
In the name of ALLAH

Urinary system (histology)

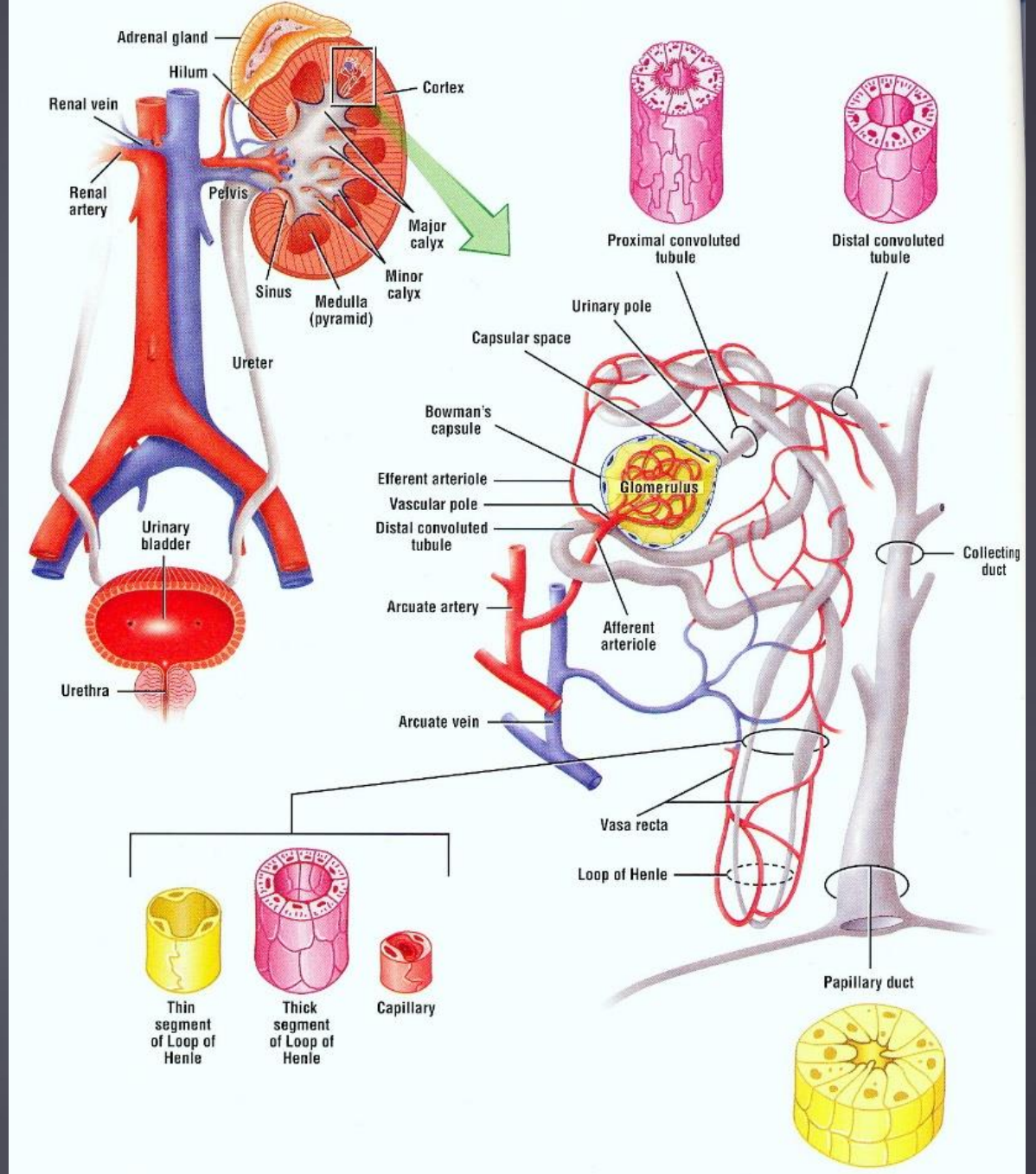
1: Lapine Kidney
2: Feline Kidney

3: Canine Kidney
4: Porcine Kidney

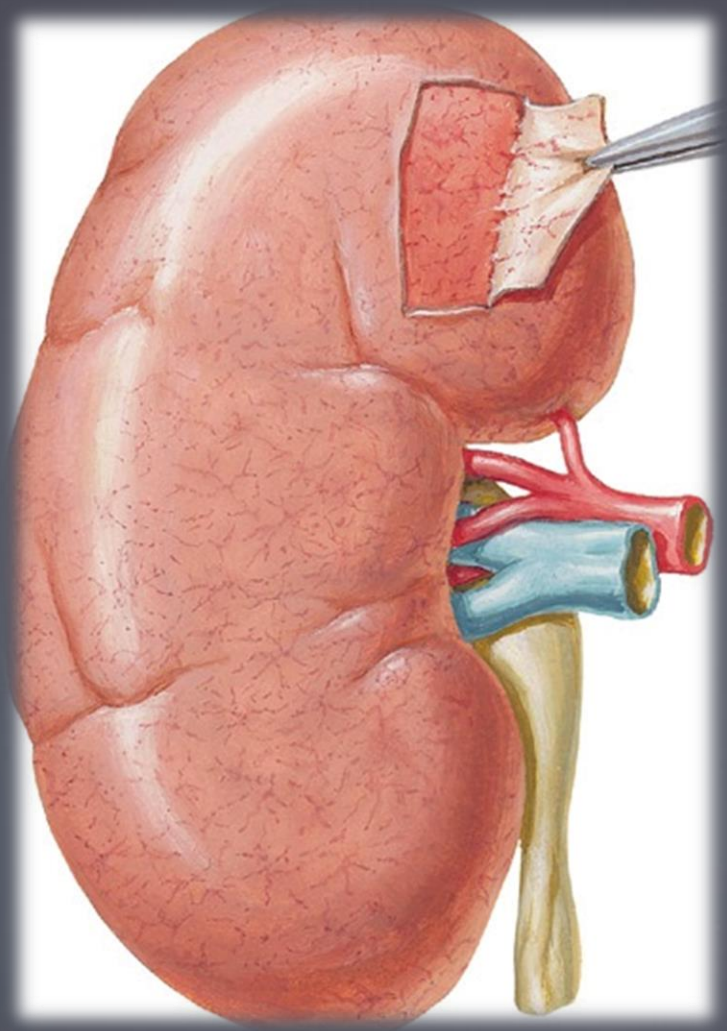
5: Ovine Kidney
6: Bovine (Calf) Kidney

7: Equine Kidney
8: Bovine (Adult) Kidney

Anatomy

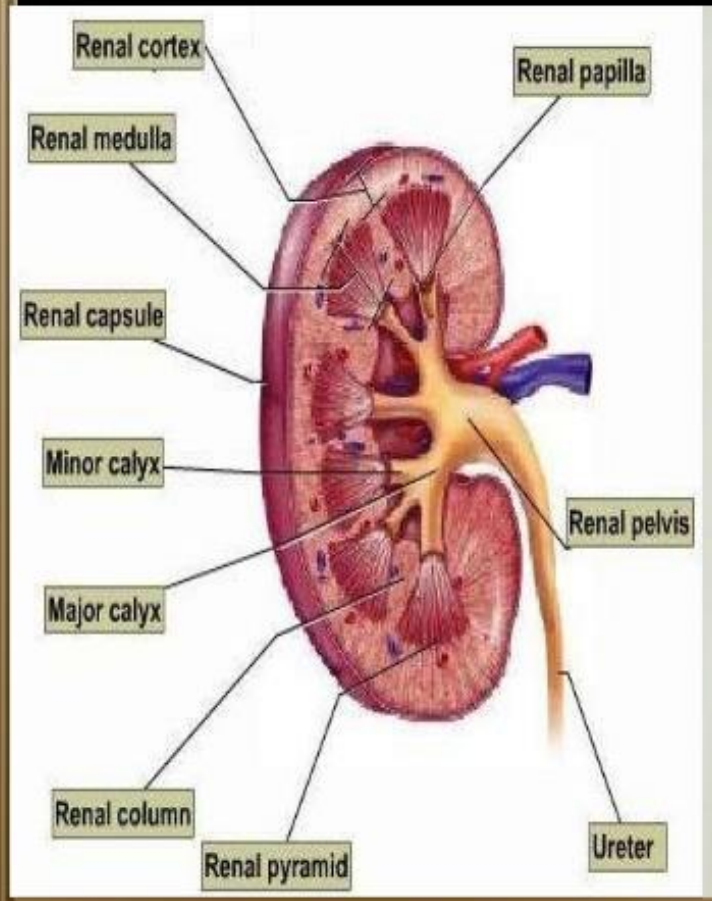


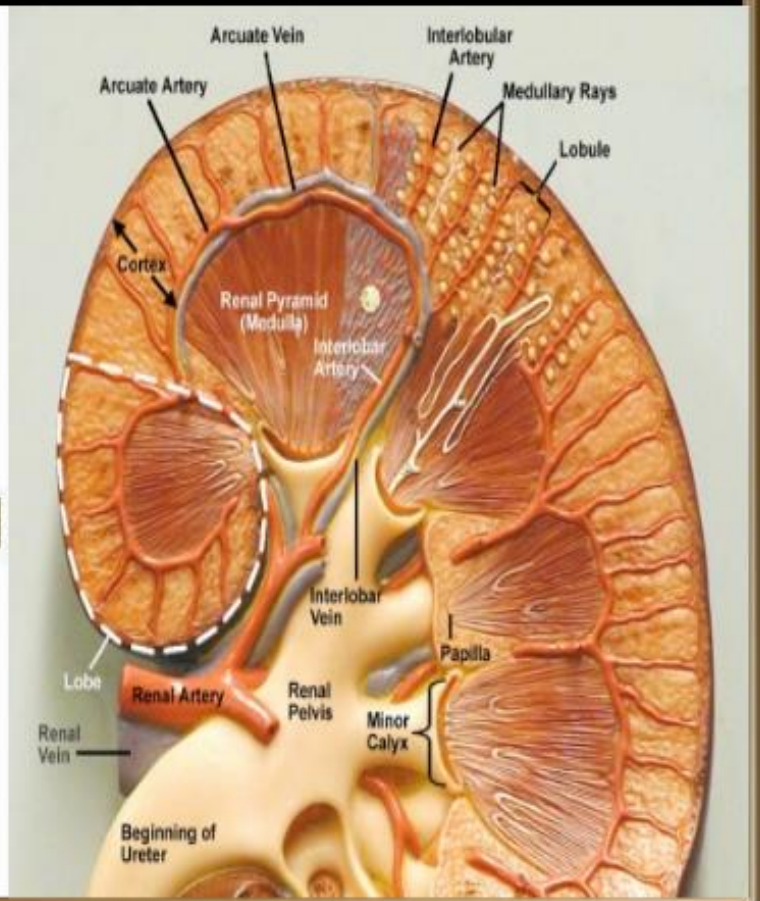
OVERVIEW FIGURE ■ A sagittal section of the kidney showing the cortex and medulla, with blood vessels and the ex
cretory ducts, including the pelvis and the ureter and a histologic comparison of the blood vessels, the different tubules o
the nephron, and the collecting ducts.

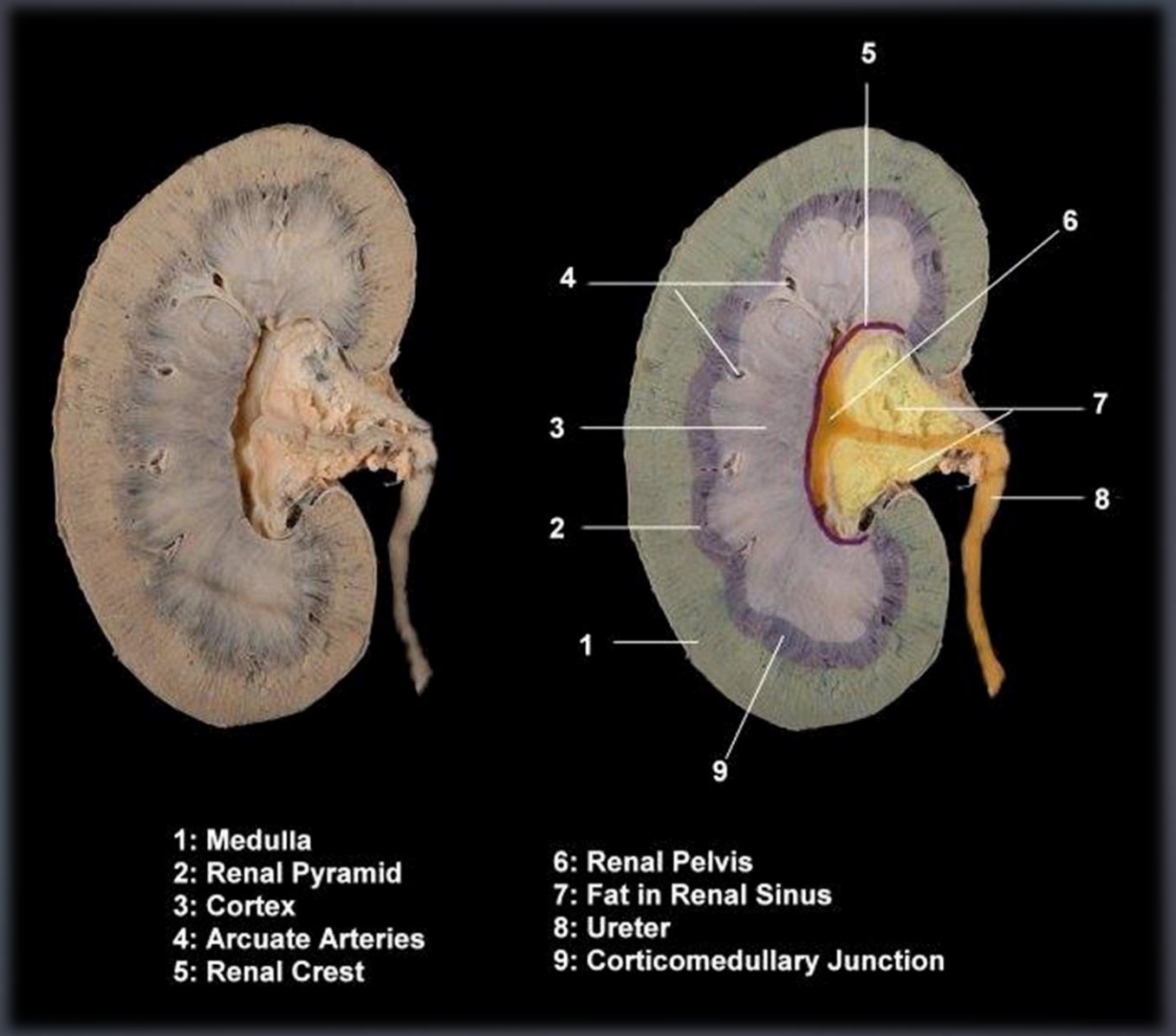


Renal capsule

RENAL STRUCTURE






5
6
4
7
3
8
2
1
9
1: Medulla
2: Renal Pyramid
3: Cortex
4: Arcuate Arteries
5: Renal Crest
6: Renal Pelvis
7: Fat in Renal Sinus
8: Ureter
9: Corticomedullary Junction

