PLATE 41

Fig. 130. Graphic reconstruction of the muscle insertion pattern on the left side of the shell in Spec. III. The areas with muscle insertion cells were projected on a horizontal plane. For explanations compare Fig. 131.

Fig. 131. Diagram of the insertion pattern of a typical muscle group in *Neopilina*, showing at the same time the meaning of the designations used in Fig. 130.

Fig. 132. Insertion pattern on the anterior shell wall of Spec. IV. The areas with muscle attachment cells have been projected on a transversal plane. The insertion areas of muscles related to the ventral body wall are hatched, those of the radula muscles are black.

Fig. 133. The pattern of muscle scars on the inner side of the shell of *Pilina unguis*, drawn on the basis of the specimen shown in Fig. 134, and completed in agreement with KNIGHT (1941). The present authors' interpretations have been introduced.

A-H = muscle attachment groups A to H
A_1 = musculus obliquus anterior A
ap = apex
di. sc = "diaphragm scar"
m. br. ex = musculus branchialis externus (white, double contour)
m. br. i = musculus branchialis internus (black, double contour)
m. ci. int = musculus circularis intermedius (black, white dots)
m. lp = musculus latero-pedalis (black)
m. mp = musculus medio-pedalis (large black dots)
m. obl. a = musculus obliquus anterior (horizontal streaks)
m. obl. p = musculus obliquus posterior (vertical streaks)
m. ra. l = musculus radulae longus
pa. l = pallial line
pa. m = pallial muscles (small dots)
X = insertion area X
X_1 = musculus protractor radulae
X_2 = musculus protractor cartilaginis dorsalis (the small head)
X_3 = musculus protractor cartilaginis dorsalis (the large head)
X_4 = musculus protractor vesicae minor
X_5 = musculus praeoralis
X_6 = musculus protractor cartilaginis profundus
X_7 = musculus protractor vesicae major, including also the heads of m. tensor membranae anterior and m. protractor diverticulorum dorsalis
Y = insertion area Y
Y_1 = the muscle Y_1
Y_2 = musculus oralis anterior
Y_3 = musculus cartilaginis antero-lateralis
Z = musculus tensor radulae
1-7 = the different parts of the muscle scar complexes in *Pilina* (Fig. 133), interpreted as:
1 = musculus latero-pedalis
2 = musculus medio-pedalis
3 = musculus obliquus posterior
4 + 5 = musculus branchialis externus and a pallial muscle
6 = musculus obliquus anterior
7 = musculus branchialis internus and (or) a pallial muscle

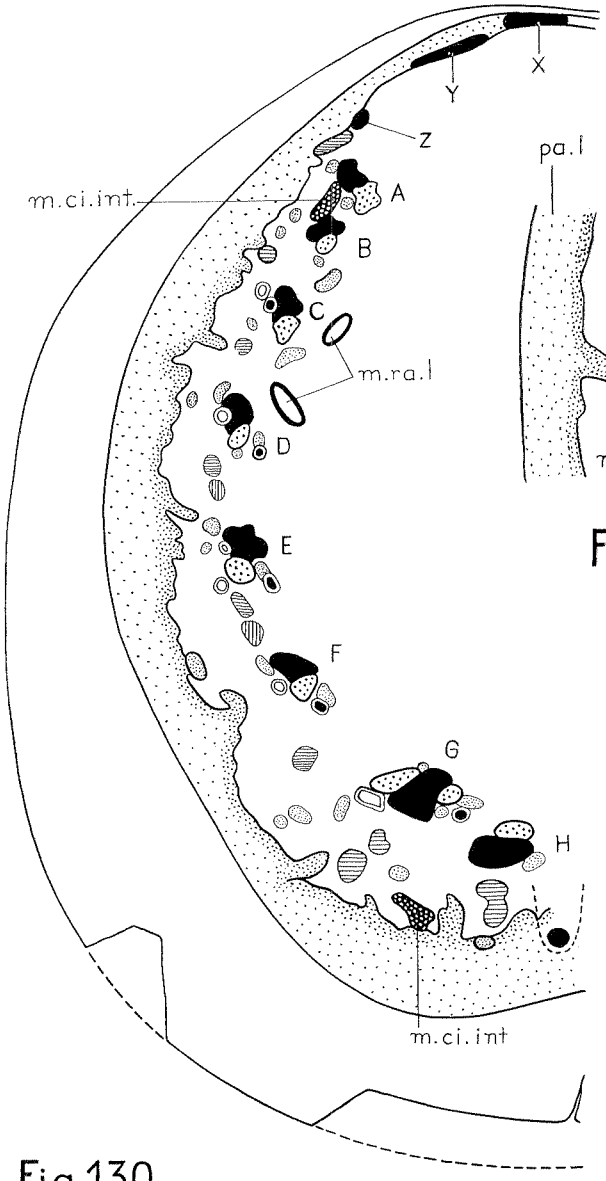


Fig.130

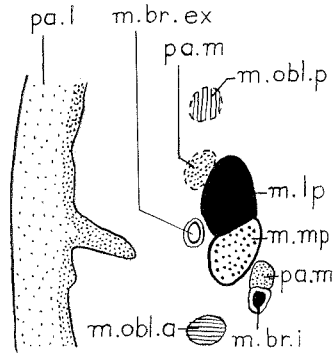


Fig.131

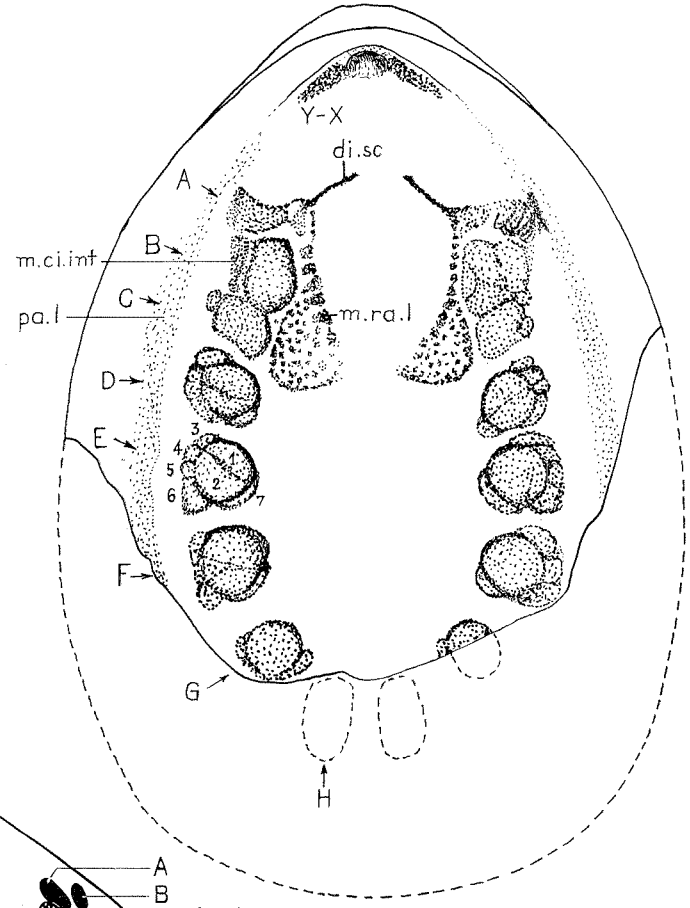


Fig.133

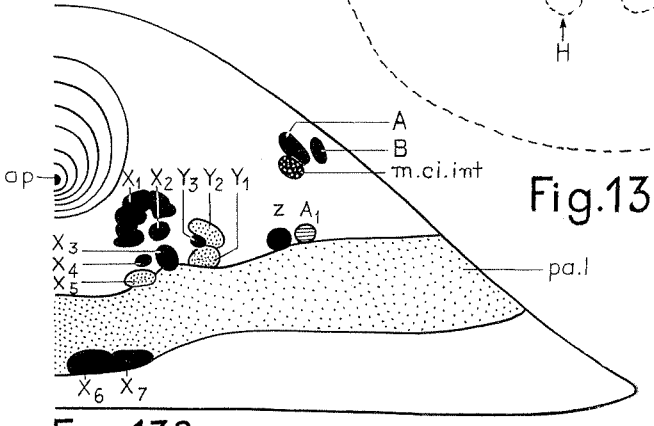


Fig.132

PLATE 42

Fig. 134. *Pilina unguis* (LINDSTRÖM), from the Silurian of Gotland (Compare LINDSTRÖM, 1884, pl. 19, fig. 2). Inner side of shell, smoked with ammonium chloride to make the muscle scars distinct. For interpretation see Fig. 133.

Specimen and photograph from the Paleozoological Department of the Swedish Museum of Natural History, Stockholm (Director, Prof. ERIK STENSIÖ).

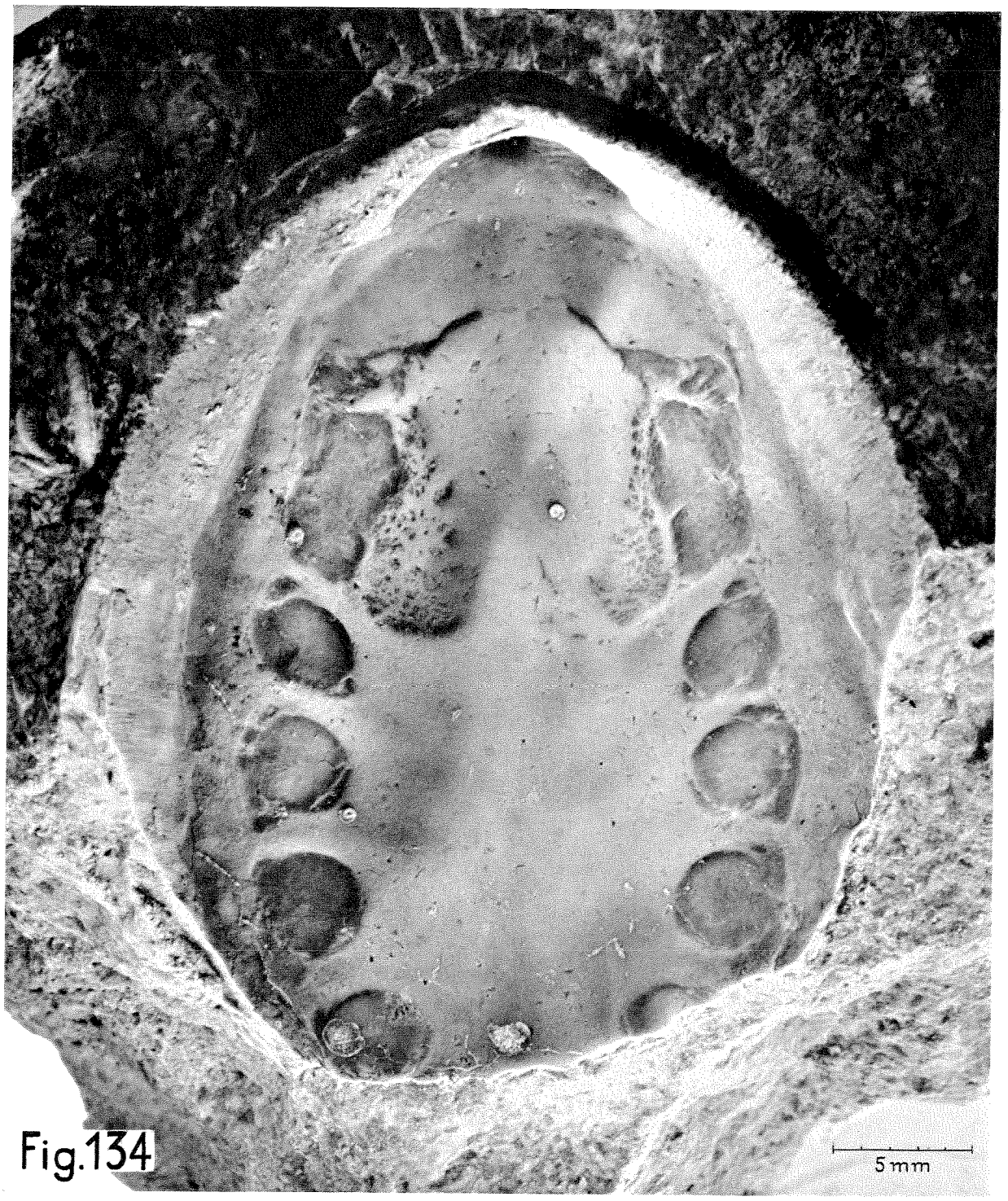


Fig.134

PLATE 43

Fig. 135. The nervous system, projected on a horizontal plane by means of graphic reconstruction. The right side includes all the traceable branches, the left one shows the latero-pedal connectives and the gill nerves only. Spec. III.

