THE UNIVERSITY OF MELBOURNE

Melbourne Veterinary School

# Intestines of herbovores and omnivores: comparative anatomy

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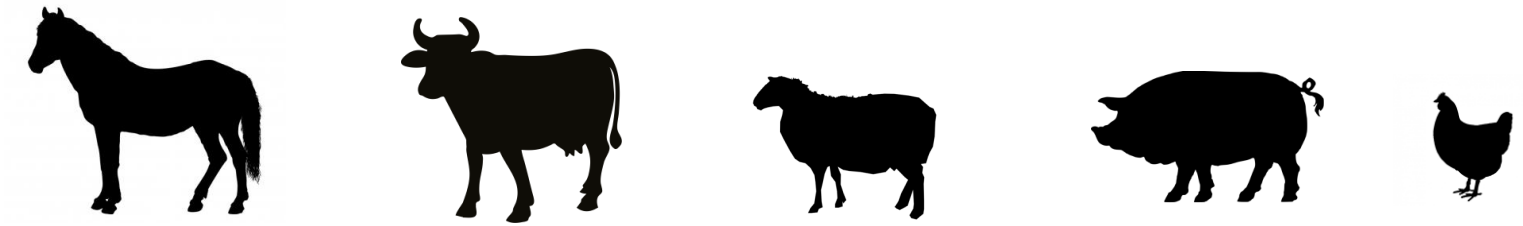
VETS30016 / VETS90120

# Intended learning outcomes

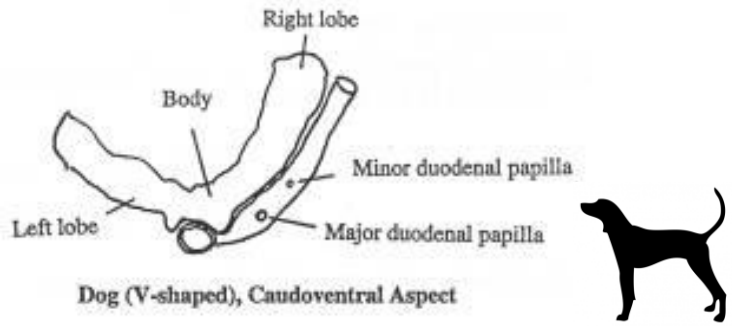
In the major herbivore/omnivore animal species…

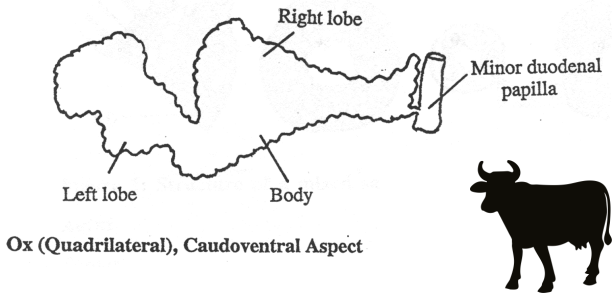
- Describe the comparative gross anatomy of:
  - Small intestine
  - Large intestine
  - Pancreas
- Describe the course and position in the body of the small and large intestines
- Relate some of these differences to the ways in which different species utilise different diets

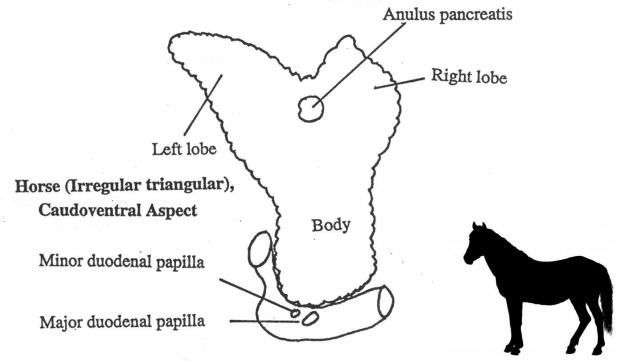


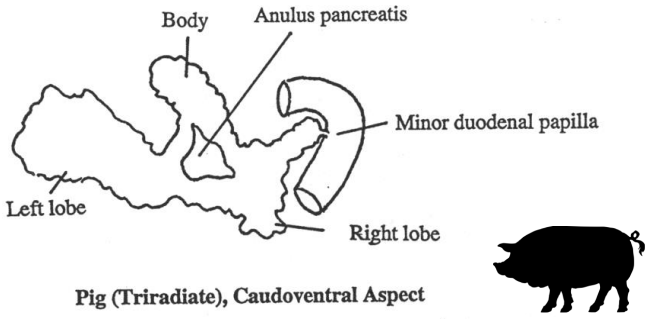
# Small intestine & pancreas

- Previously introduced to structure/function and terminology in carnivore species

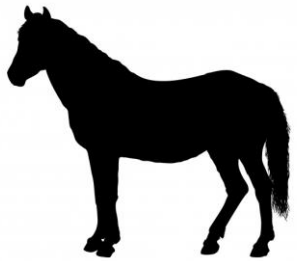


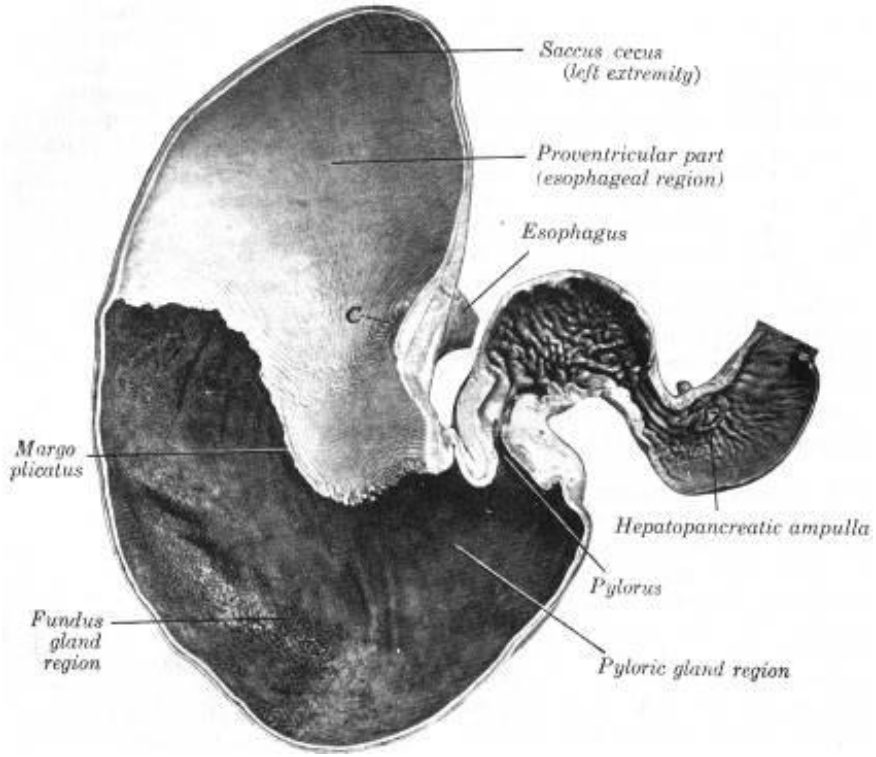



# Horse: Small intestine

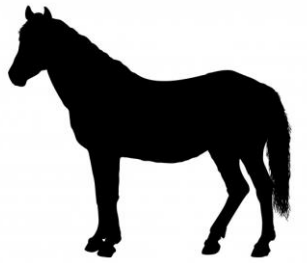


Duodenum

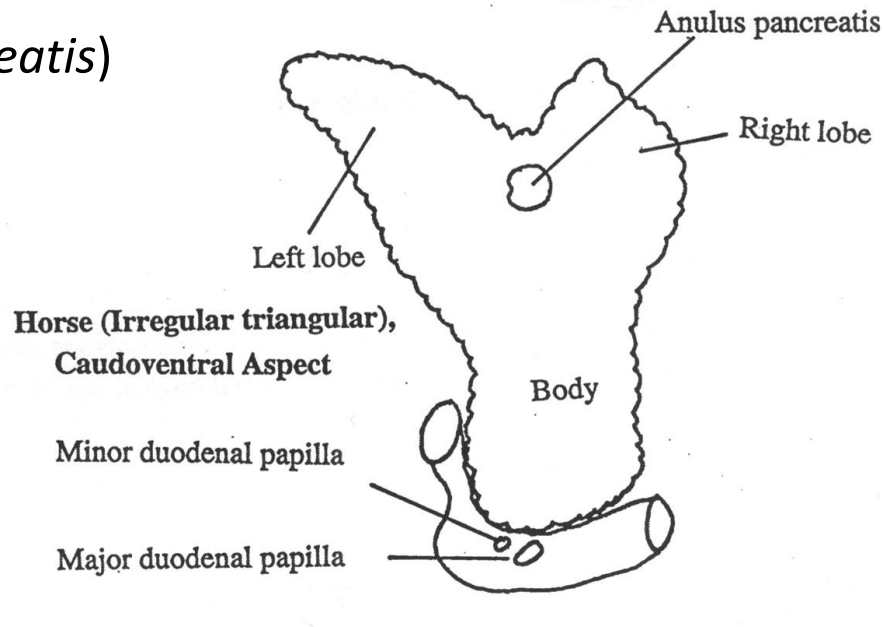
- Pyloric end: S-shaped curve
- Associated with the pancreas
- 2 duodenal papillae
  - 2 pancreatic ducts



# Horse: Pancreas



- Irregular triangular shape
- Apex fits second concavity of duodenal flexure
- Largely to the right of the median plane
- Portal vein passes obliquely through pancreatic ring (*annulus pancreatis*)



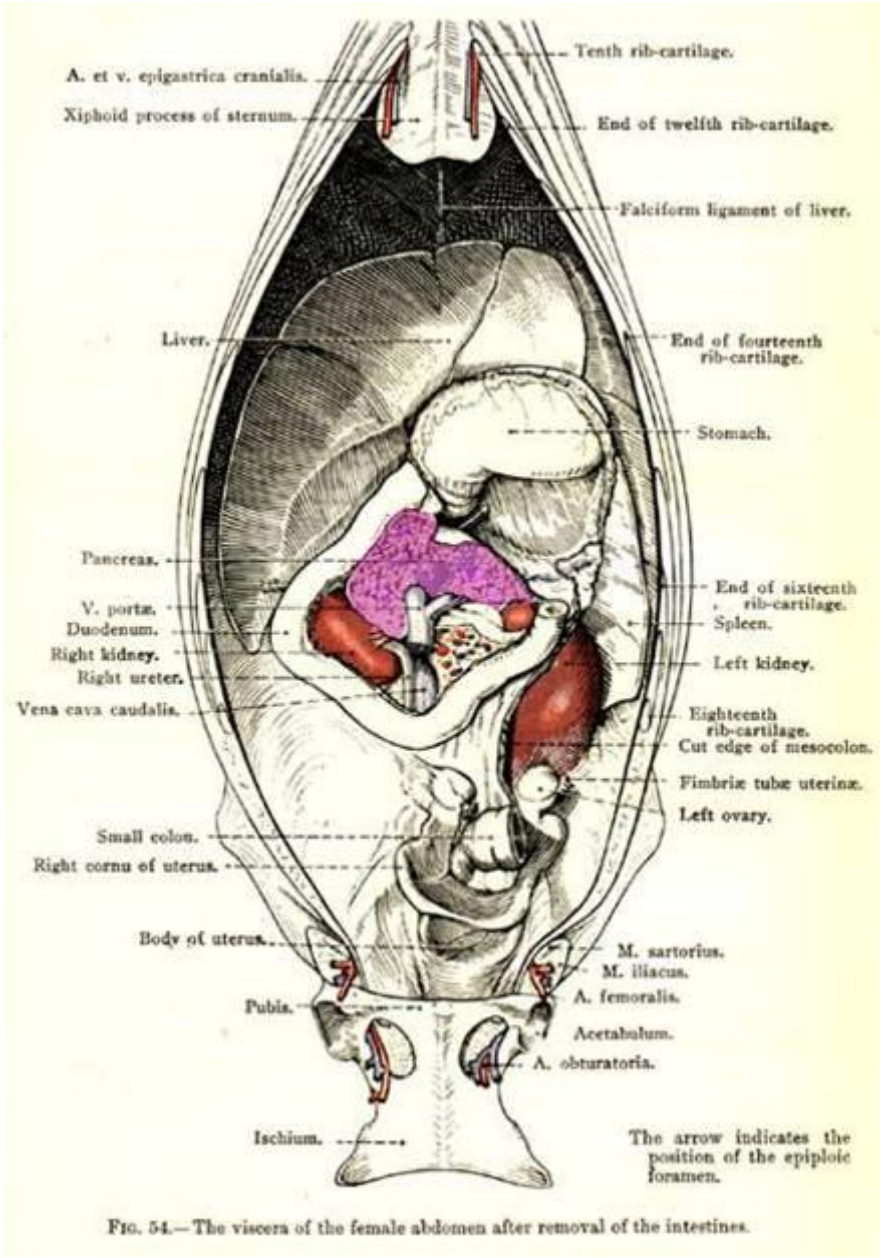
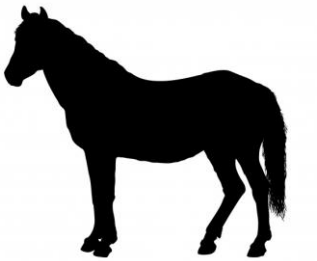
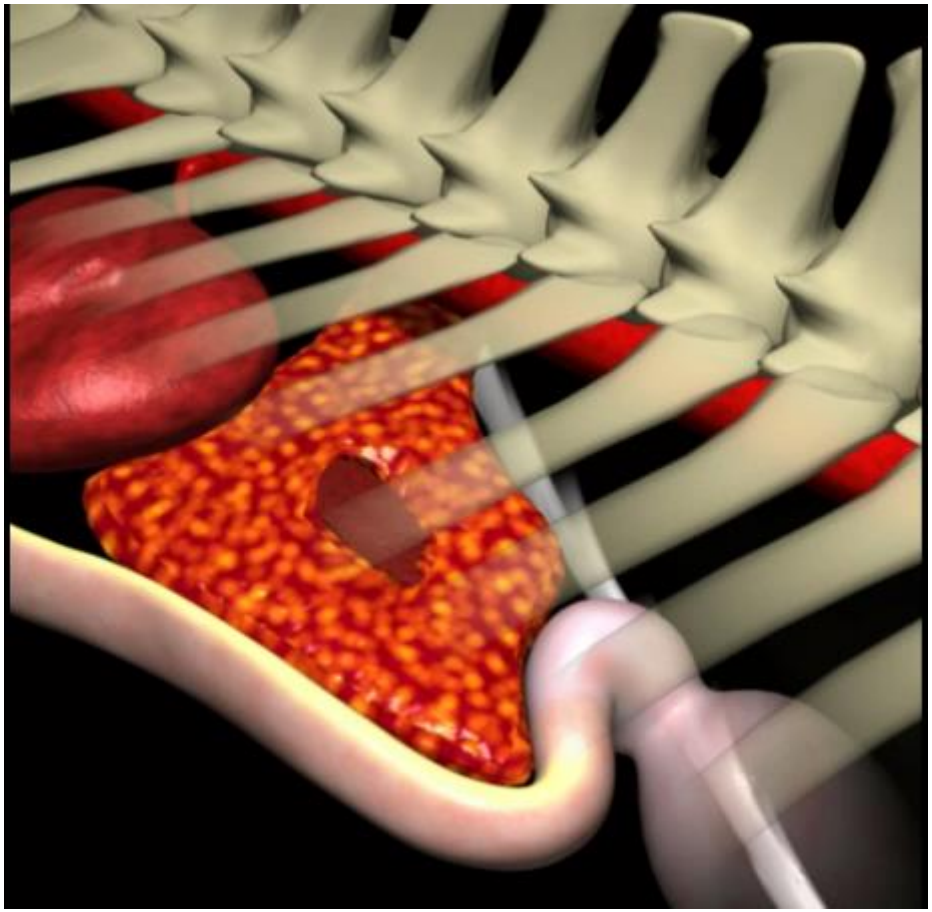


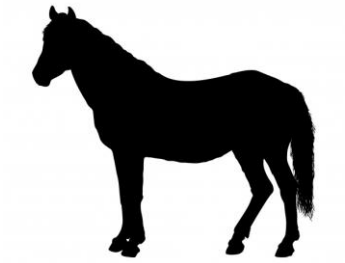

FIG. 54.—The viscera of the female abdomen after removal of the intestines.



