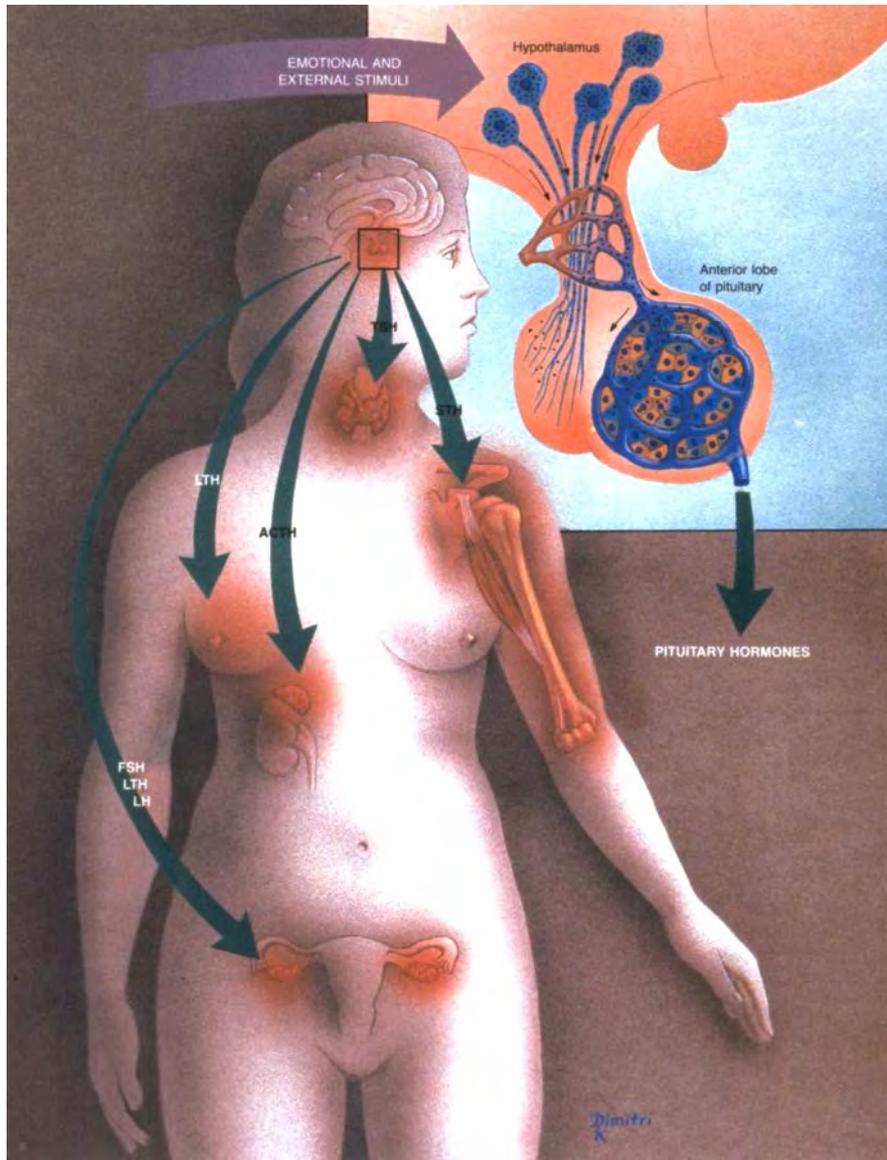


# Endocrine System



## Organs and Tissues:

- Pituitary
- Adrenals
- Pancreas
- Thyroid
- Parathyroids

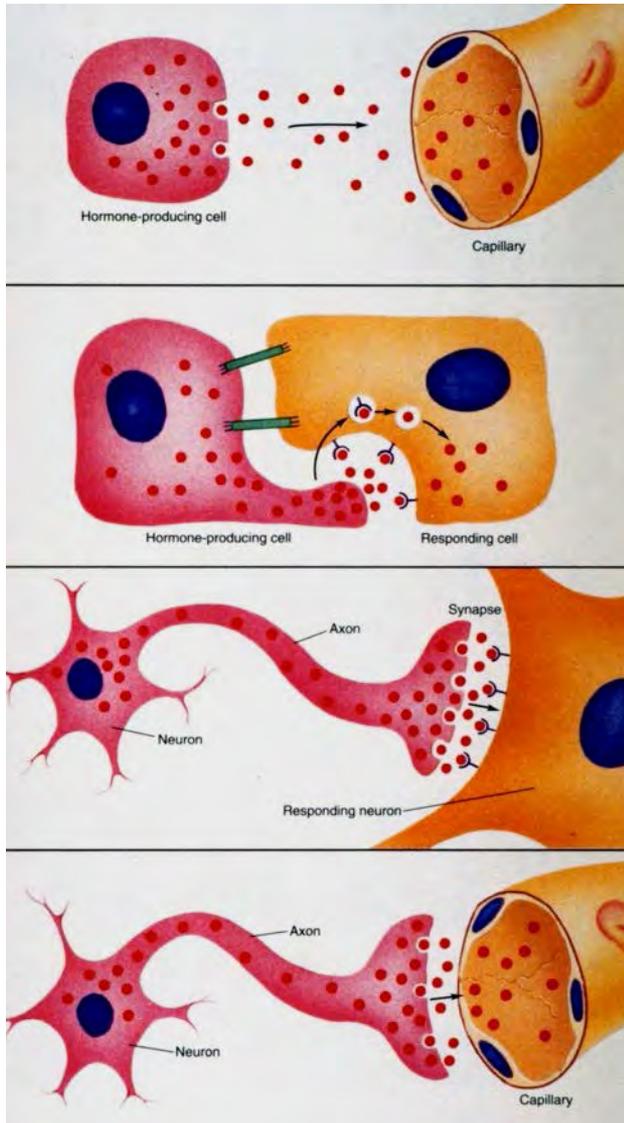
Bruce A. Fenderson, Ph.D.

Pathology, Anatomy & Cell Biology

Sidney Kimmel Medical College

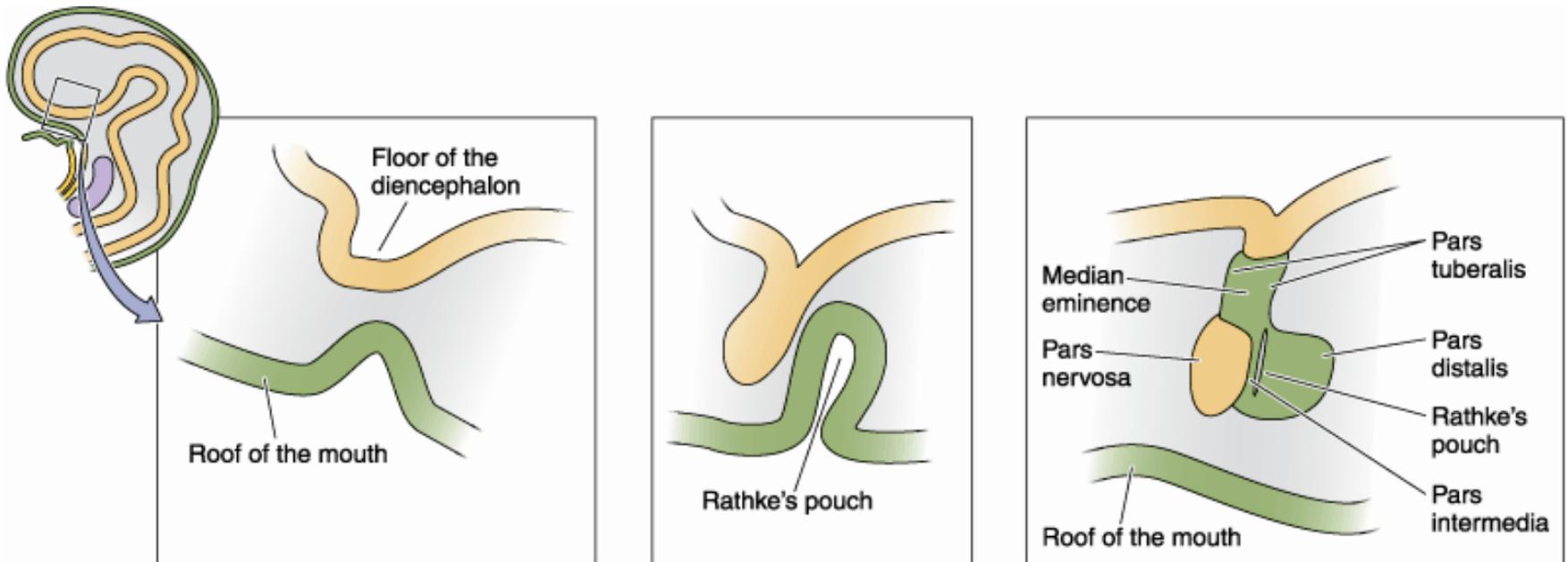
Bruce.Fenderson@Jefferson.edu

# Mechanisms of Cell Communication



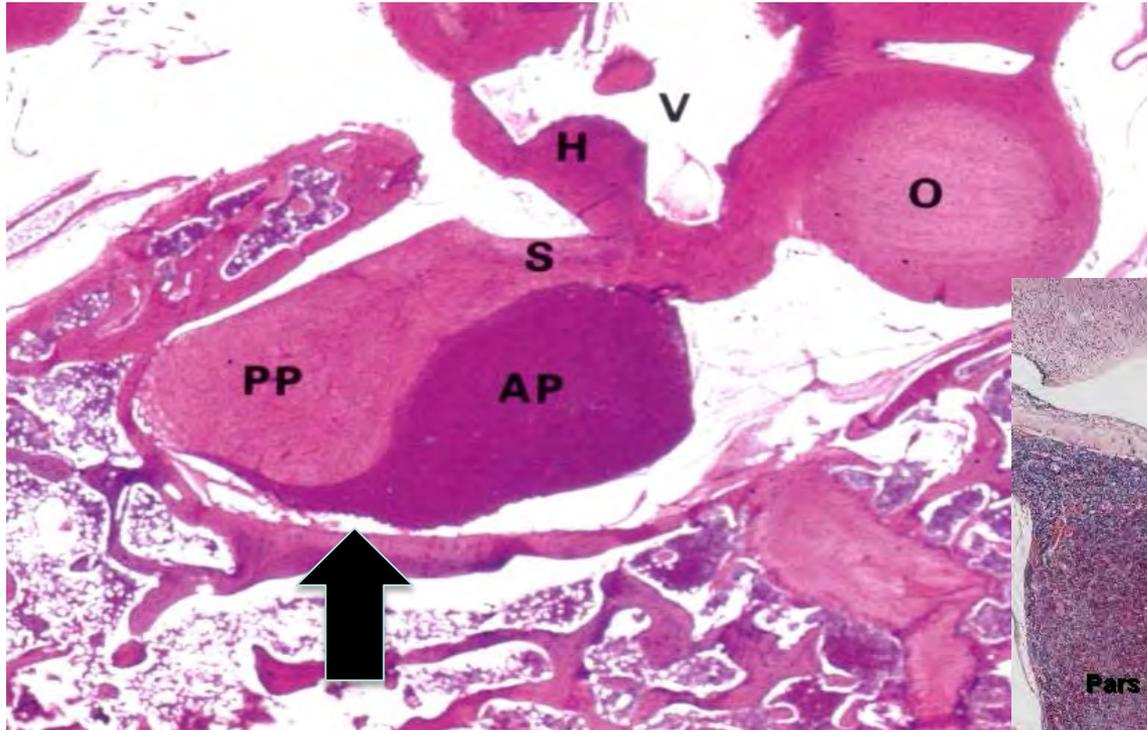
- Endocrine
- Paracrine, autocrine
- Synaptic
- Neuroendocrine

# Development of the Pituitary (Neurohypophysis & Adenohypophysis)

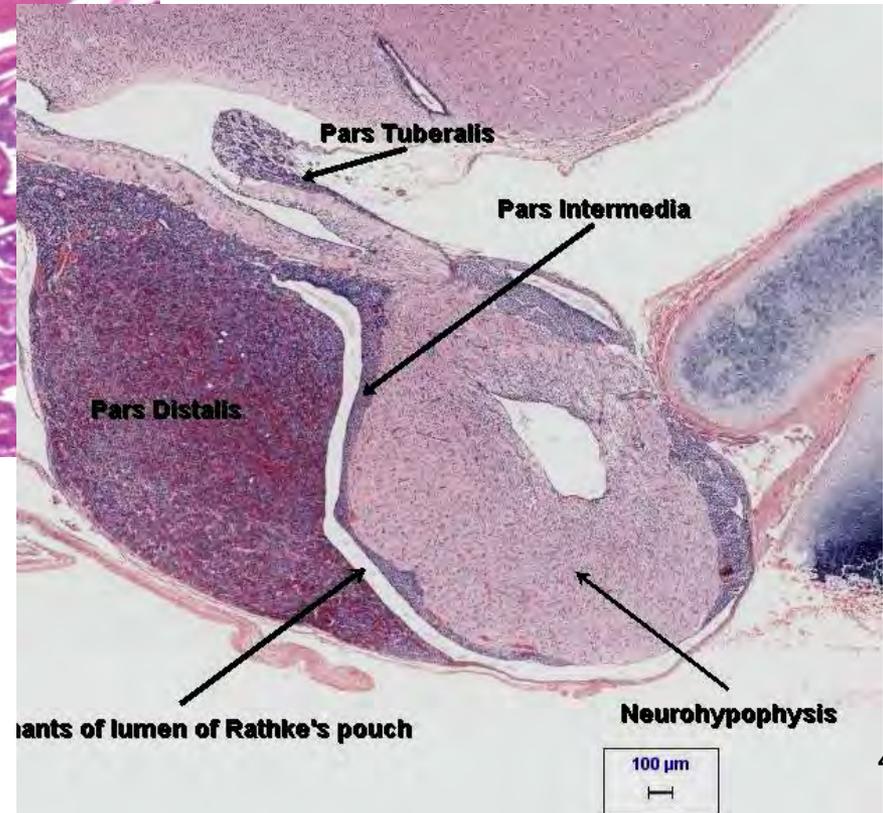


From Junqueira's *Basic Histology Text and Atlas*

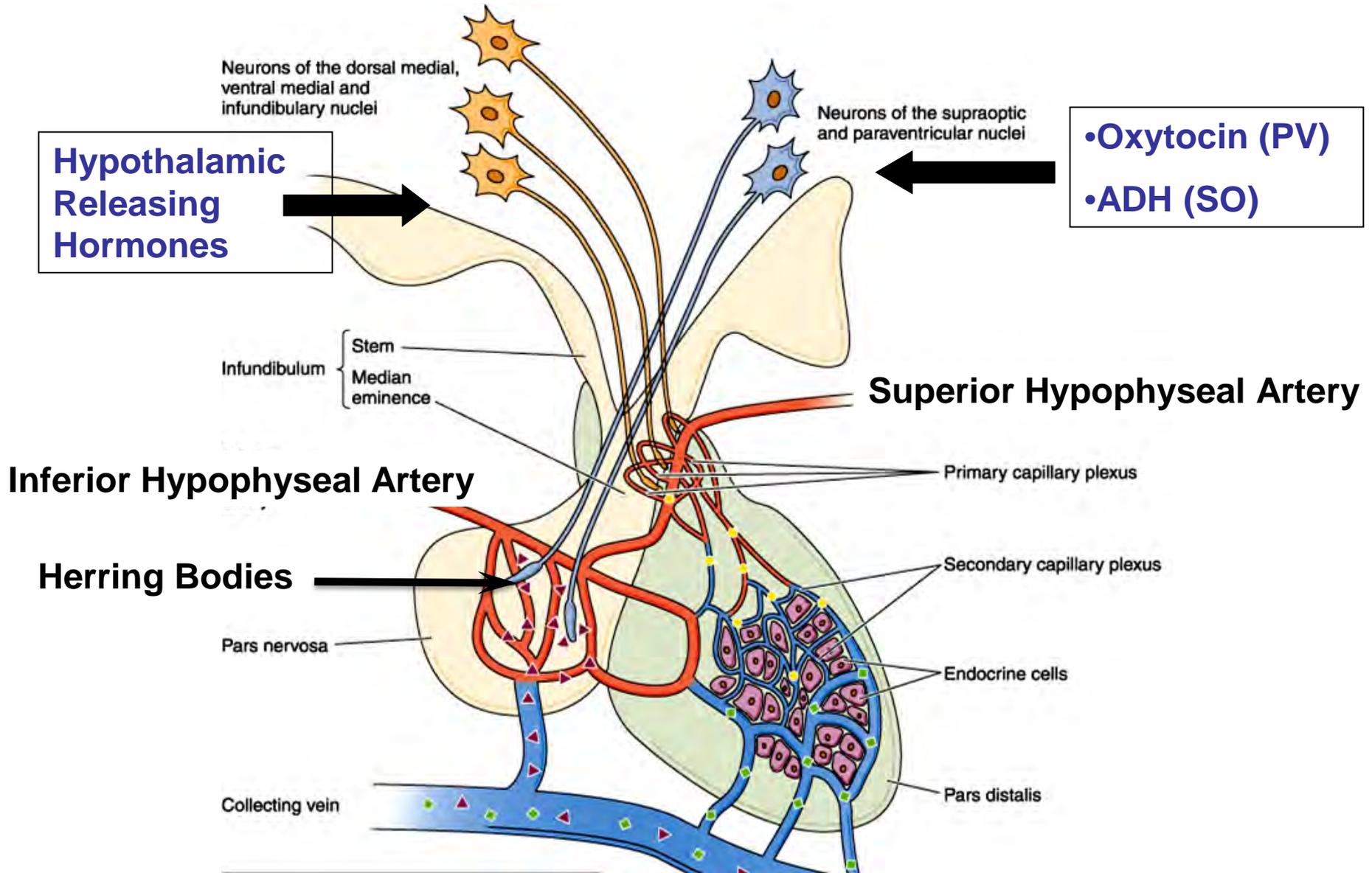
# Pituitary Gland (Master Gland)



