

CLASSIFICATION OF C&L EPITHELIA

- **ONLY TWO CRITERIA**

- **SHAPE** of cells in the **TOP** layer

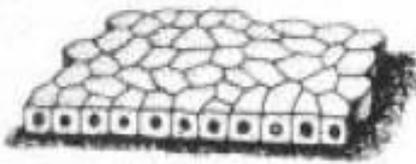
- **NUMBER** of layers

1 = “simple”

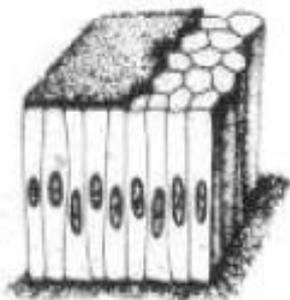
>1 = “stratified”



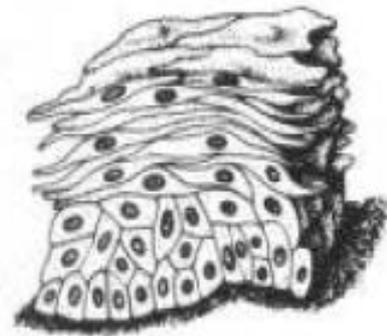
Simple squamous



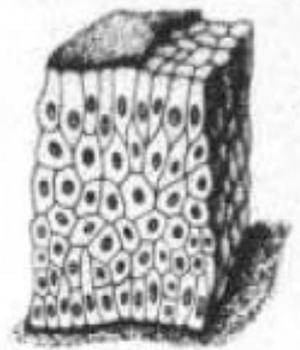
Simple cuboidal



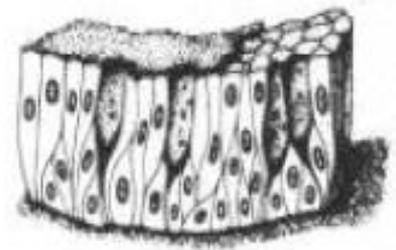
Simple columnar



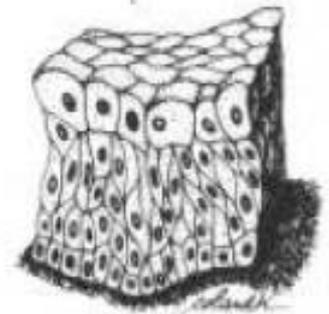
Stratified squamous



Stratified columnar



Pseudostratified columnar

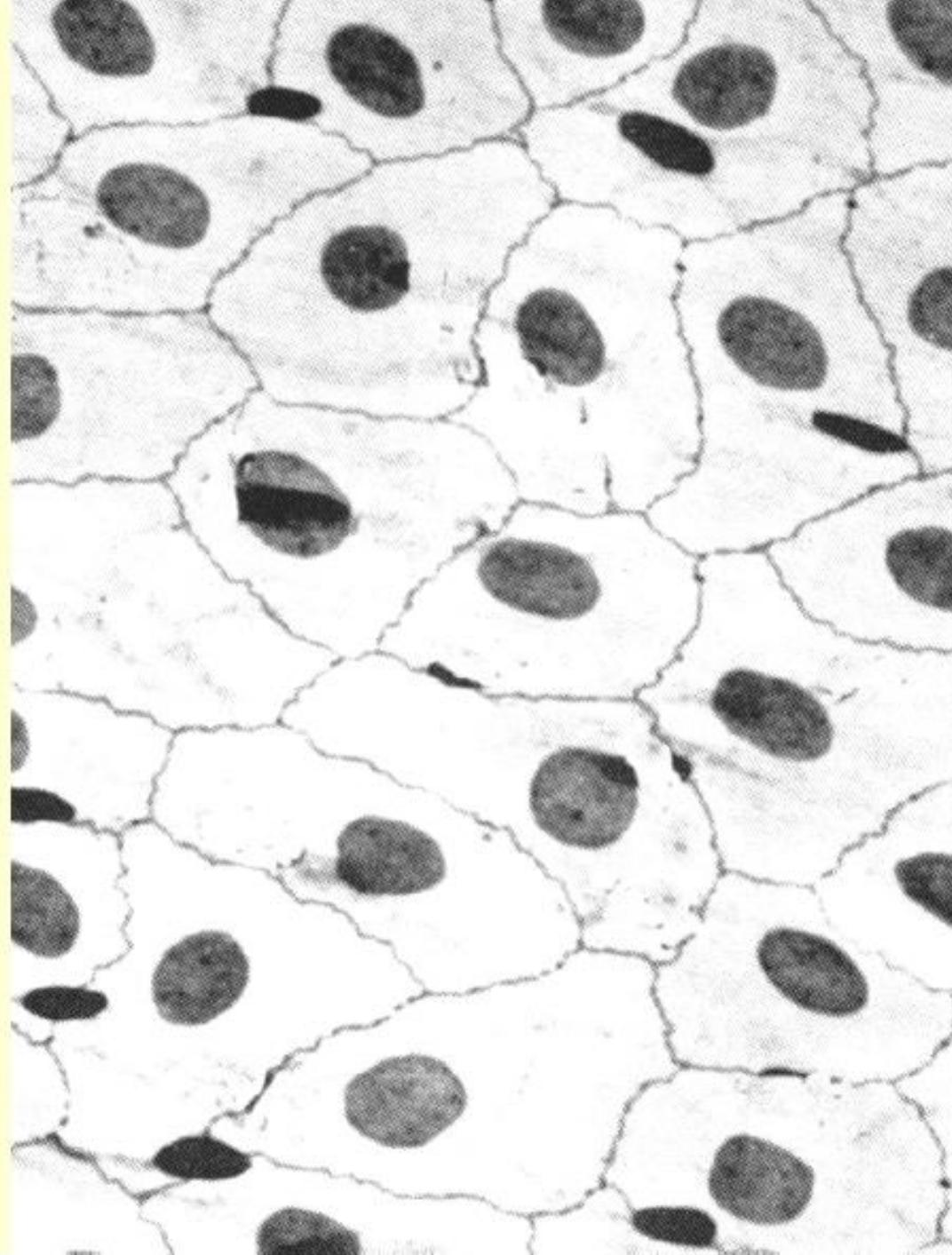


Transitional

CLASSIFICATION OF C&L EPITHELIA BY SHAPE

SQUAMOUS

- **Cells have a “Fried Egg” shape; irregular outlines**
- **EXAMPLES:**
Lining of blood vessels
Mesothelium covering internal organs

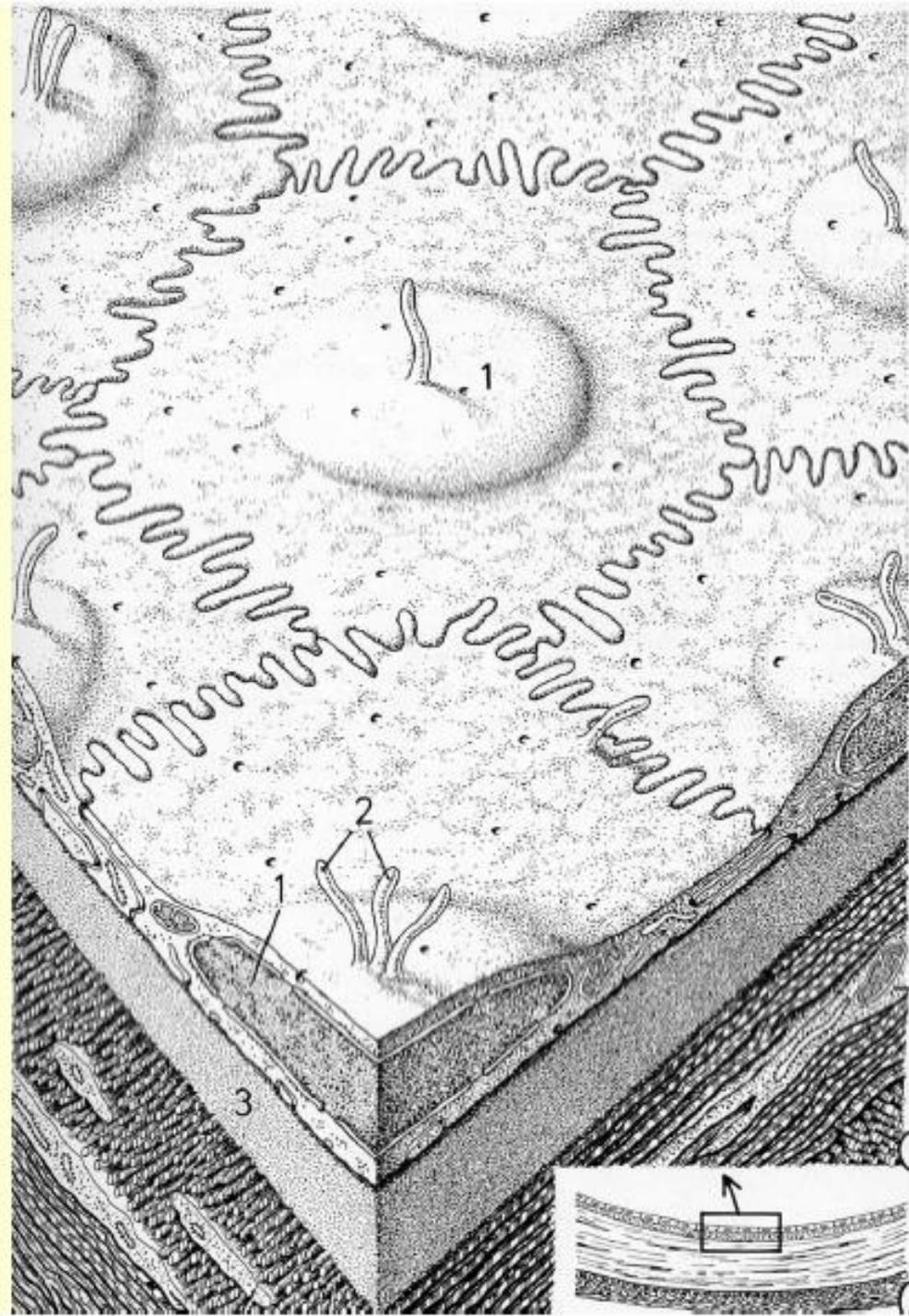
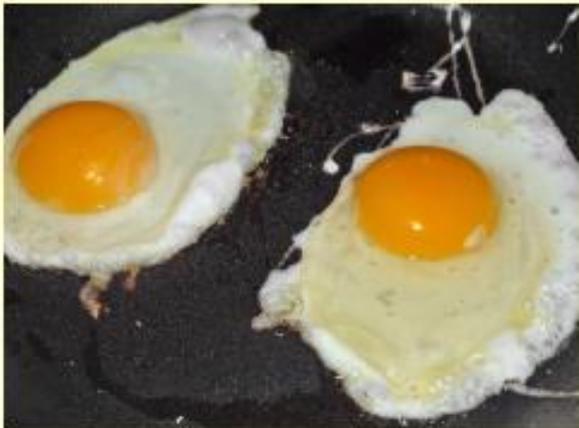