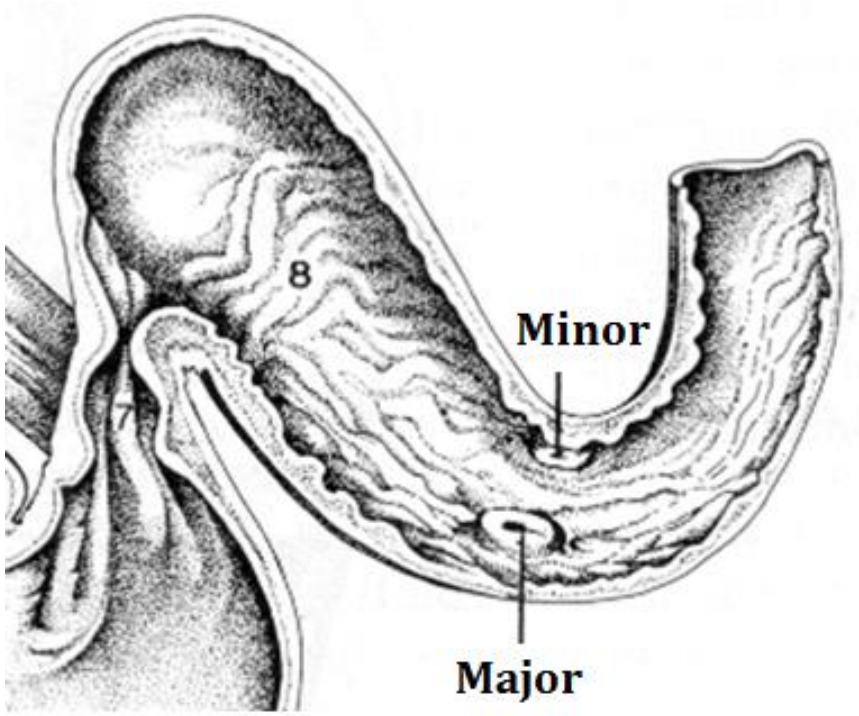


Glass Horse

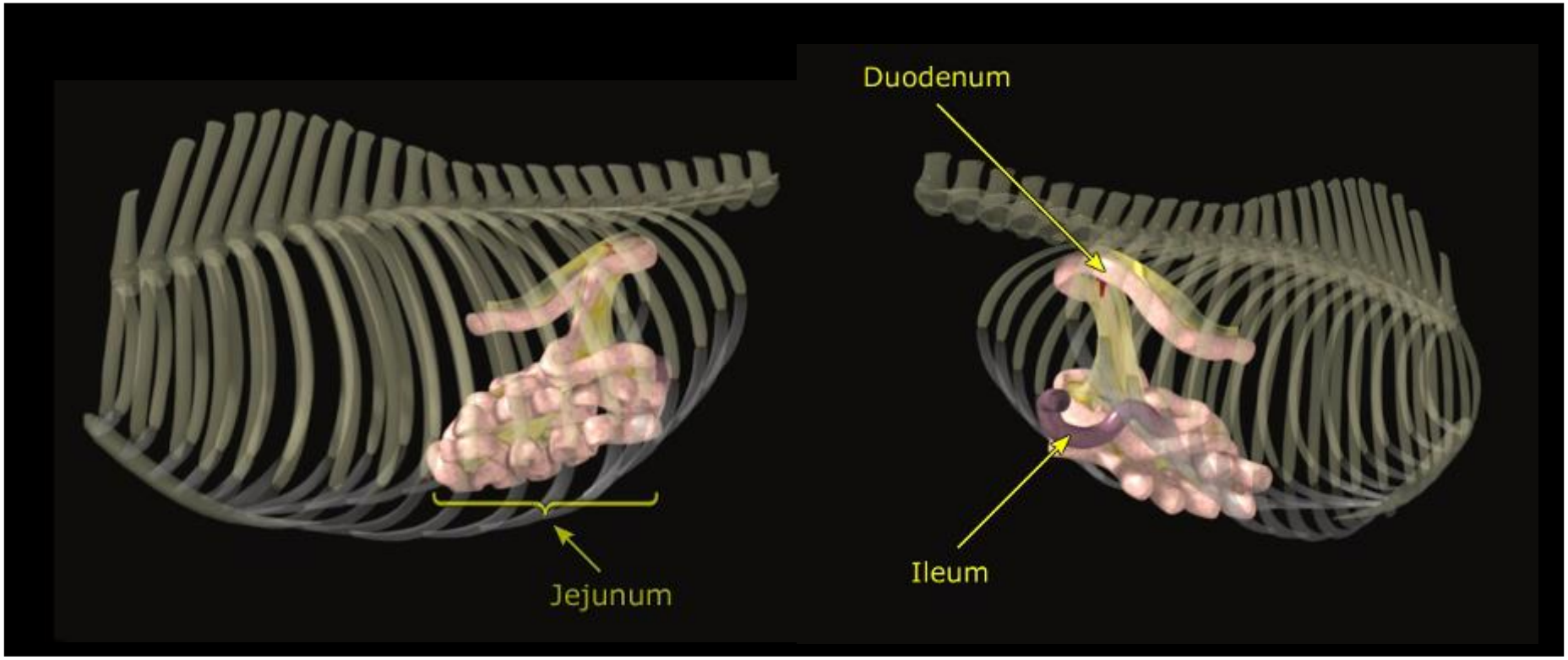
# Horse: Pancreas



- Two ducts
  - Pancreatic duct
    - Larger duct in horse
    - Opens with bile duct on hepatopancreatic ampulla (major duodenal papilla)
  - Accessory pancreatic duct
    - Smaller duct in horse
    - Opens on minor duodenal papilla

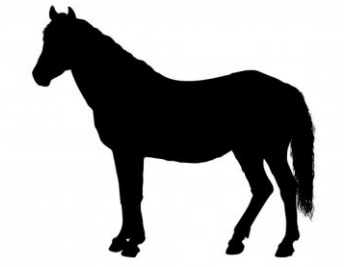


# Horse: Small intestine



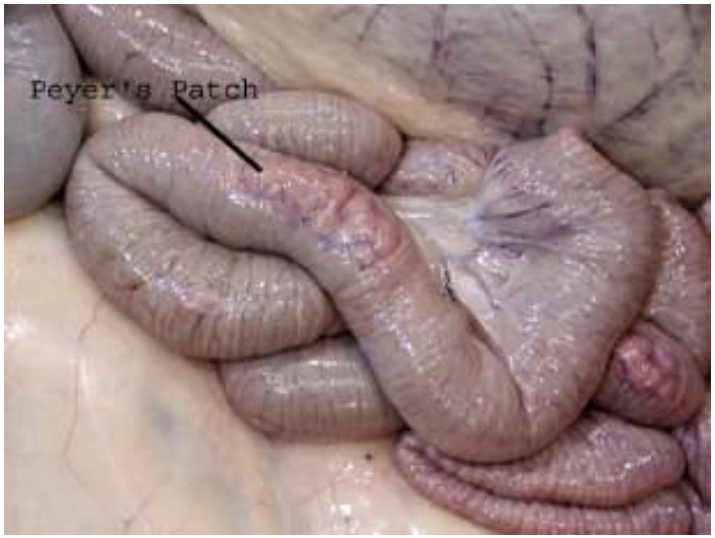

Glass Horse

# Horse: Small intestine



## Jejunum and ileum

- Long mesentery
- Left dorsal region of the abdomen
- Ileum terminates in the caecum at the ileocaecal orifice
- Mucous membrane forms the ileal papilla
- Peyers patches largest in the ileum



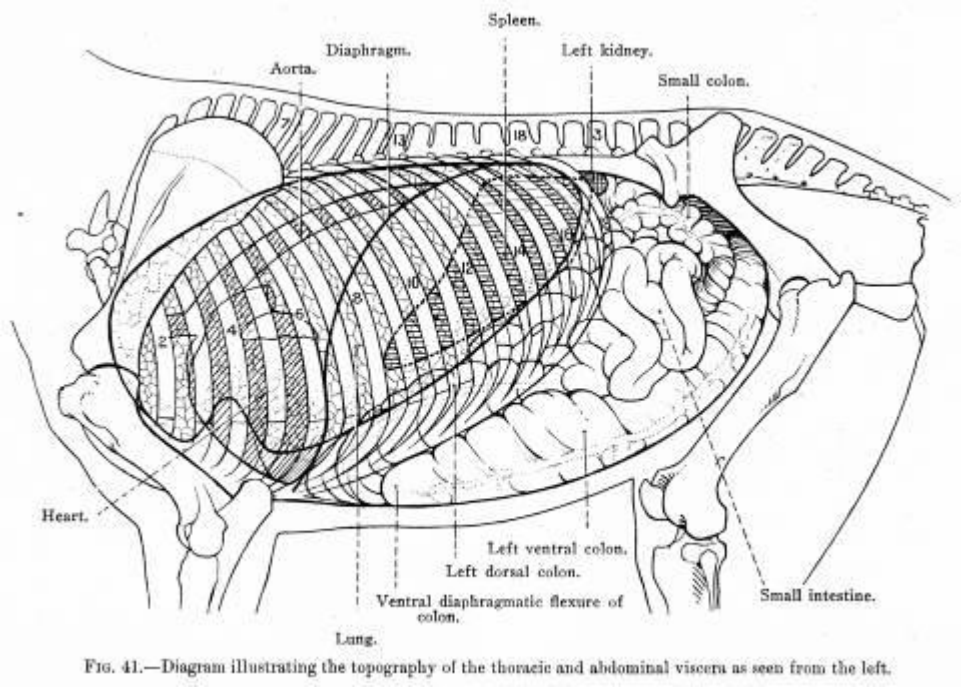
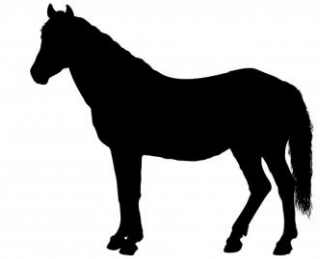



FIG. 41.—Diagram illustrating the topography of the thoracic and abdominal viscera as seen from the left.



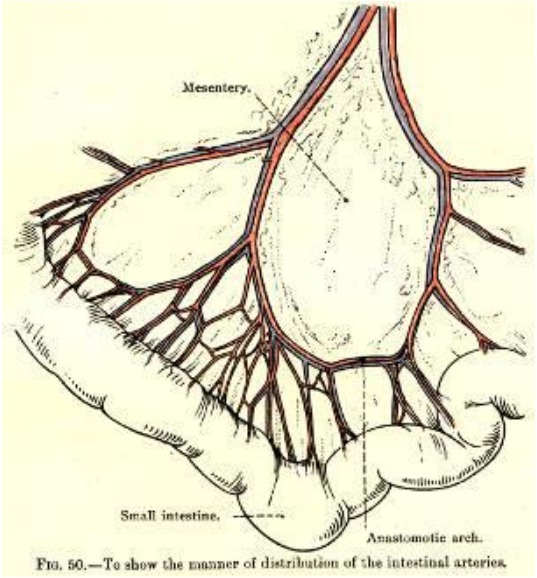
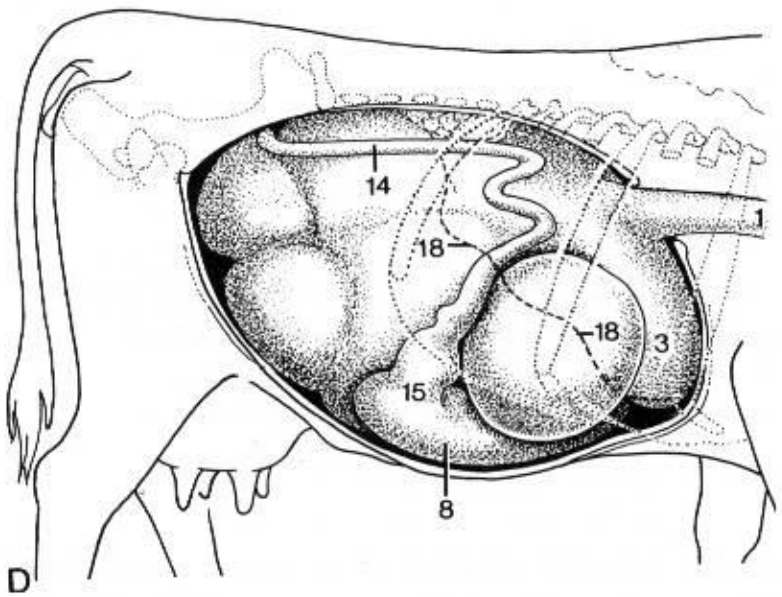



FIG. 50.—To show the manner of distribution of the intestinal arteries.

