THE CEPHALOPODA

PART I: OEGOPSIDA
PART II: MYOPSIDA, OCTOPODA

ATLAS
NOTE TO PLATE LXVIII
Figure 7 should read Figure 8
Figure 9 should read Figure 7

GERMAN DEEPSEA EXPEDITION 1898–1899. VOL. XVIII
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ON BOARD THE STEAMSHIP "VALDIVIA" 1898–1899
Volume Eighteen
UNDER THE AUSPICES OF THE GERMAN MINISTRY OF THE INTERIOR

Supervised by CARL CHUN, Director of the Expedition
Professor of Zoology, Leipzig.
After 1914 continued by
AUGUST BRAUER
Professor of Zoology, Berlin

CARL CHUN

THE CEPHALOPODA
PART I: OEGOPSIDA
PART II: MYOPSIDA, OCTOPODA
ATLAS

Translated from the German

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Since the study of the Cephalopoda is a very specialized field with a unique and specific terminology and phraseology, it was necessary to edit the translation in a technical sense to insure that as accurate and meaningful a representation of Chun's original work as possible would be achieved. We hope to have accomplished this responsibility.

_Clyde F. E. Roper and Ingrid H. Roper_
_Technical Editors_

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List of Plates

I Thaumatolampas diadema n.gen.n.sp. 50
II Thaumatolampas diadema CH. 50
III Thaumatolampas diadema CH. 50
IV Thaumatolampas diadema, luminous organs 61
V Abraliopsis morisii VÉR. 64
VI Abraliopsis morisii VÉR., male and juvenile stages 64
VII Young larvae of Abraliopsis 80
VIII Abraliopsis morisii VÉR., arm apparatus and buccal funnel 68
IX Abraliopsis morisii VÉR., mantle complex and genitalia 73
Abal, veranyi RÜPP., mantle complex and genitalia 76
X Abraliopsis morisii VÉR., hectocotylus, genitalia, luminous organs 67
XI Pyroteuthis margaritifera VÉR. 106
Enoploteuthis leptura D’ORB. 86
XII Pyroteuthis giardi FISCHER, males and juvenile forms 87
XIII Pyroteuthis giardi, Pt. gemmata, arm, buccal funnel, larvae 87
Pyroteuthis margaritifera 90
Indeterminable larvae of Enoploteuthidae 85
XIV Pyroteuthis giardi, Pt. gemmata, arrangement of luminous organs 95

Pyroteuthis margaritifera 106

XV Pyroteuthis giardi, Pt. gemmata, hectocotylus and genitalia 93
XVI Pyroteuthis giardi, Pt. gemmata, luminous organs 96
XVII Octopodoteuthis RÜPPEL (Verany KROHN), larvae 109
XVIII Calliteuthis hoylei GOODRICH 133
Calliteuthis reversa 136
Histoteuthis 138
XIX Histoteuthis 138, 139
Calliteuthis hoylei GOODRICH 133
Calliteuthis reversa 136
XX Calliteuthis hoylei GOODRICH 118, 124, 133
Calliteuthis reversa 136
Calliteuthis ocellata 128, 130
XXI Histoteuthis rappelli 130, 138
XXII Telepodoteuthis cariaba LESUEUR 141, 142
XXIII Larvae of Onychoteuthidae 143
Telepodoteuthis cariaba, clubs 141
XXIV Benthoteuthis megalops VERRILL (Bathyteuthis abyssicola HOYLE) 145
XXV Benthoteuthis megalops VERRILL, arm apparatus 145, 151–152
XXVI Benthoteuthis megalops VERRILL, intestinal tract, vascular system 145, 152
XXVII Benthoteuthis megalops VERRILL, eye and luminous organ 145

Ctenopteryx sp., juvenile 135
XXVII Rhynchoteuthis, larvae 157–160
XXIX Rhynchoteuthis, larvae 157–160
Brachioteuthis, larvae 166
Brachioteuthis picta CHUN 162
XXX Brachioteuthis, juvenile 166
Brachioteuthis picta 162
XXXI Brachioteuthis picta n.sp. 162
Juvenile Brachioteuthis, gladius and arm apparatus 166
XXXII Brachioteuthis picta n.sp., head, intestinal tract, vascular system 162
XXXIII Mastigoteuthis glaukopis n.sp. 184
M. flammea n.sp. 181
XXXIV Mastigoteuthis cordiformis n.sp. 177
XXXV Mastigoteuthis VERRILL, gladius, cartilage, arm apparatus
M. cordiformis n.sp. 177
M. glaukopis n.sp. 184
M. flammea 181
XXXVI Mastigoteuthis, anatomy
M. flammea 181
M. cordiformis 177
XXXVII Mastigoteuthis, luminous organs
M. glaukopis 184
M. flammea 181
M. cordiformis 177
XXXVIII Chiroteuthis (Chiroteuthis) imperator n.sp. 189
XXXIX Chiroteuthis imperator 189
Doratopsis exophthalmica 228
D. lippula 229
D. sagitta 227
C. CHUN

XL Chiroteuthis veranyi
FERUSSAC 221
Chiroteuthis imperator
189
Ch. picteti 192
XLI Chiroteuthis imperator,
nervous system, gladius,
viscera 201, 207
XLII Chiroteuthis, mantle
complex, intestinal tract
Ch. imperator 189
Ch. veranyi 221
XLIII Chiroteuthis imperator
189
XLIV Chiroteuthis, luminous
organs, glandular knobs
Ch. veranyi 221
Ch. imperator 189
XLV Doratopsis sagitta n.sp.
227
D. lippula n.sp. 229
XLVI Doratopsis exophthalmica
n.sp. 228
D. lippula n.sp. 229
XLVII Doratopsis, anatomy
D. sagitta 227
D. exophthalmica 228
D. verruculuris RÜPELL 231
XLVIII Cranchia scabra LEACH
257
Liocranchia valdiviae n.sp.
264
XLIX Cranchia scabra LEACH
257
L. Cranchia scabra, anatomy
257
LI Liocranchia anatomy,
juvenile forms
L. reinhardtii 269
L. valdiviae 264
LII Eucyzuena pacifica ISSEL
279
Leuchia eschscholtzii
RATHKE 271
LIII Desmotheuthis pellicuda
CHUN 278
Crystalloteuthis glacialis
n.gen.n.sp. 290
LIV Desmotheuthis pellicuda,
anatomy 278
Crystalloteuthis glacialis,
anatomy 290
LV Corynemma specular
n.gen.n.sp. 286
LVI Teuthowenia antarctica
n.sp. 293
Sandolops melancholis
n.gen.n.sp. 295
Bathothauma 242
Toxeuma belone 296
LVII Bathothauma 250
Teuthowenia antarctica n.
sp. 293
LVIII Toxeuma belone n.gen.n.sp.
296
Bathothauma lyromma
n.gen.n.sp. 303
LIX Galiteuthis (Taonidium)
submit HOYLE 297
LX Luminous organs of
Cranchiidae
Cranchia scabra 268
Liocranchia valdiviae 268
Leuchia eschscholtzii 275
Corynemma specular 289
Desmotheuthis pellicuda
283
Bathothauma lyromma
303
LXI Larvae of Cranchiidae 304
LXII Rossia mastigophora n.sp.
311
LXIII Rossia mastigophora, arm
apparatus, mantle
complex 314
LXIV Spirula australis LAM.
319
LXV Spirula australis LAM.,
mantle complex, arm
apparatus 325
LXVI Spirula australis 319
LXVII Spirula australis 319
LXVIII Spirula australis, intestinal
tract 343
LXIX Spirula australis, nervous
system, sensory organs
346
LXX Spirula australis, vascular
system, oviducts,
liminous organs 351
LXXI Larvae of Spirula 361
LXXII Spirula australis, shell
332
LXXIII Spirula australis, larva and
shell 332
LXXIV Argonauta 369
LXXV Velodona togata, n.gen.n.
sp. 373
LXXVI Velodona togata n.gen.n.
sp. 373
LXXVII Tremoctopus hylinus
RANG, juvenile 371
Polypus, juvenile 378
LXXVIII Larvae bristle bearing
Octopoda 381
LXXX Polys acus, HOYLE 380
LXXX Polys acus valdiviae 378
LXXXI Eledone pygmea
VERR. 383
LXXXII Bolitaena diaphana
STEENSTR. 385
LXXXIII Bolitaena diaphana
STEENSTR., juvenile
385
LXXXIV Bolitaena 385
LXXXV Bolitaena diaphana,
Eledonella pygmea,
nervous system 392
LXXXVI Bolitaena diaphana,
Eledonella pygmea,
static organs, oesphradium 405
LXXXVII Bolitaena diaphana,
intestinal tract, male
genitalia 410
LXXXVIII Bolitaena, development of
chromatophores 398
LXXXIX Bolitaena diaphana,
chromatophores, musculature, nervous
network, structure of
bristle tufts 389
XC Vampyroteuthis infernalis
n.gen.n.sp. 419
XCI Vampyroteuthis infernalis
n.gen.n.sp. 419
Amphioctopus pelagicus
HOYLE 415
XCH Cirrothoasna murayi
CHUN 422
XCHII Cirrothoasna murayi
CHUN 422
XCVI Opisthoteuthis mehoudoides
n.sp. 422
Opisthoteuthis extensa n.sp.
421
XCVII Opisthoteuthis mehoudoides
s.sp. 422
Opisthoteuthis extensa s.sp.
421
WISSENSCHAFTLICHE ERGEBNISSE
DER
DEUTSCHEN TIEFSEE-EXPEDITION
AUF DEM DAMPFER „VALDIVIA“ 1898-1899

IM AUFTRAGE DES REICHSAMTES DES INNERN
HERAUSGEGEBEN VON
CARL CHUN
PROFESSOR DER ZOOLOGIE IN LEIPZIG
LEITER DER EXPEDITION

ACHTZEHNTER BAND
CARL CHUN
DIE CEPHALOPODEN
I. TEIL: OEGOPSIDA
ATLAS

JENA
VERLAG VON GUSTAV FISCHER
1910

Eingegangen den 15. November 1909, C. Chun
Plate I

*Thaumatolampas diadema* n. gen. n. sp.

Figure 1. Specimen from Station 89, southern part of the Benguela Current. Left side. × 2.5

Figure 2. Same, ventral side. The ventral luminous organs are visible through the mantle.

Figure 3. Specimen from Station 118: West Wind Drift, south of Cape Province. Chromatophores on mantle were abraded; the light-colored gills and branchial hearts and the brown-red stomach are visible through the mantle. × 2.5

Figures are based on color sketches of the live animal.
Plate II

*Thaumatolampas diadema* Ch.

Figure 1. Luminous organs of specimen from Station 118
  Drawing based on a photograph of the live animal

Figure 2. Head and funnel of specimen from Station 89, diagonally from the right. X 5.

Figure 3. Specimen from Station 118, with opened mantle cavity. X 2.5

Figure 4. Specimen from Station 89. Funnel opened to show the funnel organ, the middle part
  of which is situated before the anus with the two and appendages. Anal organs red

Figure 5. Mantle complex of specimen from Station 89. Right anal organ (red) covered by vena cava

Figure 6. Buccal funnel of specimen from Station 89, ventral Attachment to ventral arms has
  been cut, and ventral arms and tentacles bent down.

  1, 2, 3, 4—points of buccal funnel

Figure 7. Deep attachment of 3rd and 4th arms.

Figure 8. Central and two adjacent eye organs.
  Drawn after the preserved specimen.

**ABBREVIATIONS**

*a.* post. — posterior artery

*br.* 3 — 3rd arm

*br.* 4 — 4th arm

c. br. — branchial heart

col. buce. 3 — 3rd buccal pillar

fun. br. 4 — attachment of 4th arm

fung. t. — muscular attachment of tentacle

lam. tent. — protective membrane

luc. an — anal luminous organ

luc. br. — branchial organ

luc. tent. — organ of tentacle

luc. v. — median ventral organ

luc. v.a. — median ventral organ

luc. v. p. — posterior ventral organ

mus. depr. inf. — funnel depressor

mus. obl. 3 — deep attachment from 3rd to 4th arm

mus. obl. 4 — deep attachment from 4th to 3rd arm

mus. r. abd. — musculus rectus abdominis

nid. — nidamental gland

s. — knob on 3rd buccal pillar

tent. — tentacle

tub. olf. — olfactory tubercle

ur. — papilla of renal sac

v. abd. — abdominal vein

v. branch. — branchial vein

v. c. — vena cava

v. br. — funnel valve
Plate III

*Thaumatolampas diadema* Ch.

Figure 1. Specimen from Station 89. Arm apparatus and buccal funnel. Appr. X 4
Figure 2. Specimen from Station 89. Right tentacle club
Figure 3. Upper jaw, lateral. Station 118
Figure 4. Lower jaw, lateral.
Figure 5. Lower jaw, viewed from below.
Figure 6. Gladius, ventral. X 3.5. Specimen from Station 118
Figure 7. Same, lateral. X 7
Figure 8. Posterior end of gladius. X 12
Figure 9. Neck cartilage. X 6. Specimen from Station 89
Figure 10. Sucker of ventral arm. Station 118
Figure 11. Sucker of ventral arm in longitudinal section.
Figure 12. Sucker of tentacle club. Chitinous ring, seen from above. Specimen from Station 118
Figure 13. Denticles of tentacle suckers, lateral.
Figure 14. Outer denticle of tentacle suckers, lateral.
Figure 15 a. b. Radula. Specimen from Station 118
Figure 16. Longitudinal (radial) section of buccal pillar and buccal lips. X 55. Hemalum. Station 118
Figure 17. Longitudinal section of knob of 3rd buccal pillar. Hemalum. Station 118
Figure 18. Right branchial area and adjacent organs of specimen from Station 118.
Figure 19. Right oviduct of specimen from Station 89. X 30

**ABBREVIATIONS**

a. cul. — gular lamella of lower jaw  
a. pal. — palatine lamella of upper jaw  
a. r. — rostral wings  
an. ring of suckers  
app. c. — appendages of branchial heart  
app. ren. — venous appendage of renal sac  
c. br. — branchial heart  
ch. — chitinous ring of sucker  
chr. — chromatophores  
d. — inner teeth of suckers  
d'. — outer teeth of suckers  

e. a. — ganglionic layer in sensory knob  
e. gl. — nidamental gland  
e. ovd. — oviduct gland  
lb. ext. — outer buccal lip  
lb. i. — inner buccal lip  
lig. br. — branchial ligament  
m. dep. int. — funnel depressor  
ma. — matrix of chitinous ring  
n. nerve  
op. — muscular pad of sucker  
ped. — stalk of sucker  
pil. — buccal pillar  
r. — rostrum  
v. — vein  
v. abd. d. — right abdominal vein  
v. br. — branchial vein  
v. p. d. — right pallial vein  
vill. — buccal villi
Plate IV

Luminous organs of *Thaumatolampas diadema* after preservation in formol-alcohol

Figure 1. Transverse section of distal tentacle organ (double organ).

Figure 2. Branching of nerve in luminous body of central tentacle organ. Zeiss F. 2

Figure 3. Section of middle and two lateral organs of eye.

Figure 4. The small double organ of the marginal organ of the eye. Hemalum. × 350

Figure 5. Lateral luminous cells of middle organ of eye. Hemalum. Zeiss F. 2

Figure 6. Luminous cells from center of middle organ of eye and capillary network. Hemalum. Zeiss F. 2

Figure 7. Squamous cells of middle organ of eye. Hemalum. Zeiss F. 2

Figure 8. Squamous cells seen from the surface. Hemalum. Zeiss F. 2

Figure 9. Median section of anal organ. Hemalum

Figure 10. Marginal cells of tapetum of base of anal organ. Hemalum. Zeiss F. 2

Figure 11. Tapetal cell of inner surface of anal organ. Hematum. Zeiss F. 2

Figure 12. Branching of nerve radiating into luminous body of anal organ. Iron-hematoxylin.

Zeiss F. 2

Figure 13. Section through fibrous squamous cell of anal organ. Hemalum. Zeiss F. 2

Figure 14. Marginal nerve fibers of anal organ, joined arcade-like below the squamous cells.

Hemalum. Zeiss F. 2

Figure 15. Median and right ventral organ viewed from inner side, under magnifying lens.

Figure 16. Lateral view of large posterior ventral organ. × 72

Cleared in oil of cloves.

Figure 17. Lateral view of right branchial organ. × 72

Cleared in oil of cloves.

Figure 18. Longitudinal section through middle and lateral ventral organ. A few details were copied from adjacent sections. Picrocarmine. × 60

Figure 19. Luminous cells and capillary network of lateral ventral organ. Picrocarmine. Zeiss F. 2

Figure 20. Fibrous cells of reflector of lateral ventral organ. Picrocarmine. Zeiss F. 2

Figure 21. Epithelial cells of renal sac, bordering on ventral organ. Hemalum. Zeiss F. 2

Figure 22. Silken-sheeny fiber in upper distal organ of tentacle. Hemalum. Zeiss F. 2

ABBREVIATIONS

a.—pad of fibrous cells  
art.—artery  
c. sq.—squamous cells  
c. sq. ext.—outer squamous cells  
c. sq. int.—inner squamous cells  
cap.—capillaries  
cp. nephr.—epithelium of renal sac  
fibr.—fibrous connective tissue  
lam.—fine lamellae (anal organ)  
luc. centr.—central luminous body (of tentacle organ)  
luc. ext.—peripheral luminous body  
luc. inf.—inner organ of eye  
luc. oc. 3—3rd eye organ  
luc. oc. 4—4th eye organ  
luc. oc. 5—5th eye organ  
m.—envelope (ventral organ)  
mus.—muscle fibers  
mus. long.—longitudinal muscles  
mus. rect. abd.—musculus rectus abdominis  
n.—nerves  
n. tent.—nerve of tentacle  
nephr.—renal sac  
nu.—nuclei  
nu. cap.—nuclei of capillaries  
pall.—mantle  
pg.—pigment  
phot.—luminous body  
phot. ext.—luminous body of outer organ 
phot. int.—luminous body of inner organ 
str.—silken-sheeny fibers  
str. ext.—outer fibers  
str. int.—inner fibers  
tap.—tapetum  
tap. ext.—outer tapetum  
tap. int.—inner tapetum  
v.—vein or vessel, resp.  
r. c.—branches of vena cava  
ven.—vein
Plate V

Abraliopsis morisii Vér.