4-10 = latero-pedal connectives 4 to 10
bu. co = buccal connective
bu. g = buccal ganglion
cer. co = cerebral commissure
cer. g = cerebral ganglion
ex. g. n = external (anterior) gill nerve
f. m = foot margin
G = gills
i-p. co = inter-pedal commissure
in. g. n = internal (posterior) gill nerve
la. n. c = lateral nerve cord
la. pe. n = lateral pedal nerves
l-p. co_4 = latero-pedal connective 4
me. pe. n = medial pedal nerves
pa. n = pallial nerves
pe. n. c = pedal nerve cord
rp. n = nerve to the renopore

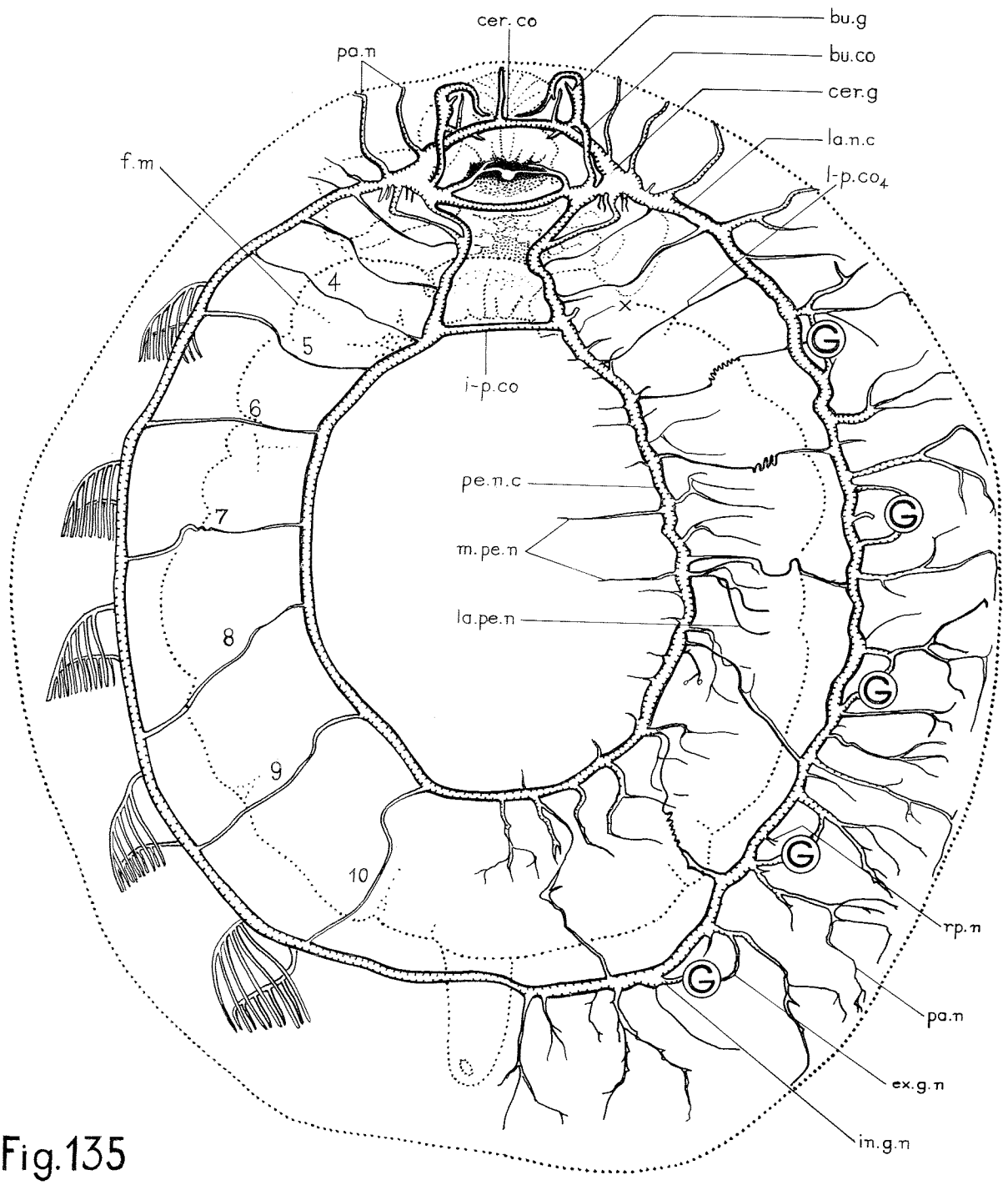

cer. co
bu.g
pa.n
bu.co
cer.g
la.n.c
f.m
l-p.co4
4
5
i-p.co
6
pe.n.c
7
m.pe.n
la.pe.n
8
9
10
rp.n
pa.n
ex.g.n
im.g.n

Fig.135

PLATE 44

Fig. 136. Anterior part of the nervous system, seen from above. The pharynx and the subradular organ are drawn to the left only. The base of the velum, the anterior lip, and the tentacle ridge is indicated by stippling, and the nerves passing to these organs are not particularly marked. Graphic reconstruction. Spec. III.

Fig. 137. The relation between the nervous system and the musculature in the anterior body region. Only muscles associated with the ventral body wall are shown. Graphic reconstruction. Spec. III.

1-6 = latero-pedal connectives 1 to 6
A-D = pedal retractors A to D
b. ant. 1 = base of anterior lip
b. te. ri = base of tentacle ridge
b. ve = base of velum
bu. co = buccal connective
bu. g = buccal ganglion
ce. co = cerebral commissure
ce. g = cerebral ganglion
ex. gi. n_1 = external (anterior) nerve of 1st gill
i-p. co = inter-pedal commissure
in. gi. n_1 = internal (posterior) nerve of 1st gill
la. n. c = lateral nerve cord
m. ci. pe = musculus circularis pedis
m. cru = musculus cruciatus
m. obl. A = musculus obliquus anterior A
m. or. a = musculus oralis anterior
m. or. p = musculus oralis posterior
m. pro = musculus praeoralis
m. te. tr = musculus tentacularis transversus
m. tr. A = musculus transversalis A
pa. n = pallial nerves
pe. n. c = pedal nerve cord
ph = pharynx
pr. te = base of preoral tentacle
sce. co = subcerebral commissure
sr. g = subradular ganglion
sr. n = subradular nerve
sr. s = subradular sac
st = statocyst
st. d = statocyst duct
st. n = statocyst nerve
ve. n = velar nerves and branches to anterior lip
Y_1 = the muscle Y_1

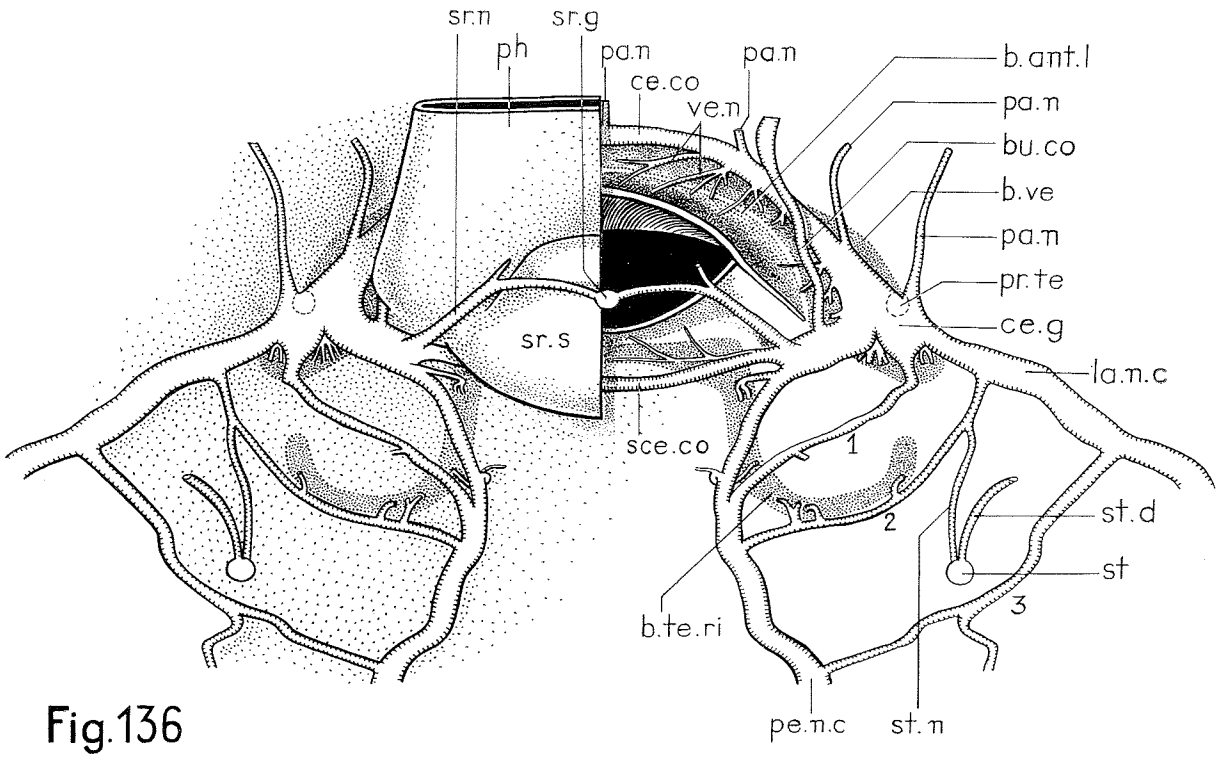


Fig.136

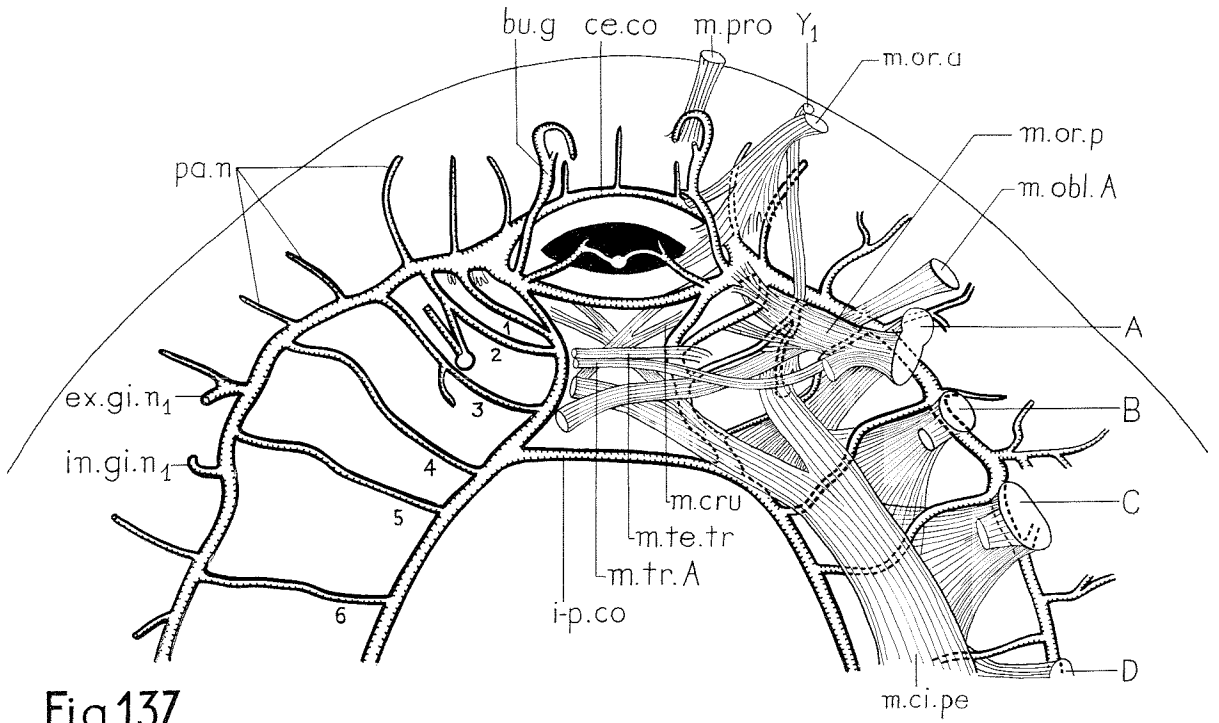


Fig.137

Plate 45

Fig. 138. Transversal section through the ventral body wall just inside the foot margin, showing the pedal nerve cord with its superficial layer of nerve cells. Microphotograph. Spec. III.