# Cow: Small intestine

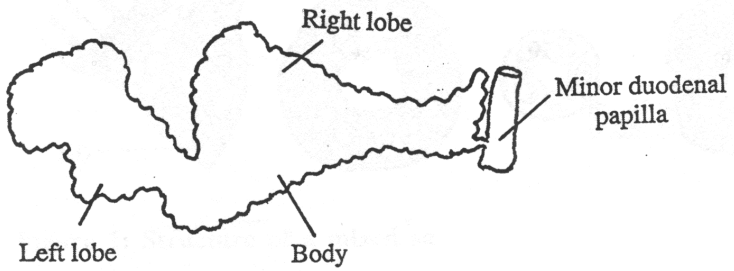
Duodenum

- Forms a sigmoid flexure after pylorus
- Associated with the pancreas
- Two duodenal papillae; one pancreatic duct
  - Single (Accessory) pancreatic duct
    - Opens on minor duodenal papilla
    - 20-25 cm caudal to entry of bile duct on the major duodenal papilla

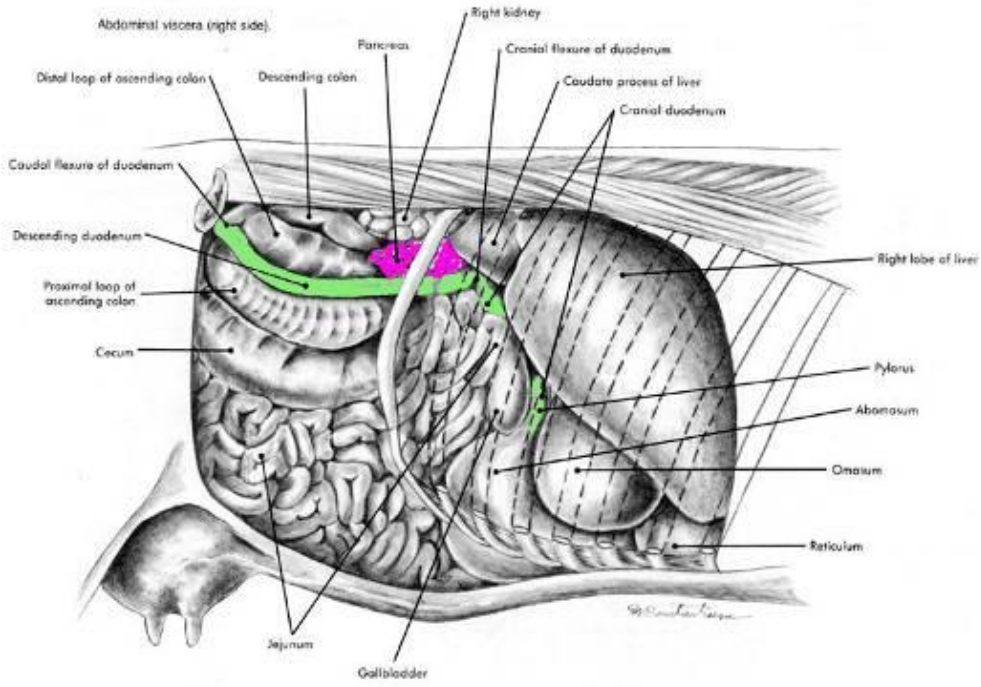


# Cow: Pancreas

- Irregular shape (quadrilateral)
  - Located to right of median plane
  - Two lobes join in a body
  - Deep notch – opposite the body
    - Portal vein and cranial mesenteric artery pass through




Ox (Quadrilateral), Caudoventral Aspect



# Cow: Small intestine

## Jejunum and ileum

- Occupy the right side of the abdomen in the supra-omental recess

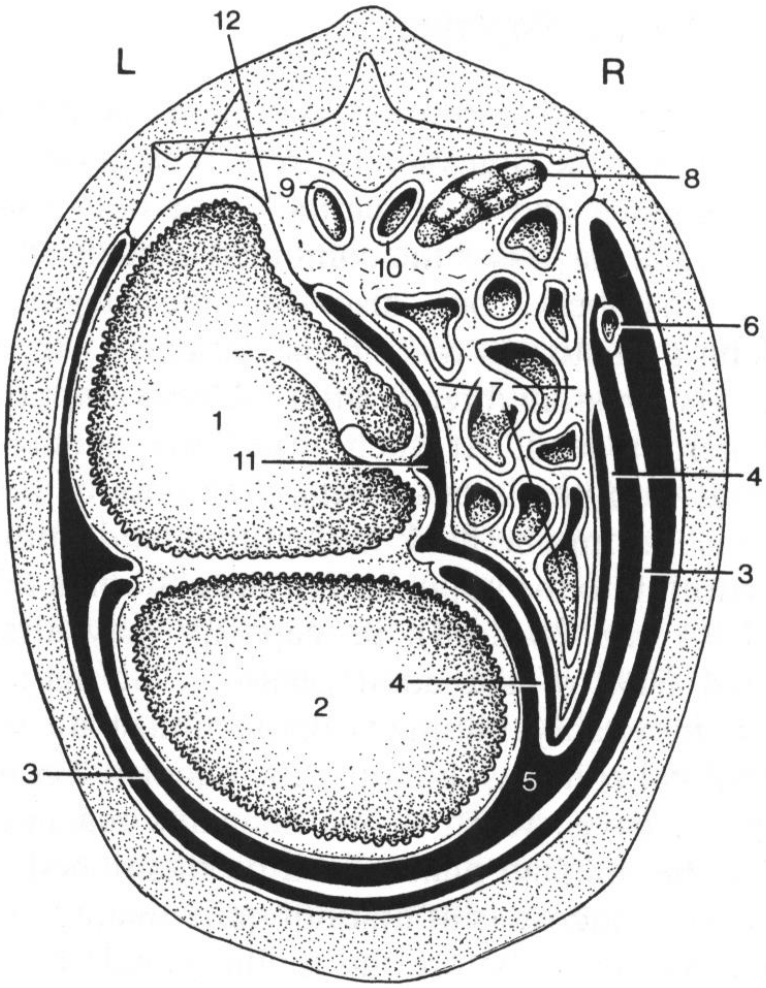
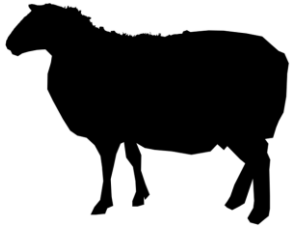


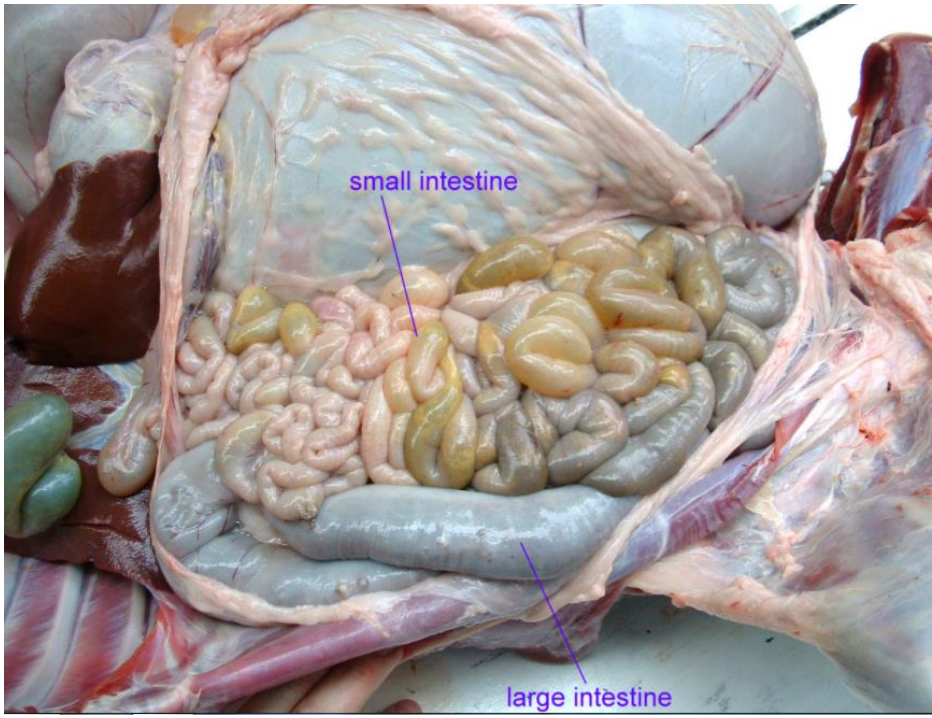

**Figure 28–21.** Schematic transverse section of the abdominal cavity to show the disposition of the greater omentum.

1, Dorsal sac of rumen; 2, ventral sac of rumen; 3, superficial wall of greater omentum; 4, deep wall of greater omentum; 5, omental bursa; 6, descending duodenum; 7, intestinal mass; 8, right kidney; 9, aorta; 10, caudal vena cava; 11, supraomental recess; 12, retroperitoneal attachment of rumen.

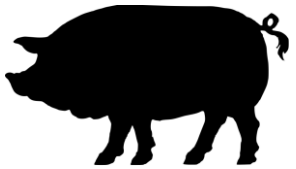
# Sheep: Small intestine



- Small intestine total length approx. 25m
- One duodenal papilla
- One pancreatic duct
  - Opens on the single (major) duodenal papilla
  - Opens in conjunction with the bile duct

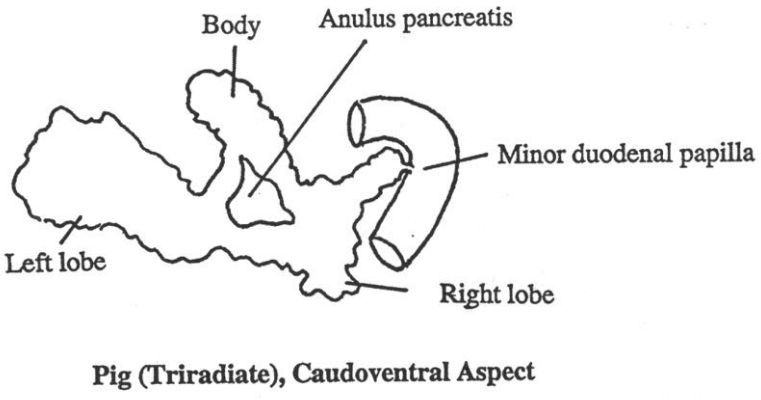


# Pig: Small intestine



## Duodenum

- Two duodenal papillae
- One pancreatic duct
  - Opens on minor duodenal papilla
  - ~ 10-12 cm caudal to pylorus

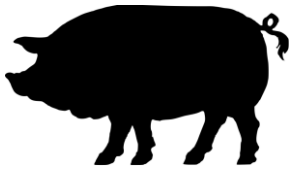


Pig (Triradiate), Caudoventral Aspect

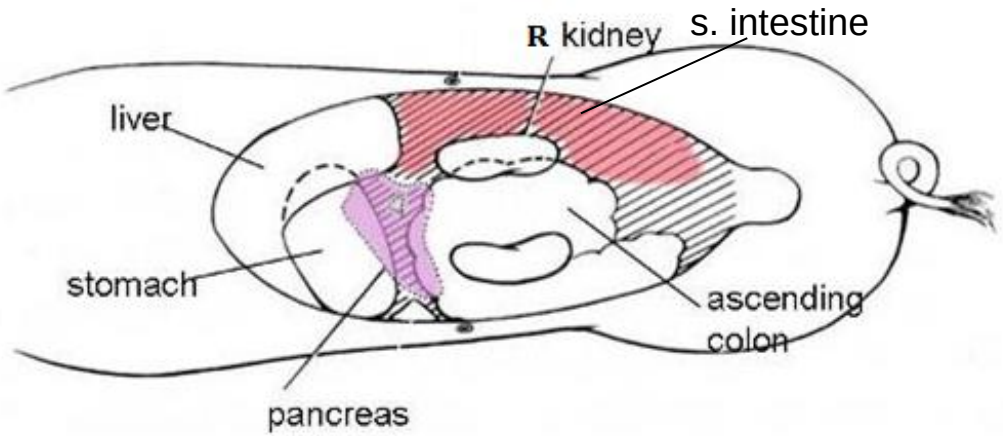
## Pancreas

- Irregular triangular (Tri-radiate)
- 2/3 lies to left of median plane
- Two lobes and middle portion (body)
- Pancreatic ring in middle portion (annulus pancreatis)
  - Portal vein passes through

# Pig: Small intestine



- Located right side of abdomen
- Total s.i. length 15-20m



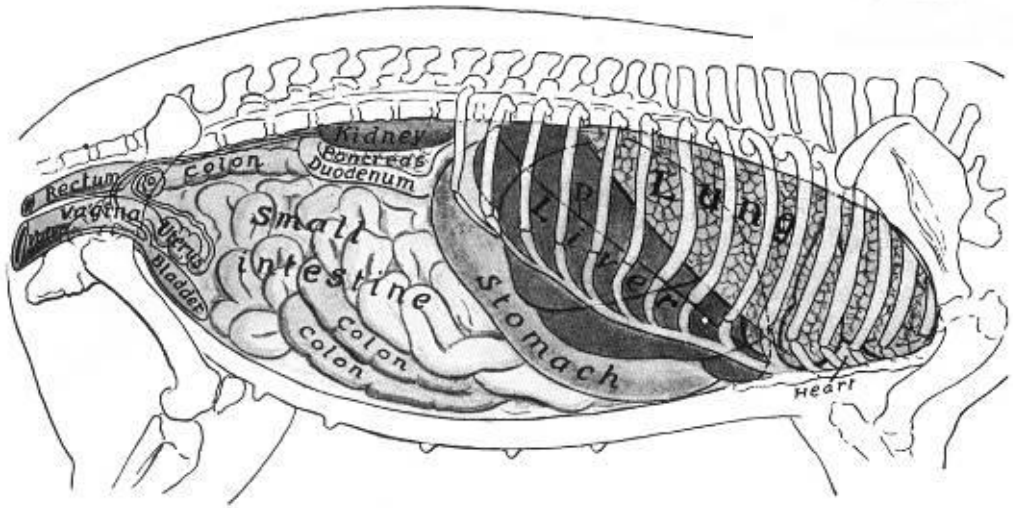




**FIGURE 40–27. Projection of viscera of pig on body wall; right side.**

D, Costal line of diaphragm; O, ovary. The pancreas and duodenum are not in contact with the flank, as would naturally be inferred from this figure, but are situated more medially and are covered laterally by small intestine.

# Comparative anatomy: Large intestines

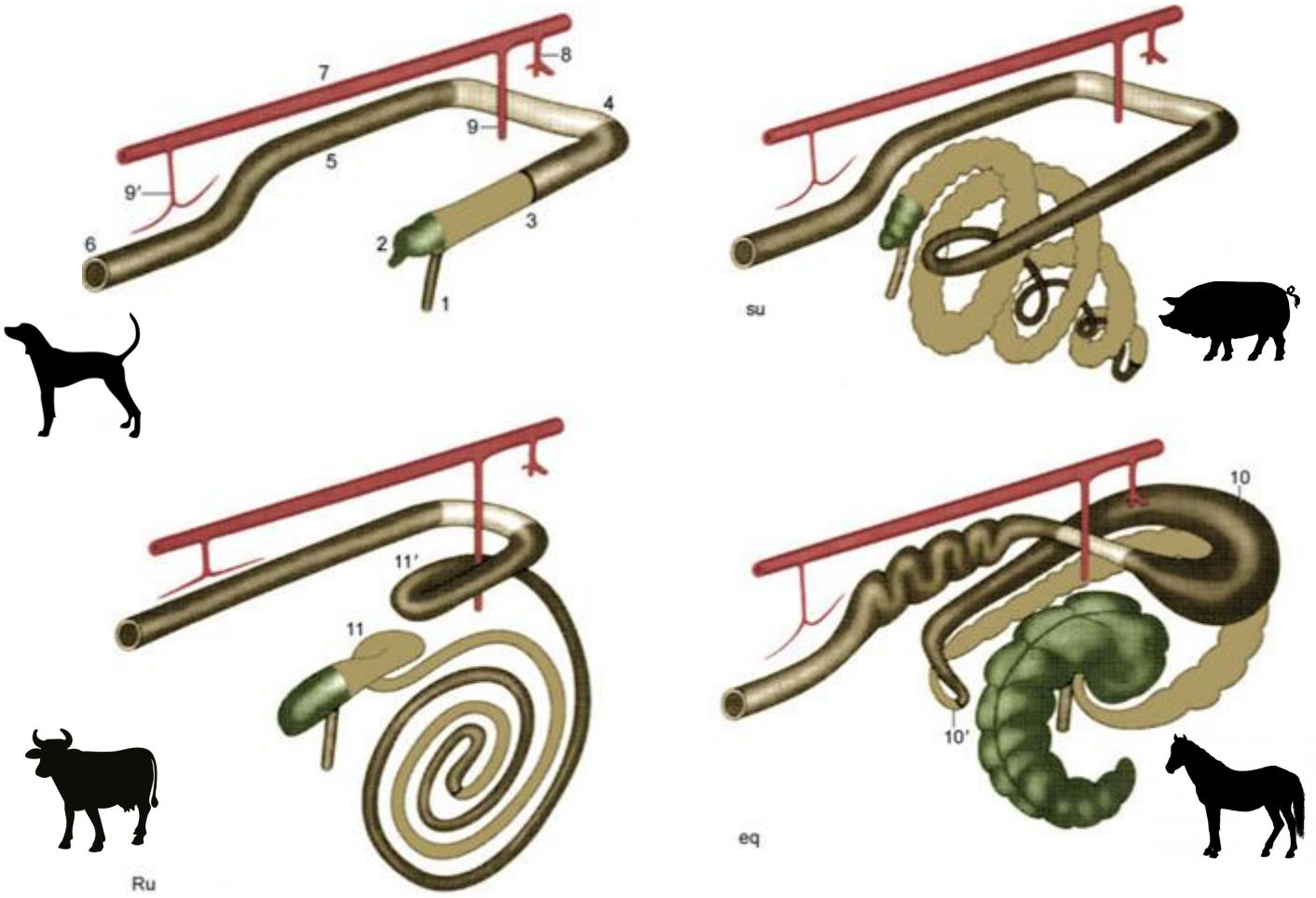
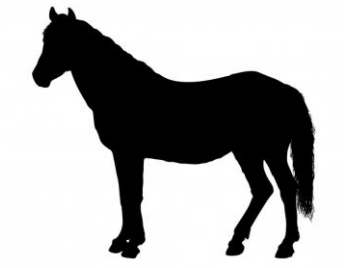


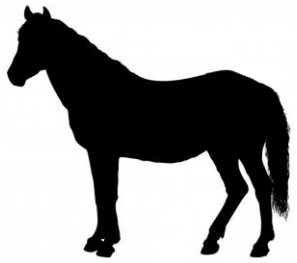

Fig. 3-45. Schematic drawing of the large intestine of the domestic mammals: carnivores (Car), the pig (su), ruminants (Ru), and the horse (eq). Cranial is to the upper right. 1, Ileum; 2, cecum; 3, ascending colon; 4, transverse colon; 5, descending colon; 6, rectum and anus; 7, aorta; 8, celiac artery; 9, 9′, cranial and caudal mesenteric arteries; 10, 10′, dorsal diaphragmatic and pelvic flexures of ascending colon; 11, 11′, proximal and distal loops of ascending colon.

