

Dept. of Anatomy & Histology,  
Faculty of Vet. Med., Assiut University,  
Head of Dept. Prof. Dr. A. Hifny.

**TOPOGRAPHY AND MORPHOLOGY OF THE LIVER  
AND BILIARY DUCT SYSTEM IN FOWL,  
PIGEON, QUAIL, HERON AND KESTREL**  
(With 1 Table & 9 Figs.)

By

**I.A. IBRAHIM; K.E.H. ABDALLA; A.A. MANSOUR  
and M. TAHA**

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دراسات طبوغرافية ومورفولوجية للكبد والجهاز القنوي المراري  
في الفراخ والبط والحمام والسمان وأبو القردان والعوسق  
المصري

اسماعيل ابراهيم ، كمال عبد الله ، علي منصور ، محمد طـــــــــــــــــ

لقد تم في هذا البحث دراسة الخصائص الطبوغرافية والمورفولوجية لكل من الكبد والجهاز القنوي المراري بطريقة مقارنة في كل من الفراخ والبط والحمام والسمان وأبو القردان والعوسق المصري . ولقد إتضح من الدراسة أن الكبد في هذه الطيور تختلف في وصفها وشكلها وكذلك إلى جانب وضع الحوصلة الصفراوية وتتكون الكبد من فصين أيمن وأيسر وينقسم الفص الأيسر فقط في الفراخ والسمان . كما إتضح من الدراسة أن الجهاز القنوي المراري في هذه الطيور يتكون من قناتين كبديتين يمنى ويسرى حيث تتحد هاتين القناتين عند الحفيرة الكبدية مكونتا القناة الكبدية العامة والتي تنشأ منها القناة الكبدية المعوية العامة والتي تصب في الجزء الصاعد من العفج في كلا من الفراخ والبط والسمان وأبو القردان والعوسق أما في الحمام ولغياب الحوصلة الصفراوية فإنه توجد فقط قناة كبدية معوية يمنى والتي تنشأ من القناة الكبدية اليمنى ، وهذه القناة تصب أيضاً في العفج ولقد إتضح كذلك أن أبو القردان يتميز بوجود قناة كبدية معوية يمنى بجانب القناة الكبدية المعوية العامة وهذه القناة تصب في الجزء الهابط من العفج . هذا وتم عمل مناقشة للنتائج المستخلصة مع الأبحاث المعمولة في طيور أخرى .

### SUMMARY

The liver is situated in the ventral part of the body cavity against the sternum. The relation between the caudal termination of the liver and the caudal end of the sternal crest depends upon the species of the studied birds. In fowl and kestrel, the liver terminates about 0.5 and 1.5 cm cranial to the caudal end of the sternal crest respectively, while in pigeon and quail the liver terminates nearly at the caudal end of the sternal crest. However, in duck and heron, it projects 2.9 and 2 cm behind the caudal end of the sternal crest. The liver forms about 62.07% in duck, 43.75% in quail, 35.45% in heron, 30.83% in pigeon, 28.57% in fowl and 25% in kestrel of the whole length of

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the body cavity. In all the studied birds, the liver is divided by *Incisura interlobaris cranialis et caudalis* into a larger *Lobus dexter* and a smaller *Lobus sinister*. Only in fowl and quail the *Lobus sinister* is subdivided again into *Pars caudodorsalis* and *Pars caudoventralis*.

The lobes of the liver are drained by the right and left hepatic ducts. These two ducts unite with each other at the *Porta hepatis* forming the common hepatic duct. Except in pigeon, a common hepatoenteric duct arises from this duct and opens in the distal part of the ascending duodenum. In heron there is a right hepatoenteric duct in addition to the common one.

The gall bladder is drained by a cysticoenteric duct which opens in the ascending duodenum.

### INTRODUCTION

Only little information was given by McLELLAND (1975) as well as NICKEL, SCHUMMER and SEIFERLE (1977) about the topography and morphology of the liver as well as its biliary duct system in fowl, duck and pigeon while nothing was given in quail, heron and kestrel. The aim of the present work is to throw a light on the topography and morphology of the liver and its biliary duct system in fowl, duck, pigeon, quail, heron and kestrel.

### MATERIAL and METHODS

The present study was carried out on the liver of ten of each of fowl, duck, pigeon, quail, heron and kestrel of both sexes and of different ages. The examined birds were weighed then slaughtered and opened for topographic study of the liver. After that the livers of each bird were removed and weighed, then preserved in 10% formalin solution before morphological study.

The nomenclature used is that adopted by the *NOMINA ANATOMICA AVIUM* (1979) as if it was possible.

### RESULTS

The liver which is located in the ventral part of the body cavity lies against the sternum, but the relation between its caudal termination and the caudal end of

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the sternal crest differs in the different species of the studied birds. In fowl and kestrel, the liver ends about 0.5 and 1.5 cm cranial to the caudal end of the sternal crest respectively, while in pigeon and quail it terminates nearly at the caudal end of the sternal crest. However, in duck and heron, the liver projects 2.9 cm and 2 cm behind the caudal end of the sternal crest respectively.

Weight and relative situation of the liver are also depend upon the species. As recorded in table (1) the weight of the liver represents nearly about 1.3% - 1.6% of the total body weight in fowl, 2.4% - 2.7% in duck, 2.1% - 2.5% in pigeon, 2% - 2.3% in quail and 2% - 2.8% in heron and kestrel. Table (1) and (Fig. 1) indicate also that, the relative length of the liver to the total length of the body cavity is about 62.07% in duck, 43.75% in quail, 35.45% in heron, 30.83% in pigeon, 28.57% in fowl and 25% in kestrel. This result explains that, the liver occupies more than the half of the total length of the body cavity in duck, nearly the half in quail and one quarter in kestrel, but in fowl, pigeon and heron, the liver occupies nearly one third of the total length of the body cavity. In all examined birds except the duck the liver is mainly located in that part of the body cavity which enclosed by the ribs on both sides with a remainder projecting part extends caudal to the last rib. In fowl, pigeon and heron it is nearly located in the middle third of the body cavity. However, in duck it is located in the middle two quarters. In kestrel it lies at the cranial quarter of the caudal half of the body cavity. In duck it is only enclosed by the ribs on the right side. In quail the liver is located in the cranial half of the body cavity.