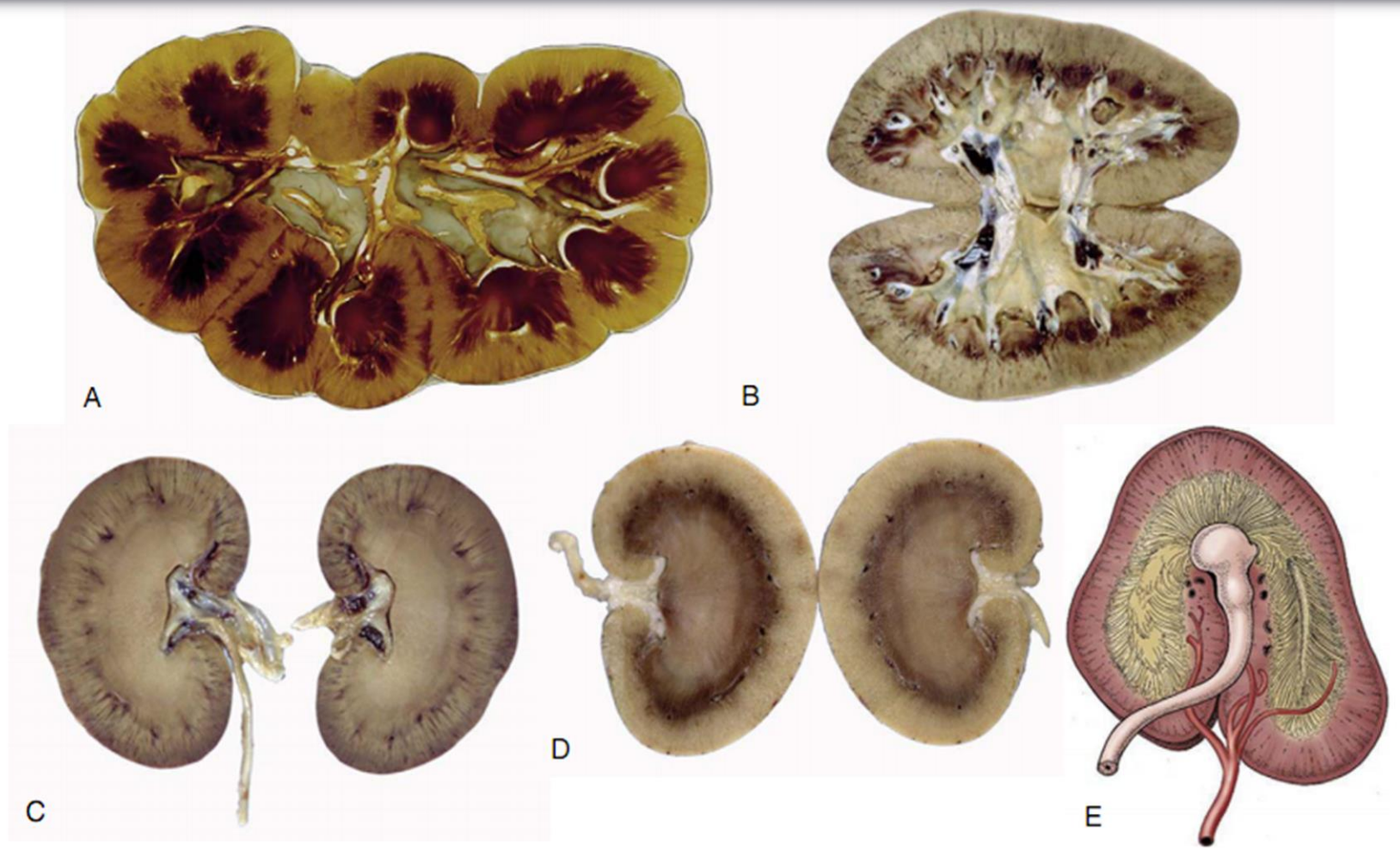
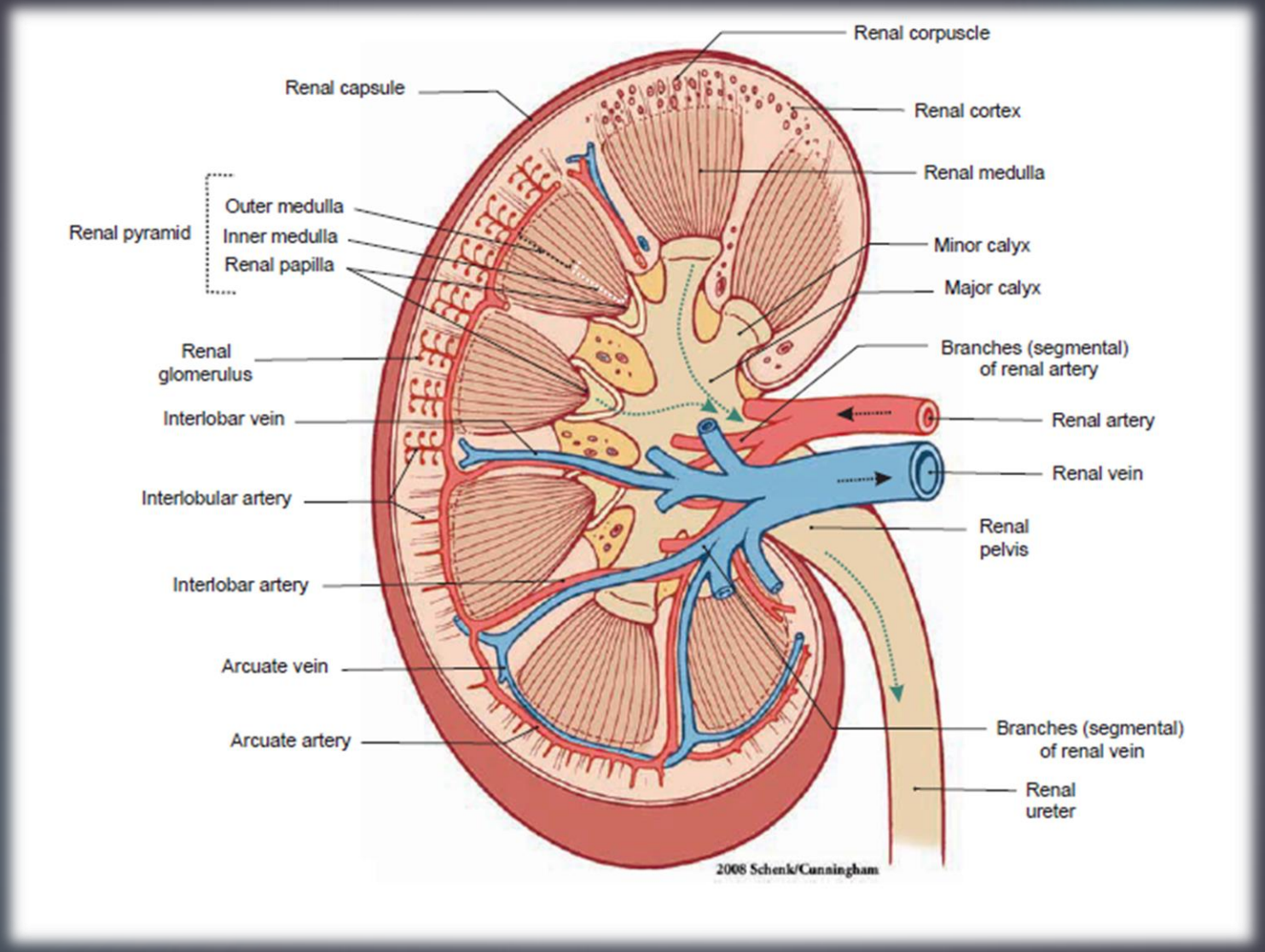
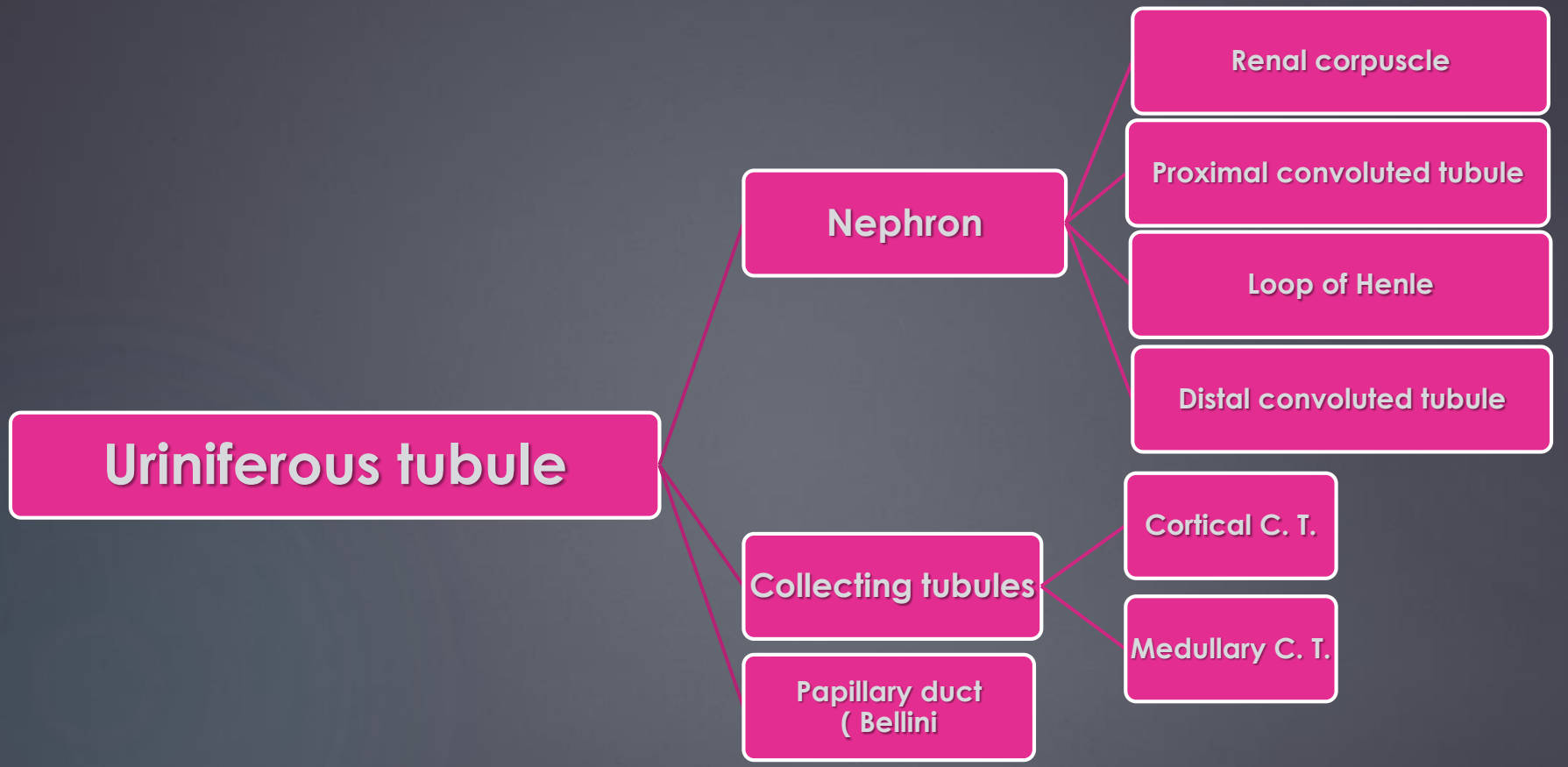
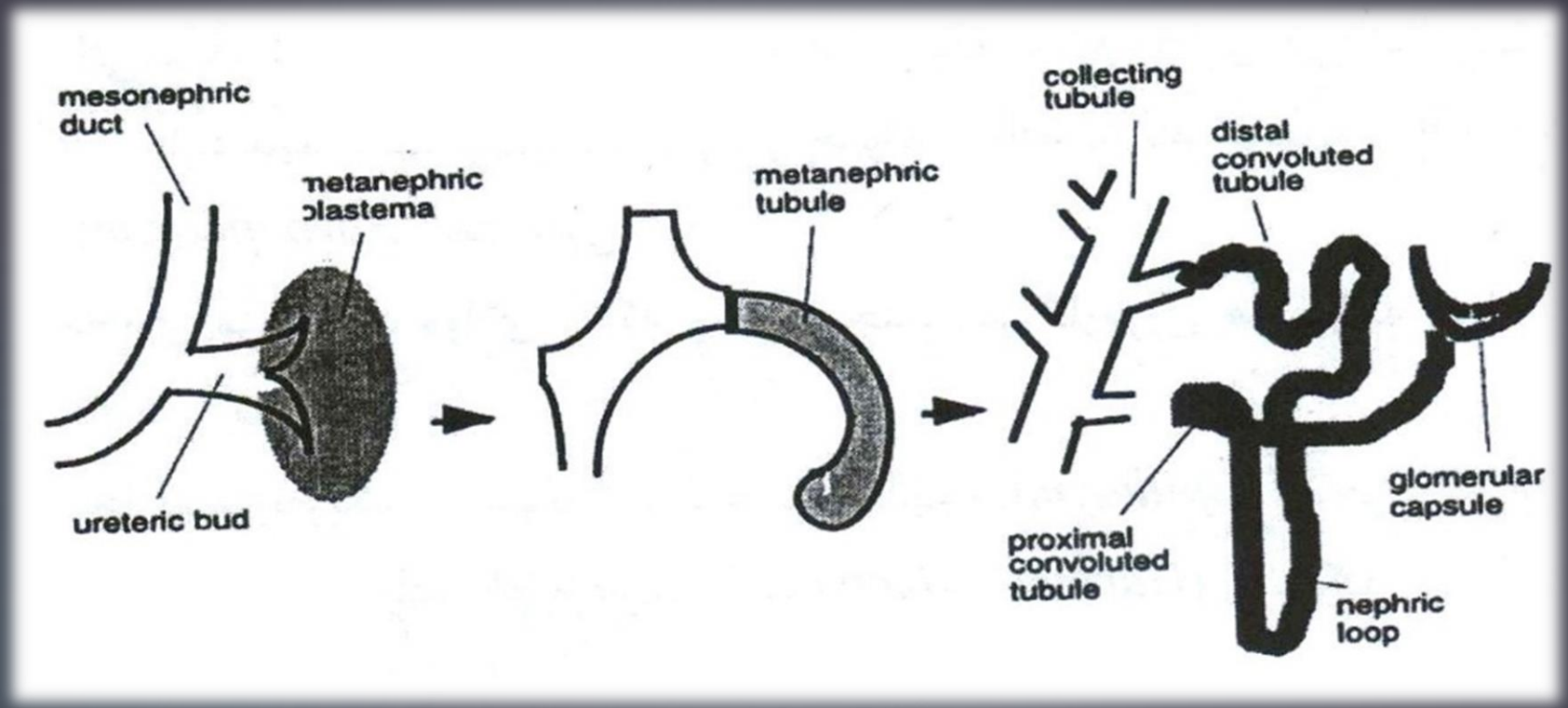


Figure 5–23 Sectioned kidney. Notice that the complexity of the renal pelvis decreases from cow to horse. Cow (plastinated specimen) **(A)**, pig **(B)**, dog **(C)**, cat **(D)**, horse **(E)**.

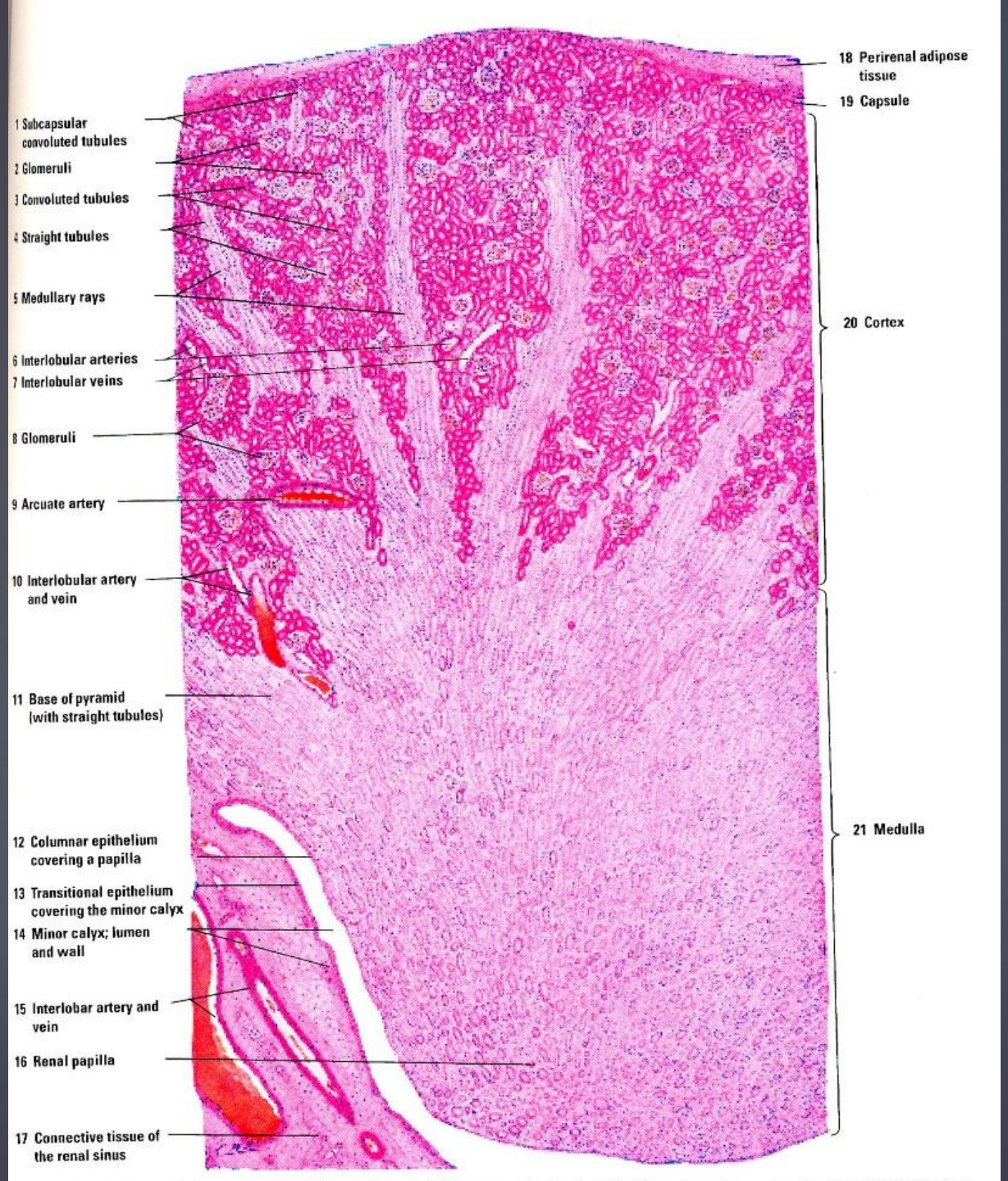


Human kidney


Uriniferous tubule
Nephron
Renal corpuscle
Proximal convoluted tubule
Loop of Henle
Distal convoluted tubule
Collecting tubules
Cortical C. T.
Medullary C. T.
Papillary duct
(Bellini



Embryonic stages of development of the urinary tract


1 Subcapsular convoluted tubules
2 Glomeruli
3 Convoluted tubules
4 Straight tubules
5 Medullary rays
6 Interlobular arteries
7 Interlobular veins
8 Glomeruli
9 Arcuate artery
10 Interlobular artery and vein
11 Base of pyramid (with straight tubules)
12 Columnar epithelium covering a papilla
13 Transitional epithelium covering the minor calyx
14 Minor calyx; lumen and wall
15 Interlobar artery and vein
16 Renal papilla
17 Connective tissue of the renal sinus
18 Perirenal adipose tissue
19 Capsule
20 Cortex
21 Medulla

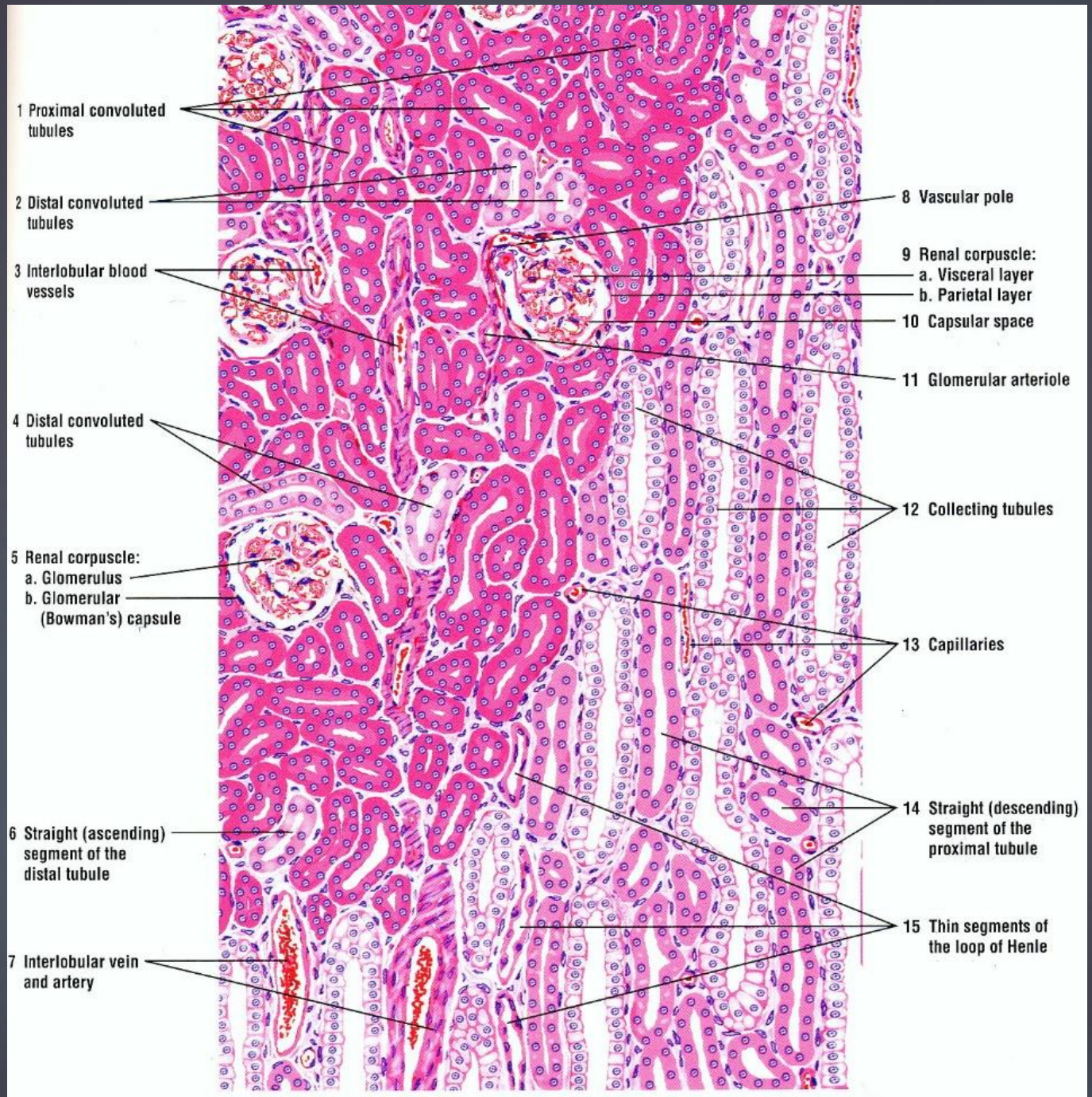
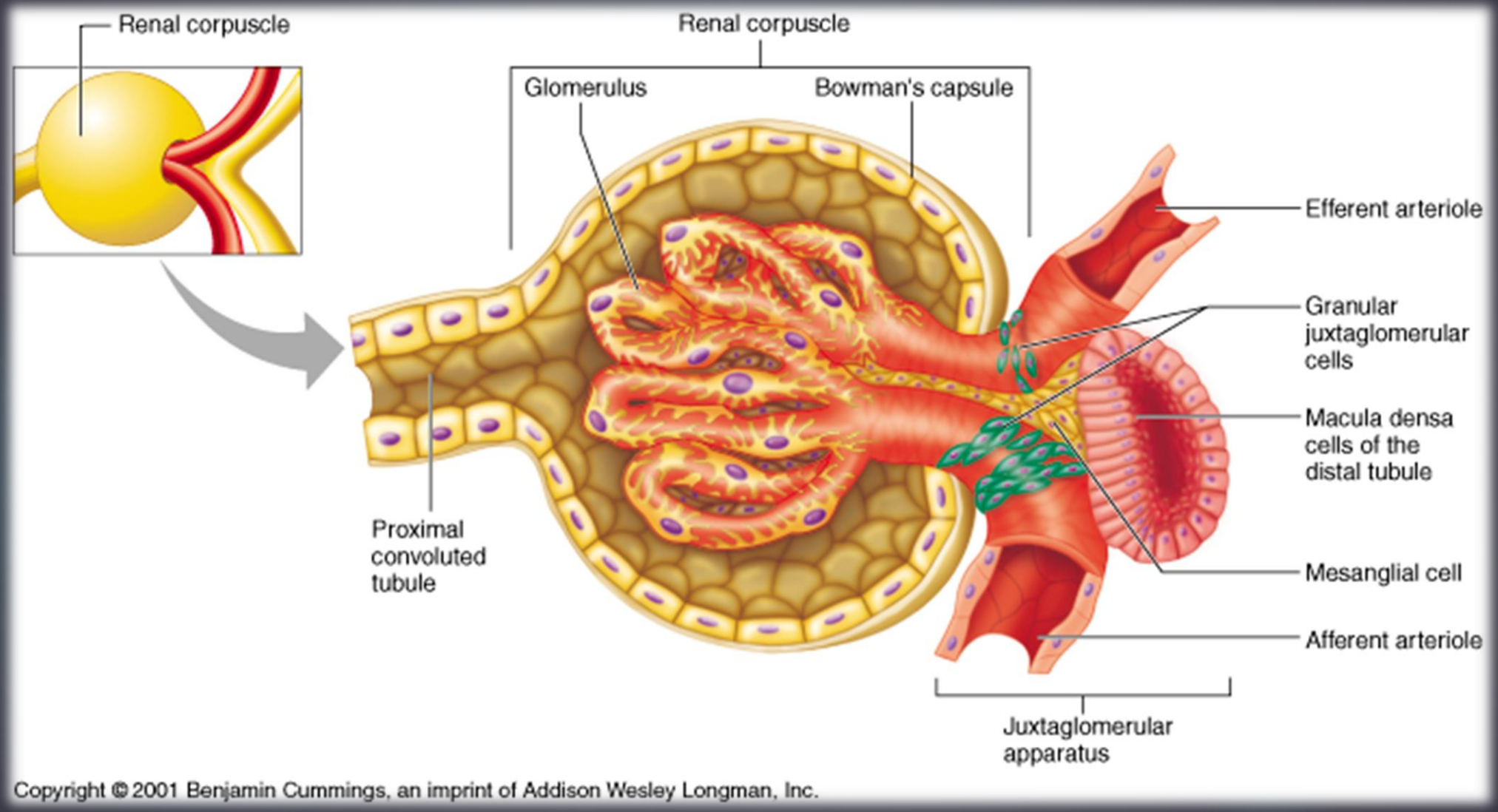


FIGURE 16.2 ■ Kidney cortex and upper medulla. Stain: hematoxylin and eosin. Low magnification.