Mature female from Station 256 in Indian North Equatorial Current. × 2.
After color sketches of the live animal
Figure 1. Left side.
Figure 2. Ventral
Figure 3. Dorsal.
Plate VI

_Abraliopsis morisii_ Ver. Male and juvenile stages

Figure 1. Male with hectocotylized left ventral arm. Station 54, Guinea Current. × 3. After color sketch of the live animal

Figure 2. Older juvenile stage from Station 54, Guinea Current. Ventral view (*Micrabraillia Pfeffer*). × 6

Figure 3. Juvenile stage from Station 323, Indian Countercurrent. Ventral (*Compsoteuthis Pfeffer*)

Figure 4. Same, left side.

Figure 5. Juvenile stage from Atlantic South Equatorial Current. Right side (*Compsoteuthis Pfeffer*)

Figure 6. Same, ventral.
Plate VII

Young larvae of *Abraliopsis*, *Thelidioteuthis*, and of *Enoploteuthidae*

Figures 1-8. Larvae of *Abraliopsis*

Figure 1. Larva of *Abraliopsis*, Indian Countercurrent, Station 228. ×6. (*Compsoteuthis Pfeffer*)

Figure 2. Left tentacle club of same larva.

Figure 3. Larva from Indian Countercurrent, Station 231. Dorsal. ×6

Figure 4. Same larva. Ventral. ×6

Figure 5. Tentacle club of same larva.

Figure 6. Younger larva from Indian Countercurrent. Ventral. ×6

Figure 7. Youngest larva, ventral. Indian Countercurrent. Station 228. ×6

Figure 8. Left tentacle club of same larva.

Figures 9-13. Youngest larvae, probably belonging to the development cycle of *Abraliopsis*

Figure 9. Larva from Indian North Equatorial Current. Station 217. ×6

Figure 10. Tentacle club of larva of Figure 11.

Figure 11. Youngest larva from Station 217, lateral. ×7.3

Figure 12. Youngest larva, Guinea Current. Station 43. ×22

Figure 13. Tentacle of same larva.

Figures 14-19. Larvae of *Thelidioteuthis alessandrini* Vér. and similar younger larvae

Figure 14. Larva from Indian North Equatorial Current. Station 218. ×10

Figure 15. Tentacle club of same larva. Appr. ×40

Figure 16. Older larva of *Thelidioteuthis* from Indian South Equatorial Current, Station 235. Ventral. ×6

Figure 17. Tentacle club of same larva. Appr. ×24

Figure 18. Larva from Indian Countercurrent. Station 223. Ventral

Figure 19. Tentacle club of same larva. Appr. ×50

Figures 20-23. Larvae that perhaps belong to *Enoploteuthis*

Figure 20. Larva from Indian North Equatorial Current. Station 218. Ventral. ×7

Figure 21. Dorsal view of same larva. ×7

Figure 22. Tentacle club of same larva.

Figure 23. Smaller larva of same species from Indian North Equatorial Current, Station 218. ×6

Figure 24. Larva from Guinea Current. Station 54. ×10

Figure 25. Tentacle club of same larva. ×50
Plate VIII

*Abraliopsis morisii* Ver. Arm apparatus and buccal funnel

Figure 1. *Abraliopsis morisii*, male. Buccal funnel viewed diagonally from the side. The 2nd and 3rd left arms are spread to show the deeper attachments: 1—dorsal, 2—dorsolateral, 3—ventrolateral, 4—ventral buccal peak.

Figure 2. Arm apparatus and buccal funnel (Station 254), seen from above. × 4

Figure 3. Left tentacle club of a male. Station 256. × 15

Figure 4. Right tentacle club of a male. Station 254. × 20

Figure 5. Left tentacle club of adult male. Station 54. × 20

Figure 6. Neck cartilage. Station 254. × 9

Figure 7. Knob of ventral arm, longitudinal section of the arm.

Figure 8. Granulate cells of knob tissue. Zeiss F. 2 Pr

Figure 9. Granulate cells of knob, with capillaries (*cap.*). Zeiss F. 2 Pr

**ABBREVIATIONS**

cap.—capillaries
*fun. br.* 2.—deep attachment from 2nd to 3rd arm
*fun. br.* 3.—deep attachment from 3rd to 2nd arm
*fun. tent.*—muscle of attachment of tentacle
Plate IX

Abraliopsis. Abralia. Mantle complex and genitalia

Figures 1–5. Abraliopsis morisii VéR.

Figure 1. Opened mantle cavity of male. Spermatophore sac filled with spermatophores.
Station 254, Indian Ocean. Appr. X 4

Figure 2. Opened mantle cavity of an Atlantic male with markedly swollen testes and far projecting end of spermatophore sac. Appr. X 4

Figure 3. Opened mantle cavity of large female from Station 256 (Indian Ocean), with ripe eggs and markedly swollen oviduct glands. X 4

Figure 4. Oviduct glands and adjacent organs of same female, diagonally viewed from the right. X 4

Figure 5. Male gonducts, dorsal. Station 254, cf. Figure 1. X 9

Figures 6 and 7. Abralia owenii VéR.

Figure 6. Left oviduct of young female from Nice (dorsal length of mantle—22 mm), natural position, ventral

Figure 7. Same oviduct, exposed.

ABBREVIATIONS

a.—artery
a. pinn.—artery of fins
a. post.—posterior artery
amp.—opening of vas deferens
app. c.—appendage of branchial heart
app. prost.—appendage of prostate
b. sperm.—Needham’s sac (spermatophore sac)
c. branch.—branchial heart
gl. od. i.—lower half of oviduct gland
gl. od. s.—upper half of oviduct gland
mu. depr. inf.—funnel depressor
nephr.—renal sac
or. od.—opening of oviduct
ov.—ovary
pen.—terminal part of spermatophore sac
prost.—prostate
sept.—mantle septum
sus.—branchial ligament
test.—testis
tub. olf.—olfactory tubercle
v.—vein
v. abd.—abdominal vein
v. def.—vas deferens
ves. sem.— seminal vesicle
ves. sem. 3—3rd part of seminal vesicle
Plate X

Abraliopsis morisii Ver. Hectocotylus, genitalia, luminous organs

Figure 1. Hectocotylus, buccal funnel and attachment of adjacent arms, ventral. Male from Station 54. X 12

Figure 2. Male gonducts, ventral. Specimen from Station 254

Figure 3. Gonducts of male from Station 254, dissected out.

Figure 4. Skin with luminous organs, directly anterior to funnel. Station 256

Figure 5. Part of mantle and funnel with luminous organs. Station 256

Figure 6. Median section of a large luminous organ of the eye. Zeiss C. 2. Station 254. X 224

Figure 7. Section through fully developed organ of mantle. Station 254

ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>amp.</td>
<td>opening of vas deferens</td>
</tr>
<tr>
<td>app. prost.</td>
<td>appendage of prostate</td>
</tr>
<tr>
<td>b. sperm.</td>
<td>spermaphore sac (Needham's sac)</td>
</tr>
<tr>
<td>c.</td>
<td>central luminous cells</td>
</tr>
<tr>
<td>can. cil.</td>
<td>ciliated canal</td>
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<tr>
<td>cart.</td>
<td>cartilage of eye</td>
</tr>
<tr>
<td>che.</td>
<td>chromatophores</td>
</tr>
<tr>
<td>co.</td>
<td>outer sheath of luminous organ</td>
</tr>
<tr>
<td>t.</td>
<td>bars of connective tissue</td>
</tr>
<tr>
<td>fibr.</td>
<td>fibers of connective tissue</td>
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<td>l.</td>
<td>lens</td>
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<tr>
<td>lac.</td>
<td>lacuna</td>
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<td>nu.</td>
<td>nuclei</td>
</tr>
<tr>
<td>or. cil.</td>
<td>opening of ciliated canal</td>
</tr>
<tr>
<td>phot.</td>
<td>luminous body</td>
</tr>
<tr>
<td>prost.</td>
<td>prostate</td>
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<tr>
<td>ret.1</td>
<td>cuppola of reflector</td>
</tr>
<tr>
<td>ret.2</td>
<td>lateral parts of reflector</td>
</tr>
<tr>
<td>str.</td>
<td>fibrous cells of eye organ</td>
</tr>
<tr>
<td>v.</td>
<td>vessel</td>
</tr>
<tr>
<td>v. def.</td>
<td>vas deferens</td>
</tr>
<tr>
<td>v. eff.</td>
<td>vas efferens</td>
</tr>
<tr>
<td>ves. sem.</td>
<td>1st, 2nd and 3rd part of seminal vesicle</td>
</tr>
<tr>
<td>ves. sem.1,2,3</td>
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Plate XI

Figures 1–4. Pyroteuthis margaritifera V&L.

Figure 1. Male from Messina. Ventral view with ventral luminous organs. × 2
Figure 2. Hectocotylus with large lobes, lateral. Appr. × 6
Figure 3. Same, inner side. Appr. × 6
Figure 4. Right tentacle of female. Appr. × 18

Figures 5 and 6. Enoploteuthis leptura d’Orb.

Figure 5. Young male from Atlantic South Equatorial Current. × 2.5
Figure 6. Tentacle club. Appr. × 12.
Plate XII

*Pterygioteuthis giardi* Fischer. Males and juvenile forms

Figure 1. Medium-sized male from Station 217, Indian North Equatorial Current. Dorsal view. Color sketch of live animal. × 5

Figure 2. Same, ventral.

Figure 3. Small male from Station 215, Indian North Equatorial Current. Right side. Color sketch of live animal. × 5.5

Figure 4. Same, ventral.

Figure 5. Older juvenile stage from Station 117, Agulhas Current. Ventral

Figure 6. Older juvenile stage from Station 66, South Equatorial Current. Ventral. × 7.5

Figure 7. Larva from South Equatorial Current. Ventral. × 7.5

Figure 8. Larva from South Atlantic. Ventral

Figure 9. Larva from Atlantic South Equatorial Current. Dorsal. × 7.5

Figure 10. Same, ventral.

Figure 11. Same, left side.

Figure 12. Larva from Station 231, Indian Countercurrent. Left side. × 7.3

Figure 13. Youngest larva from South Atlantic. Right side. × 7.3

Figure 14. Youngest larva from Station 214, Indian North Equatorial Current. Left side. × 7.3

Figure 15. Same larva, ventral diagonal. × 25
Plate XIII

Pterygioteuthis, arm apparatus and buccal funnel; larvae of Enoploteuthidae

Figure 1. Pterygioteuthis giardi. Young male from Indian North Equatorial Current, Station 217 (Plate XII, Figures 1, 2). Buccal funnel, ventral. Ventral arms bent downward, their attachment cut. × 8

Figure 2. Same specimen, arms and buccal funnel dissected out. Appr. × 8

Figure 3. Pt. gemmata, female. Attachment of ventral arms and tentacle, left side. The thin, long muscle of attachment of the tentacle passes below the deep attachment of the 3rd arm to the base of the tentacle. Porus aquiferus present between chocolate-brown buccal funnel and deep attachment

Figure 4. Tentacle club of young male of Pt. giardi from Station 217 (Plate XII, Figures 1, 2)

Figure 5. Pt. giardi. Young male from Station 215. Sail-shaped connection of dorsal arms seen from the outside

Figure 6. Pyroteuthis margaritifera, female. Attachment between 2nd and 3rd arm on the right side

Figure 7. Pterygioteuthis giardi. Young male from Station 215. Buccal funnel viewed from the ventral diagonal. Ventral arms (not drawn) bent down

Figure 8. Pt. giardi. Neck cartilage of male from Station 217.

Figures 9–12. Larvae of Pterygioteuthis

Figure 9. Tentacle of youngest larva from Station 214 (Plate XII, Figure 14), anterior and lateral. Appr. × 50

Figure 10. Posterior end of body of same larva, dorsal.

Figure 11. Tentacle of larva from Station 231 (Plate XII, Figure 12).

Figure 12. Tentacle of larva from Station 46 (Plate XII, Figure 13).

Figures 13–23. Larvae of Enoploteuthidae

Figure 13. Larva from southern part of Benguela Current. Station 91. × 6

Figure 14. Left tentacle club of same larva. × 30

Figure 15. Younger larva from Station 91, southern part of Benguela Current. × 10

Figure 16. Tentacle club of same larva. Appr. × 20

Figure 17. Young larva from Station 102, Agulhas Bank. × 10

Figure 18. Tentacle club of same larva. Appr. × 30

Figure 19. Younger larva, same stage as in Figure 17, ventral. Station 102, Agulhas Bank. × 10

Figure 20. Younger larva, same stage, lateral. Station 102, Agulhas Bank. × 10

Figure 21. Tentacle club of same larva. Appr. × 30

Figure 22. Youngest larva from Station 102, Agulhas Bank.

Figure 23. Arm apparatus of same larva.
Plate XIV

_Pterygioteuthis._ Arrangement of luminous organs

Figure 1. Adult of _Pterygioteuthis giardi_ with opened mantle cavity. Station 218, Indian North Equatorial Current. × 5.2

Figure 2. Slightly younger male of _Pt. giardi_ from Indian North Equatorial Current. Station 217 (Plate XII. Figure 11. Mantle cavity and funnel opened. × 6

Figure 3. Young male of _Pt. giardi_ from Indian North Equatorial Current (Plate XII. Figure 4). Abdominal wall opened to show testis. δ—male gonaducts

Figure 4. Mantle organs of male of _Pt. gemmata._
Drawn after a specimen fixed in formol by VANHÖFFEN. North of Tristan da Cunha

Figure 5. Eye organs of female of _Pt. gemmata._ Right eye. Eyeball turned slightly down, so that organ No. 10 is not visible

Figure 6. Eye organs of adult male of _Pt. giardi_ (Figure 1). Right eye

Figure 7. Eye organ No. 10 of _Pt. giardi_, exterior surface, with pigment cup and lens.

Figure 8. Eye organs of _Pyroteuthis margaritifera_ (Messina). Left eye turned slightly outward to show the small organs

Figure 9. Left anal organ of male of _Pt. gemmata_ (cf. Figure 4). Lateral view

**ABBREVIATIONS**

an. — anus
app. prost. — appendage of prostate
luc. an. — anal organ
luc. branch. — branchial organ
l. br. — dto.
luc. v. 1. — first ventral organ
luc. v. 2 — 2nd ventral organ
luc. v. 3 — 3rd ventral organ
luc. v. 4 — 4th ventral organ
pen. — terminus of spermatophore sac
ur. — papilla or renal sac
v. abd. — abdominal vein
Plate XV

*Pterygioteuthis.* Hectocotylus and genitalia

Figure 1. Hectocotylus of adult male of *Pterygioteuthis giardi*, inner surface (cf. Plate XIV, Figure 1)

Figure 2. Hectocotylus of adult male of *Pt. gemmata* n.sp. Surface facing median plane

Figure 3. Same hectocotylus of *Pt. gemmata*, inner surface.

Figure 4. Tooth plate and lamellar region of gland of the hectocotylus of *Pt. giardi* shown in Figure 1, outer surface.

Figure 5. Tooth plate and lamellar region of gland of younger male of *Pt. giardi* (Plate XII, Figure 2). Hectocotylus, outer side

Figure 6. Longitudinal section of distal half of hectocotylus and glandular swelling of *Pt. gemmata*, Hemalum, Zeiss A. 0

Figure 7. Cross section through hectocotylus of *Pt. gemmata* between the two glandular swellings. Hemalum, Zeiss A. 0

Figure 8. Cross section through hectocotylus of *Pt. gemmata* at level of proximal glandular swelling. Hemalum, Zeiss A. 0

Figure 9. Male genitalia of *Pt. gemmata*.

Figure 10. Ciliated funnel of ciliated canal of *Pt. gemmata*, longitudinal section. Formol-alcohol. Iron-hematoxylin. Zeiss F. 0

Figure 11. Slightly oblique transverse section of end of ciliated duct of *Pt. gemmata*. Iron-hematoxylin. Zeiss F. 0

Figure 12. Gland cells of first part of seminal vesicle of *Pt. gemmata*. Formol-alcohol. Hemalum. Zeiss F. 2

**ABBREVIATIONS**

*amp.*—opening of *vas deferens* in body cavity

*app. prost.*—appendage of distal *vas deferens*

*b. sperm.*—spermatophore sac (Needham's sac)

*can. cil.*—ciliated canal

*gl.*—glandular sacs of hectocotylus

*gl. dist.*—distal glandular pad

*gl. prox.*—proximal glandular pad

*gl. str.*—glandular grooves of hectocotylus

*lam. dent.*—toothed lamella of hectocotylus

*lam. nat.*—swimming membrane

*m. brach.*—arm musculature

*n.*—arm nerve

*n'.—lateral branches of arm nerve

*or. cil.*—ciliated funnel of ciliated canal

*or. gl.*—opening of glandular sac

*prost.*—accessory gland (prostate)

*v. d.*—*vas deferens*

*v. eff.*—*vas efferens*

*ves. sem. 1*—1st part of seminal vesicle (spermatophore gland)

*ves. sem. 2*—2nd part of spermatophore gland

*ves. sem. 3*—3rd part of spermatophore gland

*α, β, γ*—the 3 subdivisions of the 3rd part
Plate XVI

Luminous organs of *Pterygioteuthis*

Preparations were made from specimens fixed in formol. All outlines were drawn using prism

Figure 1. *Pt. gemmata*, male. Section of eye organ No. 1. Hemalum. × 135
Figure 2. *Pt. gemmata*, male. Organ No. 10. × 133
Figure 3. *Pt. giardi*, Station 217. Median section of organ No. 10. Hemalum
Figure 4. *Pt. giardi*, male. Station 218. Organ No. 10. × 53
Figure 5. *Pt. gemmata*, male. Organ No. 6. × 133
Figure 6. *Pt. giardi*, male. Organ No. 6. × 53
Figure 7. *Pt. gemmata*, male. Organ No. 6. × 53
Figure 8. *Pt. gemmata*, male. Small organ No. 11, with lens. × 133
Figure 9. *Pt. gemmata*, male. Small organ No. 12. × 133
Figure 10. *Pt. gemmata*, male. Large anterior abdominal organ. Iron-hematoxylin. Section is transverse to longitudinal axis of body. × 133
Figure 11. *Pt. gemmata*, male. Second abdominal organ. Median section. × 133
Figure 12. *Pt. gemmata*, male. Left anal organ. Hemalum. × 133
Figure 13. *Pt. gemmata*, male. Median section of the right branchial organ. Hemalum. × 133
Figure 14. *Pt. gemmata*. Part of luminous body of right branchial organ. Zeiss, homog. immersion
Figure 15. *Pt. gemmata*. Part of eye organ No. 3; lamella of inner reflector with nerves and vessels penetrating the lamella. Zeiss F. 0
Figure 16. *Pt. gemmata*. Squamous cell from eye organ No. 3. surface view
Figure 17. *Pt. gemmata*, female. Large anterior eye organ. Fixed in sublimate: nerves entering luminous body stained black with iron-hematoxylin. Zeiss, homog. immersion
Figure 18. Same object as in Figure 17. Bundle with 3 nerve fibers radiating into it
Figure 19. Part of branchial organ of *Pt. gemmata*; nerve bundles entering luminous body.

