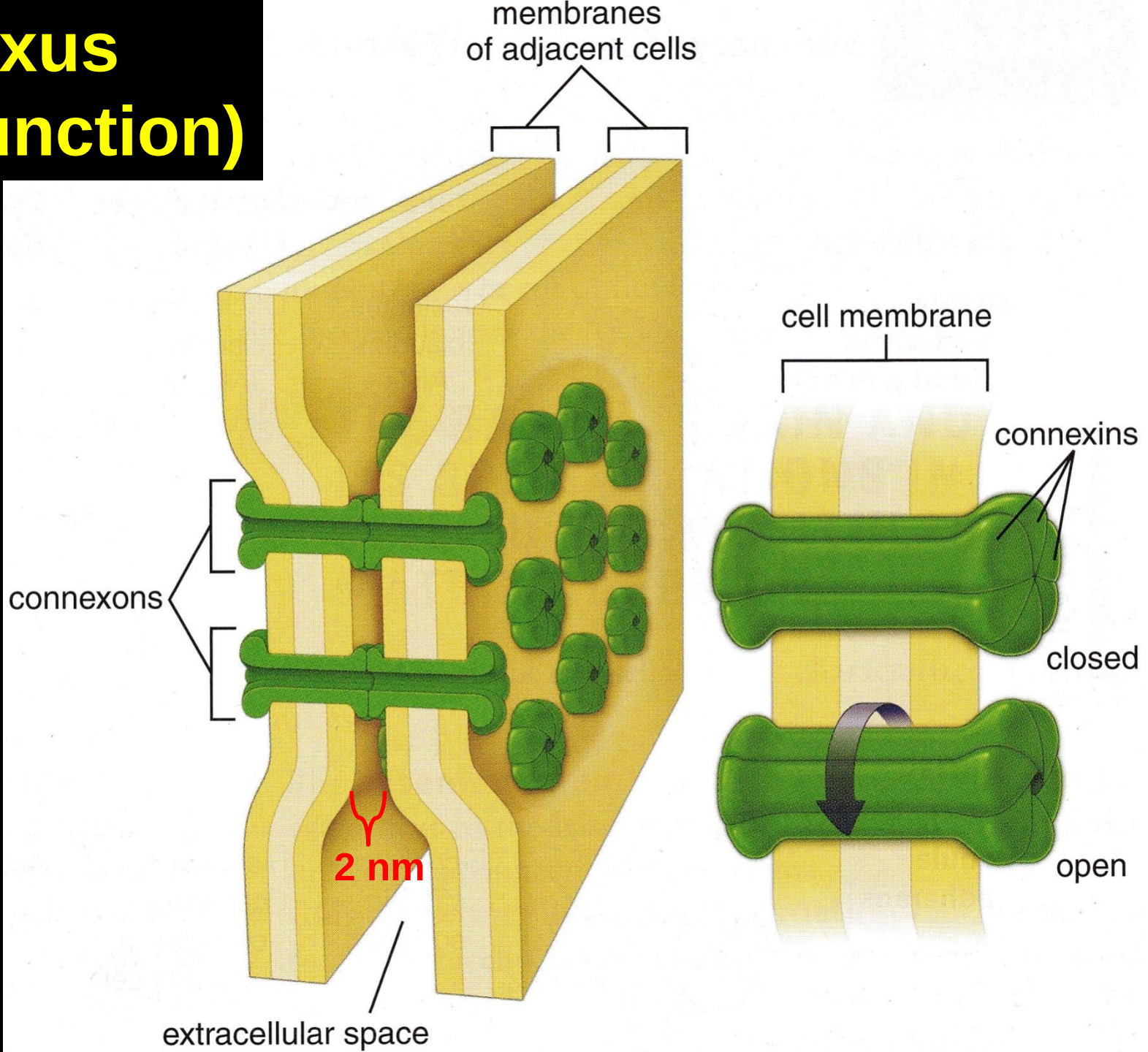
desmoglein
desmocollin

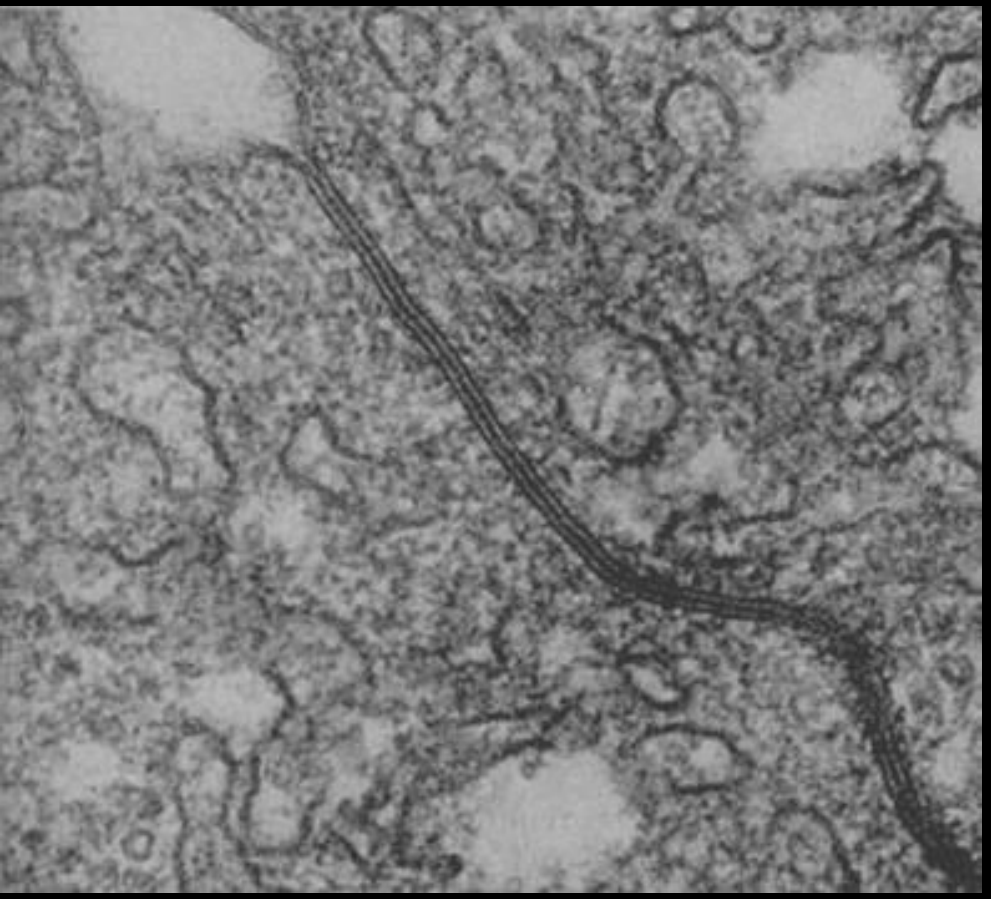
desmoplakin
plakoglobin

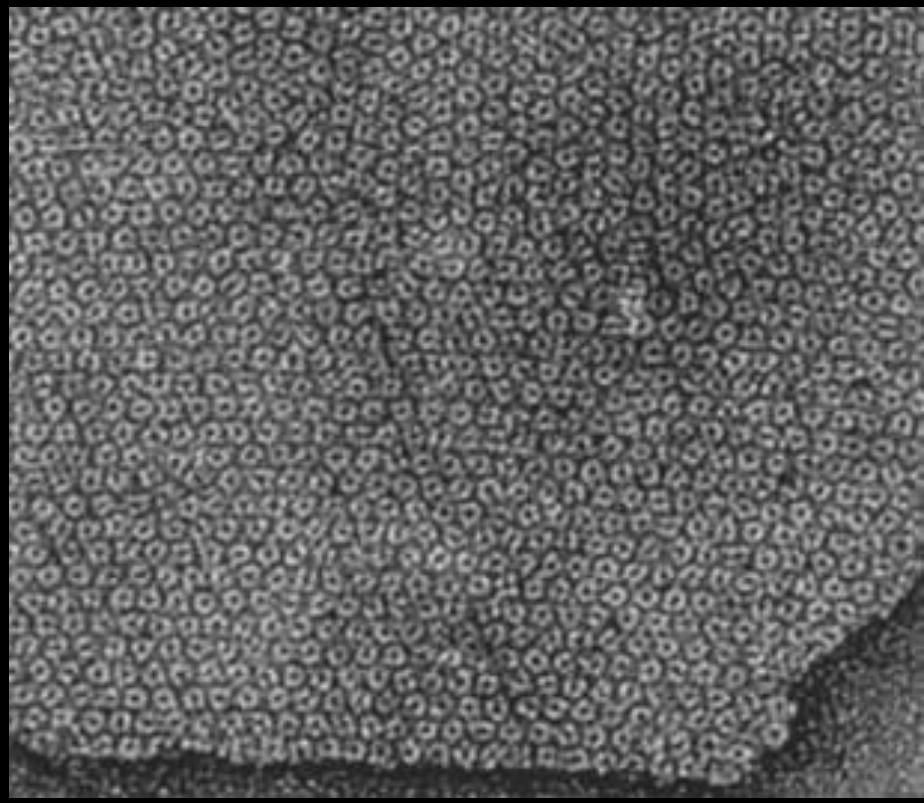



Apical junctional complex
zonula occludens
terminal bar
zonula adhaerens
macula adhaerens = desmosome

Nexus (gap junction)





