

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME XXXIII



WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

ADVERTISEMENT.

The Scientific publications of the National Museum consist of two series—Proceedings and Bulletins.

The proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prompt dissemination of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the thirty-third of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum have been published as Bulletins.

CHARLES D. WALCOTT,

Secretary of the Smithsonian Institution.

MARCH 16, 1908.



TABLE OF CONTENTS.

	Page.
BARTSCH, PAUL. A New Fresh-water Bivalve (<i>Corneocyclas</i>) from the Mountains of Ecuador.—No. 1584. February 29, 1908 ^a	681-682
New species: <i>Corneocyclas davisi</i> .	
———. New Marine Mollusks from the West Coast of America.—No. 1564. October 23, 1907 ^a	177-183
New species: <i>Seila montereyensis</i> , <i>Bittium tumidum</i> , <i>Cerithiopsis cosmia</i> , <i>C. pedroana</i> , <i>Metaxia diadema</i> .	
New subspecies: <i>Bittium</i> (<i>Stylidium</i>) <i>eschrichti icelum</i> , <i>B. (S.) eschrichti montereyensis</i> , <i>B. esuriens multifilum</i> , <i>B. quadrifilatum ingens</i> .	
———. Notes on the Fresh-water Mollusk <i>Planorbis magnificus</i> and Descriptions of Two New Forms of the same Genus from the Southern States.—No. 1587. March 4, 1908 ^a	697-700
New species: <i>Planorbis eucosmius</i> .	
New subspecies: <i>Planorbis eucosmius vaughani</i> .	
———. The West American Mollusks of the Genus <i>Triphoris</i> .—No. 1569. December 12, 1907 ^a	249-262
New species: <i>Triphoris montereyensis</i> , <i>T. pedroanus</i> , <i>T. callipyrgus</i> , <i>T. carpenteri</i> , <i>T. hemphilli</i> , <i>T. catalinensis</i> , <i>T. stearnsi</i> , <i>T. peninsularis</i> , <i>T. excolpus</i> , <i>T. panamensis</i> , <i>T. dalli</i> , <i>T. galapagensis</i> , <i>T. chathamensis</i> , <i>T. adamsi</i> .	
———. See under Dall, William Healey	491-534
BEAN, BARTON A. On <i>Ctenolucius</i> Gill, A Neglected Genus of Characin Fishes, with Notes on the Typical Species.—No. 1588. March 4, 1908 ^a	701-703
———. See under Seale, Alvin	229-248
CAUDELL, ANDREW NELSON. On some Earwigs (<i>Forficulidae</i>) collected in Guatemala by Messrs. Schwarz and Barber.—No. 1563. October 23, 1907 ^a	169-176
New genus: <i>Arthraedetus</i> .	
New species: <i>Cylindrogaster diplatyoides</i> , <i>Arthraedetus barberi</i> , <i>Sparratta minuta</i> , <i>Labia schwarzi</i> , <i>L. breviforceps</i> , <i>Forficula cacaoensis</i> .	

^a Date of publication.

	Page.
CLARK, AUSTIN HOBART. Descriptions of New Species of Recent Unstalked Crinoids from the Coasts of Northeastern Asia.—No. 1561. September 17, 1907 ^a	127-156
New species: <i>Antedon multicolor</i> , <i>A. versicolor</i> , <i>A. propinqua</i> , <i>A. separata</i> , <i>A. flavopurpurea</i> , <i>A. callista</i> , <i>A. anthus</i> , <i>A. macropoda</i> , <i>A. hana</i> , <i>A. villosa</i> , <i>A. pubescens</i> , <i>A. hepburniana</i> , <i>A. lata</i> , <i>A. scalaris</i> , <i>A. garrettiana</i> , <i>A. orion</i> , <i>A. minor</i> , <i>A. diadema</i> , <i>A. aster</i> , <i>A. alboblava</i> , <i>A. ruber</i> , <i>A. diomedea</i> , <i>A. tigrina</i> , <i>A. bowersi</i> , <i>A. abbotti</i> , <i>A. styliifer</i> , <i>A. delicatissima</i> , <i>A. rubroflava</i> , <i>A. thetis</i> , <i>A. hawaiiensis</i> , <i>Comatula mariae</i> , <i>C. solaster</i> , <i>C. serrata</i> .	
New names: <i>Comatula orientalis</i> , <i>Atelectrinus pourtalesi</i> .	
———. Descriptions of New Species of Recent Unstalked Crinoids from the North Pacific Ocean.—No. 1559. September 17, 1907 ^a	69-84
New species: <i>Decametrocrinus borealis</i> , <i>Antedon rara</i> , <i>A. hartlaubi</i> , <i>A. tenelloides</i> , <i>A. asperrima</i> , <i>A. perplexa</i> , <i>A. laodice</i> , <i>A. inexpectata</i> , <i>A. rathbuni</i> , <i>A. brachymera</i> , <i>A. serratissima</i> , <i>A. mariae</i> , <i>A. hondensis</i> , <i>A. elio</i> , <i>A. erythrizon</i> , <i>A. fragilis</i> , <i>A. tenuis</i> , <i>A. ciliata</i> , <i>A. isis</i> , <i>A. arctica</i> , <i>A. briseis</i> .	
———. Infrabasals in Recent Genera of the Crinoid Family Pentaerinitidae.—No. 1582. February 29, 1908 ^a	671-676
———. The Crinoid Genus <i>Comatula</i> Lamarck; with a Note on the <i>Encrinus parrae</i> of Guérin.—No. 1585. February 29, 1908 ^a	683-688
New name: <i>Comaster carpenteri</i> .	
CUSHMAN, JOSEPH A. Fresh-water Crustacea from Labrador and Newfoundland.—No. 1589. March 4, 1908 ^a	705-713
New species: <i>Herpetocypris testudinaria</i> .	
DALL, WILLIAM HEALEY. Supplementary Notes on Martyn's Universal Conchologist.—No. 1565. October 23, 1907 ^a ...	185-192
——— and PAUL BARTSCH. The Pyramidellid Mollusks of the Oregonian Faunal Area.—No. 1574. December 31, 1907 ^a	491-534
New species: <i>Turbonilla</i> (<i>Turbonilla</i>) <i>gilli</i> , <i>T.</i> (<i>Chemnitzia</i>) <i>matricatoides</i> , <i>T.</i> (<i>Strioturbonilla</i>) <i>serræ</i> , <i>T.</i> (<i>Pyrgolampros</i>) <i>taylori</i> , <i>T.</i> (<i>P.</i>) <i>berryi</i> , <i>T.</i> (<i>P.</i>) <i>lyalli</i> , <i>T.</i> (<i>P.</i>) <i>victoriana</i> , <i>T.</i> (<i>P.</i>) <i>valdezi</i> , <i>T.</i> (<i>P.</i>) <i>newcombei</i> , <i>T.</i> (<i>P.</i>) <i>oregonensis</i> , <i>T.</i> (<i>Pyrgiscus</i>) <i>canfieldi</i> , <i>T.</i> (<i>P.</i>) <i>morchii</i> , <i>T.</i> (<i>P.</i>) <i>antestriata</i> , <i>T.</i> (<i>P.</i>) <i>eucosmobasis</i> , <i>T.</i> (<i>P.</i>) <i>castanea</i> , <i>T.</i> (<i>Mormula</i>) <i>eschschoeltzi</i> , <i>Odostomia</i> (<i>Chrysallida</i>) <i>cooperi</i> , <i>O.</i> (<i>C.</i>) <i>astricta</i> , <i>O.</i> (<i>C.</i>) <i>montereyensis</i> , <i>O.</i> (<i>C.</i>) <i>oregonensis</i> , <i>O.</i> (<i>Ividia</i>) <i>navisa</i> , <i>O.</i> (<i>Iolaea</i>) <i>amianta</i> , <i>O.</i> (<i>Menes tho</i>) <i>harfordensis</i> , <i>O.</i> (<i>M.</i>) <i>exara</i> , <i>O.</i> (<i>Ealea</i>) <i>tillamookensis</i> , <i>O.</i> (<i>E.</i>) <i>angularis</i> , <i>O.</i> (<i>E.</i>) <i>jewetti</i> , <i>O.</i> (<i>E.</i>) <i>columbiana</i> , <i>O.</i> (<i>E.</i>) <i>deliciosa</i> , <i>O.</i> (<i>E.</i>) <i>tacomaensis</i> , <i>O.</i> (<i>E.</i>) <i>valdezi</i> , <i>O.</i> (<i>E.</i>) <i>phanea</i> , <i>O.</i> (<i>Amaura</i>) <i>kennertleyi</i> , <i>O.</i> (<i>A.</i>) <i>montereyensis</i> .	
New subspecies: <i>Turbonilla</i> (<i>Turbonilla</i>) <i>gilli delmontensis</i> , <i>Odostomia</i> (<i>Ividia</i>) <i>navisa delmontensis</i> .	
New names: <i>Turbonilla</i> (<i>Chemnitzia</i>) <i>montereyensis</i> , <i>Odostomia</i> (<i>Menes tho</i>) <i>pharacida</i> .	

	Page.
EDWARDS, CHARLES LINCOLN. The Holothurians of the North Pacific Coast of North America collected by the Albatross in 1903.—No. 1558. September 14, 1907 ^a	49-68
New species: <i>Chiridota albatrossii</i> .	
EIGENMANN, CARL H., and FLETCHER OGLE. An Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species.—No. 1556. September 10, 1907 ^a	1-36
New genus: <i>Phenacogrammus</i> .	
New species: <i>Curimatus brevipes</i> , <i>Prochilodus beani</i> , <i>Parodon paraguayensis</i> , <i>P. piracicabæ</i> , <i>Leporinus paræ</i> , <i>Cheirodon ribeiroi</i> , <i>C. micropterus</i> , <i>Odontostilbe microcephalus</i> , <i>Aphyocharax rathbuni</i> , <i>A. stramineus</i> , <i>Holopristes riddlei</i> , <i>Hemigrammus micropterus</i> , <i>H. tridens</i> , <i>H. boulengeri</i> , <i>H. anisitsi</i> , <i>H. santæ</i> , <i>H. inconstans</i> , <i>Astyanax emperador</i> , <i>A. orthodus</i> , <i>A. atratoensis</i> , <i>A. megalops</i> , <i>Charax atratoensis</i> .	
New subspecies: <i>Curimatus leuciscus boliviæ</i> , <i>Astyanax rutilus nicaraguensis</i> .	
New specific names: <i>Curimatus boulengeri</i> , <i>Leporinus steindachneri</i> , <i>Gilbertolus</i> , <i>Evermannolus</i> .	
FRANKLIN, HENRY JAMES. On a Collection of Thysanopterous Insects from Barbados and St. Vincent Islands.—No. 1590. March 4, 1908 ^a	715-730
New species: <i>Euthrips insularis</i> , <i>Anthothrips gowdeyi</i> , <i>Trichothrips niger</i> , <i>Cryptothrips fasciapennis</i> .	
GIRTY, GEORGE H. Descriptions of New Species of Upper Paleozoic Fossils from China.—No. 1557. September 10, 1907 ^a	37-48
New genus: <i>Carnegia</i> .	
New species: <i>Lonsdaleia chinensis</i> , <i>Michelinea favositoides</i> , <i>Carnegia bassleri</i> , <i>Fistulipora willisiana</i> , <i>Geinitzella chinensis</i> , <i>Batostomella meekana</i> , <i>Fistulipora waageniana</i> , <i>Spirifer blackwelderi</i> , <i>Notothyris willisiana</i> , <i>Aviculipecten richthofeni</i> .	
HERRE, ALBERT CHRISTIAN	157-167
——— See under Jordan, David Starr.	
HOUGH, WALTER. The Pulque of Mexico.—No. 1579. February 18, 1908 ^a	577-592
JORDAN, DAVID STARR, and ALBERT CHRISTIAN HERRE. A Review of the Cirrhitoid Fishes of Japan.—No. 1562. October 23, 1907 ^a	157-167
New genus: <i>Isobuna</i> .	
——— and ROBERT EARL RICHARDSON. A Review of the Flat-heads, Gurnards, and other Mail-cheeked Fishes of the Waters of Japan.—No. 1581. February 28, 1908 ^a	629-670
New genera: <i>Rogadius</i> , <i>Bambradon</i> , <i>Ebisinus</i> , <i>Dactyloptena</i> , <i>Daicocus</i> .	
New species: <i>Hoplichthys gilberti</i> .	

	Page.
JORDAN, DAVID STARR, and ROBERT EARL RICHARDSON. Description of a New Species of Killifish, <i>Lucania browni</i> , from a Hot Spring in Lower California.—No. 1572. De- cember 24, 1907 ^a	319-321
New species: <i>Lucania browni</i> .	
———. On a Collection of Fishes from Echigo, Japan.—No. 1570. December 12, 1907 ^a	263-266
New species: <i>Lefua echigonia</i> , <i>Pallasina eryngia</i> , <i>Chloea nakamurae</i> .	
——— and ALVIN SEALE. List of Fishes collected in the River at Buytenzorg, Java, by Dr. Douglas Houghton Campbell.—No. 1575. December 24, 1907 ^a	535-543
New species: <i>Glossogobius campbellianus</i> .	
LINTON, EDWIN. Notes on Parasites of Bermuda Fishes.— No. 1560. October 14, 1907 ^a	85-126
New species: <i>Echinorhynchus medius</i> , <i>Rhynchobothrium spiracornutum</i> , <i>Otobothrium penetrans</i> , <i>Distomum subtenue</i> , <i>D. gyrinus</i> , <i>D. lamelli-</i> <i>forme</i> , <i>D. trulla</i> , <i>D. lerenseni</i> , <i>D. fenestratum</i> ; <i>D. tomex</i> .	
LYON, MARCUS WARD, JR. Mammals collected in Western Borneo by Dr. W. L. Abbott.—No. 1577. December 24, 1907 ^a	547-572
New species: <i>Sciurus sanggau</i> .	
New subspecies: <i>Sciurus borneoensis palustris</i> .	
MASON, OTIS T. Basketry Bolo Case from Basilan Island.— No. 1566. October 25, 1907 ^a	193-196
OGLE, FLETCHER	1-36
———. See under Eigenmann, Carl H.	
RICHARDSON, HARRIET. On Some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with Descrip- tions of a New Genus and Two New Species.—No. 1586. February 29, 1908 ^a	689-696
New genus: <i>Arthropryxus</i> .	
New species: <i>Holopryxus giardi</i> , <i>H. californiensis</i> , <i>Arthropryxus</i> <i>beringanus</i> .	
RICHARDSON, ROBERT EARL. See under Jordan, David Starr	263-266
———. See under Jordan, David Starr	319-321
———. See under Jordan, David Starr	629-670
SEALE, ALVIN and BARTON A. BEAN. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with Descriptions of Seven New Species.—No. 1568. November 21, 1907 ^a	229-248
New genus: <i>Mearnsella</i> .	
New species: <i>Barbus quinquemaculatus</i> , <i>Mearnsella alestes</i> , <i>Rasbora</i> <i>punctulatus</i> , <i>Polydactylus opercularis</i> , <i>Cephalopholis maculatus</i> , <i>Choerops zamboangae</i> , <i>Callyodon latifasciatus</i> .	

	Page
SEALE, ALLEN. <i>See</i> under Jordan, David Starr	535-543
STEJNEGER, LEONHARD. A New Geckoid Lizard from the Philippine Islands.—No. 1576. December 24, 1907 ^a	545-546
New species: <i>Luperosaurus macgregori</i> .	
———. A New Species of Flying Lizard from the Philippine Islands.—No. 1583. February 29, 1908 ^a	677-679
New species: <i>Draco mindanensis</i> .	
———. Two New Species of Toads from the Philippines.— No. 1578. February 18, 1908 ^a	573-576
New species: <i>Phrynixalus anulatus</i> , <i>Kalophrynus stellatus</i> .	
WALSINGHAM, LORD. Descriptions of New North American Tineid Moths, with a Generic Table of the Family Blastobasidae.—No. 1567. October 29, 1907 ^a	197-228
New genera: <i>Valentinia</i> , <i>Catacrypsis</i> , <i>Cynotes</i> , <i>Menestomorpha</i> , <i>Celopata</i> , <i>Pseudoxylesthia</i> .	
New species: <i>Gelechia laudatella</i> , <i>Ethmia albitogata</i> , <i>Valentinia nothrotetes</i> , <i>Blastobasis</i> sp., <i>Holcocera nigrostriata</i> , <i>H. aplidiella</i> , <i>Catacrypsis nucella</i> , <i>C. stygna</i> , <i>C. ursella</i> , <i>C. irenica</i> , <i>C. inconspicua</i> , <i>C. morrisoni</i> , <i>Hypatopa texanella</i> , <i>H. episcia</i> , <i>H. conia</i> , <i>H. fasciata</i> , <i>H. orites</i> , <i>Menestomorpha oblongata</i> , <i>Coleophora lapidicornis</i> , <i>C. vagans</i> , <i>Celopata glutinosi</i> , <i>Hyponomeuta diaphorus</i> , <i>Bucculatrix eurotiella</i> , <i>Lithocolletis cervina</i> , <i>L. cerifera</i> , <i>L. leucothorax</i> , <i>Ornix immotata</i> , <i>Tischeria albostraminea</i> , <i>Scardia gracilis</i> , <i>Pseudoxylesthia angustella</i> , <i>Tinea sparsipunctella</i> , <i>Homonymus coloradellus</i> .	
New name: <i>Hypatopa</i> .	
WILLIAMSON, EDWARD BRUCE. The Dragonflies (Odonata) of Burma and Lower Siam—II. Subfamilies Cordulegasterinae, Chlorogomphinae, and Gomphinae.—No. 1571. December 13, 1907 ^a	267-317
New genus: <i>Burmagomphus</i> .	
New species: <i>Gomphidia abbotti</i> , <i>Gomphus xanthenatus</i> .	
WILSON, CHARLES BRANCH. North American Parasitic Copepods belonging to the Family Caligidae. Parts 3 and 4.—A Revision of the Pandarinae and the Cecropinae.—No. 1573. December 31, 1907 ^a	323-490
New genus names: <i>Pholidopus</i> , <i>Prosates</i> .	
New species: <i>Echthrogaleus torpedinis</i> .	
———. North American Parasitic Copepods: New Genera and Species of Caliginae.—No. 1580. February 28, 1908 ^a	593-627
New genera: <i>Abasia</i> , <i>Tuxophorus</i> .	
New species: <i>Caligus rufus</i> , <i>Lepeophtheirus longispinosus</i> , <i>Parapetahus occidentalis</i> , <i>Abasia pseudorostris</i> , <i>Tuxophorus caligodes</i> .	

^aDate of publication.



LIST OF ILLUSTRATIONS.

TEXT FIGURES.

	Page.
<i>Curimatis brevipes</i>	4
<i>Prochilodus beani</i>	5
<i>Leporinus paræ</i>	8
<i>Hemigrammus inconstans</i>	17
<i>Astyanax atratoensis</i>	28
<i>Bramocharax bransfordii</i>	32
<i>Charax squamosus</i>	33
<i>Charax atratoensis</i>	34
<i>Chiridota albatrossii.</i> a-c, Calcareous rods.....	51
<i>Chiridota albatrossii.</i> d-f, Calcareous rods.....	51
<i>Chiridota albatrossii.</i> Stone canal and madreporite.....	52
<i>Ankyroderma jeffreysii.</i> Spoon-like rod with rudimentary spire.....	52
<i>Cucumaria calcigera.</i> Upper surface of table from the body-wall.....	55
<i>Cucumaria calcigera.</i> Side view of table from the body-wall.....	55
<i>Cucumaria calcigera.</i> Perforated plate of the introvert.....	56
<i>Cucumaria calcigera.</i> Supporting table from a pedicel.....	56
<i>Cucumaria calcigera.</i> Spinose, perforated tentacle rod.....	57
<i>Cucumaria calcigera.</i> Fragment of calcareous ring network.....	57
<i>Cucumaria calcigera.</i> Stone canal and madreporite.....	58
<i>Stichopus challengerii.</i> Curved supporting rod of a tentacle.....	66
<i>Cirrhitichthys aureus</i>	162
<i>Goniistius zonatus</i>	165
Prospectus of Martyn's Universal Conchologist.....	188
Jacanesæ bolo case. Front view.....	193
Jacanesæ bolo case. Back view.....	194
Inside of Jacanesæ bolo case.....	195
Outer technic of Jacanesæ bolo case.....	195
Border of Jacanesæ bolo case.....	196
<i>Barbus quinquemaculatus</i>	230
<i>Mearnsella alestes</i>	232
<i>Rasbora punctulatus</i>	233
<i>Polydactylus opercularis</i>	234
<i>Cephalopholis maculatus</i>	235
<i>Chærops zamboangæ</i>	237
<i>Callyodon latifasciatus</i>	238
<i>Scatophagus argus</i> , young.....	246
<i>Lefua echigonia</i>	263
<i>Pallasina eryngia</i>	264
<i>Chloëa nakamurae</i>	266
Diagrammatic wing of a Dragonfly of the Family <i>Æshnidae</i> showing the nomenclature of the venation.....	270

	Page.
Wings of male <i>Anotogaster sieboldii</i> from Japan.....	276
Wings of male <i>Orogomphus atkinsoni</i> . De Selys' collection	277
Wings of female <i>Orogomphus atkinsoni</i> . De Selys' collection.....	278
Wings of male <i>Ictinus melenops</i> from Siam.....	280
Wings of female <i>Ictinus melenops</i> from Siam.....	280
Wings of male <i>Gomphidia abbotti</i> from Siam	282
<i>Gomphidia abbotti</i> from Siam. A, dorsal, and B, lateral views of male abdominal appendages. 9 and 10, abdominal segments	284
Wings of male <i>Sieboldius japonicus</i> from Siam.....	285
Wings of male <i>Hagenius brevistylus</i> from North America	286
Wings of female <i>Davidius fruhstorferi</i> from Tonkin	287
Wings of male <i>Macrogomphus quadratus</i> from Big Tambelan Island, China Sea.....	288
Wings of female species of <i>Macrogomphus</i> from Siam	288
<i>Macrogomphus quadratus</i> from Big Tambelan Island, China Sea. A, lateral, and B, dorsal views of male abdominal appendages. 9 and 10, abdominal segments.....	289
Wings of male <i>Leptogomphus semperi</i> from Borneo.....	292
Wings of male species of <i>Leptogomphus</i> from Tonkin. Martin's collection	293
Wings of male <i>Leptogomphus inclitus</i> . De Selys' collection	293
Wings of female <i>Leptogomphus inclitus</i> . De Selys' collection.....	294
Wings of male <i>Microgomphus chelifer</i> . De Selys' collection	296
Wings of female <i>Microgomphus chelifer</i> . De Selys' collection.....	296
Wings of female <i>Cyclogomphus heterostylus</i> . De Selys' collection	297
Wings of <i>Anisogomphus occipitalis</i> . De Selys' collection	297
Wings of female <i>Anisogomphus occipitalis</i> . De Selys' collection	298
Wings of male <i>Anormogomphus heteropterus</i> . De Selys' collection	299
Wings of male <i>Burmagomphus vermiculatus</i> from Burma	299
<i>Burmagomphus vermiculatus</i> from Burma. A, lateral, and B, dorsal views of male abdominal appendages. C, profile of accessory genitalia of abdominal segment. 9 and 10, abdominal segments.....	300
Diagrams representing the thoracic color pattern of some oriental Gomphine.....	302
Wings of male <i>Platygomphus dolabratus</i> . De Selys' collection.....	304
Wings of female <i>Platygomphus dolabratus</i> . De Selys' collection.....	304
Wings of male <i>Gomphus xanthenatus</i> from Burma	305
<i>Gomphus xanthenatus</i> from Burma.....	307
Wings of female <i>Onychogomphus annularis</i> from Burma.....	308
Wings of male <i>Onychogomphus saundersii</i> from Burma.....	310
<i>Onychogomphus saundersii</i> from Burma.....	311
Wings of male species of <i>Onychogomphus</i> from Burma.....	315
Wings of male <i>Heterogomphus cochinchinensis</i> from Tonkin	316
Wings of male <i>Merogomphus pariei</i> from Tonkin	317
<i>Lucania browni</i>	320
Photograph of dorsal fin of sand shark, showing both sexes of <i>Pandarus sinuatus</i>	326
Ventral surface of female <i>Pandarus sinuatus</i> , showing adhesion pads.....	329
Ventral surface of first three pairs of swimming legs of <i>Echthrogaleus denticulatus</i> showing accessory adhesion pads	330
A newly hatched Nauplius of <i>Pandarus sinuatus</i>	333
A newly hatched Nauplius of <i>Nesippus alatus</i>	336
The Metanauplius of <i>Nesippus alatus</i>	337
The mouth tube, maxillæ, and mandibles of the Metanauplius of <i>Nesippus alatus</i>	338
The first and second maxillipeds of the Metanauplius of <i>Nesippus alatus</i>	338

	Page.
A mandible of the Metanauplius of <i>Nesippus alatus</i>	338
The first three pairs of swimming legs of the Metanauplius of <i>Nesippus alatus</i>	339
A Chalimus of <i>Perissopus communis</i>	340
The four pairs of swimming legs of the Chalimus shown in the preceding figure	341
A Chalimus of <i>Perissopus communis</i> , one-third larger than the one in Fig. 11..	342
A Chalimus of <i>Perissopus communis</i> , fully developed.....	343
Dorsal view of a female <i>Pandarus sinuatus</i> , showing the parts of the body....	387
Dorsal view of a male of <i>Pandarus cranchii</i>	388
Section of the genital segment of <i>Pandarus sinuatus</i> , with the sixth segment and abdomen still attached. End view, showing the distance between the dorsal plate and the abdomen.....	389
The genital segment and abdomen of <i>Pandarus cranchii</i> , showing anal laminae with two wings, dorsal and ventral.....	392
<i>Rasbora lateristriata</i>	539
<i>Glossogobius campbellianus</i>	542
Sketch map of lower Kapuas River, Western Borneo.....	547
A. Last two maxillary teeth of <i>Lutra barang</i> , adult female, Pulo Lankawi.	
B. Last two maxillary teeth of <i>Lutra lovii</i> , adult female, Pulo Saparo, in Kapuas River, Western Borneo.....	560
Region near Tunol, Durango, Mexico; Agaves in foreground, prickly pear in middle ground	578
Natural growth of agave, prickly pear, and cacti on hills near Tunol, Durango, Mexico. Workman with lever on shoulder.....	579
Agave plantation near City of Mexico; Chapultepec in the distance.....	580
Large agave plant prepared for incubation. Near City of Mexico.....	581
Machete. Handle of horn riveted to iron blade.....	581
Huge agave showing bandera impaled on point of leaf. Collector at work with siphon and skin sack.....	582
Collector of aguamiel at work with siphon.....	582
Gourd siphon shod with horn. Musquitee Indians.....	583
Siphon made of tin. Durango, Mexico.....	583
Scraper of wrought iron. Durango, Mexico.....	583
Skin sack for transporting aguamiel.....	584
Collectors of aguamiel. Zumpango, Mexico.....	584
Transportation of aguamiel in jars slung on the back. Tepeaca, Mexico.....	585
Vat house and workmen, Hacienda de San Antonio. Ometusco, Mexico.....	585
Field vat for preparation of pulque.....	586
Sieve for straining aguamiel, Durango, Mexico	586
Pulque shop named for Queen Xochitl, Cuernavaca, Mexico	588
Tepache vendor's outfit consisting of an olla, olla ring, and two cups. Durango, Mexico	589
Gusono gnawing the agave.....	591
<i>Rogadius asper</i>	631
<i>Thysanophrys spinosus</i>	633
<i>Thysanophrys japonicus</i>	637
<i>Thysanophrys crocodilus</i>	639
<i>Hoplichthys langsdorffii</i>	646
<i>Hoplichthys gilberti</i>	648
<i>Lepidotrigla alata</i>	651
<i>Ebisinus cheirophthalmus</i>	665
<i>Daicocys peterseni</i>	668
Radials, Basals, and Infrabasals of <i>Isocrinus decorus</i> (a young specimen)	672

	Page.
Radials, Basals, and Infrabasals of <i>Isocrinus decorus</i> (a mature specimen)	672
Radials, Basals, and Infrabasals of <i>Metacrinus rotundus</i>	673
Uppermost columnar of <i>Metacrinus rotundus</i>	673
Isolated Infrabasals of <i>Metacrinus superbus</i>	675
Section of Calyx of <i>Metacrinus superbus</i> , showing the infrabasals in position...	675
Ventral view of isolated Infrabasals of <i>Metacrinus superbus</i>	675
Dorsal view of isolated Infrabasals of <i>Metacrinus superbus</i>	676
<i>Cornucyclus davisi</i> Bartsch	682
<i>Holophryxus giardi</i> . Adult female. Dorsal view. Lateral view. Ventral view	690
<i>Holophryxus giardi</i> . Immature female and host.....	691
<i>Holophryxus giardi</i> . Immature female. Dorsal view. Lateral view. Ventral view	692
<i>Holophryxus californiensis</i> . Adult female and host.....	693
<i>Holophryxus californiensis</i> . Male	694
<i>Arthropryxus beringanus</i> . Adult female. Dorsal view. Ventral view	695
<i>Arthropryxus beringanus</i> . Adult male	695
<i>Ctenolucius hujeta</i>	703

PLATES.

	Facing page.
1. Parasites of Bermuda Fishes.....	126
2. Parasites of Bermuda Fishes.....	126
3. Parasites of Bermuda Fishes.....	126
4. Parasites of Bermuda Fishes.....	126
5. Parasites of Bermuda Fishes.....	126
6. Parasites of Bermuda Fishes.....	126
7. Parasites of Bermuda Fishes.....	126
8. Parasites of Bermuda Fishes.....	126
9. Parasites of Bermuda Fishes.....	126
10. Parasites of Bermuda Fishes.....	126
11. Parasites of Bermuda Fishes.....	126
12. Parasites of Bermuda Fishes.....	126
13. Parasites of Bermuda Fishes.....	126
14. Parasites of Bermuda Fishes.....	126
15. Parasites of Bermuda Fishes.....	126
16. West American Mollusks	262
17. The female of <i>Perissopus communis</i> , and the variety <i>stimpsoni</i>	490
18. The male of <i>Perissopus communis</i>	490
19. The female of <i>Echthrogaleus coleoptratus</i>	490
20. The female of <i>Echthrogaleus denticulatus</i>	490
21. The female of <i>Echthrogaleus torpedinis</i>	490
22. The female of <i>Dinematura ferox</i>	490
23. The female of <i>Dinematura producta</i>	490
24. The female of <i>Dinematura latifolia</i>	490
25. The male of <i>Dinematura latifolia</i>	490
26. The male of <i>Pandarus brevicaudis</i>	490
27. The female of <i>Pandarus bicolor</i>	490
28. The male and female of <i>Pandarus cranchii</i>	490
29. An Adult and a young Female of <i>Pandarus smithii</i>	490
30. The male and a young female of <i>Pandarus smithii</i>	490
31. The female of <i>Pandarus satyrus</i>	490
32. The female of <i>Pandarus sinuatus</i>	490

Facing page.

33. The male of <i>Pandarus sinuatus</i>	490
34. An adult and a young female of <i>Nesippus alatus</i>	490
35. The male of <i>Nesippus alatus</i>	490
36. The male of <i>Nesippus curticaudis</i>	490
37. The male of <i>Nesippus borealis</i>	490
38. The female of <i>Cecrops latreillii</i>	490
39. The male of <i>Cecrops latreillii</i>	490
40. The female of <i>Orthagoriscicola muricata</i>	490
41. The male and a Chalimus of <i>Orthagoriscicola muricata</i>	490
42. The female of <i>Philorthragoriscus serratus</i>	490
43. The male of <i>Philorthragoriscus serratus</i>	490
44. West American Turbonilla.....	534
45. West American Turbonilla.....	534
46. West American Odostomia.....	534
47. West American Pyramidellidæ.....	534
48. West American Odostomia.....	534
49. The male and female of <i>Caligus hæmulonis</i>	628
50. The female of <i>Caligus rufus</i> , new species.....	628
51. The female of <i>Lepeophtheirus monacanthus</i>	628
52. The female of <i>Lepeophtheirus longispinosus</i> , new species.....	628
53. The female of <i>Parapetatus occidentalis</i> , new species.....	628
54. The male and female of <i>Abasia pseudorostris</i> , new genus and species.....	628
55. The female of <i>Tuxophorus caligodes</i> , new genus and species.....	628
56. The male of <i>Tuxophorus caligodes</i> , new genus and species.....	628
57. Species of Planorbis from North Carolina and Louisiana.....	700
58. Fresh-water Crustacea from Labrador and Newfoundland.....	714
59. Fresh-water Crustacea from Labrador and Newfoundland.....	714
60. Fresh-water Crustacea from Labrador and Newfoundland.....	714
61. Fresh-water Crustacea from Labrador and Newfoundland.....	714
62. Fresh-water Crustacea from Labrador and Newfoundland.....	714
63. West Indian Thrips.....	730
64. West Indian Thrips.....	730
65. West Indian Thrips.....	730



AN ANNOTATED LIST OF CHARACIN FISHES IN THE
UNITED STATES NATIONAL MUSEUM AND THE MU-
SEUM OF INDIANA UNIVERSITY, WITH DESCRIPTIONS
OF NEW SPECIES.

By CARL H. EIGENMANN and FLETCHER OGLE,
Of Indiana University, Bloomington, Indiana.

In the following pages are enumerated the Characin fishes belonging to the United States National Museum. They are principally derived from the following sources:

1. A series of Dr. Chr. Lütken's species from the collections made by J. Reinhardt, at Lagoa Santa and the Rio das Velhas, Brazil (1850-1856).
2. A collection of the United States and Mexican Boundary Survey (1851-1854).
3. A collection made by Lieut. Lardner Gibbon, U. S. Navy, in Bolivia (1852).
4. A collection made by Capt. T. J. Page, U. S. Navy, in Paraguay (1853).
5. The collections made for J. C. Brevoort and E. G. Blackford, chiefly at Para, Brazil.
6. A collection by Lieut. N. Michler and A. Schott from the Truando near the Rio Atrato, Colombia (1857-58).
7. A collection from the Marañon and Napo rivers, Brazil, made by James Orton (1867).
8. The collections from Panama and Nicaragua made by Dr. J. F. Bransford (1876).
9. A collection from the Nile River, Egypt, made by the Senff Expedition (1899).

Unless otherwise indicated the numbers are those of the catalogues of the United States National Museum.

The National Museum also contains the collection from the Amazon River, made by Prof. J. B. Steere in 1901.

These have been reported on elsewhere.^a The collection of Page

^a See Eigenmann and Bean, Proc. U. S. Nat. Mus., XXXI, pp. 659-668.

from Paraguay is the most extensive, and at the time it was made was by far the most important collection from that region. But the numerous new forms it contained when it was made have since been described by Perugia, Boulenger, and Eigenmann from other collections.

A small but very interesting series is that which was made by Michler and Schott in the Atrato Basin. Inasmuch as the Atrato River forms part of the probable route of migration of the eastern fresh-water fishes to the Pacific slope everything from that part of Colombia is of great interest.

In preparing these notes use has also been made of the collections of Indiana University, which include the following:

1. A collection by H. von Ihering from Rio Grande do Sul, Brazil.
2. A collection by H. von Ihering from São Paulo, Brazil.
3. Duplicates of the collections of C. F. Hartt from the Amazon Basin, Brazil.
4. Collections of the Indiana University Expedition to Guatemala.
5. Various collections from the Paraguay Basin made by J. D. Anisits.
6. Duplicate specimens from the Mexican collections of S. E. Meek.
7. Duplicate specimens from the Argentine collections of J. W. Titcomb (1903-4).
8. A collection from Trinidad, made by Mr. Lechmere Guppy, jr. We have also examined the Princeton University collections made by Prof. W. B. Scott in Buenos Aires, Argentina, and the collection made by Mr. O. Riddle in Venezuela.

The following new names appear in this paper:

- Gilbertolus Eigenmann* (new name).
- Evermannolus Eigenmann* (new name).
- Curimatus boulengeri Eigenmann* (new name).
- Curimatus brevipes Eigenmann* and Ogle.
- Curimatus leuciscus boliviæ Eigenmann* and Ogle.
- Prochilodus beani Eigenmann*.
- Parodon paraguayensis Eigenmann*.
- Parodon piracicabæ Eigenmann*.
- Leporinus paræ Eigenmann*.
- Leporinus steindachneri Eigenmann* (new name).
- Cheirodon ribeiroi Eigenmann*.
- Cheirodon micropterus Eigenmann*.
- Odontostilbe microcephalus Eigenmann*.
- Aphyocharax rathbuni Eigenmann*.
- Aphyocharax stramineus Eigenmann*.
- Holopristes riddlei Meek*.
- Hemigrammus micropterus Meek*.
- Hemigrammus tridens Eigenmann*.
- Hemigrammus boulengeri Eigenmann*.
- Hemigrammus anisitsi Eigenmann*.
- Hemigrammus santæ Eigenmann*.

Hemigrammus inconstans Eigenmann and Ogle.

Astyanax rutilus nicaraguensis Eigenmann and Ogle.

Astyanax emperador Eigenmann and Ogle.

Astyanax orthodus Eigenmann.

Astyanax atratoensis Eigenmann.

Astyanax megalops Eigenmann.

Phenacogrammus Eigenmann.

Charax atratoensis Eigenmann.

I am informed that the names *Gilbertella* and *Evermannella* proposed for Characin genera are preoccupied. For the former I propose the name *Gilbertolus* Eigenmann; for the latter, *Evermannolus* Eigenmann.

Psectrogaster auratus Gill.

No. 5878. Type Bolivia, Gibbon collection.

Psectrogaster curviventris Eigenmann and Kennedy.

No. 2106. Two specimens, Paraguay, Page collection.

Curimatus albula Quoy and Gaimard.

No. 44956. Two specimens, Lagoa Santa, Brazil, Reinhardt collection.

Curimatus boulengeri Eigenmann, new specific name.

For *Curimatus güntheri* BOULENGER, not of Eigenmann and Eigenmann.

Curimatus bimaculatus Steindachner.

No. 1639 (part). Two specimens, Paraguay, Page collection.

No. 2107. Two specimens, Paraguay, Page collection.

Curimatus platanus Günther.

No. 1639 (part). One specimen, Paraguay, Page collection.

Head 3.4; depth 3.25; D. 12, counting everything; A. 10½; scales between 53 and 57. A small black caudal spot, no dorsal spot.

? **Curimatus gilberti** Quoy and Gaimard.

No. 39148. A specimen 42 mm. to base of caudal. From Montevideo, Uruguay.

Head nearly 4; depth 3½; D. 12; A. 9; scales 6–36–5; tail with a dusky lateral streak ending in a large black spot in front of the caudal. Entire back with obscure dark spots.

Curimatus brevipes Eigenmann and Ogle, new species.

Type.—Cat. No. 35333, U.S.N.M. A specimen 131 mm. to base of caudal, Peru?, Orton collection.

Allied to *C. leucostictus*. Head 3.5; depth 3½; D. 12, including the first rudiment; A. 10; scales 8–47–6½ (above ventrals). Heavy, elongate, rhomboidal. Preventral region broadly rounded, without keels and without a median series of scales; postventral region and postdorsal region rounded; predorsal region obscurely ridged; mouth subterminal.

Anterior profile very slightly concave, strongly convex behind the occiput; eye equal to snout, 3¼ in head, 2 in interorbital; scales crenate; caudal apparently entirely naked. Highest dorsal ray probably

little longer than head, less opercle; anal emarginate, its highest ray probably not reaching caudal; ventrals not reaching vent, pectorals

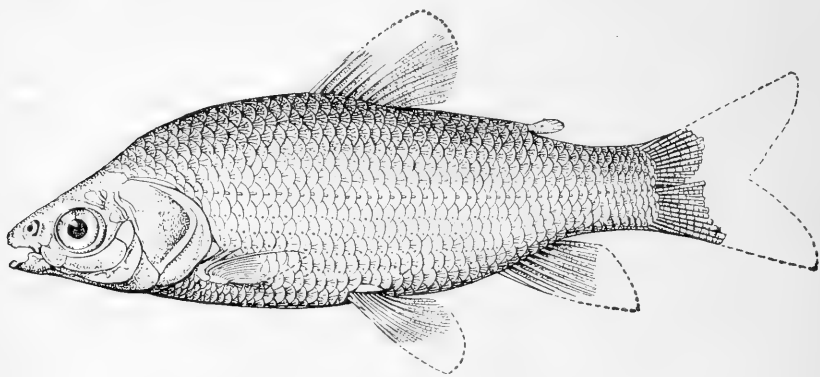


FIG. 1.—*CURIMATUS BREVIPES*.

not to ventrals. Brassy, darker above. No definite spots, distal part of dorsal and a line between every two of the last seven rays, dotted; distal part of anal dotted.

Curimatus leuciscus boliviæ Eigenmann and Ogle, new subspecies.

Type.—Cat. No. 44832, U.S.N.M. One specimen 95 mm. to base of caudal, Bolivia, Gibbon collection.

This variety differs from the typical species in having but 57 scales in the lateral line instead of 60–64, in the absence of a dusky spot at the tip of the occipital process, and by the presence of a dark spot on the seventh dorsal membrane, some distance from its base.

Curimatus knerii Steindachner.

No. 34697. Probably from Para, Brazil, presented by J. C. Brevoort.

Anodus latior Spix.

No. 44836. One specimen, Bolivia, Gibbon collection.

Elopomorphus elongatus (Spix).

No. 5926. One specimen (type of *E. jordani*), Bolivia, Gibbon collection.

Hemiodus othonops Eigenmann and Kennedy.

No. 2103. One specimen, Paraguay, Page collection.

Rhytiodus microlepis Kner.

No. 5876. One specimen, Bolivia, Gibbon collection.

Distichodus fasciolatus Boulenger.

No. 44815. One specimen, Congo, Africa, collected by J. H. Camp.

?*Distichodus brevipinnis* Günther.

No. 52096. One specimen, Nile-Atbara Junction, Senff-Expedition collection, collected by Bashford Dean.

Head $4\frac{2}{3}$; depth $2\frac{2}{3}$; eye 5; D. $21\frac{1}{2}$; A. 15; scales 16–90–14. Lower jaw with about 20 teeth. Distance between dorsals more than twice

the base of adipose; base of dorsal equals length of head. About 12 indistinct cross bands, their lower ends more or less disconnected to form a series of spots below the lateral line, the first spot most prominent and in part on the lateral line.

Prochilodus insignis Schomburgk.

No. 3070. One specimen, Bolivia, Gibbon collection.

Prochilodus vimboides Heckel.

No. 26696. One specimen, Brazil, presented by the Museum of Comparative Zoology.

Prochilodus beani Eigenmann, new species.

Type.—Cat. No. 1662, U.S.N.M. A specimen about 195 mm. long, 153 to end of lateral line. Truando, Colombia, collected by A. Schott.

Cotype.—Cat. No. 1662a, U.S.N.M. A specimen about 195 mm. long, 160 mm. to end of lateral line.



FIG. 2.—PROCHILODUS BEANI.

Allied to *brevis*, *rubrotæniatus*, *cephalotes*, *magdalenæ*, *argenteus*, *platensis*, and *scrofa*.

Head 3.8 in length to end of lateral line (3.6 in cotype); depth $2\frac{5}{8}$ (3); D. 11; A. 11; scales 8-44-7 (8-43-7). Snout slightly projecting; eye about 4 in head, interorbital not quite 2; snout $2\frac{2}{3}$; opercle faintly striate; suborbitals covering about half the cheek; fontanel linear, extending to nares; dorsal inserted over tenth scale of the lateral line, the ventrals below the tenth or eleventh; height of dorsal equals length of head less upper lip, equal to the distance between the dorsals; pectorals reaching ventrals; highest ray of anal reaching tip of last; scales rough.

Dorsal with numerous paired spots before and behind the rays, these more conspicuous backward, sometimes joined into lines, absent from first two or three rays; caudal uniform except for a faint spot at the base of its middle rays; anal and upper surface of pectorals dusky;

faint stripes along the rows of scales; faint dark cross shades. These specimens differ from the specimen of *scrofa* recorded by Eigenmann and Norris from Piracicaba in the number of scales (9-48-8), the height of the dorsal (equals head less snout in front of nares), the extent of the pectorals (to third scale in front of ventrals). There are other minor differences, but the two forms are evidently quite similar. Origin of dorsal over the eleventh scale of the lateral line, origin of ventrals below the fifteenth.

Named for Mr. Barton A. Bean, Assistant Curator, Division of Fishes, United States National Museum.

***Prochilodus scrofa* Steindachner.**

No. 21445. One specimen, Paraguay, Page collection.

No. 1632. One specimen, Paraguay, Page collection.

***Parodon paraguayensis* Eigenmann, new species.**

Parodon affinis EIGENMANN and KENNEDY (not Steindachner), Proc. Acad. Nat. Sci. Phila., 1903, p. 512.

Type.—No. 9953, I. U. Museum, a specimen 18 mm. long to base of caudal. Asuncion, Rio Paraguay. Anisits. 70

Cotypes.—No. 9953a, Museum of Indiana University. Numerous specimens, Asuncion. Also other specimens, Nos. 9952, 9975, and 10237, Indiana University Mus., 35 to 105 mm. to base of caudal, the largest 105 mm., Asuncion; and Cat. No. 1641, U.S.N.M., one specimen 100 mm. to end of lateral line. Paraguay, Captain Page; and Cat. No. 2108, U.S.N.M., 112 and 105 mm. to end of lateral line.

Teeth 2-4, 4-2; head 3.5 to 4; depth 4.33-5.5; D. 11 or 12; A. 8; P. 12; scales 4-42 to 44-4; eye $3\frac{1}{2}$ -4 in head; snout 3; interorbital about equal to snout; width of mandible $5-5\frac{1}{2}$ in the length of the head.

Origin of dorsal equidistant from tip of snout and tip of adipose or a little posterior; height of dorsal equal to head in front of upper angle of gill opening; margin of dorsal obliquely truncate, the highest ray extending beyond tip of last; adipose over anal; ventrals under seventh or eighth dorsal ray, their tips 2 or 3 scales removed from anus; tips of pectorals 4 scales removed from ventrals. Scales highly iridescent; a dark band from tip of snout along lateral line to tip of middle caudal rays, a silvery band below it; back with faint dark cross shades.

***Parodon piracicabæ* Eigenmann, new species.**

Parodon affinis EIGENMANN and NORRIS (not Steindachner), Revista Museum, Paulista, IV, 1900, p. 356.

Type.—No. 9292, Indiana University Museum, 108 mm. to end of lateral line; Piracicaba, von Ihering.

Cotypes.—No. 9292a, Indiana University Museum, 105 and 100 mm. to end of lateral line. Piracicaba. Teeth 2-4, 4-2; head 5; depth $4\frac{1}{2}$; D. 12; A. 8; P. 14; scales 4-41 or 42-3; eye 3.6-4 in head; snout about 3; interorbital about equal to snout; mandibles narrow, the

width of their margin 6 in the length of the head; dorsal and ventral outlines about equally arched.

Origin of dorsal about equidistant from tip of snout and middle of adipose; highest dorsal ray about equal to length of head in front of upper angle of gill opening, its margin obliquely truncate, the longest ray scarcely projecting beyond tip of last ray; origin of ventrals below seventh to ninth dorsal ray, their tips one or two scales from anus; tips of pectorals about 6 scales from ventrals.

A dark stripe from tip of snout along lateral line to end of middle caudal rays, another between first and second scale below dorsal from occiput to adipose dorsal; a silvery band below the lateral band; a dusky spot or two in front of the dorsal; back with faint cross shades.

Anostomus borellii Boulenger.

Anostomus borellii BOULENGER, Boll. Mus. Univ. Torino., XV, 1900 (Carandasiñho, near Corumba).

Anostomus fasciatus EIGENMANN and KENNEDY, Proc. Acad. Nat. Sci. Phila., 1903, p. 512 (Rio Paraguay and Estancia la Armonia). Not of Spix.

Cat. No. 1632, U.S.N.M., 6 specimens, about 125 mm. to end of lateral line, Paraguay, Page collection.

These specimens differ from the type of *A. borellii* in having 9 or 10 anal rays instead of 8.

Anostomus isognathus Kner.

No. 2105. One specimen, Paraguay.

Schizodon fasciatus Spix.

No. 34687. One specimen, Para, Brazil, presented by J. C. Brevoort.

No. 44834. One specimen, Bolivia, Gibbon collection.

Leporinus trifasciatus Steindachner.

No. 4942. One specimen, Uruguay River at Salto, September 17, 1860, Page collection.

No. 1629. One specimen, Paraguay, Page collection.

Leporinus frederici Bloch.

No. 1628. One specimen, Paraguay, Page collection.

Leporinus reinhardti Lütken.

No. 44958, probably one of the types, Lagoa Santa, Brazil.

Leporinus megalepis Günther.

No. 44951. One specimen (one of the types of *L. maregraviæ*), Rio das Velhas, Brazil.

?Leporinus myuscorum Steindachner.

No. 1656. Three specimens, Truando, Colombia, Michler and Schott collection.

D. 12, 12, 13; A. 10; lat. line 39, 40, 41.

Leporinus striatus Kner.

No. 34660. One specimen, presented by J. C. Brevoort (?).

No. 1657. Two specimens, Truando, Colombia, collected by A. Schott.

Leporinus tæniatus Lütken.

No. 44952. One specimen (probably one of the types), Rio das Velhas, Brazil.

Lat. line 37; D. 13; A. 9; head, $4\frac{1}{2}$; depth about $3\frac{3}{4}$; a dark lateral band. Dorsal and anal rounded, the latter reaching caudal. A second specimen, labeled *tæniatus* by Lütken, from Rio das Velhas, Brazil, seems to be distinct.

Lat. line 36, D. 13; A. 11; head 4, depth about 4. No markings apparent; anal and dorsal rounded, the former reaching caudal.

Leporinus paræ Eigenmann, new species.

Type.—Cat. No. 34613, U.S.N.M. Specimen 76 mm. to the end of the lateral line. Para, Brazil. Presented by J. C. Brevoort.

Cotype.—Cat. No. 34613a (part). Specimen 63 mm. to end of the lateral line.

Cotypes.—Cat. No. 34575, two specimens, 126 and 74 mm. to end of the lateral lines, respectively. Presented by J. C. Brevoort.

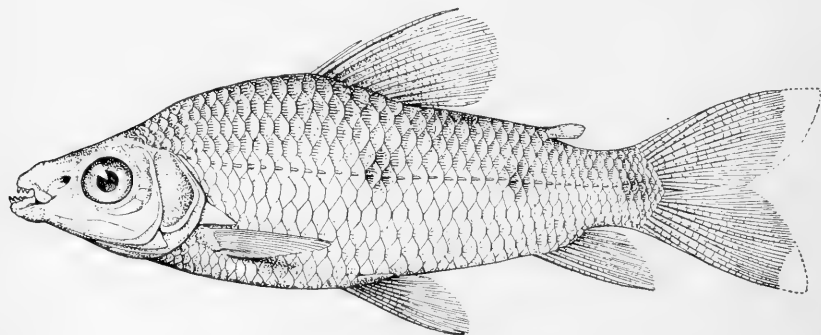


FIG. 3.—LEPORINUS PARÆ.

Allied to *nattereri*, *agassizii*, *megalepis*, and *frederici*.

Head 4; depth 3; D. 12; A. 10 or 11; scales 5–37 to 39–5. Compressed; profile slightly concave over eye, convex from nape to dorsal; basis of dorsal more oblique than the slope posterior to the dorsal; eye $3\frac{2}{3}$ –4; snout 3, interorbital 2–2.25; maxillary groove extending to below the point midway between the nostrils; nostrils close together or more remote, teeth 4–4, rather small but sharp; dorsal and anal rounded, highest anal rays reaching to the caudal, much beyond tips of last ray; highest dorsal ray little less than length of head; caudal short, the upper lobe about equal to the highest dorsal ray; pectorals not reaching ventrals by the length of about 3 scales.

A small dark spot just behind the gill openings and below the lateral line; a dark spot on the lateral line below the dorsal, another on the lateral line in front of the anal, and a third just in front of the caudal; traces of a silvery streak along the lateral line as in *L. nattereri*; lighter lines following the rows of scales, especially below the lateral line; back with faint traces of darker marblings.

Leporinus steindachneri Eigenmann, new specific name.

Leporinus affinis STEINDACHNER, Süßwf. Südöstl. Bras., II, 1875; p. 18, pl. III (Rio Arassuahy, tributary of the Rio Jequitinhonha). Not of Günther.

Characidium fasciatum Reinhardt.

No. 44950, Rio das Velhas, Brazil, Reinhardt collection.

Cheirodon interruptus Jenyns.

A comparison of the specimens recorded by Eigenmann and Kennedy^a as *C. interruptus* and *C. insignis*, with a specimen of *calliurus* from Carandasiño, received from the British Museum, shows them to belong to the same species. It is possible that these are distinct from the *C. interruptus* of Jenyns, but we are unable to point out the differences.

Cheirodon monodon Cope.

No. 11090, Museum of Indiana University, one of the specimens recorded by Eigenmann^b as *Tetragonopterus fasciatus interruptus*, from Rio Grande do Sul, Brazil, seems to belong to this species.

Cheirodon ribeiroi Eigenmann, new species.

Type.—No. 10229, Museum of Indiana University. Specimen 35 mm. to base of caudal. Puerto Max, Paraguay Basin. Collected by J. D. Anisits.

Head 3.4; depth 3; D. 11; A. 26; scales 5–33–4; eye $2\frac{1}{2}$, much larger than in *C. interruptus*, equal to postorbital portion of head, greater than interorbital; fontanels reaching a little beyond middle of eye; teeth black; premaxillary with 4 very broad-tipped teeth, the middle point not much greater than the lateral ones; each ramus of the mandible with 4 teeth (apparently no smaller ones on the sides); maxillary comparatively long and slender, reaching beyond anterior margin of the eye; pectorals reaching ventrals, ventrals not to anal; adipose fin well developed; dorsal behind the ventrals. A black line concurrent with the back from eye to caudal peduncle; a large black humeral spot above the lateral line, just posterior to base of pectorals; caudal spot occupying the entire width of the caudal peduncle. Another much smaller specimen from the Arroyo Pypucu probably belongs to this species. It has one tooth multicuspid in each maxillary.

Named in honor of the naturalist of the Brazilian National Museum, Dr. Alipio de Miranda Ribeiro.

Cheirodon micropterus Eigenmann, new species.

Tetragonopterus bellottii ULREY, in part, Ann. N. Y. Acad. Sci., VIII, 1895, p. 286. Not of Steindachner.

Type.—No. 11092, Museum of Indiana University. Specimen 27 mm. to base of caudal. Santarem, Brazil.

^aProc. Acad. Nat. Sci. Phila., 1903.

^bAnn. N. Y. Acad. Sci., VII, p. 634.

Scales 6-31-4; A. 20; head about 4; depth 3; eye 2.6, twice as long as snout, but very little greater than interorbital; maxillary short, not extending beyond front of eye, with two teeth; mouth small, teeth all broad-tipped and multicuspid, about 5 in each premaxillary, 4 or 5 in each ramus of the lower jaw. Dorsal profile arched; origin of dorsal midway between tip of snout and base of caudal. Pectoral short, just reaching ventral; ventrals not to anal. No humeral spot; a well defined caudal spot not extending to the ends of the middle rays, otherwise plain.

Odontostilbe microcephalus Eigenmann, new species.

Type.—No. 11086, Museum of Indiana University. Specimen 46 mm. in total length, Rio Pilcomayo, Bolivia.

Cotype.—No. 11086a, Museum of Indiana University. Specimen 45 mm. in total length, from the same locality.

Both these specimens were received in exchange from the British Museum, and were labelled *Cheirodon pequirá*. They lack the complete dentition and the peculiar marking of the dorsal of *pequirá*. They seem to represent a new species of *Odontostilbe* in its narrowest sense; that is, the teeth are in a single series, the maxillary has but few teeth, and the lateral line is complete. This species is very nearly allied to if not identical with *fugitiva*.

Head 4.33; depth 4; D. 10; A. 18-20; scales 6-36-5; eye 3 in head, equal to interorbital.

Elongate, slender, the dorsal and ventral profiles very little arched; head very small, slightly convex; frontal fontanel reaching about to middle of eye; mouth small, the maxillary slender, reaching to below margin of eye; teeth broad, many pointed, the middle point prominent, 5 in each premaxillary, 1 on the maxillary and 6 graduated ones on the mandibles; cheeks mailed, a narrow naked area between suborbitals and the vertical limb of the preopercle; origin of dorsal in the middle of the length, behind the base of the ventrals; pectorals not reaching ventrals, ventrals not to anal; caudal much longer than head; lateral line decurved, running below middle of body. A silvery lateral band, a dusky spot at base of caudal.

Aphyocharax rathbuni Eigenmann, new species.

Aphyocharax anisitsi (part), EIGENMANN and KENNEDY, Proc. Acad. Nat. Sci. Phila., 1903, p. 517.

Type.—No. 10025 museum of Indiana University; specimen 26 mm. to base of caudal, Arroyo Chagalalina, Paraguay Basin.

Head 4; depth 3; A. 20; D. 9; scales 5-35-3; eye 3 in head, about twice as long as snout; mouth minute, maxillary not reaching anterior margin of orbit, its free surface very much convex; no teeth on maxillary, about 5 on each premaxillary and about 6 on each side of the lower jaw, the middle one much the largest, the next two graduated, the lateral ones minute; pectorals not quite reaching ventrals, ventrals

not quite to anal; dorsal over posterior third of ventrals. Caudal margin dusky; anal margin to the anterior lobe black, two or three spots continuing the black to the beginning of the second third of the first full-length rays; ventrals dusky; dorsal with its basal half and last rays black; no humeral spot; back peppered, a few large cells on the opercle.

Named in honor of Dr. Richard Rathbun, of the U. S. National Museum.

Aphyocharax stramineus Eigenmann, new species.

Aphyocharax alburnus EIGENMANN and KENNEDY, Proc. Acad. Nat. Sci. Phila., 1903, p. 517. Not of Günther.

Type.—No. 10030. Museum of Indiana University. Specimen 25 mm. to base of caudal, Arroyo Trementina.

Head 4; depth 3; D. 10; A. 19; scales 5–35–3 (to ventrals); eye $2\frac{3}{4}$ in head; snout little more than half the eye in length; dorsal and ventral outlines equally arched; mouth very minute; premaxillary with 7 teeth; maxillary short, its anterior face below the teeth semicircular, about 2 teeth on its upper part; about 9 teeth on each side of the lower jaw; maxillary reaching to below posterior nostrils; pectoral not reaching ventrals by 2 scales; ventrals not to anal; origin of dorsal over last third of ventrals; adipose well developed; no distinct markings on fins. A comparison of this specimen with specimens of *A. alburnus* makes it certain that it is distinct.

Holopristes riddlei Meek, new species.

The two species of *Holopristes* may be distinguished as follows:

- a* Humeral spot surrounded by a bright ring; caudal spot dark brown, fins otherwise plain; a sharp gray line between humeral and caudal spots; caudal partly scaled, the peduncle very slender; dorsal posterior to origin of ventral; 6–8 scales of the lateral line perforate; A. 26–28; head $3\frac{1}{2}$ – $3\frac{2}{3}$; depth $2\frac{2}{3}$ – $2\frac{3}{4}$; scales 5–31– $3\frac{1}{2}$ *ocellifer*.
- aa* A humeral spot, no caudal spot; dorsal, anal, and ventrals each with a conspicuous, jet-black spot; dorsal spot not extending upon the last ray, and leaving base and tips of rays hyaline; anal spot covering the third, fourth, and fifth of the rays forming the anterior lobe; ventral spot leaving the outer and inner rays and bases and tips of all the rays hyaline; head about 4; depth 2.6; scales, 33; A. 21–23; eye 2.64 in head; snout 4.12; maxillary 2.2; pectorals not reaching ventrals, ventrals to anal *a* *riddlei*.

This species is named for Dr. Oscar Riddle, who collected it.

Genus HEMIGRAMMUS Gill.

This genus differs from *Astyanax* only in the incompleteness of its lateral line. One of its species, *inconstans*, here described, varies in this respect, some of the specimens having the lateral line complete.

^a This description is based on a specimen collected by Dr. Oscar Riddle at Los Castillas, Venezuela, and now in the collections of the Field Columbian Museum, Chicago.

others not. Whether some of the specimens of this species examined are simply abnormal variations, whether the species is normally variable in this respect or whether we are dealing here with a mutation in the Devriesian sense still remains to be seen. If the species normally varies in this respect it forms a bridge between *Astyranax* and *Hemigrammus* and the latter must be merged with the former. (A similar condition is found in *Maenkhansia*, one of whose species, *agassizii*, occasionally presents specimens with an incomplete lateral line.) For the present the two genera may be kept distinct. The species of *Hemigrammus* are all small, none of them reaching a length of 4 inches. Most of them are much smaller. They are distributed from Oaxaca, Mexico, to the Rio de la Plata and from Para to the Peruvian and Ecuadorian Amazons. They are not recorded from the Pacific slope. As the species are all small we may expect many additions to the genus. *H. lütkeni*, *H. unilineatus*, *H. gracilis* appear the most widely distributed species, the first being recorded from Rio Grande do Sul and the Paraguay Basin, the second from Trinidad to Bahia and the last from the Rio San Francisco to the Amazons. Of the 19 species I have been able to examine all but *elegans* and *robustus*.

KEY TO THE SPECIES OF THE GENUS HEMIGRAMMUS.

a Scales 30-36.

b Dorsal conspicuously marked with a well-defined black spot; anal with definite markings.

c A deep humeral spot; dorsal almost entirely black, middle caudal rays, last five anal rays and distal two-fifths of the remaining anal rays black; D. 10 or 11; A. 27 or 28; depth $2\frac{3}{5}$ -3; head $3\frac{1}{5}$ - $3\frac{3}{5}$; eye $2\frac{3}{5}$ - $2\frac{1}{2}$; scales 6 or 7-33 or 34-5 or 6, five scales with pores; maxillary with two teeth, each with 3 points of nearly equal length. (Boulenger)..... *callistus* (Boulenger) 1.

cc No humeral or caudal spots; a large black spot on the upper part of the dorsal, sometimes obsolete; a narrow stripe of black from anus along margin to the tip of the first anal rays; head 3.75; depth 2.75; eye 3 in the head; scales 6-34-5; five teeth in maxillary *unilineatus* (Gill), 2.

bb Dorsal without well-defined markings.

d Anal with black markings.

e A milk-white stripe on the fore edge of the anal, and a rather broad violet stripe immediately behind it; a faint lateral band; A. 24; head $3\frac{1}{4}$ - $3\frac{2}{5}$; depth $2\frac{2}{5}$ - $2\frac{3}{5}$; scales 5 or $5\frac{1}{2}$ -30 or 31-4.

elegans, (Steindachner), 3.

dd Anal without definite dark markings.

f No humeral spot, caudal spot usually developed. (See *ulreyi*.)

g Maxillary without teeth; anal rays 17-19; height of anal nearly equal to the length of its base; 4-7 perforated scales in the lateral line; pectoral nearly to ventral; caudal deeply lobed; a large, diffuse, dark caudal spot extends to the end of some of the rays and fades out anteriorly; an inconspicuous silvery lateral band; depth 4; scales $3\frac{1}{2}$ -30 to 32- $2\frac{1}{2}$ *nanus* (Reinhardt), 4.

gg Maxillary with 2-4 conical or 3-pointed teeth.

h No caudal spot, maxillary with two minute conical or slightly notched teeth; dorsal and anal falcate, caudal widely forked;

anal 23-25; a small black humeral spot, a blackish line along the middle of the side and a black line along the base of the anal; dorsal blackish at the end; depth $2\frac{1}{2}$ - $2\frac{3}{4}$; head $3\frac{1}{3}$ - $3\frac{1}{2}$; eye 2 in the head; D. 10; scales 32-33, pores 8 or 9; no maxillary teeth *ulreyi* (Boulenger), 5.

hh Sometimes a caudal spot not extending to the end of the rays, fading out forward; maxillary with two minute conical teeth; a more or less conspicuous silvery lateral band; caudal deeply lobed; dorsal behind the ventrals, the pectorals extending to the ventrals, ventrals to anal; A. 21-24; head $4\frac{1}{4}$; depth 4; scales 5-32 or 33-4, 6-12 scales with pores *gracilis* (Reinhardt), 6.

hhh Maxillary with four conical or notched teeth; no lateral band; a small dark spot at base of each caudal lobe, fins all plain; head 3.85; depth 2.66; D. 9; A. 19... *riddlei* Meek, new species, 7.^a

ggg Maxillary teeth with 4 or more points.

i Maxillary with one 4-pointed tooth; a single median caudal spot continued to end of middle caudal rays; dorsal over ventrals, pectorals not nearly reaching ventrals, ventrals not to anal; a black lateral line; dorsal scales margined with black; head 4; depth 3.2; scales 32, pores developed on 10 scales; A. 24.

micropterus Meek, new species, 8.^b

ii Maxillary with two 5-pointed teeth; a broad black band across base of caudal, extending forward to a blunt point, and backward as three prongs, a short one along the edge of each lobe and a longer one along the middle rays but not reaching the end of the rays; a dark lateral band; no humeral spot; depth 3, head about $3\frac{2}{3}$; eye $2\frac{1}{2}$... *tridens* Eigenmann, new species, 9.

fff Caudal and humeral spots both developed.

j Maxillary teeth conical or 3-pointed.

k Maxillary with one notched and two conical teeth; humeral spot indistinct, small; a small, inconspicuous, silvery-gray lateral band, margined above by a sharp, blue-gray line; a well-defined caudal spot; eye very large, 2 in head; snout $3\frac{1}{2}$; A. 20-23; head $3\frac{2}{3}$; depth 3; scales 5-30 or 31-3, 7-16 scales perforate..... *schmardæ* (Steindachner), 10.

kk Maxillary with one 3-pointed tooth.

l Anal 22; scales about 30; maxillary 2.75 in head; a narrow black lateral line lying deeper than the caudal spot and not continued with it; caudal spot well defined, not quite reaching to end of middle rays; lower half of caudal blackish; basal two-thirds of anal dusky; ventrals reaching past origin of anal; pectorals past base of ventrals.

boulengeri Eigenmann, new species, 11.

ll A. 25-26; scales 33-36; mouth large, maxillary 3 in head, caudal spot rather abruptly continued to the end of the middle caudal rays, gradually narrowed in front into a dark lateral line; lower caudal lobe hyaline; distal third of anal dusky; ventrals to anal, pectorals to origin

^a Based on specimens collected by Dr. O. Riddle at Los Castillas, on the Orinoco, and now in the collections of the Field Museum of Natural History.

^b Based on specimens collected by Dr. Oscar Riddle at Los Castillas, on the Orinoco, and now in the collections of the Indiana University, and of the Field Museum of Natural History.

of ventrals; scales 6-33 to 36-5 or 6; lateral line developed on 10-25 scales.

anisitsi Eigenmann, new species, 12.

kkk Maxillary with 5 small stout teeth; anal rays 27; humeral spot not surrounded by a bright border; a greenish lateral band, humeral and caudal spots indistinct; middle of caudal fin blackish; body brown, muzzle black; maxillary reaching to middle of the pupil; dorsal behind the ventrals; head $3\frac{1}{2}$; depth $2\frac{1}{4}$; eye 3 in the head; scales 7-35-6..... *robustus* Cope, 13.

jj Maxillary teeth multifold.

m Anal 20-22; maxillary 3 in head; eye 3.25 in head, equals interorbital; maxillary with two 3- to 5-pointed teeth; depth 3; head 3.6; scales 5-32-4; pectorals not reaching ventrals... *santa* Eigenmann, new species, 14.^a

mm Anal 24-26; mouth small.

n Maxillary with two broad, 7 or more pointed teeth; eye equals interorbital, 2.75 in head; depth 2.3-2.6 in the length; head 3.7-4.4; scales 30-33; a humeral spot; a distinct silvery lateral band ending in a caudal spot which may or may not be continued to the end of the rays..... *lütkeni* Boulenger, 15.

mmm Maxillary with one very broad-tipped tooth much shorter than eye; A. 24-26; depth 2.6-2.75; head 4; scales 6-32 or 33-5; an obscure humeral spot, an indistinct lateral band; a conspicuous caudal spot which is not continued on the middle caudal rays; fins dusky; lateral line complete or incomplete..... *inconstans*, new species, 16.

fff No caudal spot; maxillary with two minute, conical teeth; the humeral spot intense dark brown surrounded by a bright ring, round or vertically oval; a sharply marked blue-gray line along sides to base of caudal; dorsal behind the ventral; pectorals reaching ventrals, ventrals to anal; eye $2-2\frac{1}{2}$ in head; snout 4; A. 22-24; head $3\frac{1}{2}-3\frac{3}{4}$; depth $3\frac{1}{3}-3\frac{2}{3}$; scales 5-31 or 32-3, 5-7 scales with pores.

bellottii (Steindachner), 17.

ffff No caudal or true humeral spot, a very conspicuous dark lateral band expanded anteriorly and bordered above by a very evident silvery band; anal with the first six rays elongate; maxillary with 4 conical teeth, reaching nearly to the center of the pupil; D. 10; A. 20-23; head $3\frac{1}{2}$; depth 3; eye $2\frac{1}{2}$ in head; lat. line 32-34.

heterorhabdus (Ulrey), 18.

aa Scales 40-48.

o Anal rays 40-46; scales 10-40 to 45-8; head $4\frac{1}{2}$; depth $2\frac{1}{2}$; lateral line with interruptions to the last fourth of the anal; a narrow dusky lateral band; maxillary with one minute, 3-pointed tooth.

kenedyi Eigenmann, 19.

oo Anal rays 25 to 27; scales 45-48; head $3\frac{1}{2}$; depth $2\frac{1}{2}$; D. 11; much compressed; no lateral bands or spots; dorsal with a conspicuous spot on the basal half of the anterior rays; maxillary with 5 notched or conical teeth..... *compressus* Meek, 20.

^aBased on Lütken's *Tetragonopterus interruptus*.

Hemigrammus nanus Lütken.

No. 44958. Four specimens from Lagoa Santa, Brazil, presented by Dr. Chr. Lütken. These are probably some of the types. No maxillary teeth.

Hemigrammus gracilis Lütken.

No. 44959. Four specimens, probably from Lagoa Santa, Brazil, presented by Lütken. A microscopic preparation shows the maxillary to have two conical teeth, scarcely projecting beyond the margin of the jaw.

Hemigrammus micropterus Meek, new species.

Type.—No. 10802. Museum of Indiana University. Specimen thirteen-sixteenths inch long; Los Castillos, Venezuela; Oscar Riddle, collector.

Head 4; depth 3.2; A. 24; scales 4-32-4; maxillary reaching to front of pupil; eye $2\frac{3}{4}$ in head; interorbital about equal to eye; maxillary with a single, 4-pointed tooth. Pectorals reaching within one scale of the ventrals, ventrals not quite to anal; origin of dorsal over origin of ventrals. Scales of the back with rather broad dark margins, a black lateral line, most intense above anal, not quite reaching the caudal spot, which extends to the end of the middle rays.

Hemigrammus tridens Eigenmann, new species.

Type.—No. 11262, Museum of Indiana University. Specimen 20 mm. to base of caudal. Arroyo Pypucu, Paraguay Basin, collected by J. D. Anisits.

Cotype.—No. 11262a, Museum of Indiana University, specimen 18 mm. to base of caudal. Arroyo Pypucu, Paraguay Basin, collected by J. D. Anisits. Head 3.4; depth 3; A. 16-19; lateral line probably between 30 and 35; eye 2.4 in head, considerably longer than the width of the interorbital. Maxillary extending to below eye, nearly to the pupil, with two 5-pointed teeth, the points nearly equal in length; premaxillary teeth with five long points, the middle one much the largest. Origin of dorsal behind the ventrals, about equidistant between base of middle caudal rays and middle of eye. Anal short, its origin about equidistant from base of middle caudal rays and origin of pectorals. Ventrals reaching anal, pectorals not to ventrals. A rather broad, blackish band overlying a deeper black line; a jet-black band across end of tail, continued forward to a blunt median point and backward along the edge of each caudal lobe and along the middle caudal rays, but not to their tips.

Hemigrammus boulengeri Eigenmann, new species.

Tetragonopterus fasciatus interruptus EIGENMANN, part, Ann. N. Y., VII, 1894, p. 634 (Rio Grande do Sul). Not of Lütken.

Type.—No. 11073, Museum of Indiana University. Specimen 36 mm. to base of caudal, 45 over all. Rio Grande do Sul, Brazil, von Ihering.

Head 3.33; depth 2.66; A. about 22; lateral line about 30; eye

2.6 in head; maxillary 2.75; interorbital 2.75. Maxillary with one 3-pointed tooth; ventrals reaching past origin of anal, pectorals past base of ventrals; highest anal ray $1\frac{1}{4}$ in the base of anal. Humeral spot vertically elongate, distinct; a narrow, black lateral line lying deeper than the caudal spot and not connected with it; caudal spot well defined, not quite extending to end of middle rays; lower half of caudal with many pigment cells, blackish, upper half hyaline; basal two-thirds of anal dusky.

Named for Dr. G. A. Boulenger, of the British Museum of Natural History.

Hemigrammus anisitsi Eigenmann, new species.

Hemigrammus lütkeni EIGENMANN and KENNEDY, part, Proc. Acad. Nat. Sci. Phila., 1903, p. 519 (Estancia la Armonia). Not of Boulenger.

Type.—No. 10182, Museum of Indiana University, a specimen 37 mm. long, Villa Rica, J. D. Anisits.

Cotypes.—No. 10182a, three specimens as above.

Cotypes.—No. 9995, Museum of Indiana University. Ten specimens 22 mm. long, Estancia la Armonia, J. D. Anisits.

Head 3.5; depth 2.75; A. 24–26; lateral line 33–36; eye about 2.75 in head, greater than interorbital. Mouth comparatively large, maxillary not nearly reaching to end of first suborbital, about 3 in head, having a single, 3-pointed tooth. Highest anal ray 1.5 in the anal basis; ventrals to anal, pectorals to origin of ventrals; origin of dorsal equidistant from base of middle caudal rays and front of eye. Caudal spot forming a band on the end of the caudal peduncle, faintest above and below, rather *abruptly* continued posteriorly to the end of the middle caudal rays, *gradually* narrowed in front into a dark lateral line; caudal lobes hyaline; humeral spot vertically elongate; *distal* third of anal dusky, basal two-thirds of anterior rays free from pigment.

Named for Prof. J. D. Anisits, of Asuncion, Paraguay.

Hemigrammus santæ Eigenmann, new species.

Tetragonopterus rivularis interrupta LÜTKEN, Velhas-Flodens Fiske, XIII, 1875, p. 215 (Lagoa Santa).

Type.—Cat. No. 55652, U.S.N.M.

A comparison of specimens sent by Doctor Lütken to the National Museum, No. 44960, from Lagoa Santa shows that two of the specimens have a complete lateral line and two have it interrupted. They represent, respectively, Lütken's *fasciatus* and *interruptus*. There is no doubt but that these specimens are specifically and generically distinct. The latter is a *Hemigrammus* and differs, aside from the generic characters, in the proportions and color. In 1894 I recorded specimens of *H. interruptus* from Rio Grande do Sul, Brazil. A reexamination of these in connection with Lütken's specimens shows that they are not specifically identical with Lütken's specimens, and probably represent two distinct species, *boulengeri* and *lütkeni*. Lütken's speci-

mens which may be called *santæ* have the following characters: Depth 2.6; head 3.5; A. 21; eye 3.5, slightly longer than snout; interorbital 3 in head; maxillary slightly longer than interorbital; scales 6-30-3 $\frac{1}{2}$. A second specimen: scales 5-33-3 $\frac{1}{2}$.

Hemigrammus inconstans Eigenmann and Ogle, new species.

Type.—Cat. No. 34591, U.S.N.M., presented by J. C. Brevoort, Para (?), Brazil. One specimen, 44 mm. long to base of caudal (58 over all).

Type.—Cat. No. 55652, U.S.N.M.

Scales 6-32-4 $\frac{1}{2}$; A. 26; lateral line on left $13 + 4 + 2 + 3 + 1 + 7 + 2$, on right $15 + 14 + 4$; one maxillary tooth.

Cotype.—One specimen 39 mm. to base of caudal (50 over all). Scales 6 + 32 + 5; A. 26; lateral line on left $10 + 1 + 2 + 16 + 3$, on right $17 + 2 + 1 + 9 + 3$.

Cotype.—One specimen 45 mm. to base of caudal (about 57 over all). Scales 6 + 32 + 5; A. 26; lateral line complete.



FIG. 4.—HEMIGRAMMUS INCONSTANS.

Cotype.—One specimen 38 mm. to base of caudal (about 51 over all). Scales 6 + 32 + 5; A. 26; lateral line complete.

Cotype.—One specimen 37 mm. to base of caudal (47 over all). Scales 6 + 33 + 5; A. 24; lateral line complete to the last two or three scales, which are without pores.

Depth 2.6-2.75; head about 4; eye equals interorbital, $2\frac{3}{4}$ -3 in head; snout 4 in head; maxillary not reaching to end of first suborbital, much shorter than eye, with a single tooth.

Origin of dorsal behind base of ventrals, pectorals reaching slightly beyond base of ventrals; ventrals nearly or quite to anal. Highly iridescent; an obscure vertical humeral spot, an indistinct lateral band; a conspicuous caudal spot which is not continued on the middle rays. Fins all dusky. This species is evidently very closely related, if not

^aThose in italics with pores.

identical, with Cope's *Astyanax phanicopterus*. There seems no doubt that the five specimens before us belong to the same species, although they do not have the same generic characters. Of the species of *Hemigrammus* it approaches *lütkeni* most closely.

Tetragonopterus argenteus Cuvier.

No. 39403. One specimen, Brazil, collected by H. H. Rusby.

No. 44831. One specimen, Bolivia, Gibbon collection.

No. 1631. Paraguay, Page collection.

Genus ASTYANAX Baird and Girard.

In the difficult and highly interesting group of Characins there is no more difficult nor more highly interesting genus than *Astyanax*. Its divergence toward *Hemigrammus*, which is like an *Astyanax* with an incomplete lateral line, toward *Hemibrycon*, which is like an *Astyanax* with a completely denticulated maxillary, toward *Moenkhausia*, which is like an *Astyanax* with a scaled caudal; and especially toward *Petersius* (which appears to be its African counterpart), together with its universal distribution in tropical and subtropical America, all indicate its central position in the system of Characins. Some of its species are well marked, but for the most part there are groups of species within which the specific characters are not well fixed. The most notable of these groups is that centering in *Astyanax rutilus*. This is a widely variable, universally distributed species, with which throughout its distribution there are allied closely related species. In the south are *theringi*, *fasciatus*, *cuvieri*, and perhaps others. In the north, notably in Central America, Mexico, and Peru, there is an especially trying series of species, varieties, or local forms. It will require much larger series representing a much wider array of localities than are at my command to finally describe the status of these forms. Those of the northernmost localities, north of central Mexico, represented by specimens with a small number of anal rays—from 20 to 25—may readily be set aside as *mexicanus*. From southern Mexico there have been recorded *fasciatus* (= *rutilus*) and *æneus* (Oaxaca). Through the courtesy of Prof. S. E. Meek, I have been able to examine many specimens from Perez, all of which appear to be *æneus*, and others from Montzorongo, some of which are *æneus*, and others with a larger eye and maxillary extending considerably beyond origin of eye may (?) represent *rutilus*.

From the Pacific slope of Guatemala have been recorded *rutilus*, *microphthalmus*, and *humilis*. I am not acquainted with either of the two latter. From the Atlantic slope probably come *rutilus*, *æneus*, and *brevimanus*; the last, a species with few anal rays, is probably a *mexicanus*. From Nicaragua have been recorded *arstedii*, which is not distinguishable from *æneus* or *rutilus*, and *nicaraguensis*, which is distinguished by the increased number of maxillary teeth.

Astyanax cuvieri Lütken.

No. 44961. Rio das Velhas (?), Brazil, Lütken. Two specimens agree with Lütken's (Velhas Flodens Fiske) fig. 13. They are marked *cuvieri*. They differ conspicuously from specimens of *rutilus* from Para and Rio Grande do Sul. In the largest specimen (49 mm. to base of caudal) we have depth 3.33; head 3.66; A. 29; scales 7-37-5; eye 2.5; maxillary long, equal to length of eye; snout 4; interorbital 3.66. Lütken's figure 14 represents a form intermediate between the typical *rutilus* and the specimens at hand.

Astyanax iheringii Boulenger.

No. 39132. La Paz, Montevideo, Uruguay, collected by W. E. Safford.

No. 39147. One specimen, Montevideo, Uruguay, collected by Archavaleta.

Astyanax fasciatus Cuvier.

No. 4889. Museum of Indiana University, Rio Grande do Sul, Brazil. *a* 102 mm. to base of caudal. Depth 2 $\frac{3}{4}$; A. 21; eye 3.6, equal to snout; maxillary longer than eye, 3+ in head; bony interorbital, 2.66 in head; an oval humeral spot.

b 76 mm. to base of caudal. Depth 2.6; A. 24; eye 2.8; snout 4; maxillary about length of eye; bony interorbital 2.8 in head.

c 73 mm. to base of caudal. Depth 2.66; A. 25; eye 2.8; snout 3 $\frac{1}{2}$; maxillary not quite as long as eye; bony interorbital 2.8.

On account of the small eye and wide interorbital the first of these specimens can readily be distinguished from specimens of *A. rutilus*, but otherwise, as stated under *A. rutilus*, there is such an intergrading between the two species that we are very doubtful whether they are distinct.

No. 44960 (part). Lagoa Santa, Brazil. Presented by Dr. Chr. Lütken.

These specimens represent Lütken's *A. rivularis*. They agree very closely with the specimens of *A. fasciatus* from Rio Grande do Sul.

a 70 mm. to base of caudal. Depth 3.25; head 4; A. 21; eye 3.75, equal to snout; interorbital 3 in head; maxillary equal to interorbital. Scales 6-33-3 $\frac{1}{2}$. A second specimen has anal 23; scales 6-36-3.

Astyanax rutilus (Jenyns).

I am not at all sure that *rutilus* and *fasciatus* are distinct species. I have numerous specimens from a variety of localities. In the more southern ones and those along the southeast coast of Brazil there are a few in which the number of anal rays is slightly less than in those from the Paraguay River. In depth there is a wide difference, ranging from the variety *jequitinhonhae*, whose depth is 3 in the length, to specimens from Tieté, in which it is 2.25. In a small specimen, 1 $\frac{1}{2}$ inches, from Piracicaba, the depth is even 4 in the length. The shoul-

der spot differs very widely in distinctness. A similar condition exists at the northern end of the range of this widely distributed species. Specimens from Nicaragua (*arstedtii*) are not distinguishable. A better marked variety is the many-toothed *nicaraguensis*. Still further north comes *xeneus*, and finally *mexicanus*. It will take a large series of specimens to demonstrate the validity of these varieties.

I add details of a number of specimens in the museum of Indiana University and the National Museum.

Specimens collected by John W. Titcomb for the U. S. Fish Commission at Cordova, Argentine, are like those collected by Page in Asuncion, Paraguay.

a 88 mm. to base of caudal. Depth $2\frac{5}{8}$; A. 27; eye 3 in head; maxillary very slightly longer than eye; bony interorbital 8 in head; shoulder spot not evident.

b 94 mm. to base of caudal. Depth 2.8; A. 30; eye 3.2 in head; maxillary equal to eye; bony interorbital 2.9 in head; shoulder spot faint.

c 101 mm. to base of caudal. Depth 2.75; A. 28; eye 3 in head; maxillary equal to eye; bony interorbital 3.2 in head; shoulder spot faint.

No. 9267. Museum of Indiana University. Rio Tieté, Brazil, Von Ihering collection.

a 90 mm. to base of caudal. Depth $2\frac{3}{4}$; A. 27; eye 3; maxillary slightly shorter than eye; snout 3.7; interorbital equal to eye; scales 6-36-6. A very faint humeral spot.

b and *c* are much deeper.

b 97 mm. to base of caudal. Depth 2.25; A. 26; eye 3.1; maxillary equal to eye; snout 4 in head; interorbital 2.8; humeral spot scarcely evident; scales 6-34-5.

c 99 mm. to base of caudal. Depth 2.25; A. 24; eye 3.3; maxillary equal to eye; snout 4 in head; interorbital 2.8; humeral spot scarcely evident; scales 6-34-6.

These specimens are all much deeper than the usual *rutilus*.

No. 10788. Museum of Indiana University. Rio Tieté, Brazil, Von Ihering collection.

a 63 mm. to base of caudal, 78 mm. to tips of caudal. Depth 2.5; A. 23; eye 3; maxillary slightly shorter than eye; snout 4; interorbital equal to eye; scales 5-35-5. A vertical humeral spot; caudal band almost obsolete.

b 48 mm. to base of caudal. Depth 2.66; A. 25; scales 5-35-5.

These specimens are much slenderer than the older ones from the same place. Caudal band reduced to the minimum; shoulder spot well developed.

No. 10786. Museum of Indiana University. Rio Grande, a tributary of the Parana.

117 mm. to base of caudal. Depth 2.66; A. 28; eye 3.1; maxillary equal to snout; snout 3.6; interorbital 2.9; humeral spot faint; scales 6-39-5½.

No. 10787. Museum of Indiana University. Rio Camaguam, Rio Grande do Sul, Brazil.

73 mm. to base of caudal. Depth 2½; A. 30; eye 2.75; maxillary equals four-fifths diameter of eye; interorbital 3 in head; snout 4; humeral spot faint; scales 7-39-6 (4 above ventrals).

No. 9294. Museum of Indiana University. Rio Grande do Sul, Brazil.

This was considered by Eigenmann and Norris to be *scabripinnis*, but may be *fasciatus* or *rutilus*.

Depth 2.6; A. 25; eye 2.5; maxillary three-fourths as long as eye; snout 4; interorbital 3+ in head. Humeral spot faint; scales 7-34-5½.

No. 9285. Museum of Indiana University. Piracicaba. This was considered by Eigenmann and Norris to be *jequitinhonhae*.

a 92 mm. to base of caudal. Very similar to 10787. Depth 2½; A. 30; eye 3, very slightly longer than the maxillary; snout 4.2; interorbital 3.2; humeral spot not evident; scales 6-35-6.

b 95 mm. to base of caudal. Depth 3; A. 29; eye 3, equal to the maxillary; snout 4; interorbital 3.25; no evident humeral spot.

c 41 mm. to base of caudal=new species?. Depth 4; A. 24 at least; eye 3, equal to maxillary in length; snout 3.75; interorbital 3; very faint humeral spot; scales 5-39-4.

No. 9268. Museum of Indiana University. Taubaté.

82 mm. to base of caudal. Depth 2.5; A. 29; eye 3.2, equals length of maxillary; snout 4 in head; bony interorbital 2.6; humeral spot faint; scales 8-39-6.

Anal rays and scales in other specimens in the museum of Indiana University from Paraguay are as follows:

From Asuncion, A. 25-30; scales 5-37 to 38-4.

From Villa Rica, A. 24-27; scales 34 to 35.

From Arroyo Chagalalina, A. 25; scales 36.

From Bahia Negra, A. 26 to 27; scales 35 to 36.

No. 1624. Three specimens, Paraguay, Page collection.

a 93 mm. to base of caudal. Depth 3; A. 30; eye 3 in head, snout 3.66; maxillary equals length of eye; bony interorbital 3+ in head.

b 101 mm. to base of caudal. Depth 3; A. 30 (3+27); eye 3 in head, snout 4; maxillary equals length of eye; bony interorbital, 3½ in head.

c 103 mm. to base of caudal. Depth 3; A. 31; eye 3 in head, snout 3.8; maxillary equals length of eye; bony interorbital, 3+ in head.

No. 3064. One specimen, Paraguay, Page collection. 95 mm. to base of caudal. Depth 2½; A. 30; eye 3 in head, snout 4; maxillary equals length of eye; bony interorbital 3 in head.

No. 34590. Locality probably Para, Brazil, presented by J. C. Brevoort.

a 52 mm. to base of caudal. Depth 2.66; A. 28; eye 2.75, maxillary nearly equals eye; interorbital 3; a faint humeral spot; scales 6-38-7 (5 above ventral).

b 70 mm. to base of caudal. Depth $2\frac{2}{3}$; A. 30; scales 6-37-6.

c 57 mm. to base of caudal. Depth $2\frac{2}{3}$; A. 29; scales 6-39-6.

No. 34589 (part). Para, Brazil, presented by J. C. Brevoort. Three specimens, A. 28, 29, and 29.

No. 8225. Napo or Marañon, Brazil, Orton collection. This specimen is 108 mm. long and is probably the *Astyanax carolinæ* of Gill. The only serious discrepancy seems to be in the length of the maxillary, which Gill says extends to the end of the first suborbital below the vertical from the anterior margin of the pupil.

Length to base of caudal, 85 mm.; depth 32 mm.; head from tip of snout to end of opercle 22 mm.; eye $6\frac{1}{3}$; interorbital 8; A. 26; scales 6-36-5; maxillary reaching beyond origin of eye, not to end of first suborbital; no teeth on maxillary. Caudal spot continued to end of middle rays; humeral spot faint.

No. 1659 (part). Eight specimens, 112-141 mm. long, Truando, Colombia, Michler and Schott collection.

These specimens are in all essential characters *A. rutilus*.

They average larger than specimens from other localities.

a A. 27, D. 10; scales 6-38-5 $\frac{1}{2}$.

b A. 27, D. 11; scales 6-38-6.

c A. 28, D. 11; scales 6-38-5 $\frac{1}{2}$.

d A. 26, D. 11; scales 6-38-5.

e A. 31, D. 12; scales 6-38-5.

f A. 27, D. 11; scales 6-37-5 $\frac{1}{2}$.

g A. 28, D. 10; scales 6-38-5.

h A. 29, D. 11; scales 6-37-5.

The depth ranges from $2\frac{2}{5}$ - $2\frac{2}{3}$; head 4-4 $\frac{1}{3}$; eye 3; maxillary about equal to the eye; interorbital $2\frac{1}{2}$ -3.

No. 32515. Two specimens, Truando (?), Colombia, A. Schott. A. 29-30; scales 6-37-7; 7-37-6. Average number of anal rays of all the Truando specimens 28.3.

No. 19904. Two specimens, 115 and 120 mm. to base of caudal. West coast of Central America. A. 29; scales 7-37-6 to ventrals.

No. 19906. Twenty-three specimens. Central America. A. 28-32.

No. 19913. Central America.

***Astyanax rutilus œrstedii* Lütken.**

Two series of specimens from Nicaragua represent Lütken's species. They are intermediate between typical *rutilus* and *œneus*, and could without violence be placed either with *rutilus* or with *œneus*.

They are as follows:

No. 37828. Nicaragua, Central America, Bransford collection.

Beginning with the largest of the 11 specimens under this number, we have the following:

a A. 29; scales 7-38-6; a humeral spot, a band-like caudal spot; depth $2\frac{5}{6}$.

b A. 31; scales 8-37-7; a humeral spot, a band-like caudal spot; depth $2\frac{3}{4}$.

c A. 32; scales 7-?-?-; a humeral spot, a band-like caudal spot; depth $2\frac{3}{4}$.

d A. 30; scales 7-38-7; a humeral spot, a band-like caudal spot; depth $2\frac{3}{4}$.

The anal rays in detail are one with 27, five with 29, two with 30, one with 31, two with 32; average 29.7. Maxillary usually with 2 teeth, sometimes but one.

No. 39918. Nicaragua, presented by L. F. H. Birt? Eight specimens.

A humeral and a caudal spot, the latter distinct and band-like; scales lost at origin of lateral line, and the count, therefore, uncertain.

A. 30; scales 7-34-6; depth $2\frac{3}{4}$.

A. 28; scales 7-35-6; depth $2\frac{3}{4}$.

A. 28; scales 7-37-6; depth 3.

The anal rays are, one with 27, three with 29, two with 30, two with 31; average, 29.5. Maxillary always with 2 teeth.

Astyanax rutilus nicaraguensis Eigenmann and Ogle, new subspecies.

Type.—Cat. No. 55653, U.S.N.M. From Nicaragua, Bransford collection.

Cotypes.—Several specimens from the same source.

Maxillary slender, having 2-7 teeth, in the latter case the teeth extending along more than half the length of the bone. Of 35 specimens, there are 9 with 2 teeth, 2 with 3 teeth, 5 with 4 teeth, 5 with 5 teeth, 5 with 6 teeth, 5 with 7 teeth, 3 with 8 teeth, and one with 9 teeth on the maxillary.

Three have 27 anal rays, twelve have 28, eight have 29, ten have 30, three have 32; average 29.

It is possible that the specimens with numerous maxillary teeth are all males.

In general characters the specimens agree with the specimens identified as *arstedii*, and those with but two maxillary teeth are indistinguishable from them. The fact that such a large per cent. of specimens have a large number of maxillary teeth entitles them to a separate name.

Astyanax rutilus, variety?

No. 43597. Two specimens. Mexico, presented by A. Dugès.

A. 28; scales 8-37-5; depth 3.

A. 29; scales 7-37-5; depth 3.

In one the interorbital is distinctly less than the diameter of the eye, in the other just equal to it; the maxillary about equal to the eye, which is $2\frac{3}{4}$ in the head. The pectorals extend a little beyond the origin of the ventrals.

These specimens and the next one have much larger eyes than specimens of *æneus* from Mexico. I am not able to say definitely what the name of the variety should be. Specimens collected by Meek at Montzorongo and labeled *æneus* belong in part to *æneus* and in part to this large-eyed variety.

No. 44946. One specimen. Veracruz, Mexico, collected by A. L. Herrera. A caudal band and a humeral spot?

A. 31; scales 8-38-7; depth $2\frac{3}{4}$; eye $2\frac{3}{4}$; maxillary not equal to the eye; interorbital not quite equal to eye; eye $2\frac{3}{4}$ in head.

Astyanax rutilus æneus Günther.

We have been able to examine a very large series of specimens of this species collected by Prof. S. E. Meek in Mexico and by Newton Miller in Guatemala.

No. 10928. Museum of Indiana University. Montzorongo, Mexico; Meek collection.

No. 10929. Museum of Indiana University. Perez, Mexico; Meek collection.

No. 11129. Museum of Indiana University. Sulphur River, $3\frac{1}{2}$ miles west of Puerto Barrios, Guatemala, collected by Newton Miller.

No. 11130. Museum of Indiana University. Rio Motagua at El Rancho, Guatemala.

No. 11131. Museum of Indiana University. Rio Tenedores at Tenedores, Guatemala.

No. 11132 and 11135. Museum of Indiana University. Rio Kilagua at Los Amates, Guatemala.

No. 11133. Museum of Indiana University. Rio Gualan at Gualan, Guatemala.

No. 11134. Museum of Indiana University. Rio Motagua at Gualan, Guatemala.

No. 11136. Museum of Indiana University. Rio Managua at Algeria, Guatemala.

No. 11137. Museum of Indiana University. Brook east of Los Amates, Guatemala.

No. 11138. Museum of Indiana University. Swamp one-half mile east of Los Amates, Guatemala.

Specimens from Guatemala are broader headed than those from Mexico.

I doubt very much whether specimens of *fasciatus* and *mexicanus*, *rutilus*, *arstedii*, and *æneus*, if freshly collected, similarly preserved, and mixed in one heap, could be separated specifically.

Of twenty specimens from No. 11134 selected at random two have 25 anal rays, two have 26, five have 27, six have 28, one has 29, two have 30, and two have 31; average 27.8.

Of twenty specimens from No. 10929 one has 23 rays, three have 25, seven have 26, seven have 27, two have 28; average 26.25.

Of ten specimens from No. 11136 one has 25 anal rays, four have 27, two have 28, three have 29; average 27.8.

It is seen from the above that the Mexican specimens are more nearly like *mexicanus* than the Guatemalan specimens, having 26.25 rays, as compared with 27.8.

***Astyanax mexicanus* (Filippe).**

No. 836. Nineteen specimens, collected by C. B. Kennerly.

No. 869. One specimen, Rio Nueces, Texas, collected by J. D. Graham.

No. 869. Two specimens, Devils River, Texas, collected by J. D. Graham. Type.

No. 870. Eight specimens, Rio Leone, Texas, collected by J. D. Graham. A. 20-24.

No. 871. Three specimens, collected by J. D. Graham.

No. 875. Fourteen specimens, Comanche Springs, Texas, collected by J. D. Graham.

No. 875. Eight specimens, Elm Creek, Texas, collected by J. D. Graham.

No. 876. Twenty-four specimens, Devils River, Texas, collected by J. D. Graham.

No. 877. Twenty-nine specimens, Brownsville, Texas, collected by Captain Van Vliet.

No. 881. Three specimens, Rio Seco, Texas, collected by C. B. Kennerly.

No. 882. Eight specimens, Comanche Spring, Texas, collected by Heermann.

No. 884. Eleven specimens, Caderita, Texas, collected by D. N. Couch. Type. A. 21-24.

No. 885. Five specimens, China, near Leon, Texas, collected by D. N. Couch. Type.

No. 886. Eight specimens, Caderita, near Leon, Texas, collected by D. N. Couch.

No. 8796. Twenty-one specimens. (?) (?)

No. 8969. Twenty-two specimens, Stockton, Texas, collected by P. Duffy.

No. 20095. One specimen, Rio Grande, Texas, collected by J. H. Clarke. Type.

No. 20264. Thirty-four specimens, Matamoras, Texas, collected by L. B. Couch.

No. 34597. Two specimens, Mexico, collected by A. Dugès. A. 27-28.

No. 44641. Five specimens, Las Moras Creek, Texas, collected by E. A. Mearns.

No. 49076. Thirty-five specimens, Fort Clark, Texas, collected by E. A. Mearns.

No. (?). Four specimens, (?) collected by C. B. Kennerly. Type.

No. (?). Six specimens, near Monterey (?), collected by D. N. Couch.

The anal rays in specimens at random from different localities were as follows:

Two have 20 rays; two have 21; ten have 22; seventeen have 23; seventeen have 24; two have 25; average 23.

***Astyanax fischeri* Steindachner.**

Through the courtesy of Prof. C. H. Gilbert I have been able to examine a large number of specimens from the Pacific slope of Panama. These specimens present the following characteristics:

A vertical humeral spot bordered in front and behind by a light area; a second vertical spot behind the light area; a lateral band silvery or plumbeous ending in a caudal spot on the last (5) rows of scales, not continued on the middle caudal rays; caudal and anal narrowly margined with dusky; all markings more or less distinct.

Maxillary with 1 to 3 teeth; eye 3-3.2 in head, 1-1.25 in the inter-orbital, distinctly longer than snout; maxillary equals length of snout. Dorsal behind the ventrals. Head, 4; depth, 2.4-2.7; scales, $6\frac{1}{2}$ -7 $\frac{1}{2}$; 34 to 37-5 $\frac{1}{2}$ to 6 $\frac{1}{2}$; A. 23 to 26.

The scales and anal in a number of specimens are as follows:

Scales 7-37-6; A. 26. Scales 7-36-6; A. 28.

Scales 7-35-6; A. 25; female. Scales 7-37-5; A. 27.

Scales 7-37-6; A. 25.

Scales 7-35-5; A. 27; male. Scales 6-35-5; A. 23.

Scales 7-35-6; A. 25.

Scales 7-35-5; A. 25. Scales 7-36-6; A. 25.

In one small specimen the scales are 7-35-7; A. 27.

One specimen, Panama, presented by Capt. J. M. Dow.

No. 16678. Rio Frijole, Panama, Bransford collection. A. 24-29, usually 25-27.

Nos. 16680, 16681. Empire Station, Panama, Bransford collection. A. 24-27; scales 6 or 7-34 to 37-5.

***Astyanax emperador*, new species.**

Type.—Cat. No. 55651, U.S.N.M. A specimen 52 mm. to base of caudal; Empire Station, Panama.

Cotypes.—No. 55651a, U.S.N.M. Two specimens 37-35 mm. long to base of caudal. Empire Station, Panama, Bransford collection.

Scales 8-45-7; 8-40-6; 8-39-7; A. 29, 28, 29; head 3.6 or 3.5; depth 2.7-3; eye large, 2.8-2.6 in head; interorbital 3.25 in head; maxillary long, equal to eye, having two narrow teeth.

Elongate, body deepest a little behind origin of pectorals; dorsal placed behind the origin of ventrals, its origin equidistant from front of eye and base of middle caudal rays. Highest dorsal ray equal to head without opercle; pectorals reaching ventrals, ventrals to anal.

A faint humeral spot; caudal spot distinct, not reaching end of middle caudal rays. A silvery lateral band.

This species is closely related to *fischeri*, with which the specimens were confounded. They differ in the smaller scales.

***Astyanax bimaculatus* (Linnæus).**

No. 34437. Five specimens, Para, Brazil, presented by J. C. Brevoort.

No. 34453. One specimen, Para, Brazil, presented by J. C. Brevoort.

No. 34591. Five specimens (?), Brazil, presented by J. C. Brevoort.

No. 36764. Five specimens, British Guiana, British Museum.

No. 44957. Four specimens, Lagoa Santo, Brazil, presented by Chr. Lütken.

***Astyanax bimaculatus lineatus* (Perugia).**

Nos. 1621, 1695, and 3065, and one without number; five specimens. Paraguay, collected by Page.

***Astyanax orthodus* Eigenmann, new species.**

Type.—Cat. No. 55655, U.S.N.M. Specimen 92 mm. long to origin of caudal, Truando, Colombia, Michler and Schott, collectors.

This species is identical with *Astyanax bimaculatus* in apparently all characters except the teeth. In *bimaculatus* the teeth of the inner series of the premaxillary are convex behind; the denticles correspond to this convexity and are therefore arranged in a curve. This curve varies from a crescent to U-shape in a specimen from Piracicaba. In *orthodus* the anterior and posterior surfaces of the teeth are alike, the denticles being arranged in nearly a straight line. These species differ, therefore, as *Micralestes* differs from *Myletes*.

Head 4; depth $2\frac{2}{5}$; D. 11; A. 33; scales 6-40-6 above ventrals, 8 above origin of anal. Dorsal and ventral profiles equally curved, the ventral curve continuous, the dorsal profile very slightly concave over the eyes; eye a little more than 3 in the head; interorbital $2\frac{1}{2}$; maxillary distinctly longer than in a specimen of *bimaculatus* of the same size, longer than eye, a little less than 3 in the head; maxillary with a single tooth.

In the position of the dorsal, equidistant from tip of snout and base of upper caudal rays, and the position of the ventrals the specimen agrees exactly with one of *bimaculatus* of equal size from Rio Grande

do Sul. Pectorals reaching to ventrals; ventrals to near anal; anal basis convex; adipose well developed.

A longitudinal oval humeral spot, *not* surrounded by a light area; caudal spot continued to end of middle rays.

***Astyanax abramis* (Jenyns).**

Nos. 1621 and 1622. Two specimens, Paraguay, collected by Page.

***Astyanax stilbe* (Cope).**

No. 34589 (part). Several specimens, probably from Para, presented by J. C. Brevoort.

***Astyanax atratoensis* Eigenmann, new species.**

Type.—Cat. No. 1659, U.S.N.M. Specimen 105 mm. long over all, Truando, Colombia, Michler and Schott, collectors.

Cotypes.—Four specimens, respectively 100, 75, 68, and 68 mm. to base of caudal. The longest specimen was probably over 120 mm. in



FIG. 5.—*ASTYANAX ATRATOENSIS*.

total length. All from Truando, Colombia. Very closely related to its neighbor in the Cauca, *Astyanax caucanus* Steindachner.

It differs from it in the general shape, scales, and the presence of a maxillary tooth. D. I, 10 or 11; A. 38 or 39; scales 8 or 9–36 to 40–10 or 11 to anal, 8 or 9 to the ventrals; depth 2–2.2; head 3.66–4; eye 2.8–3 in head, snout 4; interorbital 2.66.

Much compressed, the postventral surface trenchant; subrhomboidal, the dorsal profile being equally arched with the ventral, the anal basis being nearly parallel with the predorsal profile; profile slightly concave over the eye, nape not sharply convex as in *Tetragonopterus*.

Interorbital distinctly convex, the fontanel extending to over the anterior border of the eye; cheeks entirely covered; mouth moderate, the slender maxillary not extending much, if any, beyond origin of eye; premaxillary with four teeth in the outer row and five in the

inner; inner surface of the inner teeth convex, the points being arranged in a curved line, the middle point distinctly largest; maxillary with one small tooth; cheeks entirely mailed.

Dorsal over the eleventh scale of the lateral line, origin of ventrals under the ninth; dorsal pointed, the anterior rays longest; caudal deeply forked, anal basis long, its origin nearer base of pectorals than to the end of the anal; ventrals nearly reaching anal, pectorals beyond origin of ventrals. Scales regular, cycloid, decreasing regularly in size from the back to the origin of the anal.

Iridescent; a well marked *vertically* oval humeral spot; a silvery lateral band, a small caudal spot, not continued on the middle rays.

Astyanax multiradiatus Eigenmann and Kennedy.

No. 1622 (part). One specimen, Paraguay, Page collection.

Astyanax megalops Eigenmann, new species.

Type.—Cat. No. 5192, Museum of Indiana University. Specimen 42 mm. to base of caudal, Itaituba, Brazil.

Scales 5–35–4; A. 28; depth 2.66; head 3.6; eye 5 in snout, 2.3 in head; interorbital 3 in head; maxillary long, nearly as long as eye, with 3 small teeth. Deepest at origin of dorsal, compressed. Dorsal high, its longest ray longer than head, its origin over base of ventral, much nearer tip of snout than base of caudal; pectorals extending a little beyond base of ventrals; ventrals not to anal. Colors apparently much faded; a conspicuous, well-defined silvery lateral band; traces of a vertical humeral spot; no caudal spot. Related to *A. bahiensis*.

Nannæthiops unitæniatus (Günther).

No. 12679. One specimen, Gaboon River, Africa, presented by the British Museum.

Myletes dentex Linnæus.

No. 52092. One specimen, Atbara River, Egypt, Senff-Expedition collection.

No. 52091. Two specimens, Atbara River, Egypt, Senff-Expedition collection.

Myletes baremose Joannis.

No. 52084. Two specimens, Atbara River, Egypt, Senff-Expedition collection.

Brycinus macrolepidotus Cuvier and Valenciennes.

No. 52085. One specimen, Nile River, Atbara Junction, Egypt, Senff-Expedition collection.

No. 52093. One specimen, Atbara River, Egypt, Senff-Expedition collection.

Brycinus nurse Rüppell.

No. 52089. One specimen, Atbara River, Egypt, Senff-Expedition collection.

No. 52088. One specimen, Atbara River, Egypt, Senff-Expedition collection.

No. 52090. One specimen, Atbara River, Egypt, Senff-Expedition collection.

No. 52086. Two specimens, Atbara River, Egypt, Senff-Expedition collection.

No. 52087. Two specimens, Atbara River, Egypt, Senff-Expedition collection.

Bryconæthiops microstoma Günther.

No. 44814. One specimen, Congo, Africa, collected by J. H. Camp.

PHENACOGRAMMUS^a Eigenmann, new genus.

This genus differs from *Micralestes* as *Hemigrammus* differs from *Astyanax*, and as *Cheirodon* differs from *Odontostilbe*, etc. It is *Micralestes* with an incomplete lateral line.

Type.—*Micralestes interruptus* Boulenger.

Brycon reinhardti Lütken.

No. 44955. One specimen, Rio das Velhas, Brazil, presented by Dr. Chr. Lütken.

Brycon dentex Günther.

No. 39909. One specimen, Nicaragua, collected by L. F. H. Birt.

No. 22154. One specimen, Nicaragua, Bransford collection.

No. 16884. Two specimens, Lake Nicaragua.

Brycon striatulus Kner.

No. 5932. Two specimens in bad condition, Aspinwall, Panama, collected by Russell.

Brycon hilarii (Cuvier and Valenciennes).

No. 1613. One specimen, Paraguay, Page collection.

No. 1614. One specimen, Paraguay, Page collection.

Markiana nigripinnis (Perugia).

No. 1627. One specimen, Paraguay, Page collection.

Gasteropelecus sternicla Linnæus.

No. 34454. Para, Brazil, presented by J. C. Brevoort.

The premaxillary teeth in two of these specimens are strictly in a single series, very regularly arranged and graduated; no teeth in the maxillary. In two others the teeth are crowded, one on each side being forced forward to form an anterior series. There are apparently no maxillary teeth.

No. 1602. Guiana, collected by J. Wyman.

Premaxillary teeth in a single series; no maxillary teeth.

^a From φέναξ, deceptive; and γραμμή, line.

Genus THORACOCHAROX Fowler.

Type.—*Gasteropelecus stellatus* Kner.

In the Proceedings the Academy of National Sciences of Philadelphia (1906, p. 452) Fowler describes this as a new subgenus with the character "anterior profile of back convex." It deserves generic rank with the following characters:

Breast expanded into a large, sharp-edged disk.

Premaxillary teeth in two separate series, the outer series consisting of two teeth on each side; the pair of middle teeth enlarged, between the front and second series of teeth, projecting over the lower jaw when the mouth is closed; maxillary with several large, divergent canine-like teeth.

This genus is like a *Gasteropelecus*, with two series of premaxillary teeth and several canine-like teeth on the maxillary.

Chalcinus angulatus Agassiz.

No. 1616. Two specimens, Paraguay, Page collection.

