

## 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.

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# THE FROG—I Opening up the Body Cavity

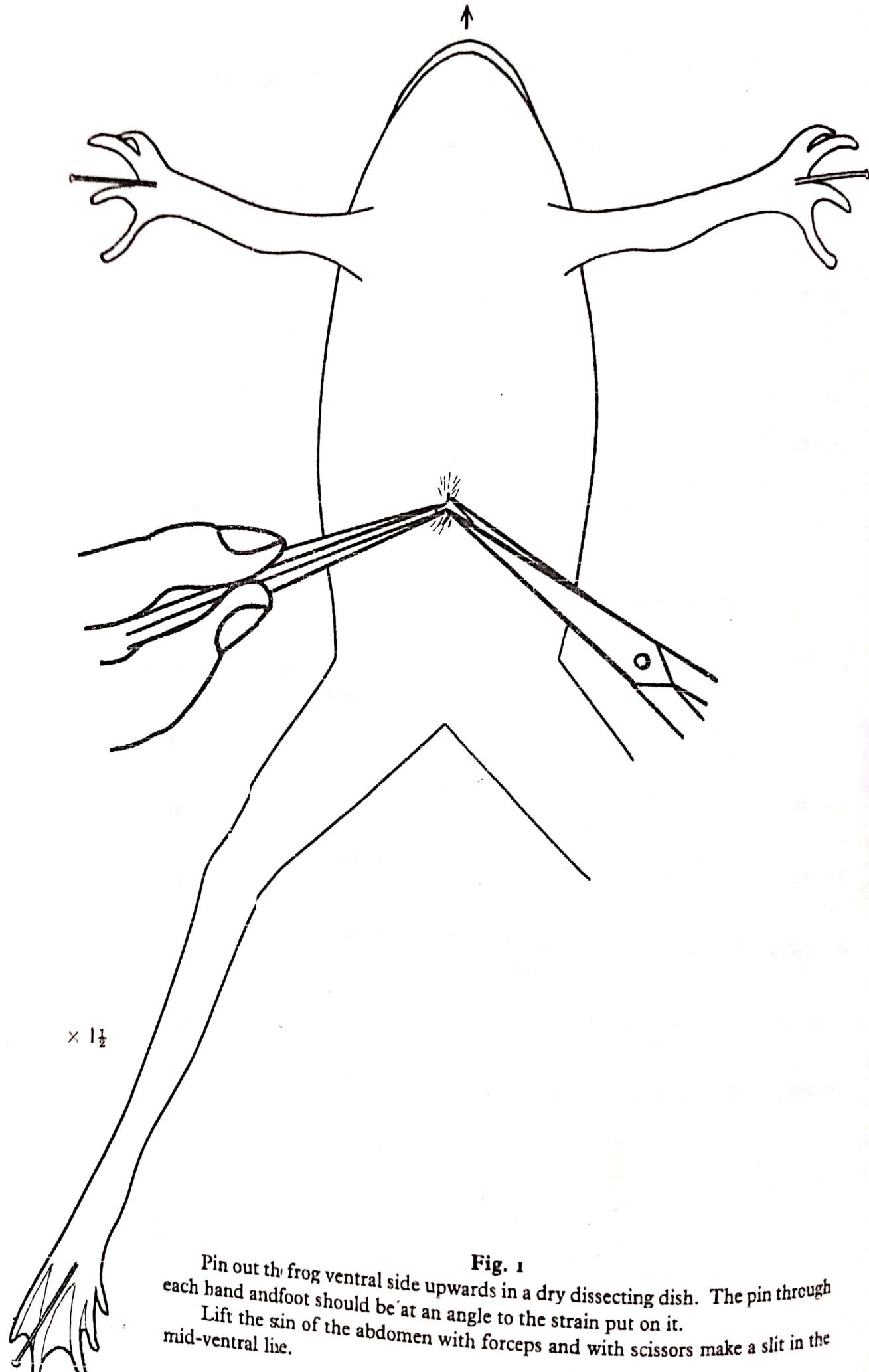
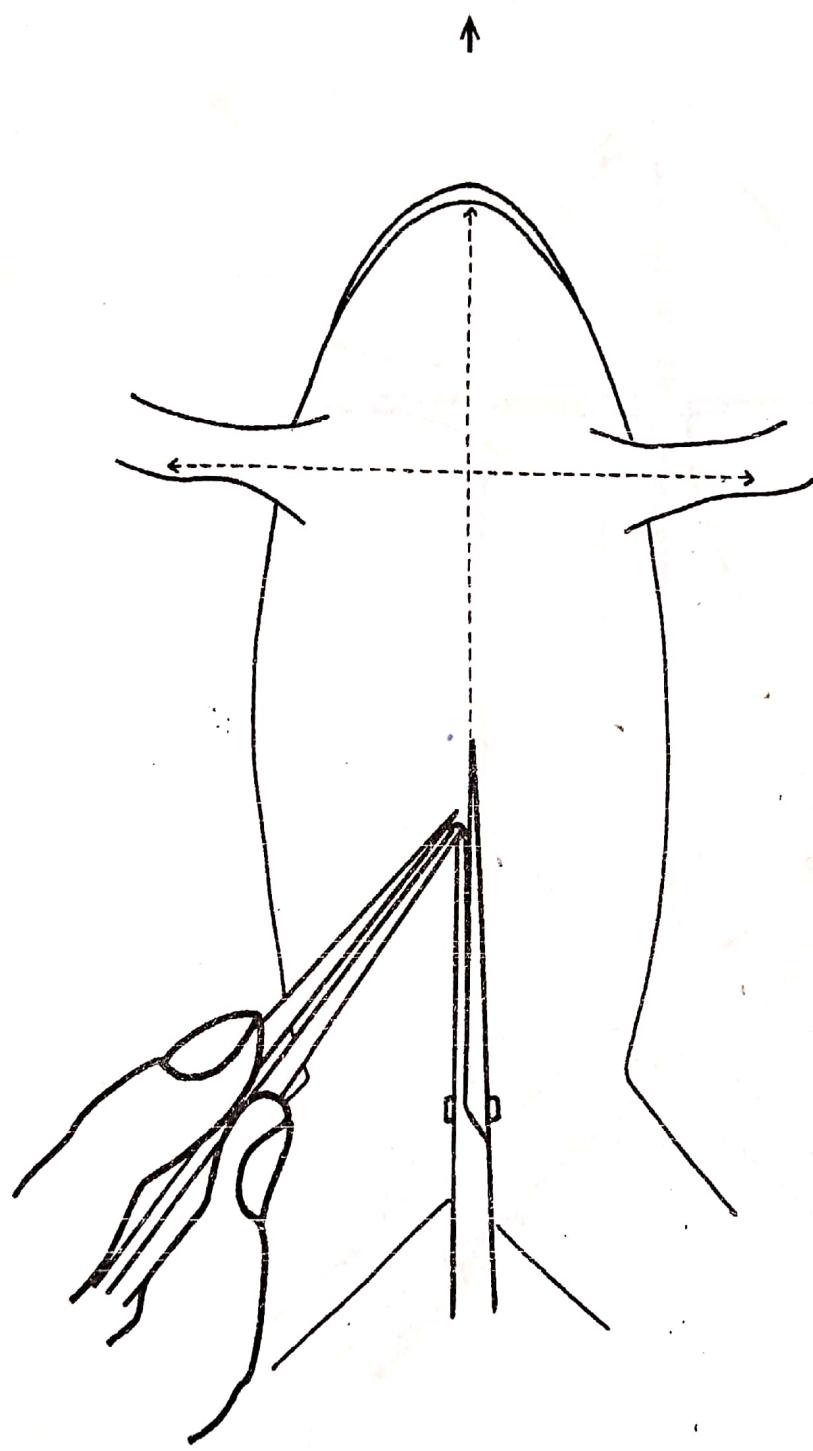


Fig. 1

## THE FROG—Opening up the body cavity



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

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

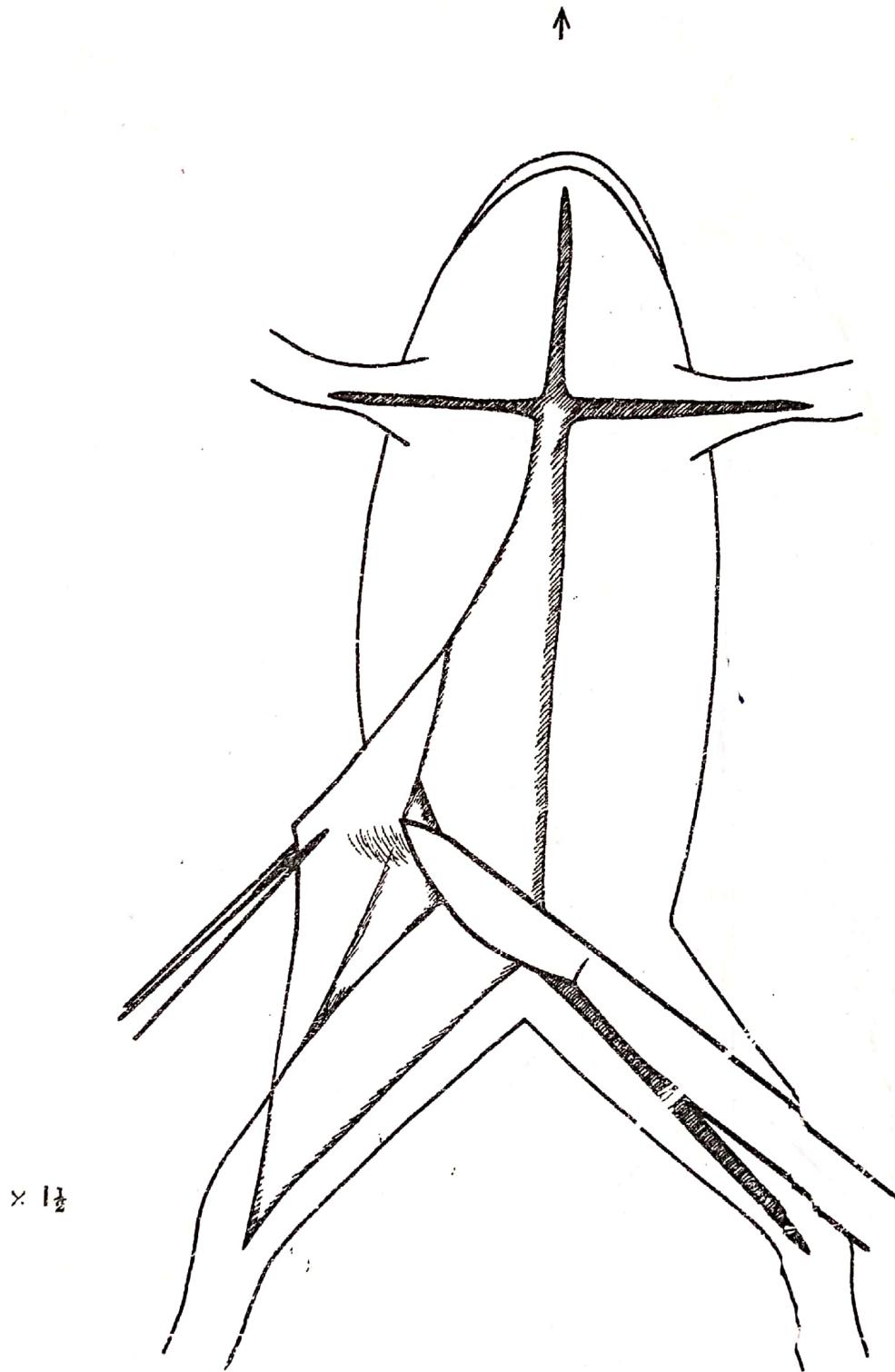


Fig. 3

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

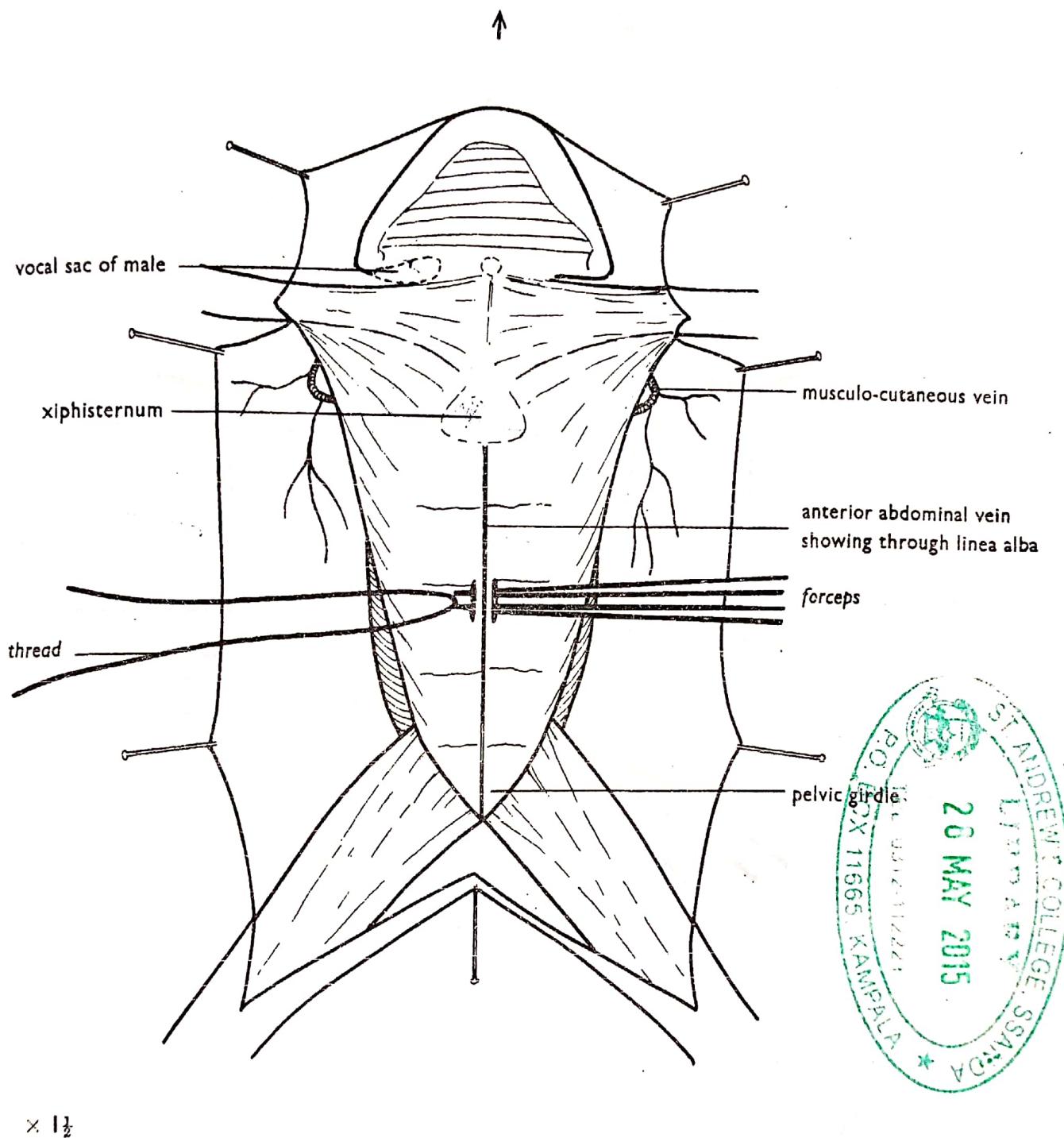


Fig. 4

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.

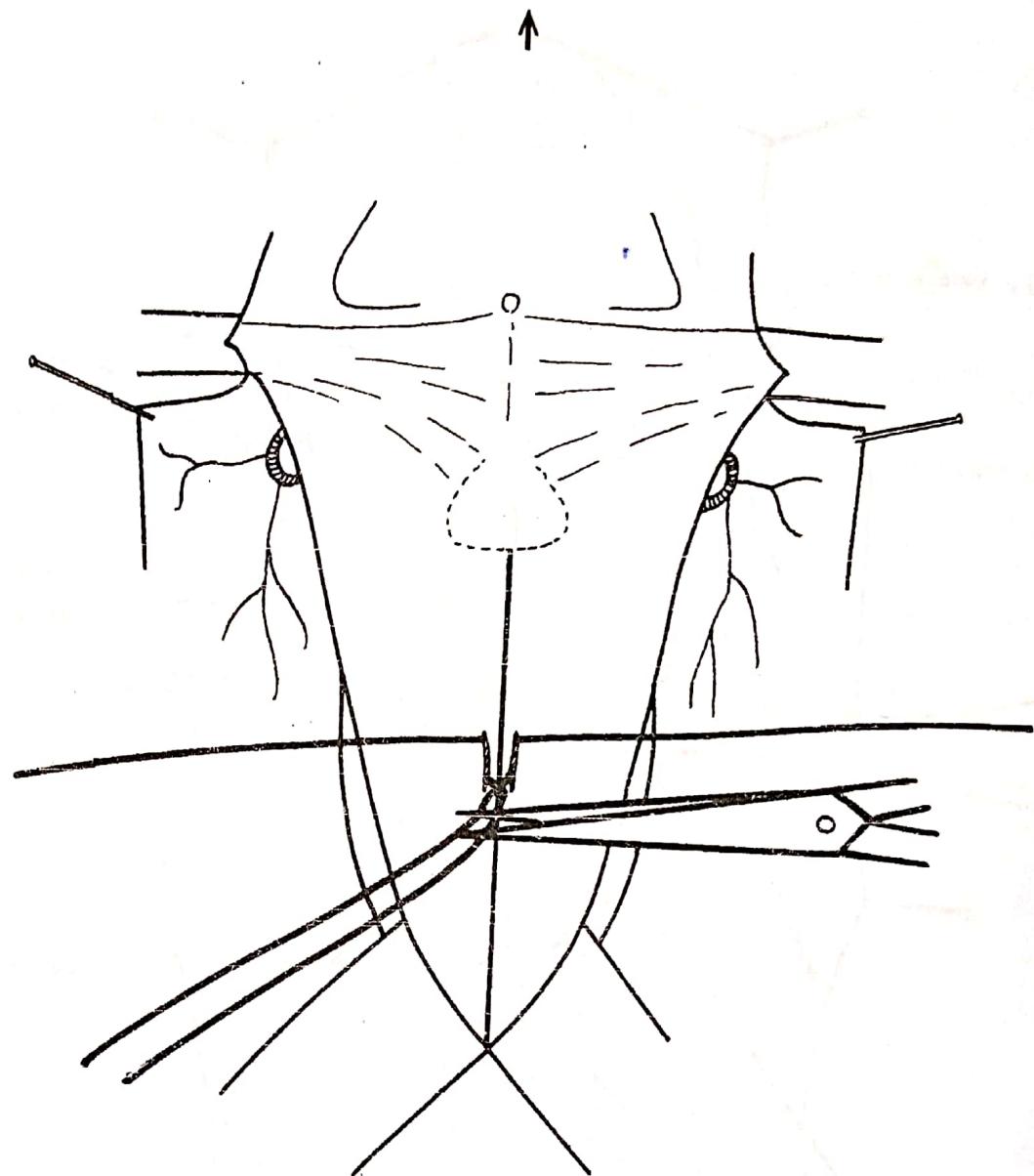
With scissors make two small incisions ( $\frac{1}{4}$  inch) in the abdominal wall one on either side of the mid-ventral line and about half way between the xiphisternum and the pelvic girdle. Use the technique shown in Fig. I.

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



× 1½

Fig. 5

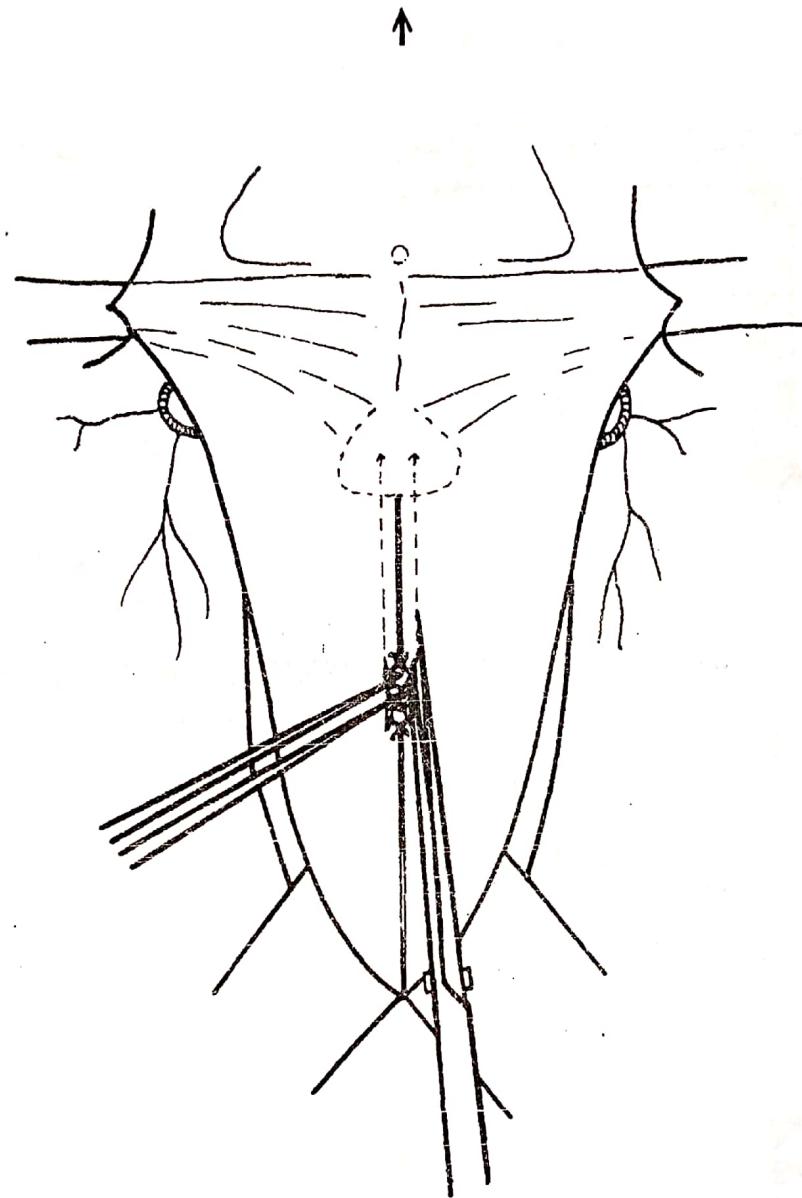
Pull the thread through the slits and cut the loop.

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 as shown.

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

## THE FROG—Opening up the body cavity



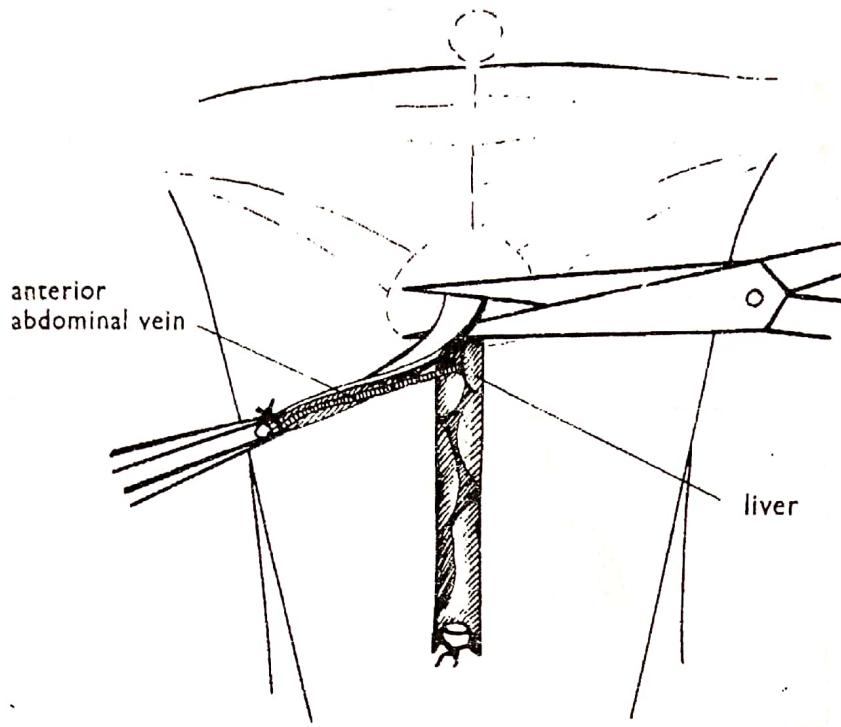
$\times \frac{1}{2}$

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.

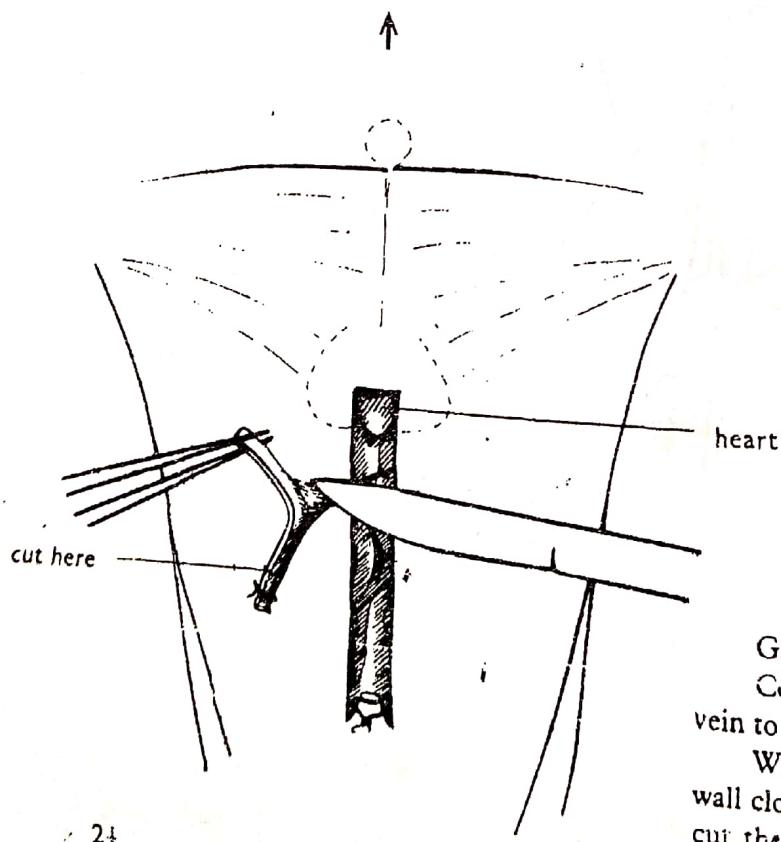
# THE FROG—Opening up the body cavity



$\times \frac{2}{3}$

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.



$\times \frac{2}{3}$

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

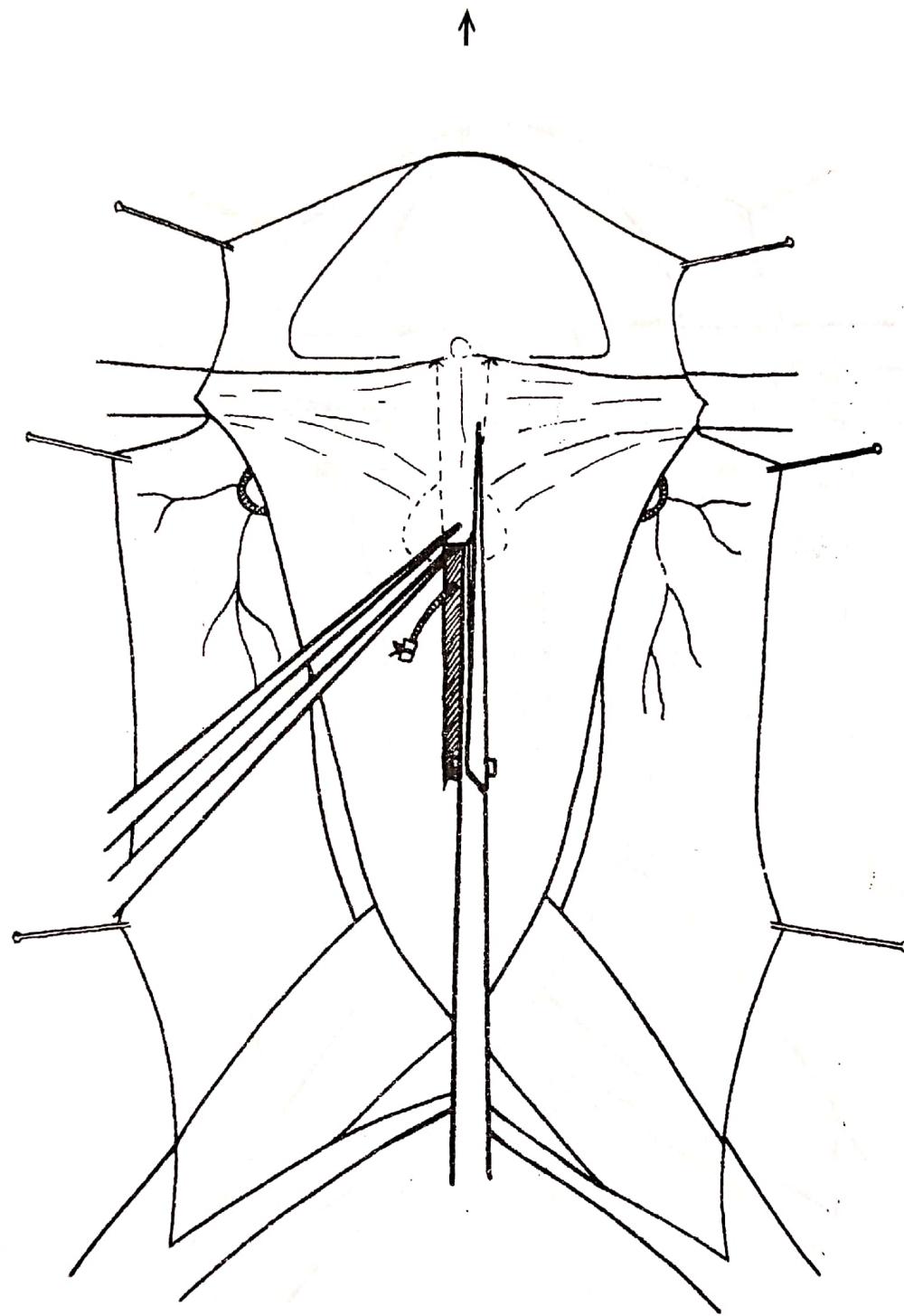
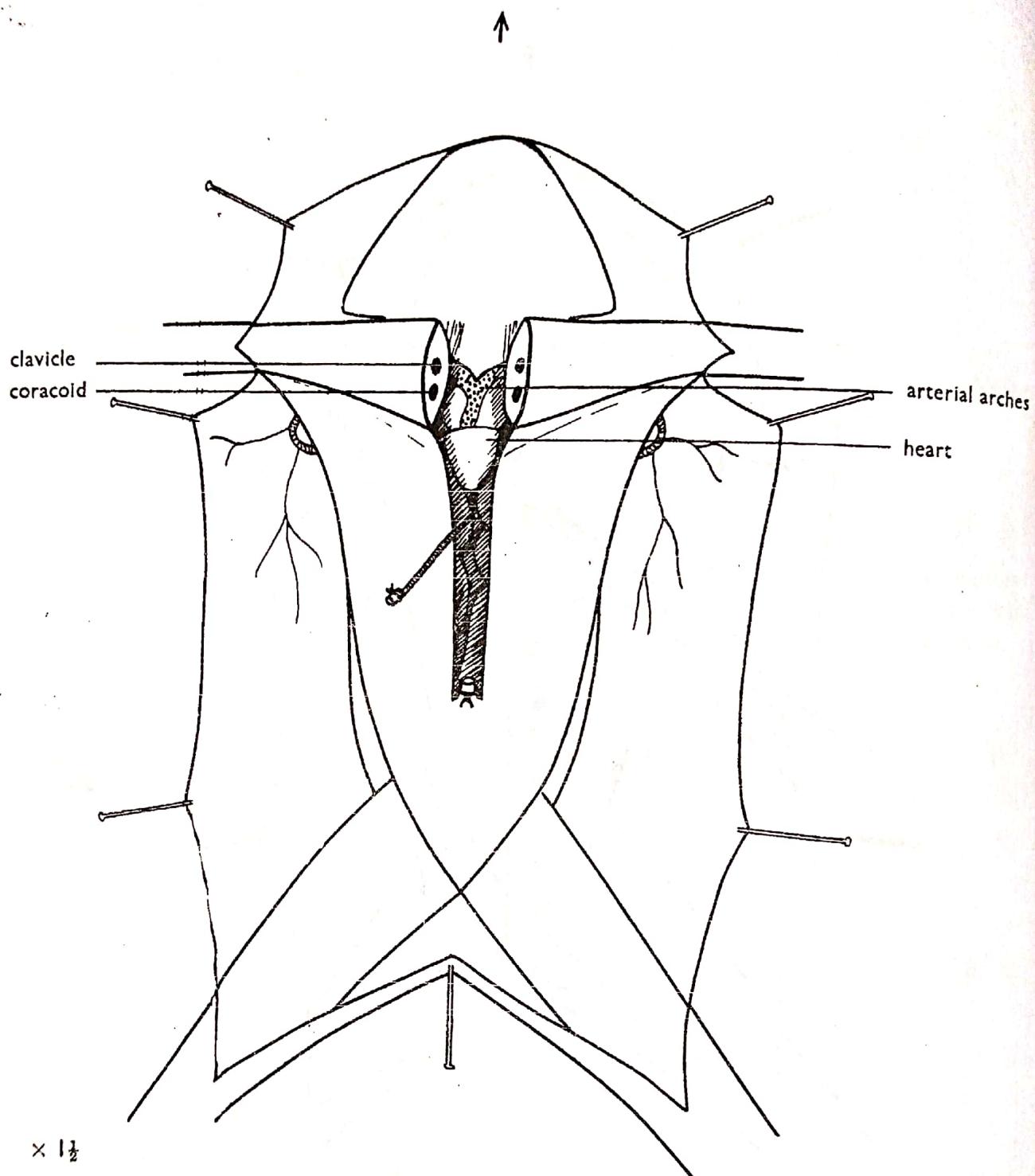


Fig. 9

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.**

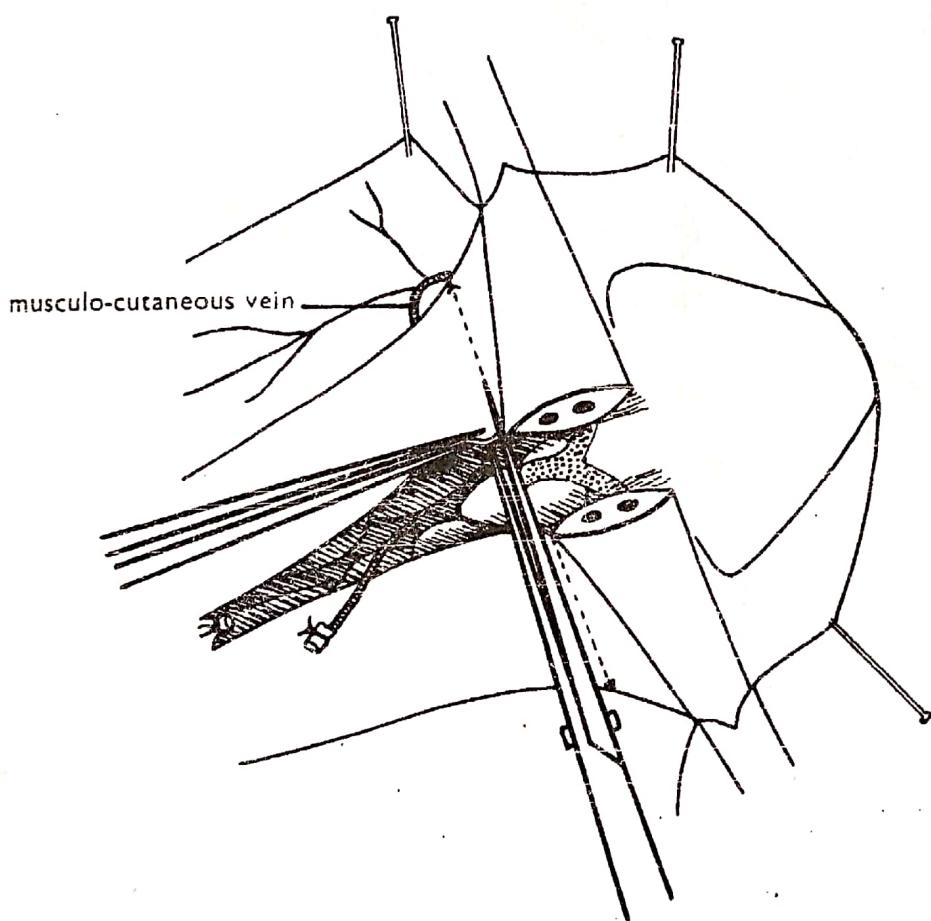
## THE FROG—Opening up the body cavity



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.