The colour of the liver varies from red brown through light brown to yellow. It is light brown in fowl, yellowish brown in duck, pigeon and quail, while it is red brown in heron and kestrel.

Whilst, the general form of the avian liver seems to be relatively constant within a species, considerable variations may occur. The liver in all examined birds is divided by *Incisura interlobaris cranialis et caudalis* into *Lobus hepaticus dexter et Lobus hepaticus sinister* which are joined together cranially in the midline between the incisures by *Pars interlobaris*. The relative proportions of the right and left lobes greatly vary between species and between individuals of the same species. In all examined birds, the right lobe is longer and heavier in general than the left one. The relation of the length between the two lobes depends upon the species. Table (1) and Fig. (2) show that the length of the right lobe is about 5.3 cm in fowl, 9 cm in duck, 3.8 cm in pigeon, 3.5 cm in quail, 3.9 cm in heron and 2.5 cm in kestrel. However, the length of the left lobe is about 3.6 cm in fowl, 1.5 cm in duck, 2.1 cm in pigeon, 3 cm in quail, 3.7 cm in heron and 1.3 cm in kestrel. Therefore, the left lobe represents about two thirds the length of the right one in fowl, quail and heron, one sixth in duck and nearly 1/2 in pigeon and kestrel. On the other hand, the weight of the left lobe represents about 2/3 that of the right one in fowl and kestrel, 1/8 in duck,

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1/4 in pigeon, 6/7 in quail and 1/2 in heron. In fowl, quail and kestrel the two lobes envelope the apical half of the heart cranially forming a deep *Impressio cardiaca* (Fig. 3, 6, 8/6). While in heron and pigeon the lobes of the liver are in contact only with the apex of the heart. However, in duck, the heart is only in contact with the right lobe of the liver.

The liver has *Facies parietalis* and *Facies visceralis*.

The ventrally directed *Facies parietalis* is convex and smooth except on its cranio-ventral part where there is the deep cardiac impression in fowl, quail and kestrel. It is moulded to the contour of the body wall and is related to the sternum and ribs on both sides except in duck where it is related to the sternum and to the ribs of the right side only.

The dorsally directed *Facies visceralis* in contrast is concave and quite irregular since it is closely moulded to the adjacent viscera which make permanent and well defined impressions on it. It is related to the terminal part of the esophagus, stomach, intestine, spleen and the gall bladder except in pigeon.

In fowl, the right and left lobes begin cranially nearly at the same level opposite to the 2nd rib. The right lobe terminates 1.5 cm caudal to the last rib while the left one ends 0.5 cm caudal to the foregoing rib. In duck, the right lobe extends from the level of the 3rd intercostal space cranially to a level 3 cm caudal to the last rib while the left lobe begins opposite to the 4th intercostal space and terminates caudally opposite to the 6th intercostal space. In pigeon, the right and left lobes begin cranially at the same level opposite to the 3rd intercostal space. The right lobe extends caudally to a level about 1.3 cm caudal to the last rib while, the left lobe ends at a level with the caudal border of the last rib. In quail the right lobe begins cranial to the left one. It extends from the level of the first rib to terminate 1 cm caudal the left lobe begins at the level of the 2nd rib and terminates 1.5cm caudal to the last one to the last rib. In heron the right lobe extends from the 3rd rib and terminates 0.8 cm caudal to the last one, but the left lobe begins slightly caudal to the right one at the level of the 3rd intercostal space and extends caudally to terminate 0.3 cm caudal to the last rib. In kestrel the right and left lobes begin at the same level at the 2nd rib and extends to the 6th rib for the right lobe and the 5th rib for the left one.

The shape of each lobe of the liver depends upon the species of the examined birds. In fowl, the right lobe is roughly triangular in shape (Fig. 3 B, B'/4) with its base directed cranially and the apex directed caudally while the left lobe (Fig. 3, B, B'/5) is nearly rectangular in outline. In duck, the right lobe (Fig. 4, B, B'/4) is elongated tongue shaped while the left one is a small roughly bean shaped (Fig. 4 B, B'/5). In pigeon the right lobe is pyramidal (Fig. 5 B, B'/4) and the left one

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is nearly triangular in shape (Fig. 5 B, B'/5). On the other hand, the heron has a tongue shaped right lobe (Fig. 7 B, B'/4) and an elongated bean shaped left lobe (Fig. 7 B, B'/5) while the quail and the kestrel have a roughly triangular right and left lobes with the base directed caudally and the apex directed cranially (Fig. 6, 8 B, B'/4, 5).

The left lobe is only divided in fowl and quail among the other examined birds by a caudal very deep intralobular fissure (Fig. 3, 6 B, B'/3). This fissure extends cranially for about 3 cm in fowl and 2 cm in quail to divide this lobe into unequally Pars caudodorsalis (Figs. 3, 6 B; B'/5') and Pars caudoventralis (Figs. 3, 6 B; B'/5'') of which Pars caudodorsalis is the largest. It was noticed that, in about 40% of the examined cases in fowl, the caudal fissure extends upwards to reach the dorsal margin of the liver. It was also noticed that a small Processus intermedius projects from the visceral surface of each right and left lobes in fowl (Fig. 3 B, B'/7) and quail (Fig. 6 B, B'/7) as well as the left lobe in pigeon (Fig. 5 B, B'/7).