No. 1696. Two specimens, Paraguay, Page collection.

No. 5558. One specimen, Bolivia, Gibbon collection.

Nos. 34545, 34455, and 34689. Three specimens, Para, Brazil, presented by J. C. Brevoort.

Piabucus melanostomus Holmberg.

No. 2104. One specimen, Paraguay, Page collection.

Piabucina panamensis Gill.

No. 16676 (type). One specimen, Atlantic side of Panama, Bransford collection.

No. 16677 (type). One specimen, Rio Frijoli, Panama, Bransford collection.

Ichthyoborus microlepis Günther.

No. 52083. One specimen, Atbara River, Egypt, Senff-Expedition collection, B. Dean, collector.

Hydrocyon forskalii Cuvier.

No. 52095. Two specimens, Atbara River, Egypt. Senff-Expedition collection.

No. 52094. One specimen, Nile-Atbara Junction, Egypt. Senff-Expedition collection.

Hydrolycus pectoralis Günther.

No. 39402. Brazil, collected by H. H. Rusby.

No. 5686. Bolivia, Gibbon collection.

Rhaphiodon vulpinus Spix.

No. 55667. One specimen, 760 mm., Paraguay, collected by E. Palmer.

Bramocharax bransfordii (Gill).

No. 16885. Three specimens, Lake Nicaragua, Bransford collection.

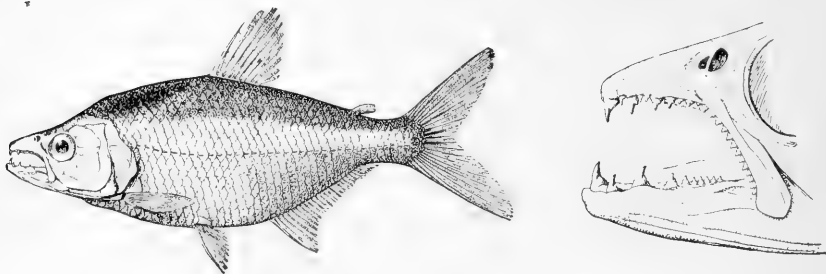


FIG. 6.—BRAMOCHARAX BRANSFORDII.

Ræboides guatemalensis Günther.

No. 39958. Two specimens, Rio San Juan, Nicaragua, collected by T. L. H. Birt.

Ræboides prognathus (Boulenger).

No. 1619 (part). Paraguay, Page collection.

No. 44835 (part). Marmora River, Bolivia, Gibbon collection.

Ræboides myersii Gill.

No. 21426. One specimen, Napo or Marañon River, Brazil, Orton collection (?). One of the types.

Ræboides xenodon Reinhardt.

No. 44962. One specimen, Rio das Velhas, Brazil.

Cynopotamus argenteus Valenciennes.

No. 1619 (part). One specimen, Paraguay, Page collection.

Charax sanguineus (Cope).

No. 8225. Four specimens, Napo and Marañon rivers, Brazil, Orton collection.

Charax gibbosus Linnæus.

No. 1603. One specimen, Guiana, collected by J. Wyman.

No. 1619 (part). Three specimens, Paraguay, Page collection.

Subgenus **CYRTOCHARAX** Fowler.

Type.—*Anacyrtus limæsquamis* Cope.

This is a subgenus of *Charax*, probably synonymous with *Cynopotamus*, and was described by Fowler^a as a new genus with the character "scales rough, very small or about 100 in lateral line. No palatine teeth." It may further be described as compressed, elongate, of moderate depth; dorsal near middle of body over the origin of the long anal; pectoral overlapping ventral; dorsal profile gibbous on occiput, concave in front; mouth large, oblique,

^aProc. Acad. Nat. Sci. Phila., 1906, p. 454.

the maxillary in the adult extending beyond the eye; maxillary with a series of nearly equal, conical teeth; premaxillary with a canine at each end and a double series of small teeth between, of which the inner series is composed of two teeth; mandible with a single series of teeth which are small, conical along the sides and larger on its anterior half, four of which are canines. One of these is near the front, but lateral to the anterior premaxillary canine; another, the smallest of the series, is directed outward more than the rest and nearly half way to the third, which is the largest, received in a groove of the upper jaw in front of the posterior premaxillary canine; the last is about as far back of the posterior premaxillary canine as the last mentioned is in advance of it.

This subgenus includes, besides the type, the *squamatus* Eigenmann and Kennedy, the *caliurus* and *atratoensis* of Eigenmann, and probably the *amazonus* of Günther.

Charax limæsquamis Cope.

No. 44835 (part). One specimen, Marimera River, Bolivia, Gibbons collection.

No. 1694. One specimen, Paraguay, Page collection.

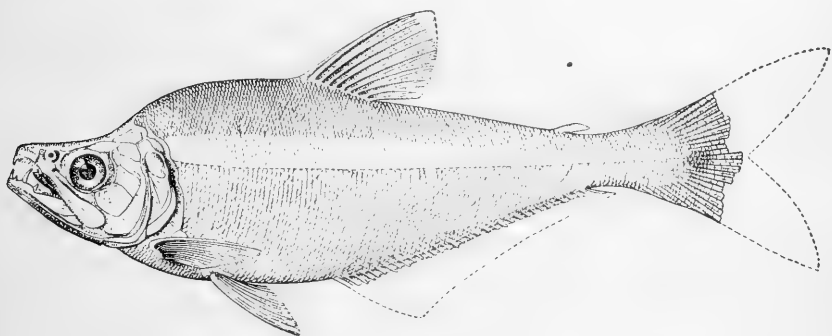


FIG. 7.—CHARAX SQUAMOSUS.

Charax squamosus Eigenmann and Kennedy.

No. 44837. One specimen, La Plata, Argentina, collected by S. S. Brooks.

Charax atratoensis Eigenmann, new species.

Type.—Cat. No. 1664, U.S.N.M. Specimen 300 mm. to end of lateral line, Truando, Colombia, Michler and Schott collection.

Cotype.—No. 1664, U.S.N.M. Specimen 217 mm. to end of lateral line, Truando, Colombia.

This species greatly resembles *Cynopotamus magdalenæ*, but has only a single series of teeth in the lower jaw and the cheeks are not so completely covered by the suborbitals. It is allied to *C. squamosus*,

with a shorter, blunter head, and to *C. limæsquamis*, from which it differs in little but the length of the anal.

D. 11; A. 47-50; head $3\frac{3}{5}$ - $3\frac{5}{7}$; depth a little more or less than 3. Scales 25-110 to 112-25; eye $4\frac{1}{2}$ to 6 in the head; snout $3\frac{1}{2}$ - $3\frac{3}{4}$; inter-orbital 4.

Profile very strongly concave, the occiput greatly arched; distance from tip of snout and tip of maxillary equal to distance from tip of snout through upper margin of eye to edge of preopercle; suborbitals extending back to vertical limb of preopercle, leaving only a small area behind the end of the maxillary exposed; teeth as in other members of the genus.



FIG. 8.—*CHARAX ATRATOENSIS*.

Pectorals extending past middle of ventrals to anal in smaller specimen, not quite so far in the larger. Entire surface of the scales very rough.

A silvery lateral band, a faint humeral spot in the smaller specimen, a large caudal spot, not continued to the end of the rays. Highly iridescent.

***Salminus maxillosus* Cuvier and Valenciennes.**

Nos. 1630 and 1631. Three specimens, Paraguay, Page collection.
***Acestrorhynchus falcatus* (Bloch).**

The species *A. falcatus* was based on a specimen from Surinam with anal rays 26; Müller and Troschel gave the lateral line as 80 and the anal as 30. Cuvier and Valenciennes had 3 (4) specimens, one from Surinam and two from Mana. One (not stated which) had lateral line 80, the others at least 100 “cent vingt” at one place, and “à cent” in another. I have a specimen from Surinam (Cat. No. 24670 U.S.N.M.) Bloch's type locality with lateral line 82-85 and A. 27, which is very probably the *falcatus* of Bloch. This specimen differs notably from other specimens in the Indiana University and National Museum collections, and from the *falcatus* of recent authors, and should be kept distinct from them. It is very probable that the smaller scaled

specimens in my possession, and referred to by recent authors under the name *falcatus*, should be referred to the *ferox* of Günther.

Acestrorhynchus falcirostris (Cuvier).

No. 12712. One specimen.

Acestrorhynchus ferox (Günther).

No. 1639. Two specimens, Paraguay; Page collection.

No. 1640. One specimen, Paraguay; Page collection.

No. 2102. One specimen, Bahia; Page collection.

No. 34464. Two specimens, Para (?), Brazil; presented by E. G. Blackford and J. C. Brevoort.

Nos. 33768 and 33769. Two specimens, Para (?), Brazil; presented by J. C. Brevoort.

Acestrorhynchus lacustris (Lütken).

No. 44963. One specimen, Lagoa Santa, Brazil; presented by Lütken.

? **Acestrorhamphus jenynsii (Günther).**

No. 39141. One specimen, La Paz, Montevideo, Uruguay; collected by W. E. Safford.

Serrasalmo marginatus Valenciennes.

No. 1611. Seven specimens, the largest 225 mm. long.

No. 2112 (part). Paraguay; Page collection.

Serrasalmo brandti Lütken.

No. 44964. One specimen, 217 mm. long, Lagoa Santa, Brazil; presented by Dr. Chr. Lütken.

Serrasalmo spilopleura Kner.

No. 2111. One specimen, Paraguay; Page collection.

Pygocentrus altus Gill.

No. 21432. One specimen, 155 mm. long. Napo or Marañon River, Brazil; Orton collection.

This is probably the type; the species is very close to *P. piraya* if not identical with it.

Pygocentrus nattereri Kner.

No. 1612. Four specimens, Paraguay; Page collection.

No. 5856. One specimen, Brazil; Gibbon collection.

? **Pygocentrus scapularis (Günther).**

No. 33227. One specimen, South America; presented by J. C. Brevoort.

Metynnis hypsauchen (Müller and Troschel).

No. 33772. Five specimens, South America; presented by J. C. Brevoort.

These specimens probably belong to this species. They have D. 16, 16, 17, 18, and 18; A. 39, 39, 40, 40, 43; abdominal serræ 34, 38, 39,

39, 40; depth about 1.25. Adipose at least equal to its distance from the dorsal, two-thirds or three-fourths as long as the dorsal.

? No. 3071. One specimen (in too poor condition for satisfactory examination), Trinidad, Bolivia.

Myleus levis Eigenmann and McAtee.

No. 1613. One specimen, Paragua; Page collection. D. 29; A. 38; abdominal serræ 38+9.

Mylossoma albiscopis (Cope).

No. 5888. Two specimens, Paraguay.

? **Piaractus brachypomus** Cuvier.

No. 26462. One specimen skin, about 550 mm. long, Paraguay; Page collection.

This specimen and one in the museum of Indiana University, 540 mm. long, lack an adipose. D. 16; A. 24; abdominal serræ 54+6; gill-rakers about half the length of the eye.

Sarcodaces odoe Bloch.

No. 44824. Several specimens in bad condition, Leopoldville, Africa.

Hoplias malabaricus Bloch.

No. 26695. Two specimens, Brazil; presented by the Museum of Comparative Zoology.

No. 34432. Two specimens, South America; presented by J. C. Brevoort.

No. 34696. One specimen; presented by J. C. Brevoort.

No. 6033. Two specimens, Island of Trinidad; collected by Th. Gill.

No. 1663. One specimen, Truando, Colombia; Michler and Schott collection.

No. 44959. One specimen, Lagoa Santa, Brazil; presented by Chr. Lütken.

Hoplerythrinus "unitæniatus" Spix.

No. 33764. Three specimens, South America; presented by J. C. Brevoort.

No. 5882. One specimen, Island of Trinidad; collected by Th. Gill.

^aThe genus *Ophiocephalops* recently proposed by Fowler is a synonym of *Hoplerythrinus*.

DESCRIPTIONS OF NEW SPECIES OF UPPER PALEOZOIC FOSSILS FROM CHINA.

By GEORGE H. GIRTY,

Custodian of Carboniferous Invertebrate Fossils, United States National Museum.

The Carnegie Expedition to China, in charge of Mr. Bailey Willis, obtained a small number of Carboniferous fossils, which were placed in my hands for study. My report was finished over a year ago, but the publication of the paleontologic results has been held up for the completion of another portion of the investigation. As an indefinite, perhaps a long, time may elapse before the full report passes the press, it seemed desirable to fix such species as appeared to be new by a preliminary publication of the descriptions, to be followed by the reprint with illustrations in the final report.

CŒLEENTERATA.

LONSDALEIA CHINENSIS, new species.

Description.—This species occurs in large masses, one fragmentary specimen having a length of 18 mm. and a width somewhat greater. The corallites are irregularly polygonal, so that it is difficult to name an average size, unusual length in one direction being compensated by narrowness in another. Perhaps 8 mm. represents the average in nearly symmetrical corallites.

Our specimens do not separate into constituent cells, but break across the walls. In sections the latter appear to be rather thick, with denticles projecting inward from both sides, and a dense median line.

Structurally each corallite is made up of three zones inclosed within an outer wall. The external zone consists of vesicles without septa, the median of septa and tabulæ, while the center is occupied by a pseudocolumella having a vesicular structure. The outer zone, which is rather thick, is formed by large cysts, which, as usual, present the convex side upward and slope strongly downward toward the center. The inner surface of this zone is well marked. The septate portion is

clearly defined, and has a nearly circular shape, irrespective of the asymmetry of the corallite as a whole. This portion is rather constant in size, and in few instances does it attain a diameter of more than 4 mm. The septa, which number from 25 to 27, are irregular. They are often alternately long and short, but in parts of the same corallite may be equal, or in appearance replaced by vesicular tissue. Not infrequently one of the smaller (secondary) septa is seen to bend to one side and to become confluent with a primary one. The interseptal loculi are rather abundantly partitioned by what in cross sections looks like dissepimental tissue, but in reality has more the nature of nearly flat horizontal tabulæ. As previously remarked, the septa are often so contorted that they can not be distinguished from the interseptal plates with which they intersect.

The pseudocolumella, which occupies the central area, is fairly distinct from the surrounding structures and consists of relatively small concentrically arranged cysts, which are nearly vertical in position, but with the upper end distinctly inclined toward the center. The ends of the septa reach nearly or quite to the pseudocolumella, and some of them appear to connect with the plates which compose it.

As members of the genus *Lithostrotion*, Lonsdale described and figured a number of *Lonsdaleias* from Uralian Russia, some of which may be related to the form under consideration. Lonsdale discriminated his species upon characters which are not shown in ordinary conditions of preservation, not, for instance, in the Chinese material, and at the same time failed to give precise data regarding features which I was able to ascertain. On this account a satisfactory comparison of the present form with his species can not be made. It seems to be distinct from the American and European types whose descriptions I have seen. No species belonging to the genus has as yet been described from China.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssī-ch'uan (Stations 1 and 2).

MICHELINEA FAVOSITOIDES, new species.

Of this species our collection contains a single specimen, which presents the following characters:

Description.—The shape appears to have been hemispherical, with a flat base and a width greater than the height. The latter dimension is estimated at about 40 mm., and the entire width at about 80 mm. The corallites are rather regular in size and shape, and usually small, few of them attaining a diameter of $2\frac{1}{2}$ mm. The septa are closely approximate, 11 to 13 occurring in the space of 5 mm. They are on the whole rather regular, but are distinctly convex and not infrequently confluent. Mural pores appear to be present, but, as shown

in transverse sections, they are rather rare and their arrangement has not been determined.

Any statement as to septa depends upon the interpretation of certain appearances in thin sections. The bounding walls are not thick and show a dense median line, which is usually more or less wavy. On either side of the median line is a tolerably thick layer, intermediate in transparency between the material filling the intertabular spaces and that of the median plate. The inner edge of this supplementary wall is somewhat strongly denticulate, the projections being in some places rather regular and in other portions of the same corallite absent or irregular. Whether these projections are really denticles or are continuous ridges has not been ascertained. The tabulæ show the same degree of transparency as the supplementary wall, the projections of which can apparently with justification be interpreted as pseudosepta, the dense median line being the plane of cleavage separating the truly double-walled corallities. It is hardly possible to count the pseudosepta or to ascertain the average number present.

At first sight one might well feel somewhat doubtful where to place this species, whether in *Favosites* or *Michelinea*, the unusually small size of the corallites certainly suggesting the former genus, as well as the mural pores, which appear to be rather rare. Some support might also be found in the character of the tabulæ, which, if they are somewhat too convex, too irregular, and too confluent for *Favosites*, possess these features in too slight a degree for typical *Michelinea*. On the other hand, the somewhat fluted condition of the median plate, which may be connected with the development of pseudosepta, together with the apparent presence of well-developed pseudosepta themselves, seem to distinguish it structurally from *Favosites*. The range of the latter genus, furthermore, appears to terminate with horizons early in the Mississippian, while the present form is of much later occurrence. *Michelinea*, on the other hand, is already known in upper Carboniferous and Permian (?) terrains. On this account it has seemed that the form under consideration should be denied to *Favosites* and placed with *Michelinea*.

Kayser figures an unidentified species of *Michelinea* from China which differs from the present one in the much greater size of the corallites. By the same character *Michelinea favositoides* may be distinguished from other members of the genus known to me, even from the small-celled Russian species *M. concinna* Lonsdale.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssī-ch'uan (Station 3).

CARNEGIA, new genus.

The characters of this genus are included in the diagnosis of the type species as given below:

Type of the genus.—*Carnegiei bassleri*.

CARNEGIA BASSLERI,^a new species.

This name is introduced for what appears to be a new genus of Stomatoporoid corals. Until Waagen and Wentzel described some forms from the Salt Range of India the known occurrence of this group would have warranted the statement that it passed out of existence before the commencement of Carboniferous time. The discovery of a different but related type in an area so close geographically, and in strata of such similar age as are those of India and China, is thus deprived of most of its surprise. The Chinese form possesses characters which forbid joining it with any of the established genera whose descriptions have been before me, and it represents, with little doubt, a new genus. On the other hand, as but a single specimen is known, and as in this group, more than in many others, the difficulty is great of distinguishing between specific and generic characters without the comparisons which several generically related species afford, I have adopted the plan of including the genus and species in a single description.

Description.—The growth of *Carnegiei bassleri* is in small lenticular masses, having a slight thickness relative to their spread. One example, for instance, has a thickness of but 4 mm. and a diameter of 35 mm. The structure is fine and dense, and seems to be entirely without the lamellate appearance which gives this group its name.

In transverse section the cœnosteum is seen to be made up of walls and apertures, both possessing a very irregular and tortuous pattern. The walls are especially vermicular and inosculating, giving off disconnected spurs and dividing the inclosed space into small separate apertures. The entire course of the walls seems to be made up of curves, and the outlines of the apertures are of course correspondingly curvilinear. The walls are relatively thick, and where projecting spurs are given off these often appear to be rounded and enlarged at the disconnected end, as if terminating in a pillar. Similar enlargements can be observed also in other portions of the walls. The zooidal apertures are nearly equal in size, and the whole structure seems to be quite regular, but not infrequently several of the apertures are confluent, although the larger one thus formed is so tortuous that it fails to have this appearance in the *tout ensemble* of the section. Astrorhizæ appear to be entirely absent.

In longitudinal section the skeleton is seen to be composed of continuous zooidal tubes and continuous walls, the latter being, as already

^aThis species is named after Mr. R. S. Bassler.

shown in transverse section, relatively thick. The zooidal tubes are rather closely tabulate, and the walls are perforated. The perforations are of unequal sizes and irregular distribution. It is without doubt owing to these interruptions in the radial walls that in cross section two or more of the zooidal tubes appear to be connected into a single large vermicular one. Sometimes, owing perhaps to the influence of tabulæ and porous developments, the walls in longitudinal section have a nodose appearance, somewhat as in *Stenopora*. Of course the two genera are otherwise widely different and have different affinities.

In the lower part of the cœnosteum the zooidal tubes are narrow and bent inward toward the point of origin, as in colonies of compound corals and bryozoans. In this region the walls are thin and the pores and tabulæ much less plentiful.

This form appears to be but distantly related to those described from the Salt Range of India, and it presents more structural affinities with the older genus *Stromatopora*. From this, however, it is clearly distinguished by the pattern of the apertures and by the absence of astrorhizæ and of latilaminæ. The zooidal tubes and bounding walls are much more continuously and regularly developed and the walls themselves apparently somewhat different in construction. They appear to be dense, and but for the local thickening, which may represent radial pillars, structureless. *Carnegiea* seems to belong to the Stromatoporidæ, but to be distinctly different from any of the genera at present assigned to that family.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Liang-ho-k'ou, East Ssi-ch'uan (Station 7).

BRYOZOA.

FISTULIPORA WILLISIANA,^a new species.

Description.—This species grows in thin, epithecate expansions, occurring in considerable numbers in the limestone of which it appears to constitute a paleontologic feature of some importance. The largest fragment seen measures 15 mm., but the original size may have been considerably greater. The thickness of the typical specimen is but little over one-half mm. The growth is irregular and contorted. Maculæ are present, but their size and distribution have not been determined. The zoœcia are quite small; they occur six or seven in a distance of 2 mm., and are situated at intervals of about one or two times their own diameter. A lunarium is well developed. Mesopores are usually large and, as a rule, separate the zoœcia in single rows. They are about the size of the zoœcia themselves, and in some cases are even larger.

^aThis species is named for Mr. Bailey Willis.

This species is distinguished by its thin, lamellate growth and by the small size of the zoecial tubes.

Locality and horizon.—Pre-Pennsylvanian (?); near Ta-miau-ssī, East Ssī-chu'an (Stations 6, 8, and 9).

GEINITZELLA CHINENSIS, new species.

Description.—The growth of this species is dendroid, specimens occurring in long cylindrical trunks, from which, in some instances, spring smaller branches. All the specimens examined are fragmentary, the largest having a length of 110 mm. They vary much in point of size. The largest yet noted has a diameter of 17 mm., but the average is nearer 15 mm. In some specimens low monticules, more or less distinctly elongated in a transverse direction, form a noticeable feature, which may have been present in all. The mature region, where the cells had a horizontal direction, measures 4 mm. in a large example.

In thin sections the species shows the usual structural variation where different stages of development are examined. From seven to eight cells occur in a linear distance of 2 mm. The acanthopores are large, and vary greatly in number and appearance in sections made at different points of the same zoarium. In longitudinal section a few scattered diaphragms occur just before the cells thicken their walls and bend into a horizontal direction.

This species is closely related to *Geinitzella columnaris* Schlotheim, as identified by Waagen and Wentzel in India, but it hardly seems that the Chinese form can be immediately placed with that species. Waagen and Wentzel state that *G. columnaris* rarely attains a size of 5 mm., and that a diameter of but 2 mm. is often met with. The Chinese form is thus seen to be at least three times as large. So far as observed also, it is never incrusting, a mode of growth which the Indian form is said to exhibit. In thin sections, however, the two species are extremely similar. One distinction which appears to exist is that the cells are a little larger in the Chinese form. Waagen and Wentzel do not state this character in their description, and certain discrepancies which appear to exist between different degrees of magnification said to be represented by their figures, make it impossible to obtain altogether reliable measurements from that source. Apparently *G. columnaris* presents nine or ten cells in 2 mm. The presence or absence of tabulae is not stated in the text of their description, but none are represented in their figures. The Chinese form certainly possesses tabulae, and it seems likely that they will also be found in that from India.

With the differences above noted it seems inadvisable to refer the Chinese form to *G. columnaris*, though it is possible that it will prove

no more than a variety, better marked, however, than any of the varieties recognized by Waagen and Wentzel.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssi-ch'uan (Stations 1 and 4).

BATOSTOMELLA MEEKANA,^a new species.

This form has not been found free, and the following description has been drawn up from thin sections. It evidently occurs as cylindrical, probably branching, stems, of which some grow to a diameter of 4 mm., while others were only about 3 mm. thick.

Description.—The cells are slightly oval in outline, one diameter being a little greater than the other. In the mature region they are separated by intervals about equal to one-half their own diameter, and number about five in 2 mm. longitudinally. The acanthopore-like granules are relatively few, and as a very prevalent rule occur in single rows between the apertures. On the average about eight surround each cell, but as they vary greatly in distribution sometimes more (as many as 12 and 13) and sometimes less can be counted. They are also very irregular in point of size, some having a diameter twice or even three or four times as great as others. Very often they appear to be in two well-marked grades of size, but sometimes another intermediate grade can be recognized, and it seems likely that there is no absolute classification to which they can be reduced in this respect. While in a general way the large and small granules appear to be regularly distributed, no definite system or arrangement can be made out. In sections longitudinal to the tubes, the thickened or mature region is quite shallow, about twice the width of the apertures. The latter, however, here appear of much smaller diameter than in the transverse section, being only about half as wide as the intercellular granuliferous spaces, which therefore present nearly square areas in thin sections cut longitudinally.

This form is structurally very closely related to *Rhombopora lepidodendroides*, but is clearly distinct from that widely distributed American species. Kayser identified *Rhombopora lepidodendroides* in the Lo Ping fauna. From this *Batostomella meekana* seems to be distinct, as it without much question is if the Lo Ping form is correctly identified. Of the two species of *Rhombopora* described by Waagen, from India, it may be distinguished from *R. polyporata* by the much smaller number of granules. Though more similar to *R. obliqua*, it also differs in several particulars. It is a more robust form. The cells are more nearly circular and apparently of larger size, since, according to Waagen's figure, only about three occur longitudinally in 2 mm. Furthermore, Waagen states that the granules are all of a size

^aThis species is named for Mr. F. B. Meek.

in his species, which is conspicuously not the case in the one under consideration.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssī-ch'uan (Station 4).

FISTULIPORA WAAGENIANA,^a new species.

Description.—Of this species our collection contains but one specimen, which displays the following characters: The form is that of a hollow cylinder, the diameter of which is 25 mm., the length of the fragment being 45 mm. The thickness of the zoarium varies somewhat, but has an average of about 5 mm. It can not be determined whether the original shape was incrusting, hollow cylindrical, or solid cylindrical. So far as can be observed, there is no epitheca upon the inner surface, nor is there any flexing of the cells toward a point of origin. From this circumstance it can perhaps be inferred that the original form was a solid cylinder, of which the axial portion, including the immature region of the cells, has by some means been destroyed.

In thin sections the zœcial tubes are seen to occur about four in the space of 2 mm. Their distribution, however, is quite irregular. They have very thick walls, which in some cases are almost in contact and in others are separated by distances equal to about the inner diameter of the tubes. In the region of maculae their distance is sometimes two or three times the diameter. The cells are of course nearly circular, and as a rule separated by rather large mesopores in single rows. Near the surface the spongy tissue of the mesopores gives place to solid investment, in which, though the inner portion of the tubes has still a circular section, the outer boundary, more or less clearly shown, is sharply polygonal. A lunarium is as a rule entirely absent, but in rare cases indistinct but certain traces of the structure can be observed. It is also more or less regularly developed in young stages. Tabulae are rather few and distant, and they are developed at very irregular intervals. The vesicles observed in longitudinal sections vary greatly in size. As a rule they are but gently convex, the upper and lower surfaces often being nearly flat and parallel.

This species is clearly distinct from American forms of similar geologic age, and also from *F. parasitica*, the only species described by Waagen and Wentzel from the Salt Range. It is also very distinct from *F. tuberosa*, a member of the Lo Ping fauna described by Kayser.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssī-ch'uan (Station 2).

^a This species is named for Mr. William Waagen.

BRACHIOPODA.

SPIRIFER BLACKWELDERI,^a new species.

This form has been obtained at two localities, and occurs in considerable abundance in the shape of casts of separate valves. The following characters have been observed:

Description.—The shape of the ventral valve is subquadrate. The convexity is high, the beak large, erect, gibbous. The area is well defined, high, and concave. The foramen is large, its width at the base being almost one-third that of the whole area. The cardinal angles are rounded and the cardinal line considerably shorter than the greatest width. A narrow and moderately deep sinus traverses the shell, becoming gradually broader and less well defined toward the front. The sinus is not divided by plications, nor do any ribs mark the sides. On the interior there are two strong dental plates, but no septum.

The dorsal valve is transversely subelliptical in outline. The cardinal extremities are rounded, and the hinge line is shorter than the greatest width. The beak is small and depressed. A moderately high, rather well-defined mesial fold passes downward, gradually widening in its course.

The surface lacks ribs either upon the sides or on the fold and sinus, but is marked by very fine radiating striae.

I know of no Carboniferous species which really requires comparison with the present. In general appearance it suggests a *Reticularia*, such as *R. lineata*, but the fine, continuous, liræ can hardly be interpreted as marks left by the spines which characterize that group.

The development of fine subsidiary liræ seems to be a much more common feature in the English *Reticularias* (see *R. lineata* var. *reticulata*), judging from Davidson's description and figures, than in the American, where it is essentially unknown. We have at least one, though a little known, form possessing this character, which was apparently described by Swallow as *Spirigera prouti*. I am not prepared to speak positively as to the internal structure of this type, but dental plates and septa seem to be absent or but slightly developed. In the American *Reticularias* (*R. pseudolineata*, etc.), and I suppose in the European ones, there is a median septum in both valves, while the ventral valve possesses long dental plates as well. The Chinese shell thus differs in structure from the *lineatus* group of *Spirifers*, although it shows some points of superficial resemblance.

S. blackwelderi differs from *S. lineatus* as identified by Kayser from Chinese specimens, as well as from any other Chinese species identified or described by him, nor can it be found among the shells de-

^aThis species is named for Mr. Eliot Blackwelder.

scribed by Waagen from India or by Tschernyschew from Russia. In fact, closer parallels can be drawn with certain Silurian forms, such as *Spirifer radiatus*, than with those usually found in the Carboniferous. In the *radiatus* group, as in *S. blackwelderi*, the ventral valve possesses dental plates, but while socket plates, and sometimes a low septum, are found in the dorsal valve of the former, that of *S. blackwelderi* appears to be without those structures.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hién, East Ssi-ch'uan (Stations 1 and 2).

NOTOTHYRIS WILLISIANA,^a new species.

Description.—Shell small, subspherical. Ventral valve subovate, gibbous, rapidly and rather suddenly contracting at the beak, which is strongly deflected and truncated by a relatively large foramen. Toward the front this valve is marked by a narrow, moderately strong but shallow sinus extending about half the length. There should be other modifications of the mesial portion to correspond with the plications on the accompanying valve, but if present they are obscured in the typical specimen. On each side of the sinus traces of some six or seven ribs are found. Only about four of these are developed as plications on the shell, the remainder appearing on the margin, as denticulations. Even these four, however, are obscure, and decrease in intensity in proportion to their distance from the sinus.

The dorsal valve is subcircular in outline, highly gibbous. Beak small, pointed, slightly prominent. There is a strong, deep, ill-defined mesial sinus, which projects in front as a sort of linguiform extension corresponding to a deep emargination of the front of the opposite valve. The sinus, which dies out long before reaching the hinge line, is subdivided by a strong mesial fold, extending about as far from the edge as the sinus itself, and each of the two channels thus formed is apparently again subdivided by an obscure plication limited to the marginal region. On each side of the sinus there are about six plications, shown rather by denticulations at the edge of the shell than by folds upon its surface.

Internal structure unknown. Shell strongly and finely punctate.

As only a single specimen of this form was found, it was impracticable to mutilate it for the purpose of ascertaining its internal structures; therefore the generic position of the species is somewhat conjectural. The shell structure and configuration consigned it at once to the Terebratulidæ, and in the character last mentioned it much more closely resembles the genera *Notothyris* and *Hemiptychina* than the plicated *Diclasmas*. It is somewhat uncertain whether this fossil should be regarded as having a dorsal sinus in which a mesial rib has been

^aThis species is named for Mr. Bailey Willis.

developed, or a dorsal fold with two deep channels upon its sides, but the former interpretation seems to be more natural. Upon that view the species under consideration would be one of the *antiplicatæ*, and its generic position would be with *Notothyris* in preference to *Hemiptychina*. On one side of the specimen may be noticed an appearance similar to that often observed in *Diclasma* when fracture or cleavage takes place along the dental plates, but in the present case this may be due to exfoliation of the thick shell. Of course the presence of dental plates would debar this form from *Notothyris* and *Hemiptychina* alike.

In its specific relations this form differs sufficiently from any of the species whose descriptions have come into my hands to make a detailed comparison unnecessary. It is perhaps as near to *N. inflata* Waagen and *N. djoulfensis* Abich as any.

Locality and horizon—Pennsylvanian (Wu-shan limestone), near Liang-ho-k'ou, East Ssī-ch'uan (Station 7).

PELECYPODA.

AVICULIPECTEN? RICHTHOFENI,^a new species.

Description.—What appears to be the left valve of this species presents the following characters: Size small, general shape semielliptical, slightly inclined backward. Length and breadth approximately equal. Hinge line nearly as broad as the greatest width. Outline somewhat retracted below the ill-defined wings, but spreading again, and with the sides and front broadly rounded.

The surface is marked by angular ribs situated at relatively wide intervals. The flat interspaces are marked by very fine radiating liræ. New ribs are introduced interstitially, probably by the enlargement of one of the liræ. The whole is crossed by fine, somewhat lamellose concentric liræ.

A shell supposed to represent the left valve has an outline similar to that of the right, but of course is inclined in an apparently opposite direction. There is no byssal sinus, and the broad wings are undefined. The convexity is a little lower than that of the right valve, and the beak less prominent.

The surface is without ribs or radial marking, and is in fact nearly smooth, showing only delicate, somewhat unequal and irregular concentric lines.

This species is represented in our collections by a number of right valves and only two left valves. All the larger examples of the right valve are imperfect, so that measurements can not be made, but the length indicated is certainly less than 15 mm. The large specimens,

^a This species is named for Baron von Richthofen.

so far as one can be told, do not differ, except in size, from the smaller ones.

It can not be definitely stated that the flatter and nearly smooth shell here described as the right valve of the species really had that relation. The correspondence in size and shape, however, and occurrence in the same beds render this interpretation quite probable. If so, however, it is certain that the form under consideration is not an *Ariculipecten*, since a byssal sinus, which is well developed in that genus, is here inconspicuous or absent.

In shape and sculpture this form recalls to a certain extent some of the Russian species of *Avicula*. *A. kazànensis* De Verneuil, of the Russian Permian, is perhaps the nearest of these, though it is still considerably different. *Avicula elegantula* Stuckenburg, of the Gschelian, is still more different.

Locality and horizon.—Post-Pennsylvanian (?) (Kui-chóu series); near Ta-ning-hien, East Ssī-ch'uan (Station 5).

THE HOLOTHURIANS OF THE NORTH PACIFIC COAST
OF NORTH AMERICA COLLECTED BY THE ALBATROSS
IN 1903.

By CHARLES LINCOLN EDWARDS,
Of Trinity College, Hartford, Connecticut.

This paper is based on a collection of Holothurians made by the Bureau of Fisheries steamer *Albatross* along the north Pacific coast of North America during the Alaska salmon investigations of 1903. The collection contains eleven species, one of which, *Chiridota albatrossii*, is a new form. The specimens have been added to the general collection of the United States National Museum.

The synonymy is given only for the species discussed. The literature bearing on such forms is appended. In filling out the habitats I am particularly indebted to the important work of Ludwig, published in 1900.

1. CHIRIDOTA LÆVIS (Fabricius) 1780.

June 20, 1903.—One tentacle-crown and one body fragment; Station 4193; lat. $49^{\circ} 20' 30''$ N., long. $123^{\circ} 35' 40''$ W.; 18 to 23 fathoms; bottom, temperature 50.3° , green mud and fine sand.

Habitat.—Eastern coast of North America from Massachusetts (lat. 42° N.) to Labrador (Ayers, 1852; Stimpson, 1853; Packard, 1860; Verrill, 1861, 1866; Selenka, 1867; Bush, 1883; Lampert, 1885; Ganong, 1884, 1886, 1890?; Whiteaves, 1901). West coast of Greenland to lat. 69° N. (Fabricius, 1780; Lütken, 1857; Stimpson, 1863; Norman, 1876; Duncan and Sladen, 1881; Ludwig, 1882). West and north of West Spitzbergen to lat. 80° N. (Ljungman, 1879). Norwegian coast to Finmark (Vahl, 1806; M. Sars, 1850, 1861); Danielssen, 1861; Bidentkap, 1899; Östergren, 1902). Murman coast (Jarzynsky, 1885). Kara Sea (Stuxberg, 1886). Ludwig, 1900 (p. 165), gives the entire range from lat. 70° W. to 68° E., but Clark, 1902, reports this species from Sitka and the *Albatross* Alaska Salmon Investigations, 1903, from the Gulf of Georgia, Halibut Bank, Vancouver Island, British Columbia, so that now it can be given as circumpolar. Depth, 0 to 27 fathoms, exceptionally to 45 fathoms.

2. *CHIRIDOTA ALBATROSSII* Edwards, new species.

June 25, 1903.—No tentacle-crown, but twelve body fragments; Station 4201, 138 to 145 fathoms; bottom, temperature 45.5° , soft gray mud, sand, broken shells. July 6.—Three tentacle-crowns and eleven body fragments; Station 4223; lat. $55^{\circ} 1' 9''$ N., long. $130^{\circ} 42' 3''$ W.; 48 to 57 fathoms; bottom, temperature 44.6° , soft, green mud. July 7.—One body fragment; Station 4226; lat. $55^{\circ} 36' 18''$ N., long. $131^{\circ} 37' 16''$ W., 31 to 62 fathoms; bottom, temperature 44.8° , rocky. July 7.—One tentacle-crown and one body fragment; Station 4228; lat. $55^{\circ} 36' 15''$ N., long. $131^{\circ} 42' 30''$ W.; 41 to 134 fathoms; bottom, temperature 47.8° , gravel, sponge. July 7.—One body fragment; Station 4232; lat. $55^{\circ} 35' 36''$ N., long. $131^{\circ} 53' 49''$ W.; 77 to 93 fathoms; bottom, temperature 43.3° , green mud, sponge, rocky. July 9.—One body fragment; Station 4239; lat. $55^{\circ} 28' 35''$ N., long. $131^{\circ} 46' 48''$ W.; 206 to 248 fathoms; bottom, temperature 48.8° , coarse sand, rocky.

These specimens resemble *C. lævis* (Fabricius) in many respects, but the presence of rods in the anterior part of the body wall, the greater size of the body, and the larger number of wheel-papillæ constitute the chief differential characters of this new species.

In 1851 Pourtalés described a *Chiridota* from Florida under the name of *Synapta rotifera*. Pourtalés's species also has rods in addition to the wheels, but it is much smaller than *albatrossii* and lives among the branches of coral in shallow water.

Generally *C. lævis* has been taken from rather shallow water (up to 27 fathoms, only exceptionally up to 50 fathoms, Ludwig, 1900, p. 165), while these specimens come from a range of 31 to 248 fathoms.

Body.—Elongated, cylindrical. One fragment 21.5 cm. long and 9 mm. in diameter, whole posteriorly, has some of the detached ends of gonads in the anterior coelom, where it is broken off from the tentacular piece, so it may represent approximately the length of the individual in alcohol. But in this specimen the body wall is greatly contracted, as shown by the many thickened folds and the crowded dorsal wheel-papillæ. Therefore it is probable that the living animal is considerably longer. Another fragment, also with anal end intact, is 22 cm. long and the diameter varies from 6 mm., where most contracted, to 12 mm. in the well-expanded parts, where the skin is stretched thin. A third fragment, with both anterior and posterior ends missing, measures 17 cm. in length and 5 mm. in diameter. Since the remaining shorter pieces are of about the same average diameter as the above, it may be assumed that, with the tentacular part added, the species would have a length of 18 to 25 cm. and a diameter of 6 to 12 mm. In regard to the size of *C. lævis*, Duncan and Sladen, 1881 (p. 14), say: "The largest example of this species has been recorded by Sars, and measured 100 mm. in length; generally,

however, they range from 20 to 40 mm." Consequently this new species is over twice the greatest and seven times the average length of *C. lævis*.

Color.—In alcohol, vinaceous with spots of burnt sienna scattered all over the body and the tentacles.

Tentacles.—Twelve, generally with 8 to 12 digits; in one specimen some tentacles have 6 digits; in another, 14.

Spicules of the body wall.—Wheels in all respects like those of *C. lævis*. (See Duncan and Sladen, 1881, Plate I, fig. 18.) Diameter, 0.08 to 0.12 mm.; average, 0.1 mm. The wheel-papillæ are arranged in

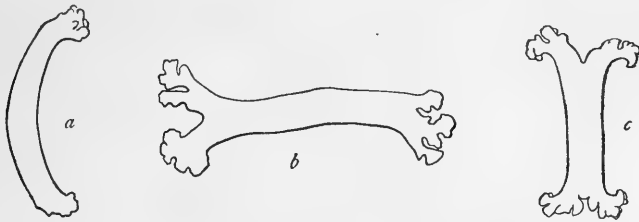


FIG. 1.—CHIRIDOTA ALBATROSSII. *a-c*, CALCAREOUS RODS. ($\times 340$.)

three rather irregular, more or less distinct, longitudinal rows in the dorsal inter-radii, while ventrally they are few and scattered. In the fragment of the body, 17 cm. long, there are about 68 to 75 in each row. In *C. lævis* there are 20 to 30 in each of the three rows.

Rods.—In the anterior body wall. In the longest specimen with tentacles these rods are at the posterior end of the piece, 4 cm. from the tentacles. The rods are straight to crescentic (fig. 1*a*), ends



FIG. 2.—CHIRIDOTA ALBATROSSII. *d-f*, CALCAREOUS RODS. ($\times 340$.)

spinose, now one (fig. 1*b*) and then both (fig. 1*c*) bifid, while very rarely the branches unite to make perforations. Often there is a small cluster of spines at the middle (fig. 2*d*).

Occasionally the rod has compound curves (fig. 2*e*), and very rarely it is triradiate (fig. 2*f*).

Size of rods in millimeters.—Length, 0.05 to 0.15, average, 0.1; width, 0.007 to 0.02; average, 0.01; width of branched ends, up to 0.06.

Spicules of the tentacles.—Rods similar to those in the body wall.

Calcareous ring.—Like *C. lævis*.

Polian vesicles.—In the four specimens, 10, 16, 17, and 18, scattered from right to left dorsal radius. In one specimen the longest is

10 mm. In the other three the longest are 5 mm. and the shortest 1.5 mm.

Stone canal.—Much coiled, adherent to the dorsal mesentery. The madreporite (fig. 3) has a number (in one case 27) of transverse folds, which project from the mesentery.

Gonads.—In two tufts, one each side of the mesentery; tubes dichotomously branched. Of the specimens with gonads, two are female and one male.

Retractor muscles.—Well developed.

Ciliated funnels.—On the mesentery, near the body wall, similar to those of *C. lericis* (Duncan and Sladen, 1881, Plate I, fig. 17).

Habitat.—Queen Charlotte Sound, off Fort Rupert, Vancouver Island, British Columbia; Boca de Quadra, vicinity of Naha Bay, Behm Canal, junction of Clarence Strait and Behm Canal, southeast Alaska. (*Albatross* Alaska Salmon Investigations, 1903.) These localities constitute the type region.

Type.—Cat. No. 25003, U.S.N.M.



FIG. 3.—CHIRIDOTA ALBATROSSII. STONE CANAL AND MADREPORITE. ($\times 29$.)

3. ANKYRODERMA JEFFREYSII Danielssen and Koren, 1879.

June 20, 1903—Six specimens; Station 4198; lat. $49^{\circ} 18' 30''$ N., long. $123^{\circ} 46' 12''$ W.; 157 to 230 fathoms; bottom temperature, 46.8° , soft, green mud. July 6—One specimen; Station 4224; lat. $55^{\circ} 9' 24''$ N., long. $130^{\circ} 41' 48''$ W.; 156 to 166 fathoms; bottom temperature, 43.7° , dark, green mud. July 7—One specimen; Station 4230; lat. $55^{\circ} 35' 13''$ N., long. $131^{\circ} 50' 11''$ W.; 108 to 240 fathoms; bottom temperature, 42.4° , rocky.

Not one anchor was found, albeit in most cases a stump of varying length is present. This I take to be the proximal part of the stock of the anchor, the distal part, with the arms having been broken off. As Théel, 1886 (p. 49), suggests, such a stump with broken end might easily have been taken

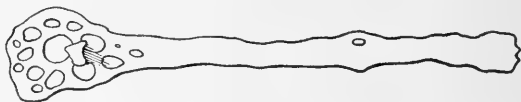


FIG. 4.—ANKYRODERMA JEFFREYSII. "SPOON-LIKE" ROD WITH RUDIMENTARY SPIRE. ($\times 111$.)

for the long process of the "cups" by v. Marenzeller in describing his *A. roretzii*. On many of the "spoon-like" rods there arises, about the middle of the widened part of the rod, a sort of rudimentary spire, or process (fig. 4), which hitherto has not been described. In some specimens a degeneration has affected the "spoon-like" rods so that they are wholly or partially absorbed, with, at the same time, a

deposition upon them of the red matter ordinarily peculiar to the wine-red bodies. Théel, 1886, notes a similar change of color in the tables of *Trochostoma antarcticum* Théel.

Habitat.—Lesser Antilles, lat. 12° to 16° N., long. 62° W.; also lat. 33° to 42° N., long. 66° to 76° W. (Théel, Blake Report, 1886). Finmark and north to Barents Sea to lat. 70° to 75° N., long. 21° to 31° E. (Danielssen and Koren, 1882, Hoffman, 1882, Sluiter, 1895). Northwest of Spitzbergen to lat. 80° N., long. 6° E. (Danielssen and Koren, 1882), lat. 81° to $81^{\circ} 15'$ N., long. 19° to 23° E. (Ludwig, 1900). Gulf of Georgia, Vancouver Island, British Columbia, Boca de Quadra, Naha Bay, southeast Alaska (*Albatross* Alaska Salmon Investigations, 1903).

4. TROCHOSTOMA OÖLITICUM (Pourtalès), 1851.

After the examination of a large series of specimens, Clark, 1904, concludes that *Molpadia borealis* Sars, 1861, is a synonym of the species described by Pourtalès in 1851 as *Chirodota oöliticum* and following Danielssen and Koren, 1879, usually given as *Trochostoma boreale*.

June 20, 1903.—Two specimens; Station 4194; lat. $49^{\circ} 19' 30''$ N., long. $123^{\circ} 35' 40''$ W.; 111 to 170 fathoms; bottom, temperature 48.3° , soft, green mud. June 20.—One specimen; Station 4198; lat. $49^{\circ} 18' 30''$ N., long. $123^{\circ} 46' 12''$ W.; 157 to 230 fathoms; bottom, temperature 46.8° , soft, green mud. July 8.—One specimen; Station 4237; lat. $55^{\circ} 50' 40''$ N., long. $131^{\circ} 46' 38''$ W.; 194 to 198 fathoms; bottom, temperature 42.6° , green mud. July 9.—One specimen; lat. $55^{\circ} 28' 0''$ N., long. $131^{\circ} 57' 40''$ W.; 248 to 256 fathoms; bottom, temperature 48.8° , hard coral.

Habitat.—Florida Reefs (Pourtalès, 1869). Lesser Antilles (Théel Blake Report, 1886). Portland, Maine (Verrill, 1873). Casco Bay, Maine (Kingsley, 1901). West of Norway (Danielssen and Koren, 1882, Östergren, 1902). Finmark and northward (M. Sars, 1861, Danielssen and Koren, 1882). South and northwest of Spitzbergen (Danielssen and Koren, 1882). Barents Sea (v. Marenzeller, 1877, Hoffman, 1882, Danielssen and Koren, 1882, Sluiter, 1895). Kara Sea (Stuxberg, 1879, 1880, 1886, Levinsen, 1886, Sluiter, 1895). East of Cape Tscheljuskin (Stuxberg, 1880). Point Barrow (Murdoch, 1885). Gulf of Georgia, Halibut Bank, Vancouver Island, British Columbia, Behm Canal, southeast Alaska (*Albatross* Alaska Salmon Investigations, 1903). The range given by Ludwig, 1900 (p. 161), as 287 degrees through the northern Atlantic Ocean to the Siberian Polar Sea from the Florida Reefs (long. 83° W.) to Point Barrow (long. 156° W.) is now extended south in the northern Pacific to Vancouver Island, British Columbia (lat. 50° N., long. 127° W.). Depth from 20 to 650 fathoms, usually more than 55 fathoms and less than 540 fathoms.

5. *CUCUMARIA CALCIGERA* (Stimpson), 1851.

1851. *Pentacta calcigera* STIMPSON, p. 67.
1867. *Pentacta calcigera* PACKARD (cf. Whiteaves, p. 45).
1867. *Cucumaria koreni* SELENKA, p. 350.
1867. *Cucumaria calcigera* SELENKA, p. 351.
1888. *Pentacta calcigera* GANONG, p. 52.
1900. *Cucumaria calcigera* LUDWIG, p. 146.
1901. *Cucumaria calcigera* CLARK, p. 162-171.
1901a. *Cucumaria calcigera* CLARK, p. 492.
1901. *Pentacta calcigera* KINGSLEY, p. 164.
1901. *Pentacta calcigera* WHITEAVES, p. 45

(For other titles in the synonymy see Ludwig, 1900, p. 146).

July 7, 1903.—Four specimens; Station 4231; lat. $55^{\circ} 35' 36''$ N. long. $131^{\circ} 52' 33''$ W.; 82 to 113 fathoms; bottom, temperature 43.0° , green mud, slate fragments, sponge, rocky. July 8.—Two specimens; Station 4233; lat. $55^{\circ} 54' 16''$ N., long. $131^{\circ} 45' 58''$ W.; 39 to 45 fathoms; bottom, temperature, 44.7° , soft, gray mud, rocky. July 11.—Eleven specimens; Station 4246; lat. $55^{\circ} 27' 57''$ N., long. $132^{\circ} 15' 0''$ W.; 101 to 123 fathoms; bottom, temperature 44.1° , gray, green mud; coarse sand, shells.

The following description includes an account of the stone canal, perforated plates of the introvert (peristome), supporting rods of the tentacles and certain features of the spicules of the body wall, which up to this time have not been described.

Form.—The body is curved like a crescent tapering to both anterior and posterior extremities, the latter being much more slender. Often the curvature is so increased that the two ends come together. One example with the tentacles completely extruded (and thus 15.5 cm. long on the dorsal mid-line) shows the anterior fifth (2.8 cm.), straight, of a uniform diameter (0.8 cm.) and devoid of pedicels for 2 cm. from the base of the tentacles. This anterior portion is thin and flexible in contradistinction to the firm, stiff main part of the body, and may be called the introvert (peristome of Delage and Hérourard, 1903-4). When it is retracted the apparent anterior extremity, as seen in most alcoholic specimens, is as Théel, 1886 (p. 103), says "more truncated" than the caudal portion.

Size.—The average measurements of the 17 specimens in the collection gives in centimeters: Length from the apparent anterior end of the body (the introvert being retracted) to anus, along mid-dorsal line, 4.3, range 1.7 to 7.7; along mid-ventral line 8.42, range 3.5 to 12.7; largest diameter, dorso-ventral 1.45, range 0.7 to 2.2, transverse 1.28, range 0.6 to 1.7.

Color.—White, with tints of cream color to tawny olive in certain parts derived from slime which has been deposited, especially along the bands of pedicels. Oral disk, clove brown.

Tentacles.—Ten, the two ventral about half the size of the others and arising somewhat nearer the mouth. Color, mixed white and clove brown.

Genital papilla.—Three millimeters long, colored like the tentacles.

Pedicels.—Confined to the ambulacra; dorsal in two zigzag rows, ventral in four to five zigzag rows toward the middle. Smaller toward the extremities, especially posteriorly. Each pedicel is conical, non-retractile, the longest ventrally (2 to 3 mm.).

Body wall.—Thin (about 0.3 mm. thick), semitransparent, firm and rough to the touch from the numerous crowded, imbricated spicules. In the introvert, especially thin and transparent with scattered, knobbed plates.

Bell, 1883 (pp. 481-484), Lampert, 1885 (p. 142), Lütken, 1857 (pp. 6-7), Marenzeller, 1874 (pp. 11-12), Théel, 1886 (pp. 103-104), Duncan and Sladen, 1881 (p. 7), and Ludwig, 1886 (pp. 278-279), have described the spicules. The last two descriptions, together with that of Lütken, are especially good, but since I have found new spicules in the introvert and tentacles, as well as ridges on the perforated plates and the disks of the tables, I have concluded to redescribe the spicules in general.

Spicules of the body wall.—*Tables*.—Disk flat, very irregular, round to four-rayed with all intermediate forms. Four central holes surrounding the spire constitute a diamond (fig. 5), and vary from 0.02 to 0.04 mm. in diameter, being generally, but not always, larger than the peripheral holes, which vary from 0.01 to 0.04 mm. In the elongated and stellate forms the holes, numbering from four to forty, are in one to three rows. These rows are usually more distinct in the prolongations.

FIG. 6.—*CUCUMARIA CALCIGERA*. SIDE VIEW OF TABLE FROM THE BODY-WALL. ($\times 110\frac{1}{2}$.)

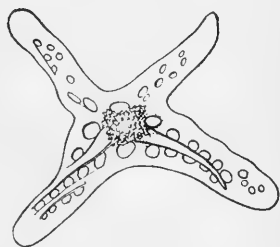


FIG. 5.—*CUCUMARIA CALCIGERA*. UPPER SURFACE OF TABLE FROM THE BODY-WALL. ($\times 110\frac{1}{2}$.)

Besides the rows there are often additional holes irregularly distributed. In the circular disks the holes are in one to two irregular rings. Sometimes there are ridges running out from the spire onto the rays between the rows of holes (fig. 5).

Size of disks in millimeters.—Length 0.15 to 0.45, average 0.23; width 0.06 to 0.44, average 0.18; diameter of circular forms 0.1; average width of rays in stellate forms 0.08.

Spire.—Conical or club shaped (fig. 6); may be solid, but generally gives evidence of being composed of four rods, which, in their more or less complete fusion, leave from one to four distal holes, and sometimes one to two below these. In the young (10 to 15 mm. long) the

spires are present on all of the outer plates as drawn by Duncan and Sladen, 1881 (Plate I, fig. 6), but in older individuals I find that the spires may occur only occasionally. This agrees with the important and suggestive results obtained by Mitsukuri, 1897, for *Stichopus japonicus* Selenka.

Size of spire in millimeters.—Height 0.06 to 0.1, diameter 0.45.

Crown generally bears from 6 to 40 teeth, average number 13 (fig. 6). In some cases the teeth arise from projections which may be subdivided;



FIG. 7.—*CUCUMARIA CALCIGERA*. PERFORATED PLATE OF THE INTROVERT. *a*, UPPER SURFACE; *b*, PROFILE. ($\times 166$.)

vided; in other cases the teeth are very small and difficult to count, or, again, they may be almost fused into one mass (fig. 5).

Diameter of crown in millimeters.—0.02 to 0.04, average 0.03.

Perforated plates.—Smooth, round to four-rayed, holes arranged as in the disk of the tables, or irregularly distributed. Sometimes ridges arise running between the rows of holes.

Size of plates in millimeters.—Length 0.12 to 0.54, average 0.29; width 0.09 to 0.45, average 0.15; thickness 0.008 to 0.03, average 0.02; diameter of holes 0.008 to 0.03.

Spicules of the introvert.—Irregular perforated plates with jagged edges and bearing spines (fig. 7*a*); usually more numerous on one

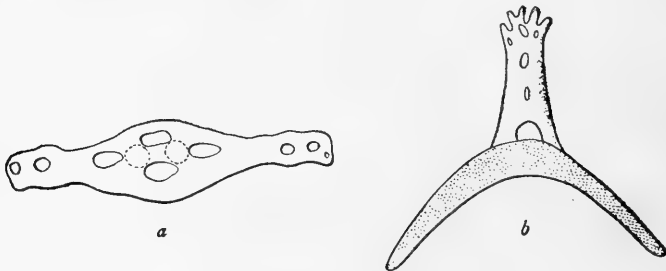


FIG. 8.—*CUCUMARIA CALCIGERA*. SUPPORTING TABLE FROM A PEDICEL. *a*, UPPER SURFACE; *b*, PROFILE. ($\times 340$.)

face than the other, as seen in the profile view (fig. 7*b*). The number of holes varies from 1 to 21, average 5.4; the number of spines from 1 to 21, average 11.8,

Size of plates in millimeters.—Length 0.11 to 0.27, average 0.17; width, 0.08 to 0.11; average, 0.09.

Spicules of pedicels.—No supporting rods other than the supporting tables (fig. 8*a-b*).

Disks.—Arched, elongated, wider at the middle, with four central holes and one to four holes in the ends of the two rays (fig. 8a-b).

Size of disk in millimeters.—Length 0.09 to 0.17, average 0.13; height of arch 0.02 to 0.06, average 0.05; width at middle 0.03 to 0.08, average 0.04; width of ends about one-half of that of middle.

Spire.—Composed of rods not so much fused as in the tables of the body wall, leaving one proximal hole, none to six distal holes, and sometimes a distinct hole between the proximal and distal holes (fig. 8). The spire is often compressed. The spires are longer and more slender than those drawn by Bell, 1883 (Plate VIII, fig. 2a), and Ludwig, 1886 (Plate VI, fig. 5). The figures of Bell are intermediate between that of Ludwig and my own, so that I think all may be taken as within the range of variation. I have often noticed spires which have been broken off that resemble Bell's figures.

Size of spire in millimeters.—Height 0.03 to 0.09, average 0.05; diameter at base 0.02 to 0.04, average 0.03; at crown 0.008 to 0.03, average, 0.02.

Crown.—Four to twenty generally simple teeth arise from the end and sides (fig. 8b). The crown may be compressed or rounded.

Terminal plate.—Holes may be all of the same size, or small at the center and larger peripherally, or vice versa.

Diameter in millimeters.—0.11 to 0.15, average 0.12.

Spicules of tentacles.—Supporting rods of very diverse form, occasionally irregular plates. The rods (fig. 9) are spinose and perforated. The plates also may bear spines. The spicules are apparently adapted in curvature and size to the special parts of the tentacles in which they occur. The plates are usually found in the terminal branches and resemble those of the introvert, except in size.



FIG. 9.—CUCUMARIA CALCIGERA. SPINOSE, PERFORATED TENTACLE ROD. ($\times 110\frac{1}{2}$.)

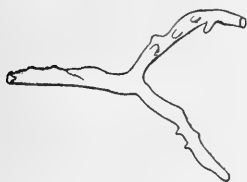


FIG. 10.—CUCUMARIA CALCIGERA. FRAGMENT OF CALCAREOUS RING NETWORK. ($\times 340$.)

Size in millimeters—Tentacular supporting rods.—Length 0.14 to 0.72, average 0.35; width 0.008 to 0.11, average 0.05. *Plates* 0.06 to 0.18, average 0.1; width 0.02 to 0.08, average 0.05.

Calcareous ring.—Of ten rather slender species, each being made up of a calcareous network (fig. 10), rather thicker in places, and therefore appearing composite. Radialia shallow-tailed posteriorly, the two prolongations extending to the ring canal. Interradialia wedge-shaped, pointed anteriorly.

Polian vesicle.—One, distended, pear-shaped. Length 0.7 to 1.2 mm., average 0.85 mm.

Stone canal.—Hitherto the small, delicate stone canal has been overlooked. It is single, straight, or convoluted, embedded in the dorsal mesentery until near the madreporite, which projects free in the cœlom generally to the right, but in one case to the left of the mesentery. The madreporite is kidney-shaped (fig. 11*a*), and consists of two leaves or valves with thickened edges as if a round, thick-lipped disk attached at the center to the stone canal had been once folded, so that the opposite edges lie near together, forming the distal portion of the structure. (Fig. 11*b*.) In the fifteen specimens examined one stone canal had its terminal part bifid for a short distance, each branch bearing a head of normal size; another had, besides the usual madreporite, two small subsidiary heads, sessile upon the main tube, a short distance from the distal end. Average length of the stalk 3 mm.; of the head 0.8 mm. After treatment with potash it is

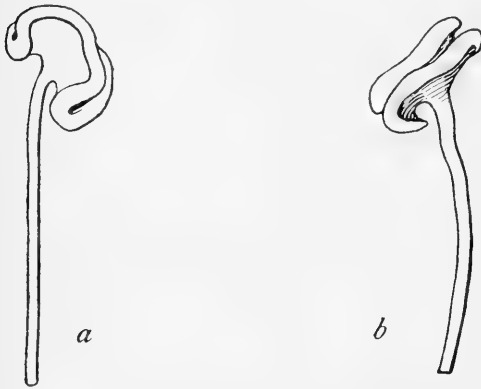


FIG. 11.—*CUCUMARIA CALCIGERA*. STONE CANAL AND MADREPORITE. *a*, SIDE VIEW; *b*, DISTAL VIEW. ($\times 27$.)

found that at the junction of the madreporite with the stone canal the calcareous network is comparatively coarse and open, but proceeding toward the periphery the calcareous threads become finer and the meshes smaller, until in the thickened rim they are decidedly finer, densely crowded, and clearly marked off from the central part of the disk.

Gonads.—In two tufts of simple tubules, one either side of the dorsal mesentery.

Respiratory trees.—Two, each with small branch given off near the cloacal origin. The main stems are in the right and left dorsal inter-radii, reaching nearly to the anterior end of the body, the right being slightly longer. The branches lie in the right and left ventral inter-radii, extending to about the middle of the body.

Retractor muscles.—Strongly developed. In comparison the longitudinal bands are weak.

Habitat.—Massachusetts (Stimpson 1851, Verrill 1866). Cape Breton Island, Nova Scotia (Whiteaves 1901). Labrador (Verrill 1866, Packard 1867). West Greenland to lat. 69° N. (Lütken 1857, Norman 1876, Ludwig 1883). Assistance Bay, lat. 74° N., North American Polar Sea to lat. 75° N., long. 95° W. (Forbes 1852, Duncan and Sladen 1881). Wajgatsch Island, lat. 73° N. Kara Sea to long. 64° E. (Stuxberg 1879, 1886). Plover Bay, Bering Sea (Lud-

wig 1886). Bering Strait (Stuxberg 1880). (Thus from long. 173° W. to long. 65° E., two-thirds circumpolar Ludwig, 1900). Pacific Grove, California (Clark 1901a). Naha and Yes Bays, Behm Canal, Prince of Wales Island, southeast Alaska (*Albatross* Alaska Salmon Investigations, 1903).

6. *CUCUMARIA CHRONHJELMI* Théel, 1886.

June 27, 1903.—One specimen; Quarantine Station, Dock Port Townsend, Washington. June 30.—One specimen; Station 4209; lat. $48^{\circ} 8' 55''$ N., long. $122^{\circ} 41' 10''$ W.; 24 to 25 fathoms; bottom, temperature 50.3° , rocky, coarse sand, shells.

The deficiency in figures of the spicules in Théel's original description is supplied by Clark, 1901. In the tentacles, the supporting rods vary in form to irregular plates, and either the rods or plates may bear spines, a fact not brought out by Clark's description, or figure.

Habitat.—Vancouver Island (Théel, 1886), Puget Sound (Clark, 1901), Port Townsend, Washington (*Albatross* Alaska Salmon Investigations, 1903).

7. *CUCUMARIA VEGÆ* Théel, 1886.

August 24, 1903.—One specimen from Shakan Beach, southeast Alaska.

This specimen, in general agreement with the description of Théel, 1886, has the following measurements in centimeters: Length, 2.7; dorso-ventral diameter, 1.2; transverse diameter, 1.1. The color of the specimen in alcohol is slate-black around the mouth and anus as well as in the dorsal region, shading laterally to mixed light gray and smoke gray on the ventral surface. The tentacles are black and the ends of the pedicels cream color. Usually, in larger individuals especially, the color is seal-brown dorsally shading to chocolate ventrally. There are many examples of this species in the collections of the United States National Museum which I have at hand, and, as Clark, 1902, notes, this species is very abundant in the North Pacific.

Habitat.—Bering Island, Théel Challenger Report, 1886. Sitka, Pribilof Islands, Copper Island (Clark, 1902). Shakan Beach, southeastern Alaska (*Albatross* Alaska Salmon Investigations, 1903).

8. *CUCUMARIA FRONDOSA* (Gunnerus), 1767.^a

Synonymy in Ludwig, 1900, p. 141-2.

August 3.—One specimen; Station 4272; Afognak Bay, Afognak Island; 12 to 17 fathoms; bottom, sticky mud. August 6.—One specimen; Station 4273; Alitak Bay, Kadiak Island; 36 fathoms; bottom, green mud, fine sand.

^a Ludwig, 1900, gives 1770 the date of the German translation instead of 1767, the date of publication of the original description of Gunnerus in Kongl. Vetenskaps Acad. Hand-lingar för År, 1767.

Size in millimeters.—Introvert extended, length; specimen *a*, 50; greatest diameter, 25; introvert retracted, length, specimen *b*, 90; greatest diameter, 70.

Spicules of body wall.—Irregular perforated plates as described and figured by Clark, 1904.

Culcareous ring.—Well developed when compared with *japonica*.

Polian Vesicle.—In *b*, one, rather long. In *a*, three; one in the right ventral interradius, one in the left ventral interradius, and one in the left ventral radius.

Stone canal.—One, short, in dorsal mesentery, with a single head of very closely crowded madreporites projecting from the dorsal mesentery toward the oral ring.

Ludwig, 1900, and Clark, 1901*a*, 1904, question the occurrence of this species on the Pacific coast of North America, but these two specimens, with the chief characters as briefly related above, are, beyond question, of the type *frondosa* as described, for instance, by Clark, 1904, page 566.

Habitat.—(?) Florida Reef (Pourtales, 1869). Massachusetts to Labrador (Gould, 1841, Ayers, 1851, Stimpson, 1853, Verrill, 1866, Packard, 1867, Ludwig, 1882, Ganong, 1884, 1888, Lampert, 1885, Ludwig, 1900, Kingsley, 1901, Whiteaves, 1901, Clark, 1904). Baffins Bay (Duncan and Sladen, 1877, 1881). Assistance Bay, Barrow Strait, lat. 75° N. (Forbes, 1852). West coast of Greenland to lat. 69° N. (Fabricius, 1780, O. F. Müller, 1788, Lütken, 1857, Stimpson, 1863, Norman, 1876, Ludwig, 1882, 1883). Iceland (O. F. Müller, 1788, Lütken, 1857, Ludwig, 1883). Jan Mayen (Fischer, 1886). Färöe Islands (Lütken, 1857, Bell, 1892, Sluiter, 1895, Hørring, 1902, Schmidt, 1904). South from Scandinavia to Kattegat (Düben and Koren, 1846). Coast of Norway, south to Hardanger fjord, lat. 59° N. North to North Cape and Finnmark (Gunnerus, 1770, O. F. Müller, 1806, Düben and Koren, 1846, M. Sars, 1850, 1861, Lütken, 1857, M'Andrew and Barrett, 1857, Lampert, 1885, Kükenthal and Weissenborn, 1886, Grieg, 1889, and 1896, Nordgaard, 1893, Sluiter, 1895, Östergren, 1902). Bären Island (Danielssen and Koren, 1882). Shetland Islands (Forbes, 1841, Dalyell, 1851, Ludwig, 1882). Orkney Islands (Bell, 1892). Coast of Scotland (Forbes, 1841, Dalyell, 1851, M'Intosh, 1875, Bell, 1892). Ireland (Thompson, 1840, 1844, Théel, 1886. Southwest England to lat. 50° N. (Bell, 1892). Spitzbergen, to lat. 80° N. (v. Heuglin, 1874, Ljungman, 1879, Ludwig, 1900). Barent's Sea (Sluiter, 1895). Murman coast (Jarzynsky, 1885, Pfeffer, 1890). Kara Sea (Levinsen, 1886). Point Franklin, Alaska (Murdoch, 1885). San Francisco (Ayers, 1855). Admiralty Inlet, Port Townsend, Washington, Afognak Island, Kadiak Island (*Albatross*, Alaska Salmon Investigations, 1903). Ludwig, 1900 (p. 143), gives this species as two-thirds circumpolar.

Depth 0 to 218 fathoms; usually lives in from 2 to 30 fathoms.

9. *CUCUMARIA JAPONICA* Semper, 1868.

1868. *Cucumaria japonica* SEMPER, p. 236.

1885. *Cucumaria japonica* LAMPERT, p. 143.

1886. *Cucumaria japonica* THÉEL, p. 110.

1900. *Cucumaria japonica* LUDWIG, p. 143.

1902. *Cucumaria japonica* CLARK, p. 562.

June 29, 1903.—Three specimens; Station 4205; lat. $48^{\circ} 8' 10''$ N., long. $122^{\circ} 41' 48''$ W.; 15 to 26 fathoms; bottom, temperature 50.8° , rock, shells. August 24.—One specimen; Station 4302; off Shakan, Sumner Strait, southeast Alaska; 169 to 212 fathoms; bottom, temperature 44.2° , blue mud. Without data—two specimens.

Size in millimeters.—Introvert extended; length: specimens *a*, 55; *b*, 170; greatest diameter, *a*, 19; *b*, 38; introvert retracted, length, *c*, 24; *d*, 33; *e*, 40; *f*, 170; greatest diameter, *c*, 15; *d*, 19; *e*, 20; *f*, 65. Individuals *b* and *f* may be taken as adult and the others as young.

Color.—Dark, or light, tint of ecru-drab. *c*, heliotrope-purple, from which as a natural color, the ecru-drab might result after loss of color in alcohol.

Spicules of body wall.—Perforated plates of irregular form and size. In most of the specimens, as shown in sections, the large, radially placed, perforated plates are massed near the opening of the cloaca, as described by Semper, 1868 (Plate XXXIX, fig. 3). Clark, 1902, did not find these large plates in his four specimens, which otherwise agree with the descriptions given by Semper, 1868, and Lampert, 1885.

Calcareous ring.—In form like *frondosa*, but very delicate and generally greatly reduced, not, however, to the mere vestige described by Semper.

Polian vesicle.—Five specimens with one Polian vesicle, longer than the body, the terminal portion turned forward and coiled among the gonad tubes and branches of the respiratory trees. Length in *b*, 200 mm.; *f*, 354 mm. Since usually but one Polian vesicle has been given, it is worthy of note that *e* has 4, one in the right ventral radius, one either side of the mid-ventral radius, and one in the left dorsal interradius.

Stone canals.—*Length in millimeters.*—As generally twisted, 3; when straightened, 5; madreporite, 1. *Number and location.*—*a*, 5, in right and left tufts at edge of base of Polian vesicle; *d*, 6, around base of Polian vesicle; *e*, 9; *e*, 18, scattered around oral canal; *b*, 95; *f*, 140, closely crowded in a row around the posterior margin of the entire oral canal. This increase in number accompanies growth, which is strikingly demonstrated in the large number of canals in the adult. This fact I have shown for other Holothurians in a recent paper (Edwards, 1905). *Form.*—Simple, or distally bifid or trifid, each branch bearing a small madreporite. Stone canal twisted, sometimes two twisted together, or, again, two may be united at the base.

Habitat.—Japan (Semper, 1868). Gulf of Georgia (Lampert, 1885). Sitka (Clark, 1902). Shakan, Summer Strait, southeast Alaska (*Albatross* Alaska Salmon Investigations, 1903).

10. *PANNYCHIA MOSELEYI* Théel, 1882.

1882. *Pannychia moseleyi* THÉEL, pp. 88-90.

(?) 1894. *Pannychia moseleyi* var. *henrice* LUDWIG, pp. 95-99.

1901. *Pannychia moseleyi* SLUITER, pp. 71-72.

July 31, 1903.—One specimen; Station 4265; lat. $56^{\circ} 56' 30''$ N., long. $136^{\circ} 10' 0''$ W.; 590 fathoms; bottom, temperature 38.2° , green mud, rocky.

Form.—Flattened ventrally, arched dorsally.

Dimensions of body.—97 mm. long; 13 mm. wide; 10 mm. dorso-ventral diameter.

Color.—In alcohol heliotrope-purple above, white below. Pedicels and papillæ whitish, ends cream color. Tentacles like the body on the stalks, but with the ends cream color.

Number of tentacles.—Twenty, three broken off.

Distribution of pedicels.—Thirty-two in the right lateral ventral radius. Twenty-eight in the left lateral ventral radius. In both of these rows the posterior pedicels are smaller. Twenty-four in the mid-ventral radius.

Papillæ.—Length, 10 mm.; diameter, 0.4 mm. About 170 on each side of the bivium, being somewhat thicker along the radii. In the middle third of the mid-dorsal region there is a naked longitudinal space only 2 mm. wide. At the extreme anterior end of the bivium there are three papillæ on either side and in the line of the madreporic papilla one on either side, each with a stiff firm wall, thicker base (1 mm. diameter), and with the stalk colored heliotrope-purple.

Ampullæ.—Of the pedicels, covered in the body-wall. Of the papillæ, branched, projecting into the coelom.

Thickness of body wall.—Ventrally 0.5 to 2 mm.

Calcaneous spicules.—In general like those described by Théel, 1882, and for the details I refer to his paper.

Spicules of the body wall.—In the bivium are found the large wheels of 13 or 14 spokes, but no spicules similar to the small wheel-shaped plates or small round plates with 35 to 50 holes. In the trivium, to the contrary, the first-mentioned large wheels are lacking, while the small wheel-shaped plates and perforated plates with many holes, together with straight or arcuated, simple or branched, spinose supporting rods are present.

Spicules of the ambulacral appendages.—*Pedicels*.—Large wheels, small wheel-shaped plates, small round perforated plates, simple or branched, spinose supporting rods, large irregular plates at the top of

the processes, terminal plates with numerous holes in several layers, and net-like bodies with wide, irregular meshes.

Papillæ.—Scattered small wheel-shaped plates and simple or branched spinose supporting rods, with some of the large wheels near the tips.

Tentacles.—Many of the large wheels and small wheel-shaped plates in the stalks, but in the disks only the last, together with crowded spinose supporting rods.

Calcareous ring.—Rudimentary, fragile, spongy; its true form not distinct.

Polian vesicles.—Two, each 20 mm. long, 1.6 mm. diameter, with a common base for 3 mm.

Stone canal.—Ends in dorsal madreporic papilla, 1 mm. in diameter, 9 mm. posterior to the tentacles; a clear, slightly whitish, spherical body, of no particular structure.

Gonads.—On either side of dorsal mesentery one long (70 mm.) tube, giving off richly branched lateral branches. The gonaduct opens 10 mm. posterior to the tentacles.

Comparative.—The one individual above extends the geographical distribution of this species from one extreme of the Pacific to the other. From the three records now published, together with the above description of the *Albatross* specimen, it is difficult to say whether there are several varieties of Théel's type or just one very variable species. The descriptions of *Pannychia moseleyi* Théel, given by Théel, Sluiter, and myself, and of *P. moseleyi* var. *henrice* Ludwig agree well enough and so intergrade as to constitute the one species. Because of the inadequate description, the position of *Pannychia wood-masoni* Walsh, 1891, given by the author as closely allied to *P. moseleyi* Théel is very uncertain, as both Ludwig (pp. 95-96) and Sluiter (p. 72) have indicated.

Ludwig established his variety upon the smaller number of pedicels in the mid-ventral radius and the presence of three genital tubes, instead of one, on each side of the dorsal mesentery. The number of pedicels depends upon growth, although we have, as yet, no exact formula for the determination of the age of a Holothurian. The size, of course, in a general way gives some idea of age and maturity, as Mitsukuri, 1903, found in the case of *Stichopus japonicus* Selenka, and, as I have demonstrated in recent studies (1905), of *Holothuria floridana* Pourtalès and *H. atra* Jaeger.

While in general, as Ludwig suggests (p. 98), the number of appendages increases with size and age, yet my specimen, with a length included in Ludwig's smallest class (66 to 175 mm.), has a larger number of lateral pedicels than even Théel's type. The number of mid-ventral pedicels in my specimen (24) agrees exactly with that of Sluiter, and both are intermediate between Théel's type (55) and Lud-

wig's variety (2-14). Considering the variation recorded for the pedicels, it is doubtful, with our present knowledge of the species, if a variety should be established upon this basis. The presence of three genital tubes instead of one on each side of the mesentery, since in both cases they are of the same form, might also be taken as within the possible limits of variation and growth. Upon comparing my specimen with Théel's drawing (Plate XVII, fig. 2) I was impressed with the different appearance it presented. Instead of the rather scattered papillæ showing considerable inequality in size and the long, broad, naked mid-dorsal space, as pictured by Théel's artist, my specimen gives the impression of more nearly equal, more slender, shorter, and crowded papillæ. This impression is borne out by Théel's count of 100 papillæ on each side of the back, while I found about 170, and the length of the papillæ, which he gives as 15 to 20 mm., while 10 mm. is the longest in my specimen. Thus, in respect to form and distribution of papillæ, Théel's type is one extreme and my specimen the other, with Ludwig's (Plate X, fig. 2) intermediate. The anterior dorsal "transverse, thin, lobe-like extension of the skin, sending out several processes" of Théel (p. 89) is probably represented by the stiff-walled, heliotrope-purple colored papillæ, each with a base (1 mm. in diameter) twice the width of the ordinary papilla and arranged three on each side at the extreme anterior end, with an additional one on each side in the line of the madreporic papilla. The two Polian vesicles, with a common base in my example, may easily be regarded as a variation, as also the smaller size and lack of structure shown in the madreporic papilla when the latter is compared with Ludwig's specimen. The characters of Sluiter's two specimens are in general intermediate between those of Théel and Ludwig.

II. *STICHOPUS CALIFORNICA* (Stimpson), 1857.

June 20, 1903.—Two specimens; Station 4193; lat. $49^{\circ} 20' 30''$ N., long. $123^{\circ} 35' 40''$ W.; 18 to 23 fathoms; bottom, temperature 50.3° , green mud; fine sand. June 20.—Two specimens; Station 4197; lat. $49^{\circ} 20' 34''$ N., long. $123^{\circ} 35' 54''$ W.; 31 to 97 fathoms; bottom, temperature 46.8° , sticky, green; fine sand.

In these four small specimens (length 3.5 to 4.5 cm.) the gonads are not developed, but the spicules and other characters agree so well with what there is in the meager original description of Stimpson, 1857, and the much better characterization of Clark, 1901, that I have little hesitation in this determination.

Habitat.—Tomaes Bay, Pacific coast (Stimpson 1857). Pacific Grove, California (Clark 1901a). Sitka (Clark 1902). Gulf of Georgia, Vancouver Island, British Columbia (*Albatross* Alaska Salmon Investigations 1903).

12. *STICHOPUS CHALLENGERI* (Théel), 1886.

July 7, 1903.—Three specimens; Station 4230; lat. $55^{\circ} 35' 13''$ N., long. $131^{\circ} 50' 11''$ W.; 108 to 240 fathoms; bottom, temperature 42.4° , rocky. August 14.—One specimen; Station 4289; Uyak Bay, Kadiak Island; 74 to 80 fathoms; bottom, temperature 42.2° , gray mud. August 15.—One specimen; Station 4291; lat. $57^{\circ} 45' 0''$ N., long. $154^{\circ} 2' 30''$ W.; 48 to 65 fathoms; bottom blue mud, sand, gravel. August 15.—One specimen; Station 4293; lat. $57^{\circ} 45' 0''$ N., long. $154^{\circ} 12' 0''$ W.; 106 to 112 fathoms; bottom blue mud, fine sand.

The study of these six individuals of *Stichopus challengerii*, which Théel described from "a single slightly macerated specimen," gives an opportunity to add a few things to the admirable description of that author. It is of interest that Théel's specimen, found in lat. $46^{\circ} 53'$ S., long. $51^{\circ} 52'$ E., gives the two regions now recorded for this species on opposite sides of the earth.

Body.—Size in centimeters: Length, 5.1 to 18.8; average, 12.3; dorso-ventral diameter, 1.2 to 2.3; average, 1.8; transverse diameter, 2.0 to 3.2; average, 2.7.

Color.—In alcohol; three specimens brownish drab dorsally, shading to light hair brown, or white, ventrally; the other three heliotrope-purple dorsally, shading to lavender ventrally.

Tentacles.—Nonretractile; four specimens with 20 and two with 19 (Théel's example had 19). Color cream-buff. Ampullæ extremely short, the longest being 3 mm.

Genital papilla.—Inconspicuous, at most 1.5 mm. high, 0.5 to 1.4 cm. from base of tentacles.

Pedicels.—Ventral, nonretractile, white, with cream-color ends. Three specimens have two rows the entire length of the ambulacra. In one specimen the two lateral ambulacra have two rows and the mid-ventral is partly with two and partly with four rows. The other two specimens have four rows in the mid-ventral ambulacrum in the middle of the body. This increase in number of rows is obviously due to contraction and is of interest in relation to Théel's description of the "median series, composed, apparently, of about four rows of pedicels on the posterior half of the body; anteriorly the odd ambulacrum carries only two rows of pedicels."

Pupillæ.—Dorsal, usually the most anterior are longer and form a fringe projecting in front of the body. Length, 0.6 to 1.7 mm.; average, 1.1 mm.

Color.—Stalks, like body; some of the ends, white.

Body wall.—Rough, 0.1 to 5.0 mm. thick; average, 2.2 mm.

Spicules of the body wall.—In addition to the structures described by Théel, occasionally the four-rayed forms have the ends of the rays joined to make perforated disks or tables.

An incomplete table is shown in Théel's figure. All stages between the simple bifurcated, or perforated, ends of the rays to the completed disk may be observed. Théel's suggestion that the two C-shaped deposits he observed belonged to another species is borne out by the absence of any such spicules in the six *Albatross* specimens.

Spicules of the tentacles.—The supporting rods (fig. 12) vary greatly in size and degree of curvature. They may be straight or form a semicircle, or the curvature may be represented by an acute angle. Generally the ends are perforated. The rods are smallest at the tips of the tentacles.

Size of rods in millimeters.—Length of chord, 0.06 to 1.4; width of rod, 0.008 to 0.08.

Polian vesicle.—Only one in each of the six individuals in contradistinction to Théel's, which had two. Form, cylindrical. Length, 11.0 to 24.0 mm.; average, 13.5 mm.



FIG. 12.—*STICHOPUS CHALLENGERI*. CURVED SUPPORTING ROD OF A TENTACLE. ($\times 50$.)

Stone canal.—Single, in dorsal mesentery with madreporite adherent to coelomic epithelium. Length, 6.0 to 18.0 mm.; average, 13.0 mm.

Madreporite, disk formed (in one case spherical) with stone canal attached to one edge. Diameter, 1.0 to 3.0 mm.

Gonads.—In both sexes like a string of beads. Gonaduct accompanies the stone canal anteriorly, joining the genital papilla just posterior to the madreporite. Five specimens were females, one male.

Respiratory trees.—Present in three specimens, with two branches as described by Théel, except in one individual, which has three. Length, trunk, 5.0 to 12.0 mm.; average, 8.0 mm.; longest branch, 30.0 to 59.0 mm.; average, 39.7 mm.; shortest branch, 23.0 to 43.0 mm.; average, 30.7 mm.

Habitat.—Lat. $46^{\circ} 53' S$.; long. $51^{\circ} 52' E$.; depth, 550 fathoms (Théel, *Challenger* Report, 1886). Naha Bay, Behm Canal, southeastern Alaska, Uyak Bay, Kadiak Island, Shelikof Strait (*Albatross*, Alaska Salmon Investigations, 1903).

LITERATURE.

1883. BELL, F. JEFFREY. On the Spicules of *Cucumaria hyndmanni*, *C. calcigera*, and two allied forms. Jour. Roy. Mic. Soc. London, (2), III, pp. 481-484.
1899. BIDENKAP, OLAF. Tromsøundets Echinodermer. Tromsø Mus. Aarsh., Hft. 20, pp. 104-112.
1835. BRANDT, JOH. FRID. Prodrum descriptionis animalium ab H. Mertensio observatorum. Fasc. I.
1883. BUSH, KATHARINE J. Proc. U. S. Nat. Mus., VI.
1901. CLARK, HUBERT LYMAN. The Holothurians of the Pacific coast of North America. Zool. Anzeig., XXIV, pp. 162-171.

- 1901a. CLARK, HUBERT LYMAN. Echinoderms from Puget Sound. Proc. Boston Soc. Nat. Hist., XXIX, (15), pp. 323-337.
1902. ———. Notes on Some North Pacific Holothurians. Zool. Anz., XXV, (677).
1904. ———. The Echinoderms of the Woods Hole Region. Bull. U. S. Fish Com., pls. I-XIV, pp. 545-576.
- 1903-4. DELAGE, Y., and HÉROUARD, E. Traité de zoologie concrète. 3; Les Échinodermes. 8vo., 53 pls., 565 text. figs., pp. x+496, Paris.
1881. DUNCAN, P. MARTIN, and SLADEN, W. PERCY. A Memoir on the Echinodermata of the Arctic Sea to the West Coast of Greenland. London. 82 pp. 6 pls.
1905. EDWARDS, CHARLES LINCOLN. A Quantitative Study of *Holothuria atra* Jaeger and the Reestablishment of *Holothuria floridana* Pourtales (= *Holothuria mexicana* Ludwig). Science, n. s., XXI, (532), pp. 383-384, Mar. 10.
1852. FORBES, EDWARD. Notes on Animals of the Class Echinodermata. Sutherland, Peter C. Journal of a voyage in Baffins Bay and Barrow Straits in the years 1850-51, II, London, Appendix, pp. cexiv-cexvi.
1884. GANONG, W. F. On the Zoology of the Invertebrate Animals of Passamaquoddy Bay. Bull. Nat. Hist. Soc. New Brunswick, (4), pp. 87-102.
1888. ———. The Echinodermata of New Brunswick. Bull. Nat. Hist. Soc. New Brunswick, (7), pp. 45-53.
1891. ———. Zoological Notes. Bull. Nat. Hist. Soc. New Brunswick, (9). (Reprint in 14 pp., but no date.)
1767. GUNNERUS, JOHN ERNST. Beskrifning På trenne Norrska Sjö-Kräk, Sjö-Pengar kallade Kongl. Ventenskapps Acad., Handlingar för År 1767, XXVIII pp. 114-124, tab. 4.
1902. HØRRING, R. Rapport om Fiskeriundersøgelserne under Faerøerne og Island i Sommeren 1901. Fiskeri-Beretn. for 1900-1901, pp. 181-209.
1901. KINGSLEY, J. S. Preliminary Catalogue of the Marine Invertebrata of Casco Bay, Maine. Proc. Portland Soc. Nat. Hist., II, pp. 159-183.
1885. LAMPERT, KURT. Die Seewalzen. Semper, Reisen im Archipel der Philipinen, Wiesbaden, Teil 2, IV, Abt. 3, 4, 310 pp., 1 pl.
1883. LUDWIG, HUBERT. Verzeichniss der Holothurien des Kieler Museums. 22 Bericht d. Oberhess. Gesellsch. f. Natur-u. Heilkunde, pp. 155-176.
1886. ———. Echinodermen des Berings-meeres. Zool. Jahrbücher, I, pp. 275-296, 1 pl.
1894. ———. 12. The Holothurioidea. Reports on an exploration off the West Coasts of Mexico, Central and South America, and Galapagos Islands, in charge of Alex. Agassiz, U. S. Fish. Com. str. *Albatross*, during 1891, Lieut. Com. Z. L. Tanner, U. S. N., commanding. Memoirs Mus. Comp. Zool. Harvard Coll., XVII, (3), 183 pp., 19 pls.
1898. ———. Holothurien. Hamburger Magelhaensischen Sammelreise. Ergeb. Hamburg Magelh. Sammelreise, 3 Lief. (1), 98 pp., 3 pls.
1900. ———. Arktische und subarktische Holothurien. Fauna Arctica herausgegeben von F. Römer u. F. Schaudinn. Jena, I, pp. 133-178.
1857. LÜTKEN, CHR. FR. Oversigt over Grönlands Echinodermata. Videnskabelige Meddel. fra den Naturhist. Forening i Hjøbenhavn, pp. 88-110.
1874. MARENZELLER, E. v. Kritik adriatischer Holothurien. Verhandl. zool.-bot. Gesellsch. Wien., pp. 299-320.
1897. MITSUKURI, K. On Changes which are found with Advancing Age in the Calcareous Deposits of *Stichopus japonicus*, Selenka. Annot. Zool. Japon., V, Pts. 1 and 2, pp. 31-42, 3 text figs.
1903. ———. Notes on the Habits and Life History of *Stichopus japonicus* Selenka. Annot. Zool. Japon., V, Pt. 1, pp. 1-21, 4 figs.

1877. NORMAN, A. M. J. Gwyn Jeffreys Preliminary Report of the Biol. Results of a cruise of H. M. S. *Valorous* to Davis Strait in 1875. Proc. Roy. Soc. London, XXV (1876), pp. 202-215.
1867. PACKARD, A. S. View of the Invertebrate Fauna of Labrador. Memoirs Boston Soc. Nat. Hist., I.
1894. PFEFFER, GEORG. Echinodermen von Ost. Spitzbergen, nach der Ausbeute der Herren Prof. W. Kükenthal und Dr. Alfr. Walter in Jahre 1889, Zool. Jahrbücher, Abt. f. Syst., VII, pp. 100-127.
1851. POURTALÉS, L. F. On the Holothuriae of the Atlantic Coast of the United States. Proc. Am. Ass. Adv. Sc., 5 Meet., pp. 8-16, Wash.
1861. SARS, M. Oversigt of Norges Echinodermter. Christiania., 160 pp., 16 pl.
1904. SCHMIDT, J. Fiskeriundersøgelser ved Island og Faerøerne i Sommeren 1903. Skrift. Komm. f. Havundersøgelser (I) vi+148 pp., X charts, Oct.
1867. SELENKA, EMIL. Beiträge zur Anatomie und Systematik der Holothurien. Zeitschr. f. wiss. Zool., XVII, pp. 291-374, pls. xvii-xx.
1868. SEMPER, CARL. Reisen im Archipel der Philippinen, Wiesbaden. Teil 2, Bd. I, Holothurian, 288 pp., 40 pls.
1901. SLUITER, C. PH. Die Holothurian der Siboga-Expedition. Monograph. 44, Uitkomsten op Zool. Bot. Ocean en Geol. Gebied Versameld in Nederland. Ost-Indië 1899-1900 aan boord H. M. Siboga onder commando Van Luit. G. F. Tydeman. Leiden.
1854. STIMPSON, W. Proc. Boston Soc. Nat. Hist., IV.
1857. ———. Crustacea and Echinodermata of the Pacific Coast of North America. J. of Boston Soc. of Nat. Hist., VI, pp. 444-532.
1879. STUNBERG, ANTON. Echinodermier från Novaj Semljas haf samlade under Nordenskiöldska expeditionerna 1875 och 1876. Oefversigt af Kongl. Vetenskaps-Akademiens Forhandlingar (1878), Stockholm. (3), pp. 27-40, pl. 6.
1886. ———. Fauna på och kring Novaja Semlja. Vega-Expeditionenes Vetenskapliga Jakttagelser, Stockholm, V, 239 pp. I Karte.
1882. THÉEL, HJALMAR. Report on the Holothuriodea, Pt. I. Report on the Scientific Results of the Voyage of H. M. S. *Challenger*, Zoology, IV, Pt. 13, London, 176 pp., 46 pls.
1886. ———. Report on the Holothuriodea, Pt. 2. Report on the Scientific Results of the Voyage of H. M. S. *Challenger*, Zoology, XIV, Pt. 39, London, 290 pp., 16 pls.
- 1886a. ———. Reports on the Results of Dredging, under the supervision of Alex. Agassiz, in the Gulf of Mexico (1877-78), in the Caribbean Sea (1879-80), and along the Eastern Coast of the U. S. during the summer of 1880, by the U. S. Coast Survey str. *Blake*, Lieut. Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., commanding. Report on the Holothuriodea, Bull. Mus. Harvard Coll., XIII, pp. 1-21.
1866. VERRILL, A. E. On the Polyps and Echinoderms of New England. Proc. Boston Soc. Nat. Hist., X, Boston, pp. 333-357.
1891. WALSH, J. A. TULL. Natural History Notes from H. M. Indian Marine Survey steamer *Investigator*, (24). List of Deep-Sea Holothurians collected during seasons 1887-1891, with descriptions of new species. J. Asiatic Soc. Bengal, LX, 1891, pp. 197-204.
1901. WHITEAVES, J. F. Catalogue of the Marine Invertebrata. Geol. Sur. Canada, Ottawa, (722), p. 44.

DESCRIPTIONS OF NEW SPECIES OF RECENT UNSTALKED CRINOIDS FROM THE NORTH PACIFIC OCEAN.

By AUSTIN HOBART CLARK,
Of the United States Bureau of Fisheries.

This paper is based upon material collected by the United States Fisheries steamer *Albatross* in the Pacific Ocean north of Mexico and southern Japan. All but two of the species were collected on the recent Japanese cruise in the Bering Sea and about Japan. The *Eschrichtii* group is best represented in regard to numbers, with over 1,750 specimens, mostly of Bering Sea and eastern Pacific forms. Unfortunately, *Antedon eschrichtii* var. *maxima* is so large (about 3 feet in diameter) that on the last cruise, although we obtained it in enormous numbers—on one or two occasions, in fact, there was very little else in the trawl—we found it impracticable to preserve an extensive series. The species of this group in the eastern Okhotsk Sea, off eastern Japan, off the Pacific-American coast, and in the Bering Sea are all remarkable for the strong overlapping of the arm joints, which have serrate distal edges, a fact which was first noticed for this district by Hartlaub in *Antedon tanneri* from Panama. The lower pinnules also have a distal comb, resembling that in some species of *Comatula*, but much longer than is usual in that genus. Another interesting fact is that the species from the western American coast all have the third syzygy in the fourteenth brachial and not in the twelfth, as do those from the Bering Sea and Asiatic coast. The distal intersyzygial interval in the North Pacific species (excepting those from southern Japan and the Japanese Sea) is almost invariably two joints, whereas in most of the others it is three. All these species will be more fully described and figured in my report on the North Pacific crinoids.

The following keys have been prepared with reference to all of the described species in the respective groups, and it is believed that the information given in them is amply sufficient to differentiate the new species from any of those given in the *Challenger* reports or subsequently described.

KEY TO THE SPECIES DESCRIBED.

Genus DECAMETROCRINUS Minckert.

A. Centro-dorsal large and conical, bearing about 80 cirri.

(1) *Decametrocrinus borealis*, new species.

Genus ANTEDON de Fréminville.

A. A syzygy in the radial axillary.

a. 10 arms: the first pinnule much elongated, with a distal comb-like process as in *Comatula* ^a (2) *Antedon rara*, new species.aa. 20 arms: distichals 4 (3 + 4) ^b: cirri smooth, with 15 joints.(3) *A. hartlaubii*, new species.

AA. Three articulated radials.

a. The lower pinnules long and flagellate, the first with very short, the second and following with much elongated joints: cirri smooth, with greatly elongated joints and a long terminal claw: brachials mostly oblong.

(4) *A. tenelloides*, new species.

aa. The lower pinnules long and flagellate, with numerous short and broad joints.

[ESCHRICHTII group.]

b. Cirri always more or less spiny: distal joints of first pinnule short and broad like the basal.

c. Fifth pinnule longer than the first: first and sixth pinnules usually about equal, but the sixth may be the longer: arm joints strongly overlapping, short-triangular: intersyzygial interval two joints.

d. Third syzygy in the twelfth brachial (5) *A. asperrima*, new species.dd. Third syzygy in the fourteenth brachial... (6) *A. perplexa*, new species.

cc. Fifth pinnule much shorter than the first.

d. Third pinnule the longest, with elongated joints, differing from the first and second, which have short and broad joints: fourth pinnule much shorter: 40 cirrus joints (7) *A. laodice*, new species.

dd. Third pinnule equal to, or not much shorter than, the second.

e. Joints of the third pinnule mostly wider than long as in the first and second: arm joints short and triangular: more than 40 cirrus joints: arms smooth: third pinnule most like the second.

(8) *A. eschrichtii* (J. Müller).

ddd. Third pinnule has fewer but much longer joints than the first and second.

e. Less than 40 cirrus joints: arm joints triangular.

f. Arm joints short, much wider than long, strongly overlapping: 35 to 40 cirrus joints (9) *A. inexpectata*, new species.ee. Over 40 cirrus joints: arm joints triangular, strongly overlapping: lower brachials strongly tubercular... (10) *A. rathbuni*, new species.

dddd. Third pinnule composed of a few elongated joints, and much shorter than the second, which has short joints.

^a It is unfortunate that the name *Actinometra* of Johannes Müller is untenable. Müller proposed the name in 1841 (Wiegmann's Archiv für Naturgesch., 1841, Bd. I, p. 140), naming as the type *Actinometra imperialis*, which was described by him at the same time. Later, after visiting the Paris Museum, Müller found that his *Actinometra imperialis* was identical with the *Comatula solaris* of Lamarck, which is the type of the genus *Comatula* proposed by Lamarck in 1816 (Hist. Nat. des Animaux sans vertèbres, II, p. 530.). Thus *Comatula* 1816 and *Actinometra* 1841, being founded on the same species, are synonyms, and it becomes necessary to replace the latter by the older name established by Lamarck.

^b 4 (3+4): four joints, the third and fourth united by syzygy.

- e. Middle and distal arm joints very short, much wider than long.
- f. Calyx and arm bases smooth: third syzygy in the twelfth brachial.
- g. Distal arm joints with smooth edges, not overlapping: intersyzygial interval 1 to 5, usually 3 joints.. (11) *A. brachymera*, new species.
- gg. Distal arm joints strongly overlapping, with serrate edges: intersyzygial interval 2 joints..... (9) *A. inexpectata*, new species.
- ff. Calyx and arm bases spinous: third syzygy in the fourteenth brachial..... (12) *A. serratissima*, new species.
- dddd. The third pinnule, while much shorter than the second, has similar joints, which are more elongate than those of the first.
- e. 60 cirrus joints: first pinnule the longest: radials and lower brachials with raised and spiny edges..... (13) *A. maria*, new species.
- ee. 35 to 40 cirrus joints: radials and lower brachials smooth.
(14) *A. hondoensis*, new species.
- bb. Cirri perfectly smooth: distal joints of first pinnule somewhat elongate.
(15) *A. clio*, new species.
- aaa. Lower pinnules long and flagellate, with elongated joints... [TENELLA group.]
- b. Cirri with more than 30 joints: centrodorsal long and conical with 5 inter-radial ridges, each inclosing 3 rows of cirrus sockets.
- c. First pinnule much longer than the second.. (16) *A. erythrizon*, new species.
- cc. Second pinnule as long as the first..... (17) *A. fragilis*, new species.
- bb. Cirri with about 20 joints.
- c. First pinnule twice as long as the second..... (18) *A. tenuis*, new species.
- cc. Second pinnule nearly as long as the first.
- d. Middle arm joints triangular: syzygial interval 2 or 3 joints.
- e. Cirrus joints long: lower pinnules not carinate.
(19) *A. ciliata*, new species.
- ee. Cirrus joints short: lower pinnules strongly carinate.
(21) *A. arctica*, new species.
- dd. Middle arm joints quadrate and elongated: syzygial interval 1, sometimes 2 joints..... (20) *A. isis*, new species.
- bbb. Cirri with less than 15 joints.
- c. Cirri smooth, with elongated joints: radials and lower brachials in contact and tubercular: first two pinnules short..... (22) *A. briseis*, new species.

I. DECAMETROCRINUS BOREALIS, new species.

Centro-dorsal conical, 9 mm. in diameter, and comparatively high, bearing about 80 cirri, the dorsal pole free. Cirri lacking.

First radials just visible; first brachial short, about three times as wide as high, somewhat incised by the second; second brachial irregularly quadrate, about as long as wide, with a backward projection, rising into a tubercle; following brachials quadrate, becoming triangular after the basal third of the arm, then quadrate again toward the end and elongate at the tip. Syzygies in the fourth brachials, again about the eighth or ninth, and distally at intervals of from 2 to 6 (usually about 3 or 4) joints. Arms 125 mm. in length, with about 100 joints.

First pinnule, on the second brachial, 15 mm. long, slender, with 45 or 50 short joints. Second pinnule, on third brachial, 12 mm. long, resembling the first; third pinnule like the second; distal pinnules 15 mm. long, with about 20 long, slender joints.

The color in life is purplish brown, the skeleton nearly white; the disk is black.

Type.—Cat. No. 22652, U.S.N.M., from *Albatross* station No. 4918; $30^{\circ} 22' 00''$ north latitude, $129^{\circ} 08' 30''$ east longitude (Eastern Sea); 361 fathoms; August 13, 1906.

2. ANTEDON RARA, new species.

Centro-dorsal large and discoidal, bearing about 20 cirri. These are 5 mm. long, with 8 or 10 joints, the basal half greatly elongated, centrally constricted, the distal short and compressed.

Second radials barely visible; axillaries pentagonal, wider than high, with a syzygy; 10 arms 35 mm. long, the first 3 brachials oblong, the remainder quadrate (the fifth to the ninth almost triangular) becoming elongate distally. A syzygy in the third brachial, another about the tenth, and others distally at intervals of about 2 joints.

First two (outer) pinnules the longest, with about 20 short joints, bearing a comb distally, as in *Comatula*. The third to the sixth pinnules are shorter, without combs, and bear much swollen rounded genital glands on the second and third joints; distally the pinnules are longer and more slender. Disk that of a typical *Antedon*.

The color in life is light clear yellow, the cirri white.

Type.—Cat. No. 22605, U.S.N.M., from *Albatross* station No. 4892; $32^{\circ} 27' 30''$ north latitude, $128^{\circ} 33' 00''$ east longitude (Eastern Sea); 181 fathoms; August 9, 1906.

3. ANTEDON HARTLAUBI,^a new species.

Centro-dorsal a thick disk, the pole beset with small spines, bearing about 30 marginal cirri; these are smooth, without dorsal spines, 20 mm. long, with 15 remarkably uniform joints, all of which are somewhat longer than wide. There is no opposing spine to the terminal claw.

Radials concealed as far as the syzygy in the axillary; axillaries low and wide; distichals 4, the two outer united by syzygy; rarely 3, the two outer united by syzygy; 20 arms 120 mm. long, the first eight brachials oblong, the remainder triangular, somewhat wider than high, becoming quadrate at the tips of the arms; a syzygy in the third brachial, another about the fifteenth, and others distally at intervals of from 4 to 7 joints.

First pinnule on the second distichal, always on the outer side of the rays, 4 mm. long, with about 20 joints, the first three or four broad, with rough dorsal projections, the distal short but slender; the second brachial bears a slender pinnule 11 mm. long with about 40 short joints, the first two with dorsal processes. From the first two brachial pinnules,

^aFor Dr. Clemens Hartlaub, in recognition of his work on the unstalked crinoids of the Indian Archipelago.

the pinnules gradually decrease in size, increasing again and becoming very slender distally.

Color in life yellowish brown, the skeleton whitish.

Type.—Cat. No. 22606, U.S.N.M., from *Albatross* station No. 4934; $30^{\circ} 58' 30''$ north latitude, $130^{\circ} 32' 00''$ east longitude (off Kagoshima Gulf); 152–103 fathoms; August 16, 1906.

4. ANTEDON TENELLOIDES, new species.

Centro-dorsal a thick disk, bearing about 60 or 70 slender marginal cirri; these are 35 mm. long, with fifteen to seventeen greatly elongated joints, perfectly smooth, the cirrus ending in a long sharp terminal spine.

Second radial partially visible, the centro-dorsal usually extending up to the inferior end of the axillary; the axillary is wider than high; 10 arms 110 mm. long, with about 120 brachials, usually regularly oblong throughout the arm, proportionately longer distally. Syzygies in the third, eighth, and twelfth brachials, and distally at intervals of 2 joints.

First pinnule 14 mm. long, slender, composed of 35 to 40 short joints, all of which are wider than long; second pinnule 10 mm. long, with 20 joints, all but the basal 3 or 4 much longer than wide; third pinnule 8 mm. long, with 15 joints, the basal 4 squarish, the rest longer than wide, with a large genital gland on the fourth to the eighth; following pinnules to the thirteenth essentially like the third; distal pinnules 20 mm. long, very slender, with 25 to 30 elongated joints.

Color in life grayish brown, dorsal surface and cirri nearly white.

Type.—Cat. No. 22607, U.S.N.M.; from *Albatross* station No. 5092; $35^{\circ} 04' 50''$ north latitude, $139^{\circ} 38' 18''$ east longitude (Uraga Straits, entrance to Tokyo Gulf); 70 fathoms; October 26, 1906.

5. ANTEDON ASPERRIMA, new species.

Centro-dorsal hemispherical, 9 mm. in diameter, bearing 30–70 (usually 50–60) cirri, the upper 50–53 mm. long with 50–60 joints short and squarish at the base, becoming about twice as long as wide, then gradually becoming square or even wider than long toward the tip; the lower 25 mm. long with 25–30 joints, not much longer than wide, and stout in proportion to their length, being as thick as, or even thicker than, the more elongate cirri of the upper row. The cirri are not always dimorphic in this species; frequently they are all of one type.

First radials almost concealed by the centro-dorsal; second radials very short and trapezoidal, about four times as wide as long; axillaries about as wide as high, equal in width to the horizontal diameter of the second brachials, with a sharp distal angle; 10 arms about 230 mm. in length,

with 250-300 joints, the edges of all raised distally and overlapping the succeeding joint, this character becoming marked after the eighth brachial. The distal edges of the joints are set with a row of fine sharp teeth, each with a median ridge which is continued in a raised line for some distance back onto the joint, giving it a longitudinally striate appearance. All the syzygies except the proximal two or three are supplied with a row of these teeth, becoming distally quite as prominent as those on the articulations. The first brachial is trapezoidal in shape, the outer edge being about twice as long as the inner; the second brachial is triangular when viewed externally; the succeeding joints to the tenth are quadrate, having pinnules on their shorter sides, and their apposed edges rising to tubercular prominences, alternating in position; from the tenth on the brachials are triangular, rather short, and becoming shorter distally. Syzygies always in the third, eighth, and twelfth brachials, and distally at intervals of 2 joints.

The first pinnule is 20 mm. long with nearly 100 very short joints; the second pinnule is 24 mm. long, both this and the first with a strong comb on their distal half; the third pinnule is 25 mm. long, with much more elongate joints and only the last quarter with a comb; the fourth pinnule is 24 mm. long, the fifth 23 mm. long, and the sixth 20 mm. long, all with much elongated joints; the fourth and following pinnules bear genital glands; distally the length decreases to about the twelfth pinnule, then increases again.

This species is readily distinguished by the great length of all the pinnules, and especially of the first six or eight pairs, which are remarkably uniform, combined with the presence of a syzygy in the twelfth brachial.

Color in life yellow, the cirri whitish.

Type.—Cat. No. 22650, U.S.N.M.; from *Albatross* station No. 3332; 54° 02' 50" north latitude, 166° 45' 00" west longitude (Bering Sea); 406 fathoms; August 21, 1890.

6. *ANTEDON PERPLEXA*, new species.

In general similar to the preceding species, but more slender, the arm joints more elongate and quadrate, the axillary considerably wider than the second radial, and the third syzygy almost invariably in the fourteenth brachial, rarely in the thirteenth, and never in the twelfth.

Color in life yellow or brownish yellow, the cirri whitish.

Type.—Cat. No. 22611, U.S.N.M.; from *Albatross* station No. 3070; 47° 29' 30" north latitude, 125° 43' 00" west longitude (off the coast of Washington); 636 fathoms; June 28, 1889.

7. *ANTEDON LAODICE*, new species.

Centro-dorsal low, hemispherical, bearing about 40 cirri; these are 40 mm. long, with 40 joints, the basal half of which are longer than wide, the distal short and furnished with low spines.

First radials partially visible; second radials short, oblong, incised by a backward projection of the axillary; axillaries about as wide as high, with a backward projection forming a tubercle; 10 arms; first brachial irregularly quadrate, with a short inner and long outer border; second brachial almost triangular; following brachials quadrate, becoming triangular after the fourteenth or fifteenth; syzygies in the third, eighth, and twelfth or thirteenth brachials, and distally at intervals of 3 joints.

Two first pinnules 20 mm. long, slender and flagellate, with 50 very short joints; third pinnule 22 mm. long with 46 joints; the fourth shorter; fifth and sixth much shorter, with the joints more elongate. The first 4 pinnules bear combs.

Color in life lemon yellow, the cirri lighter.

Type.—Cat. No. 22609, U.S.N.M.; from *Albatross* station No. 4969; $33^{\circ} 23' 40''$ north latitude, $135^{\circ} 33' 00''$ east longitude (off southern Japan); 587 fathoms; August 29, 1906.

8. *ANTEDON ESCHRICHTII* (J. Müller.)

The specimens of this species obtained in the Okhotsk Sea and the Sea of Japan appear to be structurally identical with others from Europe and the Atlantic coast of America, but the size is much greater, the extent reaching 700 mm. and the cirri 115 mm., as against a maximum of 500 mm. and 70 mm., as given by Dr. P. Herbert Carpenter in the *Challenger*^a report. *Antedon eschrichtii* in the Pacific has a remarkably restricted range, being found only in the Sea of Okhotsk, about southern Sakhalin and La Perouse straits, in parts of the Gulf of Tartary, and in the northern part of the Sea of Japan. On the southern and eastern shores of Japan, along the Kurils and in the Bering Sea it is replaced by quite different species. Considering the isolated and circumscribed habitat of this species in this region, together with its uniformly greater size, it seems best to bestow upon it, for the present at least, the varietal name of *Antedon eschrichtii maxima*, taking as the type-locality $43^{\circ} 01' 35''$ north latitude, $140^{\circ} 10' 40''$ east longitude, in 248 fathoms, off the coast of Hokkaido, in the Sea of Japan.