SIMPLE SQUAMOUS

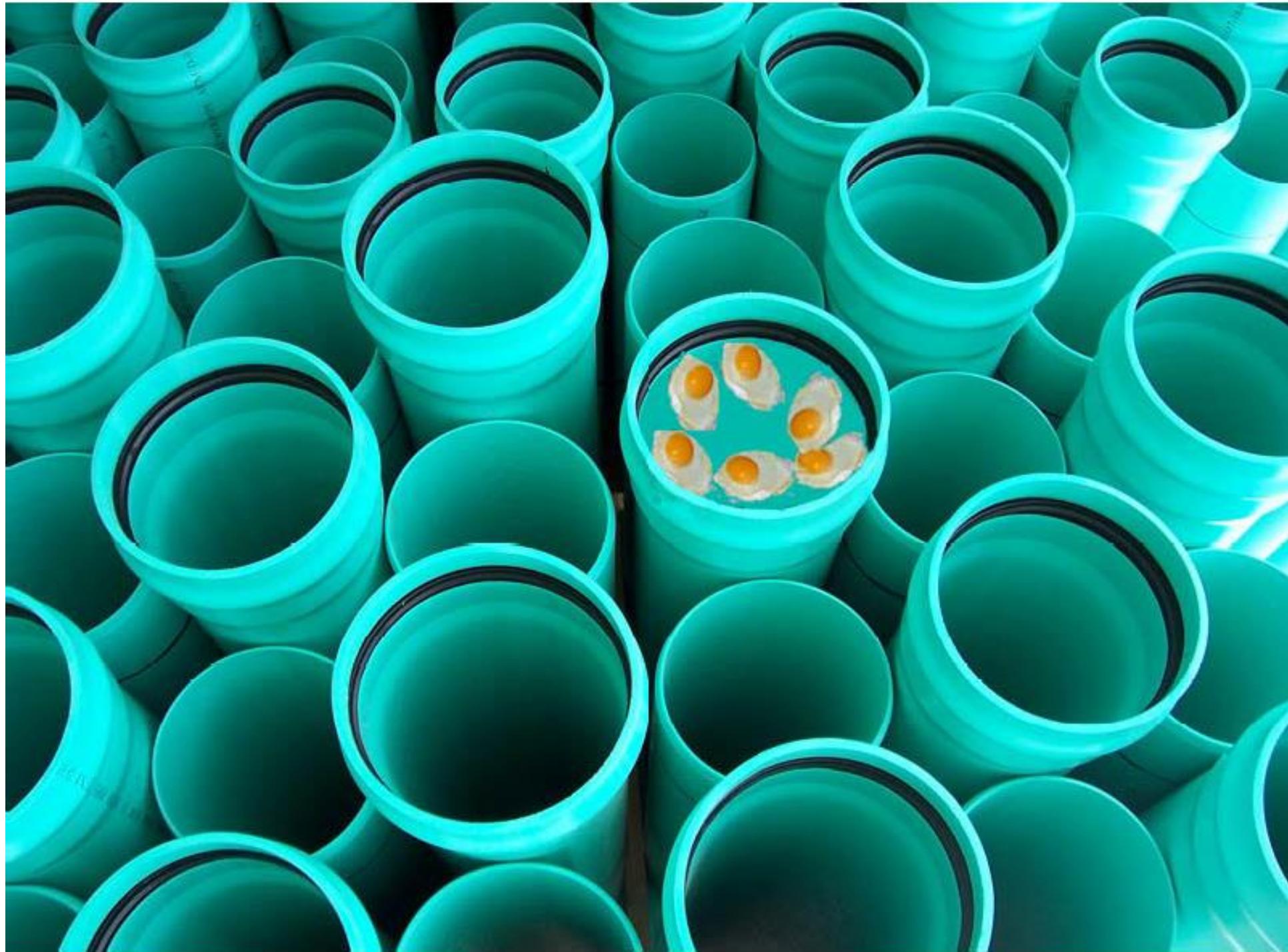
**Single Layer of
Cells**

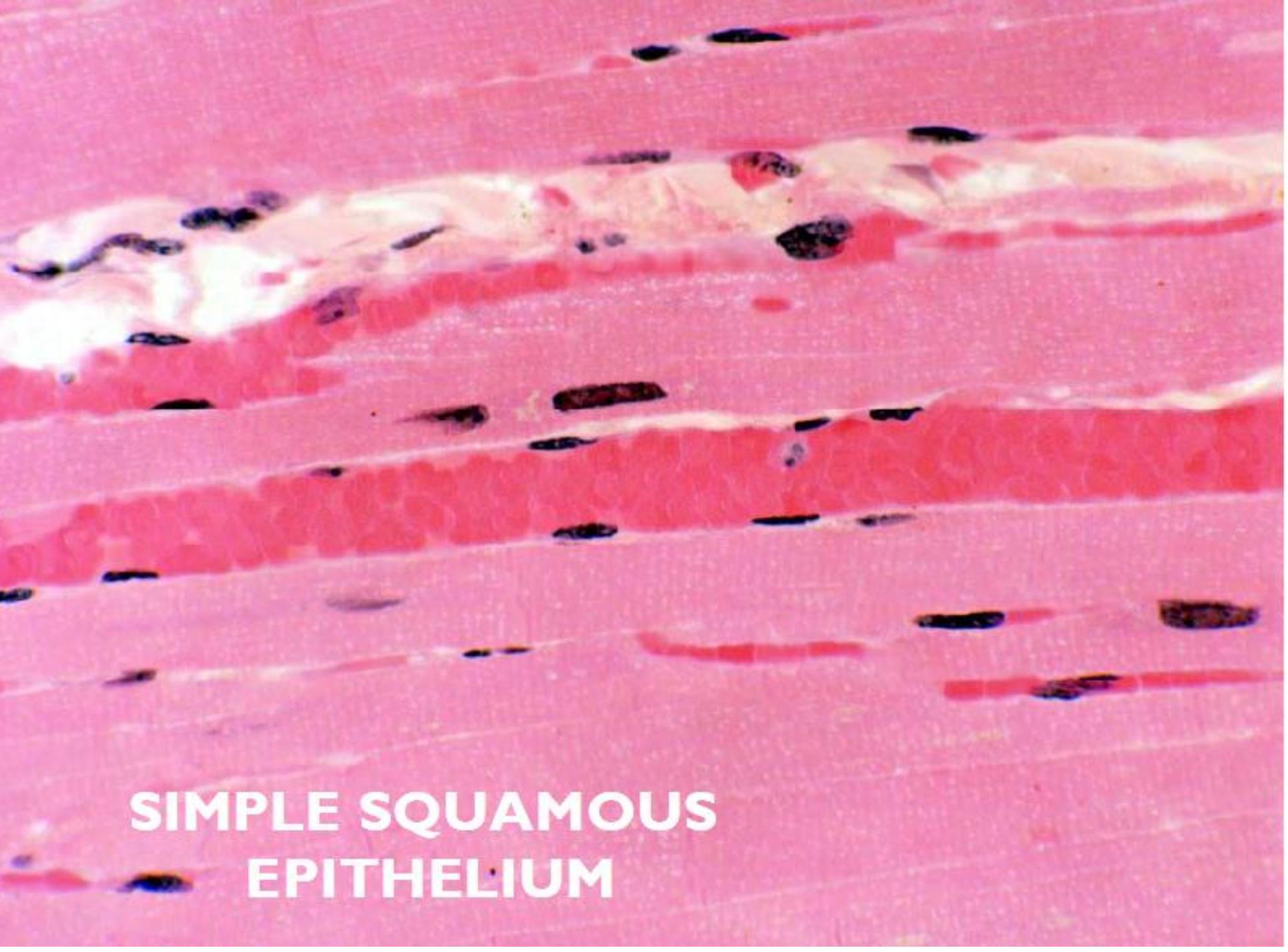
Squamous shape

**Example: Lining of
a blood vessel**

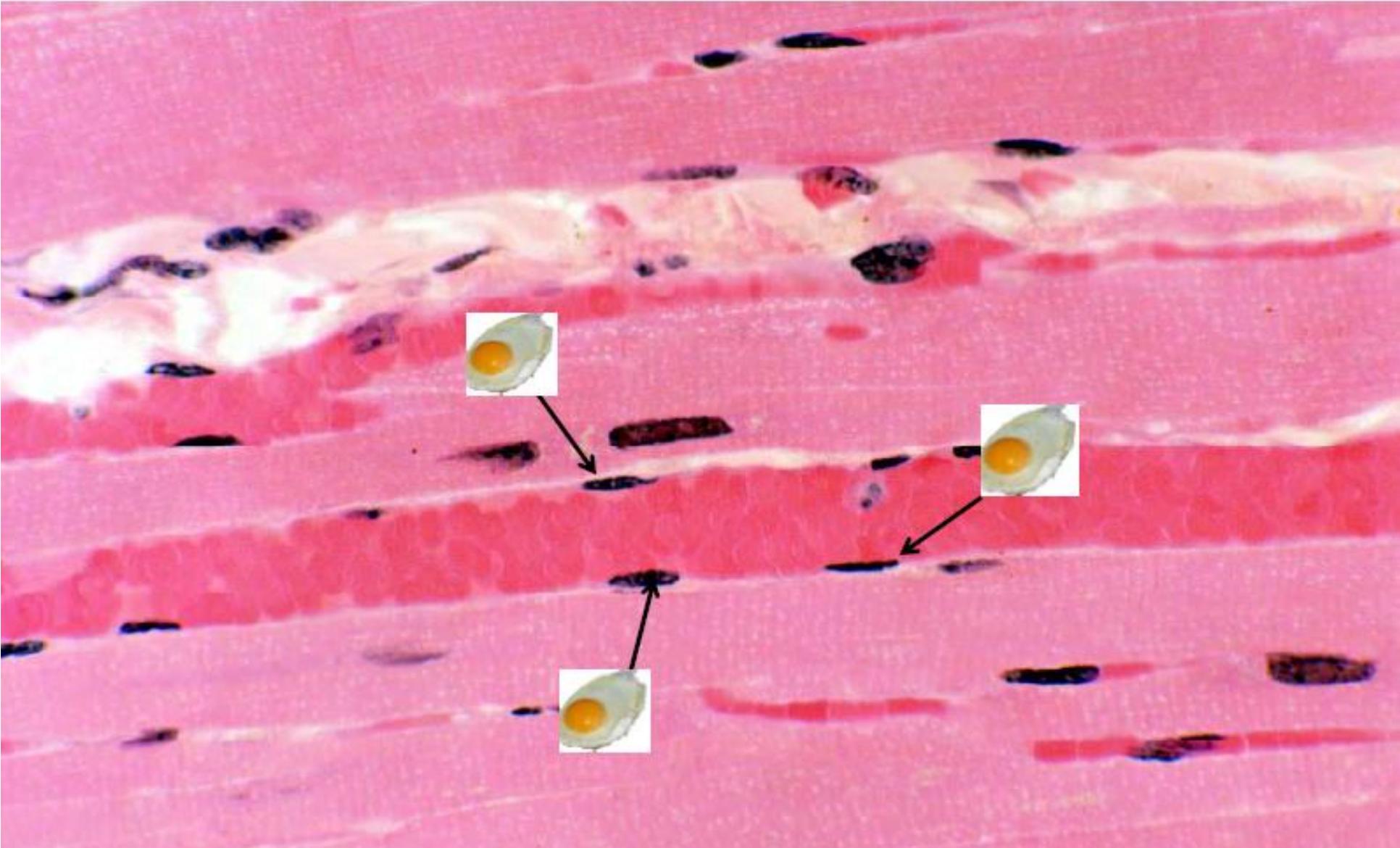








**SIMPLE SQUAMOUS
EPITHELIUM**

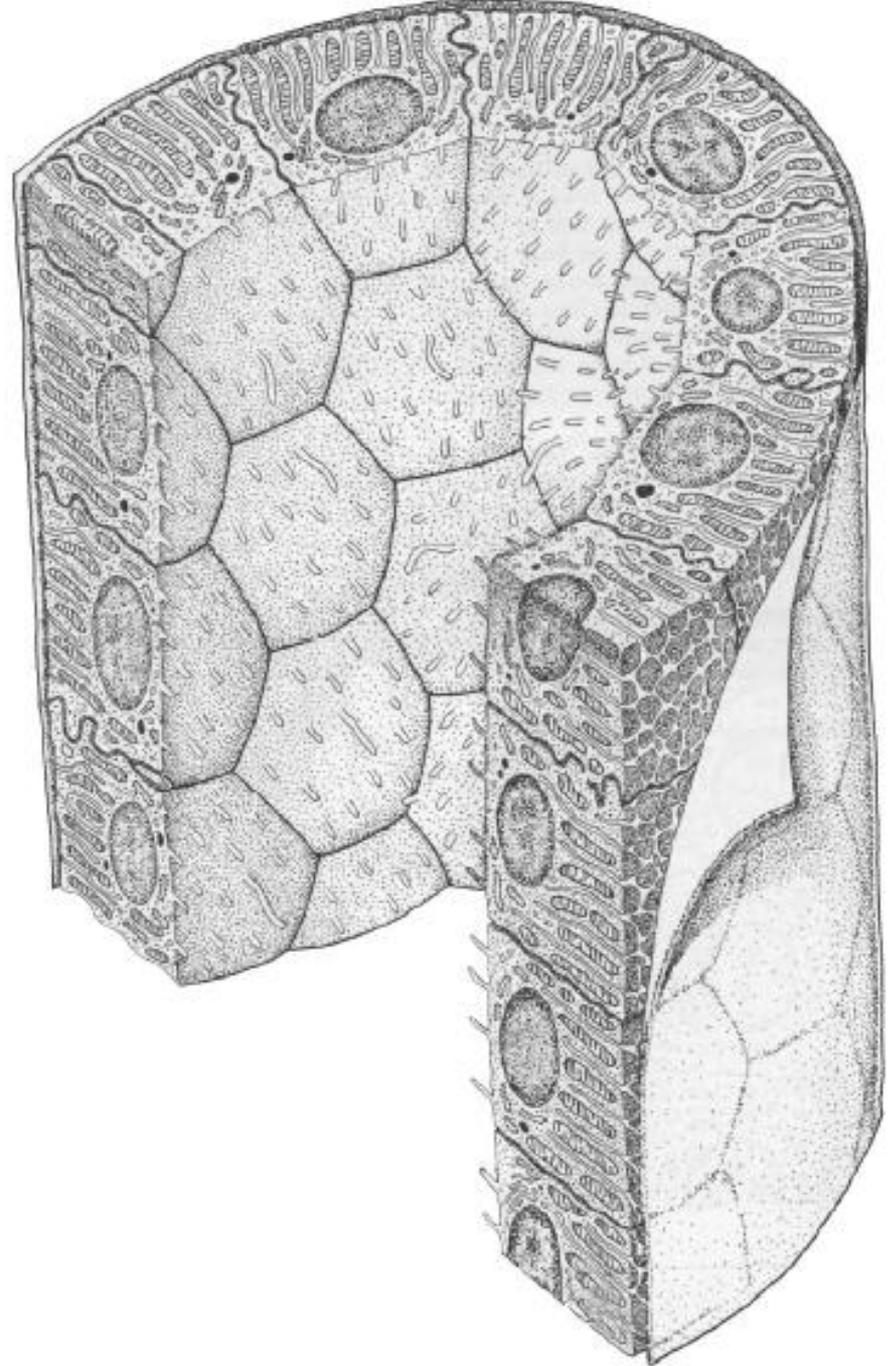


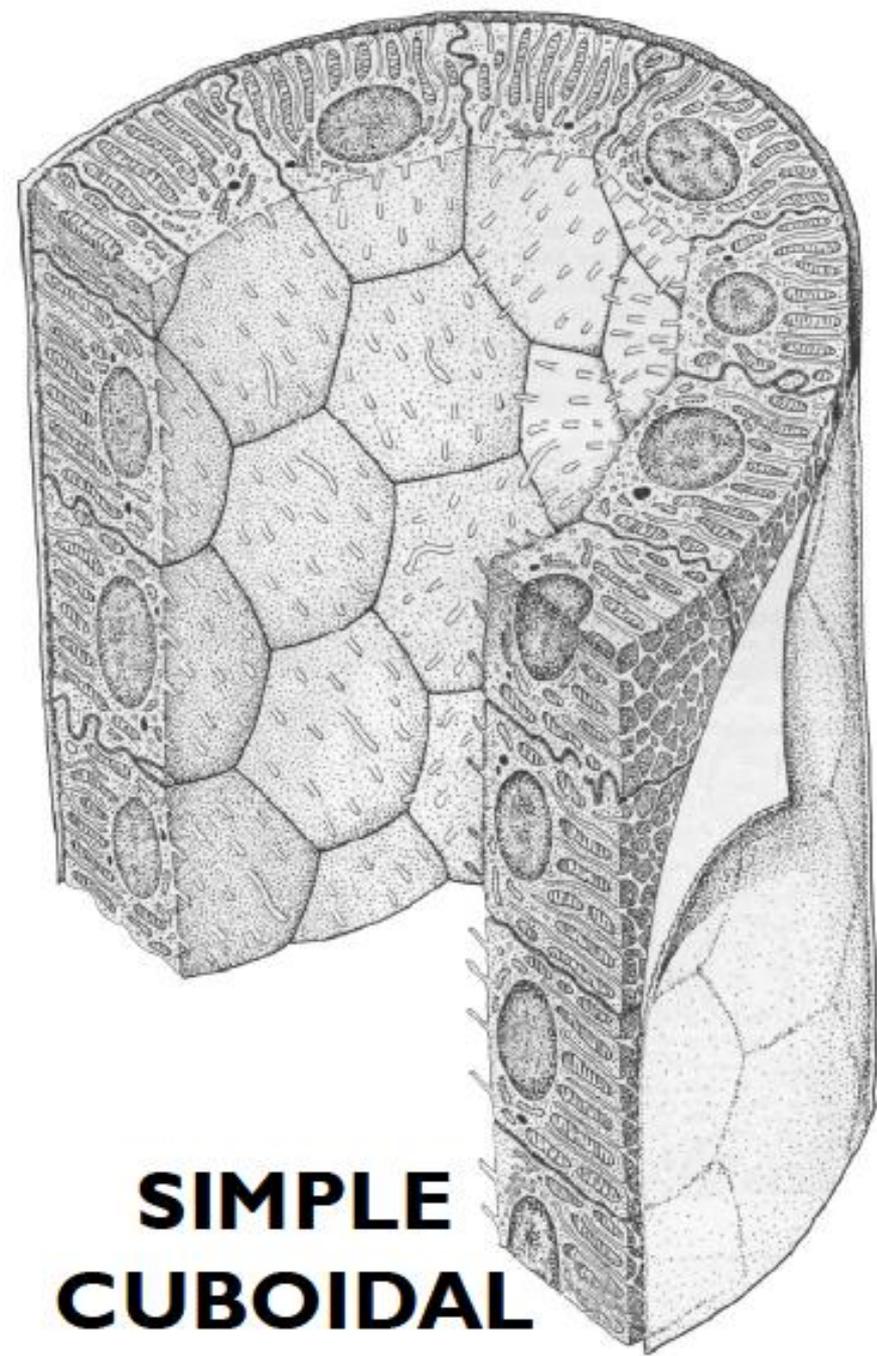
**SIMPLE SQUAMOUS
EPITHELIUM**

CLASSIFICATION OF C&L EPITHELIA BY SHAPE

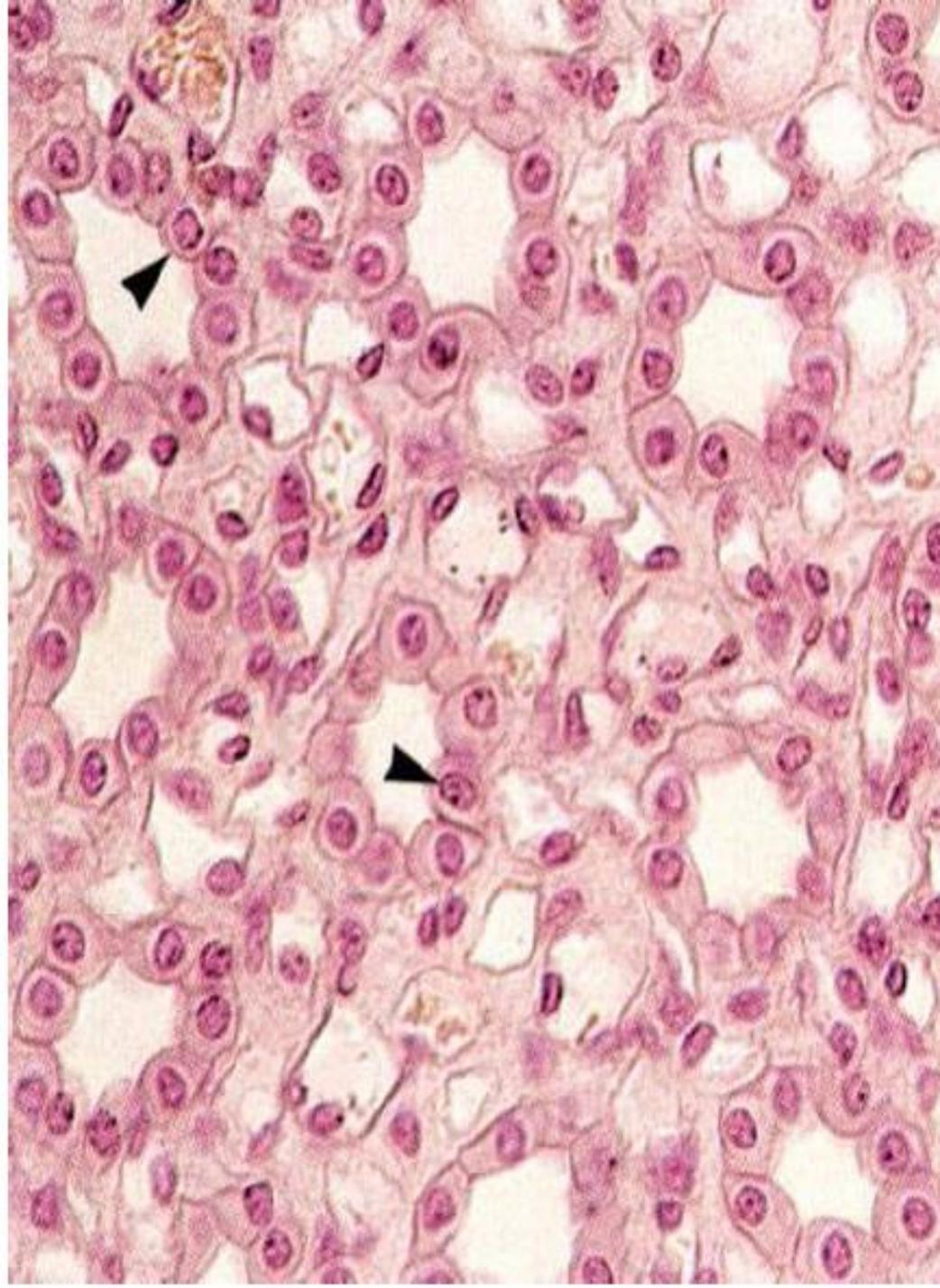
- **CUBOIDAL**

- Cells are **APPROXIMATELY** as tall as they are wide.
- **EXAMPLES:**
 - Lining of gland ducts
 - Walls of thyroid gland follicles





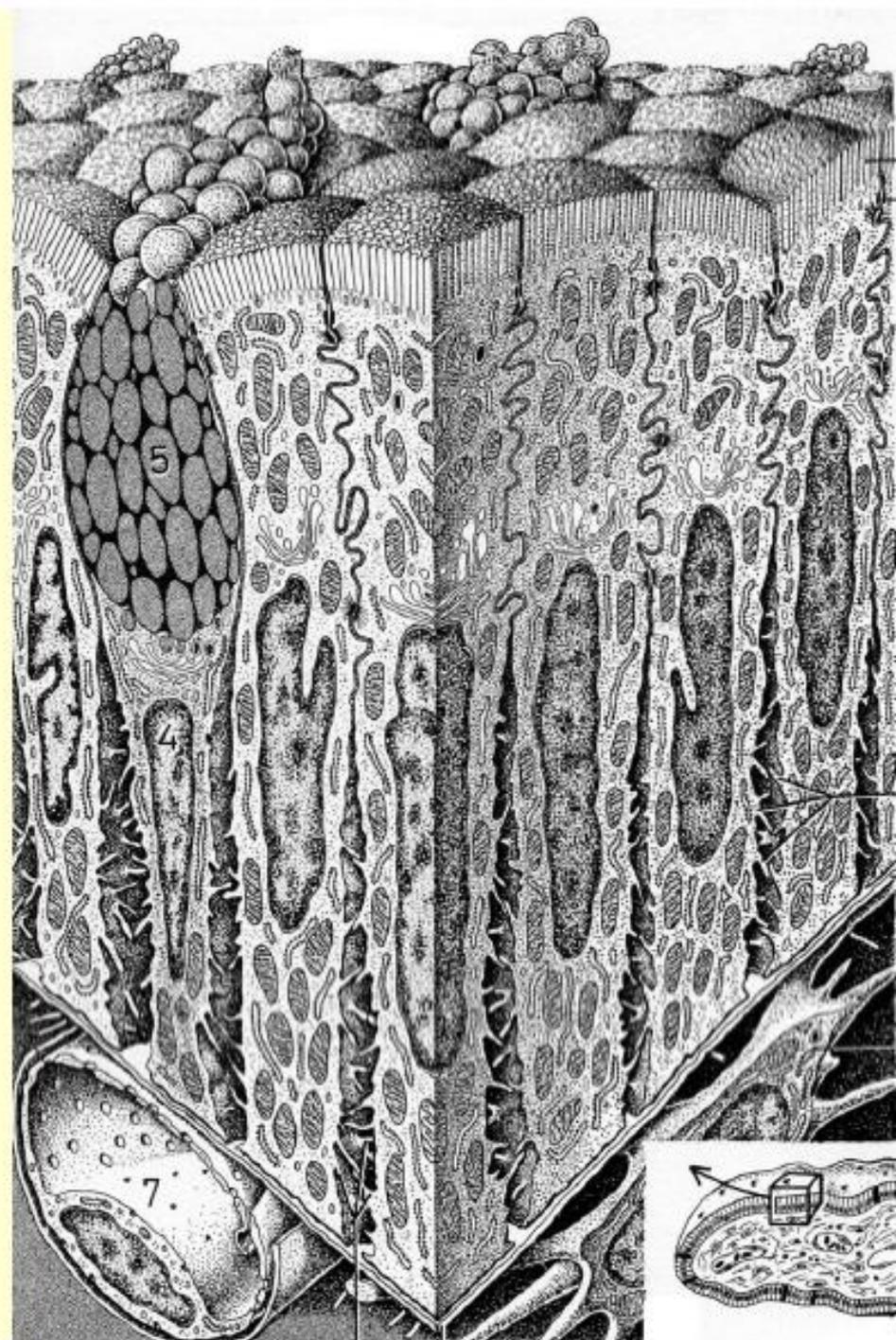
**SIMPLE
CUBOIDAL**

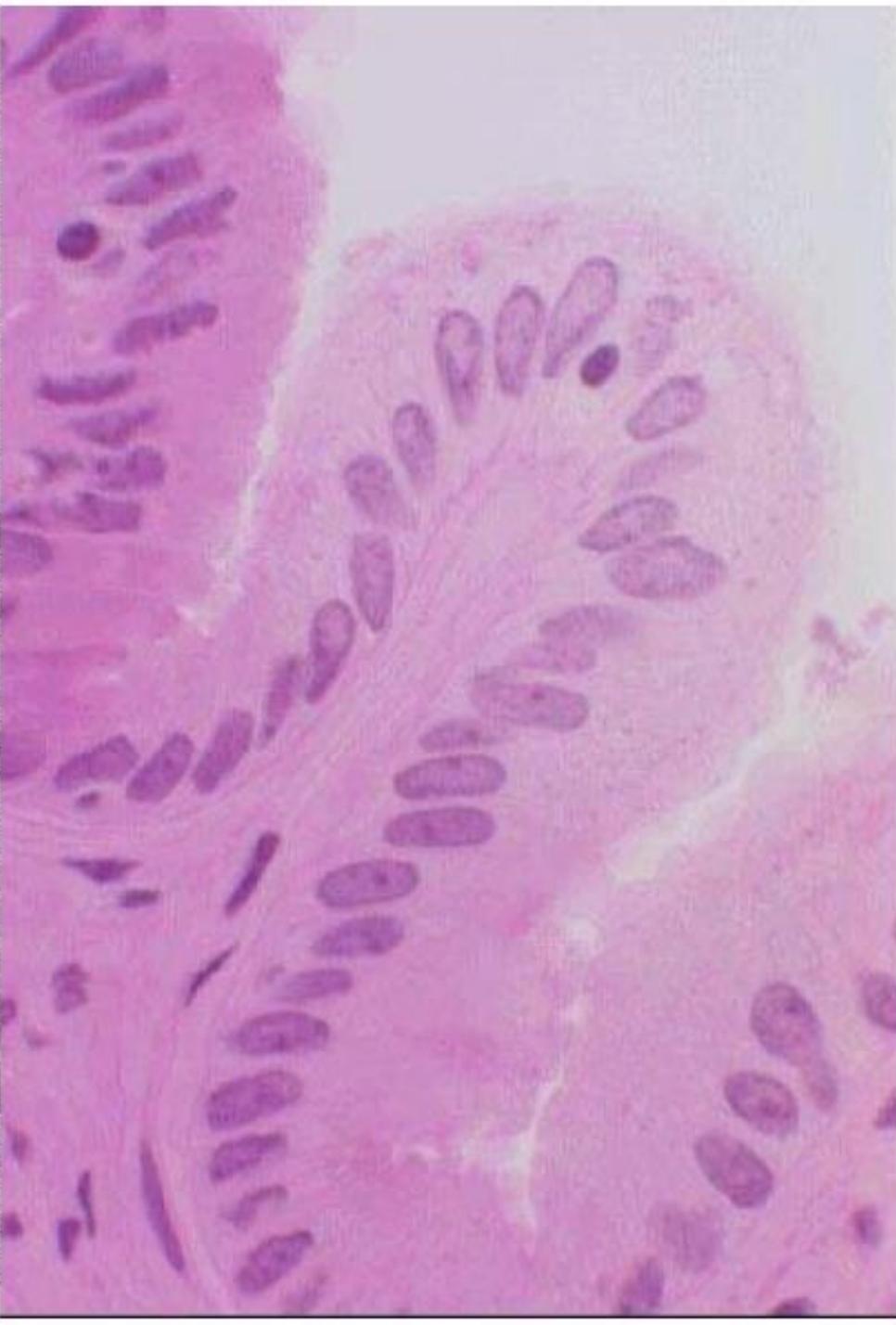
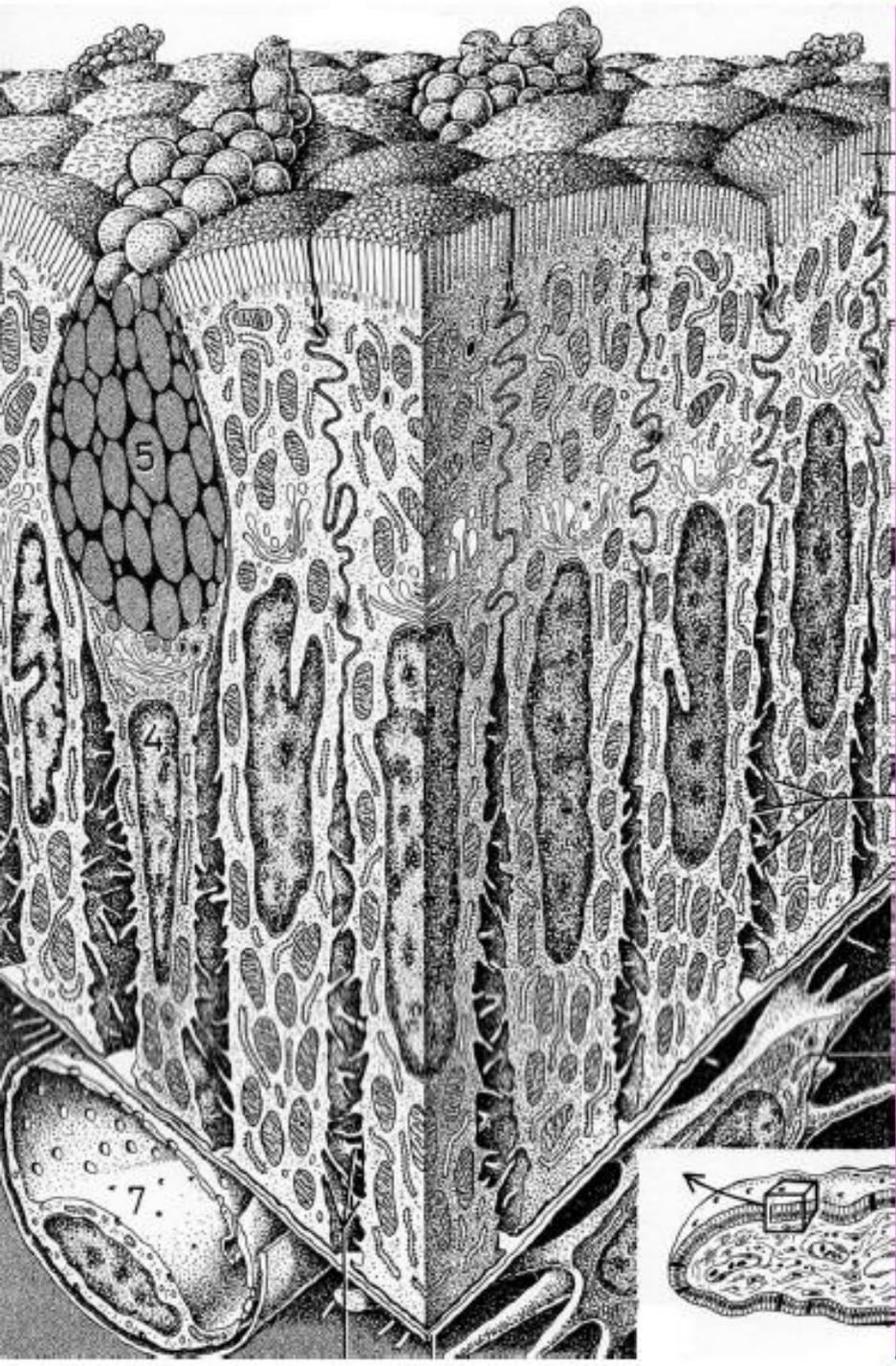


CLASSIFICATION OF C&L EPITHELIA BY SHAPE

COLUMNAR

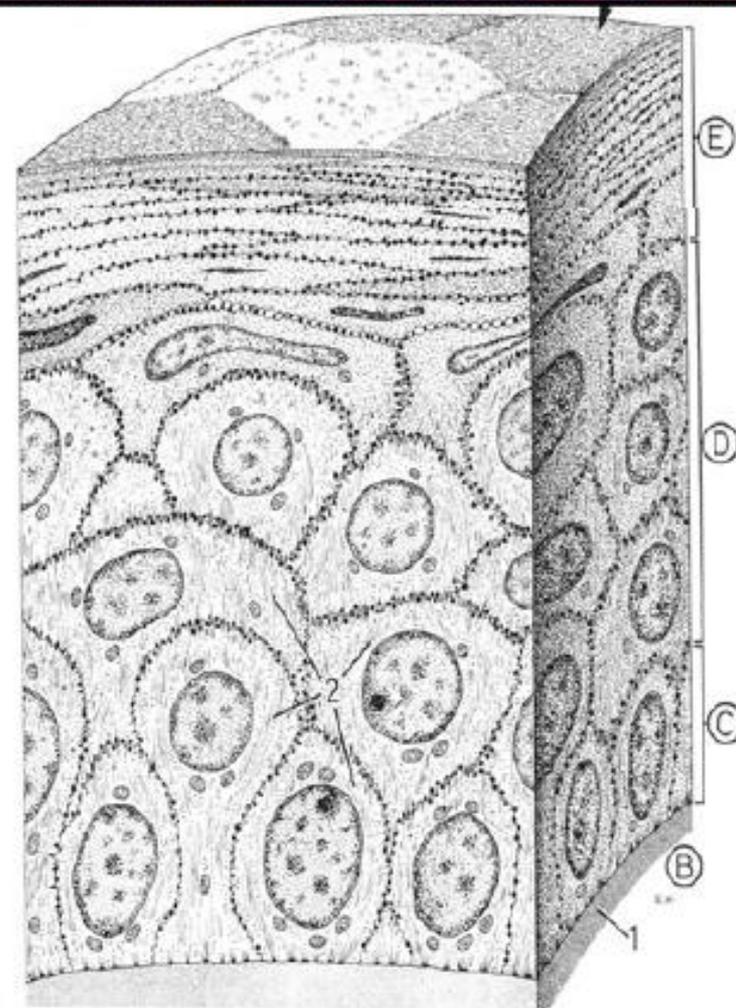
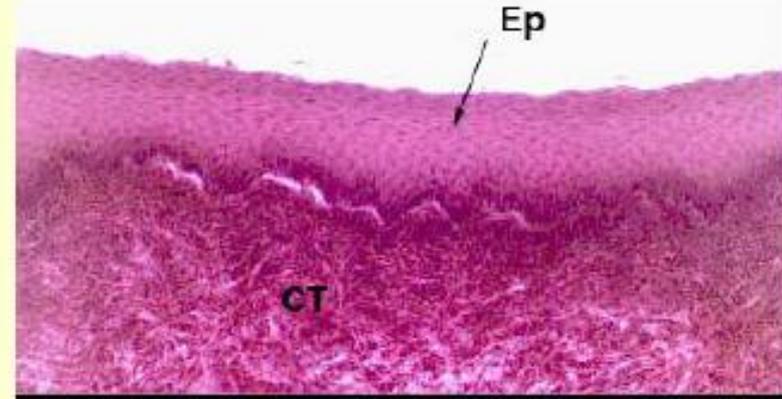
- Cells are distinctly taller than they are wide
 - EXAMPLES:
 - Lining of intestine
 - Some large gland ducts

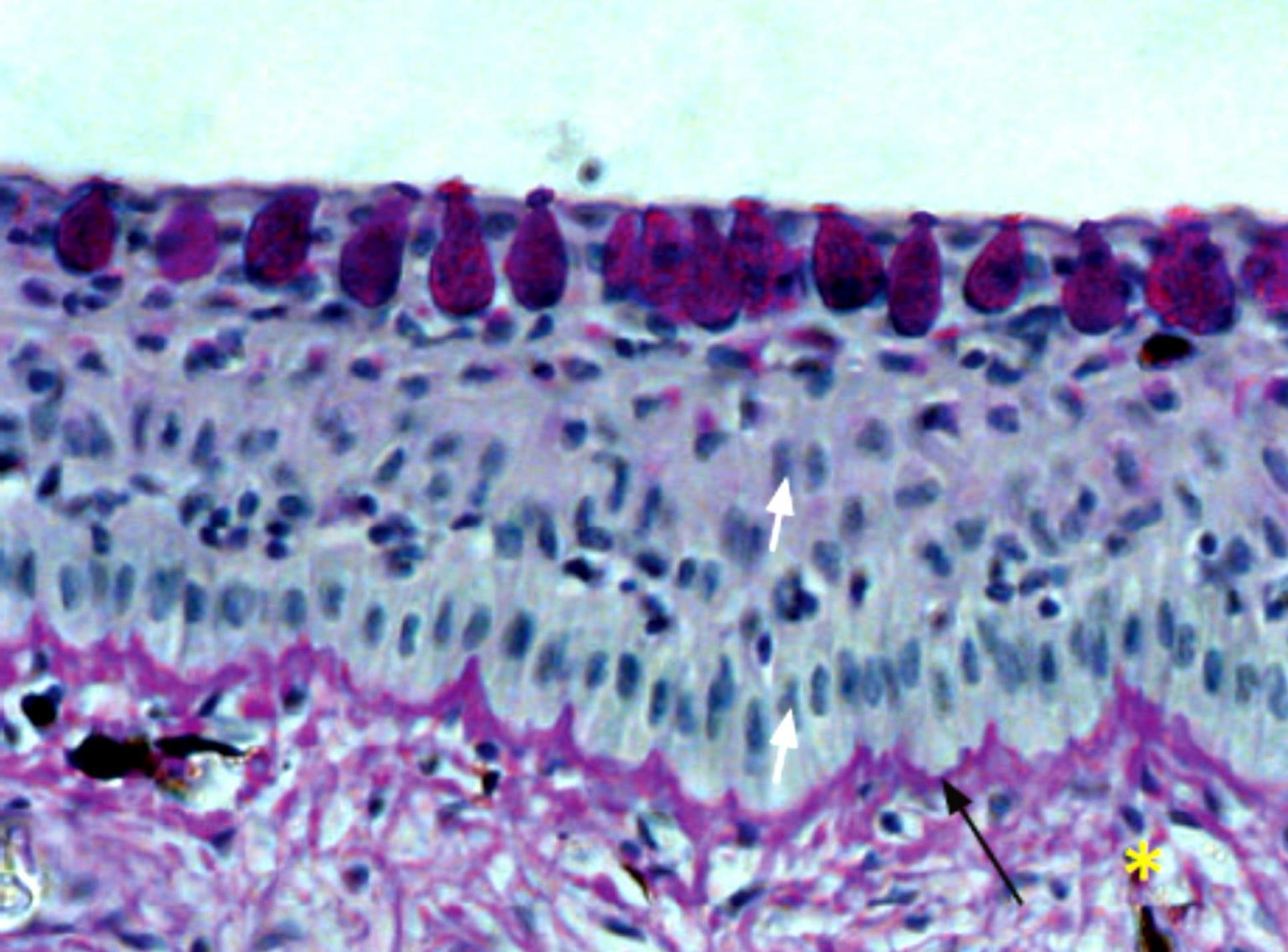


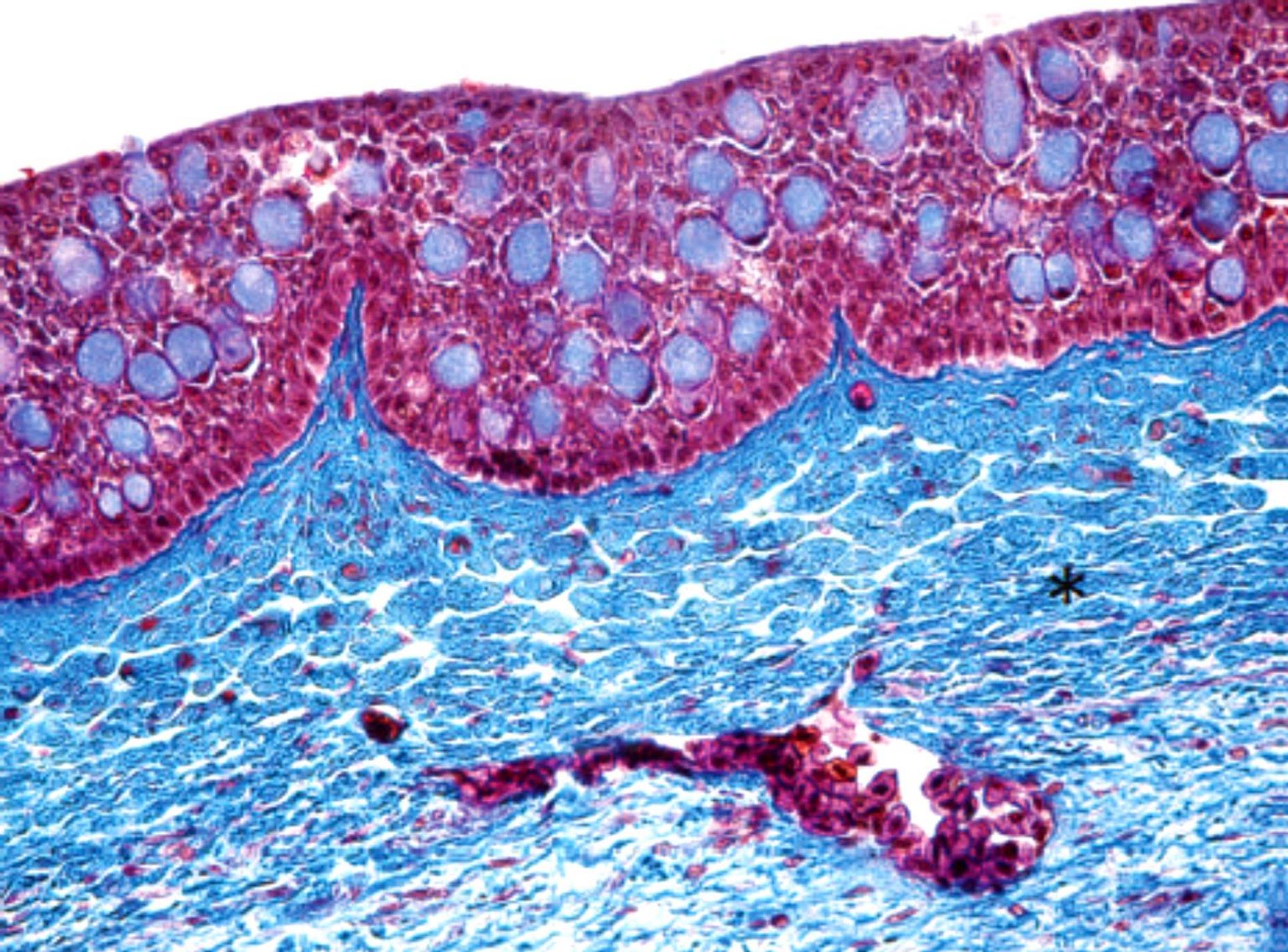


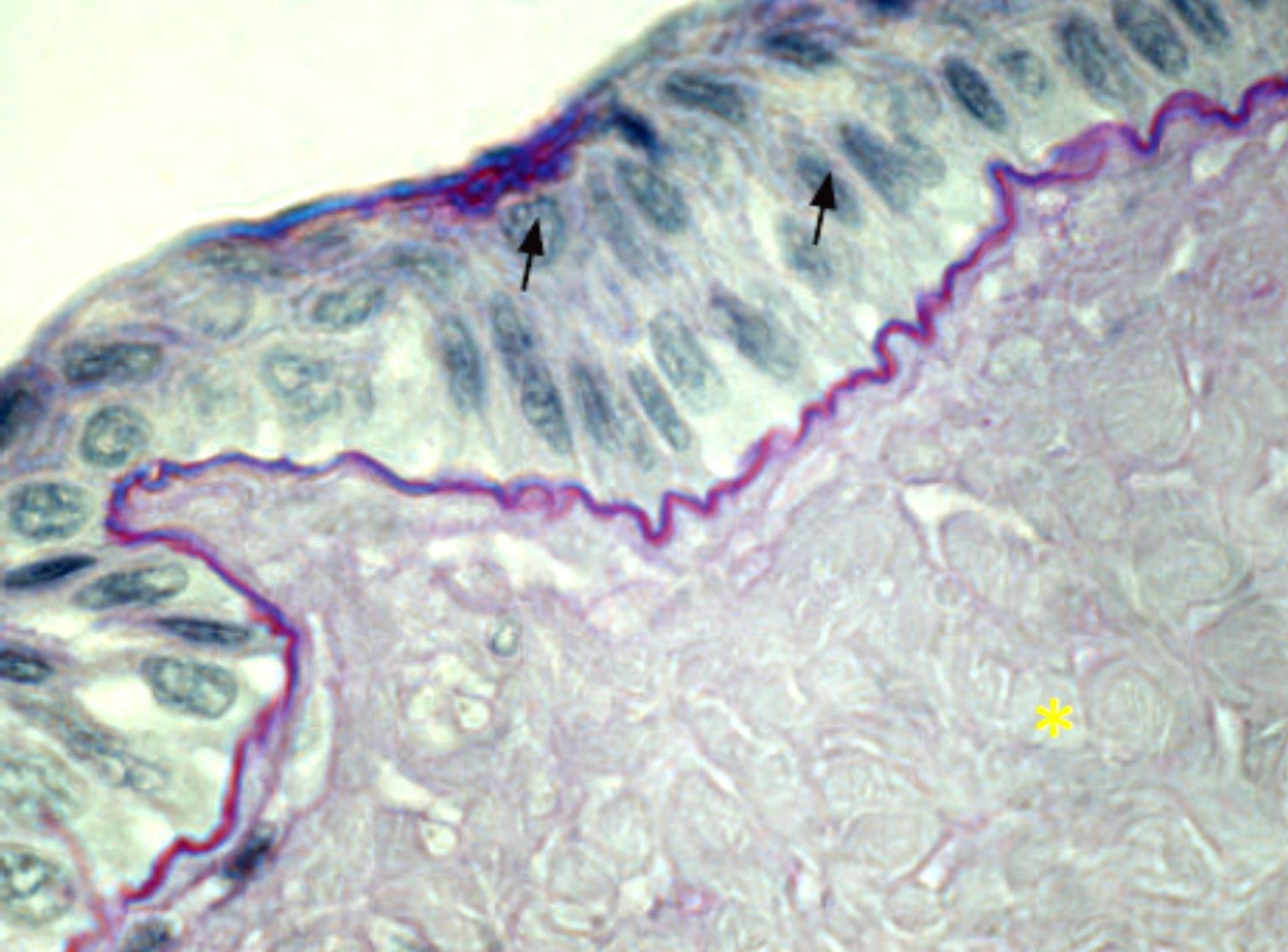
STRATIFIED SQUAMOUS

- More than one layer!
 - TOP layer is squamous
- Very common
 - Epidermis of the skin
 - Lining of bodily orifices
- Often found in regions of heavy wear
 - May be hardened or cornified (keratinized)