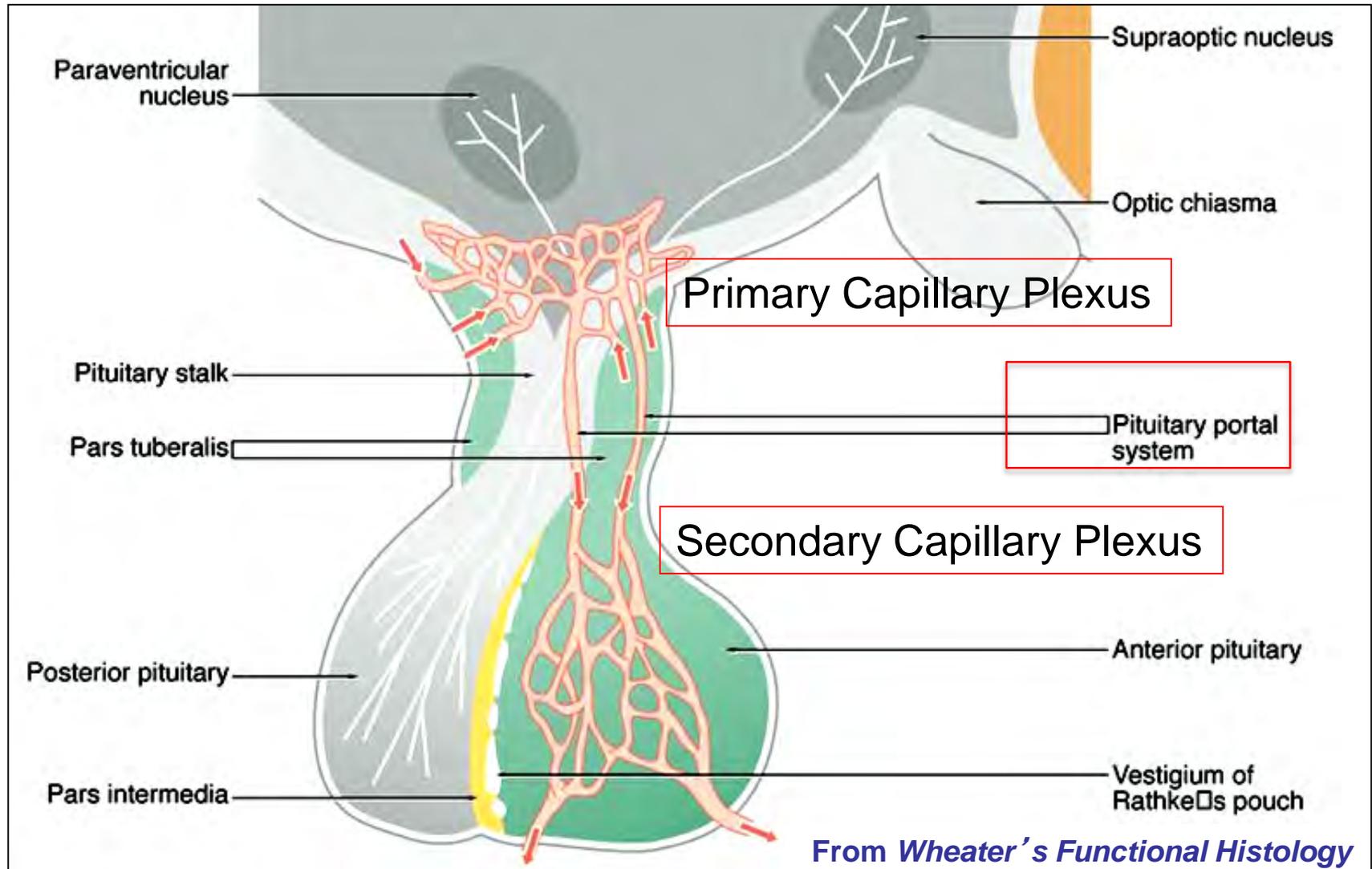
From *Wheater's Functional Histology*



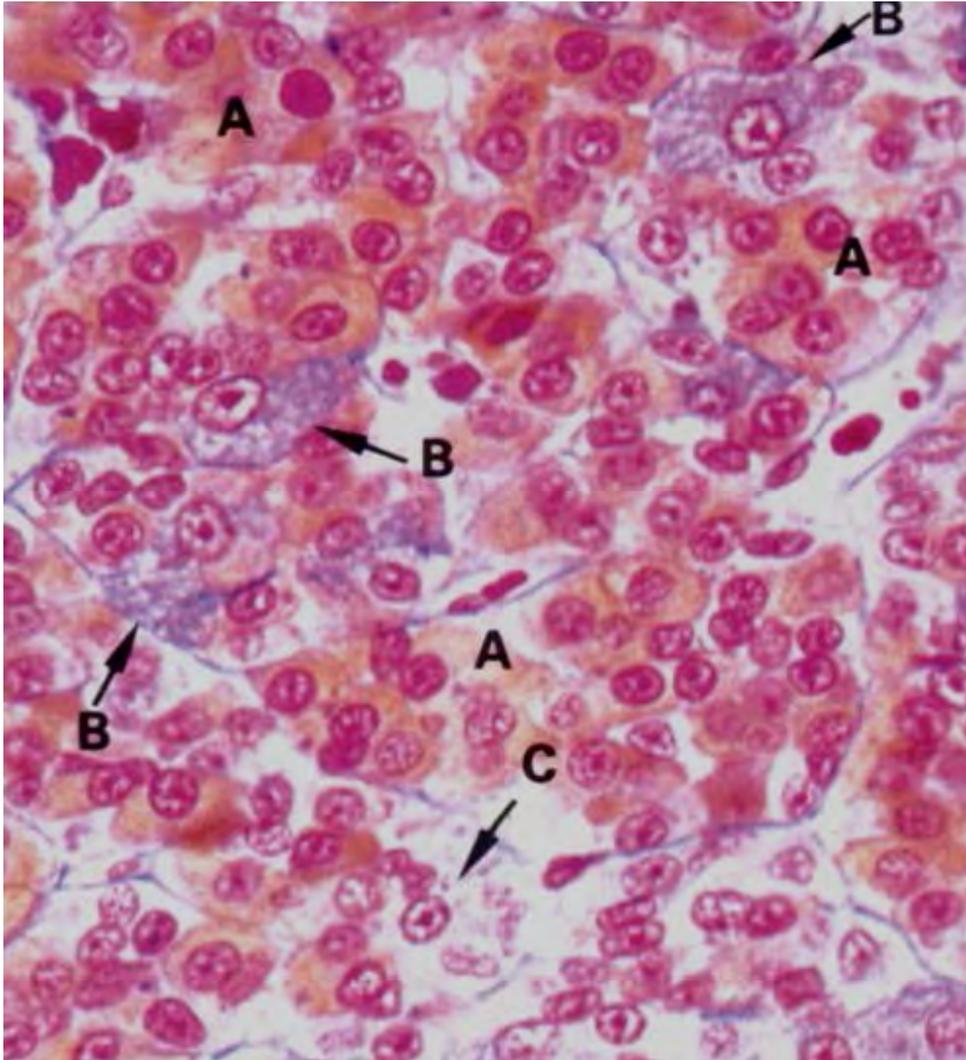
# Hypothalamo - Hypophyseal System



# Anterior and Posterior Pituitary



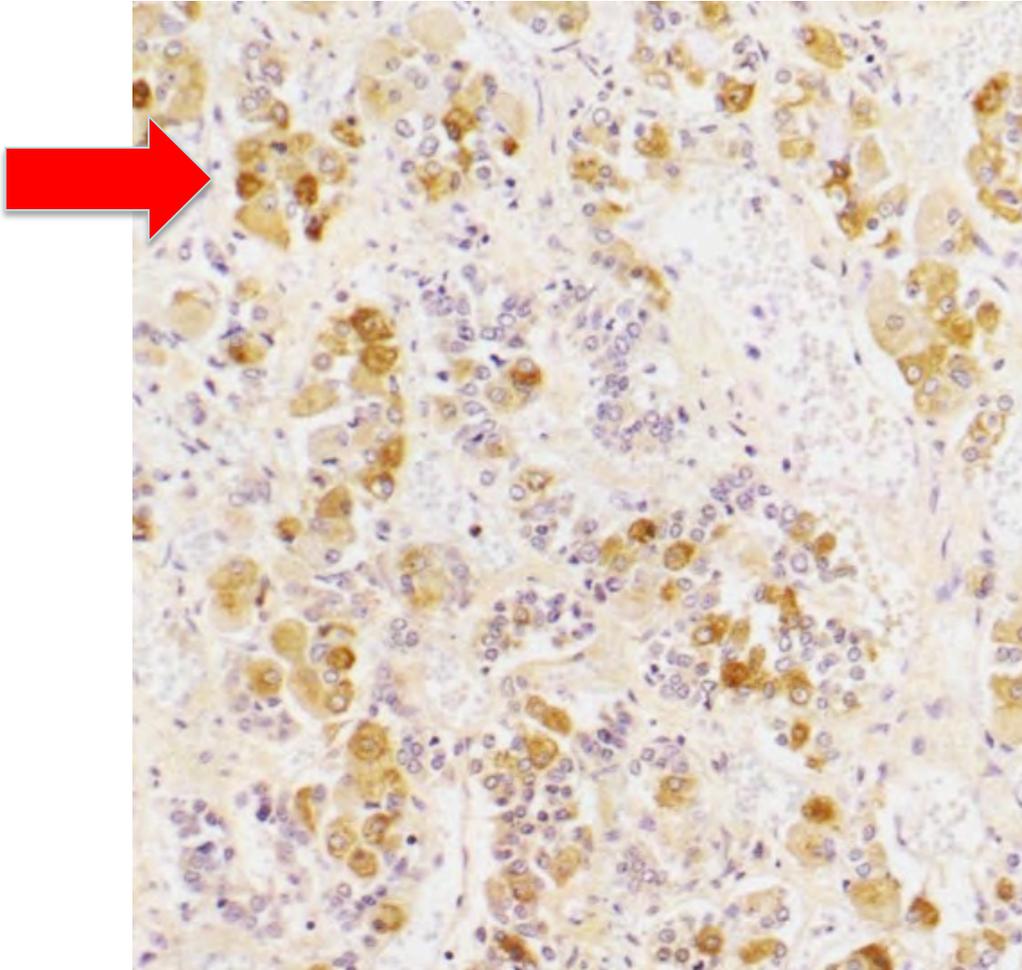
# Anterior Pituitary (Pars Distalis)



- Glandular epithelial cells with fenestrated capillaries
- Mixture of cell types producing different polypeptide hormones

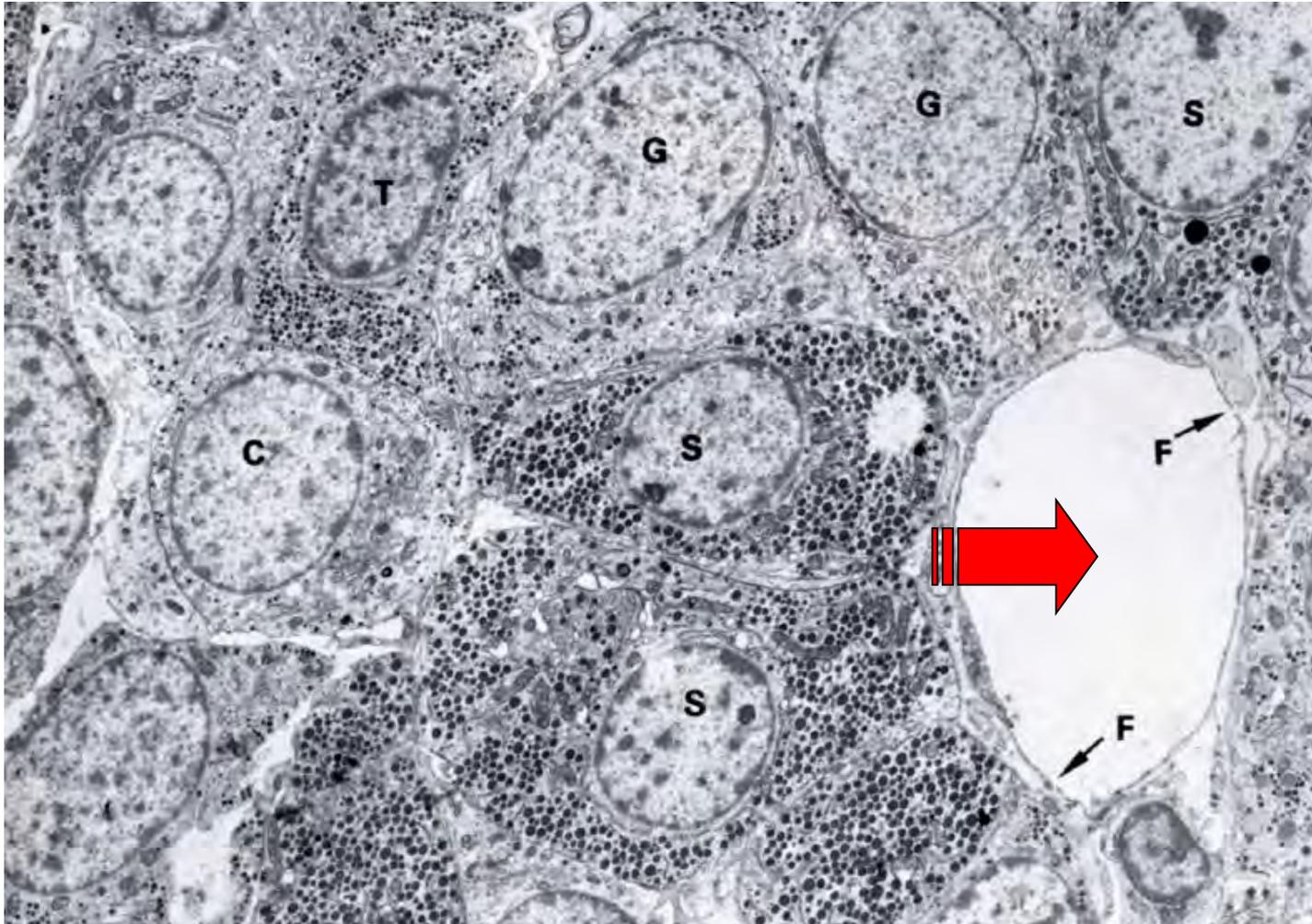
- Acidophils
- Basophils
- Chromophobes
- ↕
- Somatotrophs
- Lactotrophs
- Corticotrophs
- TSH, MSH, FSH

# Immunolabeling Can Be Used to Localize Specific Pituitary Hormones

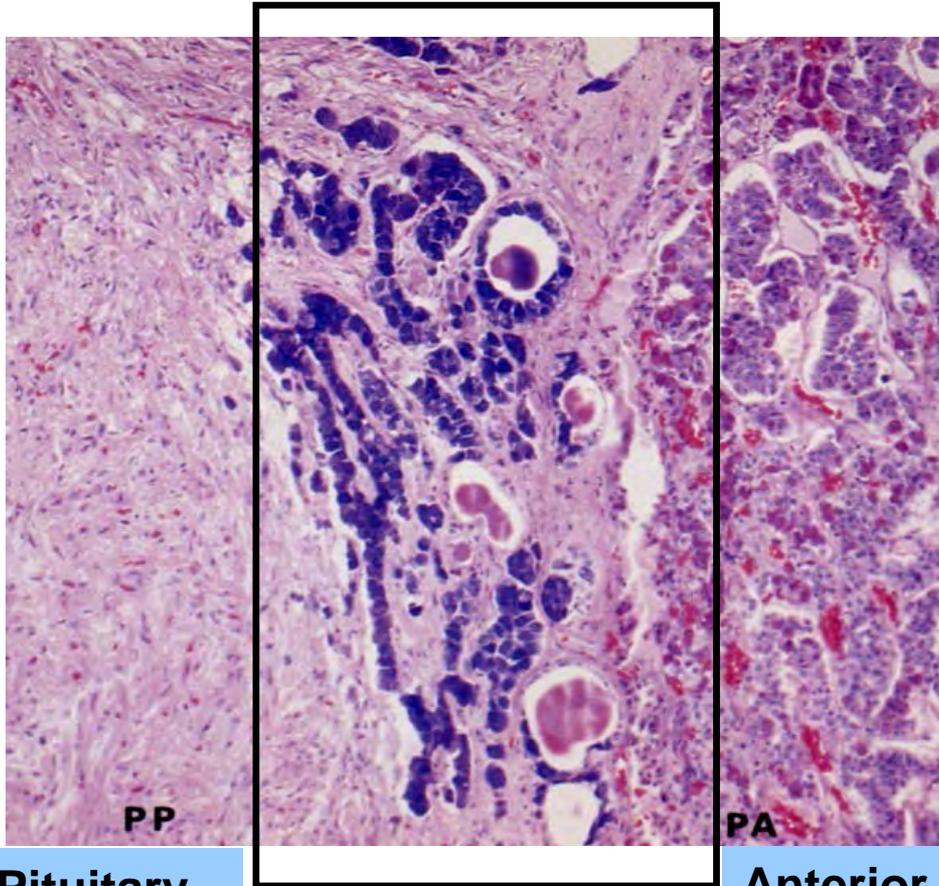


- Identification of hormone-producing cells using specific antibodies
- Method is used to help establish tumor diagnosis (e.g., type of pituitary adenoma)