Fig. 10

## THE FROG—Opening up the body cavity

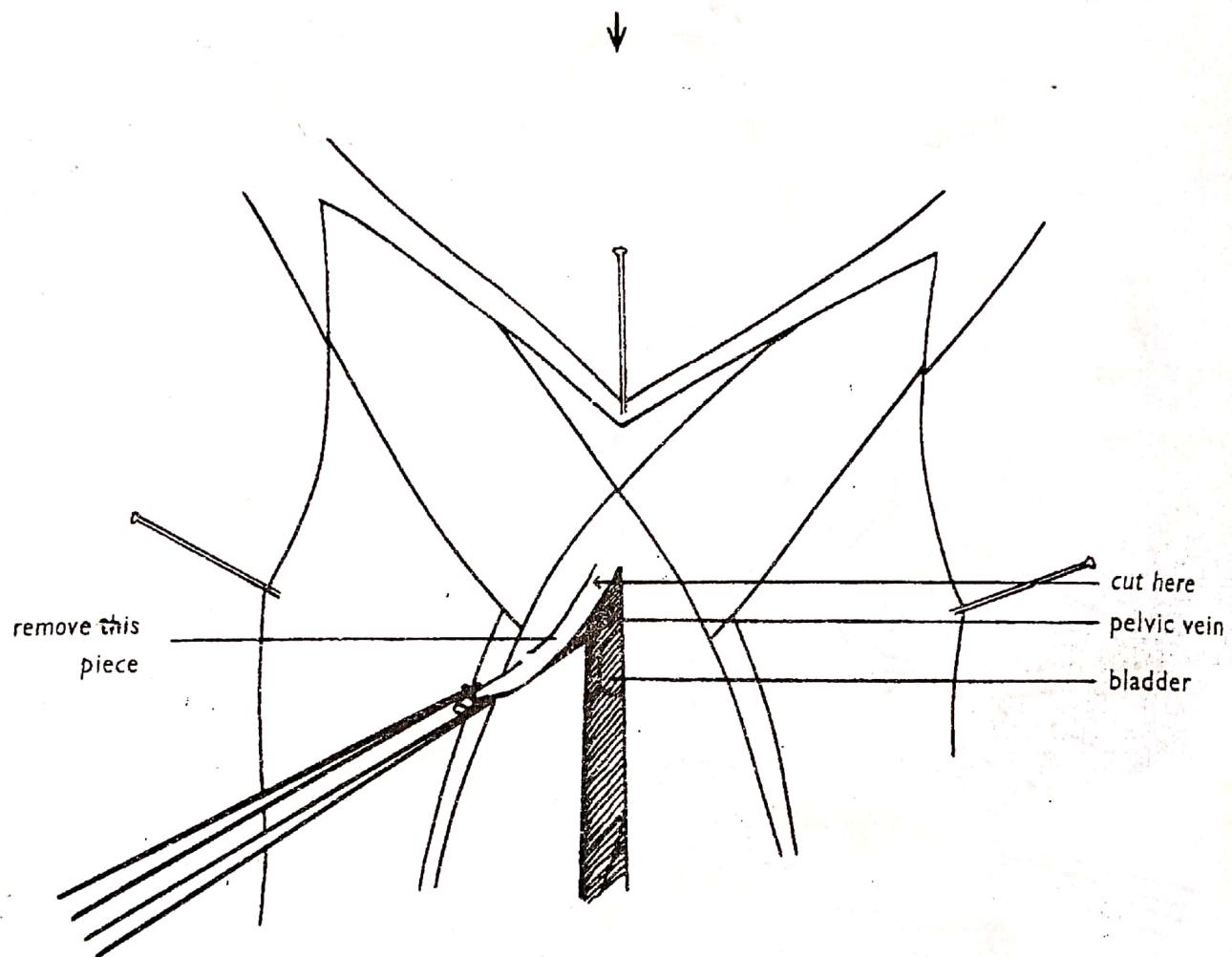


$\times \frac{1}{2}$

Fig. II

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

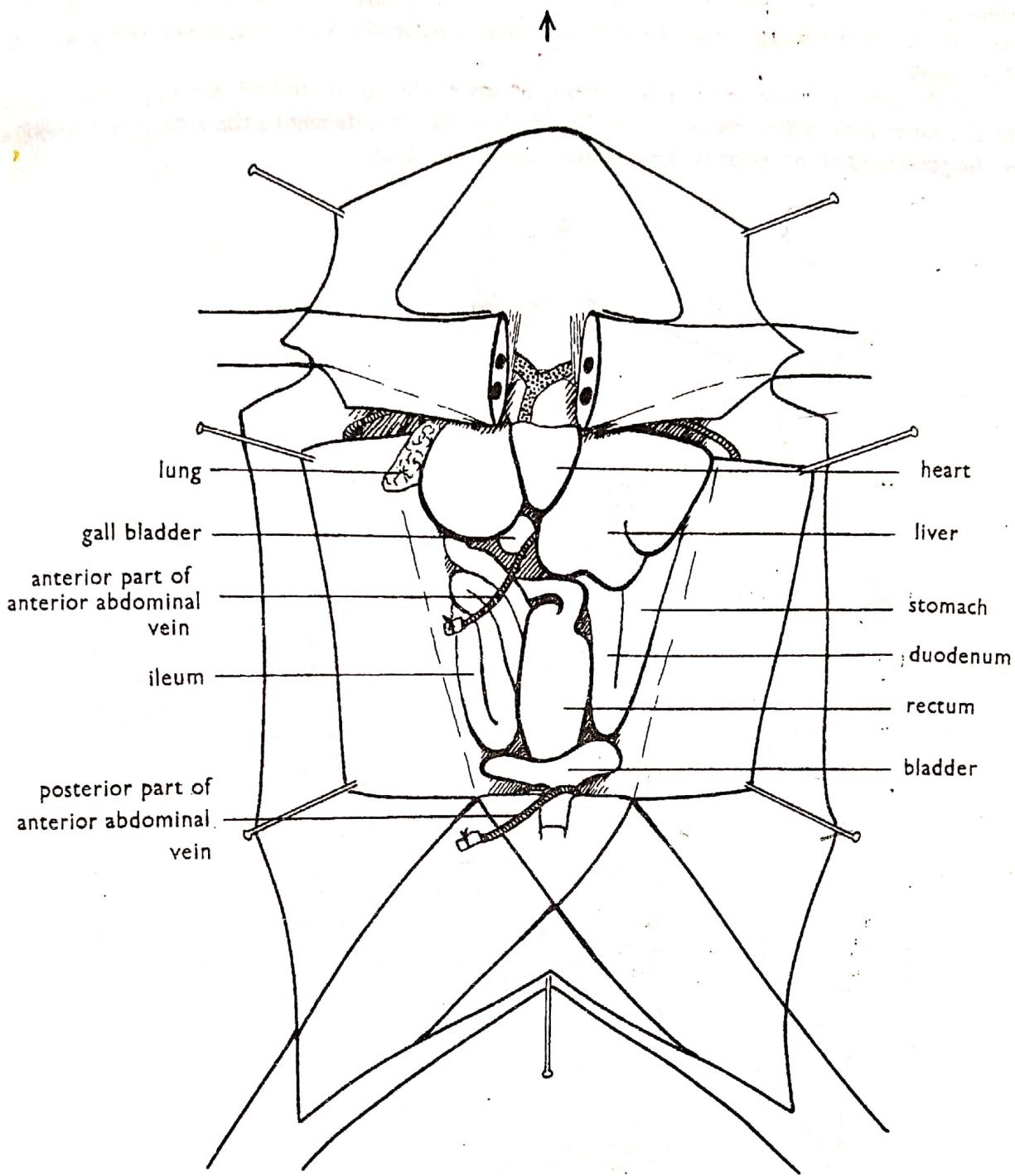


× 1½

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.

Fig. 12

## THE FROG—Opening up the body cavity



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

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.

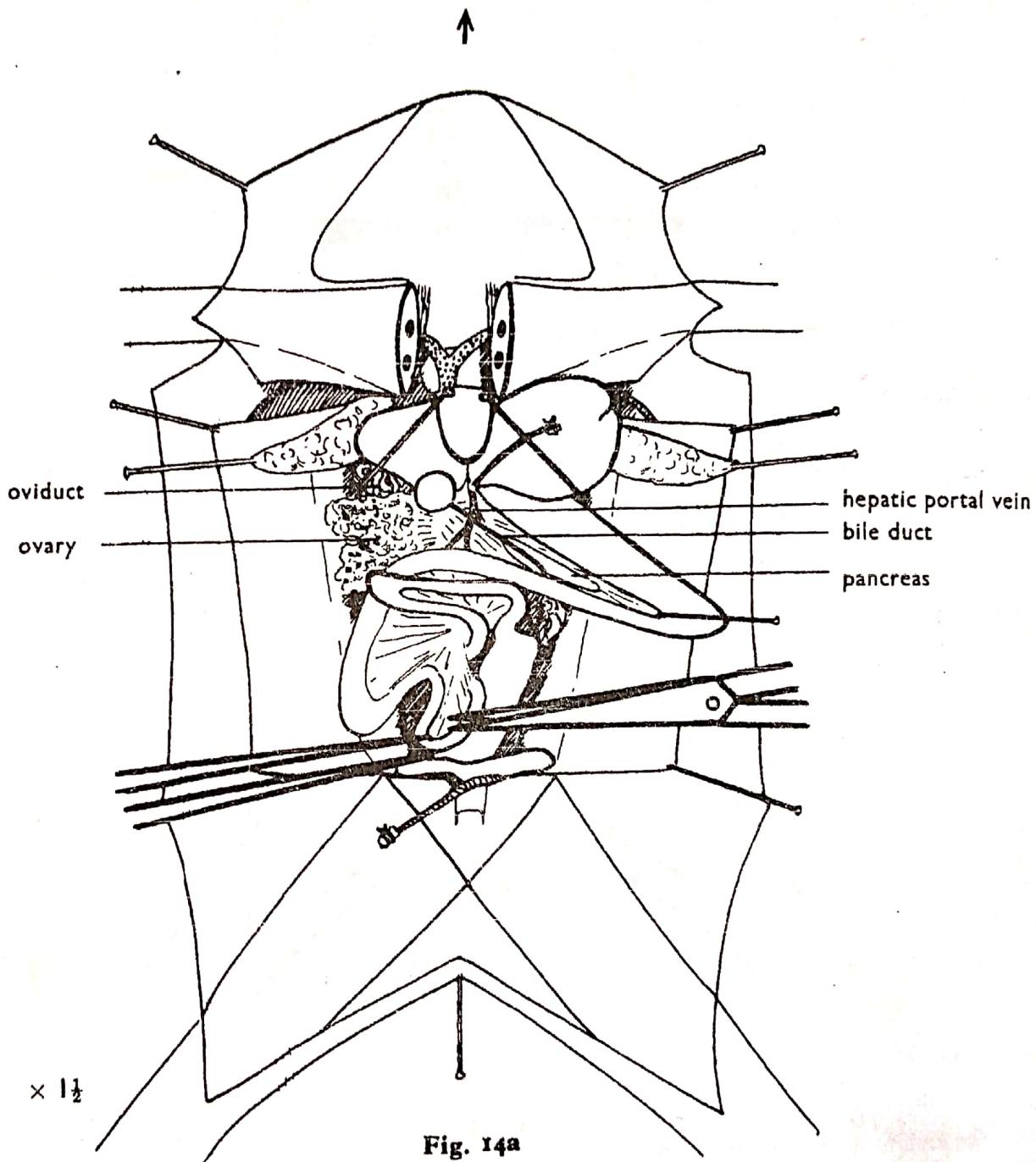


Fig. 14a  
Female

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)*

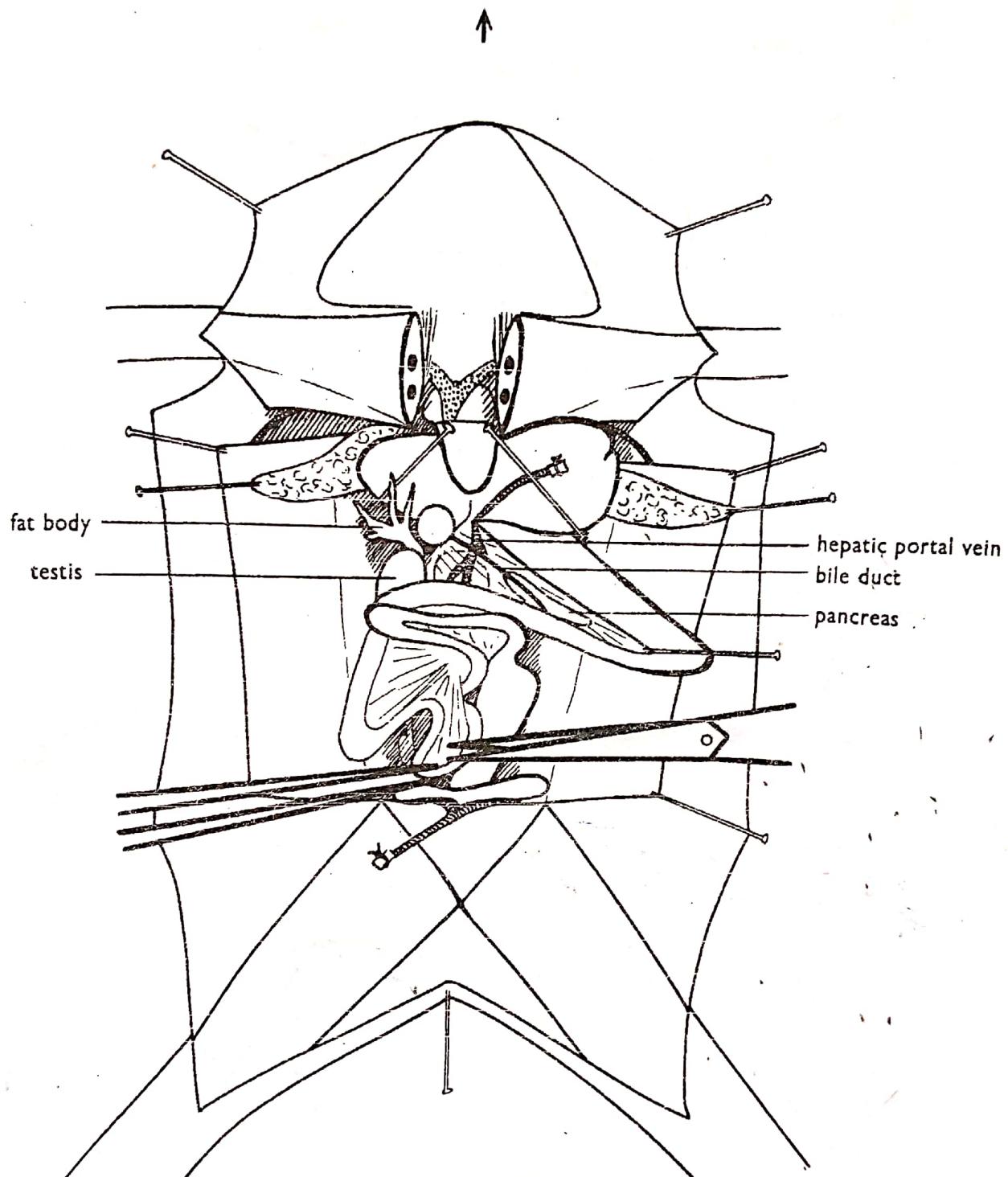


Fig. 14b

Male

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

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)*

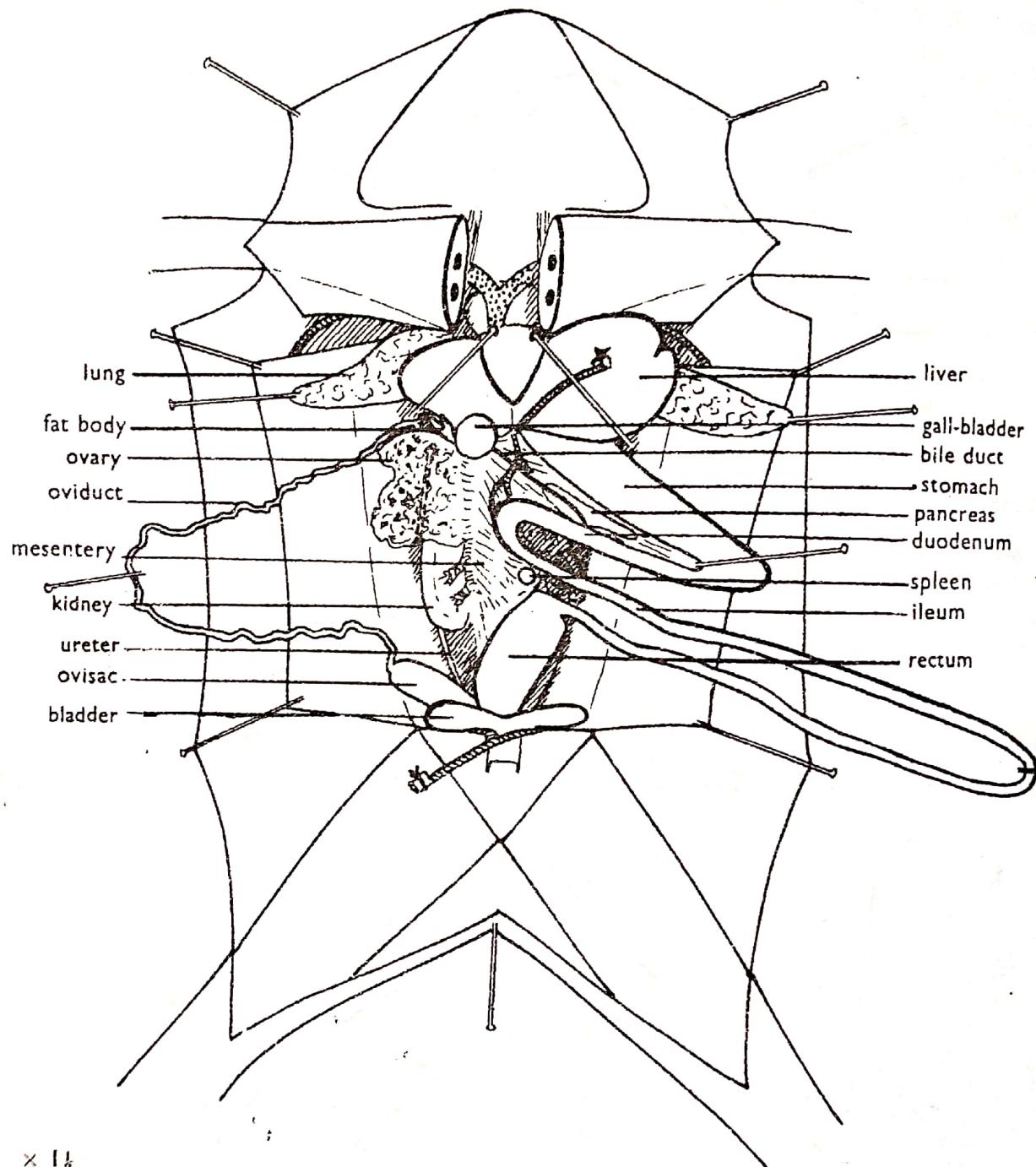
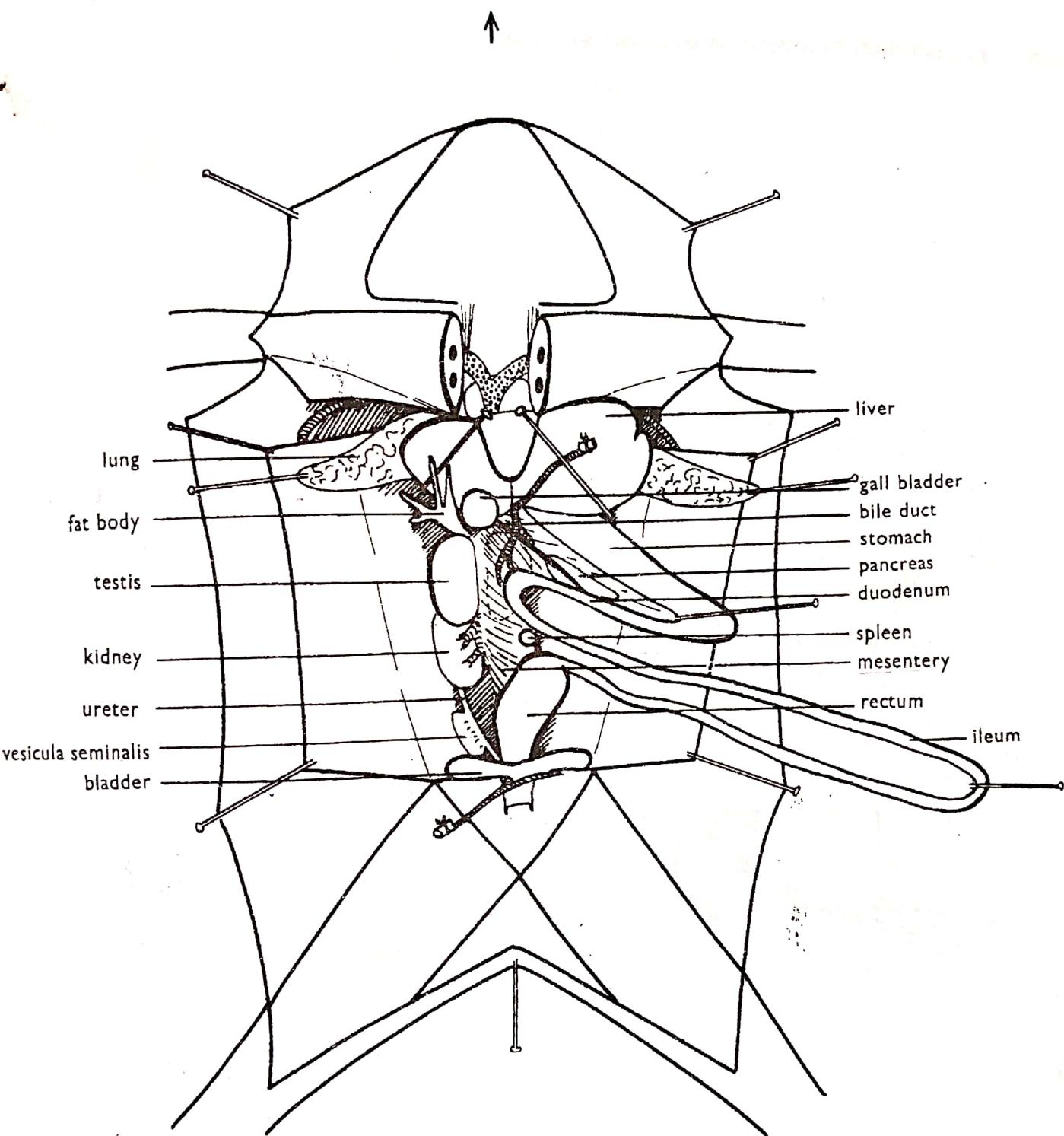


Fig. 15a  
Female

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)*



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

Fig. 15b

Male

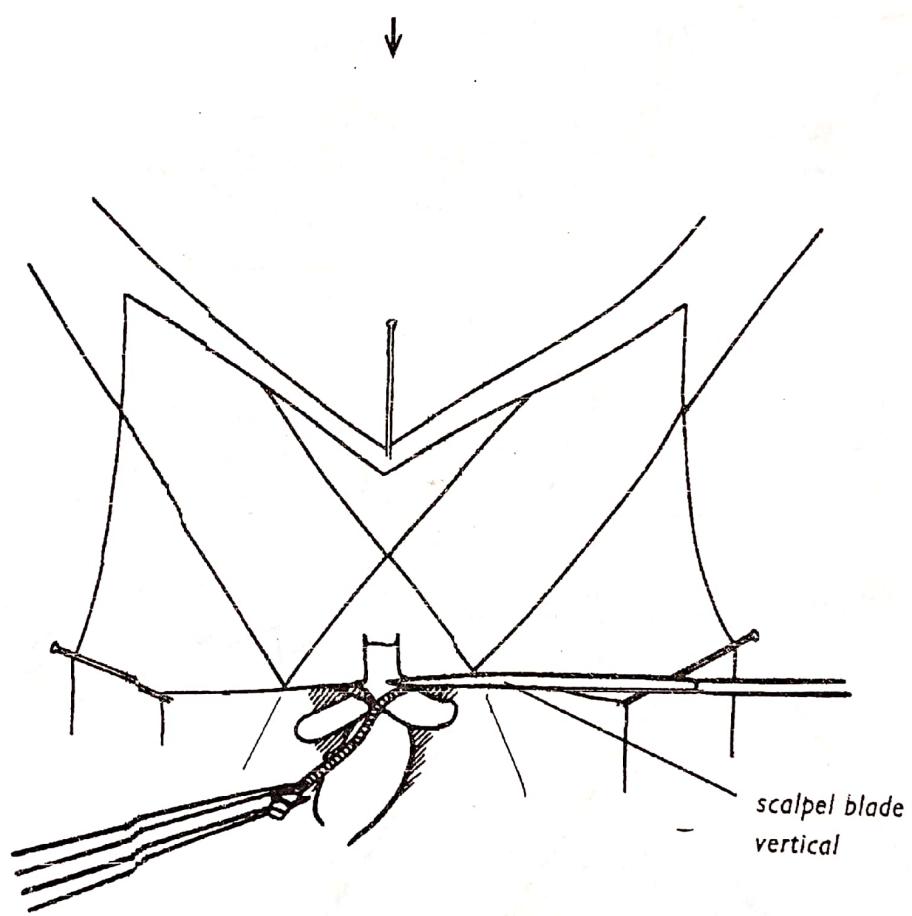
Pin out the ileum to your right.

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 ~~l~~er 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.

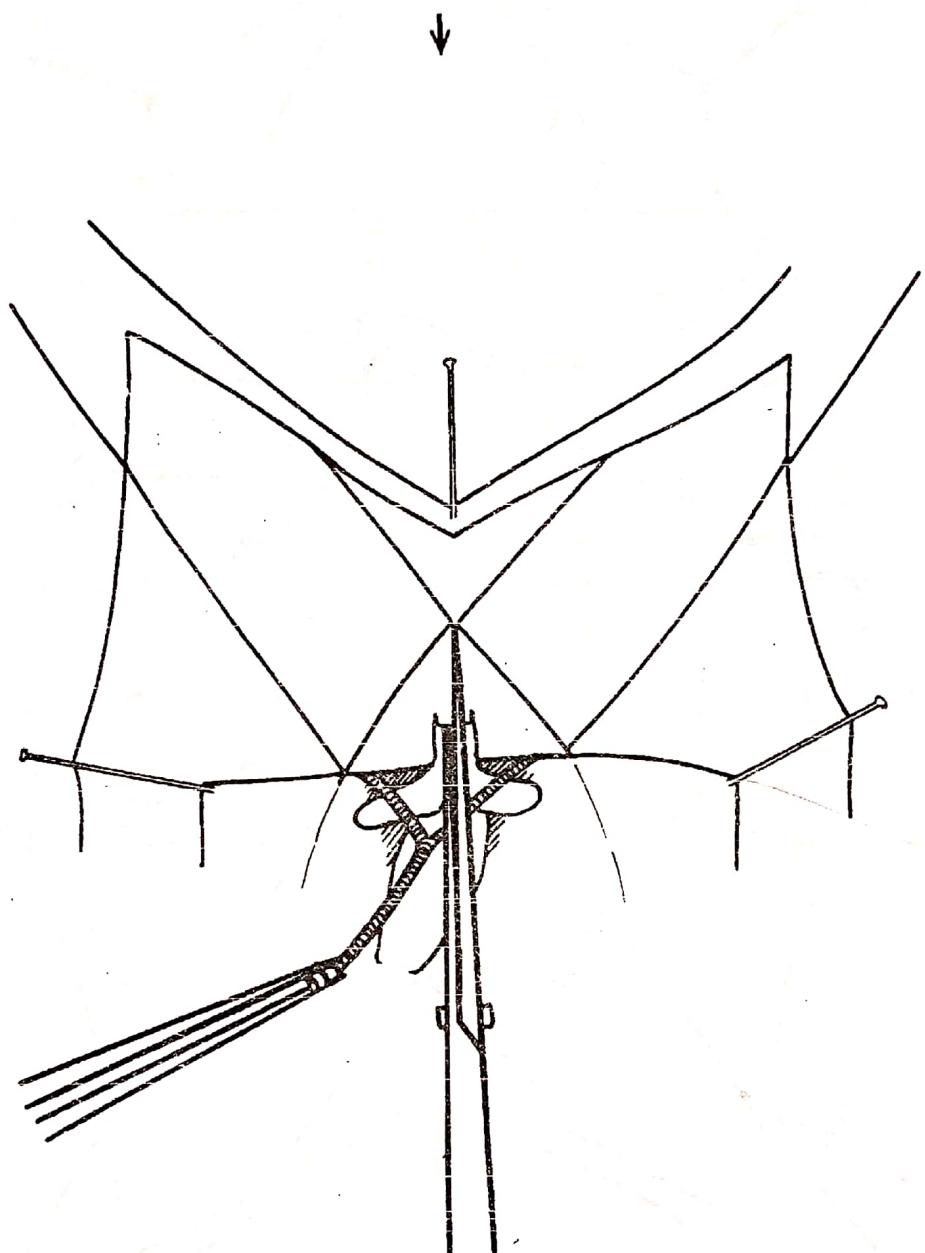


$\times \frac{1}{2}$

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. Losen 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*



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

Fig. 17

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

Cut ~~through~~ 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*

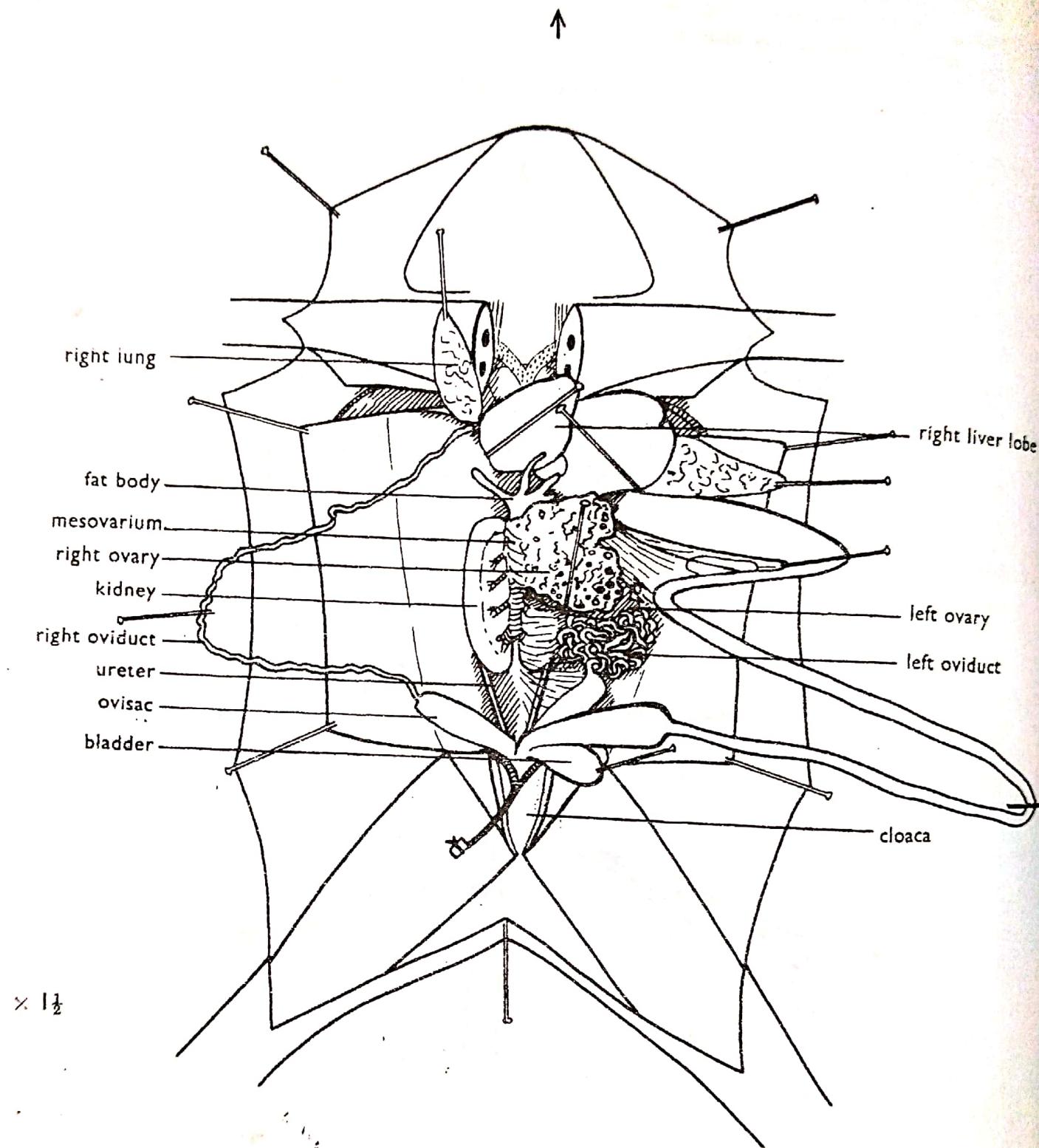


Fig. 18a

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.