Renal Corpuscle



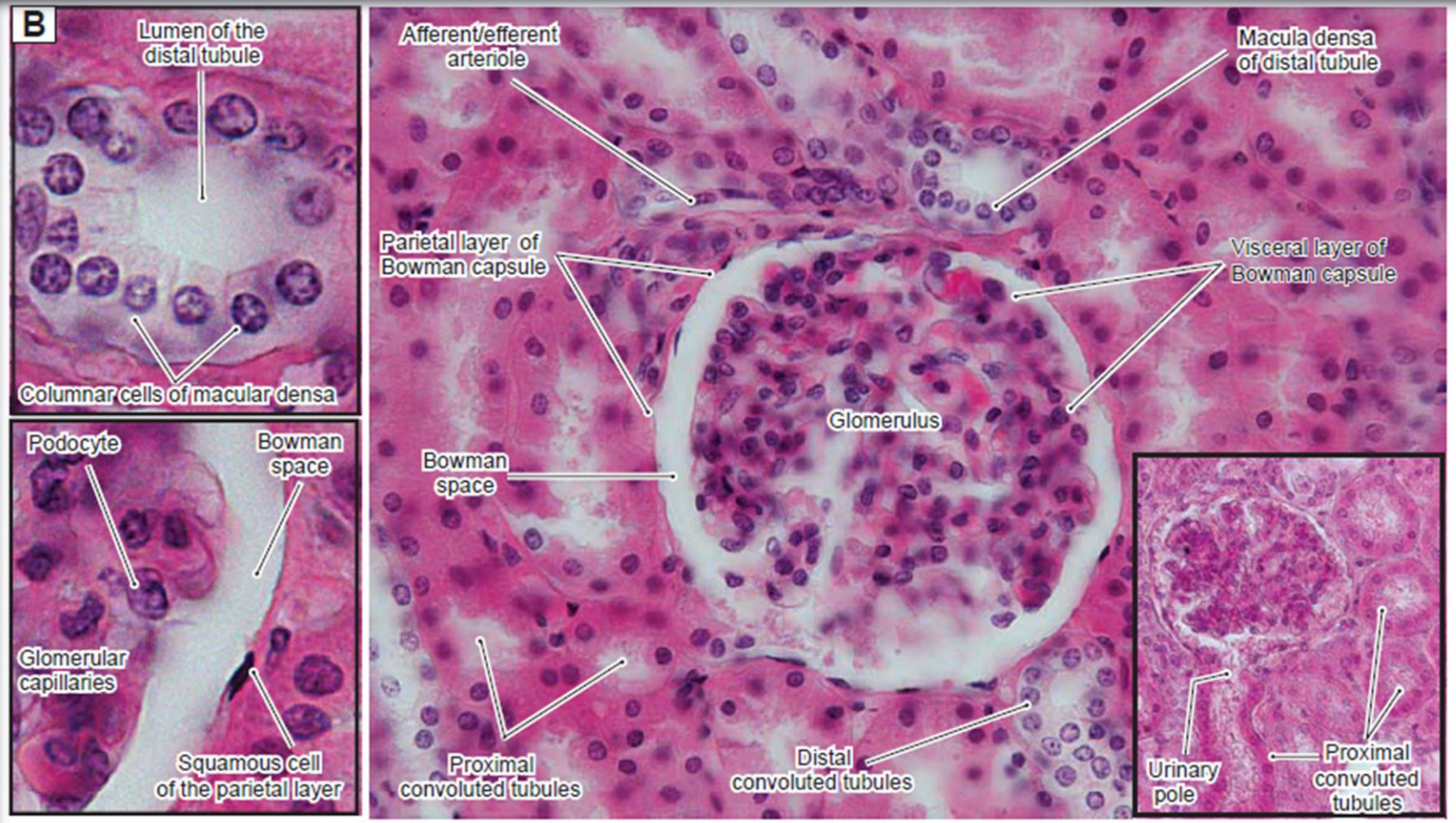
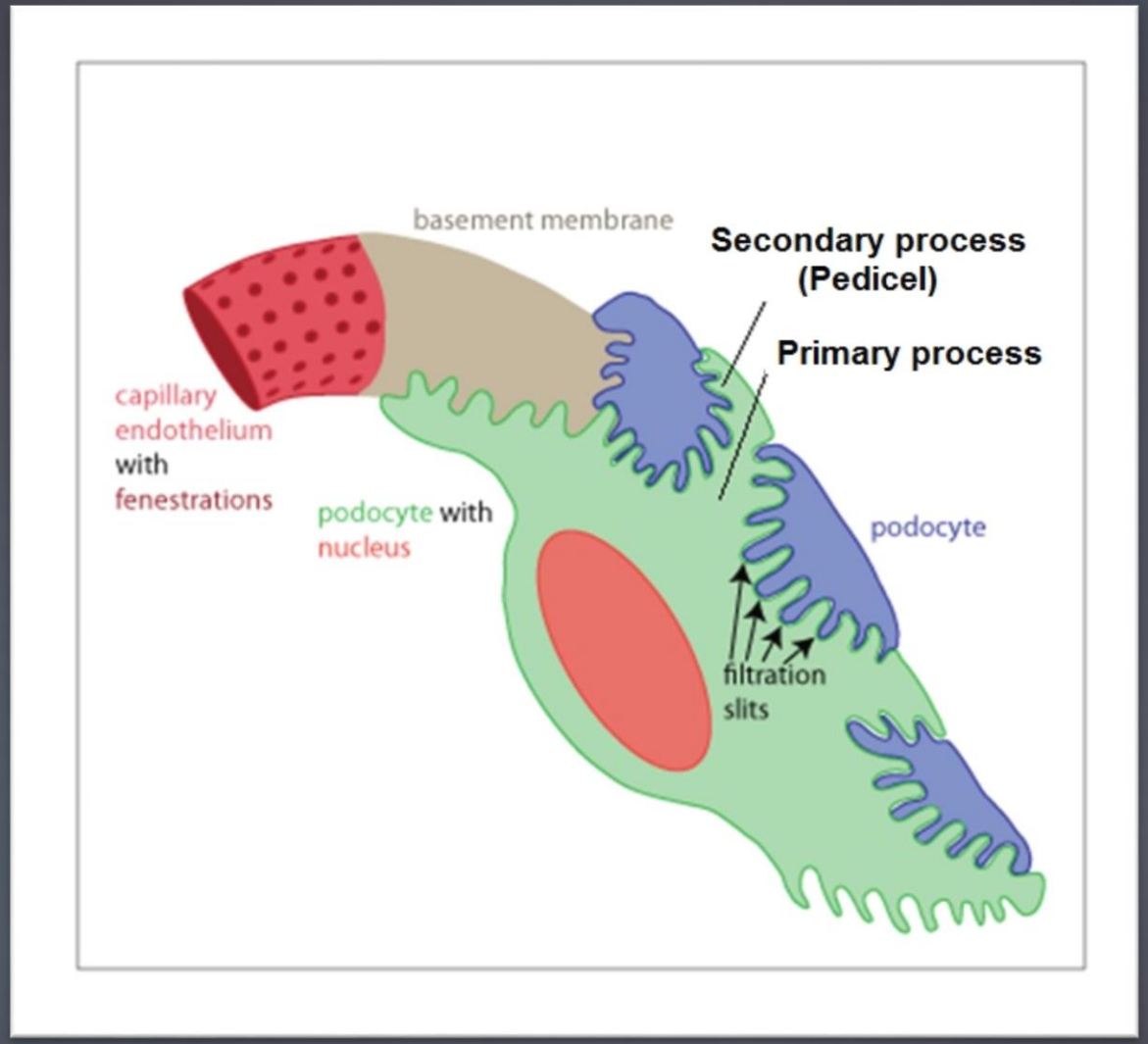


Figure 12-5B. Renal corpuscle, glomerulus and Bowman capsule. H&E, ×402; insets (*left*) ×921; insets (*lower right*) ×183



Podocyte cell

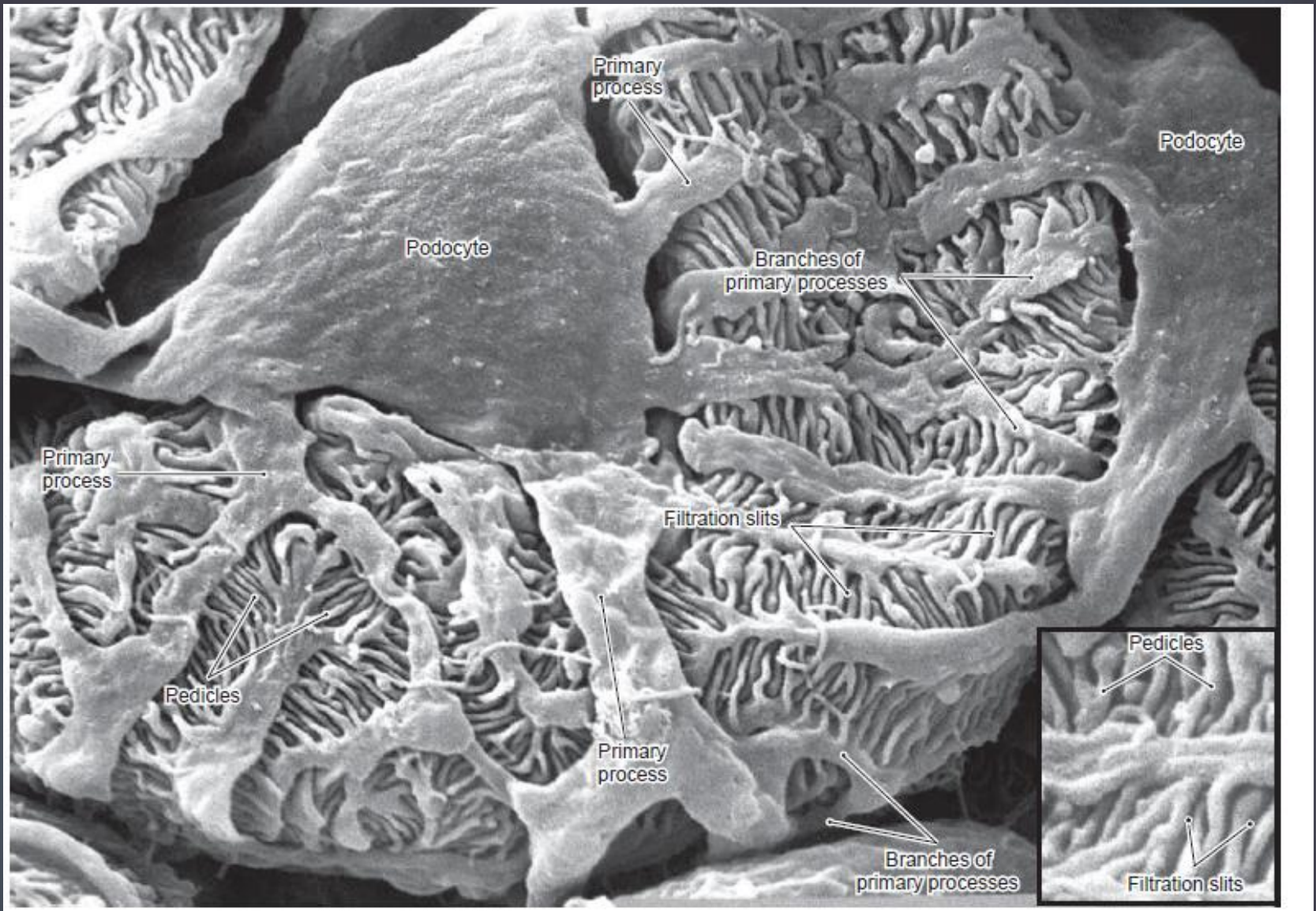


Figure 12-7. Glomerulus and podocyte. SEM, ×9,677

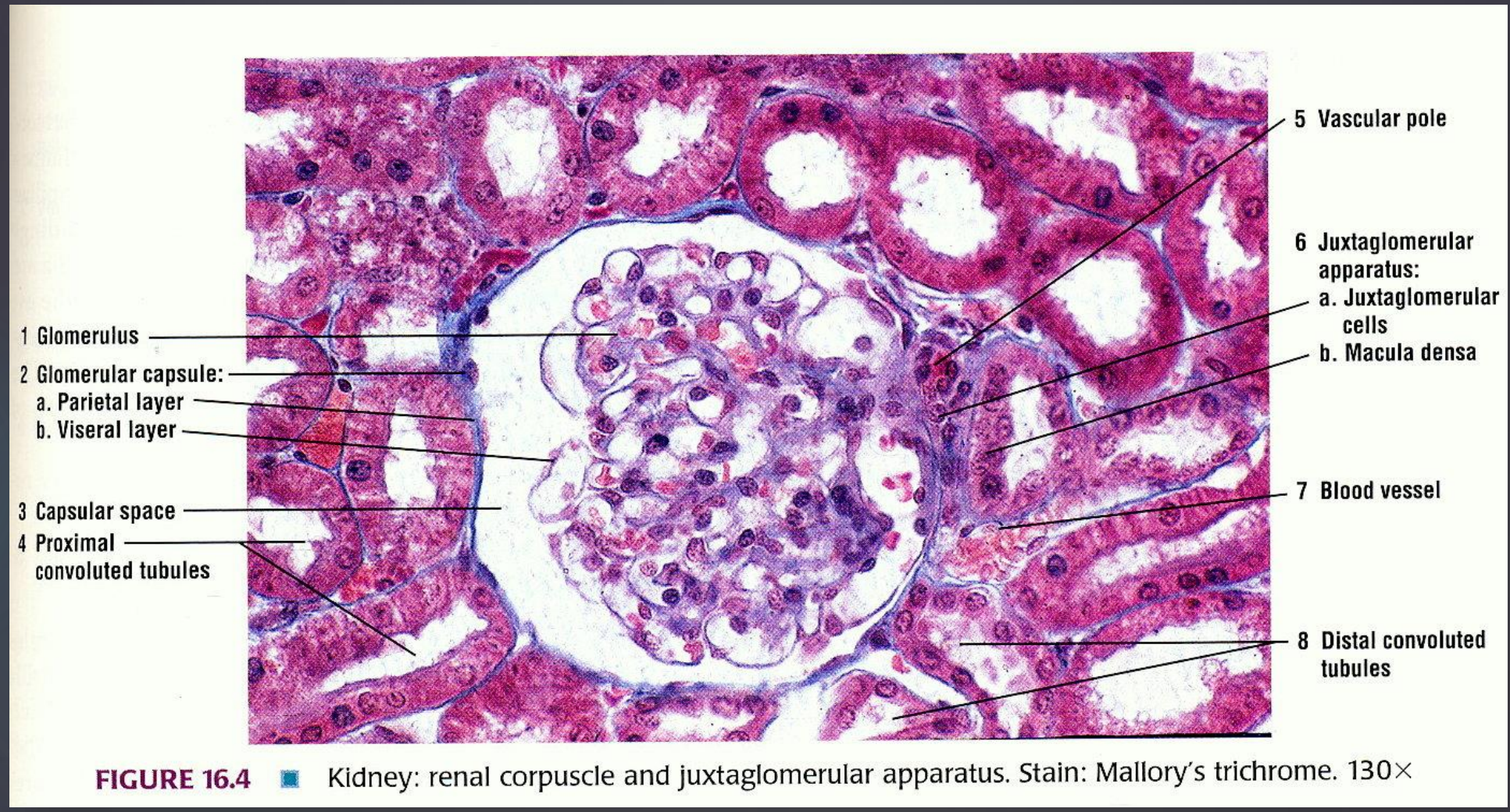
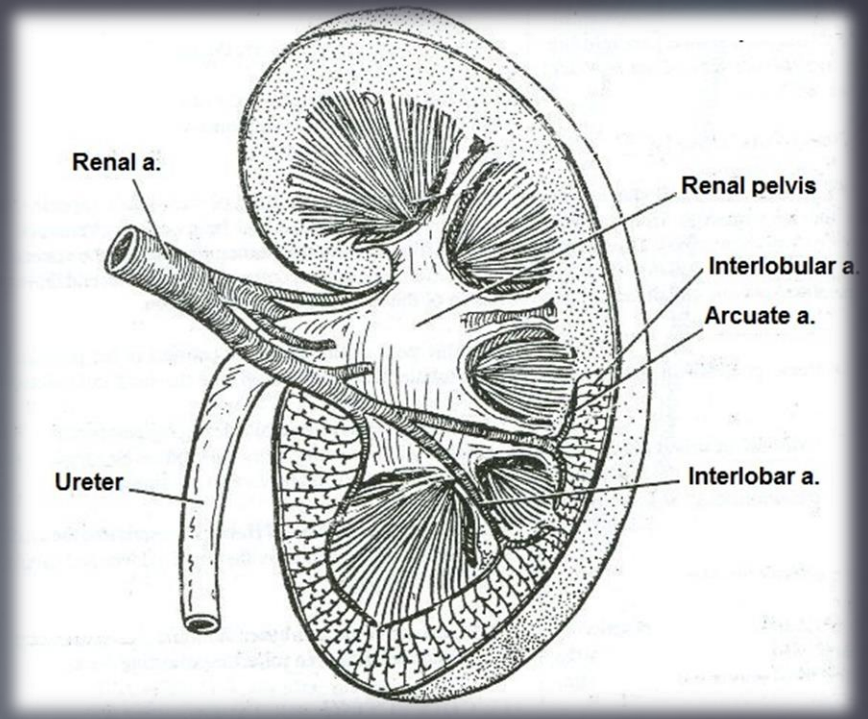
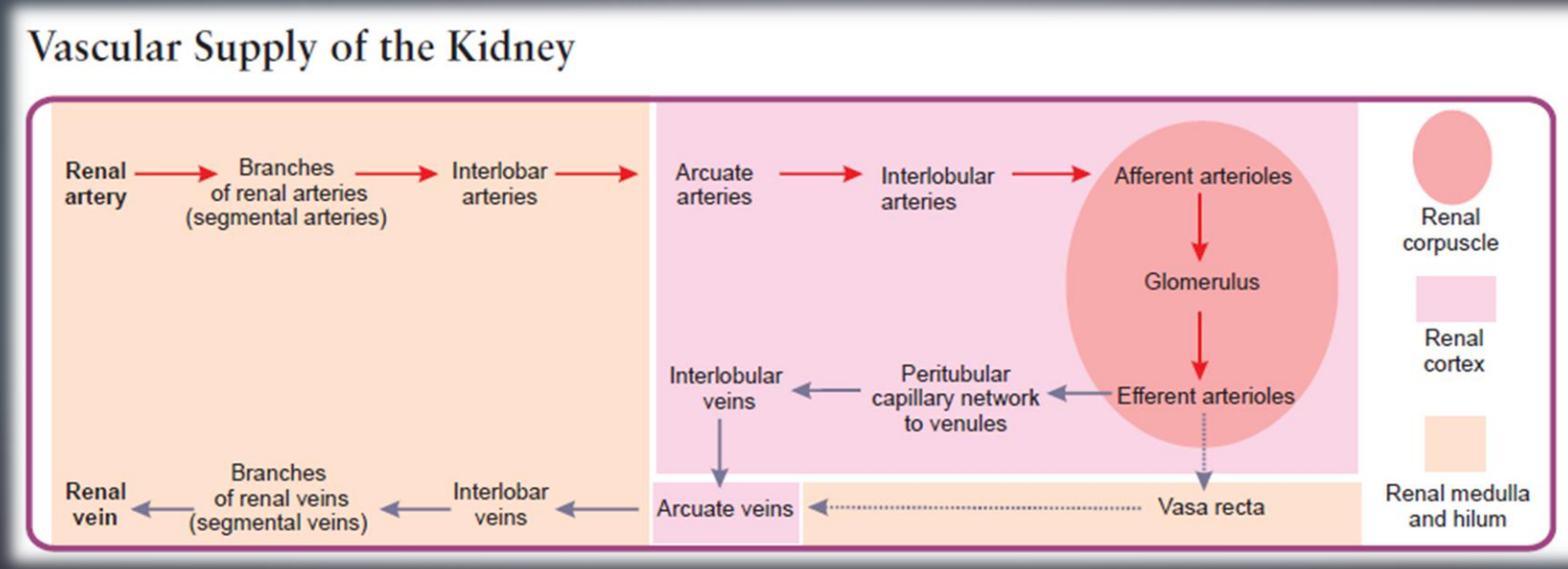
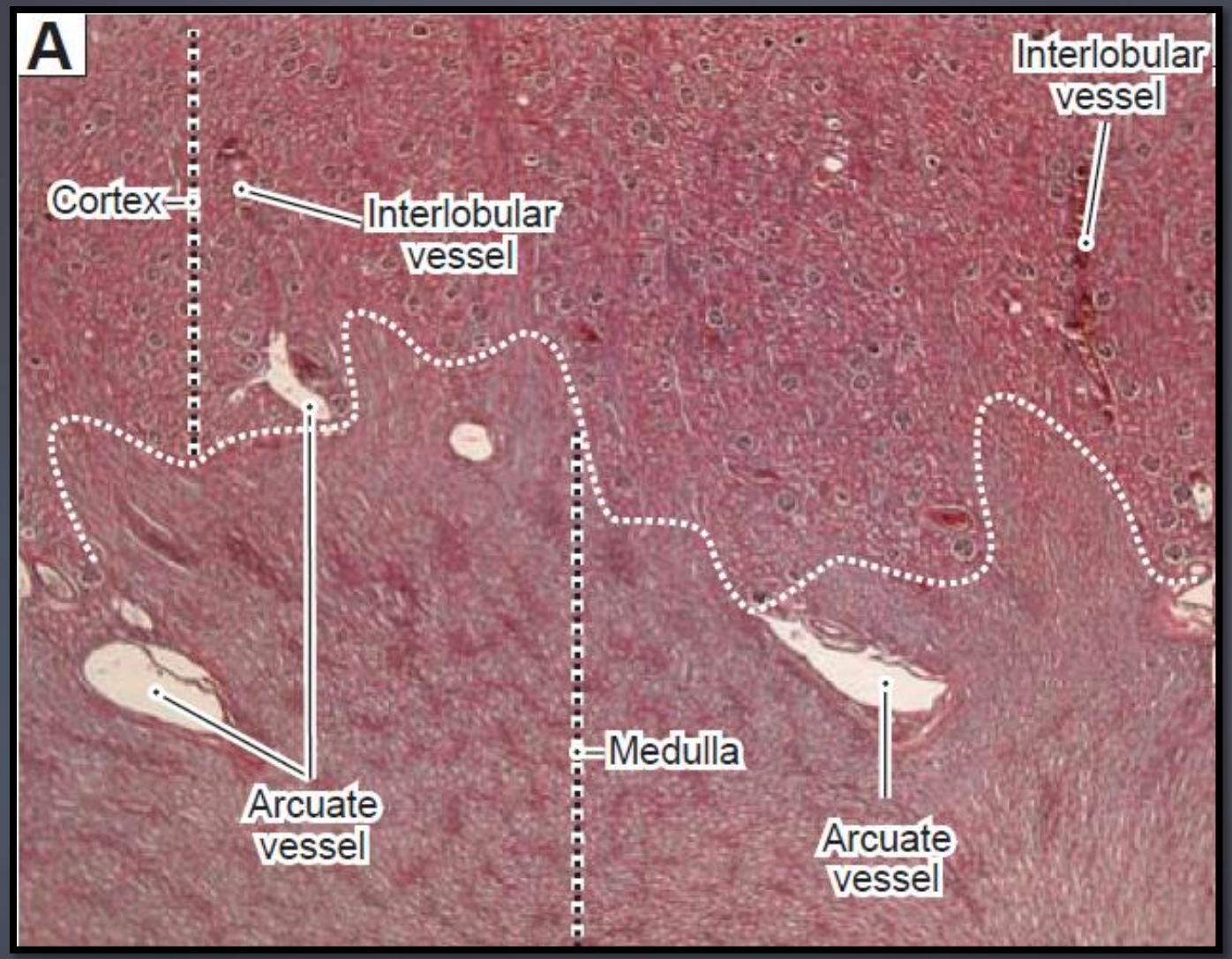