Fig. 139. Transversal section through the statocyst. Note the high and dark epithelium forming the bottom and the sides. Microphotograph. Spec. III.

Fig. 140. Part of the ventral body wall and of the foot of a dissected specimen, seen in transmitted light. The pedal nerve cord and the regularly spaced latero-pedal connectives are distinct. Photograph. Spec. X.

Fig. 141. Blood cells in a pallial blood sinus. Microphotograph. Spec. III.

Fig. 142. Leydig cells in loose connective tissue from the inner part of the pallial fold. Microphotograph. Spec. III.

bl. s = blood sinus
l-p. co = latero-pedal connective
ov = ovary
pe. n. c = pedal nerve cord

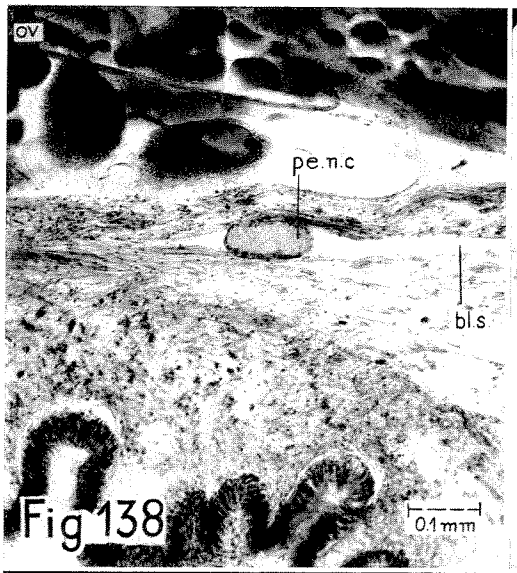


Fig.138

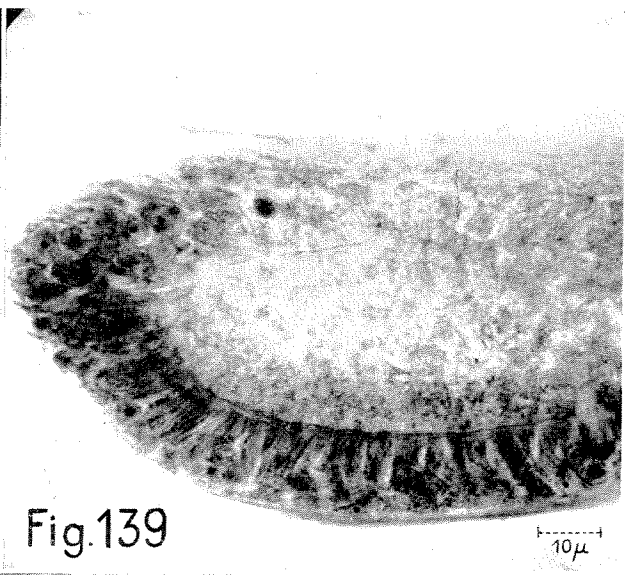


Fig.139

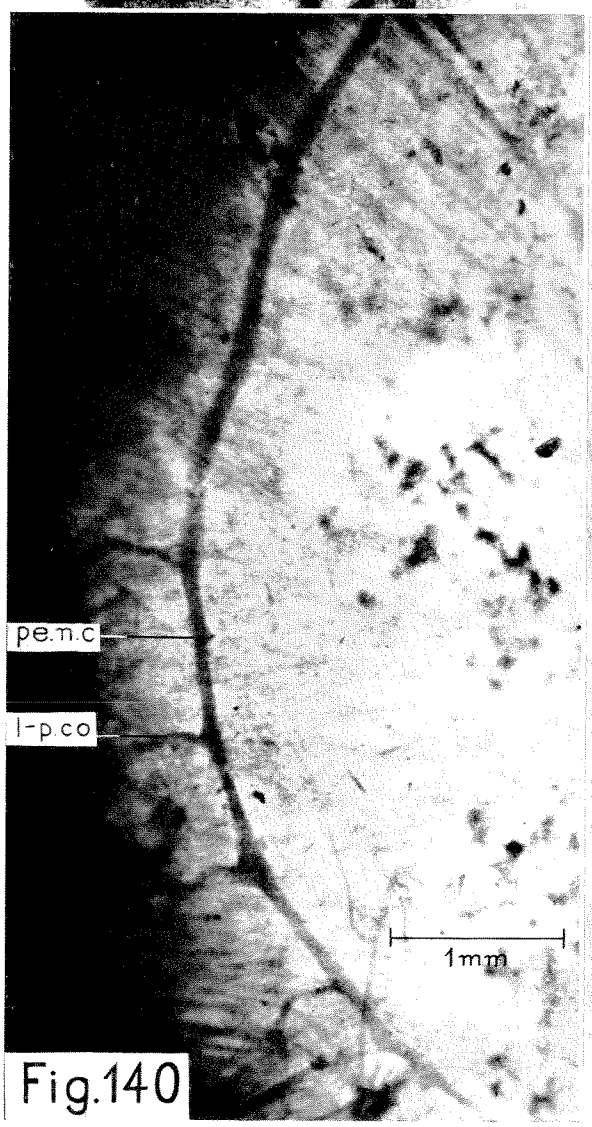


Fig.140

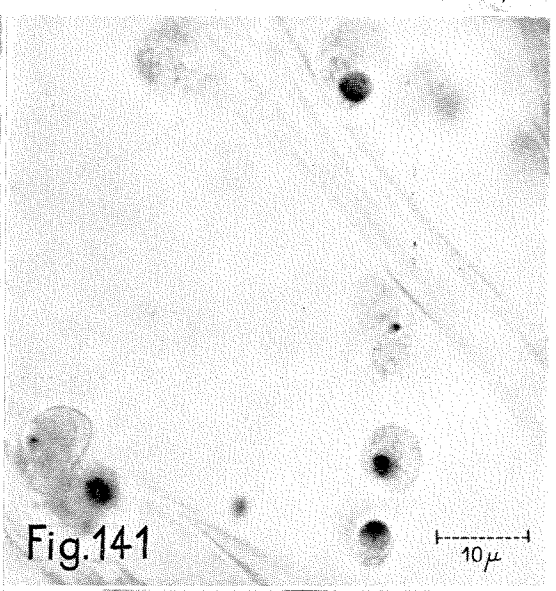


Fig.141

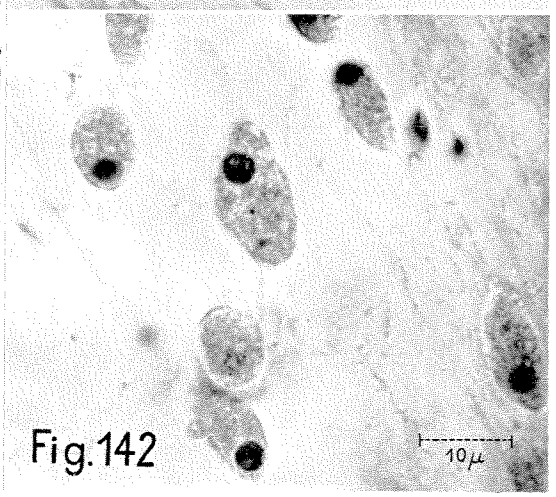


Fig.142

PLATE 46

Fig. 143. Diagrammatical section through the heart region, showing the heart and its connection with the gill circulation. Arrows indicate the supposed direction of the blood stream and of the water current through the gills.

Fig. 144. Graphic reconstruction of the arterial part of the vascular system, superimposed on the urogenital system. For explanations see also Fig. 145. Spec. III.

A-H = position of the pedal retractors A to H (not drawn)
an = anus
ao = aorta
a. pa. s = arterial pallial sinus
ar. cl = artificial cleft between pericard and dorsal epithelium
art. g. v_{1-5} = entrance of arterial vessels from 1st to 5th gill
atr = atrium, 1 and 2 indicates 1st and 2nd pair resp.
a-v. v = atrio-ventricular valves
gi. st = gill stem
m = mouth
ne = nephridia
od_2 = second oviduct
ov = ovary
per. bl. s = peri-intestinal blood sinus
perc = pericard
po. f. m = posterior foot margin
re = rectum
rep_{1-2} = renopores 1 and 2
ve. h = ventricle of heart
ve. pa. s = venous pallial sinus