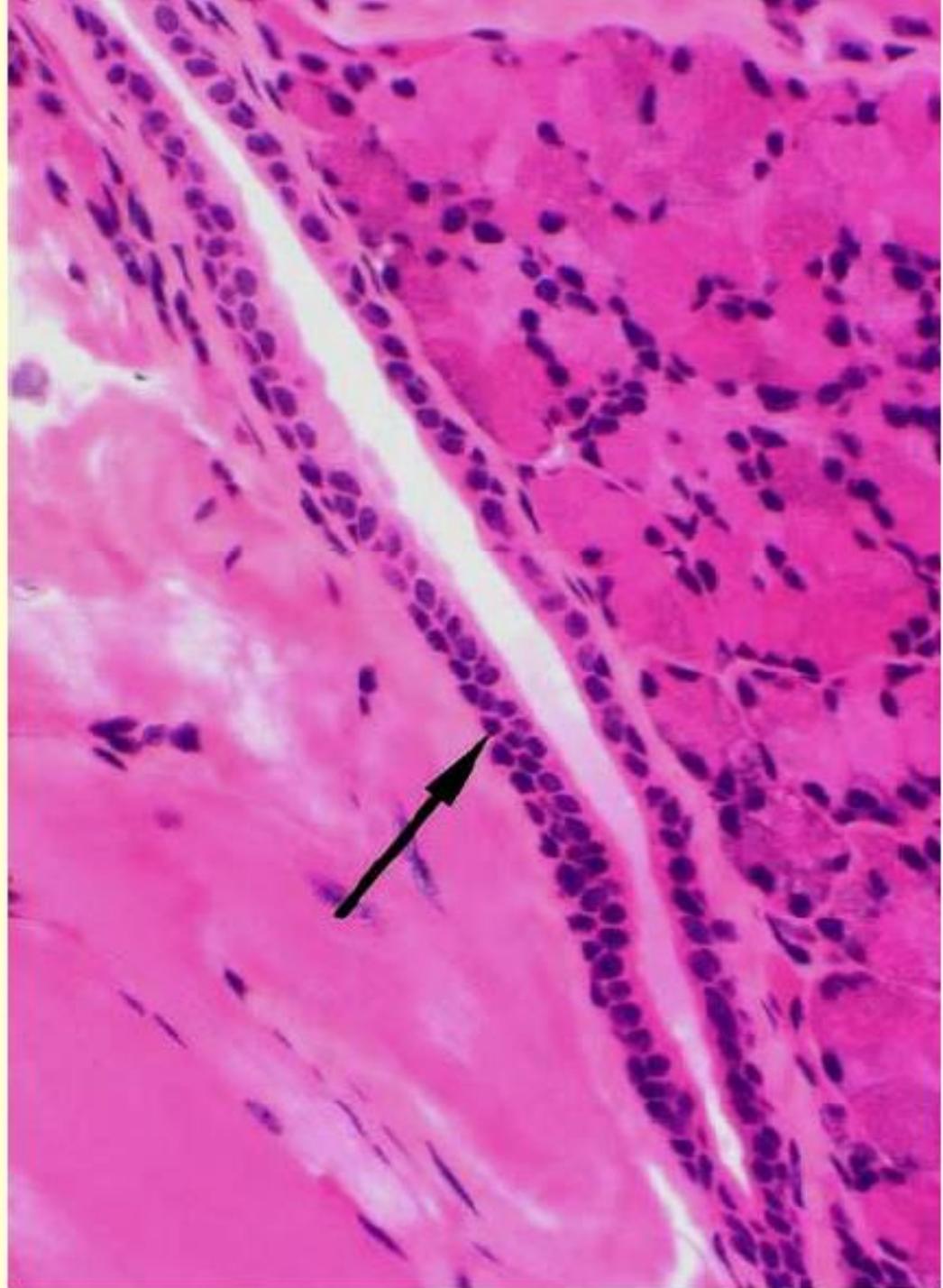




**STRATIFIED
CUBOIDAL
OR
COLUMNAR**

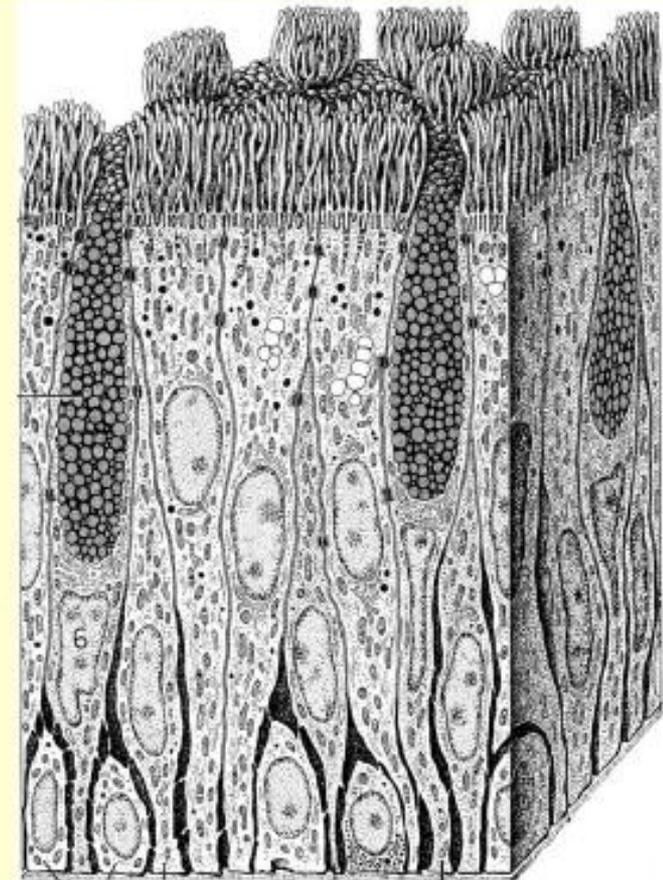
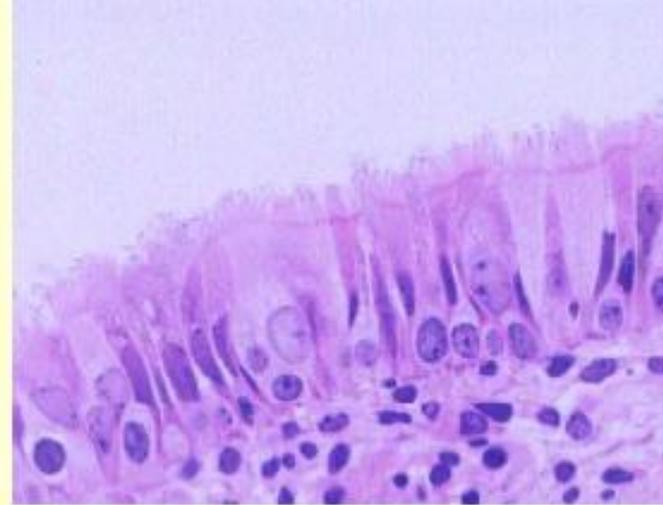
**Lining of
larger gland
ducts**

**Repro tract in
some animals**



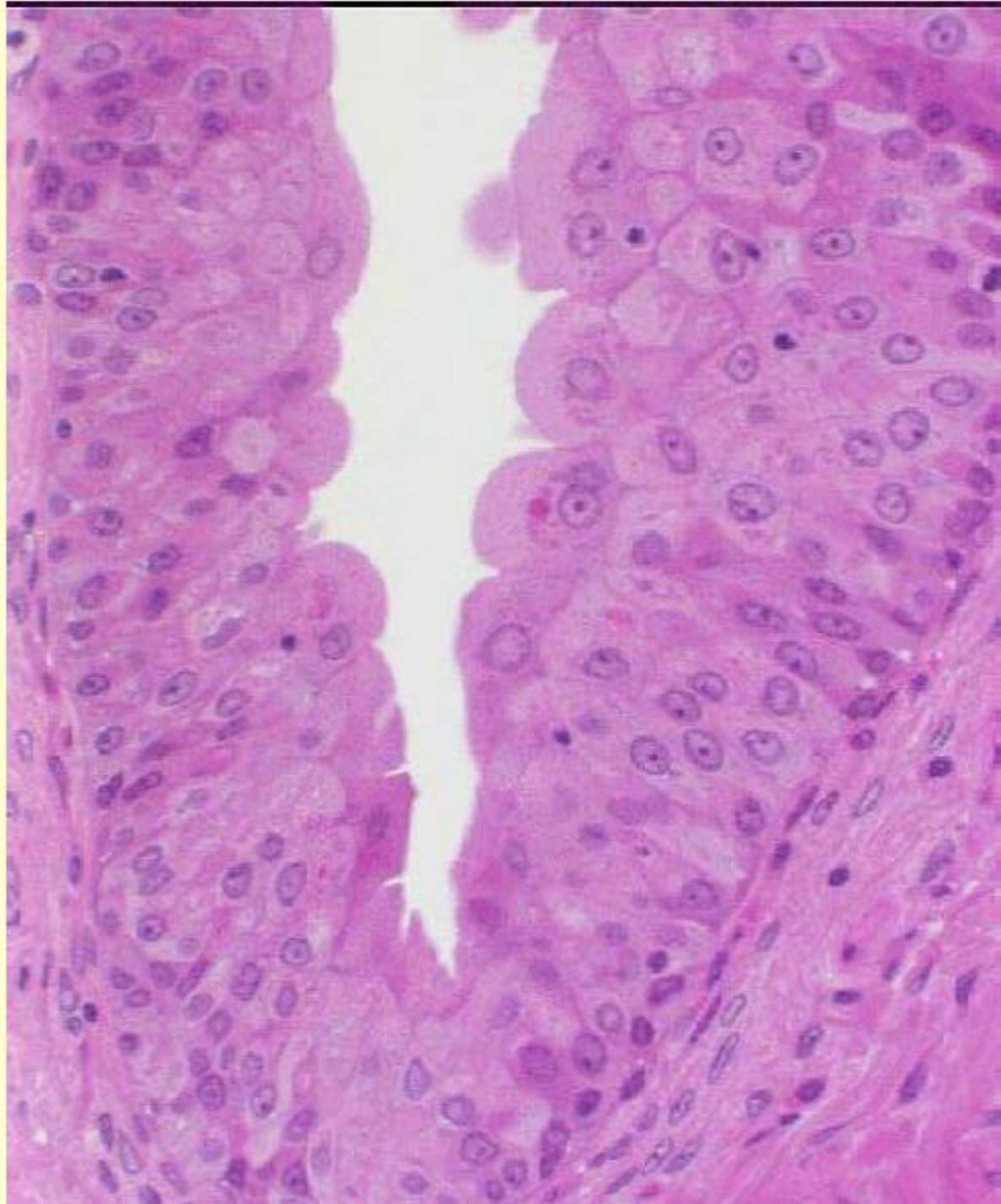
SPECIAL TYPES: PSEUDOSTRATIFIED

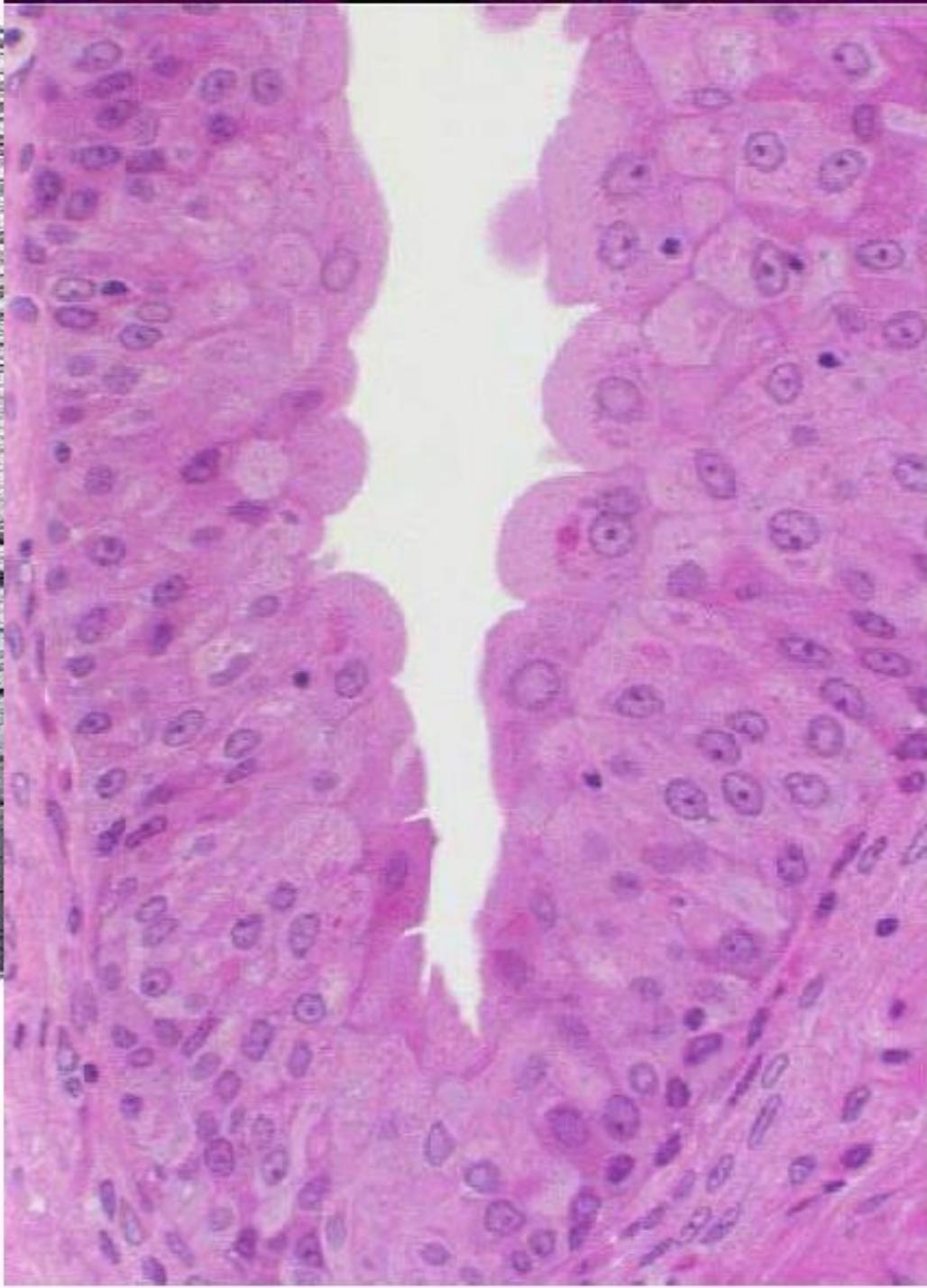
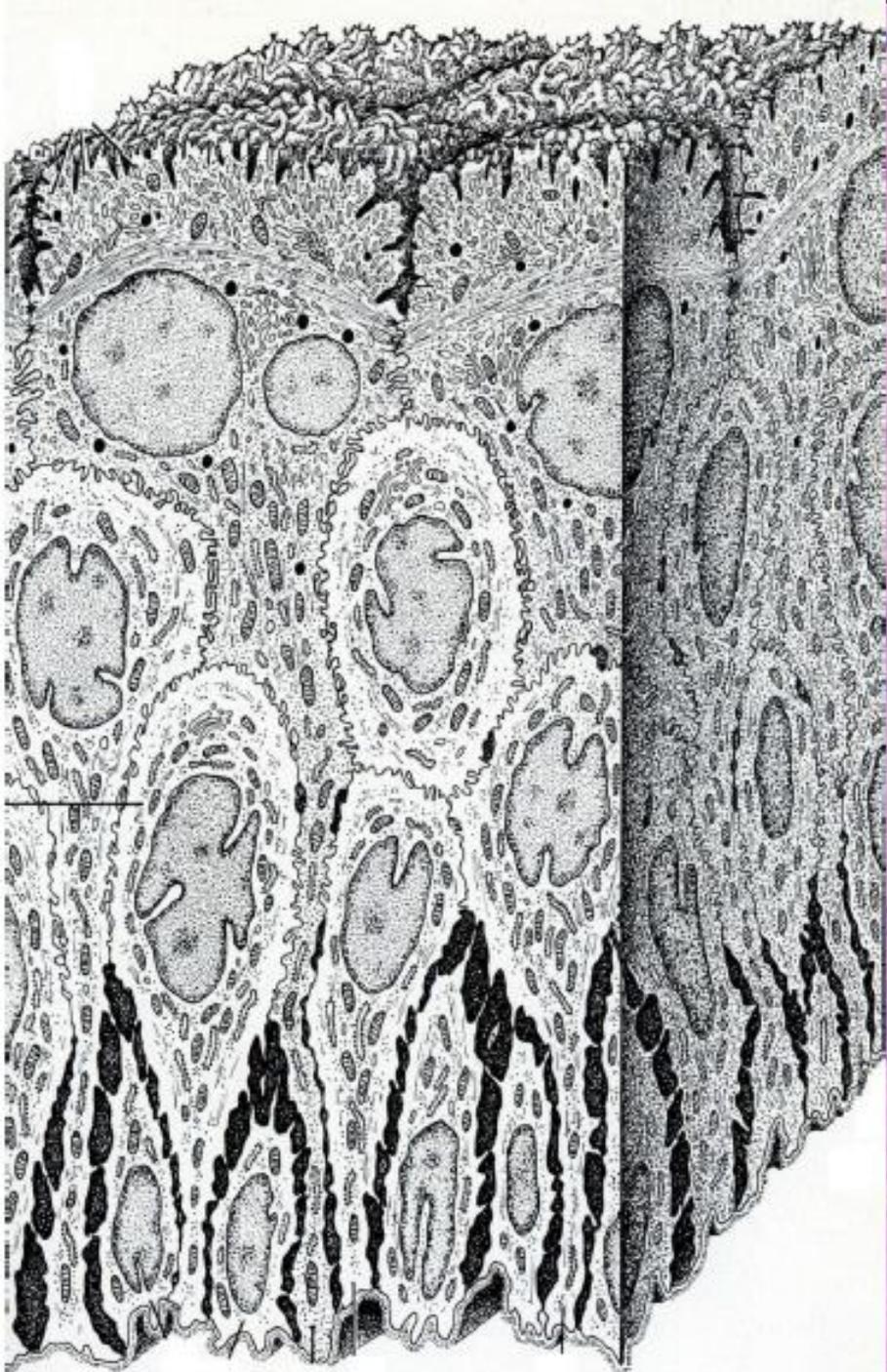
- Principally in respiratory tract, but also in other locations
- *Not all cells reach free surface*
- *All cells reach basement membrane*
- Truly a “simple” type
- **NOT “always ciliated”!**



SPECIAL TYPES: URINARY

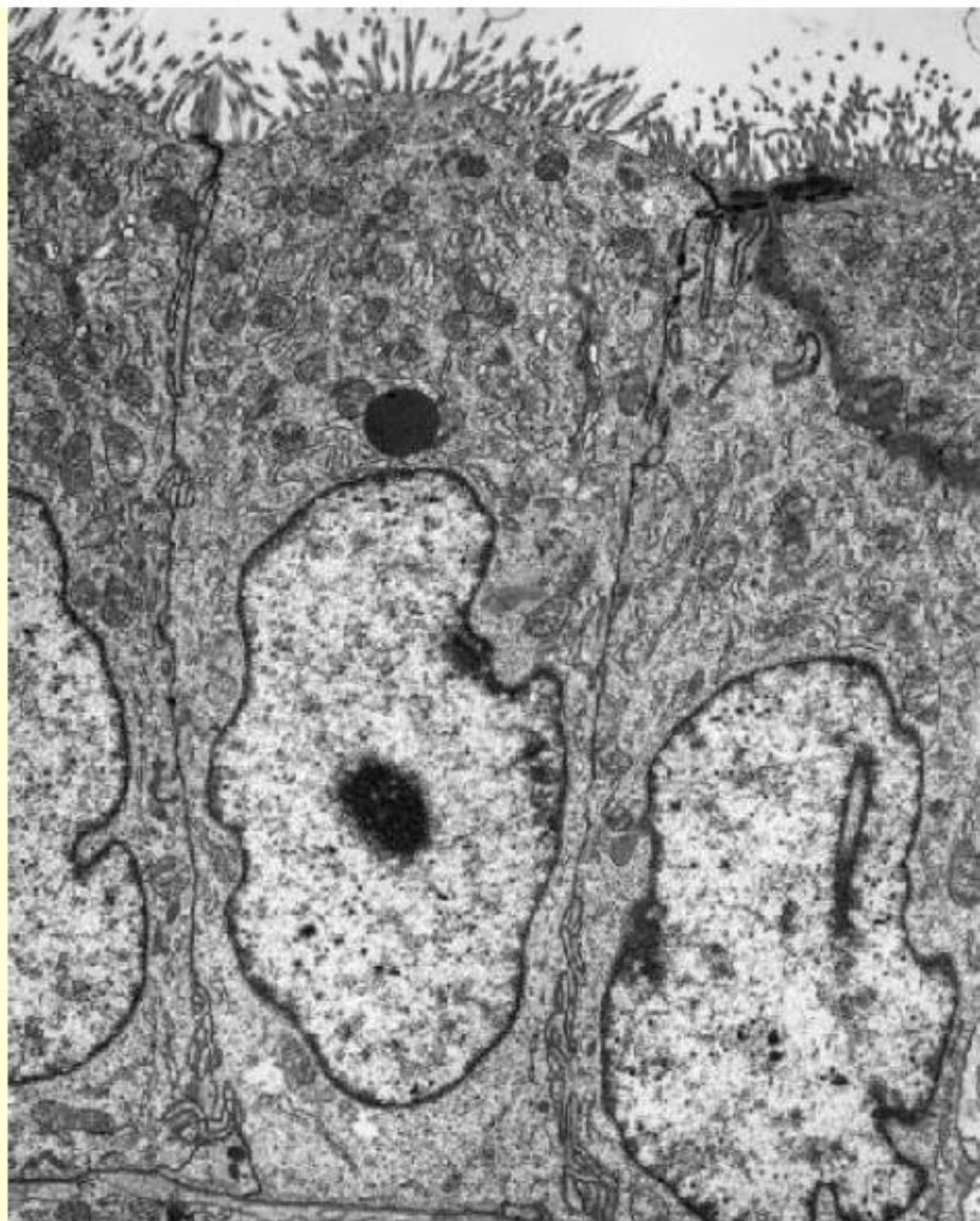
- **Found only in urinary passages**
- **A “tight” epithelium with many occluding junctions**
- **A truly stratified type**





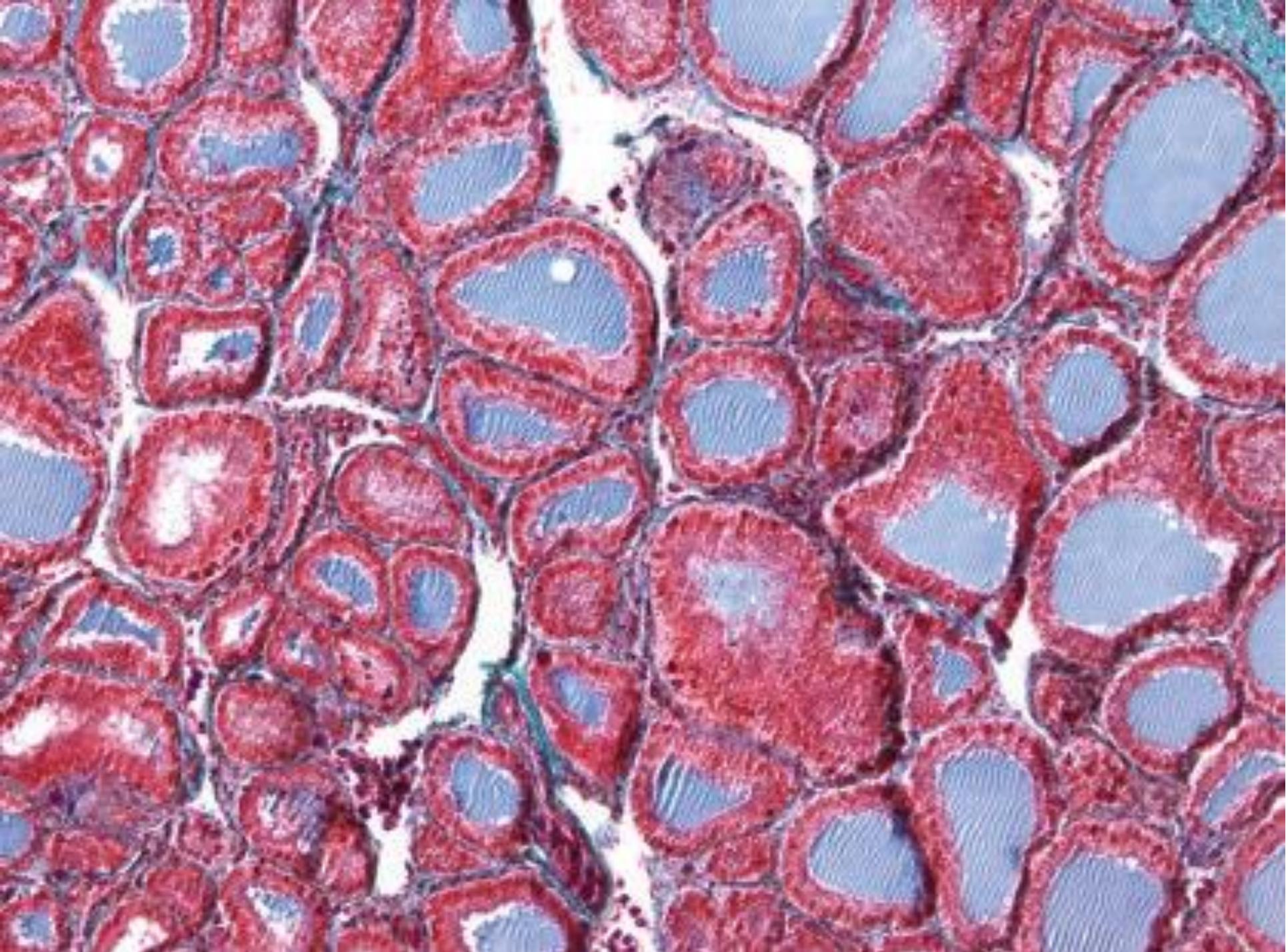
Microvilli

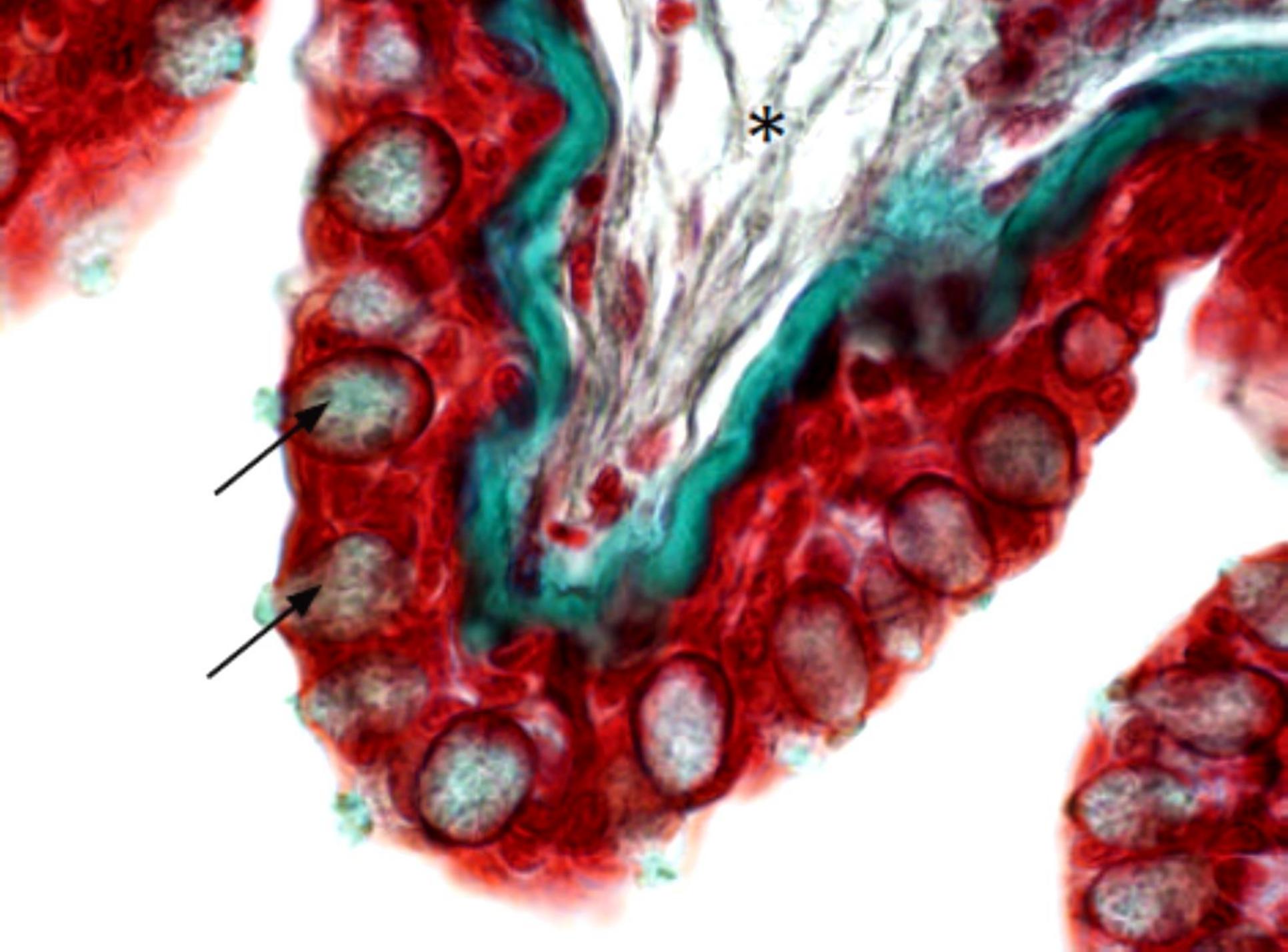
- Found on many cell types; often on epithelial sheets
- Associated with secretion or absorption function
- “Brush border” or “striated border” in LM



