Digestive system 2 (stomach, gut)

WALL OF DIGESTIVE TUBE

1/ tunica mucosa

a) lamina epithelialis

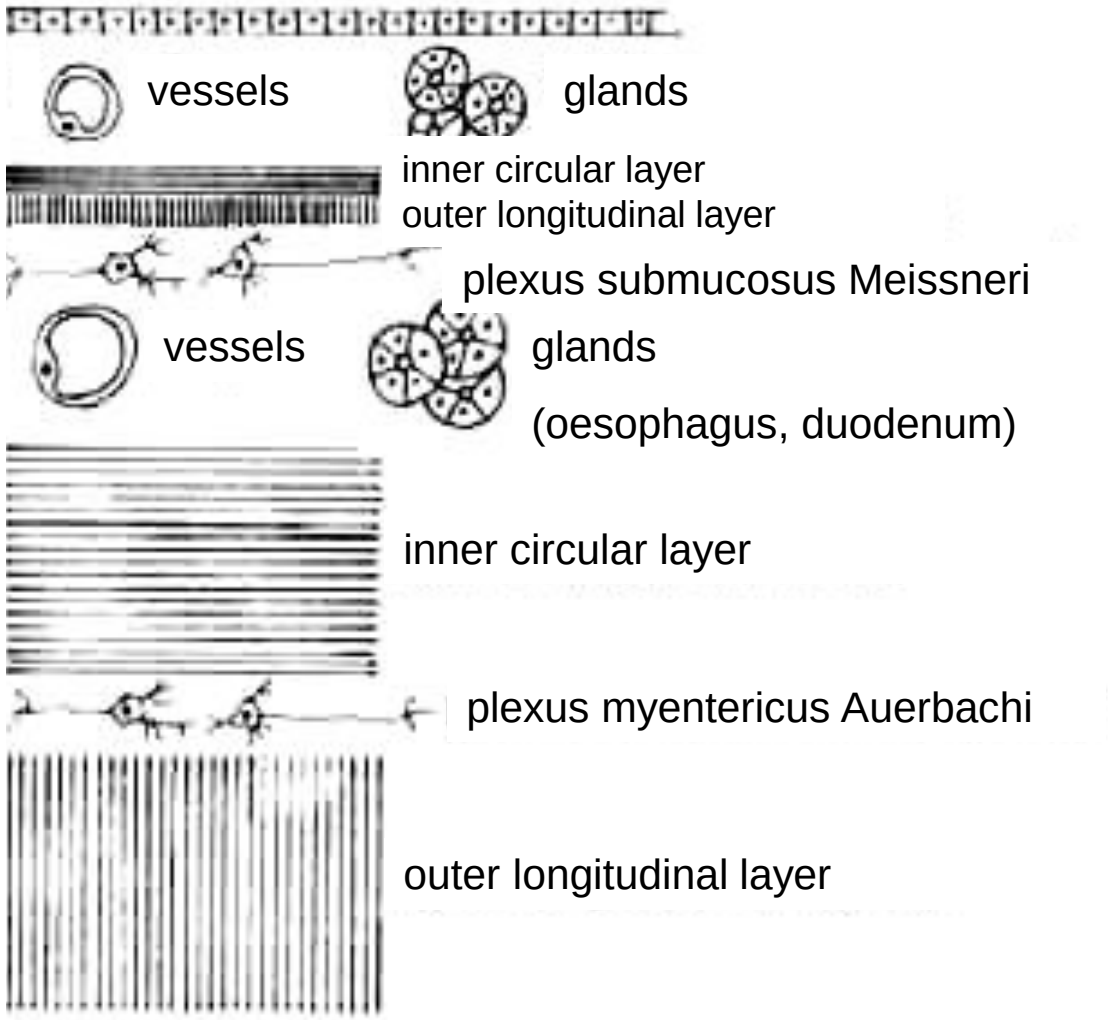
b) lamina propria mucosae

c) lamina muscularis mucosae

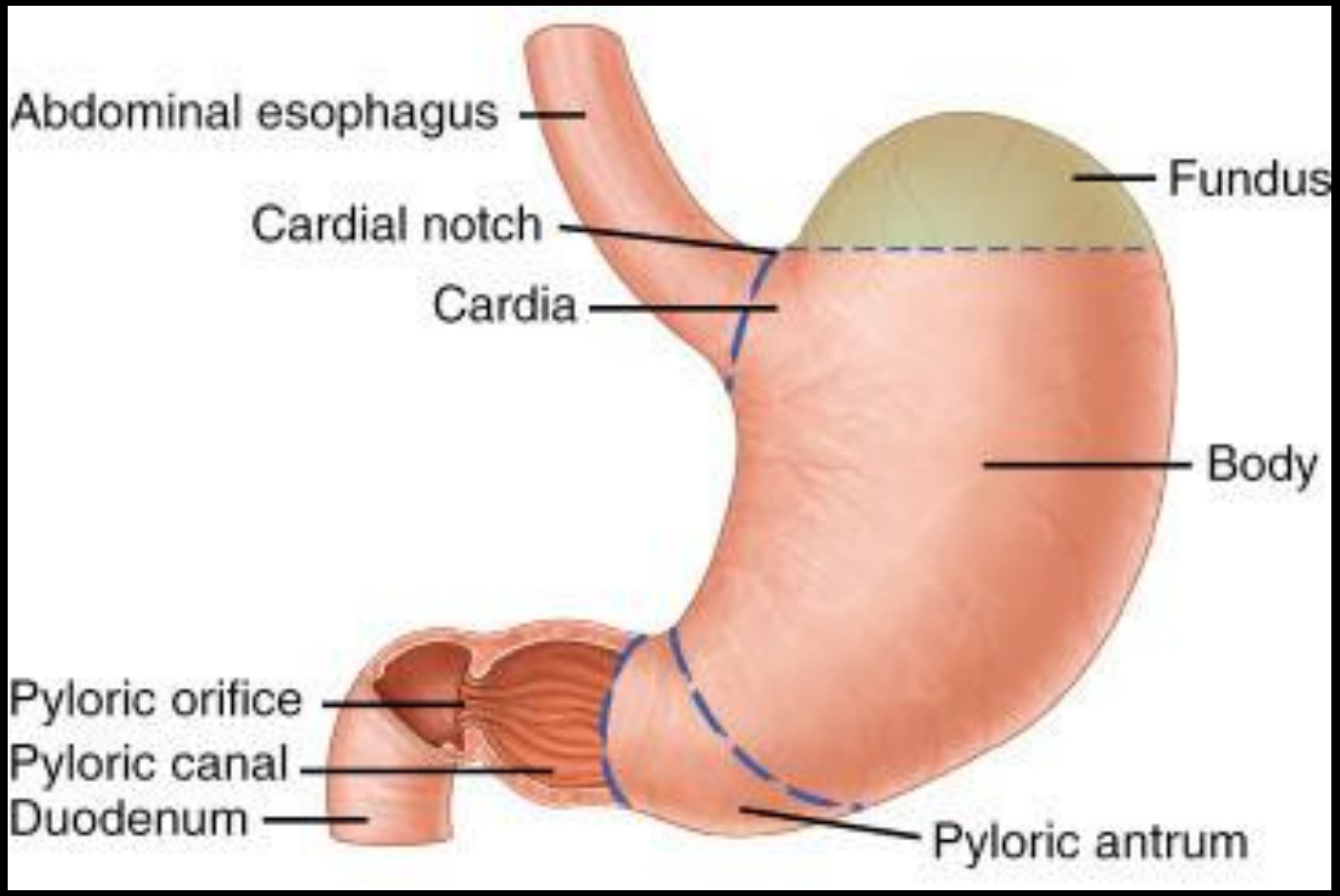
2/ tela submucosa

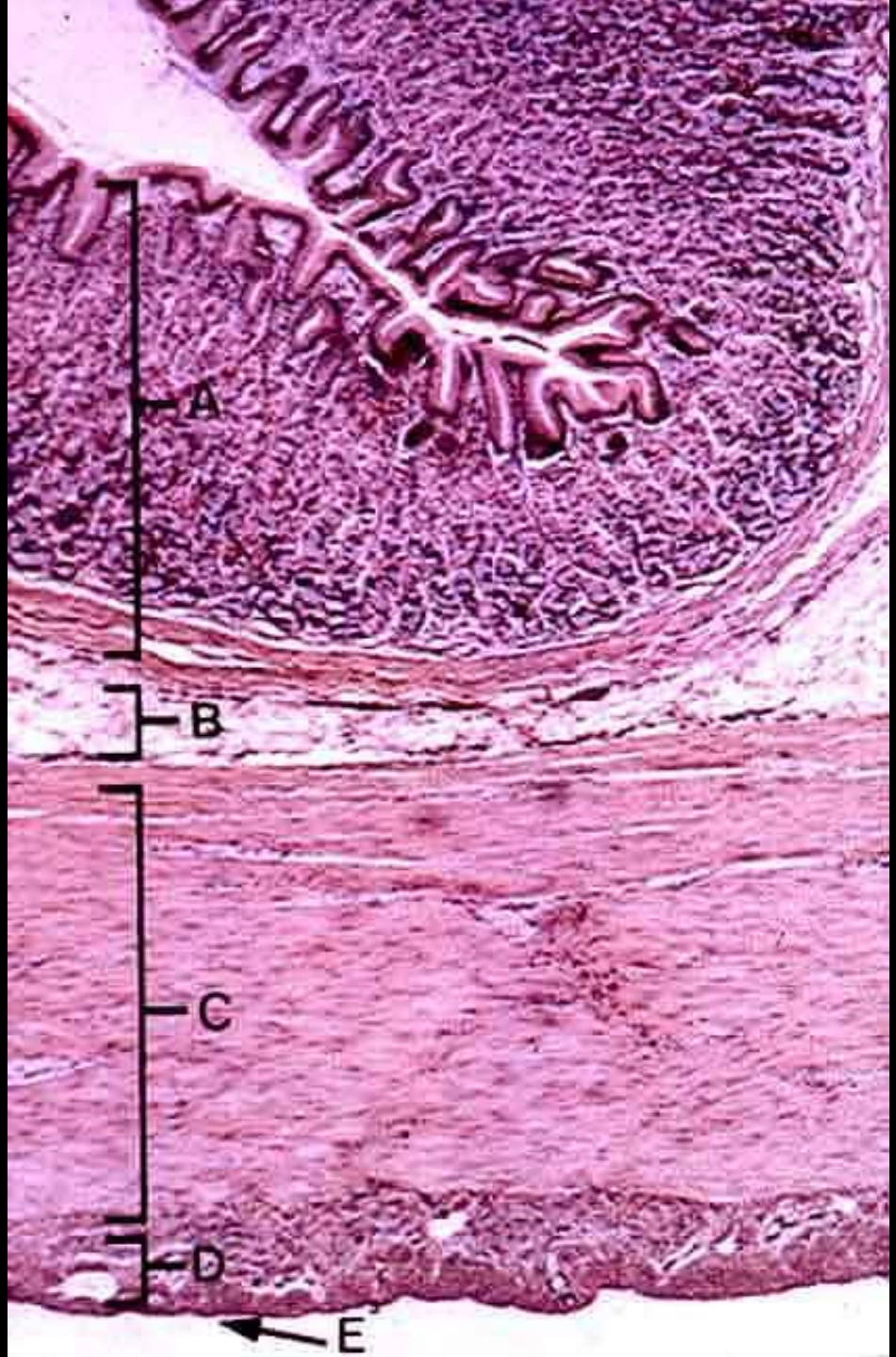
3/ tunica muscularis (externa)

4/ tunica serosa or adventitia



Stomach (Ventriculus, Gaster)





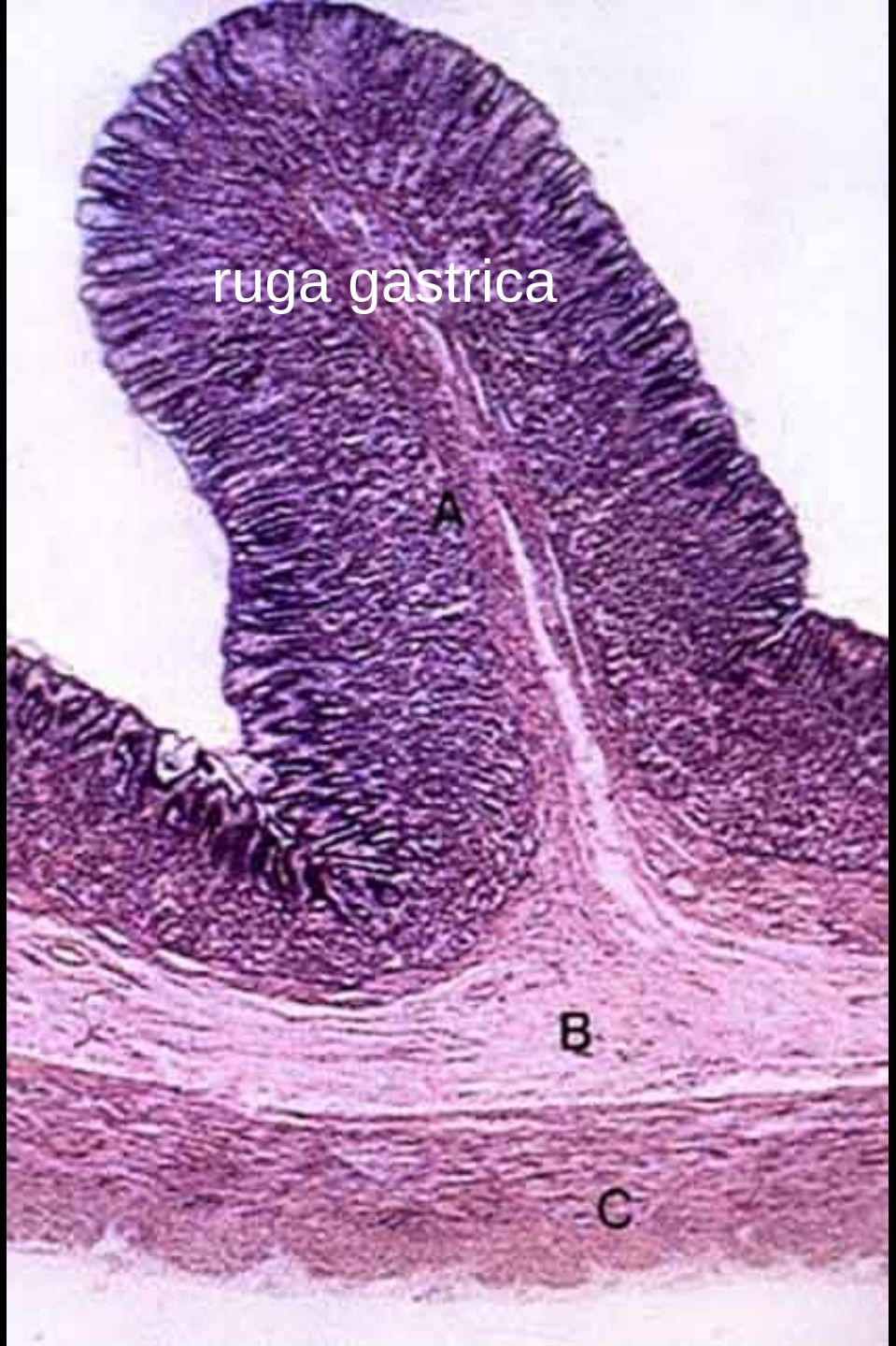
Stomach

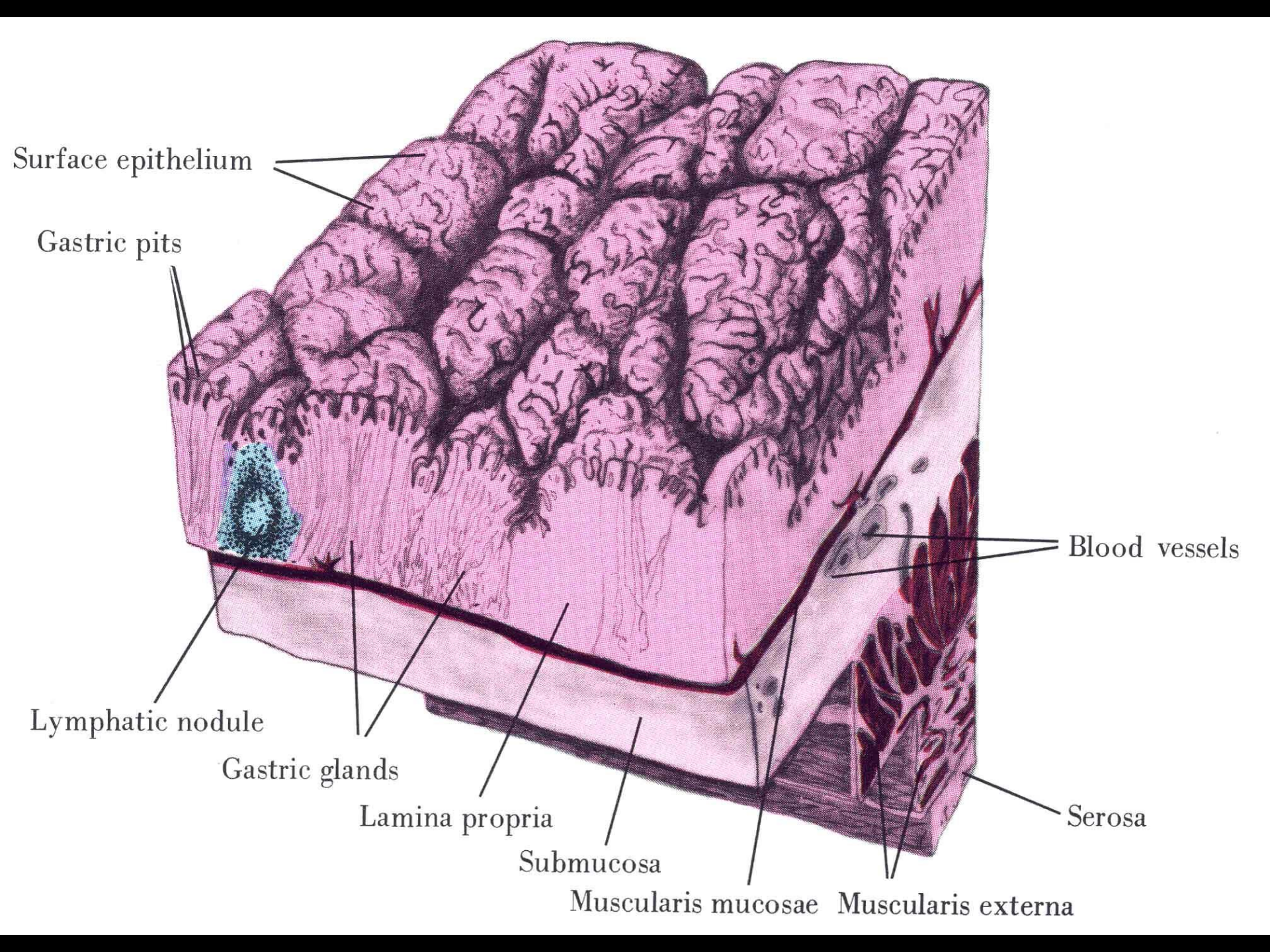
tunica mucosa

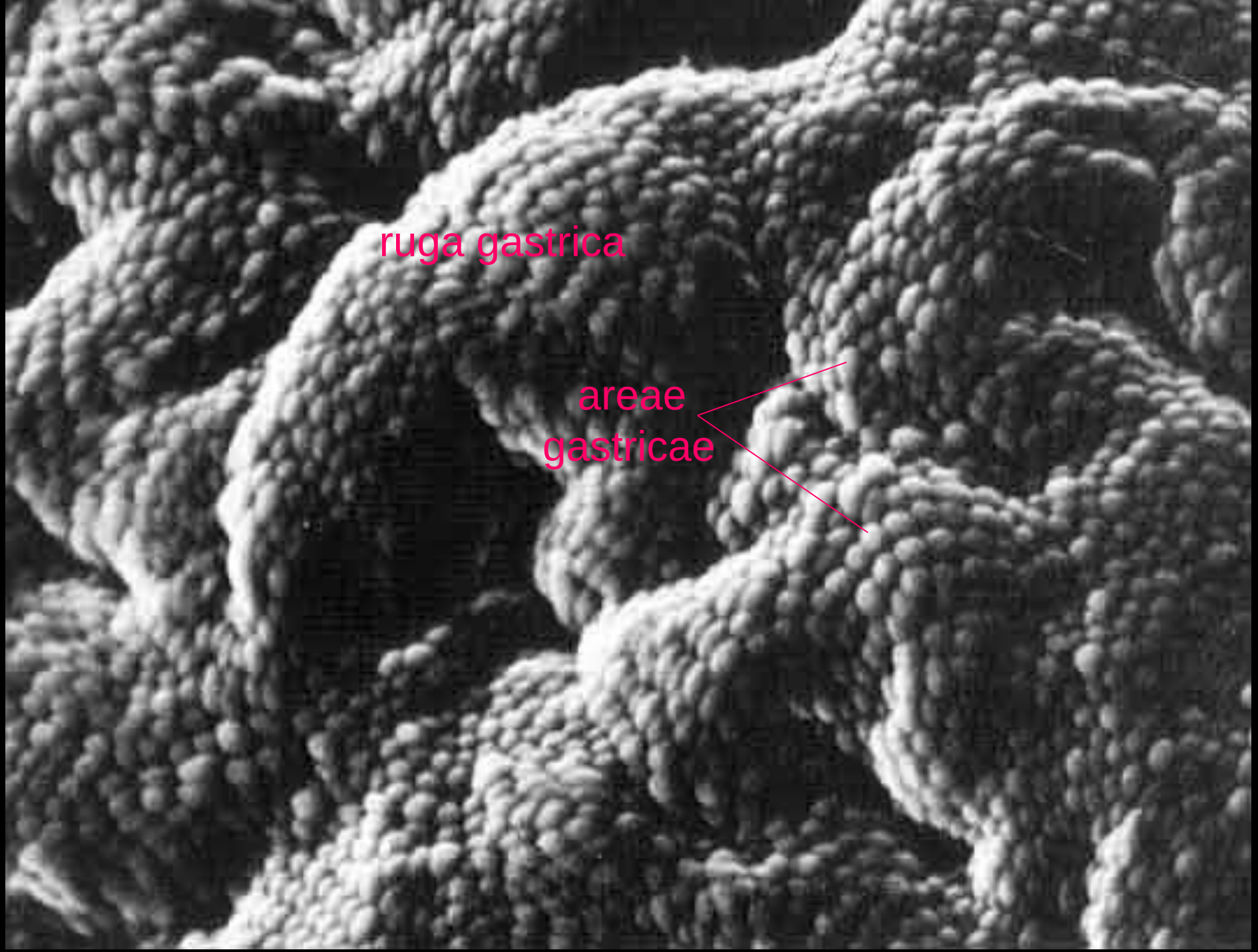
tela submucosa

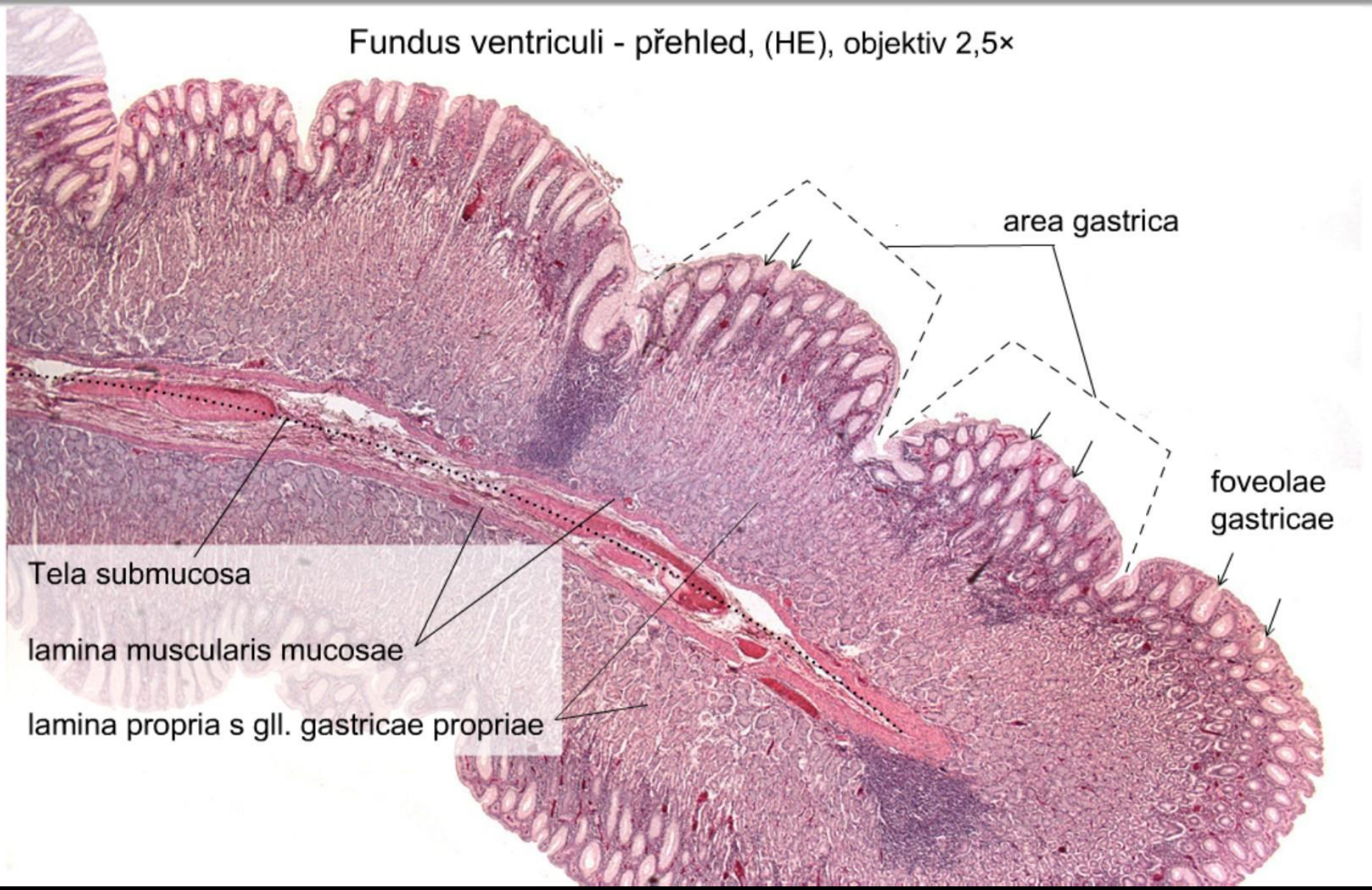
tunica muscularis externa

tunica serosa

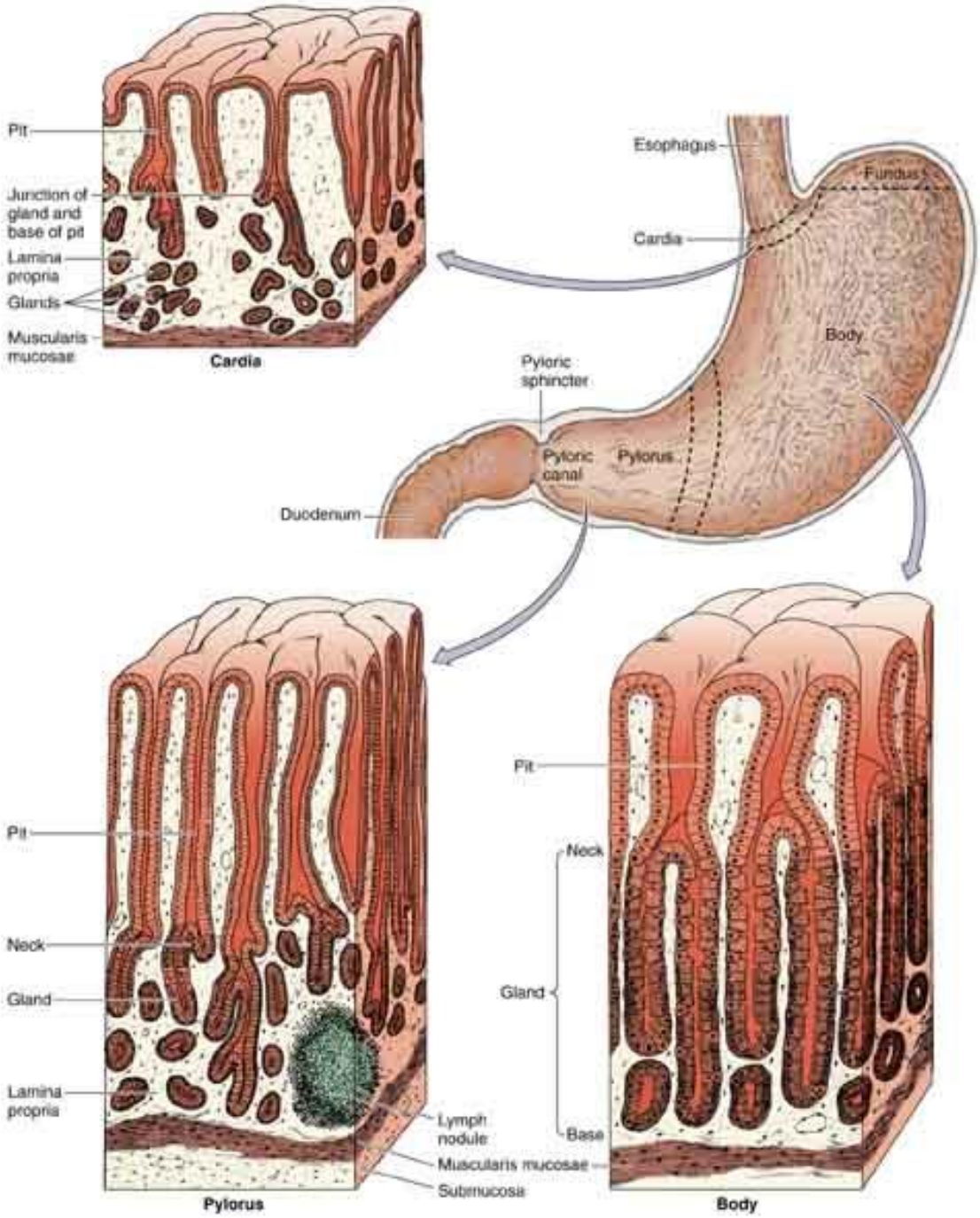

ruga gastrica
A
B
C


Surface epithelium
Gastric pits
Blood vessels
Lymphatic nodule
Gastric glands
Lamina propria
Submucosa
Muscularis mucosae
Muscularis externa
Serosa