9. *ANTEDON INEXPECTATA*, new species.

This species resembles *Antedon asperima* and *A. perplexa* in general appearance, but the third pinnule is distinctly smaller than the first and second (which are about equal in size), frequently very much

^a *Challenger* Reports, Report on the Crinoidea, Zoölogy, xxvi, p. 139.

so; the fourth pinnule is still smaller, the minimum being reached on the seventh or eighth, after which the length increases distally. *Antedon inexpectata* is a somewhat stouter species than *A. asperima*, and is usually smaller, although some individuals are fully as large as my largest of that species, measuring, arms 230 mm., cirri 70 mm. The third syzygy is in the twelfth brachial.

The color in spirits is brownish yellow.

Type.—Cat. No. 22647, U.S.N.M.; from *Albatross* station No. 2853; $56^{\circ} 00' 00''$ north latitude, $154^{\circ} 20' 00''$ west longitude (south of Alaska Peninsula); 159 fathoms; August 9, 1888.

10. ANTEDON RATHBUNI,^a new species.

This species resembles *Antedon asperima*, but is very much more robust, with the lower arm joints strongly tubercular; the first three pinnules are of equal length, the fourth somewhat, and the fifth much shorter, little over half as long as the third. The arrangement of the syzygies is as in *A. asperima*.

The color in life is bright yellow.

Type.—Cat. No. 22648, U.S.N.M.; from *Albatross* station No. 5033; $44^{\circ} 04' 20''$ north latitude, $145^{\circ} 28' 00''$ east longitude (in Yezo Straits); 533 fathoms; September 30, 1906.

11. ANTEDON BRACHYMERIA, new species.

Centro-dorsal hemispherical, bearing 30 to 50 cirri; these are 45 mm. or 50 mm. long, with 40 to 45 joints of which the distal third bear low dorsal spines.

First radials just visible; second radials short, trapezoidal, much wider than high; 10 arms 160 mm. long; first 14 or 15 brachials smooth, slightly tubercular, wider than long, irregularly oblong or somewhat quadrate; following brachials low-quadrate, becoming shorter distally, the distal edges produced outward, but smooth and not overlapping; none of the brachials are triangular, and all are wider than long, the middle and distal very much so; syzygies in the third and eighth, usually also in the twelfth brachials, and distally at intervals of from one to five, usually three joints.

First pinnule 30 mm. long with 65 to 70 short and wide joints, the distal third with a comb; second pinnule the same length or very slightly shorter, similar to the first, but with the comb not so pronounced; third pinnule like the fourth, 16 mm. long with 28 joints, mostly rather longer than wide; the following pinnules decrease in length to about the tenth, then increase again distally.

Color in life yellowish white, readily distinguishable from the lemon yellow *Antedon eschrichtii maxima*, with which it is always associated.

^aFor Dr. Richard Rathbun, in recognition of his work on the Crinoidea.

Type.—Cat. No. 22649, U.S.N.M.; from *Albatross* station No. 4986; 43° 01' 40" north latitude, 140° 22' 40" east longitude (Sea of Japan); 172 fathoms; September 19, 1906.

12. *ANTEDON SERRATISSIMA*, new species.

Centro-dorsal hemispherical, with 40 or 50 stout cirri, almost all the joints of which bear strong dorsal spines; the cirri are 30 mm. long, with about 36 joints, which exhibit a tendency to overlap.

First radials concealed; second barely visible; axillaries very broad; 10 arms 105 mm. in length; first brachials very short; second triangular, approximately equilateral; third irregularly oblong; following brachials to the tenth or twelfth, wedge-shaped, then triangular. Syzygies in the third, eighth, and fourteenth brachials, and distally at intervals of 2 joints. The radials and lower brachials are thickly set with small sharp spines. Brachials overlapping, the edges of all set with numerous small sharp teeth.

The first pinnule is 17–21 mm. long with 45–60 short joints, and bears a long comb distally; the second pinnule (which is longer than the first) is from 18–22 mm. in length, with 45–60 joints; the third pinnule may be 20 mm. long with 36 joints and bearing a comb like the second, or it may be 12 mm. long with elongated joints, like the fourth; the distal pinnules are long and slender, their joints overlapping, the distal edges set with spines.

Color in life yellow, the cirri whitish; in spirits white, brown, or red.

Type.—Cat. No. 22612, U.S.N.M.: from *Albatross* station No. 3464; 48° 14' 00" north latitude, 123° 20' 40" west longitude (off the coast of Washington); 40 fathoms; September 4, 1891; 32 other specimens from the coast of Washington, Oregon, and northern California.

This is a much stouter species than *Antedon perplexa*, with proportionately shorter arms. It is readily distinguishable from that form by the spiny character of the radials, lower brachials, and pinnules, and the proportionately greater size of the centro-dorsal, which entirely conceals the first and almost entirely the second radials.

13. *ANTEDON MARIÆ*,^a new species.

Centro-dorsal hemispherical, bearing about 50 cirri (the pole free) dimorphic in character; the upper (about the edge of the centro-dorsal) 60 mm. in length, with 60 joints, compressed laterally, elongate proximally, short distally, the distal joints with faintly indicated spines; the lower 35 mm. in length with about 30 joints.

First radials concealed except for a narrow border; second radials short, about four times as wide as long; axillaries about as high or

^a For Mrs. Mary W. Clark, of Boston, Massachusetts, to whom I am indebted for much valuable assistance in my work on the unstalked crinoids.

higher than wide, triangular, the middle of the proximal border raised into a slight tubercle, the inferior edge set with fine teeth. Ten arms; the first brachial with short inner and long outer edge, the latter with a row of small sharp spines; second brachial irregularly quadrate; third brachial with a longer inner than outer edge; following brachials to the eleventh oblong, the next few quadrate, then triangular.

First pinnule 22 mm. in length, slender and flagellate, with 60 short joints, wider than long, of which the terminal 25 or 30 bear a comb; second pinnule 19 mm. long with about 40 joints, longer in proportion than those of the first; third pinnule 16 mm. long, with 40 joints, and, like the second, with a terminal comb. Following pinnules much shorter, with fewer and longer joints and no comb; the pinnule on the twenty-sixth brachial is 12 mm. long, slender, with 20 elongated joints.

Color in life clear yellow, cirri lighter.

Type.—Cat. No. 22608, U.S.N.M.; from *Albatross* station No. 5092; $35^{\circ} 04' 50''$ north latitude, $139^{\circ} 38' 18''$ east longitude (Uraga Straits, entrance to Tokyo Gulf); 70 fathoms; October 26, 1906.

14. ANTEDON HONDOENSIS, new species.

Centro-dorsal hemispherical, bearing 30 to 50 cirri, the pole bare; cirri 40 mm. long, with 35 to 40 joints, the distal half spiny, the articulations rather prominent.

First radials just visible; second radials very short; axillaries somewhat wider than high, with an open distal angle; ten arms 140 mm. long; first brachial very short, the next triangular; following brachials to about the tenth irregularly oblong, almost squarish, then becoming quadrate as long as or longer than wide, the proportion remaining about the same to the end of the arm.

First two pinnules 24 mm. long, with short and broad joints, becoming squarish after the first five or six; the basal five or six joints bear high but short dentate dorsal processes, those on the different joints separated from each other by deep notches; third pinnule 14 mm. long, with rather elongated joints, resembling those of the second. The fifth pinnule bears a small genital gland, which increases in size on the sixth and following. The distal pinnules are long and slender, with the edges of the joints set with small spines.

This species is peculiar in having the position of the third syzygy quite irregular, but usually on the twelfth, thirteenth, or fourteenth brachials; the distal intersyzygial interval is two joints.

Type.—Cat. No. 22651, U.S.N.M.; from *Albatross* station No. 5048; $38^{\circ} 09' 24''$ north latitude, $141^{\circ} 52' 30''$ east longitude (off Kinka San Light, east coast of Nipon); 129 fathoms; October 10, 1906.

15. *ANTEDON CLIO*, new species.

Centro-dorsal hemispherical, bearing 40–50 cirri, a large polar area free; cirri 17 mm. long, slender, with 25–30 joints, of which the fourth to fifteenth are much longer than wide, then decreasing in length, becoming squarish distally; the distal joints do not bear dorsal spines.

First radials visible at angles of calyx, laterally separated distally; second radials very short, widely separated laterally, very deeply incised by the rhombic axillaries; axillaries rhombic, or possibly slightly longer than wide, the distal angle somewhat open. Ten arms, 55 mm. long; first brachial very short and deeply incised, the inner edge much shorter than the outer; second brachial irregularly quadrate, produced distally on the outer side of the ray, and proximally in the median line; third brachial quadrate, the inner side more than twice the length of the outer, the epizygial quadrate with the inner side longer than the outer, the hypozygial triangular, with the short side in the inner side of the ray, the apex on the outer; next five brachials irregularly oblong, then quadrate for five or six, then triangular, about as wide as high, becoming quadrate again distally; syzygies in the third, eighth, and twelfth brachials, and distally at intervals of three joints; the lower brachials are raised distally, giving the lower part of the arms a distinctly serrate appearance; the edges of the outer brachials are slightly roughened, but do not overlap.

First pinnule 10 mm. long, very slender, with about 30 joints, the basal 6 or 7 of which are short and wide, then becoming more elongate, but never much more than twice as long as wide; second pinnule much shorter (7 mm.) and stouter, with 15 joints, the first 3 short, the remainder greatly elongated; the following pinnules are stouter, but in general similar to the second; they gradually decrease in length to about the seventh, then become more slender and increase in length distally where they are 8 mm. long with about 20 slender joints, all but the basal two, which are short, greatly elongated.

Color in life light yellow, banded with white, the cirri white, with occasional narrow bands of yellow.

Type.—Cat. No. 22618 U.S.N.M.; from *Albatross* station No. 4904; 32° 31' 20" north latitude, 128° 32' 40" east longitude (Eastern Sea); 107 fathoms; August 10, 1906.

16. *ANTEDON ERYTHRIZON*, new species.

Centro-dorsal long and conical, divided by 5 interrarial ridges into areas containing 3 parallel rows of cirri, about 12 in each area, or 60 in all. The cirri are about 50 mm. long, with 35–40 elongated, much compressed, smooth joints, the longest between 3 and 4 times as long as wide, decreasing in length distally; terminal spines very small.

First radials visible at angles of calyx; second radials crescentic, deeply incised to receive the strong backward projection of the axillaries; axillaries quadrate in form, about as long as wide, all the sides somewhat concave; 10 arms; the first brachials have long outer and short inner sides, and are very deeply incised by the second brachials, which are nearly square; the six following brachials are oblong, subsequently becoming quadrate for a few joints, then triangular; a syzygy in the third brachial, another about the eighth, and others distally at intervals of from 5-10 joints.

The first pinnule is about 20 mm. long and very slender, composed of 16 greatly elongated joints; the second pinnule is 15 mm. long with about 12 elongated joints; the following pinnules decrease in length, their component joints being much shorter proportionately; the distal pinnules are 17 mm. long with about 17 greatly elongated joints.

Color in life, dull purple, rather dark.

Type.—Cat. No. 22613 U.S.N.M.; from *Albatross* station No. 4981; $42^{\circ} 58' 15''$ north latitude, $140^{\circ} 09' 10''$ east longitude (Sea of Japan); 406-390 fathoms; September 19, 1906.

17. ANTEDON FRAGILIS, new species.

This species is similar to *A. erythrizon* in the character of its centro-dorsal and in its general appearance; but the cirri consist of about 30 greatly elongated smooth joints; the first two pinnules are equal in length, comparatively short (14 mm.) but slender, with about 20 elongated joints, the third longer and distinctly stouter; the axillaries and lower brachials are more elongated than in *A. erythrizon*; syzygial interval 2, sometimes 3, joints.

Color in life, light purplish brown.

Type.—Cat. No. 22614, U.S.N.M.; from *Albatross* station No. 5032; $44^{\circ} 05' 00''$ north latitude, $145^{\circ} 30' 00''$ east longitude (Yezo Straits); 500 fathoms; September 30, 1906.

18. ANTEDON TENUIS, new species.

(?) *Antedon* species, VON GRAFF *Challenger* Reports 1884, vol. X of Zoology, No. 27, p. 79 (Vladivostok).

Centro-dorsal flattened hemispherical, bearing about 40-50 cirri, the pole free; the cirri are 25 mm. long and have about 20 elongated joints, becoming shorter distally and developing a low dorsal spine.

First radials concealed; second radials short and deeply incised by the axillaries; axillaries slightly wider than high, rhombic, the edges slightly concave; the axillaries are wider than the second radials; 10 arms, 110 mm. long and very slender; first brachial very short, the outer edge longer than the inner; second irregularly quadrate; following brachials to the eighth squarish, then quadrate to somewhat past the middle of the arm, after which they become long and "dicebox

shaped;" syzygies in the third, eighth, and twelfth brachials, and distally in alternate joints.

First pinnule 20 mm. long, very slender, with 30 joints, the basal 5 wider than long, then becoming slender and greatly elongated; second pinnule about half as long as the first, with about 20 joints, the basal two or three wider than long, the rest elongated, a large genital gland on the fifth to eleventh joints; third and following pinnules like the second; distal pinnules 13 mm. long with 25 very slender joints, the two basal short and somewhat flattened.

Color in life, light yellow-brown.

Type.—Cat. No. 22615, U.S.N.M.; from *Albatross* station No. 4997; 47° 38' 40" north latitude, 141° 24' 30" east longitude (Gulf of Tartary); 318 fathoms; September 23, 1906.

19. *ANTEDON CILIATA*, new species.

Centro-dorsal low hemispherical, the pole bare, with 40–50 cirri, the longest (about the margin) reaching 35 mm. in length, and consisting of about 20 (usually rather less) elongated joints, all of which are longer than wide, the basal half very much so; apical cirri much shorter and more slender, but with the same number of joints.

First radials concealed; second radials short and wide, more or less incised by the axillaries; axillaries rhombic in form, wider than high, with the sides slightly concave, and considerably wider than the second radials; 10 arms 130 mm. in length; the first brachial irregularly quadrate, with a long outer and short inner edge; second brachial irregularly quadrate, with a long outer and short inner edge; third brachial squarish; following brachials to the tenth irregularly oblong with the borders somewhat, often strongly, tubercular; succeeding brachials triangular, about as wide as high, becoming quadrate distally; syzygies in the third, eighth, and twelfth brachials, and distally at intervals of 2, sometimes 3, joints.

First pinnule 20 mm. long, with 35 joints, the proximal 12 short and wide, mostly wider than long, the distal 23 extremely long and slender; second pinnule somewhat less, with 20 joints, the 2 basal wider than long, the basal 10 carinate, the distal 10 much elongated and slender, and a large genital gland occupying the third to eleventh; following pinnules like the second; distal pinnules long and very slender, with 30 joints, the first two short and wide, the others greatly elongated, especially distally.

Color in life, light purplish brown, the skeleton lighter; cirri nearly white.

Type.—Cat. No. 22616, U.S.N.M.; from *Albatross* station No. 4982; 43° 00' 00" north latitude, 140° 10' 30" east longitude (Sea of Japan); 390–428 fathoms; September 19, 1906.

20. *ANTEDON ISIS*, new species.

Centro-dorsal hemispherical, bearing 30–40 slender cirri, 10 mm. long, with 20 joints, not especially elongate, the fourth, which is the longest, being little more than twice as long as high; all the joints are expanded distally, slightly overlapping, but do not develop dorsal spines.

First radials visible at angles of calyx; second radials narrow and much curved; axillaries approximately square, with the sides concave. Ten arms 65 mm. long, very slender; first brachial short, with a long outer and short inner edge; second brachial irregularly quadrate; third and following brachials irregularly quadrate, becoming longer later, and very long and “dice-box” shaped distally; syzygies in the third, eighth, and twelfth brachials and distally in alternate joints, sometimes with intervals of 2 joints.

First pinnule 7 mm. long, moderately slender, with about 20 joints, the basal 3 or 4 short, the others longer than wide; the second pinnule somewhat shorter, with about 12 joints, the basal 4 short, the rest longer than wide; third pinnule like the second and of the same length; the fourth and following pinnules bear large genital glands; distal pinnules 9 mm. long, very slender, with 15 joints, the first 2 short and expanded, the remainder much elongated.

Color in life yellowish brown, the skeleton and cirri lighter.

Type.—Cat. No. 22617, U.S.N.M.; from *Albatross* station No. 4917; 30° 24' 00" north latitude, 129° 06' 00" east longitude (about 90 miles WSW. of Kagoshima Gulf); 361 fathoms; August 13, 1906.

21. *ANTEDON ARCTICA*, new species.

Centro-dorsal small, hemispherical, bearing about 30 cirri; these are 13 mm. long, with 20 to 25 joints, the longest about twice as long as broad, becoming short and squarish in the distal half; distal 6 or 7 joints may or may not have blunt dorsal spines.

First radials just visible; second radials very short, trapezoidal, more or less incised by the axillary; axillary nearly twice as wide as high. Ten arms, the first 9 brachials squarish, then quadrate, longer than wide, becoming more elongate distally; syzygies usually in the third, eighth, and twelfth (sometimes seventh and eleventh or thirteenth) brachials, and distally at intervals of two joints. The arms are 25 mm. long to the twenty-fifth brachial.

First two pinnules very long (8 mm.) about equal in length, flagellate, the first with 25 joints, less than twice as long as broad, serrate at the tip, the basal 6 or 7 joints strongly carinate; second pinnule with rather fewer, more elongate joints, also carinate basally, but not so much so as the first; third pinnule much shorter, stouter, with elongate

cylindrical joints, not carinate basally; the following pinnules gradually become more slender and elongated.

Color (in spirits) rather dark brown.

Type.—Cat. No. 22610, U.S.N.M.; Camp Clay, Cape Sabine, arctic coast of Alaska; received from Lieut. (now Maj. Gen.) A. W. Greeley, U. S. Army, in 1886.

This species is interesting in belonging to quite a different type of the *Tenella* group from those heretofore known as inhabitants of the Arctic seas, which agree in having from half again as many to twice as many cirrus joints as *A. arctica*, and the second pinnule usually much smaller than the first, whereas in *A. arctica* the second pinnule is as long as or even a trifle longer than the first. *A. arctica* represents a group of species occurring in the southern seas from 46° south latitude north to about the equator; and this fact is of especial interest in that the Bering Sea and north Pacific (exclusive of the Okhotsk Sea and Sea of Japan) species of the *Eschrichtii* group are also more nearly related to the antarctic than to the arctic species.

22. ANTEDON BRISEIS, new species.

Centro-dorsal discoidal or low hemispherical, the pole papillose, bearing about 20 cirri in 2 or 3 irregular marginal rows; cirri 8 mm. long with 12 to 14 joints, all longer than wide, the second to the seventh greatly elongated; the joints are somewhat constricted in the middle, with prominent articulations, and do not bear dorsal spines.

First radials just visible; second radials very short, about four times as wide as long, somewhat incised by the axillary; they have strong rounded median keels, posterior lateral tubercles on each side, and a dorso-ventral ridge in the anterior portion; axillaries rhombic, about as wide as high, all the sides, especially the two posterior, much incurved, with a strong posterior median tubercle, which is continued backward over the second radial. Ten arms 23 mm. long; the first brachial has a short inner and long outer edge, and is deeply incised by the backward projection of the second brachial; second brachial irregular in shape, the inner edge very short, the outer long, the two proximal edges much incurved; there is a large tubercle on its posterior border, overlapping the first brachial; third brachial squarish; following brachials quadrate, at first wider than long, but becoming longer than wide after the tenth, and elongate distally; syzygies in the third, eighth, and twelfth brachials and distally at intervals of two joints.

First pinnule 2.5 mm. long with 7 joints, all but the first 2, which are squarish, greatly elongated; second pinnule similar, but apparently very slightly shorter; the distal pinnules are 4 mm. long, exceedingly slender, with about 15 joints, all but the first 2, which are very

short, greatly elongated. The radials and first brachials are in close apposition laterally, and are somewhat flattened.

Color in life light yellowish brown with broad bands of darker yellow brown on the arms.

Type.—Cat. No. 22658, U.S.N.M.; from *Albatross* station No. 4876; Sea of Japan.

This species is nearest to *A. nana* Hartlaub (= *A. macropygus* Lütken MS) from Amboina and the Tonga Islands, from which it differs in having the cirri smooth, the radials and lower brachials carinate and tubercular, and the brachials elongate.

NOTES ON PARASITES OF BERMUDA FISHES.

By EDWIN LINTON,

Of Washington and Jefferson College, Washington, Pennsylvania.

INTRODUCTION.

These notes are based on investigations made by the writer at the Bermuda Biological Station for Research, Flatts, Bermuda, from July 7 to August 7, 1903.

I am under obligations to many of my colaborers in the laboratory for their friendly assistance, and especially to Mr. Thomas Barbour, to whom I am indebted for the identification of many of the fish which were examined, and without whose energetic and disinterested help my list of fish would be shorter than it is.

It gives me pleasure also to record my grateful acknowledgments to the Bermuda Natural History Society and to Doctor Mark and Doctor Bristol for the privileges of the laboratory.

The opportunities for getting material were limited, and, moreover, much of the material was in poor condition. This was especially true of many of the small distomes. When it is remembered that the temperature of the laboratory was not often as low as 80° F., day or night, it will be easily understood that much care was necessary to prevent the rapid deterioration of material.

While an examination of a greater number of fish would, without doubt, add many parasitic forms to the list contained in this paper, enough has been ascertained to afford some data relative to the degree to which the Bermuda fishes are infested.

So far as my observation teaches, those fishes which are found on the inner reefs are freer from encysted parasites than are those which live on the outer reefs and in the deeper waters outside. On account of the exceeding transparency of the Bermuda waters, sharks, which are the great disseminators of cestode ova, do not frequent the shallower waters of the shoals. This fact probably accounts for the comparative scarcity of cestode larvæ in the fish which were taken on the shoals. On the other hand, the large groupers and rock fish, all of which were from about 14 fathoms of water on the outer reefs, were found to harbor numerous encysted cestodes on the viscera, and especially in the walls of the stomach. A recurring feature in the

larger groupers, hinds, and rock fish was the occurrence of cysts, inclosing waxy, degenerate tissue in the walls of the stomach. These cysts are of various shades of brown, from light amber to almost black, and are due, not to cestodes alone, but also to nematodes and acanthocephala.

List of fish examined for parasites with summary of results.

Scientific name of host.	Common or local name of host.	Number of fish examined.	Acanthocephala.	Nematoda.	Cestoda.	Trematoda.	Eucelepodia.	Isopoda.	Food notes.
<i>Carcharias platyodon</i> (Poey).	Cub shark	6			4				Fragments of fish in stomachs.
<i>Lycodontis moringa</i> (Cuvier).	Spotted moray	2		2		84			
<i>Elops saurus</i> Linnaeus.	Bony-fish	1							Small fish in stomach.
<i>Synodus saurus</i> (Linnaeus).	Snake fish	2				12			
<i>Fundulus bermuda</i> Günther.	Mangrove minnow	1							
<i>Tylosurus acus</i> Lacépède.	Round	2		++	++	3			Small fish (fry).
<i>Hyporhamphus unifasciatus</i> (Ranzani).	Half-beak	4							Green algae.
<i>Atherina harringtonensis</i> Goode.	Fry	27					++		Young gastropods and copepods.
<i>Sphyræna sphyræna</i> (Linnaeus).	Barracuda	5				3			Fish.
<i>Holocentrus ascensionis</i> Osbeck.	Squirrel	4		1		2			Small crustaceans.
<i>Upeneus maculatus</i> (Bloch).	Goat fish	1		1					Fragments of crustaceans and annelids.
<i>Seriola lalandi</i> (Risso)	Amber Jack	6			few.	11			Fish.
<i>Seriola fasciata</i> (Bloch)	Bonito	1				2			Small fish.
<i>Seriola falcata</i> Cuvier and Valenciennes.	Bermuda salmon	1							Fish.
<i>Trachurus crumenophthalmus</i> Bloch.	Big-eyed sead							1	
<i>Bodianus fuscus punctatus</i> (Linnaeus).	Cony	4	2	few.	1	1			Crustaceans.
<i>Epinephelus striatus</i> Bloch.	Grouper, Hamlet	24	++	6	74	49	4		Fish and crabs.
<i>Epinephelus maculosus</i> Cuvier and Valenciennes.	Hind	11	+	+	+	6			Fish, crustaceans, annelids.
<i>Epinephelus morio</i> (Cuvier and Valenciennes).	Deer Hamlet	1	1						Fragments of crustacea and jaws of squid.
<i>Mycteroperca apua</i> (Bloch).	Rock fish	3	++	10	+	26			Fish; and fragments of mollusk shells, probably from intestines of fish.
<i>Paranthias furcifer</i> (Cuvier and Valenciennes).	Barber fish	3		++	++	1			Globigerina, spicules of sponge, setæ of annelids and shells of a small pteropod.
<i>Priacanthus arenatus</i> (Cuvier and Valenciennes).	.....							1	
<i>Neomansis griseus</i> (Linnaeus).	Gray snapper	9	2	5	6				Fish, crustaceans and annelids.
<i>Neomansis apodus</i> (Walbaum).	School master	3		2					Fish and crabs.
<i>Neomansis synagris</i> (Linnaeus).	Silk snapper	4		1	17				Fish, mussel, and bivalve and univalve shells.
<i>Neomansis hastingi</i> Bean.	Black-finned snapper	2	1						Crustaceans and small lamellibranchs.
<i>Neomansis</i> , sp	White-water snapper	1		1					Crustaceans.
<i>Ocyurus chrysurus</i> (Bloch).	Yellowtail	13	6		few.	28			Fish.
<i>Hemulon macrostomum</i> Günther.	Streaked Grunt								Annelids and ophiurans.
<i>Hemulon carbonarium</i> Poey.	Black Grunt	1		2					Fragments of small fish and algae.

1 Frequent or many.

++ Numerous.

List of fish examined for parasites with summary of results—Continued.

Scientific name of host.	Common or local name of host.	Number of fish examined.	Acanthocephala.	Nematoda.	Cestoda.	Trematoda.	Eucelepodia.	Isopoda.	Food notes.
<i>Hamulon flavolineatum</i> (Desmarest).	Yellow Grunt	16	1		1	12			Crustaceans, annelids, green algae, and broken shells.
<i>Bathystoma striatum</i> (Linnaeus).	White Grunt	4			1	2			Fragments of crabs.
<i>Calamus calamus</i> (Cuvier and Valenciennes).	Porgy	15	++			14			Crabs and mussels.
<i>Diplodus sargus</i> (Linnaeus).	Bream	11		2	2	1			Fish, crustaceans, broken mussel shells, tests and spines of sea urchins, stems of hydroids, green algae, small univalve mollusks and sand.
<i>Kyphosus sectatrix</i> (Linnaeus).	Chub	1							Vegetable debris.
<i>Eupomacentrus fuscus</i> (Cuvier and Valenciennes).	Brown-cockeye Pilot	1			1				Small crustaceans, bryozoa, foraminifera, algae, sand.
<i>Abudefduf saxatilis</i> (Linnaeus).	Cow Pilot	13			1				Vegetable debris.
<i>Lachnolaimus maximus</i> (Walbaum).	Hog fish	7	11			1		1	Mussel shells, seaweed and sand.
<i>Harpe rufa</i> (Linnaeus).	Spanish Hogfish ..	1		1		1			
<i>Iridio radiatus</i> (Linnaeus).	Bluefish	2		++		2			Large numbers of crushed shells of gastropods and bivalves, and tests and spines of sea-urchins.
<i>Iridiobittatus</i> (Bloch)	Slippery Dick	5				2			Shells and byssus of mussel, annelid, spine of sea-urchin.
<i>Scarus vetula</i> (Bloch and Schneider).	Parrot-fish	4							Stomach and intestine filled with crabs, univalve shells, sea-urchin spines, seaweed, and sand.
<i>Chaetodon ocellatus</i> Bloch.	Four-eye	2							Algae.
<i>Chaetodon</i> , sp.	Butter-fish	3				5			Fragments of fish.
<i>Angelichthys ciliaris</i> (Linnaeus).	Angel fish	11				4			Alimentary canal filled with a red sponge; a few annelids; bryozoa, a small mollusk shell and seaweed.
<i>Tenthis carulcus</i> (Bloch and Schneider).	Blue Tang	4				1			Broken shells, mainly Serpula tubes and small gastropods, bryozoa, sponge, foraminifera, seaweed and sand.
<i>Tenthis hepatus</i> Linnaeus.	Doctor fish	5				2			Ascidian (<i>Botrylloides</i>), algae and sand.
<i>Balistes carolinensis</i> Gmelin.	Turbot	4			Few.	157			Alimentary canals crowded with broken mussel shells; setae of large annelid.
<i>Balistes vetula</i> Linnaeus.	Bastard Turbot ...	1			1				Fragments of adductor muscle of a bivalve mollusk.
<i>Lactophrys trigonus</i> Linnaeus.	Cuckold	1		9					
<i>Lactophrys tricornis</i> Linnaeus.	Cowfish	6		3					Amphipods, mussels, bryozoa, seaweed, sand.
<i>Gobius soporator</i> Cuvier and Valenciennes.	Goby	3							
<i>Salariichthys textilis</i> Quoy and Gaimard.	Molly Miller	4				1			Foraminifera, vegetable debris.

++ Numerous.

Order ACANTHOCEPHALA.

Representatives of this order were found in 11 of the 51 species of fish examined. They belonged to a single species and were immature and encysted on the viscera in all cases, except the rock fish, where they were also found mature in the alimentary canal. These worms have been referred to the new species *Echinorhynchus medius*.

ECHINORHYNCHUS MEDIUS, new species.

Plate IV, figs. 21-30.

Type.—Cat. No. 5796, U. S. N. M.

Body elongated, nearly linear, diameter greatest just behind base of sheath, whence it tapers gently to the neck; anterior end of body slightly deflected in same direction as the proboscis, which is inclined at an angle of 45° , more or less, to the axis of the body; anterior end of body also armed with sagittate spines, which, on the concave side, extend back a distance approximately one-third the length of the sheath, and about half as far on the convex side. The neck is smooth and conical, its length being somewhat less than its diameter at base. The proboscis varies from nearly linear to fusiform, with about 22 vertical rows of hooks, and about 20 hooks in one vertical row; hooks strongly recurved, stoutish, of nearly uniform size and shape, except at the base, where for about five rows the hooks are smaller than they are on the remainder of the proboscis. The hooks are deeply immersed in the cuticle and have strong but somewhat narrow basal supports; those near the base are about 0.045 mm. in length, others 0.06 mm., spines on body from 0.03 to 0.045 mm. in length. Sheath rather slender-fusiform, usually more than twice the length of the proboscis. Lemnisci long and slender.

In the male the testes are two, small, oblong-elliptical, situated about the anterior third of the length and separated from each other by a distance equal to five or more times the length of one. Remainder of male genitalia simple, consisting of the vas deferens and a long-oval cement gland near the posterior end; bursa large, oblong, its length not much exceeding its diameter in mounted specimens which are somewhat compressed.

The posterior end of the female is rather abruptly narrowed to a blunt point which is deflected, in some cases almost at right angles to the axis of the body.

Dimensions, in millimeters, of a male mounted in balsam: Length, 42; diameter, anterior 0.75, at posterior end of sheath 1.35, middle of body 1; bursa, length 1.5, diameter 1.2; neck, length 0.45, diameter at anterior end 0.37, at base 0.57; proboscis, length 1.4, diameter near base 0.45, near tip 0.30; sheath, length 3, anterior diameter 0.3, middle 0.67, posterior 0.3; distance from base of neck to first testis 12;

distance from first to second testis 6; lemnisci extend about 5.4 back of posterior end of sheath, diameter 0.15; testis, length 1, diameter 0.5.

Length of female, mounted in balsam, 54; ovarian masses, length 0.3, diameter 0.12; embryos 0.075 by 0.024.

This species is near *E. pristis*, in external appearance, but differs in the greater length of the lemnisci. The genitalia of the male are also much simpler; furthermore the species which I have found in a number of the Beaufort fishes and have recorded under the name *E. pristis*, is characterized by having a circle of hooks at the base of the proboscis which are longer than the other hooks.

Adult stage.—The adult worms were found in but one host:

Mycteroperca apua, intestine.

July 22, numerous. One of the largest specimens, after having been placed in fresh water, where it became turgid, measured 50 mm. in length. Among the preserved specimens a male measured 42 mm. and a female 54 mm.

Immature stage.—Immature forms, referred to this species, were found in the following hosts encysted in the viscera:

Bodianus fulvus punctatus.

July 22, three, on viscera, in thin connective tissue capsules incrustated with yellow pigment. One was removed from a cyst which was filled with dark-brown waxy secretion.

Calamus calamus.

July 16, ten, encapsuled on the viscera. When these worms were liberated from the thin cysts which enveloped them they were collapsed and the proboscides were retracted. Placed in fresh water they became plump and the proboscides were evaginated. July 18, two; August 3 and 7, numerous, on viscera and mesentery. Two of these immature forms were mounted in balsam and proved to be far enough developed to show the rudiments of various organs. The testes in this case were situated close together and back of the sheath a distance about equal to the length of that organ. In the female a small cluster of globular bodies at the posterior end of the sheath evidently represents the rudiments of the primitive egg masses.

The body is largest at the base of the sheath, whence it tapers each way. Proboscis slightly fusiform, one side straight or very slightly concave, the other convex, usually deflected in the direction of the convex side; about 20 hooks in a vertical row and 22 or 23 vertical rows, those near the base of the proboscis more slender than the others. Neck smooth and conical. Anterior end of body with about 20 rows of spines. These, on account of the manner in which they penetrate the cuticle, appear sagittate in front view. Sheath fusiform; longer than proboscis; lemnisci appear to be long and slender. Dimensions of female mounted in balsam, in millimeters: Length, 12;

proboscis, length 1.2, diameter, exclusive of hooks, at base 0.37, middle 0.55, apex 0.37, length of longer hooks 0.08; length of neck, approximate, 0.33; diameter of neck, anterior 0.35, posterior 0.50; sheath length 2.4, diameter, middle 0.63; diameter of body, at base of sheath, 0.9, near posterior end 0.45; testes about equal, length 0.24, breadth 0.16.

Epinephelus maculosus.

July 14, two, from cysts on serous coat of rectum, some dark pigment in cysts. August 3, one, on viscera.

Epinephelus morio.

July 22, one, on viscera. Dark brown degenerate tissue associated with cyst, also in the cyst along with the worm.

Epinephelus striatus.

July 16, one, an immature female; July 27, twelve, on pyloric cæca; August 3, numerous on viscera and mesentery.

Hæmulon flavolineatum.

July 27, one, encapsuled on viscera.

Lachnolaimus macrinus.

August 3, eleven, encapsuled on viscera.

Myxeroperca apua.

July 21, two, encapsuled on viscera.

Neomænis griseus.

July 27, two, encapsuled on viscera.

Neomænis hastingi.

July 27, one, encapsuled on viscera.

Ocyurus chrysurus.

July 14, six, from serous coat of viscera.

Order NEMATODA.

Nematodes were found in 15 of the 51 species of fish examined. Immature nematodes, while found in 8 species of fish, were not abundant in any. In many cases they were found to have given rise to cysts in the stomach wall. All but one of the finds of immature nematodes belong to the same species. Nematodes were found in the muscular tissue of but 1 species of fish, the gar.

ASCARIS, species.

Plate I, figs. 1-1b.

Head truncate, lips squarish, no interlips; esophagus long, cylindrical, with bulbous base, from which springs a slender and usually short diverticulum; intestine relatively large with thick sacculated walls, its diverticulum short; nearly linear, tapering at each end, and crossed by exceedingly fine transverse striæ and by coarser furrows,

the latter making a crenulate outline. The anal papillæ are very small and numerous; the exact number was not determined. Seen in lateral view there appeared to be about 8 postanal and probably as many as 60 preanal papillæ.

The above description was based on a specimen mounted in balsam. The teeth and papillæ on the lips were not very distinct. The teeth appeared to be simple tubercular, and there appeared to be two papillæ on each of the lateral lips.

Postanal region slender pointed. Other details are given under the several hosts. This ascarid was found in three of the Bermuda fishes, as follows:

Bodianus fulvus punctatus.

July 22, one. Dimensions in millimeters of specimen mounted in balsam: Length, 7; diameter of head 0.12, at base of esophagus 0.3, middle 0.3, at anal aperture 0.10; distance from anal aperture to posterior end, 0.21; length of jaw 0.045, breadth 0.06; length of esophagus, 1.5, diameter of esophagus, anterior 0.12, middle 0.14, base 0.14; length of diverticulum of esophagus 0.33, of intestine 0.15.

Epinephelus striatus.

July 11, five, females, from intestine. These worms were yellowish, except at the extremities, where they were translucent white. The jaws were broader than long, with rather wide transparent borders and distinct branching pulp. Length, 12 to 14 mm.

Mycteroperca apua.

July 21, one, male; length in balsam, 8 mm. The postanal region was rather more slender than in others and the esophageal diverticulum was longer, but still shorter than the esophagus.

IMMATURE NEMATODES.

Plate I, fig. 2.

These all appear to belong to the same species and are probably young stages of the foregoing, *Ascaris*, species, from *Bodianus*, etc. They are characterized by having a very short diverticulum of the intestine and a longer and more slender diverticulum of the esophagus.

These immature forms were found in the following hosts:

Bodianus fulvus punctatus.

July 22, few, very small. Numerous small cysts containing amber-colored waxy secretion were found on the viscera of the fish taken on both the 22d and 23d. These were 0.7 mm. and less in diameter. A minute nematode was obtained from one of these cysts.

Epinephelus maculosus.

July 8 and 14, one on each date. Dimensions, in millimeters, life: Length, 5; length of esophagus 0.75, of bulb at base 0.04, of diverticulum 0.45; intestinal diverticulum very short, about equal to the

esophageal bulb; distance from anal aperture to posterior end 0.02. Cysts, usually numerous, were found in this host on July 8, 14, 22, 29, and August 3. They were found in the muscular coats of the stomach, and were of various sizes, from 0.6 mm. to 6 mm. in diameter. In all cases they contained waxy degenerate tissue which was dark brown or amber colored. One small cyst, less than 1 mm. in diameter was found to contain a minute nematode.

Epinephelus striatus.

Cysts like those found in *E. maculosus* were found in this host on July 11, 15, 16, 18, and August 3. In some cases they were most abundant in the submucous coat of the stomach; in others they were most numerous in the muscular coats. In the latter case they were as a rule in greatest numbers in the pyloric region, where the dark brown, sometimes almost black, cysts were in sharp contrast with the white tissue in which they were embedded. They are most abundant in the large groupers, and evidently represent entozoa which have had a long residence in their host and have either succumbed or migrated.

Mycteroperca apua.

July 21, two. Large numbers of cysts were also found on the mesentery and serous coat of the viscera generally. They contained dark-brown waxy degenerate tissue, and varied in size from 2 mm. or less to 20 mm. or more. They were irregular in shape, often nodular, sometimes flattened. No entozoa were found in them. The smaller ones are probably due to nematodes, the larger to cestodes.

Hæmulon carbonarium.

July 31, one, small.

Iridio radiatus.

July 29, numerous, also on July 31, many. These nematodes were first found in washings from the alimentary canal. It was observed that there were many small cysts in the intestinal wall, with the usual waxy contents. Some of these cysts were crushed under a cover glass and in one of them, a minute nematode, agreeing with the free specimens, was found.

Neomænis apodus.

July 17, two. These worms were active after lying about ten hours in water to which a little formalin had been added.

Neomænis griseus.

July 17, one, very small. Dimensions in millimeters, life: Length, 3.6; diameter, anterior, 0.04, middle, 0.07, at anal aperture 0.05; length of esophagus 0.3, of diverticulum of esophagus 0.3, of diverticulum of intestine 0.03.

Paranthias furcifer.

July 29, numerous, from intestine.

Upeneus maculatus.

July 11, one. This specimen was exceptional in that the diverticulum of the esophagus was longer than the esophagus. The diverticulum of the intestine was just as long as the basal bulb of the esophagus.

IMMATURE NEMATODE.

Plate I, fig. 3.

A fragment of a small nematode from the intestine of *Harpe rufa* is different from the foregoing. The fragment is from the posterior end. The post-anal region tapers gradually and is slightly arcuate.

Dimensions, in millimeters, alcoholic: Length, 5.25; diameter 0.05, at anal aperture 0.03; distance from anal aperture to posterior end 0.06.

HETERAKIS FOVEOLATA Rudolphi.

Plate I, figs. 5-7; Plate II, figs. 8-10.

A small nematode found sparingly in several Bermuda fishes is referred, with some hesitation, to this species. It agrees very closely with specimens found at Beaufort, North Carolina, and referred to this species.^a

In the use of the generic name *Heterakis* in the Beaufort report I followed Schneider and Stossich. As a matter of fact these nematodes, while agreeing closely with Schneider's description of *H. foveolata*, are much nearer the type species of the genus *Dacnitis* than they are to the type species of *Heterakis*. The species *Dacnitis esuriens* Dujardin is included by Schneider among the synonyms of *H. foveolata*.

It would be out of place in this paper to enter into a discussion of nomenclature, and until a more detailed study can be made I shall retain the name used in my Beaufort paper.

Head obtusely rounded in front; mouth bilabiate; lips dorsal and ventral, each with about two small papillæ, and armed with numerous minute, simple teeth, of uniform size and shape, which make a crown-like border to the mouth. Neck narrowing behind the head, but enlarging again gradually, the body remaining nearly linear from the base of the esophagus to near the posterior end, where it tapers to an acute point. The anterior part of the body is, in many cases, curved backward. The esophagus narrows behind the conspicuous pharynx, then enlarges to the base.

The genital papillæ, so far as made out, are as shown in fig. 7, namely, six post-anal papillæ, two pairs of which are near the median line and near together; the other two are situated one on each side of the median pairs. Lateral to the anal aperture and near to it on each side

^a Bulletin, Bureau of Fisheries, XXIV, p. 330, etc.

are three small papillæ near together, and lateral to each of these groups is a single papilla. Three pairs of pre-anal papillæ were made out, the bursa being, on all observed cases, between the two anterior pairs. The eight papillæ near the anal aperture were less distinct than either the pre- or post-anal papillæ, and were not always clearly made out. Between the anal aperture and the bursa there are strong diagonal muscles running from the lateral region medio-caudad. Spicules about equal.

The first sections of a series of transverse sections show the bilabiate mouth with an elongate aperture (fig. 8). The chitinous walls of the pharynx soon give evidence of a trifid division (fig. 9). The lumen of the esophagus becomes triradiate (fig. 10), each of the three divisions having two semicircular thickenings of the chitinous lining, which indicate the presence of six longitudinal chitinous ridges in the lining of the esophagus extending from the pharynx to the base. A series of sections made from one of the Beaufort specimens was compared with a series made from a specimen from *Mycteroperca apua*, and was found to agree.

I have found a nematode at the Tortugas which agrees with this species very closely.

NOTES ON HABITATS.

Diplodus sargus.

July 13, one, female. Dimensions in millimeters, life: Length 8; diameter, anterior 0.12, middle 0.3, at anal aperture 0.12; length of esophagus 0.8; distance from anal aperture to posterior end 0.27; distance of reproductive aperture from posterior end 3.

July 14, one, male. Dimensions in millimeters, life: Length 4, length of esophagus 0.6; diameter, anterior 0.10, middle 0.16, at anal aperture 0.09; distance of anal aperture from posterior end 0.15; length of spicules 0.42.

July 24, two, male and female; length in balsam, 3 and 8 mm.

Holocentrus ascensionis.

July 31, one, male. This specimen may belong to a different species. It was not in good condition, but appeared to agree with those from *Diplodus*, etc. Transverse sections show the lumen of the esophagus as a narrow slit with nearly parallel sides until near the base, where it has a tendency to become triradiate.

Lycodontis moringa.

August 3, one, male; length 5.27 mm.

Mycteroperca apua.

July 2, four; July 22, one.

Neomænis griseus.

July 14, four; July 27, two; August 3, one.

HETERAKIS, species.

Plate II, figs. 11 to 14; Plate III, figs. 15 to 20.

This agrees very closely with a form from the flounder.^a

The body is rather plump, truncate anteriorly, tapering posteriorly. Mouth bilabiate, but in some cases appearing to be obscurely trilobed in dorsal or ventral view. Lips armed with very numerous small teeth of nearly uniform size and shape, and each provided with about three papillæ. Diameter of neck but little less than that of the body, but narrowing slightly very near the anterior end. The esophagus is much narrower than the neck. It is largest at the anterior end, where it expands into the pharynx. Its smallest diameter is a little in front of its middle point, whence it enlarges posteriorly, the posterior third being nearly cylindrical. The reproductive aperture of the female is a little back of the middle. The uterus is voluminous, the eggs being retained in it until segmentation has begun. Behind the anal aperture of the female there are two papillæ. The postanal region is somewhat variable in length and is mucronate at the tip.

Transverse sections show that the cuticle is unusually thick, especially toward the anterior end. The character of the esophagus, as revealed in sections, is much like that of the preceding species.

These worms have been found thus far widely distributed, but only in very small numbers.

In *Fundulus heteroclitus* at Woods Hole, Massachusetts, males of this or a closely allied species were found.^b The genital papillæ in these males are arranged as follows: In the postanal region, lateral view, there are three larger papillæ with three smaller papillæ lateral to them, the most anterior of the larger papillæ being very close to the anal aperture and lateral to it. In the preanal region, lateral view, there are two large papillæ near together a little anterior to the anal aperture and lateral, two others between these and the bursa, and two in front of the bursa, thus making in all twelve postanal and twelve preanal papillæ.

NOTES ON HABITATS.

Hæmulon carbonarium.

July 31, one. Dimensions in millimeters, life, slightly compressed: Length 4; diameter, anterior 0.16, middle 0.40, at genital aperture (2.25 from posterior end) 0.36, at anal aperture 0.09; distance from anal aperture to posterior end 0.15; esophagus, length 0.53, diameter, anterior (pharynx) 0.12, middle 0.05, base 0.08.

^aBull. U. S. Fish Com. for 1899, p. 481, pl. VII, figs. 57-61. See also Bull. Bureau of Fisheries, XXIV, pp. 325, 390, 392, 412, 414, figs. 24, 25.

^bBull. U. S. Fish Com. for 1899, p. 441, pl. XVII, figs. 207, 208.

Neomænis griseus.

July 27, one. Dimension in millimeters, life: Length 6; diameter, anterior 0.45, at base of esophagus 0.96, middle 1, 1 millimeter from posterior end 0.90, at anal aperture 0.22; esophagus, length 1.20, diameter at anterior end 0.22, narrowing to 0.08 and expanding again to 0.18 at base.

ICHTHYONEMA GLOBICEPS Rudolphi.

The flesh of two specimens of *Tylosurus acus*, which were examined on July 16, was found to be filled with parasitic worms.

These worms were very numerous in both gars, and were most abundant near the backbone, where they were distributed along the greater part of the length. The color of the worms was blood-red, and, since many of them were in tangled clusters, the appearance which they presented when the flesh was cut open was much like that of small blood vessels gorged with blood. With some difficulty some of the worms were extracted whole and found, after killing and straightening, to be about 80 mm. in length. All that were examined were females.

While the general color was blood-red, the intestine showed as a dark-brown stripe. In most cases the uterus was crowded with young, which were in a state of unceasing activity. The young worms were characterized by having a few black, granular spots in the middle of the body. In some of the adults ova, with what were taken to be spermatozoa, were seen mingled together in the uterus.

Dimensions of specimen mounted in balsam: Length 55; diameter of head 0.19; diameter of body nearly uniform, differences due mainly to contraction and pressure from 0.45 to 0.70.

ICHTHYONEMA, species.

Plate I, figs. 4 and 4a.

The following notes are made on finds of worms belonging to this genus, but on account of the fragmental nature of the material, satisfactory identifications could not be made:

Epinephelus maculosus.

July 22, fragments from testes; young and ova together in uterus.

Epinephelus striatus.

July 18, one from ovary of large, spent female.

Lycodontis moringa.

August 3, one, small, 10 mm., or less, in length; diameter, anterior 0.09; middle, and for almost the entire length 0.15; near posterior end 0.07.

Mycteroperca apua.

July 22, several fragments from testes; intestine dark-brown with elongated cells in its walls; ova, but no young, in the uterus; longest fragment 75 mm. in length.

Neomænis, species.

July 27, fragments from ovary; intestine narrow, very dark; young in uterus still active on the 28th.

Order CESTODA.

Cestodes were found in 18 of the 51 species of fish examined.

There seemed to be a notable scarcity of encysted forms and especially of the small larvæ known as *Scolex polymorphus*, which are very common in the alimentary canals of our coast fishes. This may be explained perhaps by the fact that most of the fish which were examined came from the inner reef. All the larger fish from the deeper water on the outer reef, where sharks abound, had numerous cysts on and in the viscera. Cestode flesh parasites were found only in the gar.

DISCOCEPHALUM PILEATUM Linton.

Plate V, fig. 31.

Discocephalum pileatum LINTON, Report U. S. Fish Com. for 1887, pp. 781-787, pl. x, figs. 1-7; Bull. U. S. Fish. Com. for 1899, p. 272.

On July 31 seven of these cestodes were found with their heads embedded in the mucous membrane at the anterior end of the spiral valve of a small cub shark (*Carcharhinus platyodon*). These worms varied in length from 10 to 340 mm. Five of the largest were attached within a space about 10 mm. square. Only two of the strobiles were immature. In the longer of the immature strobiles, which measured 100 mm. in length, reproductive organs were developing in the posterior segments. In addition to the attached strobiles there were several fragments of mature strobiles in the chyle.

The disk-like heads, shaped like a mushroom anchor, were firmly embedded in the submucosa with the mucous membrane closely embracing the necks. They can not be removed by simply pulling them away from their lodgment. This would merely break them and leave the heads securely embedded in the intestinal wall. Indeed, from the appearance of the pits after the worms have been removed, it seems doubtful whether they can detach themselves after they have once gained lodgment. It is probable, however, that they can do so, since the disk is a very muscular organ and doubtless is capable of assuming very diverse shapes; besides there is no evidence of degeneration either in the head or the surrounding tissue, which would be the case if the heads were permanently attached.

RHYNCHOBOTHRIMUM SPECIOSUM Linton.

Plate V, figs. 32-35.

Rynchobothrium speciosum LINTON, Proc. U. S. Nat. Mus., XIX, p. 801-805, pl. LXIV, figs. 13, 14; pl. LXV, figs. 1-7; Bull. U. S. Fish Com. for 1898, p. 784; same for 1899, p. 413, etc.; Bull. Bureau of Fisheries, XXIV, p. 332, etc.

This species was found in five of the Bermuda fishes. It is highly probable that the adult stage will be found in the cub shark.

NOTES ON HABITATS.

Epinephelus maculatus.

July 8, one, from cyst on viscera; cyst thin, yellowish, on account of the presence of a waxy secretion, length 20 mm.; blastocyst translucent bluish-white, about same length as cyst; larva with triangular head, and neck enlarging posteriorly and slightly swollen at the bulbs. A specimen mounted in balsam and slightly compressed yielded the following measurements in millimeters: Length of bothria 0.75, breadth 0.52; length of head and neck 4.5; diameter of neck, anterior 0.36, middle 0.67, at bulbs 0.80; proboscis, length 2.2, diameter near base, excluding hooks 0.054, including hooks 0.078.

Epinephelus striatus.

July 11, several long-clavate cysts on viscera with yellowish-brown secretion. Two larvæ measured 12 and 20 mm., respectively.

July 27, five, cysts on viscera and mesentery, mostly clavate. Length of one cyst 25 mm., of the larva 15 mm. August 3, two cysts.

Mycteroperca apua.

July 21 and 22, several clavate cysts from 20 to 25 mm. in length on viscera with dark-brown secretions.

Neomænis griseus.

July 27, six cysts on viscera.

Neomænis synagris.

July 18, one clavate cyst, length 20 mm., diameter 5 mm.

RHYNCHOBOTHRIMUM SPIRACORNUTUM, new species.

Plate V, figs. 36-38.

Type.—Cat. No. 5797, U.S.N.M.

Head usually broader than long, orbicular or cordate; bothria lateral—that is, coinciding with the lateral margins of the body, with raised borders—neck long, slender, nearly linear, enlarging at base, sometimes appearing to begin abruptly by an articulation with the head and usually abruptly larger than the anterior end of the body; proboscides much shorter than neck, with a tendency to coil up into rather close spirals when everted; sheaths nearly straight, bulbs long-ovate, retractor muscle attached to posterior end. The hooks are of

many different shapes and sizes, but on account of the similarity of the hooks, which make up the several longitudinal rows, the general effect is that of uniformity and symmetry. There is some resemblance in the arrangement of the hooks to that of *R. speciosum*, particularly in the case of one of the longitudinal rows, where the small hooks of which it is composed are placed by twos on account of the lengthening of alternate intervals between the hooks of the row. A characteristic feature of this species is the distinctness of the longitudinal rows of hooks. There was no indication of segments. Dimensions given below.

NOTES ON HABITATS.

Epinephelus maculosus.

July 29, one clavate cyst from viscera, length 28 mm. Bothria with raised borders and reticulated surface; neck linear but may present irregularities due to contraction. Dimensions of larva in millimeters, life: Length 20; bothria, length 0.75, breadth 0.60; diameter of neck, anterior 0.45, at base 0.60; bulbs, length 1.20, breadth 0.21. The following additional measurements are from the mounted specimen: Length 20; head, length 0.60, breadth (bothria spread apart) 0.90; length of head and neck 5.7; proboscis, length, approximate, 1.05, diameter near base, excluding hooks 0.036, including hooks 0.06. The hooks were denser and longer than in *R. speciosum*, and the proboscides coiled into close spirals when everted.

Epinephelus striatus.

July 18, four cysts from viscera. One larva measured 30 mm. in length. In a mounted specimen, the bothria being seen in marginal view, the length of the head is 0.60, the breadth 0.82 mm. The neck is linear except in front of the bulbs, where it is swollen, a condition evidently due to unequal contraction.

Paranthias furcifer.

July 29, four dark-brown cysts of various shapes. One of the larvæ differed from the others in that the outline of the head was somewhat triangular or cordate instead of orbicular in corresponding view.

OTOBOTHRIUM CRENACOLLE Linton.

Otobothrium crenacolle LINTON, Report U. S. Fish Com. for 1887, pp. 850-853, pl. XIII, figs. 9-15; pl. XIV, figs. 1-4; Bull. U. S. Fish Com. for 1899, pp. 273, 428; Bull. Bureau of Fisheries, XXIV, p. 331, etc.; XXVI, pp. 111-132, pls. I and II.

This widely distributed cestode was found in three of the Bermuda fishes.

Balistes carolinensis.

July 14 and 22, few on each date from cysts in walls of stomach and intestine. The cysts were small, oval, white; when compressed they revealed the larva in its blastocyst.

Dimensions in millimeters, life: Cyst, length 2.3, breadth 1.12; length of embryo 0.4.

Diploodus sargus.

July 14, two cysts inclosed in a mass of brown secretion on the serous coat of the viscera.

Ocyurus chrysurus.

July 22, few, small, from cysts on mesentery.

OTOBOTHRIUM PENETRANS, new species.

Plate VI, figs. 39-48.

Otobothrium, species, Bull. Bureau of Fisheries for 1904, XXIV, p. 357, figs. 102-109.

Type.—Cat. No. 5798, U. S. N. M.

Bothria marginal, widely divergent, with pits characteristic of the genus; neck somewhat elongated, at least longer than the head, stout, widely flaring and emarginate at posterior end; contractile bulbs curved, concave on lateral, convex on medial sides, approximate at their anterior ends but strongly divergent at the posterior ends; proboscides stout and of moderate length; hooks of many different sizes and shapes, the larger ones strongly recurved with rather narrow, unsymmetrical base. A few of the slender hooks near the base of the proboscides are somewhat spirally crooked.

Dimensions in millimeters of alcoholic specimen: Length of scolex to base of bulbs 4; breadth of head 1.75. Another, in balsam: Head compressed, length 1.12, breadth 1.95; approximate length of proboscides 1.8, diameter, including hooks 0.24, excluding hooks 0.15, length of longest hooks 0.09. In another, length of contractile bulbs 1.35, breadth 0.55; approximate length of proboscis 2.25.

Blastocyst (*plerocercus*): Elongated, white, very irregular in shape; one, somewhat contracted, measured 25 mm. in length.

NOTES ON HABITAT.

Tylosurus acus.

Blastocysts very numerous in the flesh of each of two gars, July 16. These were generally distributed in the muscles of the back and sides, but were most abundant along the dorsal region; a few were found in the peritoneum. They were all relatively large, white, and very active, even after they had been in sea water for several hours.

TETRARHYNCHUS BISULCATUS Linton.

Rhynchobothrium bisulcatum LINTON, Report U. S. Fish Com. for 1886, pp. 479-486, pl. iv, figs. 9-23.

Tetrarhynchus bisulcatus LINTON, Report U. S. Fish Com. for 1887, pp. 857-861, pl. xiv, figs. 10-12; pl. xv, fig. 1; Proc. U. S. Nat. Mus., XIX, pl. lxvi, figs. 11-15; XX, pp. 452; Bull. U. S. Fish Com. for 1899, pp. 272 and 414, etc.; Bull. Bureau of Fisheries, XXIV, p. 333, etc.

Found in two of the Bermuda fishes.

Balistes vetula.

July 27, one, from cyst in intestinal wall. The intestine of the fish was thickly beset throughout its length with chalky cysts. A number of these cysts were removed and left over night in sea water. When they were examined the following morning nothing was found in them but a pulpy, granular mass. The larval tetrarhynch was found free in the dish with the cysts. The scolex was still active, the bothria constantly changing their shape, and the proboscides at frequent intervals were protruded and withdrawn. This action was somewhat rythmical. The hooks were characteristic of the species; the collar was elongated and conical. Dimensions, in millimeters, life: Length 1.8, of bothria 0.75, of collar 1.05; breadth of head, maximum 0.60, of neck, behind bothria 0.52, at posterior end 0.22; diameter of proboscis 0.04.

Paranthias furcifer.

July 29, one, from a small degenerate cyst on viscera.

SCOLEX POLYMORPHUS Rudolphi.

Scolex polymorphus RUDOLPHI, Larval Tetrabothria, Rep. U. S. Fish Com. for 1886, pp. 3-4, pl. vi, figs. 8, 9; Larval Echeineibothria, Proc. U. S. Nat. Mus., XIX, pp. 789-792, pl. i, figs. 4-15; Larval Cestodes, Bull. U. S. Fish Com. for 1899, pp. 270-284; p. 413, etc.; Bull. Bureau of Fisheries, XXIV, pp. 332, 333, etc.

Found in three of the Bermuda fishes:

Abudefduf saratilis.

July 31, few, in alimentary canal. They were small, the bothria without costæ. There were two red pigment spots in the neck and numerous calcareous bodies in the parenchyma. Length 0.60, breadth 0.27 mm.

Epinephelus maculosus.

July 8, two, in intestine, small; prominent terminal sucker; bothria without costæ and no pigment in neck. Length 0.9, breadth 0.2 mm.

Epinephelus striatus.

July 11, about 60 found after going over washings from the alimentary canal of three large groupers several times. These were small, with two red pigment patches just behind the head, and no costæ on the bothria. In contracting there was a tendency to lengthen the posterior end of the body into a slender, pointed tail, the head, at the same time becoming nearly globular. Most of them, when contracted, are transversely wrinkled. A contracted specimen was 0.6 mm. in length and 0.4 mm. in breadth. August 3, two cysts on viscera.

LARVAL DIBOTHRIA.

Cestode larvæ, which appear to belong to the genus *Dibothrium*, were found in three of the Bermuda fishes.

Bodianus fulvus punctatus.

July 23, fragment. This specimen was finely and transversely wrinkled and the parenchyma contained numerous calcareous bodies. It resembles the posterior end of an immature *Dibothrium*.

Eupomacentrus fuscus.

July 11, one. This specimen was exceedingly variable in shape, and there were no definite organs. The anterior end was densely covered with short spines, and there was an aperture in front into which the anterior end of the body could be inverted. As the worm became quiescent under the cover glass the anterior end was permanently retracted and the worm assumed a vase shape.

Paranthias furcifer.

July 29, numerous cylindrical cysts, most of them dark brown, and some of them degenerate. One of the larger cysts measured 22 mm. in length and 2 mm. in diameter. The larva measured 14 mm. in length and 1.5 mm. in diameter. It was corrugated transversely, slightly inverted at the anterior end and had a small pore at the posterior end. There were numerous calcareous bodies in the parenchyma. The smaller cysts were from 3 to 5 mm. in length.

In one of the larger specimens numerous glandular bodies were seen. Similar structures have already been noted by me.^a These structures have been made the subject of special inquiry by Pintner.^b

The generic character of these larvæ is uncertain.

CESTODE LARVÆ, CYSTS, ETC.

Larvæ too immature for identification and cysts with indefinite or indeterminable contents are here noted:

Bathystoma striatum.

July 17, one blastocyst from viscera; too immature for identification.

Hæmulon flavolineatum.

July 27, one cyst with blastocyst, but no larva recognizable.

Neomænis synagris.

July 18. Amber-colored cysts of uncertain origin, with waxy contents, were found in the stomach wall of the largest fish of the three examined. These cysts may be due to nematodes.

Ocyurus chrysurus.

July 7, one small blastocyst, white, variable, but for the most part pyriform; no larva in it. Length 1.5 mm., breadth 0.15, tapering to 0.05 mm.

^a Proc. U. S. Nat. Mus., XIX, p. 797, pl. LXIII, figs. 14, 15; Bull. U. S. Fish Com. for 1899, p. 300, fig. 100.

^b Sitz. d. k. Akad. d. Wissensch. in Wien, CXII, Abt. i, July, 1903.

Order TREMATODA.

Trematodes were found in 29 of the 51 species of fish examined. In many cases only one, and often but very few, of a kind were found. In other cases the material was in poor condition, so that identification was not possible.

I have employed the old generic name *Distomum*, but in those cases where the form could be identified by the use of Pratt's Synopsis I have added the new generic name. Since many of the forms which can not be referred to any genus in Pratt's Synopsis were represented by a single example, or at best by few, and they in poor condition, it has seemed best not to burden the nomenclature of helminthology with any new generic names at present.

ENCOTYLLABE, species.

Plate VII, figs. 49-53.

A single specimen from the gills of *Calamus calamus*, July 16, is referred to this genus.

Body elliptical, flattened; posterior sucking disk joined to the body by a stalk, provided with two hooks but without radial ridges; two anterior suckers, which were circular in the living but elliptical in the preserved specimen. The anterior end is provided with numerous small lobes, which probably represent two lobate antero-lateral prolongations of the body with lobulate borders. The genital aperture is on the left side of the median line a short distance behind the left sucker. The specimen was rolled up when first seen and was too fragile to allow of satisfactory manipulation.

Dimensions, in millimeters, balsam: Length 3; length of body 2.25; breadth, anterior 0.6, maximum 1; diameter of stalk 0.4; posterior sucking disk, length 0.45, breadth 0.42; transverse diameter of anterior sucker 0.13; length of hooks 0.3.

MICROCOTYLE, species.

Plate VII, fig. 54.

Body lanceolate, tapering both anteriorly and posteriorly from about the middle. Vitellaria conspicuous along each margin, and leaving only a narrow median line, extending the entire length of the body proper from a point just behind the cirrus.

Dimensions, in millimeters, life: Length of body proper 4, of posterior suckorial part 3.2; breadth, anterior 0.16, maximum 0.6; each anterior sucker, length 0.09, breadth 0.04; about fifty pairs of posterior suckers, each, length 0.07, breadth, 0.03. An ovum in oviduct of specimen mounted in balsam measured 0.69 by 0.19.

The above notes were made on a specimen collected from the gill of *Calamus calamus*, July 14.

On the same date another specimen was obtained from the gill of *Diplodus sargus*. Only the body was seen, and it was in poor condition. Dimensions, in millimeters, life: Length 1.5; breadth, anterior 0.12, maximum 0.25; length of an anterior sucker 0.06, breadth 0.04. The cluster of copulatory spines resembles that of the specimen from *Calamus*.

ASPIDOGASTER RINGENS Linton.

Plate XV, figs. 98, 99.

Aspidogaster ringens LINTON, Bull. Bureau of Fisheries, XXIV, pp. 367, 397, figs. 243-249.

It is possible that either the genus *Aspidogaster* should be revised in order to include this species, or, which is more in accord with present tendencies, a new genus will have to be provided for it.

This species was found in but one Bermuda fish, *Iridio radiatus*, from which two specimens were obtained on July 31.

These specimens agree closely with forms found in *Micropogon undulatus* and *Trachynotus carolinus* at Beaufort, and referred, with some hesitation, to this genus.

The large ventral disk is elliptical, with about forty-two loculi around the border, between which are marginal sense organs. There are about eighteen transversely elongated depressions, thus suggesting *Cotyloaspis*, but there is a low median ridge which divides the depressions into two longitudinal series of alveoli, which, with the marginal loculi, make four rows of depressions, a characteristic of the genus *Aspidogaster*. On account of the indistinctness of this median ridge, however, the genus *Aspidogaster* offers but an insecure resting place for this species. The upper lip is trilobed and the lower entire, or slightly undulate. In the Beaufort specimens the under lip is trilobed. The structure of the head suggests *Cotylogaster* but there is only one testis. In these specimens both the head and the conical tail protrude a short distance beyond the ventral disk. Color white, except in the dorsal region, where the mass of ova impart a yellow color.

Dimensions, in millimeters, of specimen mounted in balsam: Length 2; length of disk 1.77, breadth 0.9; diameter of head 0.42, of neck 0.33; pharynx, length 0.18, breadth 0.14; ova 0.06 by 0.03 and 0.08 by 0.04.

DISTOMUM MONTICELLII Linton.

Plate VIII, fig. 58.

Distomum monticellii LINTON, Proc. U. S. Nat. Mus., XX, p. 518-520, pl. XLIV, figs. 2-8; Bull. U. S. Fish Com. for 1899, pp. 451, 473, 482; Bull. Bureau of Fisheries, XXIV, p. 334, etc., pl. XXII, fig. 158.

This species was found in two Bermuda fishes.

Mycteroperca apua.

July 21, one. Dimensions, in millimeters, life, side view, compressed: Length 1.05; diameter of oral sucker 0.12, of ventral sucker 0.32; ova 0.02 by 0.01.

Synodus saurus.

July 20, twelve. These distomes were collected in the evening and placed in sea water to which a little formaldehyde had been added. They were still active on the following morning. These specimens are in agreement with this species in the general character and relative positions of testes, ovary, vitellaria, and seminal vesicle. The habit of the body suggests *D. læve*; the testes, also, as in that species, are situated near the ventral sucker. They appear to be identical with forms found in *Synodus fæstens* at Beaufort.

Dimensions, in millimeters, life: Length 2.55; diameter of oral sucker 0.15, of ventral sucker 0.33; ova 0.018 by 0.012.

This species belongs to the family Hemiurinae, and is near *Protopyge* Looss.

DISTOMUM VITELLOSUM Linton.

Plate IX, figs. 63, 64.

Distomum vitellosum LINTON, Bull. U. S. Fish Com. for 1899, p. 290, pl. xxxvii, figs. 38-39; p. 416, etc., pl. xxx, figs. 333-340; Bull. Bureau of Fisheries, XXIV, p. 335, etc., pl. xxiv, figs. 176-178.

This variable distome, belonging according to Pratt to the subfamily *Psilostominae*, was found in five of the Bermuda fishes.

Bathystoma striatum.

July 17, one, small, imperfect.

Bodianus fulvus punctatus.

July 22, one, minute, about 1 mm. in length.

Calamus calamus.

July 14, one. This specimen agrees with this species in the general arrangement of the genital organs, size of ova, and proportions of the suckers. The ventral sucker is evidently pushed posteriorly by the extreme contraction of the body, since the uterus lies for half of its length directly dorsal to it. Dimensions, in millimeters, life: Length 1.72, breadth 0.67; ova 0.06 by 0.04. In balsam, length 1.40, greatest breadth 0.60; diameter of oral sucker 0.22, of pharynx 0.15, of ventral sucker 0.34.

Hæmulon flavolineatum.

July 9, four; 31, six. Length 1.35 to 2.78 mm. While agreeing closely with this species it was noted that on the dorsal surface at the anterior end there was a slight roughening due to low nodular projections.

Holocentrus ascensionis.

July 31, two, length 1.35 and 1.73 mm.

DISTOMUM SUBTENUE, new species.

Plate IX, fig. 65.

Type.—Cat. No. 5799, U.S.N.M.

While none of the distomes referred to this species showed as much of the anatomy as could be desired, they were easily recognized in the several hosts by the large cirrus and the elongated ova.

An attempt was made to refer them to some genus in Pratt's Synopsis, but without success.

Body subcylindrical; ventral sucker larger than oral and prominent; testes two, globular, close together in a medio-dorsal position, and immediately preceded by the ovary; uterus extending back of the testes to the posterior end of the body; cirrus robust; genital pore a short distance in front of the ventral sucker and a little to the left of the median line; vitellaria confined to a few isolated patches in the median region of the body near the testes; uterus passing to the left of the cirrus; ova somewhat elongated; intestinal caeca not clearly made out, but apparently extending to the posterior end of the body. The ova are crowded at the posterior end of the body behind the testes, whence they extend ventrally to a point a little in front of the ovary. The longer diameter of the ova is more than twice the shorter. In a ventral view the apertures of the suckers are seen to be transverse. Dimensions, in millimeters, life: Length 3.60; diameter of body 0.63, of oral sucker 0.39, of ventral sucker 0.68; ova 0.05 by 0.02. Dimensions of specimen in balsam: Length 2.07; breadth 0.52; oral sucker, length 0.25, breadth 0.30; pharynx, short-fusiform, length 0.15, breadth 0.15; ventral sucker, length 0.30, breadth 0.48; ova, collapsed and crowded, not easily measured, 0.042 by 0.015.

This species was found in four Bermuda fishes.

Calamus calamus.

August 3, six; August 7, five.

Harpe rufa.

August 7, two. These distomes are smaller than those from *Calamus*, but they agree with them in essential particulars; length 1.02 mm., in balsam.

Iridio bivittatus.

July 9, two, immature. These were cylindrical, slightly arcuate with prominent ventral sucker. Dimensions, in millimeters, life: Length 0.6; diameter anterior 0.06, posterior 0.07, at ventral sucker 0.18.

Lachnolaimus maximus.

July 18, one, length 1.28 mm.

DISTOMUM MACROCOTYLE Diesing.

Plate IX, fig. 66.

One specimen of this distome was found in *Tenthis hepatus*, August 3.

Dimensions, in millimeters, life: Length 4.8; diameter of oral sucker 0.3, of ventral sucker 0.5; ova 0.03 by 0.02.

Dimensions of same mounted in balsam: Length 4.35; diameter of neck 0.35, of middle of body 0.63, near posterior end 0.35; oral sucker, length 0.24, depth 0.30; diameter of pharynx 0.12; ventral sucker, length 0.72, depth 0.54; ova 0.027 by 0.015.

Anterior end white to ventral sucker, back of ventral sucker pink; yellowish in alcohol.

This distome is referred to the genus *Accaculium* in Pratt's Synopsis.

DISTOMUM NITENS Linton.

Plate X, figs. 67, 68.

Distomum nitens LINTON, Proc. U. S. Nat. Mus., XX, p. 534, pl. LI, figs. 5, 6; pl. LII, fig. 1.

Two specimens of this distome were obtained, July 16, from *Tylosurus acus*. They were elongated, cylindrical, slightly irregular in outline, slender, suckers whitish, body orange, neck lighter in color than the body and concave below; ventral sucker somewhat prominent.

Dimensions of living worm in millimeters: Length 5; length of oral sucker 0.30, of ventral sucker 0.63; ova 0.028 by 0.014.

No spines were observed on these specimens. The ovary is transversely elongated instead of globular; a seminal receptacle was noted behind the ovary. Other details are given in the sketch.

These specimens belong to this species or are near it.

According to the later classification of distomes *D. nitens* belongs to the subfamily *Plagiorchinæ*, and probably is near the genus *Enodlia* Looss.

DISTOMUM GYRINUS,^a new species.

Plate X, figs. 72-74.

Type.—Cat. No. 5800, U.S.N.M.

Body cercaria shape, the tail portion equaling, in some cases exceeding the length of the anterior portion, smooth; intestine not seen; pharynx absent.

Anterior sucker much larger than ventral; testes two, relatively large, lateral, transverse, beginning behind oral sucker and near it and extending posteriorly a short distance back of the ventral sucker; seminal vesicle in front and to right of ventral sucker, dorsal; ovary

^a From the Latin word *Gyrinus*, signifying a tadpole.

behind ventral sucker; vitellaria filling the tail portion and extending forward on the left side as far as the testes.

Dimensions, in millimeters, life: Length 1.85; length of tail 0.98; diameter of anterior portion 0.45, of tail 0.18; diameter of oral sucker 0.25, of ventral sucker 0.09. Dimensions of specimen in balsam: Length 0.98; anterior portion, length 0.38, diameter 0.24; posterior portion, length 0.60, diameter at middle 0.08; diameter of oral sucker 0.12, of ventral sucker 0.04.

Average of three specimens, in life: Length 0.95; diameter of oral sucker 0.103, ventral sucker 0.04.

In Pratt's Synopsis this distome appears to be near the genus *Eumegacetes* Looss, but in reality is a very different form from that.

These distomes were found in two of the Bermuda fishes.

Lactophrys trigonus.

August 3, eight, maximum length 0.95 mm.

Lactophrys tricornis.

August 1, two, maximum length 1.85 mm.

DISTOMUM LAMELLIFORME, new species.

Plate X, fig. 75; plate XI, figs. 76-78.

Type.—Cat. No. 5801, U.S.N.M.

Body orbicular, flat and leaf-like, smooth, often broader than long. Ventral sucker larger than oral, sessile, with circular aperture, relative proportions of suckers somewhat variable, but in alcoholic specimens ventral sucker not twice the diameter of the oral. The average of four was: Oral sucker 0.075 mm., ventral sucker 0.10 mm.

Mouth subterminal, pharynx near oral sucker, globular; esophagus short; intestinal crura simple extending to near the posterior end of the body.

Testes two, round, or, under pressure, with undulate outline, situated behind ventral sucker on opposite sides of the median line and separated from each other by a space approximately equal to the diameter of the testis. Seminal vesicle to the right of the ventral sucker preceded by the prostate gland and both inclosed in the cirrus pouch. Cirrus relatively large. Vitelline glands abundant, distributed throughout the posterior and lateral regions of the body as far forward as the pharynx. Ovary behind the ventral sucker and between the testes obscurely lobed. Uterus along median line between testes and passing to left of ventral sucker, in some cases a little in front, in others at same level, and in yet others a little behind that organ.

Ova relatively few and large.

Dimensions, in millimeters, life, specimen flattened under cover glass: Length 0.82, breadth 1.20; oral sucker, length 0.06, breadth 0.07; ventral sucker, length 0.15, breadth 0.21; ova 0.075 by 0.036. Another, length 0.72, breadth 0.65; another, length 1.10, breadth 1.20.

In Pratt's Synopsis this distome comes near the genus *Sperostoma*. The species was found in three of the Bermuda fishes.

Balistes carolinensis.

July 14, one hundred and fifty-one; July 22, two. The smaller specimens were longer than broad, the larger ones were broader than long. Many were folded by the approximation of the anterior and posterior ends.

Lactophrys tricornis.

August 1, one, circular, translucent-white, vitellaria yellowish. Dimensions, in millimeters, life: Length 1.73; breadth 1.77; diameter of oral sucker 0.14, of pharynx 0.09, of ventral sucker 0.15; ova 0.058 by 0.036.

Lactophrys trigonus.

August 3, one, small. Dimensions, in millimeters, life: Length 0.64, breadth 0.72; diameter of oral sucker 0.07, of ventral sucker 0.12; ova 0.07 by 0.04. The vitellaria were profuse. The stained specimen shows the ovary to be trilobed, the anterior lobe projecting dorsally.

DISTOMUM TRULLA,^a new species.

Plate XI, fig. 79.

Type.—Cat. No. 5802, U.S.N.M.

In Pratt's Synopsis this species falls in the genus *Halicometra*.

Body pyriform, compressed, densely covered with small, low, round spines; oral and ventral suckers about equal; pharynx equal in length to the diameter of the ventral sucker, separated from the oral sucker by a short pre-esophagus, which may become indistinguishable in a contracted specimen; esophagus short; rami of intestines simple, apparently extending to near the posterior end of the body; testes two, near posterior end, diagonally placed and near together, unequal; cirrus pouch long-clavate, dorsal to ventral sucker and to the left; uterus between testes and ventral sucker, the thick-walled and glandular extremity lying beside the cirrus on the left; ovary three-lobed, in front of testes and contiguous with anterior testis and a little to the right of the median line of the body; ova rather numerous, their length equal to about one-fourth the diameter of the ventral sucker; vitellaria diffuse, filling the posterior and lateral regions of the body as far forward as the pharynx.

Dimensions, in millimeters, balsam: Length 1.14; breadth, anterior 0.27, middle 0.73, near posterior 0.47; oral sucker, length 0.15, breadth 0.14; pharynx, length 0.12, breadth 0.11; ventral sucker, length 0.14, breadth 0.15; ova 0.042 by 0.027.

From *Ocyurus chrysurus*.

July 22, three.

^a From the Latin word *trulla*, signifying a trowel.

DISTOMUM LEVENSENI, new species.

Plate XII, figs. 80-83.

Type.—Cat. No. 5803, U.S.N.M.

Body depressed, linear but with tendency to be inflated in the cervical region, wholly covered with minute, low, rounded spines, most conspicuous anteriorly, but discernible along the lateral margins to the posterior end. The oral and ventral suckers are about equal, the latter situated at about the anterior third or fourth of the length; mouth subterminal, circular, sometimes with the opening distorted; very short pre-esophagus; pharynx moderately elongated; esophagus rather longer than pharynx; intestinal crura extending to posterior end of the body. The testes are nearly equal, slightly lobed in specimens which have been killed under pressure, unequal, the posterior being usually the more elongated and larger. In all cases the testes were end to end and behind the middle of the body; in compressed specimens they are separated from each other by a short space. The seminal vesicle is behind the ventral sucker and inclosed in the cirrus pouch, which is inconspicuous. The cirrus passes to the left of the median line and opens in front of the ventral sucker a little to the left. The cirrus was not seen distinctly, but the whole pouch is elongated. Ovary smaller than testes, irregular oval, or oblong elliptical, or subglobular, in front of and close to anterior testis, in uncompressed specimens; in specimens killed under pressure it may be separated from the anterior testis by a space equal to once or even twice the diameter of the ovary. A seminal receptacle lies close to the ovary and dorsal to it. Vitelline glands diffuse but presenting some striking variations (figs. 81 and 82); in most cases they fill the greater part of the body behind the ventral sucker along the marginal region, covering and concealing the intestinal rami. These glands appear to lie behind the ventral sucker for the most part, although a diffuse and deeply staining layer, which may also be a part of this gland, continues anteriorly to the pharynx. The uterus is in front of the ovary, the ova being, for the most part, between the ovary and the base of the cirrus pouch. The uterus continues anteriorly beside and to the left of the cirrus to open at the genital aperture in front of the ventral sucker and to the left. Ova rather few and large.

This distome, according to Pratt's Synopsis, belongs to the genus *Allocreadium*. It is near the species *D. oculatum* Levensen.

The species was found in two of the Bermuda fishes.

Epinephelus maculosus.

July 8, two; July 29, four. The living worms of the first lot were yellowish white with an amber-colored spot between the ventral sucker and the ovary where the ova lay; length 2.5 mm., breadth 0.5 mm. One of these, which had been fixed over the flame and afterwards

mounted in balsam, had the following dimensions, in millimeters: Length 1.8, breadth 0.33; diameter of oral sucker 0.08, of ventral sucker 0.08; pharynx, length 0.05, breadth 0.03; ova 0.048 by 0.024.

The specimens in the second lot present considerable variation in size and proportions. Three of them agree fairly well, the fourth is larger. It was somewhat macerated and consequently was flattened more than the others when placed under the cover glass.

Dimensions of living specimens.

Length.	Breadth.	Oral sucker.	Pharynx.	Ventral sucker.	Ova.
<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
1.20	0.52	0.09	0.05	0.09	0.06 by 0.04
1.38	0.40	0.13	0.10	0.16	0.06 by 0.01
3.45	0.60	0.12	0.08	0.12	0.07 by 0.01

The principal difference between this lot and the former is in the size of the ova.

Epinephelus striatus.

July 11, twenty; July 14, four; July 18, twenty-three.

Most of the distomes in the first lot were broken. They were faint flesh color by reflected, yellowish-white by transmitted light.

Dimensions of a perfect specimen, in millimeters, life: Length 2.78; breadth, anterior 0.36, at ventral sucker 0.68; oral and ventral suckers each 0.24 in diameter, with circular aperture; ova 0.045 by 0.022. In the other lots there was great variety in size and proportions but they are all apparently the same species.

DISTOMUM FENESTRATUM, new species.

Plate XII, figs. 86-91.

Distomum, species, Bull. Bureau of Fisheries for 1904, XXIV, p. 373, 374, figs. 213, 214.

Type.—Cat. No. 5804, U.S.N.M.

This species will eventually have to be referred to a new genus, but, in view of the fact that the individuals thus far found are immature, it seems to me to be best not to give a generic name at present. On account of the ease with which they may be recognized, however, a specific designation appears desirable.

The reproductive organs not being in evidence, it is not possible to identify it with Pratt's *Synopsis*. The absence of a pharynx suggests the subfamily *Gorgoderinæ*.

So far as the anatomy of these distomes was worked out, their characterization is as follows: Body subcylindrical, tapering at each end; ventral sucker much larger than oral and situated at about the anterior fifth; pharynx none; esophagus slender, communicating with the capacious intestine a short distance in front of the ventral sucker.

The intestinal rami originate at the ventral sucker and dorsal to it. At their origin they constitute a somewhat convoluted or lobed mass, from which they continue to the posterior end of the body as greatly inflated, somewhat spiral tubes with very thin walls and filled with a clear, structureless, or colloid material. The intestinal rami occupy the greater part of the body behind the ventral sucker and are very conspicuous. Both in the living and the preserved material the intestinal rami appear as a series of semitransparent spaces. No genital organs, even as rudiments, were distinguished.

Transverse sections reveal the following structure: The epidermis is underlaid by a thin layer of longitudinal fibers. Next within this is a somewhat broken layer which, from its position, suggests the rudiments of vitellaria. The remainder of the body is filled with parenchyma, as shown in the figures.

Lengths of five living specimens, in millimeters: 2.15; 1.98; 1.68; 1.28; 1.05. Corresponding breadths: 0.35; 0.48; 0.38; 0.32; 0.27. Detailed measurements of one: Length 2.15, breadth 0.35; diameter of oral sucker 0.06, of ventral sucker 0.21. One specimen, which may be abnormal, had the following dimensions: Length 2.40, breadth 0.18; oral sucker, length 0.07, breadth 0.06; ventral sucker not quite definite but appeared to be 0.18 in diameter.

Forms resembling these were found in *Coryphæna equisetis* and *C. hippurus* at Beaufort, North Carolina, and in *Brevoortia tyrannus* at Woods Hole, Massachusetts.

They were found in one of the Bermuda fishes.

Lycodontis moringa.

August 3, eighty-four, in alimentary canal. Most of these specimens were found in washings from the intestines. A few cysts under the serous coat of the intestine were opened, and from two of them distomes of this species were obtained. Nothing distinguishable was found in the other cysts. These cysts were white, rather soft, and filled with a whitish, granular material.

DISTOMUM TOMEX,^a new species.

Plate XIV, figs. 94-96.

Type.—Cat. No. 5805, U.S.N.M.

Body long and slender, unarmed; ventral sucker near the anterior end, smaller than oral sucker, with transverse aperture; oral sucker pyriform, the larger end in front, aperture circular and terminal; no pharynx; esophagus distinct; intestinal rami extending to the posterior end of the body; genital papilla prominent, at base of oral sucker on ventral side, with 2 external apertures; uterus with greater part of ova at posterior end of body, but opening at the genital papilla; vas

^a From the Latin word *tomex*, signifying a cord.

deferens distinct along the median line anteriorly, not so distinctly seen near the testes as shown in the sketch. Other genitalia not quite satisfactorily made out. What were taken to be the testes are two elongated, lobed bodies, one following the other, but diagonally placed, and situated near the posterior end, but in front of that portion of the uterus which contains the greater part of the ova. Another organ, probably the ovary, lies beside the anterior testis. Clusters of deeply staining bodies, which extend from about the anterior sixth to a point a little in front of the middle, may possibly be the vitellaria, although some of them appeared to be folds of the intestinal rami.

Dimensions of specimen mounted in balsam, in millimeters: Length 12; diameter of anterior projection containing oral sucker 0.14; diameter of body, anterior 0.33, at ventral sucker 0.48; anterior sucker, length 0.14, breadth, anterior 0.08, posterior 0.06; genital papilla, length 0.04, breadth 0.05; ventral sucker, length 0.07, breadth 0.11; length of esophagus 0.3; distance of ventral sucker from genital papilla 0.46, from anterior end 0.63; ova 0.018 by 0.012. Length of living worm 14; breadth 0.2 to 0.5.

From *Epinephelus striatus*.

July 14, one.

I do not find any distome at all resembling this in Pratt's Synopsis.

UNDETERMINED DISTOMES.

The following distomes are not given specific names on account of either the small amount of material in each case or its unsatisfactory condition.

It is hoped that the notes which it was possible to make, together with the naming of the host in each instance, will prove to be of use to future investigators.

Distomum, species from *Seriola fasciata*. (Plate VII, figs. 55, 56.)

July 31, two. These worms being immature and partly macerated, but little of their anatomy could be made out. Testes, two, globular, near together, one following the other and near the posterior end; ovary small, globular, in front of anterior testis and separated from it by a distance about equal to the diameter of the testis. The anterior end of one was retracted, and there was a small mass of black pigment in each between the oral and ventral suckers. The vitellaria were not distinct. The character of the intestines could not be made out. Each of the specimens was linear and smooth.

Dimensions in millimeters, life: Length 3.30; breadth at ventral sucker 0.40, behind ventral sucker 0.30; diameter of oral sucker 0.19, of ventral sucker 0.30.

Dimensions of specimen in balsam: Length 2.55, breadth 0.25; diameter of oral sucker 0.18, of ventral sucker 0.24; distance of ventral sucker from anterior end 0.37, distance of posterior testis from

posterior end 0.22. The pharynx was not visible in this specimen, but in the other its length was 0.06. In the latter specimen the length of the oral sucker was 0.16, of the ventral sucker 0.21, whole length 2.

Distomum, species from *Angelichthys ciliaris*. (Plate VII, fig. 57.)

July 14, two; July 17, two. None of the specimens were in good condition. The body is subcylindrical and curved ventrally. Numerous dark brown blotches were noted in one. These are conspicuous in the mounted specimen, and appear to represent the intestines. Some deeply staining granular masses lay near each lateral margin at about the posterior third. They have the general structure of vitellaria. The ova, to the number of about two hundred, lay between these bodies.

Dimensions in millimeters, life: Length 2.16, breadth 0.7; suckers near together and about equal, the anterior 0.18 in diameter; ova 0.030 by 0.014. Length of another 1.65; breadth 0.42.

Distomum (*Lecithocladium*), species from *Seriola dumerili*. (Plate VIII, figs. 59, 60.)

July 16, nine; July 24, one. Body cylindrical, finely ringed, a character which may disappear when the specimen has been for some time under slight pressure; posterior end of body retractile; neck cylindrical, very contractile, with a tendency to arch; testes close together behind the ventral sucker, the left a little in advance of the right; cirrus and cirrus pouch in neck, genital pore just behind the oral sucker and a little to the left of the median line; seminal vesicle in front of testes; ovary close behind testes; folds of uterus behind testes and ovary, passing forward to right of cirrus to the genital pore; vitellaria tubular, convoluted, on either side of ovary; ventral sucker much larger than oral, pharynx oval, diameter about equal to length; rami of intestine extending nearly to the posterior end.

Dimensions, in millimeters, balsam: Length, exclusive of retractile portion, 1.14, diameter 0.30; diameter of oral sucker 0.15, of pharynx 0.06, of ventral sucker 0.27; ova 0.016 by 0.007.

Distomum, species from *Teuthis hepatus*. (Plate VIII, fig. 61.)

July 21, one and fragment, neither in good condition.

The stained and mounted fragment shows only the following meager details: Beginning at the posterior end the body is seen to be filled with ova. A small structure, 0.7 mm. from the posterior end, about 0.2 mm. in diameter, transversely striated, is apparently a seminal receptacle. At the anterior border of this organ is a cluster of oval bodies, four or more in number, which may represent a deeply lobed ovary with lobes 0.1 mm. in length. At a distance 0.6 mm. in front of these bodies a testis was made out, and beside it the faint indications of another. About 0.6 mm. in front of the testis a large seminal vesicle was seen.

Dimensions, in millimeters, balsam: Length 1.57, diameter 0.52; oral sucker, length 0.11, breadth 0.12; diameter of pharynx 0.09; ventral sucker, length 0.35, breadth 0.33; ova 0.018 by 0.009, mainly at the posterior end of the body. Vitellaria diffuse in median part of the body; oral sucker retracted, ventral sucker also slightly withdrawn.

The length of the fragment is 3.75 mm. It represents only the post-acetabular region.

Distomum, species from *Tylosurus acus*. (Plate VIII, fig. 62.)

July 16, one. Color of body orange, neck light orange, suckers whitish. The body is fusiform, tapering more to the posterior end than to the anterior. Ventral sucker larger than oral; pharynx separated from oral sucker by a pre-esophagus. Ovary subglobular, behind ventral sucker; uterus between ovary and ventral sucker and passing to the left of the ventral sucker to the genital aperture, which is in front of the ventral sucker and on the left of the median line. Vitellaria diffuse lateral and posterior, abundant, extending to ventral sucker. Testes not clearly made out, but appear to be represented by a mass of cells behind the ovary. Cirrus and its pouch in front of the ventral sucker and to the left. Ova few and large.

Dimensions of mounted specimen, in millimeters: Length 1.77; diameter, anterior 0.25, at ventral sucker 0.63, near posterior end 0.15; diameter of oral sucker 0.22, of pharynx 0.13, of ventral sucker 0.36; ova 0.07 by 0.04.

According to the later classification of the distomes this species probably belongs to the genus *Allocreadium*.

Distomum, species from *Chaetodon*, species. (Plate X, fig. 69.)

July 30, two; August 3, four; all the specimens in poor condition, as if macerated.

So far as could be made out from these imperfect specimens they have the following characters: Ventral sucker a little larger than oral; ovary with three or four lobes and situated half way between the ventral sucker and the posterior end; vitellaria abundant, diffuse, at posterior end and along margins to ventral sucker, overlying other organs in places. To the rear of the ovary and at its right side are about nine bodies which appear to be testes. The cirrus and its pouch were indistinctly seen, but they appear to pass dorsal to the ventral sucker to open in front of it on the left of the median line. There is a distinct prostate, with a seminal vesicle at its posterior edge, just behind the ventral sucker. In a larger specimen than the one sketched the seminal vesicle is farther back; the ova are rather few, mostly in front of the ovary, but a few are behind it, or at least very close to it. The uterus passes to the left of the cirrus to open immediately in front of the ventral sucker, and close to the median

line. The prostate is at the posterior border of the ventral sucker, a little to the left.

Dimensions, in millimeters, life: Length 2.25, breadth 0.54; diameter of oral sucker 0.10, of pharynx 0.06, of ventral sucker 0.13; ova 0.054 by 0.036. Length of smaller specimens 1 and 1.5.

Distomum, species from *Bodianus fulvus punctatus*. (Plate X, fig. 70.)

July 22, one, immature. Dimensions, in millimeters, life: Length 0.9, breadth 0.42; breadth of oral sucker, retracted, approximately 0.12; ventral sucker, length 0.10, breadth 0.12. Measurements of the specimen in balsam show that the diameter of the two suckers and the pharynx is about the same, namely 0.07; each a little wider than long.

In the mounted specimen several granular bodies are disclosed which are the rudiments of the reproductive organs. The anterior end is beset with exceedingly minute spines.

Distomum, species from *Sphyræna sphyræna*. (Plate X, fig. 71.)

July 17, three, in poor condition, as if macerated by the digestive juices of their host. The barracuda indeed may not be the proper final host of these distomes.

Body elongated, the posterior half nearly linear, tapering to anterior end; oral sucker lost in all the specimens; pharynx preceded by a pre-esophagus and about two-thirds the size of the ventral sucker. The ventral sucker and its aperture longer than broad. Testes two, oval, on median line, separated from each other by a distance slightly less than the length of one, the posterior testis situated at about its own length from the posterior end of the body. Ovary globular and placed in front of the anterior testis, from which it is separated by a short interval. Vitellaria diffuse, posterior and lateral, extending forwards to a point about 0.7 mm. behind the ventral sucker. Faint indications of a seminal vesicle were seen behind the ventral sucker, and of a seminal receptacle in front of the ovary. The ova are rather large and numerous, the body being crowded with them for a distance of 3.75 mm. in front of the ovary.

Dimensions in millimeters of specimen mounted in balsam: Length 15; maximum diameter, at posterior testis, 0.96, at pharynx, 0.33; pharynx, length 0.33, breadth 0.25; ventral sucker, length 0.45, breadth 0.37; distance of pharynx from ventral sucker 1.8; distance of posterior testis from posterior end 0.9; posterior testis, length 1.05, breadth 0.60; anterior testis, length 0.90, breadth 0.54; distance between testes 0.67; diameter of ovary 0.30; distance of ovary from first testis 0.94; ova 0.06 by 0.03. The anterior end was macerated and drawn out into a slender thread, the oral sucker being lost and the pharynx about 0.75 mm. from the anterior end. On account of the macerated condition of these distomes the absence of spines is without significance.

Distomum, species from *Balistes carolinensis*. (Plate XII, fig. 84.)

July 14, three. Body thickish, depressed, covered with spines which are low and rounded in front, dense on head and anterior part of body, less dense posteriorly. Ventral sucker larger than oral; mouth subterminal; esophagus none; intestinal rami broad and extending to posterior end of body; testes two, close together, one in front of the other, about halfway between the ventral sucker and the posterior end, not lobed; ovary subglobular, in front of testis, near and a little to the right; uterus in front of testes passing to the left of the ventral sucker to open in front of it and a little to the left. Cirrus and its pouch very indistinct. Seminal vesicle in front of ovary and behind ventral sucker but not clearly shown. Cirrus dorsal to ventral sucker and on left side. Vitelline glands diffuse, posterior and marginal, covering and hiding other organs and extending in front of ventral sucker. Ova relatively few and large.

Dimensions, in millimeters, life, Length 3.45; breadth 0.56; diameter of oral sucker 0.22, of pharynx 0.15, of ventral sucker 0.3; ova 0.06 by 0.03.

In Pratt's Synopsis this species appears to belong in the genus *Halicometra*.

Distomum, species from *Paranthias furcifer*. (Plate XIII, fig. 85.)

July 29, one. Body nearly linear, covered with low, rounded spines; oral sucker slightly exceeding the ventral; ventral sucker nearly equally distant from the two extremities, aperture transverse; pharynx large, esophagus distinct, intestinal rami extending to posterior end; testes two, one following the other, near posterior end; ovary at front edge of anterior testis; uterus between ovary and ventral sucker; vitellaria diffuse, posterior and lateral, extending in front of ventral sucker.

Dimensions, in millimeters, life: Length 1.38; breadth, anterior 0.18, at ventral sucker 0.40; oral sucker, length 0.18, breadth 0.15; pharynx, length 0.15, breadth 0.12; diameter of ventral sucker 0.15; ova 0.05 by 0.036. Same, in balsam: Length 1.28; oral sucker, length and breadth, each 0.13; ventral sucker, length 0.10, breadth 0.12. The outline of the testes differs from that shown in the sketch, which was made from life; each testis is broader than long and the margins are uneven.

Although the specimen seems to be in fairly good condition and the testes, ovary, and vitellaria are well differentiated by the stain, there is no indication of cirrus, pouch, or genital aperture.

This distome appears to belong to the genus *Halicometra* of the later classification.

Distomum, species from *Salariichthys textilis*.

July 16, one. This distome was exceedingly minute. It was inclosed in an amber-colored, globular cyst. It was seen while examining some foodstuff with the microscope.

Diameter of the cyst about 0.2 mm. The distome was curved in a horseshoe shape inside the cyst.

Numerous minute spherical bodies, probably concretions in the excretory vessels, were noted. These concretions measured 0.004 mm. in diameter.

Distomum, species from *Teuthis cœruleus*.

July 22, one, partly macerated. This distome was stained and mounted, but is not in a condition to admit of identification or satisfactory description.

The mount yields a lateral view of the compressed specimen. The vitellaria are diffuse, not close to the margin, but filling the interior of the body from the posterior end to the ventral sucker. The ventral sucker is very indistinct; uterus in front of ovary; ova relatively few.

Dimensions, in millimeters, life: Length 1.35, breadth 0.83; oral sucker 0.21, pharynx 0.10, ventral sucker 0.21; ova 0.036 by 0.021.

So far as can be made out, the anatomy bears a general resemblance to that of *D. vitellosum*.

MONOSTOMUM VINAL-EDWARDSII Linton.

Plate XV, fig.-97.

Monostomum vinal-edwardsii LINTON, Bull. U. S. Fish. Com. for 1899, p. 470, pl. XXIV, figs. 373-376; Bull. Bureau of Fisheries, XXIV, pp. 379, 410, figs. 220-222.

This species was found in two of the Bermuda fishes.

Neomænis synagris.

July 18, fifteen large and two small. Dimensions, in millimeters, formalin: Larger, length 2.98, maximum breadth 0.98. Smaller, length 0.57, breadth 0.30.

Ocyurus chrysurus.

July 7, three; July 14, twenty-four; July 22, twenty. Large and small specimens were found together, as in the snapper.

MONOSTOMUM, species.

Plate XIV, figs. 92, 93.

Three small monostomes, from two Bermuda fishes appear to belong to the same species. In each case they were in poor condition, being somewhat macerated.

Bathystoma striatum.

July 17, one. Dimensions, in millimeters, life: Length 1; breadth, anterior 0.22, middle 0.42, posterior 0.15; ova, somewhat variable, largest 0.018 by 0.011.

Hæmulon flavolineatum.

July 31, two. Dimensions of larger, in millimeters, life: Length 1.05; breadth, anterior 0.12, middle 0.31, posterior 0.12; diameter of oral sucker 0.09, of pharynx 0.03, of genital sucker 0.08; ova 0.018 by 0.011.

GASTEROSTOMUM, species.

Trematodes belonging to this genus were found on two occasions in the rock fish (*Mycteroperca apua*), in each case in poor condition.

The relative position of the vitellaria, ovary, testes, uterus, and cirrus much as in *G. arcuatum*; the vitellaria, however, are more crowded, in some of the specimens at least, than in that species, although agreeing closely in number, 28 having been counted in one and 29 in another. The anterior end is bluntly rounded, and the anterior sucker is relatively large, as in *G. baculatum*.

July 21, twenty; length 2 mm., breadth 0.3 mm.; ova 0.024 by 0.015 and 0.03 by 0.02 mm. July 22, five; no two alike in shape, but generally slender; length 0.66 mm., breadth 0.3 mm.

UNDETERMINED TREMATODE.

Plate XV, figs. 100-102.

This is possibly a new genus, related, but not closely, to *Phyllodistomum*.

Body nearly circular, rather thin, with edges folded under. The neck is subcylindrical and sharply marked off from the body. Ventral sucker larger than oral, with a nearly circular aperture. Mouth circular, probably nearly terminal, pharynx not clearly seen and very small, if any. The intestinal rami are simple and elongated, beginning near the oral sucker and extending to the posterior end, where, although they were not clearly seen, they appear to meet. The reproductive organs, if correctly interpreted, have the following arrangement: Testes two, transversely placed, not granular, but appearing as crumpled or folded structures; ovary in front of right testis, near it and ventral; vitellaria two, lobed, immediately behind ventral sucker; uterus between and behind testes; genital aperture behind oral sucker at bifurcation of intestine; cirrus and pouch in neck. Ventral disk nearly circular, marked with transverse lines, and minute longitudinal striæ between the lines.

Dimensions, in millimeters, life: Length of disk 0.75, breadth 0.93; neck, arched and bent ventrally, diameter 0.42, length, estimated, 0.87. Specimen mounted in balsam: Body, length 0.75, breadth 0.90; neck, length 0.75, breadth 0.36; oral sucker, length

0.24, breadth 0.27; ventral sucker, length 0.34, breadth 0.30; diameter of ventral disk 0.58; ova of different sizes, largest 0.042 by 0.015.

This specimen was found in *Balistes carolinensis*, July 14.

PARASITIC COPEPODS.

I am indebted to my friend Prof. C. B. Wilson for the identification of the only species of parasitic copepod found.

Lepeophtheirus dissimulatus Wilson.

Proc. U. S. Nat. Mus., XXVIII, pp. 631-635, pl. xxii. This species was found on two of the Bermuda fishes.

Epinephelus striatus.

July 11, two; July 18, two. Found only on the large groupers.

Mycteroperca apua.

Five specimens collected by Mr. Louis Mowbray, St. Georges, Bermuda.

PARASITIC ISOPODS.

The parasitic isopods obtained by me in Bermuda were sent to Dr. Harriet Richardson, who has kindly furnished the following identifications:

Cymothoa astrum (Linnaeus).

Mr. Louis Mowbray of St. Georges, Bermuda, brought to the laboratory two isopods, one large the other small. The small one was from the mouth of a fish which was identified by Mr. Mowbray as *Trachurops crumenophthalmus*. It was collected on March 6, 1903. The large specimen was from the mouth of a fish which he identified as *Priacanthus arenatus*.

Irona nana Schoedte and Meinert.

From *Atherina harringtonensis*, July 15, numerous. These isopods were easily removed from the fish, and they could detach themselves at will. They were abundant; all that were seen were females with ova.

Nerocila acuminata Schoedte and Meinert.

From *Lachnolaimus maximus*, August 3, one, from fin. The specimen was a female, length 32 mm., breadth 17 mm.

Corallena, species.

This specimen was brought in with other material collected on a dredging expedition to the Challenger Banks conducted by Capt. W. E. Meyer, August 1 and 2. The host was not noted.

EXPLANATION OF PLATES.

REFERENCE LETTERS USED IN FIGURES OF TREMATODES.

<i>a.</i> ventral sucker.	<i>ph.</i> pharynx.
<i>c.</i> cirrus.	<i>sr.</i> seminal receptacle.
<i>cp.</i> cirrus pouch.	<i>sv.</i> seminal vesicle.
<i>ex.</i> excretory vessel.	<i>t.</i> testes.
<i>g.</i> genital aperture.	<i>u.</i> uterus.
<i>gs.</i> genital sucker.	<i>vd.</i> vas deferens.
<i>i.</i> intestine.	<i>vg.</i> vitelline gland.
<i>o.</i> ovary.	<i>vr.</i> vitelline reservoir.
<i>oe.</i> esophagus.	<i>vd.</i> vitelline duct.
<i>p.</i> prostate gland.	

PLATE I.

Ascaris, species from *Mycteroperca apua*.

FIG. 1. Optical section of anterior end showing characteristic diverticulum of intestine (*id*), and of esophagus (*od*); in balsam; length of esophagus 1.5 mm.

1a. Head enlarged; diameter 0.12 mm.

1b. Ventral view of posterior end, balsam; diameter at anal aperture 0.09 mm.

Immature Nematode from *Epinephelus maculosus*.

2. Diagrammatic sketch of anterior end, life.

Immature Nematode from *Harpe rufa*.

3. Posterior end; diameter at anal aperture 0.03 mm.

Ichthyonema, species from *Lycodontis moringa*.

4. Anterior end, optical section, life; diameter, anterior, 0.09 mm.

4a. Posterior end of same; diameter 0.07 mm.

Heterakis foveolata Rudolphi.

5. Female from *Diplodus sargus*; length 8 mm.

5a. Male; length 4 mm.

5b. Posterior end of male, lateral view, life; distance of anal aperture from tip 0.015 mm.; *an*, anal aperture; *b*, bursa; *sp*, spicule.

5c. Posterior end of female, life; diameter at anal aperture 0.12 mm.

6. Optical section, balsam, specimen from *Lycodontis moringa*; length of esophagus 0.8 mm.

7. Diagram of anal papillæ. The specimen from which this sketch was made was from *Neomænis griseus*.

PLATE II.

Heterakis foveolata Rudolphi, continued.

FIG. 8. Transverse section of specimen from *Mycteroperca apua*. Anterior end of pharynx showing beginnings (*a a*) of longitudinal divisions of esophagus. The position of the third division will be at the lower end of the figure where, in this section, a few of the teeth are shown; maximum diameter, 0.13 mm.

- FIG. 9. Transverse section back of pharynx showing structure of esophagus; diameter, 0.13 mm.
10. Transverse section of esophagus of specimen from *Micropogon undulatus*, Beaufort, North Carolina, introduced here for comparison; diameter, 0.08 mm.

Heterakis, species.

11. Lateral view of female from *Neomænis griseus*, balsam; length, 6 mm.
- 11a. Lateral view of same, enlarged.
- 11b. Posterior end, ventral view of female from *Hæmulon carbonarium*.
12. Nearly transverse section of lips showing four of the mouth papillæ and the teeth; length of section, 0.12 mm. Figs. 12 to 15 are made from a specimen collected at Beaufort, from the southern flounder (*Paralichthys albiguttus*).
13. Sketch, somewhat diagrammatic, of anterior end of pharynx; breadth of gap of mouth, 0.11 mm. See fig. 15.
14. Section behind pharynx showing structure of esophagus; diameter, 0.25 mm; *a*, lateral area; *m*, muscle cell.

PLATE III.

Heterakis, species, continued.

- FIG. 15. Section of posterior end of pharynx, showing the division of the cuticle into three parts which become the three symmetrical longitudinal divisions shown in fig. 14; breadth of gap, 0.10 mm.
16. Dorsal view of specimen shown in fig. 11, enlarged.
17. Cross section of anterior end of specimen from *Neomænis griseus*, partly diagrammatic; breadth of section, 0.17 mm.
18. Cross section of pharynx, showing beginning of divisions of cuticle into three parts; maximum diameter, 0.26 mm.
19. Section a little behind that sketched in fig. 18. Note the very thick cuticle; *pa*, pulp of papilla; maximum diameter of section, 0.30 mm.
20. Cross section of esophagus, near base; maximum diameter, 0.14 mm.

PLATE IV.

Echinorhynchus medius, new species.

- FIG. 21. Adult male with bursa everted, from *Myeteroperca apua*; in balsam; length, 40 mm. *b*, bursa; *cg*, cement gland; *l*, lemnisci; *ps*, proboscis sheath.
22. Anterior end of female, proboscis and neck everted; length of proboscis, 1.35 mm.
23. Another, anterior end of body partly inverted; length of proboscis, 1.28 mm.; *a*, spine from body enlarged; actual length, 0.04 mm.
24. Transverse section of proboscis, middle; diameter, exclusive of hooks, 0.4 mm.
25. Same, near base; *rm*, retractor muscle.
26. Immature male from *Calamus calamus*; balsam; length, 12 mm.
27. Immature female; balsam; length, 14 mm.
- 28-30. Hooks from proboscis, enlarged; length, 0.08 mm.

PLATE V.

Discocephalum pileatum Linton, from *Carcharhinus platyodon*.

FIG. 31. Worms attached to mucous membrane, heads embedded, life; about natural size.

Rhynchobothrium speciosum Linton.

32. Head and neck of scolex from cyst in *Epinephelus striatus*; balsam; length to base of contractile bulbs 5 mm.; *cb*, contractile bulbs; *ps*, proboscis sheath.

33. Posterior end of same.

34, 35. Two views of proboscis; diameter, including hooks, 0.06 mm.

Rhynchobothrium spiracornutum, new species.

36. Head and neck of scolex from cyst in *Epinephelus maculosus*; balsam; length to base of bulbs 5 mm.; *a*. Posterior end of larva; *cb*, bulbs; *ps*, sheath.

37, 38. Two views of proboscis; diameter, including hooks, 0.06 mm.

PLATE VI.

Otobothrium penetrans, new species, from *Tylosurus acus*.

FIG. 39. Blastocyst (plerocercus), alcoholic; length, 10 mm.

40. Scolex, alcoholic; length, 3.5 mm.

41. Front view of bothria.

42. Scolex, alcoholic; length, 4 mm.

43. Front view of head.

44. Another, with proboscides everted; breadth, 2 mm.

45. Scolex with anterior end retracted; breadth at base of bulbs, 2.1 mm.; in balsam; *cb*, bulb; *ps*, sheath.

46-48. Different views of proboscides, all near base; diameter, including hooks, 0.22 mm.

PLATE VII.

Encotyllabe, species, from *Calamus calamus*.

FIG. 49. Ventral view, life; length, 3.5 mm.

50. Lateral view of posterior end.

51. Anterior end, ventral view; in balsam.

52. Dorsal view of same.

53. Posterior end; in balsam.

Microcotyle, species, from *Calamus calamus*.

54. Hooks on retracted cirrus highly magnified; in balsam.

Distomum, species, from *Seriola fasciata*.