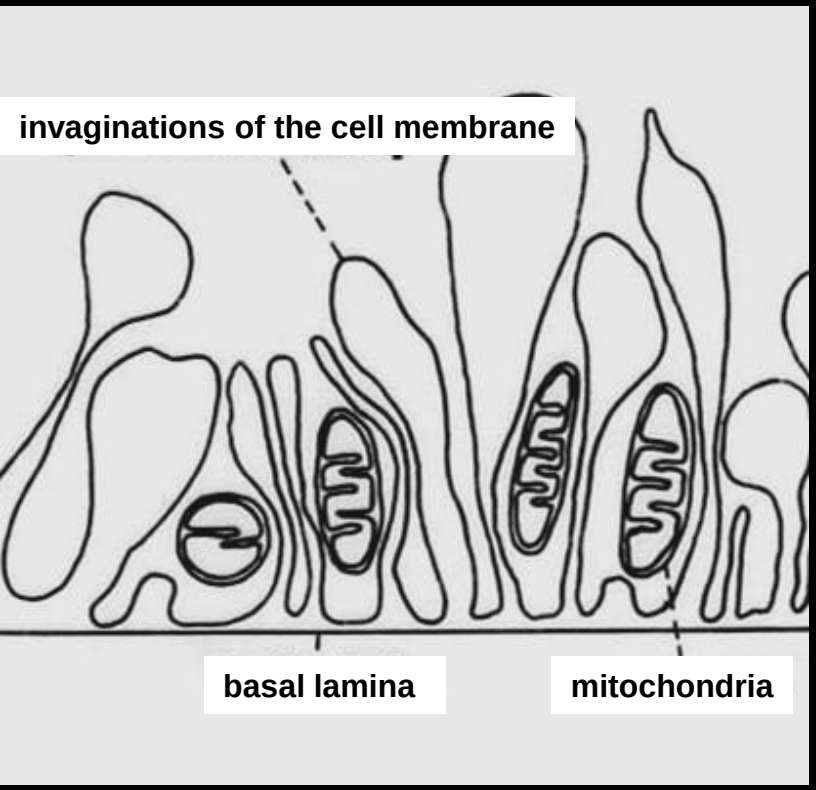


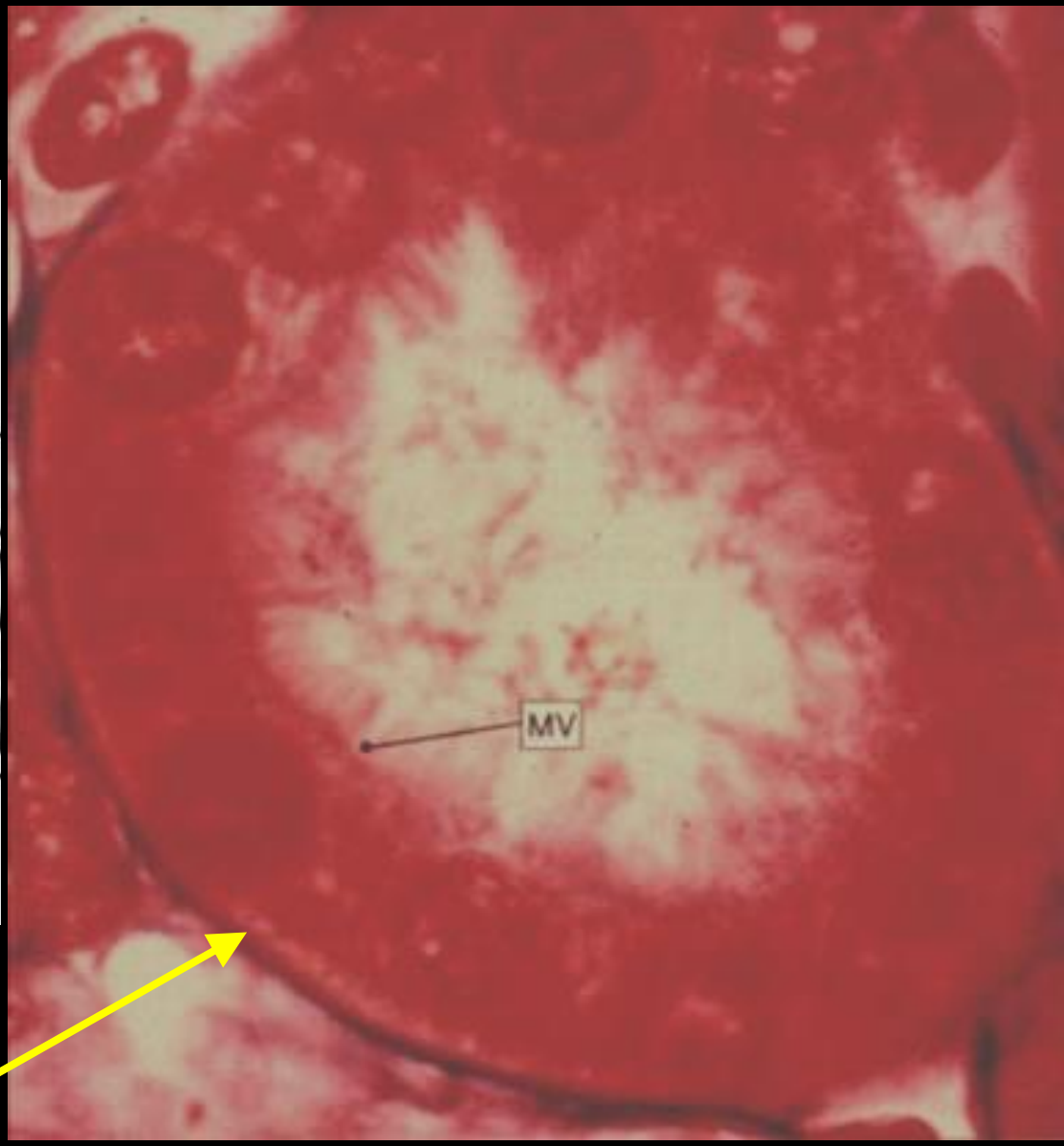
SPECIALIZATIONS OF BASAL SURFACE OF EPITHELIAL CELLS

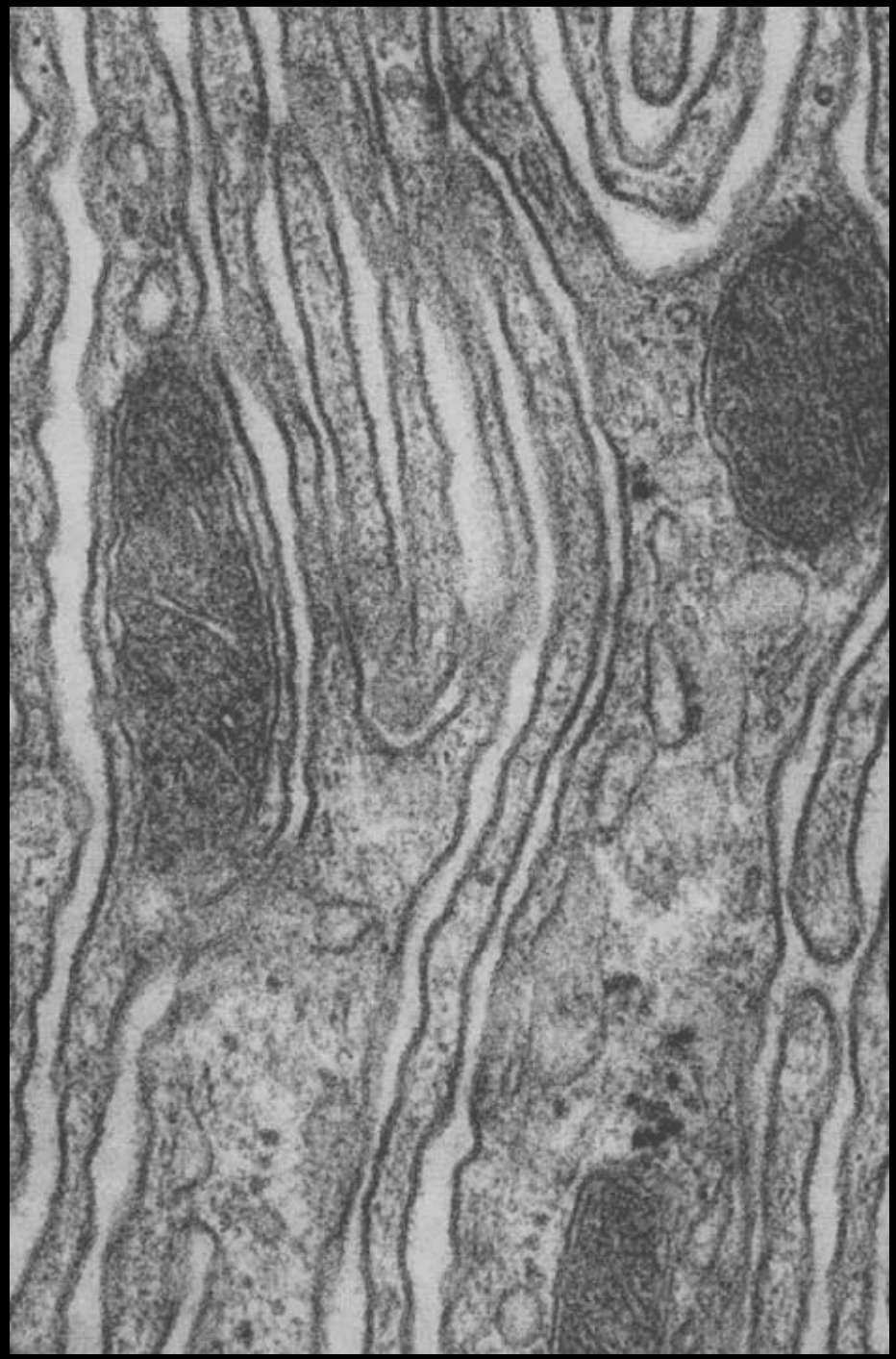
basal labyrinth

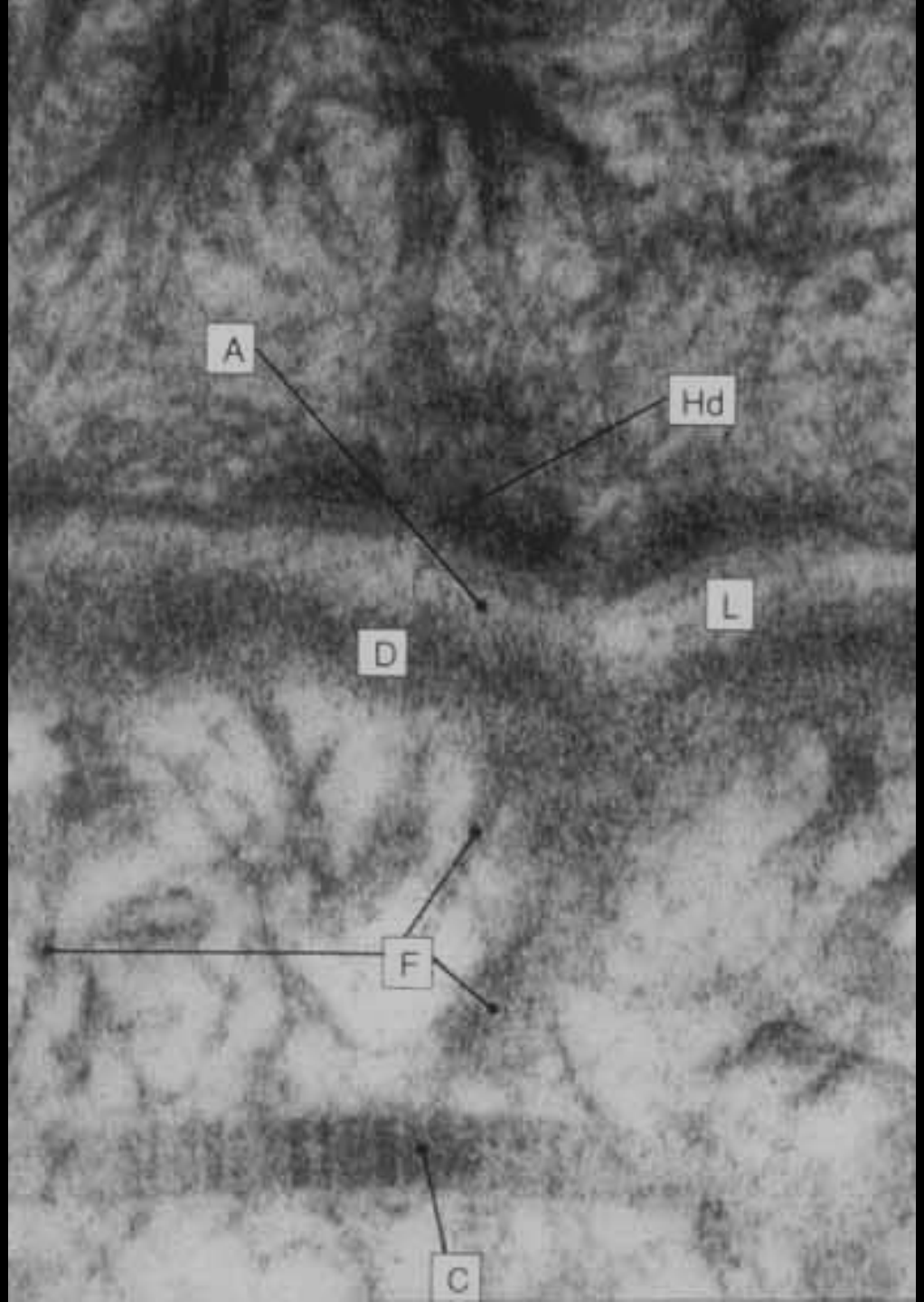
hemidesmosome

Basal labyrinth









Hemidesmosome

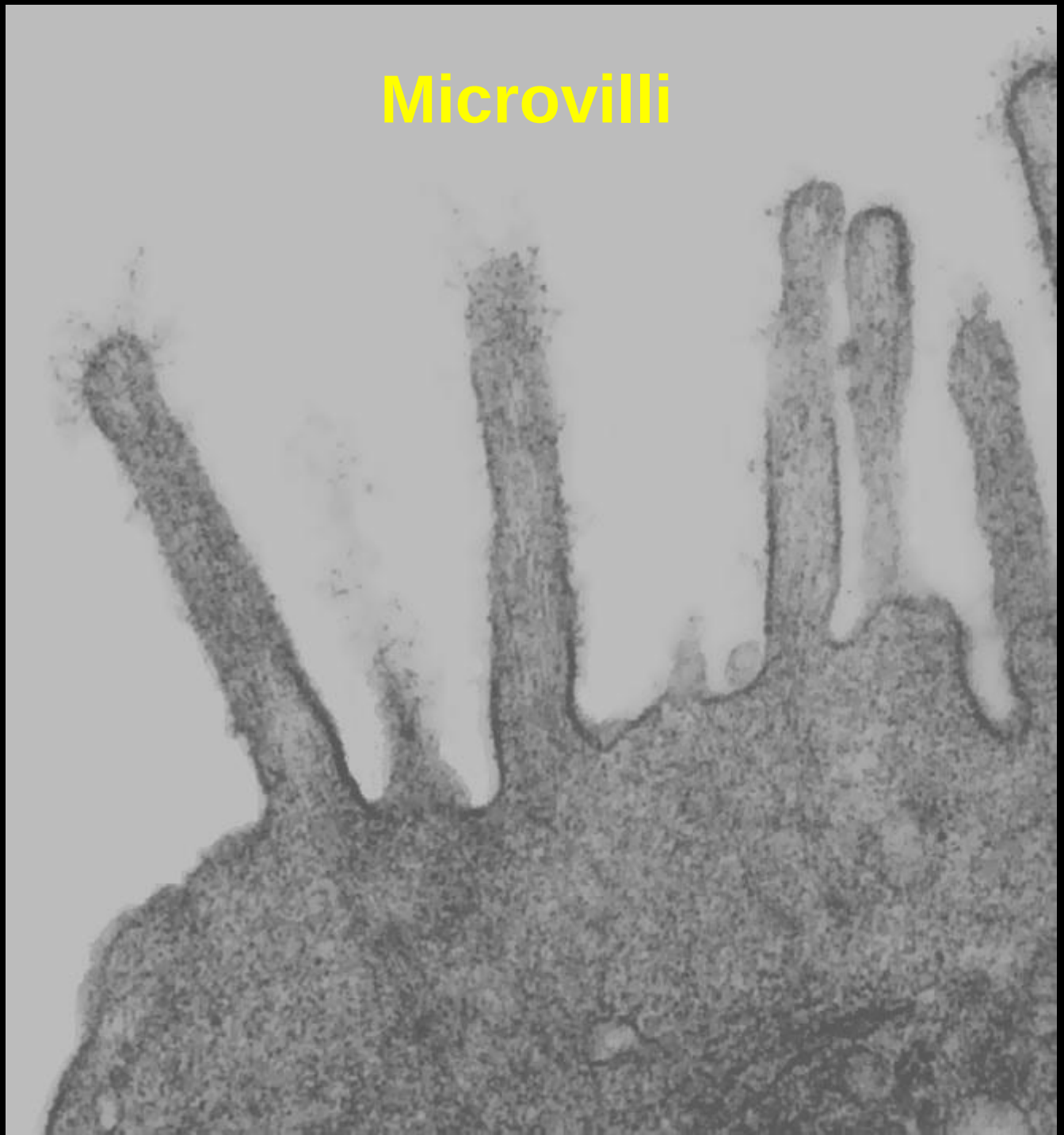
SPECIALIZATIONS OF APICAL SURFACE OF EPITHELIAL CELLS

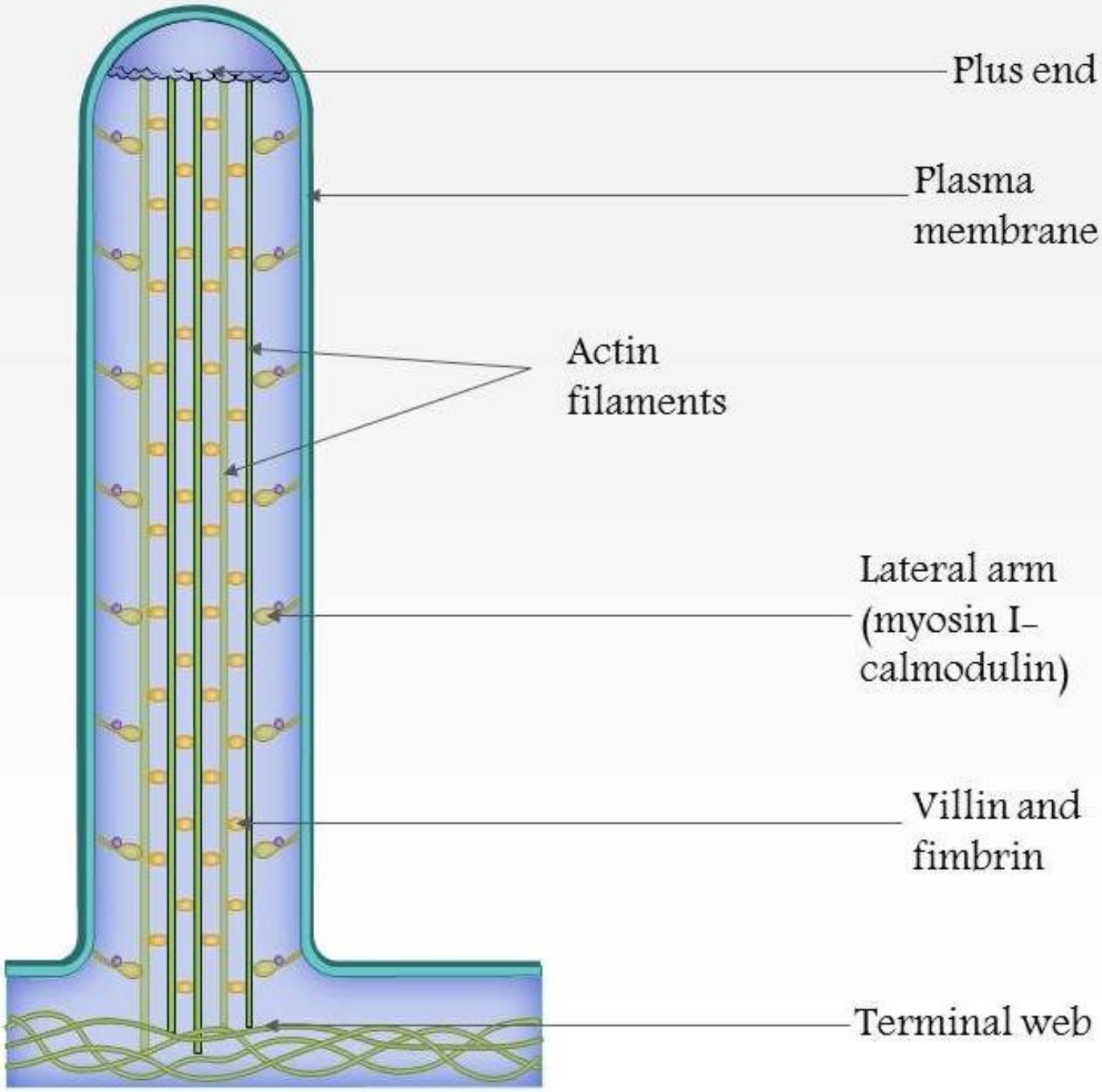
microvilli (0.5 – 1 μm)

stereocilia (7 μm)

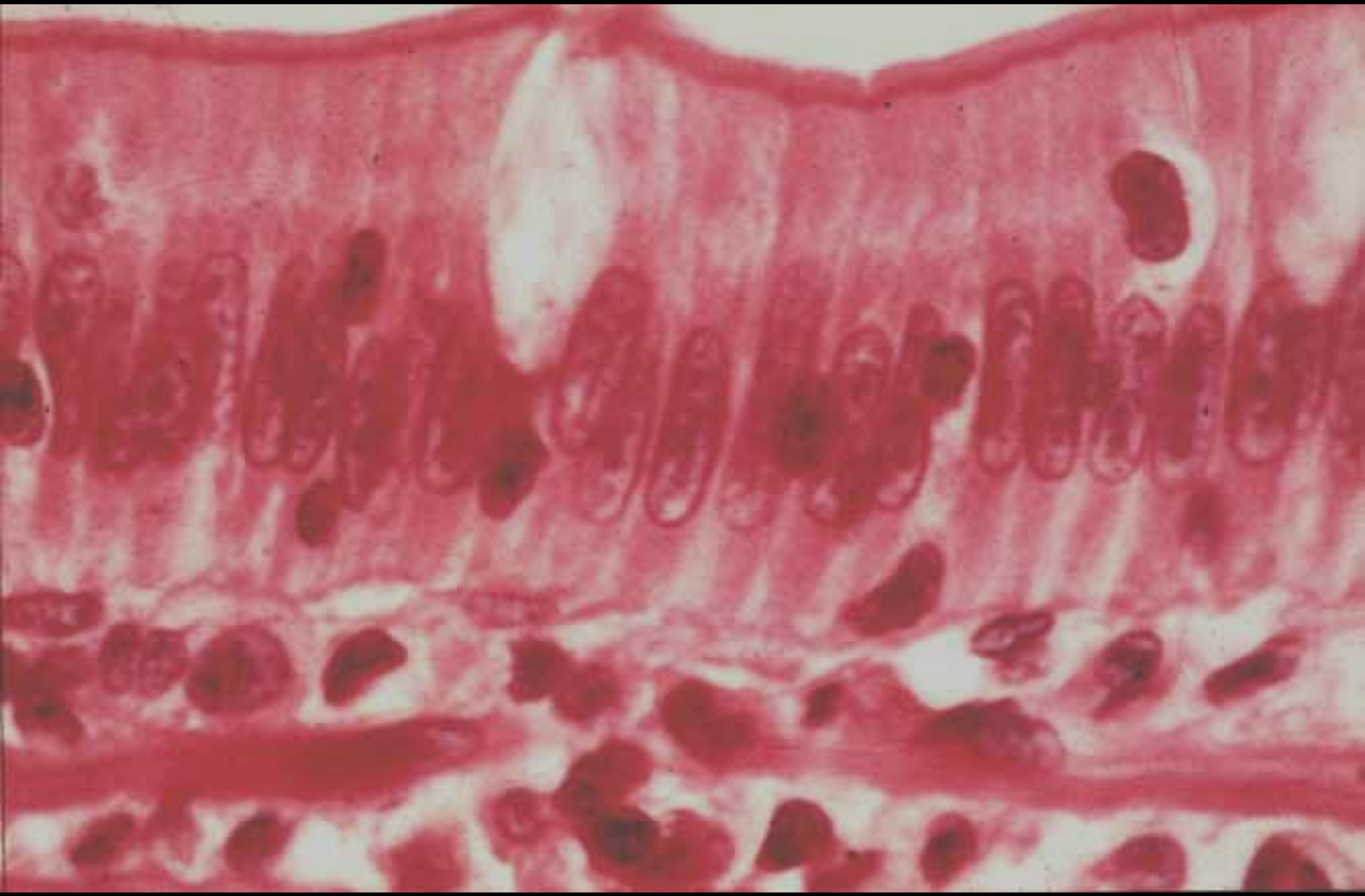
kinocilia (10 μm)

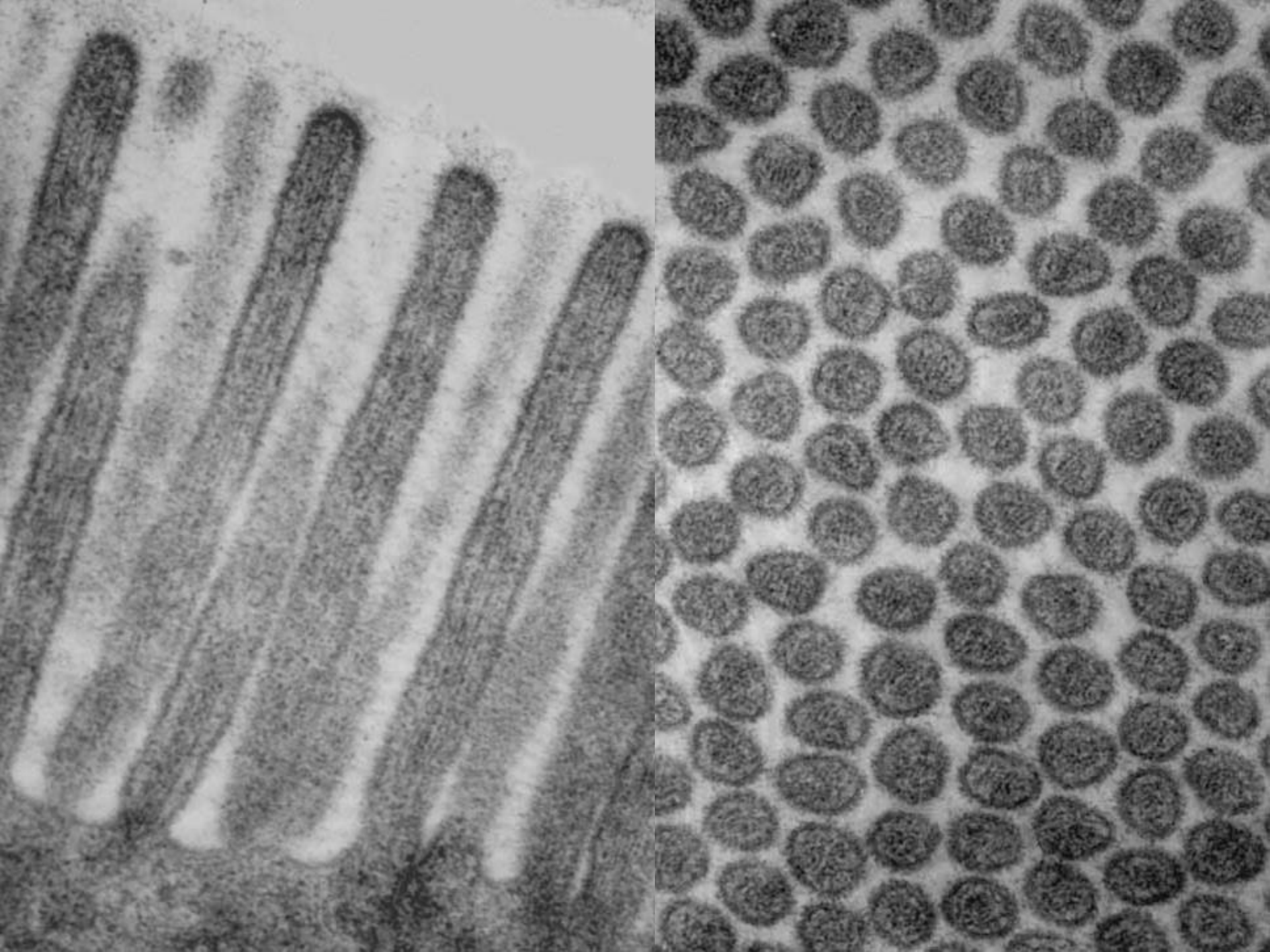
Microvilli



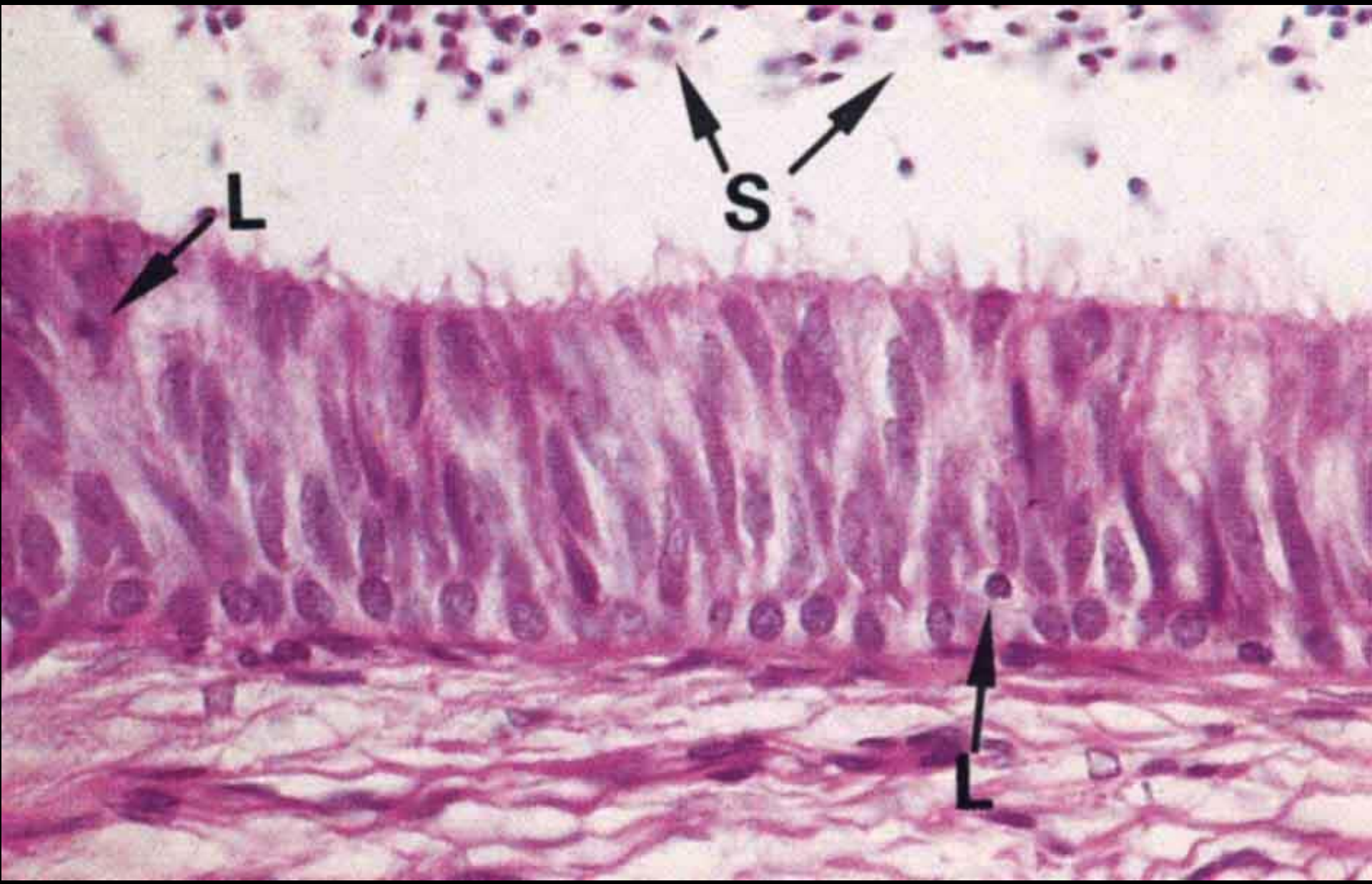

Plus end
Plasma membrane
Actin filaments
Lateral arm (myosin I–calmodulin)
Villin and fimbrin
Terminal web