STRUCTURAL CLASSIFICATION OF EXOCRINE (DUCTED) GLANDS

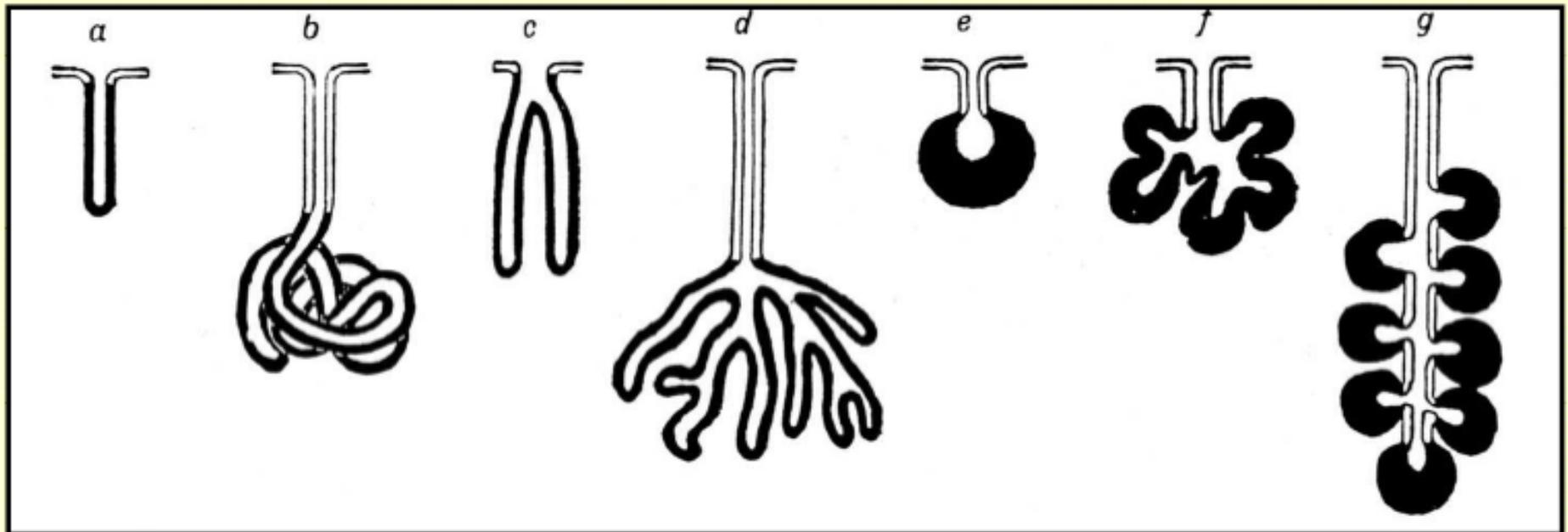
- **BASED ON TWO CRITERIA**
 - **SHAPE OF SECRETORY REGION**
 - Tubular
 - Coiled tubular
 - Acinar/alveolar
 - Tubuloacinar
 - **DEGREE OF DIVISION OF DUCTWORK**
 - Simple
 - Compound
 - “Compound” is NOT = “Branched”

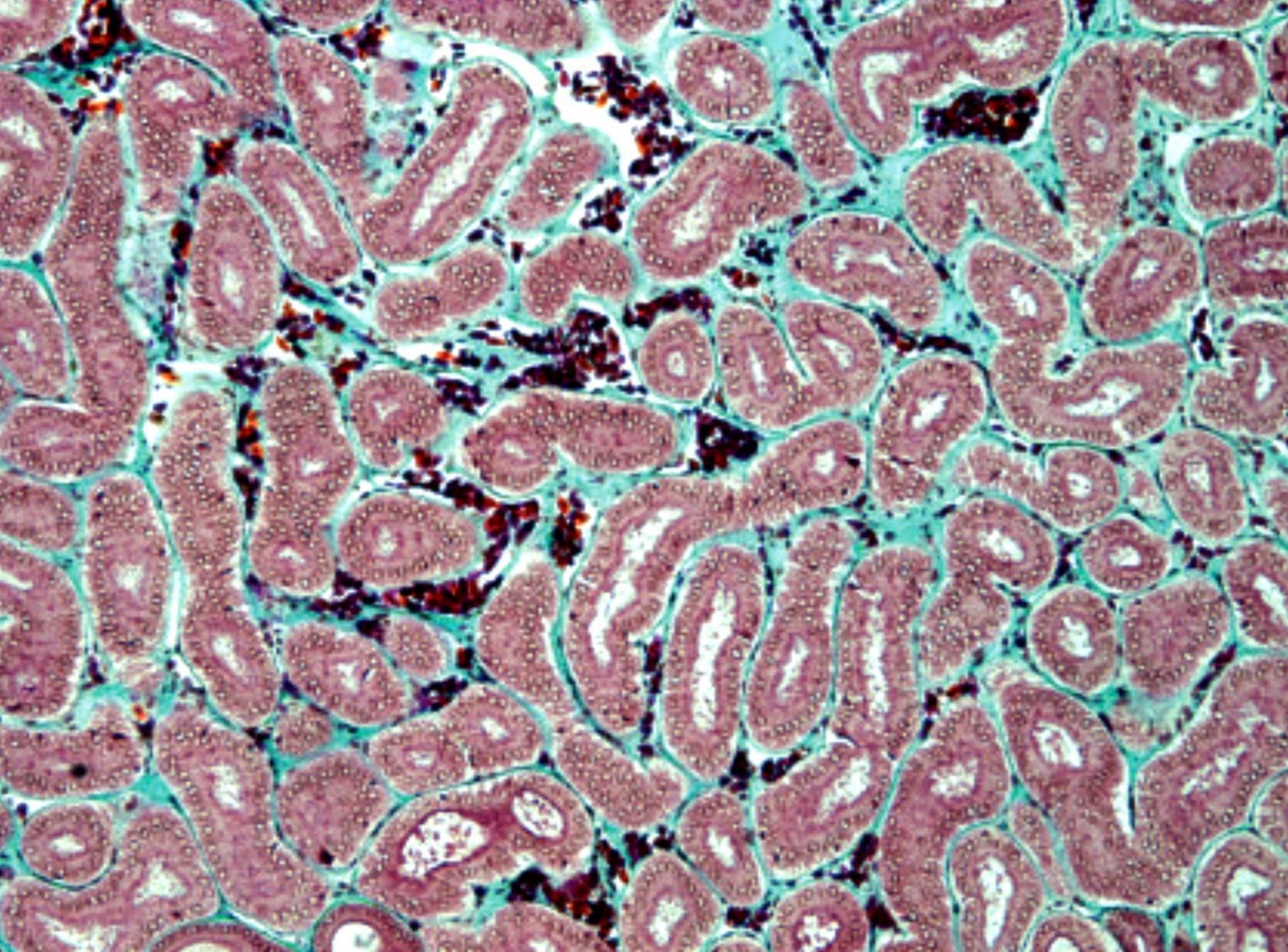




SIMPLE EXOCRINE GLANDS

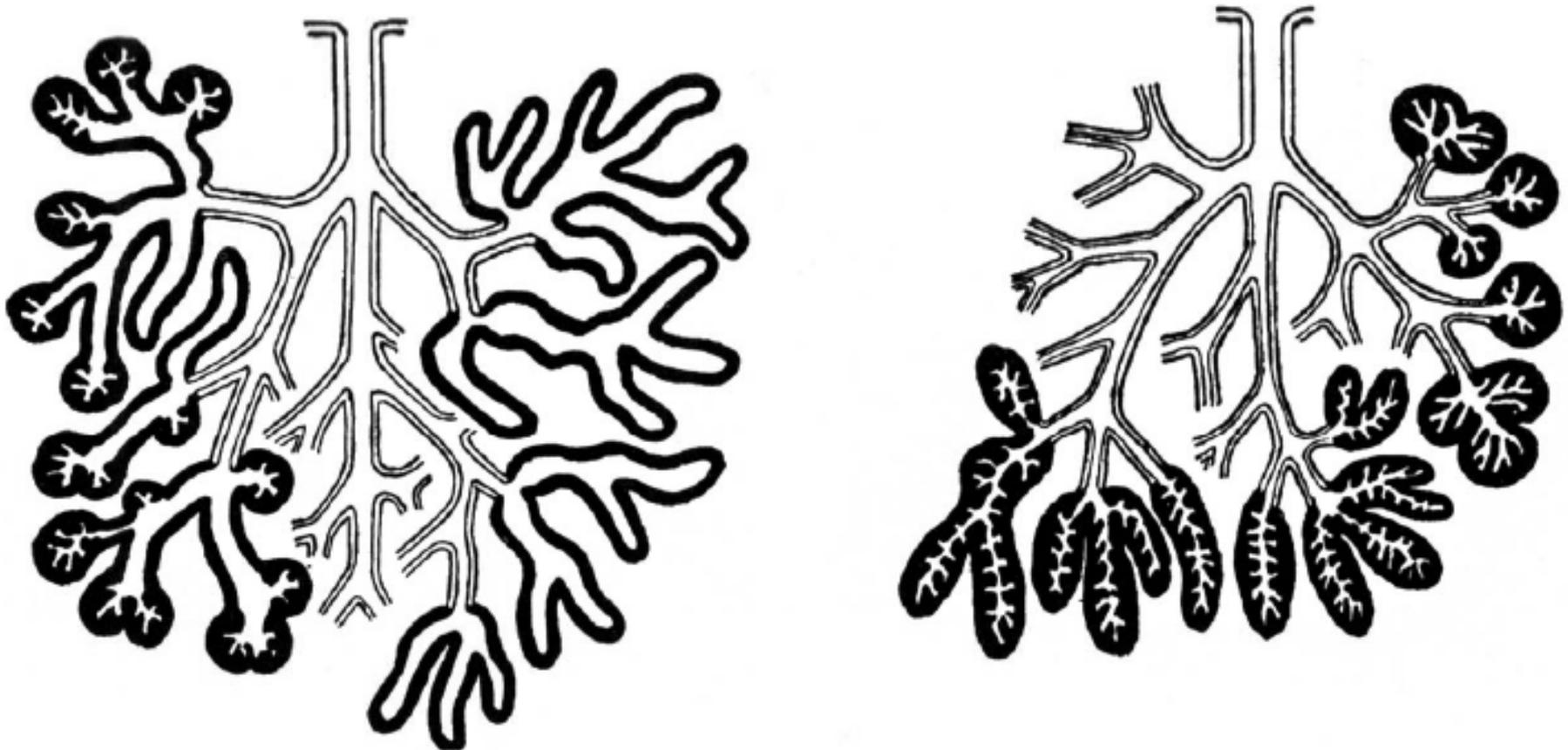
- Duct is **NOT** divided
- Secretory Region **MAY** be divided =
“Branched”





COMPOUND EXOCRINE GLANDS

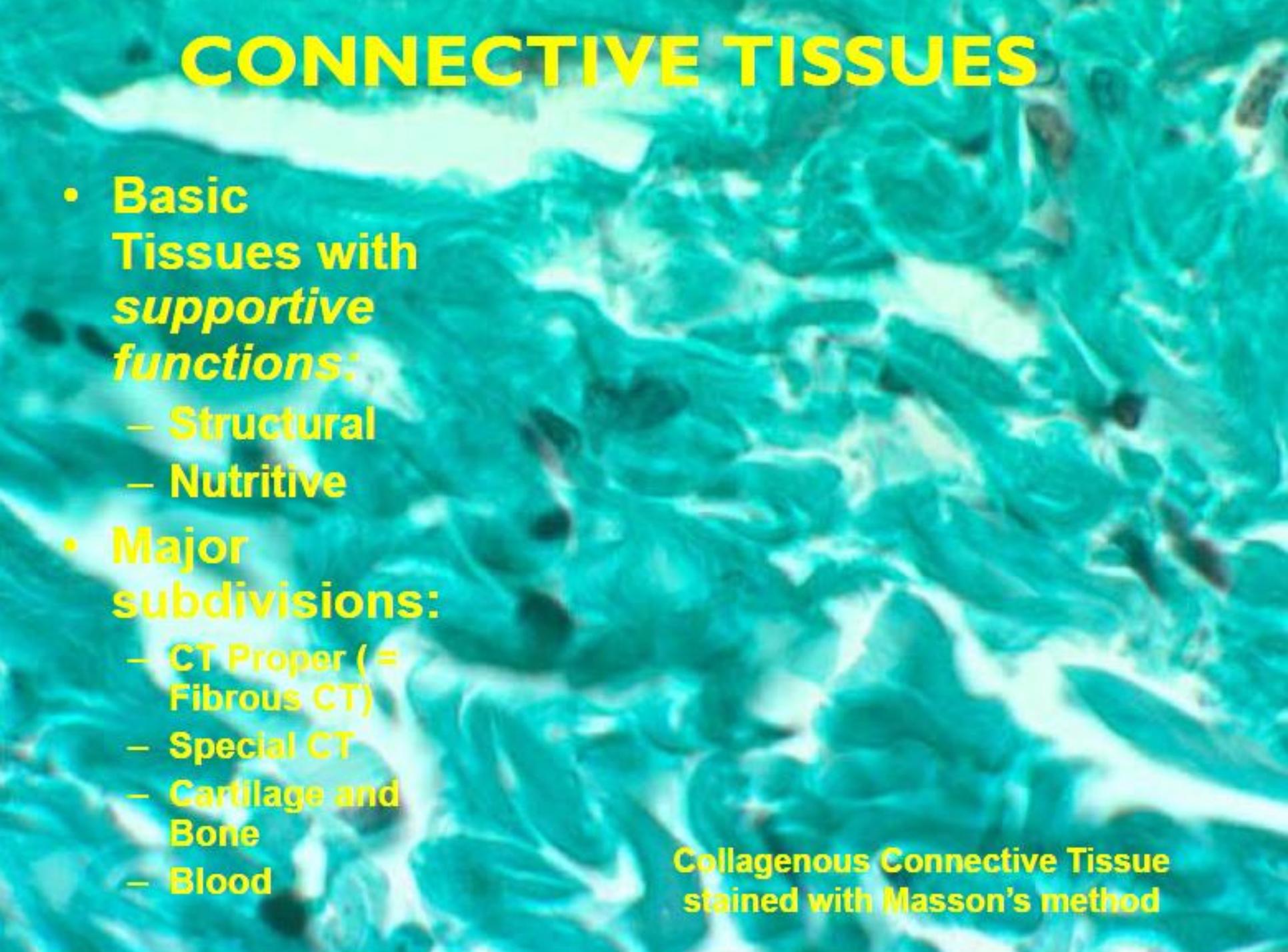
- **DUCT** is divided = “Compound”
- **Secretory region** usually divided





**CONNECTIVE TISSUES I:
PROPER & SPECIAL CT**

CONNECTIVE TISSUES



- **Basic Tissues with *supportive functions*:**
 - Structural
 - Nutritive
- **Major subdivisions:**
 - CT Proper (= Fibrous CT)
 - Special CT
 - Cartilage and Bone
 - Blood

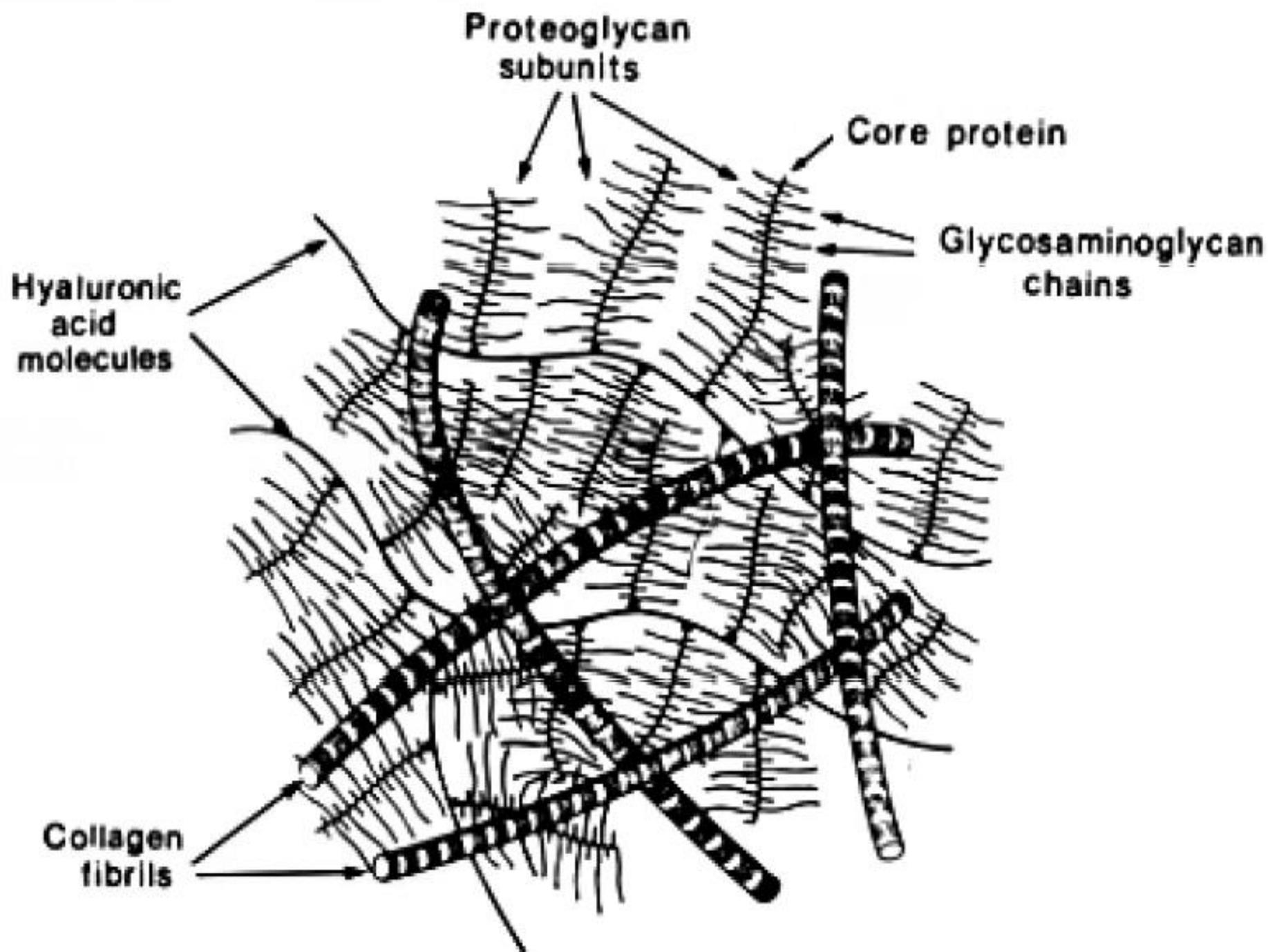
**Collagenous Connective Tissue
stained with Masson's method**

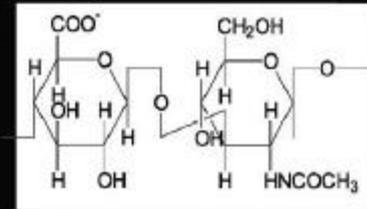
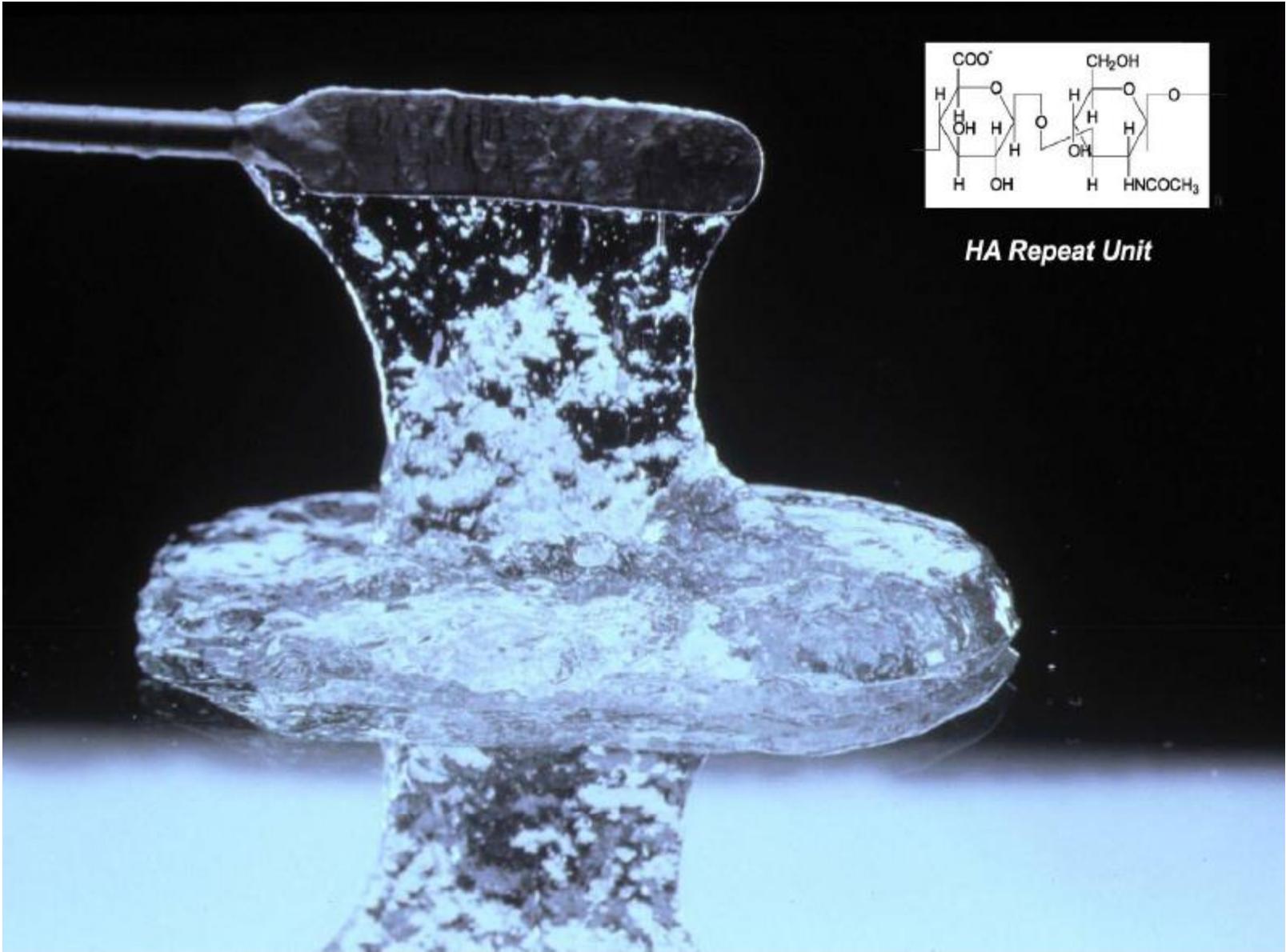
COMPONENTS OF CT

- All CT's have three components:
 - Extracellular *Matrix*
 - Extracellular *Fibers*
 - Characteristic cell types
- Proportions vary widely
 - Ratio determines properties
- *All CT's have similar components and share cell types*

THE MATRIX

- **Fibrillar components and cells *reside in an amorphous matrix***
 - **Produced by CT cells**
 - **Usually a viscous liquid or gel**
 - **Invariably contains glycoproteins and/or proteoglycans**
 - **Strongly PAS+**
 - **Most important component is hyaluronic acid**
 - **Fills interstices of the tissue**
 - **Barrier to bacteria**
 - **Shock absorber**





HA Repeat Unit

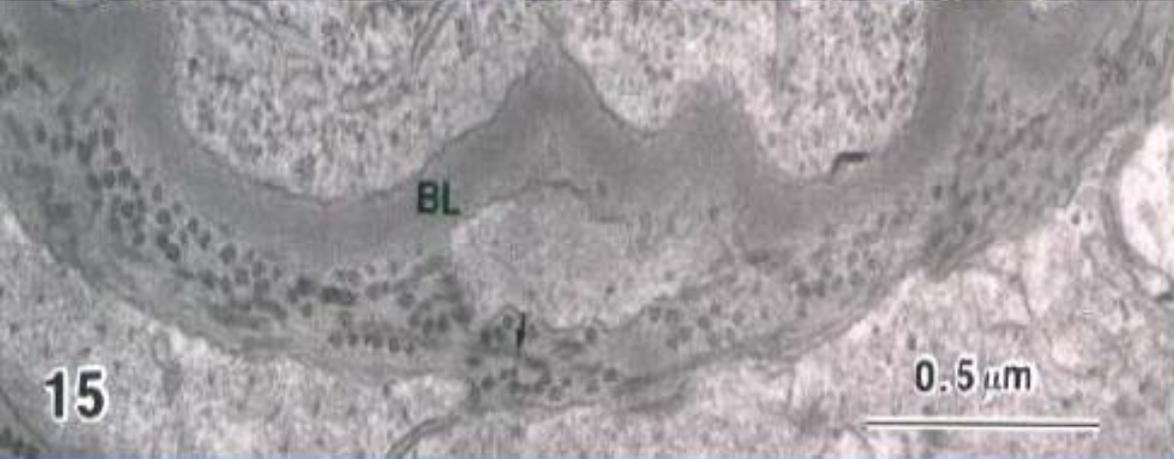
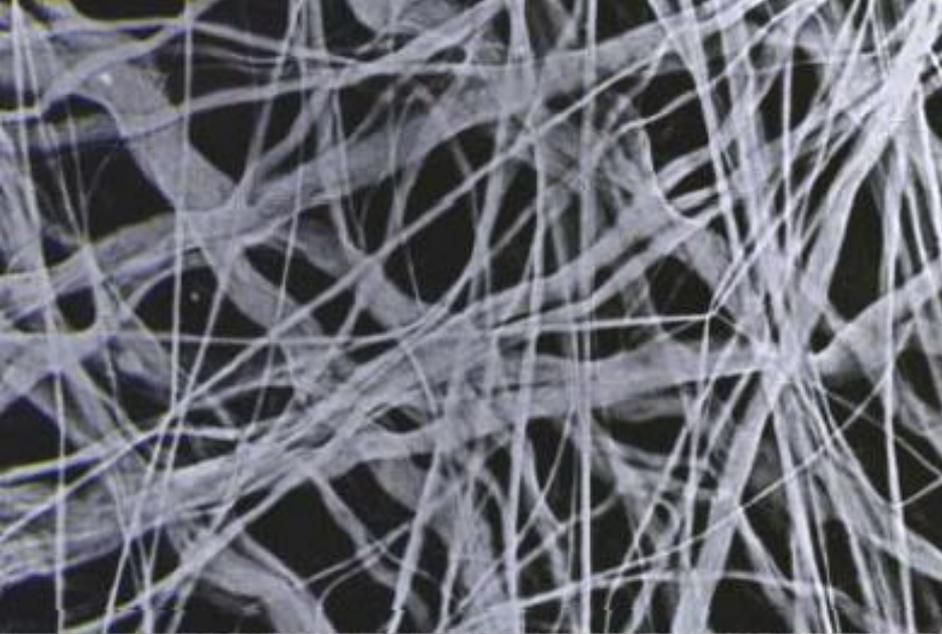
A microscopic image showing a dense network of fibers, likely collagen, in a connective tissue matrix. The fibers are stained and appear as a complex, interwoven structure. The text is overlaid on this image.