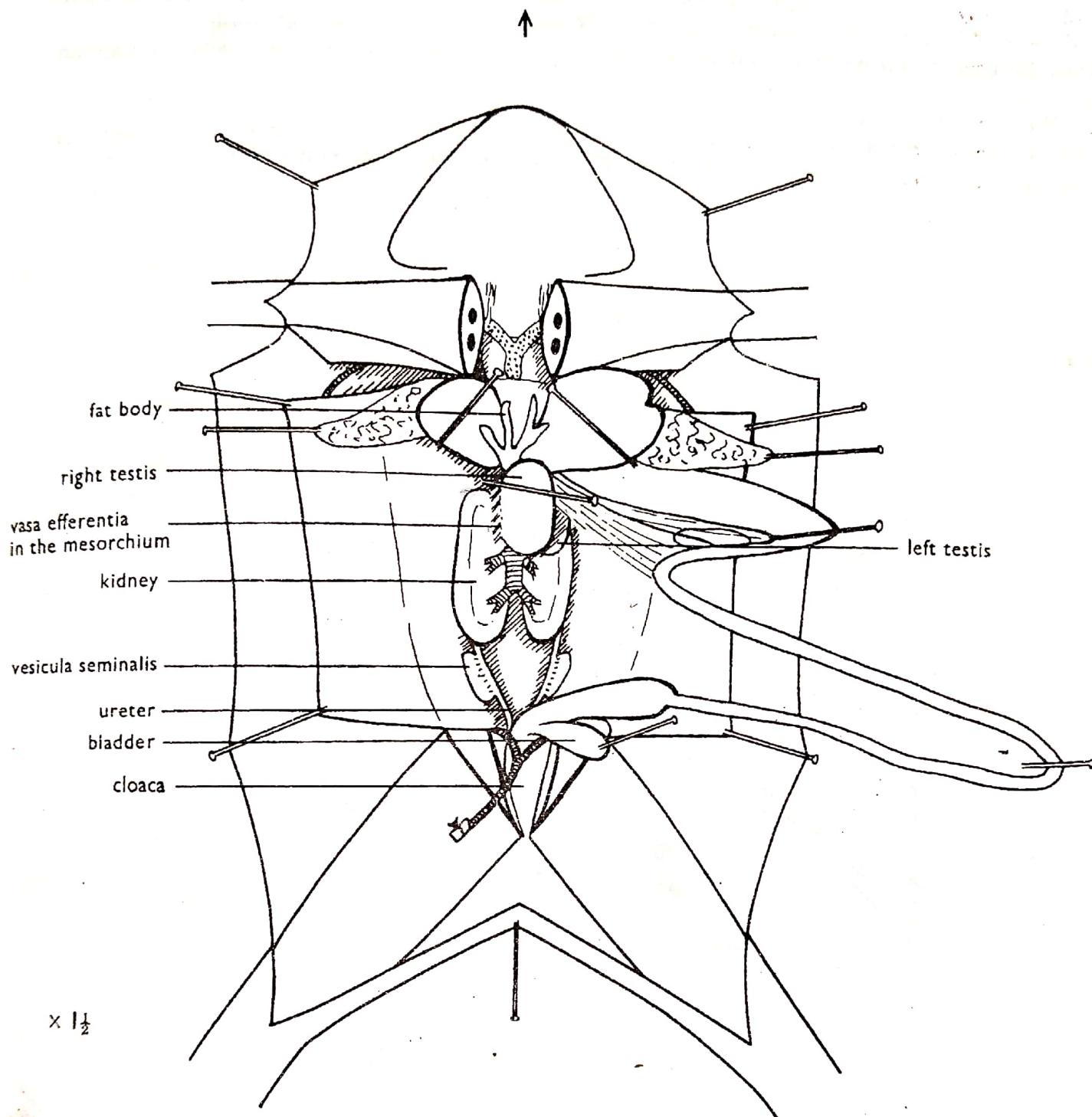
Pin the bladder aside.

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

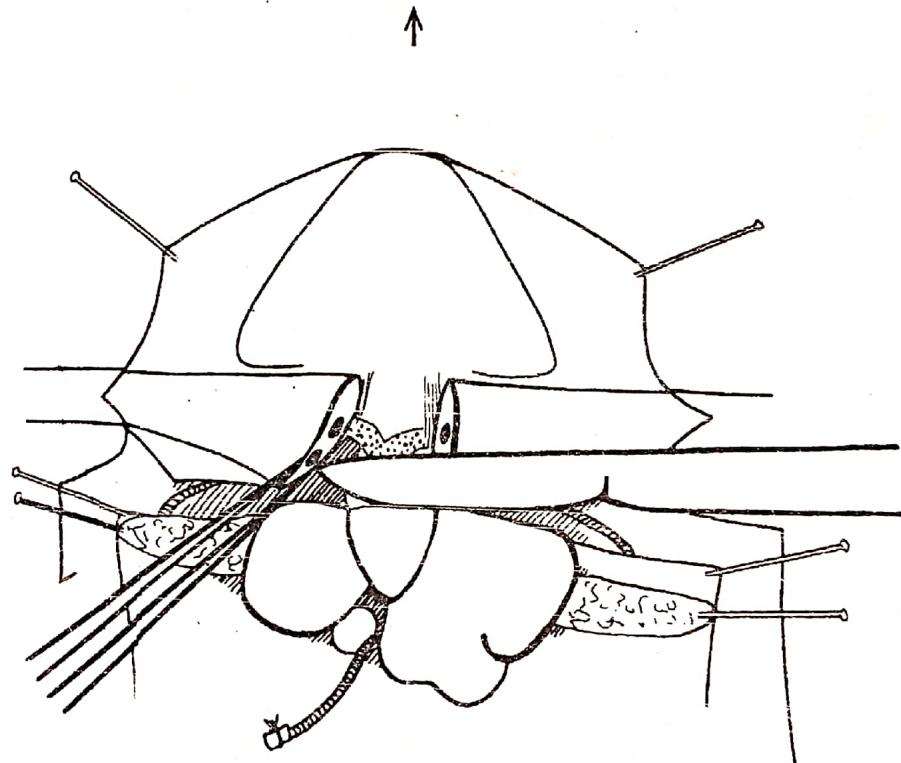
## THE FROG—4 The Venous System

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.

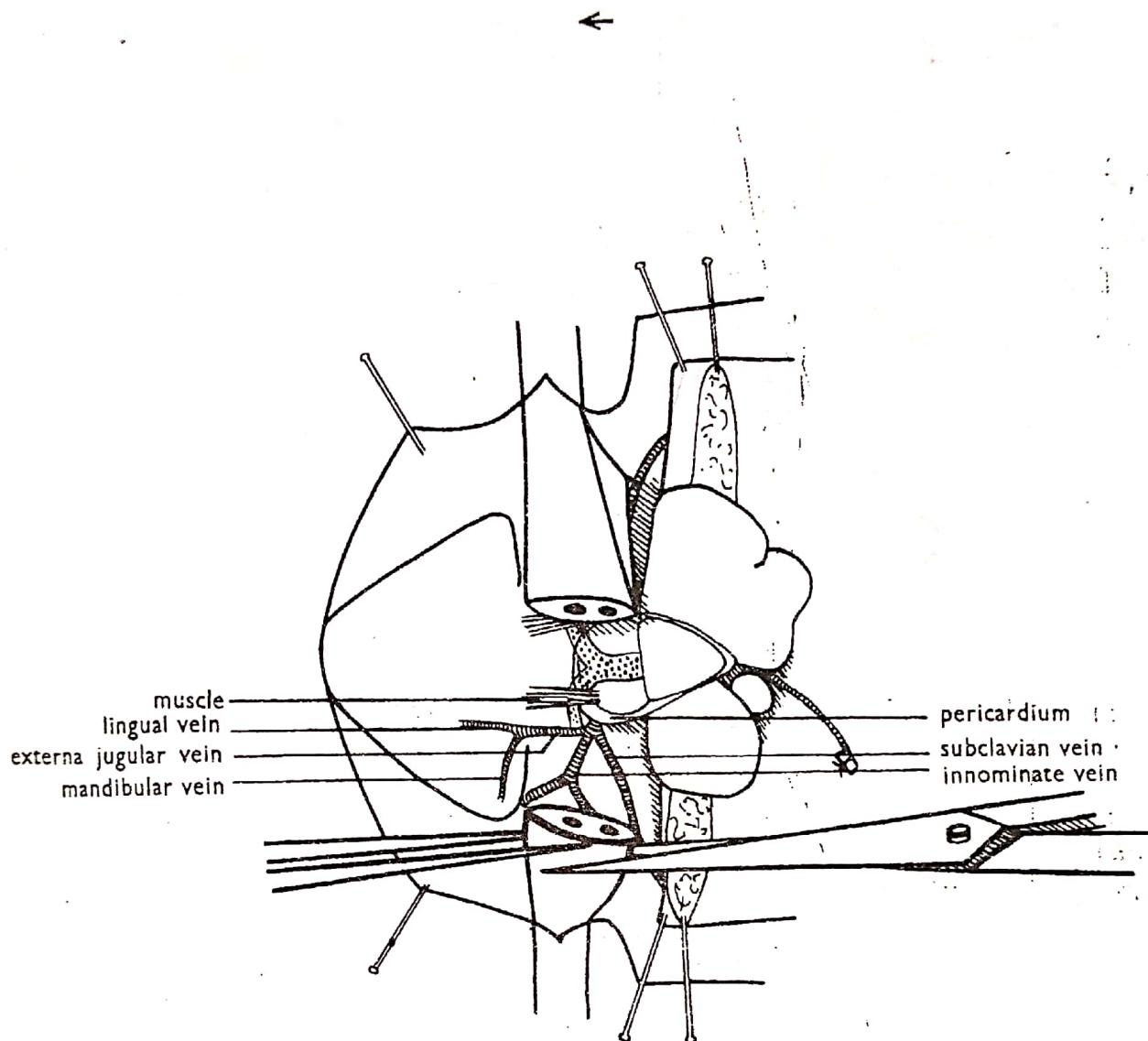


× 1½

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.

Fig. 19

## THE FROG—*The venous system*



× 1½

Fig. 20

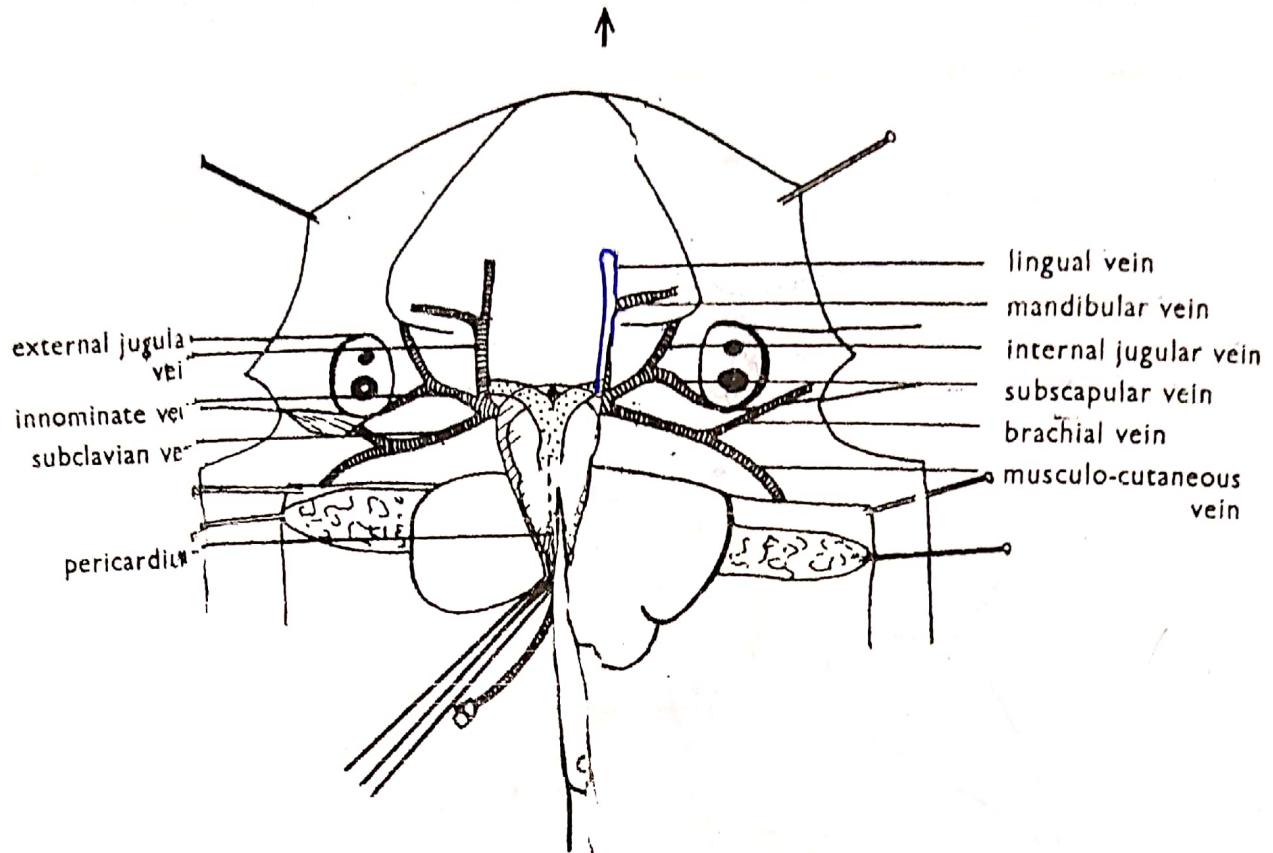
Turn the dish sideways.

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. 1**

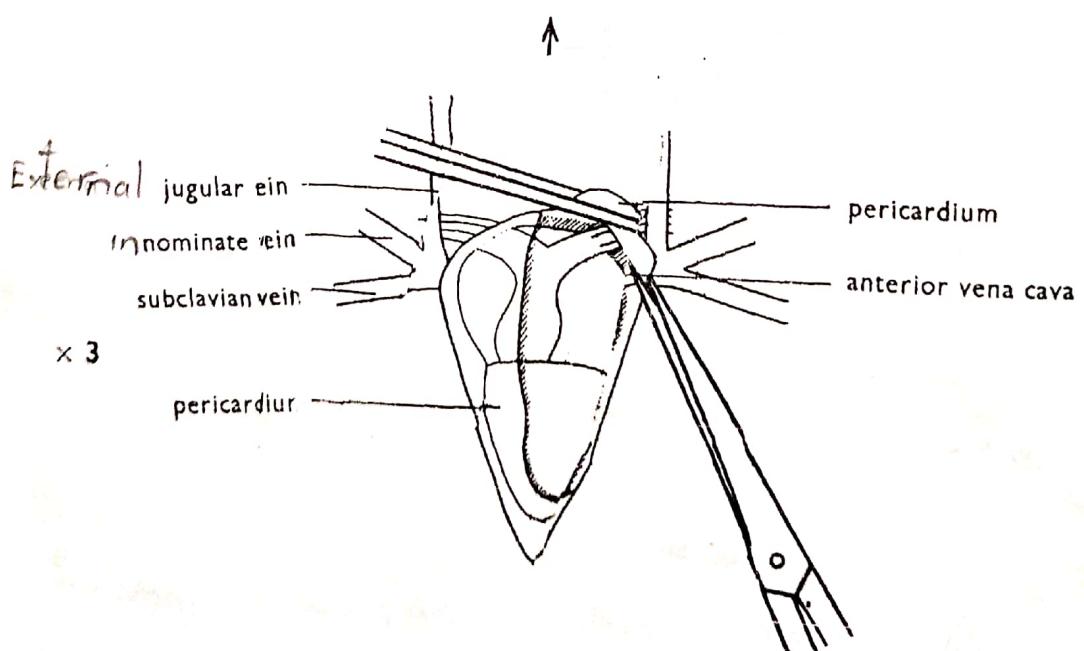
Restore the cis to normal position.

Identify the veins named in the figure above. Note how the innominate vein comes 'up' ventrally 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 close 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*

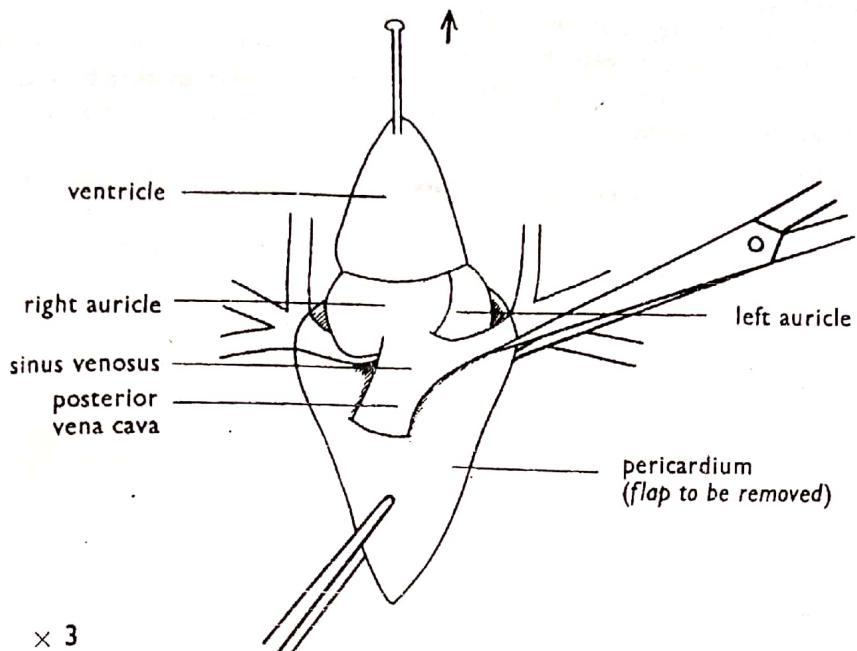


Fig. 23

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

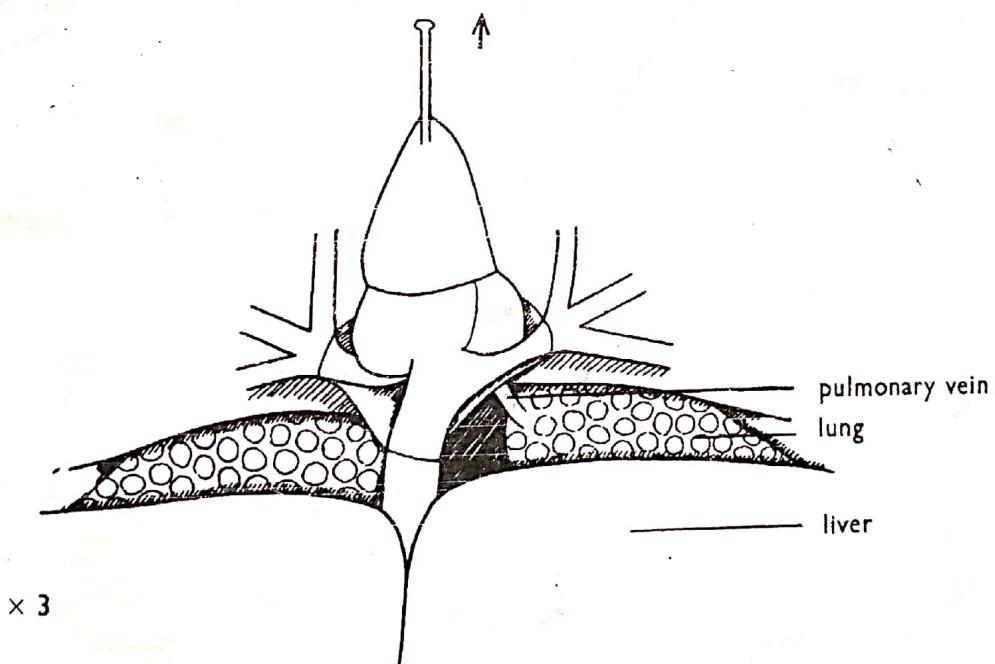


Fig. 24

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*

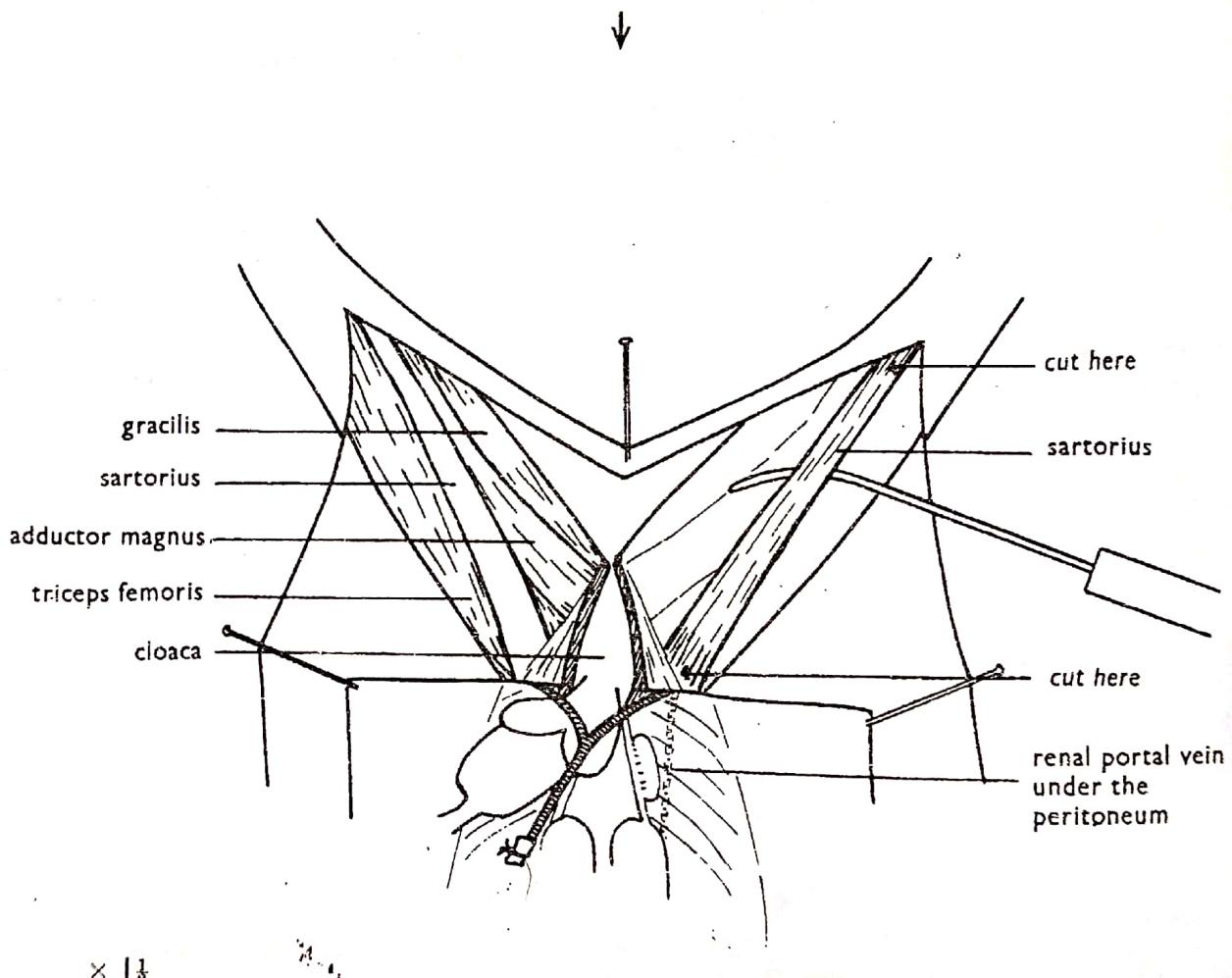
### (b) The Veins of the leg

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.



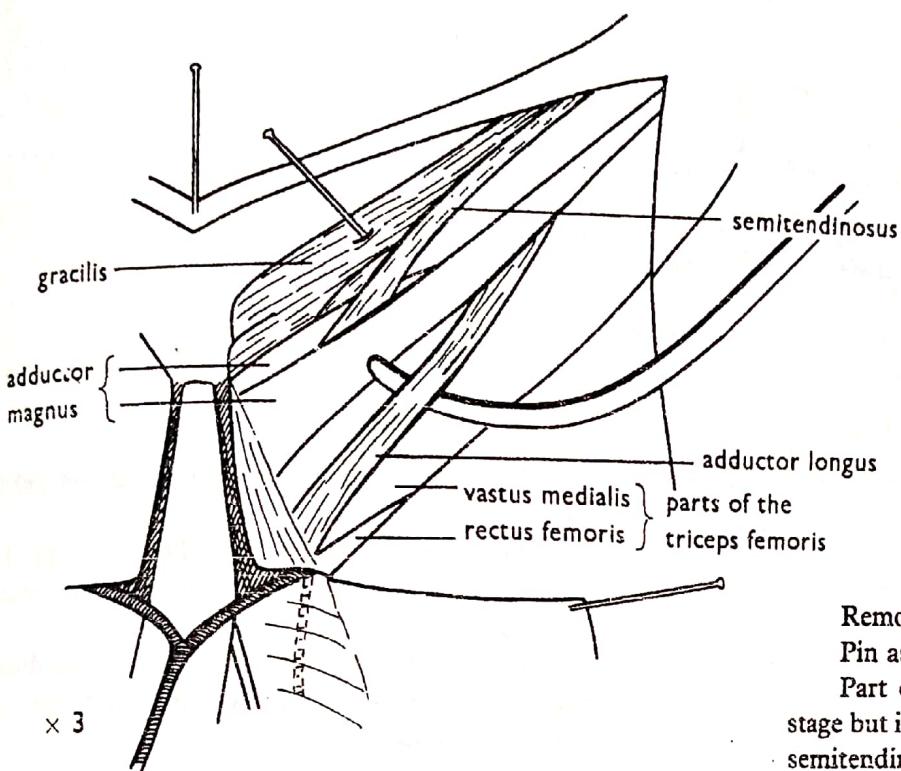
Turn the dish so that the legs are directed away from you.  
Identify the principal superficial muscles of the front of the thigh.

By means of a seeker separate the sartorius from the underlying muscle.

The removal of the sartorius exposes the adductor longus, see Fig. 26.

**Fig. 25**

THE FROG—*The venous system*

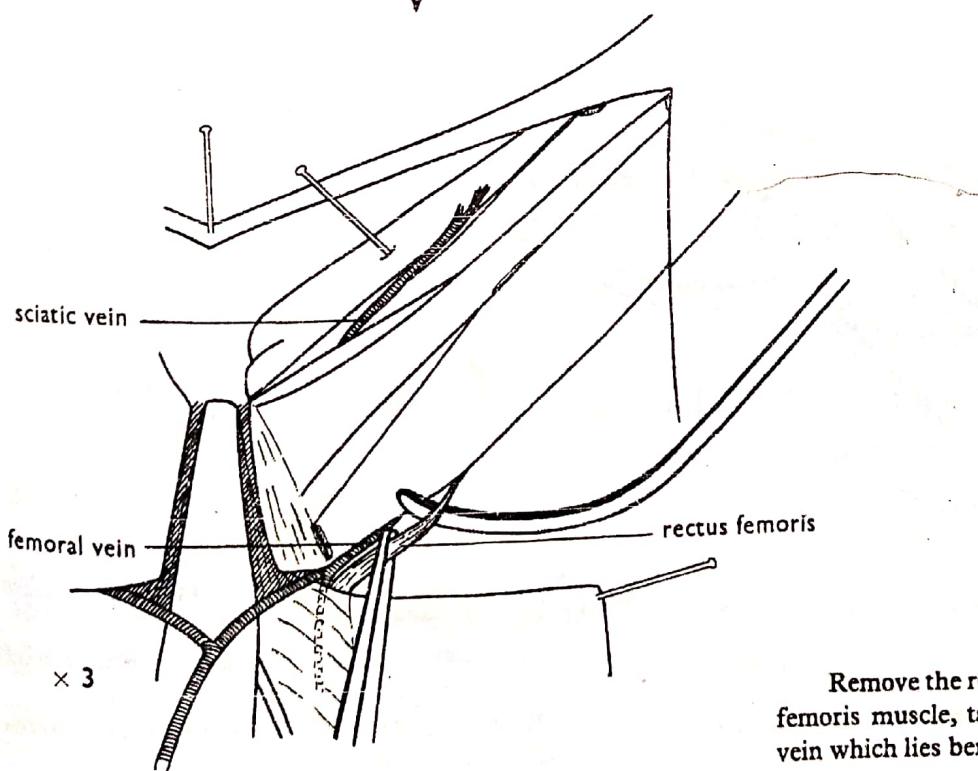


**Fig. 26**

Remove the adductor longus.

Pin aside the gracilis muscles.

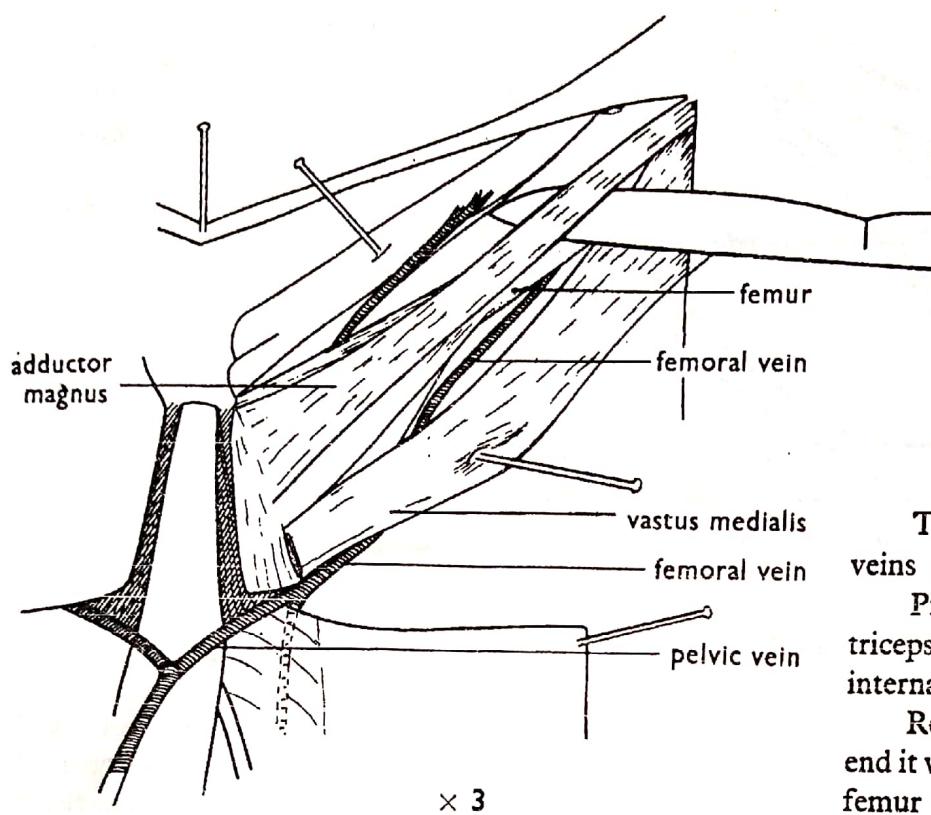
Part of the sciatic vein may be visible at this stage but it is usually masked by the two heads of the semitendinosus muscle. Remove this muscle, cutting both heads and noticing the sciatic vein then exposed, see Fig. 27.



**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*

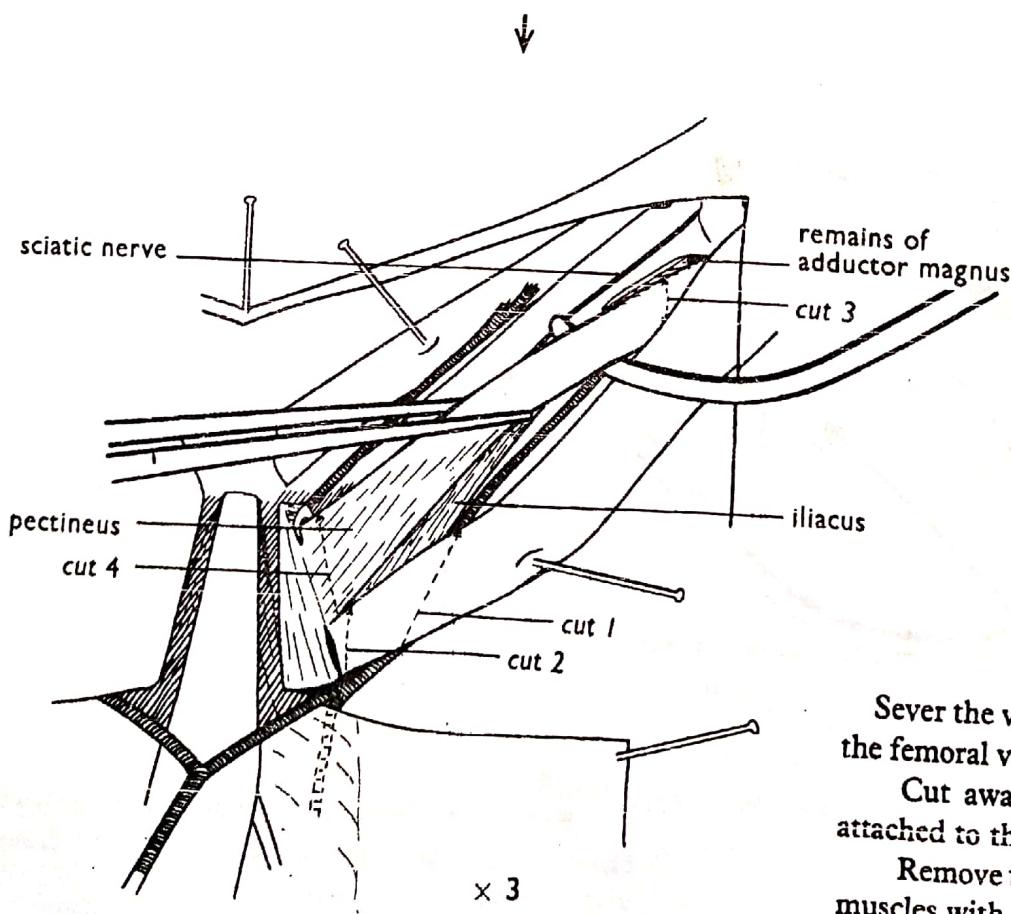


**Fig. 28**

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

Pin back the vastus medialis portion of 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.