The visca felea which is absent in pigeon is situated in the Fossa visclae felleae on the visceral surface of the liver of the other examined birds. It is located in the cranial third of this surface in duck (Fig. 4), middle third in heron (Fig. 7) while it lies in the caudal half in fowl quail and kestrel (Fig. 3, 6, 8). It is cylindrical in shape in fowl, quail and heron but spherical in shape in duck and kestrel. Its length measures about 3 cm in fowl, 2 cm in heron, 1.5 cm in duck, quail and 1 cm in kestrel. The apex of the gall bladder ends about 0.5 cm cranial to the caudal border of the right lobe. It is noticed that, the gall bladder in case of fowl and quail can be seen from the parietal surface of the right lobe. On the contrary in duck, quail, kestrel and heron the gall bladder can't be seen from the parietal aspect of that lobe.

#### Biliary duct system:

In birds, the bile canaliculi drain into interlobular ducts which extend through the liver in close association with the branches of the portal vein and hepatic arteries. These canaliculi unite forming the lobar bile ducts which unite finally at the porta hepatis of the liver forming the Ductus hepaticus dexter et sinister (Fig. 9 A, B, C, D/2, 3). The two ducts drain the right and left lobes of the liver. The number of these lobar bile ducts vary with the different species of the examined birds. In fowl and duck (Fig. 9 A/1), their number varies from 5-6 for the right lobe and 3-4 for the left one while in pigeon, quail, heron and kestrel (Fig. 9 B, C, D/1) they are 2-3 in number for the right and left lobes. In all examined birds, the right and left hepatic ducts unite on the visceral surface of the right lobe forming the Ductus hepaticus communis (Fig. 9 A, B, C, D/4). From this duct a Ductus hepatointestinalis arise (Fig. 9 A, B, C, D/5) and passes distally in the mesoduodenum to

open by a small papilla on the inner surface of the distal part of the ascending duodenum. In heron another Ductus hepatoentericus dexter arises (Fig. 9 D/6) from the right hepatic duct at its beginning. This duct passes distally and open in the proximal part of the descending duodenum. The gall bladder is attached to the right hepatic duct by the Ductus hepatocysticus (Fig. 9 A, B, D/7). From the gall bladder a Ductus cysticoentericus (Fig. 9 A, B, D/8) arise and open in the distal part of the ascending duodenum proximal to the hepatoenteric duct. In pigeon in which there is no gall bladder, a Ductus hepatoentericus dexter arise from the right hepatic duct (Fig. 9 C/6) and opens directly into the ascending duodenum.

### DISCUSSION

According to KING and McLELLAND (1979) the liver of birds, generally, fills most of the ventral parts of the cranial and middle regions of the body cavity. On the other hand, NICKEL, et al. (1977) reported that, the largest part of the liver is situated in that part of the body which is enclosed by the ribs while the remainder projecting from this space, lies against the sternum. The present investigation shows that, the liver of the studied birds located in the ventral part of the body cavity against the sternum, but the relation between the caudal termination of the liver and the caudal end of the sternal crest depends upon the species of the examined birds. In fowl and kestrel, the liver ends about 0.5 and 1.5 cm cranial to the caudal end of the sternal crest respectively while in pigeon and quail it terminates nearly at the level of the caudal end of the sternal crest. However, in duck and heron, the liver projects 2.9 cm and 2 cm caudal to the caudal end of the sternal crest respectively. In fowl, pigeon and heron the liver occupies nearly the middle third of the body cavity. In quail the liver occupies nearly the cranial third of the body cavity but in duck it occupies the middle two quarters. In kestrel it occupies the cranial quarter of the caudal half of the body cavity.

The present study shows that, the relative length of the liver to the total length of the body cavity is about 62.07% in duck, 43.75% in quail, 35.45% in heron, 30.83% in pigeon and 25% in fowl and kestrel. This explains that the liver of the duck occupies more than the half of the total length of the body cavity and nearly the half in quail but in the other examined birds the liver occupies nearly one third of the total length of the body cavity.

According to HANES (1912), CALHOUN (1954), COOK and BLETNER (1955) as well as KAPP and BALAZS (1970), the liver has a bright yellow colour at hatching, later it gradually changes to the red brown in the adult liver. NICKEL, et al. (1977) mentioned that the colour of the liver varies from red-brown through light brown

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to yellow. In the present study, the colour of the liver differs in the different studied birds. It is light brown in fowl, yellowish brown in duck, pigeon and quail while it is red brown in heron and kestrel.

As stated by NICKEL, *et al.* (1977) the liver of fowl weighs between 31 and 51 gm and forms 1.7-2.3% of the total body weight, in duck 58-113 gm and forms 3.1-4.1%, in pigeon 8-10.5 gm and forms 1.5-3.6%. In the present work, the liver of the fowl weighs between 15-25 gm and forms 1.3-1.6% of the total body weight, in duck 35-55 gm and 2.4-27% in pigeon 6.5-10 gm and 2.1-2.5%, in quail 5-8 gm and 2-2.3% and 5-10 gm and 2-2.8% in heron and kestrel.

Whilst, the general form of the avian liver seems to be relatively constant within a species, considerable variations in detail may occur. In all examined birds, the liver is divided by cranial and caudal longitudinal fissures into right and left lobes which are joined together cranially in the midline between the fissures by an interlobar part. This is in agreement with that described by GRAU (1943), LUCAS and DENINGTON (1956), KERN (1963), FLECHSIG (1964), McLELLAND (1975), NICKEL, *et al.* (1977) in domestic birds as well as GADOW (1891), BEDDARD (1898) and KING and McLELLAND (1979) in wild birds. The relative proportion of these two lobes greatly varies. Similar to that mentioned by GADOW (1891), BEDDARD (1898) as well as LUCAS and DENINGTON (1956) in most birds the right lobe was larger than the left one. However, in the present study the left lobe represents nearly about two thirds the length of the right one in fowl, quail and heron; one sixth in duck and nearly the half in pigeon and kestrel. On the other hand, the weight of the left lobe represents about 2/3 that of the right one in fowl and kestrel; 1/8 in duck; 1/4 in pigeon; 6/7 in quail and 1/2 in heron. As mentioned by KING and McLELLAND (1979) much less commonly the two lobes were equal in size as for example in Rhea or the left lobe was larger as in Alcatorda. The greatest discrepancy in size which was observed between the lobes by GADOW (1891) occurred in a shear water in which the right lobe was six times larger than the left one.

