

**Tissues.**

**The histophysiology of  
the Epithelial tissue.**

# The plan of the lecture

1. Tissue.
2. The basic types of tissues.
3. The common characteristics of epithelia.  
Histogenesis of the epithelia.
4. The epithelial reactivity and the regeneration.
5. The general characteristics of glands.
6. The morphology of the secretory cycle.

**The tissue – is the morphological or morphofisiological system.**

**Tissue is the team of the same differentiated cells (F. Shter, 1917).**

**Tissue is the number of connecting cells, which are modified for the realization of the function (V.P. Karpov, 1917).**

**“Although some cells in the body are essentially migratory and therefore to some extent independent entities, most exist in aggregations which carry out similar or closely related functions, and which behave in a coordinated manner. Such groups are termed tissues”.**

**The tissues are systems of cells and noncellular structures characterized by similar structural, functional properties and development (M.j. Subbotin)**

**The tissue is the system of interacting differons, which development, structure and functions are determined by phylogenesis and ontogenesis (R.K.Danilov)**



**– the stack of  
cells from low-  
to the high-  
es.**

**Differentiation – the morphofunctional exchange of the same organized cells.**

**The main result of the differentiation is the pool of the active functioning cells.**

**Time-differentiation** – the stages of the cell's morphofunctional exchange as the tissual unit.



## Layers

**Stratum corneum**

**Stratum lucidum**

**Stratum granulosum**

**Stratum spinosum**

**Stratum basale**

**CONNECTIVE TISSUE**



# Time-differentiation – creation of the different types of cells.

There are elements of the ciliar epithelium:

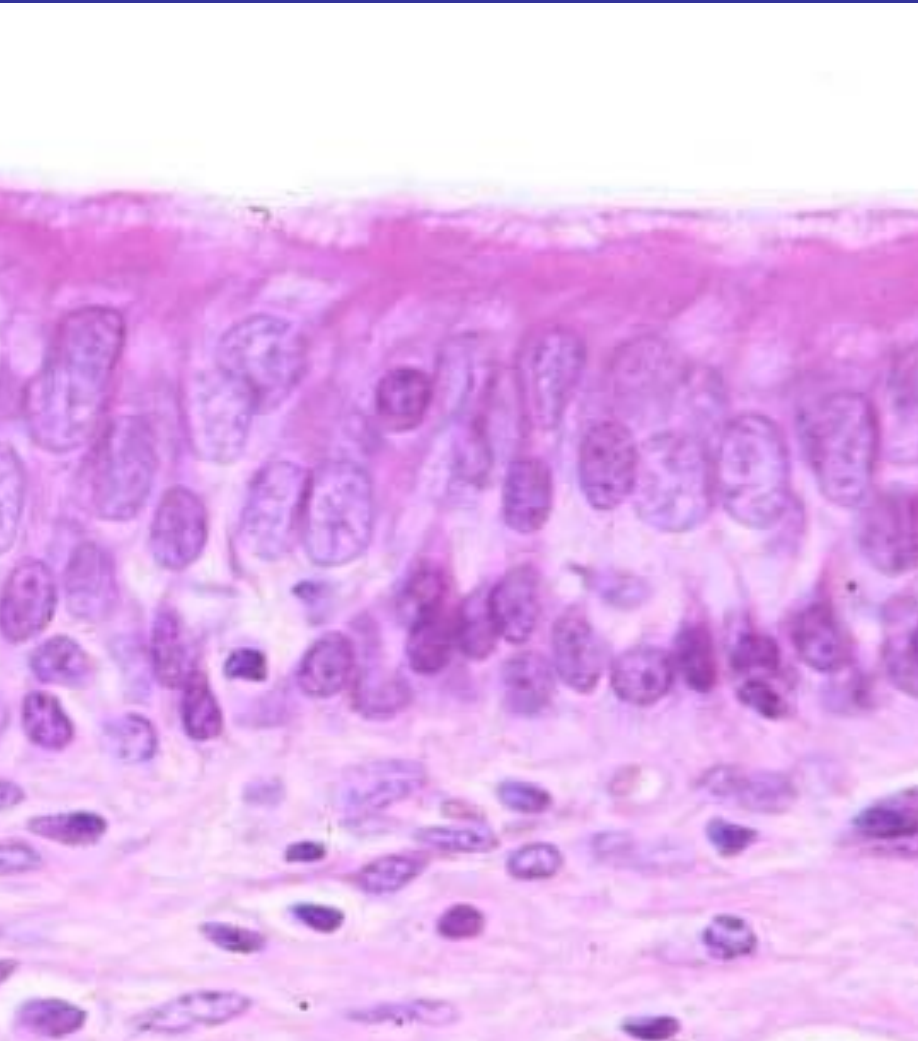
**CILIAR CELLS**

**GOBLET CELLS**

**BASE CELLS**

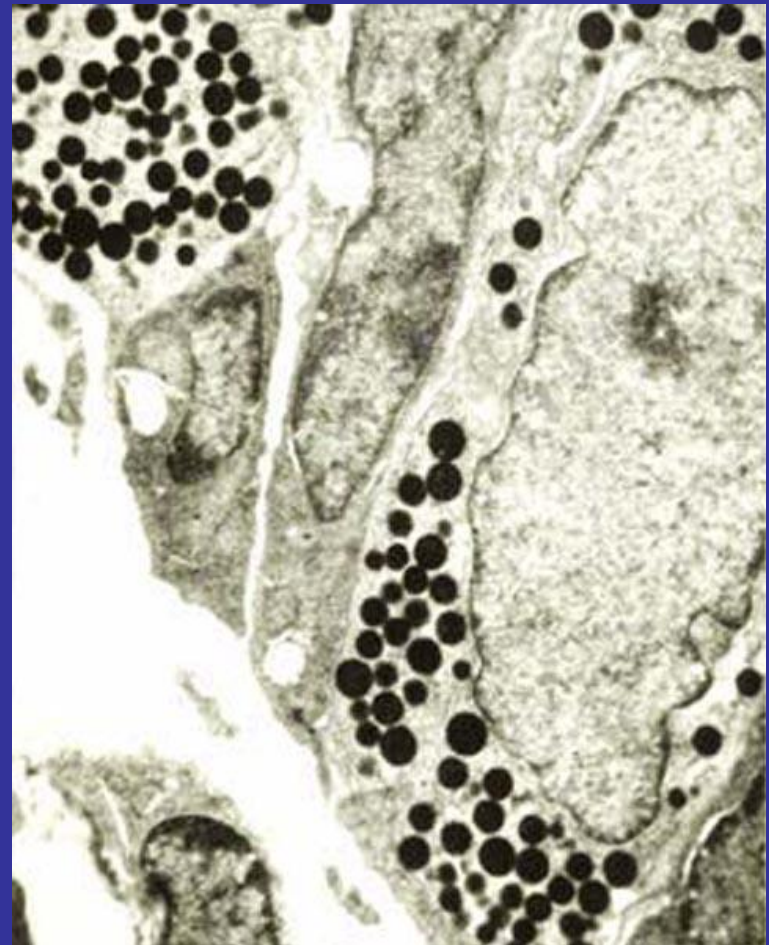
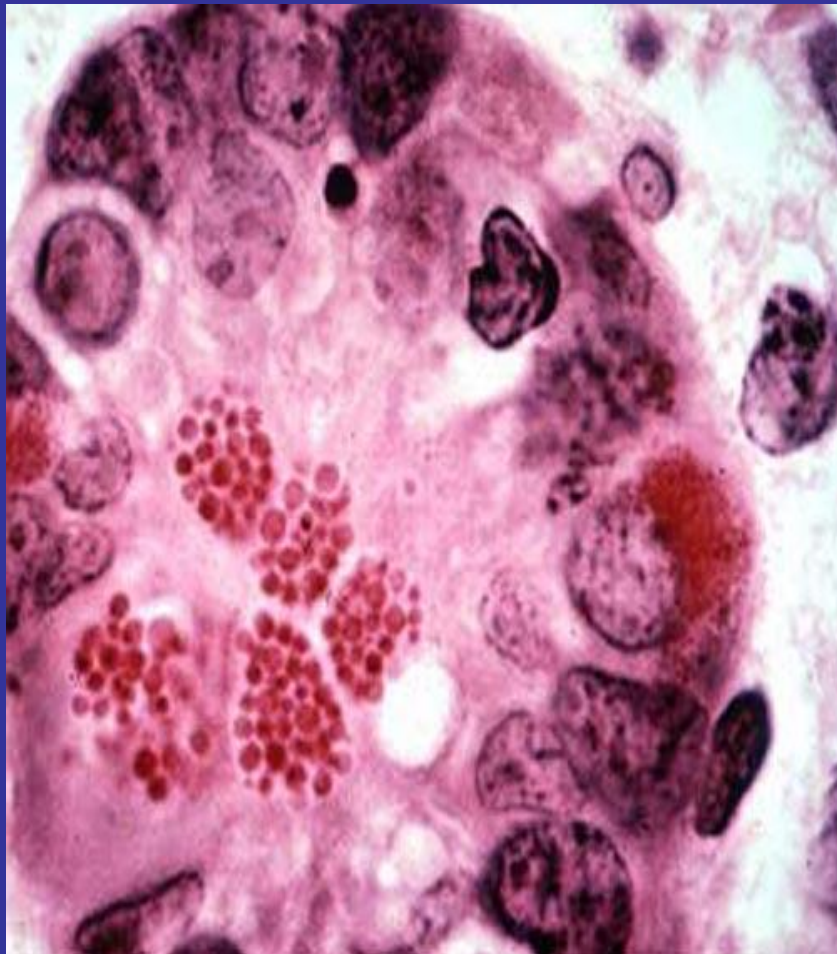
**INTERMEDIATE CELLS**