# Dense, Membrane-Bound Secretory Granules Contain Pituitary Hormones



# Pars Intermedia



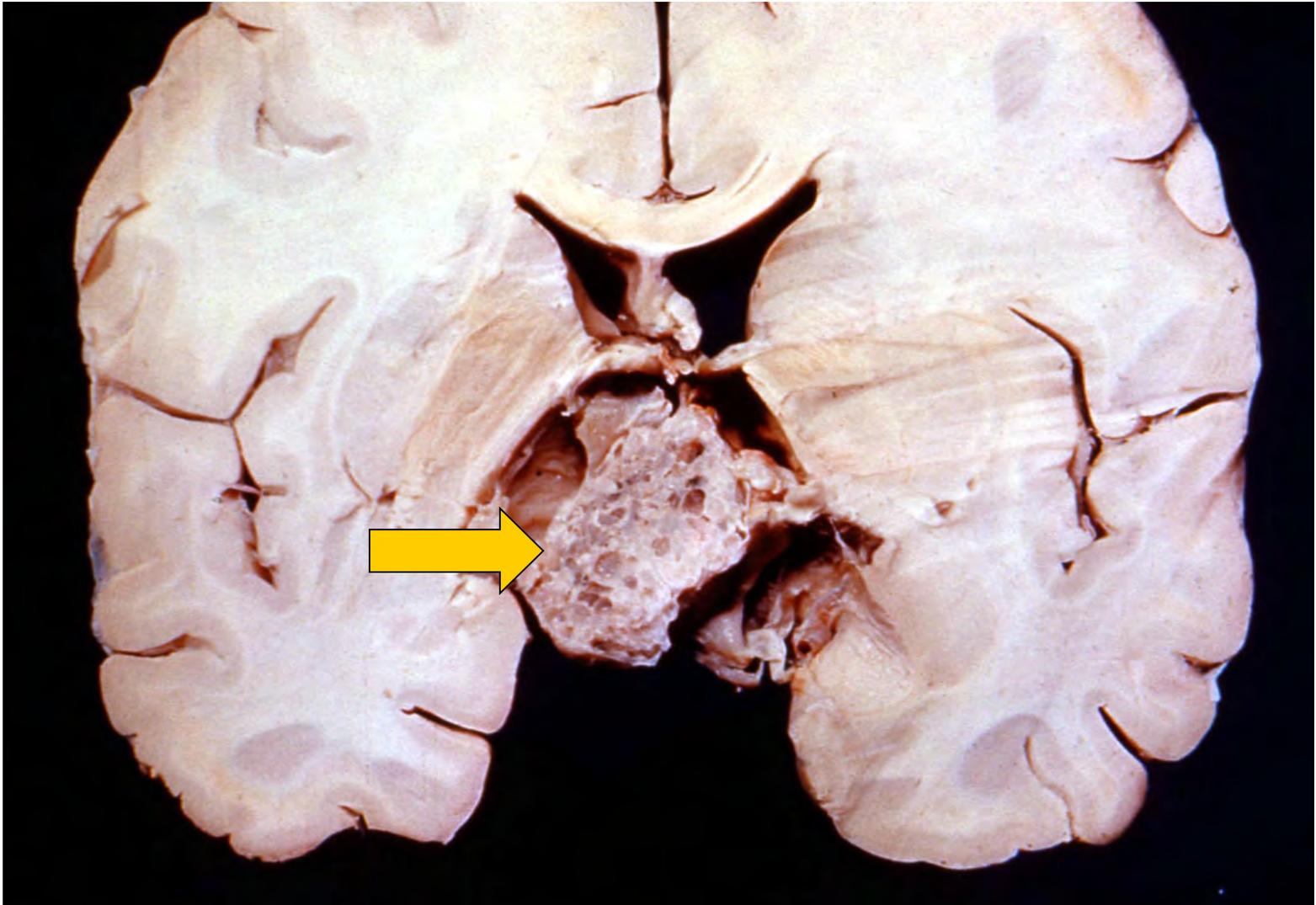
- Epithelial cells representing the residuum of Rathke's pouch
- Cords and follicles that produce some melanocyte-stimulating hormone (MSH)

Posterior Pituitary

Anterior Pituitary

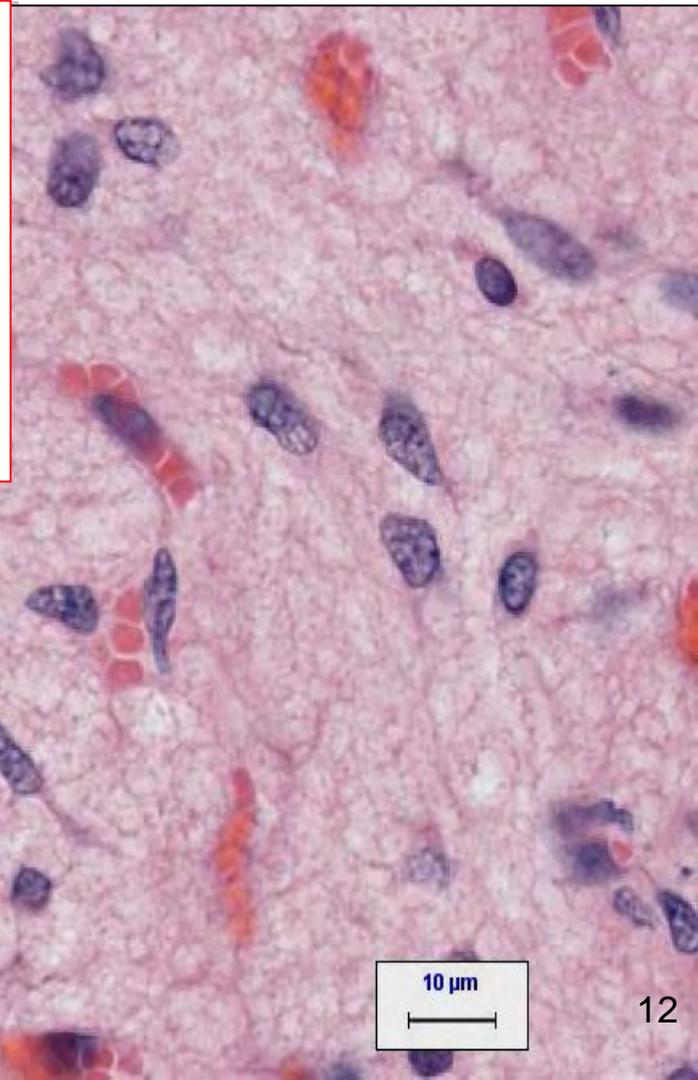
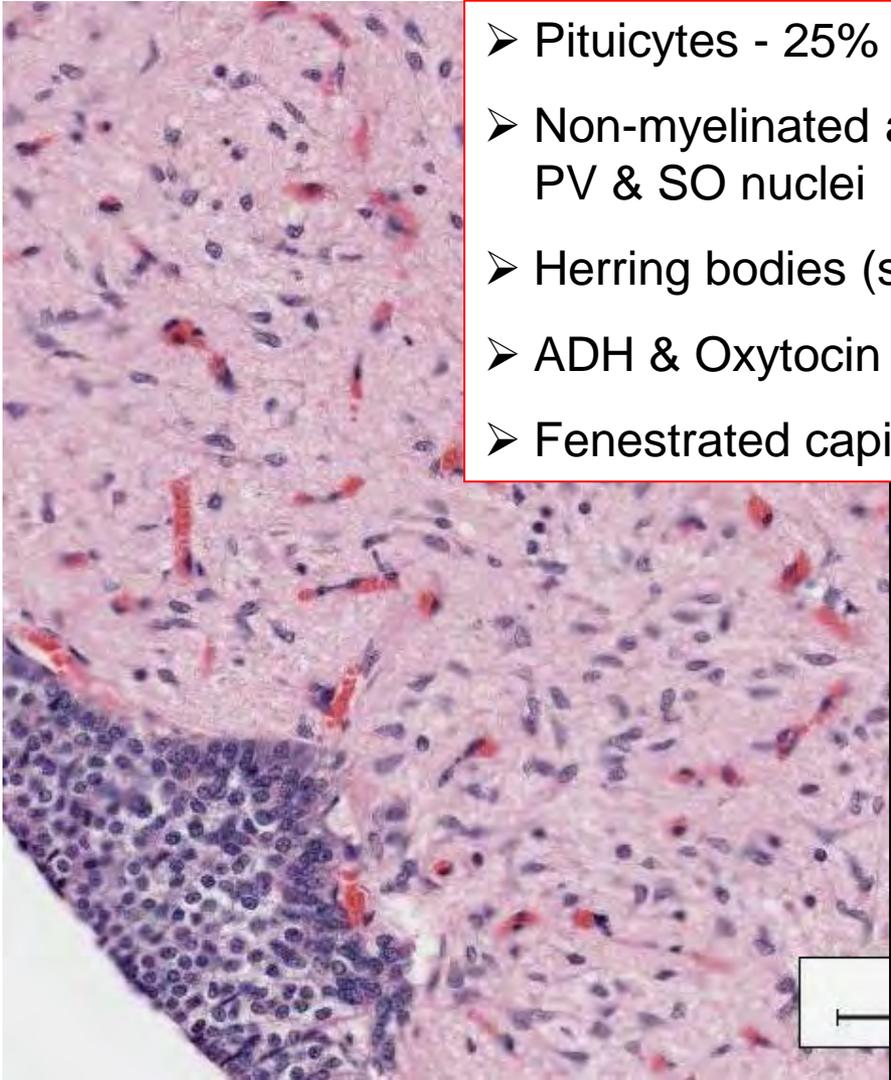
# Craniopharyngioma

(tumor derived from remnants of Rathke's pouch)

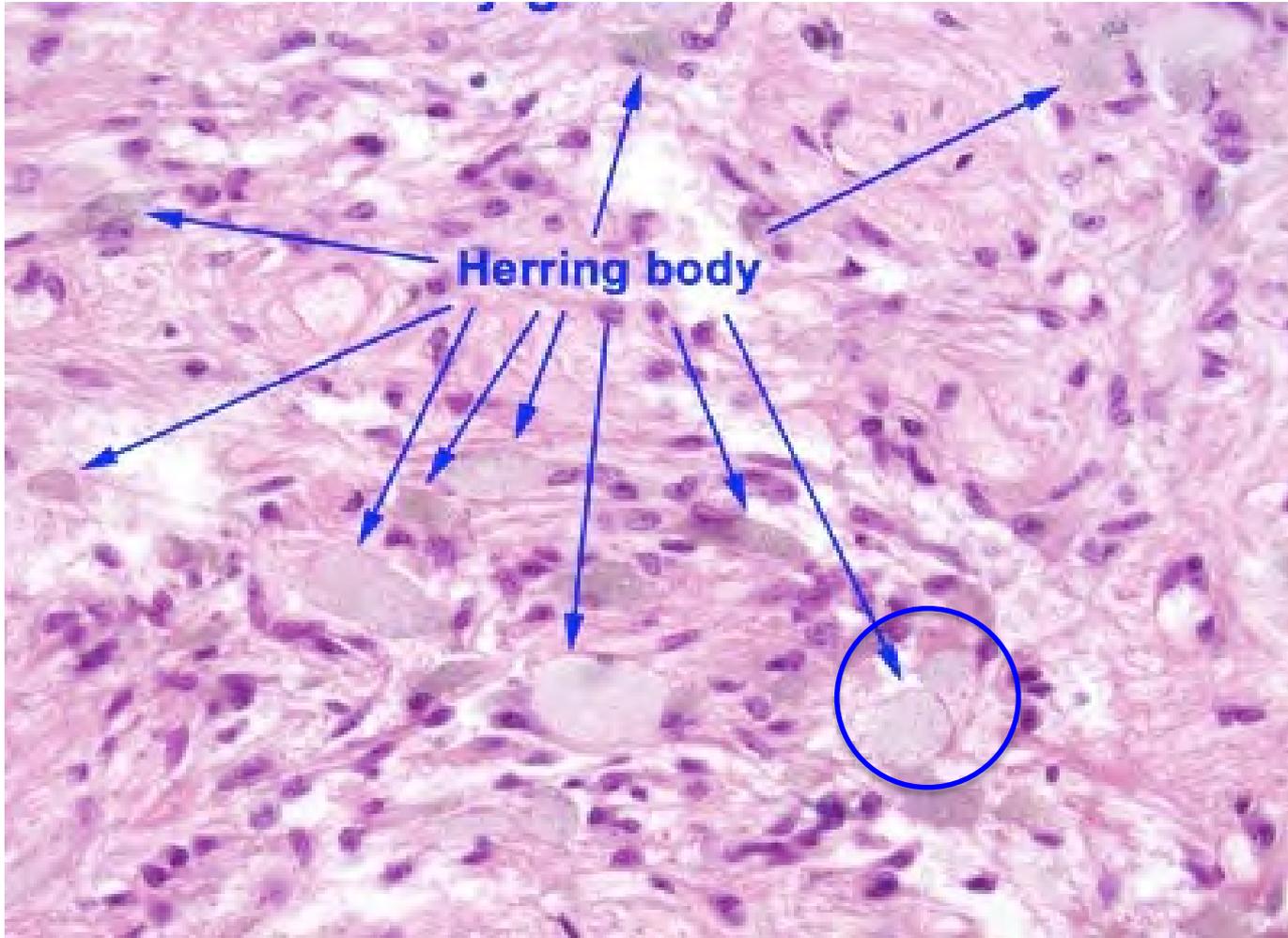


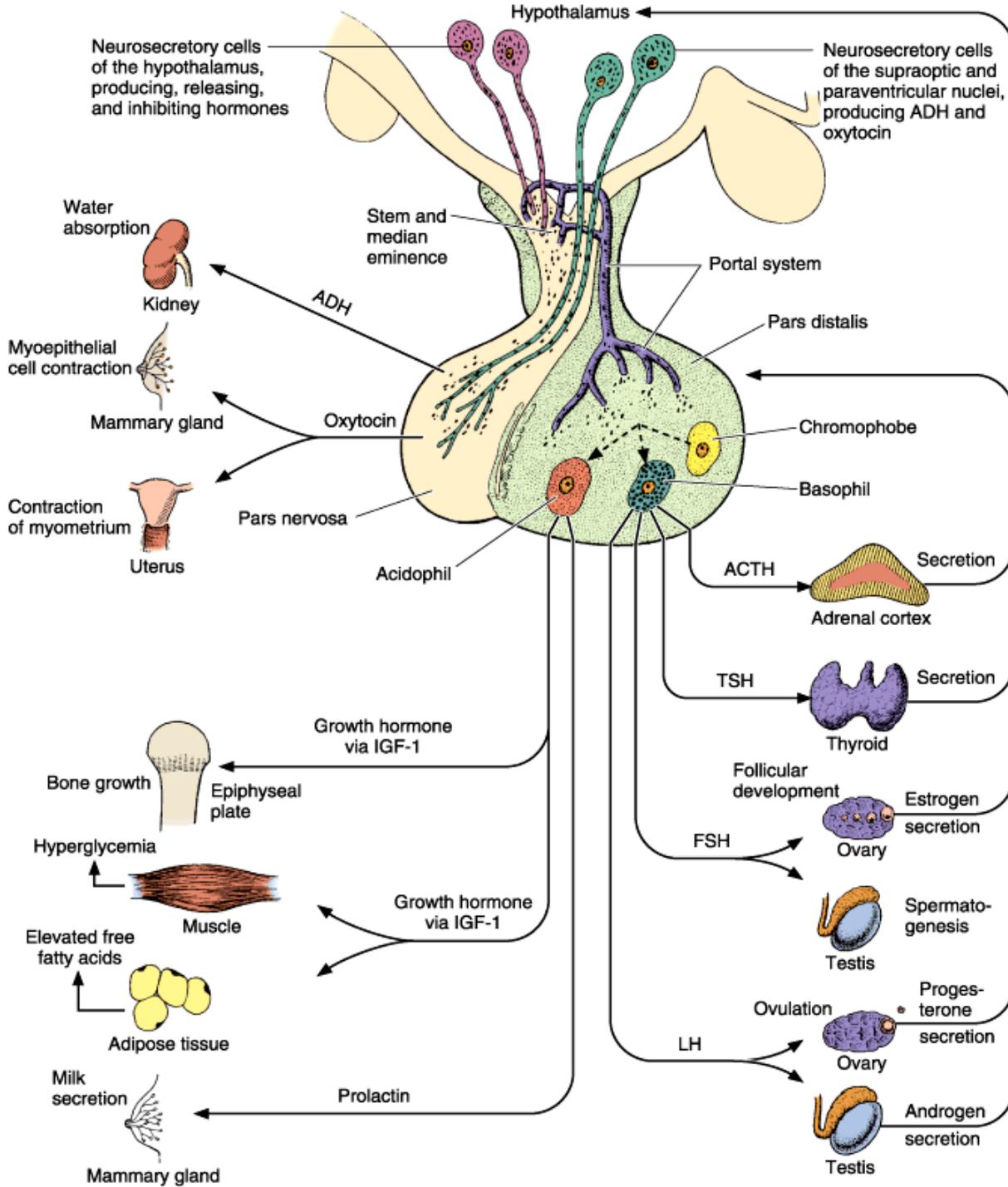
# Posterior Pituitary (Pars Nervosa)