FIBERS OF CT'S

- **TWO PRINCIPAL TYPES**
 - **COLLAGEN**
 - “Reticular fibers”
 - A subdivision
- **ELASTIC FIBERS**

COLLAGEN

- Most common protein in animals
- Present in all CT's to some extent
- Many different types known
- Confers strength and tearing resistance to CT's
- Most types have a typical appearance in EM as "banded" fibrils

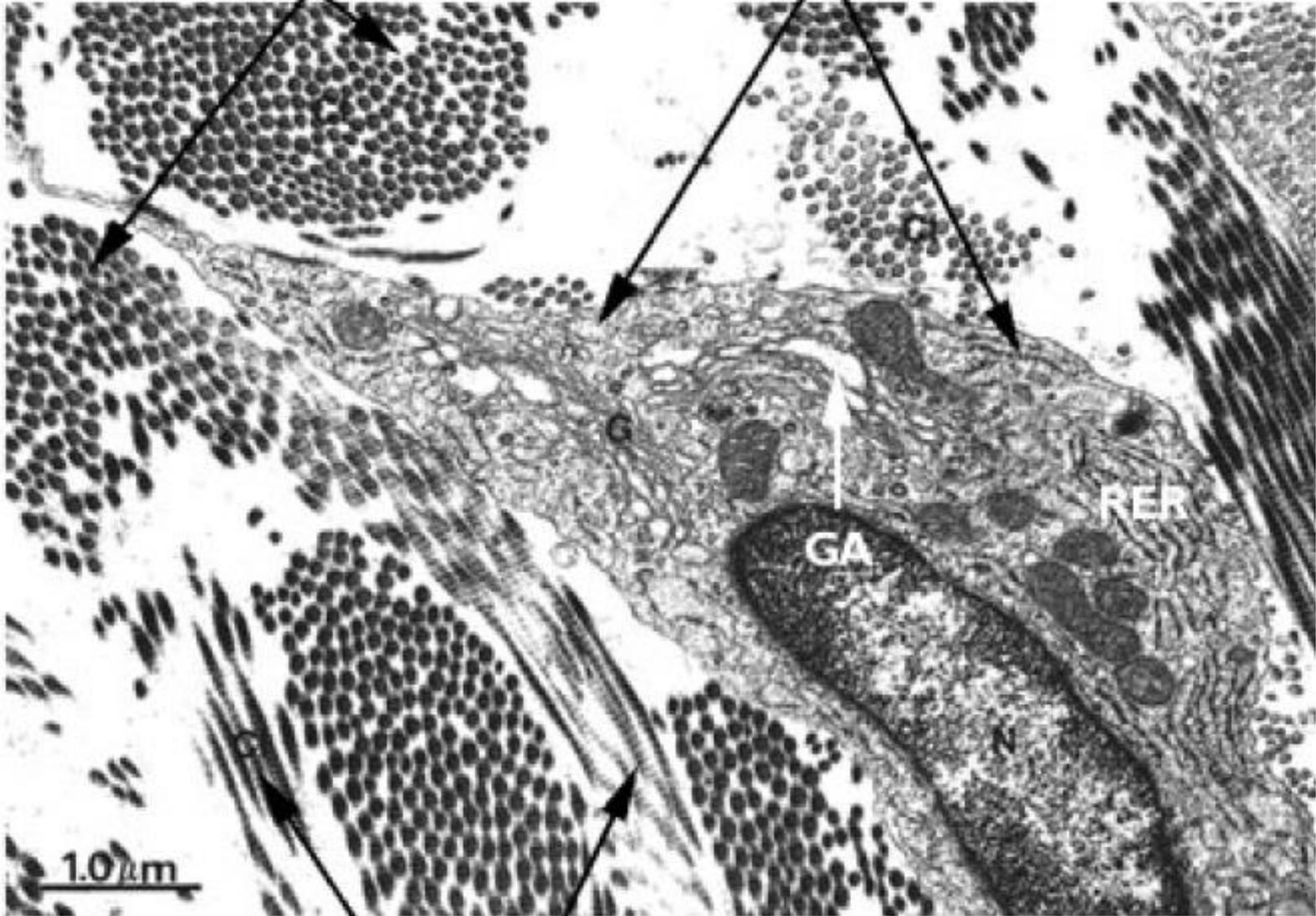


COLLAGEN TYPES
Clockwise from upper left,
Type I, Type III, Type IV

- **Type I: most abundant; skin, bone, tendon, Type II: unbanded; found in cartilage**
- **Type III: “Reticular fibers”**
- **Type IV: unbanded; major component of basement membranes**

Collagen fibers in cross-section

Fibroblast in active state



Collagen fibers in longitudinal section

“RETICULAR FIBERS”

A high-magnification light micrograph showing a dense network of dark-stained reticular fibers. The fibers form a complex, interconnected web-like structure. Several larger, dark-stained structures, possibly nuclei or other cellular components, are scattered throughout the field of view.

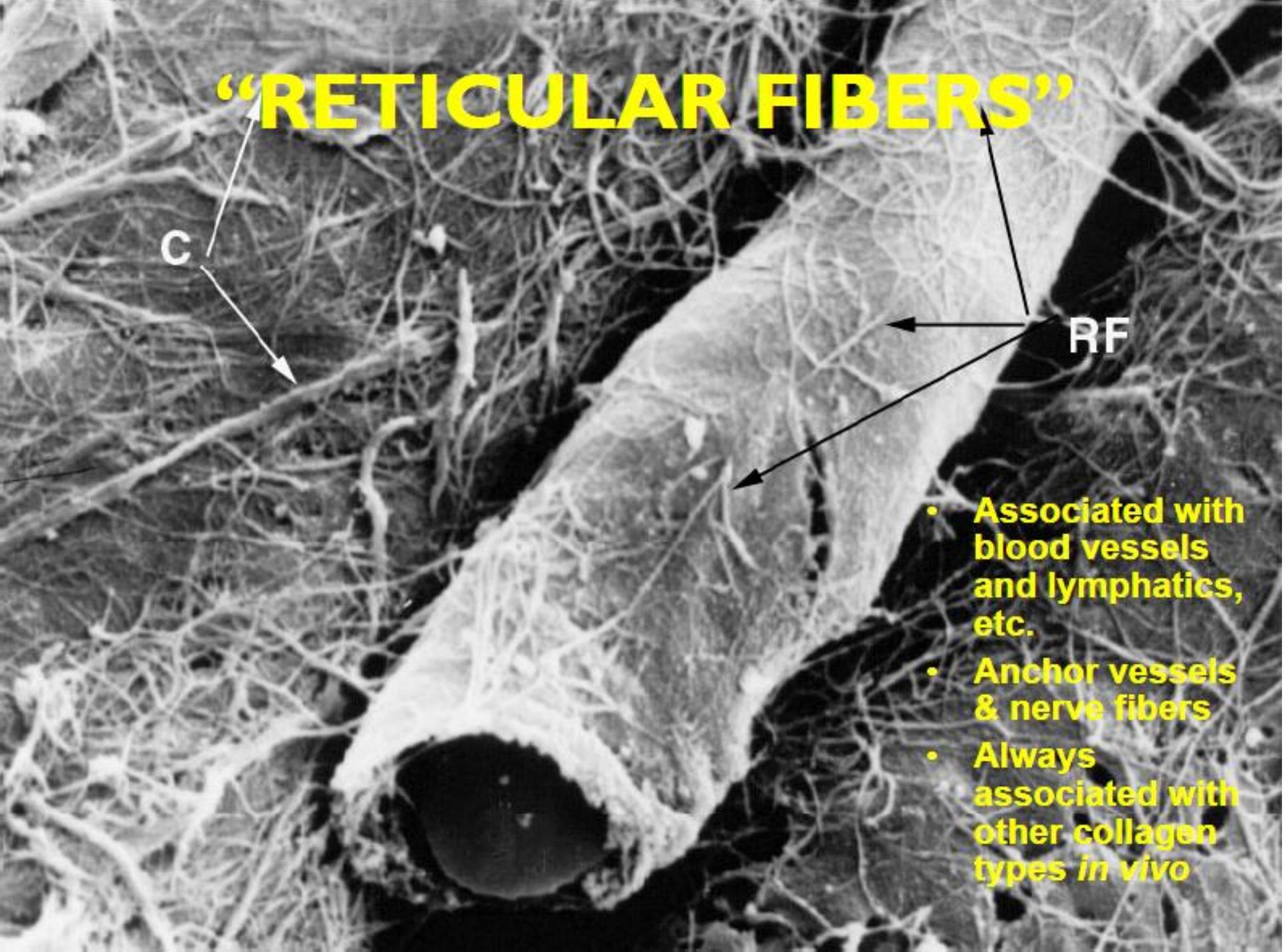
- Outmoded term still used
- *Chemically a form of collagen, Type III*
- Fibrils smaller than most other collagen
Assembled as webs and fine networks, not bundles

“RETICULAR FIBERS”

C

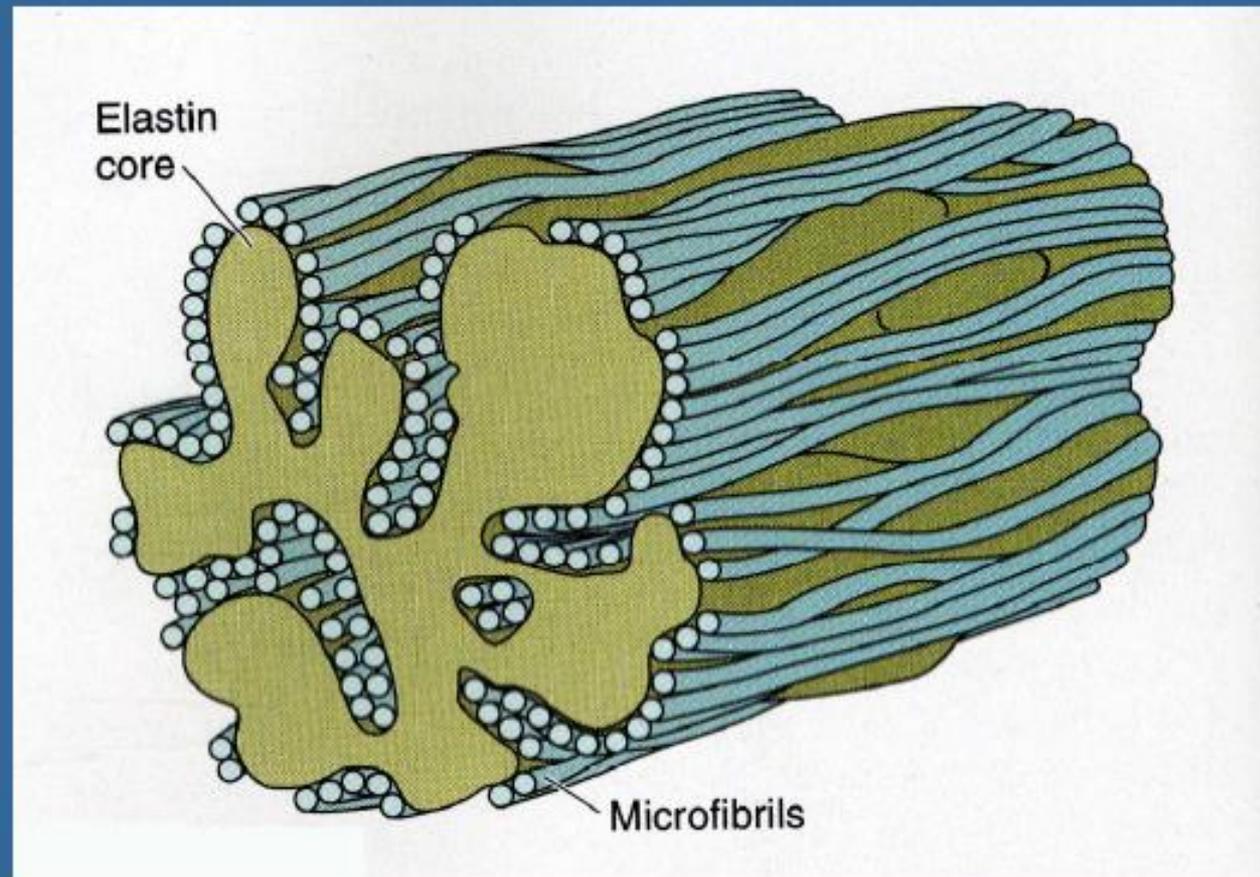
RF

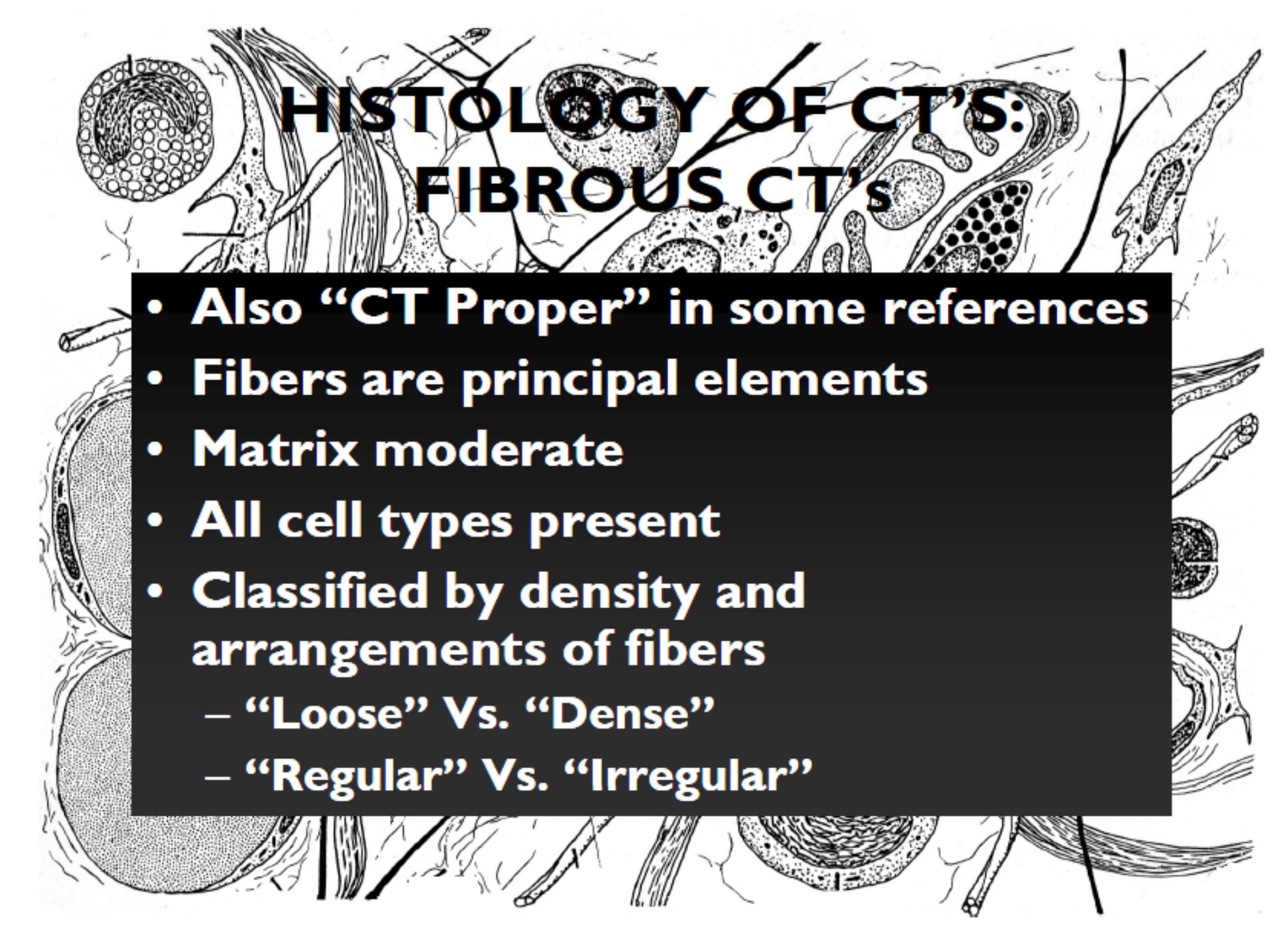
- Associated with blood vessels and lymphatics, etc.
- Anchor vessels & nerve fibers
- Always associated with other collagen types *in vivo*



- **NOT COLLAGEN**
 - Chemically different
- Two components: fibrils & amorphous ground material, *elastin*
- Confer “springiness”
- Much less common than collagen
- **Always associated with collagen**
- Form strands or sheets
- Fibers contain elastin

ELASTIC FIBERS





HISTOLOGY OF CT'S: FIBROUS CT'S

- Also “CT Proper” in some references
- Fibers are principal elements
- Matrix moderate
- All cell types present
- Classified by density and arrangements of fibers
 - “Loose” Vs. “Dense”
 - “Regular” Vs. “Irregular”

TYPES OF FIBROUS CT'S

- **COLLAGENOUS**

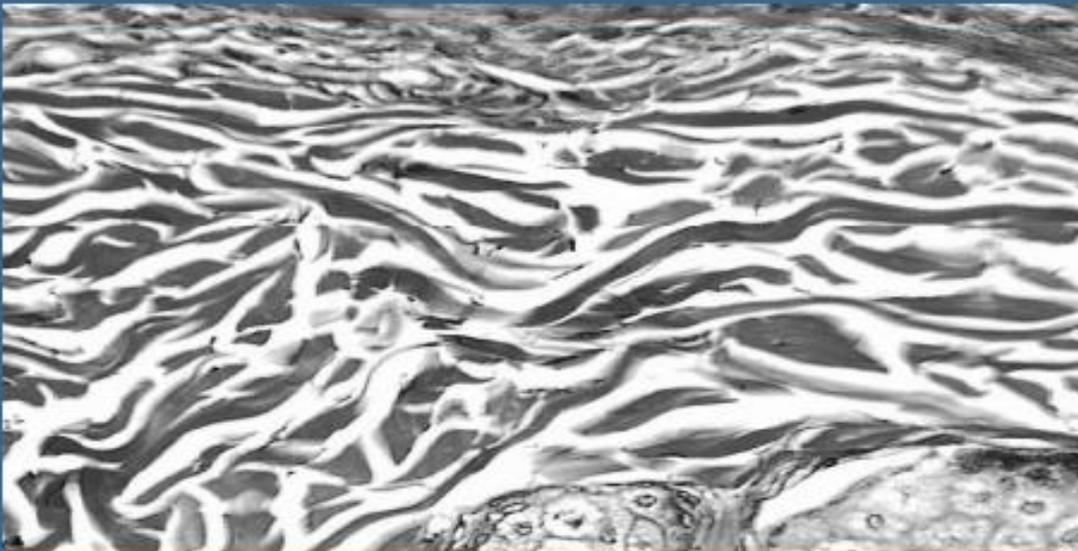
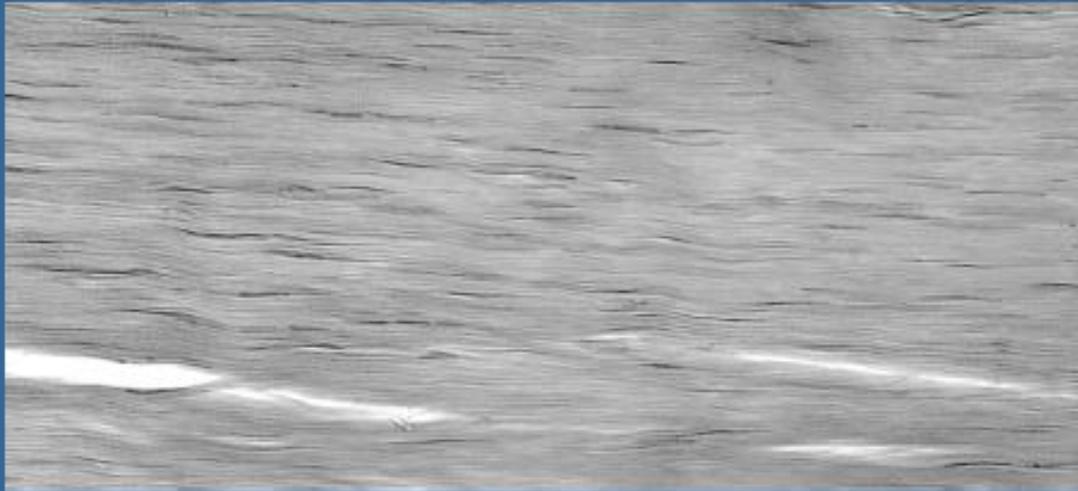
- **Mainly collagenous fibers**
 - **Elastic Fibers** *always* present
- **Most common type, many forms**
- **High tensile strength due to collagen**

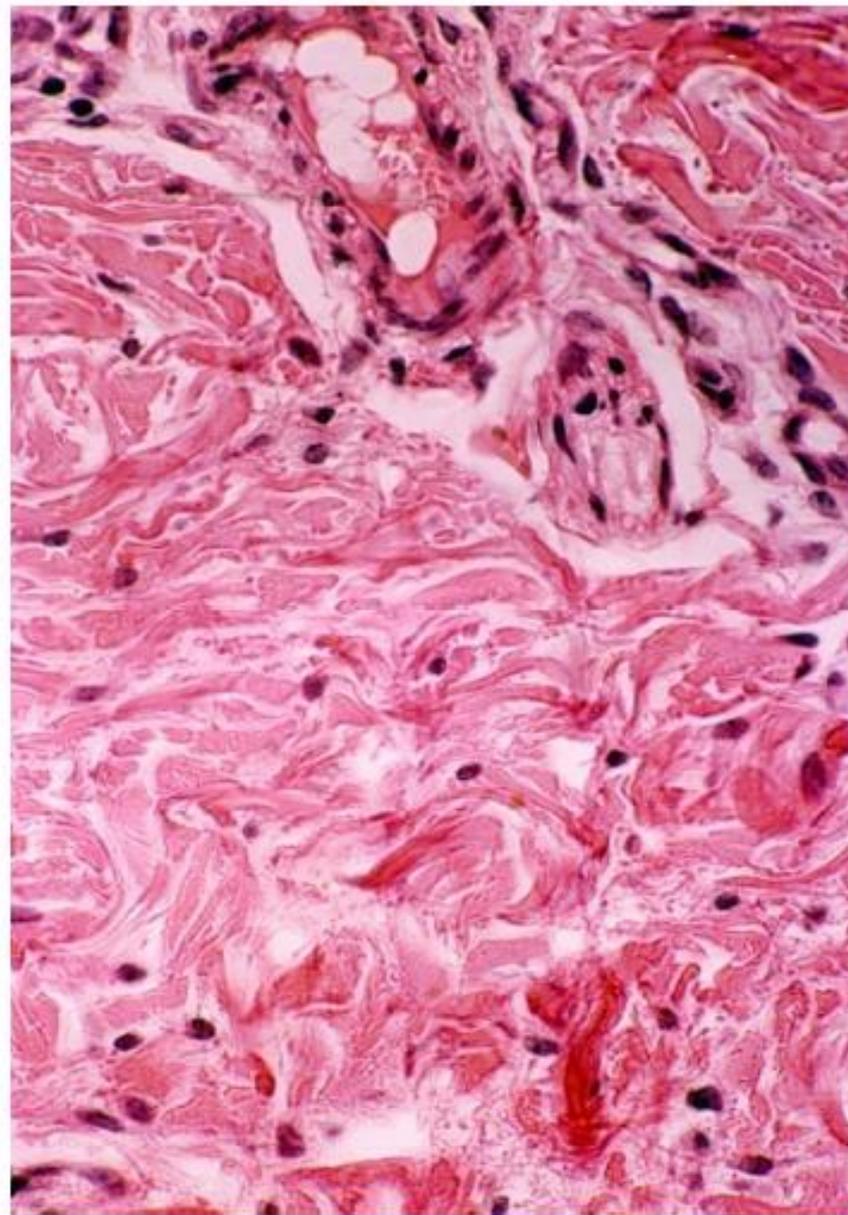
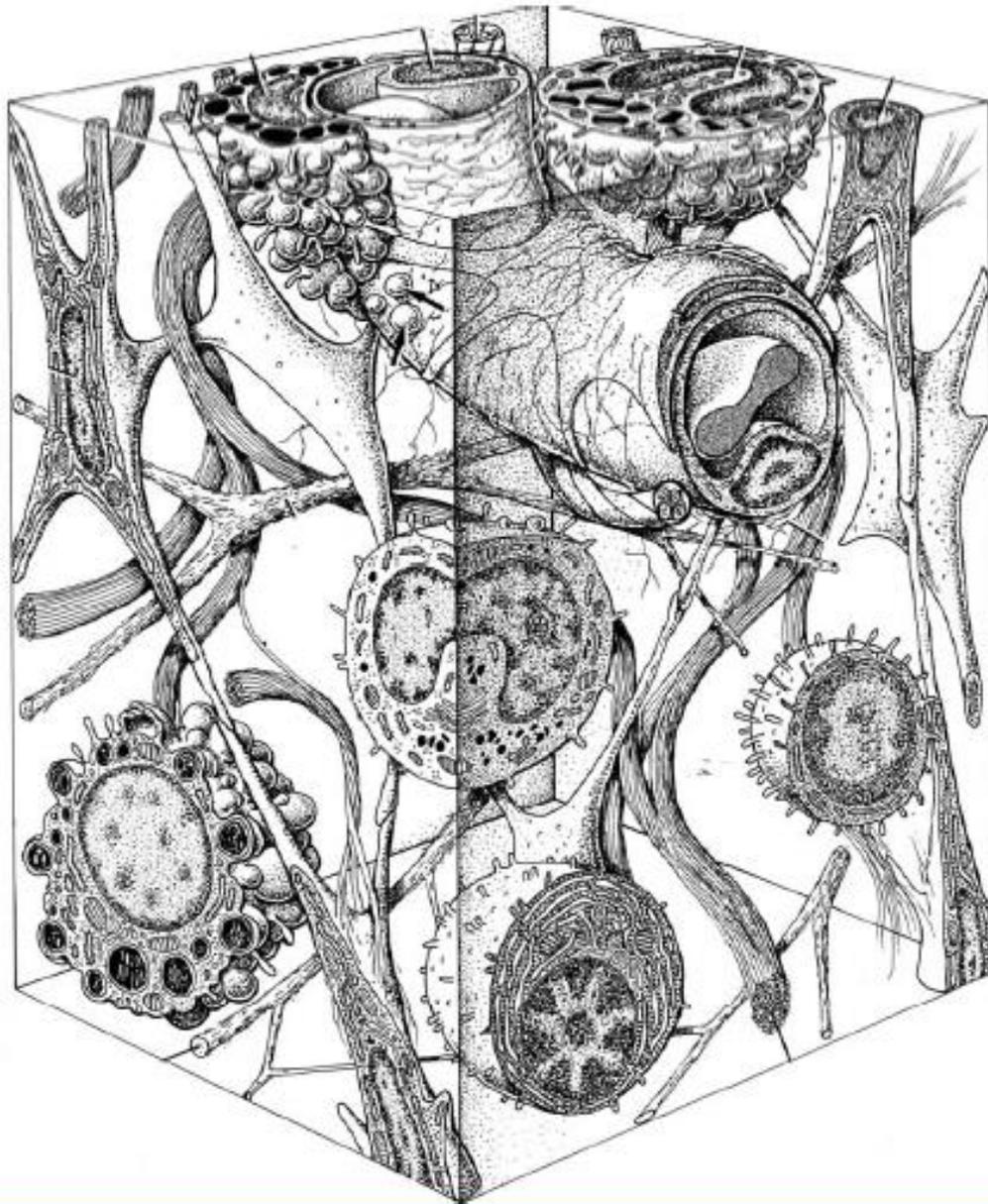
- **ELASTIC**

- **Principally elastic fibers**
 - **Collagen Fibers** *always* present
- **Form bands and sheets**
- **Provides for elasticity, resilience, shape retention**

CLASSIFYING FIBROUS CT'S

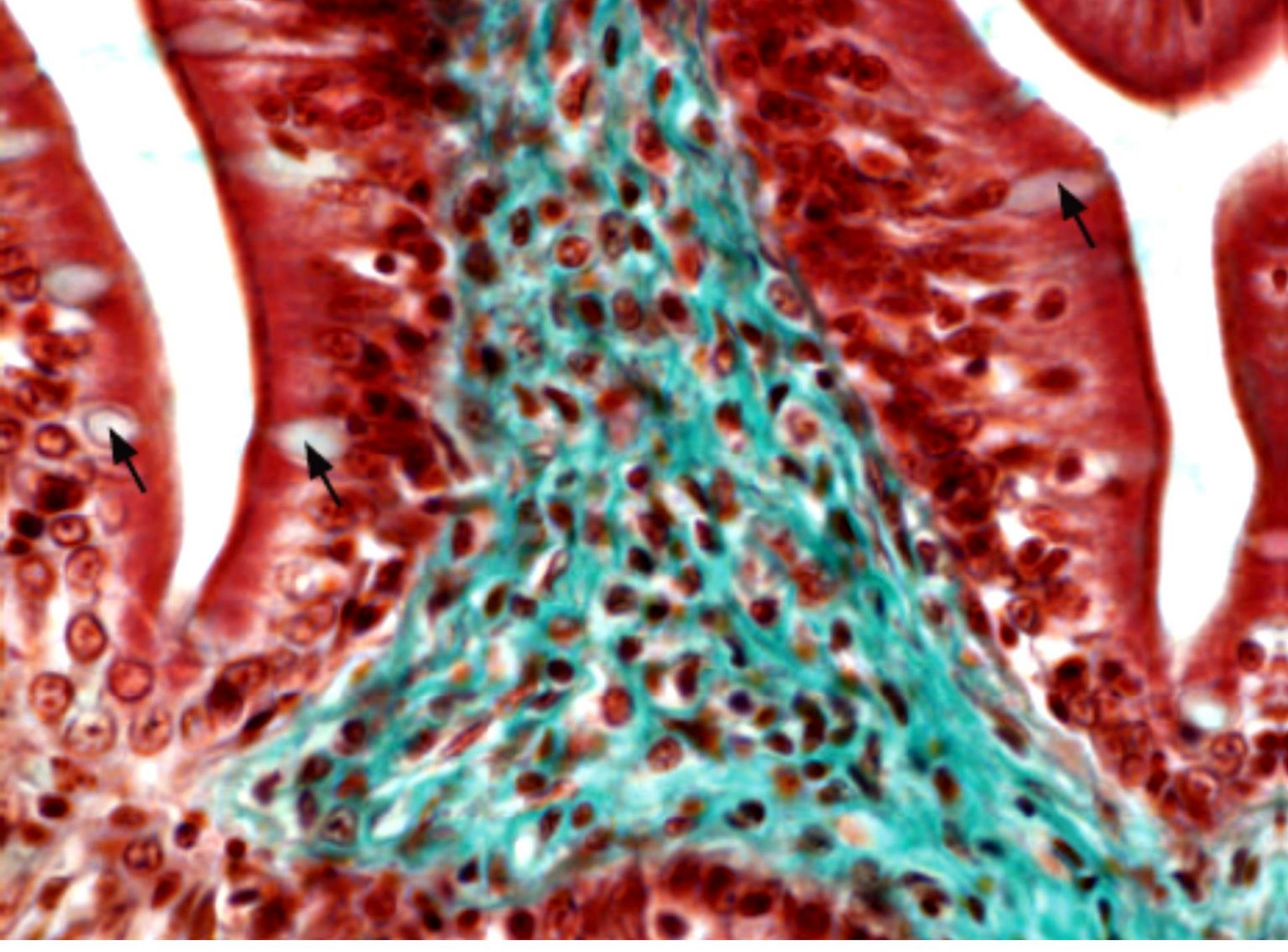
- **FIBER ORIENTATION**
 - *Regular or irregular*
- **FIBER PACKING**
 - *Loose or dense*
- **FIBER TYPE**
 - **COLLAGEN**
 - **ELASTIC**





“IRREGULAR”

Both “Dense” & “Loose” forms exist



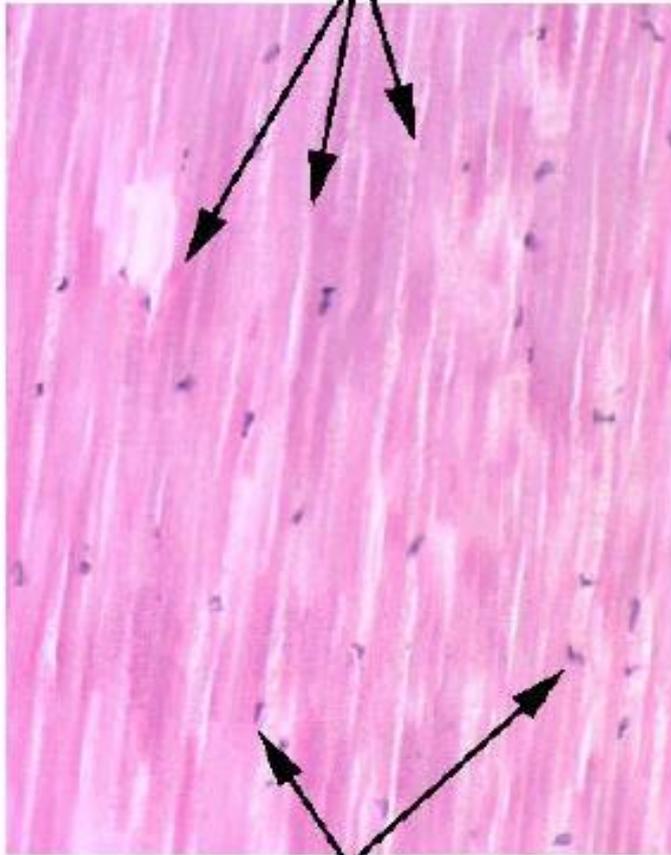
“REGULAR”

Only the “dense” form exists!