**ENDOCRINE CELLS**



Biochemical-differentiation – creation of the cells producing specific proteins.

## EXOCRINE AND ENDOCRINE CELLS OF THE INTESTINAL EPITHELIUM





**First of all start to differentiate the stem cells source the differenton.**

**Stem cell's characteristics:**

- 1. They self-support the cell's pool.**
- 2. Mitosis.**
- 3. An ability to start differentiation for some daughter cells after division of the mother cell.**

**The differentiation is supervised by the nerve, endocrine and the immune systems.**

**Regeneration** – the capability of the tissue to recover itself after violation. There are known different mechanisms of the regeneration at the different tissues.

**Intracellular regeneration** – organell's recovering. Most typical for the nerve tissue, myocardium, salivary glands. The reason – there are no stem cell at that tissues.

**Cell regeneration** – possible by mitosis of the stem cells. Most typical for epithelium and muscular tissue.

**Histotypical regeneration** – an exchange of the parenchymal cells by the stromal one.

**Physiological regeneration** – the recovering of the cell's population after the death of some cells.

**Reparation** – the recovering of the cell's population or the cell's structure after the violation.

# The History.

**1665 год. Robert Hook was describe the “cell”.**

**1830 год. Jan Purcinje - cytoplasm.**

**1833 год. Brown - nucleus.**

**1838 год. Muller & Shwann were sum the known up to that time facts stated the first statements of the modern cell-theory.**

**1858 год. Virchov found that the new cell is the result of the mother-cell division.**

**1866 год. Kellicker was classify all tissues in 4 types.**

**1934 год. Zavarsin stated the parallelism in tissue evolution.**

# THE BASIC TYPES OF TISSUES

**EPITHELIAL**

**CONNECTIVE (SUPPORT) AND BLOOD**

**MUSCLE**

**NERVOUS**



# THE COMMON CHARACTERISTICS OF EPITHELIA

- COVER SURFACES OR LINE CAVITIES
- FORM CONTINUOUS LAYERS
- INDIVIDUAL CELLS ARE TIGHTLY JOINED BY JUNCTIONS
- REST ON BASEMENT MEMBRANES WITH UNDERLYING CONNECTIVE TISSUE
- AVASCULAR (NO BLOOD VESSELS)
- SURFACE AND CYTOPLASM ARE SPECIALIZED INTO THE APICAL AND BASAL PARTS
- ARE RENEWING TISSUES (POSSESS STEM CELLS)



# CLASSIFICATION OF EPITHELIA

## 1.ARRANGEMENT OF LAYERS

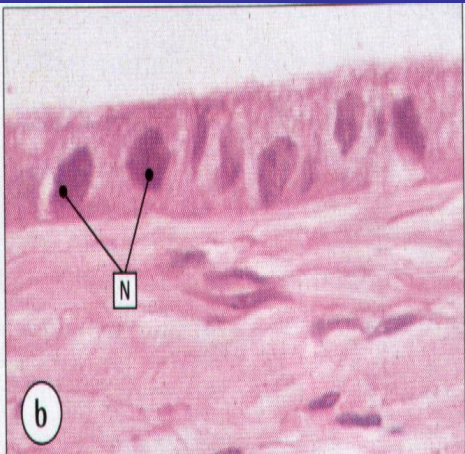
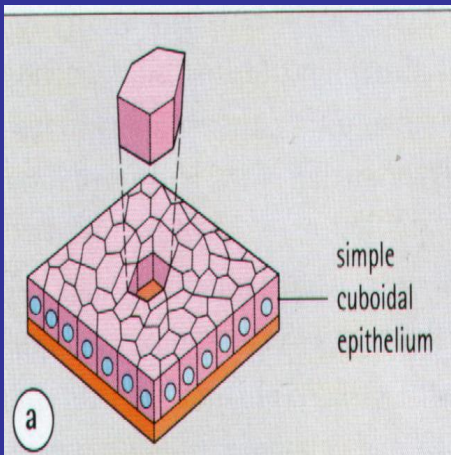
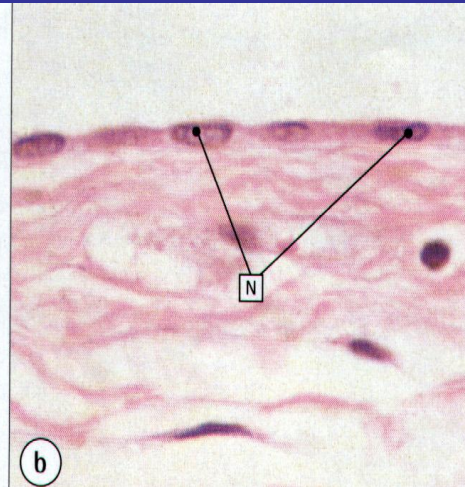
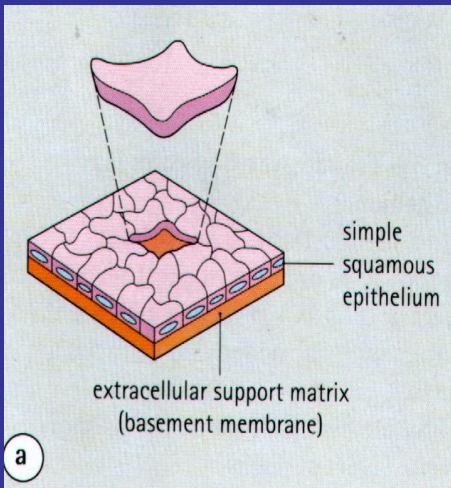
- **SIMPLE** (ALL OF THE CELLS CONTACT UNDERLYING BASEMENT MEMBRANE)
- **STRATIFIED** (ONLY BOTTOM LAYER IS IN CONTACT WITH BM)

## 2.THE SHAPE OF COMPONENT CELLS

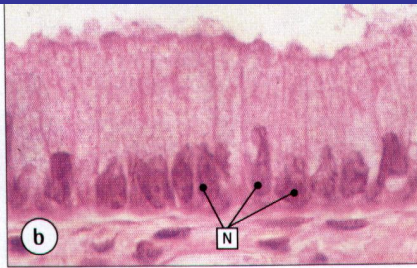
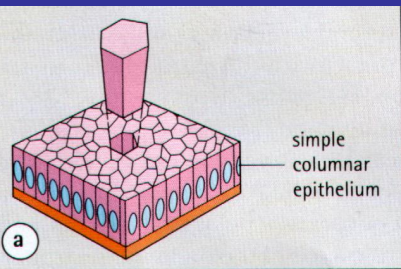
- **SQUAMOUS**
- **CUBOIDAL**
- **COLUMNAR**

