Iconography on the abdominal cavity and viscera of the Balaenoptera, with special remarks upon the peritoneal coverings

BY

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In the baleen whales the abdominal and pelvic viscera with the peritoneal coverings have been seldom studied; only a few authors mentioned them in papers concerning stomach, ovary and testis etc. Meanwhile H. von W. Schulte was probably the only one scientist who worked systematically upon this subject, when he dissected a female foetus of the Sei whale. Recently I had the opportunity to go into this problem by observing foetuses obtained on board of the factory ship, "Nissin Maru No. 1" in the Antarctic expedition in 1948–49. Following foetuses, fixed with formalin, were examined with naked eye.

Serial Number	Species	Sex	Body length
26	Fin	female	3 feet
28	Fin	female	3 feet 5 inches
43	Blue	male	7 feet 8 inches

In the description I will mention at first the general form of the abdomina cavity, dividing it for the sake of convenience into the preumbilical and thel postumbilical region; illustrations of the relatively more simple constructed postumbilical region in both sexes will follow, and then the pictures showing the more complicated preumbilical region will be added. Next each of the abdominal and pelvic viscera will be treated, laying stress especially on the peritoneal coverings as well as on the topographical relations between the viscera and the parietal peritoneum. Bibliography will be noted at the end.

OBSERVATIONS

I GENERAL OUTLINE

The lateral view of the abdominal cavity is schematically shown in Fig. 1, in which the capacious preumbilical region is more of a rounded form, while the postumbilical region is narrow in dorsoventral direction. The narrowness of the latter is due to the huge mass of longitudinal muscles, which lie ventrally to the

vertebral column, protruding considerably from the dorsal wall in this part of the body. The postumbilical region is divided by a large peritoneal fold, plica urogenitalis, or better to be called plica genitalis, as it is not concerned with urinary organs, into two cavities, excavationes rectovesicales dorsalis et ventralis.[1)]

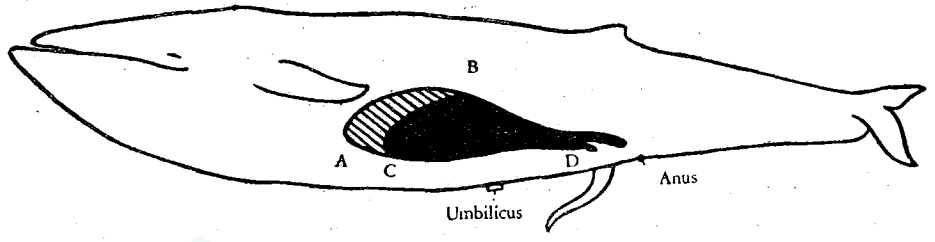


Fig. 1

The highest point of the abdominal cavity, that is, the locus, where the diaphragma reaches the most deeply into the thoracic cavity (Fig. 1, A), is at the level of 9. thor. vertebra, while the lowest point of the thoracic cavity, where the diaphragma takes origin from the posterior abdominal wall (Fig. 1, B), is at the upper end of 3. lumb. vertebra (median) or the lower end of 4. lumb. vertebra (laterally) and the point, where the diaphragma is attached to ribs median ventrally (Fig. 1, C), corresponds to the level of 12. thor. vertebra. The caudal end of the excavatio rectovesicalis ventralis (Fig. 1, D) is at the height of 14. lumb. vertebra.

Actual measurements in No. 26 resulted; A-D 20.5 cm, the greatest breadth of the abdominal cavity 8 cm, the greatest depth 7 cm, both at the level of the 2. lumb. vertebra.

The black area in Fig. 1 denotes the abdominal cavity, the obliquely lined area a portion of the diaphragma which is projecting into the thoracic cavity, with the heart on its ventral slope and with the lungs on its dorsal slope.

Fig. 2 shows the ventral view of the parietal peritoneum, muscles and fat tissues entirely picked off. At the middle the cut surface of the umbilical cord is found, having two arteries and two veins. Cranially to it and median, the umbilical vein is seen, two at first but soon they join into one. Caudally to the navel there is the bladder with the umbilical arteries on both sides; besides, the liver, the intestines, and the plica urogenitalis are visible through the thin parietal

1) Although they are called "excavatio rectouterina et vesicouterina" in the human anatomy, these names are not appropriate here, for the conditions in the whale are nearly the same between male and female.