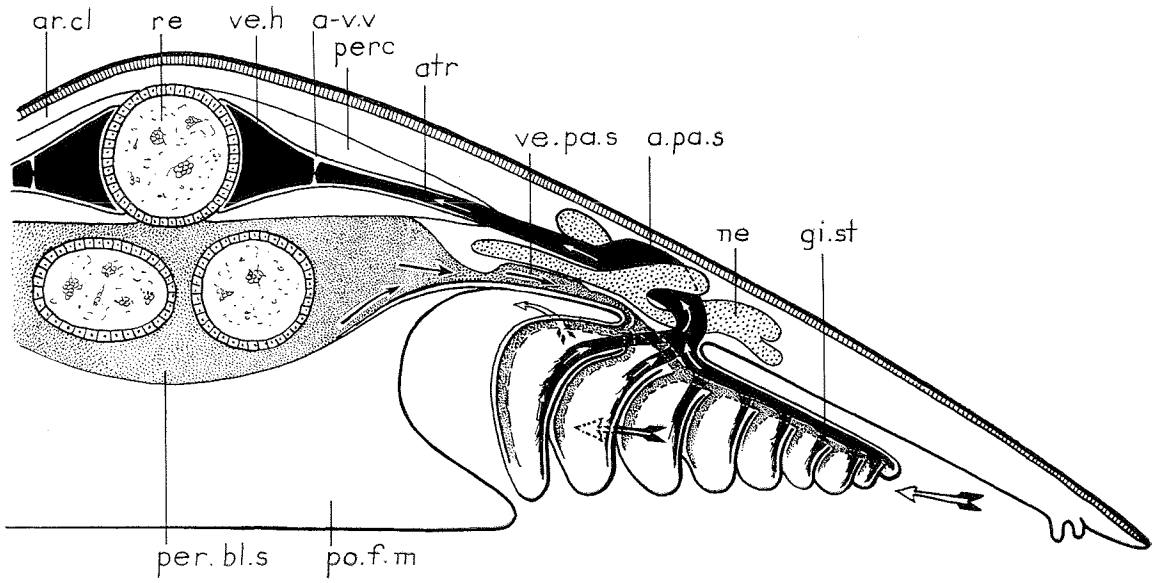


Fig.143

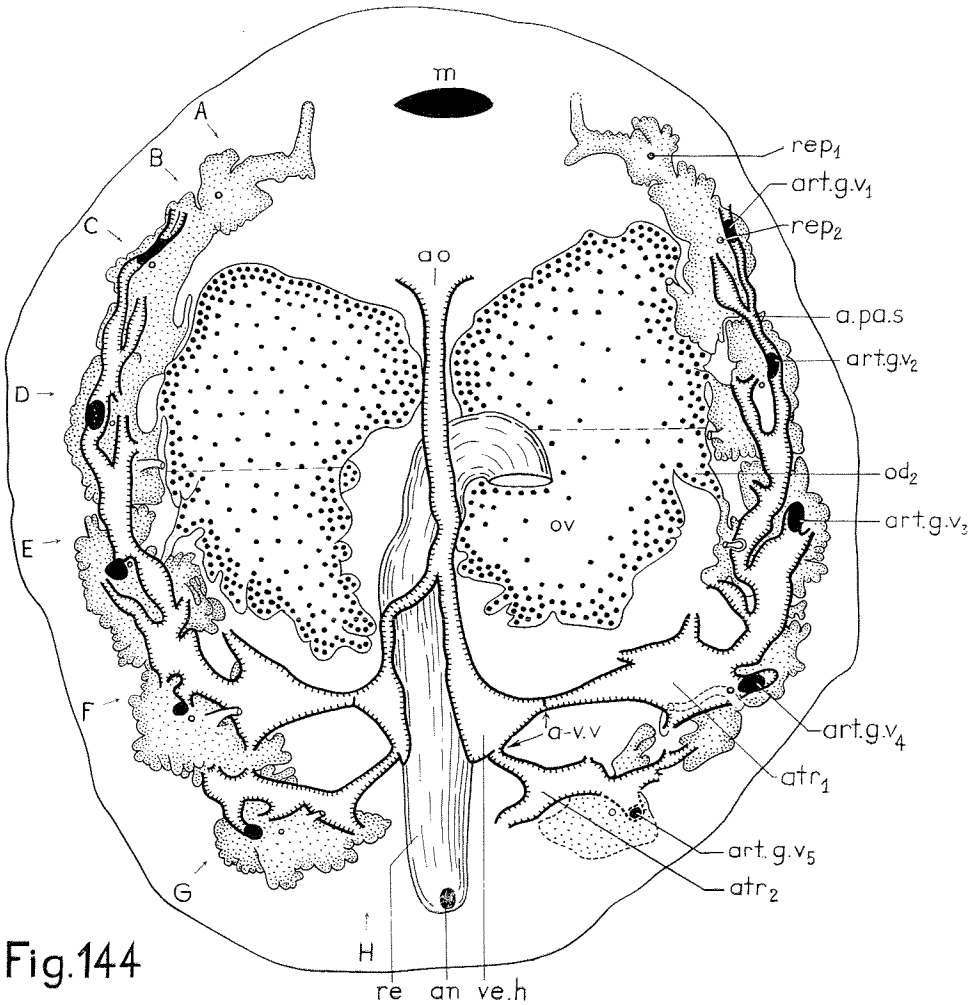


Fig.144

PLATE 47

Fig. 145. Graphic reconstruction of the urogenital system. Dorsal view. Spec. III. The posterior right nephridium is damaged in the preparations. Some of the nephrostomes are difficult to trace (compare text!).

Fig. 146. Graphic reconstruction, including the urogenital system, vessels, and coelomic cavities. Spec. III. For explanations compare Fig. 145 and 144. Some damage made the reconstruction of the dorsal coelom uncertain in the medio-dorsal region in front of the aorta.

A-H = position of pedal retractors A to H (not drawn)
a. pa. s = arterial pallial sinus
ant. ne. d = anterior nephridial diverticula
an = anus
ao = aorta
art. g. v_{1-5} = entrance of arterial vessels from 1st to 5th gill
d. coe = dorsal coelom (with crosses)
m = mouth
$nest_{2-6}$ = nephrostomes, corresponding to 2nd-6th renopore
od_{1-2} = oviducts, 1st and 2nd, resp.
ov = ovaries (two pairs probably present)
perc = pericard (short vertical strokes)
perc. d = pericardial diverticula along the aorta (interrupted lines)
pro. coe = preoral diverticula of dorsal coelom
rep_{1-6} = renopore 1-6

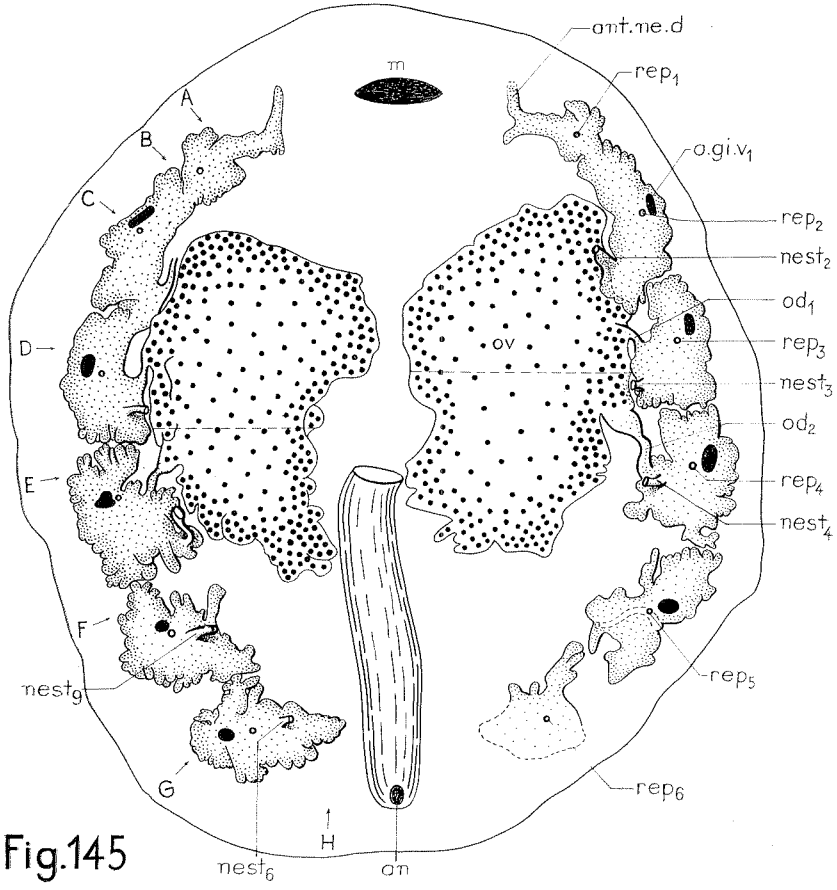


Fig.145

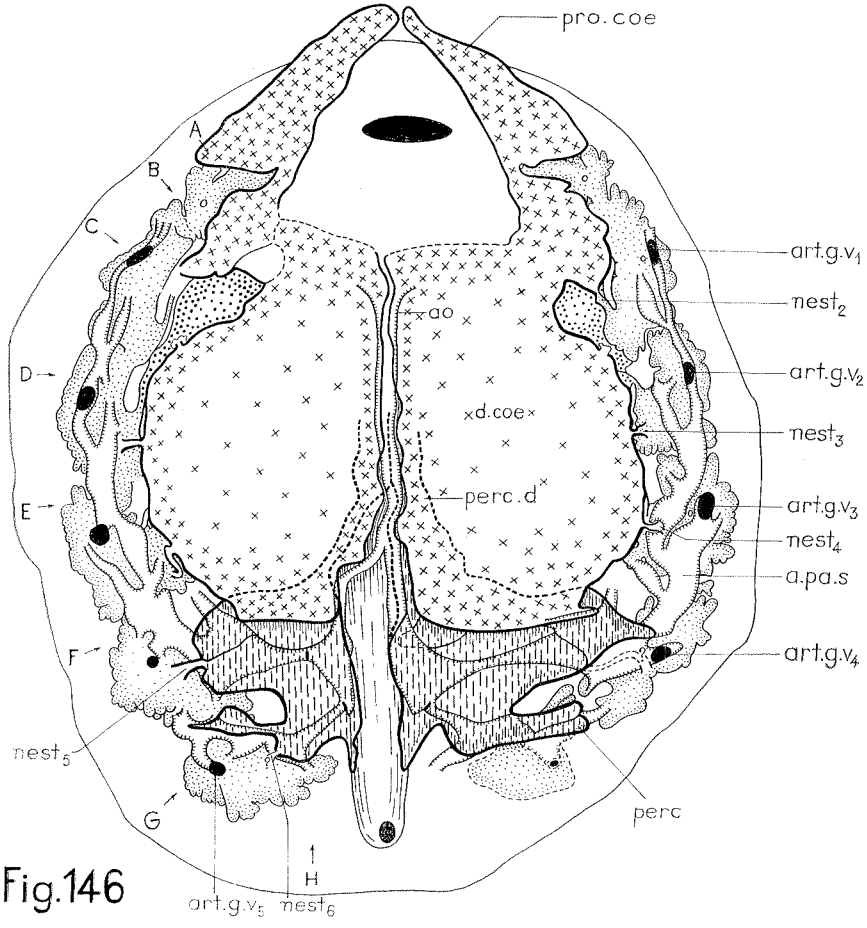


Fig.146

PLATE 48

Fig. 147. Transversal section through the heart region. Microphotograph. Spec. III.
Fig. 148. Transversal section through the middle body region, showing the blood sinuses in the pallial fold. Microphotograph. Spec. III.

a-v. v = atrio-ventricular valve
art. pa. s = arterial pallial sinus
atr_1 = atrium, anterior pair
do. coe = dorsal coelom
f. m = foot margin
f. s. ep = foot side epithelium
gi = gill
la. n. c = lateral nerve cord
m. lp. E = musculus latero-pedalis E
m. obl. a. E = musculus obliquus anterior E
ne = nephridia
ov = ovary
perc = pericard
re = rectum
ve. f. ep = ventral foot epithelium
ve. h = ventricle of heart
ve. pa. s = venous pallial sinus