## 3.SURFACE MODIFICATIONS

- **WITH MICROVILLI (STRIATED BORDER, BRUSH BORDER), STEREOCILIA**
- **WITH CILIA**
- **KERATINIZED**
- **NONKERATINIZED**



# THE LOCATION OF THE MAJOR TYPES OF EPITHELIA

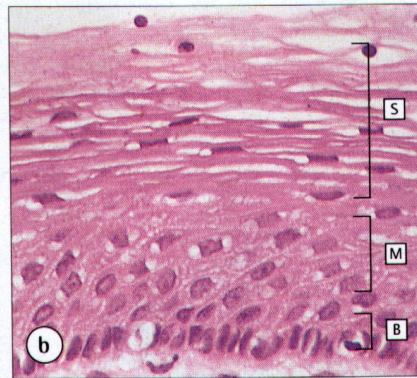
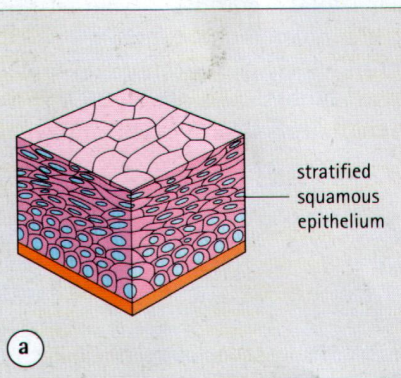


**SIMPLE  
SQUAMOUS**

- BLOOD VESSELS
- SEROUS MEMBRANES
- Henle's loops OF KINDEY

**SIMPLE CUBOIDAL**

- KIDNEY TUBULES
- SMALL DUCTS OF GLANDS



**SIMPLE  
COLUMNAR**

- STOMACH
- GALL BLADDER & BILE DUCTS
- INTESTINAL MUCOSA**

**WITH MICROVILLI**

**PSEUDOSTRITIFIED  
(CILATED)**

- RESPIRATORY PASSAGES

**STRATIFIED  
NONKERATINIZED**

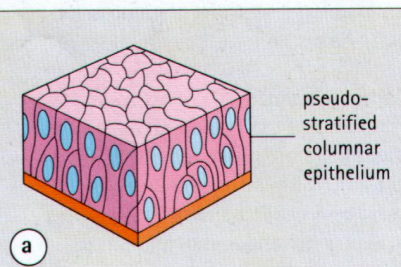
- ESOPHAGUS
- ANTERIOR CORNEAL SURFACE
- PART OF ORAL CAVITY

**STRATIFIED  
KERATINIZED**

- SKIN
- PART OF ORAL CAVITY

**TRANSITIONAL**

- URINARY PASSAGES





# SPECIALIZATIONS OF THE PLASMA MEMBRANE

**1.APICAL PART** – MICROVILLI, CILIA, STEREOCILIA, BORDERS

**2.LATERAL PART** – CELL JUNCTIONS

**3.BASAL PART** – HEMIDESMOSOMES, BASAL STRIATION

## EPITHELIAL CELL JUNCTIONS:

**OCCLUDING JUNCTIONS** – TO FORM BARRIER

**ANCHORING JUNCTIONS & DESMOSOMES**– TO PROVIDE MECHANICAL STRETCH

**COMMUNICATING JUNCTIONS** – ALLOW MOVEMENTS OF MOLECULES BETWEEN CELLS

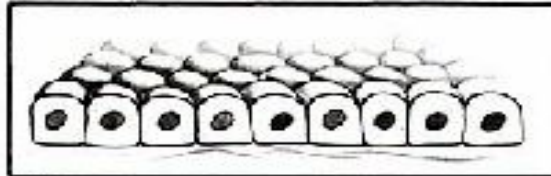
# EPITHELIAL TISSUES

SQUAMOUS

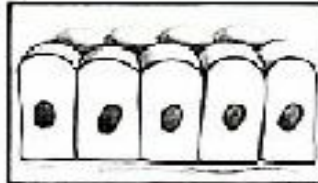


... see also: mesothelium – lining coelomic surfaces;  
endothelium – lining vascular channels.

CUBOIDAL



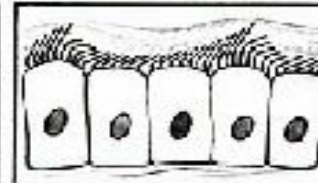
COLUMNAR



Without surface  
specialization



With microvilli  
(brush/striated border)



Ciliated



Glandular

UNILAMINAR  
(SIMPLE)

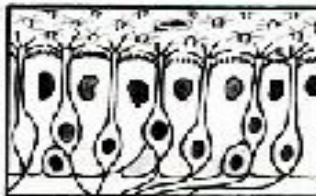


Pseudostratified

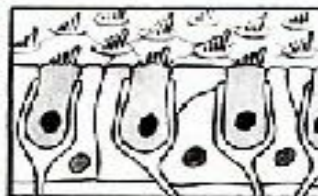
SENSORY



Gustatory



Olfactory



Stato-acoustic

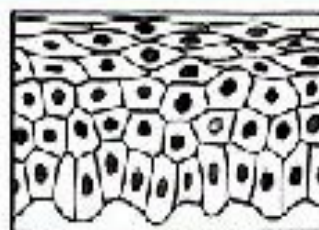
MYOEPIITHELIOCYTE



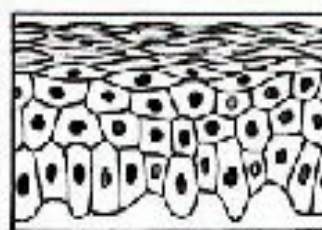


# MULTILAMINAR

## STRATIFIED SQUAMOUS



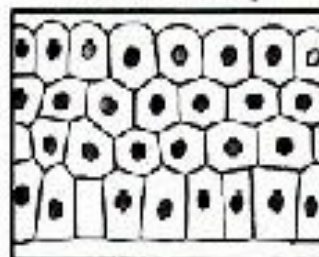
Non-keratinizing



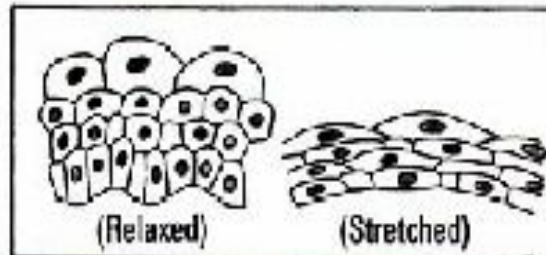
Keratinizing

May include pigmented components

## STRATIFIED CUBOIDAL/COLUMNAR



## UROTHELIUM (TRANSITIONAL)



(Relaxed)

(Stretched)