- Pituicytes - 25% of cells
- Non-myelinated axons from PV & SO nuclei
- Herring bodies (storage)
- ADH & Oxytocin
- Fenestrated capillaries



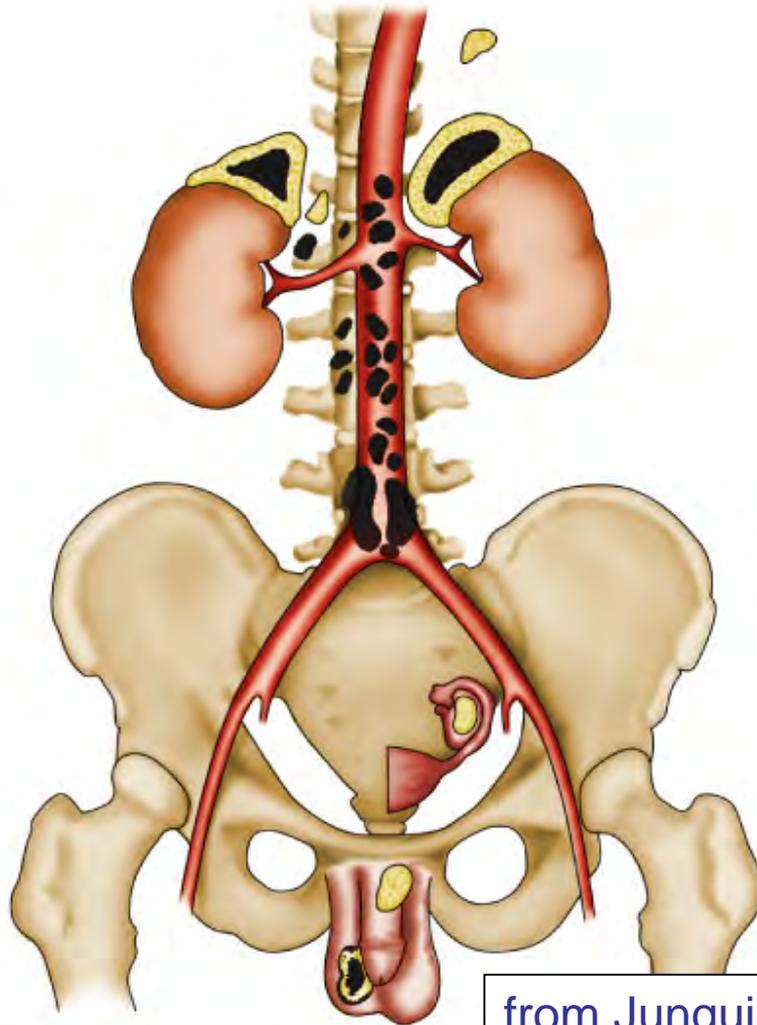
# Herring Bodies in Neurohypophysis (dilated terminals of axons)





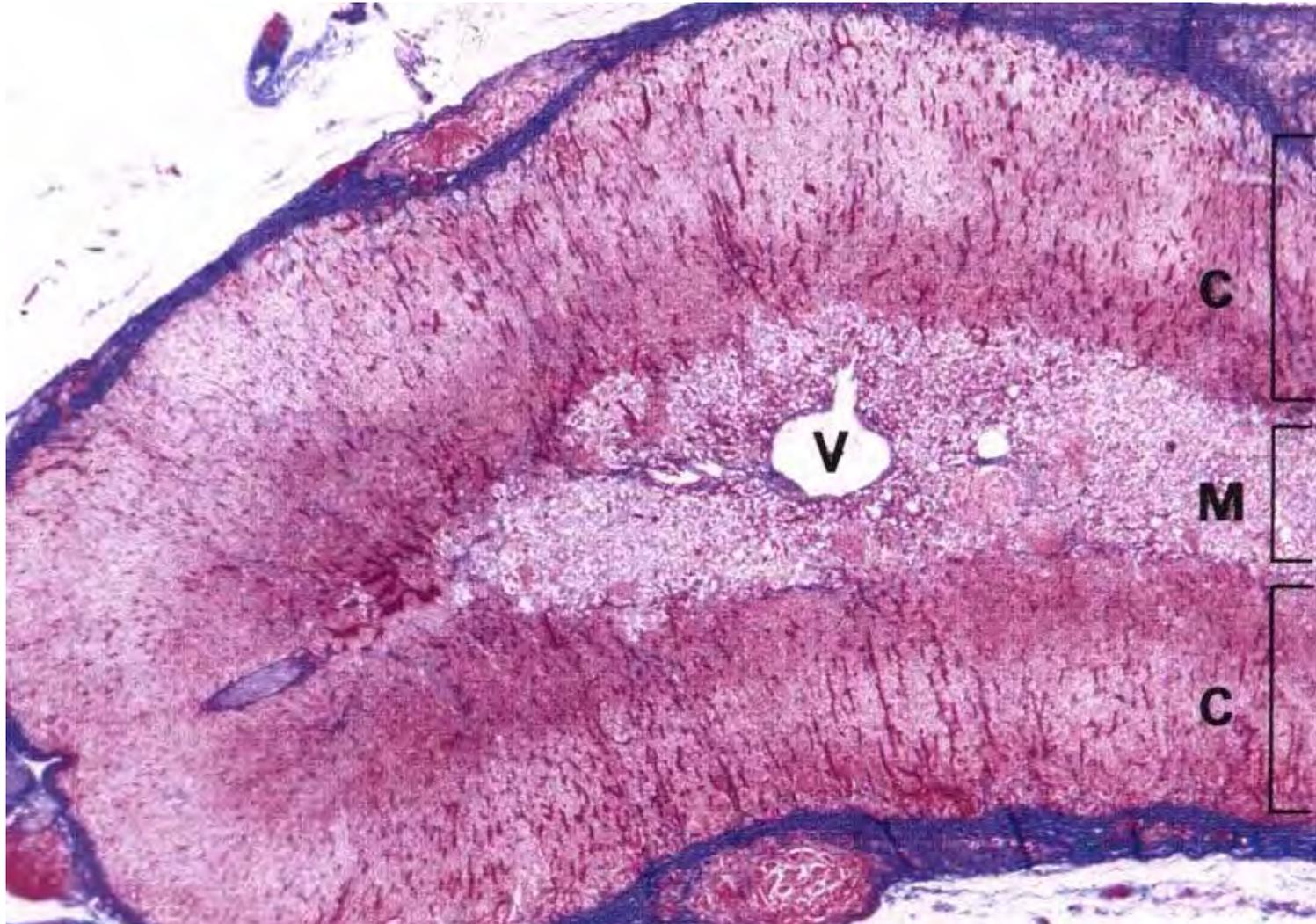
Multiple effects of pituitary hormones on target organs with **feedback inhibition...**

# Adrenal (Suprarenal) Glands

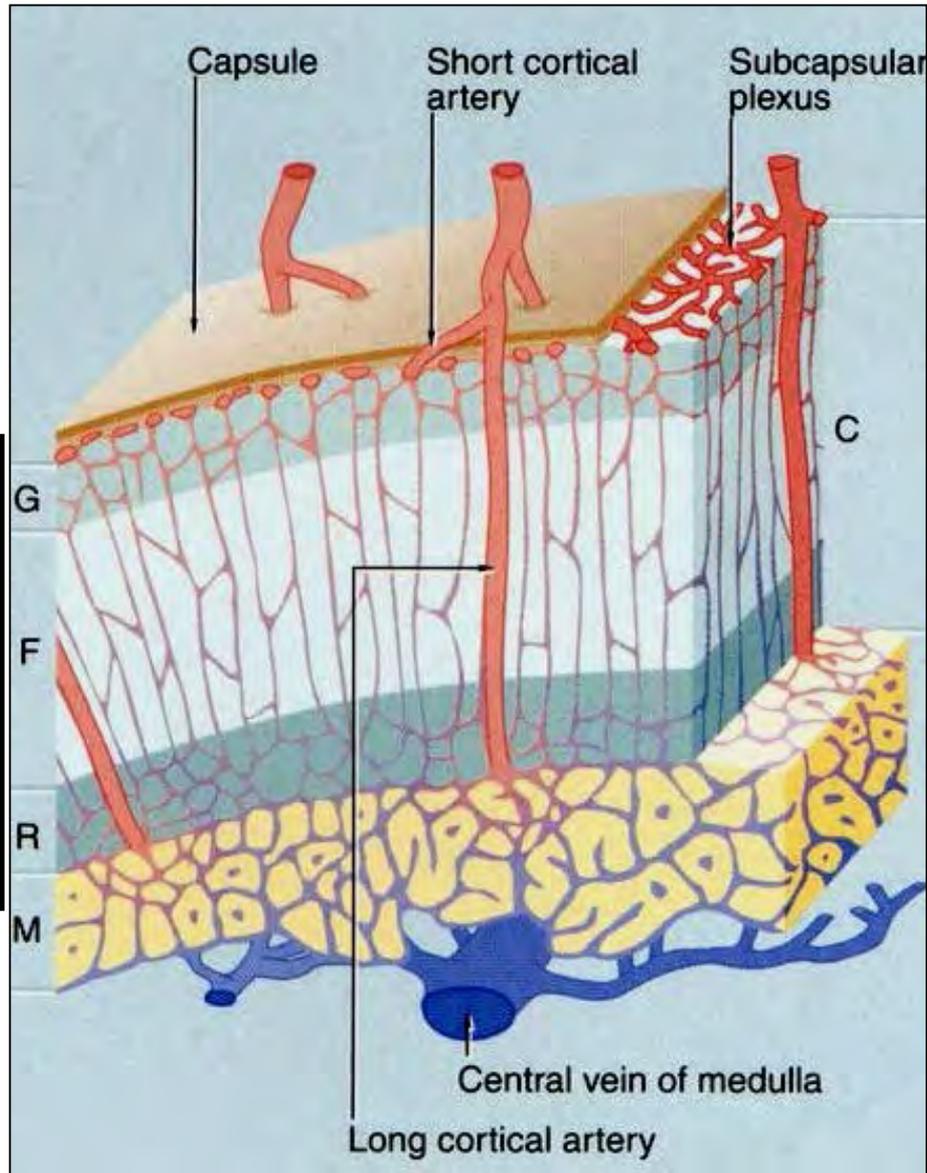


- Developmentally regulated glands
- Pituitary-dependent function (ACTH)
- Extra-adrenal cortical and medullary tissues (relevant to rare tumors)

# Adrenal Cortex and Medulla



# Vascular Supply to the Adrenals



Glomerulosa

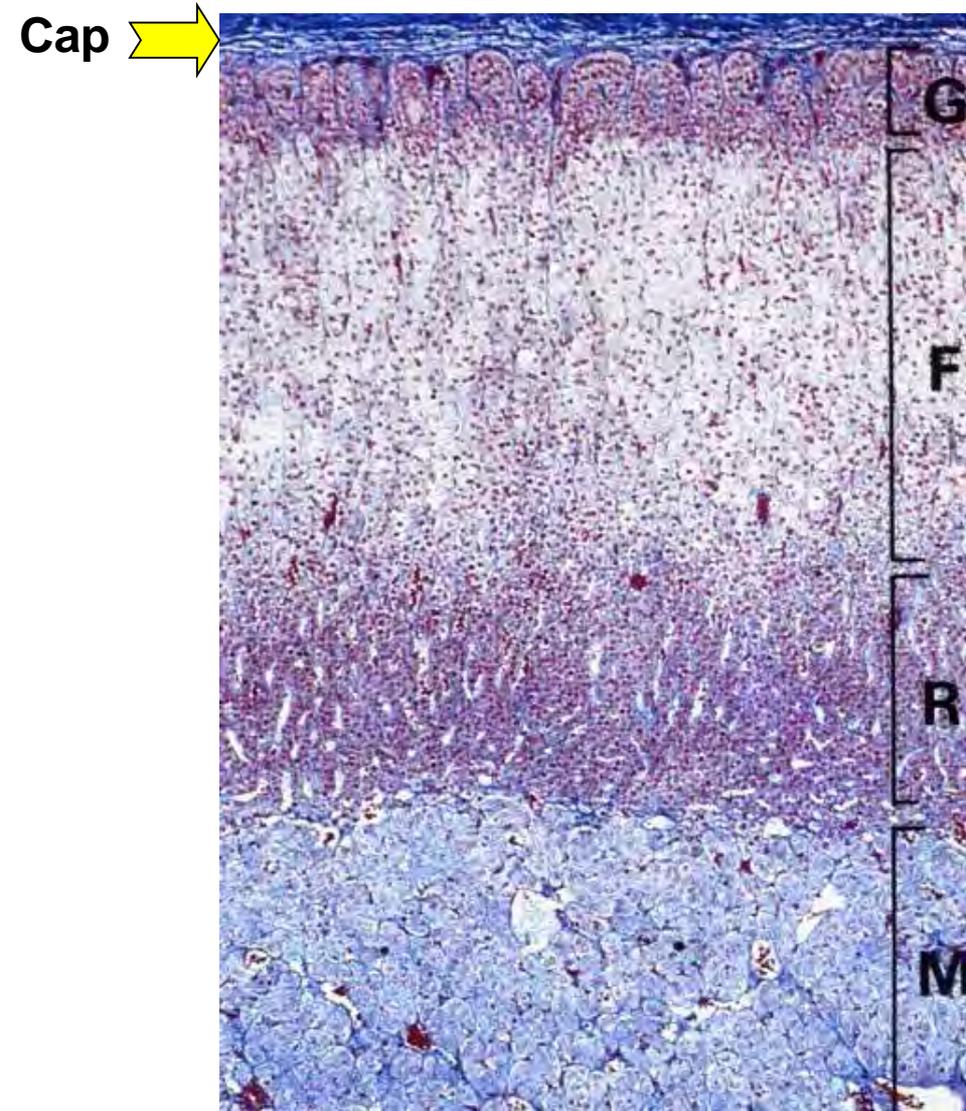
Fasiculata

Reticularis

➤ Cortex

➤ Medulla  
a

# Adrenal Zones and Hormones



## \*\*\*Zona Glomerulosa

Mineralocorticoid (aldosterone)

## \*\*\*Zona Fasciculata

Glucocorticoids (cortisol)