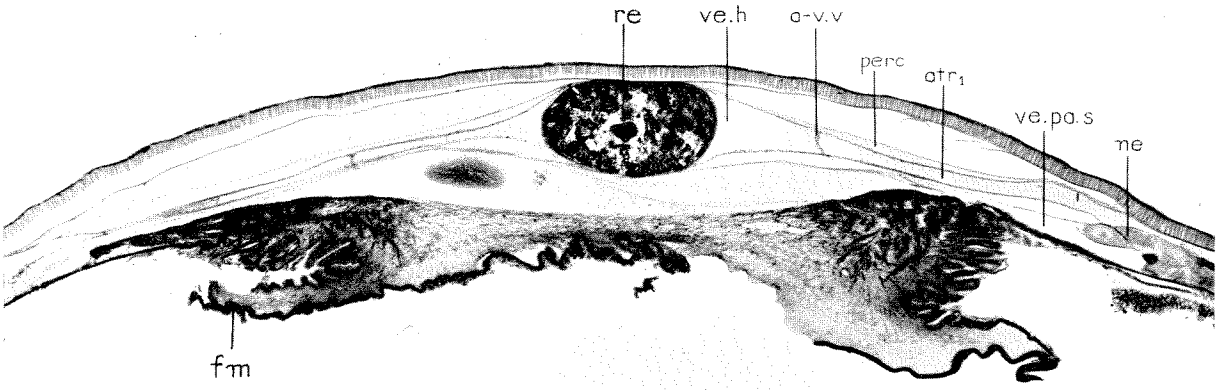


Fig.147

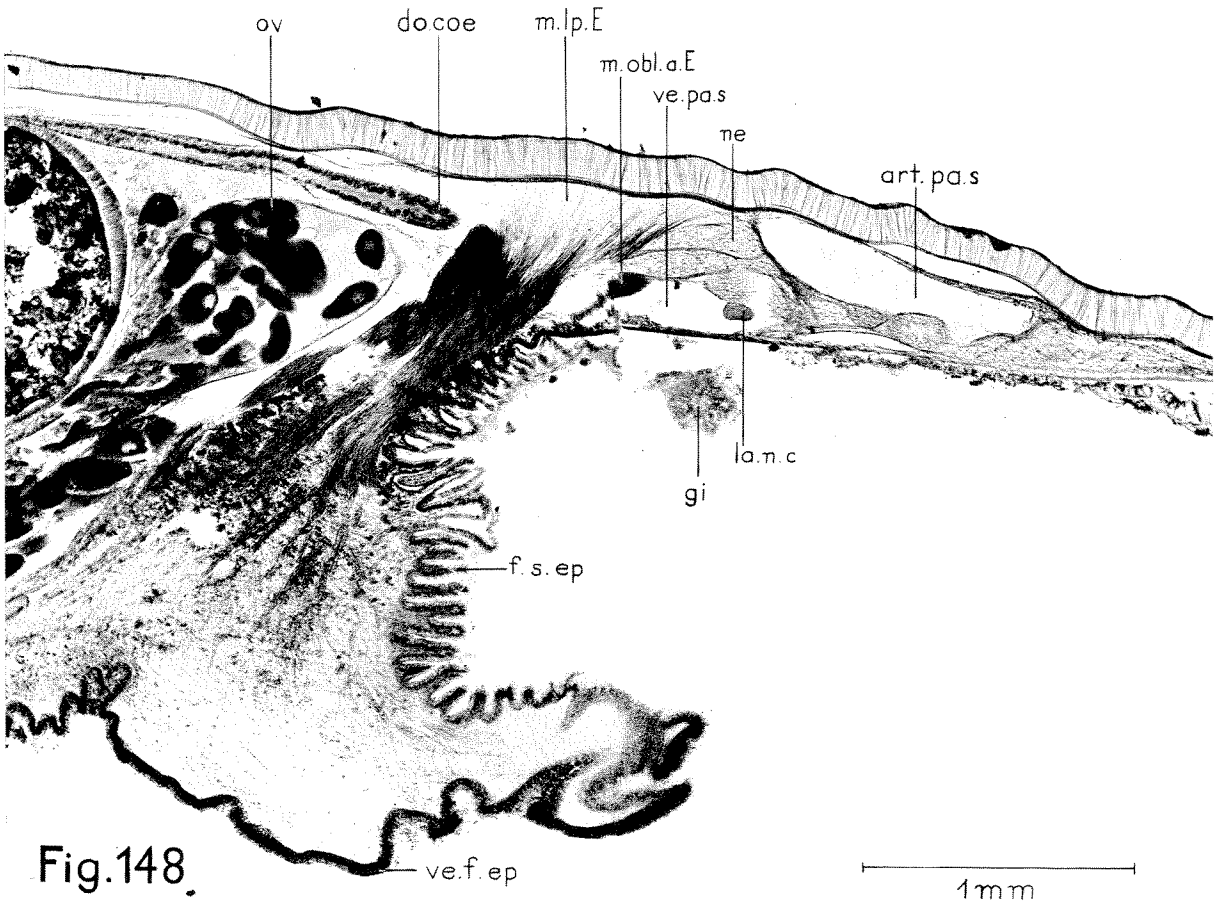


Fig.148

PLATE 49

Fig. 149. The sac-like dilatations of the dorsal coelom between the foremost pedal retractor muscles. Horizontal section. Anterior direction to the right. Microphotograph. Spec. IV.

Fig. 150. Epithelium of the dorsal coelomic cavity with pigment granules. Microphotograph. Spec. III.

Fig. 151. Detail of transversal section showing the thin walls of the ventricle, the atrium, the pericard, and the atrio-ventricular valve. The empty space above the pericard is an artefact. Microphotograph. Spec. III.

Fig. 152. Section through the atrio-ventricular valve. The membrane is covered on both sides by a layer of large (cross-sectioned) muscle cells, in which metaphase-like lumps of basophilic granules can be seen. Microphotograph. Spec. IV.

A and B = pedal retractors A and B
at = atrium of heart
a-v. v = atrio-ventricular valve
coe = coelom
coe. ep = coelomic epithelium
li = liver
na. l = nacreous layer
ne = nephridia
perc = pericard
ph. d = pharyngeal diverticula
pr. l = prismatic layer
st. p = sterile epithelium of pallium
te = testis
ve. h = ventricle of heart

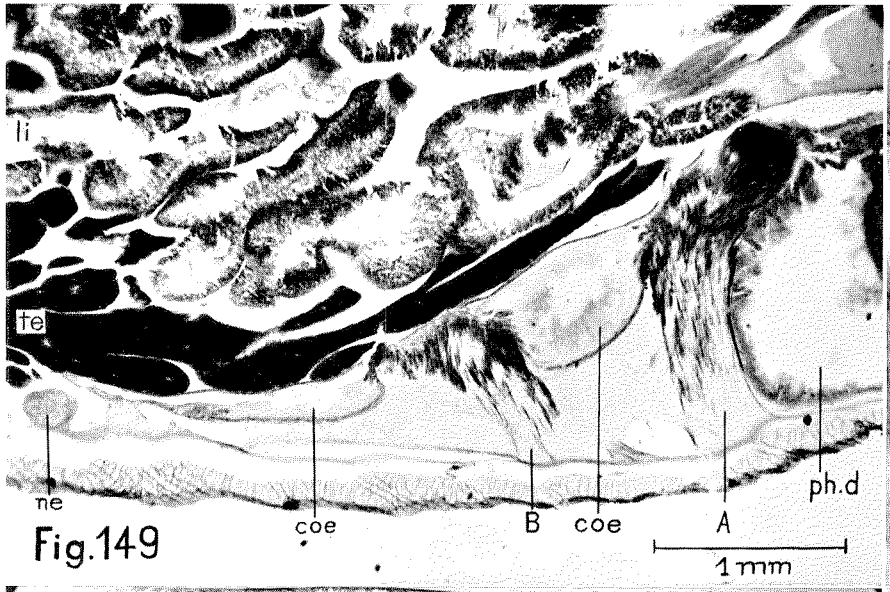


Fig.149

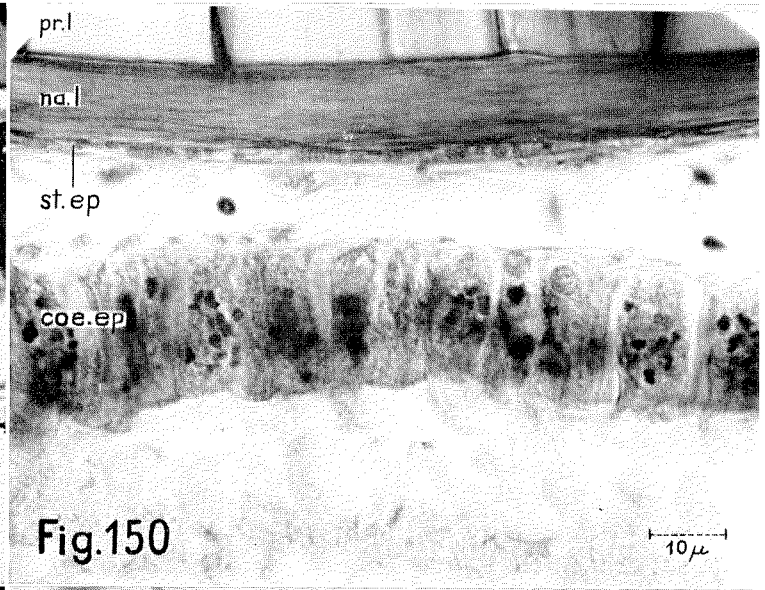


Fig.150

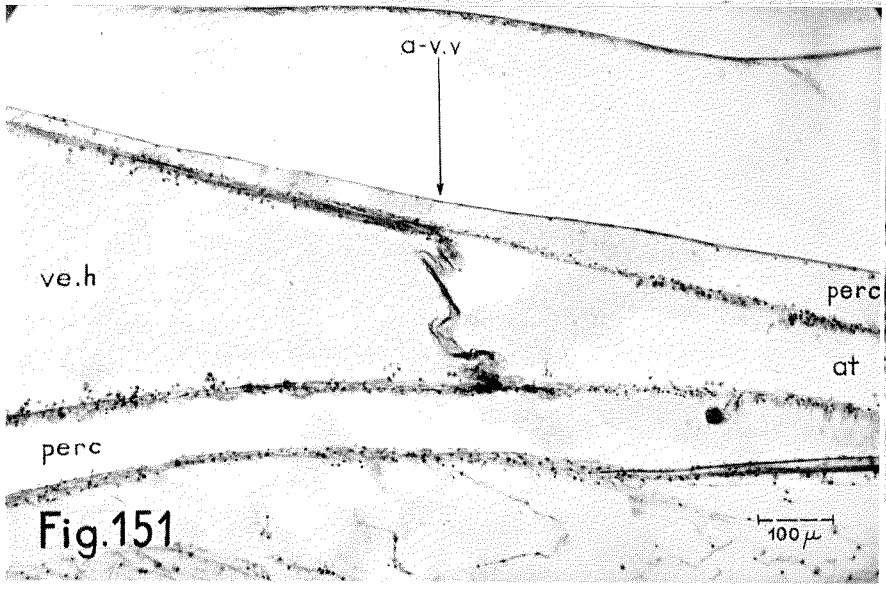


Fig.151

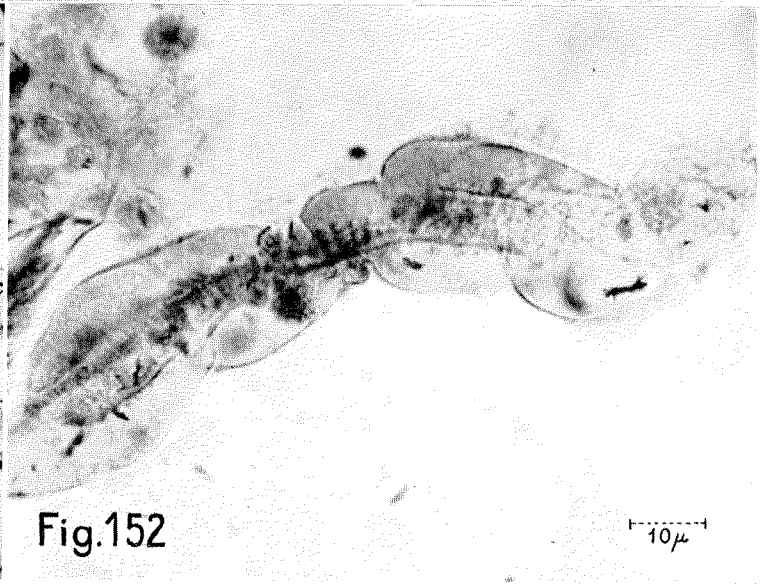


Fig.152

Plate 50

Fig. 153. Detail of transversal section, showing the aorta and its relation to the rectum, the dorsal coelom, and the pericard. Microphotograph. Spec. III.

Fig. 154. Transversal section, showing the pallial fold with the base of the gill and the renopore. Microphotograph. Spec. III.

Fig. 155. Transversal section through the lateral margin of the dorsal coelom, showing one of the nephrostome-like pouches (nest). Microphotograph. Spec. III.