FIGURE 16.4 ■ Kidney: renal corpuscle and juxtaglomerular apparatus. Stain: Mallory's trichrome. 130×

Blood supply of the kidney






A
Cortex
Interlobular vessel
Interlobular vessel
Medulla
Arcuate vessel
Arcuate vessel

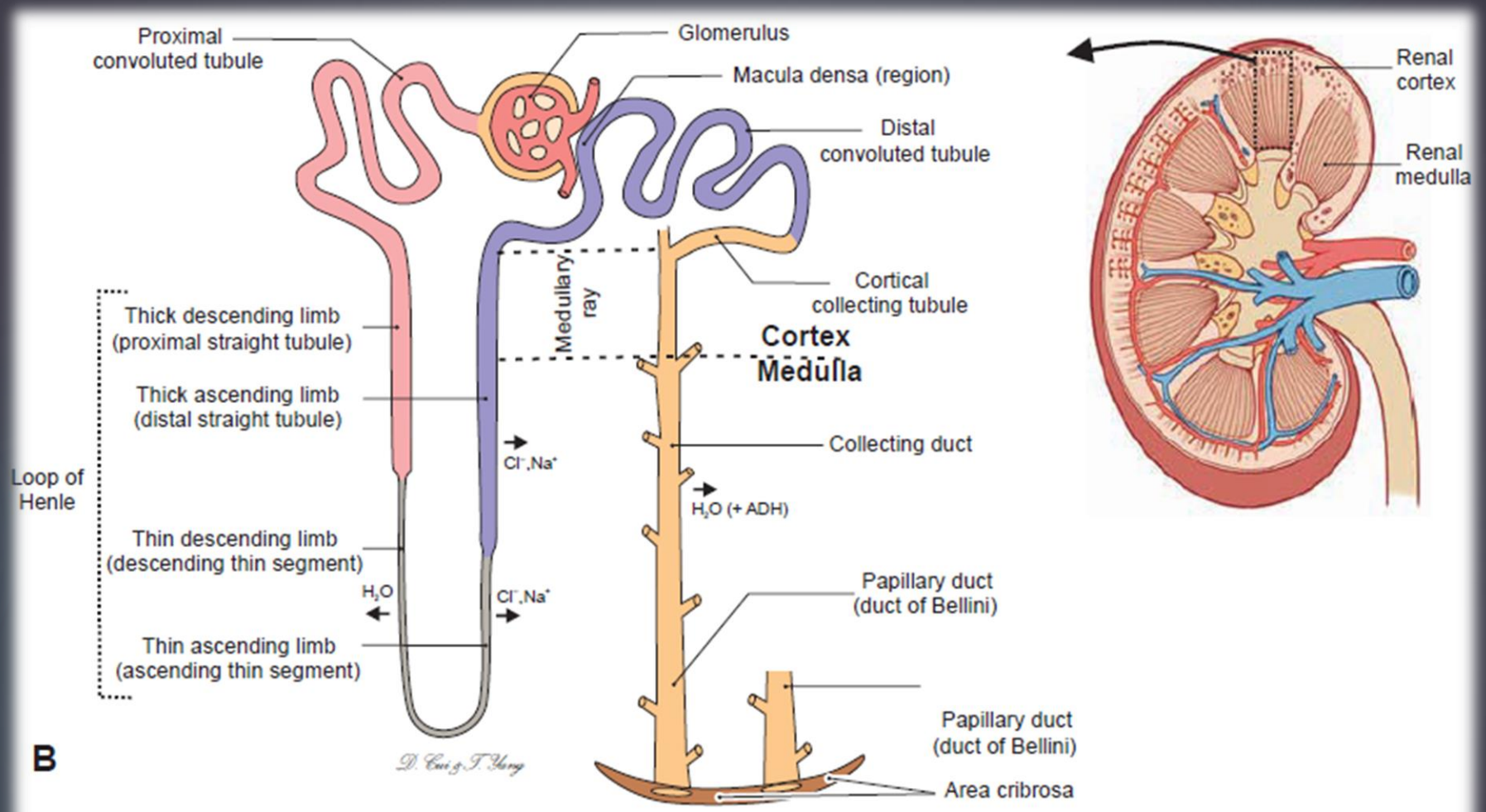
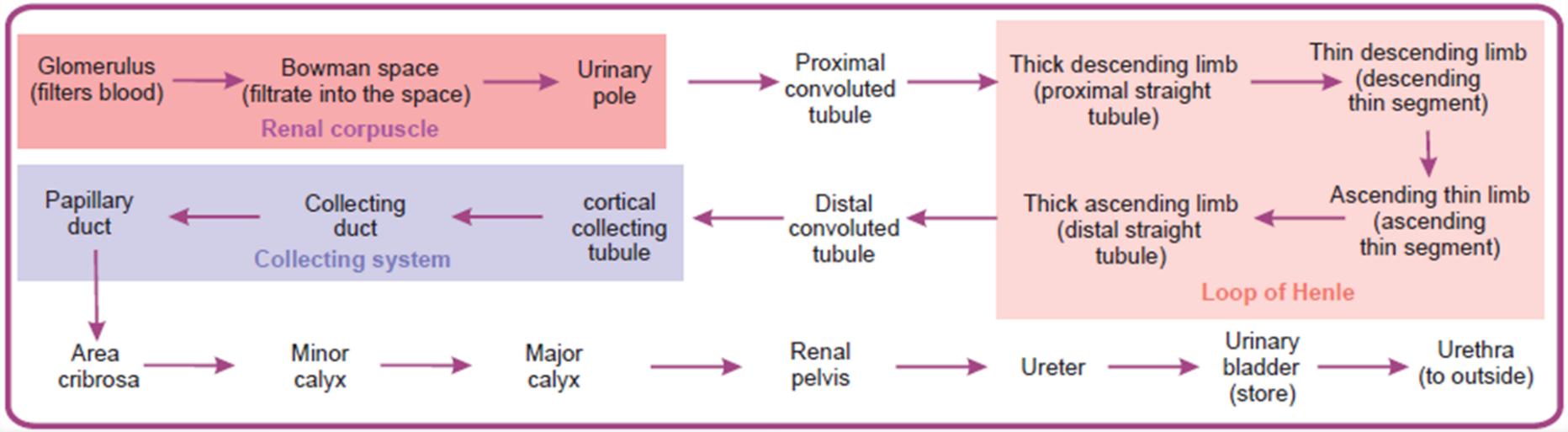


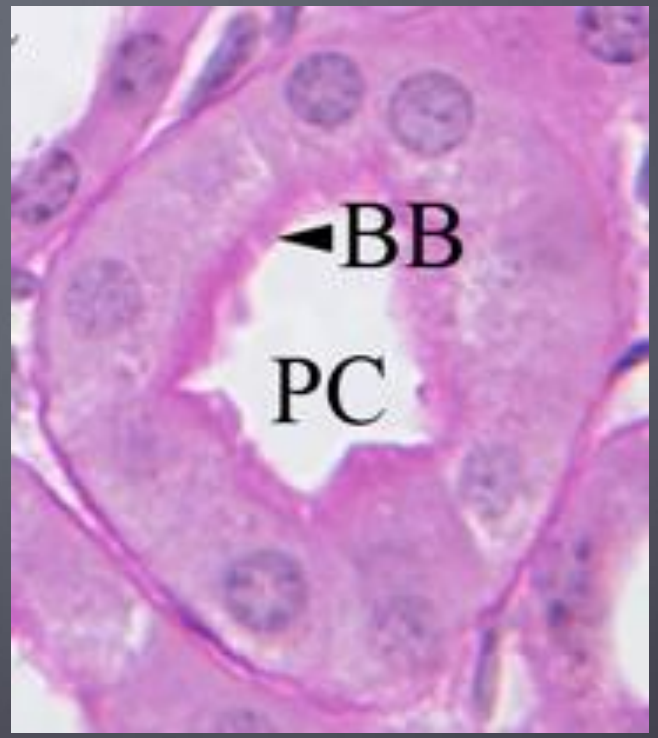
Figure 12-8B. The nephron and collecting system of the kidney.

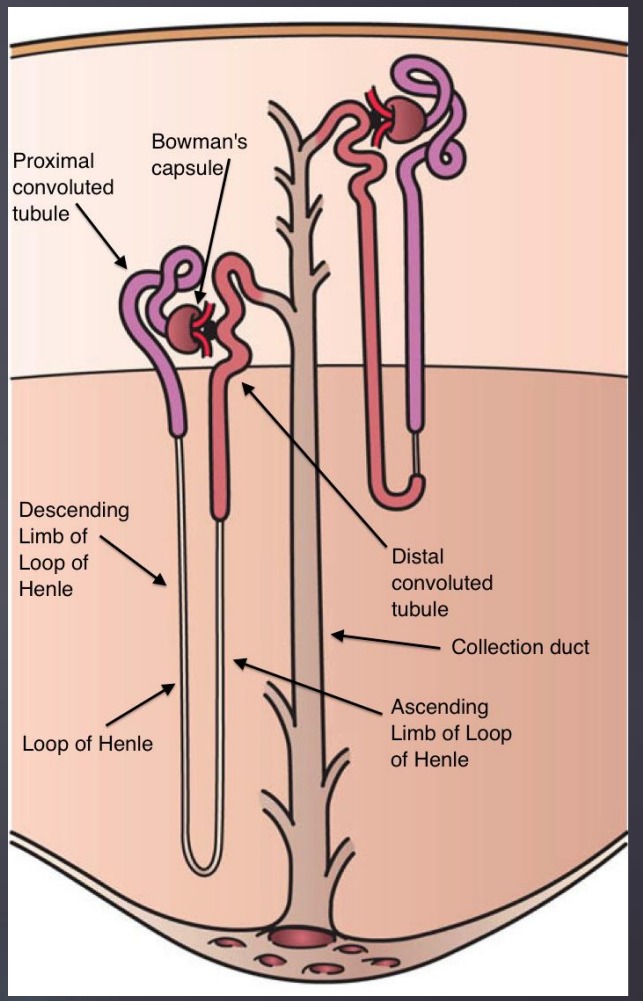
Production and Drainage of Urine



Proximal convoluted tubule

- Reabsorption of water, nutrients and solids (obligatory)
- Lined by simple cuboidal epithithelium resting on a thin b. lamina
- Tubule cells have microvilli on their luminal surfaces (typical brush border)
- Tubule cells appear striated due to numerous basal infoldings & plenty of mitochondria





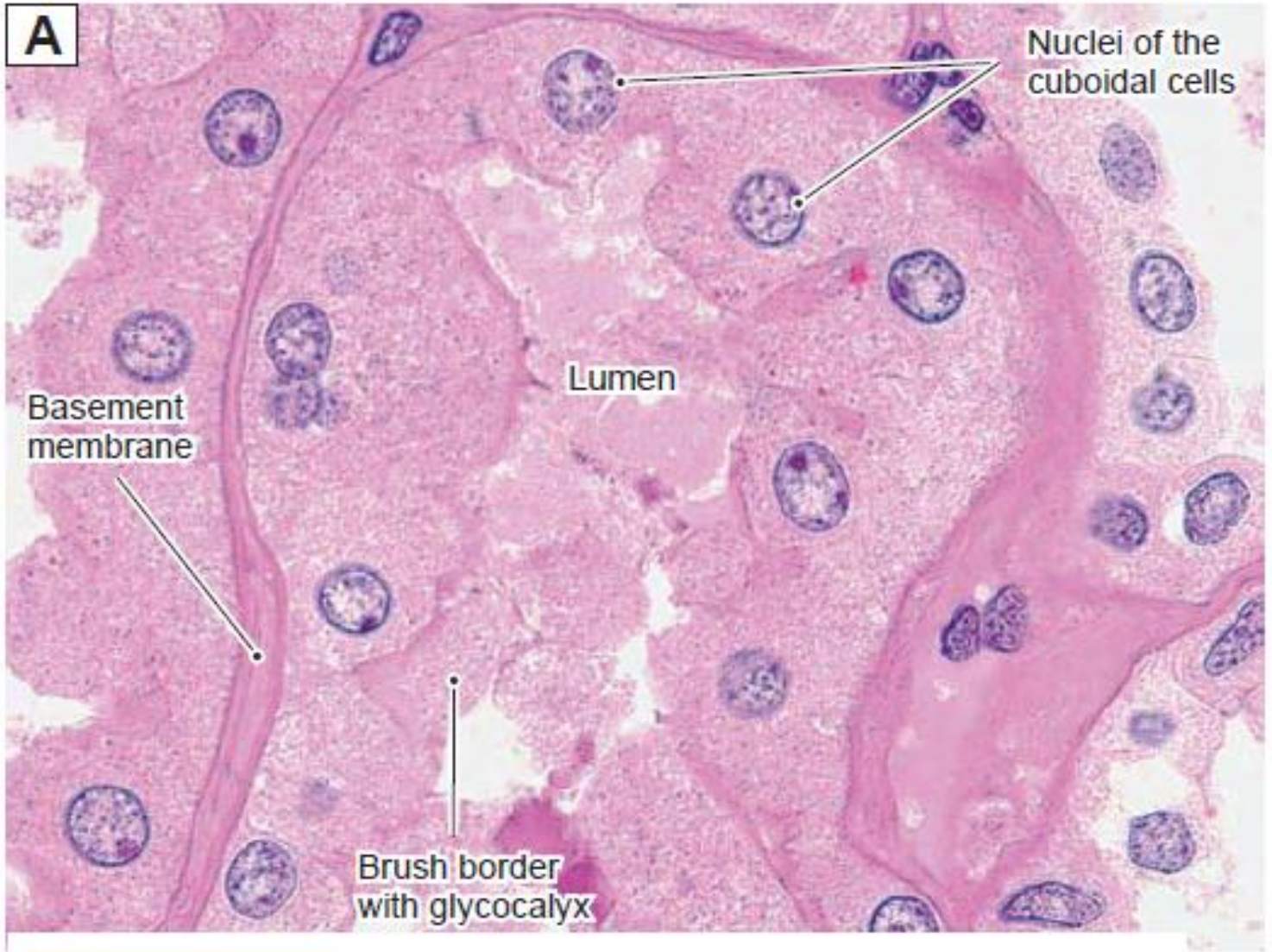


Figure 12-9A. Proximal tubules, renal cortex. H&E, ×754

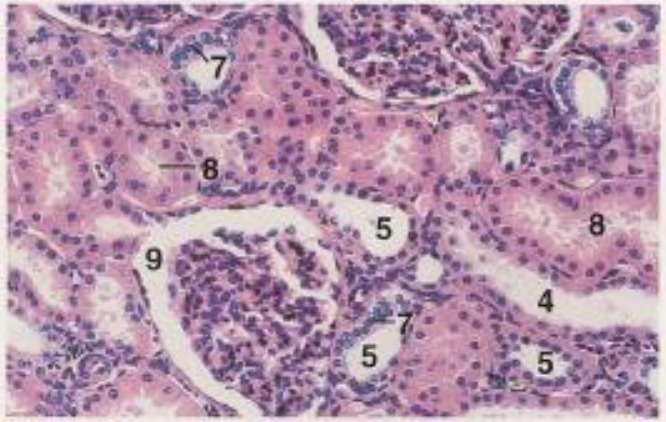


Figure 14.7 ×125

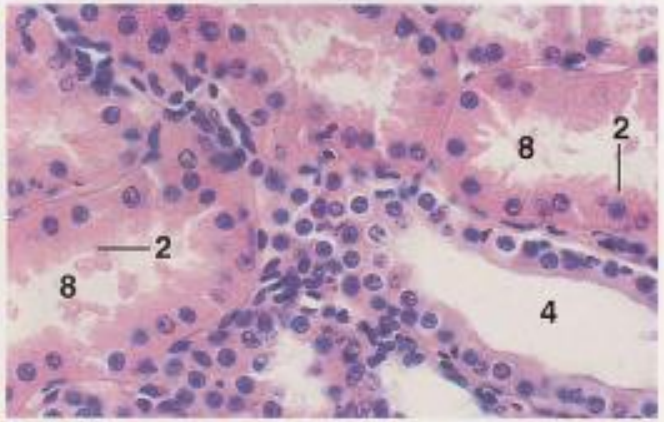


Figure 14.8 ×250

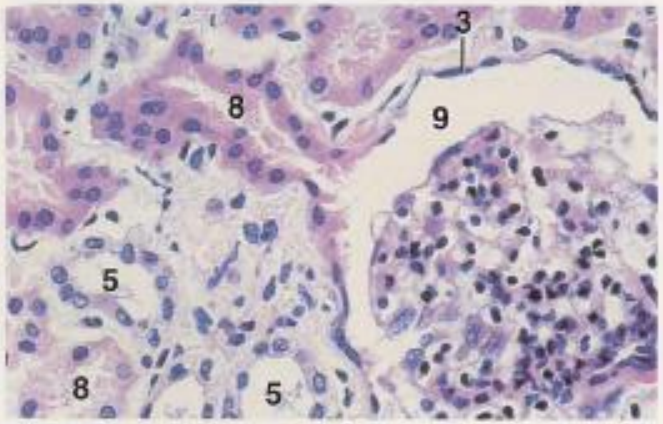


Figure 14.9 ×250

KEY	
1. Afferent arteriole	6. Juxtaglomerular cells
2. Brush border	7. Macula densa
3. Capsular epithelium	8. Proximal convoluted tubule
4. Collecting tubule	9. Urinary space
5. Distal convoluted tubule	

Figure 14.7. Cortex, Kidney, Horse. Portions of three renal corpuscles, each with an accompanying macula densa, are present. In the horse the macula densa commonly consists of a stratified layer of cells.

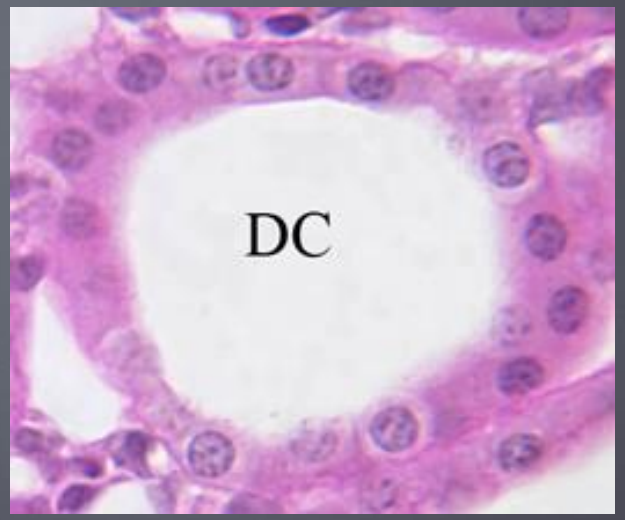
Figure 14.8. Cortex, Kidney, Horse. A collecting tubule with clearly defined cells and a smooth lining can be contrasted with proximal convoluted tubules whose cells possess a brush border of microvilli.

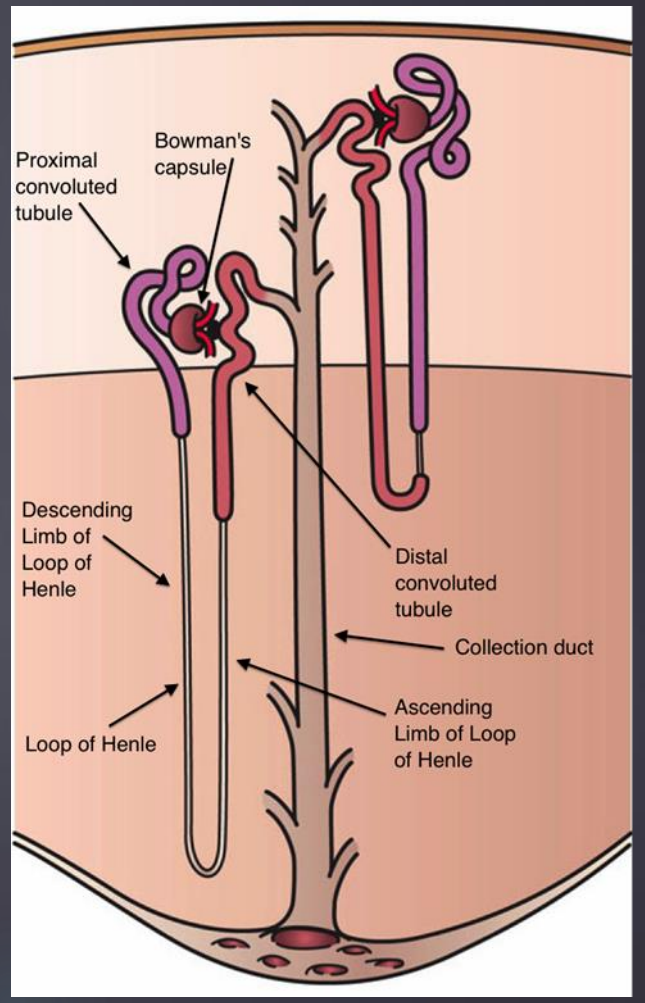
Figure 14.9. Cortex, Kidney, Pig. The junction of a proximal convoluted tubule with the capsule of a renal corpuscle is shown.