55. Lateral view; in balsam; length, 2 mm.

56. Ventral view of another specimen; in balsam; length, 2.5 mm.

Distomum, species, from *Angelichthys ciliaris*.

57. Lateral view, life; length, 1.26 mm.

PLATE VIII.

Distomum monticellii Linton, from *Synodus saurus*.

FIG. 58. View of specimen, in balsam; length, 2.55 mm.

Distomum (*Lecithocladium*), species, from *Seriola dumerili*.

59. Specimen with tail everted; length, 1.65 mm.

60. Another, tail inverted; length, 1.14 mm.

Distomum, species, from *Teuthis hepatus*.

61. Lateral view, life, specimen partly macerated; length, 2.55 mm.

Distomum, species, from *Tylosurus acus*.

62. Ventro-lateral view, balsam; length, 1.77 mm.

PLATE IX.

Distomum vitellosum Linton, from *Hemulon flavolineatum*.

FIG. 63. Sketch from life, specimen partly macerated; length 2.78 mm.

64. Ventral view of specimen from *Calamus calamus*, balsam; length 1.4 mm.

Distomum subtenue, new species, from *Calamus calamus*.

65. Lateral view, balsam; length 1.5 mm.

Distomum (*Accacaelium*) *macrocotyle* Diesing, from *Teuthis hepatus*.

66. Lateral view, balsam; length 4.35 mm.

PLATE X.

Distomum nitens Linton, from *Tylosurus acus*.

FIG. 67. Sketch of specimen mounted in balsam; length 4.5 mm.

68. Ventral view of anterior end.

Distomum, species, from *Chatodon*, species.

69. Ventral view, life; breadth 0.3 mm.

Distomum, species, from *Bodianus fulvus punctatus*.

70. Sketch from life, anterior end inverted; length 0.9 mm.

Distomum, species, from *Sphyræna sphyræna*.

71. Ovum, alcoholic; longer diameter 0.07 mm.

Distomum gyrinus, new species, from *Lactophrys trigonus*.

72. Dorsal view, balsam; length 0.95 mm.

73. Ventral view of another, balsam, diameter, anterior 0.24 mm.

74. Ventral view, life, specimen from *Lactophrys tricornis*; length 1.58 mm.

Distomum lunelliforme, new species, from *Lactophrys trigonus*.

75. Ventral view, balsam; diameter 0.57 mm.

PLATE XI.

Distomum lomelliforme, new species, continued.

- FIG. 76. Ventral view of specimen from *Balistes carolinensis*, balsam; breadth 0.9 mm.
 77. Dorsal view, life; length 0.82 mm., breadth 1.20 mm.
 78. Ventral view of specimen from *Lactophrys tricornis*, life; length 1.78 mm.

Distomum trulla, new species, from *Ocyurus chrysurus*.

79. Ventral view, balsam; length 1.14 mm.

PLATE XII.

Distomum lereusei, new species.

- FIG. 80. Dorsal view of specimen from *Epinephelus striatus*, balsam; length 1.3 mm.
 81. Dorsal view of specimen from *Epinephelus maculosus*, balsam; length 1.8 mm.
 82. Posterior end of same, showing excretory vessel with muscular bulb; diameter of bulb 0.03 mm.
 83. Ventral view of another; length 0.96 mm.

Distomum, species, from *Balistes carolinensis*.

84. Dorsal view, life; length 1.77 mm.

PLATE XIII.

Distomum, species from *Paranthias furcifer*.

- FIG. 85. Dorsal view, life; length 1.38 mm.

Distomum fenestratum, new species, from *Lycodontis moringa*.

86. Ventral view, balsam; length 1.65 mm.
 87. Anterior end of same, enlarged.
 88. Sketch of a less usual form than that shown in figure 86, life; length 2.4 mm.
 89. Transverse section of neck; diameter 0.16 mm. *cu*, cuticle; *gl*, glandular layer; *lm*, longitudinal muscles; *oe*, esophagus.
 90. Transverse section through anterior part of ventral sucker; diameter 0.18 mm. *i*, convoluted beginning of intestine; *vs*, ventral sucker; other letters as in fig. 89.
 91. Transverse section, middle of body; transverse diameter 0.27 mm. *ii*, intestine; other letters as in fig. 89.

PLATE XIV.

Monostomum, species, from *Bathystoma striatum*.

- FIG. 92. Dorsal view, life; length 1 mm.

Monostomum, species, from *Hæmulon flavolineatum*,

93. Ventral view, life; length 1.05 mm.

Distomum tomex, new species, from *Epinephelus striatus*.

94. Ventral view, balsam; length 12 mm. *a'*, ova; length 0.018 mm.
 95. Anterior end of same; diameter at ventral sucker 0.48 mm.
 96. Genital papilla; transverse diameter 0.05 mm. *c*, aperture of cirrus; *u*, aperture of uterus.

PLATE XV.

Monostomum vinal-edwardsii Linton, from *Ocyurus chrysurus*.

FIG. 97. Dorsal view, balsam; length 2 mm.

Aspidogaster ringens Linton, from *Iridio radiatus*.

98. Dorsal view, balsam; length 2 mm.

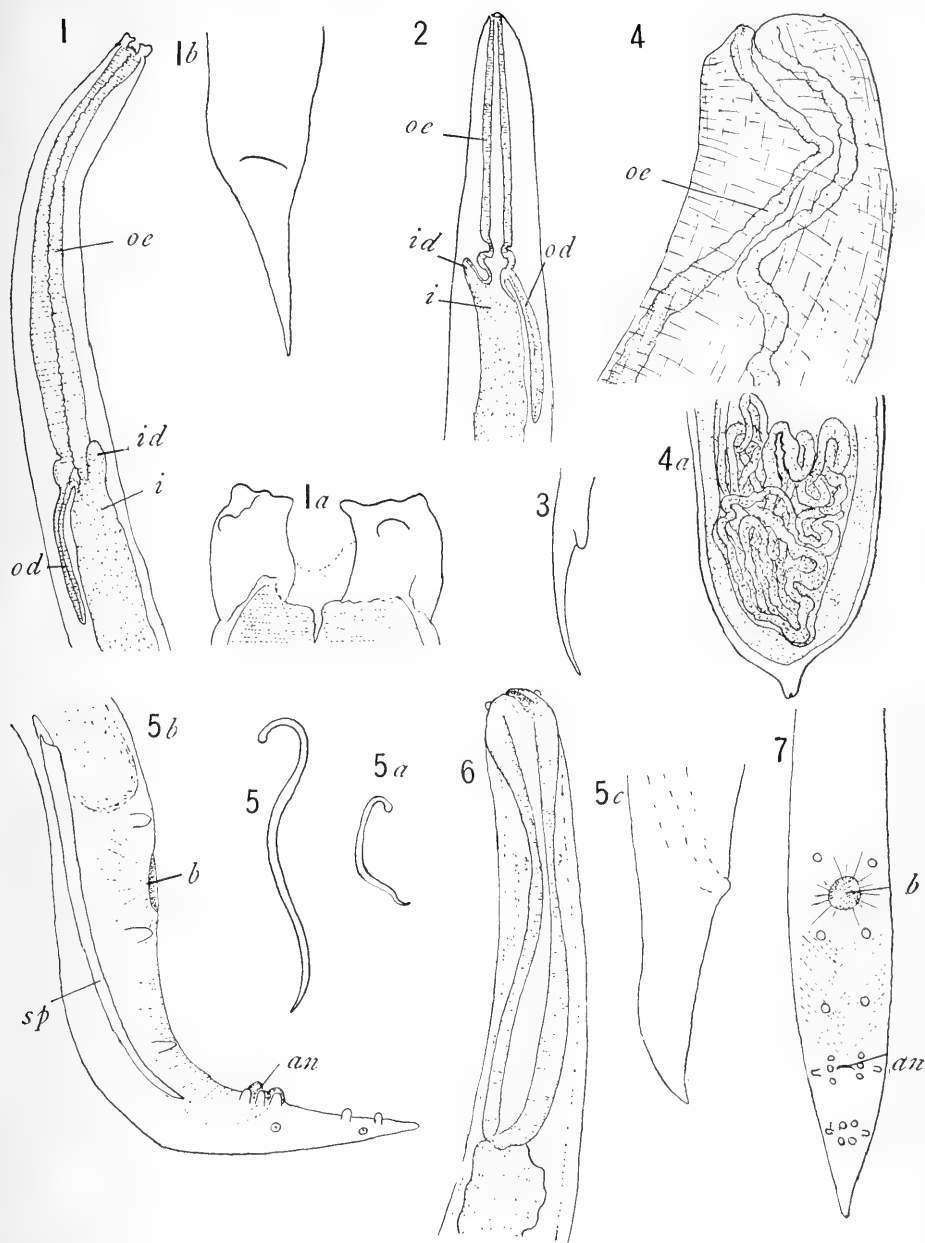
99. Ventral view of head and anterior portion of sucking disk, balsam; diameter of head 0.42 mm.

Undetermined *Trematode*, allied to *Phyllodistomum*, from *Balistes carolinensis*.

100. Ventral view, life; diameter of body 0.93 mm.; *d*, disk.

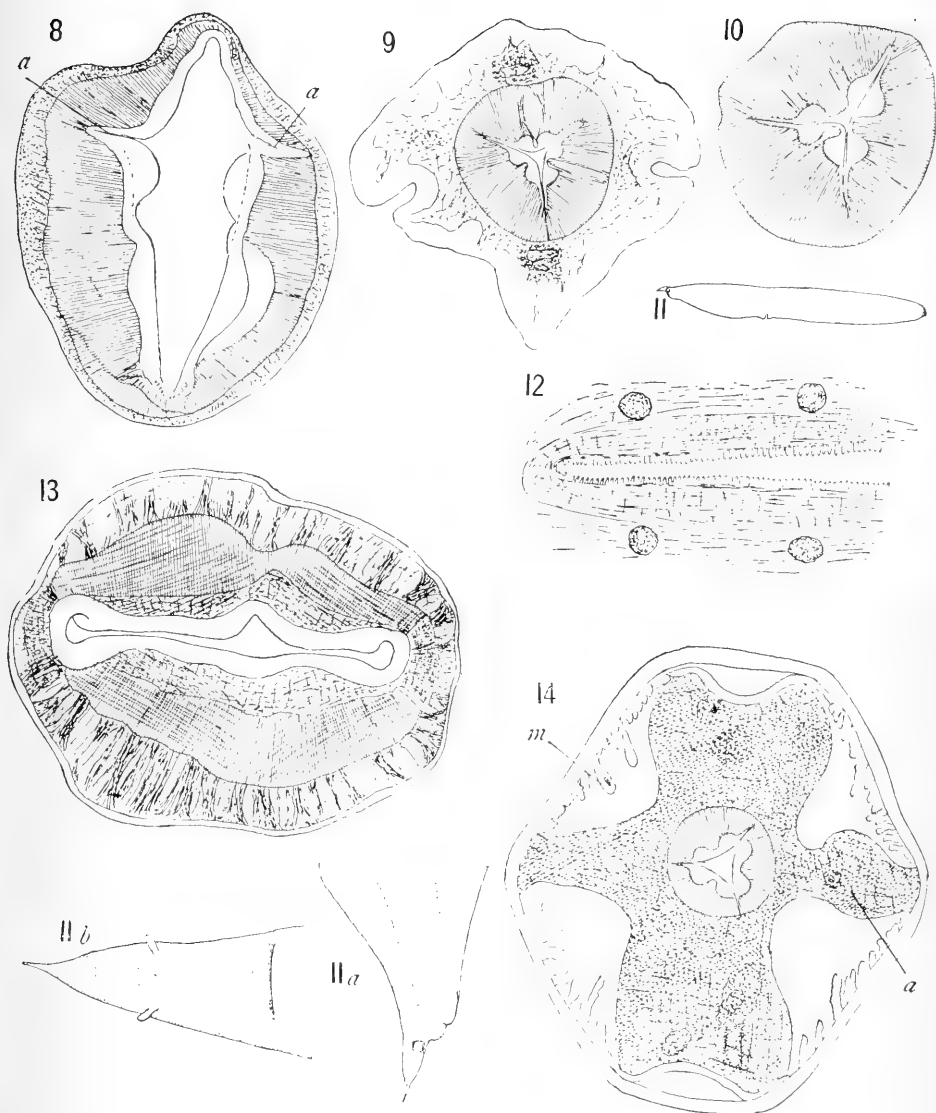
101. Same, stained and mounted in balsam.

102. Portion of ventral disk highly magnified; distance between striæ 0.015 mm.



PARASITES OF BERMUDA FISHES.

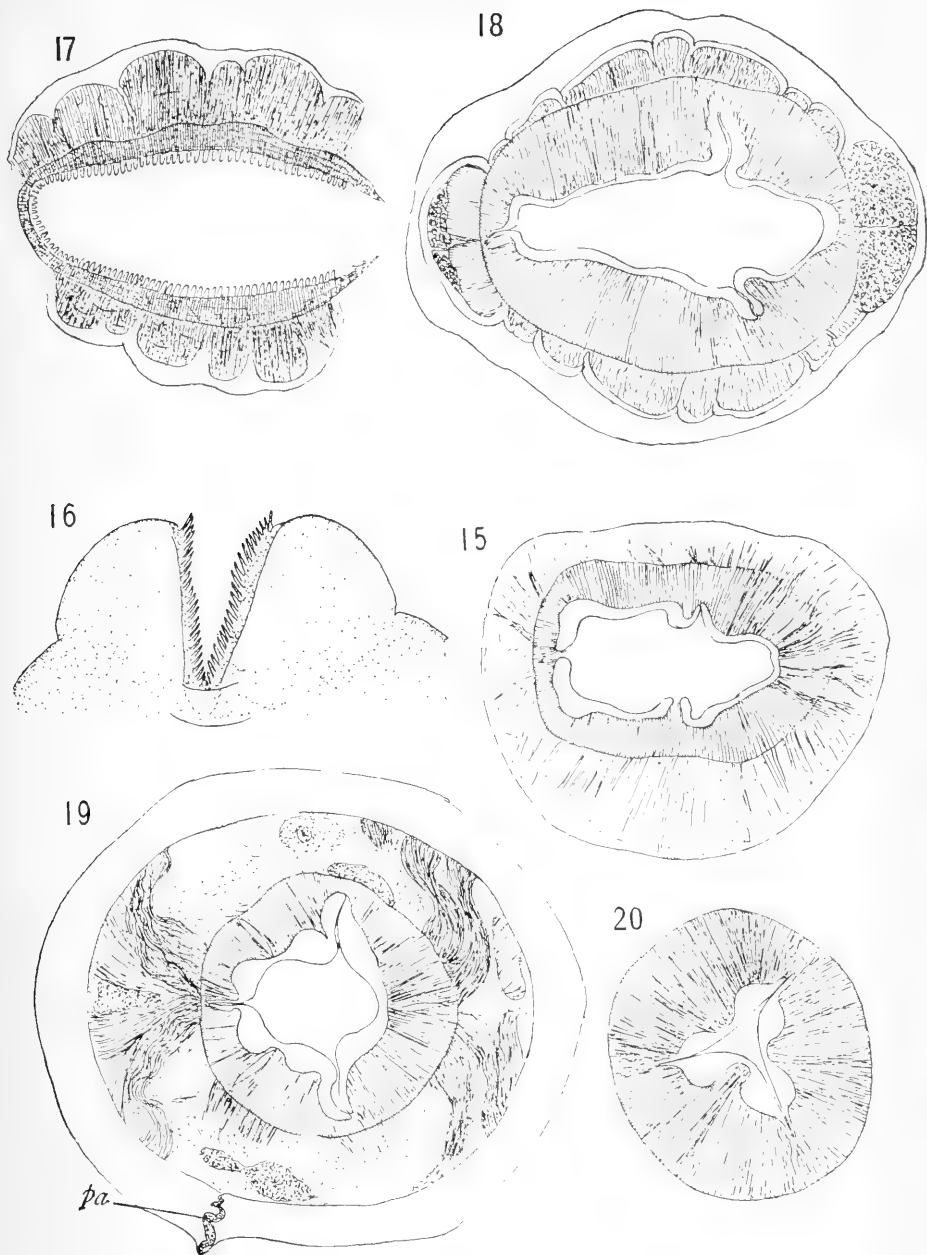
FOR EXPLANATION OF PLATE SEE PAGE 121.



PARASITES OF BERMUDA FISHES.

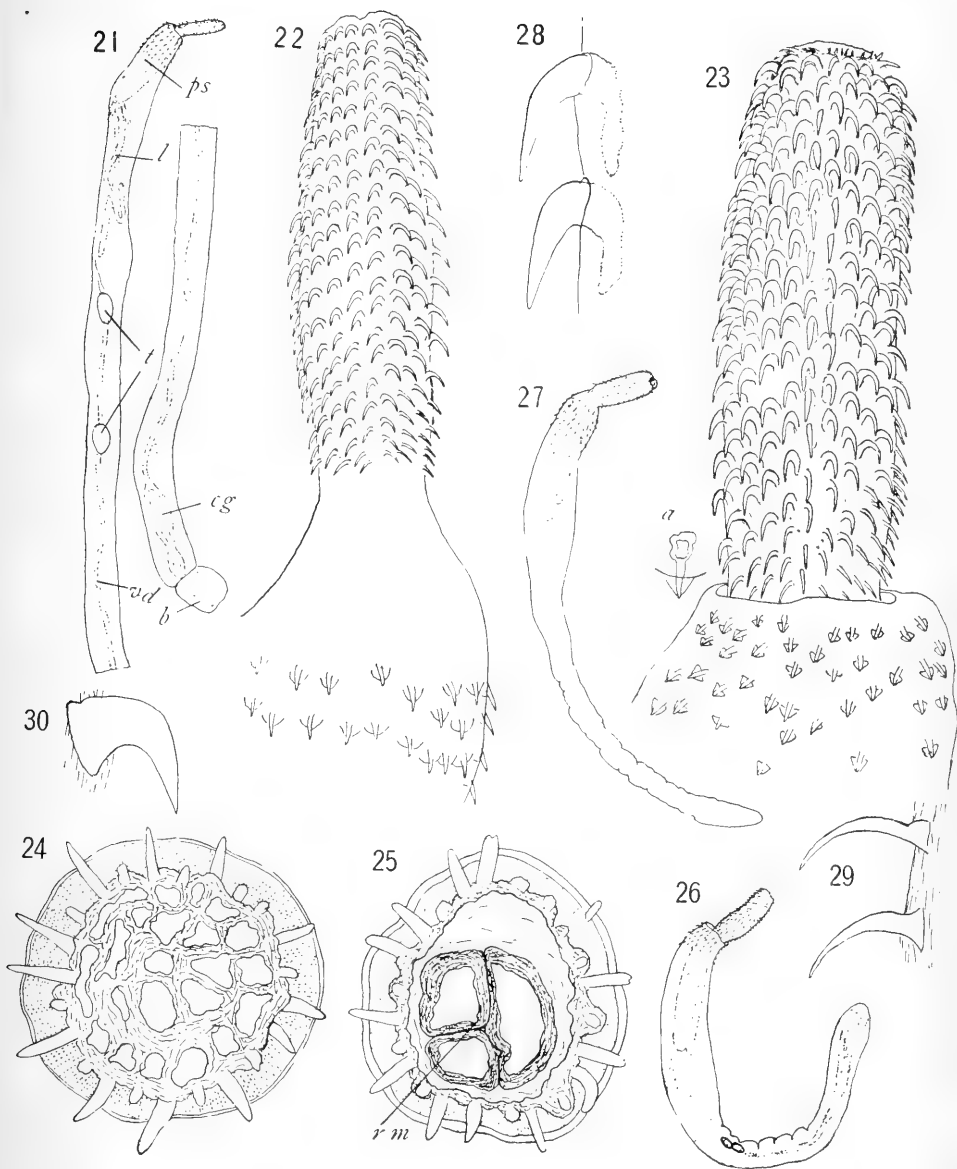
FOR EXPLANATION OF PLATE SEE PAGES 121, 122.





PARASITES OF BERMUDA FISHES.

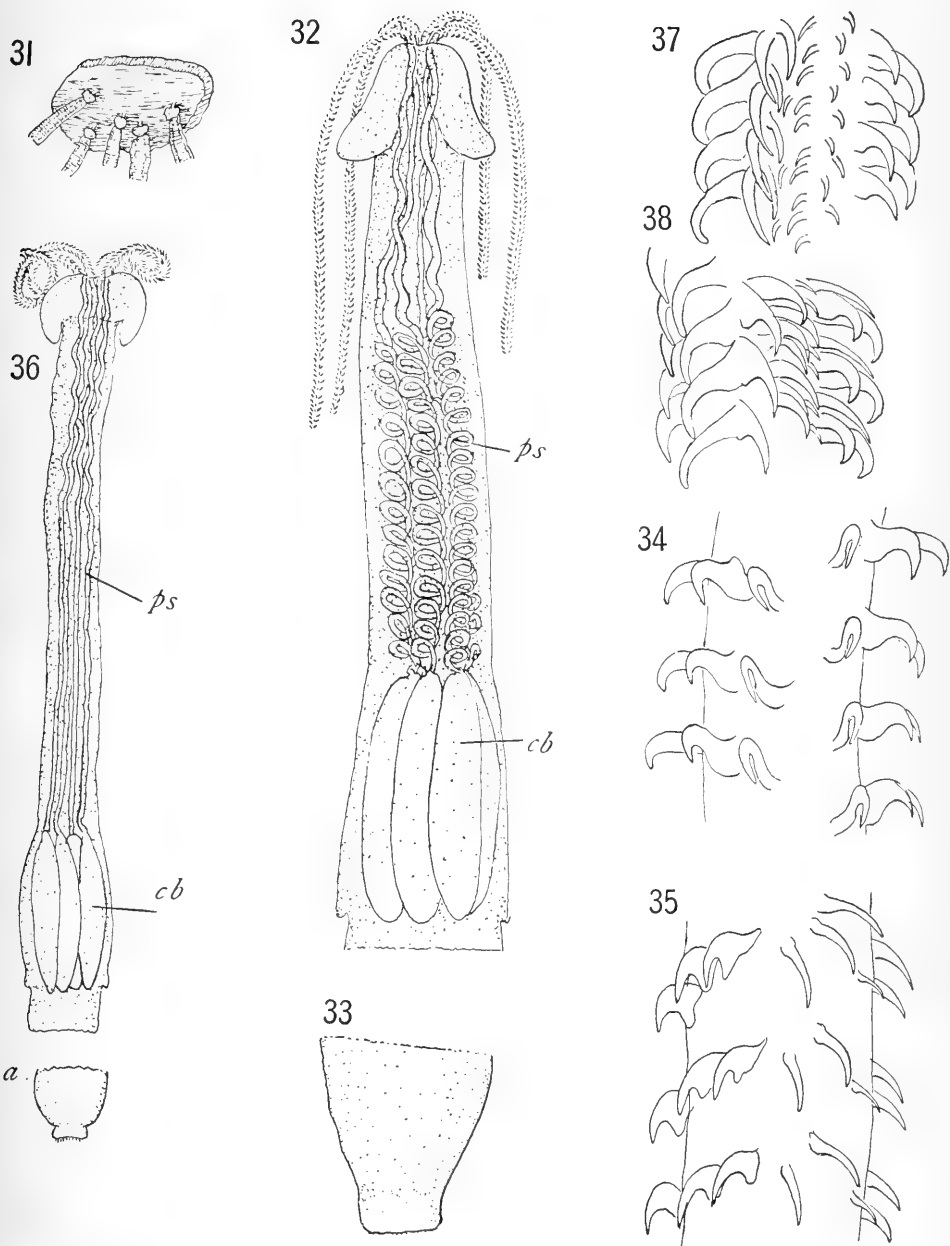
FOR EXPLANATION OF PLATE SEE PAGE 122.



PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 122.

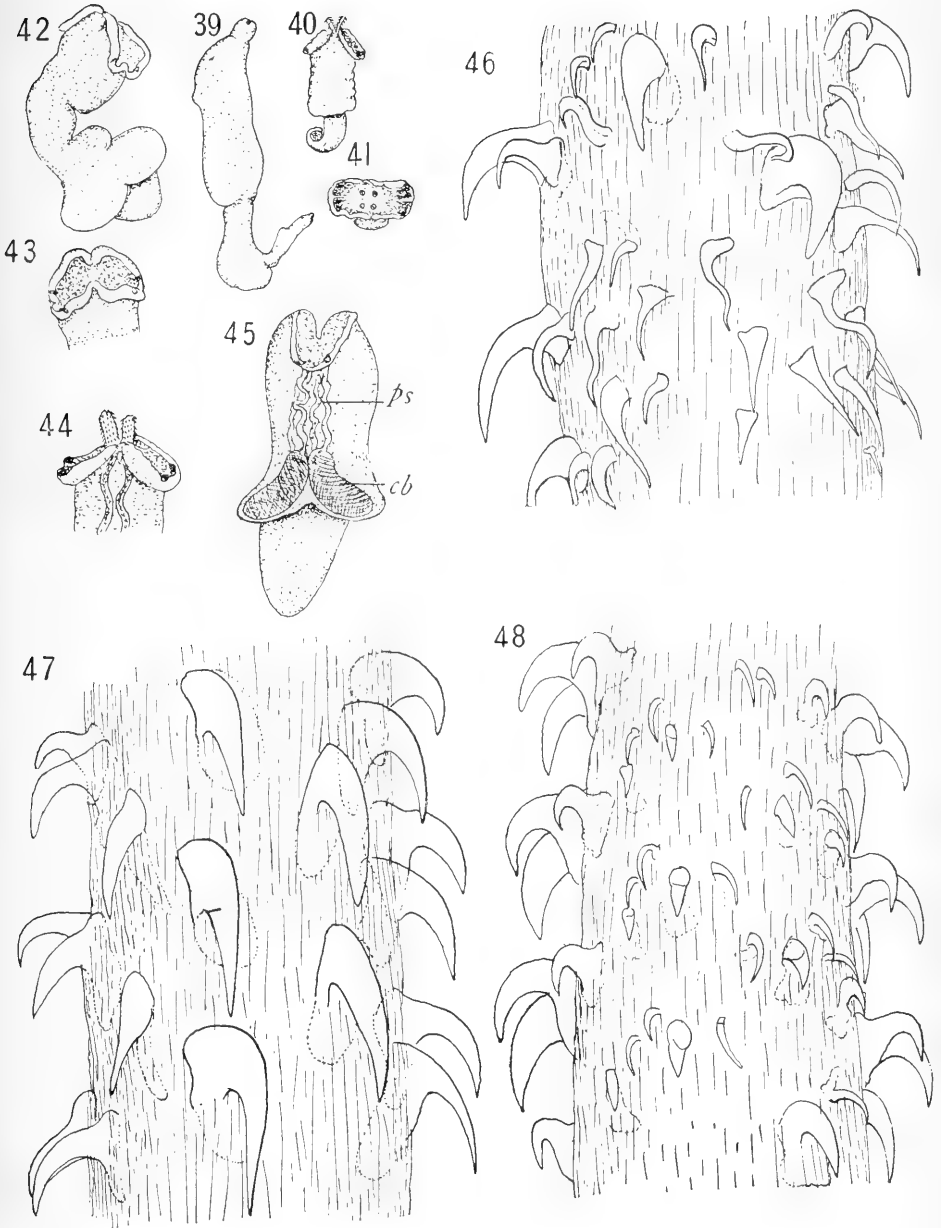




PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 123.





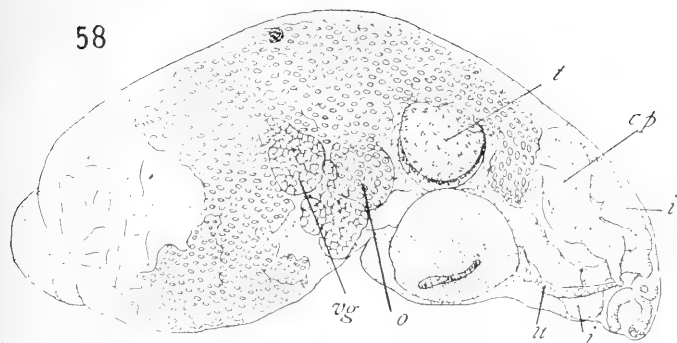
PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 123.

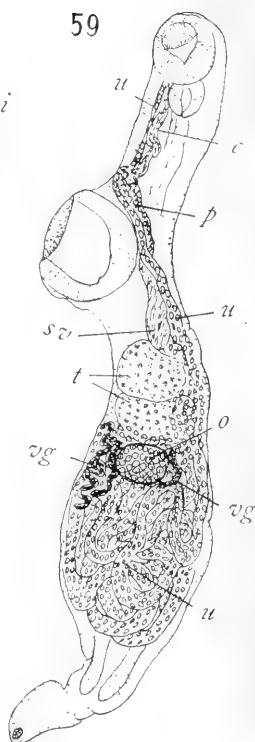
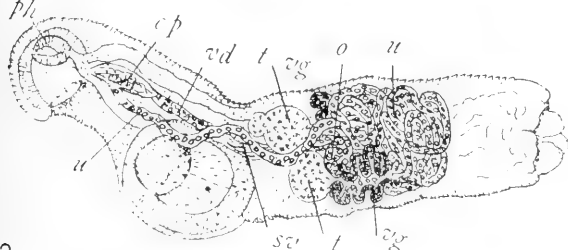




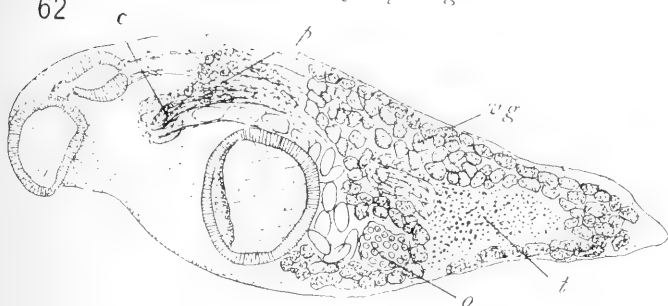
58



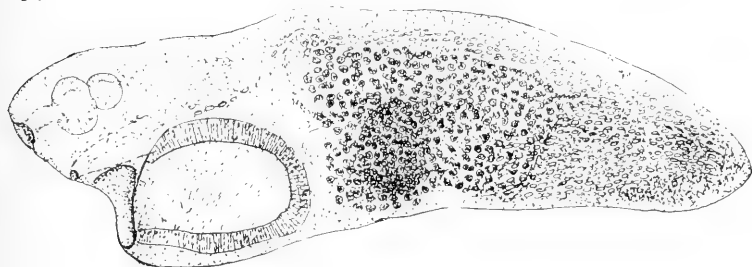
59

60 $\frac{ph}{h}$ 

62



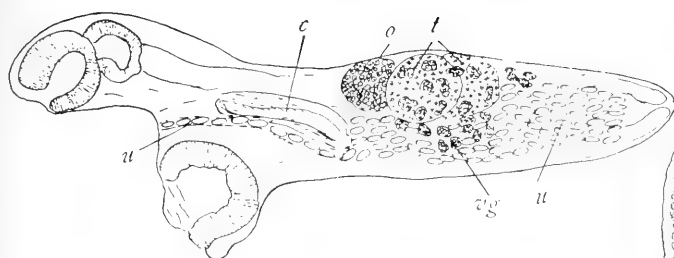
61



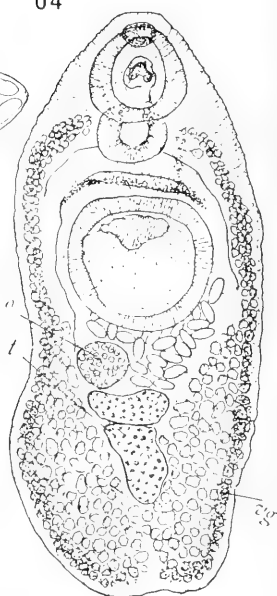
PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 124.

65



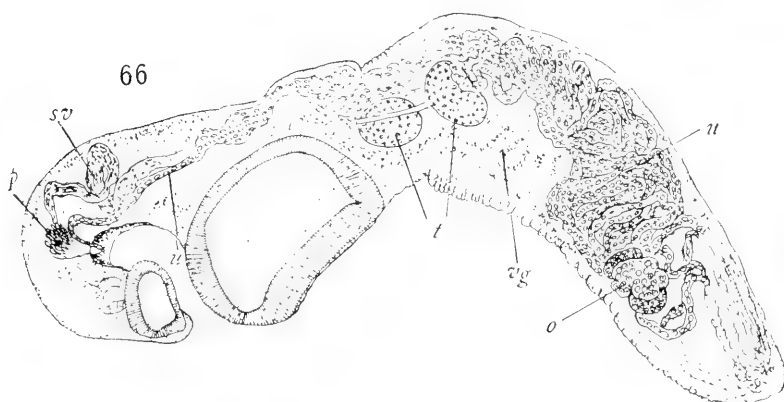
64



63

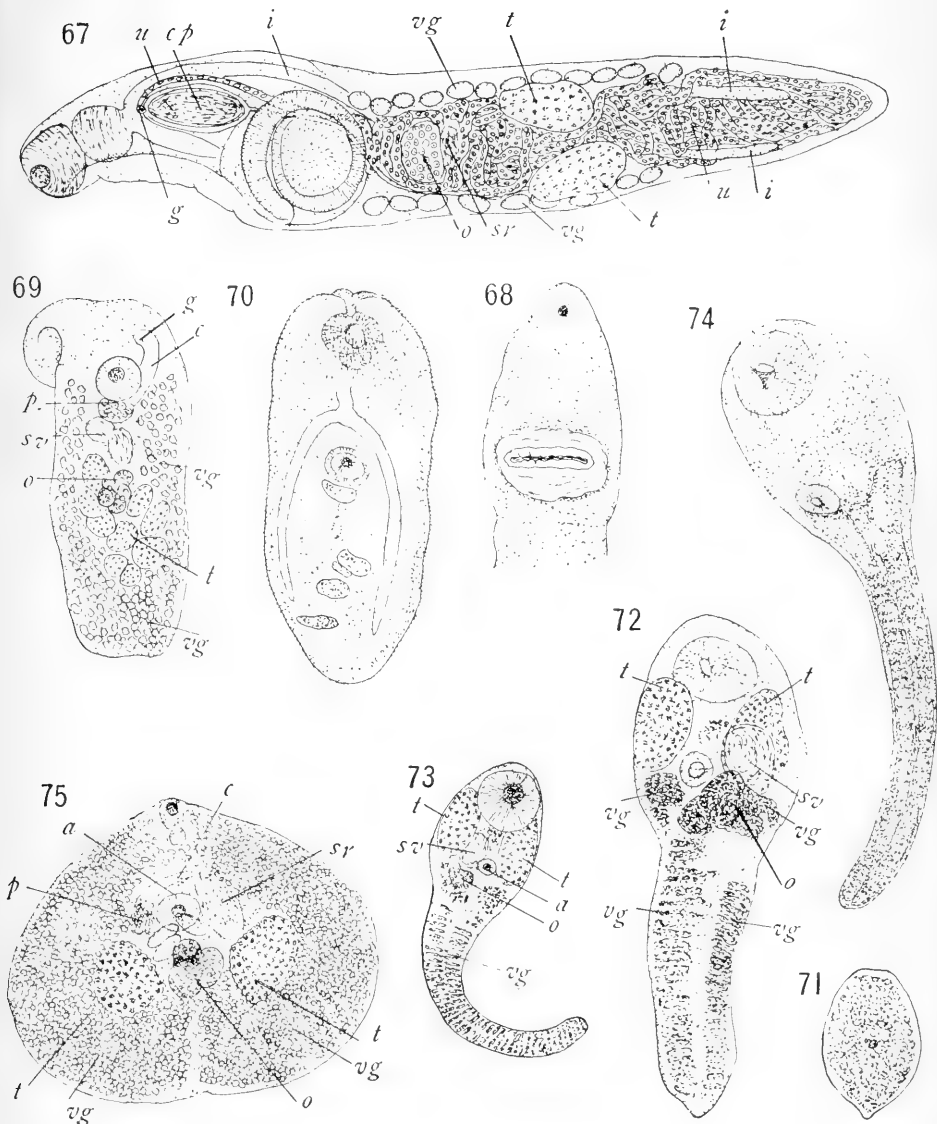


66



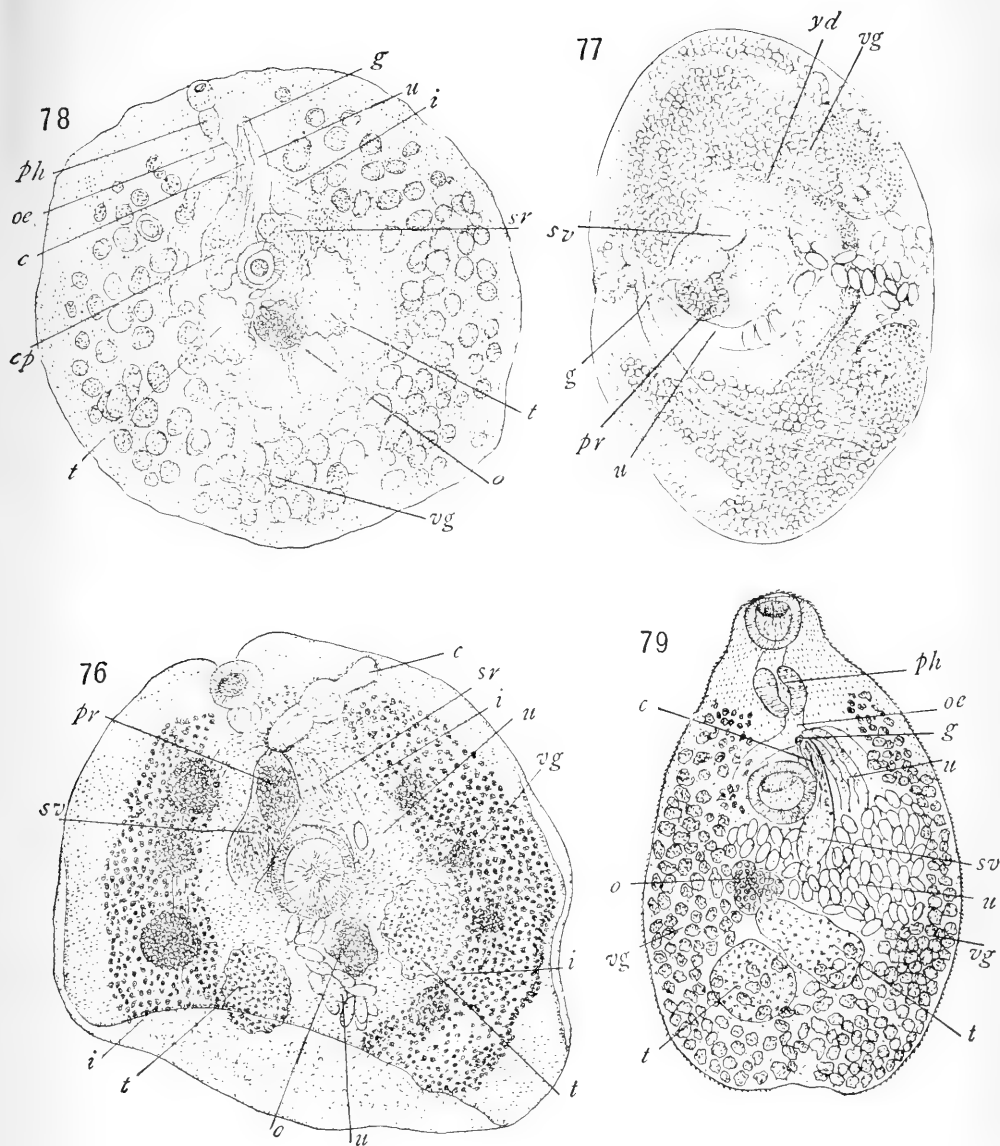
PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 124.



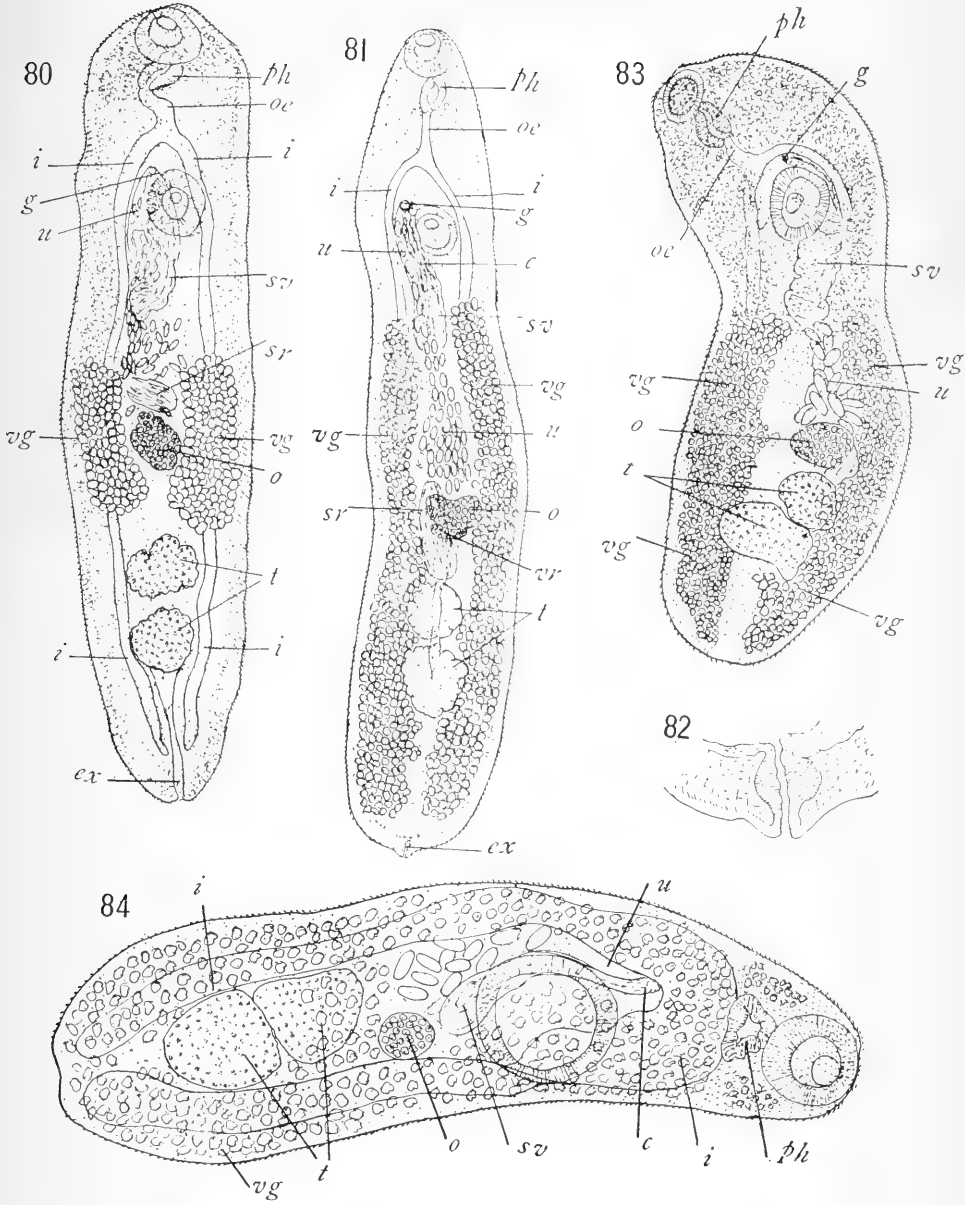
PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 124.



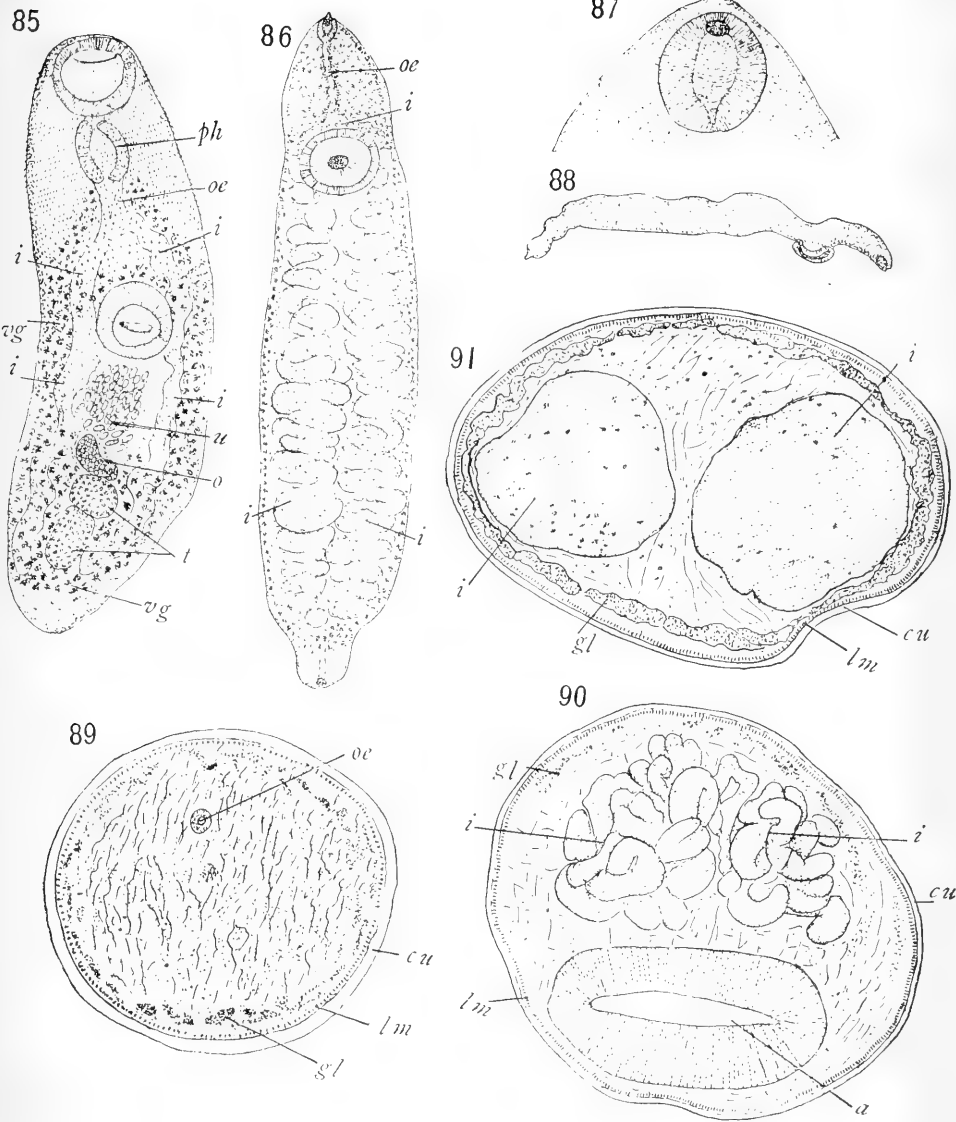
PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 125.



PARASITES OF BERMUDA FISHES.

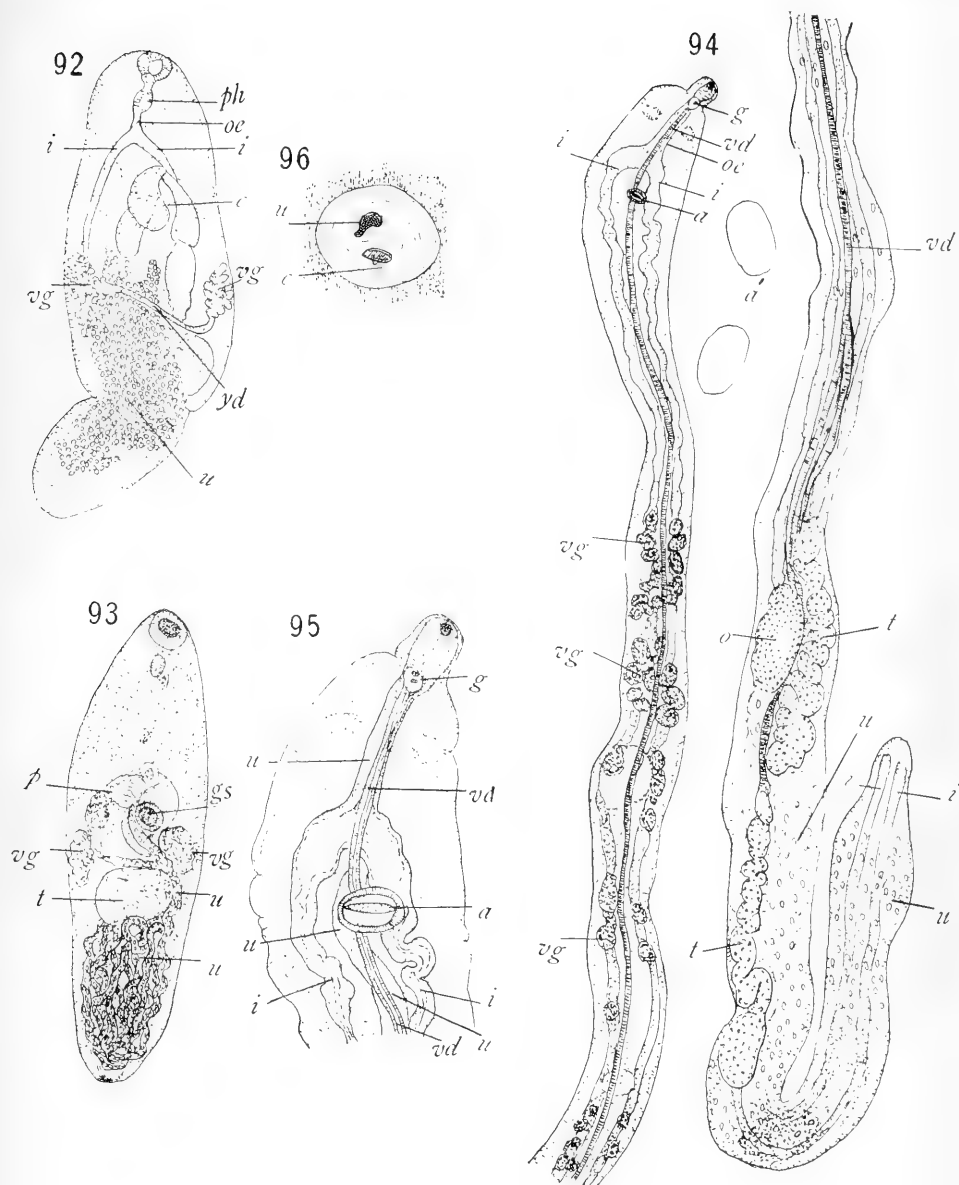
FOR EXPLANATION OF PLATE SEE PAGE 125.



PARASITES OF BERMUDA FISHES.

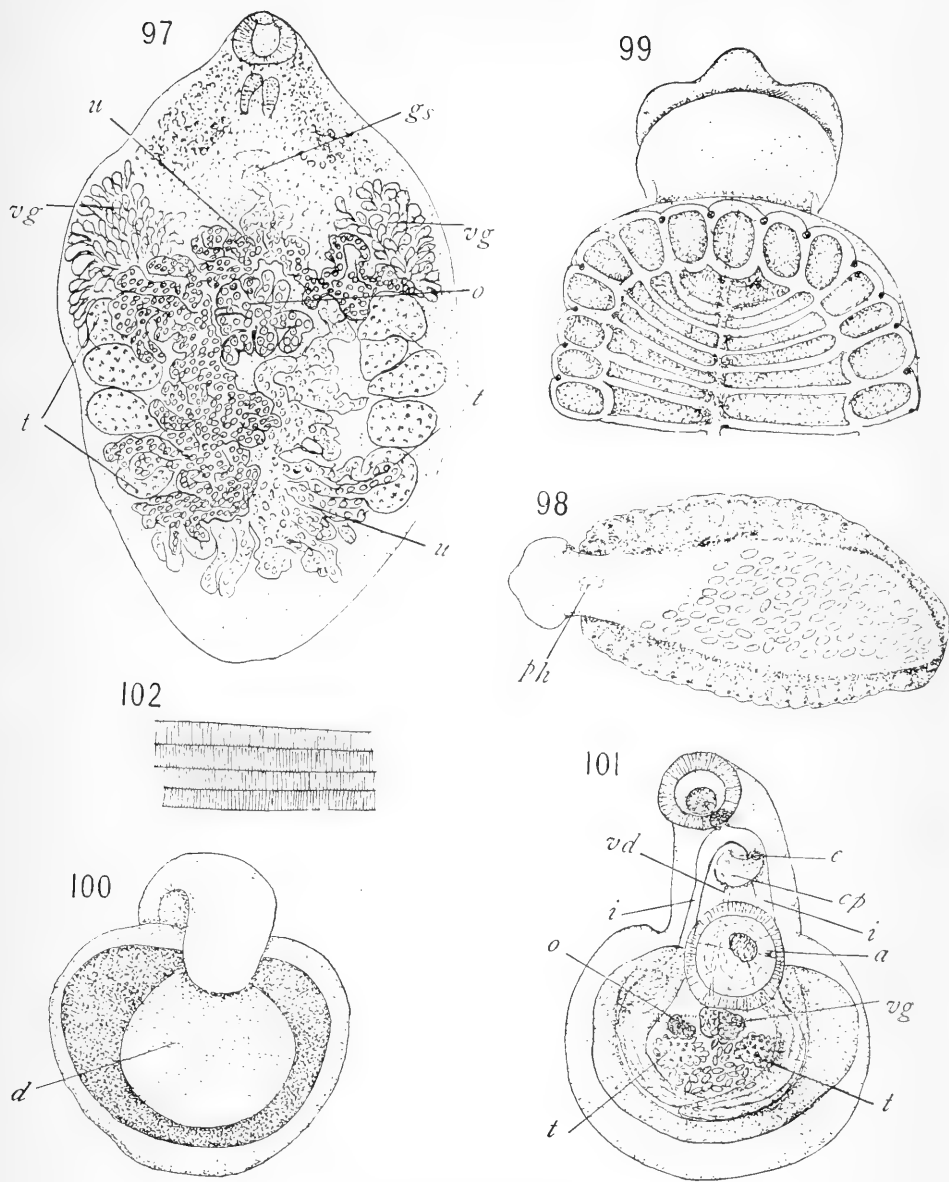
FOR EXPLANATION OF PLATE SEE PAGE 125.





PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 125.



PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 126.

DESCRIPTIONS OF NEW SPECIES OF RECENT UNSTALKED CRINOIDS FROM THE COASTS OF NORTHEASTERN ASIA.

By AUSTIN HOBART CLARK,
Of the United States Bureau of Fisheries.

In a previous paper^a I published preliminary descriptions of new species of unstalked crinoids belonging to the genus *Decametrocrinus* and the *Elegans*, *Eschrichtii*, and *Tenella* groups of the genus *Antedon*, from the collections made by the U. S. Fisheries steamer *Albatross* in the north Pacific and in the Japanese seas. In the present paper are included the new species belonging to the *Basicurva*, *Spinifera*, and *Palmata* groups of the genus *Antedon*, together with the bidistichate representatives of the *Acœla* group (which are here referred to as comprising the *Multicolor* group), the species lacking the pinnule of the third brachial, a species in which the first pinnule is the longest, and another species of the *Elegans* group. Three new species of *Comatula* are also described, and a species of *Comatula* and another of *Atelecrinus* are renamed. Attention is called to the varied and handsome coloration of the *Multicolor* group in life, a group in which this feature appears to attain its maximum so far as the Crinoidea are concerned. *A. rubroflava* is very handsome, bright yellow, banded with equally bright red, each color occupying areas about half an inch wide; this is the only species I have seen alive with this type of coloration; but a specimen of *A. stylifer* taken at Kagoshima in 1859 still shows evidence of having been similarly colored, although the specimen of the latter which I obtained is entirely different. The species described in this paper will be described in more detail and figured later. The keys preceding the descriptions are based on those of Dr. P. H. Carpenter, so far as possible; but all the species described since the publication of the *Challenger* report have been taken into consideration, and the characters of the new species here described are presented in such a way that their relations to those previously known will, it is hoped, be perfectly clear.

^aProc. U. S. Nat. Mus., XXXIII, pp. 69-84.

KEY TO THE SPECIES DESCRIBED.

- A. Ten-armed species, with the disk and ambulaera plated, but the rays not wall-sided; the pinnules stiff and rod-like [ACCELA group].
- a. First radials produced anteriorly, separating the second radials; second radials and axillaries rounded and widely separated (29) *Antedon thetis*.
- aa. The radials have flange-like lateral processes, which are in apposition laterally (4) *A. separata*.
- B. Bidistichate species, with the disk and ambulaera plated, but the rays not wall-sided; the pinnules stiff and rod-like [MULTICOLOR group].
- a. First radials anchylosed, forming a radial cup with interrarial processes reaching to the disk and widely separating the rounded second radials; 15 cirri of 35 joints (1) *A. multicolor*.
- aa. First radials not anchylosed; interrarial processes very narrow, lower part of second radials meeting above them; larger part of the second radials and the axillaries widely separated laterally: 20-25 cirri of 45 joints.
- (2) *A. versicolor*.
- aaa. First radials appear as small interrarial triangles with no distal process; second radials in apposition for entire lateral edge, but axillaries widely separated (3) *A. propinqua*.
- aaaa. The radials have flange-like lateral processes, which are in apposition laterally.
- b. Lower brachials (and distichals when present) rounded, and widely separated from those on adjacent rays (4) *A. separata*.
- bb. The first distichals have flange-like processes, and are in apposition laterally.
- c. Cirri short, with 30 short joints; the second or third (or both) pairs of pinnules much elongated; first radials only just visible.
- (5) *A. flavopurpurea*.
- cc. Cirri long and slender, with 40 elongated joints; the proximal pinnules not elongated; first radials large and prominent (6) *A. callista*.
- C. Ten-armed species, in which the radials and lower brachials have flattened sides. [BASICURVA group.]
- a. Pinnule ambulaera plated.
- b. The later cirrus joints have dorsal spines.
- c. First pinnule smaller than the second; cirri three-fourths length of arms, with 80 joints; dorsal surface of radials smooth (7) *A. anthus*.^a
- cc. First pinnule nearly or quite as long as the second; cirri longer than the arms, with about 110 joints (8) *A. macropoda*.^a
- ccc. First pinnule longer than the second.
- d. Over 60 cirrus joints.
- e. First pinnule much flattened exteriorly; cirri very slender, with about 70 joints; radials and brachials strongly carinate; arms compressed, with prominent overlapping spines (9) *A. hana*.
- dd. 30 to 50 cirrus joints.
- e. First pinnule flattened on outer side; much larger and stouter than second.
- f. Cirri in 15 vertical rows; radials and lower brachials thickly set with short spines (10) *A. villosa*.^a
- ff. Cirri in five well-separated double vertical rows; radials and lower brachials bordered with stout spines (30) *A. hawaiiensis*.^b

^a Also a bidistichate species; see p. 129.^b Also a tridistichate species.

- ee.* First pinnule not flattened on outer side; cirri in 10 vertical rows.
f. 20 cirri; calyx and arm bases smooth.....*A. latipinna.*^a
ff. 30 cirri; calyx and arm bases spiny (11) *A. pubescens.*
bb. Less than 30 cirrus joints, without dorsal spines.
c. Pinnules of eighth and following brachials have broad lower joints and strong plates covering the genital glands.
d. Third and fourth joints of genital pinnules broad and nearly flat on the outer side, but the fifth joint smaller.
e. First radials visible; arm bases smooth; 7-10 cirrus joints.
(12) *A. hepburniana.*
dd. Lower joints of genital pinnules uniformly expanded.
e. First radials concealed; less than 20 cirrus joints.
f. Calyx and arm bases rugose; first pinnule flagellate, with 40 or more joints (13) *A. lata.*
ff. Rays separated laterally; radials scale-like, with a thin marginal flange; second radial hemispherical (14) *A. scalaris.*
cc. Pinnules of tenth and following brachials have the lower joints as long as or longer than wide, with no extensive plating over the genital glands.
d. Basals prominent; radials long, not carinate..... (15) *A. garrettiana.*^b
dd. Basals, first radials, and often more or less of the second radials concealed; cirri stout and rounded basally, slender and compressed distally..... (16) *A. orion.*
aa. Pinnule ambulacra not plated.
b. Three radials visible; stoutest pinnule on second brachial; 30-40 rather elongate cirrus joints..... (17) *A. minor.*
D. Bidistichate species with the radial axillaries and some of the following joints more or less wall-sided, and a well-marked ambulacral skeleton on the pinnules [SPINIFERA group].
a. Over 30 cirrus joints, the later ones spiny.
b. The first pinnule much smaller than the second; less than 20 cirri in five well-separated double rows; arms long and slender, with more than 100 joints; cirri long and rather stout, with about 80 joints..... (7) *A. anthus.*
bb. The first pinnule about the same length as, or only slightly shorter than, the second; cirri longer than the arms, stout, with about 110 joints.
(8) *A. macropoda.*
bbb. The first pinnule as long as or longer than the second; cirri shorter than the arms.
c. Centro-dorsal conical or shortly columnar, with 5 double rows of cirrus sockets.
d. 20 arms of sharply carinate joints.
e. 70-90 slender cirrus joints.....*A. quinquecostata.*^a
ee. 50-55 stout cirrus joints..... (18) *A. diadema.*
dd. 20 arms of rounded joints; radials not carinate; surface of radials and lower brachials smooth; first pinnule not much stouter than succeeding; 35-40 cirrus joints..... (19) *A. aster.*
ddd. Less than 15 arms of rounded joints; radials not carinate; surface of radials and lower brachials covered with spines; first pinnule much larger and stouter than the succeeding; 50 cirrus joints.
(10) *A. villosa.*
dddd. Less than 15 arms of rounded joints, but radials strongly carinate; 30 cirrus joints..... (20) *A. alboflava.*

^aInserted for comparison.^bAlso a bidistichate species; see p. 130.

- aa.* Less than 25 cirrus joints, usually smooth.
- b.* Centro-dorsal conical, the cirri in 5 radial clusters; cirri rather slender, with 16 smooth joints; basals and first radials large and prominent.
- (15) *A. garrettiana.*
- bb.* Centro-dorsal discoidal, the marginal cirri without definite arrangement; basals and first radials concealed; radials narrow, rounded or flattened; cirri stout and rounded basally, slender and compressed distally.
- (16) *A. orion.*
- E. Ten-armed species with no pinnule on the third brachial.
- a.* First pinnule the longest..... (21) *A. ruber.*
- aa.* First two pinnules about equal, or the first slightly shorter than the second; long conical processes at the junctions of the two outer radials and first two brachials..... (22) *A. diomedea.*
- aaa.* Second pinnule much elongated, the joints with serrate ends; radials and lower brachials smooth, not tubercular (23) *A. tigrina.*
- F. Ten-armed species with the first pinnule the longest.
- a.* About 30 smooth cirrus joints, the basal ones elongate..... (24) *A. bowersi.*
- G. Bidistichate species with an unplated disk and no definite ambulacral skeleton; the sides of the lower brachials are scarcely, if at all, flattened; the first pinnule smaller than its successors [PALMATA group].
- a.* The third brachial has a pinnule.
- b.* One post-radial axillary; the rays quite free laterally.
- c.* 40-45 cirrus joints; lateral flange-like processes on the radials and distichals.
- (25) *A. abbotti.*
- bb.* One post-radial axillary, the radials and distichals in close contact laterally.
- (26) *A. stylifer.*
- bbb.* Two or more post-radial axillaries.
- c.* Third pinnule larger than the second.
- d.* Cirri not spiny.
- e.* Cirri elongate, with 40 or more joints (27) *A. delicatissima.*
- H. A syzygy in the radial axillary..... [ELEGANS group].
- a.* Cirri very stout, the joints about as broad as long; there are no dorsal spines, but the penultimate joint bears a strong opposing spine; second radials visible (11 arms in the type) (28) *A. rubroflava.*

I. ANTEDON MULTICOLOR, new species.

Centro-dorsal a thick disk, bearing 15 cirri in a single marginal row; these are 20 mm. long with about 35 short joints, of which the sixth and seventh are squarish, the others wider than long; the joints overlap somewhat and distally bear small dorsal spines.

First radials completely anchylosed laterally, extending up in a tongue-like process in each interradial area to the disk, thus widely separating the second radials; second radials oblong, slightly over twice as wide as high; axillaries pentagonal, slightly less than twice as wide as high. Axillaries and second radials of each ray rounded and widely separated from those of adjacent rays; the lower part of the calyx bears a strong resemblance to that of *Atelecrinus balanoides*; but the "basal ring" in the case of *Antedon multicolor* is formed of the coalesced first radials, consequently there are only two radials above it, whereas in *Atelecrinus* there are three. The articulation between the two outer radials in *Antedon multicolor* is

of such a character as to almost appear syzygial, and the two joints are entirely incapable of motion on one another; but the articulation between the first and second radials admits of a very considerable dorso-ventral motion. Judging from Dr. P. H. Carpenter's figure of *Atelecrinus balanoides*, a similar condition appears to occur in that species. Distichals two, resembling the two outer radials, but higher in proportion to their width; 20 arms 60 mm. in length with about 75 brachials, quadrate proximally, becoming triangular, about as high as wide, about the tenth or eleventh. The longer edges of all the brachials are convex and bear a pinnule in the center. The second brachial is considerably swollen on the side bearing the pinnule. Syzygies occurs in the third brachial, again about the tenth or twelfth, and distally at intervals of 2, sometimes 3, joints.

First pinnule short and very slender, flexible, with 19 joints, the first two enormously expanded, the remainder very small and squarish; second pinnule usually more than twice its length, stiff, stout, and rod-like, with 15-20 joints, the first two much expanded, the remainder elongate. The length of the second pinnule is very variable even in a single specimen; the second pinnule on one arm may be half as long again as that on another, or one of the second pair may be much longer and stouter than its fellow; however, the second pinnule is always much longer than the first, and always stiff and spine-like, while the first is weak and flexible. The third pinnule is usually considerably smaller than the second, though similar in character, and from then on the length gradually diminishes to the seventh or eighth, after which they remain very uniform to the ends of the arms. The enlargement of the two lower joints, which is greatly exaggerated on the first pinnule, is much less marked on the second, still less on the third, and hardly noticeable after the fourth.

The color in life is usually a delicate light grayish purple, or lavender, with narrow bands of dull yellow on the arms; one specimen, however, is pure white, the arms crossed by a broad, deep purple band near the middle and another near the tip. The cirri are light lavender, usually with a narrow band of yellow about the end of each joint.

This small group, of which *A. multicolor* is the type, illustrates better than any other with which I am acquainted in life the utter worthlessness of color as a specific character among many of the unstalked crinoids. All but one of my specimens were lavender, narrowly banded with dull yellow; this is the color of all my examples of *A. flavopurpurea* except three, which are a beautiful orange yellow, becoming bright orange on the rays and centro-dorsal; it is also the color of *A. delicatissima* of the *Palmata* group, most closely related to *A. bimaculata* Carpenter, which is dark purple up to the last axillary, then white; but this last type of coloration also occurs in *A. manca* (= *A. disciformis* = *A. claræ*), a species widely different from *A. bimaculata*

and usually dull white, spotted more or less thickly with grayish or reddish purple, resembling some color phases of *A. diomedea*. One specimen of *A. multicolor* is white, with purple bands, almost exactly like the type of *A. callista*. *A. versicolor*, which is most nearly allied to *A. multicolor*, is reddish brown, resembling species of the *A. palmata* group, but quite different from any known form of coloration in its own group. *A. propinqua*, also, which is reddish brown marbled with white, is quite different from any others in the group.

Type.—Cat. No. 22619, U.S.N.M.; from *Albatross* station No. 4894; 32° 33' 00" north latitude, 128° 32' 10" east longitude (Eastern Sea); 95 fathoms; August 9, 1906.

2. *ANTEDON VERSICOLOR*, new species.

Centro-dorsal a low disk, bearing 20–25 marginal cirri; these are moderately stout, 23 mm. long, composed of 45 short, squarish joints, overlapping somewhat, and bearing spines distally.

First radials visible as triangles in the interradi al areas, the distal apices much produced; the sutures between the first radials are distinctly visible; second radials oblong, between three and four times as wide as high, bluntly carinate, in apposition basally, free distally; axillaries widely pentagonal, twice as wide as high, bluntly carinate in their posterior half, widely separated; distichals like the two outer radials, but rather higher in proportion. Twenty arms 90 mm. long with 130 brachials, the first 5 irregularly oblong, then quadrate to the twelfth, after which they become triangular, about as high as wide, the long outer side convex and bearing the pinnule at its distal apex; brachials strongly overlapping, slightly compressed and slightly carinate; first syzygy in the third brachial, another about the eighteenth, and others distally at intervals of one, two, or three joints.

First pinnule about 7 mm. long, slender, delicate, and flexible, with 30 joints, the first enormously expanded, the second very broad and trapezoidal, the others very small and square; second pinnule 10 mm. long, stiff and spinelike, with 25 joints, the first two much enlarged, the remainder elongated; third pinnule 13 mm. long, resembling the second, but with the joints more elongate; fourth similar, but slightly shorter; the following pinnules decrease in length to about the ninth, which is 7 mm. long with 15 joints, the first two broad, the others elongated, after which there is a slight increase in length distally; the distal expansion of the first joint is marked on all the pinnules, but less so distally; on most of the pinnules after the fifth it rises into a low tubercle.

Color in life rich, deep purplish brown, the basal portion of the arms with a row of lateral yellow spots; rays yellow, transversely banded with purplish brown; cirri purplish brown, with the distal half yellow; disk purplish brown, marbled with yellow in the interambulacral areas.

Type.—Cat. No. 22620, U.S.N.M.; from *Albatross* station No. 4884; 32° 32' 00" north latitude, 129° 30' 45" east longitude (Eastern Sea); 53 fathoms; August 8, 1906.

3. *ANTEDON PROPINQUA*, new species.

Centro-dorsal discoidal, bearing 25 marginal cirri in two alternate rows; cirri 25 mm. long, moderately slender, with 45 joints, the basal half of which are rather longer than wide, the distal half bearing strong dorsal spines.

First radials visible as a low interrarial triangle with no apparent median suture; second radials low and wide, their lateral edges produced into flangelike marginal processes which meet those of the adjacent second radials, so that the second radials are all in apposition for their entire length; axillaries pentagonal, with the lateral edges produced, but entirely free; the two distichals resemble the two distal radials, but their sides are rounded without lateral processes, and they are proportionately higher. Twenty arms, 70 mm. long, with about 120 joints, of which the basal 3 are roughly oblong, then quadrate to the tenth or eleventh, then triangular, about as long as wide; the long sides of all are convex, bearing the pinnule at the distal apex.

The first pinnule is very small, delicate, and flexible, with 20 joints, the first enormously enlarged, the second less than half as large, the remainder very small and squarish; the second pinnule is much longer and stouter, stiff and rod-like, with about 15 joints, the first short and broad, the second squarish, the remainder much elongated; the third pinnule is even longer and stiffer, after which the pinnules gradually decrease to about the eighth, then increase very slightly distally.

Color in life reddish and purplish brown marbled with light yellow, the dark and the light in about equal proportions; rays and lower brachials purple, with a medium line of white; two or three areas of white with purple spots distally on the arms.

Type.—Cat. No. 22621, U.S.N.M.; from *Albatross* station No. 4895; 32° 33' 10" north latitude, 128° 32' 10" east longitude (Eastern Sea); 95 fathoms; August 9, 1906.

4. *ANTEDON SEPARATA*, new species.

Centro-dorsal rounded-discoidal, bearing about 15 cirri in two irregular rows; these are 15 mm. long, with 35 joints, of which about one-half are slightly longer than wide and the distal two-thirds bear dorsal spines.

First radials narrow and band-like; second radials short, oblong; axillaries low and wide, pentagonal; the two last usually have the lateral edges more or less produced and flangelike and in apposition.

Seven of the specimens have 10 arms only, two have 11, and one has 12; arms 55 mm. long, with 85 brachials, the first 5 quadrate, then triangular about as long as wide, becoming quadrate and elongate distally; the long sides of the joints are convex, and bear the pinnules in the distal angles.

First pinnule small, slender, and delicate, the first two joints greatly enlarged, the others small and squarish; second pinnule much longer with elongated joints, the pinnules from then on remaining very uniform to the end of the arm, the second and third being only very slightly or not at all longer than the succeeding.

Color in life bright yellow, banded with purple; lower brachials purple; cirri deep purple, or purple banded with white.

Type.—Cat. No. 22622, U.S.N.M.; from *Albatross* station, No. 4893; 32° 32' 00" north latitude, 128° 32' 50" east longitude (Eastern Sea); 106 fathoms; August 9, 1906.

5. ANTEDON FLAVOPURPUREA, new species.

Centro-dorsal low-hemispherical, the pole somewhat flattened, bearing about 20 marginal cirri in two irregular rows; the cirri are 15 mm. long and have 30 rather stout joints, the first 10 slightly longer than wide, the others short; all the joints are slightly compressed and have expanded and overlapping distal edges, and the distal two-thirds are provided with a dorsal spine, which becomes more prominent toward the tip; penultimate joint and terminal claw rather small.

First radials just visible, not produced anteriorly; second radials oblong, terminating laterally in a tubercle, and furnished with a strong median keel; axillary triangular, about twice as wide as high, with a median tubercle just forward of the center, continued backward in a keel, corresponding with the keel on the second radial; surface of second radial and axillary rough, and furnished with a few small blunt tubercles. Two articulated distichals, the first irregularly oblong, slightly raised in the center, furnished exteriorly with a broad lateral flange, the axillary triangular, a low tubercle on its lower margin. Usually 20 arms of about 120 joints, the first 5 irregularly oblong, then triangular to about the middle of the arm, about as high as wide, then becoming quadrate; all the brachials have overlapping edges, the lower ones furnished with a row of fine sharp teeth. A syzygy in the third brachial, another about the fourteenth, and others at intervals of about 4 joints.

The first pinnule is small, slender, and delicate, 4 mm. long, with 15 joints, the first 2 disproportionately large, the others longer than wide; second pinnule 6 mm. long, with 15 joints, the first 2 enlarged, the rest elongate; the third pinnule is 7 mm. long and resembles the second. The following pinnules decrease gradually in length to the seventh or eighth, which are 4.5 mm. long, with about 10 joints, then

gradually increase distally, where they are 6 or 7 mm. long, with 12-15 joints. The pinnules from about the tenth to the twenty-fourth brachials have the first 5 or 6 joints somewhat, though not greatly, expanded.

Color in life, lavender, the arms crossed by bands of dull yellow; cirri yellow; lower pinnules yellow, banded at the junction of alternate joints with purple. Other specimens are similar, but the rays and centro-dorsal orange, the cirri purple. Another type of coloration is: rays and centro-dorsal orange, the arms clear yellow, sometimes faintly blotched with light purple; cirri deep purple, banded with white.

Type.—Cat. No. 22623, U.S.N.M.; from *Albatross* station, No. 4935; 30° 57' 20" north latitude, 130° 35' 10" east longitude (off Kagoshima Gulf); 103 fathoms; August 16, 1906.

6. ANTEDON CALLISTA, new species.

Centro-dorsal short-columnar, bearing about 30 cirri in two rows; these are 23 mm. long, slender, with about 40 joints, most of which are longer than wide, the lower ones very much so; the distal two-thirds bear dorsal spines.

First radials comparatively large from one-half to nearly the whole height of the second radials in the median line, not produced interradially, in apposition all around, the sutures almost obsolete; second radials low and wide, about four times as broad as long, roughly oblong, the edges in apposition laterally; axillaries triangular or low pentagonal, about twice as wide as high; radials and axillaries bluntly carinate; distichals (when present) 2, like the two outer radials, but the first distichal has a broad lateral flange on its outer side. Fifteen arms 70 mm. long, the first two brachials oblong, then quadrate to the eighth, then triangular, about as long as wide; the brachials in the proximal half of the arm are somewhat tubercular; syzygies in the third brachial, the eighth to twelfth (usually the eighth), and distally at intervals of 2 or 3 joints.

First pinnule 5 mm. long, very slender and delicate, the first two joints greatly expanded, the remainder short and squarish; second pinnule 6 or 7 mm. long, with 20 joints, the first expanded, the next two short, the remainder elongated. The following pinnules decrease very slightly in length as far as the basal third of the arm, then increase very slightly distally. The expansion of the proximal pinnule joints is not marked after the first three.

Color in life, white, a broad band of deep purple in the basal third of the arm, and two or three narrower bands distally.

Type.—Cat. No. 22624, U.S.N.M.; from *Albatross* station, No. 4903; 32° 31' 10" north latitude, 128° 33' 20" east longitude (Eastern Sea); 139-107 fathoms; August 10, 1906.

7. *ANTEDON ANTHUS*, new species.

Centro-dorsal long and columnar, terminating in a truncated cone with a shallow central crater having a coarsely papillose border and 5 low interradi al ridges. The cirri are very regularly arranged in 10 vertical rows, usually of 2 each; the vertical rows are in pairs, each pair separated from its neighbors by a broad vertical line or shallow groove, radial in position. The cirri are 20 in number, 60 mm. long, with 80 joints of fairly uniform width, but becoming rather narrower distally. The first 6 or 7 joints bear dorsal spines; the following joints are smooth up to about the twentieth, where spines begin again to develop, becoming prominent distally. The first 7 or 8 joints are wider than long, then squarish or slightly longer than wide to about the twentieth, then gradually becoming shorter distally.

The ends of the basal rays are just visible as small tubercles at the base of the upper pair of cirri in each interradi al area. The radials resemble those of *Antedon longicirra*, but the axillaries are shorter. The radials and first brachials are rounded, but not very convex, and there is no central tubercle as described in *A. longicirra* nor median keel as in *A. macropoda*. The first 7 brachials are short and oblong, the following triangular, wider than high, after the fortieth becoming compressed and carinate and developing a forward projecting dorsal spine. The radials and first 10 brachials have flattened sides. Distichals 2, like the 2 outer radials. A syzygy in the third (in one case the fourth) brachial, again in the eighth-fourteenth, and distally at intervals of 2-5 (usually 2) joints. The arms are 13 in number, 80 mm. long.

First pinnule comparatively short, with 9 joints, stout basally, tapering to a point. Second pinnule more than half as long again, with 12 joints; third pinnule about the same, or slightly shorter; the next 2 or 3 are very slightly shorter, the length then increasing distally. All the pinnules are flattened on their outer sides, with their distal edges sharply carinate.

Color in life, dull brownish yellow, the cirri almost white.

Type.—Cat. No. 22625, U.S.N.M.; from *Albatross* station No. 4936; 30° 54' 40" north latitude, 130° 37' 30" east longitude (off Kagoshima Gulf); 103 fathoms; August 16, 1906.

8. *ANTEDON MACROPODA*, new species.

Centro-dorsal columnar, the terminal portion conical, ending in a rosette of 5 tubercles, radially situated. Cirri about 15 in number, somewhat longer than the arms, 100 mm. in length, situated in 10 rows very close together, not separated off into pairs, as in *Antedon anthus*, one, sometimes two, in each row; cirri with 100-120 joints, those in the proximal half but slightly, if any, longer than wide, those

in the distal half short; the cirri are broadest in the distal third; terminal claw very small; there are no dorsal spines on the proximal joints, and the distal dorsal spines are not so prominent as in *A. anthus*.

Basals visible as a more or less prominent interrarial tubercle.

First radials short; second radials rather large; axillaries triangular or pentagonal, rather low; the radials are carinate, usually rather strongly; distichals (when present) 2, resembling the two outer radials, but rather higher in proportion to their width. Ten to twelve arms, 95 mm. long, of more than 100 joints, at first oblong, rather short, becoming triangular, wider than long after about the ninth, and about the middle of the arm becoming laterally compressed and developing strong forward-projecting median spines. The last four or five joints are very short, high, and compressed, bear no pinnules, and are strongly curved inward, giving the appearance of the arm having been broken off at the tip, as the distal pinnules exceed the arm joints by 3 or 4 mm. A syzygy in the third brachial, another in the ninth-eleventh, and others distally at intervals of 4 or 5 joints.

The pinnules are styliform and very stiff, like those of *A. anthus*; the first pinnule consists of 13 joints, and is only slightly, when at all, shorter than the second, which consists of 10. The remaining pinnules are very uniform in length, and have about 15 joints; all are strongly carinate.

Color in life light brownish-yellow, cirri white.

Type.—Cat. No. 22626, U.S.N.M.; from *Albatross* station No. 4935; 30° 57' 20" north latitude, 130° 35' 10" east longitude (off Kagoshima Gulf); 103 fathoms; August 16, 1906.

9. *ANTEDON HANA*,^a new species.

Centro-dorsal small, hemispherical, divided by 5 interrarial lines into trapezoidal areas, each with 2 rows of cirri of 2 each, making 20 in all. Cirri 45 mm. long, slender and much compressed, with 65–75 short joints, basally slightly longer than wide, becoming wider than long after about the twenty-fifth, the joints distally developing sharp dorsal spines.

First radials crescentic, very narrow, with a fringe of teeth along the superior border; second radials narrow, very deeply incised by the axillaries, and furnished with teeth along their entire edge; axillaries slightly wider than long, with a high median keel in the posterior half. Ten arms, 60 mm. long, with about 100 joints, the first 8 roughly oblong with strong lateral processes and a blunt median keel, overlapping in a short spine anteriorly, the succeeding joints quadrate, much compressed, with a sharp median keel and long overlapping spine.

^a From the Japanese word *hana*, signifying flower.

First pinnule the longest, about 5 mm. long with 8-10 stout squarish joints, the first much expanded; following pinnules decrease in length to the fifth, after which they gradually increase distally, becoming much more slender, reaching a length of 8 mm. with 15-18 joints. The radials, first 3 or 4 brachials (including the first two pinnules), are flattened laterally.

Color in life bright yellow, sometimes banded with white; cirri white, with a few narrow bands of yellow.

Type.—Cat. No. 22632, U.S.N.M.; from *Albatross* station No. 4903; 32° 31' 10" north latitude, 128° 33' 20" east longitude (Eastern Sea); 139-107 fathoms; August 10, 1906.

10. *ANTEDON VILLOSA*, new species.

Centro-dorsal bluntly conical, the cirri arranged in 15 vertical rows, 3 in each interradius, 2 or 3 cirri in each row, making 40-45 in all; the cirri about the basal part of the centro-dorsal are 33 mm. long with 50 joints, the fourth-eleventh longer than wide, the remainder rather short; all but the basal 6 or 7 bear dorsal spines, which become more prominent distally; the apical cirri are usually somewhat shorter and stouter, with 30-40 joints; the bare apical portion of the centro-dorsal has 5 interradi al ridges, and is thickly covered with fine hair-like spines.

The basals are visible as small tubercles at the angles of the calyx; first radials just visible, very narrow and crescentic; second radials short, about three times as wide as high; axillaries widely pentagonal, and wider than high. Ten (in one example eleven, bidistichate) arms 95 mm. long, with 90-110 joints, the first 10 oblong, then quadrate, becoming more elongate distally; a syzygy in the third brachial, another about the sixteenth or eighteenth, and others distally at intervals of 4-8 joints.

First pinnule 10 mm. long, very stout, with 20 short joints, tapering gradually from the base to the tip, and flattened on the outer side; second pinnule 7 mm. long, with 15 joints, much more slender than the first; the following pinnules about 6 mm. long, with 13 or 14 joints; distal pinnules 14 mm. long, stout, carinate, with about 22 joints, the basal half of which are squarish, the rest elongate; pinnule ambulacra plated. The radials and 4 or 5 lower brachials are thickly set with fine hair-like spines; pinnule joints strongly overlapping and with the distal edges set with spines; arm joints with both the proximal and distal edges turned outward and furnished with spines.

Color in life bright yellow, the centro-dorsal, radials, and lower 4 or 5 brachials dark greenish; cirri yellow.

Type.—Cat. No. 22630, U.S.N.M.; from *Albatross* station No. 4780; 52° 01' 00" north latitude, 174° 39' 00" east longitude (western Bering Sea); 1,046 fathoms; June 7, 1906.

11. *ANTEDON PUBESCENS*, new species.

Centro-dorsal rather small, bluntly conical, with 10 vertical rows of cirrus sockets, usually 3 in a row; cirri 25 to 30 in number, slender, 30 mm. long, with 50 to 55 joints, the basal 10 or 12 longer than wide, distally developing rather low dorsal spines.

Basals and first radials just visible in the angles of the calyx, the former as small tubercles; second radials short and band-like, sharply carinate, with raised and serrate edges; axillaries low and wide, a sharp keel in the posterior half. Ten arms, 80 mm. long, the first 6 or 7 brachials oblong, the rest quadrate, becoming elongate distally; syzygies in the third brachials, again about the fourteenth, and distally at intervals of 2, 3, or 4 joints.

First pinnule 7 mm. long, with 21 or more short joints, the basal 4 or 5 of which are produced dorsally into a broad thin keel; all the joints have their edges armed with bunches of very fine spines; second pinnule 5 mm. long, with 16 joints, the basal 3 or 4 of which have a thin dorsal keel which, however, is not nearly so wide as that on the first pinnule; the first and second pinnules are somewhat flattened laterally; the three following pinnules are in general similar to the second, but more slender; the next 3 or 4 pairs have the third to sixth joints laterally expanded, covering the genital glands, after which the pinnules become slender and more elongated, reaching a length of 8 mm. with 15 joints.

The radials and lower brachials are covered with numerous and thick-set very fine spines, which become less apparent after about the tenth brachial, after which the joints develop an overlapping border of very fine teeth, and longitudinal striations, which last, on the distal brachials, become more pronounced, and break up on the outer portion of the joints into numerous fine spines.

Color in life, light yellow.

Type.—Cat. No. 22631, U.S.N.M.; from *Albatross* station No. 4919; 30° 34' 00" north latitude, 129° 19' 30" east longitude (Eastern Sea); 440 fathoms; August 13, 1906.

12. *ANTEDON HEPBURNIANA*,^a new species.

Centro-dorsal low-hemispherical with a rough dorsal pole, but without interrarial processes, bearing about 10 marginal cirri; these are 7 mm. long, usually in a single row, and consist of about 10 stout joints which do not develop a dorsal spine.

Basals visible as interrarial tubercles.

First radials short and band-like, with curved borders, the lateral edges raised into a blunt tubercle; second radials longer, about four

^aI take great pleasure in dedicating this species to Lieut. Arthur J. Hepburn, U. S. N., to whom is largely due the success attending the recent cruise of the *Albatross* in the north Pacific.

times as wide as high, and bluntly carinate; axillaries low and wide, about three times as wide as high, with a blunt median keel; the radials and first 4 or 5 brachials have wall-like sides. Ten arms, 45 mm. long, the first brachials oblong with a blunt median keel, becoming quadrate after the fifth, and more elongate toward the end of the arms; a syzygy in the third brachial, another about the tenth, and distally at intervals of 3 or 4 joints.

First pinnule 2.5 mm. long, with 10 to 13 short joints, the first 4 or 5 considerably wider than the others; the pinnule on the third brachial is similar, but slightly shorter, with the basal joints not so much enlarged; the second pinnule (fourth brachial) is 2 mm. long, with 6 joints, of which the third and fourth are laterally greatly expanded; the next 5 pinnules are similar, with 6 or 7 joints, and usually the third and fourth, sometimes the third, fourth, and fifth, greatly expanded laterally; distally the pinnules become uniformly tapering and slender, reaching 3.5 mm. in length, with about a dozen joints but little longer than wide.

Color in life, bright yellow.

Type.—Cat. No. 22635, U.S.N.M.; from *Albatross* station No. 4890; 32° 26' 30" north latitude, 128° 36' 30" east longitude (Eastern Sea); 135 fathoms; August 9, 1906.

This species is related to *Antedon incisa* Carpenter, but differs markedly in the character of the pinnules and cirri, and in the arrangement of the latter on the centro-dorsal.

13. *ANTEDON LATA*, new species.

Centro-dorsal a thick disk, bearing about 20 robust cirri in two marginal rows; the cirri are 21 mm. long and have 15 short and stout joints, of which the sixth and seventh are the longest, and are slightly longer than wide; the distal joints do not bear spines, but overlap somewhat dorsally.

First radials concealed; second radials and axillaries short and wide, the edges crenulate, a large blunt tubercle occupying the center of each, with several other smaller blunt tubercles about the edges; the radials and first 5 or 6 brachials are wall-sided and in close apposition. Ten arms, 115 mm. in length, the first two brachials very irregularly oblong with large median tubercles and crenulated edges; the third brachial is more regularly oblong, the hypozygal with a row of 4 or 5 small blunt tubercles; the following 7 brachials are irregularly quadrate, their surfaces uneven, but not tubercular; after the tenth the brachials become triangular, slightly wider than high, the edges overlapping somewhat, this condition becoming more prominent distally, where the joints become again quadrate; syzygies in the third brachials, again about the twelfth, and distally at intervals of 7 to 10 joints.

The first pinnules are 10 mm. long, comparatively slender, with about 40 short joints, the basal 8 or 10 flattened exteriorly and rather broad; the pinnule tapers rather gradually from the base to the tip; the second pinnule is much shorter than the first and has about 23 joints, of which the proximal 8 or 9 are much expanded laterally; the third pinnule like the second, but somewhat shorter, the 6 basal joints even more expanded, reaching a maximum on the third or fourth, then tapering toward the tip; following pinnules to the fiftieth brachial similar, but the number of joints increasing from 12 on the fourth pinnule (eighth brachial) to 20 on the pinnule on the fiftieth brachial; as the great lateral expansion is always confined to the first 6 joints (reaching a maximum on the third or fourth, then gradually decreasing to the sixth, which, distally, is of normal diameter) it necessarily follows that the expanded joints covering the genital glands progressively occupy less and less of the pinnule; while in the lower they take up most of its length, in that on the fiftieth brachial they occupy barely the proximal third; distally the pinnules are 11 mm. long, slender, with about 20 elongated joints. The ambulacra are well plated.

Color in life, yellowish brown.

Type.—Cat. No. 22628, U.S.N.M.; from *Albatross* station No. 4918; 30° 22' 00" north latitude, 129° 08' 30" east longitude (Eastern Sea); 361 fathoms; August 13, 1906.

14. ANTEDON SCALARIS, new species.

Centro-dorsal short-columnar, terminating in a stellate figure with rounded angles and elevated center, bearing about its edges numerous small knoblike tubercles, one at the base of each of the apical cirri. Cirri stout, 20 mm. long, with 15 joints, about 20 in number, irregularly situated in two or three rows, with all of the joints longer than wide, not bearing dorsal spines.

First radials concealed; second radials hemispherical, the curved side down; axillary with the proximal border well rounded, almost a semicircle; the last two joints have their lateral and posterior borders produced into a thin flange; on one of the rays in the type there is a fourth radial, a little more than half the size of the second, interpolated between the second radial and the axillary. Ten arms 110 mm. long, the first two brachials short, their lateral edges produced, the following to the eighth irregularly quadrate, then triangular, as long or rather longer than wide, becoming quadrate at the tips of the arms; a syzygy in the third brachial, another in the eighth-eleventh, and distally at intervals of 2 or 3 joints.

First pinnule 7 mm. long, slender, tapering, and almost flagellate, with 22 squarish joints; second pinnule shorter with 15 joints, the first 7 short and broad, the others very small; following pinnules to the

eighth or ninth with 10 joints, of which the third-seventh are bluntly keeled and much expanded dorso-ventrally, and bear a large genital gland, protected with large plates; the terminal joints of these pinnules are minute, the basal not especially stout; the terminal pinnules are 10 mm. long, with 15 moderately elongated joints, the ambulaera well plated.

Color in life yellowish brown.

Type.—Cat. No. 22629, U.S.N.M.; from *Albatross* station No. 4918; $30^{\circ} 22' 00''$ north latitude, $129^{\circ} 08' 30''$ east longitude (Eastern Sea); 361 fathoms; August 13, 1906.

15. *ANTEDON GARRETTIANA*,^a new species.

Centro-dorsal subconical, bearing about 15 closely set cirri, roughly divisible into 5 radial clusters, indicated by slight dorsal prolongations of the basals; cirri 20 mm. long, with 16 joints, all somewhat longer than wide, sharply carinate dorsally, but without dorsal spines.

Basals prominent, appearing as tubercles between (and below) the first radials.

First radials short, smooth, with a strong, rounded dorsal keel; second radials much longer, between two and three times as wide as high, also with a strong rounded median keel; axillaries widely pentagonal, about twice as wide as high, with a rounded keel extending from the base to the apex of the pentagon; radials and first 3 brachials in close contact all around, and with sharply flattened sides. Eleven arms, 65 mm. long, bidistichate; first 9 brachials discoidal, the first with a strong rounded keel, which soon becomes inconspicuous and disappears altogether on the eighth; succeeding brachials quadrate, becoming elongate toward the end of the arms; a syzygy in the third brachial, another about the thirteenth, and distally at intervals of 6–10 joints.

First pinnule slightly the longest, 6 mm. long, with 20 nearly square joints, the first but little wider than the others, which taper regularly to a point; the following pinnules gradually decrease in length to about the seventeenth brachial, which has a very short pinnule, then increase again distally, where the pinnules are 6 mm. long, moderately slender, with 15 joints.

Color in life, dull yellowish white.

Type.—Cat. No. 22633, U.S.N.M.; from *Albatross* station No. 4894; $32^{\circ} 33' 00''$ north latitude, $128^{\circ} 32' 10''$ east longitude (Eastern Sea); 95 fathoms; August 9, 1906.

This species comes nearest to *A. aculeata* Carpenter, from which, however, it is readily distinguished by the presence of prominent basals, the much greater proportionate length of the radials, and the obsolete and faintly indicated carination of the lower brachials.

^a For the late Lieut.-Commander Leroy M. Garrett, U. S. N., the commanding officer of the *Albatross* during the recent cruise.

16. ANTEDON ORION, new species.

Centro-dorsal a thick disk, bearing 9-25 (usually about 12-15) smooth cirri, irregularly disposed in one or two rows about the margin. The cirri are 20 mm. long, with 15-25 joints, the distal bearing low spines. The cirri are of peculiar shape: the first 5-7 joints are large and stout, rounded, the first 3 very short and wide, the others longer than wide; the remaining joints are conspicuously less in diameter, compressed, and short; moreover, the stout basal joints are dull greenish in color, and have a dull surface; the slender distal joints are light yellow in color, with a highly polished surface; the transition takes place on a joint shaped like a truncated cone, the distal portion encircled by a raised and highly polished collar; this joint is usually darker in color than those preceding it, and, like them, has a dull surface, except for the terminal collar. In most cases it is very conspicuous.

The disk is moderately but sometimes rather scantily plated; the ambulacra are always well plated.

First radials usually concealed; second radials short and bandlike, bluntly carinate, the edges rough; axillaries triangular or widely pentagonal, always much wider than high, the surface rugose. Distichals two, the first very short, the axillary about as wide as high, almost triangular. Ten to eighteen arms, 140 mm. long; first brachials very short and bandlike; the succeeding brachials to the tenth or twelfth irregularly oblong or slightly quadrate, short, and slightly tubercular; following brachials more distinctly quadrate, soon becoming triangular, the distal edges abruptly turned outward, this condition becoming marked after the tenth, at which point projections in the produced distal edge on alternate sides of the arm begin to appear, which distally draw nearer and nearer in the median line, resulting, after the thirtieth brachial, in a strong median carination, produced distally into overlapping spines, resembling those in *Antedon quinque-costata*; after the thirtieth brachial, too, the arms, which heretofore have been rounded dorsally, become laterally compressed, the diameter decreasing rather suddenly and the arms becoming narrow.

First pinnule the longest, 6.5 mm. long, with 15 short squarish joints, somewhat flattened on the outer side, the basal stout, the distal tapering gradually; second pinnule like the first, but slightly shorter; following pinnules decreasing in length to about the sixth, which is 4 mm. long, with 9 joints, all rather broad except the last two; distally the length increases gradually to 7 or 8 mm., with 18 squarish joints, tapering gradually from the base. All the pinnules are strongly carinate.

Color in life bright yellow, usually banded rather narrowly with white; cirri dull greenish basally, light yellow distally, the colors

separated by a darker band. Some specimens, more often the larger ones, are grayish, the distal portion of the arms bright yellow.

Type.—Cat. No. 22627, U.S.N.M.; from *Albatross* station No. 4934; $30^{\circ} 58' 30''$ north latitude, $130^{\circ} 32' 00''$ east longitude (Eastern Sea); 152–103 fathoms; August 16, 1906.

17. *ANTEDON MINOR*, new species.

Centro-dorsal conical, rather long, with 30–40 cirri 15 mm. long with 40–45 joints, the basal half of which are longer than wide, the terminal third with a very slight dorsal spine.

The pinnule ambulacra are not plated.

Three radials visible; the first crescentic and furnished with several large blunt teeth in the middle of the distal edge; the second wide, low, irregularly oblong, furnished laterally with several large blunt teeth, often interlocking with those on the neighboring brachials, and a row of large blunt teeth on the distal edge; axillaries high, produced anteriorly into a sharp angle. Ten arms 50 mm. long; first brachial irregular in shape with a much longer outer than inner edge, and incised by the backward projection of the second brachial, which is irregularly quadrate; third to fifth brachials oblong; following brachials quadrate, about as wide as high, becoming elongate later.

First pinnule with 8 or 10 elongated joints, considerably longer and stouter than its successors, which decrease in length to about the fifth, then gradually increase distally, where they are about 6 mm. long with 12 joints, the first 2 expanded and trapezoidal, the others elongated and slender.

Color in life light yellow.

Type.—Cat. No. 22638 U.S.N.M.; from *Albatross* station, No. 4965; $33^{\circ} 35' 20''$ north latitude, $135^{\circ} 10' 50''$ east longitude (off southern Japan); 191 fathoms; August 28, 1906.

This species is nearest to *Antedon pusilla* Carpenter, but it differs in the much more numerous cirri, which are longer and more slender with a much greater number of joints, in the character of the centro-dorsal, which is conical and usually rather long instead of low-hemispherical, and in the aspect of the radials, which are markedly longer.

18. *ANTEDON DIADEMA*, new species.

Centro-dorsal long and columnar, the tip conical, bearing about 20 slender cirri in 10 rows of 2 each, those of one row alternating in position with those of the adjacent rows; cirri 25 mm. long with 50–55 joints, the basal half elongate, the distal short with prominent dorsal spines.

Basals just visible as small interrarial tubercles.

Radials rather long, the first and second about the same size, the axillary widely pentagonal, broader than high, the axillary and second

radial with a high and sharp median keel; distichals two, like the two outer radials, and with a prominent keel; 11 to 18 arms, 30 mm. long (only one-fifth longer than the cirri), the first 8 brachials oblong, rather long, then becoming quadrate; all the brachials are strongly carinate and compressed, the arms becoming very narrow after the basal third, where the brachials begin to develop overlapping dorsal spines.

First pinnule considerably the largest, with 8 or 10 elongated joints; the following pinnules decrease in length to the fifth or sixth, then increase again slowly distally.

Color in life bright yellow.

Type.—Cat. No. 22637, U.S.N.M.; from *Albatross* station, No. 4934; 30° 58' 30" north latitude, 130° 32' 00" east longitude (off Kagoshima Gulf); 152–103 fathoms; August 16, 1906.

19. *ANTEDON ASTER*, new species.

This species is nearest to *Antedon quinquecostata* Carpenter (= *A. conifera* Hartlaub), of which I have 7 Japanese examples for comparison; but the cirri are shorter and proportionately stouter, with 35–40 joints, the radials and brachials are rounded and not compressed, the former with their edges armed with fine teeth, the distal brachials strongly overlapping, the distal half as well as the distal edge of each joint beset with numerous fine teeth.

Color in life bright yellow.

Type.—Cat. No. 22636, U.S.N.M.; from *Albatross* station, No. 5088; 35° 11' 25" north latitude, 139° 28' 20" east longitude (Sagami Bay, southern Japan); 369–405 fathoms; October 25, 1906.

20. *ANTEDON ALBOFLAVA*, new species.

Centro-dorsal hemispherical or bluntly conical, bearing about 15 cirri; cirri 20 mm. long with 30 short joints, only a very few of which are longer than wide, the sixth and following with sharp dorsal spines.

First radials visible as paired interrarial tubercles, sometimes as a very narrow band below the second radials; second radials short, deeply incised by the axillaries, strongly carinate; axillaries over twice as wide as high, with a pronounced median keel. Thirteen to 15 arms, 65 mm. long, of about 110 joints; first 8 or 9 brachials oblong, then triangular, about as long as wide, the distal brachials overlapping; a pronounced median keel on the first two brachials; distichals two, resembling the two outer radials and, like them, strongly carinate.

First pinnule 6 mm. long with 12 squarish joints, flattened exteriorly; following pinnules successively shorter to the fifth or sixth, which is 3 mm. long with 7 short joints, then becoming gradually longer again distally, where the pinnules are 8 mm. long with 17 or 18 rather short joints.

Color in life light yellow, banded with white; cirri white.

Type.—Cat. No. 22634, U.S.N.M.; from *Albatross* station, No. 4936; 30° 54' 40" north latitude, 130° 37' 30" east longitude (off Kagoshima Gulf); 103 fathoms; August 16, 1906.

21. *ANTEDON RUBER*, new species.

Centro-dorsal low, bearing about 30 cirri in 15 vertical rows; cirri 11 mm. long with about 30 joints, the first 8 longer than wide, the others short, sharply carinate distally, but without distinct dorsal spines.

First radials narrow and crescentic, in apposition laterally; second radials about twice as wide as high, oblong; axillaries pentagonal, nearly as high as wide. Ten arms 35 mm. long, the first five brachials nearly oblong, then quadrate, becoming elongated toward the ends of the arms; syzygies in the third, and seventh-tenth brachials, and about every other joint distally.

First pinnule on second brachial, 4 mm. long, with 12 joints, the distal ends raised and serrate or spinous; the third brachial has no pinnule, the second, third, and fourth pinnules are of the same character as the first, but gradually decrease in length; distal pinnules 6 mm. long with about 12 joints, slightly expanded at their junctions.

The disk of this species is well plated in the areas between the arms; the anal tube is about three times the diameter of the disk in length, reaching to the fifteenth brachial.

Color in life salmon red, the pinnules yellow, the cirri white.

Type.—Cat. No. 22643, U.S.N.M.; from *Albatross* station, No. 4894; 32° 33' 00" north latitude, 128° 32' 10" east longitude (Korean Straits); 95 fathoms; August 9, 1906.

22. *ANTEDON DIOMEDEÆ*, new species.

Centro-dorsal small, rounded-conical (rarely long conical) bearing 30-40 slender cirri in 15 closely set vertical rows; cirri 30 mm. long, slender, with about 40 joints, the basal half elongate, the distal short, developing strong dorsal spines.

First radials oblong, about twice as wide as high, in apposition all around; second radials similar, but rather higher, and well separated; axillaries about as wide as high, with an extravagantly elongated conical tubercle on the junction of the second radial and axillary. Ten arms, 70 mm. in length, with about 70 joints, at first irregularly oblong, then quadrate, becoming elongate distally; there is another long tubercle on the junction of the first two brachials. Syzygies occur in the third, eighth, and twelfth brachials, and distally at intervals of 3 joints.

The third brachial bears no pinnule; the pinnule on the second brachial is 7 mm. long, moderately stout, with about 12 joints, roughly

twice as long as wide; the pinnule on the fourth brachial (second pinnule) is similar, and about the same size, usually slightly shorter, rarely somewhat longer; the next few pinnules decrease in length, the distal pinnules becoming longer again and very slender, with about 20 elongated joints.

Color in life rich reddish purple, spotted and blotched with white; the radials and lower brachials are white, the tubercles purple, the radials with narrow purple transverse lines; cirri white, banded with purple. Younger examples are lighter in color, very small ones being nearly all white.

Type.—Cat. No. 22640, U.S.N.M.; from *Albatross* station No. 4947; 31° 28' 20" north latitude; 130° 35' 30" east longitude (off the southern shore of Nipon); 51 fathoms; August 20, 1906.

23. ANTEDON TIGRINA, new species.

Centro-dorsal discoidal, much smaller than the disk, bearing 25–30 marginal cirri in a single irregular row; the cirri are 10 mm. long, with about 20 short joints, of which the distal half bear small paired spines, which become single near the tip.

First radials concealed, or barely visible; second radials over twice as wide as high, oblong, well separated laterally; axillaries pentagonal, a low, rounded tubercle at the junction of the axillary and second radial. Ten arms, reaching 50 mm. in length in the largest specimen; first 6 brachials oblong (except the third, which is almost square) about twice as wide as high; the next two or three quadrate, the following triangular, becoming quadrate and elongate distally; distal edges of brachials finely serrate, and turned outward and slightly backward; syzygies in the third, eighth, and twelfth brachials, and distally at intervals of 4–9 joints.

First pinnule (on second brachial) about 5 mm. long, slender, with 13 joints, the first 3 or 4 squarish, the others longer than wide; the third brachial has no pinnule; second pinnule (on fourth brachial) about 10 mm. long, with 20 joints, the first 2 about as long as wide, the others elongated; following 3 or 4 pinnules decrease rapidly in length; the distal pinnules are 9 or 10 mm. long, slender, with 20–25 joints, not greatly elongated; the joints of the lower pinnules are slightly expanded distally, with finely serrate margins; the first 5 or 6 pairs of pinnules are very stiff.

Color (in spirits) whitish, the brachials broadly edged with deep reddish brown; radials and first 6 or 7 brachials purple, with a median band of white; lower pinnules white, purple, or banded, the distal pinnules usually purplish or reddish brown; cirri light purplish.

Type. Cat. No. 22642, U.S.N.M.;? Kagoshima Bay, Japan; the 19 specimens of this species were obtained by the United States North

Pacific Exploring Expedition, under Capt. John Rodgers, U. S. Navy, and are labeled "Kagoshima Bay;" but there appears to be some doubt as to whether they really were obtained there.^a

24. *ANTEDON BOWERSI* ^b new species.

Centro-dorsal conical, bearing about 30 cirri in 15 closely set vertical rows; the cirri are 13 mm. in length, with 30 joints, of which only about the first 7 are longer than wide; the distal joints do not bear spines.

First radials just visible, in apposition all around; second radials oblong, short, and wide, well separated; axillaries pentagonal, wider than high. Ten arms, 40 mm. long, the first 5 brachials oblong, then quadrate, becoming elongate distally; syzygies in the third, eighth, and twelfth brachials, and distally at intervals of 1 or 2 joints.

First pinnule (on second brachial) the largest, 4 mm. long, stiff, with 10 elongated joints; second pinnule (on fourth brachial) similar, but shorter, and rather less stout; following pinnules more slender, and increasing in length to about 6.5 mm., with 15 joints, the first 2 expanded and trapezoidal, the others elongated.

Color in life brownish yellow, the skeleton and cirri nearly white.

Type.—Cat. No. 22641, U.S.N.M.; from *Albatross* station No. 4934; 30° 58' 30" north latitude; 130° 32' 00" east longitude (off Kagoshima Gulf); 152–103 fathoms; August 16, 1906.

25. *ANTEDON ABBOTTI*, ^c new species.

Centro-dorsal saucer-shaped, with 15 marginal cirri; these are 23 mm. long, stout, with 40–45 short joints, the distal bearing a small, low tubercle dorsally.

First radials just visible, the distal corners free; second radials about twice as wide as long, bearing distally on the lateral edges small tubercles; axillaries pentagonal, rather long, also with lateral tubercles; distichals 2, like the outer radials, but first distichals in apposition for almost their entire length; the distichals and the first brachials have lateral tubercles; no further arm division. Twenty arms 100 mm. long, the first 8 or 9 brachials oblong, then quadrate, soon becoming triangular, about as wide as high; a syzygy in the third brachial; in the arms having an additional syzygy it is in the forty-first (twice), forty-second, forty-fourth, forty-seventh, fifty-fourth, and ninetieth brachials, respectively.

The disk is very deeply incised.

^a Since the description of *Antedon tigrina* was put in type I have examined several specimens of the species taken in Sagami Bay in 1900, so I have no doubt that the originals really did come from Japan.

^b For the Hon. George M. Bowers, the Commissioner of Fish and Fisheries.

^c For Dr. W. L. Abbott, to whom we are indebted for much of our knowledge regarding the fauna of the Indo-Malayan region.

First pinnule 5 mm. long, with 20 squarish joints, tapering evenly from the base; second pinnule 12 mm. long, very stout, with 20 short joints; following pinnules rather smaller than the first, becoming elongate distally.

Color (in spirits) dark purplish brown, cirri and second pair of pinnules lighter and yellowish.

Type.—Cat. No. 22644, U.S.N.M.; from Pulo Taya, China Sea; obtained in July, 1899, by Dr. W. L. Abbott.

26. *ANTEDON STYLIFER*, new species.

Centro-dorsal hemispherical, bare at the pole, with 30 cirri; cirri 20 mm. long, with 30 joints, very slightly longer than wide, remarkably uniform in size; there are no dorsal nor opposing spines.

First radials just visible; the second short, in close contact laterally, and less than half the height of the irregularly rhombic axillary; first distichal oblong, about two and one-half times as wide as high, the axillary triangular, about half as high as wide; the junction between the 2 outer radials and the 2 distichals is elevated into a low tubercle; the radials, distichals, and first brachials are in close contact laterally. Nineteen arms 70 mm. long, with about 150 joints, the first 8 oblong, then triangular (much wider than high) to the fortieth brachial, after which they become irregularly oblong; syzygies in the third brachials, again about the twelfth, and distally at intervals of about 4 joints; the lower brachials are slightly tubercular, and all the brachials have slightly overlapping edges.