**ABBREVIATIONS**

cap.—capillaries
cart.—cartilage of eye
coll.—marginal lamellae of anal organ
cps.—outer sheath of ventral organs
fibr.—layer of connective tissue
l.—lens
l.1.—granulate cells of lens of eye organs
l.2.—homogeneous cells of lens of eye organs
l.sq.—squamous cells of lens
lam.—system of lamellae
lam. l.—lateral system of lamellae
lam. ext.—outer system of lamellae
lam. int.—inner system of lamellae
n.—nerves
n.1.—nerve layer of branchial organ
nu. l.—nuclei of lens cells
nu. lam.—nuclei of lamellae
nu. m.—muscle fibers
nu. l.—longitudinal muscles
pez.—pigment
phot.—luminous body
phot.1.—luminous body of the double organ
refl.—reflector
sq.—squamous cells
sq. int.—inner squamous cells
str.—fibers of lens
v.—vessel
vem.—vein
Plate XVII

*Octopodoteuthis* Rüppell (*Veranya Krohn*). Larvae from Indian Ocean

Figure 1. Oldest larva. Station 271, Gulf of Aden. Ventral. $\times 6$
Figure 2. Same larva, dorsal.
Figure 3. Larva from Station 102, Agulhas Current. Ventral. $\times 6$
Figure 4. Same larva, dorsal. $\times 6$
Figure 5. Younger larva from Station 102, Agulhas Current. Anterior region, ventral. Appr. $\times 28$
Figure 6. Same larva. Anterior region, dorsal. Appr. $\times 28$
Figure 7. Tentacle club of oldest larva. Lateral. Appr. $\times 40$
Figure 8. Same club, broad side. Appr. $\times 40$
Figure 9. Arm apparatus of larva from Station 102 (cf. Figure 3).
Figure 10. Arm- and buccal apparatus of oldest larva from Station 271 (cf. Figure 1).
Figure 11. Anterior region of youngest larva. Station 215. Indian North Equatorial Current. Appr. $\times 32$
Figure 12. Tentacle club of youngest larva. Station 215. Appr. $\times 90$
Plate XVIII

Calliteuthis, Histiotethis juv.

Figure 1. *Calliteuthis hoyleri* Goodrich. Station 235, Indian South Equatorial Current near the Amirantes. Ventral. X 2
Color sketch of the live animal.

Figures 2, 3, 4. *Calliteuthis reversa*. Station 223, Indian Countercurrent near Chagos Archipelago
Color sketch of the live animal.

Figure 2. Dorsal. X 2
Figure 3. Ventral. X 2
Figure 4. Left side. X 2

Figure 5. *Calliteuthis*. Juvenile form from Station 112, southern part of Aqulhas Bank. Ventral. X 8

Figure 6. *Histiotethis*. Juvenile form. Deepwater catch near Villefranche. Right side. X 7

Figure 7. Same, ventral. X 7
Plate XIX

_Histioteuthis_ jv., _Calliteuthis_

Figure 1. Juvenile form of _Histiotoeuthis_. ventral. Messina. Appr. × 7
Figure 2. Right club of same specimen. Appr. × 20
Figure 3. Juvenile form of _Histiotoeuthis_. left side. Station 73. Benguela Current. Appr. × 8
Figure 4. Right club of same specimen.
Figure 5. Right club of _Calliteuthis reversa_. Station 223 (cf. Plate XVIII, Figures 2-4). Appr. × 16
Figure 6. Right club of _Calliteuthis hoylei_. Station 235 (cf. Plate XVIII, Figure 1). Appr. × 16
Plate XX

Anatomy of Calliteuthis

Figure 1. Calliteuthis hoylei. Station 235. Left eye, lateral. × 6
Figure 2. C. hoylei. Station 235. Neck cartilage. × 8
Figure 3. C. reversa. Station 223. Buccal funnel and attachment. × 4
Figure 4. C. reversa. Station 223. Neck cartilage. × 8
Figure 5. C. hoylei. Station 235, young female. Mantle complex. × 7
Figure 6. C. reversa. Station 223, young female. Mantle complex. Appr. × 4
Figure 7. C. ocellata. Sagami Bay (Japan). The double genitalia of the mature male. Natural size
Figure 8. C. ocellata. Sagami Bay. Spermatophore
Figure 9. C. ocellata. Oral end of spermatophore tube
Figure 10. C. hoylei. Anal end of spermatophore tube
Figure 11. C. reversa. Anal end of spermatophore tube
Figure 12. C. hoylei. Longitudinal section of luminous organ. Formol-alcohol. Hemalum
Figure 13. C. reversa. Squamous cell of reflector, surface view. Formol-alcohol; homog. imm. 1/12
Figure 14. C. reversa. Luminous cells; homog. imm. 1/12

ABBREVIATIONS

a. pall. — pallial artery
a. pinn. — artery of fins
a. post. — posterior artery
amp. — opening of vas deferens
app. prost. — appendage of prostate
b. sperm. d. — right spermatophore sac
b. sperm. s. — left spermatophore sac
c. alb. — white body
c. branch. — branchial heart
c. cil. s. — left ciliated canal
c. sq. — squamous cells
chr. — chromatophores
cil. — ciliated body
coll. — swelling substance
fil. — terminal filament

g. opt. — optic ganglion
glut. — adhesive pad
inf. — ciliated funnel
l. — lens
P. — inner fibers of lens
mu. depr. inf. — funnel depressor
n. — nerve
nid. — nidamental gland
od. — oviduct
or. — opening of projectile tube
pq. — pigment
proj. — projectile tube
prot. d. — right prostate
prot. s. — left prostate
refl. — reflector

sacc. ven. — venous sac
sp. — sperm
spec. — mirror
spec. ’ — mirror of posterior organ
spec. — spermatophores
stom. — stomach
test. — testis
ur. — papilla of renal sac
v. abd. — abdominal vein
v. def. d. — right vas deferens
v. def. s. — left vas deferens
ves. sem. 1 — 1st part of seminal vesicle
ves. sem. 2 — 2nd part of seminal vesicle
ves. sem. 3 — 3rd part of seminal vesicle
x — cord of connective tissue
Plate XXI

_Histioteuthis riippellii_ VERANY

Large male from Nice with both dorsal arms hectocotylized. Two-thirds natural size
Plate XXII

*Teleoteuthis caribaea* Lesueur

Juvenile stages from Station 49, Atlantic South Equatorial Current, surface

Figure 1. Youngest stage, ventral.  × 4
Figure 2. Same stage, dorsal.  × 4
Figure 3. Slightly older stage, dorsal.  × 4
Figure 4. Same, ventral.
Figure 5. Intermediate stage, dorsal.  × 4
Figure 6. Same, ventral.  × 4
Figure 7. Oldest stage, dorsal.  × 3
Figure 8. Same, ventral.  × 3
Plate XXIII

Larvae of Onychoteuthidae, clubs of *Teleoteuthis caribaea*

Figure 1. Youngest larva, right side. Station 218, Bay of Bengal. × 10
Figure 2. Arms of same larva, seen from above.
Figure 3. Young larva, right side. Station 172, southern part of Indian Ocean. × 10
Figure 4. Arms of same larva.
Figure 5. Young larva, left side. Station 48, Atlantic South Equatorial Current. × 10
Figure 6. Arms of same larva.
Figure 7. Older larva, left side. Station 218, Bay of Bengal. × 10
Figure 8. Arms of same larva.
Figure 9. Oldest larva, left side. Station 74, Benguela Current. × 10
Figure 10. Arms of same larva.

Figures 11–14. Clubs of juvenile stages of *Teleoteuthis caribaea*. Station 49

Figure 11. Club of youngest stage (cf. Plate XXII, Figures 1, 2). Appr. × 30
Figure 12. Club of young stage (cf. Plate XXII, Figures 3, 4). Appr. × 30
Figure 13. Club of intermediate stage (cf. Plate XXII, Figures 5, 6). Appr. × 18
Figure 14. Club of oldest stage (cf. Plate XXII, Figures 7, 8). Appr. × 18
Plate XXIV

*Benthoteuthis megalops* Verrill (*Bathyteuthis abyssicola* Hoyle)

Based on color sketches of live animals

Figure 1. Largest specimen, dorsal. Station 221, Indian Countercurrent near Chagos Archipelago. × 3

Figure 2. Same specimen, ventral. × 3

Figure 3. Medium-sized specimen, dorsal. Station 217, Indian North Equatorial Current. × 3

Figure 4. Medium-sized specimen, ventral. Station 115, Benguela Current South of Cape of Good Hope. × 3

Figure 5. Same, right side. × 3

Figure 6. Small specimen, left side. Station 207, Indian Ocean (Surat passage). × 3

Figure 7. Head of medium-sized specimen, ventral. × 6

Figure 8. Head of same specimen, obliquely from left side. × 6
Plate XXV

*Benthoteuthis megalops* VERRILL. Arm apparatus, mantle complex

Figure 1. Mantle complex of large specimen, Station 221. Appr. × 4
Figure 2. Arm apparatus, diagonally dorsal. Small specimen, Station 115. Appr. × 15
Figure 3. Arm apparatus, diagonally ventral. Large specimen, Station 221
Figure 4. Club of the large specimen from Station 221. Appr. × 30
Figure 5. Club of small specimen from Station 115. Appr. × 30
Figure 6. Funnel organ of the large specimen from Station 221. × 8
Figure 7. Neck cartilage of same specimen. Appr. × 10
Plate XXVI

*Benthoteuthis megalops* Verrill. Intestinal tract, vascular system. Large specimen from Station 221

Figure 1. Mantle complex, ventral. Abdominal wall with heart and vessels removed. X 10
Figure 2. Intestinal tract, left side. X 10
Figure 3. Intestinal tract, dorsal. X 10
Figure 4. Mantle complex with intestinal tract, vascular system, and female genitalia, ventral. X 10
Figure 5. Vascular system, nidamental glands and oviduct, dorsal. X 10

**ABBREVIATIONS**

*a. branch.*—branchial artery
*a. ceph.*—cephalic aorta
*a. post.*—posterior aorta
*an.*—anus
*ao.*—cephalic aorta
*app. c.*—appendage or branchial heart
*atx.*—ink sac
*branch.*—gill
*c.*—heart
*c. branch.*—branchial heart
*d. coel.*—coelomic duct to renal sac
*d. hep.*—hepatic duct
*hep.*—liver
*hep!.*—anterior part of liver

*lig. an.*—anal ligament
*lie. g. g.*—gastro-genital ligament
*mu. depr. inf.*—funnel depressor
*mu. retr. cap. lat.*—musculus retractor capitis lateralis
*neph.*—renal sac
*nid.*—nidamental gland
*ood. s.*—left oviduct
*oes.*—esophagus
*o.st.*—opening of stomach
*ov.*—ovary
*ovid.*—oviduct
*pancr. d.*—right pancreas
*pancr. s.*—left pancreas

*rect.*—rectum
*s. ven.*—venous sac
*s. ven. hep.*—venous sac of liver
*saliv. post.*—posterior salivary gland
*st.*—stomach
*st.?—anterior part of stomach
*st. coec.*—caecum
*ar.*—papilla of renal sac
*v. abd.*—abdominal vein
*v. branch.*—branchial vein
*v. c.*—vena cava
*v. hep.*—hepatic vein
*v. hep. pancre.*—hepato-pancreatic vein
*v. pall.*—pallial vein
Plate XXVII

Figures 1–8. *Benthoteuthis megalops* Verrill. Eye and luminous organ
Fixation in formol (eye) and osmic acid (lum. organ)


Figure 1. Left eye of large specimen of *Benthoteuthis megalops* from Station 221. Right side.
Appr. × 12

Figure 2. Same, ventral. Appr. × 12

Figure 3. Median section through eye of large specimen from Station 221.

Figure 4. Section through fovea of same eye. × 195

Figure 5. Posterior margin and fovea of same eye after clearing in oil of cloves. × 23

Figure 6. Marginal part of retina of same eye. × 195

Figure 7. Vascular whorl near fovea.

Figure 8. Longitudinal section of luminous organ of a medium-sized specimen. × 400

Figure 9. Juvenile form of *Ctenopteryx* sp., dorsal. South Atlantic Benguela Current. Station 86. × 6

Figure 10. Same, ventral × 6

Figure 11. Right fin of same specimen, lateral. Appr. × 25

**ABBREVIATIONS**

*bac.*—rods

*bg.*—connective tissue

*c. alb.*—white body

*c. epith.*—epithelial (ciliated) body

*cap.*—capillaries

*cart.*—cartilage of eye

*cart. cr.*—cartilage of cranium

*cart. ir.*—cartilage of iris

*chrom.*—chromatophores

*ep. pg.*—pigmented epithelium

*fovea.*—fovea of retina

*g. opt.*—optic ganglion

*glom.*—glomerulus

*ir.*—iris

*lim.*—membrana limitans of rod layer

*m.*—margin of retina

*mu.*—muscle fibers

*mu. l.*—longitudinal muscles

*n.*—nerve

*mu. lim.*—nuclei of cells of membrana limitans

*mu. sens.*—nuclei of sensory cells

*pg.*—pigment

*phot.*—luminous body

*ret. dors.*—dorsal retina

*ret. ventr.*—ventral retina

*sel.*—sclera of eyeball
Plate XXVIII

*Rhynchoteuthis*, larvae of Ommastrephidae. × 10

Figure 1. Youngest larva, ventral. Station 215, Bay of Bengal
Figure 2. Young larva, ventral. Station 64, southern Atlantic near São Tomé Island
Figure 3. Young larva, right side. Station 64
Figure 4. Intermediate larva, ventral. Station 41, Guinea Current
Figure 5. Intermediate larva, right side. Station 41, Guinea Current
Figure 6. Intermediate larva, right side. Station 236, Indian Ocean near Seychelles
Figure 7. Intermediate larva, left side. Station 173, southern Indian Ocean
Figure 8. Young larva, ventral. Station 64, Atlantic Ocean near São Tomé Island
Figure 9. Intermediate larva, ventral. Station 173, southern Indian Ocean
Figure 10. Young larva, left side. Station 125, Indian North Equatorial Current
Figure 11. Older larva, ventral. Station 175, Indian South Equatorial Current
Figure 12. Older larva, ventral. Station 90, South Atlantic Benguela Current
Figure 13. Oldest larva, left side. Station 228, Indian Countercurrent
Figure 14. Same, dorsal.
Figure 15. Same, ventral.
Plate XXIX

Figures 1–9. Rhynchoteuthis
Figures 9–11. Brachioteuthis (Tracheloteuthis)
Figures 12, 13. Larva caught in locking net

Figure 1. *Rhynchoteuthis*. Head and arms of intermediate larva, seen from above. Station 175. Appr. ×18

Figure 2. Head and arms of oldest larva (cf. Plate XXVIII, Figure 14), seen from above. Station 228. Appr. × 18

Figure 3. Neck cartilage of oldest larva. Station 228. Appr. × 20

Figure 4. Mantle complex of oldest larva. Station 228. Appr. × 20

Figure 5. Eye of young larva, lateral. Station 64

Figure 6. End of fused tentacles of young larva. Station 55, Guinea Current

Figure 7. Anal appendage of older larva. Station 90, southern Atlantic. Appr. × 50

Figure 8. Anal appendage of oldest larva. Station 228, Appr. × 50

Figure 9. *Brachioteuthis*, youngest larva, left side. Station 237. Indian South Equatorial Current, × 8

Figure 10. Head of same larva, dorsal. Appr. × 20

Figure 11. *Brachioteuthis picta* n.sp. Buccal funnel and attachment of arms, seen from above. Station 67, northern branch of Benguela Current. Appr. × 10

Figure 12. Larva caught in locking net at 1,500–2,000 m, right side. Station 120, West Wind Drift, × 10

Figure 13. Same larva, ventral. × 10
Plate XXX

Figures 4, 5. *Brachioteuthis picta* n.sp.