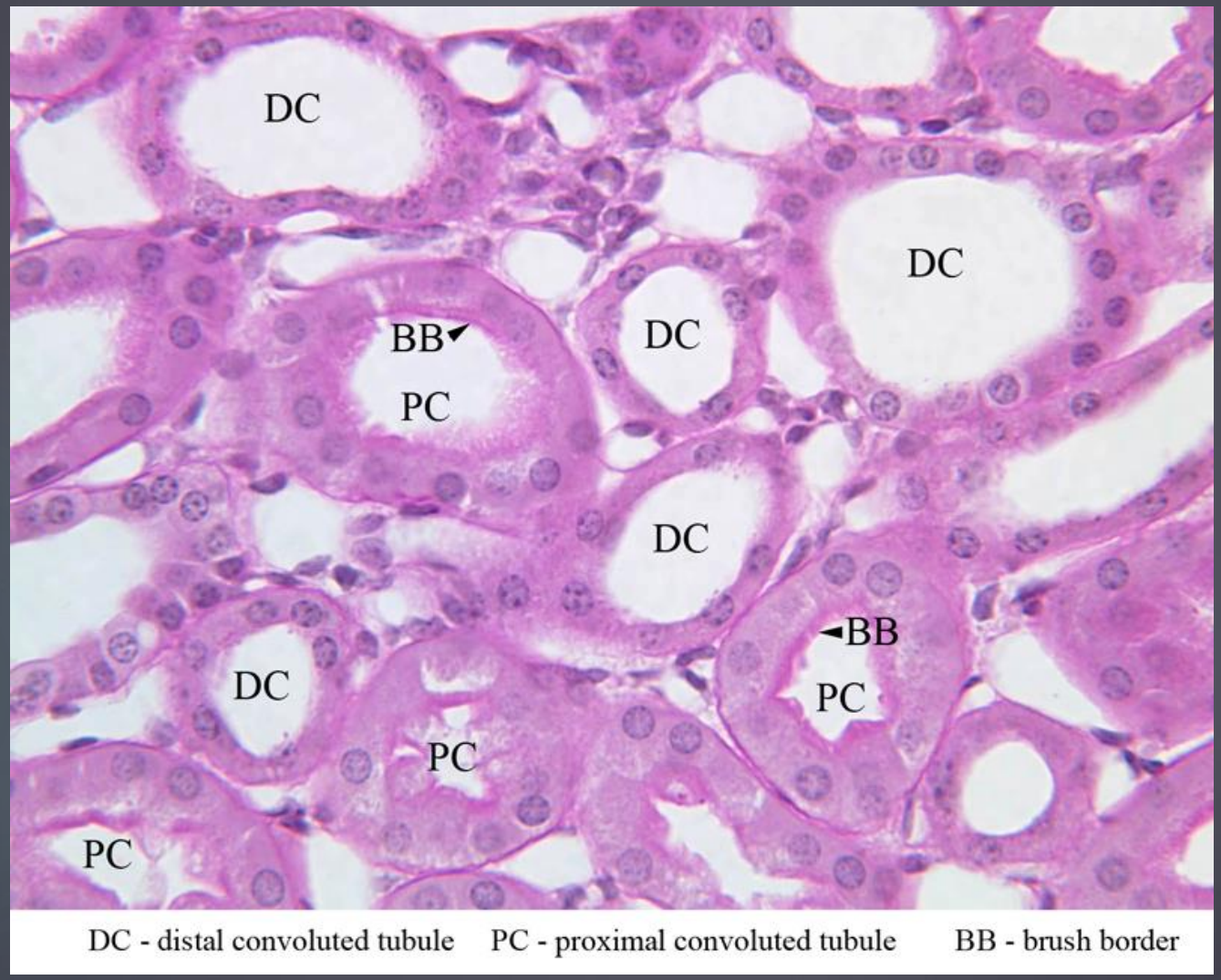
Figure 14.10. Afferent Arteriole, Kidney, Pig. An afferent arteriole, with juxtaglomerular cells, is entering a glomerulus. The juxtaglomerular cells are epithelioid. Note that a macula densa borders the afferent arteriole.

Distal convoluted tubule

- Reabsorbs most of substances contained in ultrafiltrate especially glucosa and amino acids (mainly facultative)
- Reabsorption regulated by ADH and aldosterone
- Continues from the m. loop and extends to collecting tubule within cortex
- Lined by low simple cuboidal epithelium resting on a thin BL
- The cells lack microvilli but are striated, with basal infoldings and but less mitochondria
- Its epithelial cells stain less osmophilic compared to those of PCT






DC
DC
BB
DC
PC
DC
BB
DC
PC
PC
PC
DC - distal convoluted tubule
PC - proximal convoluted tubule
BB - brush border

Juxtaglomerular apparatus

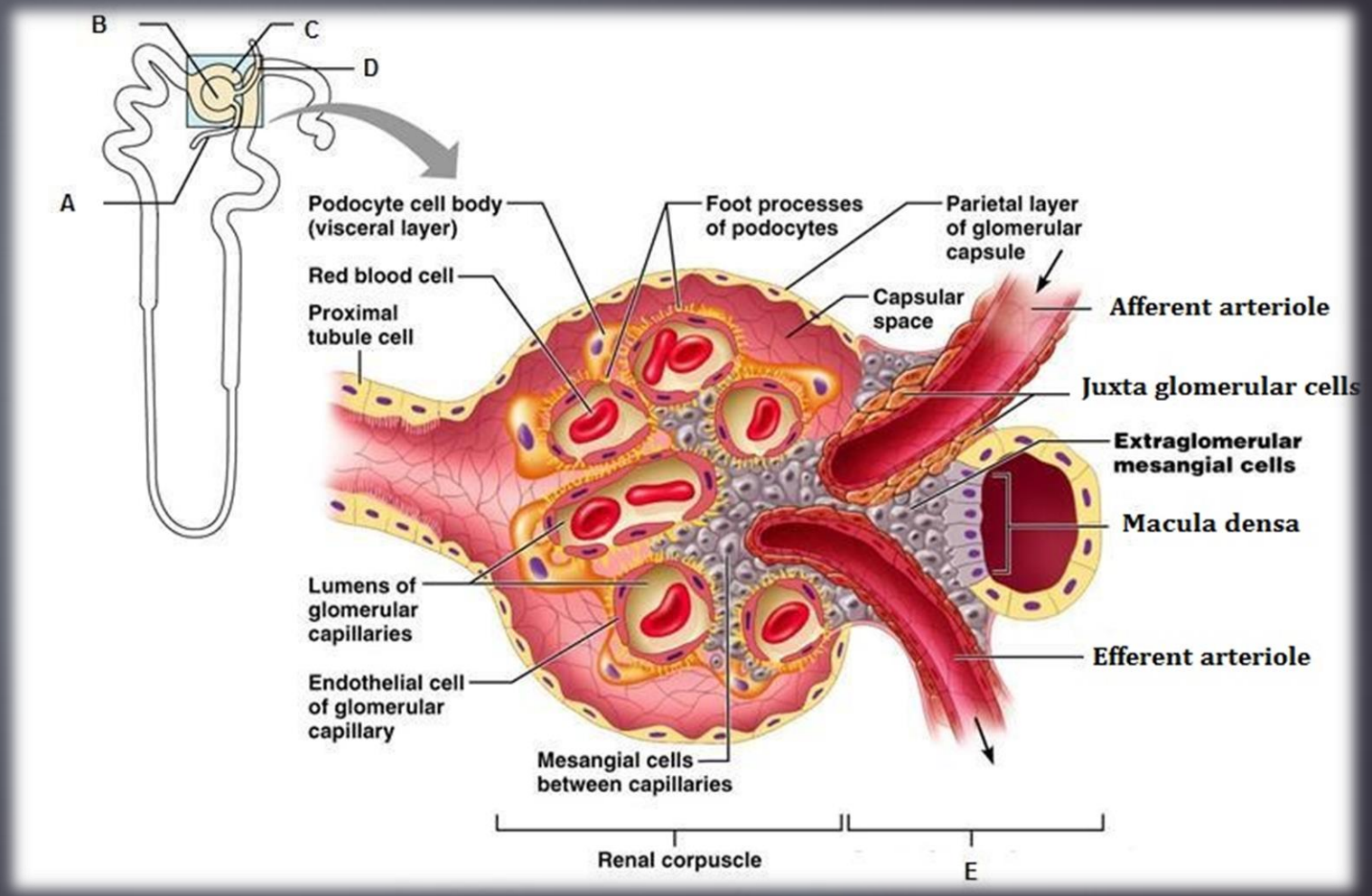
- Formed where the DCT contacts the afferent arteriole of parent r. corpuscle
- Constituted by 3 cell types;

i. macular densa cells of DCT (t. cells that become columnar & closely packed)

ii.Juxtaglomerular cells of afferent arteriole (smooth muscle cells of tunica media that become spherical and contain renin granules)

iii. Extraglomerular mesangial cells (similar to those within glomerulus and surrounded by thick BL)

- Produce renin which converts angiotensinogen to angiotensin, (a vasoconstricter which raises bld pressure thus flow of ultrafiltrate)



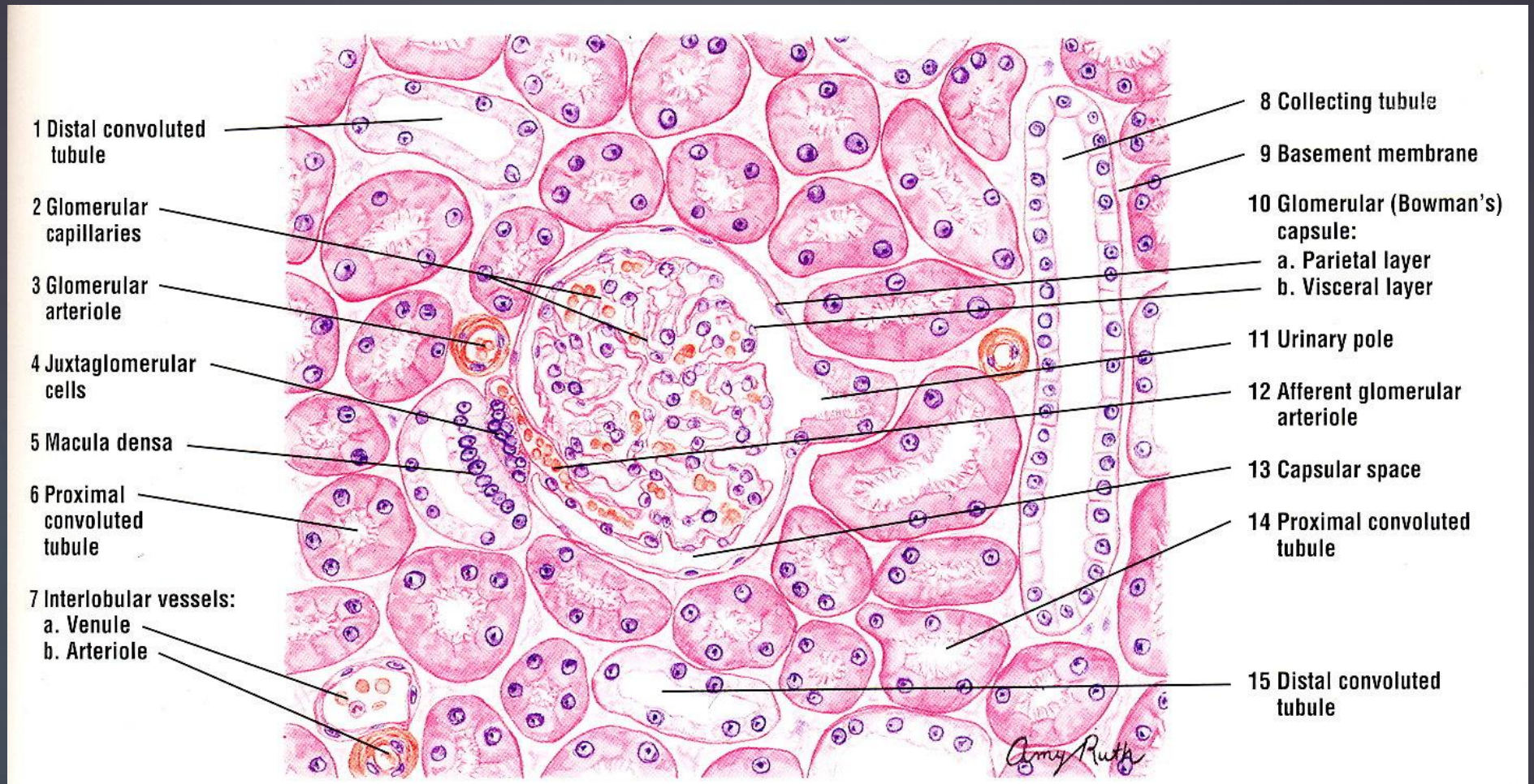
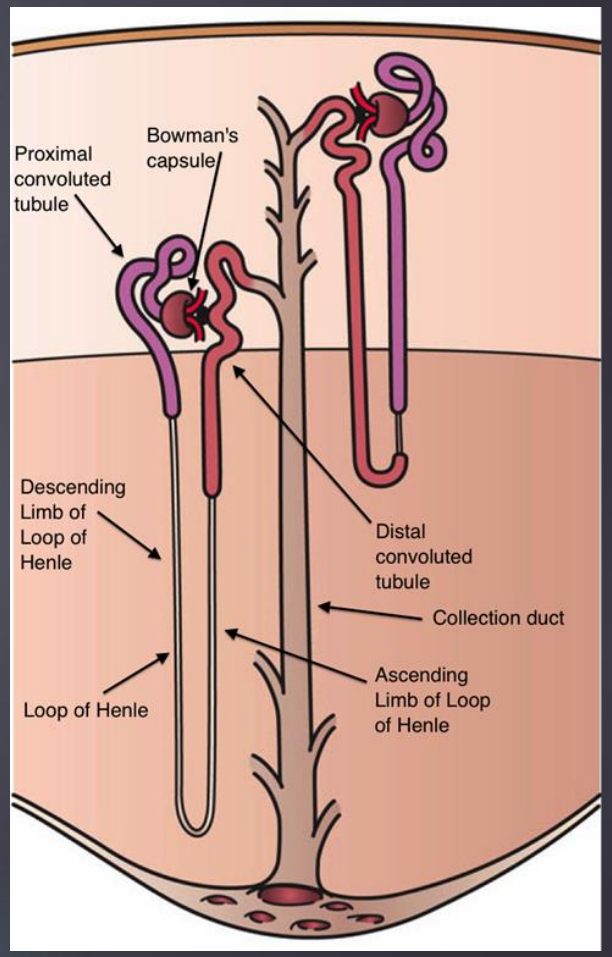
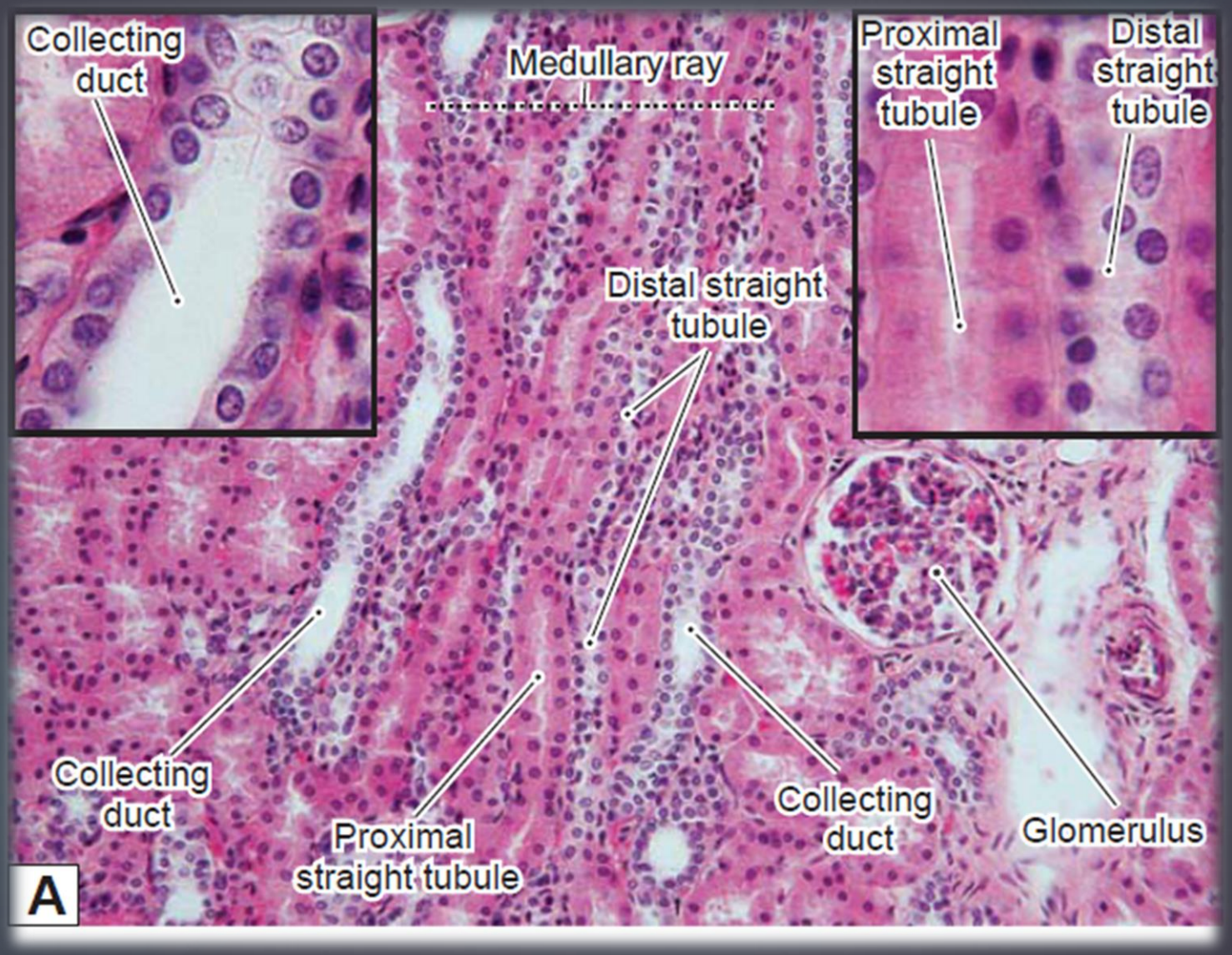


FIGURE 16.3 ■ Kidney cortex: juxtaglomerular apparatus. Stain: periodic acid-Schiff and hematoxylin. Medium magnification.