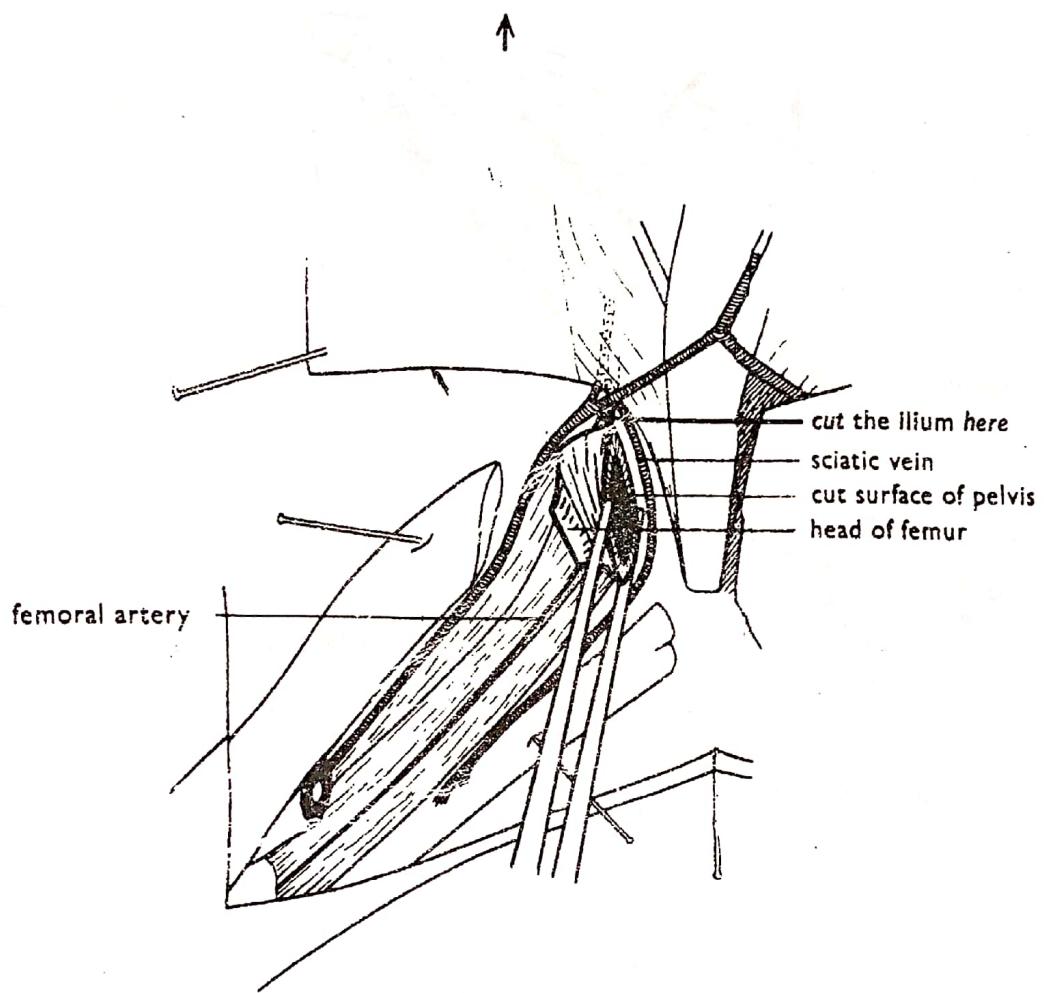
**Fig. 29**

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.

## THE FROG—*The venous system*



× 3

Fig. 30

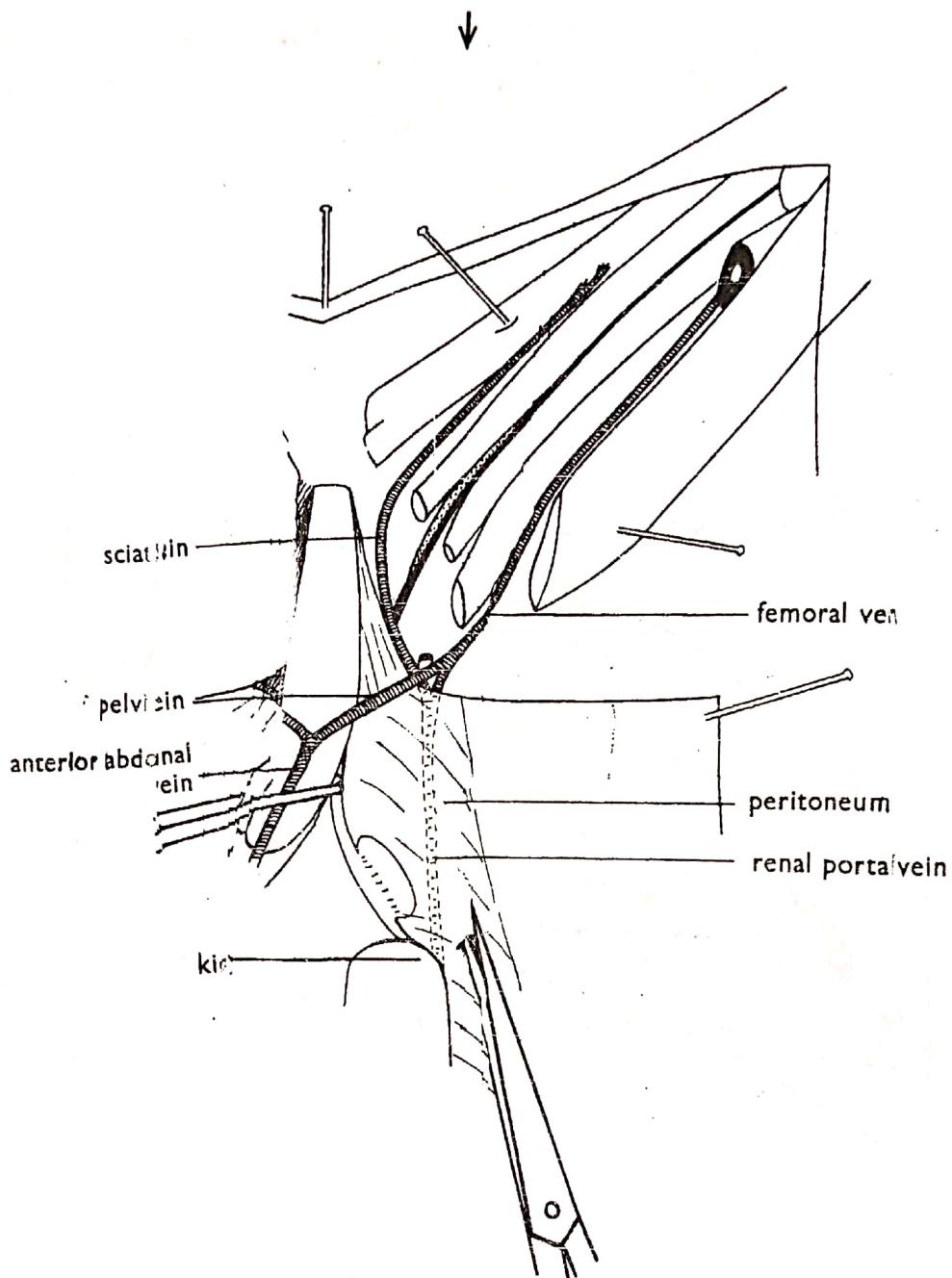
Turn the dish round.

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*



$\times 3$

**Fig. 31**

Turn the dish again.

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

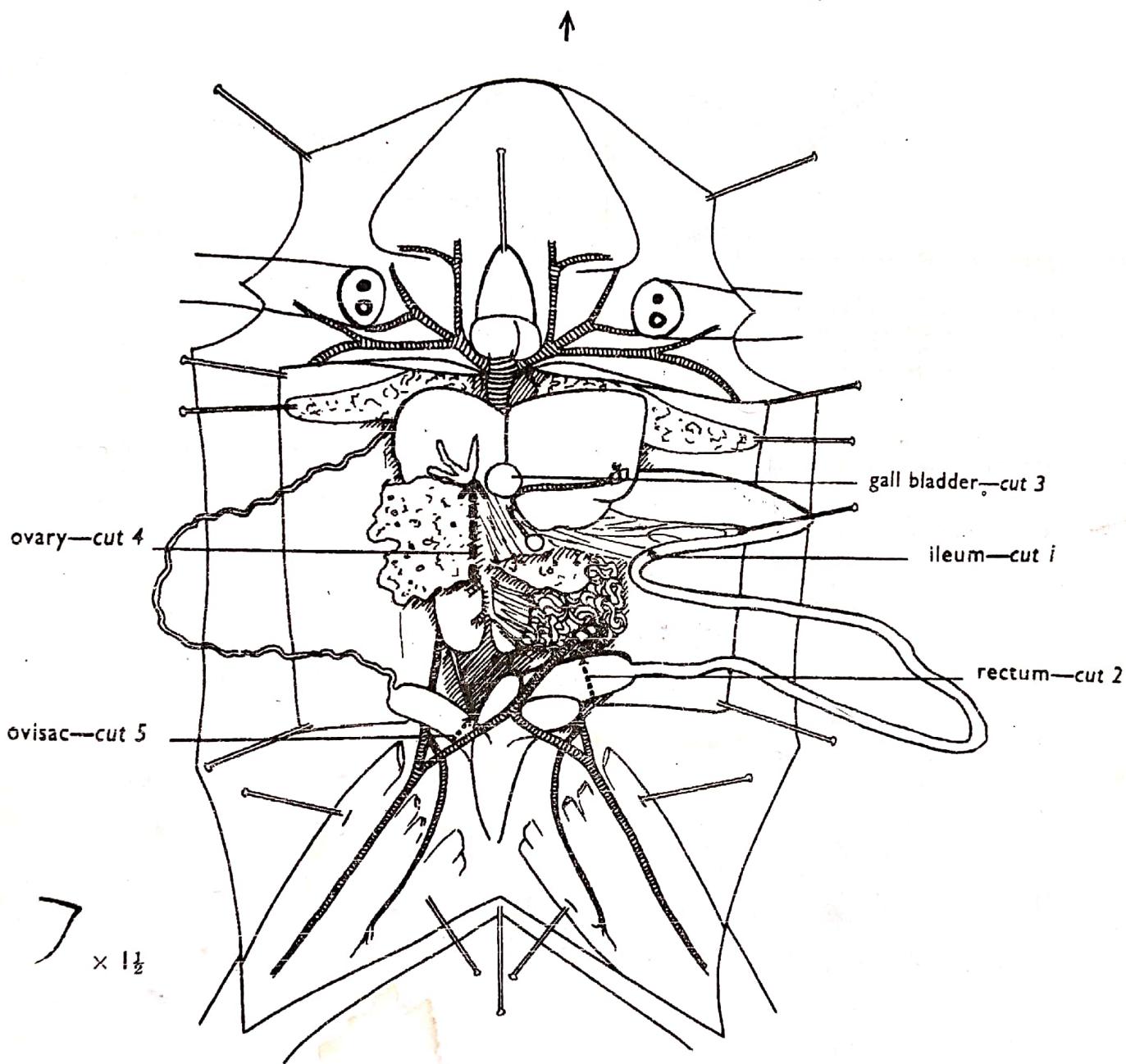
Clean the connections of blood vessels as required. Hold the loose pieces of connective tissue taut with forceps and cut with scissors close to the vessels as possible. If the previous parts of the dissection have been done tidily there will be little loose connective tissue left.)

Repeat Figs. 25–31 on 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.

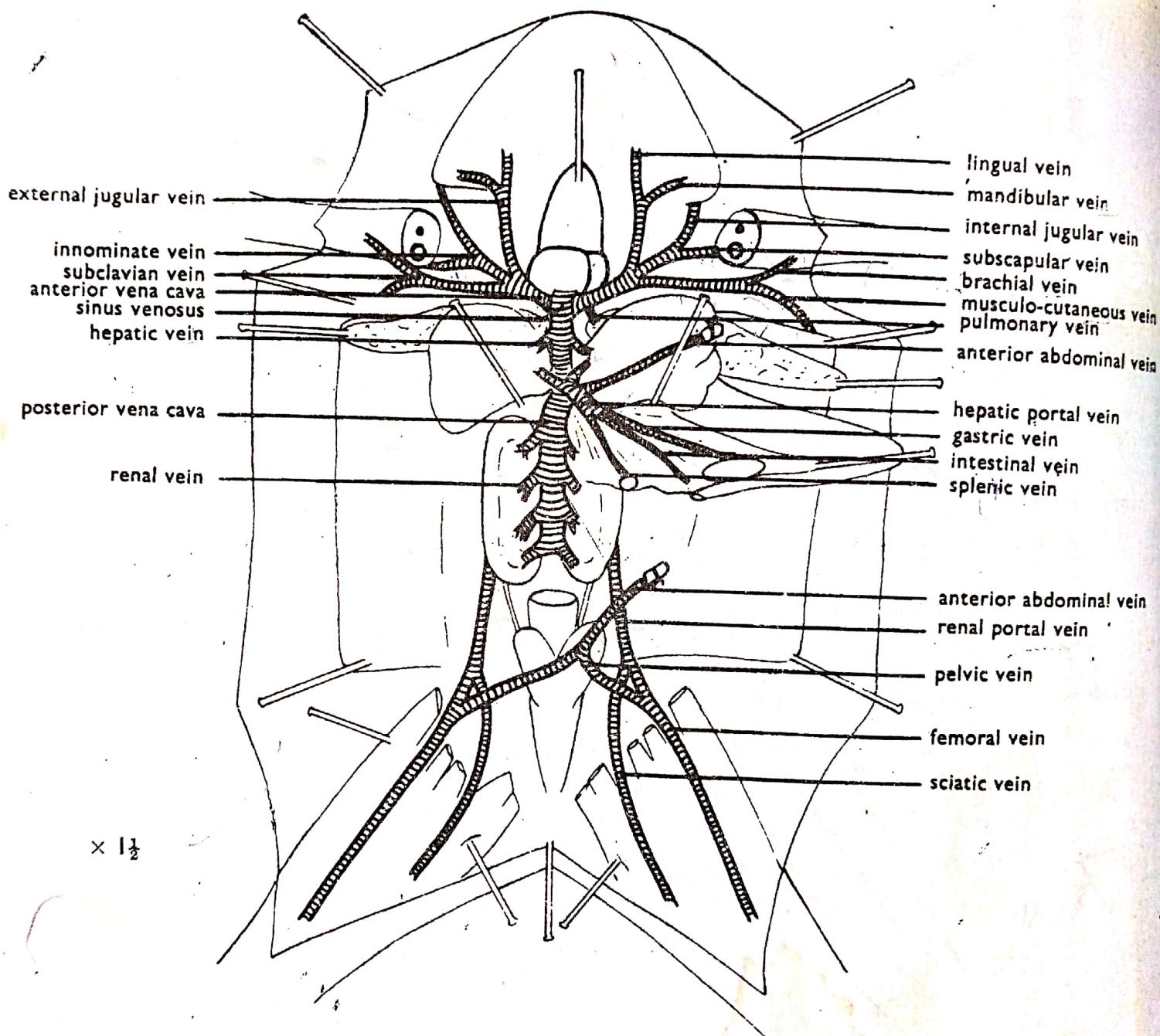


Fig. 33

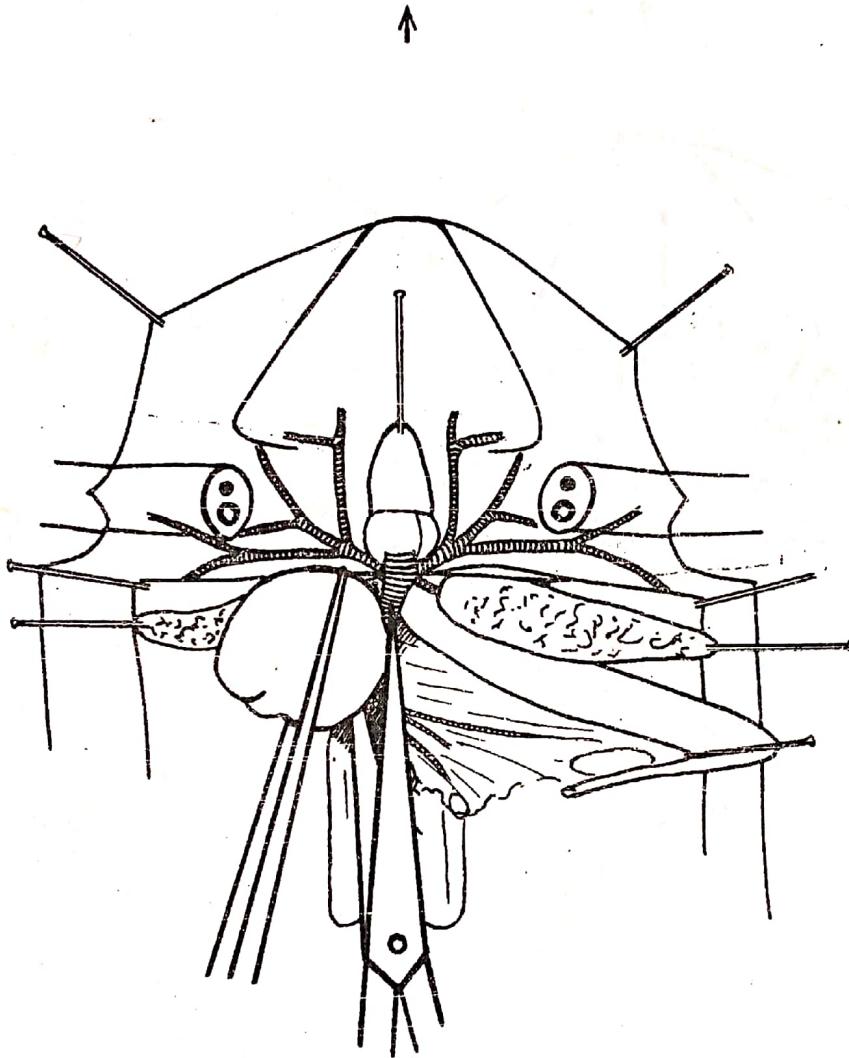
Place pins to hold the liver lobes apart, but do not pin through the liver tissue. The branching of the hepatic portal vein to the two sides of the liver and the two hepatic veins should be visible but a short length of the posterior vena cava will be masked by the liver tissue.

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.



× 1½

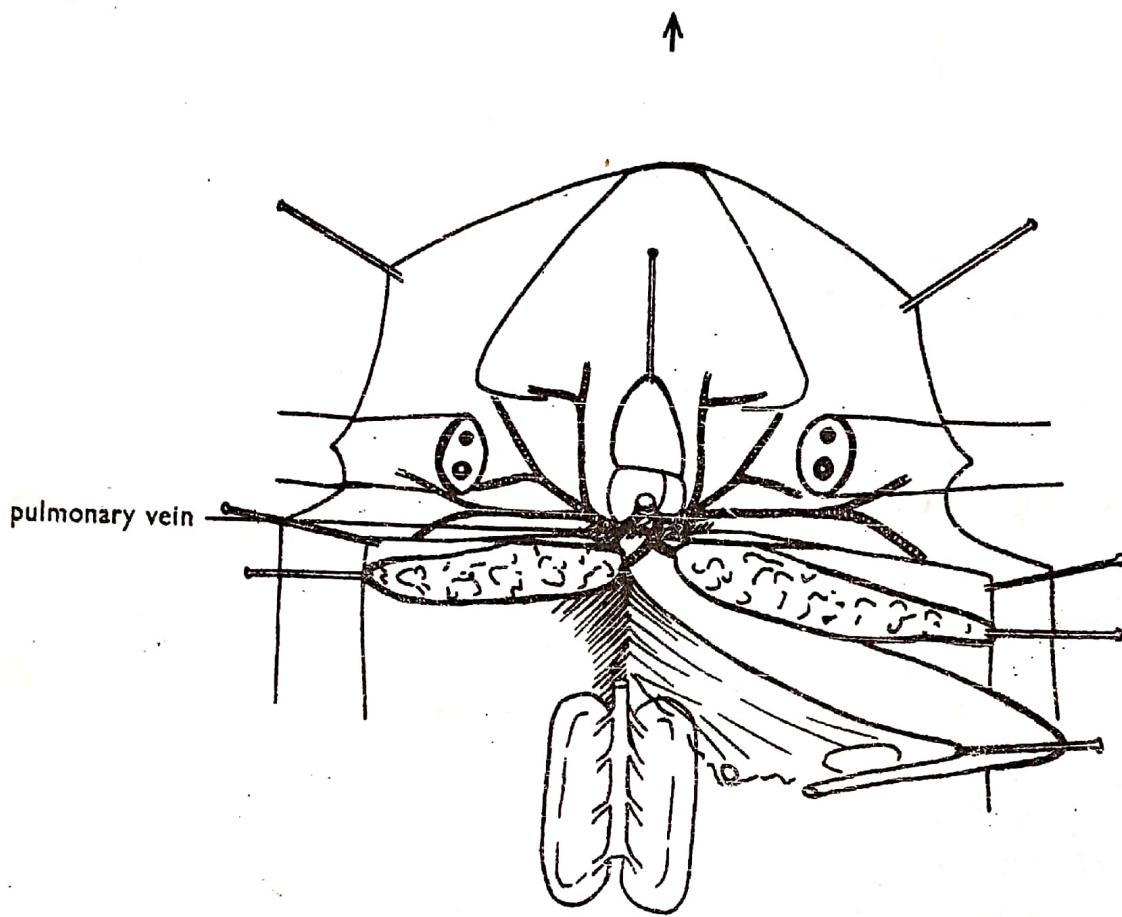
Fig. 34

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*



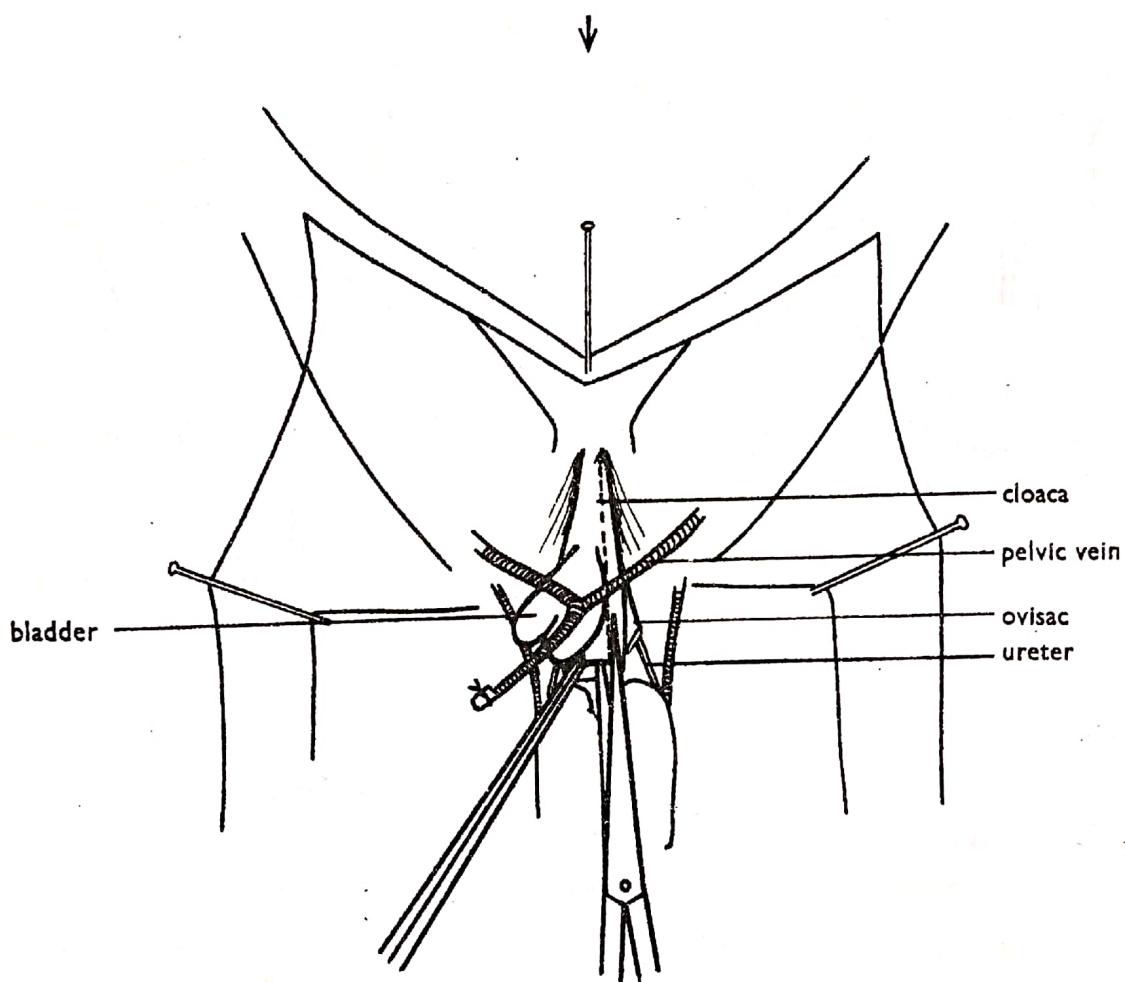
$\times \frac{1}{2}$

Notice the pulmonary veins and their connection with the left auricle.  
DRAW  
Fig. 35  
Clear away connective tissue as required.

## 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.

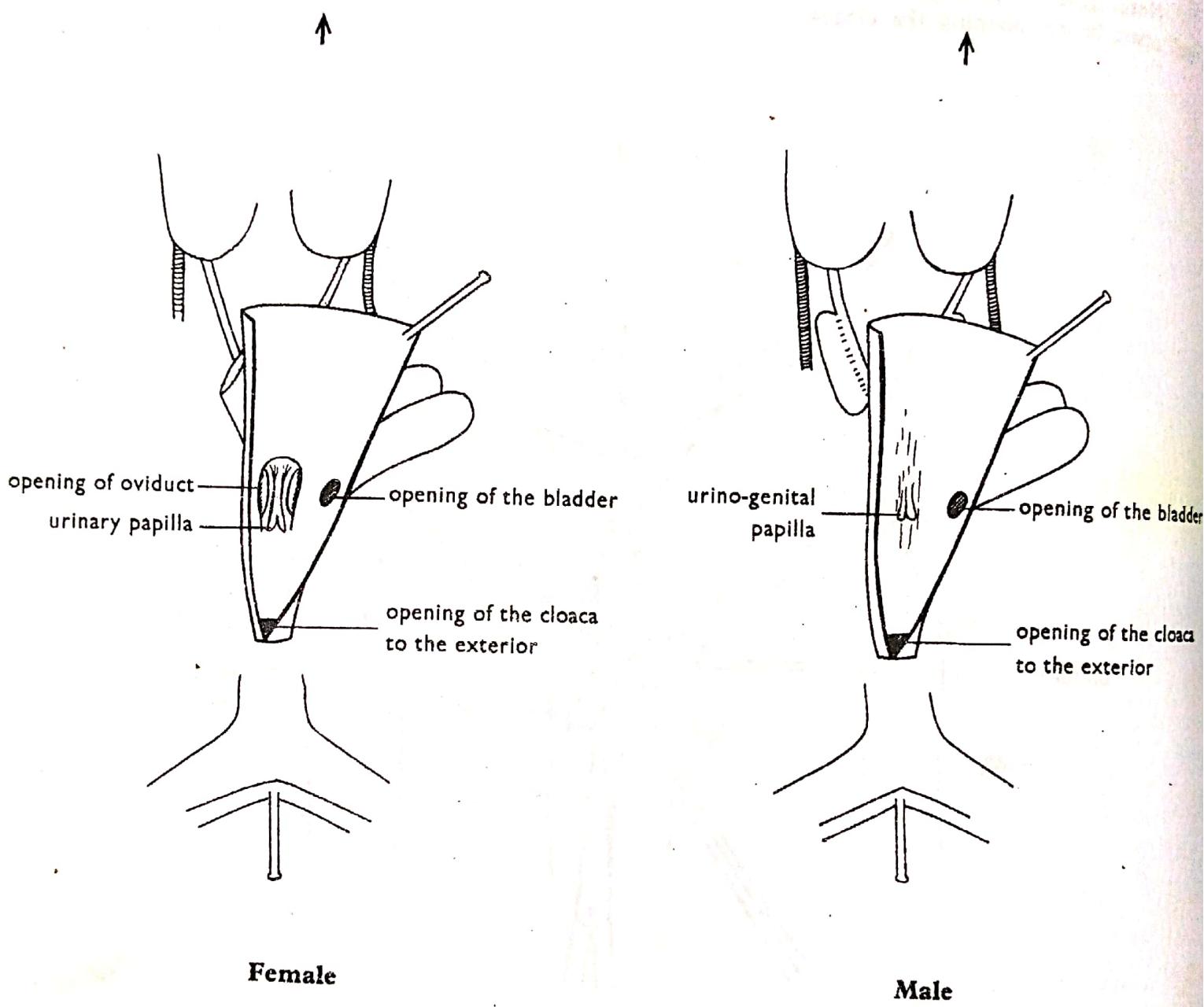
Cut down one side of the rectum and cloaca as far as the cloacal aperture. The pelvic vein is cut during this process.

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

# THE FROG—*The cloaca*

After you have examined the cloaca, turn the dish back to its original position and pin the cloaca open again. Examine the interior of the cloaca.

According to the following, make sketches and illustrate the following to show your drawing.



$\times 3$

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

**Fig. 37a & 37b**

## 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.

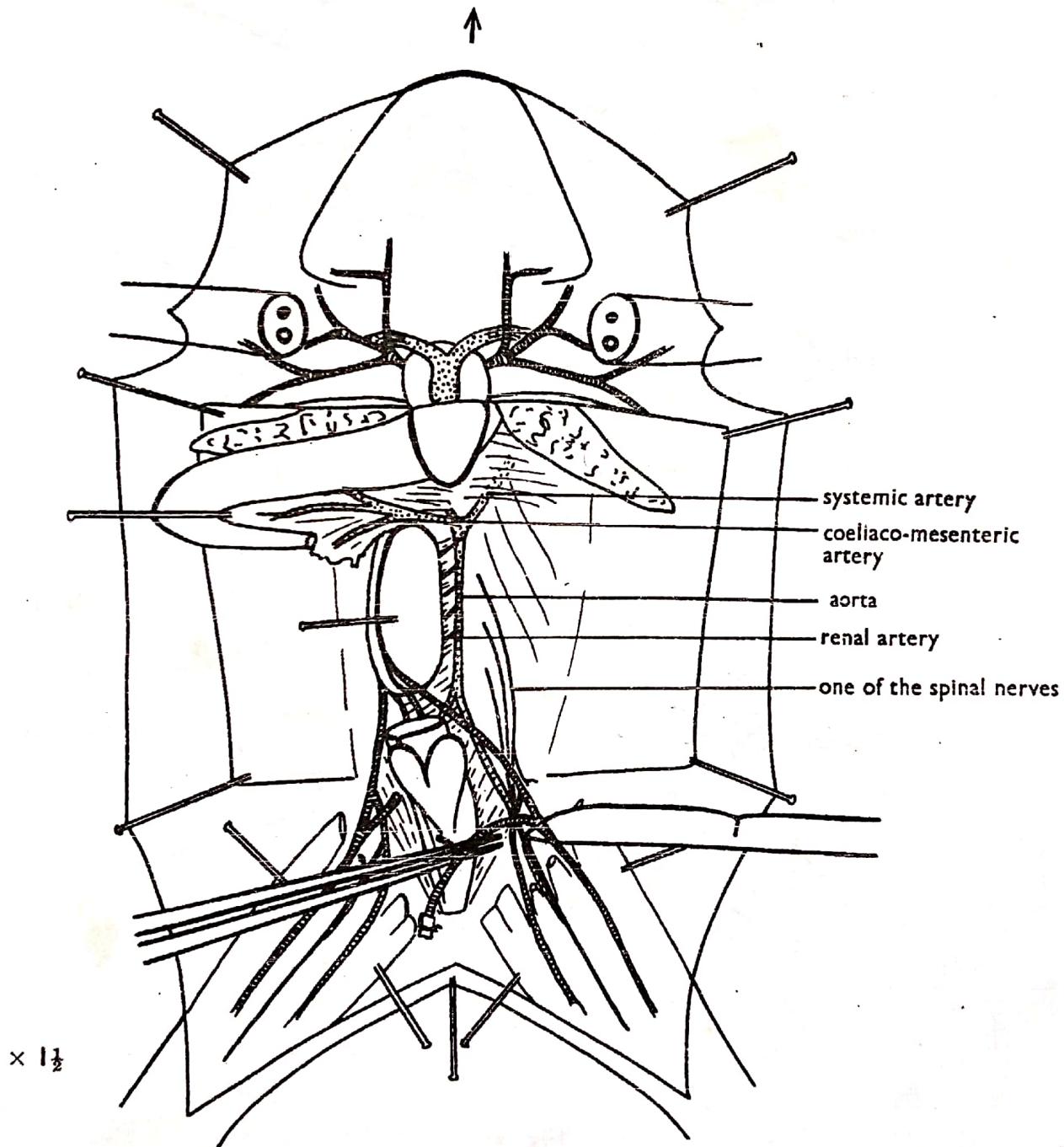


Fig. 38

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.