Figure 1. Juvenile form of *Brachioteuthis*, probably belonging to *Br. riisei*. STEENSTR., left side. Station 66, northern branch of Benguela Current. × 8

Figure 2. *Brachioteuthis* juv., dorsal. Station 236, Indian South Equatorial Current near Amirantes. Appr. × 8

Figure 3. Same larva, ventral. Appr. × 8

Figure 4. *Brachioteuthis picta* n.sp., dorsal. Station 67, northern branch of Benguela Current. × 2

Figure 5. Same specimen, ventral. × 2
Plate XXXI

Figures 1, 2, 3, 5, 7, 8. Brachioteuthis picta n.sp.
Figures 4, 6. Juvenile forms of Brachioteuthis (Tracheloteuthis). Gladius and arm apparatus

Figure 1. Brachioteuthis picta Cht. Gladius, ventral \( \times 5 \)
Figure 2. Br. picta. Left club, outer surface. \( \times 10 \)
Figure 3. Same, inner surface.
Figure 4. Club of juvenile form from Station 236 (cf. Plate XXX, Figures 2, 3)
Figure 5. Large sucker of club of Br. picta.
Figure 6. Club of juvenile form from Station 66 (cf. Plate XXX, Figure 1). Appr. \( \times 20 \)
Figure 7. Row of suckers in middle of 3rd arm of Brachioteuthis picta, ventral. Appr. \( \times 18 \)
Figure 8. Same, dorsal. Appr. \( \times 18 \)
Plate XXXII

*Brachioteuthis* (*Tracheloteuthis*) *picta* n.sp. Head, intestinal tract, and vascular system

Figure 1. Mantle complex. Funnel slightly displaced. × 4
Figure 2. Head with neck folds, olfactory tubercle, and funnel, left side. × 10
Figure 3. Visceral complex, right side. × 11
Figure 4. Intestinal tract, left side. × 11
Figure 5. Neck cartilage. × 8
Figure 6. Vascular system, dorsal. × 11

**ABBREVIATIONS**

a. *branch*—branchial artery
a. *ceph*—cephalic aorta
a. *pall*—pallial artery
a. *post*—posterior artery
app. *an*—anal appendages
app. *c*—appendage of branchial heart
atr.—ink sac
c.—heart
c. *branch*—branchial heart
hep.—liver
int.—mid-intestine
lig. *g. g*—gastro-genital ligament
mu. *depr. int*—funnel depressor
n. *visc*—visceral nerve
oes.—esophagus
pancr.—pancreas
pancr. 1—anterior lobe of pancreas
rect.—rectum
sacc. *v*—venous sac
sacc. *v* 1—anterior venous sac
sacc. *v* 2—posterior venous sac
sin. *st*—sinus of stomach
st.—stomach
st. *coec*—caecum
st. *coec* 1—hood of caecum
test.—testis
v. *abd*—abdominal vein
v. *branch*—branchial vein
v. *c*—vena cava
v. *hep*—hepatic vein
v. *pall*—pallial vein
Plate XXXIII

Figures 1–2. *Mastigoteuthis glaukopis* n.sp.

Figure 1. *M. glaukopis*, left side. Station 261, Indian South Equatorial Current near East Africa. × 2

Figure 2. Same, ventral.

Figures 3, 4. *M. flammea* n.sp.

Figure 3. *M. flammea*, dorsal. Station 64, near São Tomé Island in the South Atlantic. × 2

Figure 4. Same, ventral. × 2
Plate XXXIV

*Mastigoteuthis cordiformis* n.sp.

Figure 1. *M. cordiformis*, dorsal. Station 194, Indian Countercurrent near Nias. Natural size

Figure 2. Same, ventral.
Plate XXXV

*Mastigoteuthis* Verrill. Gladius, cartilage, and arm apparatus

Figure 1. *Mastigoteuthis cordiformis* n.sp. Right funnel cartilage. Station 194
Figure 2. *M. glaukopis* n.sp. Right funnel cartilage. Station 261
Figure 3. *M. flammea*. Right funnel cartilage. Station 53
Figure 4. *M. flammea*. Right funnel cartilage. Station 64
Figure 5. *M. cordiformis*. Gladius, ventral. $\times 2$
Figure 6. Same, right side. $\times 2$
Figure 7. Neck cartilage of *M. flammea*. Station 64
Figure 8. Bases of arms, buccal funnel, and tentacles of *M. cordiformis*, seen from above. $\times 2$
Figure 9. Buccal funnel and its attachment, *M. flammea*. Station 64
Figure 10. Proximal part of club of *M. cordiformis*.
Figure 11. Tentacle sucker of *M. cordiformis*, lateral.
Figure 12. Tentacle sucker of *M. cordiformis*, seen from above.
Figure 13. Arm sucker of *M. cordiformis*, lateral.
Figure 14. Arm sucker of *M. cordiformis*, seen from the opening.
Figure 15. Tentacle of *M. glaukopis*. Station 261. Appr. $\times 2.5$
Figure 16. Part of club of *M. glaukopis*, outer side. Appr. $\times 20$
Plate XXXVI

*Mastigoteuthis.* Anatomy

Figure 1. *Mastigoteuthis flammea.* Mantle complex, ventral. Station 64. Left gill cut at base of branchial heart and folded aside. Abdominal wall removed on left side

Figure 2. *Mastigoteuthis flammea.* Mantle complex of specimen from Station 53, ventral

Figure 3. *Mastigoteuthis cordiformis.* Mantle complex, ventral

Figure 4. *Mastigoteuthis cordiformis.* Stomach and caecum with gastric ganglion and veins. Ventral

Figure 5. *Mastigoteuthis cordiformis.* Neck cartilage. × 3.5

ABBREVIATIONS

- *a. branch.*—branchial artery
- *a. post.*—posterior artery
- *app. c.*—appendage of branchial heart
- *c.*—heart
- *c. branch.*—branchial heart
- *g. astra.*—gastric ganglion
- *g. stell.*—stellate ganglion
- *hep.*—liver
- *int.*—mid-intestine
- *ile. g. g.*—gastro-genital ligament
- *luc.*—luminous organ
- *mus. coll.*—collaris
- *mus. depre. int.*—funnel depressor
- *n. pall.*—pallial nerve
- *nid.*—nidamental gland
- *oes.*—esophagus
- *ov.*—ovary
- *pancr.*—pancreas
- *rad.*—spiral folds
- *sacc.*—abdominal wall
- *sacc. v.*—venous sac

- *st.*—stomach
- *st.'*—tip of stomach
- *st. coec.*—caecum
- *sup.*—ligament of gills
- *tub. olf.*—olfactory tubercle
- *ur.*—papilla of renal sac
- *v. abd.*—abdominal vein
- *v. branch.*—branchial vein
- *v. c.*—vena cava
- *v. g.*—gastric vein
- *v. pall.*—pallial vein
Plate XXXVII

*Mastigoteuthis*. Luminous organs

Figure 1. *Mastigoteuthis glaukopis* n.sp., Station 261. Longitudinal section of organ of left eye. Formol, alcohol-hemalum. $\times$ 130

Figure 2. *M. flammea* n.sp., Station 64. Section through mantle organ. Formol, alcohol-hemalum

Figure 3. *M. flammea*, Station 64. Section through mantle organ.

Figure 4. Mantle organs of *M. flammea*, surface view. Under magnifying glass

Figure 5. *M. cordiformis* n.sp. Section through conical tubercle (luminous organ?) of skin

**ABBREVIATIONS**

chr.—chromatophores
ep.—epithelium
gel.—gelatinous connective tissue
mu.—muscle fibers
phot.—luminous body
v.—vessel
x.—central cord of cells
Plate XXXVIII

*Chiroteuthis (Chiroteuthis) imperator* n.sp.

Specimen from Station 194, South Channel of Nias. Natural size

Figure 1. Right side.
Figure 2. Dorsal.
Plate XXXIX

Chiroteuthis, Doratopsis

Figures 1-10. Ch. imperator. Station 194, Indian Countercurrent, near Nias

Figure 1. Neck cartilage and opposite cartilage. Natural size
Figure 2. Buccal funnel with attachments and arm bases, seen from above.
Figure 3. Buccal funnel, ventral surface, lateral.
Figure 4. Arm suckers, lateral.
Figure 5. Arm suckers, seen from the opening.
Figure 6. Tentacle suckers, seen from the opening.
Figure 7. Tentacle suckers, lateral.
Figure 8. Left funnel cartilage. X 5
Figure 9. Right funnel cartilage. X 5
Figure 10. Opposite cartilage of mantle. X 5

Figures 11-15. Doratopsis

Figure 11. Tentacle of D. exophthalmica, Station 169.
Figure 12. Tentacle club of D. lippula, Station 74.
Figure 13. Tentacle club of D. exophthalmica, Station 26.
Figure 14. Base of large ventral arm of D. exophthalmica, Station 169.
Figure 15. Base of large ventral arm of D. sagitta, Station 39.
Plate XL

*Chiroteuthis*

Figure 1. *Ch. veranyi* FÉRUSSAC. Adult male, natural size, ventral. Mantle was opened and the right eye exposed to show the luminous stripes

Figures 2–7. *Ch. imperator*

Figure 2. End of tentacle club with glandular knob, lateral. Station 194. Appr. × 20
Figure 3. Glandular knob on club tip, external surface.
Figure 4. Part from middle of tentacle club. Specimen from Sagami Bay
Figure 5. Olfactory tubercle, diagonally lateral. Station 194
Figure 6. Left eye of *Ch. picteti*, after JOUBIN's description of original specimen
Figure 7. *Ch. imperator*. Mantle complex of younger male with both ventral luminous organs. Renal sac opened. Sagami Bay

**ABBREVIATIONS**

*luc.*—ventral luminous organs
*ur.*—papilla of renal sac
Plate XLI

*Chiroteuthis imperator.* Nervous system, gladius, visera

Figure 1. Nervous system of medium-sized specimen, dorsal. Visceral nerve and its branches was slightly displaced to the right.

Figure 2. Inferior buccal ganglion with adjacent anterior salivary glands and branches of buccal artery.

Figure 3. Stellate ganglia and commissure of medium-sized specimen.

Figure 4. Right orbit after removal of eye, with parts of central nervous system shining through, × 5.2

Figure 5. Central nervous system and thicker nerves of large specimen from Station 194. Left side. Cartilage of static organ cut open. Larger arteries and veins also indicated. Of the intestinal tract, course of esophagus and position of posterior salivary gland is indicated, × 4.7

Figure 6. Gastric ganglion with nerves.

Figure 7. Heart, branchial hearts with efferent vessels and left oviduct of medium-sized specimen. Dorsal diagonal view. Oviduct not presented in right half of figure, × 4.2

Figure 8. Opening of right oviduct near branchial ganglion, ventral surface.

Figure 9. Vena cava and appendix below point of entrance into cranium, with funnel nerves and adjacent muscle part. Lateral

Figure 10. Gladius of medium-sized specimen, dorsal surface. Natural size

Figure 10a, b, c. Slightly enlarged cross sections of gladius at level indicated by dotted lines.

Figure 11. Same gladius, right side.

Figure 12. Initial part of cone, ventral, under the magnifying glass.

Figure 13. Posterior tip of gladius, lateral, showing also end of gelatinous tube and the delicate septa, × 14

Figure 14. Initial part of cone of large specimen from Station 194, with projecting gelatinous pad and end of gastro-genital ligament. Viewed diagonally from the right

Figure 15. Section from posterior half of body, dissected out to show initial part of cone and adjacent organs, ventral

Figure 16. Same preparation, left side.

Figure 17. Male gonaducts of younger specimen, dorsal, × 6

Figure 18. Same, ventral, × 6

Figure 19. Testis of young male, ventral surface.

Figure 20. Same, lateral, with posterior end of stomach and gastro-genital ligament.

**Abbreviations**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
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<td>branchial artery</td>
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<td>a. branch.</td>
<td>branchial artery</td>
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<td>a. ceph.</td>
<td>cephalic aorta</td>
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<td>a. ophth.</td>
<td>ophthalmic artery</td>
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<td>a. paner.</td>
<td>pancreatic artery</td>
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<td>pharyngeal artery</td>
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<td>a. pinn.</td>
<td>fin artery</td>
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<td>a. post.</td>
<td>posterior artery</td>
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<td>a. saliv.</td>
<td>salivary artery</td>
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<td>funnel adductor</td>
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<td>alh.</td>
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<td>amp.</td>
<td>opening of vas deferens</td>
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<td>appendage of branchial heart</td>
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<td>app. pro.</td>
<td>appendage of prostate</td>
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<td>b. sperm.</td>
<td>spermaphore sac</td>
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<td>(Nedham's sac)</td>
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<td>c.</td>
<td>heart</td>
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<td>c. b. s.</td>
<td>commissure of buccal ganglia</td>
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<td>branchial heart</td>
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<td>posterior visceral commissure</td>
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<td>appendix of vena cava</td>
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<td>cone of gladius</td>
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<td>duct of posterior salivary gland</td>
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<td>div. oes.</td>
<td>diverticulum of esophagus</td>
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<td>brachial ganglion</td>
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<td>g. branch.</td>
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<td>g. bucc. inf.</td>
<td>inferior buccal ganglion</td>
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<td>g. bucc. sup.</td>
<td>superior buccal ganglion</td>
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<td>g. cer.</td>
<td>cerebral ganglion</td>
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<td>g. visc.</td>
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<td>glad.</td>
<td>gladius</td>
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<td>gl. od.</td>
<td>oviduct gland</td>
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<td>i.g. g.</td>
<td>gastro-genital ligament</td>
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<td>m. cr.</td>
<td>cranial ridge</td>
</tr>
<tr>
<td>mu.</td>
<td>muscle</td>
</tr>
<tr>
<td>mu. flab.</td>
<td>fan-shaped muscle</td>
</tr>
<tr>
<td>mu. pall.</td>
<td>mantle musclecuture</td>
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<td>n.a.o.t.</td>
<td>inferior antorbital nerve</td>
</tr>
<tr>
<td>n.a.o.v.</td>
<td>superior antorbital nerve</td>
</tr>
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<td>n. atr.</td>
<td>nerve to ink sac</td>
</tr>
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<td>n. brach.</td>
<td>brachial nerve</td>
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<tr>
<td>n. brach 1-2</td>
<td>branches of brachial nerve to 1st, 2nd, 3rd, 4th arms</td>
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<tr>
<td>n. branch.</td>
<td>branchial nerve</td>
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<td>n. c. branch.</td>
<td>nerve of branchial heart</td>
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<td>n. inf.</td>
<td>funnel nerve</td>
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<td>n. inf. orb.</td>
<td>orbital branch of funnel nerve</td>
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<td>n. i. phar.</td>
<td>nerves of inferior buccal ganglion</td>
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<tr>
<td>n. m.</td>
<td>cone of gladius</td>
</tr>
<tr>
<td>n. o. i. o.</td>
<td>oculomotor nerve</td>
</tr>
<tr>
<td>n. o. off.</td>
<td>olfactory nerve</td>
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<td>n. ophth. i.</td>
<td>inferior ophthalmic nerve</td>
</tr>
<tr>
<td>n. ophth. s.</td>
<td>superior ophthalmic nerve</td>
</tr>
<tr>
<td>n. opt.</td>
<td>optic nerve</td>
</tr>
<tr>
<td>n. p. orth.</td>
<td>postorbital nerve</td>
</tr>
<tr>
<td>n. pall.</td>
<td>pallial nerve</td>
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<tr>
<td>n. s. phar.</td>
<td>nerves of supraesophageal ganglion</td>
</tr>
<tr>
<td>n. stat.</td>
<td>static nerve</td>
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<tr>
<td>n. symp.</td>
<td>sympathetic nerve</td>
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<tr>
<td>n. tent.</td>
<td>nerve of tentacle</td>
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<tr>
<td>n. vesc.</td>
<td>visceral nerve</td>
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<td>o. stat.</td>
<td>static organ</td>
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<tr>
<td>oes.</td>
<td>esophagus</td>
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<td>od.</td>
<td>oviduct</td>
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<tr>
<td>pen.</td>
<td>end of spermatophore sac</td>
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<tr>
<td>prost.</td>
<td>prostate</td>
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<td>r.</td>
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<td>r. d. hep.</td>
<td>nerve branch to hepatic duct</td>
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<tr>
<td>r. paner.</td>
<td>nerve branch to pancreas</td>
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<tr>
<td>r. stom.</td>
<td>nerve branch to stomach</td>
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<tr>
<td>r. stom. cocc.</td>
<td>nerve branch to caecum</td>
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<tr>
<td>sac.</td>
<td>shell gland</td>
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<tr>
<td>sac. c.</td>
<td>venous sac</td>
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<td>saliv. a.</td>
<td>anterior salivary gland</td>
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<td>saliv. p.</td>
<td>posterior salivary gland</td>
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<tr>
<td>sept.</td>
<td>septa of cone</td>
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<td>stom.</td>
<td>stomach</td>
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<td>test.</td>
<td>testis</td>
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<tr>
<td>v.</td>
<td>vein</td>
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<td>v. abd.</td>
<td>abdominal vein</td>
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<td>v. brach.</td>
<td>branchial vein</td>
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<td>v. cep.</td>
<td>cephalic vein</td>
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<td>v. c.</td>
<td>vena cava</td>
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<td>v. cr.</td>
<td>cranial vein</td>
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<td>v. def.</td>
<td>vas deferens</td>
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<td>v. eff.</td>
<td>vas efferens</td>
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<tr>
<td>v. len.</td>
<td>splenic vein</td>
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<tr>
<td>v. saliv.</td>
<td>salivary vein</td>
</tr>
<tr>
<td>ves. sem. 1</td>
<td>ves. sem. 2, ves. sem. 3</td>
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Plate XLII

Chiroteuthis. Mantle complex and intestinal tract

Figures 1-4. Ch. imperator

Figure 1. Mantle complex of specimen from Station 194, ventral. Funnel opened

Figure 2. Intestinal tract of younger female, left side.

Figure 3. Viscera of same specimen, right side, with ovary situated on them.

Figure 4. Intestinal tract of young male, ventral. Mid-intestine cut at exit from stomach; dots indicate its position. × 3

Figure 5. Chiroteuthis veranyi FÉRUS. Mantle complex of adult male from Messina. Ventral surface, viewed slightly diagonally from the left

ABBREVIATIONS

a. post.—posterior artery
atr.—ink sac
b. sperm.—spermatophore sac
c. branch.—branchial heart
cart. pull.—mantle cartilage
d. hep.—hepatic duct
d. hep. pancre.—hepato-pancreatic duct
g. gastr.—gastric ganglion
hep.—liver
int.—mid-intestine
lig. g. g.—gastro-genital ligament
luc.—ventral luminous organ

mus. coll.—collaris
mus. depr. inf.—funnel depressor
mus. st.—muscular ridge of stomach
n. pull.—mantle nerve
n. symp.—sympathetic nerve
nid.—nidamental gland
oes.—esophagus
org. inf.1.—median funnel organ
org. inf.2.—lateral funnel organ
ov.—ovary
pancr.—pancreas
pen.—end of spermatophore sac
rect.—rectum
sacc. v.—venous sac
sept.—mantle septum
st.—stomach
st.1.—appendage of stomach
st. coec.—caecum
sus. branch.—branchial ligament
test.—testis
v. abd.—abdominal vein
v. c.—vena cava
valv.—funnel valve
ves. sem.—seminal vesicle
Plate XLIII

Chiroteuthis imperator

Figure 1. Mantle complex of specimen from Station 194, ventral.
Figure 2. Specimen from Sagami Bay. Head viewed from the ventral side, to show the luminous organs of the eye and the nerves and vessels that extend from base of cranium.
Figure 3. Dorsal view of head, showing cranial capsule and organs situated outside it, Sagami Bay.
Figure 4. Same specimen as in Figure 3. with cranial capsule and anterior nerves removed.

