



GUIDE TO DISSECTION

H G Q ROWETT

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GUIDE TO DISSECTION

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DISSECTION
THE RAT AS A SMALL MAMMAL
BASIC ANATOMY AND PHYSIOLOGY

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HISTOLOGY AND EMBRYOLOGY

DISSECTION GUIDES

I The Frog II The Dogfish III The Rat

IV The Rabbit V Invertebrates

THE RAT AS A SMALL MAMMAL

BASIC ANATOMY AND PHYSIOLOGY

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GUIDE TO DISSECTION

H. G. Q. ROWETT, M.A., M.I.BIOL.

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GUIDE TO DISSECTION

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INTRODUCTION

The types included in this volume are commonly studied in elementary zoology courses. Only those processes which are normally performed by the student himself are described, skeletal material and specially prepared sections being omitted because they are adequately explained in most text-books. Such material and sections are, however, an important part of the practical work and should not be forgotten.

The series of drawings is designed to aid dissection with the minimum of written instruction. It is not always possible to show the exact position of the instruments for making every cut, but full indications are given.

The scales of the diagrams vary throughout the book, the aim being to maintain some uniformity when dealing with any one creature and at the same time have the diagrams as large as the pages permit. The scales recorded are only approximate because of the variability of the size of the specimens.

At the conclusion of each section of the work the student should make a *fully labelled* drawing of his *own* dissection on as large a scale as possible.

H. G. Q. R.

I

THE DOGFISH

The dogfish supplied for dissection is always in the preserved condition. The preservation is carried out either (a) by soaking the fish in formalin, or (b) by injection with formalin followed by soaking till required for use.

The rate of penetration of formalin is slow, therefore when the former method is used the dogfish is opened up to allow the preservative to reach the internal structures before they have time to decay. This preliminary treatment includes the removal of a small portion of the roof of the skull in order to open the brain-case, a small central part of the pectoral girdle to open the pericardium, and the greater part of the ventral wall of the abdomen to expose the viscera. At the same time, the tail is usually cut off, as it is not required during the dissection and would occupy a great deal of storage room.

If this is the condition of the fish the student can proceed directly to Fig. 4.

The injection method of preservation has the advantage that the viscera are not displaced or damaged during storage or transport, but it has the disadvantage that the blood is forced from the efferent branchial vessels, rendering them completely colourless.

If the dogfish is preserved in this way the tail only is removed. The body cavity must be opened up as shown in Figs. 1-5 before dissection of the alimentary canal, urinogenital system and abdominal blood-vessels.

The tissues of the dogfish are extremely tough. This dissection therefore tends to blunt the instruments very rapidly. It is a good rule to keep the finest scalpel and pair of scissors for delicate work and fine trimming only. Rub the scalpels on a sharpening-stone at frequent intervals.

The dogfish is dissected on a wooden board to which it is fixed by means of strong wooden or brass-handled dissecting pins. A process of 'carving' is used, in which the tissue is sliced away little by little till the desired result is achieved. It is important not to cut off large pieces blindly.

NOTE. Unless otherwise stated, a male fish is shown in the diagrams. The female differs from it in the absence of claspers and in the form of the cloaca.

ORDER OF DISSECTION OF DOGFISH

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THE DOGFISH—I Opening up the Body Cavity

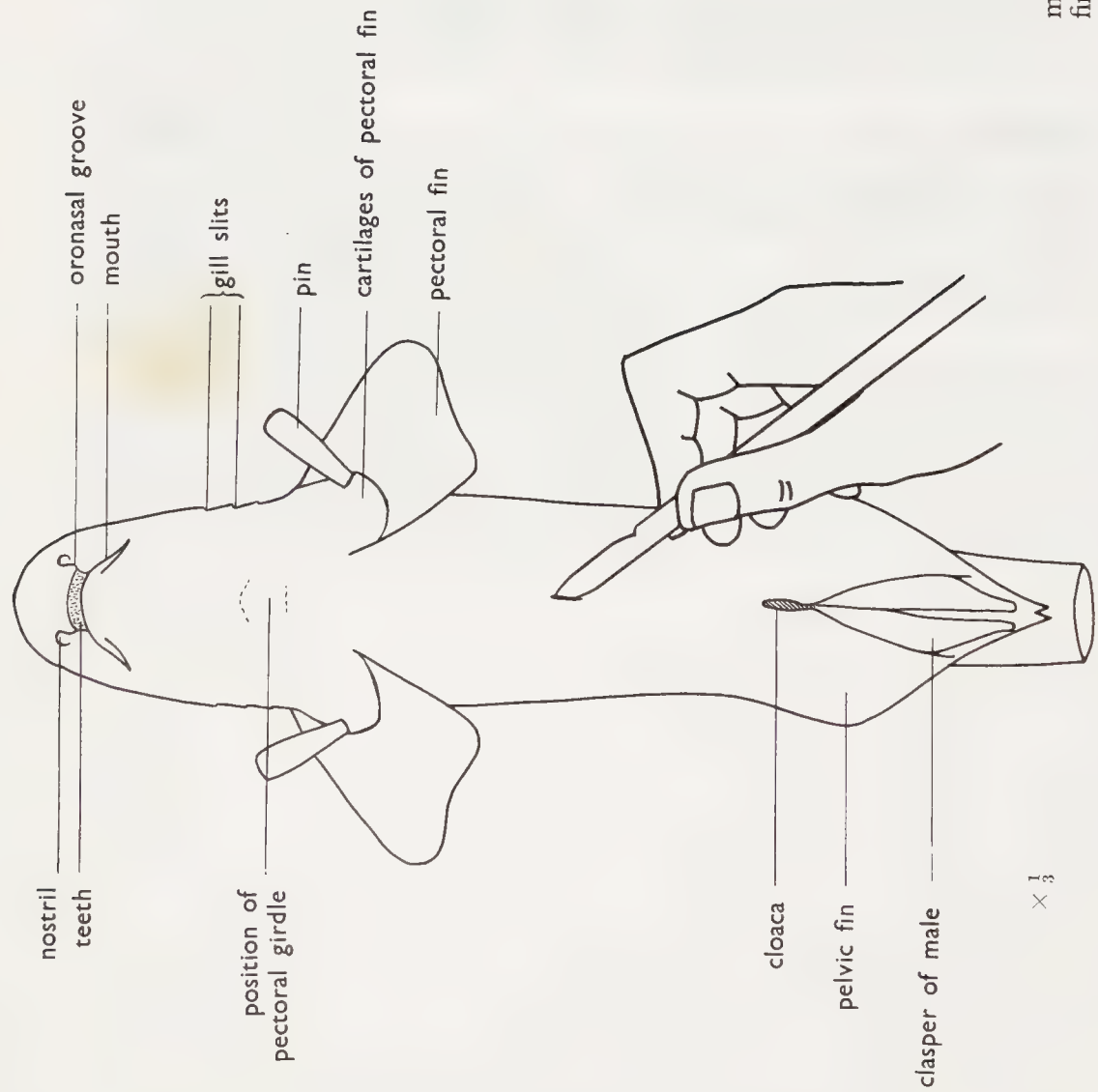


Fig. 1

Place the dogfish on the dissecting-board ventral side uppermost and pin through the CARTILAGENOUS PART of each pectoral fin. The pins must be long and strong.

NOTE. If the pins are inserted through the region of the fin rays the fins tear when strain is put upon them.

Make a small incision in the skin in the mid-ventral line by means of a scalpel. The skin is firmly fixed to the underlying muscle which will therefore usually be cut also. DO NOT CUT DEEPLY at first.

THE DOGFISH—Opening up the body cavity

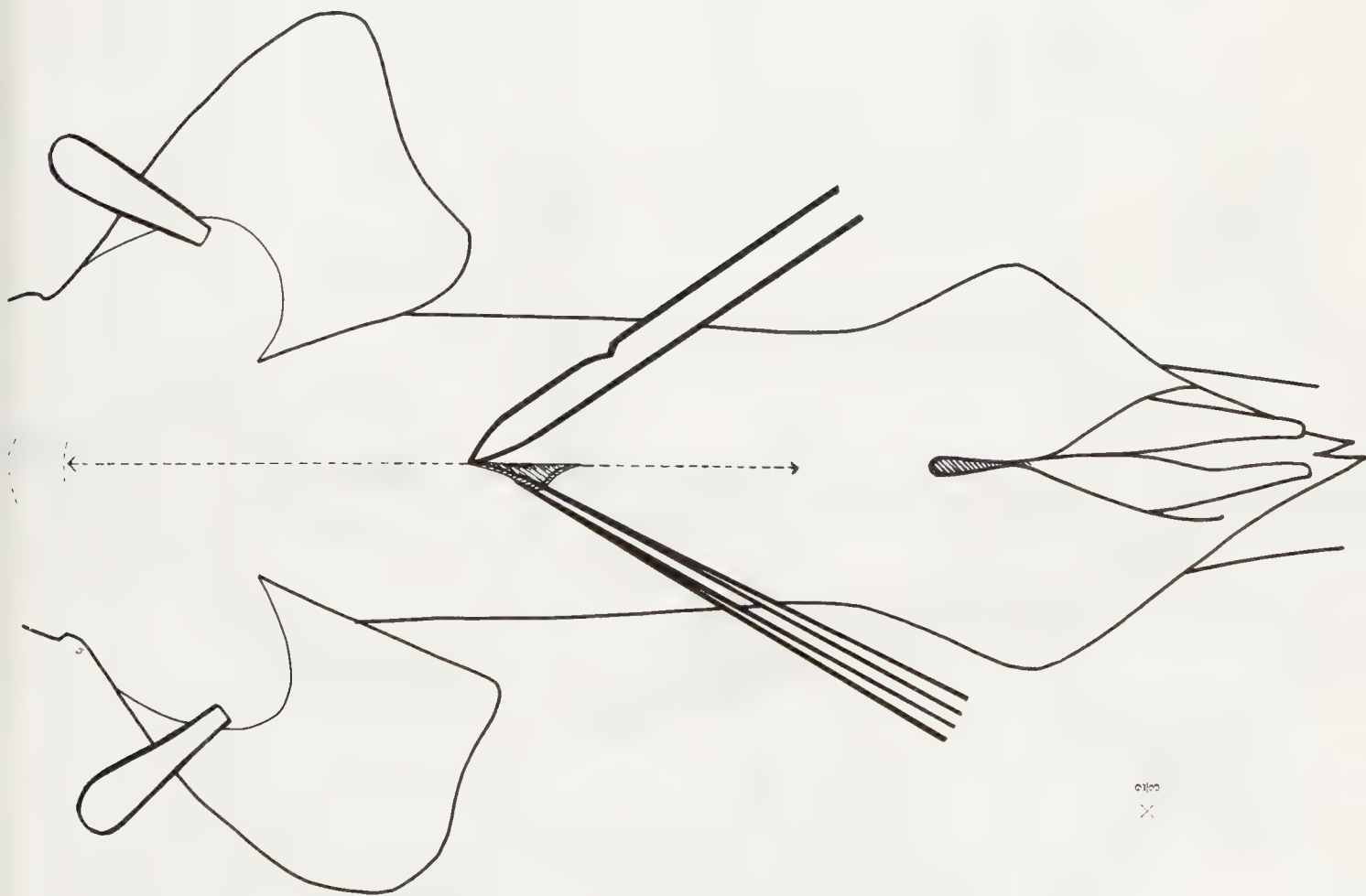


Fig. 2

Grip the edge of the slit made in Fig. 1 and pull the body wall up slightly.

Cut with a scalpel, using small upward strokes until the abdominal cavity is perforated.

Grip the cut edge more firmly and continue the slit forwards to the level of the pectoral girdle and backwards to the pelvic girdle. The girdles can be felt through the skin.

N.B. Be careful not to cut the abdominal viscera.

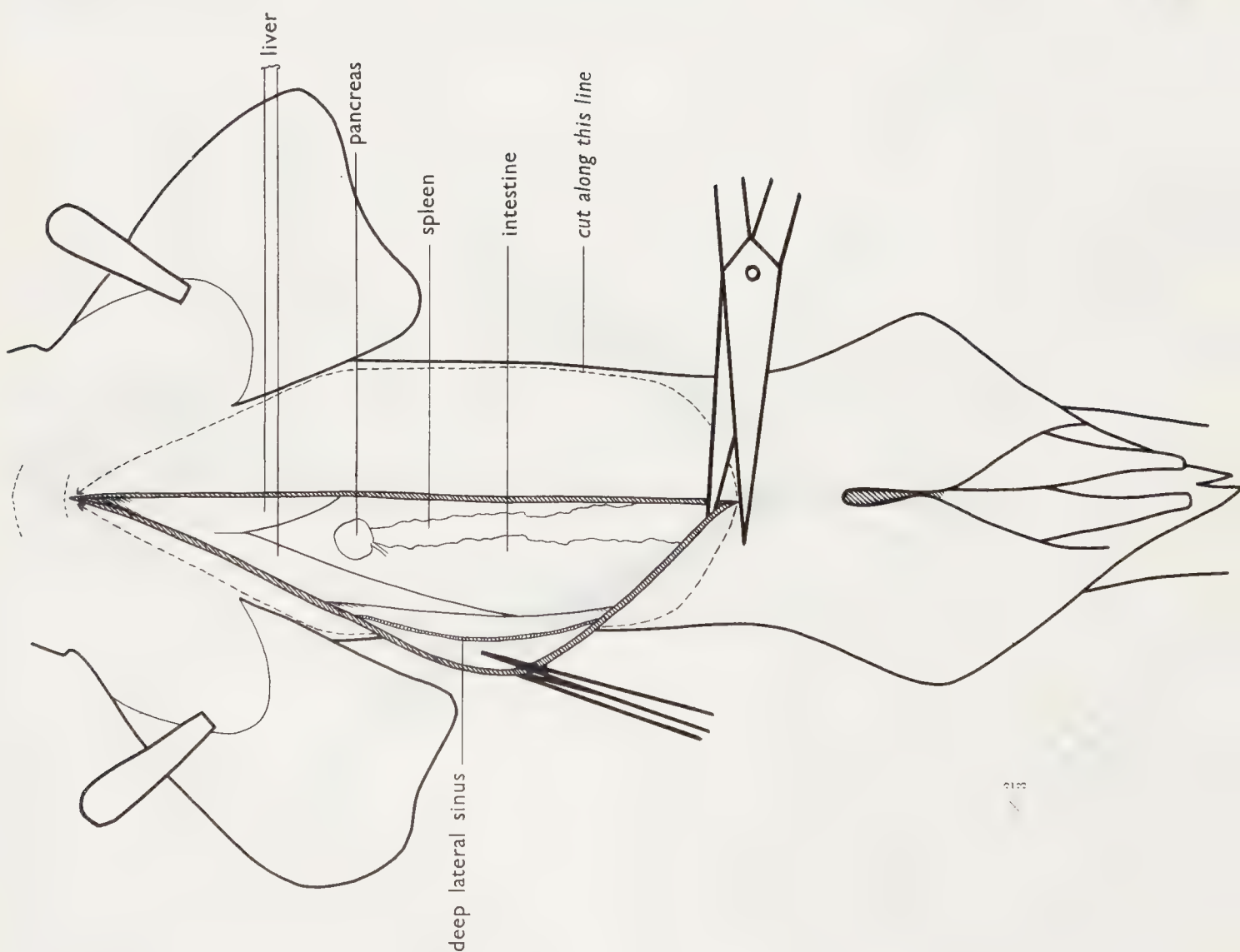


Fig. 3

Hold aside the ventral part of the body wall and look for the deep lateral sinus.

Cut away the skin and muscle of the abdominal wall together, keeping the lateral part of the cut just ventral to the above sinus.

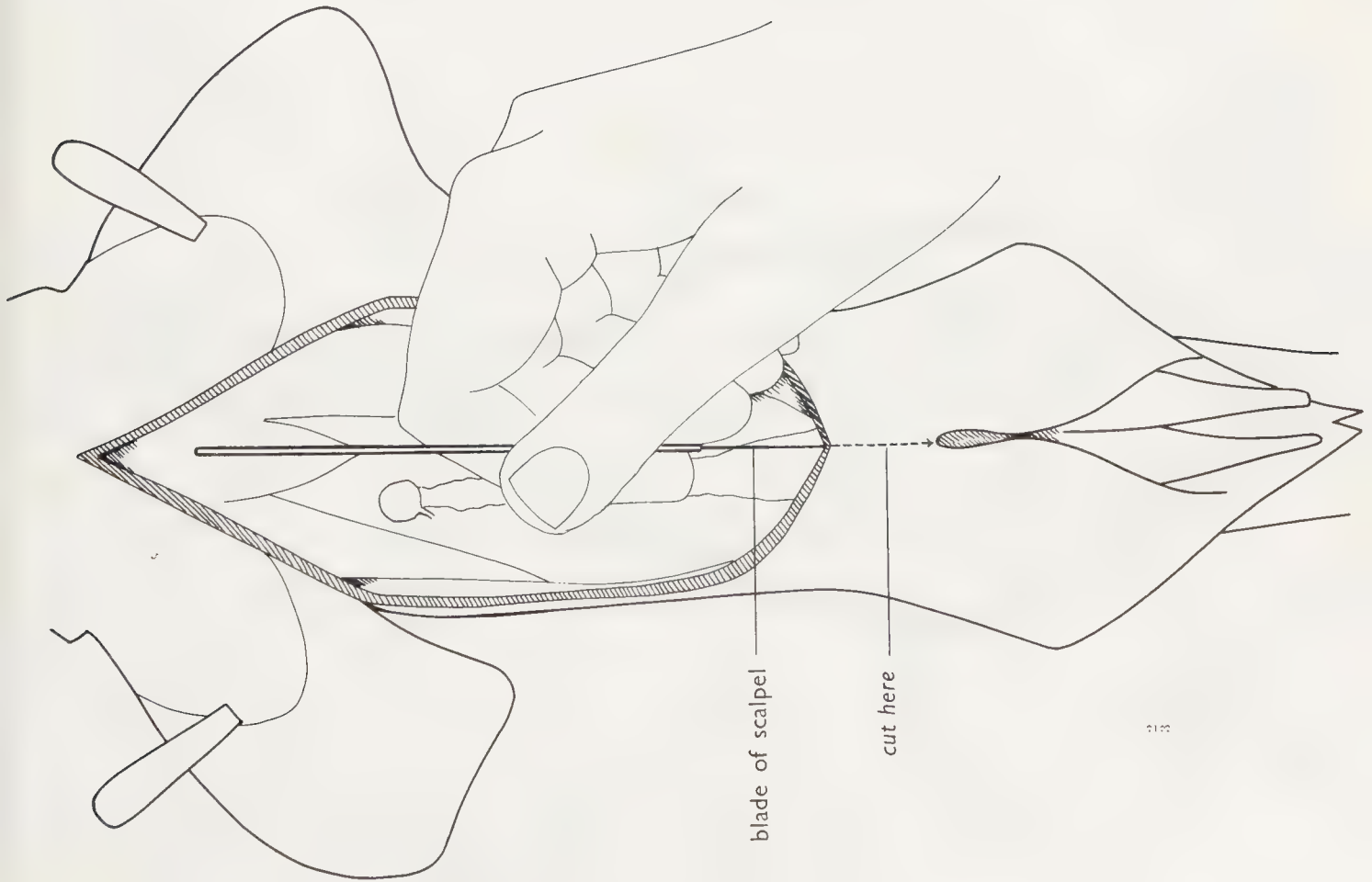


Fig. 4

Holding the scalpel as shown, cut the body wall back to the cloaca. Cut through the pelvic girdle at the same time so that the abdominal cavity is opened to its posterior limit.

NOTE. If preferred, the board may be turned and scissors be used for this cut.

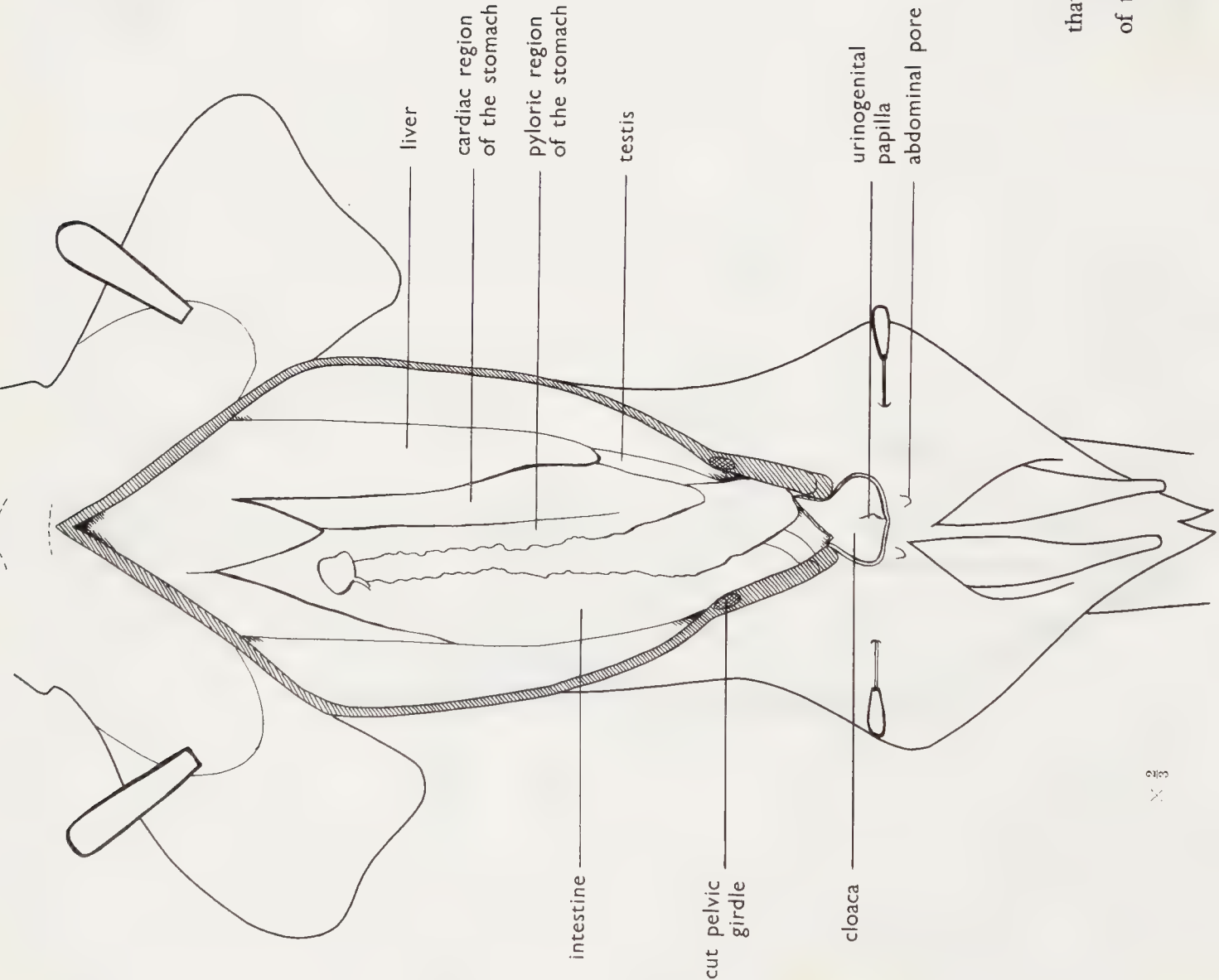


Fig. 5

Pin the pelvic fins to the lateral musculature in such a way that the cloaca is stretched open as shown.
Adjust the pins through the pectoral fins so that the sides of the abdominal wall are drawn apart laterally.
NOTE. The form of the female cloaca is shown in Fig. 20.
Examine and DRAW the viscera in situ.

THE DOGFISH—2 The Alimentary Canal

The abdominal portions of the alimentary canal and their associated glands should be displayed as shown in Figs. 6-8.

The dissection of the anterior parts of the canal must be postponed if the venous sinuses and afferent branchial arteries are required later. The method of display of the buccal cavity and pharynx is shown in Figs. 42 and 43.

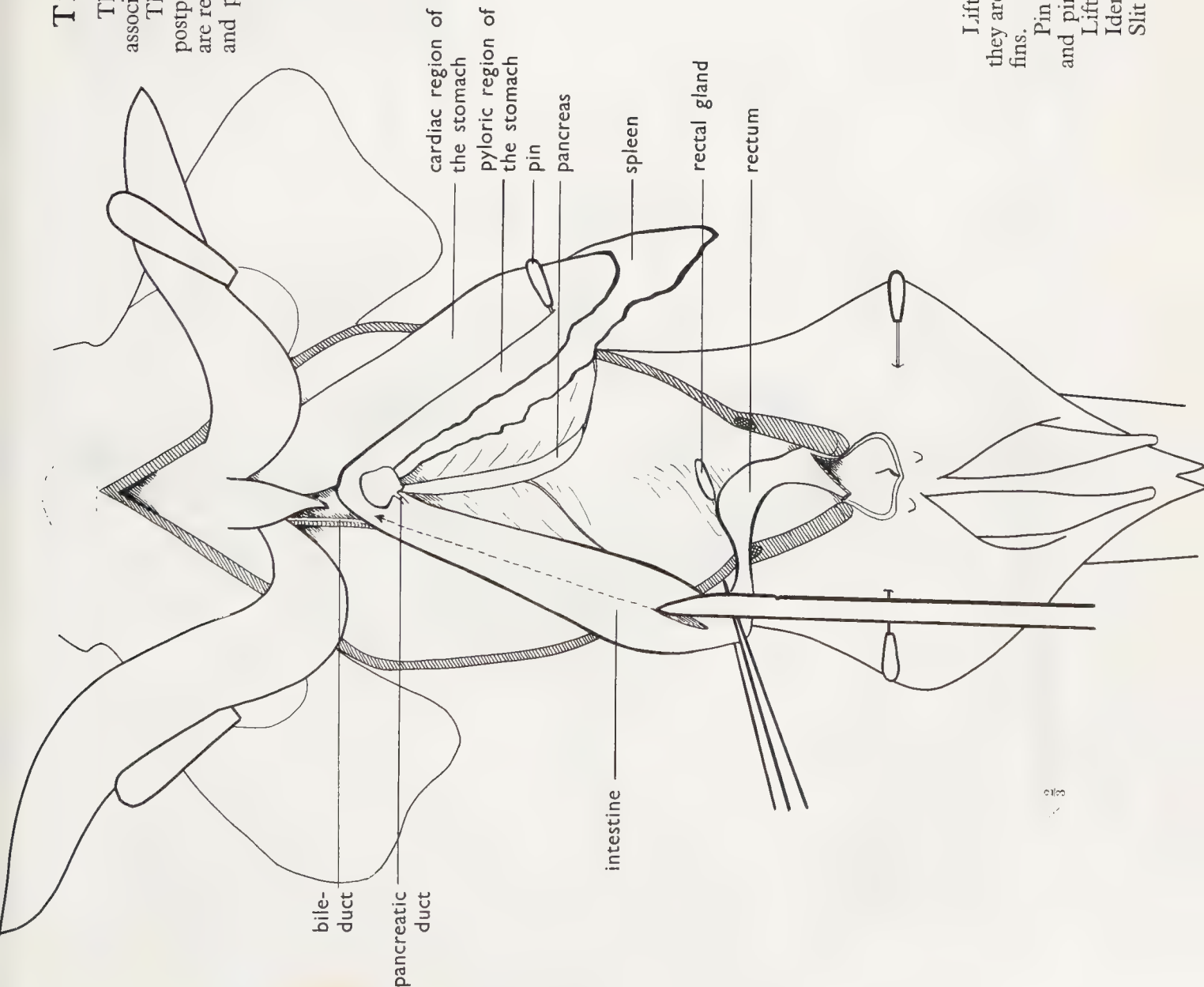


Fig. 6

Lift the right and left liver lobes and place them so that they are supported as shown by the pins which hold the pectoral fins.

Pin the stomach to your right, using a small dissecting-pin and pinning to the body wall.

Lift the intestine to the left.

Identify the parts shown in the diagram.
Slit up the ventral side of the intestine.

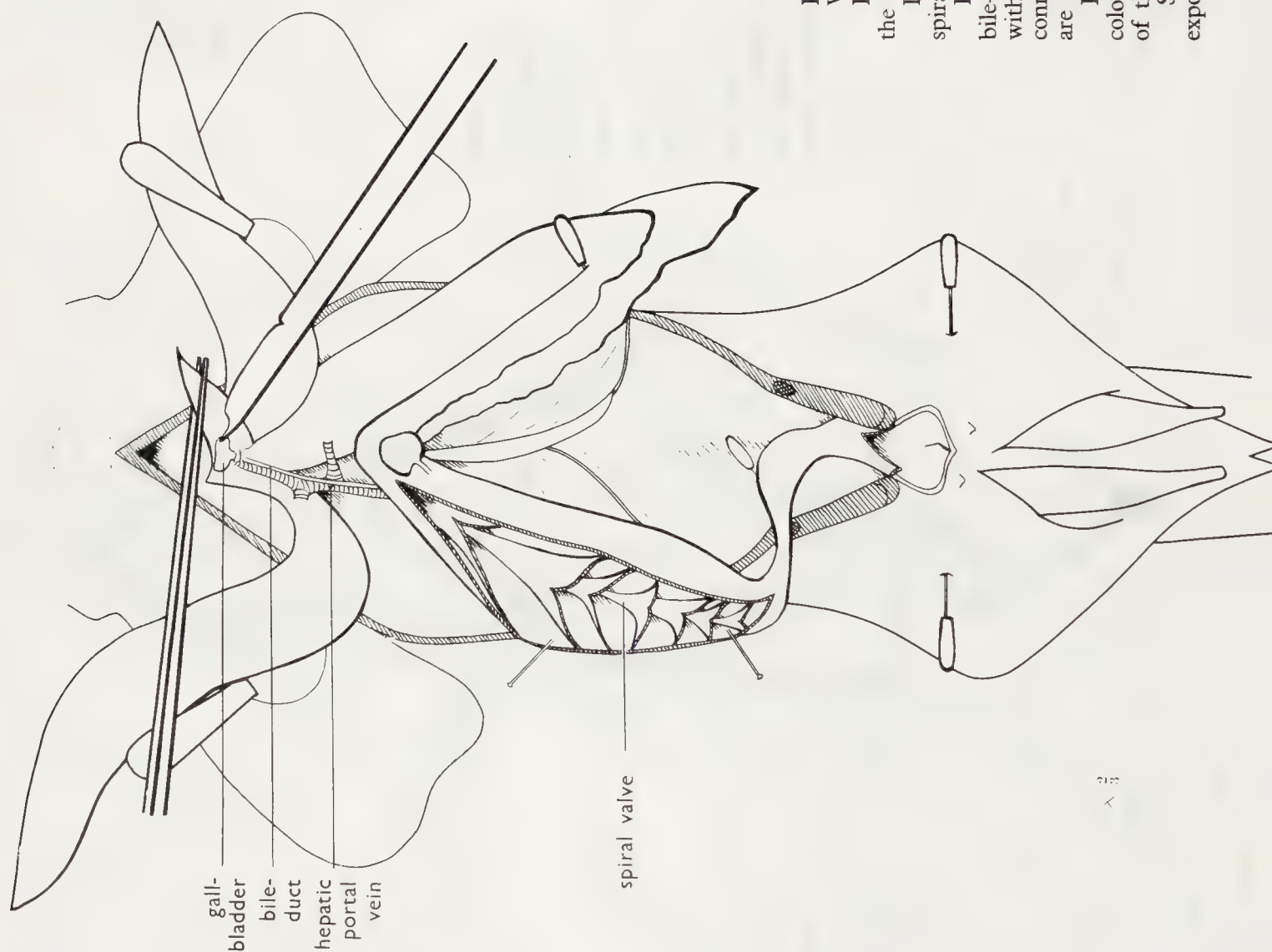


Fig. 7

Remove the dogfish from the board.

Wash out the contents of the intestine.

Replace the dogfish on the board. Fix with pins and adjust the liver lobes as before.

Pin open the intestine as shown in order to display the spiral valve.

Hold the small median lobe of the liver aside and trace the bile-duct. Notice that it lies close to the hepatic portal vein with which it is often confused. It can be identified by (a) its connections, (b) its whiter colour, and (c) the fact that as you are viewing it, it lies to the right of the vein.

Look for the small portion of the gall-bladder (greenish in colour) which usually shows on the surface of the median lobe of the liver.

Scrape away the liver tissue till the gall-bladder is fully exposed.

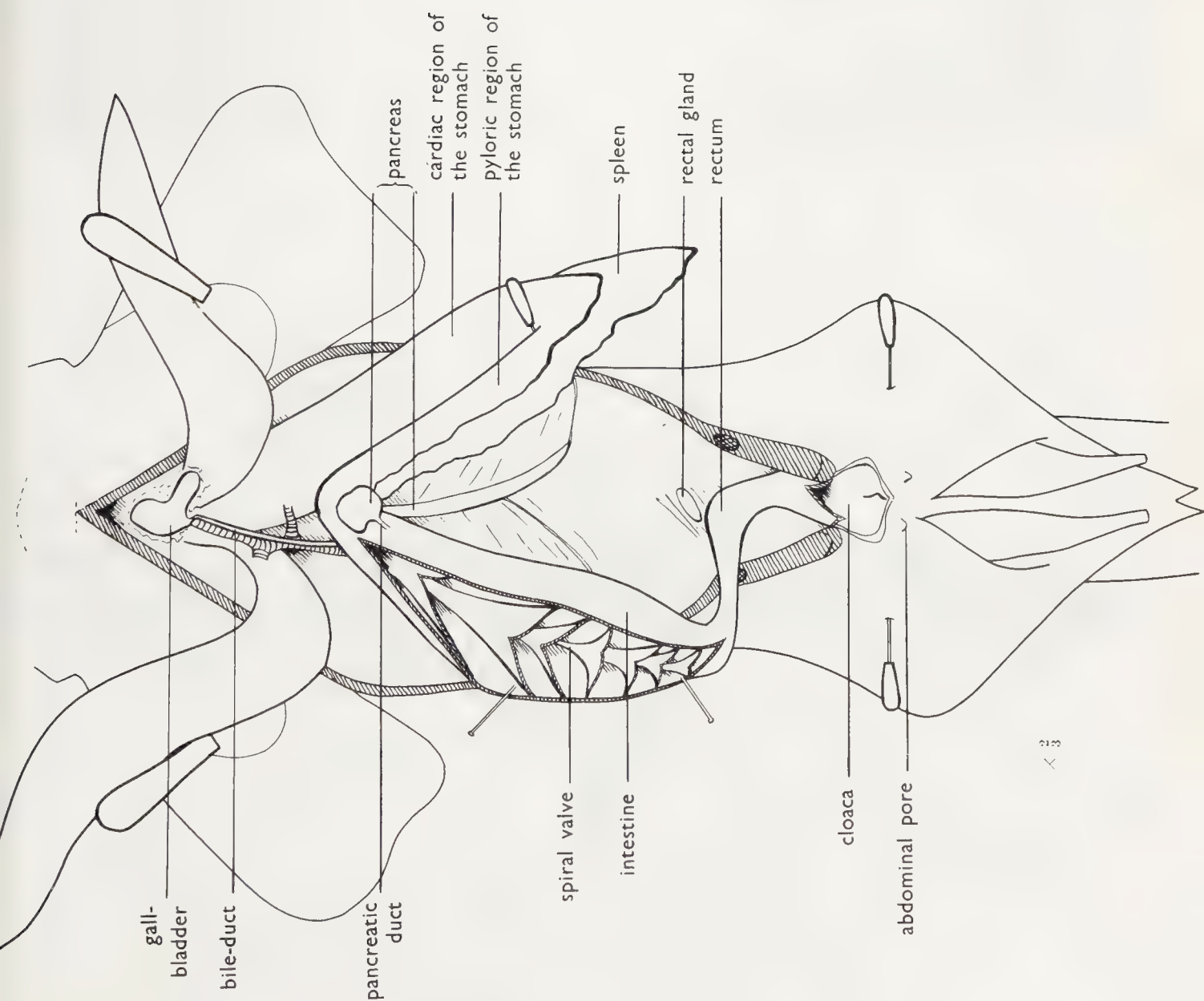


Fig. 8

Examine and DRAW the completed dissection.

THE DOGFISH—3 The Arteries and Veins of the Alimentary Canal

The principal blood-vessels to and from the alimentary canal lie dorsal to the structures which they serve. To see them it is necessary to turn the alimentary canal over. Remember that your drawing therefore becomes largely a dorsal rather than a ventral view and that structures usually seen to your right are now left, and vice versa.

There are considerable individual differences in the detail of the distribution of the blood-vessels on the surface of the stomach and intestine. No attempt has therefore been made to show them. Notice how the arteries and veins accompany one another.

In order to see all the vessels clearly it is necessary to adjust the positions of the organs carefully.

NOTE. If the cardiac region of the stomach is much distended with food, slit it open ventrally and wash out the contents before attempting to display the blood-vessels.

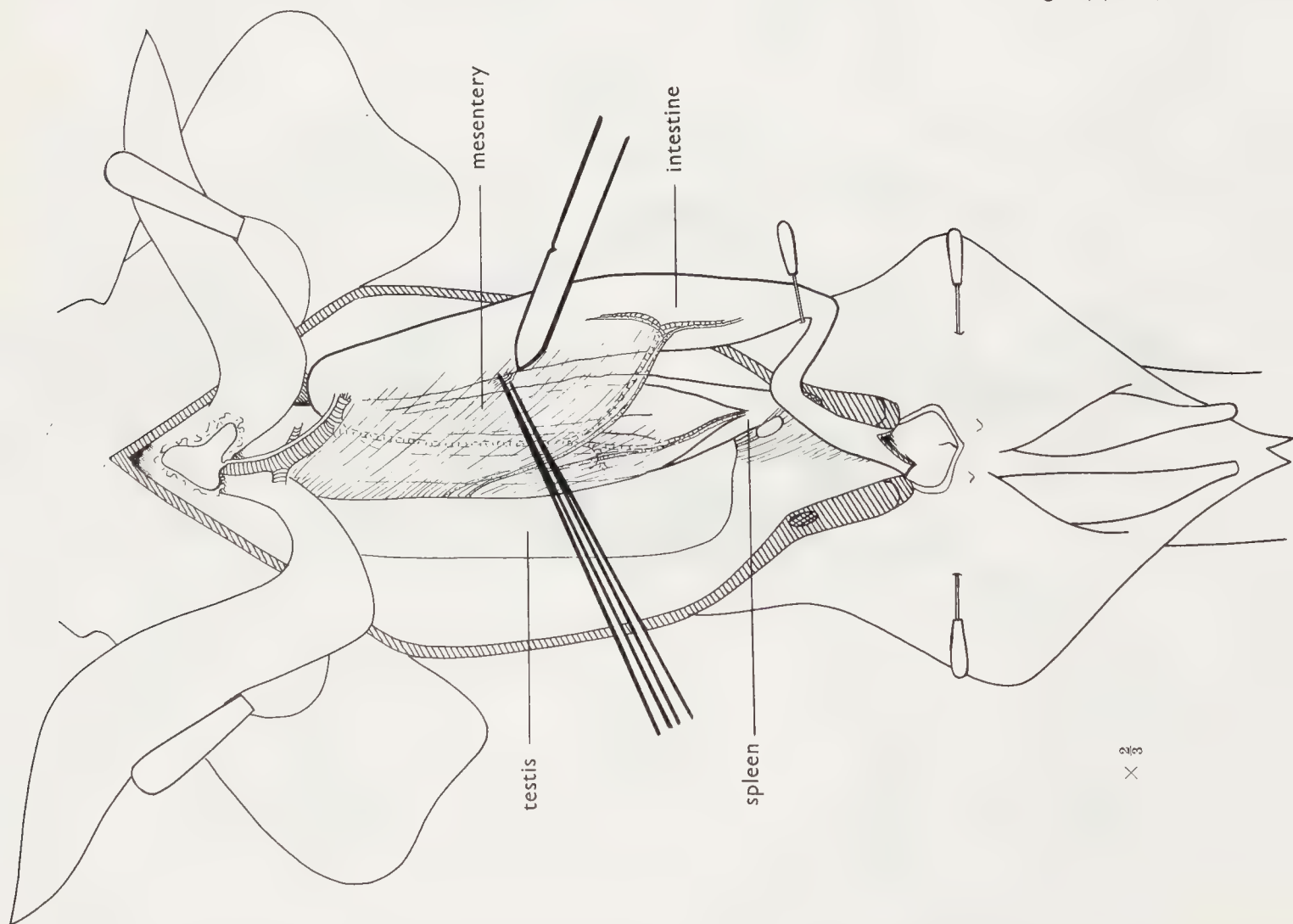


Fig. 9a. Male

Remove the pins from the stomach and intestine.

Turn the stomach and intestine over and hold in place by means of a pin.

The blood-vessels do not show clearly because of the mesentery. Remove this mesentery carefully, stripping off small pieces at a time.

N.B. WATCH FOR THE BLOOD-VESSELS indicated by the dotted lines in this figure and those shown in Fig. 10.

NOTE. The crossing of the lienogastric and anterior mesenteric arteries takes place within the mesentery proper and there is no need to displace the mesorchium.

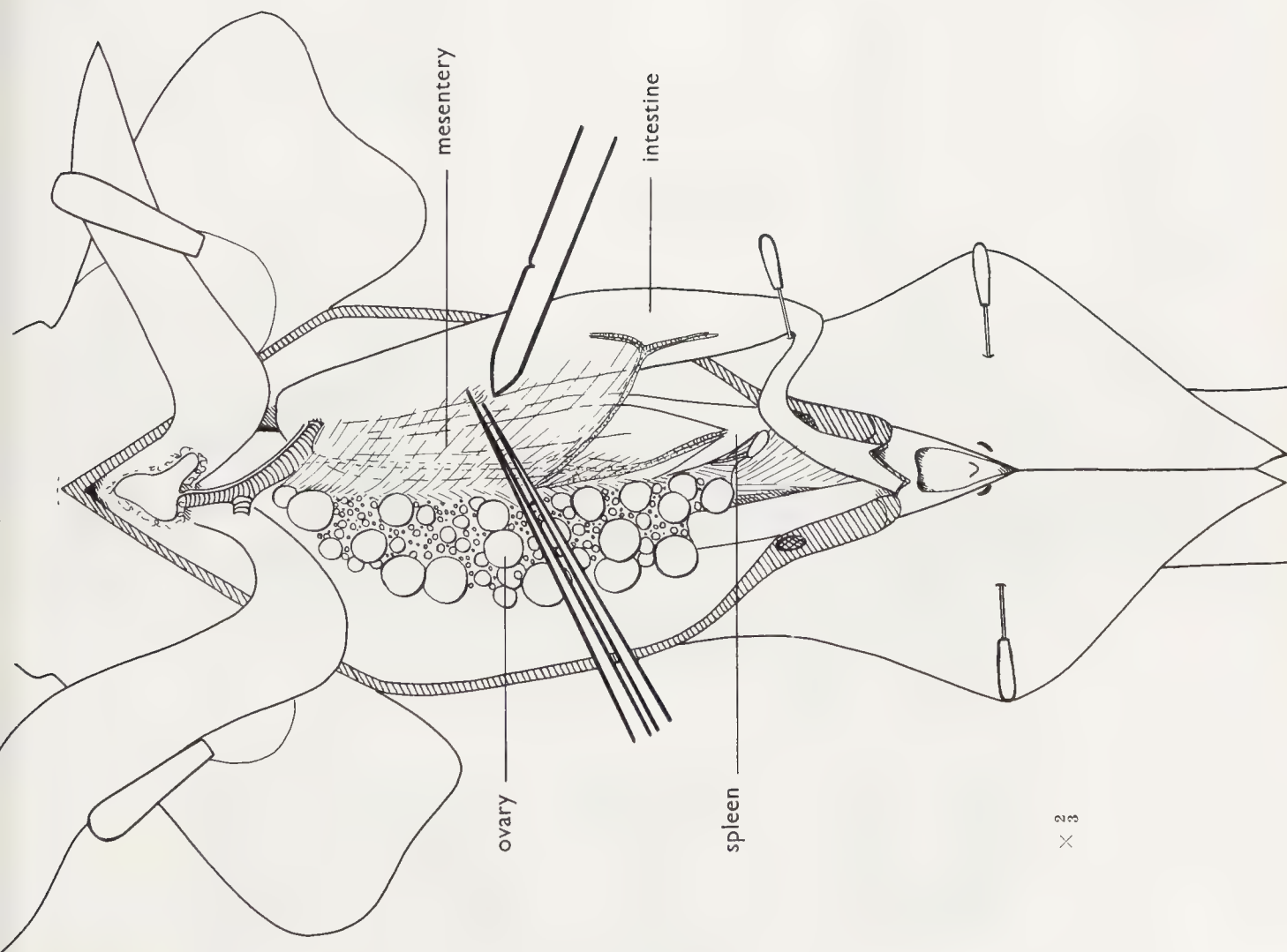


Fig. 9b. Female

As for Fig. 9a, but note that the mesentery is attached to the mesovarium and the crossing over of the lienogastric and anterior mesenteric arteries takes place within the latter. It is important not to cut the mesovarium if the urinogenital system is to be displayed later.

THE DOGFISH—*The arteries and veins of the alimentary canal*

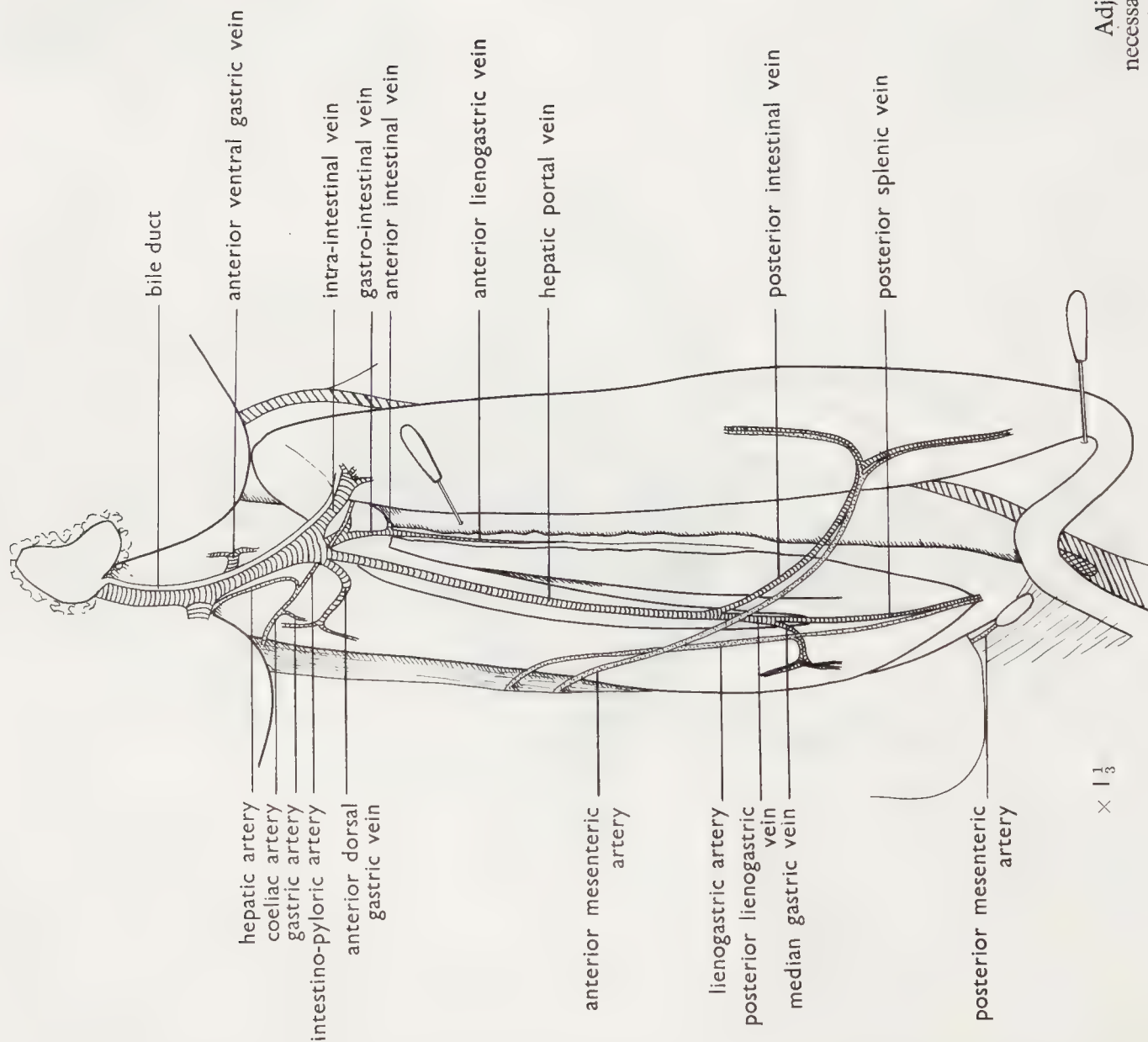


Fig. 10a. Male

Adjust the position of the alimentary canal, using pins if necessary.

Identify the blood-vessels shown and DRAW.

THE DOGFISH—The arteries and veins of the alimentary canal

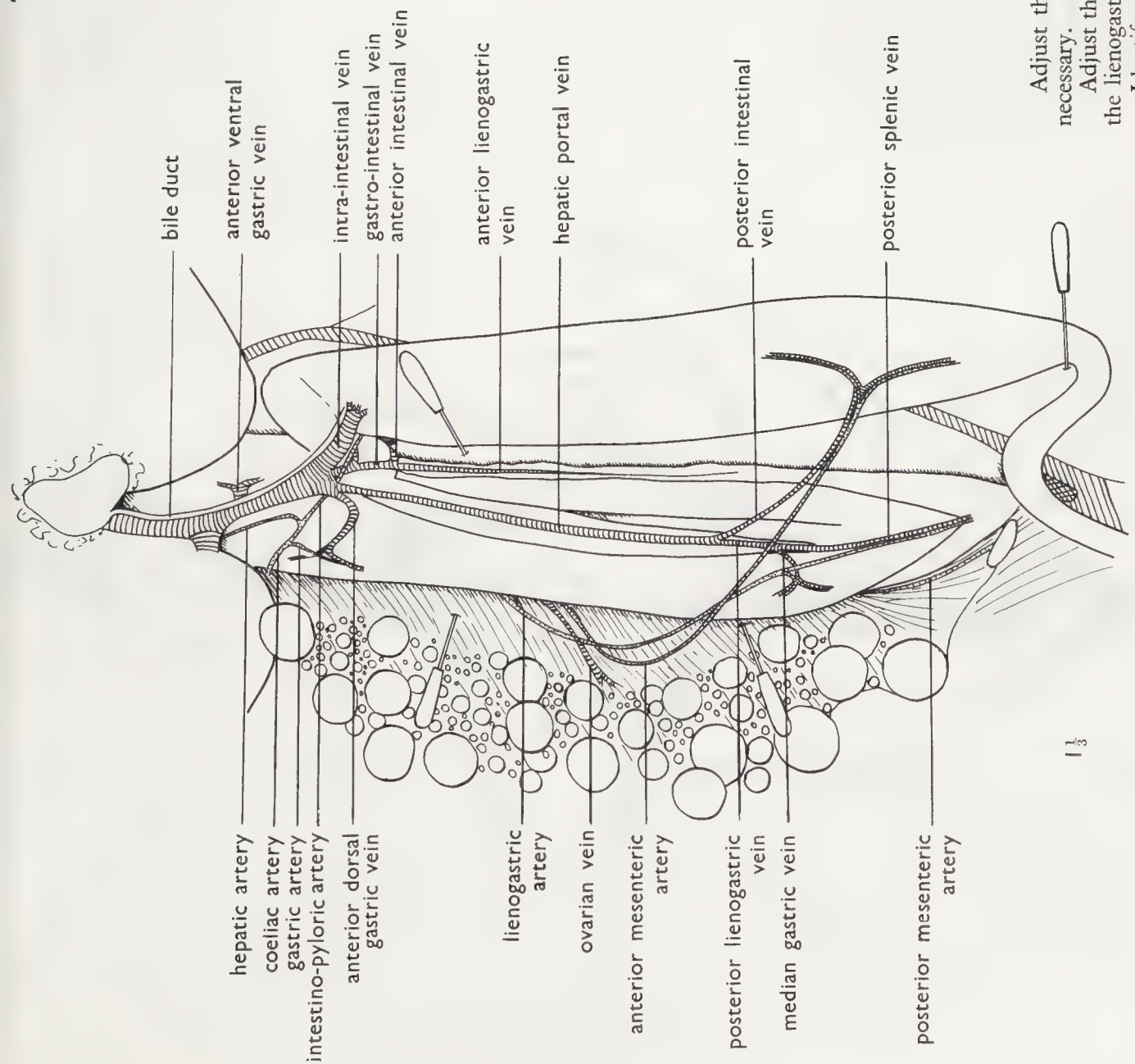


Fig. 10b. Female

Adjust the position of the alimentary canal, using pins if necessary.

Adjust the position of the ovary so that the crossing over of the lienogastric and anterior mesenteric arteries shows clearly.

Identify the blood-vessels shown and DRAW.

THE DOGFISH—4 The Urinogenital System

(a) MALE

In the male dogfish the kidneys and the ducts of the urinogenital system (except the vasa efferentia) lie against the dorsal wall of the abdomen and are covered over by a tough layer of peritoneum. The testes are, however, suspended freely in the body cavity by a relatively delicate mesorchium within the anterior part of which run the vasa efferentia. The mesorchium tears easily and therefore the testes are often found to be lying loose when the specimen is received. Before drawing the completed dissection the student should place the testes in the positions shown in Fig. 19 and should indicate the vasa efferentia by dotted lines only. The exact position of these ducts and the form of the testes vary considerably.

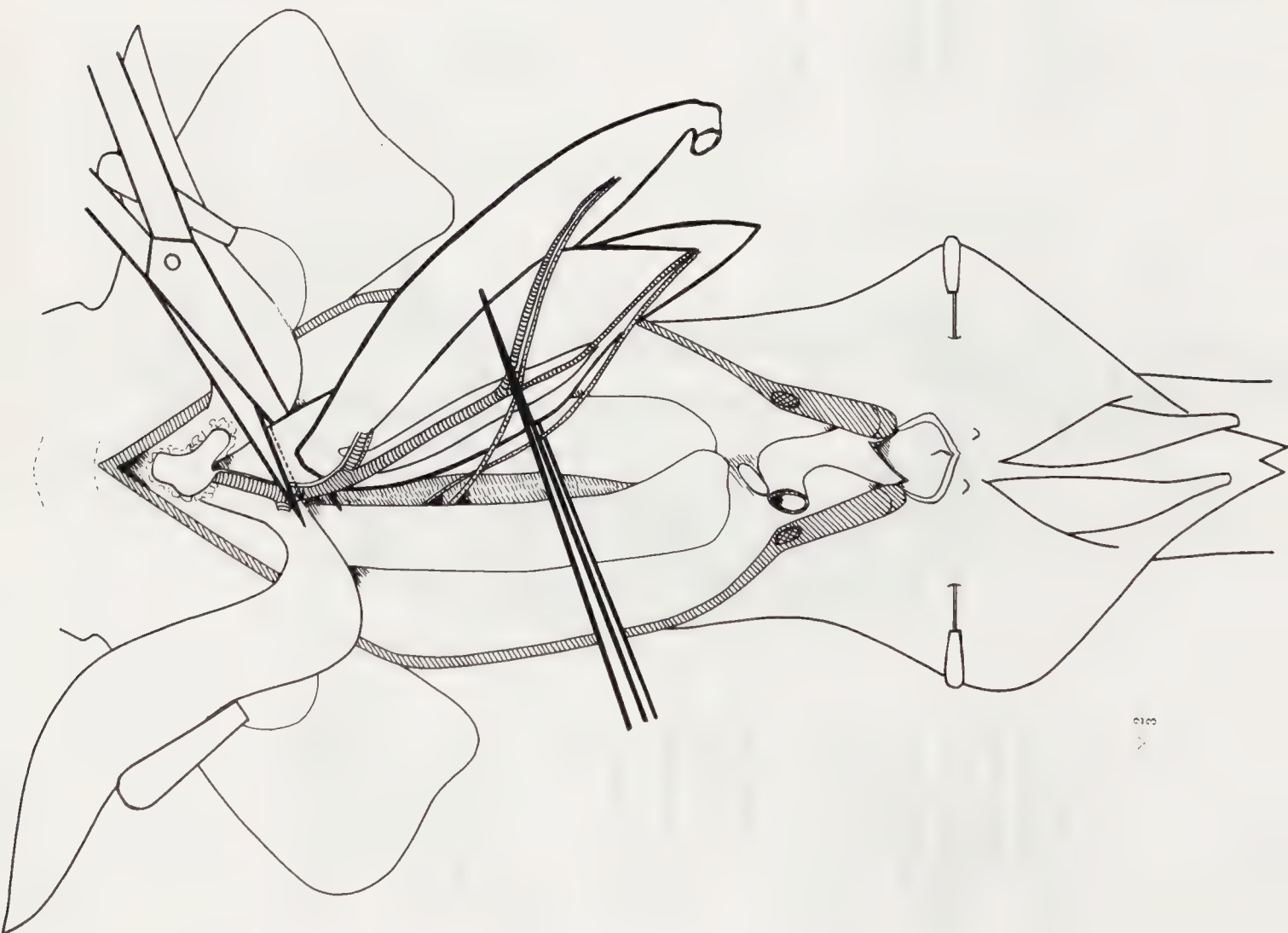


Fig. 11

Remove any pins which are holding the alimentary canal. Grip the alimentary canal as shown.

Cut through the rectum close to the rectal gland.

Cut through the oesophagus, the bile-duct and the hepatic portal vein. Cut through the lienogastric and anterior mesenteric arteries.

Remove the stomach and intestine, taking the pancreas and spleen with them.

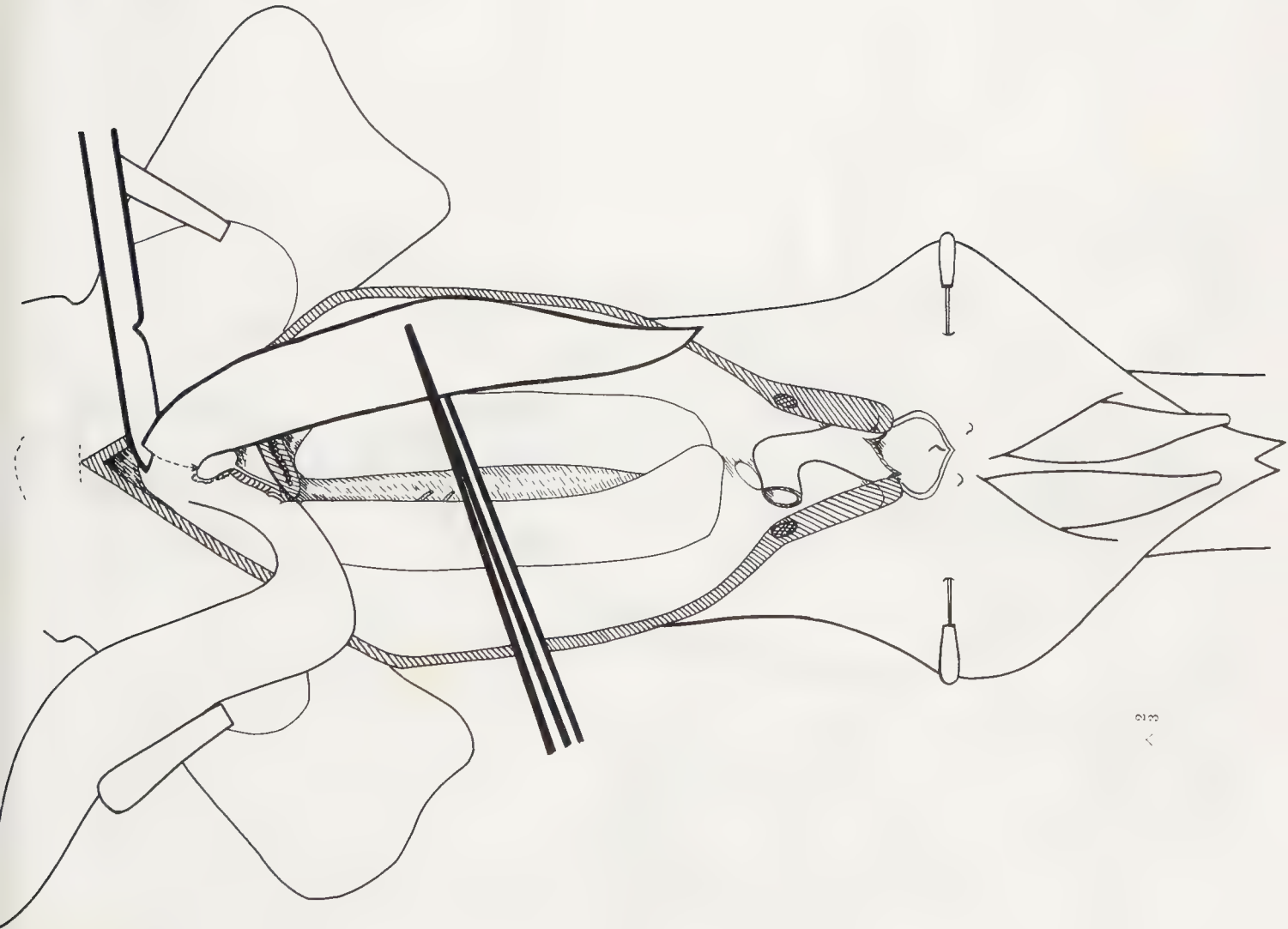


Fig. 12

Grip one lobe of the liver and pull it gently towards you so that the anterior boundary is drawn out of the abdominal cavity.

Cut away the liver lobe as completely as possible.
Repeat to remove the other lobe of the liver.

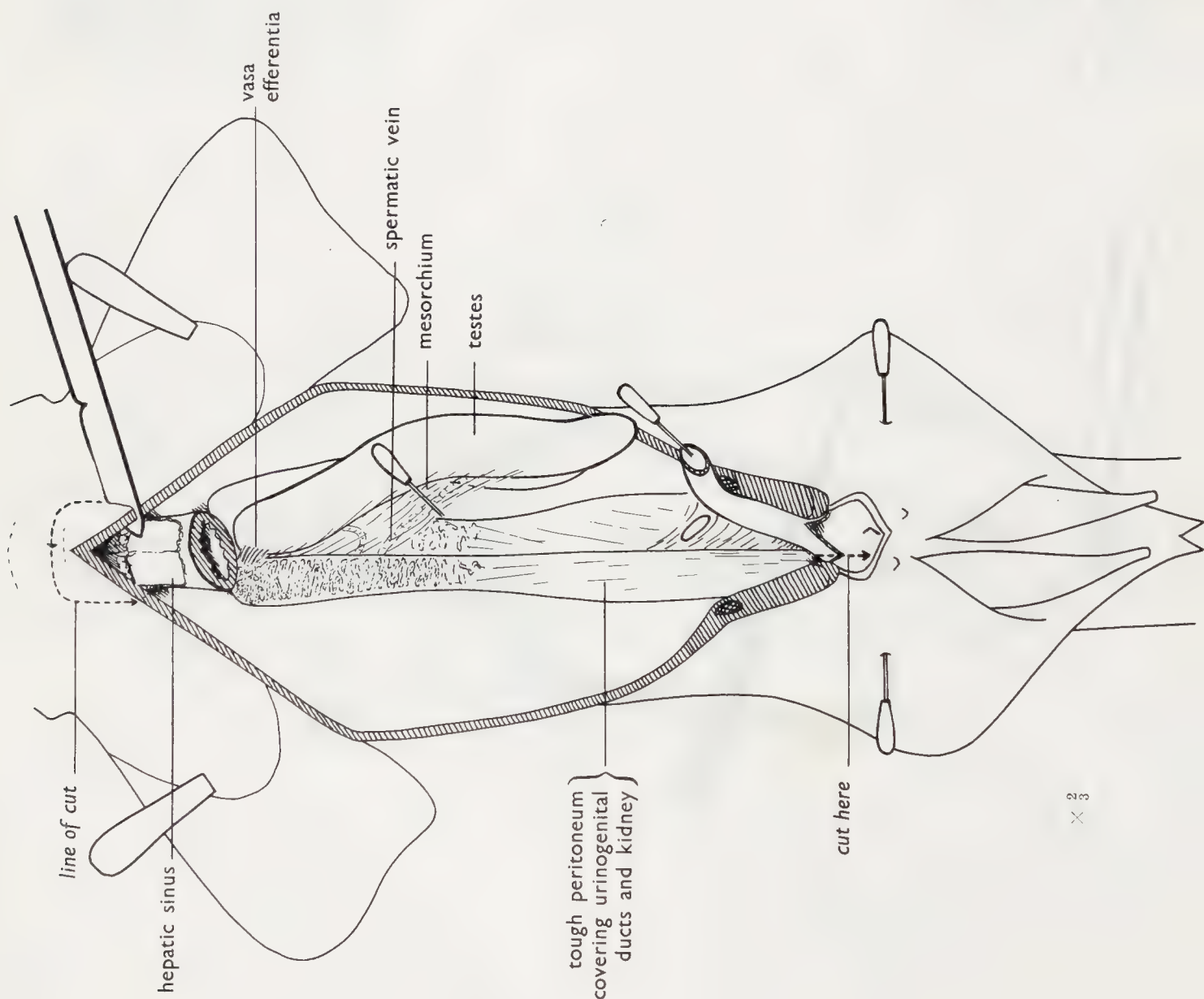


Fig. 13

Lay both testes over to one side and hold in place by means of a pin placed as shown, BESIDE not through the testes.

Pin aside the rectum.

Slit down the side of the cloaca to the posterior limit of the abdominal cavity.

Carve away a further portion of the wall of the anterior end of the abdominal cavity, cutting through the cartilage of the pectoral girdle at the same time so that the pericardial cavity is opened.

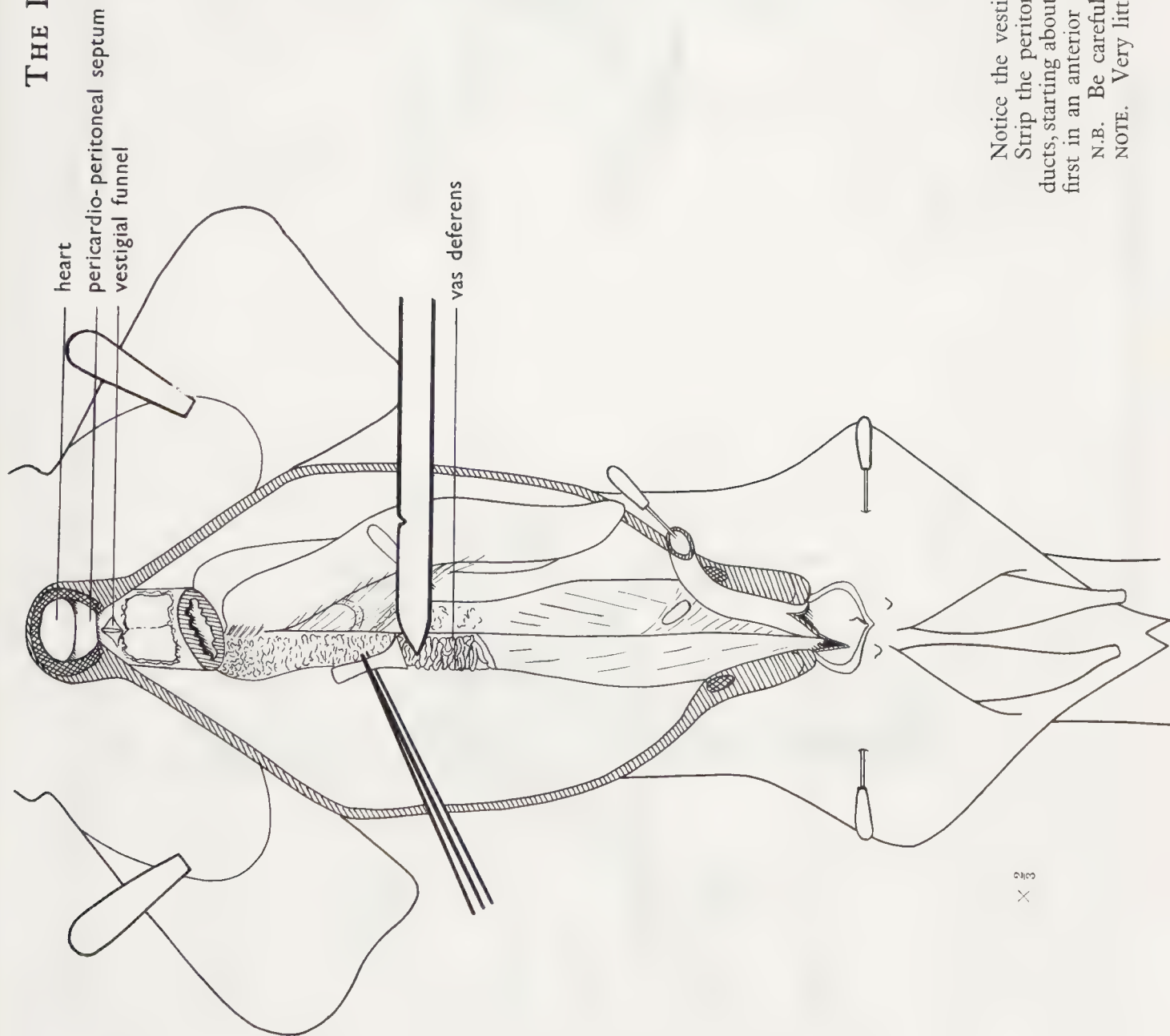


Fig. 14

Notice the vestigial oviducal funnel.

Strip the peritoneum from the surface of the urinogenital ducts, starting about halfway down the body cavity and working first in an anterior and then in a posterior direction.

N.B. Be careful not to damage the ducts.

NOTE. Very little of the kidney is visible at this stage.

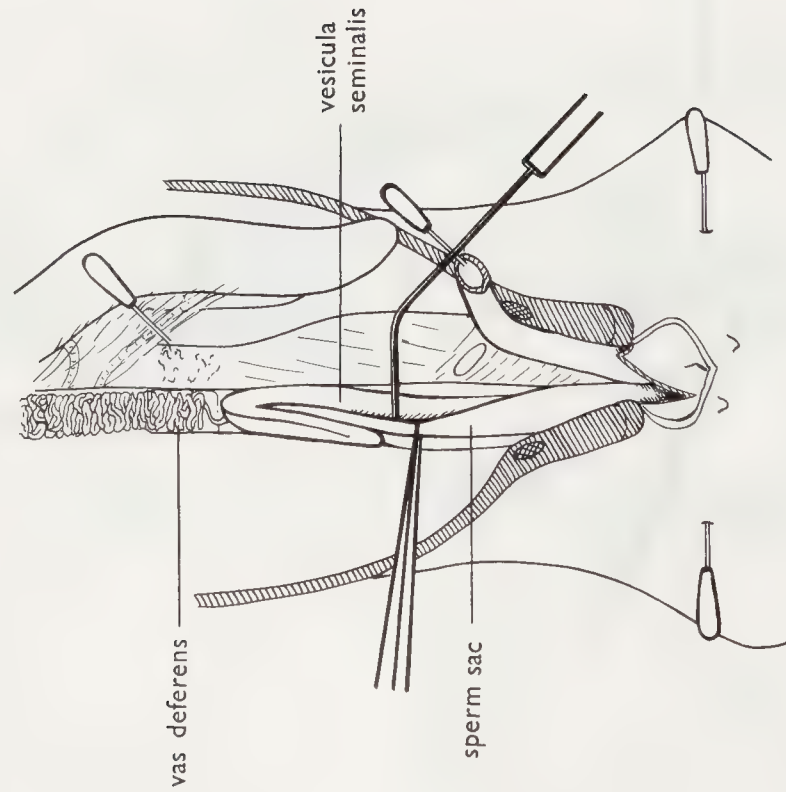


Fig. 15

Using a seeker, gently separate the sperm sac from the vesicula seminalis to which it is attached by very soft connective tissue.

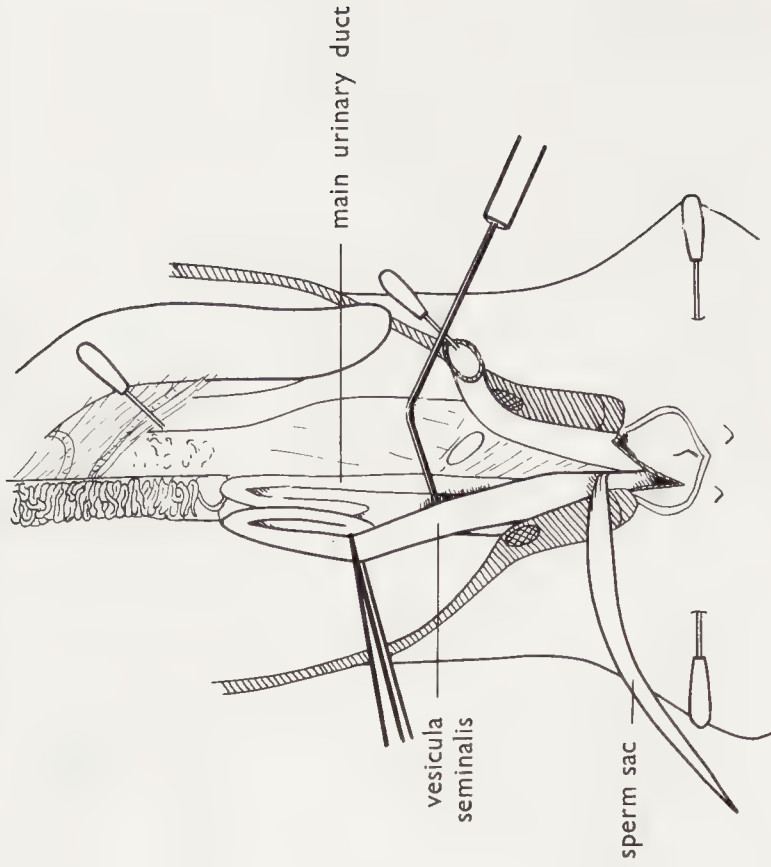


Fig. 16

Similarly loosen the vesicula seminalis from the main urinary duct and the surface of the kidney.

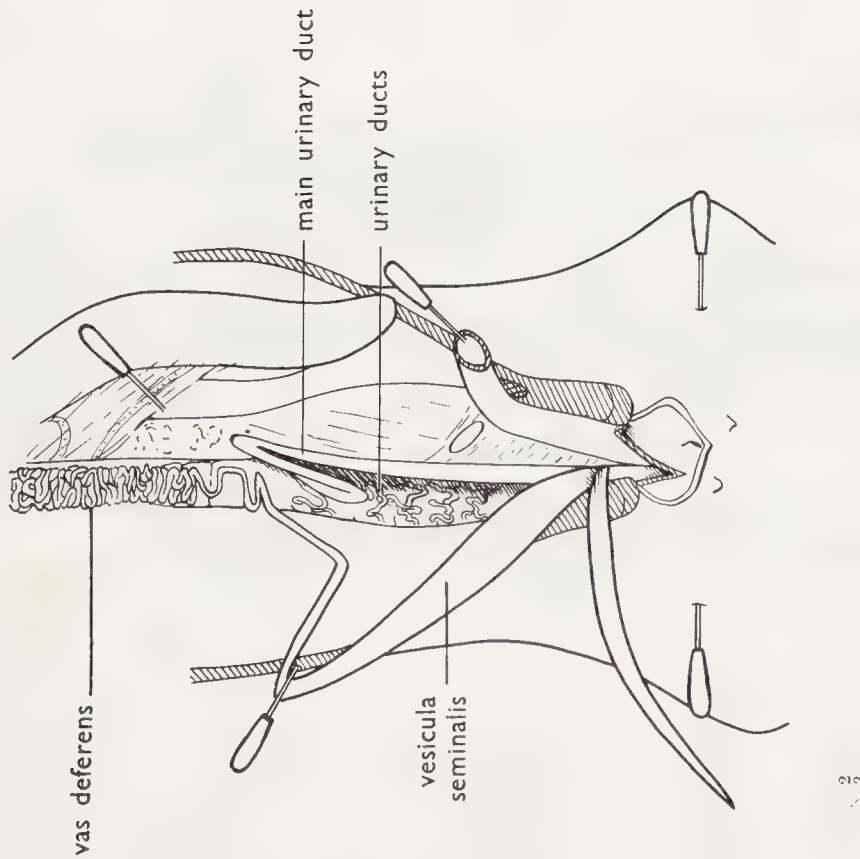


Fig. 17

Trace the connection between the vesicula seminalis and the vas deferens, loosening the connective tissue as required. Pin the vesicula seminalis aside.

VERY GENTLY loosen the main urinary duct and its tributaries from the kidney.

N.B. The urinary ducts are VERY DELICATE and utmost care must be taken when endeavouring to loosen them from the connective tissue.

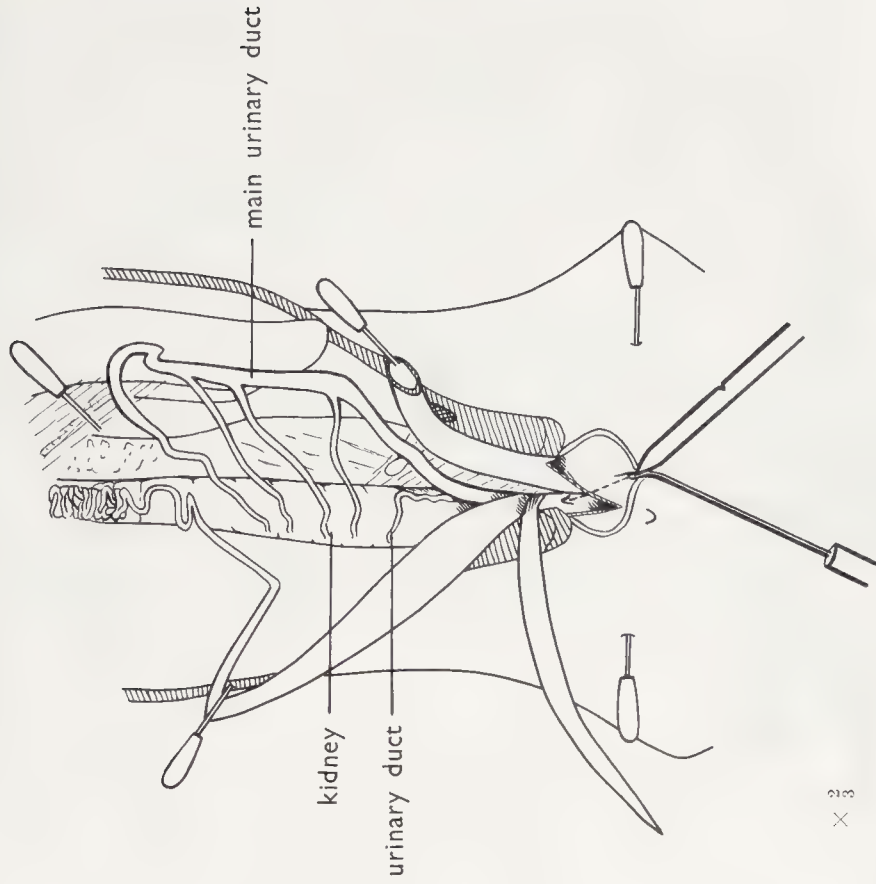


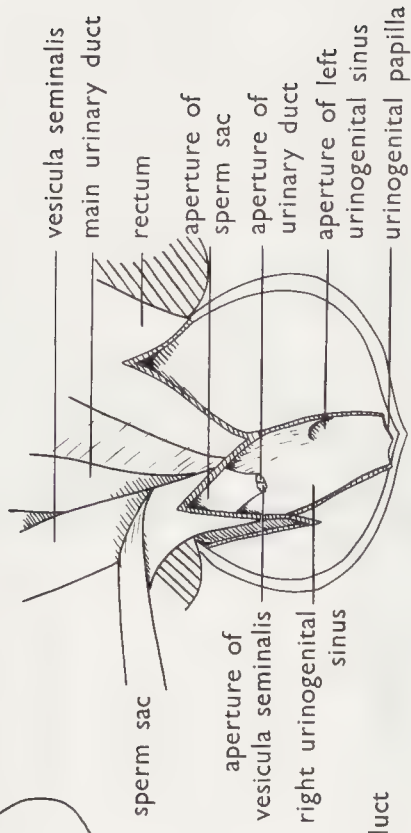
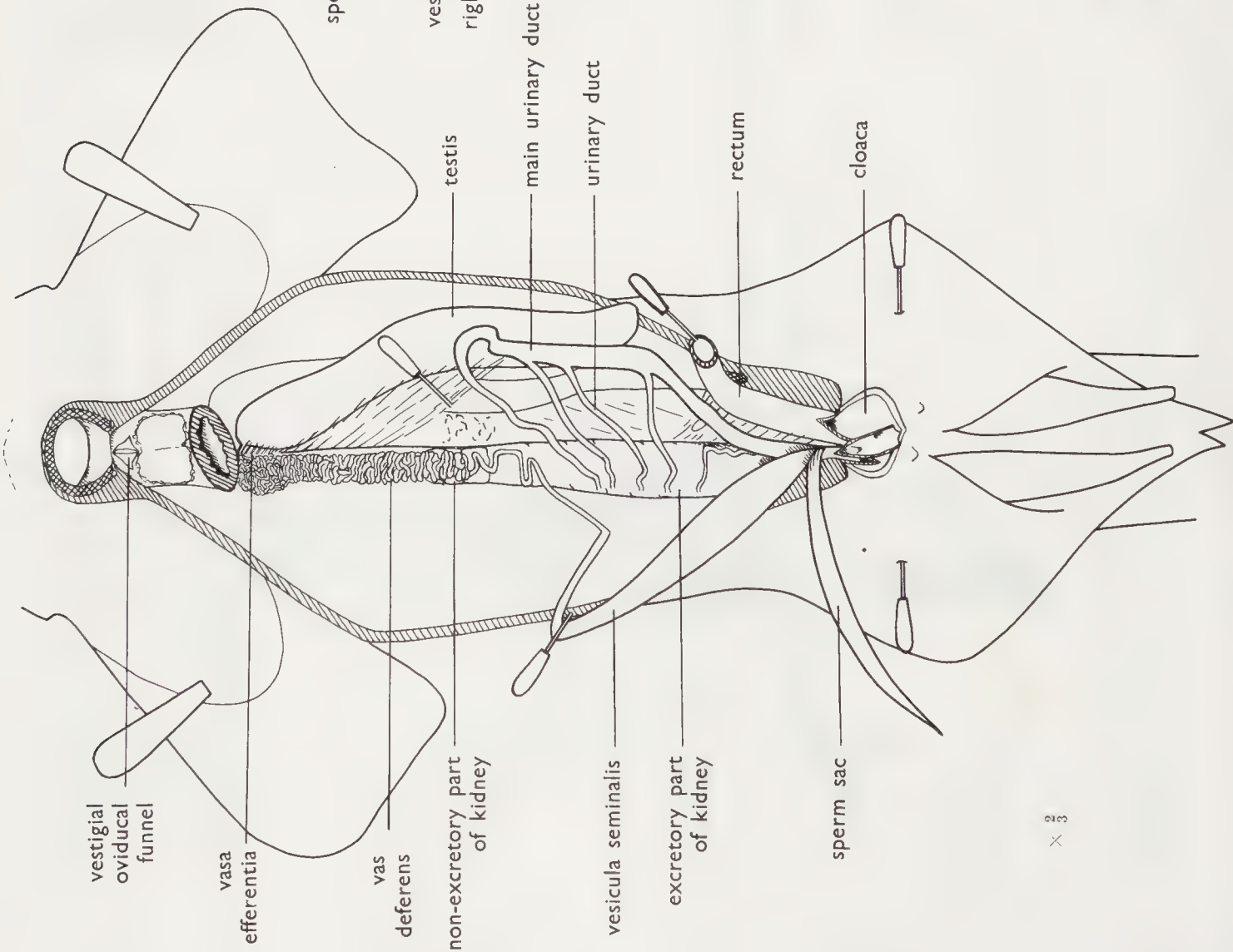
Fig. 18

Display the urinary ducts as shown.

Insert a seeker through the urinogenital aperture into the urinogenital sinus and thence into the sperm sac.

Use the seeker as a guide to make a cut along the line indicated.

N.B. Keep the point of the scalpel as close to the seeker as possible and make a series of short cuts.



Inset

Fig. 19

Notice the apertures of the vesicula seminalis and urinary duct.
The inset is an enlargement of the cloacal region to show detail.

DRAW the completed dissection.

(b) FEMALE

The peritoneum varies considerably in thickness. Where it forms the mesovarium it is very fine and must be handled carefully, especially when the ovary is ripe. N.B. There is only ONE ovary, although there are two oviducts. The membrane supporting the oviduct is considerably tougher, while that covering the median parts of the kidneys is very tough indeed. The latter merges with a thin covering over the urinary sinus. It is necessary to remove the covering of the median part of the kidney without damaging the urinary sinus, which can then be laid aside to display the kidney and urinary ducts.

In some specimens there is a large swelling of the oviduct posterior to the shell gland. It indicates the presence of an egg in its case ready for oviposition, and can be examined by slitting the oviduct open. The egg itself is usually in a bad state of preservation owing to the slow penetration of the formalin through the horny capsule. In specimens of young dogfish the aperture of the genital sinus is covered over by the membranous hymen. It usually tears a little when the cloaca is opened.

Fig. 20

Remove the alimentary canal and liver as indicated in Figs. 11 and 12.

Carve away a portion of the wall of the anterior end of the abdominal cavity as shown in Fig. 13.

Observe the oviducal funnels.

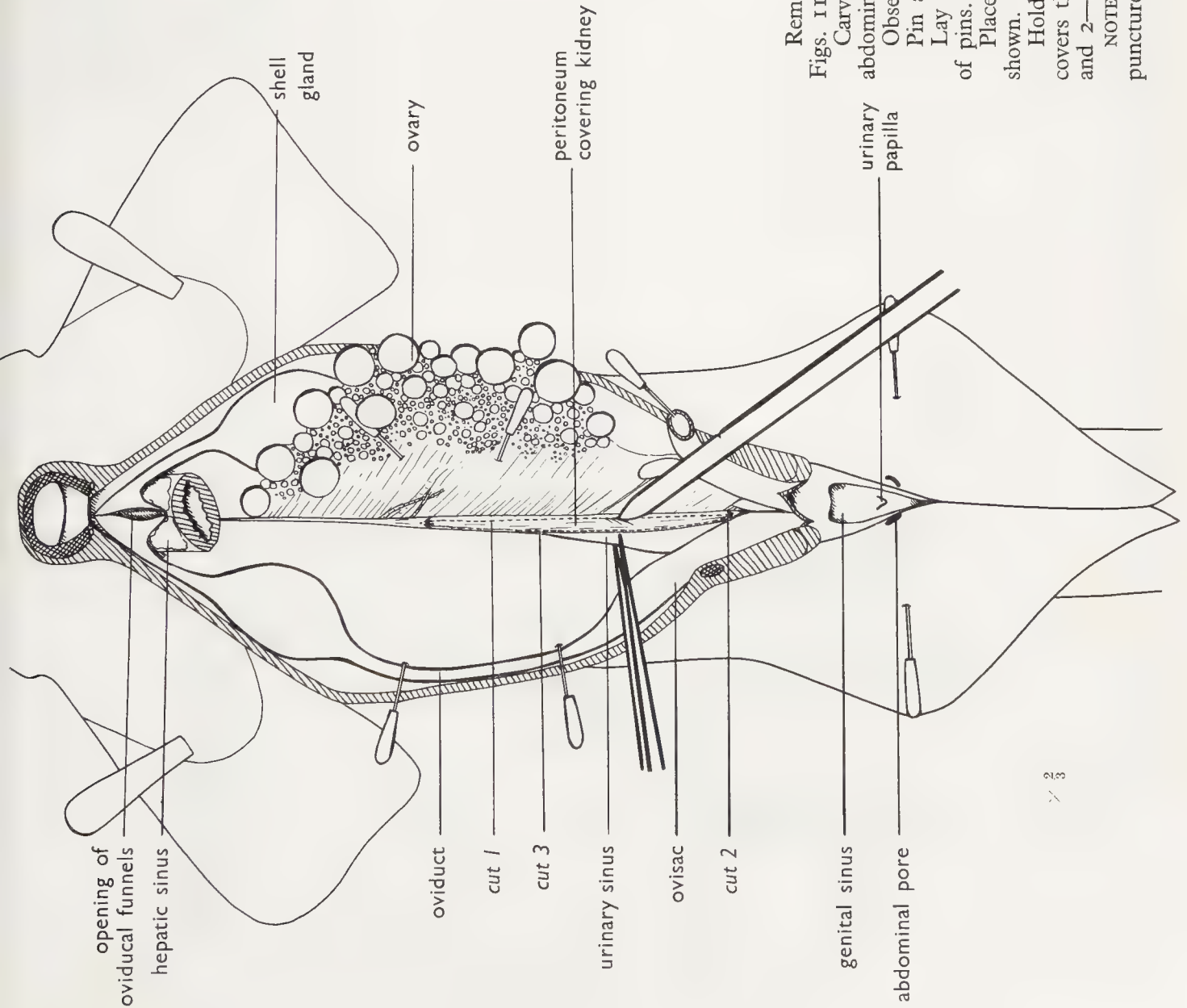
Pin aside the rectum.

Lay the ovary over to one side and hold in place by means of pins.

Place pins to hold the oviduct of the opposite side as shown.

Hold aside the urinary sinus and slit the peritoneum which covers the kidney as close to the midline as possible—cuts 1 and 2—and again close to the urinary sinus—cut 3.

NOTE. Make a series of small cuts and be careful not to puncture the posterior cardinal sinus.



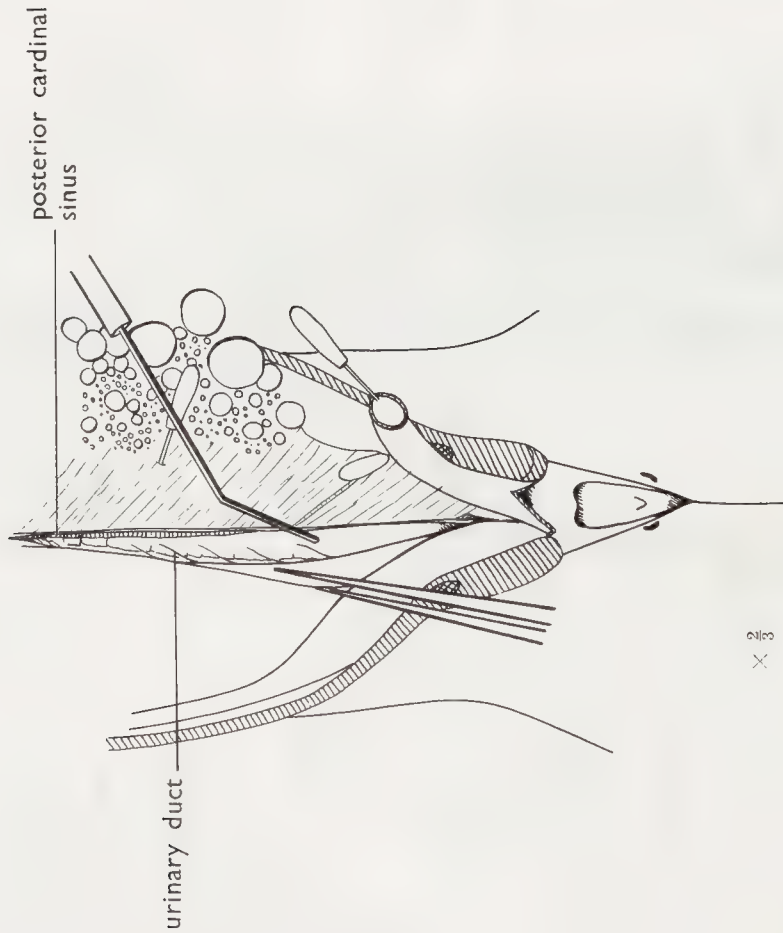


Fig. 21

Lift the urinary sinus and gently loosen the soft connective tissue which binds it to the kidney. WATCH FOR THE FOUR OR FIVE VERY DELICATE URINARY DUCTS.

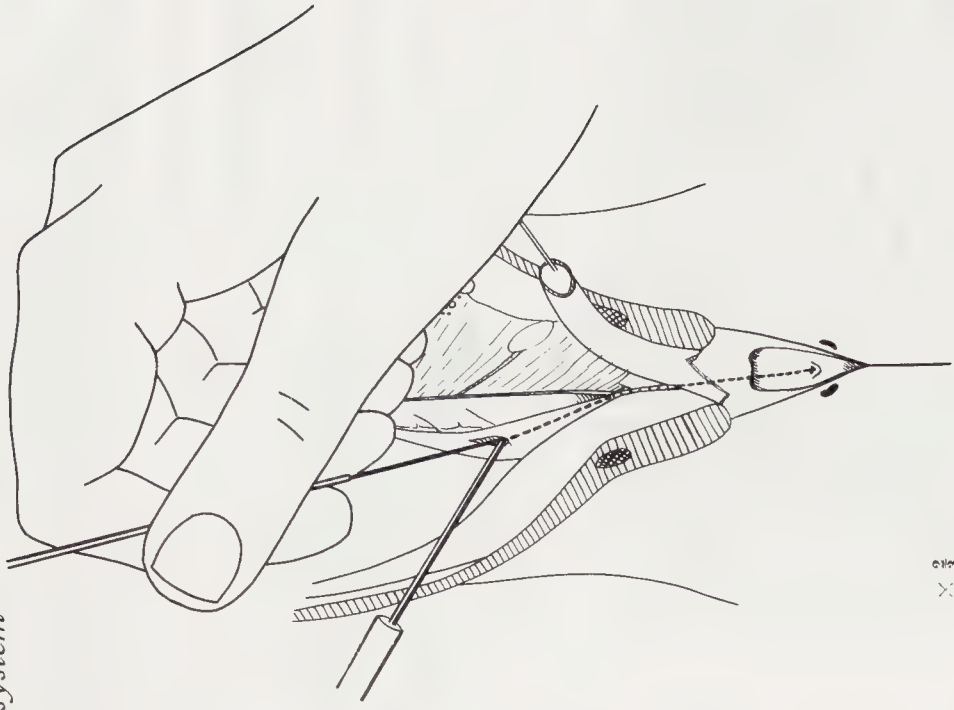


Fig. 22

Make a small slit in the urinary sinus.
Insert a seeker into the urinary sinus as shown.
Cut with a scalpel along the line indicated, using the seeker as a guide.

NOTE. The walls of the oviducts are firmly fused together in this region. The cut should separate them and will also pass through the roof of the genital sinus and through the cloaca. It should open the urinary sinus and show its connection with the urinary papilla.

Slit the urinary sinus open to its anterior limit.

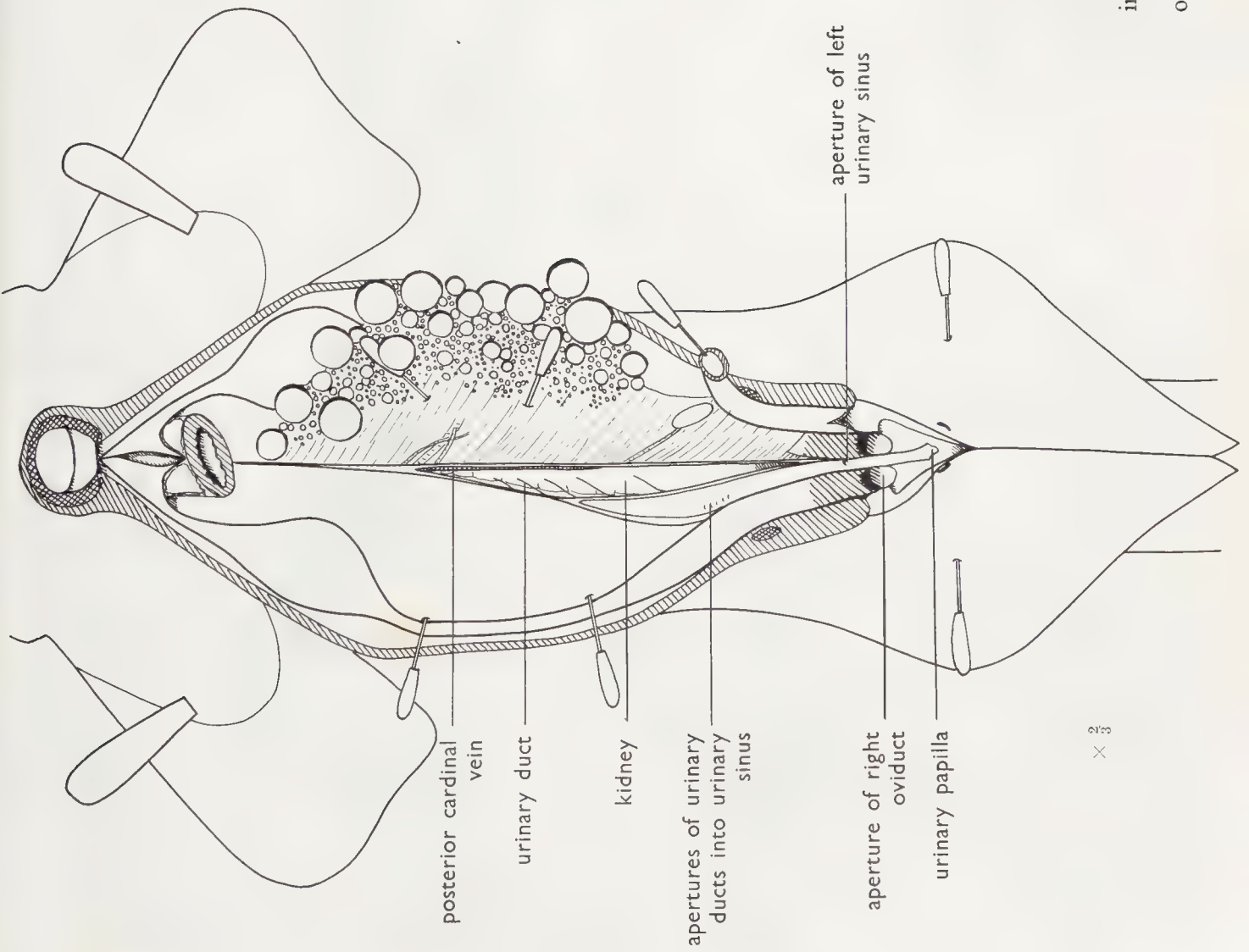


Fig. 23

Adjust the pins through the pelvic fins so that the slit made in Fig. 22 is stretched widely.
Notice the openings of the oviducts and of the urinary sinus of the undissected side.
DRAW the completed dissection.

THE DOGFISH—5 The Venous Sinuses

Students are not generally required to make a complete dissection of the venous sinuses. Such a dissection involves cutting in such a way that the arteries and nerves are difficult to dissect afterwards.

It is usually sufficient to open up the sinus venosus and the ductus Cuvieri of one side and to identify the apertures of the principal sinuses into them.

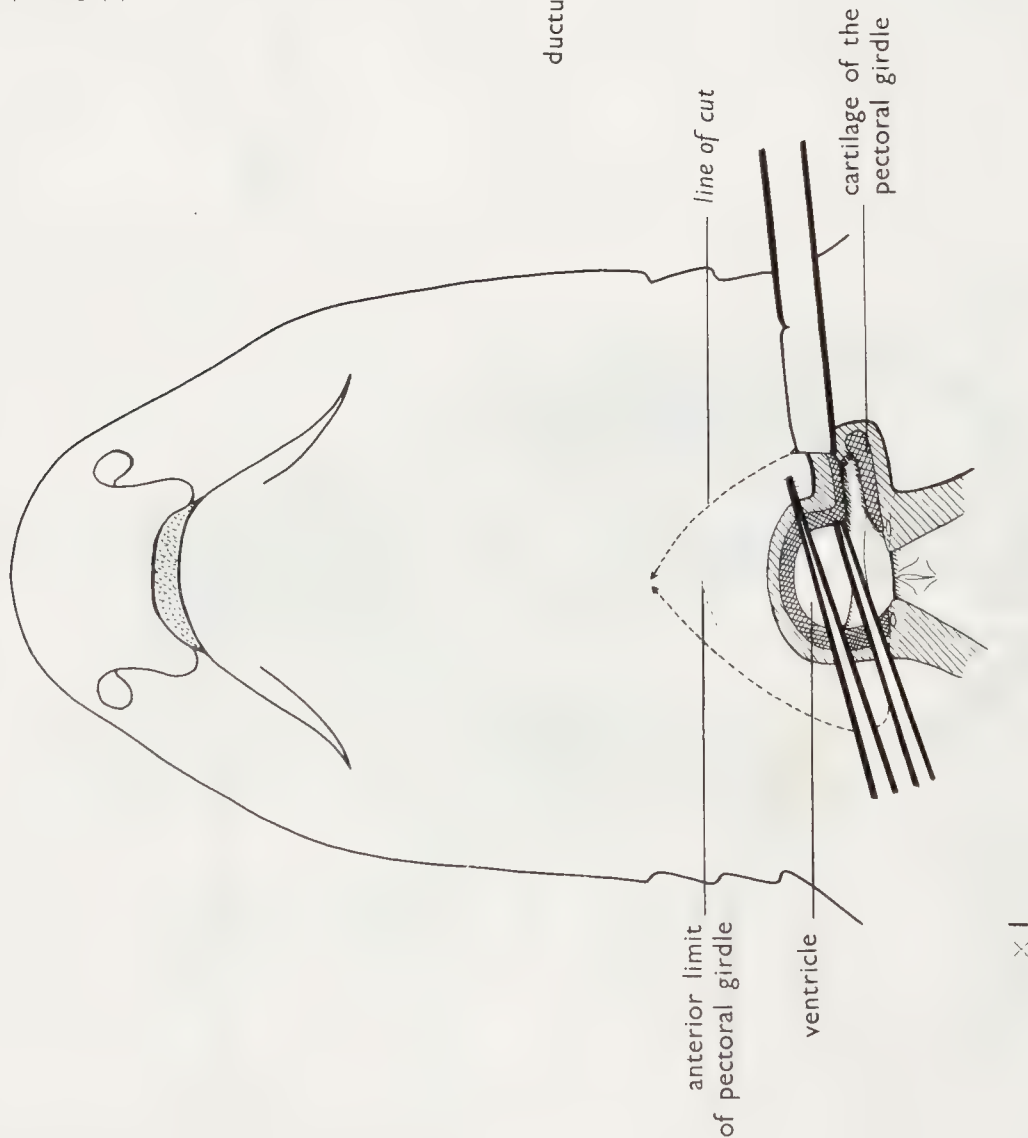


Fig. 24

Carve away the floor of the pericardial cavity, cutting first laterally and then forwards as shown.

N.B. Take care that the point of the scalpel is within the pericardial cavity at the beginning of each stroke.

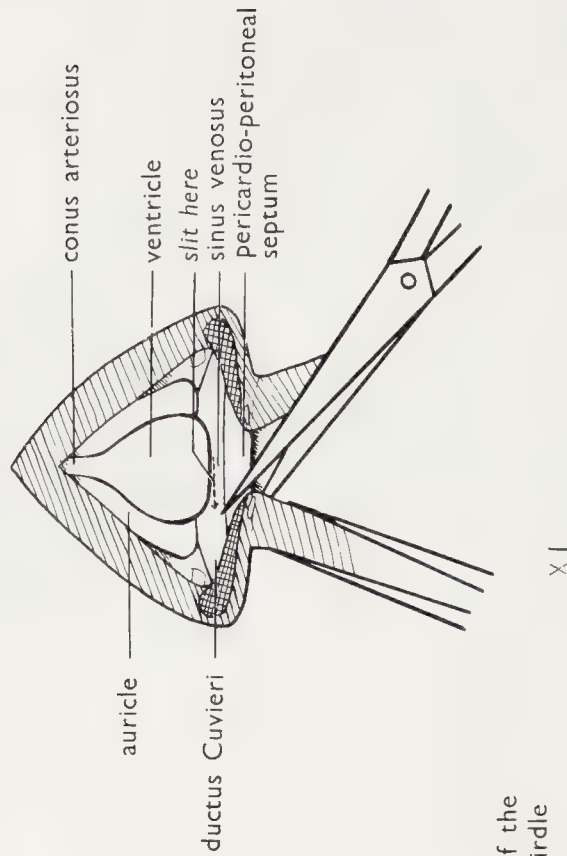


Fig. 25

Notice the heart within the pericardial cavity.

Using scissors, cut the pericardio-peritoneal septum close to the body wall on one side only. Extend the cut to the lateral limit of the pericardial cavity.

Adjust the pins through the pectoral fins so that the posterior boundary of the pericardial cavity is stretched. Make a slit in the sinus venosus.

Fig. 26

Insert a seeker into the slit in the sinus venosus and well down through the ductus Cuvieri.
Cut to follow the seeker through the ductus Cuvieri and into the posterior cardinal sinus.

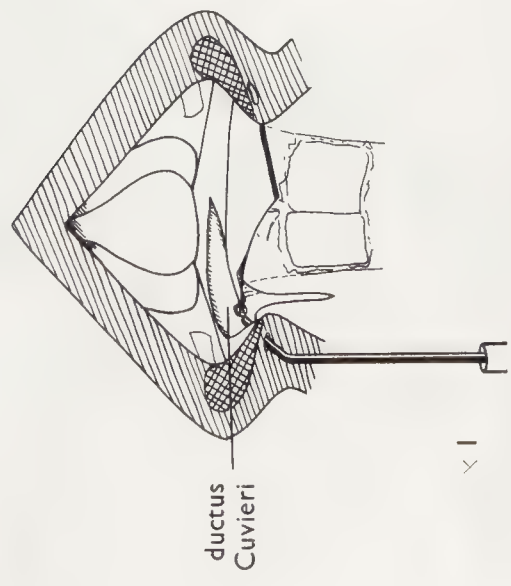
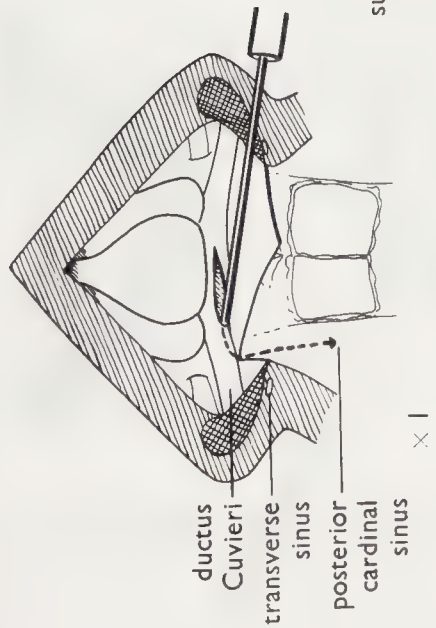


Fig. 27

Insert a seeker into the transverse sinus and through the subclavian sinus into the ductus Cuvieri.
Cut following the seeker and clear away the tissue on either side of the opened sinus.
If necessary, open the sinus venosus further to show the apertures of the hepatic sinuses.

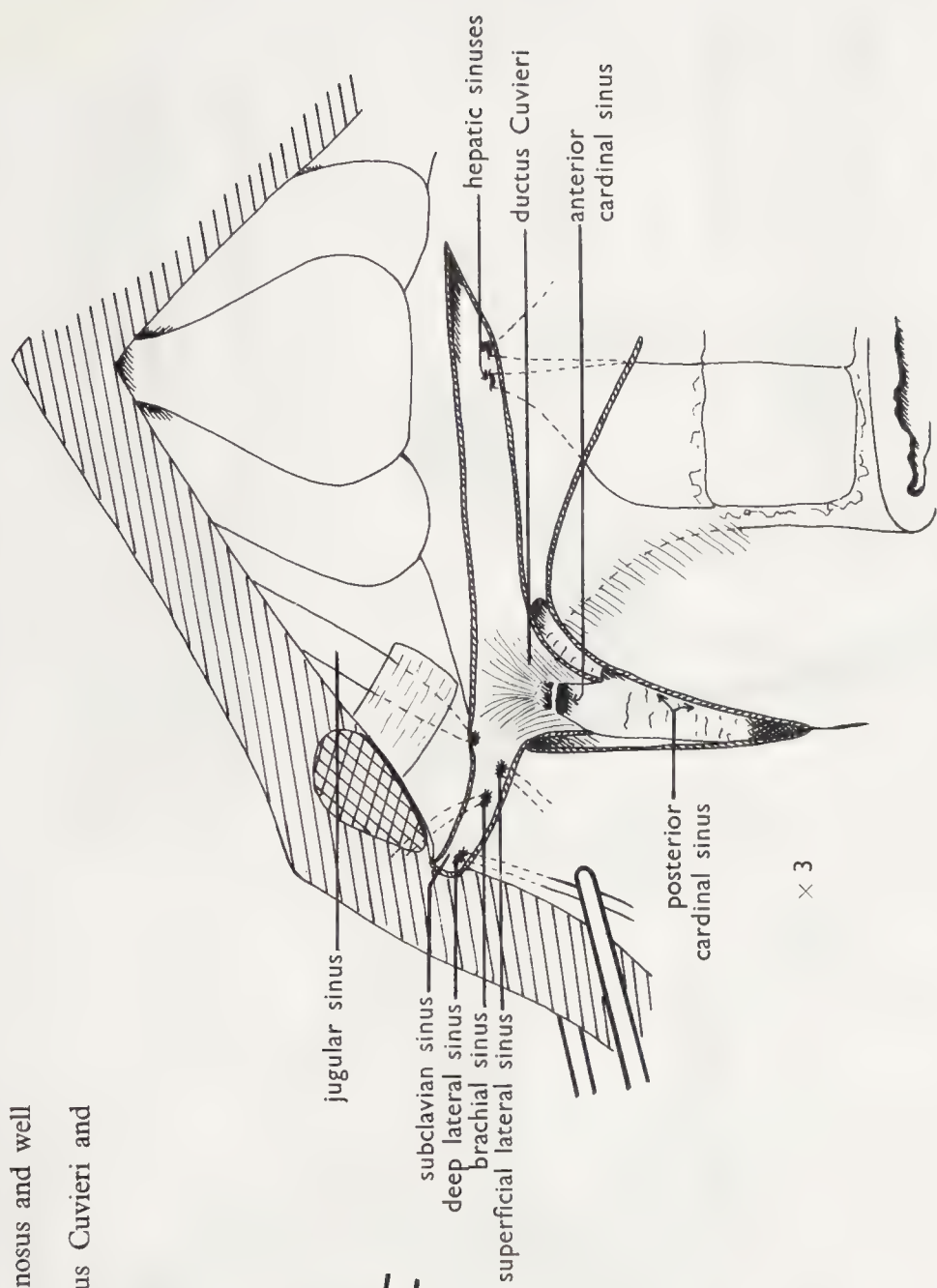


Fig. 28

Hold aside the body wall.
Insert a seeker into each of the following sinuses in turn and so examine the distribution of the principal venous spaces :
(a) the posterior cardinal sinus.
(b) the anterior cardinal sinus.
(c) the inferior jugular sinus.
(d) the deep lateral sinus.
(e) the brachial sinus.
(f) the superficial lateral sinus.
(g) the hepatic sinus.
DRAW.

THE DOGFISH—6 The Arterial System

(a) THE VENTRAL AORTA AND AFFERENT BRANCHIAL ARTERIES

This part of the arterial system lies ventral to the pharynx. The dissection is made easier if the latter be distended by a small cylinder of cork or wood about 2 inches long by $\frac{1}{2}$ inch in diameter. Insert the cylinder into the mouth and push it well down the pharynx. Do not let any of it remain between the jaws.

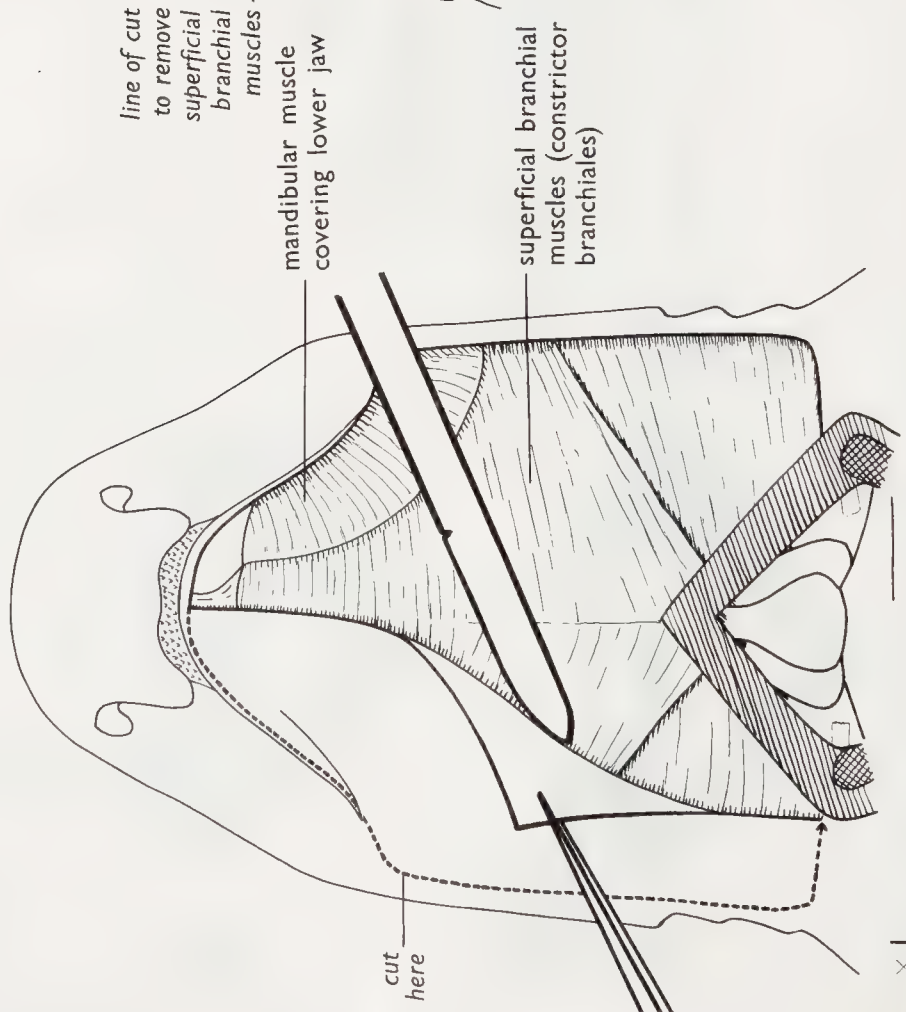


Fig. 29

Remove the skin from the ventral surface between the mouth and the heart.

Notice the superficial branchial muscles and the mandibular muscles.

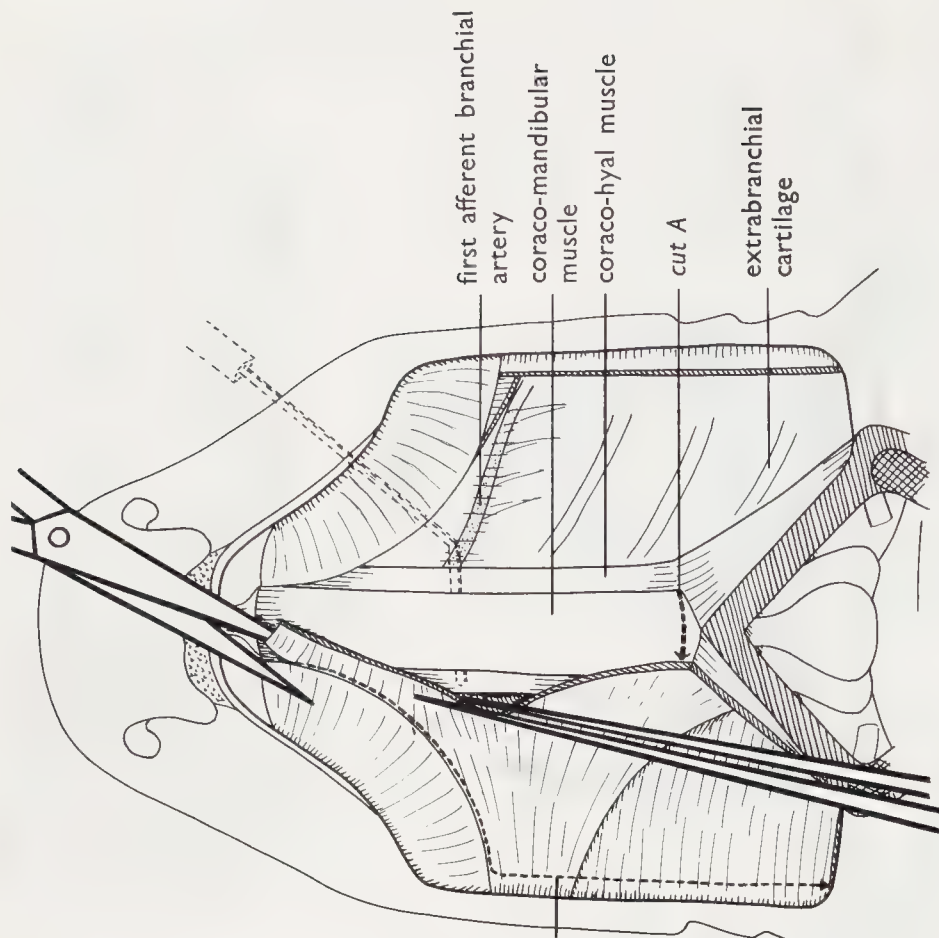


Fig. 30

Remove the superficial branchial muscles, cutting as close to the lower jaw as possible.

Notice the first afferent branchial artery.

Use a seeker to loosen the coraco-mandibular muscle from the underlying coraco-hyal muscles. Cut the coraco-mandibular muscle as close to its posterior end as possible—cut A.

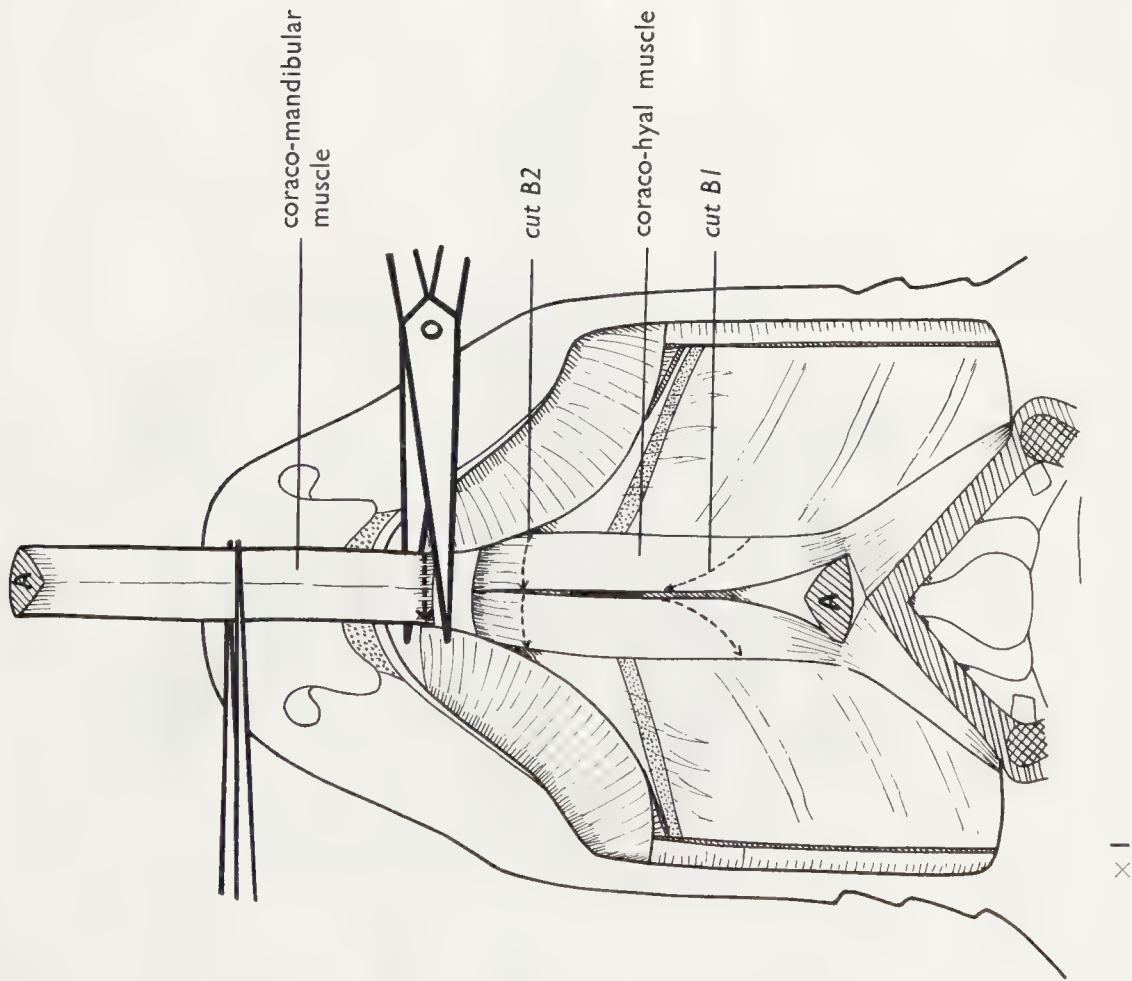


Fig. 31

Turn the coraco-mandibular muscle forwards. Free it carefully to its insertion in the ligament between the mandibles. Cut as indicated.

Remove the coraco-hyal muscles in a similar way—cuts B1 and B2.

NOTE. Some students may find it helpful to open the gill pouches at this stage—see Figs. 33 and 34.

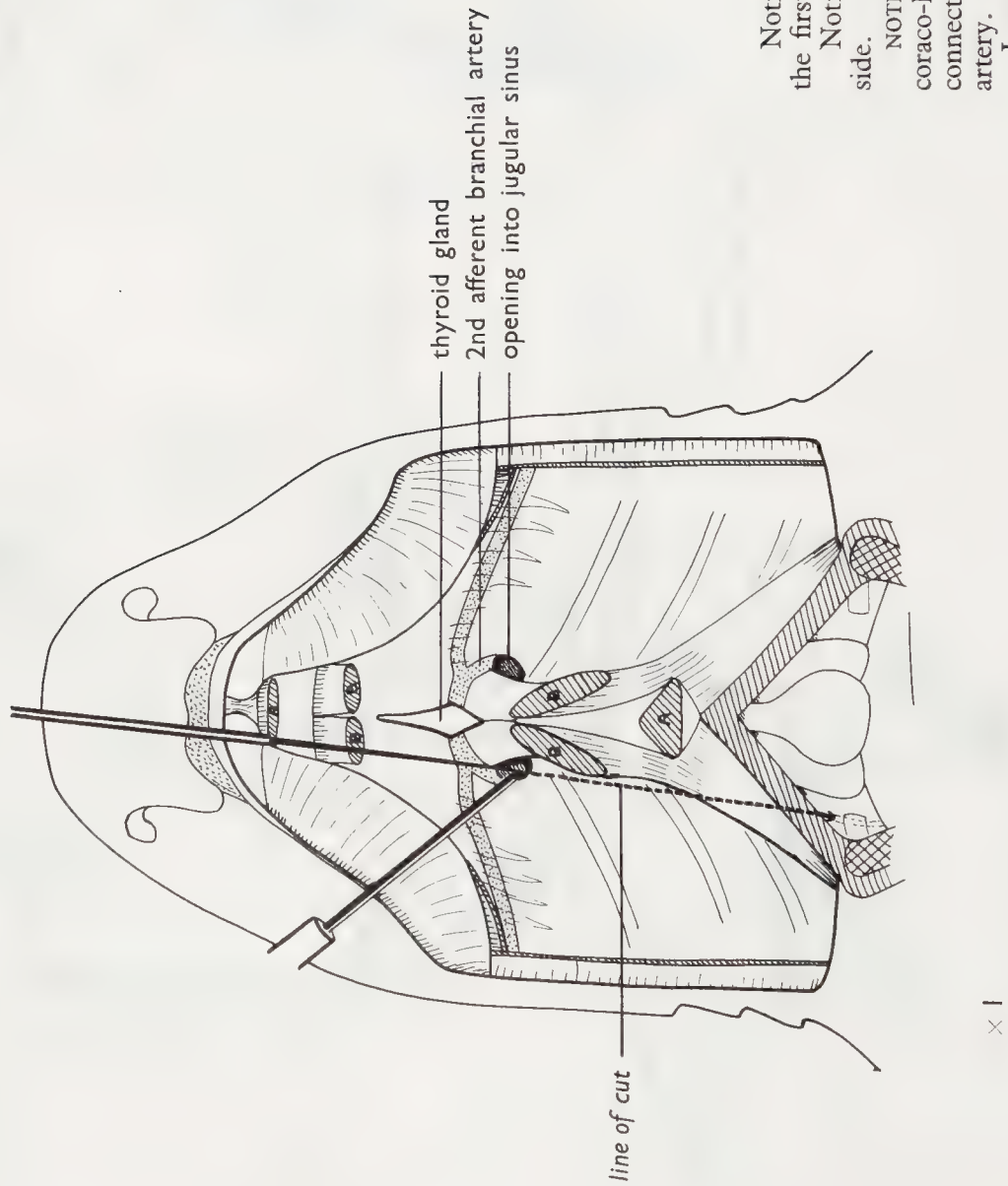


Fig. 32

Notice the second afferent branchial artery branching from the first.

Notice the opening of the inferior jugular sinus on either side.

NOTE. This sinus is usually opened by the removal of the coraco-hyal muscles, but if it is not visible, gently loosen the connective tissue along the line of the second afferent branchial artery.

Insert a seeker little by little into the sinus. As the seeker follows the sinus use a scalpel held as shown in Fig. 4 to cut through all the tissue ventral to the sinus.

N.B. DO NOT USE FORCE on the seeker. It should follow the line of the sinus easily.

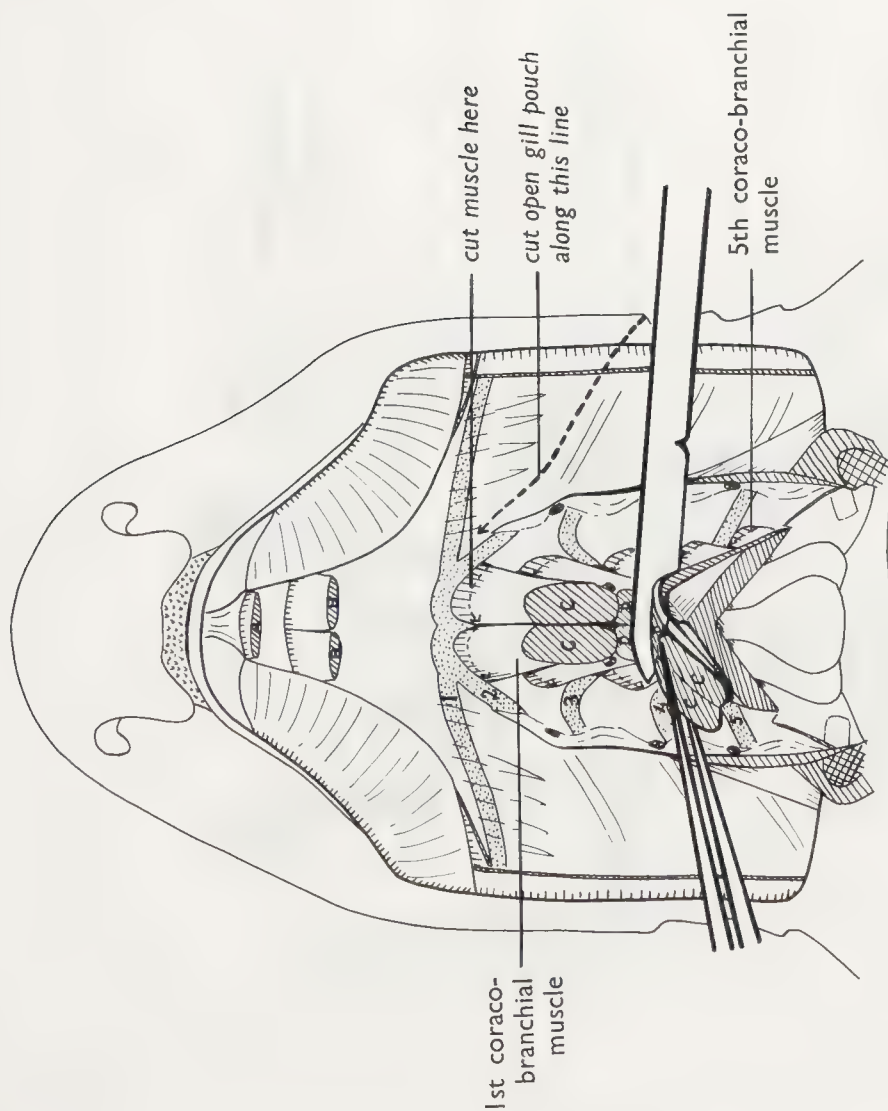


Fig. 33

Notice the third, fourth and fifth afferent branchial arteries (3, 4 and 5 in diagram) crossing the roof of the jugular sinus. Notice also the coraco-branchial muscles.