# THE FROG—*The arterial system*

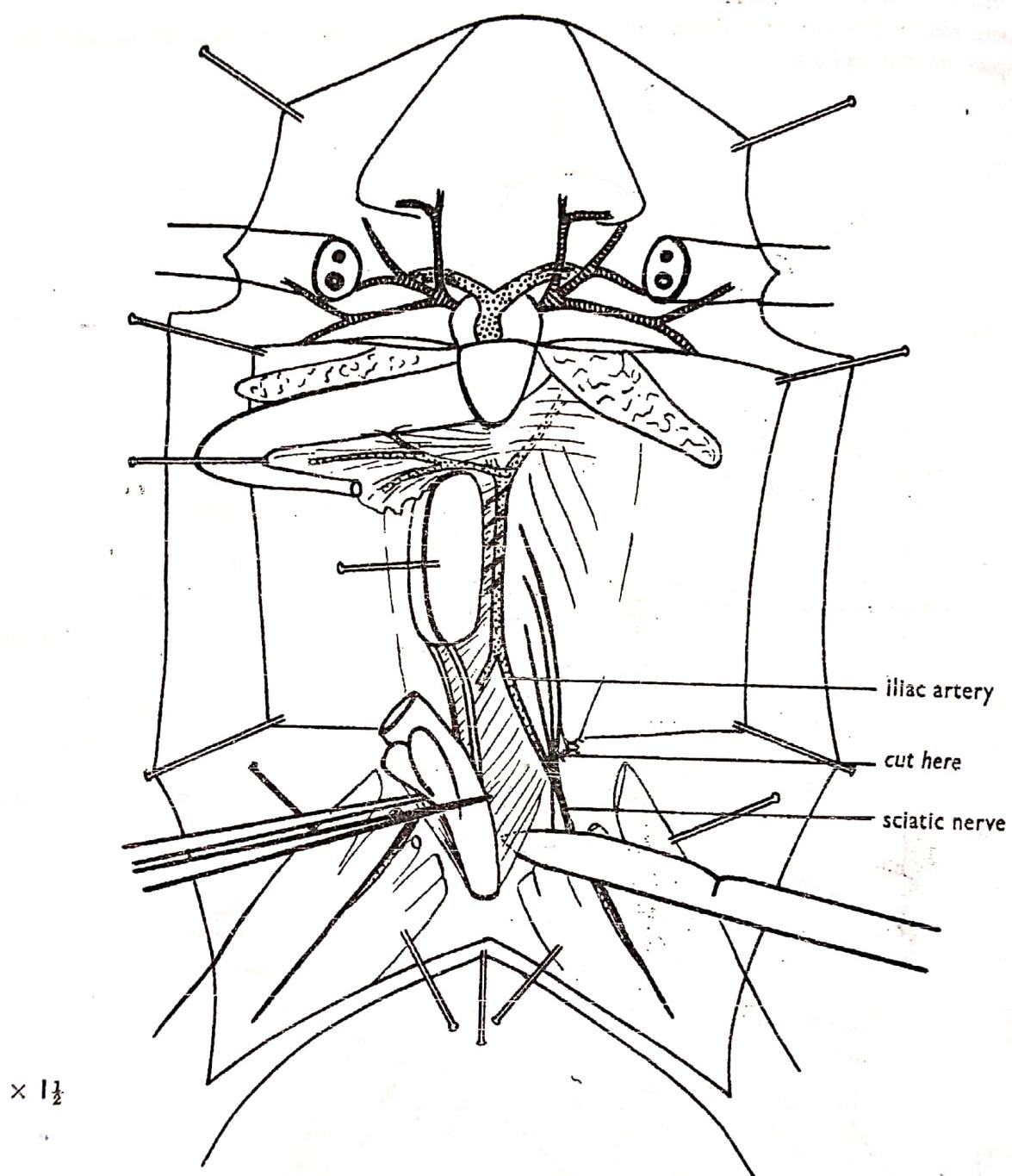


Fig. 39

Remove the cloaca, bladder and ureters.

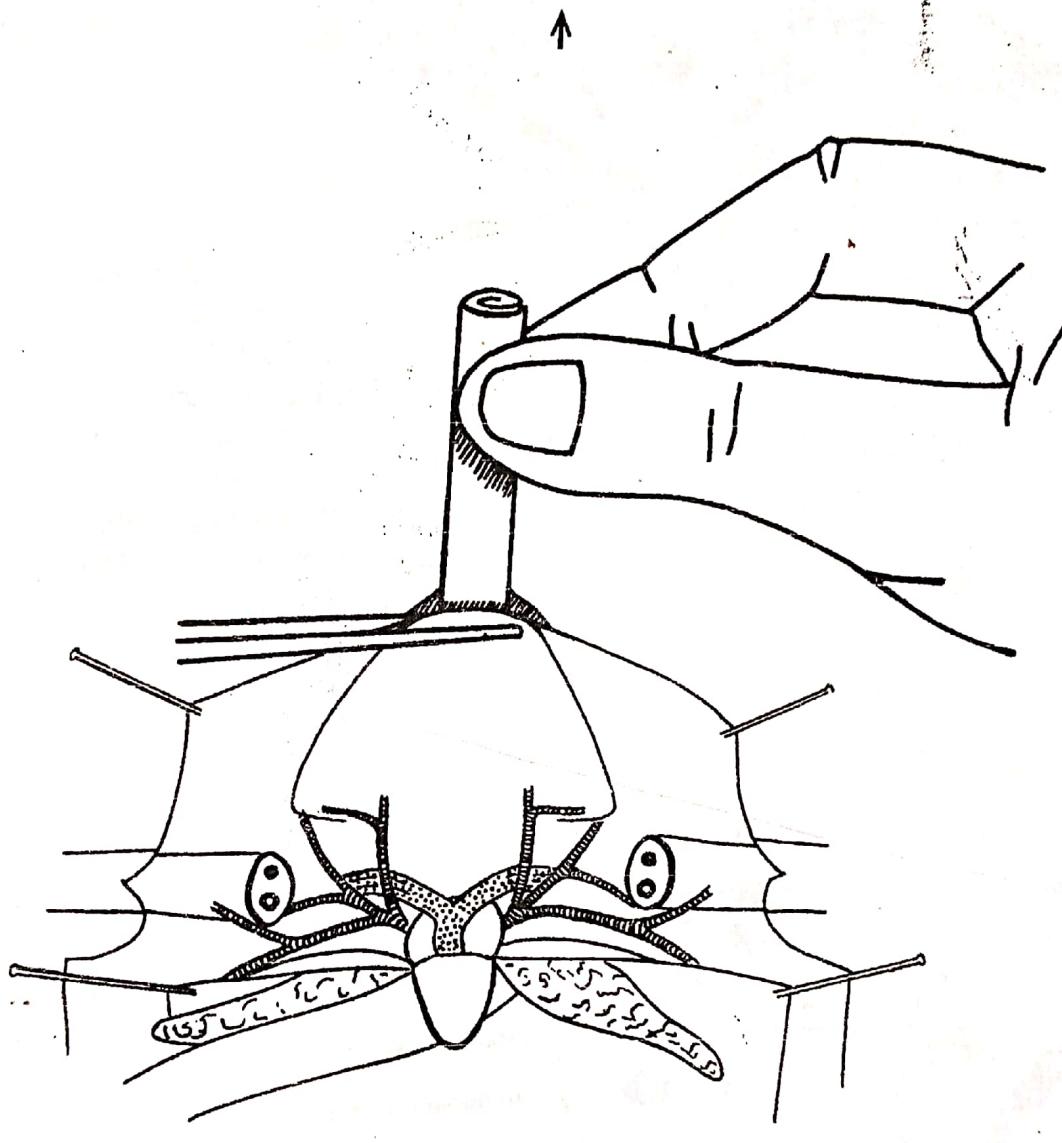
Remove any remaining connective tissue around the iliac veins, gripping the connective tissue with forceps and cutting with a scalpel while under tension.

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.

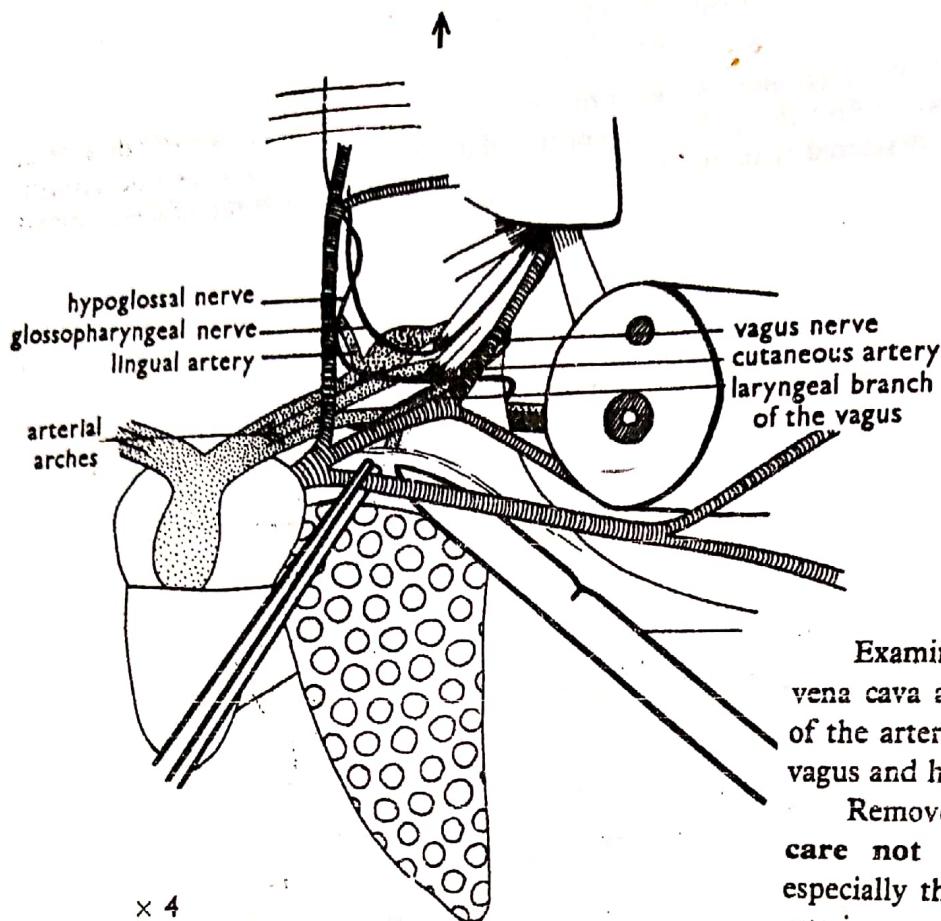


× 1½

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.

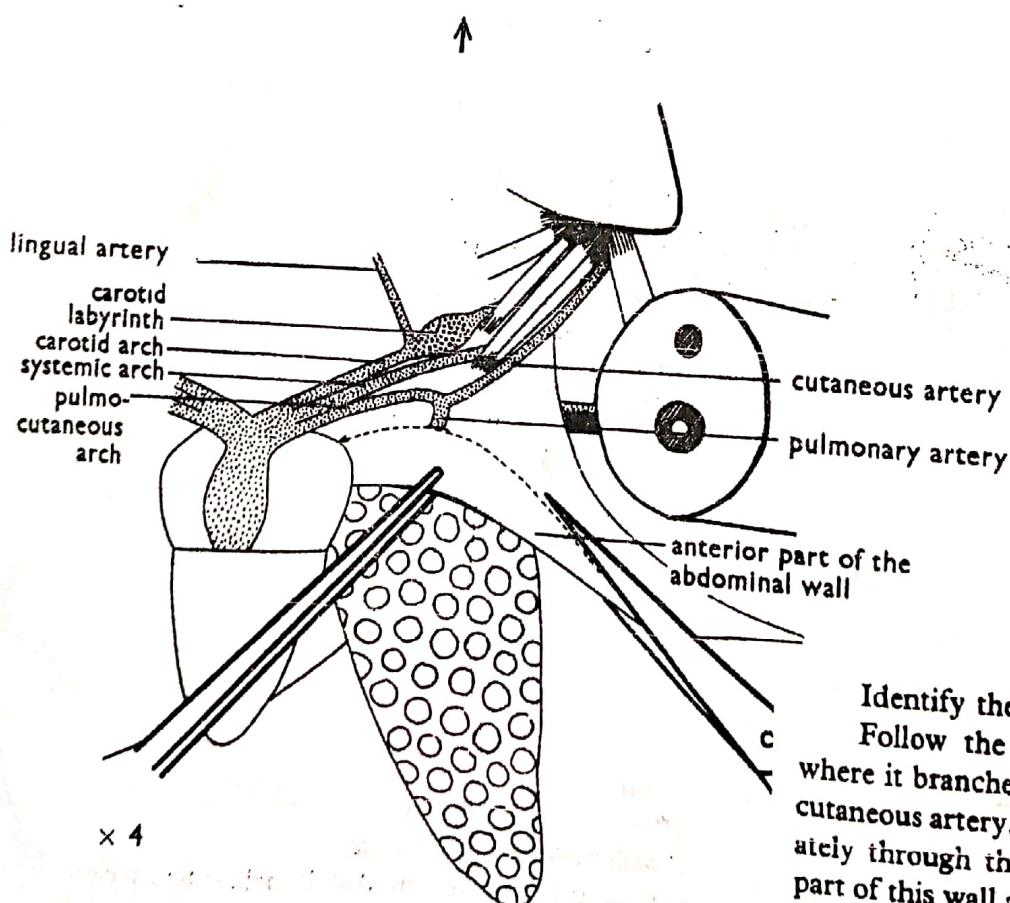
# THE FROG—*The arterial system*



**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 veins.

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

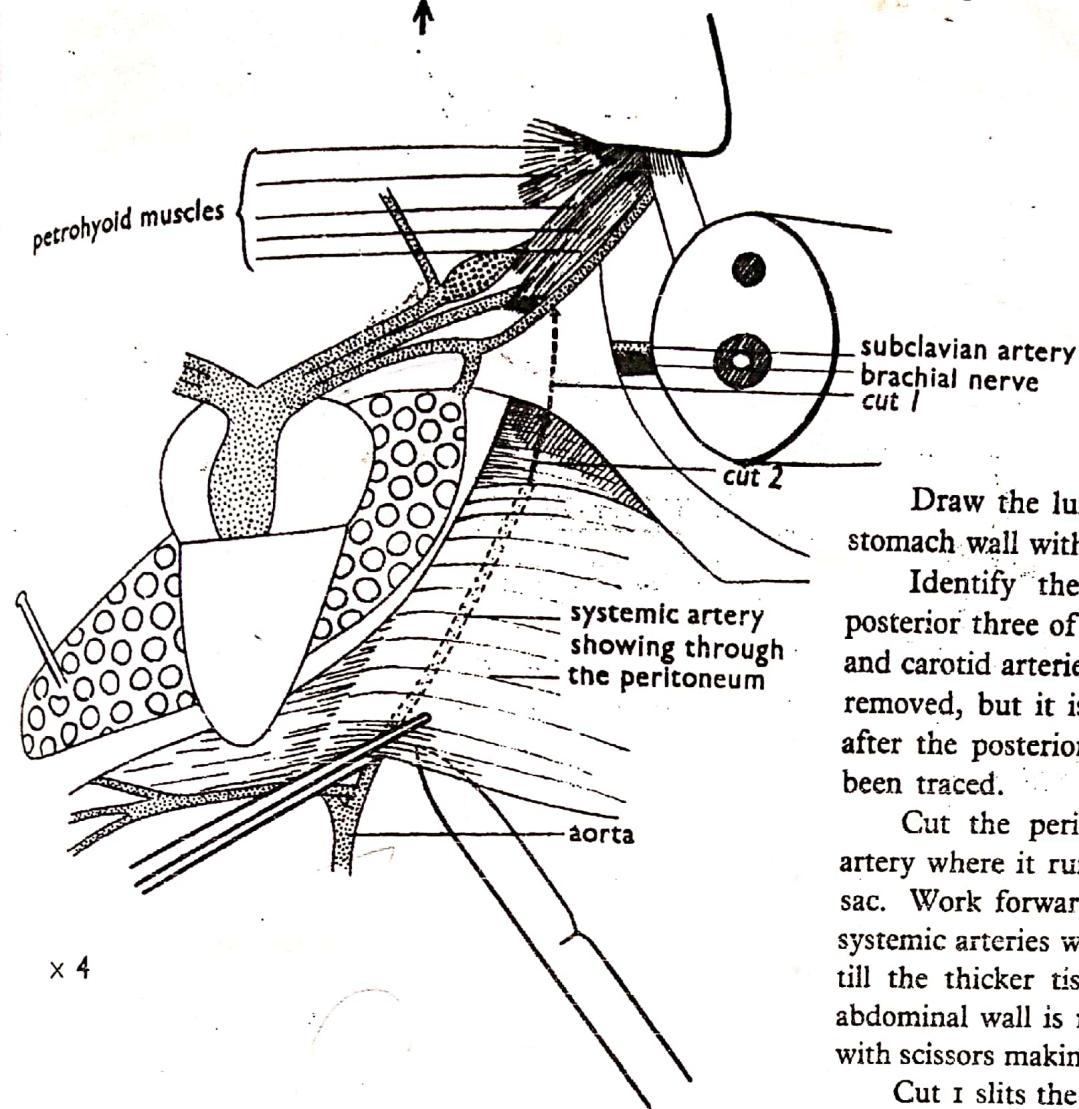


**Fig. 42**

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.

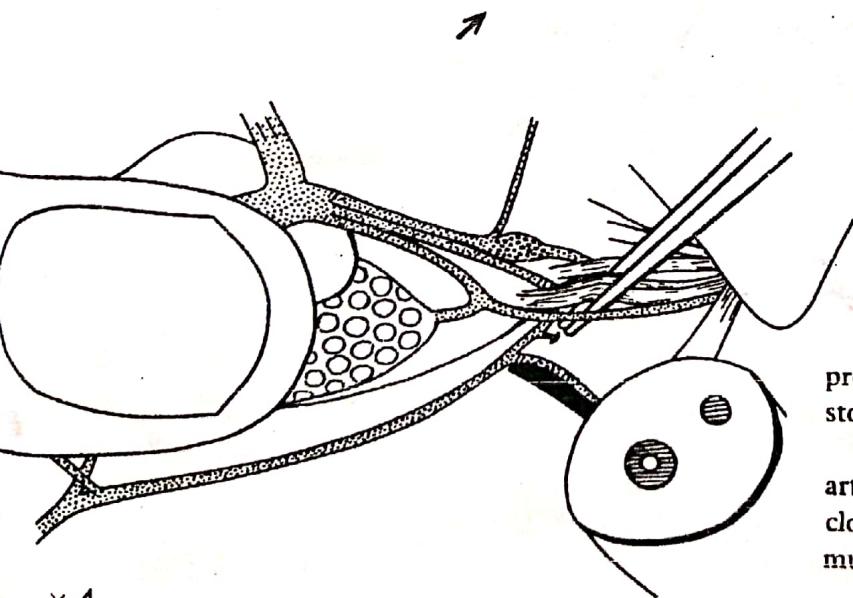
Identify the five petrohyoid muscles. The posterior three of these muscles cross the systemic and carotid arteries as shown and must therefore be removed, but it is better to leave this removal till after the posterior part of the systemic artery has been traced.

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

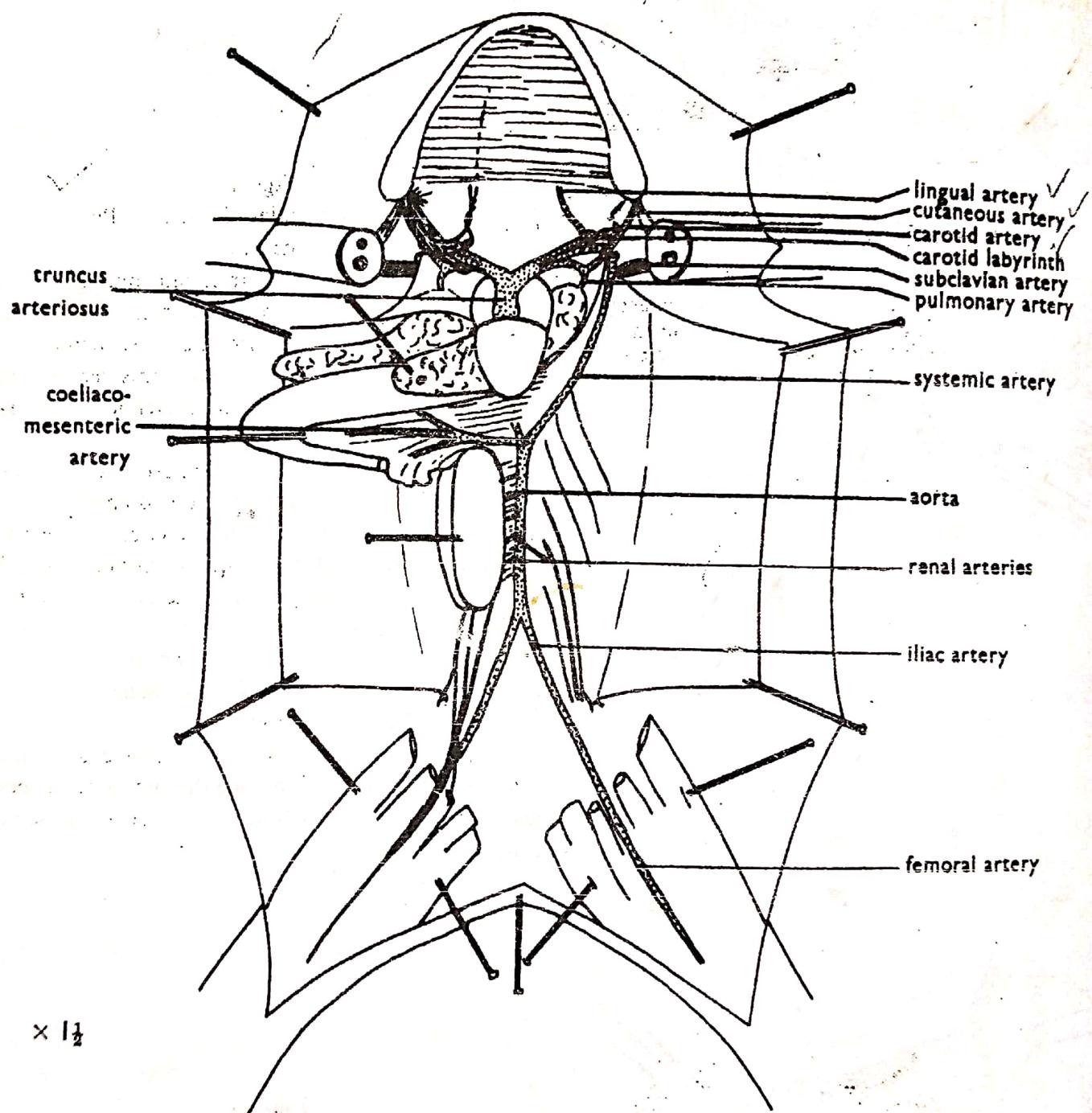


Fig. 45

(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.

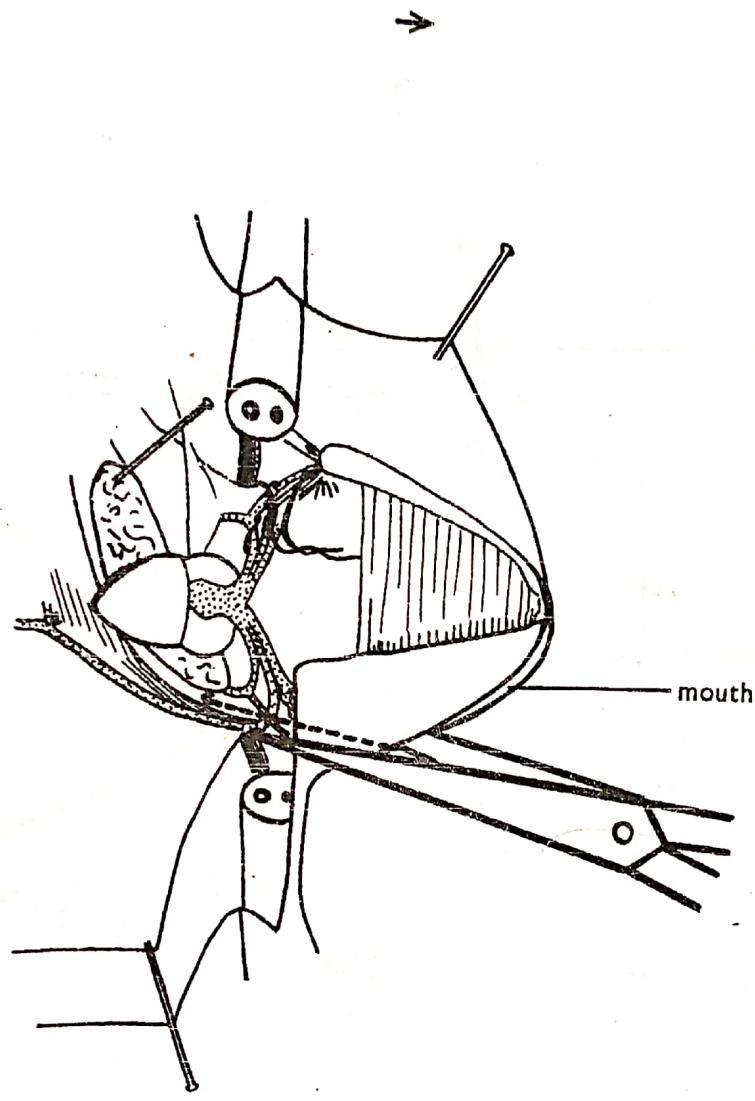


Fig. 46

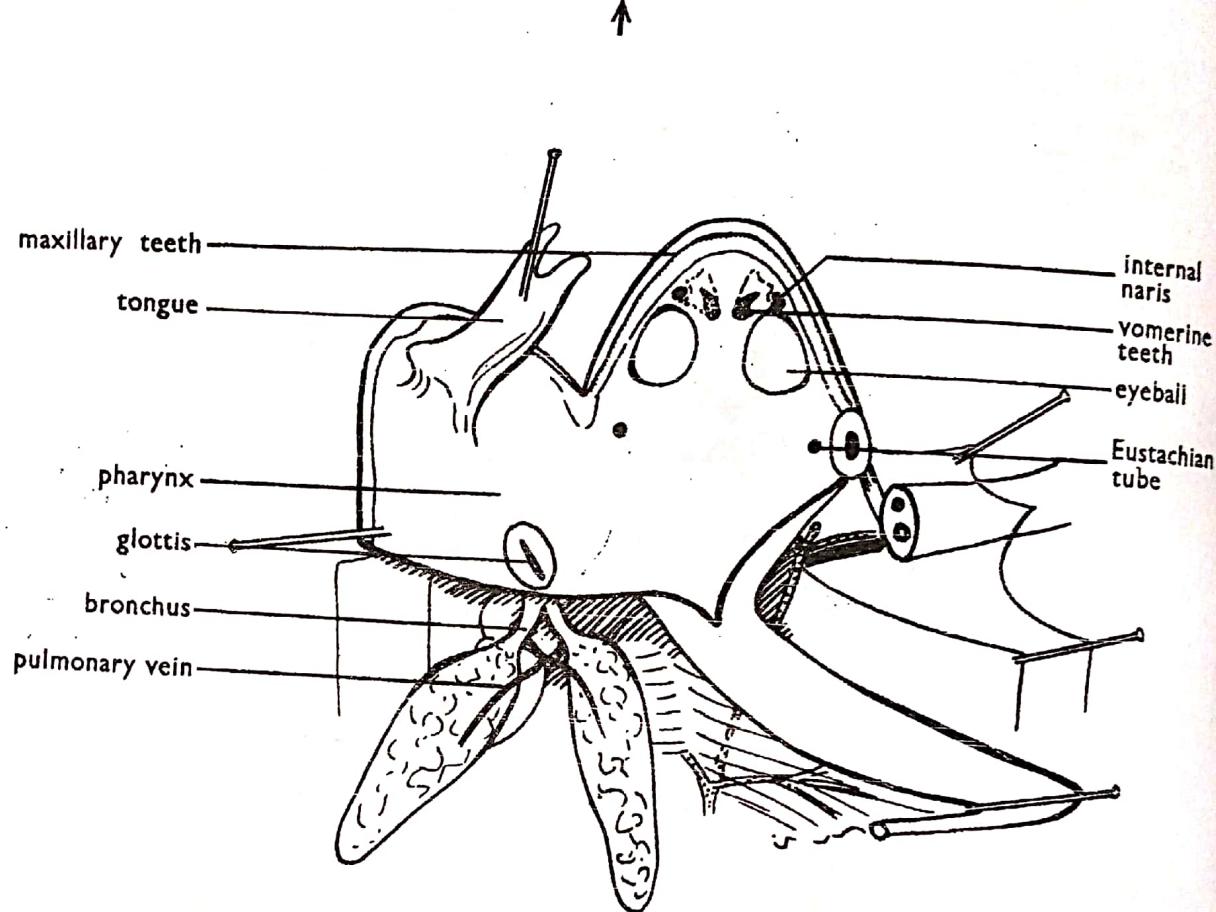
Turn the dish sideways.

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

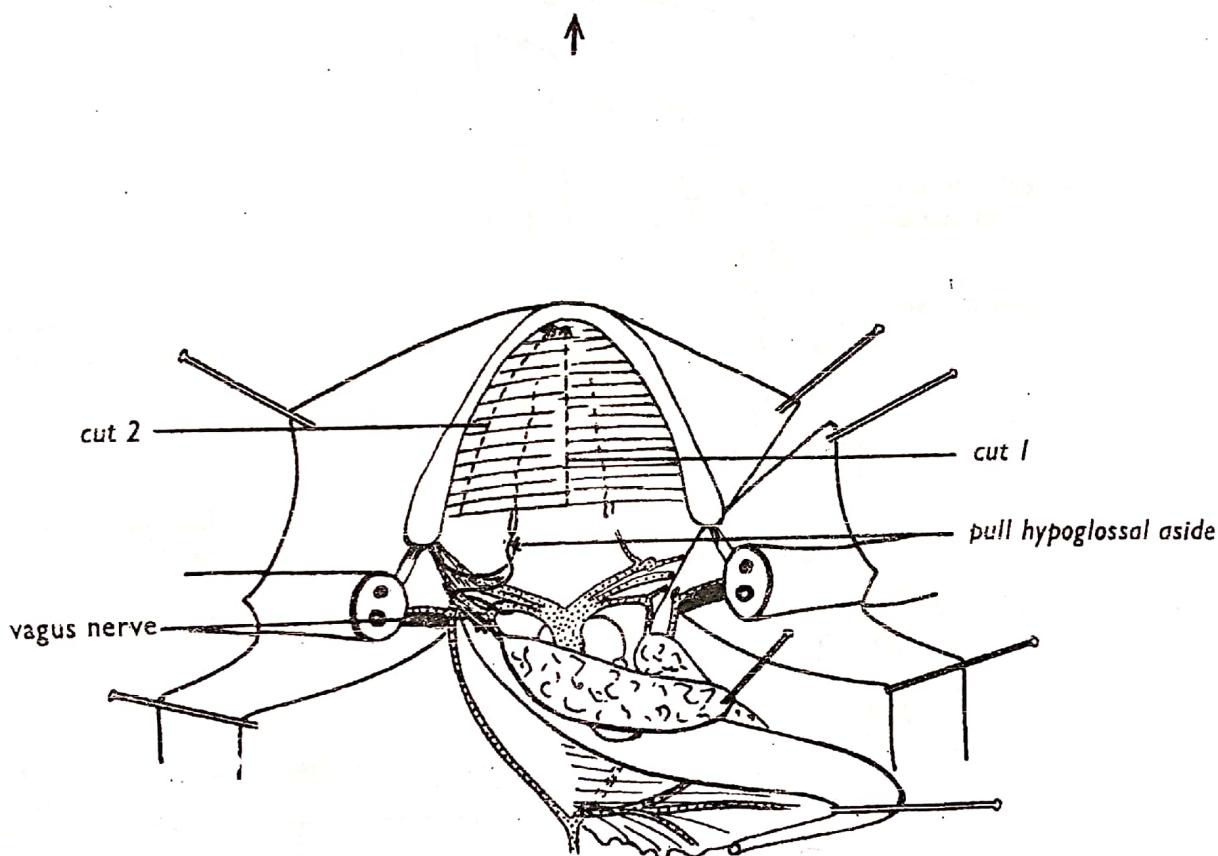
Fig. 47

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.



× 1½

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.

Clear away the abdominal wall from the systemic artery, refer to Fig. 43.

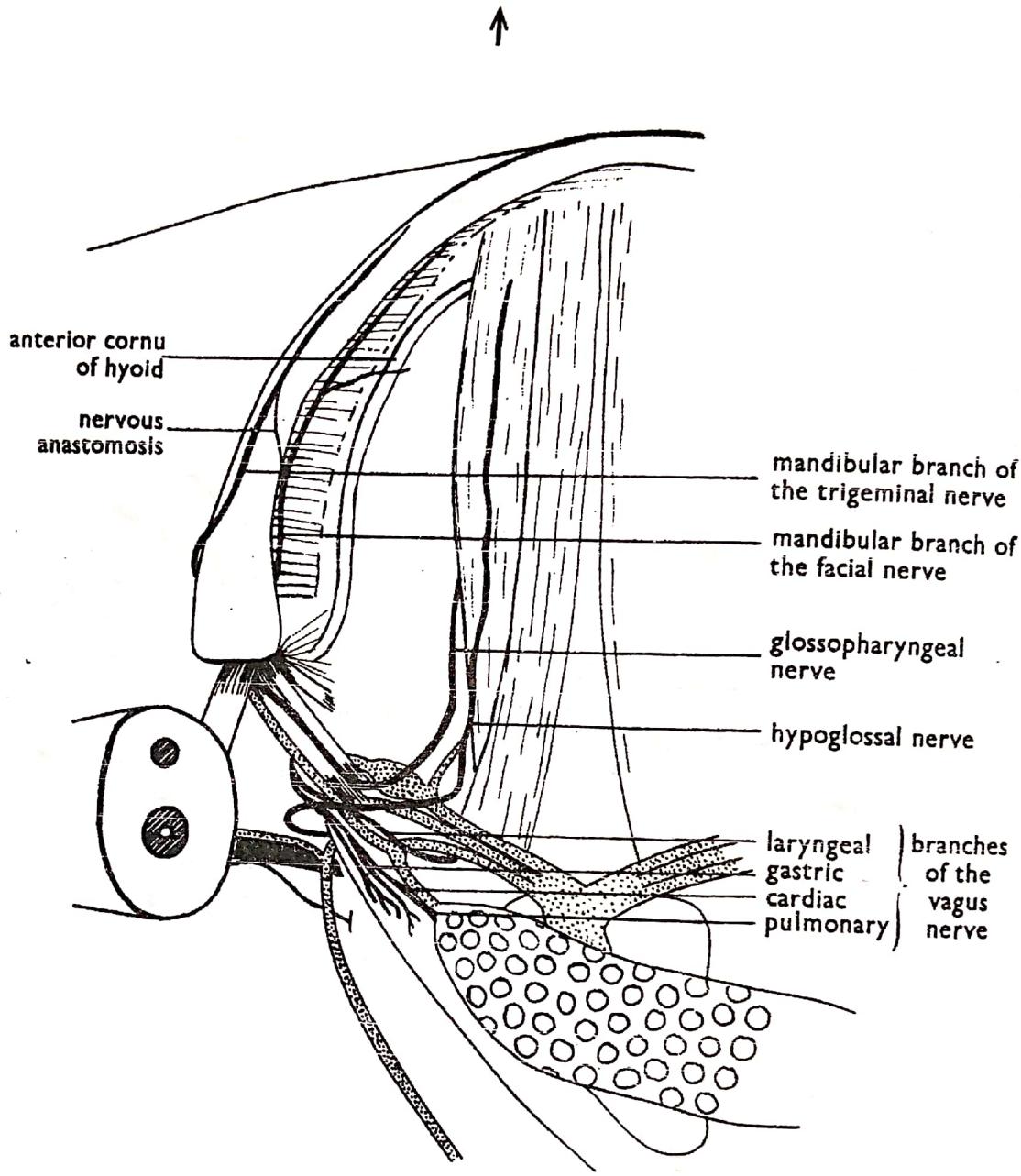
Turn the heart and lungs over and pin as shown. Clear the abdominal wall from the systemic artery, refer to Fig. 44.