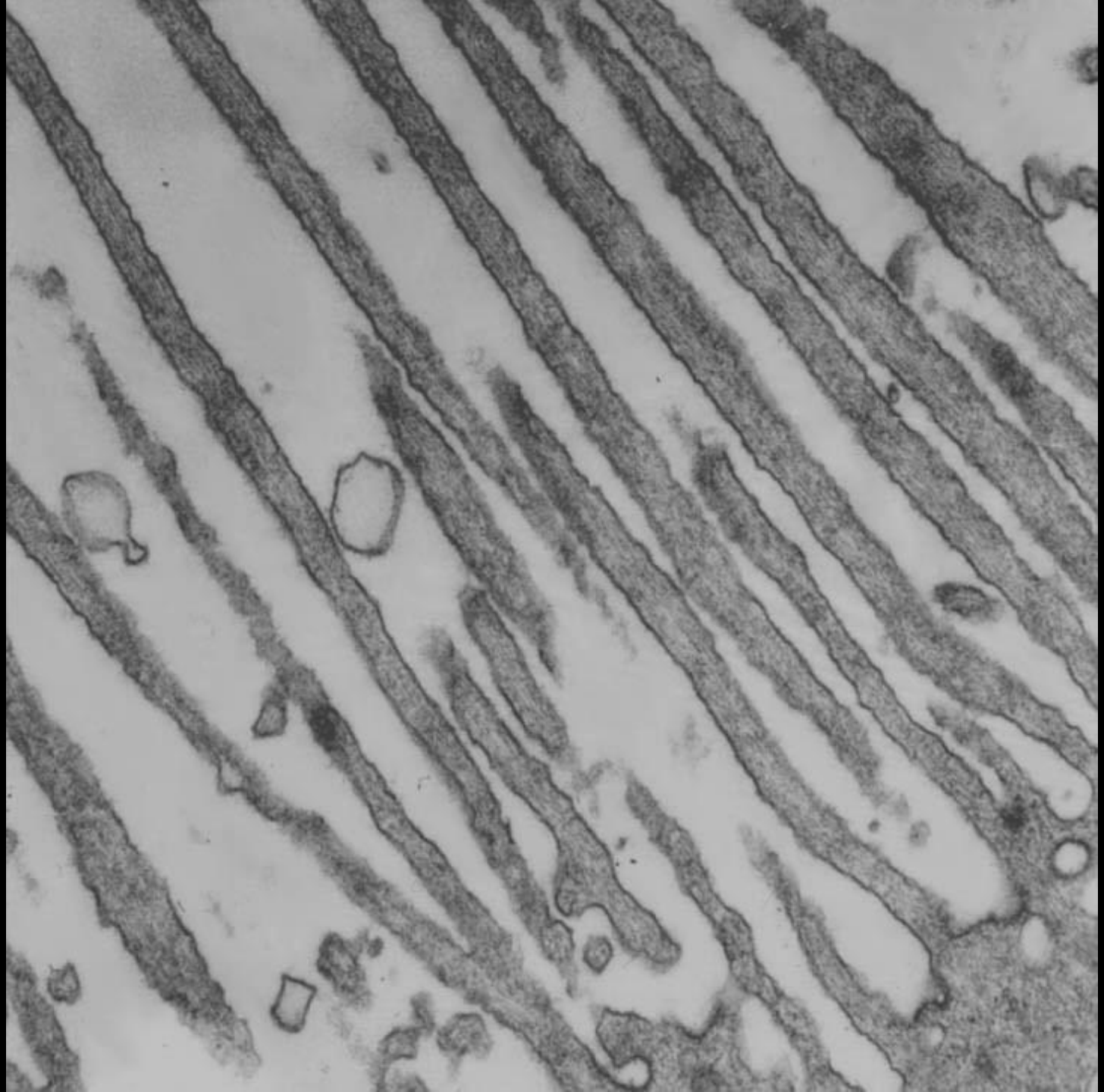
Brush (striated) border

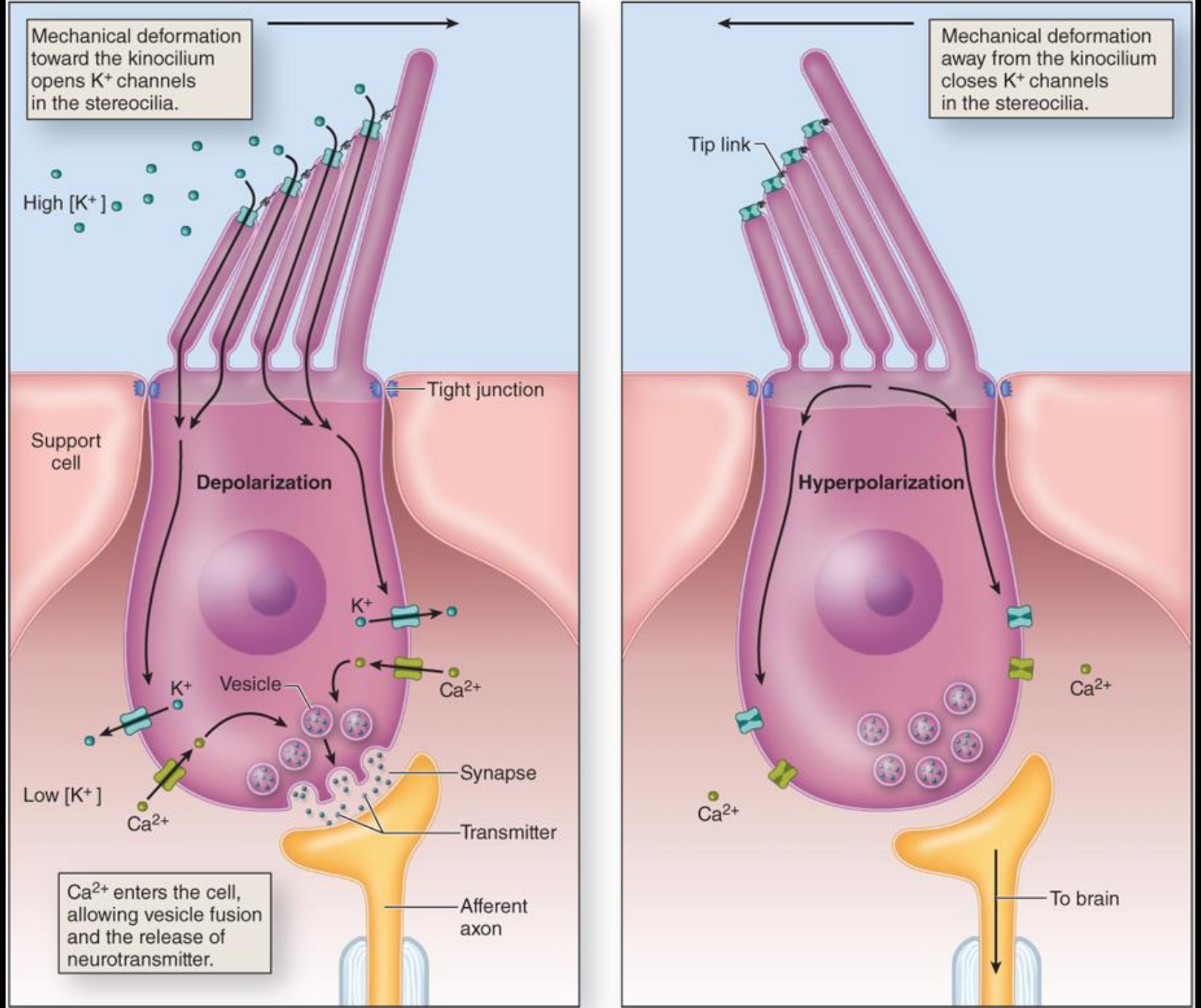


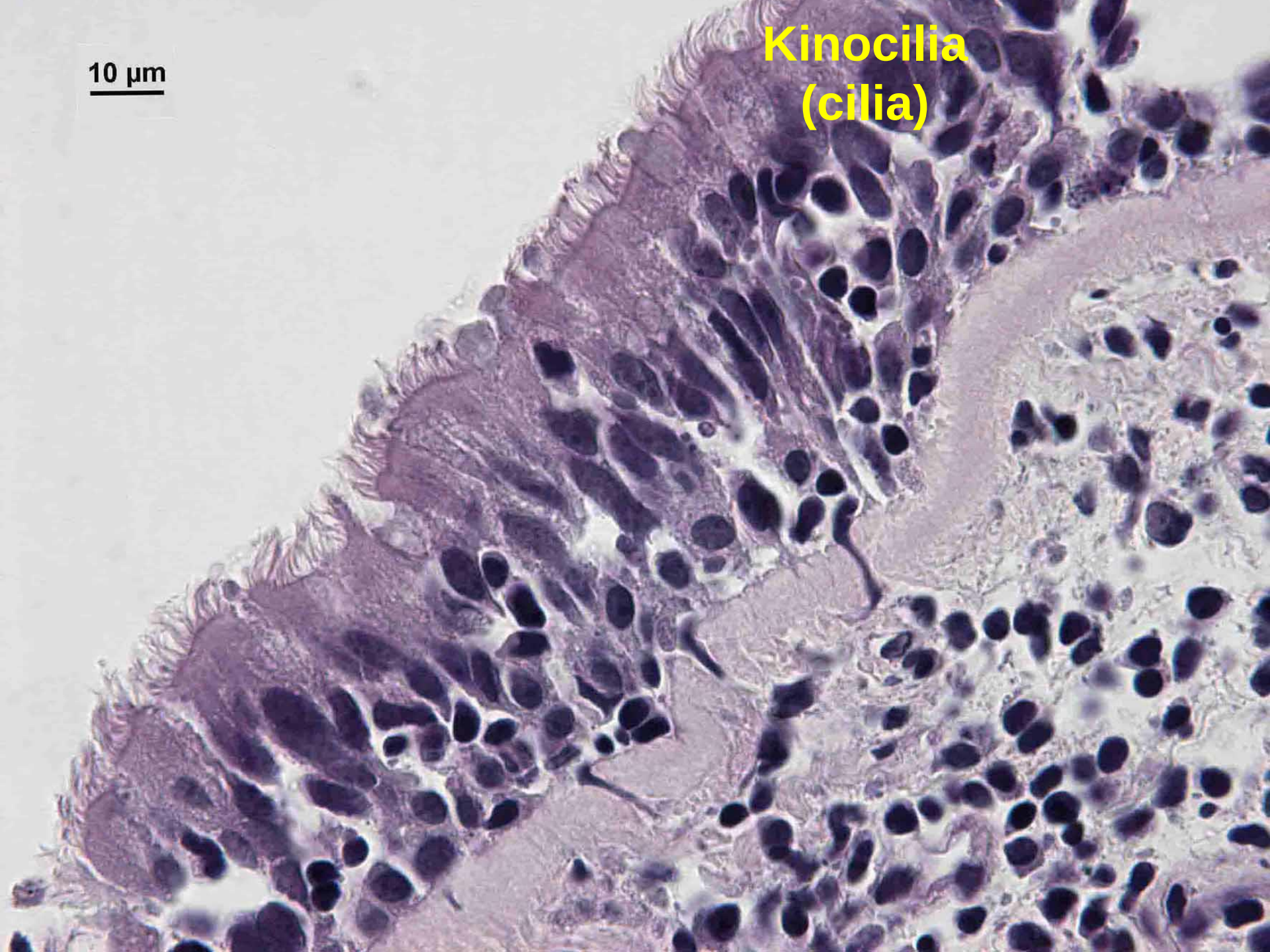


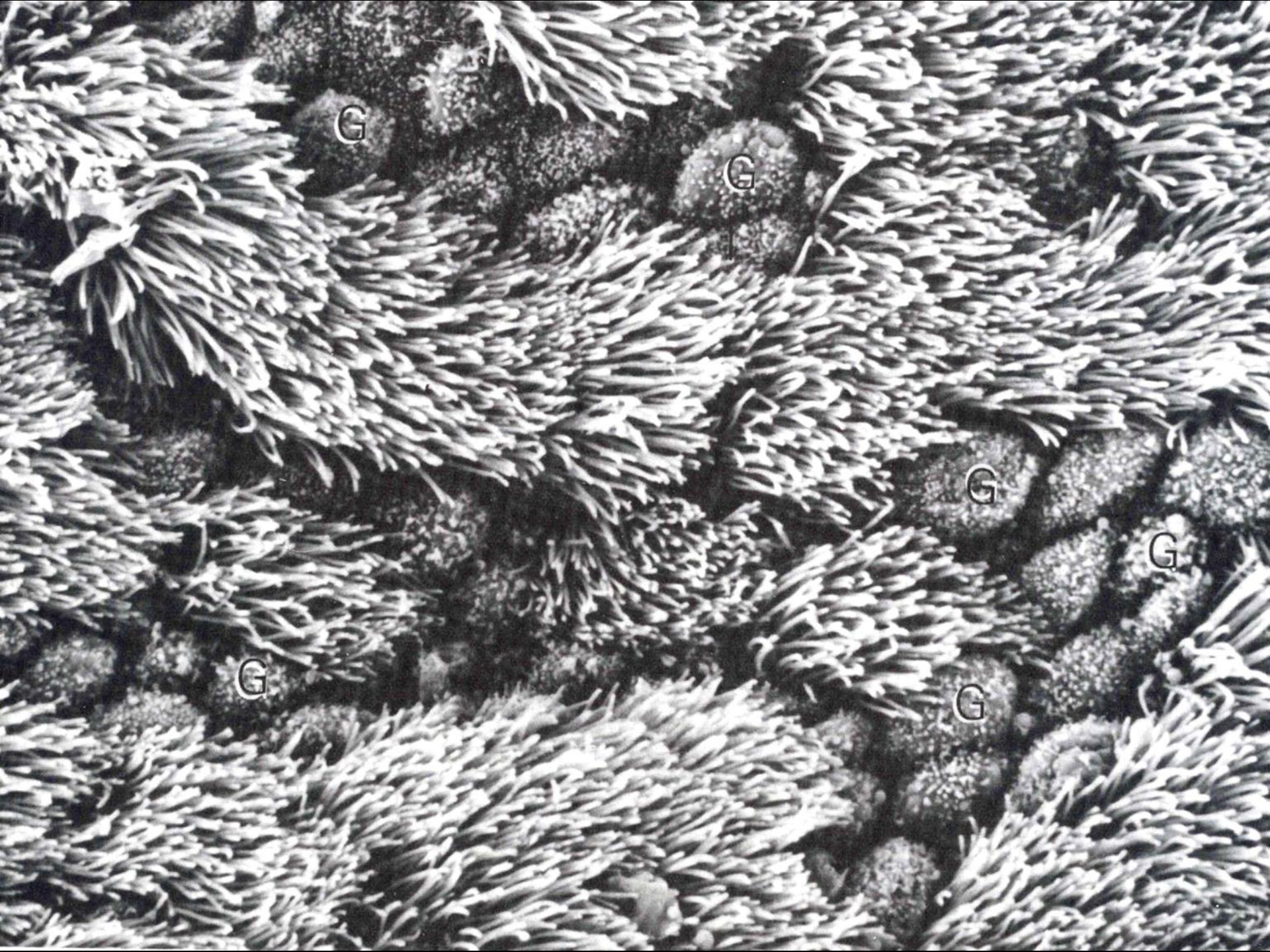
Stereocilia

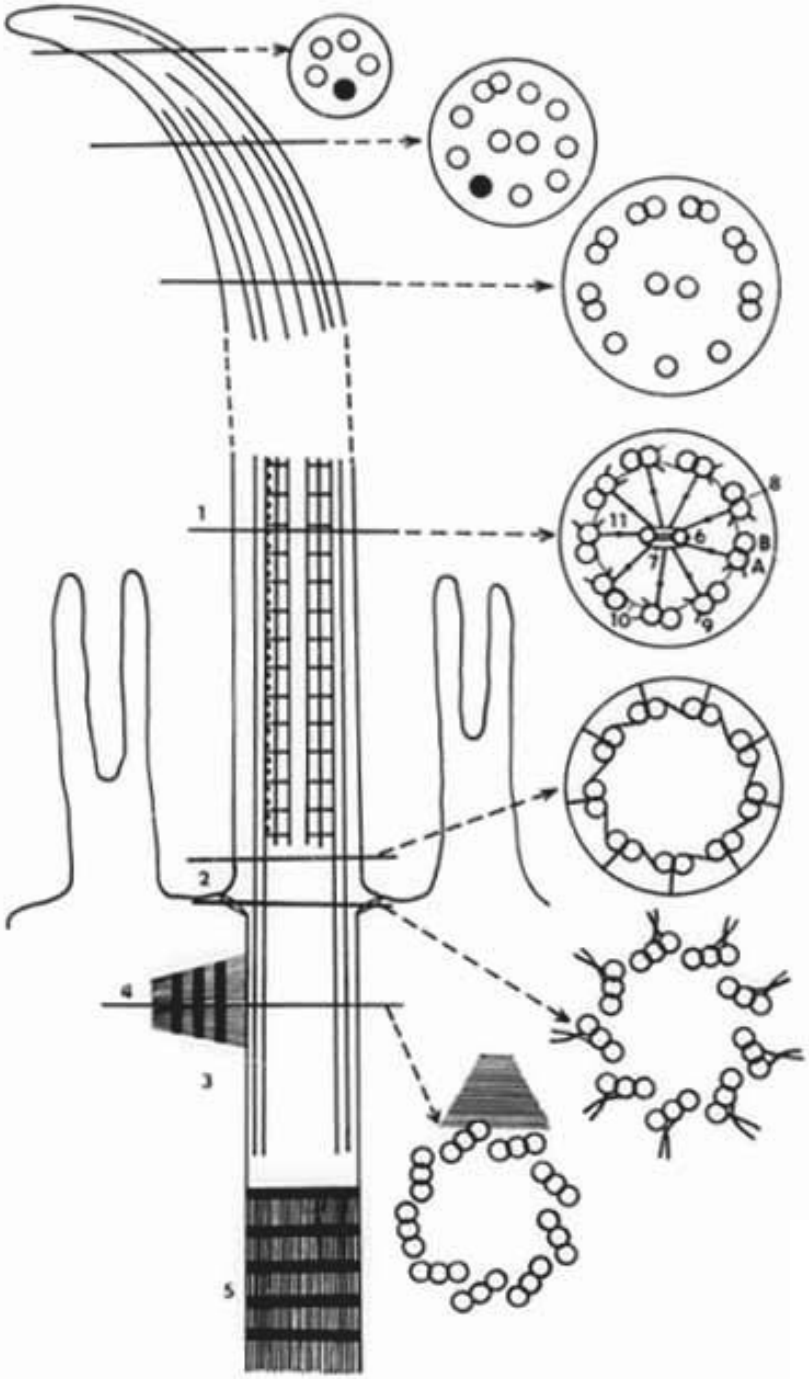


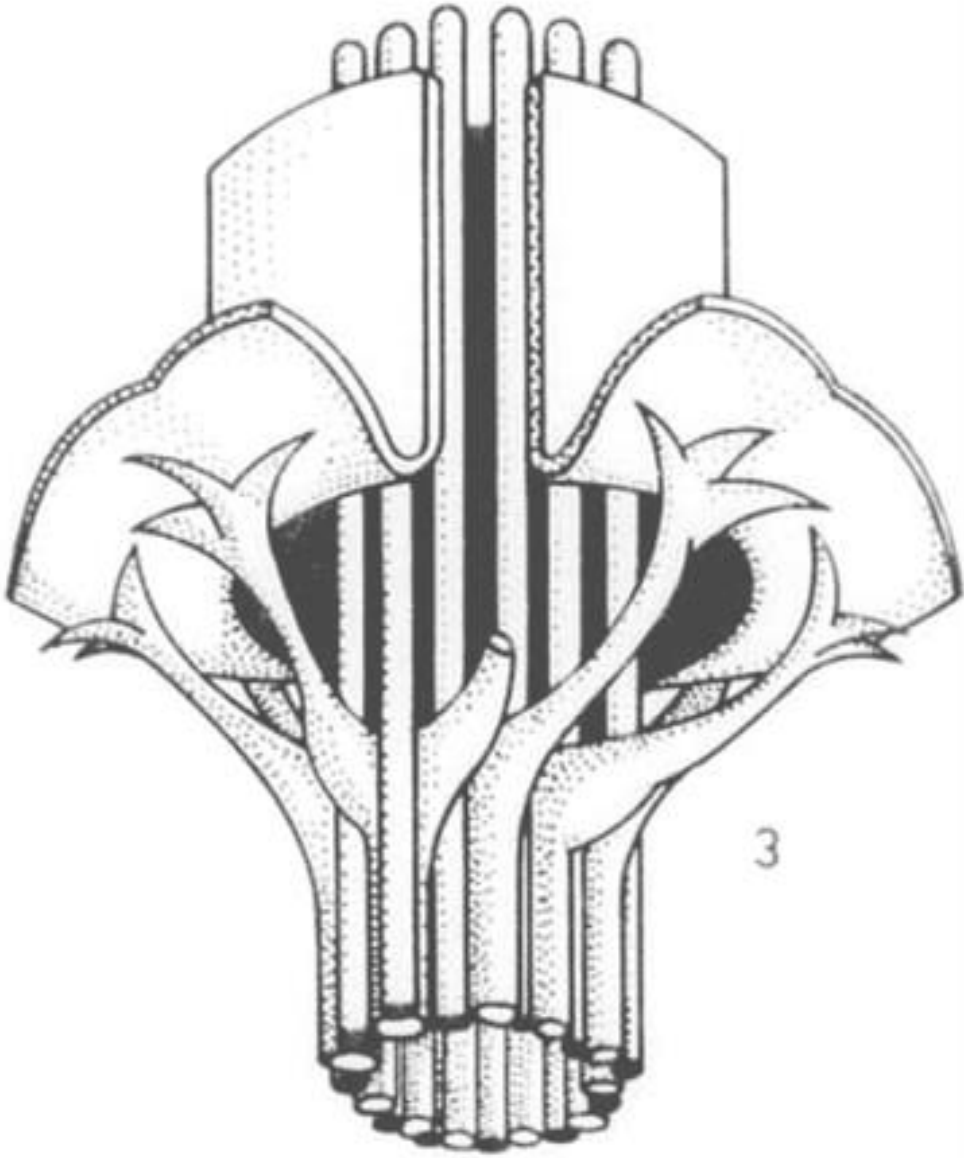



Mechanical deformation toward the kinocilium opens K+ channels in the stereocilia.
High [K+]
Tight junction
Support cell
Depolarization
K+
K+
Vesicle
Ca2+
Low [K+]
Ca2+
Synapse
Transmitter
Afferent axon
Ca2+ enters the cell, allowing vesicle fusion and the release of neurotransmitter.
Mechanical deformation away from the kinocilium closes K+ channels in the stereocilia.
Tip link
Hyperpolarization
Ca2+
Ca2+
To brain

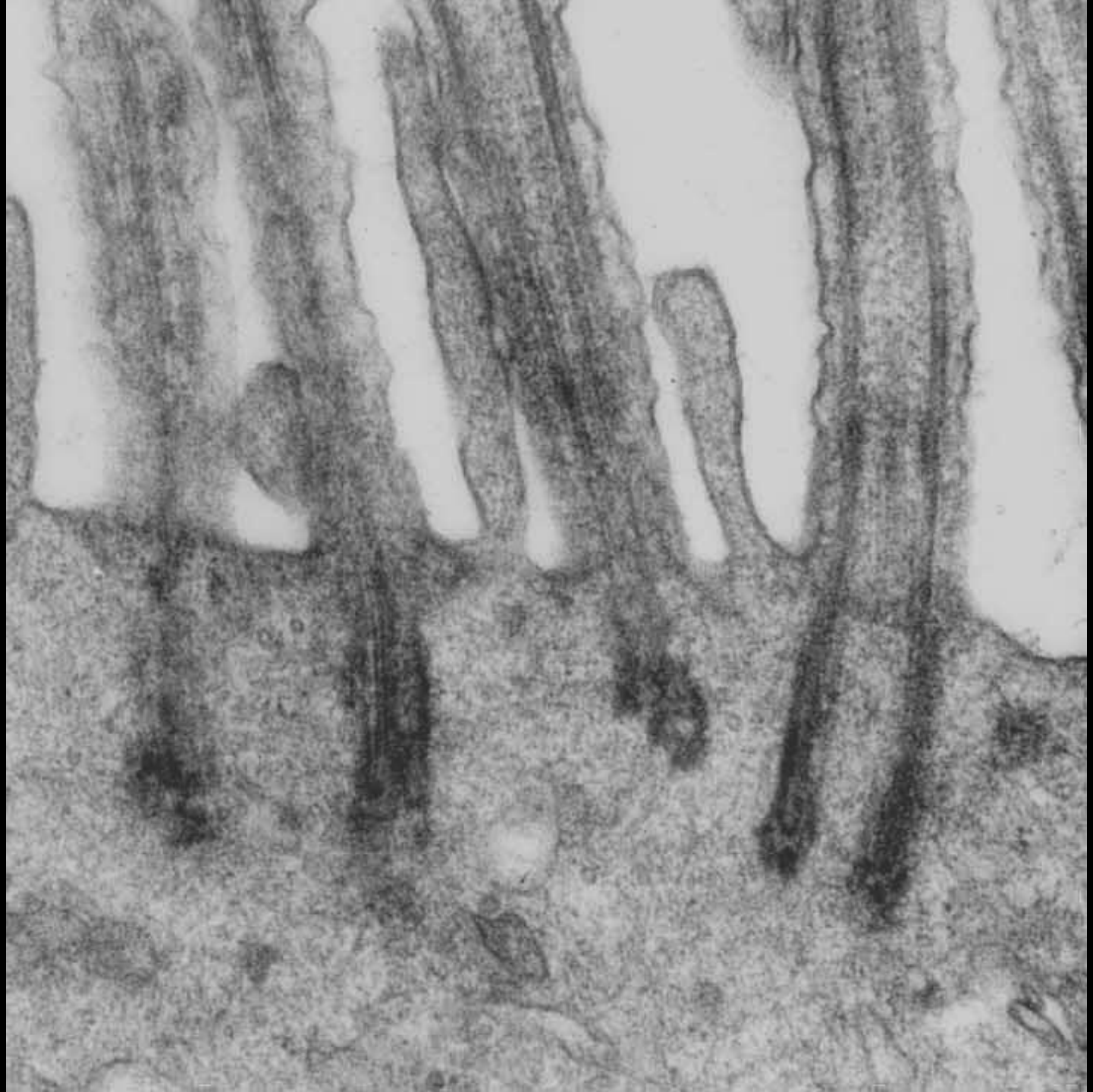

10 µm
Kinocilia
(cilia)