First pinnule 8 mm. long, rather slender, with 16 moderately elongated joints; second pinnule 11 mm. long, with 17 joints, stouter than the first; third pinnule 15 mm. long, stout, stiff, and rigid, with 16 long cylindrical joints; this pinnule is much stouter and stiffer than any of the others; fourth pinnule 10 mm. long, fifth 7 mm. long; distal pinnules 8 mm. long, with about 20 joints, tapering gradually from the base to the point.

Color in life purple, the skeleton and cirri light brownish yellow.

Type.—Cat. No. 22645, U.S.N.M.; from *Albatross* station No. 4929; $30^{\circ} 12' 30''$ north latitude, $130^{\circ} 43' 00''$ east longitude (Eastern Sea); 84 fathoms; August 15, 1906.

27. *ANTEDON DELICATISSIMA*, new species.

Centro-dorsal low-hemispherical, a large area at the pole bare, bearing about 30 marginal cirri; these are 30 mm. long, with 40 joints, much elongated basally, short distally, none of them bearing dorsal spines.

Disk naked, deeply incised, the anal tube greatly elongated (9 mm. in length), the anal interambulacrum being much larger than the others, the mouth subcentral.

First radials concealed; second radials short, in lateral contact for the basal half; axillaries low-pentagonal, well separated laterally; distichals and palmars 2, articulated (the latter developed on the outer side of the rays only), resembling the two outer radials, but longer in proportion to the width. Twenty-eight arms 70 mm. long, the first 10 brachials oblong, then short-quadrate, becoming oblong again distally; syzygies in the third (sometimes the second) brachials, again about the fourteenth to twentieth, and distally at intervals of 3-5 joints.

First pinnule short, 5 mm. in length, with 15 short joints; second pinnule longer; third pinnule much the longest, 11 mm. long, with about 20 elongated cylindrical joints; succeeding pinnules short, becoming long and slender distally.

Color in life light purplish gray, the skeleton yellowish white, with a narrow purple median line.

Type.—Cat. No. 22646, U.S.N.M.; from *Albatross* station No. 4930; 30° 12' 00" north latitude, 130° 44' 00" east longitude (Eastern Sea); 84 fathoms; August 15, 1906.

This species comes nearest to *Antedon bimaculata* P. H. Carpenter, from which it differs in its elongate cirri, with nearly double the number of joints, the short intersygyial interval and the more proximal position of the second syzygy, the proportions of the lower pinnules, and the less number of arms.

The color of *A. bimaculata* is probably quite unreliable as a specific character, for of the 80 specimens I have at hand of *A. manca* one is colored exactly as described for *A. bimaculata*, although all the others are quite different. *A. delicatissima* in color agrees most nearly with certain specimens of *A. multicolor*.

28. ANTEDON RUBROFLAVA, new species.

Centro-dorsal discoidal, broad, slightly concave on the dorsal surface, bearing 35-40 very stout cirri in two marginal rows; the cirri have 15-20 joints, stout, about as wide as long, which exhibit a slight tendency to overlap ventrally, but do not bear dorsal spines; the joints are somewhat compressed and are constricted in the middle, thus giving especial prominence to the articulations; the penultimate joint is furnished with an opposing spine.

First radials concealed; second radials partially concealed; axillaries pentagonal, wider than high, with a syzygy; distichals 3, the axillary a syzygy. Eleven arms 180 mm. long, with 260 or more joints, the first 8 or 9 brachials nearly oblong, becoming distally triangular, all the brachials with overlapping edges, furnished with

two or more rows of very fine teeth; there is a slight rounded tubercle on the junction of the first two brachials; syzygies occur in the third brachial, again about the eighth or ninth, and usually in the twelfth or thirteenth, with others distally at intervals of 5-7 joints in the proximal part of the arm and 3 joints toward the tip.

The first pinnule is on the second distichal and resembles that on the second brachial; pinnule on second brachial 8 mm. long, of about 28 joints, flagellate, the second to the fourth joint furnished with large dorsal keels; the pinnule on the fourth brachial is 11-15 mm. long, with 35-40 joints, flagellate, the first 2 or 3 joints with a dorsal keel; the pinnule on the sixth brachial is 12-16 mm. long, with about 40 joints; that on the eighth is about the same, that on the tenth slightly shorter, like that on the twelfth; from this point the pinnules gradually decrease in length and become more slender, the joints much more elongate; the pinnule on the fortieth brachial is 9 mm. long, with 23 long and very slender joints.

The color in life is brilliant yellow, the arms broadly banded with bright red; the cirri are dull orange red.

Type.—Cat. No. 22639, U.S.N.M.; from *Albatross* station No. 4880; 34° 16' 00" north latitude, 130° 16' 00" east longitude (Korean Straits); 59 fathoms; August 2, 1906.

This species is readily distinguishable from *A. hartlaubii* by having fewer arms, which are longer and more slender, by having the second radials visible, and by the character of the cirri, which are more numerous, stouter, with shorter joints, and with a prominent opposing spine on the penultimate. The very brilliant and unusual coloration may be a good specific character.

29. *ANTEDON THETIS*, new species.

Centro-dorsal discoidal, bearing about 12 marginal cirri; these are about 10 mm. long, with 25 to 30 joints, of which the fourth, fifth, and sixth are squarish; the others wider than long, developing prominent spines distally.

First radials very short; but laterally they are in apposition, forming a large interradiar triangle, produced anteriorly, separating the second radials; second radials rather short, trapezoidal; axillaries pentagonal, less than twice as wide as high; the second radials and axillaries are rounded laterally, and widely separated. Ten arms 30 mm. long; the first brachials on each arm in close apposition for their entire length, roughly oblong; second brachials squarish, strongly convex exteriorly; third brachials longer than wide, constricted in the middle; following 2 or 3 brachials quadrate, then becoming triangular, longer than wide, the outer side convex, becoming elongate and quadrate distally.

First pinnule small, short, and weak, with about 25 squarish joints;

the first joint is enormously expanded laterally, the second intermediate between it and the other joints; second pinnule greatly elongated, stiff, and spinelike, with 15 elongated joints; third pinnule usually shorter, but similar in character; following pinnules decrease in length, becoming somewhat longer distally. Pinnule ambulacra plated.

Color (in spirits) light purple, banded with dull yellow; cirri purple, banded with white.

Type.—Cat. No. 22654, U.S.N.M.; from *Albatross* station, No. 3744; Suno Saki bearing east, 8.83 miles distant (off Nipon, Japan); 46 fathoms; May 19, 1900.

This species belongs to the *Accele* group, but is readily distinguished from the other 10-armed species by having the second radials separated by a forward projection from the first radials, as in *A. multicolor*, combined with the lack of any lateral processes on the radials.

30. ANTEDON HAWAIIENSIS, new species.

Centro-dorsal large, hemispherical or short columnar, with 5 well-separated double rows of cirri, usually about 20 cirri in all; these are 32 mm. long, rather slender, with 50 to 55 short joints, the fourth to the eighth rather longer than wide, the others wider than long; from the tenth onward dorsal spines are developed which are long and prominent.

Basals sometimes just visible; first radials just visible, crescentic; second radials very short; axillaries about one and one-half times as wide as long. The radials and first (sometimes, also, the second) brachials (or first and second distichals, when present) fringed with numerous rather long, stout spines; there may be also a few scattered spines on their dorsal surface. Distichals, when present, 4 (3+4). Ten to 12 arms 110 mm. long, the first 6 brachials oblong, wider than long, then triangular, about as long as wide; distally the arms are compressed, and the brachials develop long, curved, overlapping spines, as in *A. spinifera*. A syzygy in the third (or, after a distichal series, the first) brachial, another at about the twentieth, and distally at intervals of from two to four joints.

First pinnule the longest, very stout, flattened exteriorly, with about 12 joints, tapering rapidly after the seventh or eighth; second and following pinnules much more slender, shorter, with fewer joints but slightly longer than wide; the distal pinnules are somewhat elongated, with elongate joints, except the first two, which are short, somewhat expanded, and trapezoidal.

Color (in spirits) white, the radials, distichals, and lower brachials dusky.

Type.—Cat. No. 22653, U.S.N.M.; from *Albatross* station, No. 3475; 21° 08' 00" north latitude, 157° 43' 00" west longitude (Hawaiian Islands); 351 fathoms; December 6, 1891.

31. *COMATULA MARIÆ*,^a new species.

Centro-dorsal discoidal, 9 mm. in diameter, bearing about 30 marginal cirri in two irregular rows; cirri 25 mm. long, moderately stout, with 27 to 30 joints, the proximal half of which are somewhat longer than wide, the distal half short; from the sixth joint the distal dorsal edge begins to project, forming prominent broad dorsal spines on the distal two-thirds of the cirrus.

First radial concealed; second radials rather short, very broad, in apposition laterally; axillaries more than twice as broad as long, free laterally. Twenty-six arms, 160 mm. long. The distichal and palmar series in this species are quite unique, no other previously described form at all approaching it in irregularity. There are 9 distichal series present, 3 consisting of an axillary only, 1 of 2 joints united by syzygy, 4 of 2 articulated joints, and 1 of 4 joints, the 2 outermost united by syzygy. Of the 7 palmar series, 3 are of 3 joints, the 2 outer united by syzygy, 2 are of 2 joints united by syzygy, 1 is of 2 articulated joints and 1 is of 4 joints, the 2 outer united by syzygy. The first arm syzygy is usually in the second brachial, but often in the first; sometimes both the first and second are syzygies, while again there may be none until the third. Succeeding syzygies are quite irregular; the second may be anywhere from the sixteenth to the fortieth brachial, and the distal intersyzygial interval anywhere from 7 to 22 or more joints. The arms are slender, remarkably uniform in width; the first 5 to 7 brachials are oblong, then triangular about twice as wide as long, becoming short and discoidal in the distal half of the arm; all the brachials overlap somewhat, the distal edges being finely serrate.

The lower pair or two of pinnules are 20 mm. long, and slender, the lower 5 or 6 joints the largest, but not especially enlarged. The following pinnules decrease rapidly in length to about the sixth pair; the following 4 or 5 pairs of pinnules are comparatively stout, with the 4 or 5 basal joints enlarged somewhat, after which the pinnules become more elongated. The distal edges of all the pinnule joints are everted, prominent, and serrate.

Color in life brownish yellow, the pinnules grayish.

Type.—Cat. No. 22655, U.S.N.M.; from *Albatross* station, No. 4880; 34° 16' 00" north latitude, 130° 16' 00" east longitude (near the Oki Islands, Sea of Japan); 59 fathoms; August 2, 1906.

32. *COMATULA SOLASTER*, new species.

Centro-dorsal large, flat, and discoidal, bearing about 20 cirri in a single marginal row; these have about 20 or 21 (rarely more, though sometimes as many as 30) joints, the third to the seventh much elon-

^aFor Mrs. Mary W. Clark, of Boston, who has been of great assistance to me in my work on the unstalked crinoids.

gated, the others shorter than broad, the distal bearing low spines. The cirri are moderately stout, resembling those of *C. japonica*.

Radials usually concealed as far as the axillary. Axillaries triangular, over twice as broad as long. Distichals and palmars 4 (3 + 4), in close apposition, and flattened, as in the *Basicurva* group of *Antedon*. In some places the distichals are separated enough to make room for the dorsal keel of the much flattened distichal pinnule, but the perisome is never visible from the dorsal surface. Twenty to 30 arms, very stout, tapering rather rapidly, the brachials quadrate, very short, and strongly overlapping. Lower pinnules not especially large, but greatly compressed and very strongly carinate for the basal 8 to 12 joints. This carination decreases in degree after the first 3 or 4 pairs of pinnules, but is evident even on the distal pinnules. The pinnules (except for the first few pairs) have their joints overlapping and finely spinous.

Color in life dark purple, the disk, cirri, and pinnules brownish yellow.

Type.—Cat. No. 22656, U.S.N.M.; from *Albatross* station No. 4944; 31° 38' 15" north latitude, 130° 46' 50" east longitude (in Kagoshima Gulf); 43 fathoms; August 17, 1906.

This species is readily distinguished by its very massive radials and distichals, which form a solid cup, so that none of the perisome is perceptible from the dorsal side; very small specimens show that this character is assumed at an early period of growth. In the adults the radials and distichals are so closely welded together that it becomes difficult to trace the sutures.

33. *COMATULA SERRATA*, new species

Centro-dorsal a thick, flat, pentagonal disk with about 15 marginal cirri in two irregular rows; the cirri are small, with 10 joints, the third and fourth much elongated, becoming rapidly shorter distally. The terminal 7 joints bear small dorsal spines, that on the penultimate being the largest; terminal claw rather long.

First and most of the second radials concealed; two outer radials united by syzygy; distichals 4 (3 + 4); rarely 2 (1 + 2); rays separated from the second radial; first brachials closely united interiorly, the second brachials free; first two brachials united by syzygy. First three brachials oblong, then quadrate, becoming triangular, about as wide as long after the seventh; the radials, distichals, palmars, and brachials all have everted and serrate edges; in the only arm remaining the ninth, twelfth, fifteenth, eighteenth, and twenty-first brachials are syzygies. The pinnule joints have strongly spinous distal edges.

Color in life dull greenish yellow.

Type.—Cat. No. 22657, U.S.N.M.; from *Albatross* station No. 4895; 32° 33' 10" north latitude, 128° 32' 10" east longitude (southern part of the Sea of Japan); 95 fathoms; August 9, 1906.

Another specimen, from station No. 4893, is somewhat smaller, but otherwise agrees perfectly with the type. One of the rays, however, has the distichal series of only two joints, united by syzygy, like the palmars; neither of the specimens has the disk in position.

34. COMATULA ORIENTALIS, new name.

In the *Challenger*^a report on the Comatulæ Dr. P. Herbert Carpenter gave the name *Actinometra simplex* to a curious little species from the Admiralty Islands; in 1881, however,^b he stated that in the Paris Museum he found specimens of *Comatula parvicirra* bearing the name of *C. simplex*. He mentioned certain peculiarities of these specimens, showing how they differ from Müller's original description of *Alecto parvicirra*, thus making it clear that they can not belong to the *Challenger* species to which he gave the name *Actinometra simplex*. As the two are congeneric, however, it becomes necessary to designate the species described in the *Challenger* report by a new name, and for it I propose the name *Comatula orientalis*.

35. ATELECRINUS POURTALESII,^c new name.

In 1869,^d L. F. de Pourtalès described *Antedon cubensis* from two specimens dredged in 450 fathoms off Cojima, near Habana, Cuba; but his description is applicable only to the larger and more perfect specimen. Although later he seems to have suspected that the two were different, he never gave a name to the smaller form.

In 1881^e Doctor Carpenter, in his preliminary report on the Comatulidæ collected by the United States Survey Steamer *Blake*, showed that the smaller specimen was not only specifically but generically distinct from the larger one, and he proposed the genus *Atelecrinus* for it and an allied form, also from Cuba, which he called *Atelecrinus cubensis* and *Atelecrinus balanoides*, respectively. The name *cubensis* he credits to Pourtalès, saying that the species "may retain the name *cubensis*, originally conferred upon it by Mr. Pourtalès." But, although the *Antedon cubensis* was a composite species, the type specimen is clearly indicated in the the original description, and it is quite a different

^a Challenger Reports, Zoology, XXVI, p. 312.

^b Notes from the Leyden Museum, III, p. 20.

^c For the late L. F. de Pourtalès, to whom we owe much of our knowledge respecting the crinoid fauna of the Caribbean Sea.

^d Bull. Mus. Comp. Zool., I, No. 11, p. 356.

^e Bull. Mus. Comp. Zool., IX, No. 4, p. 166.

thing from *Atelecrinus cubensis* of Carpenter, belonging to a different genus.

Now, Doctor Carpenter has restricted the use of *Antedon cubensis* to the smaller of the two original specimens described by Pourtalès, while Pourtalès himself indicated the larger as the type of the species; the name can not, of course, be applicable to both, and must stand for the species represented by the larger specimen. As this leaves the species called by Doctor Carpenter *Atelecrinus cubensis* (Portalès) without a name, I propose that it be known as *Atelecrinus pourtalesi*.

A REVIEW OF THE CIRRHITOID FISHES OF JAPAN.

BY DAVID STARR JORDAN AND ALBERT CHRISTIAN HERRE.

Of Stanford University, California.

In the present paper is given an account of the fishes of the families of Cirrhitidae and Aplodactylidae known to inhabit the waters of Japan. It is based on the collections of Professors Jordan and Snyder, series of which are deposited in the U. S. National Museum.

KEY TO FAMILIES OF CIRRHITOID FISHES FOUND IN JAPAN.

- a.* Dorsal spines 10, the spinous part of the fin longer than the soft; vertebrae 10+16; eye with a suborbital shelf CIRRHITIDÆ
aa. Dorsal spines 15 or more; the soft dorsal as long as spinous; anal short with acute or incisor-like vertebrae more than 10+16; nosuborbital shelf.

APLODACTYLIDÆ

Family CIRRHITIDÆ.

Body compressed, oblong, covered with moderate scales which are cycloid or ctenoid; dorsal and ventral outlines not similar; lateral line continuous, concurrent with the back, not extending on caudal; mouth low, terminal, with lateral cleft; eye lateral, of moderate size; premaxillaries protractile; maxillary narrow, not sheathed by preorbital; teeth small, pointed, sometimes present on vomer or palatines; cheeks without bony suborbital stay; branchiostegals, usually 6; gill membranes separate, free from the isthmus; preopercle serrate or entire; opercle unarmed; nostrils double; forehead flattened; no spines or serrations on bones of cranium; second suborbital with an internal lamina supporting the globe of the eye; dorsal fin continuous, long, the spinous part longer than the soft, usually of 10 spines, the spines not depressible in a groove; soft dorsal low; spines rather low and strong; pectoral fin short and broad as in the Cottidae; lower half of fin with its rays simple and enlarged; the membranes deeply incised; ventral fins thoracic, but considerably behind root of pectorals, the rays 1, 5; air bladder large and complicated; pyloric caeca few; skull very compact and solid. Carnivorous fishes of the warm parts of the Pacific; apparently really allied on the one hand to the

Serranidæ, with which group Boulenger finds that the skeleton has much in common; on the other hand, they show affinities with the Scorpenidæ.

Boulenger separates the Cirrhitidæ from the Aplodactylidæ and Latrididæ, regarding the first named as a subfamily of Serranidæ.

KEY TO GENERA.

- a.* Scales ctenoid, large and rough; cheeks with large scales; palatine teeth present; canines small; preopercle serrulate..... *Isobuna*, 1.
- aa.* Scales cycloid or nearly so; preopercle more or less serrate.
 - b.* Profile decurved or convex, scarcely incurved at the nape.
 - c.* Palatine teeth present; scales on cheeks small..... *Cirrhitus*, 2.
 - bb.* Profile more or less incurved or concave, above the pointed snout; teeth on palatines; preopercle sharply serrate..... *Cirrhitichthys*, 3.

1. ISOBUNA Jordan, new genus.

Paracirrhitus STEINDACHNER, *Fische Japans*, II, 1883, p. 25 (*japonicus*) not *Paracirrhitus* Bleeker, 1875, ^{type *forsteri*.}

Body oblong, compressed, with strongly toothed scales; pointed teeth in jaws, and on vomer and palatines; upper jaw with two small canines in front; preopercle toothed. Dorsal rays X, 15; anal rays III, 7. Scales large; 6 or 7 lower pectoral rays simple, not thickened. One species known. The genus is well distinguished by the large rough scales. The name chosen by Steindachner was already in use for a large genus of the same family.

(*isobuna*, the Japanese name; *iso*, sea shore; *funa*, *buna* for euphony, gold-fish.)

Type of genus.—*Isobuna japonica*.

1. ISOBUNA JAPONICA (Steindachner).

ISOBUNA.

Paracirrhitus japonicus STEINDACHNER, *Fische Japans*, II, 1883, p. 25 (Japan), Coll. Cristoforo Bellotti, in Mus. Milan.—JORDAN and SNYDER, Check List, 1901, p. 84.

Habitat.—Coast of southern Japan.

Head $2\frac{2}{3}$ in length; depth $2\frac{2}{3}$ (eye) 5 in head; D. X, 15; A. III, 7; scales 2-23 or 34-10.

Upper profile moderately arched; head pointed in front; ventral outline to anal nearly straight. Mouth large, oblique, the maxillary extending a little beyond eye; eye 5 in head; breadth of forehead 8; snout with chin, nearly 4; lower jaw slightly projecting. Teeth slender, sharp, those of the outer row a little enlarged; a small canine on each side of upper jaw in front; Preopercle finely serrate, opercle with three short spines, the middle one sharpest and largest. Head well scaled, except lips and space before snout. Large scales on cheeks and opercles; scales on top of head small. Scales all very rough. Lateral line concurrent with back. Dorsal deeply notched, 5th and

6th dorsal spines $3\frac{1}{2}$ in head, the last spine half as long as eye; first soft ray as high as highest spine. Caudal weakly concave, $1\frac{1}{4}$ in head; second anal spine strong, longer than third and weakly curved, longer than the highest dorsal spine. Ventrals not reaching vent. Pectoral with 6 or 7 lower rays simple but not thickened, the fin reaching 4th soft ray of anal. Bases of fin rays scaly.

Color golden brown, with a faint spot of golden yellow in the center of each scale along the sides (Steindachner).

This species is known from a single specimen, 15 cm. in length, in the museum at Milan. We have not seen it.

2. CIRRHITUS Lacépède.

Cirrhitus LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 3 (*maculatus*=*marmoratus*).

Cirrhites CUVIER and VALENCIENNES, Hist. Nat. Poiss., III, p. 1829 (change in spelling).

Cirrhichthys GÜNTHER, Cat., II, 1860, p. 73, in part.

Scales large, cycloid; head obtuse, rounded in profile; snout short; cheeks with small scales, teeth on vomer and palatines; jaws with small canines; preopercle finely serrate; opercle with a flat spine; dorsal rays about X, 11, anal III, 6; caudal truncate, anterior nostrils fringed; dorsal spines not fringed. Tropical Pacific.

(*cirrus*, a lock of hair.)

2. CIRRHITUS MARMORATUS (Lacépède).

Labrus marmoratus LACÉPÈDE, Hist. Nat. Poiss., III, 1801, p. 492, pl. v, fig. 3 (no locality given).

Cirrhitus marmoratus GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 107 (Hawaii n Islands).—JORDAN and EVERMANN, Fishes of Hawaiian Islands, 1905, p. 452, pl. LXX (Hawaii).—JORDAN and SEALE, Fishes of Samoa, p. 278 (Samoa).—JORDAN and STARKS, Proc. U. S. Nat. Mus., 1906, p. 699 (Yaku Island).

Cirrhites marmoratus BLEEKER, Verh. Koninkl. Ak. Wet., XV, 1875, p. 3; (Sumatra; Amboyna).—JENKINS, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), p. 491 (Honolulu).—SNYDER, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), p. 527 (Honolulu; Puako Bay, Hawaii).

Cirrhitus maculatus LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 3 (no locality given).—GÜNTHER, Fische der Südsee, III, 1874, p. 71, pl. LI, fig. A (Hawaiian Islands, Society Islands, Cook Island).

Cirrhichthys maculatus GÜNTHER, Cat. II, 1860, p. 74 (Polynesia, India, Hawaiian Islands, Ile de France).—KLUNZINGER, Fische des rothen Meeres, p. 131, in Verh. Zool. Bot. Ges. Wien, XX, 1870, p. 798 (East coast of Africa, Polynesia).—GÜNTHER, Shore Fishes, Chall., I, 1880, p. 59 (Honolulu).

Cirrhites (Cirrhichthys) maculatus STEINDACHNER, Denks. Ak. Wiss. Wien, LXX, 1900, p. 490 (Honolulu; Laysan).

Cirrhites maculosus BENNETT, Zool. Journ., IV, 1829, p. 38 (Sandwich Islands).—RÜPPELL, Atlas, Fische, 1828, p. 13, pl. xv, fig. 1 (Red Sea).

Cirrhites alternatus GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 122 (Hawaiian Islands, young).

Habitat.—Coral islands of the tropical Pacific, north to Yakushima, southern Japan.

Head 2.75 in length; depth 2.75; eye 5.75 in head; snout 3; maxillary 2.4; mandible 2.1; preorbital 4.8; interorbital 5.75; D. X, 11; A. III, 6; scales 6–40–8; Br. 5.

Body short and stout, moderately compressed; head heavy, longer than deep; snout bluntly conic; mouth large, slightly oblique, the jaws subequal; maxillary rather long, reaching middle of pupil; patches of villiform teeth on vomer and palatines; tongue naked; jaws with bands of villiform teeth, 2 or more enlarged canines in front of upper jaw and about 4 somewhat longer canines on each side of lower jaw; dorsal profile moderately arched, the curves strongest between nape and origin of dorsal; eye moderate, high, the supraorbital rim projecting strongly above the profile; interorbital concave; nostrils moderate, nearly circular, close together, the anterior with a bushy filament about as long as diameter of pupil; origin of dorsal over base of pectoral, its distance from snout equaling its base; dorsal spines rather strong, fourth or fifth longest, about equaling snout; dorsal rays about equal to length of spines a little greater than longest spine; caudal truncate or slightly rounded when expanded; anal spines stout; second and third about equal in length, a little shorter than snout; anal rays moderately long, longest ray 2 in head; the 7 lowermost rays of pectoral thick and free at the posterior ends, the sixth from bottom longest, 1.8 in head or, measured from base of fin, 1.4 in head; scales large, smooth, arranged somewhat irregularly; nape, opercle, and breast with large scales; cheeks with very small scales, rest of head naked; preopercle finely serrate; opercle ending in a soft flap, projecting beyond a flat obscure spine; gill-membranes broadly connected across the isthmus.

Color in life, body marbled and blotched with bluish olivaceous, brownish and white, with numerous red spots of varying sizes, the white appearing as 5 ill-defined vertical bars; head bluish white with irregular lines of yellowish or orange brown, these palest on cheek; lower jaw pale blue with cross-markings of darker blue; base of pectoral pale with yellowish-brown blotches; posterior portion of back with 4 large reddish-brown blotches, the first under the last 2 dorsal spines, the second under sixth and seventh dorsal rays, the third under last dorsal rays, fourth on upper edge of caudal peduncle; spinous dorsal pale-yellowish blue, crossed by 3 series of large orange-red spots on the membranes, the uppermost series least complete; tips of membrane of spinous dorsal whitish, above black blotches; soft dorsal pinkish with a series of redder spots along the base; caudal pale pinkish, crossed by about 4 series of bright blood-red blotches; anal pale rosy, whitish at base, with 3 series blood-red blotches; an olive

blotch near middle of first and second spines; pectoral and ventral pale rosy.

This well-known species, abundant among the coral islands throughout the Pacific, has been once taken in Japan, a specimen having been sent from the offshore island of Yaku in southern Japan. A beautiful colored figure by Capt. Charles B. Hudson is given by Jordan and Evermann. Of the closely related genus, *Paracirrhites* Bleeker, distinguished by absence of palatine teeth, no species has been recorded from Japan. *Amblycirrhites* Gill^a is probably identical with *Paracirrhites*.

(*marmoratus*, marbled.)

3. CIRRHITICHTHYS Bleeker.

Cirrhitchthys BLEEKER, Naturk. Tydschr. Nederl. Ind., X, 1856, p. 474 (*graphidopterus*=*aprinus*).

Cirrhitopsis GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 109 (*aureus*).

Body oblong, the back arched, the profile somewhat concave at the nape on account of the more or less projecting snout; preopercle sharply serrate; preorbital serrulate or entire; no canines; teeth on vomer and palatines; branchiostegals 6; scales large, slightly ctenoid or cycloid; dorsal rays X, 12; anal III, 6 or 7; first dorsal ray elongate; dorsal spines moderate; second spine elongate; pectoral with 6 simple rays; first soft ray of dorsal sometimes elongate.

Species of the tropical Pacific, one of them found in Japan. It differs from *Cirrhites* mainly in the more produced snout and notched or incurved profile.

(*Cirrhites*; *ιχθύς* fish.)

3. CIRRHITICHTHYS AUREUS (Schlegel).

OKIGONBE (OFFSHORE SPRITE).

Cirrhites aureus SCHLEGEL, Fauna Japonica, Poiss., 1843, p. 15, pl. VII, fig. 2, (Nagasaki).—RICHARDSON, Ichth. China, 1846, p. 239 (Canton).—JORDAN and SNYDER, Check List, 1901, p. 85.

Cirrhitchthys aureus GÜNTHER, Cat., II, 1860, p. 75 (Canton, China).—NAMIYE, Class. Cat., 1881, p. 95 (Awa).—ISHIKAWA and MATSUURA, Prel. Cat., 1897, p. 52 (Boshu, Kagoshima).

Habitat.—Southern Japan to China (and to India, if *Cirrhitchthys*^b *bleekeri* Day, from Madras, should prove to be the same, which is not probable.)

Head 3 in length to base of caudal; depth $2\frac{1}{4}$; eye $4\frac{2}{3}$ in head; D. X, 12, A. III, 6; scales 4–42–9, P. 14, with 6 rays simple.

^aProc. Ac. Nat. Sci. Phila., 1862, p. 106 (*fasciatus*).

^b*Cirrhites fasciatus* Jerdon, Madras Journal, 1851, p. 132 (Madras); not of Cuvier and Valenciennes.

Cirrhitchthys bleekeri Day, Fishery Rept., CXCI, no. 207.

Cirrhitchthys aureus Day, Fishes India, 1876, p. 145, pl. xxxv, fig. 5, Madras.

Body short, compressed, the profiles above and below strongly arched; the outline incurved at the nape; snout short, scarcely longer than eye; mouth small, the jaws equal; outer teeth of lower jaw enlarged; villiform teeth on vomer and palatines. Scales large, mostly cycloid, the smaller slightly ctenoid. Preopercle strongly serrate; cheeks with 4 rows of scales; suborbital rim and preorbital apparently scaleless, but with mucous striae; opercle scaled; opercular spine obsolete; supraorbital rim somewhat elevated; interorbital area very narrow, $1\frac{3}{5}$ in eye. Branchiostegals 5. Gill-rakers short and blunt, about 6+6.

First soft ray of dorsal filiform (broken in specimen); dorsal fin not notched; fourth spine not elevated, 2 in head; a slight fleshy tag behind tip of each spine; second anal spine enlarged, $1\frac{3}{9}$ in head; anal fin truncate; pectoral with 6 simple rays, the longest reaching beyond origin of soft rays of anal, a little longer than head; caudal lunate.

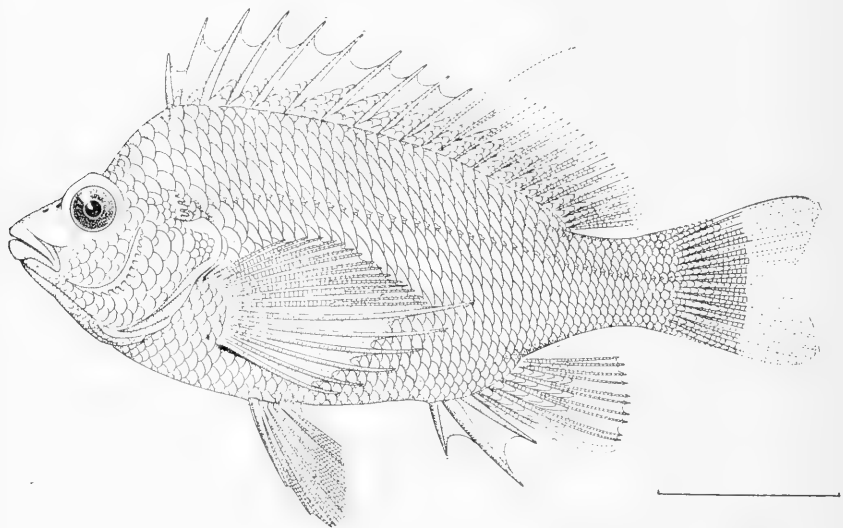


FIG. 1.—*CIRRHITICHTHYS AUREUS*.

Color uniform pale, doubtless orange or yellow in life, with no traces of markings of any kind. Of this rare species we have seen but one specimen, $4\frac{1}{2}$ inches in length. It was taken at Misaki, and was presented to us by Professor Mitsukuri. It probably lives in rather deep water. It is the type of the subgenus *Cirrhitopsis* Gill, said to be distinguished from *Cirrhitichthys* by the scaly suborbital. The suborbital ring is said to be naked in the type of *Cirrhitichthys* (*graphidopterus* = *aprinus*). We are, however, unable to find true scales on the narrow suborbital of *C. aureus*. The preorbital has striae or muciferous ducts resembling scales. The species is very close to *Cirrhitichthys bleckeri* Day, of India, and it may prove to be the same, which is the latest judgment of Doctor Day. The two have the same numbers of

scales and fin rays, but *C. bleekeri* is said to be much more elongate, the depth, $2\frac{2}{3}$ in length ($3\frac{1}{3}$ in total length, with caudal); the eye $3\frac{1}{2}$ in head; the color rosy, with pale streaks, a large black blotch below soft dorsal, a dark blotch behind opercle; caudal with red spots; dorsal and caudal banded. The Indian species is probably different from the Japanese.

(*aureus*, golden.)

Family APLODACTYLIDÆ.

This family agrees with the Cirrhitidæ in having the lower pectoral rays simple, elongate, and thickened, and in having the ventrals inserted well behind the pectorals.

It differs technically, according to Boulenger, in the absence of a suborbital shelf, and also in the much larger number of dorsal spines, the soft dorsal also being many rayed. Anal fin short, vertebræ more than 10 + 16, teeth acute or incisor-like. Shore fishes of the warm parts of the Pacific.

a. CHEILODACTYLINÆ. Teeth pointed not incisor-like, dorsal spines about 18, the spinous part of the fin not longer than the soft; preopercle entire.

b. Anal fin short, III 8, or III 9; dorsal fin deeply notched, the fourth spine elevated; soft dorsal of about 30 rays *Goniistius*, 4.

4. GONIISTIUS Gill.

Goniistius GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 120 (*zonatus*).

Zeodrinus CASTELNAU, Proc. Linn. Soc. N. S. W., III, 1878, p. 377 (*vestitus*).

Body highest anteriorly, the anterior profile steep and compressed. Head small; cheeks and crown scaly; preopercle entire; opercle ending in a flat spine; mouth small, the lower jaw included; teeth small, in several series, the outer enlarged; vomer and palatines toothless; branchiostegals 6; adult with a pair of tubercles above eye and one above snout; scales moderate; dorsal fin very long, the spinous and soft parts about equal, the rays about XVII-30, the fin deeply notched, the fourth spine much elevated and curved backward; anal with three small spines, the rays about III, 8, the last rays rapidly shortened; pectorals with about 6 simple rays, of moderate length; ventrals well behind pectorals; caudal forked; body with oblique black bands. Species about 6, of the tropical Pacific. The genus is closely related to *Cheilodactylus*, from which it differs mainly in the elevated, notched dorsal, the soft dorsal being longer than in *Cheilodactylus*. From *Dactylosparus* Gill (*D. carponemus*) the short anal distinguishes *Goniistius*. *Goniistius vittatus* from Hawaii is allied to *G. zebra*, and still other species inhabit Australian waters.

(*γωνία*, angle: *ἰστίον*, sail: for dorsal fin.)

KEY TO SPECIES.

- a. Body with about 9 oblique dark brown cross-bands, two on the head, the second across opercle, and base of pectoral; membrane of opercle jet-black; a lengthwise band along dorsal fin; ventral fin pale; caudal with several round white spots. D. XVIII, 32. A. III, 8. Scales 60. Fourth dorsal spine $1\frac{3}{4}$ in head *zonatus*, 4.
- aa. Body with 7 oblique jet-black bands; 3 of these on the head, the second extending across eye and across base of pectoral, the seventh covering most of caudal peduncle and lower lobe of caudal fin, ventral fin black; fourth, fifth, and sixth bands extending across dorsal fin. Dorsal rays XVII, 34, Anal III, 8. Scales, 70; fourth dorsal spine $1\frac{3}{4}$ in head..... *zebra*, 5.

4. GONIISTIVUS ZONATUS Cuvier and Valenciennes.

TAKANOHADAI (HAWK-PORGY), TAKAPA (HAWKLET), KIKORI (WOOD-CHOPPER).

Labre du Japon KRÜSENSTERN, Reise, Atlas, 1809, p. 63, pl. XLIII, fig. 1 (Japan).
Cheilodactylus zonatus CUVIER and VALENCIENNES, Hist. Nat. Poiss., 1830, V. p. 365, pl. CXXIX (Japan).—SCHLEGEL, Fauna Japonica, Poiss., 1843, p. 64, pl. XXIX (Nagasaki).—RICHARDSON, Ich. China., 1846, p. 239 (Canton); Proc. Zool. Soc., London, 1850, p. 66.—RICHARDSON, Ann. Mag. Nat. Hist. (2), 1851, VII, p. 282.—BLEEKER, Nieuwe Nalez., Japan, 1857, p. 83 (Nagasaki).—GÜNTHER, Cat. Fish., II, 1860, p. 82 (Canton; Japan).—STEINDACHNER and DÜDERLEIN, Fische Japans, II, 1881, p. 27 (Tokyo).—NAMIYE, Class. Cat., 1881, p. 95 (Tokyo).—NYSTRÖM, Svensk. Vet. Ak. Handl., XIII, 1887, p. 18 (Nagasaki).—ISHIKAWA and MATSUURA, Prel. Cat., 1897, p. 52 (Tokyo, Riu Kiu Islands).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 358 (Tokyo); Proc. U. S. Nat. Mus., XXIII, 1900, p. 752 (Yokohama); Check List, 1901, p. 84 (Yokohama).

Habitat.—Coasts of Japan and southern China, north to Tokyo, generally common.

Head $3\frac{1}{2}$ in length to base of caudal; depth $2\frac{2}{7}$; eye $4\frac{2}{3}$ in head; D. XVII, 32; A. III, 8; P. 13, with 6 rays simple; scales 9–60–16.

Body oblong, deep, compressed, the lower profile nearly straight, the upper compressed and highest forward; steep and nearly straight from tip of snout to front of dorsal. Mouth small, the lips produced, thick and fleshy; small teeth in jaws only; 2 fringed flaps over the anterior nostril, the posterior flap double the size of the anterior one; posterior nostril without flaps or processes; interorbital space broad, 4 in head; snout and preorbital scaleless; top of head, cheeks and opercles with small or minute scales; preopercle entire; opercle entire, rounded. Branchiostegals 6; gill-rakers 14+8, short, stout. Dorsal deeply notched, second spine equal to diameter of eye, high, about 2 in head; anal spines rather small, the third $3\frac{3}{4}$ in head; last soft rays much shortened, the longest a trifle more than 2 in head; pectoral almost as long as head, not quite reaching vent; ventrals moderate inserted opposite end of lowest simple pectoral ray and reaching beyond vent; caudal deeply and evenly forked. Scales moderate, cycloid; base of pectoral scaled; a scaly sheath about base of anal and dorsal; caudal largely scaled.

Color of body olive brown, paler on belly, about nine parallel oblique crossbars of deep brown, bright dark olive-orange in life, a little narrower than the interspaces; the first extending across the eye and cheek, the second from nape to base of pectorals, forming a jet-black blotch on opercle, and a dark bar across base of pectoral; the third, fourth, fifth, and sixth extend diagonally backward from dorsal to belly, where they disappear; the seventh, eighth, and ninth bands encircle the body, the seventh including the posterior portion of the soft dorsal; these three bands are confluent along the lateral line; dorsal fin brown; with a darker basal shade and one or two pale spots posteriorly. Caudal dark brown, with large round white spots about twelve in number; two or three similar white blotches on caudal peduncle; anal and ventrals black; pectorals uniform, pale brown



FIG. 2.—*GONIISTIUS ZONATUS*.

except the scaly base which is marked by a dusky crossbar; lips blackish, edged with rosy brown; two dark lengthwise lines across cheeks, from preorbital backward.

This description is taken from a specimen 8 inches long from Wakanoura. Larger examples are similarly colored, but the dark bands, always paler than in *Goniistius zebra*, grow fainter with age, and orange specks sometimes appear between them. The spots on the caudal fin are obsolete in some old examples.

Of this common species, we have specimens from Tokyo, Misaki, Wakanoura, Hakata, and Nagasaki. It is a food-fish of moderate importance and is called Takanohadai, or hawk-porgy, Tai being the common name applied to *Pagrus major* and all similar fishes.

(*zonatus*, banded.)

5. *GONIISTIUS ZEBRA* (Döderlein).

Cheilodactylus gibbosus STEINDACHNER and DÖDERLEIN, Fische Japans, II, 1883, p. 27, pl. VII, fig. 2 (Tokyo; not of Richardson; the synonymy given being all incorrect).—NYSTRÖM, Svensk. Vet. Ak., Handl., XIII, 1887, p. 18 (Nagasaki).—JORDAN and SNYDER, Check List, 1901, p. 84.

Cheilodactylus zebra DÖDERLEIN, Fische Japans, II, 1881, p. 29 (Tokyo; same specimen; a provisional name.)

Habitat.—Coast of Japan, known from Tokyo, Wakanoura, and Nagasaki.

Head $2\frac{3}{8}$ in length; depth $3\frac{1}{2}$. Eye $3\frac{3}{4}$ in head; snout about 3; inter-orbital width 4. D. XVII, 32. A. III, 8. Scales 10–70–15.

Body oblong, much compressed, the lower profile relatively straight, the upper much compressed, and elevated forward; a deep notch at the nape and another at the nostril; mouth small; lips thick; teeth in jaws only, the outer a little enlarged; a blunt projection over each eye growing larger with age, and one at the nostril; snout and preorbital scaleless; top of head, cheeks, and opercles with small scales; preopercle entire; opercle ending in two flat points; gill-rakers 12+5.

Dorsal deeply notched, the fourth spine $1\frac{1}{2}$ in head; anal spines moderate, the second thickest; last soft rays rapidly shortened, the longest $1\frac{5}{7}$ in head; pectoral longer than head, reaching vent; ventrals moderate, inserted well behind pectorals; caudal deeply and evenly forked.

Body rosy brown, with oblique cross bands of deep brown or rather orange black; three of these on the head, the second across eye and base of pectoral, the third forming a large blotch on the opercle; fourth including first three dorsal spines and extending across to ventrals fading below, the ventral fins being jet black; fifth and sixth bands extending on dorsal and ceasing near middle of side, the sixth confluent below with seventh; seventh fully confluent with eighth, leaving only three spots of the pale ground color between them; seventh and eighth not extending on dorsal, but covering almost all of caudal peduncle and the lower half of caudal fin. Anal fin a little dusky; fins pale except where crossed by the extension of the dark cross bands.

From Steindachner's excellent figure our specimen differs in the greater extension downward of the fourth band, and in the partial separation of the seventh and eighth bands. Of this species we have in hand a single specimen 10 inches long. It was found in the market of Yokohama by Pierre L. Jouy. A specimen was also seen at Wakanoura. It is otherwise known only from the specimen of Steindachner, and that recorded by Nyström. The species is certainly distinct from *Goniistius gibbosus* (Richardson) of the coast of Australia, with which Steindachner has confounded it, and probably from *Goniistius vestitus* (Castelnau) and *Goniistius quadricornis* (Günther), both Australian species. *Goniistius vittatus* Garrett, of Hawaii, which Steindachner

calls a "*Farbenvarietät*," is also nearly related. It is, however, clearly distinct from *Goniistius zebra*, as will appear from a comparison of Steindachner's excellent figure with that of *Cheilodactylus vittatus* (properly *Goniistius vittatus*) in Jordan and Evermann's report on the Hawaiian fishes.

(*zebra*, the zebra.)

SUMMARY.

Family CIRRHITIDÆ.

1. *Isobuna* Jordan, 1907.
1. *japonica* (Steindachner), 1883.
2. *Cirrhitus* Lacépède, 1803.
2. *marmoratus* (Lacépède), 1801; Yaku Island.
3. *Cirrhitichthys* Bleeker, 1856.
3. *aureus* (Schlegel), 1843; Misaki.

Family APLODACTYLIDÆ.

4. *Goniistius* Gill, 1862.
4. *zonatus* Cuvier and Valenciennes, 1830; Tokyo, Misaki, Wakanoura, Hakata, Nagasaki.
5. *zebra* (Döderlein), 1883; Yokohama, Wakanoura.

ON SOME EARWIGS (FORFICULIDÆ) COLLECTED IN
GUATEMALA BY MESSRS. SCHWARZ AND BARBER.

By ANDREW NELSON CAUDELL,

Custodian of Orthoptera, U. S. National Museum.

During the spring of 1906 several weeks were spent in eastern Guatemala by Messrs. E. A. Schwarz and H. S. Barber, who are both skillful collectors, having special aptitude for the discovery of minute forms of insect life. Being coleopterists, their particular attention while collecting was naturally directed toward beetles, but that other groups were not neglected is well proven by the following list of Forficulidæ collected by them. There are 88 specimens of these earwigs, representing 18 species, distributed in 13 genera, of which 6 species and 1 genus are undescribed. All of this material is in the United States National Museum.

The locality most frequently mentioned—"Cacao"—is situated in the Province of Alta Vera Paz, between Panzos and Senahú, at an altitude of about 900 feet, near the foot of the waterfalls, above which the coffee plantation of Trece Aguas is situated.

Notes by Mr. Barber are appended to the discussions of some of the species. These notes are inclosed in quotation marks.

DIPLATYS JANSONI Kirby.

Two females, Cacao, Trece Aguas, Alta Vera Paz, March 26, 31.

"One specimen beaten from dead banana leaves, the other from dead leaves from a recently felled tree. This species so closely resembles the very common Staphylinid beetle, *Paederus latus*, in form, coloration, and movements that it was by accident we discovered that it was a Forficulid, and it is probable that many more specimens were seen without being recognized."

DIPLATYS SEVERA Bormans.

Two males, 6 females, 2 larva, Cacao, Trece Aguas, Alta Vera Paz, April 13-21.

These larvæ exhibit the slender, many-segmented anal cerci, as described by Westwood some years ago under the synonymous genus

Dyscritina. The matter provoked much discussion at the time, and the rearing of the adult insects by Green definitely settled the question of the affinities of Westwood's genus, showing it to be Forficulid and congeneric with *Diplatys*. These specimens from Guatemala are, so far as I can learn, the first examples of this ancestral type of forficulid larvæ ever reported from the New World. The adult form, however, is not at all rare in certain places.

D. severa, which was described from a single female specimen, is a good species, but is very variable in coloration. The series before me comprises one with the color almost entirely black, some with the base of the abdomen and the forceps, or only the base of the abdomen, reddish, and some with the apical part of the abdomen and the forceps, or only the forceps, red. The pronotum is usually unicolorous, sometimes margined with lighter color, as in the type, and the elytra of the specimens before me are uniformly black. The projecting portion of the wings is usually, but not always, darker on the apical portion than basally. The legs are sometimes wholly black, and sometimes the middle and posterior femora are basally yellowish.

"Several specimens, including long-tailed larvæ, beaten from dead banana leaves that hang on the growing plant."

CYLINDROGASTER DIPLATYOIDES, new species.

One female, Cacao, Trece Aguas, Alta Vera Paz, April 11.

Description.—Head slightly broader than the pronotum; color shiny black above, below and about the mouth parts brownish; antennæ imperfect, clear reddish yellow in color, the long basal and very short second segments darker. Pronotum shining black above, lighter below, longitudinally broadly sulcate above, the disk anteriorly convex, posteriorly flattened; the whole pronotum is distinctly narrowed and neck-like in nearly the anterior half, the posterior portion parallel sided, truncate behind, the entire disk less than twice as long as the mesial width. Elytra piceous, not quite twice as long as the pronotum and together almost twice as broad as the pronotum, posteriorly subtruncate. Scutellum showing between the bases of the elytra, small but distinct; projecting portions of the wings a little less than one-half the length of the elytra and of the same color and texture, but narrower. Abdomen narrowing basally, reddish yellow above and below, somewhat infuscated laterally above on the basal third; there are inconspicuous lateral folds near the base of the abdomen, and the last segment is very large and subquadrate. Legs clear reddish yellow, without distinct infuscation. Forceps somewhat longer than the pronotum, moderately stout, and separated basally by a space nearly as great as the width of one of them at that point, parallel sided in the basal half, then narrowing in two terraces to a point; unarmed, the tip considerably incurved.

Length.—Body, without forceps, 7.5 mm.; forceps 2 mm.

Type-specimen.—Cat. No. 10365, U.S.N.M.

The posteriorly broader pronotum and the obscurely laterally folded abdomen is not in full accord with characters given for the genus *Cylindrogaster*, inclining rather to *Diplatys*. Other characters, however, have led me to place it here.

“In company with *Labia cacaoensis*.”

PYRAGRA CHONTALIA Scudder.

“One male, one immature female, taken onto steamer with firewood. Polochic River, below mouth of Cahabon River, March 22.”

ARTHROÆDETUS, new genus.

Description.—Female, unknown. Male, head convex above; antennæ of more than 19 segments,^a the basal segment moderately large and somewhat enlarged apically, scarcely longer than the greatest width; second segment smaller than the basal one and about one-third as long; third segment very long, being almost twice as long as the basal one and mesially about as thick; fourth segment about the same length as the second, scarcely as long as broad; the next four or five segments are about as long as broad, beyond them the segments gradually grow more elongate, the nineteenth being about four times as long as broad. Pronotum no longer than broad, no broader than the head. Elytra and wings absent. Abdomen elongate, scarcely broadened mesially and moderately convex, without lateral folds, the last dorsal segment slightly transverse. Legs moderately stout, the second tarsal segment small and simple, the first and third subequal in length, no arolium visible between the claws. Forceps of moderate length and simple, subcontiguous basally.

This genus is allied to *Echinopsalis*, but the antennal segments are somewhat different from those of the type of that genus, more like those of Rehn's *E. brevibractea*. *Arthradetus*, moreover, is apterous.

Type of the genus.—*Arthradetus barberi*.

ARTHROÆDETUS BARBERI, new species.

One male, Polochic River, May 2.

Description.—Of moderate large size; general color almost uniformly light brown above, somewhat lighter below. Head slightly darker above than the rest of the body and with a distinct transverse occipital line, and from the center of this line a longitudinal depressed line extends to the hind margin where it meets the anterior end of a deep and distinct median sulcus which extends the entire length of the pronotum and obsoletely on over the meso- and metanotum. Pronotum

^aThe antennæ of the only specimen known are imperfect.

quadrate with the anterior margin well rounded, the sides and posterior margin more broadly so; metanotum as broad as long and posteriorly roundly and deeply concave. Abdomen long and somewhat flattened. Legs light brown with a scarcely perceptible infuscated tint medially on the femora. Forceps straight, moderately swollen, and triangular basally, curved slightly inwards and cylindrical in the apical fourth, the inner margin armed on the basal three-fourths with a number of very minute denticules.



DIAGRAMMATICAL FIGURE OF THE
BASAL SEVEN SEGMENTS OF THE
ANTENNAE OF *ARTHRODETUS*
BARBERI.

Pygidium small, about as broad as long, rapidly tapered and apically truncate.

Length.—Body, without the forceps, 12 mm.; forceps, 2.5 mm.

Type-specimen.—Cat. No. 10366, U.S.N.M.

The accompanying figure represents diagrammatically the first seven segments of the antennae *Arthrodetus barberi*.

"This insect was beaten from a tangle of spiny plants and vines at a landing made to take on firewood, on the left bank of Polochic River below the mouth of the Cahabon River."

PSALIS, species.

One immature male, Cacao, Trece Aguas, Alta Vera Paz, April 23.

BRACHYLABIS NIGRA Scudder.

One male, Cacao, Trece Aguas, Alta Vera Paz, April 19.

This is the first reference, so far as I know, of this species being found north of South America.

The tarsus of the left middle leg of this specimen is deformed, having the second joint aborted and the others somewhat swollen, the whole tarsus a little shorter and stouter than normal. The golden luster is but little noticeable in this specimen. The measurements are: Length, body, without the forceps, 8 mm.; forceps, 1.75 mm.

SPARATTA MINUTA, new species.

One female, Polochic River, March 22.

Description.—Male, unknown. Female, smaller than usual in the genus. Head black; antennae imperfect, the segments present, eleven in number, unicolorously brown. Pronotum black, somewhat longer than broad, rapidly and much constricted anteriorly, being necked, and posteriorly gradually and slightly narrowing, the posterior margin rounded; the disk is mesially carinate longitudinally, but inconspicuously so, and is more flattened on the posterior portion. Abdomen much flattened, broadest in the middle, the lateral folds scarcely visible, the last segment very slightly transverse; subgenital plate projecting backward between the lower part of the forceps as a quadrate apically

notched plate, the outer apical angles of which are acute. The color of the abdomen is black above except the anal segment, which is reddish yellow, beneath paler. Elytra black, twice as long as broad, together much broader than the pronotum, posteriorly obliquely roundly truncate. Projecting portion of the wings similar to the elytra in texture and color and nearly as long but somewhat narrower, being noticeably more than twice as long as broad, posteriorly rounded. Legs reddish brown, the femora stout and somewhat infuscated basally. Forceps blackish with a reddish tinge at the extreme base inwardly, long and stout, straight, the tips incurving, armed inwardly about the middle with a minute sharp tooth and at the base on the inner inferior margin with a larger triangular tooth. Pygidium nearly quadrate, the posterior margin slightly projecting mesially and the lateral margins very little rounded.

Length.—Body, without the forceps, 5 mm.; forceps, 1.5 mm.

Type-specimen.—Cat. No. 10367, U.S.N.M.

This small species seems distinct from any of the described members of the genus. It does not appear to be found among the species recently described by Rehn and Borelli, nor does it appear to be any of the older established species. In color it is something like the *S. dentifera* of Rehn, but is much smaller.

“Under bark of Cecropia wood taken onto the steamer from the left bank of the Polochic River below the mouth of the Cahabon.”

SPARATTA FLAVIPENNULA Rehn.

Four immature specimens, Cacao, Trece Aguas, Alta Vera Paz, April 2, 21, and 26.

LABIA ARCUATA Fabricius.

Twelve males, 16 females, 3 immature specimens, Cacao, Trece Aguas, Alta Vera Paz, March 24 to April 26.

“A few individuals found singly under various circumstances, but the species was found in abundance in and under a pile of old corn husks lying on the ground beside the trail and also on the ground under and in a rotting banana plant.”

LABIA BILINEATA Scudder.

One male, Cacao, Trece Aguas, Alta Vera Paz, April 20.

LABIA SCHWARZI, new species.

Two males, 2 females, Cacao, Trece Aguas, Alta Vera Paz, April 11.

Description.—Head broader than the pronotum, shining black; eyes prominent; antennæ 14 jointed, light brown in color, the basal three segments paler. Pronotum noticeably longer than broad, a little narrower anteriorly, the posterior margin rounded, the disk posteriorly transversely depressed. Elytra dark brown with a lateral yellowish line,

broadening at the humeral angle; in length the elytra are fully twice that of the pronotum and together are considerably broader than it, posteriorly truncate. Wings brown on the inner half, yellowish on the outer, projecting beyond the tips of the elytra a distance equal to about two-thirds the length of the latter, rounded posteriorly. Legs brownish or black, the femora very stout. Abdomen convex, short, distinctly broader mesially, lateral folds scarcely in evidence, the terminal segment broadly transverse; forceps of the male about as long as the abdomen, triangular basally, apically cylindrical, curved moderately inward basally widely separated and armed on the inner margin with some minute teeth; of the female slender, somewhat shorter and straighter, the denticles in the inner margin a little larger, basally less widely separated. Pygidium of the male very broad, somewhat longer than broad and apically rounded, entire.

Length.—Body, without forceps, male, 3.5–4 mm., female, 3.5 mm.; forceps, male, 1.25–1.5 mm., female, 1 mm.

Type-specimen.—Cat. No. 10368, U.S.N.M.

Except for size this species bears a superficial resemblance to *Spongophora pygmaea* as figured by Bormans.^a The pygidium of the male will serve to separate it from *Labia bilineata* Scudder, to which it bears a somewhat close resemblance.

“Found running on and under the bark of a tree resembling *Xanthoxylon*.”

LABIA BREVIFORCEPS, new species.

One female, Livingston, Guatemala, May 5.

Description.—General color yellowish brown, the basal two segments of the antennæ lighter, beyond infuscated, the lateral margins of the pronotum and elytra and the legs yellow. The elytra show the yellow color mostly at the humeral angles, from where it shades off to brownish posteriorly. The inner margins of the projecting portions of the wings show a trace of lighter yellow. Eyes black.

Head convex, broader than the pronotum; antennæ with eighteen segments; may be more as some of the terminal ones may be missing; the third segment is about as long as the first, three times as long as the second, being about three times as long as it is wide. Pronotum about as long as wide, posteriorly semicircularly rounded, mesially transversally depressed on the disk. Elytra three times as long as broad, together considerably broader than the pronotum, posteriorly truncate; wings projecting a distance equal to about one-third the length of the elytra, posteriorly narrowly rounded. Legs short and stout, the femora thick, second tarsal joint small and simple, the third but little hairy beneath, and the claws have a small pad between them. Abdomen without lateral folds, convex, broad, mesially somewhat broadened, the last dorsal segment somewhat transverse, dorsally

^a Biol. Cent.-Amer., Orthoptera, I, pl. II, figs. 4, 5.

broadly concave, truncate, the apex obscurely bituberculate; last ventral segment transverse, rounded. Forceps very short and stout, triangular basally, nearly contiguous and curved decidedly upwards, but only slightly inwards and that only at the tip.

Length.—Body, without forceps, 5 mm.; forceps, 0.5 mm.

Type-specimen.—Cat. No. 10369 U.S.N.M.

This insect presents characters, such as the many jointed antennae, smooth abdomen, etc., not in accord with those of the genus *Labia*, but for the present I have preferred to place it questionably in that genus.

"This was beaten from leaves of recently felled trees in a new clearing at the mouth of the Rio Dulce, about two miles from Livingston."

SPHONGOPHORA PYGMAEA Dohrn.

Four males, 3 females, Cacao, Trece Aguas, Alta Vera Paz, April 2, 5, 20, and 21.

One of these specimens, a male taken April 2, represents a variety differing from the typical form in the shape of the forceps, which are uniformly bowed instead of nearly straight, and are almost unarmed on the inner margin. One of the females has the elytra and wings unicolorously black.

OPISTHOCOSMIA AMERICANA Bormans.

Four males, 2 females, 3 immature specimens, Cacao, Trece Aguas, Alta Vera Paz, April 11 to 27.

The females sometimes have the wings conspicuously marked by a yellow spot, and sometimes the spot is almost entirely absent. The forceps of the male are sometimes shaped as shown in Bormans's original figure, but in three of the four representatives of that sex now before me the forceps are tubercled about as prominently as in Bormans's figure but are nearly straight, not so sinuate, in this respect approaching the *O. anomala* of Rehn.

"Running on brush. Not uncommon."

NEOLOBOPHORA RUFICEPS Burmeister.

Two immature females, Cacao, Trece Aguas, Alta Vera Paz, April 5.

SPHINGOLABIS LINEARIS Eschscholtz.

Six males, 2 females, Cacao, Trece Aguas, Alta Vera Paz, April 9 to 27.

FORFICULA CACAOENSIS, new species.

One male, 1 female, Cacao, Trece Aguas, Alta Vera Paz, March 29 and April 19.

Description.—Male: Head moderate; eyes prominent; antennæ 13 jointed, of the usual structure. Pronotum equaling the head in width, subquadrate, posteriorly broadly rounded, anteriorly very slightly excavate, the sides straight, thin and inclined a very little upwards; disk a little convex with a persistent slender median sulcus, broader in the anterior half. Abdomen moderate, broadest mesially, the surface punctured, the segments apically rounded, the second and third with distinct lateral tubercles, those on the third segment the larger. Elytra nearly twice as long as broad, together slightly broader than the pronotum, posteriorly truncate, the sides deflexed, the posterior lateral angles rounded; the elytra meet in a slightly curved line and the left one has a slight curved depression in the middle near the inner margin. Wings projecting a very little beyond the tips of the elytra, scarcely extending over the basal segment of the abdomen, but when more specimens are examined this will probably be found to vary somewhat. Legs moderately stout, the second joint of the tarsi distinctly cordiform. Forceps contiguous on the basal eighth, or slightly less, by a basal expansion which extends almost horizontally inwards from the arm of the forceps and is dentate on the inner margin; from the ampliate contiguous base the forceps are rounded, unarmed and uniformly curved. Pygidium not visible. Color of the head, pronotum, elytra, wings, abdomen and most of the forceps black, antennæ dark brown, uniform, legs light brownish yellow, the femora slightly darkened above, forceps at the extreme base above yellowish.

Female: Similar to the male, the abdomen more uniformly heavy, not noticeably widened mesially; the wings project more than in the male type, the projecting portion of each being longer than wide; the forceps are nearly straight, the tips a little incurved apically and the basal two-thirds are triquetreous, inwardly slightly depressed and minutely serrate, the apical third cylindrical and unarmed.

Length.—Body, without the forceps, male, 7 mm., female, 10 mm.; forceps, male, 2 mm., female, 2 mm.

Type-specimen.—Cat. No. 10370, U.S.N.M.

This black earwig is superficially somewhat allied to *F. lugubris*, but is amply distinct from that species. It resembles somewhat the *F. metrica* of Rehn, but the forceps of the male will at once separate it from that species.

NEW MARINE MOLLUSKS FROM THE WEST COAST OF AMERICA.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

The present paper embraces diagnoses^a of new mollusks from the Oregonian faunal area, belonging to the genera *Seila*, *Bittium*, *Cerithiopsis*, and *Metaria*. Figures of these will appear when the monograph of these forms in course of preparation is published.

SEILA MONTEREYENSIS, new species.

Shell large, robust, brown. (Extreme apex lost in all our specimens.) One of the cotypes has two and a half nuclear whorls remaining. These are rather inflated, evenly rounded, marked by many slender obliquely retractive axial riblets. The transition of the nuclear sculpture to the post-nuclear is very abrupt. The sculpture of the post-nuclear turn consists of three very strong, equal, and equally spaced lamellar spiral keels between the sutures. Channels separating the spiral keels well rounded, a little wider than the keels, crossed by many subequal and subequally spaced slender riblets, of which about 40-50 appear on the whorls. Periphery of the last whorl marked by a fourth spiral keel not quite as strong as the keels of the spire and a little more closely placed to the keel posterior to it than that is to its neighbor above it. Base marked by a spiral keel which equals the peripheral keel in strength, separated from it by a channel a little narrower than the suprapерipheral groove. Both of these channels are crossed by the axial riblets. The remaining portion of the base slopes somewhat concavely toward the stout columella. Under the microscope the

^a In the preparation of the present diagnoses the following terminology is used: *Spiral sculpture*, the markings following the direction of the coils of the whorls. *Axial sculpture*, the markings which extend from the summit of the whorls toward the umbilicus.

The axial sculpture may be—

Vertical, when the markings are in general parallelism with the axis of the shell.

Protractive, when the markings slant forward from the preceding suture.

Retractive, when the markings slant backward from the suture.

entire surface of the spire and base appears marked by fine lines of growth and spiral striations. Aperture subquadrate, decidedly channeled anteriorly; outer lip rendered sinuous by the spiral keels, parietal wall and edge of columella covered by a moderately strong callus. The nuclear structures were described from a young specimen, Cat. No. 195206, U.S.N.M., which has 10 whorls (the first two nuclear whorls probably being lost), and measures: Length 3.6 mm.; diameter 1.4 mm. The other cotype (Cat. No. 32290, U.S.N.M.) is an adult shell in which the last 11 whorls remain, and measures: Length 12.4 mm.; diameter 4.1 mm.

This species has been known from the west coast under the name of *Cerithiopsis assimolata* C. B. Adams, a Panamic species, which is a pygmy in size compared with the present form.

Specimens examined.

Specimens.	Locality.	Collector.	Museum number.
			<i>Cat. No.</i>
2	Monterey, California	Stearns collection	32290 (1 cotype).
1	Monterey, California, (off Del Monte, 12 fathoms).	S. S. Berry	195206 (cotype).
1	Monterey, California.	W. H. Dall	56009.
2	do	Canfield	23738.
1	do	W. H. Dall	160892.
1	Santa Barbara Islands.	Cooper	15731.
6	San Pedro, California	Mrs. Oldroyd	195207.
1	do	do	195209.
4	San Pedro (Whites Point).	do	195208.
1	San Pedro (Terminal Island).	Mrs. Eshnaur	109514.
1	San Diego, California	Stearns collection	32397.
4	San Diego (Ocean Beach).	F. W. Kelsey	153046.
2	San Diego (Ash street).	Mrs. Oldroyd	195210.
1	Off Point Loma light (71 to 75 fathoms).	U. S. F. C. Station 4310.	195211.
3	Todos Santos, Lower California.	H. Hemphill	32393.

BITTIUM (STYLIDIUM) *a* ESCHRICHTI ICELUM, new subspecies.

In *B. eschrichti* only the early whorls show axial ribs. In the present form they are well developed on all the turns, weakening only on the last. The type, Cat. No. 15209*a*, U.S.N.M., was collected by J. G. Swan at Neah Bay, Washington. It has 9 whorls (the nucleus being lost), and measures: Length 15 mm.; diameter 5.5 mm. Another specimen, Cat. No. 32209, U.S.N.M., belongs to the Stearns collection and comes from Monterey, California.

BITTIUM (STYLIDIUM) *a* ESCHRICHTI MONTEREYENSIS, new subspecies.

This form is the southern race of *B. eschrichti*. It differs from the typical form in being less strongly spirally keeled, much more smooth, more slender, and in every way more elegant than *eschrichti*. The typical form varies in color from brown to white, and is very rarely

^aThe name *Stylidium* is proposed by W. H. Dall, with *B. eschrichti* Middendorff, as type, in a publication now in press.

spotted. In *montereyensis* the variegated forms predominate; that is, the shells are whitish mottled with rust brown. The type, Cat. No. 32221, U.S.N.M., has 10 whorls, and measures: Length 13.8 mm.; diameter 5 mm.

BITTIUM ESURIENS MULTIFILOSUM, new subspecies.

Shell similar to *B. esuriens*, but having 7 spiral keels between the sutures on the whorls of the spire instead of 4.

The type, Cat. No. 127051, U.S.N.M., was collected by Mrs. Oldroyd at Whites Point, San Pedro, California. It has 10 whorls, and measures: Length 9.2 mm.; diameter 3 mm.

Specimens examined.

Specimens.	Locality.	Collector.	Museum number.
			<i>Cat. No.</i>
1	Monterey, California	W. H. Dall	56002.
3	do	Stearns collection	32235.
1	Whites Point, San Pedro	Mrs. Oldroyd	127051 (type).
7	do	do	195125.
7	Catalina Island	W. H. Dall	56907b.
1	do	do	56908.
1	San Pedro (50 fathoms)	Mrs. Oldroyd	195126.

BITTIUM TUMIDUM, new species.

Shell of medium size, light yellowish-brown, shining. Nuclear whorls decollated. Post-nuclear whorls somewhat inflated, well rounded, separated by constricted sutures and ornamented with strong tuberculate axial ribs, of which there are 18 upon the second of the remaining whorls and 22 upon the penultimate turn. In addition to the axial ribs there are four unequally broad, low, spiral ridges between the sutures, which are much wider than the spaces which separate them, the latter appearing as strongly incised lines. The intersection of these ridges and the ribs form the tubercles. The whorls slope gently from the second spiral ridge toward the summit, and the first row of tubercles which is only feebly developed is located on the sloping shoulder. The second set of tubercles are rounded while the third and fourth rows are decidedly elongated. Periphery of the last turn marked by a strong smooth spiral keel, which is separated from the suprapерipheral keel by a mere constriction. Base rather short without keel, marked only by lines of growth. Aperture suboval, decidedly channeled anteriorly; outer lip rendered sinuous by the external sculpture; columella short, very broad, and slightly expanded at the insertion, a little lighter in color than the rest of the shell; provided with a strong callus on its inner edge which is reflected over the parietal wall.

The type, Cat. No. 74001, U.S.N.M., was collected by Canfield at Monterey, California. It has 8 postnuclear whorls and measures:

Length 4.2 mm., diameter 1.7 mm. A second immature specimen, Cat. No. 23261, U.S.N.M., is in the Stearns collection, also from Monterey, California.

BITTIUM QUADRIFILATUM INGENS, new subspecies.

Shell similar to *B. quadrifilatum* but in every way stronger and larger and of white color. The spiral bands in *B. quadrifilatum* do not form strong cusps at their intersections with the axial ribs, but simple nodes, while in the present form these intersections are decidedly cusped.

The type, Cat. No. 32213, U.S.N.M., from Monterey, California, has lost its nucleus; the ten remaining turns measure: Length 12.2 mm.; diameter 4.5 mm. Another specimen, Cat. No. 195159, U.S.N.M., was dredged by the U. S. Fisheries steamer *Albatross* at station 4475, 10 miles off Point Pinos Light, California, in 142 to 158 fathoms.

CERITHIOPSIS COSMIA, new species.

Shell elongate-conic, variegated with various shades of brown, white, and wax yellow. Nuclear whorls $3\frac{1}{2}$, slender, lending the apex a mucronate appearance. First nuclear whorl smooth, second crossed by feeble axial riblets. The riblets increase considerably in size in the remaining turns, where they are very regularly developed and evenly spaced. They are strongly protractive as they pass from suture to suture, the extremity at the lower suture being considerably in advance of the extremity at the summit. In addition to the vertical riblets microscopic crinkly lines appear on the intercostal spaces which intersect the riblets in oblique even curves at right angles. The transition from the nuclear to the post-nuclear sculpture is abrupt, the three chief tuberculate spiral keels being present from the very beginning of the postnuclear turn. On the first four post-nuclear turns the posterior spiral keel is less developed than the rest, but it increases with each succeeding turn and finally becomes the strongest of the three. The tubercles are the early whorls, are almost round and slope abruptly, concavely posteriorly and gently well rounded anteriorly. On the later whorls they are oblong, with their long axis vertical. Channels separating the spiral keels about as wide as the keels on the early whorls, less so in the later turns, curved by the low, broad, strong, backward slanting axial riblets. The spaces between these ribs and the spiral keels appear as rounded pits. Sutures well impressed. Periphery of the last whorl marked by a strong spiral keel. Base well rounded, marked by three equal and equally spaced spiral keels separated by equally wide and strong channels. The entire surface of the spire and base keels, tubercles, and channels are marked by microscopic lines of growth and spiral striations. Aperture subquadrate, posterior angle obtuse, decidedly chan-

neled at the junction of the short, thick, somewhat twisted columella and outer lip.

This description is based upon two specimens, cotypes, Cat. No. 195196, U.S.N.M. One has the nucleus and 11 postnuclear whorls, and has furnished the description of the nucleus. This measures: Length 7.3 mm.; diameter 2.3 mm. The other has lost its nucleus and probably the first two postnuclear turns, and measures: Length 9 mm.; diameter 2.9 mm.

Specimens in the U. S. National Museum.

Specimens.	Locality.	Collector.	Museum number.	Cat. No.
1	Monterey, California.....	W. H. Dall.....	160870.	
1	do.....	do.....	56012.	
3	do.....	do.....	56008.	
2	Catalina Island.....	do.....	160077.	
3	Whites Point, San Pedro.....	Mrs. Oldroyd.....	195196 (2 cotypes).	
5	San Pedro Bay.....	do.....	195197.	
3	Government jetty, San Diego.....	F. W. Kelsey.....	153057a.	
2	San Diego.....	H. Hemphill.....	109365.	
3	Todos Santos Bay.....	Stearns.....	32392.	

CERITHIOPSIS PEDROANA, new species.

Shell small, slender, dark brown. Nuclear whorls three, yellowish-white, smooth. Post-nuclear whorls strongly differentiated from the nuclear ones, showing the sculpture characteristic of the adult shell from the very beginning. This sculpture consists of three equally spaced tuberculate spiral keels between the sutures, the posterior one of which is slightly smaller than the other two. These keels are separated by deep rounded channels almost as wide as the keel. In addition there are many low, rather broad axial ribs, the intersections of which with the keel form the tubercles. About 20 of them occur upon the first, 22 upon the fifth, and 30 upon the penultimate post-nuclear turn. The connection between the tubercles, both spiral and axial, are about equal, inclosing deep, squarish pits. In addition to the above sculpture the entire surface is marked by fine spiral lines and lines of growth. Sutures strongly marked, constricted, showing the peripheral keel in the later whorl. Periphery marked by a broad, low, rounded keel. Another of equal width is located upon the middle of the base. The sulcus which separates these keels and the supra-peripheral sulcus are of equal width: both are crossed by the weak continuations of the axial ribs, which gradually weaken as they pass toward the columella. The basal keel is separated from the columella by broad, shallow grooves. Aperture irregularly oval, decidedly channeled anteriorly, outer lip thin, rendered sinuous by the external keel; columella stout and somewhat twisted, with a strong callus on its inner edge that extends over the parietal wall.

The two cotypes, Cat. No. 109512, U.S.N.M., were collected by Mrs. W. H. Eshnaur at Terminal Island, San Pedro, California. The one has the nucleus and 3 post-nuclear whorls; the other has lost the nucleus and has 9 post-nuclear turns and measures: Length 5.2 mm., diameter 1.8 mm.

Specimens in the U. S. National Museum.

Specimens.	Locality.	Collector.	Museum number.
			<i>Cat. No.</i>
350	Terminal Island, California.....	Mrs. W. H. Eshnaur.....	109512 (cotypes).
1	Catalina Island, California.....	W. H. Dall.....	56751.
3	San Pedro, California.....	T. Oldroyd.....	195179.
1	do.....	J. G. Cooper.....	14825.
1	San Pedro (Whites Point), California.....	T. S. Oldroyd.....	195180.
1	do.....	Brannan.....	73725a.
9	San Diego, California.....	J. M. Cooke.....	139584.
40	do.....	Stearns collection.....	32287a.
13	do.....	do.....	32220b.
3	do.....	W. H. Dall.....	56006a.
6	do.....	T. S. Oldroyd.....	123401.
1	do.....	H. Hemphill.....	109364.
7	San Diego (Government jetty), California.....	F. W. Kelsey.....	153058.
1	Point Abreojos, Lower California.....	H. Hemphill.....	106504.
1	Todos Santos Bay, Lower California.....	Stearns collection.....	32292.

METAXIA DIADEMA, new species.

Shell slender, decidedly turritid, brown. Nuclear whorls four, the first smooth, the others marked by two spiral threads, the posterior one of which falls on the middle of the whorls between the sutures, while the anterior one is about halfway between it and the basal suture. In addition to this sculpture there are slender equal and equally spaced axial riblets, of which about 28 occur upon the third and 30 upon the fourth whorl. The nuclear whorls are slopingly shouldered from the posterior keel to the summit and well rounded anterior to it. The demarcation between the sculpture of the nuclear turns and the post-nuclear turns is abrupt. Post-nuclear turns inflated, marked by four strong spiral tuberculate keels and axial ribs. These four keels are equally spaced, but not equally strong. The third excels all the others in development, the fourth or basal one comes next, the second next, while the one at the summit is the weakest of the four. The axial ribs are broad and strong and rather distantly spaced, forming decided nodes at their intersection with the spiral keels. There are about 14 of these ribs upon the first, 15 upon the fifth, and 22 upon the penultimate turn. The spiral keels connecting the tubercles are only about one-fourth as strong as the axial ribs; the areas inclosed by the two are quadrangular, the vertical diameter being the shorter. On the last whorl, where the ribs are a little more crowded, these areas become squarish. Sutures strongly constricted. Periphery of the last whorl marked by a strong keel, separated from the supra-peripheral keel by a strong channel, which is crossed by the continuations of its axial

ribs. Base rather short, sloping somewhat concavely from the peripheral keel to the insertion of the broad columella, marked by a weak spiral thread at the base of the columella and the continuation of the axial ribs which extend well up on the columella. Aperture suboval, decidedly channeled at the junction of the lip and columella with the posterior angle obtuse.

The smaller of the two cotypes, Cat. No. 195203, U.S.N.M., has the nucleus complete and 8 post-nuclear whorls and measures: Length 3.8 mm.; diameter 1.3 mm. The other, Cat. No. 153045, U.S.N.M., has 8 post-nuclear whorls, having lost the nuclear and probably two of the post-nuclear turns; it measures: Length 4.6 mm.; diameter 1.5 mm.

This species has been confounded with the European *Metaxia metaxae*, under which name it has appeared in many lists.

Specimens examined.

Specimens.	Locality.	Collector.	Museum number.
			<i>Cat. No.</i>
1	Monterey Harbor.....	R. E. C. Stearns	74012.
1	.....do.....	W. H. Dall	56011.
1	Monterey (Del Monte), 12 fathoms.....	S. S. Berry	101 Berry collection.
1	Monterey (Del Monte), 28 fathoms.....	.....do.....	
2	Monterey (Pacific Grove) .....	.....do.....	195223 (1 cotype).
6	San Pedro.....	Mrs. Oldroyd.....	130569.
1	.....do.....	.....do.....	195204.
1	.....do.....	Miss Johnston.....	152172.
1	.....do.....	S. S. Berry	39 Berry collection.
1	Ocean Beach.....	F. W. Kelsey.....	153045 (cotype).
2	Off Point Loma, 10 fathoms .....	.....do.....	152338.
1	West coast.....	Stearns collection	32304.

SUPPLEMENTARY NOTES ON MARTYN'S UNIVERSAL CONCHOLOGIST.

By WILLIAM HEALEY DALL,

Curator, Division of Mollusks, U. S. National Museum.

The publication of an account^a of Martyn and his famous work on the shells of the South Seas by me in 1905, had the hoped-for effect, in that it was the means of bringing out supplementary information which enables me to supply data missing at the date of the first paper and to confirm conclusions which in it were arrived at by circumstantial evidence. Next to the positive determination that the first 80 plates were published in 1784, the most important data relate to the correction of the so-called reprint issued by Chenu of the tables for the second 80 plates, which turns out to be entirely unreliable. The new information comes from widely scattered sources.

The copy containing the first 80 plates, belonging to the Academy of Natural Sciences at Philadelphia, is about the same size as the National Museum copy (12 $\frac{5}{8}$ by 10 $\frac{3}{4}$ inches) and is of the same date. It contains a publisher's circular offering the work separately printed on an octavo sheet dated 1787, and a manuscript note^b stating that the Duke of York's copy sold for 10 guineas. The plates and tables agree with those of the Museum copy.

The second copy examined was sent from South Dakota by a collector who sold it to Mr. John B. Henderson, jr., of Washington, and likewise consisted of 80 plates elegantly bound. This was evidently one of the "select copies" of the first issue, as it is on folio sheets (16 $\frac{1}{2}$ by 16 $\frac{1}{2}$ inches), and is dated after the first engraved title, "1784," and after the second engraved title has "MDCCLXXXIV | Tomkins scripsit | Ellis sc." | in small letters. This plate and the dedication are larger than those in the quarto edition and printed from a different engraved plate, although the wording is the same as in the quarto copies. There are no plates of medals. The text is worded the same

^a Proc. U. S. Nat. Mus., XXIX, 1905, No. 1425, pp. 415-432.

^b Taken from an account of the sale in the London Times, May 24, 1827.

as in the later issues, for the most part, but slightly differently distributed. On page 8, paragraph 2, after "South Seas," is added "comprising in all about 170 different species. The whole of which will be contained in four volumes, each volume exhibiting 40 shells or 80 figures." The later issues have only "The whole of which will be comprised in two volumes."

The Henderson copy, p. 8, footnote, asks that "correct copies of these" (i. e., drawings of unique shells for use in the work) may be sent to the author by "Christmas, 1785," in order to enrich the suite of these particular shells in this repository. This note, or a part of it, appears on page 6 of the quarto. Page 26 in the Henderson copy ends the text. Then follows the "Explanatory Table," worded as in the quarto, but engraved on a somewhat larger plate. The figures of shells follow, but, while they are the same species as in the quarto, they are in a few cases differently placed on the sheet, and the space inclosed by the neat-lines is larger.

Under the sheet of the Explanatory Table is inserted an octavo sheet of two pages, one English and one French, headed "Observations on the Explanatory Table." This sheet has not been seen in any other copy, but contains nothing of importance. It is chiefly devoted to remarks on the shells figured on plates 2, 14, 20, and 24.

The second forty plates forming "Volume II" have a copy of the 1787 circular inserted after the fly leaf, together with a note (with no headline), as follows: "As the four first volumes of this undertaking | form of themselves a distinct work and as such | may be preferred by some Persons: an additional | Title page is therefore added for such Purpose, leaving the other title page to be removed at | the Discretion of the Purchasers."

There is the same engraved title as for Volume I (first forty plates), no text, explanatory table the same as in the quarto.

The following differences are noted between the Henderson copy of the plates and the plates of the quarto:

Plate 43 has two views of shell. There is only one view in the quarto.

Plates 57 and 59; same remark.

Plates 61 and 63, the figures are side by side. In the quarto (owing to the smaller page?) they are placed diagonally.

All the other plates, except in regard to the neat-line, agree exactly with those of the quarto.

Mr. Charles Hedley, of the Australian Museum, informed me that they possess a complete copy with all the plates and also copies of the publisher's circular in octavo form, with French and English text for the issues of 1784 and 1786. These circulars are now known for 1784, 1786, and 1787. Mr. Hedley, with the concurrence of the Museum authorities, was kind enough to send me photographs of the circulars and also of the "Explanatory Tables" belonging to Volumes III and

IV, otherwise the third and fourth batches of 40 plates each. I have already called attention to the confusion caused by the publisher sometimes referring to 40 and at other times to 80 plates as a volume. The explanatory tables are marked Vol. I, II, III, and IV, respectively. I reproduce the English page of the earliest prospectus known to me, that dated 1784.

The words "This day is published" should not be taken literally, since they occur on each of the circulars. They simply mean that the books are on sale at the time of distribution of the circular, even when first issued earlier. The subsequent circulars differ but little in wording. They have the heading "Academy for Painting of Natural History," which is wanting on the circular of 1784.

For condition V of the 1784 circular that of 1786 has "That the subsequent volume, which is already in great part finished, shall be published some time in the spring, 1787."

In the circular of 1787, after the line "This day is published," is inserted "(in two volumes compleat);" the paragraph numbered V in 1786 is omitted, and paragraph VI becomes V, while there is no paragraph VI.

The prices cited also vary. In 1786 the price is raised to "nine guineas each volume, in a rich extra binding; and ten guineas and a half in morocco. Unbound, seven guineas and a half. An edition of the above Work, elegantly bound in small Folio, may be had at five guineas and a half each volume." The same prices were asked in 1787.

In 1784 the author was situated at "26 King-Street, Covent-Garden," but in 1786 and 1787 the circulars place him at "16 Great Marlborough-Street."

The data above given prove conclusively that the first eighty plates appeared in 1784, the third forty in 1786, and the work was completed probably in the spring of 1787. Also that the date on the title-pages was changed at least twice, copies existing dated 1784, 1787, and 1789; and that a separate title-page was prepared for the first four volumes of South Sea shells when it became impossible to carry out the author's plan of issuing a general iconography.

The photographs of the "Explanatory Tables" of Volumes III and IV show such discrepancies between Chenu's "reprint" and the text it purports to represent that the suspicion arises that the original table may have been submitted to some revision and additions in a later issue; otherwise it seems impossible to account for Chenu giving in each case for these two volumes the generic name *Cardium*, when the original reads *Cochlea*, and specific names to species for which no specific name had been engraved in the compartment of the table intended to hold one.

This Day is Published.

VOLUME THE FIRST; OF FIGURES of NON-DESCRIPT SHELLS,
COLLECTED IN THE

Several Voyages to the SOUTH SEAS, since the Year 1764.

DEDICATED (by Permission) to HIS MAJESTY:

CONDITIONS.

- I. THAT the whole Work, exhibiting a complete Collection of Non-descript Shells, from the South Seas, shall be comprised in four volumes, Folio.
- II. That EIGHTY FIGURES of SHELLS shall be given in each volume.
- III. That the more essential parts shall be executed By the Author only; and the whole By his Pupils, under his immediate direction.
- IV. That in each volume shall be given an engraved title page, and an explanatory table, (in French and English) shewing in different columns, 1st. The number referring to each figure in the order of its succession; 2^{dly}. The English name and family, with an initial letter denoting the genus, or division of that family, to which the shell belongs, according to the System of the Author. 3^{dly}. The latin name, and its degree of rarity. 4^{thly}. Where the shell is found. And lastly, in what cabinet it is preserved.
- V. That the subsequent volumes (which are already in great part finished) shall be published at regular intervals of five months.
- VI. That the price shall be six guineas each volume, elegantly bound, or five guineas unbound.

* A small number of SELECT COPIES will be sold at an advance of two guineas and a half on each Volume.

The subject of the Work above proposed, seems to entitle it in a particular manner to the attention of the British Naturalist, as a monument of the several voyages to the Pacific Ocean, and of those important discoveries which will do such lasting honour to the Philosophical spirit of this nation, under the present reign, so auspicious both to the liberal arts and useful Sciences. Nor is it destitute of a more general merit, which may as powerfully recommend it to the Naturalist of every country.—The merit of Novelty: No publication on these particular shells having yet appeared. This alone might be sufficient to insure it success, as a supplement to the treatises of Lister and Others. The Author, however, takes this opportunity of intimating, that he wishes this essay rather to be considered as the first part of an undertaking much more extensive; that of illustrating the whole System of Conchology, in the same superior style of accuracy and elegance. This superiority will best appear by comparing this Publication with all others extant, in this or any other branch of Natural History. The drawings will be minutely correct, and adapted to a scale, formed on an attentive observation of the more perfect specimens in the principal cabinets of this kingdom: the engraving will consist merely of a delicate outline, as a certain guide for the relative proportions of the parts; to this the utmost skill and labour of the Painter will be added, in order to produce from the whole the full effect of that beautiful contour, rich colouring, and bold relief, which the subject so peculiarly demands, and which the art of painting alone can properly supply; while the exact and lively representation of Nature in the size, shape, mouth, extremities, convolutions, and various colours of the different shells thus exhibited, will at the same time answer every purpose of science, and in some sort render the present Work truly worthy the appellation Of a *School*, for this pleasing branch of Natural History.

* Select Copies of the above work, richly bound in Morocco, may be had, at Ten Guineas and a Half each Volume.

Sold at THOMAS MARTYN'S, (the Author) No. 26, King-Street, Covent-Garden, London, 1764.

The following list gives Martyn's names for his Volumes III and IV. A comparison with the list in my first paper transcribed from Chenu's "reprint" will show the discrepancies. Several species have no specific name given to them. When the generic name is not engraved against the specific name but is indicated by the context it is placed in parentheses. In this and other respects the list agrees with the construction of my previous list. Specific names added by Chenu, but not in the original, are starred:

EXPLANATORY TABLE, VOLUME III.

- PLATE 81. *Buccinum ficus*.
 82. *Buccinum vexillum croceum*.
 83. *Buccinum coronatum*.
 84. *Buccinum lineatum*.
 85. *Buccinum tessellatum*.
 86. *Buccinum nux-odorata*.
 87. *Buccinum incisum*.
 88. *Buccinum costatum*.
 89. *Buccinum scabrum*.
 90. {*Buccinum turris picta*.
 Buccinum turris clavata.
 91. {*Buccinum galea variata*.
 Buccinum galea ferrea.
 92. {*Buccinum ornatum*.
 Buccinum luteolum.
 93. {*Buccinum vittatum*.
 Buccinum varium.
 94. {*Buccinum coelatum*.
 Buccinum sinuatum (omitted by Chenu).
 95. {*Bulla circulata*.
 Bulla villosa.
 96. *Cyprea subfuscula*.
 97. *Clava tessellata*.
 98. {*Clava nigra*.
 Clava fusca.
 99. (*Patella*) *scapula*.
 100. *Patella testudineata*.
 101. (*Patella*) *morionis-pileus*.
 102. (*Patella*) *umbella*.
 103. {*Mitra rugata*.
 Mitra denticulata.
 104. {*Mitra staminea*.
 Mitra fasciata.
 105. {*Mitra limosa*.
 Mitra vermiculata.
 106. (*Nerita*) *nux-castanea*.
 107. *Nerita acupictus*.
 108. *Nerita diversicolor*.
 109. {*Nerita pellis-arminiana*.
 Nerita litteris Hebraicis notatus (hebraea*). See note *a*, page 196.

- PLATE 110. { *Nerita stellatus*.
 { *Nerita fasciatus*.
 { *Oliva corticata*.
 { *Oliva striata*.
 { *Oliva interpuncta*.
 { *Oliva fenestrata*.
 { *Purpura scabra*.
 { *Purpura senticosa*.
 { *Purpura tubulata*.
 { *Purpura ramosa*.
 { *Limax aureus*.
 { *(Limax) tiara*.
 { *(Limax) lampas*.
 { *Limax vittatus*.
 { *Limax scaber*.
 { *Limax viperinus (serpens* Chenu)*.

EXPLANATORY TABLE, VOLUME IV.

- PLATE 121. { *Limax spicatus*.
 { *(Limax) fusca spicatus*.
 { *(Limax, nigra spicatus (omitted by Chenu)*.
 { *(Limax) flammeus*.
 { *(Limax) scutulatus*.
 { *Trochus petrosus*.
 { *(Voluta) fagina*.
 { *(Voluta) cosmographicus*.
 { *(Voluta) reticulata*.
 { *(Voluta) undata*.
 { *(Voluta) interpuncta*.
 { *(Voluta) ——— (ducis-navalis*)*.
 { *Voluta scutulata*.
 { *(Voluta) zonaria*.
 { *Cochlea bicolor*.
 { *(Cochlea) nexilis*.
 { *(Cochlea) tigrina*.
 { *(Cochlea) aquosa*.
 { *(Cochlea) crista-galli*.
 { *(Cochlea) histrix*.
 { *Cochlea implexa*.
 { *(Cochlea) purpurea*.
 { *(Cochlea) triangularis*.
 { *(Cochlea) coccinea*.
 { *(Cochlea) dentrachates*.
 { *Cochlea nimbata*.
 { *(Cochlea) marmorata*.
 { *(Cochlea) cretata.^a*
 { *(Cochlea) arborescens*.
 { *(Cochlea) russa.^b*
 { *(Cochlea) palatani*.
 { *Cochlea undata*.
 { *(Cochlea) fumosa*.

^a Marked with chalk. Martyn's English is "Figured cockle."

^b Red or rosy.

- PLATE 140. (*Cochlea*) *nebulosa*.
 141. (*Cochlea*) *castrensis*.
 142. } (*Cochlea*) *virgulata*.
 } (*Cochlea*) *inscripta*.
 143. (*Cochlea*) ——— (*albida**).
 144. (*Cochlea*) *viminea*.
 145. } (*Cochlea*) *acupicta*.
 } (*Cochlea*) *maculosa*.
 146. (*Cochlea*) *columbina*.
 147. (*Cochlea*) *striata*.
 148. (*Cochlea*) *gilva*.
 149. (*Cochlea*) *violacea*.
 150. (*Cochlea*) *personata*.
 151. } *Musc(ulus)* *fuscus*.
 } (*Musculus*) *viridis*.
 152. } (*Musculus*) *viridis undatus*.
 } (*Musculus*) *fuscus undatus*.
 153. } *Pecten rubidus*.
 } (*Pecten*) *bombycinus*.
 154. *Ostria echinata*.
 155. (*Ostria*) *spinosa*.
 156. } *Tellina cinnamar*.
 } (*Tellina*) *subrubicunda*.
 157. } (*Tellina*) *alba*.
 } (*Tellina*) *rosea*.
 158. (*Tellina*) *barbata*.
 159. } (*Tellina*) *subrubicunda radiata*.
 } (*Tellina*) *purpurea radiata*.
 160. } (*Tellina*) *adumbrata*.
 } (*Tellina*) *rubescens*.

The discrepancies between the tables as reprinted exactly above and Chenu's list are so great that it does not seem reasonable to refer them merely to carelessness. In the absence of Chenu's original or a copy of it, and from the fact that the tables as reproduced by me from the Sydney copy are marred by engravers' errors—have two species without any specific name at all, and have thirty-six species with different generic names from those cited by Chenu—I conclude that the Sydney tables are an early issue of engravings which were later corrected and completed, and that it was from one of the altered copies that Chenu's badly printed list was taken, adding a number of errors of its own.

As illustrating engraver's errors in the Sydney tables, I need only mention as misspellings such words as *coocinea* for *coccinea*, *palatam* for *palatum*, and *ostria* for *ostrea*.

Other errors of the engraver consist in reversing the order of words as indicated by the English trivial names, putting the varietal name before the specific name, as *fusca spicatus* and *nigra spicatus* for *spicatus* var. *fusca* and *spicatus* var. *nigra*. In one instance the name intended for the specific name and the descriptive phrase have changed

places in the columns, an error which seems to have been corrected in Chenu's original.^a

One species and one variety are altogether omitted from Chenu's list, and the thirty-two bivalves placed in a genus *Cochlea* by Martyn, in his Volume IV, are listed by Chenu as *Cardium*, though the two *Cochlea* of Volume II remain. The four shells listed by Martyn as *Musculus* (i. e., *Modiolus* Lamarck) have the name *Mytilus* in Chenu's list. These facts point strongly toward a revision by Martyn himself of the original engravings of the tables for Volumes III and IV.

The importance of Volumes III and IV is fortunately confined to the specific nomenclature of the forms figured. Of these but a few are American. One comes from Newfoundland, one from the Straits of Magellan, and the rest of the American forms are from the West Indies. Nearly all of them had been given specific names before Martyn's time, and there are no Pacific coast species among them. Only Volumes I and II, or the first 80 plates (dating from 1784), are important for any generic synonymy. These are also the portions most frequently quoted by Bruguière, Gmelin, Lamarck, Deshayes, and other contemporary or nearly contemporaneous authors.

The present summary will enable those interested to form a correct idea of the earliest issue of Volumes III and IV (1786-87), not seen by me when I prepared my former paper on Martyn and the Universal Conchologist, and to positively confirm the priority of Martyn's names over those of Gmelin, Bruguière, and Lamarck, as indicated by that publication.

^a *Nerita hebræa*, Plate 109, second figure.

BASKETRY BOLO CASE FROM BASILAN ISLAND.

By OTIS T. MASON,

Head Curator, Department of Anthropology, U. S. National Museum.

In the department of anthropology in the United States National Museum is a basketry toilet or bolo case of the Jacanes (Yacanes), an aboriginal tribe living in the interior of Basilan Island, southwest of



FIG. 1.—JACANESE BOLO CASE. FRONT VIEW, SHOWING FOOTING, STAINED, CARVED, AND PIERCED FOR THE INNER BODY TECHNIC; OUTER BODY TECHNIC, WITH HORIZONTAL, VERTICAL, DEXTRAL, AND SINISTRAL WEAVING; AND BORDER, SHOWING HOOP WORK, KNOT WORK, AND BRAID WORK.

Mindanao (Cat. No. 239086, U.S.N.M.). Owing to the slight clothing there needed, it is the custom to suspend the receptacle for odds and ends from the belt universally worn. It has the functions of a

pocket, a scabbard, and a woman's reticule. The Basilan Moros call it see-bah'-kan; the Jacanes, tahn-pee'-pee. When the bolo is in it, the basket is called doo'-hoong. Dimensions: Height, $13\frac{3}{4}$ inches; diameter at the top, 5 inches. Gift of Dr. E. A. Mearns, U. S. Army.

Structural parts.—Bottom; body, in shape of a cavalry legging pinched together at the bottom; border; carrying parts, only a portion of which are present; and ornamentation. The structural parts at once awaken interest through the economics displayed in uniting the greatest capacity and strength with the least weight of the vehicle. (See figs. 1 and 2, showing front and back views of specimen.)



FIG. 2.—JACANESE BOLO CASE. BACK VIEW, SHOWING THE STRENGTHENING STRIPS FOR CARRYING AND THE METHOD OF ATTACHING BY MEANS OF MALAY KNOTS.

Technic.—Its technical processes are as follows: The bottom is worked from soft wood and is divided into quite distinct portions, the outer and the inner. The former is the footing—keel-shaped, parallel-sided, and rudely carved in front. The inside portion, acting as a lining to the bottom, is in shape of a long, elliptical dish, to serve as a rest for the weapons and other belongings (fig. 3). The furrow between these parts receives the textile elements of the inner basket.

The technic of the body is in uniform, rigid splits of bamboo, in two series—the inner, one-quarter of an inch; the outer, one-half an inch wide. These are woven in four directions—horizontal, dextral, sinistral, and vertical. The inner series are the foundation, and are in

hexagonal weaving (fig. 3). The dextral and the sinistral elements are drawn through holes in the upper border of the footing, and the meshes are each large enough to allow the passage of six elements of the outer basket, two from each of the three directions—vertical, right, and left (fig. 4). Just above these holes in the footing the first horizontal split of the inner basket, or foundation, serves as a starting point of the outer basket (fig. 3). The bamboo splits of the outer series are doubled about this one, half of each split passing up vertically and the other half either to the right or to the left, and all woven in and out through the hexagonal meshes (fig. 4). The effect of this double weaving is to produce an almost compact technic, with the splits of the inner basket nearly concealed.

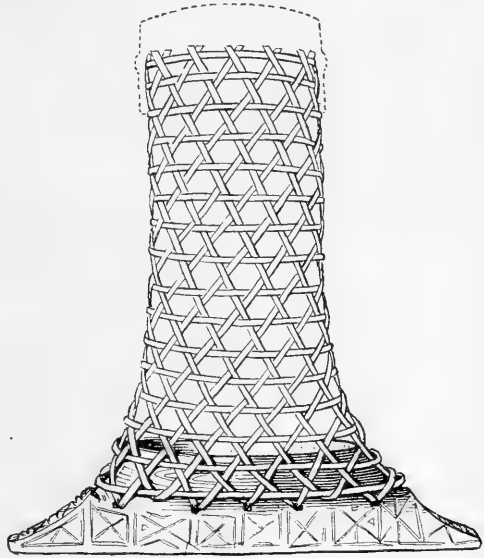


FIG. 3.—INSIDE OF JACANESE BOLO CASE, SHOWING HEXAGON WEAVE, THE METHOD OF ITS ATTACHMENT, AND THE DOUBLE FUNCTION OF THE FOOTING.

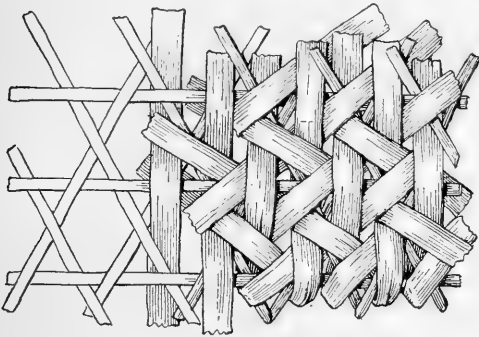


FIG. 4.—OUTER TECHNIC OF JACANESE BOLO CASE, SHOWING HOW THE ELEMENTS ARE BENT, INCLINED, AND ATTACHED TO THE HEXAGONAL WEAVING. NOTE SPECIALLY HOW THE SPLITS GO IN PAIRS, THE FLUKES ALTERNATELY DIVERGING RIGHT AND LEFT, AS IN AN ANCHOR, THEN CROSSING EACH OTHER.

The technic of the border is the most interesting of all, owing to its complexity (figs. 1, 2, and 5). It is founded on hoops and is in two sections, the upper and the lower. The former is of flat hoops surmounted by a smaller round hoop, the inner ones being covered in lace work of rattan splits (fig. 5, *a* and *b*). These laced hoops are fitted on the top of the body and fastened, as follows, by what constitutes the second por-

tion of the border: Stout hoops form the inwale and the outwale of this portion, and three series of Malay knots unite them with the

lower hoop of the laced work and with the upper edge of the body work, at the same time forming a band of simple sennit braid work on the outside (fig. 5, *c-c*). This is a remarkable example of joining Malay knot work and weaving, for the purpose of hiding the unsightly turning down of ends at the top of the body.

The carrying parts present are two strong half stems of rattan laid on the back of the body outside, a little farther apart at the bottom, and held fast by a series of Malay knots about 2 inches apart. The ends of the carrying parts are tucked in at top and bottom. (See fig. 2.)

For want of a better name the term "Malay knot" is used here for the universal appliance to bind several parts together. It is a combination of two round turns and two half hitches in splits or tough

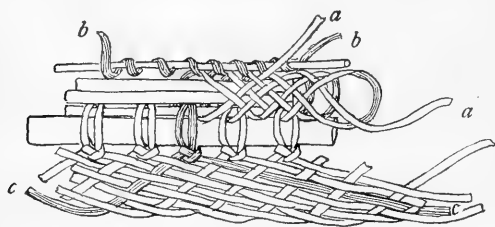


FIG. 5.—BORDER OF JAVANESE POLO CASE, SHOWING HOOP WORK AND LACE WORK (*a* and *b*), KNOT WORK AND BRAID WORK (*c*).

and pliable stems. To tie the knot, (1) pass the free end of the material to the right as far as the place where the knot is to be tied; (2) under and around the parts and back of the standing part; (3) pass the free end around in the same direction and to the left of the first round turn, bringing it in front of the standing part and then under all and forward, moving toward the right; (4) take a half hitch around the standing part from down upward and make all tight. Repeat at will, always working toward the right.

The ornamentation of the basket is in the technic, in carving and staining, and in smoking or charring—the last two processes on the front only. The footing is stained black in front and carved with very simple geometric patterns. The weaving of the body is smoked so as to present an X-shaped design in natural color, effected by laying two palm leaflets crossed on the surface while the coloring was going on. The upper outer edge of the braid work on the border has a decoration added in the shape of a little hoop joined on by overwhipping in fine split.

DESCRIPTIONS OF NEW NORTH AMERICAN TINEID MOTHS, WITH A GENERIC TABLE OF THE FAMILY BLASTOBASIDÆ.

By LORD WALSLINGHAM,

Merton Hall, Thetford, England.

INTRODUCTION.

Several papers were published under the title "Steps Toward a Revision of Chambers Index; With Notes and Descriptions of New Species" in *Insect Life*,^a a journal published by the U. S. Department of Agriculture from 1888 to 1895. The object was the gradual improvement of the catalogue of North American Tineid moths by the publication of descriptions of new species and corrections of the generic locations of old ones. The standard catalogue of North American Tineidæ at the time these papers were begun was published by V. T. Chambers under the title "Index to the Described Tineina of the United States and Canada" in the *Bulletin of U. S. Geological and Geographical Survey*, IV, No. 1, 1878. During the sixteen years that have elapsed since the last installment of these papers was printed, the journal *Insect Life* has been suspended, but the series is herewith continued under a more explanatory title.

The material on which these descriptions are based was in part received by the U. S. National Museum from the U. S. Department of Agriculture through the late Dr. C. V. Riley, and in part is contained in the author's collection. Types of the new species are in the collection of the U. S. National Museum in most cases, as indicated by the type numbers, some from the museum material and some donated by the author.

Family GELECHIADÆ.

GELECHIA LAUDATELLA, new species.

Antennæ white, annulated with brownish fuscous, the basal joint having a wider white ring than those beyond it.

Palpi white, both joints brownish fuscous at the base, terminal joint tipped with brownish fuscous.

^a The last paper of this series appeared in *Insect Life*, III, 1891, p. 389.

Head and thorax white, the latter dusted with brownish fuscous scales.

Forewings white, the base of the costa and the extreme base of the dorsum brownish fuscous; an elongate brownish fuscous spot lies above the middle of the wing between and projecting farther than the brown above and below it; a large brownish fuscous patch begins at the basal fourth of the costa, its inner edge sloping obliquely toward, but not attaining, the middle of the dorsum; beyond its lower point it is indented upward to the middle of the wing and thence continued to the apical fourth, where its straight outer edge is margined by a narrow band of white; the apical portion of the wing, together with the grayish white cilia, is dusted and clouded with brown, and at the base of the cilia, beyond the middle of the dorsum, are a few brownish fuscous scales.

Alar expanse.—10.5 mm.

Hindwings pale gray; cilia faintly tinged with ochreous.

Abdomen grayish ochreous.

Legs, hind tibiae whitish ochreous, the tarsal joints smeared above.

Type.—Female, Cat. No. 10677, U.S.N.M.; No. 142, Riley, 1886; No. 842, Walsingham, 1886.

Habitat.—Folsom, California, July 1, 1885 (A. Koebele, collector).

This species appears to be allied to the group of *fraternella* Douglass.

GELECHIA SUBTRACTELLA Walker.

Gelechia subtractella WALKER, Cat. Lep. Brit. Mus., Pt. 39, p. 592, No. 229, 1864.—RILEY in Smith's List Lep. Bor. Am., 1891, p. 102, No. 5487.

Blastobasis subtractella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 528, No. 5969.

Type.—Female in the British Museum.

Habitat.—Nova Scotia.

An old note of mine, made many years ago, "*Blastobasis* ? Wlsm. MS. 190:1892," is probably responsible for the removal of this species from *Gelechia* to *Blastobasis* in Dyar's Catalogue, but a subsequent note reads as follows: "This is a *Gelechiad*; a wretched object, unset and much worn. Palpi rather rough beneath, terminal joint a little shorter than median. Neuration and width of wing impossible to arrive at. I should call it an obscurely marked *Lita*, much mottled with subferruginous spots on middle of fold, at end of cell and near apex, also perhaps at end of fold; but these are scarcely distinguishable from the fuscous sprinkling and shading which covers the apparently paler wing-surface (much worn)." Until further evidence is forthcoming this must remain as an unrecognized *Gelechia*.

Family CECOPHORIDÆ.

Genus ETHMIA Hübner.

ETHMIA ALBITOGATA, new species.

Antennæ fuscous.

Palpi blackish, with a few white scales beneath, at the base and about the apex of the median joint; terminal joint erect, slightly recurved, somewhat shorter than is usual in the genus.

Head and *thorax* dull fuscous, the ends of the tegulæ whitish.

Forewings elongate, narrow, rounded at the apex, termen oblique, slightly convex; white, densely suffused with brownish fuscous which forms an obtuse angle on the outer half of the fold, receding very obliquely toward the basal and apical portions of the costa; a spot of the same color is conspicuous immediately above the tornus, running obliquely inward, and a smaller spot lies immediately below and adjacent to the fold near the base; the extreme costa is whitish and the darker markings here mentioned are rendered more conspicuous in the paler or less-suffused varieties, while in others they become less noticeable through the more complete shading of the general surface of the wing; cilia whitish, more or less suffused with brownish fuscous, but usually with a small white spot on the upper half of the termen below the apex; underside pale brownish fuscous, the costa and dorsum and the subapical spot in the cilia showing some white scaling.

Alar expanse.—16 mm.

Hindwings white, slightly shining, the apical fourth brownish fuscous; cilia white, with a narrow basal band of brownish fuscous coinciding with the darkened portion of the wing; underside white, with a small fuscous shade at the apex.

Abdomen brownish fuscous.

Legs whitish, much shaded with brownish fuscous; some projecting white hairs from the end of the posterior tibiæ.

Type.—Male, No. 101552, collection Walsingham; paratype male, Cat. No. 10346, U.S.N.M. (Walsingham determined, No. 823, 1906).

Habitat.—California (Zeller coll., Mus. Walsingham; Beutenmüller coll., U.S.N.M.). Two specimens.

Family BLASTOBASIDÆ.

Blastobasidæ MEYRICK, Trans. Ent. Soc. Lond., 1894, p. 22.

SYNOPTIC TABLE OF GENERA.

1,	{Hindwings with vein 4 absent.....	2
	{Hindwings with vein 4 present.....	11
2	{Antennæ with pecten.....	4
	{Antennæ without pecten (male without notch).....	3

- | | | | |
|----|---|---|----|
| 3 | { | Forewings: vein 7 to termen. <i>Arctoscelis</i> Meyrick. (Type, <i>epinyctia</i> Meyrick.) | |
| | { | Forewings: 7 to costa. <i>Endrosis</i> Hubner. (Type, <i>lactella</i> Schifferrmüller.) | |
| 4 | { | Hindwings: vein 5 remote from (3+4). <i>Agnosia</i> Walsingham. (Type, <i>evanesens</i> Walsingham.) | |
| | { | Hindwings: 5 and (3+4) connate or stalked. | 5 |
| 5 | { | Antennæ notched in male. <i>Blastobasis</i> Zeller. (Type, <i>phycidella</i> Zeller.) | |
| | { | Antennæ not notched. | 6 |
| 6 | { | Antennæ of male bifasciculate 3, attenuate at joint 4. <i>Epistetus</i> Walsingham. (Type, <i>divisus</i> Walsingham.) | |
| | { | Antennæ simple. | 7 |
| | { | Forewings: 4 and 5 stalked. | 8 |
| 7 | { | Forewings: 4 and 5 not stalked. <i>Dryope</i> Chambers. (Type, <i>ochrocomella</i> Clemens.) | |
| 8 | { | Forewings: 9 out of stalk of 7 and 8. <i>Pseudopigritia</i> Dietz. (Type, <i>dorsomaculella</i> Dietz.) | |
| | { | Forewings: 9 separate. | 9 |
| | { | Labial palpi minute. | 10 |
| 9 | { | Labial palpi of moderate length; sexually dimorphic. <i>Plocophora</i> Dietz. (Type, <i>fidella</i> Dietz.) | |
| | { | Labial palpi very small and indistinct in both sexes. <i>Epigritia</i> Dietz. (Type, <i>pallidotinctella</i> Dietz.) | |
| 10 | { | Labial palpi very short and rudimentary in male; distinct with terminal joint pointed in female. <i>Pigritia</i> Clemens. (Type, <i>laticapitella</i> Clemens.) | |
| 11 | { | Hindwings: 4 and 5 stalked. | 12 |
| | { | Hindwings: 4 and 5 connate, or stalked. | 14 |
| 12 | { | Hindwings: 4 and 5 stalked out of 3. <i>Aurimobasis</i> Walsingham. (Type, <i>persimilella</i> Walsingham.) | |
| | { | Hindwings: 3 separate. | 13 |
| | { | Antennæ notched in male. <i>Valentinia</i> Walsingham. (Type, <i>glandulella</i> Riley.) | |
| 13 | { | Antennæ not notched. <i>I-onisma</i> , Walsingham. (Type, <i>macrocera</i> Walsingham.) | |
| 14 | { | Hindwings: 5 out of stalk of 3 and 4. | 15 |
| | { | Hindwings: 5 separate (from 3 and 4 connate, or stalked). | 17 |
| | { | Antennæ notched in male. <i>Holcocera</i> Clemens. (Type, <i>chalcifrontella</i> Clemens.) | |
| 15 | { | Antennæ not notched. | 16 |
| | { | Antennæ of male bifasciculate. <i>Prosodica</i> Walsingham. (Type, <i>nephelia</i> Walsingham.) | |
| 16 | { | Antennæ not bifasciculate, slightly dentate. <i>Catacypsis</i> Walsingham. (Type, <i>nucella</i> Walsingham.) | |
| 17 | { | Antennæ notched in male. <i>Cynotes</i> Walsingham. (Type, <i>iceryacella</i> Riley.) | |
| | { | Antennæ not notched. <i>Hypatopa</i> Walsingham. (Type, <i>innuctella</i> Zeller.) | |

The stigma^a is absent from *Endrosis* and perhaps, also, from *Arctoscelis*, with which I am unacquainted.