# COMPLEX DERIVED STRUCTURES

## MULTICELLULAR GLANDS

Exocrine

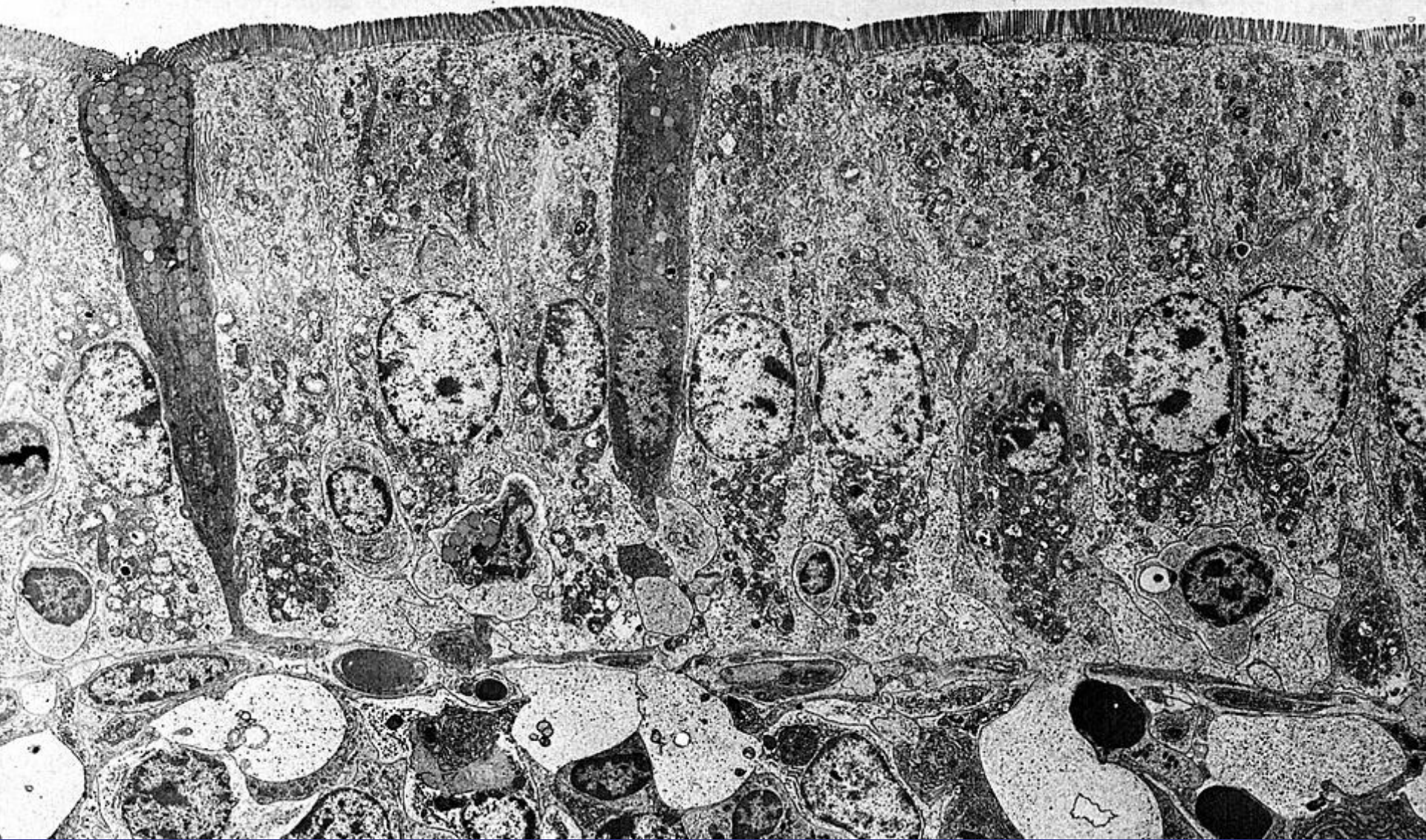
Endocrine

... see 'glands', including other complex 'combined' structures e.g. liver, pancreas, placenta, gonads.

## TOOTH GERM

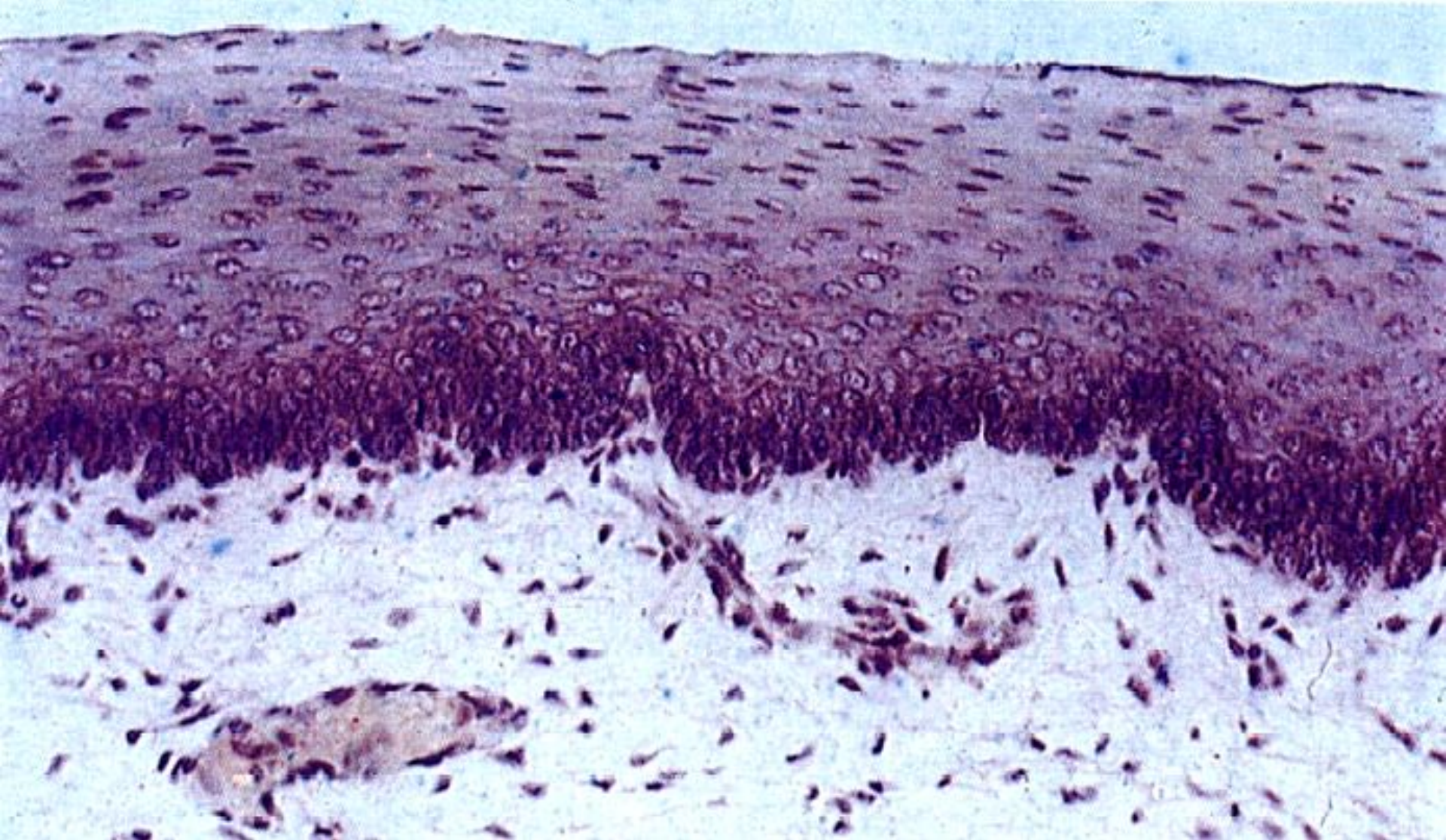
NERVOUS TISSUE (often classified as a separate tissue, but retains many characteristics of its epithelial origins).  
SEMINIFEROUS EPITHELIUM