ABBREVIATIONS:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>a. ceph.</td>
<td>cephalic aorta</td>
</tr>
<tr>
<td>a. ophth.</td>
<td>ophthalmic artery</td>
</tr>
<tr>
<td>atr.</td>
<td>ink sac</td>
</tr>
<tr>
<td>b. cran.</td>
<td>base of cranium</td>
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<tr>
<td>brach. IV</td>
<td>4th arm</td>
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<td>c. alb.</td>
<td>white body</td>
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<td>cart. inf.</td>
<td>funnel cartilage</td>
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<td>cart. neck</td>
<td>neck cartilage</td>
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<td>comm. b.s.i.</td>
<td>commissure between superior and inferior buccal ganglion</td>
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<td>comm. c.b.</td>
<td>cerebro-buccal commissure</td>
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<tr>
<td>con.</td>
<td>cone of gladius</td>
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<tr>
<td>cran.</td>
<td>cranium</td>
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<td>g. brach.</td>
<td>brachial ganglion</td>
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<td>g. bucc. inf.</td>
<td>inferior buccal ganglion</td>
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<td>g. bucc. sup.</td>
<td>superior buccal ganglion</td>
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<td>g. cer.</td>
<td>cerebral ganglion</td>
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<td>g. opt.</td>
<td>optic ganglion</td>
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<td>gel.</td>
<td>gelatinous tissue</td>
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<td>gel. con.</td>
<td>gelatinous swelling of cone</td>
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<td>gel. pall.</td>
<td>gelatinous tissue of mantle</td>
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<td>inf.</td>
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<td>luc.</td>
<td>luminous organ</td>
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<td>outer row of eye organ</td>
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<td>luc. 2</td>
<td>middle row of eye organs</td>
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<td>luc. 3</td>
<td>inner row of eye organs</td>
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<td>m. bucc.</td>
<td>buccal membrane</td>
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<td>mu. depr. inf.</td>
<td>funnel depressor</td>
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<td>mu. palp.</td>
<td>muscular mass of lid</td>
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<td>n. brach. 1, 2, 3, 4</td>
<td>nerves to 1st, 2nd, 3rd, 4th arms, respectively</td>
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<td>n. inf.</td>
<td>funnel nerve</td>
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<td>n. ophth. sup.</td>
<td>superior ophthalmic nerve</td>
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<td>n. pall.</td>
<td>pallial nerve</td>
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<td>n. pall. d.</td>
<td>right pallial nerve</td>
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<td>n.s. phar.</td>
<td>nerves of supraesophageal ganglion</td>
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<td>sympathetic nerve</td>
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<td>n. tent.</td>
<td>nerve of tentacle</td>
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<td>right abdominal wall</td>
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<td>anterior salivary gland</td>
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<td>saliv. post.</td>
<td>posterior salivary gland</td>
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<td>s. v. c.</td>
<td>appendix of vena cava</td>
</tr>
<tr>
<td>s. ven.</td>
<td>venous sacs</td>
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<tr>
<td>st.</td>
<td>stomach</td>
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<tr>
<td>v. Abd.</td>
<td>abdominal vein</td>
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<tr>
<td>v. c.</td>
<td>vena cava</td>
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Plate XLIV

Chiroteuthis. Luminous organs and glandular knobs

**Figure 1.** *Chiroteuthis veranyi* FÉRUS., Messina. Luminous organ on ventral arm, longitudinal section. Formol, alcohol, hemalum. × 110

**Figure 2.** *Ch. imperator.* Longitudinal section of ventral organ

**Figure 3.** *Ch. imperator.* Part of luminous body of ventral organ; homog. imm. 1/12 (reduced). Formol, alcohol, hemalum

**Figure 4.** *Ch. veranyi.* Confluence of several septa in gelatinous body of ventral organ; homog. imm. 1/12 (reduced)

**Figure 5.** *Ch. veranyi.* Thick nerve extending along anterior dorsal surface of ventral organ; homog. imm. 1/12 (reduced)

**Figure 6.** *Ch. imperator.* Longitudinal section through eye organ. Formol, alcohol, hemalum

**Figure 7.** *Ch. imperator.* Part of luminous body of eye organ. Formol-alcohol, hemalum; homog. imm. 1/12

**Figure 8.** *Ch. imperator.* Vessel entering eye organ; homog. imm. 1/12 (reduced)

**Figure 9.** *Ch. imperator.* Fibers of lens of eye organ:

  a) longitudinally.  
  b) cross section.

Homog. imm. 1/12. Formol, alcohol, hemalum

**Figure 10.** *Ch. imperator.* Horizontal section of glandular knob at end of tentacle club. Formol, alcohol, acid carmine

**Figure 11.** *Ch. imperator.* Longitudinal section of glandular knob at end of club. Formol, alcohol, acid carmine

**Figure 12.** *Ch. imperator.* Cross section of tentacle stalk of younger specimen, with glandular knob situated on top

**Figure 13.** *Ch. imperator.* Basal part of glandular knob of tentacle club. Horizontal section. Formol. alcohol, hemalum: homog. imm. 1/12 (reduced)

**Figure 14.** *Ch. imperator.* Basal part of gland lamella. Longitudinal section of luminous organ of tentacle club; homog. imm. 1/12 (reduced)

**Figure 15.** *Ch. imperator.* Basal part of organ of tentacle club. Longitudinal section: homog. imm. 1/12 (reduced)

**Figure 16.** *Ch. imperator.* Cross section of distal region of gland lamellae. Organ of tentacle club

**ABBREVIATIONS**

art.—artery  
gel.—gelatinous tissue  
gel. cut.—gelatinous tissue of skin  
atri.—atrium  
hom.—gelatinous mass of gland lamellae  
bg.—blood sac  
l.—lens  
cap.—capillaries  
l'—lens fibers, cut  
chr.—chromatophores  
lam.—l gland lamellae  
chr. pg.—chromatophores of arm organ  
mu.—musculature  
cps.—sheath of arm organ  
mu. circ.—circular muscle fibers  
cut.—skin  
mu. tent.—musculature of tentacle  
capillaries  
ed.—epithelium  
n.—nerve  
fibr.—fibrous cords of reflector  
n. tent.—nerve of tentacle  
u.—vessel  
mu.—nuclei  
m. cap.—nuclei of capillaries  
mu. phot.—nuclei of luminous body  
pho.—luminous body  
plica.—skin fold  
refl.—reflector  
ret.—knots of meshes of connective tissue  
sang.—blood corpuscles  
seer.—secretion
Plate XLV

*Doratopsis* de Rochebrune

Figures 1–5. *Doratopsis sagitta* n.sp.

Figure 1. *Doratopsis sagitta*, dorsal, Station 172, South Indian doldrum belt. × 3
Figure 2. Same, ventral surface. × 3
Figure 3. *D. sagitta*, dorsal surface. Station 39, Guinea Current. × 3
Figure 4. Same, ventral surface.
Figure 5. *D. sagitta*. Head of specimen from Station 39, lateral. × 12.

Figures 6–7. *Doratopsis lippula* n.sp.

Figure 6. *D. lippula*, dorsal surface. South Equatorial Current
Figure 7. Same, ventral surface.
Plate XLVI

*Doratopsis de Rochebrune*

Figures 1–5. *Doratopsis exophthalmica* n.sp.

Figure 1. *D. exophthalmica*. Station 26, Canaries Current. × 3
Figure 2. Same, ventral. × 3
Figure 3. *D. exophthalmica* from Station 169, South Indian doldrum belt. Left side. × 3
Figure 4. Same, dorsal surface. × 3
Figure 5. Head of specimen from Station 169, lateral. × 15

Figures 6–7. *Doratopsis lippula* n.sp.

Figure 6. Anterior part of body of *D. lippula*. Station 74, Benguela Current. × 3
Figure 7. Head of specimen from Station 74, lateral.
Figure 8. Youngest larva of *Doratopsis*. Station 228, Indian Countercurrent. × 3
Figure 9. Same larva, dorsal surface. × 3
Figure 10. Same larva, ventral surface. × 8
Plate XLVII

Anatomy of *Doratopsis*

Figure 1. Funnel and funnel cartilage of *D. sagitta*, Station 172.
Figure 2. Left funnel cartilage and antitragus of *D. exophthalmica*, Station 26.
Figure 3. Mantle complex of *D. vermicularis* RÜPPPELL from Messina, ventral.
Figure 4. Visceral complex of same larva, right side. × 12. (Only basal part of gill—i.e. the branchial gland—shown)
Figure 5. Visceral complex of *D. sagitta*, right side. Station 172. (Only the branchial gland shows the position of the gill)
Figure 6. *D. sagitta*. Head of specimen from Station 172, dorsal. × 12

**ABBREVIATIONS**

- *a. br.* — branchial artery
- *a. ceph.* — cephalic aorta
- *a. gen.* — artery of gastro-genital ligament
- *a. hep.* — hepatic artery
- *a. post.* — posterior artery
- *an.* — anus
- *app. an.* — anal appendage
- *app. c.* — appendage of branchial heart
- *atr.* — ink sac
- *b. br.* — gill base (branchial gland)
- *b. branch.* — branchial heart
- *d. gen.* — “anlage” of gonoducts
- *g. bucc. sup.* — superior buccal ganglion
- *g. cer.* — cerebral ganglion
- *g. opt.* — optic ganglion
- *g. vise.* — visceral ganglion
- *g. gen.* — genital gland
- *hep.* — liver
- *inf.* — funnel
- *int.* — mid-intestine
- *lig. ar.* — anal ligament
- *luc.* — luminous organ
- *m.* — margin of mantle
- *mu. add. inf.* — funnel adductors
- *mu. coll.* — collars
- *mu. depr. inf.* — funnel depressor
- *n. pall.* — pallial nerve
- *nephr.* — renal sac
- *oes.* — esophagus
- *org. inf.* — funnel organ
- *pancr.* — pancreas
- *rad.* — spiral folds
- *rect.* — rectum
- *sacc.* — visceral sac
- *sacc. v.* — venous sac
- *saliv.* — posterior salivary gland
- *st.* — stomach
- *stt.* — appendage of stomach
- *st. coec.* — caecum
- *st. comm.* — sinus of stomach
- *ur.* — papilla of renal sac
- *v. abd.* — abdominal vein
- *v. branch.* — branchial vein
- *v. c.* — vena cava
- *v. hep.* — hepatic vein
- *v. hep. sin.* — left hepatic vein
- *v. pall.* — pallial vein
Plate XLVIII

*Cranchia* Leach, *Liocranchia* Pfeffer

Figure 1. *Cranchia scabra* Leach. Large male from South Equatorial Current, Station 49
   Drawn from a live specimen after a photograph and color sketch. Natural size

Figure 2. Same specimen, dorsal. Natural size

Figure 3. *Liocranchia valdiviae* n.sp. Adult male, dorsal. Indian North Equatorial Current
   near coast of East Africa. Station 258. ×2

Figure 4. Same specimen, ventral.
Plate XLIX

Cranchia scabra Leach

Figures 1–6. Cranchia scabra. Juvenile specimen from Indian North Equatorial Current (Station 217)

Figure 1. Dorsal view. × 5
Figure 2. Arms, ventral. Appr. × 20
Figure 3. Anterior part of body, showing the arms and the 3 points of fusion on mantle. Appr. × 12
Figure 4. Cartilaginous tubercle of mantle.
Figure 5. Posterior end of body with fins.
Figure 6. End of tentacle with club. Appr. × 30
Figure 7. Opened mantle cavity of large male of Cranchia scabra (cf. Plate XLVIII, Figures 1, 2).

The projecting liver is in the middle, rectum and anal appendages are situated on it. A ligament extends from the vena cava toward the anus. The vena cava circum-scribes the liver on its right side in a wide curve. On each side behind the liver are the openings of the renal sacs. Gills and branchial hearts are situated at a large distance; they are surrounded anteriorly by the curved margin of the musculus depressor infundibuli (funnel depressor), which is transformed into a septum. The large branchial arteries and the abdominal veins extend toward the branchial hearts, the latter approaching them from behind. The opening of the male genitalia is situated in front of the left branchial heart (Figure 8). The funnel organ is folded, due to the strong contraction caused by preservation: the ventral wall of the funnel is displaced upward. In the posterior half of the body, the large caecum and, behind it, the stomach and the esophagus, which enters it, as well as the hepato-pancreatic duct are visible through the abdominal integument. The posterior artery passes over the middle of the abdominal wall; the very short mantle septum is attached to this artery.

Figure 8. Base of left gill of large male, showing branchial heart, veins and opening of genitalia. × 6
Figure 9. Gladius of medium-sized female of Cranchia scabra, ventral. × 3
Figure 9a. Cross section through anterior half of gladius.
Figure 10. Posterior end of same gladius, viewed diagonally from the side.

ABBREVIATIONS

a. branch.—branchial artery
app. prost.—appendage of prostate
c. branch.—branchial heart
m. inf. ventr.—ventral lamella of funnel
mus. depr. inf.—funnel depressor
pen.—penis (distal part of Needham’s sac)
sept.—mantle septum
susp. branch.—branchial ligament
v. abd.—abdominal vein
v. branch.—branchial vein
v. lat.—lateral vein, opening into
abdominal vein
Plate L

Anatomy of *Cranchia scabra*

Figure 1. Buccal funnel and arm apparatus, inner side. Large male from Station 49 with hexto-cotylized ventral arm. × 4

Figure 2. Outer side of tentacle club. Large male. × 4

Figure 3. Head and arms, right side (Based on the preserved large male). Eye completely covered by contracted lid membrane. × 3

Figure 4. Right eye with the 13 luminous organs (1 ... 13), after removal of lid membrane. Large male. × 2.3

Figure 5. Right eye of medium-sized female with the 13 luminous organs (1 ... 13), × 10

Figure 6. Intestinal tract, vascular system, gills and developing genitalia of medium-sized female, ventral surface. Liver and adjacent organs folded over upward, toward the front. × 7

Figure 7. Intestinal tract and vascular system of medium-sized female, right side, × 7

Figure 8. Dorsal half of liver and adjacent organs of the medium-sized female. Left side. × 7

Figure 9. Brain and eyes of medium-sized female, dorsal.

Figure 10. Stomach and ovary of medium-sized female, dorsal surface. × 7

Figure 11. Same as Figure 10, left side, × 7

Figure 12. Swellings and spiral folds of caecum, right side. Large male

Figure 13. Stomach and caecum, and adjacent gonad, of the large male, left side.

Figure 14. Posterior surface of liver with venous sacs, pancreas, and rectum. Medium-sized female, × 7

Figure 15. Gonads of large male, ventral surface. × 14

Figure 16. Same, dorsal surface. × 14

**ABBREVIATIONS**

- a. branch. — branchial artery
- a. ceph. — cephalic aorta
- a. dors. — dorsal artery
- a. hep. — hepatic artery
- a. post. — posterior artery
- amp. — ampulla of cephalic vein
- app. an. — anal appendage
- app. pro. — appendage of prostate
- b. sperm. — spermatoaphore sac
- b. branch. — branchial heart
- d. hep. — hepatic duct
- d. hep. pro. — hepato-pancreatic duct
- diaphr. — diaphragm
- g. bucc. sup. — superior buccal ganglion
- g. opt. — optic ganglion
- g. pall. — pallial ganglion
- h.e. — hectorotulus
- h. e. — liver
- inf. — funnel
- int. — mid-intestine

- ir. — iris
- lam. ext. — outer membrane
- lit. an. — anal ligament
- lit. e. g. — gastro-genital ligament
- n. ophth. sup. — superior ophthalmic nerve
- n. pall. — pallial nerve
- n.d. — nidamental gland
- oes. — esophagus
- ovd. — oviduct
- pancr. — pancreas
- pen. — end of spermatophore sac
- pros. — prostate
- rad. — spiral folds
- rect. — rectum
- sac. — sheath of male gonoducts
- sac. v. hep. — sac of hepatic vein
- sac. v. hep. ant. — anterior sac of hepatic vein
- sac. v. hep. post. — posterior sac of hepatic vein
- st. — stomach
- st. coe. — caecum
- sulc. — groove of intestine
- test. — testis
- tub. otf. — olfactory tubere
- ur. — papilla of renal sac
- v. abd. — abdominal vein
- v. branch. — branchial vein
- v. c. — vena cava
- v. def. — vas deferens
- v. dors. — dorsal vein
- v. g. — gastric vein
- v. pall. — pallial vein
- vel. — sail-shaped stomach fold
- ves. sem. 1, ves. sem. 2, ves. sem. 3 — 1st, 2nd, and 3rd part of seminal vesicle, respectively
Plate LI

*Liocranchia.* Anatomy and juvenile forms

Figure 1. Young larva, length 5.5 mm. Dorsal view of anterior half of head. Station 54, Guinea Current. × 20

Figure 2. Same larva, ventral. × 20

Figure 3. Head of youngest larva, length 4.5 mm, lateral. Station 226, central Indian Ocean. × 45

Figure 4. Youngest larva of *Cranchia scabra.* Anterior part of body, lateral. Station 54, Guinea Current. × 20

Figure 5. *Liocranchia reinhardtii.* Head of juvenile specimen, ventral. Total length: 20 mm (dorsal mantle length: 15 mm). The lid membrane forms a sac. Station 54, Guinea Current. × 15

Figure 6. *L. reinhardtii.* Arms of larva whose dorsal mantle length measures 7 mm. Station 64, near São Tomé. × 25

Figure 7. *L. reinhardtii.* Arm apparatus of medium-sized larva which measures 9 mm dorsal mantle length. Station 215. Bay of Bengal. × 18

Figure 8. *L. valdiviae.* Ventral arms of male from Station 239; dorsal mantle length 25 mm. Left ventral arm hectocotylized. Indian Countercurrent. × 15

Figure 9. *L. valdiviae.* Ventral arms of large male: dorsal mantle length 40 mm (cf. Plate XLVIII, Figures 3 and 4). Left ventral arm hectocotylized. Station 258, East African coast. × 15

Figure 10. *L. valdiviae.* Arm apparatus of male measuring 22 mm dorsal mantle length. Station 182, Indian South Equatorial Current. × 10

Figure 11. *L. valdiviae.* Club of large male, outer surface. Station 258. × 18

Figure 12. *L. valdiviae.* Tentacle of large male. Station 258. × 12

Figure 13. *L. valdiviae.* Inner organs of the large male from Station 258, ventral. × 8

Figure 14. *L. valdiviae.* Stomach with opened caecum. Station 258

**ABBREVIATIONS**

*a. branch.*—branchial artery
*a. ceph.*—cephalic aorta
*an.*—anus
*c. branch.*—branchial heart
*hect.*—hectocotylus
*hep.*—liver
*lig. g. g.*—gastro-genital ligament
*oes.*—esophagus
*pancr.*—pancreas
*pen.*—end of spermatoaphore sac (penis)
*sacc. v. hep. a.*—anterior sac of hepatic vein
*sacc. v. hep. p.*—posterior sac of hepatic vein
*spir.*—spiral winding of esophagus, intestine and hepato-pancreatic duct
*st.*—stomach
*st. coc.*—caecum
*sulc.*—groove to caecum
*ur.*—papilla of renal sac
*v. c.*—vena cava
*vel.*—stomach sail
*ves. sem.*—seminal vesicle
Plate LII

_Euzygaena, Lechia_

Figures 1–3. _Euzygaena pacifica_ Iss., male

Figure 1. Ventral, Sagami Bay. × 2

Figure 2. Right club. × 17

Figure 3. Ventral arms. Right ventral arm hectocotylized. × 25

Figures 4–7. _Leachia eschscholtzii_ Rathke. Near Borneo

Figure 4. Mature female. Mantle complex. × 4

Figure 5. _Leachia eschscholtzii_ Rathke, female. Anatomy of the internal organs, ventral

Figure 6. Openings of stomach and caecum with pancreas, ventral

Figure 7. Cap of caecum and pancreas.