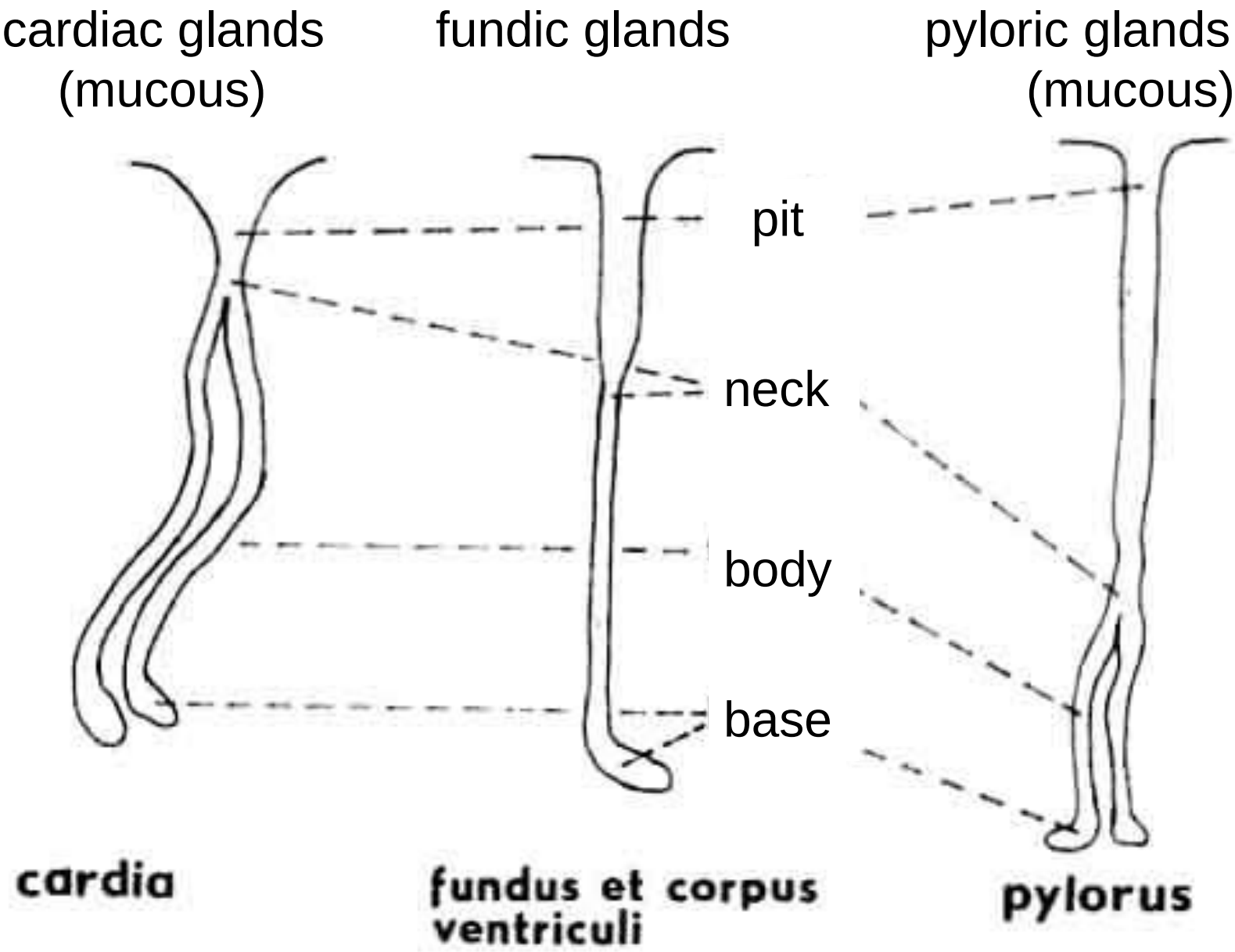

ruga gastrica
areae
gastricae


Fundus ventriculi - přehled, (HE), objektiv 2,5×
area gastrica
foveolae gastricae
Tela submucosa
lamina muscularis mucosae
lamina propria s gll. gastricae propriae

Surface epithelium

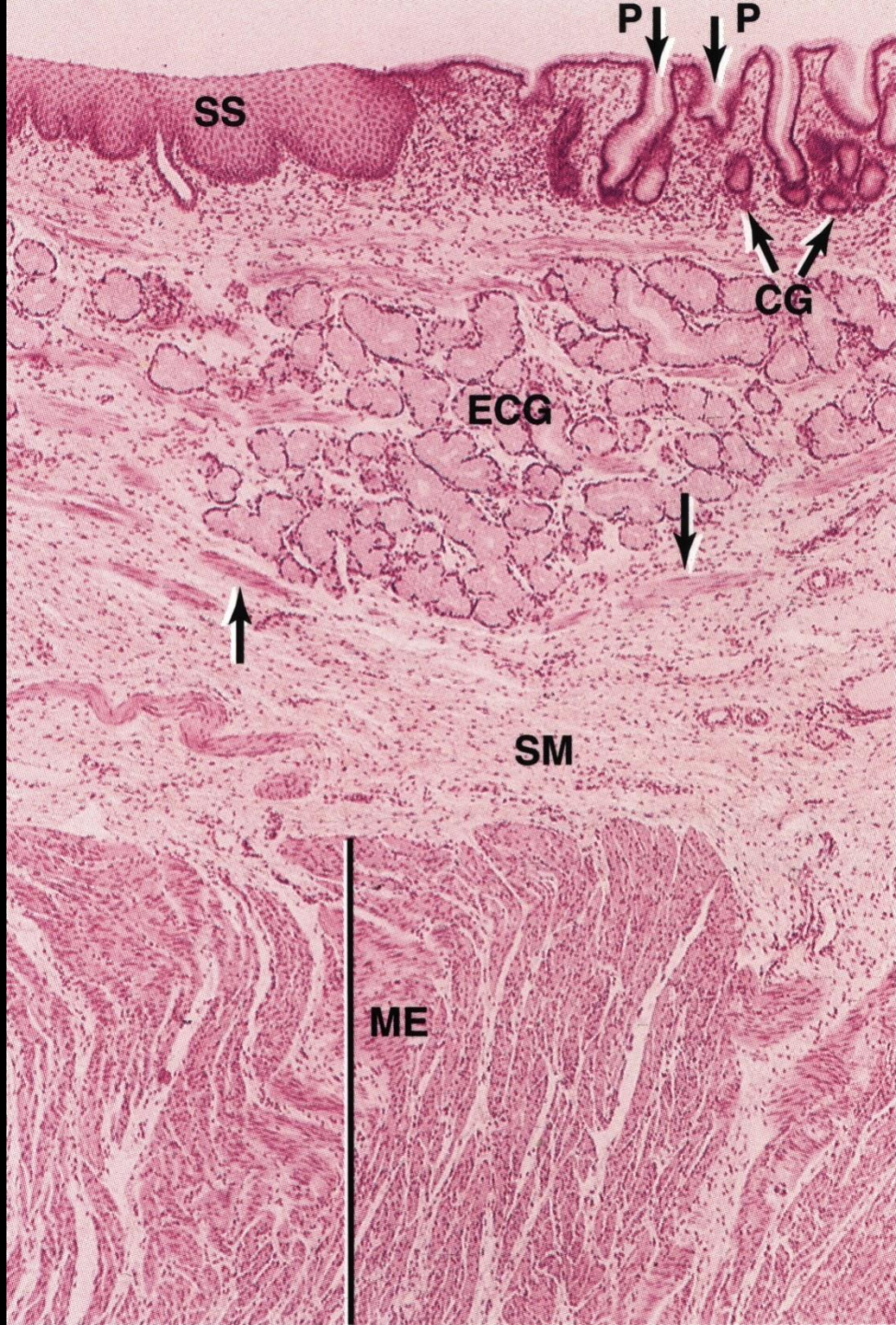

Pit
Junction of gland and base of pit
Lamina propria
Glands
Muscularis mucosae
Cardia
Esophagus
Fundus
Cardia
Body
Pyloric sphincter
Pyloric canal
Pylorus
Duodenum
Pit
Neck
Gland
Lamina propria
Lymph nodule
Muscularis mucosae
Submucosa
Pylorus
Pit
Neck
Gland
Base
Body

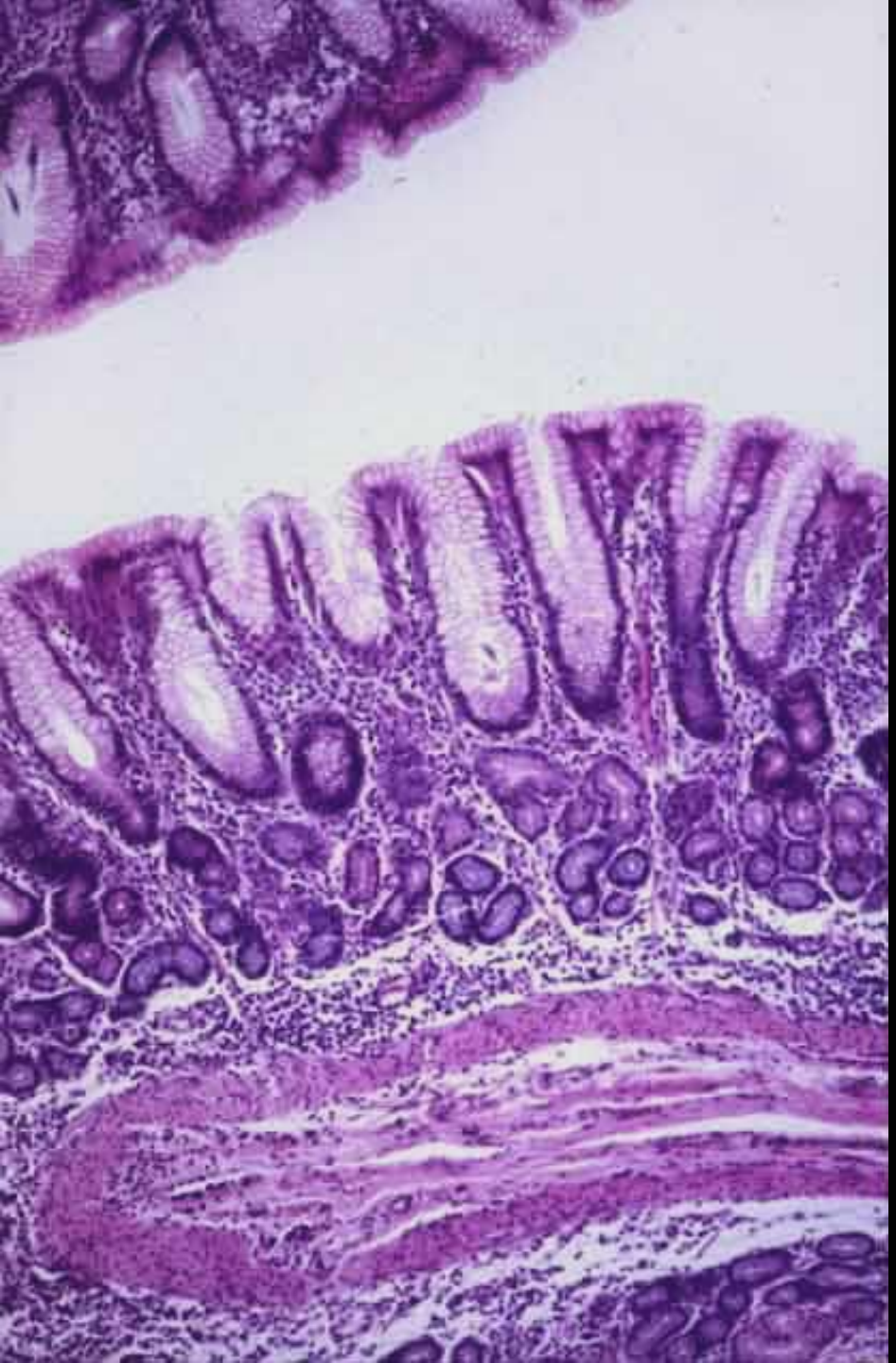
GLANDULAE GASTRICAE



Cardia

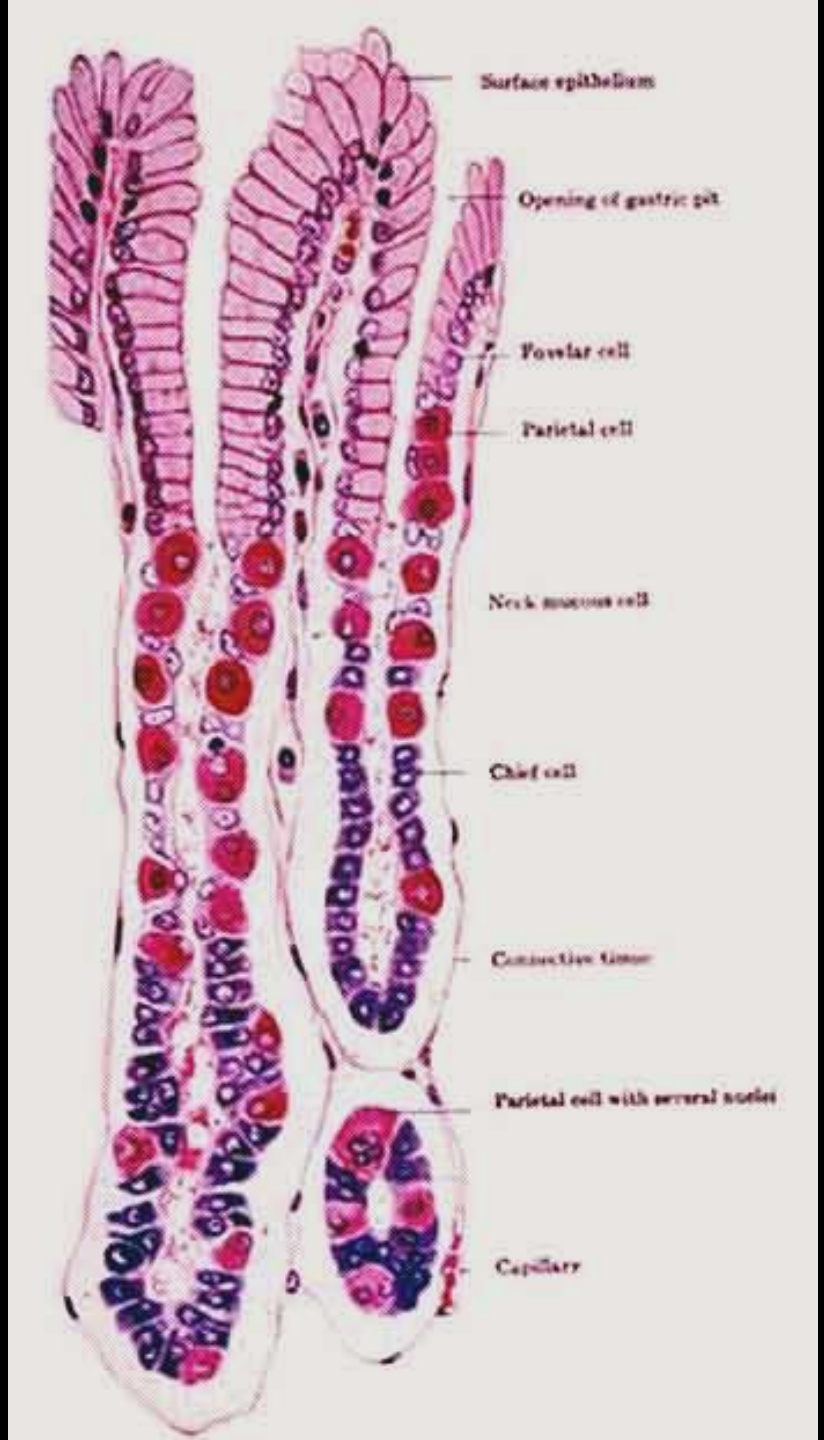
- shallow gastric pits (P)
- long, often branched cardiac glands (CG) mostly mucous; rare parietal and enteroendocrine cells





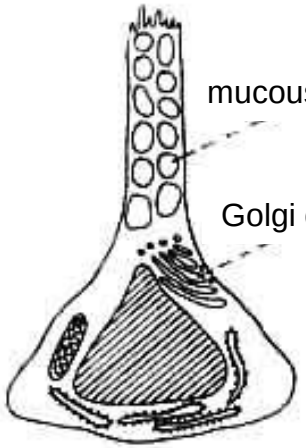
Body (fundus)

- moderate deep gastric pits
- long simple straight tubular fundic gastric glands, 5 types of cells