# Horse: Large intestine

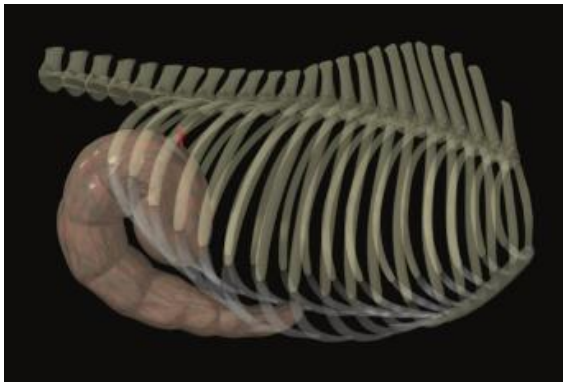


- Greatly enlarged cf. small intestine
  - “Hindgut fermenter”
- External longitudinal bands – taenia
- Sacculations – haustra
  - Chambers for bacterial fermentation
- Large (great) colon = ascending + transverse colon
- Small colon = descending colon

# Horse: Caecum



- Comma shaped
- Right iliac/sublumbar region sweeping to ventral abdominal floor (caudal to xiphoid)
- Divided into:
  - Base
  - Body
  - Apex



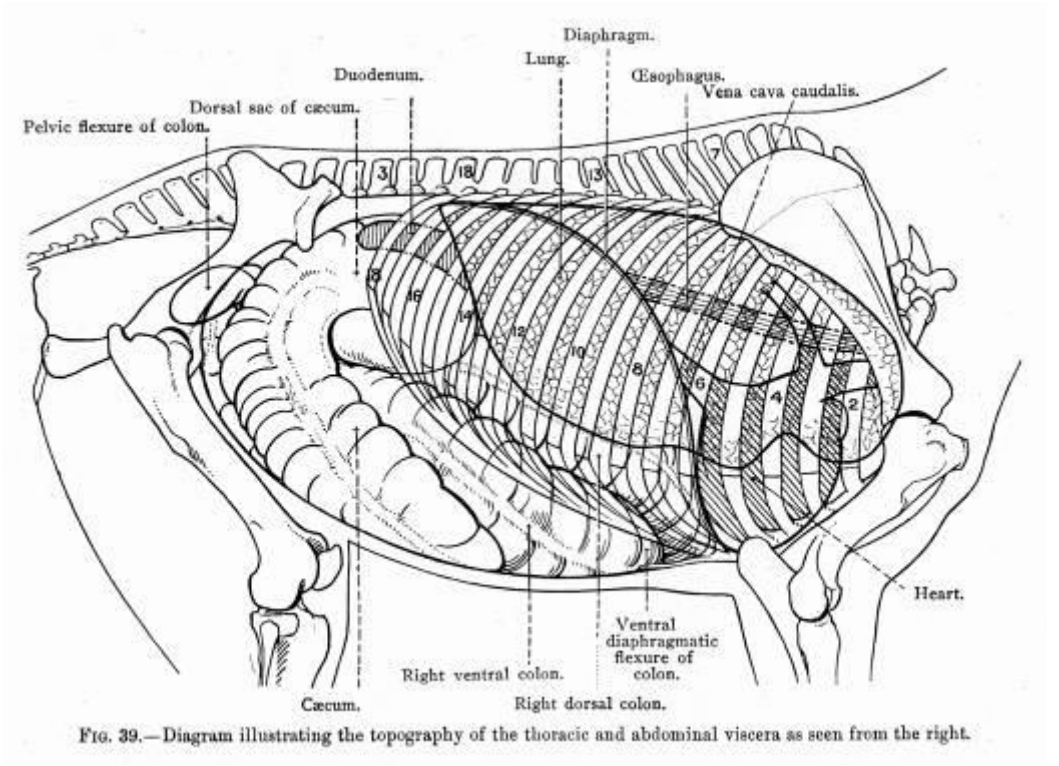
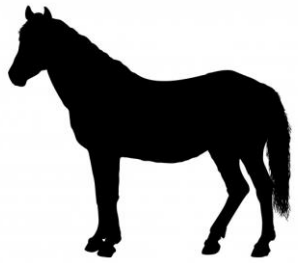



FIG. 39.—Diagram illustrating the topography of the thoracic and abdominal viscera as seen from the right.

# Horse: Caecum



- Base
  - Dorsal and caudal – capacious
  - Located: Right dorsal flank
  - Greater curvature
    - Dorsal
  - Lesser curvature
    - Ventro-medial
    - Ileocaecal orifice
    - Caecocolic orifice

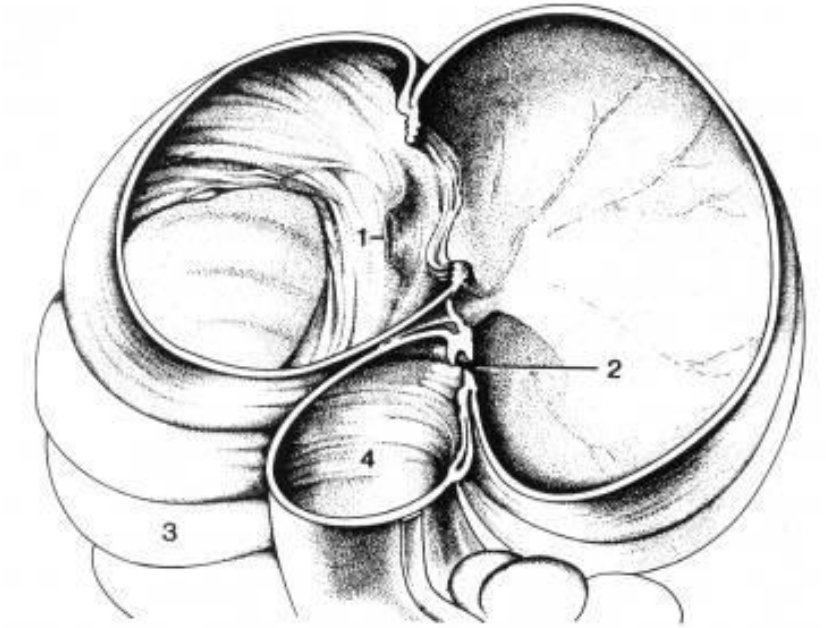
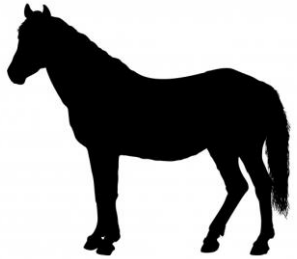



**Figure 21–16.** The interior of the base of the cecum, right lateral view.

1, Termination of ileum at ileal papilla; 2, cecocolic orifice; 3, body of cecum; 4, right ventral colon.

# Horse: Caecum



- Body
  - Runs cranio-ventrally from base
  - Displaced medially in ventral abdomen
  - Lies between RVC and LVC
- Apex
  - On the abdominal floor
    - Caudal to xiphoid

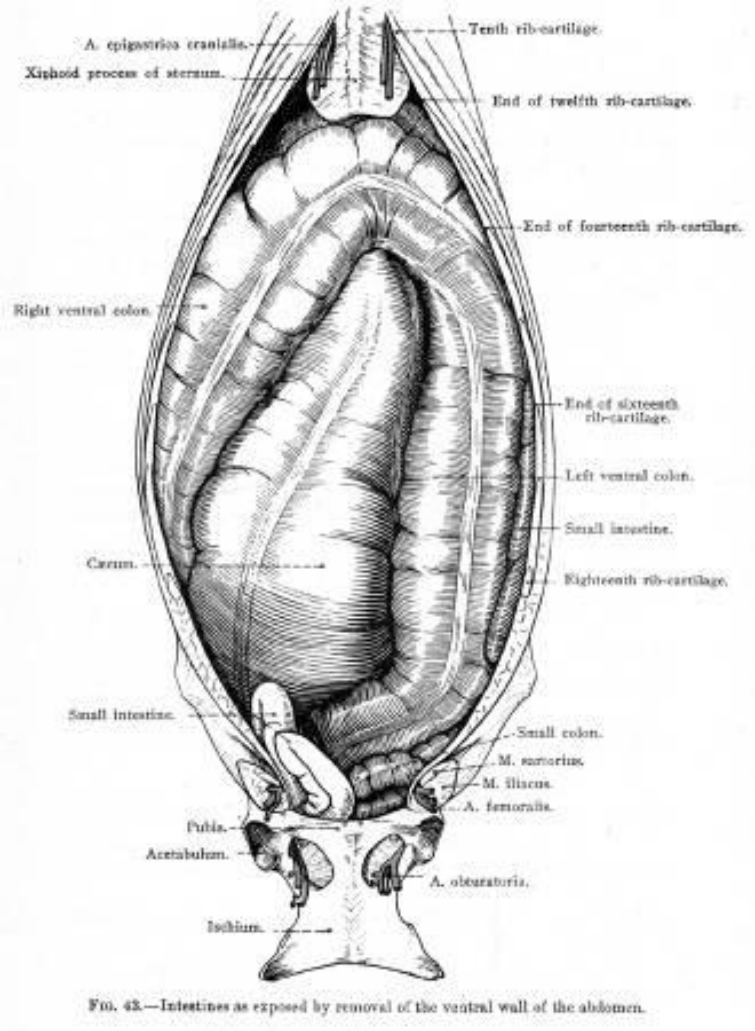
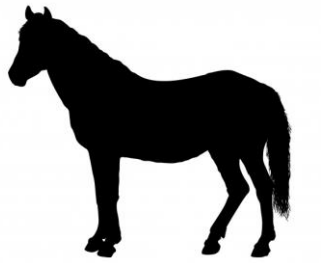


FIG. 43.—Intestines as exposed by removal of the ventral wall of the abdomen.

# Horse: Caecum



External features

- 4 longitudinal bands of smooth muscle – *Taenia*
- 4 rows of sacculations – *Haustra*
  - Haustra correspond to saccules in the lumen
  - Function to delay the passage of ingesta

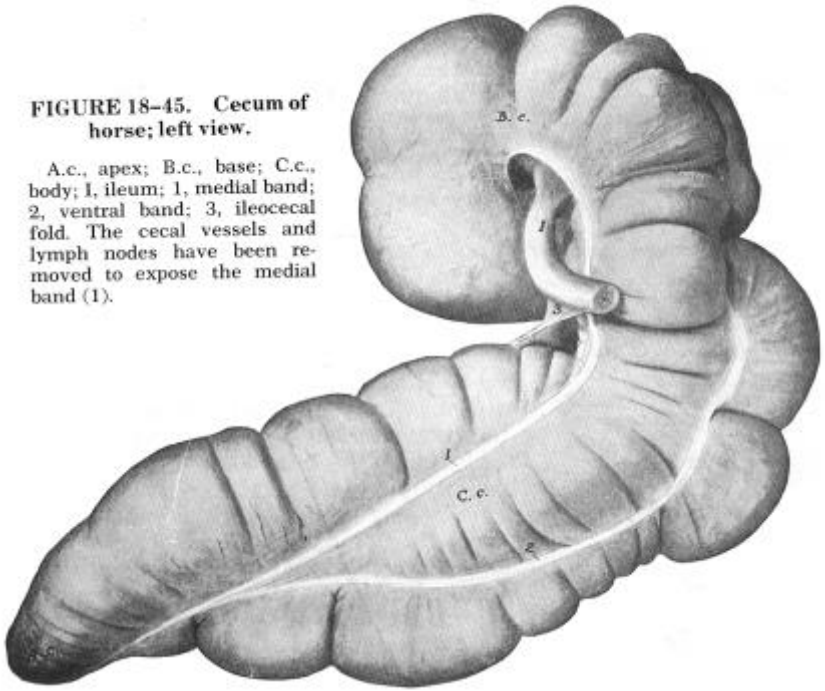
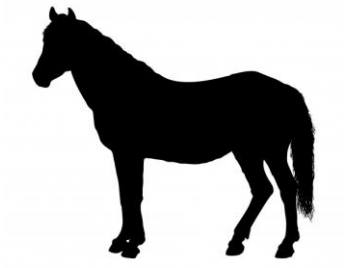


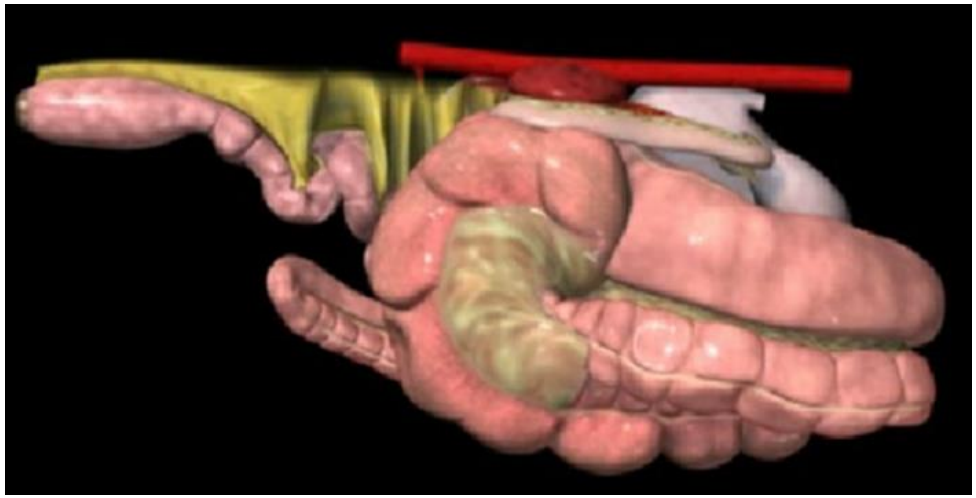

**FIGURE 18–45. Cecum of horse; left view.**

A.c., apex; B.c., base; C.c., body; I, ileum; 1, medial band; 2, ventral band; 3, ileocecal fold. The cecal vessels and lymph nodes have been removed to expose the medial band (1).