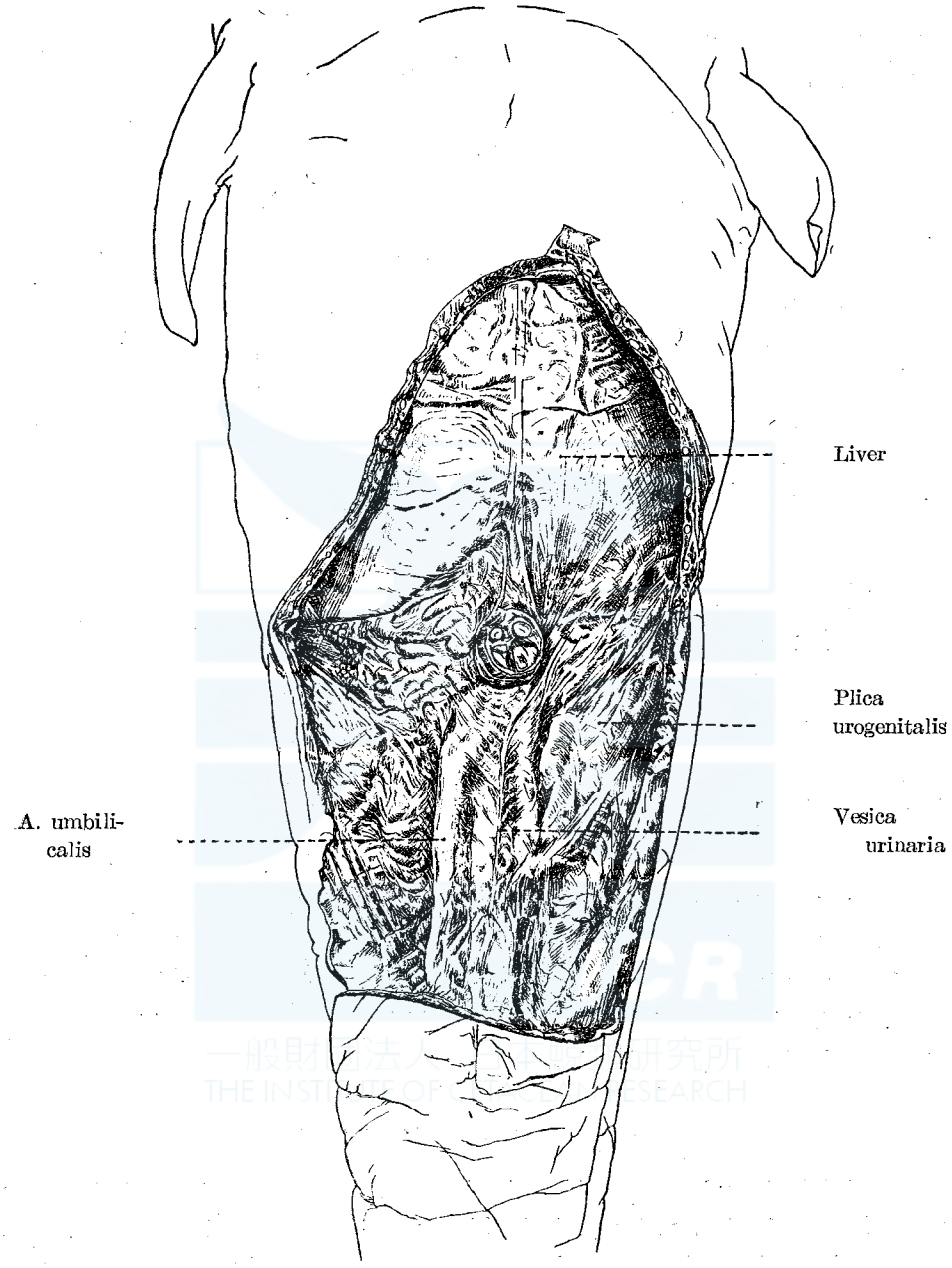


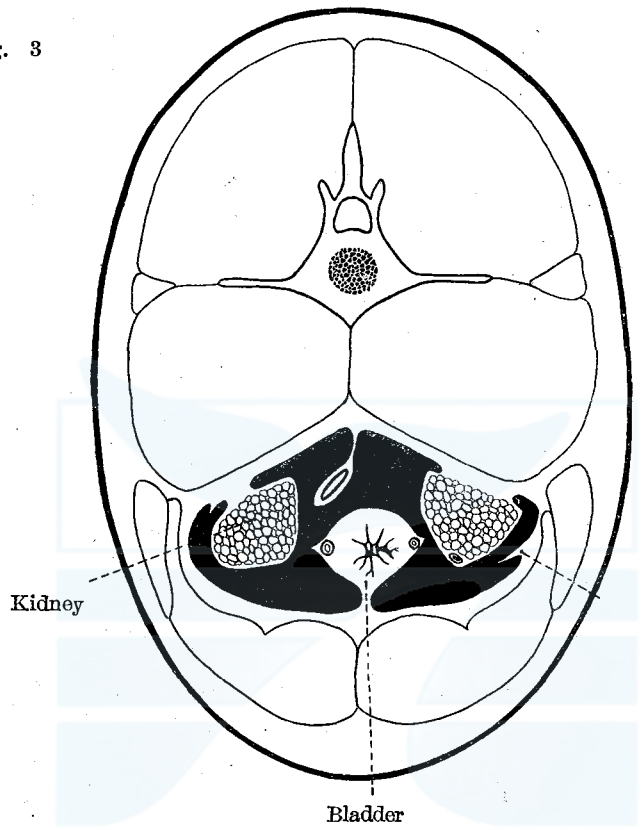
Fig. 2

peritoneum of the anterior body wall.

Fig. 3 is a diagram showing a transection of the whale's body at the lower

part of the navel. Dorsally median, mesocolon is found, kidneys lateral to it, and

Fig. 3



more ventrolaterally a part of plica urogenitalis, which deserves here the name, plica diaphragmatica, and the bladder lies ventrally median with the umbilical arteries. The large muscles dorsal to the abdominal cavity and ventral to the vertebral column is the above mentioned musculature which makes the postumbilical region so narrow in dorsoventral direction.

II POSTUMBILICAL REGION

No definite boundary is to determine between the pelvic cavity and the other parts of the abdominal cavity, and the kidneys cause remarkable prominences on the posterior abdominal wall. In both sexes the large peritoneal duplicature, plica urogenitalis, rises from the lateral wall corresponding to the height of the upper end of the kidney and extends mediocaudally and ventrally to the kidney, forming the plica diaphragmatica; both halves, left and right, of the fold join together

at the lowest level of the kidney, and form the so-called plica lata, which divides the cavity completely into two excavations already mentioned. Of them the excavatio rectovesicalis ventralis, which contains the bladder is small, while the excavatio rectovesicalis dorsalis is elongated with the colon passing in it. The plica urogenitalis shows remarkable sexual differences.

(1) In the female.

Fig. 4 represents the female pelvic viscera in situ, the parietal peritoneum deprived off. Cut surfaces of the bladder and of the umbilical artery are visible

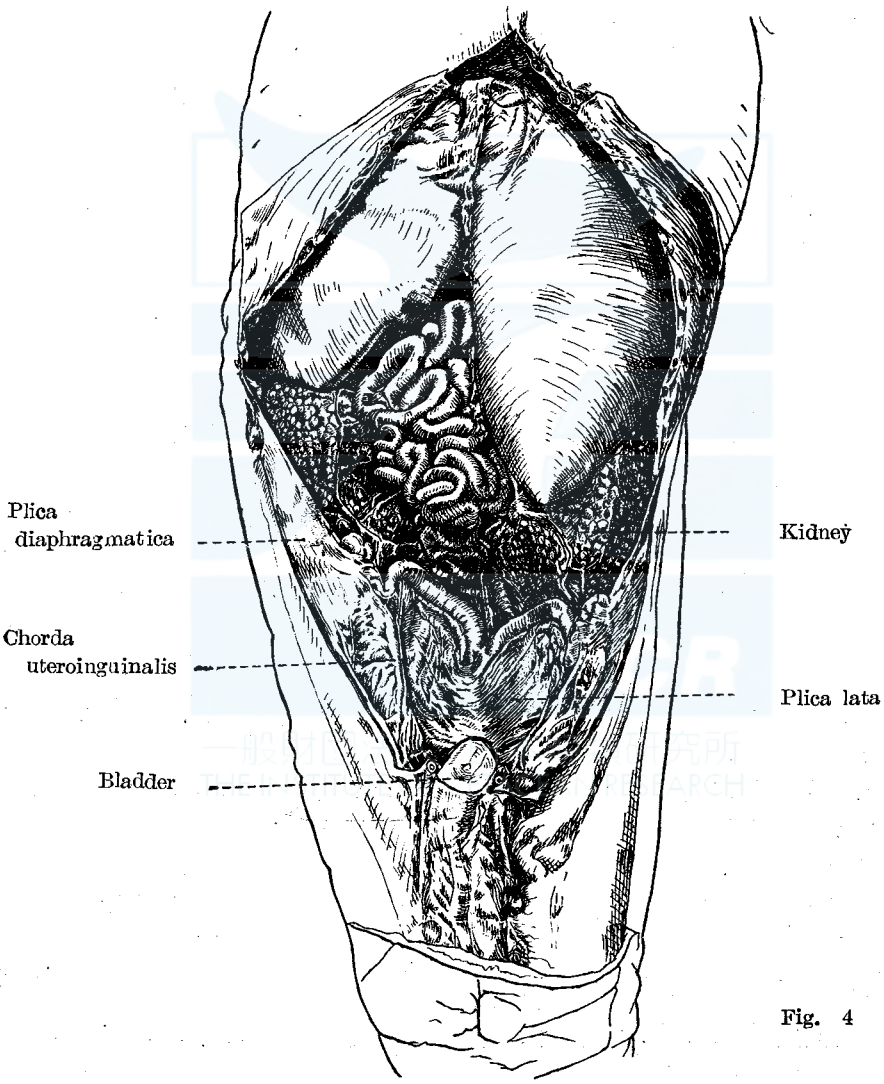
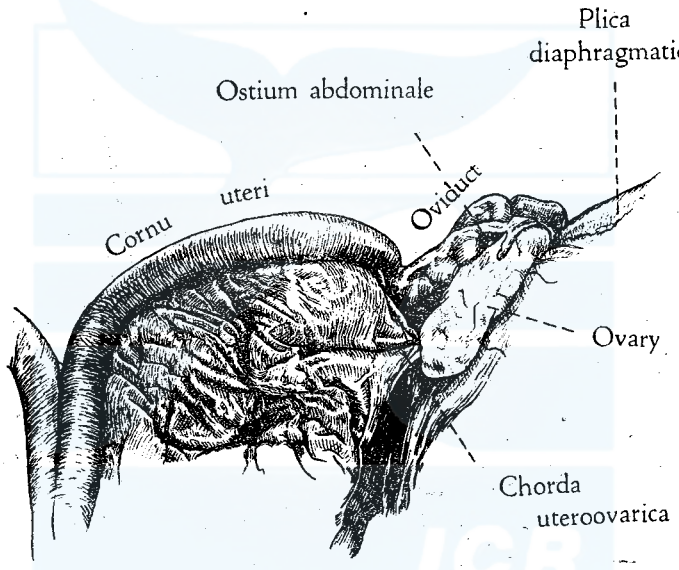


Fig. 4

in the caudal part. The ovary is attached dorsally to the plica diaphragmatica near the lower margin of the kidney. At the upper edge of the plica lata the uterine cornua and the oviducts are seen. The plica lata is thick and not so transparent, that the uterine corpus and ovary can not be seen through. On the plica lata we see a pair of thick bands (chorda uteroinguinalis=lig. teres uteri) running caudad from the distal end of the uterine cornua.