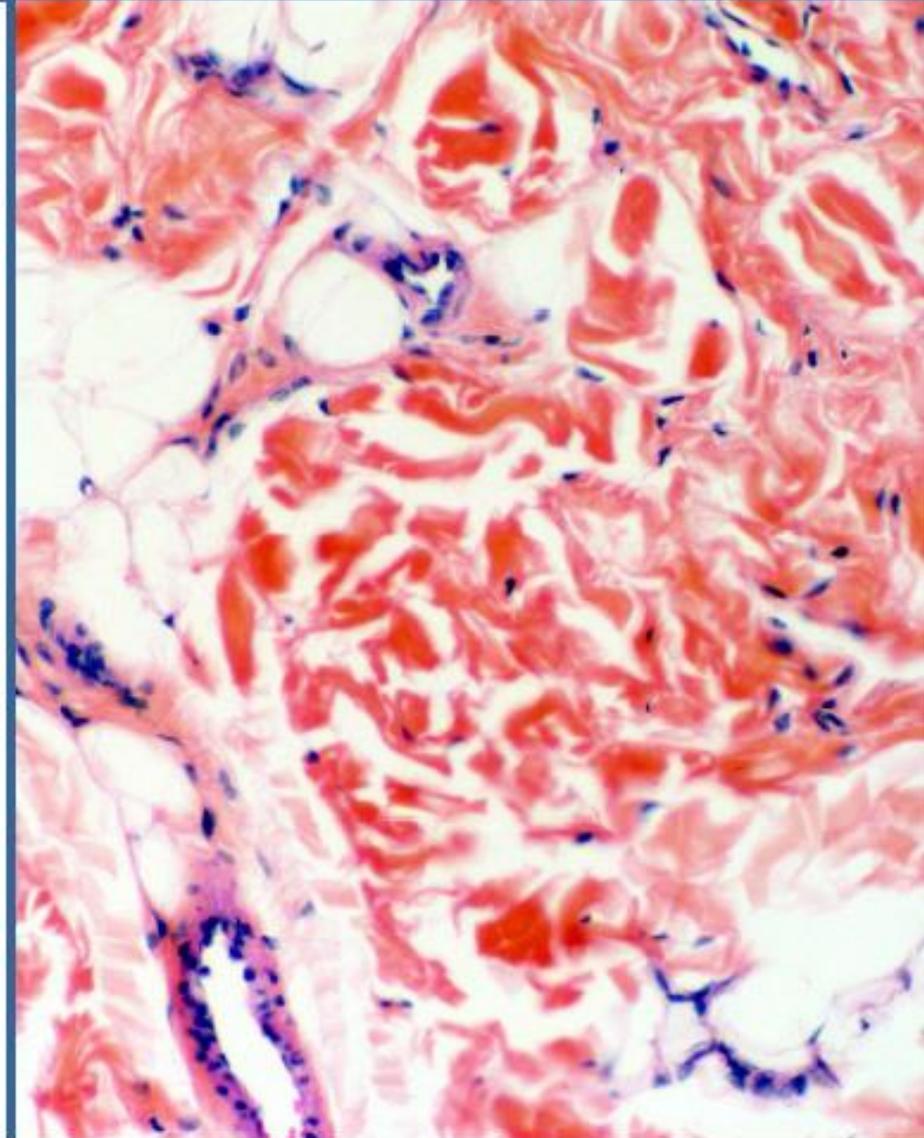


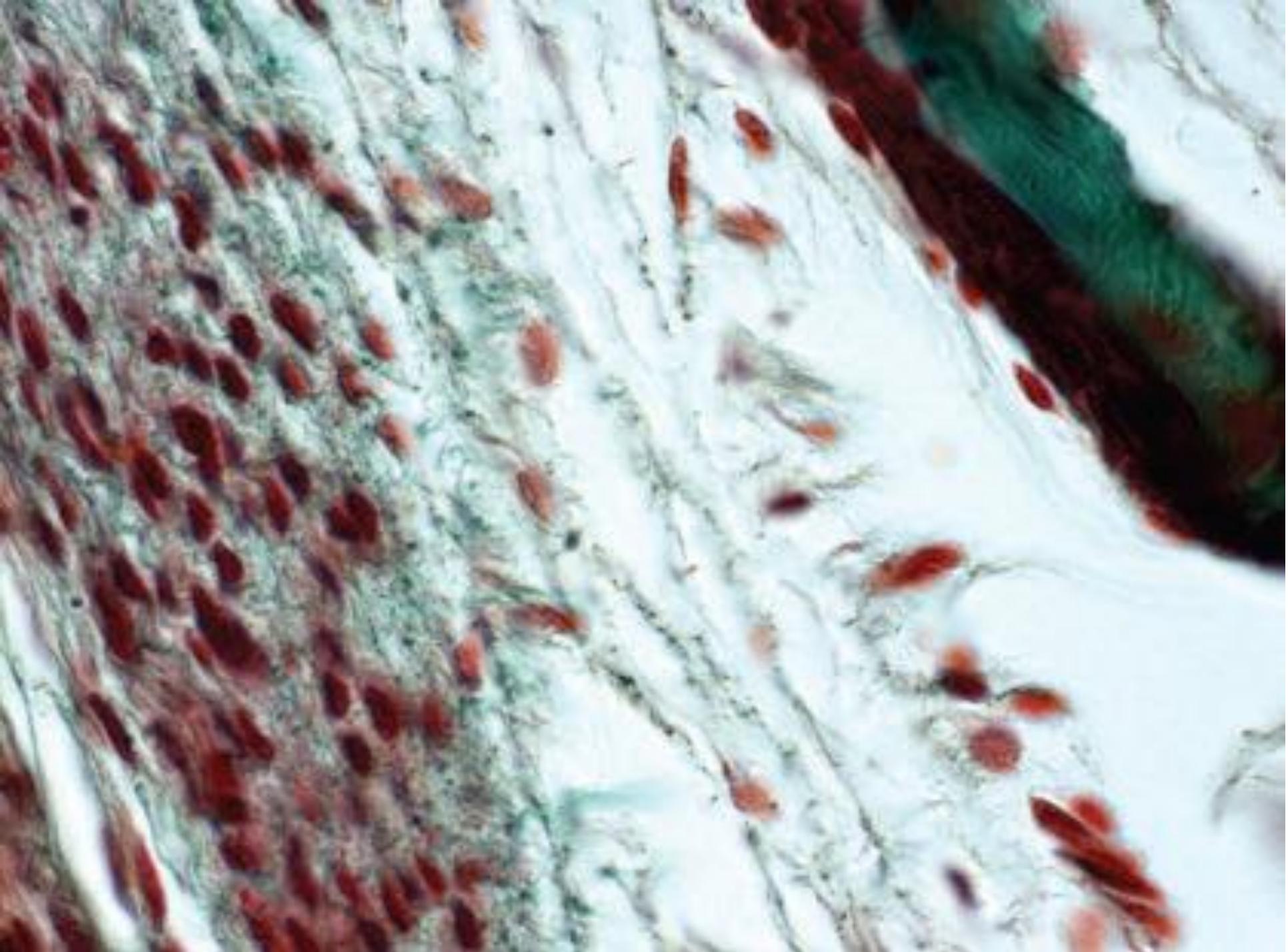
REGULAR VERSUS IRREGULAR

Collagen fibers

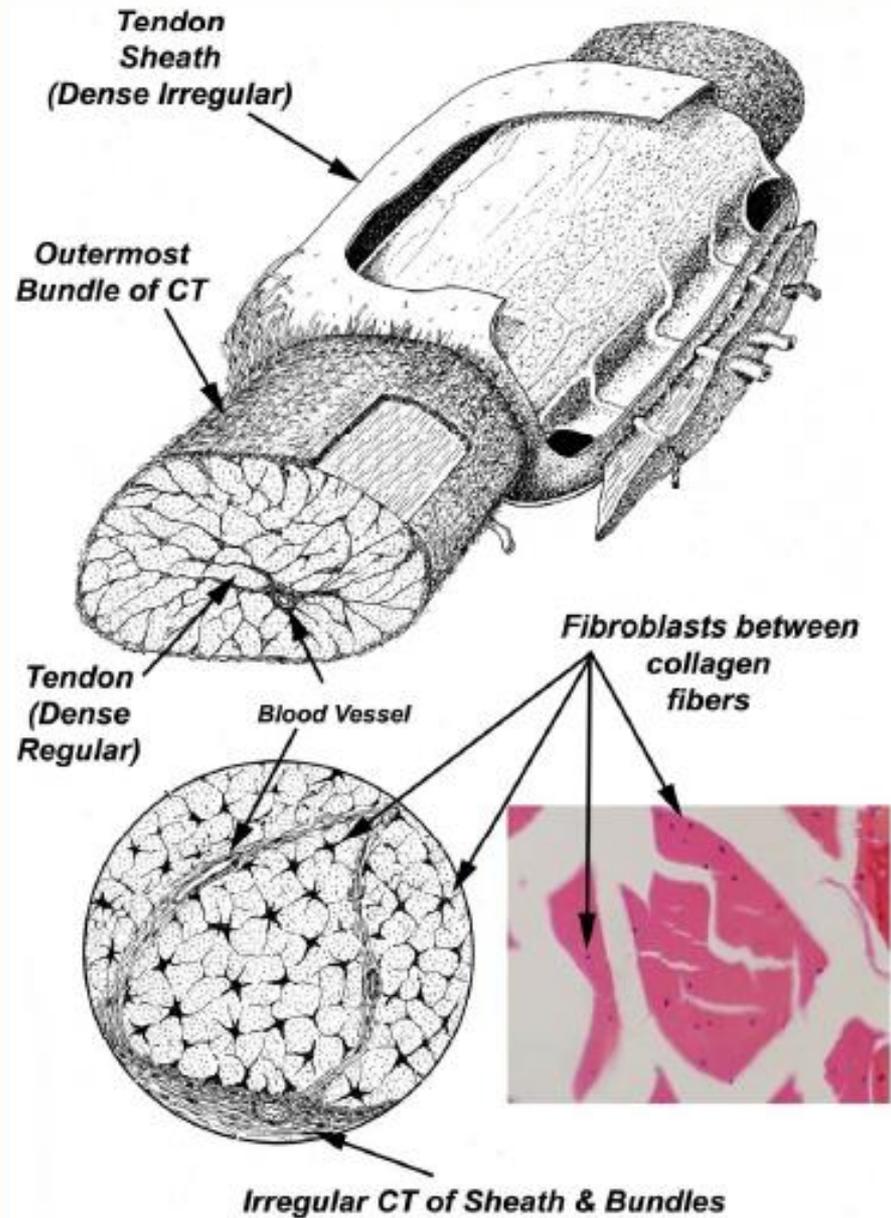
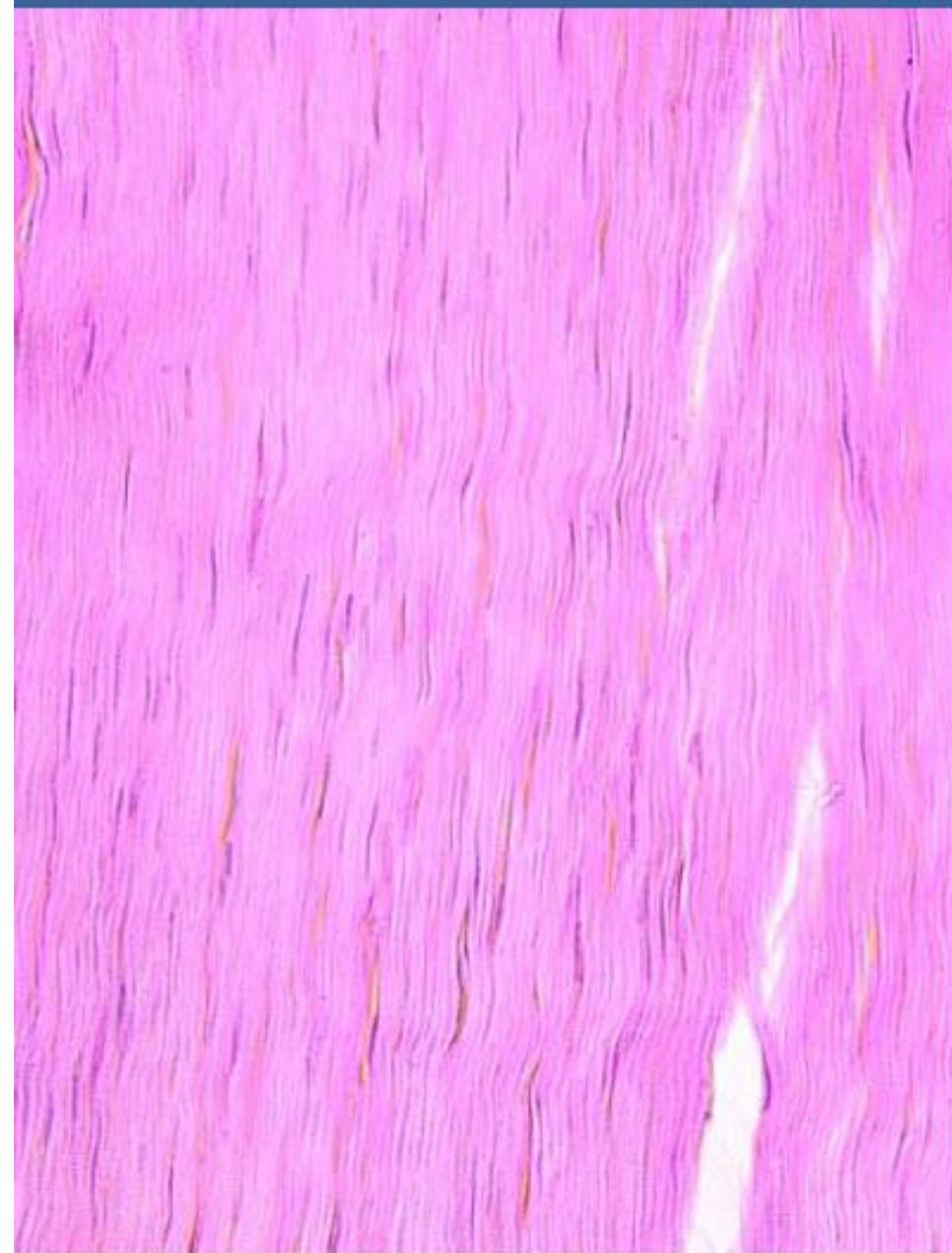