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*



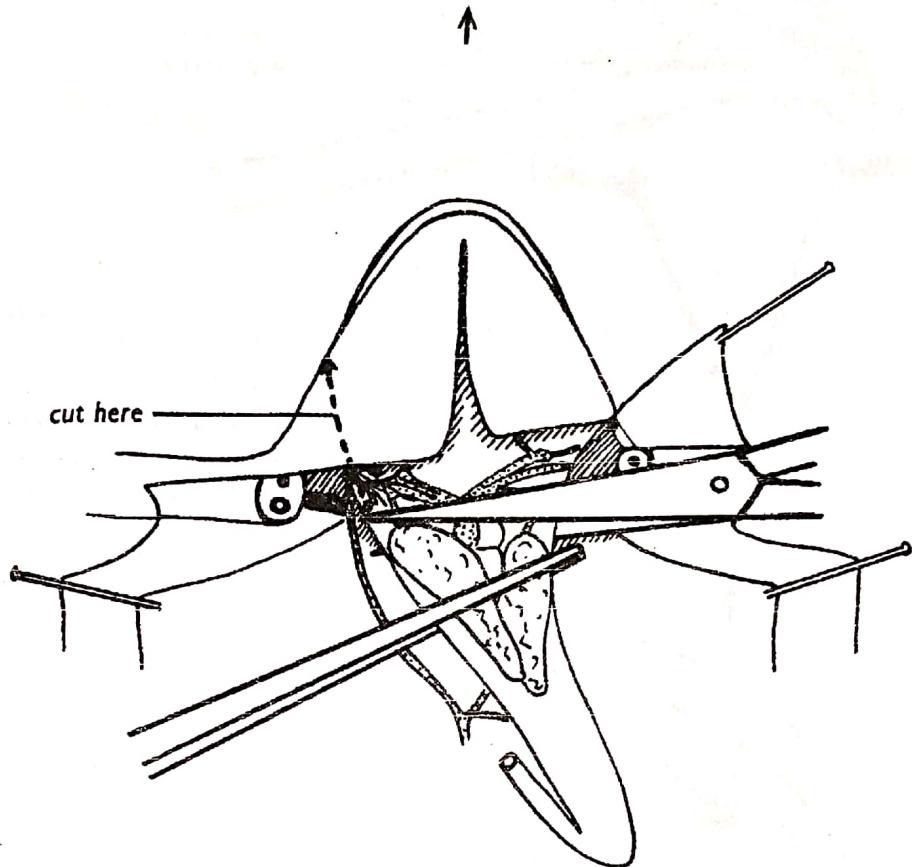
X 4

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. 49

## THE FROG—*The nervous system*



× 1½

Fig. 50

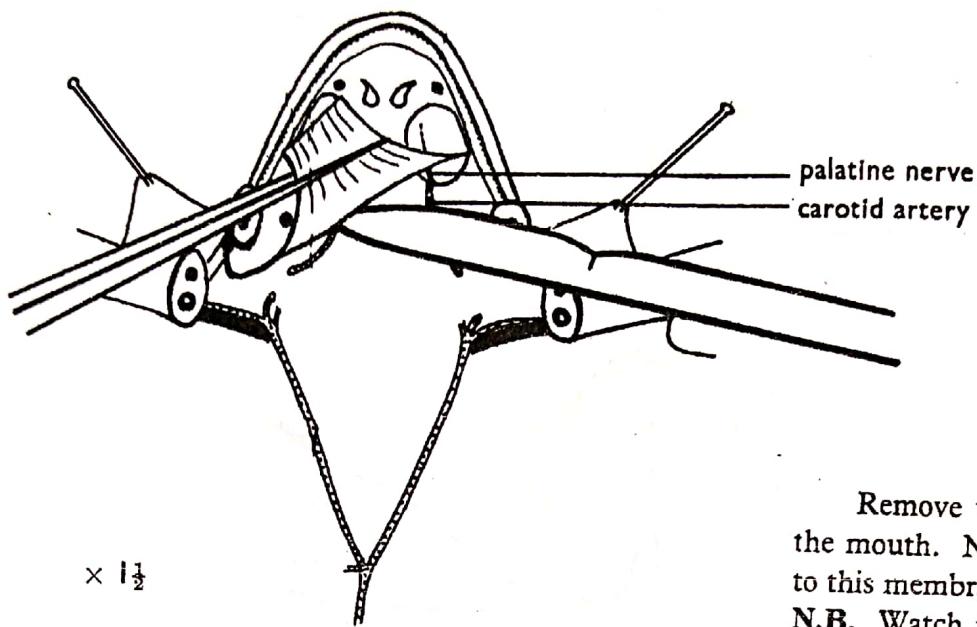
Remove the pins from the lungs and stomach.

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

Remove the pins from the skin of the head.

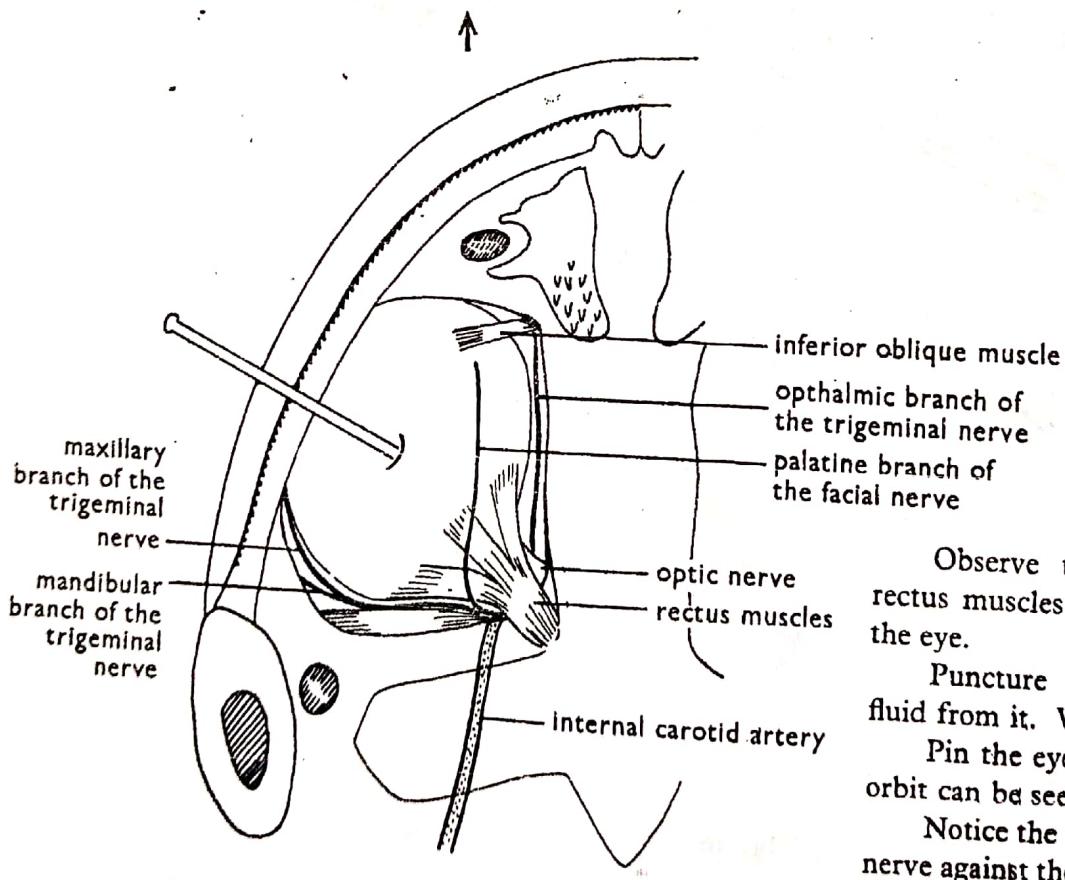
Remove the floor of the mouth by cutting through the angle of the jaw (on both sides if the pharynx has not been studied on your specimen).

## 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 eyeballs.



**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.

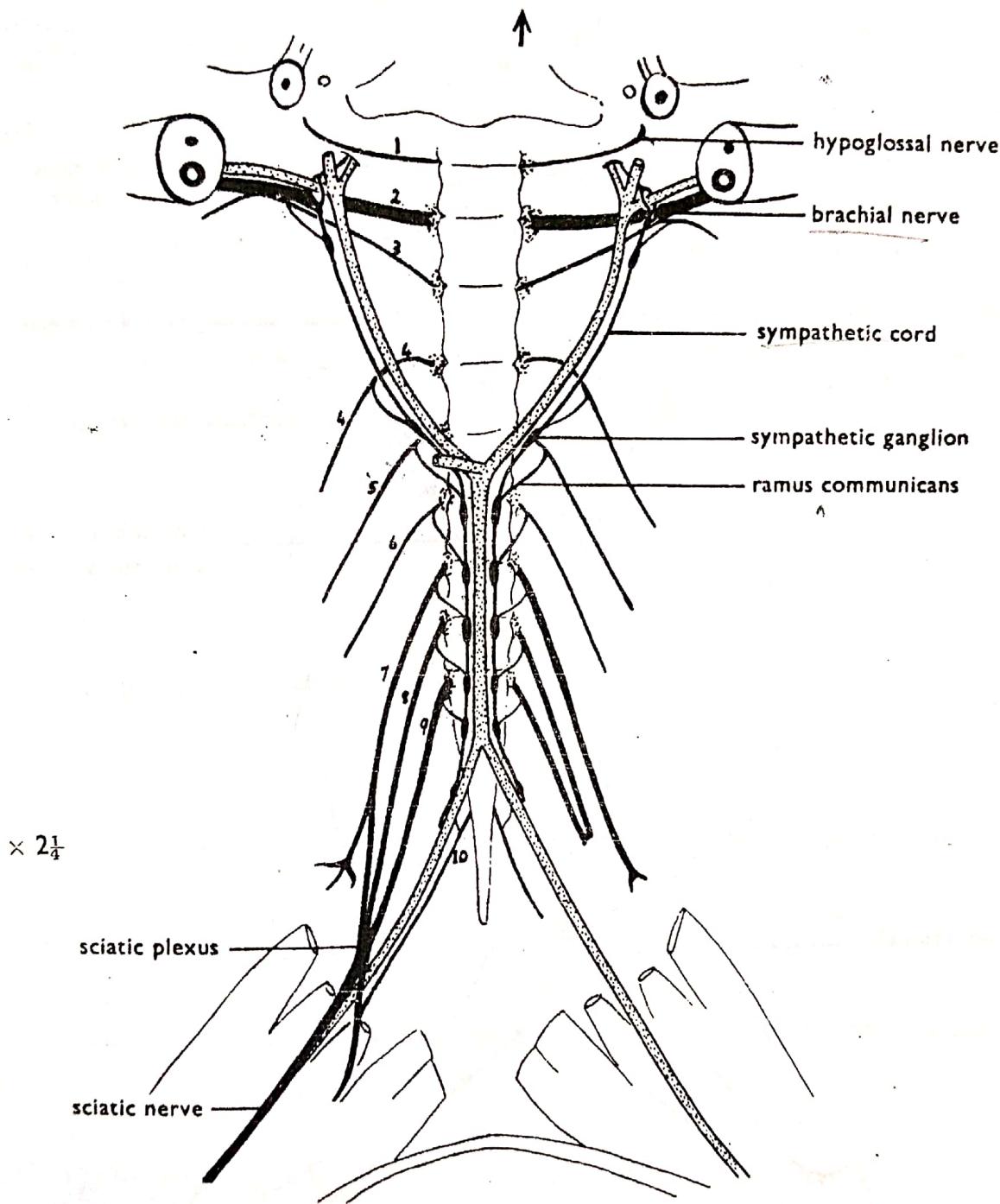


Fig. 53

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 subclavian 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.

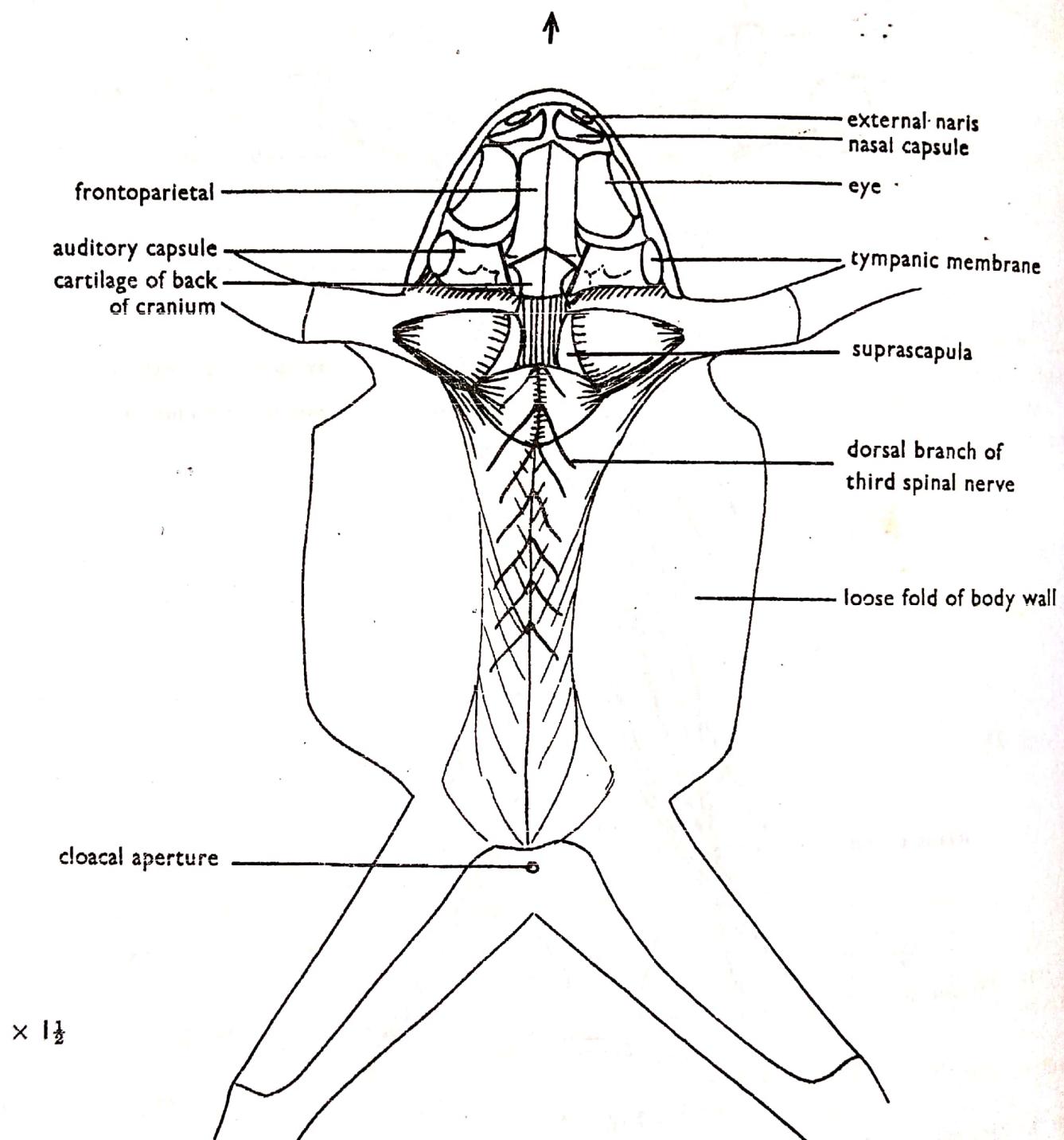
DRAW.

## 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.

## THE FROG—*The nervous system*

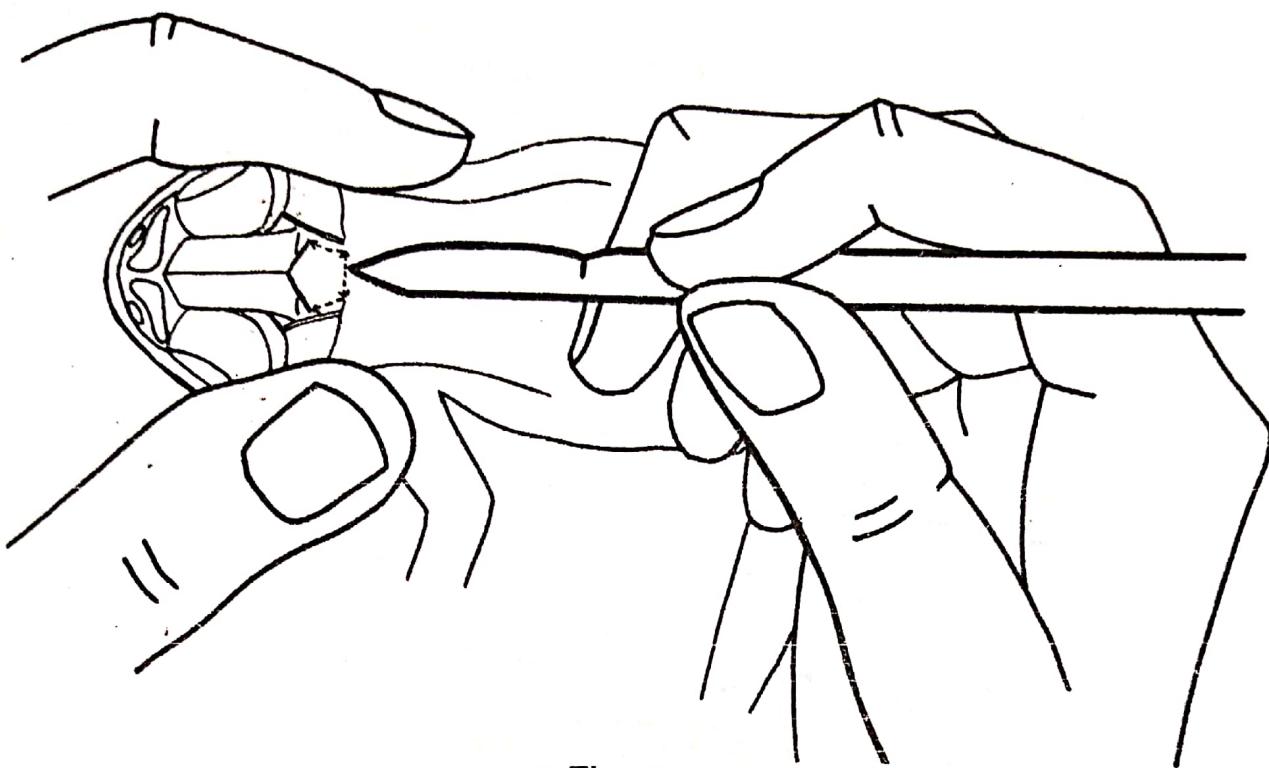


Fig. 55a

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.**

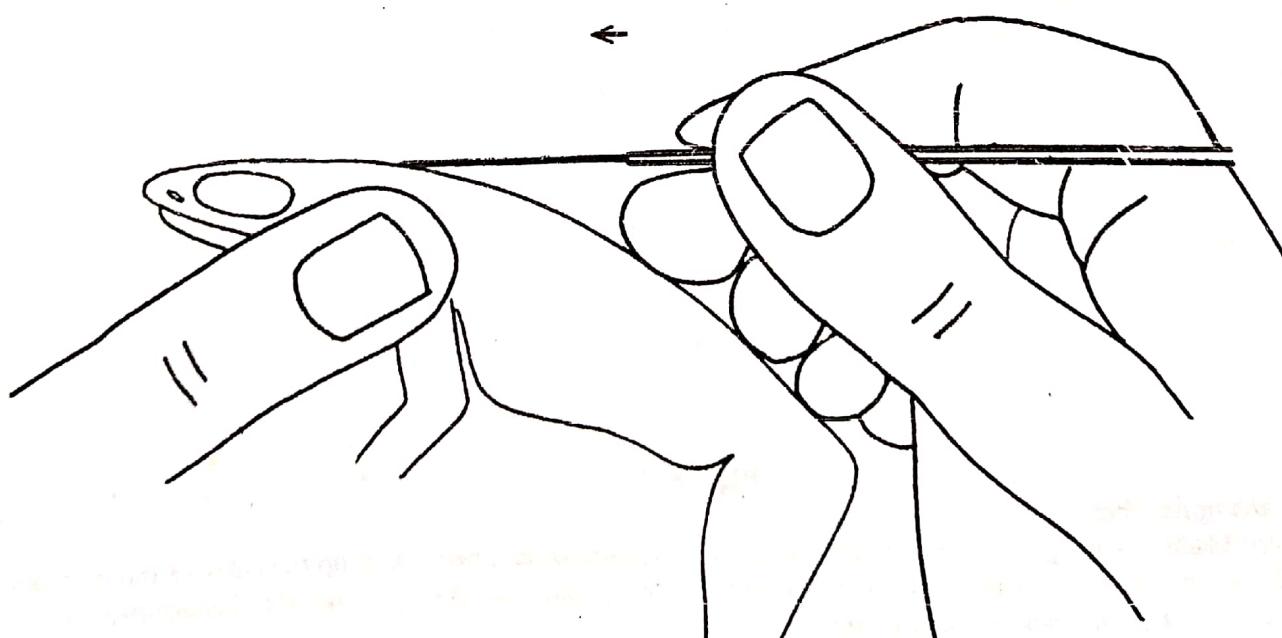


Fig. 55b

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

## THE FROG—*The nervous system*

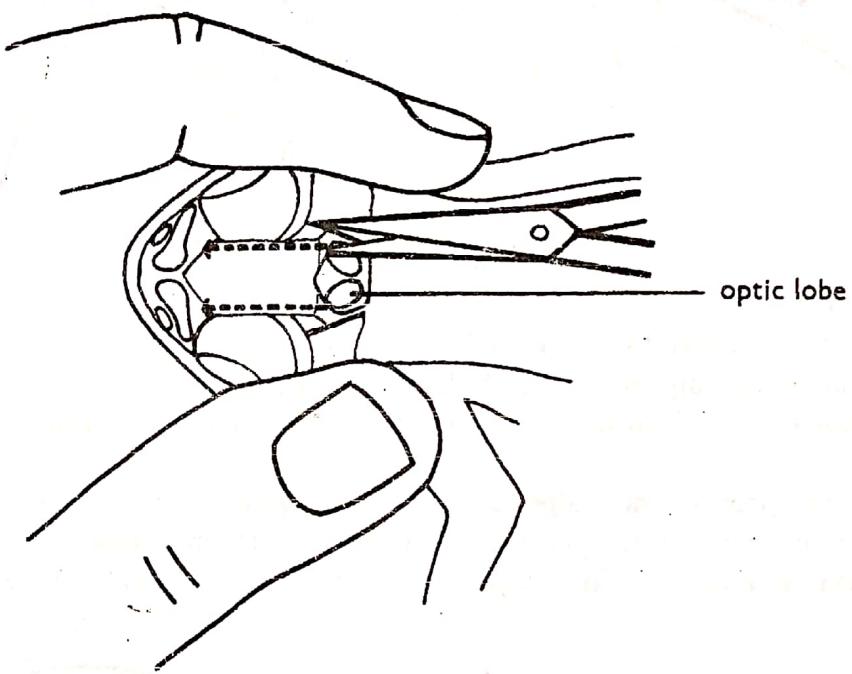


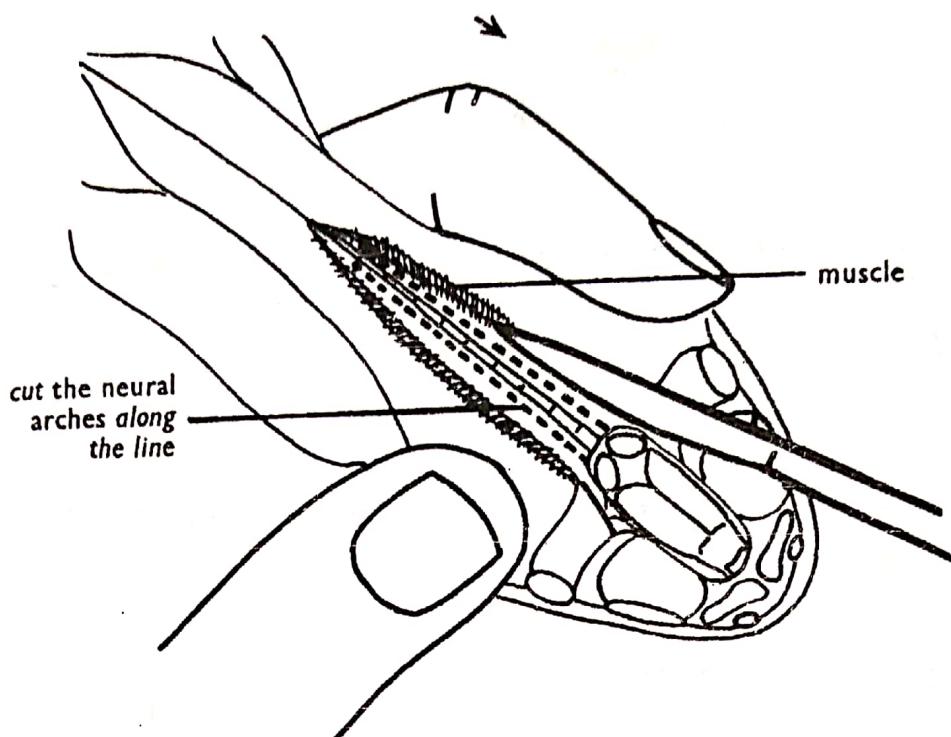
Fig. 56

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*

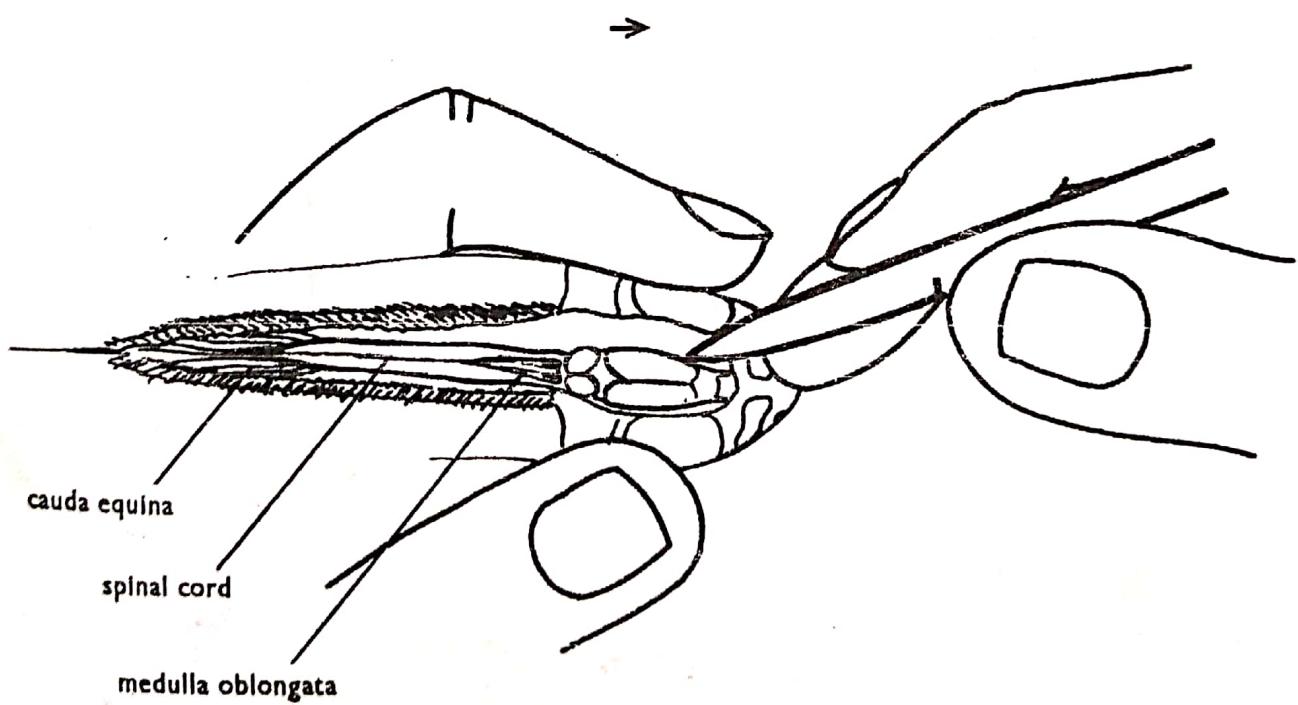


**Fig. 57**

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**

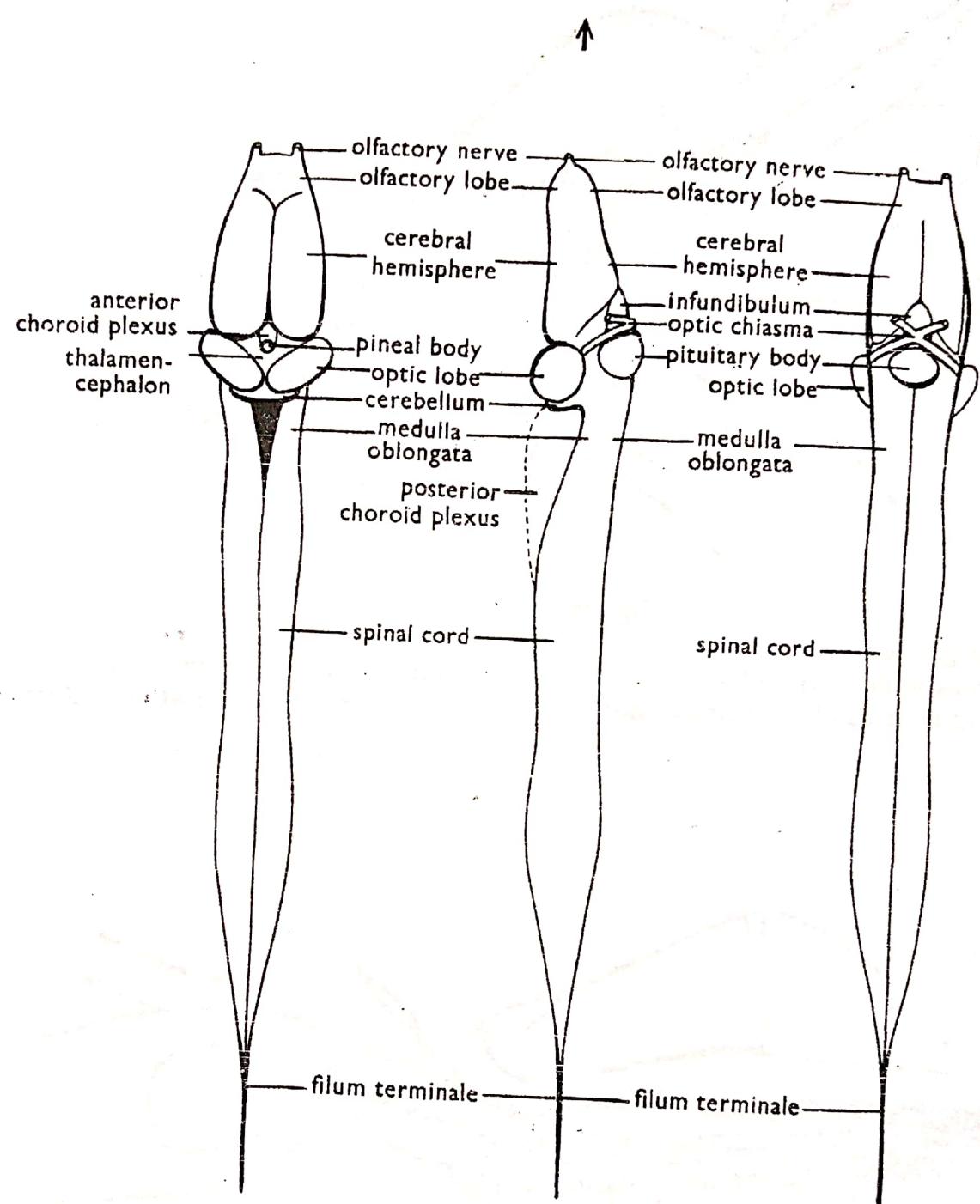
Notice the medulla oblongata and the spinal cord.

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*



× 4

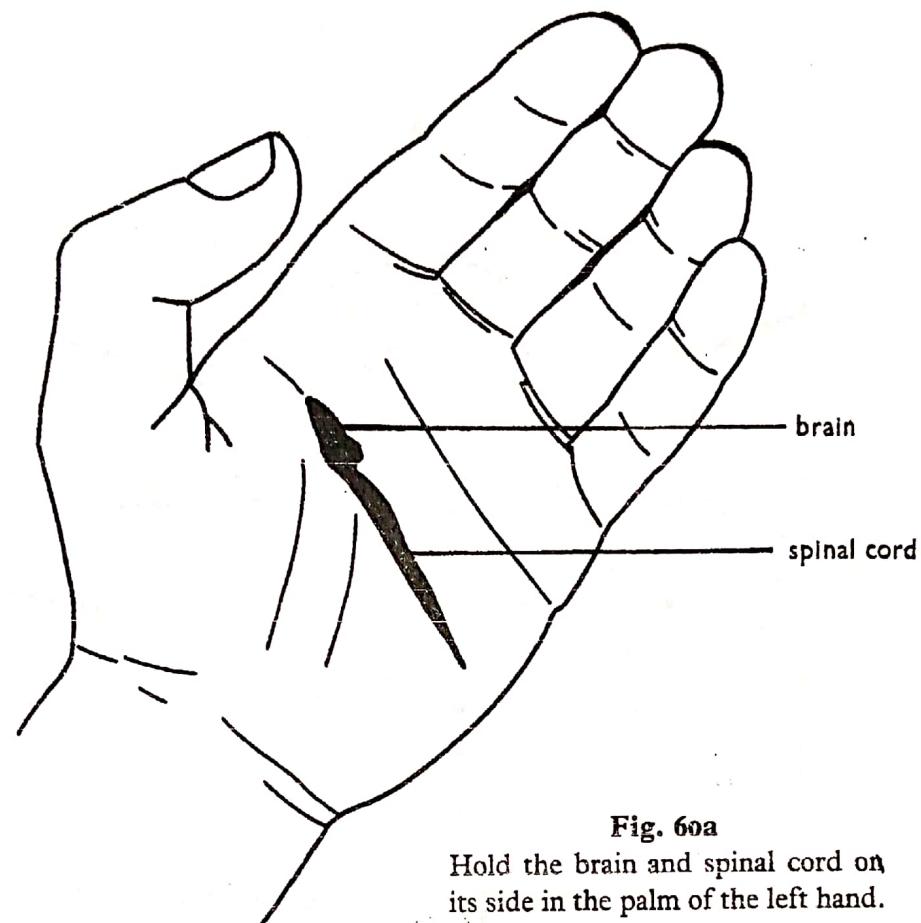
Fig. 59

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.