Fig. 5 shows a part of the plica urogenitalis seen from behind; only the right half is drawn. After making a ventral curvature, the uterus continues to the oviduct, which is short, thin but remarkably wound, lying a little lower than the border of the mesosalpinx and the part of the peritoneum more distal than the

Fig. 5



abdominal aperture of the oviduct is folded, forming a ligament.[2]. In Fig. 5 this ligament is partially cut to make the ostium abdominale visible, but no fimbriae are seen. The chorda uteroovarica (=lig. ovarii proprium) runs from the plica lata to the medial central part of the ovary. The right ovary is situated a little higher than the left.

To show this part more clearly, the transverse sections passing through the ovary and just above the union of uterine cornua are illustrated in Fig. 6 A et B. In A the ovary is found attached dorsally to the plica urogenitalis by means of

2) Ommanney noted this ligament and the wavy course of the oviduct is illustrated well in the paper of Beauregard et Boulart (1882).

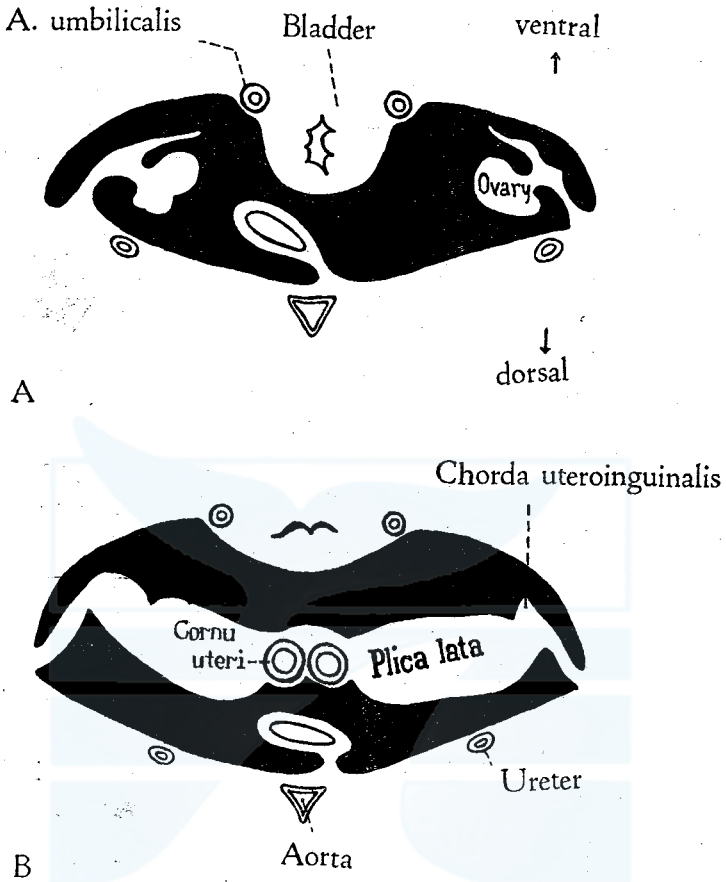


Fig. 6

mesoovarium and in B the thickness of the plica lata and of the chorda uteroinguinalis are indicated.

(2) In the male

Fig. 7 shows the postumbilical region in the male. The plica diaphragmatica suspends the testis at the height of the caudal end of the kidney. The epididymis is seen cranially to the testis and the vas deferens runs caudad, lateral to the testis and between them a deep furrow, sinus epididymidis, is formed, being bounded by a peritoneal fold on the side of vas deferens. The vas deferens is bent mediad, dorsally to the mesorchiagus of Eschricht (=gubernaculum testis?), a strong cord running from the testis on the ventral surface of the plica lata, and converges from both sides in this peritoneal fold to open into the urethra.

Fig. 8 shows schematically the relationships between plica urogenitalis, testis,

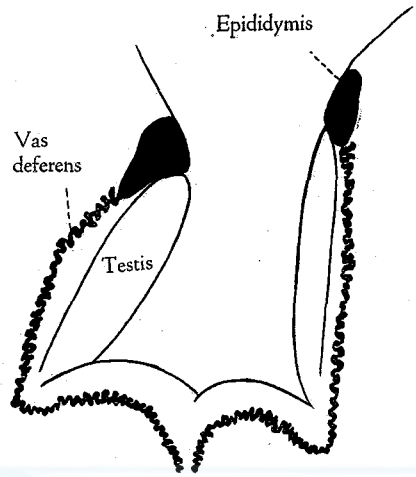

Epididymis
Vas deferens
Testis

Fig. 7

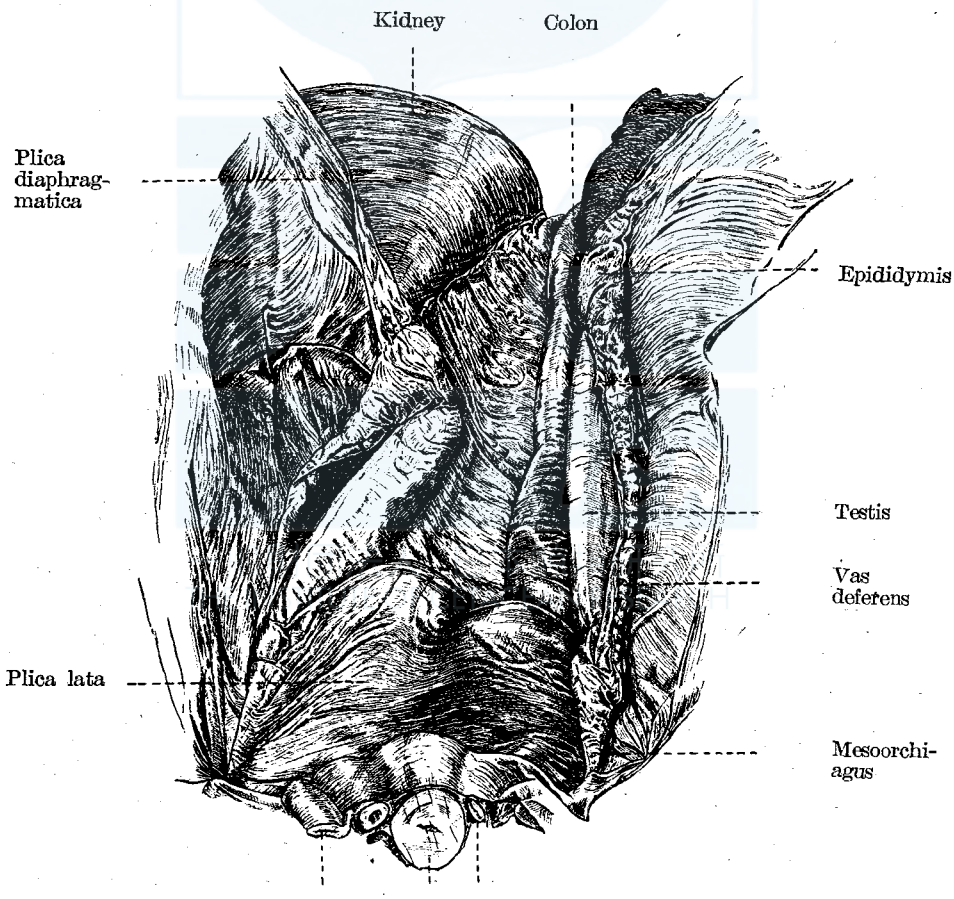

Kidney
Colon
Plica diaphragmatica
Epididymis
Testis
Vas deferens
Plica lata
Mesoorchiagus
Ureter
Bladder
A. umbilicalis

Fig. 8

epididymis and vas deferens.

The dorsal surface of the plica diaphragmatica is smooth; strong fibres are seen at the edge of this fold and at the caudal end of testis. Fig. 9 is a diagram of this part, cut near the middle of testis.