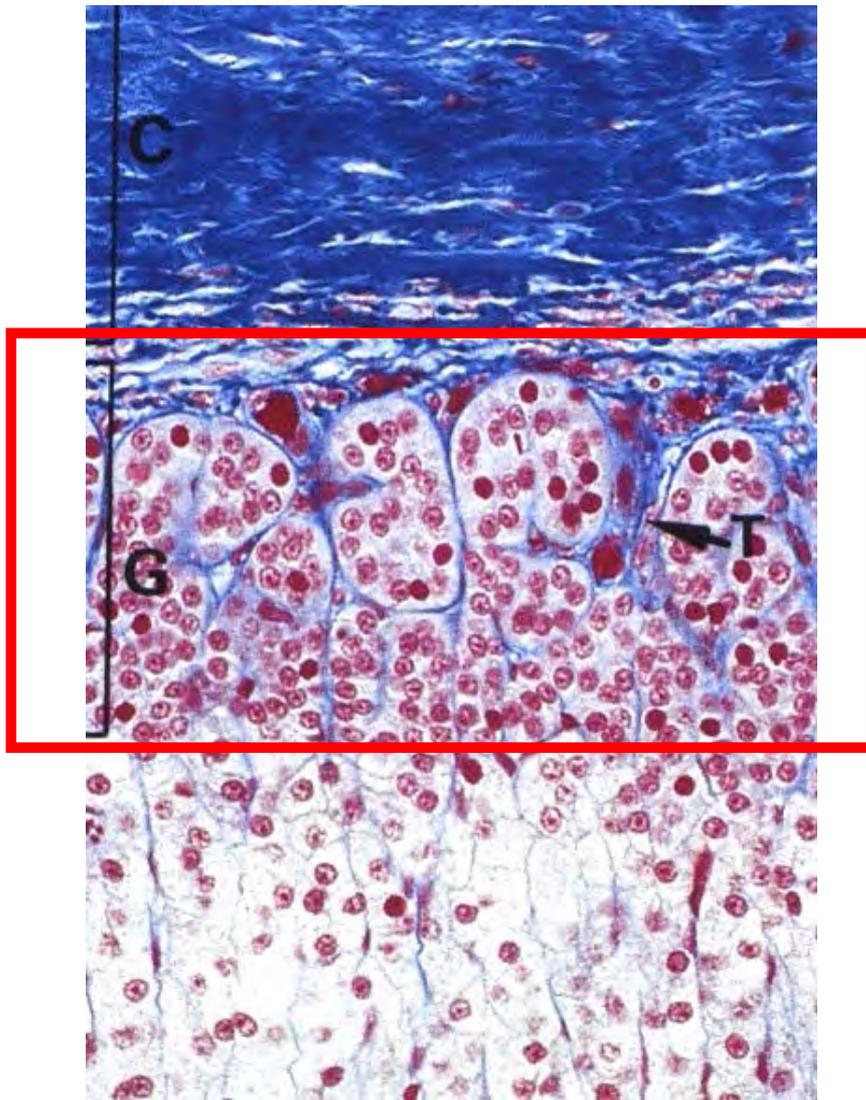
## \*\*\*Zona Reticularis

Weak androgens

## \*\*\*Medulla

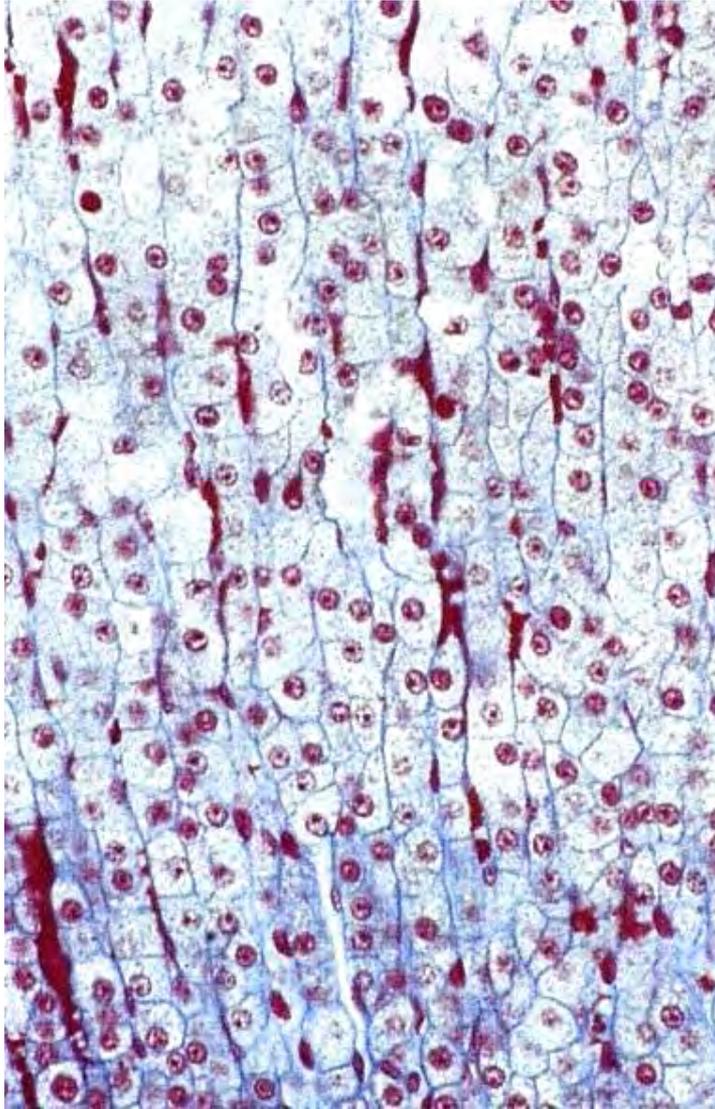
Epinephrine, norepinephrine

# Zona Glomerulosa (Aldosterone)



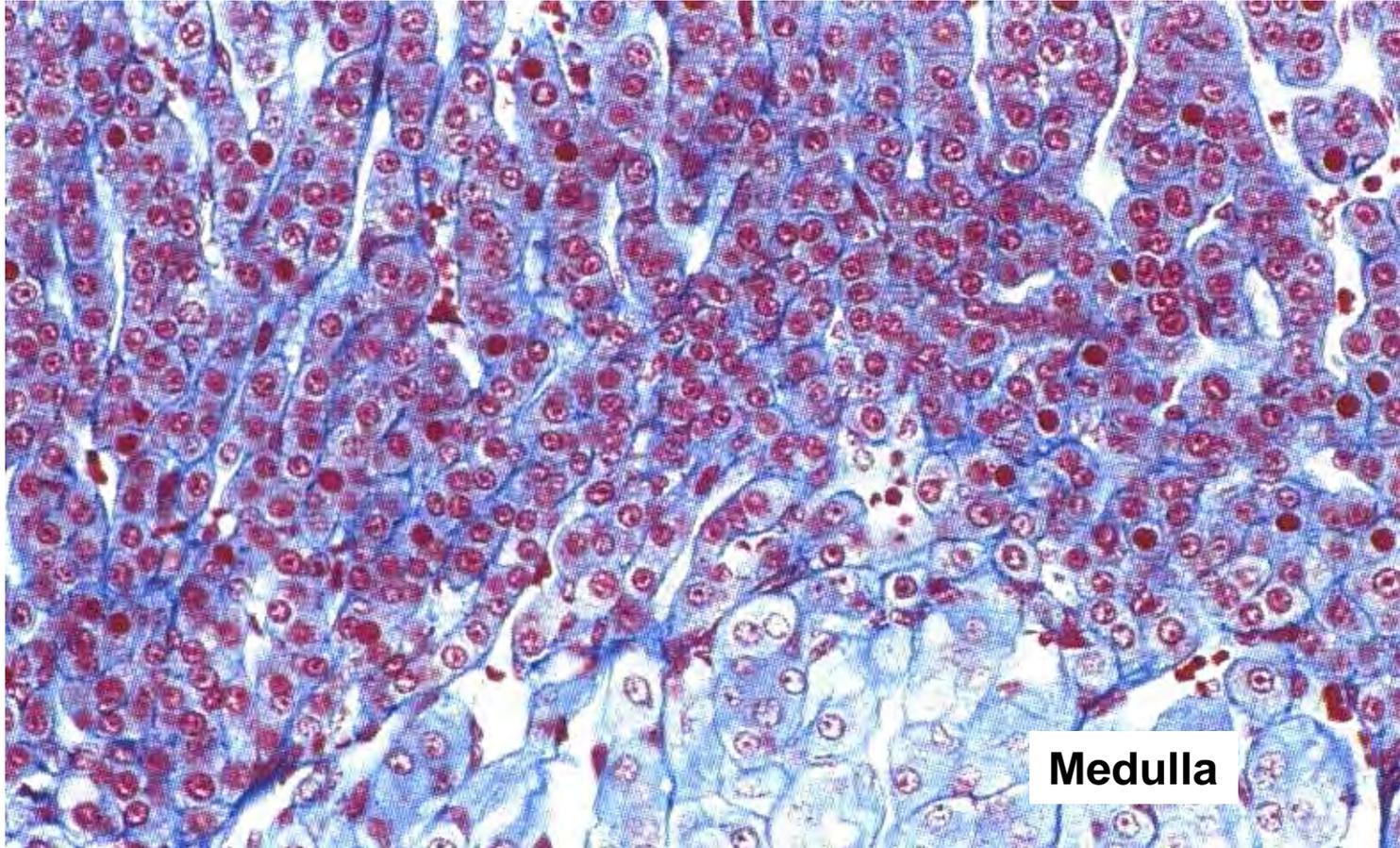
- Thin outer zone adjacent to capsule
- Small clusters of cells continuous with cords below
- Aldosterone secretion regulated primarily by the renin-angiotensin system

# Zona Fasciculata (Cortisol)



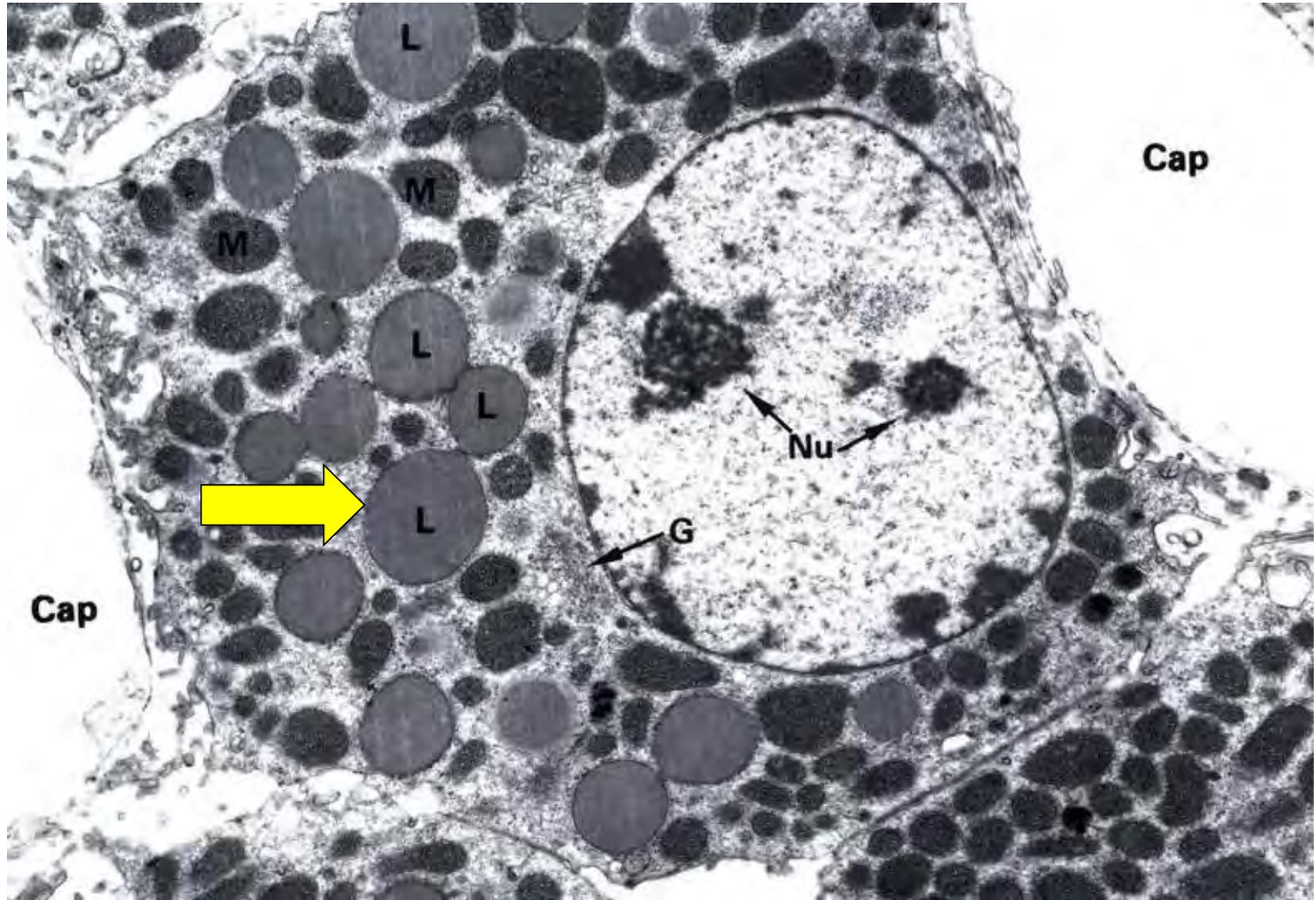
- Middle and broadest of the 3 cortical zones
- Narrow cords of secretory cells with intracellular lipid droplets in long parallel columns (“spongyocytes”)
- Separated by supporting tissue containing sinusoidal capillaries

# Zona Reticularis (Weak Androgens)

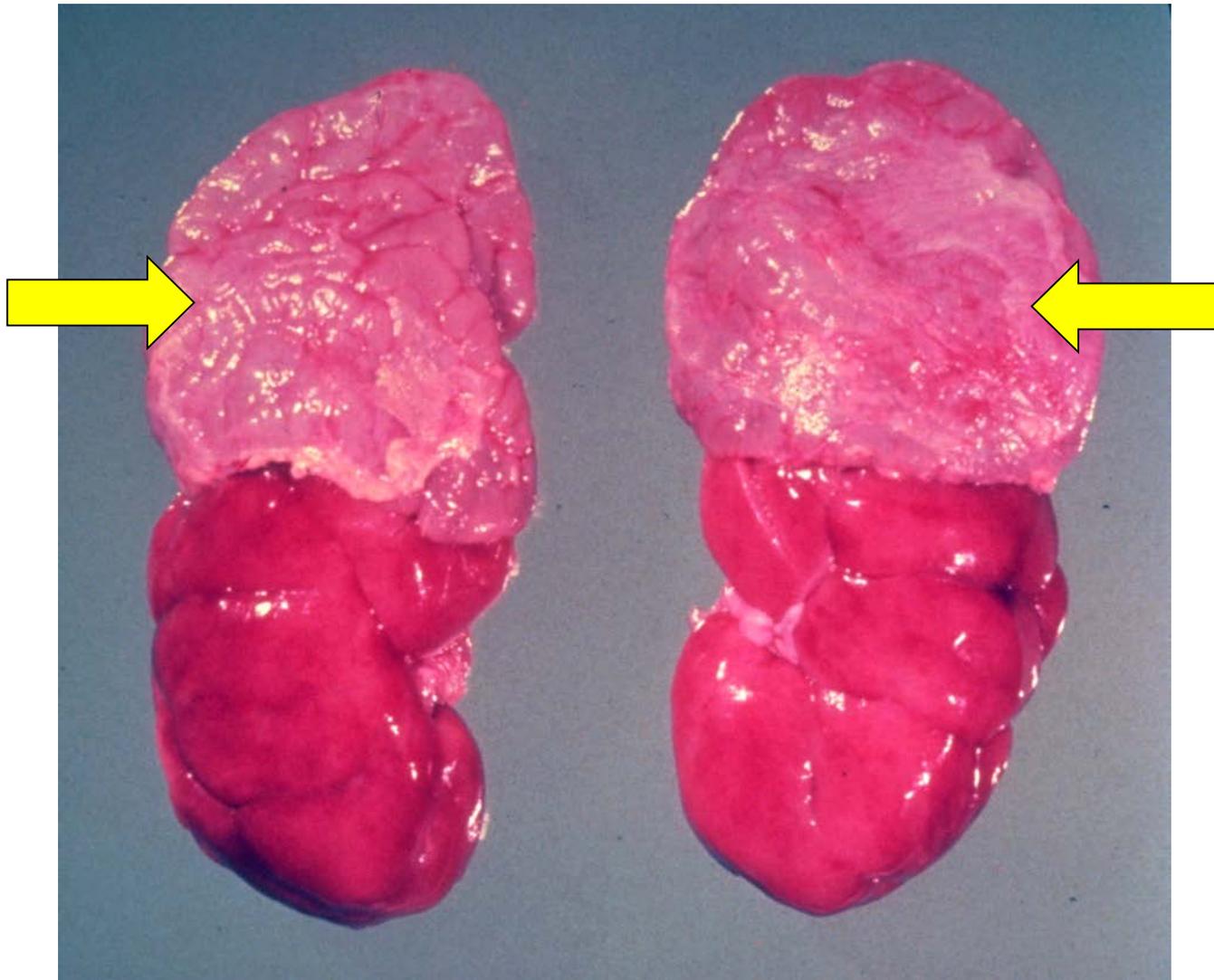


**Glandular epithelium arranged in cords and nests.**

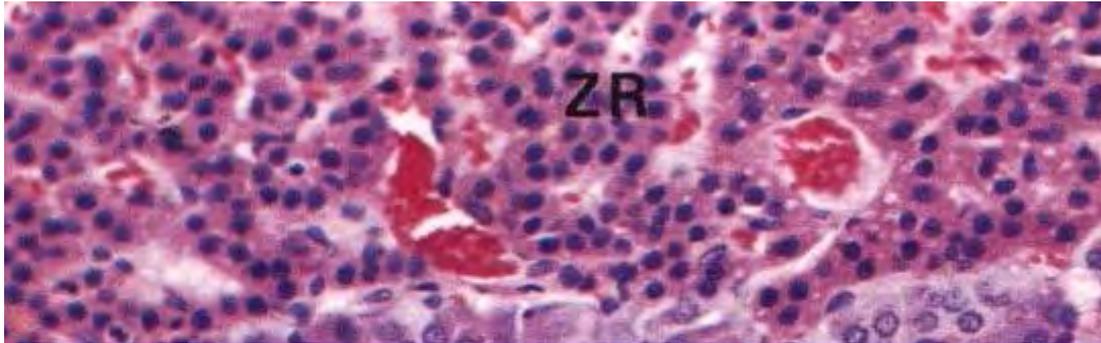
# Lipid Droplets in Steroid-Secreting Cells of the Adrenal Cortex