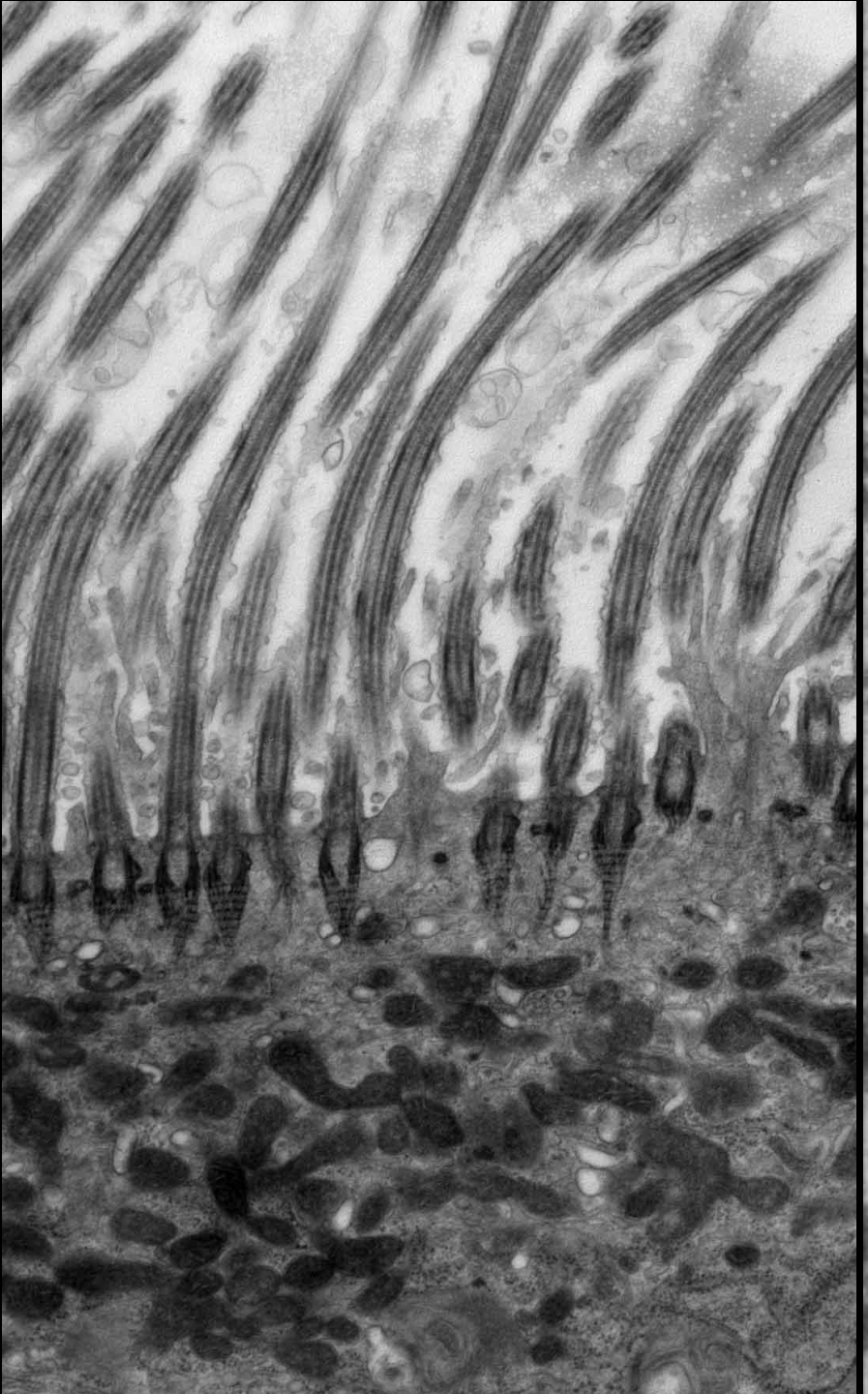

G
G
G
G
G
G

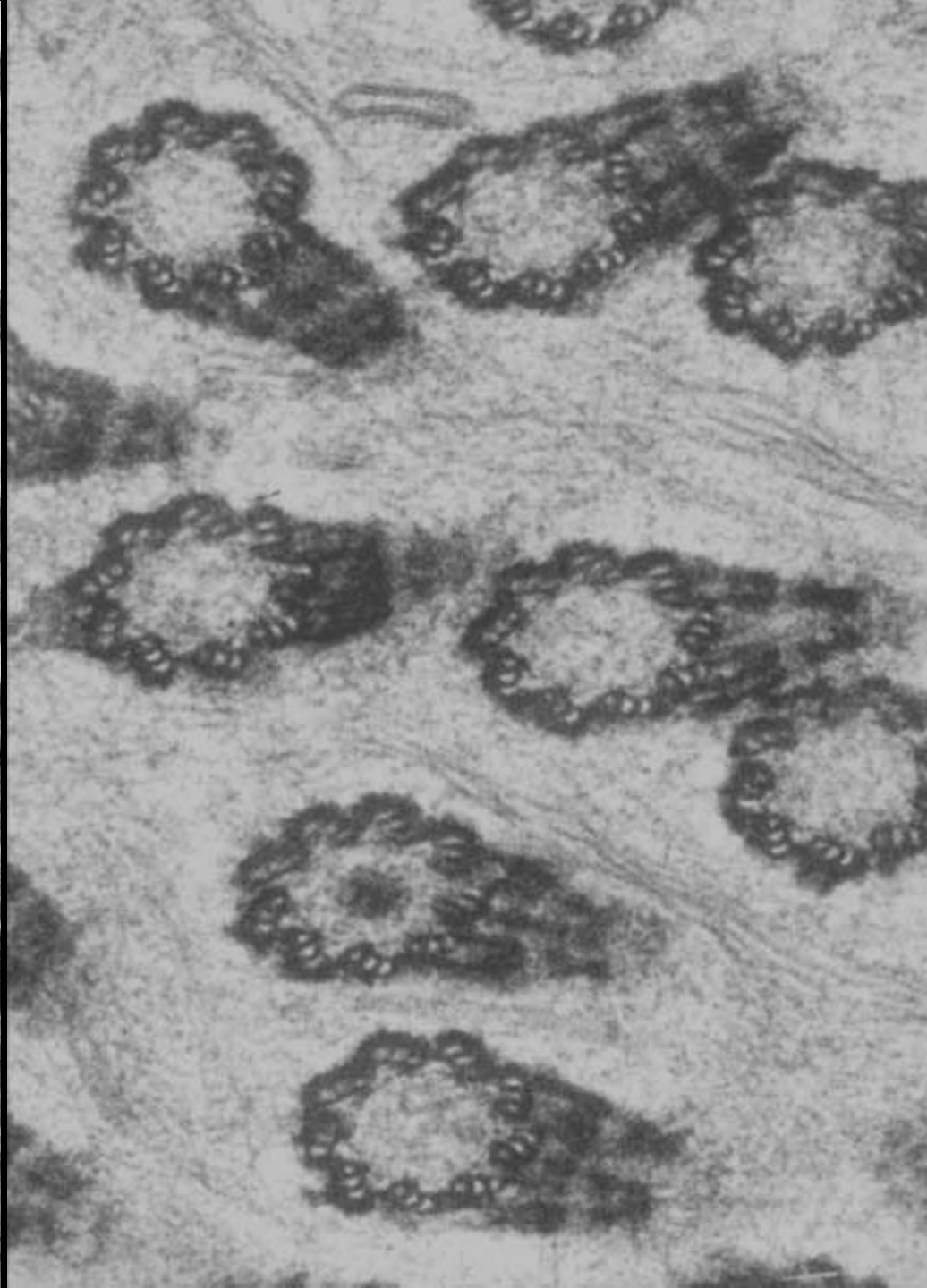


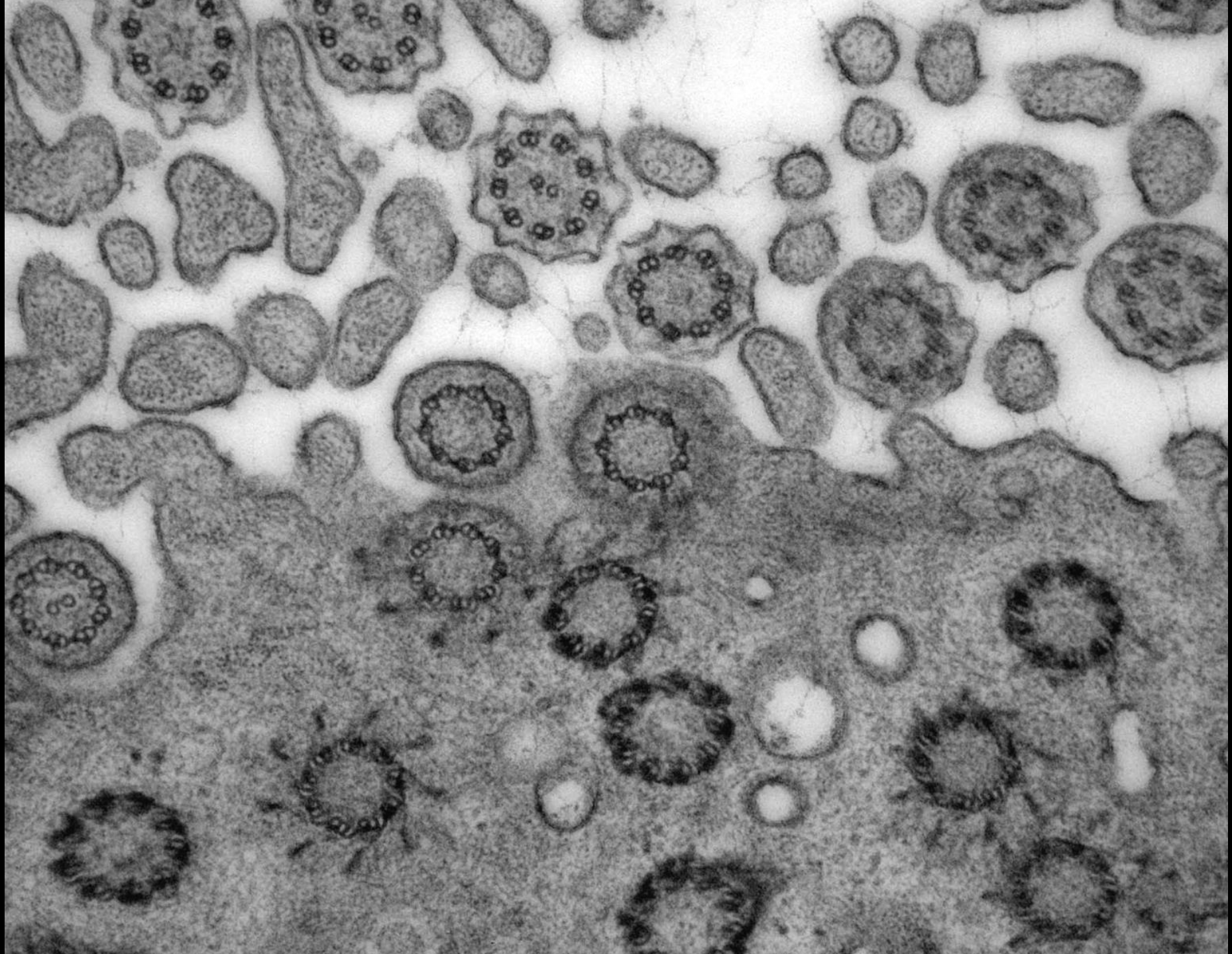


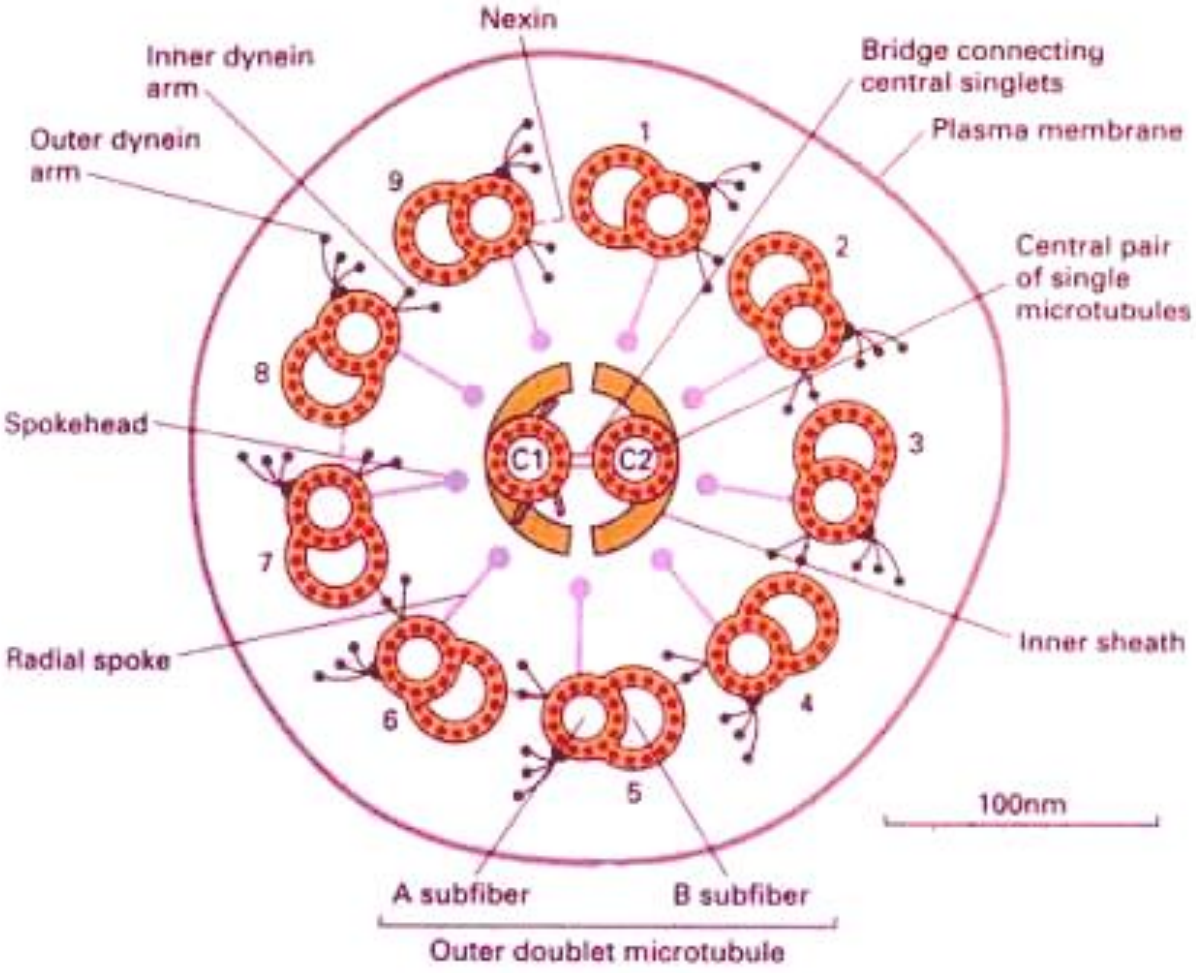
1 free cilium
2 transitional part
3 basal body
4 striated (basal) foot
5 striated (basal) rootlet

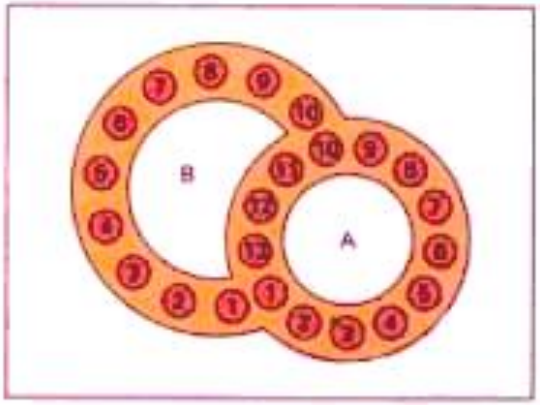


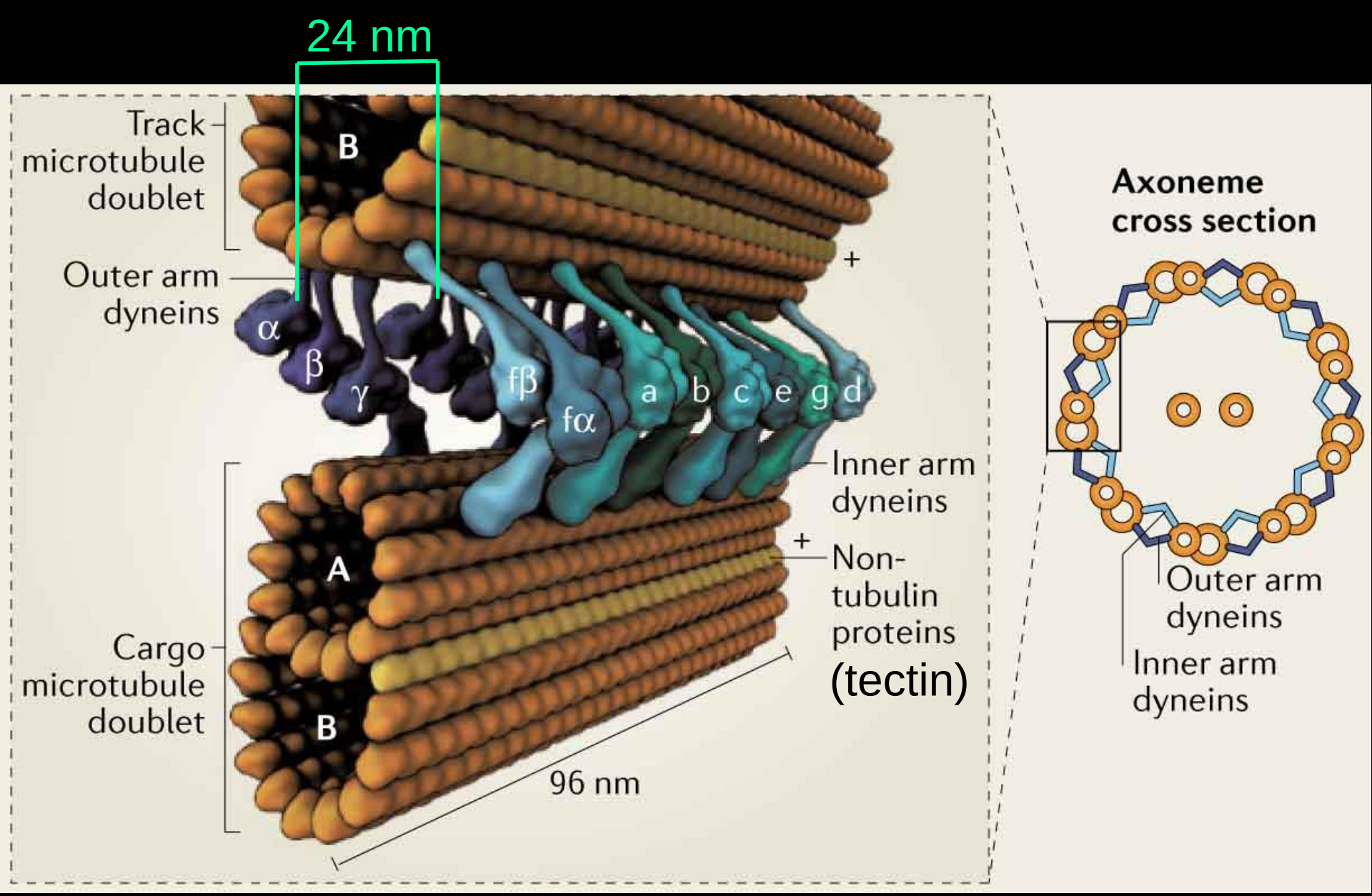




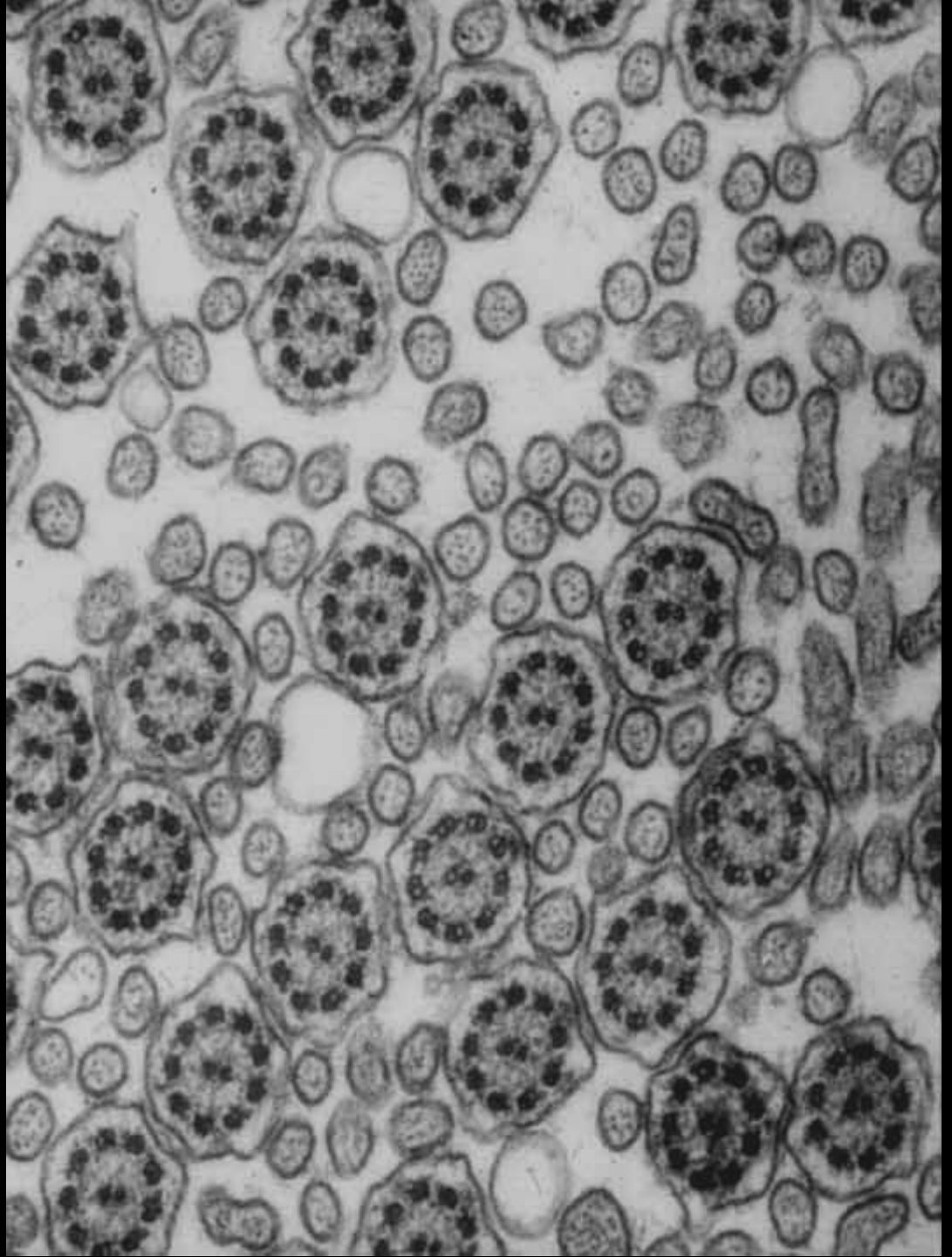


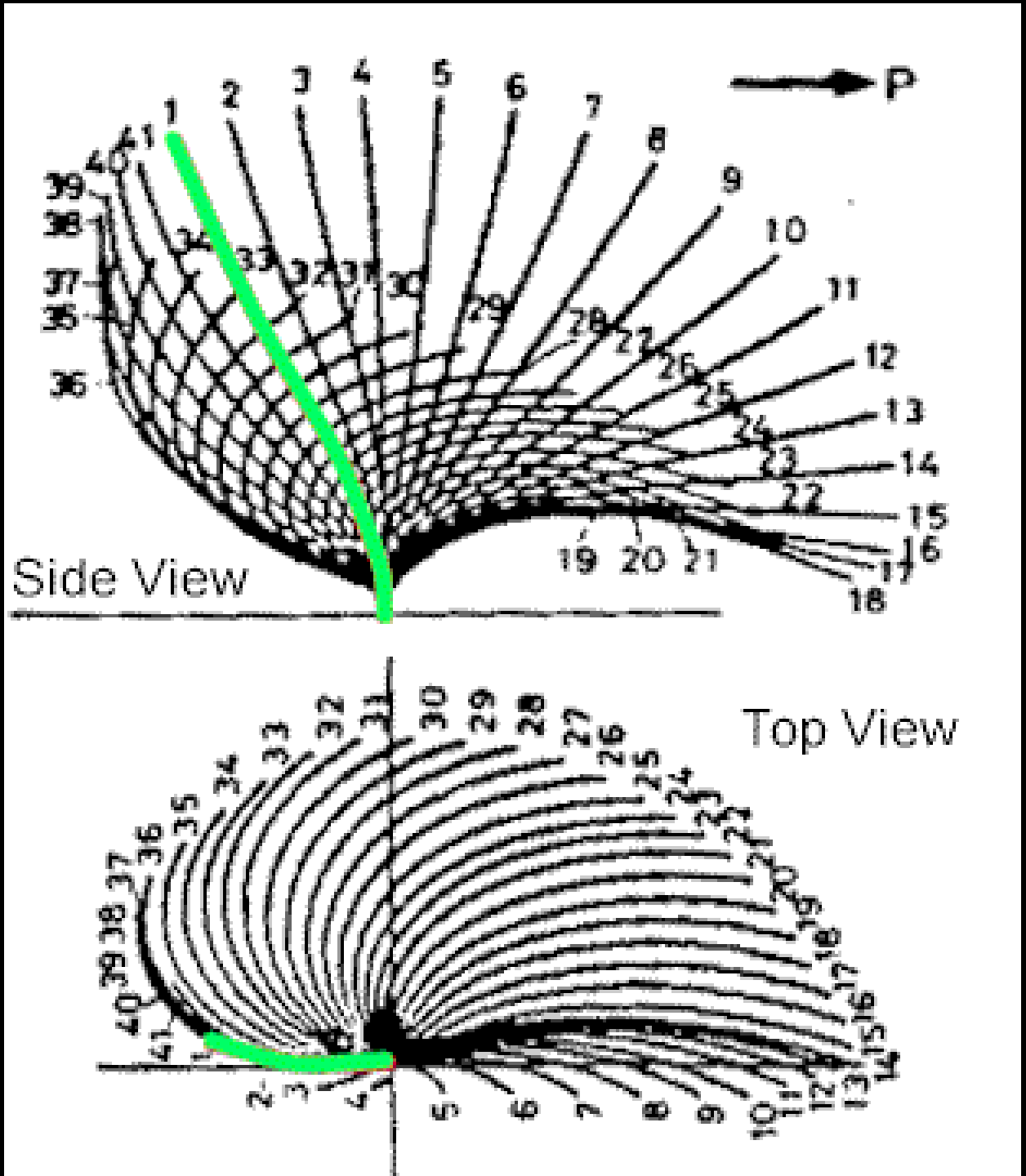

Nexin
Inner dynein arm
Outer dynein arm
Bridge connecting central singlets
Plasma membrane
Central pair of single microtubules
Spokehead
Radial spoke
Inner sheath
C1
C2
1
2
3
4
5
6
7
8
9
100nm
A subfiber
B subfiber
Outer doublet microtubule