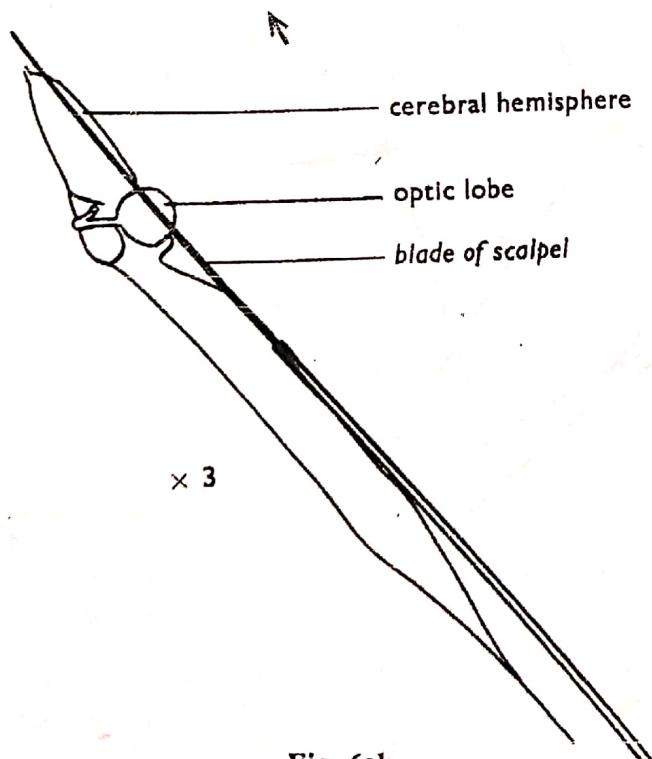
DRAW

## THE FROG—*The nervous system*



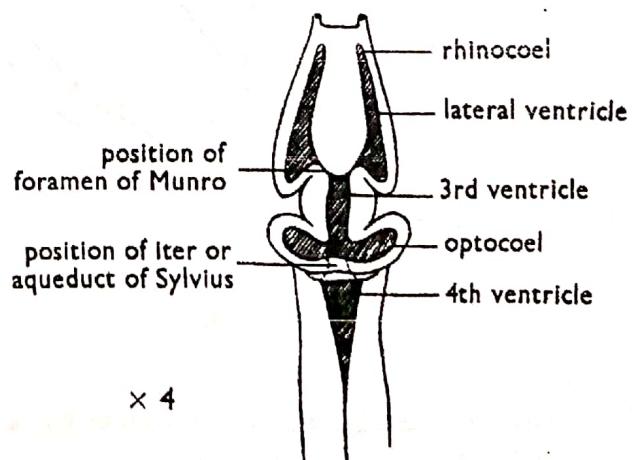
**Fig. 60a**

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.

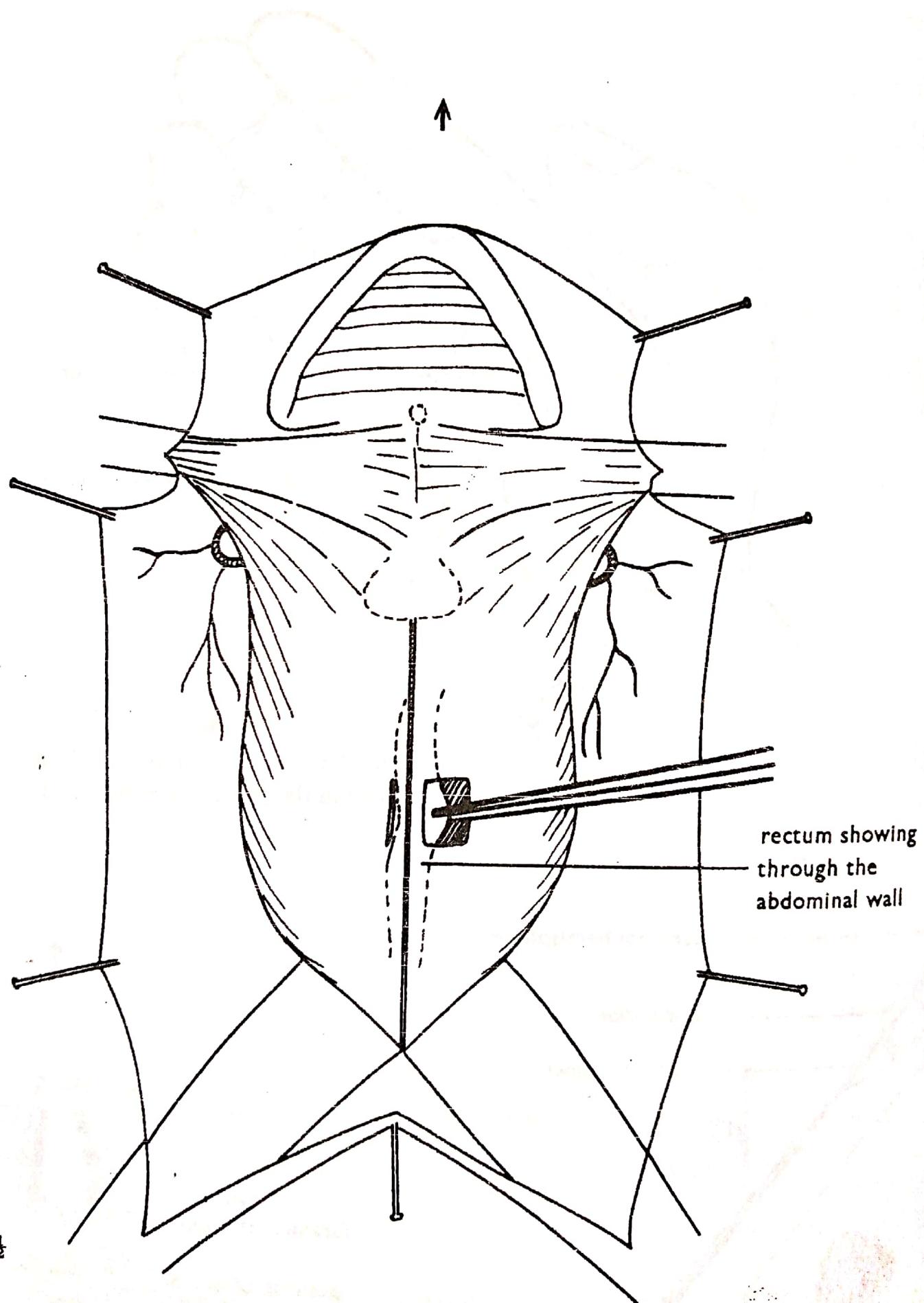


**Fig. 61**

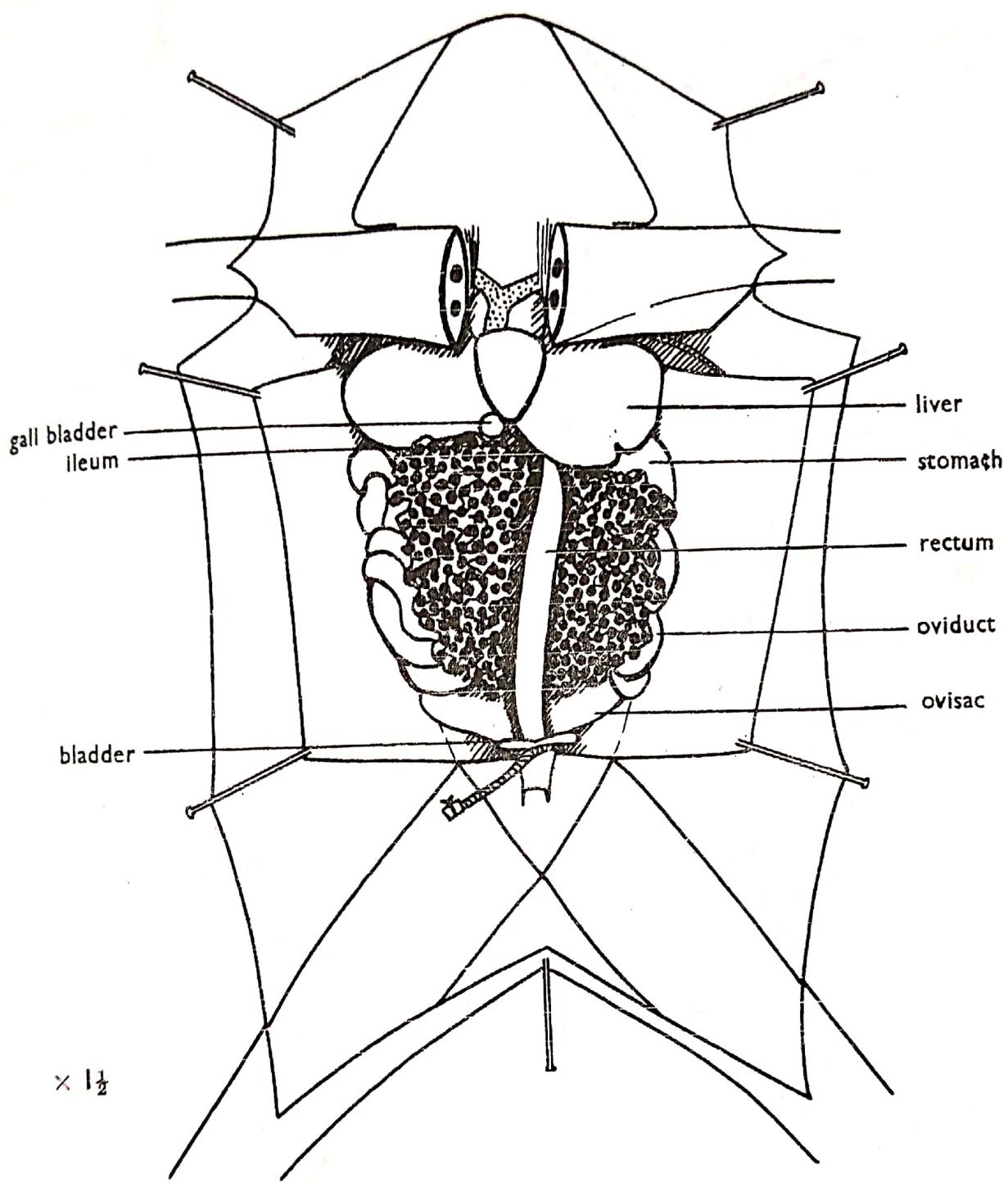
Notice the cavities of the brain.  
DRAW

## Appendix I

### Opening up a Female when She is Distended with Eggs



# 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 comes into contact with water. Should the frog be covered with water as usual the oviducts become still further etched 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.

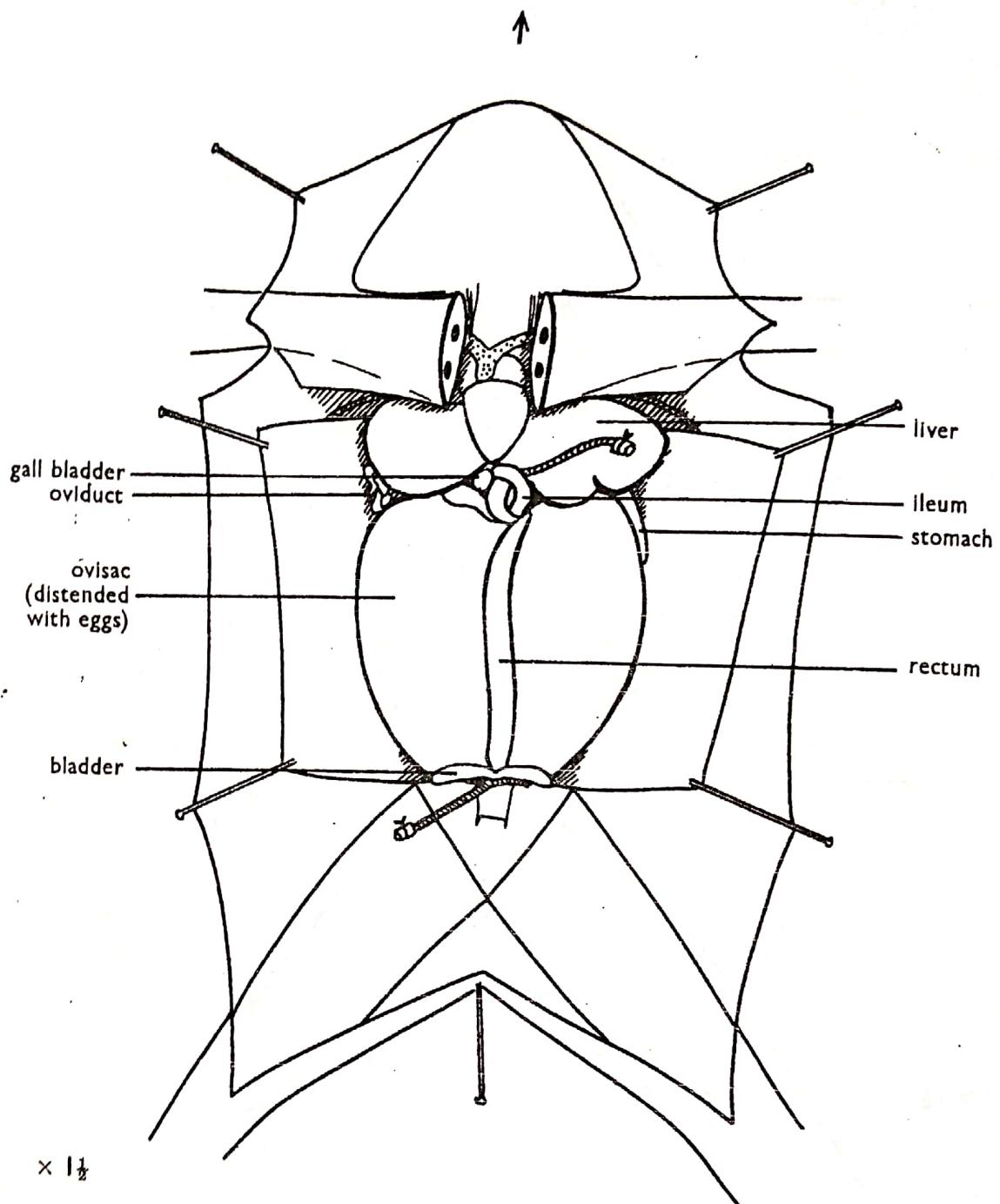
Examine the genital system and DRAW.

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.

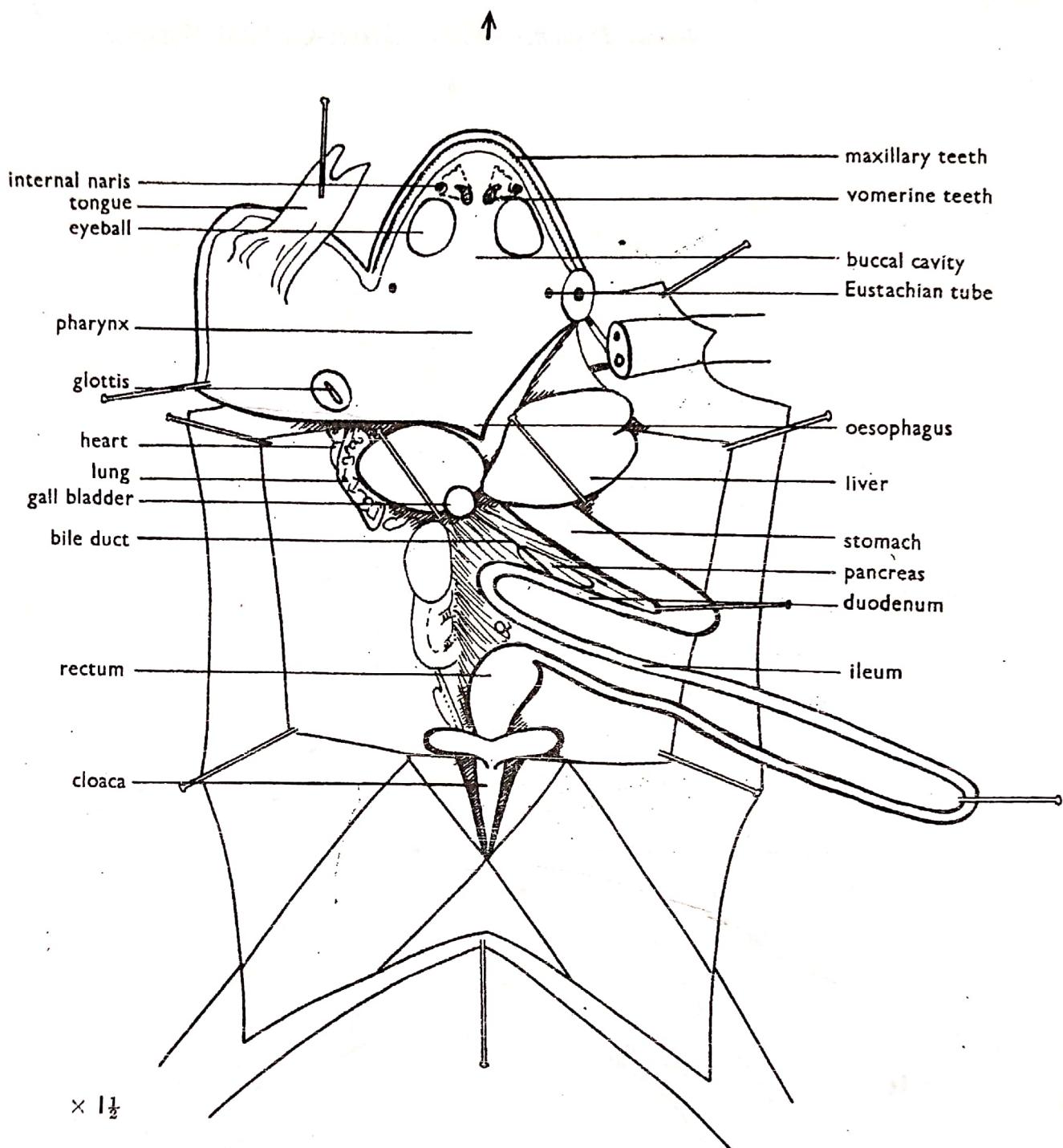
Puncture the ovisacs. Press out the eggs through as small a hole as possible.

**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.

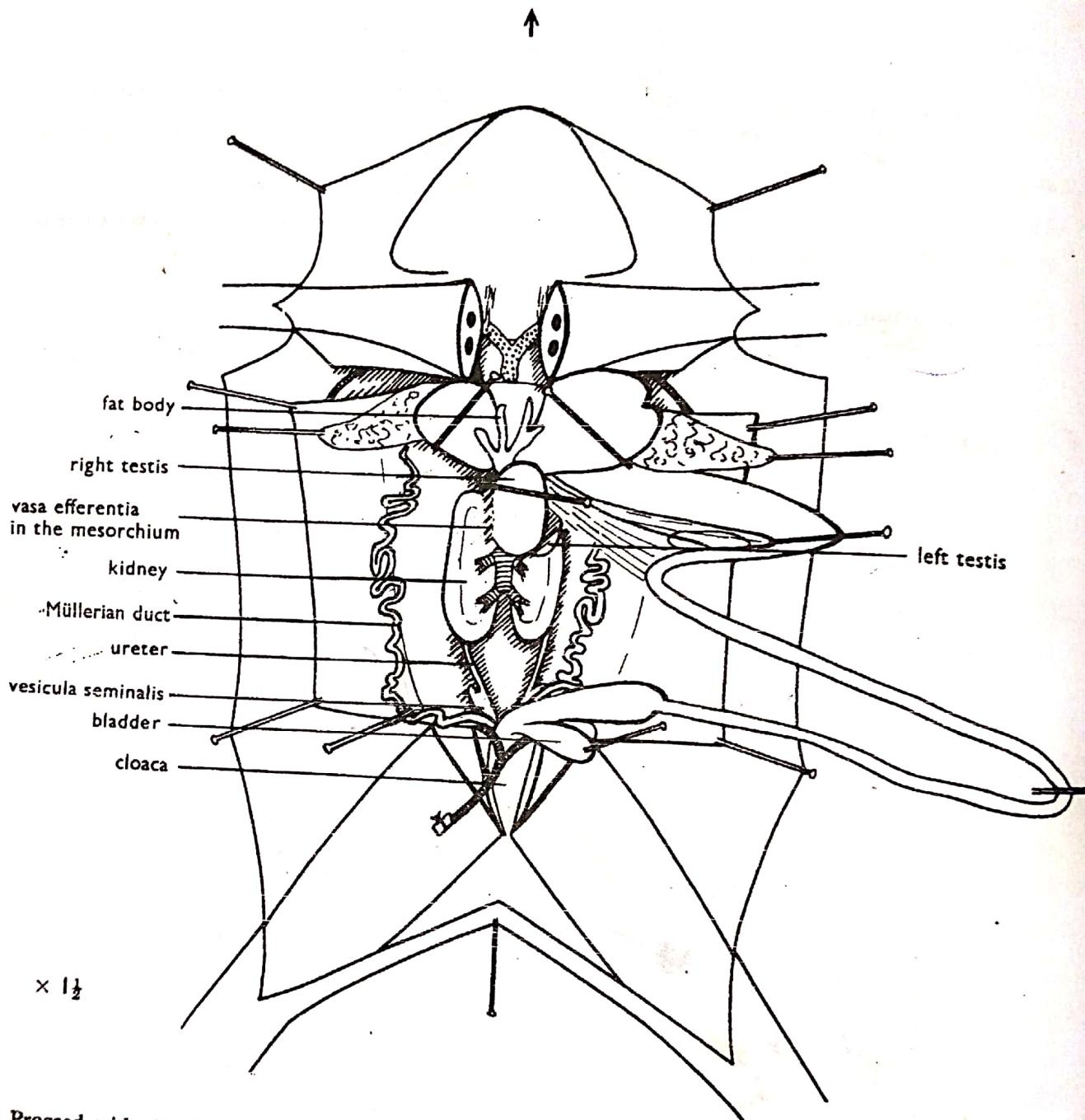
References—Stomach and Intestine, Figs. 14 & 15.

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 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.**

### 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.

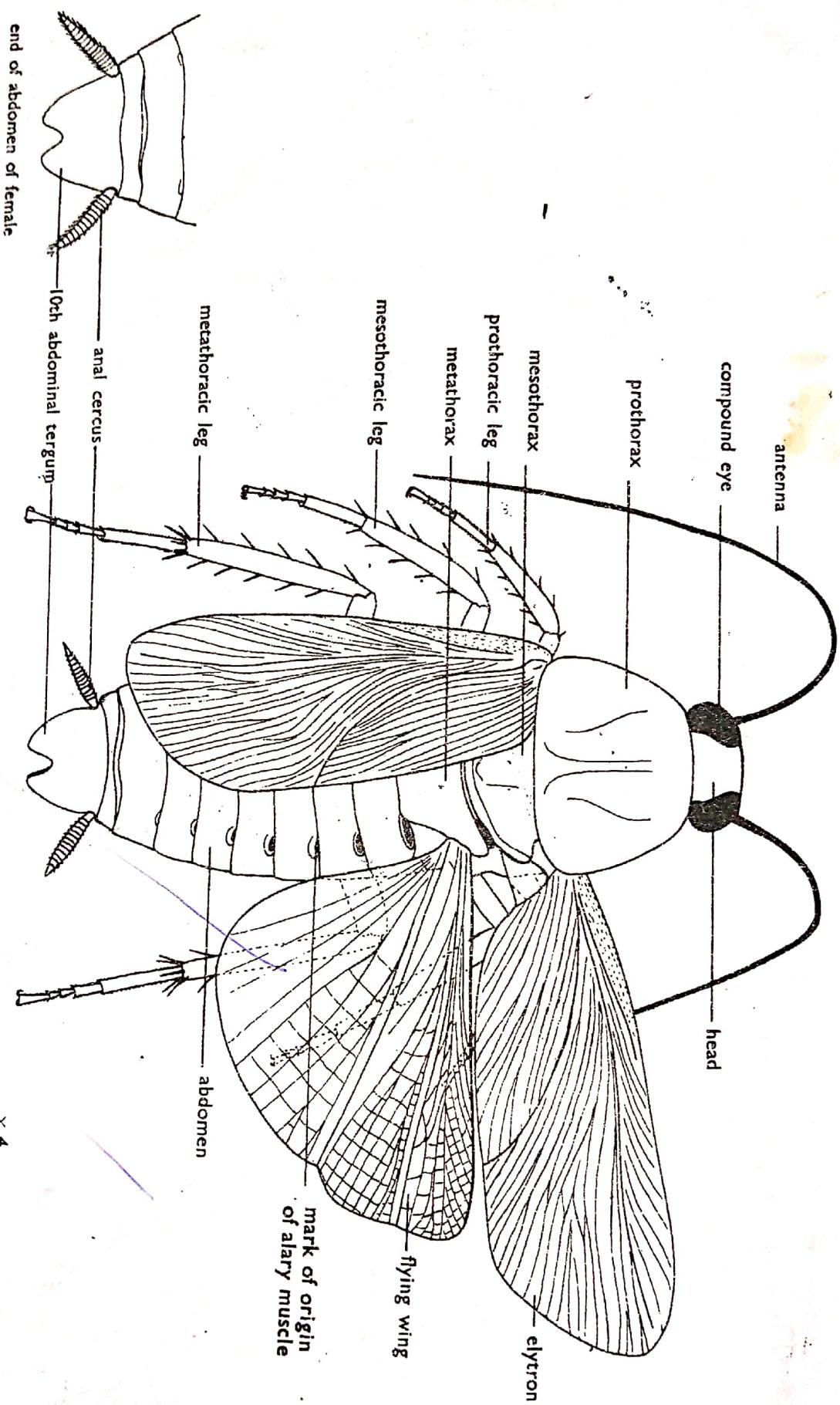


Fig. 31

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.

## Selected Invertebrates—Cockroach

217

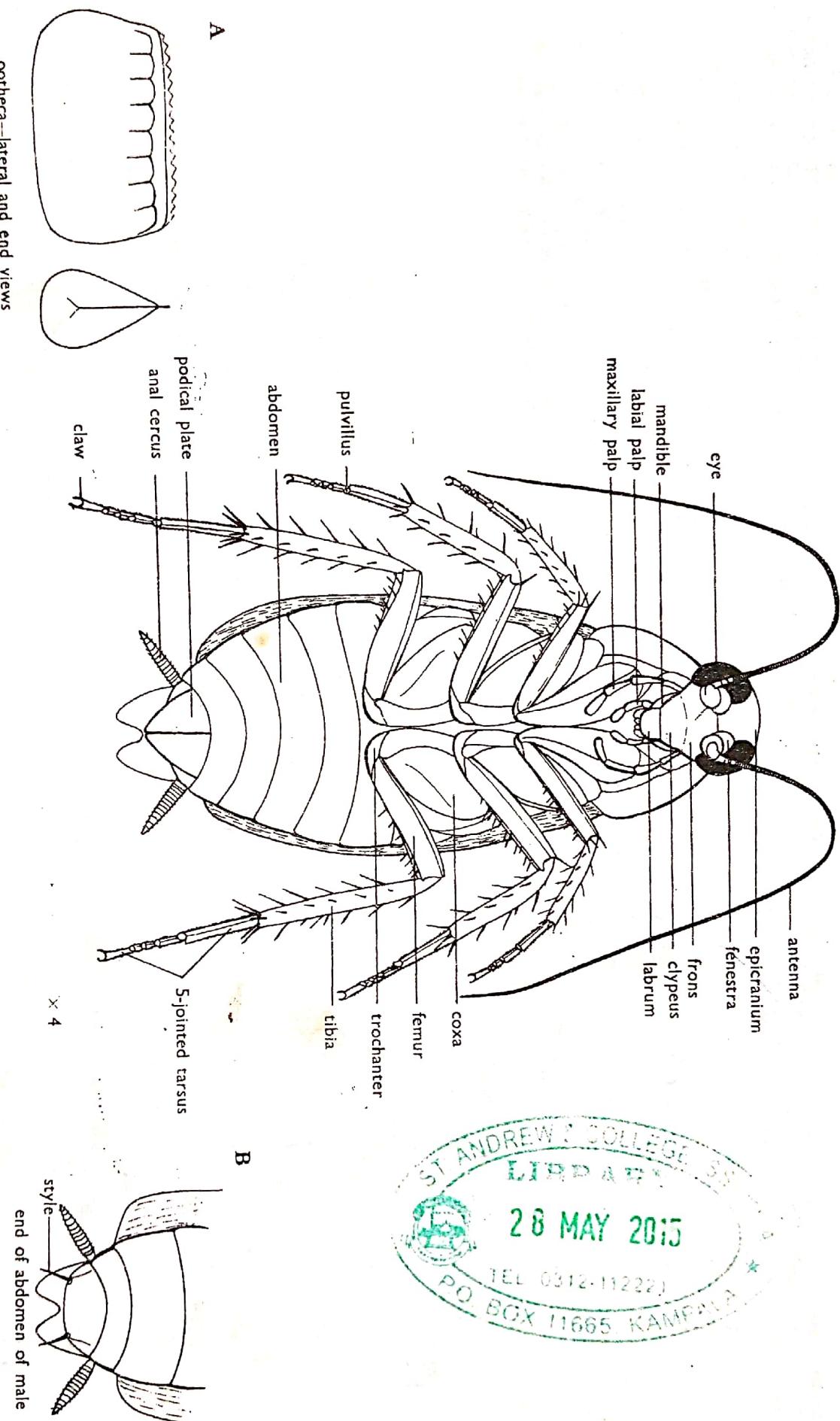


Fig. 32

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.

## Selected Invertebrates—Cockroach

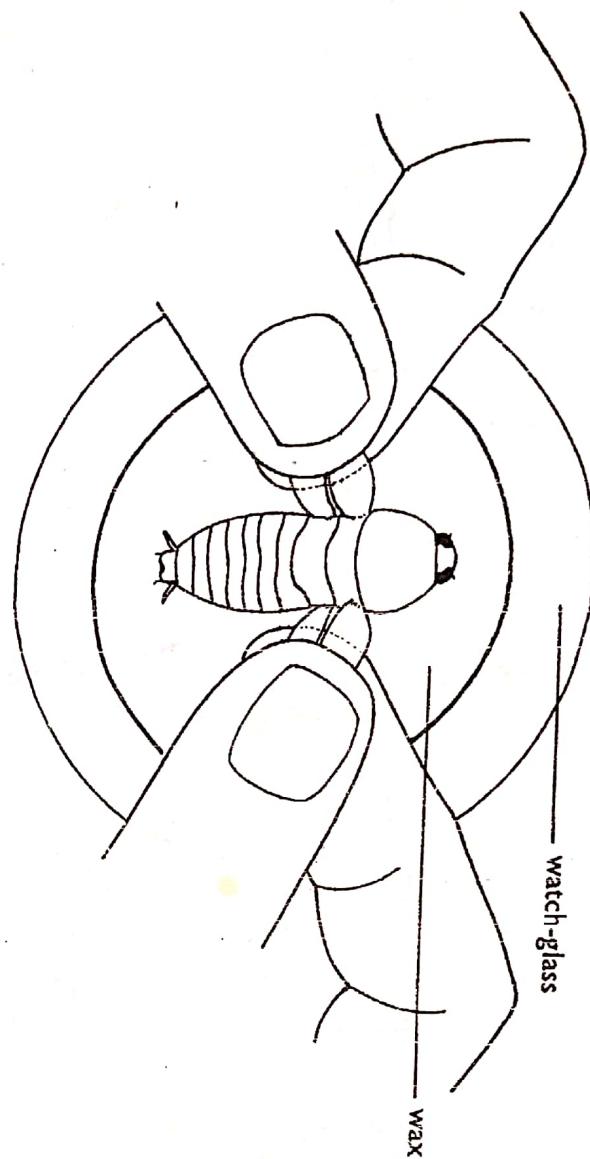


Fig. 33

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 WAX.

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.

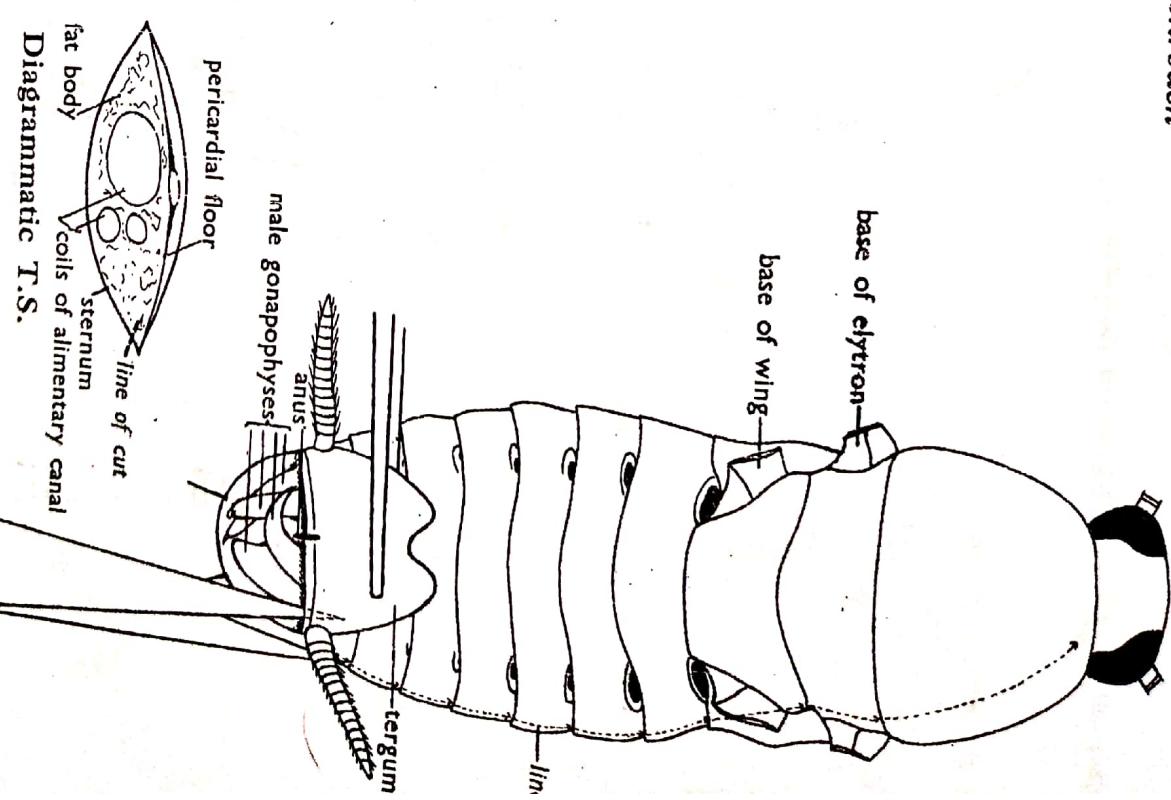


Fig. 34

Cut off the elytra and the wings close to their bases.