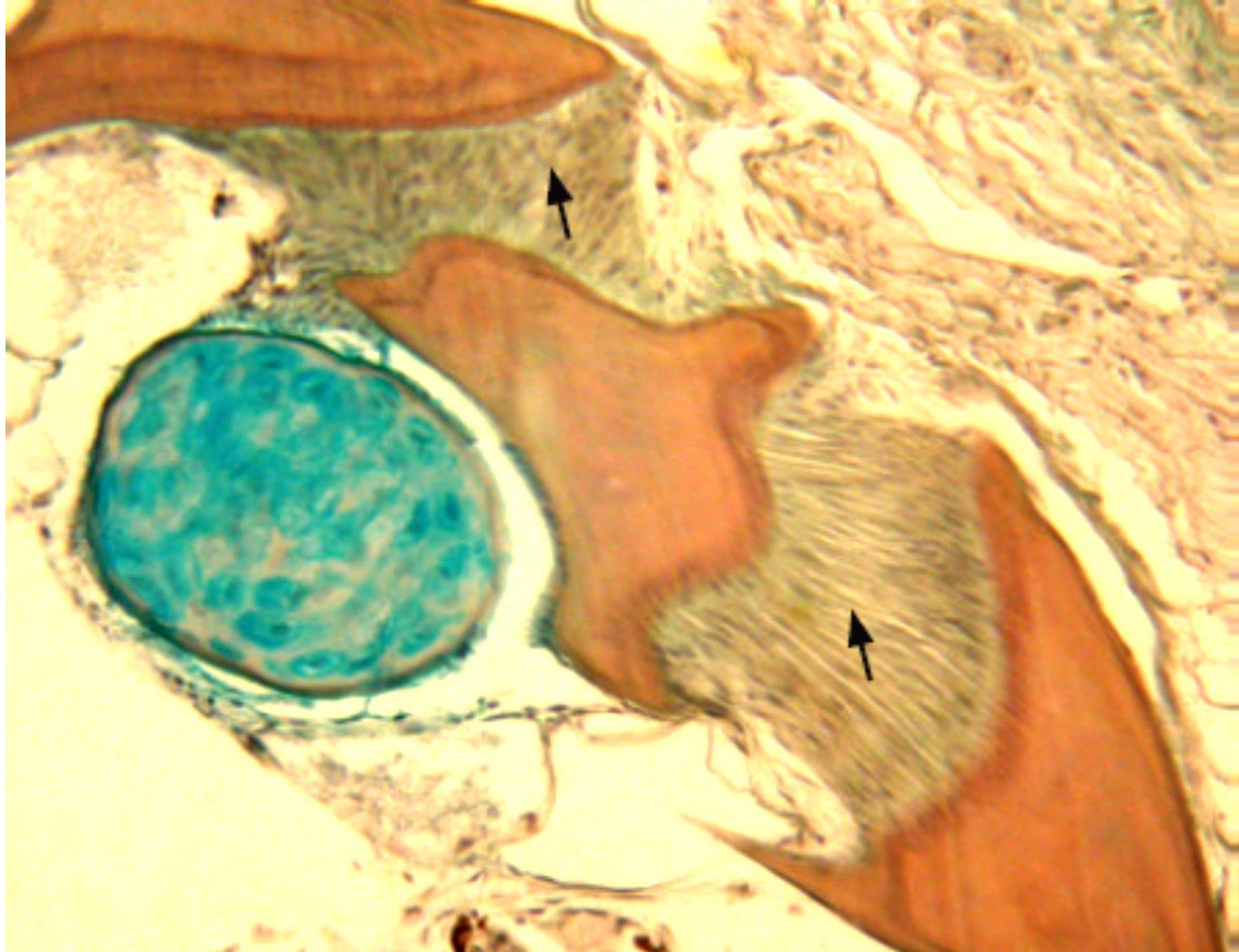
Nuclei of fibrocytes



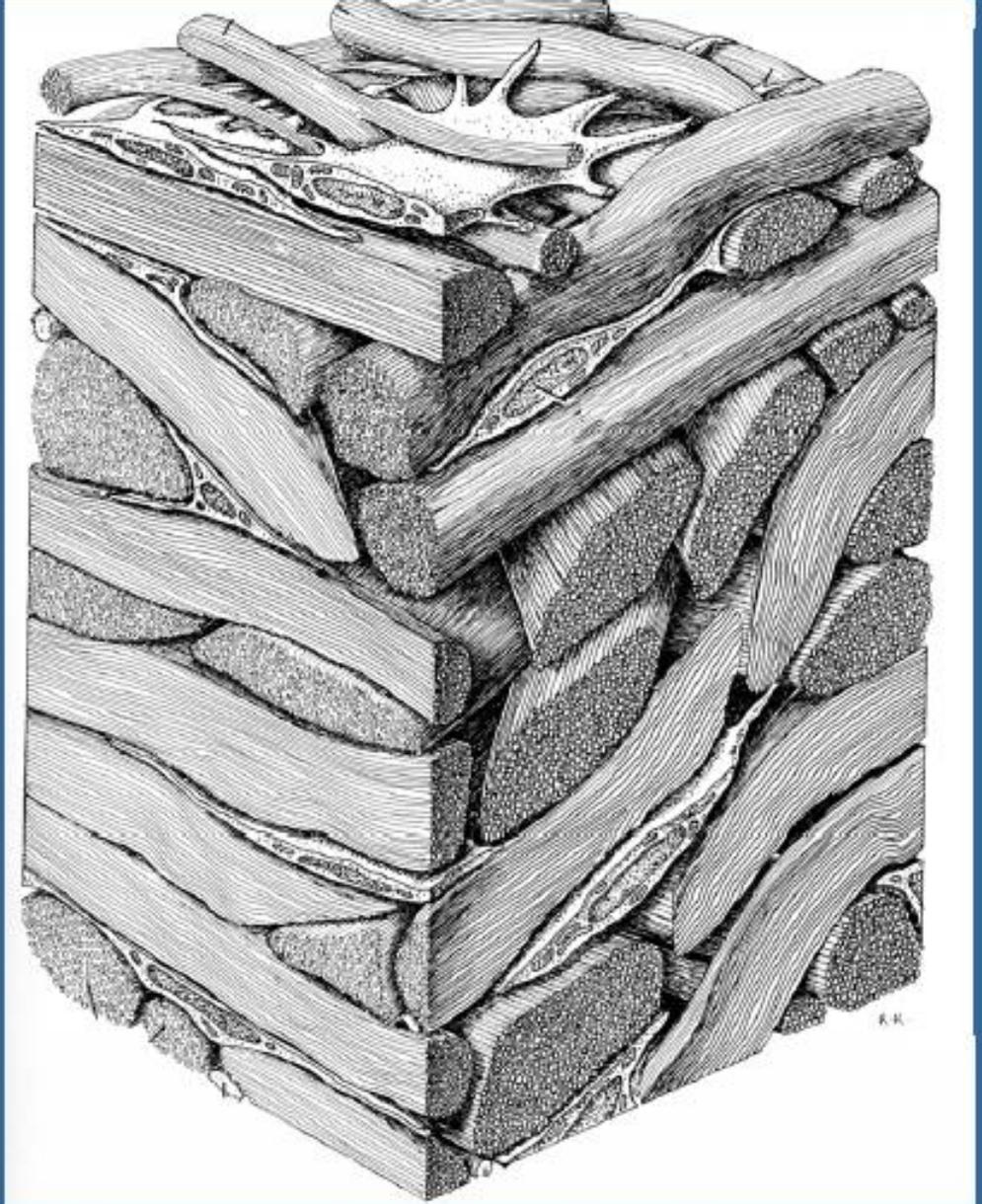


TENDON: COLLAGENOUS DRCCT

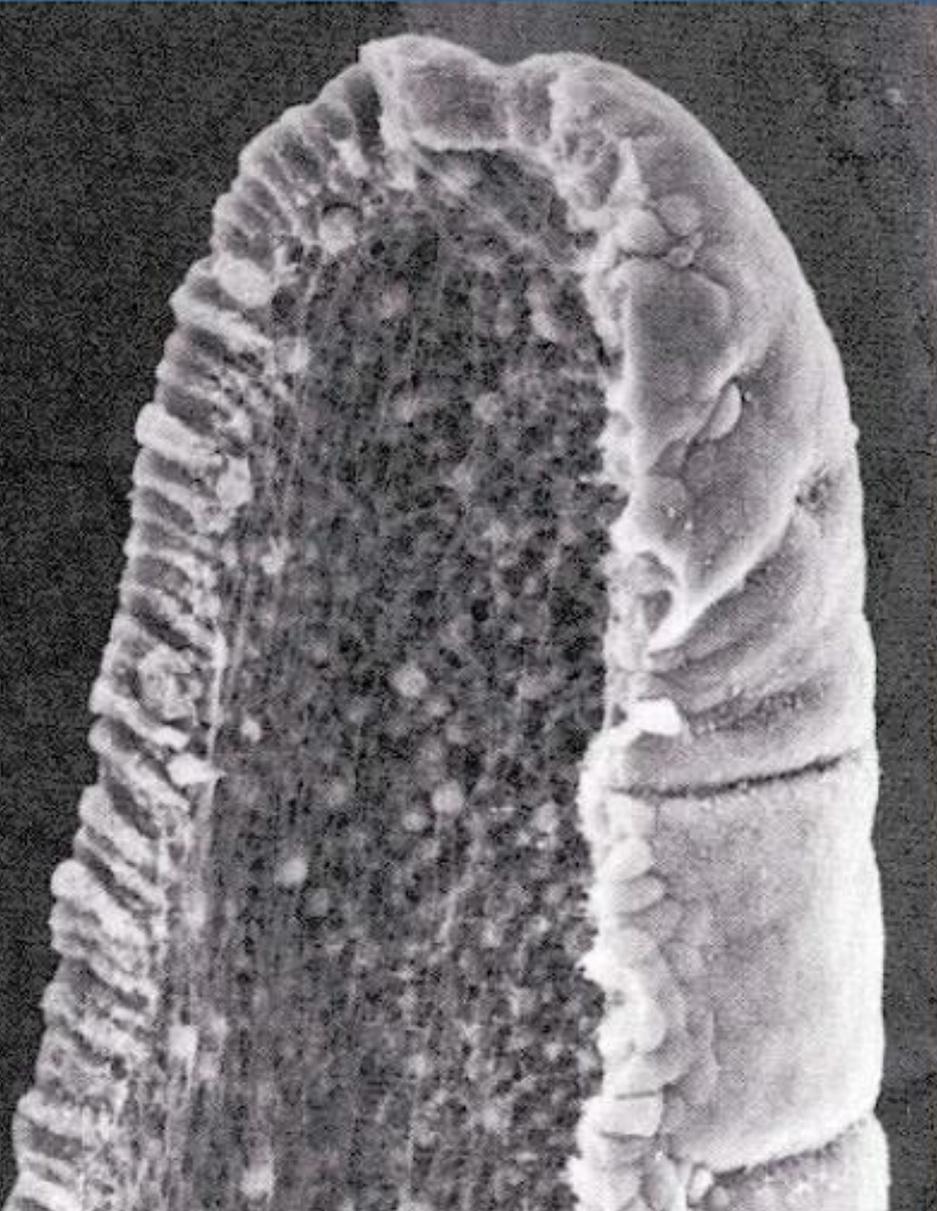




DENSE IRREGULAR CT

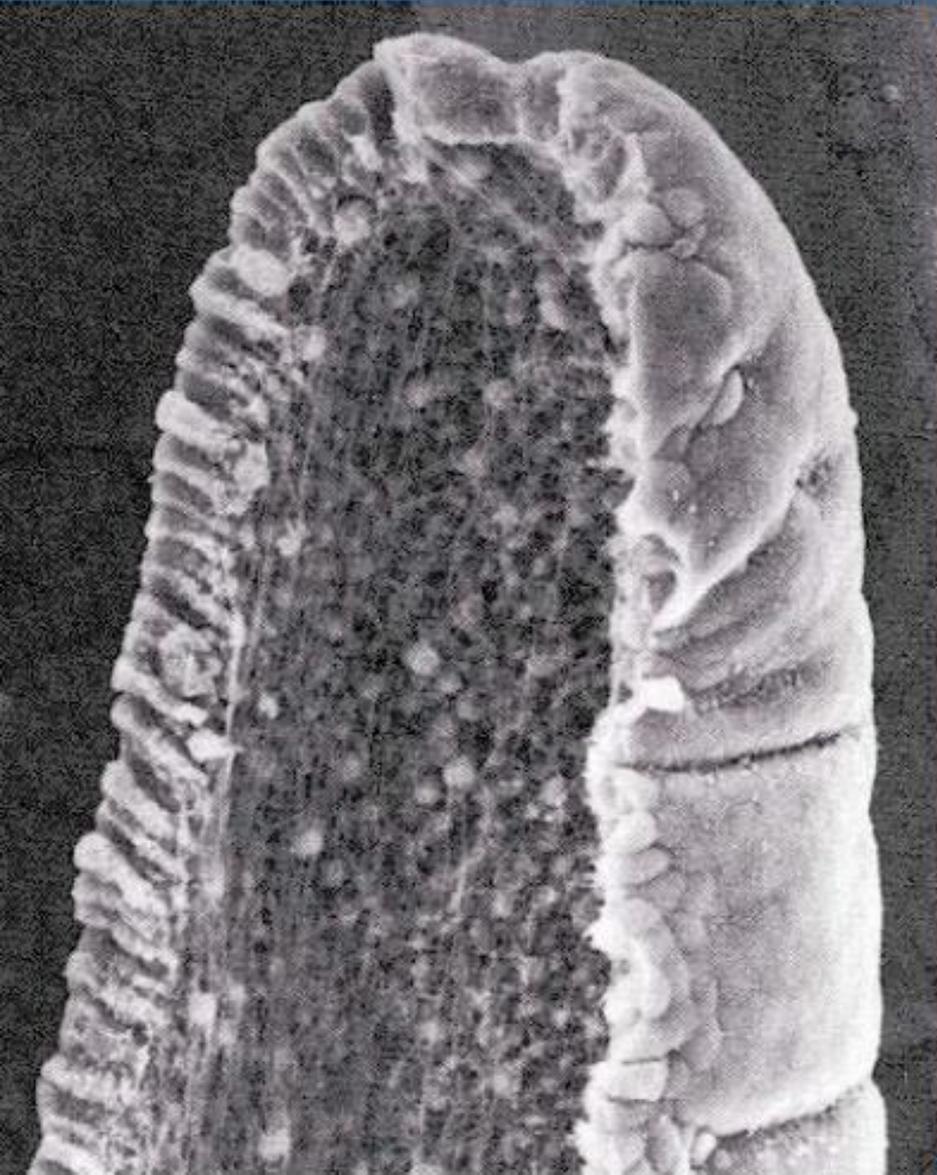


LOOSE IRREGULAR CT

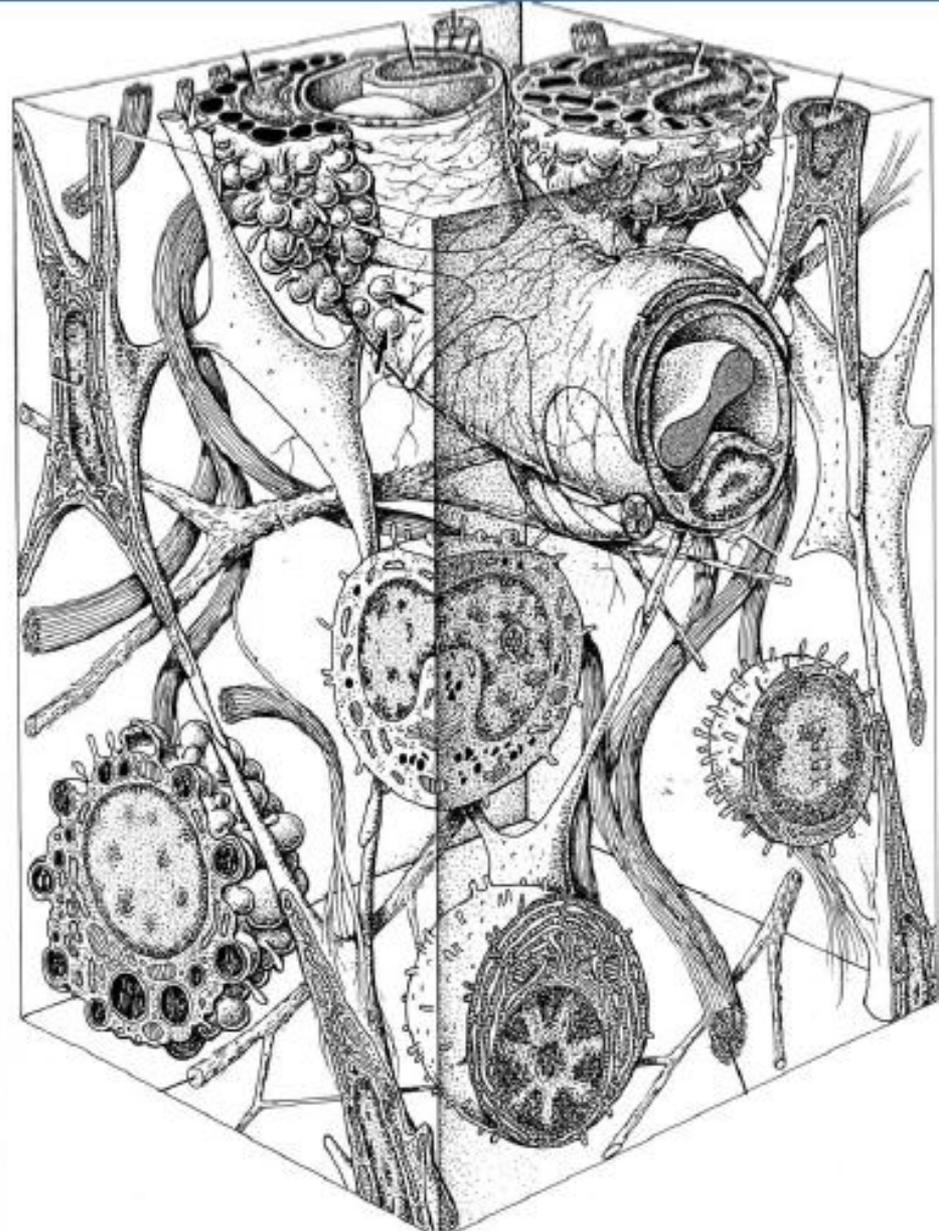
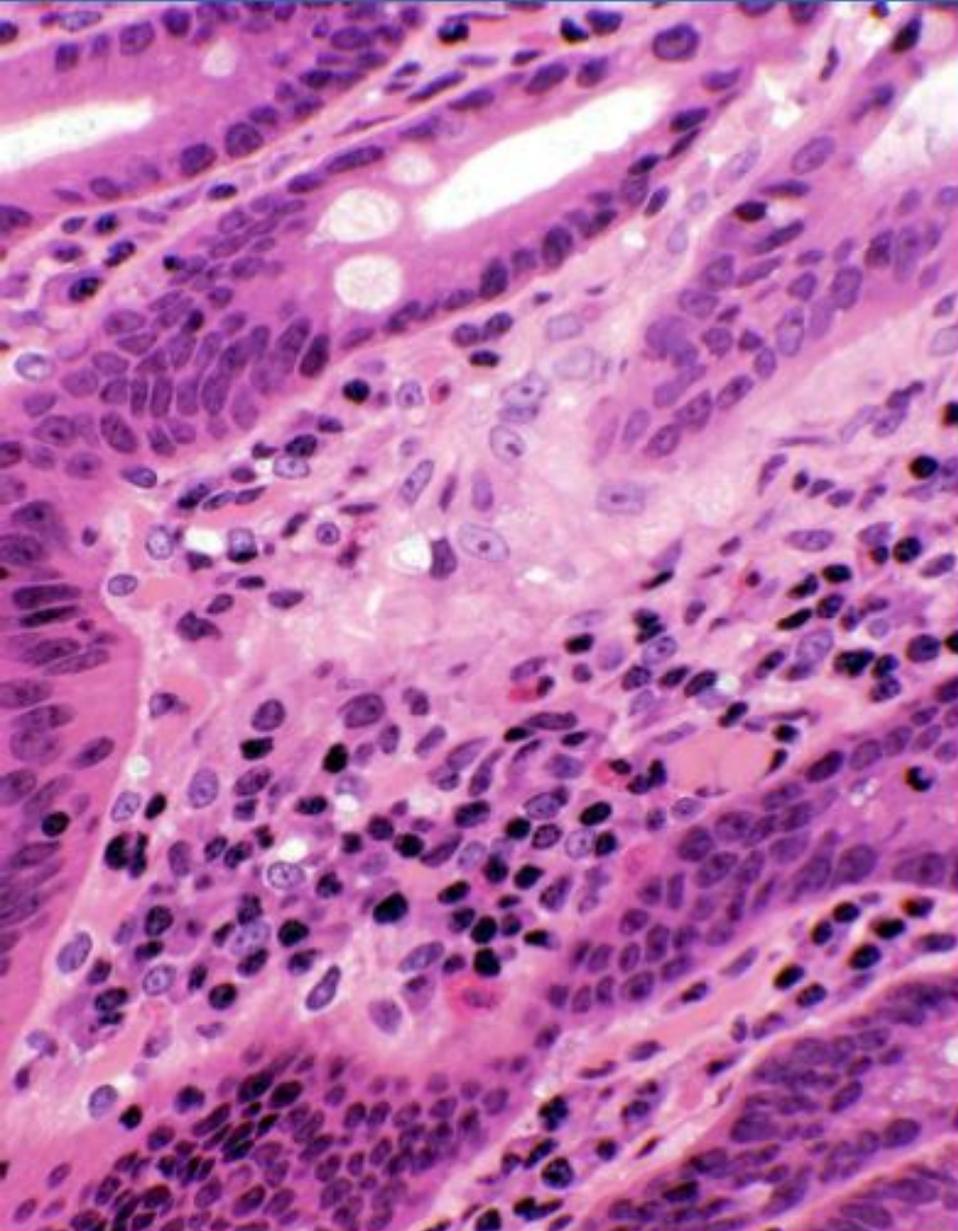


- Usually very *cellular*
- Cores of villi
- Internal “scaffolding” of some organs
- Collagen, elastic fibers
 - Smooth muscle
- Not easily seen in LM

LOOSE IRREGULAR CT



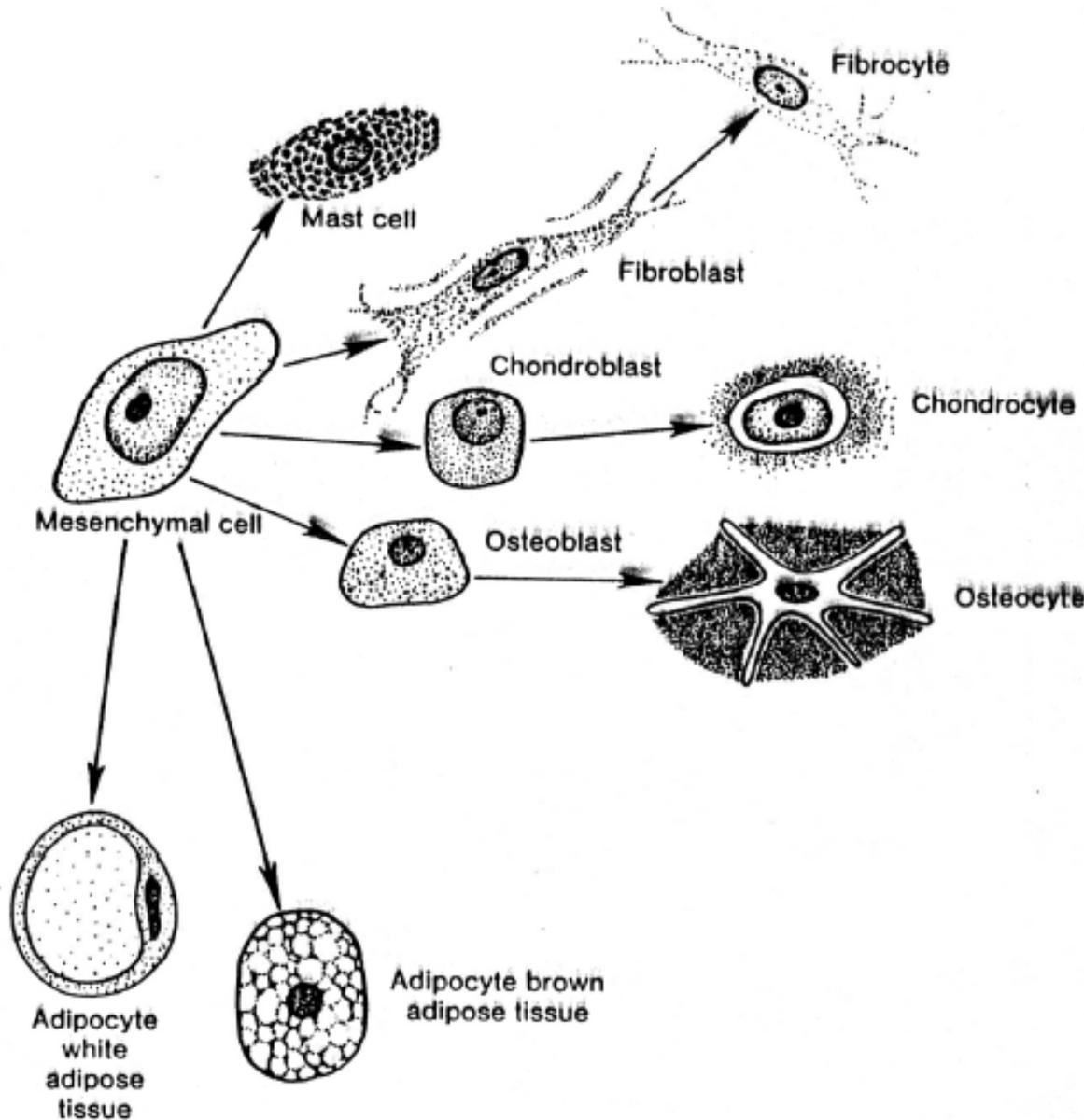
LOOSE IRREGULAR CT



CELLS OF CTs

- **CT's have MOST cell types in common**
 - Most so-called “blood cells” are really CT cells
- Cells make & maintain *all* components of *all* CT
- Usually cells *function in* CT only

ORIGINS OF CT CELLS

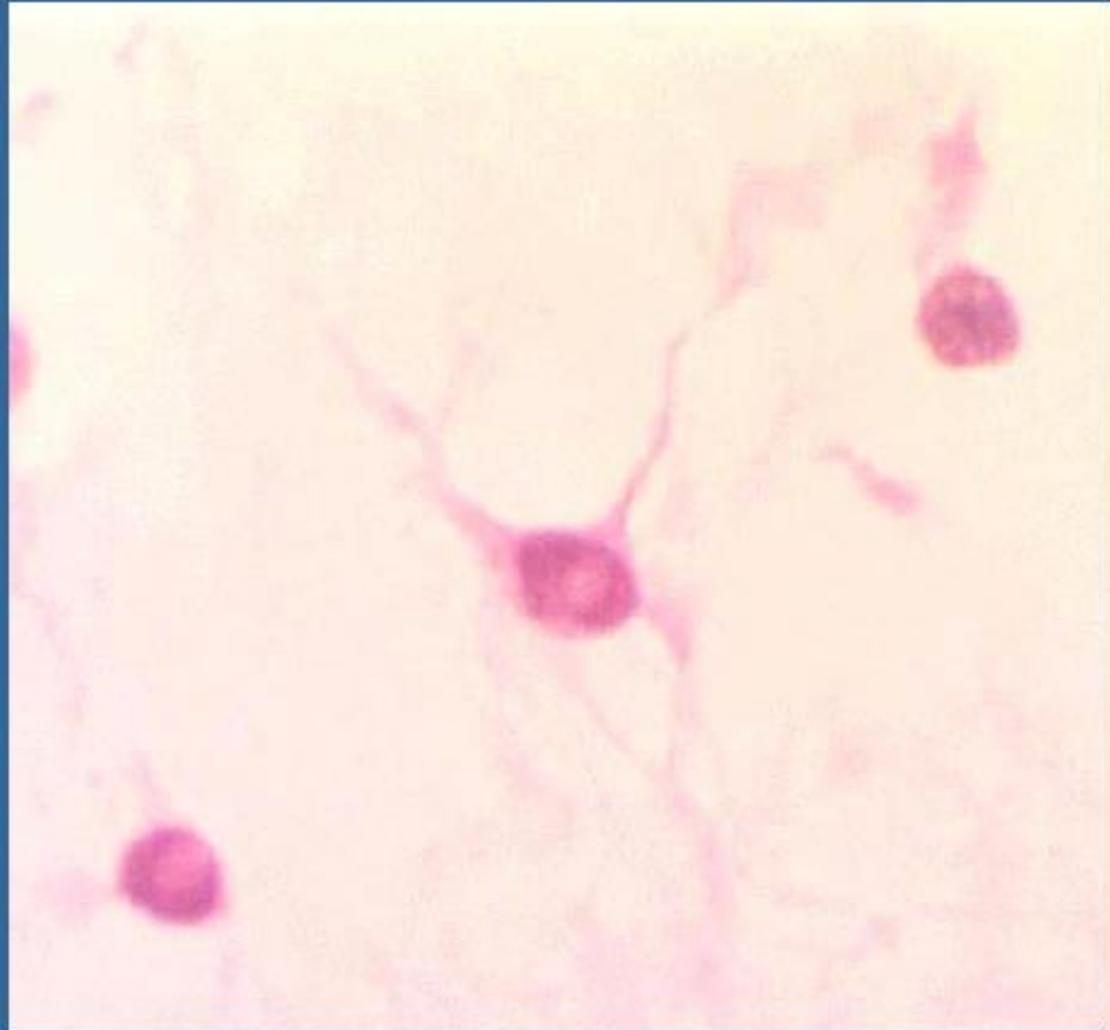


ORIGINS

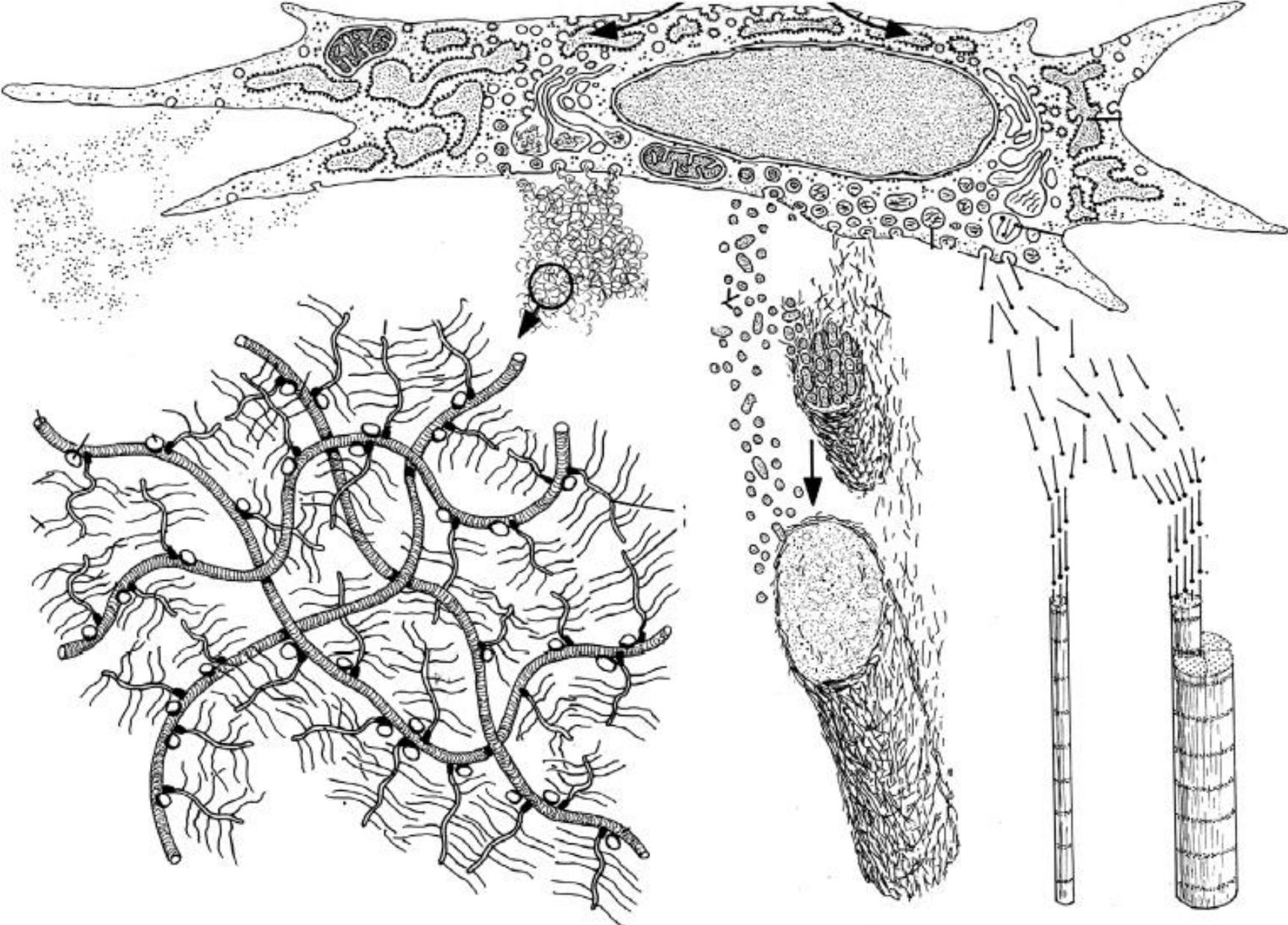
- Nearly all CT cells have common stem
- Some variant of the fibroblast is always present

FIBROBLAST

- Most important & abundant cell
- Make fibers and matrix
 - Related by lineage to cells with similar capabilities
- Found among fibers
- Long lived
- Proliferate and become active if needed
 - “Mesenchymal” cells a quiescent reserve

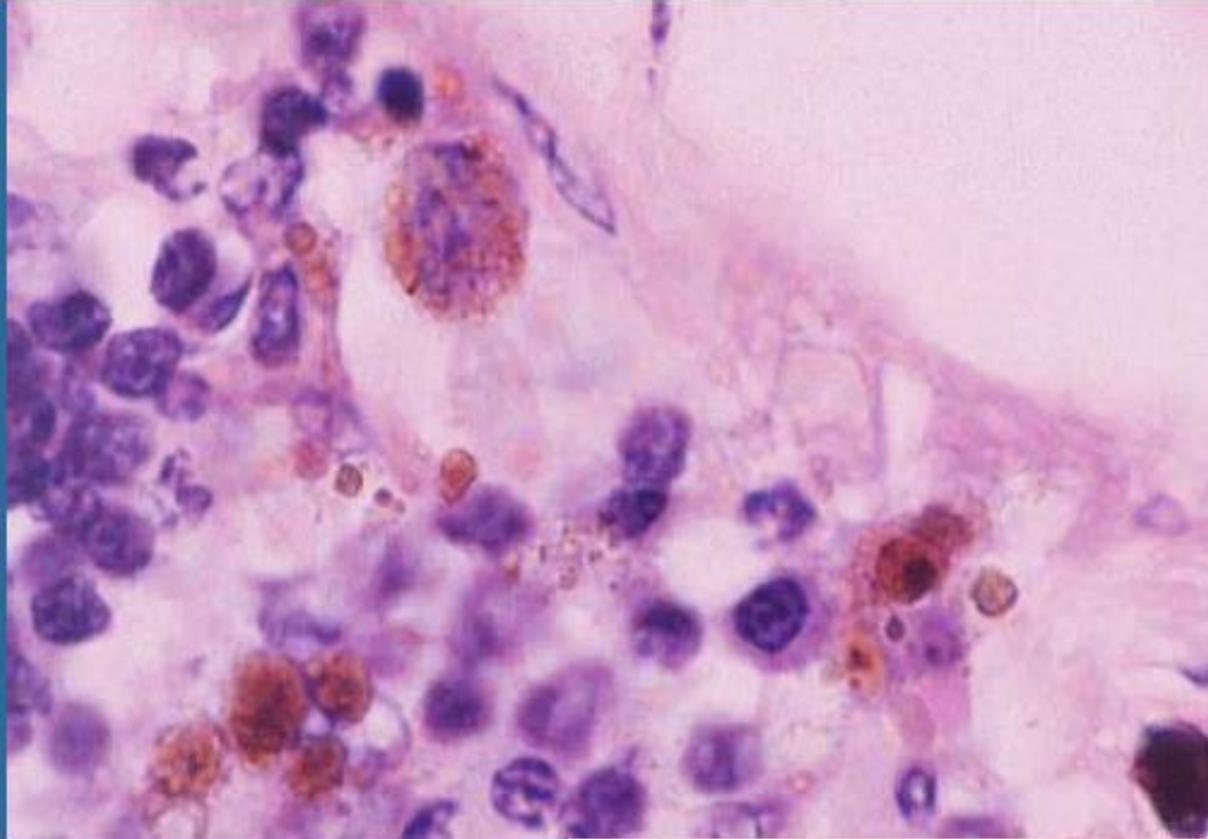


The Fabulous Fibroblast

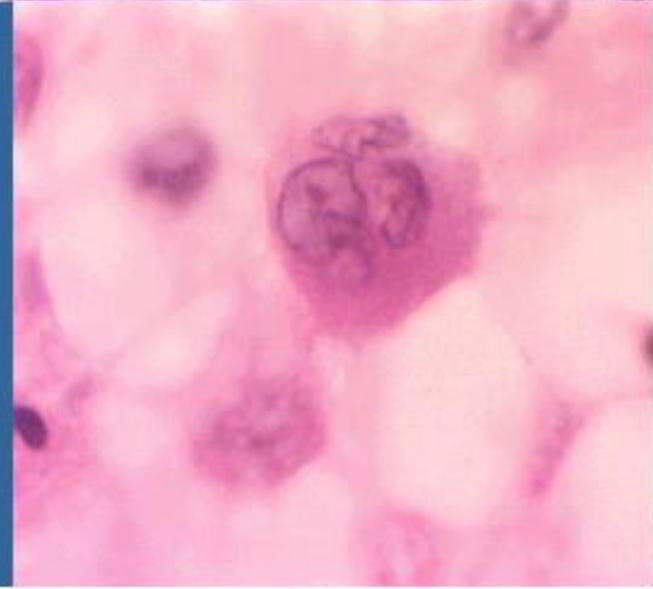


OUR FRIEND, THE MACROPHAGE

- **Very common in most CT's**
 - Ubiquitous phagocyte
- **Shares lineage with some bone cells**
 - NOT from fibroblast line
 - May coalesce to form multinucleated "giant" cells
 - Extremely important in inflammatory reaction