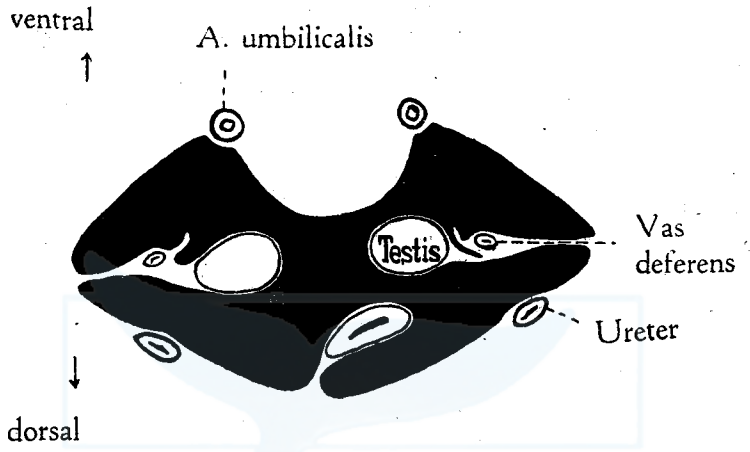


Fig. 9

(3) Excavatio rectovesicalis dorsalis

Fig. 10 shows a longitudinal section of the dorsal excavatio rectovesicalis. The rectum, except its small portion near the anus, is cut off but the mesocolon remains. From ventrally the bladder, the urethra, next the uterus and vagina are recognized

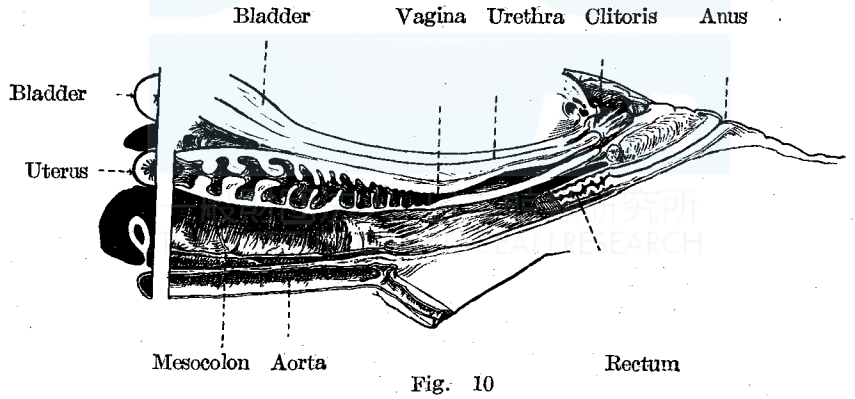


Fig. 10

and the abdominal cavity reaches very deeply near the anus. At the left side of this figure a diagram of the transectioned outline of this area is added.

III PREUMBILICAL REGION

As to this region, no remarkable sexual difference is ascertained.

In Fig. 4 the ventral mesohepaticum (=lig. falciforme hepatis) is cut off and two umbilical veins unite into one before they enter the liver. The large liver occupies the upper part of the abdominal cavity and the small intestine, forming a mass, lies under the left hepatic lobe and extends from here to the right and

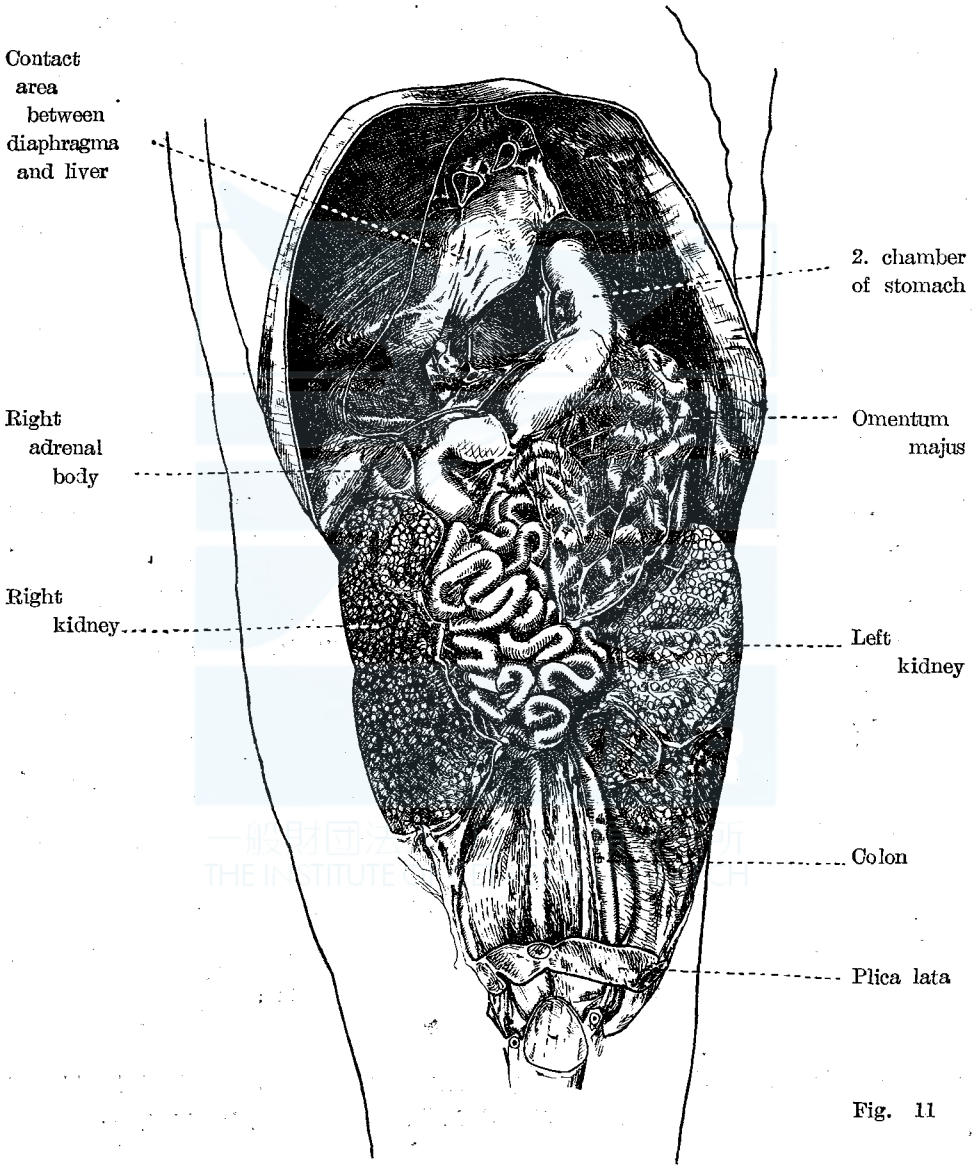


Fig. 11

caudal direction upto the umbilical region. The hepatic parenchyma is so fragile that we can easily pick it off with pincette, leaving only the capsule. The fragility seems to be due partly to insufficient fixation as I did not inject any fixing fluid intravascularly.

In Fig. 11 the plica urogenitalis and the hepatic parenchyma are taken off. The hepatic capsule is cut along the line, where it reflects upon the diaphragma and turns to the lesser omentum. The liver is adhered in a square form to the diaphragma and also to the 2. and 3. chamber of stomach, and to the pancreas. The lesser omentum is very small and no foramen epiploicum is present. The right lateral mesohepaticum (=lig. triangulare hepatis) does not exist distinctly, while the left lateral one is slender but well developed, courses at first laterad, next caudad. The 2., 3. and 4. chamber of stomach (the fourth chamber is nothing but the duodenal ampulle) come into sight and the small intestine hitherto concealed by the left hepatic lobe can be seen, its mass extending from left cranial to right caudad and nearly half of it being envelopped by the larger omentum. The larger omentum, originally situated between the stomach and the mass of the small intestine, is artificially stretched to show its whole extent. The kidney is proportionately very large; to the relatively higher located right kidney is attached the right adrenal body. In the caudal part the colon is seen running downwards between both kidneys and we see here the cut surfaces of uterus and plica lata.

By obliteration of the foramen epiploicum the omental bursa is all over closed and the larger omentum retains its cavity, bursa omenti majoris. Now the larger omentum is cut at its entrance, hiatus bursae omenti majoris, and the small intestine is for the greatest part taken off, cut at the duodenojejunal flexure and just before the ileocaecal transition, leaving the radix mesenterii. The kidneys are also cut off. Fig. 12 was drawn from a little left side. We see the attachment of the larger omentum to the stomach, but not its attachment to the pancreas, owing to the presence of colon. The caecum is located at the height of umbilicus. The colon ascends on the ventral surface of the mesentery, and without any definite transverse portion, descends then on the dorsal surface of the mesentery. The left adrenal body is located apart from the kidney, dorsally to colon descendens.