A
B

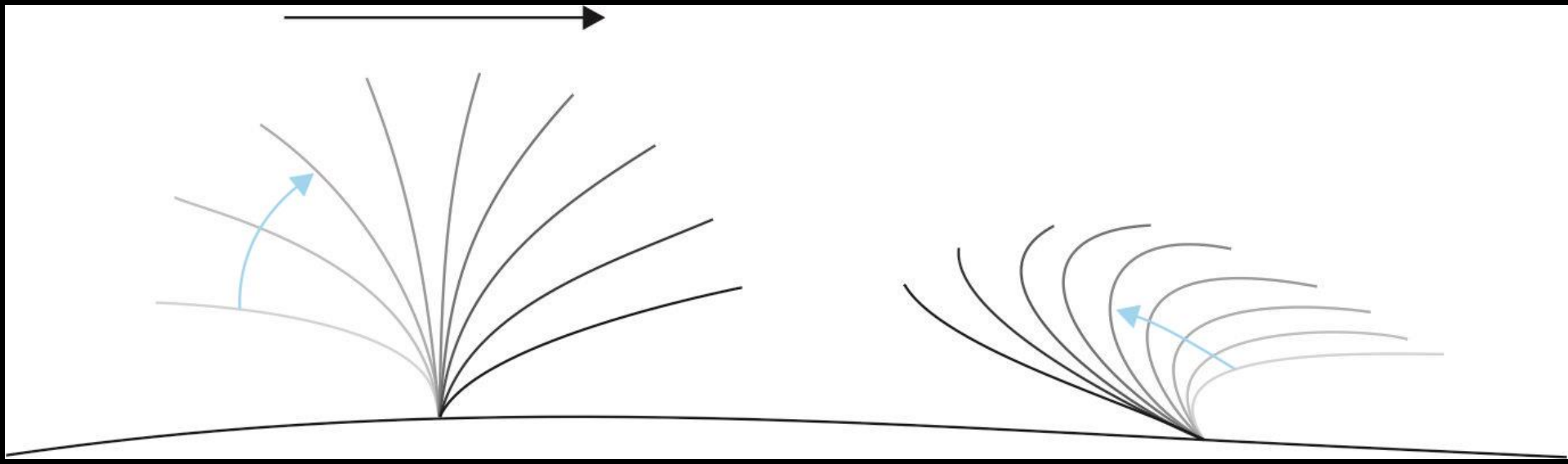


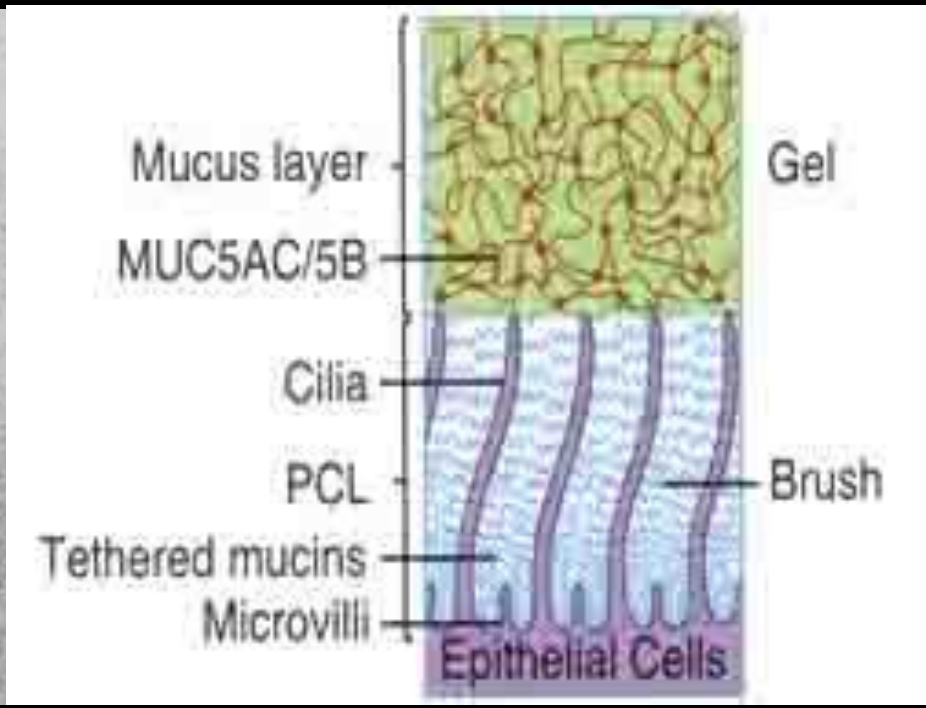
Roberts,A.J., Kon,T., Knight,P.T., Sutoh,K., Burgess,S.A.: Functions and mechanics of dynein motor proteins, Nature Reviews 14, 2013, 713-726

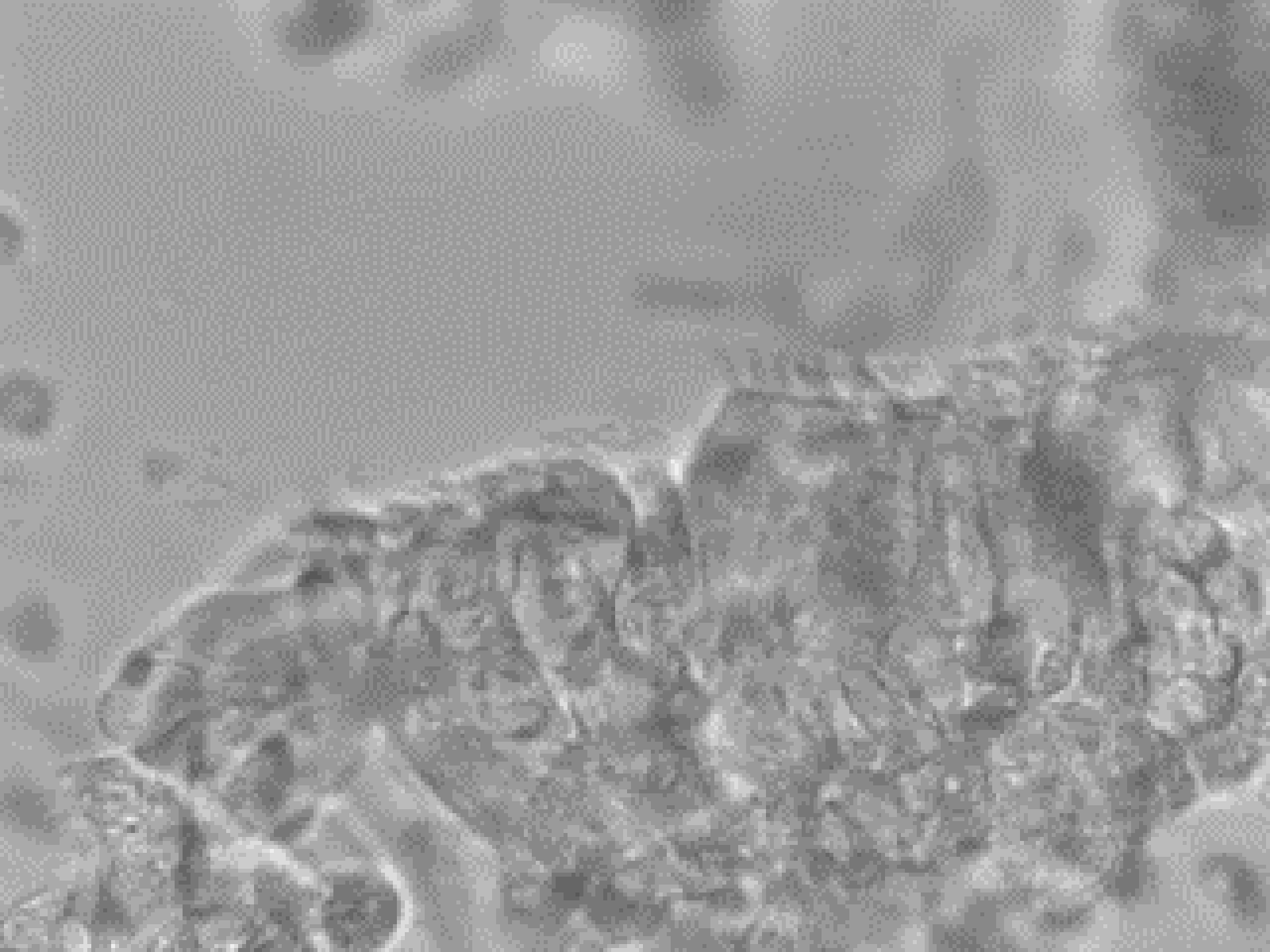




Zdroj: UBC Dep. of Zoology (http://www.zoology.ubc.ca/courses/bio332/flagellar_motion.htm, Biology 332, Protistology Term 2, Flagellar motion in Paramecium)

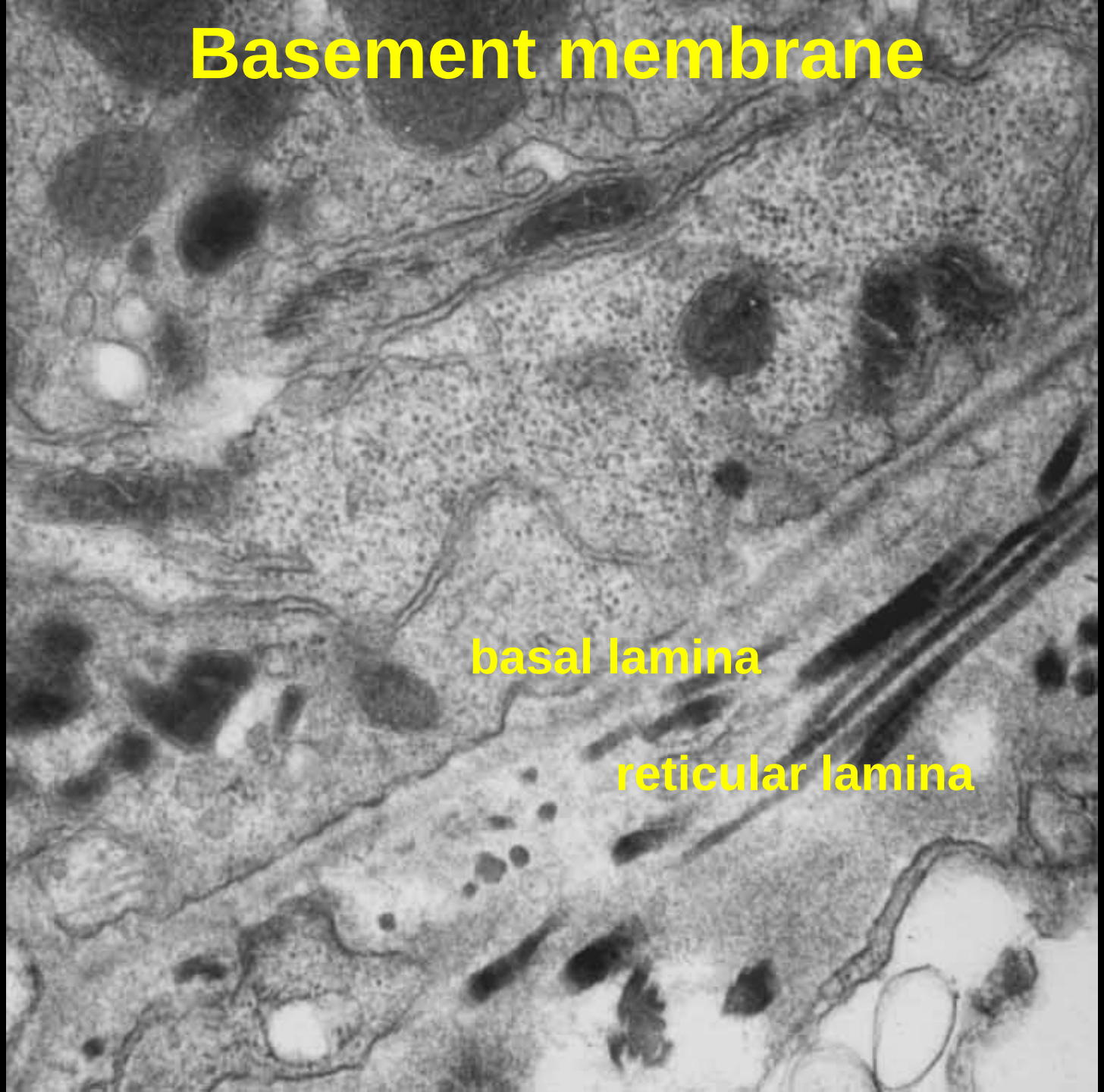


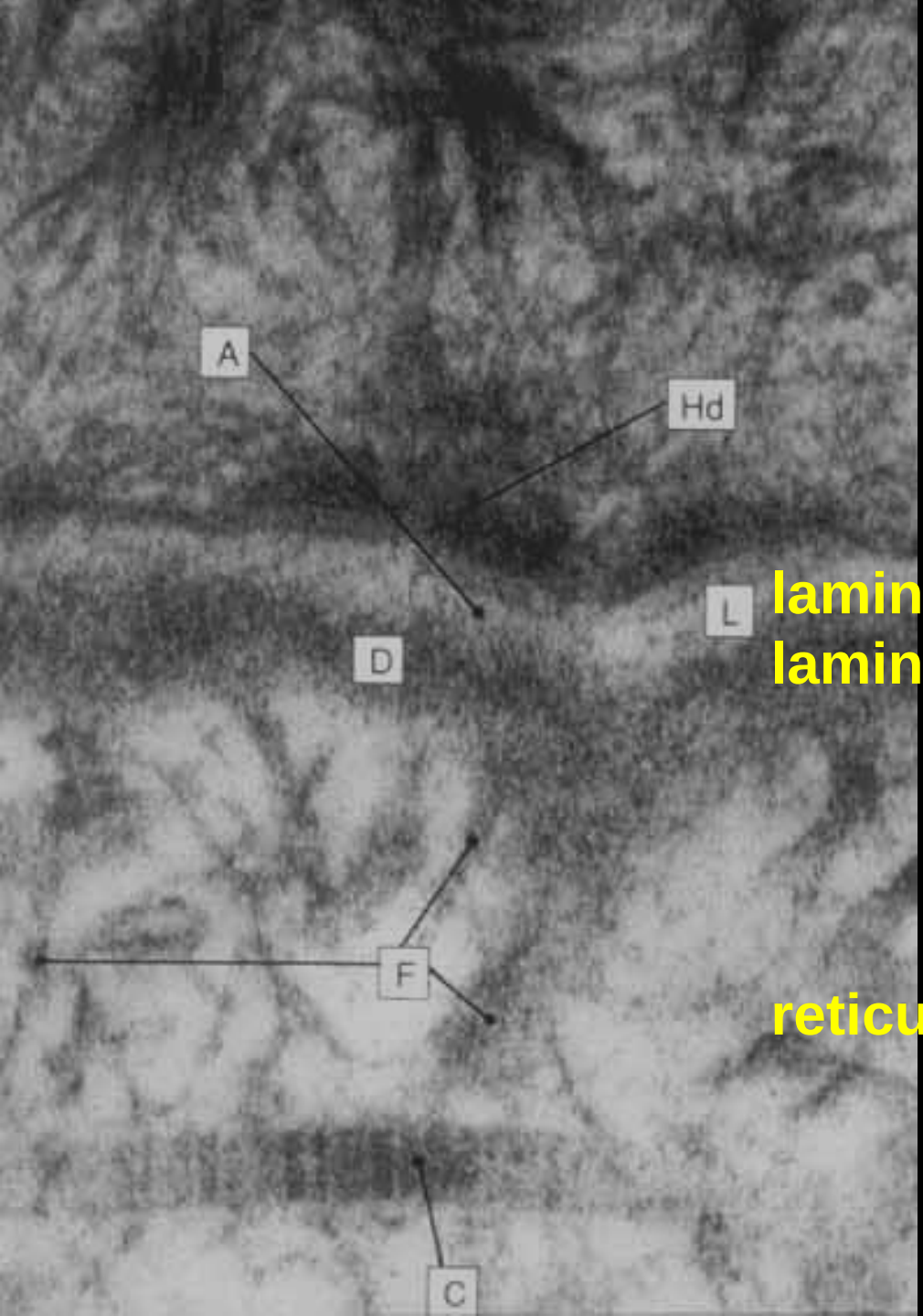

Mucus layer
MUC5AC/5B
Cilia
PCL
Tethered mucins
Microvilli
Gel
Brush
Epithelial Cells



BORDERLINE EPITHELIUM-CONNECTIVE TISSUE

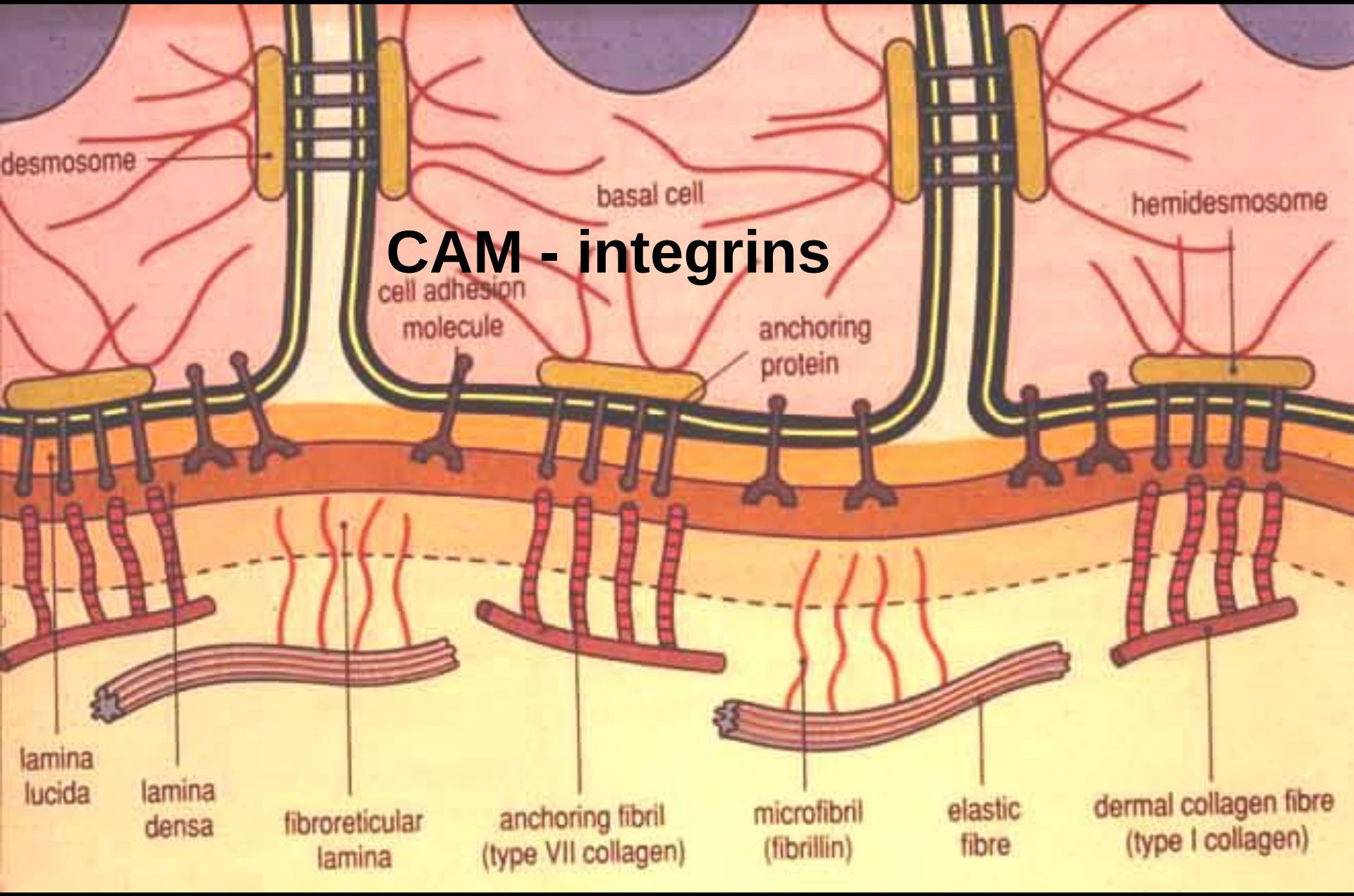
Basement membrane

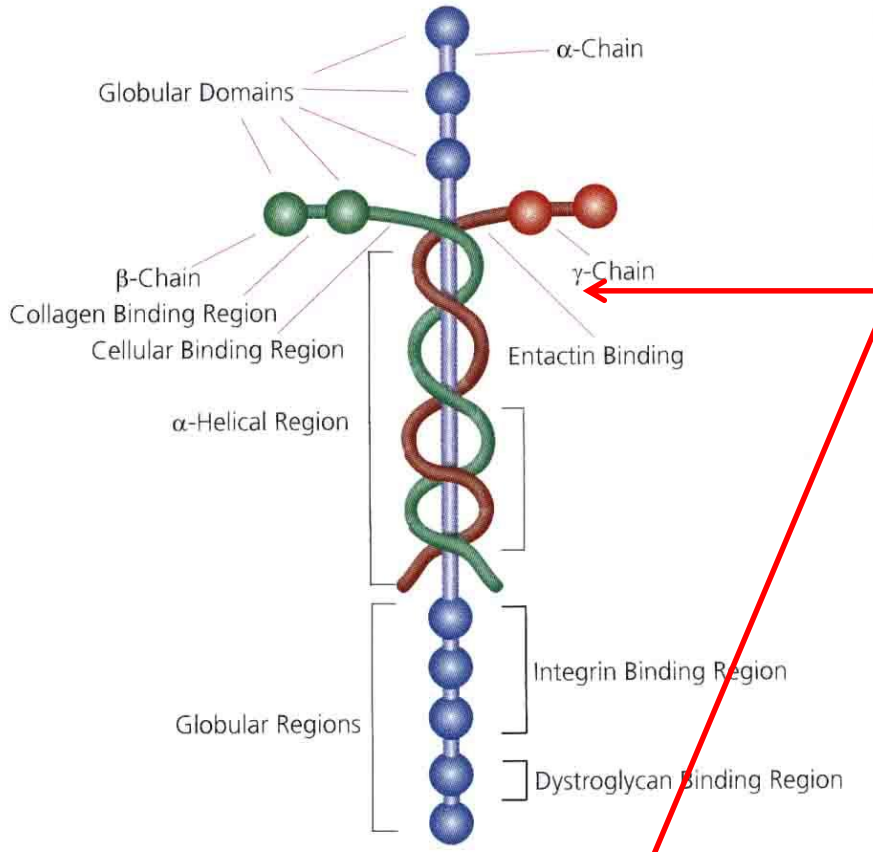


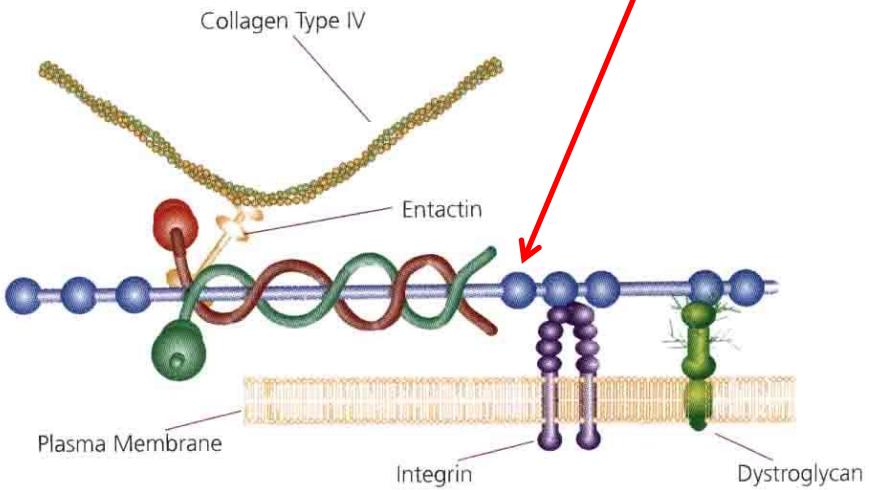


lamina lucida (rara)
lamina densa
} basal lamina

reticular lamina


desmosome
basal cell
hemidesmosome
CAM - integrins
cell adhesion molecule
anchoring protein
lamina lucida
lamina densa
fibroreticular lamina
anchoring fibril (type VII collagen)
microfibril (fibrillin)
elastic fibre
dermal collagen fibre (type I collagen)





Basal lamina

laminin
+
perlecan - heparan sulfate proteoglycan
entactin (nidogen) – glycoprotein
type IV collagen

Reticular lamina

collagen type III (reticular fibres)
+
collagen type VII (anchoring fibrils)
fibrillin (microfibrils)
tenascin – glycoprotein