In the present study, the shape of each lobe of the liver depends upon the species of the examined birds. In fowl, the right lobe is roughly triangular while the left lobe is nearly rectangular. In duck, the right lobe is largely elongated tongue shape while the left one is a small roughly bean shape. In pigeon, the right lobe is pyramidal in shape but the left one is triangular. On the other hand, heron has a tongue shaped right lobe and an elongated bean shaped left lobe while quail and kestrel has a roughly triangular right and left lobes with the apex directed cranially and the base caudally. According to McLELLAND (1975), in fowl the left lobe is prismatic in shape while the right one is heart shape. On the other hand, according to NICKEL, *et al.* (1977) the left lobe is ellipsoidal and the right one is nearly heart shaped. In duck, the right lobe is tongue shaped and remarkably long whereas the left one is more bean shaped.

Amongst domestic birds, the left lobe is subdivided in Gallus and Meleagris into caudo-dorsal and caudoventral parts. This division was observed also in quail.

The present investigation cleared that the right and left lobes begin cranially at the same level in fowl, pigeon and kestrel but they begin at two different levels in duck, quail and heron. The termination of the right lobe in all studied birds and the left one in fowl, quail and heron is caudal to the last rib. However, in duck, the left lobe termination is cranial to the last rib and in pigeon at a level with the caudal border of this rib.

According to KING and McLELLAND (1979) arising from the visceral surface ventral to the hilus in the domestic species at least are one (Gallus and turkey Melleargris) or two (Anas and Anser) intermediate processes. In the present study the two intermediate processes were observed in fowl and quail while in pigeon only one intermediate process could be observed. SIMIC and JANKOVIC (1959, 1960) have also described in the domestic birds except columba (pigeon) a papillary processes arising from the visceral surface of the craniodorsal part of the right lobe however. NICKEL, et al. (1977) mentioned that, there is neither an intermediate process nor a gall bladder in pigeon.

KING and McLELLAND (1979) stated that, the gall bladder when present lies in a pit-like depression on the visceral surface of the right lobe between the impressions formed by the two limbs of the duodenal loops. The present study shows that, in fowl the gall bladder is bear shaped and embeded in the caudal half of the right lobe and its apex extends to the caudal border of that lobe. Other than pigeon, there is a gall bladder which is cylindrical in shape in fowl, quail and heron and spheroid in duck and kestrel. It is noticed that, the gall bladder in case of fowl and quail extends to the caudal border of the right lobe so in these birds it can be seen from the parietal surface of the right lobe.

The biliary duct system in this study in general is in agreement with that mentioned by KING and McLELLAND (1979) in fowl. According to SIMIC and JANKOVIC (1959-1960) two hepatoenteric ducts in addition to the cysticoenteric duct were reported in anser. It was noticed that only in heron, there was a right hepatoenteric duct in addition to the common hepatoenteric duct as well as the cysticoenteric duct.

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## LEGENDS

**Fig. 1:** Showing the relation between the length of the liver and the length of the body cavity in the different studied birds.

**Fig. 2:** Showing the relation between the length of the right and left lobes of the liver in the different studied birds.

Fig. 3, 4, 5, 6, 7 & 8 Livers of the fowl, duck, pigeon, quail, heron and kestrel.

A) Facies parietalis.

1 - Incisura interlobaris cranialis.

2 - Incisura interlobaris caudalis.

3 - Incisura intralobularis.

4 - Lobus hepaticus dexter.

5 - Lobus hepaticus sinister.

5"- Pars caudodorsalis.

5"- Pars caudoventralis.

6 - Impressio cardiaca.

7 - Processus intermedius.

8 - Porta hepatis.

9 - Fossa vesicae felleae.

10- Visica Fellea.

Fig. 9: Diagrammatic illustrations showing the biliary duct system in the different studied birds.

A) Fowl and duck

B) Quail and kestrel

C) Pigeon

D) Heron.

1 - Lobar bile ducts.

2 - Ductus hepaticus dexter.

3 - Ductus hepaticus sinister.

4 - Ductus hepaticus communis.

5 - Ductus hepatoentericus communis.

6 - Ductus hepatoentericus dexter.

7 - Ductus cysticoentericus.

8 - Ductus cysticoentericus.

9 - Visica fellea.

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Table (1): Showing the weight of the bird, length of its body cavity in addition to the weight and length of the liver as well as its right and left lobes.

Bird	Total body weight (gm)	Length of body cavity (cm)	Prehepatic length (cm)	Hepatic length (cm)	Post hepatic length (cm)	Absolute weight of liver (gm)	Relative weight of liver (%)	Weight of R. lobe (gm)	Weight of L. lobe (gm)	Length of R. lobe (cm)	Length of L.L. (cm)	Length of gall bladder
Fowl	1150-1650	16.3	6.2	5.3	6.8	15-25	1.3-1.6	9-12	6-10	5.3-7	3.6	3.0
Duck	1435-2000	14.5	3.4	5.0	2.1	35-55	2.4-2.7	25-35	10-15	9-11	1.5-2	1.5
Pigeon	300-400	12.1	4.9	3.8	3.4	6.5-10	2.1-2.5	5.2-7	1.3-2	4.5-5	2.1-2.5	-
Quail	250-350	8	1	3.5	3.5	5-8	2-2.3	3-4	2.5-3.5	3-5	3-4	1.5
Heron	250-300	11	4.3	3.5	2.8	5-10	2-2.8	3.2-5	1.8-2.5	4.2-4.5	2.7-3	2
Kestrel	300-400	10	4	2.5	2.5	5-10	2-2.8	3.45	2.2.5	2.2-3	2-2.5	1.2