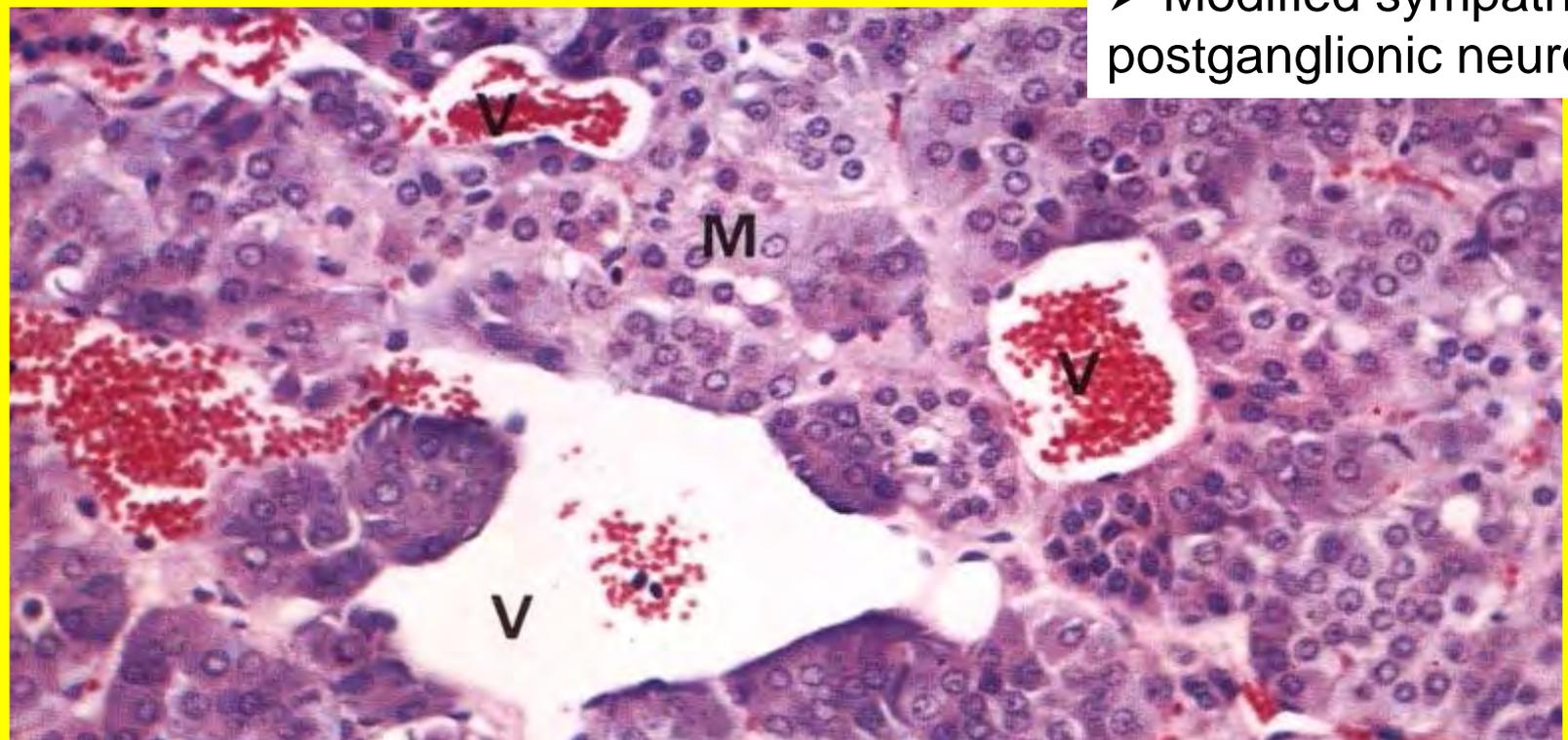
# Congenital Adrenal Hyperplasia



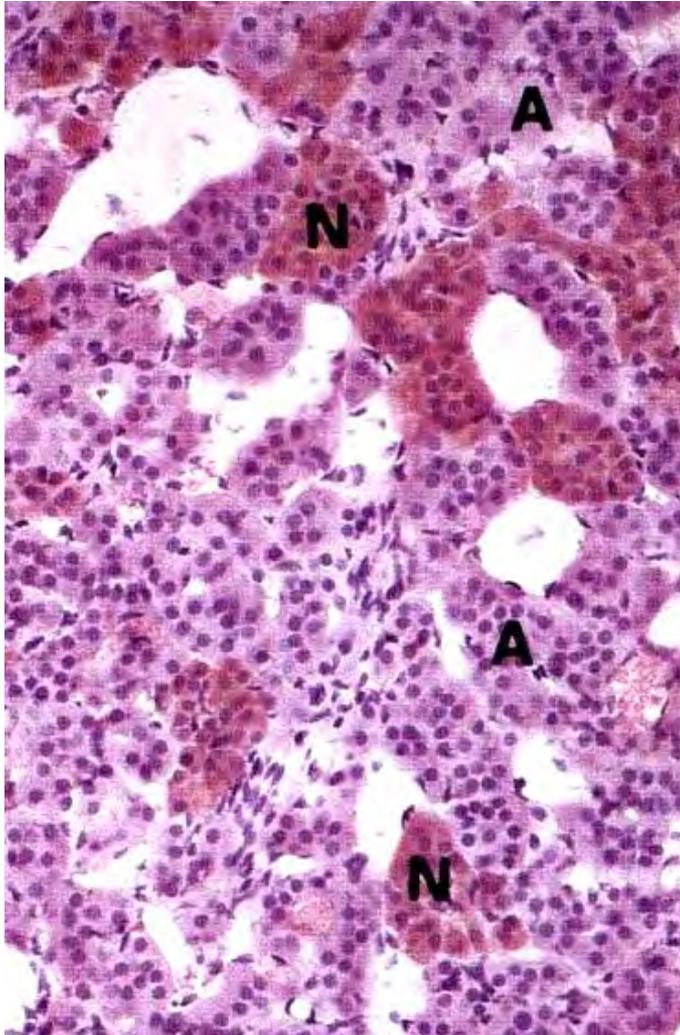
# Adrenal Medulla



- Cords of glandular epithelial cells supported by reticular fiber network
- Neural crest cells
- Modified sympathetic, postganglionic neurons



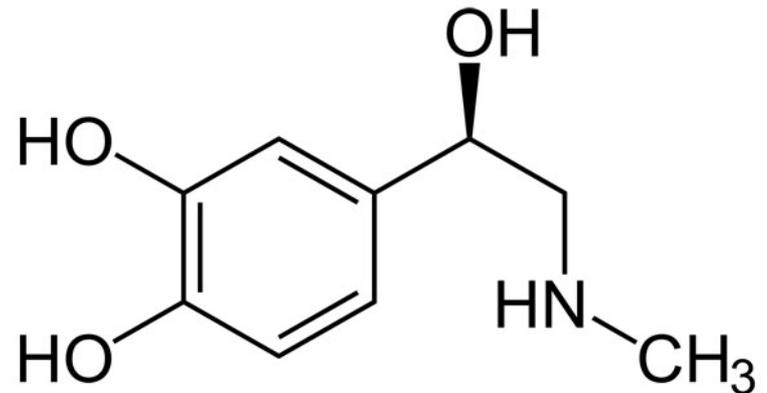
# Chromaffin Cells Secrete Catacholamines\*



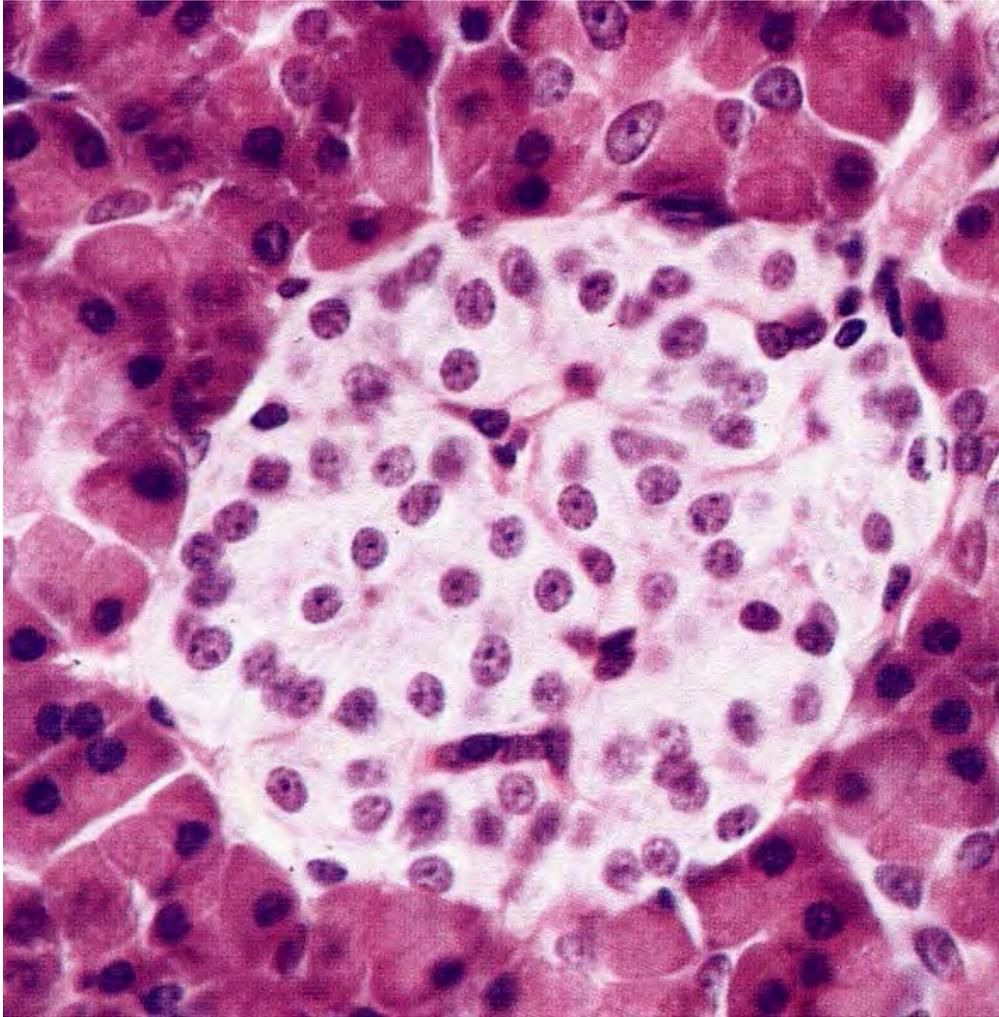
**A** – Adrenaline (epinephrine)

**N** – Noradrenaline (norepinephrine)

- Stress response stimulated by cholinergic endings of pre-ganglionic sympathetic nerves

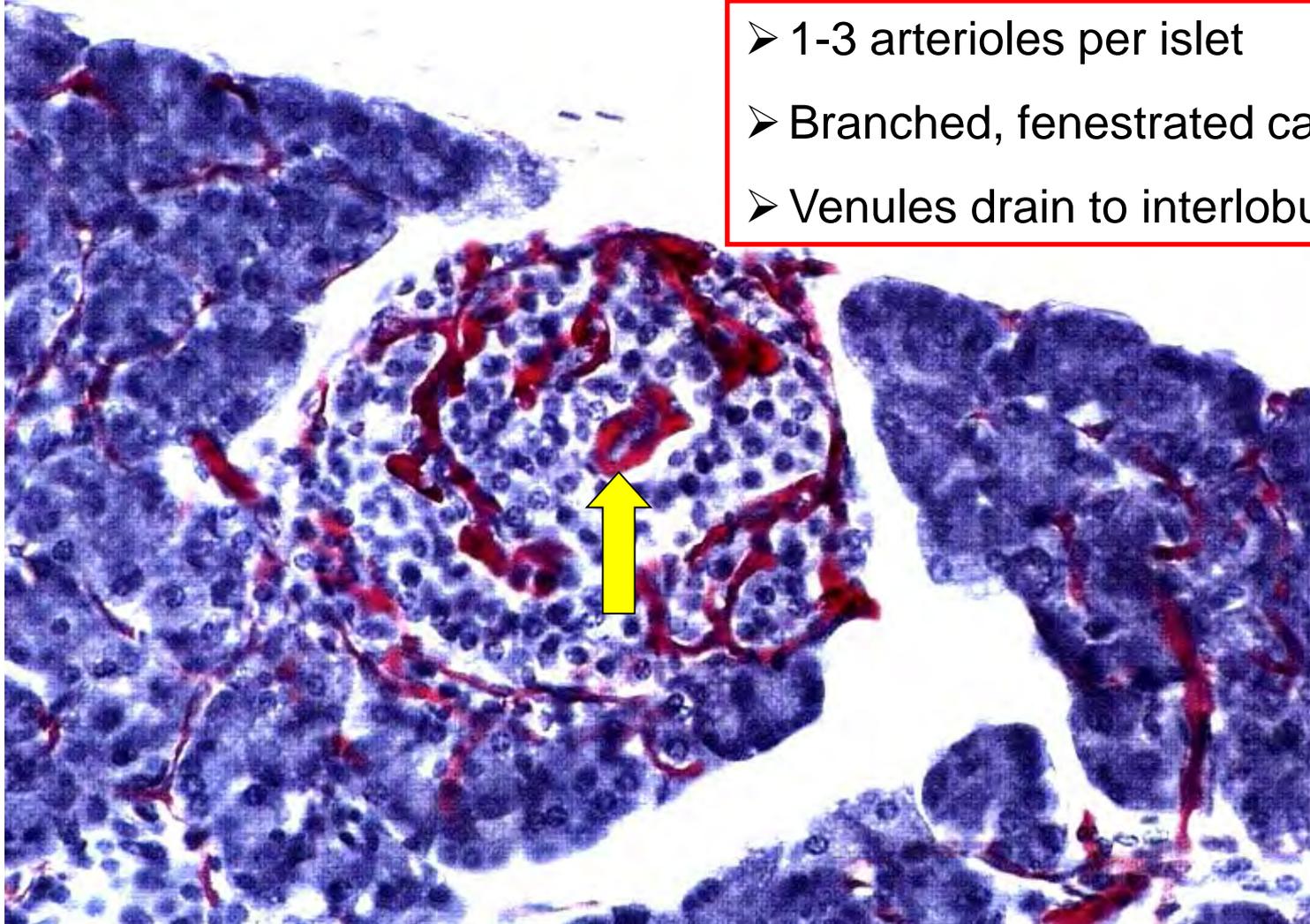


# Endocrine Pancreas (Islets)



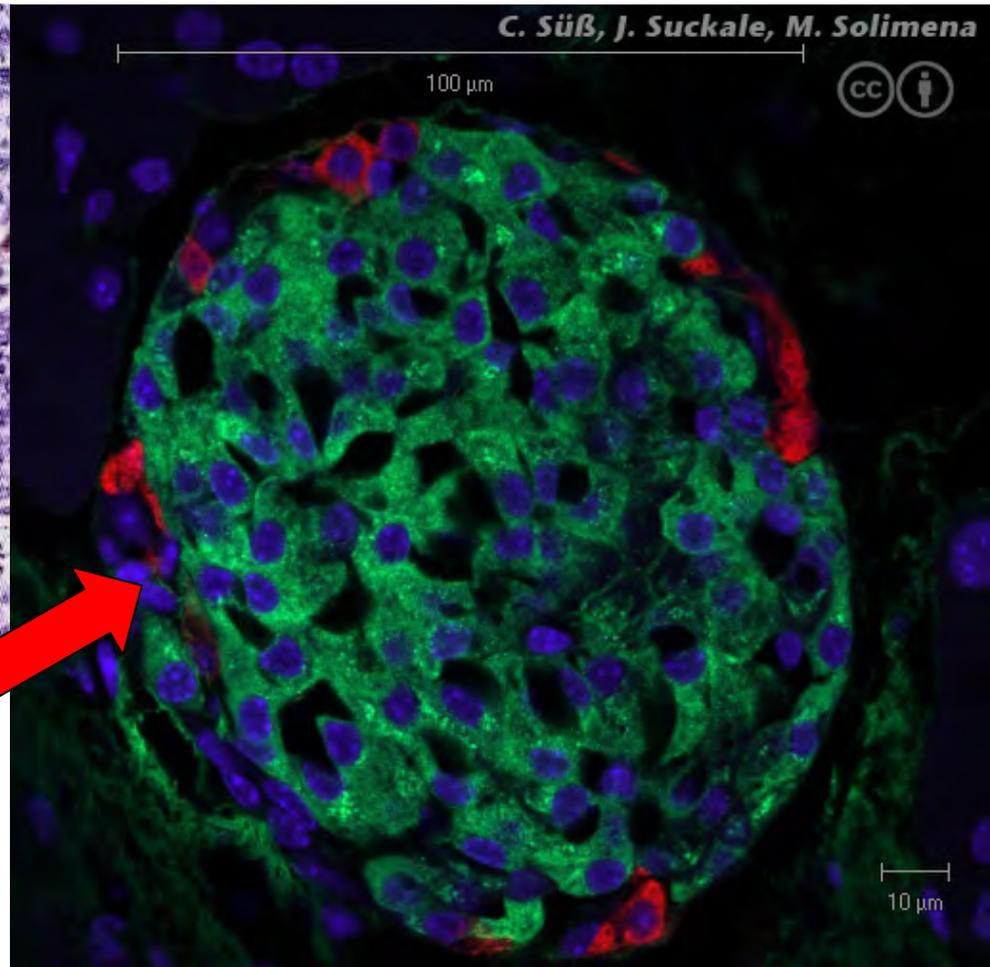
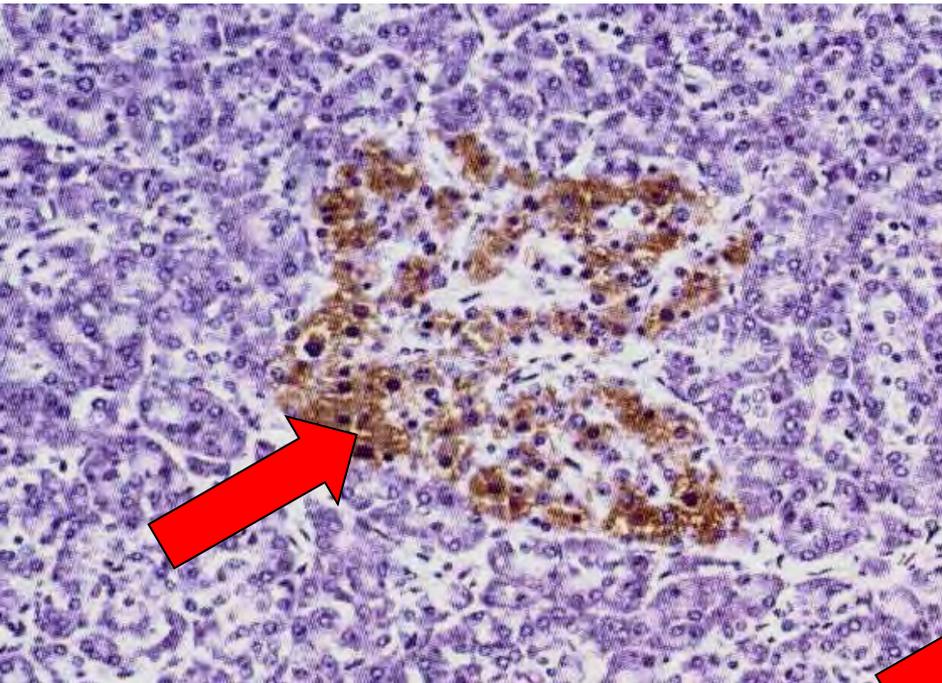
- Islets of Langerhans
- Micro-organs (approx. one million per pancreas)
- Polygonal cells with fine reticular fiber capsule
- Beta cells (70%) synthesize **insulin**
- Alpha cells (20%) synthesize **glucagon**