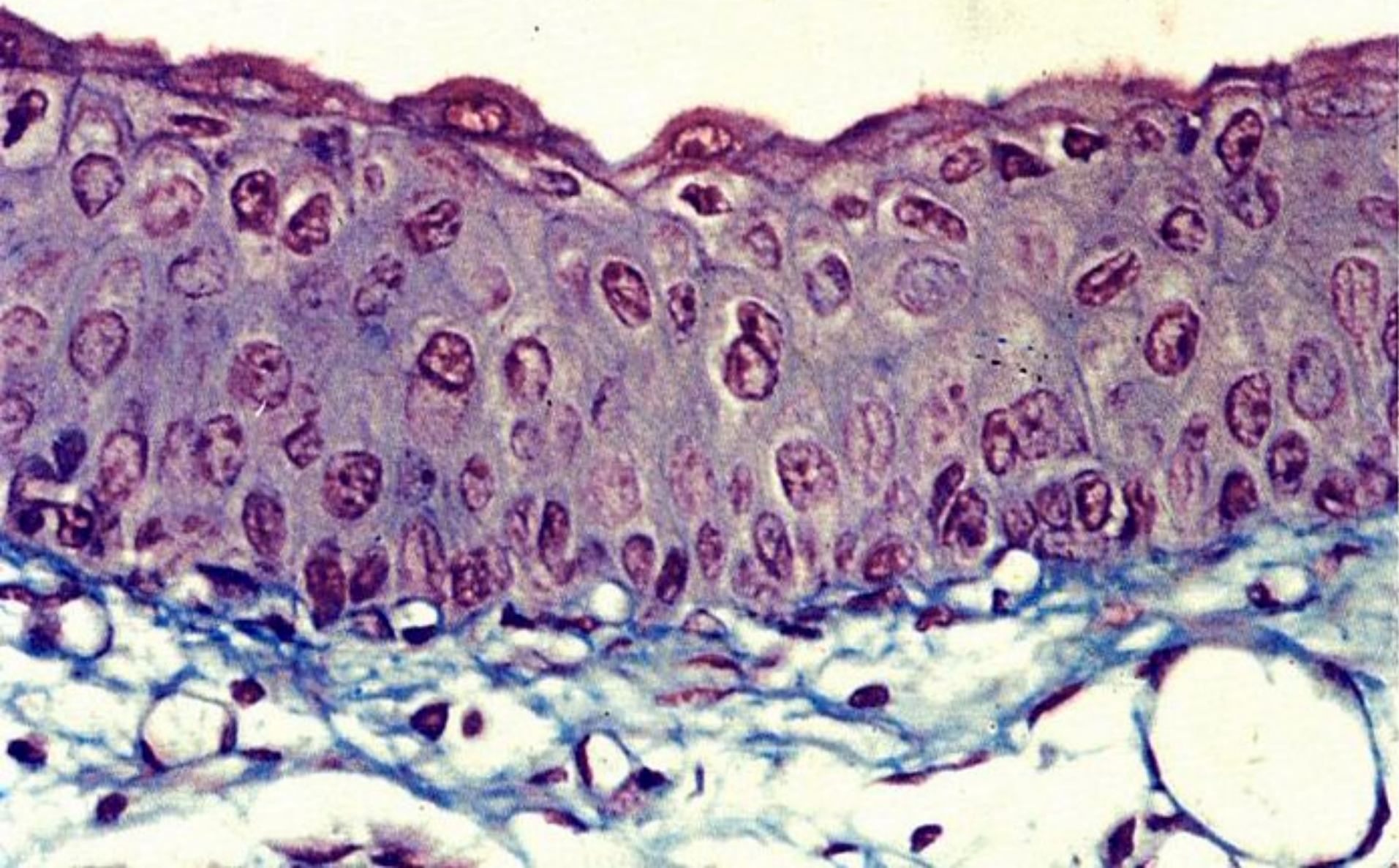
Low-power electron micrograph of a vertical section through simple columnar epithelium bearing microvilli; two goblet cells are also present. Note the presence of several small lymphocytes near the epithelial base. Small intestine. Provided by Derrick Lovell, Guy's Hospital Medical School. Magnification  $\times 8000$ .





Non-keratinizing, stratified squamous epithelium from the human tongue. A vertical section stained with haematoxylin and eosin. Note the presence of nuclei in the surface cells. Magnification  $\times 150$ .





A vertical section through the surface of a ureter to show the urothelium lining its lumen, stained by Mallory's triple staining technique. Magnification  $\times 600$ .





Scanning electron micrograph of the (relaxed) urothelial surface showing the plate-like arrangement of its plasma membrane. Magnification  $\times 6000$ .





Transmission electron micrograph of the surface of the urothelium (transitional epithelium) lining the relaxed bladder. Note the angular profiles of the epithelial surface and the plate-like areas of membrane internalization.

Magnification  $\times 15\,000$ .