Genus VALENTINIA, new genus.

Type of the genus.—*Gelechia glandulella* Riley.

Antennæ of male notched immediately beyond the basal joint, which is flattened and slightly concave beneath; with a pecten.

Maxillary palpi short, dependent.

Labial palpi smooth, recurved; the terminal joint shorter than the median and scarcely more slender.

Haustellum moderate.

^a Zeller, Hor. Soc. Ent. Ross., XIII, 1877, pp. 429–430.

Head and thorax smooth.

Forewings elongate-lanceolate, with straightened costa and depressed apex.

Neuration 12 veins; 7 and 8 stalked, 7 to costa; rest separate.

Hindwings with flexus well developed, cilia $1\frac{1}{2}$.

Neuration 8 veins; 3 separate, 4 and 5 stalked; 6 and 7 separate.

Abdomen somewhat flattened.

Legs, hind tibiæ hairy above.

I have named this genus in honor of my late friend Charles Valentine Riley, who described the type.

VALENTINIA GLANDULELLA Riley.

Gelechia glandulella RILEY, Can. Ent., III, 1871, pp. 118–119.

Holcocera glandulella RILEY, Rept. Inj. Ins. Mo., IV, 1872, pp. 144–145, figs.

66 a–g.—DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5979.

Blastobasis nubilella ZELLER, Verh. zool.-bot. Ges. Wien., XXIII, 1873, p. 297, pl. iv, fig. 36.

Holcocera nubilella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5980.

Holcocera triangularisella CHAMBERS, Cinn. Quart. Journ. Sci., II, 1875, p. 256;

Can. Ent., IX, 1877, p. 72.—DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5981.

Habitat.—Atlantic States; Texas; Kentucky; Massachusetts, Cambridge (Zeller Coll., Frey Coll.); North Carolina (Morrison, collector, 1883); California, Lake County, Blue Lake, June 15, 1871 (Walsingham).

Chambers^a regarded *nubilella* Zeller, *triangularisella* Chambers, and *sciaphilella* Zeller as varieties of *glandulella* Riley and quotes Riley as having the same opinion. We may therefore accept their opinion that *glandulella* Riley = *triangularisella* Chambers. Mr. Busck informs me that “the unique type ♀ of *nubilella* Z. in Cambridge is = *glandulella*,” but that “the unique type ♂ of *sciaphilella*, Z. in Cambridge is a true *Blastobasis*, Z. with seven veins in hindwing only.” Chambers’s figure of the neuration of *glandulella*^b is incorrect.

VALENTINIA RETECTELLA Zeller.

Blastobasis retectella ZELLER, Verh. zool.-bot. Ges. Wien, XXIII, 1873, p. 297.—

CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 132.—RILEY, Smith’s list Lep. Bor. Am., 1891, p. 104, No. 5575.

Holcocera retectella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5978.

Type.—Female, No. 101611, Mus. Walsingham.

Habitat.—Bosque County, Texas, August 29 (Belfrage, collector).

I have a second specimen (female, No. 33097, Mus. Walsingham), also collected by Belfrage, dated September 2, 1876.

^a Can. Ent., IX, 1877, p. 72.

^b Trans. Cin. Soc. Nat. His., II, 1880, p. 203, fig. 24.

VALENTINIA FRACTILINEA Zeller.

Blastobasis fractilinea ZELLER, Verh. zool.-bot. Ges. Wien, XXIII, 1873, p. 298, pl. IV, figs. 37 a-b.

Holococera fractilinea DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5984.

Type.—Male, No. 101612, Mus. Walsingham; paratype, male, No. 101613, Mus. Walsingham.

Habitat.—Bosque County, Texas, August 1-19 (Belfrage, collector).

VALENTINIA NOTHROTES, new species.

Antennæ pale slaty brownish.

Palpi grayish brown, with whitish sprinkling.

Head and thorax whitish, with grayish fuscous speckling, especially in a band across the front of the thorax and another across the posterior half of the tegulæ.

Forewings dirty white, profusely sprinkled with grayish fuscous, of which a transverse fascia crosses the wing at one-third; this is slightly angulated outward in the middle, and partially diffused outward at the middle and about the costa; at the end of the cell a somewhat less defined, straight, transverse fascia occurs, absorbing the two spots which would otherwise appear at the end of the cell, corresponding to a small discal spot at about the middle of the wing; the apical area is thickly bestrewn and mottled with grayish fuscous; cilia brownish gray, sprinkled with whitish and grayish fuscous atoms.

Alar expanse.—12 mm.

Hindwings brownish gray; cilia slightly paler.

Abdomen slaty gray, anal tuft paler.

Legs pale brownish gray.

Type.—Male, No. 35536, Mus. Walsingham.

Habitat.—Arizona, 1883 (Morrison, collector). Unique.

A small and narrow-winged species, somewhat similar in markings to *retectella* Zeller, with which it agrees in having a strong notch and pecten on the antennæ, and 4 and 5 of the hindwings stalked, but is quite distinct in size and shape.

Genus BLASTOBASIS Zeller.

BLASTOBASIS(?) CITRICOLELLA Chambers.

Blastobasis citricolella CHAMBERS, Rept. U. S. Dept. Agric., for 1879, 1880, p. 207.—

COMSTOCK, Rept. U. S. Dept. Agr., for 1879, 1880, pp. 206-7.—HY. EDWARDS, Bull. U. S. Nat. Mus., No. 35, 1889, p. 125.—RILEY, Smith's List Lep. Bor.

Am., 1891, p. 104, No. 5561.

Blastobasis citriella CHAMBERS, Rept. U. S. Dept. Agr., for 1879, 1880, p. 245.

Antennæ with strong flattened tuft beneath basal joint (not a bristly pecten, but closely packed curved scales as in *Auximobasis*); whitish cinereous.

Palpi slightly recurved, divergent, reaching well beyond the head; terminal joint more than two-thirds the length of median; whitish, speckled with fawn brown.

Head smooth; white, slightly sprinkled with brownish gray.

Thorax brownish gray above, tegulæ whitish, sprinkled with brownish gray.

Forewings with 12 veins, 7 and 8 stalked; white, suffused and sprinkled with brownish fuscous intermixed with pale fawn brown; the markings, so far as the darker shading of these colors indicates them, tend to be longitudinal and consist of a strong line along the fold from near the base, almost joining a spot in the fold above the middle of the dorsum, below the fold the base is suffused; a shorter line on the disc, above the fold, runs parallel to the upper half of the plical line, and above it, below the costa, as well as beyond it on the outer half of the disc are sundry mottlings of the same mixed color; two spots, obscurely indicated at the upper and lower angles of the cell, the lower one a little beyond the upper; an ill-defined oblique streak at four-fifths precedes a broken antemarginal shade, which, leaving the costa at the commencement of the cilia, strikes outward to the apex and reverts at an angle along the termen, the dorsal space behind its lower extremity being much shaded; cilia whitish, much speckled and shaded with pale brownish fuscous, which has a tendency to form slender parallel lines through them, but fading out towards the tornus.

Alar expanse.—19 mm.

Hindwings (detached) 7 veins, 3 and 4 coincident; 5 closely approximated to (3+4) at origin, 6 and 7 parallel; shining, pale-brownish gray; cilia dull-brownish gray.

Legs (missing).

Type.—Female, Cat. No. 3774 U.S.N.M.; Walsingham determined, No. 3688, 1898.

Habitat.—Jacksonville, Florida. Larva in dry orange infested by beetle (*Aræocerus fasciculatus*); issued, March 17, 1880. Unique.

The type, a female, consists of thorax and head, left forewing (torn), right hindwing (broken), and left antenna. The palpi are broken and the abdomen is missing as also the right forewing and left hindwing. It is probably a *Blastobasis* Zeller, but this can not be decided from a female.

This species is omitted from Dyar's List of North American Lepidoptera.

BLASTOBASIS?, new species.

Blastobasis, new species [RILEY and HOWARD], U. S. Dept. Agr. Ent. Bull., Ins. Life, IV (1892), p. 290.

Habitat.—Australia. Larva on *Chionaspis* on orange (sent to Washington by Koebele).

BLASTOBASIS COCCIVORELLA Chambers.

Blastobasis coccivorella CHAMBERS, Rept. U. S. Dept. Agr., for 1879, 1880, pp. 207, 245.—COMSTOCK, Rept. U. S. Dept. Agr., for 1879, 1880, p. 244.—PACKARD, U. S. Dept. Agr., Intr. Ent. Comm. Bull., No. 7, 1881, p. 54.—DOUGLASS, Ent. Mo. Mag., XXIV, 1888, p. 228.—HY. EDWARDS, Bull. U. S. Nat. Mus., No. 35, 1889, p. 125.—PACKARD, U. S. Dept. Agr., Rept. Ent. Comm., V, 1890, p. 219.—RILEY, Smith's List Lep. Bor. Am., 1891, p. 104, No. 5562.

Type.—A female.

Habitat.—Cedar Keys, Florida. Larva in Coccid-scales on oak (*Kermes*, species, near *pallidus* Réaumur). Collected in March; issued between April 1–10. This species is omitted from Dyar's List. If the type is still extant^a there should be no difficulty in placing it in its proper genus. Chambers's reference to the neuration is doubtless incorrect.

Genus **HOLCOCERA** Clemens.**HOLCOCERA NIGROSTRIATA**, new species.

Antennæ yellowish; basal joint considerably widened, with strong pecten, dirty whitish.

Palpi white, sprinkled with blackish scales, very densely on the outer sides.

Head and *thorax* white, sprinkled with blackish scales.

Forewings white, much sprinkled and striated with blackish scales; an elongate patch of these scales extends from the base along the fold to about one-sixth, and is diffused downward to the flexus; a narrower streak from the base near the costa extends to a little beyond one-third, running parallel with the costa, but not touching it; beyond this, and a little further removed from the costa, a shorter but darker streak follows the upper edge of the cell to its outer extremity; two other streaks, commencing rather nearer to the base, are situated on the cell and on the fold, respectively, while there is an indication of two dark dots at the end of the cell, scarcely more conspicuous than the blackish dusting which is generally distributed around them, and especially along the margins to the apex; cilia pale yellowish brown, speckled with white and fuscous.

Alar expanse.—13 mm.

^a The type is lost.—Harrison G. Dyar.

Hindwings shining, pale brownish gray; cilia yellowish.

Abdomen whitish, with transverse fuscous lines.

Legs whitish.

Type.—Female, No. 35531 Mus. Walsingham; paratype female Cat. No. 10672, U.S.N.M.

Habitat.—Arizona, 1883 (Morrison, collector). Two specimens.

This species can only be compared with *gigantella* Chambers, from which its much smaller size at once distinguishes it; it also lacks the radiating lines towards the apex of the wing. The male is unknown, but *nigrostriata* is doubtless more correctly referred to *Holcocera* than to *Catacrypsis*.

HOLCOCERA APHIDIELLA, new species.

Blastobasis aphidiella RILEY, Ann. Rept. U. S. Dept. Agr. for 1886, 1887, p. 485.

Riley's merely logonymic reference to this species is as follows:

"*Blastobasis aphidiella*, Riley MS., we have reared from larvæ feeding on the contents of *Phylloxera* hickory galls."^a

Antennæ strongly notched beyond the basal joint, the basal extremity of the notch very plainly indicated by a truncate patch of scales from the lower margin of which the slender bent stem continues; beyond this they are biciliate $\frac{3}{4}$; basal joint with a strong scale-pecten; tawny gray.

Palpi slender, pointed, slightly recurved, reaching beyond the basal joint of the antennæ, the terminal joint nearly as long as the median; brownish cinereous, the median joint darkened externally.

Head and *thorax* with an iridescent greenish luster; tegulæ tipped with cupreous.

Forewings with 12 veins, 7 and 8 stalked, 7 to costa; tawny reddish gray; a darker discal spot, a little beyond one-third, is succeeded by a larger spot (or confluent pair of spots) at the end of the cell, below which the outer extremity of the fold is also dark-shaded; cilia brownish cinereous; underside not iridescent.

Alar expanse.—17 mm.

Hindwings with 8 veins, 5 out of the stalk of (3+4); rather shining, brownish gray with greenish and cupreous iridescence toward the base; cilia brownish cinereous, with a slight ochreous tinge; underside decidedly iridescent.

Abdomen brownish cinereous.

Legs brownish cinereous.

Type.—Male, Cat. No. 10676, U.S.N.M., Walsingham determined, No. 3689, 1899 ("31. Unique; not named in Europe, 1884, 1886."—Riley).

^a Ann. Rept. U. S. Dept. Agr. for 1886, 1887, p. 485.

Habitat.—United States (probably Washington City). Pupa in gall of *Phylloxera* on *Carya alba*, October, 1882, issued May 12, 1883. Unique. This species is most nearly allied to *quisquiliella* Zeller.

CATACRYPSIS,^a new genus.

Type of the genus.—*Catacrypsis nucella* Walsingham.

Antennæ without a notch in the male; basal joint with pecten, slightly dilated and curved; not ciliate, slightly dentate on the outer half.

Maxillary palpi moderate.

Labial palpi somewhat recurved, reaching above the vertex.

Haustellum clothed.

Head and *thorax* smooth.

Forewings narrow at the base, widening outward.

Neuration 12 veins; 7 and 8 stalked, 7 to costa; 3 and 4 connate, or closely approximate.

Hindwings rather broadly ovate, at least as broad as the forewings; flexus somewhat angular.

Neuration 8 veins; 3 and 4 stalked, 5 connate, with or out of (3+4); 6 and 7 separate, nearly parallel.

Abdomen somewhat flattened.

Legs, hind tibiæ hairy, tarsi smooth.

Closely allied to *Holcocera* Clemens, but without the notch in the antennæ of the male.

CATACRYPSIS NUCELLA, new species.

Antennæ brownish fuscous; basal joint yellowish brown.

Palpi yellowish brown, shaded with brownish fuscous externally.

Head and *thorax* yellowish brown.

Forewings, male, yellowish brown, more or less suffused with purplish fuscous, especially along the costa and on the outer portion of the wing, an outwardly-bowed transverse shade of the same indicated at one-third from the base; at the end of the cell is a reduplicated fuscous spot; cilia pale yellowish brown; female with the fuscous shading having a purplish tinge, and being very much thicker and more generally distributed than in the male (in some male specimens the suffusion is almost entirely absent), the basal third of the wing and a patch at the lower extremity of the cell alone exhibiting the paler ground color.

Alar expanse.—16–18 mm.

Hindwings pale brownish gray; cilia yellowish brown.

Abdomen and *legs* pale brownish ochreous.

Type.—Male, No. 30646; female, No. 30647, Mus. Walsingham; paratypes, male and female, Cat. No. 10670, U.S.N.M.

^a From the Greek word *κατάκρυψις*, signifying occultation.

Habitat.—Colorado, Loveland, 5,000 feet, July, 1891; September, 1891 (W. G. Smith, collector). Thirty specimens.

This species could only be compared with *Holcocera purpurocomella* Clemens, of which I have only a single female, and if Clemens rightly referred his species to the genus *Holcocera* they are of course structurally distinct, but apart from this I can not regard them as identical.

CATACRYPSIS STYGNA, new species.

Antennæ pectinate, but not notched; purplish gray.

Palpi purplish gray.

Head and *thorax* purplish gray, the tegulæ with a distinct coppery tinge.

Forewings tawny vinous gray, a purplish sheen strongly expressed at the base of the costa, the middle and outer half of the costa slightly darker than the remainder of the wing; the commencement of this dark shading extends across the wing to the dorsum, leaving the preceding space outwardly angulate at the middle and of a paler or more grayish shade; a reduplicated shade-spot at the outer end of the cell is very obscurely indicated; cilia brownish gray, with a slight tawny suffusion.

Alar expanse.—18 mm.

Hindwings brownish gray; cilia pale buff-brownish.

Abdomen (missing).

Legs brownish gray, with broad tawny tarsal bands.

Type.—Male, No. 90425, Mus. Walsingham.

Habitat.—Mendocino County, north of Mendocino City, California (close to the town), June 3–5, 1871 (Walsingham, collector). Unique.

Very similar in appearance to *Holcocera purpurocomella* Clemens, but differing in the absence of the notch in the antennæ.

CATACRYPSIS URSELLA, new species.

Antennæ with pecten, but without notch; pale brownish ochreous.

Palpi brownish gray externally, dirty whitish on their inner sides.

Head and *thorax* bone-whitish, the latter tinged with brownish gray anteriorly.

Forewings bone-white, much suffused and sprinkled with brownish gray, overclouding the costa as well as the apical area beyond the cell, but less profusely along the dorsum and scarcely at all along the disc; a faintly indicated narrow brownish gray fascia seems to leave the costa at one-third from the base, and, after interruption on the cell, is bent inward from the fold to the dorsum at one-fourth; this is somewhat accentuated in the fold, where it probably absorbs a small darker spot, corresponding to, but preceding, a larger brownish fuscous discal spot about the middle of the wing; two smaller darker spots are indicated at the end of the cell, and one at the lower edge of

the cell equidistant between the inner and outer discal spots; the apex is slightly mottled, the cilia pale brownish gray.

Alar expanse.—18 mm.

Hindwings pale gray, with a slight brownish tinge; cilia pale brownish ochreous.

Abdomen grayish.

Legs pale brownish ochreous.

Type.—Male, No. 90438, Mus. Walsingham.

Habitat.—Shasta County, Bear Creek, California, July 27–28. 1871 (Walsingham, collector). Unique.

The species is larger than *inconspicua* and more marked; the general pattern much as usual in this group, but the difference of structure renders it easily distinguishable from *Valentinia glandulella* Riley, *Holcocera chalcofrontella* Clemens, or *Hypatopa texanella* Walsingham.

CATACRYPSIS IRENICA, new species.

Antennæ, female, brownish gray; basal joint with strong pecten, paler.

Palpi grayish white, median joint grayish brown externally nearly to its apex; terminal joint also sprinkled with grayish brown.

Head and *thorax* whitish, slightly sprinkled with brownish gray.

Forewings grayish white, with brown-gray sprinkling, especially on the outer two-thirds of the costa and on the dorsal and apical portions of the wing; a patch of this at the base of the costa, mixed with some ferruginous scales; a similar patch before the middle of the costa exhibiting more of the ferruginous coloring, which is diffused downward to the fold, touching the inner extremity of an elongate-ovate blackish-brown discal spot, beyond which, at the end of the cell, are two smaller spots of the same color, which is also faintly reproduced in a diffused patch or cloud on the dorsum beneath them and on the costa beyond them; cilia hoary grayish.

Alar expanse.—20 mm.

Hindwings shining, yellowish gray, with pale brownish ochreous cilia.

Abdomen whitish gray.

Legs whitish, shaded with brownish gray on their outer sides.

Type.—Female, No. 90429, Mus. Walsingham.

Habitat.—Mendocino County, mouth of Albion River, California, May 30–31, 1871 (Walsingham, collector); British Columbia, New Westminster, June 13, 1900 (C. W. Durrant, collector). Two specimens.

CATACRYPSIS INCONSPICUA, new species.

Antennæ pale grayish brown.

Palpi grayish brown, darkened externally.

Head and *thorax* grayish brown.

Forewings grayish brown through a profuse dusting, amounting to an almost entire suffusion of this color upon a pale cinereous ground; the only marking indicated is a slight and obscure transverse shade at two-fifths from the base and a reduplicated brownish fuscous spot at the end of the cell; cilia pale grayish brown.

Alar expanse.—13–14 mm.

Hindwings shining, purplish gray; cilia yellowish brown.

Abdomen shining, brownish gray.

Legs pale yellowish brown.

Type.—Male, No. 90433, Mus. Walsingham; paratype male, Cat. No. 10669 U.S.N.M.

Habitat.—Shasta County (Hatchet Creek), California, July 14–17, 1871 (Walsingham, collector.) Five specimens.

CATACRYPSIS FLUXELLA Zeller.

Blastobasis (?) *fluxella* ZELLER, Verh. zool.-bot. Ges. Wien, XXIII, 1873, pp. 301–302.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 131.—RILEY, Smith List Lep. Bor. Am., 1891, p. 104, No. 5565.

Holcocera fluxella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5971.

Type.—Male, Museum of Comparative Zoology, Cambridge, Massachusetts.

Habitat.—Bosque County, Texas, October 11, 1876 (Belfrage, collector).

Zeller described this species from a single male without notched antennæ, and with broader hindwings and palpi three or four times as long as those of *aufugella* Zeller.

B. (?) *fluxella* can not therefore be referred to either *Holcocera* or *Pigritia*. I have a single male (33096), collected by Belfrage in Texas, which exactly agrees with Zeller's description, and having vein 5 of the hindwings out of the stalk of 3 and 4 proves the species to belong to *Catacrypsis*.

CATACRYPSIS MORRISONI, new species.

Antennæ with moderate pecten; pale brownish ochereous.

Palpi brownish ochereous.

Head and *thorax* grayish brown, with paler speckling.

Forewings rather narrow, elongate, not widening outwardly; bone-white, with grayish brown suffusion, especially around the margins; a brownish shade at the base of the costa, a darker streak in the basal third of the fold, diffused and diluted to the flexus; beneath it a triangular brownish fuscous dorsal patch, arising a little before the middle, directed obliquely outward and ending obtusely on the cell at about half the wing length; beyond it a pair of brownish fuscous spots at the end of the cell and a few ill-defined similar spots around the apex and termen; cilia grayish brown.

Alar expanse.—17 mm.

Hindwings shining, pale brownish gray; cilia pale brownish ocherous.

Abdomen and *legs* pale brownish ocherous.

Type.—Male, No. 35527, Mus. Walsingham.

Habitat.—Arizona, 1882 (Morrison, collector). Unique.

A narrow-winged species, differing much in appearance from any already described, and quite unlike such exponents of allied genera as I have before me.

CYNOTES, new genus.

Type of genus.—*Blastobasis iceryaeella* Riley.

Antennæ not more than $\frac{2}{3}$; basal joint slightly dilated, curved, hollowed beneath, with a strong pecten consisting of thick scale clothing; a distinct deeply excised notch beyond it; beyond this the antennæ are biciliate, the ciliations diminishing in length outwardly.

Maxillary palpi meeting above the base of the haustellum.

Labial palpi recurved, reaching above the base of the antennæ.

Haustrum moderate, clothed.

Head thickly clothed, moderately broad, a fringe of long diverging hair scales beneath the eye.

Thorax smooth.

Forewings elongate, widening outwardly.

Neuration, 12 veins; 7 and 8 stalked, 7 to costa; rest separate.

Hindwings at least as wide toward their base as the outer half of the forewing; flexus angulate; apex obtusely rounded.

Neuration, 8 veins; 3 and 4 connate; 5 separate; 6 and 7 separate.

Abdomen rather short, flattened.

Legs stout, hind tibiae and tarsi clothed with hair-scales, the tarsi less conspicuously.

Allied to *Hypatopa*, from which it differs in the notched antennæ of the male.

CYNOTES ICERYAEELLA Riley.

Blastobasis iceryaeella RILEY, Ann. Rept. U. S. Dept. Agr. for 1886, 1887, pp. 484-485, 485-486; same for 1888, 1889, p. 86; Ins. Life, I, 1888, p. 130; Smith's List Lep. Bor. Am., 1891, p. 104, No. 5569.

Holcocera iceryaeella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 529, No. 5974.

Type.—A male and a female, Cat. No. 473, U.S.N.M.

Doctor Dyar evidently regards this species as an importation from Australia, but we still lack exact information, for Doctor Riley omitted to furnish any data when describing the species. Through the kindness of Doctor Howard I received some of Coquillett's specimens labeled "Pupa on orange." These may have been imported, but they can not affect the fact that my collector, the late Thomas Eedle,

while waiting for me to start on my collecting trip in California and Oregon, took a single specimen (No. 90428) at Sacramento between April 24 and May 16, 1871.

Genus *HYPATOPA*, new name.

Hypatima HERRICH-SCHAEFFER, Syst. Besch. Schmett. Eur., V, 1853, pp. 47, 217, pl. XIII, figs. 15–16 (not Hübner).—STAUDINGER and REBEL, Cat. Lep. Eur., Pt. 2, 1901, p. 164, No. 353.—DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 528.

Type of genus.—*Oecophora inunctella* Zeller.

A. HINDWINGS WITH VEINS 3 AND 4 STALKED.

HYPATOPA TEXANELLA, new species.

Antennæ, male, with conspicuous pecten, but without notch; pale brownish gray.

Palpi brownish gray, slightly darker on their outer side.

Head brownish cinereous.

Thorax cinereous, shaded with brownish gray.

Forewings hoary whitish cinereous, shaded and speckled with brownish gray, especially at the base, along the costa, more widely on the outer half, as well as on the apical and dorsal portions of the wing; with an outwardly curved, ill-defined, brownish gray fascia, at about one-third from the base, followed by a discal spot of the same color slightly above the middle; at the end of the cell are two spots, one above the other, corresponding to the angles of the cell, and below and beyond these is a less clearly defined spot touching the dorsum about the tornus; cilia brownish gray.

Alar expanse.—14–16 mm.

Hindwings and cilia pale yellowish brown, the former with a rather shining gloss.

Abdomen pale yellowish brown.

Legs pale yellowish brown, the tarsi faintly mottled.

Type.—Male, No. 33087; female, No. 33089, Mus. Walsingham; paratypes male and female, Cat. No. 10671, U.S.N.M.

Habitat.—Bosque County, Texas. April 28–May 20, October 6–10, 1876 (Belfrage, collector). Nine specimens.

HYPATOPA EPISCIA, new species.

Antennæ, *palpi*, *head*, and *thorax* uniformly grayish cinereous.

Forewings grayish cinereous, somewhat mottled with slightly darker shades; the first of these at the basal third takes the form of a rather wide band from the costa, but does not reach the dorsum; beyond this lies a small darkened spot, and about the tornus is a small patch of the same color preceded and followed by others smaller and less conspicuous; cilia concolorous with the wing.

Alar expanse.—14–15 mm.

Hindwings and cilia pale grayish, with a slight brownish ochreous iridescence.

Abdomen pale grayish, inclining to ochreous posteriorly.

Legs conforming in color to the hindwings, tarsal joints not shaded.

Type.—Male, No. 90420; female, No. 90421, Mus. Walsingham; paratype male, Cat. No. 10675, U.S.N.M.

Habitat.—Sonoma County, Russian River, California, May 19, 1871; Dry Creek, May 20–21, 1871; Mendocino County, head of Noyo River June 8–11, 1871; past Little Lake, June 12, 1871 (Walsingham, collector). Five specimens.

In some specimens there are two elongate spots on the fold, but such markings are so little differentiated from the ground-color as to be scarcely worthy of description. The whole insect has a plain unornamented appearance, it is somewhat darker and grayer than *conia*, from which it differs in having veins 3 and 4 of the hindwings stalked instead of connate.

B. HINDWINGS WITH VEINS 3 AND 4 CONNATE.

HYPATOPA CONIA, new species.

Antennæ cinereous.

Palpi whitish cinereous, sprinkled with brownish fuscous; median joint brownish fuscous externally, except its apex, which is whitish.

Head and *thorax* whitish cinereous, dusted with brownish fuscous.

Forewings whitish cinereous, dusted with brownish fuscous, especially on the costal and dorsal portions; an elongate brownish fuscous spot before the middle, sometimes reduplicated above toward the base; there is sometimes an elongate spot of the same color in the fold below them, a slight shade at the end of the cell, and a few ill-defined groups of brownish fuscous scales around the apex; cilia whitish cinereous, inclining to grayish at the tornus, dusted with brownish throughout; underside scarcely darker than the pale, shining hindwings.

Alar expanse.—14–16 mm.

Hindwings cinereous, with a slight brownish tinge; cilia paler, inclining to ochreous.

Abdomen pale grayish, inclining to ochreous posteriorly.

Legs of the same color as the cilia of the hindwings, tarsal joints somewhat griseous.

Type.—Male, No. 90405; female, No. 90408; Mus. Walsingham; paratypes male and female, Cat. No. 10674, U.S.N.M.

Habitat.—Lake County, Blue Lake, California, June 15–16, 1871; Siskiyou County, Mount Shasta, October, 1871 (Walsingham, collector). Fifteen specimens.

This species differs from *fasciata* in the absence of the wide curved band before the middle of the forewing, and in its paler coloring, but in other respects it bears great resemblance to it, although in many specimens the markings are wholly or partly obliterated.

HYPATOPA FASCIATA, new species.

Antennæ with a pecten, but not notched; brownish fuscous.

Palpi brownish fuscous, both joints tipped with hoary fuscous.

Head and *thorax* hoary, dusted with brownish fuscous.

Forewings hoary, profusely sprinkled with brownish fuscous; a somewhat outwardly curved brownish fuscous fascia, at one-third from the base, is preceded by a distinct line of the pale ground-color and followed about its middle by a thickened patch of brownish fuscous, sometimes divided into two spots on the pale discal surface; there is a longitudinal streak of the same color lying in the fold beyond its middle, and at the end of the fold, opposite the tornus, is a somewhat triangular patch of brownish fuscous, its apex pointing toward the costa; a series of indistinct mottlings or groups of scales are noticeable in good specimens around the termen; cilia hoary, inclining to grayish, with two slender lines running throughout from tornus to apex; underside unicolorous pale brownish gray, with a slight iridescence.

Alar expanse.—14–17 mm.

Hindwings shining, pale brownish, with an iridescent luster in a strong light; cilia the same, slightly paler along their base; underside unicolorous pale brownish gray, slightly iridescent.

Abdomen shining, pale brownish gray; anal tuft corresponding in color with the hindwings.

Legs pale brownish, the tarsal joints somewhat shaded with brownish fuscous.

Type.—Male, No. 90388, Mus. Walsingham; paratypes male, Cat. No. 10673, U.S.N.M.

Habitat.—Head of Noyo River, Mendocino County, California, June 8–11, 1871; past Little Lake, June 12, 1871; Lake County, Blue Lake, June 15–16, 1871; Colusa County, North Fork Cache Creek, June 24–26, 1871 (Walsingham, collector). Sixteen specimens.

HYPATOPA ORITES, new species.

Antennæ brownish gray; basal joint pectinate.

Palpi strongly recurved to the back of the head above; grayish white, much dusted with brownish fuscous, especially on the outer side of the median joint.

Head grayish white, sprinkled with fuscous.

Thorax grayish white, suffused and sprinkled with brownish fuscous.

Forewings grayish white, suffused and sprinkled with brownish fuscous; the central portion of the wing, on which is exhibited a dark discal shade-spot and another at the end of the cell is less overlclouded with fuscous sprinkling than the margins or apex of the wing; a little beyond the discal spot is an elongate dark streak in the fold, and a dark shade at the end of the fold is a little less obliquely placed in relation to a spot at the end of the cell; the apex and termen show slight pale interruptions in the dark shading, which gives the appearance of a series of ill-defined marginal shade-spots extending through the whitish gray cilia; the whole wing has thus a mottled and speckled appearance, the white ground-color showing chiefly before and beyond the discal spot, and in two rather oblique marks pointing to the flexus beneath the basal half of the fold.

Alar expanse.—16 mm.

Hindwings shining, grayish brown; cilia brownish ochreous.

Abdomen pale brownish ochreous.

Legs pale brownish ochreous.

Type.—Female, No. 90427, Mus. Walsingham.

Habitat.—Mount Shasta, Siskiyou County, California, August, 1871 (Walsingham, collector). Unique.

Family STENOMATIDÆ.

=*Xyloryctidæ* DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, pp. 518–9.

Allied to *Xyloryctidæ* Meyrick, but differing in having veins 7 and 8 of the forewings separate.

This family is characteristic of tropical America, but would include *Agriophara* Rosenstock^a (the only Australian genus with veins 7 and 8 of the forewings separate referred by Meyrick to the *Xyloryctidæ*) and a few Indian forms.

The species belonging to various genera of the *Stenomatidæ* have been generally erroneously described as “*Cryptolechia*” (*Oecophoridæ*) which genus differs in having 7 and 8 of the forewings stalked, and 6 and 7 of the hindwings separate and parallel.

MENESTOMORPHA^b, new genus.

Type of the genus.—Male of *Menestomorpha oblongata* Walsingham.

Antennæ biciliate ($2\frac{1}{2}$).

Maxillary palpi rudimentary.

Labial palpi recurved, median joint of even width throughout, closely clothed; terminal joint rather more than half the length of the median, reaching above the vertex, acuminate.

^a Ann. Mag. Nat. Hist. (5), XVI, 1885, p. 439.

^b From *Menesta* and *μορφή*, signifying form.

Haustellum moderate.

Head rough above.

Thorax smooth.

Forewings elongate, oblong, of approximately equal width throughout, costa very slightly depressed along middle, termen oblique.

Neuration 11 veins; 2 and 3 coincident, stalked with 4; 7 and 8 separate, 7 to apex; rest separate.

Hindwings (2), evenly rounded to the somewhat prolonged apex, not sinuate below apex.

Neuration 7 veins; 3 and 4 coincident, connate with 5; 6 and 7 stalked.

Abdomen somewhat stout.

Legs, hind tibiae hairy.

Allied to *Ide* Chambers, but differing in the loss by coincidence of a vein in both wings.

MENESTOMORPHA OBLONGATA, new species.

Antennæ cinereous.

Palpi, *head*, and *thorax* whitish cinereous, mixed with grayish fuscous scales.

Forewings whitish cinereous, streaked and speckled with grayish fuscous, a slight indication of a grayish fuscous transverse band forming a very indistinct basal patch, a slender grayish fuscous line beyond it in the fold, and above this toward the costa, some grayish fuscous shading, blending with a series of ill-defined grayish fuscous streaks, following the lines of the veins, beyond the cell to the costa and termen; along the termen, reaching to the apex, is a series of five or six obscure grayish fuscous spots; cilia grayish fuscous, with a darker line along their base above the middle; underside pale brownish cinereous.

Alar expanse 15 mm.

Hindwings brownish gray; cilia somewhat paler, a slender grayish fuscous line along the margin at the base and two parallel shades of grayish fuscous running through them; underside pale brownish cinereous.

Abdomen brownish gray, with some grayish fuscous scaling.

Legs whitish cinereous.

Type.—Male, No. 32542, Mus. Walsingham; paratype, Cat. No. 10347, U.S.N.M. (Walsingham determined, No. 4778, 1906.)

Habitat.—Fort Grant, Arizona, from Cynipid gall on oak, issued April 22, 1882 (Morrison, collector).

Family HYPONOMEUTIDÆ.

Genus COLEOPHORA Hubner.

COLEOPHORA PRUNIELLA Clemens and Walsingham.

Coleophora pruniella CLEMENS, Proc. Ent. Soc. Phil., I, 1861, pp. 78, 79.—CLEMENS in Stainton, Tin. No. Am., 1872, pp. 165-167.—ZELLER, Verh. zool.-bot. Gesell. Wien., XXIII, 1873, pp. 309, 310.—CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 111, 136.—PACKARD, U. S. Dept. Agr., Int. Ent. Comm. Bull., VII, 1881, p. 134.—HY. EDWARDS, Bull. U. S. Nat. Mus., No. 35, 1889, p. 128.—PACKARD, Rept. U. S. Dept. Agr., Ent. Comm., V, 1890, p. 528, No. 17.—RILEY, Smith's List Lep. Bor. Am., 1891, p. 106, No. 5699.—DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 533, No. 6034.

Larva on *Prunus serotinus*, imago unknown.

Antennæ grayish fuscous, without a basal tuft, basal joint enlarged.

Palpi with a very small tuft from the median joint; hoary.

Head and thorax hoary.

Forewings hoary whitish gray, sprinkled with fuscous scales, the apex irrorated with fuscous; a distinct, but not clearly defined, spot above the tornus at one-third from the dorsum; costal cilia grayish, terminal cilia hoary gray, dorsal cilia pale grayish.

Alar expanse 13.5 mm.

Hindwings shining gray; cilia pale grayish.

Abdomen and legs grayish, the tarsal joints with faintly paler bands.

Case.—This agrees with Clemens' description, but he omits to say that it is pale ochreous, with a slight ridge along the top from mouth to apex.

Type.—Female (Walsingham determined No. 4943, 1906), U.S.N.M.

Habitat.—Placer County, California. Larva on *Prunus demissa*, issued August. Unique.

This species is distinct from *occidentis* Zeller. The imago was unknown to Clemens.

COLEOPHORA OCCIDENTIS Zeller.

Coleophora occidentis ZELLER, Verh. zool.-bot. Ges. Wien., XXIII, 1873, pp. 309-311.

Coleophora occidentalis CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, p. 136.—RILEY, Smith's List. Lep. Bor. Am., 1891, p. 106, No. 5695.

Coleophora pruniella DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 533, No. 6034.

Type.—In Mus. Walsingham.

Habitat.—Massachusetts.

COLEOPHORA LAPIDICORNIS, new species.

Antennæ without a basal tuft, but the basal joint is thickened; pale stone-color, inclining to whitish ochreous, faintly annulate toward the tips.

Palpi with a slight brush from the median joint; stone-gray.

Head and *thorax* stone-gray.

Forewings stone-color, with a slight brownish tinge, with numerous lines of blackish scales intermixed with some whitish ones, especially on the outer half of the wings; the lines are not clearly defined, but one subcostal, one along the fold, one along the dorsum, and about three from the apical portion, pointing inward, are faintly distinguishable; cilia gray.

Alar expanse.—11.5 mm.

Hindwings and *cilia* gray.

Abdomen and *legs* brownish gray.

Type.—Male (Walsingham determined, No. 4927, 1906), Cat. No. 10348, U.S.N.M.

Habitat.—Akron, Ohio; Larva on *Prunus* . . . issued October 14, 1890 (E. M. Claypole, collector). Unique.

COLEOPHORA VAGANS, new species.

Antennæ faintly annulate, brownish gray.

Palpi simple, without a basal tuft; brownish gray.

Head and *thorax* dull brownish gray.

Forewings dull brownish gray, with very faintly indicated lines of mixed fuscous and pale scales; one running from the base about the middle, slightly bent downward toward the tornus; another on the fold; a few indications of oblique pale lines between the middle of the costa and the apex, pointing inward, and a slight sprinkling of blackish scales about the apex; costal cilia slightly paler than the dorsal.

Alar expanse.—12 mm.

Hindwings grayish; cilia brownish gray.

Abdomen (greasy).

Legs (broken).

Type.—Female (Walsingham determined, No. 4928, 1906). Cat. No. 10349, U.S.N.M.

Case.—Triangular at the apex, cylindrical, slightly bulged, the mouth bent over; general color stone-grayish, a brownish patch above, extending from the mouth, which is slightly lipped, to about one-third of its length.

Habitat.—New York city, larva on grass, issued August, 1888. Unique.

Genus CÆLOPÆTA^a, new genus.

Type of the genus.—Male and female, *Cælopæta glutinosi* Walsingham.

Antennæ.—Male, simple, $\frac{3}{2}$; basal joint with pecten.

^a From *κοίλος*, signifying hollow; and *ποιητής*, signifying a maker.

Maxillary palpi obsolete.

Labial palpi moderate, curved, slightly ascending; terminal joint much shorter than median.

Haustellum naked.

Ocelli absent.

Head and *thorax* smooth.

Forewings tapering, acute.

Neuration 12 veins; 2, 3, and 4 separate, discoidal subobsolete between 4 and 5; 5 out of radius before 8, apparently connate with (6 + 7 + 8); 6 and 7 stalked, inclosing the apex, 8 out of stalk of (6 + 7); tornal branch of media traceable between 3 and 4, rest of media subobsolete; 1^b strongly furcate, 1^c strongly developed outwardly. Hindwings $\frac{1}{2}$, tapering, acute, margins not sinuate; cilia 2 $\frac{1}{2}$.

Neuration 8 veins; cubitus strong, as also 2 and 3; media weak, its upper fork subobsolete, but becoming distinct as vein 5; discoidal obsolete; radius strong, 6 and 7 stalked; 8 strong.

Abdomen moderate, wide at the base.

Legs hind tibiae hairy above and beneath.

This genus belongs to the group of *Elachista* Treitschke, from which it differs entirely in its larval habits and in having all the veins present in both wings. In *Elachista* vein 6 of the forewings arises from the stalk of (7 + 8), while in *Cœlopæta* veins 6 and 7 are stalked, vein 8 arising from their stem.

COELOPÆTA GLUTINOSI, new species.

Antennæ fawn-whitish, barred on the upper side with fuscous.

Palpi whitish.

Head and *thorax* whitish, sprinkled with fawn.

Forewings fawn-whitish, profusely sprinkled and shaded throughout with fawn-ocherous, or fawn-brown, a few fuscous scales at the extreme base of the costa, and at the base of the costal and apical cilia in some specimens; cilia fawn-ocherous, sprinkled on their basal half with fawn-brown.

Alar expanse.—12–13 mm.

Hindwings tawny gray; cilia rather paler, grayish fuscous.

Abdomen gray; anal tuft fawn-whitish.

Legs whitish; hind tarsal joints barred with fuscous.

Type.—Male, No. 90511; female, No. 90512 in Mus. Walsingham; paratypes, male and female, No. 10350, U.S.N.M. (11 specimens.)

Habitat.—California, Mendocino County, Coal Creek Cañon (Potter's Valley), June 14, 1871; *larvæ* in galls on *Eriodycteon glutinosum*, June 14, issued middle of June to middle of July, 1871: Lake County, Scott's Valley (5 miles north of Clear Lake), June 17–19, 1871: Lower Lake, June 22–23, 1871: Colusa County, Phip's Place, June 26,

1871: Shasta County, Hatchet Creek, July 14-17, 1871: Bear Creek, July 27-28, 1871: Siskiyou County, Mount Shasta, August 2-September 1, 1871. Seventy-three specimens (Walsingham, collector).

The color of the forewings is somewhat variable; in some specimens the darker sprinkling gives a suffused appearance beyond the middle and is condensed in two obscure marginal spots on either side of the tornus, but in the majority this brownish sprinkling is evenly distributed over the wing surface and no markings are apparent. In other specimens the ground color becomes almost white and the darker sprinkling is unimportant.

I first met with this species in the middle of June, 1871, on the borders of Mendocino and Lake counties, California, where I took specimens flying among plants of *Eriodycteon glutinosum*; on the same plant I found bladder-like galls produced by a larva, apparently mining in the midrib. The gall occupied nearly the whole width of the leaf, which was curled up at the sides and at the end by contraction. On opening these galls a small elongate-ovate and rather flattened cocoon was found; from these the moths continued to emerge up to the middle of July. More specimens were met with at the end of July and the beginning of August on the borders of Shasta and Siskiyou counties; it is certainly abundant where it occurs.

I am indebted to the late Professor Bolander, of San Francisco, for the determination of the plant.

Genus STAGMATOPHORA Herrich-Schaeffer.

Stigmatophora HERRICH-SCHAEFFER, Syst. Besch. Schmett. Eur., V, 1853, p. 49, No. 87; VI, 1853, expl. of pl. VII.—STAUDINGER and REBEL, Cat. Lep. Eur., Pt. 2, 1901, p. 188, No. 405.—WALSINGHAM and DURRANT, Ent. Mo. Mag., XLII, 1906, p. 196-7.

STAGMATOPHORA SEXNOTECLA, Chambers.

Gelechia sexnotella CHAMBERS, Bull. U. S. Geo. Surv., IV, 1878, p. 88.—HAGEN, Papilio, IV, 1884, p. 99.—RILEY, Smith List. Lep. Bor. Am., 1891, p. 102, No. 5482.

Mompha sexnotella BUSCK, Journ. N. Y. Ent. Soc., X, 1902, p. 97-98.—DYAR, Bull. U. S. N. Mus., No. 52, 1902, p. 543, No. 6168.

Antennæ brownish fuscous, with a small white spot at the end of the basal joint.

Palpi cream-white, the terminal joint biannulate with brownish fuscous.

Head white.

Thorax brownish fuscous.

Forewings rather shining, brownish fuscous, with shining white markings; a rather outwardly oblique costal streak, from near the base, reaching over the fold but not to the dorsum, a medio-costal

spot, somewhat obliquely prolonged, and a larger costal spot before the apex; also two small dorsal spots, the first opposite the middle costal spot, the second beyond it, and a small spot at the apex; cilia brownish gray.

Alar expanse.—11 mm.

Hindwings and cilia brownish gray.

Abdomen brownish fuscous, with whitish marks along the sides.

Legs whitish, barred with brownish fuscous on the hind tarsal joints.

Habitat.—Bosque County, Texas; Georgiana, Florida; Pennsylvania; Virginia. Larva in stem-gall on *Trichostomum dichotoma*; issued June 9, 1881. Walsingham determined No. 4497, 1906.

There is a specimen from Beverly, Massachusetts, July 11, 1868 (Burgess) "*Stigmatophora argyræla*,"^a Mus. Z." (Zell. Coll. 101533), which very nearly agrees with the type, the only difference being that the two dorsal spots and some white scales on the margin between these and the apical spot are slightly raised and somewhat metallic. I must express my thanks to Mr. Busck for suppressing a prospective synonym by letting me know that this description applies to *Gelechia sexnotella* Chambers, with which I was unacquainted.

Genus HYPONOMEUTA Latreille.

HYPONOMEUTA DIAPHORUS new species.

Antennæ fuscous.

Palpi slender, projecting about the length of the head beyond it; whitish, touched with chestnut-brown.

Head and *thorax* white, dusted with grayish above.

Forewings white, with grayish dusting along the costal portion, especially near the base; numerous grayish brown spots of varying sizes run in four diverging lines from the base; on the costal portion above the cell is a row of six, the last but one of which is situated at about half the wing-length; below this series is another, of six or seven, running through the discal cell, and on the outer third of the wing are two or three detached spots above it leading up to the apical series; immediately below the fold is a third row of spots, and along the dorsum are four or five more, forming the fourth row; the apical series commences on the costa at about the end of the cell, and is continued along the termen to the tornus, consisting of about eleven spots; cilia fawn-color.

Alar expanse.—19 mm.

Hindwings light chestnut-brown, or fawn-color, somewhat intensified toward the apex; cilia concolorous.

Abdomen and *legs* agreeing in color with the hindwings.

^a From ἀργυρόηλος, signifying silver-studded.

Type.—Female, No. 5391, Mus. Walsingham; paratypes, U. S. Nat. Mus.,^a Mus. Fernald. Three specimens.

Habitat.—Texas ("Ber. Gerh.").

A single specimen given me by the late Monsieur Ragonot in 1884 agreed with another in the late Doctor Riley's collection, also from Texas; a third specimen is in the collection of Professor Fernald. The paratypes were perhaps labeled by me about 1885, "*Enæmia posticella* Wlsm. MS.;" they however differ from *Mieza* Walker (= *Eustixis* Hübner, = *Enæmia* Zeller) in the coincidence of veins 3 and 4 of the hindwings, thus agreeing with *Hyponomeuta* Latreille.

Family TINEIDÆ.

-Genus BUCCULATRIX Zeller.

BUCCULATRIX EUROTIELLA, new species.

Antennæ white, faintly annulate with grayish fuscous.

Head and *thorax* white.

Forewings white, with a patch of fawn-colored scales on the costa beyond the middle, a smaller patch of the same color before the middle; opposite to and between these two is a larger patch of fawn scales adjacent to the dorsum, with a black spot at its inner edge on the fold; the termen is shaded with fawn and contains some scattered black scales, the fawn shading extending through the cilia, which are grayish about the tornus and white at the apex; underside rather bright ochereous, with white margins.

Alar expanse.—8 mm.

Hindwings pale brownish gray; cilia slightly paler.

Abdomen pale brownish gray.

Legs whitish; hind tarsi faintly spotted.

Type.—Male (Walsingham determined, No. 4993, 1906). Cat. No. 10352, U.S.N.M.

Habitat.—Lancaster, California.

Larva from leaves of *Eurotia canata*. Pupa in a white, ribbed cocoon, issued May, 1890 (A. Koebele, collector). Unique.

Genus LITHOCOLLETIS Hübner.

LITHOCOLLETIS CERVINA, new species

Antennæ whitish.

Palpi white.

Head pale rust-brown; face white.

Forewings whitish fawn, with very indistinct whitish costal streaklets; the first, before the middle, oblique, outwardly margined with

^a This specimen does not now appear in the U. S. National Museum collection, and has been lost, presumably. It was seen by Lord Walsingham in 1886 and brought back to America by Dr. C. V. Riley. The species may be the same as *H. atomocella* Dyar, from Texas and Illinois, Cat. No. 6614, U.S.N.M.—Harrison G. Dyar.

rust-brown; the second, at about the middle, also outwardly margined with rust-brown, runs obliquely outward and is angulated on the cell, returning to the middle of the dorsum, its lower half longer and more oblique than its upper; the third costal streak is triangular, not oblique, also outwardly margined with rust-brown, which is continued across the wing to the tornus, where there is also a faint indication of a whitish spot; there is no basal streak, and, except for a slightly paler space before the line of dark scales on the middle of the dorsum, no defined dorsal streak; the space between the streaks and about the apical portion of the wing is slightly shaded with rust-brown, and the apex is profusely sprinkled with blackish scales mixed with some white ones; a slender blackish line runs around the extreme apex at the base of the pale cilia, which have a pale rust-brown line running through their middle.

Alar expanse.—6 mm.

Hindwings and cilia grayish.

Abdomen grayish.

Legs whitish, unspotted.

Type.—Male. Walsingham determined No. 4972, 1906. Cat. No. 10353, U.S.N.M.

Habitat.—New York. (Beutenmüller collection.) Unique.

This species belongs to the group of *messaniella* Zeller; there is no record of its life history.

LITHOCOLLETIS CERIFERÆ, new species.

Antennæ grayish.

Palpi silvery.

Head pale saffron-brown; face silvery.

Thorax saffron-brown.

Forewings shining saffron-brown, with two straight, transverse, silvery fasciæ, both dark-margined externally; the first at one-fourth from the base, sloping slightly inward toward the dorsum; the second slightly beyond the middle, almost at right-angles to the costa; beyond the second fascia two silvery spots, the first costal, the second opposite to it on the tornus; these are also dark-margined externally, and, being almost confluent, present the appearance (in one wing) of a third fascia, not quite so far removed from the second as this is from the first; a few fuscous scales are scattered about the apex; cilia brownish, grayish toward the tornus.

Alar expanse.—6 mm.

Hindwings and cilia brownish gray.

Abdomen dull grayish fuscous.

Legs whitish, slightly speckled with grey.

Type.—Male. Walsingham determined, No. 4969, 1906. U. S. National Museum, Cat. No. 10361.

Habitat.—New York. Larva on *Myrica cerifera*. Unique.

This species was first named *ceriferella* Walsingham MS., but as *aeriferella* Clemens is by a typographical error catalogued as *ceriferella* H. Edwards, Bull. U. S. National Museum No. 35, p. 132 (1889), the new species is now published as *ceriferæ* Walsingham.

LITHOCOLLETIS LEUCOTHORAX, new species.

Antennæ pale saffron.

Palpi white.

Head pale saffron; face white.

Forewings pale saffron, the extreme costa whitish from the base, with two very oblique, shining, whitish costal streaks tending outward, the first at the middle, the second beyond it, and two much shorter streaks in the costal cilia pointing inward—all anteriorly dark-margined; on the dorsum are three very conspicuous, broad, white streaks, tending obliquely outward, the first and second before the middle, the third beyond it—these are all also anteriorly margined with ferruginous, the ferruginous shades bent outward about the middle of the wing, giving them an angulated appearance; cilia shining, saffron, a small blackish apical dot and a dark line running from it through the cilia toward the tornus.

Alar expanse.—8.5 mm.

Hindwings whitish gray; cilia pale grayish.

Abdomen tinged with saffron; anal tuft grayish.

Legs, hind tibiae yellowish white, very faintly spotted.

Type.—Female. Cat. No. 10354, U.S.N.M.

Habitat.—Santa Cruz Mountains, California (A. Koebele, collector).

Unique. (Walsingham determined, No. 4976, 1906.)

There is no record of the life history.

LITHOCOLLETIS BIFASCIELLA Chambers.

Lithocolletis bifasciella CHAMBERS, Bull. U. S. Geol. Surv., IV, 1878, pp. 101–2, 119, 153.—PACKARD, U. S. Dept. Agr., Int. Ent. Comm. Bull., VII, 1881, p. 54.—HAGEN (and FREY), Papilio, IV, 1884, p. 151.—WALSINGHAM, Insect Life, II, 1884, pp. 24, 119; III, 1891, p. 329.—PACKARD, U. S. Dept. Agr., Rept. Ent. Comm., V, 1890, p. 219.—RILEY, Smith's List Lep. Bor. Am., 1891, p. 108, No. 5839.—DYAR, Bull. U. S. Nat. Mus., No. 52, 1902, p. 556, No. 6329.

Antennæ grayish fuscous, faintly barred with ocherous.

Palpi shining silvery white.

Head pale ocherous above, reddish brown at the sides; face shining silvery white.

Thorax rich reddish brown.

Forewings shining, rich reddish brown, with shining silvery white markings; a slightly oblique fascia near the base, further from the base on the costa than on the dorsum, a second parallel fascia at about the middle, both with a few dark scales on their outer sides; a small costal streak before the apex, preceded by another on the

dorsum before the tornus, above which are a few white scales on the costal cilia, both streaks have a few black scales on their outer side; cilia reddish brown, fading to gray about the tornus.

Alar expanse.—7 mm.

Hindwings gray; cilia grayish.

Abdomen grey.

Legs whitish, posterior tibiae very faintly spotted.

Caenotype.—Male (Walsingham determined, No. 4974, 1906) U. S. National Museum.

Type.—Female in Museum of Comparative Zoology, Cambridge, Massachusetts.

Larva on *Quercus alba*.

Habitat.—Kentucky, New York (Beutenmüller collection), U. S. National Museum.

Genus ORNIX Treitschke.

ORNIX INNOTATA, new species.

Antennæ brownish fuscous, very faintly annulate.

Palpi whitish, annulate, with fuscous before the apex.

Head brownish.

Thorax grayish brown.

Forewings grayish brown, with a series of almost undistinguishable streaklets along the costa, slightly oblique outward; a minute whitish spot occurs about the middle of the costa, and there are two pale spots in the costal cilia before the apex; the apical cilia have a pale line along their base, preceded along the margin by a few dark fuscous scales; there is also a faint indication of a darkened spot near the outer end of the fold; cilia brownish gray.

Alar expanse.—9 mm.

Hindwings grayish; cilia brownish gray.

Abdomen grayish brown; anal tuft slightly ochereous.

Legs cinereous.

Type.—Male. Cat. No. 10355, U.S.N.M.

Habitat.—United States. Unique. (Walsingham determined, No. 4984, 1906.)

Genus TISCHERIA Zeller.

TISCHERIA ALBOSTRAMINEA, new species.

Antennæ, *head*, and *thorax* pale whitish straw-color.

Forewings pale whitish straw-color, the extreme costa narrowly sprinkled with purplish brown scales to two-thirds the length of the wing, where they form a slight costal spot; a dorsal spot, consisting of a group of scales of the same color, lies about the tornus, and beyond it the apex of the wing is thickly bestrewn with purplish scales, a reddish brown hue prevailing among them; this dark scaling does not extend to the costal cilia, which are of the pale ground

color, but the apical cilia and those extending to the dorsum are pale chestnut-brownish.

Alar expanse.—7 mm.

Hindwings pale yellowish gray, the base slightly thickened; cilia slightly coppery gray.

Abdomen and legs pale yellowish gray.

Type.—Male. Cat. No. 10356, U.S.N.M.

Habitat.—New York (Beutenmüller collection). Unique. Walsingham determined, No. 4991, 1906.

A small, slender, delicate species, decidedly distinct from any known form.

Genus SCARDIA Treitschke.

SCARDIA GRACILIS, new species.

Antennæ distinctly ciliate, the joints tufted; whitish ochereous, annulate with fuscous.

Maxillary palpi strongly developed, folded; whitish ochereous.

Labial palpi whitish ochereous on their inner side, the median joint almost as long as the terminal, tinged with brownish externally on the terminal joint and on the median joint to its apex.

Head and thorax whitish ochereous; the latter with a brownish fuscous band across its middle, the tegulae anteriorly brownish fuscous.

Forewings narrow, elongate, the costa slightly bulged near the base, apex rounded, termen oblique; whitish ochereous, much clouded and speckled with brownish fuscous, which appears in a series of costal spots of varying size and in a large median costal blotch which extends in a somewhat triangular form to the lower edge of the cell, its outer edge being almost perpendicular to the dorsum; the dark coloring is also strongly apparent along the fold, arising at the extreme base of the costa, crossing the fold obliquely outward, and reaching nearly to the dorsum at about one-fifth from the base, thence angulated upward to the fold and returning to the dorsum at about its middle; thence again angulated upward and continued, with more or less interruption, parallel with the termen to the costa before the apex; a series of small dark spots along the termen; cilia whitish ochereous, with a brownish fuscous shade running through them near their base and spreading over them outwardly at about their middle; between these dark markings the intermediate space is speckled with brownish fuscous; underside with a slight cupreous tinge, the very pale margins speckled with brownish fuscous, a spot of the same showing through the wing at the end of the cell.

Alar expanse.—25 mm.

Hindwings very pale whitish ochereous, the rather shining cilia with one or two brownish fuscous spots around the apex.

Abdomen whitish ochereous, sprinkled with fuscous posteriorly.

Legs whitish ochereous, the anterior and median banded above with fuscous; the posterior tarsal joints sprinkled with fuscous.

Type.—Female. Cat. No. 10357, U.S.N.M.

Habitat.—California (Beutenmüller collection). Unique. Walsingham determined, No. 4756, 1906.

Apparently allied to *Scardia anatomella* Grote, but of a somewhat more slender and paler appearance, differing also in the dark shade reaching to the dorsum in the middle of the forewing.

Genus PSEUDOXYLESTHIA^a, new genus.

Type of genus.—*Pseudoxylesthia angustella* Walsingham.

Antennæ simple in both sexes; basal joint without pecten.

Maxillary palpi present, not folded.

Labial palpi porrect, closely clothed, terminal joint as long as median.

Haustellum long.

Ocelli absent.

Head rough above; face with appressed scales.

Thorax smooth.

Forewings narrow, elongate, of equal width throughout, apex rounded.

Neuration 12 veins, all separate; 7 to apex; 2 from near angle of cell.

Hindwings broader than the forewings, termen slightly sinuate, attenuate, but rounded at the apex.

Neuration 8 veins; 5 and 6 stalked; 7 straight; 3 and 4 remote.

Abdomen rather stout; male with shortly bifid uncus and long, narrow claspers; female, anal segment with long hairs, ovipositor extruded.

Legs not thickly but loosely clothed.

Allied to *Xylesthia* Clemens, but differing in the stalking of veins 5 and 6 in the hindwings.

PSEUDOXYLESTHIA^a ANGUSTELLA, new species.

Antennæ greyish.

Palpi hoary grayish.

Head and *thorax* hoary gray; tegulæ touched with ochereous.

Forewings hoary grayish, sprinkled with ochereous, especially along the costa and beyond the middle, also at the extreme base of the dorsum; some bands of dense fuscous speckling extend across the wing from costa to dorsum, the first, at about one-fourth, running obliquely outward from the costa reaches the dorsum at about one-third from the base, this is more or less connected with the base of the wing by dark speckling; the second beyond the middle of the costa, tends outward in the direction of the tornus, becoming dilated

^a From the Greek word ψευδής, signifying false and *Xylesthia*.

and somewhat broken-up along the dorsum, this is joined by a short, straightish band which connects it with the costa at one-third from the apex, and beyond this again is a narrower band preceding the termen, a detached costal spot before it and another almost about the middle of the wing; cilia hoary, much speckled with fuscous; underside cinereous, cilia paler.

Alar expanse.—Male 18 mm.; female 24 mm.

Hindwings brownish cinereous; cilia with a slight ochereous tinge.

Abdomen brownish cinereous; anal tuft slightly tinged with ochereous.

Legs cinereous, with some darker speckling.

Type.—Male No. 32547; female No. 5390^a Mus. Walsingham; paratype female (Walsingham determined, No. 4902, 1906); Cat. No. 10358, U.S.N.M.

Habitat.—Arizona—(Cox, collector); Texas ("Ber. Gerh."). Three specimens.

Genus *TINEA* Linnæus.

TINEA SPARSIPUNCTELLA, new species.

Antennæ blackish, white towards the base.

Maxillary palpi folded.

Labial palpi hoary, with a few projecting bristles on the upper side of the median joint.

Head and thorax hoary white.

Forewings grayish white, profusely sprinkled with brownish fuscous dots, very equally distributed about the wing; these have a tendency to run together into narrow transverse streaks in fine specimens, but are apparently very easily obliterated; somewhat more conspicuous than the others are is a line of spots along the costa and around the apex and termen to the tornus; a small patch at the end of the cell, about equidistant from the costa and dorsum, and three or four spots ranged parallel to and beneath the fold; cilia white at the base, grayish outwardly, with a darker parting line.

Alar expanse.—26 mm.

^a I wrote to Lord Walsingham, calling his attention to the fact that his *Pseudoxylestia angustella* had apparently been already described as *Dyotopasta yumaella* Kearfott. He replied as follows: "Our generic descriptions are at variance—you write 'ocelli large,' I write 'ocelli absent; you write 'tongue and maxillary palpi obsolete,' I write 'Haustellum long. Maxillary Palpi present.' Mr. Durrant and I have very carefully reexamined my types under the microscope. The male (No. 32547) from Arizona (Cox, through Riley, 1886), the head of which, however, is much distorted and possibly injured, has no tongue. The female (No. 5390) Texas (Ber. Gehr.) received from Ragonot, has a long tongue curled round one of the labial palpi and possesses distinct maxillaries." On reexamination I find that there are no ocelli; but all the specimens, both the cotypes returned by Lord Walsingham and others before me, lack tongue and maxillary palpi. Lord Walsingham's name, *Pseudoxylestia angustella*, is therefore retained based on the female type (No. 5390) in his possession.—August Busck.

Hindwings and cilia grayish fuscous.

Abdomen slightly darker: female ovipositor extruded.

Legs grayish fuscous.

Type.—Female No. 90947 in Mus. Walsingham; paratype, female, No. 90948, Cat. No. 10359, U.S.N.M.

Habitat.—Mendocino County, north of Mendocino city, California (near the town), June 3–5, 1871. Three specimens.

A very distinct species, perhaps nearest to the *occidentella* Chambers group. The veins are all present and separate in both wings.

Genus HOMONYMUS Walsingham.

HOMONYMUS COLORADELLUS, new species.

Antennæ cinereous.

Palpi erect, reaching scarcely above the base of the antennæ, thickly clothed throughout; mixed brownish ochereous and brownish fuscous, appearing slightly paler than the head and thorax above and below them.

Head and *thorax* are brownish fuscous, the scales tipped with hoary gray.

Forewings rather narrow, of about equal width throughout, except at the extreme base, the width equal about one-third the length, termen slightly convex, oblique, apex rounded.

Neuration 12 veins, all separate; dull cinereous, with some paler hoary patches running along the fold to the end of the cell, thickly sprinkled throughout with brownish ochereous and dark fuscous scales which are concentrated in some small patches, one at the end of the cell, one on, and one immediately above the fold beyond it, with a series of very obscure costal spots; cilia brownish fuscous, slightly paler along their base and mixed with brownish ochereous about the tornus; underside uniformly brownish fuscous, with narrowly pale margins.

Alar expanse.—24 mm.

Hindwings, 8 veins, all separate; slightly wider than the forewings; brownish fuscous; cilia with some paler markings.

Abdomen (missing).

Legs brownish fuscous.

Type.—Male (Walsingham determined, No. 4749, 1906), Cat. No. 10360, U.S.N.M.

Habitat.—Custer County, Westcliff, Colorado. (Collection Beutenmüller). Unique.

This agrees with the genus *Homonymus*, described from South America, but differs from the only species at present known in its shorter palpi and by the absence of deep purple coloring in the hindwings, as well as by the somewhat different pattern of the obscure markings on the forewings.

ON A COLLECTION OF FISHES FROM THE PHILIPPINE ISLANDS, MADE BY MAJ. EDGAR A. MEARNS, SURGEON, U. S. ARMY, WITH DESCRIPTIONS OF SEVEN NEW SPECIES.

By ALVIN SEALE and BARTON A. BEAN.

In the months of January and February, 1907, two lots of fishes were received from Maj. Edgar A. Mearns, U. S. Army, stationed in the Philippine Islands. One hundred and thirty-two species are represented, including seven which are described as new.

The collections are from Zamboanga, Mindanao, had been well preserved in formalin (here transferred to alcohol), and form part of Accessions Nos. 46983 and 46985, U.S.N.M. By reason of the new species and rare forms contained they are a very acceptable addition to the collection of fishes.

The arrangement of the families of fishes used here is similar to that adopted by Doctor Jordan in recent papers on fishes of the same general fauna and, although not wholly concurred in, is used for convenience and with the view of conforming in classification with the numerous papers already published and being printed upon Philippine fishes.

Family CYPRINIDÆ.

Barbus quinquemaculatus, new species.

Head, 3.33; depth, 3; eye, 3.75; snout, 3.75; interorbital, 2.75 in head; D., 11; A., 7; scales, 524/2; eight scales in front of dorsal.

Body moderately robust, back from nuchal region to dorsal fin considerably elevated; snout rather pointed; lower lip included. Barbels four, their length greater than diameter of eye. Mouth small, the maxillary ending on anterior line of orbit.

Pharyngeal teeth in three series, 5, 3, 2, mostly hooked. Gill-rakers very small, about 8 on lower arch. Opercle and preopercle entire.

Caudal peduncle rather robust, its depth 1.25 in its length.

Head naked, body firmly scaled, the lateral line with a slight curve downward anteriorly, running a little below the axis of the body and upward along the middle of the caudal peduncle. Dorsal and anal

with scaly sheaths. Ventrals with well-developed axillary scale.

Second ray of dorsal ossified and strong, its posterior margin slightly denticulate, its length 1.75 in head. Base of dorsal 2 in head. Origin of dorsal midway between the tip of snout and end of caudal vertebræ. Base of anal 2.90 in head; its longest ray 1.75 in head. Caudal large, forked, its longest ray greater than length of head. Ventrals 1.35 in head; their origin midway between origin of pectoral and that of anal, their tips scarcely reaching the anal. Pectorals 1.25 in head.

Color in spirits: Very dark grayish green on upper half of body, yellowish below; scales on lower part of sides with dark margins.

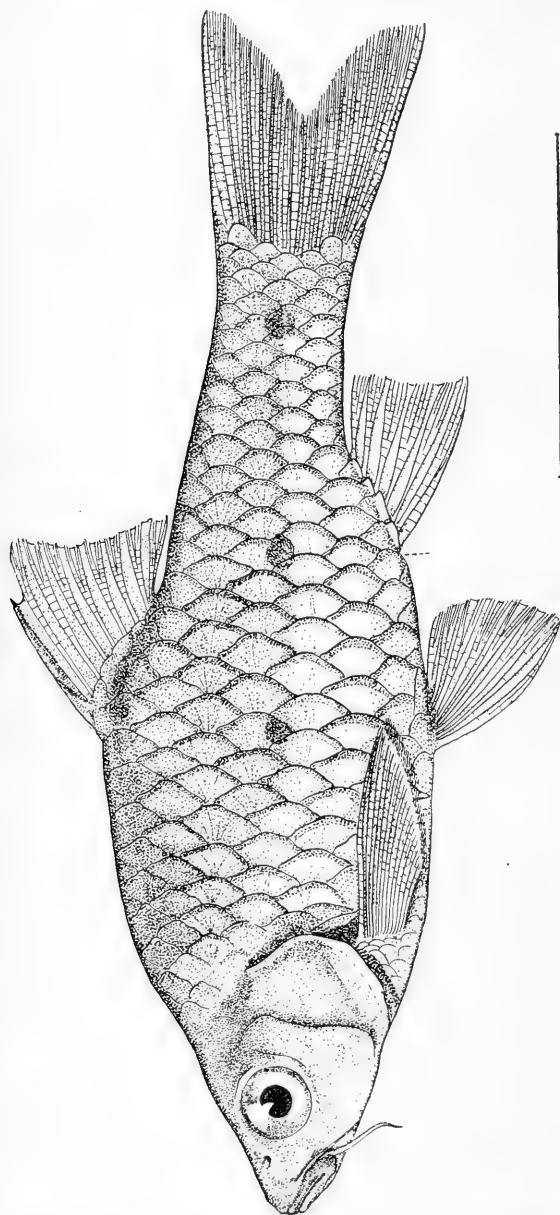


FIG. 1.—*BARBUS QUINQUEMACULATUS*.

A distinct round black spot on base of caudal, another at the origin of the dorsal, a third less distinct at origin of anal, and two round black spots on the median line near the middle of the body. A

blackish wash at the origin of the lateral line. Dorsal whitish, its osseous ray gray. Caudal and pectorals grayish. Ventrals and anal yellowish.

Type specimen.—Cat. No. 57840, U.S.N.M., 3.50 inches long, from near Zamboanga.

This species shows a wide variation in color; there may be an indistinct dusky line on sides of body, or the various spots may be scarcely perceptible, although present in all our series. The ventral surface may have a wash of bright orange.

Numerous specimens obtained by Doctor Mearns at Mount Malindang all show a splendid purplish reflection with a golden wash to belly.

The spots on these specimens are scarcely perceptible.

This species equals *Barbus maculatus* var. unnamed. See A. Günther, Voy. H. M. S. *Challenger*, Report on the Shore Fishes, pp. 53-54.

MEARNSELLA, new genus.

This genus is characterized by the presence of two barbels, and in having the pharyngeal teeth hooked and in two series, inner row with 4 and the outer with 5 teeth; body with the entire abdominal edge trenchant; pectorals elongate and anal of moderate length.

This genus of Cyprinidæ is related to *Eustira* of Günther, differing chiefly in the presence of barbels, in having but two series of pharyngeal teeth, and a smaller number of dorsal rays.

This genus is named in honor of Major E. A. Mearns, U. S. A., by whom the specimens were collected.

Type.—*Mearnsella alestes* Seale and Bean.

Mearnsella alestes, new species.

Head, 4; depth, 3.75; eye, 3.25 in head, equal to length of snout; interorbital, 2.50 in head; D., 11; A., 15; scales, 6/32/2.

Body oblong, compressed; thorax and abdomen trenchant; mouth moderately large, oblique, with lower jaw slightly projecting; maxillary ending below anterior margin of eye. A long maxillary barbel on each side, reaching to middle of opercle. Caudal peduncle long and slender, its depth 2 in its length. Pharyngeal teeth small, curved, sharp pointed and hooked, without evident grinding surface. Opercle and preopercle entire.

Lateral line abruptly bent down to axis of pectoral, extending thence along the lower portion of body to caudal. Body covered smooth, deciduous, striated scales.

Dorsal fin located on the posterior half of body, its origin opposite that of anal. Length of dorsal base one-half that of head; its longest 1.10 in head; anal origin midway between base of caudal and lower

axis of pectoral; base of anal fin 1.35 in head, about equal to its longest ray. Caudal large, forked; its longest ray about equal to head. Ventrals small; 1.75 in head. Pectorals long, being contained twice in distance of dorsal from tip of snout; their origin considerably below the axis of the body and on a line with the posterior angle of the opercle.

Color in spirits: Dull greenish, lighter below, scales of the sides shaded with brown punctulations. A distinct narrow black line from the opercle to caudal ending in a black blotch at base of caudal fin. Some dusky blotches on sides above pectoral fin. A dusky median line on back; dorsal and caudal with a slight wash of dusky; anal, pectorals, and ventrals, light grayish; a small black spot at the upper axis of the pectoral.

Two specimens.

Type-specimen.—Cat. No. 57841, U.S.N.M.; length, 2.45 inches; cotype, 2 inches long; both from near Zamboanga.

Rasbora punctulatus, new species.

Head, 4; depth, 3.10; eye, 3 in head; snout, 3.50; interorbital, 2.50; scales, $5\frac{1}{2}/26/2$; D., 9; A., 8.

No barbels. Mouth moderately small, oblique; the symphysis of the upper jaw notched to receive the curved point of the lower jaw; maxillary extending to the anterior border of eye. Pharyngeal teeth, curved, pointed, 5, 3, 2.

Body oblong, compressed, covered with large, cycloid, striate scales, 10 series in front of dorsal. Lateral line with a low curve

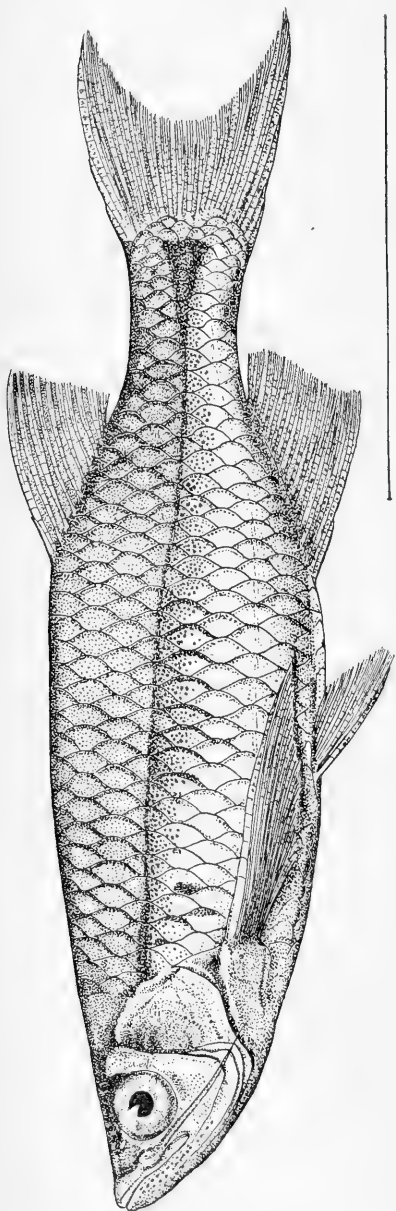


FIG. 2.—MEARNSSELLA ALESTES.

extending along lower part of sides to caudal. Caudal peduncle robust, its depth two in length.

The dorsal fin without enlarged osseous rays: its longest ray 1.25 in head. The origin of the fin is midway between tip of snout and end of caudal vertebræ. Origin of anal posterior to base of dorsal being midway between the end of the caudal vertebræ and the axis of the pectoral. Base of anal 1.80 in head; its longest ray 1.35.

Caudal large, forked, its longest ray about equal to head. Pectorals 1.10 in head. Ventrals large, 1.45 in head, their tip about reaching the vent; their origin midway between vent and posterior axis of pectoral.

Color in spirits: Dull greenish above, lighter below, scales of sides with darker margins. A distinct black stripe from the upper part of opercle to caudal fin.

Dusky blotch on opercle; entire base of anal dusky, somewhat dusky at base of caudal, otherwise fins dusky white.

Eleven specimens measuring from 1.50 to 3 inches.

Type-specimen.—Cat. No. 57842, U.S.N.M., 3 inches long, Zamboanga.

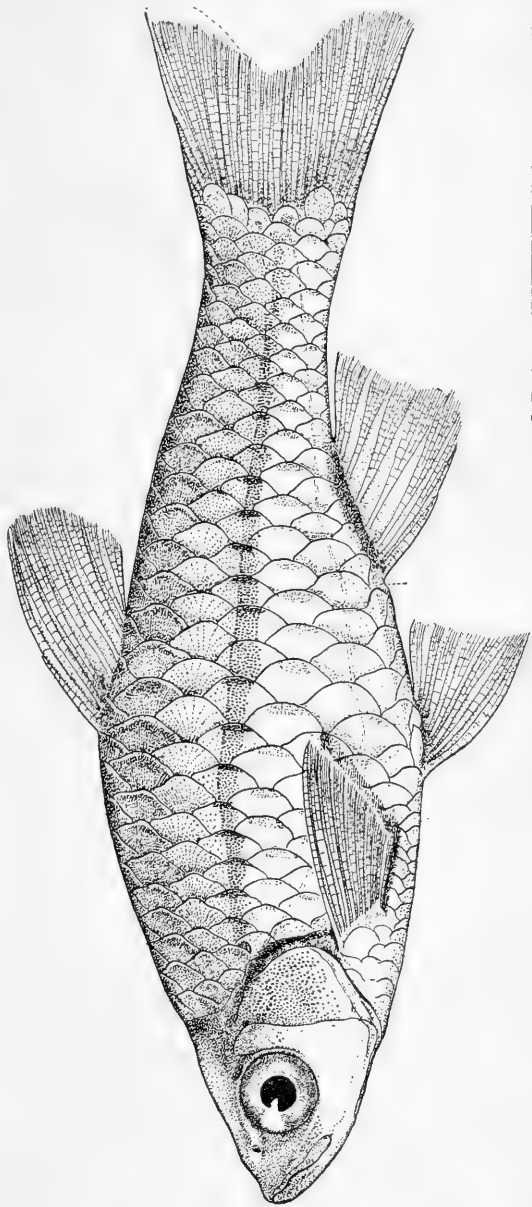


FIG. 3. *RASBORA PUNCTULATUS*.

Family POLYNEMIDÆ.

Polydactylus opercularis, new species.

Head, 3.25; depth, 3.50; eye, 4 in head; snout less than eye, 4.10 in head; interorbital space equal to eye; D., VIII, 1, 12; A., III, 11; P., VIII, +; scales, 5/55/8.

Body oblong; compressed; snout projecting beyond the inferior mouth; maxillary two in head; teeth villiform in jaws and on vomer and palatines; preopercle distinctly serrated; opercle entire; head scaled; adipose eyelid well developed. Gill-rakers long and slender, about 25 on the lower arch. Depth of caudal peduncle contained $1\frac{1}{2}$ times in its length. Fins all scaled.

Second dorsal spine 1.25 in length of head; longest dorsal ray $1\frac{1}{2}$ in head; its base 1.25 in its height. Third anal spine much the longest; longest anal ray contained 1.60 in length of head, equal to length of anal base. Origin of anal fin midway between end of caudal vertebræ and distal end of maxillary. Pectoral fin 1.12 in head. Ventrals 1.75 in head, their tip reaching to

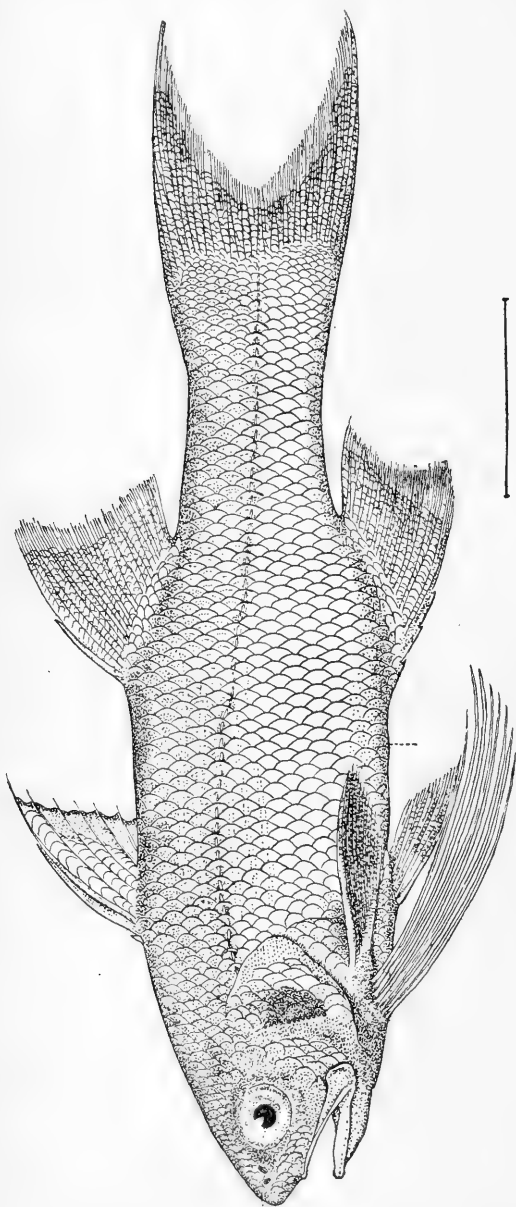


FIG. 4.—POLYDACTYLUS OPERCULARIS.

anus. Caudal deeply forked; its longest ray equals the longest pectoral filament, the latter as shown in illustration is too long.

Color in spirits silvery white, without dark stripes. A slight bluish tint on upper half of body; dusky blotch on opercles;

dorsals, caudal, and anal with dusky margins, very wide and distinct on anal. Pectorals and ventrals blackish.

One fine specimen, 6.75 inches long, from Zamboanga.

Type-specimen.—Cat.

No. 57844, U.S.N.M.

Family SERRANIDÆ.

Cephalopholis maculatus,
new species.

Head, 2.55; depth, 3.10; eye, 5 in head; snout, 4; interorbital, 7.25; D., IX, 15; A., III, 9; scales, 18/95/24; 50 pores in lateral line.

Body oblong, compressed, covered with fine ctenoid scales. Head, including end of maxillary, fully scaled. Mouth large, the pre-maxillary extending to a line from the posterior margin of the pupil; its distal end equal to the interorbital space. Teeth in jaws, vomer, and palatines; those of jaws in several series; the lower jaw with the inner series enlarged and depressible; the upper jaw with the outer series enlarged and firm; two curved anterior canines in each jaw. Gill-rakers rather short, the longest about equal to width of pupil; 15 rakers on lower arch.

Preopercle rounded, scarcely denticulate. Opercle with three spines, the middle one the largest and nearer to the lower spine than to upper. Opercular flap obtusely pointed, its upper margin being

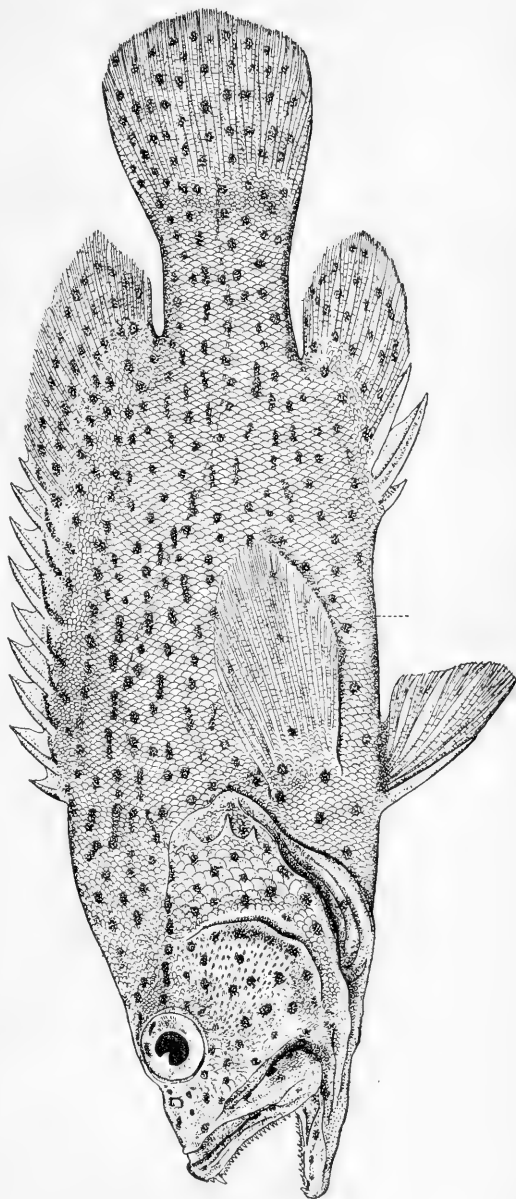


FIG. 5.—*CEPHALOPHOLIS MACULATUS*.

almost straight. Caudal peduncle of moderate strength, its depth being equal to its length. Origin of the dorsal fin directly above the axis of the pectorals; the sixth dorsal spine longest, its length 3.25 in head.

First dorsal spine short, its length equal to width of interorbital; the longest dorsal ray is 2.65 in head; base of anal fin 2.35 in head; its second spine being longest and strongest, 3.10 in head; third spine almost its equal in length. Caudal strongly rounded, its median ray 1.75 in head. Pectorals 1.45 in head; ventrals 1.90 in head; their tip barely reaching vent. Origin of ventral is midway between tip of snout and sixth anal ray. Longest anal ray 2.10 in head.

Color in spirits: Entire body and fins golden yellow, covered with numerous round and oblong spots of deep brown (dark), these tending to form irregular longitudinal lines on the upper part of head and body; maxillary and mandible with dark spots; pectorals uniform yellowish with two or three spots on base; ventrals yellowish, the outer ray with narrow margin of brown.

Dorsal, anal, and caudal spotted, membranes of spinous dorsal with oblique lines formed by the dark spots.

Two fine specimens, 9.75 inches long, from Zamboanga.

Type-specimen.—Cat. No. 57843, U.S.N.M.

Family SCARICHTHYIDÆ.

Chærops zamboangæ, new species.

Head, 3; depth, 2.75; eye, 5.20 in head; snout, 2.25; interorbital, 3.45; D., XII, 8; A., III, 10; scales, $4\frac{1}{2}$, 29, 10; 7 in front of D.

Body oblong, compressed; anterior profile of head rounded, lips of moderate thickness; five or six imperfect rows of imbricate scales on cheeks; opercle and preopercle entire; opercles well scaled, top of head and snout naked; maxillary slipping under preorbital, its distal end scarcely reaching to line with anterior margin of orbit; each jaw with four enlarged anterior canines, the second pair of upper jaw much smaller than the first; posterior canine present; no teeth on vomer or palatines; gill-rakers short, their length less than width of pupil, 11 on lower arch; caudal peduncle strong, its depth equal to its length (last anal ray to end of vertebræ); dorsal fin low, the spines stiff, longest dorsal spine equal to orbit (each with a filament); longest dorsal ray 2.50 in head; base of anal fin 1.50 in head, its third spine the longest, the longest ray 2.45 in head; pectorals 1.30 in head; ventrals 1.60 in head, their tip not reaching anal opening; the origin of the ventral fin is midway between tip of snout and base of third anal ray; caudal truncate, none of its rays produced; its median ray 1.75 in head.

Color in spirits: Yellowish white, the upper anterior two-thirds of body (including head) dull light drab; a conspicuous orange line,

equal to width of eye, extends from base of caudal to axis of pectoral fin; a short broken brown line at lower margin of orbit; a greenish blue line on lower mandible from angle to angle; a slight blotch of yellow on opercle; spinous dorsal drab; soft dorsal yellowish with narrow margin of drab; caudal yellowish; anal, pectorals, and ventrals uniform yellowish.

Two fine specimens from Zamboanga, length 8.75 and 10 in.

Type-specimen.—Cat. No. 57846, U.S.N.M.

Callyodon latifasciatus, new species.

Head, 3; depth, 3; eye, 6.50 in head; snout, 2.50; interorbital 3; D., IX, 10; A., II, 9; scales, $2\frac{1}{2}$, 23, 6; three rows of scales on cheeks, the lower row of three scales covering the preopercular limb; six rows of scales in front of dorsal.

Body oblong, compressed, the upper and lower anterior profile with a low even curve to the tip of the rather pointed snout; lips thin and narrow, covering about half of the upper jaw and less than half

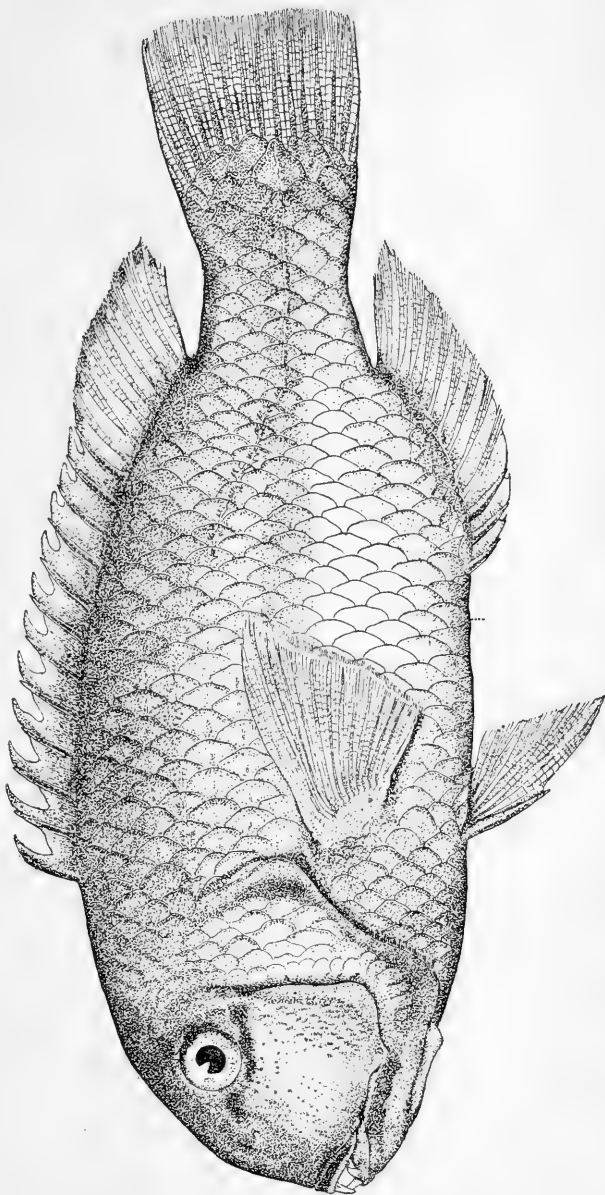


FIG. 6.—*CALLYODON LATIFASCIATUS*, ZAMBOANGA.

of the lower; teeth whitish; a posterior canine present on upper jaw; gill-rakers small and setiform, about thirty-seven on outer limb of lower arch. Caudal peduncle stout, its depth equal to its length.

Longest dorsal spine 3.75 in head, longest dorsal ray 2.90; base of anal 1.50 in head; its longest ray 3.10 in head; pectorals 1.45 in head; ventrals 1.90, their tip falling far short of anal opening; the origin of the ventral is midway between tip of snout and third anal ray. Caudal lunate, its middle ray 1.80 and its longest ray 1.30 in head.

Color in spirits: Dull brown above, the lower third of body yellowish white, between the latter and the lateral line there is a wash of deep black extending from the posterior margin of eye to the caudal peduncle. Top of snout dusky; margin of lips yellowish. Spinous dorsal dull greenish with narrow blue margin; soft dorsal fading into whitish, without the blue margin; caudal greenish yellow, with slight dusky margin to upper and lower rays. Anal, ventral, and pectorals, yellowish, without markings; a slight

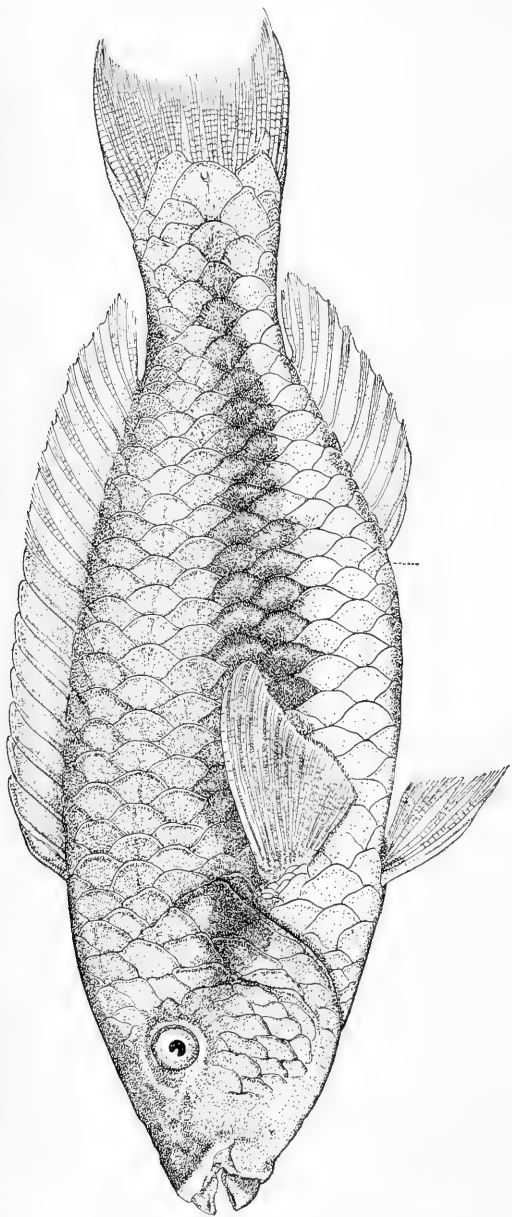


FIG. 7.—*CALLYODON LATIFASCIATUS*.

dusky blotch on upper axis of pectorals.

Two fine specimens, 10.25 and 11.25 inches long from Zamboanga. *Type-specimen*.—Cat. No. 57845, U.S.N.M.; 11.25 inches long.

An annotated list of the species other than those described as new, and which Doctor Mearns informs us were all taken at or in the immediate vicinity of Zamboanga, follows:

Family DASYATIDÆ.

Dasyatis kuhli (Müller and Henle).

One specimen, 9.50 inches long (tail absent).

Tæniura lymma (Forskål).

One specimen. Snout to vent 11 inches; vent to end of caudal 16.50 inches.

Family CHANIDÆ.

Chanos chanos (Forskål).

Two specimens, each 12 inches long.

Family CLUPEIDÆ.

Clupea melanura (Cuvier and Valenciennes).

Five specimens, 4.75 to 5.25 inches long.

Harengula moluccensis Bleeker.

One specimen, 1.75 inches long.

Family DOROSOMATIDÆ.

Konosirus nasus (Bloch).

Four specimens, 5.50 to 6 inches long.

Family ENGRAULIDÆ.

Anchovia bælama (Forskål).

Two specimens, 1.25 and 2.50 inches long. Numerous additional specimens, 3 to 3.50 inches long, are slightly more elongate than figured by Doctor Bleeker, but in other respects agree very well with the description of *A. bælama*.

Family ANGUILLIDÆ.

Anguilla mauritiana Bennett.

Four specimens, 12 to 22 inches long, bearing collector's numbers 937, 938, 939, and 980.

Family MURÆNIDÆ.

Gymnothorax fimbriata (Bennett).

One fine specimen, 30 inches long, agrees quite well with Doctor Bleeker's figure of *Gymnothorax isingleenoides*, which Doctor Gunther placed in the synonymy of *G. fimbriata*.

Family PLOTOSIDÆ.

Plotosus anguillaris (Bloch).

Three specimens, 8 to 9 inches long, and a very large number of young from 1.75 to 2.50 inches long.

Family SYNGNATHIDÆ.

Gasterotokeus biaculeatus (Bloch).

One specimen, 5 inches long.

Syngnathus schlegelii Kaup.

One specimen.

Corythoichthys bleekeri Day.

Six specimens.

Family HIPPOCAMPIDÆ.

Hippocampus kuda (Bleeker).

Two dried specimens, 3½ inches long.

Family PEGASIDÆ.

Zalises draconis (Linnæus).

Two specimens, 2.50 inches long.

Family BELONIDÆ.

Tylosurus leiurus (Bleeker).

One specimen, 3.50 inches long.

Tylosurus leiuioides (Bleeker).

Four specimens, 3.50 to 7 inches long.

Family EXOCETIDÆ.

Cypsilurus altipinnis (Cuvier and Valenciennes).

One specimen, 6.75 inches long.

Zenarchopterus dispar (Cuvier and Valenciennes).

One specimen, 6 inches long.

Zenarchopterus philippinus Peters.

Six specimens, 2 to 4 inches long.

Family ATHERINIDÆ.

Atherina lacunosa Forster.

Numerous specimens, 1.75 to 3.50 inches long. Four examples have a very distinct lateral band, but no dusky shades in pectorals.

Family MUGILIDÆ.

Liza waigiensis (Quoy and Gaimard).

Ten specimens, 1.50 to 3.50 inches long.

Liza troscheli (Bleeker).

Numerous specimens, 1 to 3 inches long.

Liza amarula (Cuvier and Valenciennes).

Numerous specimens, 1 to 4.50 inches long.

Family SPHYRÆNIDÆ.

Sphyræna obtusata (Cuvier and Valenciennes).

Two specimens, 10.75 and 18.25 inches long.

Polydactylus plebeius (Broussonet).

Head, 3; depth, 3.75; eye, 4.20 in head; snout, 4.75.

D., VIII, 1, 13; A., III, 13; scales 58 to end of caudal vertebræ, 63 to end of lateral line. Pectoral appendages 5. Color in spirits Yellowish white, darker above, and with a streak along each row of scales; fins dusky; caudal yellowish, margined with dusky.

Two fine specimens, 9.50 and 10 inches long.

Careful comparison of these examples with specimens from Samoa leave no doubt in our minds that the fish are identical, and that the species described as *Polydactylus zophomus* by Jordan and McGregor is the young *P. plebeius*. The number of rows of scales are the same.

Family HOLOCENTRIDÆ.

Holocentrus cornutus Bleeker.

Three specimens, 8 to 8.50 inches long.

Holocentrus caudimaculatum Rüppell.

One fine specimen, 10.50 inches long, from Zamboanga. Color in spirits yellowish, with indistinct pinkish lines on center of rows of scales. Spinous dorsal orange.

Myripristis murdjan (Forskål).

One specimen, 8 inches long.

Myripristis macrolepis (Bleeker).

One specimen, 8 inches long.

Family SCOMBRIDÆ.

Scomber macrolepidotus Rüppell.

Two specimens, 10 and 10.50 inches long.

Family CARANGIDÆ.

Scombroides toloo-parah (Rüppell).

Two specimens, 6.25 inches long.

Scombroides tala (Cuvier and Valenciennes).

One specimen, 26 inches long.

Caranx speciosus (Forskål).

One specimen, 15.50 inches long. Cross bands of body alternating wide and narrow; distinct.

Caranx sexfasciatus Quoy and Gaimard.

Six young specimens, 2 to 3.75 inches long.

Caranx carangus (Bloch).

Six young specimens, 2.75 to 4.75 inches long.

Megalaspis cordyla (Linnaeus).

Four specimens, 8 to 9 inches long.

Alectis ciliaris (Bloch).

One specimen, 13 inches long.

Family EQUULIDÆ.

Leiognathus dussumieri (Cuvier and Valenciennes).

One specimen, 2 inches long.

Leiognathus edentula (Bloch).

Two fine specimens, 7 to 7.50 inches long.

Family APOGONICHTHYIDÆ.

Archamia lineolata (Ehrenberg).

Five young specimens, 1.25 inches long. These have the caudal spot well developed, but do not show a distinct shoulder spot.

Amia orbicularis (Kuhl and v. Hasselt).

One specimen, mutilated, about 3.50 inches long.

Amia fasciata (Quoy and Gaimard).

One specimen, 1.50 inches long.

Family AMBASSIDÆ.

Priopis lungi Jordan and Seale.

Numerous specimens, 1.20 to 3 inches long.

Priopis urotænia (Bleeker).

Numerous specimens, 1 to 3 inches long.

Family KUHLIIDÆ.

Kuhlia rupestris (Lacépède).

Two specimens, 5.25 to 11 inches long.

Kuhlia malo (Cuvier and Valenciennes).

One specimen, 2.62 inches long.

Family SERRANIDÆ.

Epinephelus merra Bloch.

Two specimens, 6.30 and 8.50 inches long.

Epinephelus tauvina (Forskål).

Two specimens, 7.75 and 8.50 inches long.

Epinephelus fasciatus (Forskål).

Two specimens, 10.10 and 10.25 inches long.

Epinephelus undulosus (Quoy and Gaimard).

One specimen, 11.25 inches long.

Cephalopholis urodelus (Forster).

One specimen, 8 inches long.

Cephalopholis obtusauris Evermann and Seale.

One specimen, 12.50 inches long.

Cephalopholis sonnerati (Cuvier and Valenciennes).

Third anal spine slightly longer than the second, 3.50 in head; second anal spine 4.10 in head. One specimen, 14 inches long.

Family LUTIANIDÆ.

Lutianus marginatus (Cuvier and Valenciennes).

Seven specimens, 1.50 to 4 inches long.

Lutianus monostigma (Cuvier and Valenciennes).

Five specimens, 2.50 to 4 inches long.

Lutianus fulviflamma (Bleeker).

Six specimens, 2 to 7 inches long.

Lutianus chrysotænia (Bleeker).

Two specimens, 10.50 inches long.

Lutianus gibbus (Forskål).

One specimen, 19 inches long.

Lutianus vitta (Quoy and Gaimard).

One specimen, 10 inches long.

Lutianus rivulatus (Cuvier and Valenciennes).

One specimen, 14 inches long. Four young specimens from the Philippine Islands show less of the rivulated markings of the head, but the dusky vertical cross bands are very distinct.

Lutianus kasmira (Forskål).

One specimen, 8 inches long.

Diacope sebæ Cuvier and Valenciennes.

Two fine specimens, 8 to 12 inches long.

Gymnocranius lethrinoides (Bleeker).

One specimen, 12.50 inches long.

Family HÆMULIDÆ.

Cæsis lunaris (Ehrenberg).

One specimen, 12 inches long.

Cæsis erythrogaster (Kuhl and van Hasselt).

Odontonectes GÜNTHER, Fishes Brit. Mus., I, p. 265.

One specimen 12 inches long.

Terapon jarbua (Forskål).

Nine specimens, 0.75 to 8.50 inches long.

Terapon theraps Cuvier and Valenciennes.

One very young specimen.

Scolopsis cancellatus (Cuvier and Valenciennes).

Seven specimens, 7.50 inches long.

Scolopsis bimaculatus Rüppell.

One specimen, 11.50 inches long.

Pristipoma hasta (Bloch).

Three specimens, 1.50 to 13.50 inches long. These represent the form called *Pristipoma hasta* by Bleeker and figured.^a

Euelaticthys crassispinus (Rüppell).

One specimen, 4.50 inches long.

Pentapus nemurus (Bleeker).

Two specimens, 11 and 11.50 inches long.

Plectorhynchus hæmatochir (Bleeker).

One specimen, 16.50 inches long. This specimen agrees in every respect with Bleeker's figure.

Family SPARIDÆ.

Lethrinus miniatus (Forster).

Two specimens, 9.25 and 11 inches long.

Lethrinus harak (Forskål).

Three specimens, 2.75 to 12 inches long.

Lethrinus richardsoni Günther.

Three specimens, 8, 10, and 11 inches long.

Lethrinus mashenoides Ehrenberg.

Two specimens, 12.50 and 14.75 inches long. We refer this to his species with some doubt. They have a dusky mark on the sides between base of pectoral and lateral line. Head 3.10 to base of caudal vertebræ, depth 2.60; eye 3.75 in head, 1.90 in snout; dorsal X, 9; anal 8; scales 48; teeth, distinct molars on sides of jaws; canines in front; color in spirits silvery, no dark bands or bars except a dusky spot above axil of pectorals.

Lethrinus xanthotænia Bleeker.

One specimen 12 inches long.

Family GERRIDÆ.

Xystæma kapas (Bleeker).

Three specimens, 2.50 inches long.

Xystæma punctatum (Cuvier and Valenciennes).

Twenty-three young, length .25 to 1.50 inches. Characterized by the seven dark vertical bands.

Xyxtæma oyena (Forskål).

Five specimens, 1 to 4 inches long.

^a Atlas Ichthy., VIII, pl. cccxxv, fig. 3.

Family SCIAENIDÆ.

Umbrina dussumieri Cuvier and Valenciennes.

Three specimens, 5 inches long.

Family SILLAGINIDÆ.

Sillago maculato Quoy and Gaimard.

One specimen, 5.50 inches long.

Family MULLIDÆ.

Pseudupeneus moana Jordan and Seale.

Three specimens, 8.25 to 9 inches long.

Upeneus vittatus (Forskål).

Four specimens, 4.50 to 8.50 inches long.

Family TOXOTIDÆ.

Toxotes jaculatrix (Pallas).

Two specimens, 7.25 inches long.

Family POMACENTRIDÆ.

Abudefduf septemfasciatus (Cuvier and Valenciennes).

Four specimens, 2.10 to 6 inches long.

Abudefduf antjerius (Kuhl and van Hasselt).

One very young specimen, 1 inch long.

Family LABRIDÆ.

Lepidaplois bilunulatus (Lacépède).

Two specimens, 8.75 and 9 inches long.

Color in spirits, pinkish white; a large jet-black blotch extending forward at the posterior axis of soft dorsal; a wide black line extending back from angle of mouth to lower posterior edge of opercle; a black spot on anterior part of spinous dorsal.

Cheilinus trilobatus Lacépède.

One specimen, 7.50 inches long.

Cheilinus chlorurus (Bloch).

One specimen 7 inches long.

Cheilio inermis (Forskål).

Four specimens 10.50 to 11.50 inches long.

Family SCARICHTHYIDÆ.

Chærops macrodon Bleeker.

Two specimens 7 and 10 inches long; collected August, 1906.

Scarichthys cæruleopunctatus (Rüppell).

Three specimens 9.50 to 10 inches long.

Scarichthys auritus (Kuhl and van Hasselt).

Two specimens 7.50 and 8 inches long.

Callyodon nigra Rüppell.

Two specimens 11 and 12 inches long; collected August, 1906.

Callyodon macrorhinus (Bleeker).

One specimen 14.50 inches long; collected in August, 1906.

Callyodon rivulatus (Cuvier and Valenciennes).

One specimen 13.50 inches long; collected in August, 1906.

Callyodon zonularis Jordan and Seale.

Two specimens 8.50 and 9.50 inches long; collected in August, 1906.

Family PLATACIDÆ.

Platax orbicularis (Forskål).

One specimen 12.50 inches long; collected in 1906.

One young specimen 1.875 inches long.

Family SCATOPHIAGIDÆ.

Scatophagus argus? (Gmelin).

The following description of the young of this species is based on three specimens 0.40 to 0.55 inches long; collected at Zamboanga:

Body strongly compressed, elevated, the outline suborbicular;

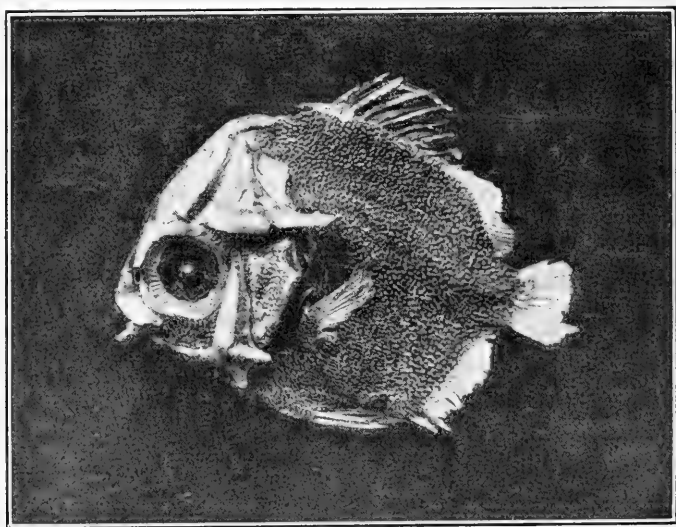


FIG. 8.—SCATOPHAGUS ARGUS, YOUNG.

trunk covered with minute setiform scales; fins unscaled except two or three rows of minute scales at base of soft dorsal and anal; caudal peduncle unarmed; head covered with bony armature; the preorbital unarmed; angle of preopercle spinate; mouth small terminal; teeth consisting of a single series of flat, notched incisors; no teeth on vomer or palatines; branchiostegal rays 5; gills 4; gill membrane slightly attached to isthmus; two dorsal fins; the spinous portion

with about eleven spines; anal with three spines; ventrals large, thoracic, I, 5.

Head, 2.10; depth, 1.25; eye, 2.30 in head; snout, 3 in head; inter-orbital about equal to eye.

D. —, XI, 16; A. III, 14; Br. 5; gills 4, a slit behind fourth. Gill-rakers short, about 12 on lower limb. Body without distinct scales, velvety. Lateral line present but indistinct.