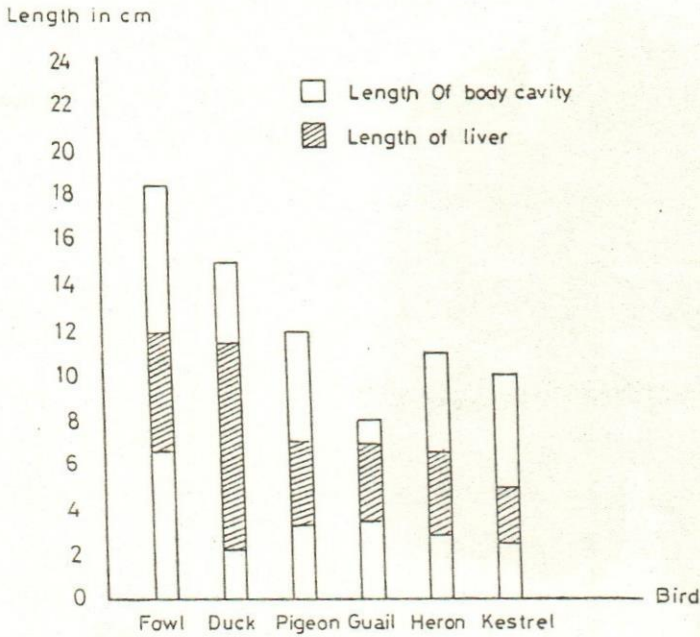
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Fig.( 1 )

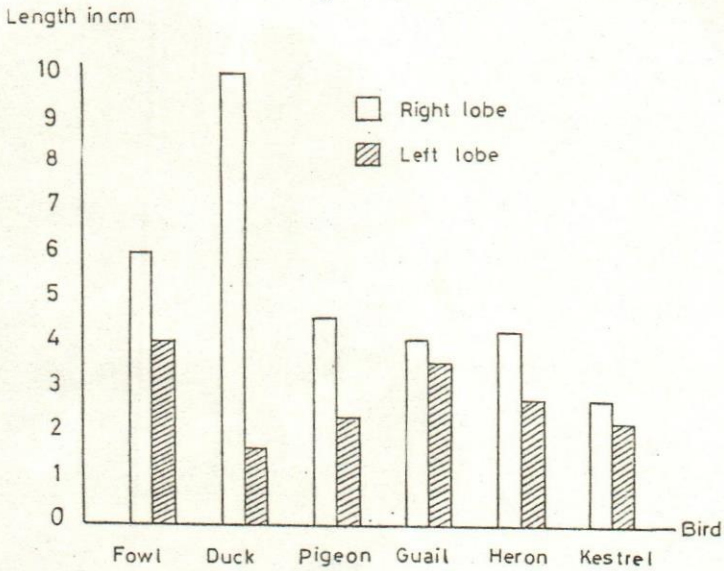
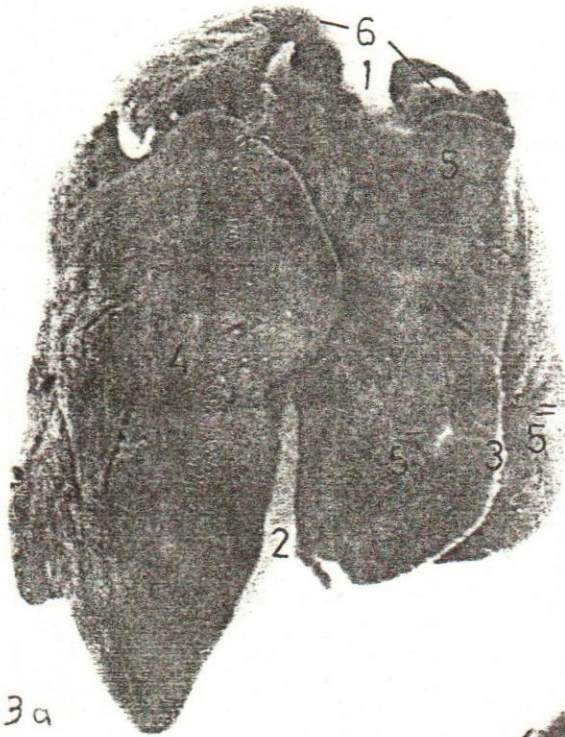


Fig.( 2 )