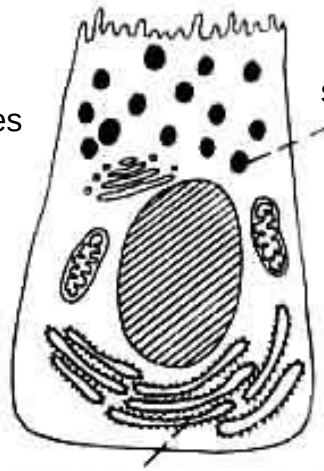


Cells of gastric glands

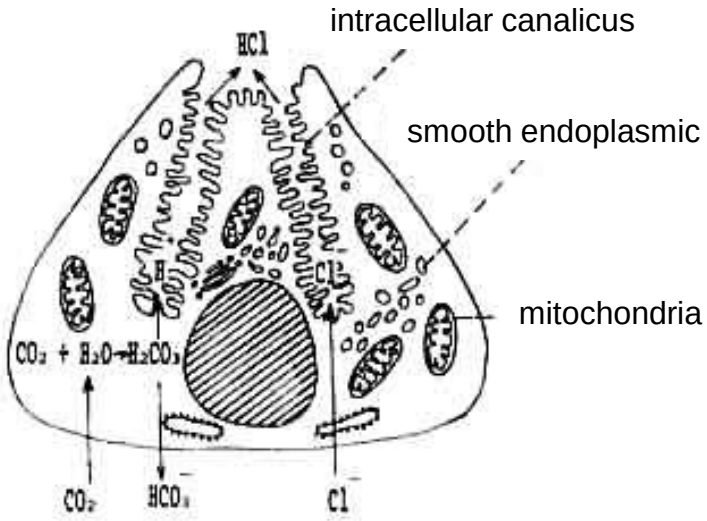
1 Neck mucous cell



2 Chief cell



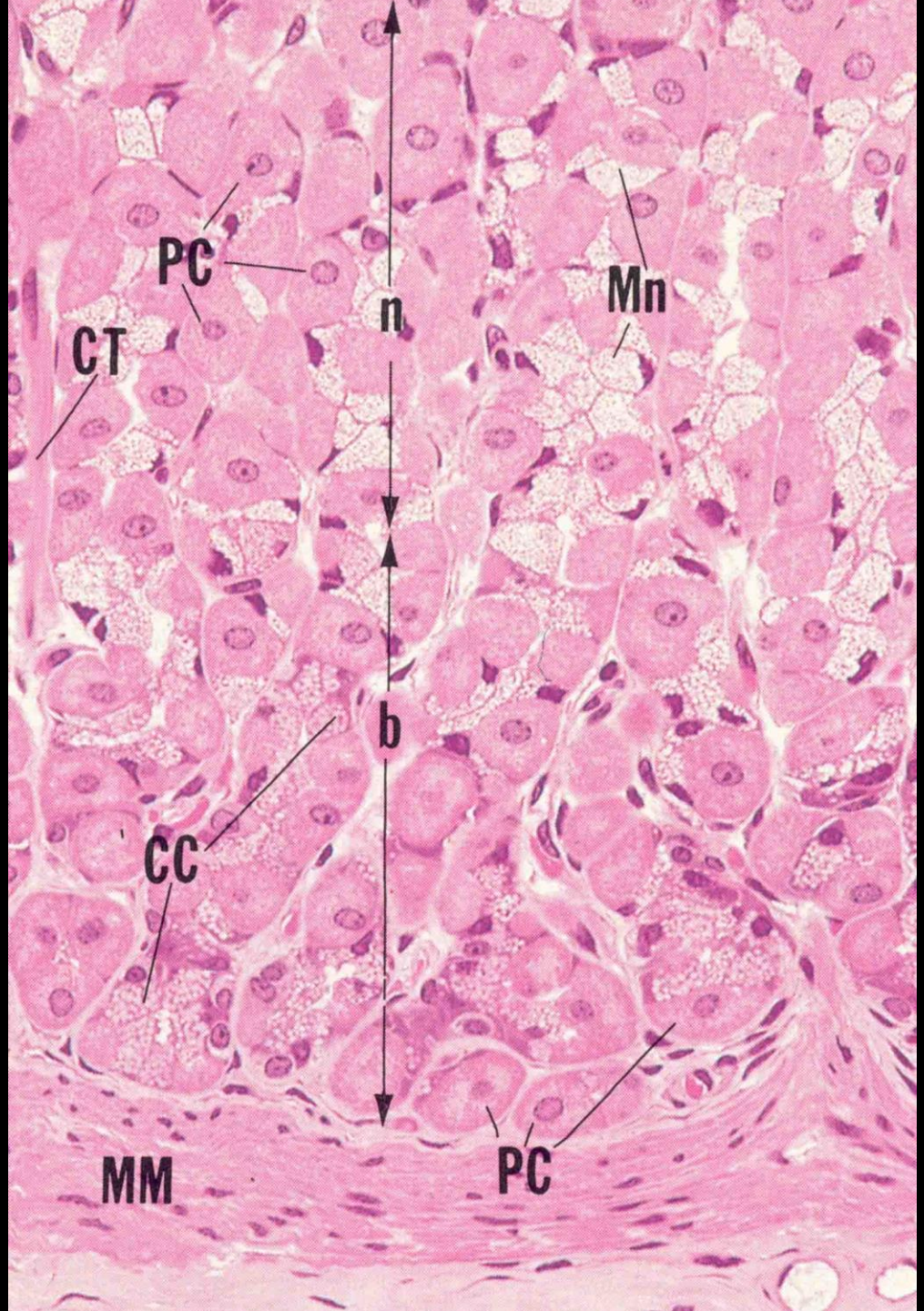
3 Parietal cell



4 enteroendocrine cells

5 undifferentiated cells

Neck
mucous cells

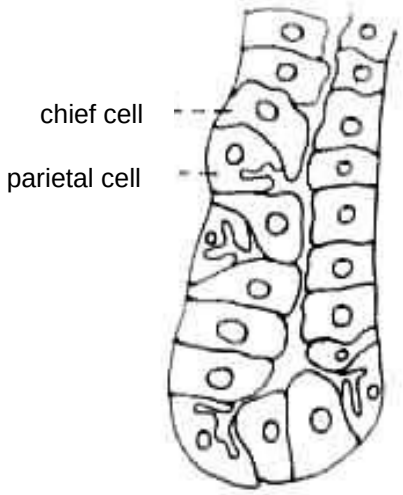


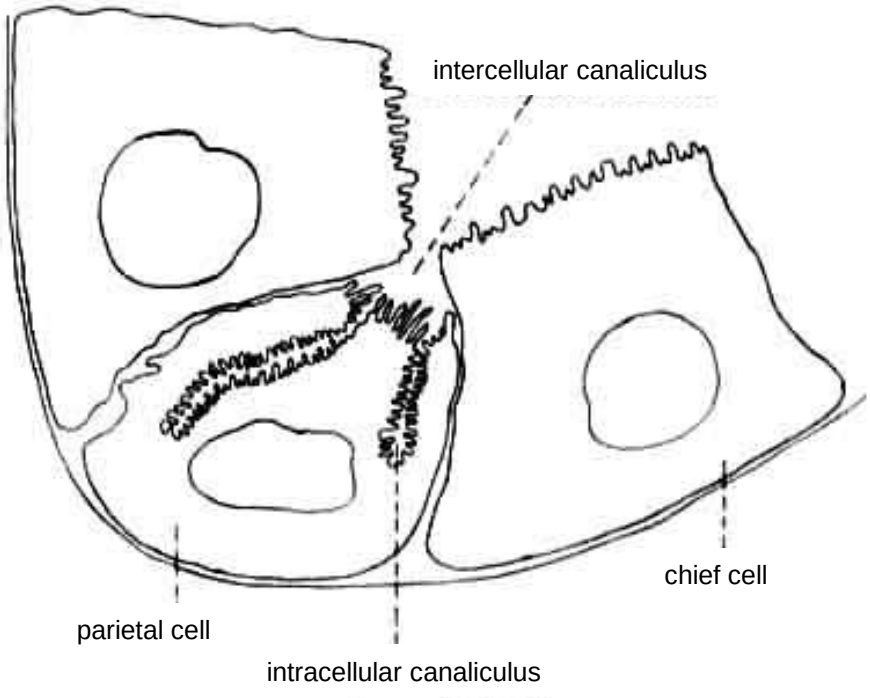
necks

bodies

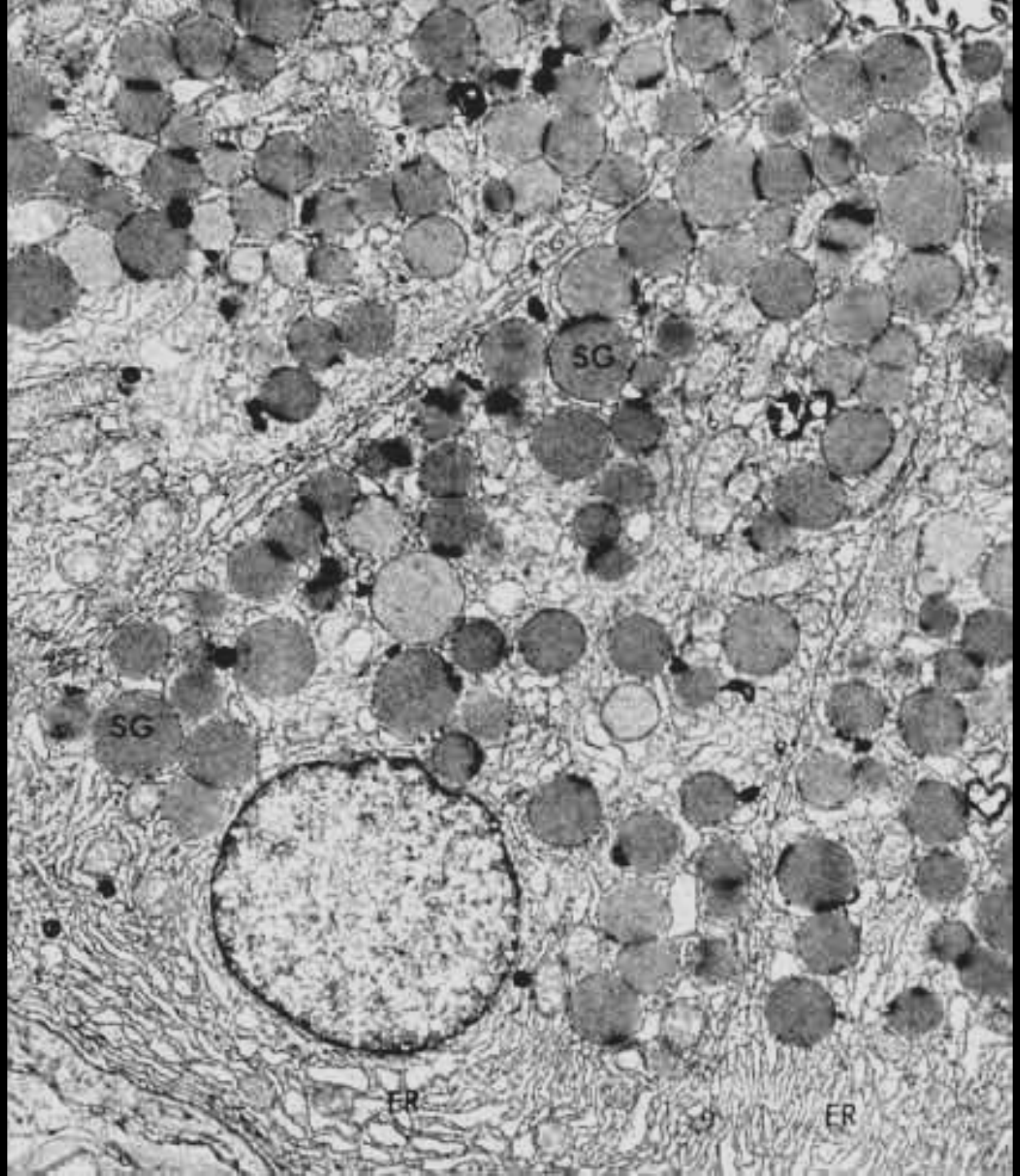
bases

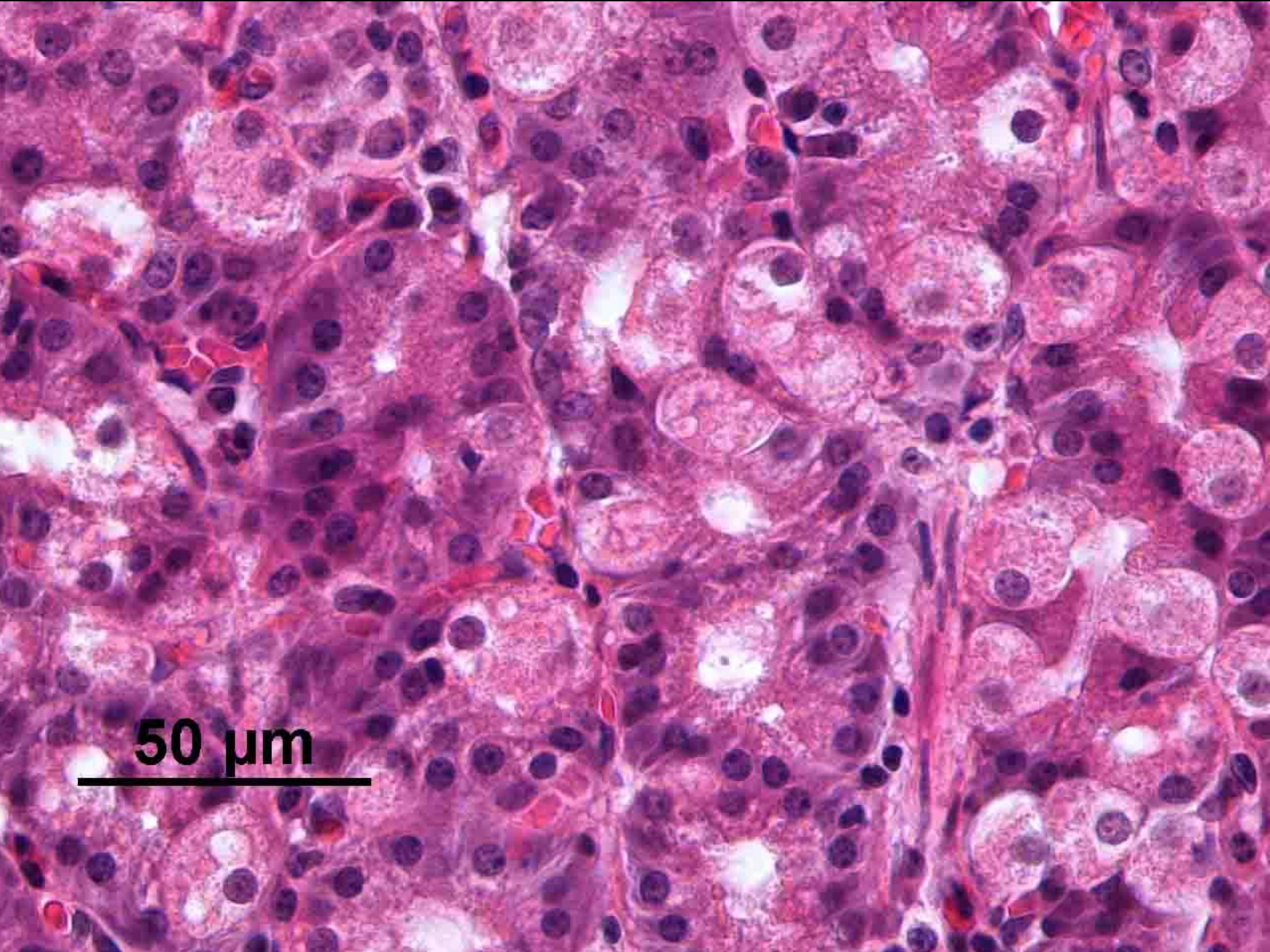
BASE OF A FUNDIC GASTRIC GLAND





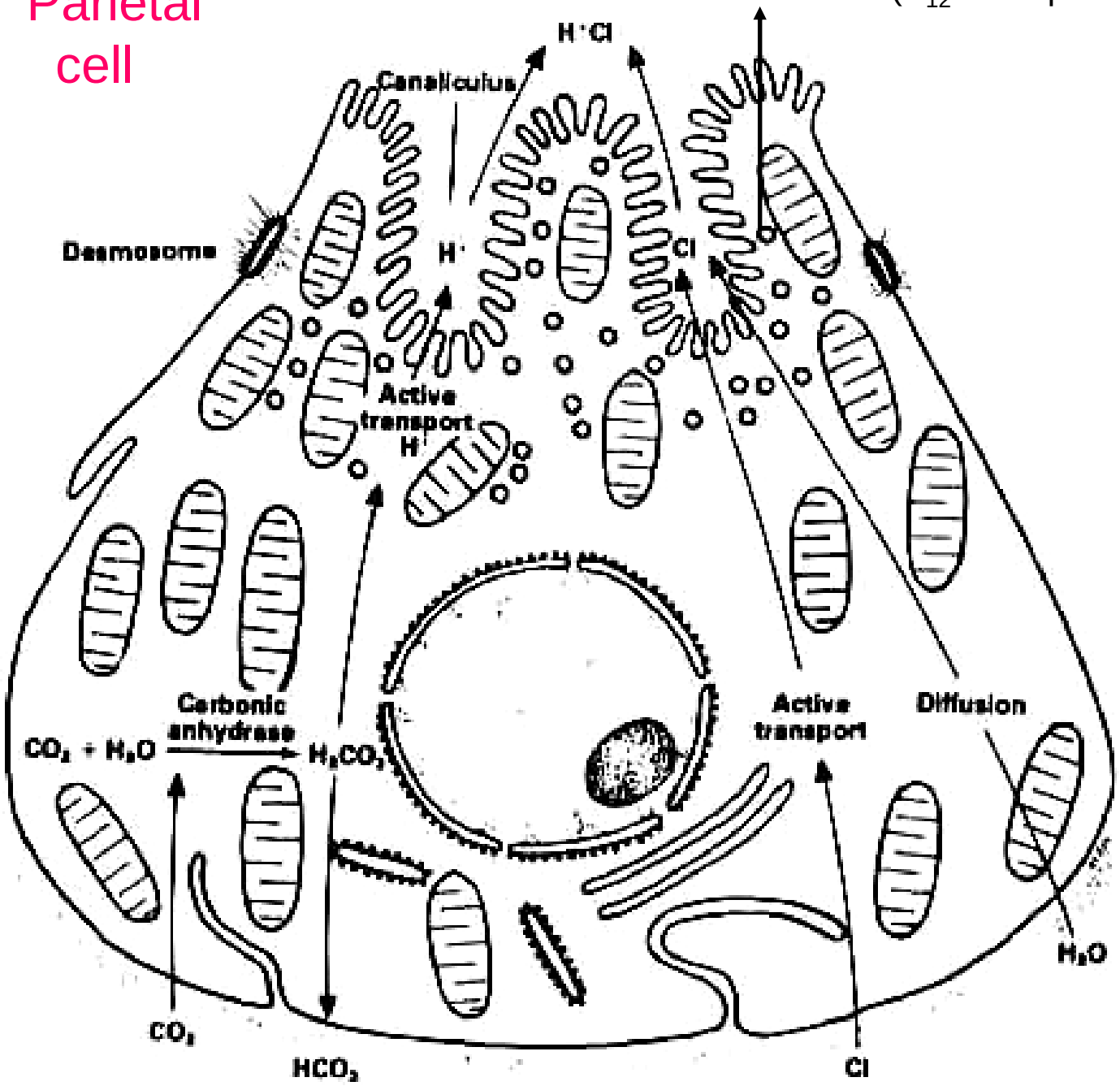
Chief cell

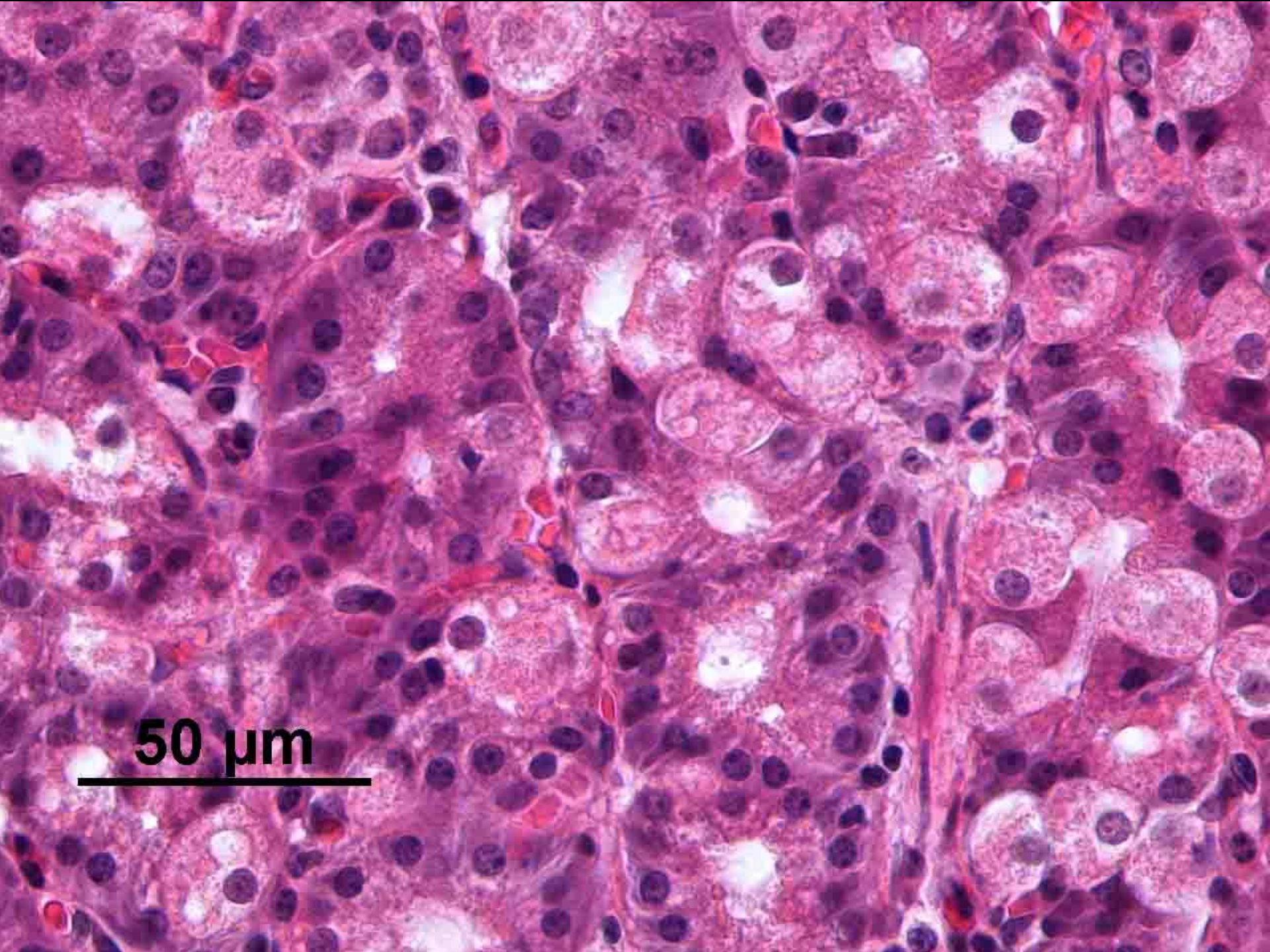



50 µm

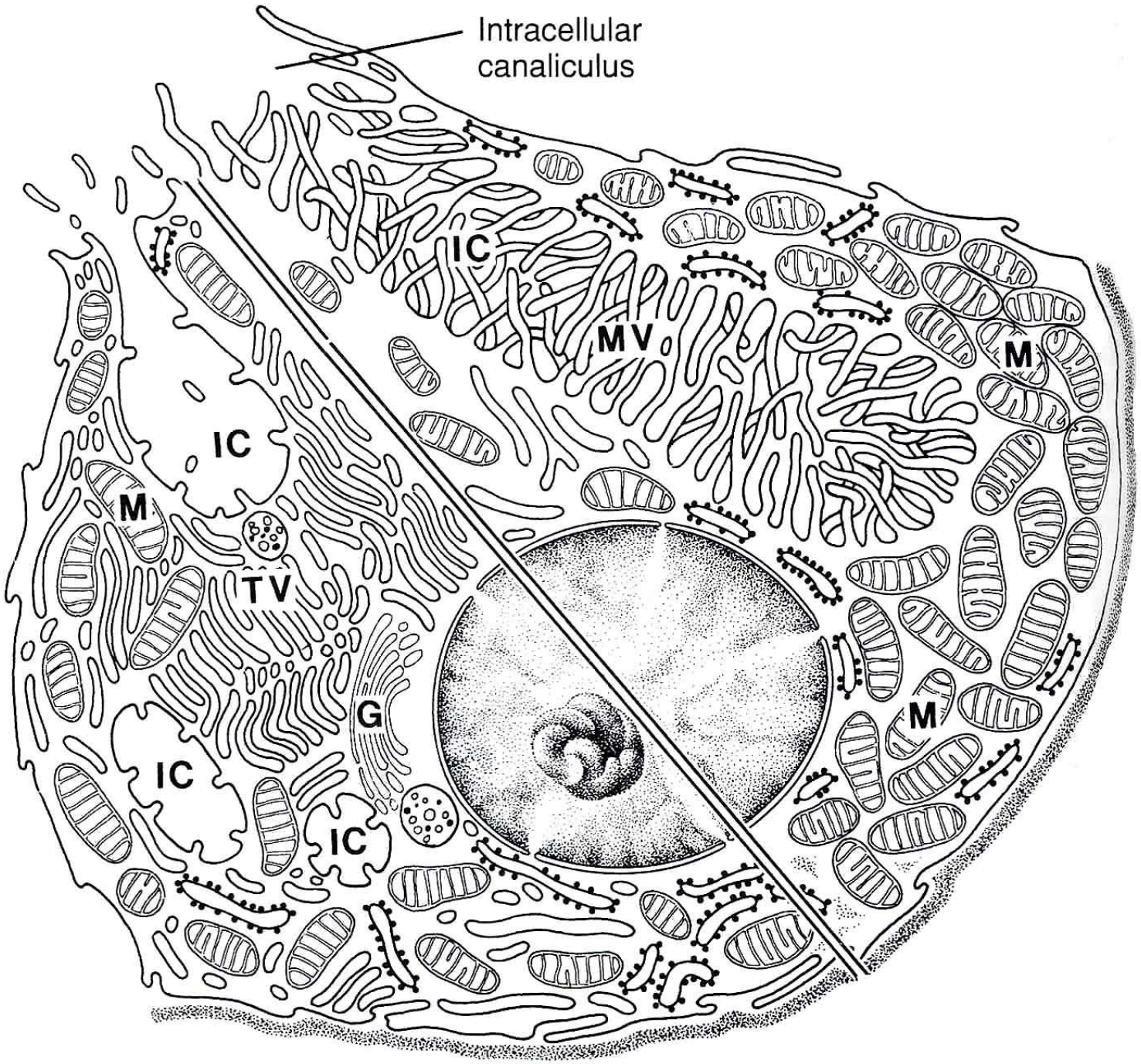
Parietal cell

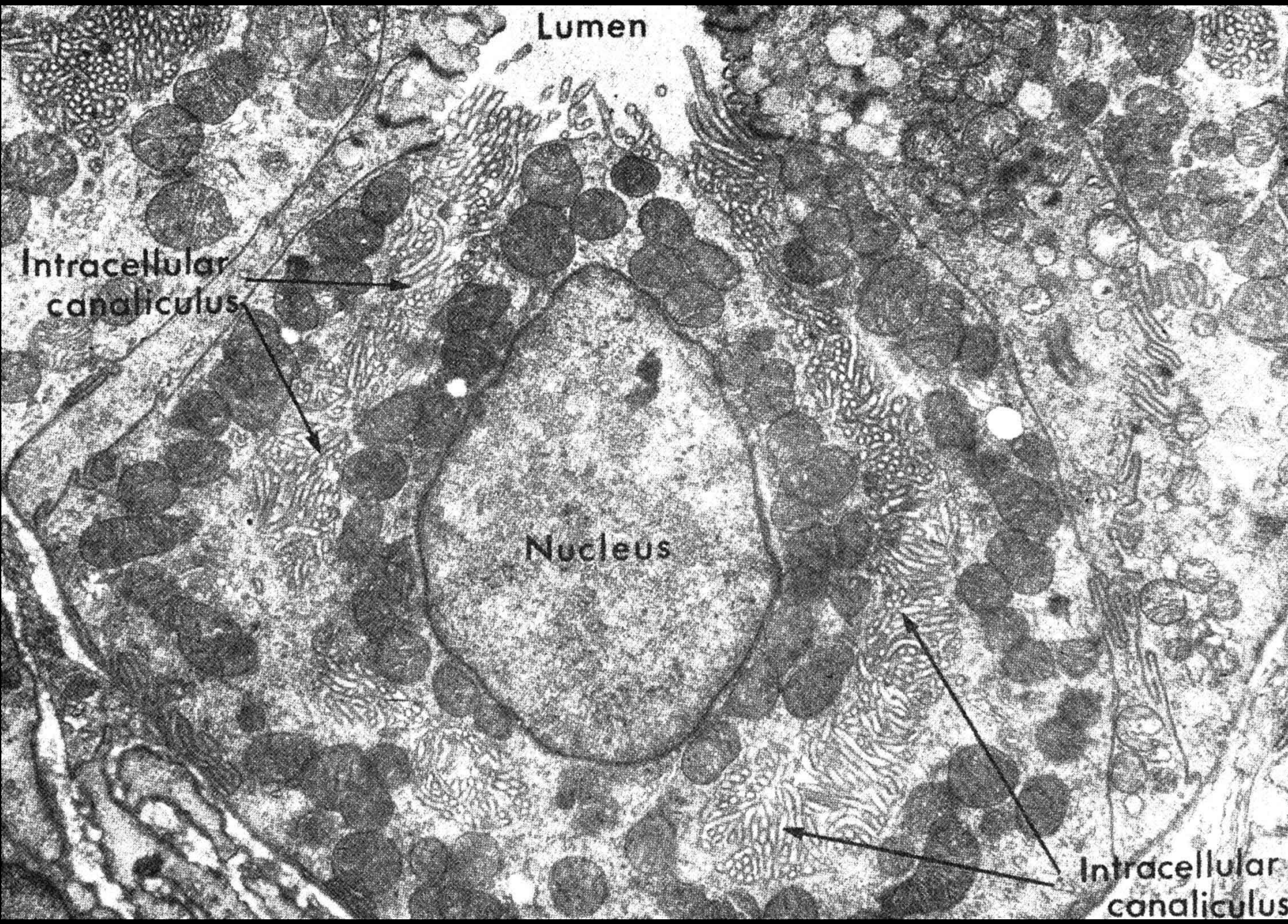
Intrinsic factor (B_{12} absorption)