External (superficial) lamina

some non-epithelial cells

CLASSIFICATION OF EPITHELIA

according to arrangement

spatial (3D) epithelia
- trabecular epithelium
- reticular epithelium

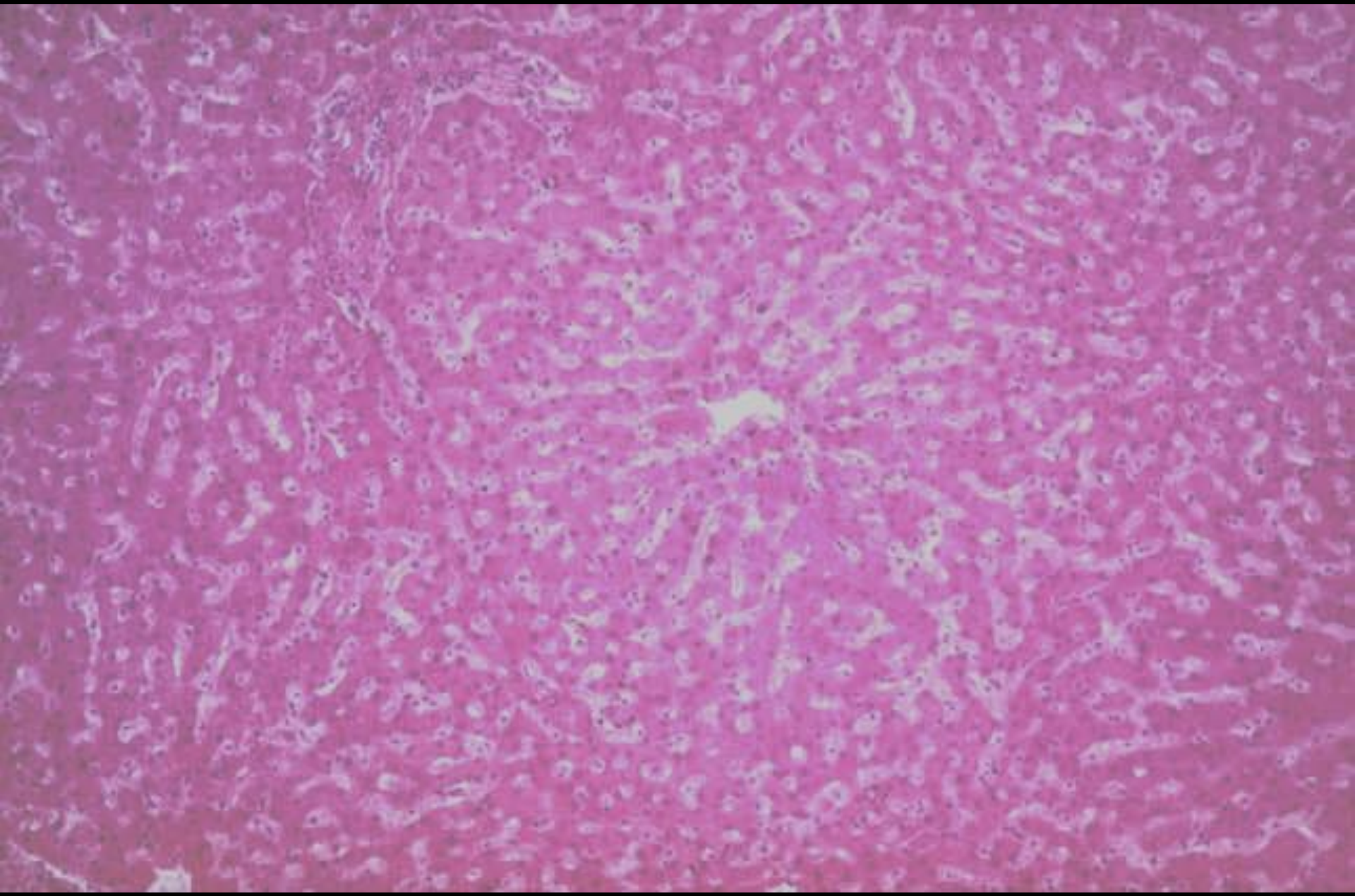
planar (2D) epithelia
number of layers
shape of cells in superficial layer

according to function

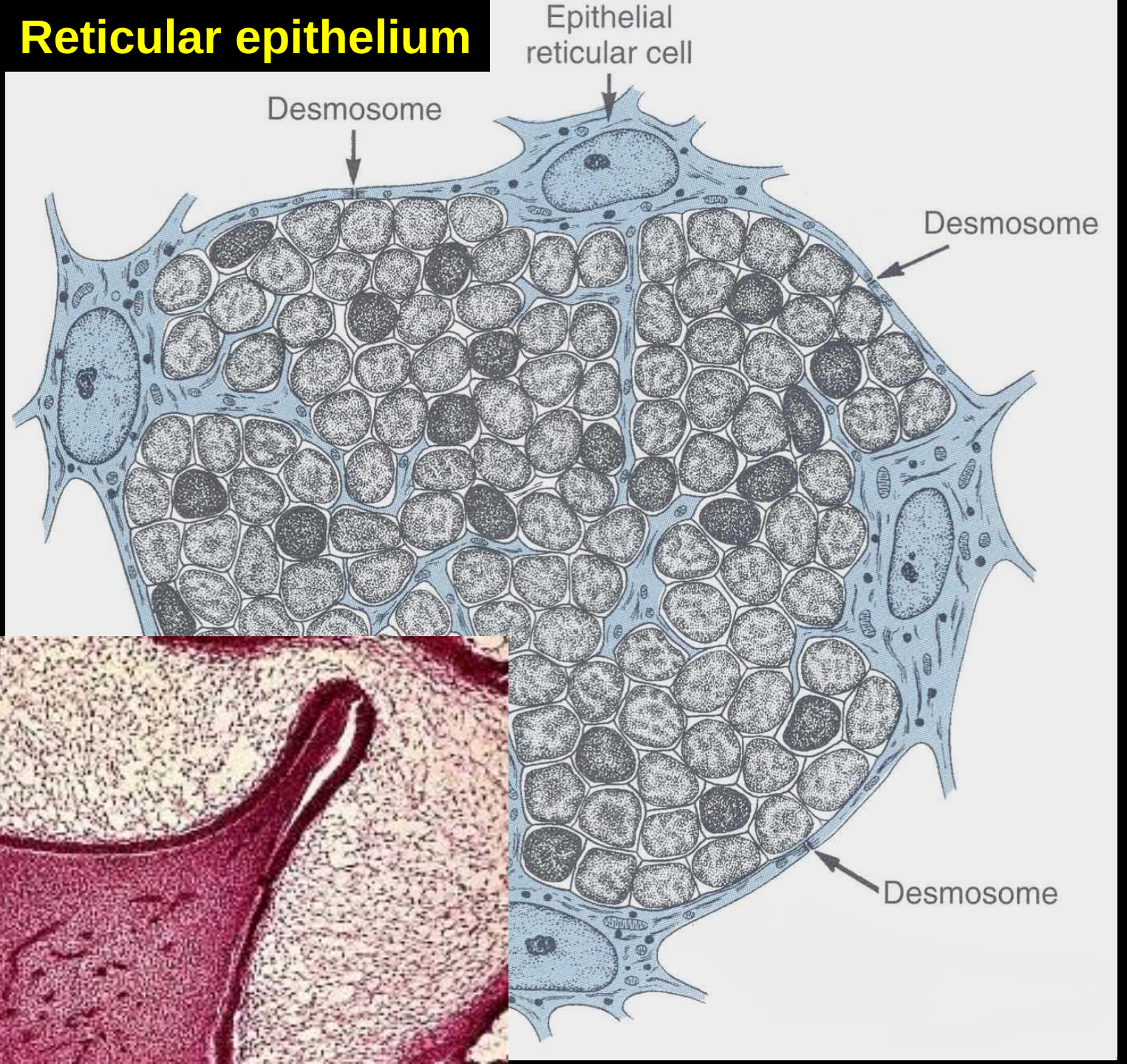
glandular (secretory)

covering (lining)

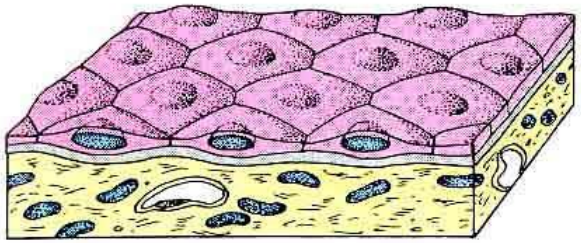
Trabecular epithelium



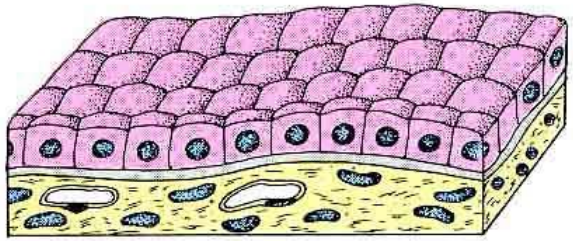
Reticular epithelium



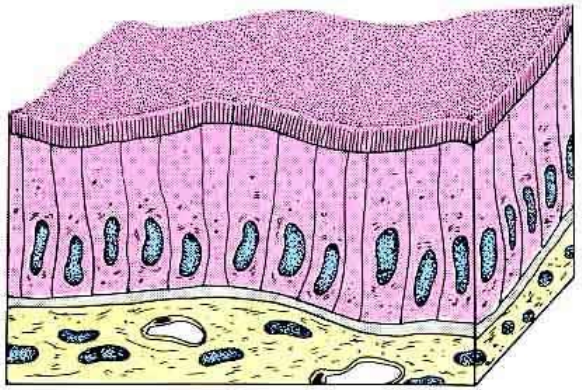
Planar epithelium



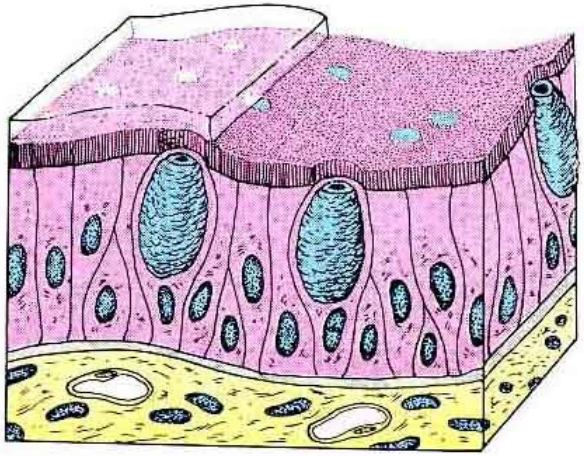
Simple squamous epithelium



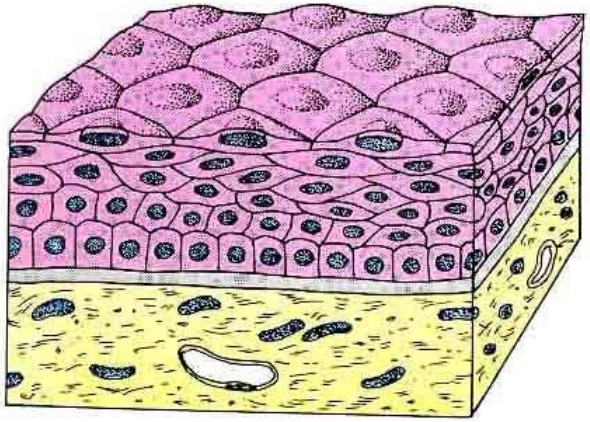
Simple cuboidal epithelium



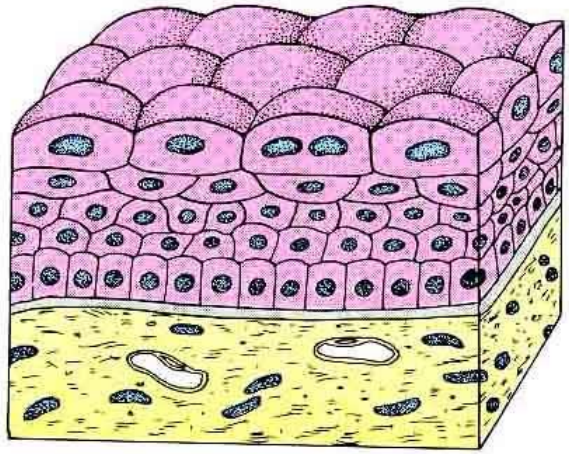
Simple columnar epithelium



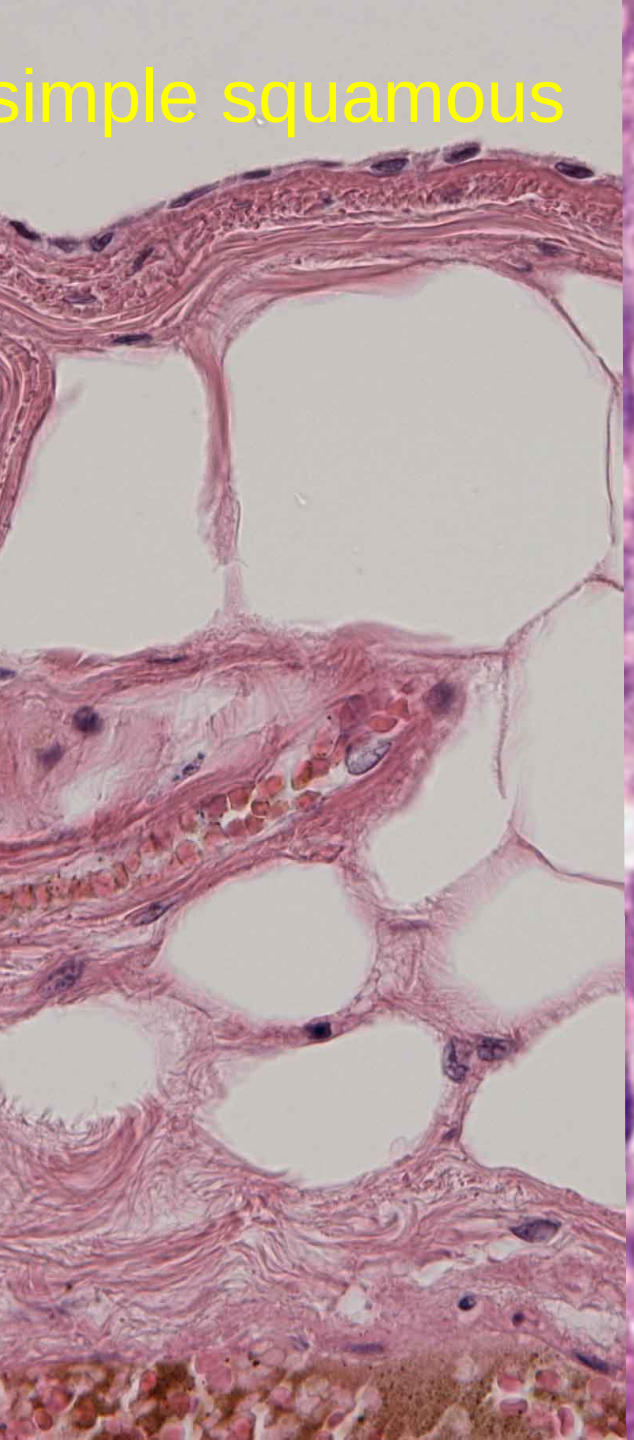
Pseudostratified columnar epithelium



Stratified squamous epithelium

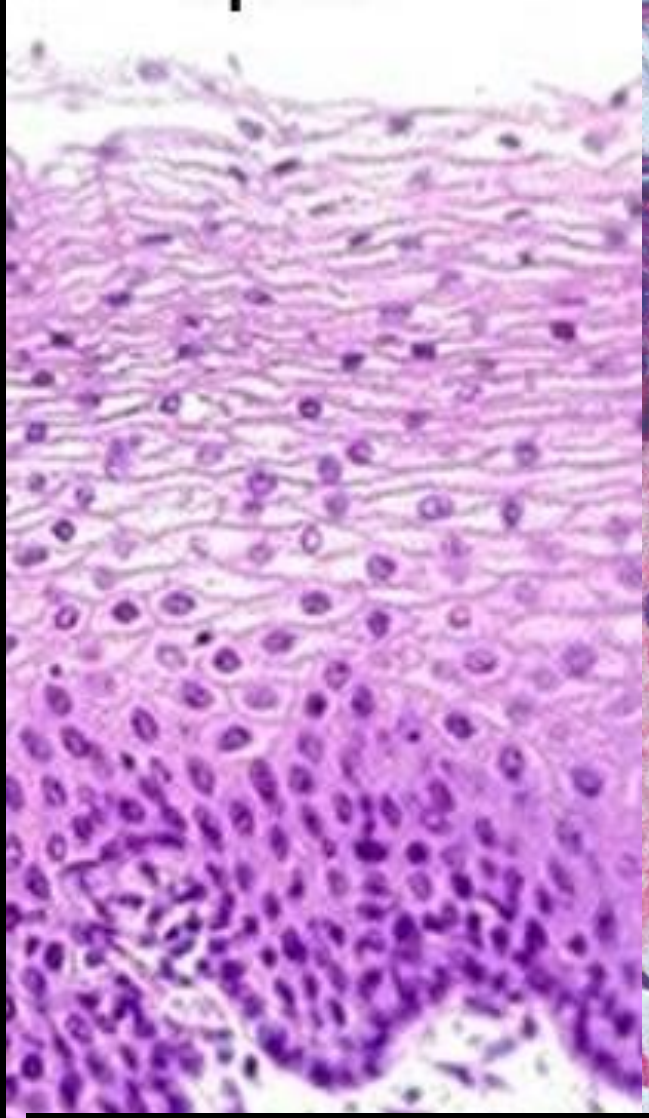


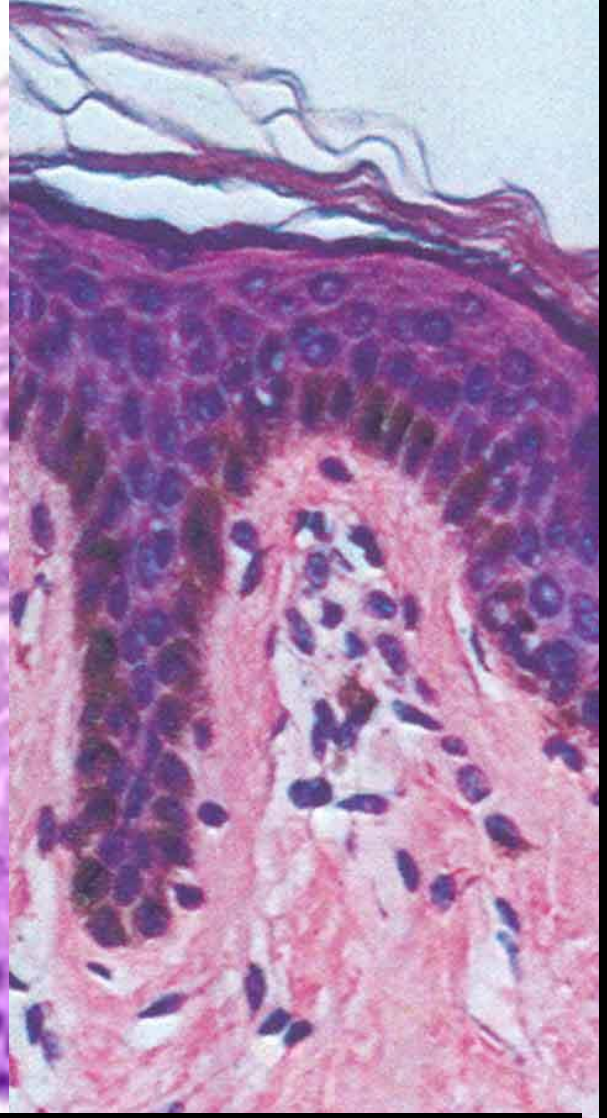
Transitional epithelium


simple squamous


simple cuboidal


simple columnar





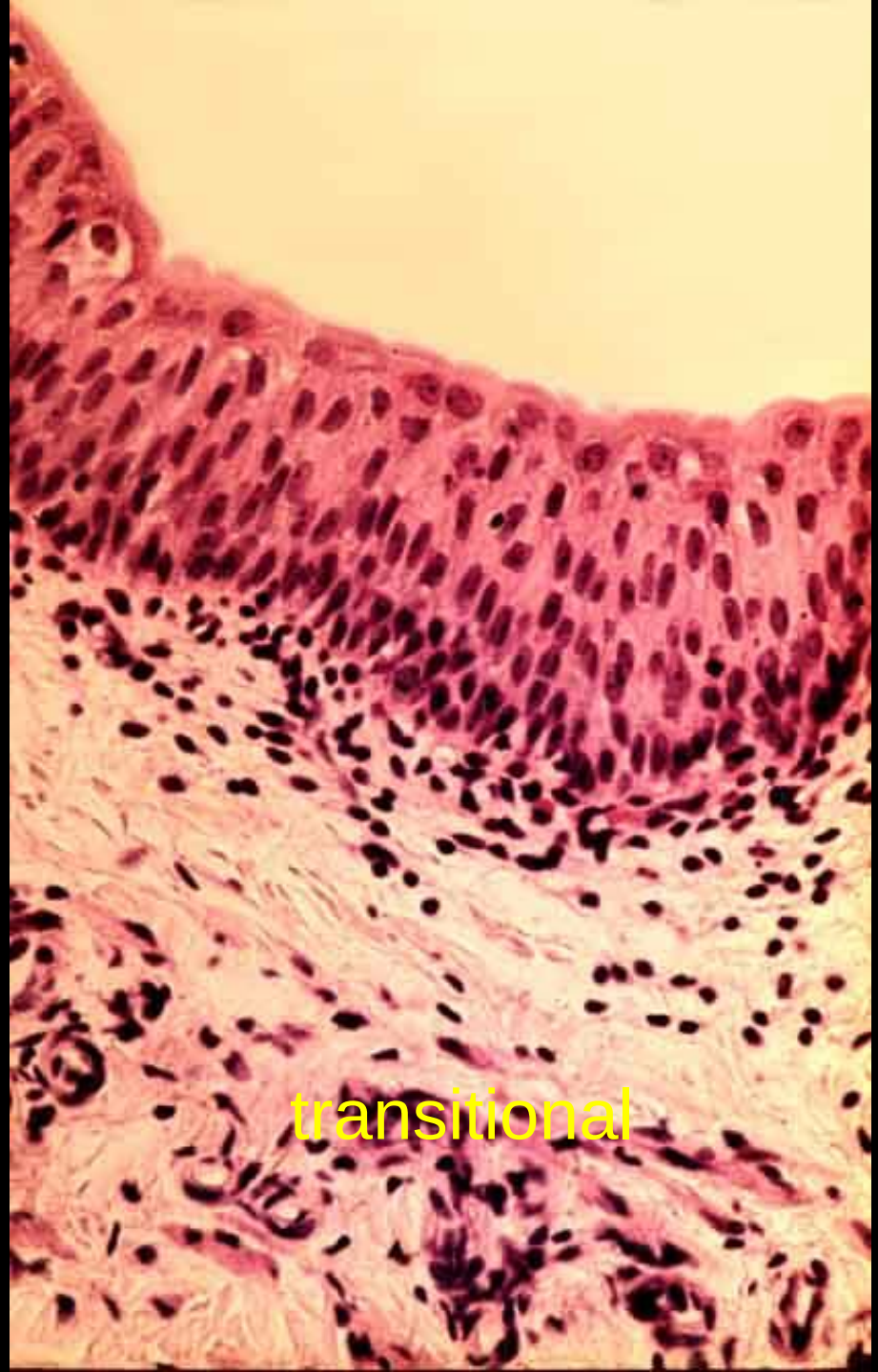
stratified squamous

nonkeratinized

keratinized

stratified columnar


pseudostratified
columnar

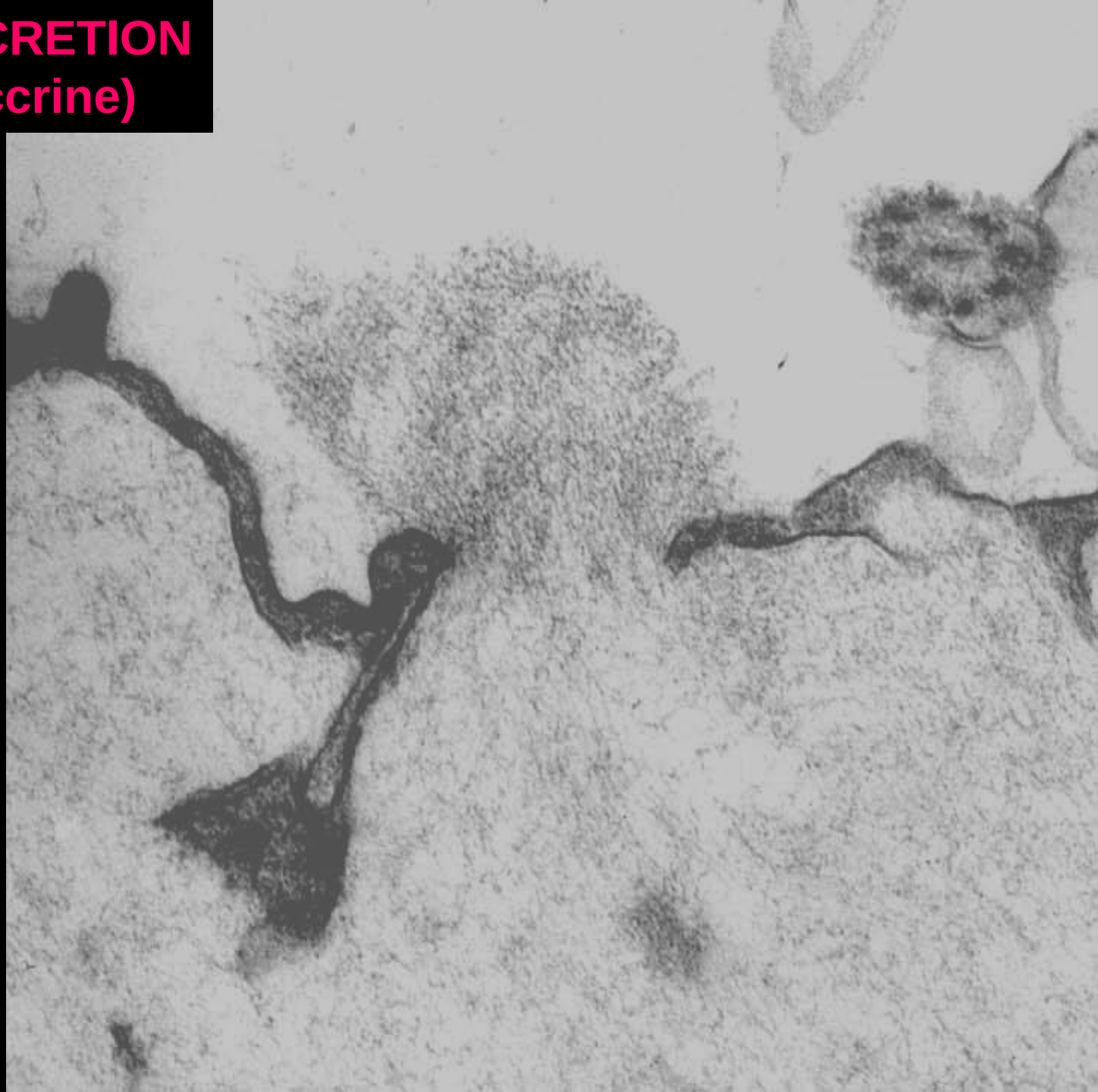

transitional

GLANDULAR EPITHELIUM

composed of cells specialized to production and secretion of various substances, which chemically differ from blood or intercellular fluid