# Blood Supply to Pancreatic Islets



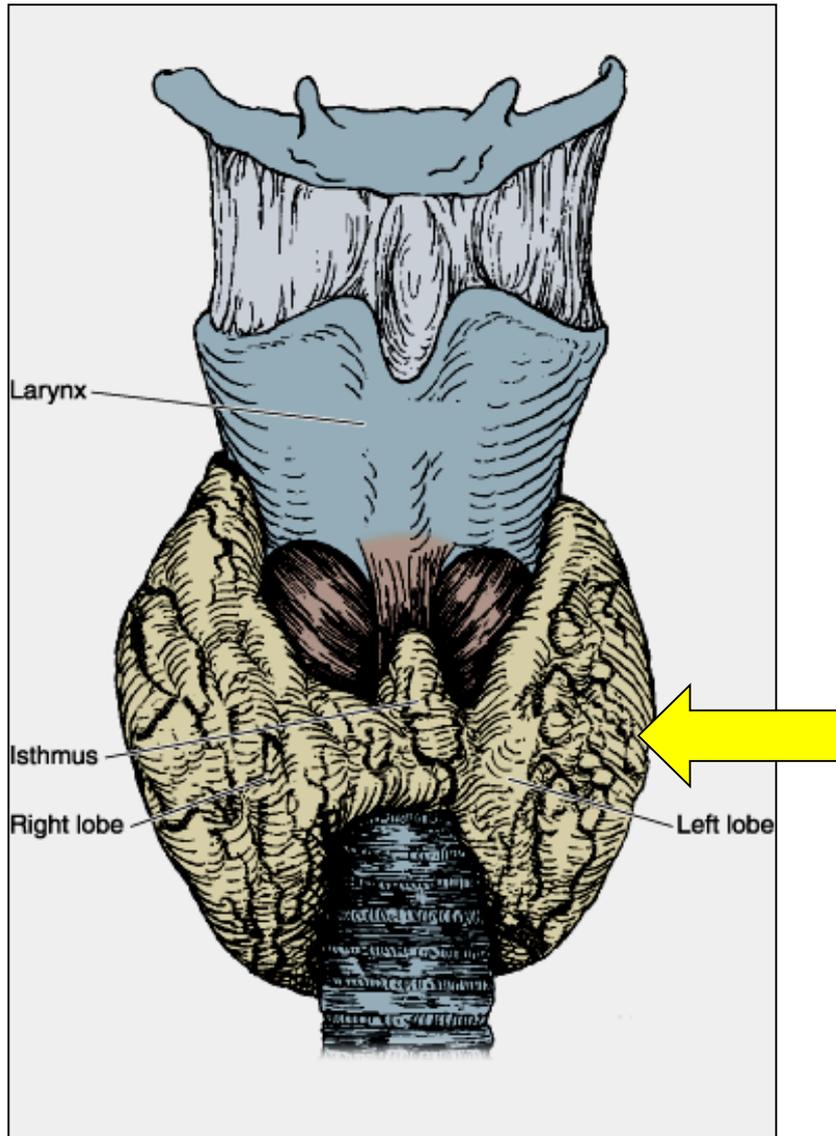
- 1-3 arterioles per islet
- Branched, fenestrated capillaries
- Venules drain to interlobular veins

# Localization of Pancreatic Hormones



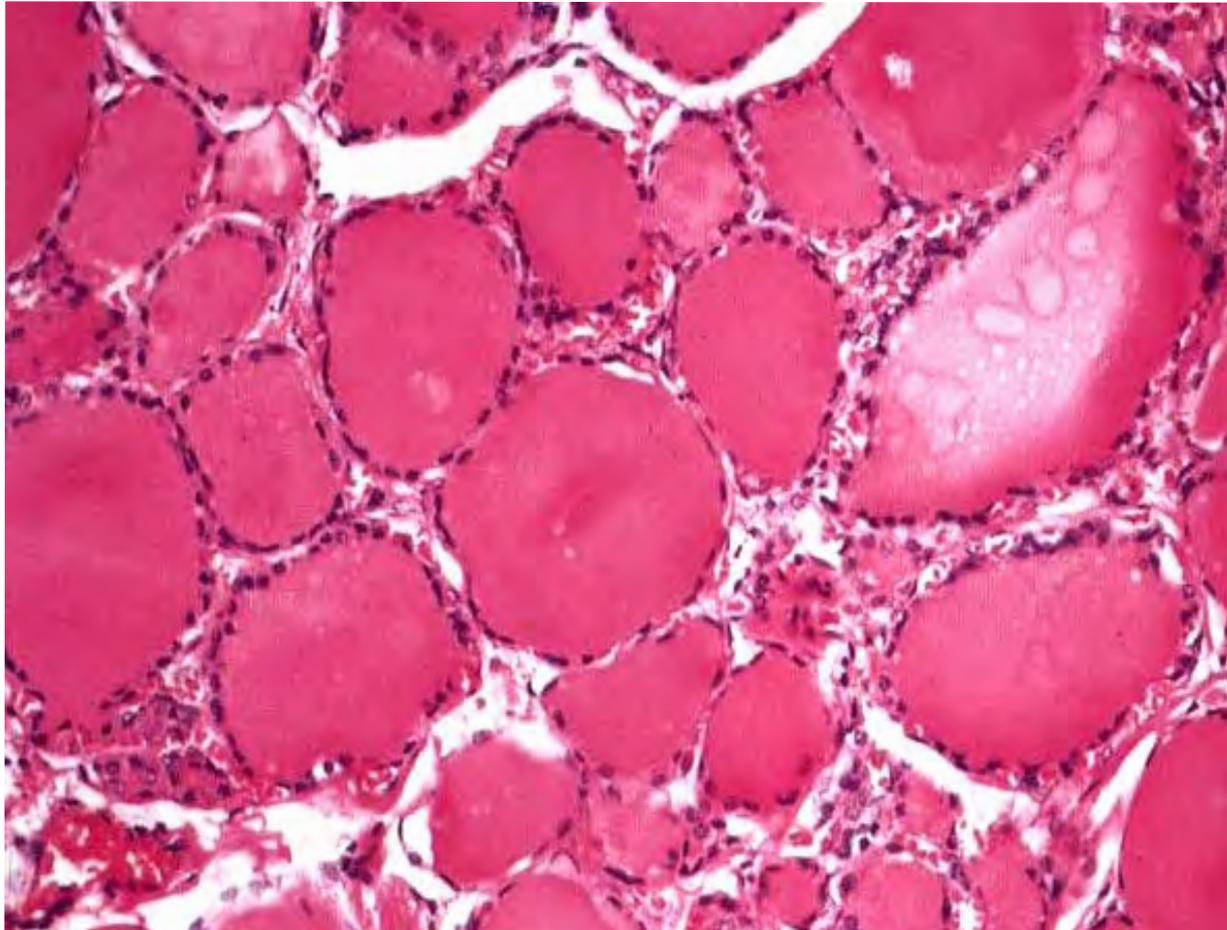
- **Insulin**
- **Glucagon**
- **Somatostatin**
- **VIP**

# Thyroid Gland



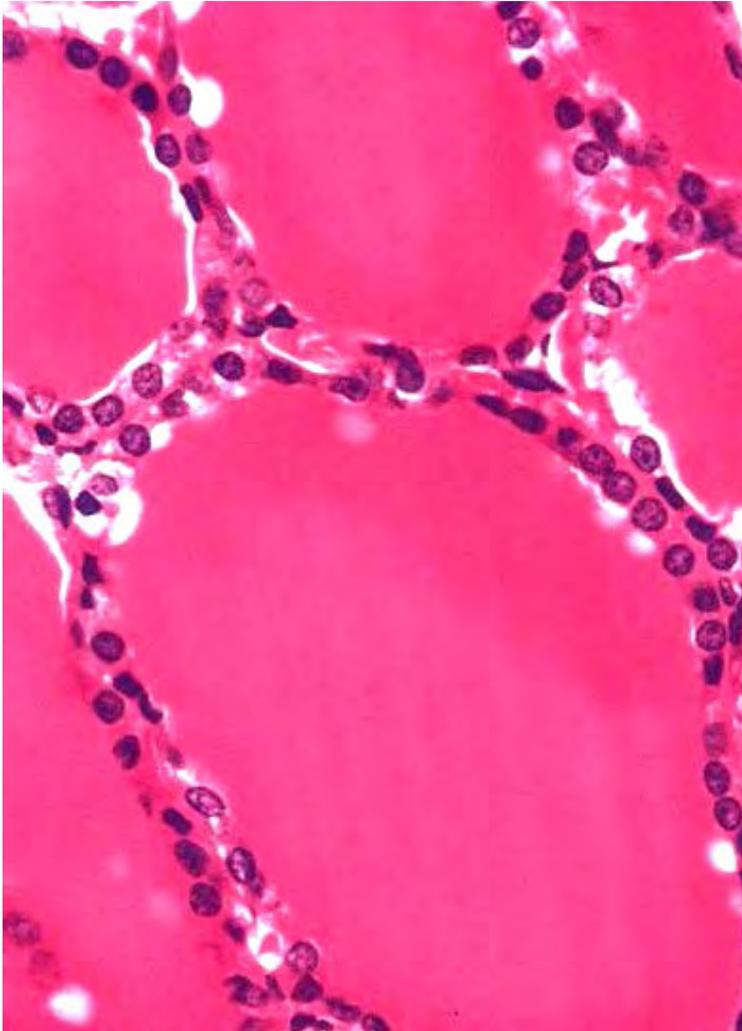
- Pituitary-dependent endocrine organ (**TSH**)
- Regulation of basal metabolic rate
- Extracellular storage of hormone as colloid (**thyroglobulin** → **T3, T4**)
- Highly vascularized tissue
- Follicular and para-follicular cells (C-cells)

# Thyroid Follicles Filled with Colloid



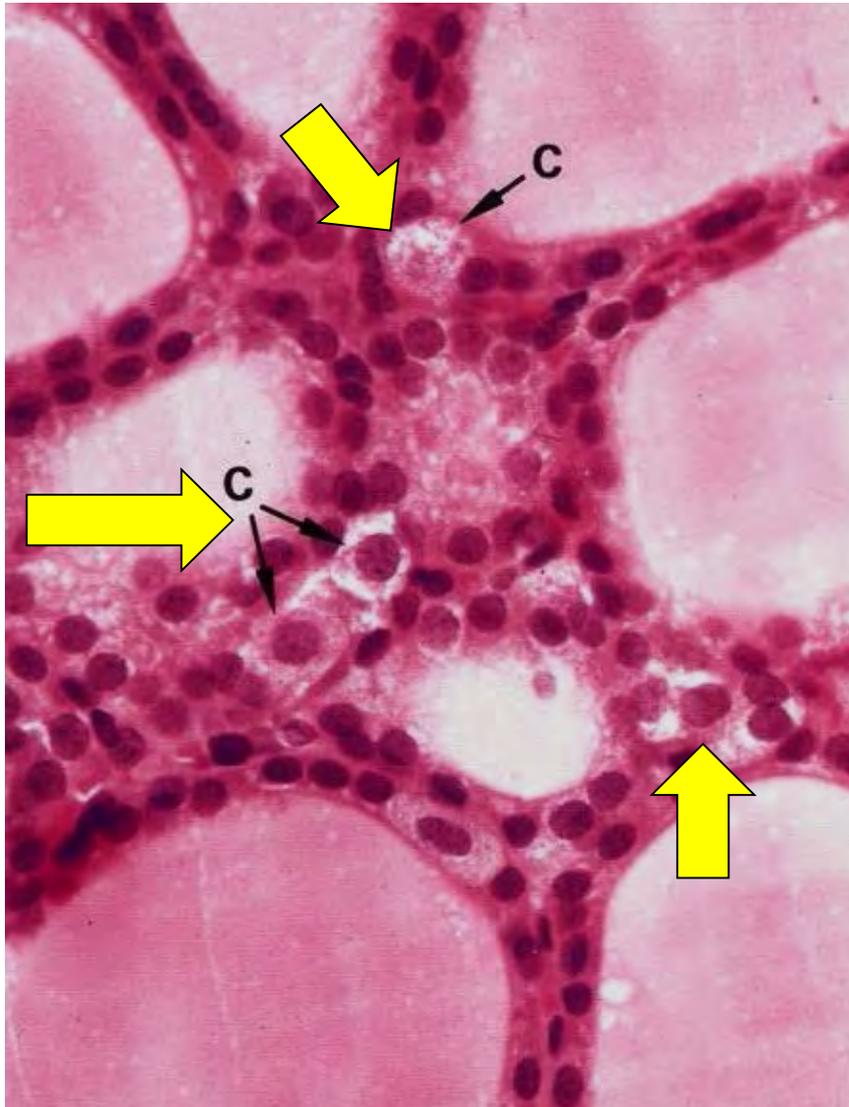
- Follicles are distended with colloid
- Diameter is variable
- Range of epithelial cell morphologies
- Fenestrated capillaries