Remove the thyroid gland.

Cut away the block of tissue from which the coraco-mandibular, coraco-hyal and coraco-branchial muscles originate by making a horizontal cut as shown. By doing so, the cut ends of the five pairs of coraco-branchial muscles C, D, [E, F, G] become exposed. Loosen these muscles from one another, watching for the ventral aorta in the midline and for the afferent branchial arteries between the second and third, third and fourth, and fourth and fifth pairs of muscles respectively.

Cut all the coraco-branchial muscle-blocks as short as possible—see Fig. 34, C, D, E, F, G.

Insert one blade of the scissors through the first gill slit and cut the floor of the gill pouch along the line shown.

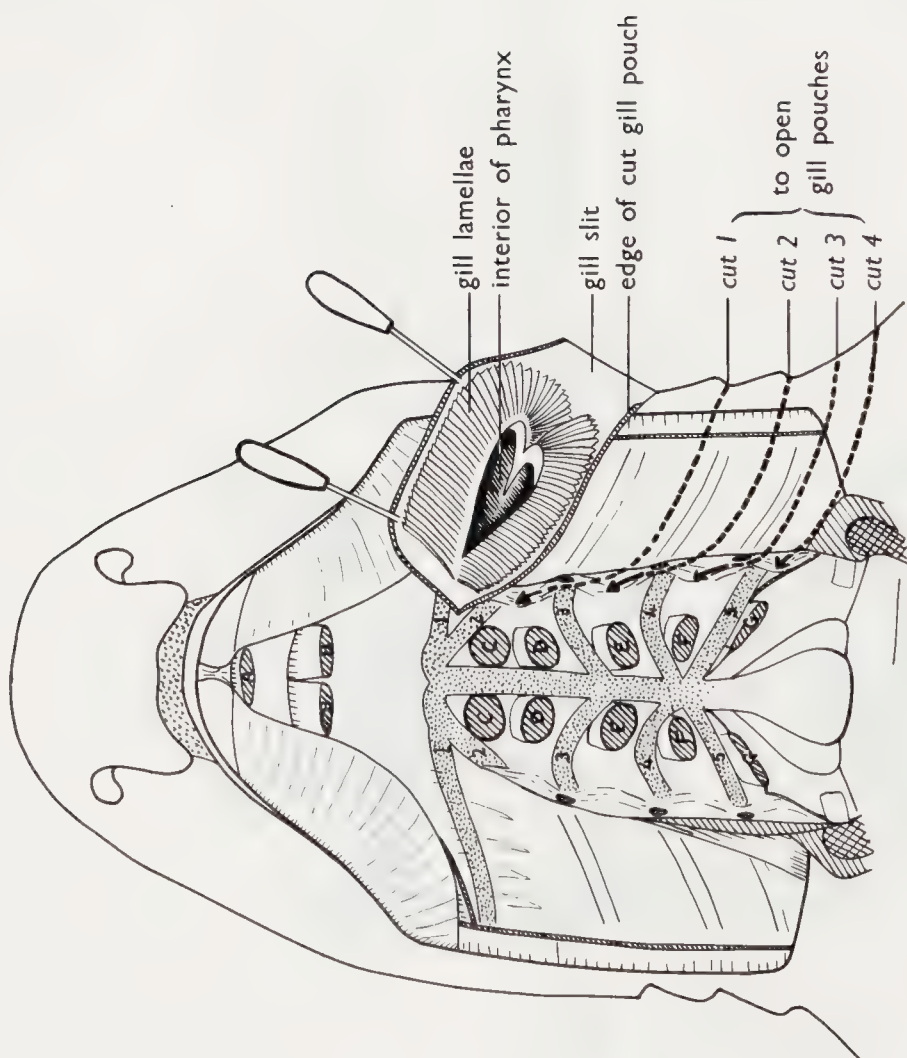


Fig. 34

This is the best stage for an examination of the interior of a gill pouch.

Pin the first gill pouch open as shown and DRAW.

After the examination of the gill pouch remove the pins and proceed to open up the other gill pouches as indicated by the dotted lines—cuts 1, 2, 3 and 4.

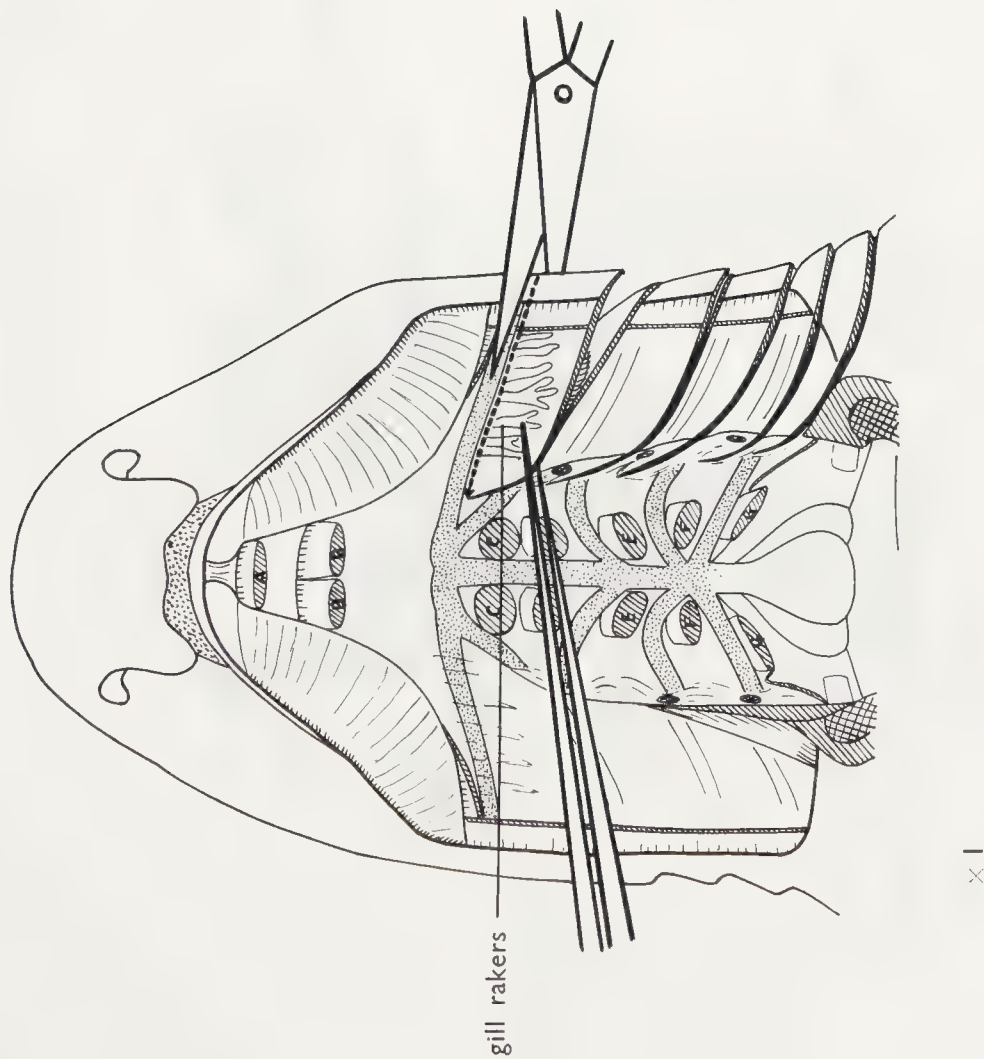


Fig. 35

The first afferent branchial artery is already visible along the hyoid arch. Clear the connective tissue from it thoroughly and trim away the gill and gill rakers to the level of the artery.

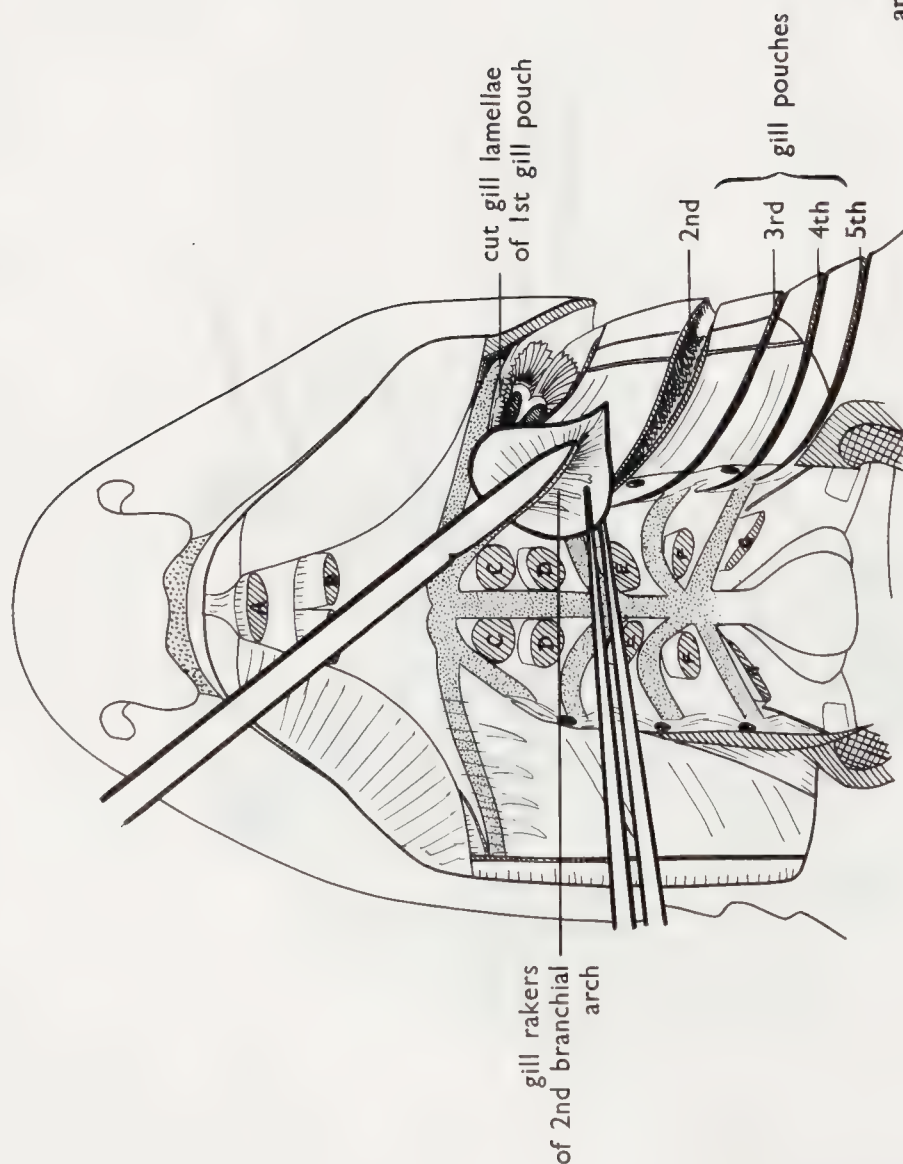


Fig. 36

Follow the second afferent branchial artery out into the gill arch. Use the **BACK OF THE SCALPEL** for this process rather than the sharp edge of the blade.

NOTE. The gill rakers arise posterior to the artery.

Observe the small holes made where the branches from the artery to the gills level with the artery as shown in Fig. 35.

Repeat to expose the third, fourth and fifth afferent branchial arteries.

NOTE. The successive afferent branchial arteries slope more steeply towards the dorsal surface so that the cuts will have to become deeper to display them.

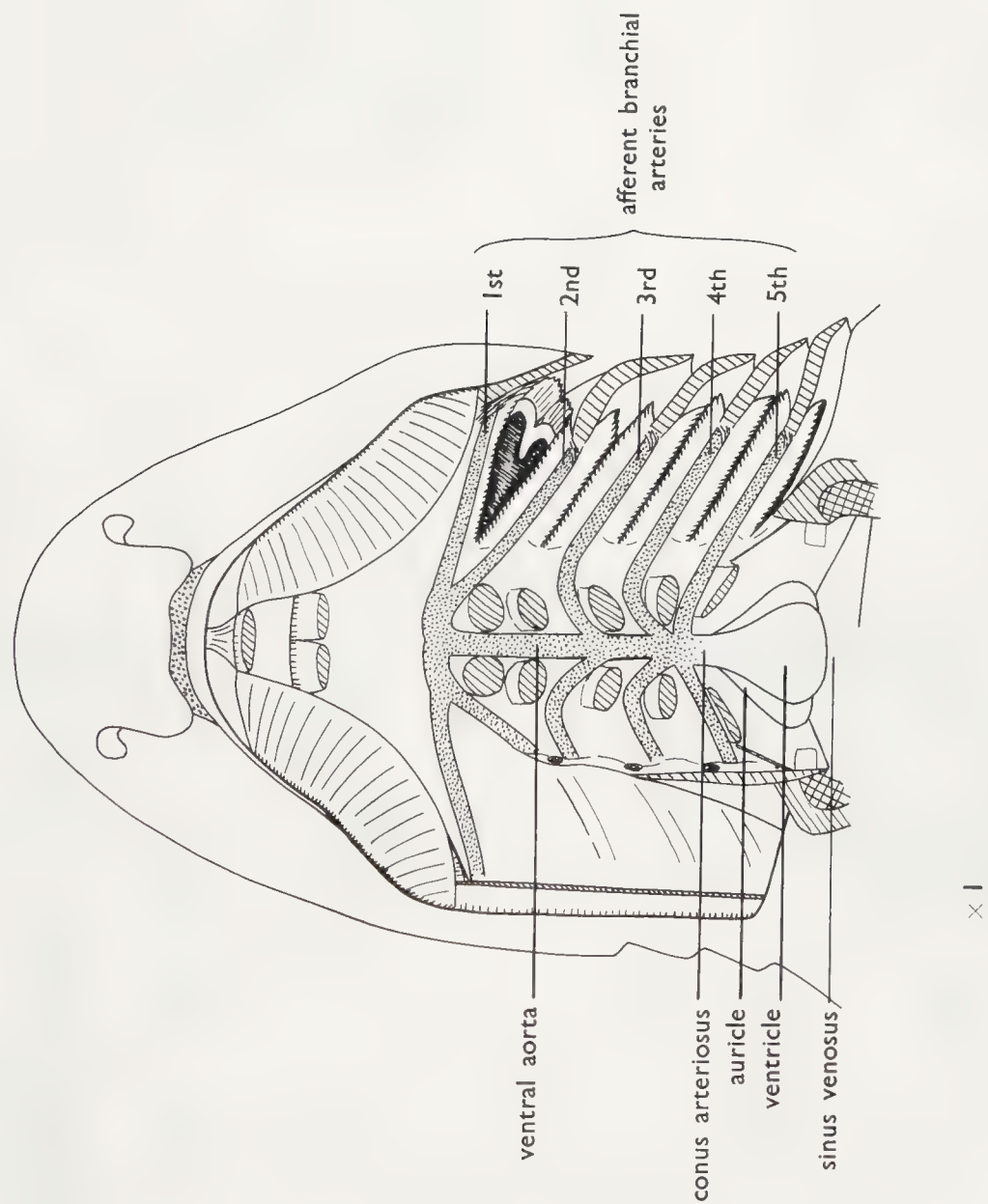
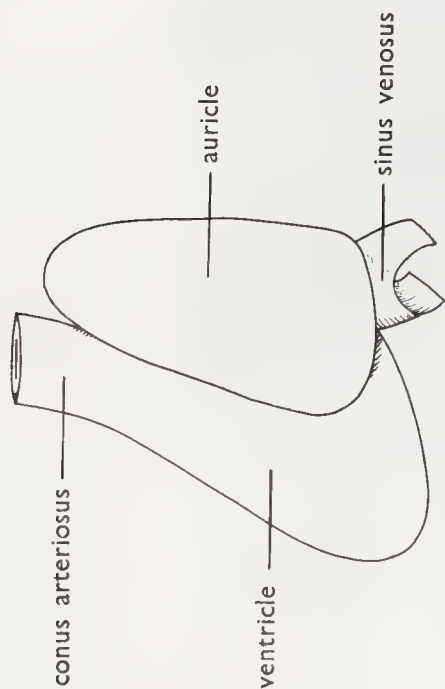


Fig. 37

DRAW the completed dissection of the ventral aorta and afferent branchial arteries.

THE DOGFISH—7 The Heart

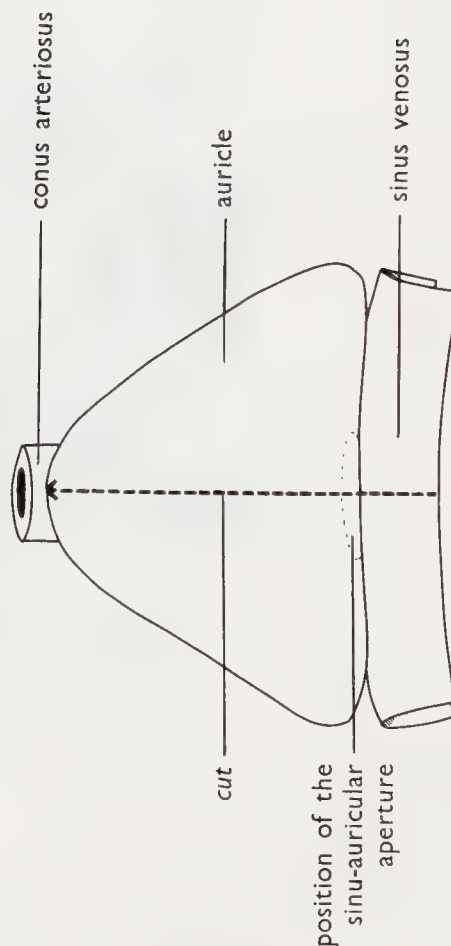
The ventral view of the heart has already been observed and included in the drawing of Fig. 37. Remove the heart from the pericardial cavity by cutting through the conus arteriosus at its junction with the ventral aorta, and through the sinus venosus.



3

Fig. 38

Study and DRAW the lateral view of the heart.



3

Fig. 39

Study and DRAW the dorsal view of the heart. Make a median dorsal slit through the wall of the sinus venosus and the auricle, inserting one blade of the scissors through the sinu-auricular aperture.

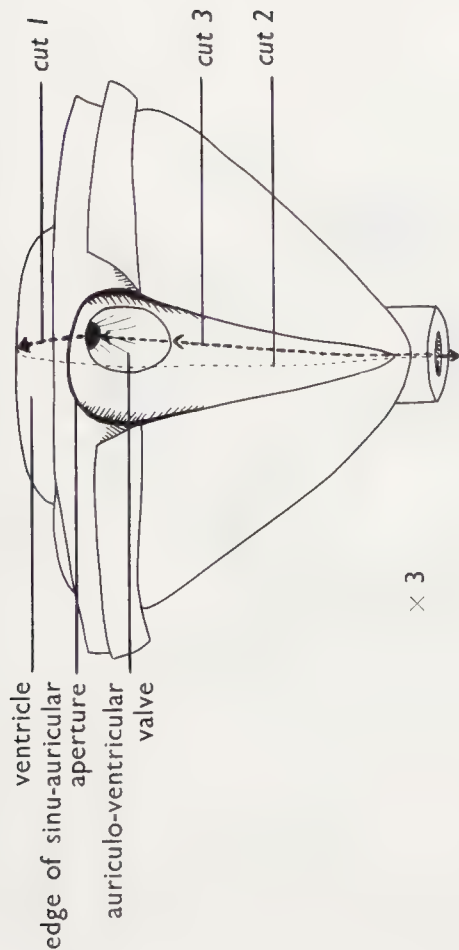


Fig. 40

Turn the heart so that the anterior end of the heart is towards you.

Notice the auriculo-ventricular aperture slightly to one side of the midline. Because of this asymmetry the heart must not be cut in two by a single median cut.

Cut through the posterior wall of the ventricle as indicated—cut 1.

Follow the cut round to the ventral side of the heart and through the conus arteriosus—cut 2.

Complete the division of the heart—cut 3.

Clean out any blood from the heart.

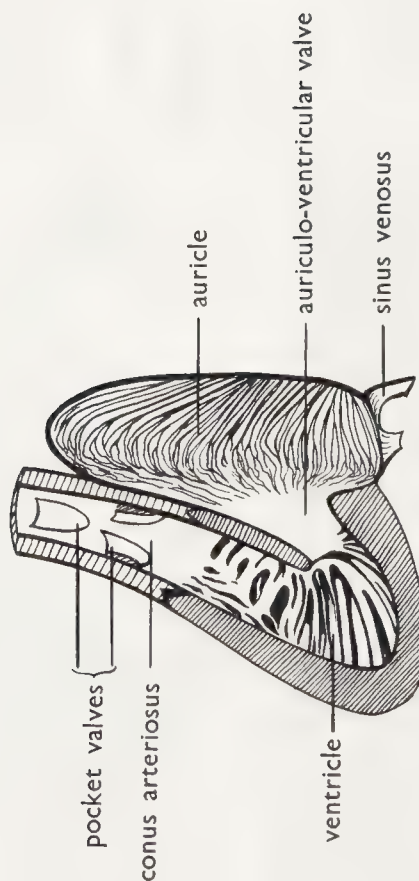


Fig. 41

Study and draw the internal structure of the heart.

THE DOGFISH—*The arterial system (6 continued)*

(b) THE EFFERENT BRANCHIAL AND EPIBRANCHIAL ARTERIES AND THE DORSAL AORTA

This part of the arterial system lies dorsal to the pharynx.

The appearance of the interior of the buccal cavity and pharynx should be studied during the course of the dissection (Fig. 43).

The amount of blood and hence the colour of these arteries varies considerably. They are never as obvious as the afferent branchial arteries.

ONLY ONE SIDE SHOULD BE DISSECTED if the nerves are required later as the branchial branches of the vagus are often cut accidentally.

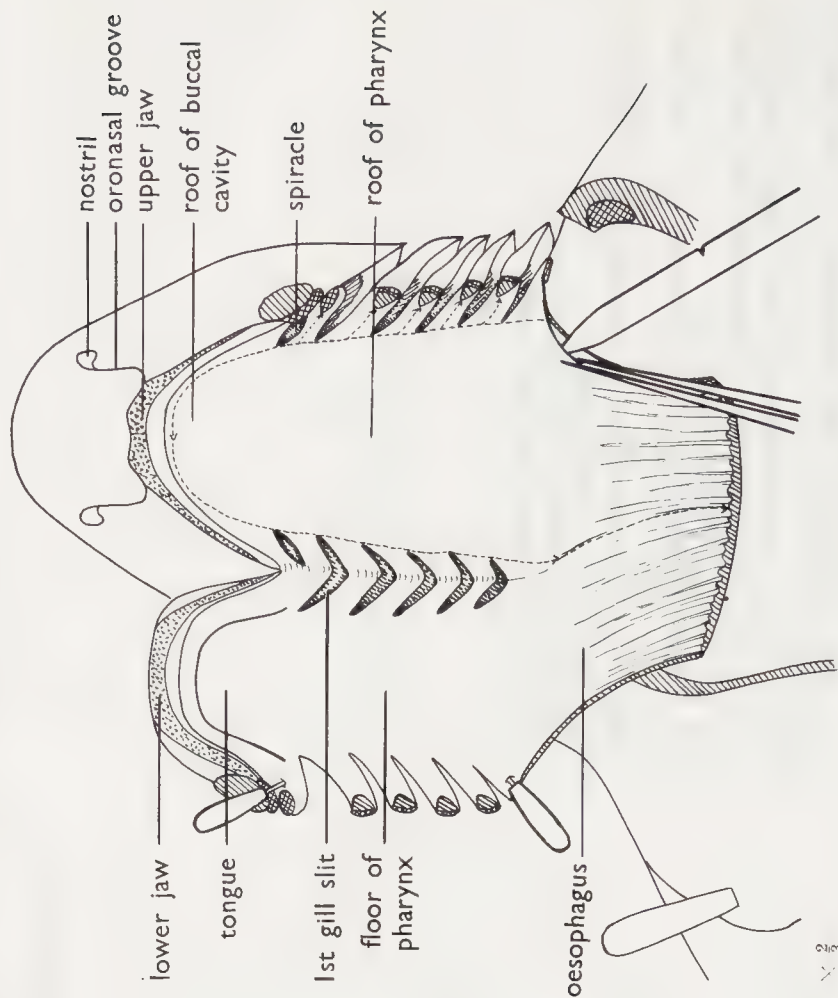


Fig. 43

Pin aside the floor of the buccal cavity and pharynx. Observe the structures shown and DRAW.

NOTE. Add this dissection to that shown in Fig. 8 if a complete display of the alimentary canal is required.

Remove the mucous membrane from the area outlined by the dotted lines.

N.B. WATCH FOR AND BE CAREFUL NOT TO CUT THE EPIBRANCHIAL ARTERIES WHICH LIE BENEATH IT.

Slit the mucous membrane along the line of each branchial arch on the side to be dissected.

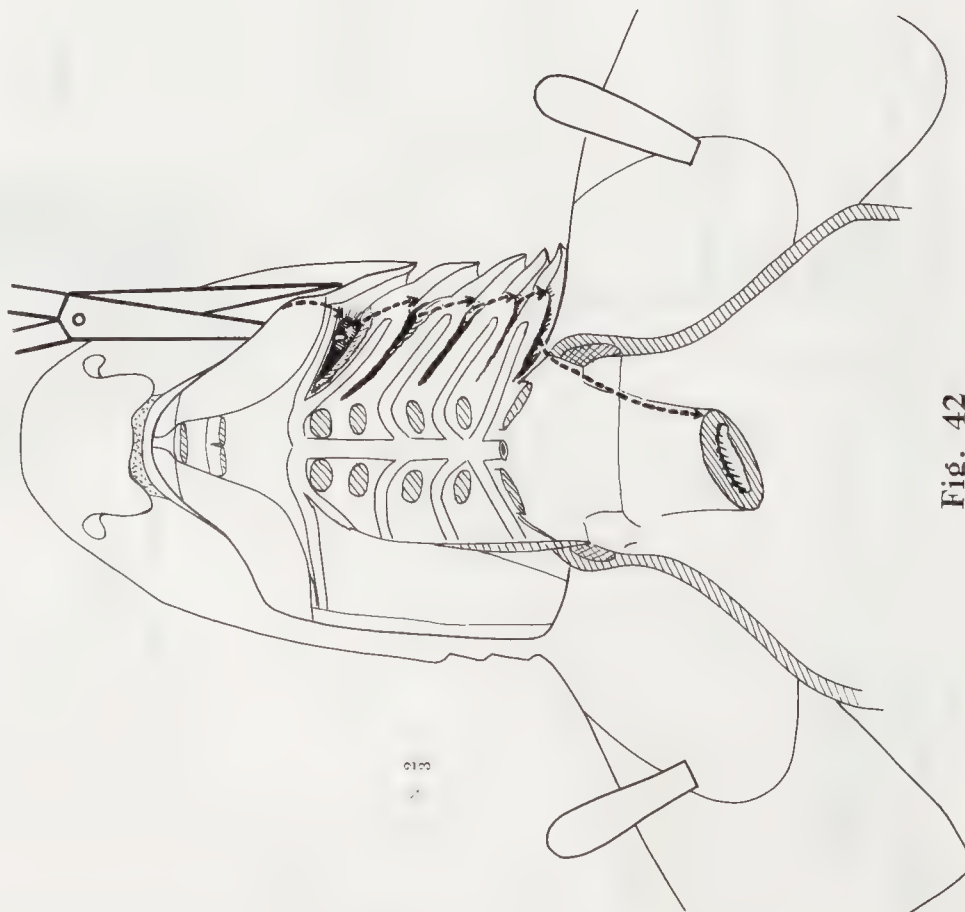


Fig. 42

Insert one blade of the scissors into the mouth and cut through the angle of the jaw. Cut through each branchial arch in turn and down the side of the oesophagus.

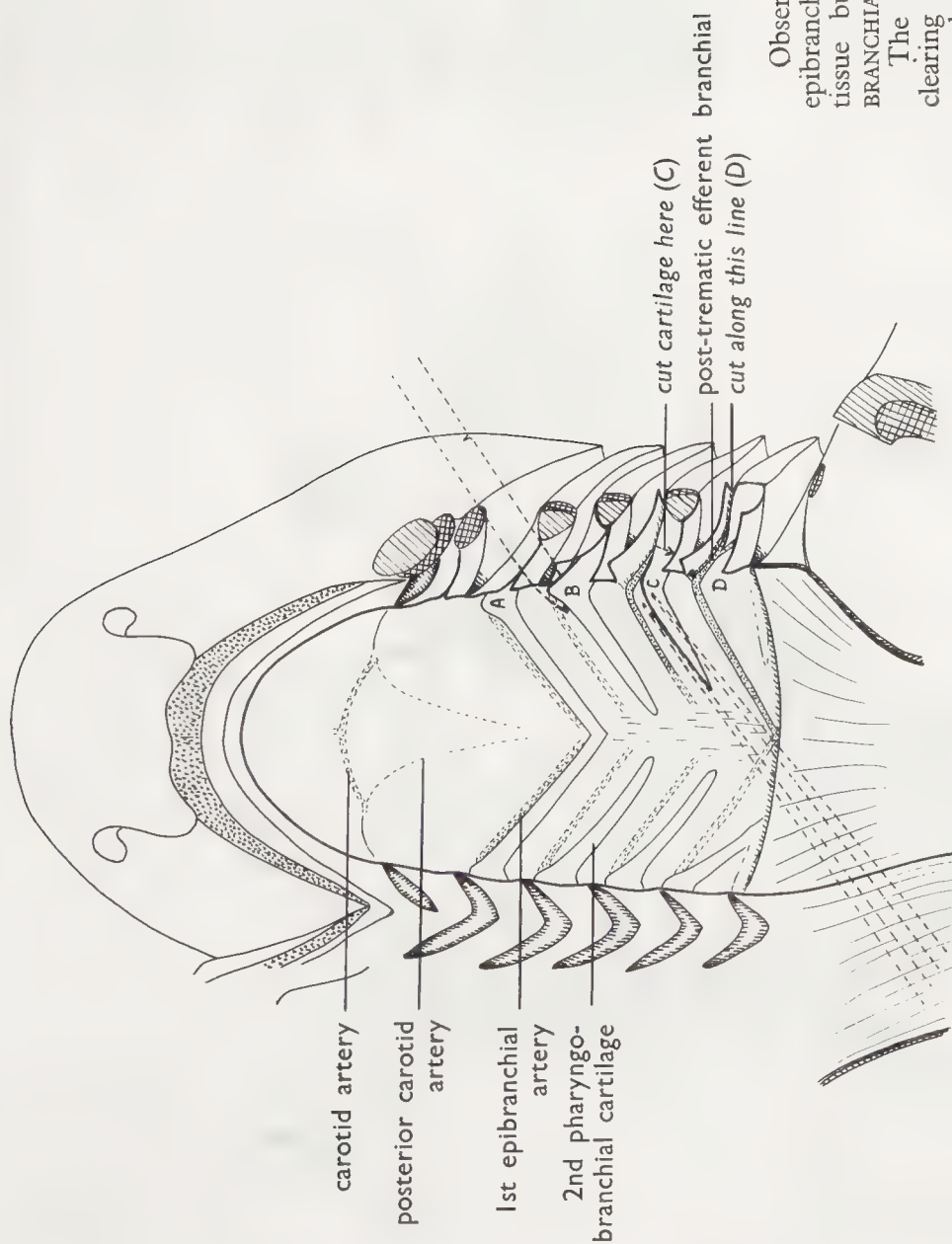


Fig. 44

Observe the pharyngo-branchial cartilages and identify the epibranchial arteries. The latter are embedded in connective tissue but SHOULD NOT BE CLEARED UNTIL THE EFFERENT BRANCHIAL VESSELS HAVE BEEN EXPOSED.

The diagram shows successive stages in the process of clearing the post-trematic efferent branchial arteries. Each stage should be repeated on each arch in turn.

A.—The pharyngo-branchial cartilage is in position.

B.—Cut under the head of the pharyngo-branchial cartilage where it joins the cerato-branchial cartilage in the gill arch.

N.B. KEEP THIS CUT AS CLOSE TO THE CARTILAGE AS POSSIBLE.

C.—Observe the blood-vessel underneath the cartilage.

Lift the cartilage as indicated. Free it from the epibranchial artery and the connective tissue and muscles of the roof of the pharynx. Cut the cerato-branchial cartilage away.

D.—Cut away the mucous membrane to expose the artery clearly.

NOTE. It is easier to work from the fourth cartilage FORWARDS to the first than vice versa. In the fourth arch the cerato-branchial cartilage should be removed completely so that the connection from the ninth efferent branchial artery is displayed.

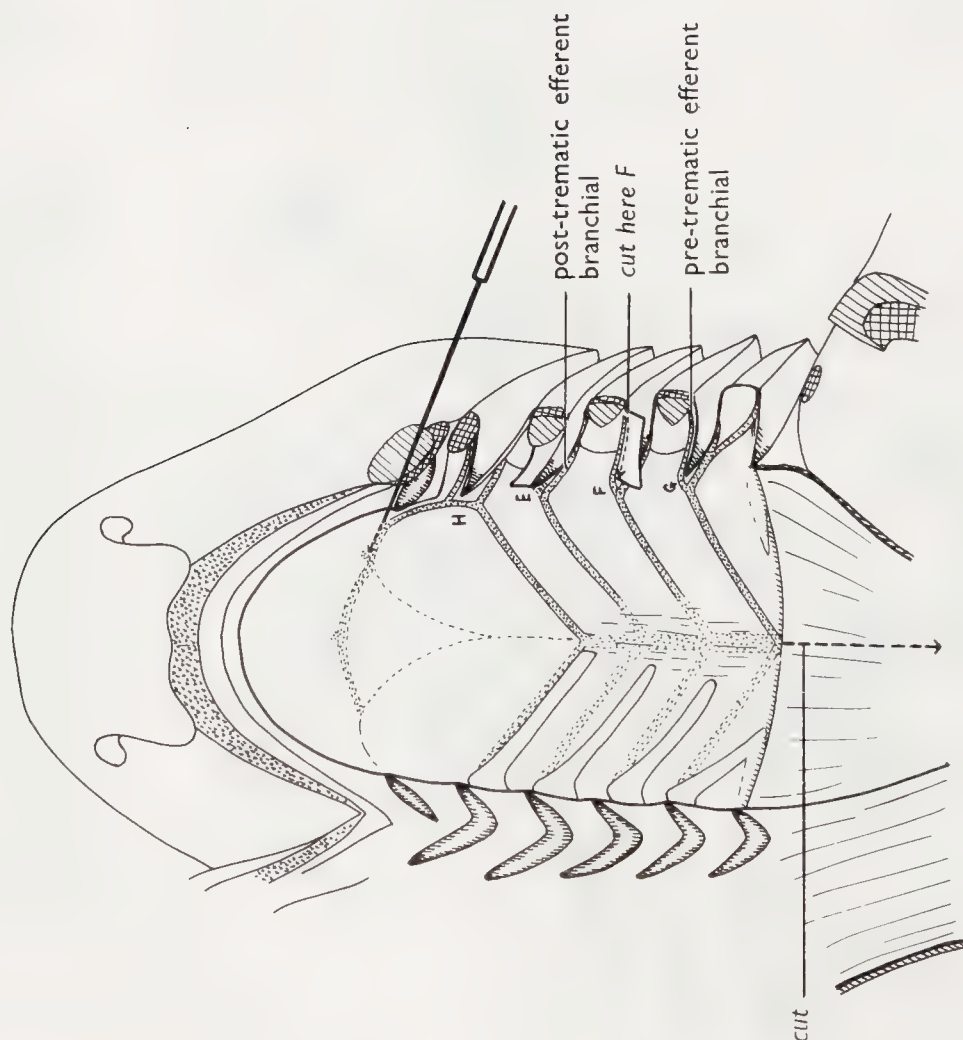


Fig. 45

Again successive stages are indicated.

E.—All the arches should appear like this after the completion of D.

F.—Follow the pre-trematic efferent branchial vessel from its junction with the epibranchial artery out into the gill arch. Cut away the mucous membrane so that the vessel is fully exposed.

G.—This is the appearance of the completed dissection of a typical arch.

H.—This shows the appearance of the first arch, which differs from the rest.

Clear the connective tissue from all the vessels indicated by dotted lines in the above figure. To do so, cut slightly to one side of each vessel. The connective tissue is sufficiently elastic to spring aside when so cut.

NOTE. The dorsal aorta is deeper in the anterior region than in the posterior one. It is therefore easier to cut the oesophagus and follow the artery **FORWARDS** than to attempt to clear the anterior end first. Clear the epibranchial arteries in turn as you come to them. Watch for the subclavian arteries Fig. 46.

Cut away part of the first pharyngo-branchial cartilage from the undissected side.

Trace the dorsal aorta as far back as desired.

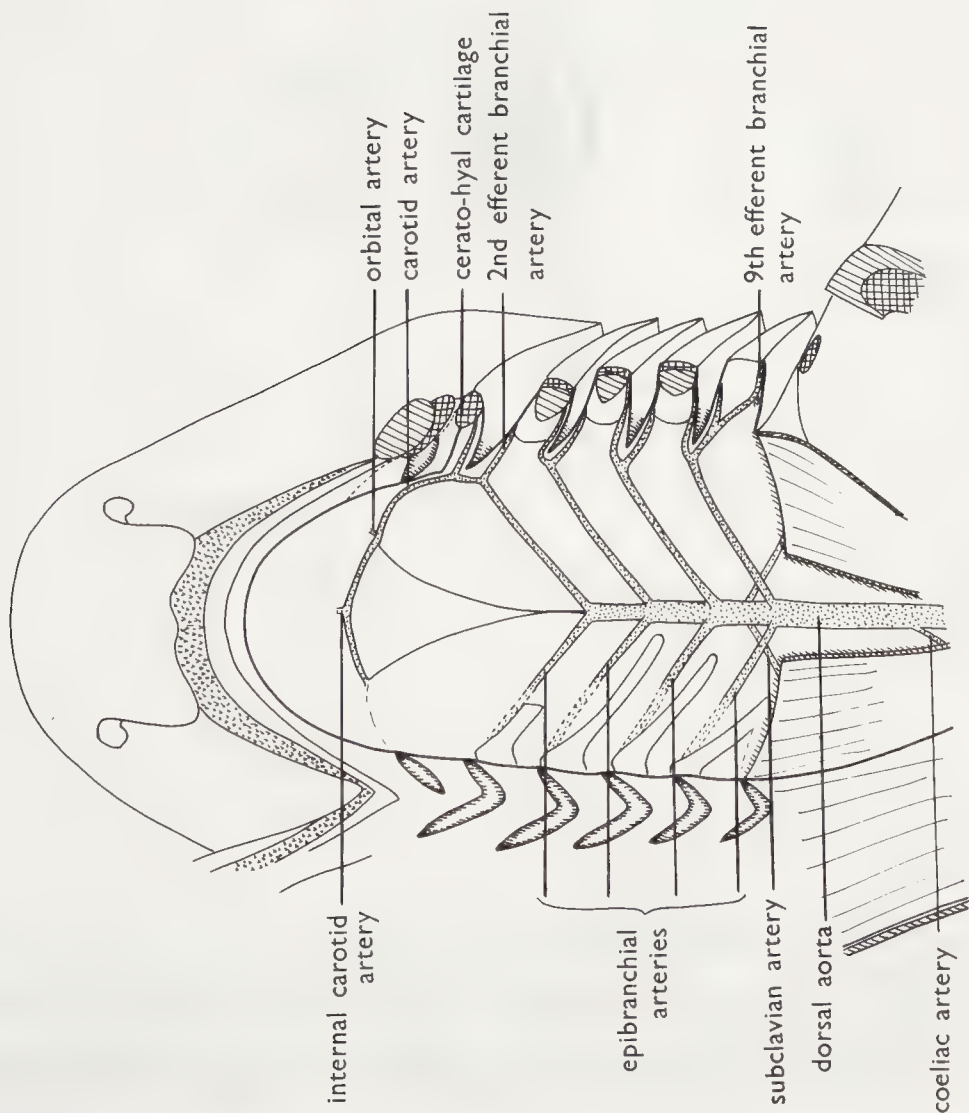


Fig. 46

Examine and **DRAW** the efferent branchial and epibranchial arteries.

It is usual to leave the dissection at this stage, but if the hyoidean artery is to be shown, proceed as follows:

Remove the mucous membrane from the area round the spiracle.

Remove the cerato-hyal cartilage, watching for the hyoidean artery which branches from the first efferent branchial artery as shown in Fig. 47.

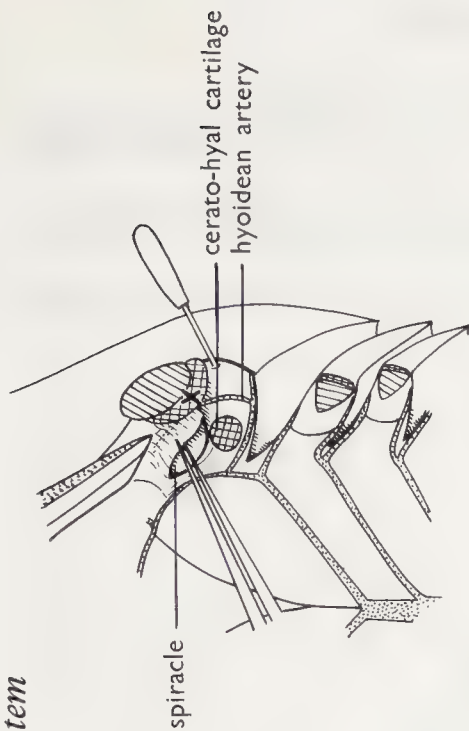


Fig. 47

Use a pin as shown to steady the hyoidean region.

Hold aside the edge of the spiracle and trace the hyoidean artery between it and the cartilages of the angle of the jaw—X.

When the artery has been traced, cut away the edge of the spiracle and the cartilage at X to allow full display of the blood-vessel.

Adjust the position of the pin.

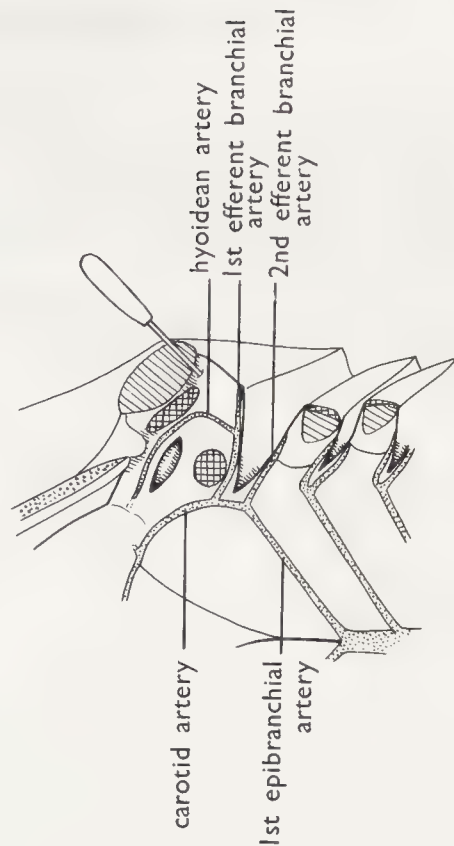


Fig. 48

The completed dissection is shown. It should be drawn in conjunction with Fig. 46.

THE DOGFISH—8 The Nervous System

(a) THE CRANIAL NERVES

If the efferent branchial arteries have been dissected use the opposite side of the dogfish for the dissection of the nerves, particularly the branchial branches of the vagus, see Figs. 59–61, which are liable to have been damaged during the removal of the epibranchial cartilages.

During this dissection drawings should be made at a number of stages in order to show such structures as the extrinsic muscles of the eye and the nerves to these muscles which are removed for full display of the trigeminal and facial nerves.

In order to minimize the labelling on the diagrams the nerves are marked with the name and number only, omitting the words “nerve” or “branch of the — nerve” as the case may be.

Before starting the dissection, study Fig. 57 carefully.

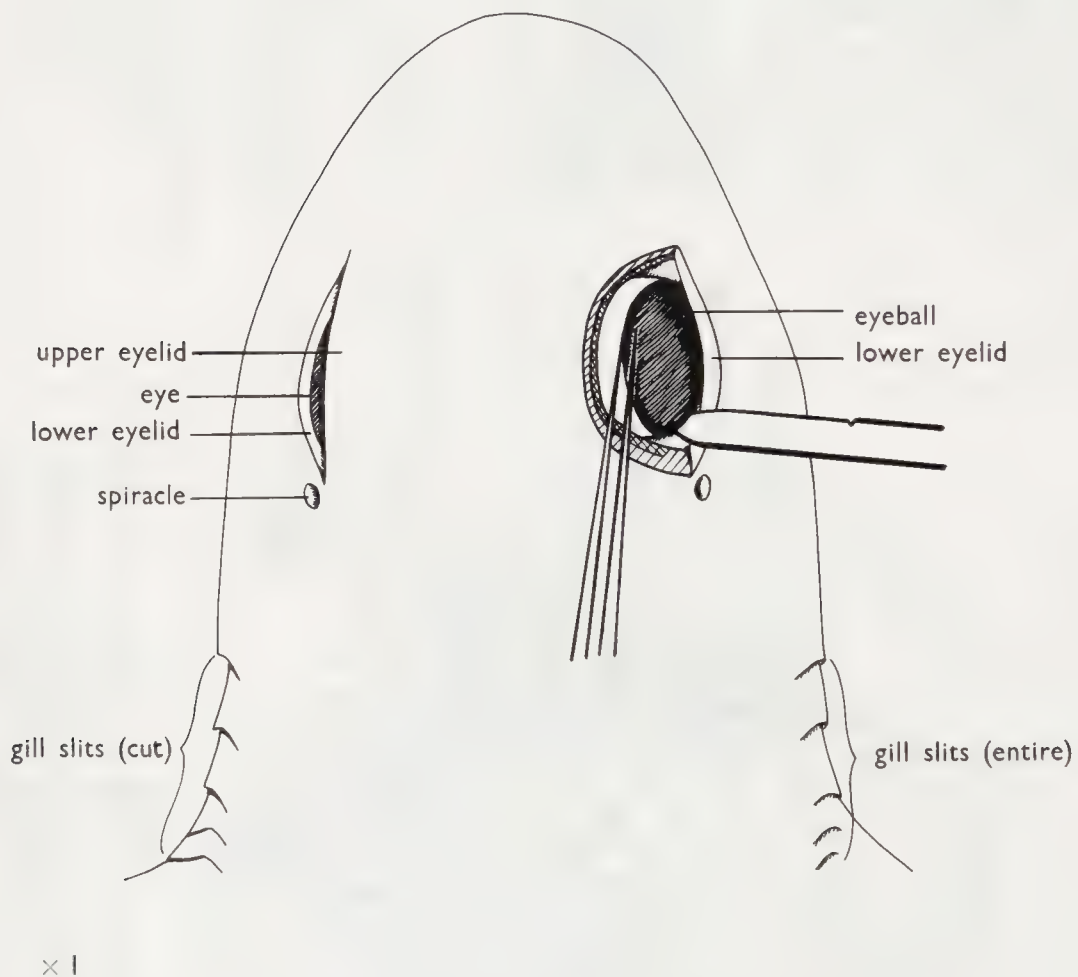


Fig. 49

Fix the dogfish to the dissecting-board DORSAL SIDE uppermost.

Examine the dorsal surface of the head.

Cut the conjunctiva between the upper eyelid and the eyeball and carve away a portion of the roof of the orbit. This exposes the eyeball as shown.

Cut the conjunctiva between the lower eyelid and the eyeball, holding the eyeball up meanwhile and being CAREFUL NOT TO CUT THE NERVES WHICH CROSS THE FLOOR OF THE ORBIT (see Fig. 51).

THE DOGFISH—*The nervous system*

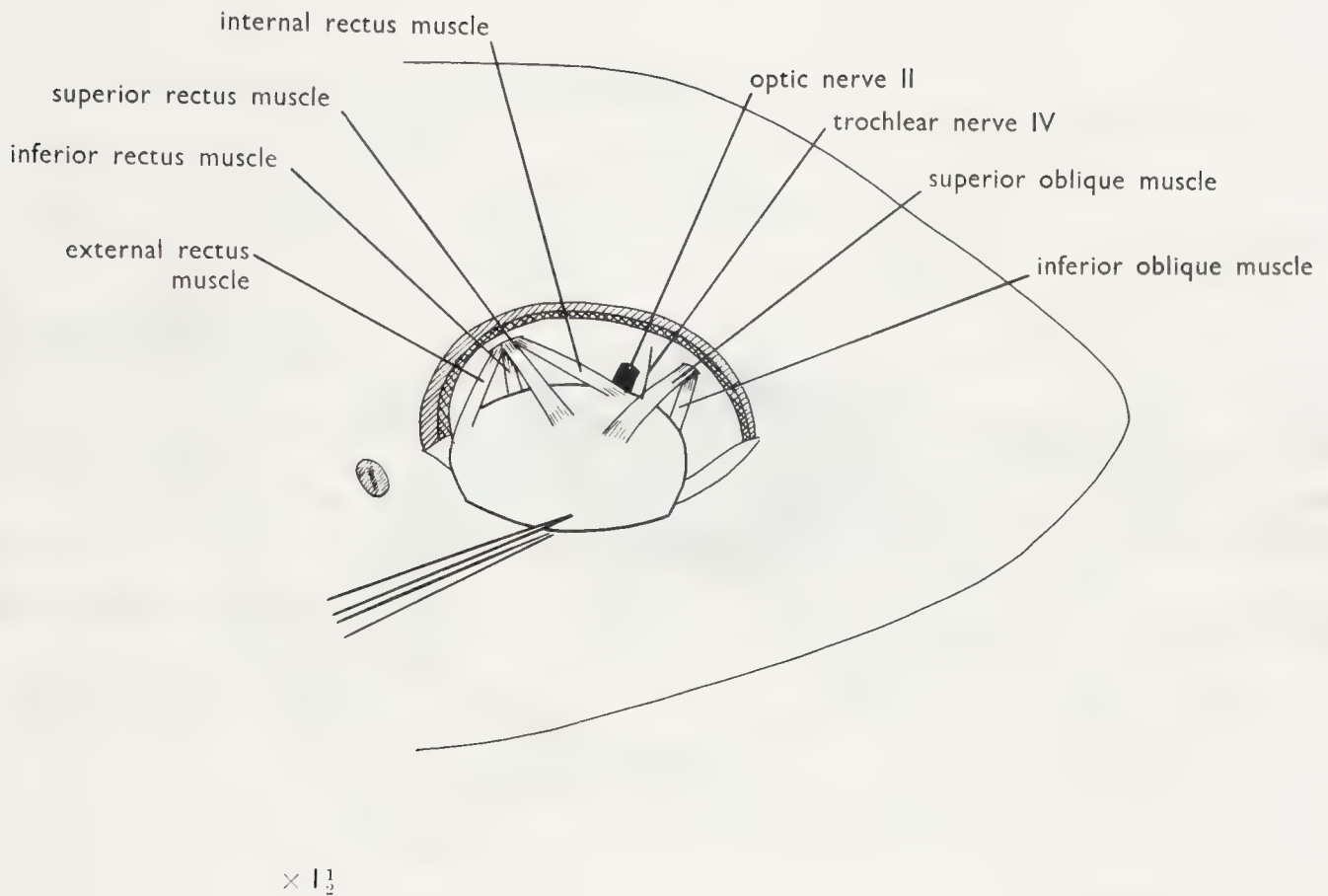


Fig. 50

Remove any loose gelatinous connective tissue from the orbit.
Turn the dogfish and view it from a dorso-lateral direction.
Pull the eyeball towards you. Examine and DRAW the eye-muscles.
Cut each eye-muscle and the optic nerve as close to the eyeball as possible.
Remove the eye.
Cut away the lower eyelid.

THE DOGFISH—*The nervous system*

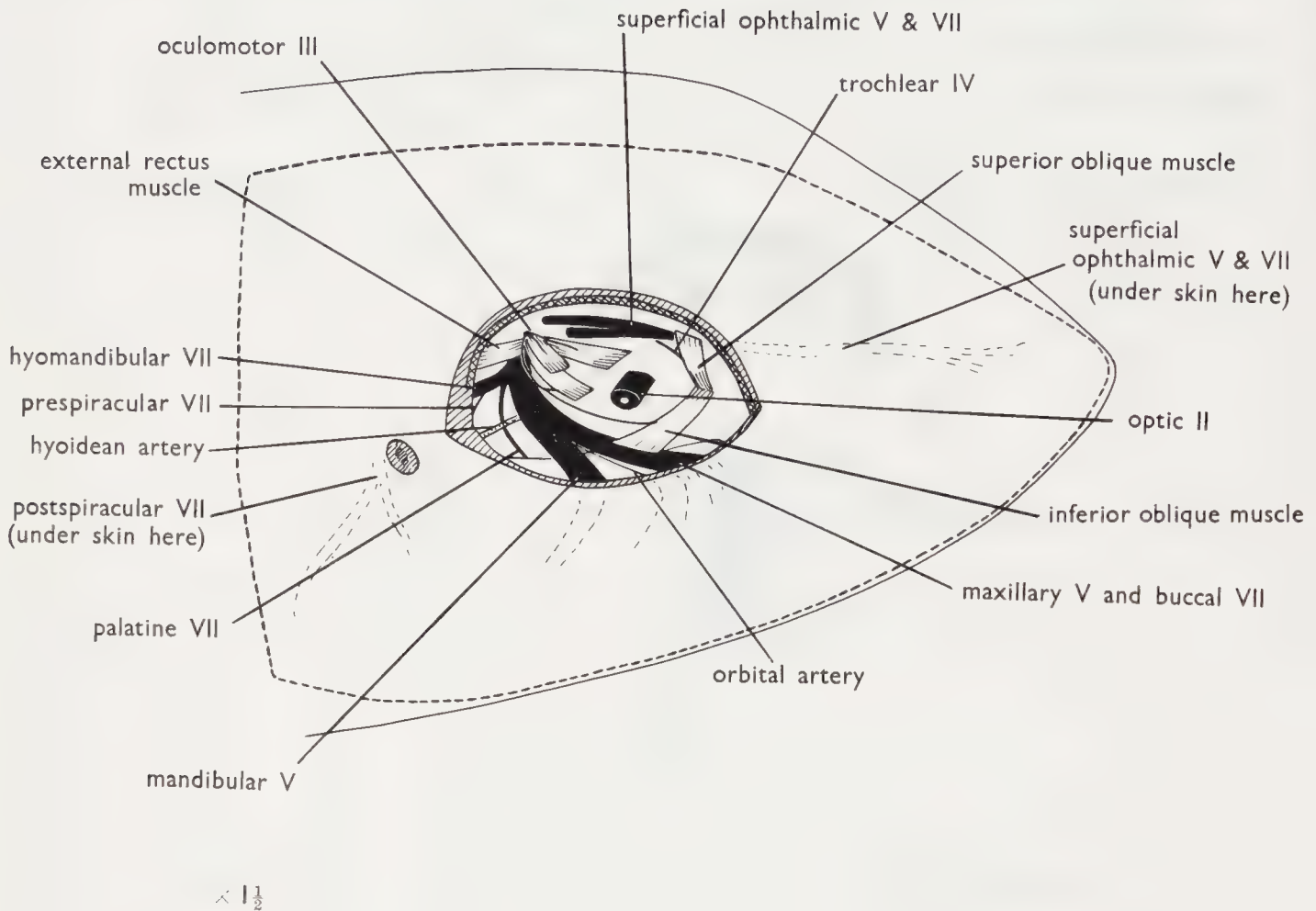


Fig. 51

Wash out the orbit.

Turn the superior rectus muscle downwards to show the root of the oculomotor nerve III.

Examine and DRAW the structures visible at this stage.

Cut away the skin from the area outlined by the thick dotted lines, watching for the nerves in the positions marked by the fine dotted lines.

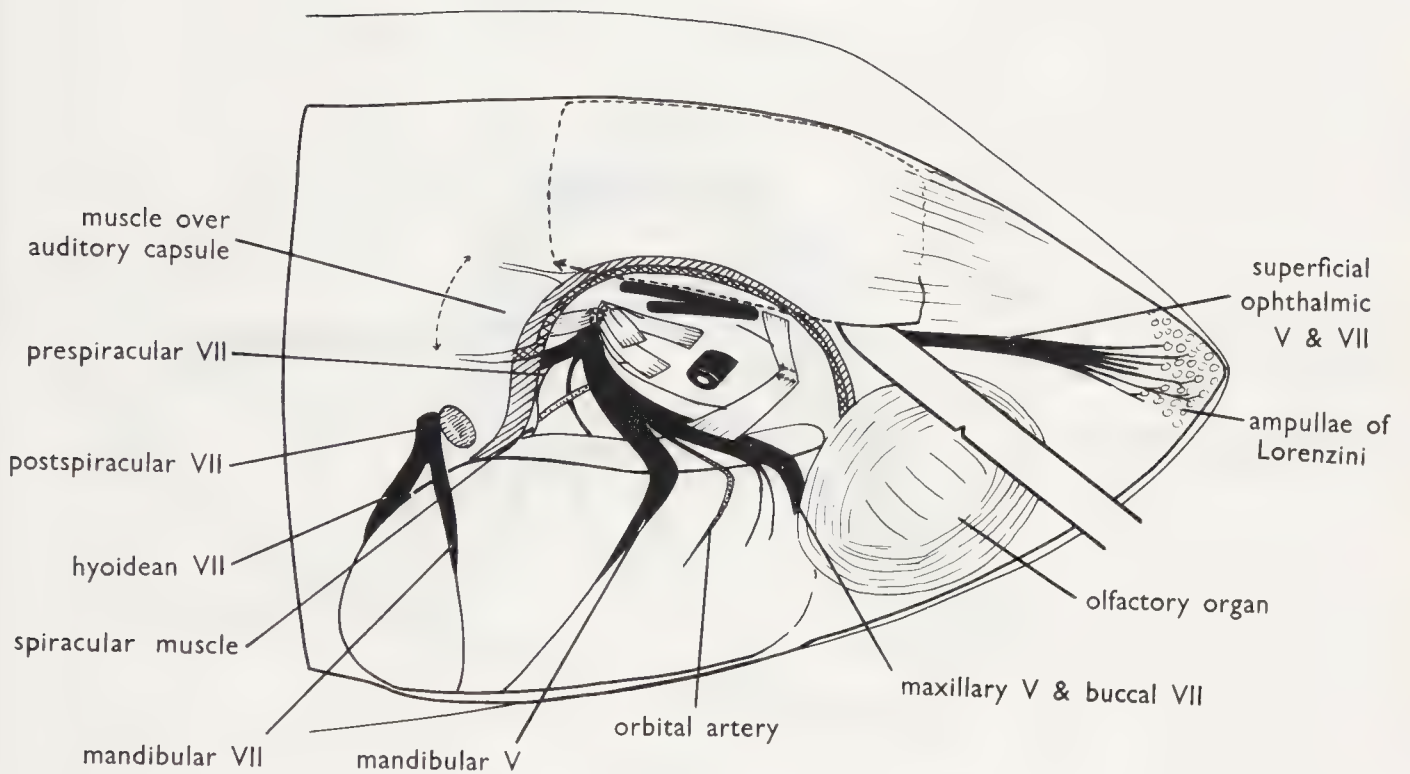


Fig. 52

Clear the hyoidean and mandibular branches of the postspiracular part of the facial nerve VII.

Similarly clear the maxillary and mandibular branches of the trigeminal nerve V and the buccal branch of the facial nerve VII.

NOTE. At this stage the maxillary V and the buccal VII are not readily distinguishable.

Both the mandibular nerves run deep in the muscle of the upper jaw, but can readily be traced if desired by following the lines visible across the muscle.

Clear the anterior portion of the superficial ophthalmic nerves V and VII.

Carve away the roof of the cranium down to the level of the exit of the ophthalmic nerves from the orbit.

N.B. BE CAREFUL NOT TO DAMAGE THE BRAIN.

Remove the rectus and oblique muscles and the third and fourth nerves.

Scrape away the muscle from the dorsal surface of the auditory capsule and cut it back to the line indicated.

THE DOGFISH—*The nervous system*

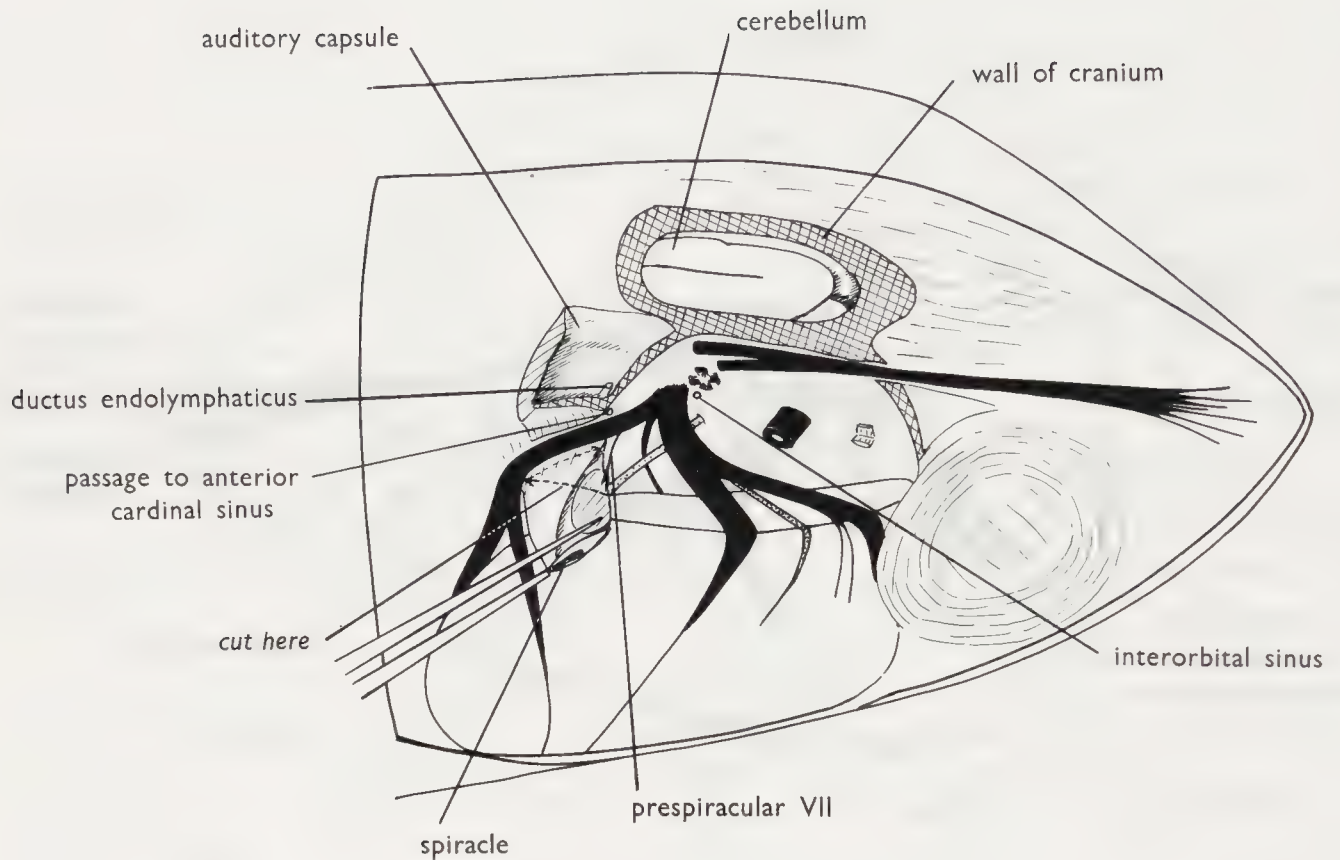
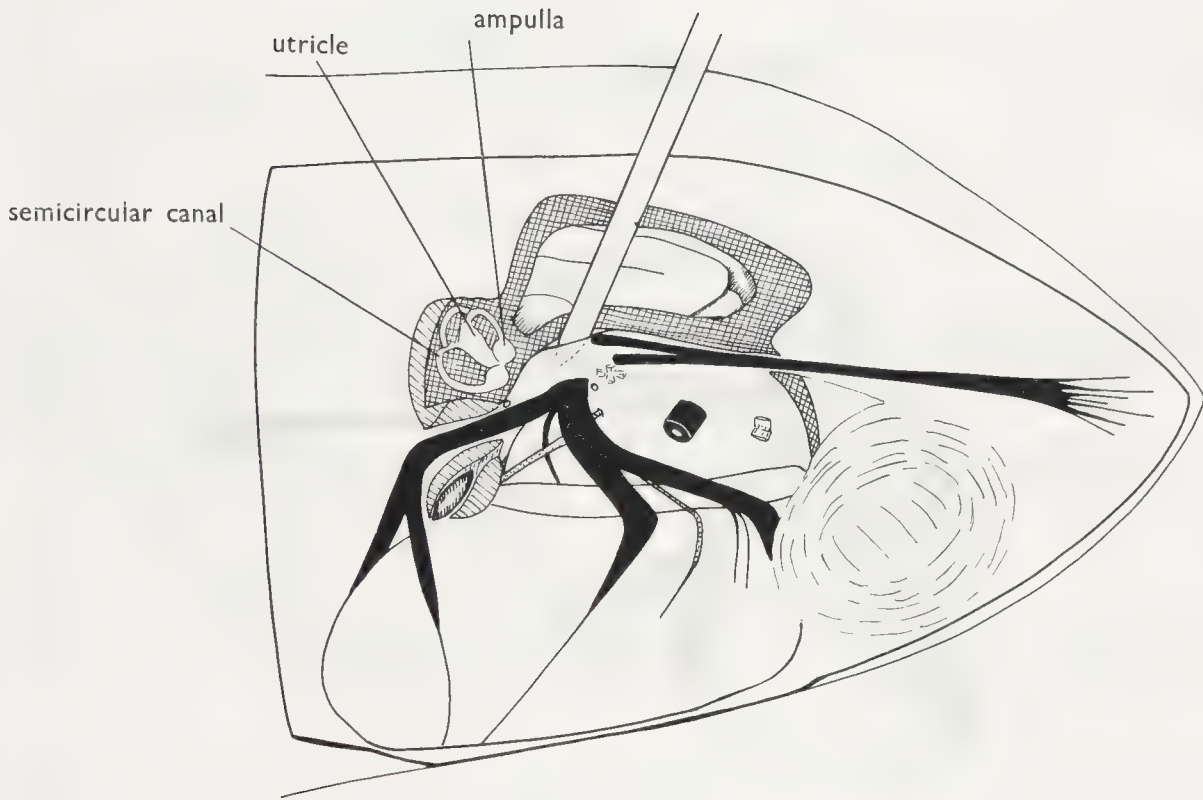


Fig. 53

Trace the postspiracular branch of the hyomandibular nerve along its course behind the spiracle. Watch for the prespiracular branch which is very small and variable in its point of origin. It lies close to the posterior wall of the orbit. Cut away the tissue round the spiracle to allow full display of these nerves.

Carve away the dorsal and lateral walls of the auditory capsule carefully. N.B. Cut away only a small piece at a time, working round the membranous labyrinth.



$\times 1\frac{1}{2}$

Fig. 54

Observe and DRAW the semicircular canals.

Remove the connective tissue lining the orbit from the cartilage over the area dorsal to the main roots of the trigeminal and facial nerves.

N.B. This may seem unnecessary, but it makes the subsequent removal of the cartilage much easier.

THE DOGFISH—*The nervous system*

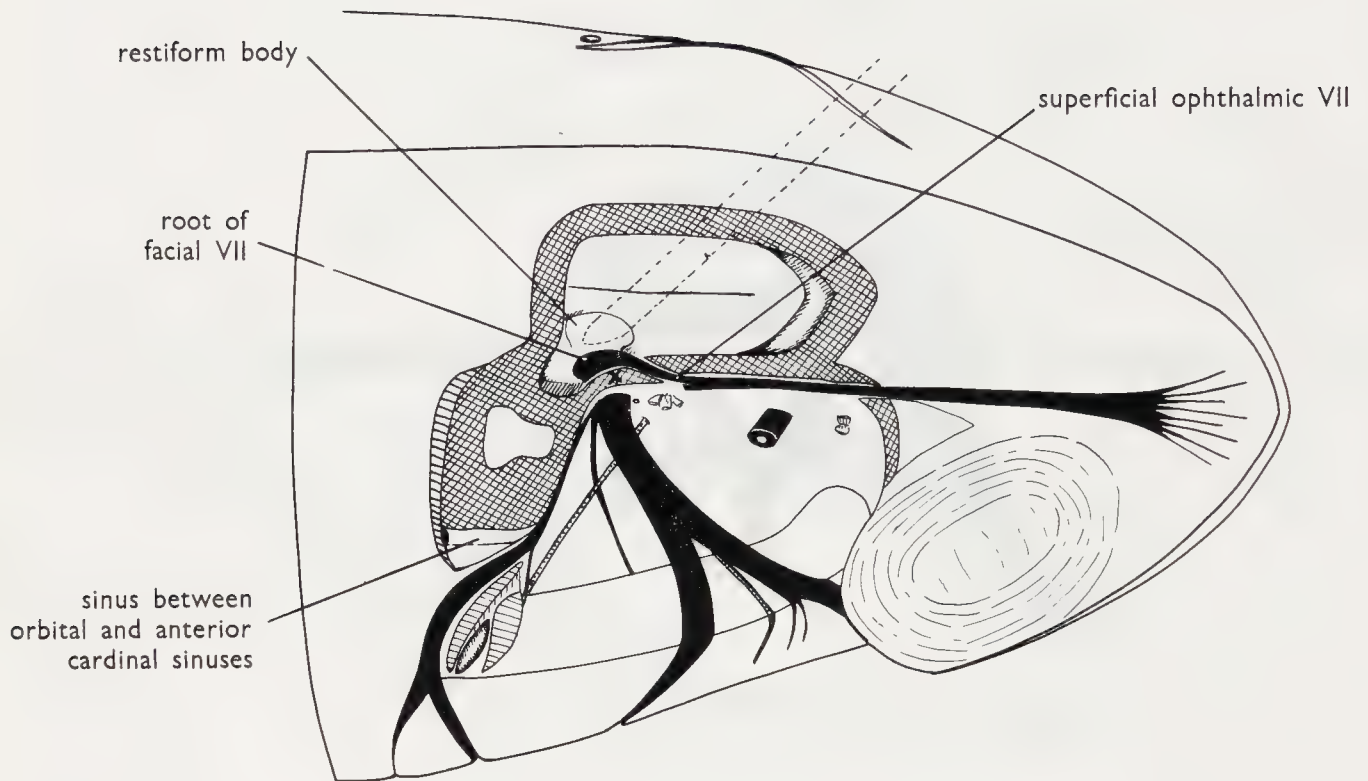


Fig. 55

Gradually carve away the cartilage in the region marked X.

NOTE. The membranous labyrinth is destroyed in this process. At intervals hold back the restiform body as indicated so that the root of the facial nerve can be seen and cutting it is avoided.

Trace the superficial ophthalmic branch of the facial nerve through the wall of the cranium.

THE DOGFISH--*The nervous system*

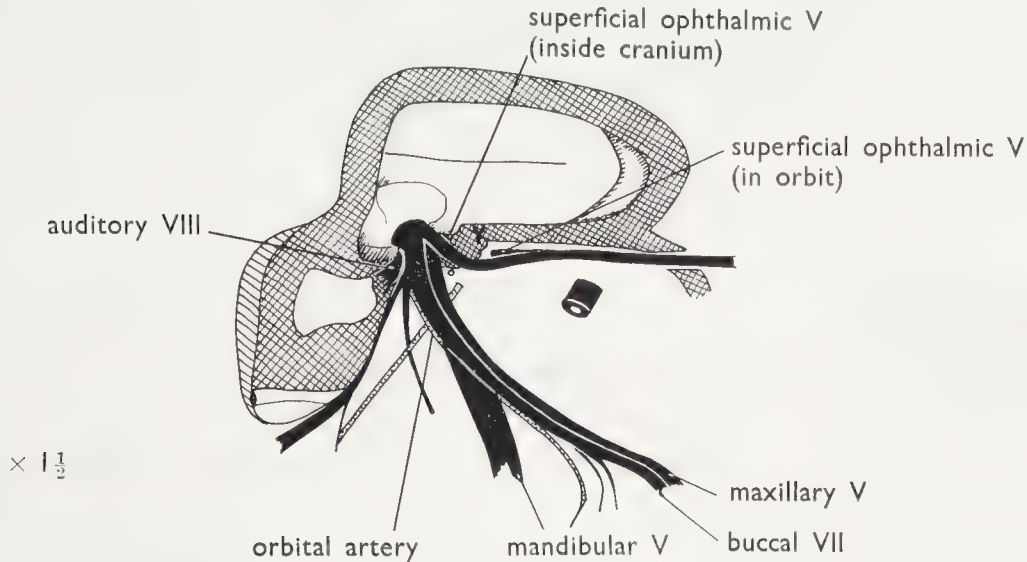


Fig. 56

Clear the root of the facial nerve. Remove the connective tissue of the lining of the orbit from the surface of the nerves. The buccal branch of the facial nerve can then be identified crossing the trigeminal nerve as shown. Use a seeker to separate these nerves and observe the branching of both buccal and maxillary nerves to serve the upper jaw.

Observe and clear the auditory nerve.

Loosen the superficial ophthalmic branch of the facial nerve from the cranial wall as shown.

Carve away the cartilage at Y to expose the superficial ophthalmic branch of the trigeminal nerve.

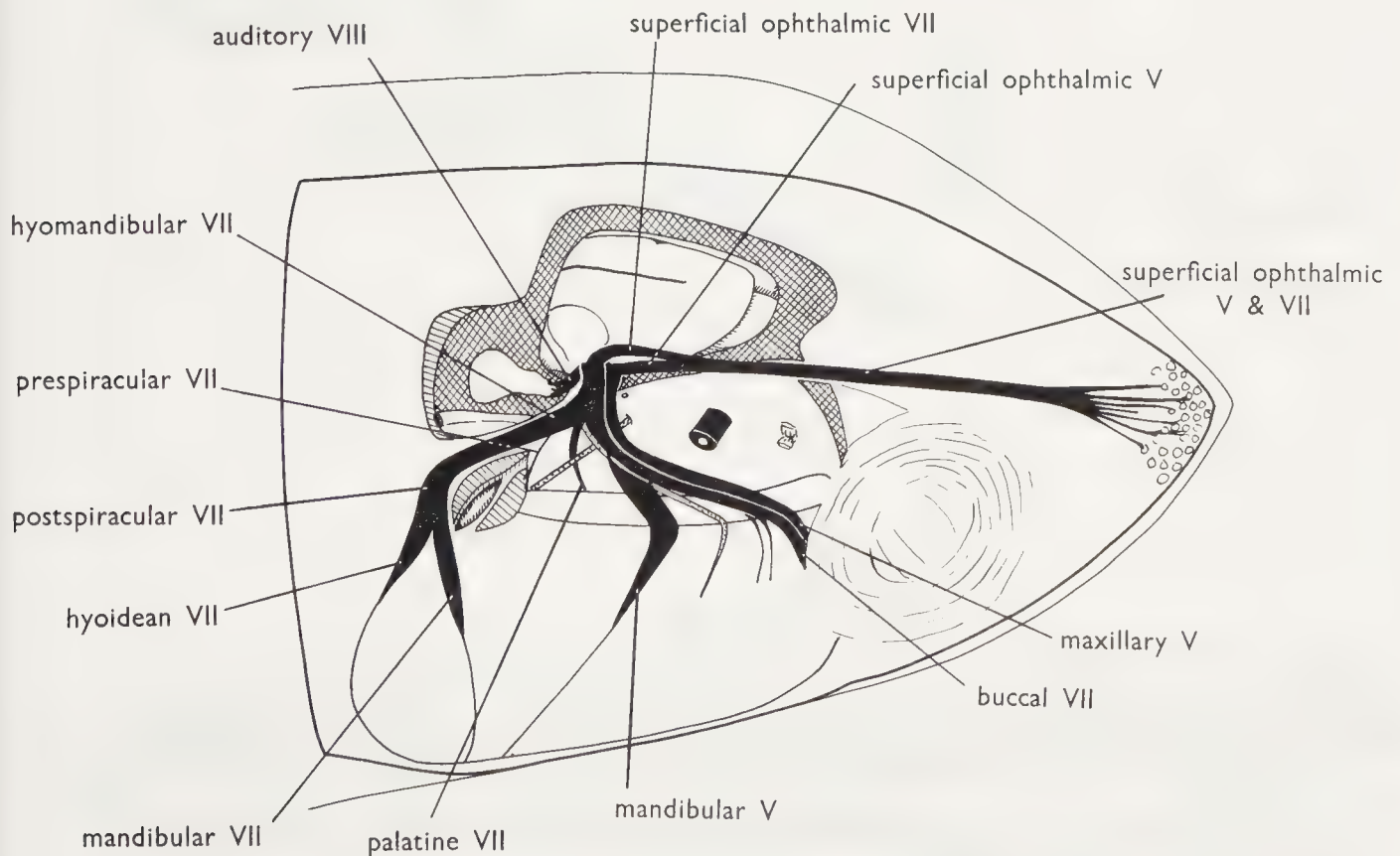


Fig. 57

Study and **DRAW** the completed dissection of the fifth and seventh cranial nerves.

THE DOGFISH—*The nervous system*

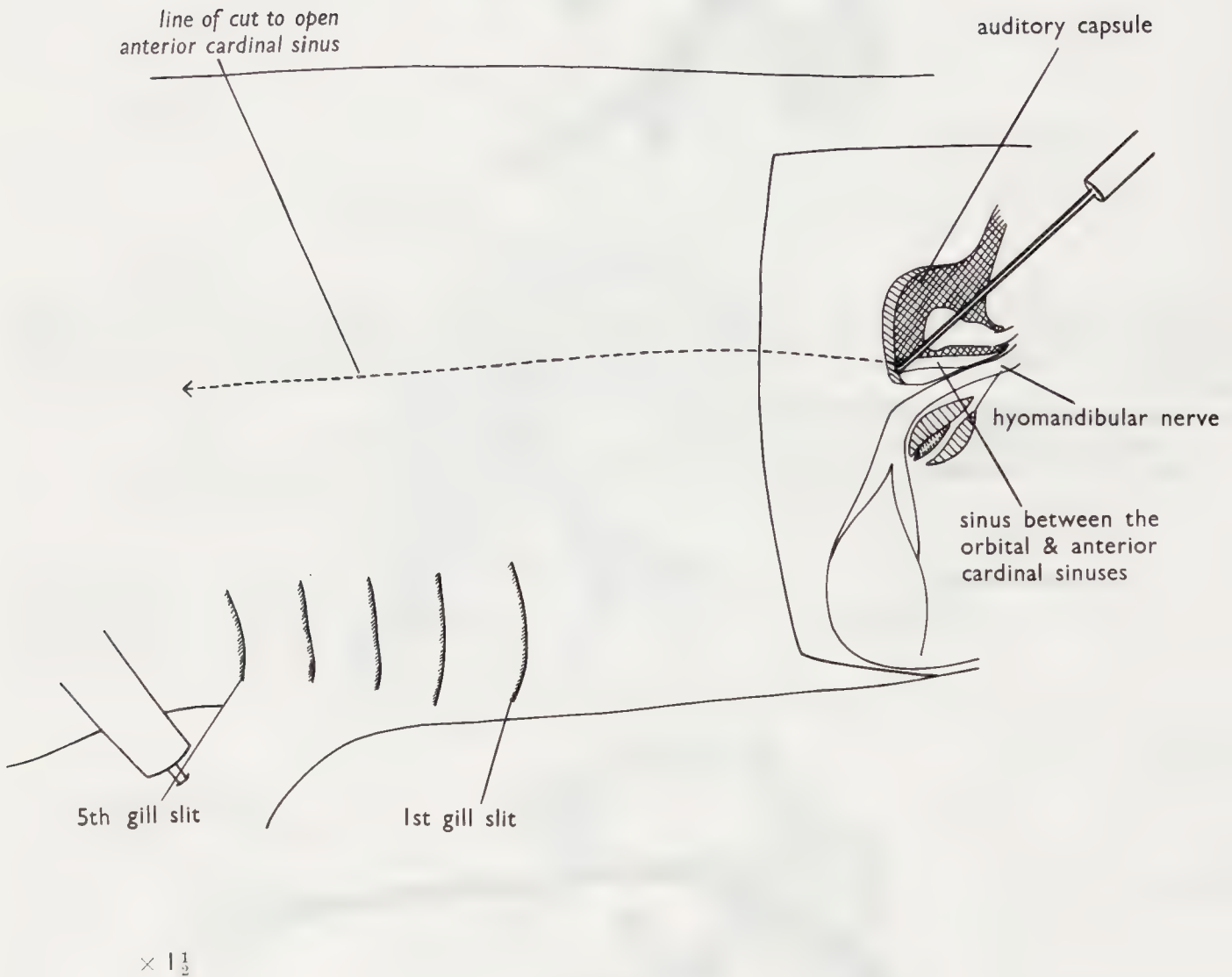


Fig. 58

Before proceeding to the dissection of the ninth and tenth cranial nerves, study Fig. 62.

Find the passage from the orbital sinus to the anterior cardinal sinus. It runs against the cartilage of the auditory capsule and will have been exposed during the previous part of the dissection—see Fig. 55.

Insert a seeker into the anterior cardinal sinus. Open the sinus by cutting along the line indicated, using the seeker as a guide.

NOTE. If the fifth and seventh cranial nerves have not previously been dissected, start the dissection of the ninth and tenth cranial nerves as follows:

- (a) Remove the skin from the region immediately dorsal to the spiracle, i.e. that covering the auditory capsule.
- (b) Remove the muscle from the dorsal and lateral surfaces of the auditory capsule. Observe the opening of the cardinal sinus and continue as above.

THE DOGFISH—*The nervous system*

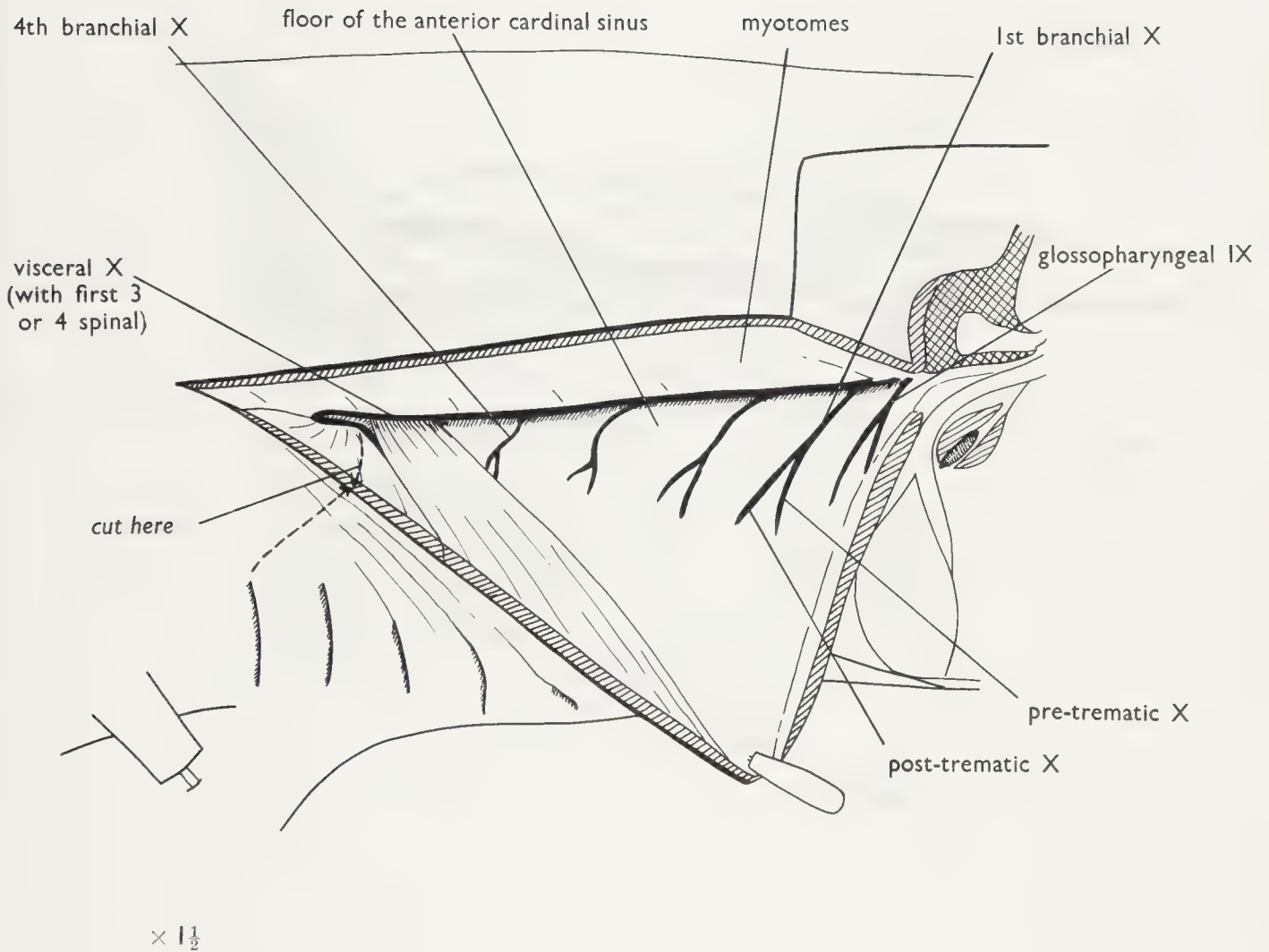


Fig. 59

Open the anterior cardinal sinus. Pin back the lateral wall. Observe the structures labelled in the diagram. Cut through the last gill slit and cut through the muscle of the pectoral girdle along a line to meet this slit.

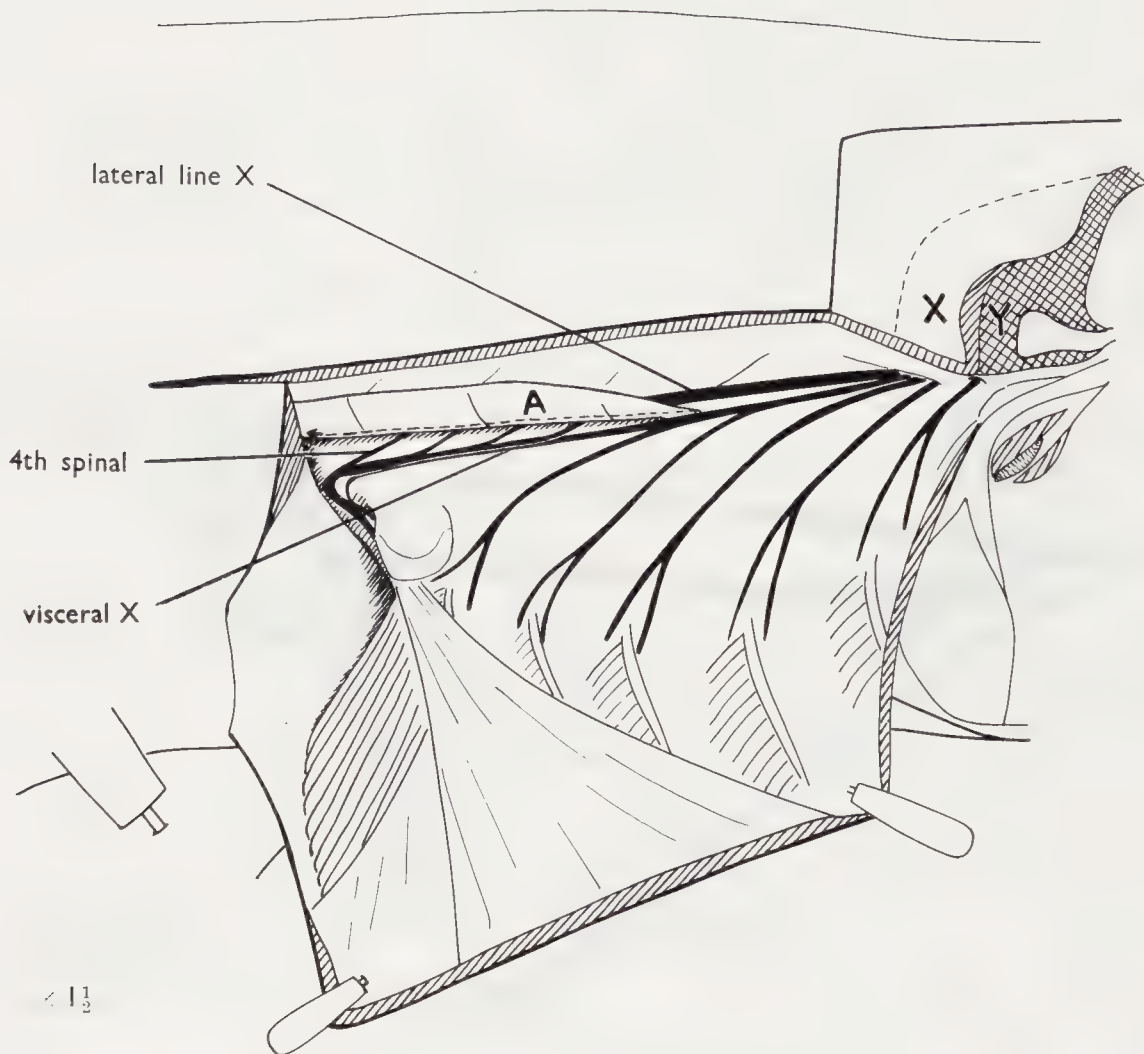


Fig. 60

Pin as shown above.

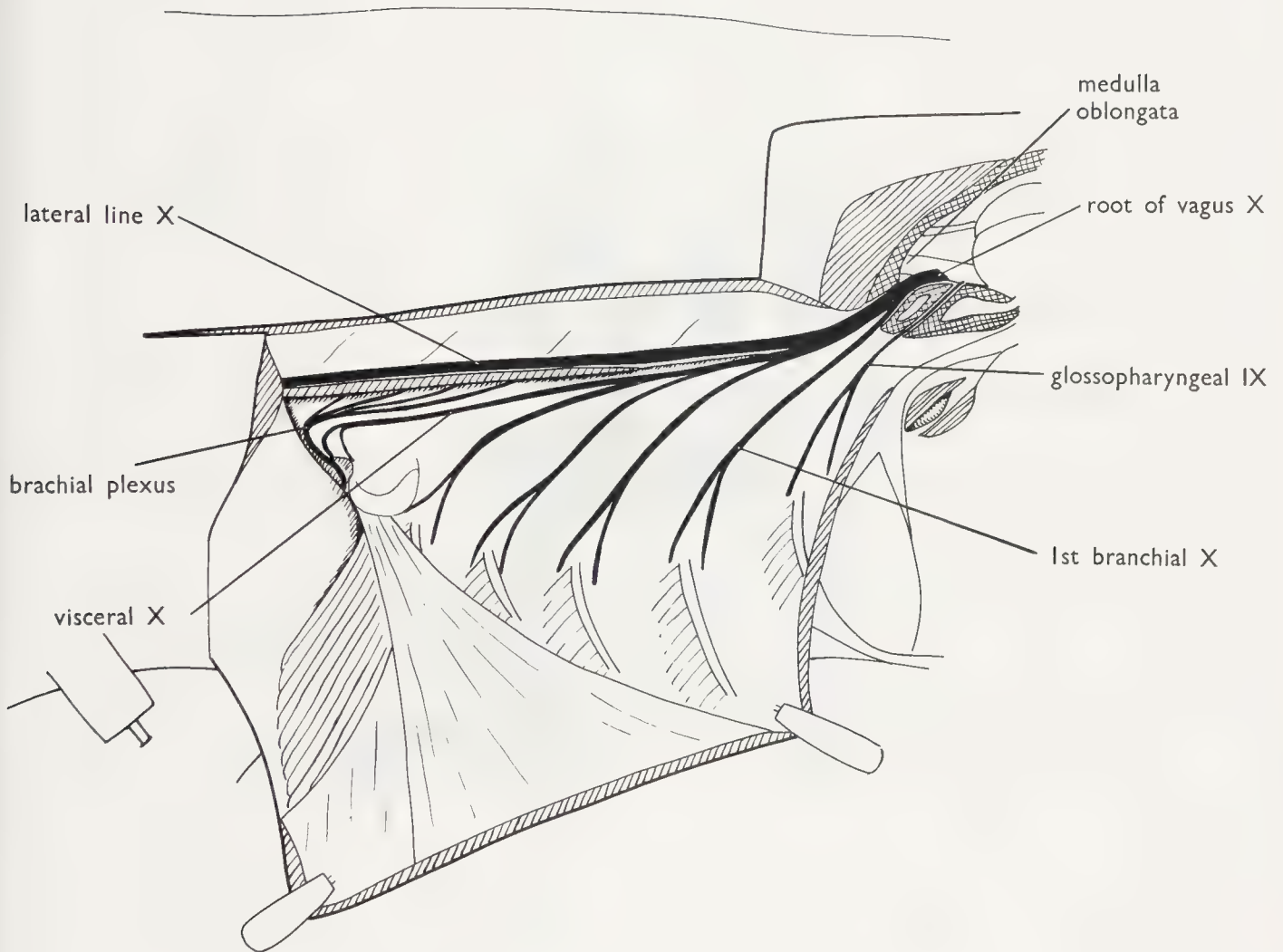
Carefully clear the connective tissue from the glossopharyngeal nerve and from the branchial branches of the vagus.

Observe the visceral branch of the vagus and the spinal nerves. They are bound together as shown and must be carefully separated.

Clean away the connective tissue from the median wall of the cardinal sinus and observe the root of the lateral line branch of the vagus.

Trace this lateral line nerve behind the muscle marked A. Cut A away as completely as possible.

Carve away the muscle at X and the cartilage at Y to trace the roots of the glossopharyngeal and vagus nerves through the floor of the auditory capsule to the brain.



11₂

Fig. 61

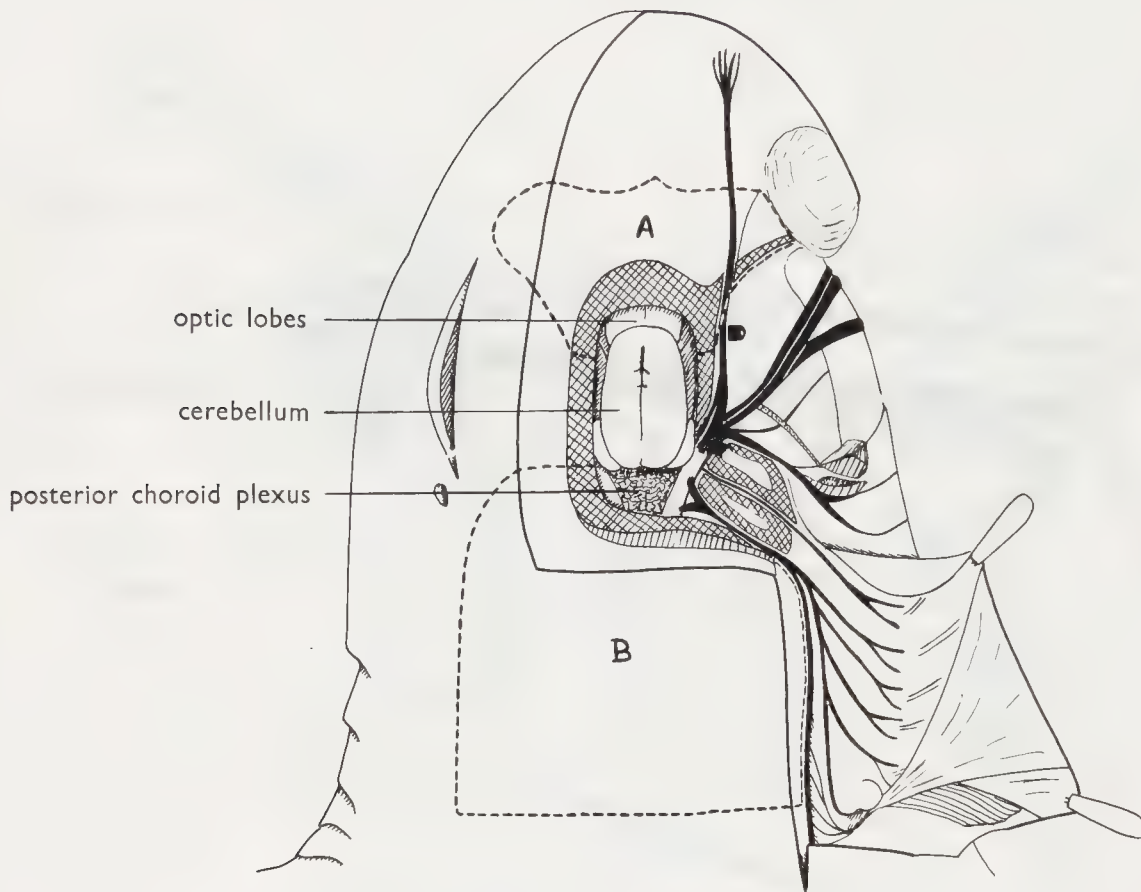
Observe and DRAW the nerves shown.

NOTICE ESPECIALLY THE SEPARATION OF THE VISCERAL BRANCH OF THE VAGUS FROM THE BRACHIAL PLEXUS.

THE DOGFISH—*The nervous system*

(b) THE BRAIN

When the dissection of the cranial nerves has been completed, the brain should be removed from the cranium and studied separately.



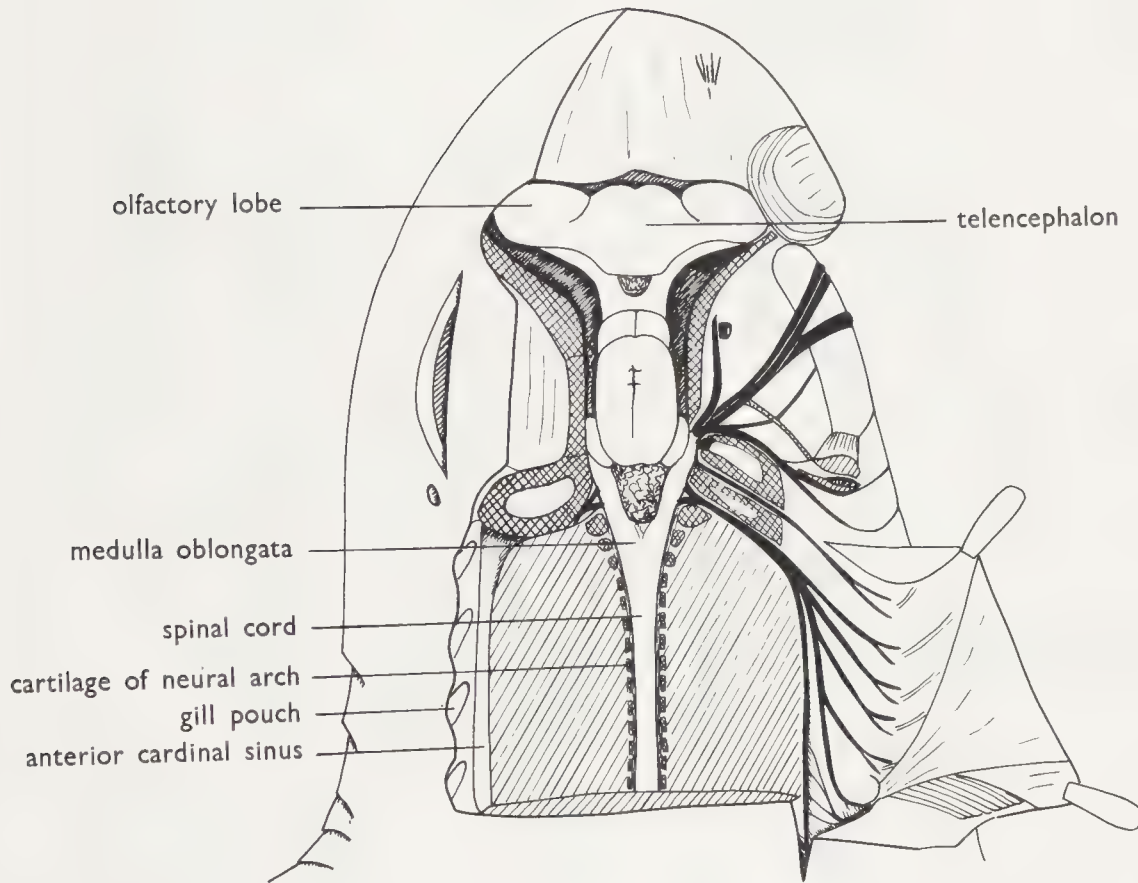
x 1

Fig. 62

The completed dissection of the cranial nerves is seen on the right of the diagram, but the left side is shown undissected.

Carve away the skin, muscle and cartilage from the areas marked A and B. Keep the scalpel horizontal while making these cuts in order to avoid damaging the brain.

THE DOGFISH—*The nervous system*



$\times 1$

Fig. 63

Observe the brain in position in the cranium.

Cut through the spinal cord a short distance behind the medulla oblongata. Cut through each of the cranial nerves in turn, working forwards and lifting the brain from the cranium as you proceed.

NOTE. CUT THE NERVES AS CLOSE TO THE CRANIUM AS POSSIBLE so that the roots can be identified later. Cut between the olfactory lobe and the olfactory organ with a scalpel, but cut the other nerves with scissors.

THE DOGFISH—*The nervous system*

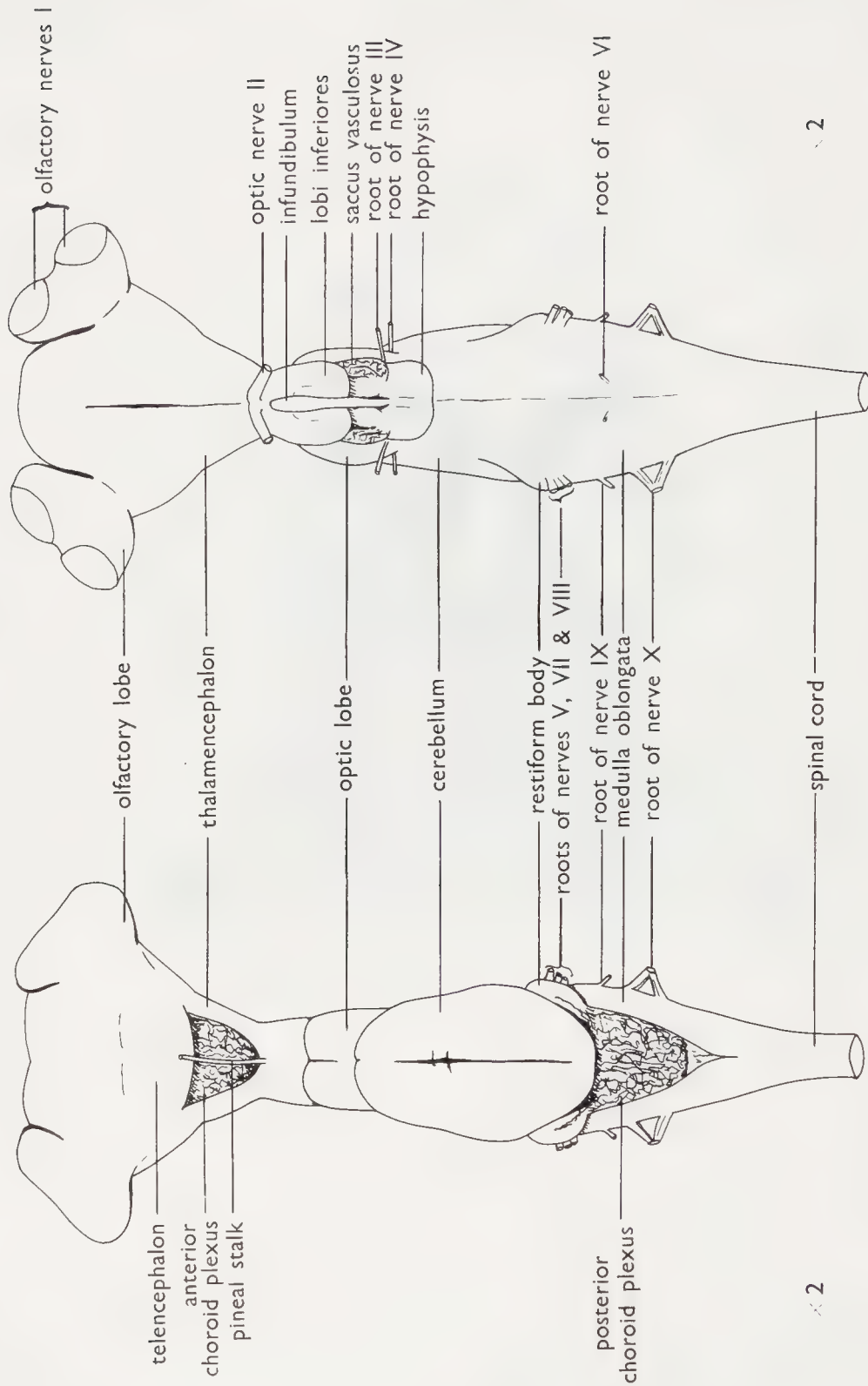


Fig. 64a (dorsal)
Examine dorsal view of the brain.
DRAW.

Fig. 64b (ventral)
Examine ventral view of the brain.
DRAW.

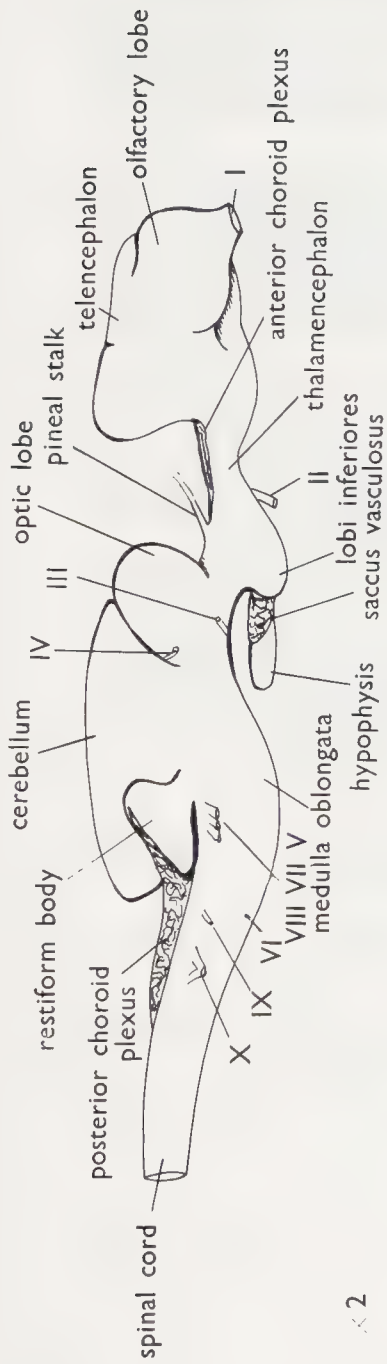


Fig. 64c (lateral)

Examine lateral view of the brain.
DRAW.

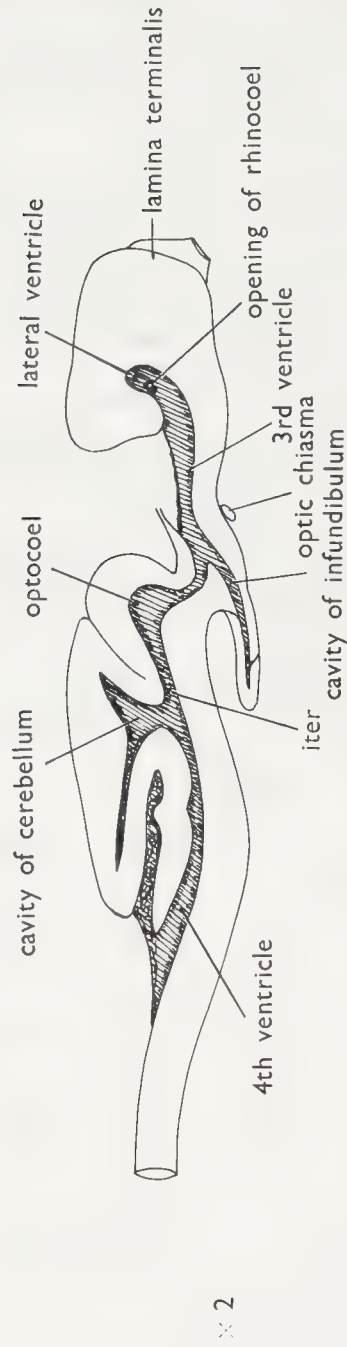


Fig. 65

Cut the brain through the median sagittal plain.
Examine one half of the brain.
DRAW.

II

THE FROG

All the systems of the frog with the exception of the brain and spinal cord are dissected from the VENTRAL side. To display these systems a preliminary opening up of the body cavity is necessary. Between the skin and the body wall there are large lymph spaces, therefore this opening up takes place in two stages:

- (a) Cutting and pinning back the skin as shown in Figs. 1-4.
- (b) Cutting and pinning back the body wall.

When the venous system is to be studied the latter process is complicated by the necessity to preserve the anterior abdominal vein. The procedure to be followed in this case is shown in Figs. 4-13. It is usual to ligature the vein and to remove the body wall from it afterwards as shown here, but those with experience in dissection may prefer to omit the ligature and simply remove the body wall from the vein.

If the veins are not required a median incision along the linea alba may be substituted for the process shown in Figs. 4-8 and 12.

The opening up is most easily done in a DRY dissecting dish especially when threads are being used to ligature the anterior abdominal vein or when the specimen is a female distended with eggs (see Appendices I-III).

A small arrow at the top of each diagram indicates the direction of the head of the frog.

The species described throughout is *Rana temporaria*. *R. pipiens* differs insignificantly except in the male urino-genital system which is shown in Appendix V.

ORDER OF DISSECTION OF FROG

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(d) <i>The pulmonary veins</i>	34 & 35	97-98
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6 The Arterial System		
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THE FROG—I Opening up the Body Cavity

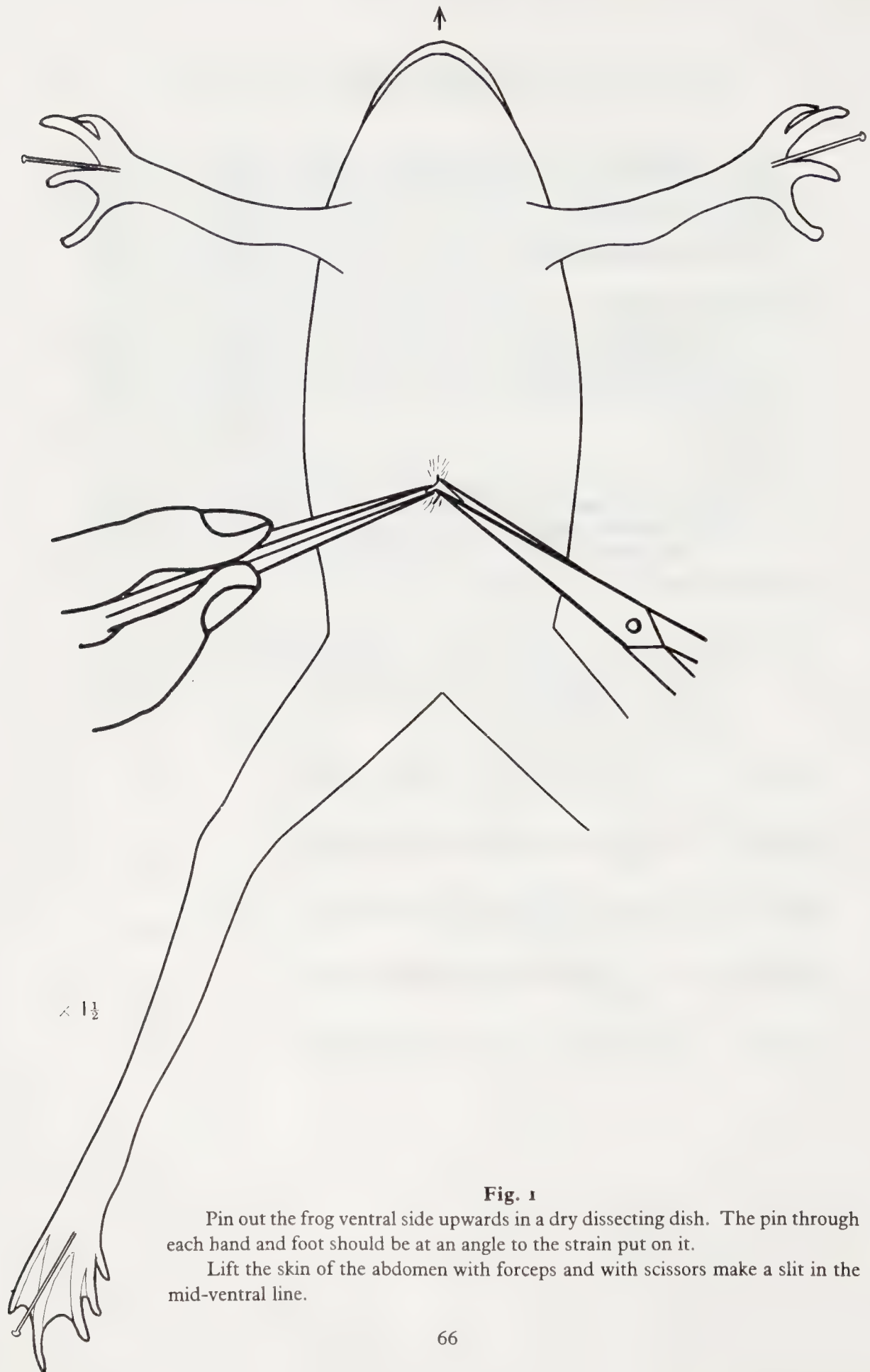


Fig. 1

Pin out the frog ventral side upwards in a dry dissecting dish. The pin through each hand and foot should be at an angle to the strain put on it.

Lift the skin of the abdomen with forceps and with scissors make a slit in the mid-ventral line.

THE FROG—*Opening up the body cavity*

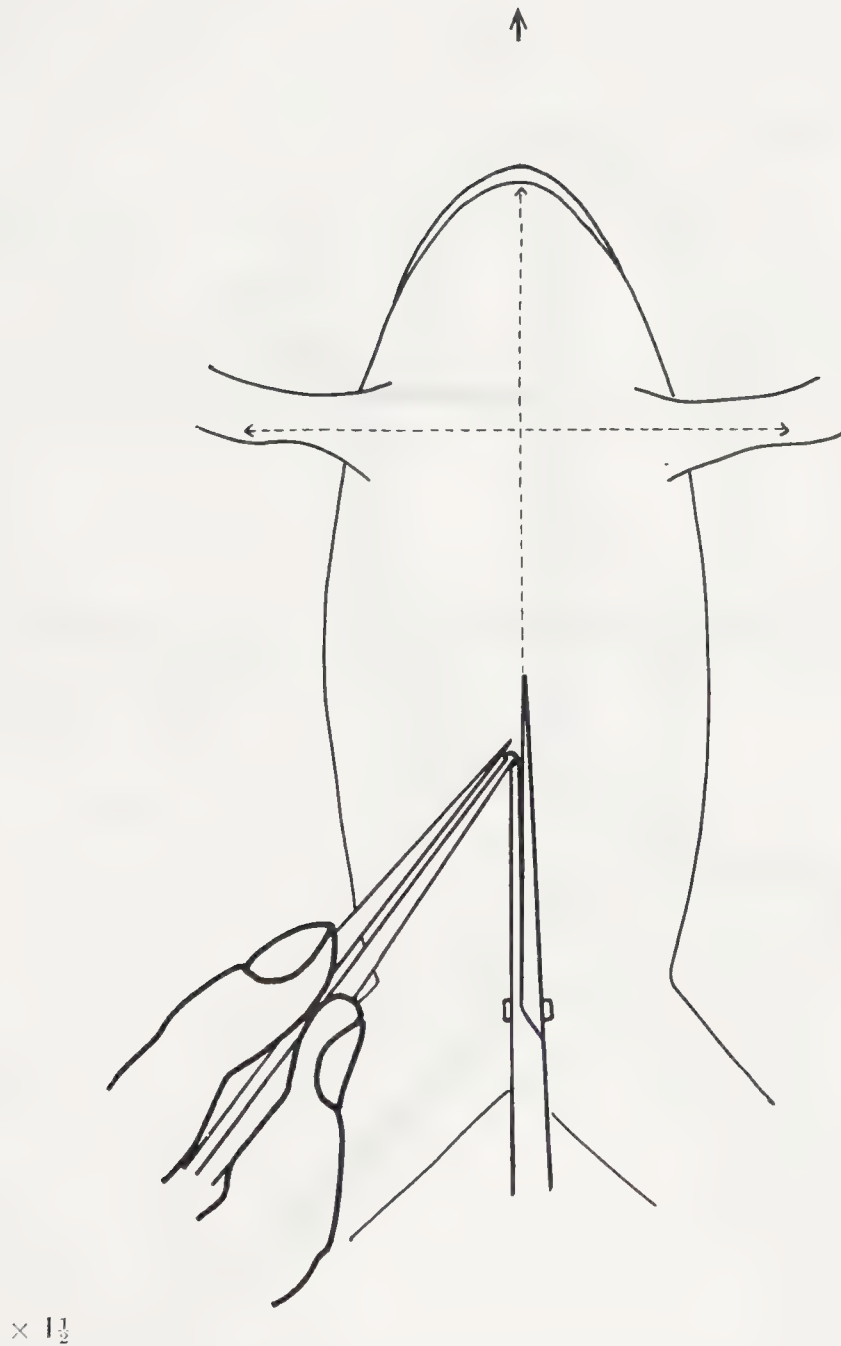


Fig. 2

Insert one blade of the scissors into the slit.

Cut the skin forwards to the level of the lower jaw.

Cut transversely at the level of the arms as far as the elbows.

Similarly cut the skin back to the level of the pelvic girdle and down each thigh to the knee.

THE FROG—*Opening up the body cavity*

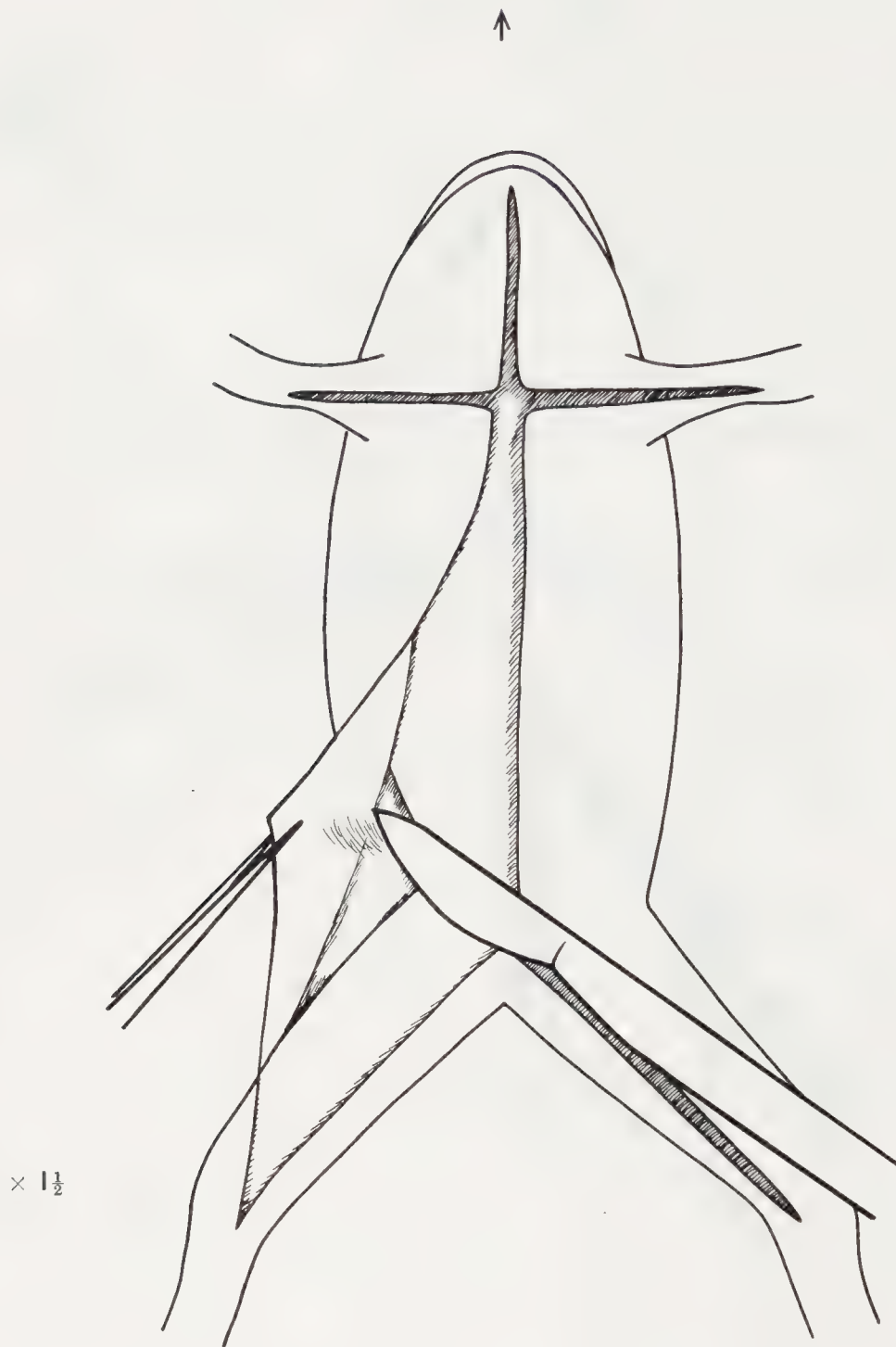
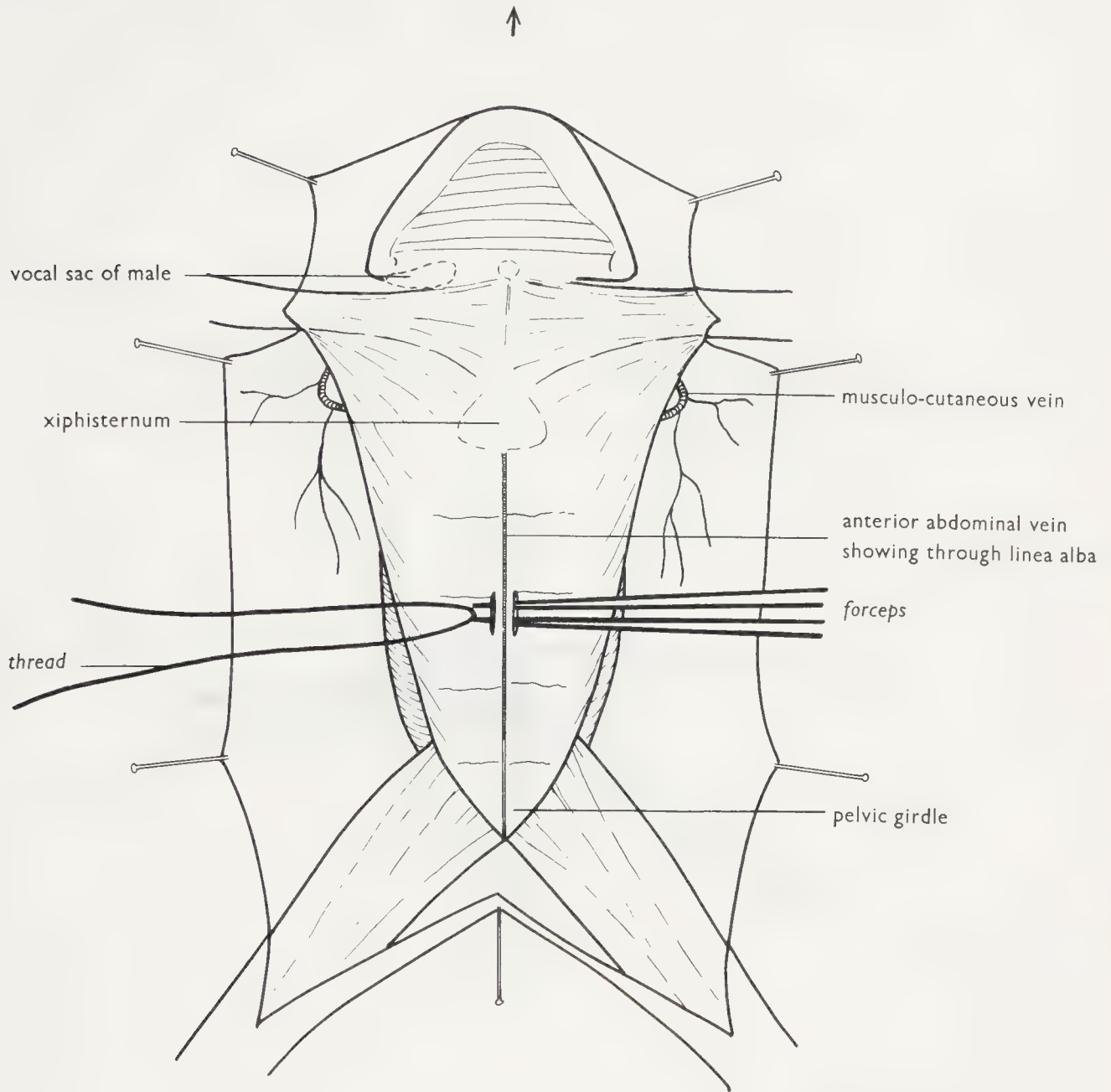


Fig. 3

Loosen the skin from the underlying muscle so that it can be turned back freely. **Care must be taken not to cut the musculo-cutaneous vein under each arm.** See Fig. 4.

THE FROG—Opening up the body cavity



$\times 1\frac{1}{2}$

Fig. 4

Pin back the skin and note the positions of muscles, the xiphisternum, the pelvic girdle, the linea alba and the anterior abdominal and musculo-cutaneous veins.

With scissors make two small incisions ($\frac{1}{4}$ inch) in the abdominal wall one on either side of the mid-ventral line and about **half way** between the xiphisternum and the pelvic girdle. Use the technique shown in Fig. 1.

N.B. Be careful not to pierce the rectum. This is especially likely to happen in females in the breeding season. See Appendix I.

Insert forceps through the slits so made.

Grip a loop of thread between their points.