Loop of Henle

- Functions as a counter-current multiplier system to determines osmolarity of urine; blood flow in the loop is counter to that in medullary vasa recta.
- Extends from corticomedullary junction to medulla
- Consists of an descending limb, a thin segment and a ascending limb
- The thin part is lined by simple squamous epithelium resting on a thin BL; the sq cells sq. cells bulge into the lumen of tubule




Collecting duct
Medullary ray
Proximal straight tubule
Distal straight tubule
Distal straight tubule
Collecting duct
Proximal straight tubule
Collecting duct
Glomerulus
A

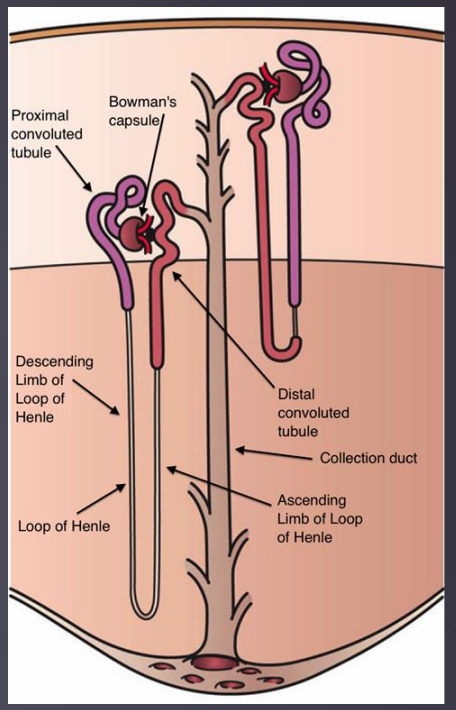
Collecting tubule

- Drain urine from nephron to renal pelvis
- Lie on medullary ray within cortex
- Progressively increase in diameter towards medullar
- In inner medullar, CD from different renal lobes unite to form large papillary ducts, which open into renal pelvis

Drain urine from nephron to r. pelvis
Progressively increase in diameter towards medullar
In inner medullar, unite with other CDs to form large papillary ducts, which open into renal pelvis
CD are lined by epithelium that has 2 cell types

1. collecting duct cells – cuboidal in cortical part, columnar in medullary
2. intercalated /dark cells- resemble those of DCT but bulge into lumen of the CD

Both cell types rest on a thin BM and lack basal infoldings
Permeability of CD to water and ions is regulated by ADH



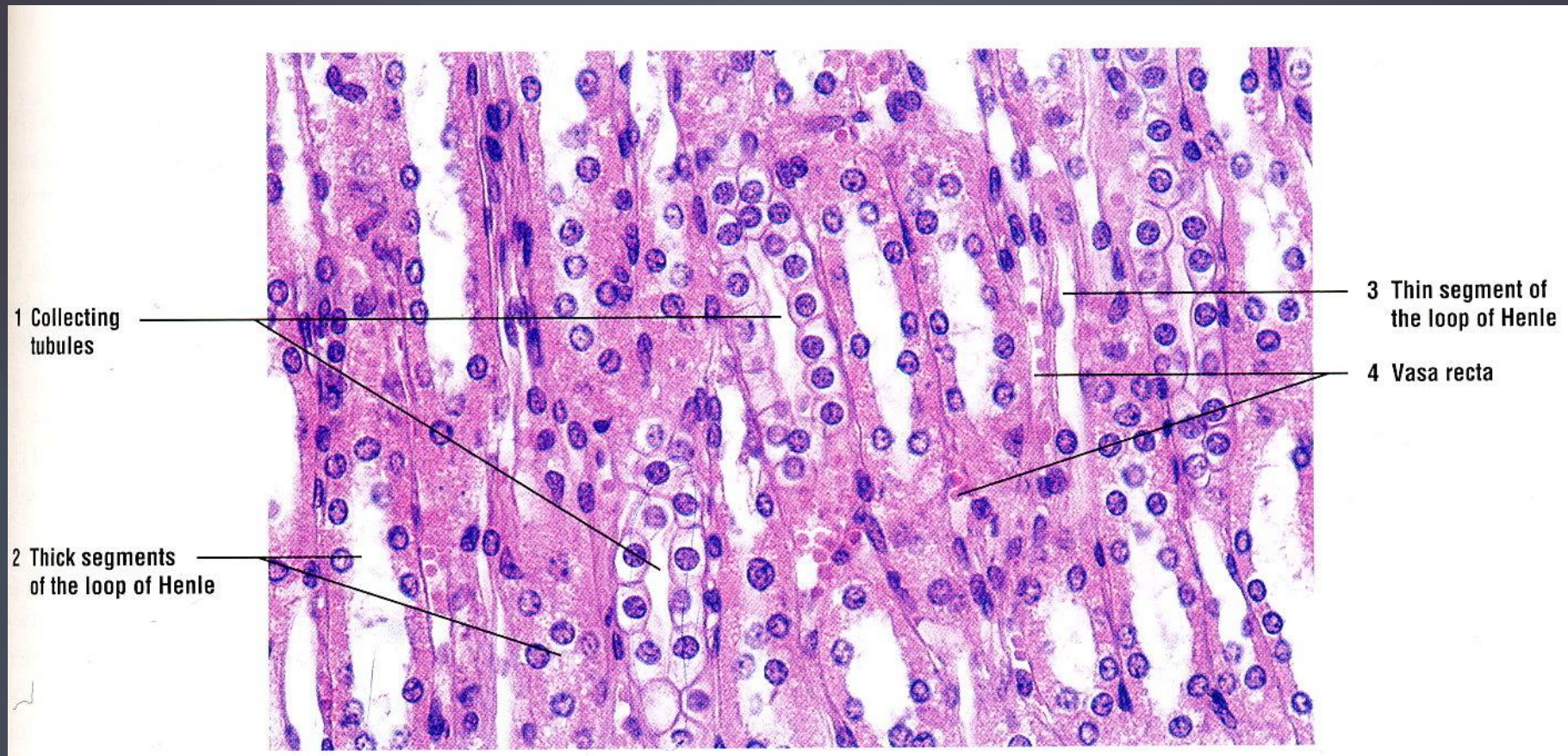


FIGURE 16.7 ■ Kidney: ducts of the medullary region (longitudinal section). Stain: hematoxylin and eosin. 130×

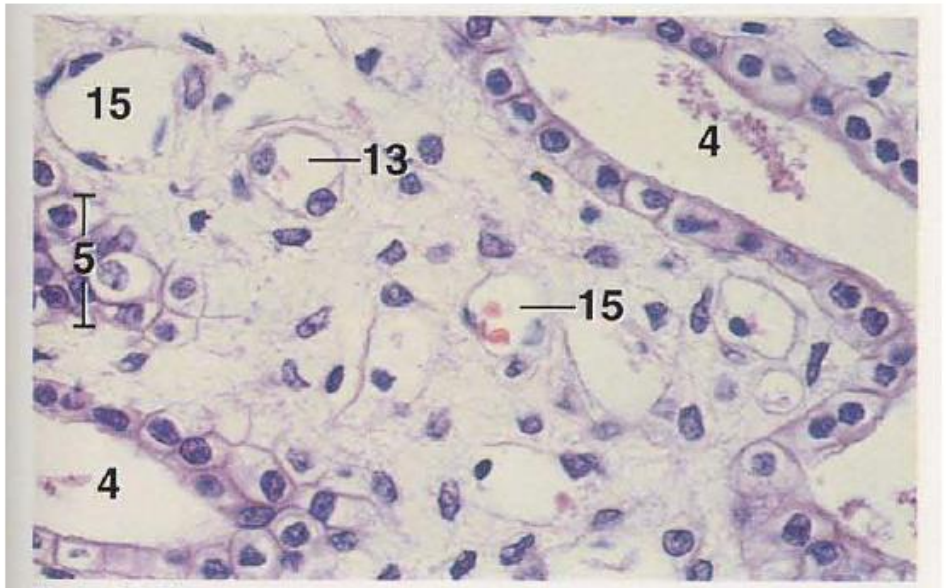


Figure 14.14 ×250

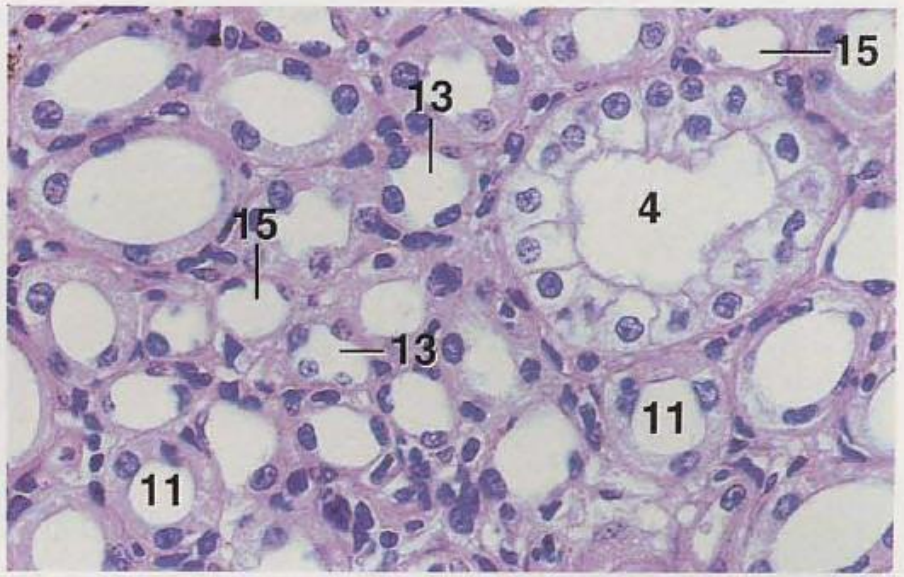


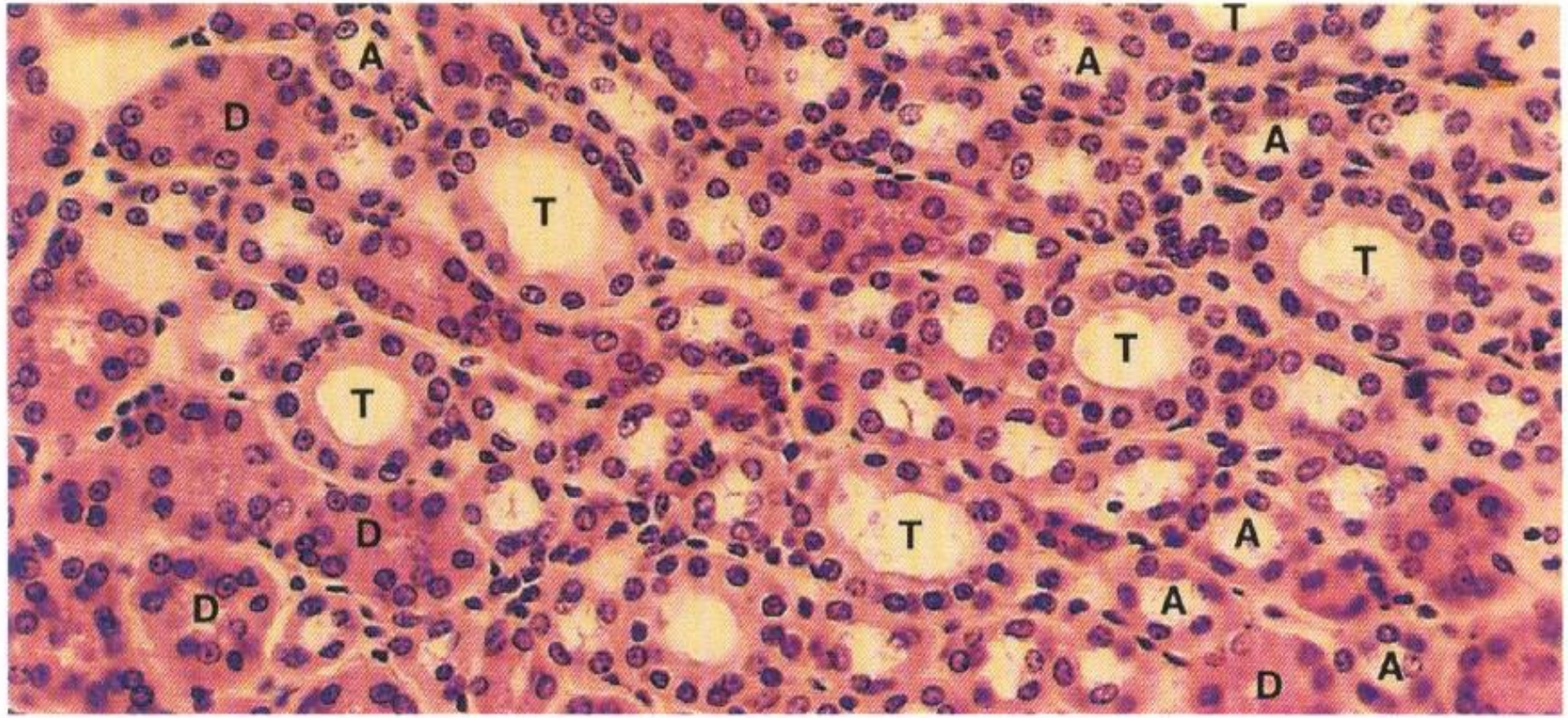
Figure 14.15 ×250

Figure 14.14. Medulla, Kidney, Dog. Nuclei of the cells lining the thin segment of Henle's loop are rounded; those of endothelial cells of the vasa recta are flattened and more darkly stained.

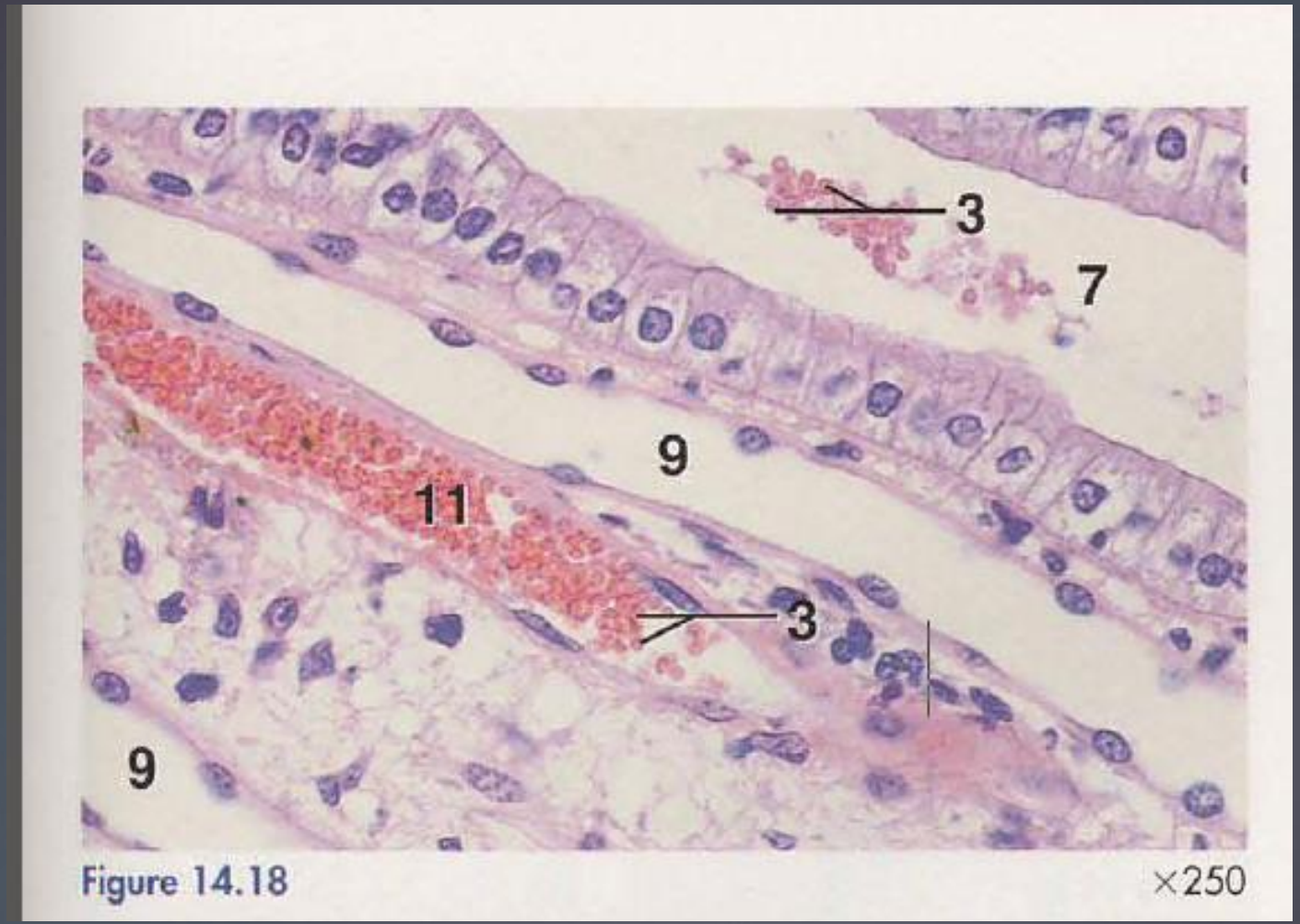
Figure 14.15. Medulla, Kidney, Horse. Various portions of uriniferous tubules appear in transverse section.

KEY

1. Adipose tissue
2. Afferent arteriole
3. Cavity of renal pelvis
4. Collecting tubule
5. Collecting tubule, surface cut
6. Efferent arteriole
7. Macula densa
8. Papillary duct
9. Proximal convoluted tubule
10. Renal papilla
11. Thick ascending, Henle's loop
12. Thick descending, Henle's loop
13. Thin segment, Henle's loop
14. Urinary space
15. Vasa recta

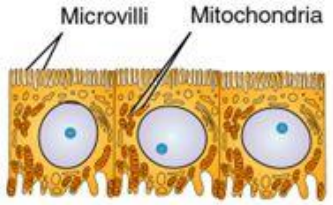


A : Thick Ascending D : Thick Descending T : Collecting tubule



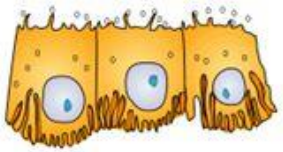
9 : Thin Segment of Henle loop

Histology of Renal Tubule & Collecting Duct

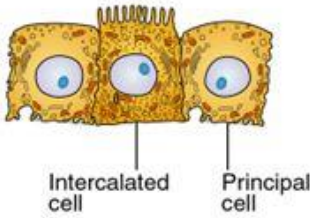


(a) Proximal convoluted tubule cells


(b) Loop of Henle cells: descending limb and thin ascending limb

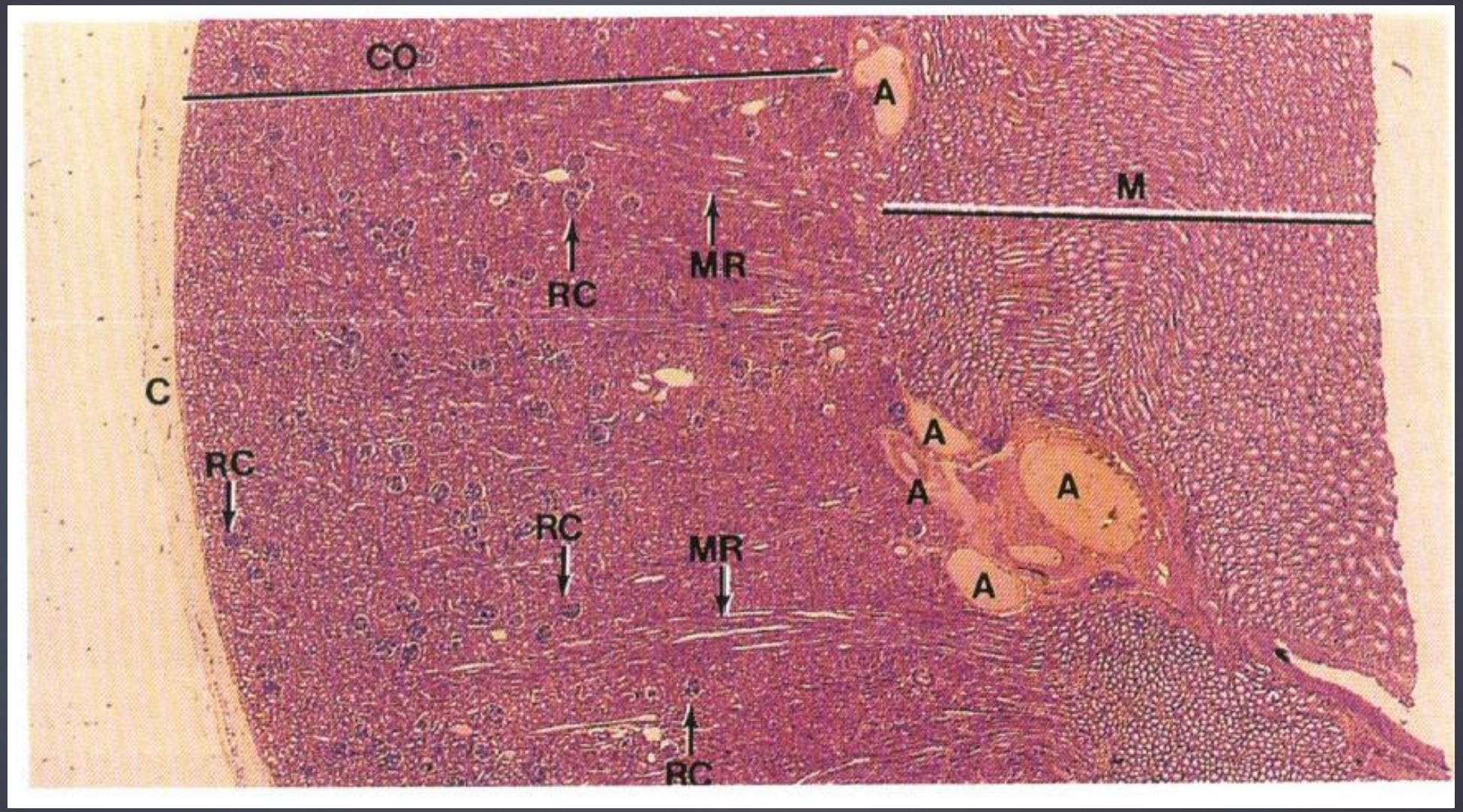

(c) Loop of Henle cells: thick ascending limb


(d) Distal convoluted tubule cells



(e) Collecting duct cells

- Proximal convoluted tubule
  - simple cuboidal with brush border of microvilli that increase surface area
- Descending limb of loop of Henle
  - simple squamous
- Ascending limb of loop of Henle
  - simple cuboidal to low columnar
  - forms juxtaglomerular apparatus where makes contact with afferent arteriole
    - macula densa is special part of ascending limb
- Distal convoluted & collecting ducts
  - simple cuboidal composed of principal & intercalated cells which have microvilli


CO
A
M
RC
MR
C
RC
A
A
A
A
RC
MR
RC

URETER

- Conducts urine from kidney to bladder
- Has 3 tissue layers

1. Tunica mucosa; lined by 5-6 cell layer of transitional epith that rests on lamina propria of loose c. tissue having bld vessels, lymphatics and with tubular mucus glands in the equidae
2. T. muscularis; has inner and outer longitudinal and middle circular layer of smooth muscles
3. T. serosa/ adventitia