50 µm

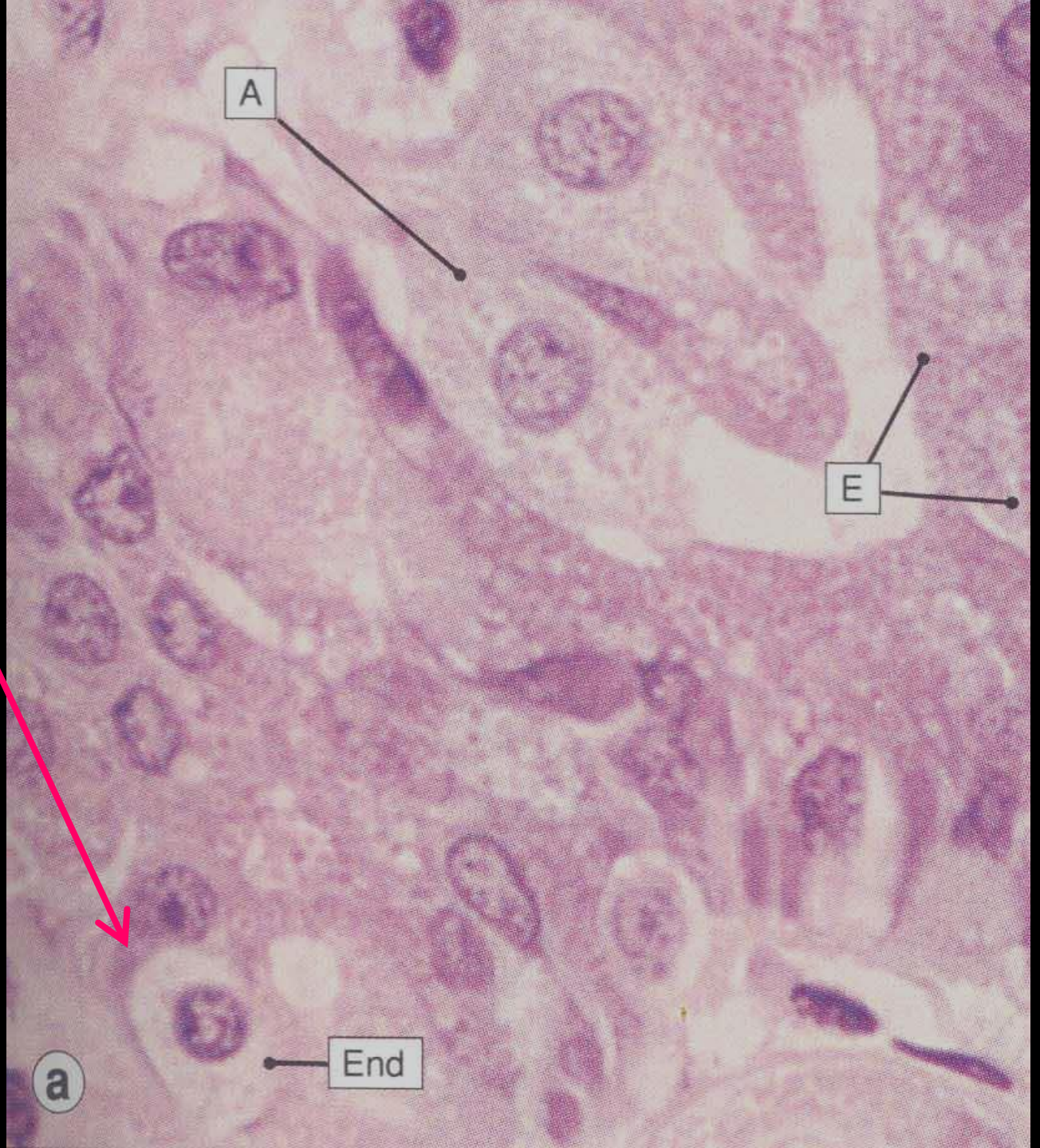

Lumen
MV
M
MV
M

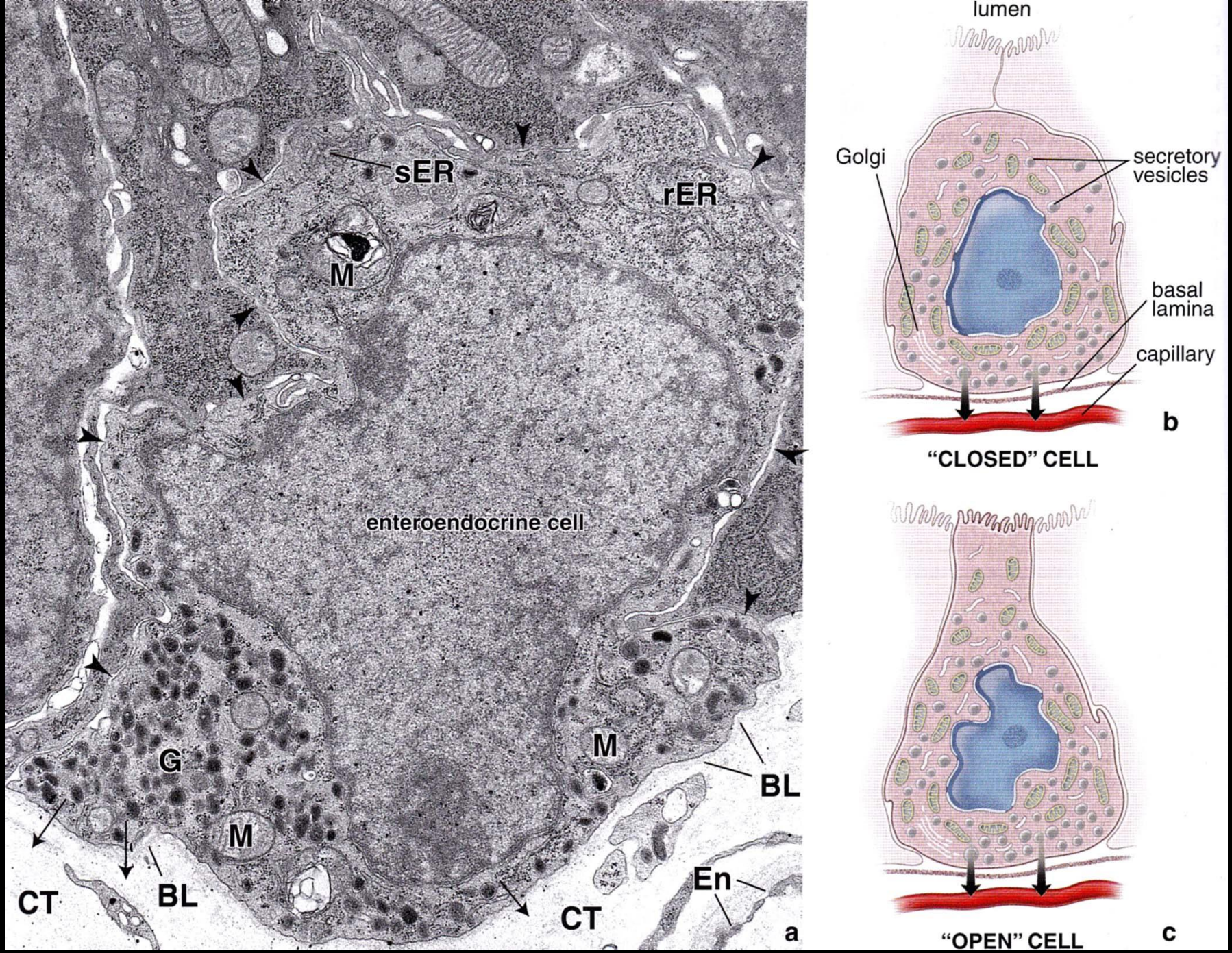

Intracellular
canaliculus
IC
MV
M
IC
M
TV
G
IC
IC
M
M


Lumen
Intracellular canaliculus
Nucleus
Intracellular canaliculus


tubular vesicles

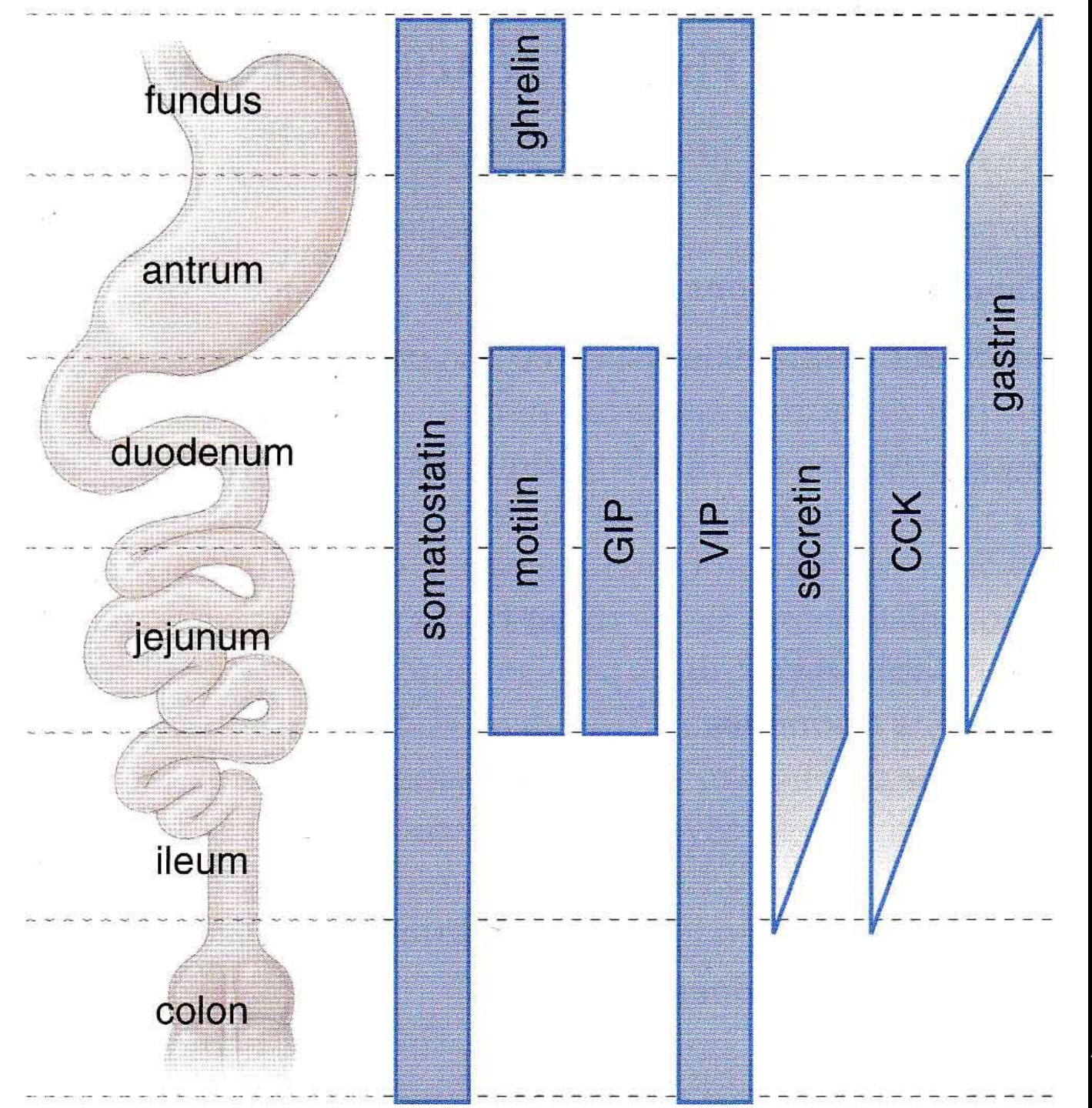
Enteroendocrine cell



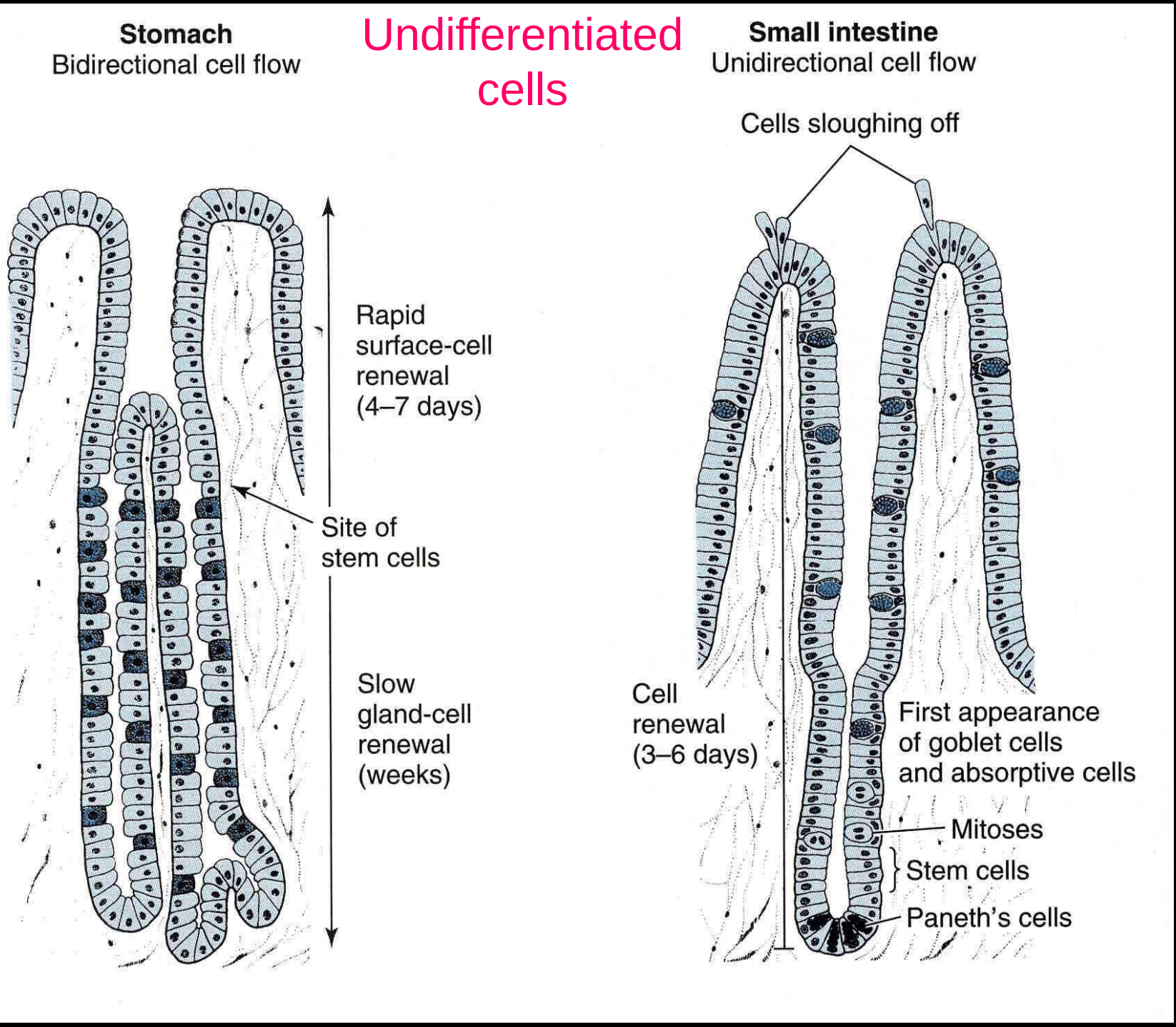


Pawlina, W.: Histology. A Text and Atlas. Wolters Kluwer 2016

Cell	Principal site	Hormone	Effect
Gr	stomach fundus	ghrelin	↑ growth hormone secretion ↑ perception of hunger
G	pylorus	gastrin	↑ gastric secretion (mostly HCl)
D	pylorus, duodenum, Langerhans‘ islets	somatostatin	↓ secretion of other secretory cells
S	small intestine	secretin	↑ secretion of bile and pancreatic juice containing water and bicarbonates ↓ gastric secretion (mostly HCl)
K	duodenum, jejunum	GIP	↓ gastric secretion (mostly HCl)
L	ileum, colon	GLP-1 peptide YY	↑ glycogenolysis, insulin secretion ↓gastric secretion (mostly HCl) ↓ perception of hunger ↑ water and ion absorption in colon
I	small intestine	cholecystokinin	↑ contractions of gall bladder ↑ secretion of pancreatic enzymes
Mo	duodenum, jejunum	motilin	↑ gastric and intestinal motility
EC	total GIT	serotonin substance P	↑ intestinal motility
D_1	total GIT	VIP	↑ intestinal motility



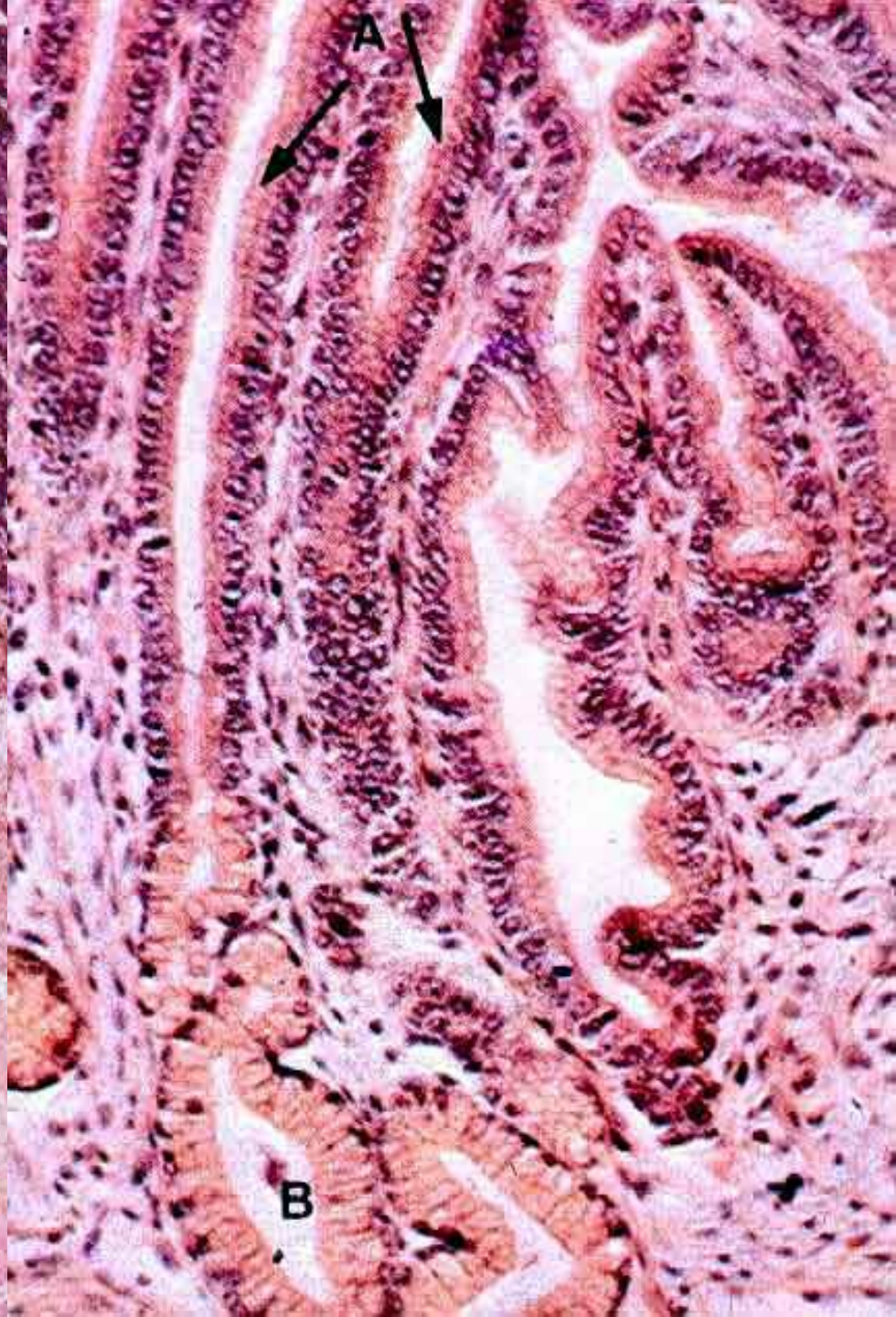
Pawlina, W.: Histology. A Text and Atlas. Wolters Kluwer 2016

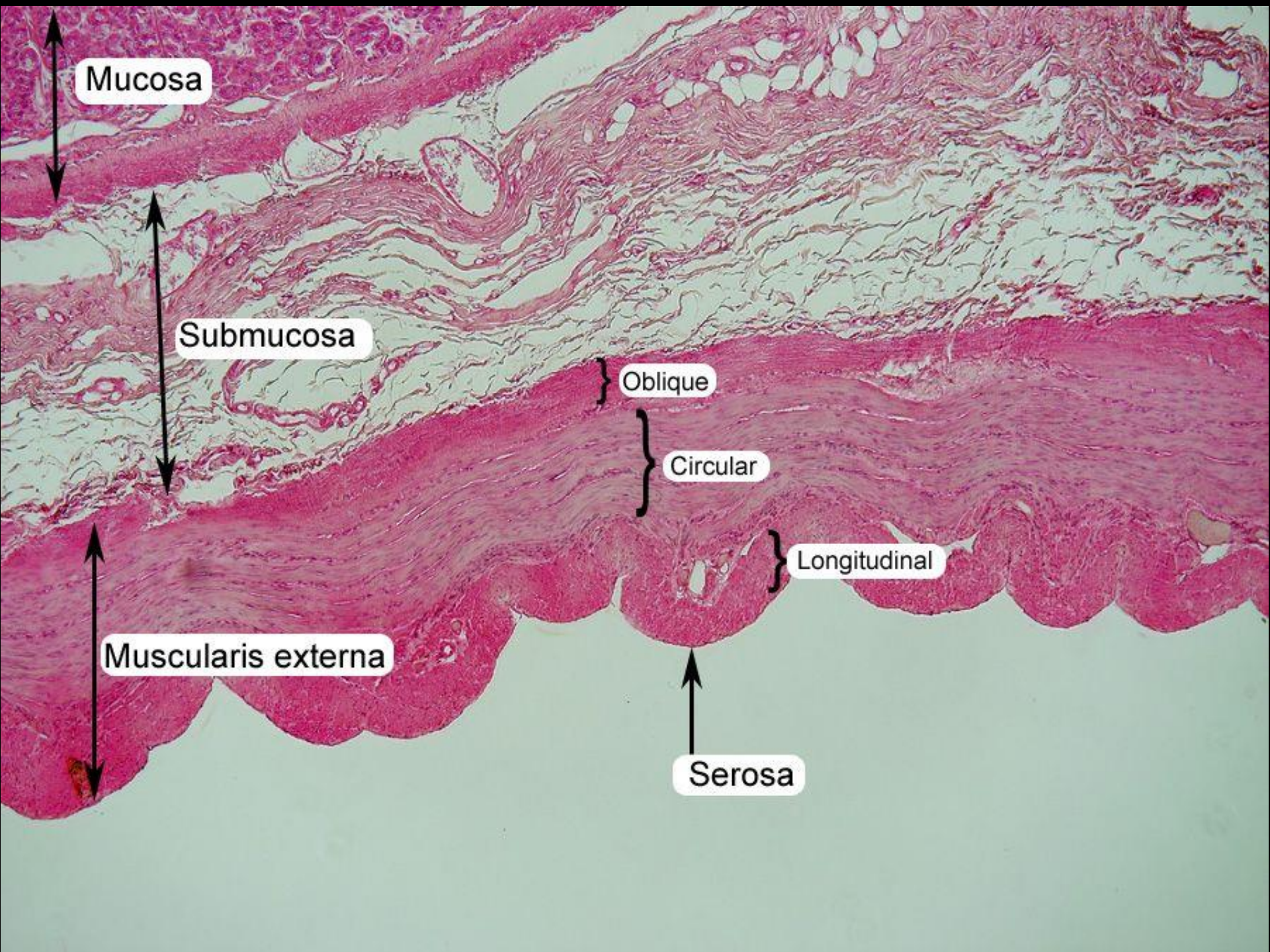

Undifferentiated cells
Stomach
Bidirectional cell flow
Rapid surface-cell renewal (4–7 days)
Site of stem cells
Slow gland-cell renewal (weeks)
Small intestine
Unidirectional cell flow
Cells sloughing off
Cell renewal (3–6 days)
First appearance of goblet cells and absorptive cells
Mitoses
Stem cells
Paneth's cells

Pylorus

- deep gastric pits
- short, often branched pyloric glands, mostly mucous; rare parietal cells and numerous enteroendocrine cells
- thickened medial circular layer of tunica muscularis

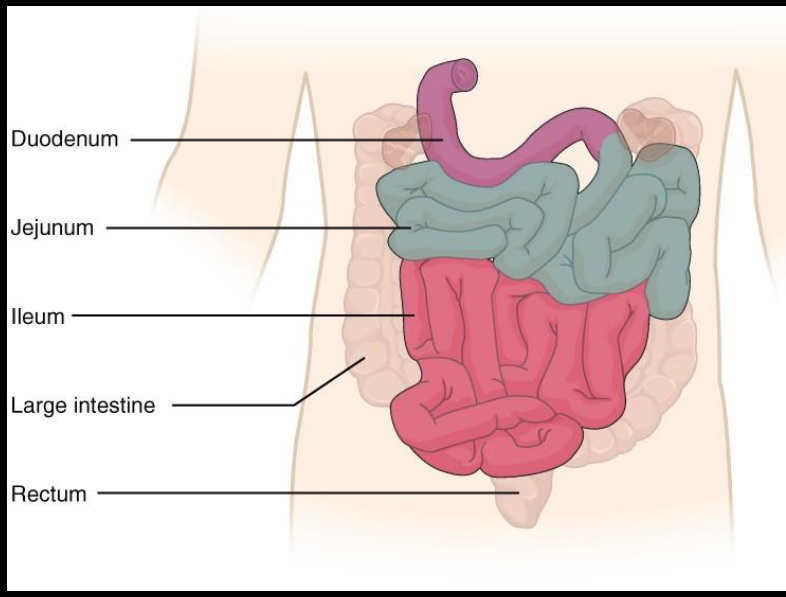

A
B
C


A
B


Mucosa
Submucosa
Oblique
Circular
Longitudinal
Muscularis externa
Serosa

Small intestine
(intestinum tenue)

- duodenum
- jejunum
- ileum



- length 4-6 m
- diameter 2,5-3 cm
- absorptive area 200-300 m^2

Small intestine
(intestinum tenue)