THE FROG—*Opening up the body cavity*

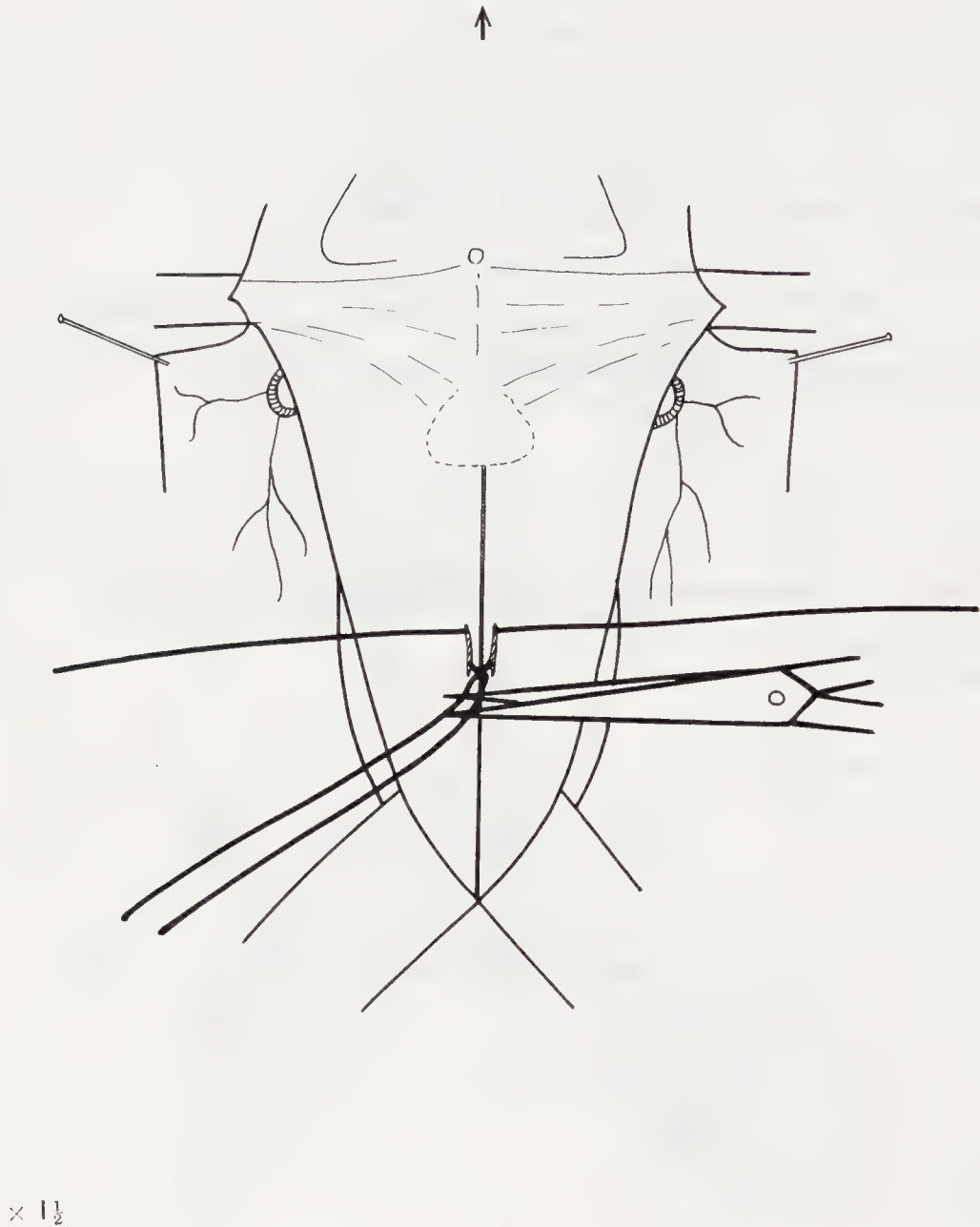


Fig. 5

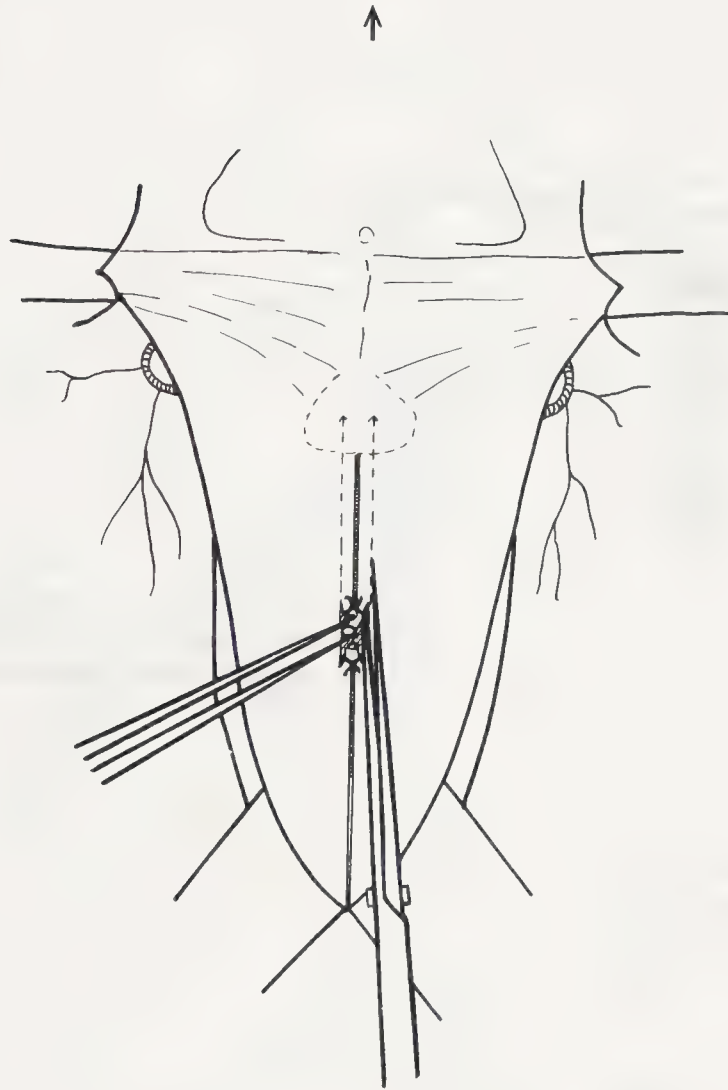
Pull the thread through the slits and cut the loop.

Tie the threads about a quarter of an inch apart in order to ligature the anterior abdominal vein.

Cut the loose ends of the threads.

Cut through the vein and the body wall between the threads.

THE FROG—*Opening up the body cavity*



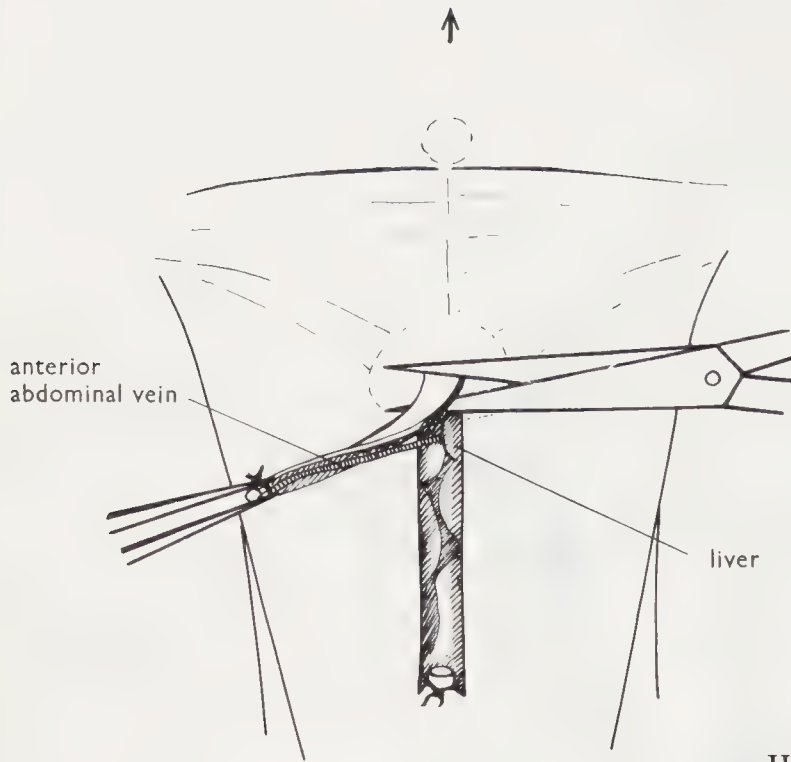
$\times 1\frac{1}{2}$

Fig. 6

Cut forwards on either side of the mid-line to the level of the centre of the xiphisternum.

Note. Hold the scissors as horizontal as possible and lift the body wall with the forceps. If care is not taken there is danger that the scissors points may puncture the internal organs.

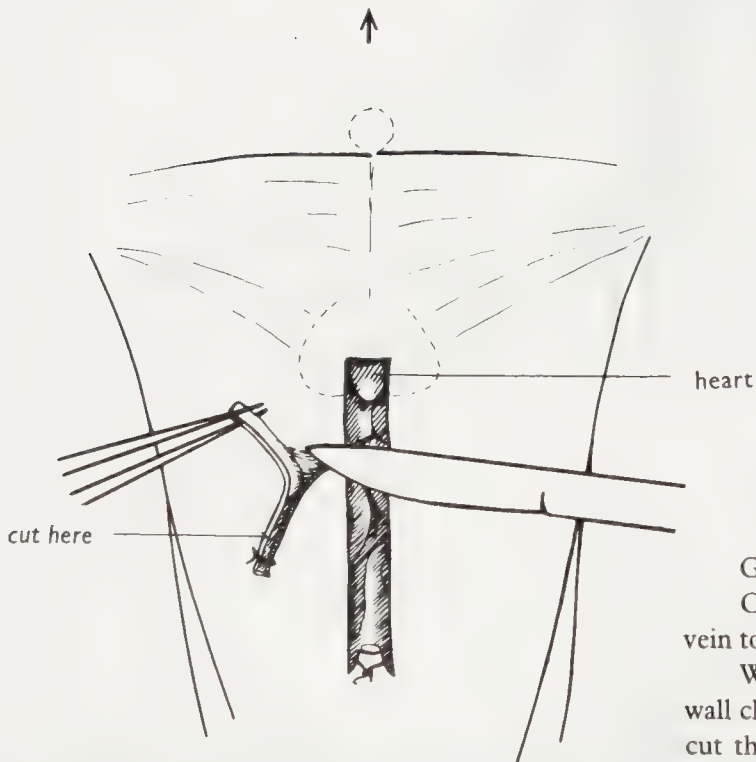
THE FROG—Opening up the body cavity



× 2 $\frac{1}{4}$

Fig. 7

Hold the loose piece of the abdominal wall well up. Notice the anterior abdominal vein entering the liver. Cut across the centre of the xiphisternum as shown.



× 2 $\frac{1}{4}$

Fig. 8

Grip the cut piece of the xiphisternum.

Connective tissue binds the anterior abdominal vein to the body wall. Loosen this as far as the ligature.

With scissors cut the loosened piece of the body wall close to the ligature as indicated. Be careful not to cut the vein.

Note. When nearing the ligature do not pull hard on the piece of body wall or the ligature will probably come off. Should it do so re-tie immediately.

THE FROG—Opening up the body cavity

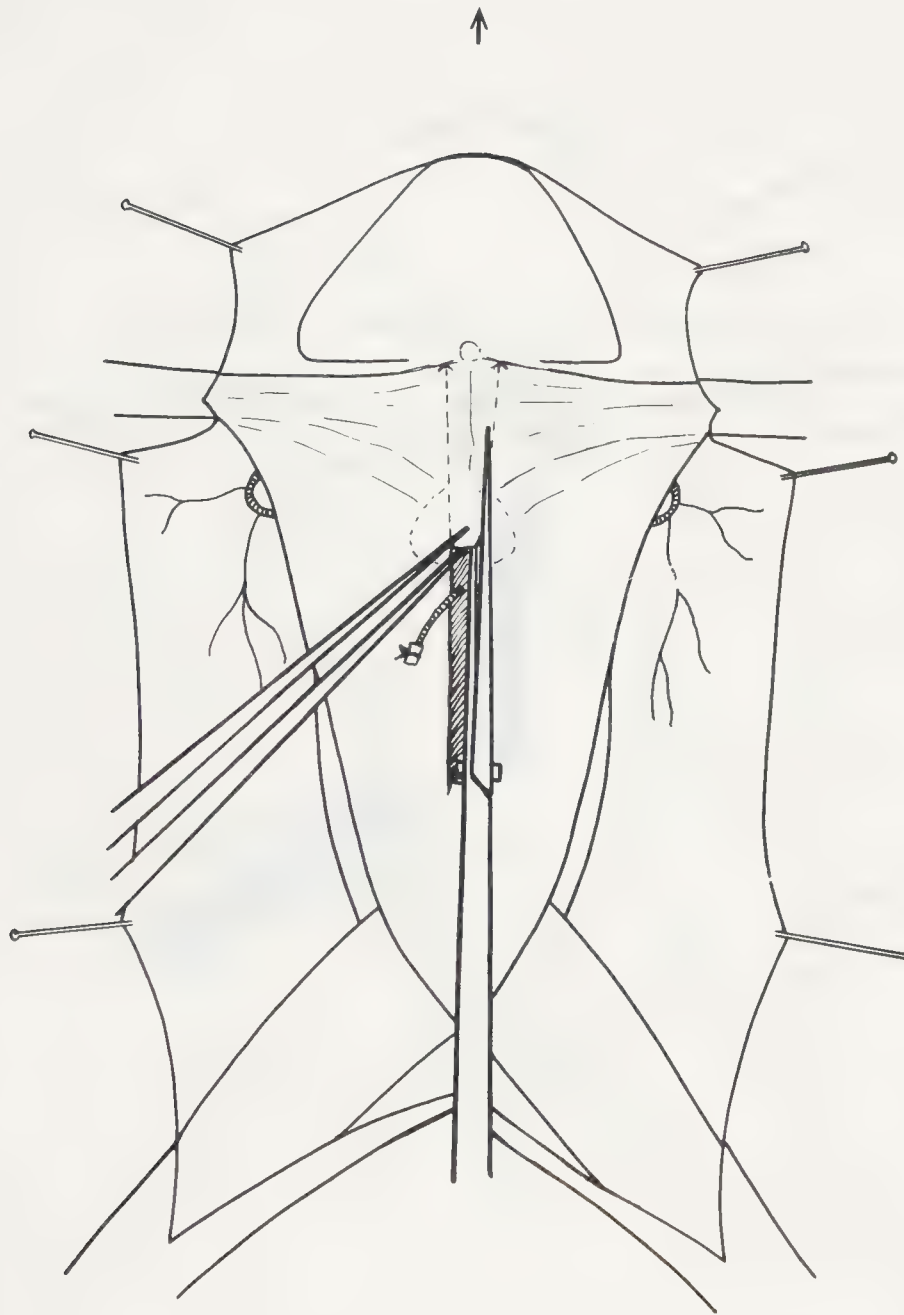


Fig. 9

Cut through the pectoral girdle on either side of the mid-line as shown. Hold the girdle up as much as possible and keep the scissors as horizontal as possible to avoid puncturing the heart.

Note. These cuts require strong scissors as the **coracoid and clavicle bones must be cut.**

THE FROG—Opening up the body cavity

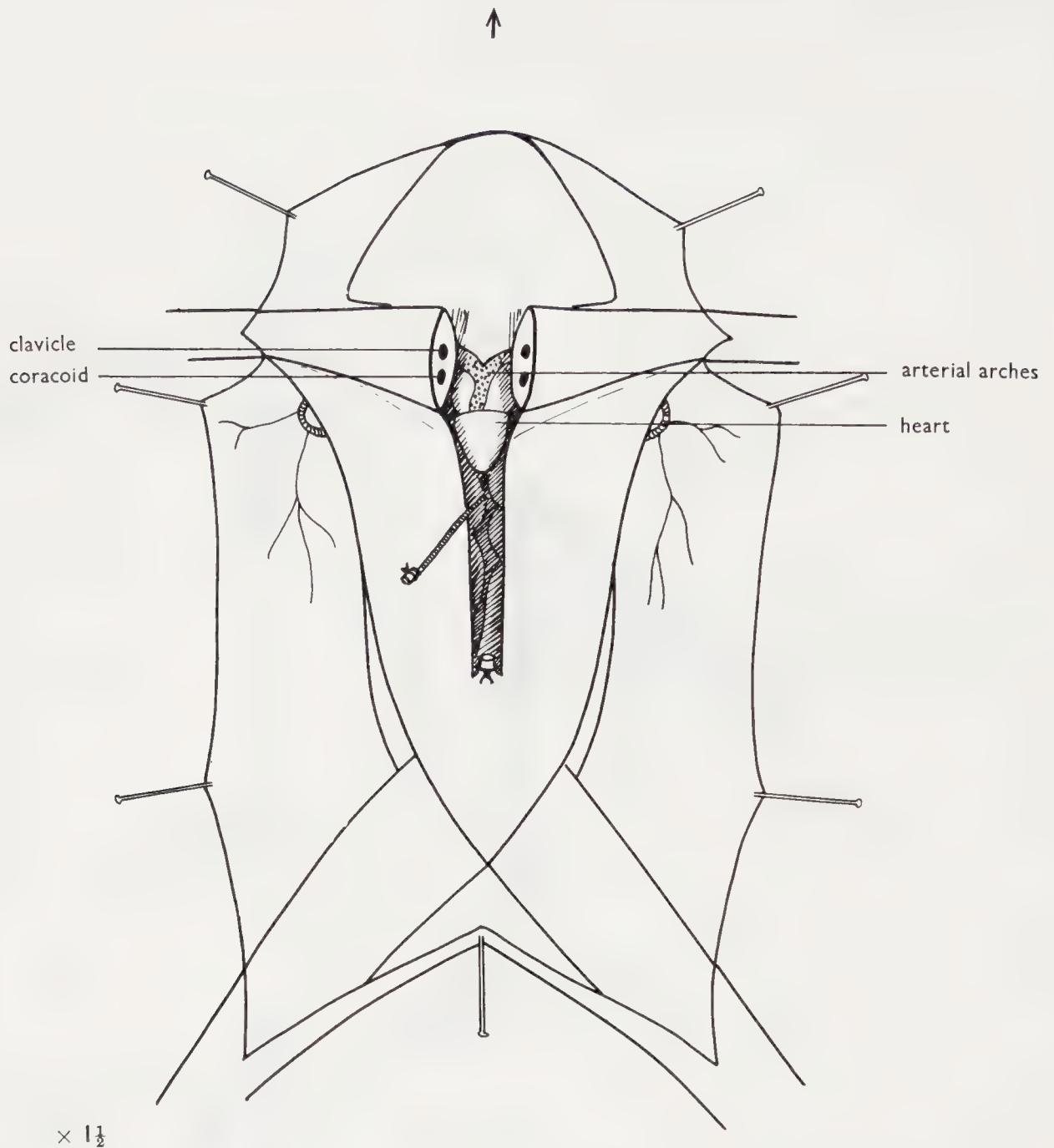


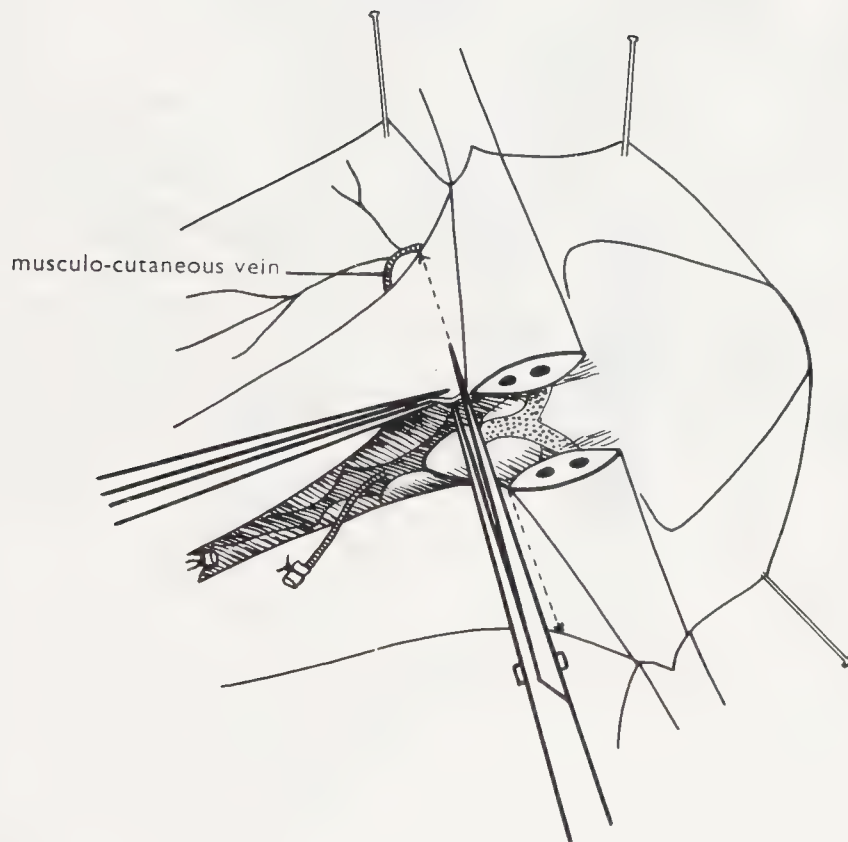
Fig. 10

Remove the central piece of the pectoral girdle and any loose muscle underneath it that may fail to come off at the same time.

Move the pins holding the arms outwards slightly to widen the gap, but do not stretch forceably or the blood vessels of this region may be torn.

THE FROG—Opening up the body cavity

↗



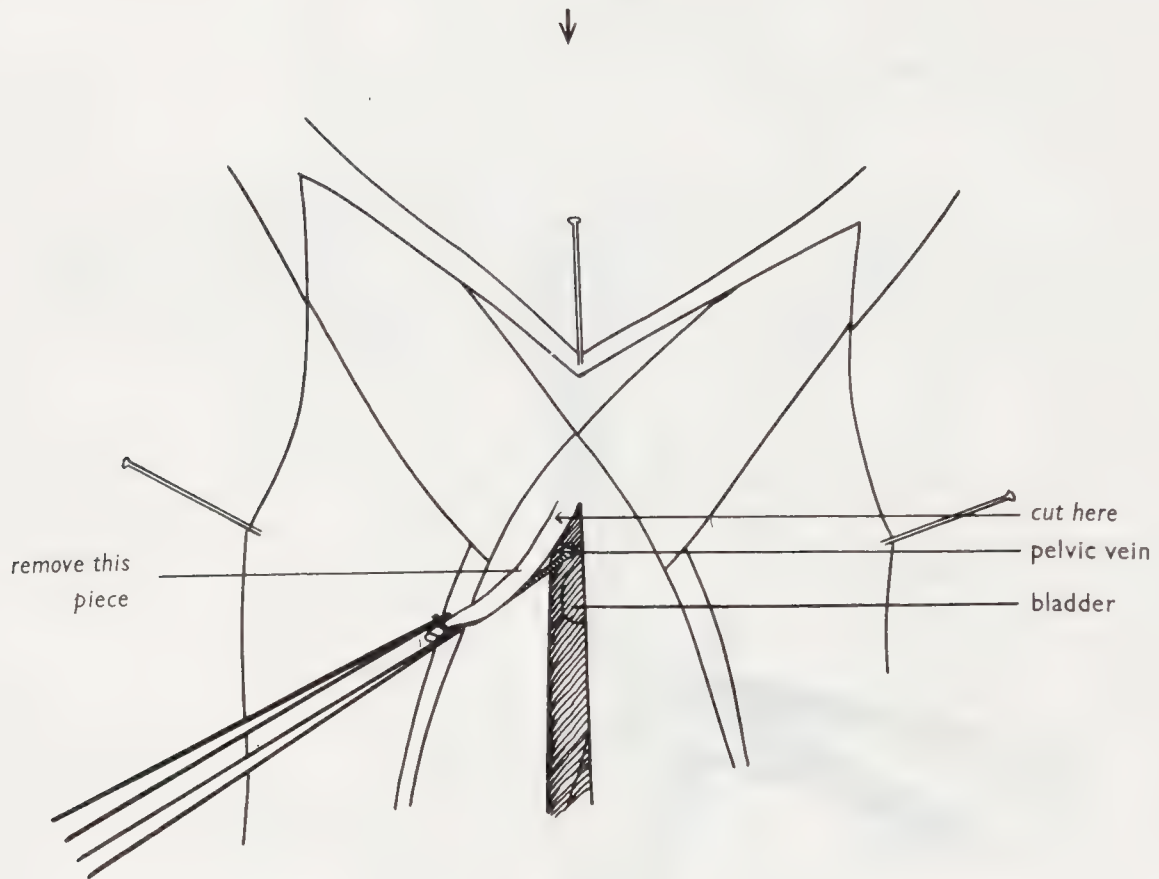
$\times 1\frac{1}{2}$

Fig. 11

Turn the dish sideways.

Cut the body wall transversely as shown, being careful not to cut the musculo-cutaneous veins.

THE FROG—Opening up the body cavity



× 1½

Fig. 12

Turn the dish so that the legs are directed away from you.

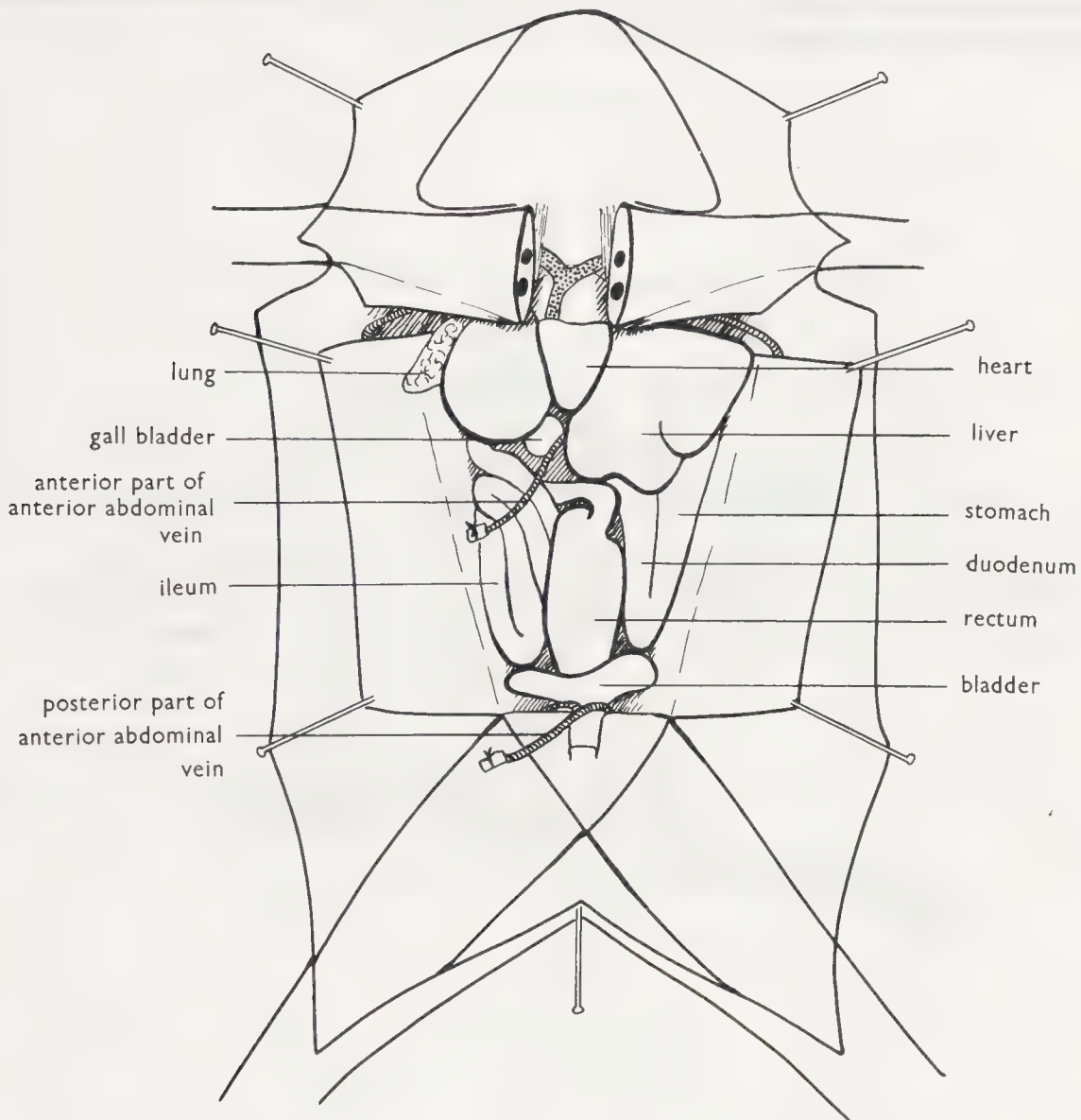
Cut the body wall on either side of the mid-line back to the pelvic region, being careful not to cut the pelvic veins. **Do not cut deeply.**

Hold the loose piece of the abdominal wall up and cut across posterior to the pelvic veins in the position shown.

Remove the portion of the body wall from the anterior abdominal vein by the method shown in Fig. 8.

Cut the body wall transversely at the level of the pelvic veins.

THE FROG—Opening up the body cavity



$\times 1\frac{1}{2}$

Fig. 13

Restore the dish to its original position.

Pin back the body wall.

Remove the pins holding the skin.

Cover the frog completely with water.

The viscera appear approximately as shown above in all males and in females except in the breeding season. See Appendices II and III.

Note. Occasionally the stomach is not visible because it has become inverted into the mouth. It can be restored to its normal position by carefully inserting the handle of a seeker into the mouth.

DRAW

THE FROG—2 The Viscera (general)

It is impossible to show all the viscera completely at one time, but a general display should be made as follows:— Figs. 14 & 15. If you are dissecting a male *Rana pipiens* consult Appendix V, p. 124, concurrently with the stages shown in Figs. 15–18.

The parts of the alimentary canal which lie in the body cavity should be studied carefully. The complete dissection of the alimentary canal is described in Appendix IV. It necessitates damaging the venous and arterial systems and must not be performed at this stage if these systems are required later.

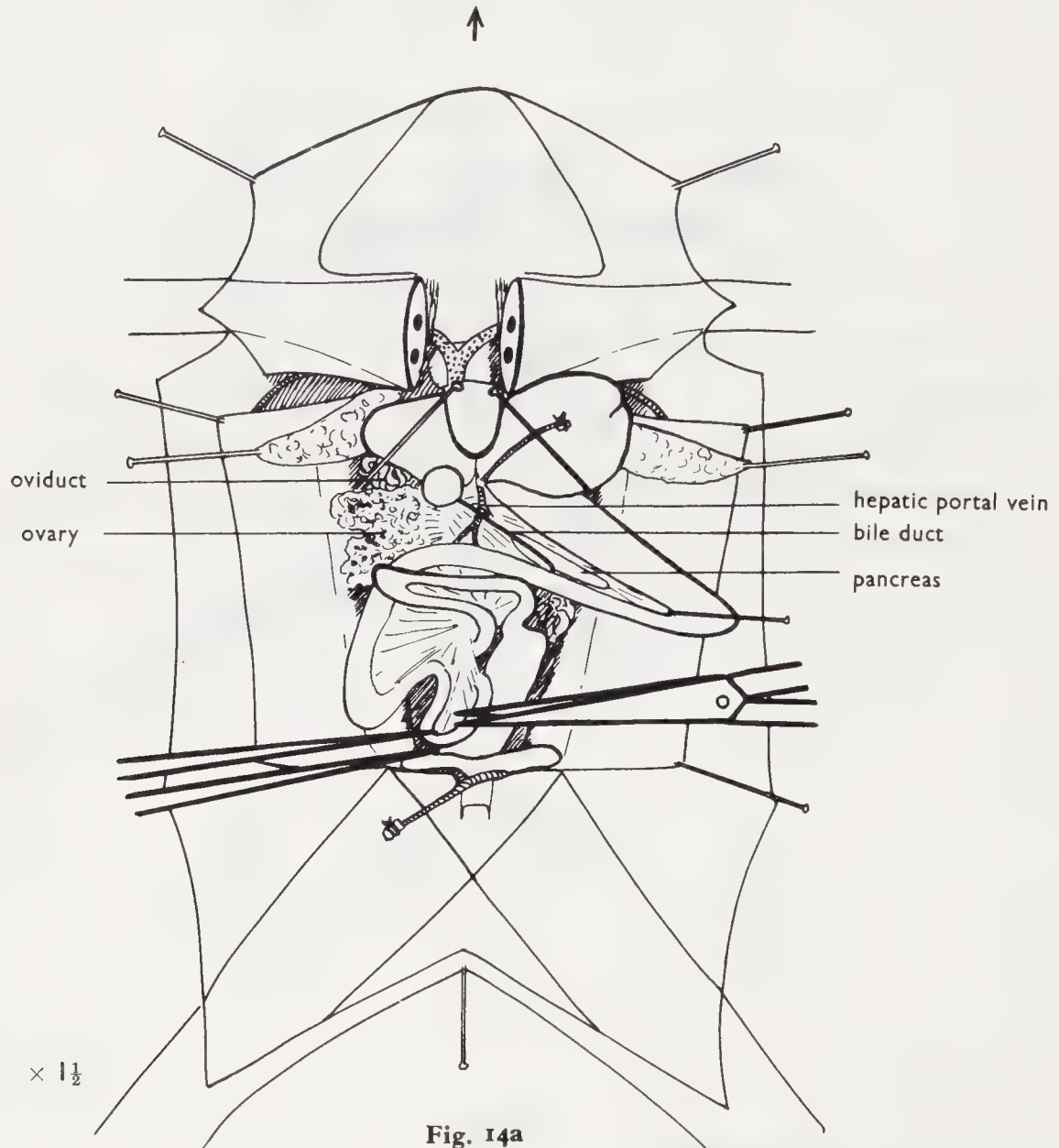


Fig. 14a
Female

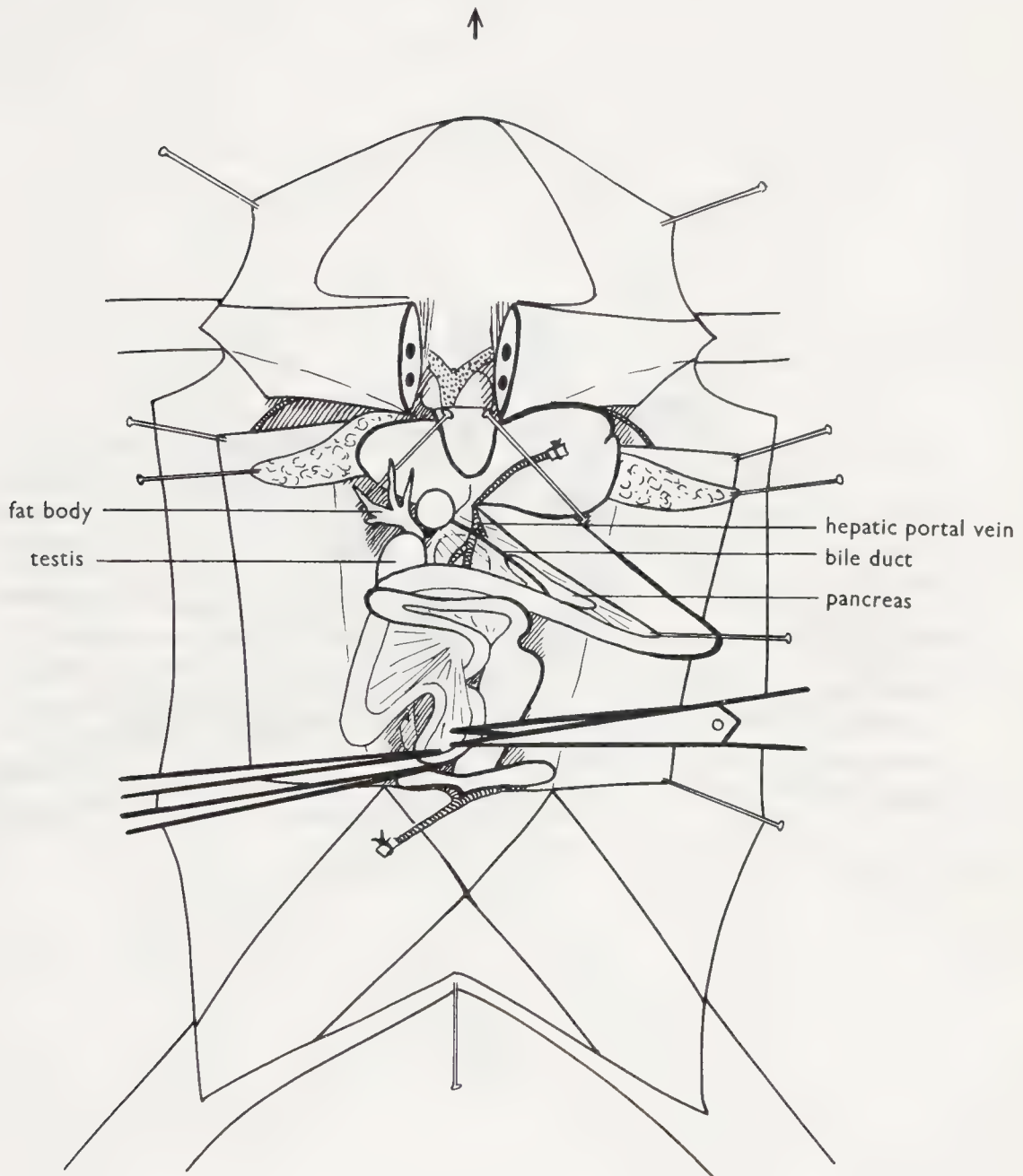
Pin out the stomach to **your right**.

Pin out the lungs. (The lungs may be distended with air by means of a blow-pipe inserted into the glottis and must not then be pinned.)

Turn the liver lobes forwards and hold them in place with pins **against** but not through the lobes. Adjust so that the heart is not obscured.

Grip the ileum and cut the mesentery to loosen the coils. **Do not cut the mesentery of the duodenum and the rectum.**

THE FROG—*The viscera (general)*



$\times 1\frac{1}{2}$

Fig. 14b

Male

Pin out the stomach to **your right**.

Pin out the lungs. (The lungs may be distended with air by means of a blow-pipe inserted into the glottis and must not then be pinned.)

Turn the liver lobes forwards and hold them in place with pins **against** but not through the lobes. Adjust so that the heart is not obscured.

Grip the ileum and cut the mesentery to loosen the coils. **Do not cut the mesentery of the duodenum and the rectum.**

THE FROG—*The viscera (general)*

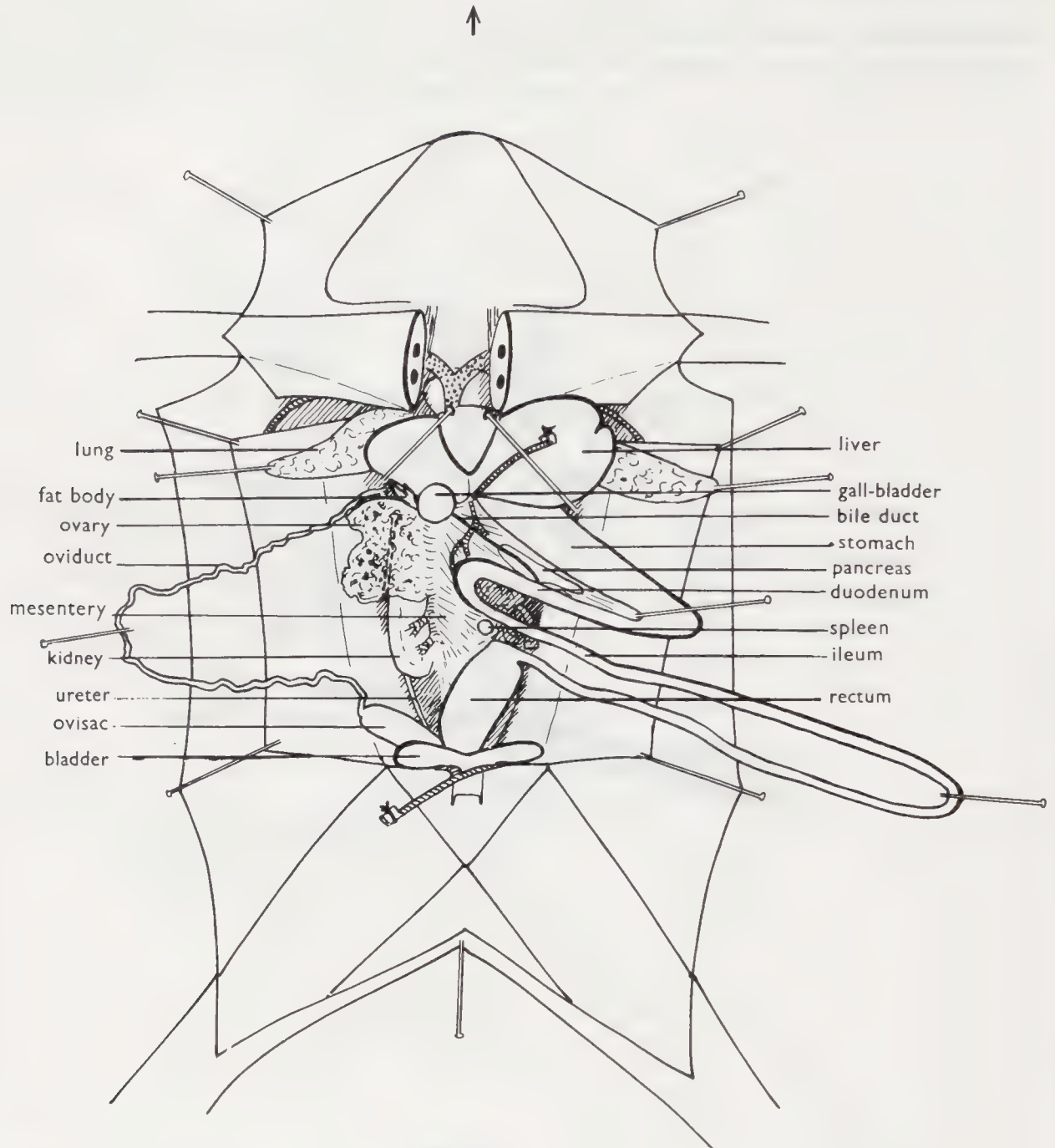


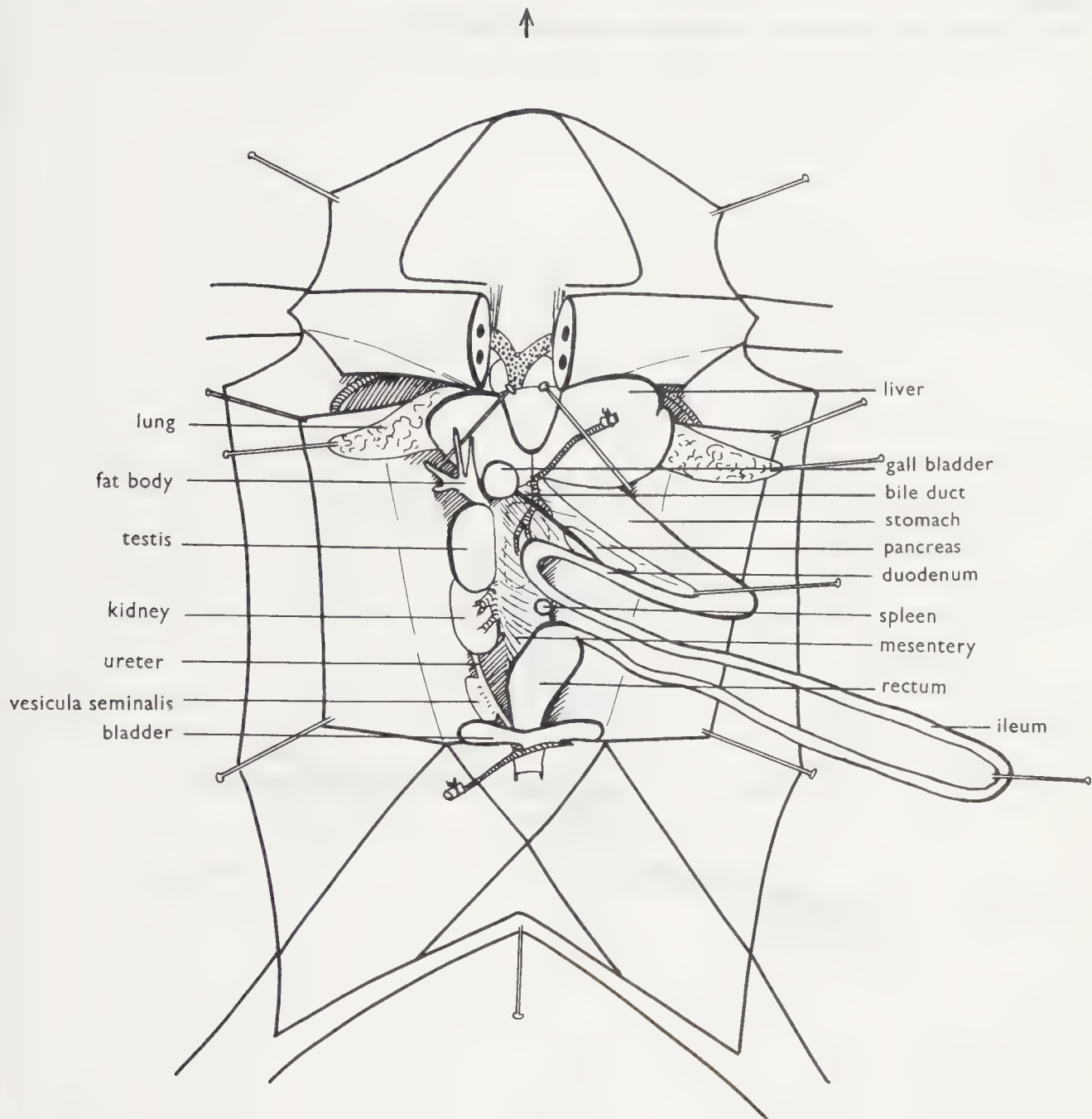
Fig. 15a
Female

Pin out the ileum to **your right**.

Loosen and pin out the right oviduct of the frog using the same technique as for the ileum. It may be necessary to pin aside the ovary to show the posterior part of the kidney.

DRAW

THE FROG—*The viscera (general)*



× 1½

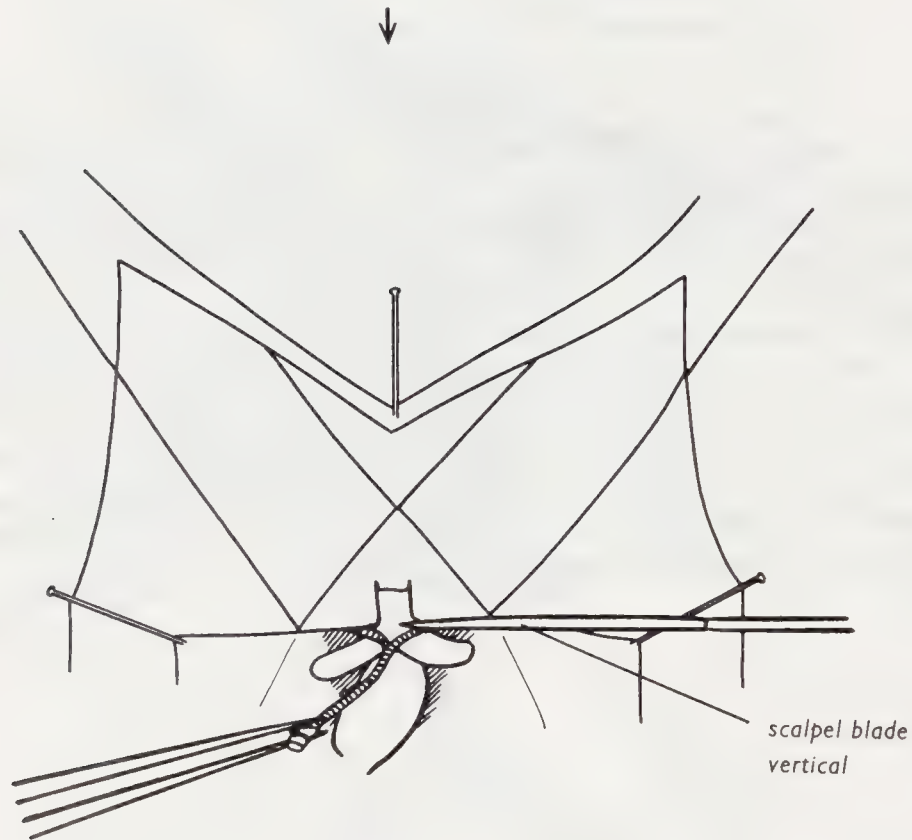
Fig. 15b
Male

Pin out the ileum to your right.
DRAW

THE FROG—3 The Urinogenital System

IN order to display this system completely the ventral portion of the pelvic girdle must be removed. If the veins are to be dissected later care must be taken to preserve the pelvic veins during the cutting of the pelvic girdle, see Figs. 16 & 17, and the opening up of the cloaca should be deferred until the veins are no longer required, see Figs. 36 & 37.

The alimentary canal must either be removed or be pinned well aside.



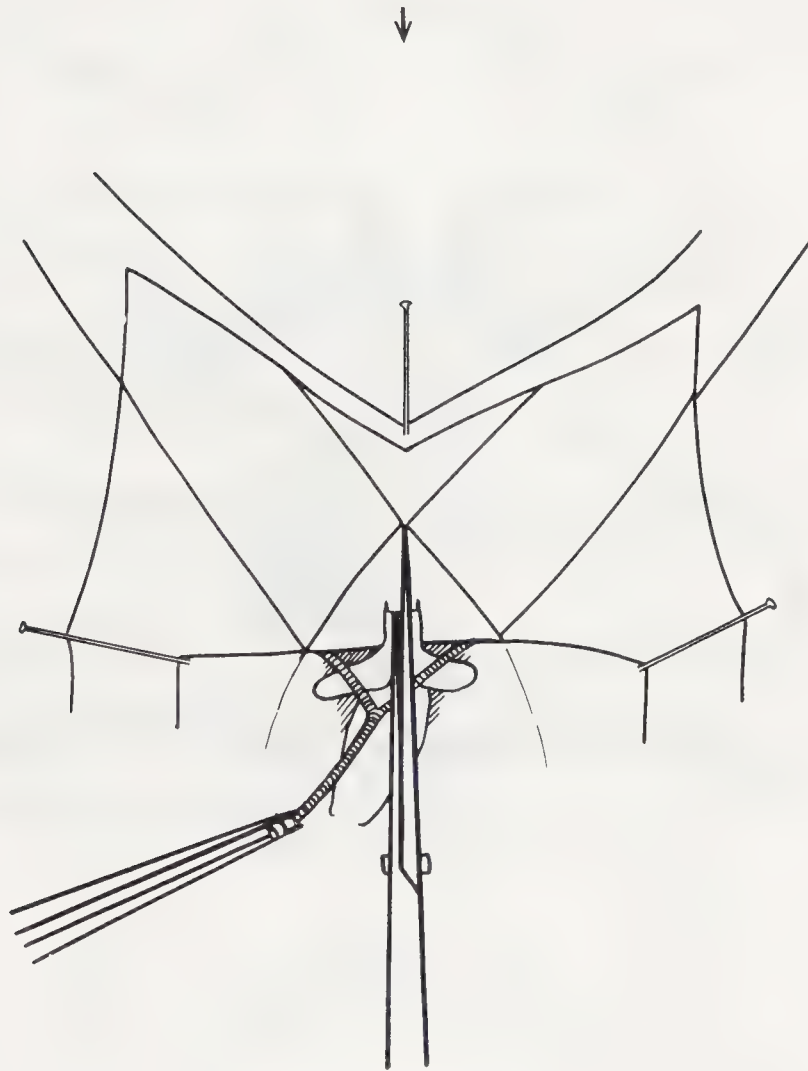
$\times 1\frac{1}{2}$

Fig. 16

Turn the dish so that the legs are directed away from you.

Grip the posterior part of the anterior abdominal vein and pull it away from the pelvic girdle. The pelvic veins should show clearly. Loosen these veins from the abdominal wall so that they can be pulled away from the pelvic region, see Fig. 17.

THE FROG—*The urinogenital system*



$\times 1\frac{1}{2}$

Fig. 17

Insert one blade of the scissors **through** the pelvic girdle.

Cut through the girdle as near to the mid-line as possible. Inevitably the blades will slip slightly to one side

Cut again in the corresponding position on the other side.

Remove the central portion of the girdle.

Move the pins from the feet and re-pin so that the gap is widened.

THE FROG—*The urinogenital system*

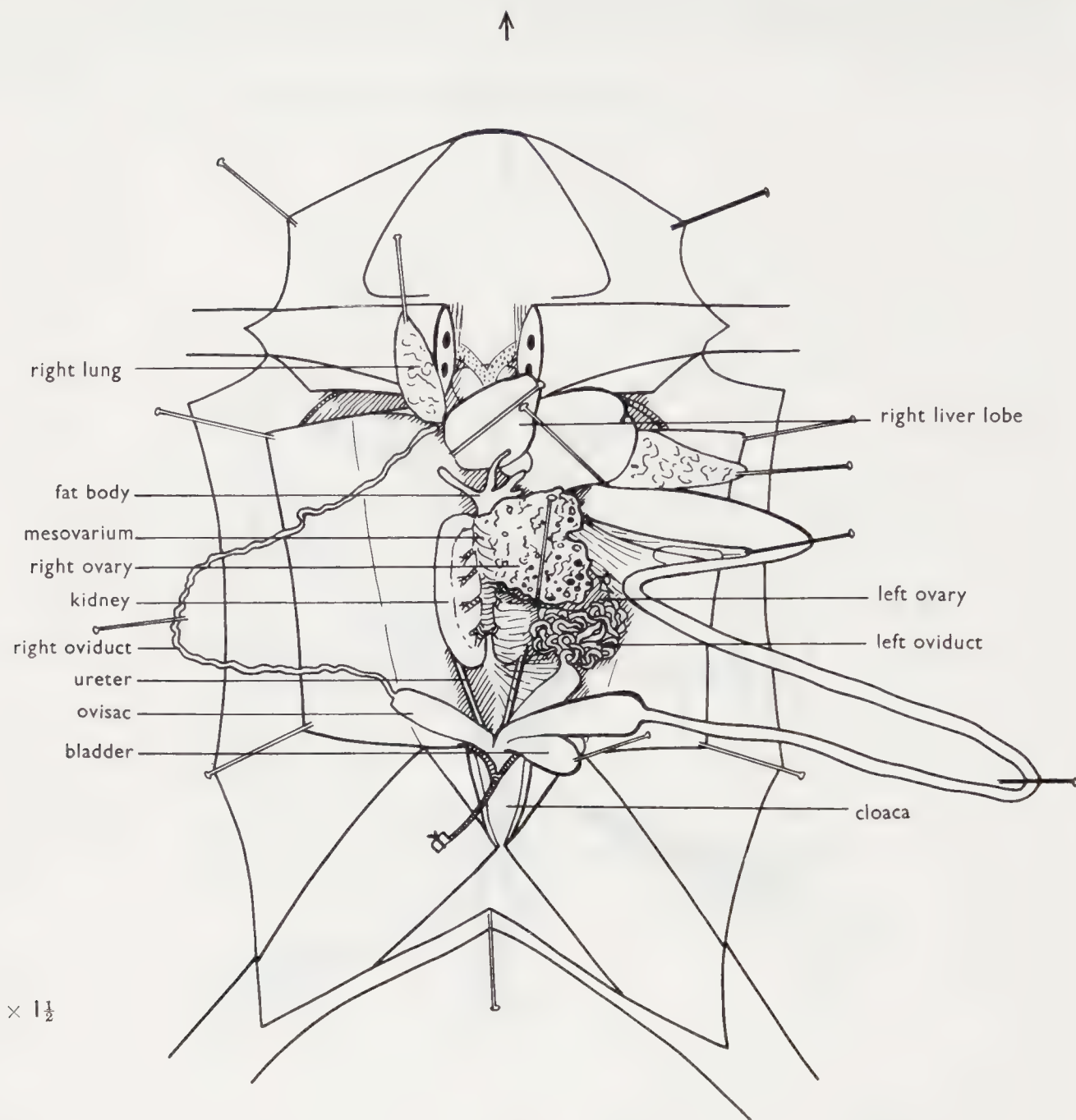


Fig. 18a

Female

Restore the dish to its original position.

Move the pins holding the right lung and the right liver lobe to the positions shown above.

Complete the loosening of the oviduct started in Fig. 15a. Observe the anterior end of the oviduct close to the base of the lung.

Pin the right ovary over on top of the left one.

Pin the bladder aside.

Cut the mesentery which holds the rectum. This is a continuation of the process started in Fig. 14a. Adjust the pins to hold the alimentary canal well aside.

DRAW

THE FROG—*The urinogenital system*

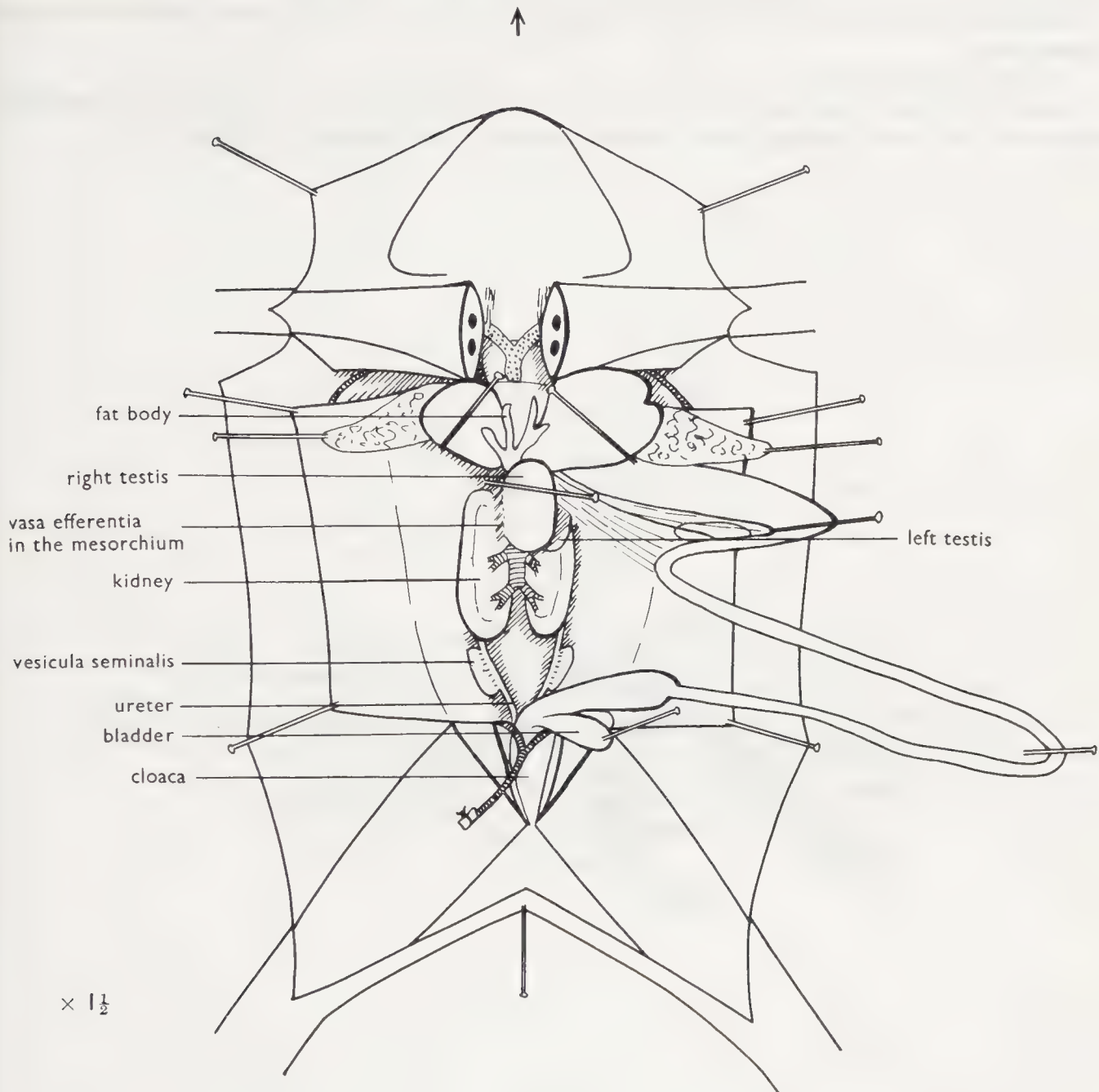


Fig. 18b

Male

Restore the dish to its original position.

Pin the right testis over on top of the left one, by means of a pin against but not through the testis.

Pin the bladder aside.

Cut the mesentery which holds the rectum. This is a continuation of the process started in Fig. 14b. Adjust the pins to hold the alimentary canal well aside.

DRAW

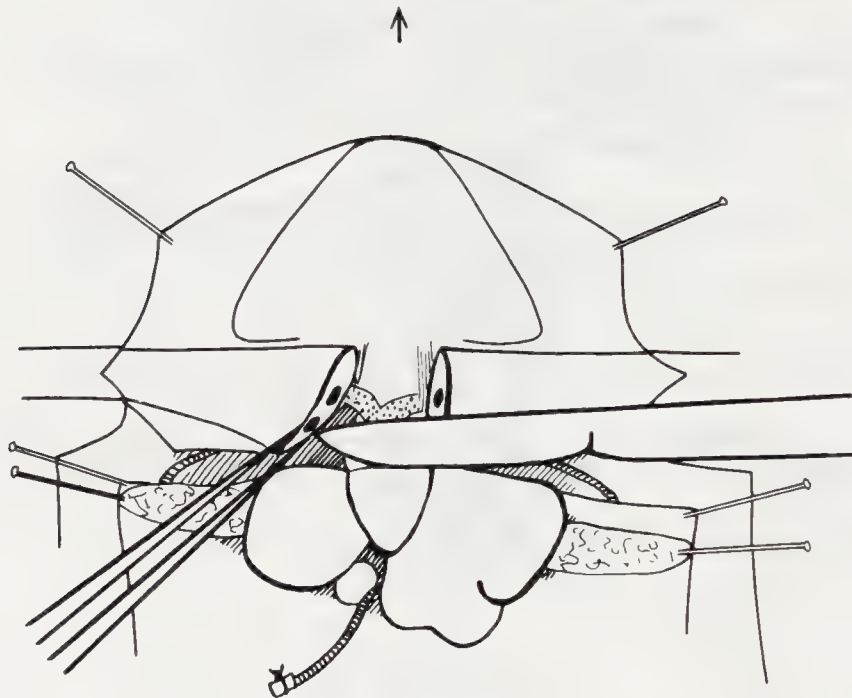
THE FROG—4 The Venous System

THE veins are easily recognised by their dark colour. This colour is due to (a) the pigmentation of their walls and (b) the thinness of these walls which allows the colour of the haemoglobin to shine through clearly.

When dissecting the venous system it is best to concentrate on the anterior and posterior parts of the system independently.

(a) The Anterior Veins

Note. If the viscera have been displayed remove the pins holding the liver, the ileum and the ovary and oviduct or the testis before starting to dissect the veins. Keep the lungs pinned out to the sides.

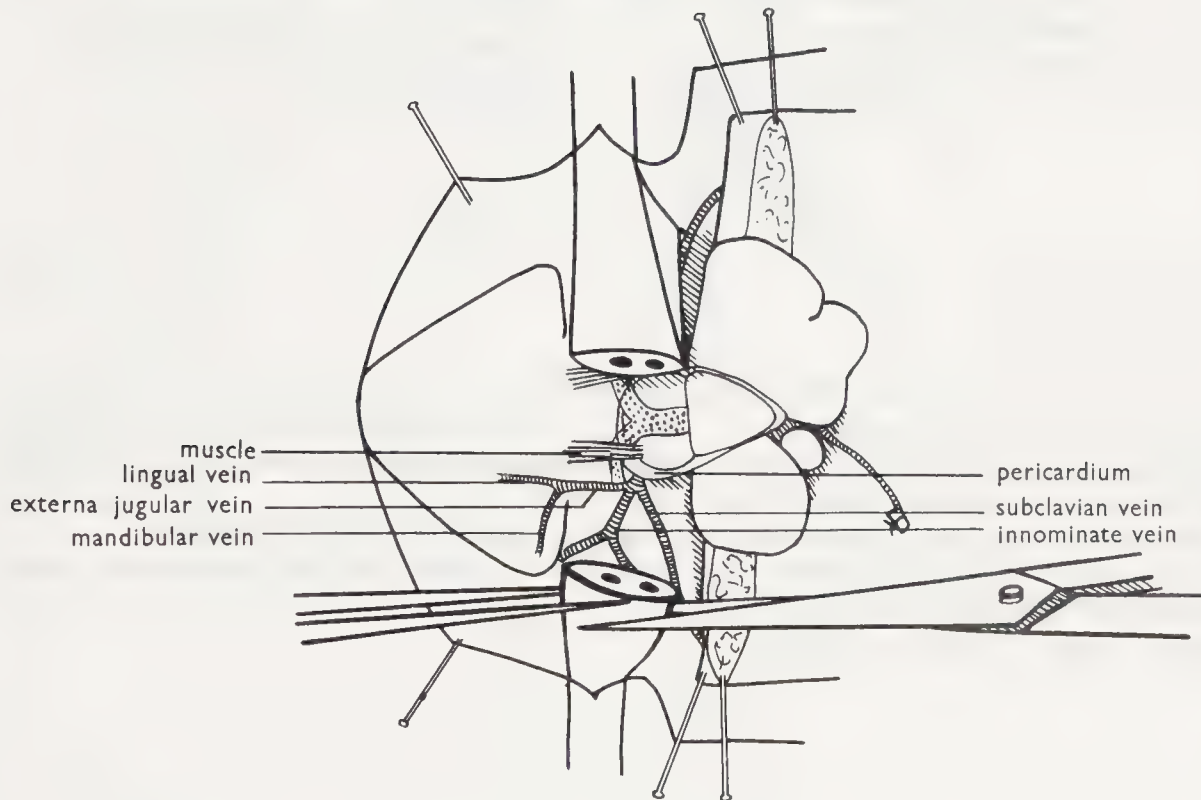


$\times 1\frac{1}{2}$

Fig. 19

Lift the cut edge of the pectoral girdle and loosen the tissue underneath, keeping as close to the pectoral muscles as possible and watching for the veins. See Fig. 20.

THE FROG—*The venous system*



$\times 1\frac{1}{2}$

Fig. 20

Turn the dish sideways.

Cut off the loosened piece of the pectoral girdle as close to the shoulder as possible, being careful not to cut the brachial vein. See Fig. 21.

Remove any muscle that remains overlying the anterior part of the heart and the roots of the arterial arches.

Repeat the operation on the other side.

THE FROG—*The venous system*

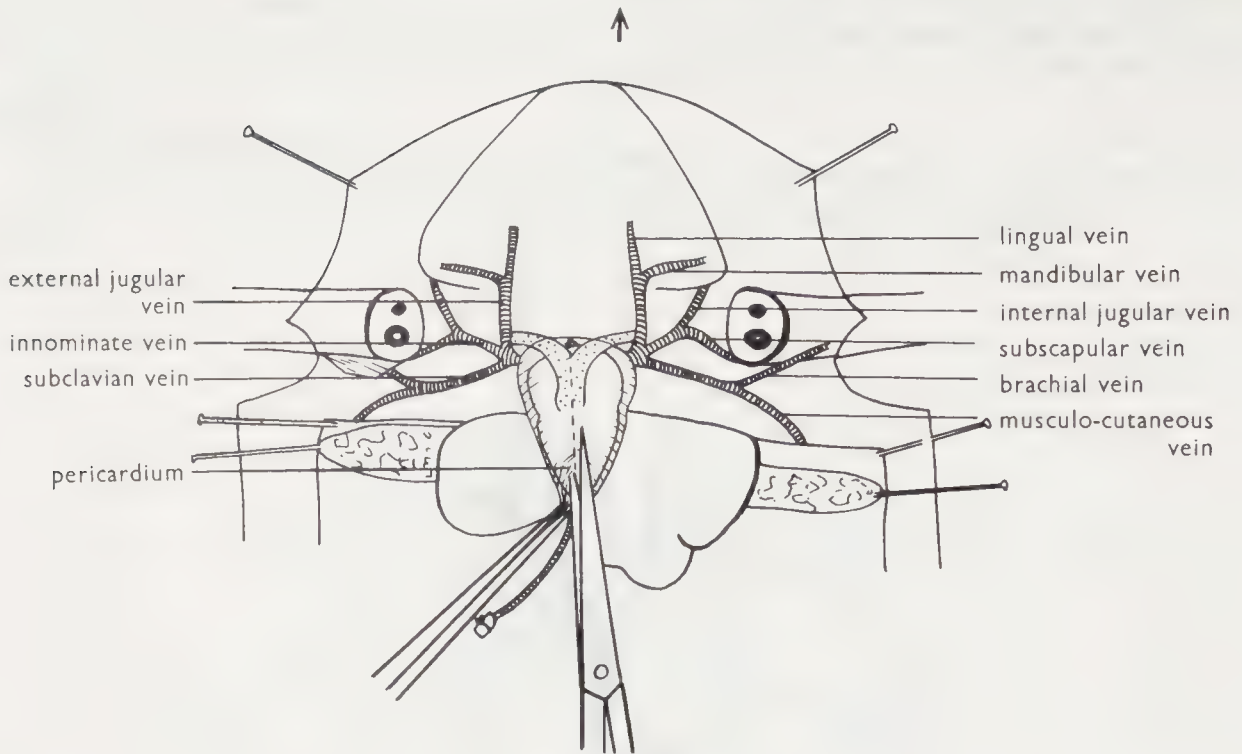


Fig. 21

Restore the dish to its normal position.

Identify the veins named in the figure above. Notice how the innominate vein comes 'up' ventralwards to meet the external jugular and subclavian veins.

Trace the brachial veins into the arms, removing connective tissue and muscle as required.

Remove any connective tissue still adhering to the other veins. To do this hold the tissue taut with forceps and cut with scissors as close as to the vessels as possible.

Slit up the ventral side of the pericardium.

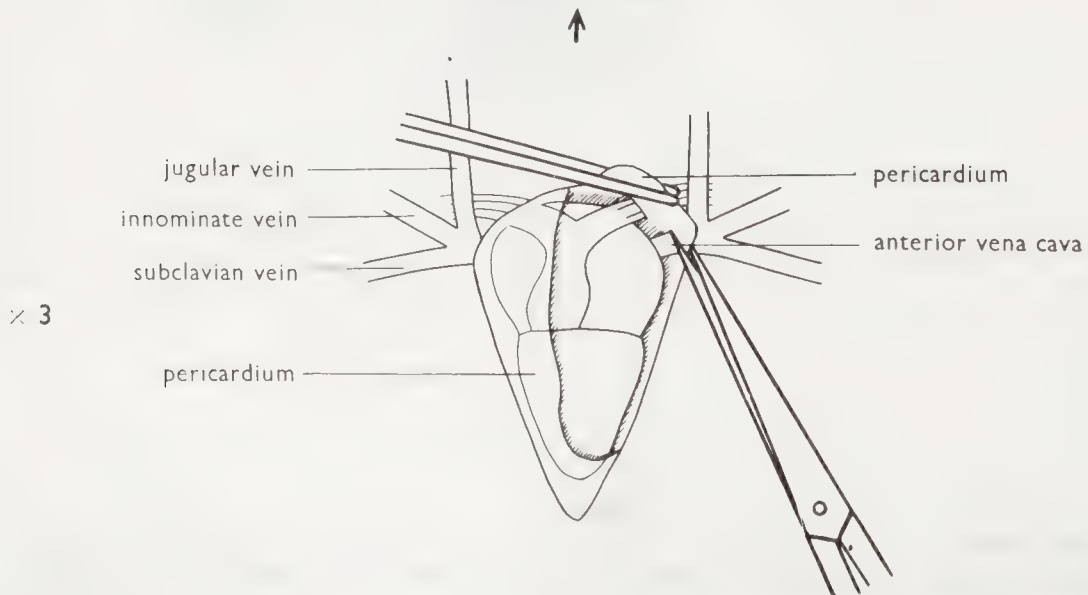


Fig. 22

Clear the pericardium carefully from the roots of the great blood vessels.

THE FROG—*The venous system*

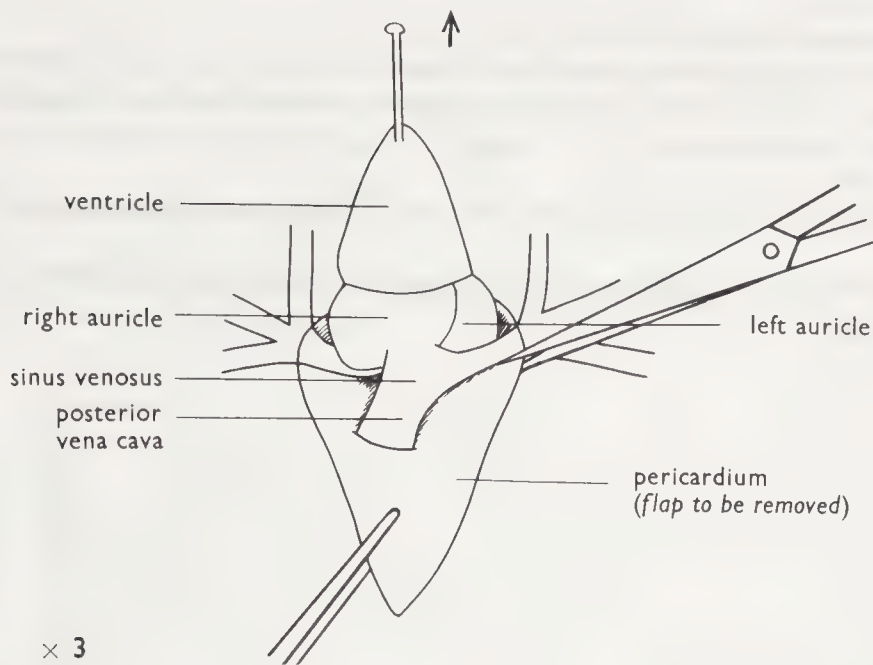


Fig. 23

Turn the heart forwards and fix it with a pin through the tip of the ventricle.
Remove the dorsal part of the pericardium.

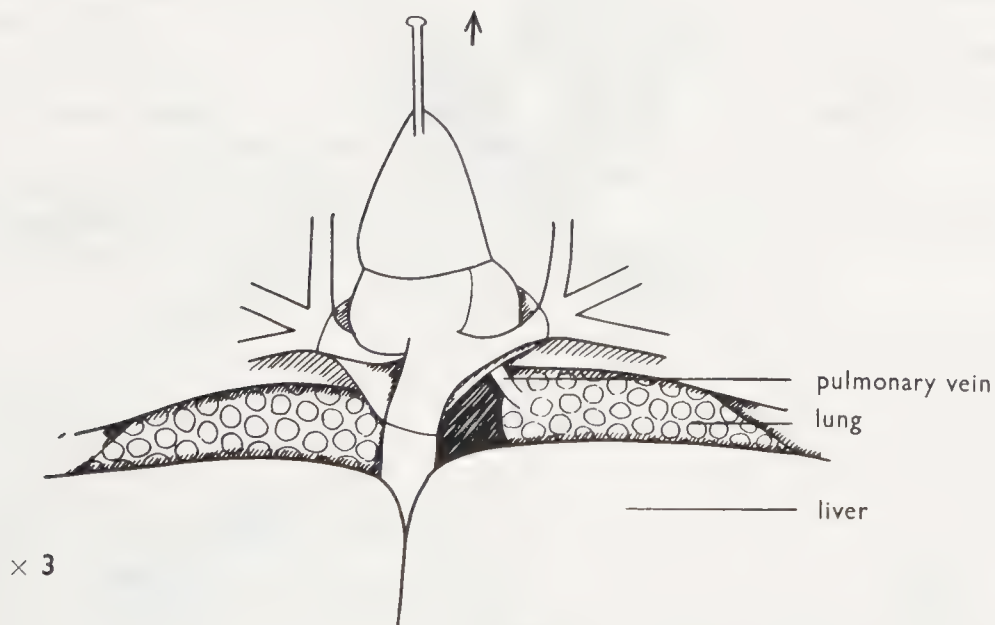


Fig. 24

The left pulmonary vein is now visible. The right pulmonary vein lies dorsal to the posterior vena cava and is therefore hidden. The complete dissection of these veins must be left until the posterior vena cava is no longer required.

THE FROG—*The venous system*

(b) The Veins of the leg

The dissection of the veins of the leg is shown in Figs. 25-31.

The femoral and sciatic veins run **between** the blocks of muscle in the leg. In order to make a tidy dissection it is important to keep each muscle as a unit. Separate the muscles from one another by means of a seeker and remove those of the front of the leg as shown in the diagrams. In each case cut the muscle neatly as close to its origin and insertion as possible.

In order to clarify the descriptions the muscles are named but it is not generally necessary for the student to remember these names.

N.B. If the pelvic girdle has not already been cut, see Figs. 16 & 17, this **must** be done now.

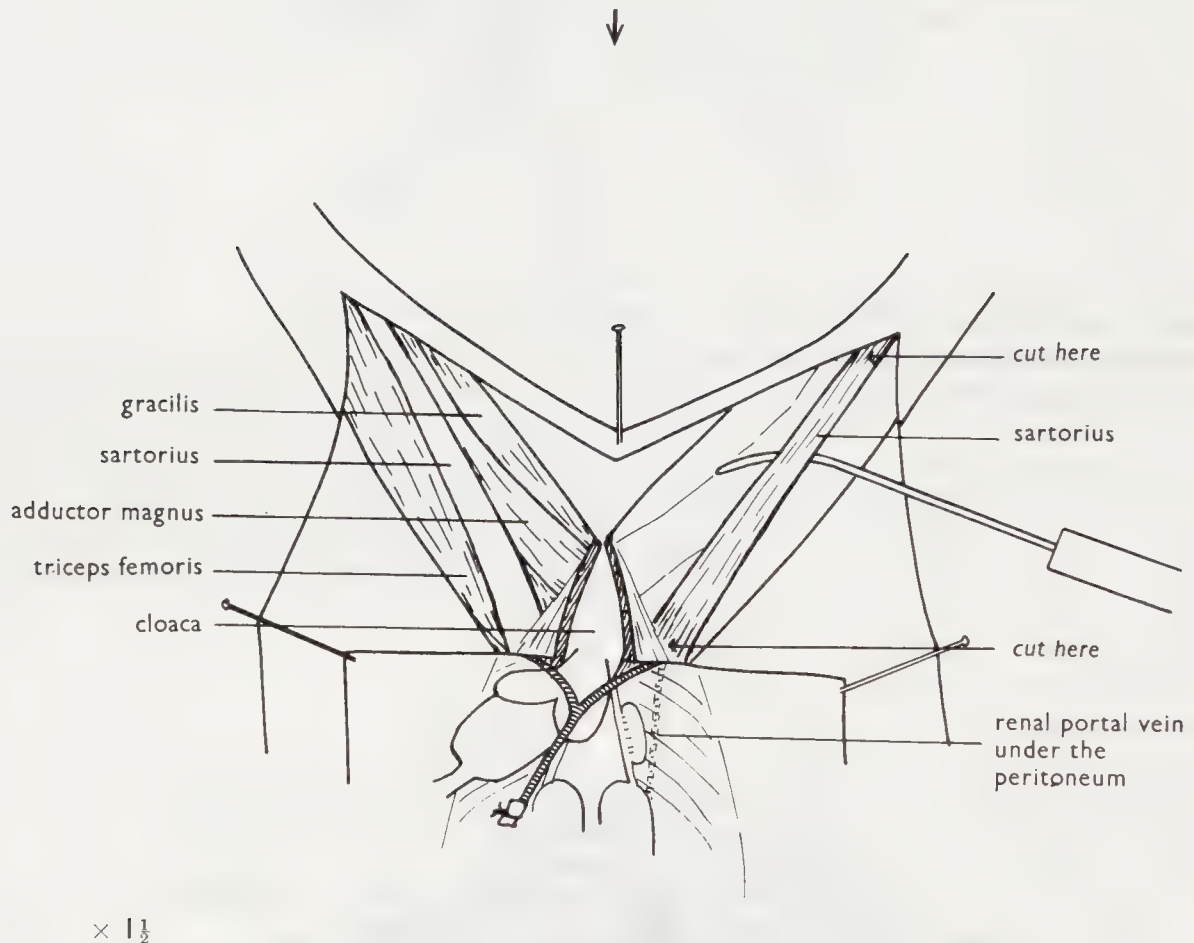


Fig. 25

Turn the dish so that the legs are directed away from you.

Identify the principal superficial muscles of the front of the thigh.

By means of a seeker separate the sartorius from the underlying muscle. Cut it at the pelvis and at the knee. The removal of the sartorius exposes the adductor longus, see Fig. 26.

THE FROG—*The venous system*

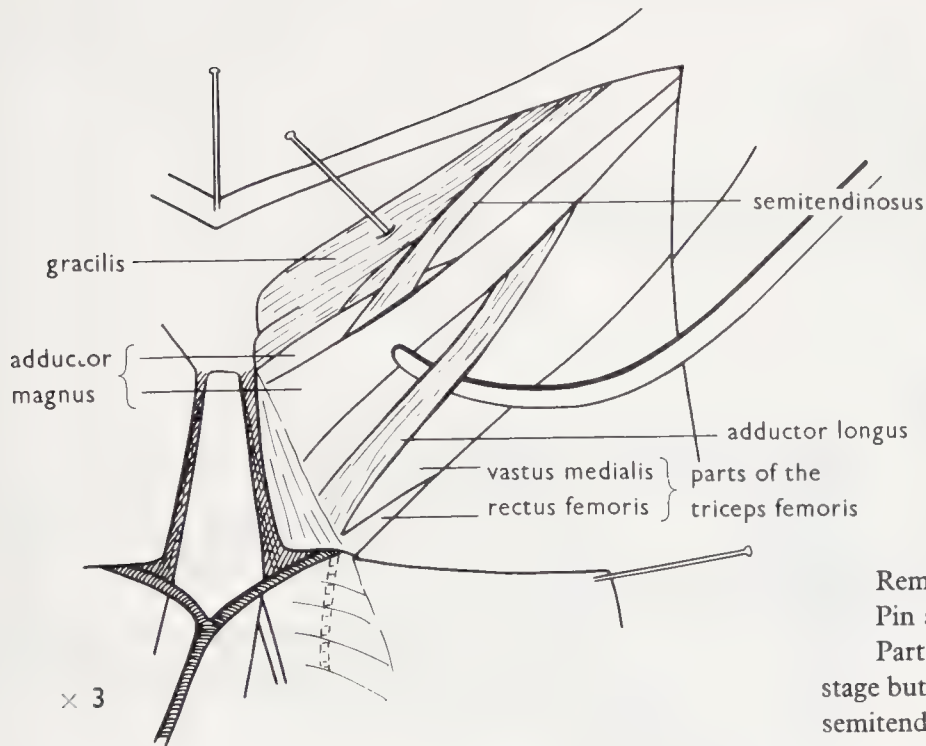


Fig. 26

Remove the adductor longus.

Pin aside the gracilis muscles.

Part of the sciatic vein may be visible at this stage but it is usually masked by the two heads of the semitendinosus muscle. Remove this muscle, cutting both heads and noticing the sciatic vein then exposed, see Fig. 27.

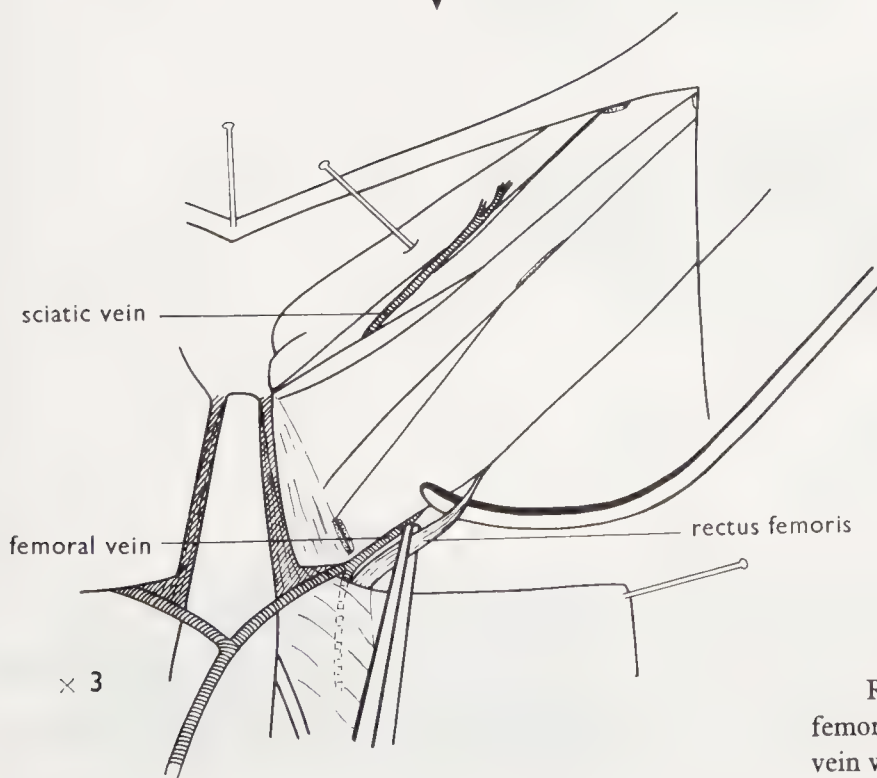


Fig. 27

Remove the rectus femoris portion of the triceps femoris muscle, taking care not to cut the femoral vein which lies beneath it.

THE FROG—*The venous system*

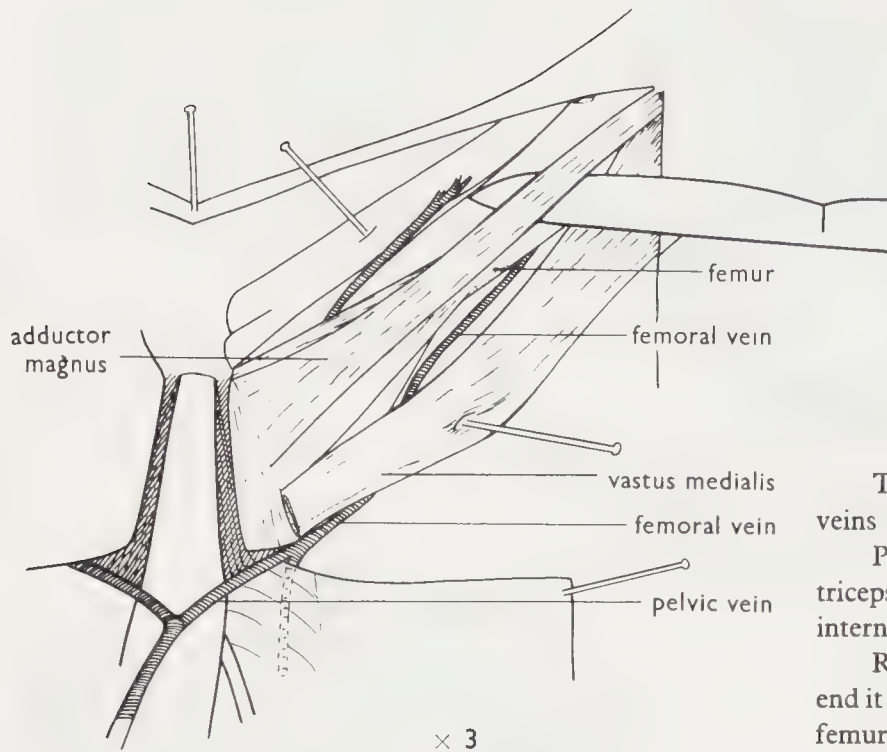


Fig. 28

The junction between the femoral and pelvic veins can be seen.

Pin back the vastus medialis portion of the triceps femoris. Notice the femoral vein lying internal to it in the leg.

Remove the adductor magnus. At the distal end it will be necessary to scrape the muscle from the femur with a scalpel.

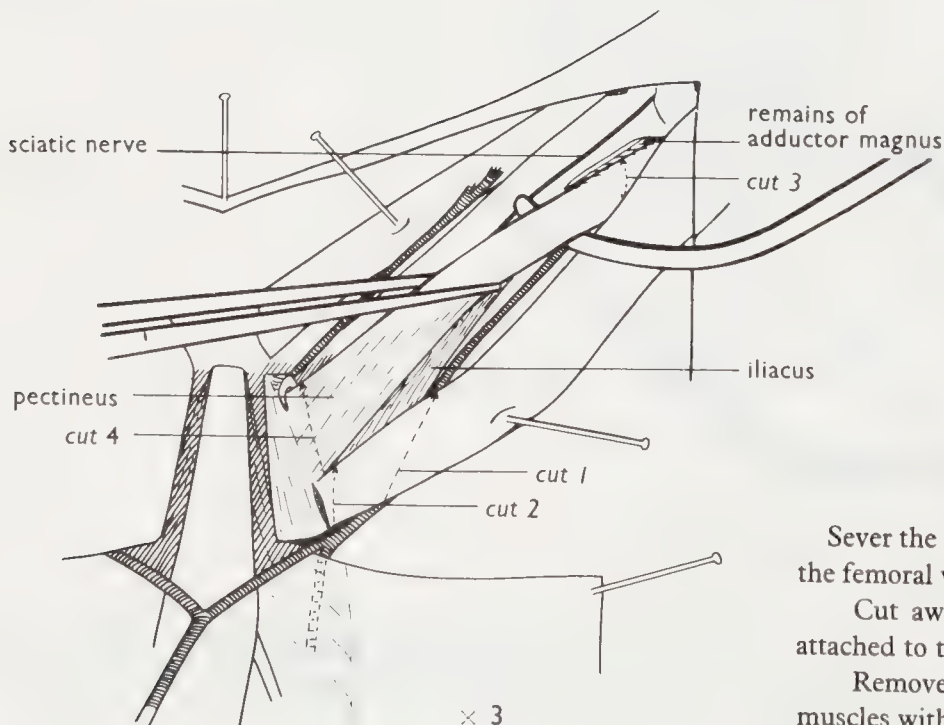
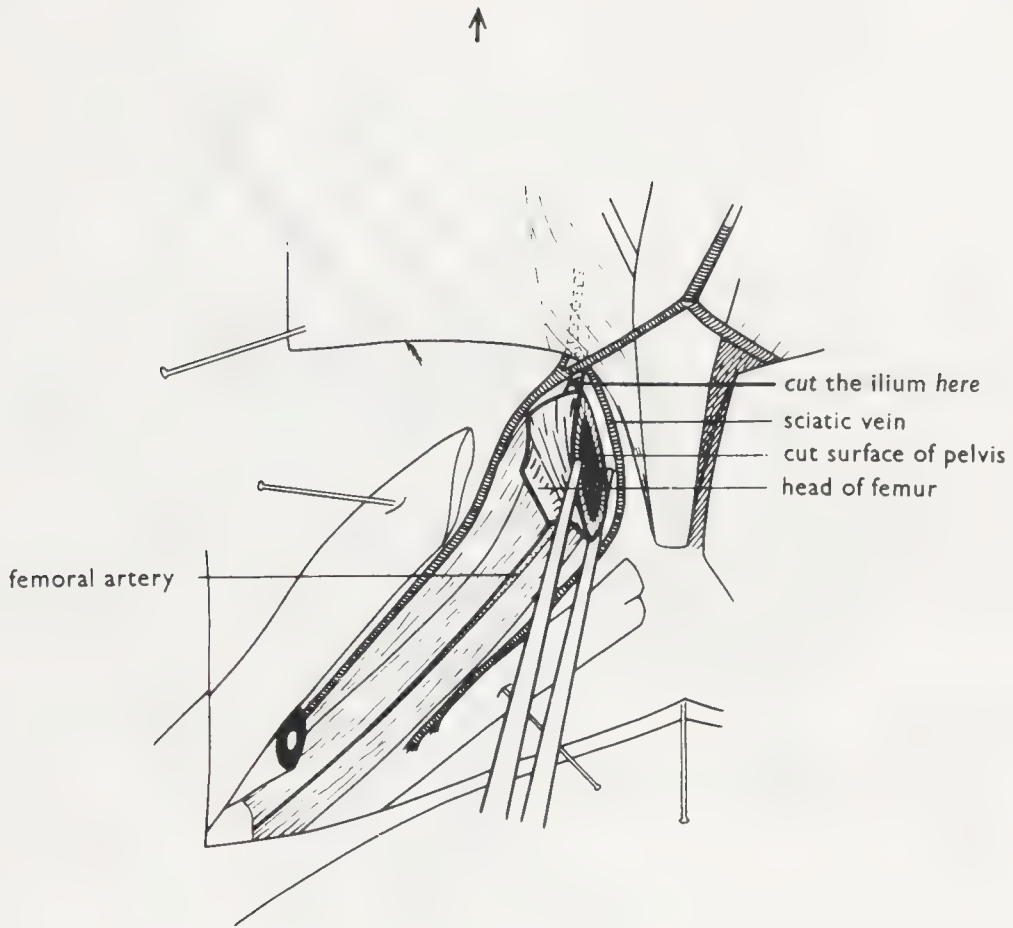


Fig. 29

Sever the vastus medialis:—cut 1 in figure. Follow the femoral vein while making this cut.

Cut away the piece of muscle which remains attached to the pelvic girdle:—cut 2 in figure.

Remove the femur (and the pectineus and iliacus muscles with it):—cuts 3 & 4.



× 3

Fig. 30

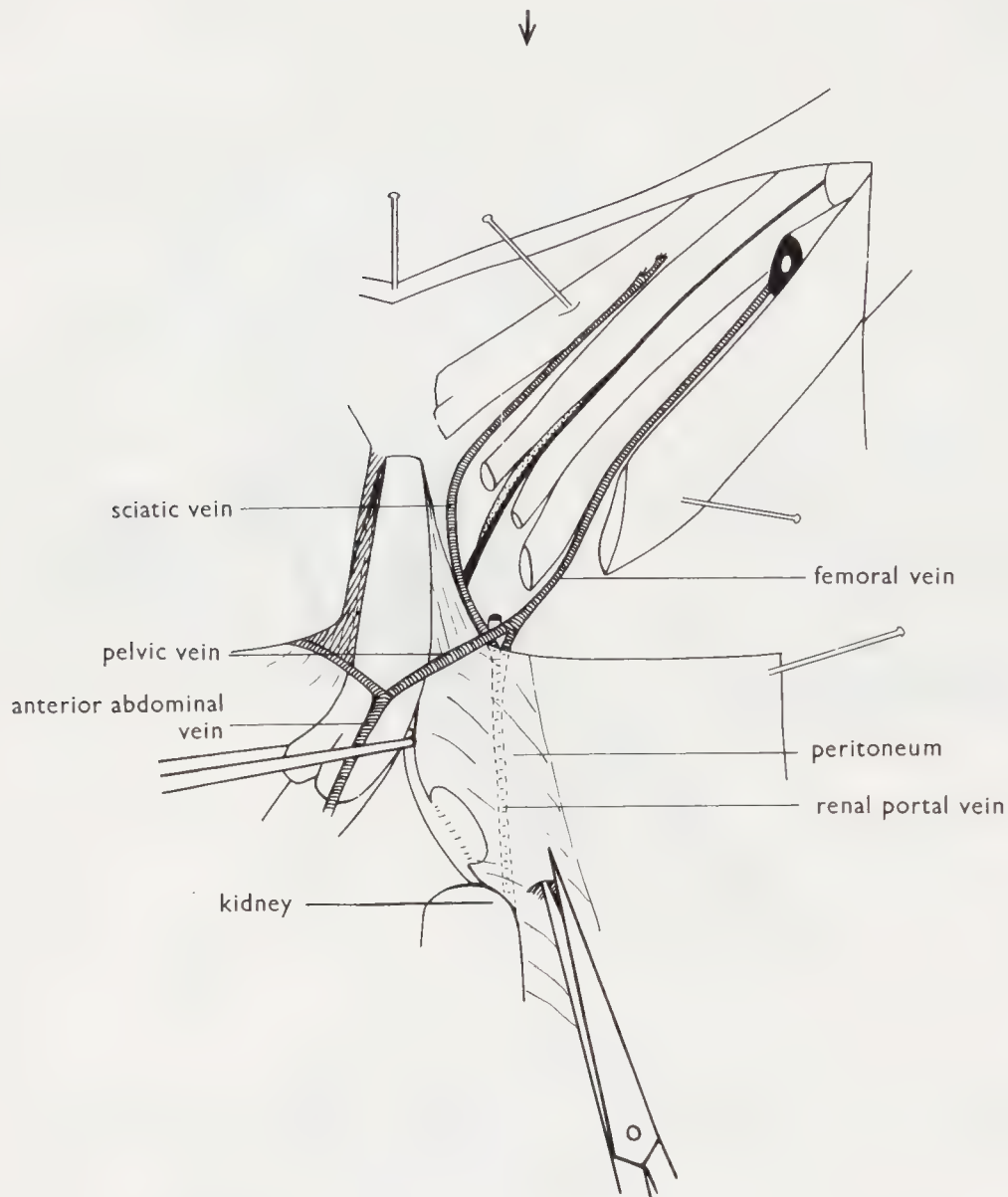
Turn the dish round.

Hold aside the block of tissue consisting of the wall of the acetabulum, the head of the femur and some muscle adherent to the remains of the pelvic girdle.

Trace the sciatic vein through the pelvic girdle, close to the cloaca.

Cut the ilium in the position indicated. Remove the block of tissue so loosened, cutting the muscles at the back of the leg as required and taking care not to cut the sciatic nerve and femoral artery if these are wanted later.

THE FROG—*The venous system*



× 3

Fig. 31

Turn the dish again.

Hold aside the rectum and the bladder (and the ovisac in the female). Cut the peritoneum to uncover the renal portal vein where it runs through the large abdominal lymph sac.

Clean the connections of the blood vessels as required. Hold the loose pieces of connective tissue taut with forceps and cut with scissors as close to the vessels as possible. (If the previous parts of the dissection have been done tidily there will be very little loose connective tissue left.)

Repeat Figs. 25-31 on the other side.

THE FROG—*The venous system*

(c) The Complete System.

To complete the study of the venous system the posterior vena cava and the hepatic portal veins must be displayed. The tributaries of the latter are supported by the mesentery of the alimentary canal and will not show clearly if too much of this mesentery has been cut away. It is usually found that if the stomach and duodenum are left in place the rest of the intestine may be removed.

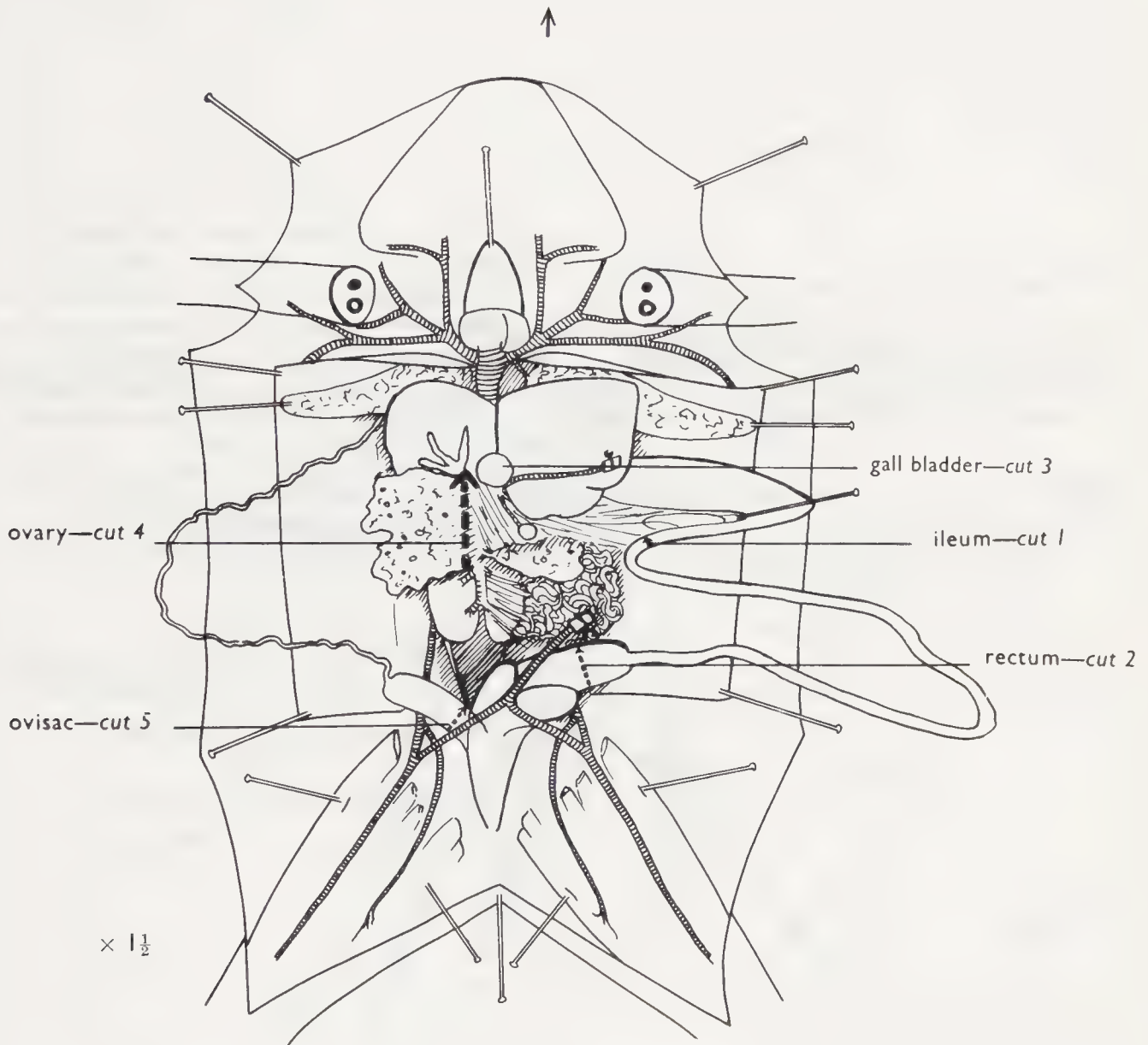


Fig. 32

Cut through the ileum—cut 1—and through the rectum about half way along its length—cut 2. Remove the piece of intestine between these cuts.

Remove the gall bladder taking care not to injure the liver—cut 3.

Remove the right ovary and fat body—cut 4.

Remove the right oviduct by cut 5 through the ovisac and pulling away the anterior end. Move the lung temporarily if necessary.

Pin the stomach temporarily to the other side and remove the left ovary and oviduct. Restore the stomach to the position shown above.

Note. In the male frog perform cuts 1, 2 and 3. Then remove the testes and fat bodies using cuts similar to cut 4 above.

THE FROG—*The venous system*

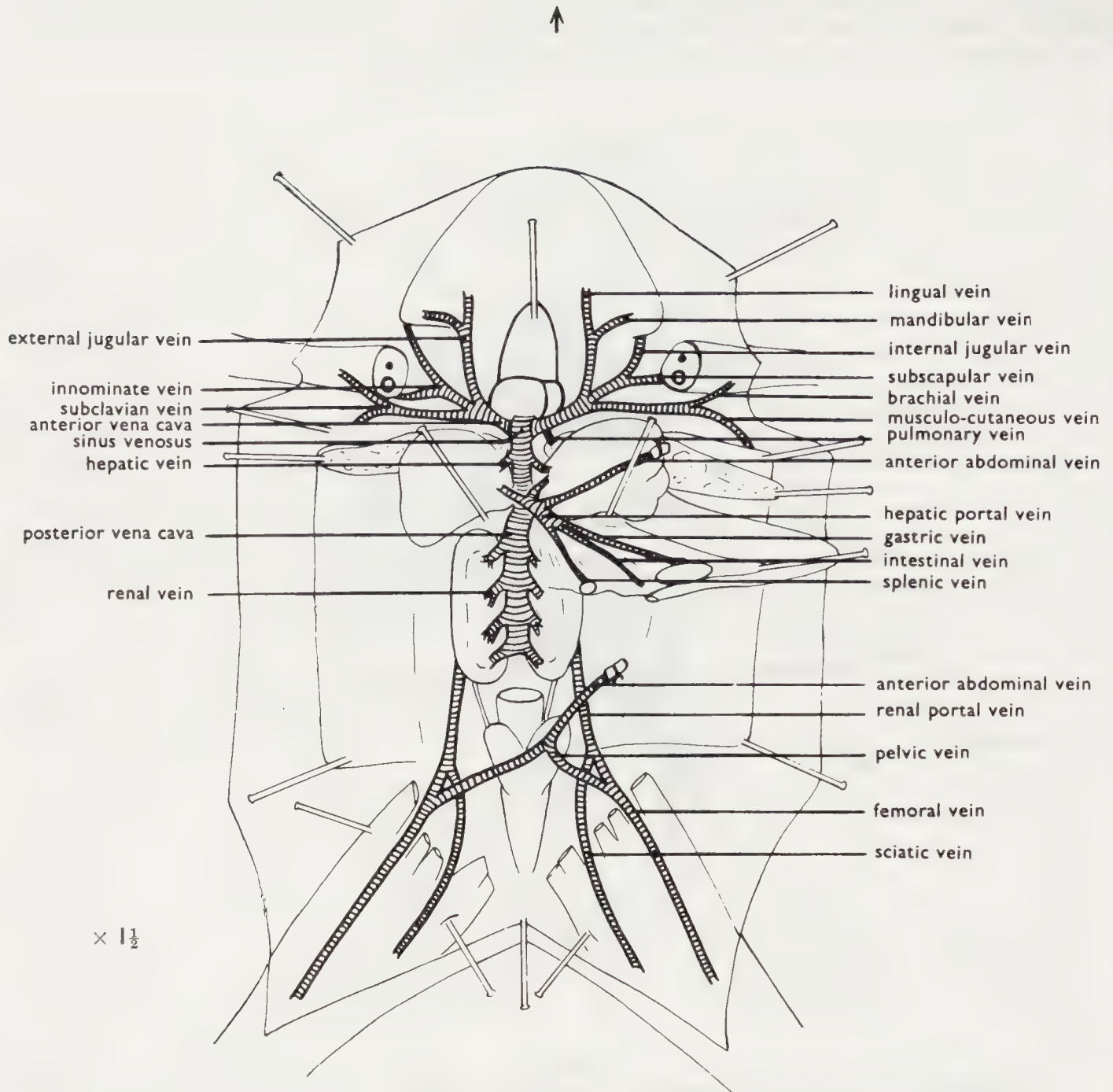


Fig. 33

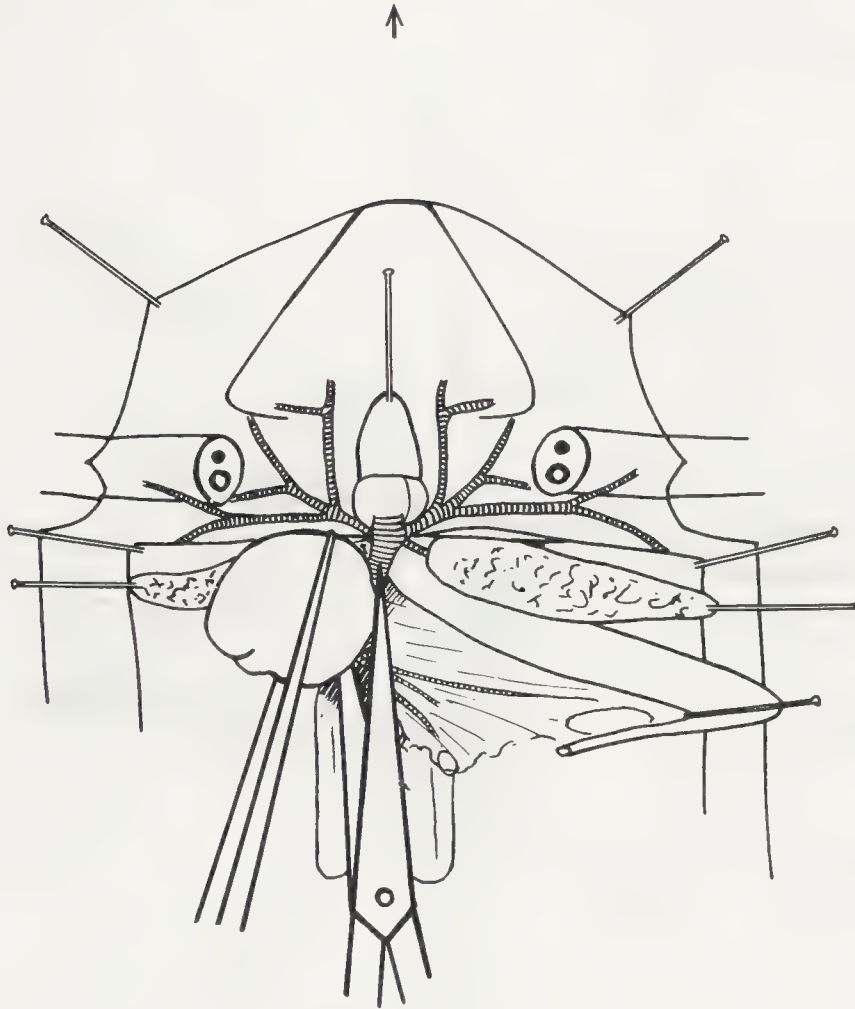
Place pins to hold the liver lobes apart, but do not pin through the liver tissue. The branching of the hepatic portal vein to the two sides of the liver and the two hepatic veins should be visible but a short length of the posterior vena cava will be masked by the liver tissue.

DRAW

THE FROG—*The venous system*

(d) The Pulmonary Veins.

As noted already (see Fig. 24) the posterior vena cava must be removed if these veins are to be displayed fully. It is best to remove the liver at the same time.



$\times 1\frac{1}{2}$

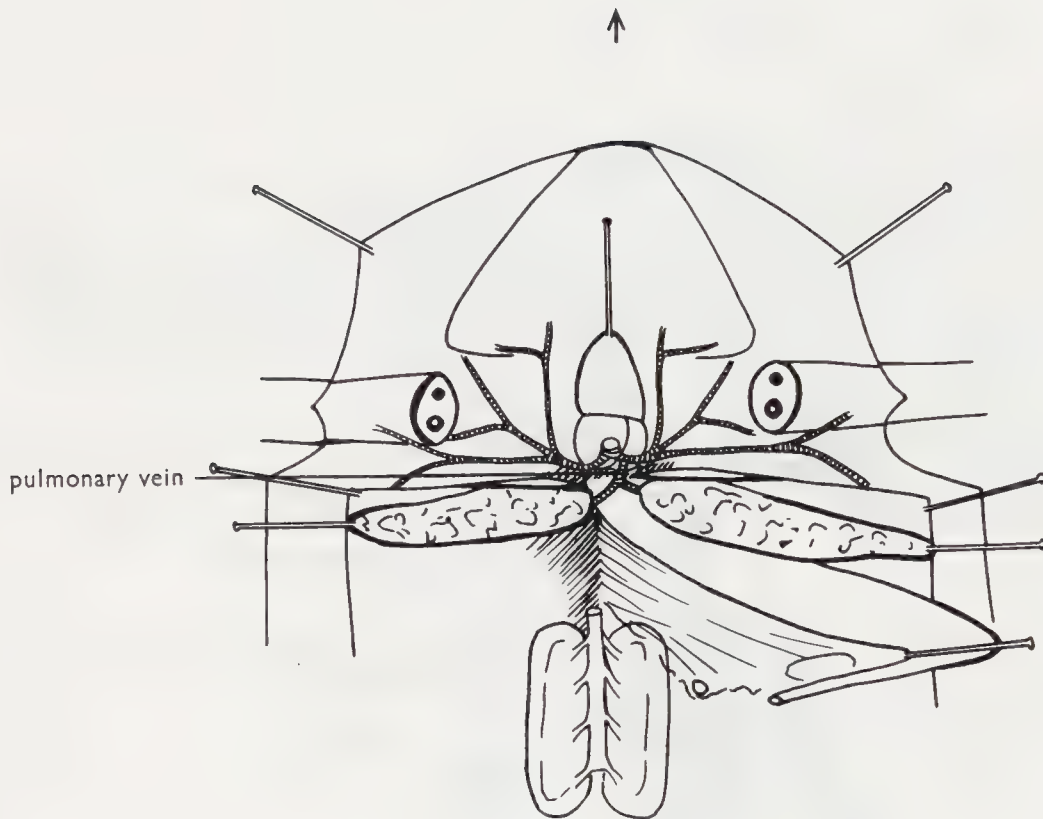
Fig. 34

Remove the pins holding the liver.

Cut away the liver and the anterior portion of the posterior vena cava with it.

Note. Considerable bleeding will occur. The sinus venosus, right auricle and the venae cavae and their tributaries will empty. The veins can however still be traced easily owing to the pigment in their walls.

THE FROG—*The venous system*



$\times 1\frac{1}{2}$

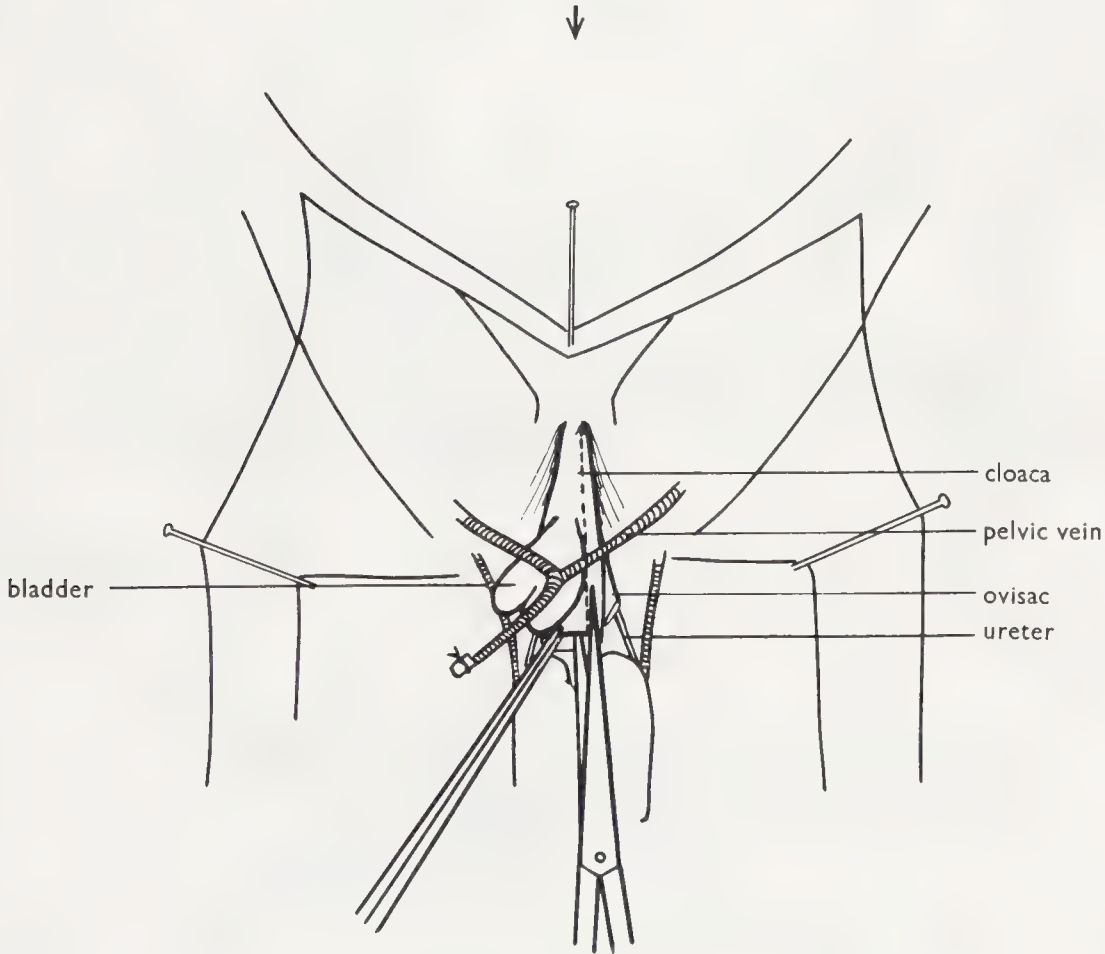
Fig. 35

Notice the pulmonary veins and their connection with the left auricle. Clear away connective tissue as required.
DRAW

THE FROG—5 The Cloaca

THE urinogenital ducts open into the cloaca. Therefore the opening up of the latter to show these apertures rightly forms part of the dissection of the urinogenital system. As explained previously however this process involves cutting the pelvic veins and must not be performed till the veins are no longer required. It should be completed before dissecting the arterial or nervous systems because for both of these it is best to remove the cloaca completely.

Note. If the venous system has not been dissected be sure that the halves of the pelvic girdle are pinned well apart before opening the cloaca.



$\times 1\frac{1}{2}$

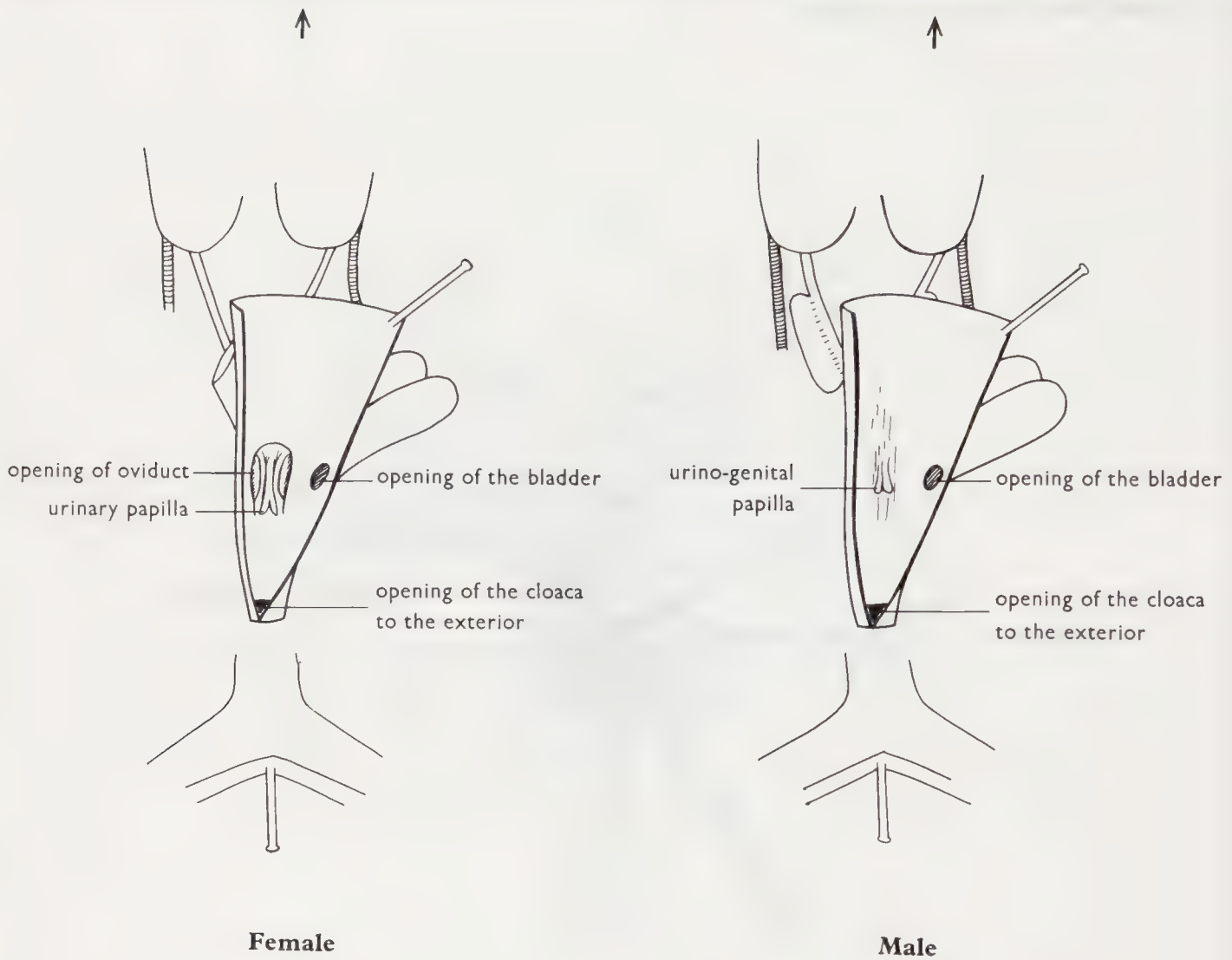
Fig. 36

Turn the dish so that the legs are directed away from you.

Cut down one side of the rectum and cloaca as far as the cloacal aperture. The pelvic vein is cut during this process.

Note. The female is shown above but the course of the cut is identical in the male.

THE FROG—*The cloaca*



× 3

Fig. 37a & 37b

Turn the dish back to its original position.
Pin the cloaca open and examine its interior.
DRAW

THE FROG—6 The Arterial System

ARTERIES may be distinguished from veins most readily by their much paler colour due chiefly to the greater thickness of their walls. Also the walls of the arterial arches are usually unpigmented or only sparingly pigmented.

In order to study the arterial system most of the veins must be removed. If the nerves are required later the arterial system must not be dissected on both sides as some of the nerves are also removed.

(a) The Aorta and its Branches.

If the venous system has not been dissected it will be necessary to remove the muscles of the front of the leg in order to display the femoral artery.

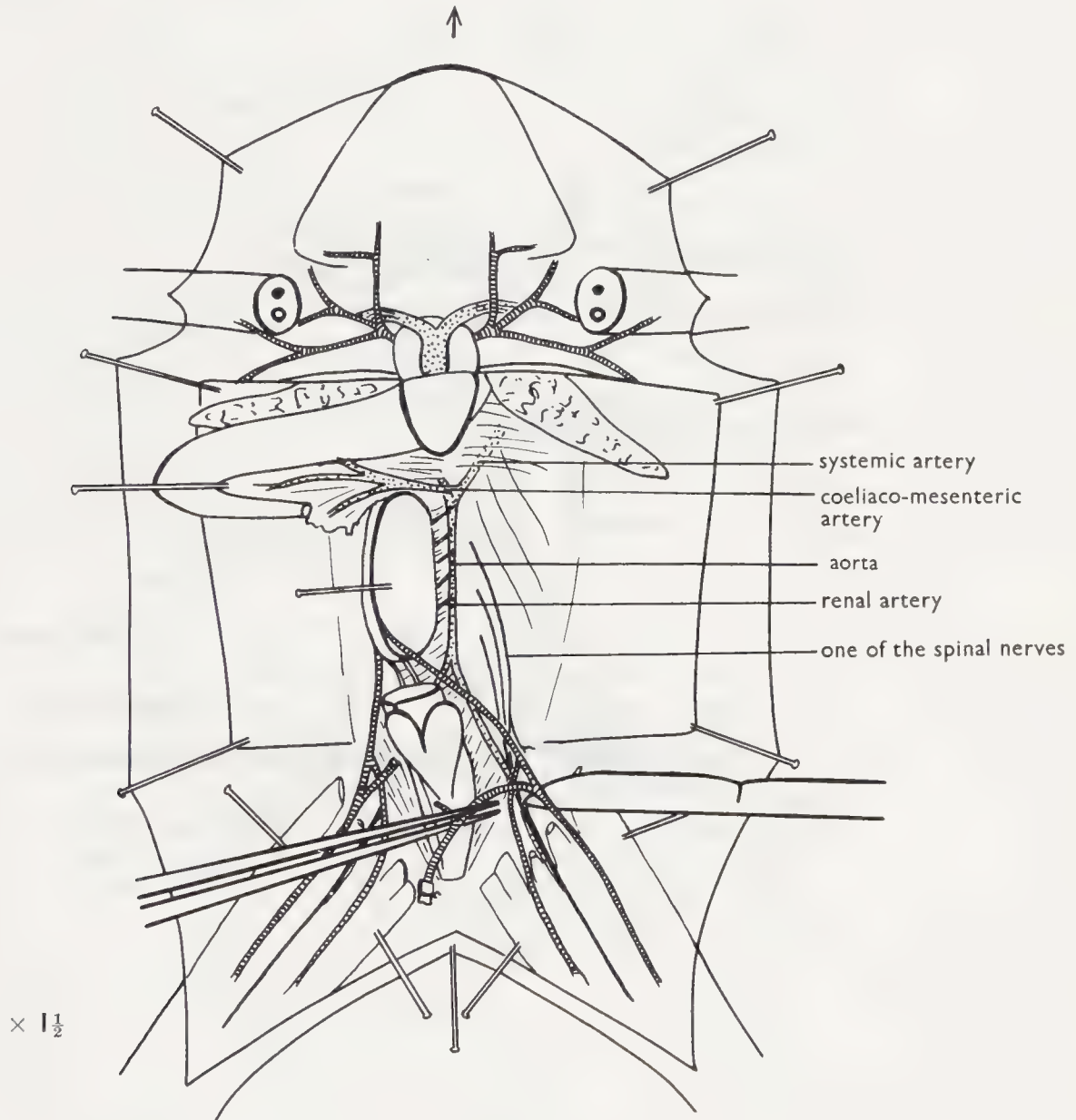


Fig. 38

Remove any pins which may be holding the viscera.

Pin the stomach out to your left to show the coeliaco-mesenteric artery.

Pin the kidneys to your left to show the aorta and the renal arteries.

Note. The arteries may be displayed on the other side but in that case the posterior vena cava must be removed to show the origin of the coeliaco-mesenteric artery from the **left** systemic arch.

Loosen and remove the femoral, sciatic and renal portal veins, lifting each in turn with forceps and cutting the connective tissue round it with a scalpel.

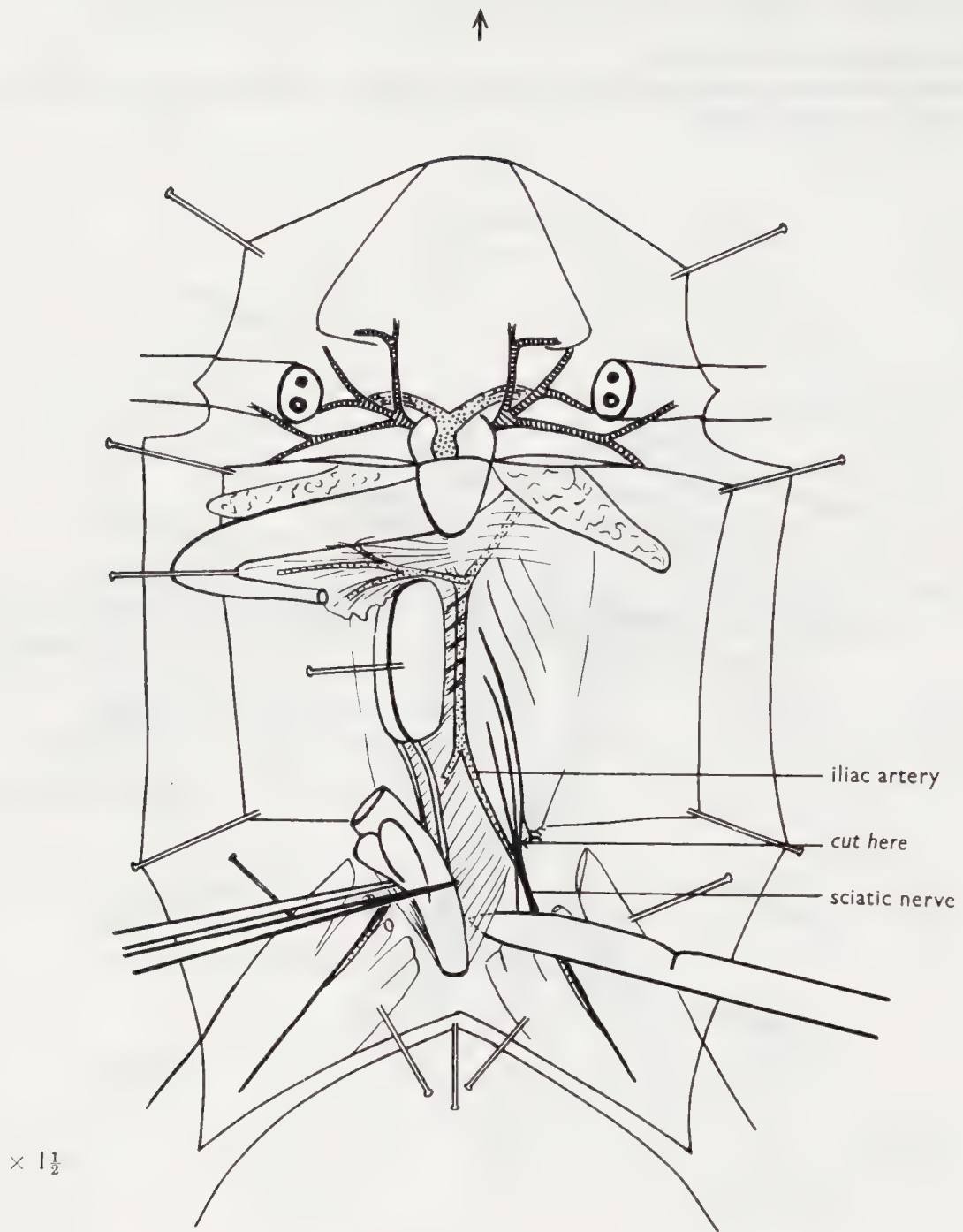


Fig. 39

Remove the cloaca, bladder and ureters.

Remove any remaining connective tissue around the iliac veins, gripping the connective tissue with forceps and cutting with a scalpel while under tension.