Head inclosed in a bony armature. A strong protuberance at the upper posterior margin of the orbit followed by a strong spine. Above this a flat nuchal spine. Preopercle with a strong vertical stay and three spine-like points diverging from its lower angle. Preorbital narrow, unarmed; mouth small. Teth, a single series of compressed lobate incisors about six on each side of lower jaw and twelve in the upper.

Body elevated, compressed. Depth of caudal peduncle about twice its length, without spines or plates. Dorsal fins scarcely united; fourth spine the longest, its length slightly greater than diameter of orbit. Soft dorsal low, its height less than that of spinous dorsal, anal similar to soft dorsal; the three anal spines about equal in length. Caudal rounded, its length 1.50 in head. Pectorals broad with about 15 united rays. Ventrals large, I, 5; their length 1.75 in head, their tip almost reaching anal.

Color very dark brown with four indistinct black vertical bands of less width than the interspaces. Spinous dorsal and ventrals black; soft dorsal, anal, and pectorals, yellowish white.

An additional specimen, 1.50 inches long, is included in the lot.

Family ACANTHURIDÆ.

Acanthurus tuberosus (Cuvier and Valenciennes).

One 11-inch specimen.

Acanthurus lituratus (Forster).

One 16-inch specimen.

Acanthurus marginatus Cuvier and Valenciennes.

One 12-inch specimen, 1906.

Acanthurus annulatus (Quoy and Gaimard).

One 20-inch specimen.

Hepatus dussumieri (Cuvier and Valenciennes).

One specimen, length 12.75 inches.

Hepatus celebicus (Bleeker).

Six specimens, length 2 to 2.25 inches, and three young.

Family SIGANIDÆ.

Siganus virgatus (Cuvier and Valenciennes).

Two specimens, length 8.25 and 9.20 inches.

Siganus fuscescens (Houttuyn).

Two specimens length 7 and 7.50 inches.

Siganus vermiculatus (Kuhl and van Hasselt).

Two specimens, length 8 and 9.25 inches.

Family BALISTIDÆ.

Balistes verrucosus Bleeker.

One specimen.

Family TETRAODONTIDÆ.

Canthigaster compressus (Procé).

One specimen, length 2.50 inches.

Tetraodon immaculatus Bloch.

Three specimens.

Tetraodon reticulatus Bloch and Schneider.

One specimen, length 1.50 inches.

Tetraodon patoca Buchanan.

Nine specimens, length 0.50 to 4 inches.

Spheroides lunaris? (Bloch).

One very young, length 0.50 inch.

Family SCORPÆNIDÆ.

Synancidium horridum (Linnæus).

Three examples, 9 and 10 inches long.

Family NOTOTHENIIDÆ.

Parapercis cylindrica? (Bloch).

One very young specimen.

Family GOBIIDÆ.

Mapo fuscus (Rüppell).

Eleven specimens.

Gnatholepis sternbergi Smith.

One young specimen, length 1 inch, referred with some doubt to this species.

Odontobutis obscurus (Peters).

Nine specimens.

Drombus plackyi Jordan and Seale.

Two specimens, one, length 2.50 inches, the other length 2.25 inches.

These specimens are larger and better preserved than the type with which we have compared them. The dark blotch in the spinous dorsal is very distinct. There is also a light margin to the soft dorsal and a whitish margin to the upper caudal rays, the body is dusky without marks. The white spot at the upper axis of pectoral is indistinct.

Eleotris ophiocephalus (Kuhl and van Hasselt).

One young, length 1.50 inches.

THE WEST AMERICAN MOLLUSKS OF THE GENUS TRIPHORIS.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

The West American members of this genus were first brought to the attention of conchologists by Prof. C. B. Adams, who in 1852 described three species in his catalogue of shells collected at Panama,^a *Triphoris alternatus*, *inconspicuus*, and *infrequens*. Of these, the last, *Triphoris infrequens* has proved to be a *Cerithiopsis*.^b Later,^c Doctor Carpenter reported the occurrence of *Triforis adversa* Montagu, a common European species, on the West Coast. The specimens referred to, by him, are not the Old World species but must be cited under one or several of the forms described in the present report.

Through the kindness of Prof. John Tyler, of Amherst College, I have been enabled to examine, redescribe, and figure, the original specimen described by Doctor Adams.

TRIPHORIS MONTEREYENSIS, new species.

Plate XVI, fig. 17.

Shell rather stout, brown, with a wax-yellow band about one-third the width of the height of the whorls encircling the middle of the turns. (Nucleus decollated in all the specimens examined), post-nuclear whorls separated by strongly channeled sutures, ornamented on the early turns by a double spiral^d row of tubercles and on the last

^aAnn. Lyc. Nat. Hist., V, pp. 382-383.

^bProc. Zool. Soc. London, 1863, p. 350.

^cRept. Brit. Ass. Adv. Sci., 1864, p. 613.

^dIn the preparation of the present diagnosis the following terminology is used:

Spiral sculpture, the markings following the directions of the coils of the whorls.

Axial sculpture, the markings which extend from the summit of the whorls toward the umbilicus.

The axial sculpture may be—

Vertical, when the markings are in general parallelism with the axis of the shell;

Protractive, when the markings slant from the preceding suture forward;

Retractive, when the markings slant from the suture backward.

three by a triple row, the median one of which is very slender on all but the last turn and is situated a little nearer the posterior row than the suprasutural one. There are twenty tubercles upon the second and twenty-six upon the penultimate turn. These tubercles are joined by moderately strong spiral bands and axial riblets which inclose strongly impressed rounded pits between them. The periphery is marked by a keel almost as strong as the suprapерipheral one, while the base, which is uniformly dark brown, bears two prominent keels, the anterior one of which is well upon the short, stout columella. The channels between these keels are crossed by the feeble extensions of the axial riblets. Aperture strongly channeled anteriorly and posteriorly; columella and parietal wall covered with a strong callus.

The type and two additional specimens, Cat. No. 32216, U.S.N.M., come from Monterey, California. The type has the last seven whorls and measures: length, 4.6 mm.; diameter, 2.2 mm. Two other specimens, Cat. No. 56015, U.S.N.M., come from the same locality, and a sixth, in the collection of Mr. S. S. Berry, was dredged in 12 fathoms off Del Monte, Monterey Bay, California.

TRIPHORIS PEDROANUS, new species.

Plate XVI, fig. 1.

Shell sinistral, elongate-conic, light brown. Nuclear whorls four, increasing regularly in size. The first three smooth, probably by erosion, the next faintly, obsoletely sculptured by about thirty-six slender, equally strong and equally spaced, axial riblets and two slender spiral threads, separated by a narrow channel near the periphery of the whorl. Succeeding turns separated by broad and deep channeled sutures; the first seven ornamented by two equally strong spiral rows of tubercles, which are separated by a channel, as wide as that at the sutures. Beginning with the eighth turn, a slender tuberculate keel makes its appearance in this channel, situated a little nearer the posterior keel than the suprasutural one. This keel increases steadily in size and on the penultimate turn exceeds the suprapерipheral one in strength. On the last three turns the tubercles of the posterior keel are a little more strongly developed than on the other keels. On all the keels the tubercles slope a little more abruptly at their posterior border, the anterior edge being gently rounded. There are fifteen tubercles upon the first, seventeen upon the fifth, and twenty-four upon the penultimate postnuclear turn. The tubercles are connected spirally by a moderately wide band and axially by slender riblets, the spaces inclosed between these connections appearing as rounded pits. The entire surface of the spire is crossed by numerous microscopic spiral lines and lines of growth. Periphery of

the last whorl ornamented by a tubercular keel, which is not quite as strong as the suprapерipheral keel. Base dark brown, moderately long, marked by two strong spiral keels, the anterior one of which is situated partly upon the columella, while the other one occupies a plane half way between the anterior and the peripheral keel. The spaces which separate these keels are about equal in width and are crossed by slender continuations of the axial riblets. Columella stout and twisted, marked by slender spiral lirations. Aperture pyriform, strongly channeled anteriorly and posteriorly; outer lip patulous, marked within by a light brown band posteriorly and a narrow dark-brown zone at the base; columella and parietal wall covered with a thick callus.

The above description is based upon two specimens, cotypes, Cat. No. 152206, U.S.N.M. An adult individual, from San Pedro, California, has furnished the description of the adult features. It has lost the nuclear whorls. The eight which remain measure: Length, 5.1 mm.; diameter, 1.9 mm. Cat. No. 56910, U.S.N.M., a juvenile specimen, collected by Dr. W. H. Dall, at Catalina Island, California, has furnished the description of the nuclear and early post-nuclear turns. It has four nuclear whorls and seven and one-half post-nuclear turns, and measures: Length, 3 mm.; diameter, 1.35 mm. A third specimen, Cat. No. 56017, U.S.N.M., was collected by Doctor Dall at San Diego, California. A fourth was collected by Mr. F. W. Kelsey among rocks in sand and gravel at low tide at Ocean Beach, California. Three fossil specimens from the Upper San Pedro Series, at the lumber yard, San Pedro, California, were examined in Mr. Delos Arnold's collection.

TRIPHORIS CALLIPYRGUS, new species.

Plate XVI, fig. 4.

Shell elongate, conic, subturritid, uniformly light brown. (Early whorls decollated.) The remaining seven are separated by strongly impressed sutures, and are ornamented with three spiral tuberculate keels on the spire. The middle one of these keels is decidedly stronger than the rest and marks the widest part of the turns, while the anterior one is the least developed on all the early turns. On the last whorl the three are subequal. In addition to the spiral keels the spire is marked by slender, axial riblets, of which there are about eighteen upon the first of the remaining and twenty upon the penultimate turn, the intersection of the riblets and the spiral keels forming the tubercles. The tubercles slope convexly toward their anterior limit and are somewhat excavated posteriorly. Periphery of the last whorl marked by a sulcus. Base with two equally strong keels on the posterior half, separated from each other by a sulcus as wide as the peripheral one, and a third weak thread on the base of the thick

columella. Aperture irregular, the main portion subcircular, strongly channelled posteriorly and anteriorly; outer lip moderately strong, columella short, stout, and decidedly twisted, covered partly by the very strong purplish parietal callus.

The type, Cat. No. 195377, U.S.N.M., comes from San Pedro, California, and measures: Length, 5.2 mm.; diameter, 2.2 mm.

This species differs from all the other Californian *Triphoris* in having the middle keel between the sutures best developed, forming a prominent shoulder at this point, while the one at the summit is only feebly represented, the reverse being true in the other species.

TRIPHORIS CARPENTERI, new species.

Plate XVI, fig. 16.

Triforis adversa CARPENTER, Rept. Brit. Ass. Adv. Sci., 1863, p. 628, in part; not *Triphoris adversus* Montagu.

Shell elongate-conic, almost cylindric, bleached, white. (Early whorls decollated.) Later turns ornamented by three spiral ridges, of which the posterior one is a little more strongly developed than the other two and forms the summit of the whorls. The other two spiral ridges are equal and equally spaced. In addition to the spiral ridges, the whorls are marked by axial ribs, about as strong as the spiral ridges, the intersection of the ribs and ridges forming strong tubercles, while the spaces inclosed between them appear as deeply impressed square pits. There appear to be about twenty-two tubercles upon all the whorls. The sutures appear as broad, deep channels, which are crossed by the extensions of the axial ribs. On the last three turns the posterior edge of the peripheral keel is apparent in the suture. In addition to the above sculpture, the entire surface of the spire is marked with microscopic lines of growth and equally fine spiral striations. Periphery of the last turn marked by a strong spiral keel. Base marked by two strong rounded keels, of which the posterior one is separated about as far from the peripheral keel as that is separated from the supraperipheral one. The anterior keel of the base is situated on the columella and is separated by a little wider and deeper channel from the posterior keel than that is from its posterior neighbor; anteriorly it is limited by a feebly impressed groove. The channels of the base are crossed by weak continuations of the axial riblets. Aperture ovate, strongly channelled anteriorly and moderately so posteriorly; columella short, stout, and twisted; covered by a strong callus which also extends over the parietal wall.

The type, Cat. No. 15583, U.S.N.M., was collected in Neah Bay, Washington, by J. G. Swan. It consists of the last eight turns, which measure: Length, 7.2 mm.; diameter, 2.2 mm.

TRIPHORIS HEMPHILLI, new species.

Plate XVI, fig. 12.

Shell sinistral, elongate-conic, chestnut brown. (Nuclear whorls decollated.) Succeeding turns separated by strong channeled sutures, ornamented on the first five turns by a double spiral row of tubercles which are separated by a channel a little wider than the tubercles. Beginning with the sixth turn, a slender, spiral, faintly tuberculate keel, placed a little nearer the posterior than the suprasutural row of tubercles, makes its appearance in the channel. This keel remains slender and does not quite attain the strength of the suprasutural one, even on the last turn. The tubercles are joined spirally by quite strong connections and axially by moderately strong riblets. The spaces inclosed by these joining elements appear as elongated pits, of which the axial axis is the longest. There are sixteen tubercles upon the second and twenty-two upon the penultimate turn. The tubercles, as well as their spiral connections, are somewhat excavated posteriorly, but well rounded anteriorly, and the posterior row of tubercles is considerably more strongly developed than the suprasutural on the last five turns. In addition to the sculpture described, the entire surface of the spire, tubercles, and intertubercular spaces are marked by slender lines of growth. Periphery of the last whorl, marked by a tubercular cord, a little less strongly developed than the suprasutural one. Base rather elongated, marked by two rather broad, low, spiral cords, the anterior one of which is partly situated upon the columella. The well rounded channel, which separates these keels, as well as the suprapерipheral channel, are crossed by weak continuations of the axial riblets. Aperture decidedly channeled anteriorly, posterior angle obtuse; columella thick and twisted, covered with a thick callus, which extends over the parietal wall.

The type has ten post-nuclear whorls and measures: Length, 5.1 mm.; diameter, 1.6 mm. It and two additional specimens are entered as Cat. No. 106423, U.S.N.M. They were collected by Mr. Henry Hemphill from shell washings at Point Abreojos, Lower California.

TRIPHORIS CATALINENSIS, new species.

Plate XVI, fig. 18.

Shell sinistral, elongate-conic, rather stout, with the posterior half of the exposed portion of the whorls white and the anterior half light brown. (Part of the nuclear whorls decollated.) The three and one-half remaining turns of the nucleus increase regularly in size and are marked by about twenty-six slender axial riblets on the first and thirty-two on the next and the third whorl. In addition to these riblets the nuclear whorls are encircled by two prominent sublamellar

slender, finely tuberculate spiral keels, which are placed about equidistant from the sutures and are a little nearer to each other than to the sutures. The anterior one of these keels is much more strongly developed on the last nuclear turn than the posterior member. The intersection of the spiral keels and axial riblets are tuberculate. The whorls have a strong sloping shoulder which extends from the posterior keel to the summit. Post-nuclear whorls separated by strongly marked sutures, ornamented by two spiral rows of nodules, of which the posterior one is the stronger. These two rows of nodules are separated on the first seven post-nuclear whorls by a spiral channel almost as wide as the suture. From the seventh post-nuclear whorl on, a slender, spiral, weakly tuberculate cord makes its appearance in the channel, growing stronger with each succeeding turn. This cord is situated a little nearer the posterior row of tubercles than the anterior, and like the posterior row of tubercles is white. The tubercles are connected by blunt, ill-defined, axial riblets. There are about twenty tubercles on the first and fifth post-nuclear whorls and twenty-four upon the penultimate turn. In addition to the strong sculpture just defined, the entire surface, tubercles and depressions, are crossed by many fine lines of growth and spiral striations. Periphery of the last whorl marked by a slender, weakly tuberculate keel. Base exceedingly short, almost flat, crossed by strong lines of growth and fine spiral striations, marked by a brown band at the insertion of the columella. Aperture subquadrate, outer lip sinuous, conforming with the external sculpture, basal wall slightly concave; columella very stout, short, and strongly twisted. Basal channel well developed.

The type, which is unique—Cat. No. 193998, U.S.N.M.—is an immature specimen and comes from Catalina Island, California. It has ten post-nuclear whorls and measures: Length, 5.3 mm.; diameter, 2.2 mm.

TRIPHORIS STEARNSI, new species.

Plate XVI, fig. 3.

Shell elongate-conic, sinistral, flesh colored. (Early whorls decolated.) The nine remaining are moderately high, marked by a double spiral row of very strong, equally developed, rounded tubercles, which are separated on the first three turns by a channel as deep and well marked as the sutures. This space between the two rows of tubercles gradually develops into a slender tuberculate keel, which on the last turn is about half as wide as the tubercular ridges. There are about eighteen tubercles on the third to seventh of the remaining whorls and twenty on the penultimate. Periphery angulated. Base short, marked by two strong spiral keels. (Aperture fractured.)

The type, Cat. No. 32259, U.S.N.M., belongs to the Stearns collection and was found in the Gulf of California. It measures: Length, 4.1 mm.; diameter, 1.4 mm.

TRIPHORIS PENINSULARIS, new species.

Plate XVI, fig. 2.

Shell sinistral, small, broadly elongate, conic, dark brown. Nuclear whorls four, light brown, increasing regularly in size, provided with spiral and axial sculpture (but this is too badly worn to be properly diagnosed in all our specimens). Post-nuclear whorls eight, separated by channelled sutures. The first four post-nuclear whorls have a double spiral row of tubercles, the posterior row being a little more strongly developed than the anterior. These rows are separated by a channel about as wide as the tubercular ridges. Beginning with the fifth whorl, a slender tuberculate cord appears in the middle of the channel which separates the two spiral ridges; this grows steadily in size with each turn, until on the last volution it is quite as strong as the suprasutural cord. On the later turns the middle and suprasutural spiral cords and their tubercles fall off quite abruptly at their posterior border and slope roundly toward their anterior limit. The tubercles on all the turns are joined by rather wide spiral bars and axial ribs, which inclose deep squarish pits between them. Periphery and base of the last turn well rounded, the former marked by a low somewhat flattened keel, which is separated from the suprapерipheral cord by a channel as wide as the one which separates the suprapерipheral keel from the middle one. The channel is crossed by the extension of the axial riblets. The base is marked by two spiral cords about as broad and of the same character as the peripheral one. These cords are separated by channels as broad as that which separate the peripheral cord from the suprapерipheral one and are crossed by feeble extensions of the axial riblets. The anterior basal cord is situated upon the base of columella and its anterior border fuses almost imperceptibly with it. The entire surface is crossed by many exceedingly fine spiral striations and lines of growth. Aperture subquadrate, posterior angle obtuse, anteriorly strongly channelled; outer lip subpatulous anteriorly, not sinuous; columella short, thick, twisted. Columella and the parietal wall are covered with a strongly developed callus.

There are three specimens of this species in the collection of the U. S. National Museum, Cat. No. 106424, collected by Mr. Henry Hemphill, at Point Abrejos, Lower California. The type, which is one of these three, has lost three of its nuclear whorls; the remaining nine turns measure: Length, 4.0 mm.; diameter, 1.5 mm.

TRIPHORIS EXCOLPUS, new species.

Plate XVI, fig. 8.

Shell sinistral, with alternating brown and white zones. (Nuclear whorls decollated.) The first three of the succeeding turns are marked by a double spiral row of tubercles. On the first two turns

the posterior row is less strongly developed than the anterior and is brown in color, while the channel that separates it from the anterior and the anterior row are yellowish white. From the third whorl on the posterior row of tubercles becomes more strongly developed than the other. Beginning with the fourth turn, a slender tubercular keel appears in the space between the two tubercular ridges, which on the sixth turn is as strong as the anterior cord. Thus the shell is marked by a brown tubercular ridge at the summit and two white tubercular ridges anterior to it after the fourth turn. The tubercles are joined by a broad spiral cord and axial riblets. The connections inclose quite deep oblong pits. There are eighteen tubercles upon the first whorl, twenty-two upon the fifth, and twenty-four upon the penultimate turn. Sutures channelled. Periphery of the last whorl strongly angulated, marked by a low subacute keel. The channel between the peripheral keel and the suprapерipheral row of tubercles is crossed by weak extensions of the axial riblets. Base short, light brown, having a single slender, spiral thread, about as far anterior to the periphery as the suprasutural tuberculated ridge is posterior to it. There are also very slender extensions of the axial riblets, which pass from the periphery to the insertion of the columella. In addition to the above sculpture, the base is marked by many exceedingly fine spiral striations and lines of growth. Aperture subquadrate; posterior angle obtuse, strongly channelled anteriorly, outer lip rendered sinuous by the external sculpture. Columella short, thick, and somewhat curved, covered by a faint callus which also extends over the parietal wall.

The type is an immature specimen which has lost the nucleus. The eight remaining whorls measure: Length, 3.7 mm.; diameter, 1.6 mm. It is Cat. No. 4069, U.S.N.M., and was collected at Cape St. Lucas, Lower California. Another badly worn individual, Cat. No. 15434, U.S.N.M., is from Guacomayo, Mexico.

TRIPHORIS PANAMENSIS, new species.

Plate XVI, fig. 19.

Shell sinistral, elongate conic, of dark-brown color. Nuclear whorls three, forming a cylindrical, smooth apex. The five succeeding turns are marked by a double spiral row of tubercles, which are separated by a channel considerably wider than the channeled sutures. Beginning with the eighth turn a tuberculate cord makes its appearance in the space between the two tubercular ridges, a little nearer to the one at the summit than the suprapерipheral one. This cord, at first faintly developed, increases steadily in size, until on the last volution it almost equals the other two in strength. The tubercles occur in regular axial series and are connected spirally and axially by slender riblets, the riblets inclosing small squarish meshes. There

are about fourteen tubercles on the fourth (the first sculptured) whorl and twenty-four on the tenth and the penultimate turn. On the last ten whorls the tubercles at the summit of the whorls are considerably stronger than the other two and darker colored. The sutures on the later whorls are deeply channeled; the channels are crossed by a slender riblet at each tubercle. Periphery of the last whorl marked by a strong keel which is weakly tuberculate. Base marked by two spiral keels a little weaker than the peripheral one. These two are ornamented by feebly developed tubercles, the deep channels between them being crossed by the continuations of the slender axial riblets. Aperture of irregular outline; posterior angle well rounded, strongly channeled anteriorly; outer lip sinuous to correspond with the external sculpture; columella very strong, twisted.

The type, Cat. No. 56014, U.S.N.M., is from Panama. It has seventeen whorls, and measures: Length, 8.7 mm.; diameter, 2.2 mm.

TRIPHORIS DALLI, new species.

Plate XVI, fig. 14.

Shell acicular, increasing regularly in size, irregularly variegated with varying shades of brown, yellow, and white. Nuclear whorls four, brown, marked by two strong, narrow spiral threads which divide the space between the sutures into three parts, of which the anterior two are about equal, while the posterior one is a little wider than the rest. In addition to the spiral threads, the surface is marked by many regular, slender, axial riblets, almost as strong as the spiral keels; of these there are about thirty upon the second and twenty-eight upon the fourth turn. The first three postnuclear turns are white, the remaining variegated. The early ones are marked by a double row of tubercles, one at the summit, the other at the periphery, separated by a broad channel. The anterior one is the stronger. Beginning with the fourth turn, a slender thread makes its appearance in the intermediate channel, a little posterior to the middle. This remains slender and on none of the turns, not even the last, becomes as strongly developed as the other two. The postnuclear whorls are also marked by poorly developed, rather broad, axial riblets, the intersection of which with the spiral keels marks the tubercles. The tubercles slope more abruptly posteriorly than anteriorly. The entire surface is crossed, in addition to the above-described sculpture, by microscopic spiral and axial lines. Sutures strongly impressed. Periphery of the last whorl marked by a well-impressed channel. Base rather short, evenly rounded, marked by three keels, of which the first adjoins the peripheral sulcus and is beaded and colored like its posterior neighbor. The other two keels are not tuberculate and

are separated by a channel a little deeper and wider than the channel which separates the middle keel from the first. The third keel is the least developed and is situated on the base of the columella. The anterior part of the base, including the median keel, is of light-brown color. Aperture irregular, the main portion circular. The posterior slit closed at the edge, but with a circular perforation a little distance behind the edge; anteriorly the outer lip is closely appressed to the columella, but a circular perforation is present at the base of the columella. Columella short and decidedly twisted. The type has seventeen whorls, and measures: Length, 6.5 mm.; diameter, 2.0 mm.

The type and three specimens, Cat. No. 195375, U.S.N.M., were dredged by the steamer *Albatross*, of the U. S. Bureau of Fisheries, at Station 2798, in 18 fathoms in the Bay of Panama.

TRIPHORIS INCONSPICUUS C. B. Adams.

Plate XVI, fig. 15.

Triphoris inconspicuus C. B. ADAMS, Ann. Lyc. Nat. Hist. N. Y., 1852, p. 383.

Shell small and slender, reddish brown fading to reddish yellow on the last turn, with the supra-sutural keel yellowish white. Nuclear whorls fine, the first two yellowish white, feebly sculptured, the other three brown, marked by two strong narrow spiral threads, which divide the space between the sutures into three parts, of which the anterior two are about equal while the posterior one is a little wider than the rest. In addition to the spiral threads, the surface is marked by regular, slender, axial riblets, which are about as strong as the spiral threads; of these there are about twenty-four upon the fourth and twenty-eight upon the fifth turn. Post-nuclear whorls separated by deeply channeled sutures, ornamented on the early whorls by two narrow, tuberculate, spiral keels, which are separated by a very wide channel. The tubercles are connected across this channel by the rather strong, protractive, axial riblets, of which there are about sixteen upon the first, twenty-two upon the fifth, and twenty-six upon the penultimate post-nuclear whorls. Beginning with the fifth post-nuclear turn, the middle band makes its appearance in the middle of the channel. This increases steadily in size, but attains only about half the size of the anterior keel on the last turn. In addition to this strong sculpture, the entire surface of the spire, tubercles, and interspaces are marked by microscopic lines of growth and spiral striations. Periphery of the last whorl marked by a rather narrow deep channel. Base with three prominent, equally strong, and equally spaced keels. The peripheral sulcus and the two basal sulci between the keels are marked by the continuations of the axial riblets. Aperture irregular, pyriform, decidedly channeled posteriorly, main portion subcircular; parietal wall covered with a very thick callus, which extends down along the short, stout, and anteriorly decidedly twisted columella.

The basal portion of the outer lip is closely appressed to the columellar callus and completely closes the anterior channel, leaving only a round perforation at the anterior extremity of the columella.

The specimen described and figured, Cat. No. 195376, U.S.N.M., has fifteen whorls and measures: Length, 4.1 mm.; diameter, 1.1 mm. It was dredged by the steamer of the U.S. Bureau of Fisheries steamer *Albatross* at Station 2798, in 18 fathoms, in the Bay of Panama. The type lot, No. 208 C. B. Adams collection, at Amherst, New Hampshire, contains ten specimens, none of which are as well preserved as the one figured.

A color form of this species has the posterior and median keel white, while the supra-peripheral one and the base are light brown. I will suggest for this form the varietal name, *bicolor*, fig. 6, Cat. No. 195376, U.S.N.M., dredged by the Fisheries steamer *Albatross* at the same station. Another specimen of this form was found among C. B. Adams type lot of *Triphoris alternatus* from Panama.

TRIPHORIS ALTERNATUS C. B. Adams.

Plate XVI, fig. 11.

Triphoris alternatus C. B. ADAMS, Ann. Lyc. Nat. Hist. N. Y., V, 1852, pp. 382-3.

Shell regularly elongate-conic, with the median and anterior spiral row of tubercles wax yellow, and the rest of the spire, periphery, and base brown on the later whorls. Nuclear whorls five, wax yellow; ornamented by two spiral ridges, the posterior one of which falls on the middle of the turns and the anterior about half way between this and the anterior suture. In addition to this they are crossed by many slender raised axial threads, thirty-two of which occur upon the last turn. The whorls are slopingly shouldered from the posterior keel to the summit. Post-nuclear whorls separated by deeply channeled sutures ornamented on the early turns by two strongly tuberculate spiral keels—one at the summit, the other at the periphery. The tubercles are formed by the intersection of the spiral keels and the axial ribs and slope rather suddenly posteriorly and roundly toward their anterior limit. Beginning with the fifth post-nuclear whorl a slender spiral cord makes its appearance in the middle of the broad channel between the two keels; this increases steadily in size, and on the last turn bears tubercles which equal those of the anterior keel in strength. Axial ribs somewhat retractive, eighteen on the first, twenty upon the fifth, and twenty-two upon the penultimate whorl. The spaces inclosed between the spiral keels and axial ribs are deep oblong pits, the long axis of which coincides with the spiral keels. Periphery of the last turn marked by a strong spiral keel. Base well rounded, marked by two strong spiral keels, the posterior one of which agrees with those posterior to it in spacing and is weakly tuberculated, while the anterior one, which is situated on the base

of the columella, is smooth and separated a little more distantly from its neighbor. The suprapertipheral and basal channels are crossed by the continuation of the axial ribs. Aperture (?) fractured; columella stout and twisted, covered by a strong callus which extends over the parietal wall.

The type, Cat. No. 207, C. B. Adams collection, Amherst College, Amherst, Massachusetts, has fifteen whorls, and measures: Length, 4.8 mm.; diameter, 1.5 mm.

There are two other specimens in the type lot, all of which were collected by Dr. C. B. Adams at Panama.

TRIPHORIS GALAPAGENSIS, new species.

Plate XVI, fig. 7.

Shell small, acicular, with the keel at the summit and the base light brown, the rest white. Nuclear whorls five, ornamented with two rather closely placed spiral threads, the posterior one of which marks the middle of the exposed portions of the nuclear whorls, and many slender, axial riblets, of which there are about twenty-four upon the fourth and twenty-eight upon the fifth turn. Post-nuclear whorls eight, separated by deep channeled sutures, ornamented on the early whorls by two strongly tuberculated keels, separated by a deep channel, which is crossed by the moderately strong axial riblets, which connect the tubercles of the two ridges. Beginning with the fourth whorl a slender keel makes its appearance between the other two, which rapidly increases in size, becomes tuberculated, and on the penultimate and last turn exceeds the basal keel in strength. There are about fourteen riblets upon the first, twenty upon the fifth, and twenty-two upon the penultimate, post-nuclear whorl. Base marked by three non-tuberculated, equally strong and equally spaced spiral ridges. Aperture irregular, pyriform, strongly channeled posteriorly and anteriorly, with a rounded opening at the anterior extremity of the short, stout, twisted columella. Parietal wall and columella covered by a strong callus.

The type and six specimens, Cat. No. 195380, U.S.N.M., were dredged by the steamer *Albatross* of the United States Bureau of Fisheries, at Station 2813, in 40 fathoms, off the Galapagos Islands. The type has thirteen whorls, and measures: Length, 3.2 mm.; diameter, 1.1 mm.

Two striking color forms of this species were found in the lot obtained from the above station. One, represented by a single specimen, Cat. No. 105380, U.S.N.M., which may be known as variety *postalbus*, fig. 5, has the posterior and median keel white, the rest brown. The other variety, *unicolor*, fig. 13, represented by nine specimens, Cat. No. 105379, U.S.N.M., is uniformly brown.

TRIPHORIS CHATHAMENSIS, new species.

Plate XVI, fig. 9.

Shell acicular, nuclear whorls light brown, the others white, excepting the narrow band that connects the tubercles into a spiral series which are brown. Nuclear whorls five, the first smooth, the rest marked by two, quite closely placed spiral threads, the posterior one of which falls on about the middle of the exposed portion of the turns. In addition to the spiral threads the whorls are marked by slender axial riblets, of which there are about twenty-four upon the second and twenty-eight upon the fifth turn. Post-nuclear whorls separated by deep sutures and ornamented from the very beginning by three tubercular spiral keels, of which the median is the most strongly and the anterior the least developed. All the tubercles slope very abruptly posteriorly, which lends them a somewhat truncated appearance at this end, and more gradually anteriorly. They are connected axially by slender riblets, of which there are about fourteen on the first, sixteen upon the fifth, and eighteen upon the penultimate post-nuclear whorl. Periphery of the last whorl marked by a slender tuberculate keel in the immature shell. Base sloping concavely from the keel to the columella; without spiral keels, crossed by the feeble continuations of the axial riblets which gradually evanesce as they approach the columella. Aperture subquadrate, irregular, strongly channeled anteriorly, outer and basal lip conforming with the external sculpture and slope, columella short, stout and slightly twisted.

The type and four specimens, Cat. No. 195381, U.S.N.M., were dredged by the U. S. Fisheries steamer *Albatross* at Station 2813, in 40 fathoms off Chatham Island, one of the Galapagos group. They are immature. The type has twelve whorls and measures: Length 2.8 mm.; diameter, 1.1 mm.

This is one of the most distinct forms known to us at present from the entire coast; the presence of the three spiral keels from the very beginning is a character possessed by only one other form, namely, *T. callipyrgus* from San Pedro, California, which is a much larger species with three basal keels.

TRIPHORIS ADAMSI, new species.

Plate XVI, fig. 10.

Shell acicular, uniformly yellowish white. Early nuclear whorls decollated; the three remaining are marked by the characteristic sculpture, the double spiral thread, the posterior one of which is upon the middle of the whorls, and many slender, axial riblets, of which there are about twenty-four upon the last turn. Post-nuclear whorls increasing very regularly in size, ornamented with a double

spiral row of strong tubercles. Channel separating these two rows quite wide. The tubercles are joined axially by low, rather broad riblets, which are decidedly protractive. Beginning with the seventh whorl the slender, median spiral thread makes its appearance. This is considerably nearer the posterior keel than the anterior, but in our specimens, which are all young, attains only a moderate development, with extremely weak tubercles. There are about eighteen ribs on the first, twenty upon the second, and twenty-two upon the penultimate post-nuclear turn. Periphery of the last whorl marked by a strong spiral keel. Base excavated without spiral keels covered by the feeble continuations of the axial riblets, which gradually fade out as they approach the short, stout slightly twisted columella. Aperture subquadrate, decidedly channeled anteriorly.

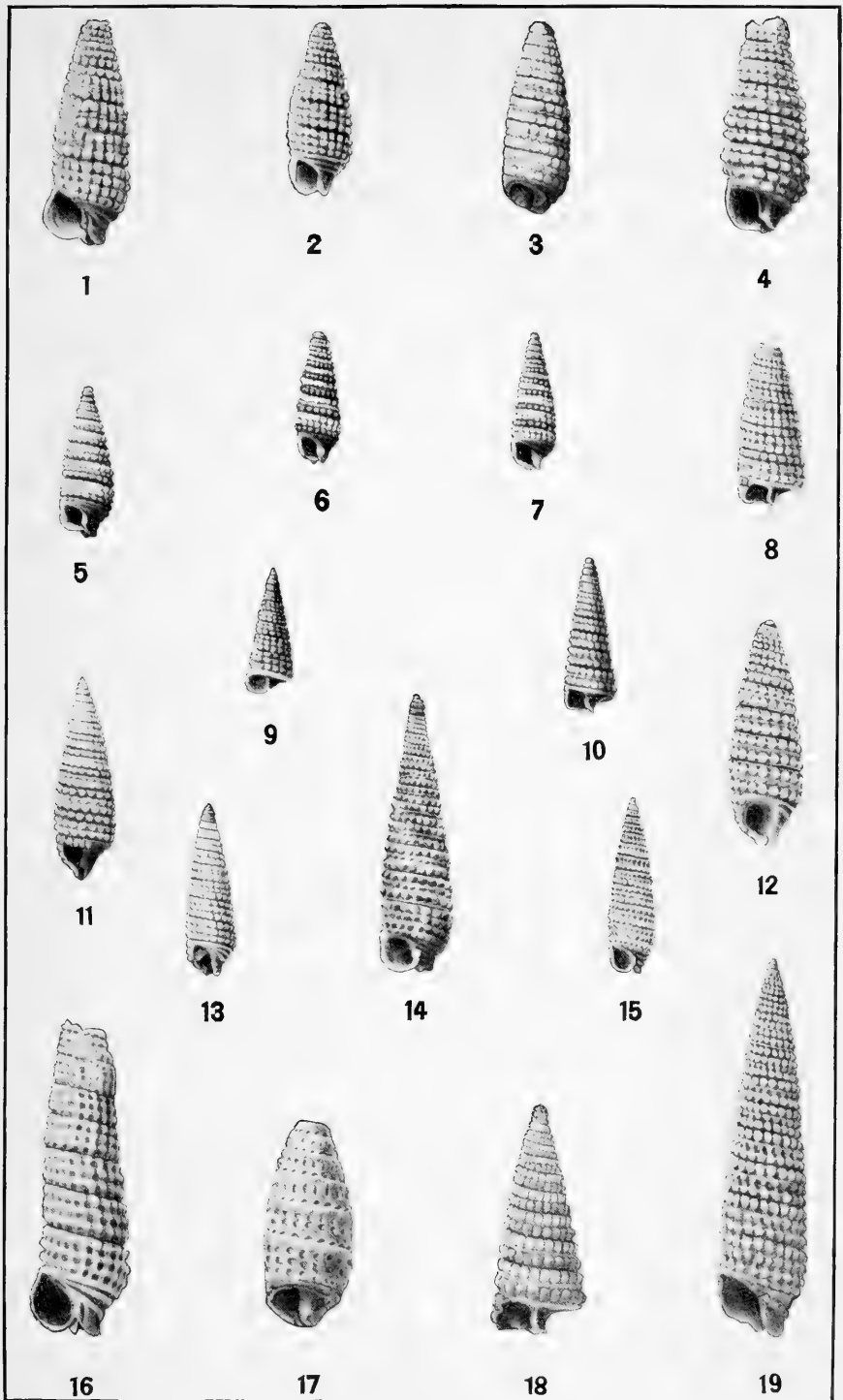
The type and two additional specimens, Cat. No. 195382, U.S.N.M., were dredged by the steamer *Albatross* of the U. S. Bureau of Fisheries, at Station 2813, in 40 fathoms, off Chatham Island, one of the Galapagos Islands. The type has twelve whorls (the first two nuclear probably having been lost) and measures: Length, 3.4 mm.; diameter, 1.2 mm.

In this form of the aperture and sculpture of the base this species agrees with *Triphoris chathamensis*, but the sculpture of the spire is entirely different.

EXPLANATION OF PLATE XVI.

The measurements cited after the name refer to the axial length of the specimen. All the figures have been enlarged six diameters.

- Fig. 1. *Triphoris pedroanus*, new species; type; 5.1 mm.
2. *Triphoris peninsularis*, new species; type; 4.0 mm.
3. *Triphoris stearnsi*, new species; type; 4.1 mm.
4. *Triphoris callipyrgus*, new species; type; 5.2 mm.
5. *Triphoris galapagensis postalbus*, new subspecies; type.
6. *Triphoris inconspicuus bicolor*, new subspecies; type.
7. *Triphoris galapagensis*, new species; type; 3.2 mm.
8. *Triphoris excolpus*, new species; type; 3.7 mm.
9. *Triphoris chathamensis*, new species; type; 2.8 mm.
10. *Triphoris adamsi*, new species; type; 3.4 mm.
11. *Triphoris alternatus* C. B. Adams; type; 4.8 mm.
12. *Triphoris hemphilli*, new species; type; 5.1 mm.
13. *Triphoris galapagensis unicolor*, new subspecies; type.
14. *Triphoris dalli*, new species; type; 6.5 mm.
15. *Triphoris inconspicuus* C. B. Adams; 4.1 mm.
16. *Triphoris carpenteri*, new species; type; 7.2 mm.
17. *Triphoris montereyensis*, new species; type; 4.6 mm.
18. *Triphoris catalinensis*, new species; type; 5.3 mm.
19. *Triphoris panamensis*, new species; type; 8.7 mm.



WEST AMERICAN MOLLUSKS.

FOR EXPLANATION OF PLATE SEE PAGE 262.

ON A COLLECTION OF FISHES FROM ECHIGO, JAPAN.

By DAVID STARR JORDAN and ROBERT EARL RICHARDSON,
Of Stanford University.

The writers have recently received from Mr. Masao Nakamura, a Japanese naturalist, teacher in the schools of Nagaoka, in the province of Echigo, in Japan, a small collection of fishes, from that region. Among these are three species new to science. Series of the specimens mentioned are in the United States National Museum and in the museum of Stanford University.

Family COBITIDÆ.

1. LEFUA^a ECHIGONIA Jordan and Richardson, new species.

Head $4\frac{2}{3}$ in length, to base of caudal; depth $5\frac{3}{4}$; D. 7 or 8; A. I, 7; scales about 90; width of head $1\frac{2}{3}$ in its length; snout 3 in head; interorbital space $2\frac{1}{2}$ in head; pectoral $1\frac{1}{2}$; ventral $2\frac{1}{4}$; eye 2 in interorbital space.



FIG. 1.—LEFUA ECHIGONIA.

Body moderately elongate, compressed behind; caudal peduncle deep, its depth fully half the length of the head; head depressed, broad and flat above, its width more than two-thirds of its length; eyes anterior, lateral; mouth somewhat inferior, subterminal, with fleshy lips, the lower jaw included, barbels 8, one pair nasal, one pair terminal on the maxillary, and two pairs on the muzzle anterior to the nasal and superior to the maxillary pair.

Scales very small, cycloid, none on the head; lateral line obsolete.

Dorsal inserted slightly behind ventrals, the base of its first ray nearer to tip of caudal than to end of snout; anal wholly behind dorsal; caudal rounded, a low adipose membrane procurent on the caudal peduncle dorsally and ventrally.

^aAccording to Dr. Leo Berg (Proc. U.S.N.M., XXXII, 1907), *Elvis* Jordan and Starks, to which this species belongs, is identical with the earlier *Lefua* Herzenstein (1888).

Color in spirits olivaceous, densely dusted everywhere except on belly with rather coarse dark specks; a lateral row of obscure, irregularly formed, or more or less broken dusky spots, each nearly as large as eye; a dark humeral spot of rectangular form situated in a pit-like depression; belly pale, whitish; dorsal and caudal finely specked with dusky; other fins plain; no large fin spots or blotches.

This species is related to *Lefua nikkomis* (Jordan and Fowler), differing from it, however, in its much smaller scales, shorter ventral fins, and in its coloration, there being no caudal blotch.

Known from three specimens $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long from a stream near Nagaoka, in Echigo, Japan, on the northwestern part of the island of Hondo.

The type is Cat. No. 20164, Stanford University. A cotype is in the U. S. National Museum.

(*Echigo*, a province in Japan).

Family AGONIDÆ.

2. PALLASINA ERYNGIA Jordan and Richardson, new species.

Head 4.2 in length without caudal; depth 3.50 in head; width of body in front of soft dorsal, where body is not subject to distention, 27.5 in length without caudal; D. VI-8; A. 10; P. 11; eye 2.5 in snout; interorbital space 2 in diameter of orbit; nose 2.1 in head; barbel twice head; plates in lateral line 50; between dorsals 12; between ventrals and anal 15.

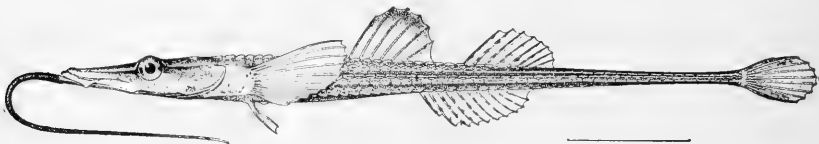


FIG. 2.—PALLASINA ERYNGIA.

Body completely encased in an armor of bony plates, as in *P. barbata* (Steindachner); plates of the dorsal and ventral edges with low keels which terminate behind in a short spine; breast with a central plate larger than the rest, surrounded by smaller plates which lie between it and the bounding pectoral edge; all the plates with radial striations proceeding from a central umbo or from the point of the keel; a sub-orbital row of small, thin plates with radiating striæ; angle of operculum and preoperculum each with a short spine; jaws with fine awl-shaped teeth in narrow bands.

Spinous a little higher than soft dorsal, its longest spine 2.6 in head; origin of anal barely in front of base of first dorsal; pectorals reaching slightly past front of first dorsal; ventrals (in male) 3.25 in head.

Color of upper parts in alcohol brownish, specked very finely and densely with darker; a rather sharp line, coinciding with the keels of

the lower row of lateral scutes, separating the upper darker from the lower paler color of the anterior part of the trunk; breast and forward part of belly pale; concavity of hinder part of belly behind front of anal, and of caudal peduncle, darkened with fine punctulations, which are more or less gathered into roundish blotches, forming a moniliform series, and not extending fully to the margins of the concavity.

Here described from a single specimen, the type, No. 20165, Stanford University, $5\frac{1}{2}$ inches long, taken on the coast of Echigo, Japan, by Masao Nakamura. Four specimens of a similar fish, 3 to 4 inches long, and with the barbel about equaling the length of the head, taken by Messrs. Jordan and Snyder at Aomori, Japan, in 1901, possibly belong to this species. The species here described is well distinguished from *Pallasina barbata*^a (Steindachner) by its slenderer body, its extremely elongated barbel, and its fewer pectoral rays (these being 12 or 13 in *P. barbata*.)

(ἰππυργος, the goat's beard.)

Family GOBIIDÆ.

3. CHLOËA NAKAMURÆ Jordan and Richardson, new species.

Head $3\frac{1}{5}$; depth $4\frac{1}{5}$; D. VII—11; A. 11; P. 18; eye $4\frac{2}{3}$ in head; nose $3\frac{2}{3}$; maxillary $2\frac{1}{5}$; interorbital $\frac{2}{3}$ of eye; scales 70.

Body robust, not much compressed, the back elevated, the profile convex behind nape, and the caudal peduncle slender, its depth about 4 in head; head pointed, deeper than wide; interorbital space concave; eyes anterior, directed somewhat upward; mouth very large, the maxillary reaching a vertical from posterior border of pupil; tongue broad, bifid; gill membranes united to isthmus at a point two eye-lengths in front of ventrals; gill-rakers on first arch 2 + 10, short and thick; pseudobranchiæ large.

Scales small and finely ctenoid; head and breast naked; belly covered with very small, easily displaced scales.

Dorsal fins separated by a distance equal to diameter of eye, the spinous scarcely higher than the soft dorsal; anal inserted under third ray of soft dorsal, length of depressed anal five-sixths of head; caudal rounded posteriorly; pectoral rounded behind, no filaments on its upper edge; ventrals reaching one-half the distance from their base to base of anal.

^aSix specimens of *Pallasina barbata* from Port Clarence, Alaska, 2 from Herendeen Bay, 3 from Chignik Bay, and 4 from Nemuro, Japan, show no noticeable variation in the body proportions, in the length of the barbel, or in the number of pectoral rays, the barbel never exceeding in length twice the diameter of the eye. The specimens mentioned include both males and females. *Pallasina aie* Starks is distinguished both from the present species and from *P. barbata* by its much larger eye, which is fully $1\frac{1}{4}$ times the diameter of the eye in specimens of the other two species, and the belly is punctulated more densely and evenly and farther forward.

Color in spirits pale muddy pinkish, everywhere densely and finely specked with black, including back, sides, belly, and head; fins and branchiostegals, with the exception of the pectorals, yet more densely specked with black, so that to the naked eye they appear almost jet black, especially at margins; pectorals pale; lightly specked with dusky.

This species is close to *Chloëa castanea* (O'Shaughnessy), from which it differs in its much longer maxillary and in coloration. It is here described from 3 specimens, $1\frac{3}{4}$ to 2 inches in length, from Nagaoka, in Echigo, Japan.

The type is No. 20163, Stanford University. Cotypes are in the U. S. National Museum. Two of the specimens are females, distended

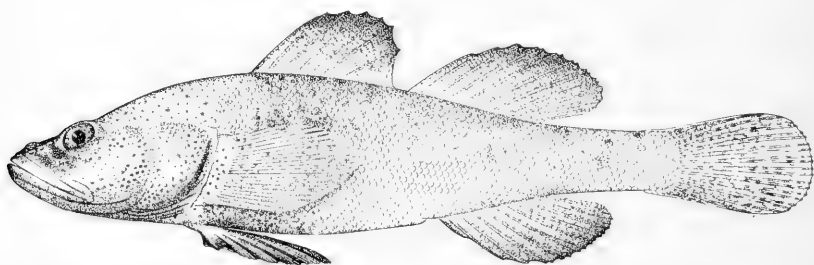


Fig. 3.—CHLOËA NAKAMURE.

with eggs, and a single one (the type) is a male. It is probable that the dark color on fins and branchiostegals is partially the evanescent nuptial coloration. The speckling of the belly (in both sexes) and the longer maxillary of this species sufficiently separate it from *Chloëa castanea*.

In the same collection with these species are numerous specimens of *Chenogobius macrognathos* (Bleeker) and of *Chloëa sarchynnus* Jordan and Snyder.

(Named for Masao Nakamura, a Japanese naturalist.)

THE DRAGONFLIES (ODONATA) OF BURMA AND LOWER
SIAM—II.^a SUBFAMILIES CORDULEGASTERINÆ, CHLOR-
OGOMPHINÆ, AND GOMPHINÆ.

By EDWARD BRUCE WILLIAMSON,
Of Bluffton, Indiana.

This paper is the second of the series, following the general plan of and based on the collections described in Part I, namely: (1) A collection made by Dr. W. L. Abbott in Lower Siam, and presented to the U. S. National Museum; (2) a collection made by Mrs. A. V. B. Crumb, presumably in the vicinity of Toungu, Burma, and owned by the Academy of Natural Sciences of Philadelphia, and (3) a collection made by Mr. R. A. Earnshaw for the present writer in the Karenni and Toungu districts, Burma. My indebtedness to Mr. R. A. Earnshaw requires a second acknowledgment. Since the publication of Part I he has sent me material containing specimens of the greatest interest and value, and necessitating at some future date additional remarks on the Calopteryginae of Burma. Through the kindness of M. Guillaume Séverin, of the Musée Royale de l'Histoire Naturelle de Belgique, I am enabled to figure in this paper the venation of twelve specimens from the De Selys collection. These photographs were made at the museum in Belgium. The photographs of other specimens were made in the laboratory of Prof. James G. Needham and under his direction. Mr. Samuel Henshaw loaned me a few very valuable specimens from the Museum of Comparative Zoology, Cambridge, Massachusetts. M. René Martin not only loaned me a number of specimens, but gave me others which have been invaluable in this study. Through the good offices of Prof. F. Foerster I purchased in Germany a collection containing many Gomphines from Tonkin. Mr. C. C. Adams has loaned me a number of specimens from India, Japan, and China. Dr. Philip P. Calvert has been freely consulted regarding many details.

In an effort to select a nomenclature for the wing veins that would meet with the approval of students in this country, at least, an exten-

^a See Part I. Subfamily Calopteryginae, Proc. U. S. Nat. Mus., XXVIII, pp. 165-187, published April 22, 1905.

sive correspondence has been carried on with Doctor Calvert, Professor Needham, and Mr. Rolla P. Currie, to all of whom I am indebted for advice and suggestions. I have tried to harmonize these suggestions as much as possible, and the names used in explaining the diagram of wing-venation are the result.

In the paper on the subfamily Calopteryginæ the species discussed were mostly well known and represented by large series of specimens in many collections, but in the subfamilies at present under discussion an entirely different condition exists. The reasons for this may be briefly discussed.

In the Calopteryginæ there are species in which the differences in color between the sexes are probably as great as in any species of bird or butterfly, although those peculiar secondary sexual characters of the male usually shown by such birds and butterflies are wanting in the order Odonata.^a Of the oriental genera of Calopteryginæ *Rhinocypha* is the largest, and shows a maximum development in these color differences. The Calopteryginæ are not specialized for protracted flight, but spend much of their lives near their birthplace; or if they wander it is by successive flights in an environment generally similar to their accustomed daily haunts. Nevertheless their flight may be swift and mobile. Like the highly colored humming-birds, some of them at least are pugnacious, though evidences of injuries to each other from this cause are wanting. Two males of *Calopteryx angustipennis* will perform such rapid evolutions about each other that the eye can scarcely follow them. Males of *Heterina* wage similar warfare. It would be strange if males of *Rhinocypha* did not fight in the same way. In *Rhinocypha* the hyaline spots in the wings of certain males might well serve the same function attributed to eye-spots and other striking markings on the outer portions of the wings of Lepidoptera,^b but none of the many specimens I have seen was so damaged as to indicate that they do so serve. In fact, I know of no evidence that the brightly colored and often metallic Calopteryginæ are ever devoured by birds. The display of colors by the male before the female has been recorded for two species belonging to two widely different genera, though the possibility of voluntary sexual selection by these insects is, it appears to me, very remote. Those most active in their display, however, probably would be the most vigorous and highly colored of their associates and would, in competition with others of the same species, stand the best chance of reproducing. The male abdominal appendages in this subfamily are but little specialized, and throughout the group are remarkably

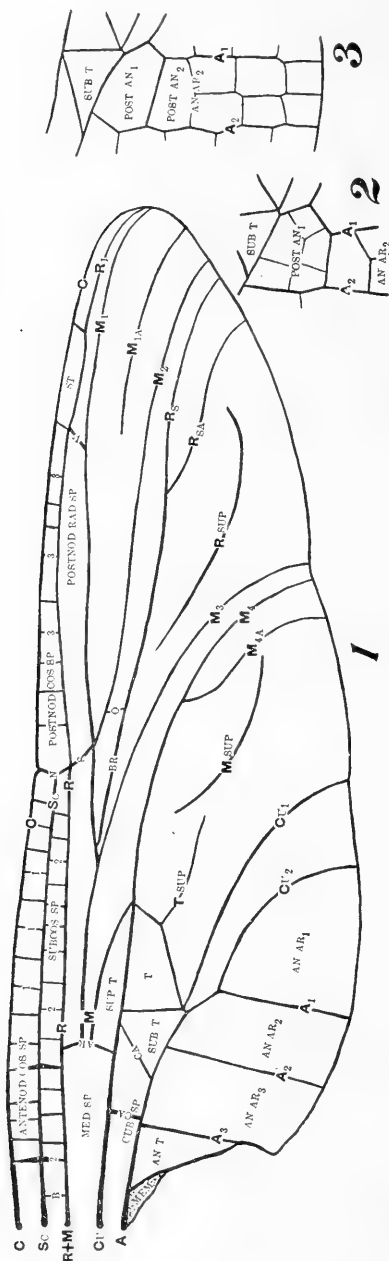
^a Some stigmatic differences may offer an exception to the rule.

^b These markings are supposed to produce on the insects' natural enemies the false impression that they are real vital organs, by which they may be captured with certainty.

similar in form. Calopteryginae generally do not display great sensitiveness to weather conditions. Temporary cloudiness and slight changes in wind or temperature do not result in immediate decrease of activity or in search for a new environment. There is reason to believe that as a group the species have a moderately long or protracted seasonal range.

Comparing now the subfamily Gomphinae—the largest of the subfamilies considered in this paper—with the Calopteryginae, I find in the former only slight differences, if any, between the sexes of any species, and these almost entirely confined to body-markings. Moreover, the Gomphinae are as a group obscurely or protectively colored. Metallic or other brilliant colors, so common in Calopteryginae and in certain beetles which are not eaten by birds, are unknown. The ground-color varies from pale brown through various shades of brown and yellowish or reddish brown to black. The markings are from white through pale green, green, pale yellow, and clear yellow to orange; or the ground-color may be the paler, marked with the darker colors. The wings are hyaline, or slightly fumose. In wing venation these dragonflies are highly specialized, adapting them to protracted flights. For example, some species spend much of their time in tall forest trees and during a day may make numerous trips from a stream to trees at considerable distances from the water. There is reason to believe that certain species spend much of their lives at a distance from the streams which gave them birth, being fully able, when the time arrives, to return by rapid and sustained flight. The size, structure, and consistency of these insects make them favorable food for medium-sized or larger insectivorous birds, and it may be well supposed that natural selection has tended to suppress brilliant colors and habits which would attract attention. The males do not make themselves conspicuous by pugnacious attacks on each other. Several may be on the wing in close proximity without attacking, though they frequently approach as if in search of females. In the form of the abdominal appendages of the male the Gomphinae are highly specialized. In the oriental region *Onychogomphus* is represented by the greatest number of species, and in this genus both venation and male appendages are highly specialized. This specialization and presumably more perfect adaptation of the appendages to their use would render the speedy capture of the female almost certain. Moreover, the scattering of the species through woodland and fields adjacent to streams would render the meeting of individuals to some extent accidental. In view of these facts conflicts between males are probably the exception. During the act of copulation Gomphinae generally seek more retired and elevated places than the Calopteryginae. Some Gomphinae, at least, display great sensitiveness to weather conditions, appearing about certain favorite

haunts only a few hours during the day, absenting themselves almost entirely one day, apparently without reason, to appear in undimin-



FIGS. 1-3.—DIAGRAMMATIC WING OF A DRAGONFLY, SHOWING THE NOMENCLATURE OF THE VENATION.

A, anal vein and its branches, A_1 , A_2 , and A_3 ; $an\ t$, anal triangle; $an\ ar$, anal area, subdivided into 3 areas, $an\ ar_1$, $an\ ar_2$, and $an\ ar_3$; the postanal cells make up the area $an\ ar_2$; ar , arcus; b , basal antenodal of second series; br , bridge; C , costa; cu , cubito-anal cross-vein; Cu_1 , cubitus, with its branches, Cu_1 and Cu_2 ; $cu\ b\ sp$, cubital space; M , media with its branches M_1 , M_2 , M_3 , M_4 , and M_5 ; M_6 and M_7 , sectors of M_1 and M_2 ; $mc\ d\ sp$, median space; $mc\ m$, membranule; $M\ sup$, median supplement; n , nodus; o , oblique vein; $post\ an$ and $post\ ar_2$, first and second postanal cells; $postnod\ cos\ sp$, postnodal costal space; $postnod\ rad\ sp$, postnodal radial space; R , radius; $R+M$, radius+media; R_s radial sector; R_s , sector of R ; $R\ sup$, radial supplement; s , subnodus; Sc , subcosta; st , stigma; $subcos\ sp$, subcostal space, $sub\ t$, subtriangle; $sup\ t$, supertriangle; t , triangle; $T\ sup$, trigonal supplement; v , stigmatic brace vein; 1, antenodal of first series, 2, antenodal of second series; 3, postnodal; figs. 2 and 3, portions of wings to show forms of postanal cells; in fig. 2, the first postanal cell is sharply divided or differentiated from those following it and is subdivided by cross veins into 5 cells; in fig. 3, the first postanal cell is divided from the second; it is free (without cross veins), followed by a single cell, followed by two rows to the wing margin; there are 5 rows of postanal cells in fig. 3.

ished numbers on the succeeding day. A cloud passing before the sun, where several males of *Gomphus* are flying, may cause every dragonfly

to forsake the water for the trees and bushes, where they rest inactive and inconspicuous till the reappearing sun brings them again to the stream. Continued cloudiness may cause them to leave the river, scattering far and wide over fields and woods. Moreover, species of this subfamily are well known to have a brief seasonal range in temperate regions, and the same thing is probably true in the tropics.

Because of the scarcity of positive records for Burma and Lower Siam of species of the subfamilies under discussion in this paper, a slightly different treatment from that employed in the paper on the Calopteryginae has seemed desirable. In this paper I have given distribution and brief notes on all the species known in the oriental fauna. From this it must not be supposed that I expect subsequent collecting to show a large percentage of these species to occur in Burma and Lower Siam. On the contrary, I believe a number of species at present undescribed will be revealed.

Throughout the paper the halftone figures of wings are of arbitrary size and give no idea of the relative size of the wings in various species. The figures representing thoracic color pattern are diagrammatic, all drawn over the same outline, and give no idea of the different forms and sizes of the insects themselves. The figure illustrating venational nomenclature is still more diagrammatic. (See figs. 1-3.) The remaining figures are drawn to scale—the same for all—and give an idea of the relative sizes in different species.

KEY TO THE ORIENTAL GENERA OF THE SUBFAMILY GOMPHINÆ (IMAGOS).

ORDER ODONATA (Neuroptera Odonata, Paraneuroptera).

aa. Front and hind wings dissimilar in shape, the latter usually broader at base; the quadrangle of the suborder Zygoptera^a divided to form the triangle and supertriangle. Males with one inferior abdominal appendage which, however, may be deeply bifid or rudimentarySUBORDER ANISOPTERA

b. Antenodals of first series mostly coinciding with those of the second series; triangle of front wing with its long axis at right angles to the length of the wing, and triangle of hind wing with its long axis parallel to the length of the wing.

FAMILY LIBELLULIDÆ

bb. Antenodals of first series not coinciding with those of the second series, excepting in the case of two, which are thickened.....FAMILY ÆSHNIDÆ

c. Radial and median supplements present; triangle of front wing at least as elongate as triangle of hind wing; M_2 paralleling M_1 at least as far as the stigma. Head globose. Lateral abdominal carinæ present.....SUBFAMILY ÆSHNINÆ

cc. Head transversely elongated; eyes separated or meeting at a single point only. Lateral abdominal carinæ wanting.

d. Radial supplement developed; triangle of front wing at least as elongate as triangle of hind wing. Median labia lobe divided...*Petalia* and allies, probably worthy of subfamily rank; (not regional.)

dd. Radial and median supplements not developed; M_2 paralleling R_s .

^a See Proc. U. S. National Museum, XXVIII, p. 167.

- c. Median labial lobe divided. Stigma of uniform width, the distance between C and R_1 a cell or two beyond stigma less than the distance between R_1 and M_1 at the same level; in front and hind wings at least 4 cross veins between M_{1-3} and M_4 .
- f. Subtriangles of front and hind wings similar in shape. Eyes touching dorsally or but little separated.
- g. Median space without cross veins; triangle of hind wing more elongate than triangle of front wing.....SUBFAMILY CORDULEGASTERINÆ
- gg. Median space with cross veins; triangle of front wing at least as elongate as triangle of hind wing.....SUBFAMILY CHLOROGOMPHINÆ
- h. Triangle of hind wing strongly narrowed in the direction of the long axis of the wing.....*Chlorogomphus*
- hh. Triangle of hind wing about equilateral.....*Orogomphus*
- ff. Subtriangles of front and hind wings dissimilar; triangle of front wing not as elongate as triangle of hind wing. Eyes widely separated.
- SUBFAMILY PETALURINÆ (not regional)
- cc. Median labial lobe entire. Eyes widely separated. Stigma wider at middle than at either end, the distance between C and R_1 a cell or two beyond stigma about equaling the distance between R_1 and M_1 at the same level; triangle of front wing less elongate than triangle of hind wing.....SUBFAMILY GOMPHINÆ
- f. Subtriangle of front wing crossed (except in *Gomphidia javanica*); supertriangular cross veins present; distance from forking of M_{1-2} and M_3 to subnodus equal in front and hind wings, in front wing equal to one-fourth the distance from wing base to subnodus; cross veins between M_{1-3} and M_4 numerous, at least 4 in hind wing; M_3 in hind wing slightly waved; R_s and M_4 with accessory sectors; stigma long, equaling one-third the distance from nodus to distal end of stigma.
- g. Lateral margins of abdominal segment 8 dilated. Triangle of front wing short, the inner and superior sides about equal.....*Itinus*
- gg. Lateral margins of abdominal segment 8 not dilated. Triangle of front wing longer, the outer and superior sides about equal.
- Gomphidia*
- ff. Subtriangle of front wing and all supertriangles without cross veins; distance from forking of M_{1-2} and M_3 to subnodus equal to about one-third the distance from wing base to subnodus in front wing; R_s and M_4 without distinct accessory sectors; stigma shorter, in length less than one-third the distance from nodus to distal end of stigma.
- g. Triangle of hind wing crossed; at least 3 rows of cells between M_4 and Cu_1 at level of penultimate antenodal in front wing.
- h. Triangle of front wing crossed; arculus in front and hind wings at level of second antenodal; anal area of front wing with 2 rows of cells proximal to the triangle, followed distally by more than 2 rows; M_4 and Cu_1 in front wing divergent, about 15 cells between at wing margin; in hind wing 2 cross veins between M_{1-3} and M_4 ; trigonal supplement distinctly present; distance from forking of M_{1-2} and M_3 to subnodus about equal in both wings.
- i. Cubital space with 2 or 3 cross veins in addition to the one forming the subtriangle; M_{1a} in front wing arising nearer nodus than stigma; basal antenodal of second series present in four wings; sectors strongly curved, the angle of R_s with the hind margin obtuse.....*Sieboldius*
- ii. Cubital space with 1 cross vein in addition to the one forming the subtriangle; M_{1a} in front wing arising nearer stigma than nodus;

- basal antenodal of second series wanting; sectors less curved, R_5 meeting the hind margin of wing at an acute angle. *Hagenius a*
- hh. Triangle of front wing free; arculus in front and hind wings near the third antenodal; anal area of front wing with 1 row of cells proximal to the triangle, followed by not more than 2 rows; M_4 and Cu_1 in front wing nearly parallel, about 9 cells between at margin; in hind wing 1 cross vein between M_{1-3} and M_4 ; trigonal supplement not distinct; distance from forking of M_{1-2} and M_3 to subnodus greater in front wing than in hind wing. *Davidius*
- gg. Triangles, subtriangles, and supertriangles all normally free; distance from forking of M_{1-2} and M_3 to subnodus greater in front wing than in hind wing; sectors uniformly curved; trigonal supplement not distinctly developed; stigma short, usually one-fourth or less in distance from nodus to distal end of stigma.
- h. Normally with 3 or more cross veins between M_{1-3} and M_4 in hind wing and 4 or more in front wing; M_{1-3} and M_4 approximated at or immediately beyond their origin at the arculus; stigma without brace vein.
- i. Basal antenodal of second series present in all wings (excepting in *Leptogomphus sp.*); anal area of front wing with 1 or 2 rows of cells before the triangle, followed by 2 or more rows.
- j. More than 2 rows of cells between M_1 and M_{1a} at level of distal end of stigma; anal area of front wing with maximum width of 3 or more cells; proximal angle of triangle in front wing not as far distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing symmetrical. *Macrogomphus*
- jj. One row of cells (rarely 2) between M_{1a} and M_{1n} at level of distal end of stigma; anal area of front wing with a maximum width of 2 cells; proximal angle of triangle in front wing at least as distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing unsymmetrical. *Leptogomphus*
- ii. Basal antenodal of second series wanting; anal area of front wing with 1 row of cells throughout; 1 row of cells between M_1 and M_{1n} at level of distal end of stigma; proximal angle of triangle in front wing at least as distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing unsymmetrical. *Microgomphus*
- hh. Normally with 1 cross vein (rarely 2) between M_{1-3} and M_4 in hind wing and 4 or less in front wing; M_{1-3} and M_4 distinctly separated at and beyond their origin at the arculus; forking of M_{1-3} and M_4 in hind wing symmetrical or not distinctly unsymmetrical; stigma with or without brace vein; proximal angle of triangle in front wing not as distant from arculus as length of inner side of subtriangle.^b

^a Characters based on a study of the American *H. brevistylus*, the only species of the genus known to me.

^b The following genera form a group of great venational uniformity marked by many minor diversities. At least 2 of them are of very wide distribution and others, not regional and not here considered, find their closest allies here. Genera have developed these many minor venational characters independently, at least in many

- i. Stigma long, in front wing equal to more than one-fourth the distance from nodus to distal end of stigma; triangle in hind wing greatly elongated, the upper side about twice as long as the inner side; basal antenodal of second series present in both wings; M_4 and Cu_1 in front wing divergent, 3 rows of cells between at level of the nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 rows of cells between M_1 and M_2 in front wing beginning nearer the stigma than the nodus; arculus in front wing at or proximal to second antenodal; cubital space in front wing with 1 cross vein in addition to the inner side of the subtriangle; anal area in front wing with 1 row of cells proximal to the triangle, followed by a maximum width of 3 cells or more; 3 rows of postanal cells in hind wing; distal angle of triangle in hind wing not separated from M_4 by a distinct stalk; stigma with brace vein.

Cyclogomphus

- ii. Stigma shorter, at the most equal to or less than one-fourth the distance from nodus to distal end of stigma; triangle in hind wing with upper side not twice as long as the inner side; basal antenodal of second series usually absent.
- j. Cubital space in front wing with 2 cross veins in addition to the one forming the inner side of the subtriangle; M_4 and Cu_1 in front wing with 3 rows of cells between at level of nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; arculus in front wing distal to second antenodal; anal area in front wing with 2 rows of cells proximal to the triangle, beyond the triangle but little better developed, normally only 2 cells wide at the maximum; 4 rows of postanal cells; distal angle of triangle in hind wing not distinctly separated from M_4 ; brace vein of stigma apparently variable.

Anisogomphus

- jj. Cubital space in front wing with one cross vein in addition to the one forming the inner side of the subtriangle.
- k. Triangle in hind wing not distinctly separated from M_4 by a short stalk; usually 2 (sometimes 3) cross veins between M_{1-3} and M_4 in front wing.
- l. A_2 in hind wing arising near the middle of the lower side of the subtriangle, postanal cells of about the same width throughout; arculus in front wing at or proximal to second antenodal; 1 or 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 cells between M_1 and M_2 in front wing beginning nearer stigma than nodus; stigma with brace vein.

cases, and, in the resulting confusion, relationships are almost impossible of discernment. At the same time I believe the genera may be accurately defined, though their proper grouping is impossible, by venational characters alone. Material accessible to me, as explained more fully in the following pages, has been such that I have been limited to a first-hand study of venational characters only, in the case of many genera, and in the case of all to but few specimens and species. It is to be expected, therefore, that the arrangement of genera is not entirely a natural one and that the definitions in many cases are too explicit to cover all the species. More material, both adult and nymphal, than that to be found at present in all the collections in the world and the tabulation of other as well as venational characters will be necessary for the ultimate solution of the relationships of these genera.

- m.* Three rows of postanal cells in hind wing.
- n.* Anal area in front wing with maximum width of 2 cells, distal to the level of the triangle scarcely 2 cells wide, and that only for a short distance; M_1 and Cu_1 in front wing parallel to beyond the nodus, 2 cells between at level of nodus.
- o.* One row of cells between M_1 and M_{1a} in front wing to the wing margin; anal area in front wing with 1 row of cells proximal to the triangle; Cu_2 in front wing ending under the nodus. *Anormogomphus*
- oo.* Two rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; anal area in front wing proximal to the triangle, 2 cells wide for a distance of 1 cell only, or only 1 cell wide; Cu_2 in front wing ending before the nodus.
- Burmagomphus*
- nn.* Anal area in front wing with a maximum width of 3 cells, proximal to level of triangle 1 cell wide; M_1 and Cu_1 in front wing divergent, at least 3 rows of cells between at level of nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma. *Platygomphus*
- mm.* Four or more rows of postanal cells in hind wing; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; anal area in front wing proximal to triangle, 2 (or in some American species 1) cells wide, distally reaching a maximum of at least 3 cells (2, fully developed, in some American species); M_1 and Cu_1 in front wing divergent, at least 3 cells between them at level of nodus. *Gomphus*^a
- ll.* A_2 in hind wing arising near or proximal to the inner angle of the subtriangle, A_1 or A_2 or both usually decidedly angled, at least 4 rows of postanal cells; anal area in front wing proximal to the triangle, 2 cells wide for at least the length of 1 cell, followed distally by a maximum width of not less than 3 cells.
- m.* M_1 and Cu_1 in front wing parallel to beyond the nodus, 2 cells between at level of nodus; arculus in front wing at or proximal to second antenodal; 1 or 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 cells between M_1 and M_2 appearing first nearer the stigma than the nodus in front wing; first postanal cell in hind wing divided, not twice as wide as the second; stigma with brace vein. *Onychogomphus*
- mm.* M_1 and Cu_1 in front wings divergent, 4 rows of cells between at level of nodus; arculus in front wing distal to second antenodal; 3 rows of cells between M_1 and M_{1a} at level of distal end of stigma in front wing; 2 cells between M_1 and M_2 appearing first nearer the nodus than the stigma in front wing; first postanal cell in hind wing divided, twice as wide as the sec-

^a As shown by Needham's studies of some of the North American species, subgroups are definable, but more material is needed for a final disposition of the subject.

ond; stigma without brace vein (in *cochinchinensis*, the only species of the genus I have studied).

Heterogomphus

kk. Triangle in hind wing distinctly separated from M_4 by a short stalk (the extreme development from the condition found in *Agriogomphus* and *Neogomphus*, for examples); M_4 and Cu_1 in front wing divergent, 4 cells between at level of nodus; 3 rows of cells between M_1 and M_{1+2} at level of distal end of stigma in front wing; 2 rows of cells between M_1 and M_2 in front wing appearing first nearer stigma than nodus; arculus in front wing distal to second antenodal; anal area in front wing with 2 rows of cells proximal to the level of the triangle, followed distally by a maximum width of 4 or 5 cells; A_2 in hind wing arising near the inner angle of the subtriangle; 5 rows of postanal cells; 3 or 4 cross veins between M_{1-3} and M_4 in front wing; stigma with brace vein.

Merogomphus

Subfamily CORDULEGASTERINÆ.

Genera ALLOGASTER De Selys, ANOTOGASTER De Selys and THECAGASTER De Selys.

No species of the subfamily Cordulegasterinæ have been reported for Burma or Siam and none is represented in the collections accessible to me, though representatives of three genera are known from India.

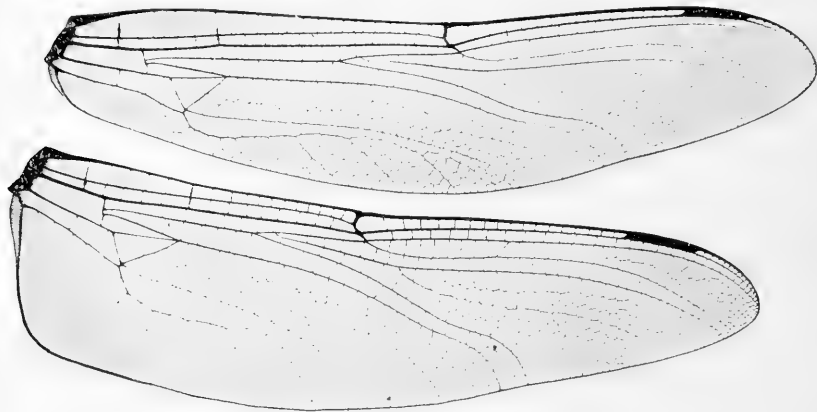


FIG. 4.—WINGS OF MALE ANOTOGASTER SIEBOLDII FROM JAPAN.

These genera are separated by De Selys as follows: *Allogaster* is distinguished by the greatly developed frons, almost as wide as the eyes, with the crest as elevated as the base of the occiput. Only one species, *latifrons* De Selys, from Bengal, is known. In *Anotogaster* the stigma is long, the head globose; and in *Thecagaster* the stigma is short, the head transverse. Four species of *Anotogaster* are known, occurring in Nepal and North India, through Tibet and China to Japan. *A. basalis* De Selys, occurring in North India,

is distinguished by De Selys from *nipalensis* De Selys, occurring in Nepal, as follows: By yellow venation instead of black; by a large yellow ring on abdominal segment 10, wanting in *nipalensis*, and by other characters. *Thecagaster* is represented by two species from North India (North India and Himalaya). These species, originally placed in this genus by De Selys, were later definitely referred by him to *Cordulegaster* (Causeries Od. No. 7). The two species, *brevistigma* De Selys and *parvistigma* De Selys, have the abdomen black with dorsal spots in a half ring. *T. brevistigma* has 14 or 15 antenodals in front wing, while *parvistigma* has 21. Some other differences mentioned by De Selys are: *T. brevistigma* has the upper lip bordered with black, and abdominal segment 10 black with a lateral longitudinal yellow spot; *parvistigma* has the upper lip not bordered with black, and 10 without yellow markings. Representatives of the subfamily Cordulegasterinæ will certainly eventually be found in Burma and probably also in Siam. (See fig. 4.)

Subfamily CHLOROGOMPHINÆ.

Genus CHLOROGOMPHUS De Selys.

This genus is represented by two species confined to Sumatra and Java.

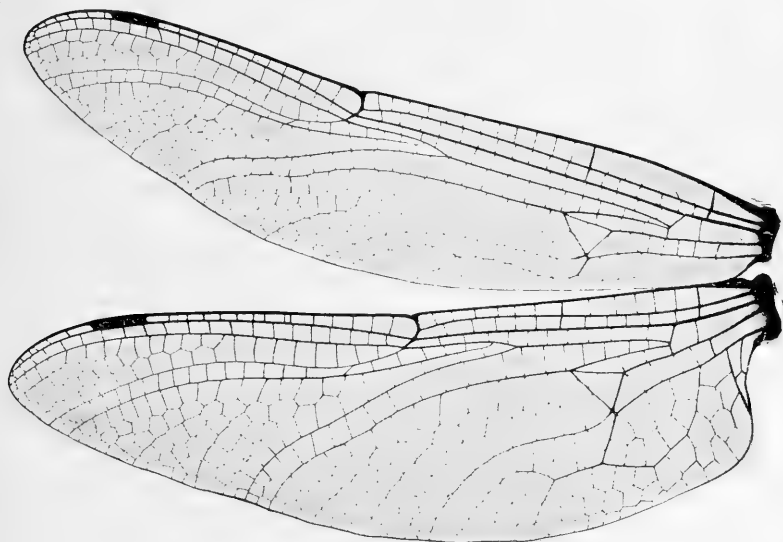


FIG. 5.—WINGS OF MALE OROGOMPHUS ATKINSONI. DE SELYS' COLLECTION.

Genus OROGOMPHUS De Selys.

Three species are known, found in Luzon, Bengal, Tonkin, and Burma. The three species are distinguished by De Selys as follows: *O. splendidus* De Selys, Luzon and Tonkin, and *speciosus* De Selys,

Burma, are distinguished from *atkinsoni* De Selys, from Bengal, by having the frons less elevated, entirely black in front; 3 yellow lateral thoracic stripes, the middle the widest, instead of 2; and the end of the abdomen a little dilated. (See fig. 5-6.)

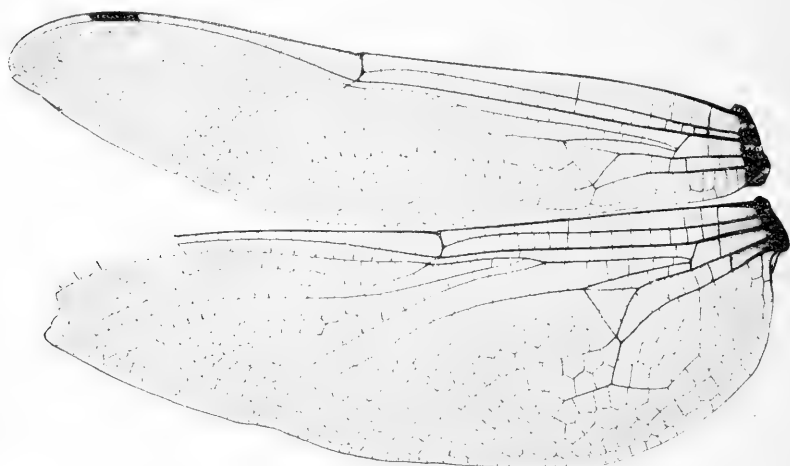


FIG. 6.—WINGS OF FEMALE *OROGOMPHUS ATKINSONI*. DE SELYS' COLLECTION.

O. splendidus has the wings marked with brownish yellow, the apices reddish brown, and abdominal segments 3-7 black. In *speciosus* the wings are hyaline, and segments 3-7 are black, with an apical yellow spot on each.

1. *OROGOMPHUS SPECIOSUS* De Selys.

“Tahò en Mars (Fea).” Known only from the female. I have not seen specimens. Abdomen 57 mm., hind wing 46 mm.

Subfamily GOMPHINÆ.

Genus *ICTINUS* Rambur.

Fifteen species and one variety of the genus *Ictinus* are at present recognized, or twelve species and four varieties, if De Selys's views are followed. Twelve of these sixteen occur in the oriental region. These have been divided into two groups by De Selys, defined most readily by the color pattern of the head, thorax, and legs, as follows:

First group.—Face largely black; posterior edge of side of thorax black; femora largely black or brown. *I. tenax* Hagen occurs in the Philippines. It has been described from a single male and an incomplete female. According to De Selys it is distinct by having the femora with an external double yellow stripe, obliterated on the second femora of the female; the nasus banded, not spotted, with yellow; abdominal segment 7 spotted, not ringed, with yellow; and the inferior abdominal appendage of the male not more divaricate

than the superior appendages. *I. decoratus* De Selys occurs in Java, Sumatra, Borneo, and Tonkin. It may be recognized by the association of the following characters: Antehumeral yellow stripe slightly or not interrupted; frons black, with a narrow yellow line; a yellow stripe between the two lateral thoracic sutures; posterior edge of side of thorax broadly black; and femora largely brown. *I. melænops* De Selys occurs in Indo-China, Sumatra, and Borneo. It is distinct from all by having the antehumeral stripe reduced to a superior spot and the area between the lateral thoracic sutures uniformly black, or with 1 or 2 small superior spots. Of the remaining four oriental species (or two species and two varieties) of this group, *pertinax* Hagen, occurring in China and Tonkin, is separated by having the nasus without a median yellow spot, abdominal segment 8 laterally spotted, without a yellow ring, and 10 all black. *I. rapax* Rambur, known from India and Indo-China, is very closely related to *præcox* Hagen, from India, and *mordax* De Selys, from India, the latter two being regarded by De Selys as varieties of *rapax*. *I. mordax* may be recognized from the fact that it has the black stripes on the lateral sutures joined at the middle, reducing the yellow stripe between them to a superior and an inferior spot; as in *pertinax*, abdominal segment 10 is black. In *rapax* the abdomen is 47–52 mm., hind wing 40–44 mm.; in *præcox* the abdomen is 50–53 mm., hind wing 39–40 mm.; in *præcox* the basal black of the frons connects at the middle with the black of the frons in front; in *rapax* yellow occupies the basal half of abdominal segment 3 and basal two-fifths of 4–6; in *præcox* the yellow is reduced. Closely related as these species are, Hagen's figures in *Monographie des Gomphines* indicate differences which should permit of more decisive definitions if material were at hand.

Second group.—Face largely yellow; posterior edge of side of thorax without black; femora largely yellow. In *angulosus* De Selys, from India, and *atrox* De Selys, from India, the leaf-like expansions of segment 8 are of medium size, largely or entirely black; in *clavatus* Fabricius, from Japan, China, and Tonkin, and *phaleratus* De Selys, from China and Tonkin, the expansion is larger, yellow, broadly bordered with black. In *atrox* the upper lip is not bordered with black, the rear of the head is black, the expansion of abdominal segment 8 is yellow at the base, and there are 5–6 enlarged spines on the posterior femora; in *angulosus* the upper lip is bordered with black, the rear of the head is black and yellow, the expansion of 8 is entirely black, and there are 7–8 enlarged spines on the posterior femora. *I. phaleratus* was regarded as a variety of *clavatus* by De Selys, distinguished by a smaller expansion of segment 8, by having segment 10 without a dorsal yellow spot, as in *clavatus*, and by having the triangle of the front wing followed by 3 cells instead of 4 as in *clavatus*. Three

males from Tonkin in my collection have segment 10 and appendages as described for *phaleratus*, but are otherwise like *clavatus* excepting that the venational character mentioned is intermediate; in one specimen the triangle in both front wings is followed by 3 rows of cells, in another specimen by 4 rows, and in the third specimen one wing has 3, the other 4 rows. Either such a species as *phaleratus* does not exist or it has been imperfectly described.

2. *ICTINUS MELÆNOPS* De Selys.

Trong, W. L. Abbott, collection U.S.N.M., 4 males, 12 females.

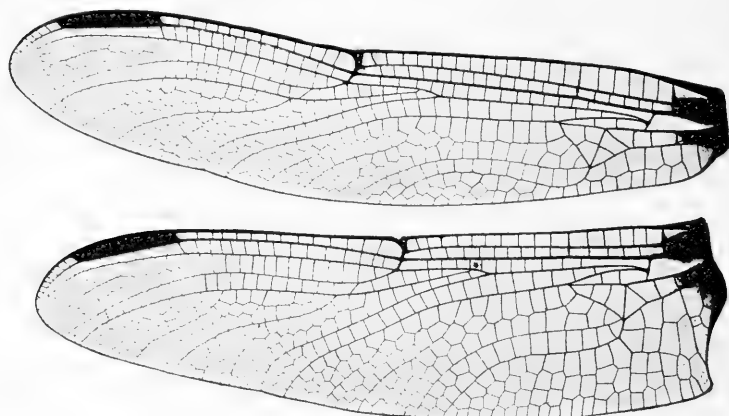


FIG. 7.—WINGS OF MALE *ICTINUS MELÆNOPS* FROM SIAM.

Wings more or less fumose in one male and nine females. Subtriangle in front wing 2-celled in all but the right wing of one

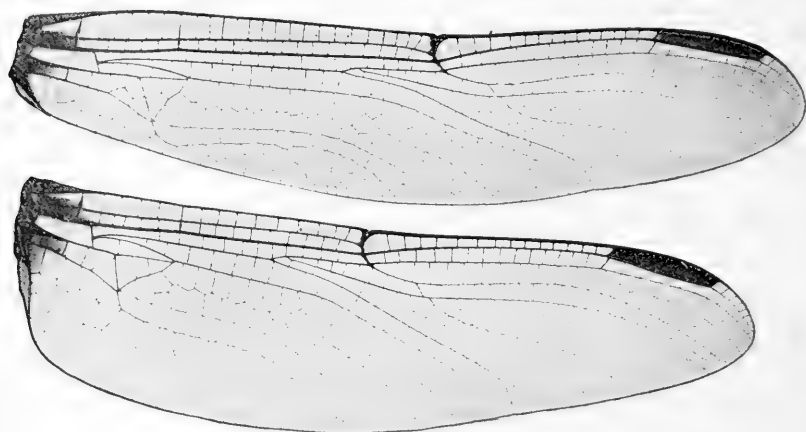


FIG. 8.—WINGS OF FEMALE *ICTINUS MELÆNOPS* FROM SIAM.

male, where it is open, and one wing of a female where it is 3-celled; subtriangle in hind wing open in all. Triangle in front wing 2 cells long, the first cell divided, making the triangle 3-celled—in

4 male wings and 10 female wings (in three cases slightly abnormal, the divisions obscured or disguised); triangle in front wing 3 cells long, the first cell divided, making the triangle 4-celled—in 3 male wings and 15 female wings (disguised in one case); triangle in hind wing 2 cells long and 2-celled—in one male wing; triangle in hind wing 3 cells long and 3-celled—in 5 male wings and 19 female wings; triangle in hind wing 3 cells long, the first cell divided, making the triangle 4-celled—in 2 male wings and 5 female wings. Upper lip entirely black in one male and one female; upper lip with 2 basal yellow spots, more or less distinct, in all the others. Nasus with a more or less distinct yellow spot at either end in all. Pale area of frons above of about uniform width in three males and five females; narrowed or divided in the middle in one male and seven females. *Ichneumon melænops*, race *sumatranus* Krüger from Sumatra does not seem sufficiently different. (See figs. 7 and 8.)

3. ICTINUS PERTINAX Hagen.

One male from Burma collected by Earnshaw.

This has the upper lip black, with two small squarish basal spots, separated by black, about equal to their width; the antehumeral stripe widely divided. I have two adult males and a teneral male from Tonkin. This teneral specimen, which I refer to *pertinax*, has the spots on the upper lip larger and connected; and the antehumeral stripes are narrowed but not divided above.

Genus GOMPHIDIA De Selys.

The seven described species all occur in the Oriental region. *G. krugeri* Martin is rivalled in size only by *perakensis* Laidlaw. It is known from Tonkin; abdomen 63 mm., hind wing 50 mm.; front wing, antenodals 24, postnodals 13–14; distinct from all the others by having the dorsal thoracic stripes on either side of the middorsal carina joined at their upper end with a spot which represents the upper end of the antehumeral stripe. *G. confluens* De Selys occurs in Central China, Tonkin, and Anam; abdomen 53 mm., hind wing 48 mm.; front wing, antenodals 19–20, postnodals 11; distinguished from all others by having the dorsal thoracic stripes joined below with the mesothoracic half collar. *G. javanica* Foerster, from Java, has the abdomen about 53 mm., hind wing 40–43 mm.; front wing, antenodals 16–18, postnodals 12; it is peculiar in having the subtriangle of the front wing free, not divided (the subtriangle of the front wing is sometimes free in *maclachlani*, but in *javanica* the rhinarium is yellow, while it is black in *maclachlani*). *G. kirschii* De Selys and *perakensis* Laidlaw are peculiar in having a relatively large number of postnodals. *G. kirschii* occurs in the Philippines, Borneo, and Tonkin; abdomen 45–48 mm., hind wing 38–42 mm.; front

wing, antenodals 18-19, postnodals 15-17; on the sides of the thorax in the black area between the two lateral sutures is a row of yellow spots. *G. perakensis* Laidlaw was described from the Malay Peninsula; abdomen 59 mm., hind wing 54 mm.; front wing, antenodals 22-23, postnodals 17-18; the abdomen is largely black, with the dorsal basal one-third of 7 yellow; Doctor Laidlaw compared his specimen in coloration with a *Macrogomphus* in the British Museum erroneously determined as *quadratus*; there is no similarity between *perakensis* and *quadratus*. The two remaining species of *Gomphidia* are separated at once by the color of the head. *G. maclechlani* De Selys occurs in Borneo, Sumatra, Tonkin, and Anam; abdomen, male 51-55 mm., female 52 mm.; hind wing, male 38-43 mm., female 46 mm.; front wing, antenodals 19-21, postnodals 10-14; face entirely black excepting part of the frons. *G. t-nigrum* De Selys is known only from North India; abdomen 52 mm., hind wing 39.5 mm.; front wing, antenodals 15-16, postnodals 9-10; face, vertex, and occiput largely yellow. An eighth species is described below as new, from a specimen from Siam.

4. GOMPHIDIA ABBOTTI, new species.

Abdomen, male without appendages 50 mm., superior appendages 3.5 mm.; hind wing, male 41 mm.

Wings hyaline, without trace of basal spot; membranule white; stigma very dark brown, covering 4 or 5 cells, brace vein present;

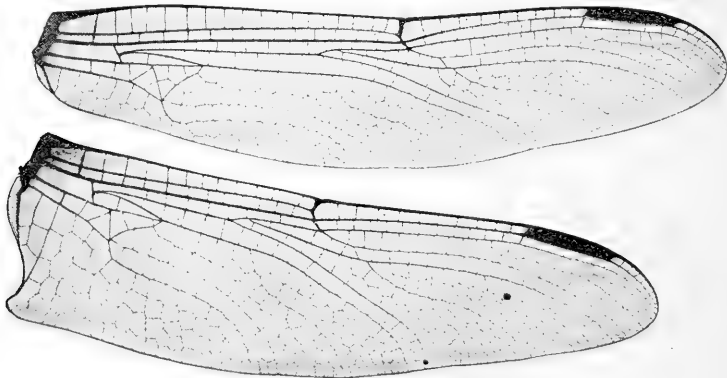


FIG. 9.—WINGS OF MALE GOMPHIDIA ABBOTTI FROM SIAM.

antenodals, front wing 18-19, hind wing 12-13; postnodals, front wing 11, hind wing 10-11; triangle in front wing 3 cells long, the first cell divided, making 4 cells in the triangle, followed by 3 cells, then 2; triangle in hind wing 2 or 3 cells long, followed by 3 or 4 cells, then 2; subtriangle in front wing once divided, in hind wing free; cubital

space in front wing with 3, in hind wing with 2 additional cross veins; 1 or 2 supertriangular cross veins in front wing, 1 in hind wing; 6-8 cross veins between M_{1-3} and M_4 in front wing, 4-5 in hind wing; anal triangle 5-celled. (See fig. 9.)

Lower lip dull brownish, the adjacent portion of the rear of the eyes dull yellow; remainder of the head black, marked with yellow as follows: Upper lip with a superior spot on either side, separated by more than their own length; base of mandibles, margined with black; rhinarium; a very small inferior lateral spot on nasus; a narrow superior line on the frons in front; the anterior half of the frons above, this pale area nearly or quite divided by a broad low triangle of black continuous with the basal black of the frons. Occiput high, rounded, with short cilia.

Prothorax rich dark brown. Thorax of the same color, paler below, marked with light yellow as follows: A wide mesothoracic half collar, divided at the median line; short, widely divaricate, cuneiform stripes on either side above, beginning just in front of the antealar sinus and reaching about half way to the mesothoracic half collar; antehumeral stripe entirely wanting, not represented by a spot or line; mesepimeron with a stripe a little more than 1 mm. wide, of nearly uniform width for its entire length; just behind the extreme upper end of this stripe a minute inconspicuous spot (probably this is variable and specimens with a row of spots in the black area would not be surprising); metepimeron with a stripe not quite 2 mm. wide at its widest part; a spot between the front wings, and a transverse row of 3 spots in juxtaposition between the bases of the front and hind wings. Legs dark brown, apices of femora and the tibiae black.

Abdomen brown anteriorly, black posteriorly, marked with yellow as follows: 1 and 2 obscurely marked, 1 with a dorsal basal spot, 2 with a dorsal median spot, the auricles dull yellowish tipped with black; basal dorsal rings on 3-7, occupying two-fifths of 3, one-third of 4-6, and nearly one-half of 7; these yellow areas minutely punctate with black and on 3-6 divided posteriorly in the median line by the encroaching black; on 7 the yellow is produced slightly posteriorly in the median line; 8 with a small obscure basal lateral spot, a hint of which is found on 9; 10 with an obscure dorsal median greenish spot, the spot itself with a median black spot; appendages black; abdomen beneath dark, base of 3, vesicle, and portion of apices of genital hamules pale. (See fig. 10.)

Genital lobe represented on the margin of the segment by a low ridge with 4-6 short black teeth; anterior lamina prominent, the median third produced posteriorly as a smoothly rounded tubercle; hamules thin, plate-like, extending well beyond the vesicle of the

penis, the anterior not reaching the apex of the posterior, its apical third a long slender hook; posterior hamule elongated triangular in general shape, the sides somewhat rounded.

Described from a single male, collection U.S.N.M., collected at Trong, Lower Siam, Jan.-Feb., 1899, by Dr. W. L. Abbott, for whom this fine species is named.

Type.—Cat. No. 10449, U.S.N.M.

Contrasted with other species of the genus certain differences may be noted. From *t-nigrum* it differs in having the triangle of the front wing followed by 3, not 4, cells; the face largely black; anterior femora without pale stripe; abdominal segment 8 black, with a lateral basal pale spot, not yellow with apical one-third black; 7 with scarcely basal half yellow, not basal three-fourths; 9 almost entirely black, and

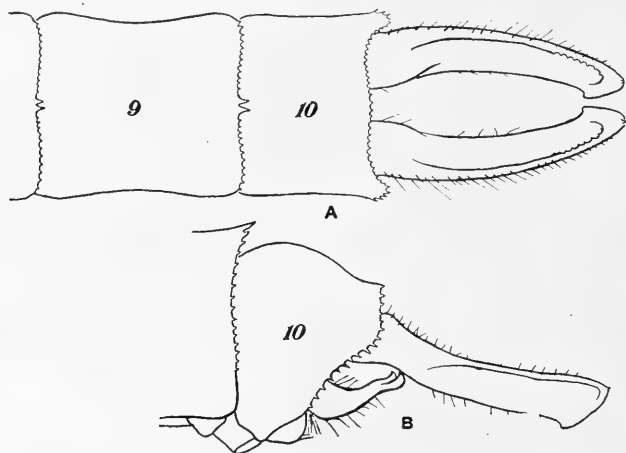


FIG. 10.—*GOMPHIDIA ABBOTTI* FROM SIAM. A, DORSAL, AND B, LATERAL VIEWS OF MALE ABDOMINAL APPENDAGES. 9 AND 10, ABDOMINAL SEGMENTS.

appendages differently shaped. From *maclachlani* it differs by having the upper lip spotted with yellow and the rhinarium yellow; the abdomen with less black, and the appendages differently shaped. From *kirschii* it differs in having a darker nasus; the antehumeral spots or stripes absent; abdominal spots not lateral but dorsal, reduced on 8 instead of more prolonged; appendages differently shaped, and a smaller number of postnodals. From *perakensis* it differs by the more extensive yellow on abdominal segments 3-6 and the smaller number of postnodals. From *confluens* it differs by having the subtriangle of front wing 2-celled, not 3-celled; by the differently colored face; by the isolated dorsal thoracic stripes; by the black legs, and by the much darker abdominal segments 7-10. From *krugeri* it differs by the 2-celled, not 3-celled, subtriangle of the front wing, by the dorsal

thoracic pattern, by the more extensive yellow on abdominal segments 3-6, and by the very different appendages. From *javanica* by having the subtriangle of front wing divided, not free; by the more extensive yellow on abdominal segments 3-6, and by the form of the appendages.

Genus SIEBOLDIUS De Selys.

Three species have been described in this genus. All are large insects, abdomen 55-61 mm., hind wing 47-55 mm: *S. albardæ* De Selys occurs at Pekin; *japonicus* De Selys is known from Borneo and the Malay Peninsula; and *grandis* Krüger has been described from two females from Sumatra. *S. grandis* is based largely on characters of the occiput and it remains to be seen if the species is separable from *japonicus*. Laidlaw's record of *grandis* from the Malay Peninsula should really be *japonicus*, I believe.

5. SIEBOLDIUS JAPONICUS De Selys.

Four males, Khow Sai Dow Mountain, 1,000 feet, Trong, Lower Siam, Jan.-Feb., 1899, Dr. W. L. Abbott, collector, collection U.S.N.M. One of these is teneral. All agree with De Selys's descrip-

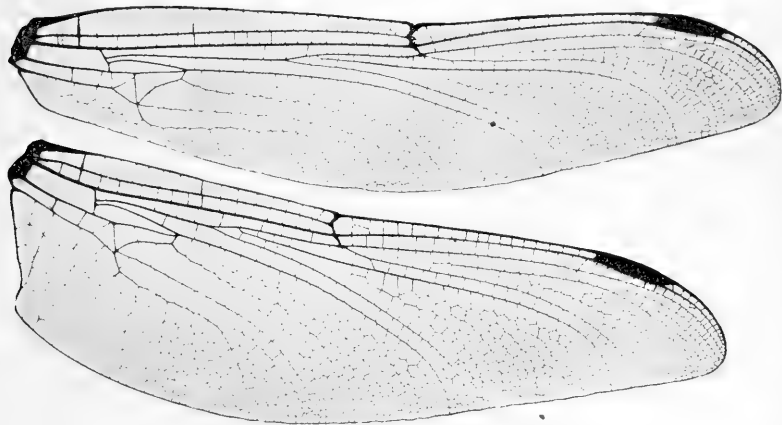


FIG. 11.—WINGS OF MALE SIEBOLDIUS JAPONICUS FROM SIAM.

tion in Odonates du Japon and with Laidlaw's description of a male "caught at the foot of Gunong Inas (about 1,000 feet above sea level) near a small jungle pool, in January, 1900." (See fig. 11.)

Genus HAGENIUS De Selys.

In addition to the American *brevistylus* De Selys, Martin has described a second species, *gigas*, from Tonkin. Martin's species is much the larger of the two, having the abdomen 71 mm. and the

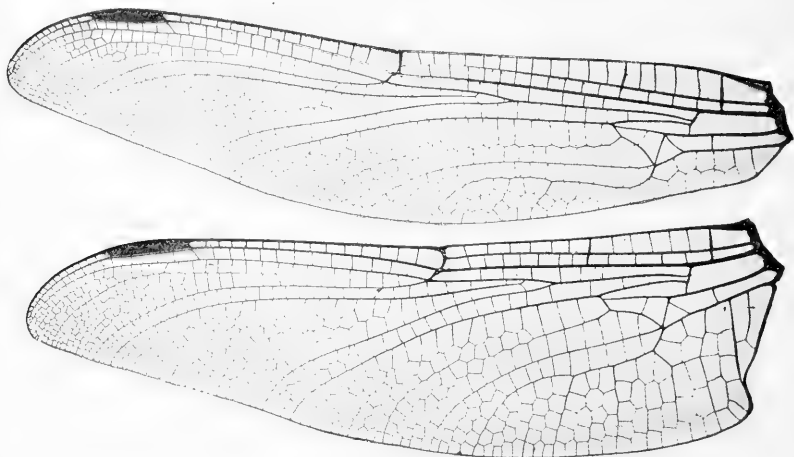


FIG. 12.—WINGS OF MALE HAGENIUS BREVISTYLUS FROM NORTH AMERICA.

hind wing 54 mm., and the dorsal thoracic stripes are joined with the mesothoracic half collar and not isolated as in *brevistylus*. (See fig. 12.)

Genus DAVIDIUS De Selys.

The species of this genus are all small or of moderate size, ranging from abdomen 29 mm. and hind wing 27 mm. to abdomen 44 mm. and hind wing 40 mm. There is great indefiniteness throughout the genus in the development of cross veins in the triangles. In *nanus* De Selys, from Japan, the triangles of all 4 wings were crossed in the first female studied by De Selys; later material had the triangle of front wing free and triangle of hind wing crossed and the supertriangle, normally free, accidentally crossed. Of *bicornutus* De Selys, from Japan, only one female has been described, and this has the triangle of front wing free and triangle of hind wing crossed. *D. davidii* De Selys, known from two females from Thibet, has the triangle of front wing free, of hind wing crossed. *D. ater* Hagen, from Japan, has the triangle free in all 4 wings, excepting that it is crossed in one hind wing of a female. *D. fruhstorferi* Martin, from Tonkin, in 6 specimens has the triangle of front wing free, of hind wing crossed; in a seventh specimen, female, all the triangles are crossed. *D. aberrans* De Selys, known from a single female from the north of India, has the triangle of one front wing free, the other triangles crossed. *D. zallorensis* Hagen, Himalaya, known from a single male, has the tri-

angle of front wing free, of hind wing crossed. None of the species has been taken in Burma or Siam. The two Indian species are very similar and were regarded by De Selys as probably the sexes of a single species. They are separated from *fruhstorferi* by having two pale areas on either side of the thorax above, instead of one; by the presence of a black stripe on second lateral suture, wanting in *fruhstorferi*; in *aberrans* and *zallorensis* there are 10–12 antenodals in the front wing (7 or 8 in hind wing of *aberrans*), and 7–10 post-

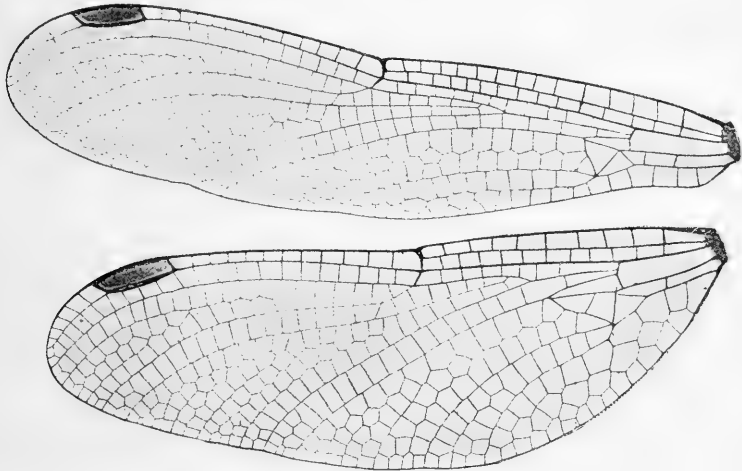


FIG. 13.—WINGS OF FEMALE DAVIDIUS FRUHSTORFERI FROM TONKIN.

nodals; in *fruhstorferi* there are 14–16 antenodals in front wing, 10 in hind wing, and 11 or 12 postnodals in front wing and 10 in hind wing. Characters for separating the two Indian species are not evident in the descriptions. In both the abdomen is largely black, 1 and 2 largely yellow, and the following segments to 8 each with a lateral basal and apical spot. The type of *aberrans* has the last 6 segments wanting. (See fig. 13.)

Genus MACROGOMPHUS De Selys.

The nine species belonging to this genus are confined to the Orient. In addition to the two distinct patterns of thoracic colors, separating these species into two groups, venational differences exist, but whether these venational differences are constant for the two groups I do not know. I have seen only one species of each of the two groups. In the case of the species of the *quadratus* group, in addition to several minor differences, the greater complexity and remarkable curving of the sectors, as compared with the species belonging to the *parallelogramma* group, may be noticed.

Quadratus group.—Dorsum of thorax black, with a large squarish yellow spot on either side below. In *quadratus* De Selys, from

Borneo, and possibly Sumatra, the yellow dorsal thoracic spots do not extend laterally beyond the humeral suture, and the auricles of the male are entirely black. In *thoracicus* McLachlan, from the Malay Peninsula and Sumatra, the thoracic spots extend laterally

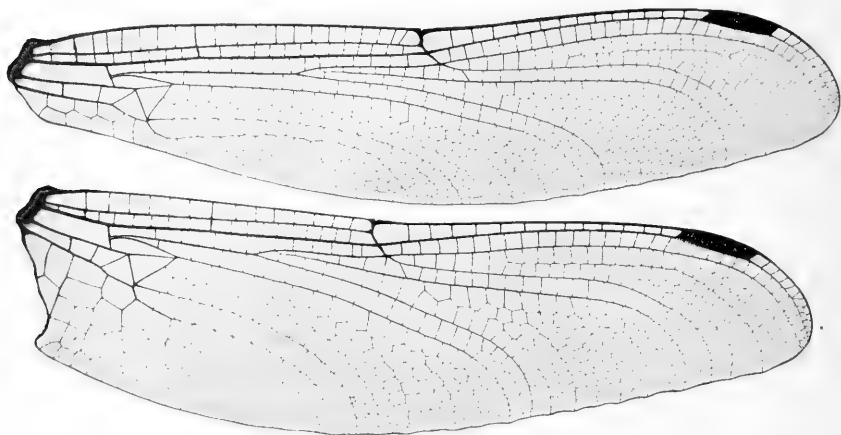


FIG. 14.—WINGS OF MALE *MACROGOMPHUS QUADRATUS* FROM BIG TAMBELAN ISLAND, CHINA SEA.

onto the mesepimeron, and the auricles are largely yellowish. In *abnormis* De Selys, probably from Borneo, the thoracic spots extend entirely across the sides of the thorax.

Parallelogramma group.—Dorsum of thorax black, with yellow dorsal stripes. The following notes are from De Selys' synopsis of the species in Quatrième Addition au Synopsis des Gomphines. In

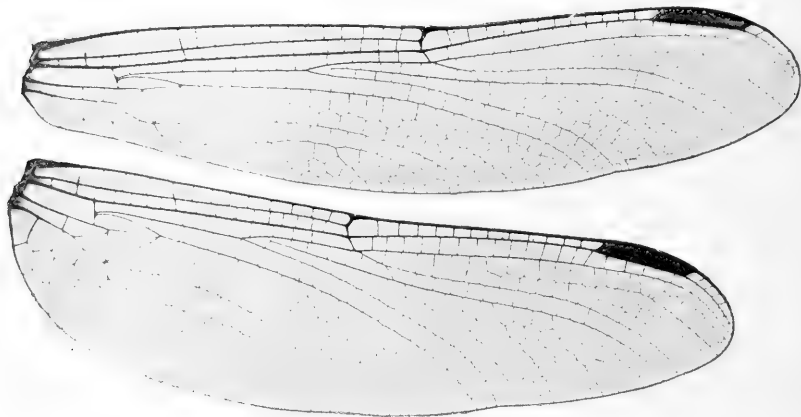


FIG. 15.—WINGS OF FEMALE SPECIES OF *MACROGOMPHUS* FROM SIAM.

annulatus De Selys, from India, Tonkin, and Anam, the outer and inner branches of the superior appendage of male are about equal in length, with a short inferior tooth; inferior appendage seen in profile with a double curve; rear of occiput of female with a median

bifid tubercle. In *robustus* De Selys, from Thibet, the male had the appendages destroyed, while the female is not known. In *albardæ* De Selys, from Sumatra, the outer branch of the superior appendage of the male is slightly shorter than the inner; branches of inferior appendage straight; a small tubercle at either end of the occiput in the female. In *parallelogramma* Burmeister, from Java and Sumatra, the outer branch of the superior appendage of the male is slightly shorter than the inner; branches of inferior appendage straight; rear of occiput of female slightly elevated. In *montanus* De Selys, from Assam, the outer branch of the superior appendage of the male is much shorter than inner branch; branches of inferior appendage straight; rear of occiput of female elevated and conical. In *decemlineatus* De Selys, from Sumatra and Borneo, the outer branch of

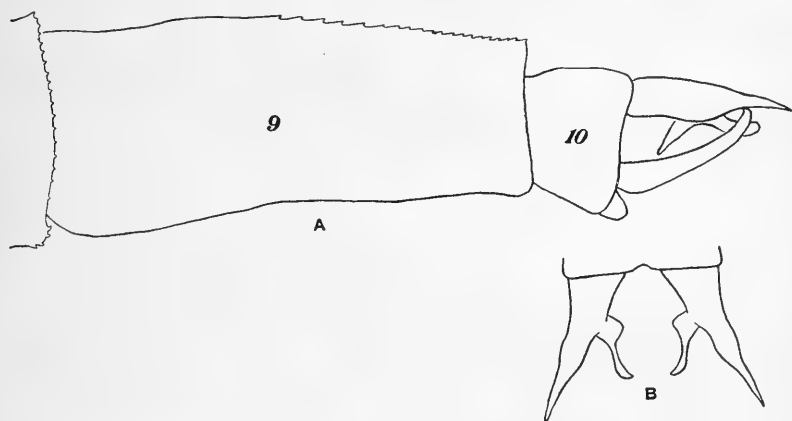


FIG. 16.—*MACROGOMPHUS QUADRATUS* FROM BIG TAMBELAN ISLAND, CHINA SEA. A, LATERAL, AND B, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES. 9 AND 10, ABDOMINAL SEGMENTS 9 AND 10. THE SHORT HAIRS PRESENT ON THE APPENDAGES ARE NOT SHOWN IN THE FIGURES.

the superior appendage of the male is much shorter than the inner; branches of inferior appendage straight; female not known.