# SECRETORY EPITHELIA AND GLANDS

- **ENDOCRINE**
- **EXOCRINE**

□ **PROTEINS SECRETING**

□ **MUCUS SECRETING**

□ **LIPIDS (STEROIDS)  
SECRETING**

□ **IONS-PUMPING**

## **EXOCRINE GLANDS**

**SIMPLE  
COMPOUND**

**ALVEOLAR  
TUBULAR  
MIXED**

**BRANCHED  
NONBRANCHED**

## **MECHANISMS OF SECRETION**

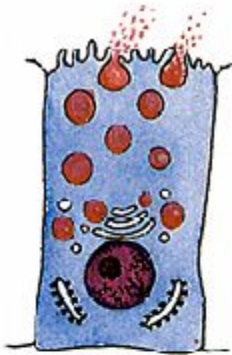
**MEROCRINE  
APOCRINE  
HOLOCRINE**



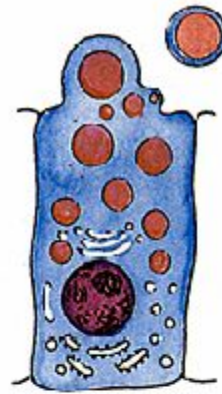
## MECHANISM OF SECRETION



a) Active transport across plasma membrane



b) Merocrine



c) Apocrine

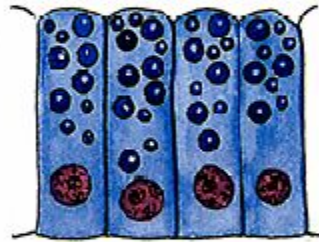


d) Holocrine

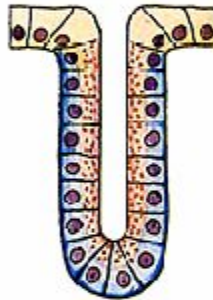
## ARRANGEMENT OF CELLS



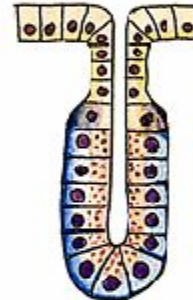
a) Unicellular



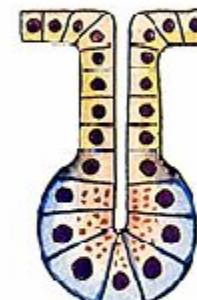
b) Multicellular, laminar



c) Simple tubular without duct



d) Simple tubular with duct

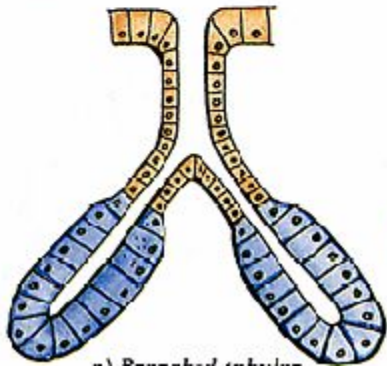


e) Simple acinar or alveolar with duct

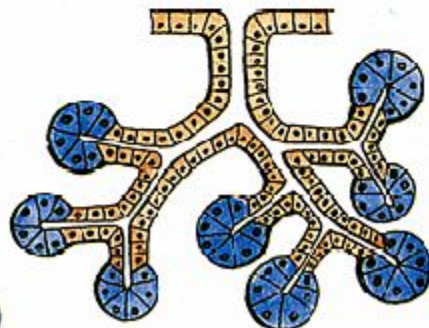


f) Saccular

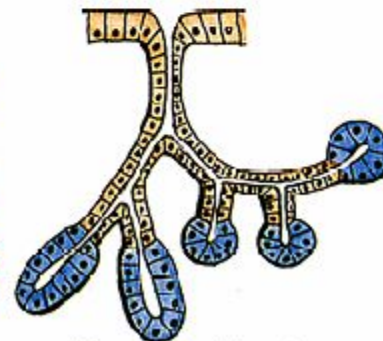
## BRANCHING PATTERN OF COMPOUND GLANDS



a) Branched tubular



b) Branched acinar/alveolar



c) Branched tubulo-acinar

## SECRETORY CONTENTS



a) Serous



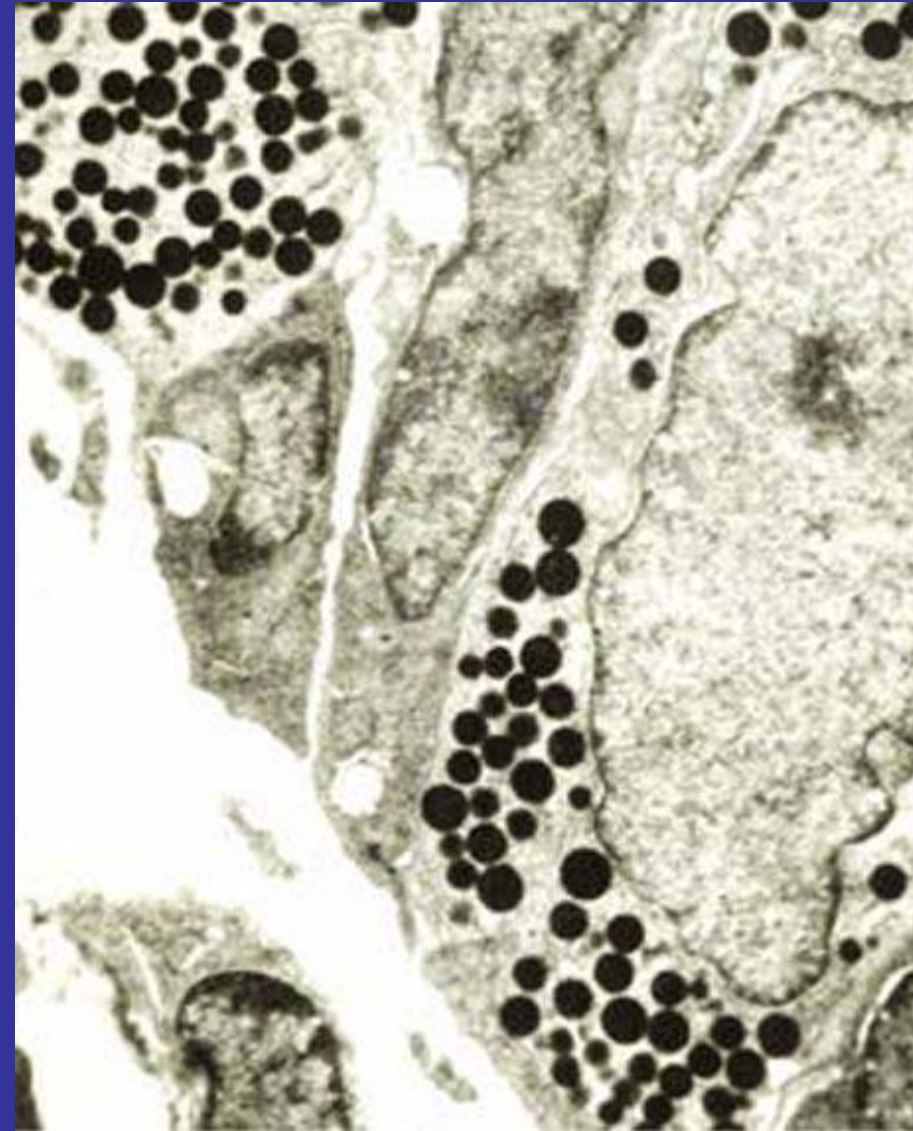
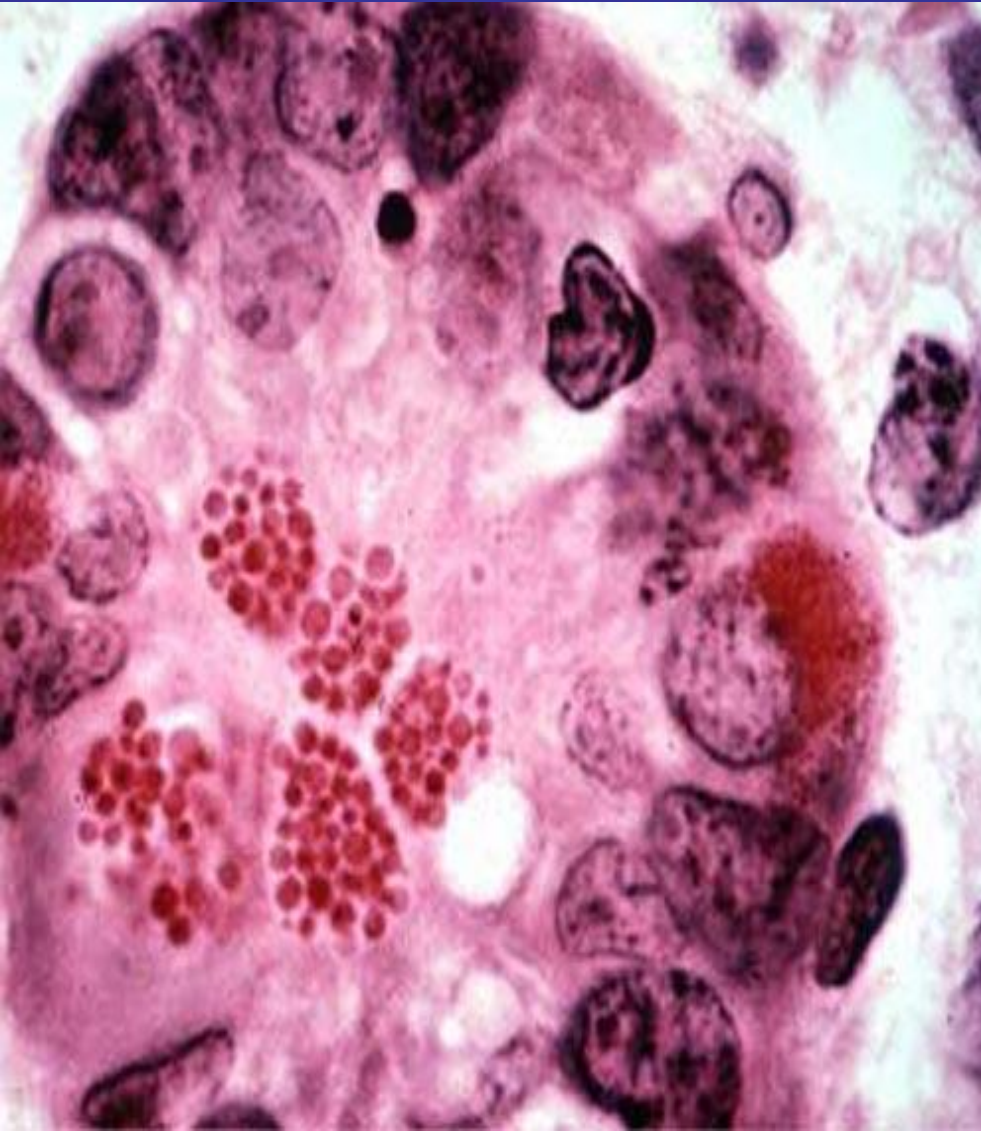
b) Mucous



c) Mucous with serous cap (demilune)