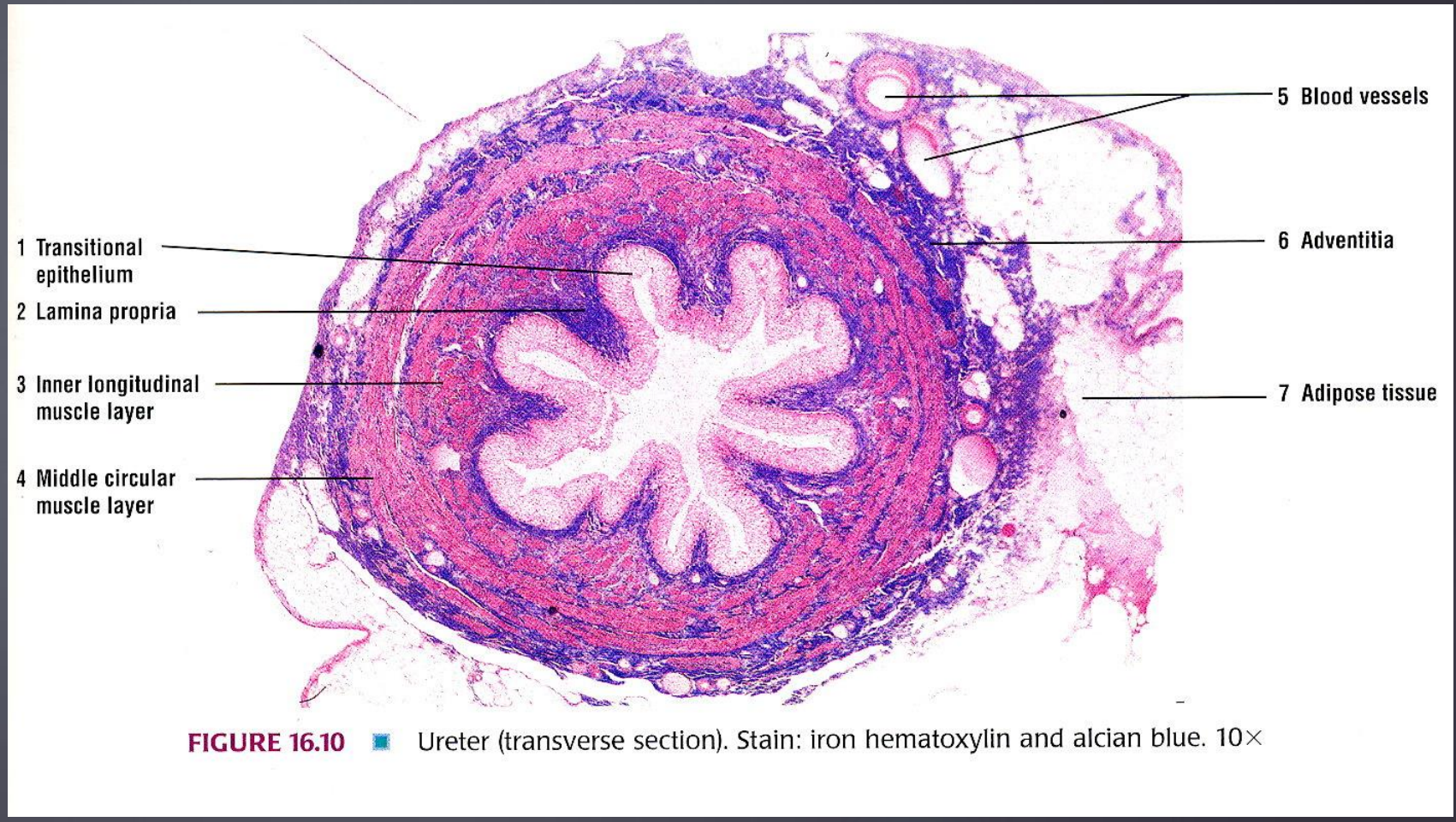


FIGURE 16.10 Ureter (transverse section). Stain: iron hematoxylin and alcian blue. 10×

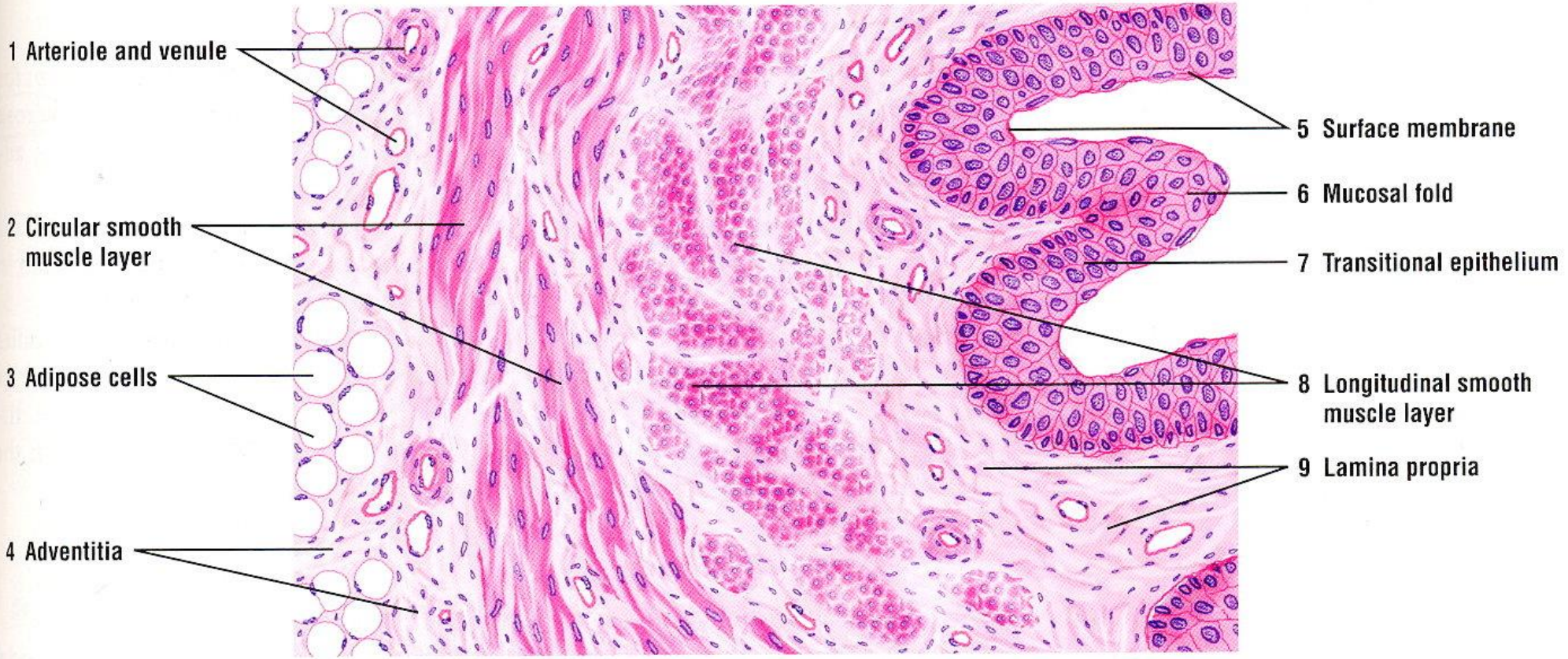
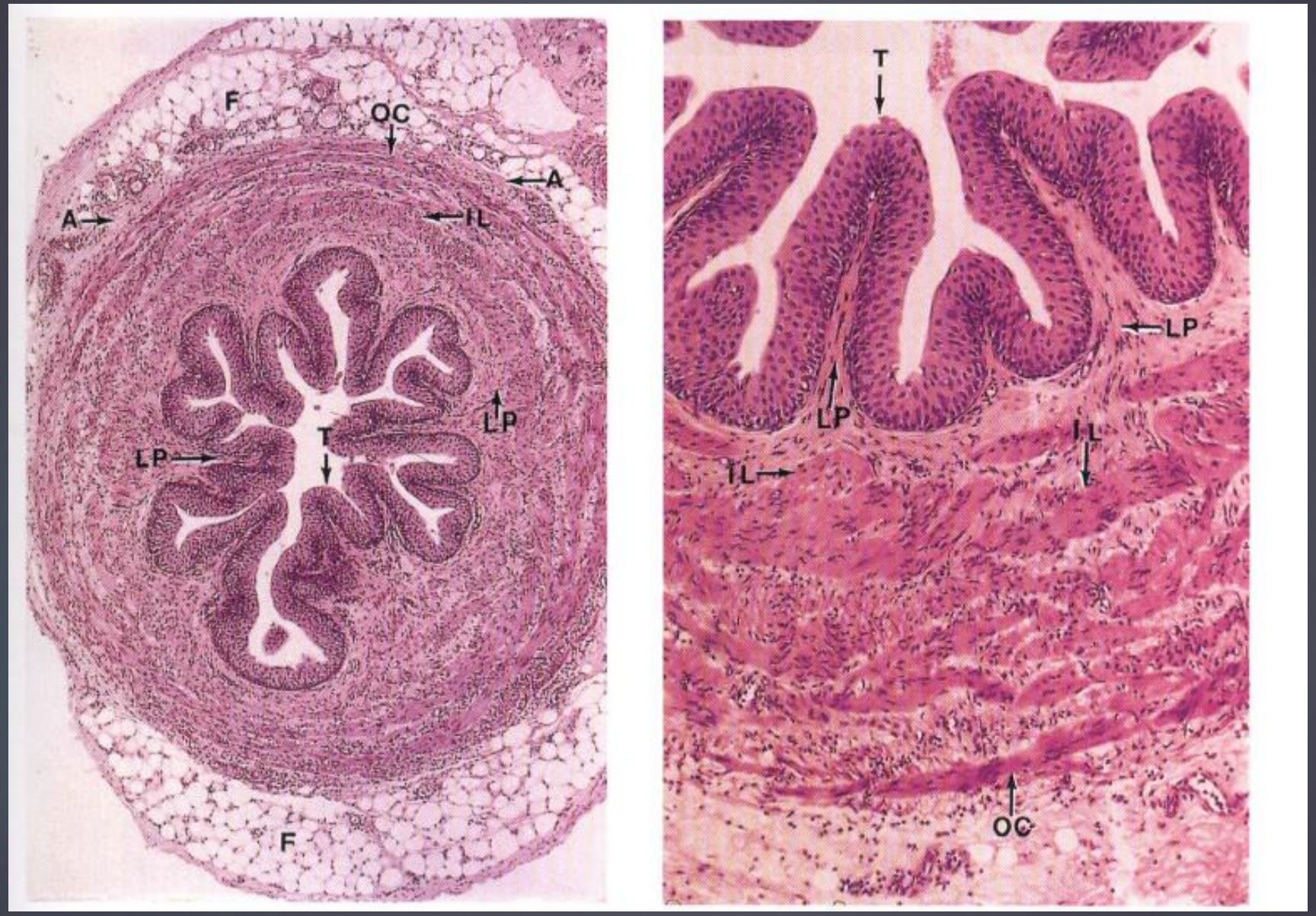
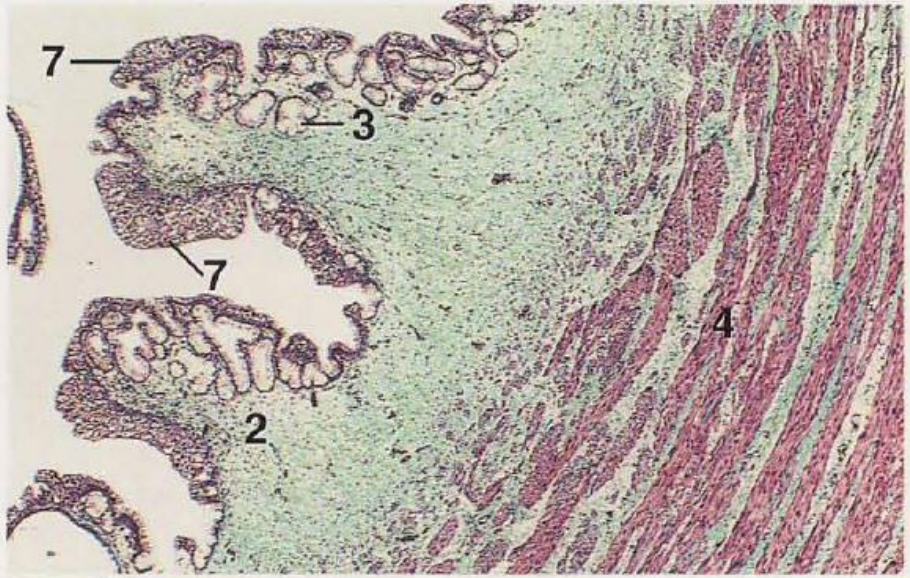
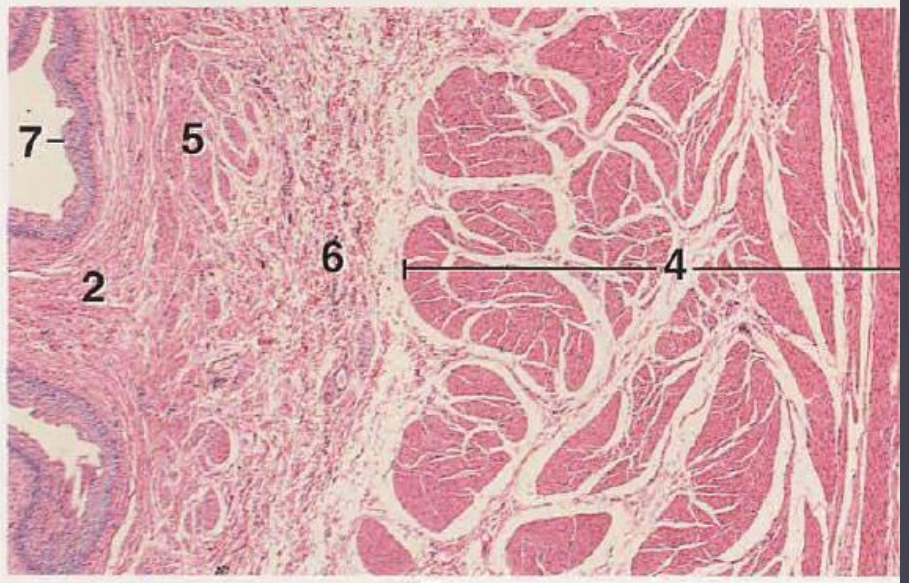


FIGURE 16.9 ■ Section of a ureter wall (transverse section). Stain: hematoxylin and eosin. Medium magnification.


F
OC
A
A
IL
LP
T
LP
LP
F
T
LP
LP
IL
IL
OC





KEY

1. Capillary
2. Lamina propria
3. Mucous gland
4. Muscularis
5. Muscularis mucosae
6. Submucosa
7. Transitional epithelium

Ureter in Horse

Bladder in Cow

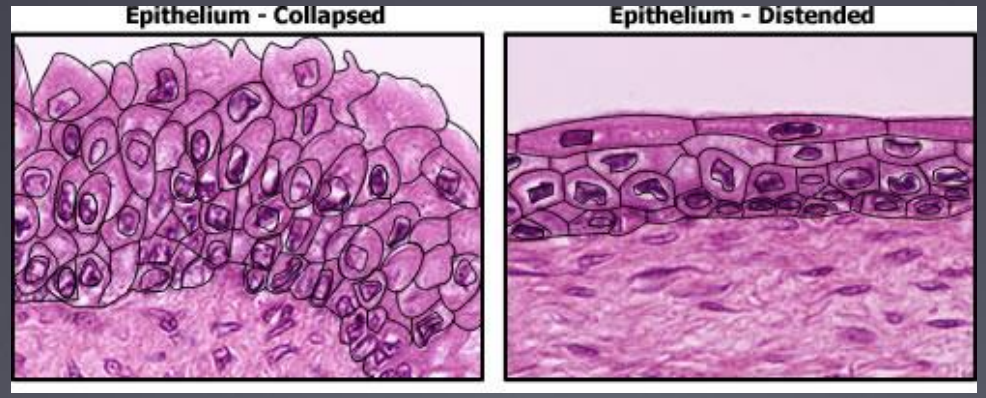
Urinary bladder

- Its wall has 4 tissue layers;-

1. Tunica mucosa; lined by transitional epith. that rests on lamina propria of loose c. tissue
2. T. submucosa; highly vascular and rich in elastic fibers
3. T. muscularis; has inner and outer longitudinal and middle layer of smooth muscles (dextruser muscles)
4. T. serosa/ adventitia

- The longi muscles form sphincters at ureterovesicular junction to prevent backflow of urine and at neck of bladder to regulate urine emptying

FIGURE 16.11 ■ Urinary bladder: wall (transverse section). Stain: hematoxylin and eosin. Low magnification.



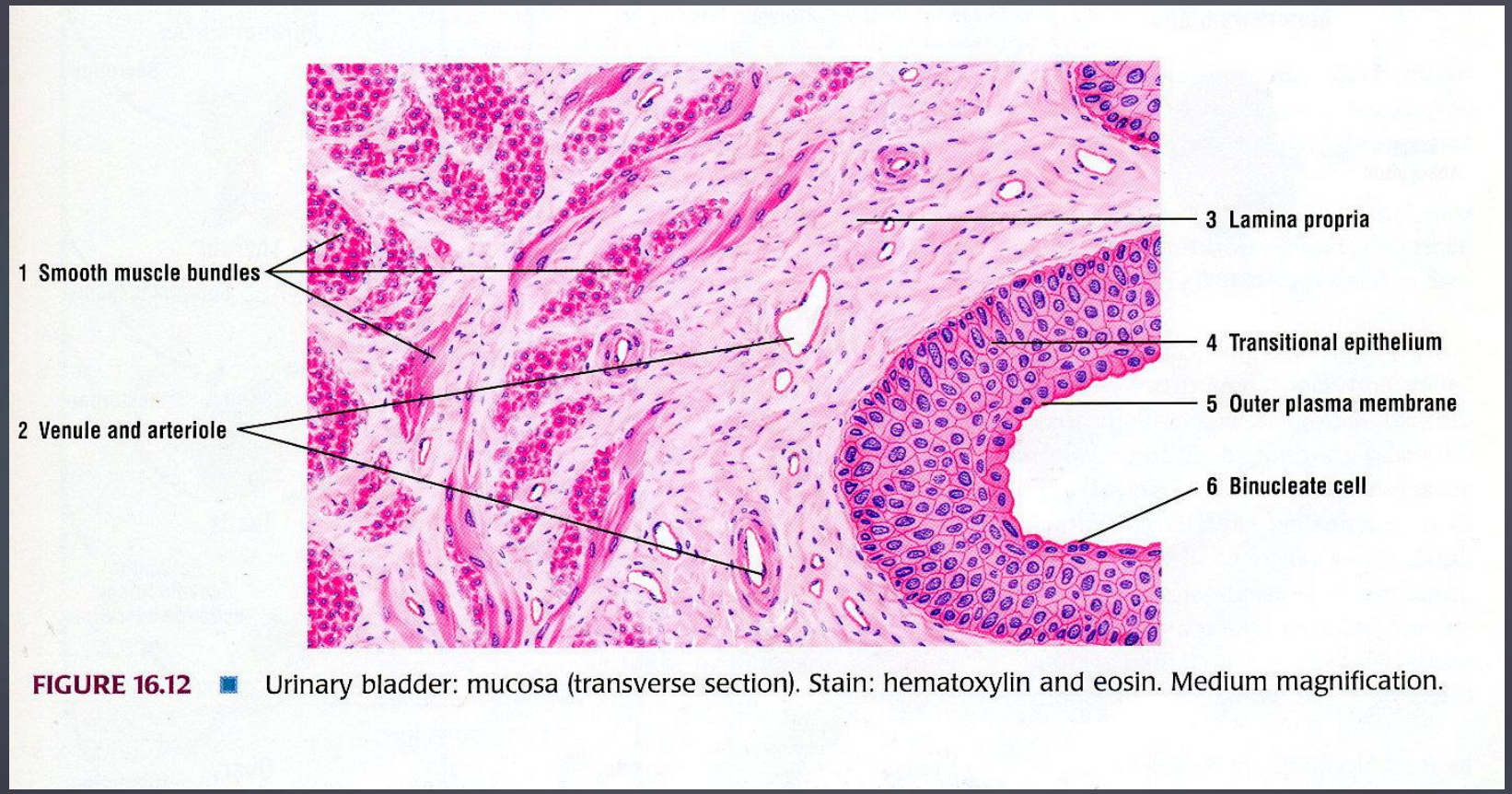
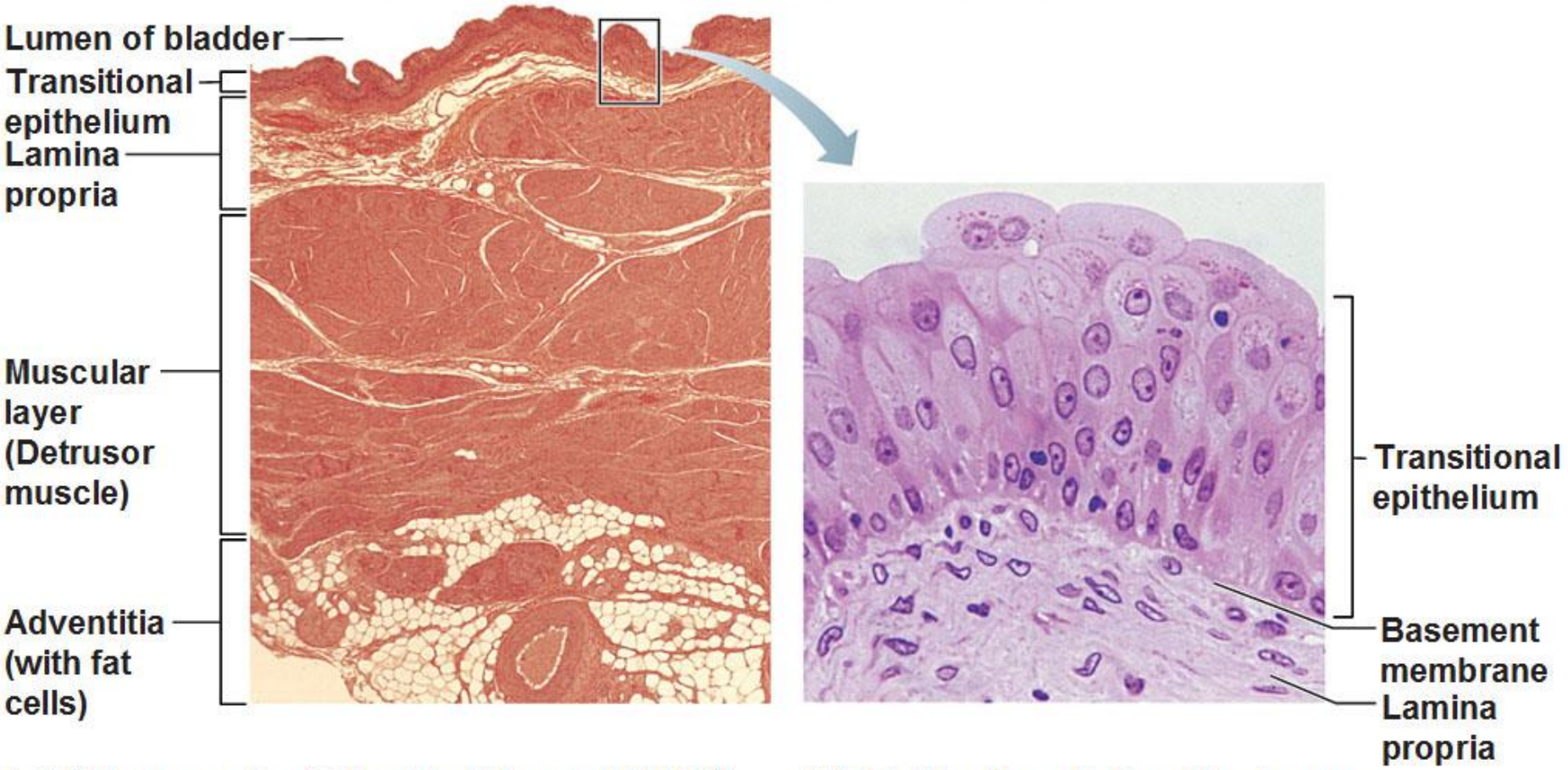


FIGURE 16.12 ■ Urinary bladder: mucosa (transverse section). Stain: hematoxylin and eosin. Medium magnification.