LIVER IN FOWL, DUCK, PIGEON, QUAIL, HERON AND KESTREL



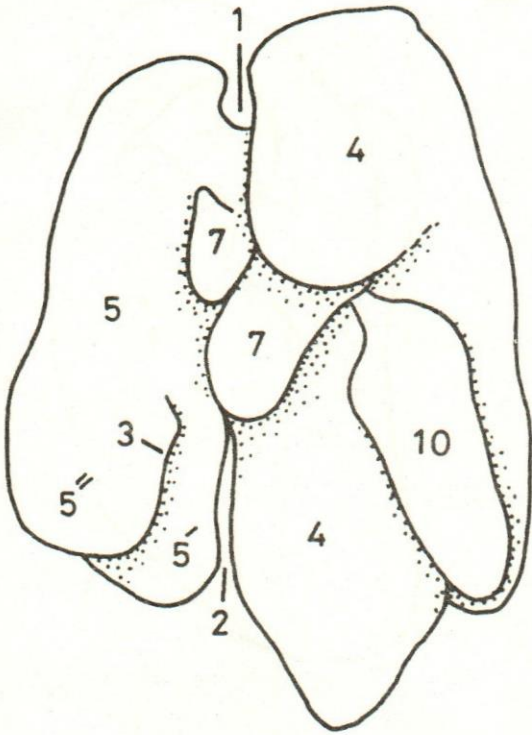
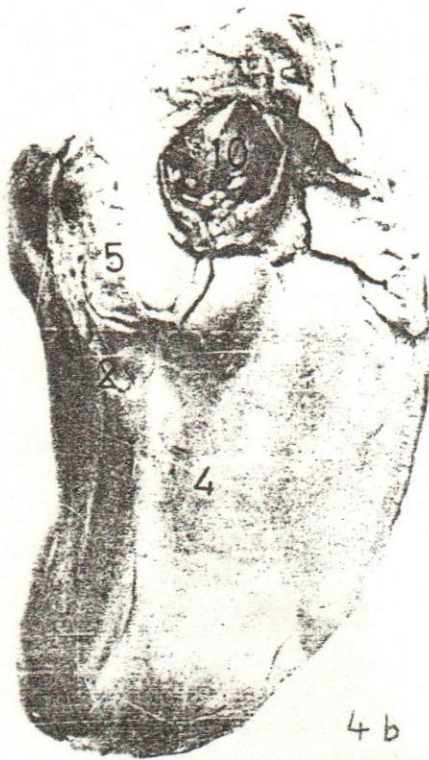


Fig. (3) B'



4a

LIVER IN FOWL, DUCK, PIGEON, QUAIL, HERON AND KESTREL



4 b

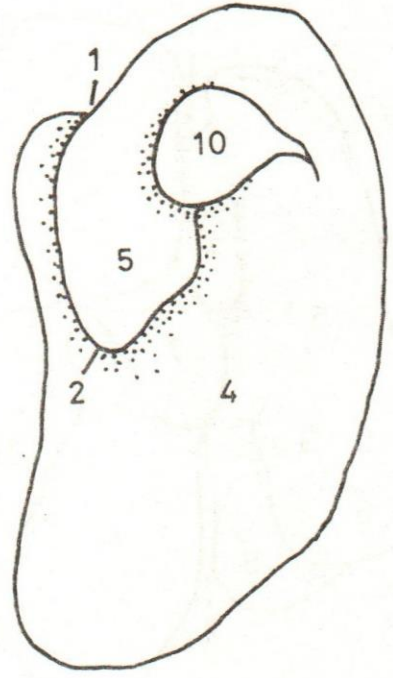
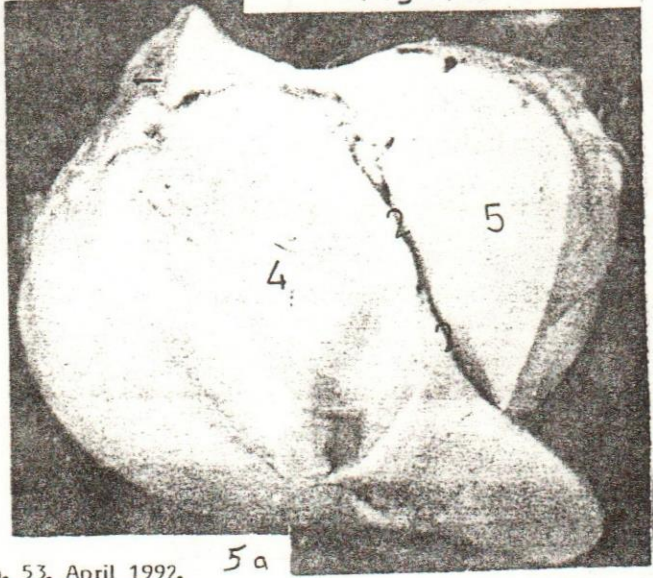
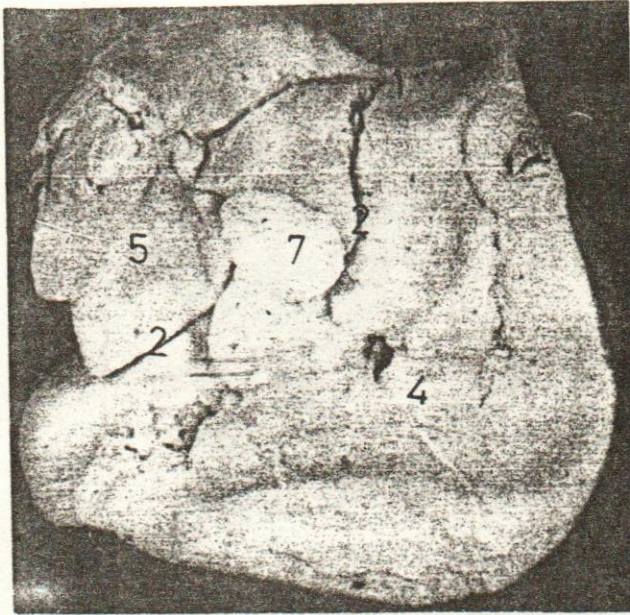


Fig. (4) B'