# Follicles Store Thyroglobulin



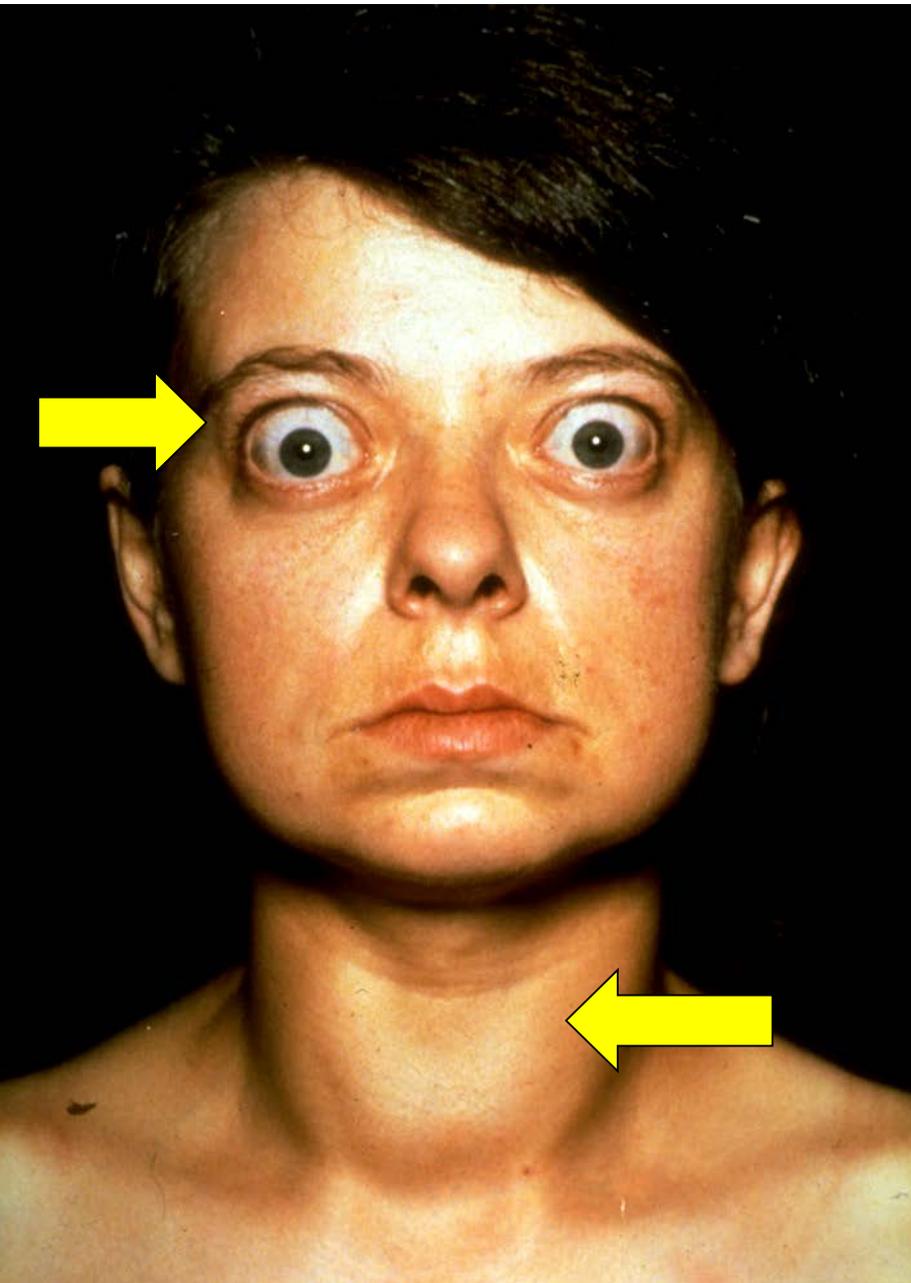
- Follicles store thyroid hormone precursor (3 months)
- Pituitary-derived TSH stimulates thyroglobulin uptake and intracellular processing by epithelial cells
- **Active T3 and T4** are then discharged into capillaries.
- Size of follicles and lining cells varies according to their activation state

# Calcitonin Producing C-Cells



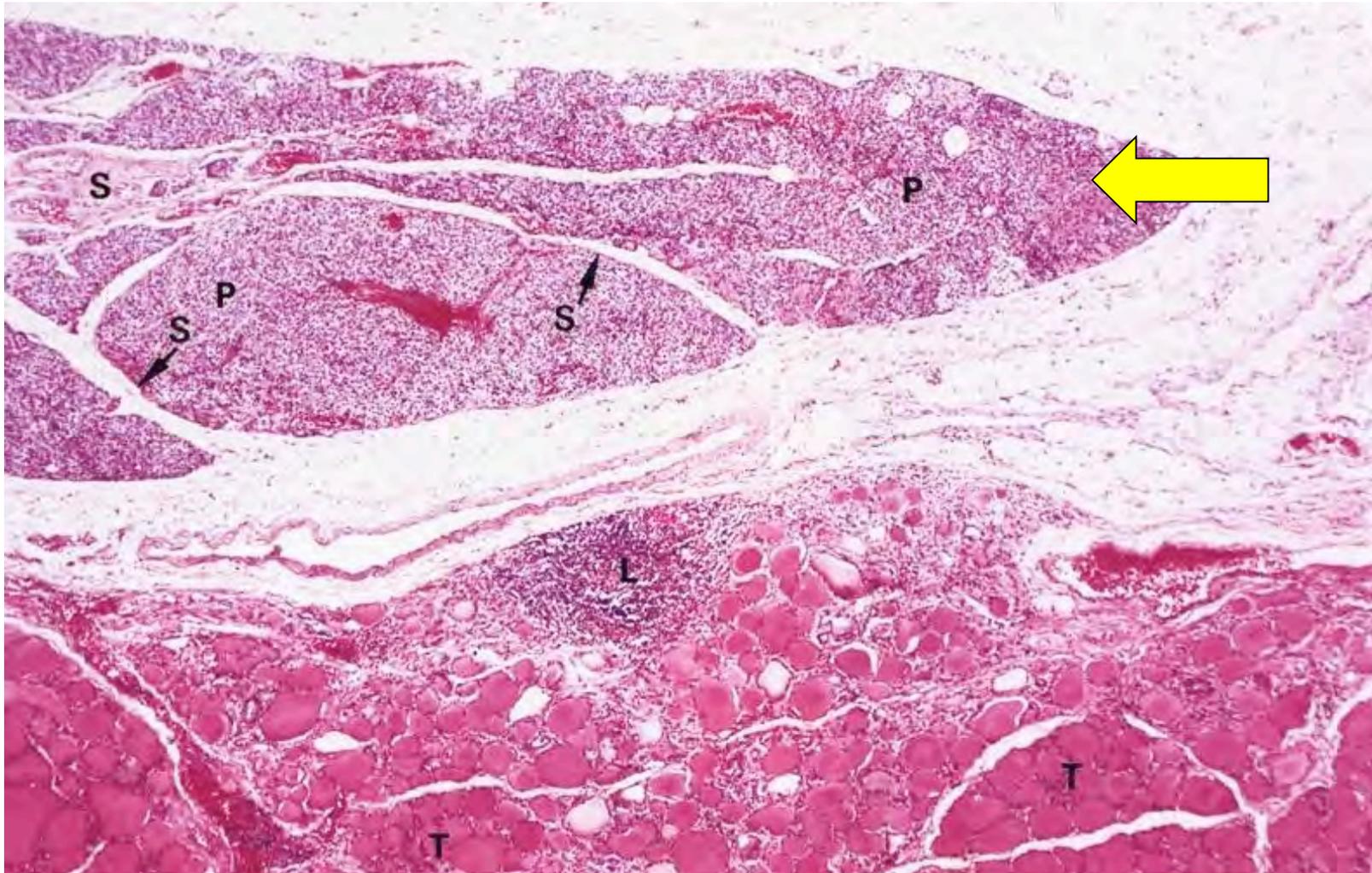
- Scattered neuroendocrine cells from neural crest reside within the basal lamina of the follicle or in clusters between follicles
- Referred to as **parafollicular** or clear **C-cells**
- Synthesize **calcitonin** to decrease serum calcium
- Medullary-type thyroid carcinoma is derived from these C-cells

# Hyperthyroidism

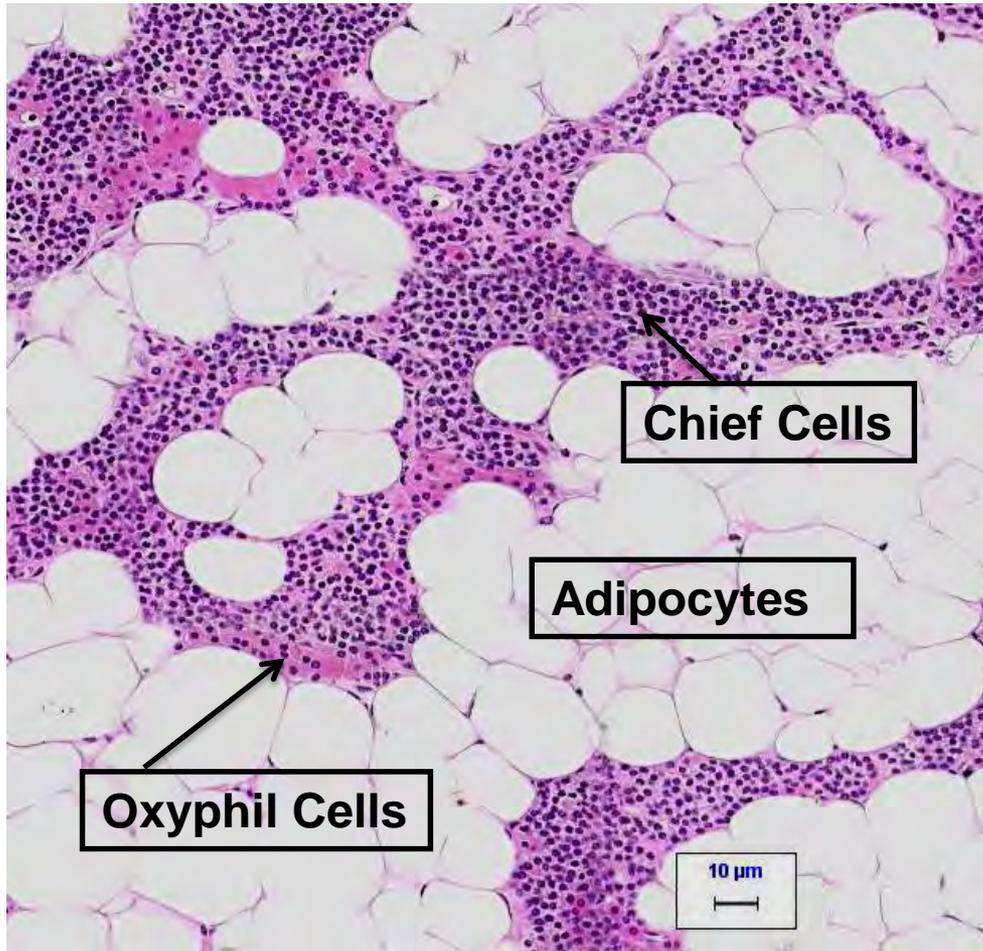


- Normal regulation of thyroid follicular cells by pituitary TSH is circumvented by the production of anti-TSH receptor antibodies (autoimmune disease).
- The result is unrelenting stimulation of the thyroid gland and clinical features of hyperthyroidism (Graves disease).

# Parathyroid Glands (4)

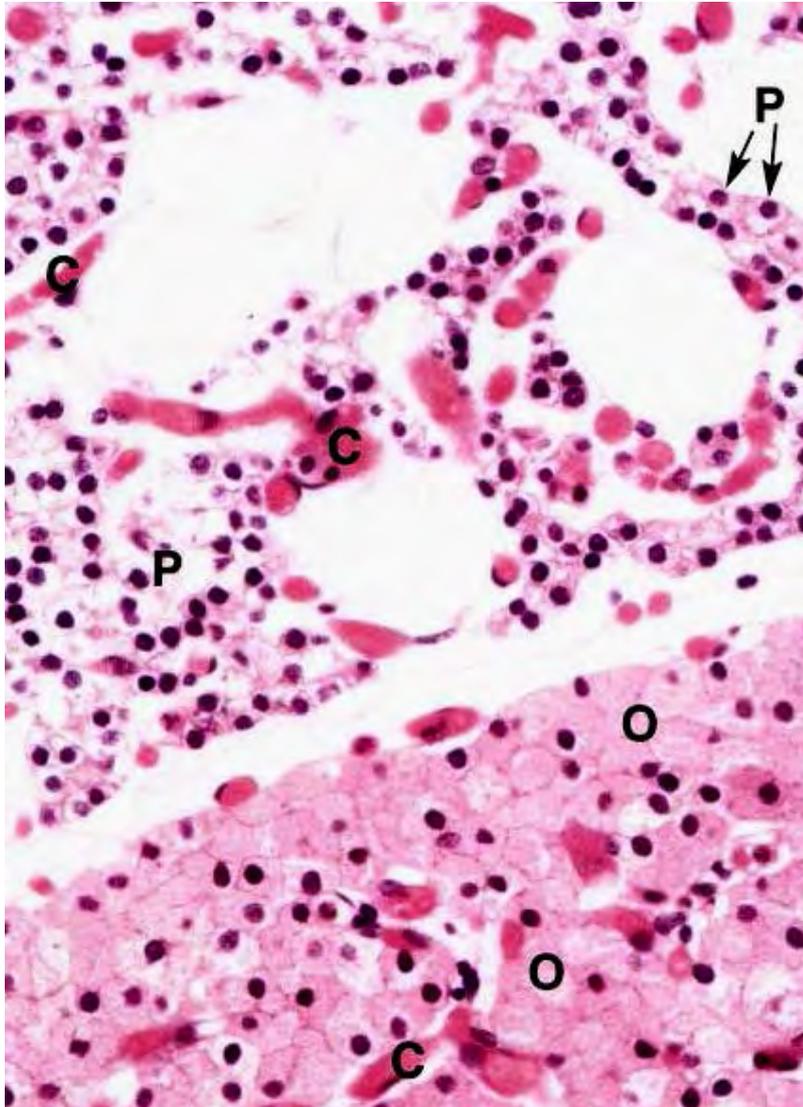


# Parathyroid Glandular Epithelium



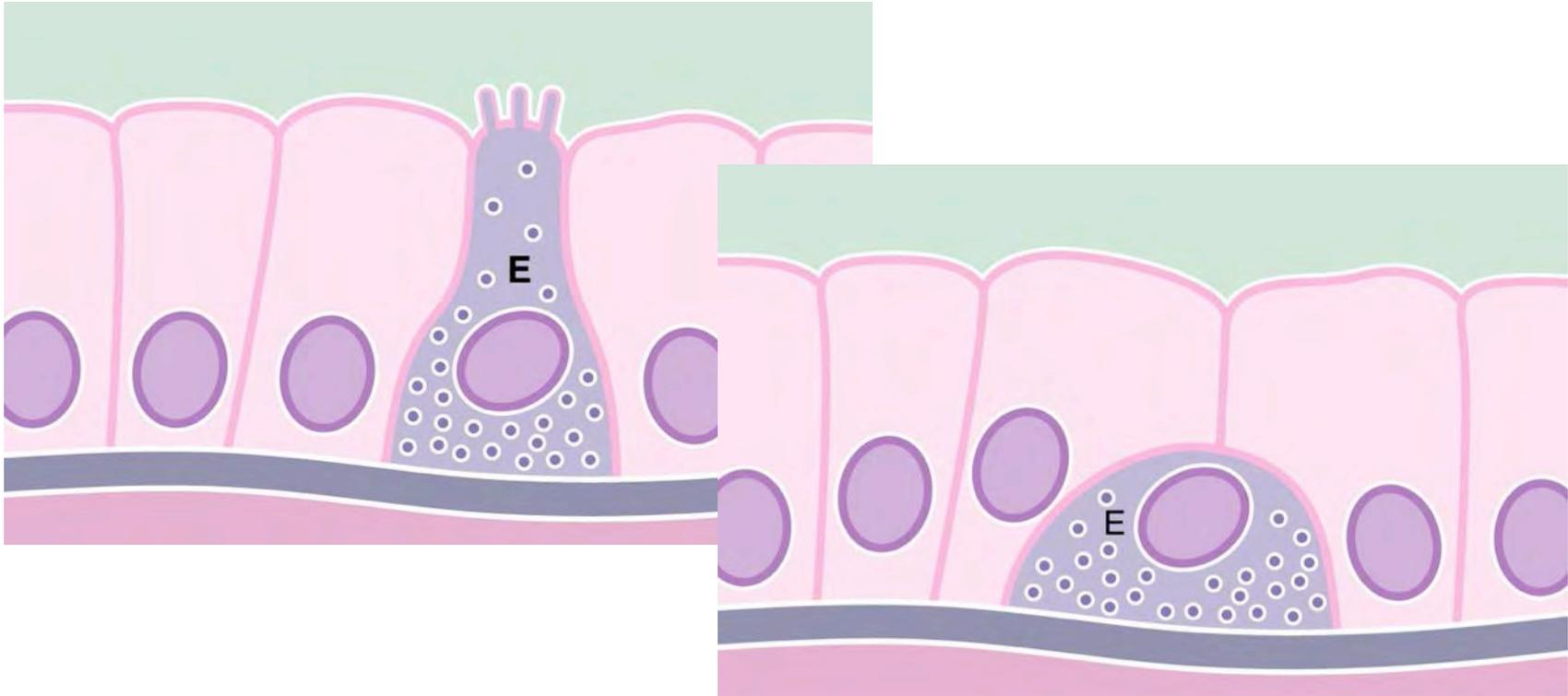
- Cord-like secretory cells and adipose tissue (A). Adipose tissue increases significantly with patient age.
- Composed of two cells types: **chief cells** (principal cells) and **oxyphil** cells.
- Chief cells synthesize and secrete parathyroid hormone (**PTH**) in response to changes in blood calcium.

# Parathyroid Gland (H & E)



- Chief cells (principal cells) secrete PTH to increase serum Ca
- Capillaries
- Oxyphil cells

# Diffuse Neuroendocrine System



An example of the diffuse neuroendocrine system is gastrin-producing cells of stomach (**APUD System**). Enteroendocrine cells may be located at any level in the mucosa, from the base of glands to the tips of villi.

# Summary of Key Points

- Pituitary (anterior & posterior lobes)
- Adrenals (cortex 3 layers & medulla)
- Pancreas (islets of Langerhans)
- Thyroid (follicular & parafollicular C-cells)
- Parathyroid (chief & oxyphil cells)

# Endocrine Organs

*Thank you... Questions?*