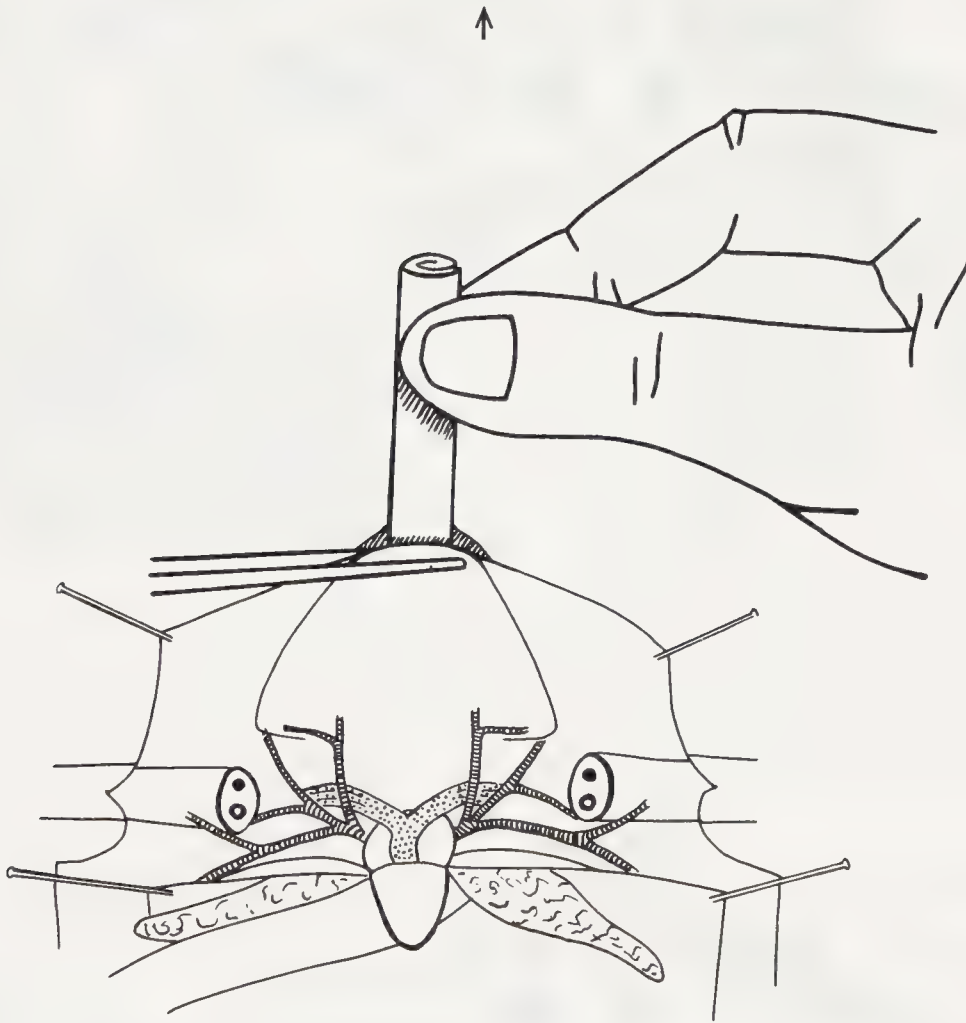
To expose the iliac and femoral arteries completely, cut the sciatic plexus where indicated and remove the sciatic nerve.

THE FROG—*The arterial system*

(b) The Arterial Arches.

These arteries are fine vessels and are much more difficult to see than the structures previously dissected.

It is best to follow each arch in turn; first the pulmo-cutaneous, then the systemic and last the carotid. If the veins have not previously been dissected it is necessary to remove the ventral portion of the pectoral girdle as described in Figs. 19 & 20.



$\times 1\frac{1}{2}$

Fig. 40

Lift the lower jaw to open the mouth slightly.

Insert a small roll of black paper into the mouth and push it well down the oesophagus.

Note. This process is optional but the dark paper shining through the oesophageal wall makes the arteries show up more clearly.

THE FROG—*The arterial system*

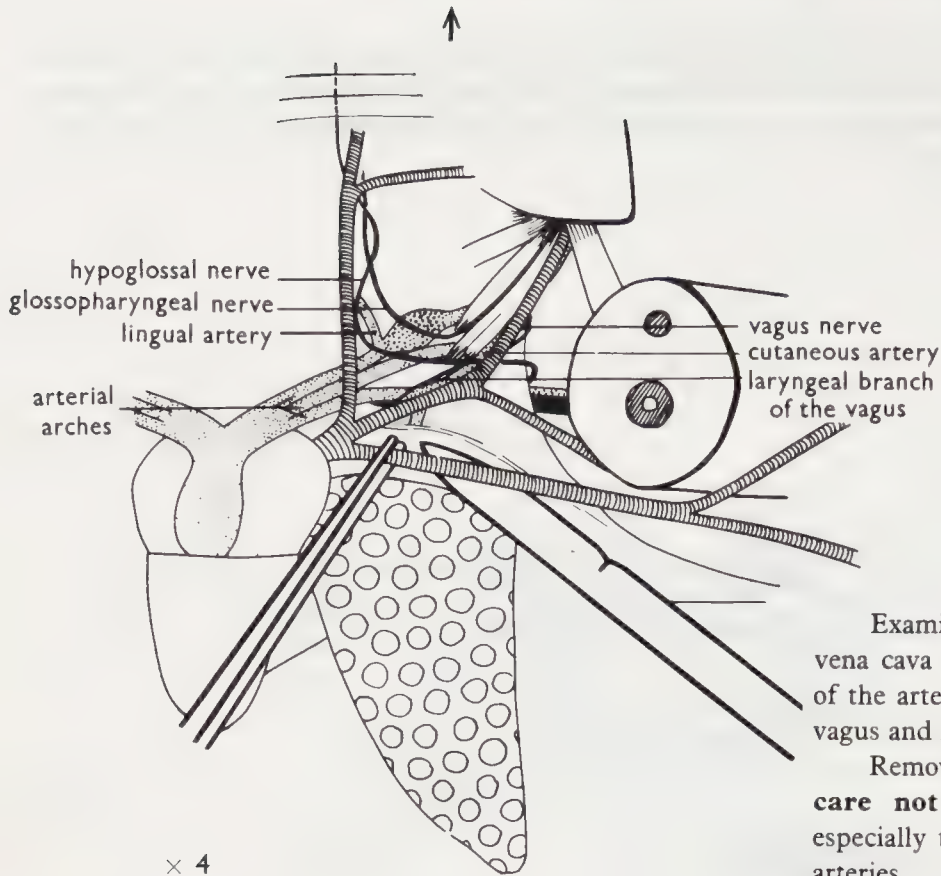


Fig. 41

Examine carefully the region of the anterior vena cava and its tributaries. Notice the positions of the arterial arches and of the glosso-pharyngeal, vagus and hypoglossal nerves relative to these viens.

Remove the viens and nerves mentioned **taking care not to damage any of the arteries**, especially the very small **lingual** and **cutaneous** arteries.

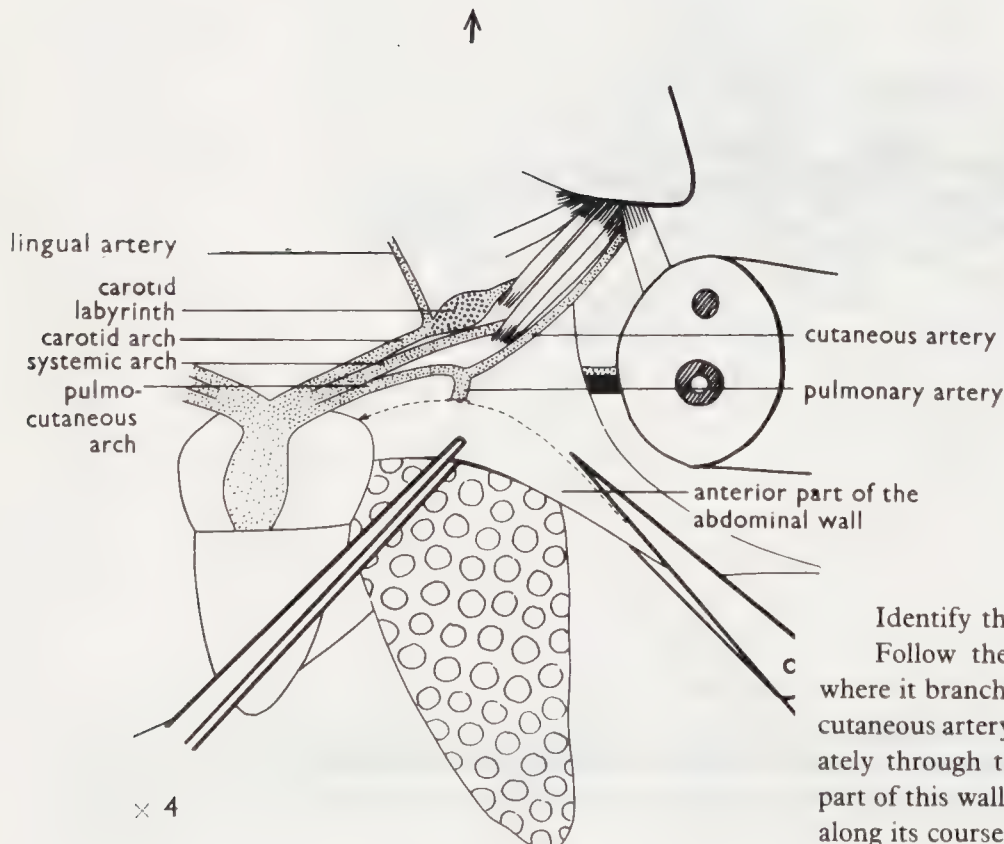


Fig. 42

Identify the three arterial arches.

Follow the pulmo-cutaneous arch and notice where it branches into the pulmonary artery and the cutaneous artery. The former passes almost immediately through the wall of the abdomen. Cut away part of this wall as shown in order to clear the artery along its course to the lung.

THE FROG—*The arterial system*

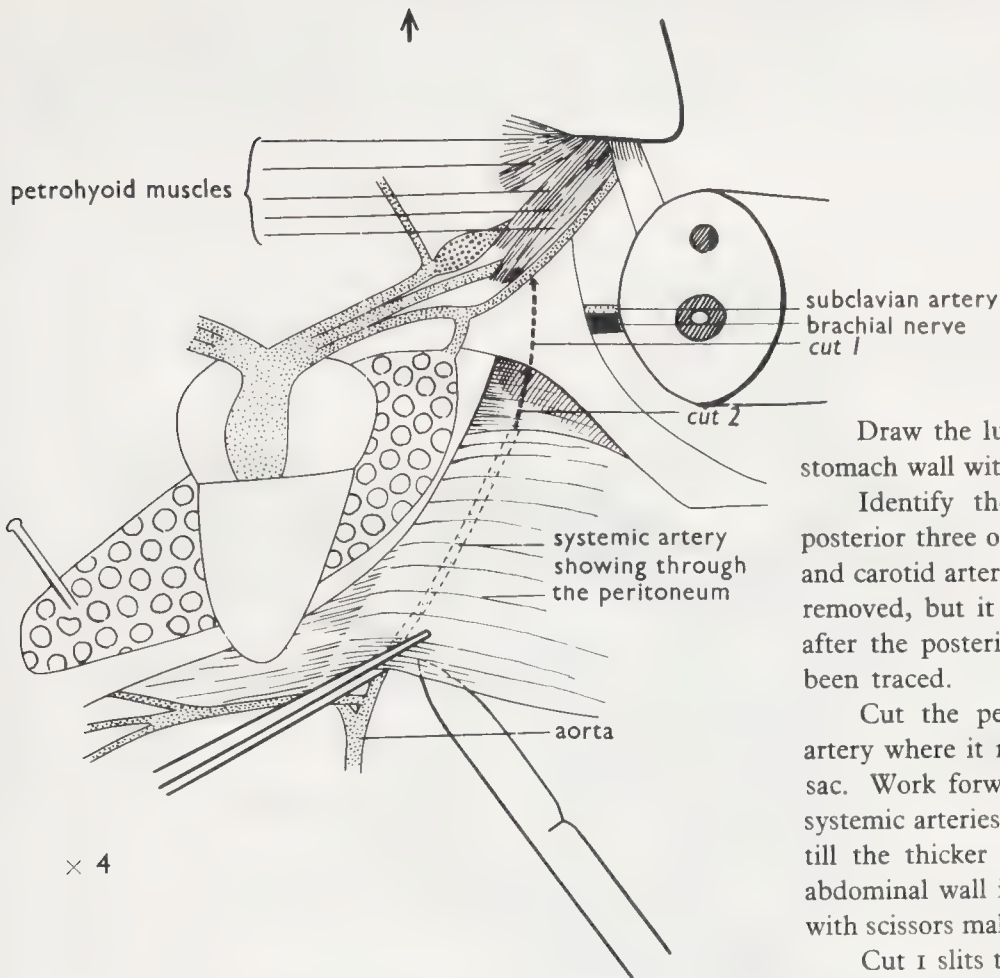


Fig. 43

Draw the lung under the heart. Pin it to the stomach wall with a small pin.

Identify the five petrohyoid muscles. The posterior three of these muscles cross the systemic and carotid arteries as shown and must therefore be removed, but it is better to leave this removal till after the posterior part of the systemic artery has been traced.

Cut the peritoneum to expose the systemic artery where it runs through the abdominal lymph sac. Work forwards from the junction of the two systemic arteries with the aorta. Continue forwards till the thicker tissue of the anterior part of the abdominal wall is reached. Cut through this tissue with scissors making two cuts as shown.

Cut 1 slits the vertical fold of tissue.

Cut 2 clears the vessel.

Clear away loose tissue as required after the vessel has been traced. Notice the subclavian artery and the brachial nerve and clear these at the same time.

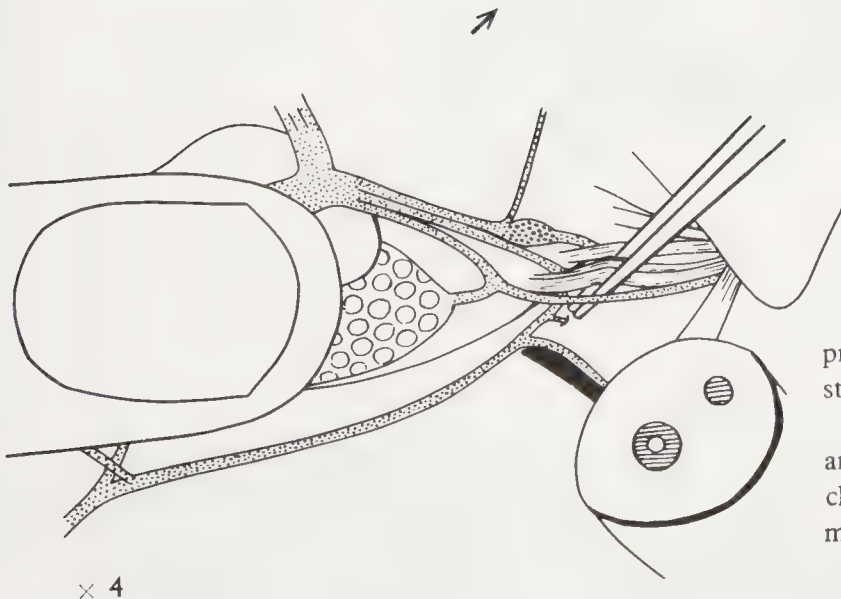


Fig. 44

Turn the dish slightly.

Hold the arterial arches steady and taut by pressure of a finger against the heart, lung and stomach.

Insert the forceps carefully **under** the cutaneous artery and grip the posterior two petrohyoid muscles close to where they cross the systemic arch. Pull the muscles away and trace the complete systemic arch.

Similarly remove the third petrohyoid muscle and trace the carotid arch.

THE FROG—*The arterial system*

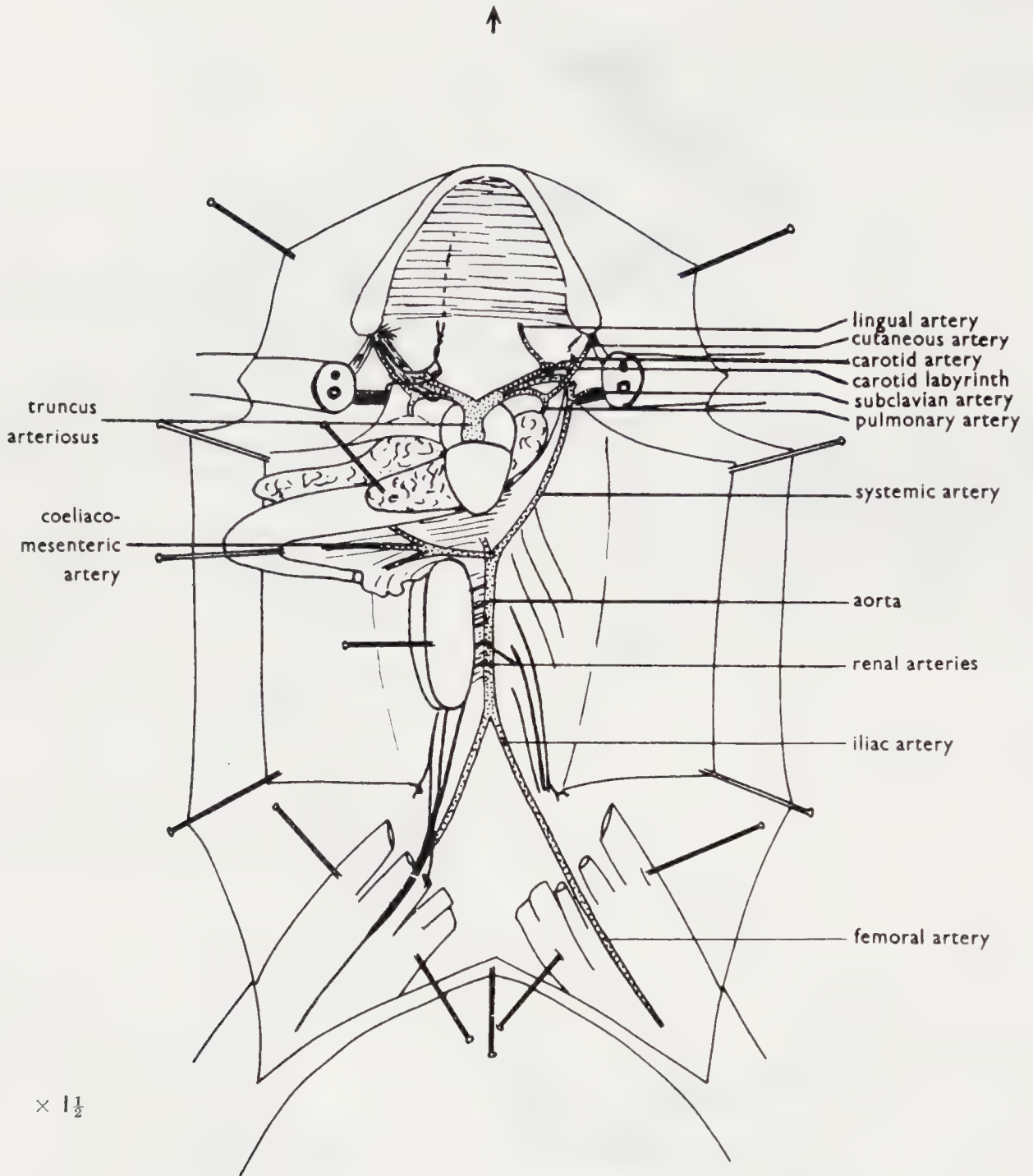


Fig. 45

(c) The Complete Arterial System.

Restore the dish to its original position.

The completed dissection of the arteries appears as shown above.

DRAW.

THE FROG—7 The Buccal Cavity and Pharynx

THIS part of the dissection necessitates the cutting of the anterior blood vessels and some of the cranial nerves on one side. When dissecting all the systems on a single frog it is therefore essential to leave the examination of the pharynx till this stage, but when more material is available it is better to complete the whole alimentary canal at one time, see Appendix IV.

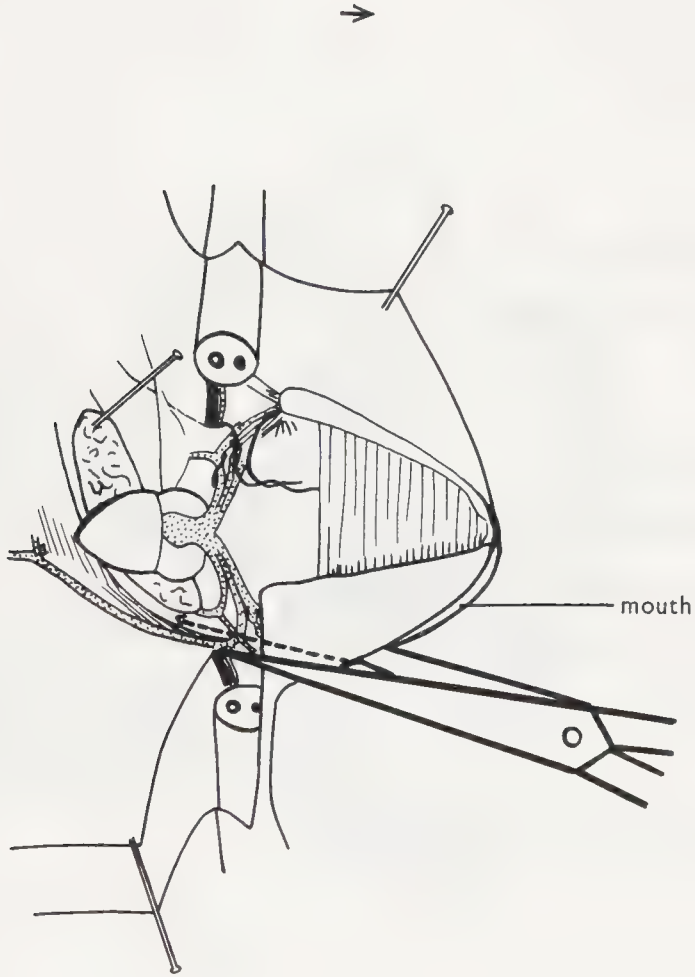
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Fig. 46

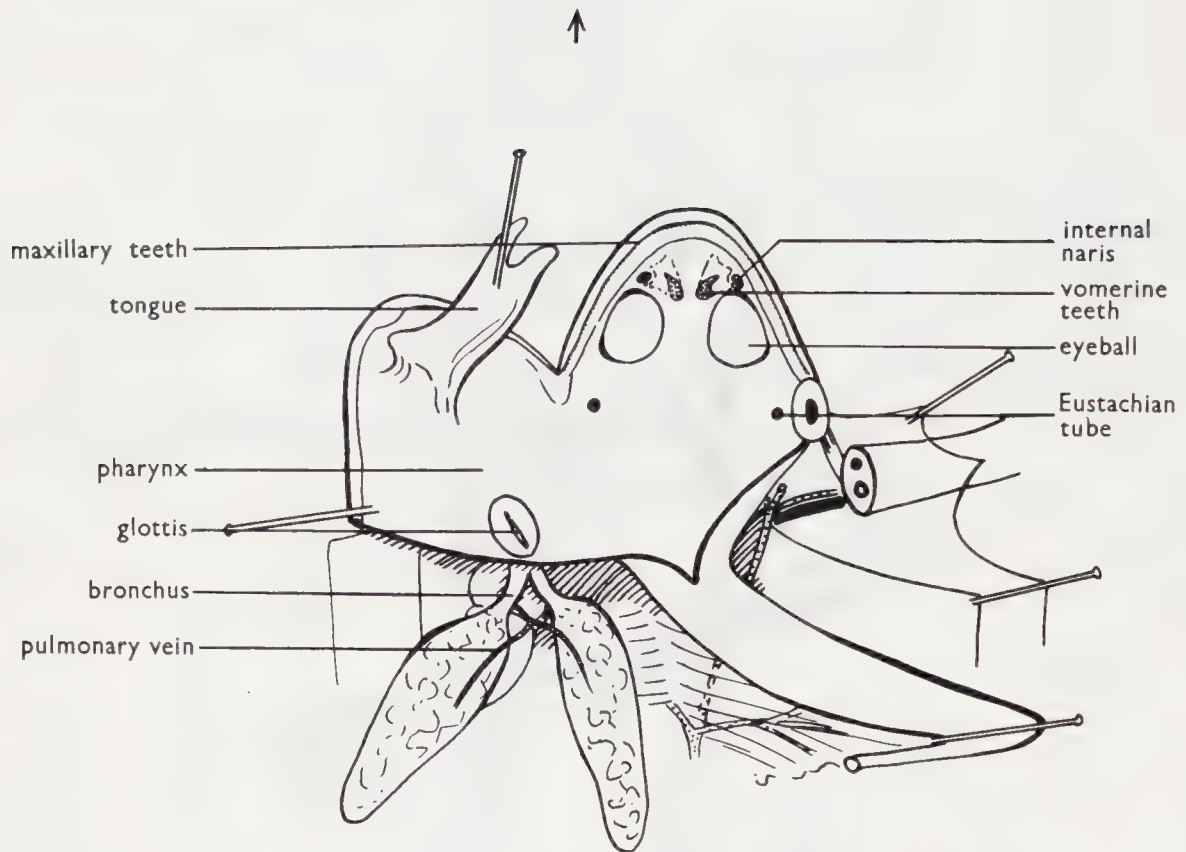
Turn the dish sideways.

Remove the paper from the mouth and remove the pin from the skin of the head on one side. (Chose the side from which the nerves have been removed while examining the arteries.)

Insert one blade of the scissors into the mouth and cut through the angle of the jaw. Continue the cut down the side of the pharynx and oesophagus as indicated.

Note. Ignore the arterial arches but avoid cutting the lung.

THE FROG—*The buccal cavity and pharynx*



× 1½

Fig. 47

Turn the dish back to its original position.

Pin aside the small fold of skin from the arm.

Remove the pin holding the lung to the stomach and that holding the stomach itself. Pin the stomach to your right as in the original display of the alimentary canal, see Fig. 15.

Pin aside the floor of the buccal cavity and pharynx as shown. Pin the tongue out to show the position of its attachment. If necessary pin the lungs to show the bronchi.

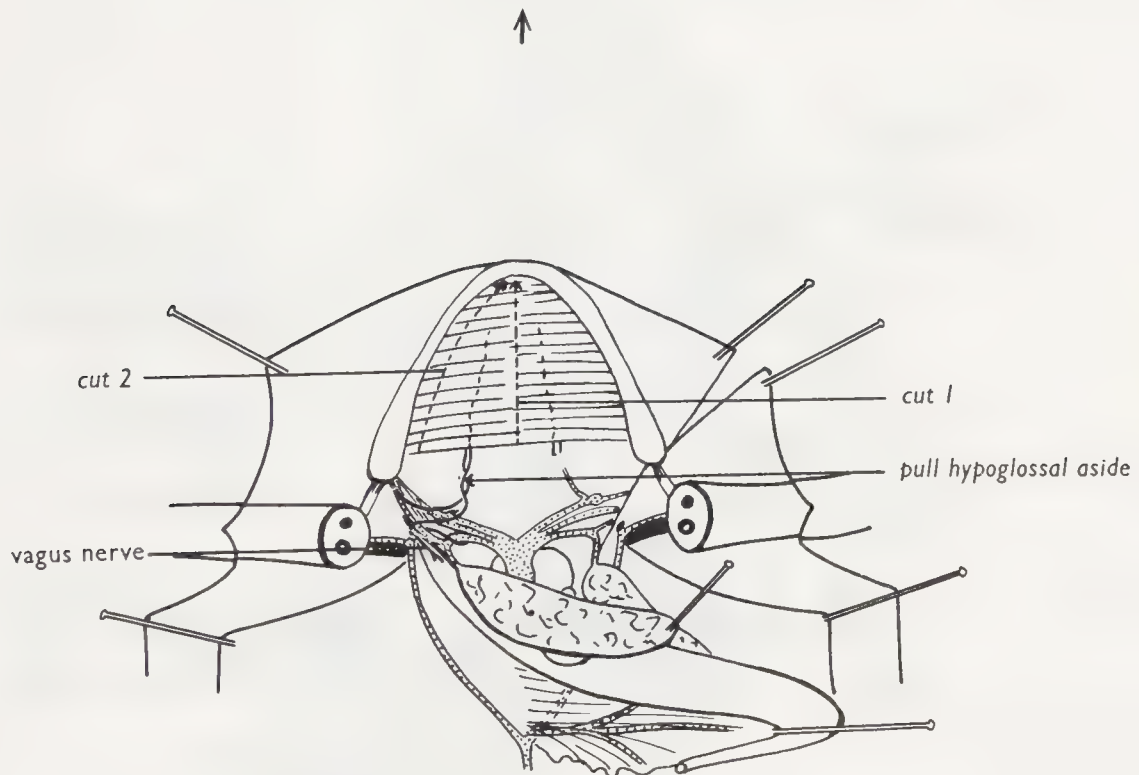
DRAW

THE FROG—8 The Nervous System

(a) The Cranial Nerves.

Most elementary students do not require to study the cranial nerves and can omit the stages shown in Figs. 48 & 49, and 51 & 52. They are included here for the sake of completeness.

If the pharynx has been opened it should be pinned back into its original position before starting this dissection.



$\times 1\frac{1}{2}$

Fig. 48

Clear away the anterior veins completely from one side, refer to Fig. 41.

Clear away the abdominal wall from the pulmonary artery, refer to Fig. 42.

Turn the heart and lungs over and pin as shown. Clear the abdominal wall from the systemic artery, refer to Fig. 43, watching for the vagus nerve and being careful not to remove its branches, see Fig. 49.

Observe the hypoglossal and glosso-pharyngeal nerves. They pass internal to and can be seen through the mylohyoid muscle. Remove this muscle cutting as indicated—cuts 1 & 2. **Keep these cuts superficial.**

Pull the hypoglossal nerve aside where it crosses the glosso-pharyngeal nerve.

THE FROG—*The nervous system*

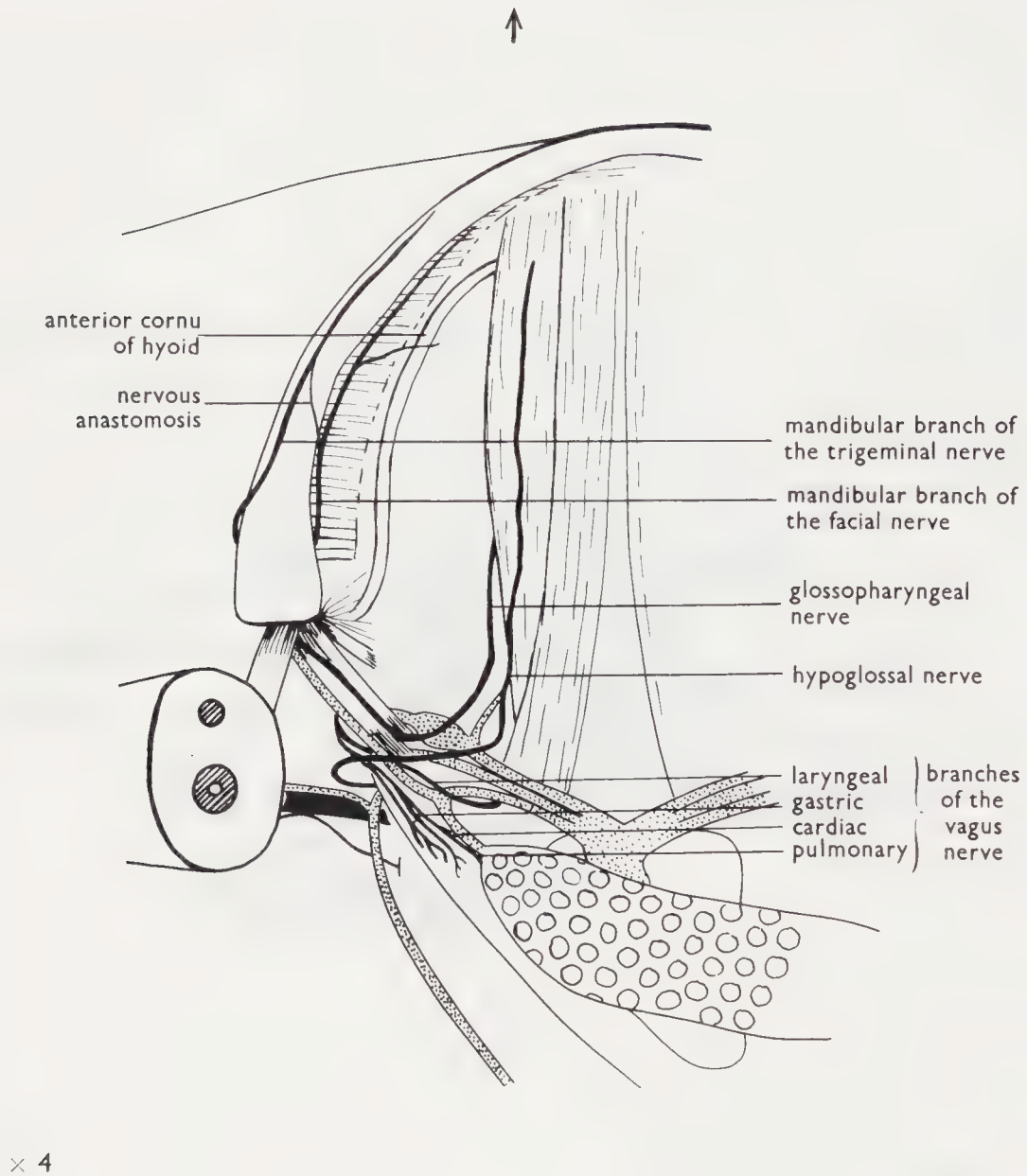


Fig. 49

Loosen the skin from the lower jaw carefully. Pull it well back, noticing the mandibular branches of the trigeminal (V) and facial (VII) nerves. Trace these nerves as far round the angle of the jaw as possible.

Complete your examination of the nerves now visible as they will be removed during the next part of the dissection.

DRAW

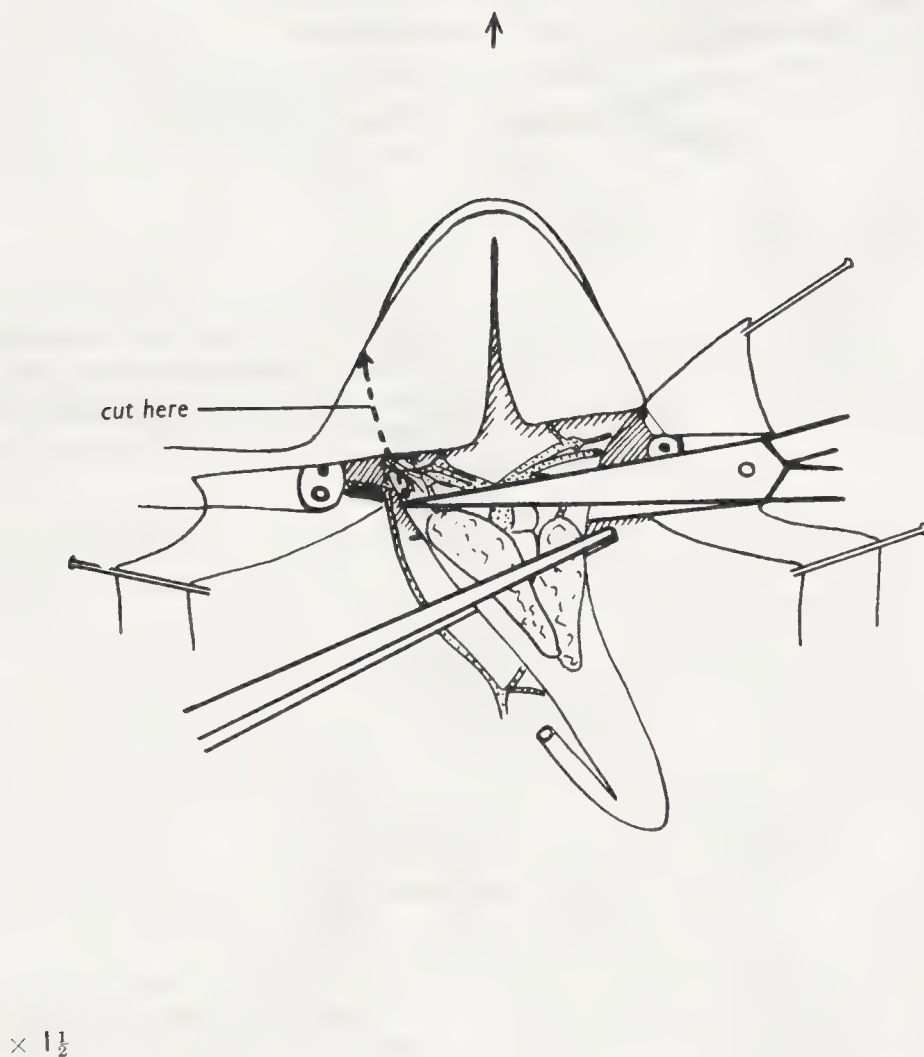


Fig. 50

Remove the pins from the lungs and stomach.

Cut through the oesophagus, bronchi and arterial arches and remove the stomach, lungs and heart.

Remove the pins from the skin of the head.

Remove the floor of the mouth by cutting through the angle of the jaw (on both sides if the pharynx has not been studied on your specimen).

THE FROG—*The nervous system*

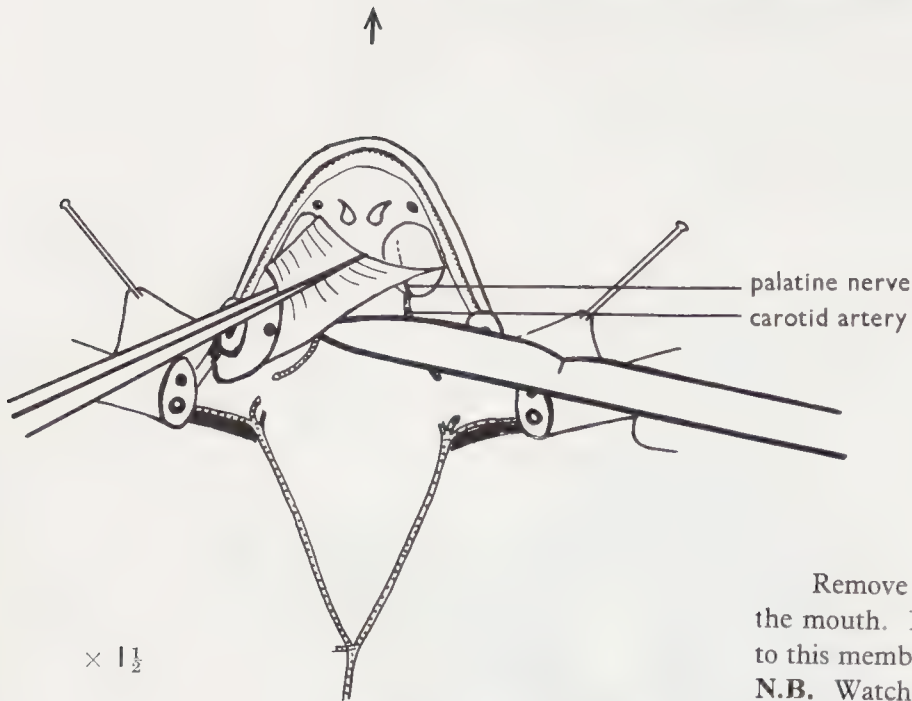


Fig. 51

Remove the mucous membrane of the roof of the mouth. Notice the carotid arteries lying dorsal to this membrane and entering the orbits.

N.B. Watch for and be careful not to remove the palatine nerves where they cross beneath the eyeball.

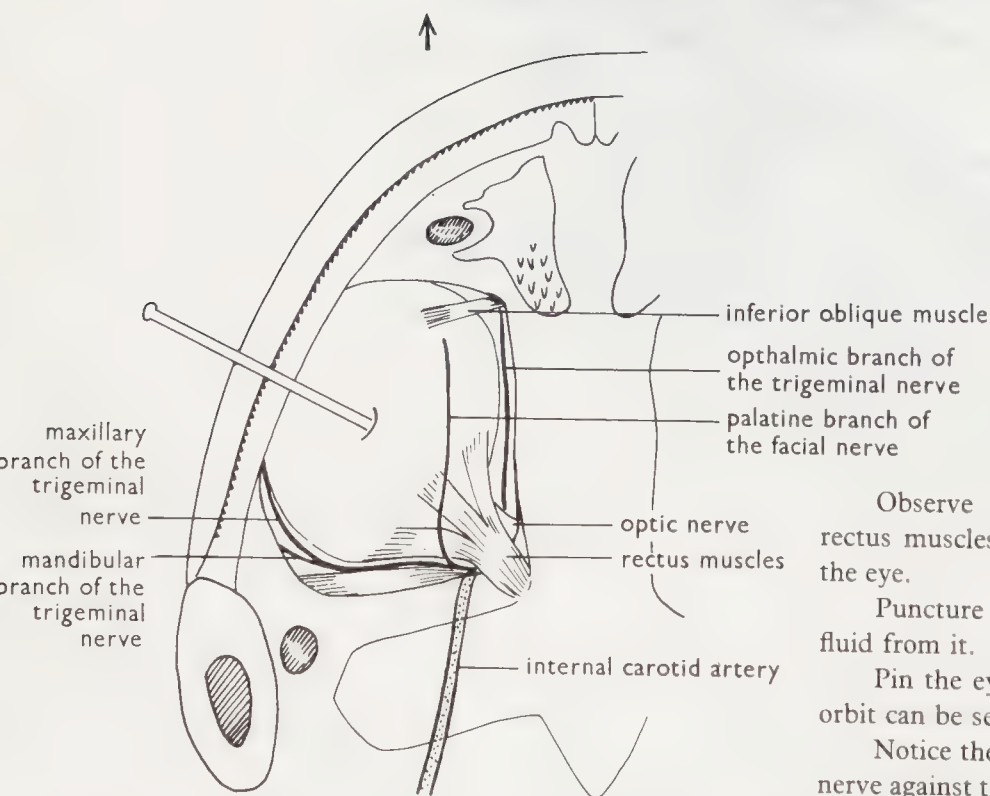


Fig. 52

Observe the inferior, internal and external rectus muscles and the inferior oblique muscle of the eye.

Puncture the eyeball. Express some of the fluid from it. Wash away the pigment.

Pin the eyeball down so that the nerves in the orbit can be seen.

Notice the ophthalmic branch of the trigeminal nerve against the medial wall of the orbit.

Notice the maxillary and mandibular branches of the trigeminal nerve against the posterior wall of the orbit.

The optic nerve is largely masked by the rectus muscles.

DRAW

THE FROG—*The nervous system*

(b) The Ventral Branches of the Spinal Nerves and the Sympathetic Nervous System.

This part of the nervous system should be studied by all students.

If the directions for the study of the cranial nerves have not been followed it is necessary to remove the stomach, lungs and heart as shown in Fig. 50 before proceeding to Fig. 53. It is best to remove the floor of the mouth also.

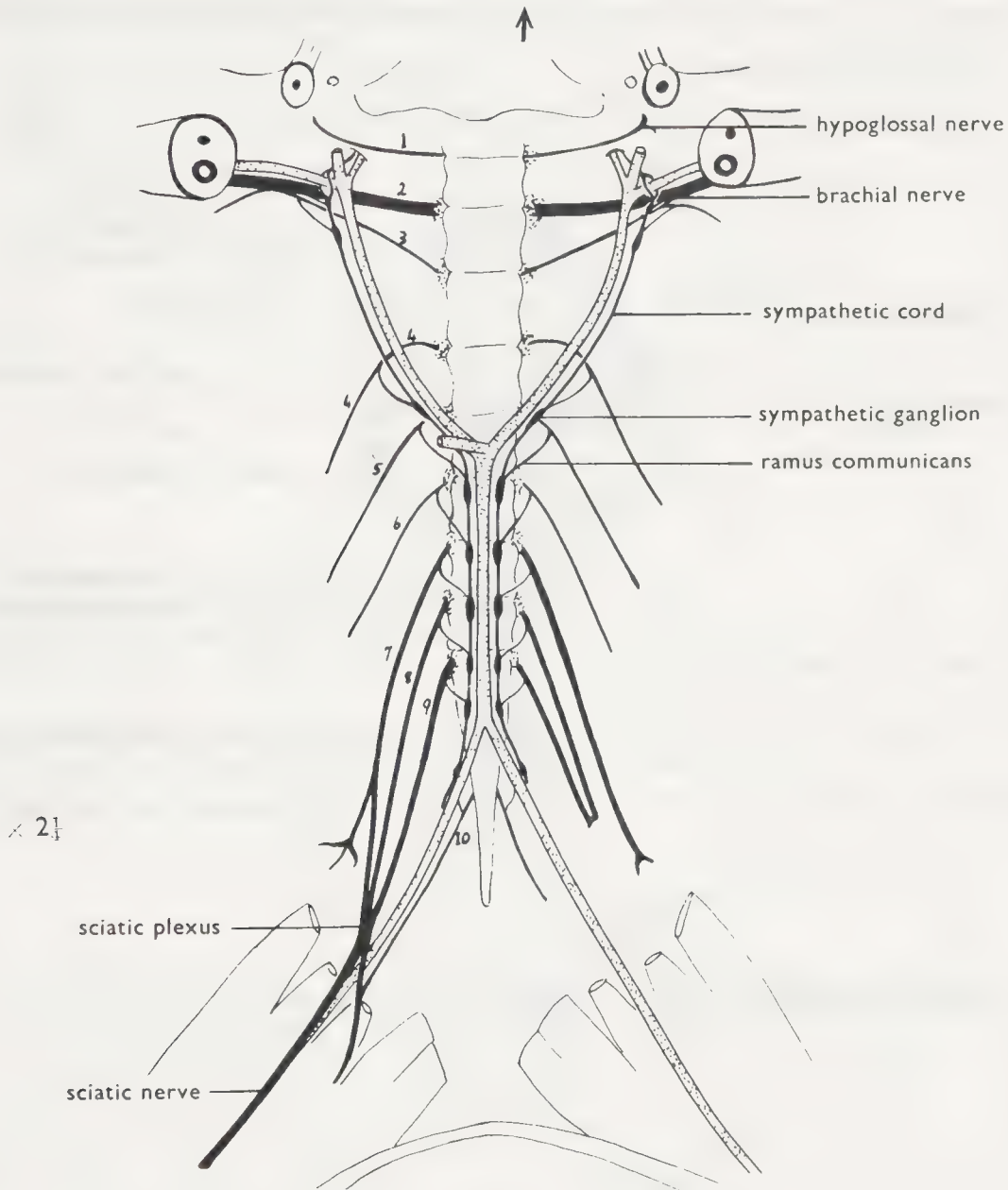


Fig. 53

Remove the kidneys, taking care not to cut the aorta.

Clear any remaining peritoneum from the abdominal lymph sacs in order to expose the ventral branches of the spinal nerves.

Identify the spinal nerves as numbered in figure above.

Trace the sympathetic cords on either side of the aorta, beside the systemic arteries, looping round the sub-clavian arteries and entering the skull with the vertebral arteries. Notice the sympathetic ganglia. Identify the rami communicantes between the spinal nerves and the sympathetic ganglia.

Note. A number of small lumbar arteries superficially resemble the rami communicantes owing to the pigment which outlines both. Careful tracing of their connections is therefore essential.

DRAW.

THE FROG—*The nervous system*

(c) The Brain and Spinal Cord.

This part of the dissection is done from the **dorsal** side. The dorsal branches of the spinal nerves are noticed incidentally while dissecting to remove the brain and spinal cord. The latter are very soft in a fresh frog, but gradually harden in preservative. The frog should be soaked for at least a week (preferably longer) in 5% formalin or alternatively for a shorter period in 70% alcohol.

It is important to use your smallest instruments and to **make very small cuts** while opening the cranial cavity and the neural canal.

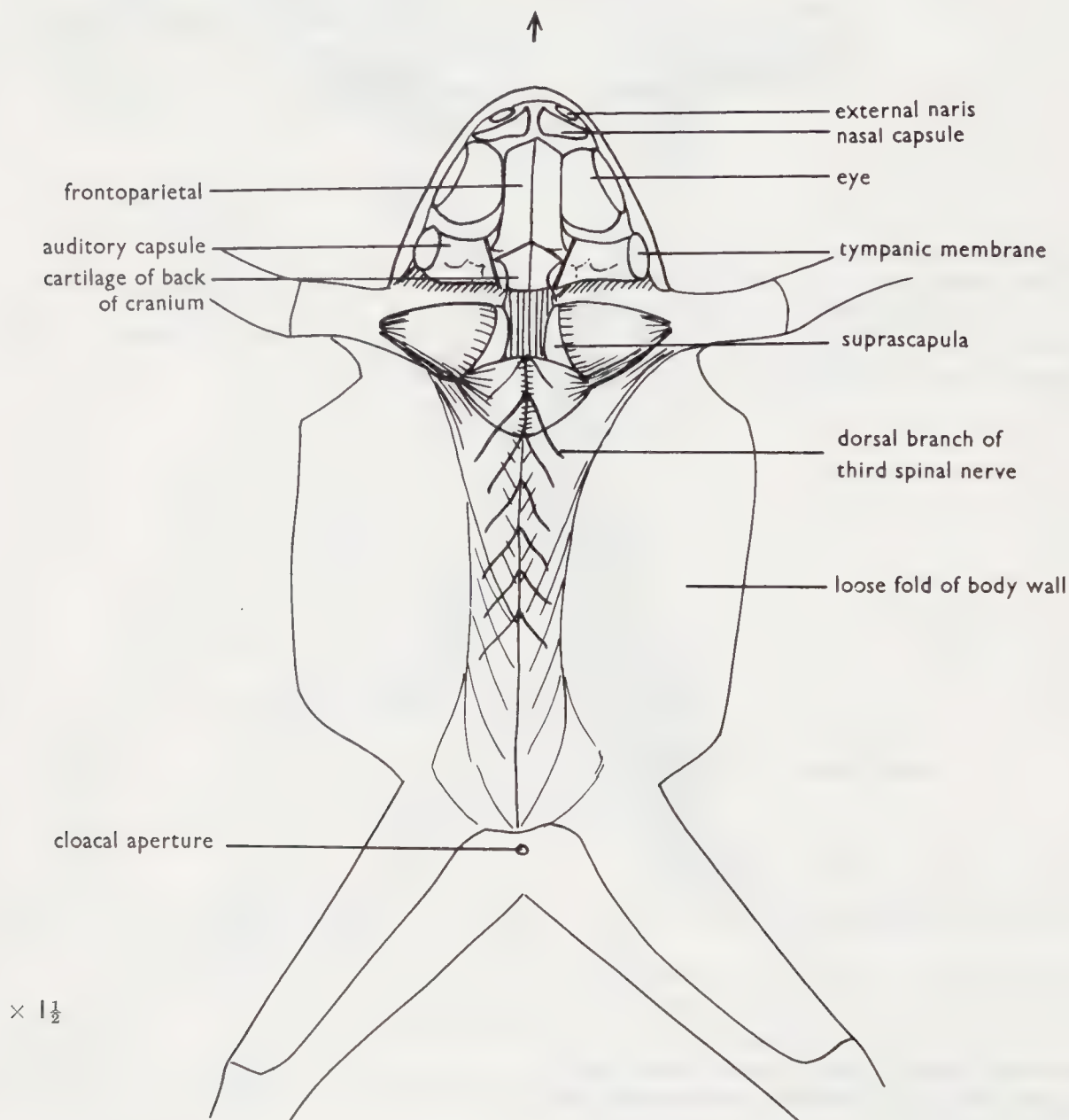


Fig. 54

Pin the frog out dorsal side upwards.

Loosen the skin from the back using the technique shown in Figs. 1-3, but cut the skin away completely instead of pinning back.

Notice the dorsal branches of the spinal nerves which serve the skin of the back.

Identify the structures indicated in figure above.

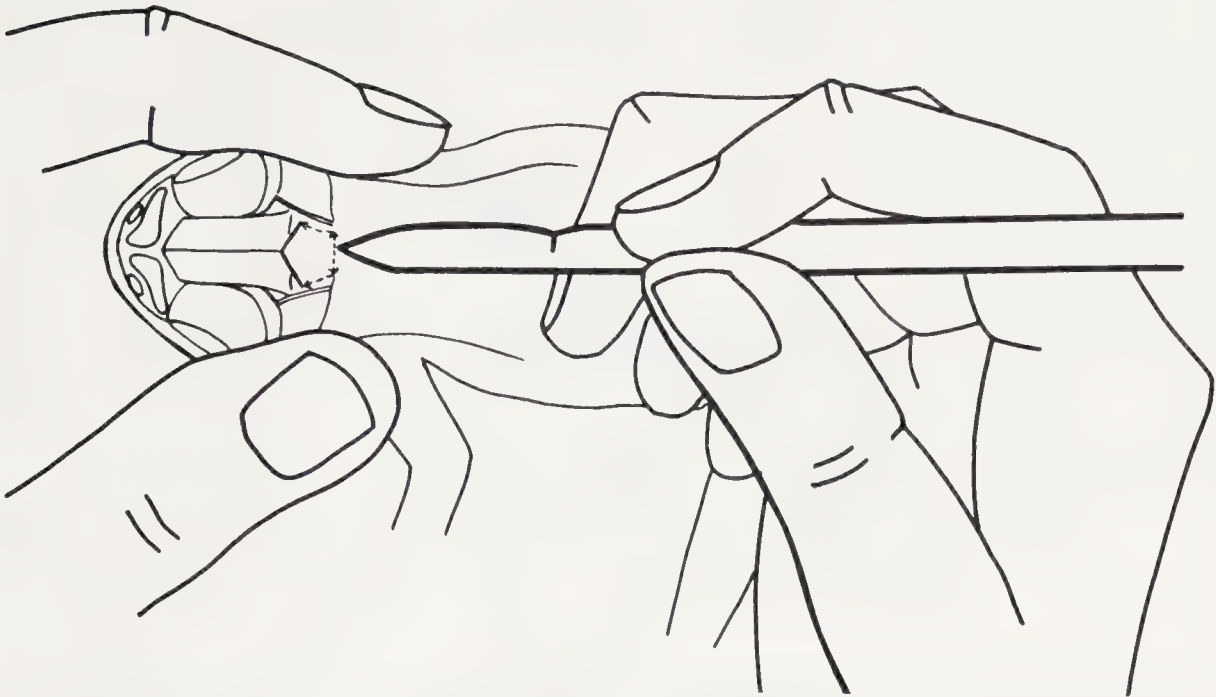


Fig. 55a

Remove the pins from the frog.

Hold the head between the thumb and forefinger of the left hand.

Rest the second, third and fourth fingers of the right hand against the back of the frog. Press slightly to curve the spine and so allow the scalpel to be held level with the back of the skull. The position of the blade is shown in Fig. 55b.

Cut horizontally to ease the point of the scalpel under the cartilage of the back of the cranium as indicated.

Cut carefully to the sides and prise up the part of the roof of the cranium so loosened.

N.B. Maintain the level position of the scalpel all the time in order to avoid damage to the brain.

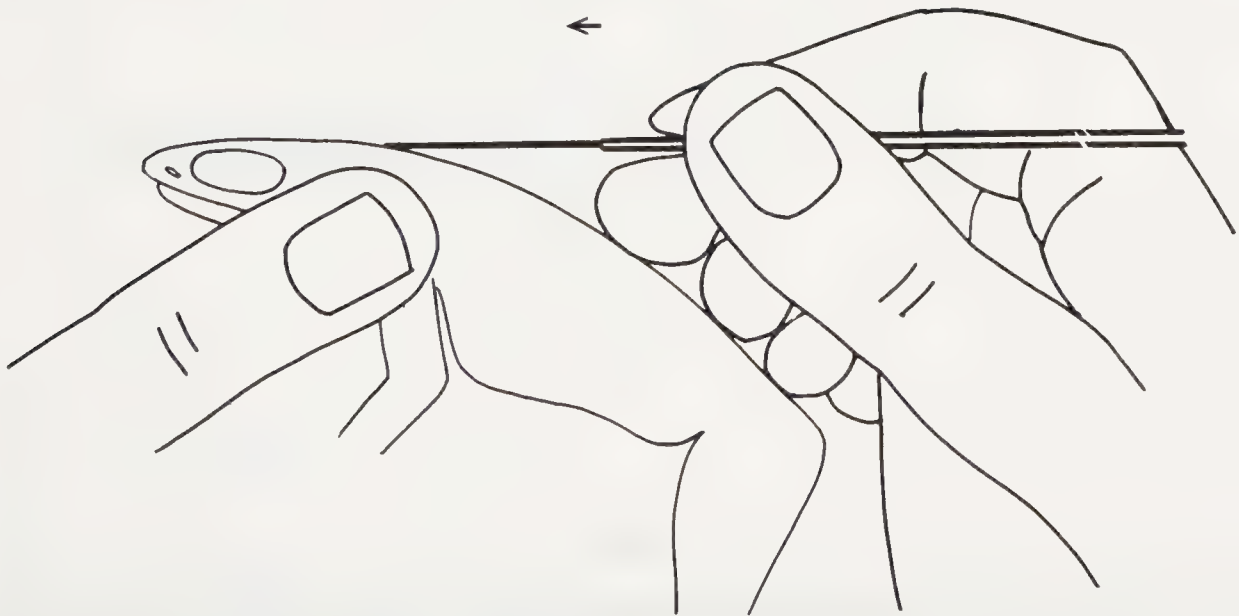


Fig. 55b

The correct position of the scalpel blade relative to the frog is indicated above.

THE FROG—*The nervous system*

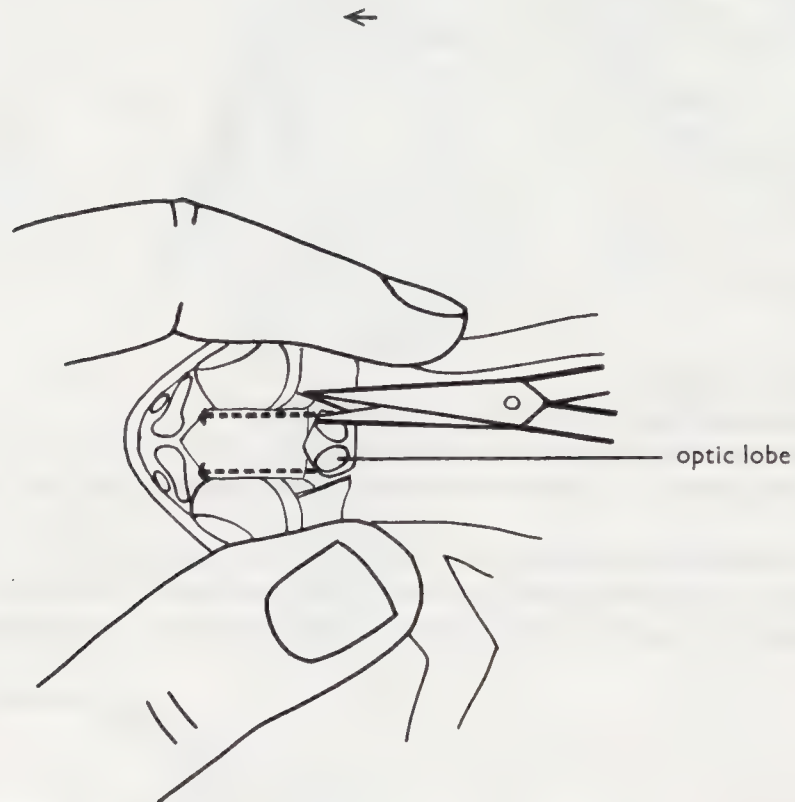


Fig. 56

Notice the optic lobes.

Insert one blade of a fine pair of scissors into the side of the cranium as shown. Cut up the sides of the cranium as indicated inserting the blade only a **very short distance at a time** and making a number of short cuts.

Remove the rest of the roof of the cranium.

THE FROG—*The nervous system*

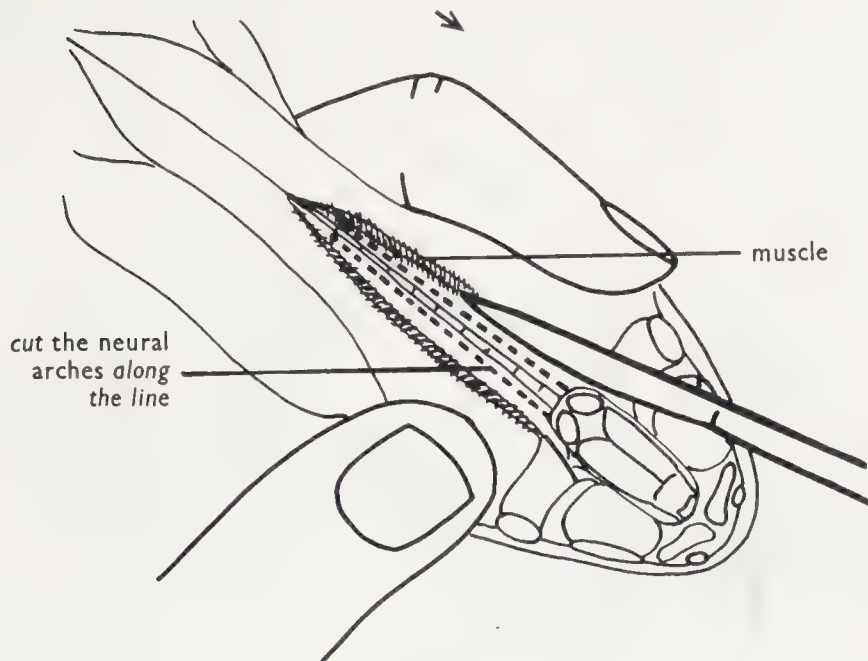


Fig. 57

Turn the frog and grip as shown.

Scrape away the muscle on both sides of the vertebral column to expose the vertebrae.

Cut back through the neural arches cutting a **short distance on either side alternately**. Remove the neural spines.

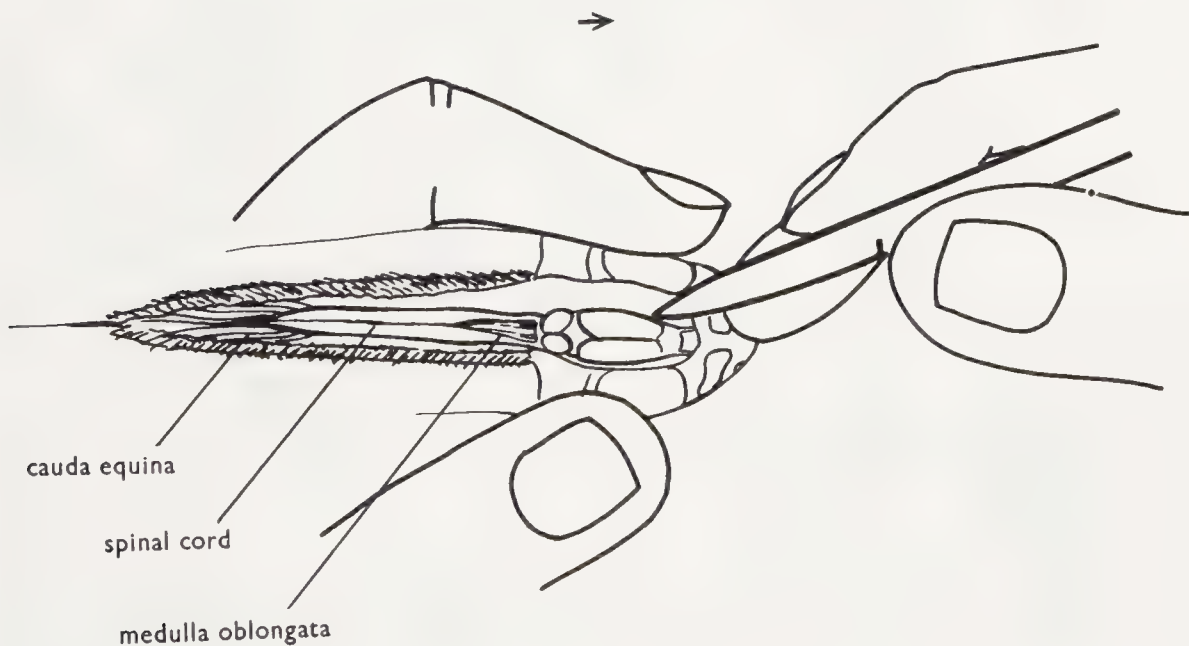


Fig. 58

Notice the medulla oblongata and the spinal cord.

Press the sides of the skull between the thumb and first finger. This should break it away from the brain.

Cut the roots of the cranial and spinal nerves carefully.

Lift out the brain and spinal cord together.

THE FROG—*The nervous system*

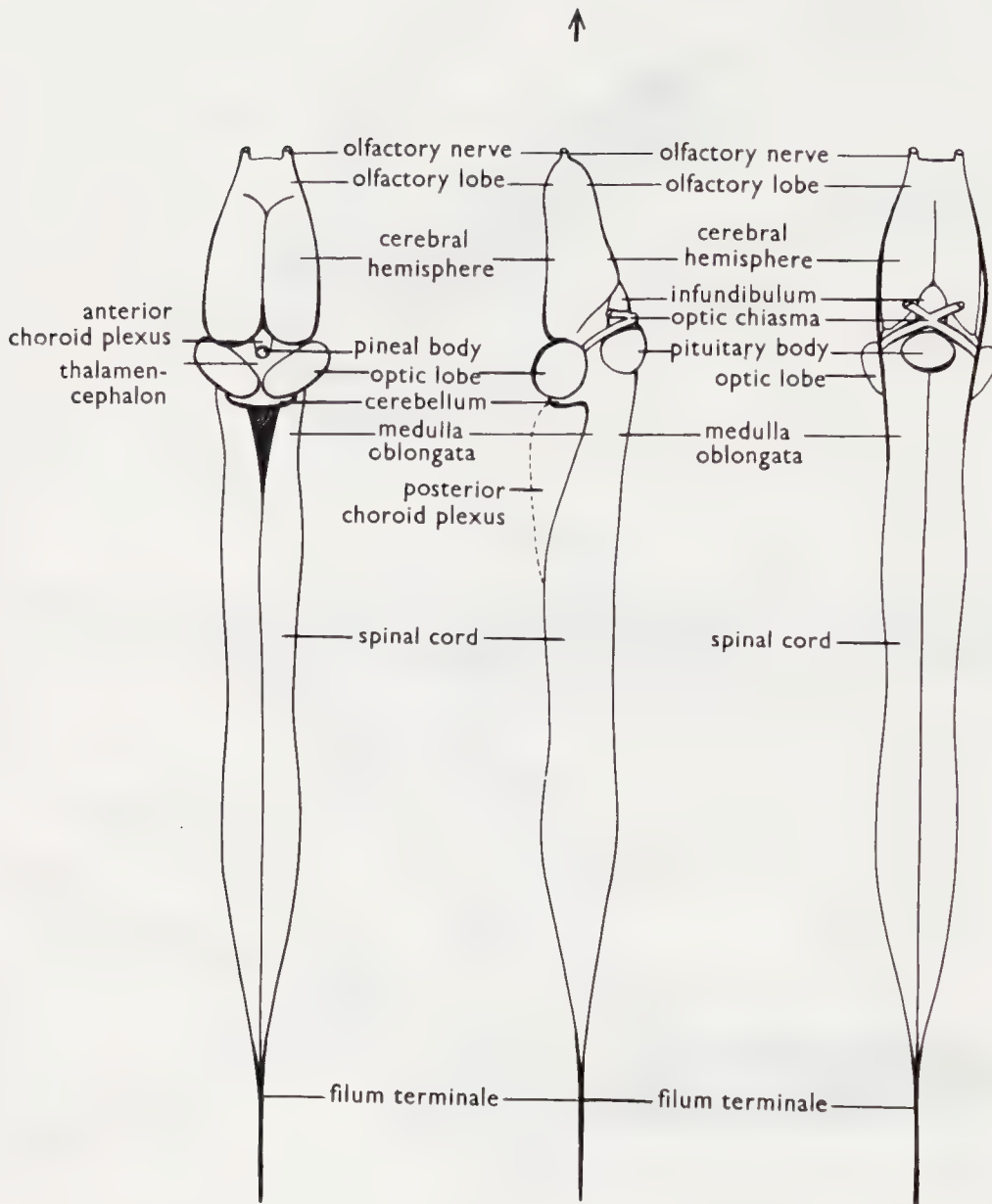


Fig. 59

Examine the brain and spinal cord in dorsal, ventral and lateral views.

Note. The posterior choroid plexus is only loosely attached and usually comes off while the brain is being removed from the skull.

DRAW

THE FROG—*The nervous system*

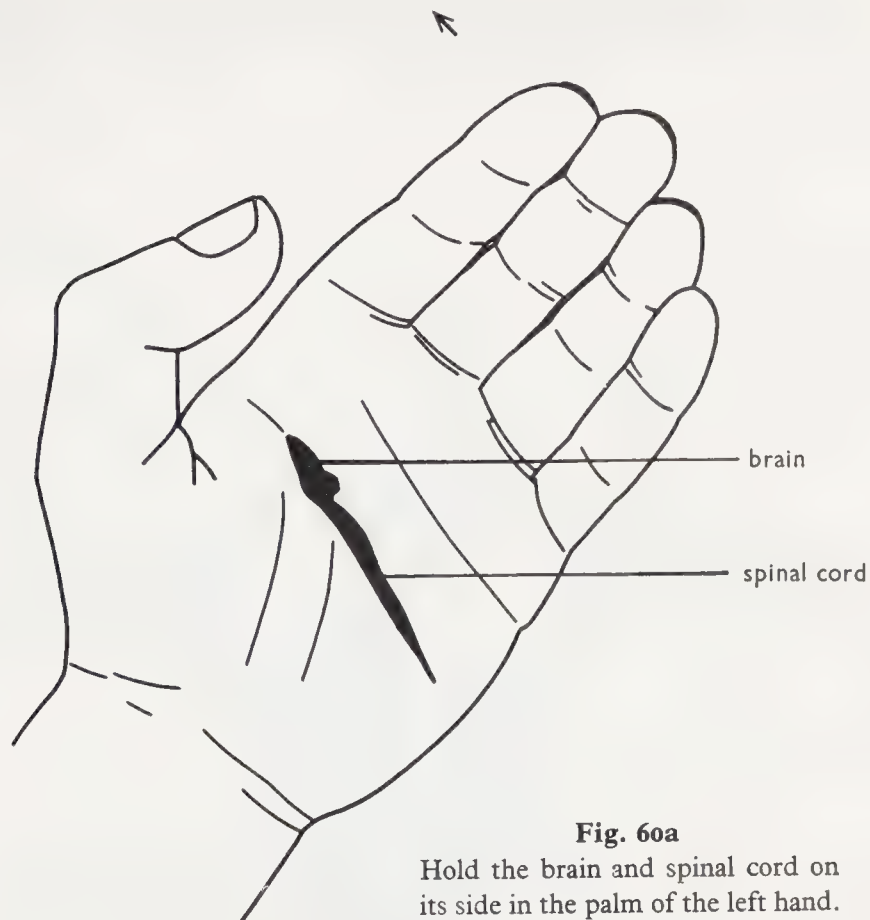


Fig. 60a

Hold the brain and spinal cord on its side in the palm of the left hand.

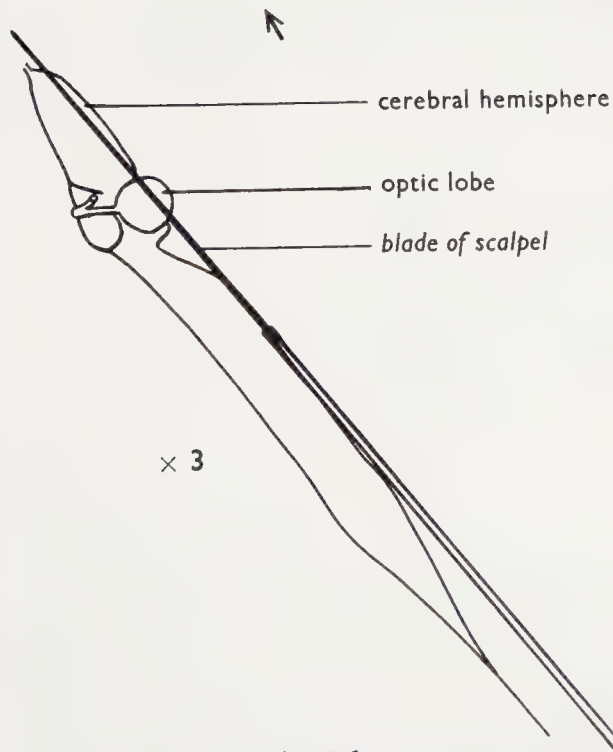


Fig. 60b

Cut with a scalpel as indicated in order to remove the dorsal wall of the cerebrum and of the optic lobes.

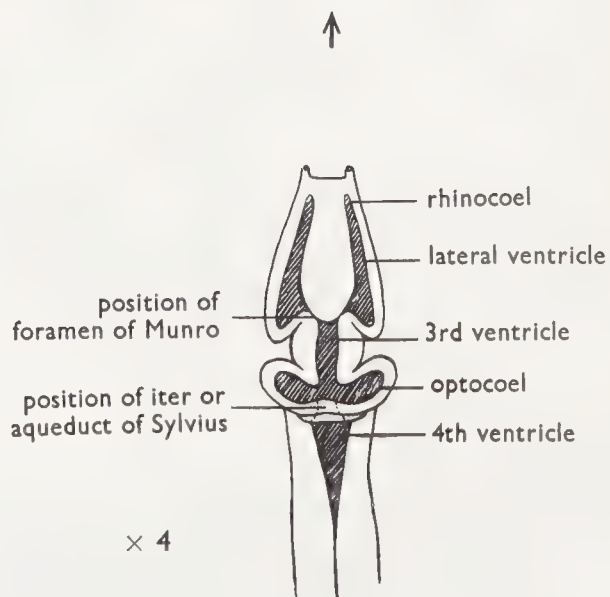
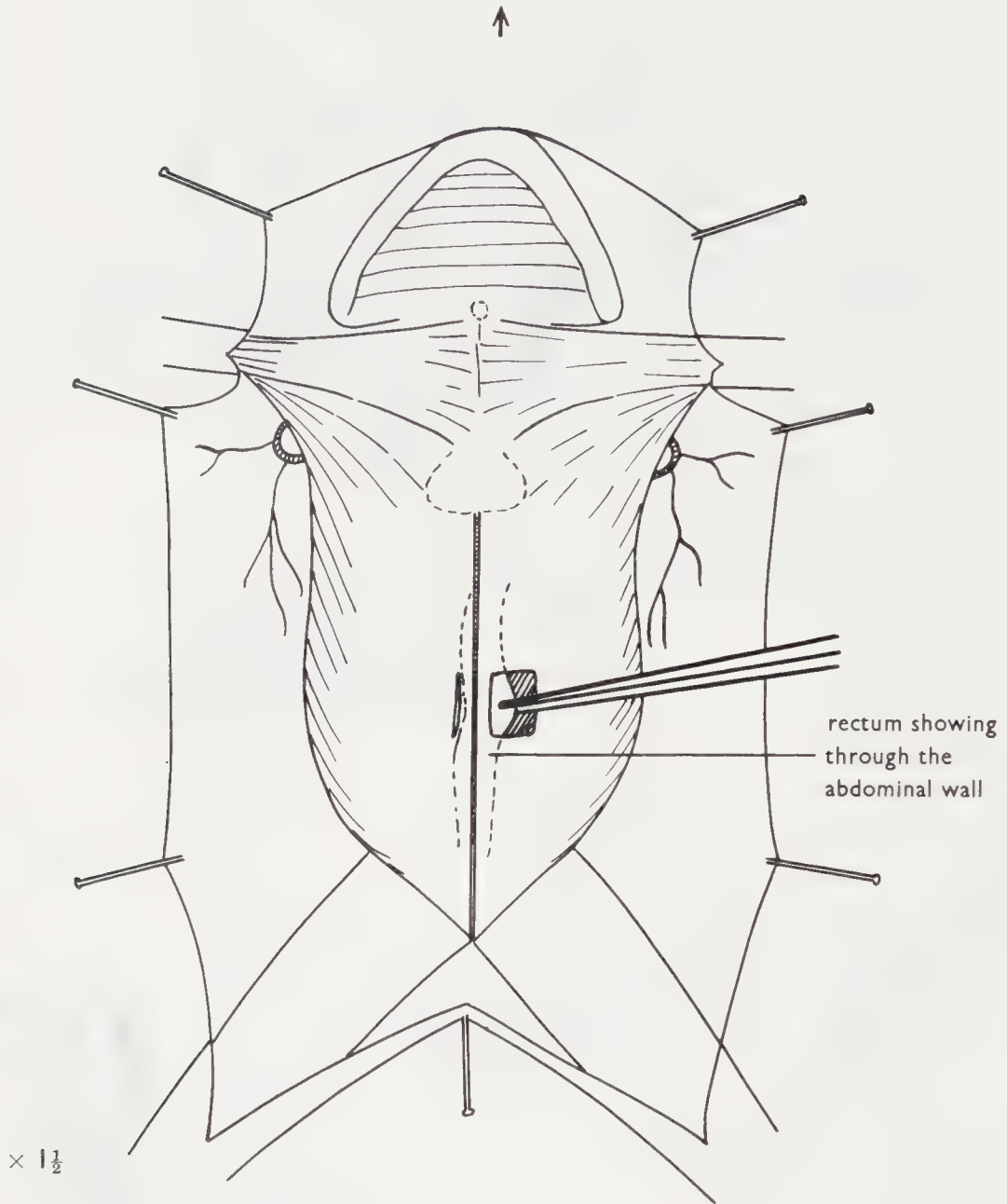


Fig. 61

Notice the cavities of the brain.
DRAW

Appendix I

Opening up a Female when She is Distended with Eggs



Dissect as usual to the stage shown in Fig. 4.

Notice the rectum showing through the stretched body wall.

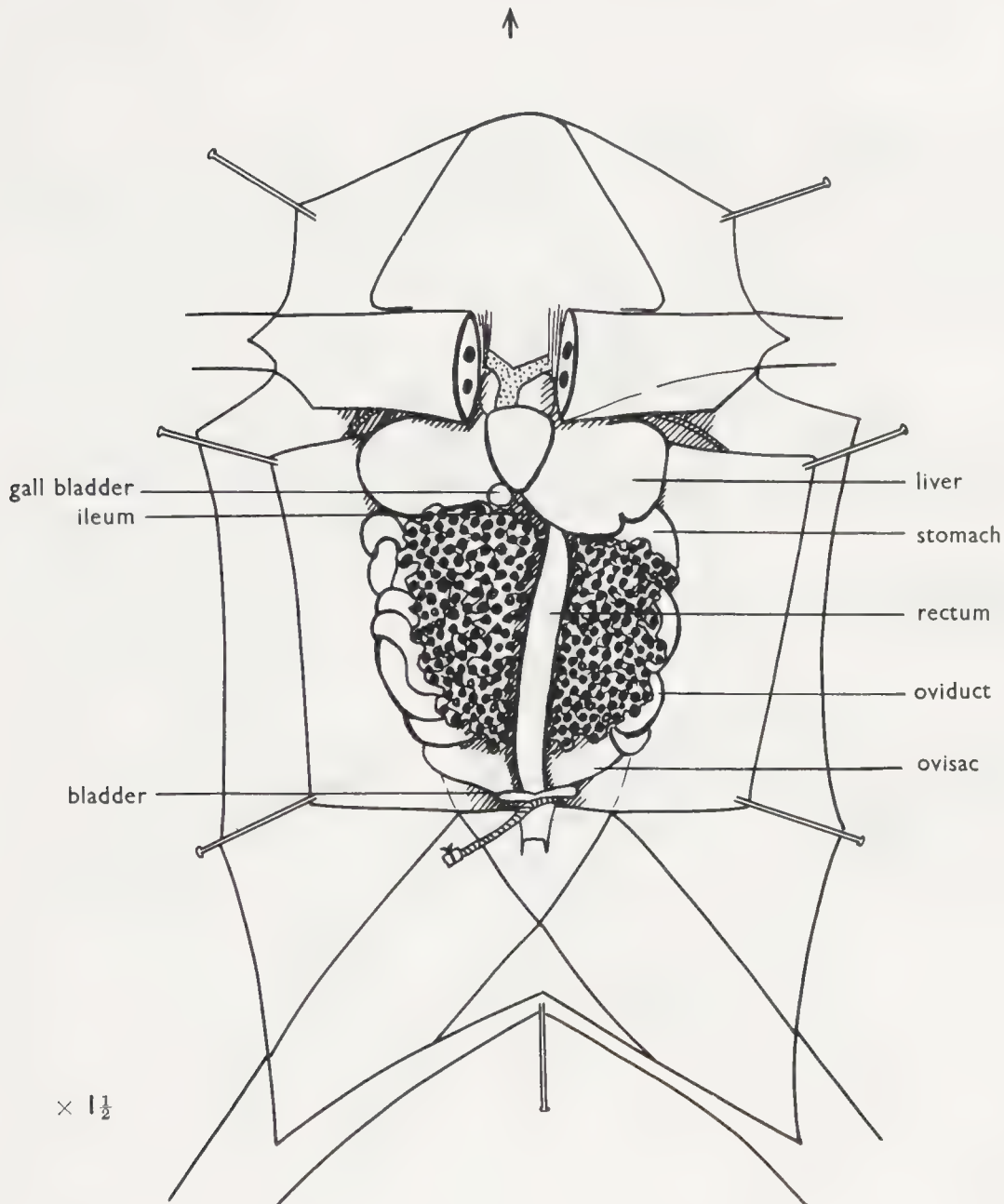
Cut a small square out of the body wall as shown.

Pull the rectum aside.

Note. If this is not done there is danger of cutting it while ligaturing the anterior abdominal vein. Continue the dissection as usual till the body cavity has been opened. Then see Appendix II or III.

Appendix II

Viscera of a Female shortly before Ovulation



Pin back the body wall.

Do NOT add water.

Note. The oviducts are distended with jelly in preparation for the coating of the eggs. This jelly swells when it comes into contact with water. Should the frog be covered with water as usual the oviducts become still further stretched and more difficult to dissect.

Pin the alimentary canal over to your right, but do not dissect it till later.

Display the right ovary and oviduct as in Fig. 18.

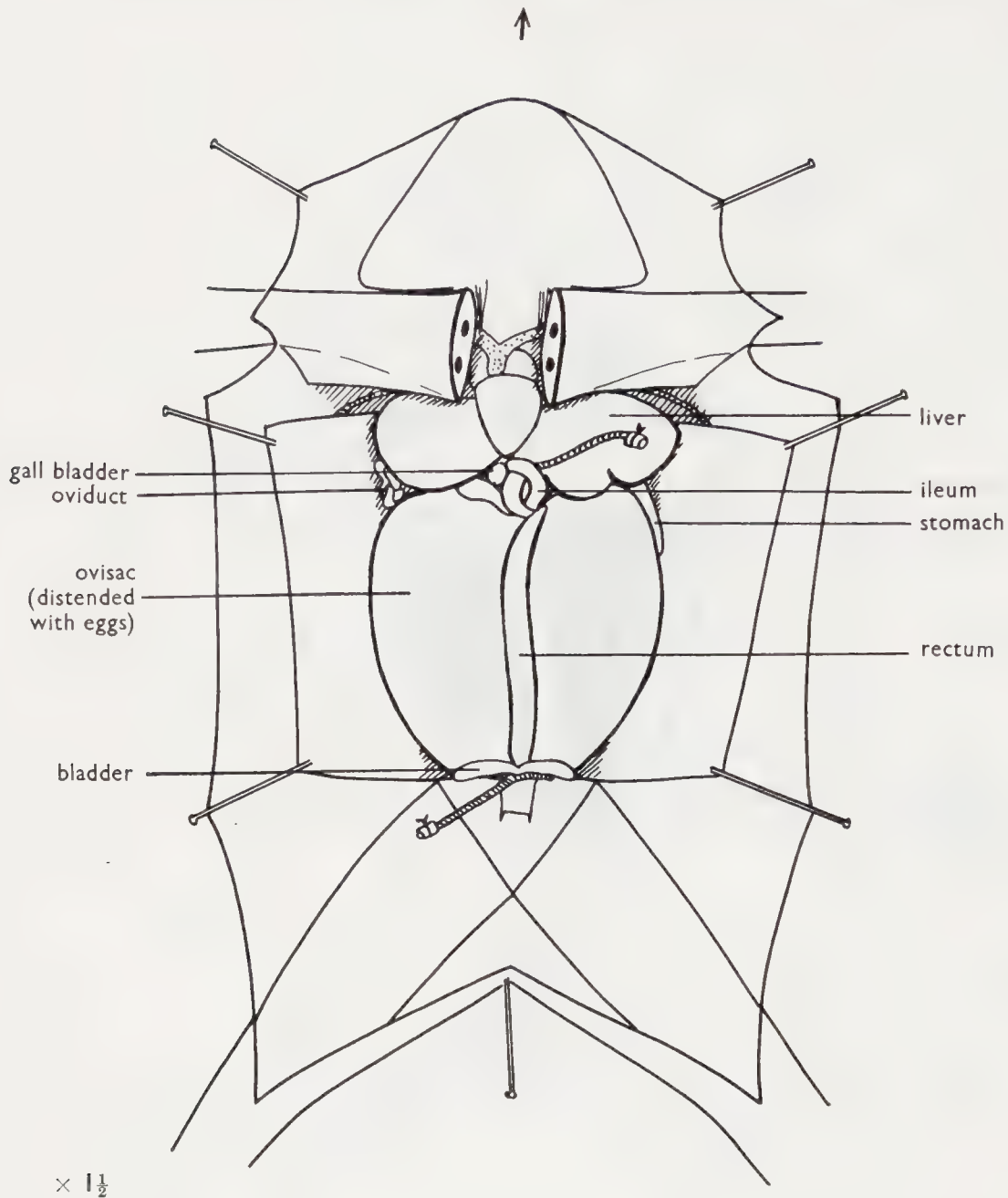
Examine the genital system and **DRAW**.

Remove the oviducts and ovaries completely.

Add water and continue the dissection as from Fig. 14.

Appendix III

Viscera of a Female after Ovulation and ready for Oviposition



Pin back the body wall.

Do NOT add water.

Note. The ovisacs are distended with eggs each of which has a gelatinous coat. This jelly swells when it comes into contact with water. Should the frog be covered with water as usual the ovisacs become still further stretched and the eggs are more difficult to handle.

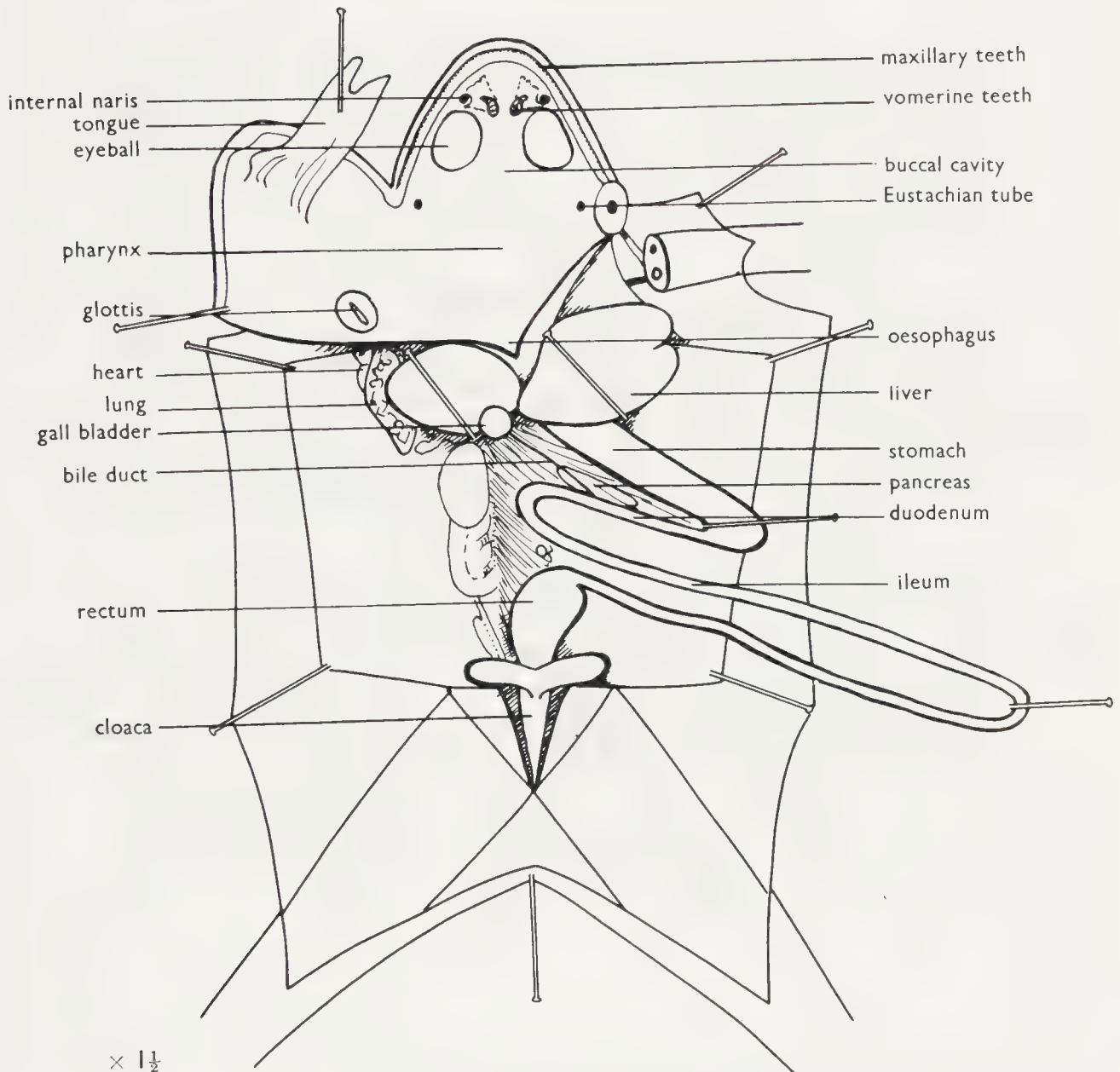
Puncture the ovisacs. Press out the eggs through as small a hole as possible.

Note. It is not necessary to empty the ovisacs completely. A few eggs left inside help to keep the collapsed ovisacs distinct from the mesenteries.

Add water and continue the dissection as from Fig. 14.

Appendix IV

The Alimentary Canal displayed completely



Open up the body cavity. The ligaturing of the anterior abdominal vein may be omitted and a median cut made instead..

Remove the ventral portions of the pectoral and pelvic girdles.

Cut through the angle of the jaw on one side.

Display the alimentary canal as shown above.

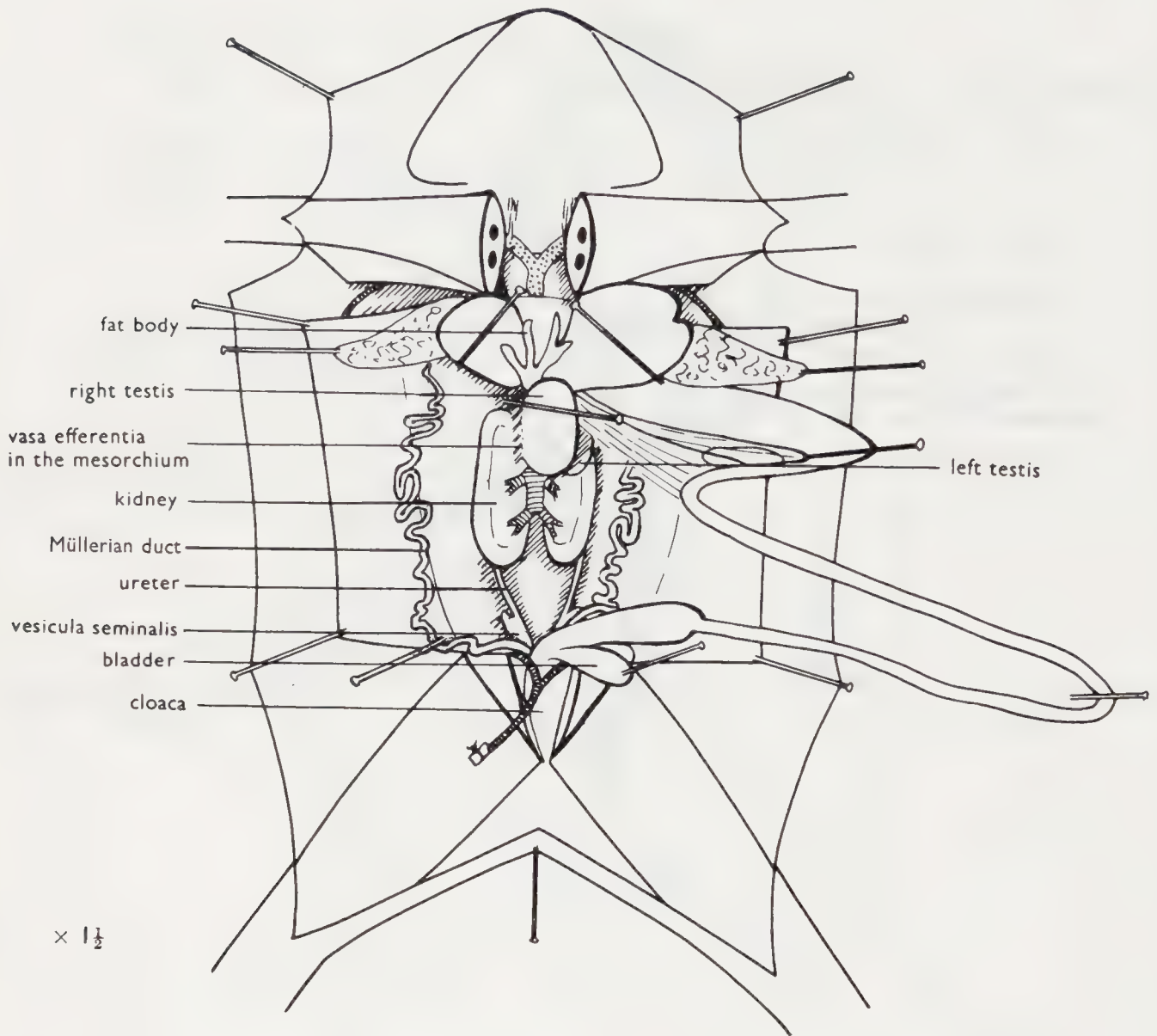
References—Stomach and Intestine, Figs. 14 & 15.

Cloaca, Figs. 16–18.

Buccal cavity and Pharynx, Figs. 46 & 47.

Appendix V

Rana Pipiens—Male Urino-Genital System



Proceed with the dissection as directed for *R. temporaria* up to Fig. 15.

Pin out the ileum to **your right**.

Observe the Mullerian ducts which are homologous with the oviducts of the female but smaller and lacking in lumen. If necessary place pins to hold the ducts aside so that the ureters and small vesiculae seminales are visible.

Expose the cloaca as directed in Figs. 16 and 17.

Pin the right testis over on top of the left one, by means of a pin against but not through the testis.

Pin the bladder aside.

Cut the mesentery which holds the rectum. This is a continuation of the process started in Fig. 14. Adjust the pins to hold the alimentary canal well aside.

DRAW.

III

THE RAT

As type specimen for mammalian dissection rat, guinea-pig and rabbit are all equally suitable, but as the rat is now most frequently used, the complete procedure for it only is included in this volume. This procedure is applicable to the guinea-pig though it differs from the rat in a number of minor details (cf. mouse), e.g. in the shape of the seminal vesicles, absence of coagulating glands and larger caecum. The rabbit, however, differs from the rat sufficiently to make alternative instructions necessary in places. These are given in an appendix.

The dissection of the rat falls into three sections, (*a*) the contents of the abdomen, (*b*) the contents of the thorax and the neck, (*c*) the brain. For the first two of these sections the rat should be attached ventral side uppermost to a wooden dissecting board. Large wooden- or brass-handled pins are used for this purpose, but a supply of ordinary pins will be found useful for holding the various structures in place during the display.

With the exception of the brain, dissection is best performed on a freshly-killed specimen. Especially is this so for display of the alimentary canal and the diaphragm.

Before the brain is dissected the nervous tissue **MUST** be hardened with preservative. To hasten the penetration of the brain by the formalin a small section of the roof of the skull may be removed, see Figs. 43-46.

N.B.—When dissecting a freshly-killed rat there is always much capillary bleeding. The blood should be kept mopped up with a cloth so that the structures retain their own shade of colour and do not become uniformly reddened and thus more difficult to identify. Owing to great variability in the amount of fat and in the position of some of the blood-vessels it is impossible to show the same degree of exactitude as in the drawings of the frog and dogfish. Wherever it occurs 'masking' fat should be removed with **BLUNT** forceps.

The standard scale as seen in Fig. 1 is about two-thirds the size of an average rat.

ORDER OF DISSECTION OF RAT

	<i>figs.</i>	<i>pages</i>
General directions in preparation for dissection of the abdomen, thorax or neck	1-3	127-129
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(b) <i>The alimentary canal</i>	5-9	132-137
(c) <i>The solar plexus</i>	10-12	138-140
(d) <i>Removal of the alimentary canal</i>	12	140
(e) <i>The male urinogenital system</i>	13-16	141-143
(f) <i>The female urinogenital system</i>	17 & 18	144-145
(g) <i>The blood-vessels of the abdomen</i>	19a & 19b	146-147
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(d) <i>Examination of the heart and lungs isolated</i>	35-42	157-160
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3 The Urinogenital System	A9-10	175-177
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THE RAT—General Directions in Preparation for Dissection of the Abdomen, Thorax or Neck

If the dissection is to be completed on a freshly-killed specimen, the skin need only be laid back as shown in Figs. 1-3. Even if preservative is to be used it is not essential to remove the skin of the rat, though it is desirable to do so in the case of the more furry mammals—see inset to Fig. 3.

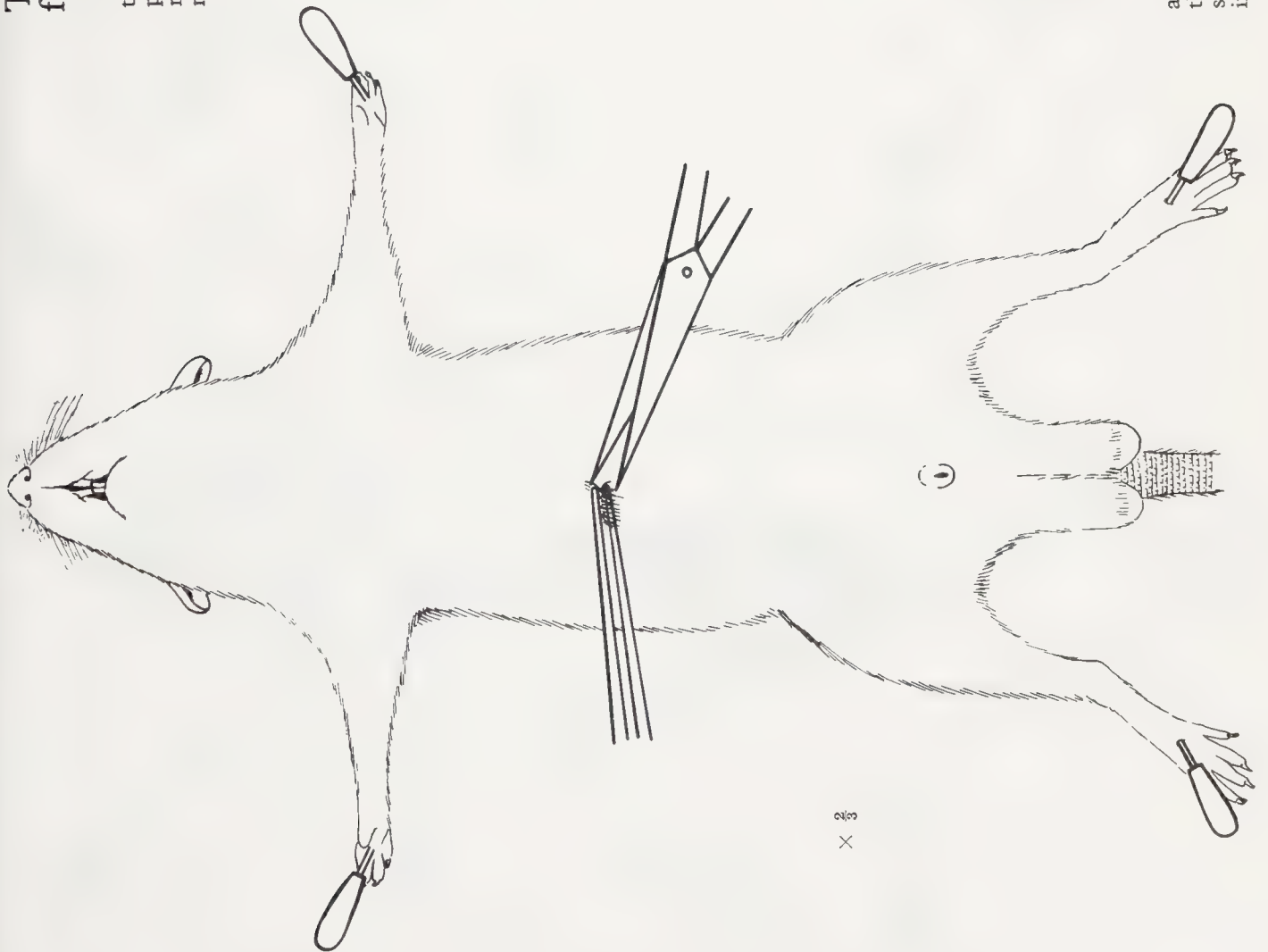


Fig. 1

Lay the rat ventral side uppermost on a dissecting board and attach it in spread-eagle position by means of strong dissecting pins through the fore- and hind-feet. Place each pin at an angle to the strain put on it. Lift the skin in the mid-ventral line and cut as indicated.

THE RAT—General directions in preparation

Fig. 2a. Male

Slit the skin along the mid-ventral line.
N.B. Keep the scissors as horizontal as possible to avoid cutting the body-wall under the skin.
Continue the cut forwards to the level of the lower lip and backwards around the penis and between the scrotal sacs.

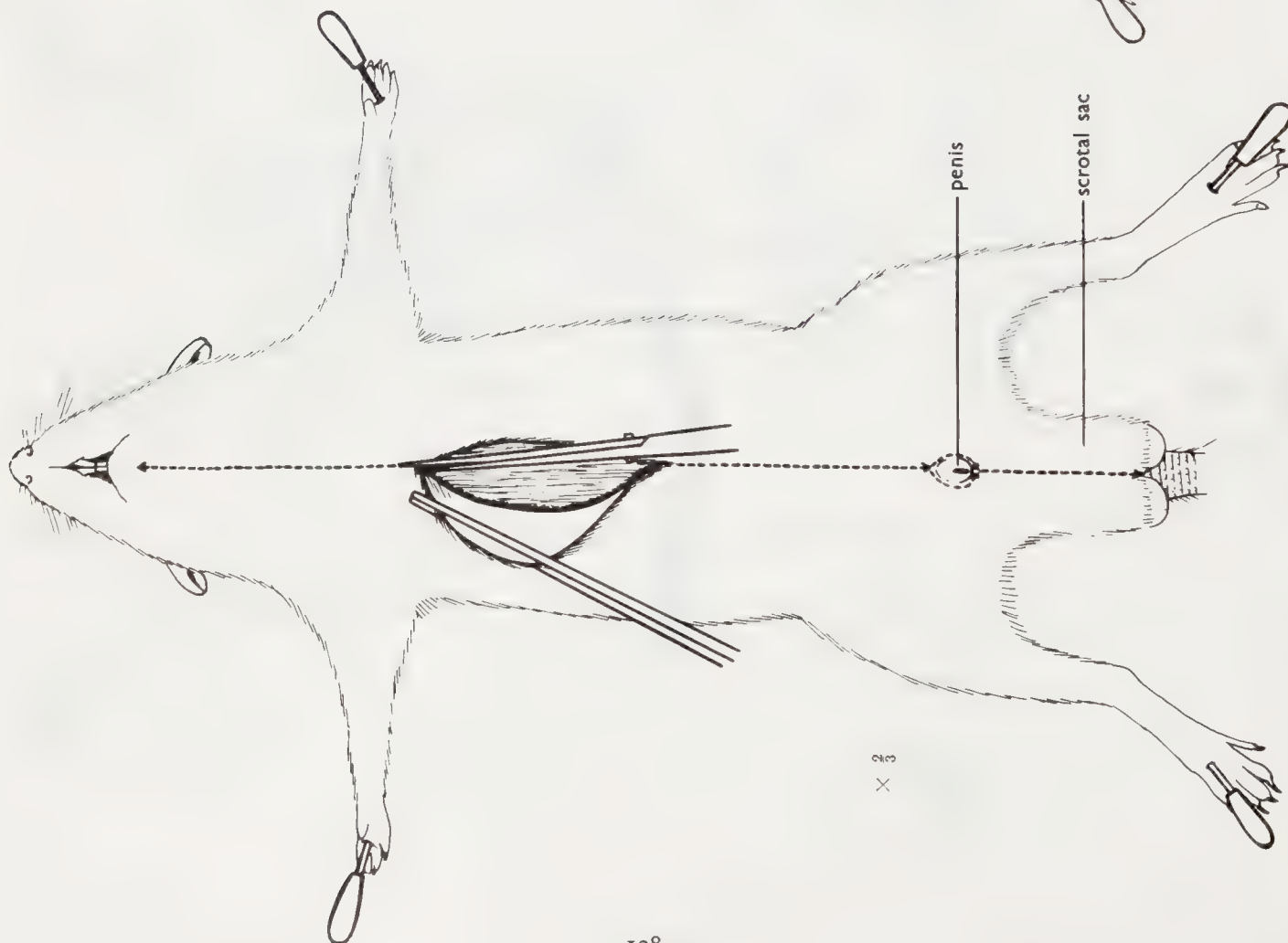
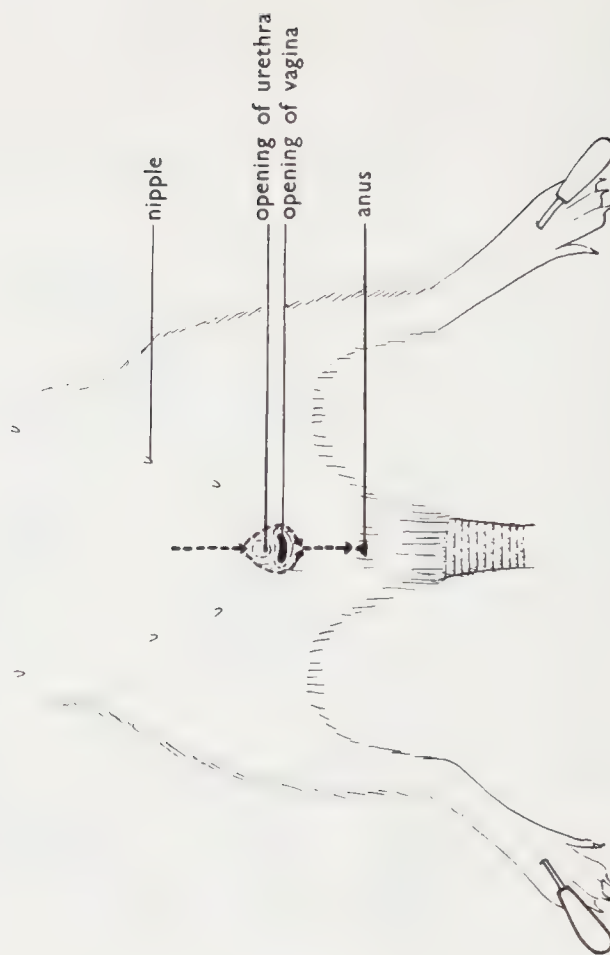
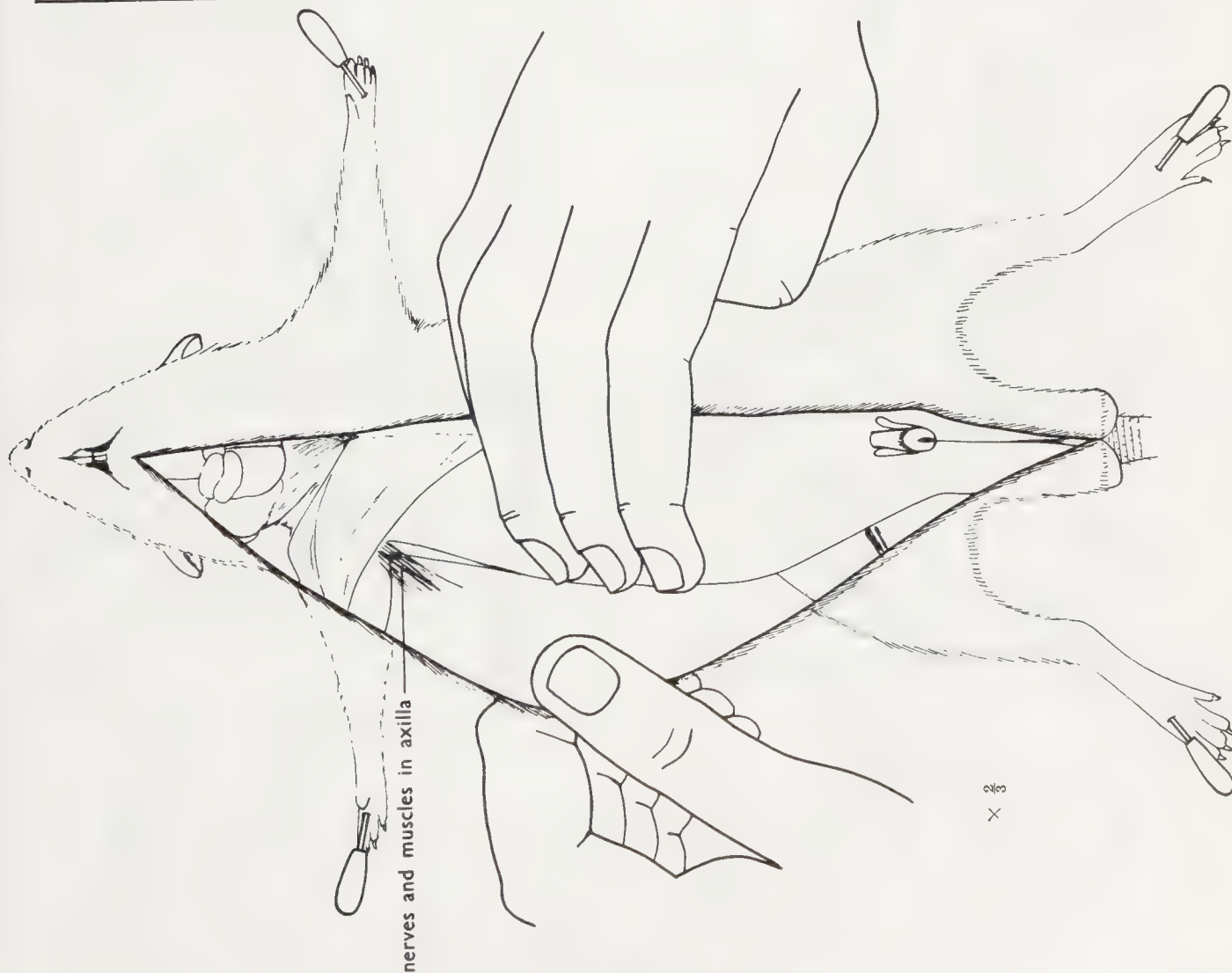


Fig. 2b. Female

Cut the skin as described for the male, but continue the cut backwards as far as the anus, passing on either side of the urinary and genital apertures.





INSET TO FIG. 3

If the skin is to be removed completely proceed as follows.

Remove the skin from the fore-limbs by turning it inside out and pulling on the elbow as shown. Pull the skin off as far down the paw as will come easily. Cut or tear it away, leaving only a little fur on the paw itself.

Repeat the process on the hind limbs.

Cut away the tail at its base.

Cut off the pinnae.

Remove as much of the fur from the head as will come easily by the same process of turning the skin inside out.

N.B. When skinning the neck be careful not to rupture the jugular veins.

Fig. 3

Pull aside the skin, loosening it from the body-wall by using the fingers as shown.

N.B. Be careful not to tear the nerves and muscles in the axillary region.

THE RAT—Section I The Abdomen

(a) OPENING UP THE ABDOMINAL CAVITY

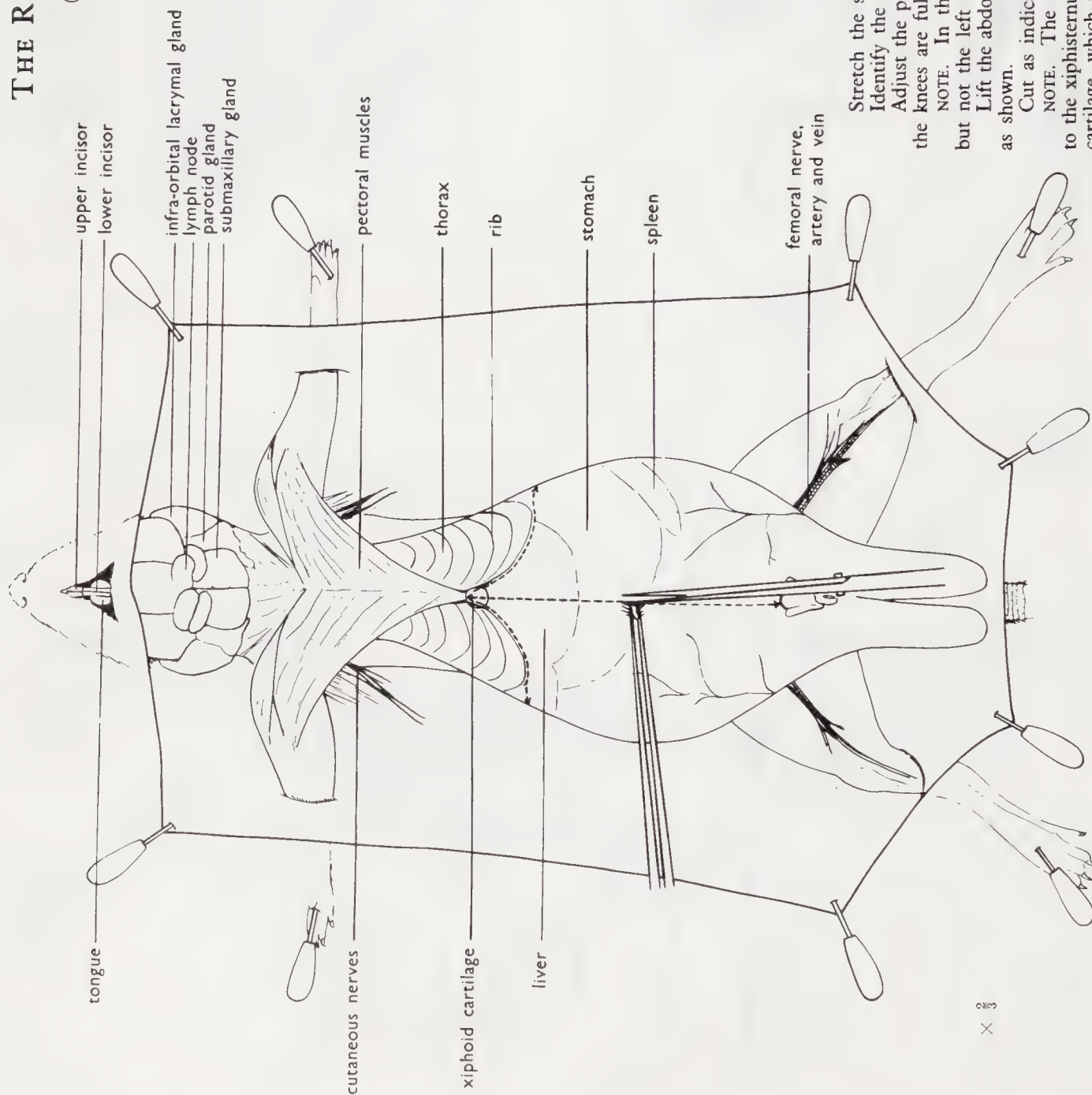


Fig. 4a. Male

Stretch the skin and pin it back as shown.

Identify the parts labelled.

Adjust the positions of the pins through the legs so that the knees are fully extended.

NOTE. In the diagram this has been done on the right but not the left side to show the difference.

Lift the abdominal wall with forceps and make an incision as shown.

Cut as indicated by the dotted lines.

NOTE. The muscles of the abdominal wall are attached to the xiphisternum. They can be lifted clear of the xiphoid cartilage, which is therefore not cut.

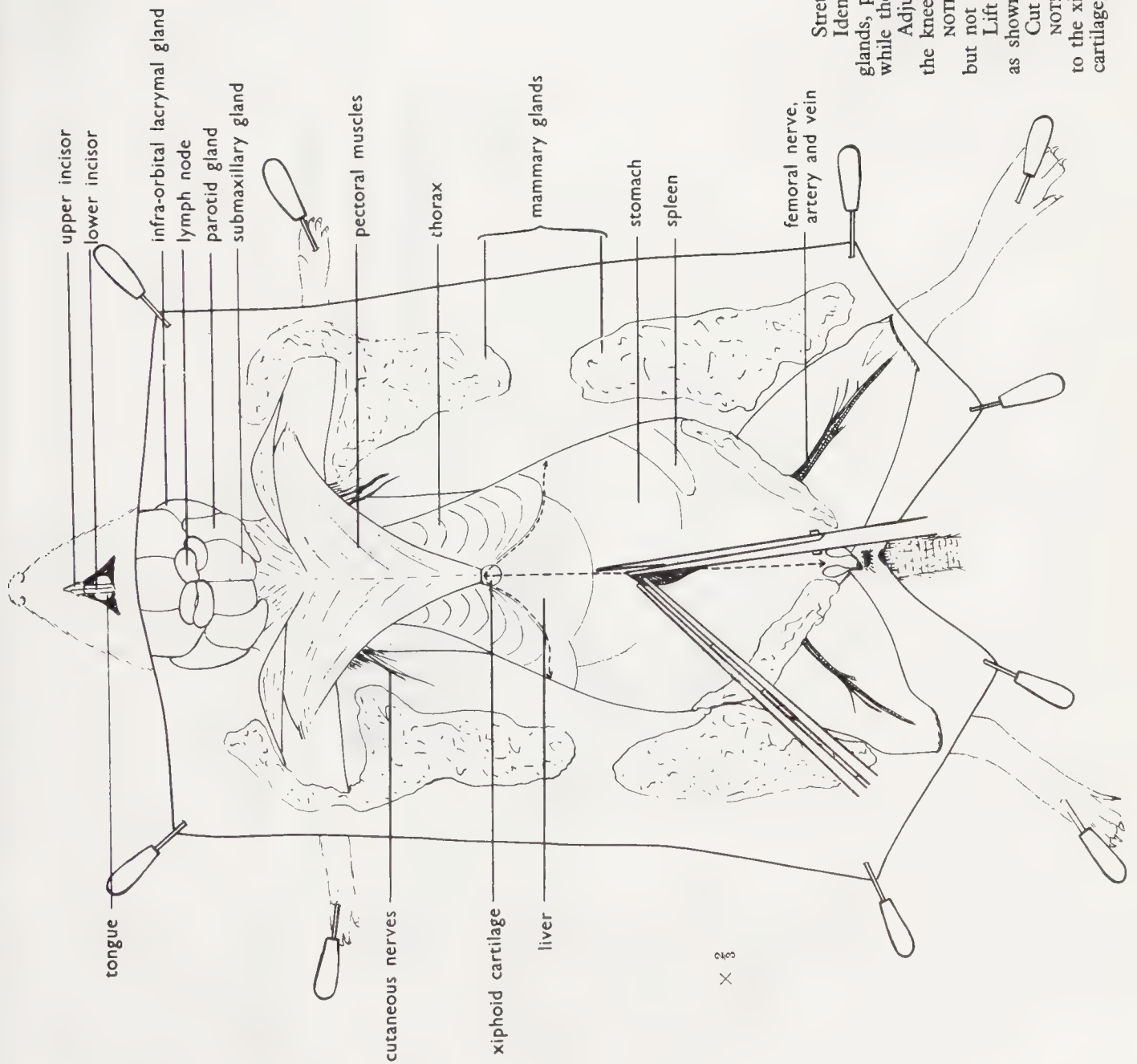


Fig. 4b. Female

Stretch the skin and pin it out as shown.

Identify the parts labelled, noticing especially the mammary glands, parts of which usually remain in the inguinal region while the rest comes away with the skin.

Adjust the positions of the pins through the legs so that the knees are fully extended.

NOTE. In the diagram this has been done on the right but not the left side to show the difference.

Lift the abdominal wall with forceps and make an incision as shown.

Cut as indicated by the dotted lines.

NOTE. The muscles of the abdominal wall are attached to the xiphisternum. They can be lifted clear of the xiphoid cartilage, which is therefore not cut.

THE RAT—*The abdomen*

(b) THE ALIMENTARY CANAL

A male rat is shown throughout this section with the exception of Fig. 5b, but the procedure is identical in the female.

With care, the abdominal parts of the alimentary canal can be displayed without further use of instruments. All that is necessary is the rearrangement of the parts so that they can be seen clearly.

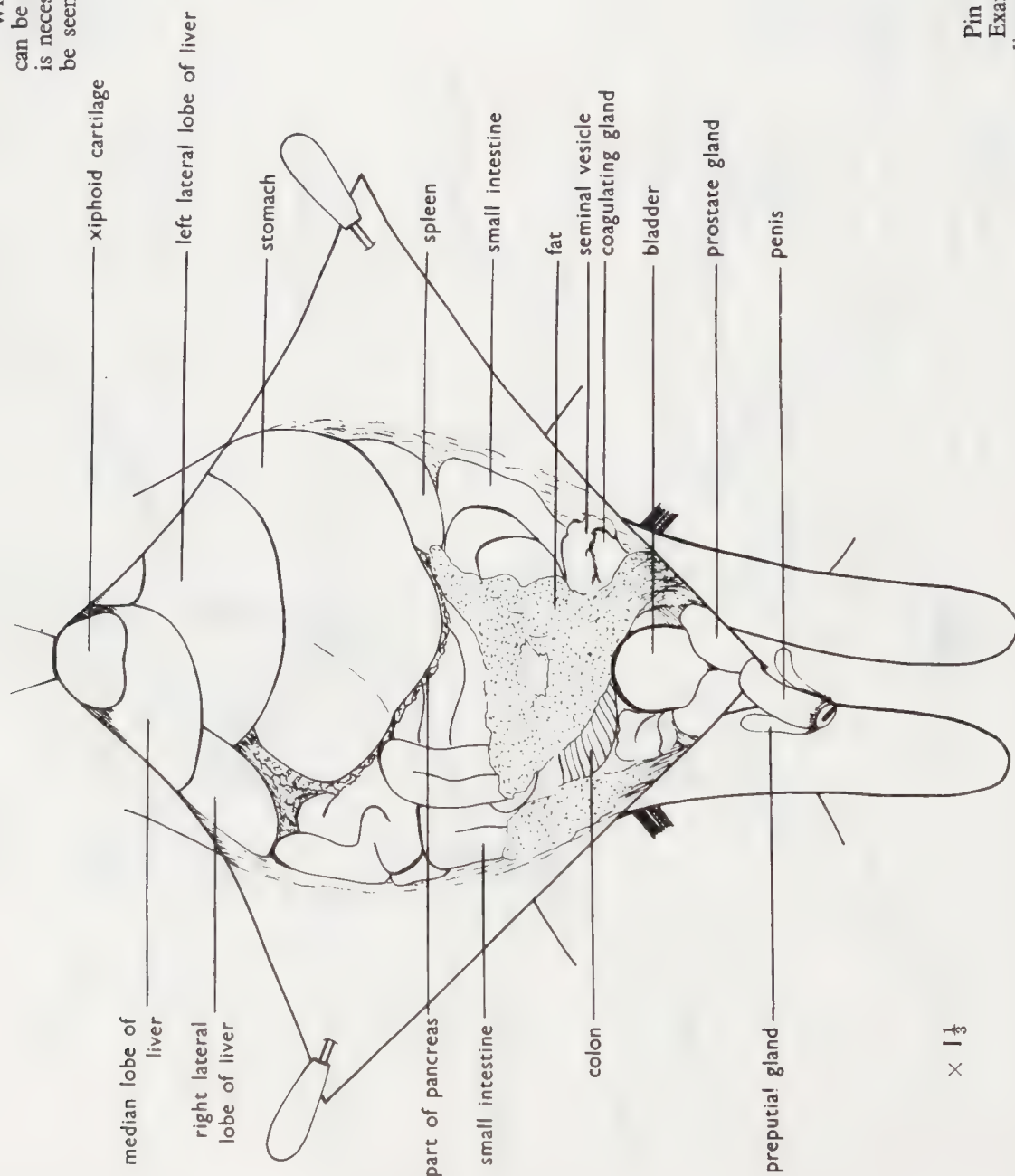


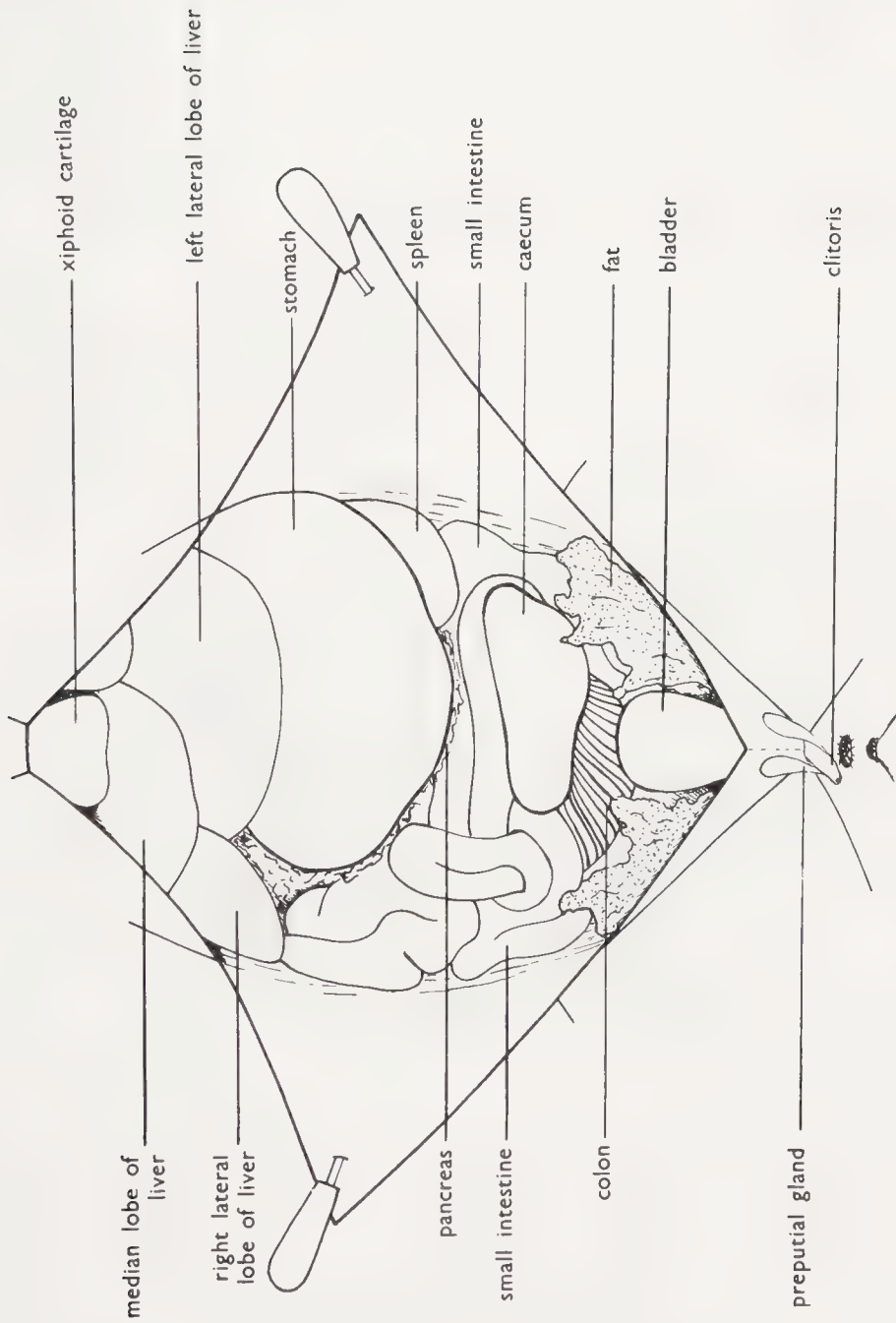
Fig. 5a. Male

Pin aside the abdominal wall.