**ABBREVIATIONS**

*a*. branch.—branchial vein  
*a*. dors.—dorsal artery  
*a*. g. g.—gastric artery  
*a*. hep.—hepatic artery  
*a*. post.—posterior artery  
*an*.—anus  
*app. an*.—anal appendages  
*branch*.—gill  
*d*. hep. c.—single hepatic duct  
*d*. hep. d.—right hepatic duct  
*d*. pancre.—pancreatic ducts  
*g*. visc.—gastric ganglion  
*gl*. od. d.—right oviduct gland  
*gl*. od. s.—left oviduct gland  
*hep*.—liver  
*int*.—intestine  
*lig*. an.—anal ligament  
*lig*. g. g.—gastro-genital ligament  
*nid*. d.—right nidamental gland  
*nid*. s.—left nidamental gland  
*oes*.—esophagus  
*ov*.—ovary  
*or. od*.—opening of oviduct gland  
*pancr*.—pancreas  
*rad*.—spiral folds  
*rect*.—rectum  
*st*.—stomach  
*st.*'—narrowed part of stomach  
*st. coec*.—caecum  
*sulc*.—groove to caecum  
*ur*.—papilla of renal sac  
*v. c*.—vena cava  
*vel*.—stomach sail
Plate LIII

*Desmoteuthis*, *Crystalloteuthis* n.gen.

Figure 1. *Desmoteuthis pellucida* Chun. Drawn after the live animal. Station 90, Benguela Current. Natural size

Figures 2–9. *Crystalloteuthis glacialis* n.gen. n.sp. Station 145, Antarctic Ocean

Figure 2. *Cryst. glacialis*. Drawn after the live animal. Dorsal. $\times 2$
Figure 3. Same, ventral. Drawn after the preserved specimen. $\times 2$
Figure 4. Arms, dorsal. $\times 12$
Figure 5. Outer side of tentacle. $\times 10$
Figure 6. Inner side of tentacle. $\times 10$
Figure 7. Head and funnel, ventral. Lid membrane of right eye removed. Mantle opened
Figure 8. Left ventral tubercle.
Figure 9. Dorsal tubercle.
Plate LIV

Desmoteuthis and Crystalloteuthis. Anatomy

Figures 1–17. Desmoteuthis pellucida

Figure 1. Arm apparatus and buccal funnel, viewed from above. × 3
Figure 2. Outer side of club of tentacle with protective membranes and swimming membrane. × 9
Figure 3. Head and arms of the preserved specimen, diagonally from above. × 4.5
Figure 4. Larger sucker of tentacle club.
Figure 5. Larger sucker of arm, dried out.
The whitish, calcified indentations of the margin and the plates of the inner chitinous layer are distinct
Figure 6. Olfactory tubercle, in profile.
Figure 7. Right eye. Ventral view, showing both luminous organs. × 4.5
Figure 8. Same eye, broad side. Lid fold contracted to form a slit
Figure 9. Cross section of mantle, showing musculature: homog.imm. 1/12, ocular No. 2.
Figure 10. Longitudinal section of mantle: homog.imm. 1/12, ocular No. 2.
Figure 11. Nuclei of outer epithelium of mantle: homog.imm. 1/12, ocular No. 2.
Figure 12. Visceral complex and vascular system, right side.
Figure 13. Cross section of viscera anterior to caecum (in direction of arrow. Figure 12).
Figure 14. Viscera, heart, and large vessels, viewed from posterior side of liver.
Figure 15. Same preparation as in Figure 14: heart and right pancreatic duct removed.
Figure 16. Caecum with opening of pancreatic duct, left side.
Figure 17. Stomach, caecum, and adjacent parts opened.
Figure 18. Crystalloteuthis glacialis. Viscera, heart, and large vessels, right side

ABBREVIATIONS
a. branch.—branchial artery
a. ceph.—cephalic aorta
a. dors.—dorsal artery
a. hep.—hepatic artery
a. pancr.—pancreatic artery
a. post.—posterior artery
amp. v.—ampulla of cephalic vein
an.—anus
app. an.—anal appendages
atr.—ink sac
bg.—connective tissue of cutis
c.—heart
d. hep. pancr.—hepato-pancreatic duct
diaphr.—diaphragm
ek.—ectoderm
g. gasr.—gastric ganglion
gen.—gonad
hep.—liver
inf.—funnel
int.—mid-intestine
lam. int.—inner marginal lamella of mantle
lam. rad.—lamella of radial fibers
lig. an.—anal ligament
lig. g. g.—gastro-gential ligament
luc. ant.—anterior luminous organ
luc. post.—posterior luminous organ
mu. circ.—ring muscles
mu. rad.—radial muscles
mu. cir.—numi of ring muscles
mu. rad.—numi of radial muscles
oes.—esophagus
ox.—ovary
p. inf.—inner funnel of renal sac
pancr.—pancreas
rect.—rectum
sacc. v. ant.—anterior venous sac
sacc. v. g. g.—sac of gastric vein
sacc. v. hep.—sac of hepatic vein
sacc. v. post.—posterior venous sac
st.—stomach
st. coe.—caecum
st. str.—striated part of stomach
str.—larger swellings
sulc.—groove to caecum
tub. olf.—olfactory tubercle
ur.—papilla of renal sac
v.—vein of caecum
v. branch.—branchial vein
v. c.—cava
v. ceph.—cephalic vein
v. cord.—cardiac vein
v. dors.—dorsal vein
v. g. g.—gastric vein
v. pancr.—pancreatic vein
Plate LV

*Corynonma speculator* n.gen. n.sp

Figure 1. Specimen from Station 237, Indian South Equatorial Current. Dorsal, $\times 3$
Figure 2. Same specimen, ventral. $\times 3$
Figure 3. Head and arms, dorsal. Appr. $\times 11$
Figure 4. Arms, viewed diagonally from above. Appr. $\times 15$
Figure 5. Eye, lateral. $\times 15$
Figure 6. Eye, diagonally dorsal. $\times 15$
Figure 7. Tentacle, inner surface. Appr. $\times 28$
Figure 8. Tentacle, outer surface.
Figure 9. Tentacle of older specimen from Atlantic South Equatorial Current. Appr. $\times 12$. 
Plate LVI

*Teuthowenia, Sandalops, Toxeuma, Bathothauma*

Figures 1–5. *Teuthowenia antarctica* n.sp.

Figure 1. Dorsal view of specimen from Station 136. Antarctic Ocean. X 4
Figure 2. Same specimen, ventral. X 4
Figure 3. Anterior part of body, ventral. X 14
Figure 4. Eye, viewed diagonally from above. X 14
Figure 5. Left eye, precisely lateral. X 17

Figures 6–8. *Sandalops melancholicus* n.gen. n.sp.

Figure 6. *Sandalops melancholicus*, right side. Southern Atlantic. X 8
Figure 7. Posterior end of body with fins. Appr. X 10
Figure 8. Anterior part of the body, ventral. Appr. X 16
Figure 9. Left eye of *Bathothauma*, diagonally lateral. Eye stalk constricted by preservation. X 7
Figure 10. Right eye of *Toxeuma*, lateral. X 9

ABBREVIATIONS

cart.—cartilage of ventral corner of mantle
con.—conus of eyeball
g. opt.—optic ganglion
inf.—funnel
luc.—luminous organ
n. ophth. inf.—inferior ophthalmic nerve
n. ophth. sup.—superior ophthalmic nerve
n. opt.—optic nerve
Plate LVII

*Bathothauma, Teuthowenia*

Figure 1. *Bathothauma lyromma* n.gen. n.sp. Mantle complex, ventral. × 4.5
Figure 2. *Bathothauma*. Heart, major vessels and adjacent organs. × 8.
Liver displaced forward

Figures 3–7. *Teuthowenia antarctica* n.sp. Station 137, Antarctic Ocean

Figure 3. Tentacle, lateral. × 15
Figure 4. Tentacle, inner surface. × 15
Figure 5. Arms and buccal funnel. × 20
Figure 6. Mantle complex, left side (after clearing in oil of cloves).
Figure 7. Mantle complex and left gill, ventral surface.

**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>a.branch.</td>
<td>branchial artery</td>
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<td>a.post.</td>
<td>posterior artery</td>
</tr>
<tr>
<td>an.</td>
<td>anus</td>
</tr>
<tr>
<td>app.an.</td>
<td>anal appendages</td>
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<td>atr.</td>
<td>ink sac</td>
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<tr>
<td>c.</td>
<td>heart</td>
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<td>c.branch.</td>
<td>branchial heart</td>
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<tr>
<td>cer.</td>
<td>brain</td>
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<tr>
<td>d.coel.</td>
<td>inner funnel of renal sac</td>
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<td>d.hep.pancr.</td>
<td>hepato-pancreatic duct</td>
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<tr>
<td>g.opt.</td>
<td>optic ganglion</td>
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<td>g.stell.</td>
<td>stellate ganglion</td>
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<tr>
<td>hep.</td>
<td>liver</td>
</tr>
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<td>inf.</td>
<td>funnel</td>
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<td>int.</td>
<td>mid-intestine</td>
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<td>lig.</td>
<td>ligament of liver</td>
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<td>lac.</td>
<td>luminous organ</td>
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<td>renal sac</td>
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<td>esophagus</td>
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<td>posterior salivary gland</td>
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<td>spiraculum</td>
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<td>st.</td>
<td>stomach</td>
</tr>
<tr>
<td>st.1</td>
<td>anterior part of stomach</td>
</tr>
<tr>
<td>st.2</td>
<td>middle part of stomach</td>
</tr>
<tr>
<td>st.3</td>
<td>end part of stomach</td>
</tr>
<tr>
<td>st.coec.</td>
<td>caecum</td>
</tr>
<tr>
<td>stat.</td>
<td>static organ</td>
</tr>
<tr>
<td>susp. branch.</td>
<td>branchial ligament</td>
</tr>
<tr>
<td>ur.</td>
<td>papilla of renal sac</td>
</tr>
<tr>
<td>v.branch.</td>
<td>branchial vein</td>
</tr>
<tr>
<td>v.c.</td>
<td>vena cava</td>
</tr>
<tr>
<td>v.hep.</td>
<td>hepatic vein</td>
</tr>
<tr>
<td>v.pall.</td>
<td>pallial vein</td>
</tr>
<tr>
<td>y.</td>
<td>narrow part of visceral sac with posterior end of stomach</td>
</tr>
</tbody>
</table>
Plate LVIII

Toxeuma, Bathothauma

Figures 1–5. Toxeuma belone n. gen. n. sp.

Figure 1. Toxeuma belone. Station 182, Indian South Equatorial Current. \( \times 2 \)

Figure 2. Same specimen, ventral. \( \times 2 \)

Figure 3. Anterior part of body, ventral. Appr. \( \times 8 \)

Figure 4. Tentacle club, outer surface. \( \times 25 \)

Figure 5. Tentacle club, inner surface. \( \times 25 \)

Figures 6, 7. Bathothauma lyromma n. gen. n. sp.

Figure 6. Bathothauma lyromma, female. Natural size. Atlantic North Equatorial Current. Ventral. Eye stalks presented are constricted by preservation

Figure 7. Same specimen, dorsal. Natural size. Eye stalks drawn after another specimen—extended
Plate LIX

*Galiteuthis (Taonidium)*

Figure 1. *Galiteuthis suhmi* H oy le (*G. armata* Joubin), dorsal. Station 51, Guinea Current. Natural size

Figure 2. Same specimen, ventral.

Figure 3. *Galiteuthis (Taonidium) suhmi*. Juvenile form, dorsal. Station 43, Guinea Current. $\times 2$

Figure 4. Same specimen, ventral.

Figure 5. Right club of adult specimen. Appr. $\times 20$

Figure 6. Right club of juvenile form (*Taonidium*). $\times 15$

Figure 7. Club of juvenile form, lateral.

Figure 8. Third and 4th arm of juvenile form, and base of tentacle, left side. Appr. $\times 24$

Figure 9. Arms and buccal funnel of juvenile form. Appr. $\times 24$

Figure 10. Arms and buccal funnel of adult. $\times 2$

Figure 11. Eye of adult specimen, ventral, showing luminous organ (*luc.*) and olfactory tubercle.
Plate LX

Luminous organs of the Cranchiidae

Figures 1-6. Cranchia scabra
Figure 1. Median section through organ No. 3 (cf. Plate L, Figure 5). Sublimate, iron-hematoxylin. X 120
Figure 2. Median section through organ No. 11. X 120
Figure 3. Median section through organ No. 12. X 120
Figure 4. Part of luminous body of organ No. 3. Homog. imm. 1/12, ocular No. 2, prism
Figure 5. Transition of the luminous body of organ No. 2 into the body epithelium. Homog. imm. 1/12
Figure 6. Cell from bottom of reflector.

Figures 7-11. Liocranchia valdiviae
Figure 7. Eye with the 4 organs, lateral. Lid fold removed, but olfactory tubercle situated outside the lid fold is shown. X 12
Figure 8. Median section of a luminous organ. X 100
Figure 9. Luminous body: transition of the finely granulate cells into the pale, vacuolated cells. Homog. imm., ocular No. 2, prism
Figure 10. Concentrically stratified luminous cells from bottom of luminous body. Homog. imm. 1/12, ocular No. 2, prism
Figure 11. Transition of the luminous cells into the body epithelium. Homog. imm. 1/12, ocular No. 2, prism

Figure 12. Leuchia eschsholtzii

Figures 13-17. Corynonuma speculator
Figure 13. The two organs on the ink sac: rectum and adjacent region.
Figure 14. Longitudinal section through an organ (parallel to median plane). X 120
Figure 15. Cross section of ink sac and luminous organ situated on it. Posterior region
Figure 16. Same series of cross sections as in Figure 15, anterior region. Ocular No. 2, prism
Figure 17. Luminous cells and capillaries. Homog. imm. 1/12, ocular, prism

Figures 18-24. Desmotesuthis pellucida
Figure 18. Median section through double organ of eye, with marginal part of retina and the epithelial body. Formol, hemalum
Figure 19. Border zone between cells of luminous body and fibrous cells of lens. Homog. imm. 1/12, ocular No. 2, prism
Figure 20. Luminous cells after staining with iron-hematoxylin. Homog. imm. 1/12, ocular No. 2, prism
Figure 21. Cells of luminous body and capillaries. Hemalum

Figure 22. Bathothauma lyronna
Figure 22. Median section through luminous organ of Bathothauma, X 72
In the course of preservation, the luminous organ detached itself from eyeball and bent outward; in life it is convex and adheres closely to the eyeball.