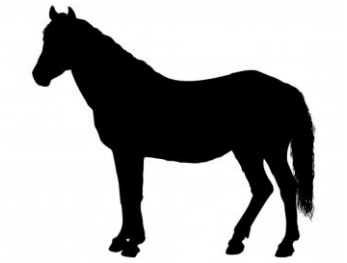
# Horse: Caecum



- Attachments
  - Base – attached by connective tissue and peritoneum
    - Dorsal body wall adjacent to pancreas and right kidney
    - Caecocolic fold
  - Body:
    - Medially to transverse colon
    - Ventrally to origin of RVC – caecocolic fold
  - Apex:
    - Free



# Horse: Large colon



- Comprises ascending and transverse colon
- Large capacity ~ 60 litres
- Arranged in double horseshoe-shaped loop
- No attachments except at origin and end

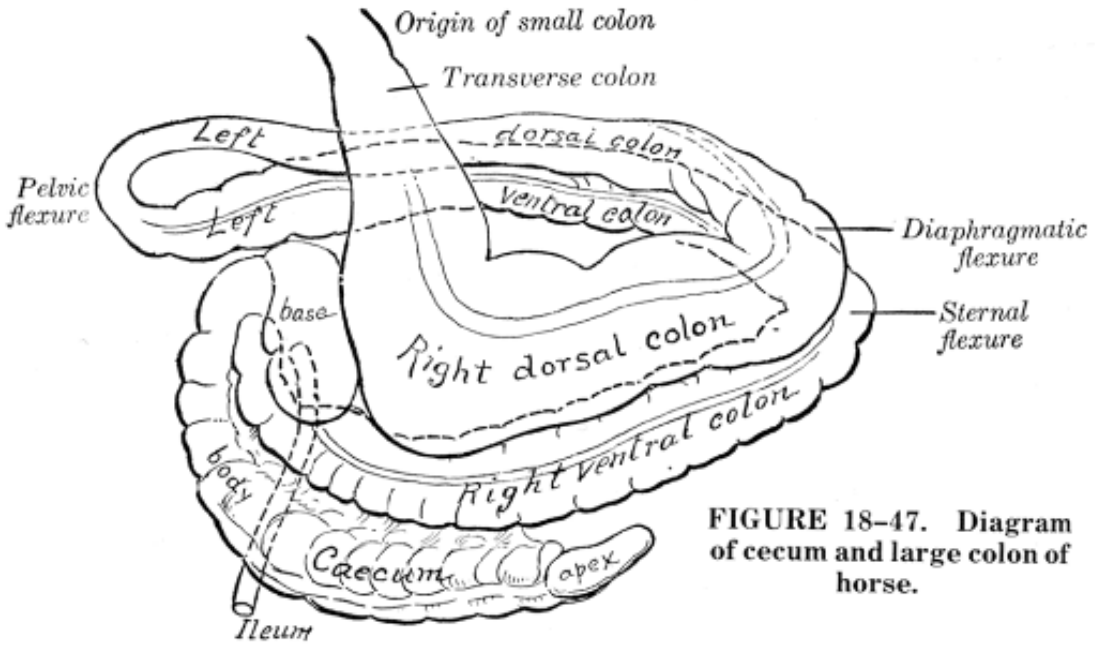
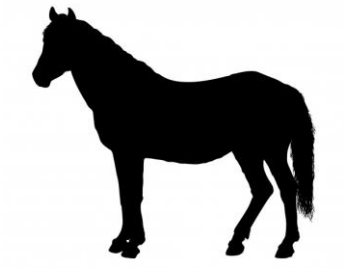
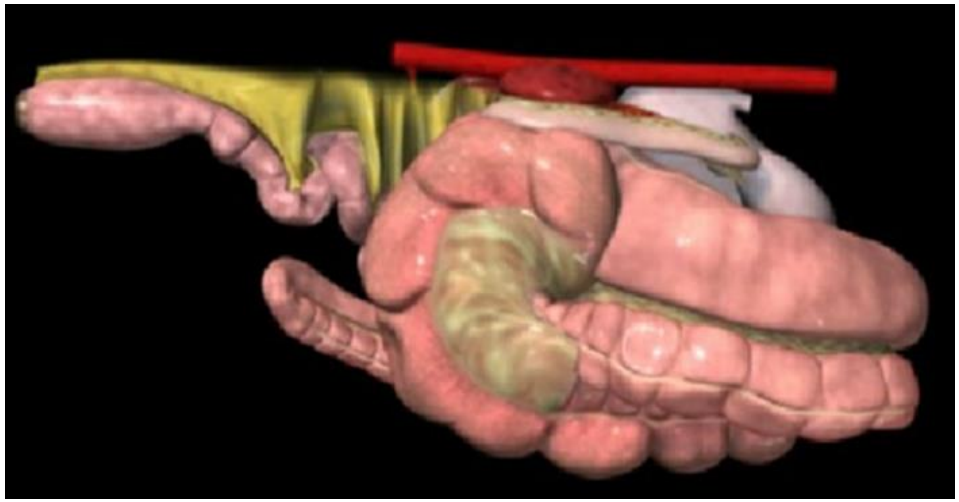



FIGURE 18–47. Diagram of cecum and large colon of horse.

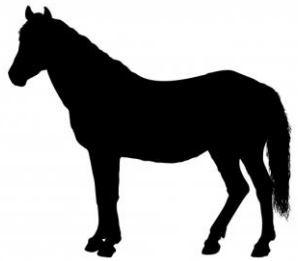
# Horse: Large colon



- Right ventral colon
  - Narrow as emerges from caecum
  - Expands quickly in size
  - Carries 4 taenia and 4 rows haustra
  - Runs ventrally and cranially on the right abdominal floor
- Sternal flexure



# Horse: Large colon



- Left ventral colon
  - Runs towards pelvis on left abdominal floor
  - Carries 4 taenia and 4 rows of haustra
- Pelvic flexure
  - Sharp and narrow
  - Joins ventral to dorsal colon
  - 3 of 4 taenia disappear (haustra disappear)

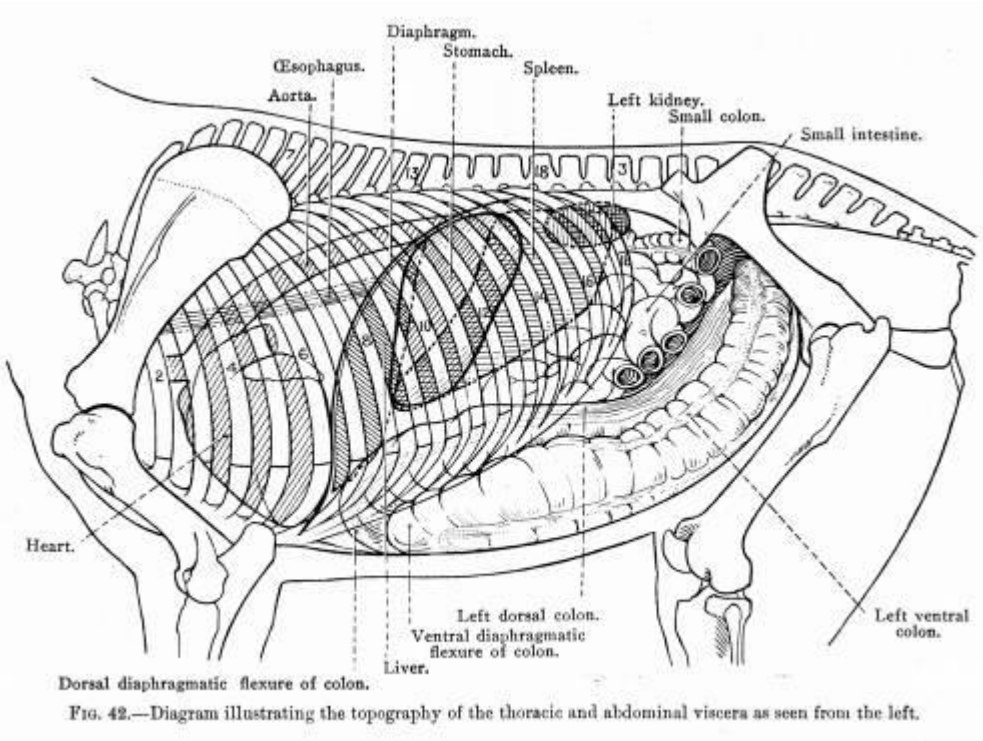
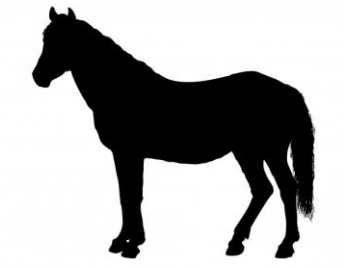
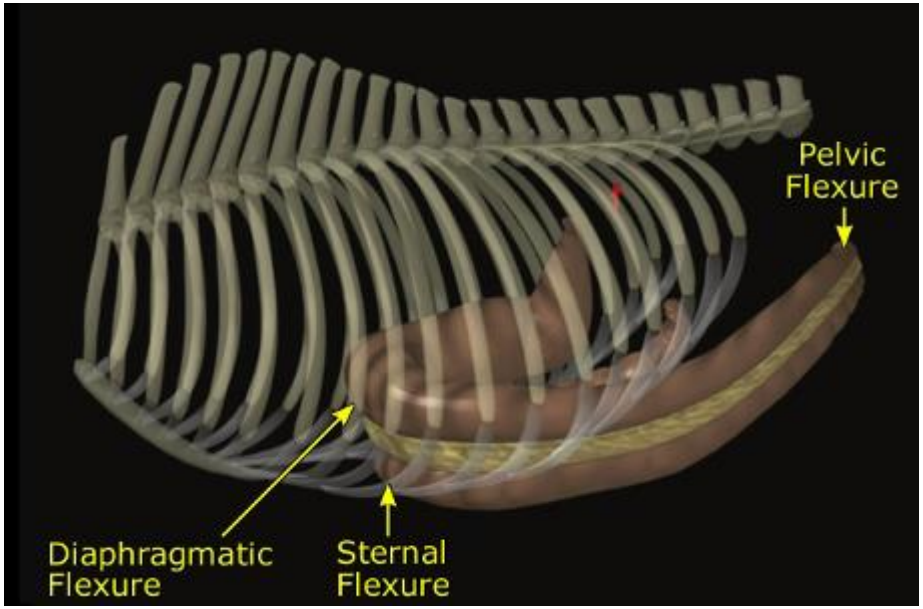



FIG. 42.—Diagram illustrating the topography of the thoracic and abdominal viscera as seen from the left.

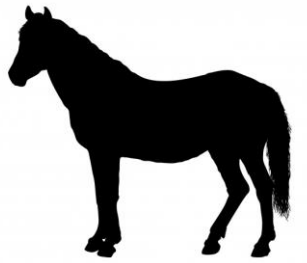
# Horse: Large colon



- Left dorsal colon
  - Narrow and smooth walled  at origin
  - Gradually widens running cranially
    - Above the LVC; Ventral to coils of S.I. and small colon
  - Taenia increase to 3 and haustra return
- Diaphragmatic flexure



# Horse: Large colon



- Right dorsal colon
  - Shortest and widest part of ascending colon
  - Carries 3 taenia
  - Runs caudodorsally to the base of caecum
- Transverse colon
  - Very short
  - Passes R to L in front of root of mesentery
  - Carries 2 taenia

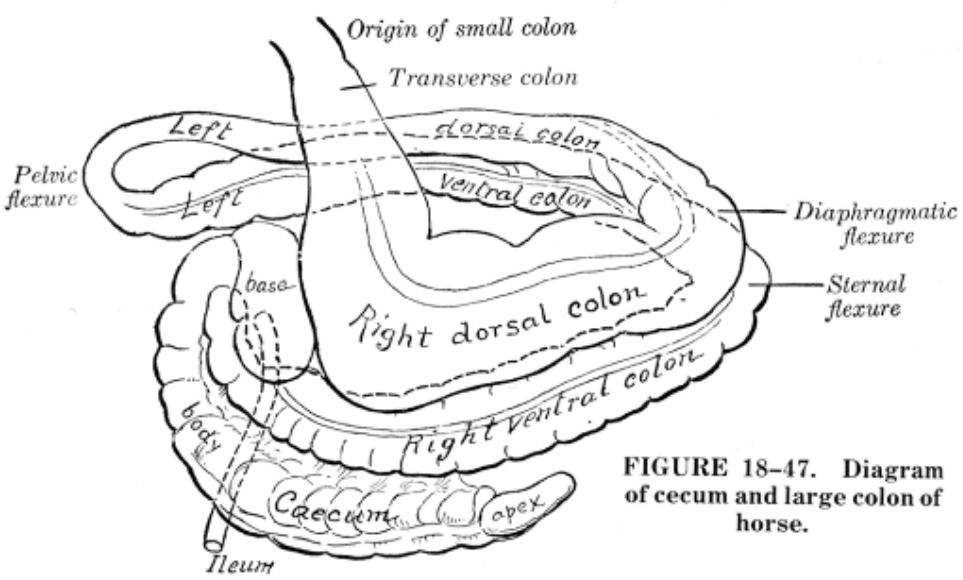
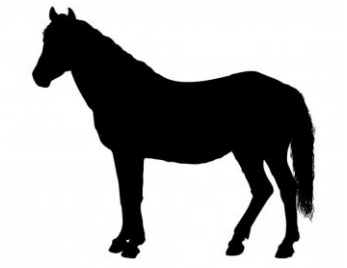


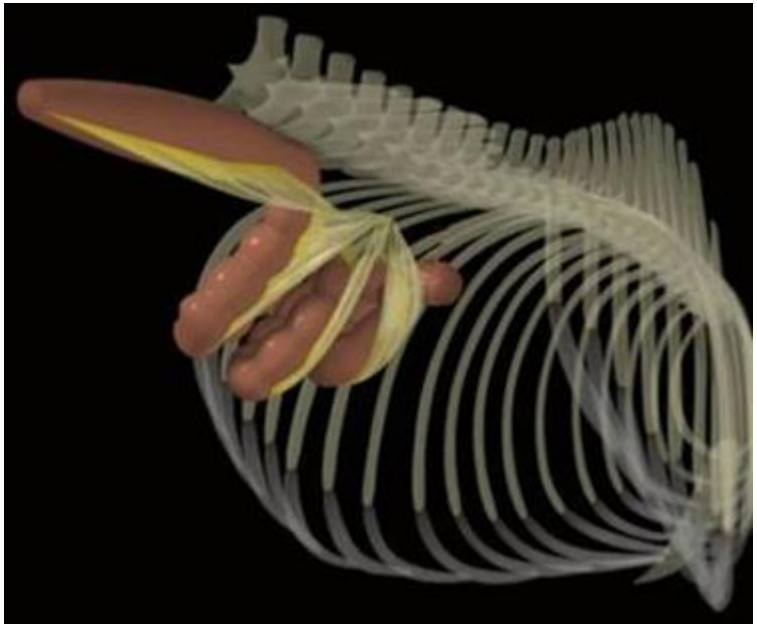

FIGURE 18–47. Diagram of cecum and large colon of horse.