In Fig. 13 the colon is cut off, and the stomach is lifted a little. The ascending colon is adhered to the pancreas and the lines of origin of the larger omentum from stomach and pancreas are clearly seen. The duodenum, continuing from the ampulla duodeni, descends and turns to left around the caudal end of radix mesenterii, then runs further transversally and ascends dorsally to reach the duodenojejunal flexure.

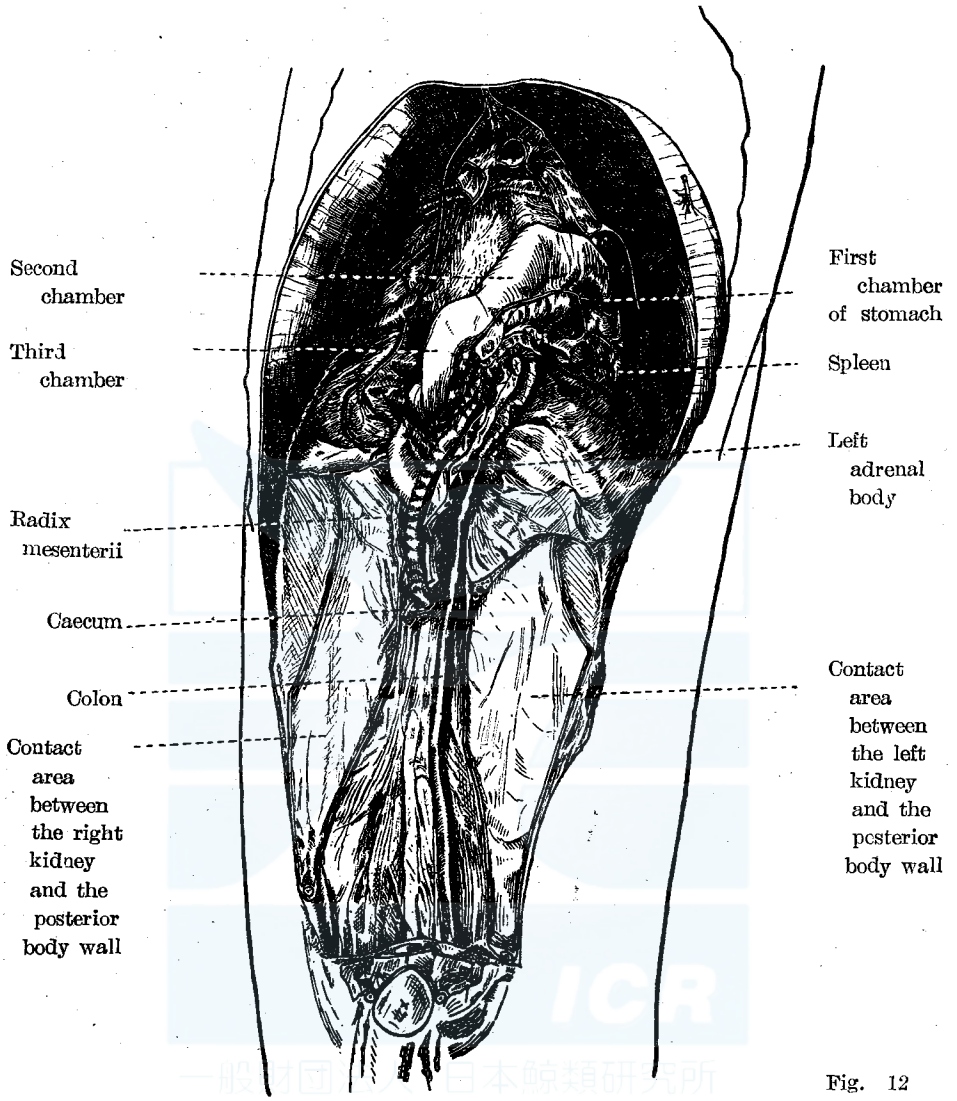


Fig. 12

In Fig. 14 all chambers of the stomach are taken off; we see now the total ventral aspect of the pancreas. The 4. chamber is cut at its junction with duodenum transversum and the colon is cut just proximally to its adhesion to the pancreas, so that a part of the colon remains attached to the pancreas. As the inferior vena cava penetrates deep through the liver, its sectioned surfaces, cranial and caudal, are seen and on the left side of its caudal cut is the area where the 1. chamber of stomach is attached to the diaphragma and at the middle of this area we see the end of the oesophagus. In the pancreas, tuber omentale is strongly formed and

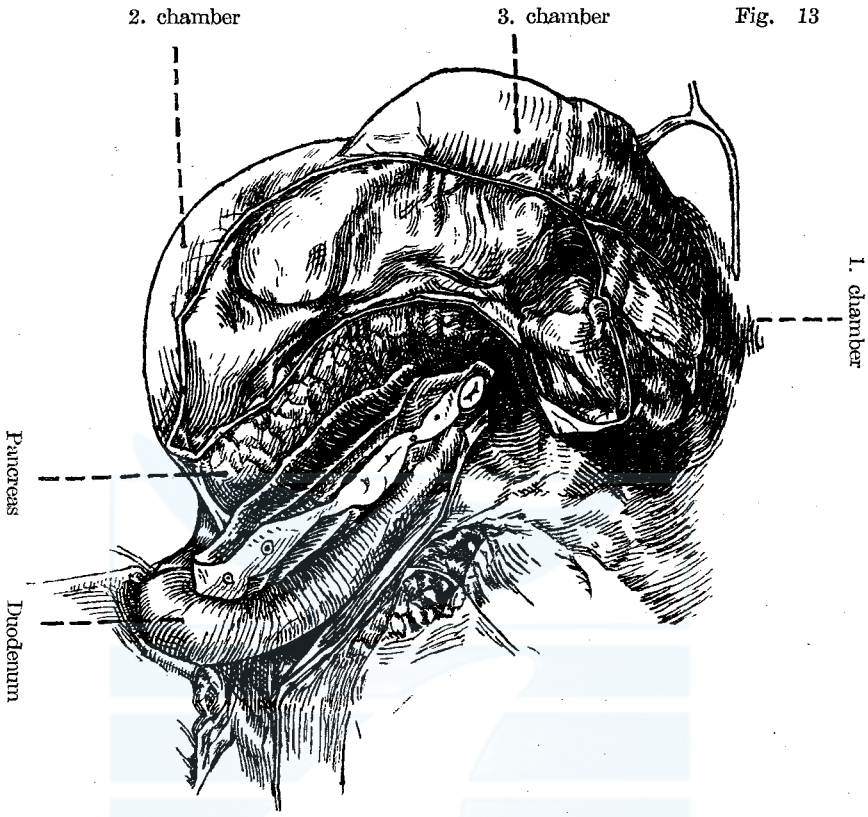


Fig. 13

the cut surface of the portal vein is visible, appearing from behind the pancreas, to enter the liver. The part of the pancreas left to tuber omentale is its corpus, which makes a part of the dorsal wall of the omental bursa, and the cauda of the pancreas is directed dorsad. The part left to tuber omentale is of a small triangular form, faces also to the omental bursa from behind and the caput of pancreas slopes dorsad at the right side of tuber omentale; the 4. stomachal chamber is adhered to the caput.