ABBREVIATIONS
a.pst.—posterior artery
an.—anus
atr.—ink sac
b. —connective tissue
branch—gill
c. cill.—ciliated body
c. hep.—capsule of connective tissue of liver
cap.—capillaries
cart.—eye cartilage
cok.—ectoderm
fibr.—fibers of connective tissue
gel.—gelatinous body
hep.—liver
ir.—iris
lim.—cells of membrana limitans
luc. ant.—anterior luminous organ
luc. post.—posterior luminous organ
m. l.—membrana limitans
mus. cill.—ciliary muscle
nu. cap.—nuclei of capillaries
nu. phot.—nuclei of luminous cells
nu. str.—nuclei of lens fibers
phot.—luminous body
phot. centr.—central luminous cell
pulv.—pad
refl.—reflector
res.—reservoir of ink sac
s. ven.—marginal vein
s. z.—cells of retina
spec.—mirror
st.—rods
str.—fibers of lens
tub. off.—olfactory tubercle
ur.—papilla of renal sac
v.—vessels
ven.—vein
Plate LXI

Larvae of Cranchiidae

Figure 1. Juvenile larva from Station 102 (Agulhas Current). Ventral. × 10
Figure 2. Same larva, lateral. × 10

Figures 3–5. Juvenile larva from Guinea Current, Station 41 (Euzygaena?)
Figure 3. Lateral. × 10
Figure 4. Ventral. × 10
Figure 5. Head, dorsal. Appr. × 30

Figure 6. Larva of Corynomma, caught in locking net at 100–200 m. Station 143, Antarctic Drift Current. Ventral. × 10

Figure 7. Larva of Teuthowenia antarctica. Station 135, Antarctic Drift Current. Diagonally ventral. × 10

Figure 8. Tentacle of the larva from Station 135 (Figure 7). Appr. × 40

Figure 9. Older larva of Taonidium (Galiteuthis). Station 64, Atlantic Ocean, near São Tomé. × 6

Figure 10. Tentacle of the larva from Station 64 (Figure 9). Appr. × 20
CARL CHUN

THE CEPHALOPODA
PART II: MYOPSIDA, OCTOPODA
ATLAS

GERMAN DEEPSEA EXPEDITION 1898-1899. VOL. XVIII, PART II
WISSENSCHAFTLICHE ERGEBNISSE
DER
DEUTSCHEN TIEFSEE-EXPEDITION
AUF DEM DAMPFER „VALDIVIA“ 1898-1899

IM AUFTRAGE DES REICHSAMTES DES INNERN
HERAUSGEGEBEN VON
CARL CHUN
PROFESSOR DER ZOOLOGIE IN LEIPZIG, LEITER DER EXPEDITION
UND NACH SEINEM TODE FORTGESETZT VON
AUGUST BRAUER
PROFESSOR DER ZOOLOGIE IN BERLIN

ACHTZEHNTER BAND

CARL CHUN
DIE CEPHALOPODEN
II TEIL:
MYOPSIDA. OCTOPODA
MIT 39 ABBLDUNGEN IM TEXT UND 34 TAFELN

JENA
VERLAG VON GUSTAV FISCHER
1915

Eingegangen im März 1914, C. Chun
Plate LXII

Rossia mastigophora n. sp.

Station 253. Indian North Equatorial Current near the East African coast. Trawl, 638 m

Figure 1. Female, dorsal view. Natural size
Figure 2. Same, ventral view. Natural size
Figure 3. Same, diagonally from the left. Natural size

From color sketches of the live animal
Plate LXIII

Rossia mastigophora n. sp.

Station 253

Arm Apparatus and Mantle Complex

Figure 1. Arm apparatus of male. $\times$ 3. $I$ — dorsal arms; $IV$ — ventral arms; $t$ — cut tentacle. Suckers partly lost

Figure 2. Club of female. $\times$ 5

Figure 3. Neck cartilage and left eye of female; collaris folded at right of neck cartilage.

Figure 4. Mantle complex of male.

Figure 5. Mantle complex of female.

Figure 6. Funnel cartilage and mantle complex of female.

ABBREVIATIONS

depr. inf. — funnel depressors
$gl', gl''$ — glands of unknown nature in the mantle cavity
$nid.$ — nidamental gland
$nid. acc.$ — accessory nidamental gland
$olf.$ — olfactory organ
org. inf. — funnel organ
$ov.$ — ovary
$pen.$ — penis
$sept.$ — mantle septum
$t$ — tentacle
$ur.$ — renal papilla
Plate LXIV

*Spirula australis* LAM.

Station 195. Nias South Canal

Figure 1. Female, diagonally from the ventral side. × 2. Color sketch after the live animal; chromatophores on mantle chafed off by the trawl

Figure 2. Same, dorsal view. × 2. Coloration of mantle completed

Figure 3. Terminal disc with fins. × 2
Plate LXV

*Spirula australis* Lam.

Station 195

Mantle Complex and Arm Apparatus

Figure 1. Female with opened mantle cavity. X 2
Figure 2. Mantle complex obliquely from the left; left nidamental glands removed. X 2
Figure 3. Neck cartilage; dorsal corner of mantle folded back. X 3
Figure 4. Funnel (opened) with funnel organ. X 3
Figure 5. Inner view of spread arms and tentacles.
Figure 6. Left club.

**ABBREVIATIONS**

depr. inf. — funnel depressors

*nid. acc.* — accessory nidamental gland

*off.* — olfactory organ

*org. inf.* funnel organ

*ov.* — ovary

*ovd.* — oviduct

*rect.* — rectum

*ur.* — renal papilla
Plate LXVI

Spirula australis

(Printed from photographs)

Figure 1. Spirula, dorsal view.
Figure 2. Spirula, right side.
Figure 3. Opened mantle cavity. Left nidamental glands removed and left posterior part of mantle folded down. Shell opened to show siphonal necks. Ventral view.
Figure 4. Mantle complex, slightly diagonally from the left. Left nidamental gland removed
Plate LXVII

*Spirula australis*

(Printed from photographs)

Figure 1. Semidiagrammatic presentation of *Spirula*, from the right. Mantle and shell cut in half; posterior end of body, which is shown transparent, covered by right fin. Extent of dorsal and ventral ovals indicated by fine contours (*d.*, *v.*)

Figure 2. Mantle complex, ventral view. Shell opened to show siphonal necks: nidamental glands removed and funnel opened by longitudinal cut. Abdominal wall removed above intestine and right half of visceral sac

Figure 3. Mantle complex after removal of renal sac and vascular system.

**ABBREVIATIONS**

*au.* — anus  
*app.* — appendage of branchial heart  
*br.* — gills  
*cart.* — funnel cartilage  
*cbr.* — branchial heart  
*coll.* — collaris  
*d.* — contours of dorsal oval  
*inf.* — funnel  
*inf.* — luminous organ  
*mu.depr.* — musculi depressores infundibali  
*mu. hep.* — muscular capsule of liver  
*neph.* — communication between the two renal sacs behind intestine  
*mach.* — neck cartilage  
*or.* — ovary with eggs at different stages of development  
*or.’* — right lobe of ovary behind stomach  
*oda., ovd.*' — oviduct  
*rect.* — rectum  
*sacc.* — shell sac  
*sacc.st.* — sac of caecum  
*sipho* — siphuncle  
*st.* — richly vascularized envelope of caecum (spiral stomach)  
*ur.* — renal papilla  
*v.* — contours of ventral oval  
*ven.* — venous appendages
Plate LXVIII

Spirula australis

Intestinal Tract

Figure 1. Liver, stomach, rectum and ovary, ventral. Caeccum and pancreas with their envelope
Figure 2. Liver, pancreas and rectum diagonally from the left side. Envelope of caecum and pancreas cut open
Figure 3. Upper view of transversely cut muscular envelope of liver and living chamber.
Figure 4. Halves of liver, spread to show esophagus and aorta. Caeccum and pancreas shown with their envelope. Dorsal view
Figure 5. Intestinal tract in a cleared preparation, ventral view: liver folded aside.
Figure 6. Unpaired part of pancreas with collecting duct.
Figure 7. Posterior salivary gland, from the posterior; cross sections of salivary duct, esophagus and aorta shown in the dorsal groove.
Figure 9. Upper (a) and lower (b) jaw, lateral view; c — lower jaw, upper view. × 5.5.

ABBREVIATIONS

a. ceph. — arteria cephalica
atr. — ink sac
d. hep. pan. — hepatic duct
d. saliv. — duct of salivary gland
g. gastr. — gastric ganglion
hep. — liver
int. — mid-intestine
lig. g. g. — gastro-genital ligament
oes. — esophagus
ov. — ovary
pancr. — pancreas
rect. — rectum
s. st. coec. — sac of caecum
st. — stomach
x — constriction
Plate LXIX

*Spirula australis* Lam.

Nervous System and Sensory Organs

Figure 1. Anterior part of body, from the right. Mantle folded dorsally and separated by a cut from the shell sac. Only penultimate septa of shell exposed; rest of shell removed. Eyelid cut and folded back in 4 corners

Figure 2. Longitudinal section through eye with adjacent optic ganglion.

Figure 3. Section through retina with adjacent cartilage.

Figure 4. Brain with nerves from the right.

Figure 5. Supraesophageal ganglion.

Figure 6. Right supra- and infraesophageal ganglia, lateral view.

Figure 7. Statolith, from the broad and from the narrow side.

**ABBREVIATIONS**

c. alb. — white body
cam. — chamber
cart. — cartilage
c. brach. — commissura brachialis
c. cer. h. — commissura cerebr. buccale
coll. — collaris
depr. inf. — musculi depressores infundibuli
g. brach. — ganglion brachiale
g. bucc. inf. — ganglion buccale inferior
g. bucc. sup. — ganglion buccale superior
g. cer. — ganglion cerebrale
g. opt. — ganglion opticum
g. ped. — ganglion pedale
g. st. — ganglion stellatum
g. vis. — ganglion viscerale
ir. — iris
lim. — membrana limitans
mu. hep. — muscular sheath of liver
n. a. o. inf. — nervus antorbitalis inferior
n. a. o. s. — nervus antorbitalis superior
n. coll. — nervus collaris
n. inf. — nervus infundibuli anterior
n. olf. — nervus olfactorius
n. ophth. s. — nervus ophthalmicus superior
n. opt. — nervus opticus
n. pall. — nervus pallialis
n. pinn. — nervus pinnalis
n. p. o. — nervus postorbitalis
n. retr. cap. a. — nervus retractor capitis anterior
n. stat. — nervus staticus
n. tent. — nervus tentacularis
n. vis. — nervus visceralis
olf. — olfactory tubercle
pall. — mantle
pg. — pigment layer
ret. — retina
s. — layer of sensory cells
sacc. conch. — shell sac
st. — rods
Plate LXX

*Spirula australis* LAM.

Vascular System, Oviducts, Luminous Organs

Figure 1. Oviducts, renal sac and vascular system, dorsal view.

Figure 2. Branching of arteria posterior and arteria recurrens, ventral view. Intestine shown by dotted line.

Figure 3. Capillary vessel with blood corpuscles from the luminous body.

Figure 4. Cross section of vena genitalis anterior to its entrance into the renal sac.

Figure 5. Radial section of terminal disc with the luminous organ.

Figure 6. Luminous body.

Figure 7. Nerve from luminous body. Fibrils stained with iron hematoxylin. Zeiss, homogeneous immersion.

Figure 8. Nerve branching in luminous body, with thicker and finer fibrils. Iron hematoxylin. Zeiss, homogeneous immersion.

Figure 9. Large nerve radiating into luminous body, with nuclei and stained efferent fibrils. Iron hematoxylin. Zeiss, homogeneous immersion.

Figure 10. Glandular epithelium of terminal disc. Zeiss, homogeneous immersion.

Figure 11. Lens tissue from vicinity of luminous body. Zeiss, homogeneous immersion.

Figure 12. Lens tissue from periphery. Zeiss, homogeneous immersion.

Figure 13. Tissue of bars of reflector. Zeiss, homogeneous immersion.

Figure 14. Cells with pigment clusters, from cutis of terminal disc. Zeiss, homogeneous immersion.

**ABBREVIATIONS**

*a.* branch. — arteria branchialis

*a.* ceph. — aorta cephalica

*a.* g. — branch of arteria recurrens to intestine

*a.* gastr. — arteria gastrica

*a.* gen. — arteria genitalis

*a.* n. — branches to renal sacs

*a.* post. — aorta posterior

*a.* pp. — appendages of branchial hearts

*a.* rec. — arteria recurrens

*a.* sacc. — branch to shell sac

*atr.* — ink sac

*c.* branch. — branchial heart

*chr.* — chromatophores

*ep.* gl. — epithelium of body

*ep.* sacc. — epithelium of shell sac

*gl.* od. — oviduct gland

*l.* — terminal knob

*lan.* refl. — layer of reflector

*mu.* — muscles

*nephr.* — renal sacs

*mu.* cap. — nuclei of capillaries

*mu.* phot. — nuclei of central body of luminous organ

*od.* — oviduct

*ov.* od. — opening of oviduct

*phot.* — central body of luminous body

*refl.* — reflector

*sacc.* — shell sac

*sang.* — blood corpuscles

*sin.* — blood sinus

*ur.* — renal papilla

*v.* abd. — vena abdominalis

*v.* branch. — vena branchialis

*v.* c. — vena cava

*v.* hep. — vena hepatica

*v.* od. — vein of oviduct

*v.* pall. — vena pallialis
Plate LXXI

Larvae of *Spirula*

Plate LXXII

*Spirula australis* Lam.

Shell

Figure 1. Initial chamber and siphuncle, median longitudinal section. Zeiss 8 mm, ocular 2. *a.p' and i.p'—outer and inner plates of the adjacent shell wall (9th, 10th and 11th chamber); ch—chitinized boat-shaped lamella with remnants of epithelium; sept1—septal neck of initial chamber, sept2, sept3—septal necks of 2nd and 3rd chamber; pros—prosiphuncle; pil—pillar substance; pil'—assumed pillar substance forming end of initial chamber; sacc—thickened part of shell sac, continued in the umbilicus (umb)

Figure 2. Initial part of shell sac occupying umbilicus (umb). Zeiss A 4. *v—branched capillaries; 1...8—region of 1st-8th chambers; umb—connective tissue of umbilicus*

Figure 3. Longitudinal section through dorsal margin of living chamber. Inner plate (i.p.) of shell wall detached from the epithelium

Figure 4. Opening of siphuncle into the living chamber. Zeiss A 4. *a—plug of connective tissue cells (ep) situated on matrix of siphonal neck; amp.v—ampulla-shaped dilation of venous stems; coel—coelom; h—envelope of liver; ep'—torn epithelial cord providing connection with epithelium of siphuncle*

**ABBREVIATIONS**

\begin{itemize}
  \item \textit{a}—plug of connective tissue
  \item \textit{amp}—ampulla of blood vessels
  \item \textit{a.p}—outer plate
  \item \textit{art}—artery
  \item \textit{cart}—cartilage
  \item \textit{ch}—chitinous lamella
  \item \textit{coel}—coelom
  \item \textit{cut}—cutis
  \item \textit{ek}—ectoderm
  \item \textit{ep}—epithelium
  \item \textit{h}—envelope of liver
  \item \textit{i.p}—inner plate
  \item \textit{ir}—iridocytes
  \item \textit{mu}—musculature
  \item \textit{mu.hep}—muscular sheath of liver
  \item \textit{pil}—pillar
  \item \textit{pros}—prosiphuncle
  \item \textit{sacc}—shell sac
  \item \textit{sept}—septal funnel
  \item \textit{umb}—umbilicus
  \item \textit{v}—vessel
\end{itemize}
Plate LXXIII

Spirula australis

Larva and Shell

Figure 1. Median section of youngest larva (Plate LXXI, Figures 1, 2). A few adjacent parts are included: stomach shown by thin line, caecum by dotted line. Shell chambers, slightly shrunk, drawn after the cleared specimen.

Figure 2. Cross section of siphuncle of adult animal. Zeiss 8 mm, ocular 2.

Figure 3. Part of cross section of siphuncle, with adjacent pillar and septal funnel. Zeiss, hom. immersion, 2 mm. Oc. 2.

Figure 4. Nuclei of epithelium of shell sac in area of umbilicus.

Figure 5. Longitudinal section of ventral wall of shell sac at level of the 3rd from last chamber. Zeiss 8 mm, oc. 2.

Figure 6. Longitudinal section of folded shell sac in area of 4th saddle. Zeiss 8 mm, oc. 4.

Figure 7. Longitudinal section of folded shell sac in area of 6th saddle. Zeiss 8 mm, oc. 4.

ABBREVIATIONS

a. — thickening of larval shell sac
an — anus
a. p — outer plate
art — artery
atr — ink sac
bg — connective tissue
c — heart
ch — chitinous lamella
ehr — chromatophore
coeo. si — coelomic tube of siphuncle
coll. — collaris
cut — cutis
d. hep. pancer — ductus hepatopancreaticus
d. sal. p — efferent duct of posterior salivary gland
ep — epithelium
ep. s — siphonal epithelium
g. brach — ganglion brachiale
g. bucc. i — ganglion buccale inferius
g. bucc. s — ganglion buccale superius
g. cer — ganglion cerebrale
g. gastr — ganglion gastricum
g. ped — ganglion pedale
g. visc — ganglion viscerale
ga — gelatinous connective tissue
gl. sal. a — anterior salivary gland
gl. sal. p — posterior salivary gland
gl. submx — submaxillary gland
go — gonad
hep — liver
inf — funnel
i.p — inner plate
mu — musculature
mu' — musculature of body wall
mu. umb — muscle inside umbilicus
n. inf. — lower jaw
n. sup. — upper jaw
n. — nerve of dorsal arm
nephr — kidney
o — mouth
o. inf. d — dorsal funnel organ
o. inf. v — ventral funnel organ
oes — esophagus
p' — dorsal arm
pall. e — outer layer of mantle
pall. i — inner layer of mantle
pall. m — middle layer of mantle
pill — pillar
pros. — prosiphuncle
sept. — septal funnel
st — stomach
stai — static organ
v — vessel
valv — funnel valve
x — space enlarged by detachment of liver
2.3.4.5.6 — 2nd to 6th chambers
Plate LXXIV

Argonauta

Figure 1. *Argonauta hians* Solander, male: Station 50, South Equatorial Current. × 6
Figure 2. *Argonauta hians* Solander, female: Station 50, South Equatorial Current. × 6
Figure 3. *Argonauta* sp., juvenile female: Station 263, Indian North Equatorial Current. × 6
Figure 4. *Argonauta hians*, male: Station 50. Funnel and mantle cartilage. Appr. × 20
Figure 5. *Argonauta hians*, male: Station 50. Arm apparatus. Appr. × 12
Figure 6. *Argonauta hians*, female: Station 50. Funnel and mantle cartilages
Plate LXXV

*Velodona togata* n. gen., n. sp.

Right side. Natural size. Drawn from color sketch of the live animal. Station 249. Trawl, 749 m. Near the Somali coast
Plate LXXVI

*Velodona togata* n. gen., n. sp.

Dorsal view. Drawn from color sketch of the live animal. Station 249. Trawl, 749 m. Near the Somali coast.
Plate LXXVII

_Tremoctopus hyalinus_ Rang, juv. (Figures 1, 4, 5, 6); _Polypus_ juv. (Figures 2, 3, 7).