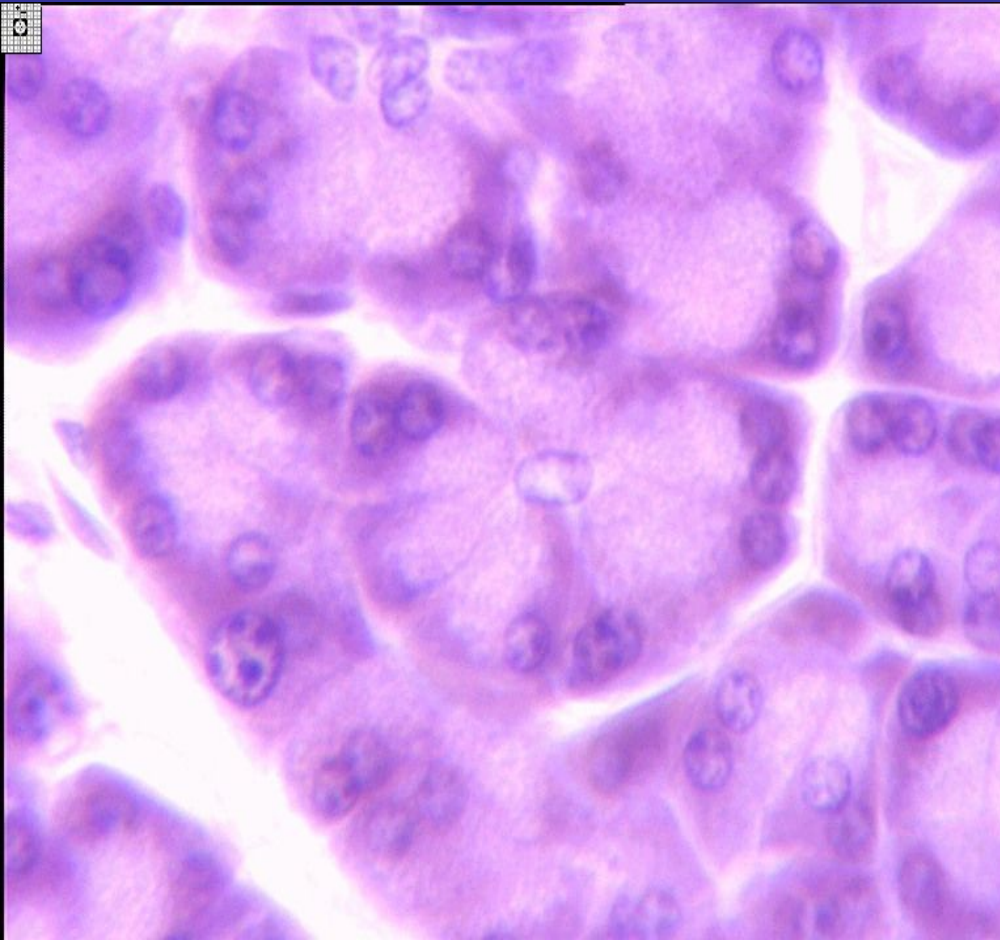


## EXOCRINE AND ENDOCRINE CELLS OF INTESTINAL EPITHELIUM

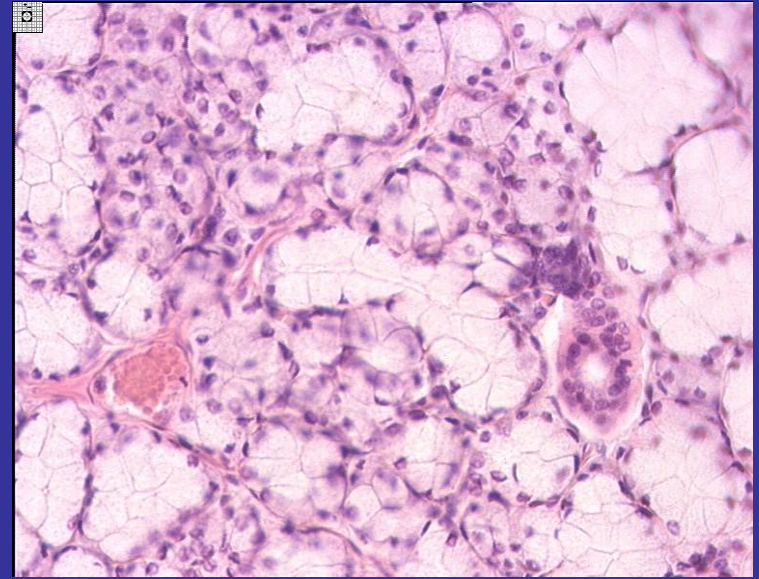




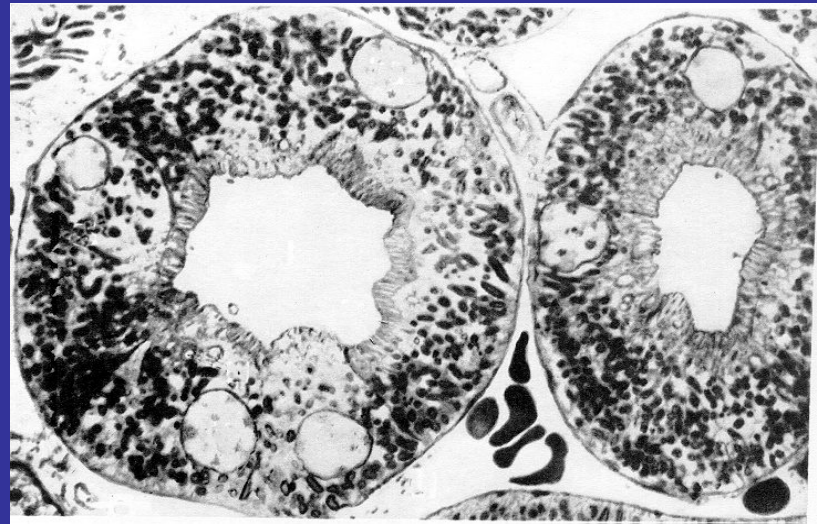
## PROTEINS-SECRETING CELLS



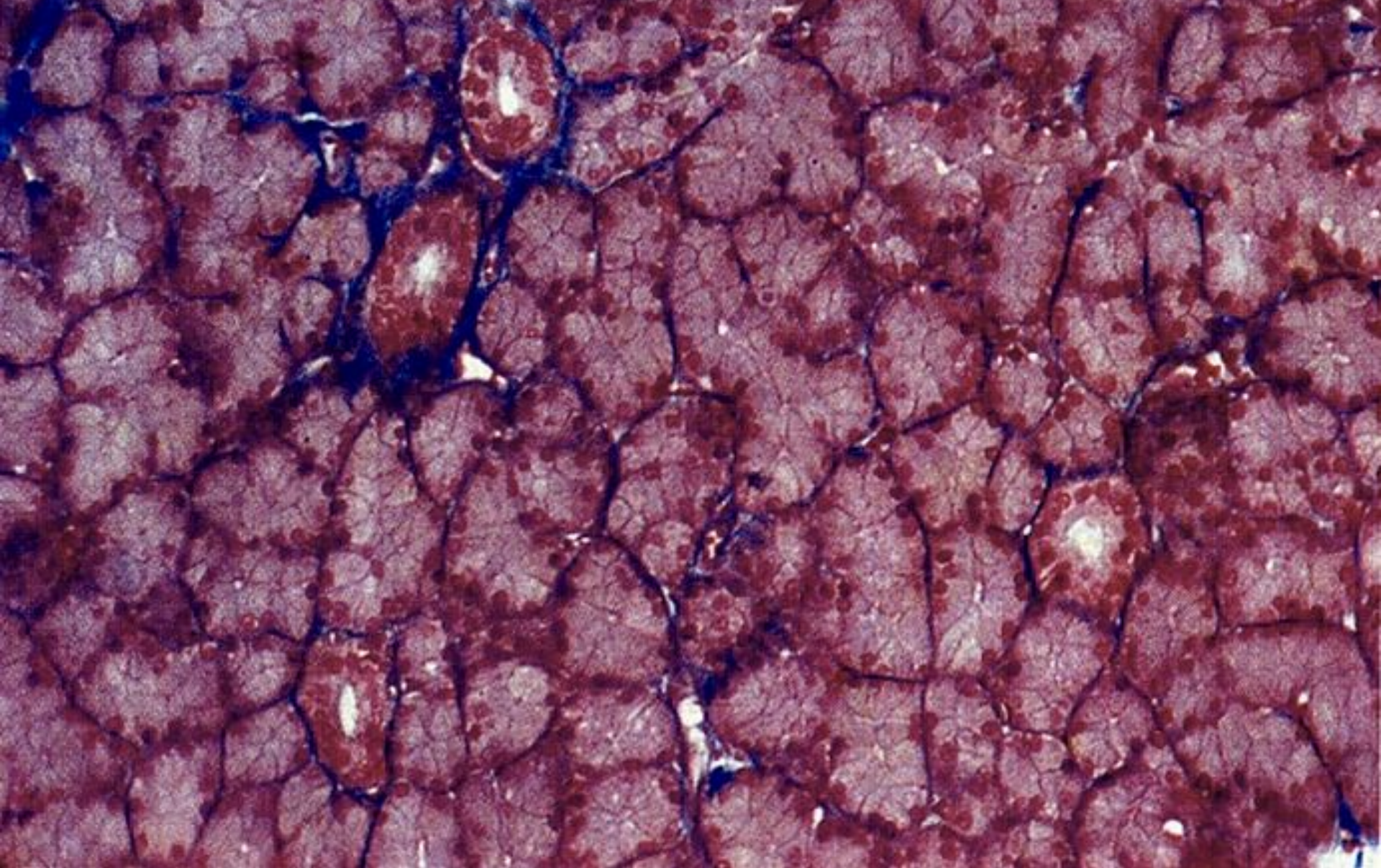
## MUCUS-SECRETING CELLS



## IONS-PUMPING CELLS

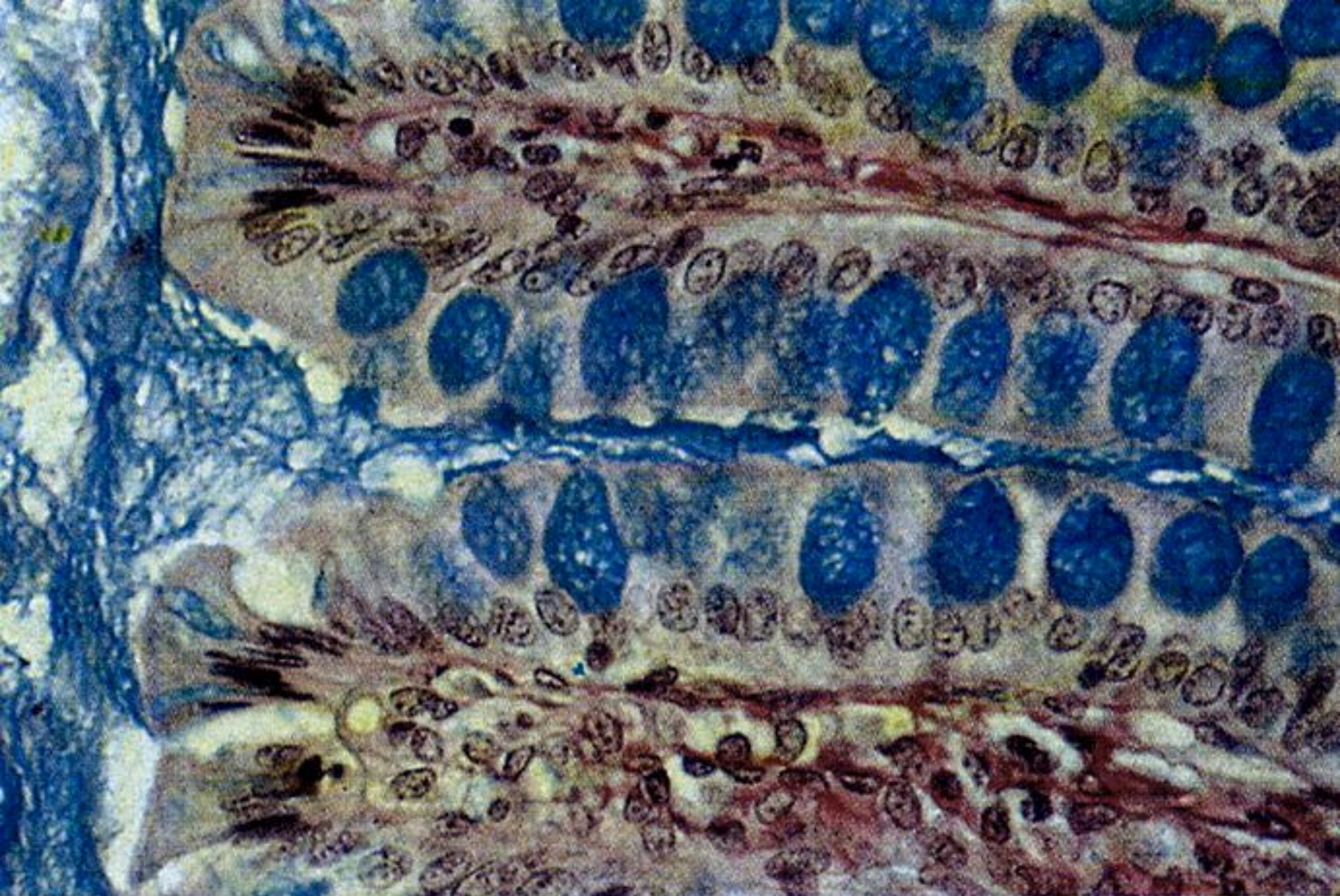






Section through a compound alveolar gland (nasopharynx), stained with periodic