5 a



5b

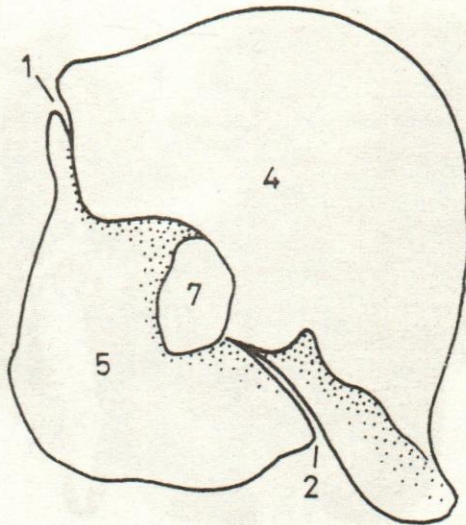
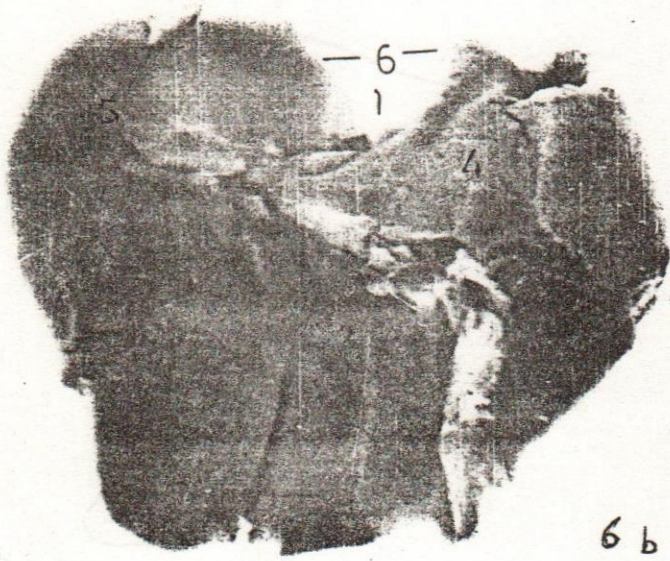
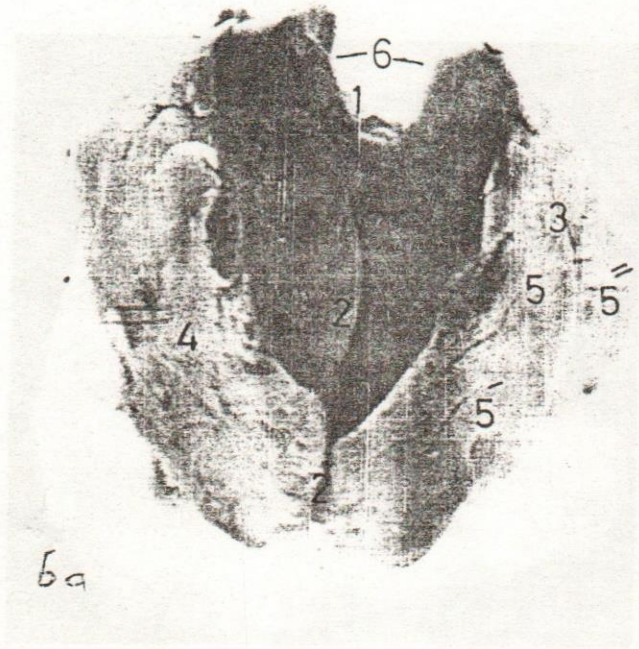


Fig. (5) B<sup>1</sup>



LIVER IN FOWL, DUCK, PIGLON, GUAILE, HERON AND KESTREL



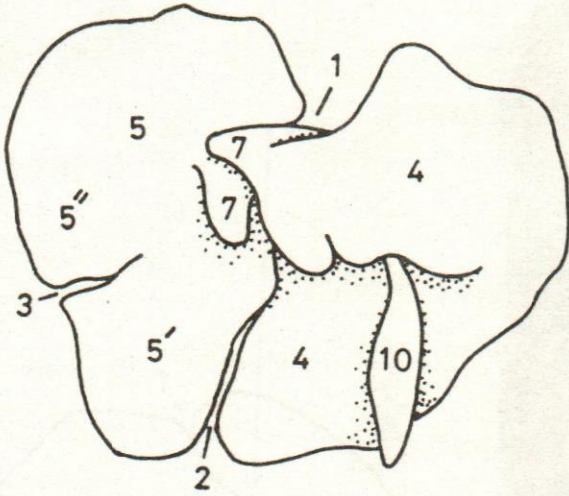
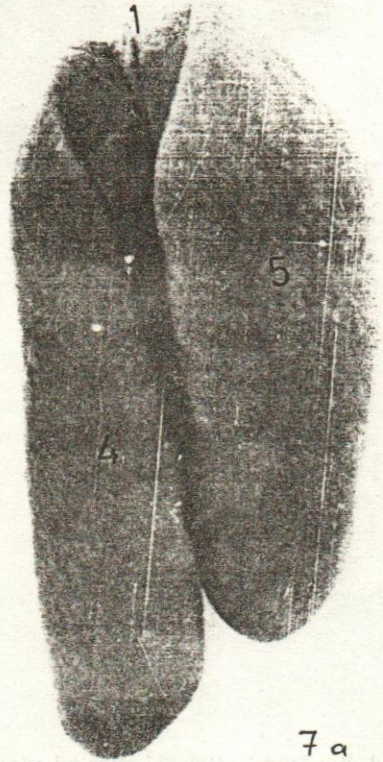


Fig. (6) B'