- ingestion
- synthesis
- storage
- secretion

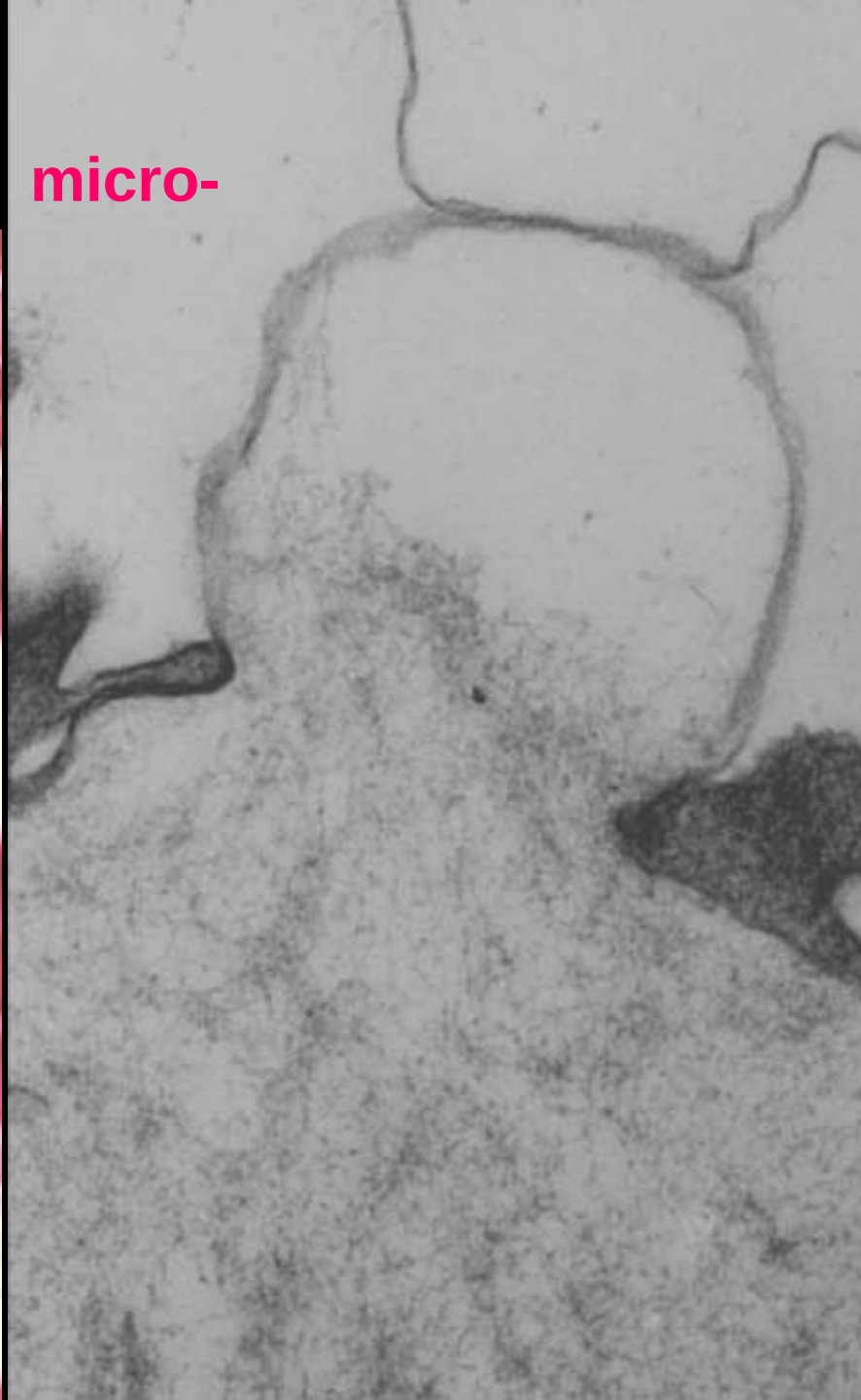
TYPES OF SECRETION
- merocrine (eccrine)



TYPES OF SECRETION
- apocrine

macro-

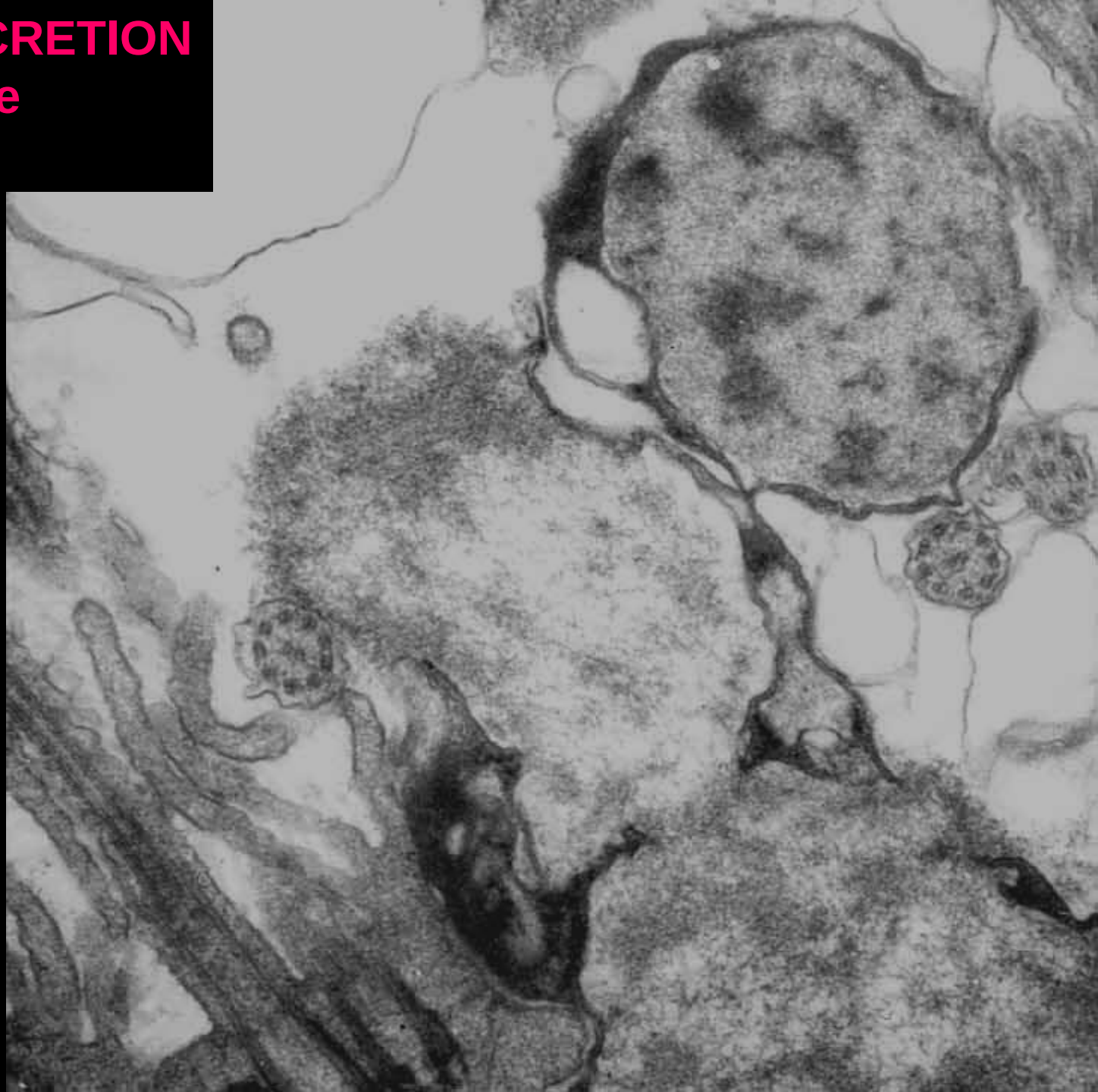
micro-



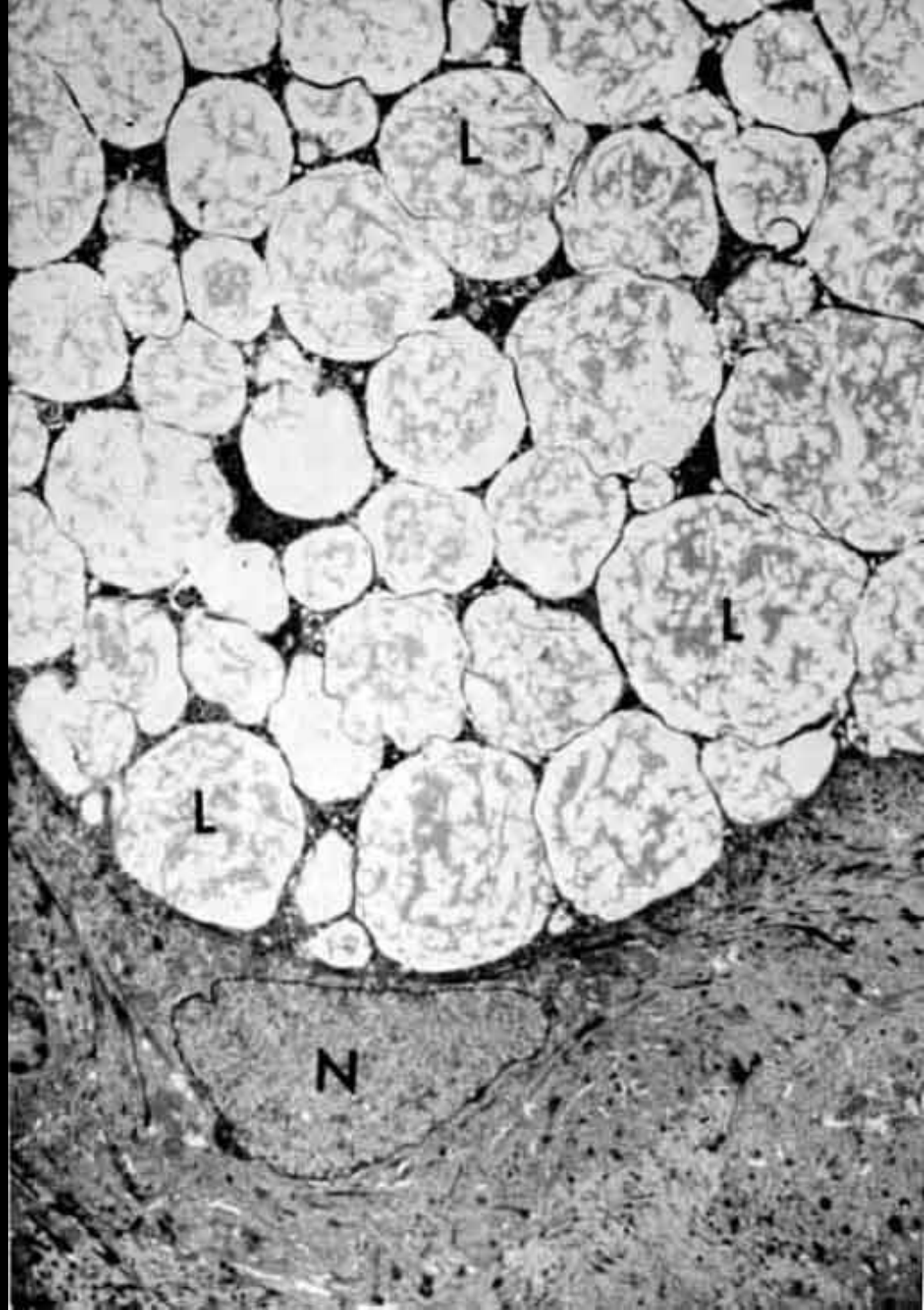
TYPES OF SECRETION

-macroapocrine

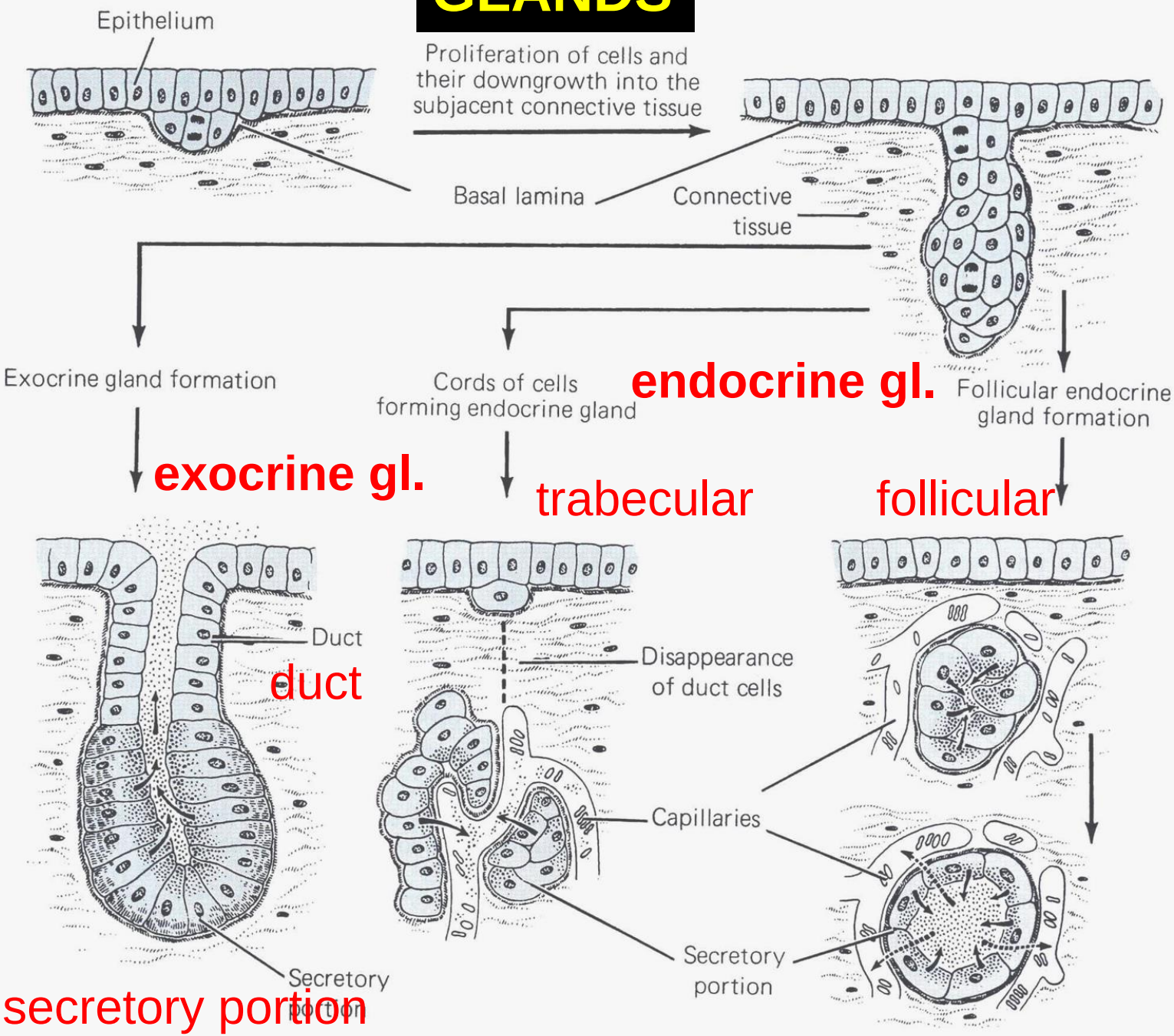
-merocrine



TYPES OF SECRETION
- holocrine



GLANDS


Epithelium
Proliferation of cells and their downgrowth into the subjacent connective tissue
Basal lamina
Connective tissue
Exocrine gland formation
Cords of cells forming endocrine gland
endocrine gl.
Follicular endocrine gland formation
exocrine gl.
trabecular
follicular
Duct
duct
Disappearance of duct cells
Capillaries
Secretory portion
Secretory portion
secretory portion

Exocrine glands

duct type

simple

branched

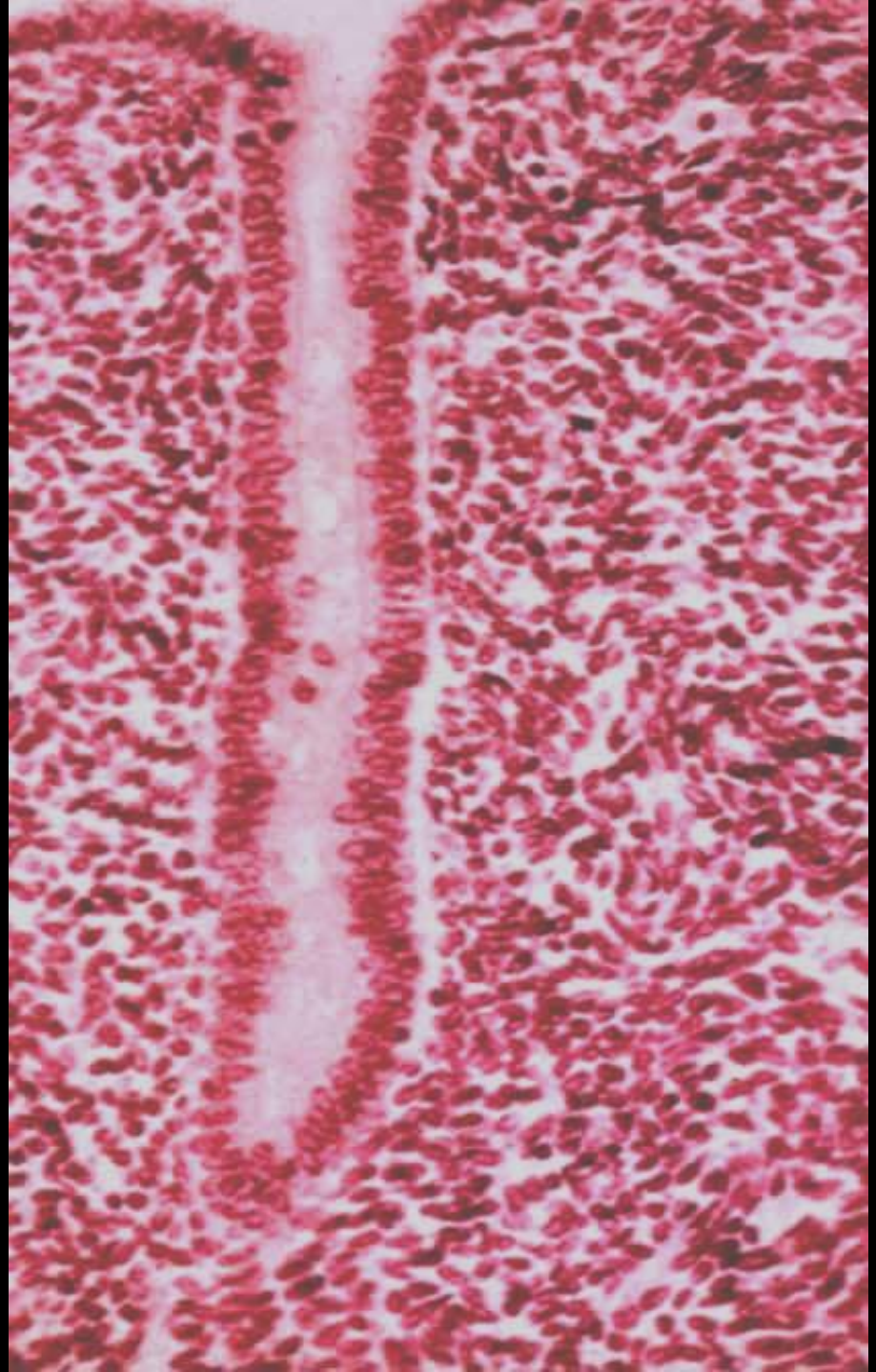
compound

type of the secretory portion

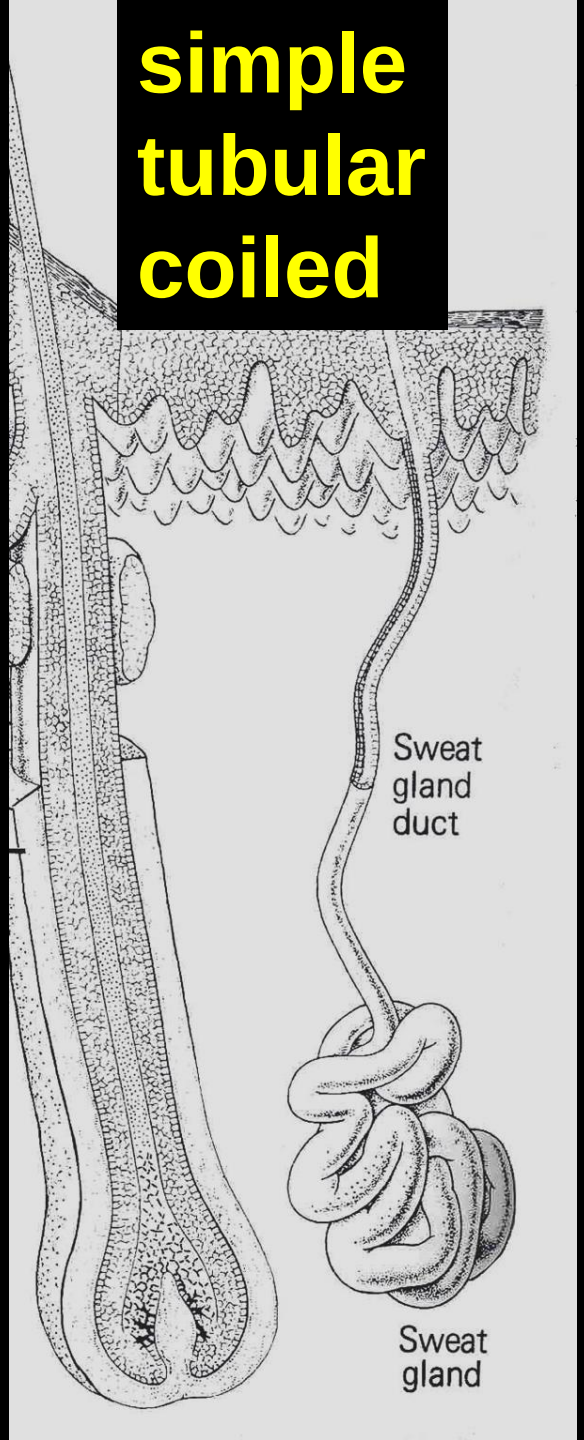
alveolar (acinar)