# Horse: Small colon

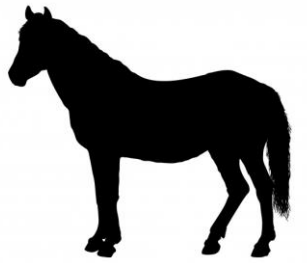


Descending colon

- Lies in left dorsocaudal abdomen dorsal to small intestine
- Narrower and thrown into coils
- Supported by long mesentery (mesocolon)
- 2 rows taenia/haustra
- Opens into rectum at pelvic brim

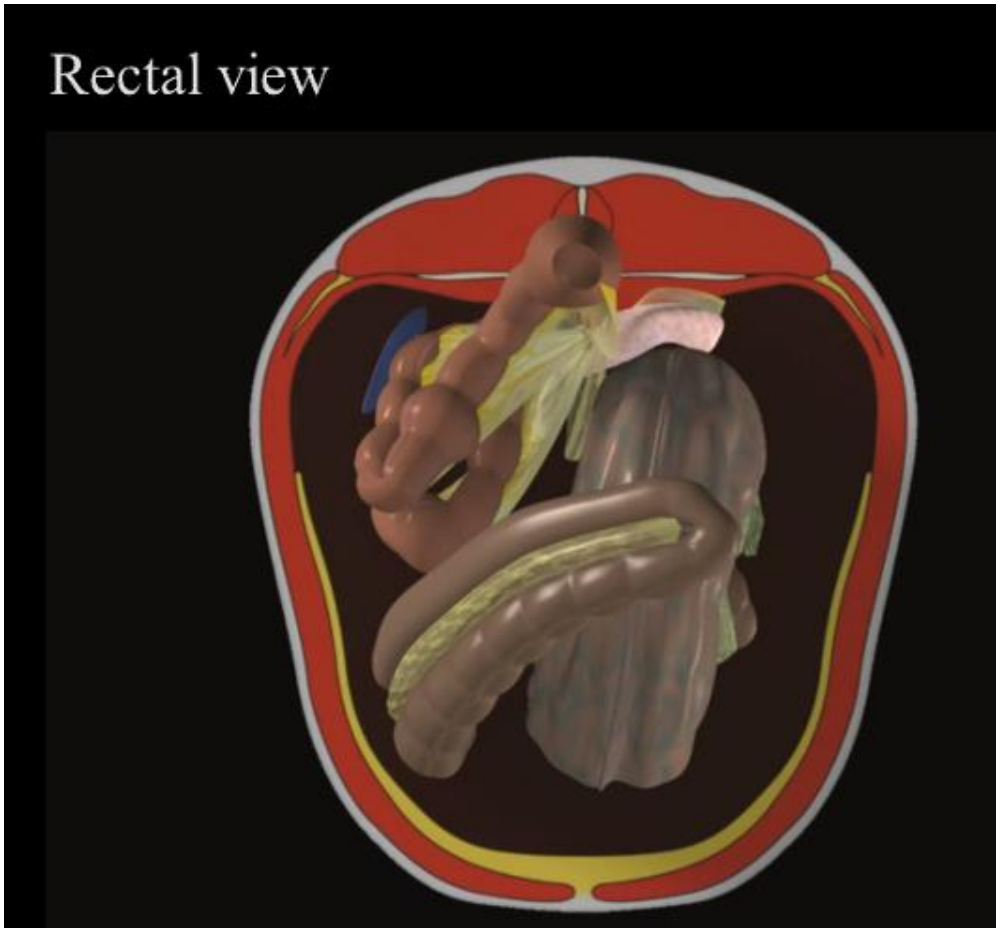


# Horse: Rectal examination

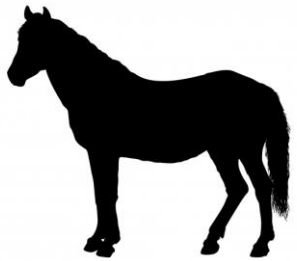


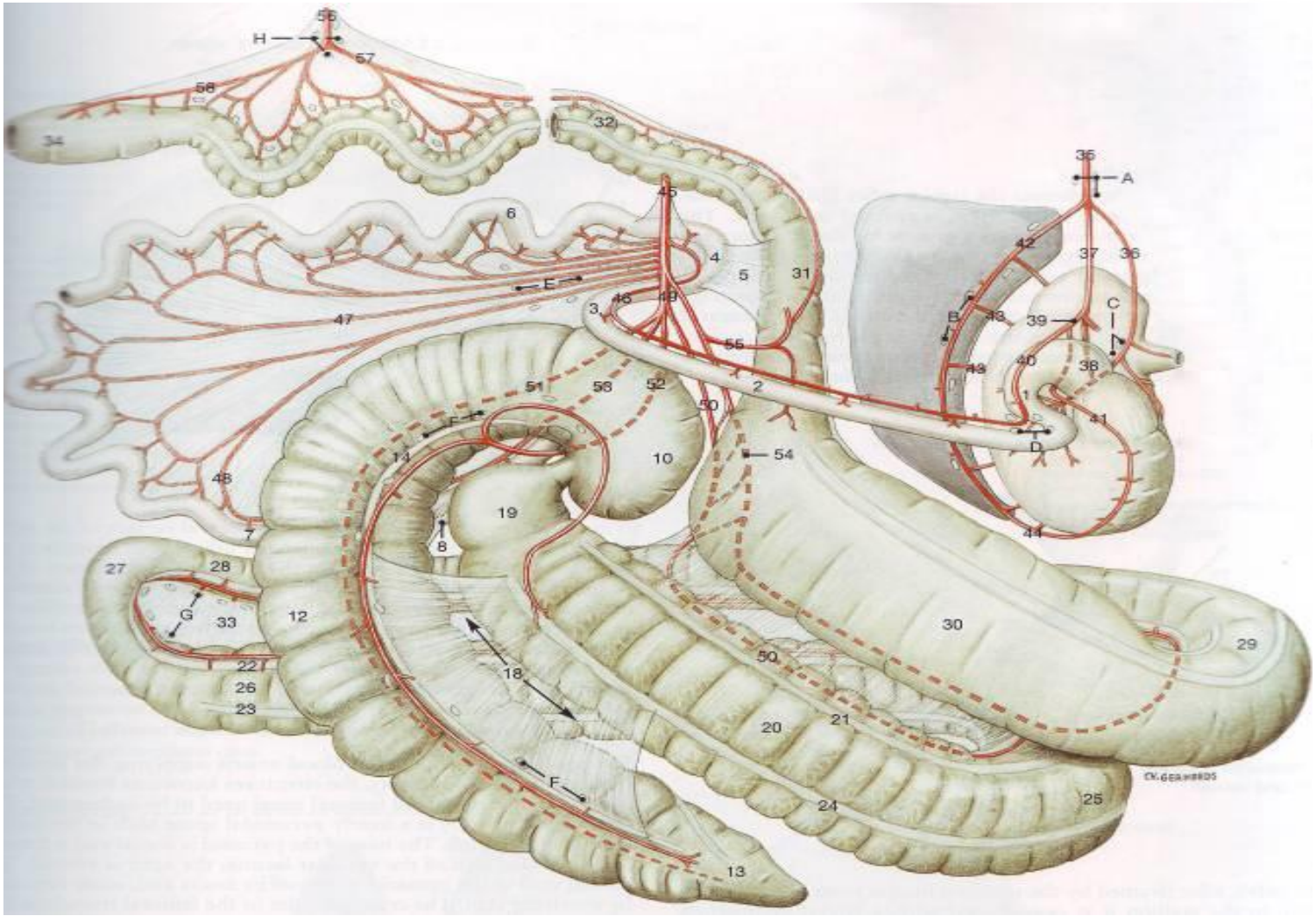
- ***Colic:*** syndrome of abdominal pain

- Common sites for impaction:
  - Base of caecum
  - Pelvic flexure
  - Terminal end of RDC
  - Small colon



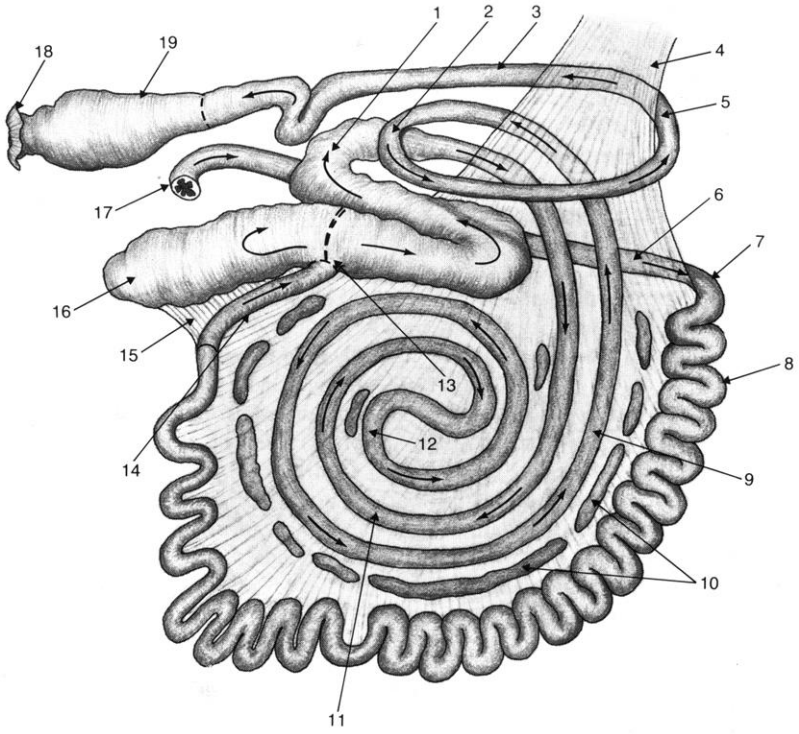
# Horse: Blood supply





# Cow: Large intestine

- Similar calibre to small intestine
- No taenia or haustra
- Lies in supra-omental recess with small intestine



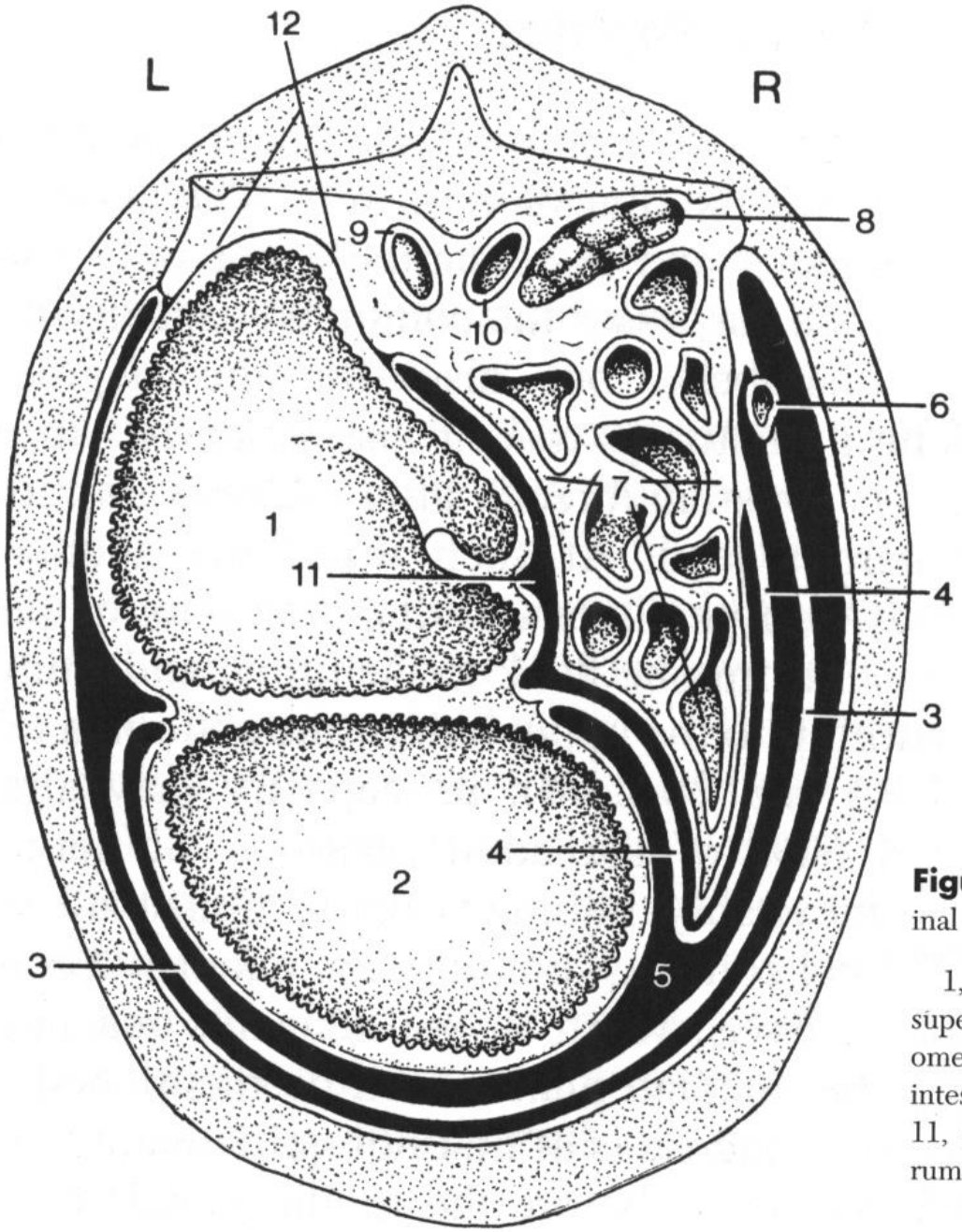
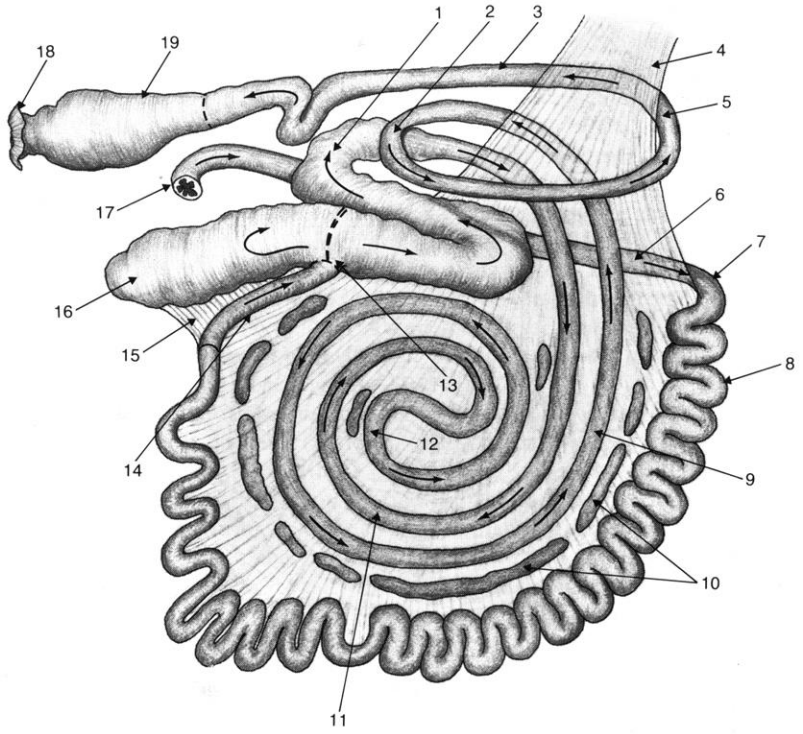



**Figure 28–21.** Schematic transverse section of the abdominal cavity to show the disposition of the greater omentum.

1, Dorsal sac of rumen; 2, ventral sac of rumen; 3, superficial wall of greater omentum; 4, deep wall of greater omentum; 5, omental bursa; 6, descending duodenum; 7, intestinal mass; 8, right kidney; 9, aorta; 10, caudal vena cava; 11, supraomental recess; 12, retroperitoneal attachment of rumen.