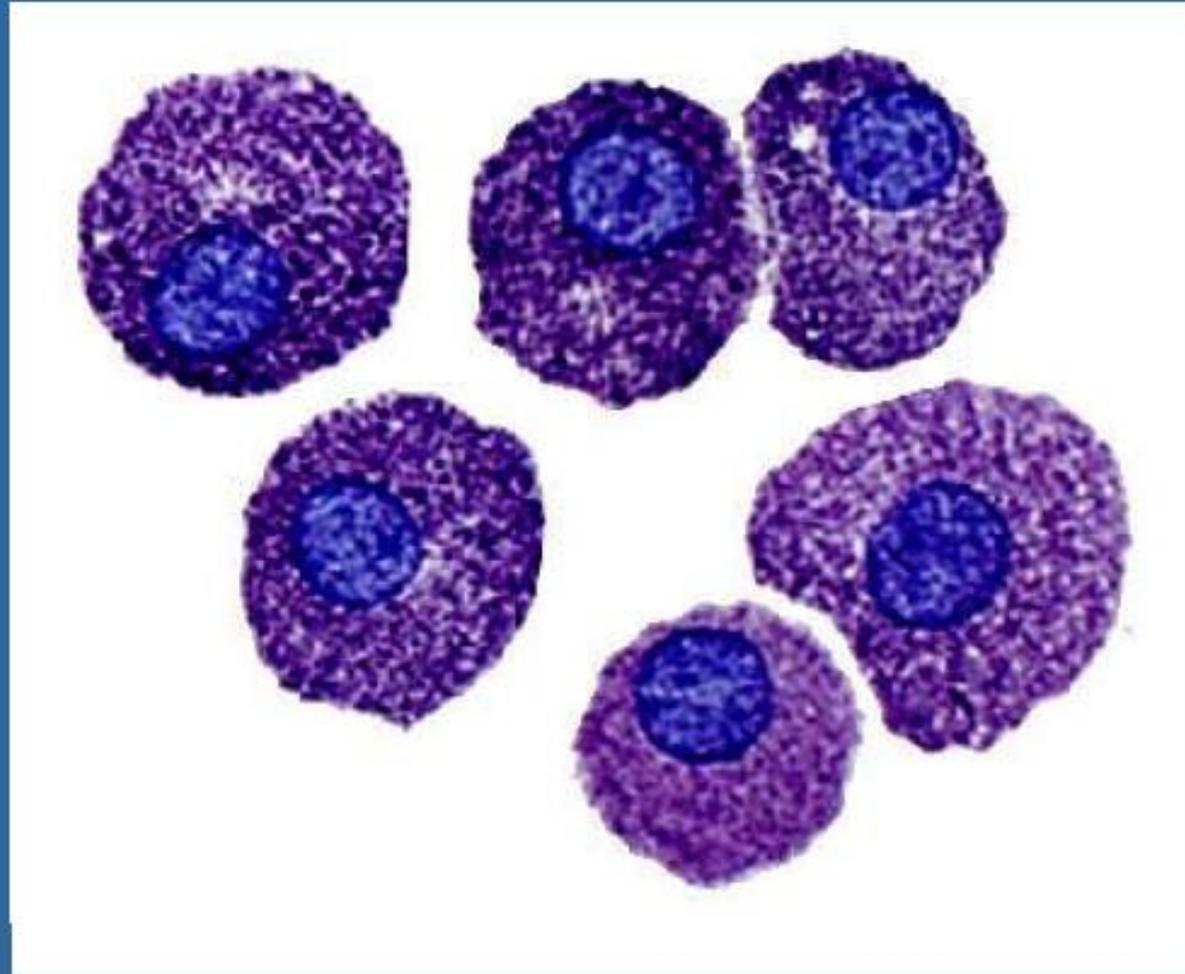


**TOP: Active
macrophage *in
situ*; BOTTOM:
A giant cell**



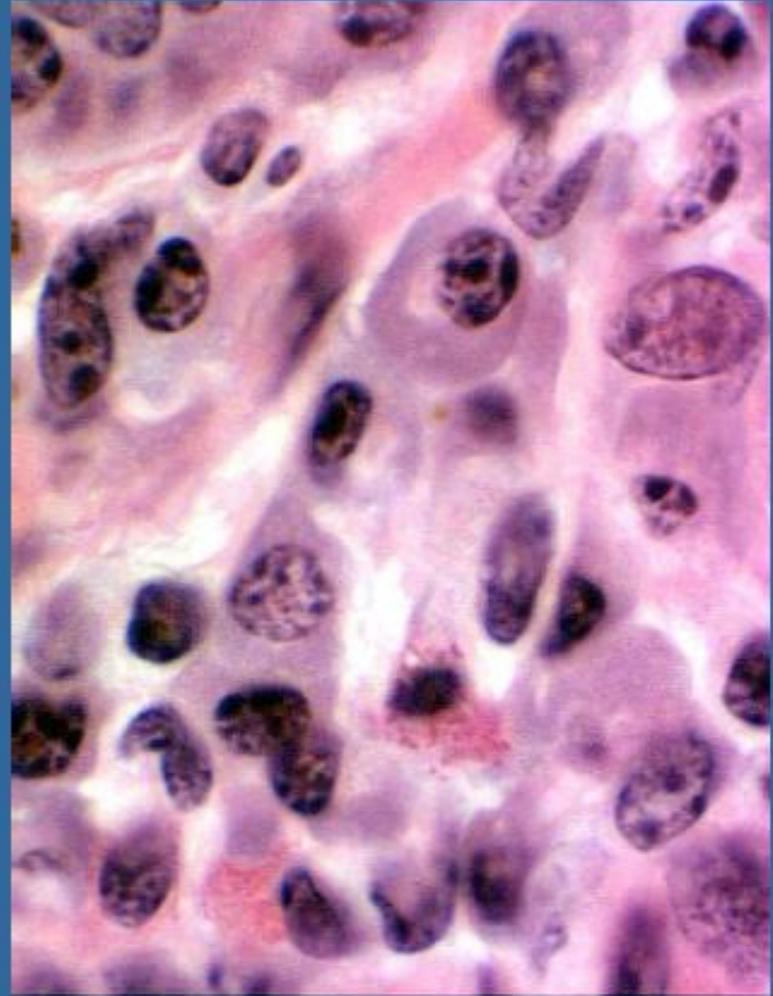
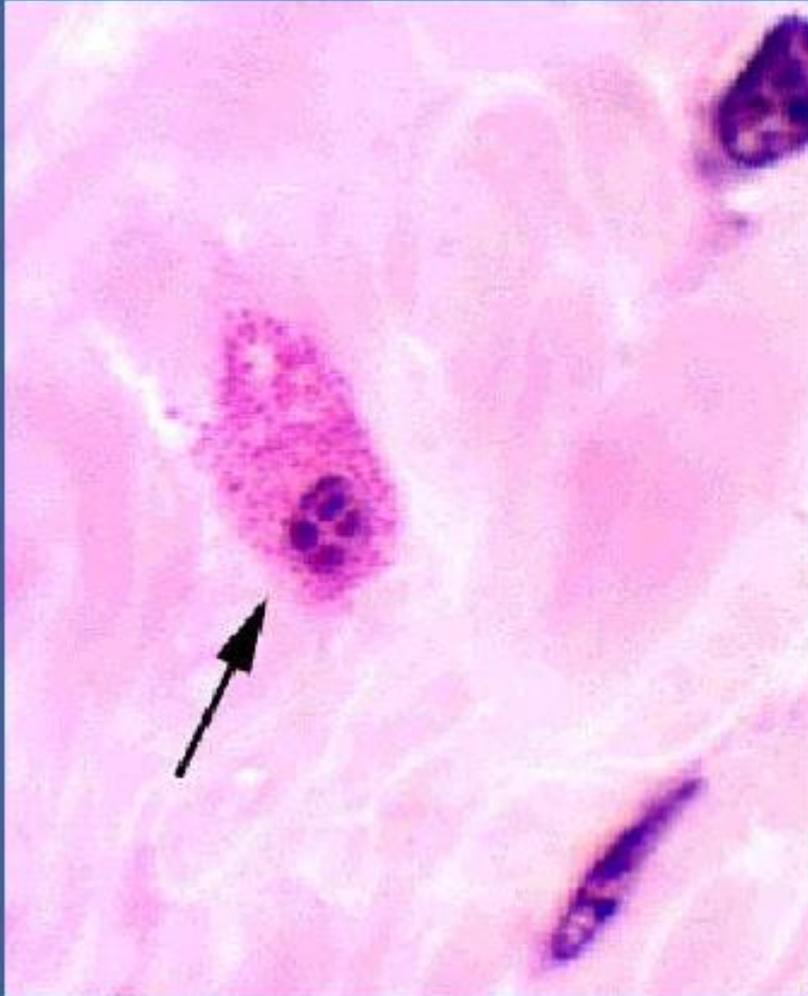
MAST CELLS

- **Widely distributed**
- **Functions not completely understood**
 - **Allergic reactions**
 - **Granules contain heparin and histamine, leukocyte attractants**
- **May contain serotonin**
- **Shared lineage with basophil of blood**



MAST CELLS WITH TB STAIN

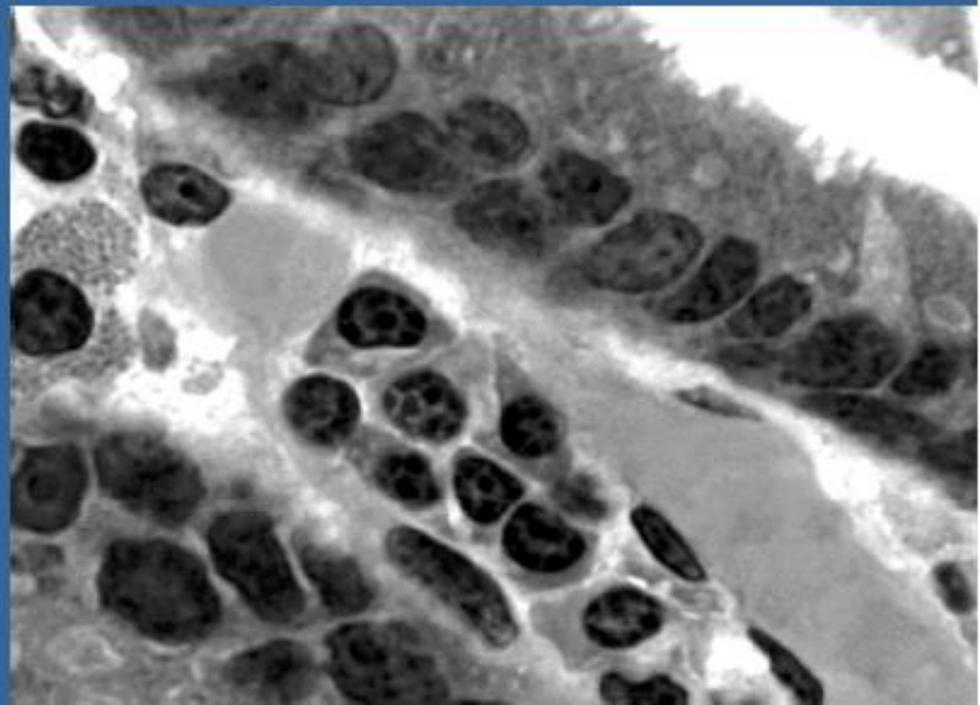
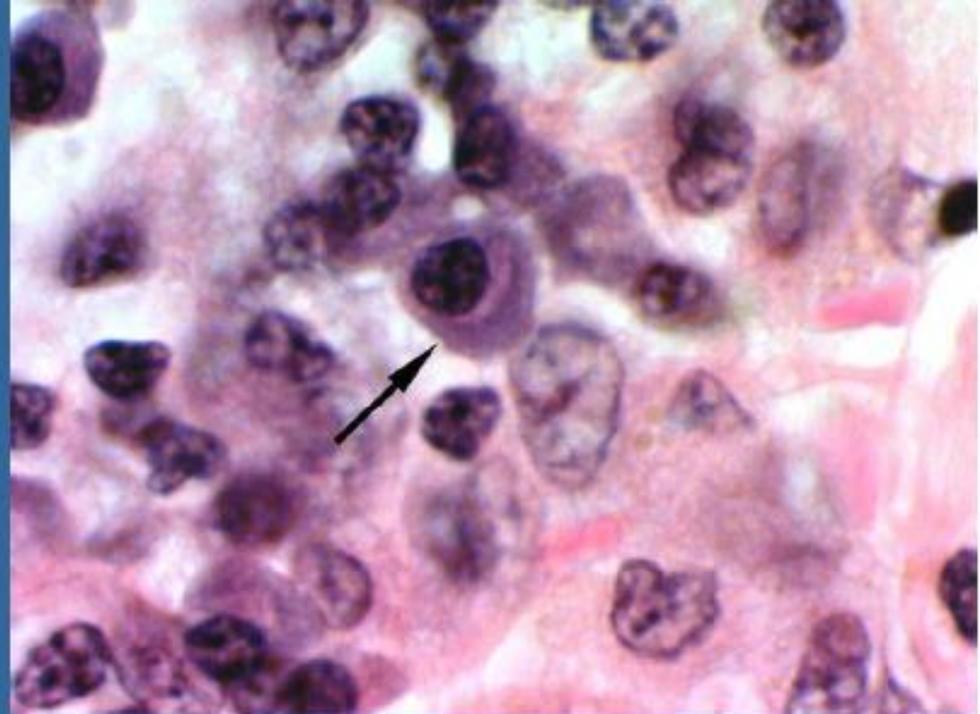
MAST CELLS



MAST CELLS WITH H&E

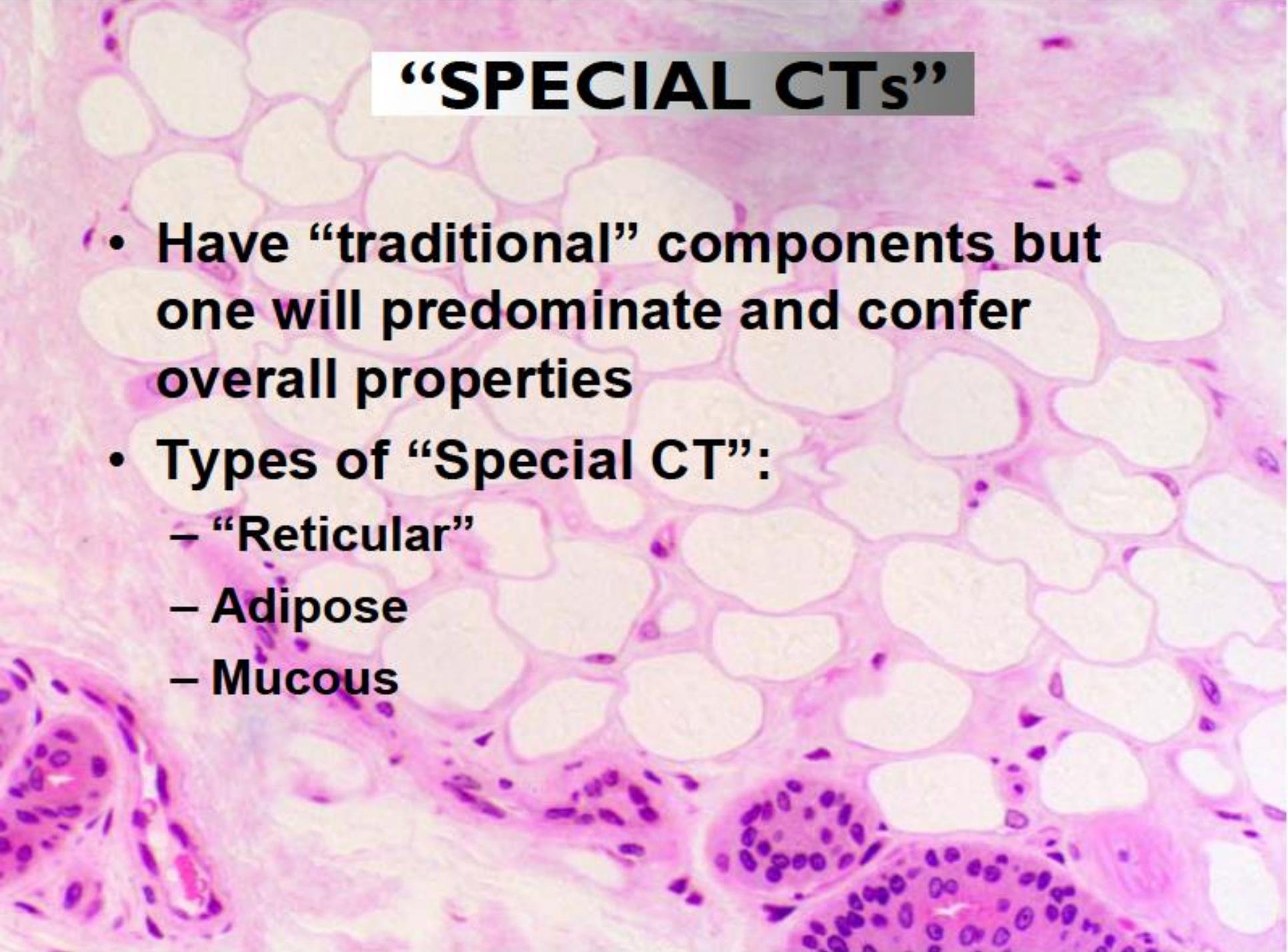
PLASMA CELLS

- An “activated” B lymphocyte
 - Site of production of antibodies
- Very numerous under epithelial sheets
- Accumulate in large numbers when body’s integrity is breached
- Characteristic appearance
 - “Clock face” chromatin
- Gradations exist



“SPECIAL CTs”

- **Have “traditional” components but one will predominate and confer overall properties**
- **Types of “Special CT”:**
 - **“Reticular”**
 - **Adipose**
 - **Mucous**

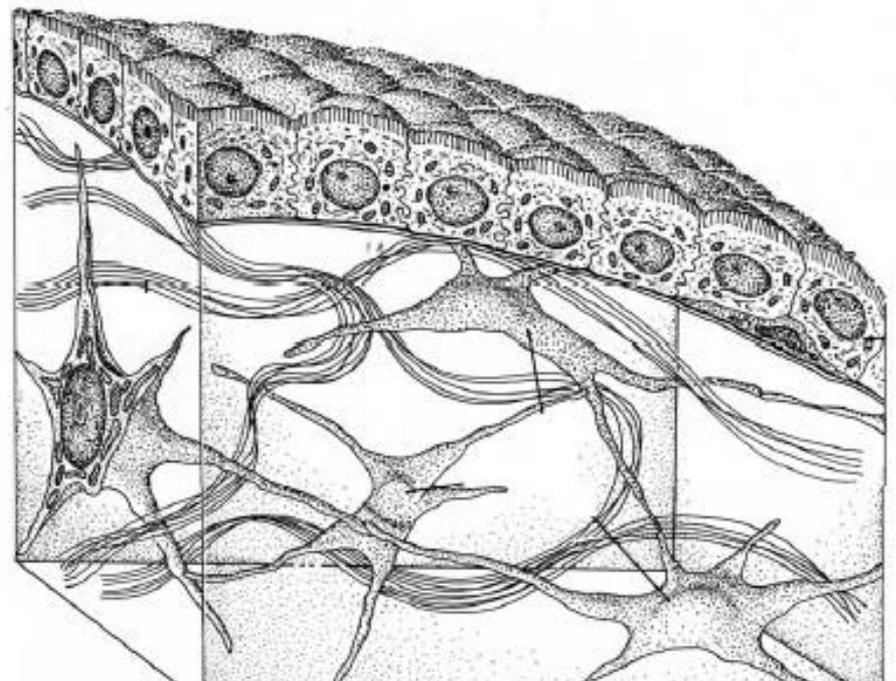


“RETICULAR” CT

- **Fibrous component is “reticular fibers,” i.e., Type III collagen**
- **Form 3-D webworks**
- **More cellular than most CT's**
- **Relatively little matrix**
- **Found in:**
 - **Stroma of lymphatic organs**
 - **Anchoring BV's**
 - **Hemopoietic areas**

MUCOUS CT

- Not normally found in *adult* mammals in any significant amount
 - Fetal tissue
 - Umbilical Cord
- Matrix material predominant element
- Gooney and wet
- Fibers very scanty; cells scattered



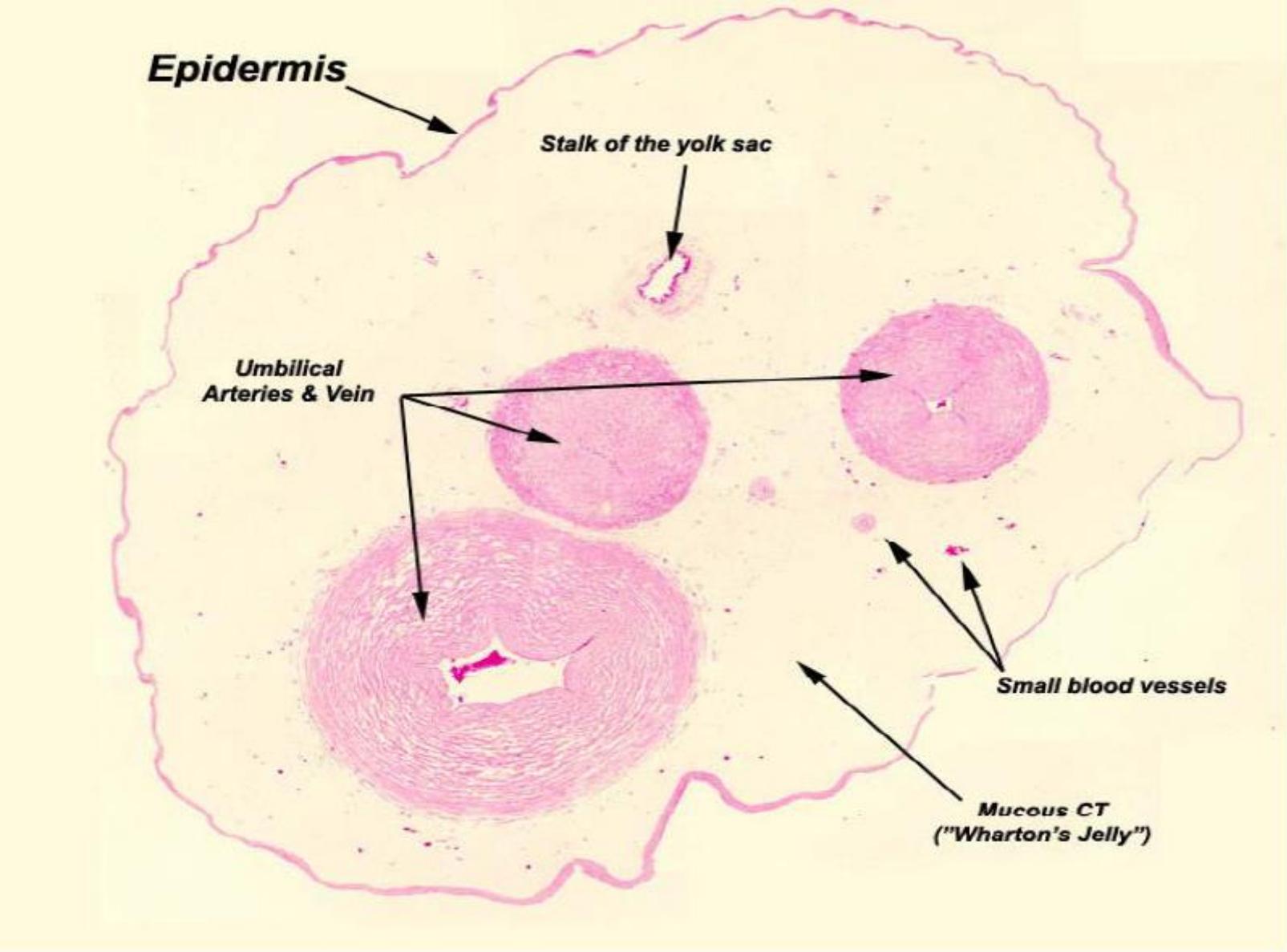
Epidermis

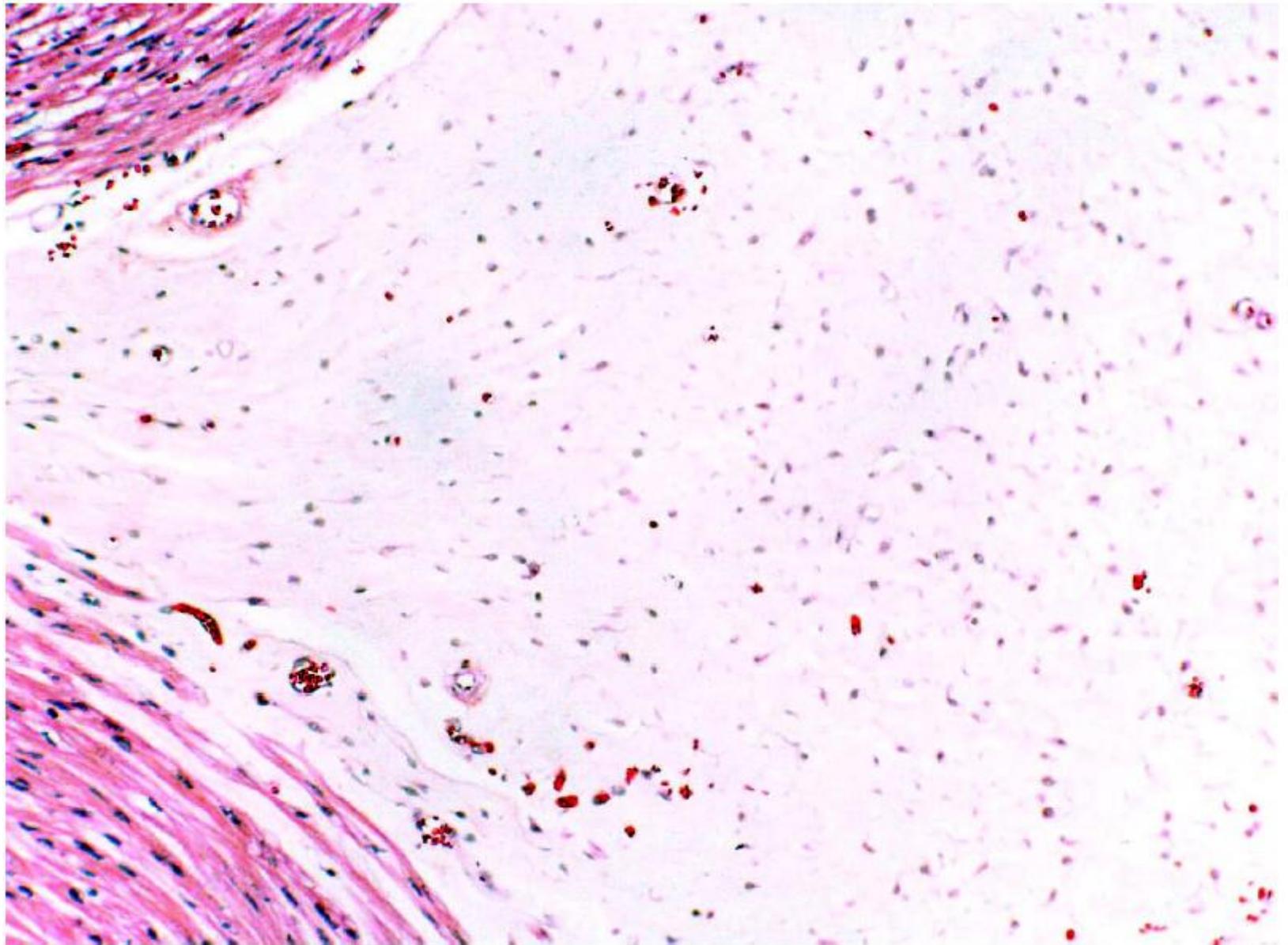
Stalk of the yolk sac

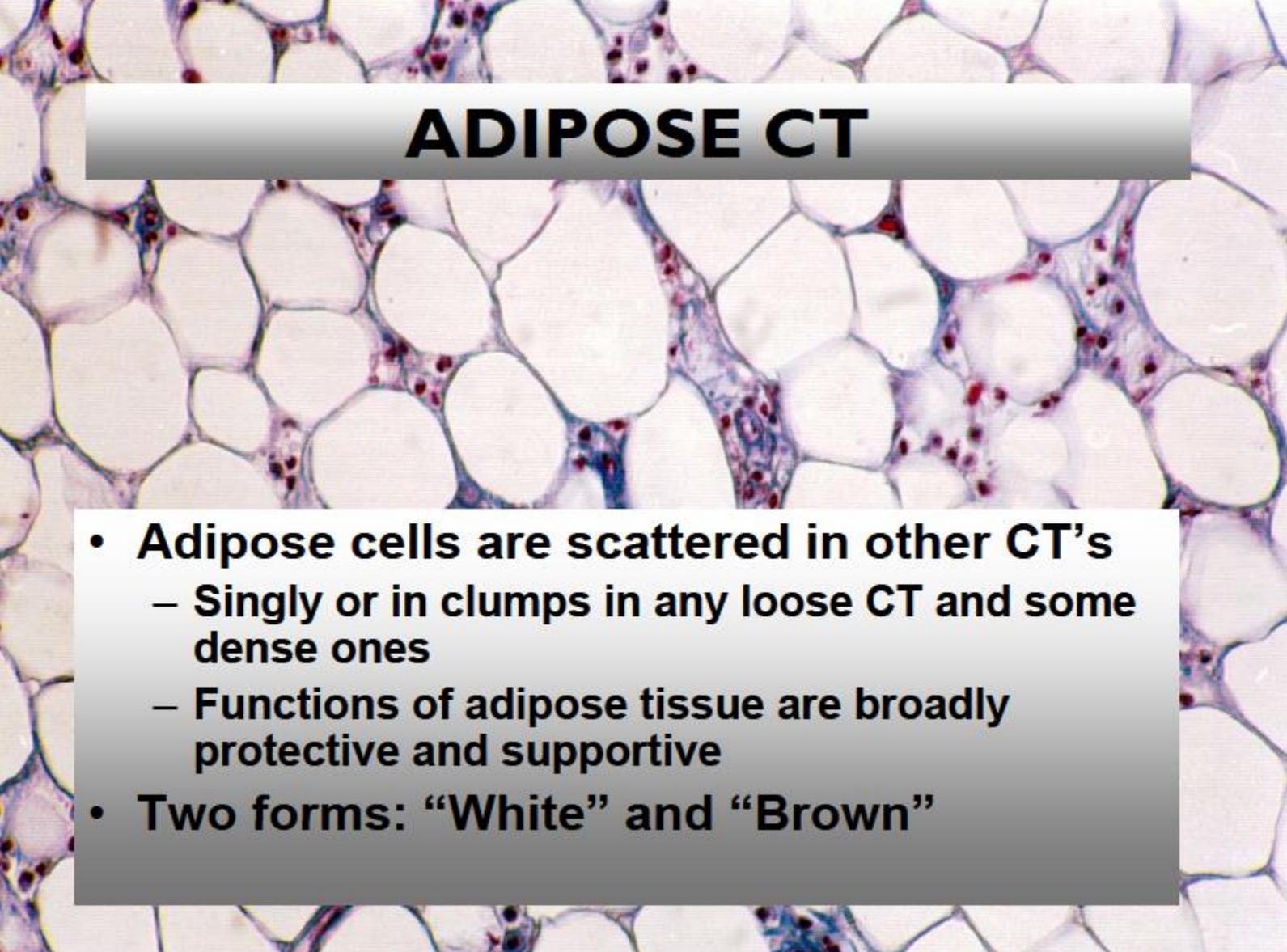
**Umbilical
Arteries & Vein**

Small blood vessels

**Mucous CT
("Wharton's Jelly")**







ADIPOSE CT

- **Adipose cells are scattered in other CT's**
 - Singly or in clumps in any loose CT and some dense ones
 - Functions of adipose tissue are broadly protective and supportive
- **Two forms: “White” and “Brown”**

WHITE FAT

- Cells occur singly or in depots in fibrous CT
- “Chicken wire” appearance
- Single droplet of lipid
- Energy storage and shock protection functions