Examine the contents of the abdominal cavity in the undisturbed condition.

DRAW

× 1½



× 1 $\frac{1}{3}$

Fig. 5b. Female

Pin aside the abdominal wall.

Examine the contents of the abdominal cavity in the undisturbed condition.

DRAW

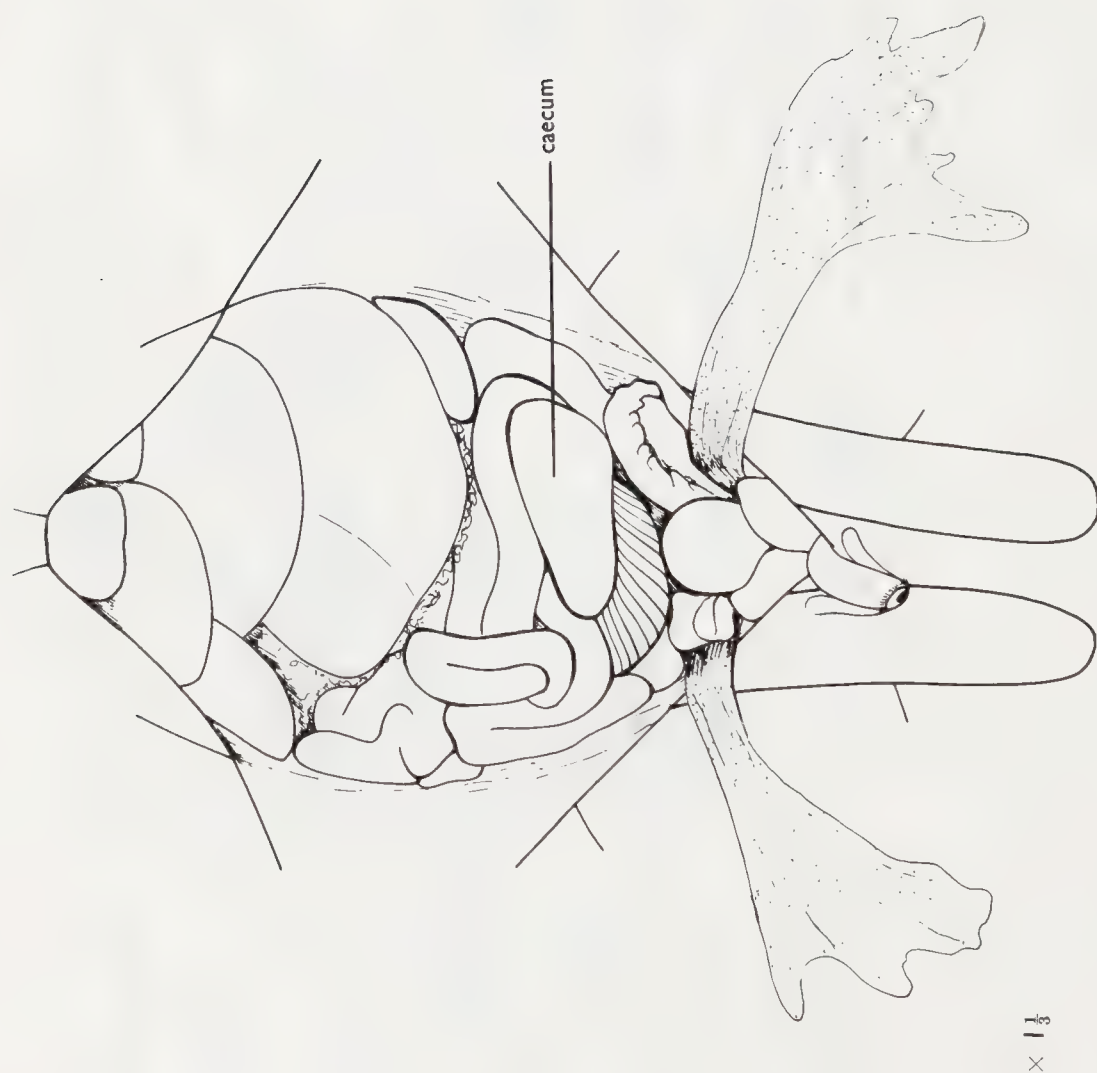


Fig. 6
Lay aside the fat bodies.

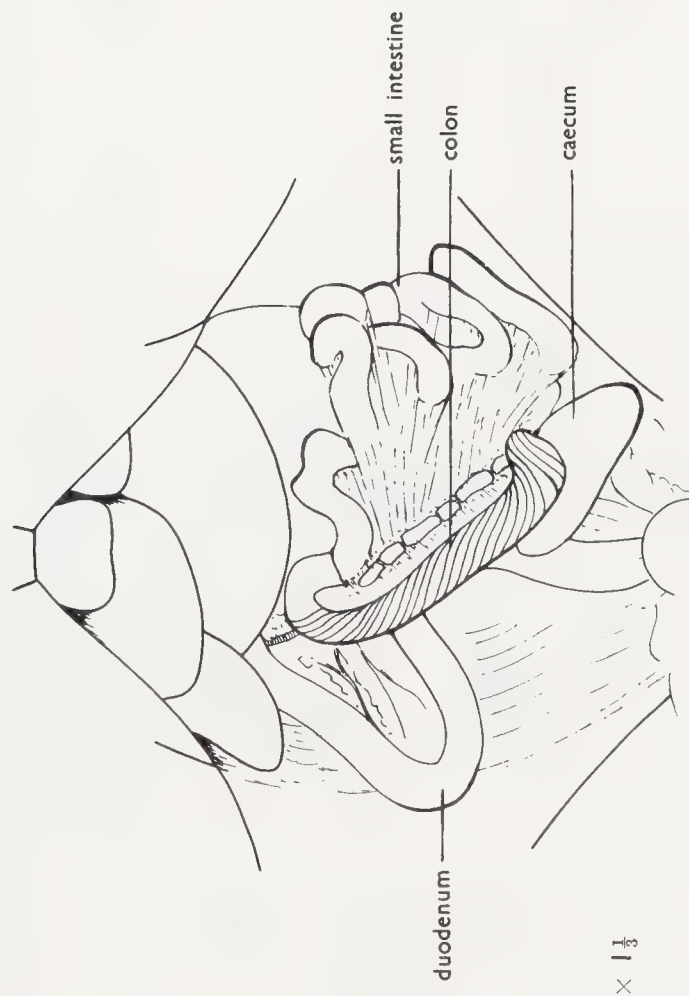
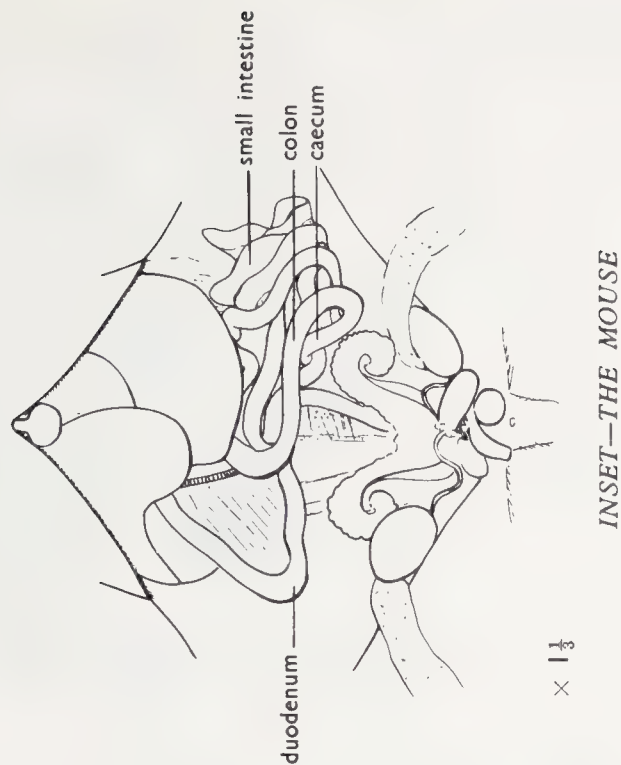
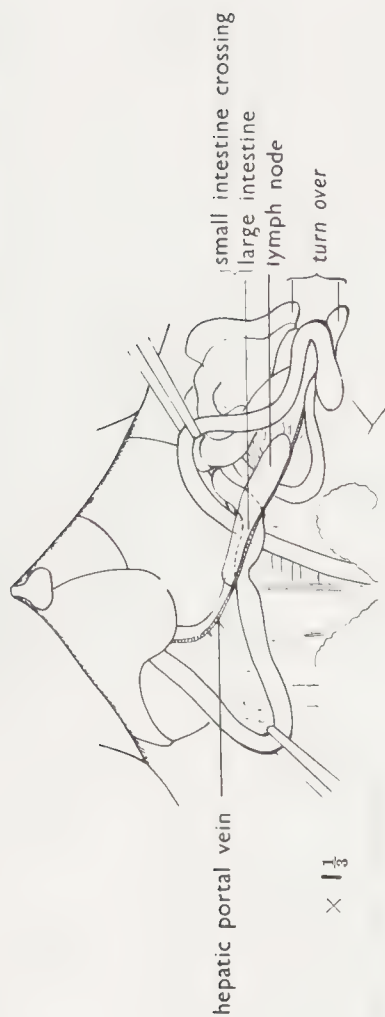


Fig. 7

Move the bulk of the intestines to your right. Find the duodenum and colon.
NOTE. There is some adhesion of their mesenteries.



INSET—THE MOUSE

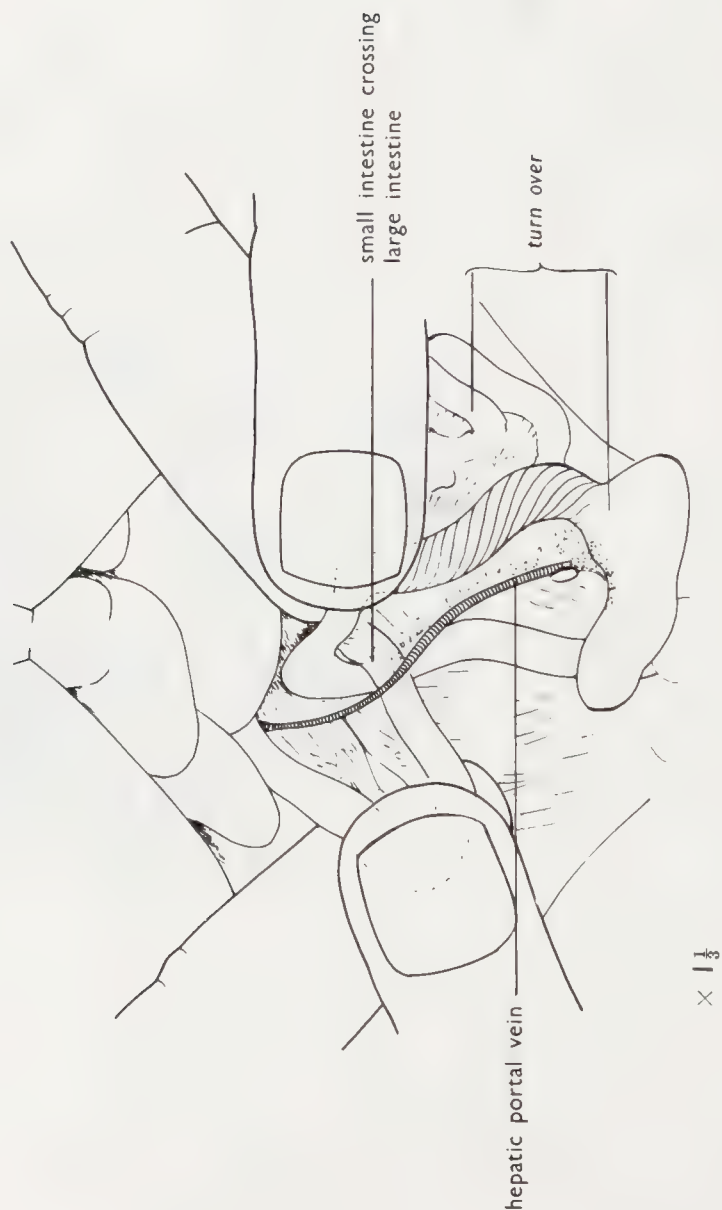
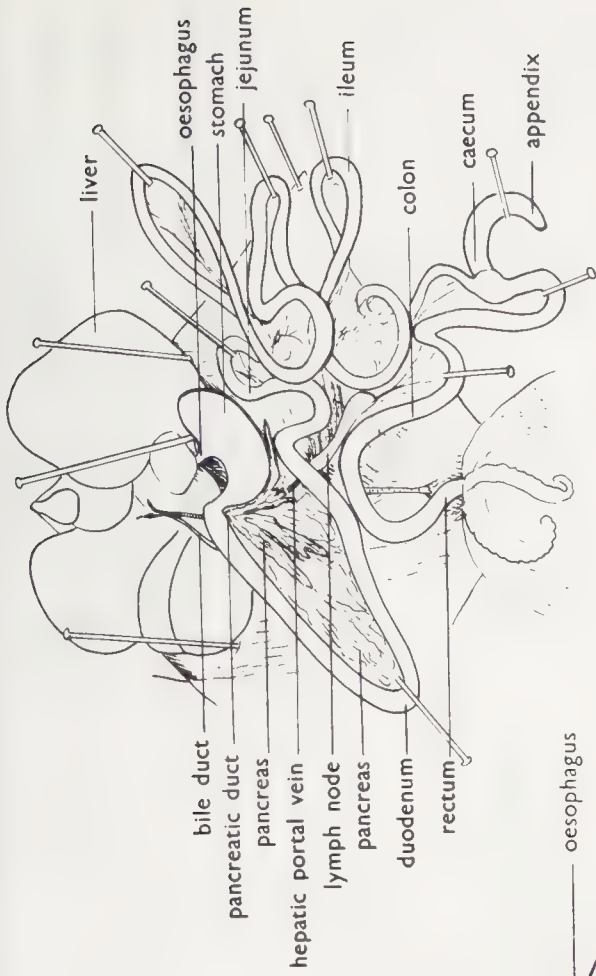
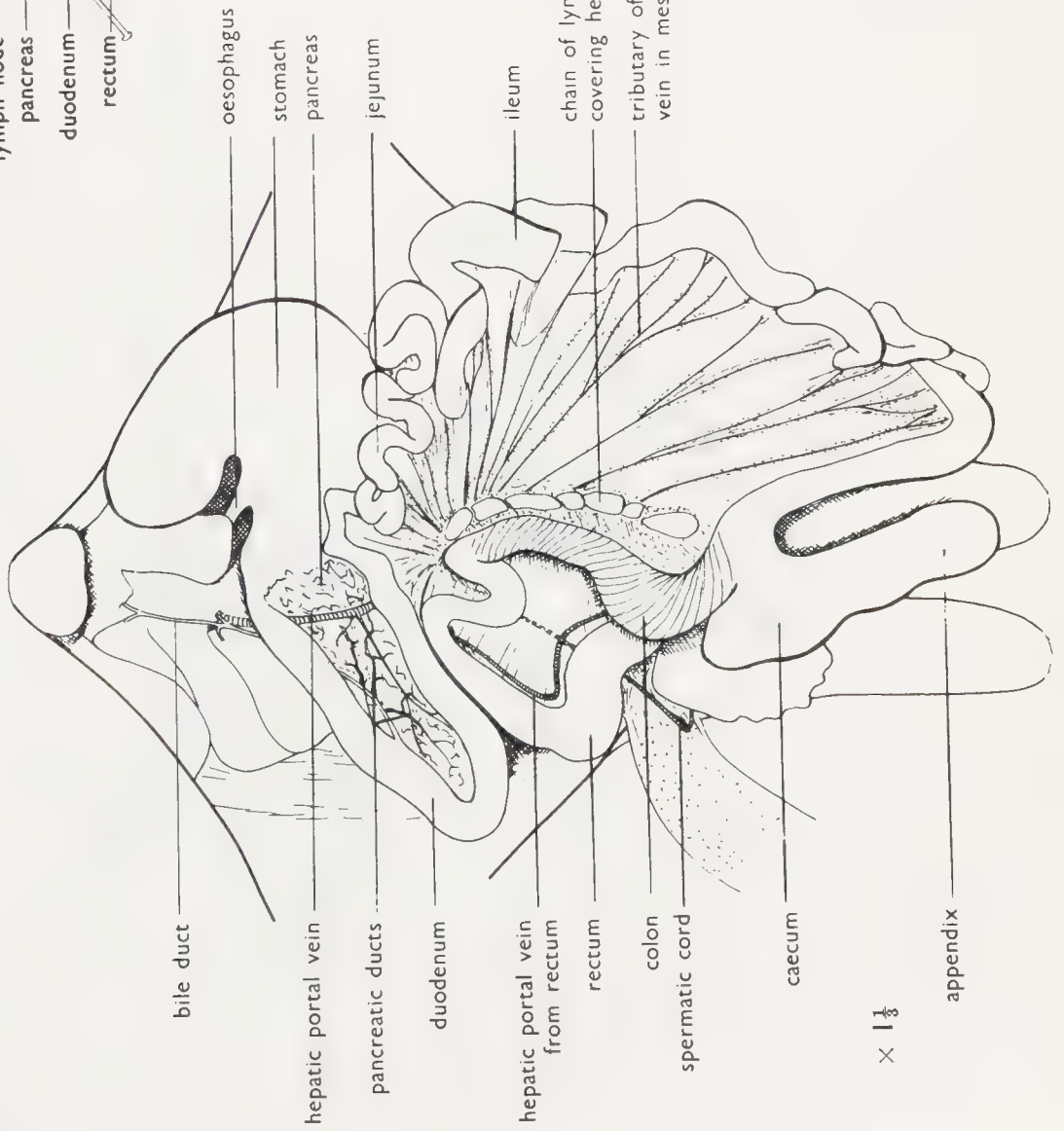


Fig. 8

Grip the duodenum and colon and carefully pull them apart, thus exposing the hepatic portal vein.
 N.B. BE CAREFUL NOT TO TEAR THE MESENTERIES.
 Notice the way in which the small and large intestines are twisted over one another.
 Turn the bulk of the intestines over to undo this twist.

THE RAT—The abdomen



× 1 1/2 INSET—THE MOUSE

Fig. 9

Adjust the positions of the structures as shown.
DRAW

THE RAT—The abdomen

(c) THE SOLAR PLEXUS

The dissection of the solar plexus is often omitted by elementary students, but is not difficult if sufficient care be taken. It is very important to AVOID CAPILLARY BLEEDING as far as possible and to mop up any that may occur.

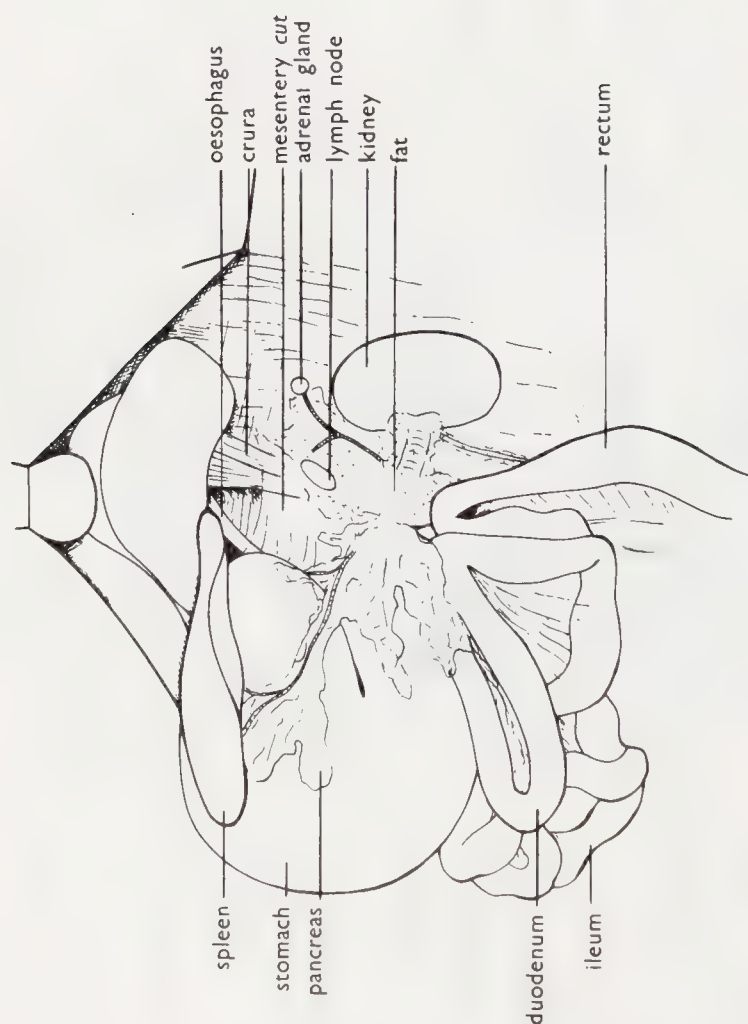


Fig. 10

Lay the stomach and intestines over to the RIGHT SIDE OF THE RAT as shown.

Identify the structures indicated.

NOTE. The amount of fat, and consequently the amount of masking, is very variable.

Cut or tear the mesentery holding the stomach, being careful not to damage any blood-vessels.

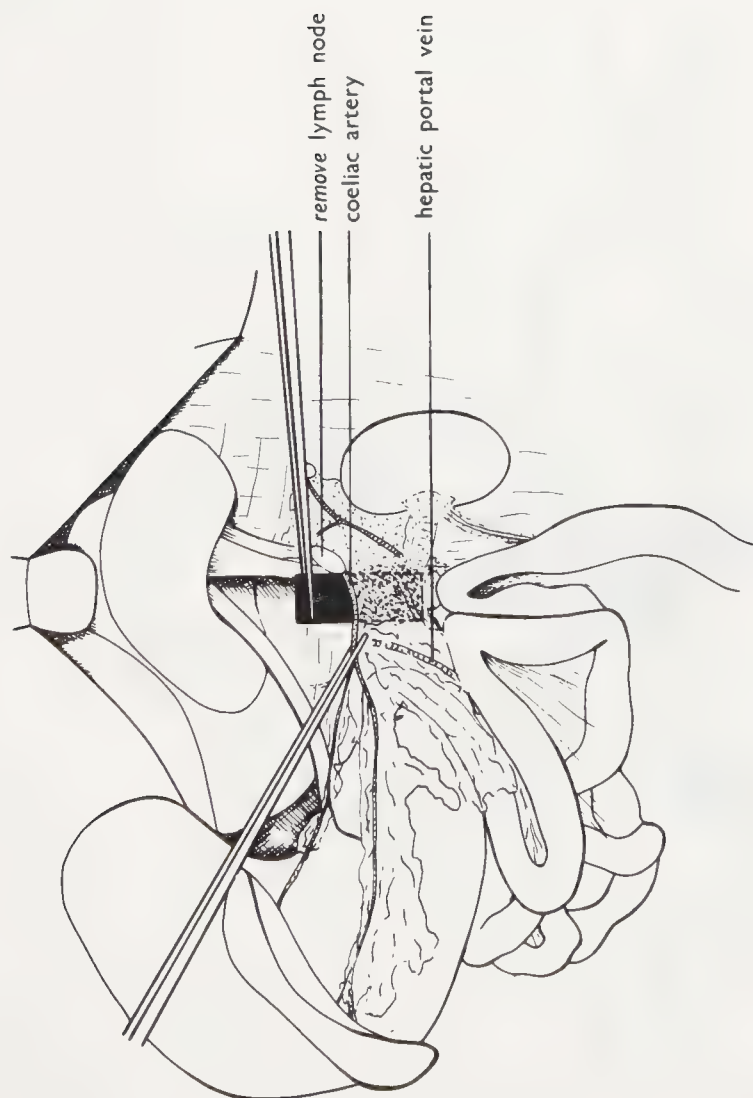


Fig. 11

Adjust the position of the stomach as shown.

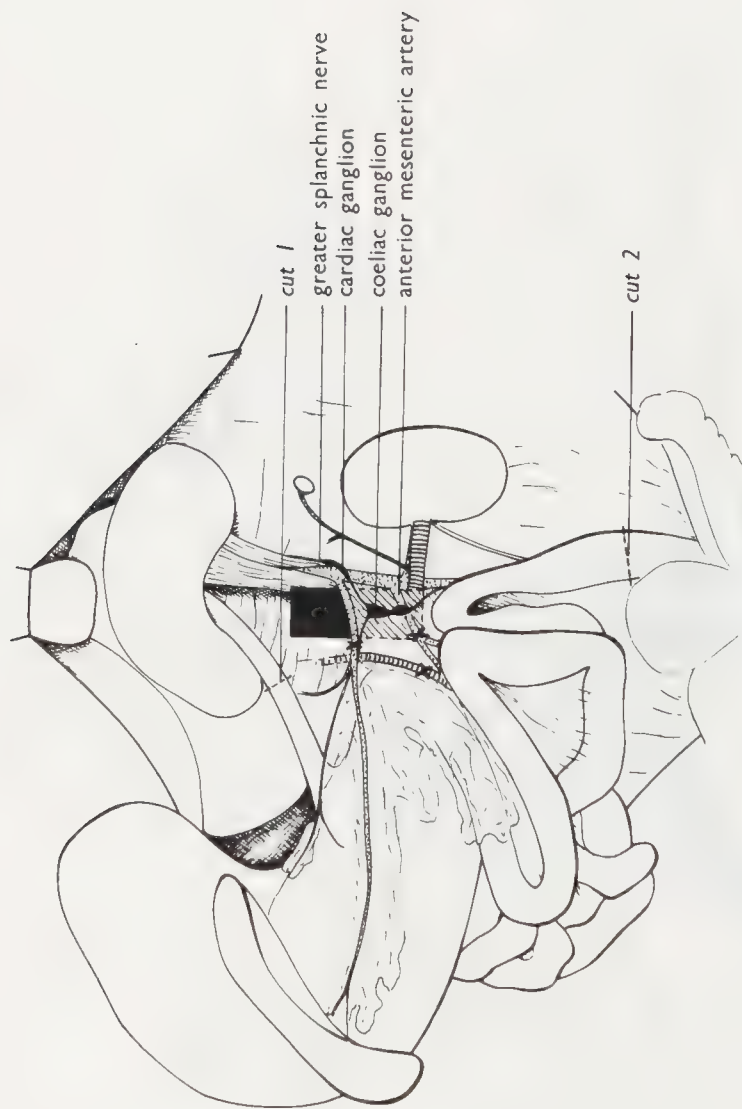
Identify and lift up the coeliac artery.

Insert a small piece of black paper behind the artery and the region immediately posterior to it.

Remove the lymph node with forceps.

With blunt forceps gently pluck away the fat from the area overlying the black paper.

N.B. Watch for the structures shown in Fig. 12.



× 1 1/3

Fig. 12

Observe and **DRAW** the solar plexus.

(d) REMOVAL OF THE ALIMENTARY CANAL

The alimentary canal must be removed before any dissection of the urinogenital system and abdominal blood-vessels.

Ligate the coeliac and anterior mesenteric arteries and the hepatic portal vein in the positions indicated by X. Cut each vessel distal to the ligature.

Cut the oesophagus—cut 1.

Cut the rectum—cut 2.

NOTE. The posterior mesenteric artery will be destroyed if the rectum is cut too near the pelvis.

Gently tear the mesentery to remove the alimentary canal.

THE RAT—*The abdomen*

(e) THE MALE URINOGENITAL SYSTEM

Before dissecting this system the alimentary canal must be removed as shown in Fig. 12.

There is considerable variation in the amount and fat and also in the finer details of the distribution of blood-vessels which, though they are shown in the following diagrams, need not be cleared till later.

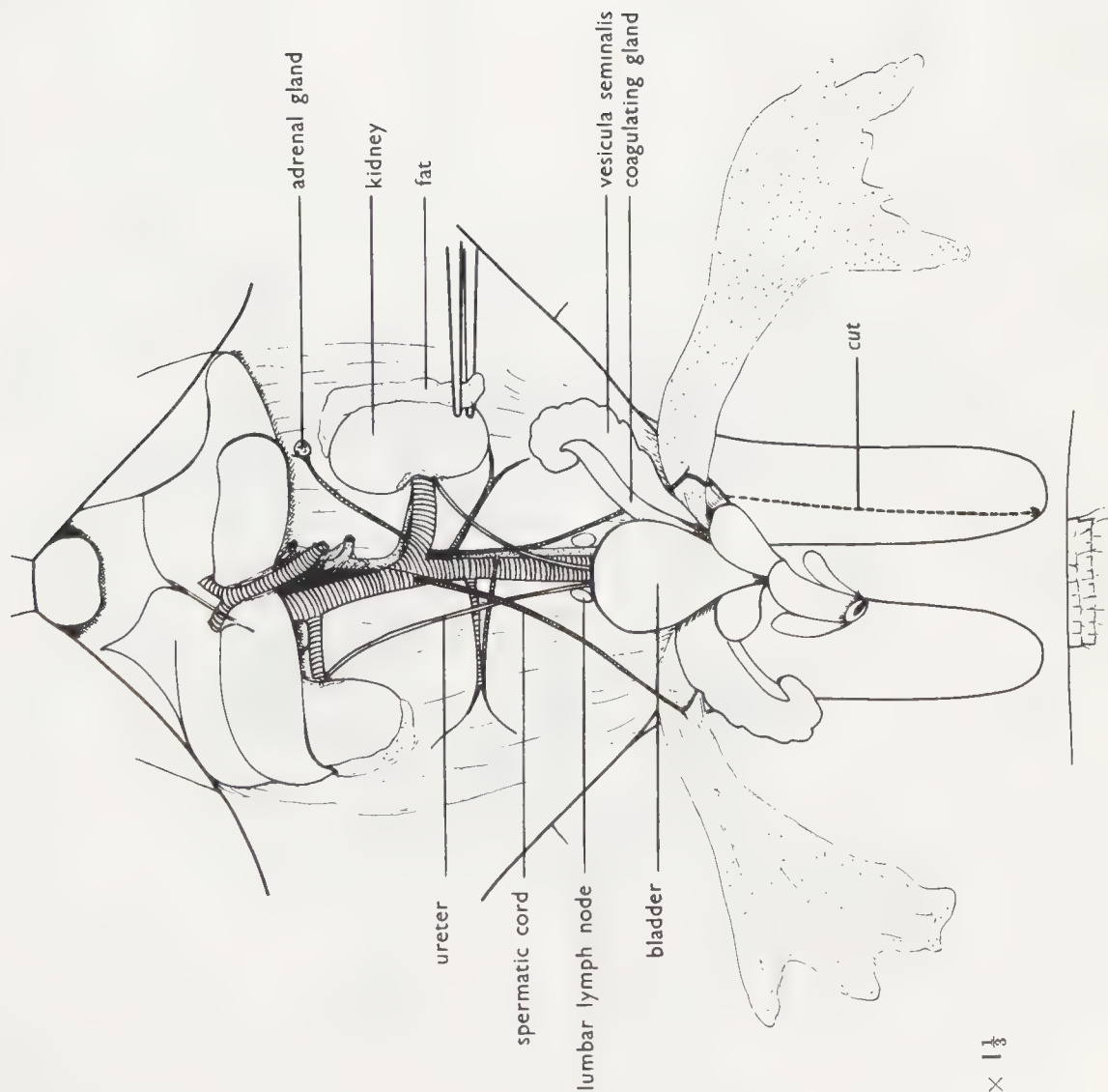


Fig. 13

Remove the fat from the kidneys, using blunt forceps as shown.

Similarly clear the ureters.

Cut through the ventral wall of the scrotal sac along the line indicated.

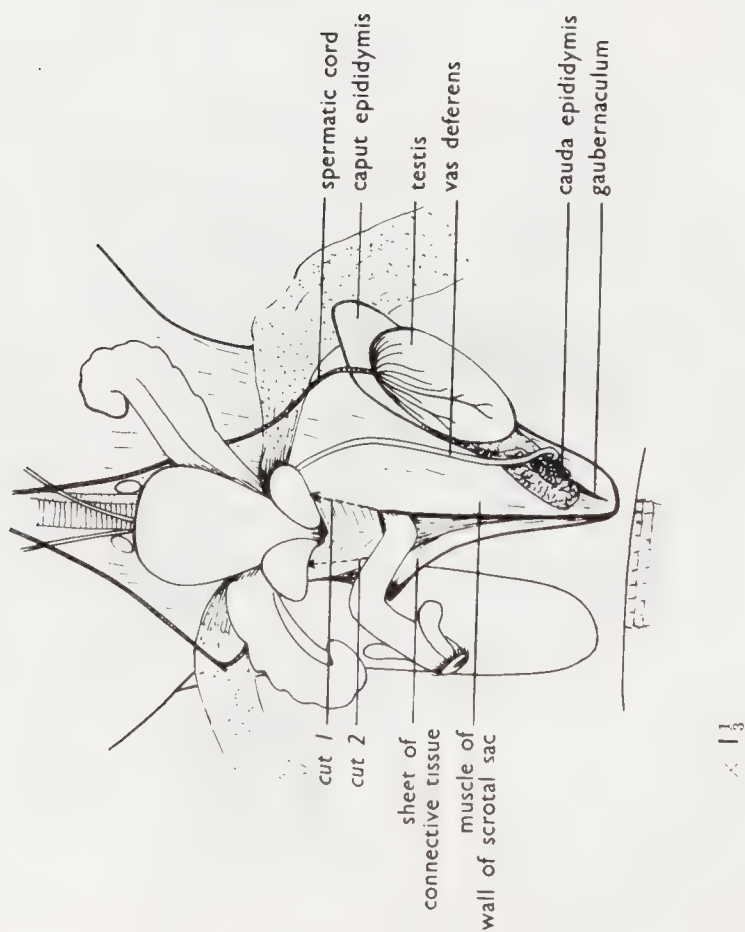


Fig. 14

Open the scrotal sac and display the contents as shown. Cut through the pelvic girdle—cuts 1 and 2. N.B. Keep the points of the scissors well up.

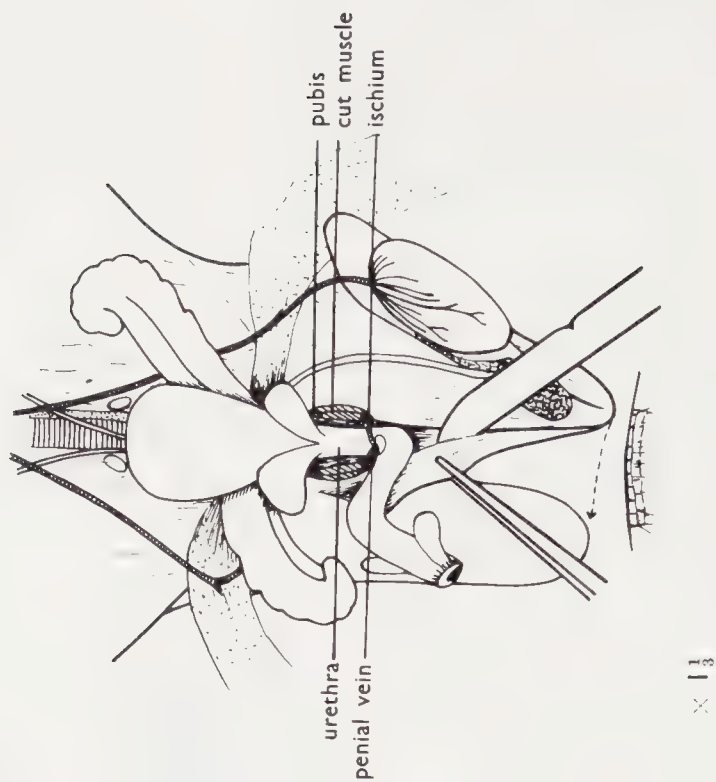


Fig. 15

Remove the connective tissue from the region between the scrotal sacs sufficiently to expose the anal canal and the muscles around the end of the rectum—see Fig. 16.

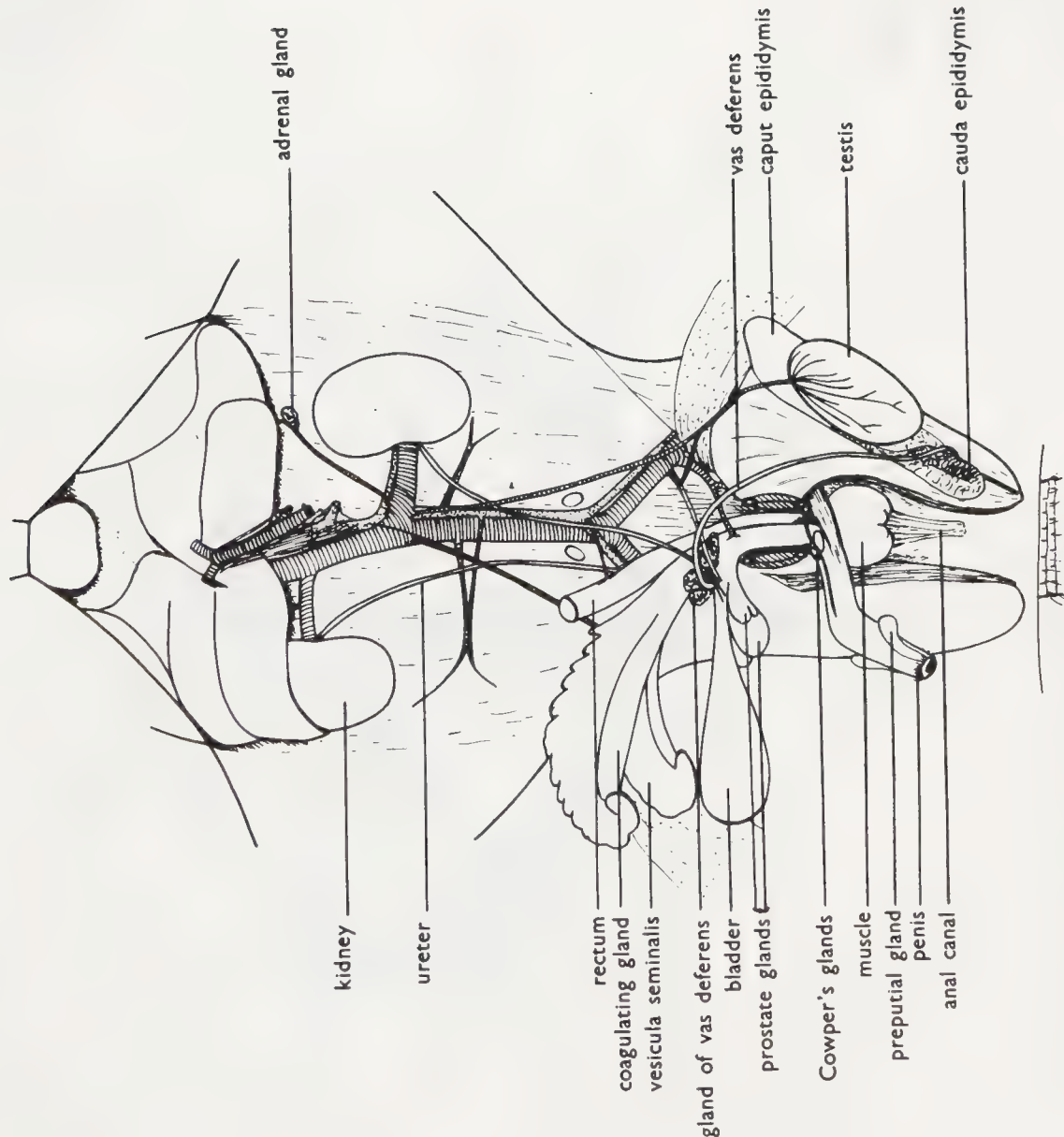


Fig. 16

Lay the bladder to one side.
Lay the seminal vesicles, coagulating glands and prostate glands over to the SAME side.
With a needle or fine forceps carefully loosen the structures from one another till they can be displayed as shown.

DRAW

THE RAT—The abdomen

(f) THE FEMALE URINOGENITAL SYSTEM

Before dissecting this system the alimentary canal must be removed as shown in Fig. 12.

There is considerable variation in the amount of fat. A pregnant female as shown in Fig. 18 generally has less fat than a non-pregnant one.

There is also variation in the finer details of the distribution of the blood-vessels which, though they are shown in the following diagrams, need not be cleared till later.

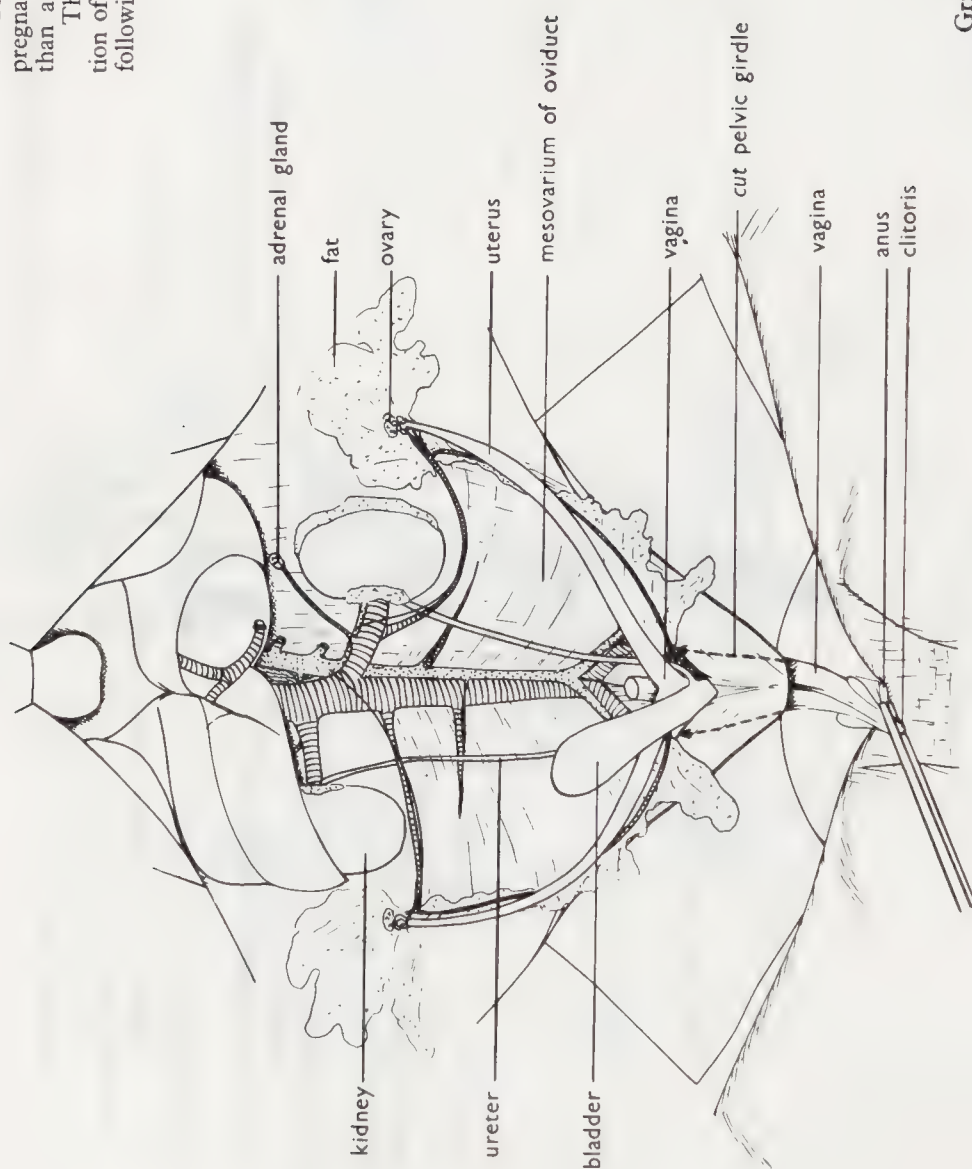


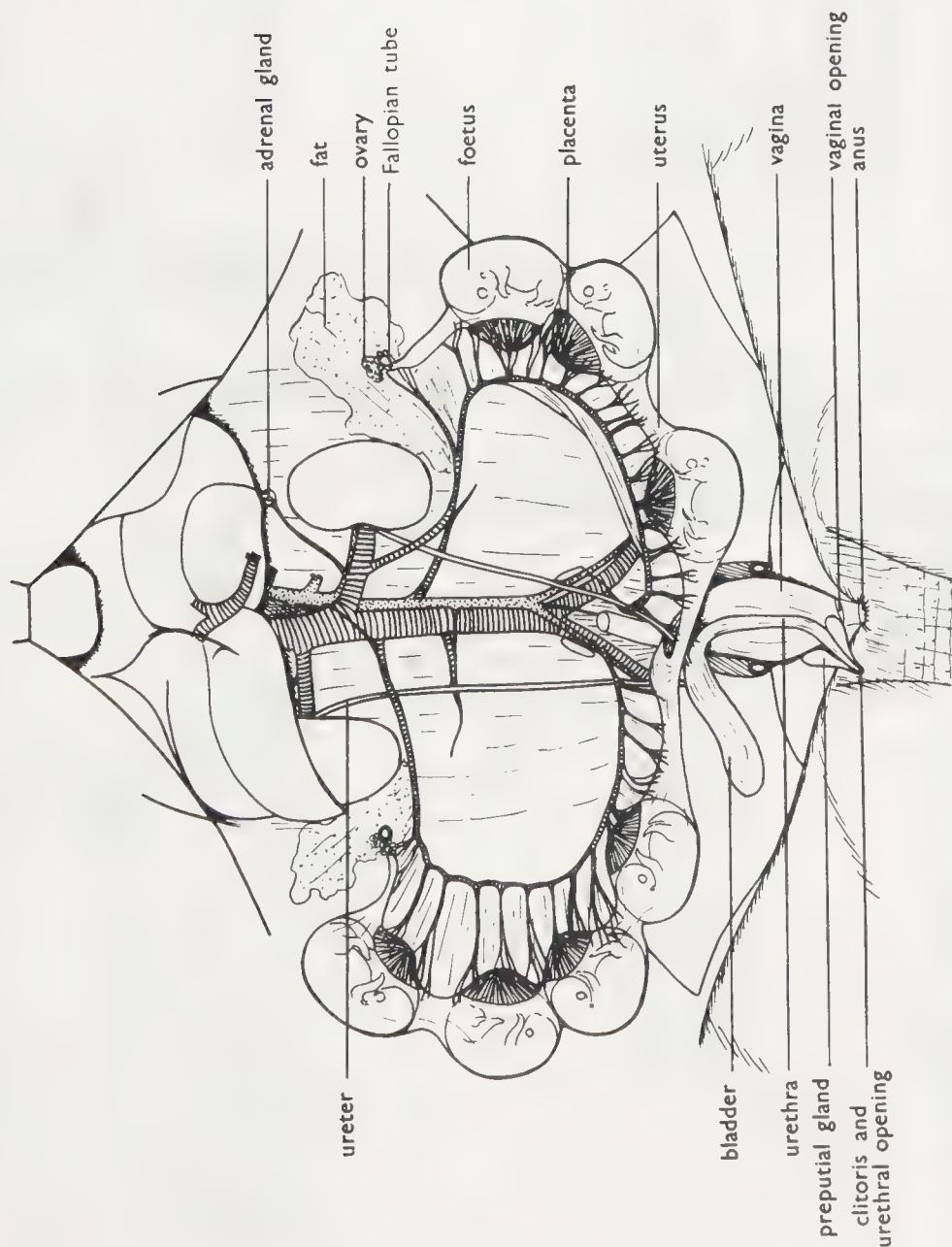
Fig. 17

Grip the clitoris and pull it gently so that the urethra is held away from the pelvis. Cut through the pelvic girdle along the lines indicated. Remove the ventral part of the girdle.

Lift the oviducts and remove the mesovarium from them sufficiently to expose the ureters but DO NOT CUT ANY OF THE BLOOD-VESSELS.

If necessary, remove fat from the kidneys and ureters. Leave the fat around the ovaries and attached to the oviducts, but displace it so that these structures may be observed.

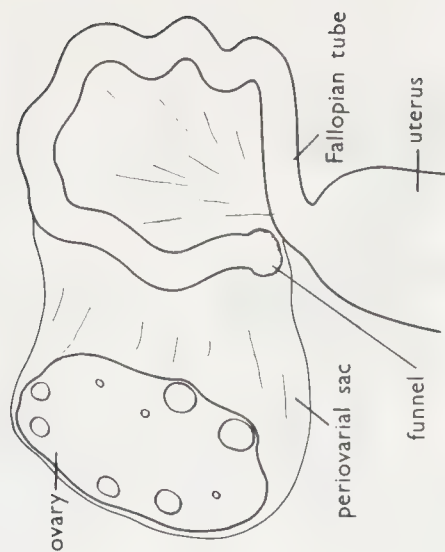
× 1 1/3



× 1 1/3

Fig. 18

Push back the cut edges of the pelvic girdle. Display the uterus of a pregnant female as shown above. NOTE. In a non-pregnant female the uterus is best left as shown in Fig. 17. DRAW



c. × 13

THE FALLOPIAN TUBE

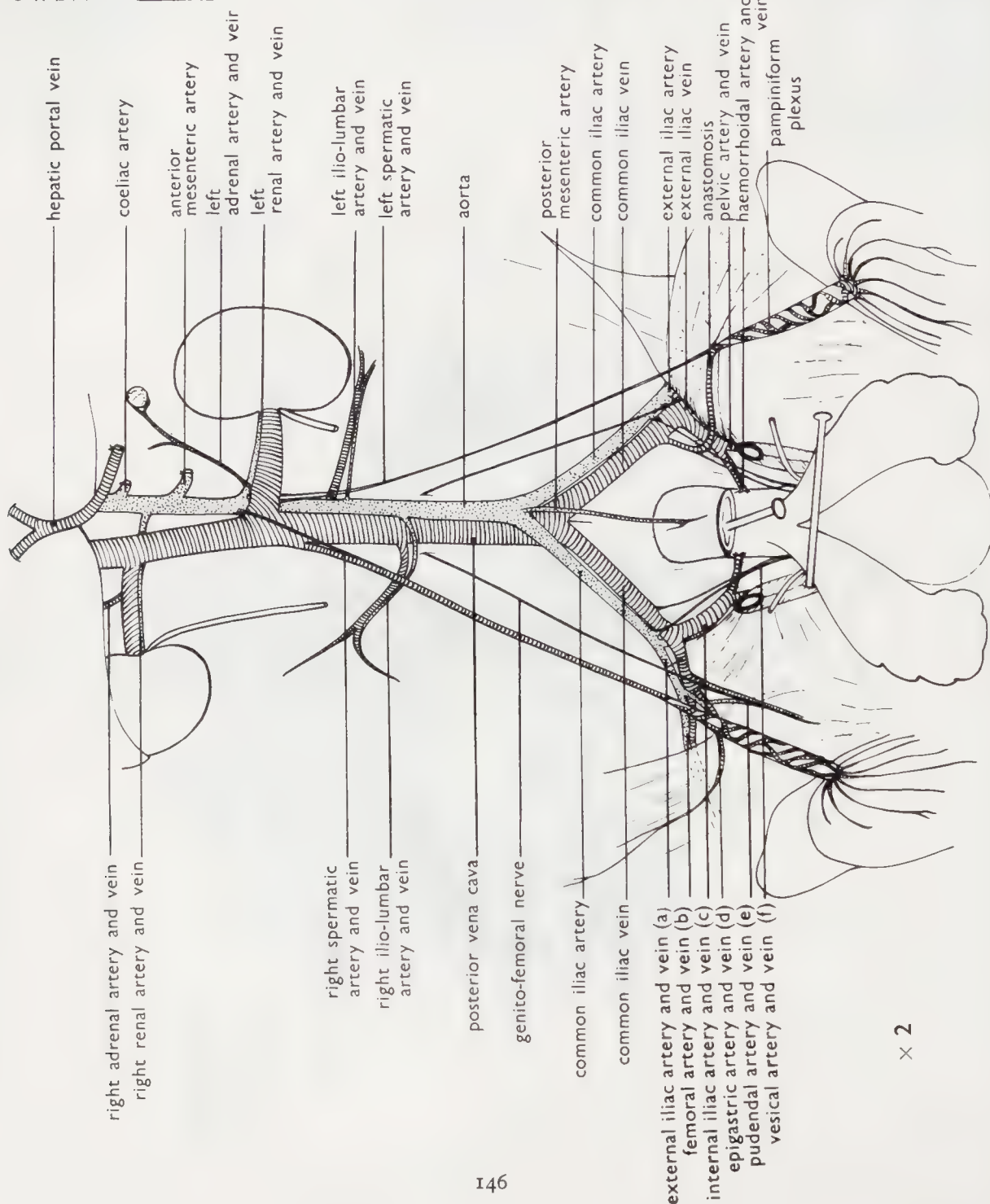
The ovary is enclosed within a thin-walled ovarian sac. The Fallopian tube is very small and much coiled. Its opening from the ovarian sac cannot be seen with the naked eye. It should be examined with the aid of a microscope AFTER completion of the examination of the blood-vessels—see Fig. 19b.

Cut the uterus about half an inch from the Fallopian tube and take out both tube and ovary together. Mount them on a slide, straightening out the coils of the tube as much as possible. Observe and DRAW

THE RAT—*The abdomen*

(g) THE BLOOD-VESSELS OF THE ABDOMEN

Before the blood-vessels of the abdomen can be fully displayed the alimentary canal must be removed as shown in Fig. 12 and the pelvic girdle should be cut as shown in Fig. 14 (male) or Fig. 17 (female).



× 2

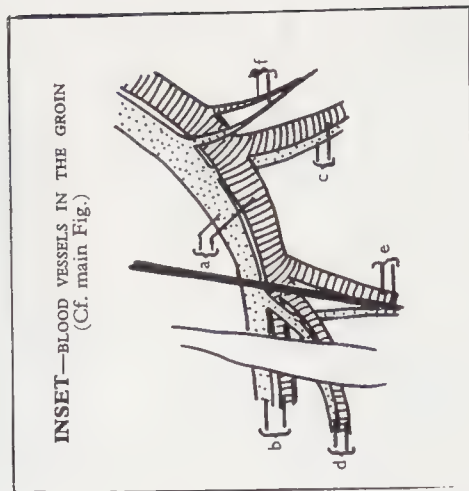


Fig. 19a. Male

Cut the ureters.

Pin the bladder, seminal vesicles and rectum out of the way as shown.

Remove the RIGHT fat body.

The blood-vessels can be traced through the RIGHT groin by easing away the muscle and connective tissue with forceps. Trim with scissors if necessary.

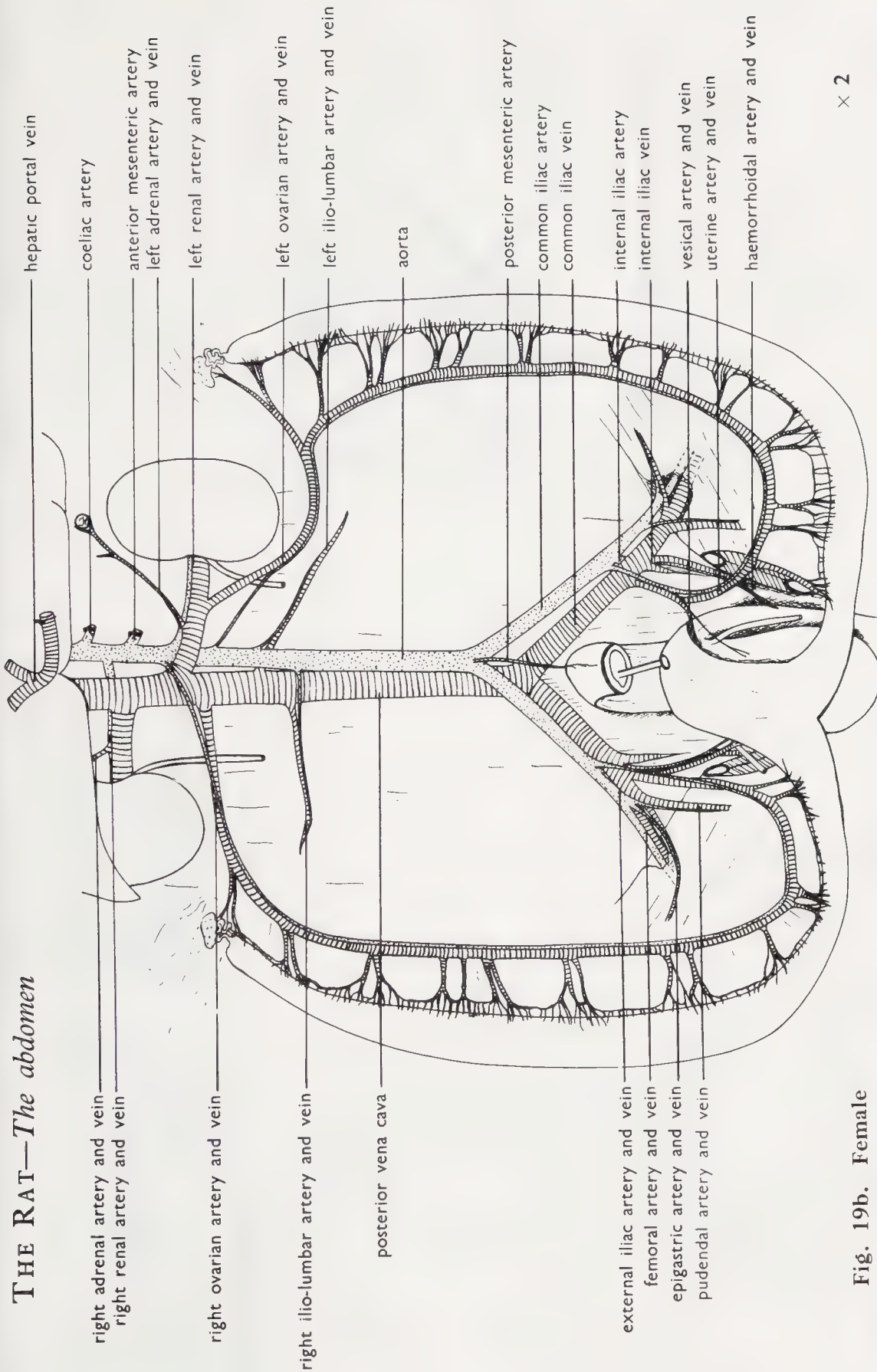
Clear away the remains of the mesentery and fat to display the aorta and posterior vena cava fully.

NOTES. (1) There is a large anastomosis between the pampiniform plexus and the vesical vein on the LEFT side only.

(2) The positions where the ilio-lumbar and spermatic arteries leave the aorta and the corresponding veins meet the posterior vena cava vary. A common condition in which the left spermatic vessels are branches of the left renal vessels is shown.

DRAW

THE RAT—The abdomen



× 2

Fig. 19b. Female

Cut the ureters.
Pin the rectum as shown.
Lay the vagina and bladder as shown, pinning if necessary.
The blood-vessels can be traced through the groin by easing away the muscle and connective tissue with forceps. Trim with scissors if necessary.
Clear away the remains of the mesentery and fat to display the aorta and posterior vena cava fully.
NOTES. (1) In some specimens the aorta passes ventral to the left renal vein.
(2) The position of branching of the iliac arteries is very variable. As shown in the diagram, it is not always the same on the two sides of the same rat, but the branches can easily be identified by tracing their distribution.
DRAW

THE RAT—The Diaphragm

The diaphragm should be examined on a freshly-killed specimen. It hardens and becomes opaque when preserved. Its elasticity and the negative pressure in the thorax cannot then be observed.

Open the abdominal cavity—see Fig. 4.

Remove the alimentary canal—see Fig. 12.

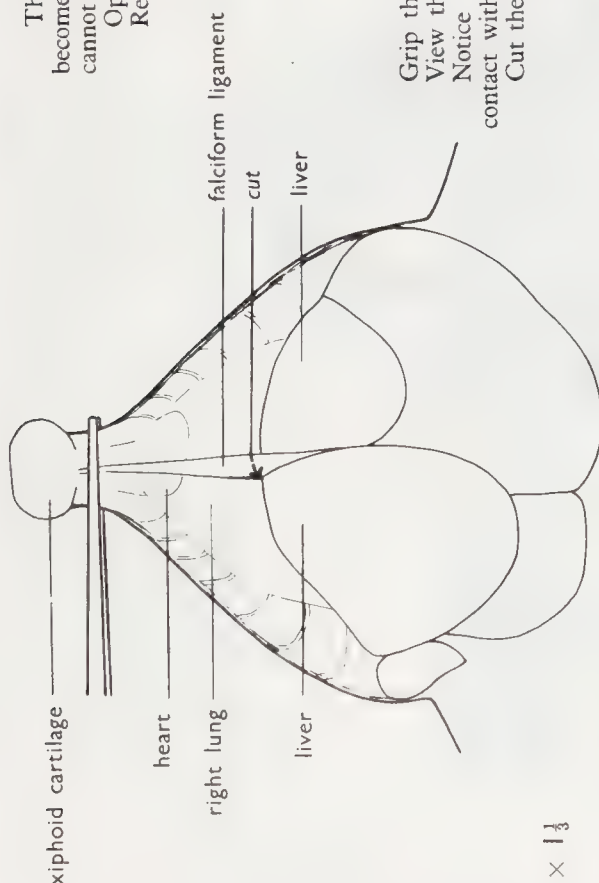


Fig. 20

Grip the xiphoid cartilage and raise it.

View the diaphragm from its posterior surface.

Notice the lungs and heart showing through the diaphragm where it is held in close contact with them by the negative pressure in the thoracic cavity.

Cut the falciform ligament so that the liver can fall further away from the diaphragm.

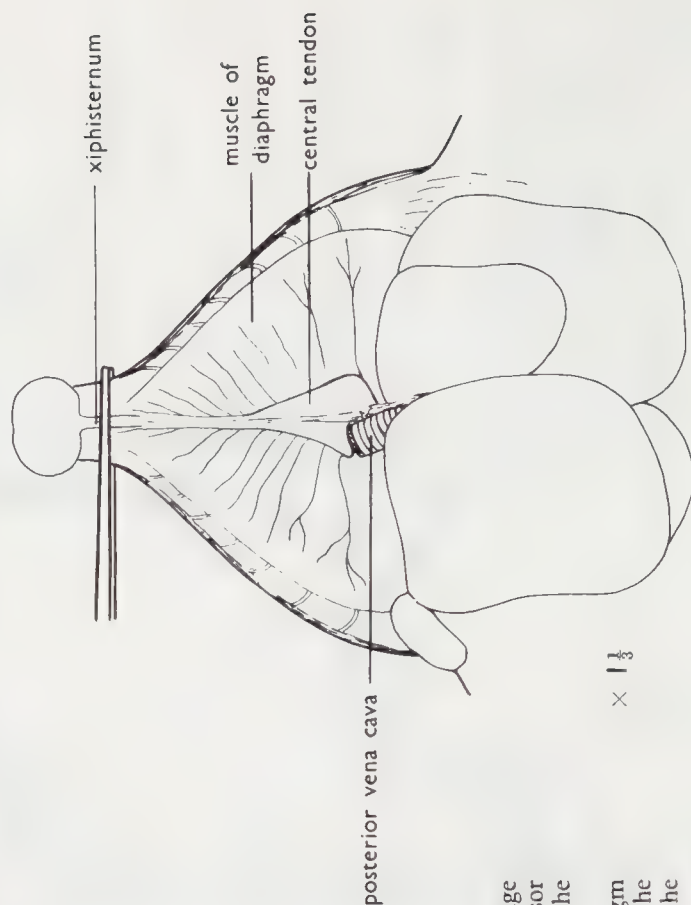


Fig. 21

While holding the xiphoid cartilage well up insert the point of a scissor blade through the side wall of the thorax. Make a small slit.

Notice that AT ONCE the diaphragm springs away from the lung on the CUT SIDE ONLY as the air enters the pleural space.

Repeat to perforate the other pleural cavity.

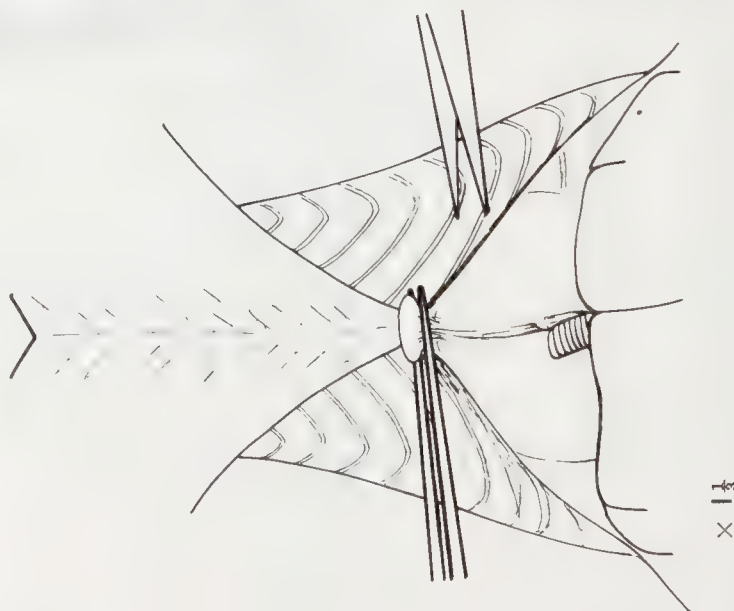


Fig. 22 Observe and DRAW the diaphragm.

THE RAT—Section II The Thorax and Neck

(a) OPENING UP THE THORACIC CAVITY

It is not essential to open the abdomen and remove the alimentary canal before dissecting the thorax, but this is usually done because the material in the canal putrefies very rapidly. If the abdomen is left entire it is not necessary to tie back the diaphragm as shown in Fig. 24.

Remember that ANY BLEEDING from the finer vessels which are inevitably cut MUST BE KEPT MOPPED UP with a soft rag. If this is not done the tissues become uniformly stained and the nerves especially are more difficult to identify.

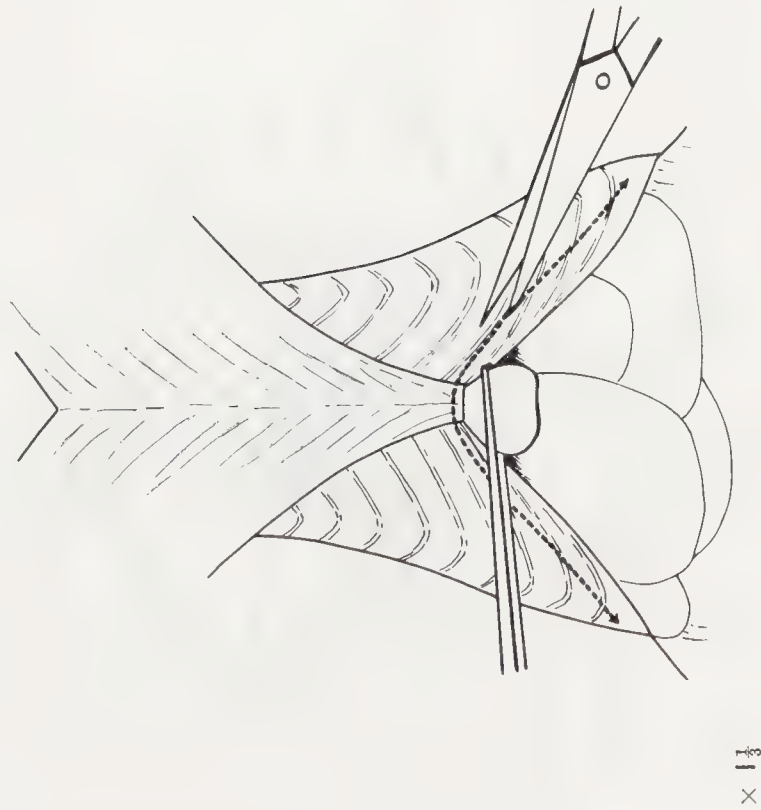


Fig. 23

Grip the xiphoid cartilage, insert a blade of a pair of scissors through the slit already made (see Fig. 21), and cut through the posterior part of the thoracic wall along the line indicated.

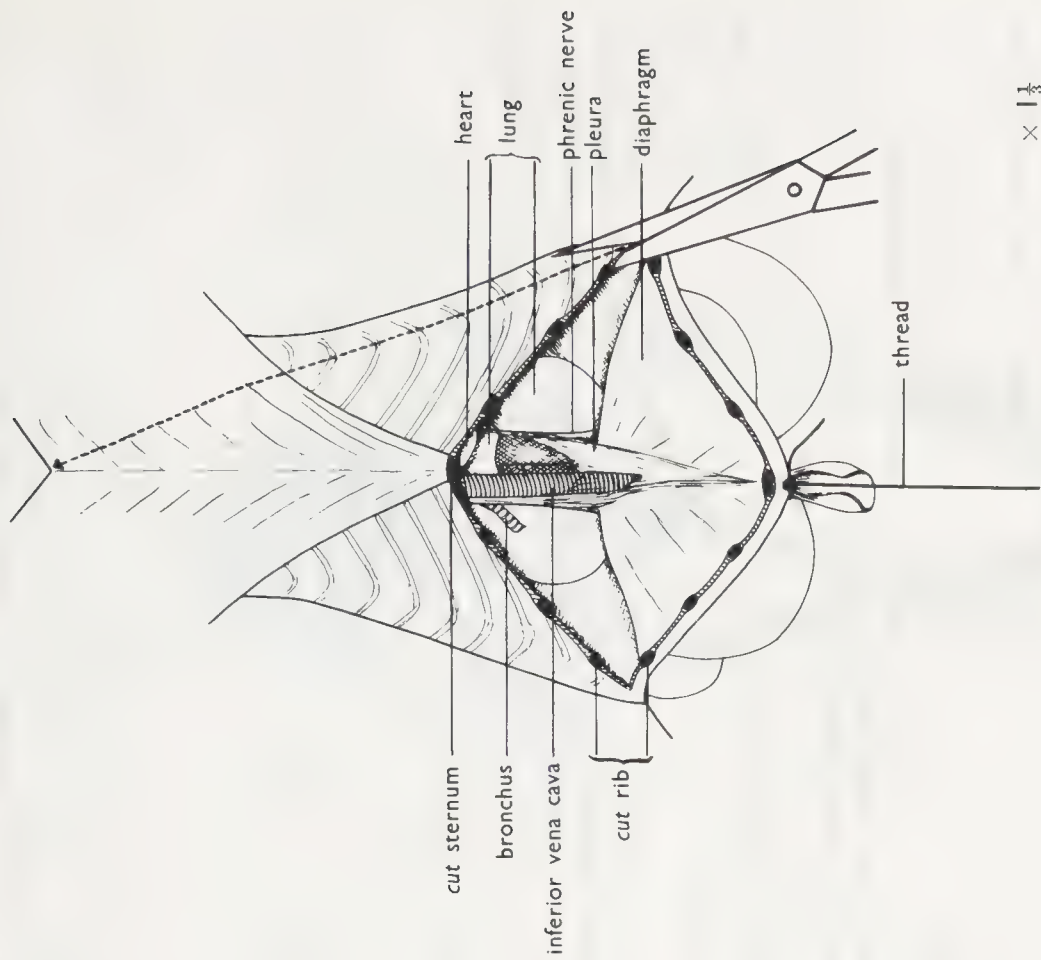
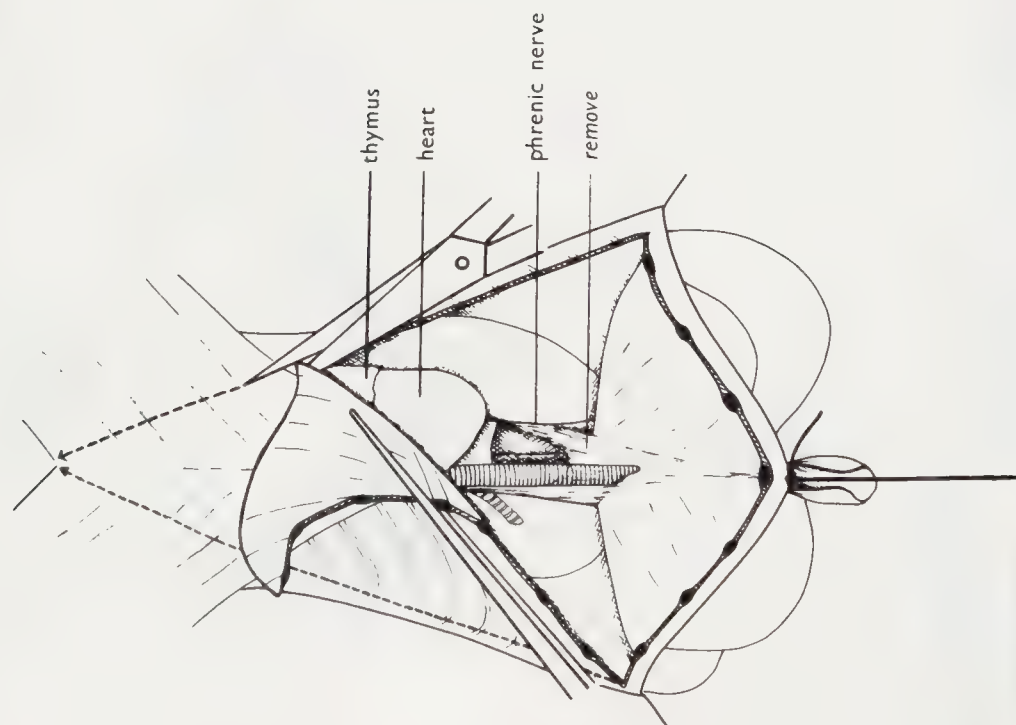


Fig. 24

Tie a thread round the xiphoid cartilage and attach the other end of the thread to the tail of the rat or to a pin so that the diaphragm is pulled back as shown.

NOTE. The pleura surrounding the mediastinum are ruptured by the tension. Cut through the side wall of the thorax along the line indicated—see also Fig. 25.

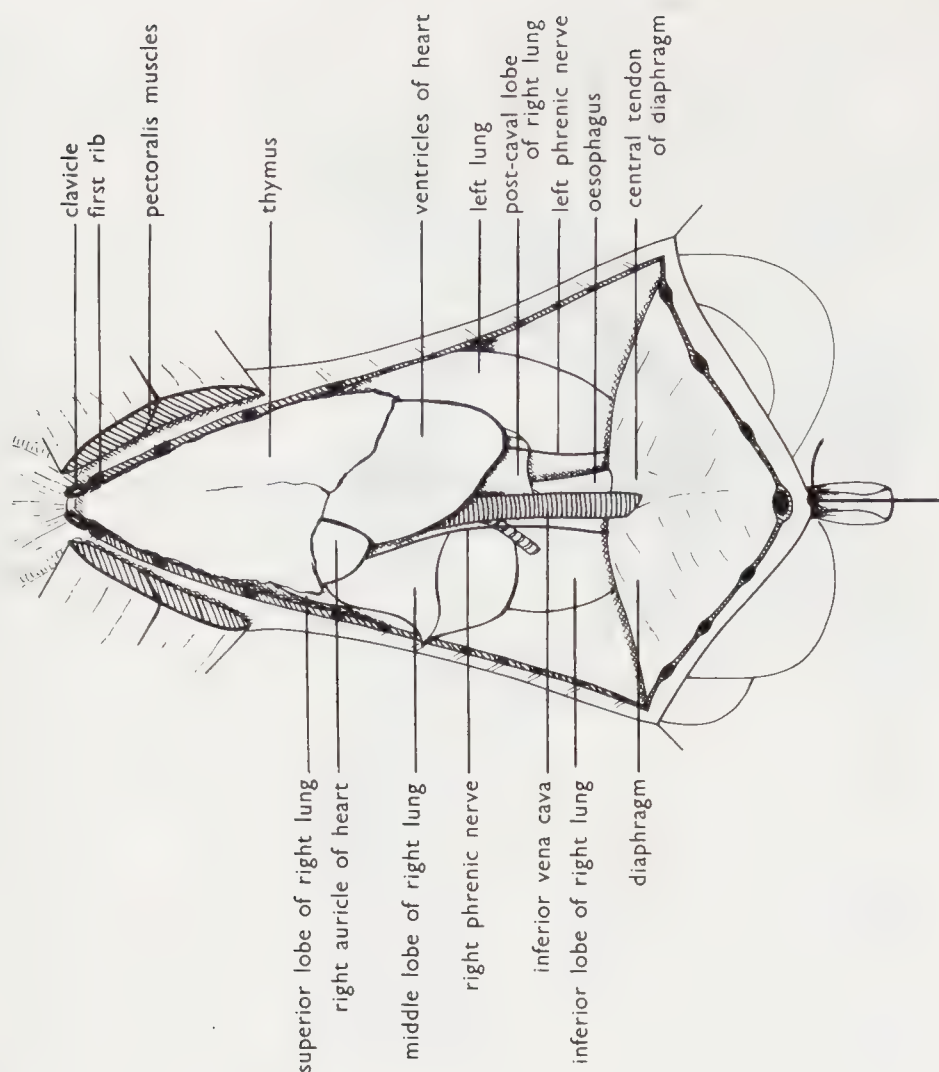


× 1 1/3

Fig. 25

Continue the cut to the apex of the thorax turning the ventral part of the wall aside and pulling it slightly so that there is less danger of cutting the heart. Repeat on the other side to remove the ventral part of the thoracic wall entirely. Clear away loose parts of the pleura.

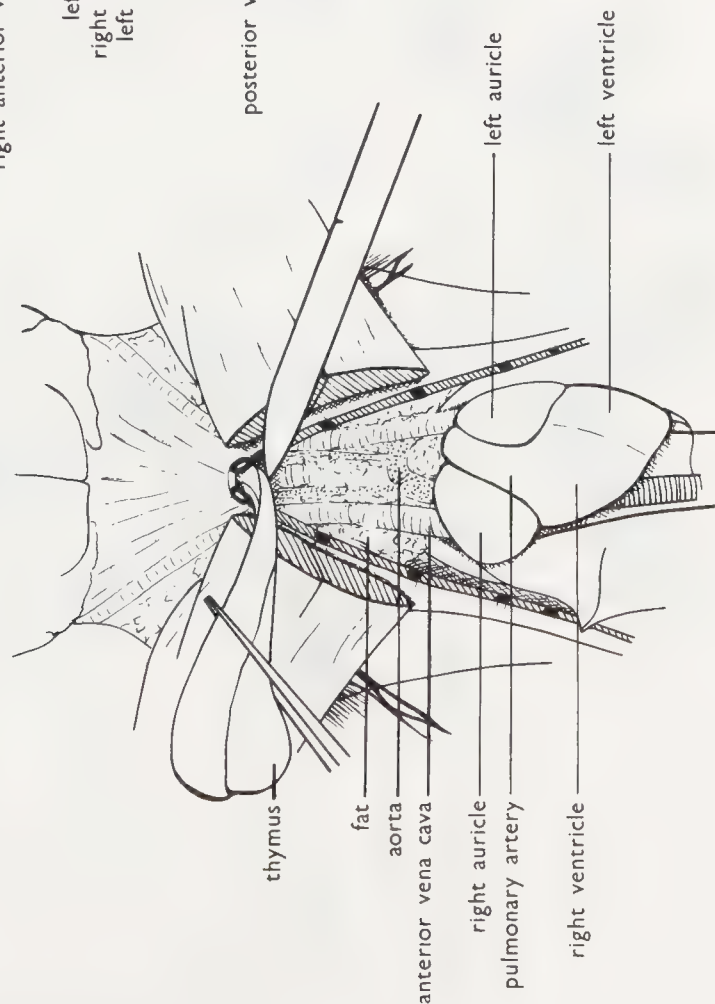
NOTE. BE SURE TO CUT THROUGH THE ANTERIOR RIBS AND TO REMOVE THE STERNUM COMPLETELY.



× 1 1/3

Fig. 26

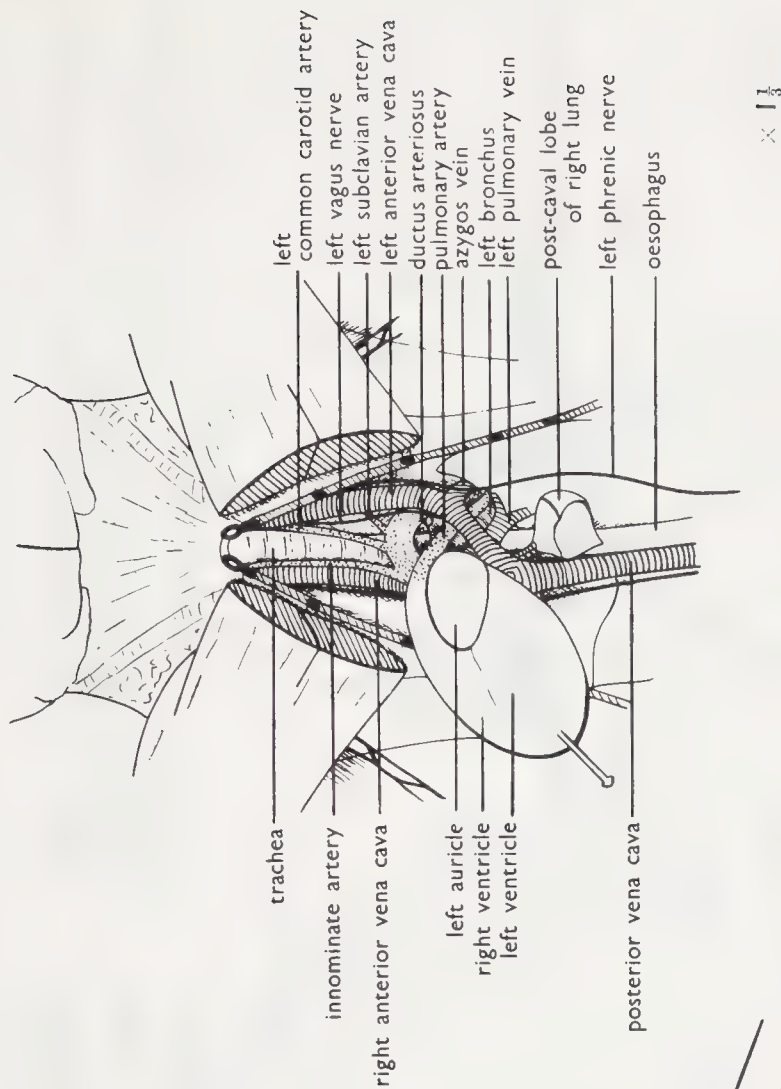
Observe and DRAW the contents of the thorax as they appear at this stage.



$\times \frac{1}{3}$

Fig. 27

Remove the thymus gland.
Clear away the fat from around the great vessels.
N.B. WATCH FOR AND DO NOT DESTROY THE PHRENIC AND VAGUS NERVES—see Fig. 28.



$\times \frac{1}{3}$

Fig. 28

Pin the heart to the RIGHT of the RAT.
Observe the structures shown in diagram.

DRAW

NOTE. If desired this diagram may be combined with

Fig. 34.

THE RAT—*The thorax and neck*

(c) THE BLOOD-VESSELS AND NERVES OF THE NECK

The blood-vessels and nerves of the fore-limbs are not usually studied in detail, but their relation to those of the neck and thorax should be noted.

A hand lens may be found useful when looking for the fine nerves of the neck.
N.B. MOP UP ALL CAPILLARY BLEEDING AT ONCE with a soft cloth.

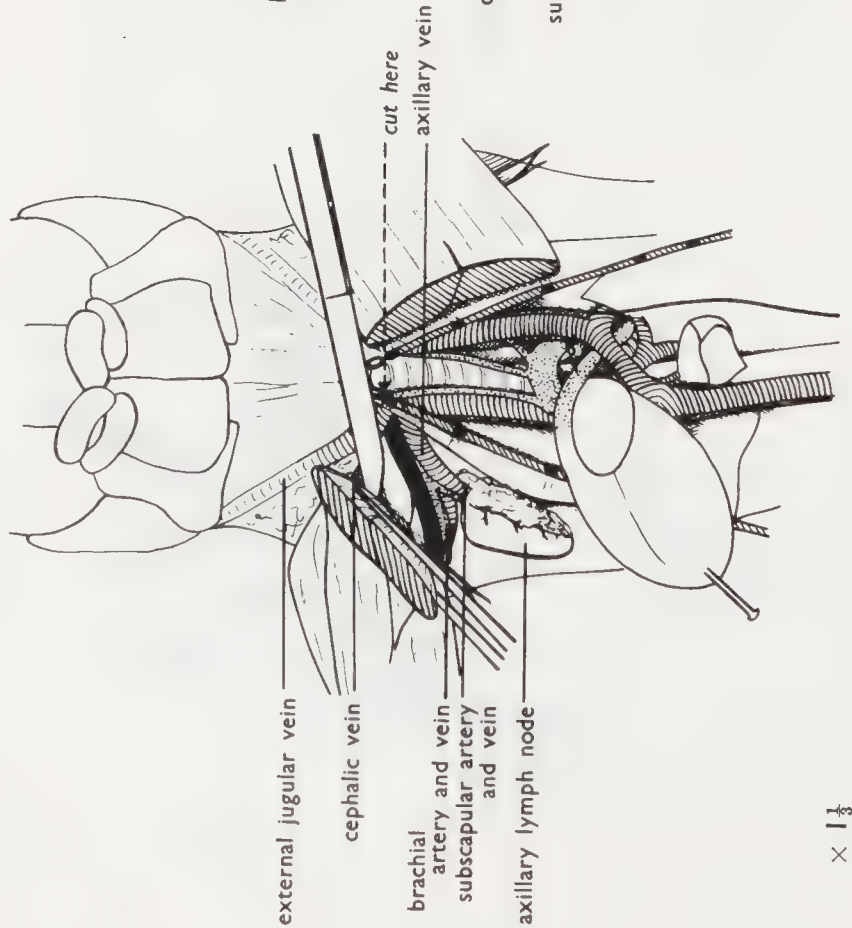


Fig. 29

Lift the pectoralis muscles and carefully clear them from the axillary vessels and nerves.

Keep the blocks of muscle entire and cut each of them as close as possible to its insertion—see Fig. 30.

Cut between the clavicle and the first rib to trace the connection between the axillary vein and the anterior vena cava, i.e. the very short subclavian vein. Push the rib aside and trim if necessary.

N.B. BE CAREFUL NOT TO CUT THE PHRENIC NERVE.
Repeat on the other side.

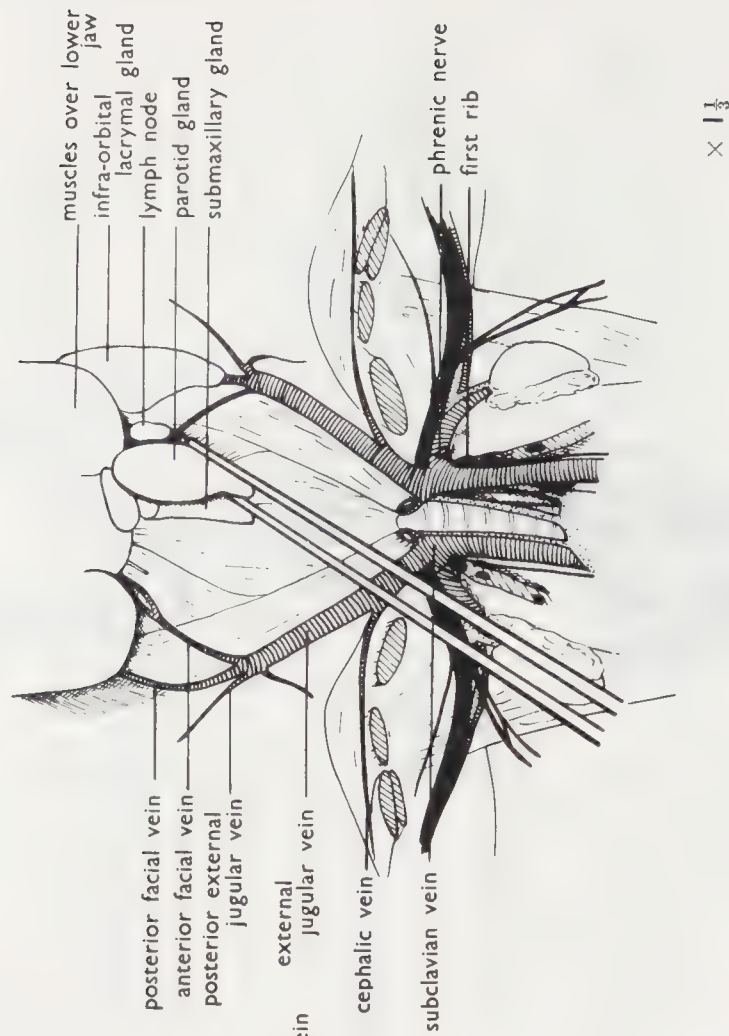


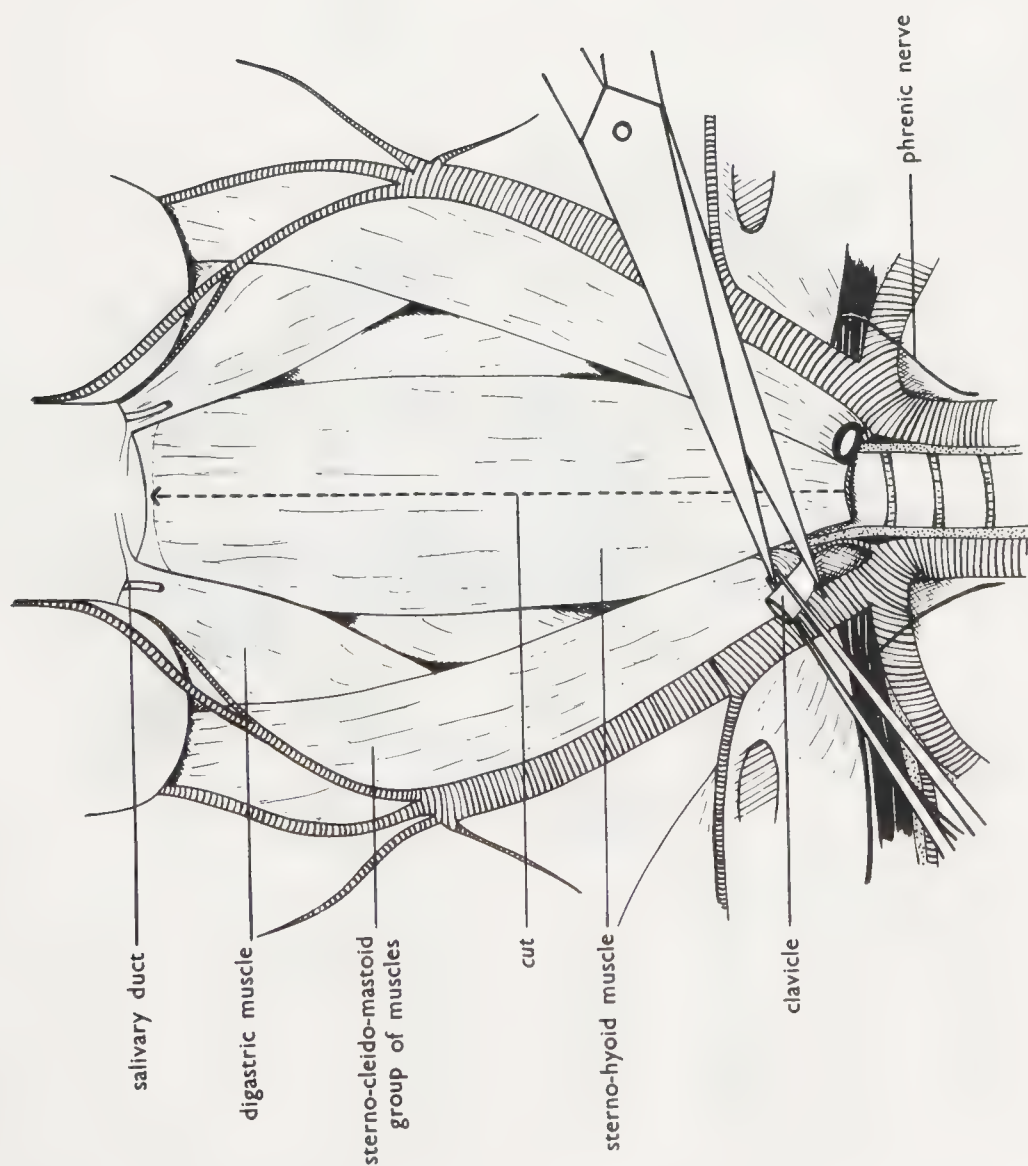
Fig. 30

Clear away any fat and connective tissue that may be masking the external jugular veins.

Lift aside the salivary glands and trace the anterior facial vein.

Remove the glands and the lymph nodes.

Remove the infra-orbital lacrimal gland to expose the posterior facial vein.



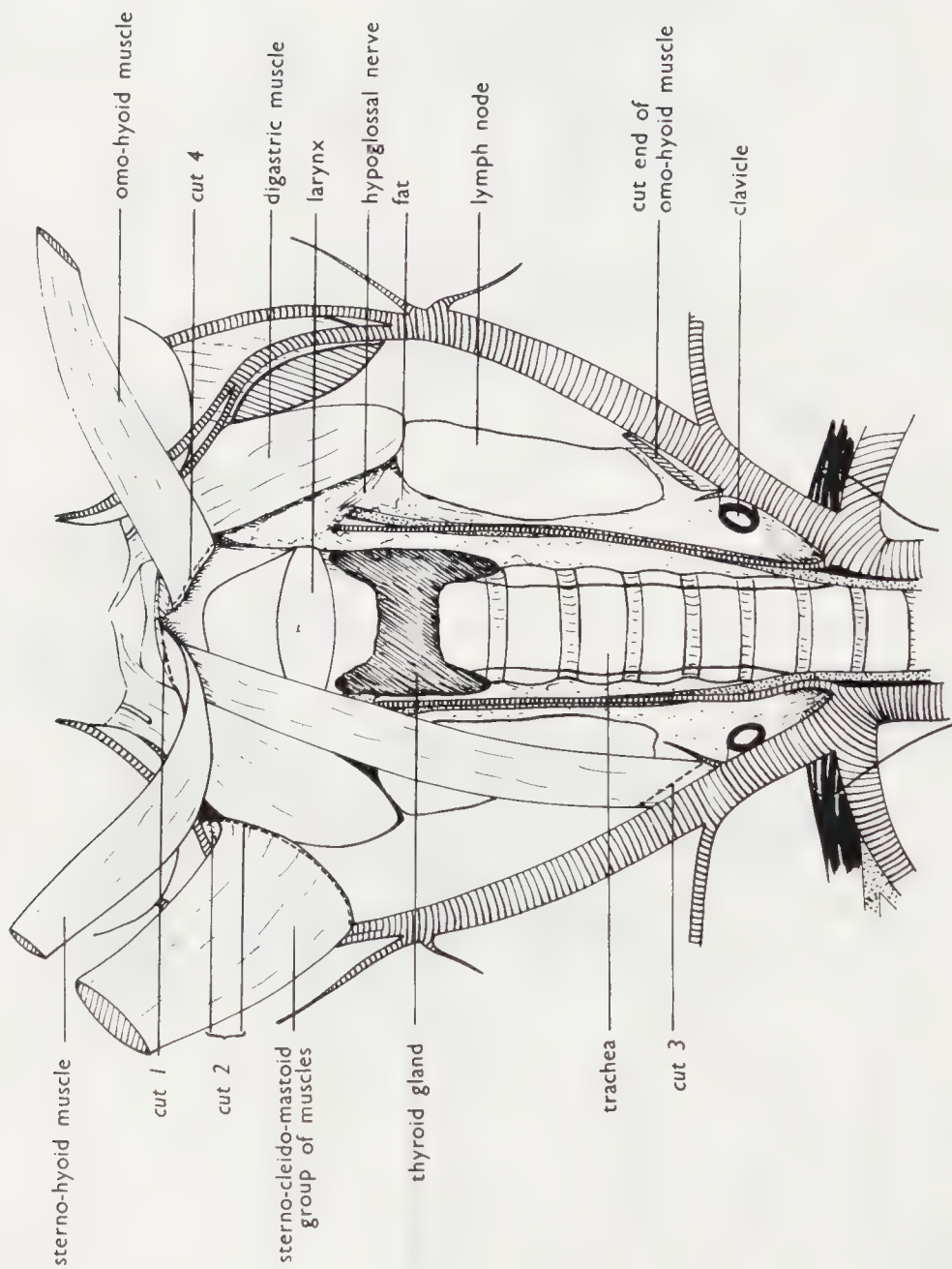
× 2 $\frac{2}{3}$

Fig. 31

Lift the clavicle and trim it as close to the external jugular vein as possible.

Cut between the blocks of sterno-hyoid muscle along the line indicated.

N.B. Be careful not to damage the trachea and larynx which lie immediately underneath these muscles.



× 2 $\frac{2}{3}$

Fig. 32

Loosen and cut the sterno-hyoid, sterno-cleido-mastoid and omo-hyoid muscles as indicated—cuts 1, 2, 3, and 4.

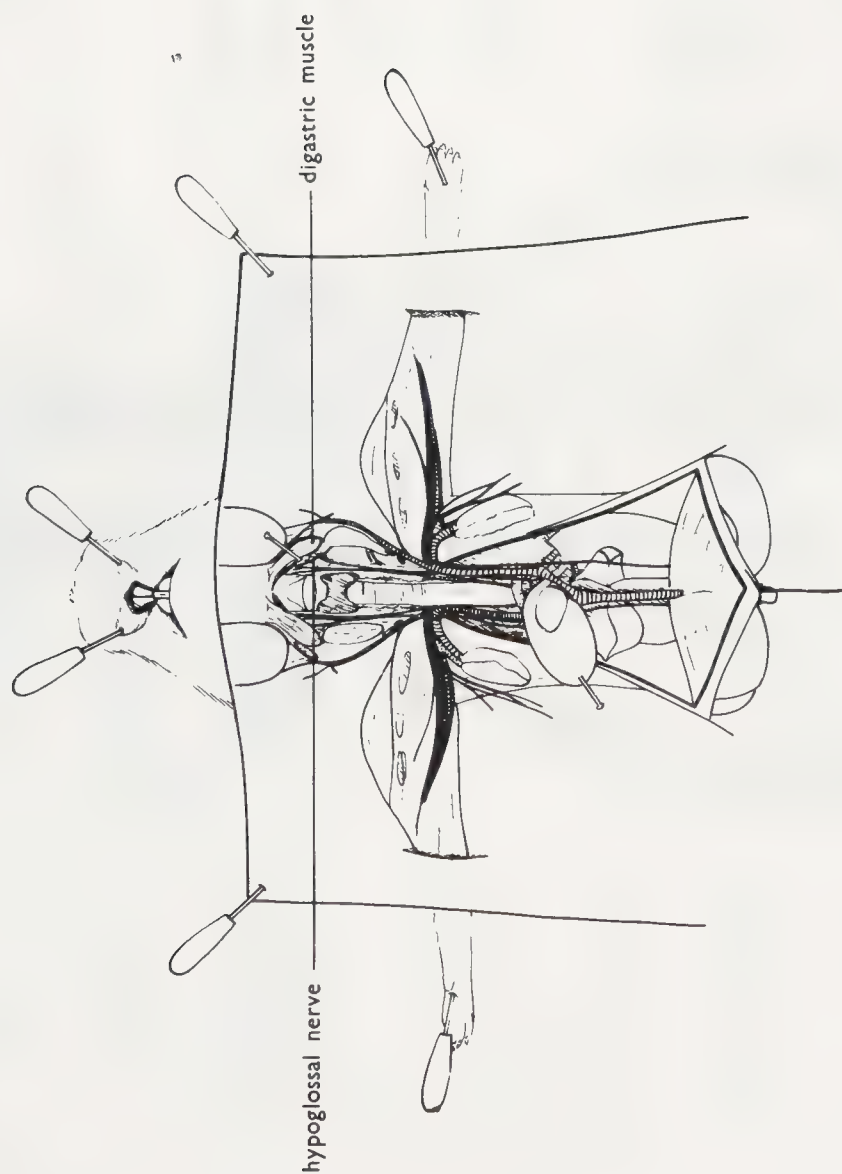


Fig. 33

Place pins through the upper lips as shown. This arches the neck slightly and makes the display of the nerves and blood-vessels of the neck easier.

Remove some of the fat carefully until the hypoglossal nerve can be identified.

Pin aside the posterior part of each digastric muscle carefully avoiding the nerve.

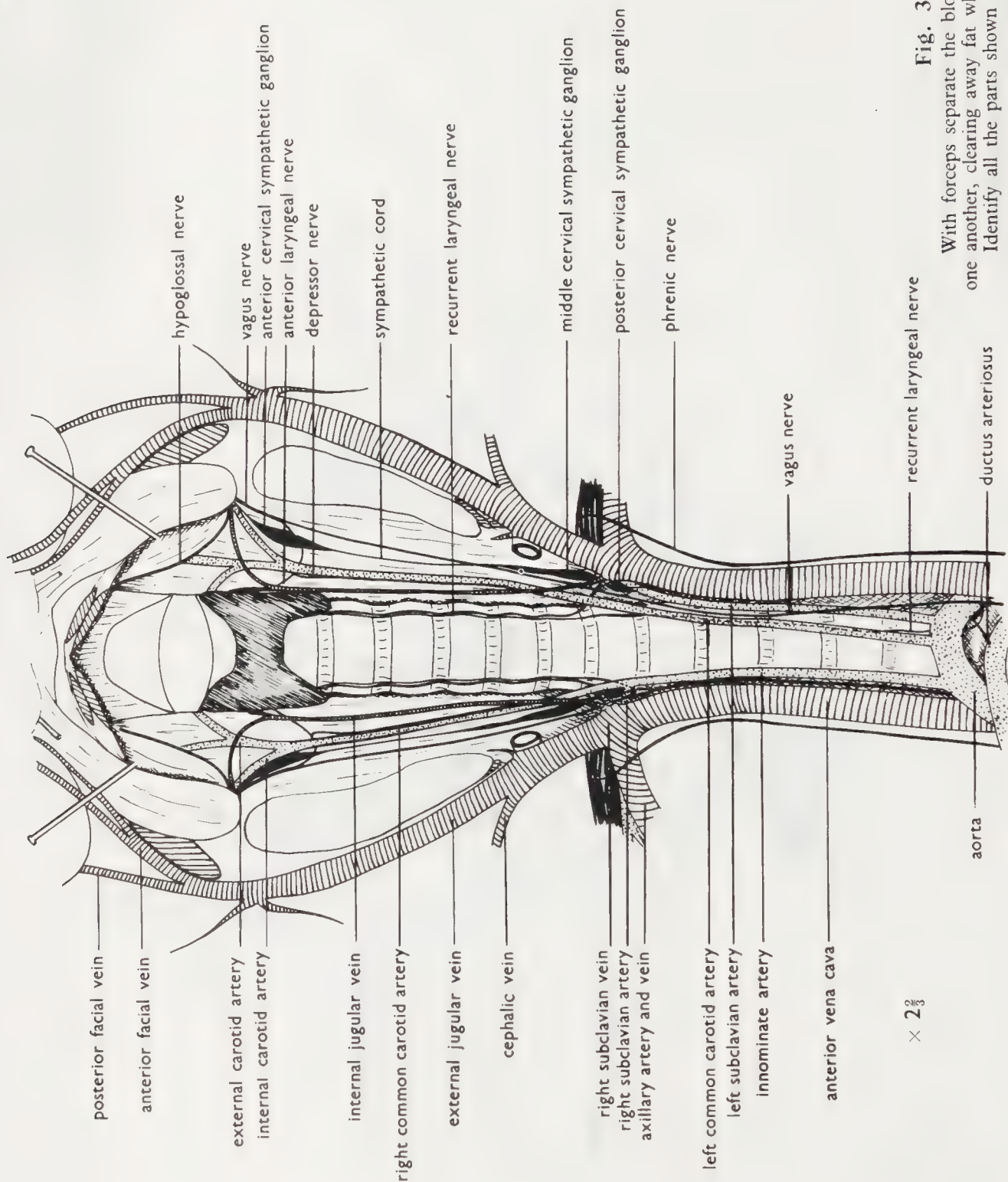


Fig. 34

With forceps separate the blood-vessels and nerves from one another, clearing away fat where necessary. Identify all the parts shown in diagram.

DRAW

THE RAT—*The thorax and neck*

(d) EXAMINATION OF THE HEART AND LUNGS ISOLATED

A more detailed study of the heart and lungs than that shown in Figs. 27 and 28 may be performed by removing them from the body and dissecting them separately.

When fresh, the isolated heart-lung preparation is soft and difficult to handle. A day or more in formalin makes the following parts of the dissection much easier.

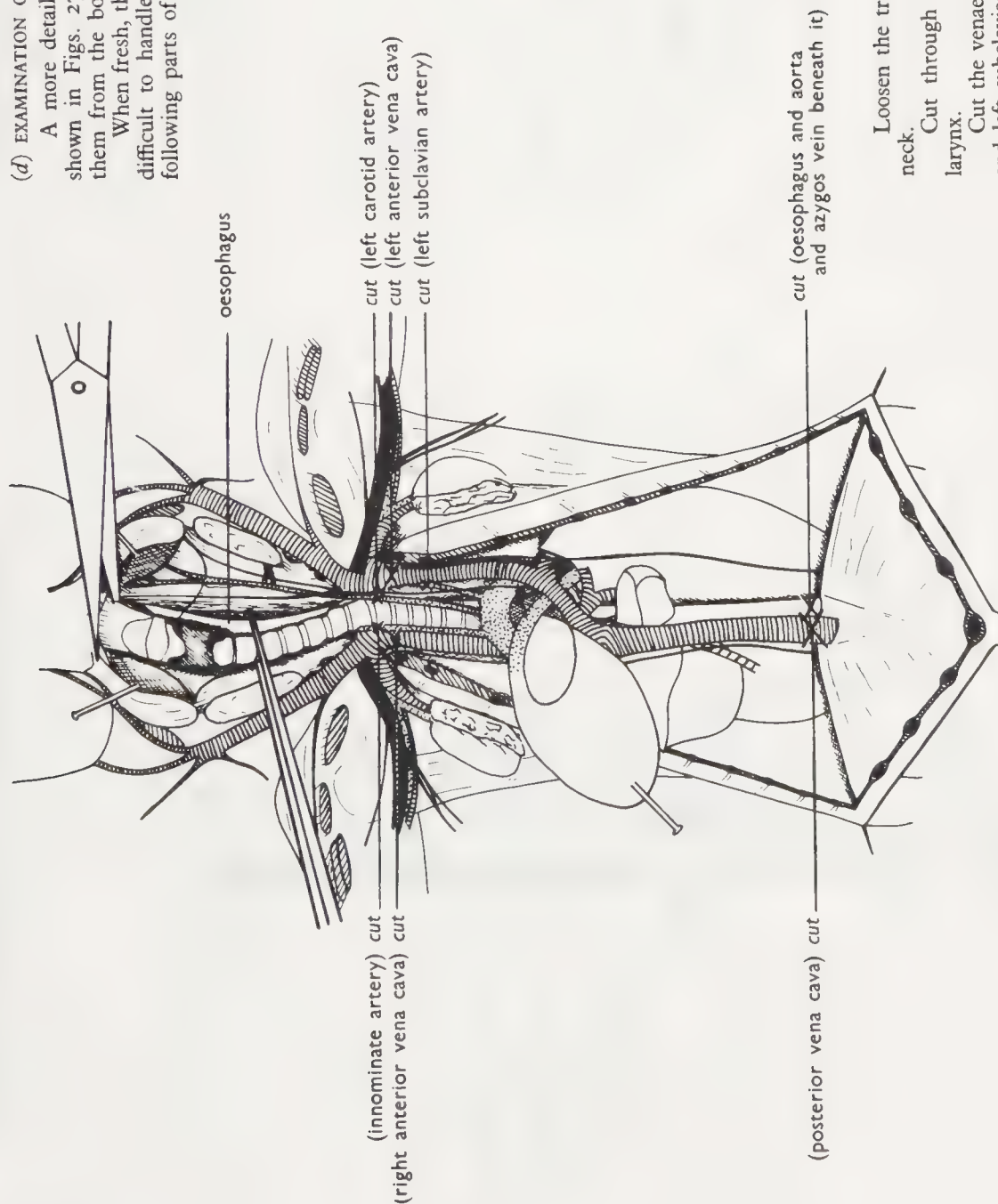


Fig. 35

Loosen the trachea and oesophagus from the back of the neck.

Cut through the pharynx immediately anterior to the larynx.

Cut the venae cavae, the innominate, left common carotid and left subclavian arteries at the points marked X.

NOTE. There is no need to ligature these blood-vessels.

Cut the oesophagus close to the diaphragm.

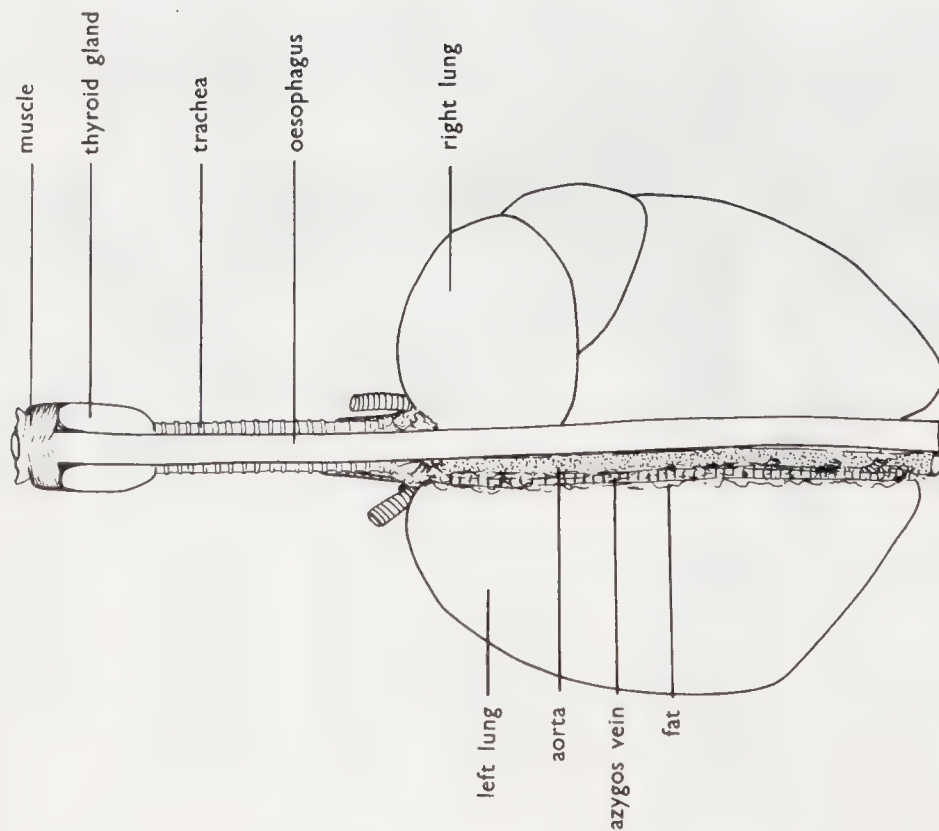
The aorta and azygos vein can then be seen and cut also close to the diaphragm.

Loosen the oesophagus, aorta and azygos vein from the back of the thorax.

Lift out the heart, lungs and oesophagus together.

× 1 1/3

THE RAT—The thorax and neck

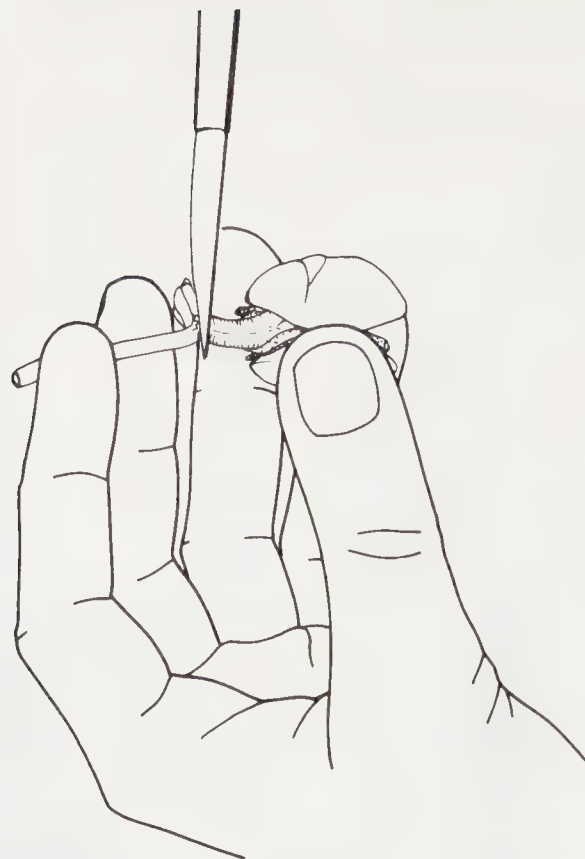


× 2

Fig. 36

Observe the parts now isolated in dorsal view. Note the relationship of the oesophagus to the larynx and trachea.

DRAW

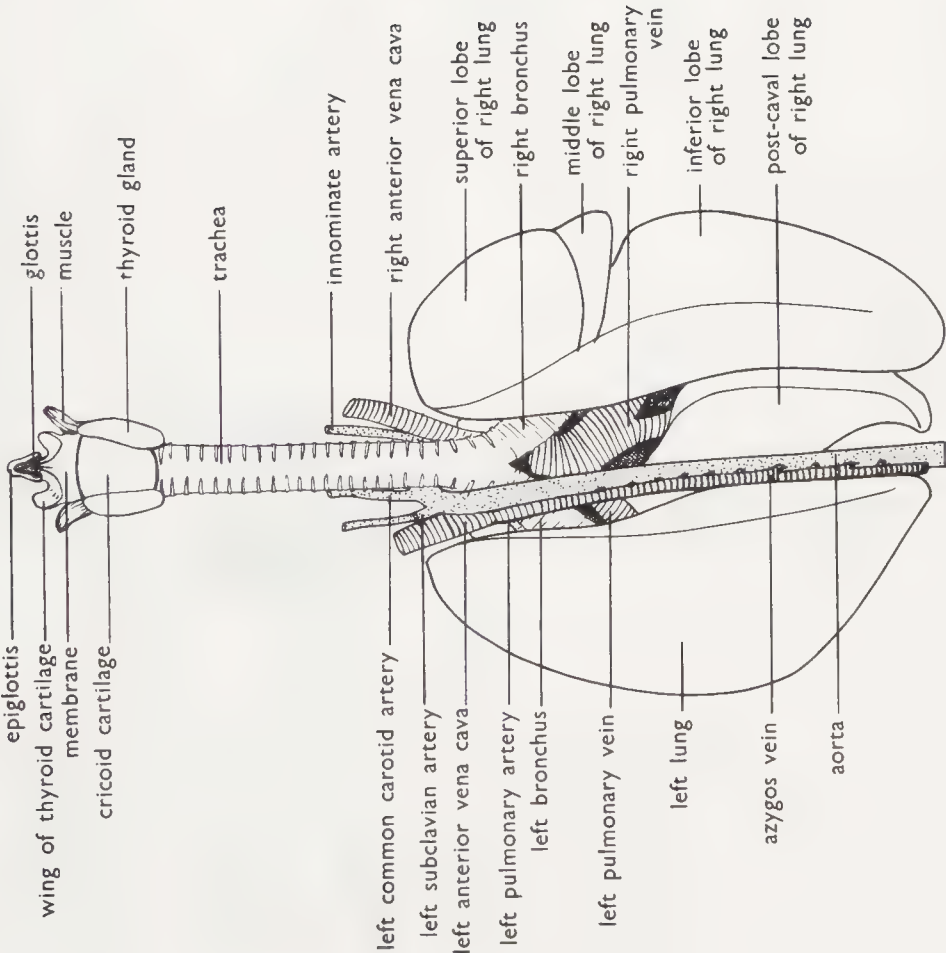


× 2

Fig. 37

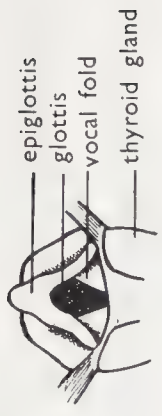
Starting at the posterior end, separate the oesophagus from the trachea, holding the preparation as shown.

THE RAT—The thorax and neck



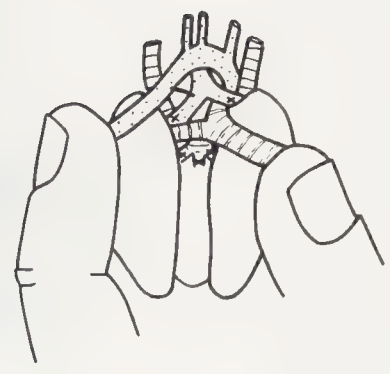
× 2

Fig. 38
Clear any fat from the bronchi and blood-vessels.
Identify the parts shown in dorsal view.
DRAW



× 3

Fig. 39
Examine the larynx in antero-dorsal view.
DRAW.



×

Fig. 40

Separate the bronchi from the pulmonary arteries.
Cut through each pulmonary vein and pulmonary artery as close as possible to the lungs—i.e. at points marked X.

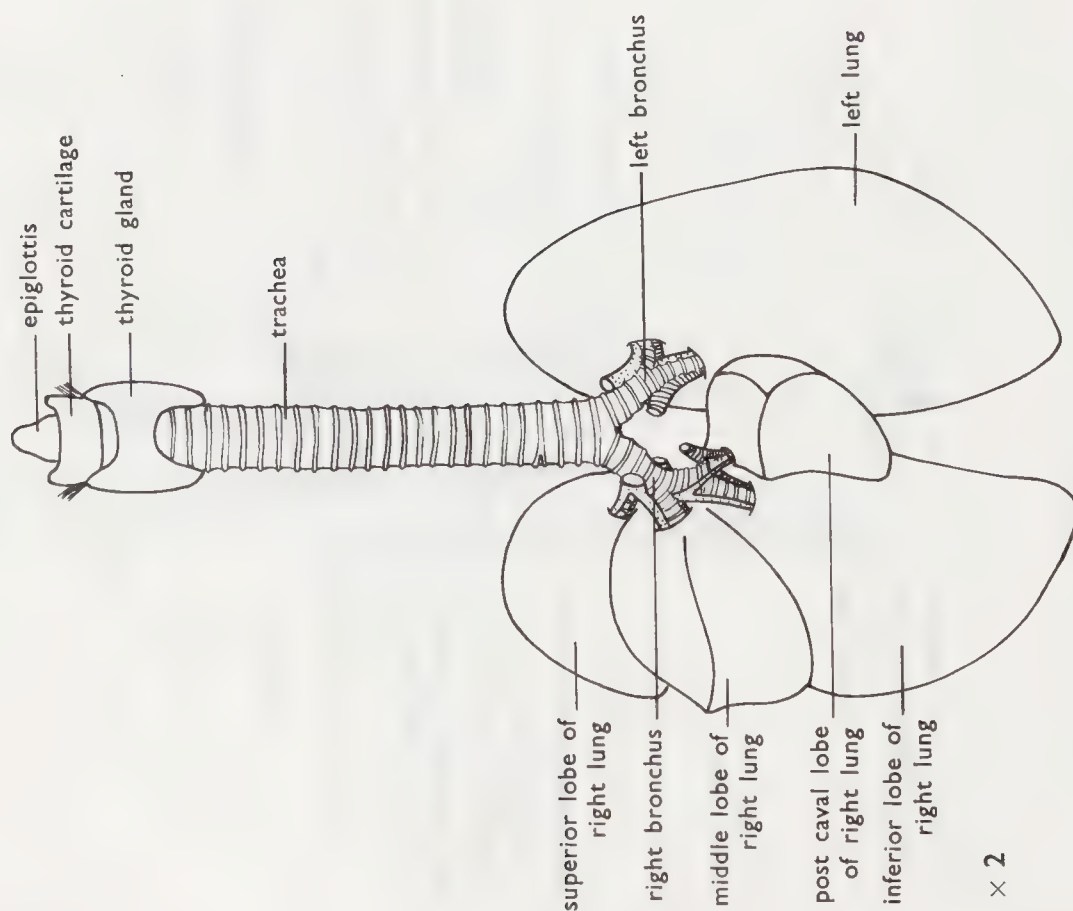


Fig. 41

Examine the lung preparation in ventral view. DRAW.

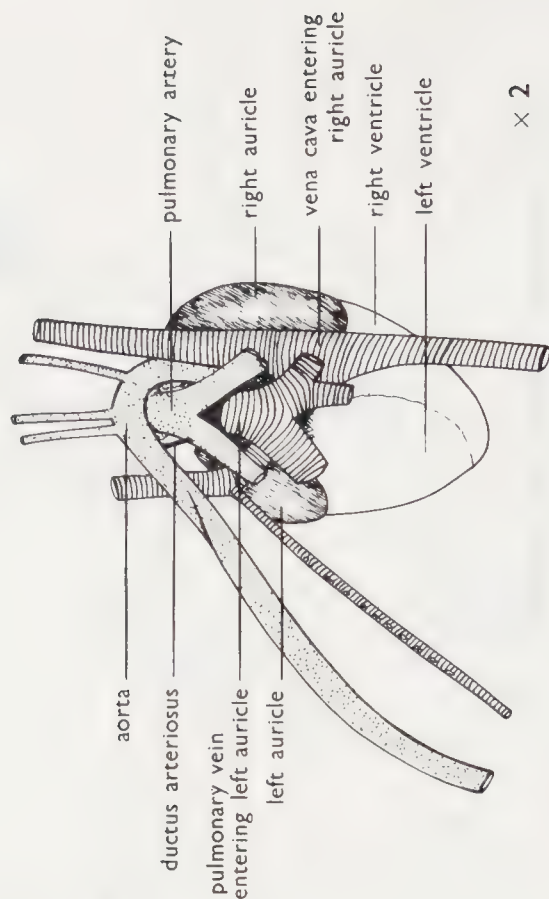


Fig. 42

Lay aside the aorta and azygos vein.
Study the dorsal view of the heart and the relation of the blood-vessels to it.
DRAW.

NOTE. The heart of the rat is too small to be convenient for dissection but it can be opened up as shown for the rabbit—page 186.

THE RAT—Section III The Brain

Nervous tissue is very soft and has very little elasticity. Even after 'hardening' with formalin it is much softer and more easily cut than other tissues. It is therefore very easily damaged by any slip of the instruments and the removal of the brain requires much care and patience. The skull must be cut away in **VERY SMALL** pieces and the pressure on the instruments must be fully under control all the time.

A hand lens will be found useful when examining the cranial nerves.

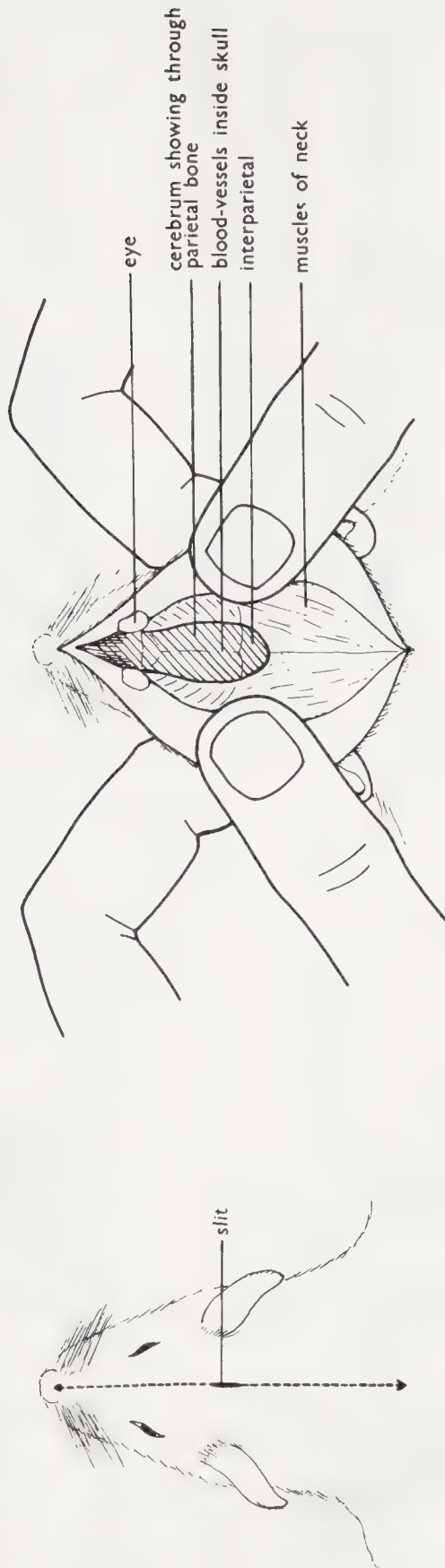


Fig. 43

Hold the rat dorsal side uppermost.
Make a small slit in the skin between the pinnae.
Continue the slit forwards to the snout and backwards to the level of the fore-limbs.

Fig. 44

Pull aside the skin, using the thumb and forefinger of each hand as shown.
Notice the brain showing through the roof of the skull.

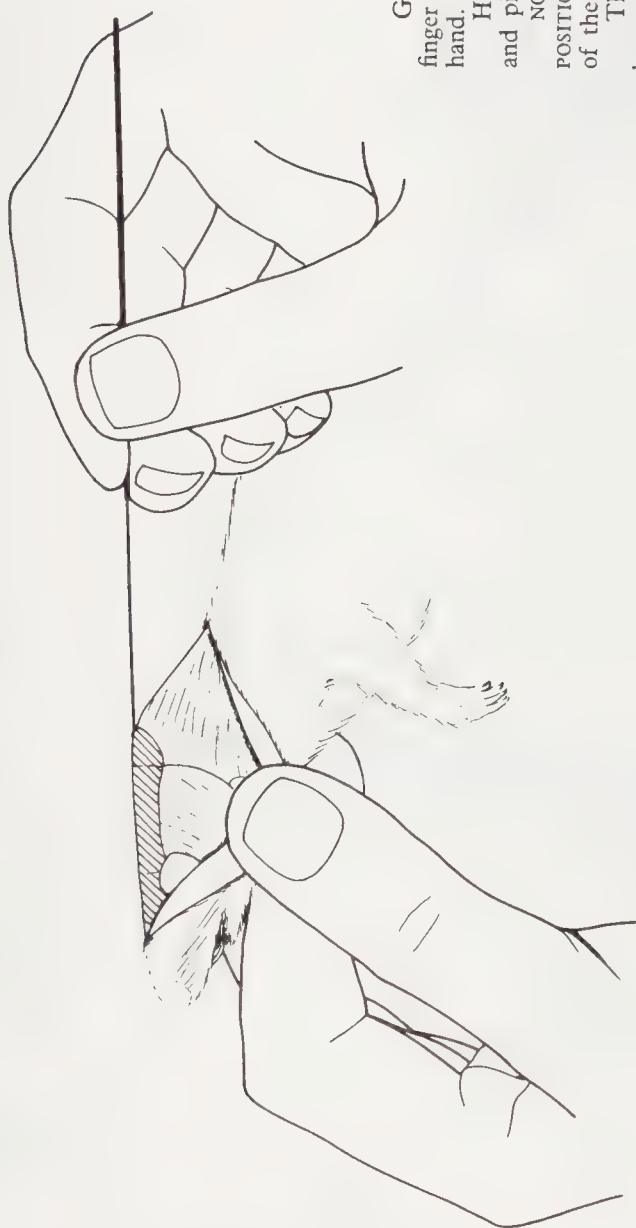


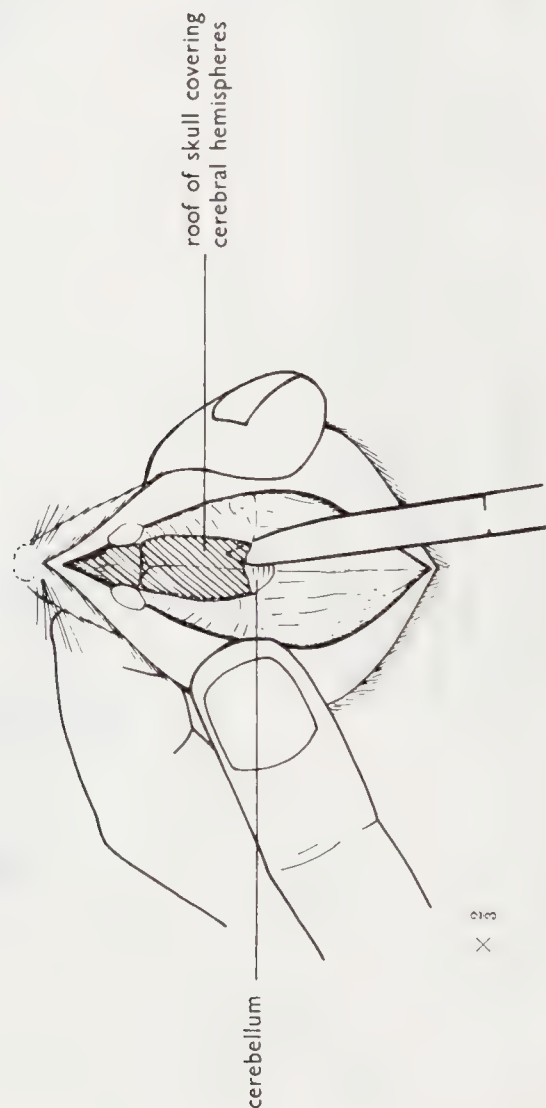
Fig. 45

Grip the head of the rat with the thumb and second finger and support the chin with the first finger of the left hand. The free part of the skin helps to give a good grip. Hold a scalpel level with the back of the skull as shown and pierce the interparietal bone.