# Cow: Caecum

- Simple sac, wide – approx. 8 litres
- Extends caudodorsally in right flank
- Apex lies to R of pelvic inlet
- Separated from right flank by greater omentum



# Cow: Colon

- Ascending colon
  - Proximal loop
  - Spiral loop
  - Distal loop
- Transverse colon
- Descending colon

# Cow: Ascending colon

- Proximal loop
  - Runs cranially, doubles back
  - Turns R to L caudal to root of mesentery
  - Runs cranially then dips ventrally as spiral loop
- Spiral loop
  - Centripetal coils - 2 full turns
  - Central flexure
  - Centrifugal coils - 2 full turns

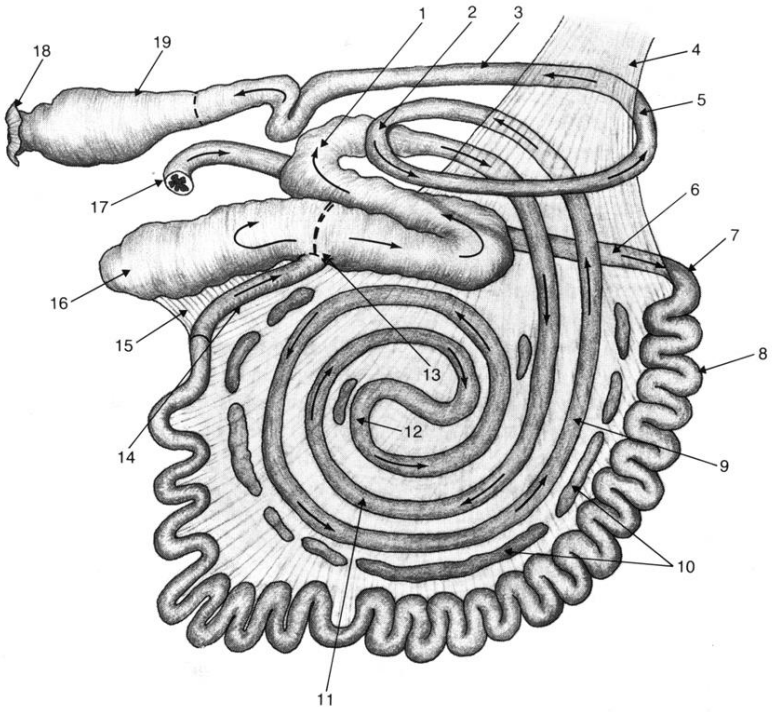
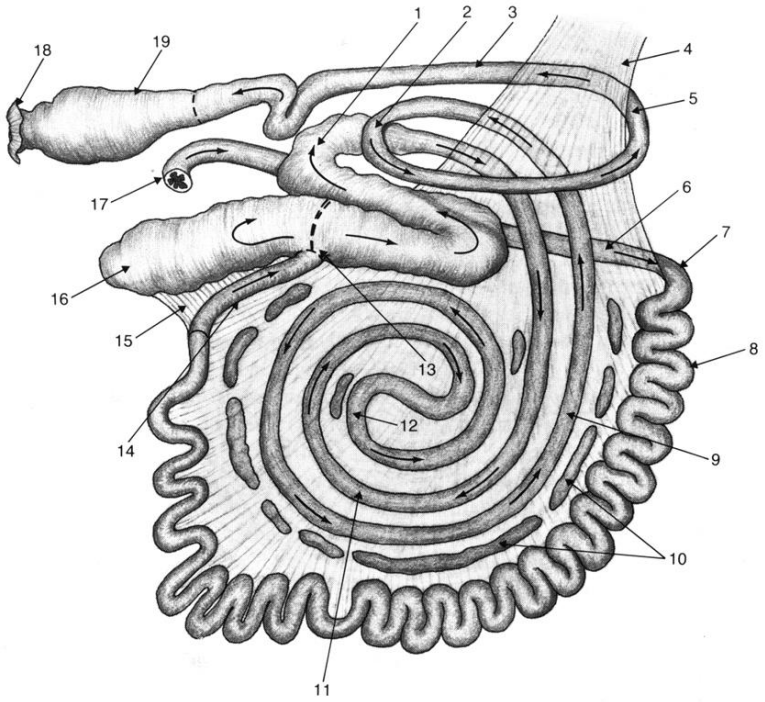



**FIGURE 4–12. Bovine intestinal tract, right lateral view.**

1. Proximal loop of ascending colon
2. Distal loop of ascending colon
3. Descending colon
4. Root of mesentery
5. Transverse colon
6. Ascending duodenum
7. Duodenojejunal junction
8. Jejunum
9. Centrifugal coil of spiral loop of ascending colon
10. Jejunal lymph nodes
11. Centripetal coil of spiral loop of ascending colon
12. Central flexure of spiral loop of ascending colon
13. Ileocecocolic junction
14. Ileum
15. Ileocecal fold
16. Cecum
17. Caudal flexure of the duodenum
18. Anus
19. Rectum

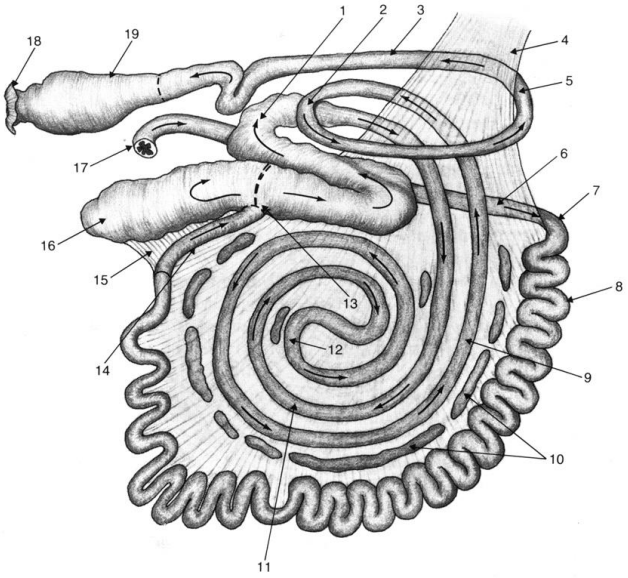
# Cow: Ascending colon

- Distal loop
  - Runs dorsally and caudally on proximal loop
  - Turns L to R caudal to root of mesentery
  - Runs cranially – continues as transverse colon



# Cow: Colon

- Transverse colon
  - Very short; passes R to L cranial to cranial mesenteric artery
  - Continues as descending colon
- Descending colon
  - Runs caudally dorsal to ascending duodenum; inclines to right
  - Forms S-shape flexure near pelvic inlet



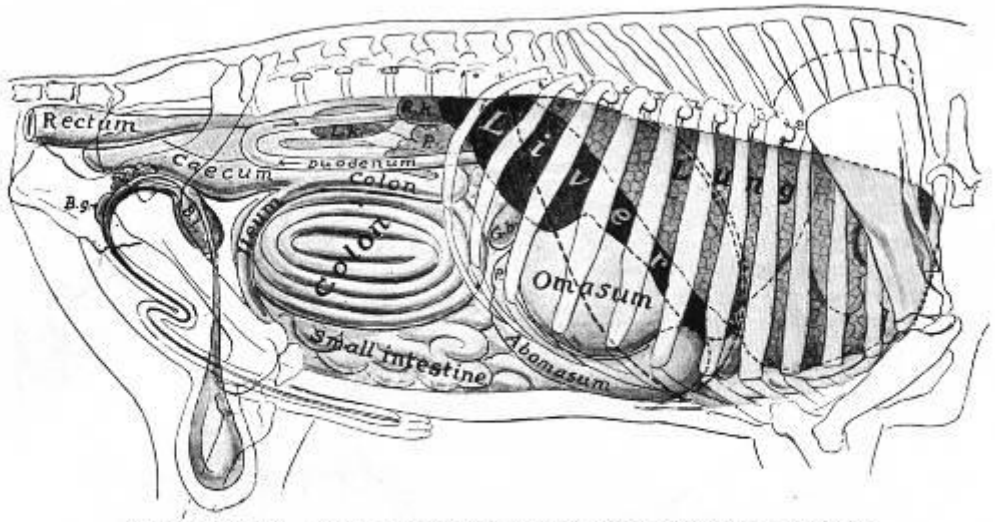
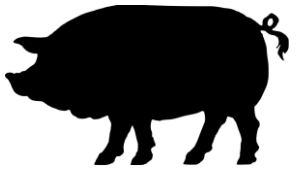



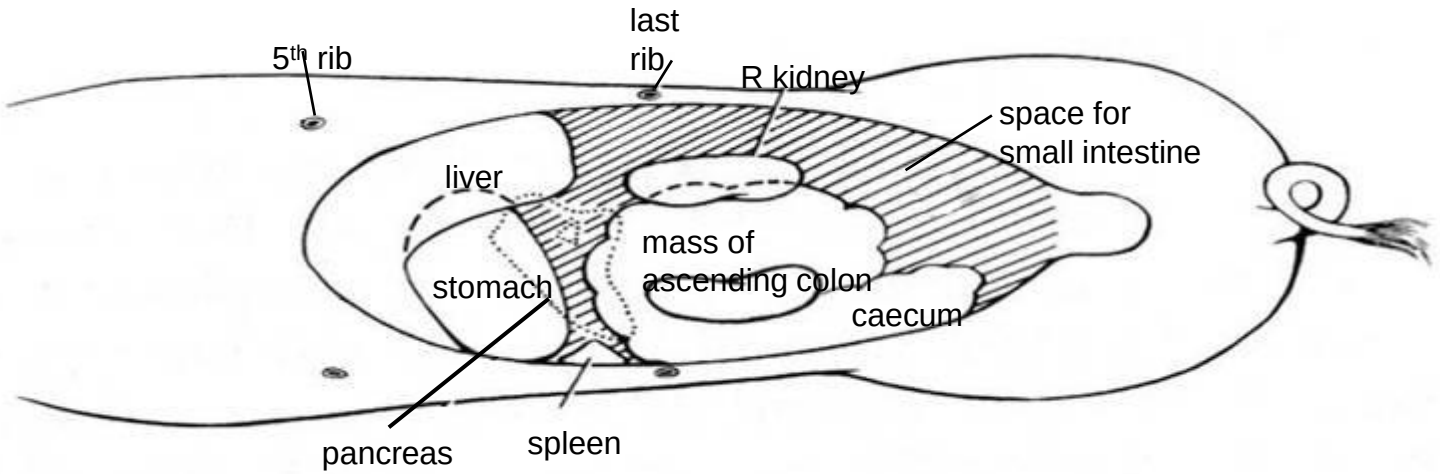

**FIGURE 29–53. Projection of viscera of bull on body wall; right side.**

B.g., bulbourethral gland; Bl., urinary bladder; G.b., gallbladder; L.K., left kidney; P (Above duodenum), pancreas; P (below G.b.), pylorus; R.K., right kidney; V.s., vesicular gland. Costal attachment and median line of diaphragm are indicated by dotted lines.

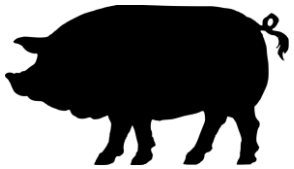
# Pig: Large intestine



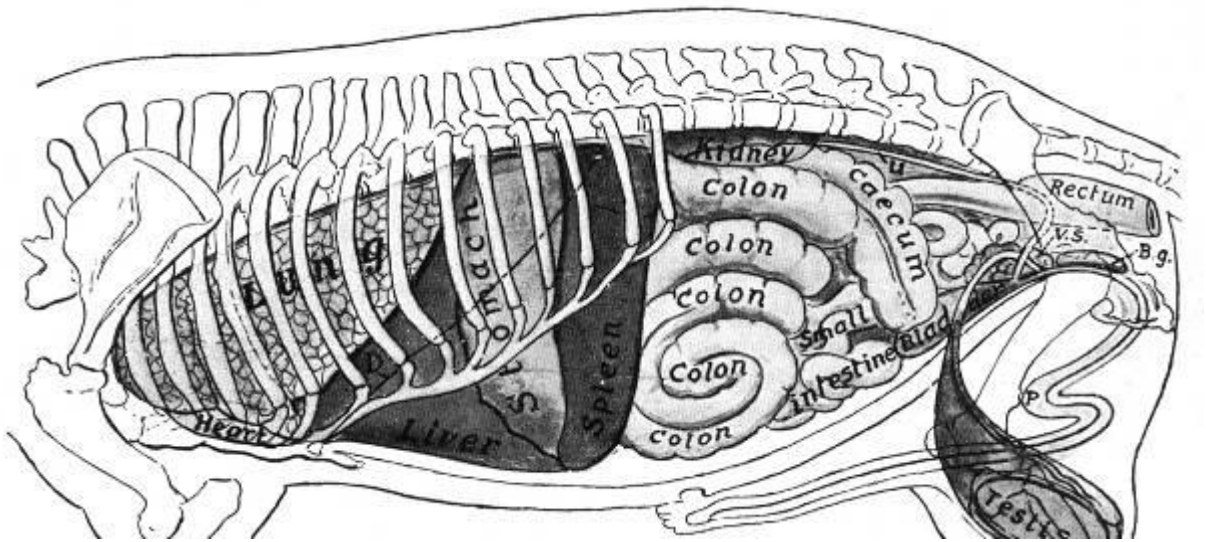
- Much wider than the small intestine
- Positioned between kidneys
- Connected by mesentery to dorsal abdominal wall



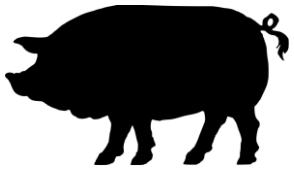
# Pig: Caecum



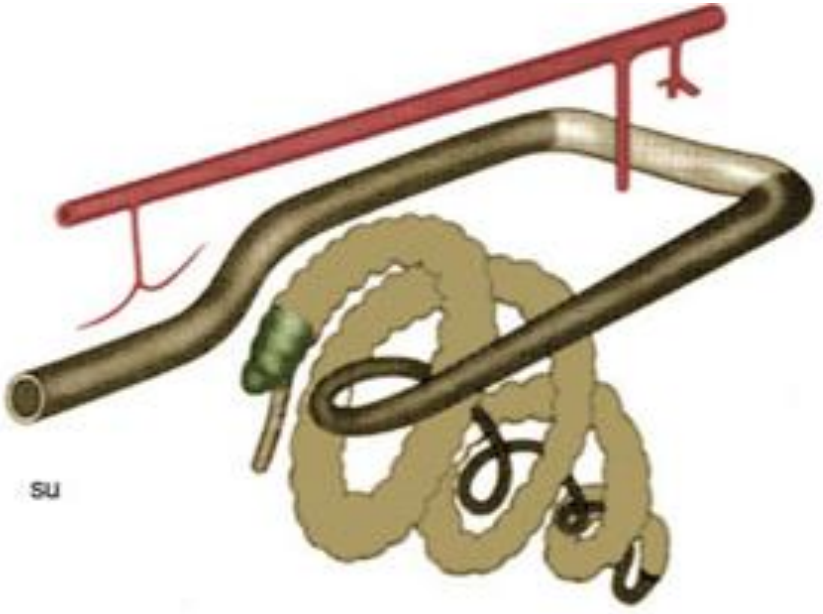
- Dorsal and cranial part of left flank
- Extends ventrally, caudal and medial to spiral colon
- Apex on floor of abdomen near median plane
- Contains 3 taenia and 3 rows of haustra