Fig. 156. The connection between the dorsal coelom and the nephridium. Microphotograph. Spec. III.

ao = aorta
d. coe = dorsal coelom
gi = gill lamellae
la. n. c = lateral nerve cord
ne = nephridium
nest = nephrostome-like pouch from the coelom
ov = ovary
pa. w = epithelium of the pallial groove
perc = pericardial diverticulum
re = rectum
rep = renopore

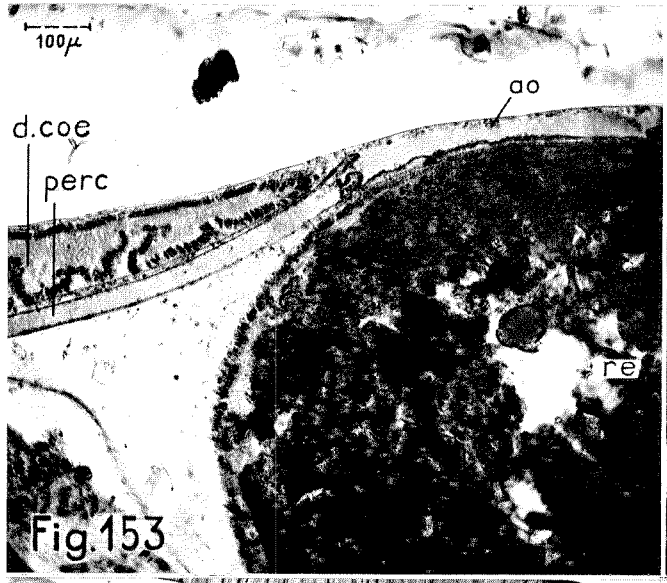


Fig.153

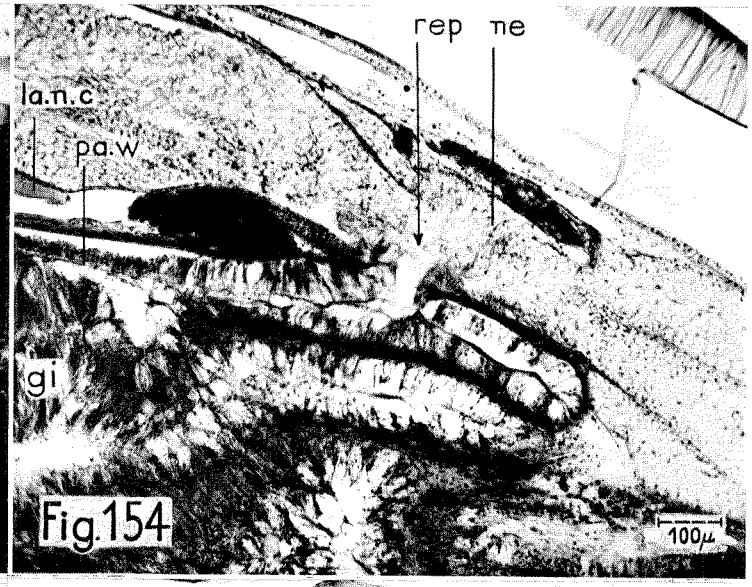


Fig.154

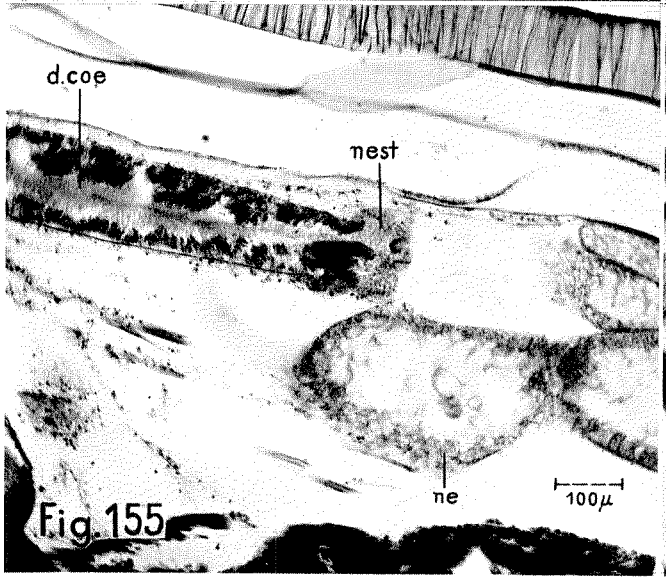


Fig.155

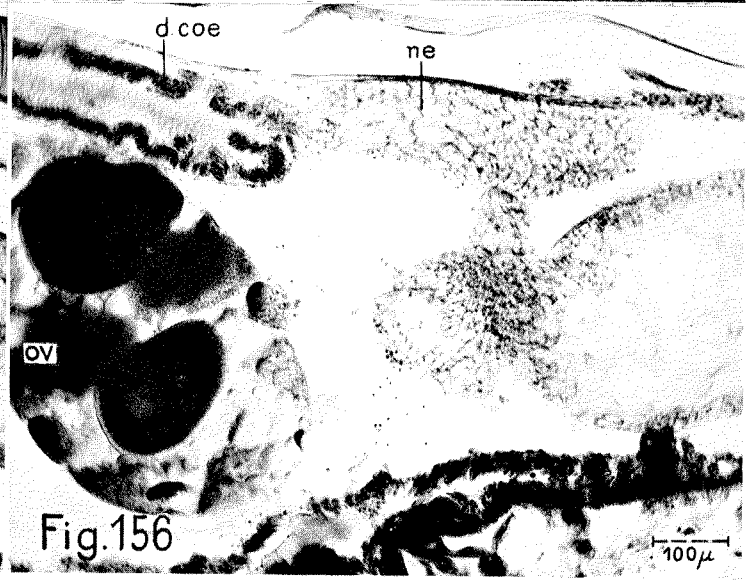


Fig.156

PLATE 51

Fig. 157. Transversal section through the middle body region, showing the relations of the uro-genital system. Microphotograph. Spec. III.

d. coe = dorsal coelom
egg ne = egg in the nephridium
f. m = foot margin
gi = gill
int. c_{1-6} = intestinal coil 1 to 6
la. n. c = lateral nerve cord
mi. ma. f = middle marginal fold
ne = nephridium
ou. ma. f = outer marginal fold
ov = ovary
pa. g = pallial groove
per = periostracum, detached from the shell margin
pe. n. c = pedal nerve cord
re = rectum

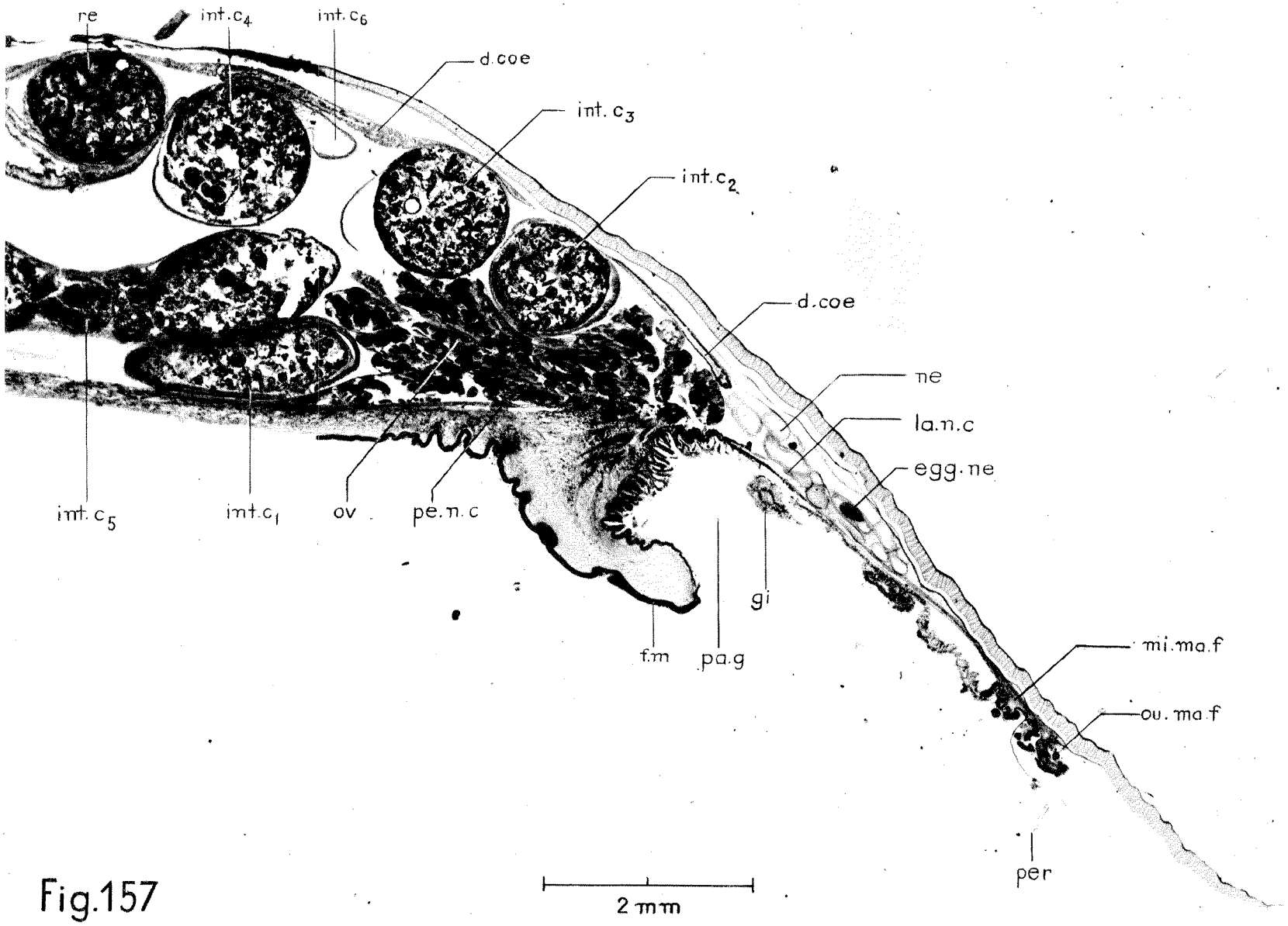

re
int.c4
int.c6
d.coe
int.c3
int.c2
d.coe
ne
la.n.c
egg.ne
int.c5
int.c1
ov
pe.n.c
gi
f.m
pa.g
mi.ma.f
ou.ma.f
per
2 mm

Fig.157

PLATE 52

Fig. 158. Section through an ovarian lobule with mature eggs. Microphotograph. Spec. III.

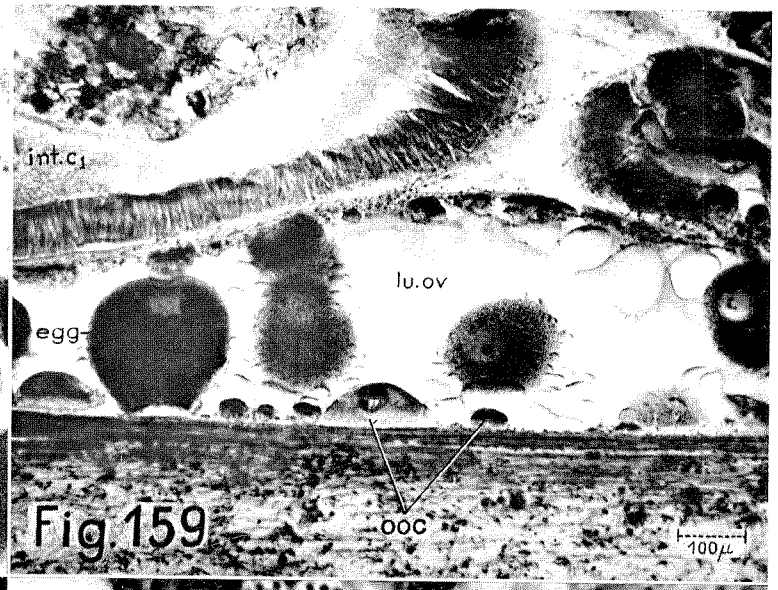
Fig. 159. Section through on ovarian lobule with developing oocytes. Microphotograph. Spec. III.

Fig. 160. Section through the testis showing the numerous and small lobules. Microphotograph. Spec. IV.