NOTE. It is very important to MAINTAIN THE HORIZONTAL POSITION OF THE SCALPEL. Any tilting will either cause piercing of the brain or failure to perforate the skull.

The entry of the scalpel point causes the interparietal bone to crack away along the sutures with the parietals and squamosals.

2109
X



2109
X

Fig. 46

Notice the exposed part of the cerebellum. With a scalpel chip away the roof of the skull over the area indicated by the dotted lines.

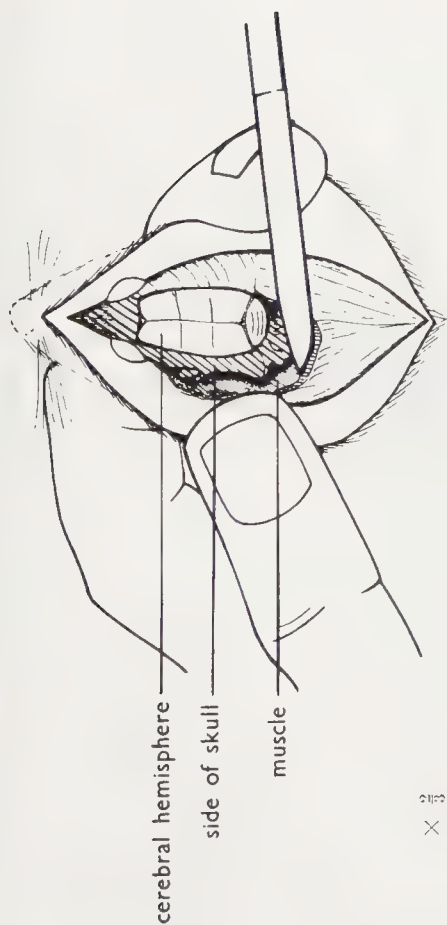


Fig. 47
Scrape aside the muscles to expose the sides and posterior part of the skull.

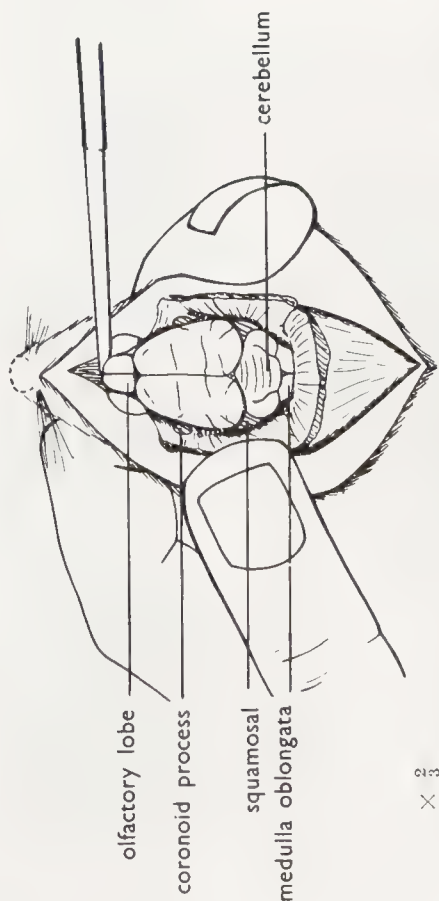


Fig. 48
Chip away the bone until the olfactory lobes, cerebral hemispheres and the main part of the cerebellum are exposed.
Remove the dorsal parts of the atlas and axis vertebrae to expose the first part of the spinal cord.
Cut under the olfactory lobes.

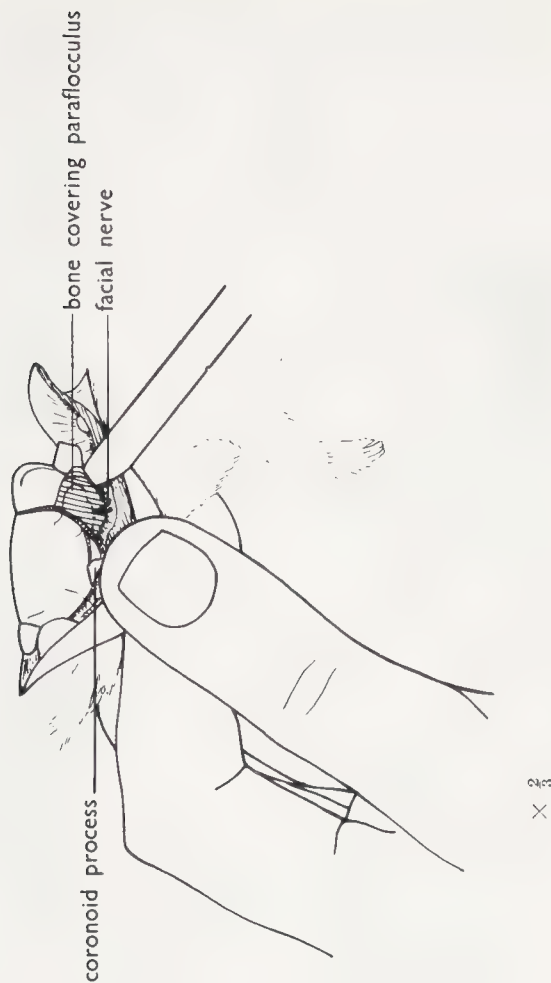


Fig. 49
Cut through the spinal cord.
Cut UNDER THE SKULL as indicated, cutting the posterior cranial nerves in the process.
Continue till the facial nerves are cut.

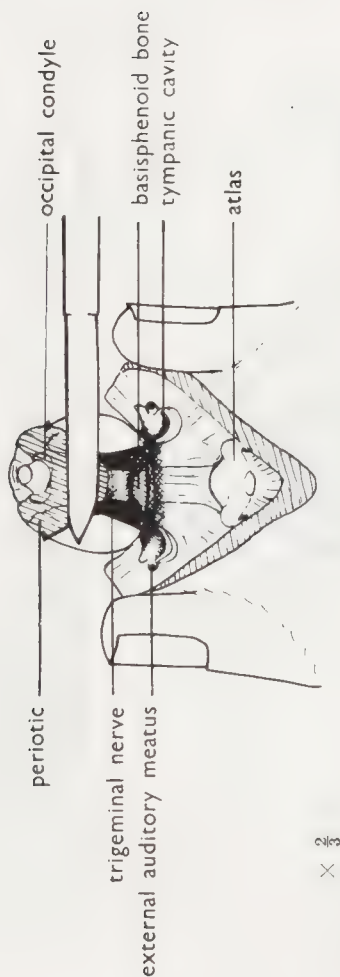


Fig. 50

Change the grip and the position of the scalpel. Prise the posterior part of the base of the skull upwards. This breaks the suture between the occipital and basisphenoid bones and also between the tympanic bulla and the periotic.

Notice the large trigeminal nerves. Cut these nerves as close as possible to the foramina through which they leave the skull.

Cut the optic nerves also—see Fig. 51.

Remove the brain from the head.

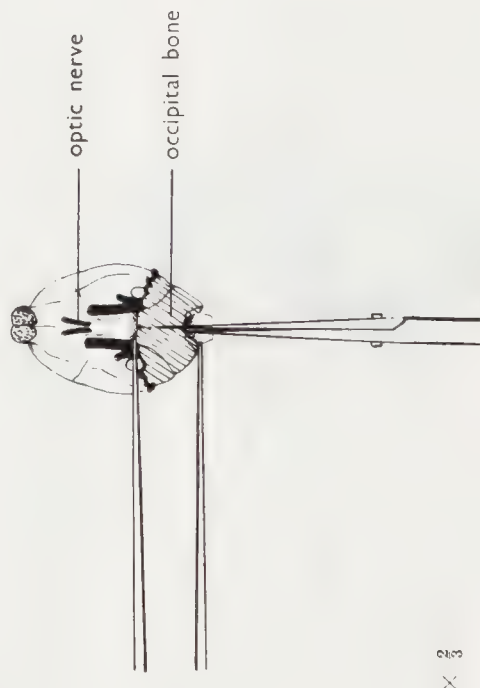


Fig. 51

Grip the piece of the skull which is still attached to the brain. Using scissors, cut through the occipital bone in the mid-ventral line.

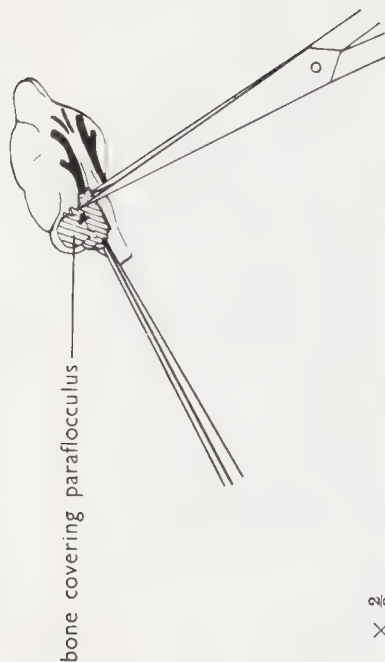


Fig. 52

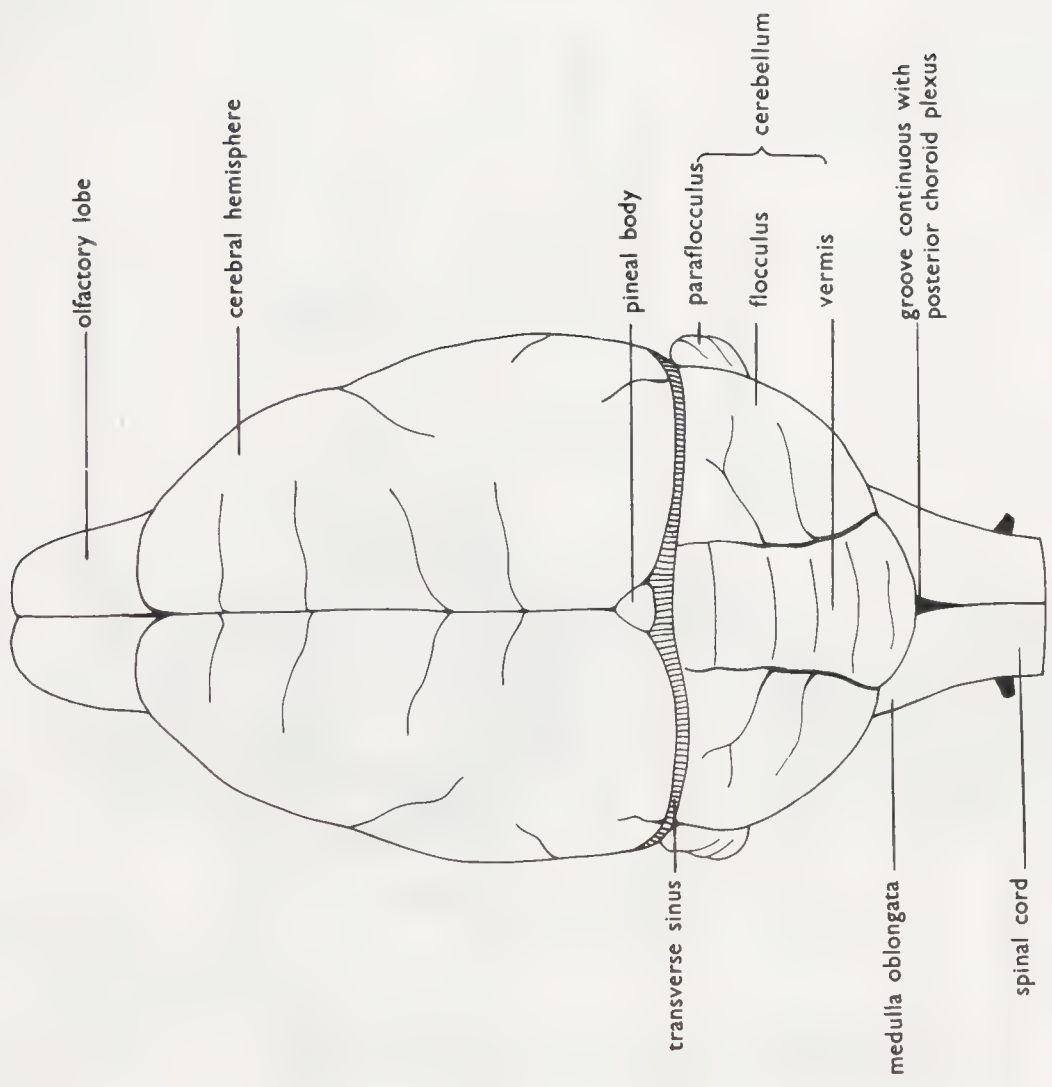
Grip the bone with forceps and cut it away little by little from the auditory region. Leave the occipital condyle as long as possible as it gives the best grip.

N.B. TRY NOT TO TOUCH OR GRIP THE NERVOUS TISSUE WITH THE INSTRUMENTS. Cut away VERY SMALL PIECES at a time.

BE VERY CAREFUL NOT TO DAMAGE THE PARAFLOCCULUS which is almost entirely surrounded by bone.

NOTE. The bone can be felt as it is hard and grates against the forceps.

The brain may be supported on the dissecting board or held with the fingers but NOT with instruments.



× 3 $\frac{1}{2}$

Fig. 53

Examine the brain in dorsal view. DRAW.

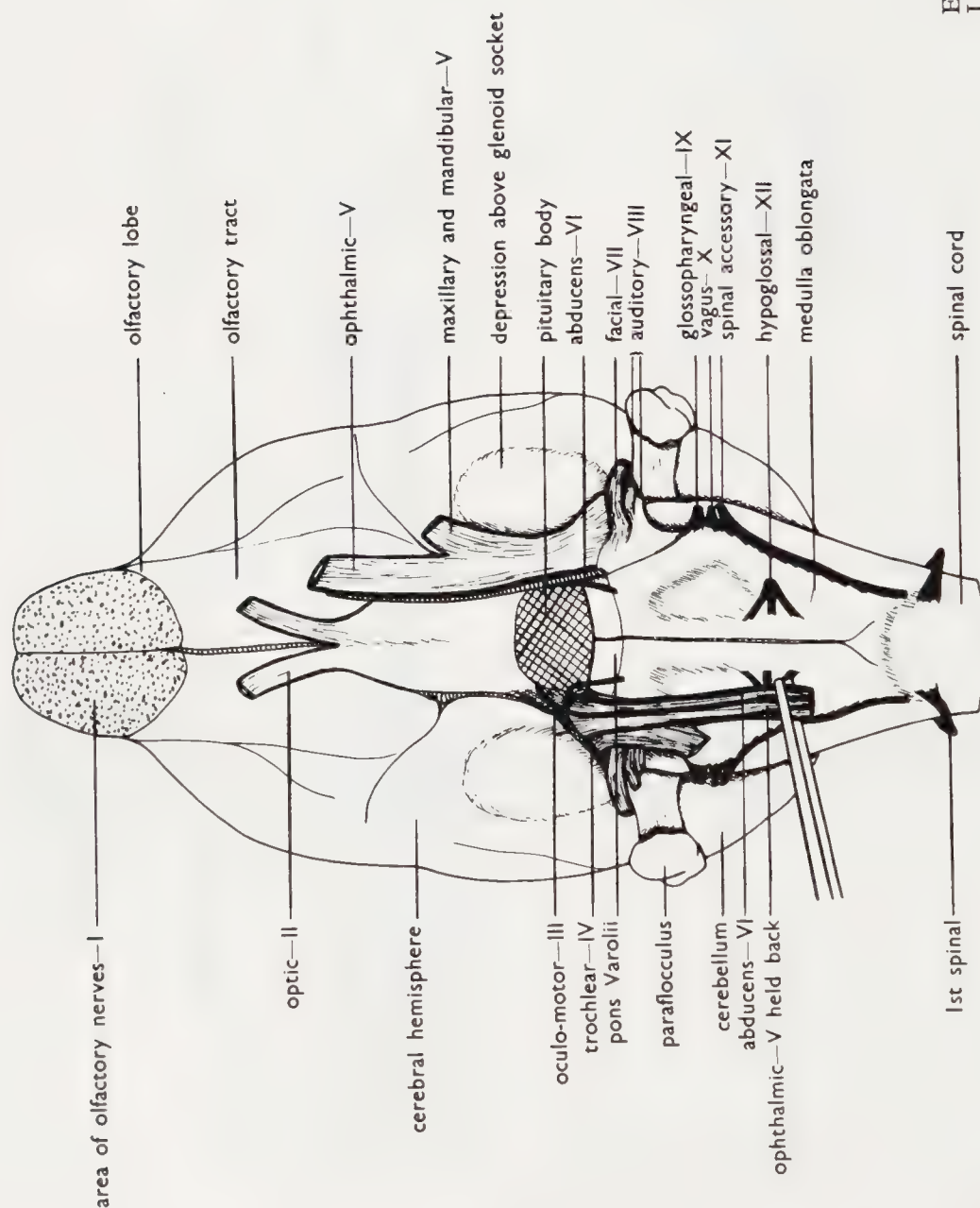


Fig. 54

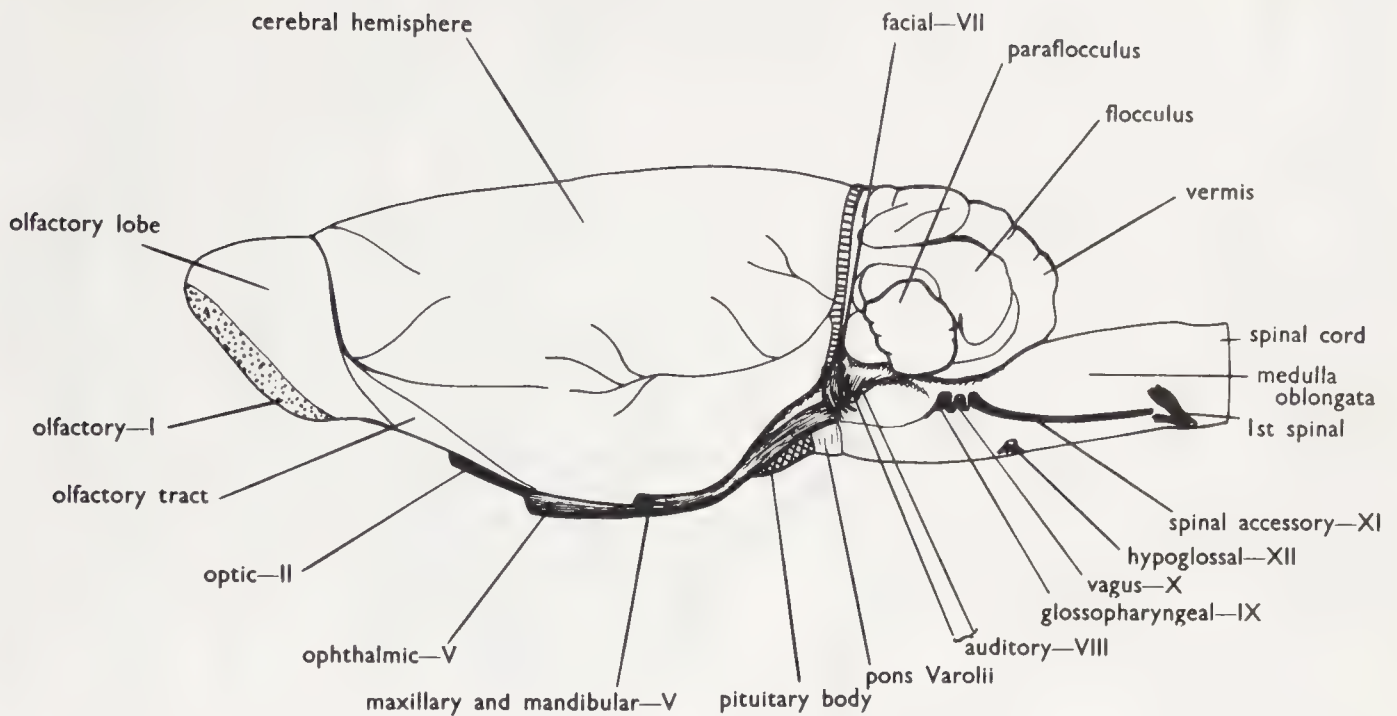
Examine the brain in ventral view.

Loosen the trigeminal nerve from the ventral surface of the fore-brain and turn it back as shown. Look for the oculomotor, trochlear and abducens nerves which lie close to the trigeminal and are turned back with it.

Holding the trigeminal nerve as shown, DRAW.

NOTE. Because of the amount of labelling in this diagram the word 'nerve' has been omitted throughout.

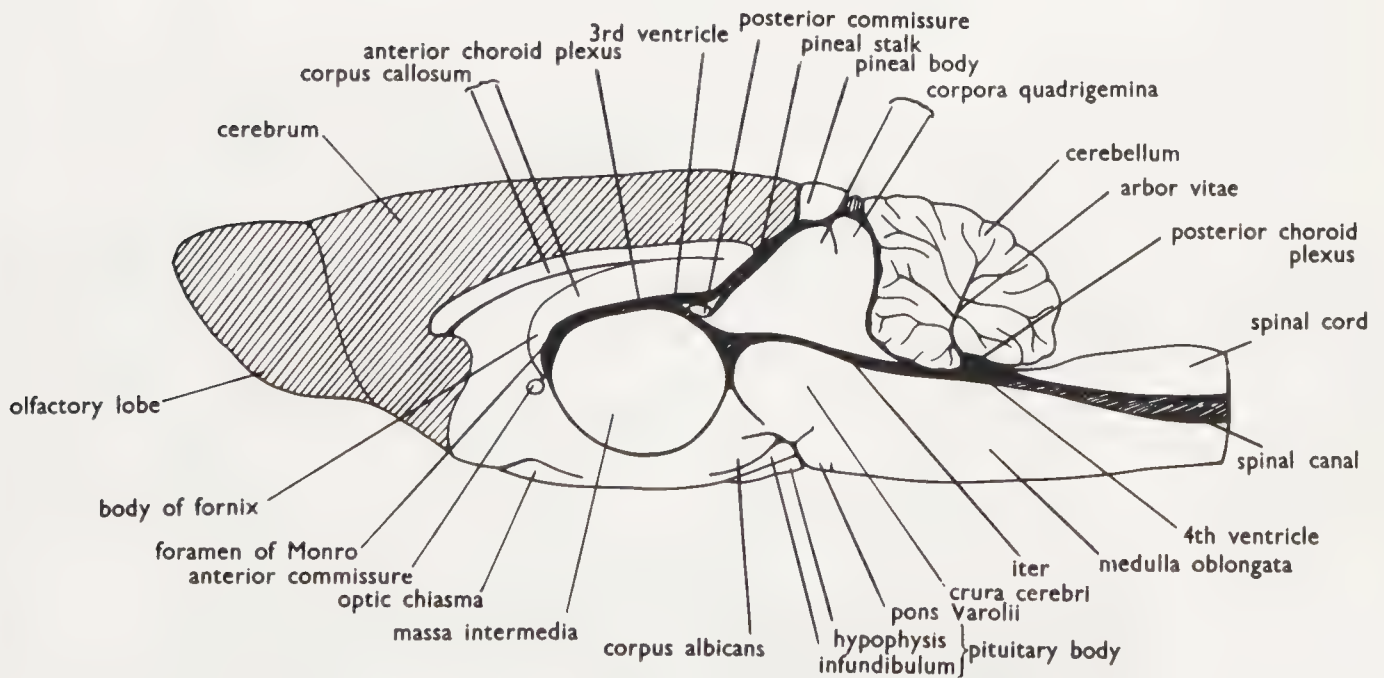
THE RAT—*The brain*



× 3 $\frac{1}{3}$

Fig. 55

Examine the brain in lateral view.
DRAW

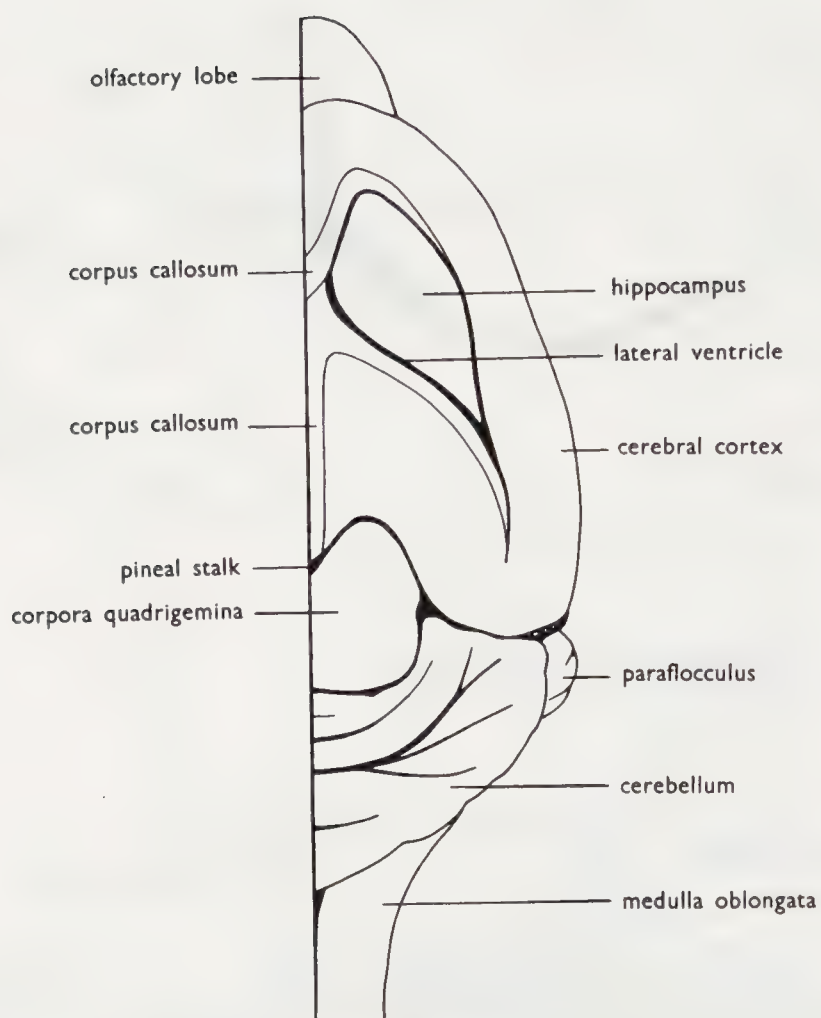


× 3 $\frac{1}{3}$

Fig. 56

Cut through the brain in the median sagittal plane.
Examine the section.
DRAW

THE RAT—*The brain*



× $3\frac{1}{3}$

Fig. 57

Using one-half of the brain, slice away the dorsal parts little by little until the hippocampus can be seen clearly.

N.B. Keep the cut level through the olfactory lobe, cerebral hemisphere, corpora quadrigemina and cerebellum.

The level required is about one-third down from the dorsal surface.

DRAW

THE RABBIT

General directions in preparation for dissection of the ABDOMEN, THORAX and NECK

Remove the skin as shown for the rat—Figs. 1-3, pp. 127-9, including inset to Fig. 3.

THE RABBIT—I The Alimentary Canal

Usually only those parts of the alimentary canal which lie in the abdominal cavity are dissected, the buccal cavity, pharynx and oesophagus being omitted.

The abdominal parts of the canal are so much longer than the cavity in which they lie that their coiling is extremely complicated. Therefore the dissection should be drawn at three stages: (a) with the parts of the canal in situ; (b) with the duodenum and parts of the hepatic portal system displayed; (c) the canal isolated and laid out separately on a board.

NOTE. If the solar plexus is to be studied this should be done before removing the canal.

Open up the abdominal cavity as shown for the rat—Fig. 4, p. 130. Then proceed as follows.

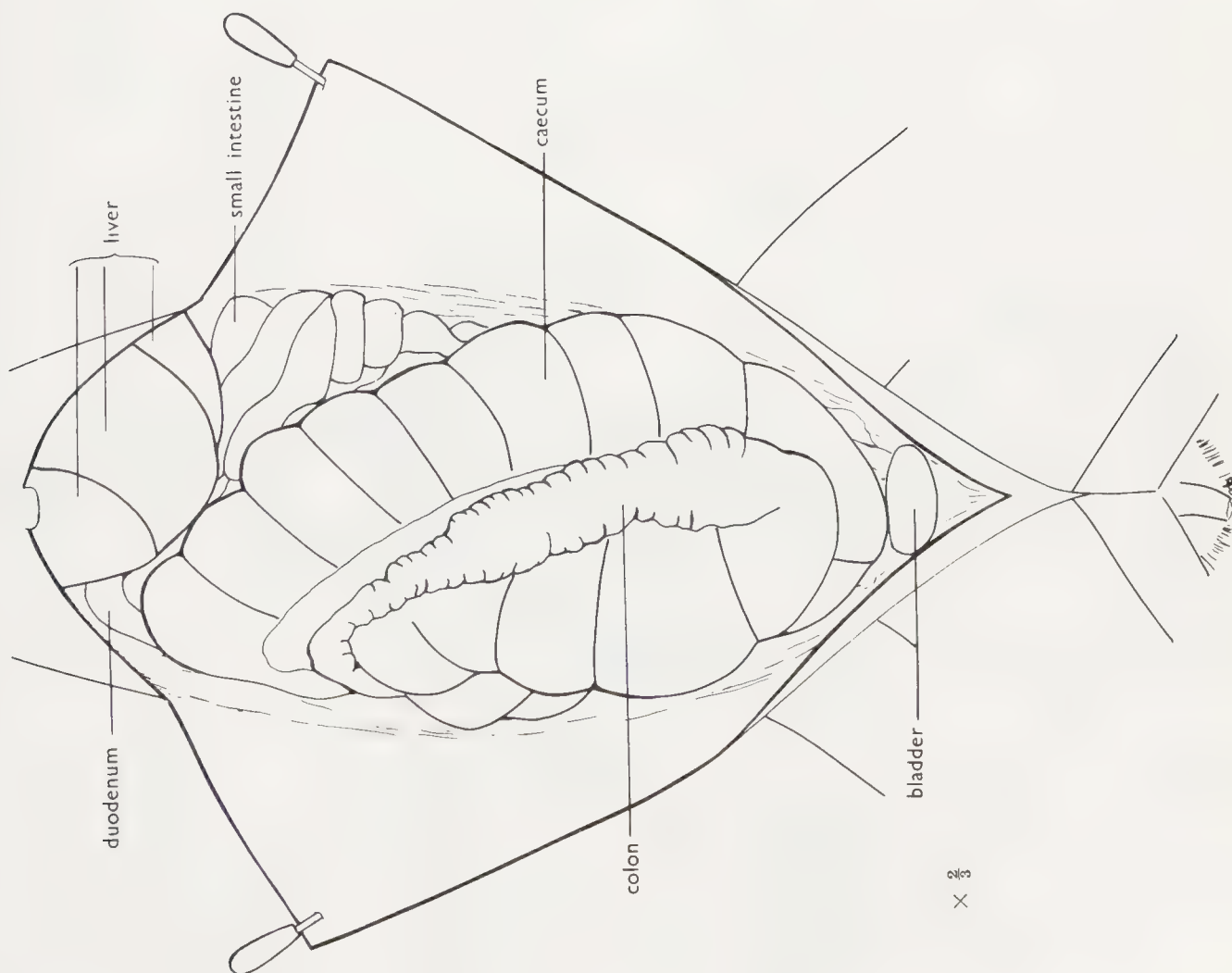


Fig. A1

Pin aside the abdominal wall and observe the intestines in situ.

DRAW.

NOTE. If the rabbit was fed shortly before killing the stomach may show, protruding from under the liver lobes.

THE RABBIT—*The alimentary canal*

Fig. A2

Lay the caecum over to the rabbit's left side as shown. Push back the lobes of the liver to expose the stomach. Look for the duodenum and pull it out to the right. Notice that the rectum partially overlies and adheres to the ascending limb of the duodenum.

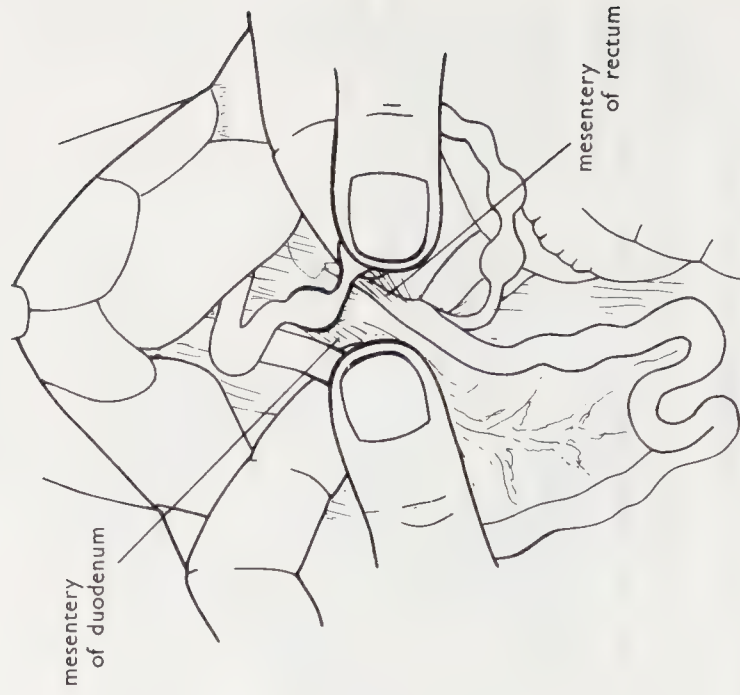
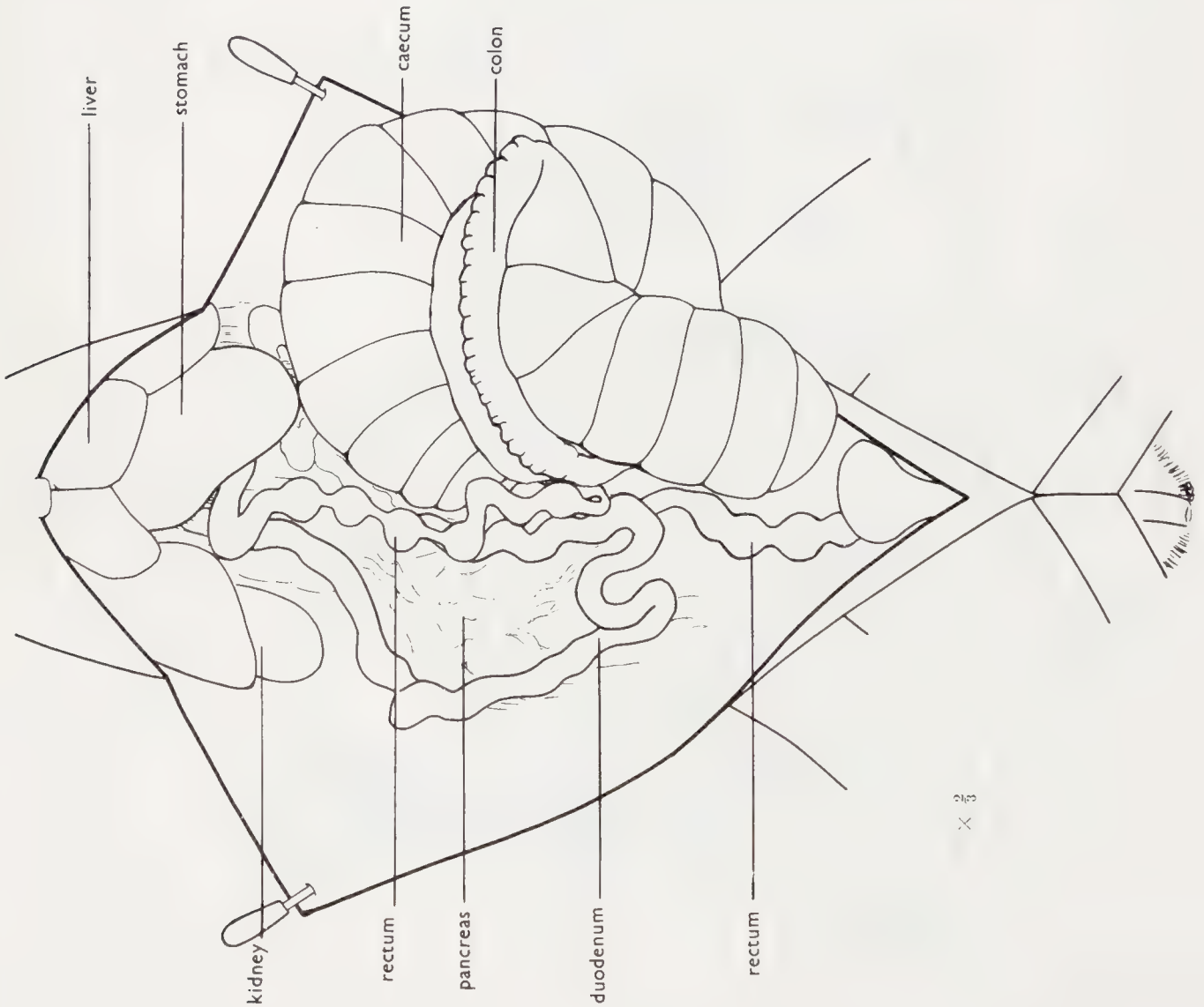


Fig. A3

Using the thumb and forefinger of each hand, grip the rectum and duodenum and pull them gently apart, thus loosening the mesentery of the rectum from that of the duodenum. TRY NOT TO TEAR MESENTERY.

THE RABBIT—*The alimentary canal*

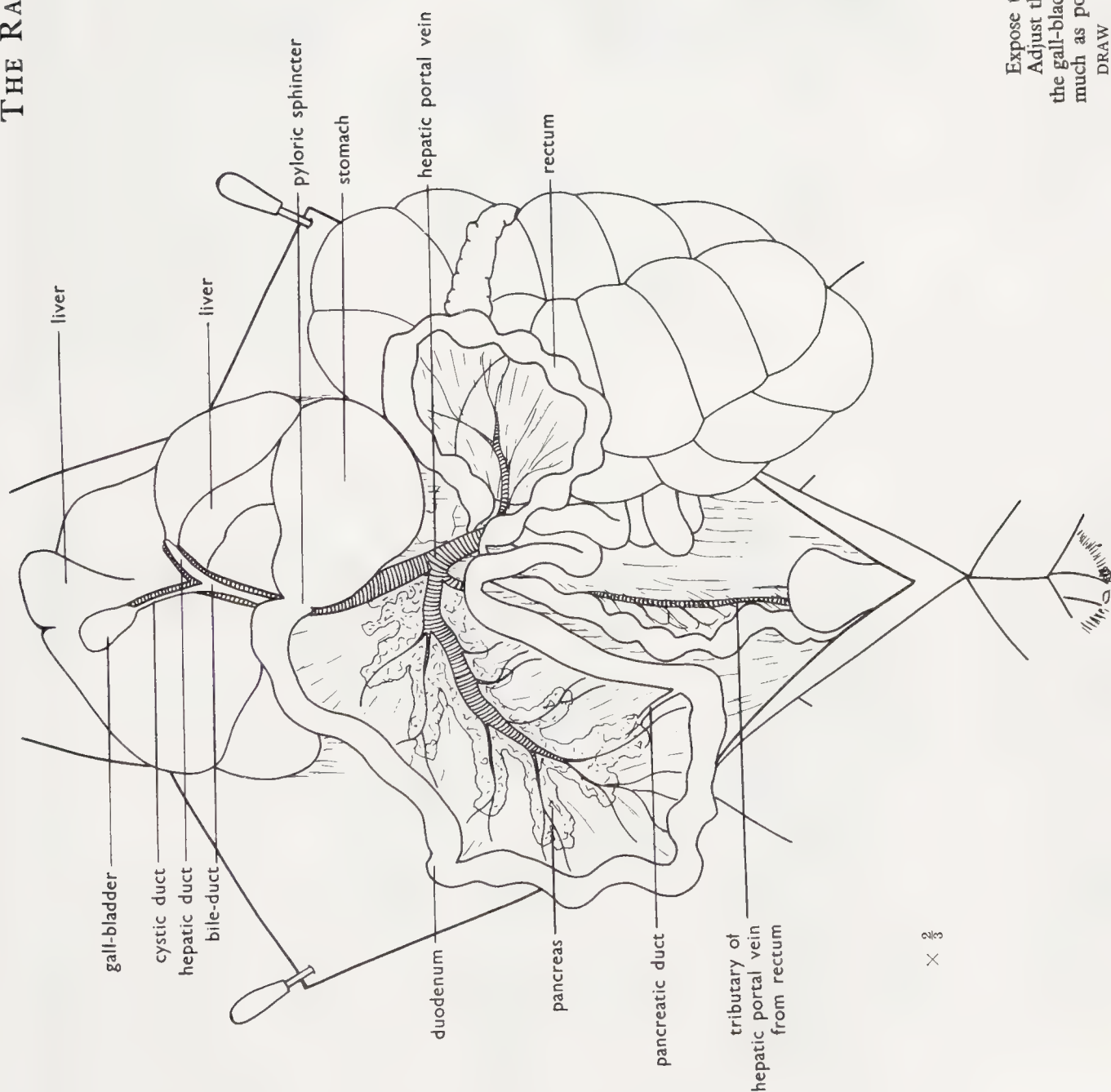
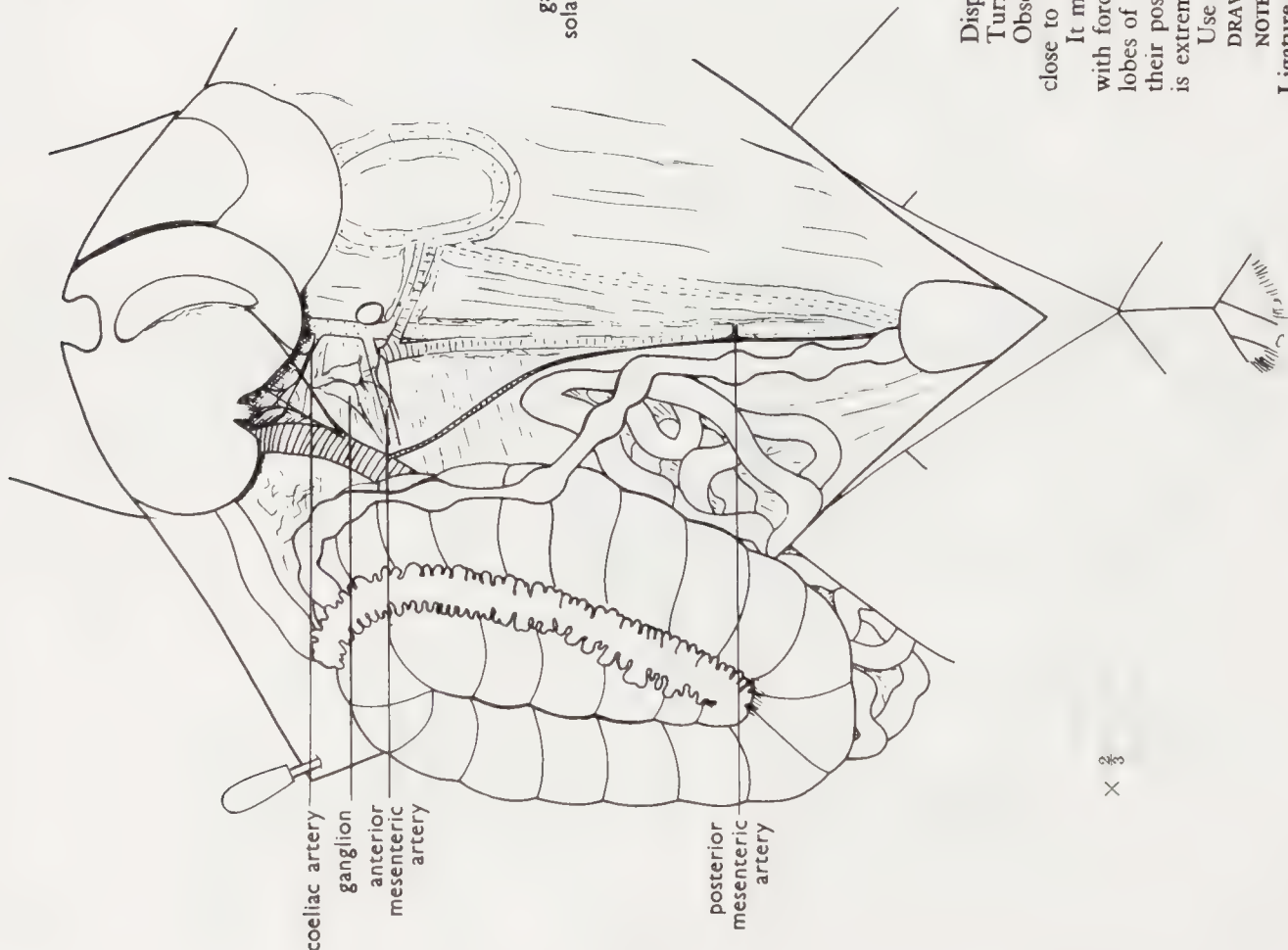


Fig. A4

Expose the duodenum and pancreas as shown.
Adjust the position of the stomach and liver lobes to show the gall-bladder and bile-duct, and of the intestines to show as much as possible of the hepatic portal vein.
DRAW

THE RABBIT—2 The Solar Plexus

If the solar plexus is to be studied it must be done at this stage before the mesenteries are damaged.



Region of Solar Plexus Enlarged

Fig. A5

Displace the intestines to the rabbit's right.

Turn the stomach forwards, supporting with a pin if necessary.

Observe the coeliac and anterior mesenteric arteries and look for the sympathetic ganglia close to the latter.

It may be necessary to remove some fat and portions of the pancreas by gentle stripping with forceps. WATCH CAREFULLY FOR THE GANGLIA. They are almost the same colour as the lobes of the pancreas and the small fat deposits of young animals, but can be identified by their position and the nerves running from them. In older, really fat rabbits this dissection is extremely difficult and great care must be taken not to remove the ganglia inadvertently. Use a lens to see detail.

DRAW as shown in the inset.

NOTE. This dissection also shows the blood-vessels to the stomach, liver and spleen. Ligate the coeliac and anterior mesenteric arteries before proceeding to remove the alimentary canal.

THE RABBIT—*The alimentary canal (I continued)*

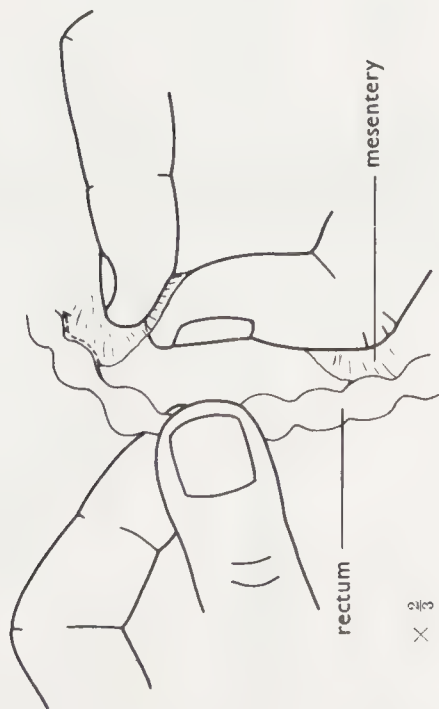


Fig. A6

Using thumb and forefinger of each hand, tear away the rectum from its mesentery. Continue in the same way along the whole length of the intestines EXCEPT THE DUODENUM.

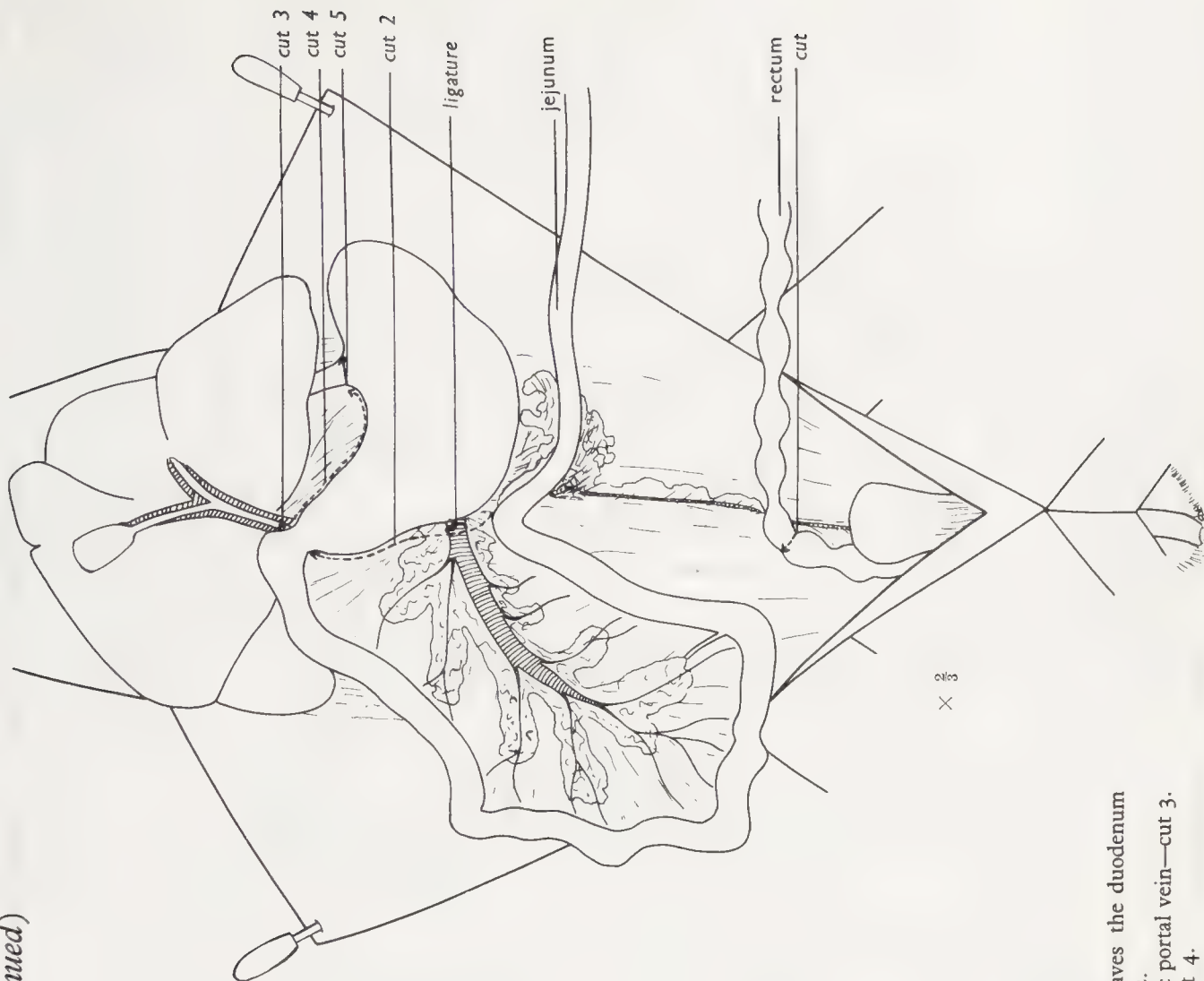
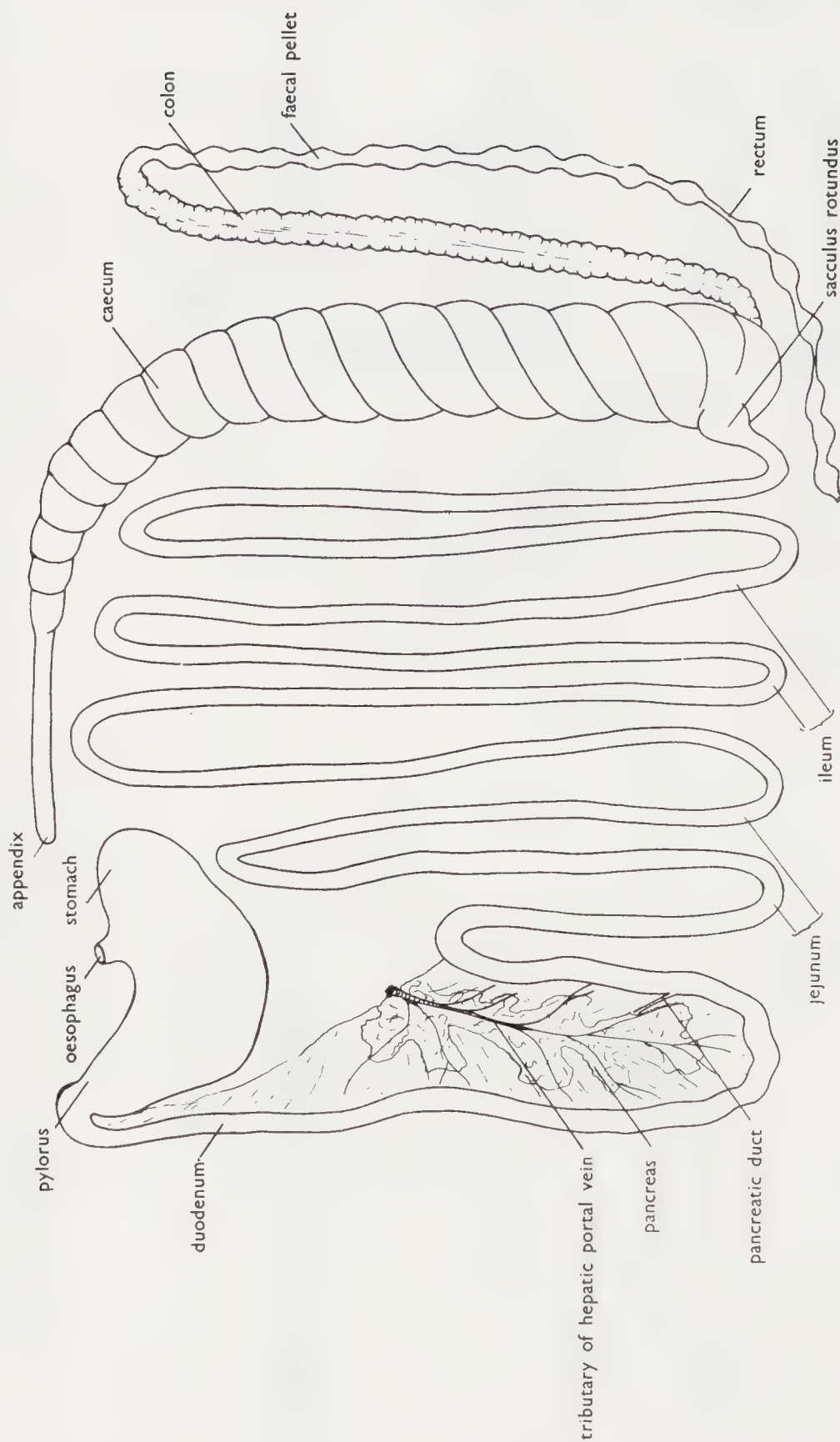


Fig. A7

Lay the intestines out of the way on the board.
Cut through the rectum—cut 1.
Ligature the tributary of the hepatic portal vein which leaves the duodenum and cut through the vein and the mesentery as shown—cut 2.
Cut through the bile-duct, taking care not to cut the hepatic portal vein—cut 3.
Cut through the mesentery which holds the stomach—cut 4.
Cut through the oesophagus—cut 5.

THE RABBIT—*The alimentary canal*



× 3

Fig. A8

Display the isolated alimentary canal on a board in the manner shown.
DRAW.

THE RABBIT—3 The Urinogenital System

The urinary and reproductive systems are usually considered together. The abdominal cavity should be opened as described in *The Rat*, Fig. 4, p. 130, and the alimentary canal removed as described in Fig. A7. The amount of masking fat is very variable, but the outlines of the structures can usually be seen through it and it is very easily removed with blunt forceps.

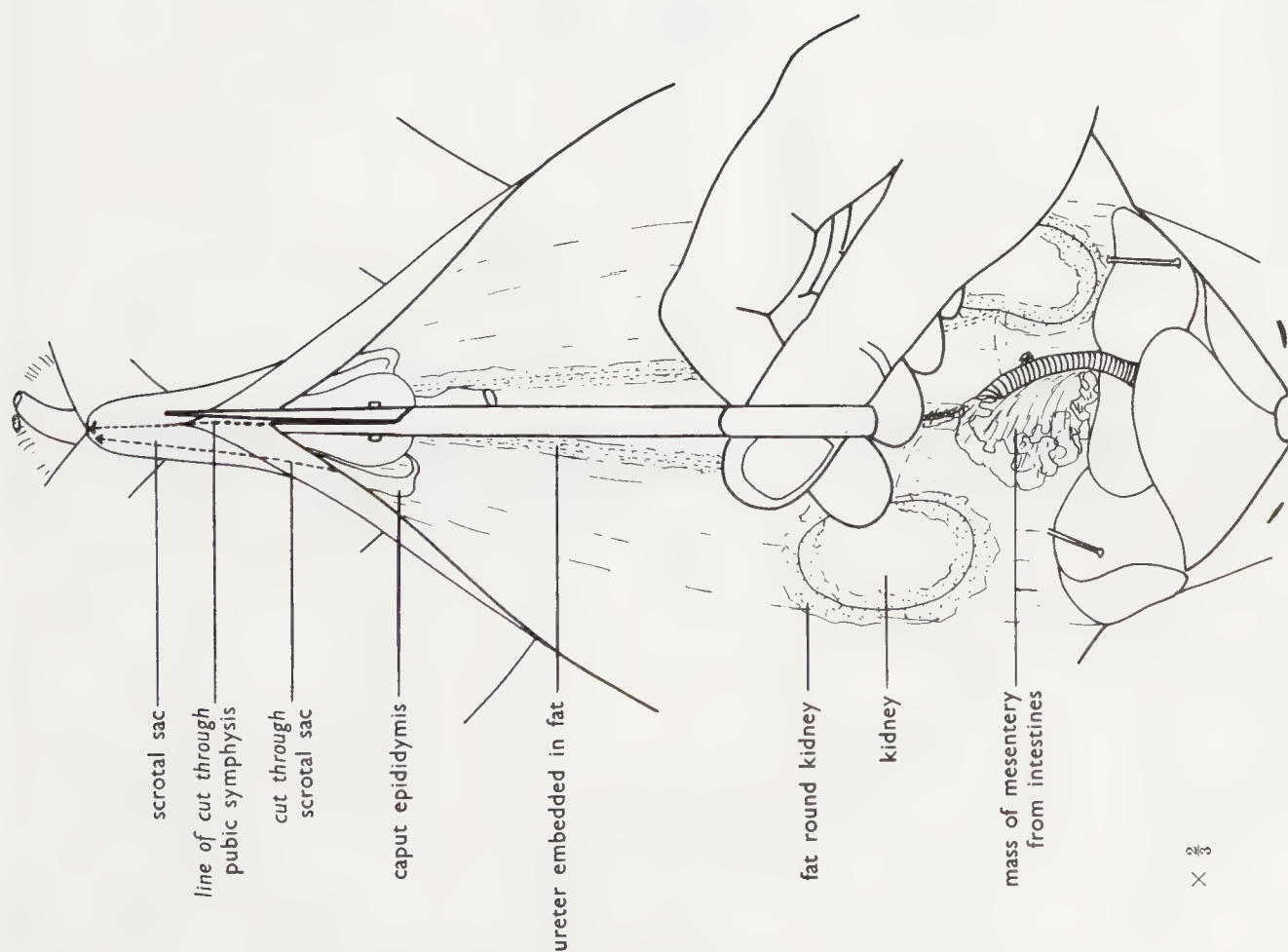


Fig. A9

Place pins to hold the liver away from the kidneys.

Turn the dissection so that scissors can be used as shown to cut through the pubic symphysis.

N.B. BE CAREFUL NOT TO PERFORATE THE BLADDER AND CUT THE URETHRA. MALE ONLY. Continue the cut between the scrotal sacs.

Cut through the wall of one of the scrotal sacs as indicated.

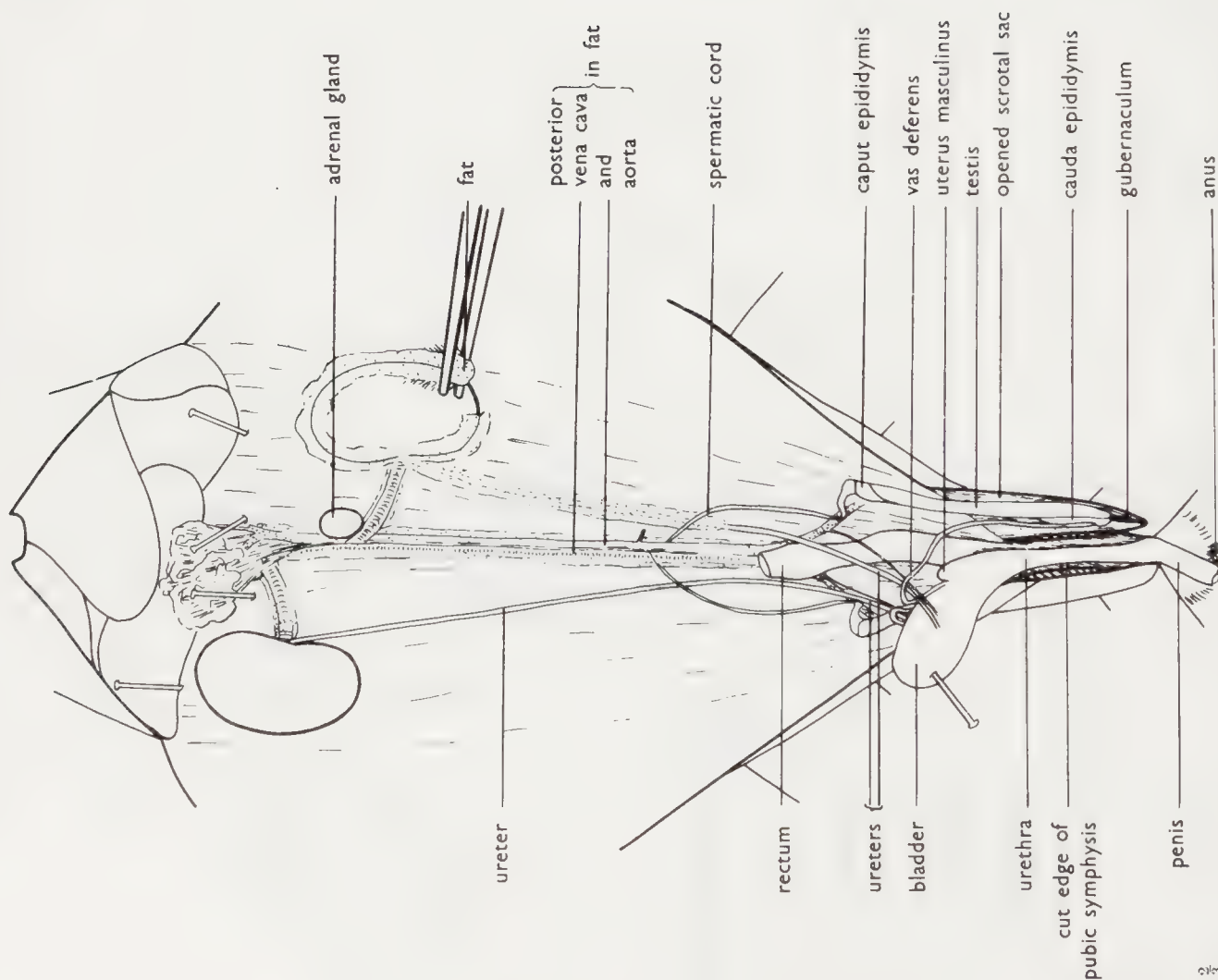


Fig. A10a. Male

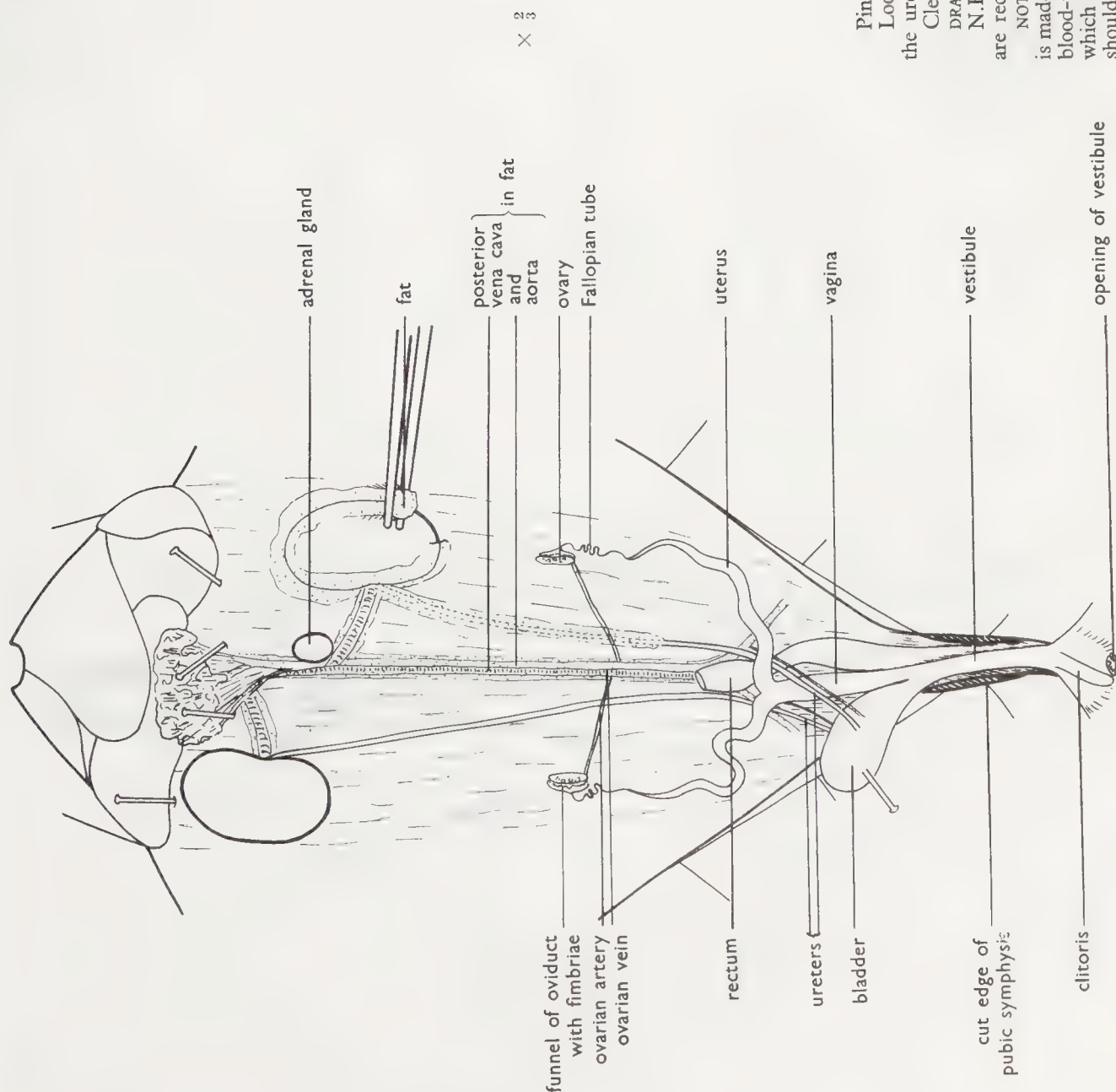
Pin the bladder aside.

Loosen the connective tissue in the pelvic region to display the vasa deferentia, ureters, urethra and rectum.

Clear away fat from the ureters and kidneys.

DRAW.

N.B. Be careful not to destroy any blood-vessels if these are required later.



× $\frac{2}{3}$

Fig. A10b. Female

Pin the bladder aside.
Loosen the connective tissue in the pelvic region to display the ureters, vagina and rectum.
Clear away fat from the ureters and kidneys.

DRAW.

N.B. Be careful not to destroy any blood-vessels if these are required later.

NOTE. The display of the dissection of a pregnant female is made difficult by the enlargement of the uteri and the uterine blood-vessels and by the quantities of fat in the mesentery which supports them. The general arrangement of the parts should however be as shown above.

THE RABBIT—4 The Abdominal Blood-vessels

It is usually considered sufficient to show the abdominal blood-vessels as described in Figs. A11 and A12, but if the details of those to the stomach, liver and spleen are required they must be studied before the alimentary canal is removed—see Fig. A5.

For a complete dissection combine Fig. A5 and Fig. A12.

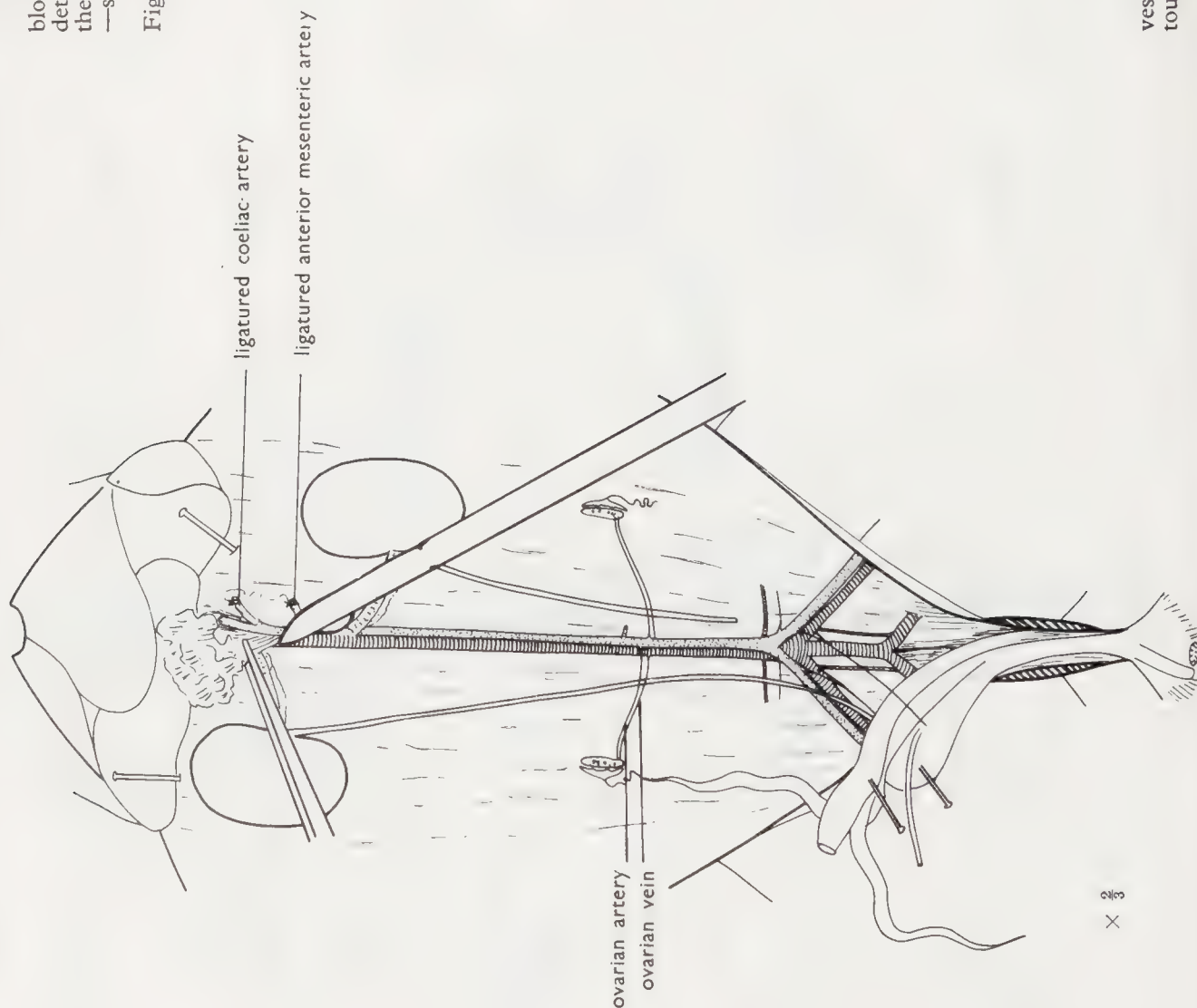


Fig. A11. Female

Cut one ureter and one uterus.

Pin aside the vagina and rectum.

Clear the fat and connective tissue from the blood-vessels, using forceps as far as possible and a scalpel for the tougher mesenteries.

DRAW. For labelling, see Fig. A12.

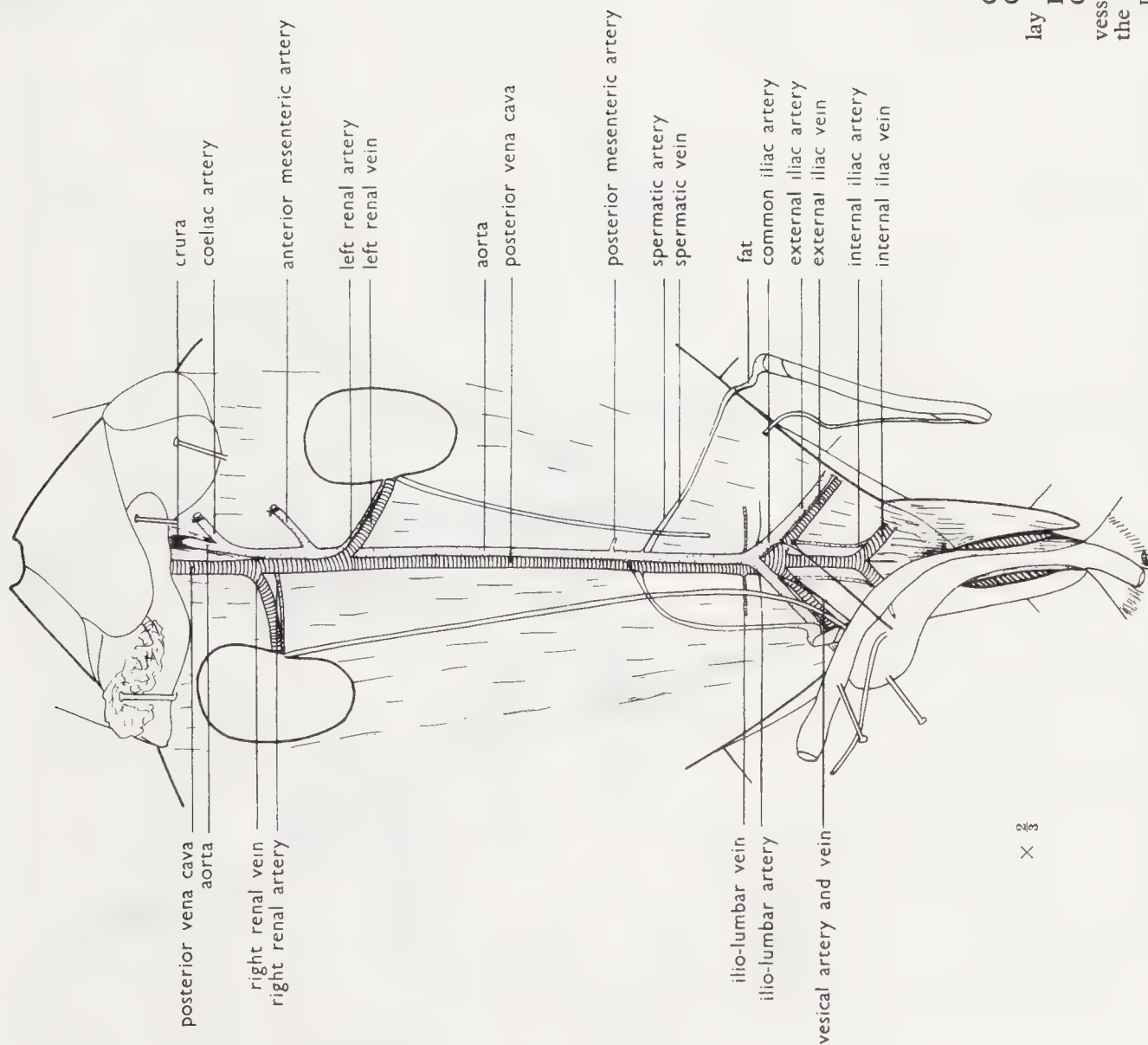


Fig. A12. Male

Cut one ureter and one vas deferens.
 Cut the gaubernaculum of the corresponding testis and lay the testis aside.
 Pin aside the rectum.
 Clear the fat and connective tissue from the blood-vessels, using forceps as far as possible and a scalpel for the tougher mesenteries—see Fig. A11.
 DRAW.

THE RABBIT—5 The Diaphragm

Proceed as described for the rat—Figs. 20-22, p. 148.

THE RABBIT—6 The Neck and Thorax

Proceed as shown for the rat—Figs. 23-25, pp. 149-50, and then continue as follows.

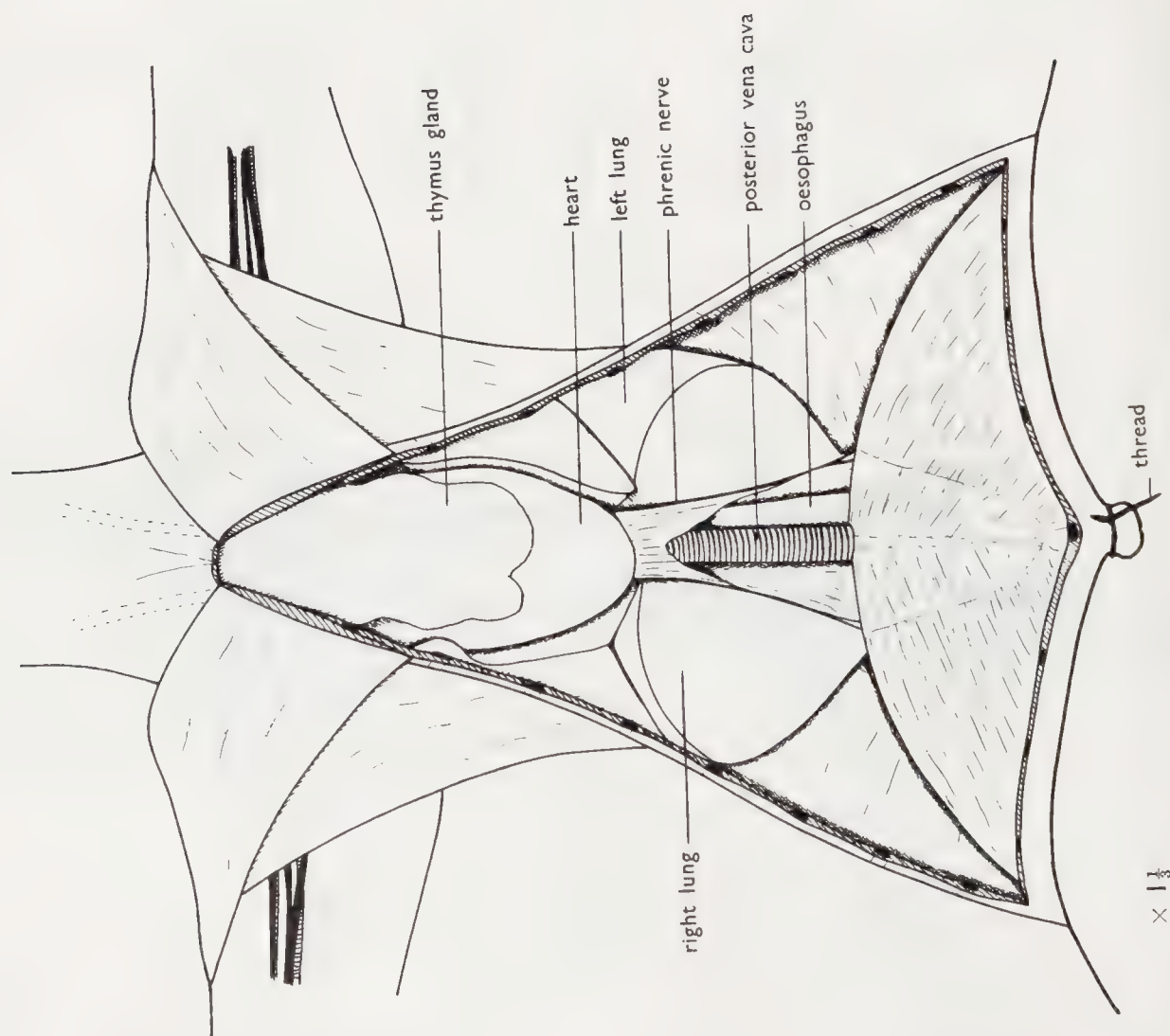
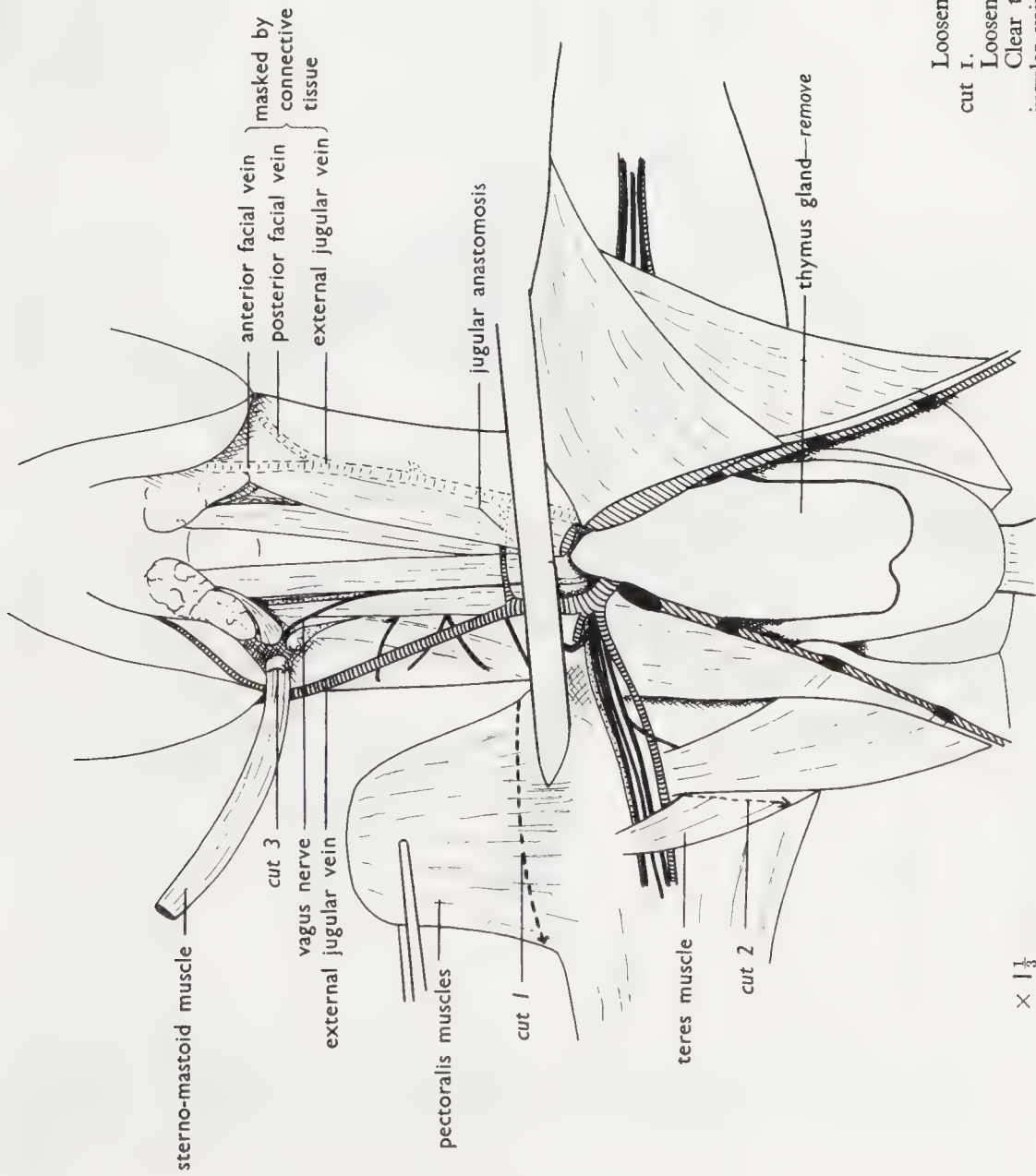


Fig. A13

If the abdominal cavity has been opened, tie a thread round the xiphoid cartilage and attach the other end of this thread to a pin placed near the tail. This holds the diaphragm back. Observe and DRAW the structures now visible.



× 1½

Fig. A14

Loosen, hold aside and cut away the large pectoral muscles—
cut 1.

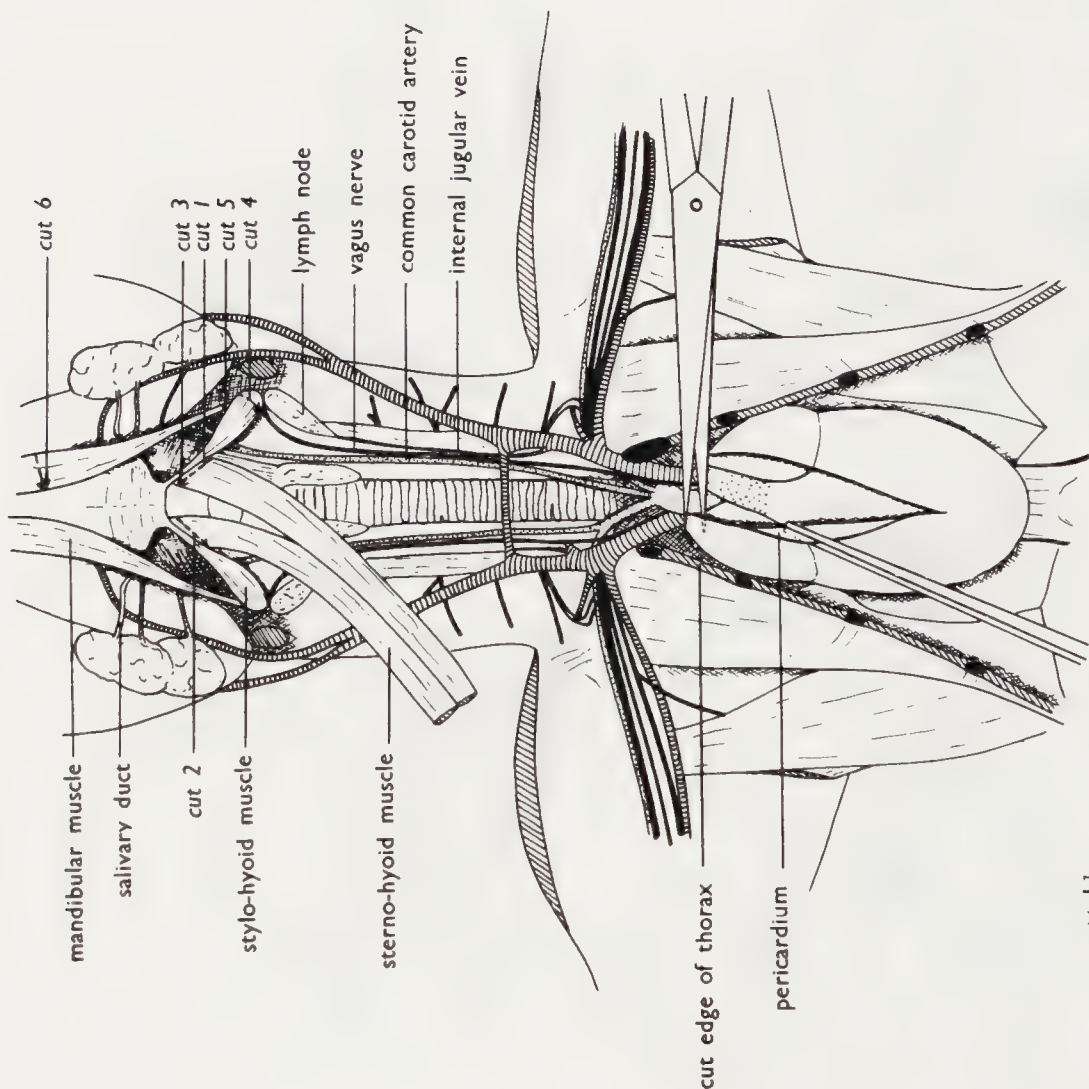
Loosen and remove the small teres muscle—cut 2.
Clear the superficial connective tissue away from the external
jugular vein and the anterior and posterior facial veins.

Loosen, hold aside and cut away the sternomastoid muscle—
cut 3.

N.B. Cut this muscle AS CLOSE TO THE SKULL AS POSSIBLE.

Repeat all the above procedures on the other side.

Remove the thymus gland.



× 1/3

Fig. A15

Lay aside the submaxillary salivary glands, noticing the salivary ducts.

Loosen the sterno-hyoid muscles from under the jugular anastomosis. Cut them as close to the hyoid bone as possible—cuts 1 and 2.

Cut away the stylo-hyoid and mandibular muscles—cuts 3, 4, 5 and 6 (repeated on both sides).

Trim the edge of the thorax to the level of the anterior venae cavae.

Slit and cut away the pericardium as close to the roots of the great blood-vessels as possible.

THE RABBIT—*The neck and thorax*

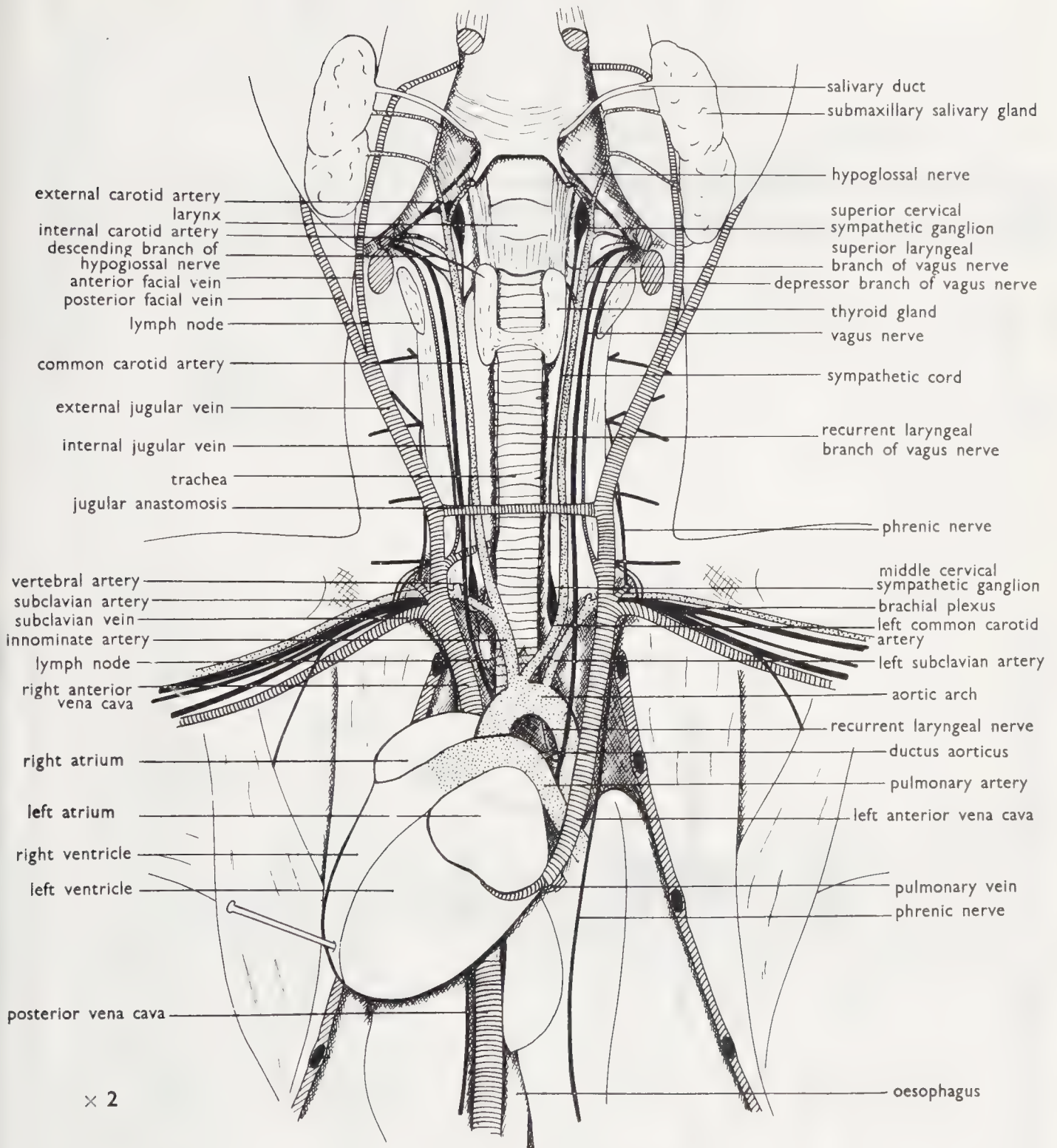


Fig. A16

Pin the heart to the rabbit's right.

Loosen the connective tissue around the blood-vessels and nerves till they can be identified. Adjust the positions of these structures to obtain a clear display as shown. Be careful not to damage the jugular anastomosis.

NOTE. It may be necessary to remove some fat, especially in the region of the aorta.

DRAW.

THE RABBIT—7 The Lungs and Heart

The examination of the lungs and heart is best performed on a preserved specimen because the lungs especially are very soft and slippery when fresh.

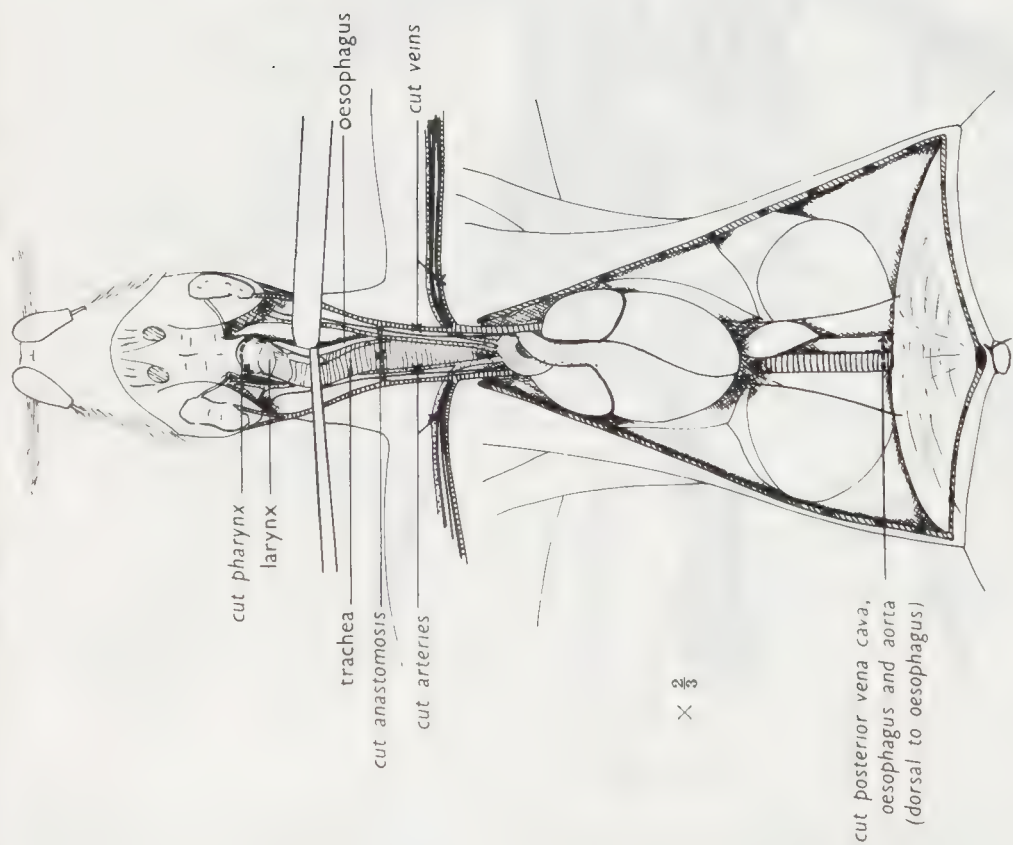


Fig. A17

Cut the jugular anastomosis.

Cut the carotid and subclavian arteries and the jugular and subclavian veins as indicated. NOTE. In a preserved specimen there is no need to ligature these vessels as the clotted blood remains in them, but with fresh material the veins at least should be tied before cutting, because if they are empty of blood they are difficult to differentiate from connective tissue owing to the thinness of their walls.

Pull the trachea and the oesophagus together away from the back of the neck. Work forwards to the larynx.

Cut through the pharynx.

Then work backwards in the same manner, lifting the oesophagus, lungs, heart and great blood-vessels together from the thoracic cavity.

Cut the posterior vena cava, oesophagus and aorta close to the diaphragm.

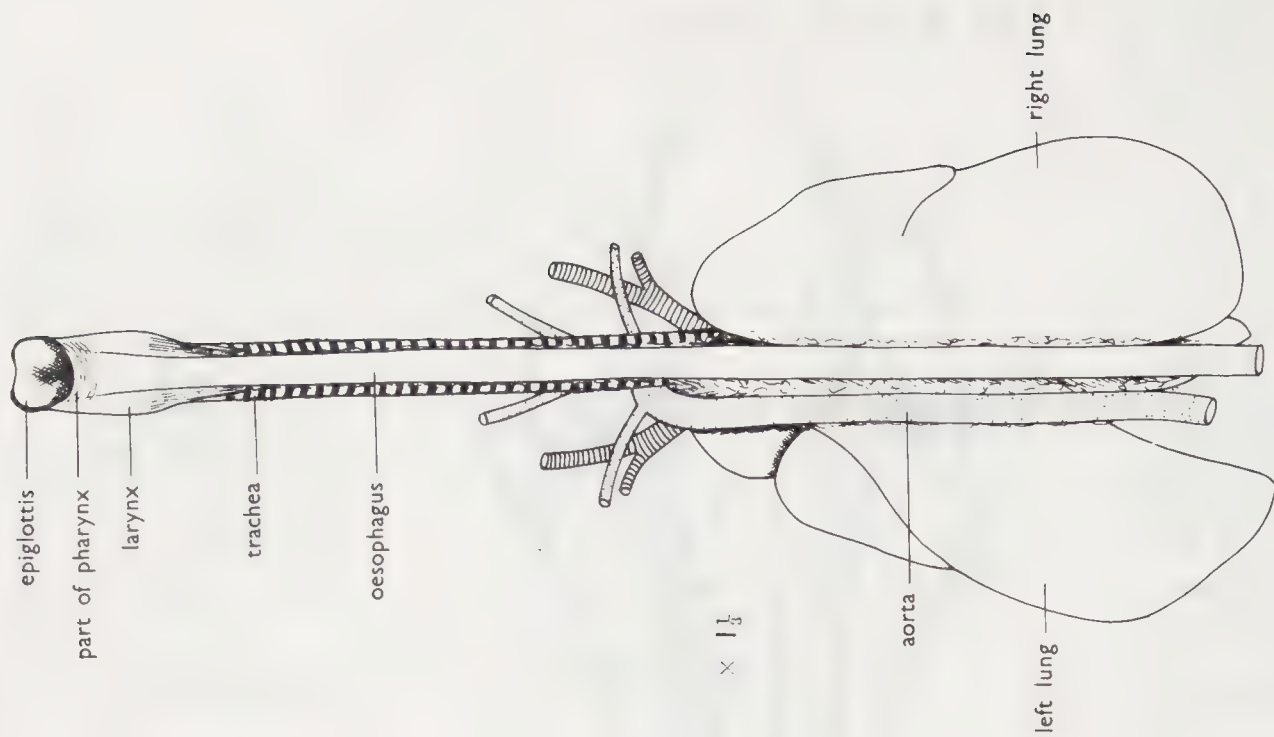


Fig. A18

Examine the preparation in dorsal view. Notice the relationship of the parts. DRAW.

THE RABBIT—*The lungs and heart*

Proceed as shown for the rat—Figs. 37 and 40, pp. 158–9.

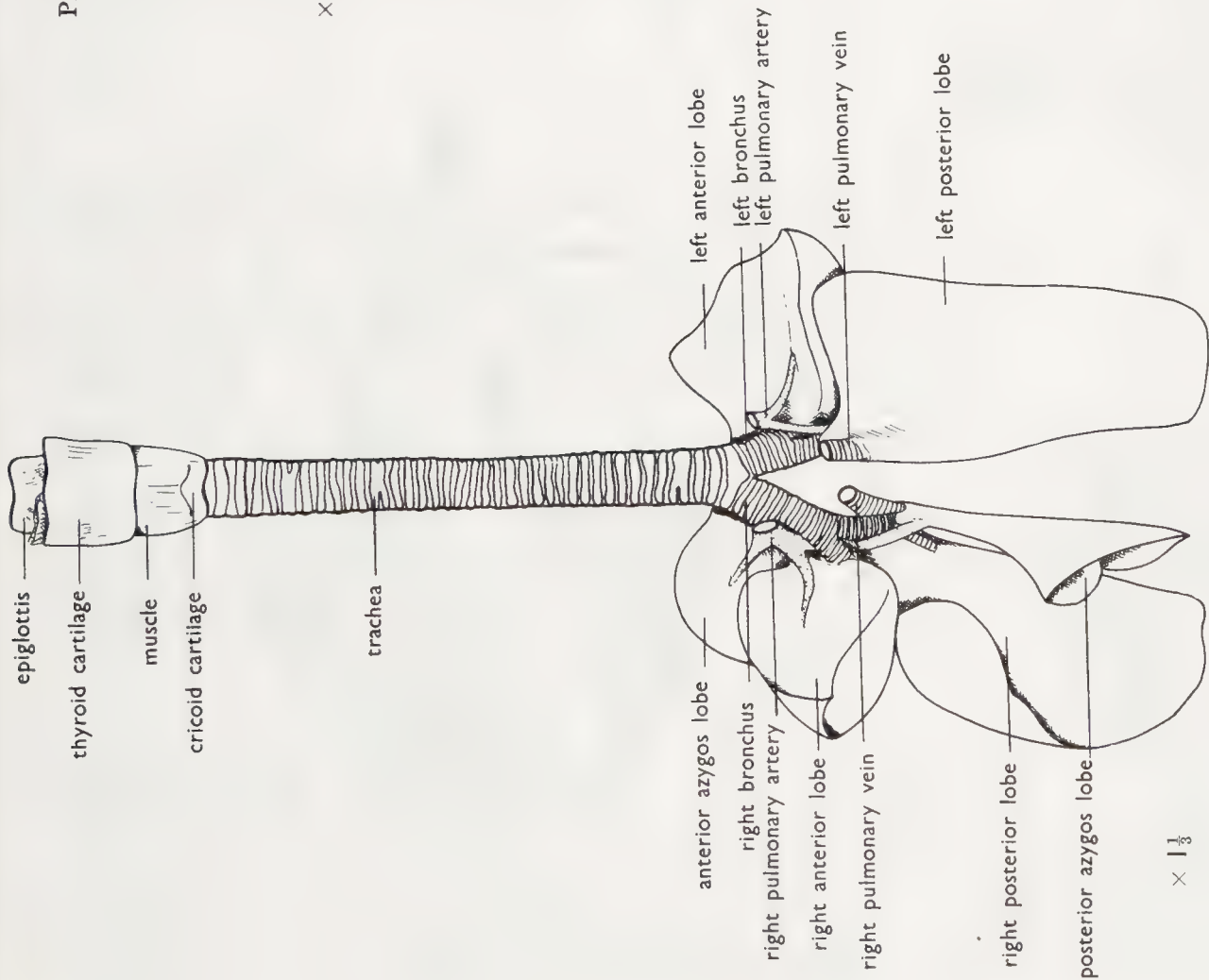


Fig. A19

Examine and DRAW the lung preparation in ventral view.

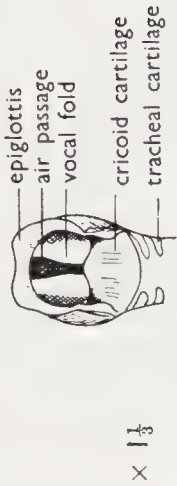


Fig. A20

Examine the larynx in antero-dorsal view.
Notice the vocal folds.
DRAW.

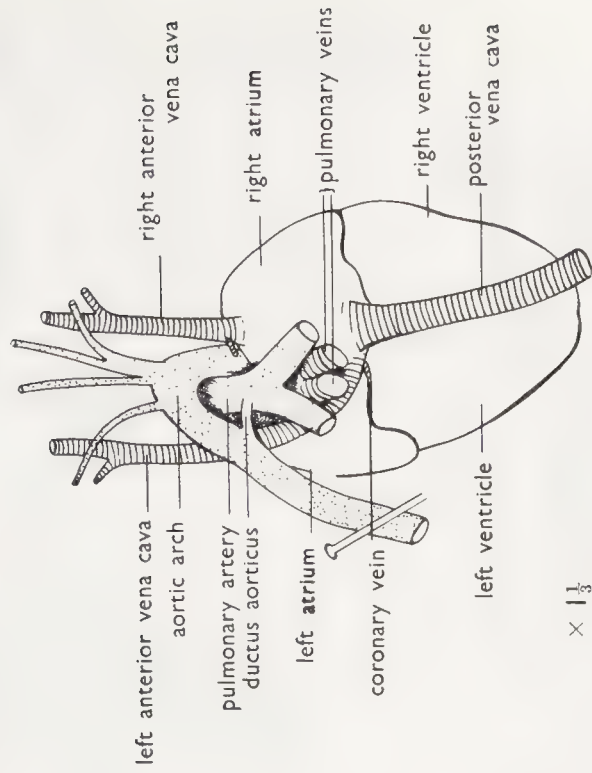


Fig. A21

Examine the heart and blood-vessels in dorsal view.
DRAW.

THE RABBIT—*The lungs and heart*

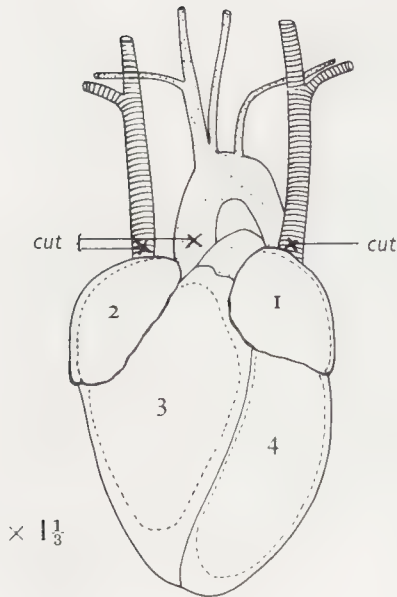


Fig. A22

Cut the aorta and great veins off short as indicated.

Slice away the anterior parts of the walls of the auricles and ventricles. This is best done in the order shown by the numbers 1-4.

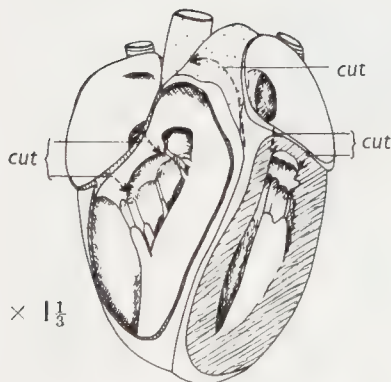


Fig. A24

When the chambers of the heart are cleared, cut away a portion of the ventral wall of the pulmonary artery and also parts of the tricuspid and bicuspid valves as indicated.

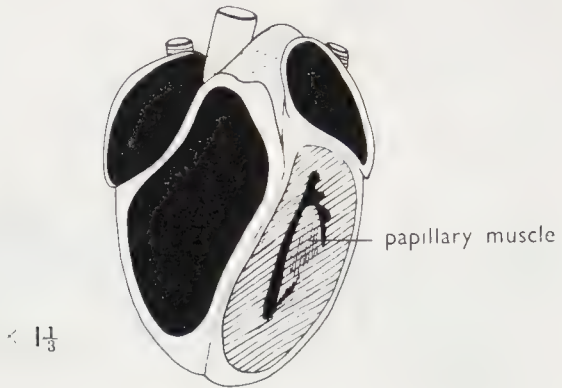


Fig. A23

Notice that the wall of the left ventricle is much thicker than those of the other chambers of the heart, and notice also the base of the anterior papillary muscle of the bicuspid valve. Remove this muscle with scissors.

VERY CAREFULLY clear the hard clotted blood from the chambers of the heart and the roots of the blood-vessels. TAKE GREAT CARE NOT TO DAMAGE THE VALVES AND THE CHORDAE TENDINEAE. Use a seeker to break up and dislodge the larger pieces of clotted blood and running water for final cleaning.

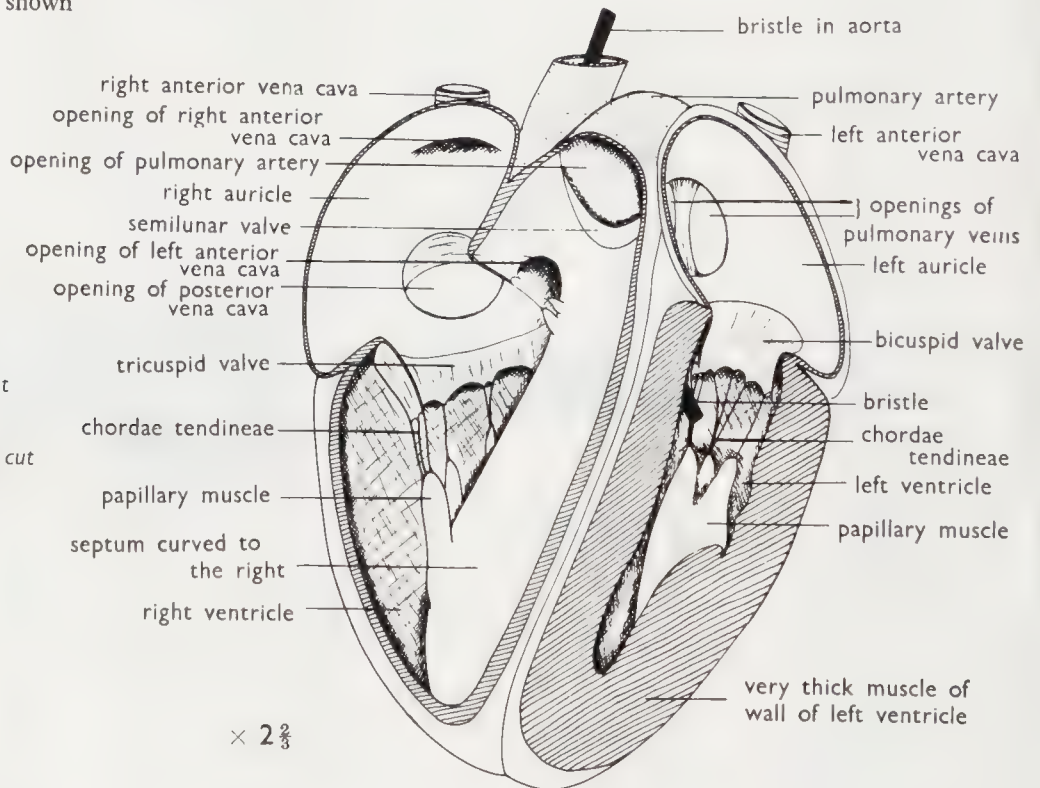


Fig. A25

Insert a bristle through the aorta as shown. Examine the internal structure of the heart. DRAW.

THE RABBIT—8 The Brain

Before the brain is dissected the nervous tissue must be thoroughly hardened by immersion in formalin for a few weeks. The longer the period the better, because the formalin takes a considerable time to penetrate the thickness of the tissues and the skull. The head may be severed from the body either before or after preservation.

Place the preserved head in dilute hydrochloric acid (about 10 per cent) for

approximately 24 hours before it is required for dissection in order to decalcify and so soften the bone of the skull. (Note. Skulls of old rabbits may require longer time and more concentrated acid for complete decalcification.) Soak in water for about half an hour to remove all the acid before handling.

Strip off any fur which may be left from the initial skinning of the rabbit.

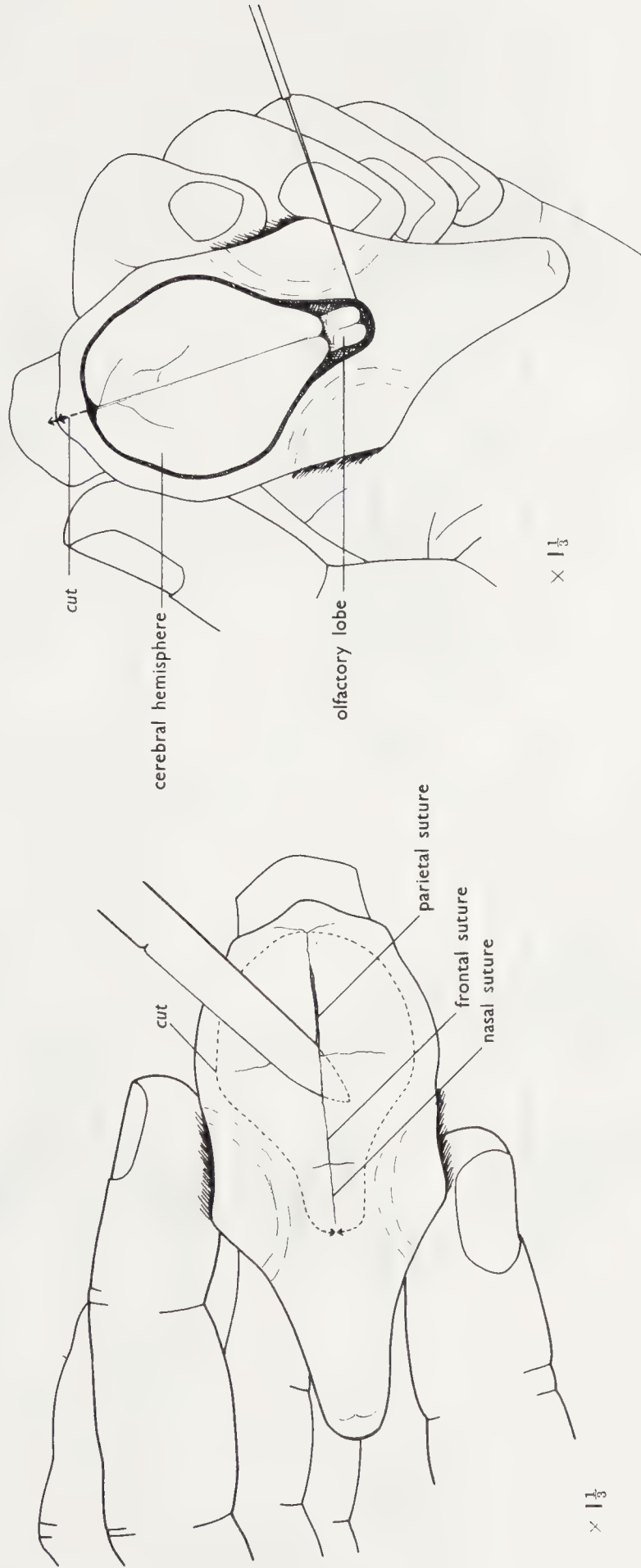


Fig. A26

Grip the skull in the left hand as shown.
With a scalpel carefully cut along the parietal suture, keeping the blade FLAT except for the initial perforation.
Continue the cut along the frontal and nasal sutures, again being sure to keep the scalpel flat so that the brain is not damaged.
Use scissors to cut round the sides of the skull as indicated and remove the roof of the cranium in two parts.

Fig. A27

Notice the cerebral hemispheres and olfactory lobes.
Make a transverse vertical cut in front of each olfactory lobe to sever the olfactory nerves.
With scissors, cut down the back of the brain-case to the neck.

THE RABBIT—*The brain*

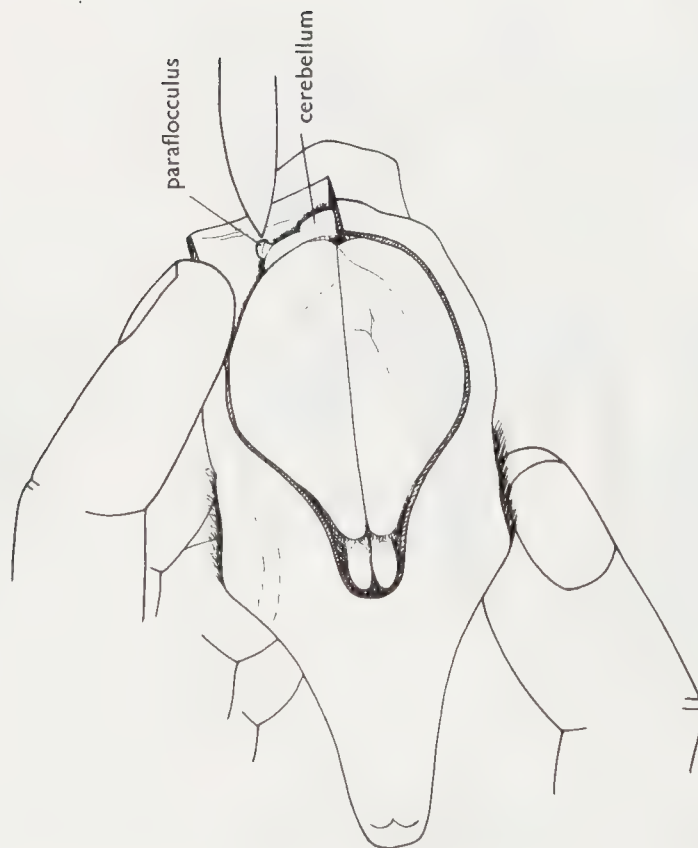


Fig. A28

Pull aside one half of the back of the skull.

Support this part with a finger while gently easing away the socket of the paraflocculus. Cut only when essential to loosen the dura mater.

N.B. BE CAREFUL NOT TO DAMAGE THE PARAFLOCCULUS.

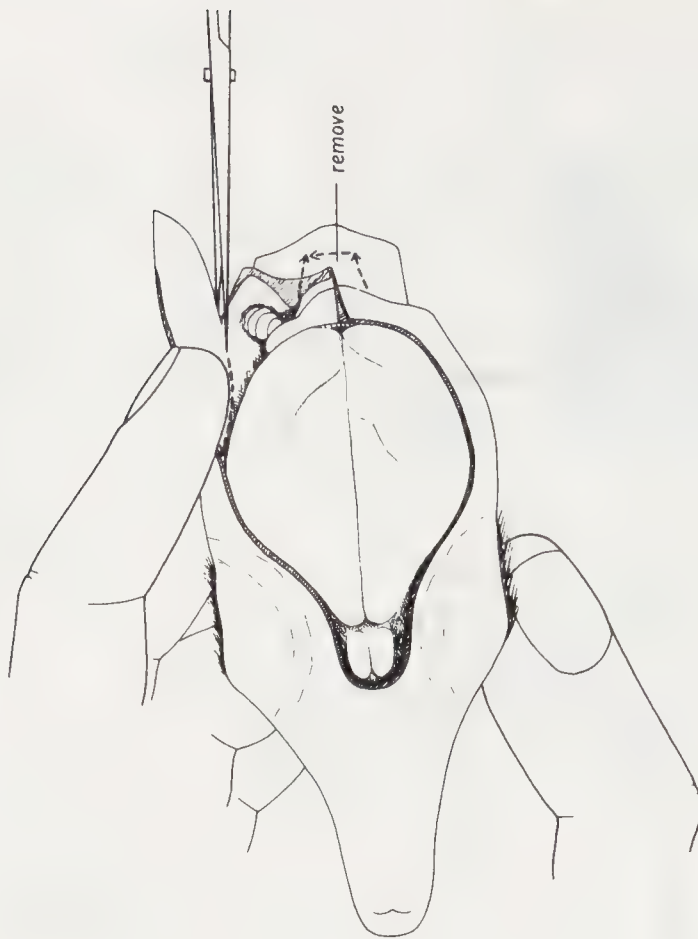


Fig. A29

Cut away the portion of the wall of the skull so loosened and any muscle attached to it.

Repeat Fig. A28 and the above on the other side.

Cut down either side of the vertebral canal and remove the dorsal part of the wall of the canal, thus exposing the medulla oblongata and the anterior part of the spinal cord—see Fig. A30.

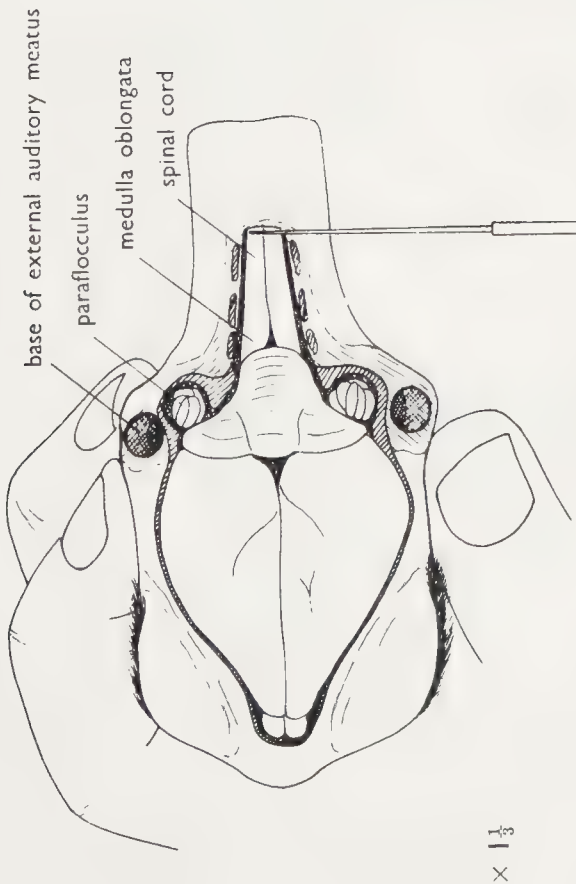


Fig. A30

Cut through the spinal cord as indicated.

Fig. A31

The final removal of the brain from the base of the skull is best done in two stages—Figs. A31 and A32.

Starting from the posterior end, loosen the meninges and cut the cranial nerves in turn as close to the skull as possible.

When the stage shown above has been reached, cut across the base of the skull and the tissues on either side and below it as indicated. The exact position of this cut is immaterial, but it is essential in order that care may be taken to free the pituitary body—see Fig. A34.

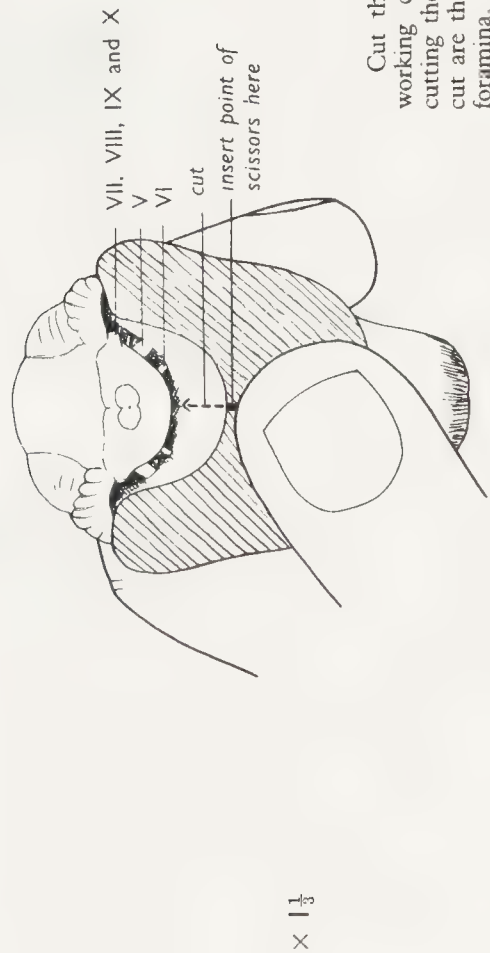


Fig. A32

Cut through the base of the skull in the mid-line, working carefully forwards to the pituitary body and cutting the cranial nerves in turn. The last nerves to be cut are the optic nerves which run forwards to the optic foramina.

Gently ease the brain out of the remainder of the skull.
NOTE. The olfactory nerves may need further cutting.

THE RABBIT—*The brain*

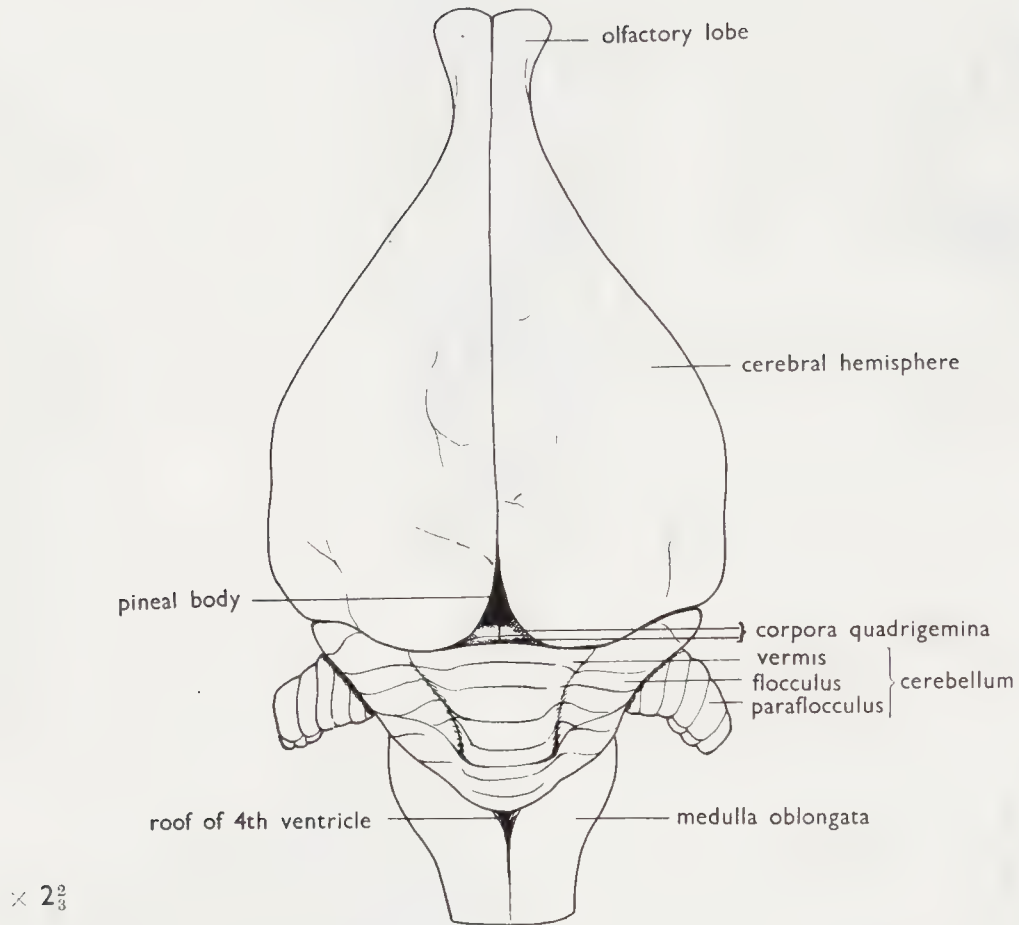


Fig. 42

If the brain has been removed carefully the pia mater with its conspicuous blood-vessels should be intact. It should be stripped off before the brain is studied.

N.B. BE CAREFUL NOT TO DAMAGE THE CRANIAL NERVES—see Fig. A34.
Observe the brain in dorsal view. DRAW.