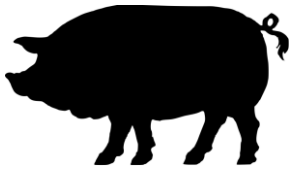
# Pig: Colon



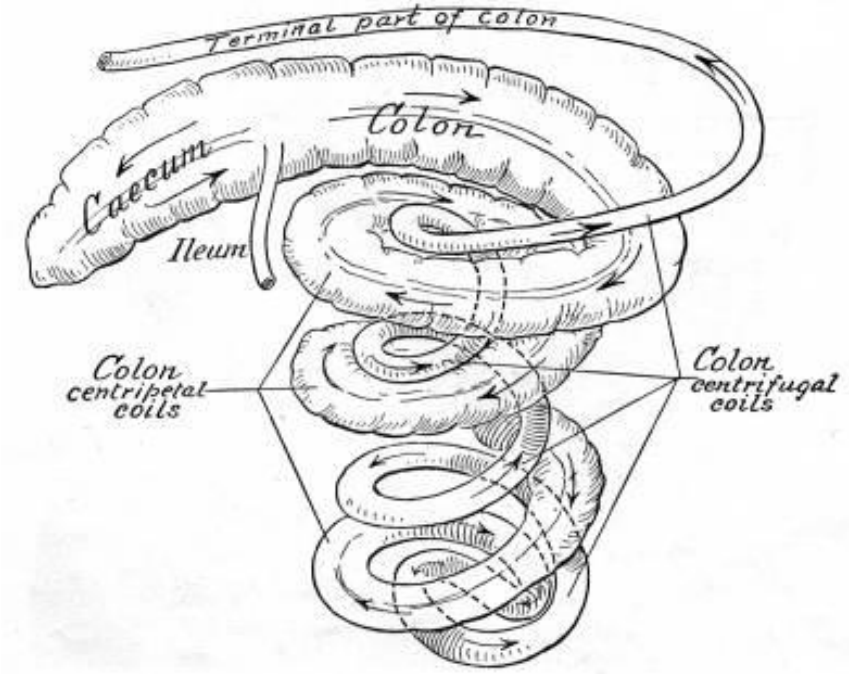
- Decreases in calibre compared to caecum
- Largely to L of median plane
- Divided into:
  - Ascending
  - Transverse
  - Descending

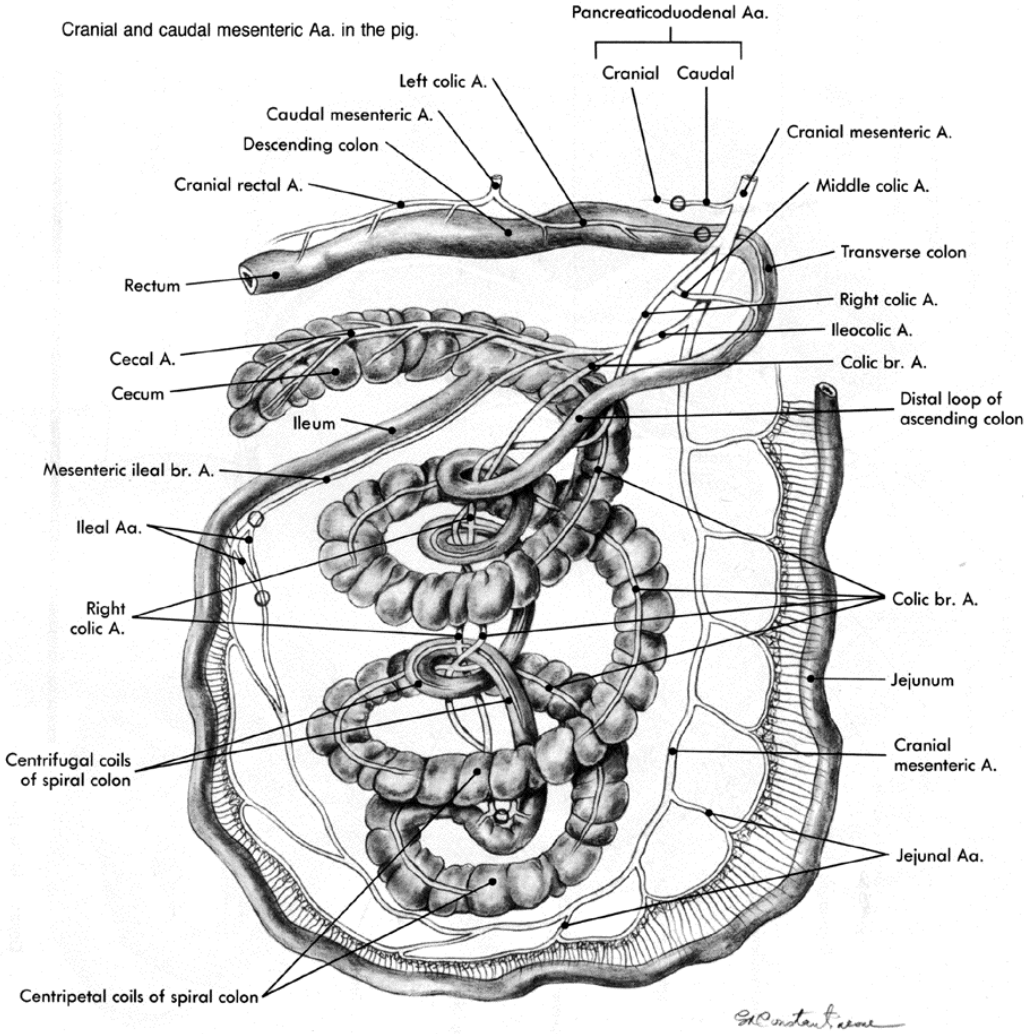


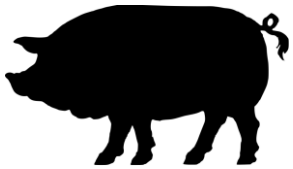
# Pig: Ascending colon



- Coiled to form a cone shaped mass
  - Base is dorsal
  - Apex is ventral
- Centripetal turns (external): 2-3 coils
  - 2 taenia and 2 haustra
- Centrifugal turns (internal)
  - Calibre greatly reduced
  - No taenia or haustra





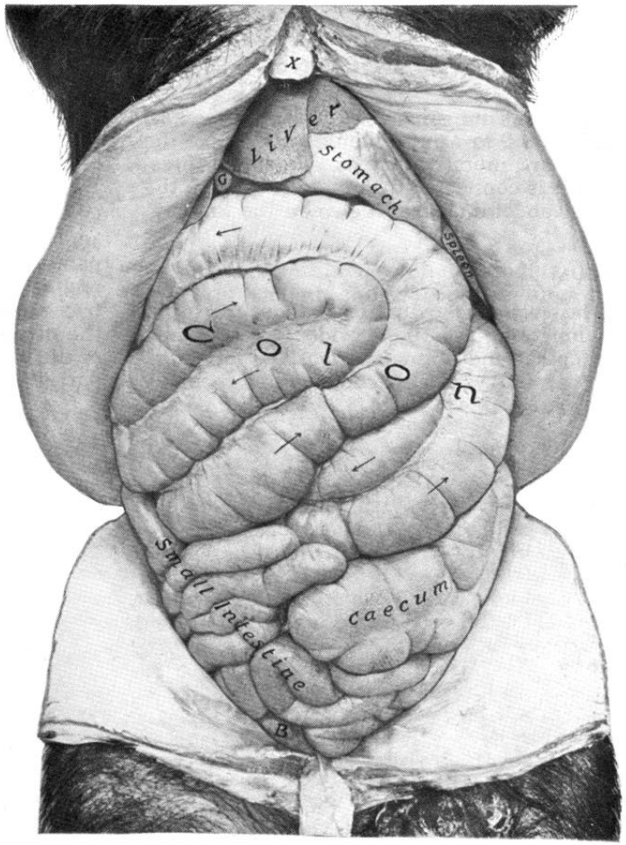



**FIGURE 40–19. Abdominal viscera of pig; ventral view.**

The greater omentum has been removed. B, Urinary bladder; G, gallbladder; X, xiphoid cartilage. Arrows indicate course of coils of colon. The spleen was contracted.

# Birds: Intestines

- Small Intestine
  - U-shaped duodenal loop on abdominal floor
  - 3 pancreatic ducts and 1 or 2 hepatic ducts
  - Umbilical and supraduodenal loops
- Large Intestine
  - Two ceca (most spp) + short colon
  - Terminates at the cloaca

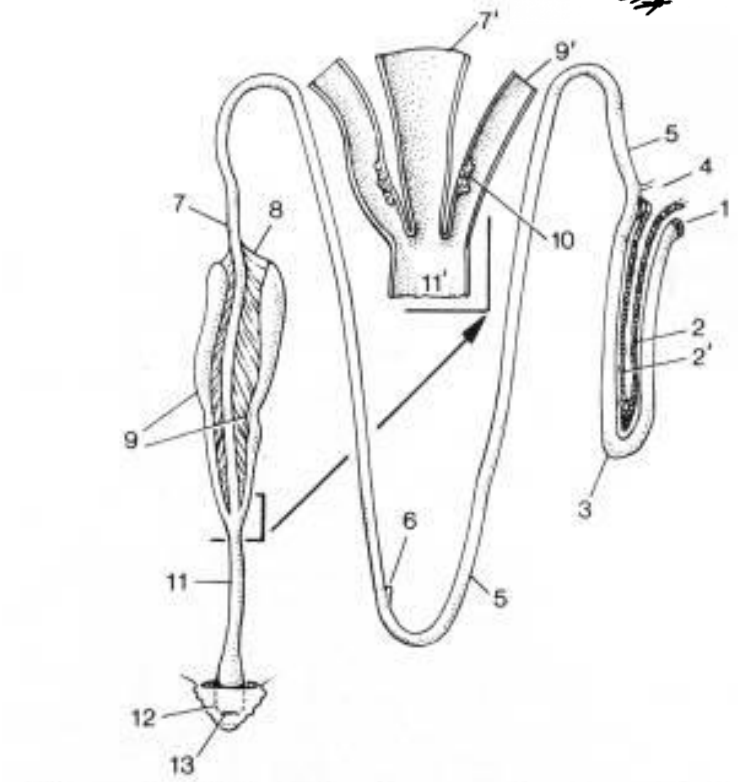



**Figure 39–13.** Isolated intestinal tract with detail of ileocolic junction.

1, Pylorus; 2, 2′, dorsal and ventral lobes of pancreas; 3, duodenal loop; 4, bile and pancreatic ducts entering duodenum; 5, jejunum; 6, vitelline diverticulum; 7, ileum; 7′, ileum opened; 8, ileocecal fold; 9, ceca; 9′, cecum opened; 10, cecal tonsil; 11, colon; 11′, colon opened; 12, cloaca; 13, vent.

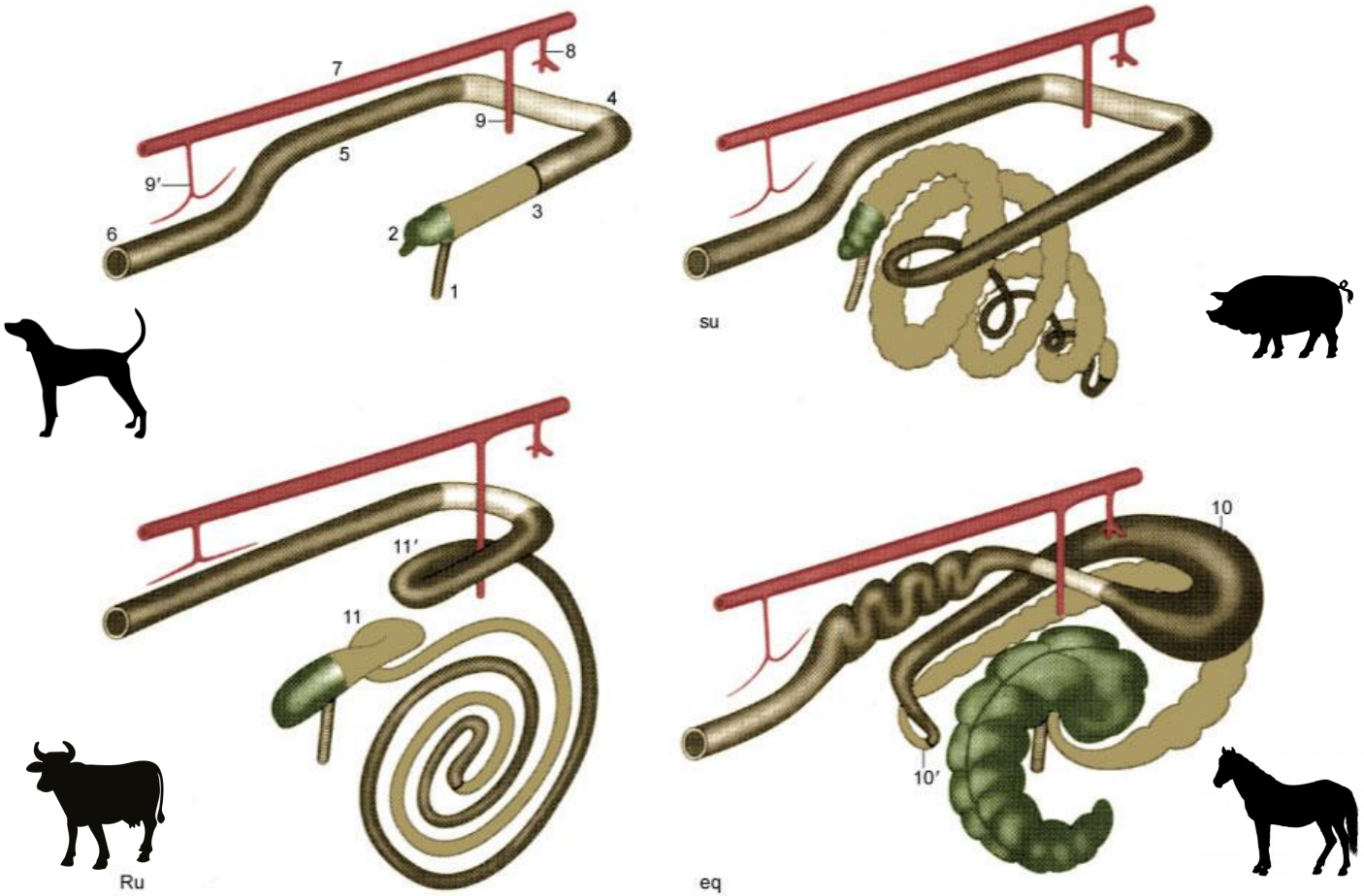



Fig. 3-45. Schematic drawing of the large intestine of the domestic mammals: carnivores (Car), the pig (su), ruminants (Ru), and the horse (eq). Cranial is to the upper right. 1, Ileum; 2, cecum; 3, ascending colon; 4, transverse colon; 5, descending colon; 6, rectum and anus; 7, aorta; 8, celiac artery; 9, 9′, cranial and caudal mesenteric arteries; 10, 10′, dorsal diaphragmatic and pelvic flexures of ascending colon; 11, 11′, proximal and distal loops of ascending colon.