Lift the roth 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.

## Selected Invertebrates—Cockroach

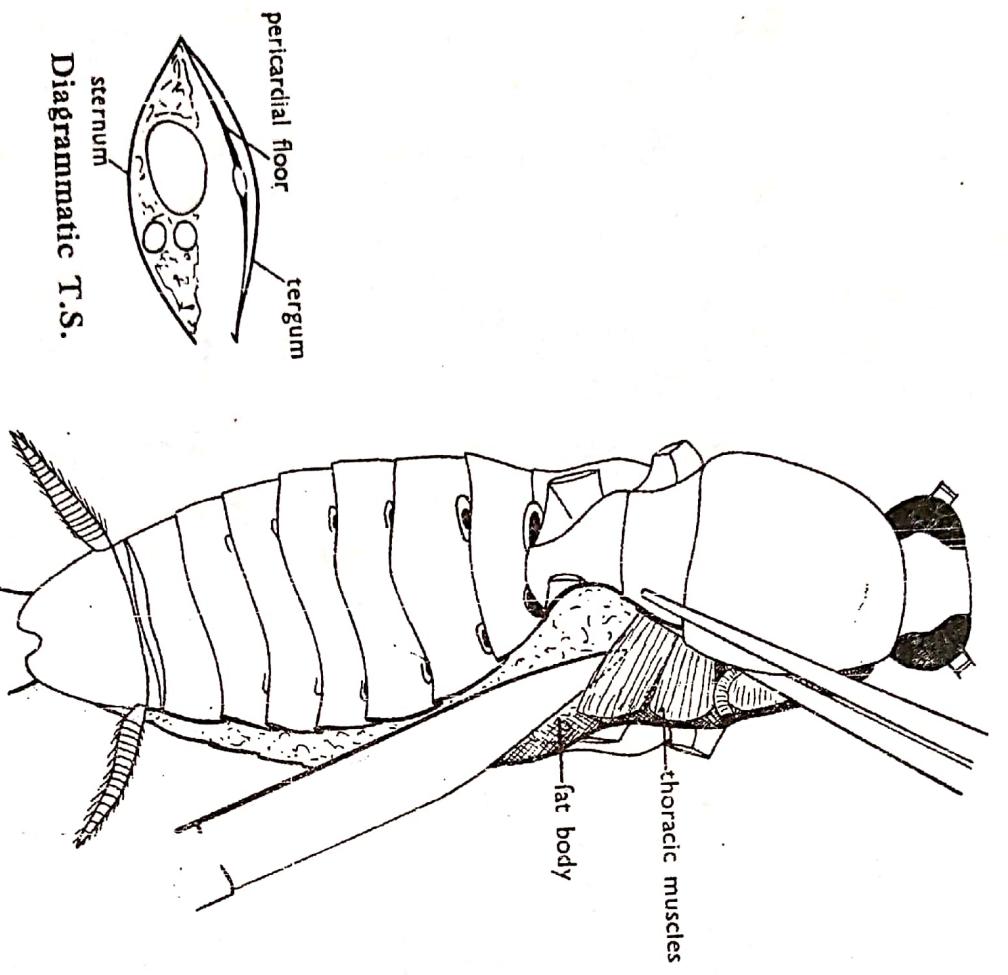


Fig. 35

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.

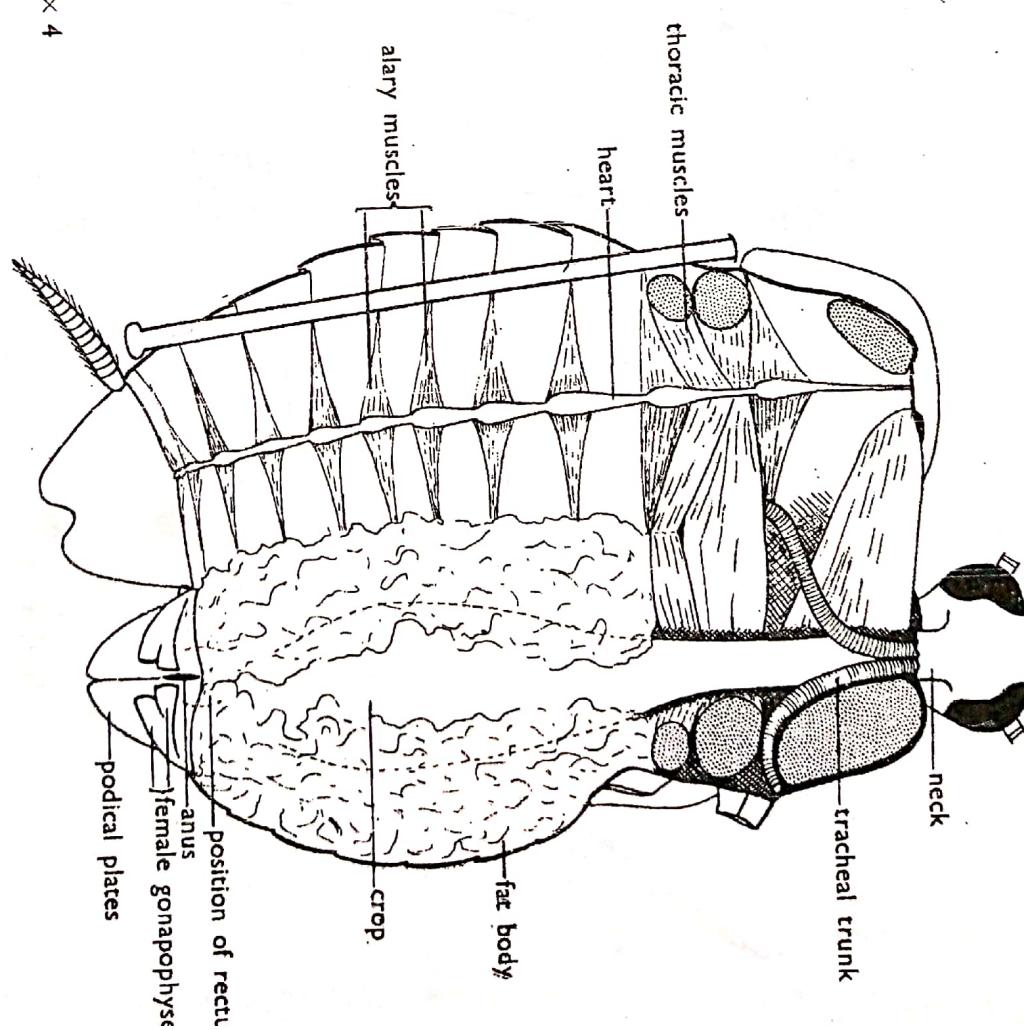


Fig. 36

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.

## Selected Invertebrates—Cockroach

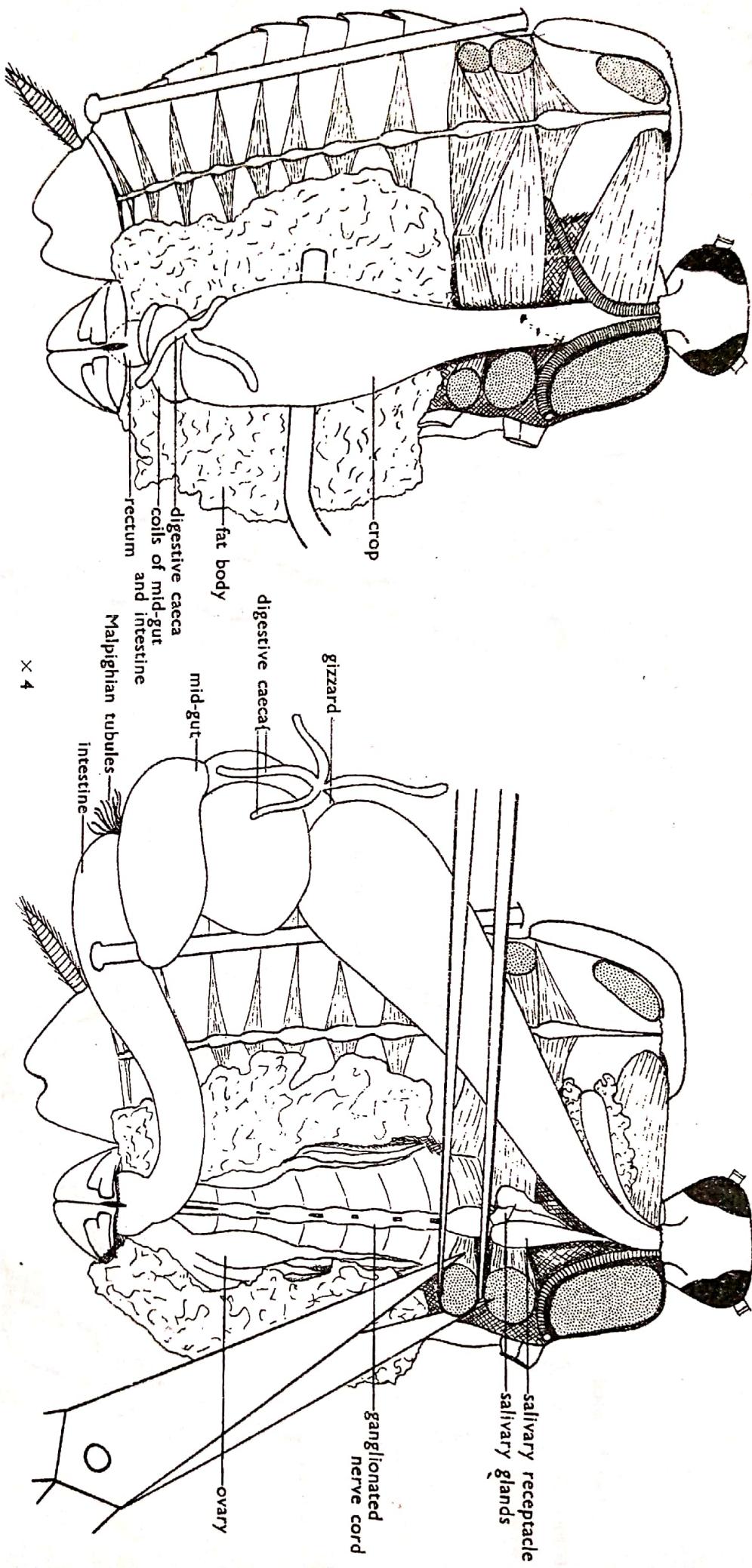


Fig. 37

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.

## Selected Invertebrates—Cockroach

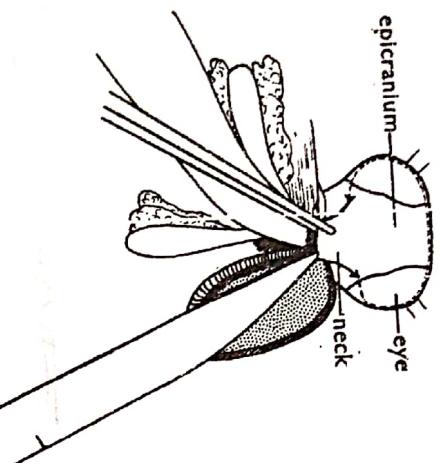


Fig. 39

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.

$\times 4$

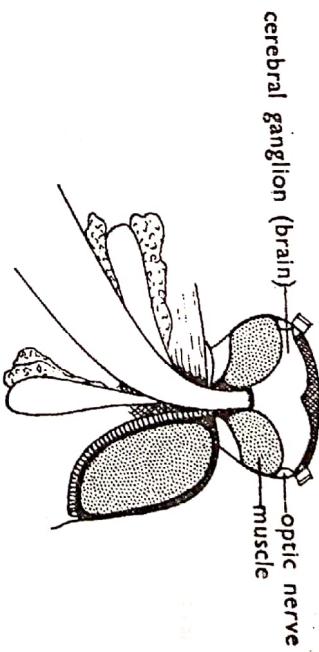


Fig. 40a

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.

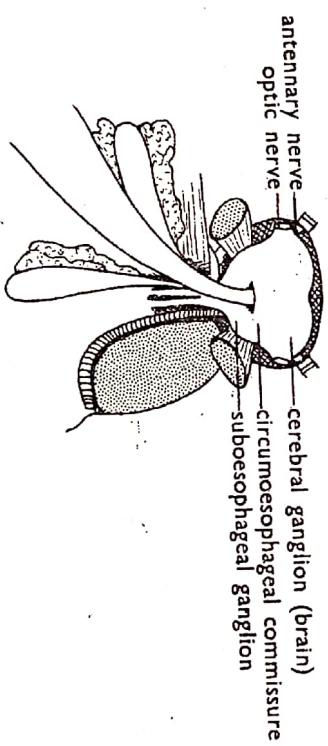
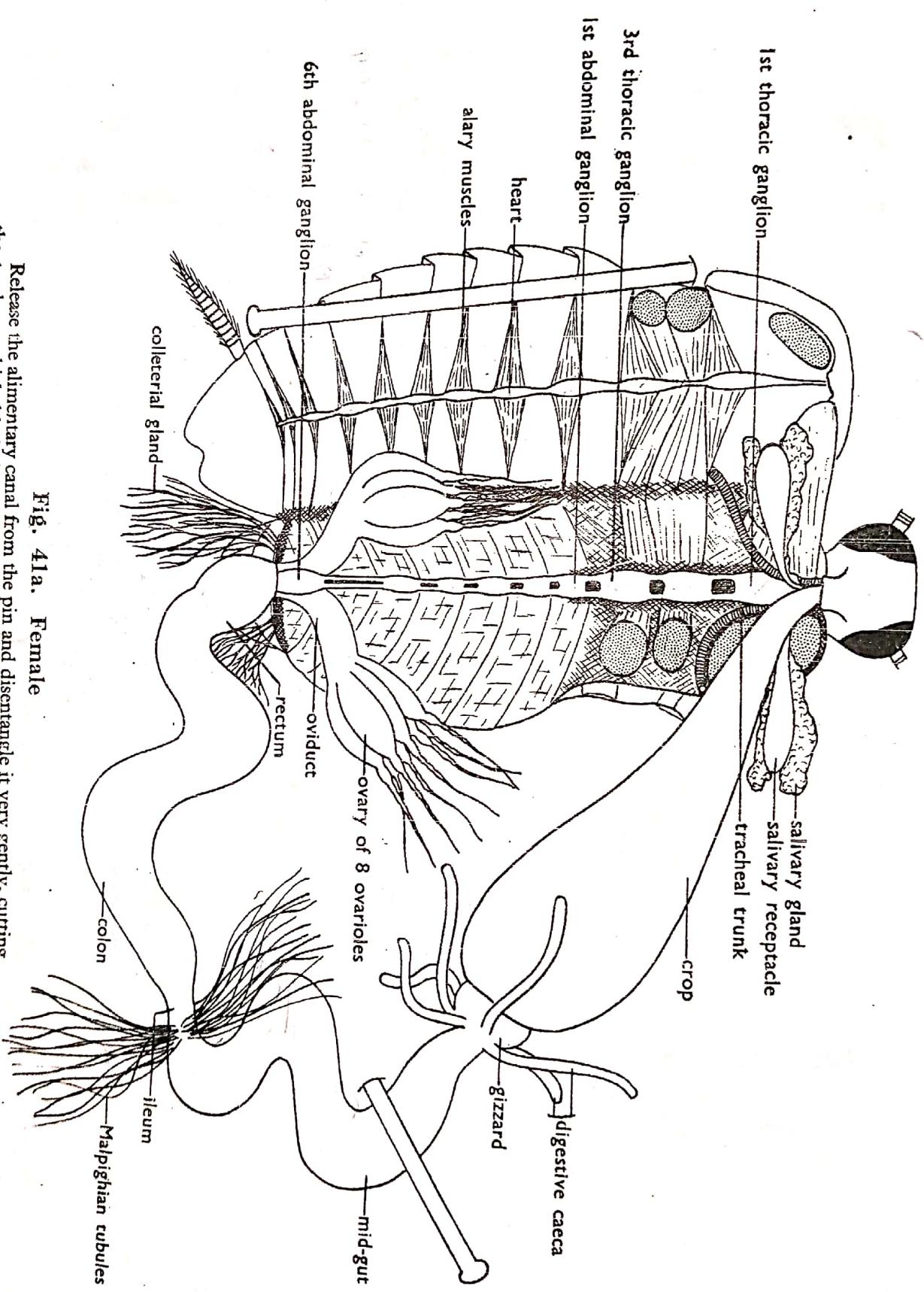


Fig. 40b

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

## Selected Invertebrates—Cockroach

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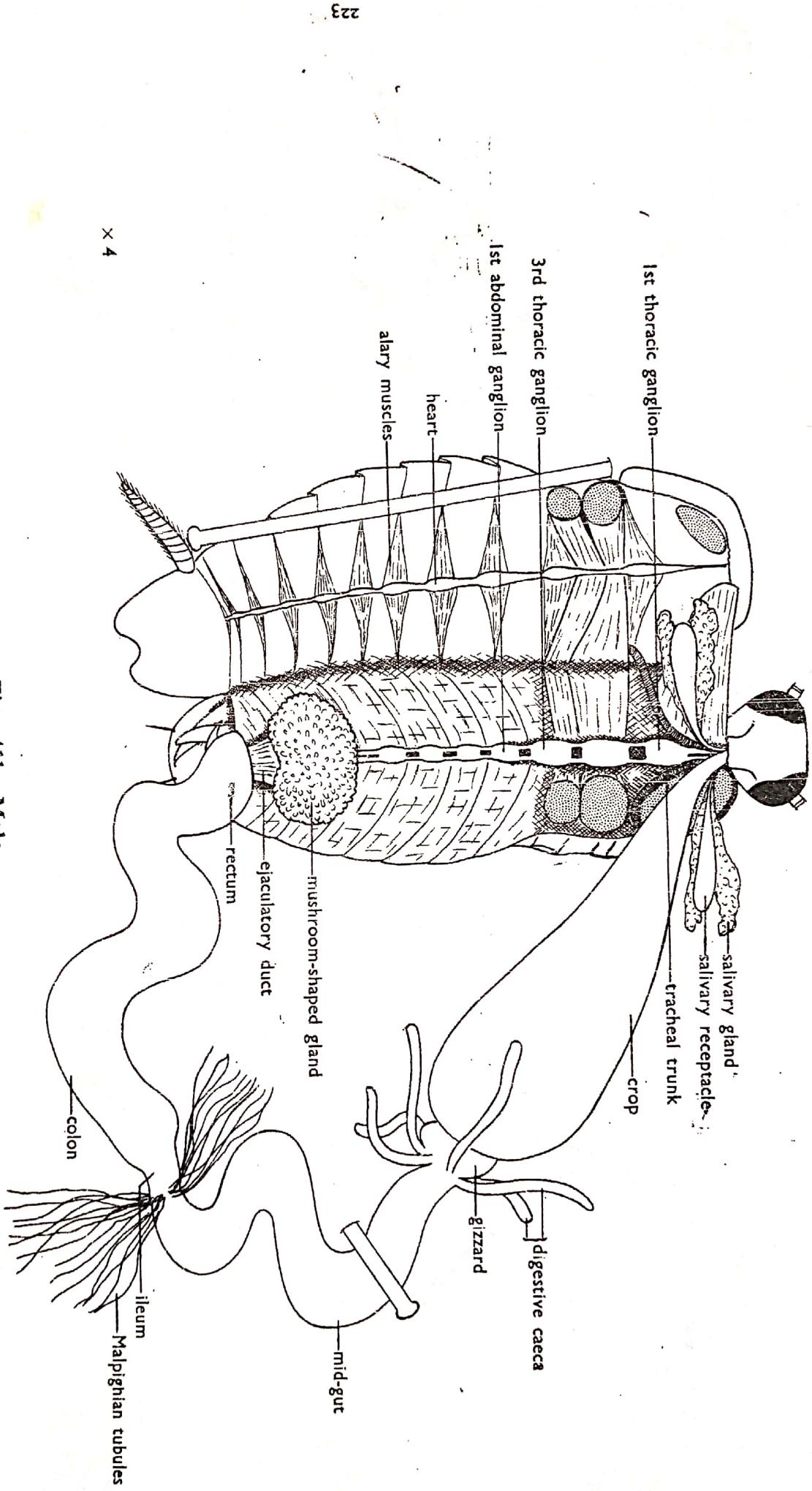
**Fig. 41a. Female**

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.

## Selected Invertebrates—Cockroach



**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.

## Selected Invertebrates—Cockroach

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 w/ the reservoirs  
and ducts, fix w/ formalin, stain in Delafield's  
haematoxylin and mount.

Fig. 42

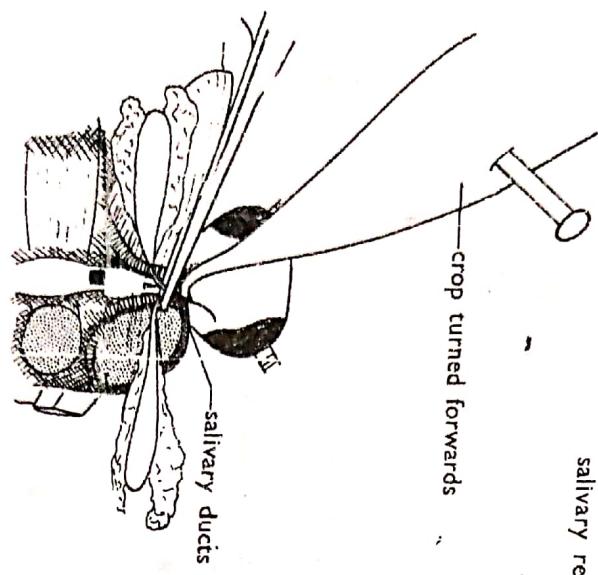
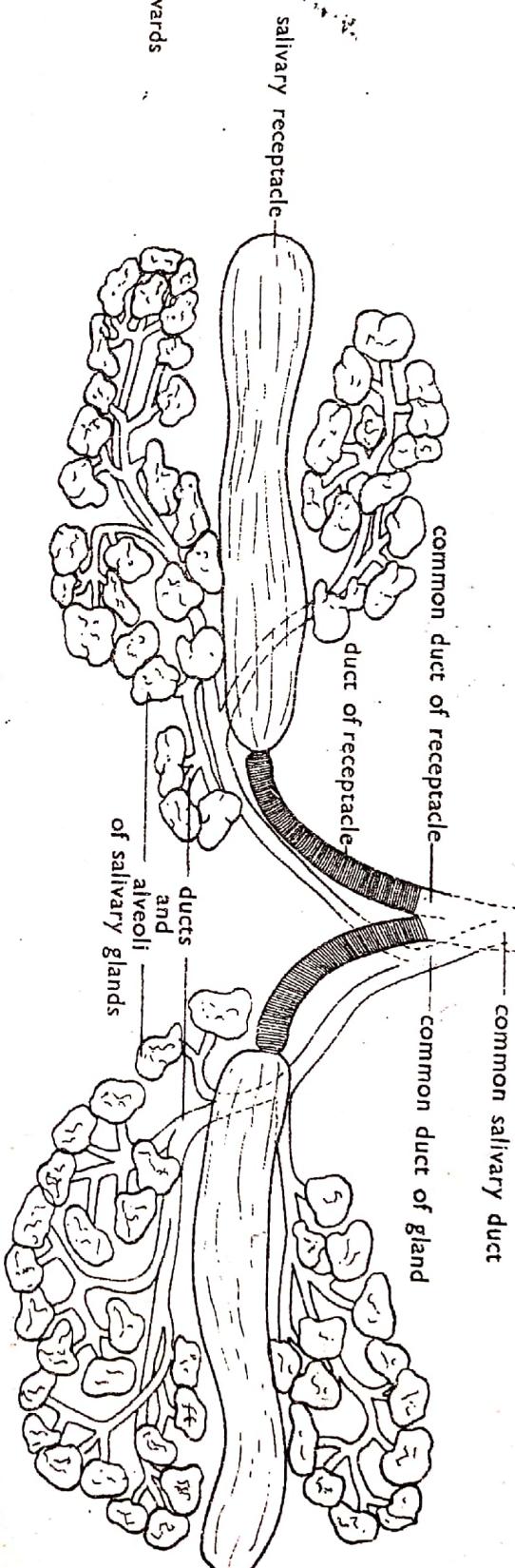
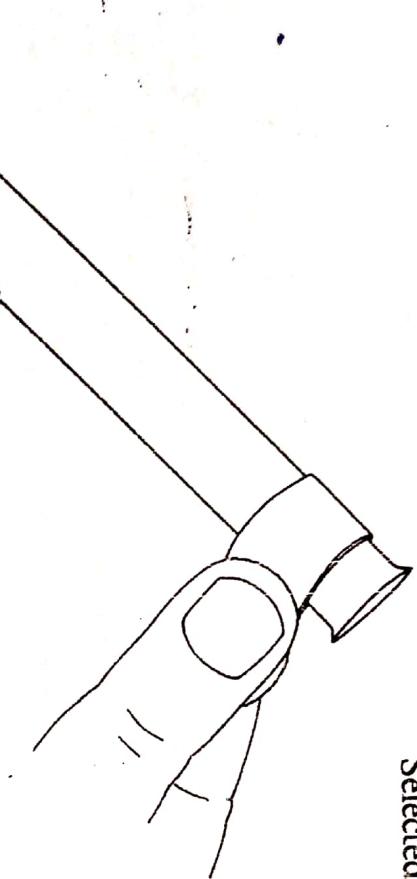


Fig. 43



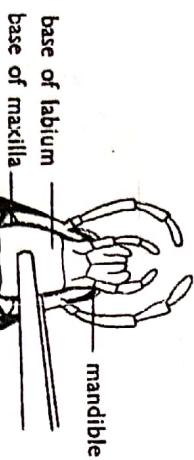
## Selected Invertebrates—Cockroach

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**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**

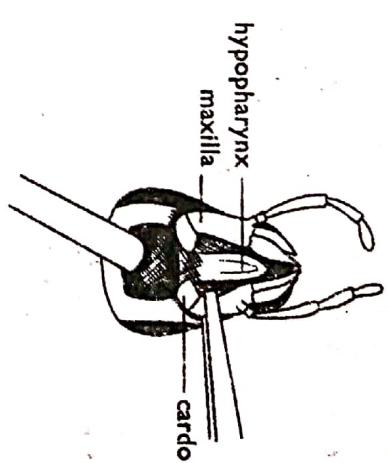
Hold the head by means of a dissecting-needle inserted through the neck. Use fine forceps to lift the labium, hold it near its base and pull gently.

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.

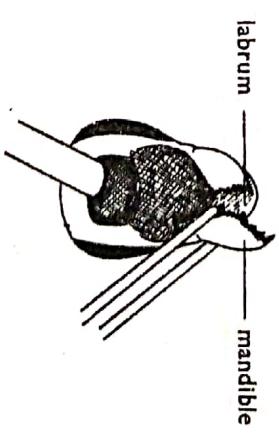
Place the labium in water in a safe place. NEVER LET THE HEAD OR MOUTH-PARTS BECOME DRY.

X 3



**Fig. 46**

Similarly remove the maxillæ 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 maxillæ and hypopharynx with the labium.

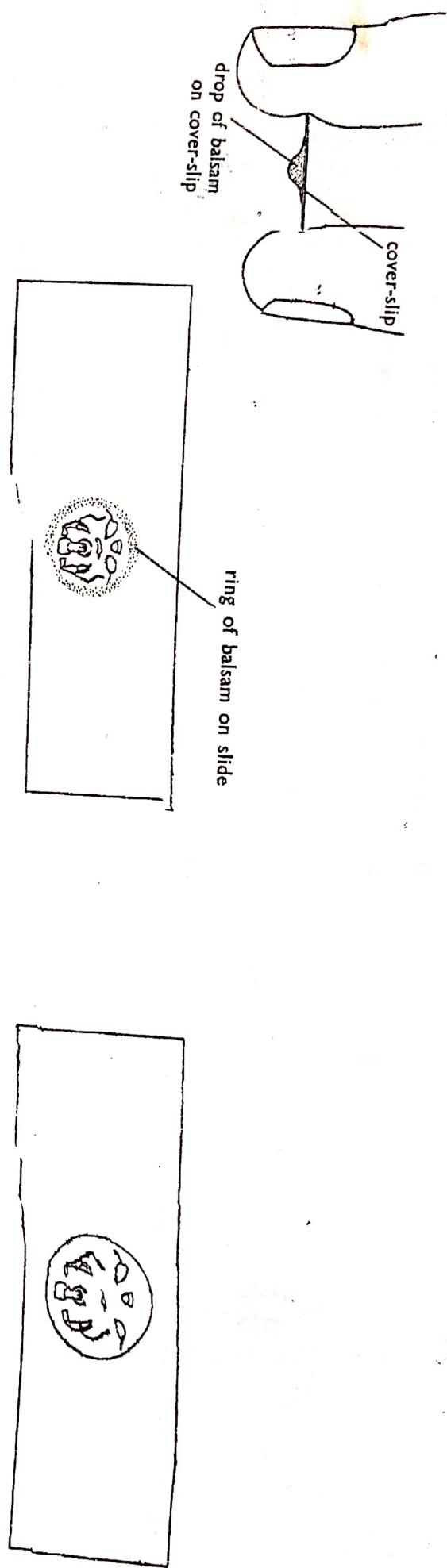


**Fig. 47**

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.

X 4



**Fig. 48**

Dehydrate ~~in~~ ~~methanol~~ 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. Place a drop of balsam round them. The ring should be smaller in diameter than the cover-slip. Make a  $\frac{5}{16}$  in.  $\times$   $\frac{1}{16}$  in. ring of balsam on the cover-slip. Invert the cover-slip rapidly so that the drop of balsam on it strikes the ring away from the slide. This holds the mouth-parts slightly far—see Fig. 49. Another white spot on the slide stops them from moving too

**Fig. 49**

The general appearance of the mount should be as shown.

## Selected Invertebrates—Cockroach

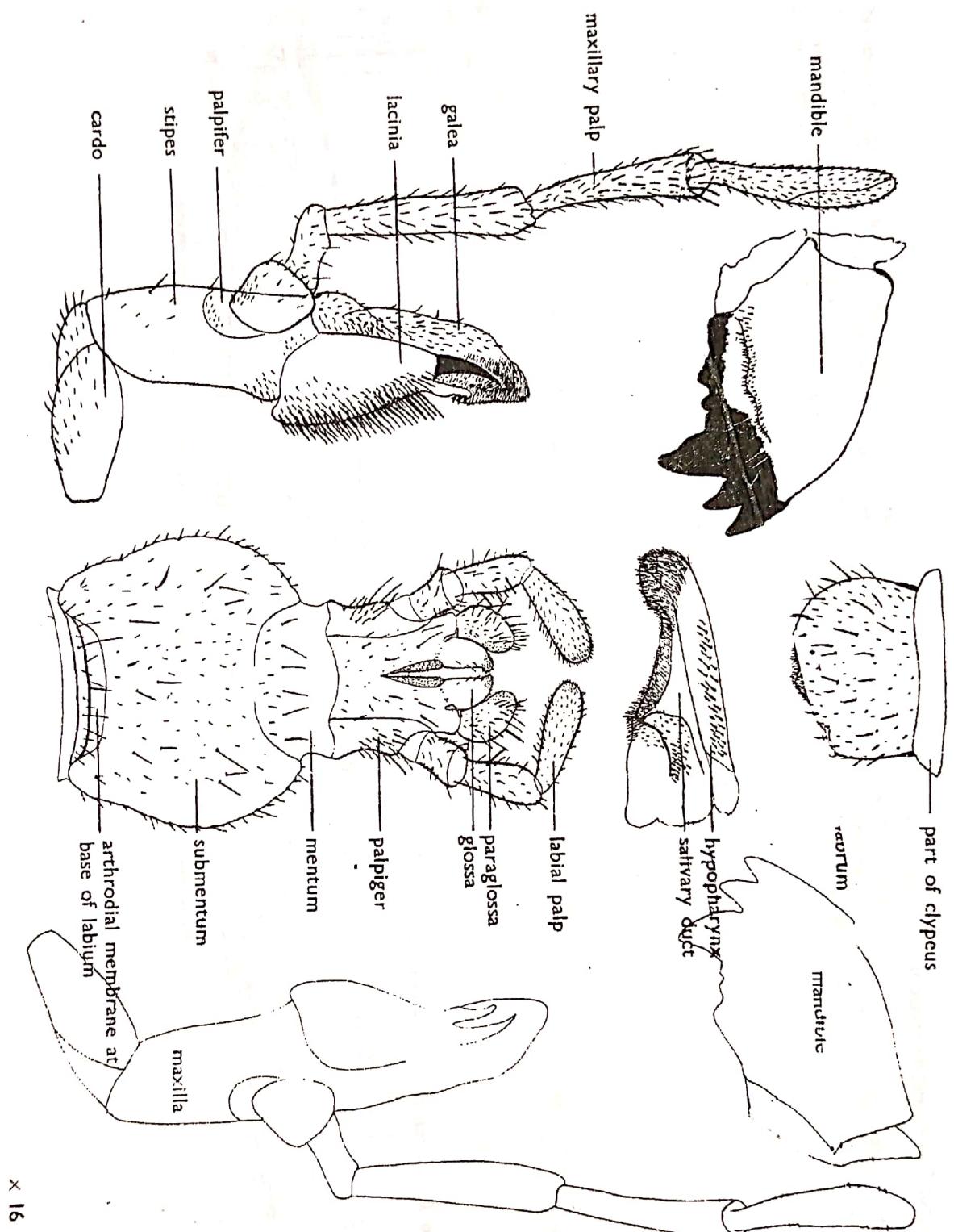


Fig. 50

Examine the individual mouth-parts microscopically and DRAW.