7 a

LIVER IN FOWL, DUCK, PIGEON, QUAIL, HERON AND KESTREL



7b

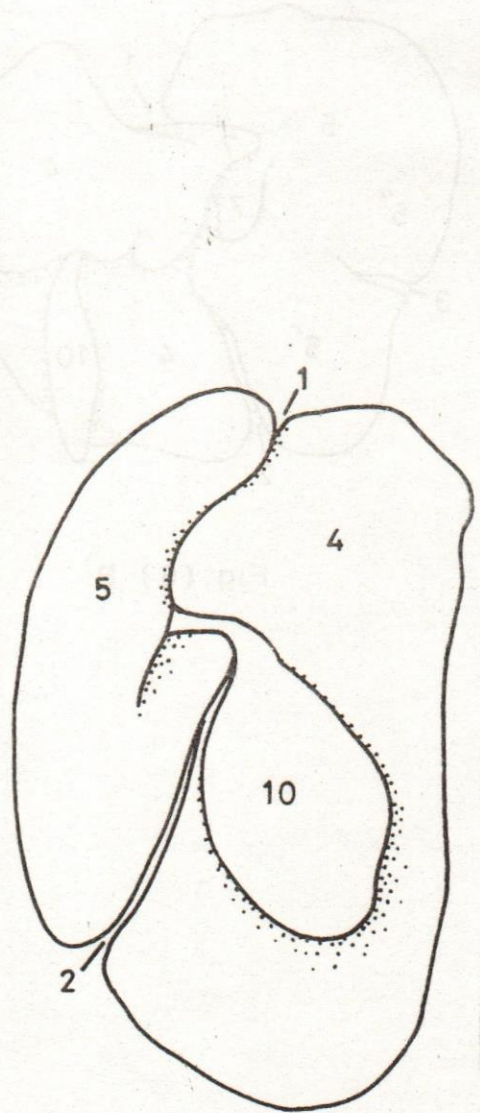
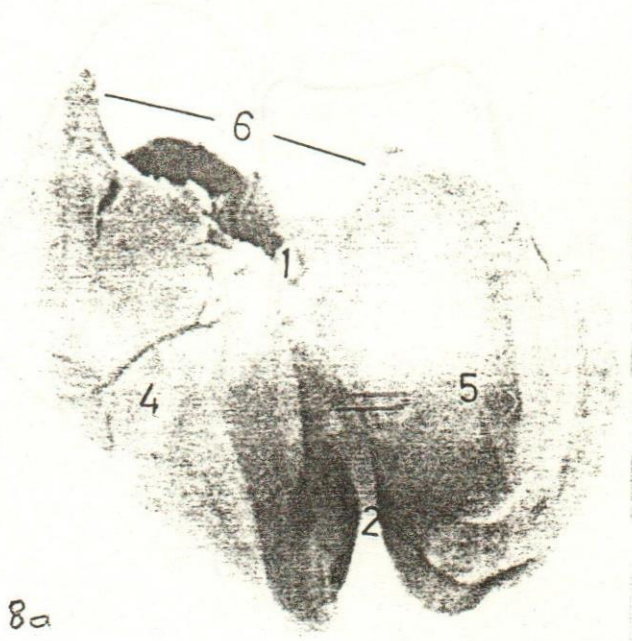
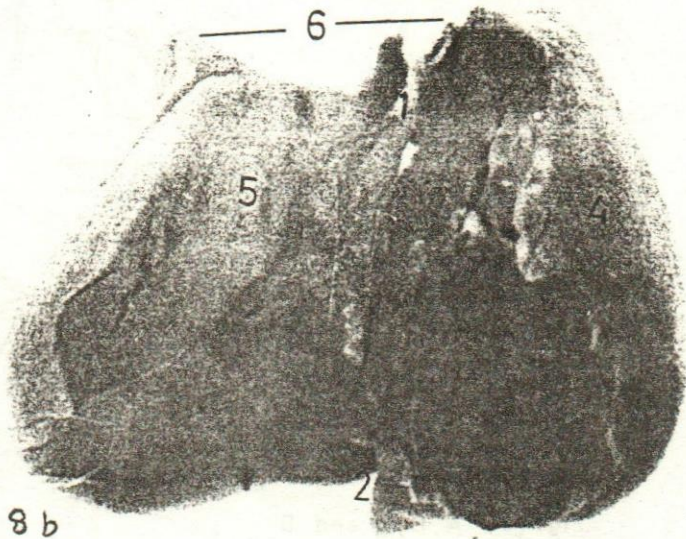


Fig. (7) B¹



8a



8b

LIVER IN FOWL, DUCK, PIGEON, QUAIL, HERON AND KESTREL

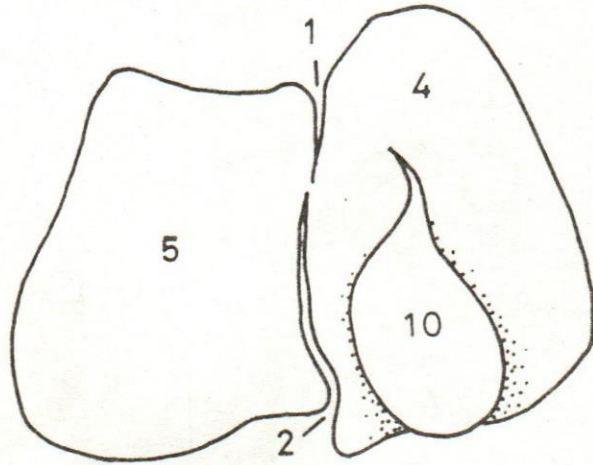


Fig. (8) B<sup>1</sup>

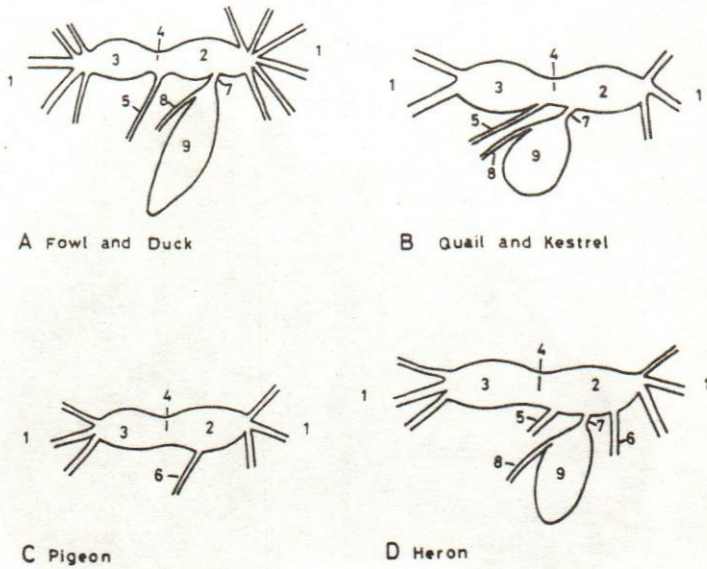


Fig. (9) A, B, C and D.