Fig. 161. The wall of a testicular lobule, with spermatogonia near the outer membrane (left). The lumen (right) is filled by ripe sperm, the tails of which can be seen as a striation in the light spaces. Microphotograph. Spec. IV.

int. c_1 = first intestinal coil
lu. ov = lumen of ovary
ooc = oocytes
r. sp = ripe sperm
spc = spermatocytes
spg = spermatogonia


Fig.158
100μ


int.c1
lu.ov
egg
ooc
Fig.159
100μ

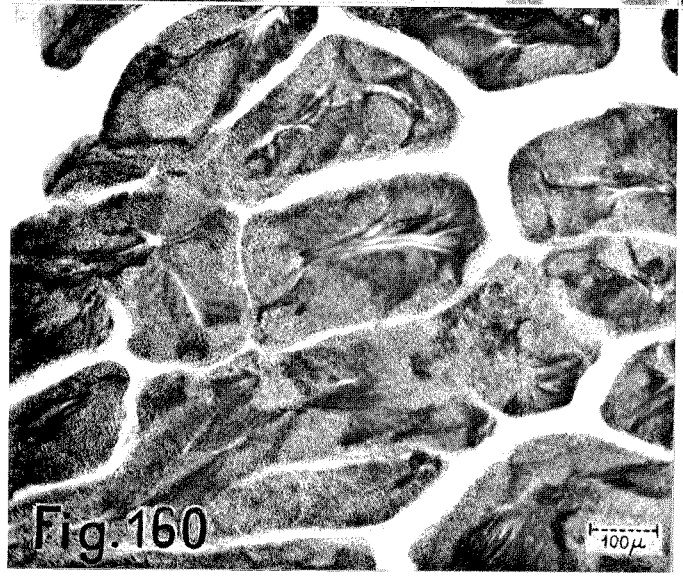


Fig.160
100μ

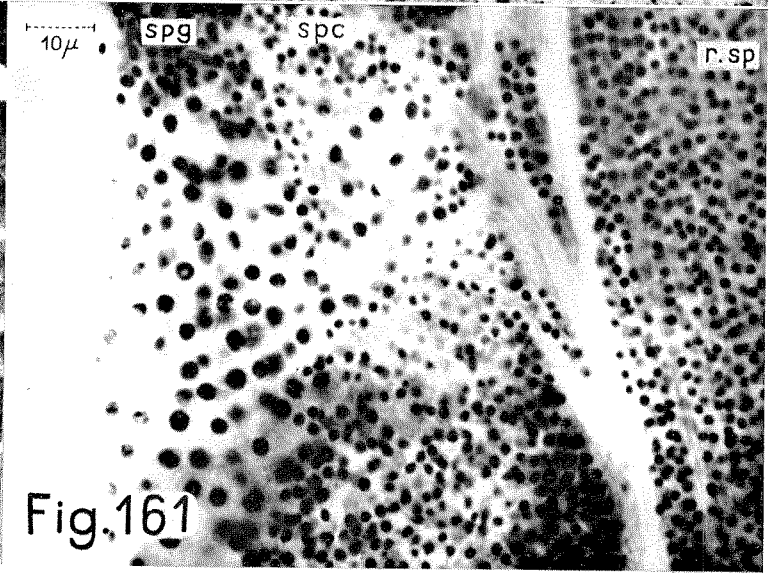

10μ
spg
spc
r.sp
Fig.161

PLATE 53

Fig. 162. Fossil tryblidians. A-D = *Pilina unguis* (Lindström) in ventral, lateral, anterior, and dorsal view. E-F = *Tryblidium reticulatum* Lindström in ventral and dorsal view. G-H = *Archaeophiala antiquissima* (Hisinger), in lateral and ventral view. Drawn after KNIGHT (1941, plate 3 and 4, and 1952, plate 1).

Fig. 163. Diagram of a young *Neopilina* (A), a young gastropod (B), and a *Nautilus*-like cephalopod (C) to show the differences in the orientation of the protoconch.

Fig. 164. Diagram of the gills of chitons (A) and of *Neopilina* (B). The gills are seen from the side, attached to the wall of the pallial groove and reaching down to the foot margin. It appears that the big, ventral lamellae of *Neopilina* correspond to the anterior lamellae of chitons.

m. s = muscle scars
sh. s = "shadow scars"
protc = protoconch

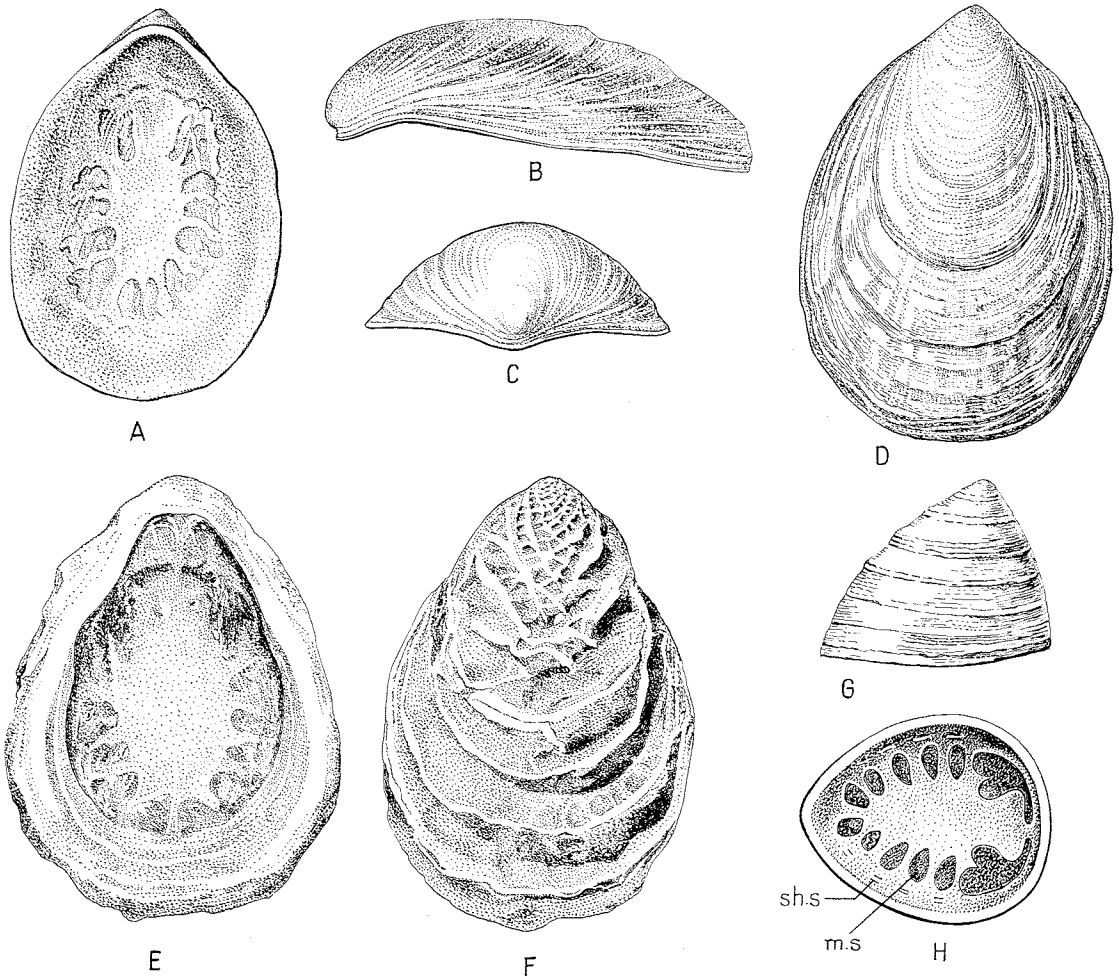


Fig.162

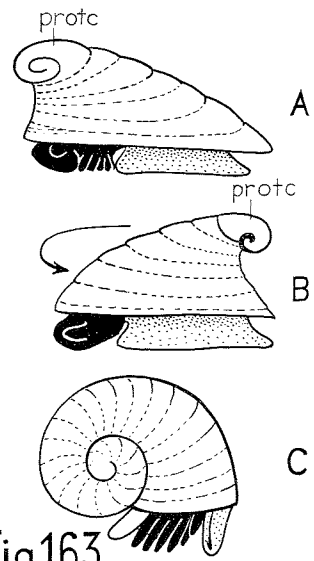


Fig.163

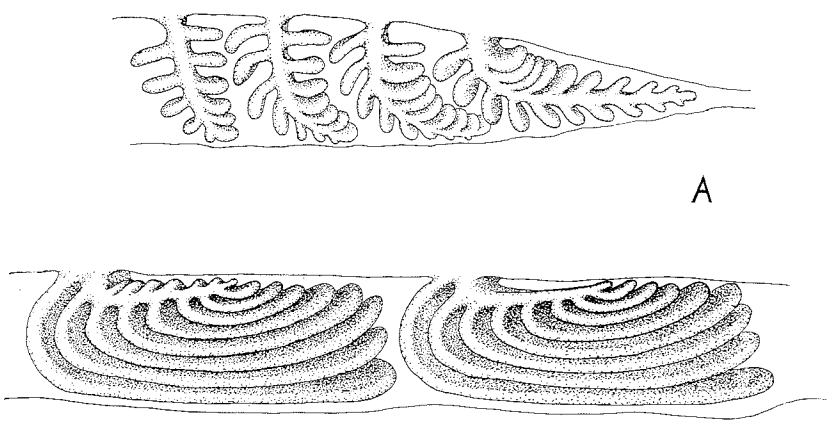


Fig.164

PLATE 54

Fig. 165. Diagram of the relations between the segmented organ systems in *Neopilina*. The gill nerves, the gill vessels, and many smaller muscles are strictly metameric but could not be included in the drawing.

A-H = foot retractor muscles A to H
an = anus
ao = aorta
at_2 = 2nd atrium of heart
ce. co = cerebral commissure
gi_5 = 5th gill
go = gonads
i-p. co = interpedal commissure
la. n. c = lateral nerve cord
lp. co_{10} = 10th latero-pedal connective
m = mouth
ne = nephridia
pe. n. c = pedal nerve cord
pr. te = preoral tentacle
st = statocyst
ve = velum
ve. h = ventricle of heart

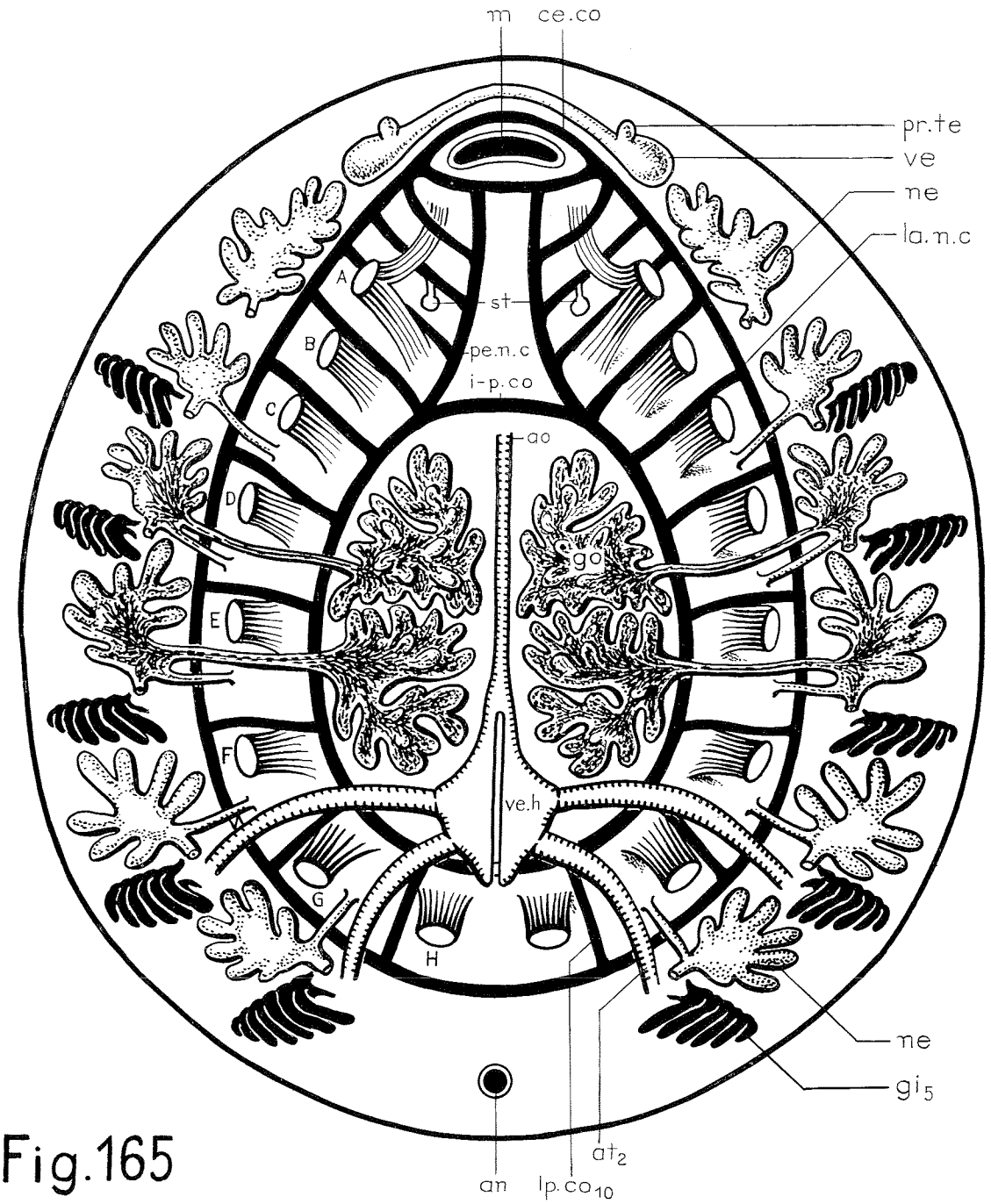

m
ce.co
pr.te
ve
ne
la.m.c
A
st
B
pe.m.c
i-p.co
C
ao
D
go
E
F
ve.h
G
H
ne
gi5
at2
an
lp.co10

Fig.165

PLATE 55

Fig. 166. Diagrammatic cross section through the middle body region of a *Chiton*. Partly after PLATE (1898).