Fig. 15 shows the posterior body wall itself, almost all of the viscera deprived of. The area of attachment of the liver and of the 1. stomachal chamber to the diaphragma is naturally the same as in the former figure but caudally to the area of the 1. stomachal chamber there is a place, where the cauda of the pancreas is attached to the diaphragma. And the inferior vena cava passes behind the middle of the pancreas area. The mesoduodenum is, after the caput of pancreas has disappeared, is directly broadly adhered to the posterior body wall, bending transversad caudally to it and disappearing at the pancreatic cauda area, where the duodenojejunal flexure lies. Scarcely any mobility of the duodenum can be assumed

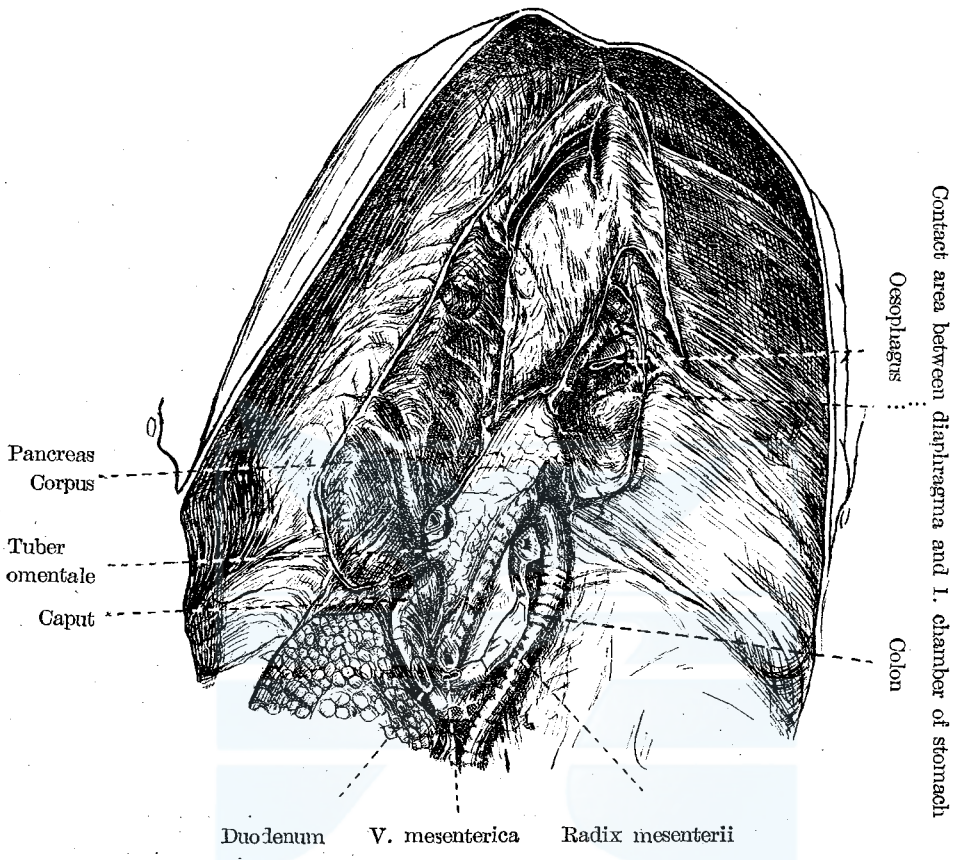


Fig. 14

from the broadness of mesoduodenum. The mesocolon is situated left to the mesoduodenum ascendens and ends at the pancreatic cauda area, for it is adhered to the ventral surface of radix mesenterii. The part between the pancreas-area and the mesoduodenum-area is radix mesenterii and there the cut end of the mesenterial artery is seen. The right adrenal body lies partially concealed by the pancreas.

Fig. 16 shows the stomach already illustrated in Fig. 11, but viewed from more right and ventral direction. The 2. and 3. chamber are adhered to the liver and the 4. chamber to the ventral surface of the pancreas. The part of the hepatic capsule which faces to the omental bursa, that is, the free surface of the papillar process is taken off, so the pancreatic corpus can be seen and the upper border of the pancreas in this figure is the entrance to the bursa of the larger omentum.

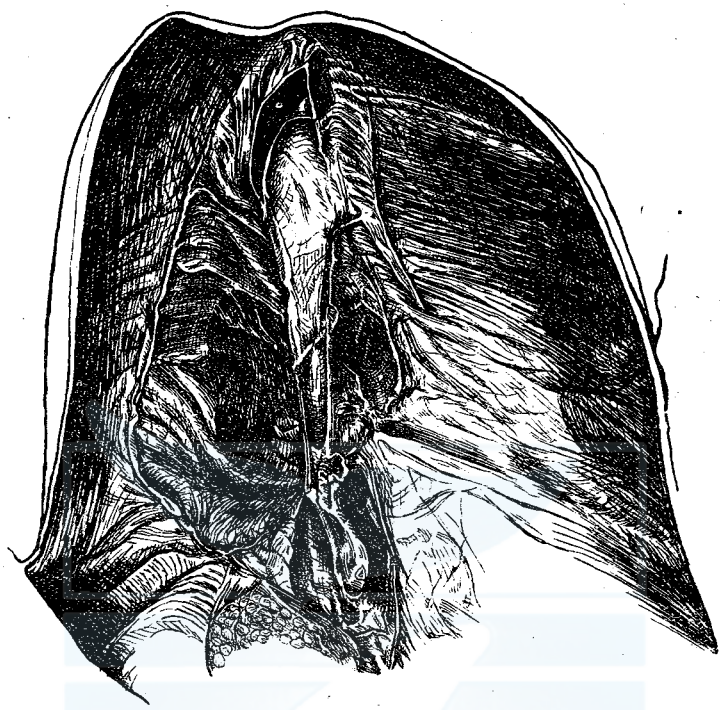


Fig. 15 (a)

IV REMARKS UPON EACH ORGAN

In this chapter, the abdominal and pelvic viscera will be described, especially in relation to the peritoneal covering. In the following figures the white area always means the part covered with peritoneum, the oblique-lined area the portion adhered to other organs or to the body wall, the dotted area the part facing to the omental bursa.

(1) Liver (Fig. 17)

It occupies nearly all of the upper abdominal cavity, its right lobe is very large, but the left lobe extends more caudally and covers from ventral the mass of small intestine, stomach and upper part of the left kindey (Fig. 4); so we can easily recognize on the dorsal surface of the liver, hollows caused by stomach, duodenum, intestine and kidney. As the inferior vena cava is entirely embedded into the liver, the caudate lobe can not be discriminated and the right and the left lobe of the liver are directly continuous in the dorsal part. Only the papillar process is well developed and adhered ventrally to the 2. and 3. stomachal chamber

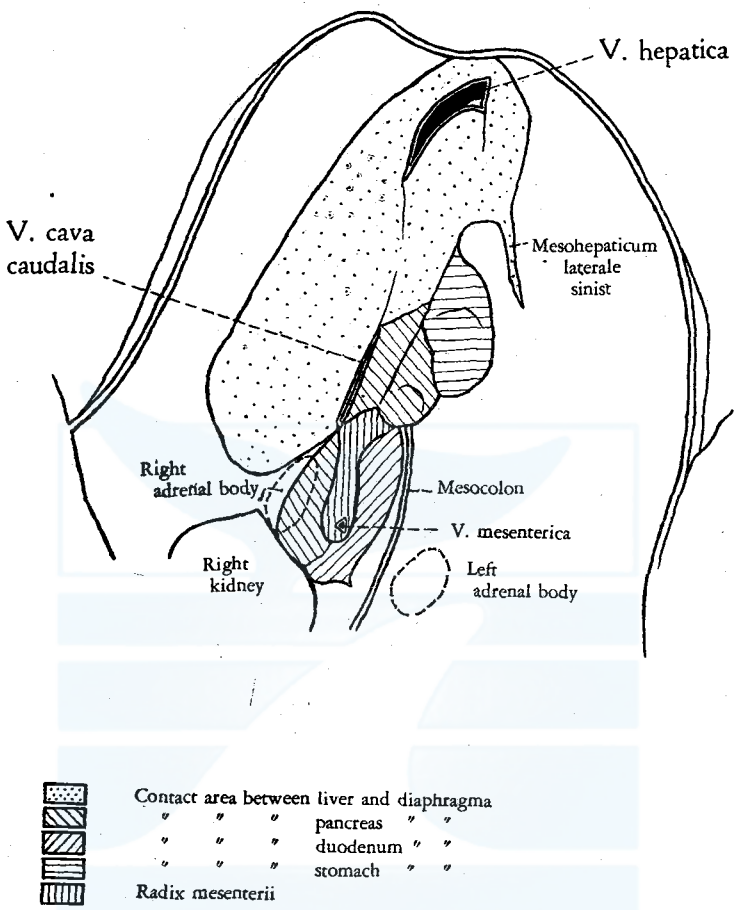


Fig. 15 (b)

and the dorsal durface of its base is attached to the pancreas so that it is nearly encircled with stomach and pancreas, projecting into the omental bursa between them. We see neither the quadrate lobe nor the gall bladder. The ventral mesohepaticum broadens from the point where the inferior vena cava passes through the diaphragma, to which the liver is attached in a square form.