Figure 1. _Tremoctopus hyalinus_ Rang, juv., Station 49, South Equatorial Current. \( \times 6 \)
Figure 2. _Polypus_ juv., Station 244, Zanzibar Canal. \( \times 6 \)
Figure 3. _Polypus (brevipes d’Orb.?)_ juv., Station 207, Indian North Equatorial Current, Surat Passage. \( \times 6 \)
Figure 4. Thickened right margin of mantle of _Tremoctopus_, Station 49.
Figure 5. Funnel, mantle margin and anus of _Tremoctopus_, Station 49. Appr. \( \times 18 \)
Figure 6. _Tremoctopus hyalinus_ juv., Station 49. Arm apparatus. \( \times 12 \)
Figure 7. _Polypus_ juv., Station 244. Arm apparatus. \( \times 12 \)
Plate LXXVIII

Larvae of Bristle Bearing Octopoda

Figure 1. Larva of Octopoda with bristles, Station 223, Indian Countercurrent. × 6
Figure 2. Larva of Octopoda with bristles, Station 41, Guinea Current. × 6
Figure 3. Same larva, higher magnification, × 30
Figure 4. Arm apparatus of larva from Station 223. Appr. × 12
Figure 5. Arm apparatus of larva from Station 41, × 12
Plate LXXIX

*Polypus levis Hoyle*, male

Station 160, Port Gazelle, Kerguelen.
Plate LXXX

Polypus valdiviae. Station 103, Agulhas Bank

Figure 4. Hectocotylus.
Figure 5. Young male?
Plate LXXXI

Eledonella pygmaea Verr.

Figures 1–2. Young females.
Figure 3. Male, probably from the material of the Michael Sars Expedition.
Figure 4. Hectocotylus of younger male.
Figure 5. Female. Station 53. Gulf of Guinea
Plate LXXXII

*Bolitaena diaphana* Steenstr.

Figures 1 and 4. Station 66b, northeast of S. Thomé.
Figures 2 and 3. Station 50, Gulf of Guinea.
Plate LXXXIII

*Bolitaena diaphana* Steenstr., juv.

Figure 1. Station 190, near Sumatra.
Figures 2 and 6. Station 217, southwest of Ceylon.
Figures 3, 4, 5, 7, 8. Station 44, south of Sierra Leone.
Figures 9 and 10. Station 66b, northeast of S. Thomé.

**ABBREVIATIONS**

*c. branch.* — branchial heart
*g. stell.* — ganglion stellatum
*sept.* — mantle septum
Plate LXXXIV

Figure 1. *Bolitaena*, ventral view, with opened gelatinous mantle. Mantle septum, strongly pigmented visceral sac and right gill visible. The larger arm (3rd right arm), which faces the observer, is hectocotylized.

**ABBREVIATIONS**

c. branch. — branchial heart
org. infund. — funnel organ
pen. — penis
sept. — mantle septum
test. — testis
Plate LXXXV

*Bolitaena, Eledonella*: Nervous System

Figures 1-5. *Bolitaena diaphana* STEENSTR. Station 50

Figure 1. Central nervous system with adjacent organs of medium-sized specimen. Dorsal view.

Figure 2. Central nervous system of same specimen, ventral view.

Figure 3. Central nervous system and nerves of arms of same specimen. Ventral view. Arms obliquely cut open, to show transverse lamellae in the gelatinous substance and nerves shining through.

Figure 4. Ganglia of visceral nerves at level of anus.

Figure 5. Infraesophageal ganglion.

Figure 6. *Bolitaena*, Station 66. Gastric ganglion

Figures 7, 8. *Eledonella pygmaea*. Experimental Station 53

Figure 7. Central nervous system, ventral view. × 20

Figure 8. Central nervous system, dorsal view. × 20

**ABBREVIATIONS**

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**Abbreviations for Nervous System**

- *a.brach* — arteria brachialis
- *a.bucc* — arteria buccalis
- *a.ceh* — arteria cephalica
- *a.inf* — arteria infundibuli
- *an* — anus
- *a.ophth* — arteria ophthalmica
- *a.saliv* — artery to salivary glands
- *a.stat* — artery to static organ
- *a.ab* — white body
- *c.brach.b* — commissura brachio-buccalis
- *c.b.s.i* — commissura supraoesophagea-infraoesophagea
- *c. brach* — commissura brachialis
- *d.saliv* — efferent duct of posterior salivary gland
- *g1* — ganglionic swelling of the optic nerve
- *g.brach* — ganglion brachiale
- *g.bucc.i* — ganglion buccale inferior
- *g.bucc.s* — ganglion buccale superius
- *g.cer* — ganglion cerebrale
- *g.gast* — ganglion gastricum
- *g.n.o.i* — ganglion nervi ophthalmici inferior
- *g.n.visc* — ganglion nervi viscerales
- *g.opt* — ganglion opticum
- *g.ped* — ganglion pedale
- *g.pedunc* — ganglion pedunculi
- *g.visc* — ganglion visceralis
- *g.saliv.a* — anterior salivary gland
- *n.abd* — nervus abdominals
- *n.acc.olf* — nervus accessorius olfactorii
- *n.add.inf* — nervus adductor infundibuli
- *n.ant* — nervus anterior
- *n.a.o.s* — nervus antorbitalis superior
- *n.brach* — nervus brachialis
- *n.inf.a* — nervus infundibuli anterior
- *n.inf.p* — nervus infundibuli posterior
- *n.lab* — nervus labialis
- *n.oc.i* — nervus oculomotorius inferior
- *n.olf* — nervus olfactorius
- *n.opt* — nervus opticus
- *n.ophth.a* — nervus ophthalmicus anterior
- *n.ophth.i* — nervus ophthalmicus inferior
- *n.ophth.p* — nervus ophthalmicus posterior
- *n.pall* — nervus pallialis
- *n.symp* — nervus sympathetic
- *n.visc* — nervus visceralis
- *oes* — esophagus
- *opt* — optic nerve
- *rect* — rectum
- *stat* — nervus staticus
- *v.c* — vena cava

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Plate LXXXVI

Bolitaena, Eleodella

Figures 1–8, Static Organs: Figure 9, Osphradium

Figure 1. Bolitaena. Station 50. Static organ, dorsal view
Figure 2. Eleodella. Macula statica princeps with statoliths, seen from above
Figure 3. Same, lateral view.
Figure 4. Bolitaena. Station 50. Ciliated canal with adjacent parts: a—nonciliated distal part
Figure 5. Eleodella. Station 49. Right static organ with brain and cerebral nerves showing through, ventral view
Figure 6. Bolitaena. Station 50. Both static organs with their capsules, ventral view. Arms of vena cava and adjacent nerves indicated
Figure 7. Bolitaena. Terminal branching of 3rd static nerve
Figure 8. Bolitaena. Nuclei of the inner wall of static organ and capillaries
Figure 9. Osphradium (tuberculum olfactorium) of Bolitaena. Station 66. a—lateral view, b—seen from above

ABBREVIATIONS

can. cil — ciliated canal
a — distal end of ciliated canal
cap — capillary vessels
caps — capsules of static organs
c.v.br — arms of vena cava (circulus venosus brachialis)
cr.st — crista statica
g.opt — ganglion opticum
g.ped — ganglion pedunculi
mac.st — sensory pad (macula statica princeps)
n.abd — nervus abdominalis
n.inf.a — nervus infundibuli anterior
n.inf.p — nervus infundibuli posterior
n.olf — nervus olfactorius, sensory branch
n.olf1, n.olf2 — nervus olfactorius, motor branches
n.ophh.a — nervus ophthalmicus anterior
n.ophh.i — nervus ophthalmicus inferior
n.opt — nervus opticus
n.pall — nervus pallialis
n.stat1 — nervus staticus, branch to macula princeps
n.stat1 — nervus staticus, branch to distal part of crista
n.stat1 — nervus staticus, branch to proximal part of crista
n.r.c — nerve of vena cava
n.visc — nervus viseralis
nu — nuclei
p — pore of ciliated canal
stat — statolith
c.inf — funnel vein
Plate LXXXVII

*Bolitaena*

Figures 1–3. Intestinal Tract: Figures 4–9, Male Genitalia

Figure 1. *Bolitaena diaphana*. Station 50. Intestinal tract, right side: pharynx and brain, dorsal view. X 5
Figure 2. Same, ventral view. X 5
Figure 3. Same, diagonally from the dorsal view, with layer of neighboring chromatophores. a—sickle-shaped muscular pad; b—connecting cord; c—lateral pad; d—terminal dome

Figure 4–9. Male genitalia of *Bolitaena diaphana*. Stations 66 and 50
Figure 4. Testis, gonoducts and adjacent organs in situ. Station 50. Younger specimen
Figure 5. Gonoducts of older specimen from Station 66 (spread).
Figure 6. Same, natural position, viewed from the outside (cf. Plate LXXXIV, Figure 4).
Figure 7. Initial part of gonoducts viewed from the inside.
Figure 8. Penis with diverticulum in optical longitudinal section. X 7
Figure 9. Aciniform gland of appendix.

**ABBREVIATIONS**

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<td>appendix</td>
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<td>c.branch</td>
<td>branchial heart</td>
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<td>caps</td>
<td>capsule of testis</td>
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<td>cer</td>
<td>cerebral ganglion</td>
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<td>coll.p</td>
<td>cervix of penis</td>
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<td>coec</td>
<td>evagination of appendix</td>
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<td>vas efferens</td>
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<tr>
<td>ves.sem¹</td>
<td>ves. sem²</td>
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<tr>
<td>ves.sem²</td>
<td>ves. sem³</td>
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<tr>
<td>ves.sem³</td>
<td>1st, 2nd and 3rd part of vesicula seminalis</td>
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Plate LXXXVIII

*Bolitaena.* Development of Chromatophores

Preparations made from mantle of two young specimens fixed with chrome-osmium acid (Fleming’s solution). The specimens are 25 mm (Station 190) and 24 mm (Station 232) long and have a mantle length of 16 and 14 mm, respectively. Dye: iron hematoxylin, Heidenhain method. One specimen (Station 190) illustrated on Plate LXXXVIII, Figure 1.

Drawings with Zeiss Apochromat homogeneous immersion 1/12 and oculars 0, 2, 4. Muscle processes stained blue, nerves brownish.

Figure 1. Nest of connective tissue cells from the gelatinous substance.
Figure 2a. Youngest stage of the chromatophore, with sphere.
Figure 2b. Sphere with central granule and radial fibers.
Figure 3. Cell with coarsely granulate nucleus and light-colored secretory vacuole that contains a spherical mass of secretion.
Figure 4. Young mononuclear chromatophore with sphere and radial pseudopodium-like processes.
Figure 5. Slightly older stage with light-colored ectoplasm that has radial processes.
Figure 6. Binuclear cell with short processes.
Figure 7. Binuclear cell with sphere and two secretory masses, without processes.
Figure 8. Young binuclear chromatophore with radial muscular processes of which 3 are innervated.
Figure 9. Young chromatophore with 4 nuclei, two of which are homogeneous, and the other two finely granulated. The ring-shaped arrangement of the contractile substance between the processes is distinct.
Figure 10. Young chromatophore with 5 nuclei, lateral view. The outward-facing hood-like dome is filled with flakes of secretion.
Figure 11. Chromatophore with 5 nuclei and its nervous network.
Figure 12. Chromatophore with 8 deeply situated nuclei which are covered by the hood-shaped dome. Mononuclear youngest stage shown situated nearby.
Figure 13. Chromatophore with 16 nuclei which are still situated centrally.
Plate LXXXIX

Bolitaena diaphana

Chromatophores, Musculature, Nervous Network, and Structure of Bristle Tufts


\[ n — nerve \quad m — nucleus \quad v — vessel \]

Figure 1. Surface preparation showing the deeply situated branched musculature, the network of nerve endings and two contracted, developed chromatophores; also visible are two young stages of chromatophores. Network of nerve endings examined with homogeneous immersion 1/12. × 165

Figure 2. Branched musculature and contracted chromatophores from ventral margin of mantle. × 100

Figure 3. Expanded chromatophores with nervous network and branched musculature. Main nucleus of chromatophore, surrounded by a halo in center of large vacuole (situated on stem of longitudinal muscles). × 100

Figure 4 a, b, c. Base of the muscular processes of developed chromatophores.

Figure 5. Young chromatophore with a central main nucleus surrounded by a honeycomb-like plasma and with peripheral nuclei displaced to the base of the muscular processes. Specimen from Station 65: fixation with sublimate and acid carmine. Homogeneous immersion 1/12

Figure 6. Young chromatophore after staining with osmium (Station 190). The cap-shaped apex (Plate LXXXVIII, Figure 10) has become flattened and has filled with light-brown pigment granules. The main nucleus is stained black by osmium; the other nuclei have moved to the base of the muscular processes

Figure 7. Division site of a nerve, with two granulate nerve nuclei and a homogeneous sheath nucleus.

Figure 8. Division site of a nerve with two homogeneous nuclei and one granulate nerve nucleus.

Figure 9. Ventral surface of specimen from Station 190, showing osmium-stained superficial longitudinal and transverse muscle fibers: chromatophores situated mainly along muscle fibers. The upper margin corresponds to the mantle margin at the level of the funnel. × 8

Figures 10-13. Development and structure of bristle tufts (specimen from Station 232). Horn immersion 1/12

Figure 10. Ectodermal cell plug with finely striated cone and basal cell situated below it.

Figure 11. Developed tuft of bristles. Two smaller nuclei are seen persisting near the large basal nucleus

Figure 12. Tuft of bristles seen from above, with basal nucleus and peripheral muscular processes.

Figure 13. Chitinous cup with thin bristle tuft.
Plate XC

*Vampyroteuthis infernalis* n. gen., n. sp.
Specimen from Station 65 (Latitude of Cape Verde)
Vertical Net to 1,200 m

Figure 1. Right side. × 3.5
Figure 2. Dorsal view. × 3.5
Figure 3. Arms with umbrella. × 4.5
Plate XCI

Vampyroteuthis, Amphitretus

Figures 1–5. Vampyroteuthis infernalis n.g. and sp.

Figure 1. Specimen from Station 65. Ventral view of mantle complex. × 3.5. Notable are the blackish stained rectum, the renal papillae, the branchial hearts (c. branch.), and the gonad (go.) which is light-colored and shines through above the stomach

Figure 2. Youngest specimen, ventral view, with spread umbrella.

Figure 3. Young specimen from Station 85 (Benguela Current), left side. Muscular bands of mantle gaping open on dorsal side. × 3

Figure 4. Left eye of specimen from Station 65. Eye protruding from lid fold. × 4.5

tub. olf. — olfactory tubercle  c. alb. — white body

Figure 5. Right eye of same specimen. Eye covered by lid fold. Brownish iris visible through pupil. × 4.5

Figures 6–10. Amphitretus pelagicus Hoyle

Figure 6. Amphitretus pelagicus Hoyle, left side. Station 102, Agulhas Current. Vertical net to 1,800 m. × 2. Specimen is damaged: gelatinous skin and funnel chafed off

Figure 7. Eyes, dorsal view. Color sketch from the live animal

Figure 8. Right eye, lateral view.

Figure 9. Median section through right eye (in direction of cross section of whole animal).

ABBREVIATIONS

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<tr>
<td>c. alb.</td>
<td>white body</td>
</tr>
<tr>
<td>cart.</td>
<td>cartilaginous ring at root of iris and epithelial body</td>
</tr>
<tr>
<td>c. epith.</td>
<td>epithelial (ciliary) body</td>
</tr>
<tr>
<td>er. pg.</td>
<td>pigmented epithelium</td>
</tr>
<tr>
<td>for.</td>
<td>pitlike depression of retina</td>
</tr>
<tr>
<td>g. opt.</td>
<td>optic ganglion</td>
</tr>
<tr>
<td>ir.</td>
<td>iris</td>
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<tr>
<td>ret.</td>
<td>retina</td>
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Figure 10. Retina of Amphitretus. Drawn after microphotograph

ABBREVIATIONS

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<tr>
<td>g. opt.</td>
<td>peripheral ganglionic layer of optic ganglion</td>
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<td>g. opt. 2</td>
<td>granulate layer</td>
</tr>
<tr>
<td>g. opt. 3</td>
<td>central ganglionic layer</td>
</tr>
<tr>
<td>gr.</td>
<td>granulate layer beneath sensory cells</td>
</tr>
<tr>
<td>lim.</td>
<td>multiply layered cells of limitans</td>
</tr>
<tr>
<td>m.</td>
<td>membrane between cells of limitans and sensory cells</td>
</tr>
<tr>
<td>m. h.</td>
<td>limiting membrane toward vitreous body</td>
</tr>
<tr>
<td>n. opt.</td>
<td>fiber layer of optic nerve</td>
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<tr>
<td>sens.</td>
<td>pad of sensory cells</td>
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<tr>
<td>st.</td>
<td>rods</td>
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Plate XCII

*Cirrothauma murrayi* Chun

Ventral view. Station 82 of the *Michael Sars* Expedition
Plate XCIII

*Cirrothauna murrayi* CHUN

Figure 1. View from mouth. Basal parts of the 8 arms visible
Figure 2. Rudimentary eye.
Figure 3. Retina.

**ABBREVIATIONS**

*a.* — outer space surrounding eyeball
*alb.* — white body
*f.* — fiber layer
*ophth. i.* — nervus ophthalmicus inferior
*ophth. s.* — nervus ophthalmicus superior
*opt.* — nervus opticus
*pg.* — pigment of retina
*s.* — sensory cells
*sin. v.* — sinus venosus
*st.* — rods
*v. ophth.* — vena ophthalmica
Plate XCIV

*Opisthoteuthis* Verrill

Figures 1 and 2. *Opisthoteuthis medusoides* n.sp., Station 243, near Dar es Salaam

Figure 1. Posterior view.
Figure 2. Lateral view.

Figure 3. *Opisthoteuthis extensa* n.sp., Station 189, Mentawei Basin. Posterior view
Plate XCV

*Opisthoteuthis* VERRILL

**Figure 1.** *Opisthoteuthis medusoides* n.sp. Anterior view
**Figure 2.** *Opisthoteuthis extensa* n.sp. Anterior view