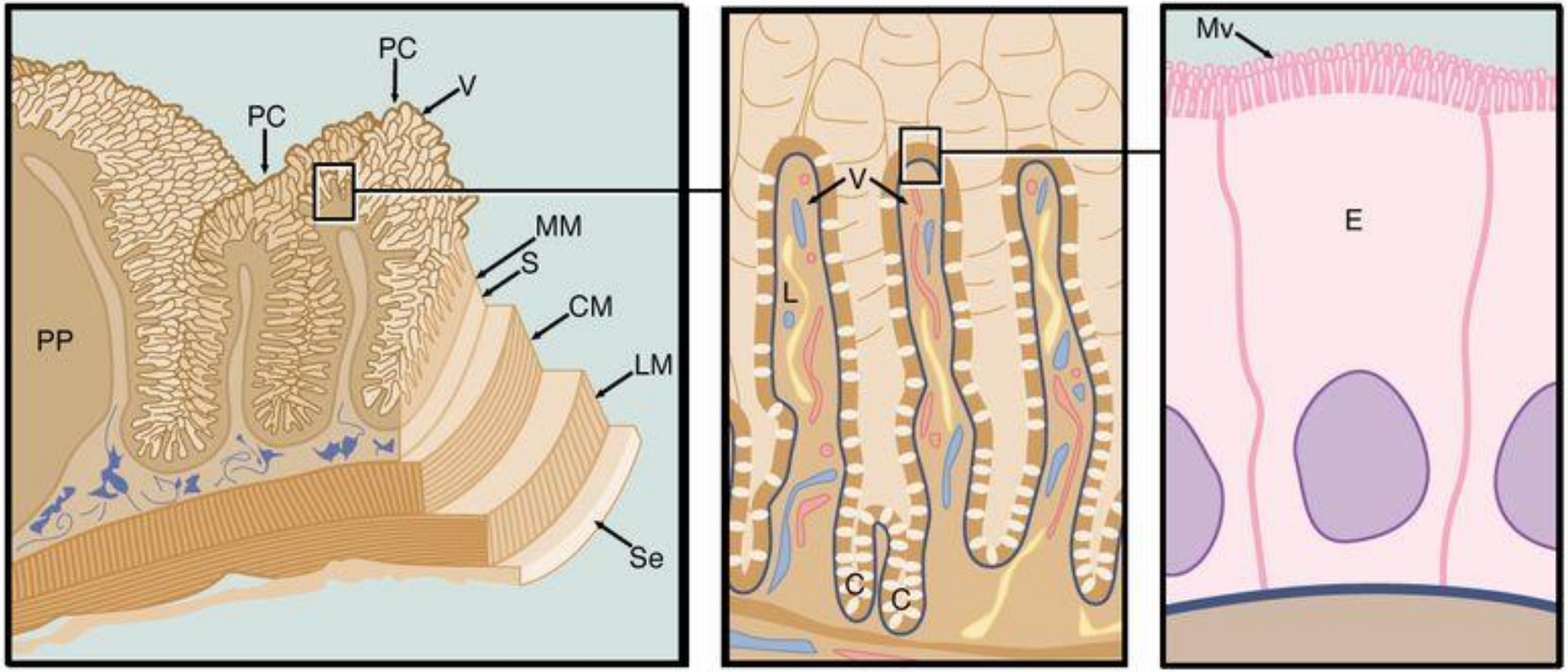
tunica mucosa

tela submucosa

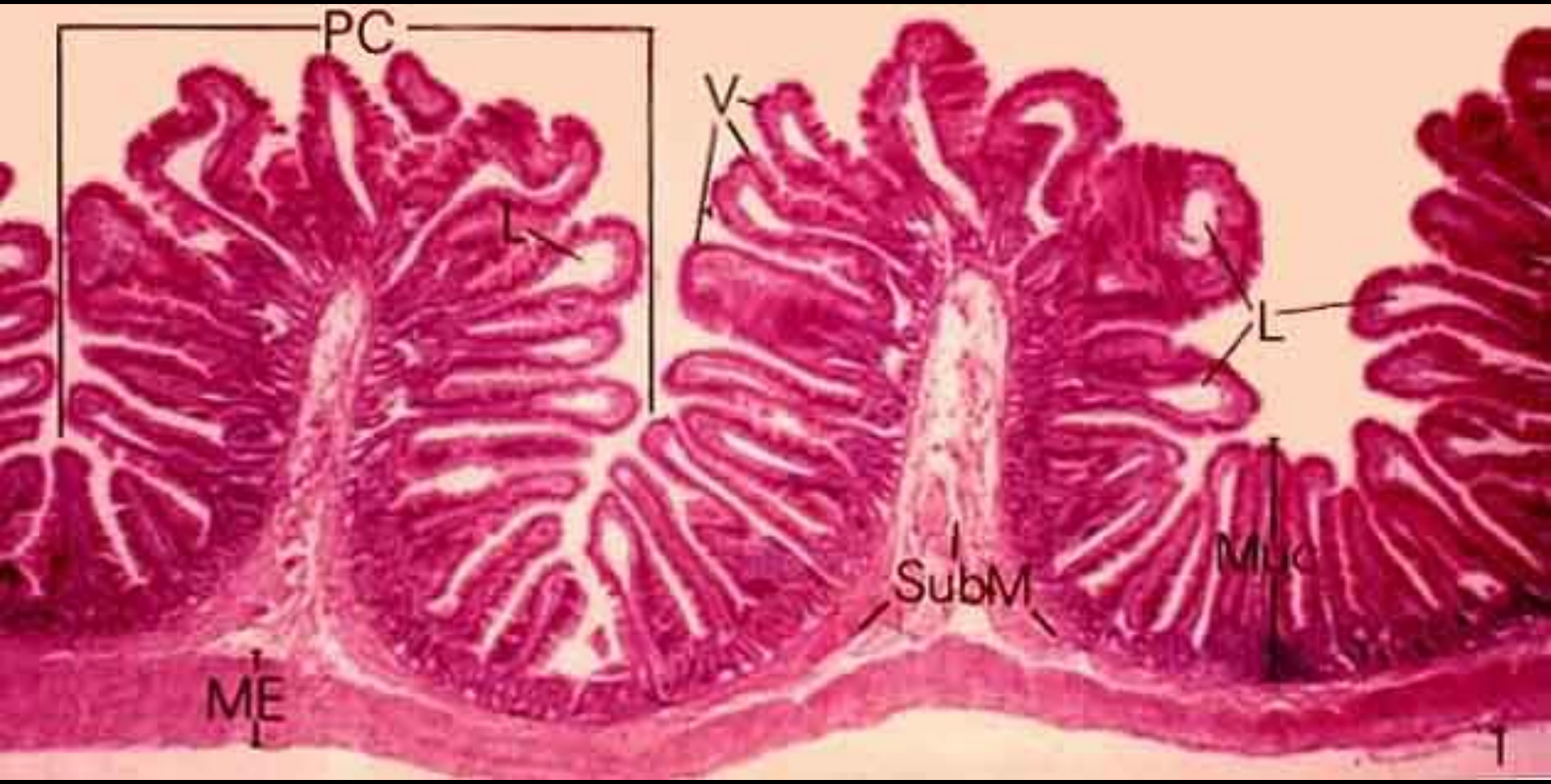
tunica muscularis externa

tunica serosa

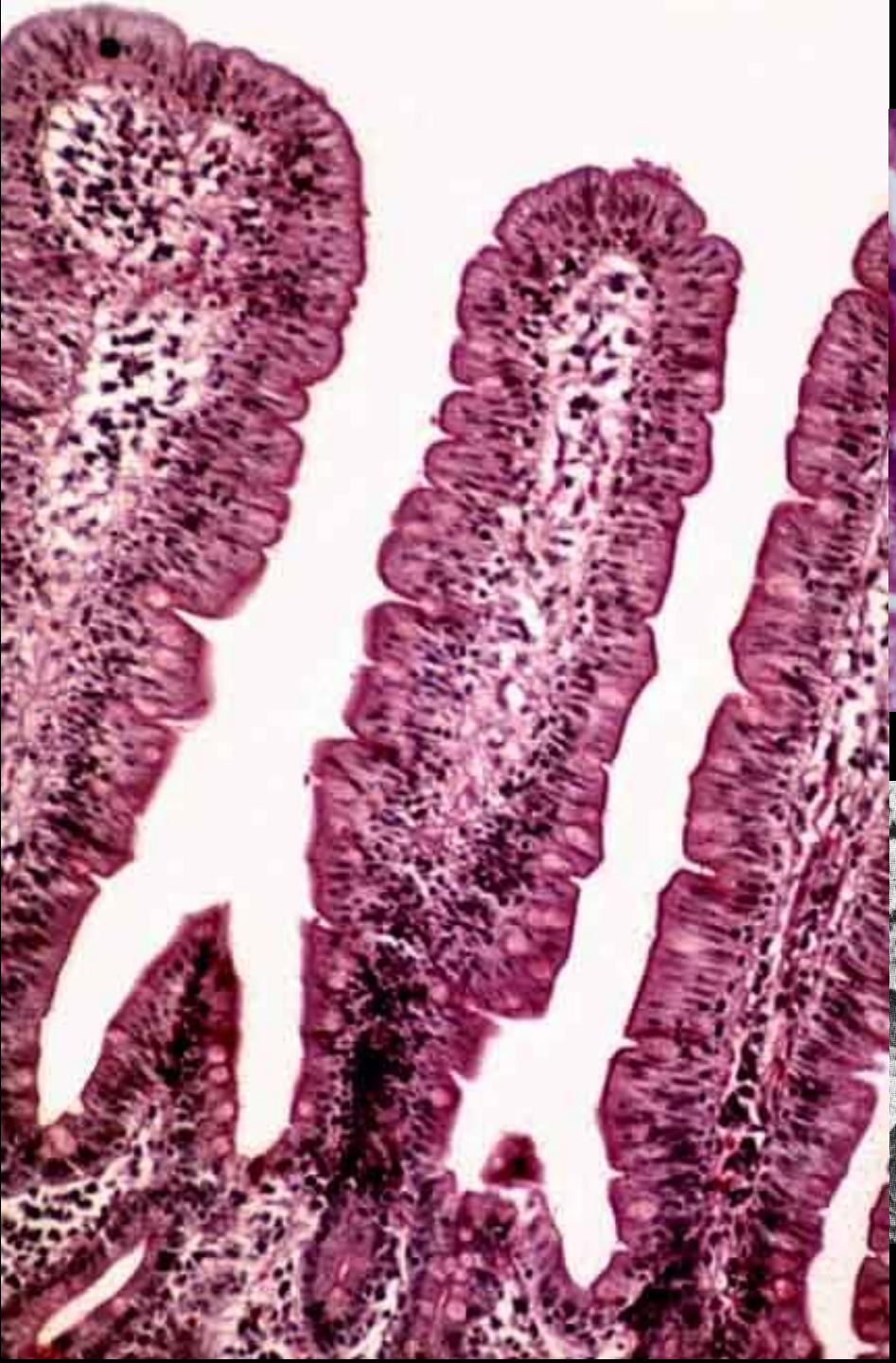
Circular plicae → Villi → Microvilli

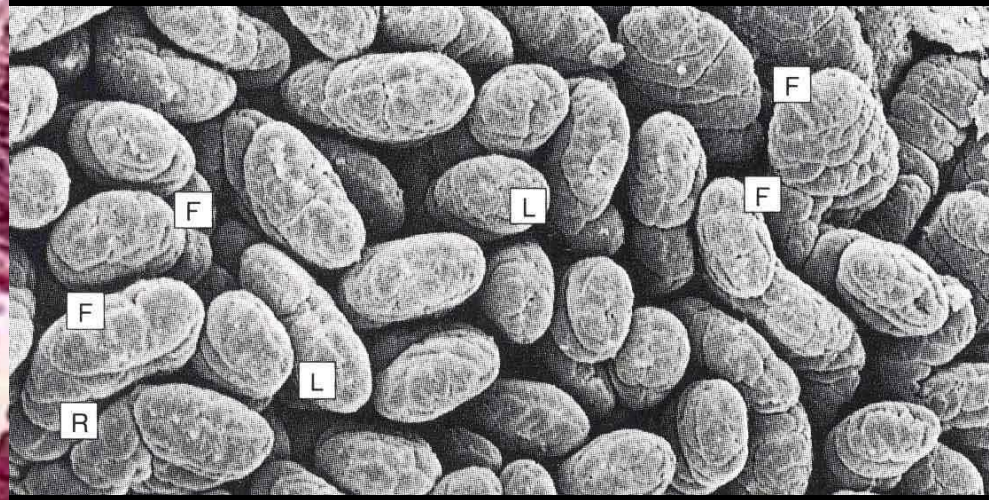


3x → 10x → 20x


PC
V
L
L
SubM
ME

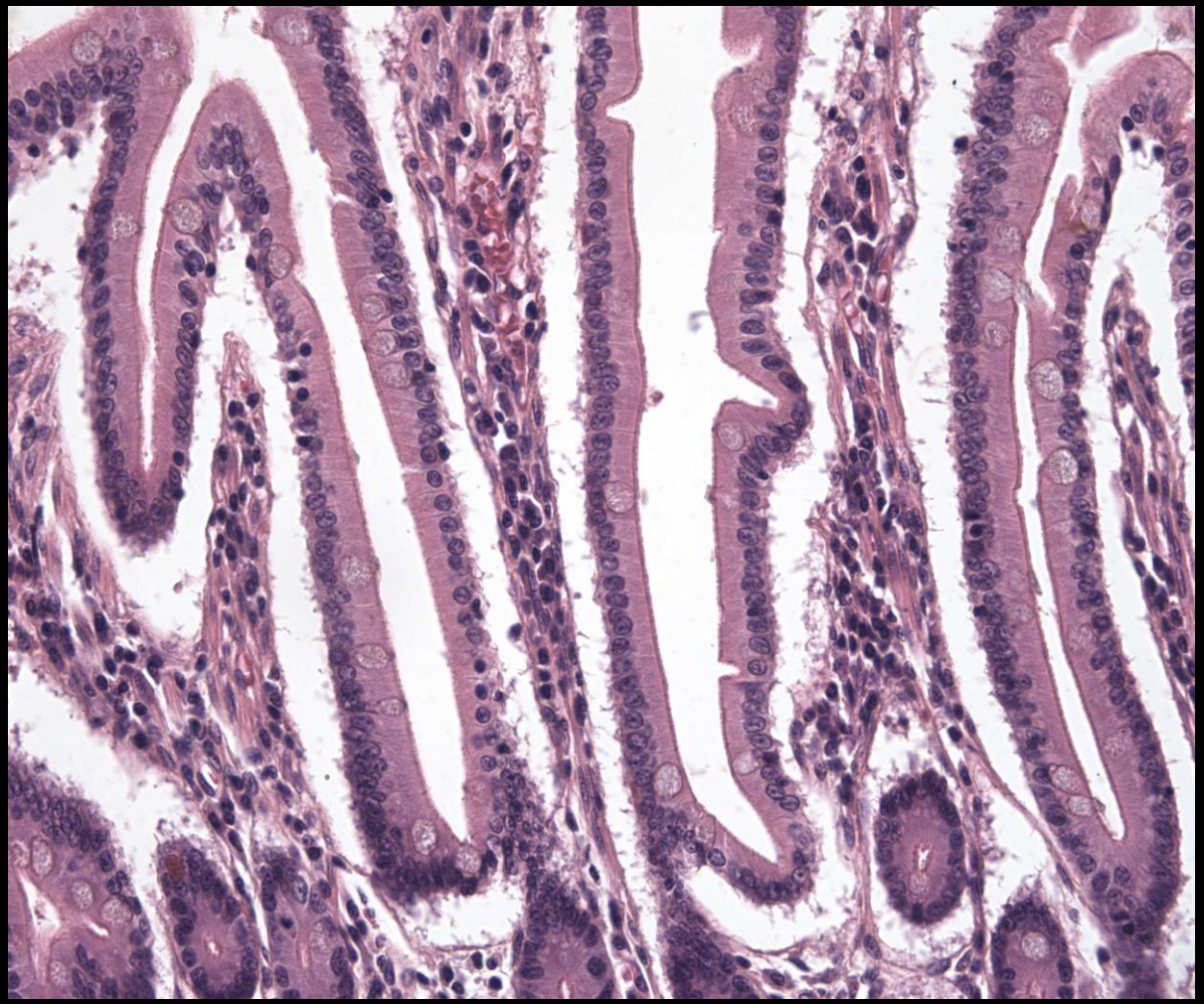
Intestinal villi



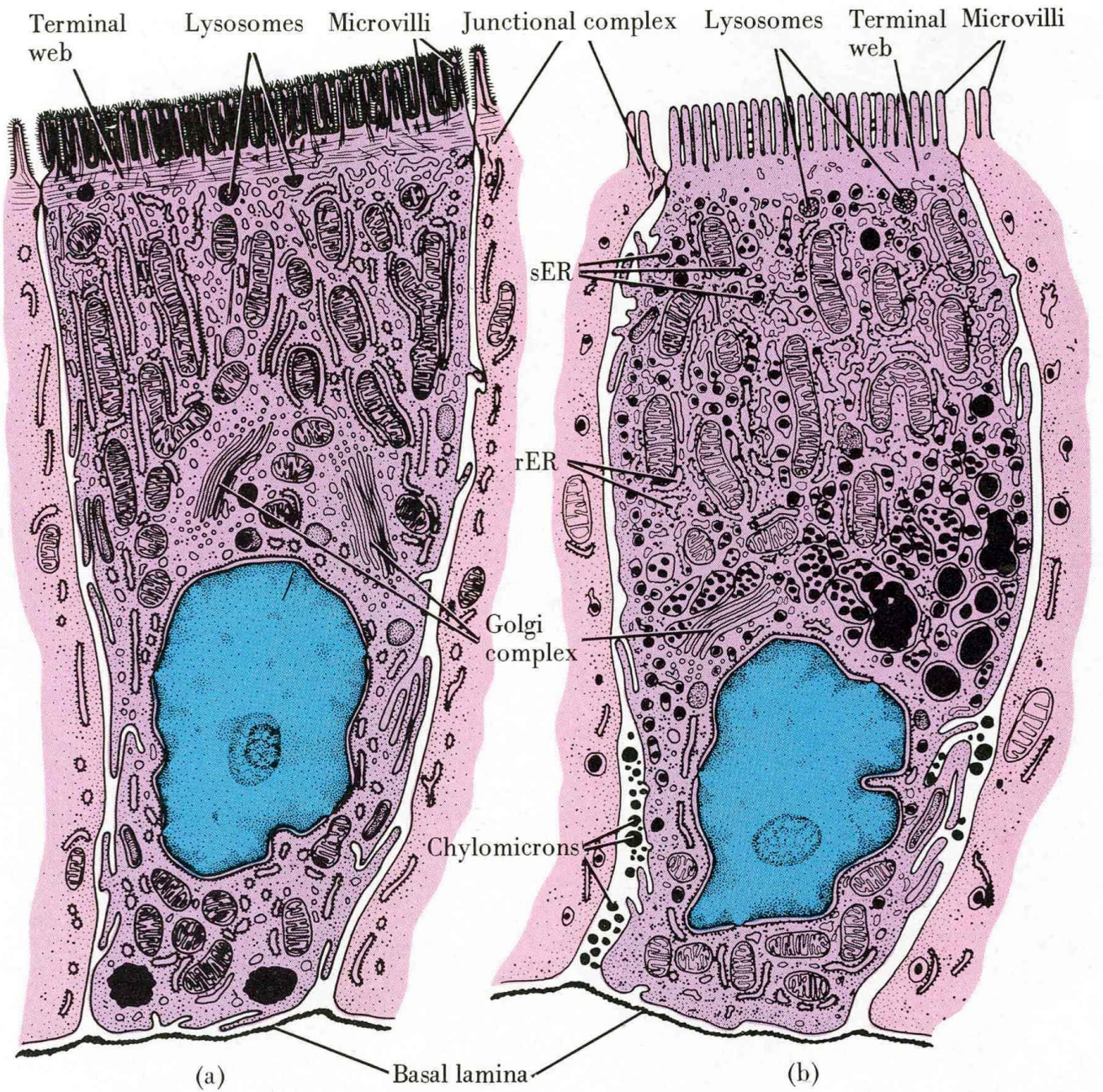


Surface epithelium

1/ enterocytes
2/ goblet cells
3/ M-cells
4/ enteroendocrine c.
5/ tuft (brush) cells