(2) Pancreas

Fig. 18 shows the relation of the pancreas to other organs. The area, where it is attached to posterior abdominal wall, is finely oblique-lined, while the area of its attachment to other organs is roughly oblique-lined. The pancreas is situated dorsally to stomach and duodenum, cranially to colon and almost parallel to

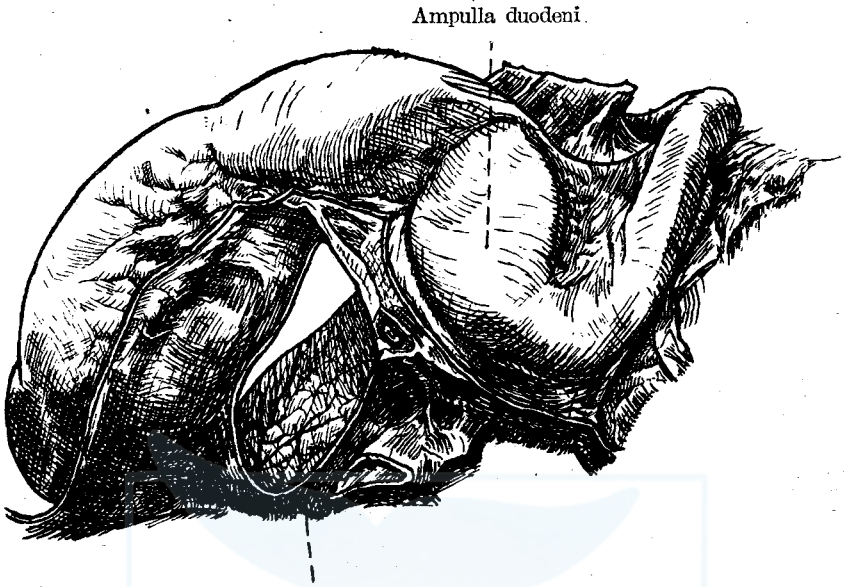

Ampulla duodeni
Pancreas

Fig. 16

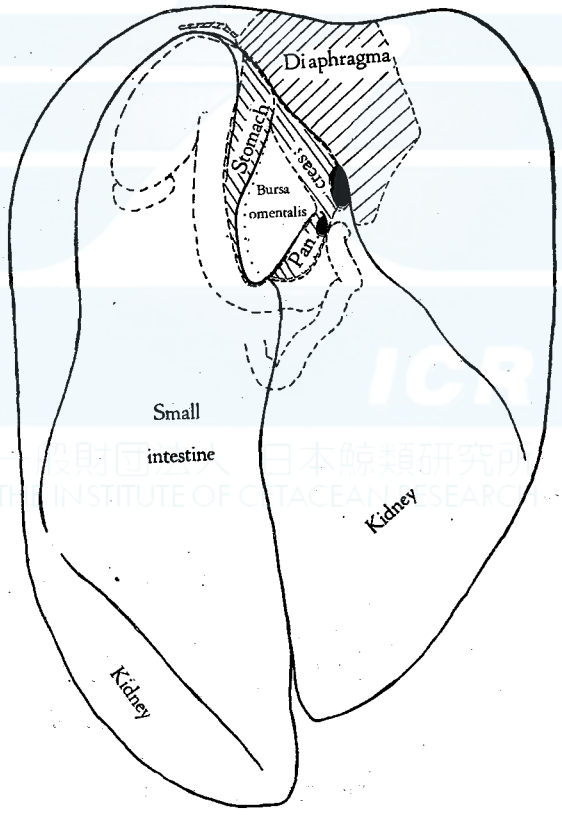
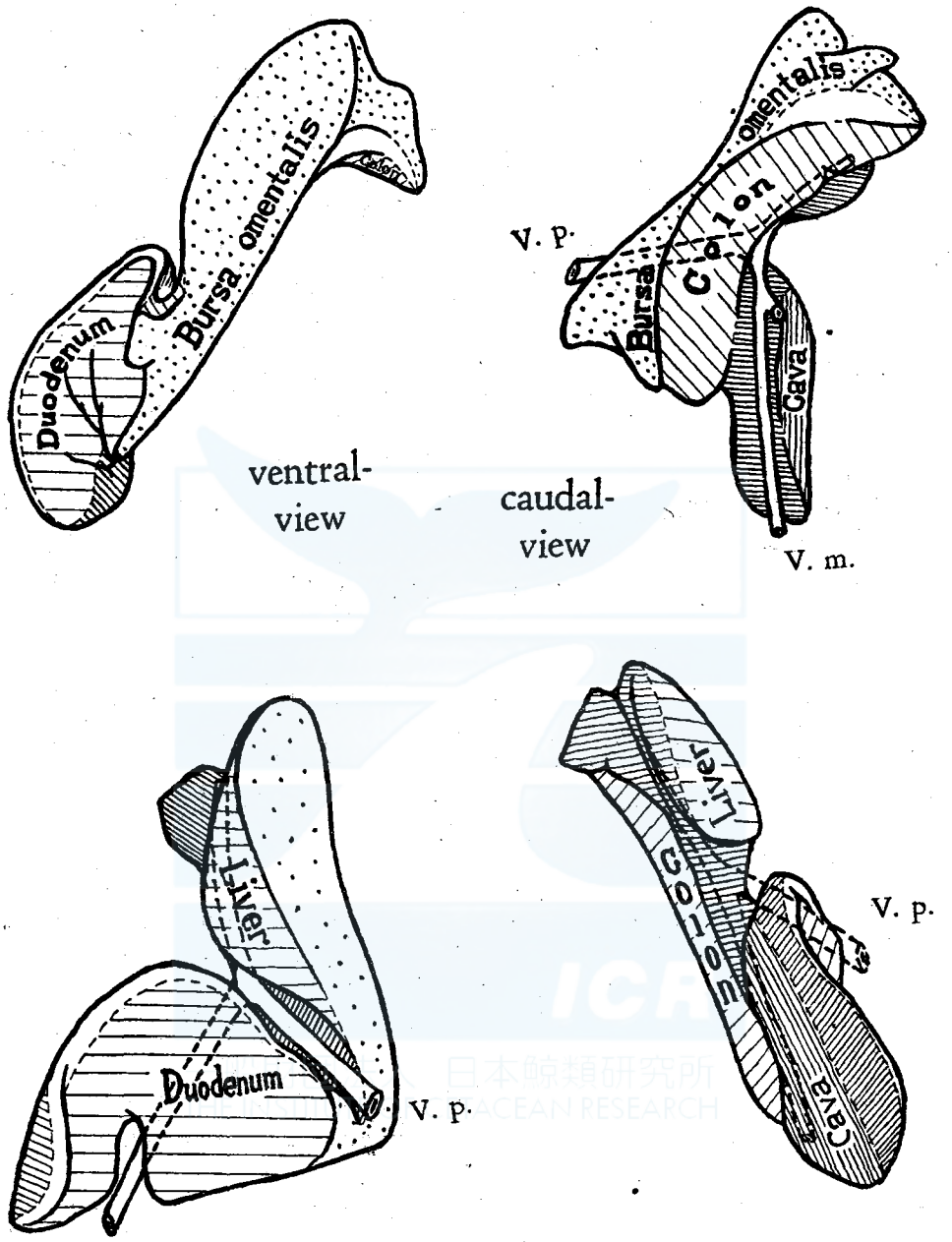

Diaphragma
Stomach
Bursa
omentalis
Small
intestine
Kidney
Kidney

Fig. 17



V. p. V. portae
V. m. V. mesenterica

Fig. 18 Pancreas

these organs, it is elongated from left cranial and dorsal towards right, ventrad and caudad. Its form is ellipsoid in the ventrodorsal direction and nearly triangular, seen from a vertical plane to its long axis. The caput is more expanded than the ampulla duodeni, which is located more ventrally; so its peripheral border has the peritoneal covering. The processus uncinatus is small. The corpus, which is near the caput triangular in shape, and more left of a square form, makes a part of the dorsal wall of the omental bursa. The boundary between caput and corpus, is remarkably prominent ventrad, tuber omentale, and in some specimens goes into the liver along the portal vein. The caudal margin of the corpus is adhered to the colon. The cauda is bent dorsad, and mark together with the 1. chamber of stomach the leftmost portion of the omental bursa. Between this area and that, where colon and pancreas are attached, there remains a small area covered with peritoneum. The pancreas of Fig. 18, seen from ventrally, is the same as that of Fig. 15 and the figure seen from cranially shows the pancreas in Fig. 16, the stomach being omitted here. The figure seen from caudally corresponds to Fig. 13 viewed from almost horizontally. The veins coming from the intestines make deep furrows on the back of the pancreas and participate in the formation of the portal vein along tuber omentale.