acid-Schiff to show mucus within secretory lobules. The connective tissue septa have been stained blue. Two small ducts are also visible. Magnification  $\times 160$ .

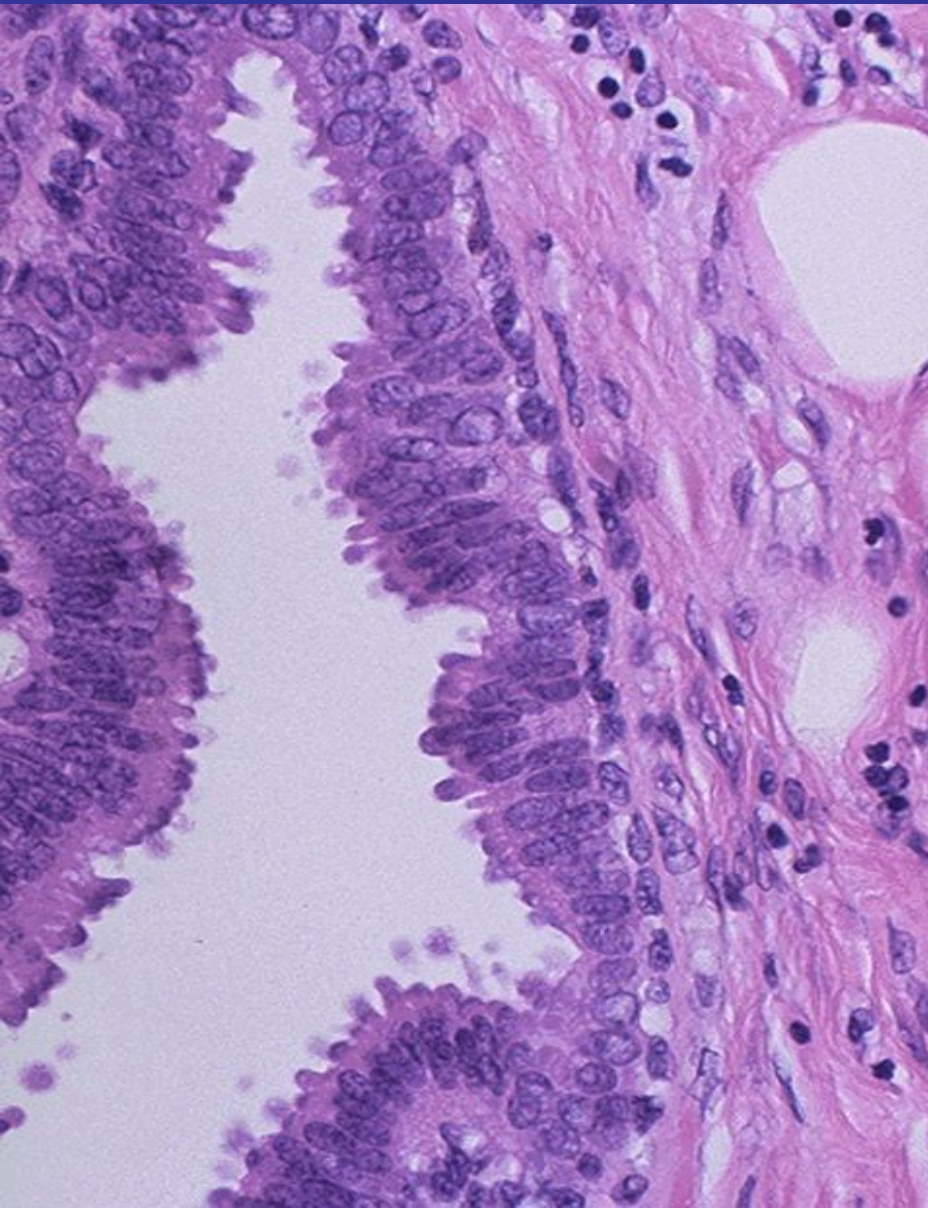




Section through part of a simple tubular gland (colon) stained with alcian blue show mucous gland cells. Magnification  $\times 500$ .



**APOCRINE SECRETION  
(MAMMARY GLAND)**



**HOLOCRINE SECRETION  
(SEBACEOUS GLANDS)**