THE RABBIT—*The brain*

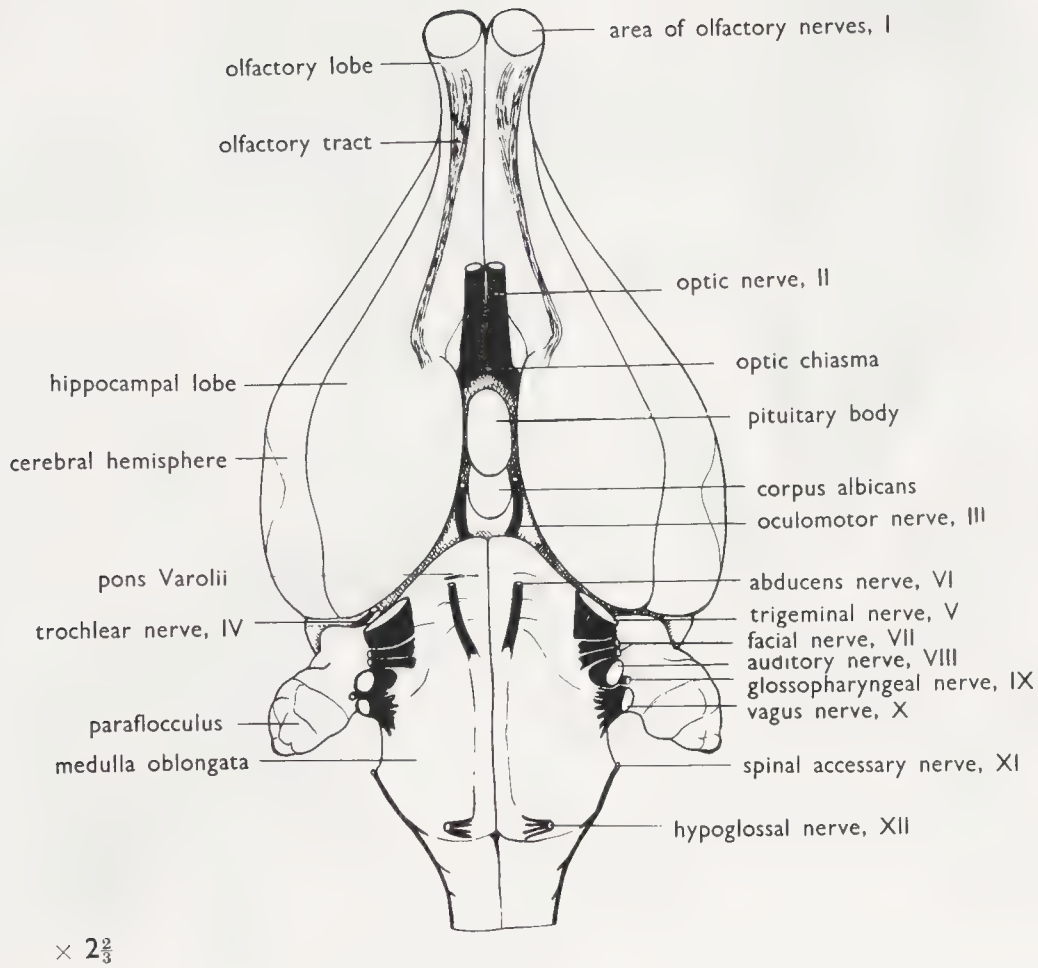


Fig. A34

Observe the brain in ventral view. DRAW.

THE RABBIT—*The brain*

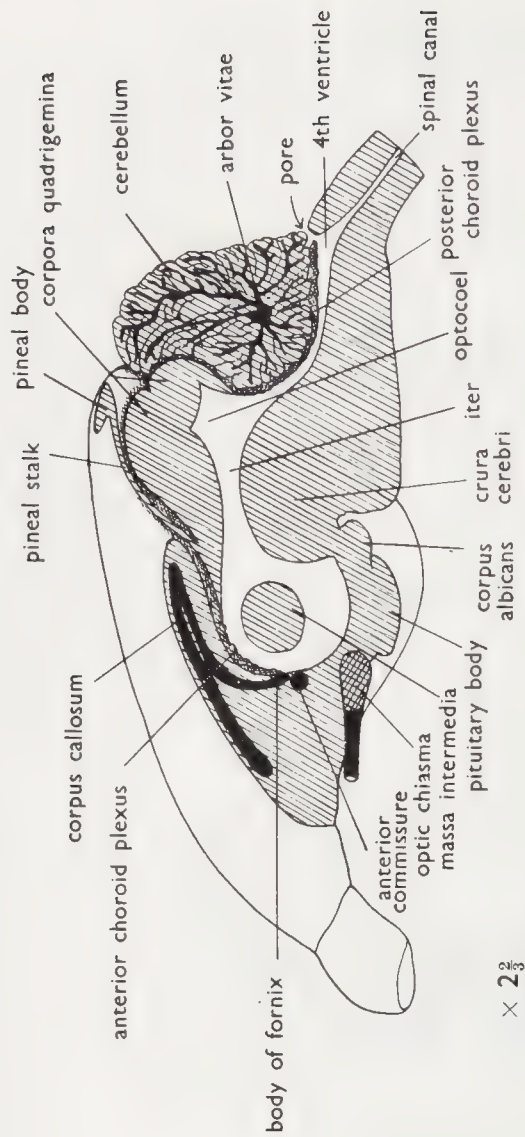


Fig. A36

Cut through the brain in the median sagittal plane.

Observe one half. DRAW.

NOTE I. In the above diagram the pineal body and the pineal stalk have been shown cut as they theoretically would be in a perfect median section. In practice, these structures usually remain attached complete to one side or the other.

NOTE II. Unless the section is truly median the third ventricle, iter and opt'coel will not show distinctly.

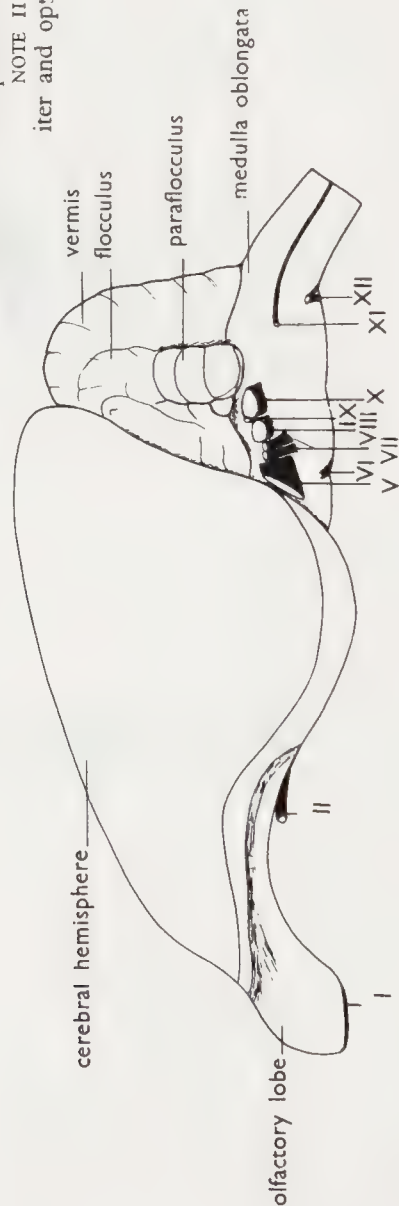


Fig. A35

Observe the brain in lateral view. DRAW.

NOTE. The names of the nerves are given in Fig. A34.

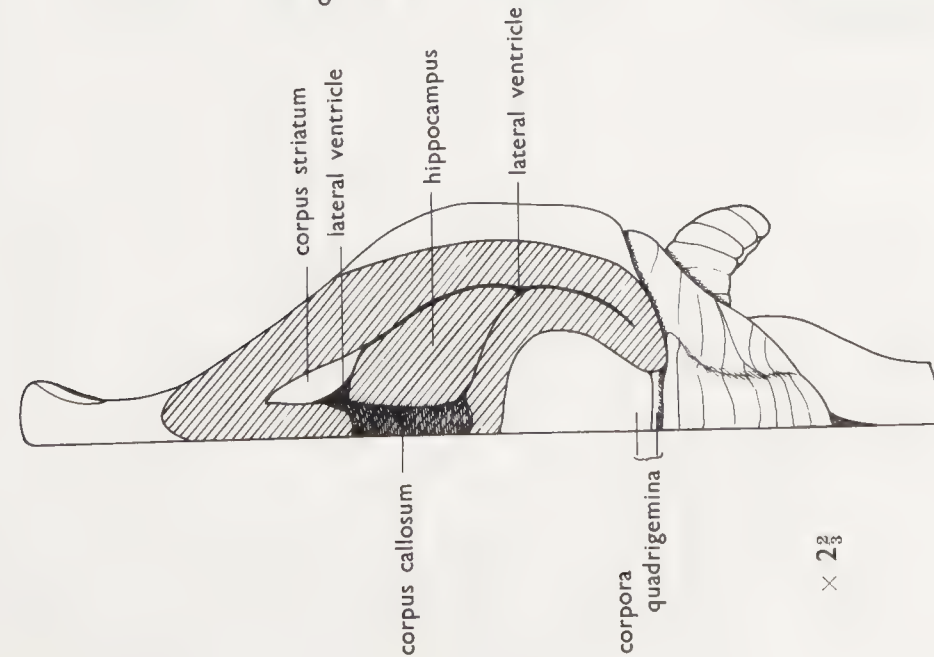


Fig. A37

Carve away the dorsal portion of the cerebral hemisphere of one half of the brain, cutting small slices until the above appearance is obtained.

NOTE. Observe the extent and shape of the lateral ventricles as seen during this and subsequent sectioning—see also Figs. A38 and A39.

Notice especially the hippocampus and corpus striatum on the floor of the cerebral hemisphere and the corpus callosum which joins the hemispheres of the two sides and half of which is clearly visible in sections at this level.
DRAW.

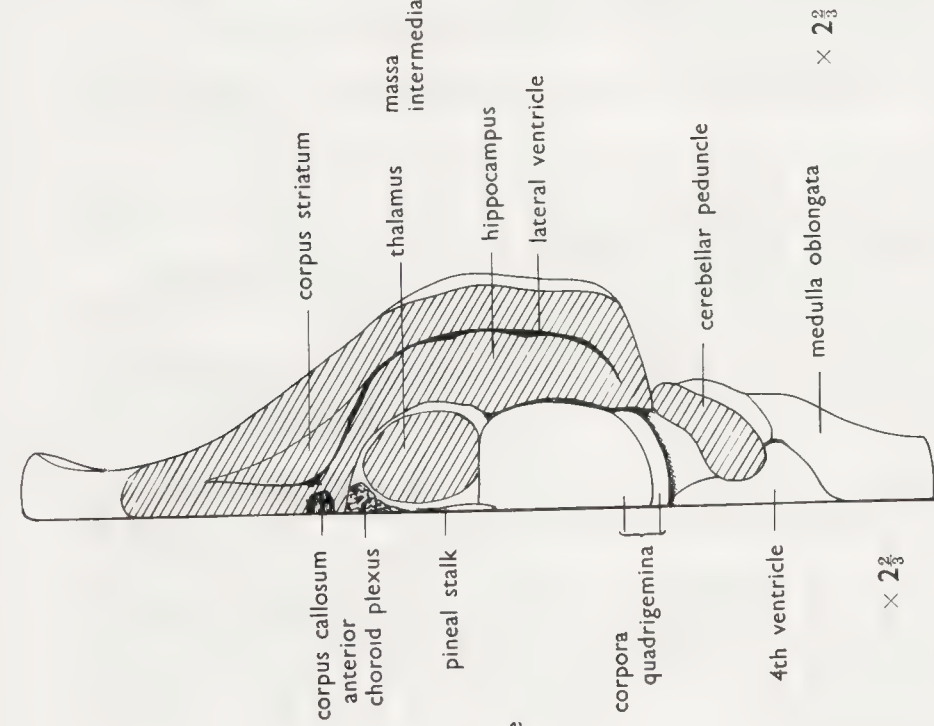


Fig. A38

Carve away further slices from the cerebral hemisphere until the thalamus is visible.

Cut through the cerebellar peduncle and remove the cerebellum so that the extent of the fourth ventricle can be seen.

Notice the size of the corpora quadrigemina.
DRAW.

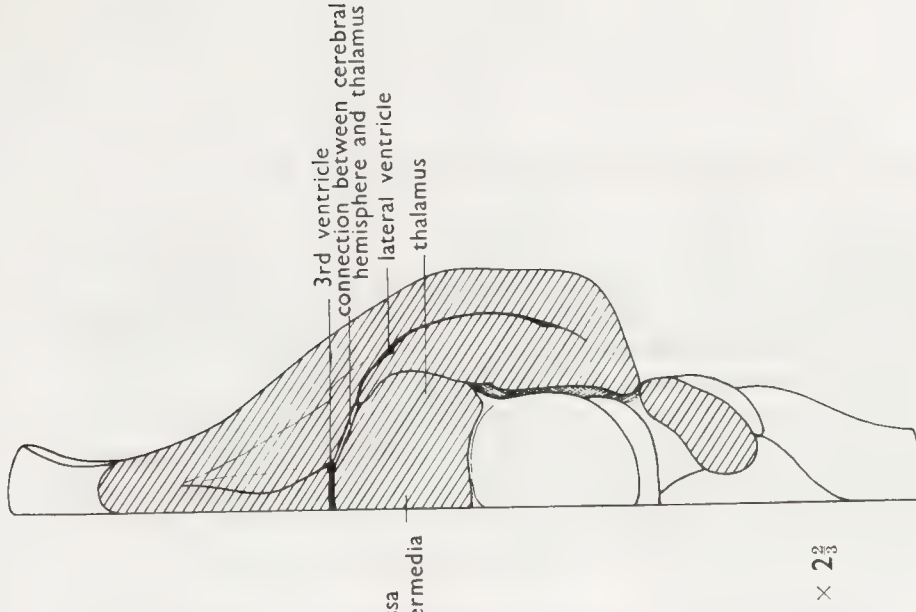


Fig. A39

Carve away still more of the cerebral hemisphere and of the thalamus until the connection between the hemisphere and the rest of the fore-brain can be seen.
DRAW.

NOTES ON THE MOUSE

The anatomy of the mouse is so similar to that of the rat that separate instructions are unnecessary. The following points should however be noted:

- 1 Because of the small size the tissues are more delicate and capillary bleeding occurs very easily. The mouse should therefore be dissected under water to wash away the blood and also to minimize the adhesion of parts.
- 2 Ordinary small pins should be used instead of dissecting pins to pin the mouse to the dish and may also be used to hold organs in place when they tend to float about. Be careful to place the pins *against*, not through the organs.
- 3 Anatomical differences of importance are:
 - (a) much larger preputial glands of a conspicuous yellow colour,
 - (b) relatively longer intestines,
 - (c) absence of ridges from the external wall of the colon (see insets to Figs. 7-9),
 - (d) separate bile and pancreatic ducts (see inset to Fig. 9),
 - (e) some of the lymph nodes differently placed (note especially the absence of the node mentioned in Fig. 11),
 - (f) scrotal sacs very shallow so that the testes slip out of them easily,
 - (g) renal and dorso-lumbar blood-vessels relatively further apart and right dorso-lumbar vessels posterior to the left ones,
 - (h) much more masking fat in older mice than rats, making dissection of the delicate blood-vessels of the pelvic region almost impossible in some cases,
 - (i) thymus gland more diffuse and more difficult to remove,
 - (j) middle cervical sympathetic ganglion more anteriorly placed than in the rat.
- 4 While with care it is possible to see almost all the structures seen in the dissection of the rat, the smaller size makes this very difficult in the case of the pelvic blood-vessels and the roots of the cranial nerves. A lens should be used where necessary and the *extreme delicacy of the tissues should be remembered throughout*.

IV SELECTED INVERTEBRATES

The Invertebrate types included in this volume are commonly studied in elementary zoology courses. As mentioned in the general introduction, only those processes which are normally performed by the student himself are described. Specially prepared sections, though omitted here, are very important and should be studied in conjunction with the dissections.

Branchiostoma (Amphioxus) has been placed with the other segmented types instead of in its natural position after the non-Chordate types in order to make allied diagrams come on opposing pages throughout.

INVERTEBRATE DISSECTIONS

	<i>figs.</i>	<i>pages</i>
1 Earthworm— <i>Lumbricus</i> and <i>Allolobophora</i>	1-16	196-203
2 Crayfish— <i>Astacus</i>	17-30	204-215
3 Cockroach— <i>Periplaneta</i>	31-50	216-227
4 <i>Amphioxus</i> — <i>Branchiostoma</i>	51-60	228-235
5 Swan Mussel— <i>Anodonta</i>	61-70	236-241
6 Snail— <i>Helix</i>	71-81	242-248
7 Round worm— <i>Ascaris</i>	82-84	249-251

Selected Invertebrates—I EARTHWORM

Among British earthworms there are seven species which grow large enough to be used for dissection. These show a number of differences, as listed in the table below, of which the number of seminal vesicles, presence or absence of

testis sacs and position of the spermathecae may affect the dissection—see Figs. 4 and 5. It is therefore important to identify the specimen to be used and not assume that it is *Lumbricus terrestris* as described in the text-books.

Prostomium	Clitellum	Tubercula pubertatis	Seminal vesicles	Testis sacs	Species	Notes
Tanylobous	31 or 32-37 26 or 27-31 or 32	33-36 28-31	3 pairs "	present	<i>Lumbricus terrestris</i> <i>Lumbricus rubellus</i>	Usually prominent orange clitellum Male pores inconspicuous
Epilobous	29-37 30-35	30-33 31-34	4 pairs "	present	<i>Octolasion cyaneum</i> <i>Octolasion lacteum</i>	
Epilobous	1/2 27 or 28-1/2 35 27 or 28-35	31 and 33 32-34	4 pairs "	absent	<i>Allolobophora nocturna</i> <i>Allolobophora longa</i>	
Epilobous	24, 25 or 26-32	28-30 or 31	4 pairs	absent	<i>Eisenia foetida</i>	Spermathecae open dorsally

Earthworms may be killed with chloroform provided that the liquid is placed on cotton-wool and not allowed to come into contact with the worms. Should it do so the worms contract violently, often rupturing themselves and causing a rigor which makes the body-wall taut and difficult to pin out without tearing. The dead worms should be left for about 1/2 hour to relax. The relaxation can be helped by gentle rubbing.

Alternatively the worms may be killed by immersion in very hot water. They should be removed from the water as soon as possible because they become flabby and decolorised if left too long. The dissection should be performed in a wax-bottomed dish using SMALL pins for attachment and display.

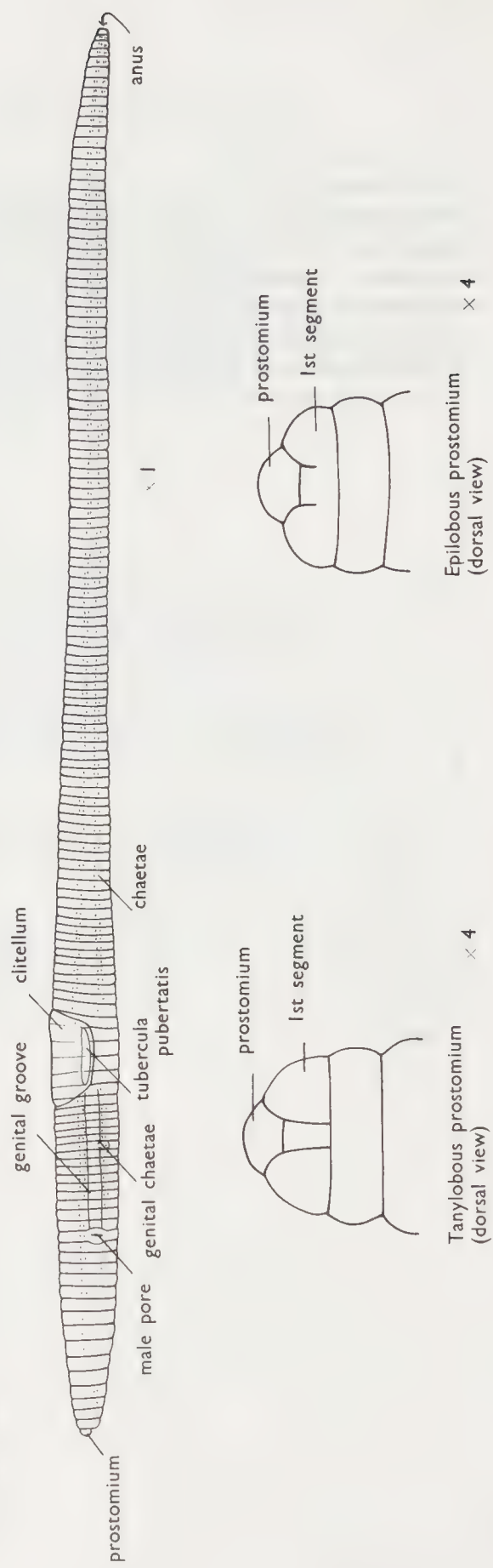


Fig. 1

Examine the worm externally, noting especially the prostomium, the chaetae and the position of the genital pores and the clitellum.

Having made quite certain which is the dorsal and which the ventral side of the worm, proceed with the dissection.

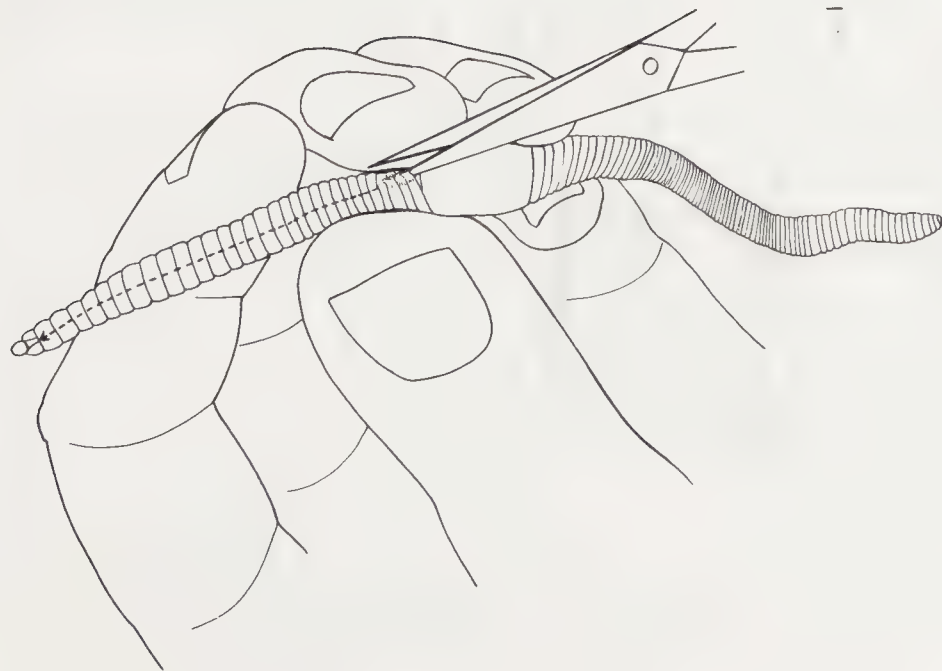


Fig. 2

Holding the worm in the left hand as shown, make a small slit in the body-wall in the mid-dorsal line in the region of the clitellum. BE VERY CAREFUL NOT TO CUT DEEPLY.

Keeping the points of the scissors well up, cut forwards as far as the prostomium.

NOTE. When dissecting *Eisenia*, diverge from the mid-line to either right or left while cutting through segments 12-8 in order to avoid the dorsally placed spermathecae.

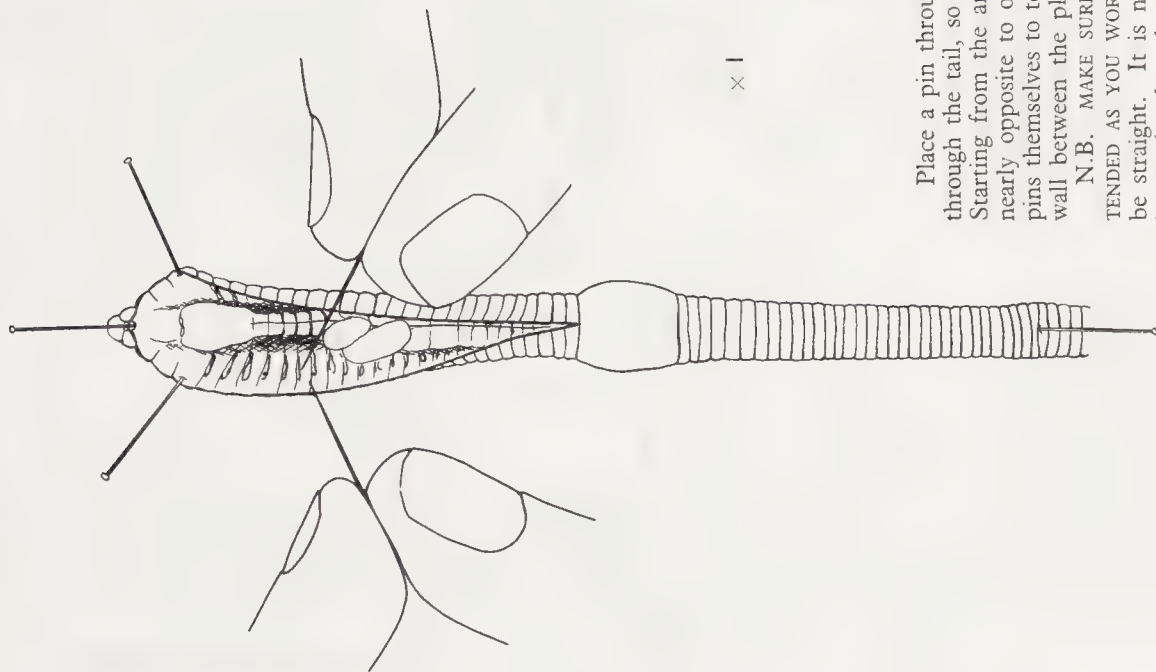


Fig. 3

Place a pin through the first segment and another through the tail, so that the worm is fully extended. Starting from the anterior end, place pins in pairs as nearly opposite to one another as possible. Use the pins themselves to tear the septa and loosen the body-wall between the placing of each pair.

N.B. MAKE SURE THAT THE WORM IS FULLY EXTENDED AS YOU WORK. The alimentary canal should be straight. It is never satisfactory if the stretching has to be done later by moving the pins. Once in place, all but the tail pin should remain in place till the end of the dissection.

NOTE. Each pin should be sloped outwards so that it takes the strain and does not interfere with the free use of the instruments.

Cover the dissection COMPLETELY with water.

Selected Invertebrates—*Earthworm*

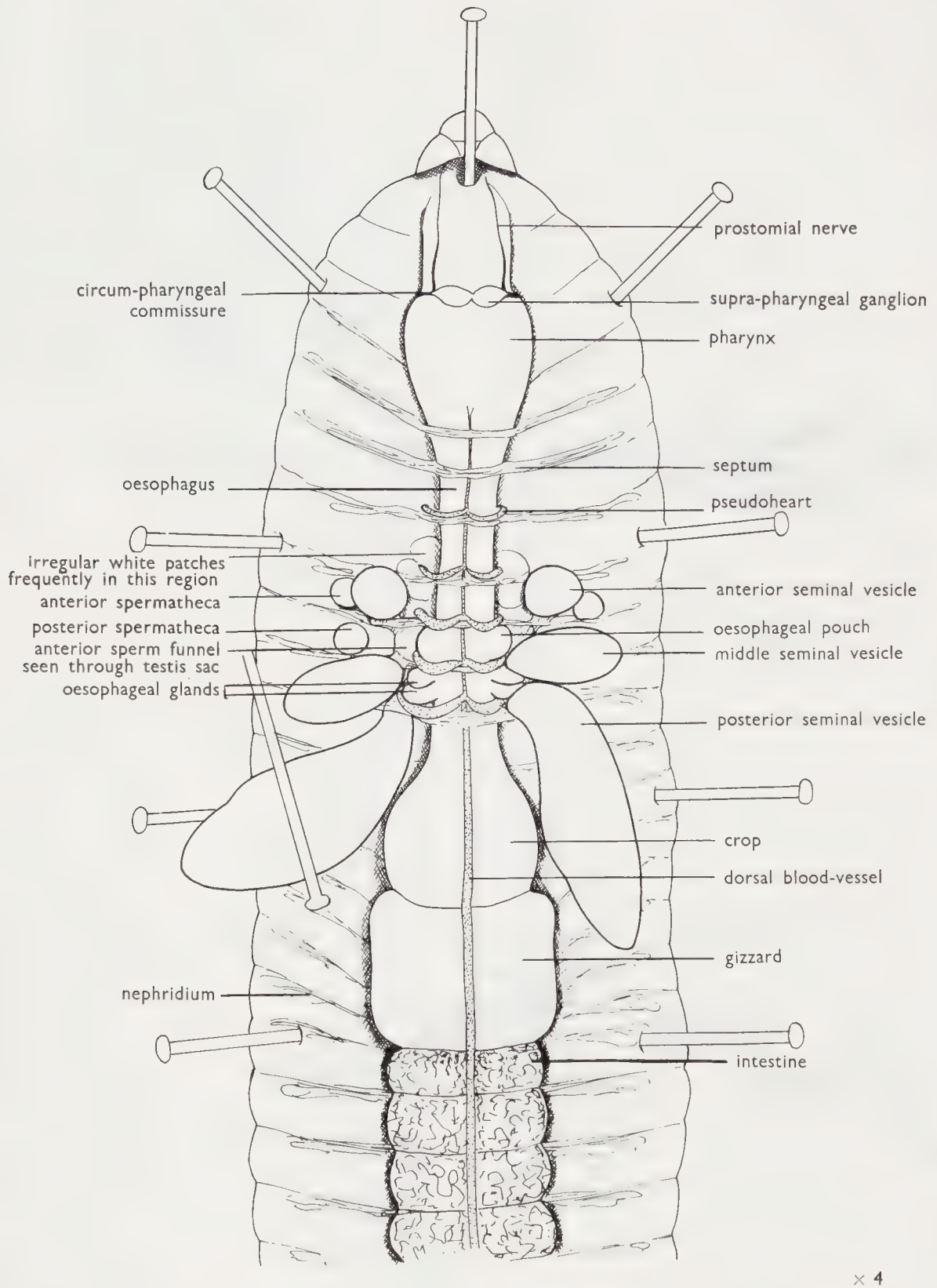


Fig. 4

Use pins where necessary to adjust the positions of the seminal vesicles. DRAW.

Selected Invertebrates—*Earthworm*

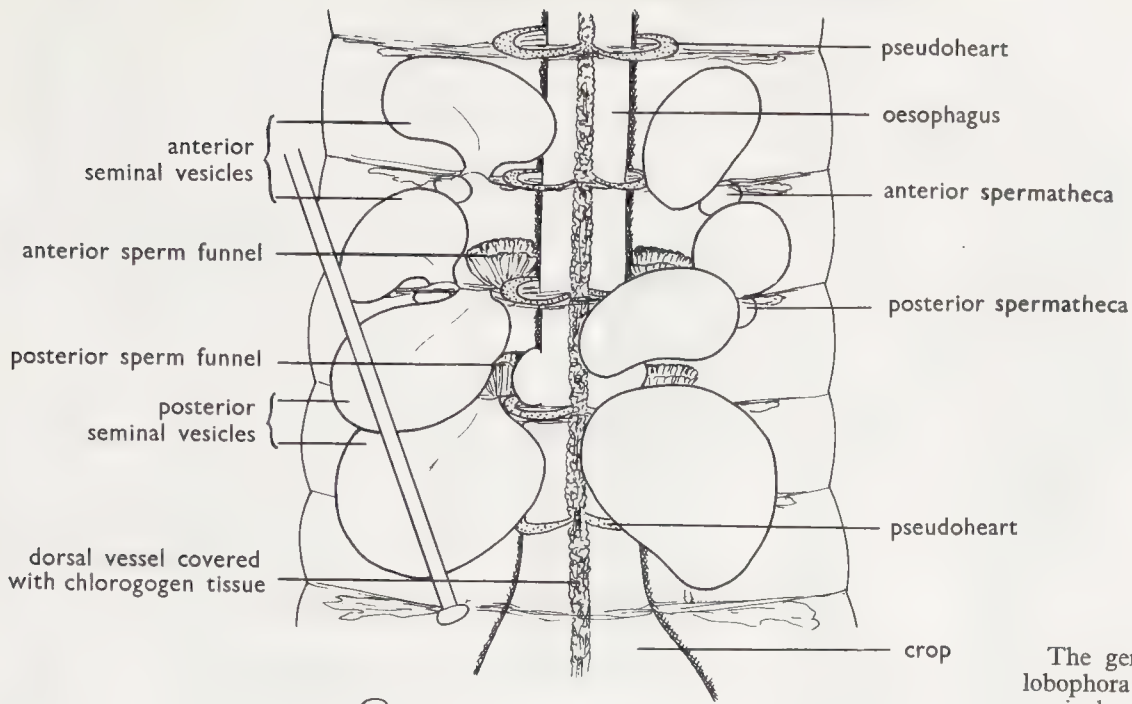


Fig. 5

The genital region of *Allolobophora* shows four pairs of seminal vesicles and the sperm funnels are exposed owing to the absence of testis sacs.

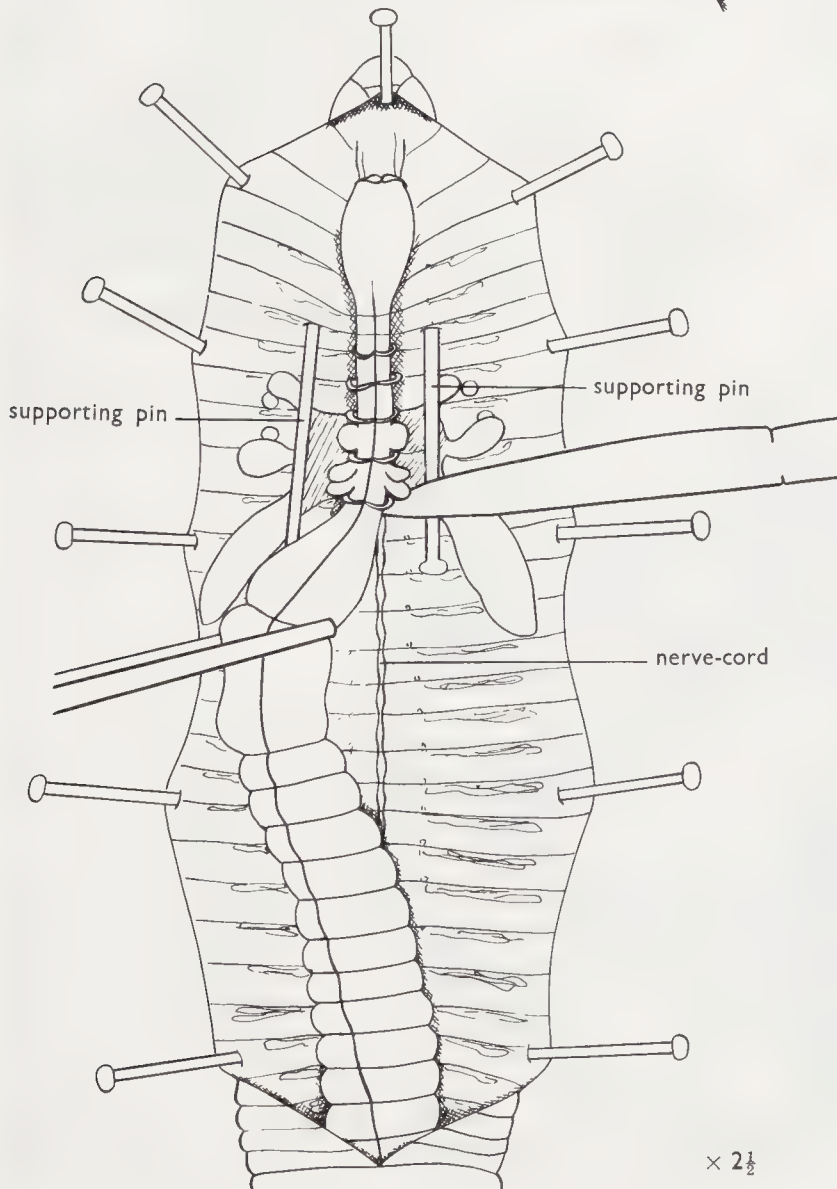


Fig. 6

Place pins as nearly horizontal as possible to hold the seminal vesicles away from the oesophagus—"supporting pins" in diagram.

Lift the alimentary canal in the region of the crop and carefully cut the septa so that it is freed from the underlying parts. Observe but do not damage the nerve-cord.

NOTE. In *Lumbricus* the ventral blood-vessel comes away with the alimentary canal, but in *Allolobophora* it usually remains lying above the nerve-cord and has to be removed separately.

Work forwards carefully, separating the alimentary canal from the testis sacs and seminal vesicles. Usually the testis sacs are cut open during this process, but the seminal vesicles should remain intact.

Continue forwards to the circumpharyngeal nerve-ring. Display the ring on one side—see Fig. 7.

Selected Invertebrates—*Earthworm*

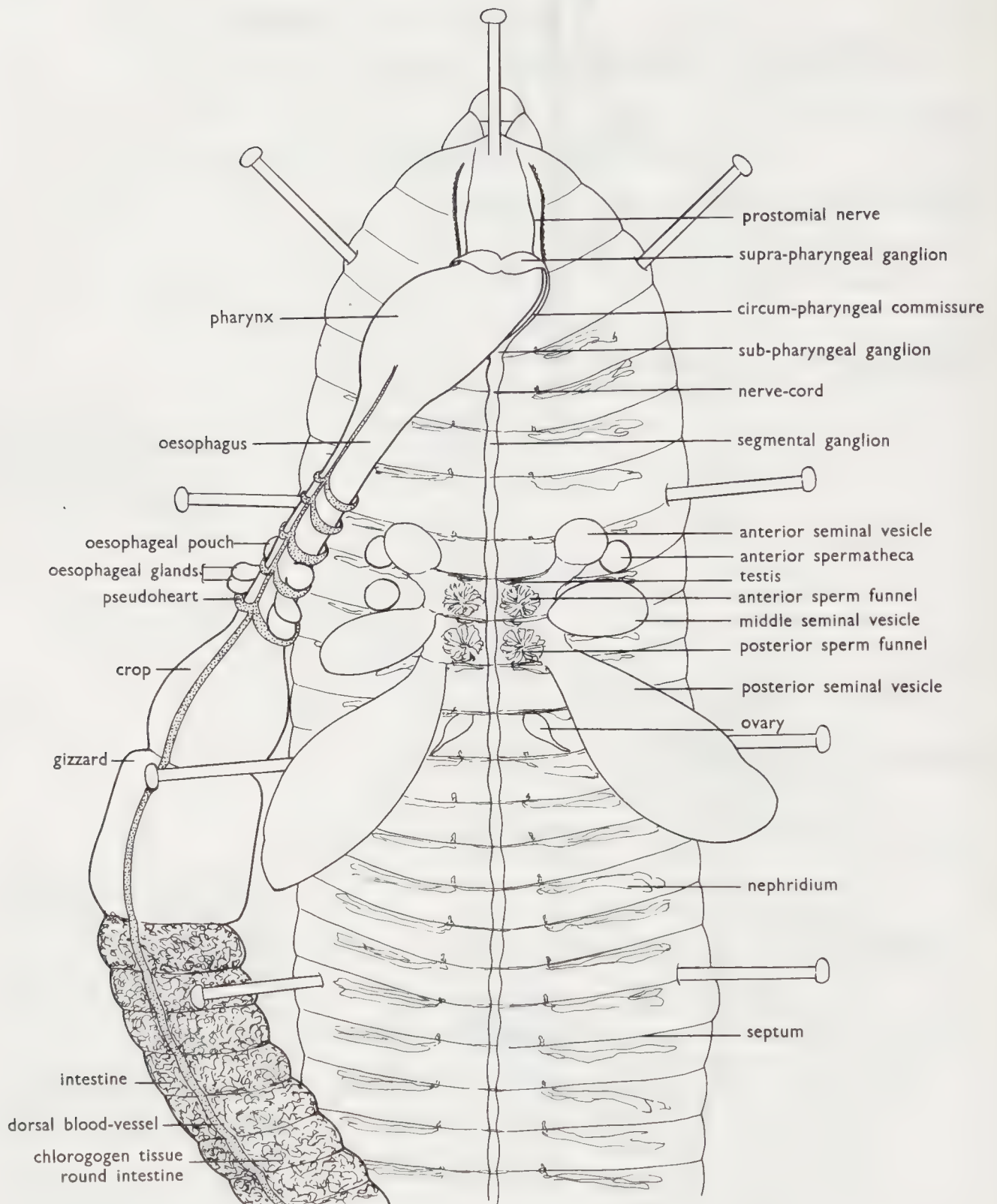


Fig. 7

Pin the alimentary canal aside.
Remove the supporting pins from the seminal vesicles.
Identify the parts and **DRAW**.

Selected Invertebrates—*Earthworm*

Fig. 8

Find the ovaries in segment 13.
Holding the septum as shown, use fine forceps to pull away an ovary along with some of the septum to which it is attached.



trophozoite of Monocystis

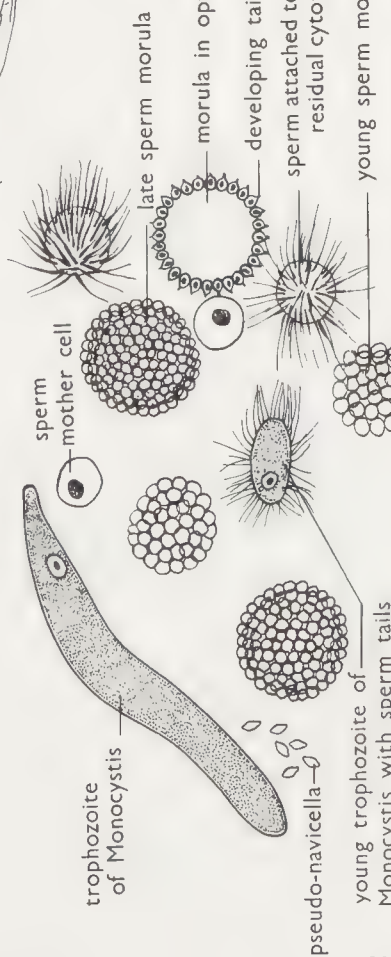


Fig. 9

Mount an ovary and observe it microscopically.
DRAW.

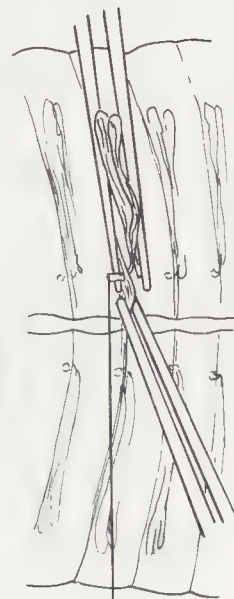
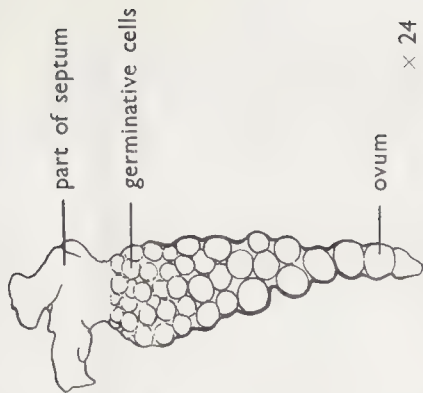


Fig. 11

Use fine forceps to remove a nephridium, watching especially for the nephrostome.

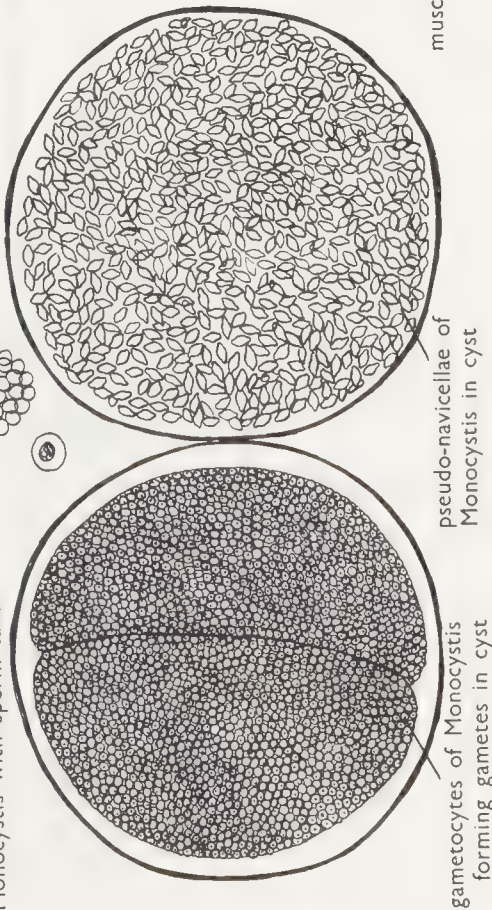


Fig. 10

Make a smear of the contents of one of the seminal vesicles.
Stain with a drop of dilute methylene blue and observe microscopically.
Notice the various stages in the maturation of the spermatozoa and also any MONOCYSTIS which may be present.
DRAW selected stages under high-power magnification.

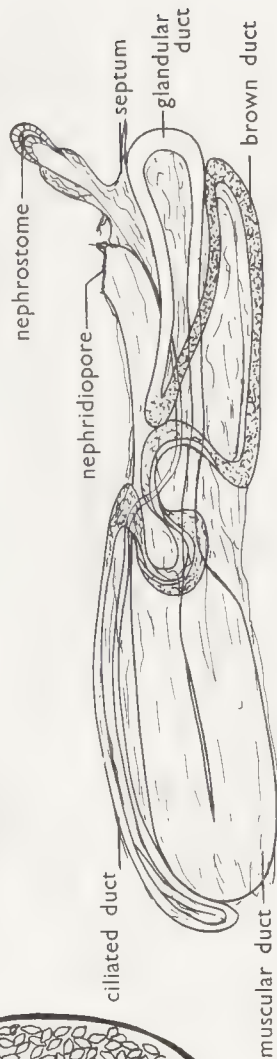


Fig. 12

Mount the nephridium and observe the action of the cilia which are usually still beating.
DRAW the nephrostome and notice the different regions of the tube. It is usually very difficult to follow out the coils.
NOTE. Small nematodes are often present in the nephridial tubes.

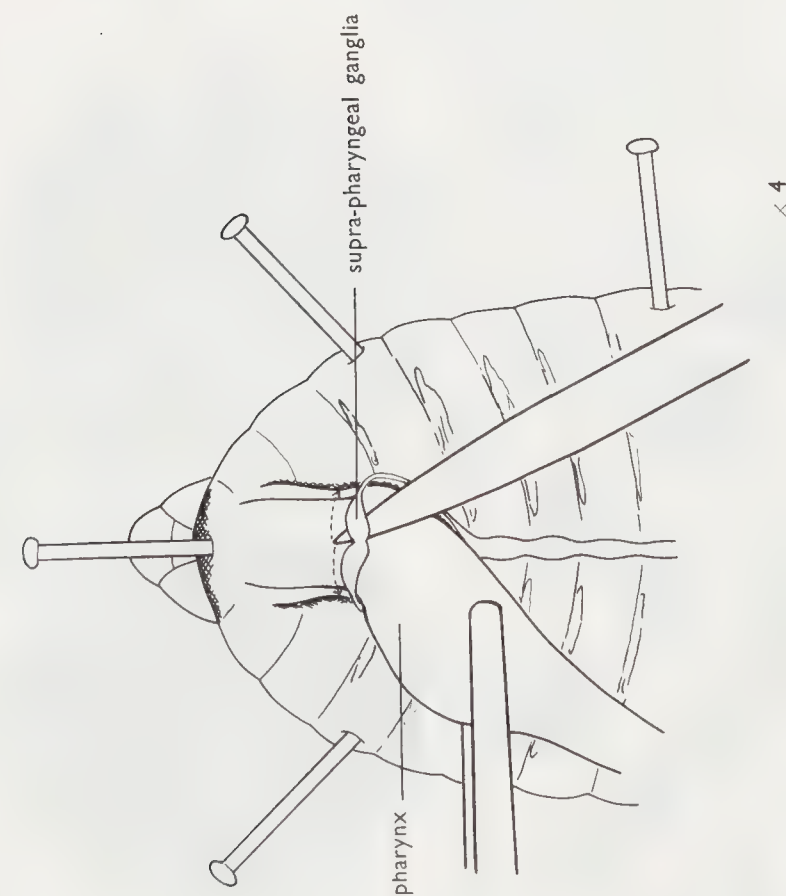


Fig. 13

Use a needle to loosen the nerve-ring from the pharynx.
N.B. Be careful not to break the ring, but loosen it as completely as possible.

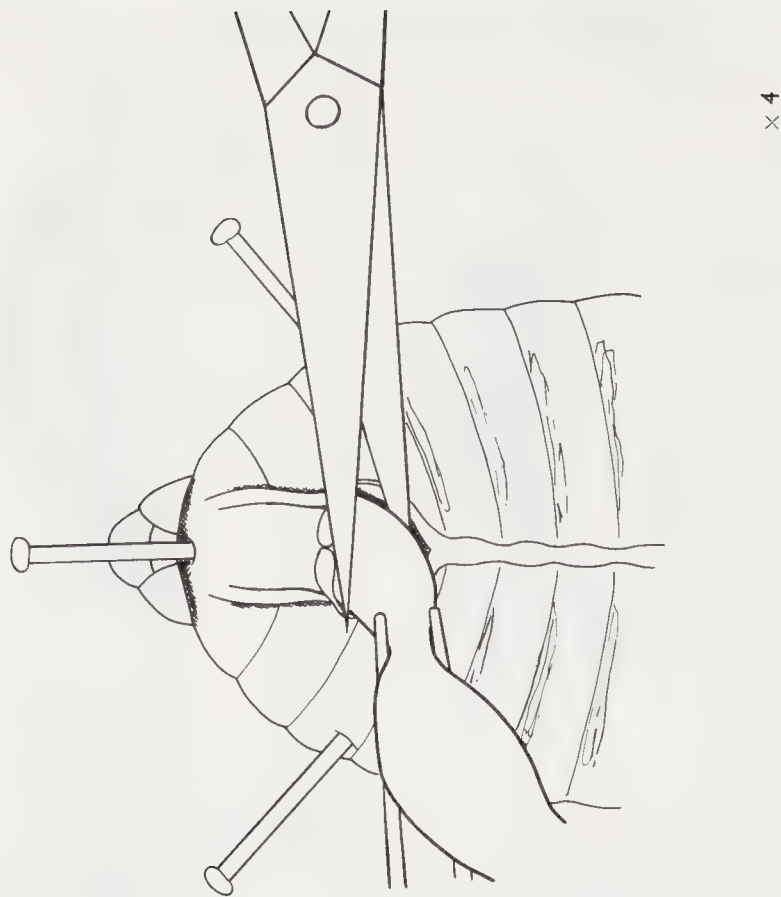


Fig. 14

Pull the pharynx as far through the ring as possible and cut it off as shown.

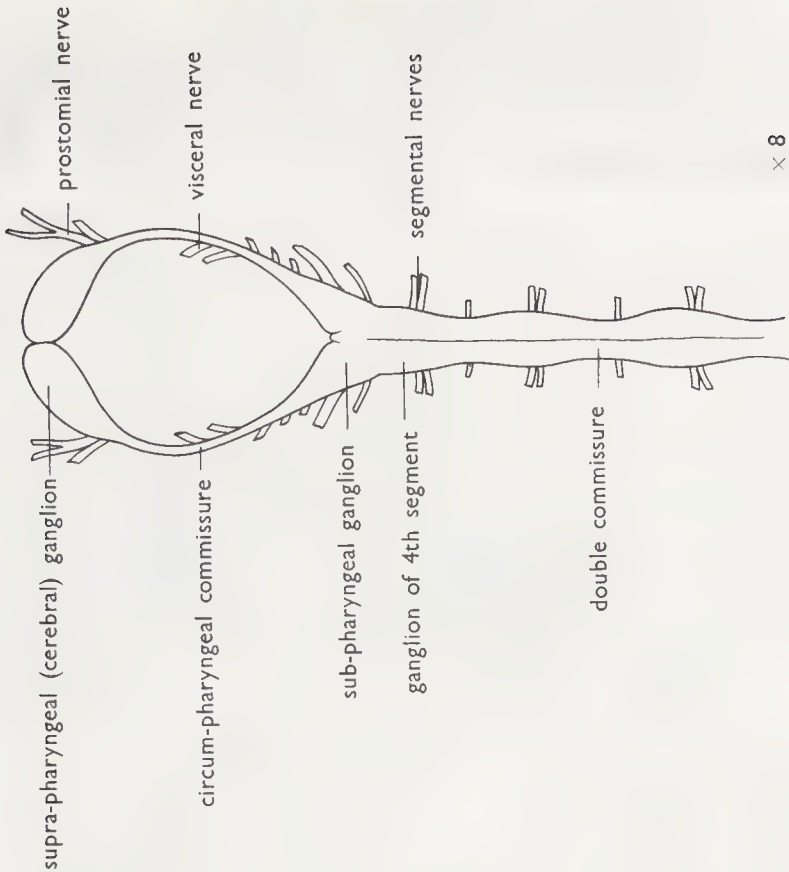


Fig. 16

Mount the nerve-ring and observe it microscopically. DRAW.

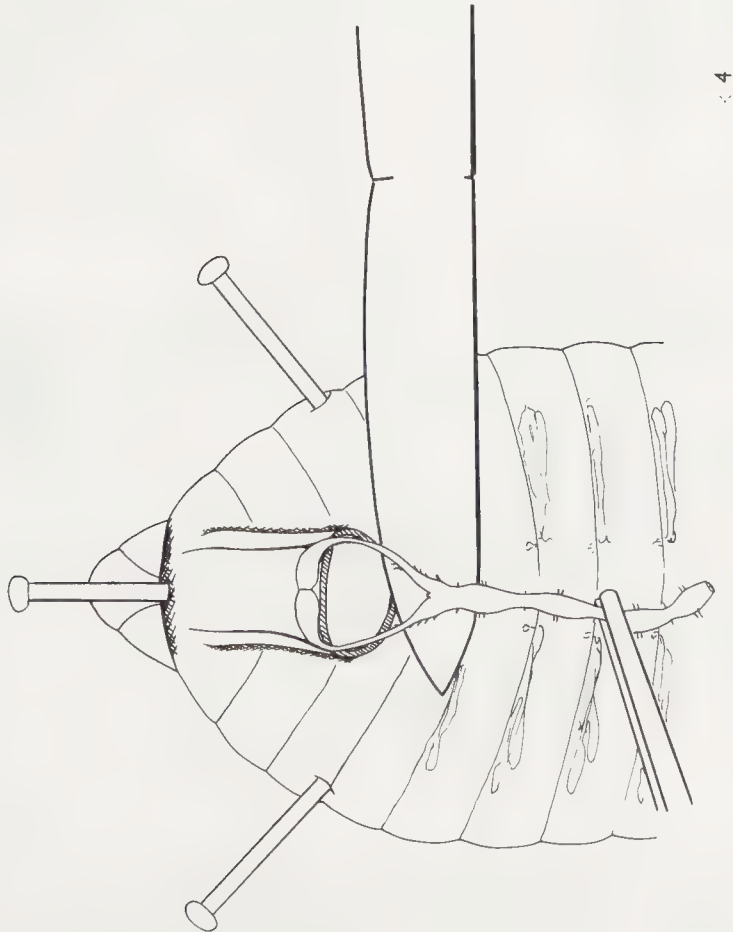


Fig. 15

The anterior part of the pharynx, which remains, should spring back through the nerve-ring, leaving the latter free.
Cut the nerve-cord about $\frac{1}{2}$ inch behind the nerve-ring. Lift the cut portion of the cord with forceps. Use a scalpel to complete the removal of the nerve-ring as shown.

Selected Invertebrates—2 CRAYFISH

Before commencing the dissection, observe the crayfish in dorsal, ventral and lateral views—see Figs. 17, 19 and 29.

The dissection may be performed on either fresh or preserved material. If the crayfish is to be preserved a small portion of the back of the carapace should be removed before immersing in formalin in order to allow more rapid penetration of the preservative.

For the greater part of the dissection the specimen is held in the left hand.

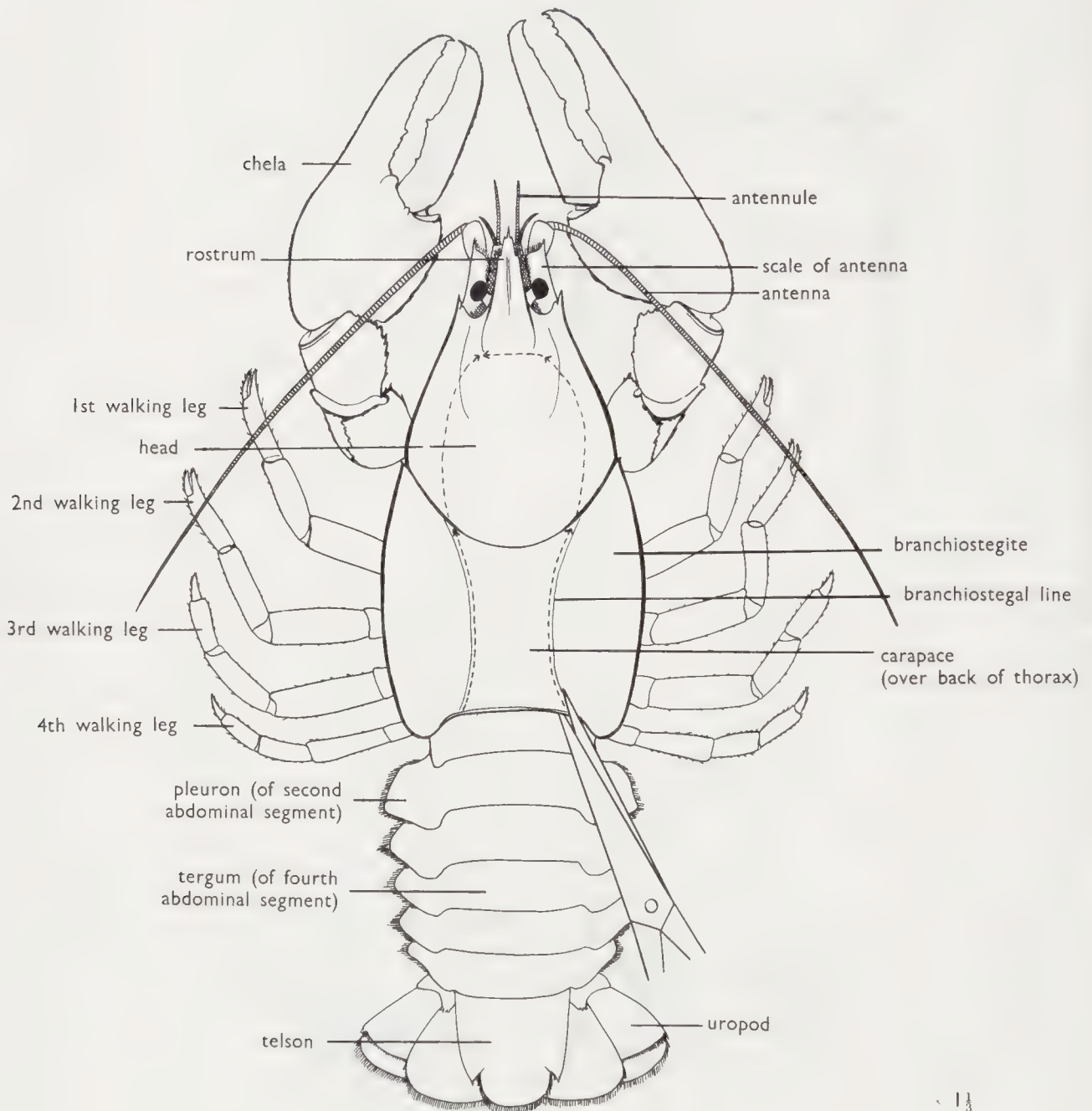


Fig. 17

Hold the crayfish in the left hand and cut through the back of the carapace along the line indicated.

N.B. Cut through the thoracic region just internal to the branchiostegal line.

NOTE. If the crayfish is about to moult there will be a thin sheet of unhardened chitin inside the hardened exoskeleton. This should be stripped off with forceps.

Selected Invertebrates—*Crayfish*

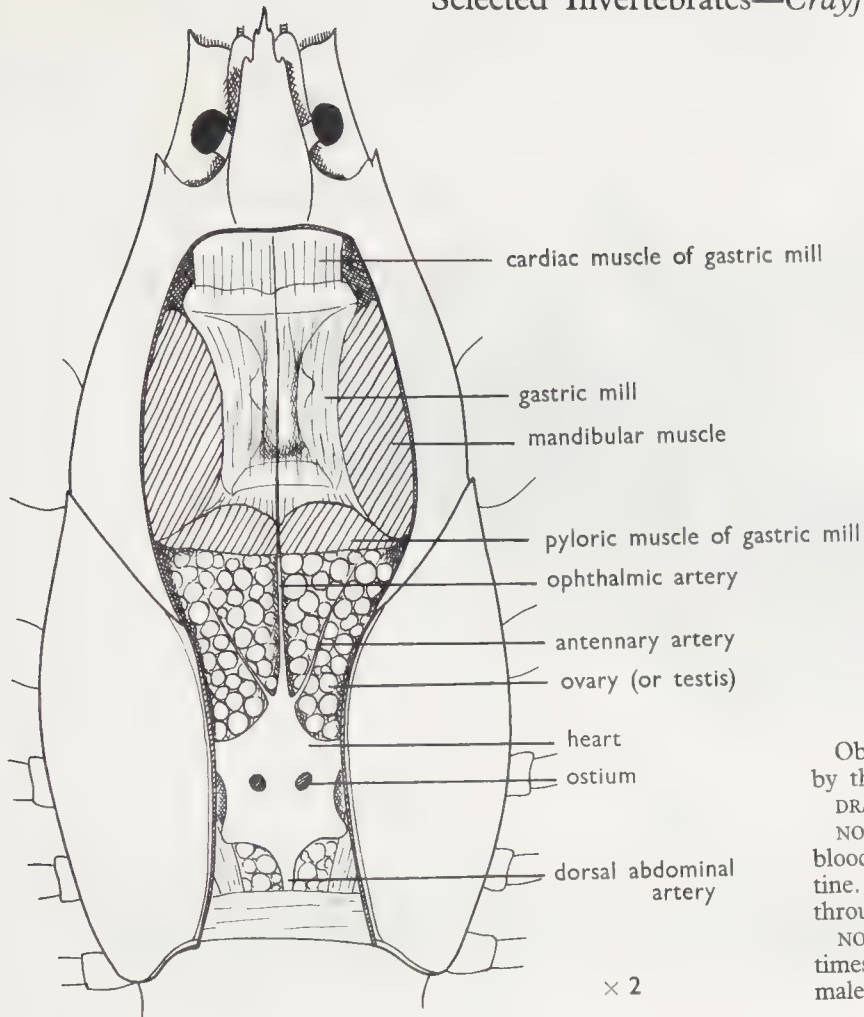


Fig. 18

Observe the heart and gastric mill as exposed by the removal of the carapace.

DRAW.

NOTE I. If desired, the heart and principal blood-vessels may be injected with coloured gelatine. The warm gelatine should be pumped in through one of the ostia by means of a fine pipette.

NOTE II. Portions of the digestive glands sometimes show anterior to the gonads, especially in males.

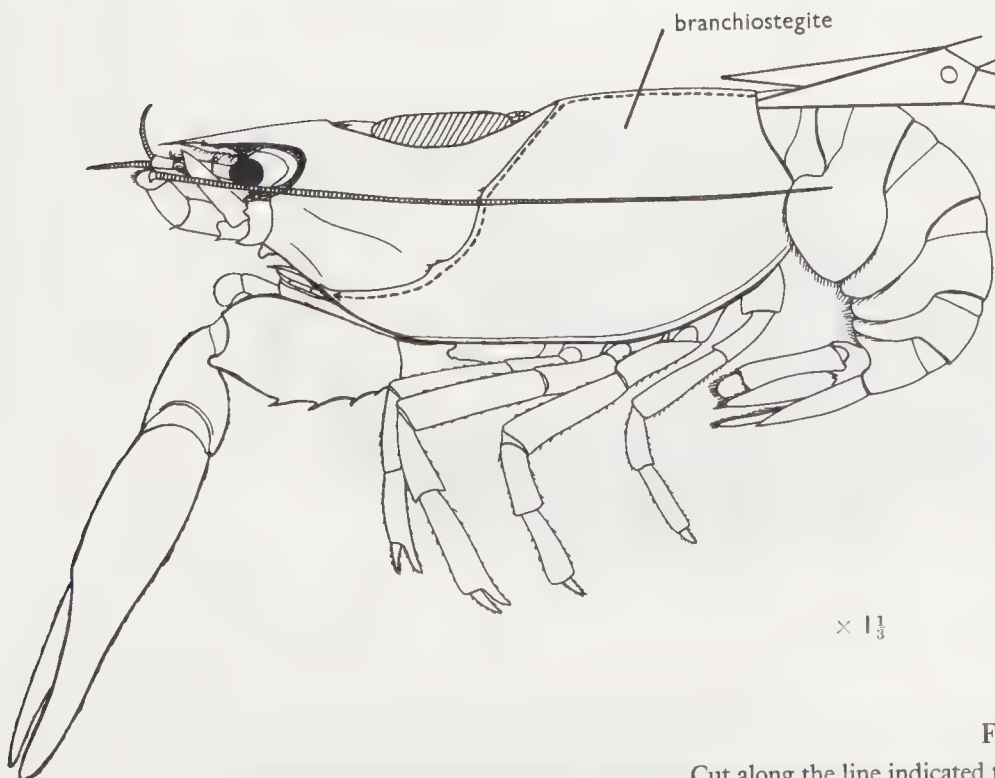


Fig. 19

Cut along the line indicated to remove the LEFT branchiostegite.

Selected Invertebrates—Crayfish

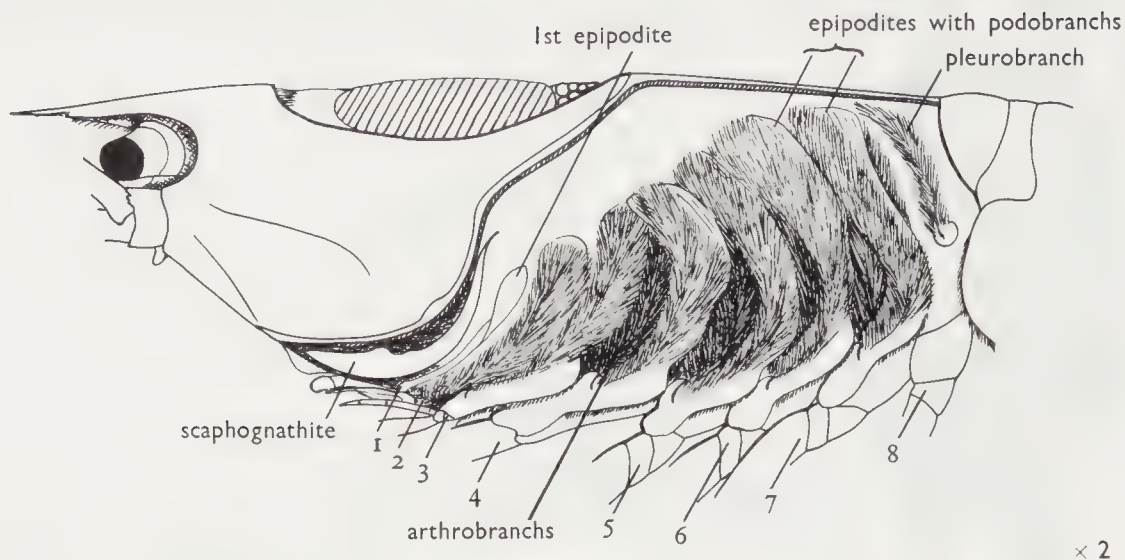


Fig. 20

Observe the gills and **DRAW**.

NOTE. Use a probe if necessary to separate the gills from one another so that the epibranchs, arthrobranchs and pleurobranch can be identified, but do not disturb their positions.

The numbers indicate the bases of the eight thoracic appendages with which the gills are associated.

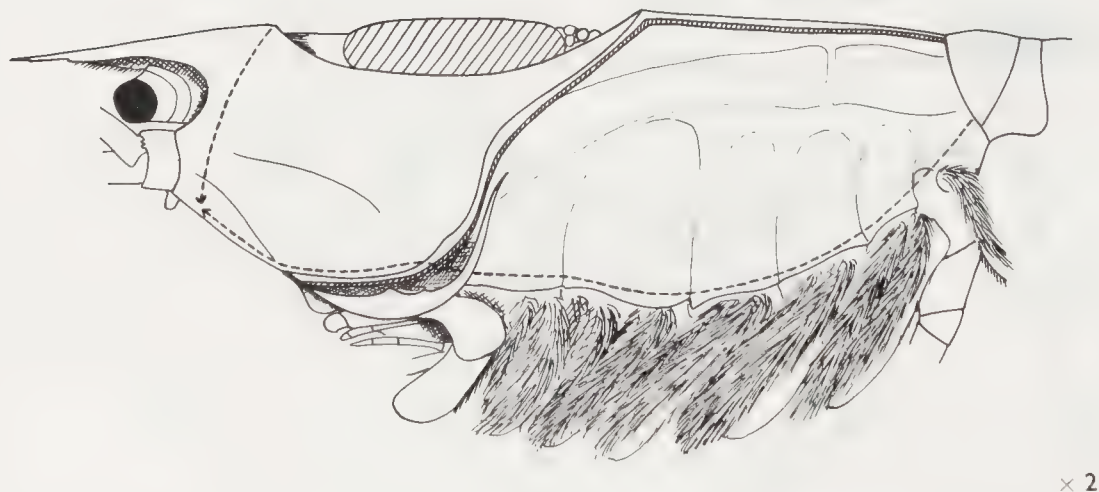


Fig. 21

Lay the gills aside.

Cut along the lines indicated to remove the side-wall of the thorax and of the head.

Selected Invertebrates—Crayfish

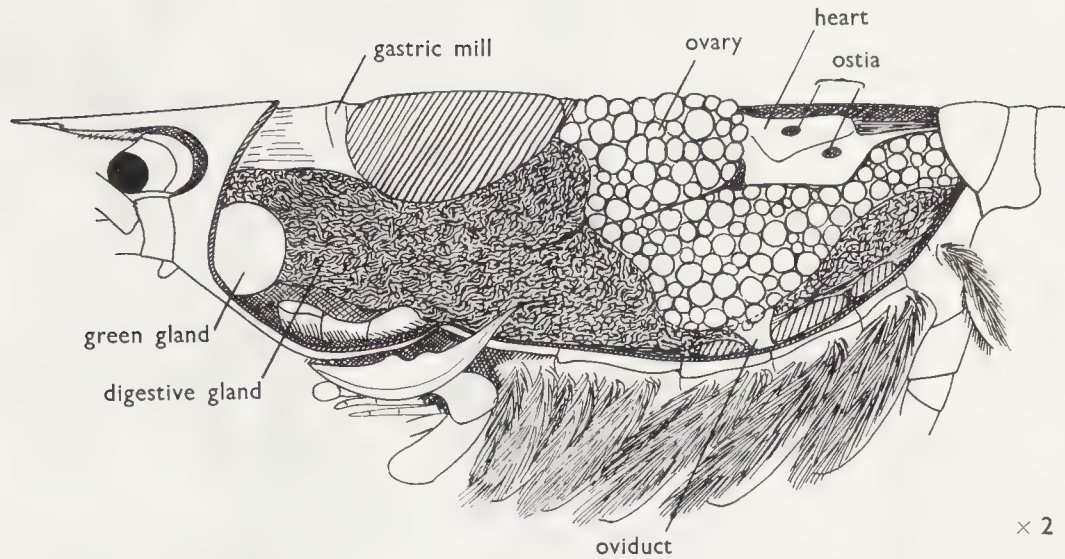


Fig. 22a. Female

Observe the digestive gland, ovary and oviduct. DRAW.

Use forceps to pluck away the left digestive gland and left half of the ovary.

N.B. BE VERY CAREFUL NOT TO DAMAGE THE ALIMENTARY CANAL AND THE STERNAL ARTERY—see Fig. 24.

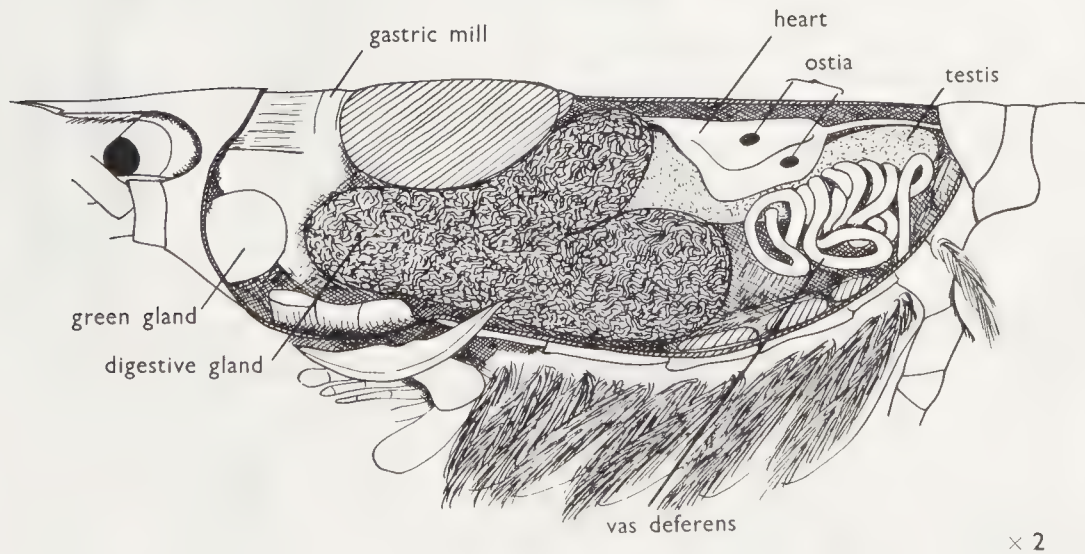


Fig. 22b. Male

Observe the digestive gland, testis and vas deferens. DRAW.

Use forceps to pluck away the left digestive gland and left half of the testis.

N.B. BE VERY CAREFUL NOT TO DAMAGE THE ALIMENTARY CANAL AND THE STERNAL ARTERY—see Fig. 24.

Selected Invertebrates—*Crayfish*

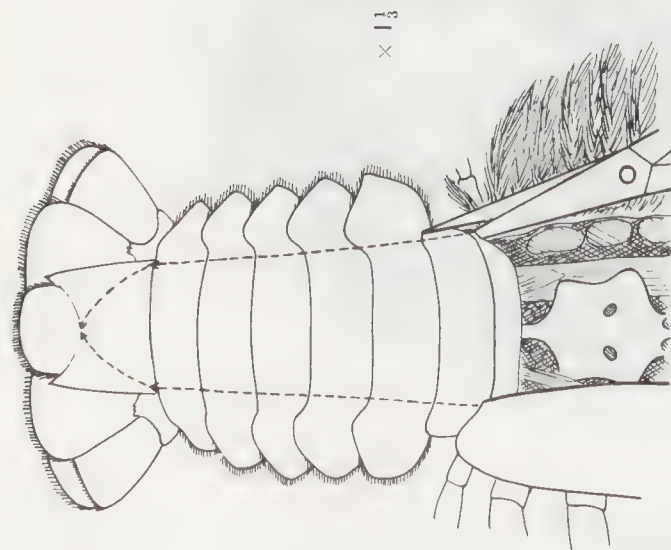


Fig. 23 (to the left)

Cut along the lines indicated to remove the terga of the abdomen.

NOTE. The extensor muscles should come away with the terga.

Fig. 24 (below)

Lay aside the mandibular muscle.

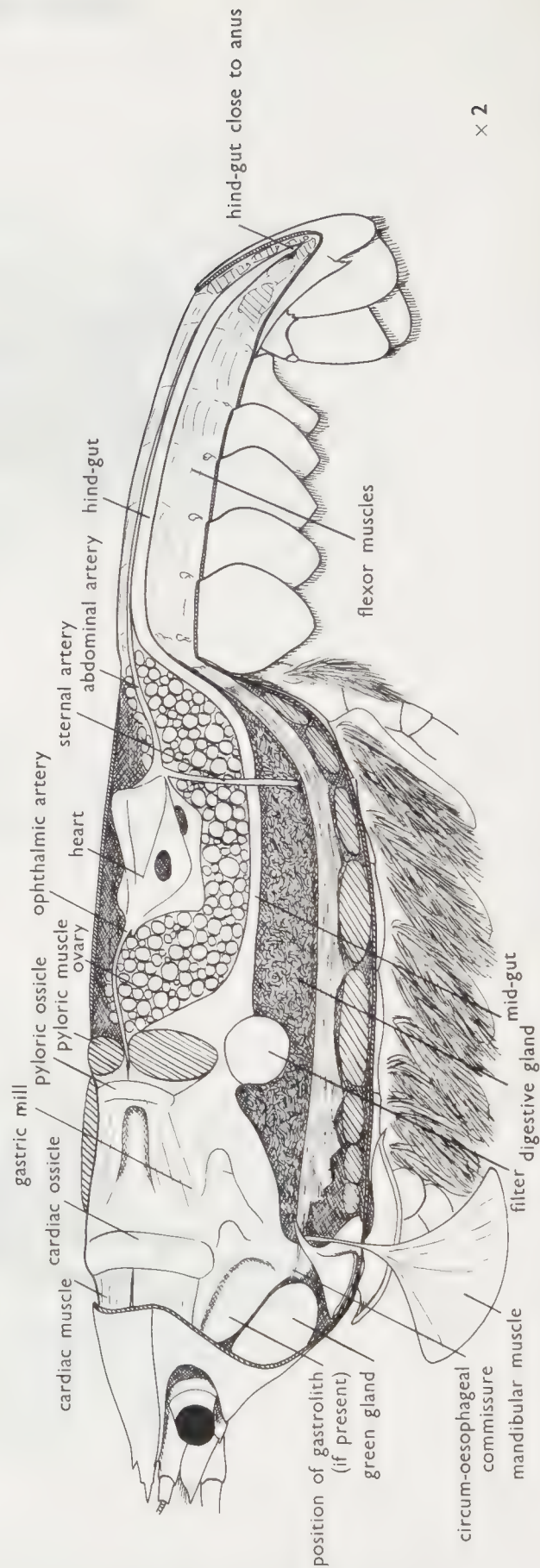
Observe the alimentary canal in dorso-lateral view. DRAW.

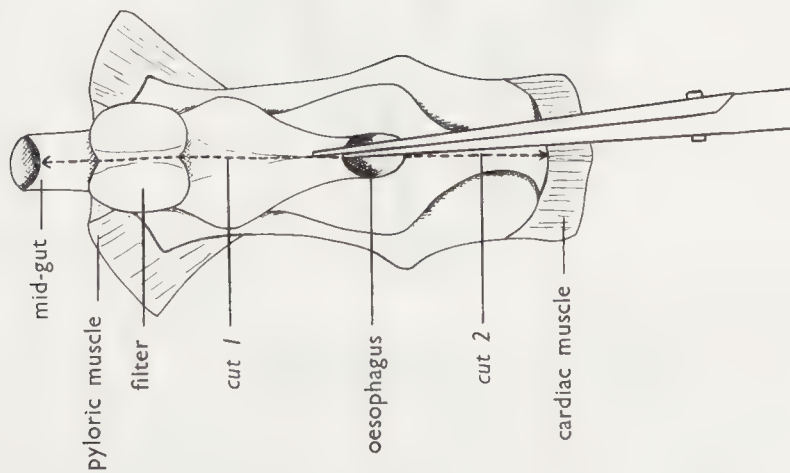
Cut through the mid-gut close to the posterior end of the gastric mill.

Cut through the cardiac muscles.

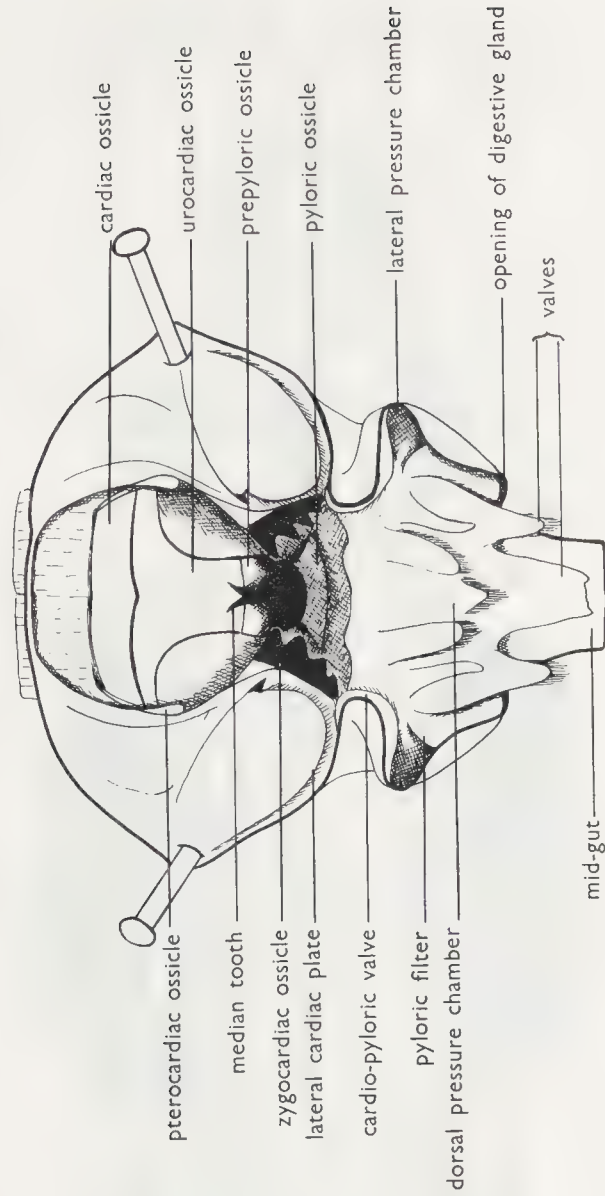
Cut through the oesophagus just above the circum-oesophageal commissure, being careful not to damage the commissure.

Remove and examine the gastric mill—see Fig. 25.





× 4



× 4

Fig. 25

Cut through the ventral wall of the gastric mill from the oesophagus to the mid-gut—cut 1.
Cut through the anterior wall of the gastric mill from the oesophagus until the mill can be opened out almost flat—cut 2.

Fig. 26

Pin out the gastric mill as shown. Allow it to dry in order to show up the ossicles more clearly. DRAW.

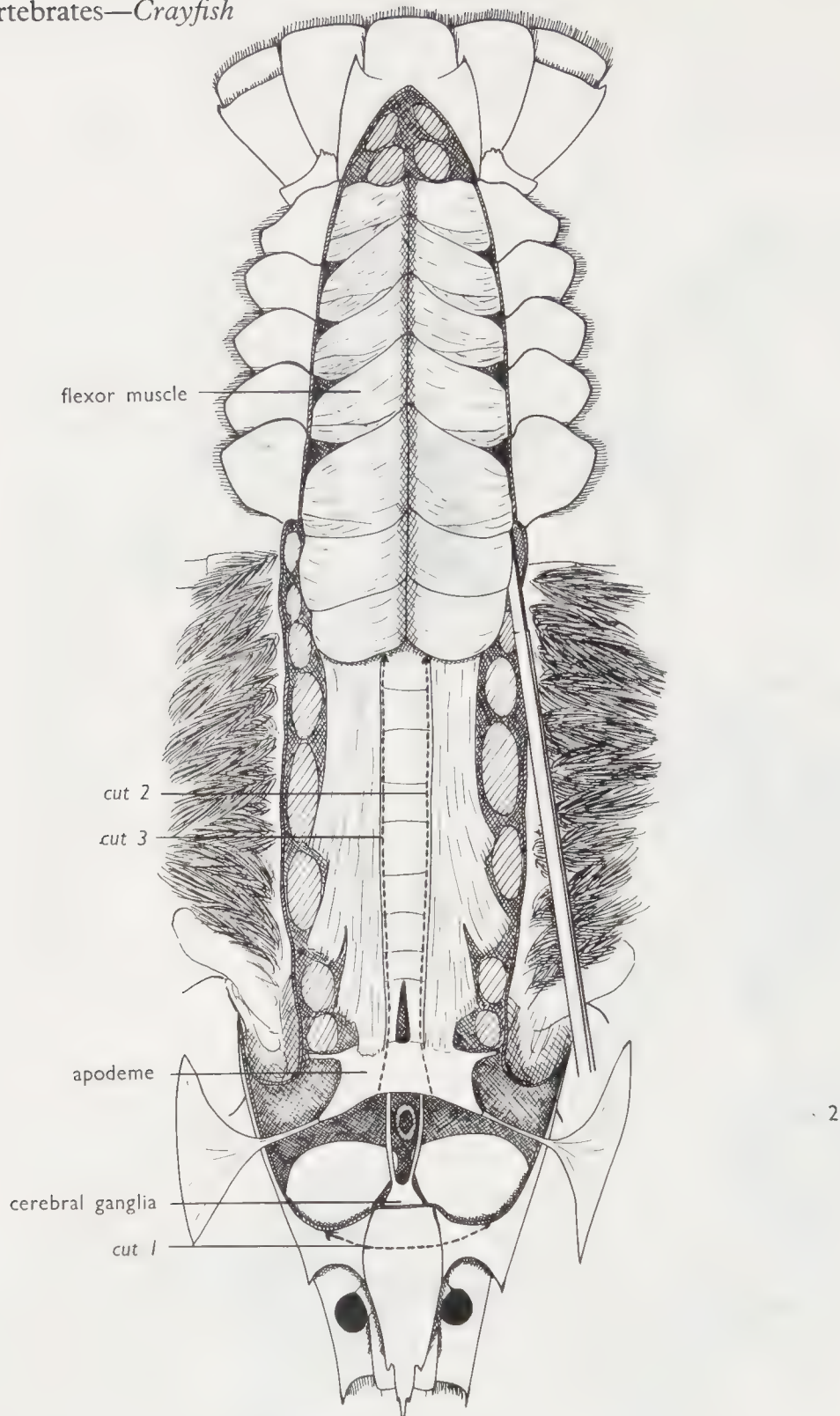
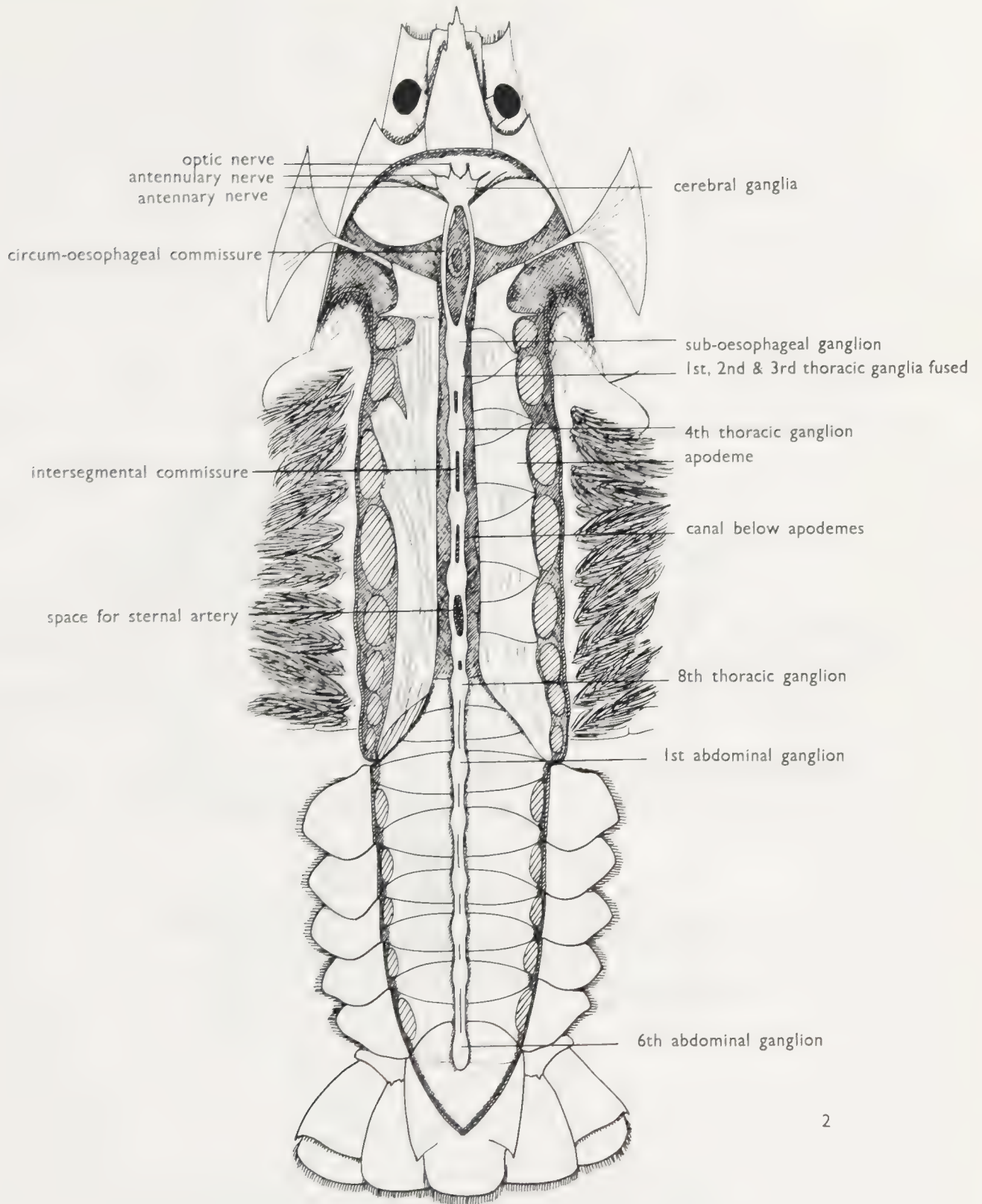


Fig. 27

Cut off the right branchiostegite—refer Fig. 19.
 Remove the right side of the thorax—refer Fig. 21.
 Clear away the alimentary canal, digestive gland and gonad completely.
 Trim the base of the rostrum so that the cerebral ganglia are fully exposed—cut 1.
 Cut through the apodemes and connective tissue on either side of the mid-line as shown—cuts 2 and 3. This exposes the thoracic part of the nerve-cord.
 Cut through the abdominal muscles close to their origins from the abdominal sterna.
 Separate the muscle-blocks carefully and remove them. N.B. Watch for the abdominal part of the nerve-cord all the time—see Fig. 28.
 NOTE. It is not necessary to remove the longitudinal flexor muscles from the thorax, but they often come away accidentally—see the right side of Fig. 28.

Selected Invertebrates—*Crayfish*



2

Fig. 28

Observe the nervous system. DRAW.

Selected Invertebrates—*Crayfish*

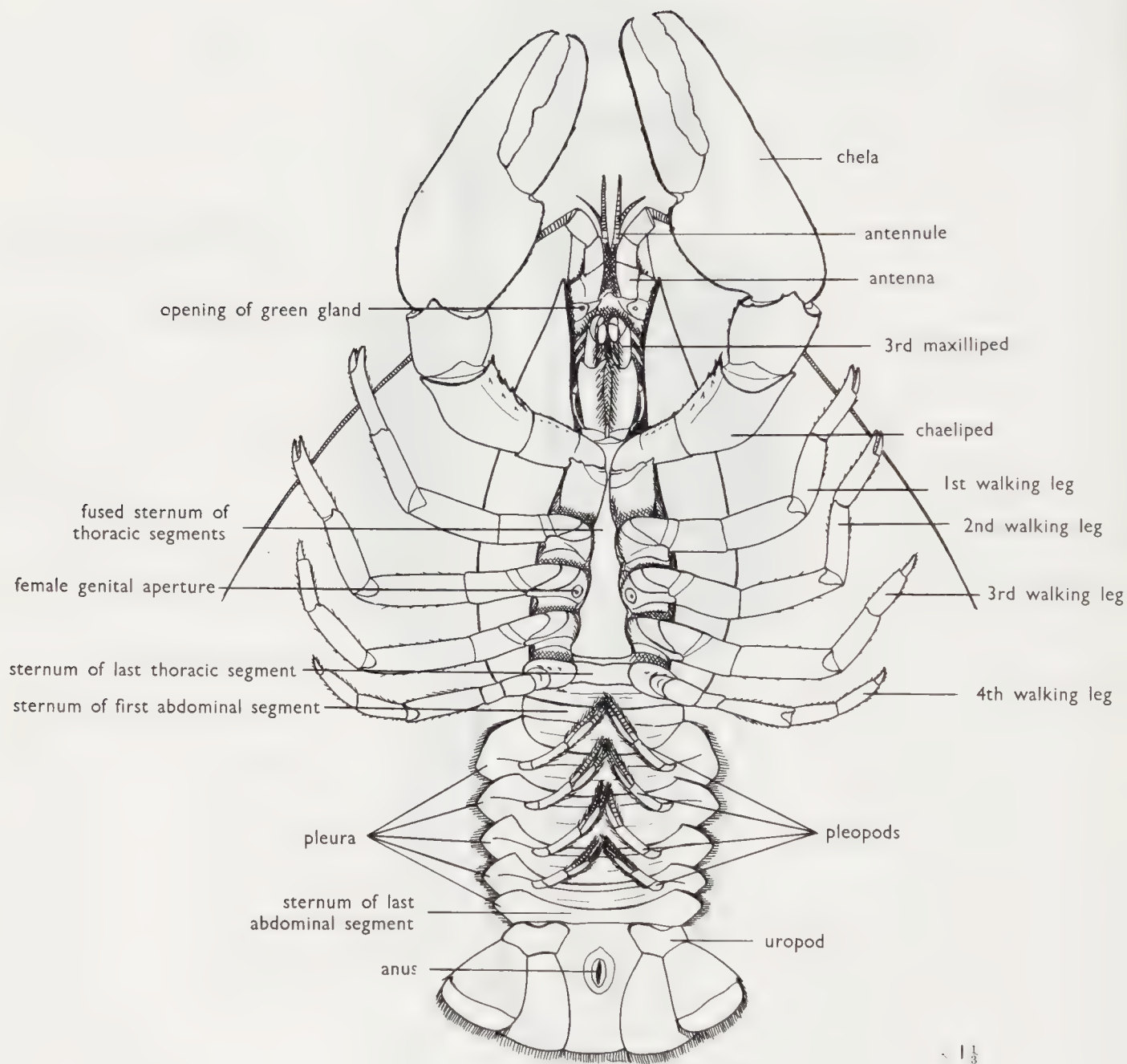


Fig. 29a. Female

Notice the wide abdomen, the four pairs of feathery pleopods and the position of the genital apertures on the 2nd walking legs.

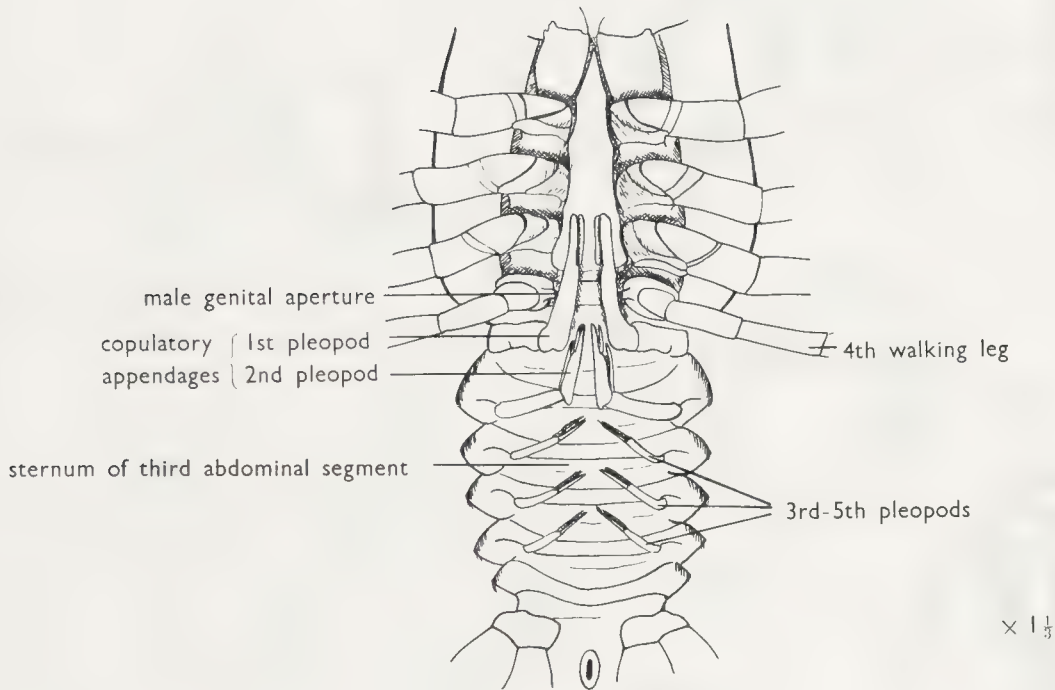


Fig. 29b. Male

Notice the narrow abdomen, the two pairs of copulatory pleopods and three pairs of tiny pleopods and the position of the genital apertures on the 4th walking legs.

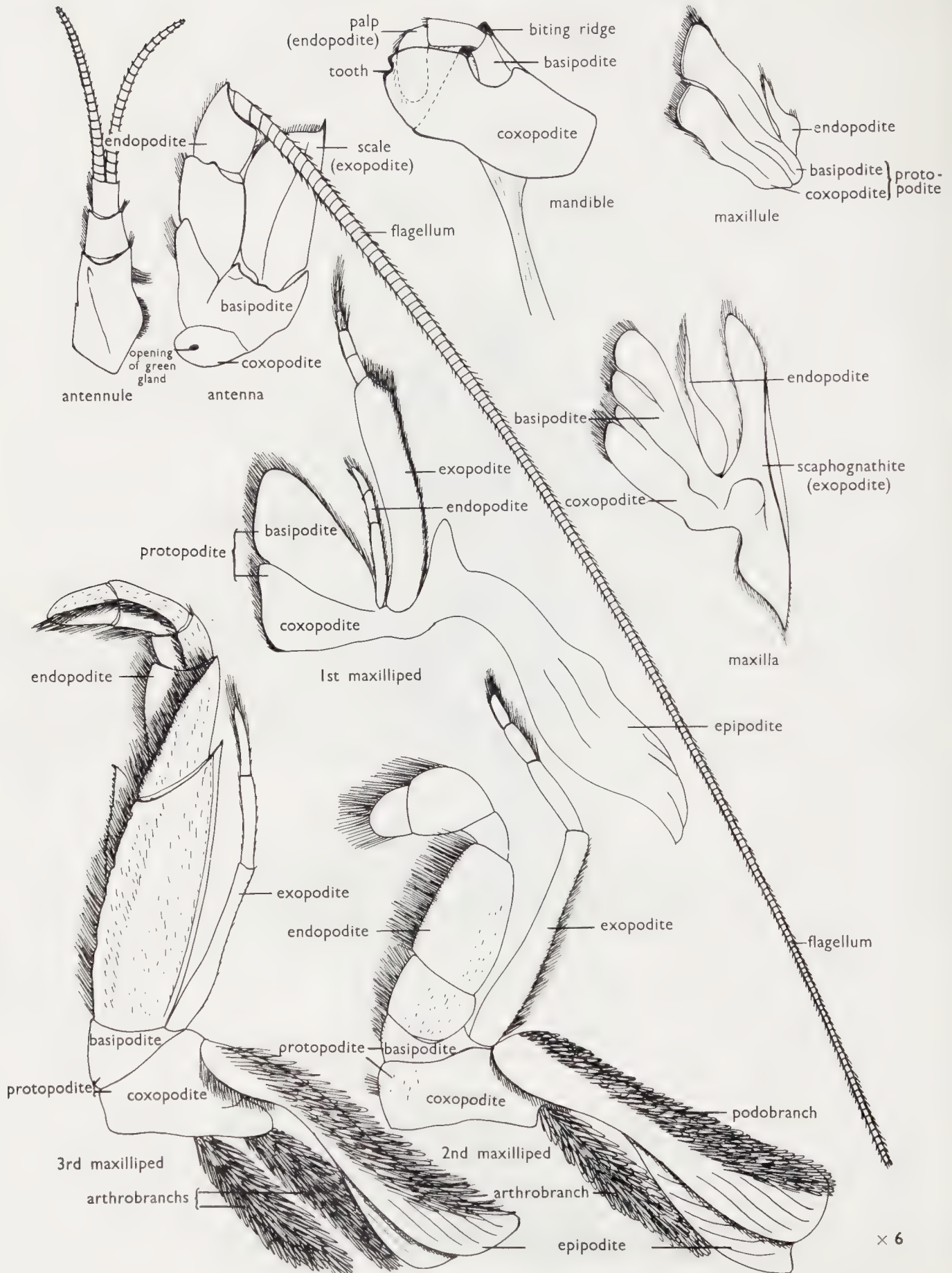
Fig. 29

Hold the crayfish ventral side uppermost and remove the appendages of one side. Start from the posterior end and work forwards, laying the appendages aside in order.

N.B. Grip each appendage by its basal joint so that it comes off entire.

NOTE. Before removing the maxillipeds and mouth-parts, the anterior end of the crayfish may be macerated by boiling in 20 per cent caustic soda to soften the muscle.

Selected Invertebrates—Crayfish



× 6

Selected Invertebrates—*Crayfish*

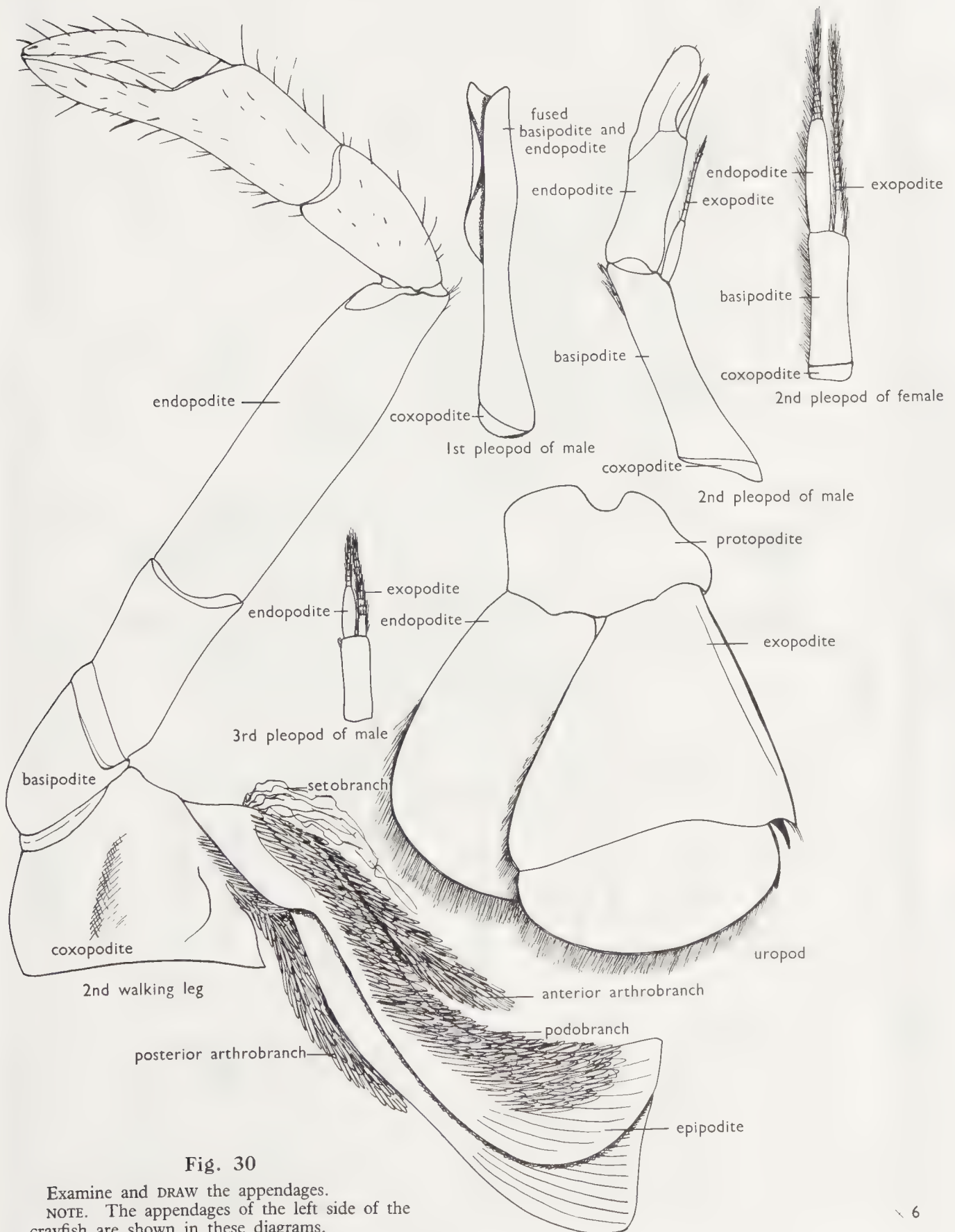


Fig. 30

Examine and DRAW the appendages.
NOTE. The appendages of the left side of the crayfish are shown in these diagrams.

Selected Invertebrates—3 COCKROACH

The dissection of the cockroach should be performed on a freshly-killed specimen which is held in place by partial embedding in wax.

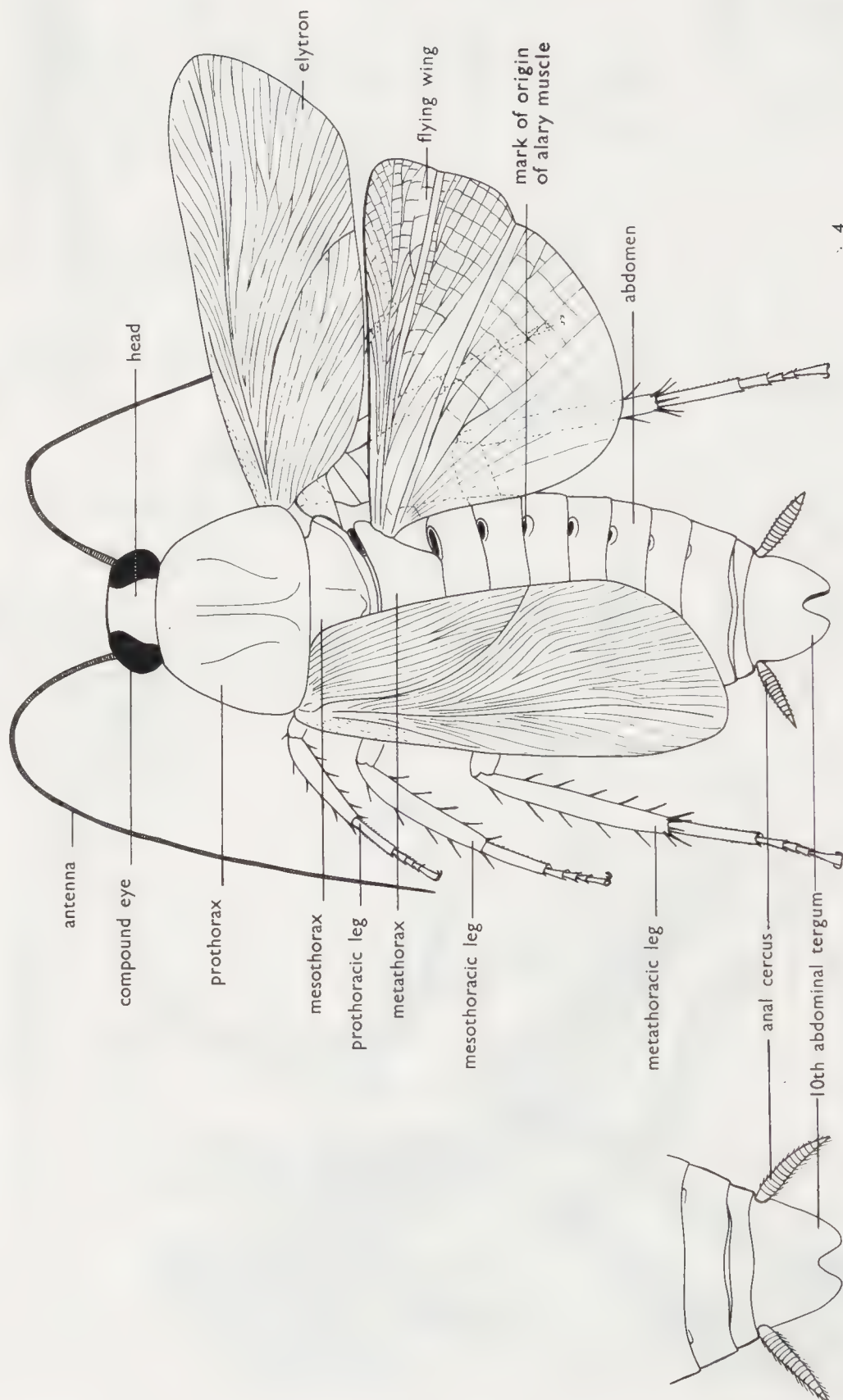
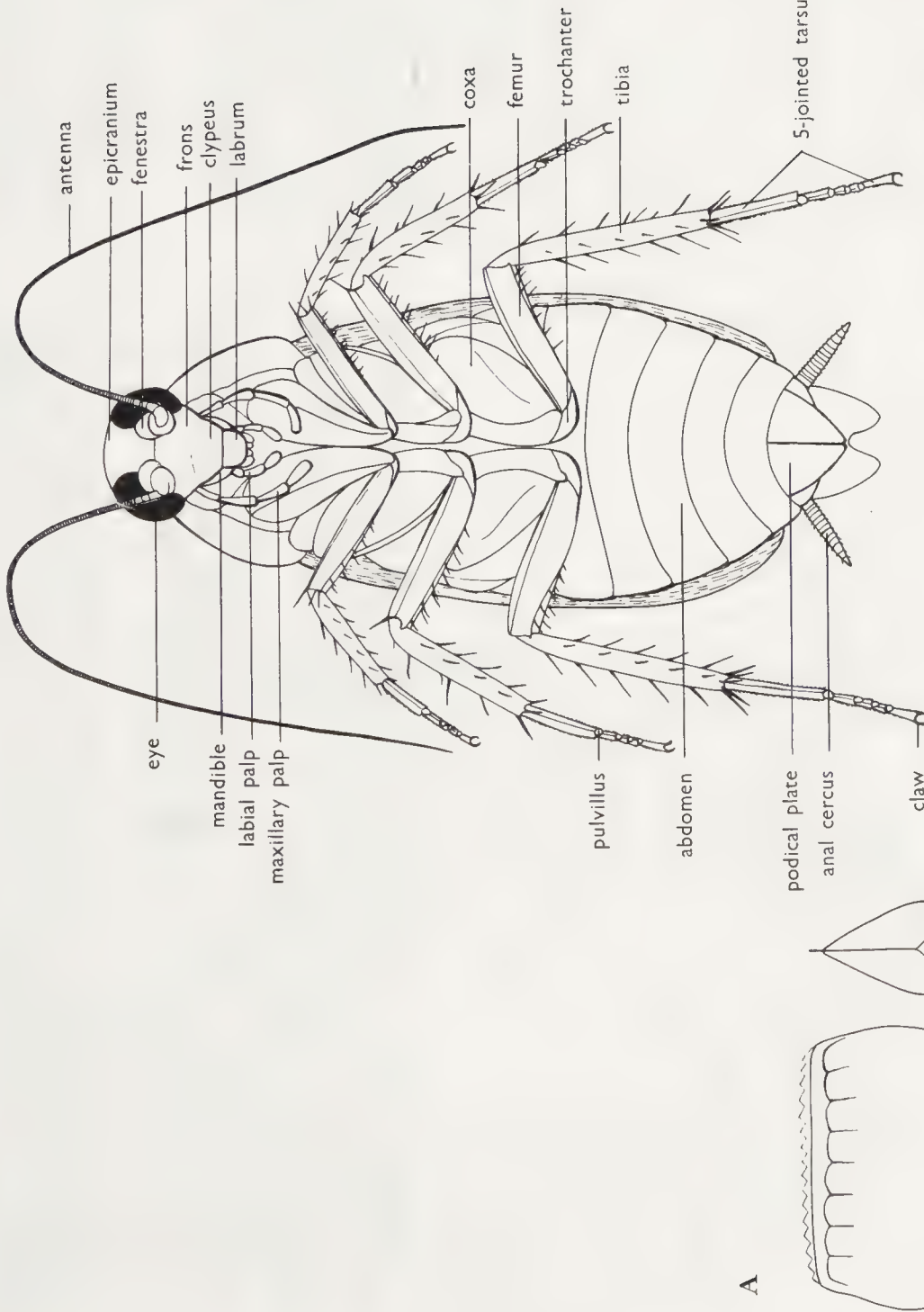


Fig. 31

Examine the cockroach in dorsal view with one elytron and one wing extended.

NOTE. The extended elytron and wing may be held in position by pins placed against, but not through, their bases.

Notice the narrow abdomen of the male and the expanded tergum of the last visible segment. Compare the end of the abdomen of the male with that of the female—see inset.



ootheca—lateral and end views

Fig. 32

Examine the cockroach in ventral view.
Notice the wide abdomen of the female and the large lateral podical plates used for carrying the ootheca—see inset A.

Compare the end of the abdomen of the female with that of the male—see inset B.
Cut through the trochanter of each leg in turn.
Cut off the antennae close to the head.

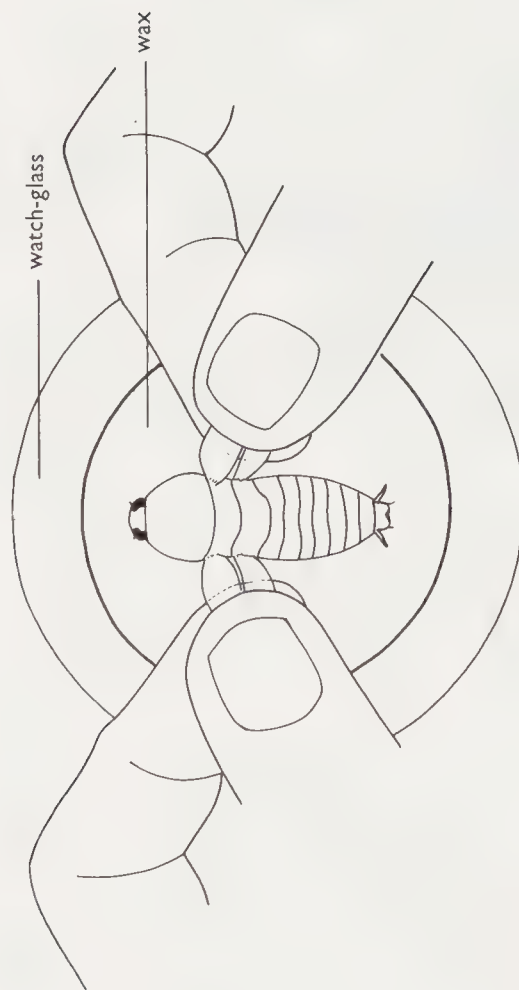


Fig. 33

Heat some paraffin-wax to JUST ABOVE MELTING-POINT. Pour it into a deep watch-glass, the inside of which has been smeared with glycerine to prevent the wax from sticking.

Hold the cockroach by its wings and embed it carefully in the molten wax. The wax should reach at least up to the level of the edge of the cockroach all round. Excess wax can be cut away later, but if the specimen is not thoroughly embedded it is liable to break free during the dissection and cannot then be re-embedded satisfactorily.

Hold the cockroach till the wax has solidified on the surface. Cooling may then be hastened by immersion in cold water. When the wax is almost hardened, slip it out of the watch-glass, place it in a wax-bottomed dish and pin it down. The slight softness of the wax allows it to be moulded to lie on the bottom of the dish and allows pins to be inserted without cracking.

COVER COMPLETELY WITH WATER.

Proceed with the dissection.

ALTERNATIVELY the cockroach may be embedded directly in the black wax of the dissecting-dish by melting a trough in the wax with the heated handle of a scalpel. Though quicker, this method is not as good as that described above because (a) students rarely melt a deep enough trough to get satisfactory embedding, (b) the opacity of the black wax makes it difficult to remove the pieces of the cockroach afterwards, (c) the head cannot subsequently be used for dissection of the mouth-parts as it is difficult to remove all the wax from it.

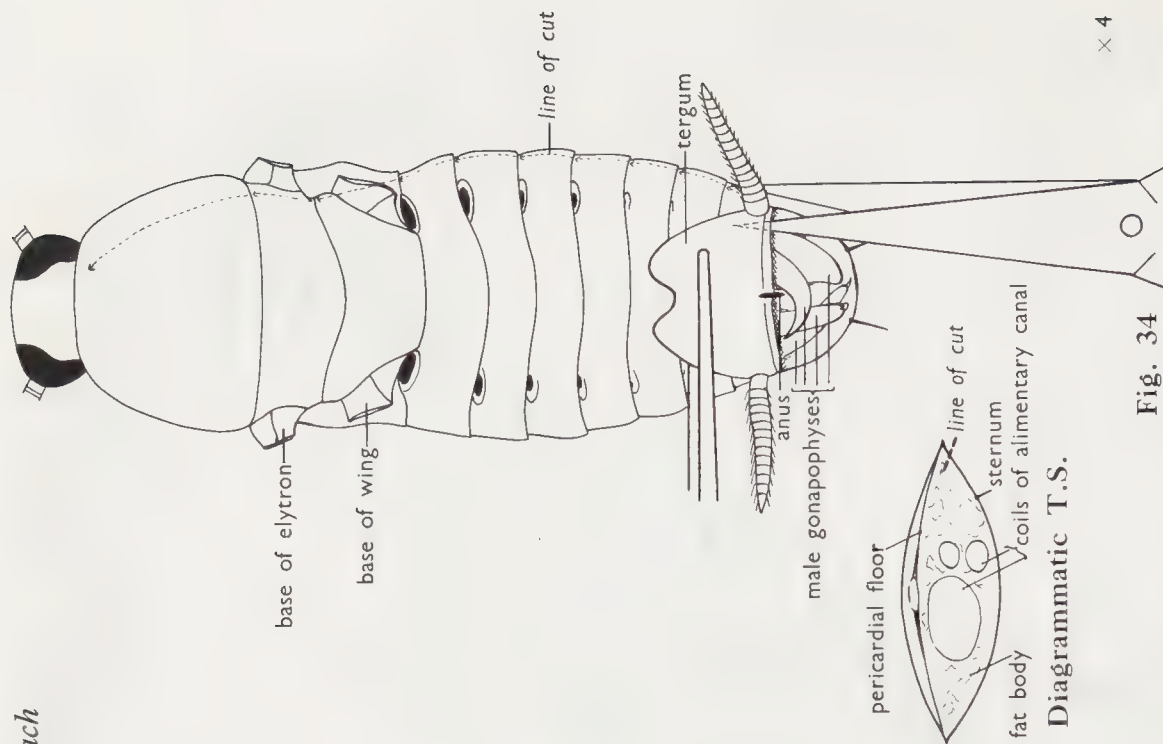


Fig. 34

Cut off the elytra and the wings close to their bases. Lift the 10th abdominal tergum with forceps.

Notice the gonapophyses—male shown here, female in Fig. 36.

Cut up one side of the abdomen and thorax as indicated by dotted lines in main diagram and inset.

N.B. Keep to the line of the body wall under the pronotum.

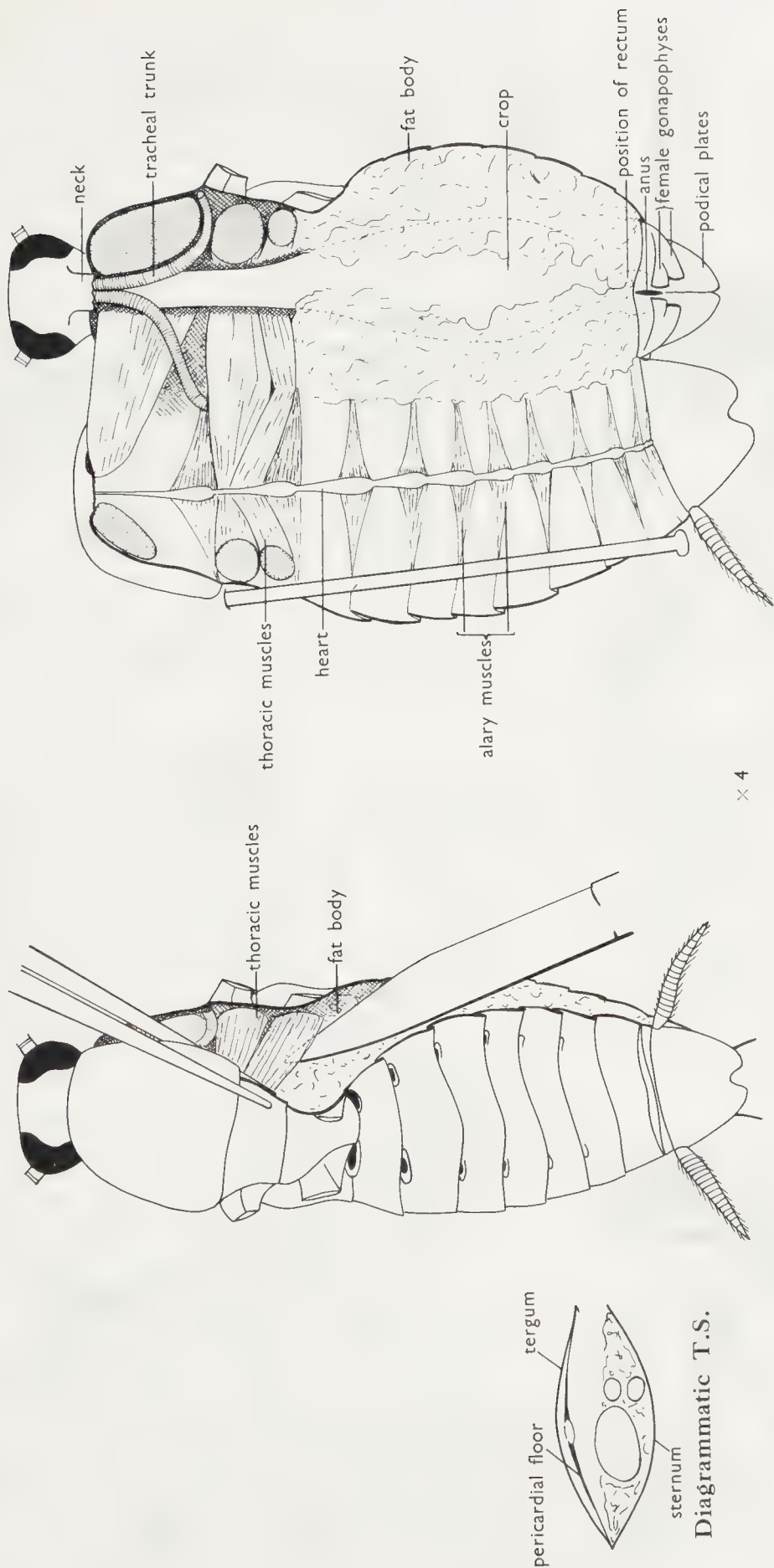


Fig. 35

Lift aside the terga with the pericardial floor and heart attached to it—see inset. Use a scalpel to cut the muscles and loosen connective tissue where necessary. Cut the pronotum away from the neck.

Fig. 36

Place a pin to hold the terga aside. Notice the heart and the position of the crop. NOTE. Only the general position of muscle blocks is indicated. The actual musculature is very complicated. Cover the dissection COMPLETELY with water.

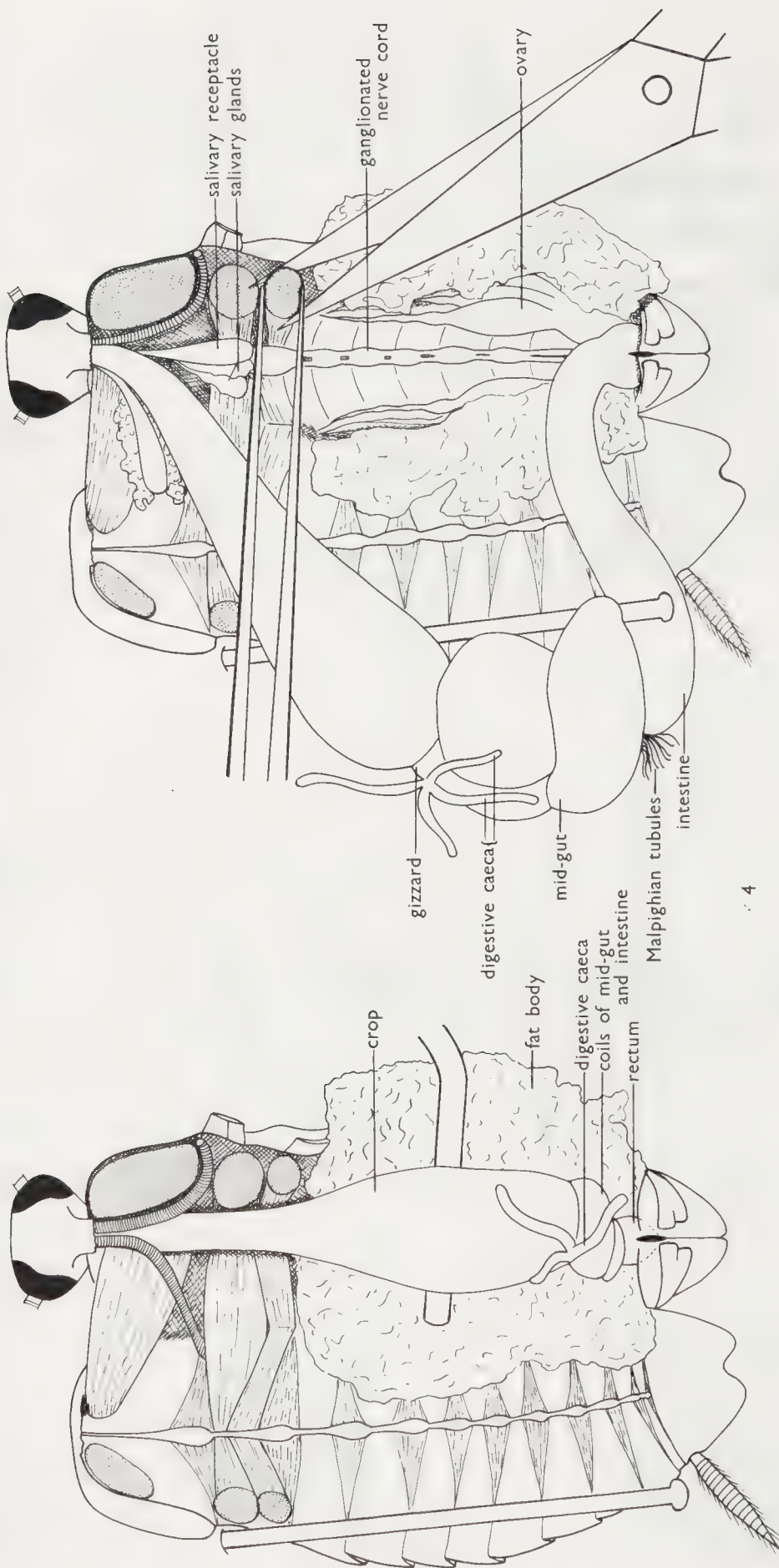


Fig. 37

Lay aside the fat bodies.
Lift the crop out of the abdomen and push it to one side—
see Fig. 38.
N.B. Notice and do not damage the salivary glands.

Fig. 38

Use a pin to keep the alimentary canal out of the way.
Cut away most of the muscle of the thorax.
Clear away the fat bodies by squirting them with water from a pipette and by
pulling with blunt forceps only when absolutely necessary. BE VERY CAREFUL NOT
TO DAMAGE THE REPRODUCTIVE ORGANS.

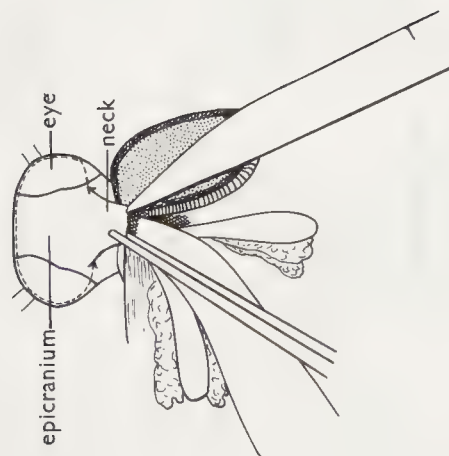


Fig. 39

The exposure of the cerebral ganglia should only be attempted by students who have considerable experience in dissection or are above average in dexterity. Use a fine, sharp scalpel to cut away the dorsal side of the neck, the epicranium and parts of the eyes.