(3) Stomach and duodenum (Fig. 19)

The abdominal part of oesophagus, between diaphragma and stomach, is rather long and the dorsal surface of 1. stomachal chamber is adhered to the diaphragma in a wide area. The 2. and 3. chamber are extended obliquely from cranial left to caudal right, and on the right side they are attached to the liver, pancreas and the basis of proc. papillaris. The 4. chamber, that is, ampulla duodeni, is adhered to the pancreatic caput dorsally and the duodenum changes its course abruptly at the radix mesenterii and ascends behind this and continues to jejunum.

(4) Bursa omentalis

By the lost of foramen epiploicum the omental bursa, the capacity of which is small, has no opening. It is surrounded by 1., 2. and 3. stomachal chambers, cauda and corpus of the pancreas and divided into three portions. The attachment of pancreas to the posterior body wall and to the liver causes the absence of vestibule and of superior recessus in the omental bursa. The papillar process is projecting into it, particularly into the area between the 2. stomachal chamber and the pancreatic corpus. The peritoneum covering the stomach turns over to the pancreas at the boundary between 3. and 4. chambers of stomach, just cranially to the border of the pancreas where it is attached to colon and it passes to 1. stomachal chamber from the pancreatic cauda and, bending near the spleen,

returns to its original point. Caudally from this hiatus extends the bursa omenti majoris.

(5) Small intestine

The coiled mass of the small intestine is in the upper abdominal cavity, specially in the left side as if its more caudal development were prevented by the

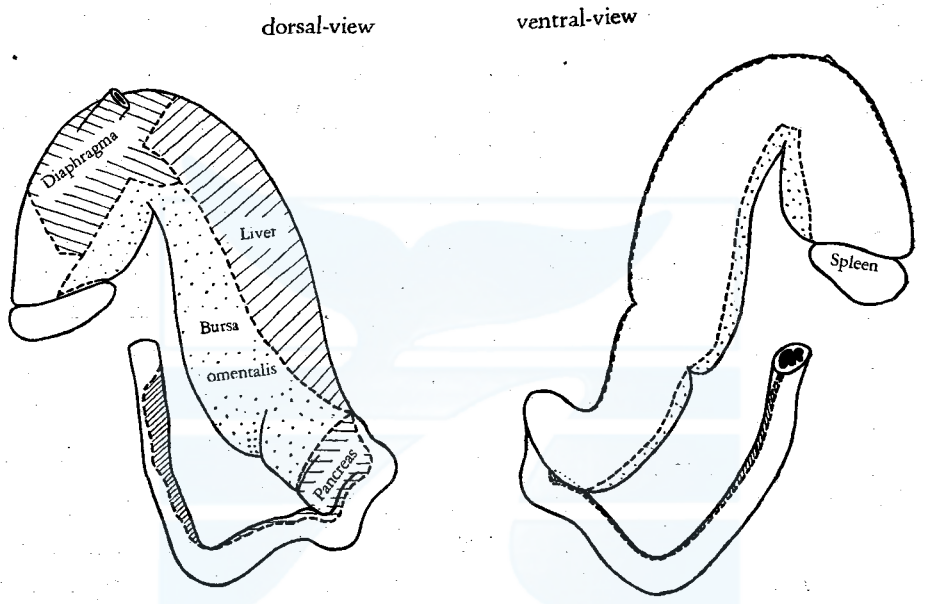


Fig. 19 Stomach

presence of kidneys. The long axis of the intestinal mass is directed from left cranial to right caudad and its upper 2/3 is covered by the left hepatic lobe. No rest of the ductus omphalomesenterica (Meckel's diverticle) is seen.

(6) Colon

The caecum is located in the right side nearly at the level of the umbilicus and the mesocolon ascendens is adhered to the ventral surface of radix mesenterii and the upper part of the colon is adhered to the pancreas. The colon bends at the cranial end of the radix mesenterii dorsad and descends dorsally along the radix mesenterii, and so the mesocolon descendens rises from the posterior body wall. Passing between both kidneys, it descends into the dorsal excavatio recto-vesicalis. No transverse portion of the colon is discernible and the whole colon is in a plane directed sagittally, that is, dorsoventrally rather than frontally.

(7) Spleen

The spleen, attached to the outer surface of 1. stomachal chamber, is relatively very small and except this area of attachment it is covered all over with peritoneum. Dorsally a strong lig. gastrolienalis is found.

(8) Adrenal body

The right adrenal body is attached to the right kidney and located between kidney, liver and duodenum, concealed partially by pancreas. The left adrenal body is tolerably distant from the left kidney and near the colon descendens about at the same level of the right one.

(9) Kidney (Fig. 20)

The voluminous kidney is seen directly by taking off the parietal peritoneum. And through its capsule numerous renculi are found. The right kidney is located

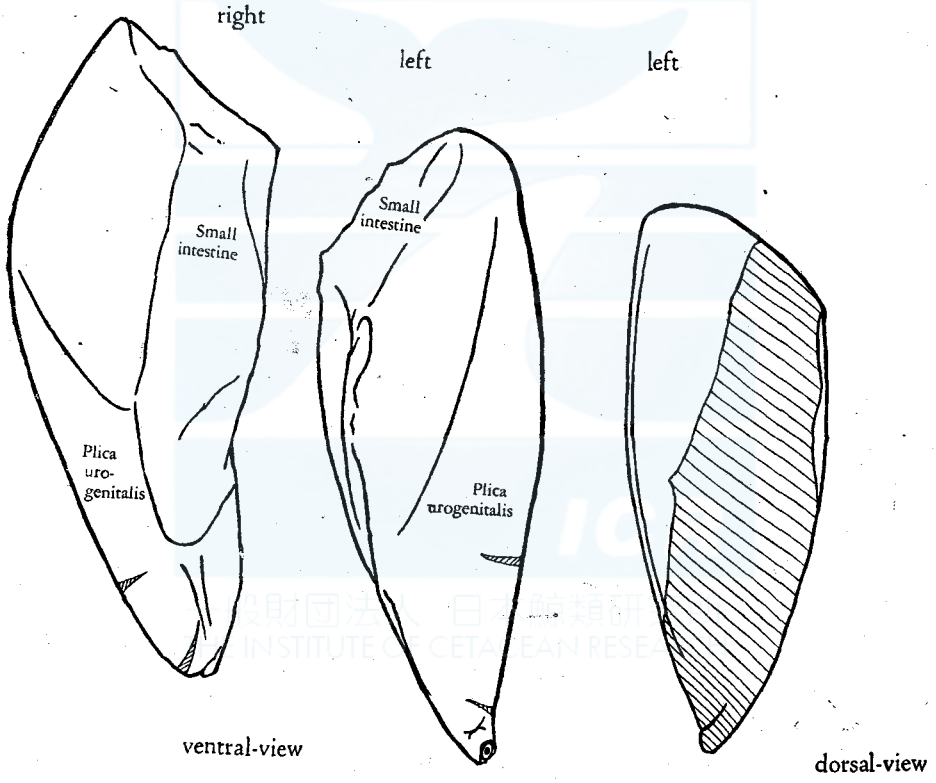


Fig. 20

a little more cranially. The area where the kidney is attached to the posterior body wall is broad, its cranial, lateral line is concave. The areas faced to the liver, small intestine and plica urogenitalis are easily recognizable. The hilus

exists at the upper end, where the blood vessels enter the kidney and it is at the caudal end that the ureter leaves. Moreover, laterally between the lateral body wall and the kidney two peritoneal folds are formed, bringing forth some recesses[3], the caudal one of which is just above the origin of the ureter.

(10) Bladder

Its dorsal surface faces to the abdominal cavity and near its cranial portion it bulges with its peduncle, but the more caudally, the less it is prominent into the abdominal cavity.

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3) These folds are well illustrated in the figure of W. Daudt (1898).

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