Histology of the Urinary Bladder



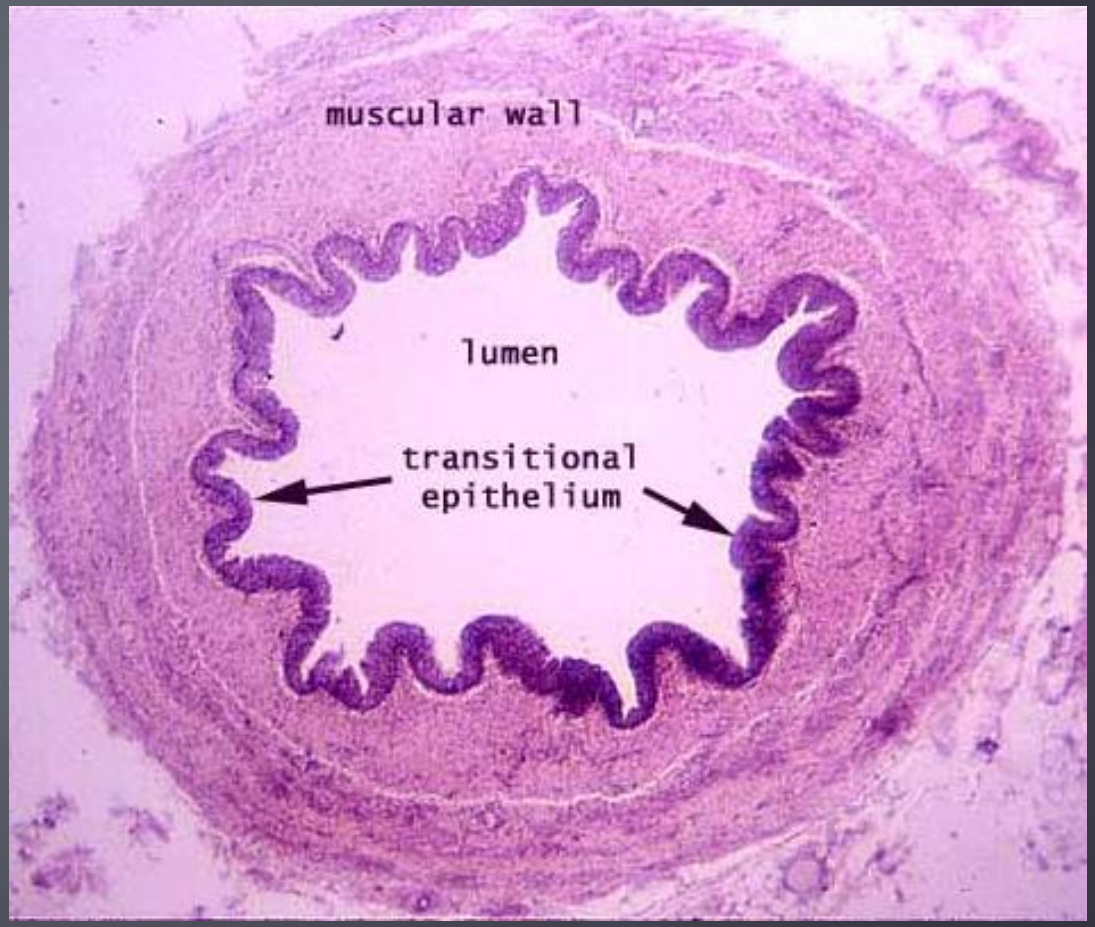
(a) Micrograph of the bladder wall (17X)

(b) Epithelium lining the lumen of the bladder (360X)

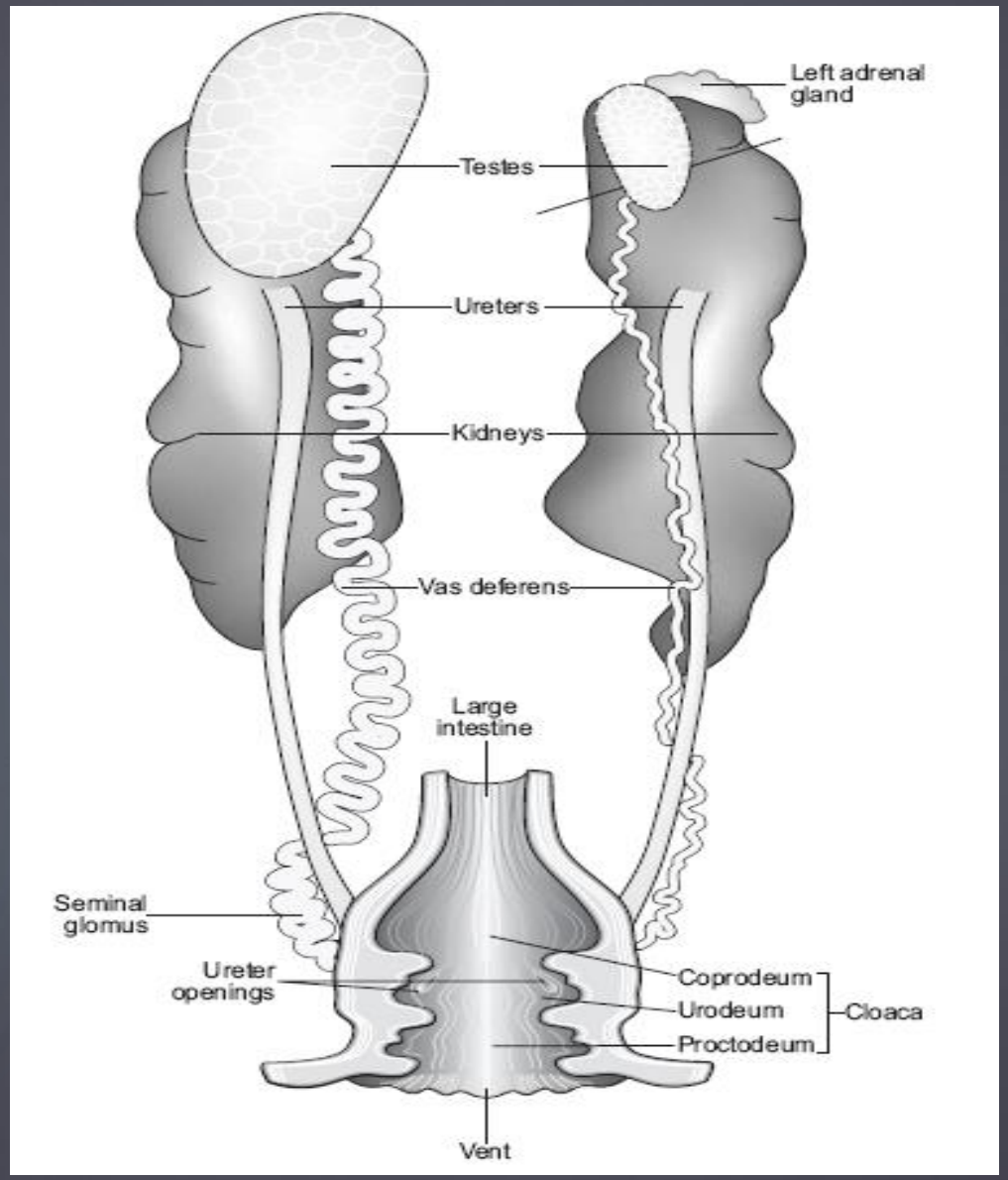
Urethra

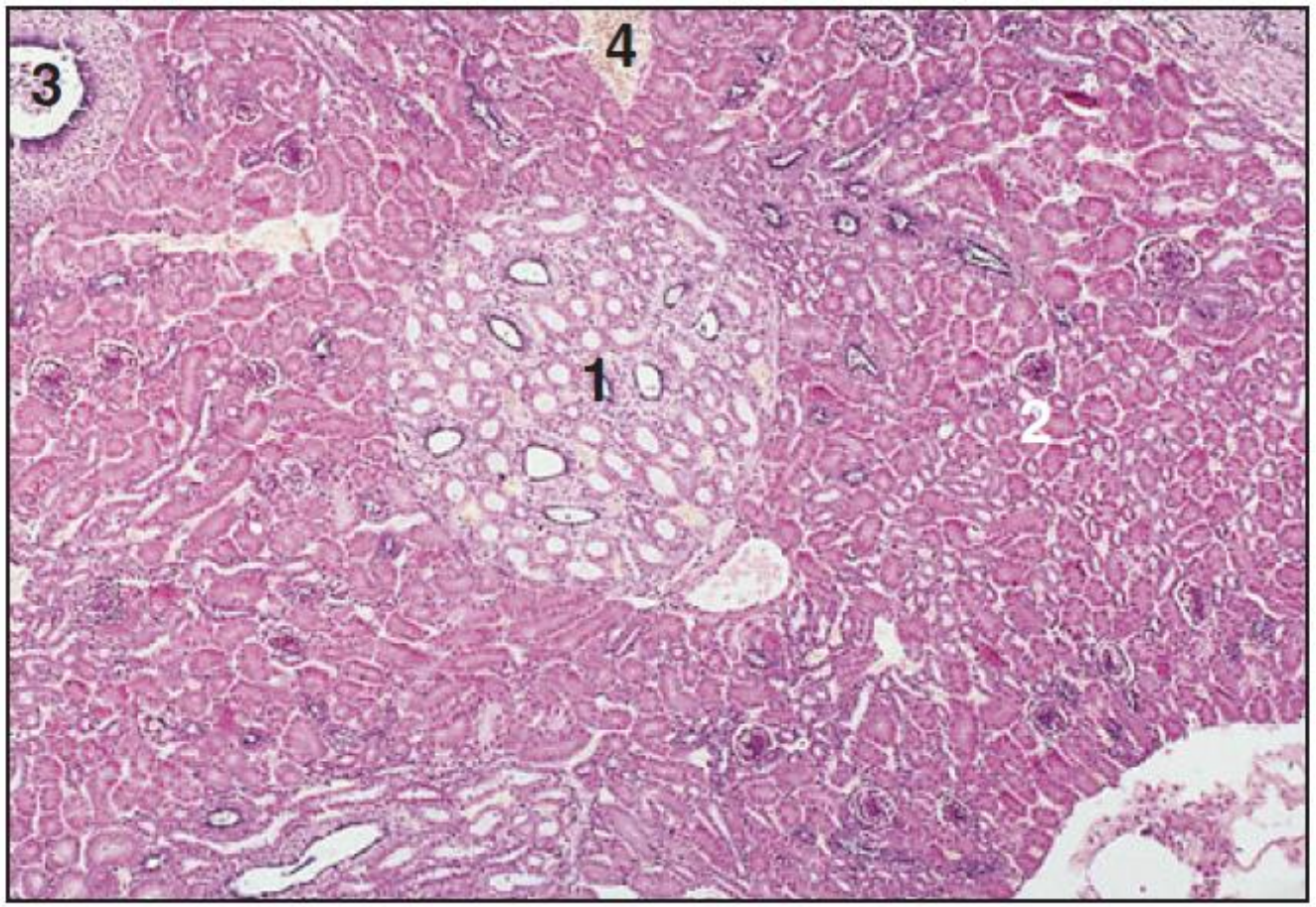
- Its wall has 4 tissue layers

1. Tunica mucosa; epith transitional but changes to stratified squamous at external urethral orifice
2. T. submucosa; has cavernous tissue spaces that are typical of erectile tissue
3. T. muscularis; has inner and outer longi and middle layer of smooth muscles as in bladder but towards external urethral orifice, it acquires an external layer of skeletal muscle called striated urethralis muscle
4. T. serosa/ adventitia



Avian urinary system





9.18 Kidney (bird). (1) The central, pale staining medullary area is surrounded by (2) the much denser staining cortical area. (3) Lobar duct. (4) Renal vein. H & E. ×25.

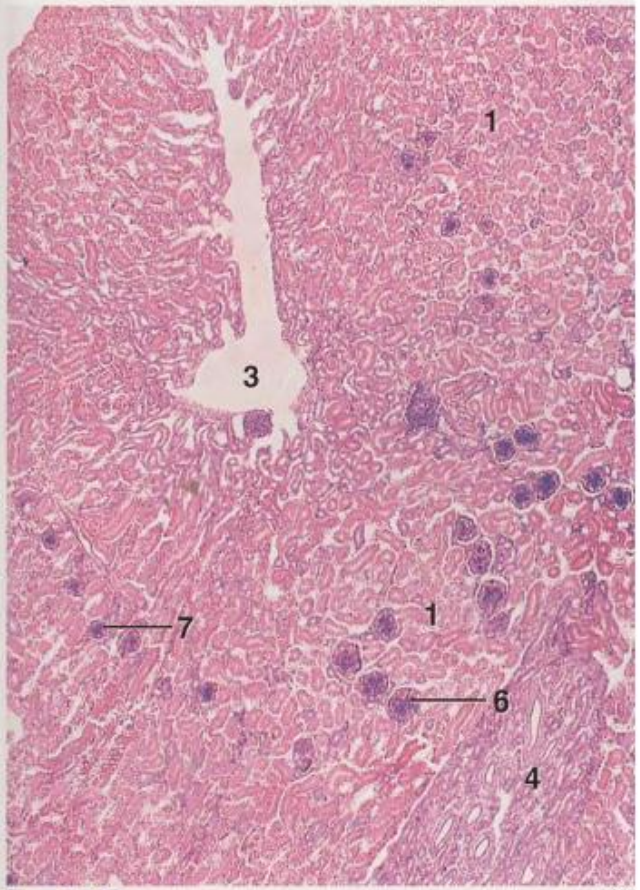


Figure 14.27 ×36

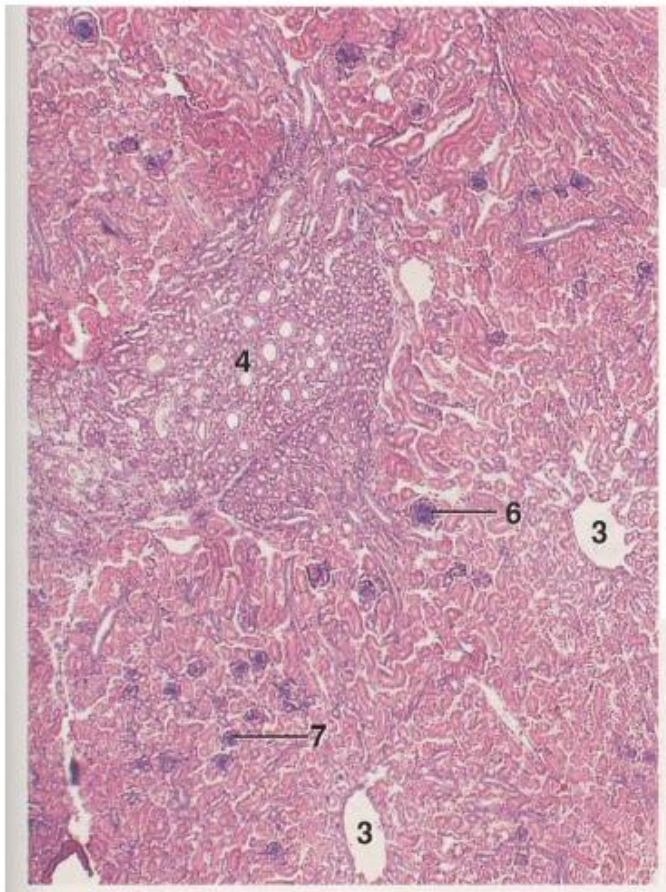
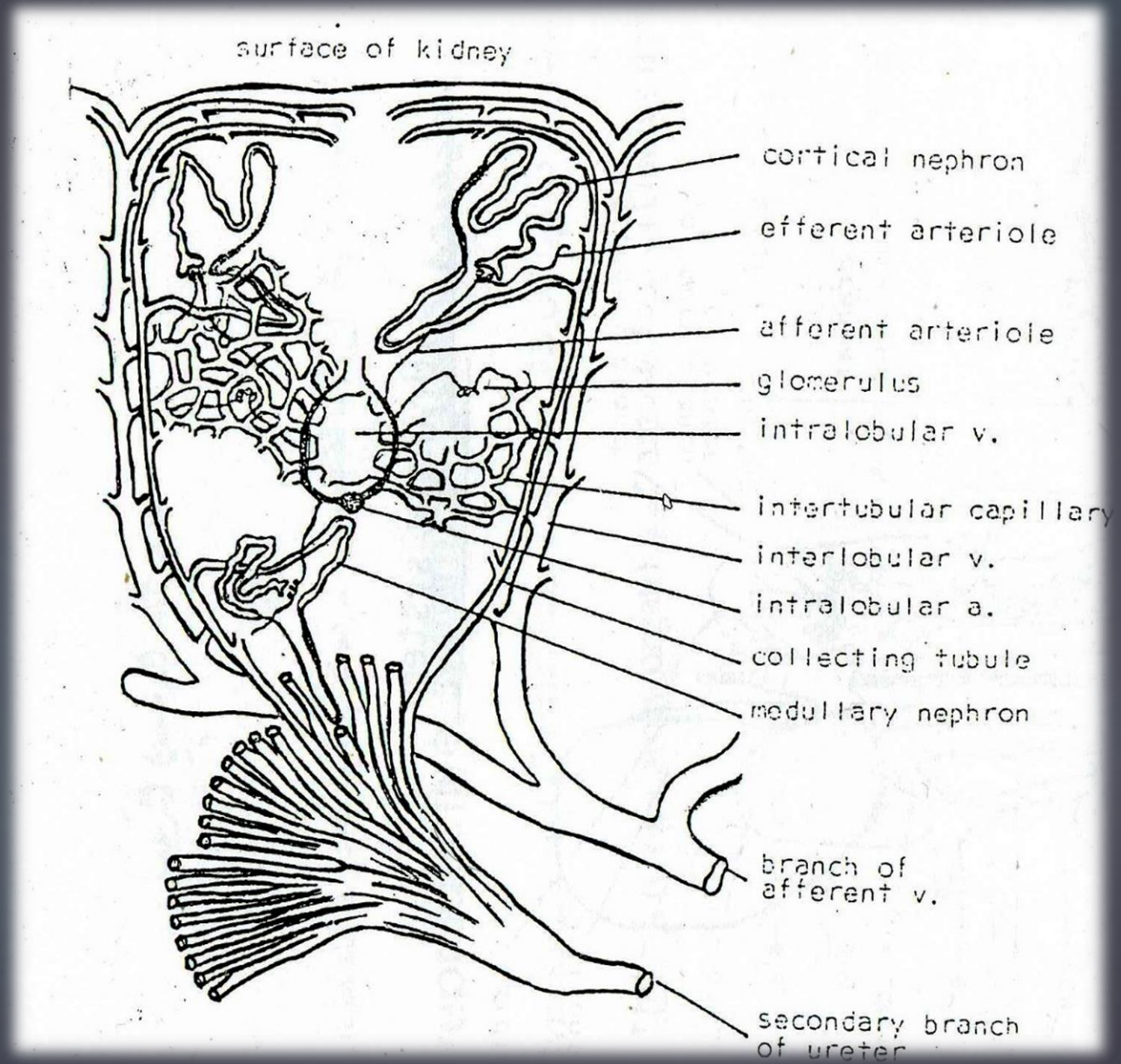


Figure 14.28 ×36

KEY	
1. Cortex	5. Proximal convoluted tubule
2. Distal convoluted tubule	6. Renal corpuscle, large
3. Intralobular vein	7. Renal corpuscle, small
4. Medullary cone	

Figure 14.27. Kidney, Chicken. Cortical parenchyma and portion of a medullary cone are shown. An intralobular vein and both cortical (small) and medullary (large) renal corpuscles are apparent.

Figure 14.28. Kidney, Chicken. A portion of a medullary cone is surrounded by cortical lobules. The intralobular veins of two cortical lobules are clearly represented.


surface of kidney
cortical nephron
efferent arteriole
afferent arteriole
glomerulus
intralobular v.
intertubular capillary
interlobular v.
intralobular a.
collecting tubule
medullary nephron
branch of afferent v.
secondary branch of ureter


WALLPAPERSWIDE.COM