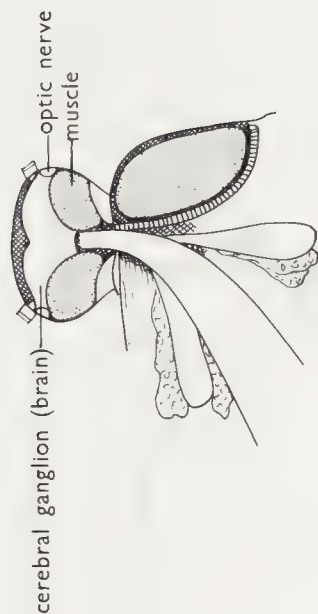


Fig. 40a

Examine with a hand lens.
Scrape aside the blocks of muscle on either side of the head in order to expose the ganglia as seen in Fig. 40b.

× 4

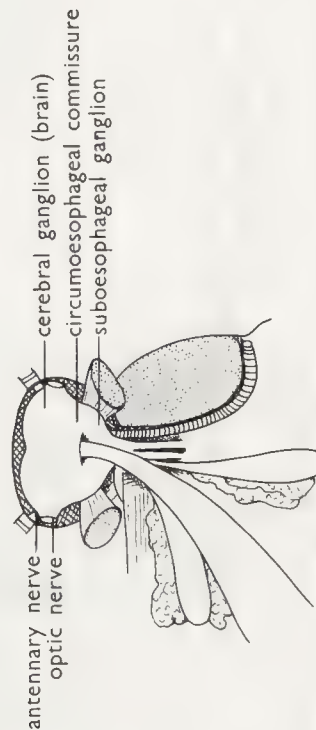


Fig. 40b

Examine the ganglia of the head.
Superimpose a drawing of this dissection on that of the complete dissection—see Figs. 41a and 41b.

Selected Invertebrates—Cockroach

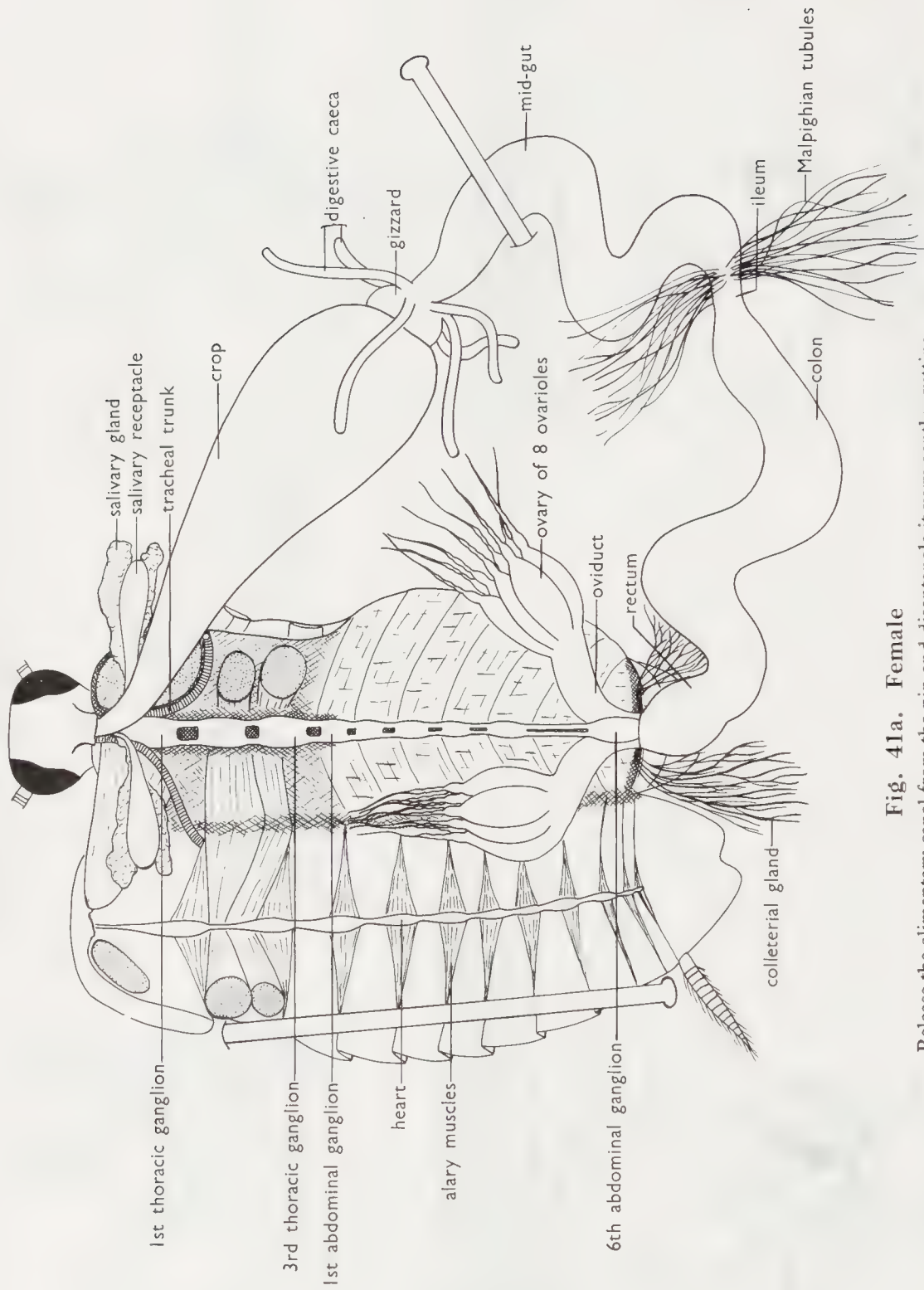


Fig. 41a. Female

Release the alimentary canal from the pin and disentangle it very gently, cutting the tracheae which bind the coils together. Use a pin to hold the alimentary canal aside as shown.

Make the dissection as tidy as possible by removal of odd pieces of fat body and tracheae.
DRAW.

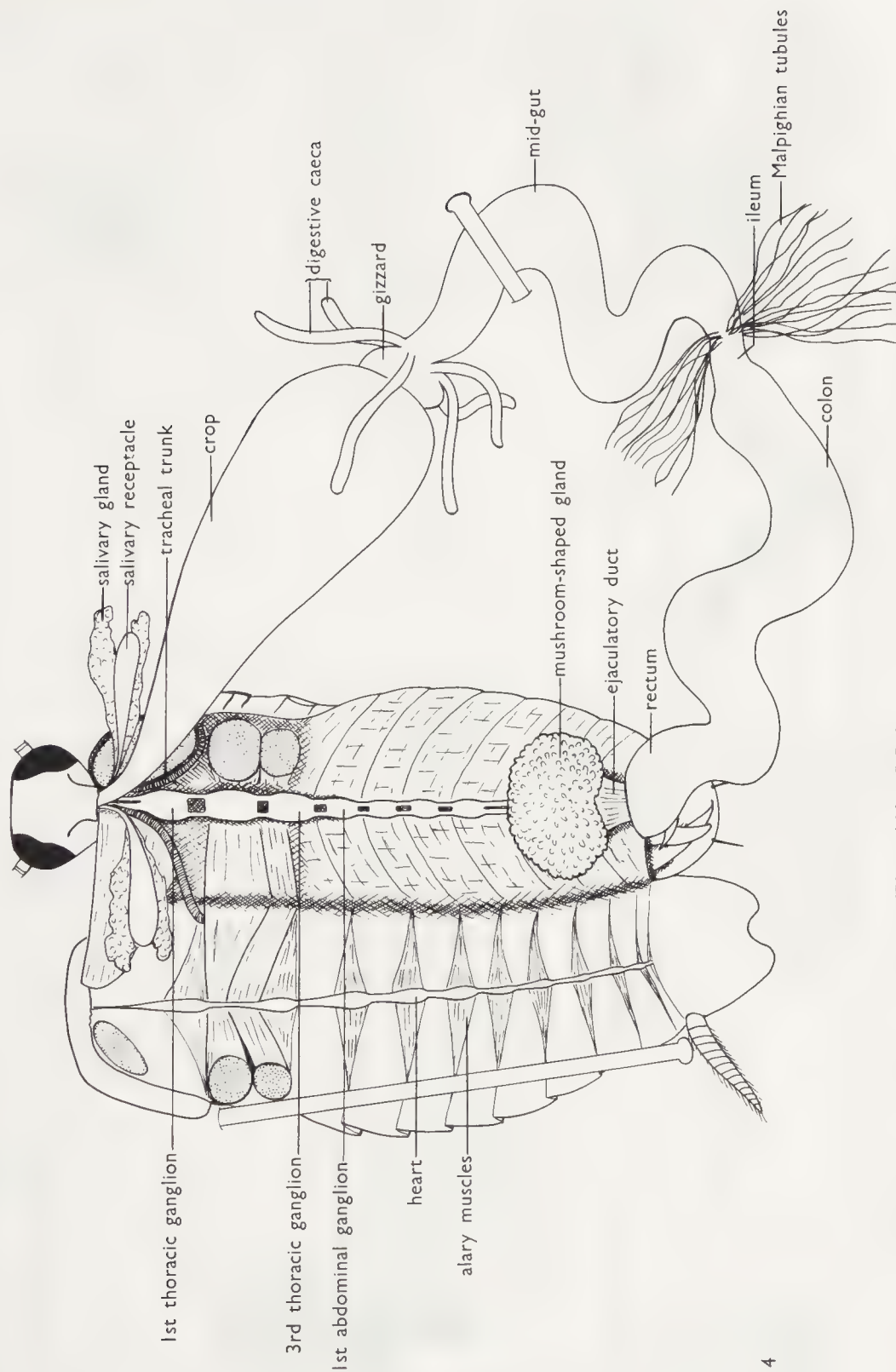


Fig. 41b. Male

Release the alimentary canal from the pin and disentangle it very gently, cutting the tracheae which bind the coils together. Use a pin to hold the alimentary canal aside as shown.

Make the dissection as tidy as possible by removal of odd pieces of fat body and tracheae.
DRAW.

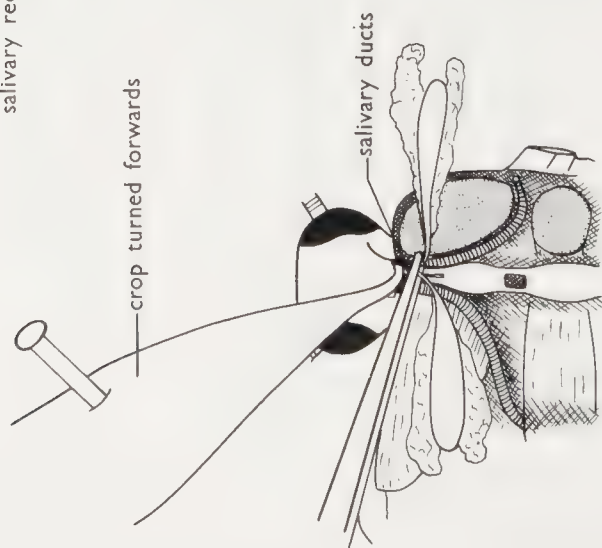


Fig. 42

Lay the crop forwards.
Trace the ducts of the salivary glands forwards under the crop.
Cut the salivary ducts as far forwards as possible.
Remove the salivary glands with the reservoirs and ducts, fix with formalin, stain in Delafield's haematoxylin and mount.

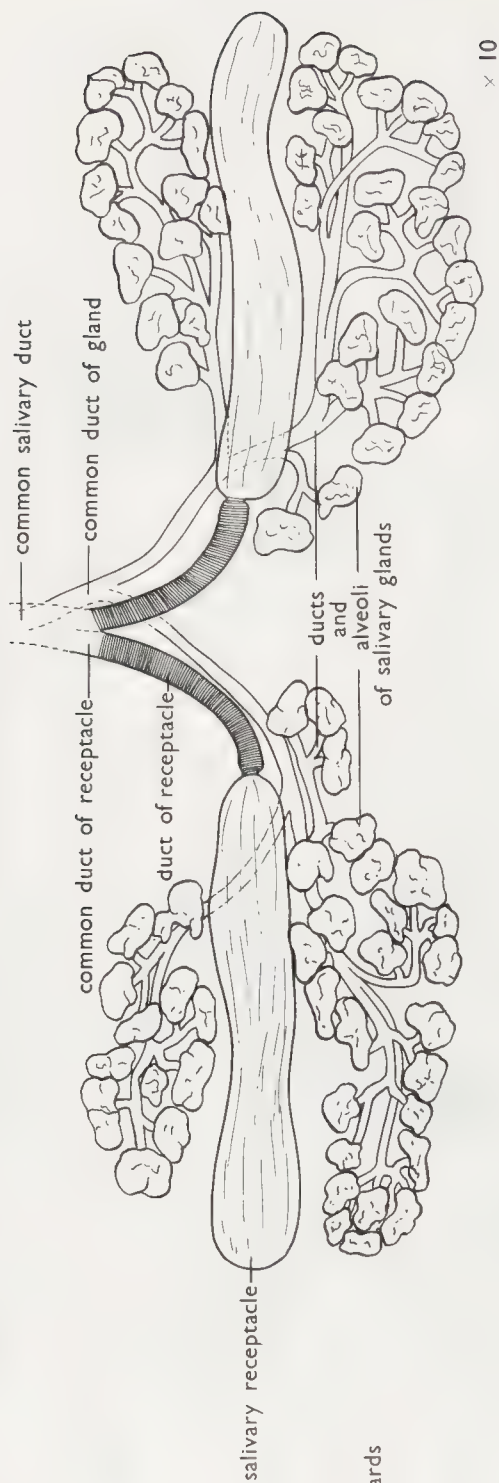


Fig. 43

Examine the salivary glands microscopically and DRAW.

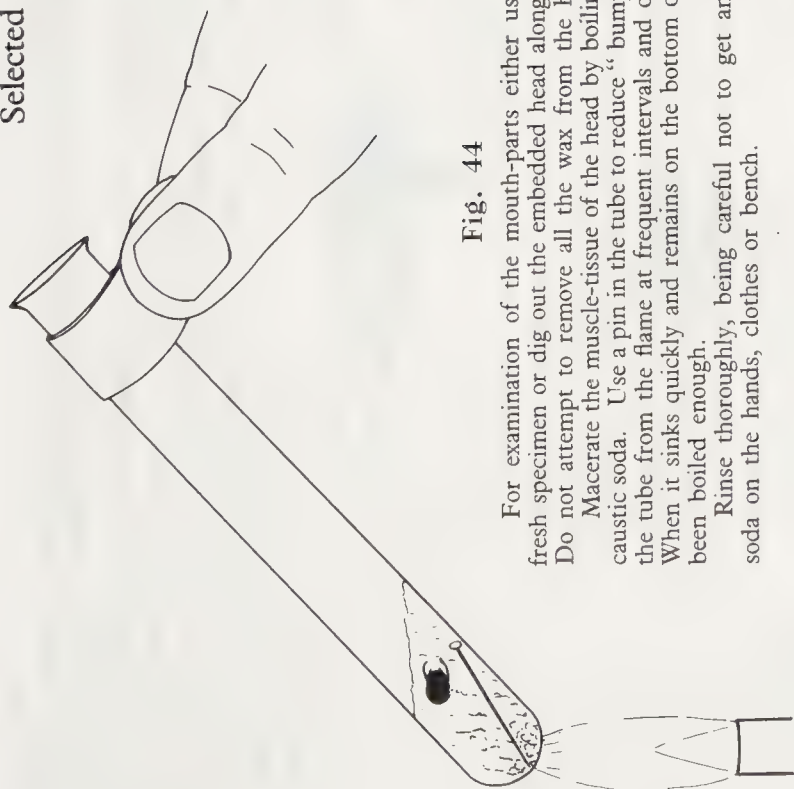


Fig. 44

For examination of the mouth-parts either use the head of a fresh specimen or dig out the embedded head along with some wax. Do not attempt to remove all the wax from the head.

Macerate the muscle-tissue of the head by boiling in 10 per cent caustic soda. Use a pin in the tube to reduce "bumping". Remove the tube from the flame at frequent intervals and observe the head. When it sinks quickly and remains on the bottom of the tube it has been boiled enough.

Rinse thoroughly, being careful not to get any of the caustic soda on the hands, clothes or bench.

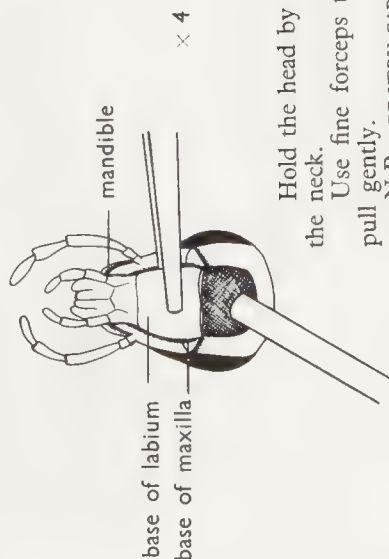


Fig. 45

Hold the head by means of a dissecting-needle inserted through the neck.

Use fine forceps to lift the labium, hold it near its base and pull gently.

N.B. BE VERY CAREFUL NOT TO DAMAGE THE OTHER MOUTH-PARTS. If the labium does not come away easily the muscle is insufficiently macerated and the head should be boiled again in caustic soda.

NOTE. Use a lens if necessary to identify the parts.

Place the labium in water in a safe place. NEVER LET THE HEAD OR MOUTH-PARTS BECOME DRY.

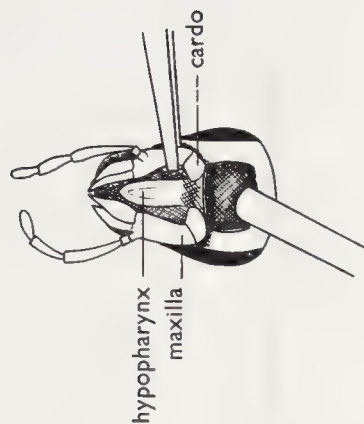


Fig. 46

Similarly remove the maxillae and the hypopharynx, slipping the forceps under each part in turn and holding it as near the base as possible when making the final pull.

Place the maxillae and hypopharynx with the labium.

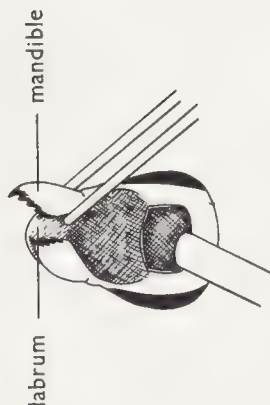


Fig. 47

Similarly remove the mandibles.

Cut off the labrum with a small piece of the clypeus.

Place the mandibles and labrum with the other mouth-parts.

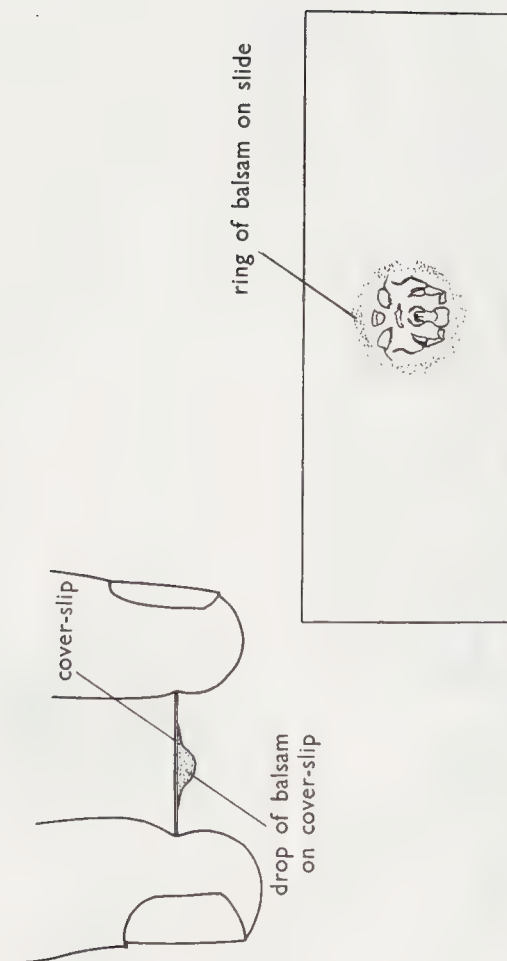


Fig. 48

Dehydrate the mouth-parts directly by soaking in 90% and then absolute alcohol.

Clear in clove oil.

Mount in balsam.

NOTE. To make a tidy mount, place the mouth-parts in the arrangement shown and as close together as possible without actually touching. Make a ring of balsam round them. The ring should be smaller in diameter than the cover-slip. Place a drop of balsam on the cover-slip. Invert the cover-slip rapidly and lower it gently into place so that the drop of balsam on it strikes the middle of the ring of balsam on the slide.

The balsam from the cover-slip spreads out and moves the mouth-parts slightly away from one another while the ring on the slide stops them from moving too far—see Fig. 49.

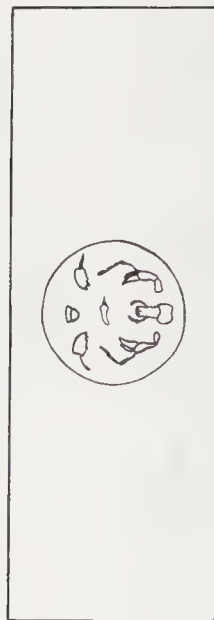


Fig. 49

The general appearance of the mount should be as shown.

Selected Invertebrates—Cockroach

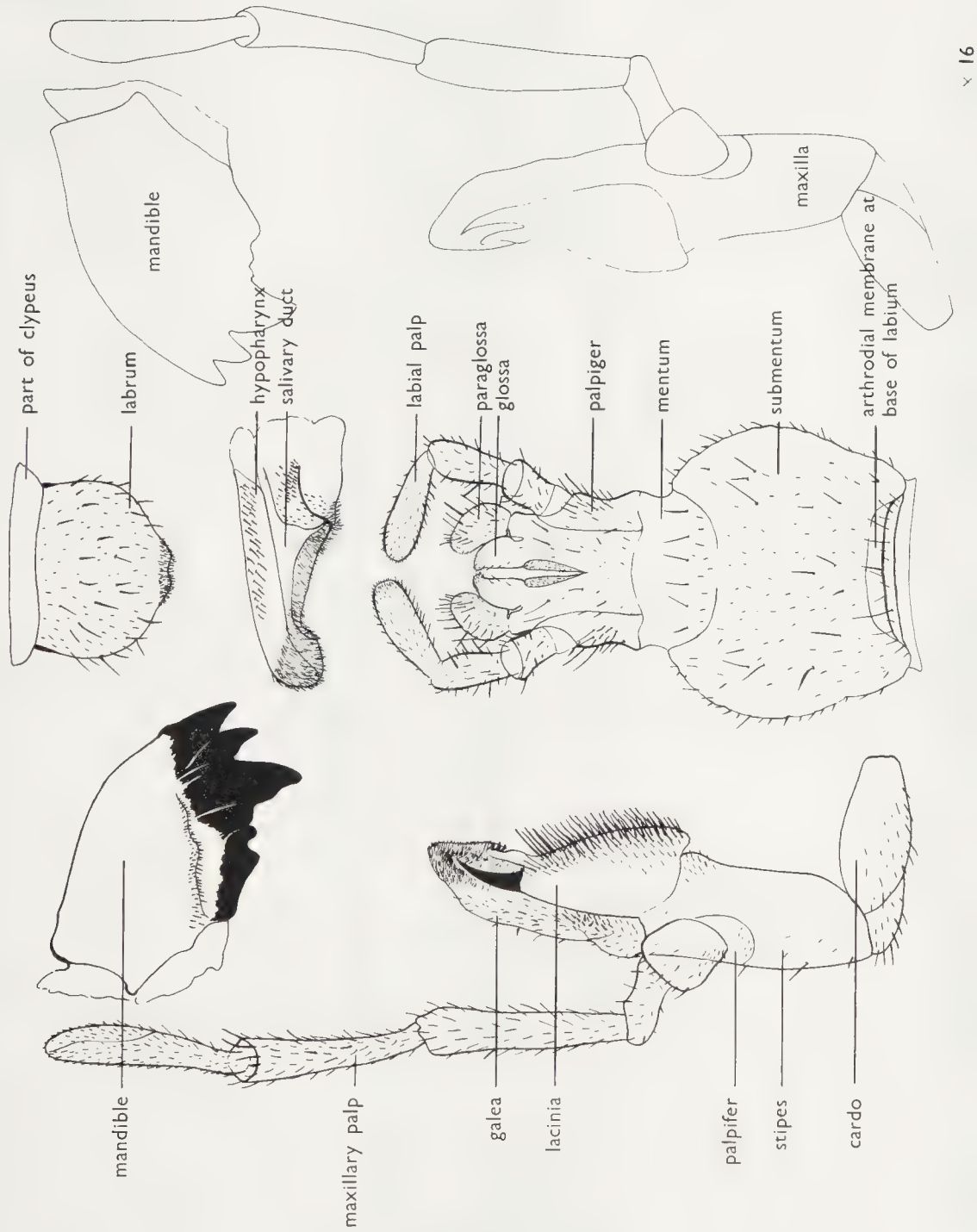


Fig. 50
Examine the individual mouth-parts microscopically and draw.

Selected Invertebrates—4 AMPHIOXUS

The dissection of Amphioxus is very simple in principle, but in practice it requires considerable skill and PATIENCE. It is important to work SLOWLY and CAREFULLY, removing only small pieces of tissue at a time. Use a lens when necessary to see detail, but avoid working under it as far as possible because it impedes

free use of the instruments. The dissection should be performed in a SMALL wax-bottomed dish. DO NOT TRY TO WORK OVER THE EDGES OF A LARGE DISH. FINE INSTRUMENTS and a steady hand are essential. (NOTE. The instruments look very large in the diagrams because of the scale on which they are drawn—approx. $\times 4$.)

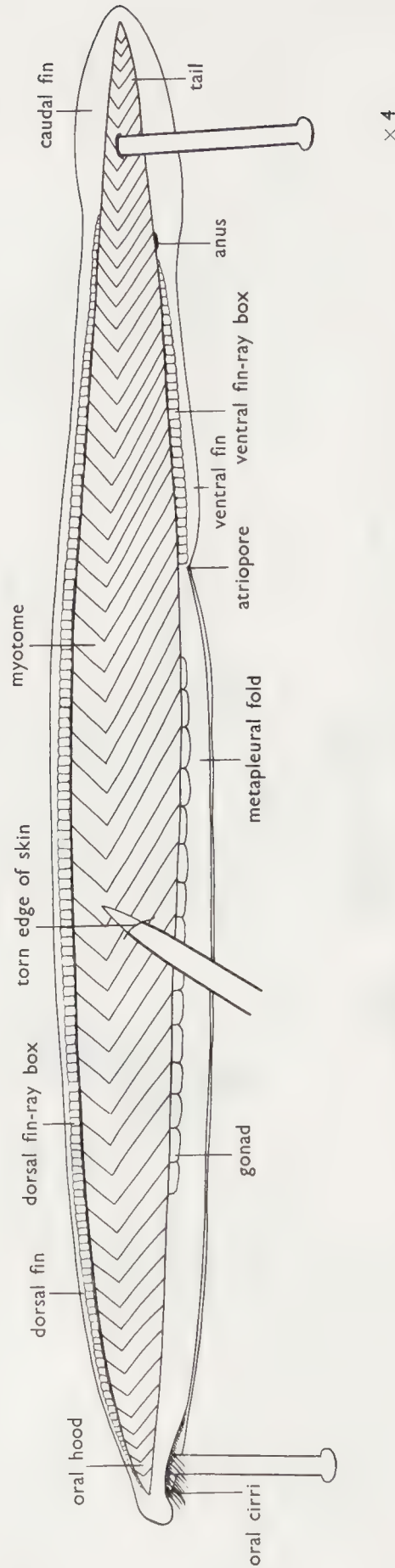


Fig. 51

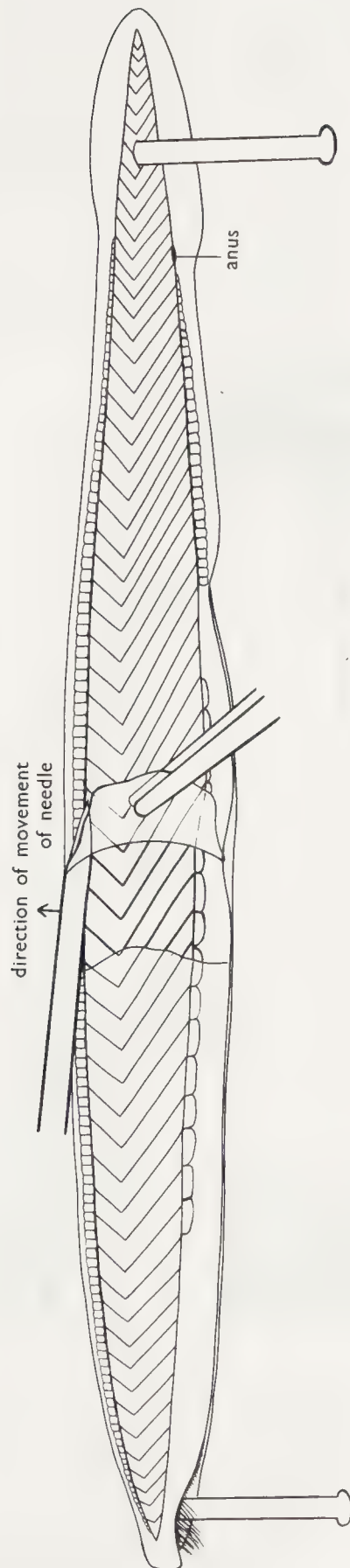
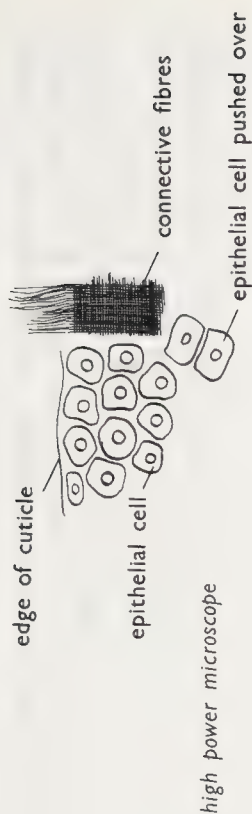
Pin the specimen to the wax of the dish with its LEFT side uppermost. Use one pin through the tail and another through the oral hood as shown.

N.B. Make up your mind where the pins are to go and LEAVE THEM THERE. If the positions of the pins have to be changed the specimen usually breaks.

Add sufficient water to cover the specimen COMPLETELY.

Notice how the V-shaped myotomes, gonads and fin-ray boxes show through the transparent skin.

Rupture the skin about halfway along the body, using a needle or fine scalpel.



× 4

Fig. 52

Pull back the torn edge of the skin. Using a needle or fine scalpel, cut the skin along the edge of the dorsal fin and that of the left metapleural fold.

NOTE. A certain amount of the skin from the underside may come off at the same time. This does not matter, but the edge of the metapleural fold should remain intact.

Work back to the base of the tail (region of the anus) and then forwards to the oral hood.

Mount a small portion of the skin so removed and examine it microscopically—see inset. Notice the cuticle showing as a faint line at the edge of the piece where the epithelial cells are in place, the cuboid epithelial cells, and the fine connective-tissue fibres showing where the epithelial cells have been rubbed off during the handling. Use differential focusing to see how the layers are arranged.

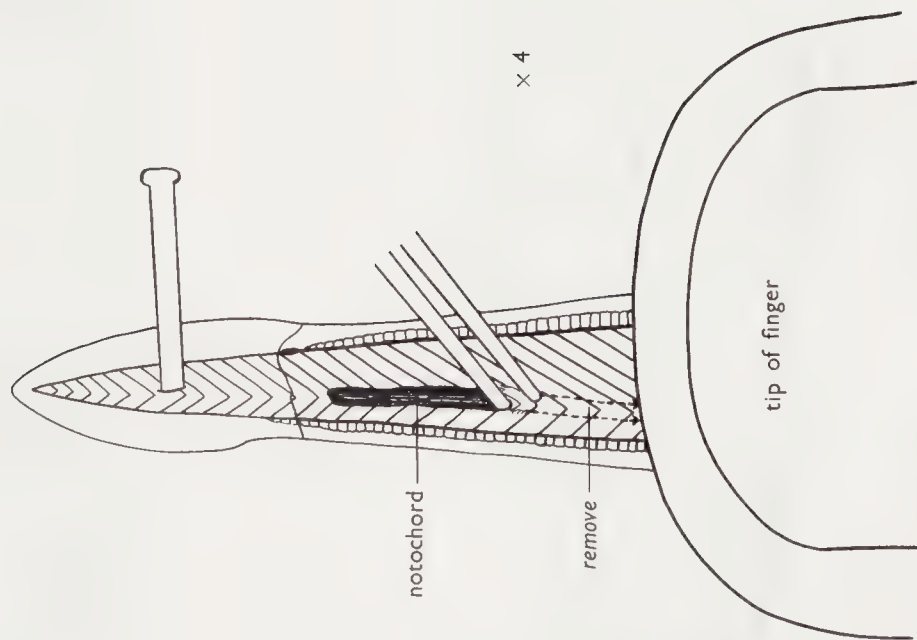


Fig. 53

Starting at the base of the tail and using fine forceps, remove the middle parts of the myotomes as shown. Work forwards along the line of the bends in the myotomes. This line lies immediately over the notochord, which is very tough and is not easily damaged by pressure from the forceps.

N.B. Avoid going too far above or below this line, particularly below, lest the delicate alimentary canal be damaged.

NOTE. Throughout this process the body should be supported by a finger placed gently on the specimen as close as possible to the working position. This relieves the strain on the pinned regions and minimizes the danger of their breaking. Move the finger from anterior to posterior and reverse the position of the dish when the work progresses from the posterior to the anterior half of the specimen.

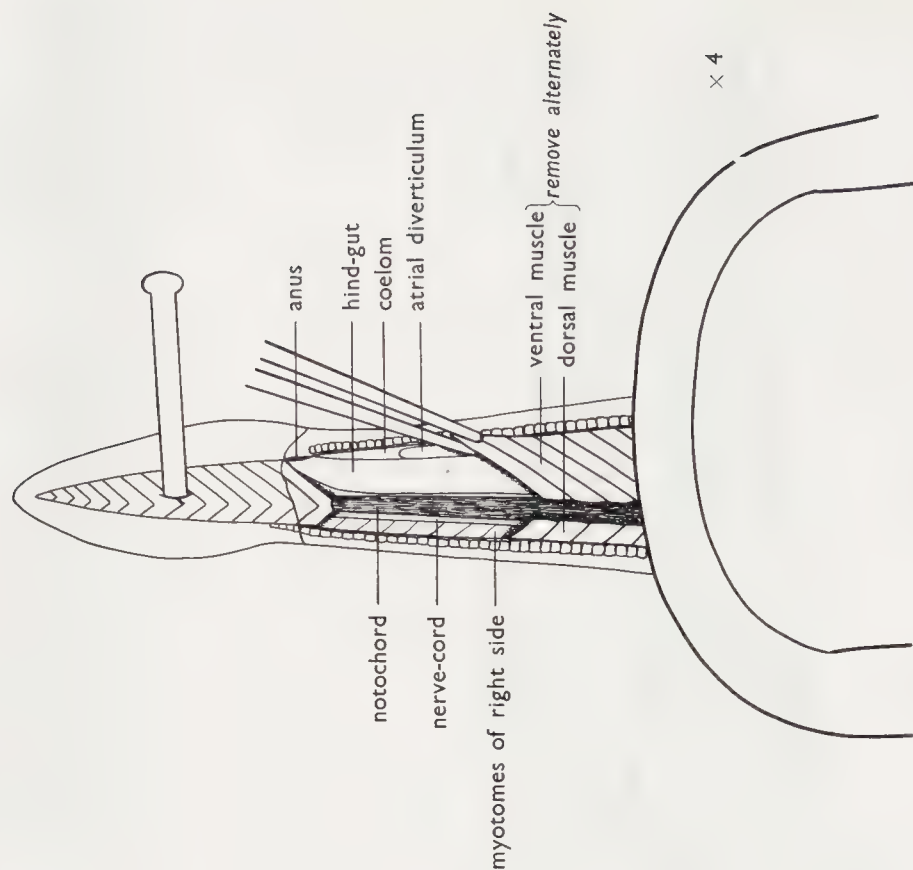


Fig. 54

Again starting at the base of the tail and supporting the body with a finger carefully remove the dorsal and ventral portions of the muscle-blocks alternately. Work forwards as far as the atriopore in this way and then continue, removing the DORSAL parts of the myotomes right to the anterior end (see Fig. 56).

NOTE. The dorsal parts of the muscles are firmly attached and the tissue beneath them is relatively tough, so that they must be scraped away. The ventral parts of the muscles on the other hand lie outside the wall of the coelom and lift off easily, taking the wall of the coelom with them. BE VERY CAREFUL NOT TO DAMAGE THE HIND GUT.

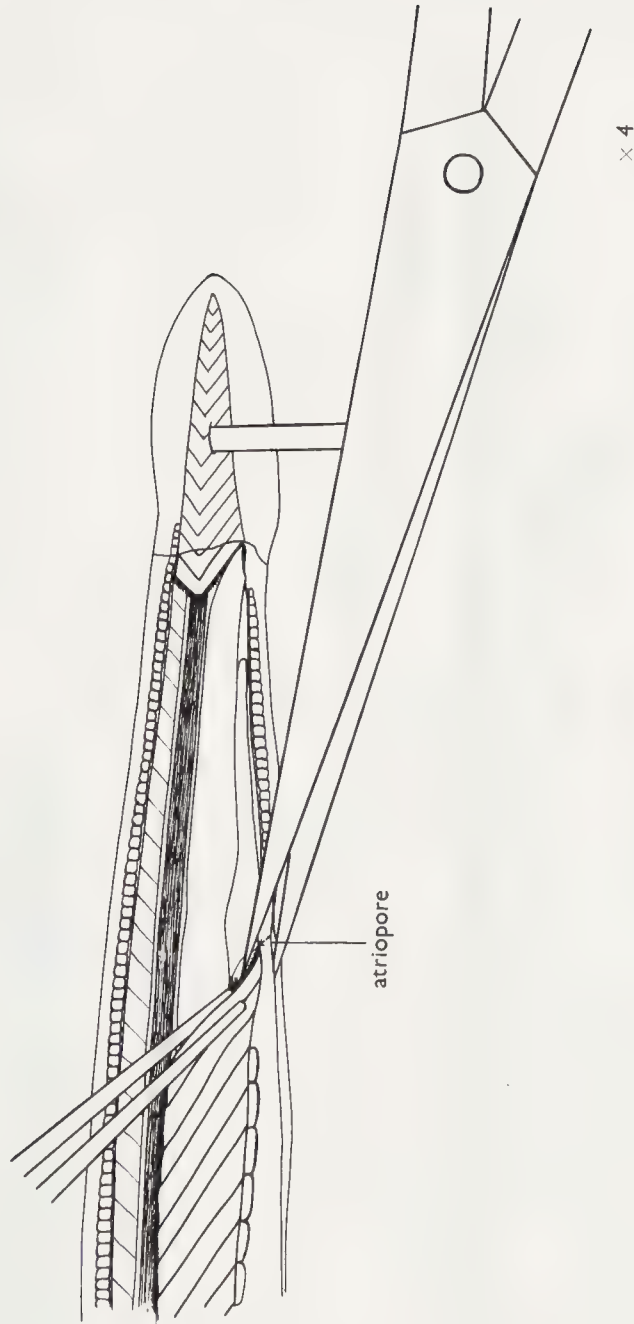


Fig. 55

VERY CAREFULLY cut into the atrium through the atriopore, cutting the most posterior part of the left metapleural fold.
N.B. This cut must be VERY SMALL and in EXACTLY THE RIGHT PLACE where the metapleural folds converge and join the ventral fin.

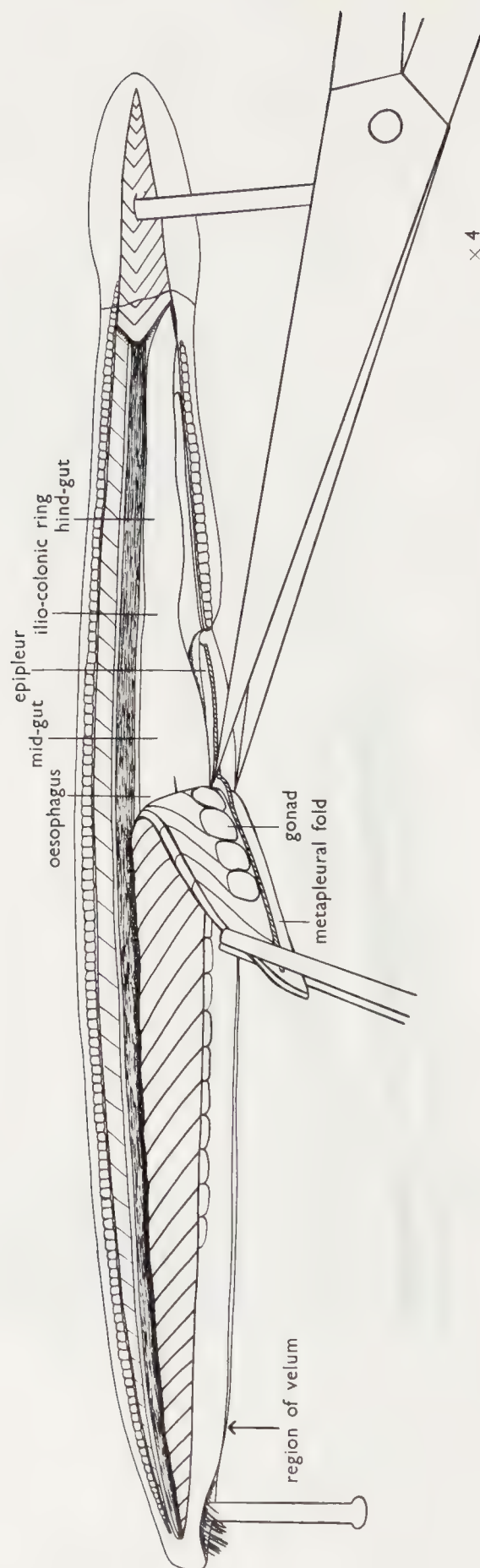


Fig. 56

Lift the cut edge of the metapleural fold so that the epipleur can be seen. Cut through the epipleur along the floor of the atrium, pulling the side-wall of the atrium away as the cutting proceeds.

N.B. Be careful not to damage any part of the alimentary canal.

Continue to work forwards to the region of the velum as indicated by the arrow in the diagram. Then strip off the remaining muscle by gentle pulling. In this way the whole of the left wall of the atrium is removed in one piece, taking the left row of gonads with it.

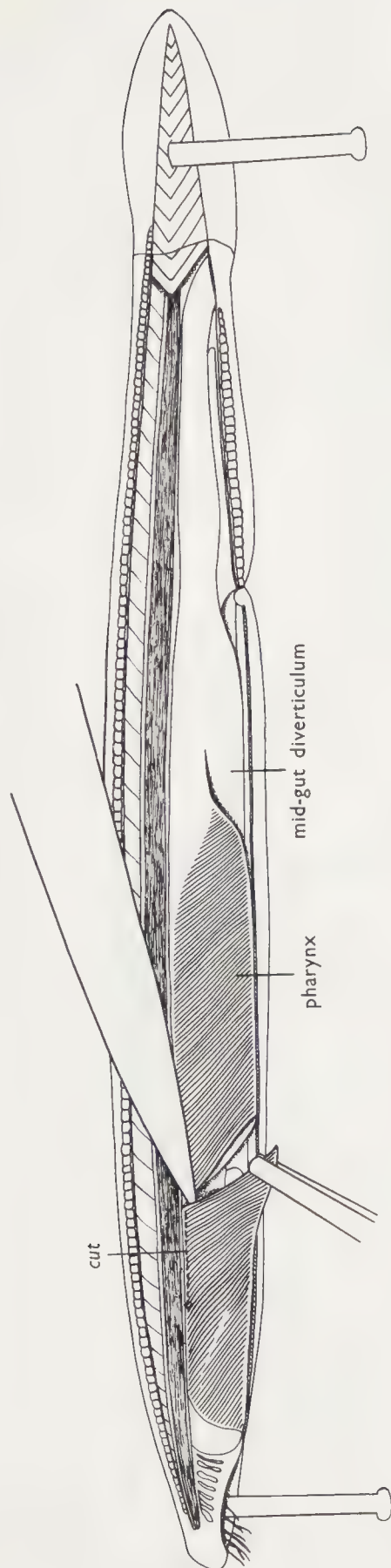


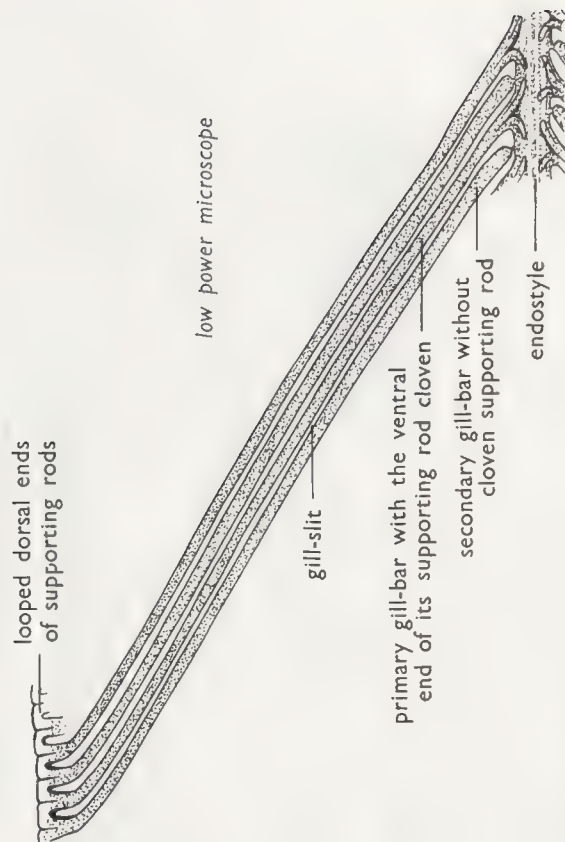
Fig. 57

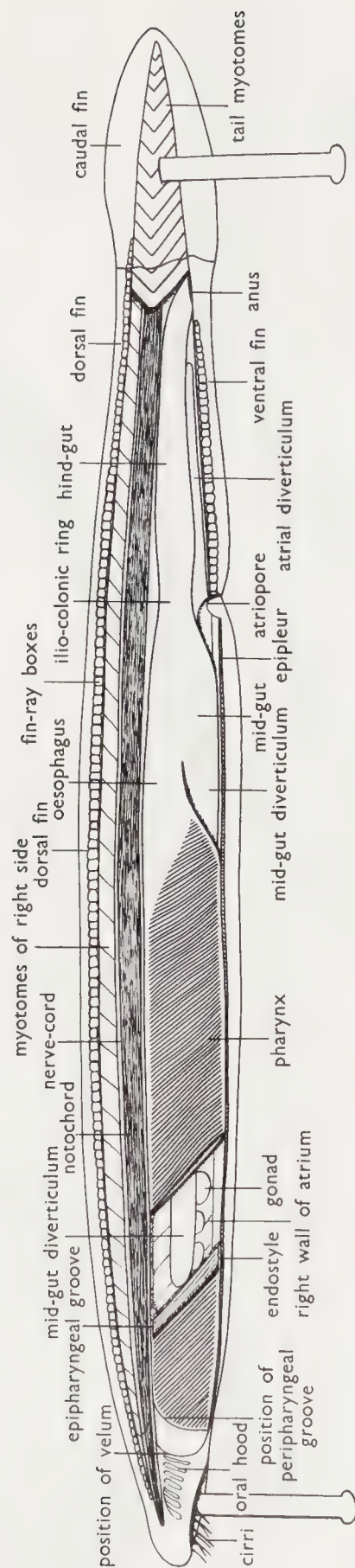
Lift a small portion of the pharynx as indicated. The endostyle immediately breaks and the pharynx parts on each side along the line of a gill-slit.

Make a cut dorsal to the gill-slits and so remove a piece of the pharynx, thus exposing a part of the mid-gut diverticulum which lies to the right of the pharynx and also showing a few of the gonads in position against the outer wall of the atrium—see Fig. 58.

Remove a few more gill-bars from the left than from the right side so that the endostyle and the epipharyngeal groove can be seen.

Mount a few of the gill-bars and examine them microscopically—see inset. DRAW.





× 4

Fig. 58
Draw the completed dissection.

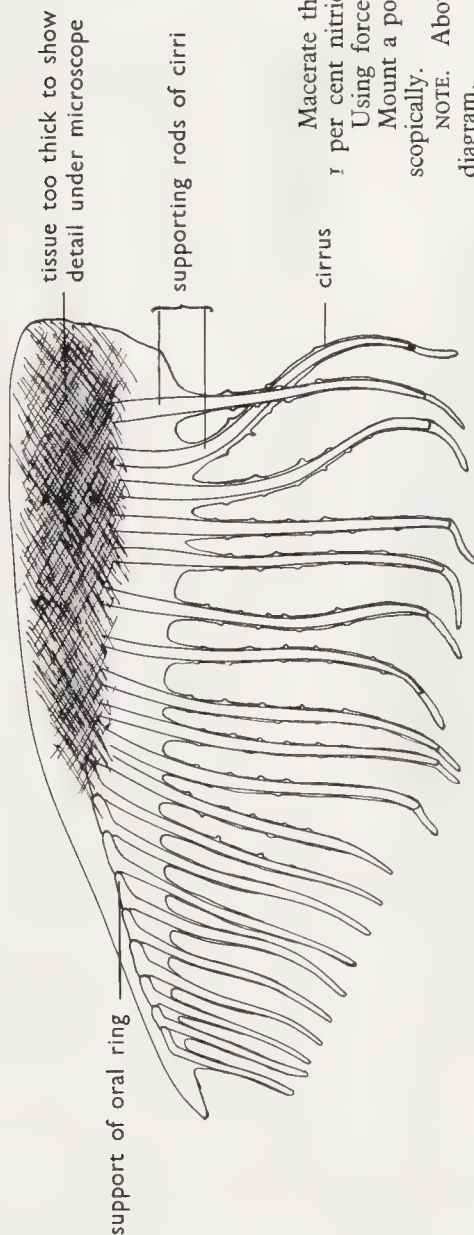


Fig. 59

Macerate the specimen slightly by soaking for a few days in 1 per cent nitric acid.
Using forceps, gently pull off the edge of the oral hood.
Mount a portion of the oral ring and observe the cirri microscopically.

NOTE. About half of the complete ring is shown in the diagram.

low power microscope

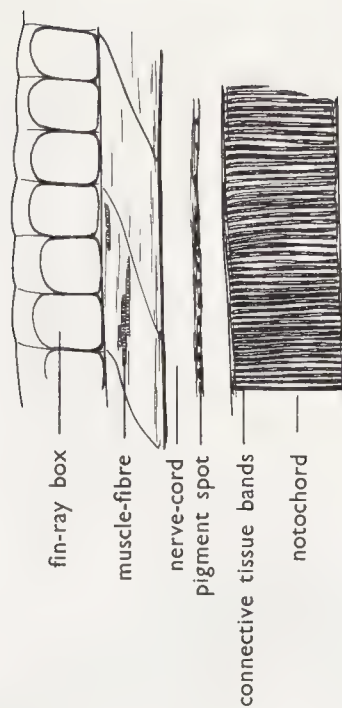


Fig. 60

Supporting the specimen with a finger only, strip away the alimentary canal and the muscles of the right side. This leaves the notochord and nerve-cord and usually parts of the dorsal row of fin-ray boxes.

Mount these and observe microscopically.

Notice especially the vertical bands of connective tissue forming the notochordal sheath, the pigment spots on the wall of the central canal of the nerve-cord and the striations on the few muscle-fibres still attached to the specimen.

Selected Invertebrates—5 ANODONTA

Anodonta may be dissected using fresh or preserved specimens.
Study the diagram of the completed dissection (Fig. 69) very carefully before starting.

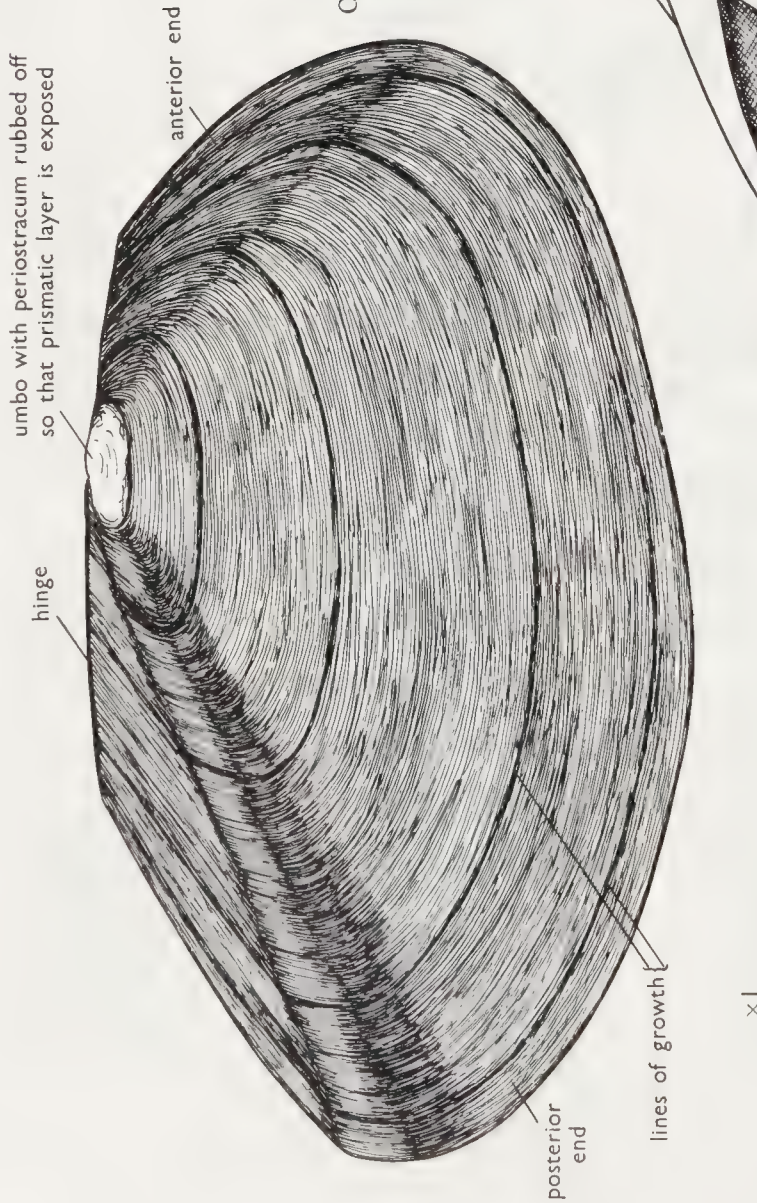


Fig. 61

Observe the shape of the shell and the lines of growth.



Fig. 62

Hold the specimen in the left hand with its anterior end towards your right and gently prise the valves of the shell apart. Grip as shown so that the thumb jams the shell slightly open.

NOTE. Do not attempt to force the valves too far apart as this will tear the muscles and possibly damage other parts at the same time. Use a scalpel to cut the muscles away from the right valve of the shell. Cut each muscle in turn and when the valve is free force it back to break the hinge.
This leaves the soft parts attached to the left valve—see Fig. 64.

Selected Invertebrates—*Anodonta*

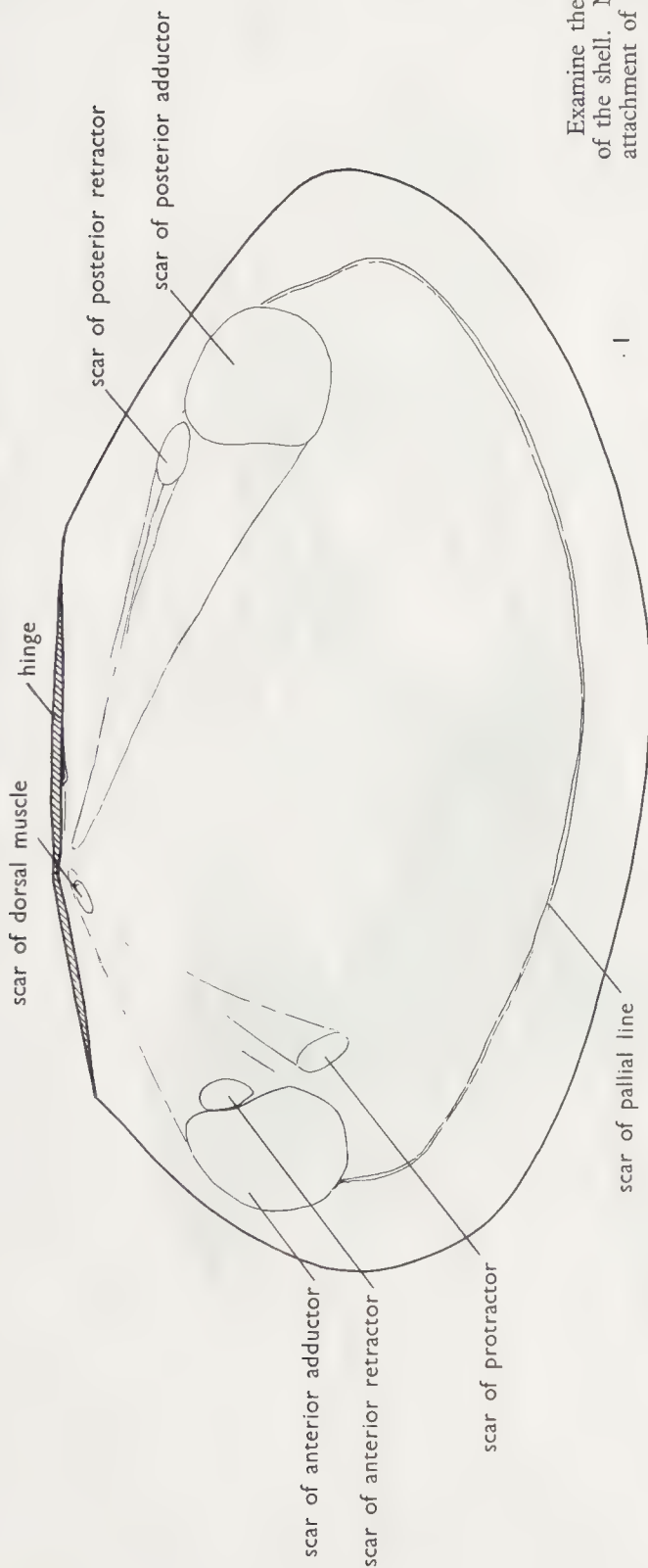


Fig. 63

Examine the inside of the right valve of the shell. Notice the positions of the attachment of the muscles. DRAW.

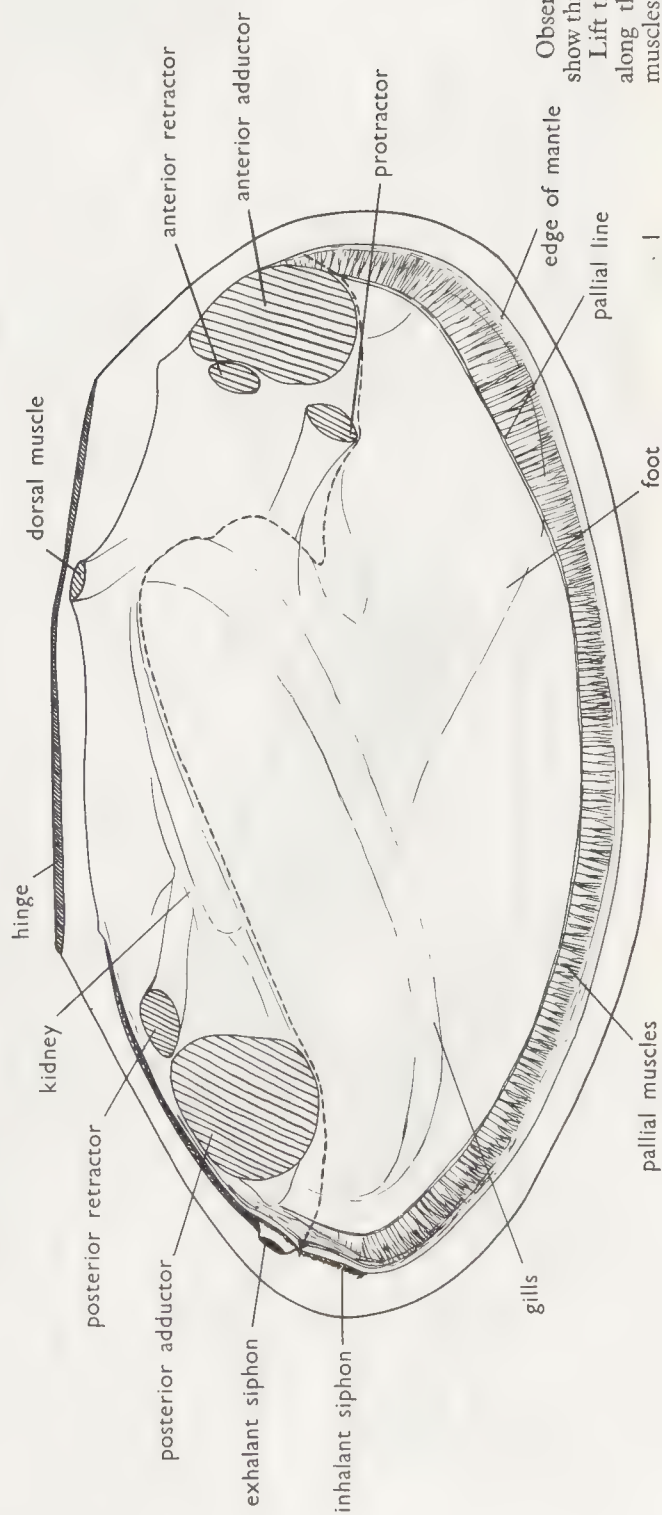


Fig. 64

Observe the various structures which show through the semi-transparent mantle. Lift the free part of the mantle and cut along the line indicated as close to the muscles and gills as possible.

Selected Invertebrates—*Anodonta*

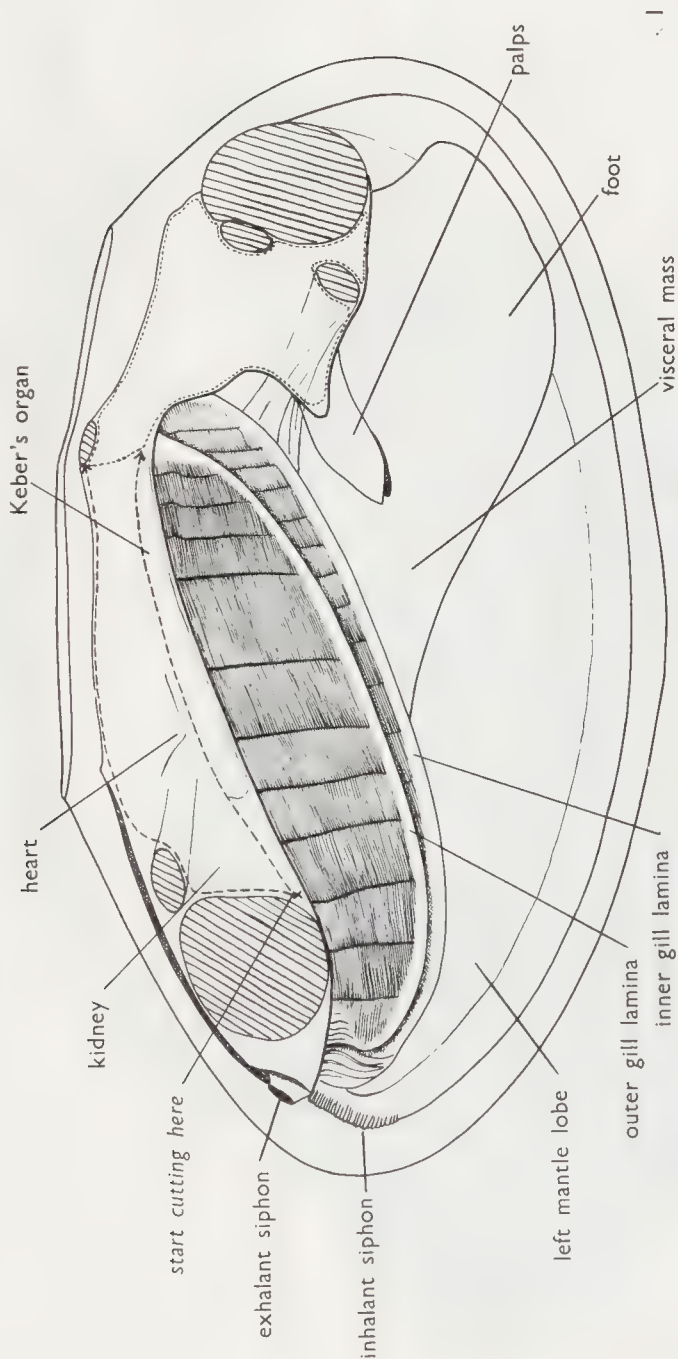


Fig. 65

Insert the point of a pair of scissors at X. Cut along the strong dotted lines as far as the heads of the arrows. This opens the kidney and the pericardium. It also usually damages the right auricle, which should be removed in any case, but BE VERY CAREFUL NOT TO DAMAGE THE VENTRICLE AND THE RECTUM—see Fig. 67. Strip the thin layer of mantle from the area outlined by the fine dotted line.

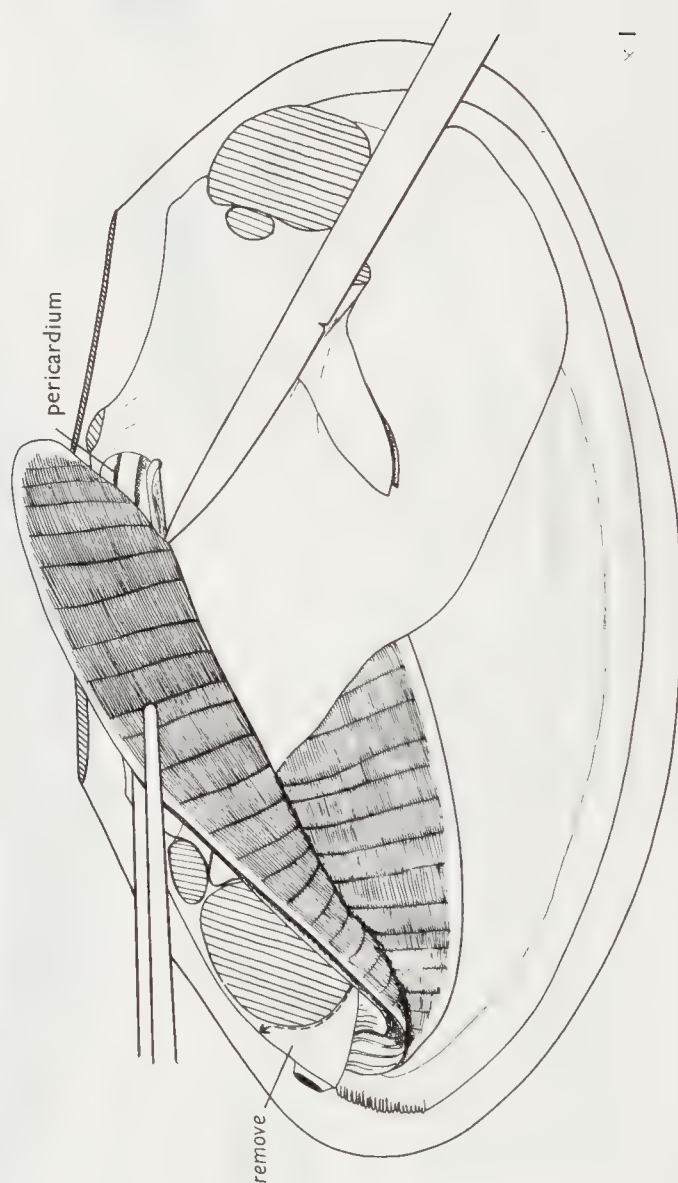


Fig. 66

Cut off the gills of the right side. Remove the right half of the exhalant siphon at the same time—see dotted line.

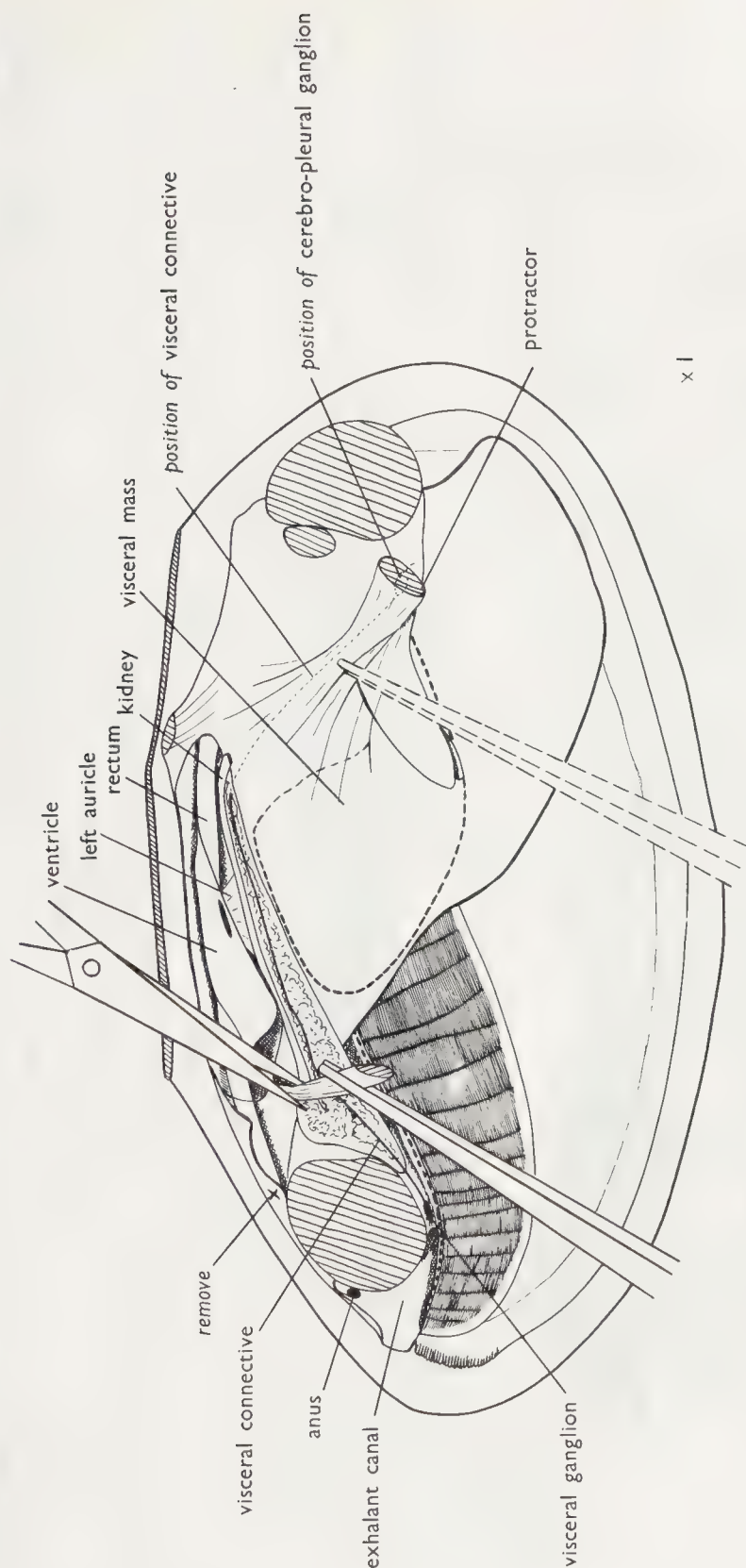


Fig. 67

Loosen and cut off a portion of the posterior retractor muscle as indicated. Clear away the remains of the mantle at X to expose the rectum to the anus. Notice the bright orange-yellow visceral ganglion against the ventral side of the posterior adductor muscle and the white visceral nerve connective running through the kidney. Clear these if necessary.

Lift a few strands of the protractor muscle as indicated (dotted forceps) and pull them away. Repeat this process VERY CAREFULLY A FEW STRANDS AT A TIME till the whole of the origin of this muscle is removed, thus exposing the right cerebro-pleural ganglion which is coloured like the visceral ganglion and the visceral nerve connective where it crosses the visceral mass—see Fig. 68.

NOTE 1. If this connective does not show, make no attempt to find it—you have already removed it accidentally.

NOTE 2. When the palps are sufficiently loosened, lay them aside out of the way—see Fig. 68.

NOTE 3. The protractor muscle-fibres merge with the fibres from the dorsal muscle and with the main muscle-wall of the visceral mass. Therefore it is necessary to use a scalpel to clear away the thicker parts which cannot be removed by simple stripping. This applies approximately to the area outlined by the thick dotted lines. N.B. HOLD THE SCALPEL HORIZONTAL and be careful not to cut deeply.

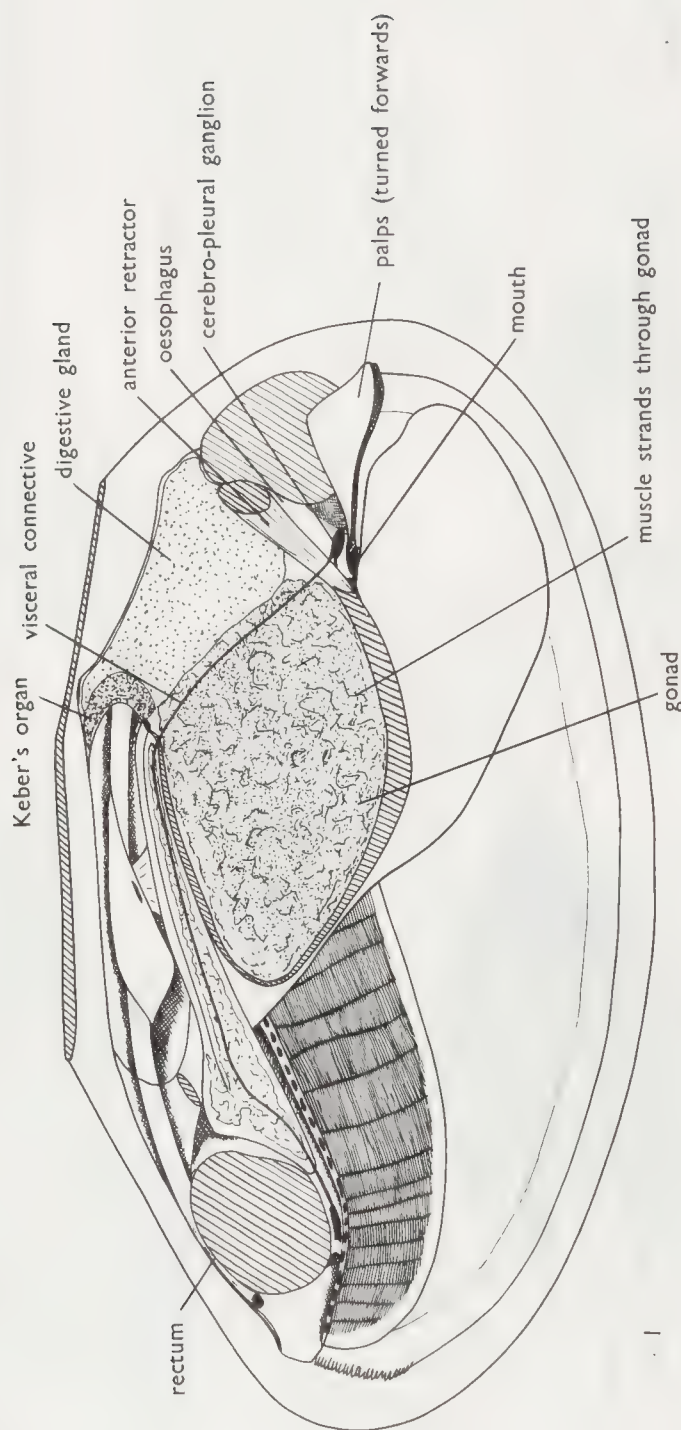


Fig. 68

Complete the clearing of the visceral connective and observe and draw this stage if you have been successful.

Using the back of a scalpel and a lot of running water, loosen and remove enough of the digestive gland and of the gonad to expose the stomach and intestine.

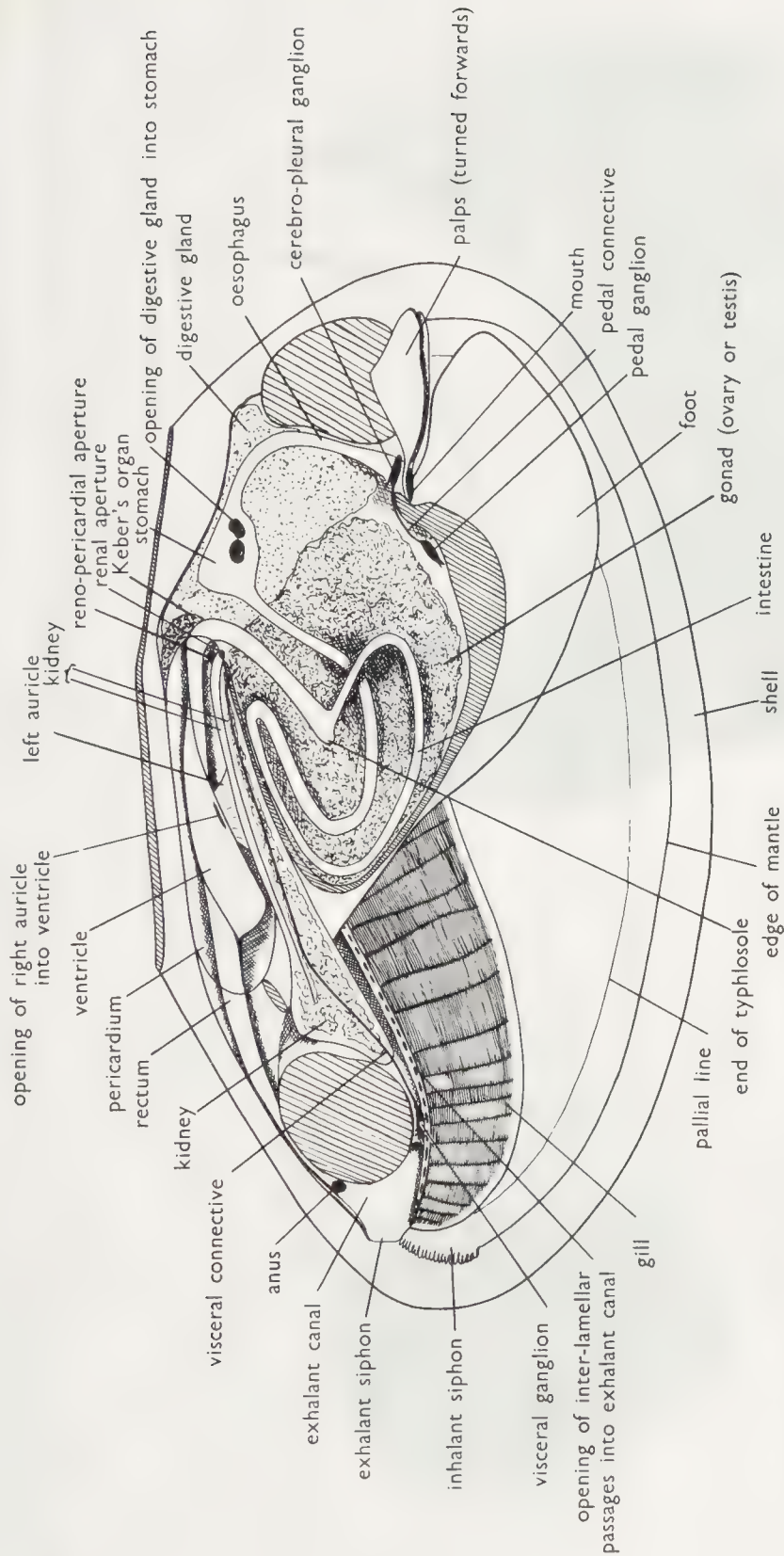
NOTE. Watch carefully for the coiling of the intestine (see Fig. 69)—and, when working from the right side, trace it from the rectal end.

Trim away the transverse strands of muscle which run through the gonad in order to tidy up the dissection and display the intestine clearly.

Cut away the right anterior retractor muscle and trim back the muscle of the foot to expose the pedal connective and the pedal ganglion.

NOTE. The latter is orange-yellow like the other ganglia but more difficult to identify in the female because the ripe ovary is a similar colour though rather paler.

Selected Invertebrates—*Anodonta*



× 1

Fig. 69

Examine the completed dissection and DRAW.

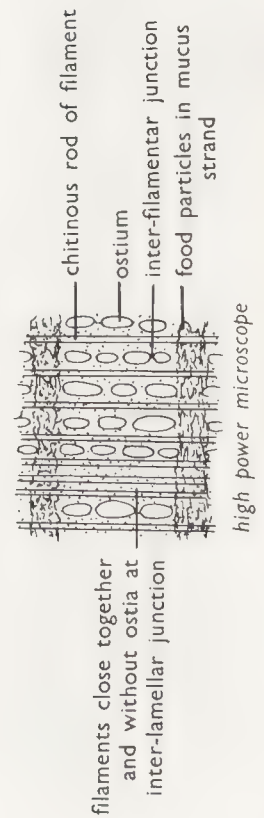
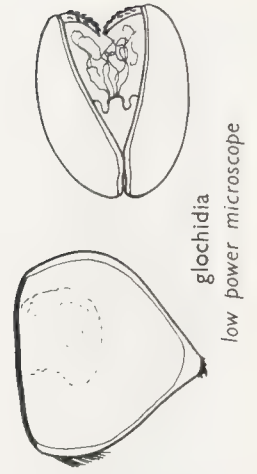


Fig. 70

Mount a small portion of a gill and examine it microscopically (Fig. 70a). Notice that the transverse lines which are visible to the naked eye are not the gill filaments which are actually very much finer and perpendicular to these lines.

NOTE. (Fig. 70b.) Female *Anodonta* may have embryos or fully-grown glochidia between the lamellae of the outer gill laminae.



Selected Invertebrates—6 SNAIL

The dissection of the snail is very simple in principle as it consists only of removing the shell and parts of the wall of the visceral mass and disentangling the various internal organs. It is, however, difficult to describe because the varying amount of contraction of the individual specimens alters the placing of the parts.

The different species of snails differ slightly internally, e.g. in the presence or absence of caecum, mucous glands and flagellum. The instructions given here should enable the student to dissect any type of snail, and a completed dissection

is shown of *Helix aspersa*, the common garden snail, and of *Helix pomatia*, the Roman snail, which is often used because of its greater size. These diagrams - Figs. 79 and 80—should be examined carefully before starting the dissection.

The dissection should be displayed in a wax-bottomed dish, using very small pins, and should be COMPLETED WITHOUT THE USE OF PRESERVATIVE because when the tissues harden they lose their elasticity and break very readily.

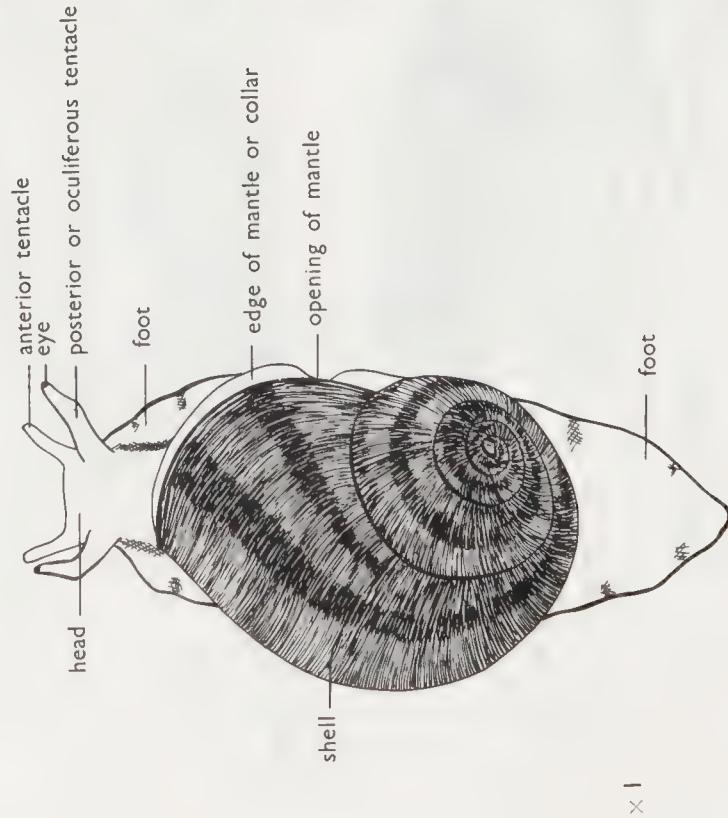


Fig. 71

Examine the snail alive and watch it crawl.

DRAW the external appearance, noticing especially the head and tentacles, which are liable to be completely retracted when the snail is killed.

Kill the snail by sudden immersion in boiling water. It immediately undergoes some contraction and secretes a lot of mucus. Wash away this mucus and by gentle stroking pull out the foot as much as possible.

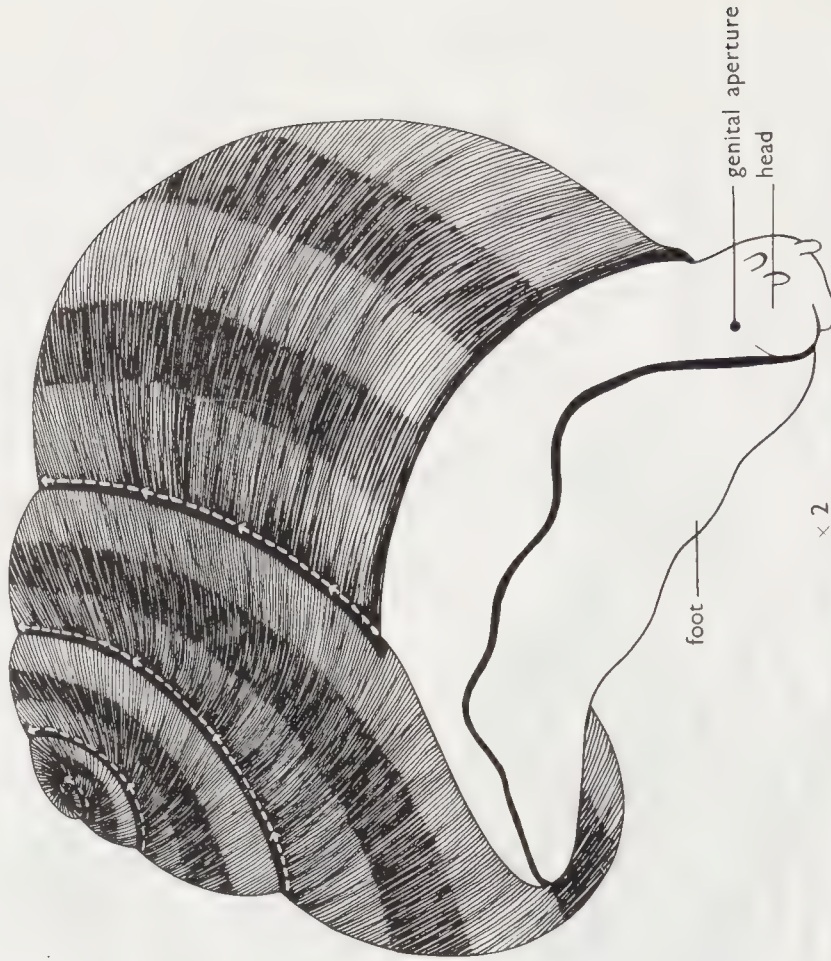
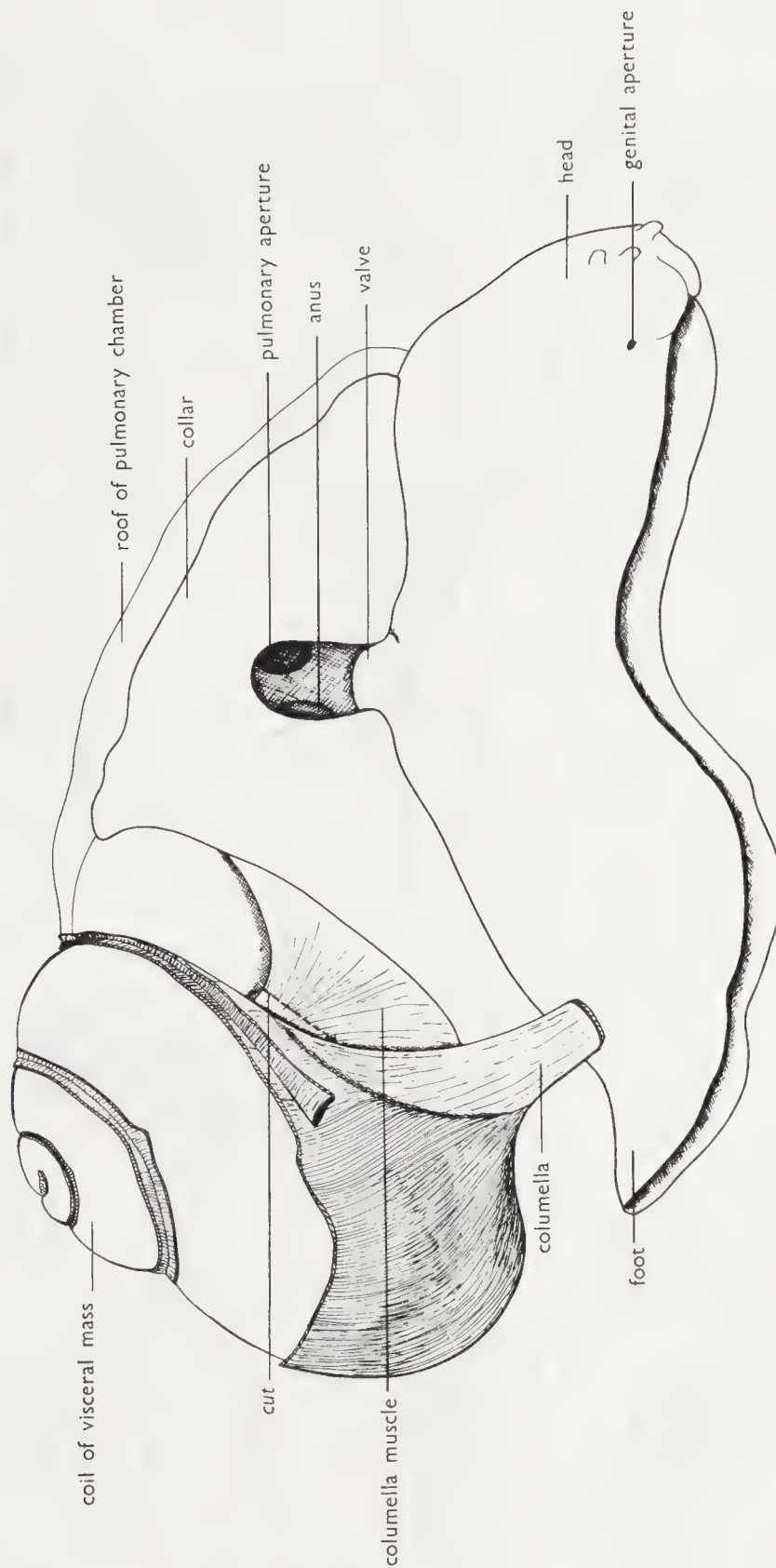


Fig. 72

Hold the snail in the left hand and cut around the spirals of the shell as indicated. Prise away the pieces as you cut, leaving only the central parts round the columella.

N.B. Be very careful not to damage the coiled part of the visceral mass.



× 2

Fig. 73

Look for the columella muscle and cut it as indicated.
Remove the remainder of the shell.

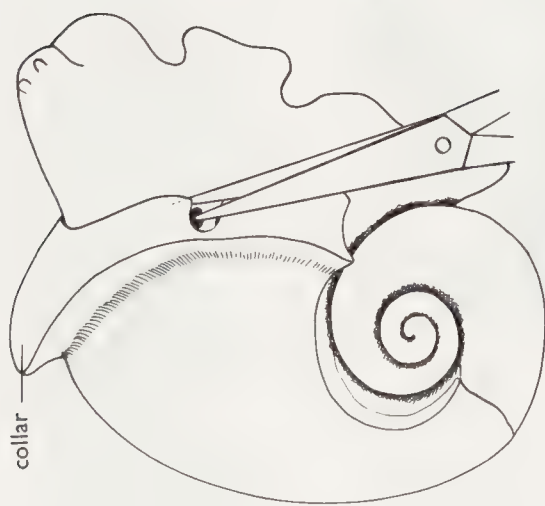


Fig. 74

Insert one blade of a pair of scissors through the pulmonary aperture and cut the mantle away from the body-wall.
NOTE. THE LINE OF ATTACHMENT OF THE MANTLE TO THE BODY-WALL IS UNDER THE COLLAR, NOT ALONG ITS EDGE.



Fig. 75

Alter the position of grip and cut in the opposite direction in order to free the rest of the collar. Continue the cut along the wall of the mantle cavity in such a way that the rectum remains attached to the loosened part.

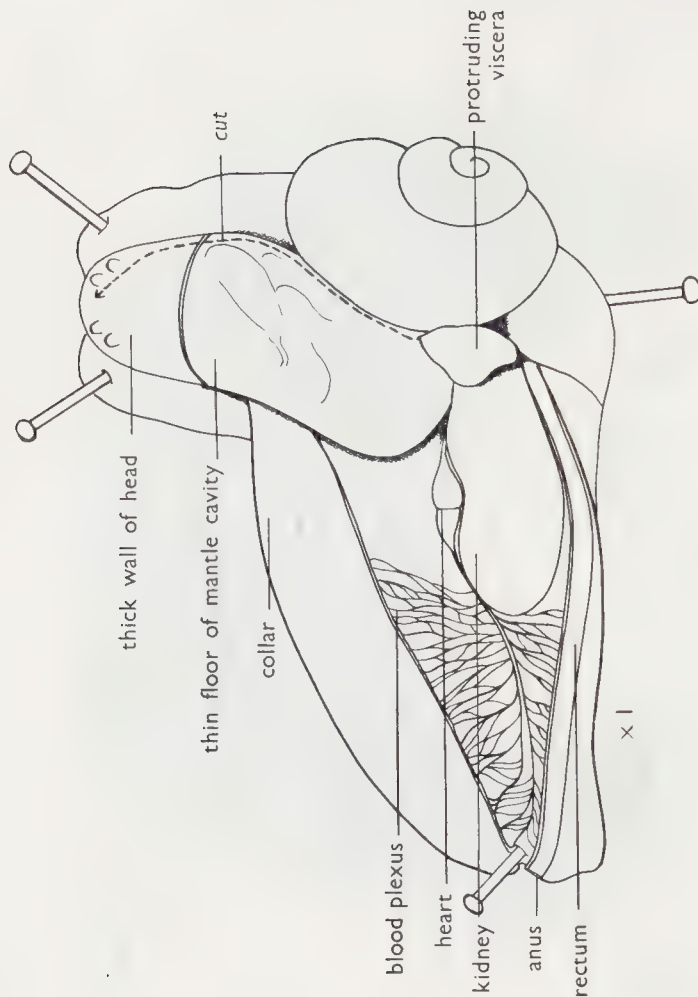


Fig. 76

Using a pin on either side of the head and another through the posterior part of the foot, attach the snail to the wax of a dissecting-dish. Turn back the mantle and pin as shown. Identify the kidney and the heart.

NOTE. A portion of the viscera—usually the crop—often bulges through the hole in the body-wall which was made when cutting the columella muscle.

Starting from this hole, cut forwards through the body-wall along the line indicated.

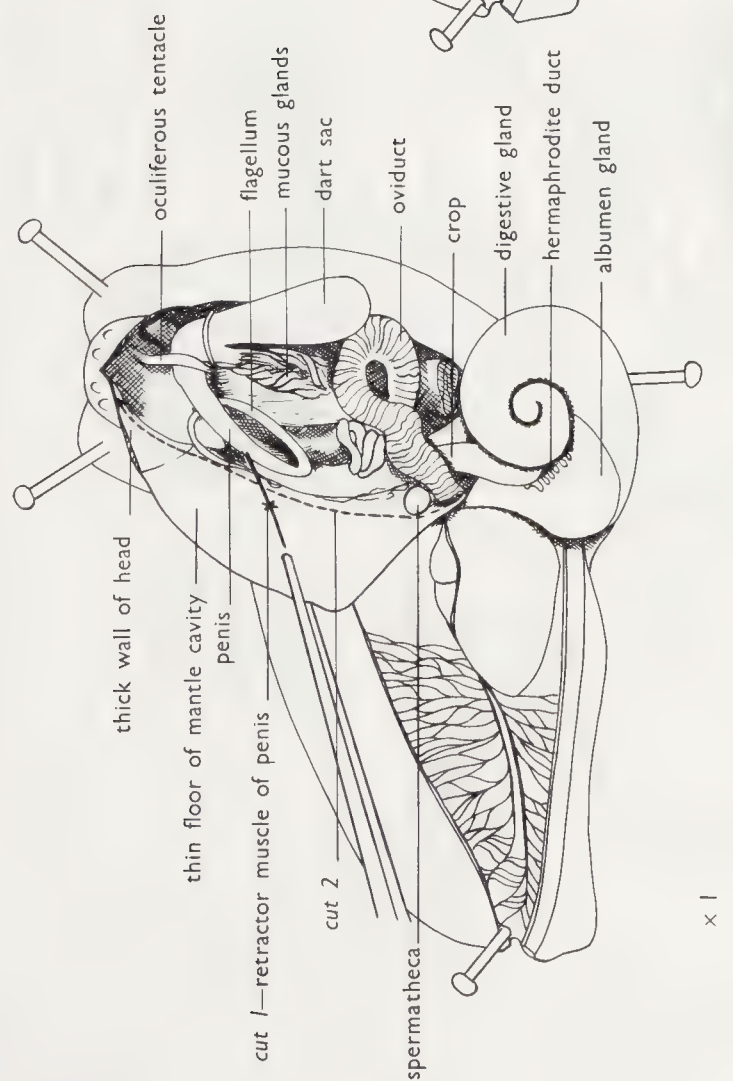


Fig. 77

Turn back the dorsal wall of the visceral mass as shown.

Notice the retractor muscle of the penis and cut it at X—cut 1.

Cut along the dotted line to remove the reflected part of the body-wall—cut 2.

NOTE. The albumen gland varies considerably in size and in texture according to degree of maturity. Approximate positions of this and other important organs are shown, but do not worry if they are not all identifiable at this stage.

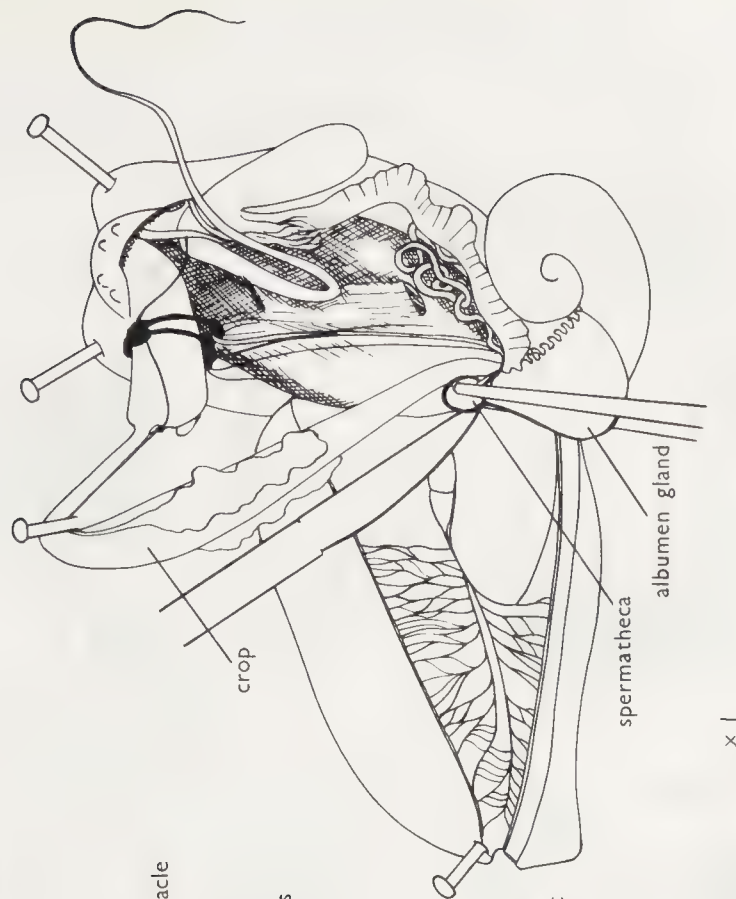


Fig. 78

Cover the specimen COMPLETELY with water.

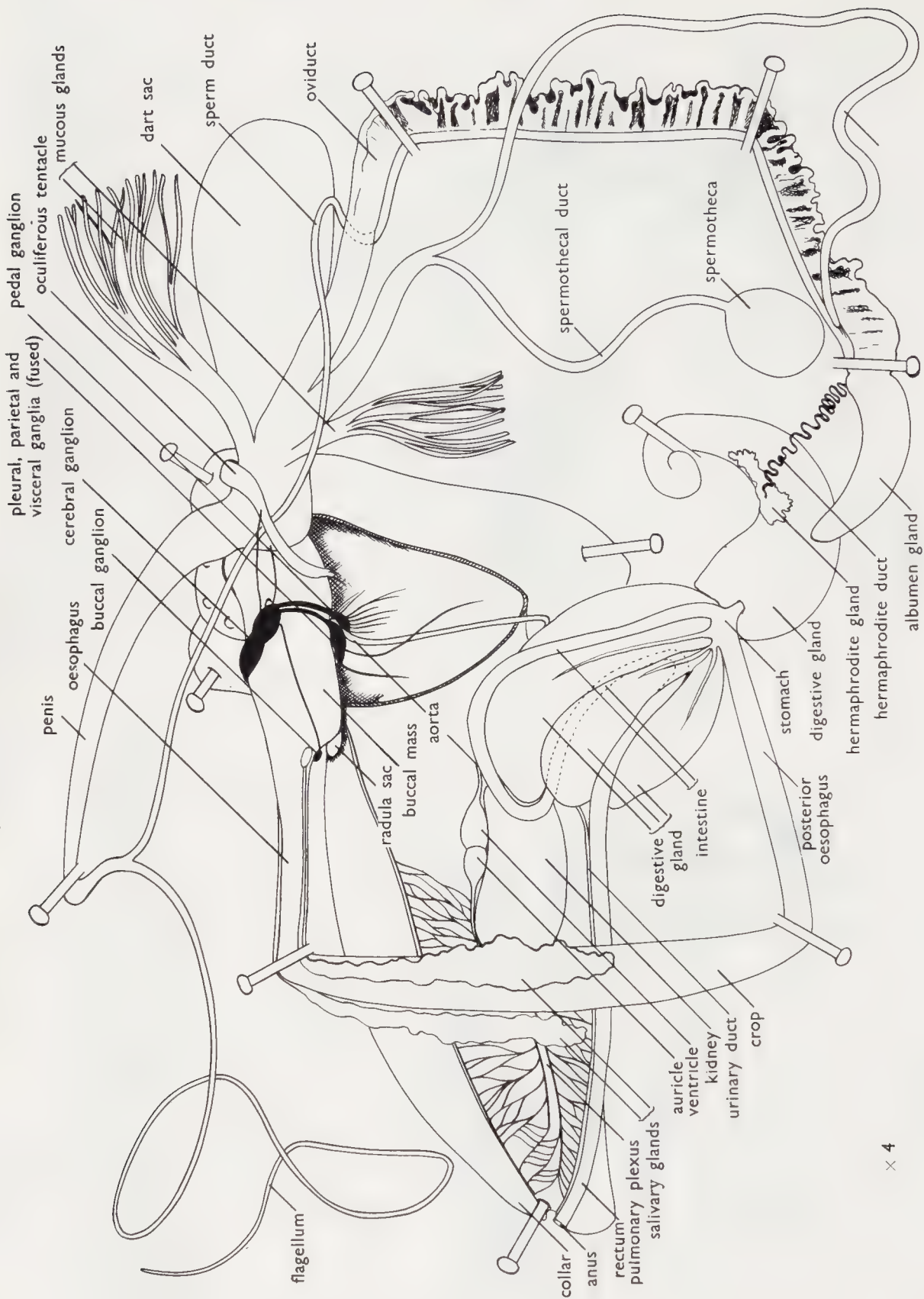
Lay the dart sac, penis and flagellum, mucous glands, oviduct, sperm duct and spermathecal duct to the right.

Loop the crop round a pin as shown so that it is pulled to the left.

Grip the albumen gland and the spermatheca gently and cut through the connective tissue so that they can be lifted away from the digestive gland.

HELIX POMATIA ONLY. Deliberately cut such blood-vessels as may be necessary to free the crop and posterior oesophagus and also cut along the edge of the respiratory portion of the mantle to free the rectum and allow the mantle itself to be stretched to a flatter position—see Fig. 80.

Selected Invertebrates—*Snail*

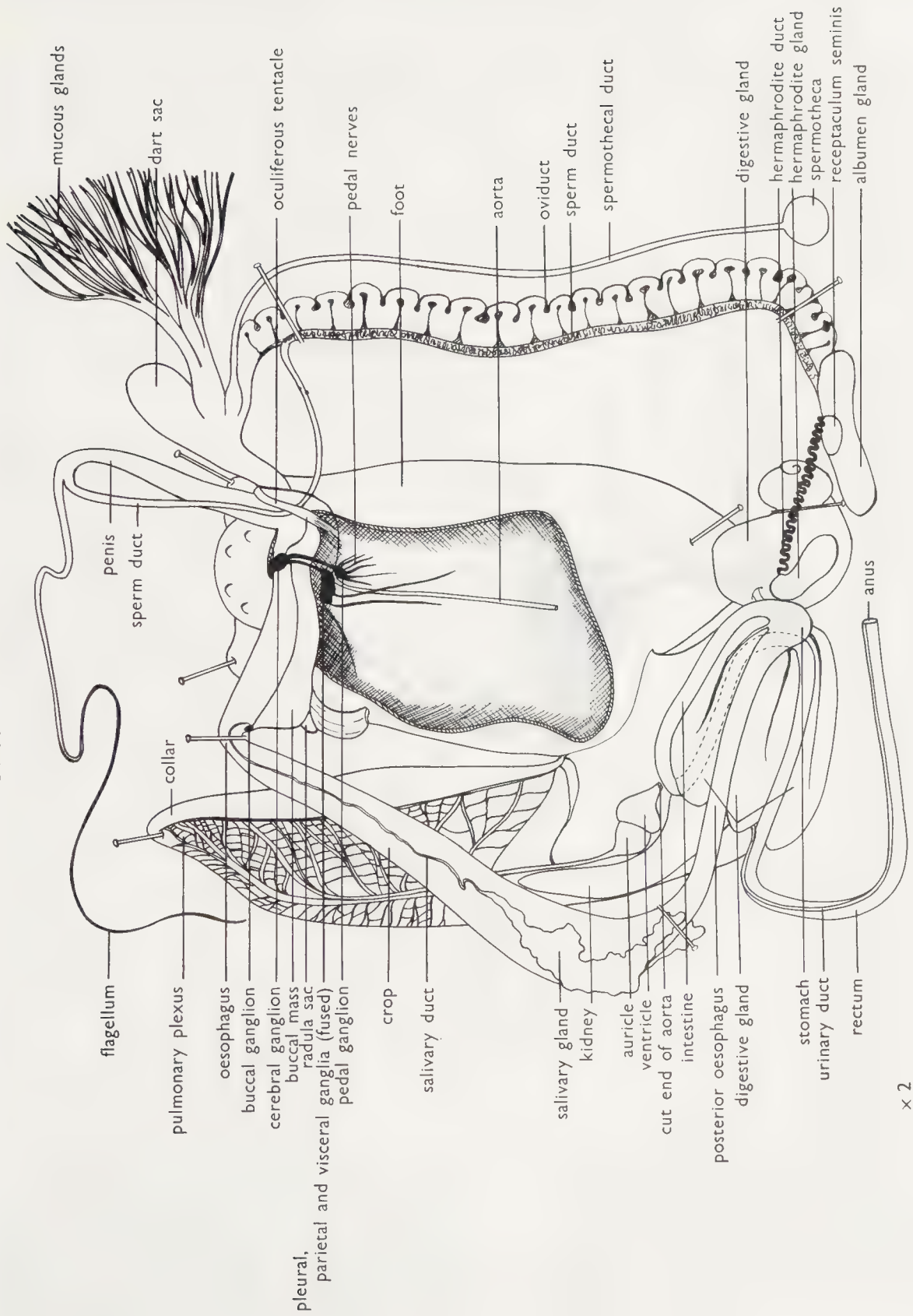


× 4

Fig. 79. *Helix aspersa*

Display the structure as fully as possible, placing pins AGAINST, but NOT THROUGH, the organs to hold them in position.
DRAW.

Selected Invertebrates—Snail



× 2

Fig. 80. *Helix pomatia*

Display the structure as fully as possible, placing pins AGAINST, but NOT THROUGH, the organs to hold them in position.
DRAW.

N.B. This diagram is on a much smaller scale than that of *Helix aspersa*.

Selected Invertebrates—*Snail*

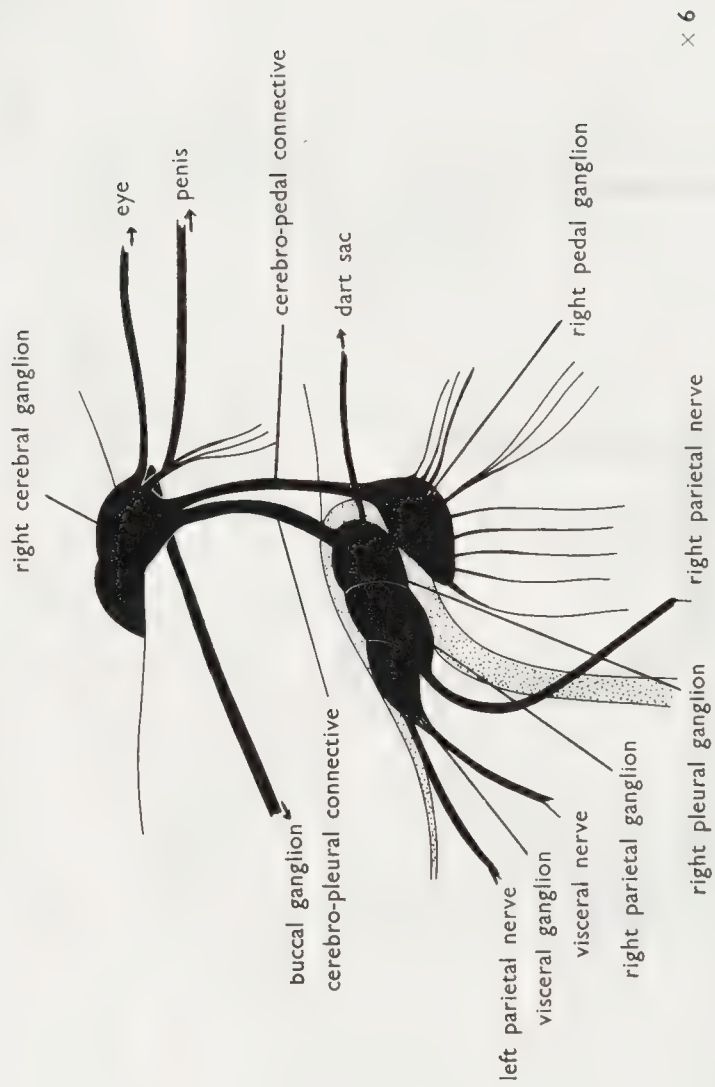


Fig. 81

Use a lens to examine the nerve mass. DRAW.

Selected Invertebrates—7 ASCARIS

Ascaris is usually supplied preserved in alcohol. In this condition the body wall is reasonably tough but the internal organs are extremely brittle and must be handled VERY CAREFULLY.

The dissection should be performed in a large wax-bottomed dish using SMALL pins to hold the body wall.

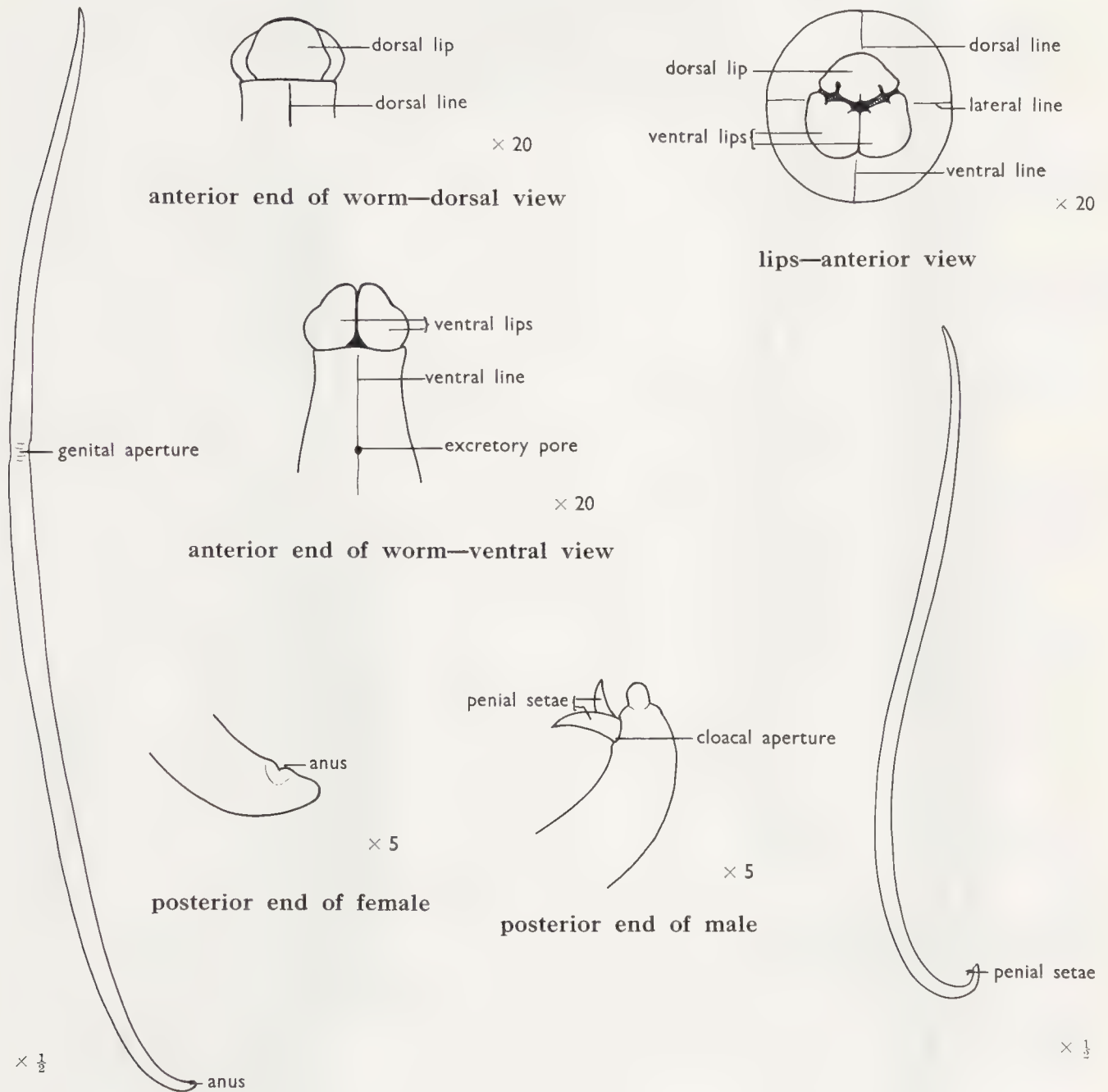


Fig. 82a. Female

Examine the external appearance carefully, using a lens to study the lips, excretory pore, genital aperture and anus—see inset diagrams.

Hold the worm as indicated in Fig. 2 (earthworm) and cut up the mid-dorsal line. If the dorsal line is difficult to see use the two distinct lateral lines as guides. Extend the cut forwards to the lips and backwards to the level of the anus.

Pin out the worm as indicated in Fig. 3 (earthworm) with the result shown in Fig. 83a.

Fig. 82b. Male

Examine the external appearance carefully, using a lens to study the lips, excretory pore and cloacal aperture—see inset diagrams.

Hold the worm as indicated in Fig. 2 (earthworm) and cut up the mid-dorsal line. If the dorsal line is difficult to see use the two distinct lateral lines as guides. Extend the cut forwards to the lips and backwards to the level of the cloaca. For the last inch diverge from the mid-dorsal line onto one or other of the lateral lines—see Fig. 83b.

Pin out the worm as indicated in Fig. 3 (earthworm) with the result shown in Fig. 83b.

Fig. 83a. Female

Cover the specimen completely with water.
Using forceps and a needle GENTLY disentangle the intestine and uteri from the much-coiled ovaries. Float rather than pull the strands apart.

NOTE. It is possible to disentangle the ovaries completely so that their extreme length and graded thickness can be seen, but this is very difficult and time-consuming and is not really worth the effort.

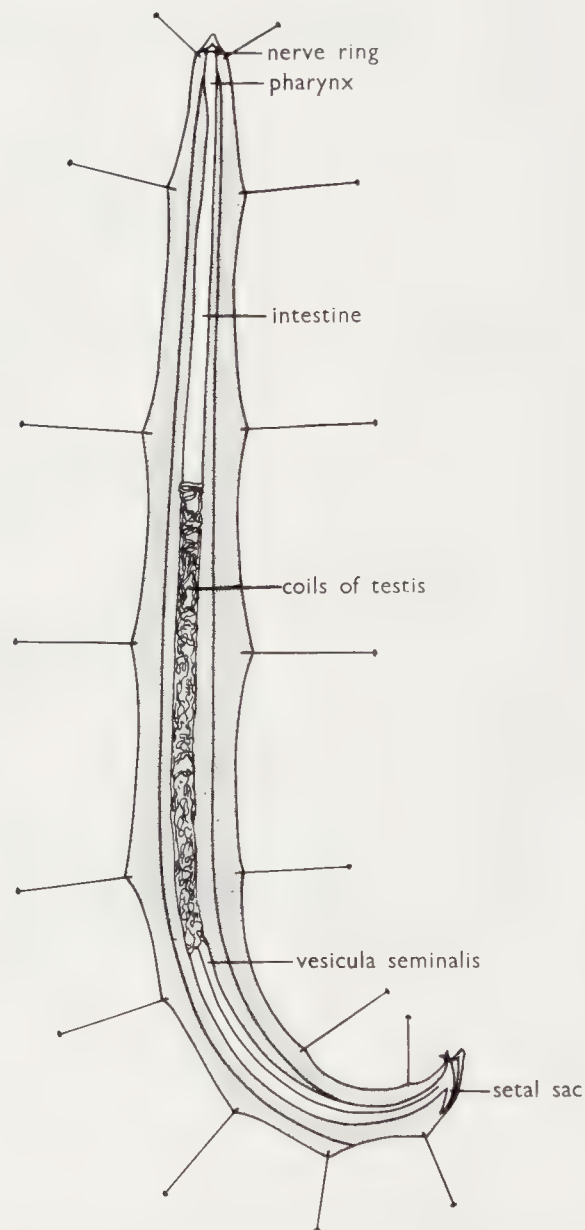
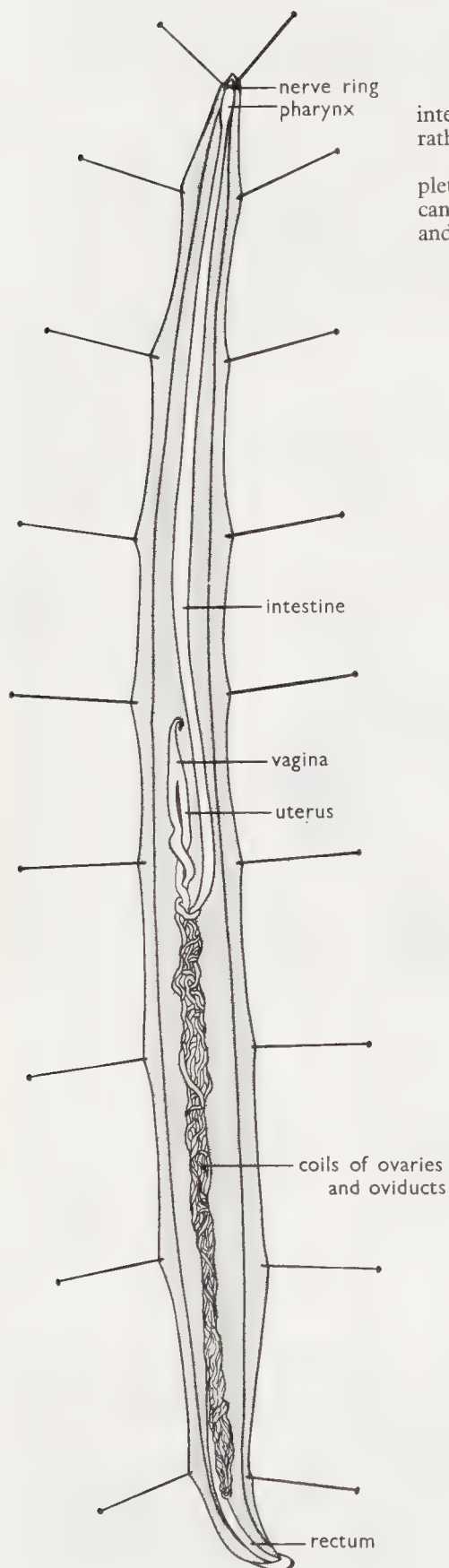


Fig. 83b. Male

Cover the specimen completely with water.
Using forceps and a needle GENTLY disentangle the intestine and vesicula seminalis from the much-coiled testis. Float rather than pull the strands apart.

NOTE. It is possible to disentangle the testis completely so that the extreme length and graded thickness can be seen, but this is very difficult and time-consuming and is not really worth the effort.

Selected Invertebrates—*Ascaris*

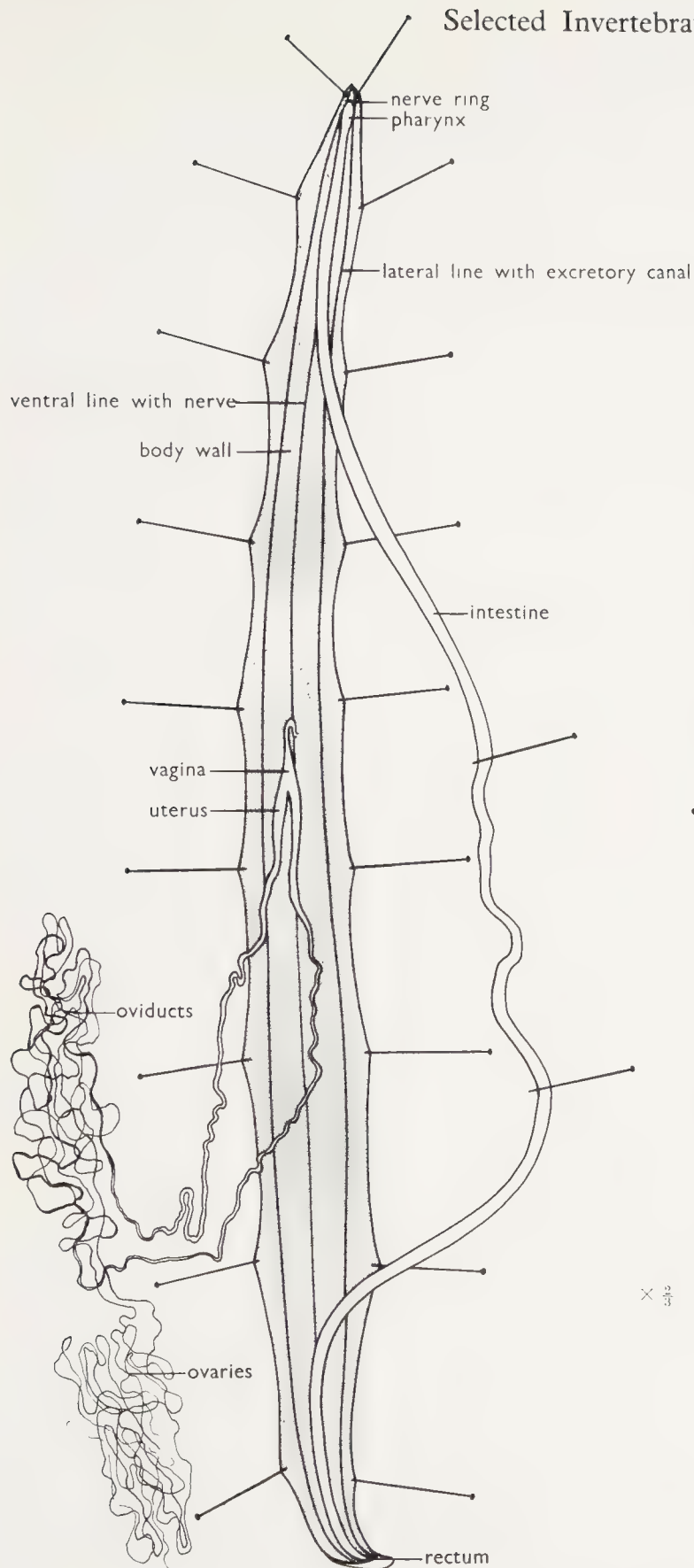


Fig. 84a. Female

Examine the completed dissection.
DRAW.

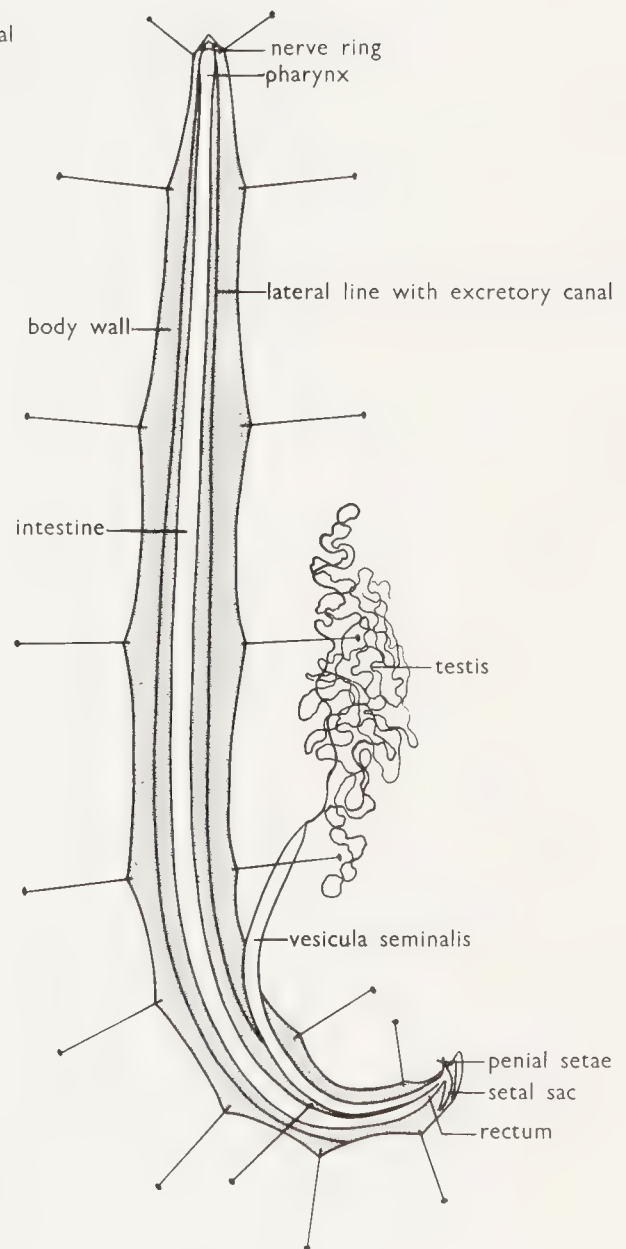


Fig. 84b. Male

Examine the completed dissection.
DRAW.

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