tubular

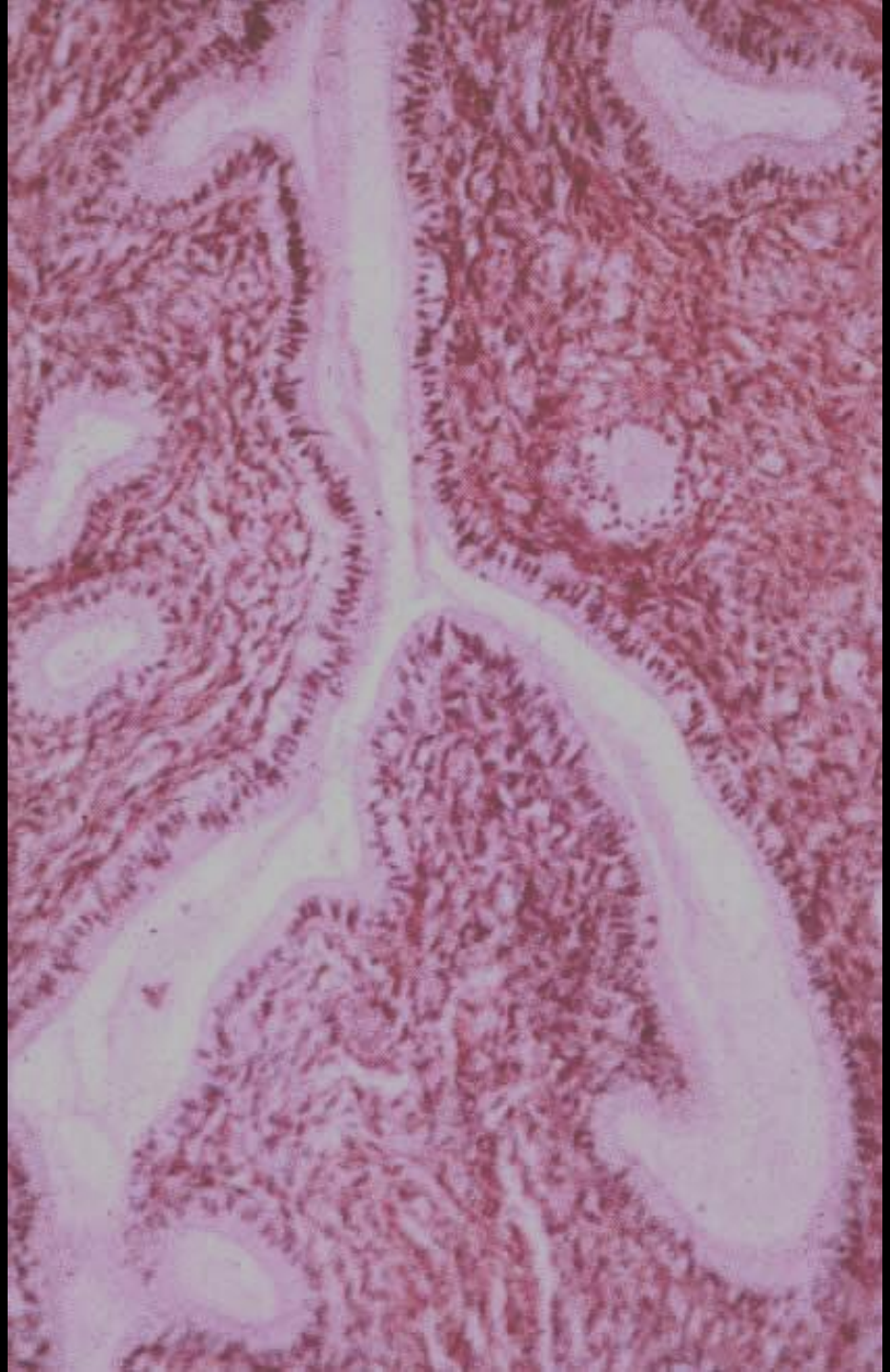
simple
tubular
straight



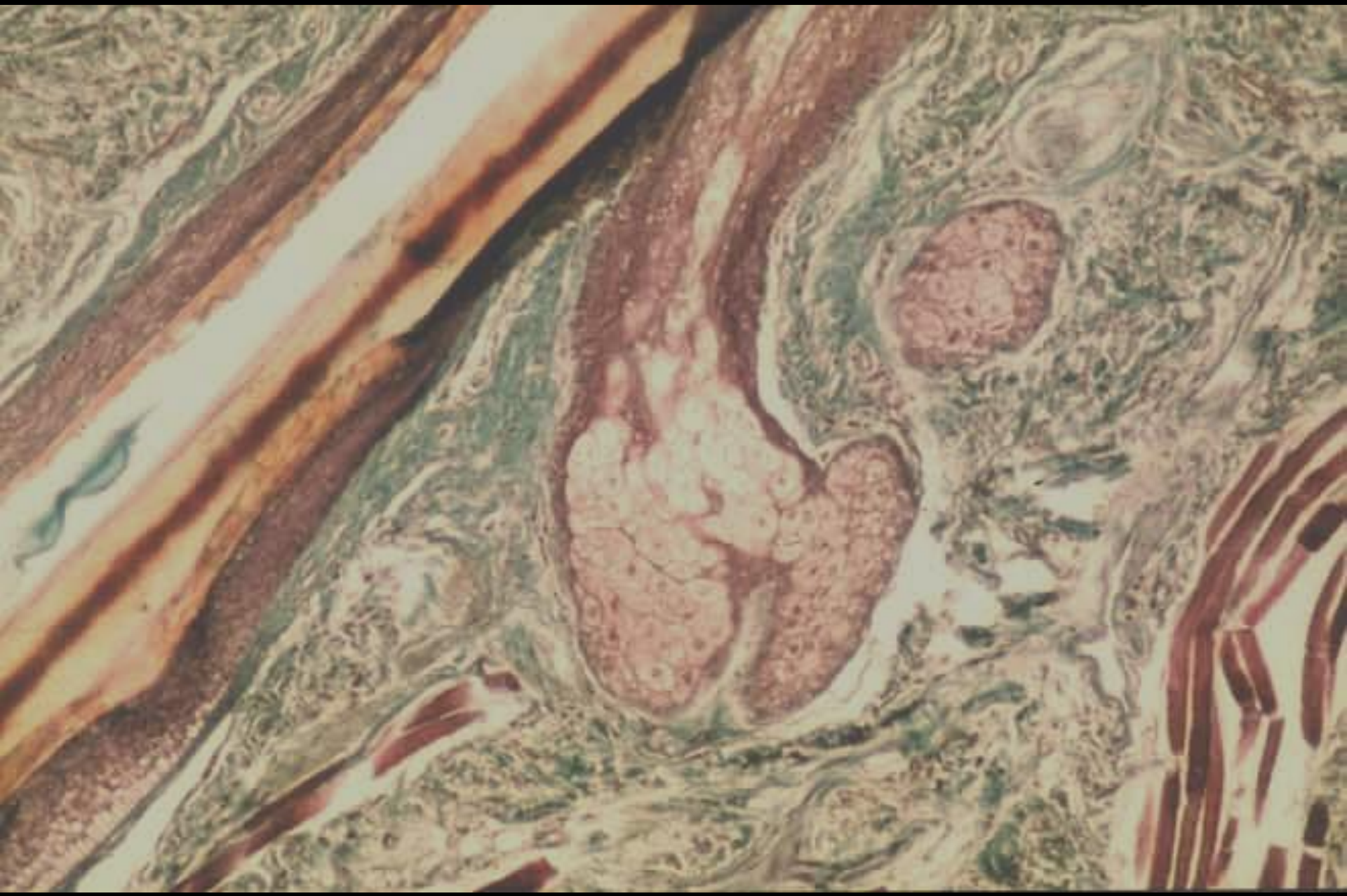
simple tubular coiled



branched tubular

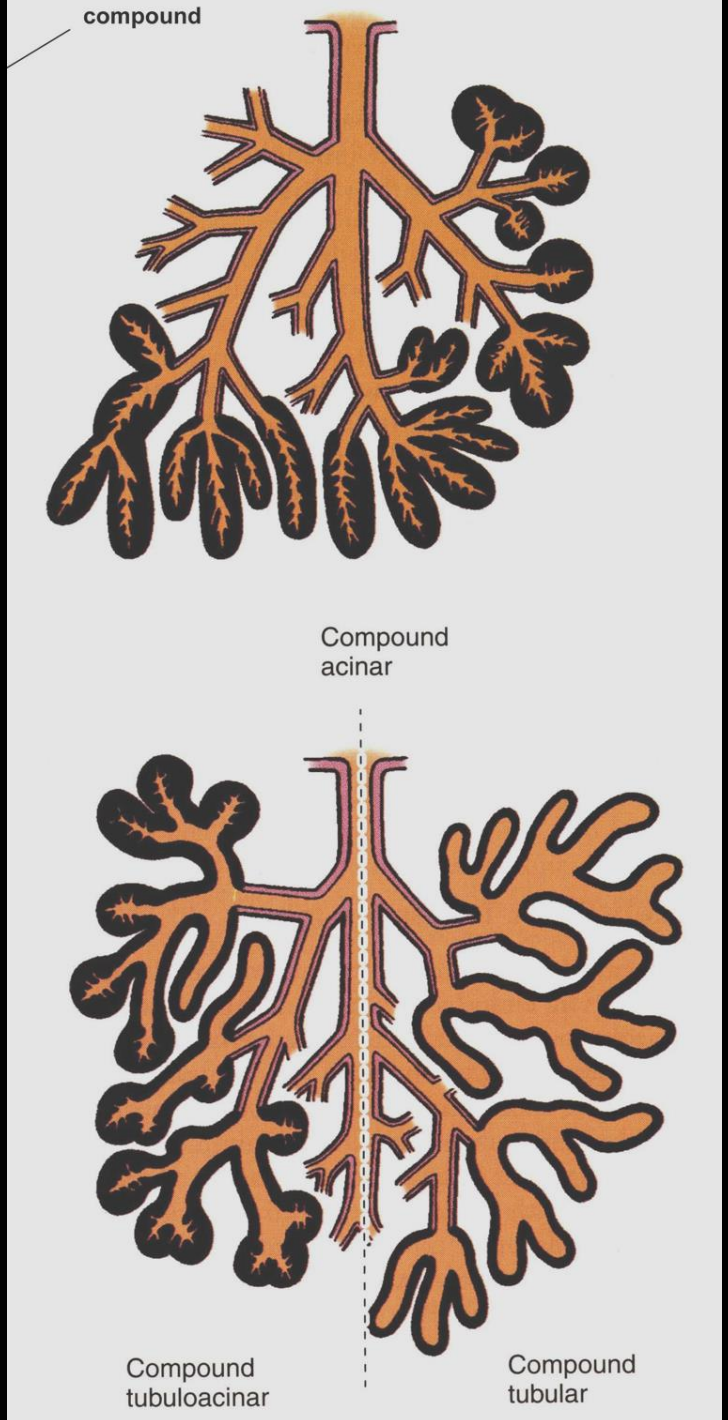


branched alveolar (acinar)



compound

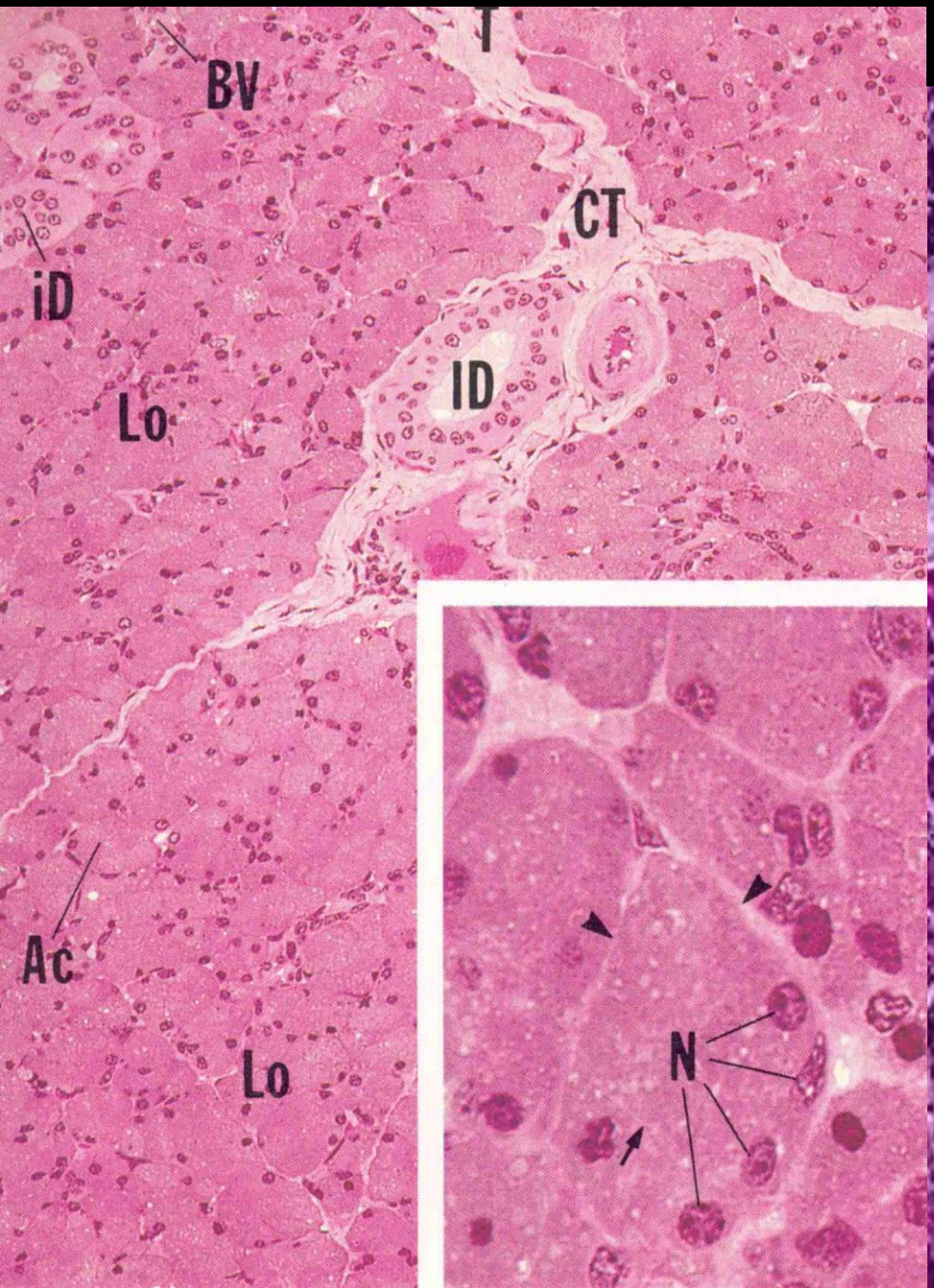
alveolar
(acinar)



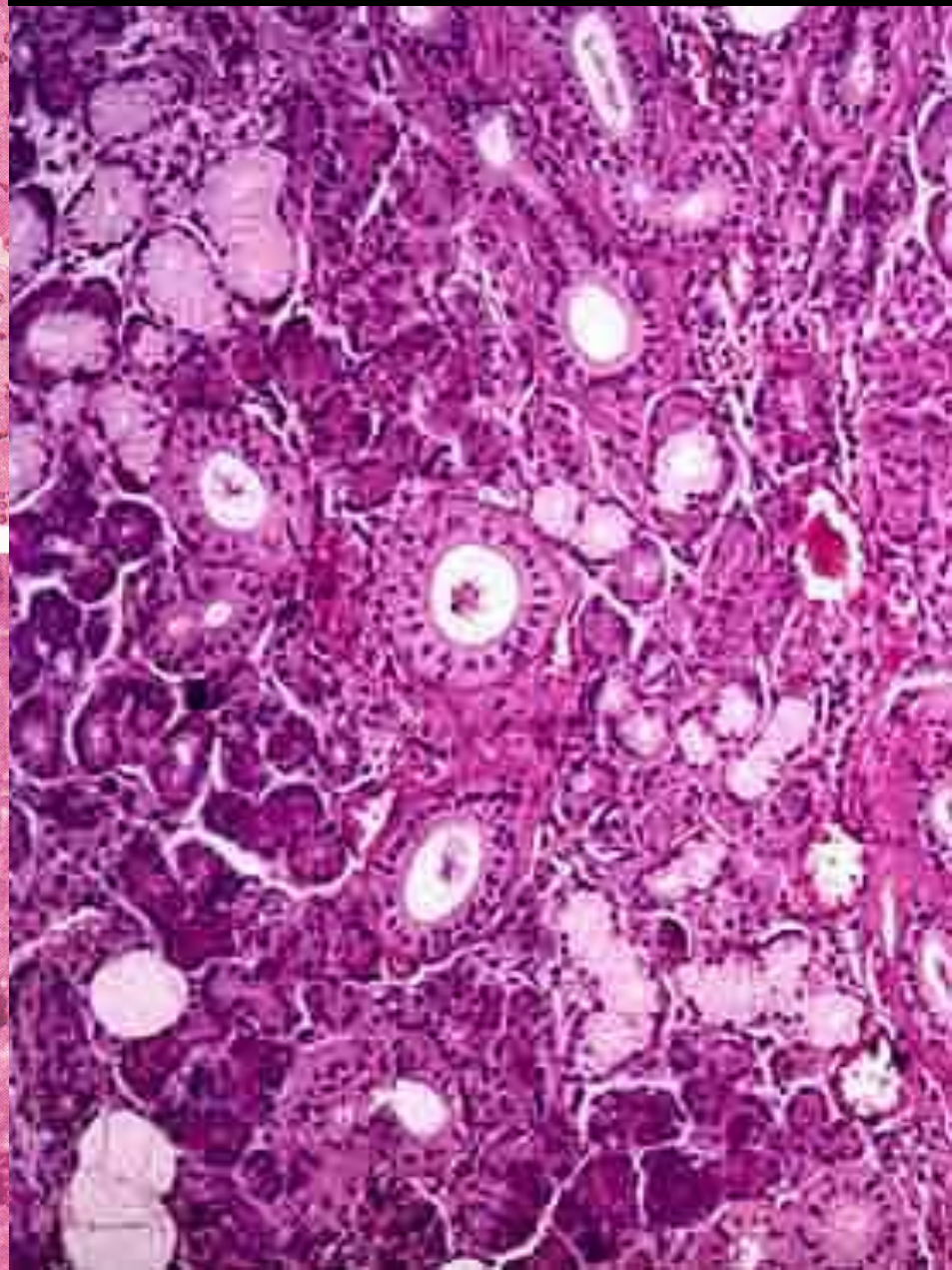
tubuloalveolar
(tubuloacinar)

tubular

compound alveolar (acinar)



compound tubuloalveolar (tubuloacinar)



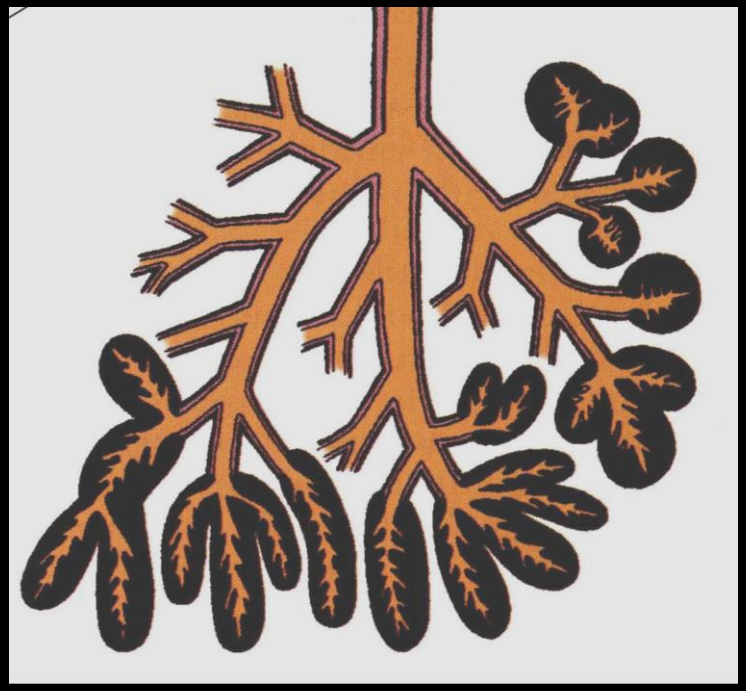
GLANDULAR DUCTS OF COMPOUND GLANDS

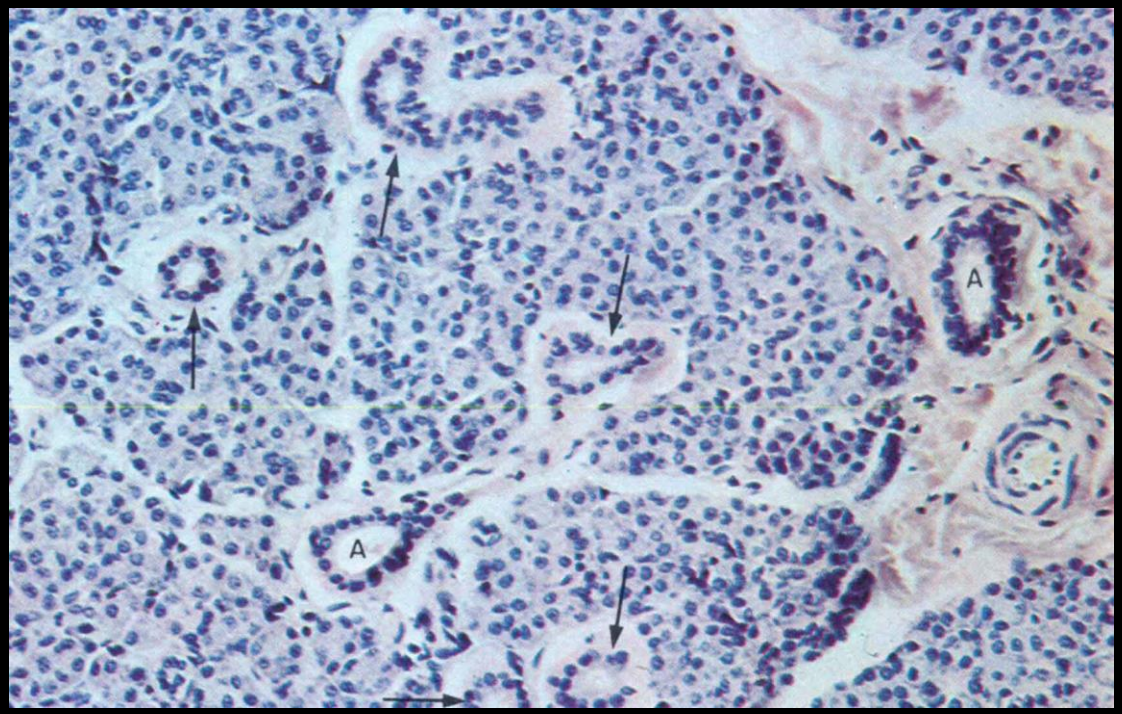
intralobular - simple squamous (intercalated ducts) to cuboidal epithelium

interlobular - simple columnar epithelium

lobar - pseudostratified to stratified columnar epithelium

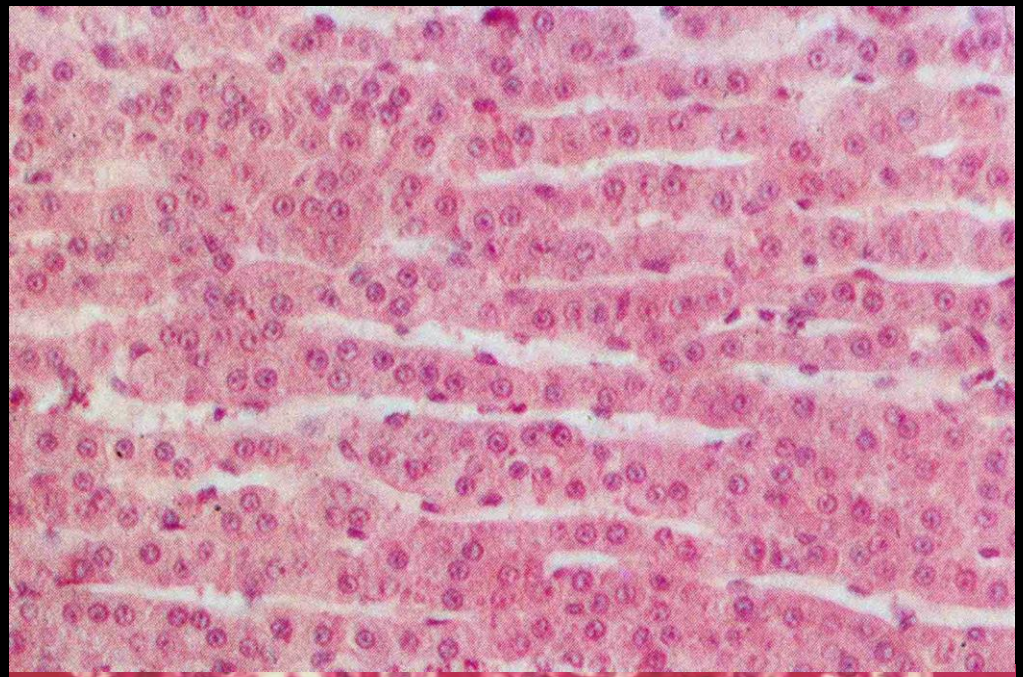
main - squamous stratified nonkeratinized epithelium





Endocrine glands

trabecular arrangement



follicular arrangement