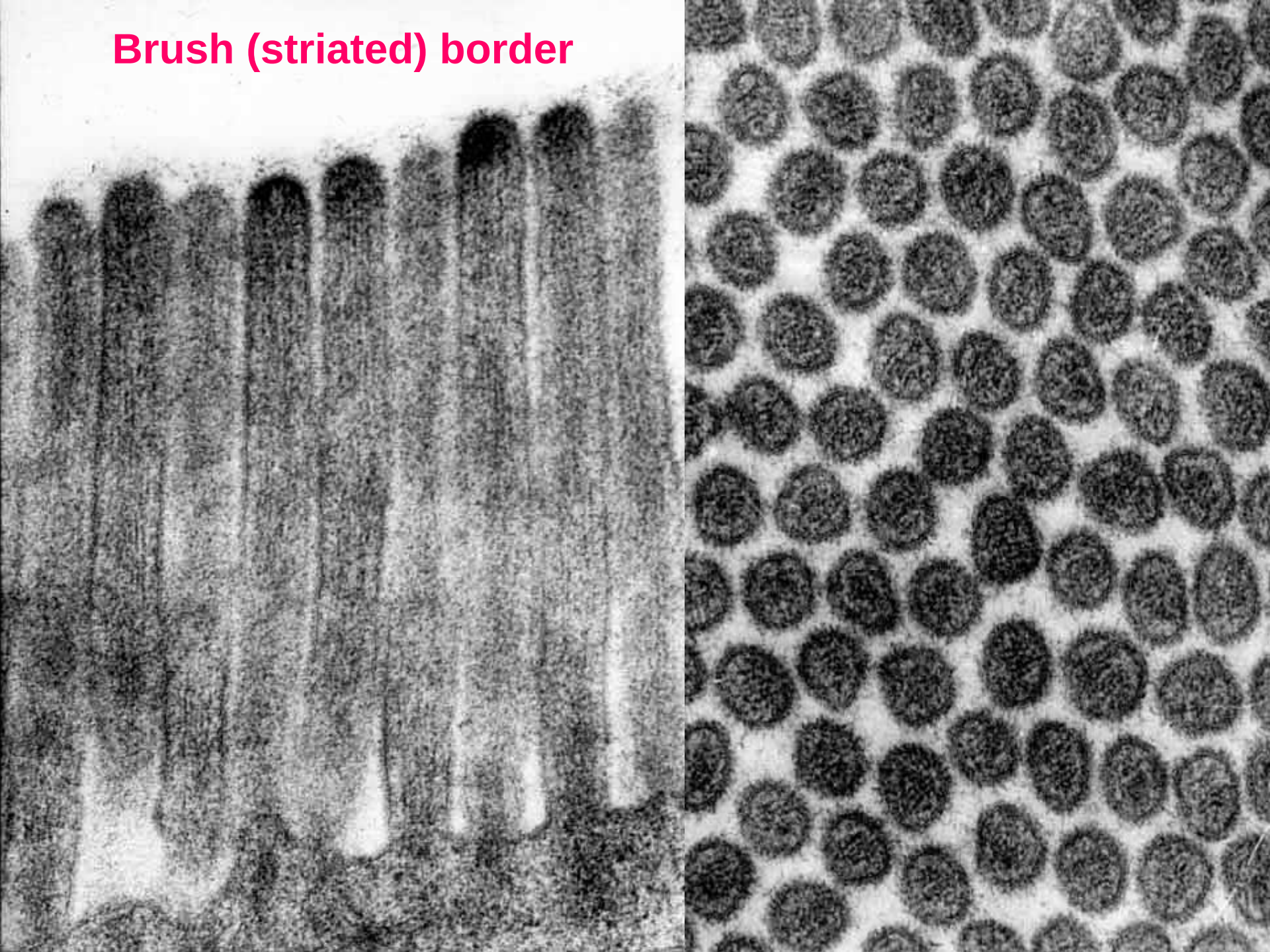
Enterocytes

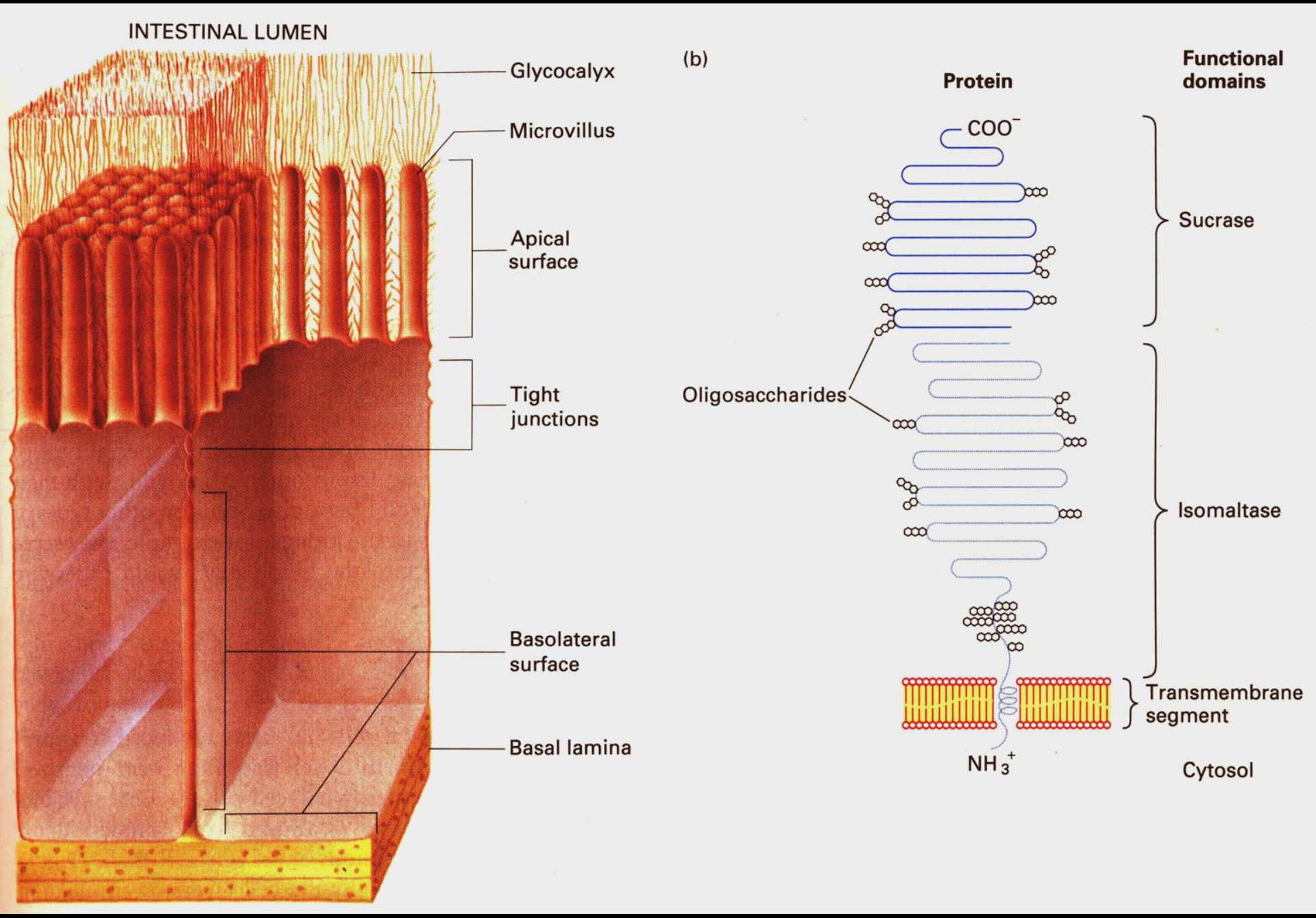


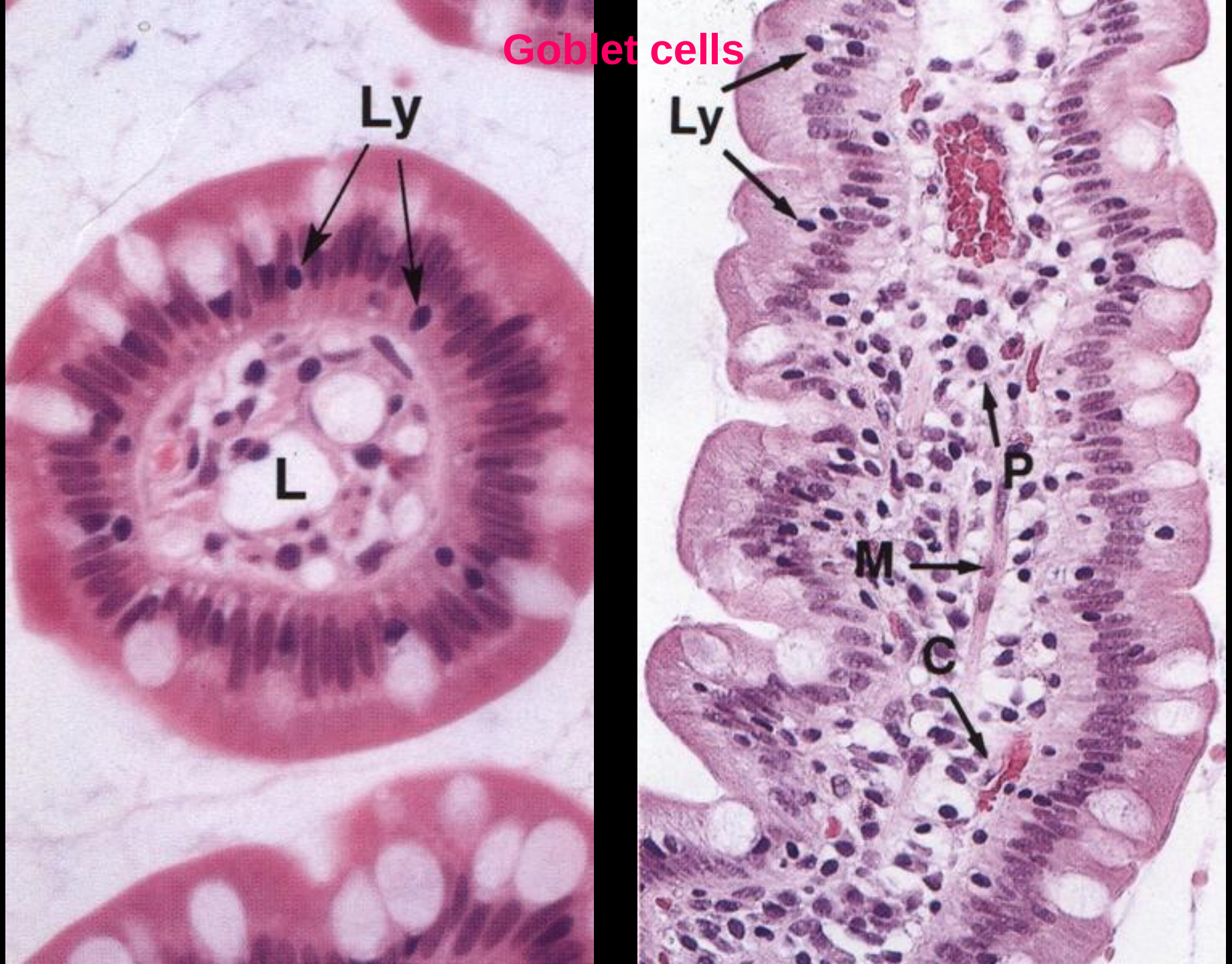
ABSORPTIVE CELLS

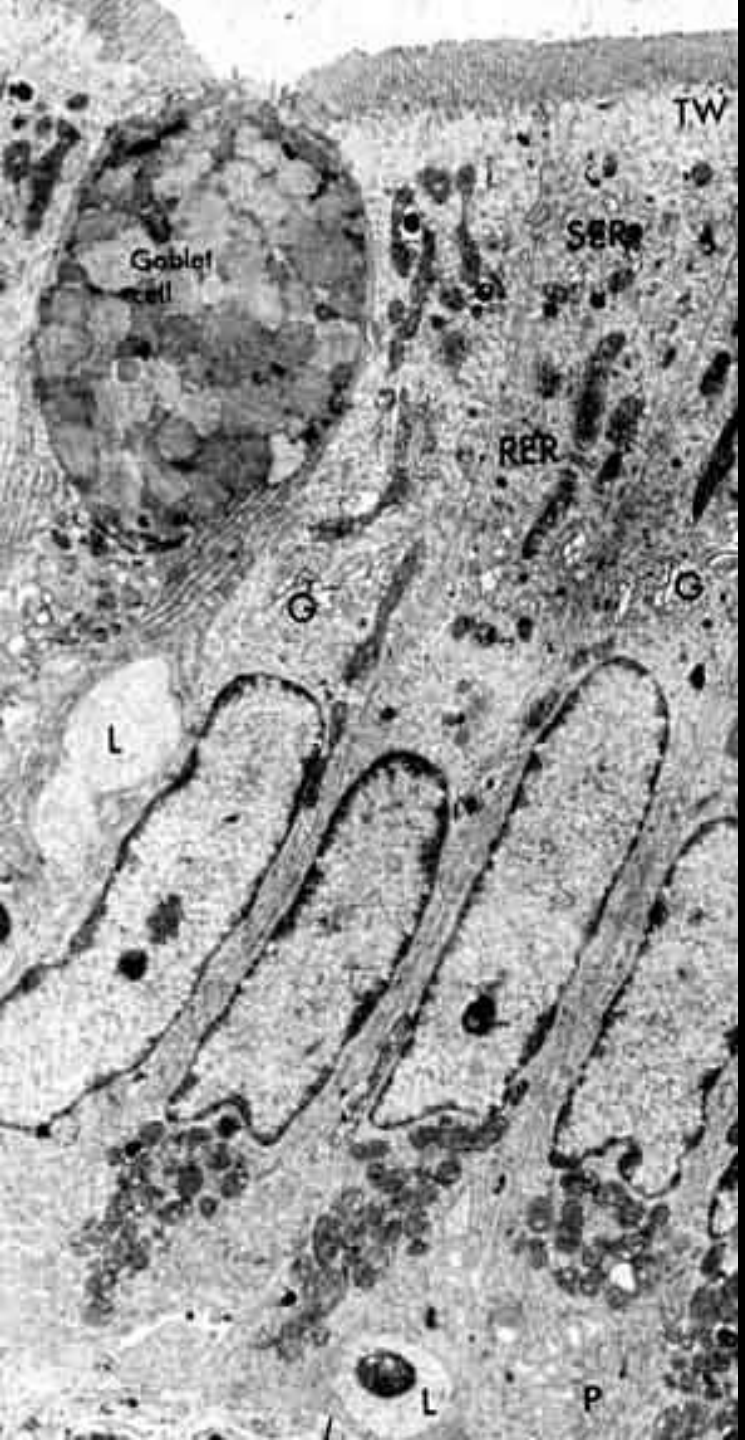

Mv
TW
Goblet cell
SER
RER
G
G
L
L
P
BL
LP

Brush (striated) border

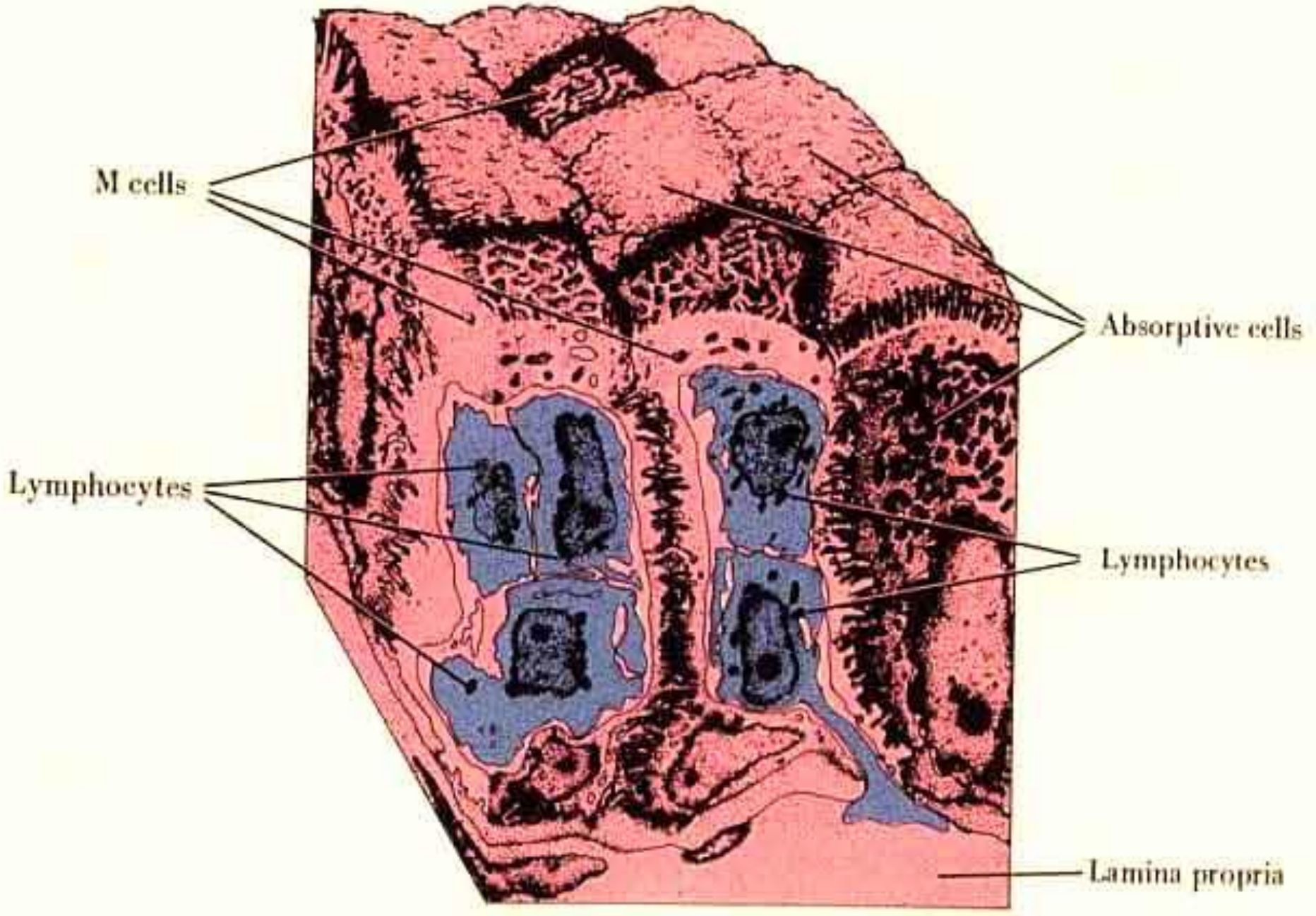


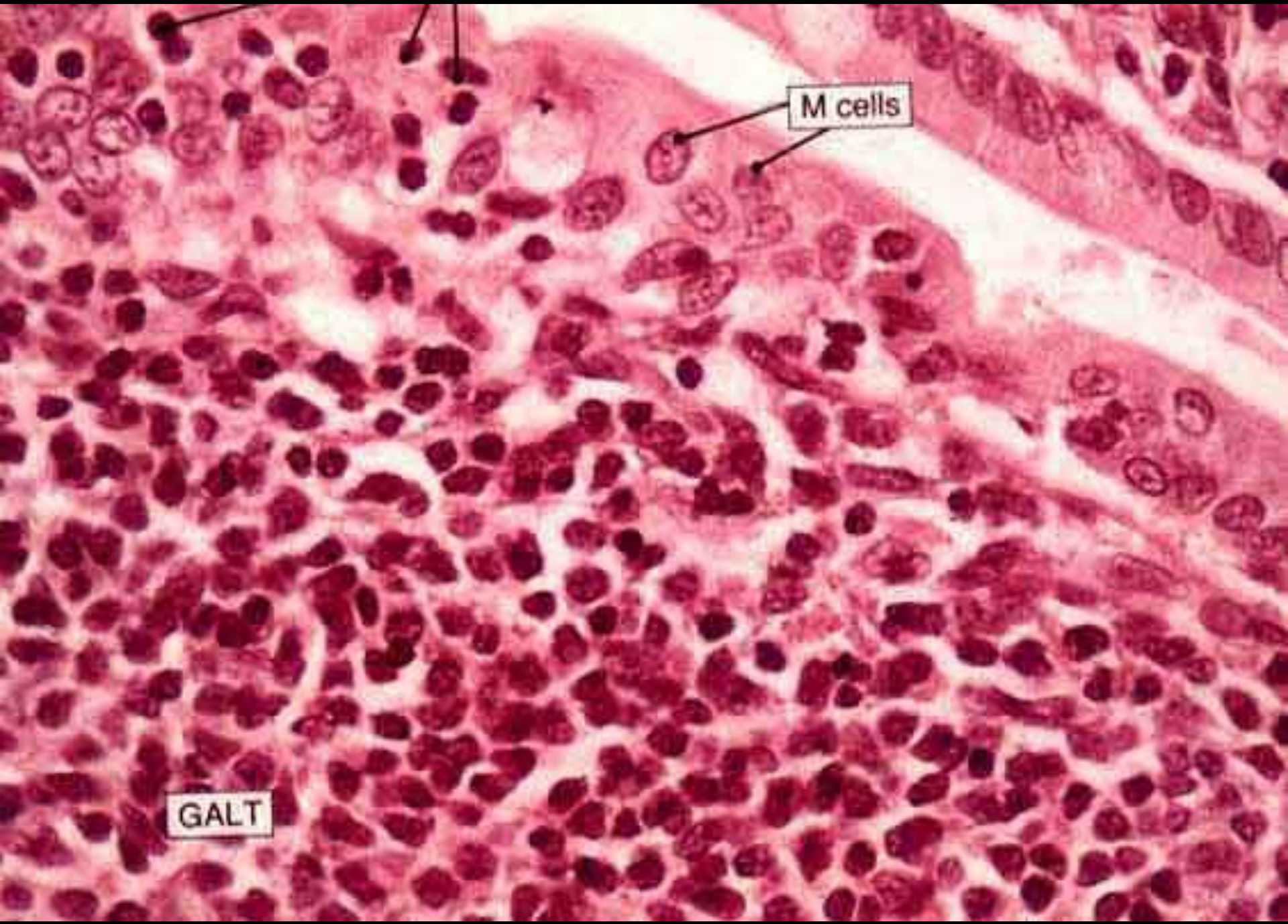

INTESTINAL LUMEN
Glycocalyx
Microvillus
Apical surface
Tight junctions
Basolateral surface
Basal lamina
(b)
Protein
Functional domains
COO⁻
Sucrase
Oligosaccharides
Isomaltase
Transmembrane segment
NH3+
Cytosol

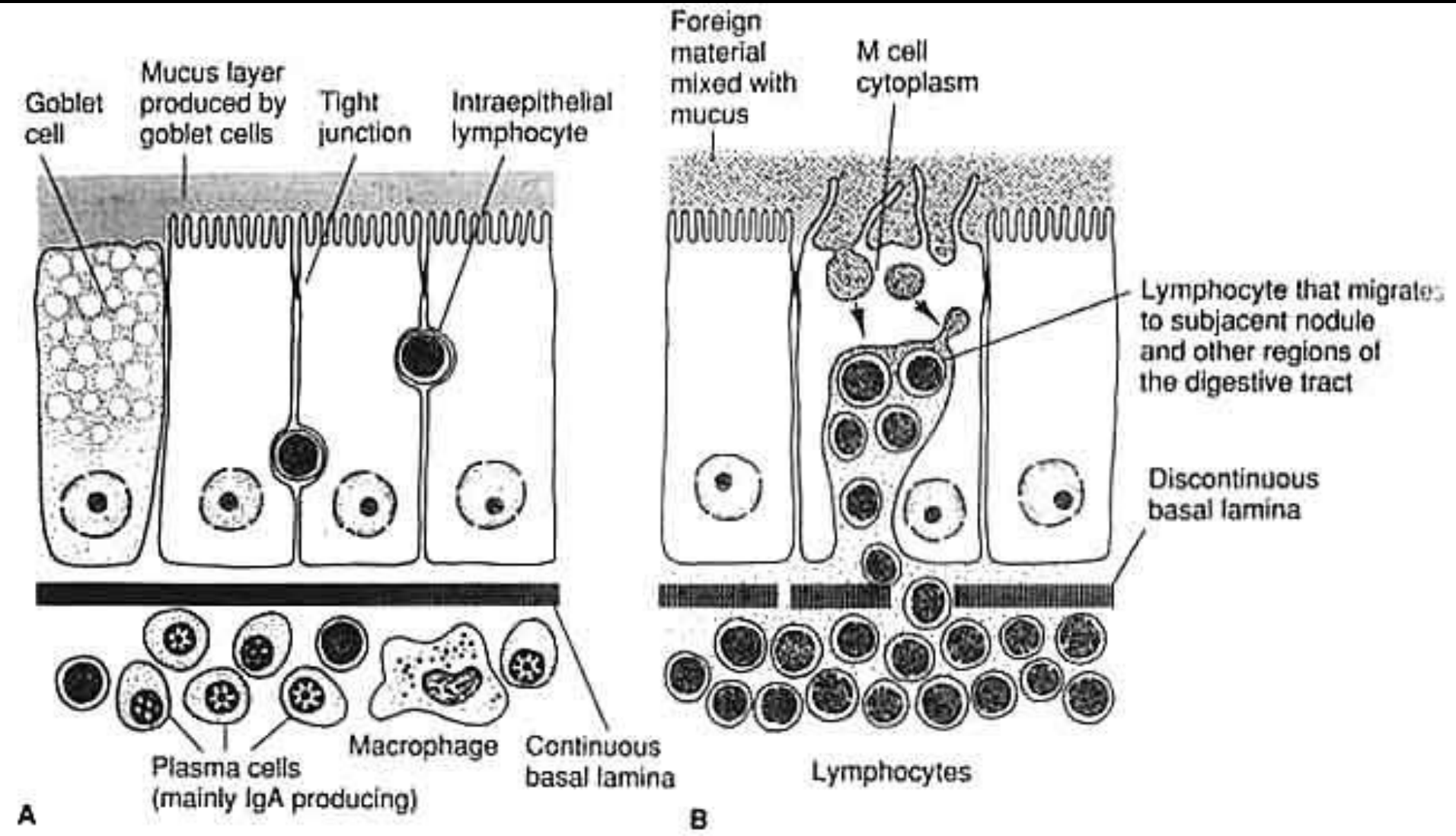

Goblet cells
Ly
L
Ly
P
M
C


TW
Goblet cell
SER
RER
G
G
L
L
P

M (microfold) cells

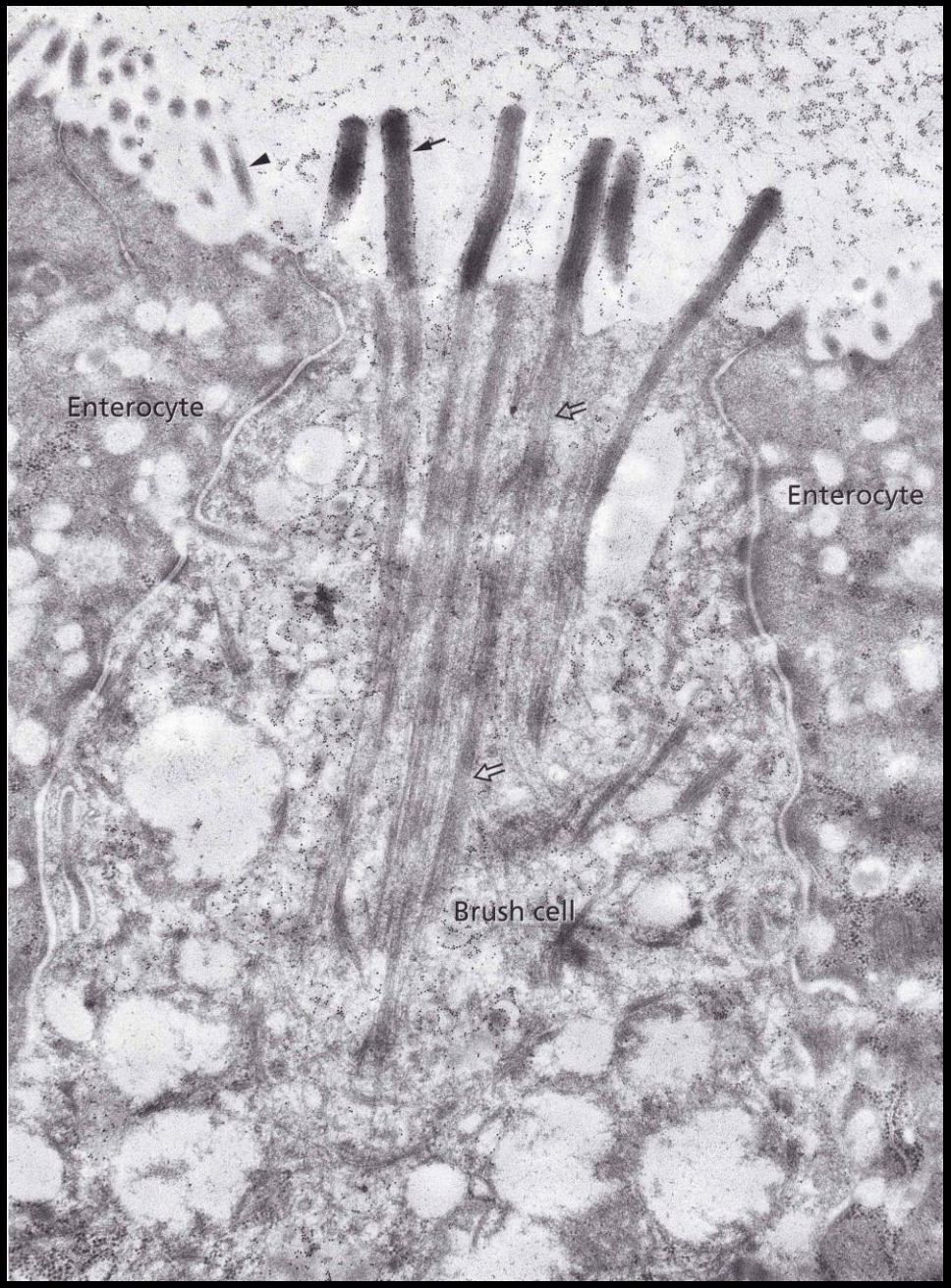



M cells
GALT


Goblet cell
Mucus layer produced by goblet cells
Tight junction
Intraepithelial lymphocyte
Plasma cells (mainly IgA producing)
Macrophage
Continuous basal lamina
A
Foreign material mixed with mucus
M cell cytoplasm
Lymphocyte that migrates to subjacent nodule and other regions of the digestive tract
Discontinuous basal lamina
Lymphocytes
B