Fig. 167. Diagrammatic cross section through the middle body region of *Neopilina*.

a. pa. s = arterial pallial sinus
ao = aorta
art = articulamentum
ci. i = musculus circularis intermedius
ci. pa = musculus circularis pallii
ci. pe = musculus circularis pedis
do. coe = dorsal coelom
f. m = foot margin
gi = gills
i. ma. f = inner marginal fold
la. n. c = lateral nerve cord
m. l. l = musculus longitudinalis lateralis
m. lp = musculus latero-pedalis
m. mp = musculus medio-pedalis
m. r = musculus rectus (longitudinal)
mi. ma. f = middle marginal fold
na. l = nacreous layer
ne = nephridia
ou. ma. f = outer marginal fold
ov = ovary
pa. m = pallial margin
pe. n. c = pedal nerve cord
per = periostracum
per. bl. s = peri-intestinal blood sinus
per. g = periostracum gland
perc = pericardial diverticula
pr. l = prismatic layer
tem = tegmentum

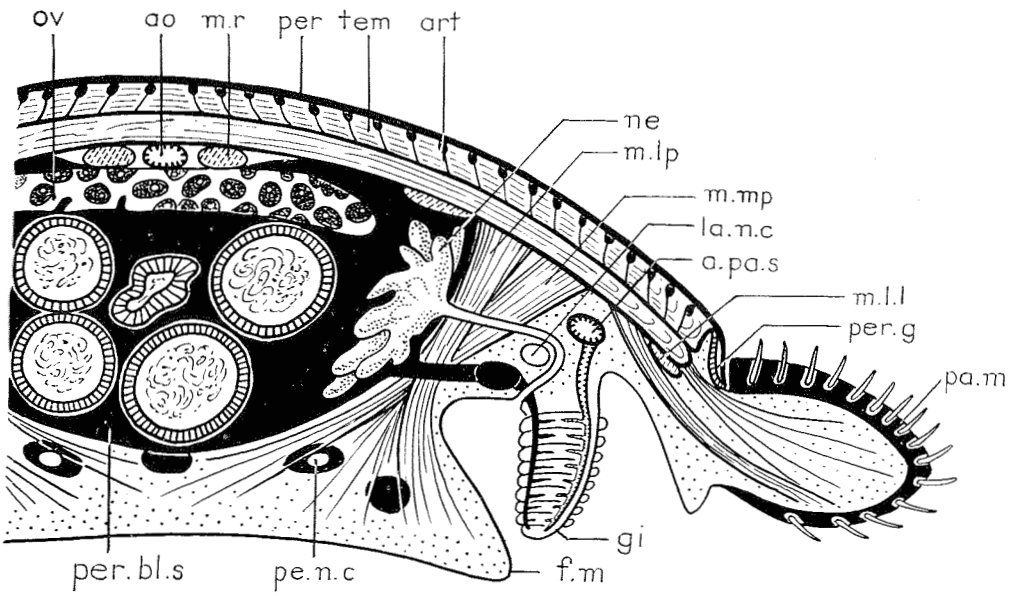


Fig.166

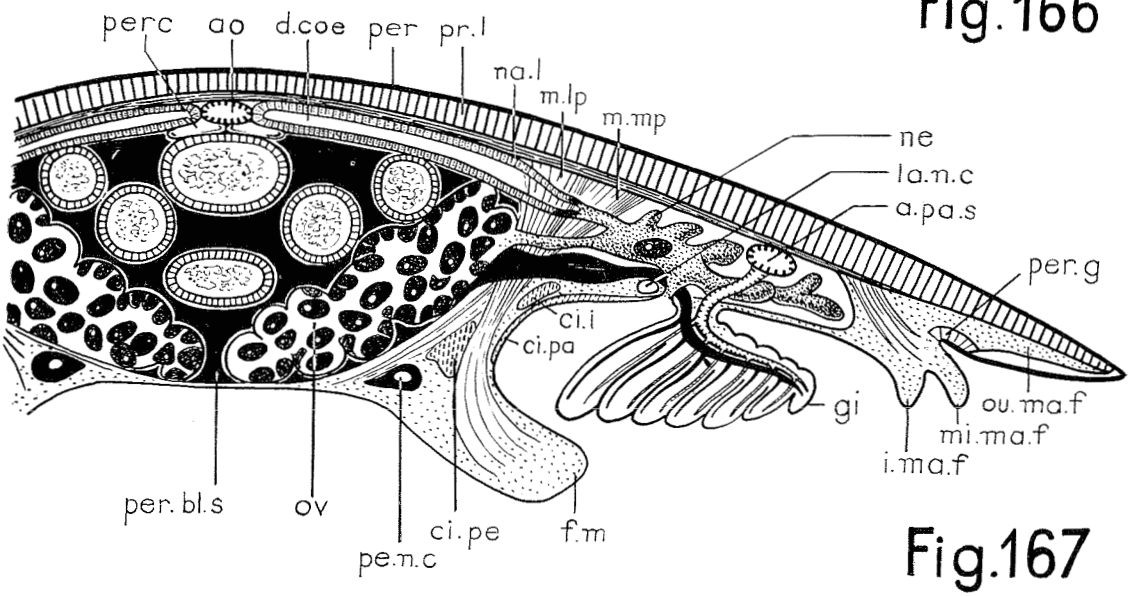


Fig.167

PLATE 56

Fig. 168. Cross section through the first intestinal coil. Radiolarians are common in the contents. Microphotograph. Spec. III.

Fig. 169. Median section through the anterior body region of a polyplacophoran, *Lepidopleurus asellus*. Microphotograph.

ae = aesthetes
ant. l = anterior lip
ce. co = cerebral commissure
f. m = foot margin
m = mouth
m. im. ra = musculus impar radulae
m. pl = mouth plate ("Mundscheibe"), the "velar" part
m. ra. l = musculus radulae longus ("retr'")
pa. m = pallial margin
ph. d = pharynx in the region of the diverticula
ra = radula
ra. ca = radula cartilage
ra. sh = radula sheath (partly damaged)
sal. g = salivary gland
sr. g = subradular ganglion
sr. o = subradular organ
ssc. co = subcerebral commissure

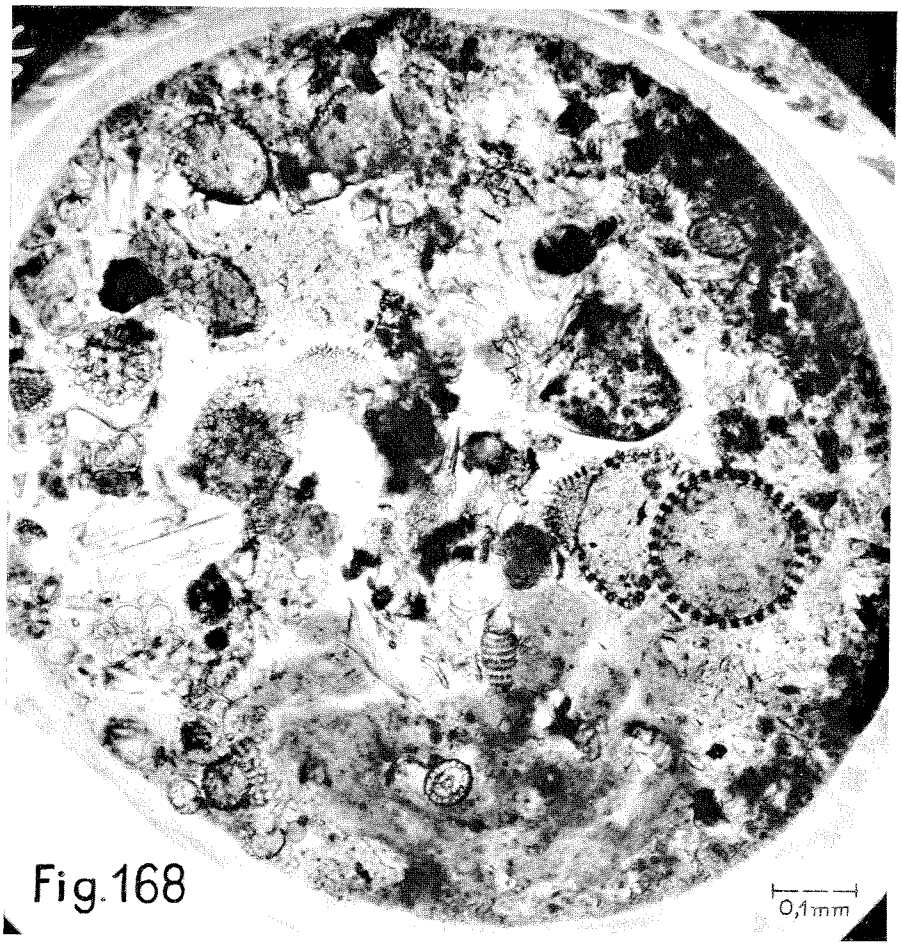


Fig.168

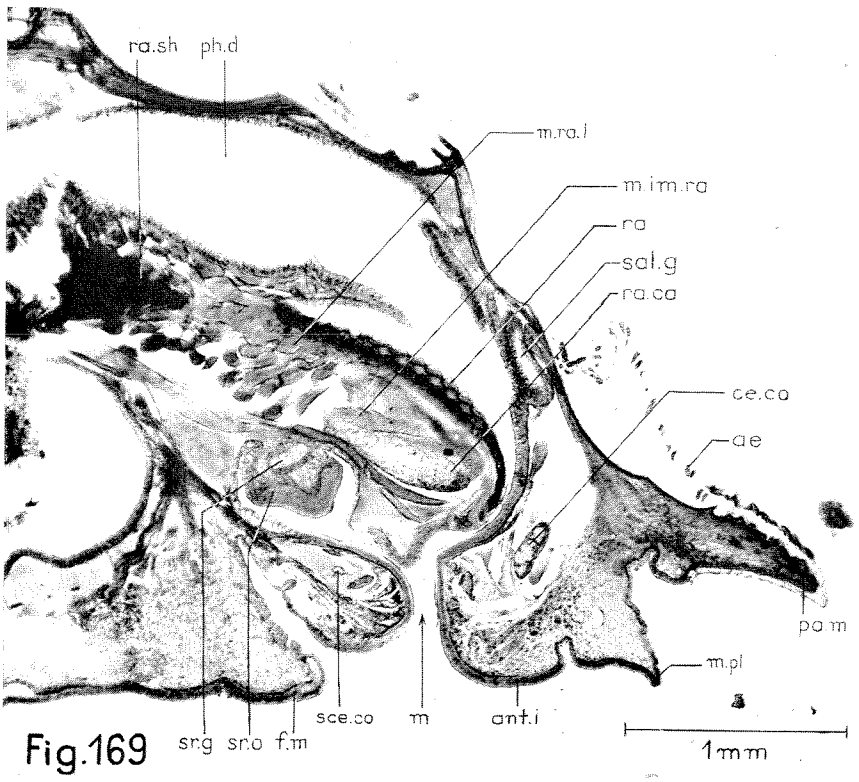


Fig.169