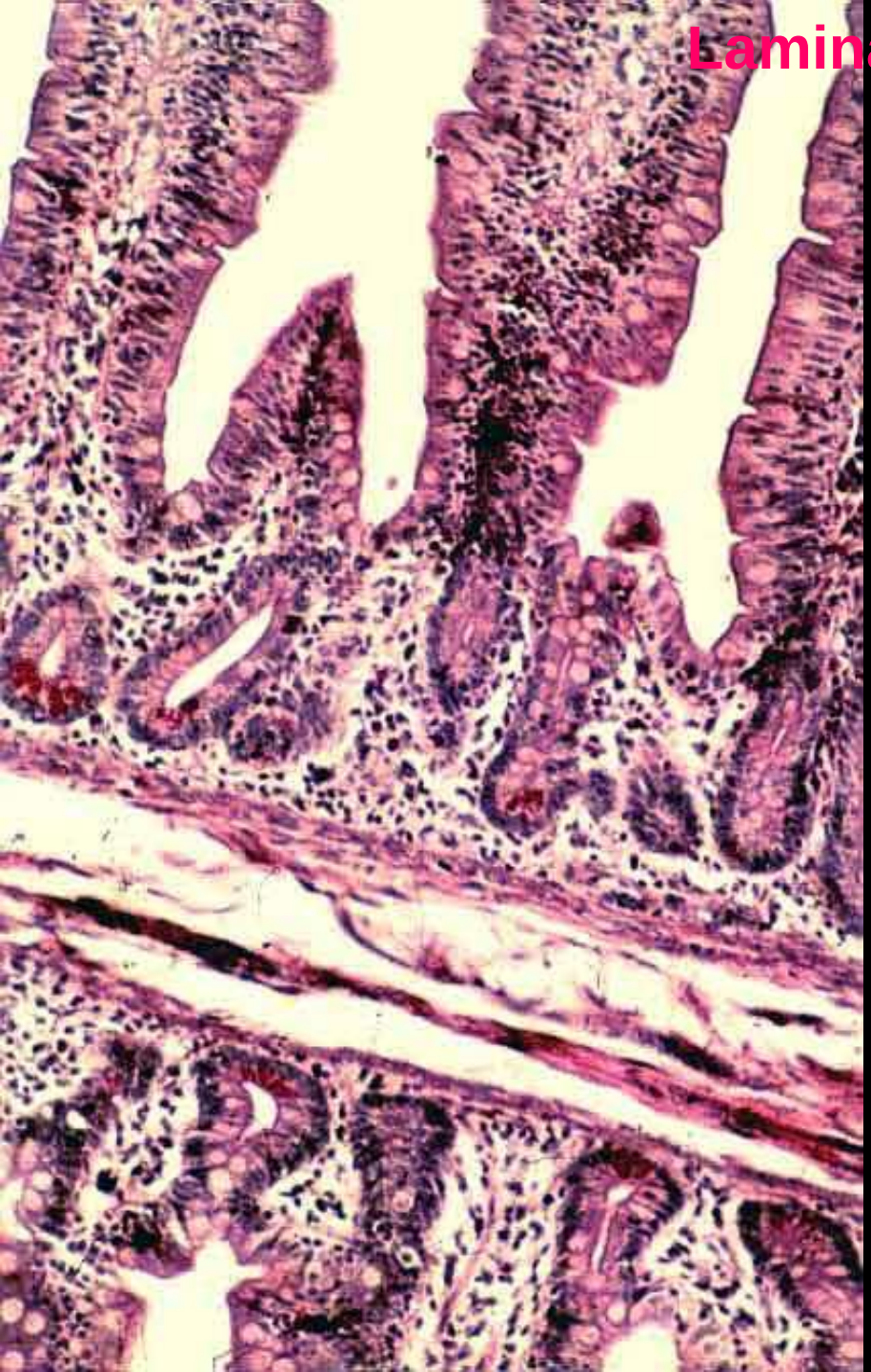
Enteroendocrine cells

Tuft (brush) cells

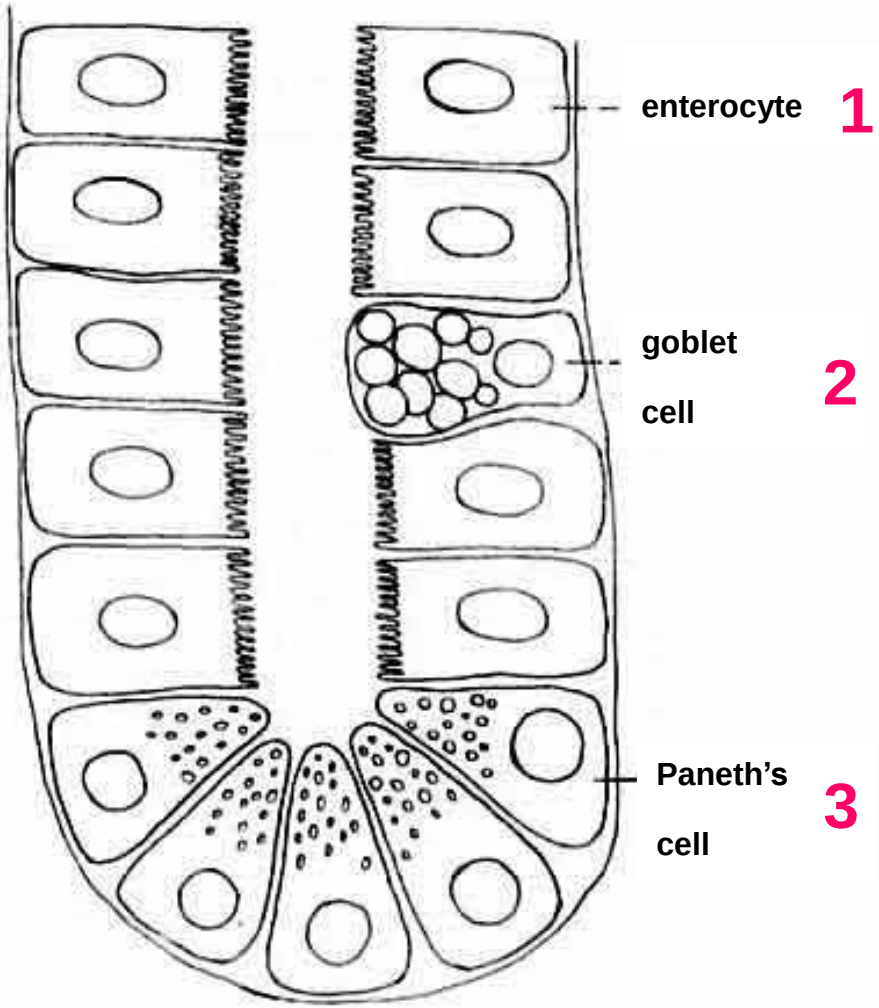


Pavelka, M., Roth, J.:
Functional Ultrastructure.
Springer 2005

Lamina propria mucosae



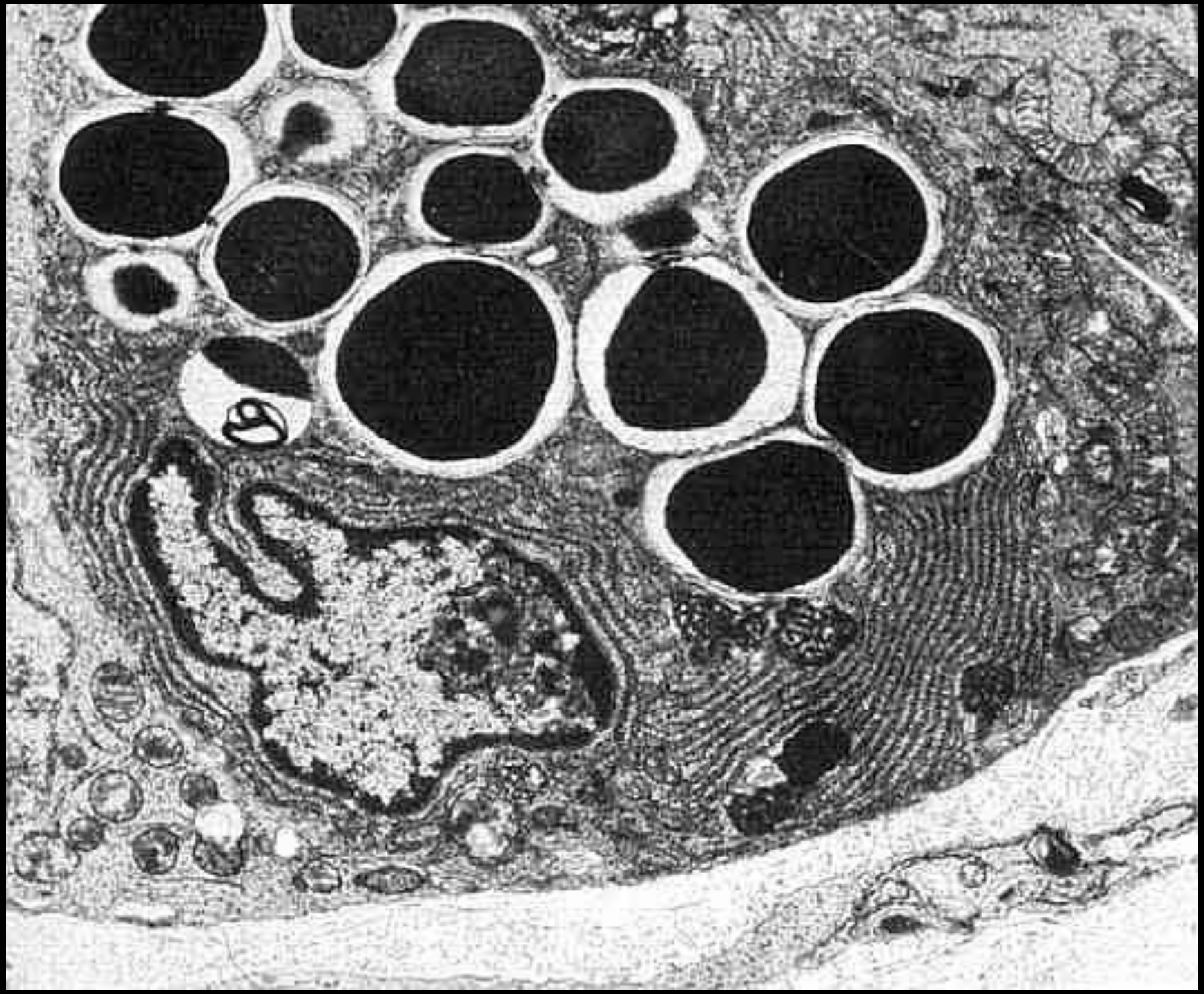
LIEBERKÜHN'S CRYPT

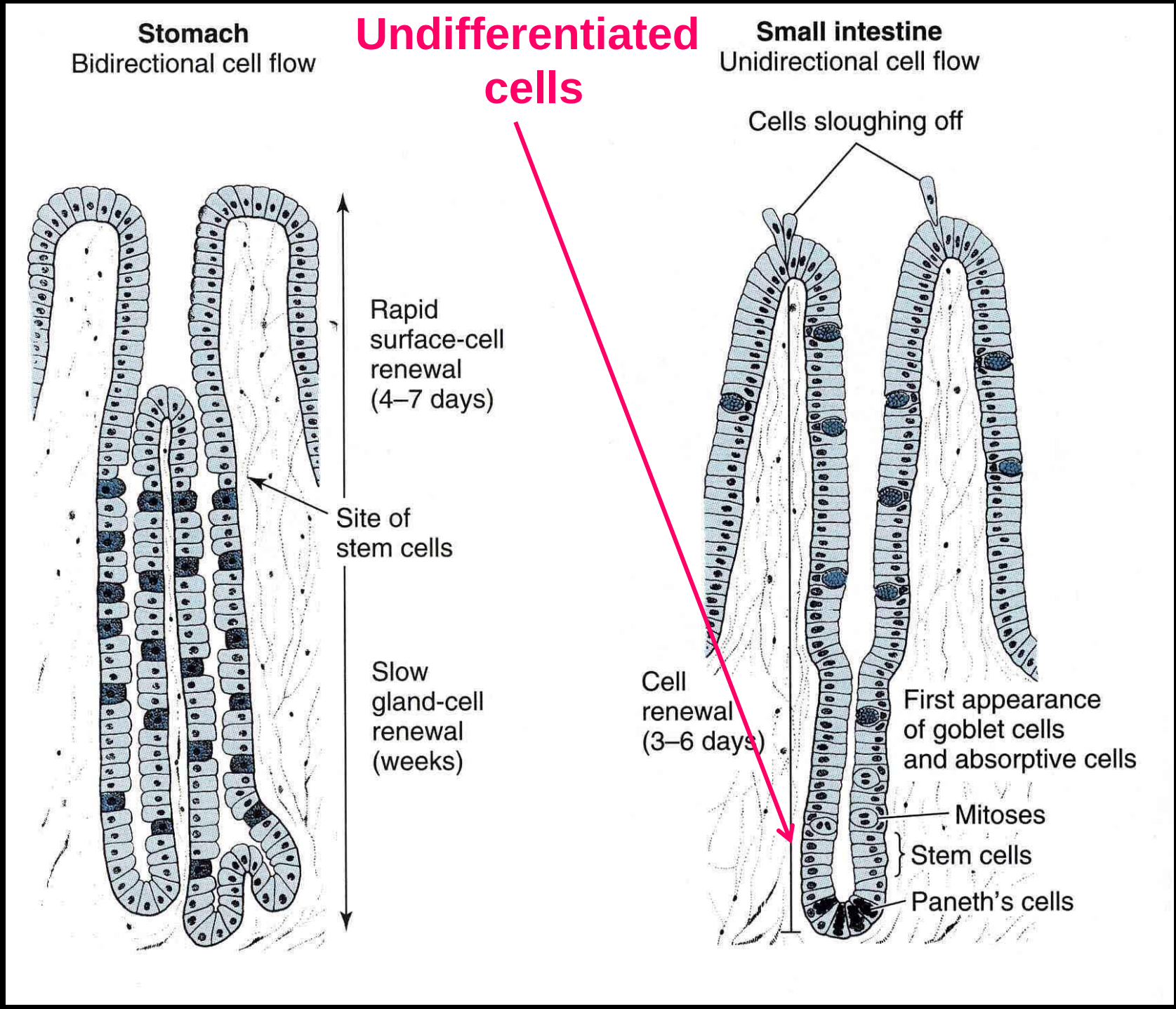


4 enteroendocrine cells
5 undifferentiated cells


Paneth's cells
20 µm


P
P
P



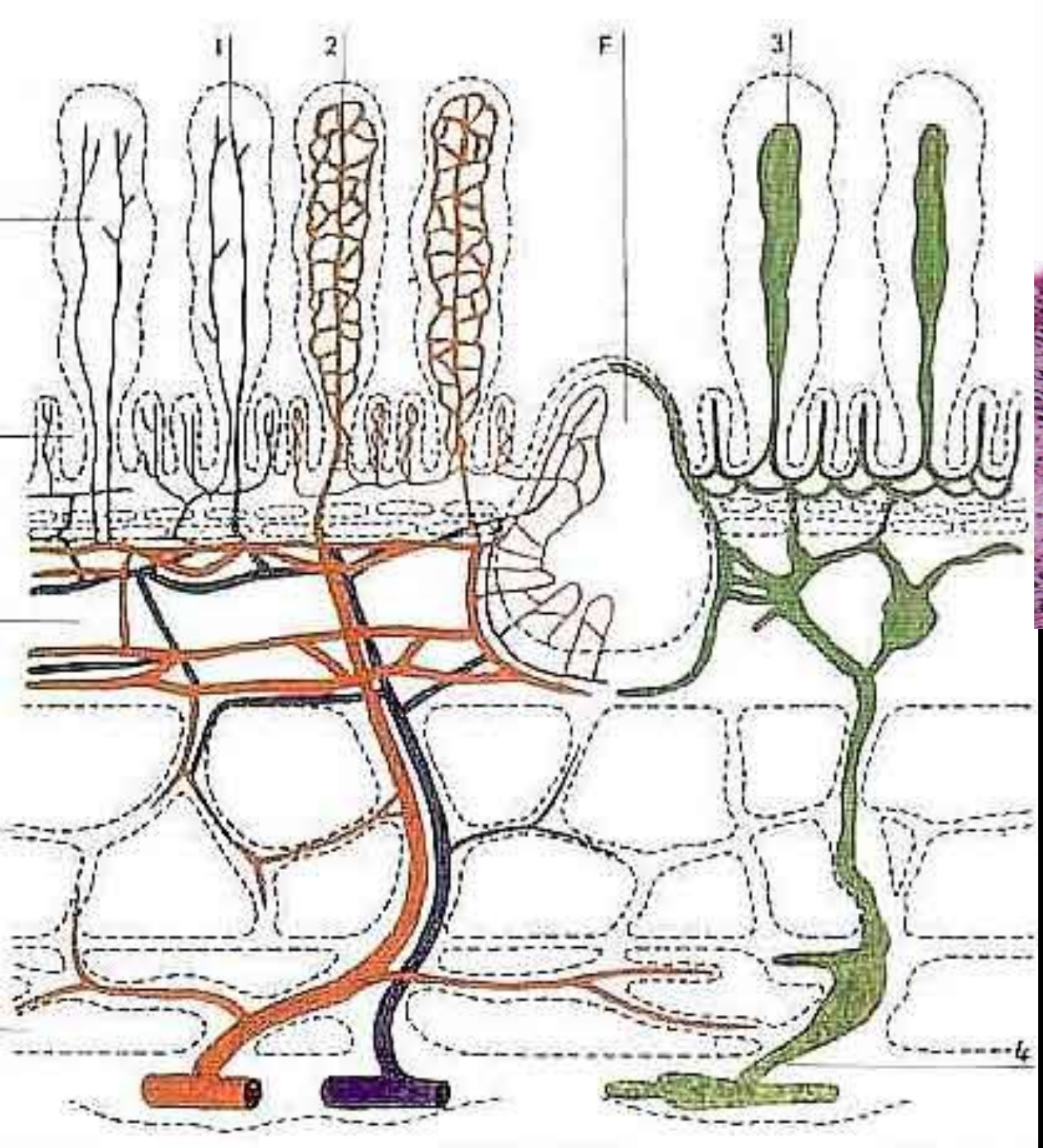

Stomach
Bidirectional cell flow
Undifferentiated cells
Small intestine
Unidirectional cell flow
Cells sloughing off
Rapid surface-cell renewal (4–7 days)
Site of stem cells
Slow gland-cell renewal (weeks)
Cell renewal (3–6 days)
First appearance of goblet cells and absorptive cells
Mitoses
Stem cells
Paneth's cells

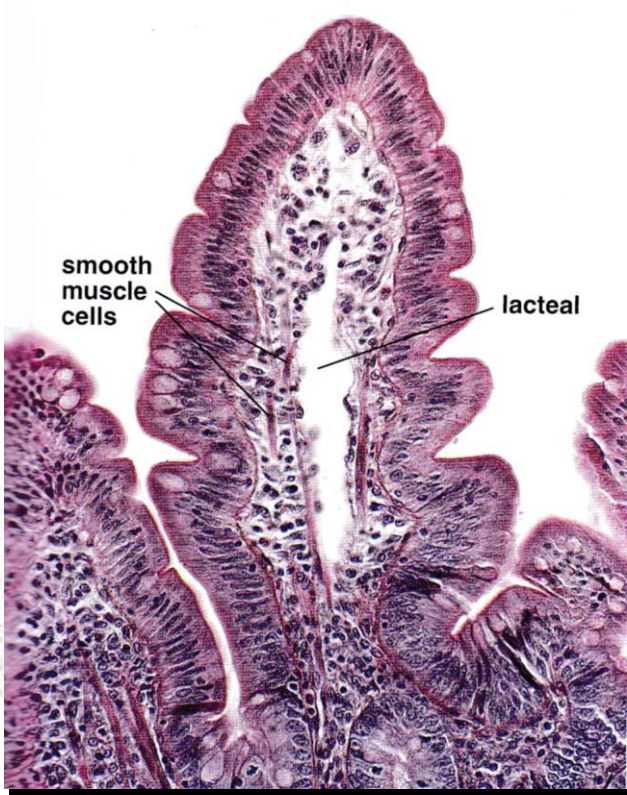
lamina propria mucosae

lamina muscularis mucosae

tela submucosa

plexus submucosus Meissneri





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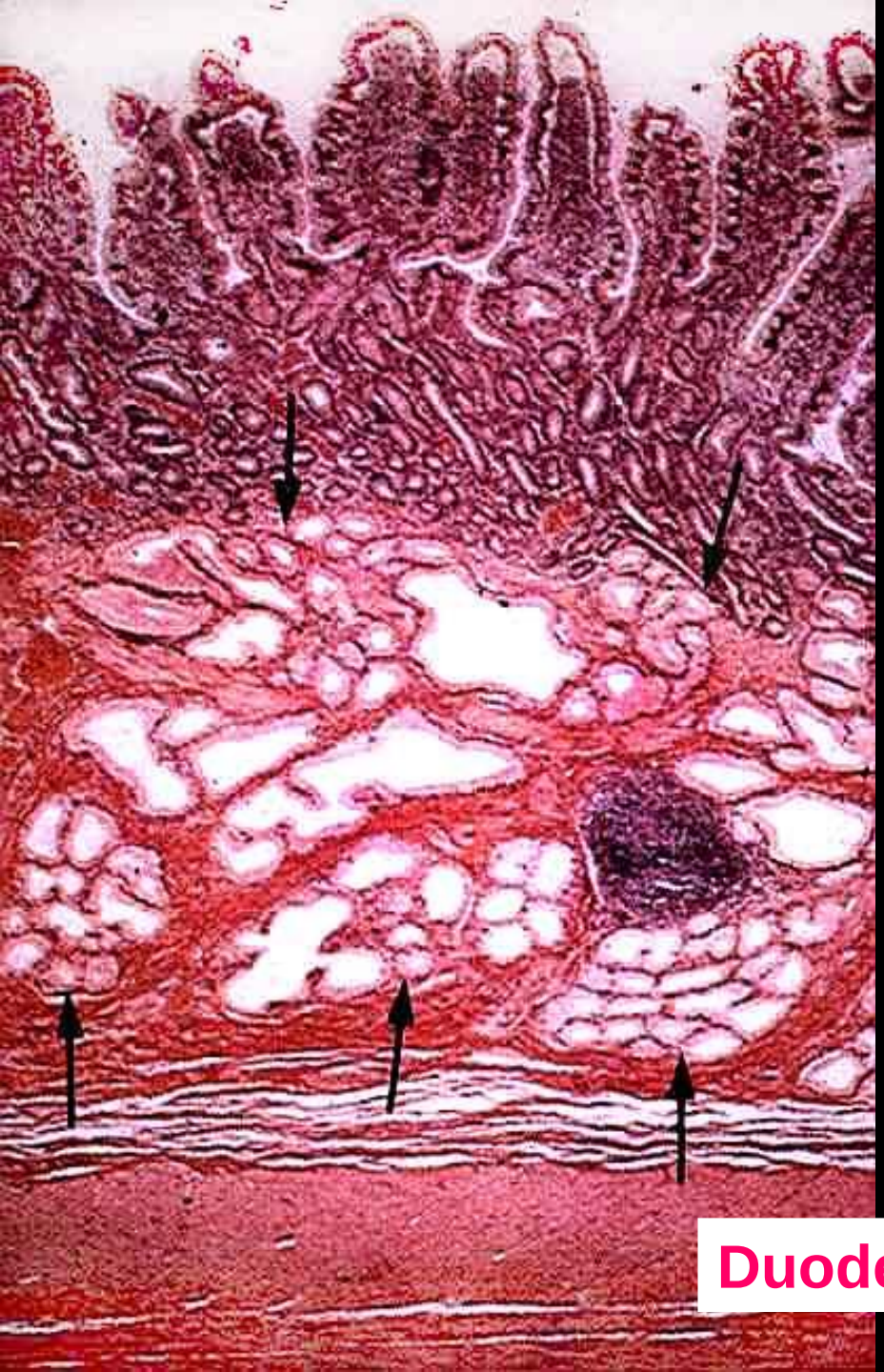
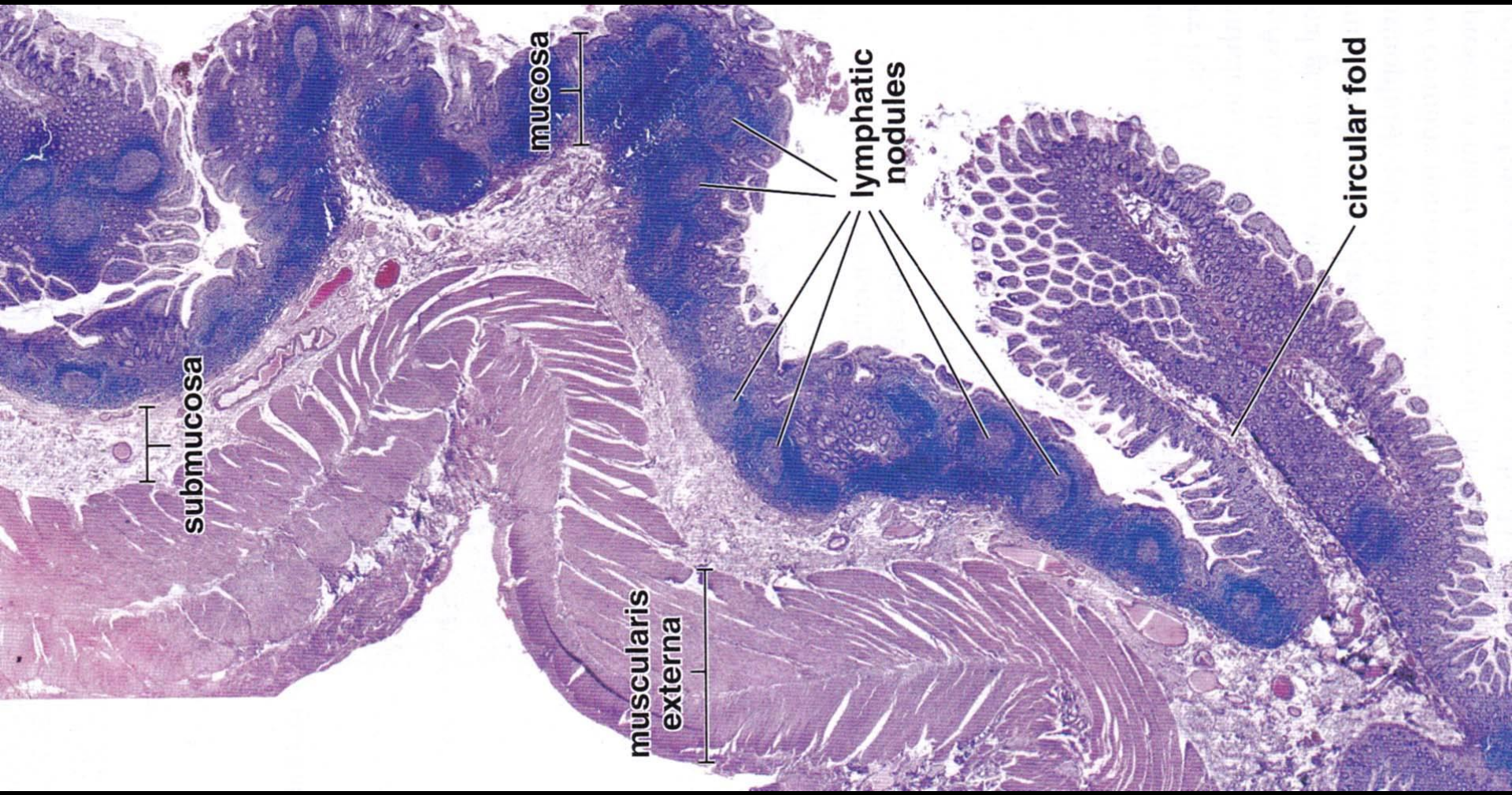


Duodenum

Brunner’s glands

Ileum



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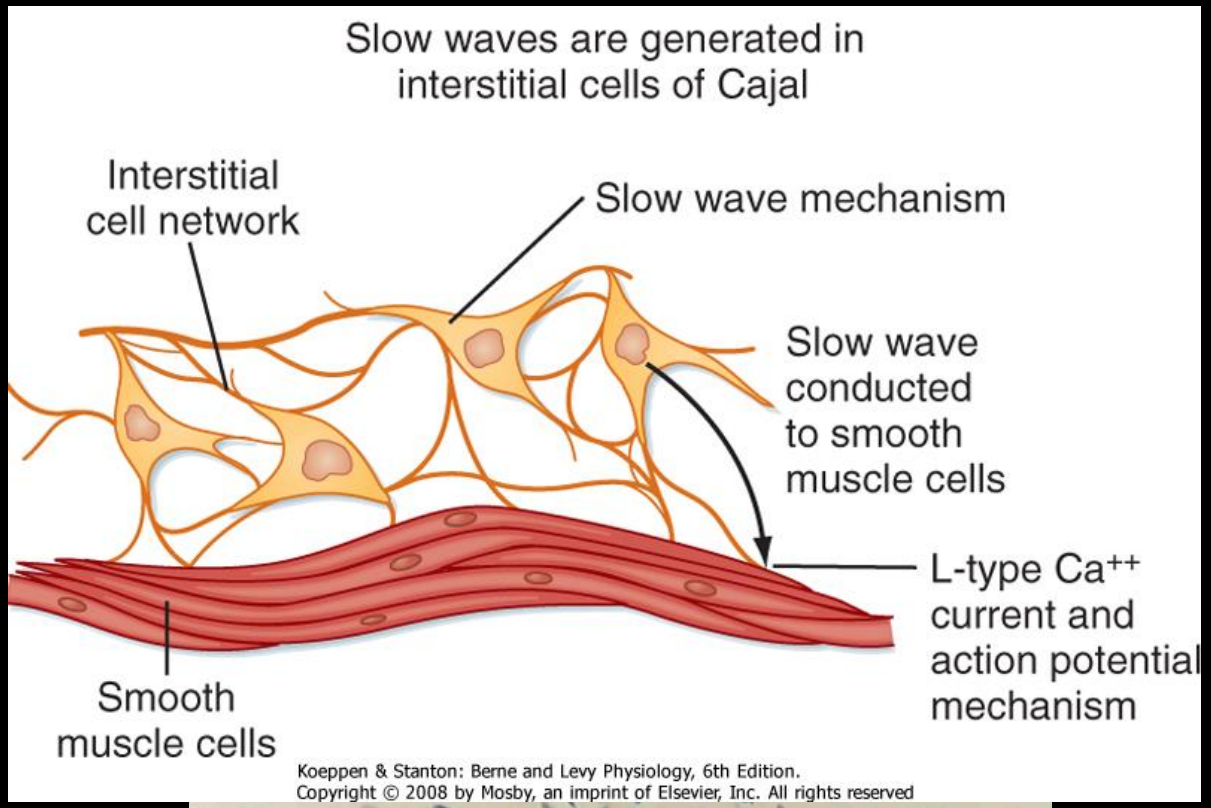
Peyer's patches

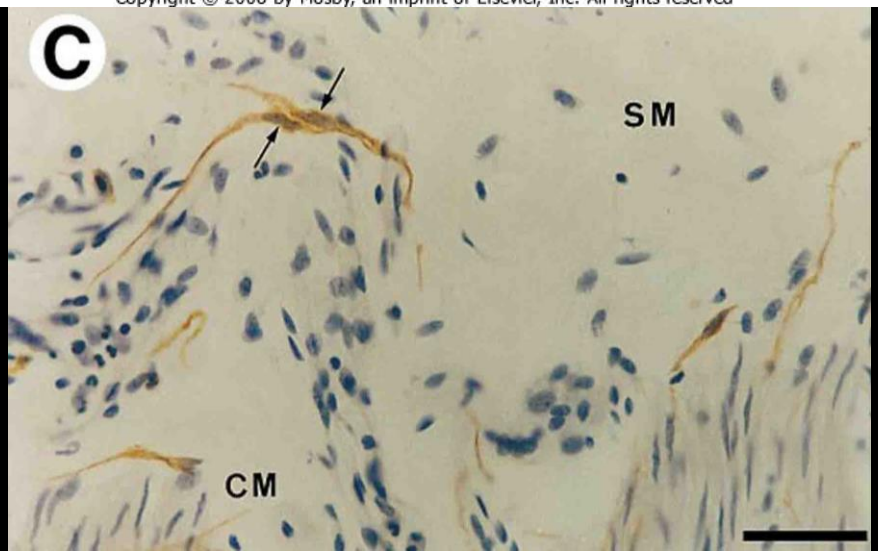
tunica muscularis externa

plexus myentericus Auerbachi

plexus myentericus Auerbachi

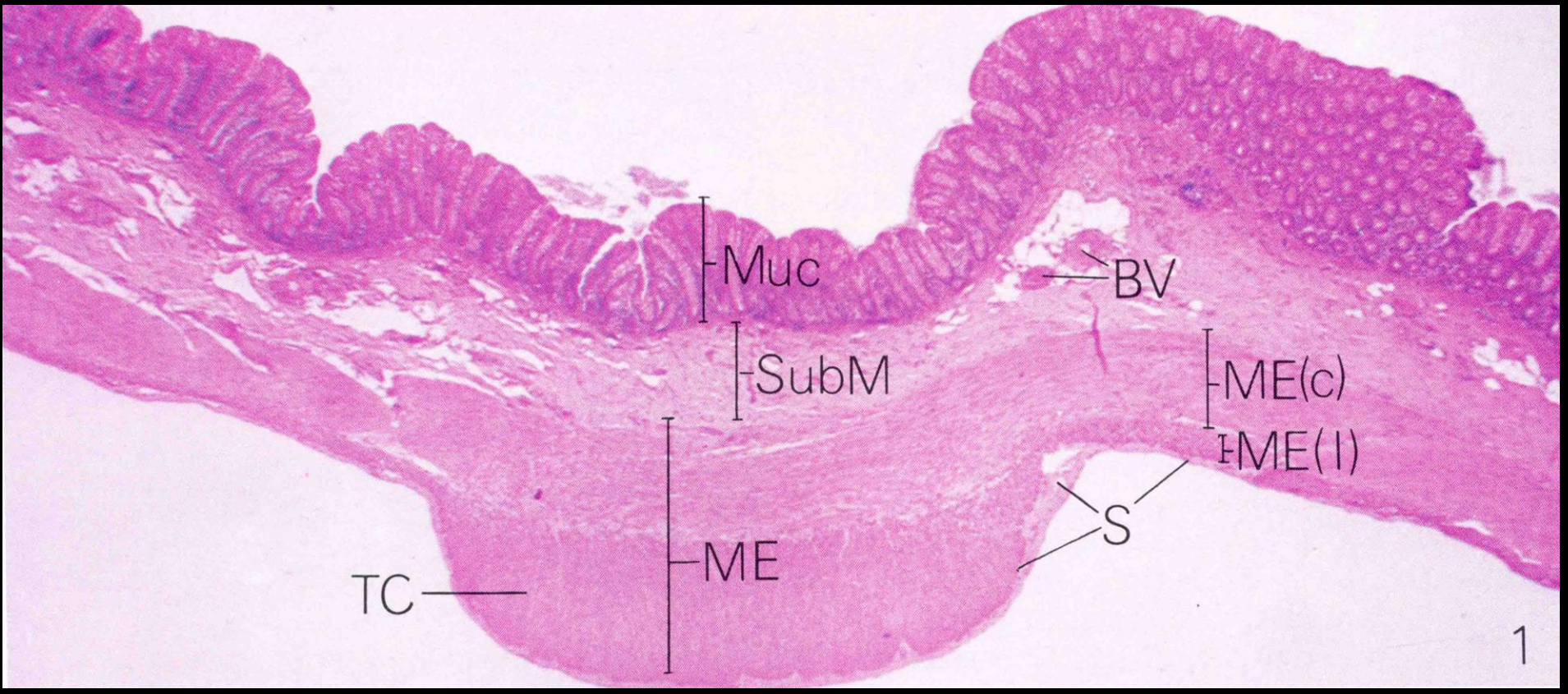
Interstitial cells of Cajal





Vanderwinden, J-M: GASTROENTEROLOGY 1996;111:901–910

Large intestine
(intestinum crassum, colon)



length 1,5 m
diameter 6-8 cm

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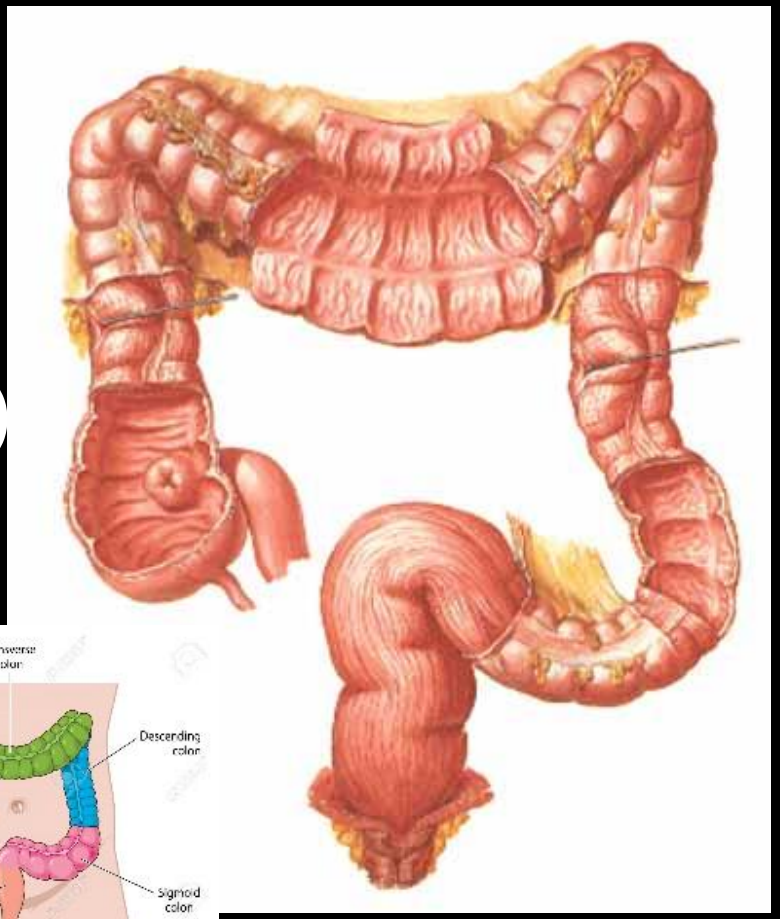
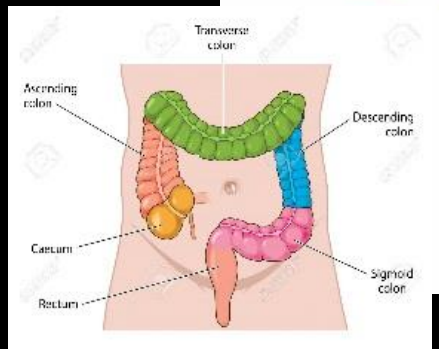
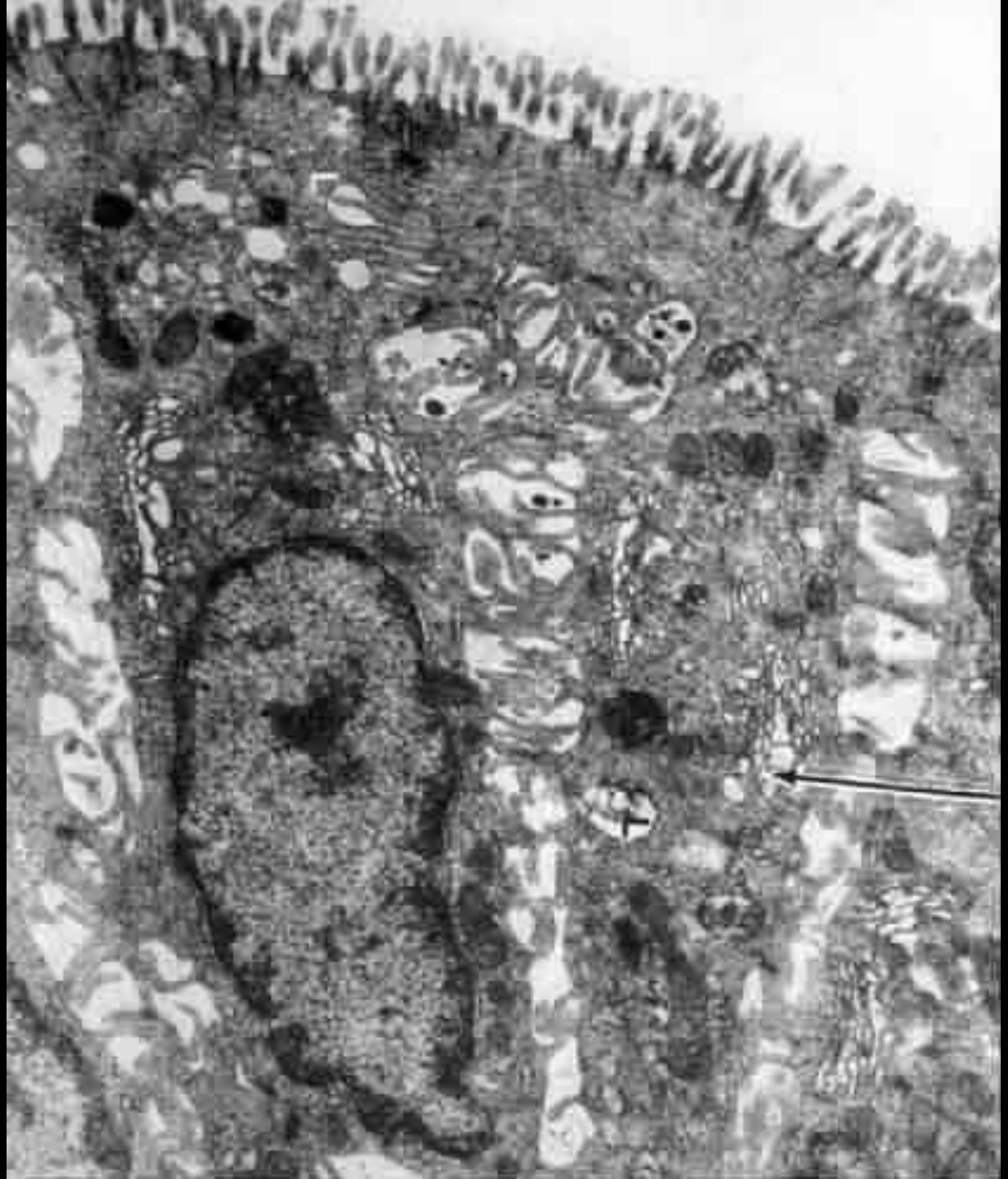
Large intestine - parts

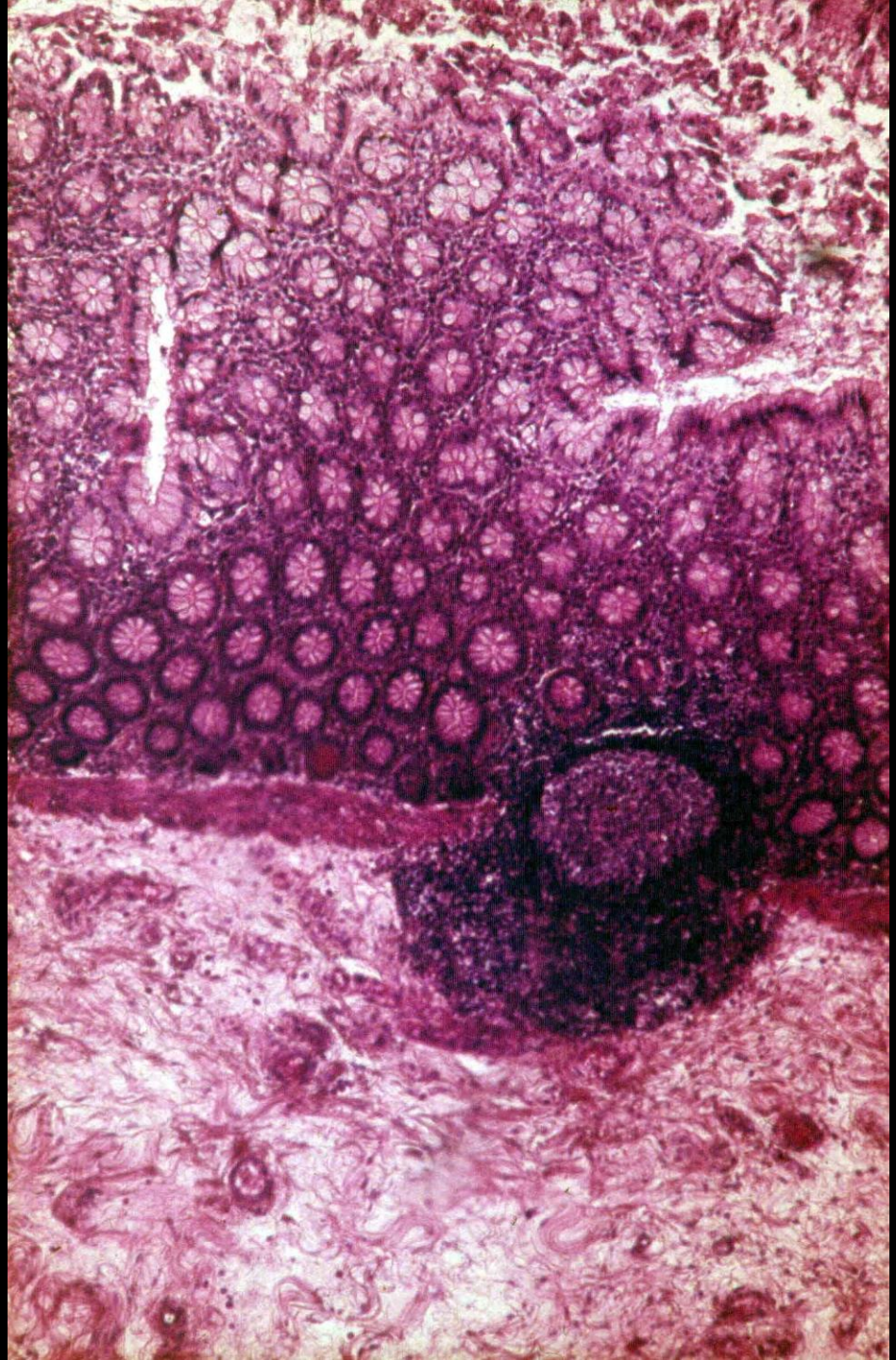
- caecum
  - appendix vermiformis
- colon ascendens
- flexura coli dx. (hepatica)
- colon transversum
- flexura coli sin. (splenica)
- colon descendens
- colon sigmoideum
- rectum
  - canalis analis



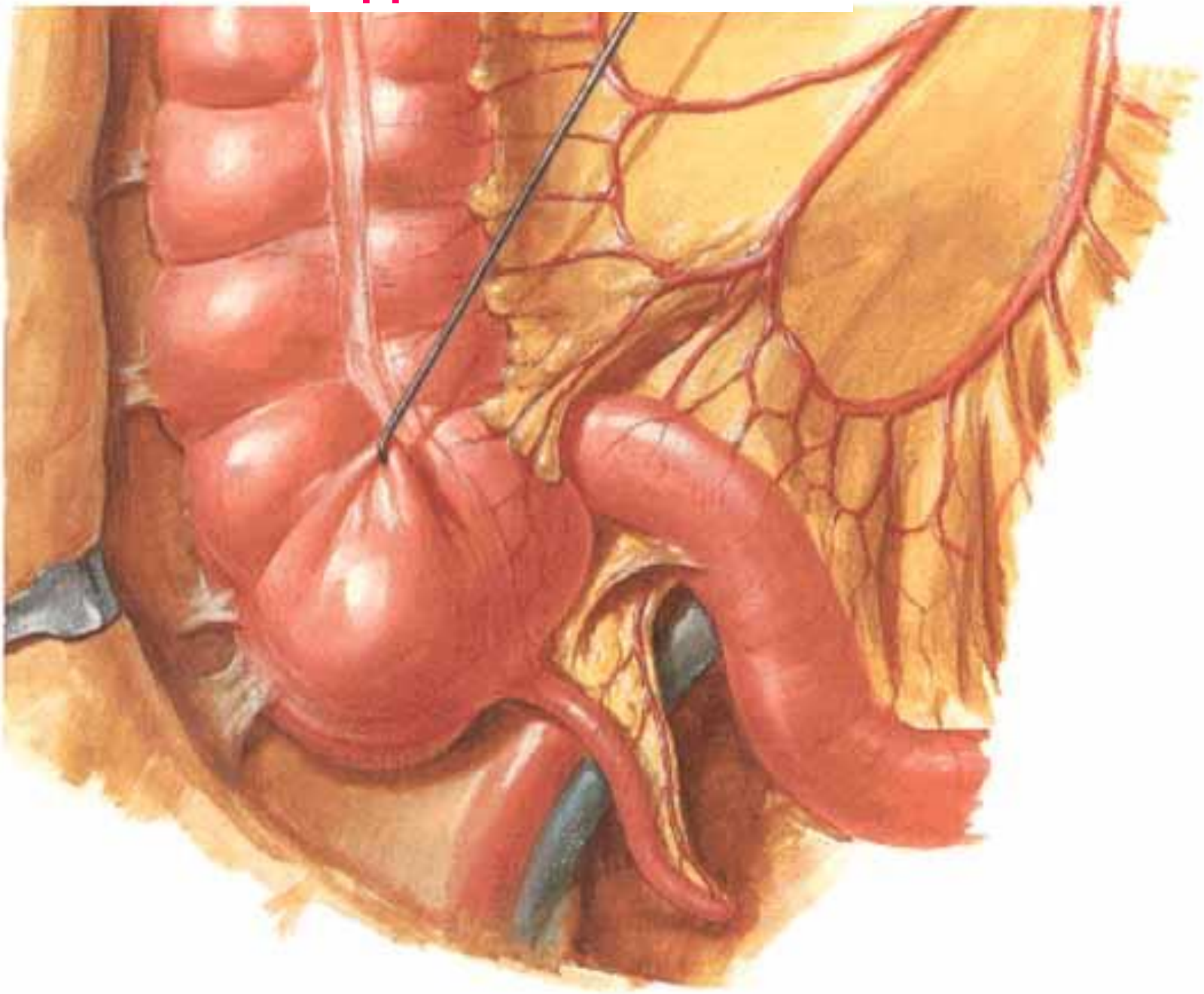


Enterocytes (colonocytes)

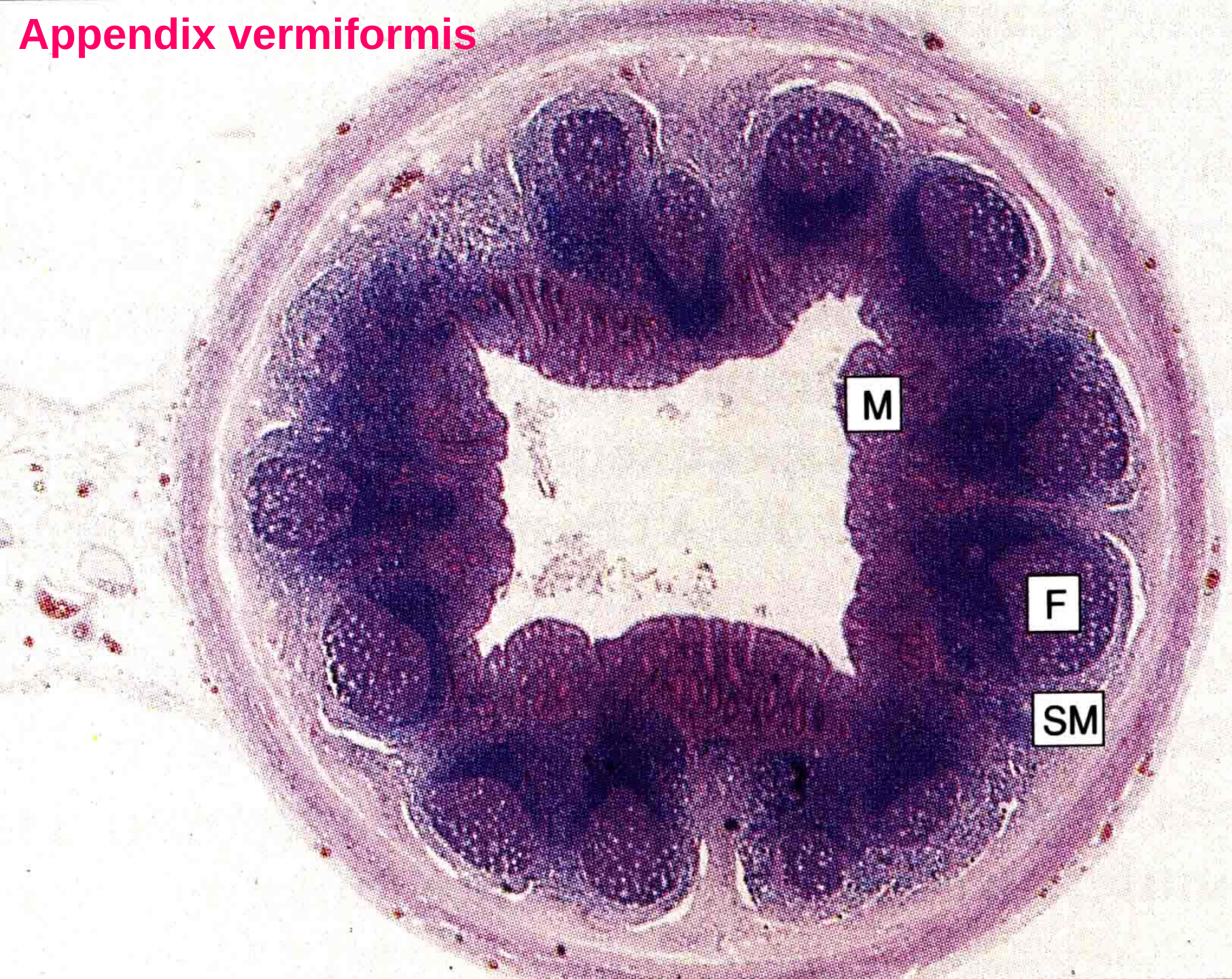


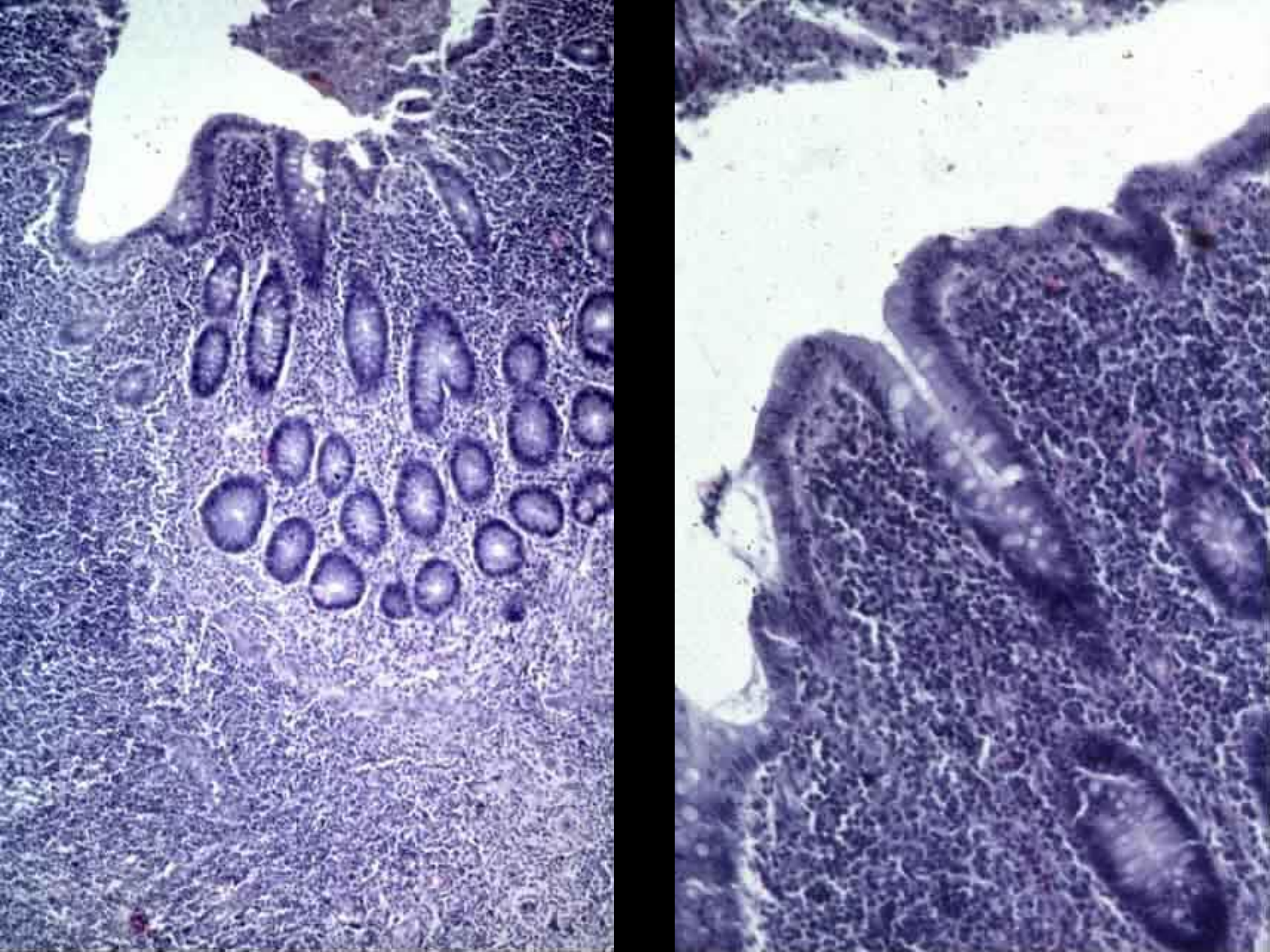


Appendix vermiformis

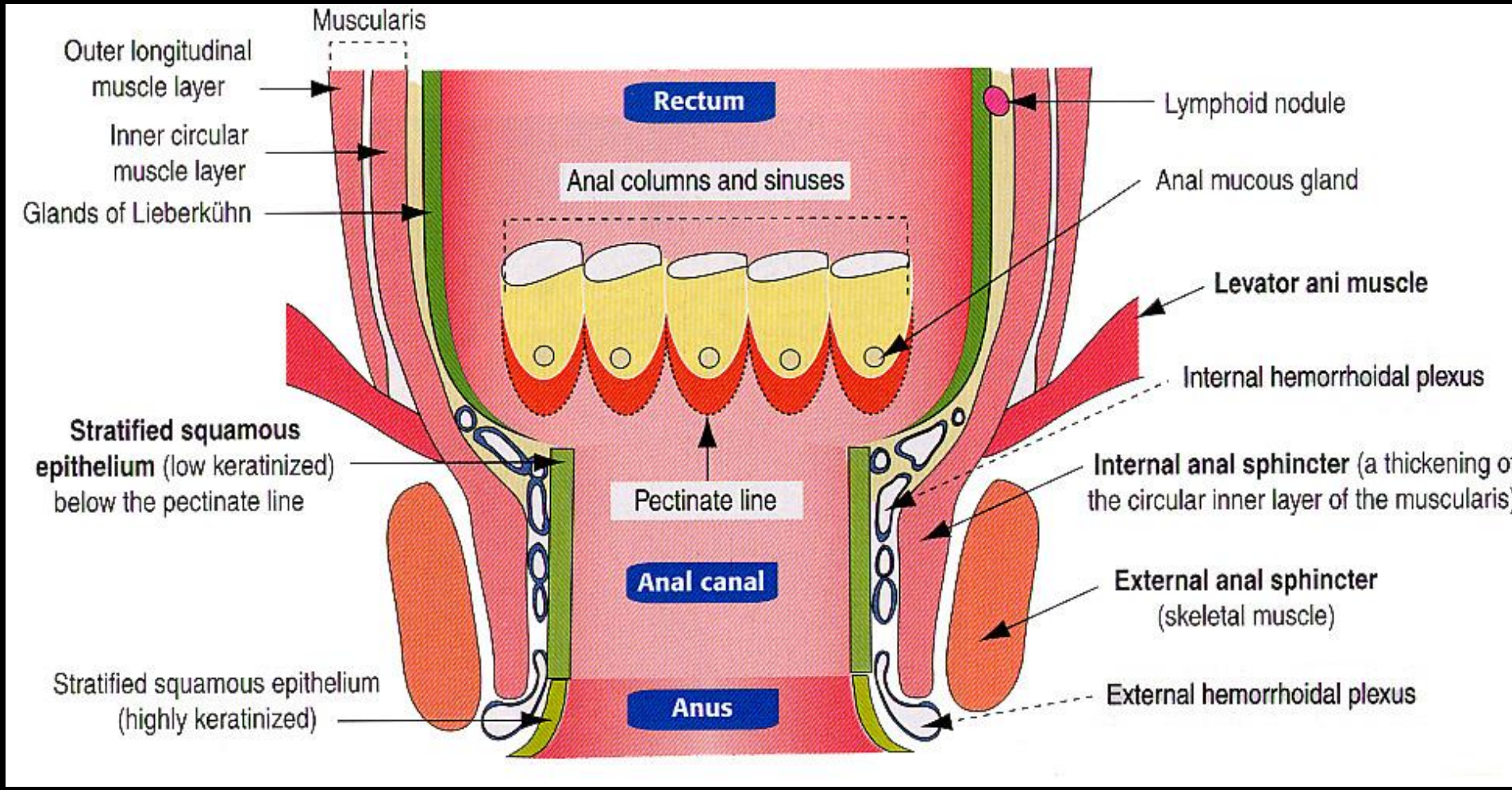


Appendix vermiformis





Anal canal


Muscularis
Outer longitudinal muscle layer
Inner circular muscle layer
Glands of Lieberkühn
Rectum
Anal columns and sinuses
Lymphoid nodule
Anal mucous gland
Levator ani muscle
Internal hemorrhoidal plexus
Stratified squamous epithelium (low keratinized) below the pectinate line
Pectinate line
Internal anal sphincter (a thickening o
the circular inner layer of the muscularis)
Anal canal
External anal sphincter
(skeletal muscle)
Stratified squamous epithelium
(highly keratinized)
Anus
External hemorrhoidal plexus