The color differences may be tabulated as follows:

1. Lips and face black *robustus*
 Lips and face black, varied with yellow *annulatus*, *parallelogramma*, *decemlineatus*
 Upper lip and face brown, varied with yellowish *albardæ*
 Lips and face yellow, varied with black *montanus*
2. Sides of thorax black, with 2 isolated oval yellow bands. *robustus*, *annulatus*, *albardæ*
 Sides of thorax black, with 3 equal isolated yellow stripes *decemlineatus*
 Sides of thorax yellow, with approximated stripes on the lateral sutures and a third stripe at the posterior edge *parallelogramma*
 Sides of thorax yellow, with black stripes on the lateral sutures *montanus*
3. Legs black *robustus*
 Legs black, first femora pale spotted beneath *annulatus*, *montanus*, *decemlineatus*
 Legs black, femora shading into reddish *albardæ*
 Legs black, femora yellow *parallelogramma*

I have seen only three specimens of *Macrogomphus*. One of these is a male of *quadratus* collected by Doctor Abbott on Big Tambelan Island, China Sea, August, 1899. The other two are females of a form which I am unfortunately unable to refer to any described species and which I hesitate to name from the single sex, though the specimens show many characters which might justify this. (See figs. 14, 15, 16.)

6. **MACROGOMPHUS SPECIES** (parallelogramma group).

Abdomen without appendages 45 mm.; hind wing 37-38 mm. Antenodals, front wing 17-18; hind wing 12-14; postnodals, front wing 12; hind wing 10-12. Cubital space in front wing with 2 additional cross veins. Five cross veins between M_{1-3} and M_4 in front wing and 3 in hind wing; basal antenodal second series present. Abdominal segments 7-10 measuring: 7, 5 mm.; 8, 3.5 mm.; 9, 6 to 6.5 mm.; 10, 1 mm.

Rear of head and lower lip pale dull yellow, darker above behind the eyes; face in front obscure brown without markings, shading continuously from the frons into paler below, so that the upper lip at its lower edge passes into the color of the lower lip; frons above entirely greenish yellow; vertex black, dull yellow at the base of the occipital plate; occipital plate dark brown, produced in the middle in a two-pointed tubercle.

Thorax black, the yellow dorsal stripes almost parallel, beginning just before the antealar sinus and widened below to form a mesothoracic half collar, interrupted at the middle. A long yellow stripe, gradually widening below, on the mesepimeron; a similar but wider stripe on the metepimeron; the black area between the stripes with a superior yellow spot, which may be greatly reduced or may extend downward half the length of the spot on the metepimeron. Legs brown, without distinct markings; tibiae and apices of femora black.

First 3 abdominal segments obscurely colored, dorsum of 2 and 3 with a median dorsal stripe, wide on the basal half of 3, reduced to a line on the apical half; 4-7 basally annulate with yellow, scarcely one-third of each segment on 4-6, fully one-half on 7; 8 black; 9 with a small obscure basal lateral spot; 10 pale obscure yellow.

Described from two females, Trong, Lower Siam, Dr. W. L. Abbott, collection U. S. National Museum. The head of one specimen is lost.

This species is separated at once from *robustus* by the color of the head. From *annulatus* it is separated by several characters: Color of head, legs, and abdomen. From *albardæ* by color of head and abdomen, and form of occiput. From *parallelogramma* by color of head and abdomen and form of occiput. From *montanus* by color

of head, thorax, and legs, and form of occiput. From *decemlineatus* by color of head, thorax, legs, and abdomen.

Genus LEPTOGOMPHUS De Selys.

The ten species referred to this genus, some with considerable question, are all members of the oriental fauna; four have been recorded for Burma. The following notes gathered from the literature of the subject may be of value in separating the species:

L. assimilis Krüger. Tentatively proposed by Krüger for Sumatran specimens very close to *lansbergei*. The size is somewhat smaller, the stigma somewhat shorter than the figures given by De Selys for *lansbergei*; there are 2 additional postoccipital spines; the upper lip has 2 large instead of 2 small yellow spots; the prothorax is more yellow, and the anterior femora are yellow beneath.

L. gestroi De Selys. Burma and Tonkin. Abdomen, male 40–42 mm., female 39 mm. hind wing, male 34–35 mm., female 35 mm.; antenodals, front wing 15–16; postnodals, front wing 11; basal antenodal of second series present in 4 wings.

L. gracilis Krüger. Sumatra. Abdomen without appendages, male 27–28 mm., female 30 mm.; hind wing, male 23–25 mm., female 25 mm.; antenodals 12–13; postnodals 10–12; basal antenodal of second series not present; between M_{1-3} and M_4 4 or 5 cross veins in front wing, 3 or 4 in hind wing. Krüger regards *nietneri* and *gracilis* as not congeneric with *semperi*.

L. inclitus De Selys. Burma and Moolai. Abdomen, female 36 mm.; hind wing, female 32–33 mm.; antenodals, front wing 14–19; postnodals, front wing 9–11.

L. kelantanensis Laidlaw. Malay Peninsula. Abdomen, 31 mm.; hind wing 26 mm.; antenodals, front wing 11, hind wing 10; postnodals, front wing 10, hind wing 10; basal antenodal of second series wanting. Laidlaw's description and figure of venation and his description of male appendages clearly indicate the genus *Leptogomphus* rather than *Gomphus*, to which he assigned the species. His figure represents 3 cross veins between M_{1-3} and M_4 in front wing and 3 or 4 in hind wing.

L. lansbergei De Selys. Java and Sumatra (see *L. assimilis* above) Abdomen, female 39 mm.; hind wing 35 mm.; antenodals, front wing 17–18; postnodals, front wing 13 (De Selys). Abdomen without appendages, male 36–37 mm., female 36 mm.; hind wing, male 29 mm., female 33 mm.; antenodals, front wing 14–16; postnodals, front wing 11–12; basal antenodal of second series present; between M_{1-3} and M_4 4 or 5 cross veins in front wing, 2 or 3 in hind wing (Krüger).

4. Abdominal segments 8-10 black.

gestroi, *gracilis*, *inclitus*, *kelantanensis*, *lansbergei*, *maculivertex*

Some yellow on at least one of segments 8-10.....*nietneri*, *parvus*, *semperi*

5. Legs largely black or dark; yellow, if any, confined to first femora.

gestroi, *gracilis*, *lansbergei*, *nietneri*, *parvus*

Legs with much yellow.....*inclitus*, *maculivertex*, *semperi*

Uncertain.....*kelantanensis*

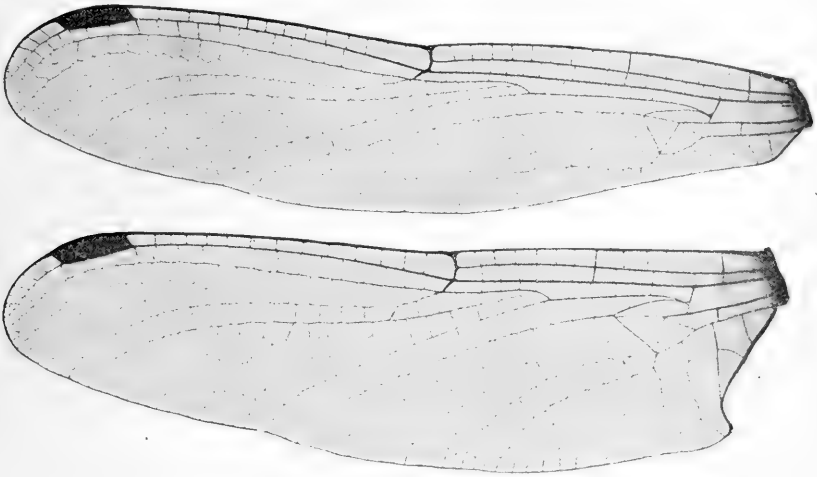


FIG. 18.—WINGS OF MALE SPECIES OF LEPTOGOMPHUS FROM TONKIN. MARTIN'S COLLECTION.

7. LEPTOGOMPHUS INCLITUS De Selys.

Described from two females from the east of Burma and a single female from Moolai, but not mentioned in Odonates de Birmanie.

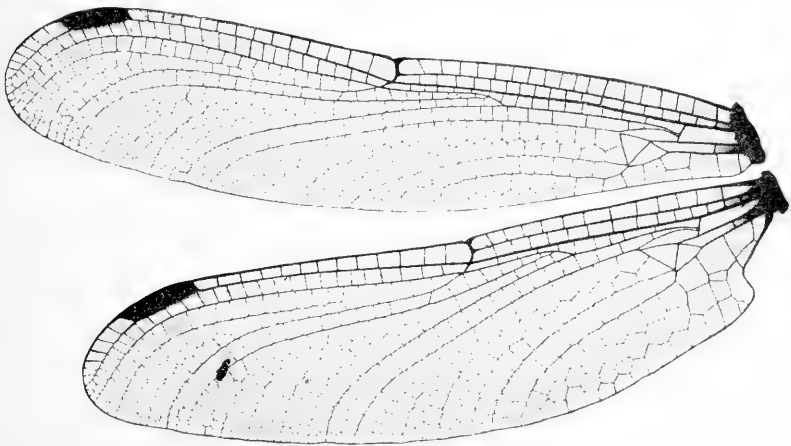


FIG. 19.—WINGS OF MALE LEPTOGOMPHUS INCLITUS. DE SELYS' COLLECTION.

I have not seen specimens. The following brief description is condensed from De Selys: Lips yellowish, the upper bordered with black

in front; rhinarium, nasus, and frons blackish, center of nasus yellowish, and frons above with yellow anteriorly. Thorax black; a dorsal stripe, confluent below with the mesothoracic half collar to form a 7,^a and an antehumeral of the same width, yellow; sides and below pale yellow, with a blackish stripe on the second suture, confluent above with a black area which occupies the upper ends of the 2 sutures and extends to the posterior edge of the thorax. Legs dusky blackish, the lower surface of the first 4 femora and a larger part of the last femora yellowish. Abdomen with 1-7 each with a dorsal yellow longitudinal stripe; 1 and 2 with lateral yellow band; 3-7 each with a similar but reduced and interrupted basal yellow band. (See figs. 19 and 20.)

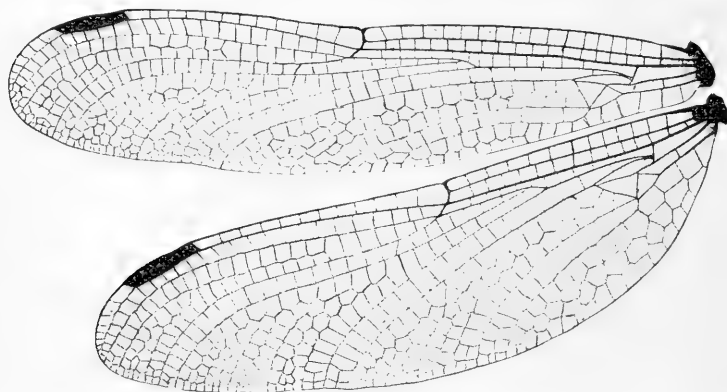


FIG. 20.—WINGS OF FEMALE *LEPTOGOMPHUS INCLITUS*. DE SELYS' COLLECTION.

8. *LEPTOGOMPHUS GESTROI* De Selys.

“Leitò, à la fin de mai (Fea).” Not represented in the collections before me. The following brief description is condensed from De Selys: Head pale yellow, black as follows: Occipital plate, vertex on either side, sutures of the face, rhinarium, and anterior border of upper lip which is obscurely and incompletely traversed. Thorax black above; a short mesothoracic half collar, isolated dorsal stripe, and an antehumeral stripe, yellow; sides and pectus yellow, first lateral suture with a black stripe, second with an irregular spot. Feet black, three-fourths of all femora and inner side of first femora livid. Abdomen black, yellow as follows: A basal spot and sides of 1, a trilobed dorsal spot and auricles of 2, a dorsal stripe, not reaching base or apex of each segment, on 3-7.

^a Not confluent in female from Moolai.

9. *LEPTOGOMPHUS*? *MACULIVERTEX* De Selys.

"Metelèd, un exemplaire unique (female), le 10 septembre, 1888 (Fea)." Not seen by me. The following brief description is condensed from De Selys: Head black, yellow as follows: A transverse band above on frons, a rounded spot on each side of nasus, a band on upper lip, cheeks, a round point at center of vesicle, and the occipital plate. Thorax black, yellow as follows: A mesothoracic half collar, narrowly interrupted in the median line, joined at either side with the dorsal stripes to form a 7; a narrow antehumeral stripe terminating above in a rounded isolated spot; a trace of pale on the mid-dorsal carina; sides and below clear yellow, a black line on the upper half of the first suture and a complete line on the second suture. Legs black, femora yellow, with an external black stripe. Abdomen black, marked with yellow; 3-7 with dorsal yellow spots not reaching the extremities of the segments, on 7 occupying only the basal two-thirds of the segment; 8-10 black.

10. *LEPTOGOMPHUS*? *NIETNERI* Hagen.

"Leitò, un male, unique pris le 27 octobre (Fea)." Not seen by me. The following brief description is condensed from Hagen and De Selys: Lower lip pale yellowish, middle lobe apically brownish; upper lip black, with 2 large yellow basal spots; rhinarium and nasus black; frons black, with a transverse yellow band in front above. Thorax black above, yellow as follows: An interrupted mesothoracic half collar, isolated oblique dorsal stripes, and a superior antehumeral spot; sides yellow, with a black stripe on each lateral suture. Legs black, femora with brown markings. Abdomen black marked with yellow; 1-7 (1-6 De Selys) with a dorsal stripe, narrowed on 3-7; on 6 and 7 a larger dorsal basal spot (not mentioned by De Selys); yellow markings on the sides of 1-3; 4-8 each with a short linear lateral basal spot (not mentioned by De Selys); a lateral apical yellow spot on 8 and 9 (not mentioned by De Selys). A comparison of Hagen's description based on a male from Ceylon with De Selys's description based on a male from Burma creates some doubt as to whether the 2 specimens really represent the same species.

Genus *MICROGOMPHUS* De Selys.

Only one species of this genus is known. It has been taken in the Malay Peninsula and Sumatra. *M. chelifera* De Selys is a small species, abdomen 25 mm., hind wing 18.5-22 mm. The face is black, marked with yellow. Thorax above black, with a pale dorsal stripe on either side joined with the interrupted mesothoracic half collar;

sides yellow, with a single black stripe. Abdomen black, with narrow indistinct basal rings and narrow mid-dorsal stripes as far as 7. (See figs. 21 and 22.)

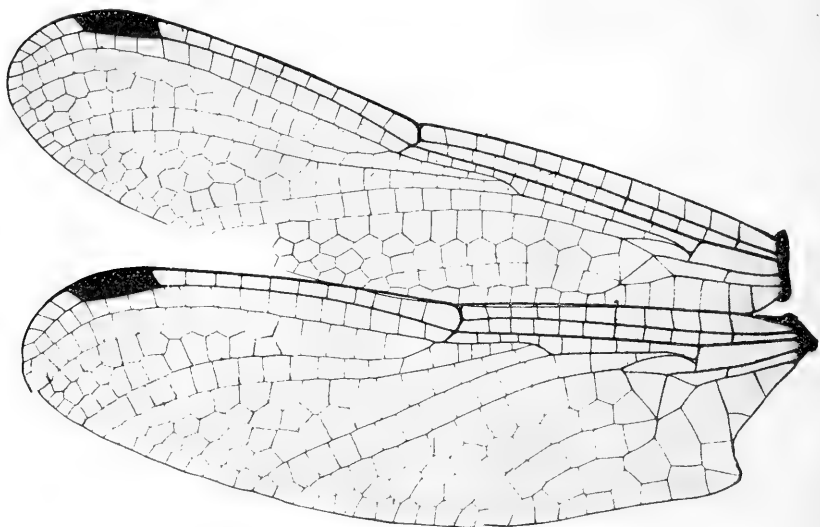


FIG. 21.—WINGS OF MALE MICROGOMPHUS CHELIFER. DE SELYS' COLLECTION.

Genus CYCLOGOMPHUS De Selys.

Six species, all described by De Selys, are known from India. *C. minusculus*, the smallest species, may be known at once by its size, abdomen 22 mm., hind wing 21 mm.; only the female is known. *C.*

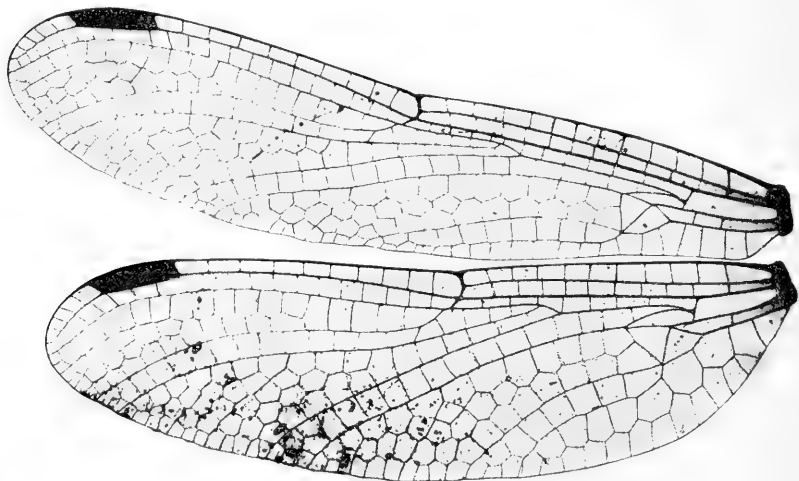


FIG. 22.—WINGS OF FEMALE MICROGOMPHUS CHELIFER. DE SELYS' COLLECTION.

verticalis, of which only the female is known, has the abdomen 27 mm., hind wing 25 mm.; it is separated from all the other species by

having a yellow spot on the vertex between the eyes. In *torquatus* and *heterostylus* the black on the sides of the thorax forms a distinct Y. *C. heterostylus*, of which the male has been described, has the stigma yellow, with a central brown spot; *torquatus* is known only from the female.

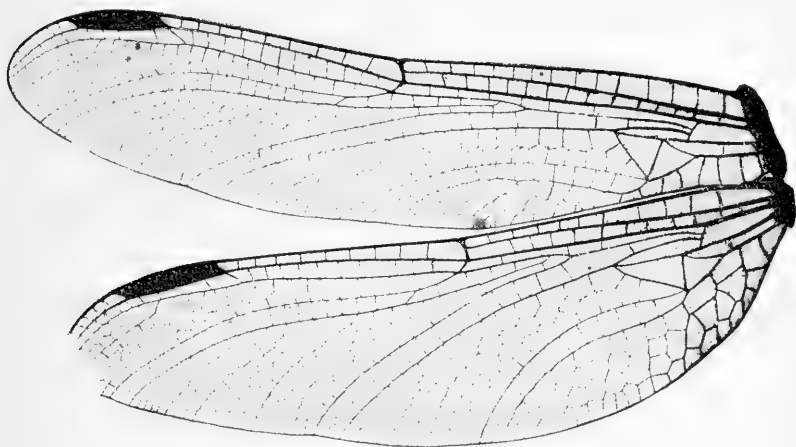


FIG. 23.—WINGS OF FEMALE *CYCLOGOMPHUS HETEROSTYLUS*. DE SELYS' COLLECTION.

In *vesiculosus* and *ypsilon* the black on the sides of the thorax does not form a distinct Y. *C. vesiculosus* has the abdomen 25 mm., hind wing 23 mm., the female is not known; *ypsilon* has the abdomen 32 mm., hind wing 29 mm. Only in the case of *ypsilon* are both sexes

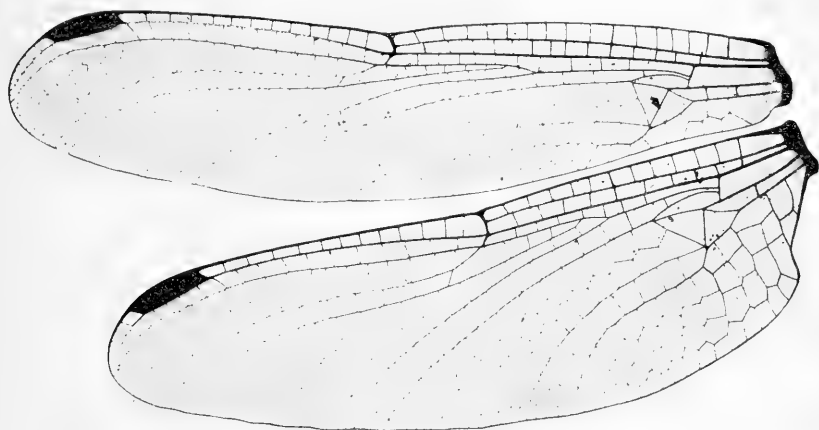


FIG. 24.—WINGS OF *ANISOGOMPHUS OCCIPITALIS*. DE SELYS' COLLECTION.

known; *heterostylus* and *vesiculosus* are known only from males, and the single male of *vesiculosus* has the last 5 abdominal segments wanting; *minusculus*, *verticalis*, and *torquatus* are known from females only. The abdominal appendages of the males in the two

species known are remarkable by the small size of the superiors and the large widely divaricate inferior, which is one and one-half to twice as long as the superiors. (See fig. 23.)

Genus ANISOGOMPHUS De Selys.

Five or six species have been referred at different times to this genus. The type of the genus and another species are oriental, the two occurring in India. *A. occipitalis* De Selys and *bivittatus* De Selys are about of the same size; *occipitalis* has the abdomen, male

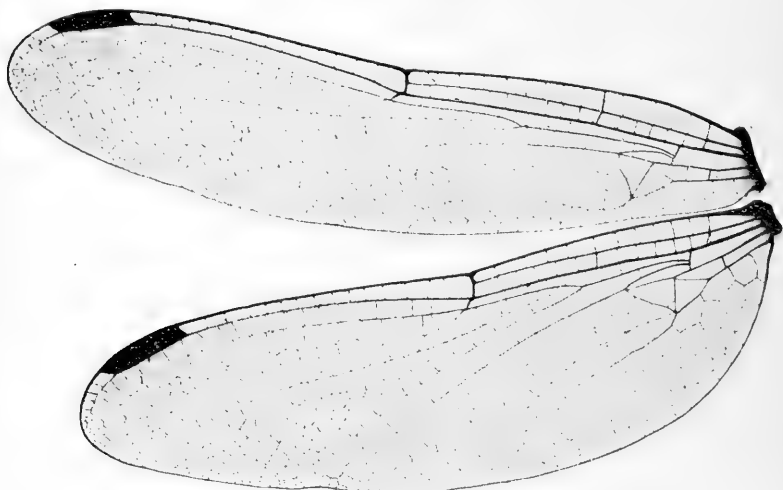


FIG. 25.—WINGS OF FEMALE ANISOGOMPHUS OCCIPITALIS. DE SELYS' COLLECTION.

33–35 mm., female 35–37 mm.; hind wing, male 29–31 mm., female 32–35 mm.; *bivittatus* has the abdomen, female 38 mm.; hind wing, male 29 mm., female 36 mm. (De Selys was not certain that the male on which the description of that sex of *bivittatus* was based, really was *bivittatus*, and he tentatively proposed the name *bifrenatus* for this specimen. Syn. Gomph. and Mon. Gomph.). In *occipitalis* the nasus is black, with median and lateral yellow spots; in *bivittatus* it is largely yellow. (See figs. 24 and 25.)

Genus ANORMOGOMPHUS De Selys.

The single species referred to this genus is known only from India. *A. heteropterus* De Selys is a small species, abdomen 25 mm., hind wing 22 mm., with largely yellow coloration. (See fig. 26.)

Genus BURMAGOMPHUS, new genus.

Type of the genus.—*Gomphus vermiculatus* Martin.^a

For details of venation see key to genera on pages 272–275. In the front wing 2 cross veins between M_{1-3} and M_4 and in the hind wing 1,

^aI have studied specimens from Burma only. These have been identified as *Gomphus vermiculatus* and from them the characters of the genus have been drawn.

the position of these cross veins definite and subject to but slight variation, the first near the distal end of the supertriangle; 3 rows

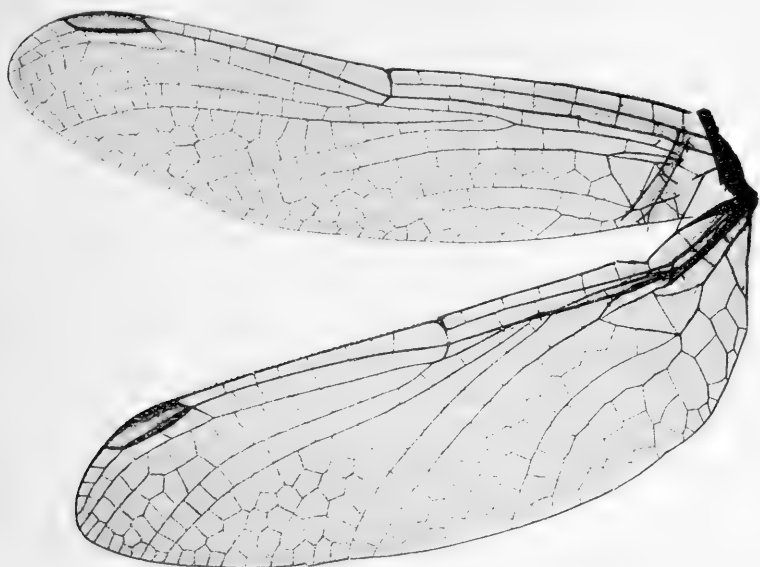


FIG. 26.—WINGS OF MALE *ANORMOGOMPHUS HETEROPTERUS*. DE SELYS' COLLECTION.

of postanal cells, the first 2 undivided, similar in size and shape, the third wider and once divided: A_2 in hind wing arising near the middle of the lower side of the triangle; area included between Cu_2 and A_1

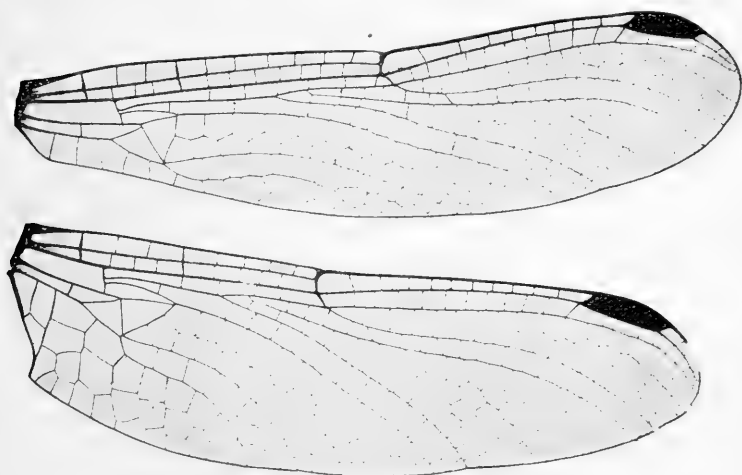


FIG. 27.—WINGS OF MALE *BURMAGOMPHUS VERMICULATUS* FROM BURMA.

in hind wing of moderate length, at the margin not twice as long as wide. At first glance the venation of the hind wing suggests *Gomphus* with the anal area reduced. In *Lanthus*, an American genus very

closely related to *Gomphus*, we have 2 small species about equal in size to *Burmagomphus vermiculatus*, described below, but in *Lanthus* no such reduction of the anal area takes place. In Gomphinae generally, however, small size is associated with reduced anal area (there are notable exceptions), so the value of this character for generic distinctions is open to question. In the minute *Microgomphus* reduction of anal area reaches its maximum in the subfamily and there are only 2 rows of postanal cells. In the venation of the front wing *Burmagomphus* is at once separated from *Gomphus* by the parallelism of M_4 and Cu_1 , a character it shares in common with several

other genera, notably *Onychogomphus*. By its well-braced stigma, strongly and symmetrically forked M_{1-2} and M_3 , reduced and definitely placed cross veins between M_{1-3} and M_4 , distinctly and strongly shaped postanal cells in the hind wing, paralleling of M_4 and Cu_1 in front wing, undivided triangles, supertriangles and subtriangles, and absence of basal ante nodals of the second series, *Burmagomphus* allies itself with the venationally highly specialized genera of Gomphinae. (See fig. 27.)

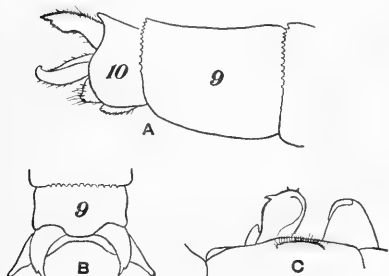


FIG. 28.—*BURMAGOMPHUS VERMICULATUS* FROM BURMA. A, LATERAL, AND B, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES. C, PROFILE OF ACCESSORY GENITALIA OF ABDOMINAL SEGMENT 2. 9 AND 10, ABDOMINAL SEGMENTS.

The relatively greatly developed and widely divaricate inferior abdominal appendage of the male suggests to a certain extent some species of *Gomphus* and the following genera: *Notogomphus*, *Anisogomphus*, *Neogomphus*, and *Cyclogomphus*. Of these genera I know the venation of all but *Notogomphus*, in which there is not the great difference in the length of abdominal segments 9 and 10, as in *Burmagomphus*, and the superior appendages are about twice as long as the inferior, and not about equal as in *Burmagomphus*. Moreover, the color patterns of both thorax and abdomen are very different in the two genera. In the thoracic pattern *Burmagomphus* is unique among Gomphinae, so far as known to me, in having the dorsal stripes united below on either side with the antehumeral stripes, the upper end of the reduced antehumerals represented by a rounded spot.

Abdominal segments 8 and 9 about equal, about two and two-thirds times as long as 10.

Legs short, hind femora slender, 5 mm., reaching to base of second abdominal segment, armed with short spines.

A male from Burma was sent to M. Martin, who writes as follows: "It is a species very near to *vermiculatus* but slenderer, the stripes of the thorax different, the inferior appendage slenderer and more divaricate." Specimens from Anam and Tonkin are slightly larger, abdomen 30-32 mm., and the antenodals and postnodals are more numerous; as described the nasus is not spotted and the pale dorsal stripe on the frons is divided; the black stripe on the first lateral suture is forked above, not reduced as in the specimens from Burma; and the color pattern of the abdomen is slightly different, with 9 bearing a small posterior spine, which is not represented in my material.

II. BURMAGOMPHUS VERMICULATUS Martin.

Abdomen, male 28 mm.; hind wing, male 23 mm. Antenodals, front wing 10, hind wing 8; postnodals, front wing 8-9, hind wing 8-10. Second thickened antenodal normally the fourth; oblique vein the second or third beyond the subnodus; stigma covering 3-4 cells, followed in the front wing by about the same number; triangle in front wing followed by 2 rows of cells, in hind wing by 3 rows, then 2 increasing; anal triangle 3-celled.

Head 6 mm. wide, distance between eyes above at closest point 1 mm.; black throughout except as follows: Lower lip white or pale plumbeous, paler at the margins; a large transverse rectangular green spot on either side of the upper lip at its base; the base of the mandibles green; a short, narrow, transverse, median, inferior streak, and a large rounded spot on either side of the nasus; frons low, yellowish green above in front, black at the base, the black extending anteriorly at the middle in a broad low triangle, but not dividing the pale area, and widening on either side, giving the pale area a rounded posterior border on either side of the median line; eyes in dried specimens chestnut brown, probably in life blue, shading below into pale.

Prothorax black, the dorsal anterior border narrowly yellow; a greenish-yellow triangular spot on either side of the posterior border, and a smaller spot below this on the inferior margin; these spots represented below by a short pale streak at the bases of the first legs. Thorax black, marked with greenish yellow as follows: A mesothoracic half collar, interrupted by the merest line, wide on either side of the median line and tapering to an acute apex at either extremity; widely divergent dorsal stripes, the lower portion of which really consists of a portion of the antehumeral stripes (see diagram of thoracic pattern, fig. 29), continued below as a pale stripe extending on to the bases of the middle legs; a dorsal antehumeral spot; a wide stripe on the mesepimeron, joined above for about one-third its length with a wider stripe on the metepisternum, the later stripe extending below on to the metinfraepisternum and with its upper posterior corner more or less isolated by a narrow black

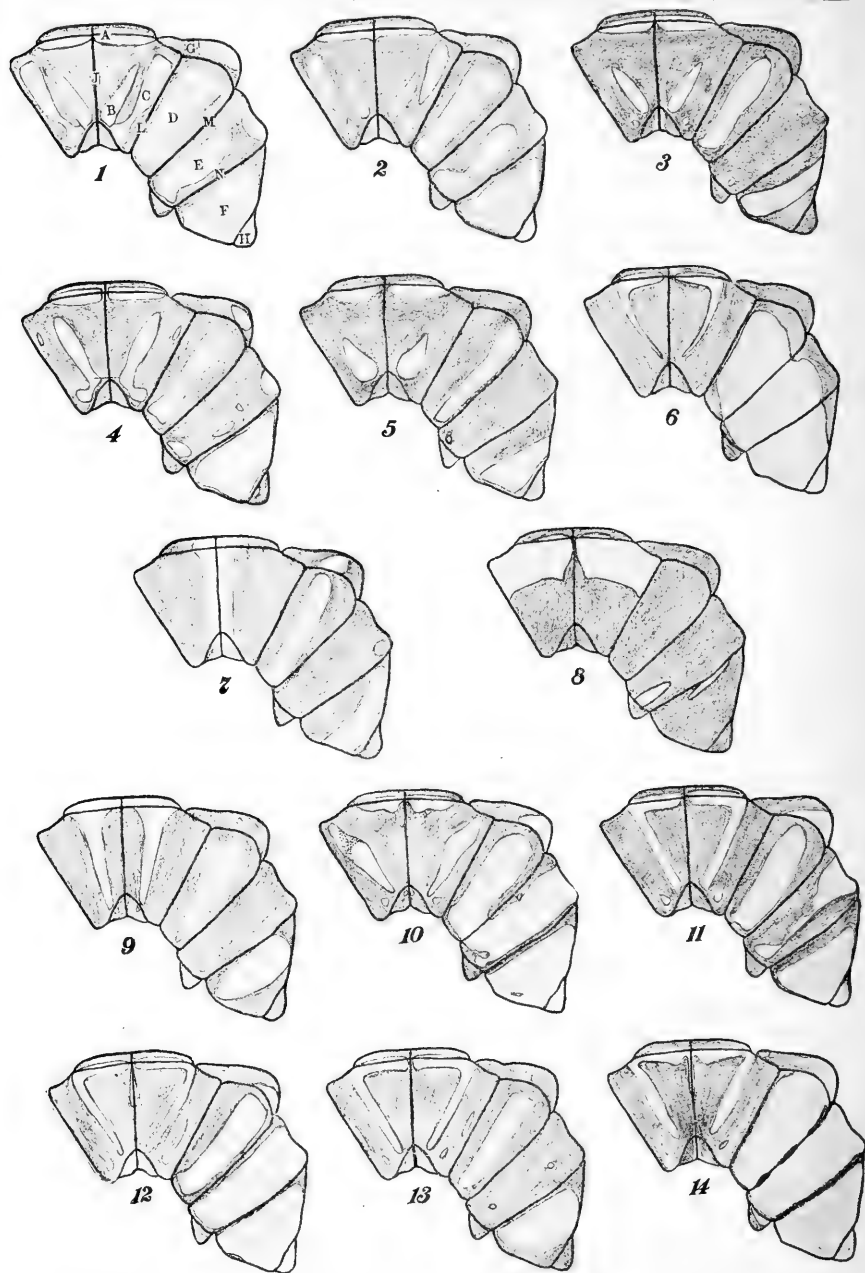


FIG. 29.—DIAGRAMS REPRESENTING THE THORACIC COLOR PATTERN OF SOME ORIENTAL GOMPHIINÆ.

1. *ICTINUS CLAVATUS*, TONKIN. 2. *ICTINUS PERTINAX*, TONKIN. 3. *ICTINUS MELENOPS*, SIAM. 4. *GOMPHIDIA KRUGELI*, TONKIN. 5. *GOMPHIDIA ABBOTTI*, SIAM. 6. *DAVIDIUS FRECHTORFERI*, TONKIN. 7. *SIEBOLDIUS JAPONICUS*, SIAM. 8. *MACROGOMPHIUS QUADRATUS*, BIG TANBELAN ISLAND, CHINA SEA. 9. *MACROGOMPHIUS SPECIES*, SIAM. 10. *BURMAGOMPHIUS VEHICULATUS*, BURMA. 11. *GOMPHIUS XANTHÆNATUS*, BURMA. 12. *ONYCHOGOMPHIUS ANXULARIS*, BURMA. 13. *ONYCHOGOMPHIUS SAUNDERSII*, BURMA. 14. *ONYCHOGOMPHIUS SPECIES*, BURMA.
- A. MESOTHORACIC HALF COLLAR. B. DORSAL THORACIC STRIPE. C. ANTEHUMERAL STRIPE (IN LITERATURE SOMETIMES HUMERAL STRIPE OR JUXTAHUMERAL STRIPE). D. PALE STRIPE ON THE MESEPIMERON. E. PALE STRIPE ON THE METEPIMERON. F. PALE AREA OR STRIPE ON THE METEPIMERON. G. MESINFREPISTERNUM. H. METASTERNUM. J. MIDDORSAL CARINA. L. HUMERAL SUTURE. M. FIRST LATERAL SUTURE. N. SECOND LATERAL SUTURE. DOTTED PORTION OF NO. 10 REPRESENTS THE PALE AREA CONNECTING THE DORSAL AND ANTEHUMERAL STRIPES.

stripe; metepimeron largely pale, narrowly edged in front with black, and a small black spot on its posterior border; pectus shaded with brown and black. Legs slender, black, the first femora and coxæ with an inner gray stripe; wings hyaline; stigma brown.

Abdomen slender, largest basally, slightly dilated apically; segments measuring in length about as follows: 1, 1 mm.; 2, 2 mm.; 3, 4 + mm.; 4, 4 + mm.; 5, 4.5 mm.; 6, 4 mm.; 7, 3 + mm.; 8, 2 + mm.; 9, 2 + mm.; 10, 0.75 mm.; appendages, 0.75 mm. Color black, marked with greenish yellow as follows: A dorsal spot and a large inferior lateral spot, not reaching the anterior border, on 1; a narrow dorsal longitudinal trilobed spot, a lateral spot covering the auricles, and a large subapical lateral spot, the 2 lateral spots joined along the inferior border, on 2; a narrow longitudinal dorsal stripe on 3, widening basally and not reaching the apex; a similar stripe on 4 and 5, the dorsal stripe shortened apically and widened basally into an almost complete ring; on 6 the basal ring is practically complete, about one-eighth the length of the segment, and with the dorsal stripe reduced to a small acute triangle; on 7 the basal ring is complete (that is, extending to the inferior margins of the segment), covering about one-sixth of the segment, and without a trace of the dorsal stripe; 8 with the merest trace of a basal ring; 9 with a little less than the apical dorsal half or third clear yellow, the pale area a low, rounded triangle in shape, with its apex dorsal and anterior, its base formed by the posterior edge of the segment and not reaching the inferior margin; this spot is the striking feature in the coloration of the abdomen, suggesting *Gomphus melænops* and its allies, all larger species. Appendages black. Considerable variation in the development of the longitudinal middorsal abdominal stripe must be expected. (See fig. 28.)

Described from three males collected by Mr. R. A. Earnshaw.^a

Genus PLATYGOMPHUS De Selys.

Three species, one of them questionably, have been placed in this genus by De Selys. *P. dolabratus* De Selys occurs in India; *P. feæ* De Selys in Burma; and *P. ? occultus* in China. In *dolabratus* the basal yellow rings on segments 3-7 are confluent with the dorsal lanceolate spot on each segment; in *occultus* the dorsal spots are narrower and are isolated; and in *feæ* the dorsal spots on 5-7 are wanting. (See figs. 30 and 31.)

12. PLATYGOMPHUS FEÆ De Selys.

"Bhamò en juillet et août (Fea)." Not seen by me. Only the male is known. The following brief description is condensed from

^aThese specimens were originally described in this paper as representing a new species. In the opinion of Prof. F. Foerster, with whom I have corresponded on the matter, and to whom I have sent a specimen from Burma, the species from Burma and Tonkin are identical. Moreover, M. René Martin seemed undecided as to the distinctness of the two, so my specimens are here referred to *vermiculatus*.

De Selys: Abdomen 35–37 mm.; hind wing 30–31 mm.; antenodals, front wing 12–13 mm.; hind wing 9–10 mm.; postnodals, front and hind wings 6–10 mm. Sutures of the face without black, vertex without a central yellow spot. Thorax above black, with small oval or triangular isolated dorsal stripes and an antehumeral stripe yellow;



FIG. 30.—WINGS OF MALE *PLATYGOMPHUS DOLABRATUS*. DE SELYS' COLLECTION.

sides yellow, with a stripe on the second suture, this stripe forked above a branch going to the base of each wing. Abdominal segments 3–6 with a basal yellow ring, prolonged on the sides; a small dorsal median spot on 3 and 4; basal half of 7 yellow; 8 and 9 dilated, the sides largely yellow; 10 light brown.

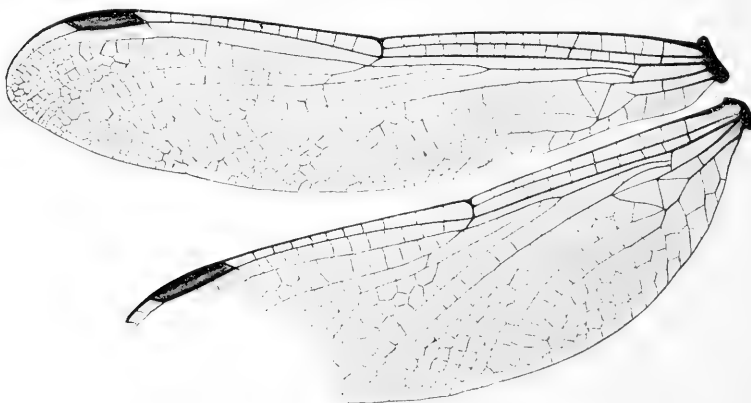


FIG. 31.—WINGS OF FEMALE *PLATYGOMPHUS DOLABRATUS*. DE SELYS' COLLECTION.

Genus *GOMPHUS* Leach.

As at present understood but two oriental species are certainly referable to this genus. For a discussion of *G. vermiculatus* Martin see *Burmagomphus*; for *G. kelantanensis* Laidlaw see *Leptogom-*

phus; and for *G. (Aeshna) thomassoni* Kirby see *Onychogomphus*. *Gomphus* ? *promelas* De Selys, from India, and *Gomphus* ? *ceylonicus* Hagen, from Ceylon, are known each from a single female, in the case of *promelas* the type lacking the last 7 abdominal segments. In the case of each the stigma is *without* brace vein; the yellow dorsal thoracic stripes are isolated, not joined below with the mesothoracic half collar. Each has the abdomen about 41 mm., hind wing 38–39 mm. The stigma is blackish in *promelas*, yellow in *ceylonicus*; the mesothoracic half collar is scarcely interrupted in *promelas*, widely interrupted in *ceylonicus*; and the dorsal stripes are more widely separated from the half collar in *ceylonicus* than in *promelas*. The two species above referred to which certainly belong in the genus *Gomphus* are *personatus* De Selys, known from Assam, Bengal, and Tonkin, and a new species described below from Burma.

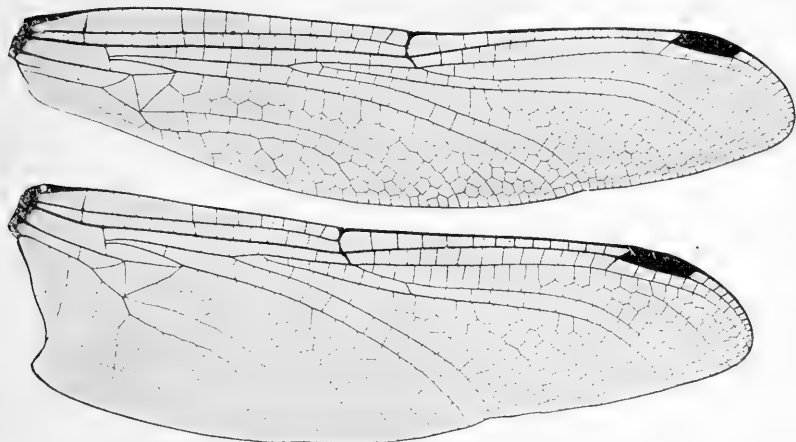


FIG. 32.—WINGS OF MALE *GOMPHUS XANTHENATUS* FROM BURMA.

13. *GOMPHUS XANTHENATUS*, ^a new species.

Abdomen, male 45 mm.; hind wing, male 39 mm. Antenodals, front wing 16, hind wing 10–12; postnodals, front and hind wings 11–12. Basal antenodal of second series present in the 4 wings of two specimens, present in front wings and wanting in hind wings of one specimen, and wanting in 4 wings of one specimen. (In a male of *melænops* it is present in the front wings, wanting in the hind wings; in a female of the same species it is present in one front wing, wanting in the other 3 wings.) (See fig. 32.)

^a The specific name refers to the conspicuous yellow area on the ninth abdominal segment.

Head black, yellow as follows: Lateral lobes of the lower lip; base of mandibles; a basal spot on either side of the upper lip; a spot at either end of the nasus; sometimes a trace at middle of rhinarium and middle of lower edge of nasus; the upper half of the frons in front and all the frons above, excepting the extreme base; the occipital plate at the middle, or entirely black.

Prothorax black, yellow as follows: The anterior border, a geminate median spot on the middle lobe, a small spot just behind it, and a large spot on either side. Thorax above black, largely yellow between the wings; middorsal carina with its extreme edge yellow for a short distance; straight, slightly divergent, yellow dorsal stripes of nearly uniform width throughout, almost reaching the antealar sinus above and connected below with the slightly narrower, broadly interrupted, mesothoracic half collar; just behind the upper end of the dorsal stripe is a round spot representing the antehumeral stripe; in one specimen this spot is prolonged downward about two-thirds the length of the mesepisternum by the faintest, frequently interrupted line; in another case the spot is reduced to the merest pin point; mesepimeron with a broad yellow stripe, represented on the mesinfraposternum by an isolated spot; metepisternum with a narrow irregular yellow stripe which is infringed on by the black stripes on the 2 lateral sutures and which may be thereby completely obliterated excepting for a large inferior spot; metepimeron largely yellow, with the black of the second lateral suture on its upper edge, and a slight trace of black on its lower edge. Pectus dark, almost or quite black.

Legs black, venation black, or dark brown; stigma reddish brown, surrounded by black veins; membranule almost wanting; anal triangle in male 3-celled.

Abdomen slender, 7-9 moderately dilated for the genus; black, yellow as follows: A dorsal longitudinal stripe on 1 and 2, trilobed on 2, in one specimen continued as the merest line to the apex of 3; sides of 1 and 2 below largely yellow, auricles yellow, genitalia black; 3-7 each with a basal yellow ring, not quite reaching the lower edge of each segment, narrowly interrupted in the middorsal line on 7, widest on 3, where it occupies about one-fourth of the segment, on 4-6 occupying scarcely one-fifth, and on 7 about one-fifth of each segment; 8 has a transverse basal linear spot on either side (wanting in one specimen), representing the basal ring of the preceding segments, and a small lateral apical spot, variable in size; in one specimen 8 has an inferior subbasal lateral spot equal in size to the more superior lateral apical spot; 9 above with the apical half or three-fourths yellow, the yellow area widening rapidly posteriorly, but not quite reaching the extreme lower edge of the segment; in shape this yellow area is that of a truncated triangle; 10 and appendages black; in one specimen 10 has a small round apical spot on either side of the dorsum

at the base of the superior appendages. Abdomen black beneath. (See fig. 33.)

Described from four males from Burma sent me by Mr. R. A. Earnshaw. One of these was sent to M. René Martin and Professor Foerster, who regard it as an undescribed species.

Paratype.—Cat. No. 10451, U.S.N.M. One specimen. The type is in the author's collection.

The small series shows an extent of variation in color remarkable in a species of *Gomphus*. This is most evident on the sides of the

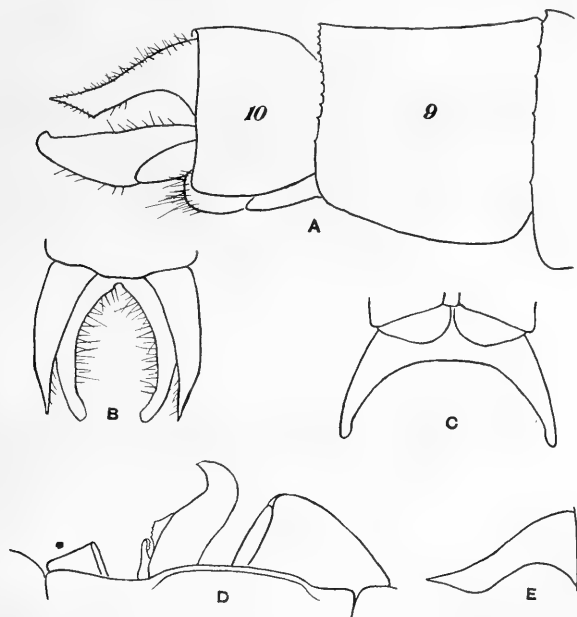


FIG. 33.—*GOMPHUS XANTHENATUS* FROM BURMA. *A*, LATERAL, AND *B*, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES, IN THIS SPECIMEN UNNATURALLY COMPRESSED BY THE ENVELOPE IN WHICH SPECIMEN WAS PRESERVED; IN *C*, VENTRAL VIEW OF INFERIOR APPENDAGE, ANOTHER SPECIMEN IS FIGURED, AND THE INFERIOR APPENDAGE IS NOT DISTORTED; IN THIS SPECIMEN THE APICES OF THE SUPERIOR APPENDAGES ARE SEPARATED BY $1\frac{1}{2}$ THE DISTANCE REPRESENTED IN *B*. AND THE INFERIOR APPENDAGE IS EQUALLY DIVARICATE; *D*, PROFILE OF ACCESSORY GENITALIA OF ABDOMINAL SEGMENT 2. *E*, LATERAL VIEW OF SUPERIOR ABDOMINAL APPENDAGE OF A SPECIMEN DIFFERING FROM *A* IN HAVING THE LOWER SUBAPICAL EDGE ROUNDED, NOT ANGULATE, AND MINUTELY TOOTHED. 9 AND 10, ABDOMINAL SEGMENTS.

thorax and on abdominal segments 8–10. Throughout the description the pale markings have been described as yellow. It is probable that in life these are not of the same color throughout, tending to greenish on the thorax and to orange on the abdomen, excepting that the pale area of 9 is probably clear yellow, paler than the markings of the segments anterior to it. Venationally, if the frequent presence of the basal antenodal of the second series is disregarded, this species and the Japanese *melænops* De Selys are similar to North American

species of Needham's subgenus *Stylurus* and to related species of which *fraternus* and *vastus* may serve as examples. *G. xanthenatus* is separated at once from *melænops* by the spotted upper lip, by the narrower dorsal thoracic stripes, not widening below, by the absence of a distinct pale antehumeral stripe, by the wider black stripes on the lateral thoracic sutures, by the annulation of segments 3-7, and the greater extent of yellow on 9. *G. personatus* De Selys is known to me only from the description. It is separated from *xanthenatus* by the presence of a pale antehumeral stripe, sometimes interrupted, by having the stripes on the lateral thoracic sutures very narrow, the first interrupted, by the pectus largely yellow, and by the abdomen with a longitudinal middorsal stripe and not annulated. *Gomphus pryeri* De Selys, from Japan, and *Gomphus scissus* McLachlan, from western China, are two related species known only from female specimens. Both are distinct from *xanthenatus* by a number of characters.

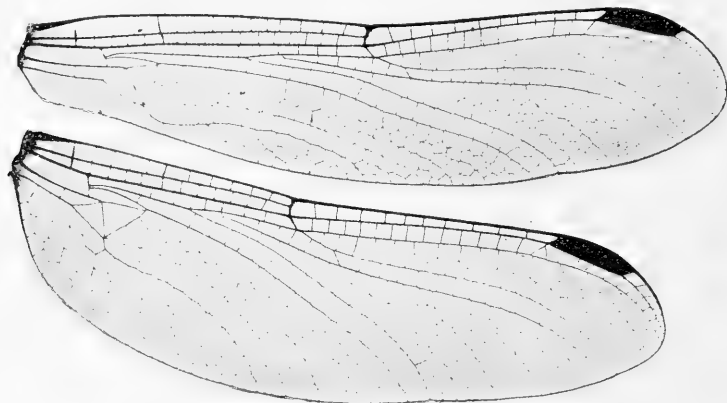


FIG. 34.—WINGS OF FEMALE ONYCHOGOMPHUS ANNULARIS FROM BURMA.

Genus ONYCHOGOMPHUS De Selys.

Of the about forty described species in this genus, seventeen are oriental. These arranged alphabetically are:

O. annularis De Selys. Known from two incomplete males from North Burma. Abdomen 34-37 mm.; hind wing 29-32 mm.; abdominal appendages not known. (See fig. 34.)

O. biforceps De Selys. Described from a single male from India; recorded from Tonkin by Martin. Abdomen 41 mm.; hind wing 32 mm. (if measurements are correct the abdomen is relatively long); male superior abdominal appendages longer than 9+10, turned abruptly downward near apex; inferior appendage equally long, near apex curved abruptly upward, the two branches separated for a distance near the base to inclose an oval space.

O. bistrigatus Hagen. Described from India. (The male described by De Selys in his Second Addition to the Synopsis des Gomphines is not certainly *bistrigatus*, and the second female described in the Mon. des Gomphines as *bistrigatus* is *m-flavum*.^a) Recorded from Anam by Martin. Abdomen 39 mm.; hind wing 33–34 mm.; male superior abdominal appendages twice as long as 10, turned downward at apex; inferior appendage slightly shorter, in profile with 2 teeth, one at the first third, the other at the second third; female vulvar lamina half as long as 9, divided at apex into two points.

O. camelus Martin. Tonkin and Anam. Abdomen 50 mm.; male abdominal appendages similar to *biforceps*, but larger, the branches of the inferior not separated at base; female described as similar to *biforceps*, but vulvar lamina and occipital plate not mentioned.

O. cerastis De Selys. India and Nepal. Abdomen 40–43 mm.; hind wing 34–37 mm.; male appendages not known; female vulvar lamina small, short, one-fourth the length of 9, notched for one-half its length; female occipital plate with two median spines.

O. circularis De Selys. North Burma. Abdomen 41 mm.; hind wing, male 32 mm.; female 38 mm.; male superior abdominal appendages equal in length to 9 + 10, curved toward each other and slightly downward, the apex beneath emarginate; inferior appendage destroyed; female vulvar lamina divided into two conical contiguous tubercles.

O. frontalis De Selys. Described from a teneral female from India. Abdomen 29 mm.; hind wing 25 mm.; vulvar lamina half as long as 9, lanceolate, the apex divided.

O. geometricus De Haan. Java. Abdomen 36–37 mm.; hind wing 29–31 mm.; male superior abdominal appendages twice as long as 10, curved toward each other and apically downward; inferior appendage little shorter, curved strongly upward, and bearing a tooth near the base; female vulvar lamina very short, its apex broadly emarginate.

O. grammicus Rambur. India. Abdomen 37–39 mm.; hind wing 30 mm.; male superior appendages as long as 9 + 10, in profile strongly curved, the apex flattened into a horizontal, almost bifid plate; inferior appendage a little shorter, enlarged and flattened basally, then curving abruptly upward in 2 slender contiguous branches.

O. inscriptus Hagen. Known only from the female from Java. Abdomen 36 mm.; hind wing 32 mm.; vulvar lamina short and wide, the apex truncated and emarginate.

O. lineatus De Selys. India and Nepal. Abdomen 33–35 mm.; hind wing 27 mm.; male superior appendages almost as long as 9 + 10,

^a Causeries Odon, VII, 1894, p. 170.

almost parallel, apically turned rather abruptly downward; inferior appendage not quite half as long, the branches inclosing an oval space, in profile forming a semicircle; female vulvar lamina short and rounded, divided to its middle by a narrow incision; occipital plate in both sexes bearing a number of small spines.

O. maclachlani De Selys. Described from a single female from North Burma. Abdomen 43 mm.; hind wing 38 mm.; vulvar lamina destroyed.

O. m-flavum De Selys. India. Abdomen 38–39 mm.; hind wing 33–36 mm.; male superior appendages longer than 10, curved toward each other and downward; inferior appendage of equal length, almost entirely divided into 2 contiguous branches, seen in profile curved upward, bearing near the middle on the upper surface a lateral tooth; female vulvar lamina very long, broad at the base, divided into 2 con-

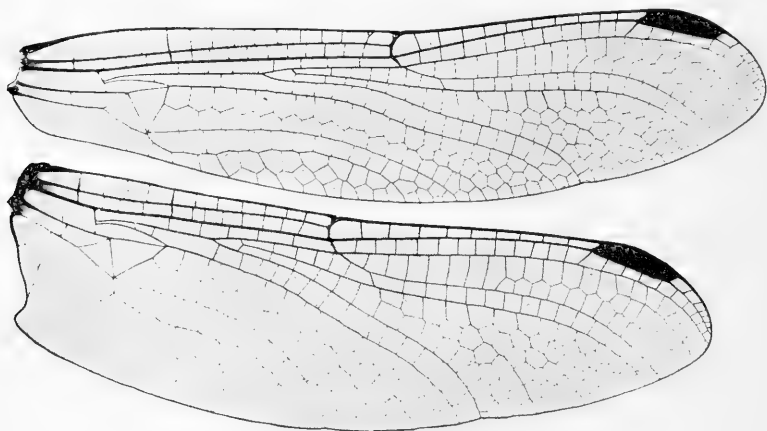


FIG. 35.—WINGS OF MALE *ONYCHOGOMPHUS SAUNDERSII* FROM BURMA.

tiguous lanceolate branches of which the acute apices reach the tenth segment.

O. modestus De Selys. India. Abdomen 27–28 mm.; hind wing 23–29 mm.; male superior appendages as long as 9 + 10, slightly curved toward each other and downward; inferior appendages as long, deeply divided into 2 contiguous branches.

O. nigrescens Laidlaw. Described as a variety of *geometricus*, from a single female from the Malay Peninsula. Doctor Laidlaw agrees with my suggestion to him that this is really *saundersii*. The venational character pointed out by Doctor Laidlaw is not peculiar to the species, but is common to a large group of genera.

O. reinwardtii De Selys. Java. Abdomen 33 mm.; hind wing 26–29 mm.; male appendages not known; female vulvar lamina one-third as long as 9, triangular, the apex bifid; occipital plate in both sexes with 10–12 small black spines.

O. saundersii De Selys. India and Indo-China. Abdomen 37–39 mm.; hind wing 31–32 mm.; male superior appendages almost as long as 9+10, curved toward each other and downward; inferior appendage about as long, in profile the basal two-thirds nearly straight, the apical third turned upward, the branches slender and contiguous; female vulvar lamina short, apex deeply emarginate. (See figs. 35 and 36.)

O. thomassoni Kirby. Hainan and Tonkin. Alar expanse 74 mm. (hind wing 35 mm.); male superior appendages longer than 10, strongly curved toward each other; inferior appendage less than half as long as the superiors, the branches divaricate and recurved at the end. On the basis of specimens of both sexes Martin takes this species from *Gomphus* and places it in *Onychogomphus*; his description of the inferior appendage does not suggest *Onychogomphus*, however, and Kirby's figure, in the pattern of the thorax, strongly suggests *Gomphus pryleri*. The details of venation in Kirby's figure are probably not accurate, but the anal triangle suggests *Onychogomphus*.

The above notes have been compiled from the literature relating to these species. On the same basis the following provisional key has been prepared:

- a. Dorsal thoracic stripes on either side of the middorsal carina isolated, not joined below with the mesothoracic half collar.
 - b. Above described stripes short, oval.
 - c. Abdominal segment 9 black; abdomen about 29 mm *frontalis*
 - cc. Segment 9 with some yellow; size larger
lineatus (India and Nepal) and *reinwardtii* (Java).
 - bb. Stripes longer, not oval.
 - c. Abdominal segments 3–6 black, with a short basal dorsal half ring of yellow; abdomen and hind wing less than 30 mm *modestus*
 - cc. Segments 3–6 with more yellow; size larger.
 - d. Segments 3–6 basally about one-third yellow.
 - e. Face without black markings; sides of thorax dark, with 2 oblique yellow bands *inscriptus*
 - ee. Face with black markings; sides of thorax yellow, sutures with black stripes *cerastis*
 - dd. Segments 3–6 largely yellowish *grammicus*
- aa. Dorsal thoracic stripes joined below with the mesothoracic half collar.
 - b. Abdominal segment 6 one-half or more yellow.
 - c. Segments 8–10 yellow, dorsally black; femora largely yellow *bistrigatus*
 - cc. Segments 8–10 black; femora largely black *geometricus*

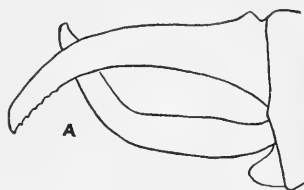


FIG. 36.—*ONYCHOGOMPHUS SAUNDERSII* FROM BURMA. A, LATERAL VIEW OF MALE ABDOMINAL APPENDAGES. THE SHORT HAIRS ON THE APPENDAGES ARE NOT SHOWN.

- bb. Segment 6 more than one-half black.
- c. Black stripes on the 2 lateral thoracic sutures confluent.
- d. Size very large, abdomen about 50 mm. *camelus*
- dd. Size smaller.
- e. Abdominal segments 8 and 9 black; dorsal thoracic stripes very wide. *thomassoni*
- cc. Segments 8 or 9 or both with lateral basal yellow spots.
- f. Segments 3-7 with basal one-fifth yellow. *maclachlani*
- ff. Segments 3-6 with basal one-fourth, 7 with basal one-half yellow. *saundersii*
- cc. Black stripes on the 2 lateral thoracic sutures not confluent for their entire lengths.
- d. Face largely yellow, nasus yellow marked with black. *circularis*
- dd. Face largely black, nasus black or black marked with yellow.
- e. Abdominal segments 8-10 all black. *annularis*
- cc. Segments 8-10 black, 8 with lateral basal yellow spots. *biforceps*
- ccc. Segments 8-10 with yellow laterally. *m-flavum*

Four species of the genus are certainly known to occur in Burma; a fifth species probably is an *Onychogomphus*.

14. *ONYCHOGOMPHUS SAUNDERSII* De Selys.

"Bhamò. Un couple en juillet et août (Fea)." I have a single male from Earnshaw. This is the only *Onychogomphus* known from Sumatra.

Head largely black; upper lip with a basal spot on each side, almost all rhinarium, a lateral spot on the nasus, and a band above on the frons anteriorly yellow; female with black more restricted, the yellow on the frons descending a little in front and upper lip yellow with a black border. Pale antehumeral stripe reduced to a line below and a spot above. Sides of thorax largely black, a yellow stripe on the mesepimeron and a wider one on the metepimeron. Legs black, first femora with inner surface pale.

15. *ONYCHOGOMPHUS CIRCULARIS* De Selys.

"*Patrie*: Nord de la Birmanie. Un couple unique. (Coll. McLachlan)." Recorded from Tonkin by Martin.

Face yellow, black as follows: Upper lip bordered and traversed, rhinarium margined, nasus at the center, and the suture between nasus and frons. Antehumeral stripe reduced to a trace. Sides of thorax yellow, with black stripes on the two lateral sutures. Femora yellow, with brown and black markings. Abdomen black, varied with yellow; 3-7 with yellow basal rings, larger on 3 and 7; 3-5 with dorsal lanceolate spots; 8 with dorsal and lateral spots; 9 and 10 black.

16. *ONYCHOGOMPHUS ANNULARIS* De Selys.

"*Patrie*: Le Nord de la Birmanie. Deux mâles (à abdomen incomplet). Communiqué par M. McLachlan." A female in my collection from Earnshaw.

Antenodals, front wing 14-16; hind wing 9-11; postnodals, front wing 9-10; hind wing 10. Head black, yellow as follows: Two spots on upper lip, rhinarium, a small spot at the upper end of nasus, frons above with a spot on each side; lower lip pale. A narrow pale antehumeral stripe, widened into a spot above. Sides of thorax yellow, the two lateral sutures with black stripes, wider on the first. Legs black. Abdomen with basal rings on 3-7 narrowly interrupted above, about one-third to one-fourth the length of each segment, largest on 7; median dorsal spot on 3 and 4 and a trace on 5; 8-10 black. Female vulvar lamina one-fourth length of 9, rounded triangular, apex notched; female occipital plate with hind margin almost straight, slightly lower at the middle; female abdominal appendages a little longer than 10, yellow, a short black tubercle between them. The venation of the female figured in this paper is peculiar for the genus, so far as known to me, by the position of the arculus in the front wing, slightly beyond the second antenodal, and by having the second postanal cell in the hind wing divided.

17. *ONYCHOGOMPHUS MACLACHLANI* De Selys.

"Patrie: Le Nord de la Birmanie. Une femelle unique (collect. McLachlan)."

Head black, frons above with an anterior yellow stripe narrowed at the middle. Sides of thorax black, with a yellow stripe on the mesepimeron and metepimeron. Legs brownish black. Abdominal segments 3-7 with basal yellow rings occupying about one-fifth of each segment; 8 with a small basal spot on each side replacing the ring.

18. *ONYCHOGOMPHUS?* SPECIES.

A single male in fragments from Earnshaw in my collection.

Hind wing 33 mm. Antenodals, front wing 13, hind wing 10; postnodals, front wing 10, hind wing 9.

Lower lip pale yellow; upper lip yellow, bordered basally and anteriorly and traversed medianly with black; rhinarium yellow, below on either side black; nasus black, a narrow margin below at the middle and a large spot at either end yellow; frons yellow, in front the lower half and above a median basal triangular spot, not dividing the yellow, black; occiput nearly straight, yellow, black against the eyes; rear of head black.

Prothorax black, margined with yellow. Thorax above black, middorsal carina below narrowly yellow; yellow stripes joined below with the uninterrupted mesothoracic half collar to form a 7 on each side of the carina; the antehumeral yellow stripes represented by a spot above and a smaller one below; first lateral thoracic suture with a black stripe interrupted to form 3 short stripes; second lateral suture

with a continuous but little wider black stripe; no trace of black posteriorly. Costa yellow, stigma black. Femora largely yellow, apically and externally with some brown; tibiae black.

Abdominal segment 1 with a dorsal interrupted crescent of brown, the ends of the crescent reaching backward and downward; 2 yellow, with a superior lateral brown stripe which at the apex of the segment meets its fellow dorsally; 3 yellow, black as follows: A very narrow basal ring, an interrupted median ring and a lateral apical triangular spot which meets its fellow dorsally; 4 similar to 3; 5-7 similar, the apical black spots confluent dorsally to form apical rings covering about one-half the segment; 7 with the median transverse black line reduced to a trace; 8-10 black; 8 with a large lateral basal yellow spot, the merest trace of which exists on 9; the suggestion of a dorsal basal spot on 8.

Superior appendages twice as long as 10, simple, slender, tapering, curved toward each other and downward, the extreme apex with a shining black tooth, the lower external edge on the curve before the apex minutely denticulate; brown at base, shading at once into light yellow. Inferior appendage a little more than one-half as long, broadly bifid for more than one-half its length, the branches simple, rounded, tapering, widely and continuously divaricate, but little recurved dorsally, terminating apically in a minute tooth; color similar to the superiors.

While the single male has served for a fairly complete description, its condition is such as to make figures of the appendages of questionable accuracy, and future study by others of this specimen will be difficult. For this reason it is unnamed, though M. Martin, who has seen it, pronounces it as certainly new.

As to its generic position some discussion is necessary. I should refer it to *Onychogomphus* without question were it not that Foerster has described as *Heterogomphus naninus* a male from Tonkin which is a darker colored but, I believe, closely allied species to the one described above. In actual usage describers of new species have defined *Onychogomphus* solely by one character, the form of the inferior appendage of the male; and De Selys in naming species based on female specimens alone has followed the generic name *Onychogomphus* with a question mark. In this Burman specimen the superior appendages are similar to the form found in a number of species of *Onychogomphus*, and had the inferior been lost, few would hesitate to refer the specimen to *Onychogomphus*. Moreover, the form of the inferior appendage throughout the genus, as heretofore understood, can hardly be defined as of one type, if we may use Hagen's figures in *Monographie des Gomphines* for comparison. The figure of *O. flexuosus* certainly shows a decided step away from *O. saundersii*, for

example, toward the condition found in the species described above. Opposed to this weak negative evidence of the form of the inferior appendage against referring this specimen to *Onychogomphus*, is the very positive evidence for such a relationship shown by the venation which is figured in this paper. Compared with *saundersii*, which is also figured, there are some very slight, and, I believe, unimportant differences. In *Onychogomphus? species* in front wing the first cells included between Cu_1 and Cu_2 are relatively short in the antero-posterior direction, and the number of cells between these 2 veins at the wing margin is larger in both front and hind wings. In the hind wing of *Onychogomphus? species* there is a single row of cells between M_1 and M_{1a} , excepting that the marginal cell is divided. There are also slight differences in the shape of the triangles and subtriangles, and other equally slight differences might be pointed out. (See fig. 37.)

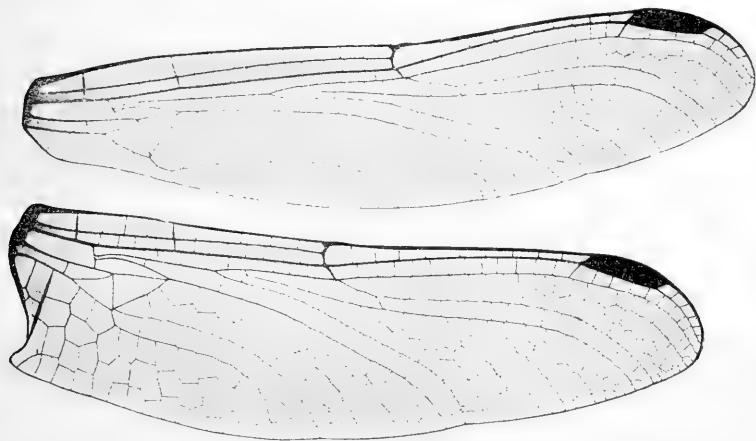


FIG. 37.—WINGS OF MALE SPECIES OF ONYCHOGOMPHUS FROM BURMA

Genus HETEROGOMPHUS De Selys.

Seven species have been named in this genus. Foerster regards *cochinchinensis* De Selys from French Indo-China, and also probably *sommeri* De Selys from China, as probably races of *smithii* De Selys from Silhet. These three are large species, with the abdomen about 55 mm. or more in length and the hind wing 47 to 55 mm. In *smithii* abdominal segments 3–7 have the orange more extensive than the black; in *cochinchinensis* and *sommeri* black predominates on 3–6 and 7 has about the basal half yellow. The character mentioned by De Selys for separating *sommeri* and *cochinchinensis* is the coloration of the frons above; in *cochinchinensis* the yellow area on the frons above is not divided medianly by black as in *sommeri*. Foerster has described a male specimen from Tonkin as *Hetero-*

gomphus naninus, which is unique in the genus by its small size (abdomen 43 mm., hind wing 32 mm.) and by the simple structure of the inferior appendage, the apices of which are not bifid or toothed, as is the case in all the other known males. (See discussion under *Onychogomphus? species*, p. 313.) The remaining three species are intermediate in size. All are distinguished by pale indefinite coloration, and all may be in reality the same species. (See fig. 38.)

H. icterops Martin, from Java, is briefly described in "Mission Pavie" from a specimen in De Selys's collection. Abdominal segment 7 is largely yellow, and this character may separate it from the other two. The first described species of this group of three is *sumatranus* Krüger from Sumatra. The remaining species is *unicolor* Martin, described from Siam.

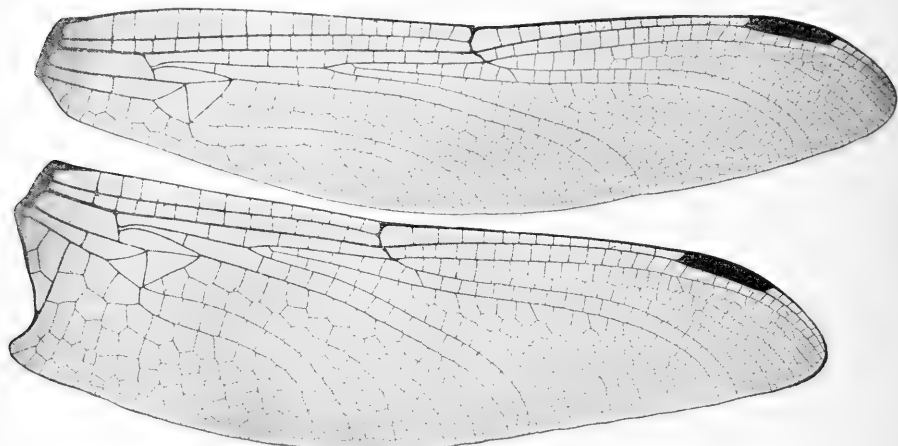


FIG. 38.—WINGS OF MALE *HETEROGOMPHUS COCHINCHINENSIS* FROM TONKIN.

19. *HETEROGOMPHUS UNICOLOR* Martin.

"Un male unique de Siam, Museum de Paris." Abdomen 52 mm., hind wing 48 mm. Face and frons entirely yellow. Thorax brown, with a poorly defined darker brown humeral stripe. Abdomen brown, tinged above, especially toward the end, with blackish; 7 tinged with yellowish.

H. sumatranus is somewhat smaller; abdomen about 50 mm., hind wing 42 mm. From the descriptions no definite distinguishing characters are recognizable, and it is probable that *unicolor* is a synonym of *sumatranus*.

Genus *MEROGOMPHUS* Martin.

The single species, *paviei* Martin, is known only from Tonkin (presumably, since in the description of both genus and species no locality is given). This is a large, handsome species; abdomen 48

mm., hind wing 40 mm. I am indebted to Monsieur Martin for a beautiful male specimen in my collection. (See fig. 39.)

SUMMARY.

Eleven genera and 19 species of the subfamilies discussed in this paper are known from Burma and Lower Siam. In the preparation of this paper 34 specimens from these localities have been studied.

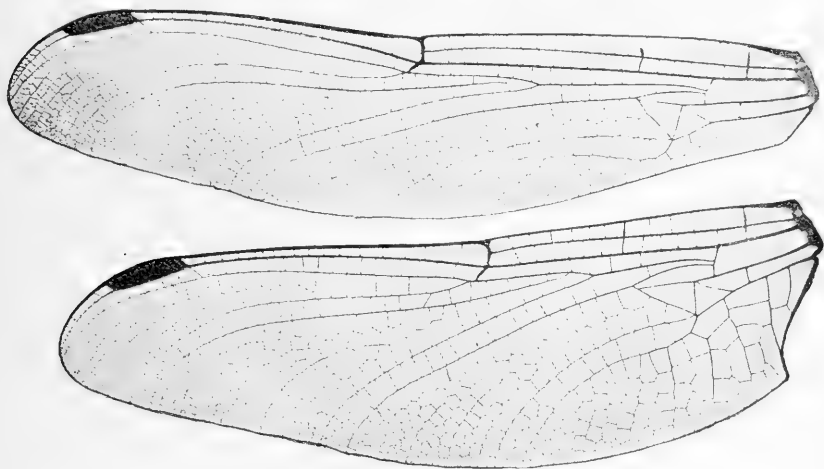


FIG. 39.—WINGS OF MALE *MEROGOMPHUS PAVIEI* FROM TONKIN.

Of the 19 species I have seen specimens of only 10. Of the 21 species of Calopteryginae known from Burma and Lower Siam I had seen 17 and studied 233 specimens. Many more specimens of Calopteryginae have been received from Mr. Earnshaw during the preparation of this paper. Further comment on the relative numbers of specimens in the different subfamilies and on the unavoidable incompleteness of this paper is unnecessary.

DESCRIPTION OF A NEW SPECIES OF KILLIFISH, *LUCANIA BROWNI*, FROM A HOT SPRING IN LOWER CALIFORNIA.

By DAVID STARR JORDAN and ROBERT EARL RICHARDSON,
Of Stanford University, California.

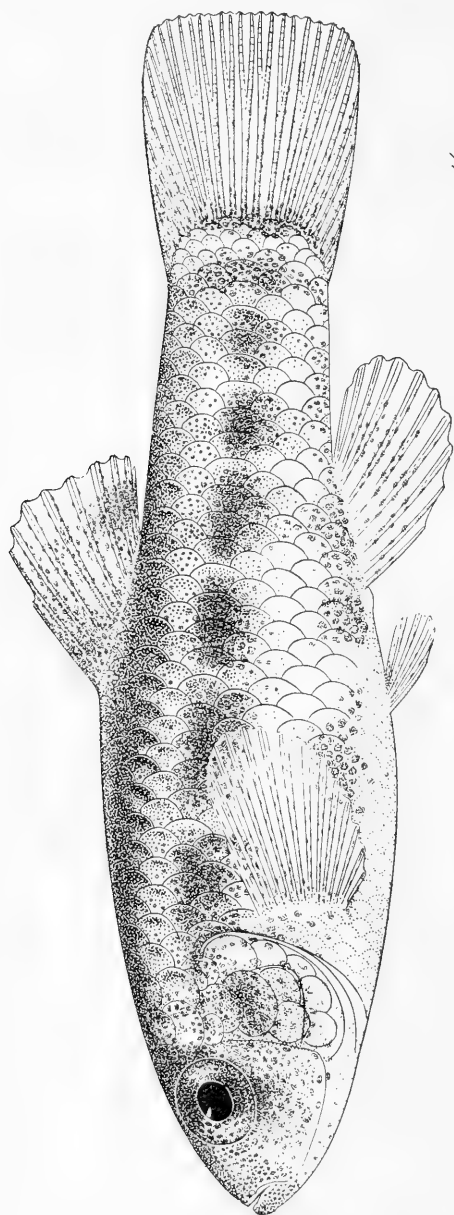
We have recently received from Mr. Herbert Brown, of Tucson, Arizona, 6 specimens of a small killifish of the genus *Lucania*, taken by Mr. Brown from a hot-water spring in northeastern Lower California. Being unable to identify these with any hitherto described species, we here describe them as new, and propose for them the name of *Lucania browni*.

LUCANIA BROWNI, new species.

Head 3.3 in length without caudal; depth 3.3 (3.5 in males); D. 10, A. 10, scales 28 (25); depth of caudal peduncle 1.9 in head; breadth of head 1.6; eye 3; interorbital space equal to eye; nose 4 in head; mouth very small and quite oblique; maxillary equals pupil, the tip of the upper lip slightly below upper rim of pupil; teeth sharp, pointed, equal, in a single row on each jaw; gill membranes connected for a short distance, the gill openings not restricted above; intestine not longer than body; dorsal inserted slightly behind ventrals, a little nearer base of caudal than end of snout; anal fin not modified into an intromittent organ in males, its length when depressed, in female 1.3 in head, in male equal to head; pectoral 1.4 in head; ventrals very small, 2.75 in head.

Color of fresh specimens in formalin: Females olivaceous, each side of body with about 8 large blotches of darker color, forming a broken lateral band in adults; the blotches continued downward on belly as cross bands in half-grown specimens; 3 diffuse clusters of punctulations on the belly just in front of and above anal fin; dorsal punctulated with dusky in both membranes and rays, with a conspicuous dark blotch behind, between the sixth and tenth rays; caudal pale, with two crescentic cross bands across its base, the interspace between them pale; ventrals and anal pale; pectorals obscurely

punctulate in the rays. Males darker in color, with the side blotches less distinct and with the fins more dusky, and with both the dorsal and the anal tipped heavily with dusky behind.



1/4 in

LUCANIA BROWNII.

Described from 6 specimens, 0.50 to 0.84 inch long, taken at a point 20 feet below the outbreak of a hot spring on the eastern margin of the salt lake that lies between the Coast and Cocopah ranges, in northeastern Lower California. The salt lake is said by Mr. Brown, who collected the specimens, to lie about 40 miles south of the international line, and is stated by him to be undoubtedly below sea level. The species is oviparous. The two largest specimens are gravid females, the largest eggs being 1 mm. in diameter. Three examples are well developed females, 0.66 to 0.78 inch in length, two of them apparently approaching nuptial coloration. A sixth specimen is half-grown.

These specimens appear to differ from other described species of *Lucania* in their shorter ventral fins and in details of coloration. The type is

Cat. No. 57838, U.S.N.M. Cotypes are in the collection of Stanford University, No. 20171. Named for Mr. Herbert Brown, of Tucson, Arizona.

The water from which these specimens were taken is thus described by Mr. Brown:

The surface of the water—or, rather, much of it—was covered with a tough thick growth of green and sulphur colored algæ. The temperature was taken in water from which the algæ had been removed. The register was 128°.

The temperature was taken by Mr. Godfrey Sykes, an engineer well known through this section of country, in the presence of myself and Dr. D.T. MacDougal, director of the Carnegie Botanical Laboratory at this place. It was with a laboratory instrument that the temperature was taken. With the exception of an open strip of water about 2 or 3 feet wide, the surface of the flow from the spring was covered with a thick growth of algæ. A portion of the algæ was removed, and the temperature taken in the hole so made. The temperature was undoubtedly hotter there than it was on the open edge of the water, but the fish darted in and out under the algæ and because of doing so were not easily caught. The water certainly was as hot under the unbroken algæ as it was where the thermometer was placed. At this particular place the flow was about 10 or 12 feet wide, and was about 20 feet from the point where the water broke out of the ground. Lower down the escaping water widened out and ran thinner over the surface. A bottle of the water was brought away and an analysis was made of it by Prof. R. E. Forbes, chemist at Territorial University. It contained 2½ per cent of soluble salts, of which salts 2 per cent were common salt and ½ per cent calcium chloride. It also contained a trace of lithium. I would like to add here that the water teemed with insect life. A second spring, of about an equal volume of water and not more than 20 feet away and running parallel with the first, contained no fish. The fish were captured and placed in a can with a closed top about 10 a. m. We were then on the move and my formaldehyde was in a large tank, and as I did not care to put the little fellows in it I carried them for nearly two days in the can in which they were first placed. It was in February and the night was cold, but when I examined them the next morning they appeared to be as lively as ever. The following afternoon they were still living, but were not so lively as in the morning. I then placed them in formaldehyde. They had lived in about a quart of water from their native spring.

NORTH AMERICAN PARASITIC COPEPODS BELONGING TO THE FAMILY CALIGIDÆ.

PARTS 3 AND 4.—A REVISION OF THE PANDARINÆ AND THE
CECROPINÆ.

By CHARLES BRANCH WILSON.

Department of Biology, State Normal School, Westfield, Massachusetts.

INTRODUCTORY.

The present is the sixth paper in the series based upon the collection of the U. S. National Museum and finishes the family Caligidæ. For many reasons a large amount of careful and painstaking collating has been rendered necessary before this paper could be published. And in consequence, as its title indicates, it has taken the nature of a thorough revision of the two subfamilies which it includes. Such a revision was found to be absolutely demanded for any intelligent discussion of the group, and especially for its accurate systematization.

In the first place, up to the present time we have been acquainted with both sexes of but one or two species in the entire subfamily Pandarinæ. Of all the other forms either the male or the female have been described alone.

This has been due not to any scarcity of the missing sex, as might be supposed, but to the fact that when found it was located elsewhere on account of the great morphological dissimilarity between the sexes. So that we find repeatedly the anomaly of a female classified under one genus and subfamily, while the male is located under an entirely different genus, and often in another subfamily.

Furthermore, all previous attempts to bring together the sexually separated species have been confined to individual cases or to closely related forms. And there has been in these attempts such an utter disregard of morphological and developmental data that they have only served to render the confusion worse confounded. To the best of the author's knowledge the present paper is the first to systematize

the group upon a morphological basis. As will be seen the structure in a few instances supports the suggestions that have been made regarding the identity of sexes, while in the great majority of cases it is directly opposed to them. It is obvious, however, that any suggestion of species identity which is not supported, or which may even be contradicted by the anatomy of the two sexes, is worthy of very little consideration.

And it is really surprising how much similarity a careful examination reveals when we remember that the two sexes have been considered generically distinct. The differences are found to be much more apparent than real, and this is particularly true of the appendages which afford a ready clew for the determination of the genera, as can be seen from the key which follows (p. 345).

There is of course no expectation of being able, in this initiatory effort, to reach a final conclusion respecting all the *Nogaus* species. Considerable additional information will be needed before that becomes even possible. But at least a good beginning can be made, and the treatment of the species can be placed upon a rational and scientific basis, which will yield good results in the future.

Each male has been included in the genus to which it belongs, so far as this is positively known, and its characteristics have been given under the genus diagnosis.

There are here described twenty species, of which one is new to science, namely, *Echthrogaleus torpedinis*, while two others, *Echthrogaleus denticulatus* Smith and *Nesippus alatus* Wilson, are figured for the first time, the latter including both sexes.

In addition the males of eight of the other species have been definitely located, described, and figured, four of them being new to science, while the other four have been boarding around among the various genera as was formerly the custom with the teachers in our old-fashioned country schools.

The males of the three species belonging to the Cecropinæ, of *Gangliopus pyriformis*, and of *Pandarus bicolor* were already known so that we now have the males of 14 of the 20 species, including at least one for every genus.

And lastly, much the hardest task of all, in the discussion of the genus *Nogaus*, which is made up entirely of males, 34 species, described by half as many authors and in seven different languages, have been carefully contrasted with one another and with the types here established, so far as the data given made this possible.

It has been found necessary to change the names of two genera on account of preoccupation. The name *Lepidopus*, proposed by Dana in 1852, had been used by Gouan for a fish genus in 1770. In its place is suggested the name *Pholidopus* which has the same meaning, namely, scale-footed.

The name *Stasiotes*, proposed by Wright in 1877, had been used by Jan for a snake genus in 1862. In its place is suggested the name *Prosaetes*, from *προσαίτης*, a beggar, who torments one by his persistence.

A complete life history is also presented by using different stages of development from different genera, but as none of the developmental stages have ever been described even this is a considerable advance.

Part 3.—THE PANDARINÆ.

ECOLOGY.

The Pandarinæ are peculiarly shark parasites, the genera and even the species, almost without exception, infesting some one of the numerous selachians along our coasts. In general the females remain throughout life fixed in the same position on their host, and even the males are rarely found swimming about freely. And yet upon occasion, as will be seen later, these males can swim as well as any of the Caliginæ. Hence it is not a case of necessity but one of choice that keeps them in close proximity to the fixed females.

In this connection Hesse writes:^a

Les poissons sur lesquels on les trouve n'étant pas, comme ceux des autres espèces, enduits d'une sécrétion mucilagineuse qui, en lubrifiant la peau, la rend plus souple et plus pénétrable et facilite ainsi les fonctions des organes destinés à la perforer. Privés de ces avantages et insuffisamment fixés sur une enveloppe épaisse et coriace, ils ne tardent pas, lorsqu'ils sont sortis de l'eau, à s'en détacher et à tomber à terre, ou dans le fond des bateaux, et alors, à raison de leur extrême petitesse, il est bien difficile de les retrouver.

This statement might give the impression that the Pandarinæ are outcasts among the parasites, unable to find anything better in the way of hosts, and so compelled to put up with these thick-skinned sharks. But such does not seem to be the case; the shark's skin is tough, but is not particularly thick for so large a fish, and it is certainly covered with mucus the same as that of other fishes. It is therefore as easy to penetrate as the skin of a fish covered with heavy scales.

Furthermore, as Hesse himself says, immediately after the passage quoted, these Pandarinæ seek out those places on the shark's body where the skin is the thinnest, such as the fins, the inside of the operculum, the border of the anal and genital orifices, and even the eyes. In fact this same preference is shown by all the Caligidæ, and is just as pronounced on a scaly fish as on these selachians, for the skin in the localities mentioned is always soft and tender enough, even on a shark, to be easily penetrated, especially by such large parasites as the Pandarinæ. Hence the reason implied by

^a Annales des Sciences Naturelles (6), XV, Article 3, p. 39.

Hesse, and stated clearly in a footnote at the bottom of the page just referred to, can not be the only one. He says in the footnote:

C'est sans doute à raison de la plus grande épaisseur de leur peau que je n'ai jamais rencontré ces parasites sur les *Scyllium canicula*, *catulus* et *annulatus*, qui cependant sont des Squales que l'on trouve plus fréquemment que les autres dans notre localité.

It is very doubtful if the skin of these sharks he mentions is any thicker than that of the dusky shark, *Carcharhinus obscurus*, and other large sharks of our own coasts which are commonly infested with these parasites. And even if it were thick and tough enough elsewhere, it would still be thin and soft at the localities mentioned, and easily penetrated by the sharp probosces of these large Pandarids. Some other reason must be found to account for the lack of parasites on the sharks mentioned.

Again Hesse writes:^a

J'ai, en effet, visité, avec le plus grand soin et depuis un assez grand nombre d'années, les poissons de toutes les espèces qui fréquentent nos côtes et je suis parvenu à trouver vingt *Caliges* différentes, ainsi que dix *Trébies*; et toutes, sans aucune exception, ont été recueillies sur le corps ou sur les branchies de poissons à peau molle, conséquemment autres que les *Squales*.

FIG. 1.—PHOTOGRAPH OF DORSAL FIN OF SAND SHARK, SHOWING BOTH SEXES OF *PANDARUS SINUATUS*. IN THE LOWER BUNCH THE PARASITES ARE ENTIRELY COVERED WITH ALGÆ.

The sharks along our Atlantic coast must be very different from those on the coast of France, since the author has found two of the Argulidæ, *Argulus laticauda* and *A. megalops*, two of the Caliginæ, *Caligus rapax* and *Lepeophtheirus edwardsi*, and two of the Euryphorinæ, *Alebion gracilis* and *A. glaber*, very commonly upon them. The two last mentioned species are practically confined to the Dogfish and Sand Shark, and are found all over the outside surface of these fishes, apparently never hunting for any thin places in the skin.

Furthermore the Caliginæ are common also upon Skates and Rays, whose skin is as tough and leathery as that of the sharks, at least six species being found on these fish.

We may reasonably conclude, therefore, that the sharks are selected by these parasites as their chosen hosts. And there is no reason for believing that they do not prove as satisfactory as any bony fish (fig. 1).

^a Same article, p. 30.

We have already stated that the females remain throughout life fixed in one position upon their host. This is true of all the genera belonging to the subfamily and constitutes a fourth step in degeneration as well marked as the three which have preceded it.^a

The last three of these steps, however, and a part of the first one, have been confined to the female, while the male has escaped their influence.

As a result we find in the present subfamily the greatest sexual dissimilarity in the entire family of the Caligidae.

Indeed, the two sexes of every genus in the Pandarinæ are so unlike that the males have been considered a separate genus from the females. And not only so, but the males of all the genera have been made congeneric, and grouped together under the single genus "*Nogagus*." Furthermore, this male "genus" has been placed by the great majority of writers in the subfamily Caliginæ rather than in the Pandarinæ, where the females all belong. This will be more fully discussed under the genus name *Nogaus* (see p. 439). It serves here simply to emphasize the sexual differences, and to make it evident that in considering their ecology as well as their morphology most if not all of the statements must be understood as confined to a single sex. The first step in degeneration, as already noted under the Caliginæ, was the mechanical hindrance afforded by the egg strings, and the strong incentives for remaining on the body of the host. Of course the latter was the only one operating upon the male, and it did not exert much influence so long as the female retained the power of free swimming.

As, however, this power gradually weakened in the Caliginæ and still more in the Euryphorinæ, the incentive for the male to remain upon the host with the female became stronger.

And here in the Pandarinæ, where the female has become a fixed form and correspondingly degenerate, the incentive operates with its full power on the male, and we find him in the same condition as were the females of *Lepeophtheirus* and other Caligids, that is, capable of swimming freely but under ordinary conditions remaining upon the same fish, along with the female, during his entire life. While the male has thus resisted the degenerative influences so much longer than the female, yet when he once yields the transition is more rapid, and in the very next subfamily, the Cecropinæ (see p. 465), we find the male degenerated into a fixed form exactly like that of the female.

^a The three previous steps are: (1) The mechanical hindrance afforded by the egg strings and the lack of incentive to free swimming; (2) the loss of the lunules on the frontal plates, and the consequent restriction of the free scuttling motion; (3) the development of dorsal plates on the thorax segments, thereby diminishing the freedom of bodily movement.

LOCOMOTION.

The female has entirely lost the power of free swimming, and almost entirely that of moving about on her host. She can and does change her position, but only for the most strenuous reasons and during the earlier stages of development. Such motion is of necessity very slow, since it involves the loosening and refastening of the hold maintained by the different prehensile organs. Some of them must remain fastened all the time, and the only progress made is the distance that can be covered by the stretching of the body between the alternate fastenings. When removed from the fish and placed in an aquarium these females simply lie upon their backs, moving the swimming legs spasmodically, but producing no change of position at all. The males, on the contrary, can swim as freely as *Caligus*, and when placed in an aquarium with the latter they resemble them so closely in form and movements as to be distinguished only by careful scrutiny. Accordingly we should expect to find some of the males swimming about freely at the breeding season, like those of *Caligus*, and there are in the U. S. National Museum collection several specimens so recorded.

None of either sex, so far as known, have lunules on the frontal plates, and hence they do not exhibit the scuttling movements characteristic of *Argulus* and *Caligus*. And yet they can move about easily and rapidly over the outside of the shark's body and are by no means confined to the immediate vicinity of the females. This motion is accomplished by means of the adhesion pads, maxillipeds, and swimming legs. The former hold the copepod to the skin of its host, while the latter push the body forward. Instead of a scuttling movement, therefore, each side of the body being advanced alternately, there is a forward gliding motion of the entire body, similar to that shown in swimming. All four pairs of swimming legs in these males are biramose, and the rami are wide flattened laminae which propel the animal swiftly through the water.

There is no broad basal apron connecting the third legs across the mid line, which was characteristic of the Caliginæ, but this is largely compensated by the fact that the fourth legs are as broad and powerful as the third pair, while in the Caliginæ they were of no actual service for swimming.

PREHENSION.

The organs of prehension include adhesion pads, claws, and modified chelæ. The adhesion pads are common to all the genera and to both sexes; they arise as accessory organs in connection with the various appendages, and are usually of different shapes in the different genera and even in the different species, thereby affording good

supplementary means of differentiation. In the genus *Pandarus*, which may be taken as the type of the subfamily, there are four pairs of these pads (fig. 2).

The first pair are connected with the bases of the first antennæ, are elliptical or oval in outline, and stand close to the lateral margins of the carapace, sometimes even projecting beyond the margin. The second pair are connected similarly with the bases of the second antennæ, are usually circular or oval in outline, and stand inside of and posterior to the first pair. The long diameters of both pairs are parallel with the body axis, as a rule. The third pair are connected with the bases of the second maxillipeds, are sometimes circular and sometimes elliptical in outline, and stand on either side of and close to the mid line about in the center of the ventral surface of the carapace. The fourth pair arise as prominences on the bases of the first pair of dorsal plates in the female, or the lateral processes of the first free segment in the male. The exterior margin of each of these plates reaches forward under the carapace to a point opposite the bases of the first legs, and here at its antero-lateral corner the pad is developed. These pads are elongate-elliptical in outline, their long diameters parallel with or slightly inclined to the body axis. There are also in some genera pads on the basal joints of the swimming legs; these are usually elliptical, with their long diameters at right angles to the body axis (fig. 3).

The first two pairs of pads are the most important, and the necks or stems by which they are united to the ventral surface of the carapace are so arranged that the pads can be lowered and pressed against the skin of the host's body. The adhesive surface of the pad is formed of a thick cushion of skin whose outer layer is raised into ridges similar to those in the epidermis on the palms of our hands. These ridges are usually transverse, but are sometimes arranged concentrically, as on the tips of our fingers. They seem to serve the same purpose on these pads that they do on our hands—the development of friction and the prevention of slipping.

The claws or chelæ are found on the tips of the second maxillipeds, which are the chief organs of prehension. In the males of all the genera and in the females of some of them the second maxillipeds end in curved claws similar to those found in the Caliginæ and Euryphorinæ.

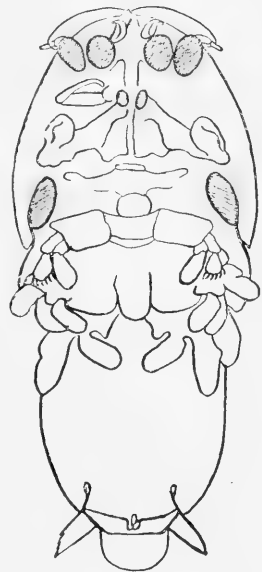


FIG. 2.—VENTRAL SURFACE OF FEMALE *PANDARUS SINUATUS*, SHOWING ADHESION PADS.

But in the females of *Pandarus*, *Nessipus*, and allied genera the claw disappears in the fully developed adult and in its place appears a pair of knob-like protuberances, armed with minute papillæ or scales which operate like a chela and obtain a hold by pinching a fold of skin between their inner surfaces.

Sometimes the males are also found with knobs instead of claws; the two occurring interchangeably, even in the same species.

Either of them give the copepod a firm grasp upon its host and, assisted by the adhesion pads, fasten it securely in place.

Indeed, it has been the author's experience that living specimens have to be removed with great care in order to avoid breaking their prehensile appendages. On the other hand, Hesse speaks of them in the quotation just given as "insecurely fastened to a skin which is tough and leathery." And he then adds: "They are not slow,

when taken from the water, to detach themselves and fall to the ground or the bottom of the boat."

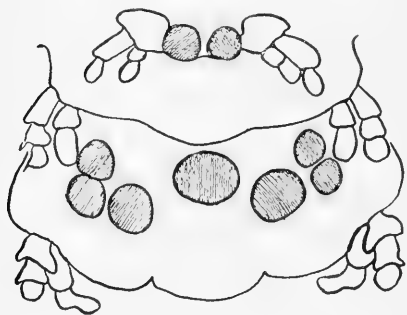


FIG. 3.—VENTRAL SURFACE OF FIRST THREE PAIRS OF SWIMMING LEGS OF ECHTHROGALEUS DENTICULATUS, SHOWING ACCESSORY ADHESION PADS.

In the experience of the present author no Pandarid has ever voluntarily detached itself; some have fallen or been rubbed off their host, but only when dead. Many scores of times, after pulling the pound-net at the U. S. Bureau of Fisheries or the Marine Biological Laboratory at Woods Hole, Massa-

chusetts, the sharks obtained, which varied from two or three to twenty-five or more in number, have been thrown on the bottom of the boat and towed from 1 to 3 miles behind a small steamer before being examined. But on reaching the wharf the Pandarid parasites were found still clinging to them, and after careful trial it was decided that so far as sharks are concerned, the chief thing to be gained by going out to the net and removing the parasites on the spot was the chance of keeping them alive a little longer. And here again the experience of the author is different from that of Hesse, who says: "I have been able occasionally to secure them alive, but have not been able to keep them in that condition for any length of time. In this they are very different from *Caligus* and *Trebius*, and even from *Cecrops* and *Læmargus*, which I have kept alive for some time."

If he is speaking of the females this is partially true, and yet the author has repeatedly kept Pandarid females alive for several days.

But the males are always as hardy as any of the genera he mentions, and usually when placed with *Caligus* or *Lepeophtheirus* they outlive the latter.

Hesse's mistakes have probably originated from another fact which has an important bearing on the length of life in these parasites. In the Caliginæ the arched carapace acts as a large sucking disk, its margin being pressed close to the surface, made continuous posteriorly by the broad lamina connecting the third legs, and the contact sealed with water and slime.

The space beneath the carapace is filled with water, and this is often retained for a long time after the surface of the fish has become dried. Living and active specimens have often been obtained from fish whose outer surface and fins had been dried for two or three hours. On the inside of the operculum and in the gill cavity they sometimes remain alive out of water for twenty-four hours after the death of the fish.

In the Pandarinæ the carapace is not thus arched and there is nothing to continue its margin posteriorly; consequently it does not retain the water, but the latter escapes as soon as the skin of the fish dries, just as it does from beneath the cover glass on a microscope slide. As soon as the fish dries, therefore, all the Pandarids on its outer surface also quickly die, and they do then drop off, or can be brushed off very easily. For the same reason, while the sharks are being brought ashore these parasites usually become exhausted for want of moisture. And although they may still be alive when removed from the fish they do not live very long afterwards. But given a fair chance, the females are as long lived as any of the fixed parasites, while the males who do retain moisture under their carapaces in the same manner as *Caligus* and *Trebius* are fully as long lived as the latter.

This subfamily of Pandarinæ are thus clearly differentiated from the Caliginæ, Trebinæ, and Euryphorinæ on the one side and from the Cecropinæ on the other by many distinct peculiarities of morphology and habits. The most striking differences are to be found perhaps in the males, although the other sex is by no means deficient in them.

In the Caliginæ we find the sexes similar, the male usually smaller, but sometimes larger than the female. The young females, and even the adults when without egg-strings, are as active as the males, and both sexes have retained fully their power of locomotion in spite of their parasitic habits. This equality of the sexes is partially explained by the fact that neither of them carry any dorsal plates on the thorax or genital segment. The family includes one genus, *Echetus*, in which the adult female has become fixed in position, but this is due to the burying of the head and thorax in the flesh of the host.

The mouth-tube is short and broad, with a bluntly rounded tip.

First maxillæ are present in the form of short claws near the margin of the carapace; the second maxillæ are in the form of simple, slender, and acuminate spines; the furca is biramose; the first and fourth legs are uniramose, while the rami of the second and third pairs have peculiar patterns of the joints, easily recognized after a little experience.

In the Euryphorinæ the sexes are also similar, the male always smaller, more slender, and more active than the adult female. The young females, however, are still as active as the males, since they are unhindered by either egg strings or dorsal thorax plates. The presence of the latter in the adults helps to render them sluggish, and yet there is no genus which actually becomes fixed like *Echetus* among the Caliginæ.

For the other characters, the mouth tube is like that of the Caliginæ, but there are no first maxillæ nor any furca. The second maxillæ show a transition from simple pointed spines in *Caligeria*, through a blunted biramose shape in *Gloiopotes*, into a flattened lamina in *Alebion*. All the legs are usually biramose, the pattern of the rami of the second and third pairs similar to that in the Caliginæ.

In the Pandarinæ, on the contrary, the sexes are very dissimilar; the females, even when young, carry so many dorsal plates on the thorax and genital segment as to render them practically helpless. They can swim but little and quickly become stationary upon their host. But the males retain the powers of locomotion and can swim or scuttle about over their host's body with as much freedom as those of either of the preceding subfamilies. They have no trace of dorsal plates, either on the thorax or genital segment; the sex differences in this subfamily, therefore, are the greatest anywhere shown in the Caligidæ. The mouth tube is long and pointed, and the mouth parts are transformed into blade-like, smooth laminae, without spines or setæ, or they remain rudimentary. The swimming legs are also characterized by the equality of the rami on the first pair and by a general tendency toward degeneration in the females. This usually affects only the last pair (*Dinematura* females), or the last two pairs (*Pandarus* females), but sometimes affects them all (*Demoleus* females). But whether degenerate or not their pattern is always totally different from that in the two preceding subfamilies.

Finally in the Cecropinæ we find the sexes again similar, but this time they both carry dorsal plates on the thorax and genital segments which effectually prevent free swimming. And both sexes become permanently fixed as soon as they have found lodgment on their host's body. The mouth tube is not as long as in the Pandarinæ, but is fully as pointed, while the maxillæ remain laminate and are much larger proportionally than in any preceding sub-

family. There is a tendency to degeneration in the swimming legs similar to that shown in the Pandarinae, but while it was there confined to the female sex only it here extends to both sexes, and may even include both the third and fourth pairs of legs in the male (*Orthagoriscicola* males).

ONTOGENY.

The life histories in this subfamily are almost the same as in the Caliginæ and Euryphorinæ. The differentiation between the two must be sought chiefly in the habits and sexual characters, as already stated. The number and size of the eggs and the changes during their development are similar to those given in the preceding subfamilies. From eight to ten weeks are required for development, and

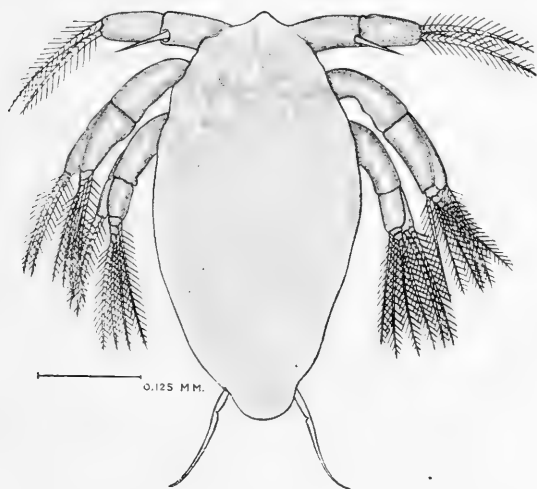


FIG. 4.—A NEWLY HATCHED NAUPLIUS OF *PANDARUS SINUATUS*.

all the eggs in the strings of any given female hatch at practically the same time. The issuing nauplius is almost an exact counterpart of that seen in the Euryphorinæ; its body has the outline of an elongated ellipse, is well rounded anteriorly, but is somewhat contracted posteriorly through the bases of the balancers (fig. 4). The eye spot is far forward and not prominent. The three pairs of appendages are of the usual pattern and arrangement. The anterior part of the body is transparent, and inside of it can be plainly seen the muscles which move the appendages. The balancers are very long, cylindrical, and narrow acuminate; they stand out nearly at right angles to the body axis and are curved slightly forward. The central portion of the posterior half of the body is filled with opaque yolk granules, leaving a narrow transparent margin around the edge. These granules are colored a uniform and very pale brownish-yellow, and there are no

pigment spots nor any color patterns in the nauplii thus far observed, a condition very different from that found in the nauplii of the Caliginæ and Euryphorinæ.

The difficulty of hatching these nauplii and rearing them through successive molts is fully as great as in the case of the Euryphorinæ, but for a very different reason. In the Euryphorinæ the unripe female moved restlessly about the aquarium all the time, and finally crawled up out of the water and remained there until dead and dried; consequently the eggs were dried and killed before they had time to hatch. Here in the Pandarinæ, on the other hand, the female is incapable of motion, and when placed in an aquarium simply falls to the bottom and lies there inert, usually upon her back. In this way the eggs fail of proper aeration and die almost as surely as when taken out of the water and dried. Fortunately here also, as in the Euryphorinæ, the hosts are common species of sharks, and a careful examination of the gills and body of these sharks during the parasites' breeding season is practically sure to yield development stages. The eggs for most of the genera hatch about the first of July, so that the best time to look for development stages is during the middle and latter part of the month.

Those of *Perissopus* and *Pandarus* are found upon the external surface, the former on the head and especially around the mouth, the latter in the vicinity of the fins. Those of *Nesippus* are found attached to the gills, usually near the ends of the gill arches. When the nauplius molts into a metanauplius the second pair of antennæ are turned forward side by side, enlarged, and developed into long prehensile hooks, whereby the larva fastens itself to its host. At the same time the second maxillipeds become organs of attachment and materially assist the second antennæ. Both organs retain their function throughout life, the second maxillipeds usually increasing in size and efficiency until they become the chief organs of prehension in the mature adult, while the second antennæ diminish somewhat, but never lose their function entirely.

The development, therefore, is very similar to, and in fact almost identical with, that of the Caliginæ. And when the metanauplius molts into a chalimus the similarity is further increased by the fact that a frontal filament is formed, very different in length and structure from that found in the Caliginæ, but entirely similar in function.

Hesse claims (1883. p. 4) to have found a larva belonging to the "Pandaridæ," which he calls "*Nogagus spinaci-achantias*" and which he says was attached by a long and slender frontal filament to its "mother's" carapace. But when his account is examined it is found that very little can be accepted as authentic until further evidence is given.

In the first place the only reason which he can give for regarding the adult as the mother and the larva as her offspring is the fact that the latter was attached to the carapace of the former. The absurdity of drawing such a conclusion from this single premise has been already shown^a and may be briefly restated as follows: When first hatched the nauplii swim freely at the surface; after two or three molts they seek out a suitable host and attach themselves to it. There is not one chance in a million that they will find the same host again, to which their mother is attached, and still less chance of finding the mother herself among other parasites of the same and different kinds. In fact, to find the mother at all necessitates the assumption of the ability on the part of the larva or the mother, or both, to recognize the other, which one hardly cares to concede.

Again, the individual to which this larva was attached, and which Hesse calls the "mother," is unfortunately of the male sex, as is clearly shown by his figures and description. It has the typical *Nogaus* form; there are no signs of dorsal plates on thorax or genital segment, and none of the swimming legs show any signs of degeneration. This fact renders any close relationship between the two practically impossible.

Finally, Hesse writes that this larva was 3 millimeters long and 1 millimeter wide, with a fully developed frontal filament. But he describes and figures only a single pair of swimming legs, and they are on the second thorax segment. Every metanauplius which has thus far been observed possesses at least two pairs of these swimming legs, and a chalimus 3 millimeters in length belonging to any of the subfamilies of the Caligidæ must possess at least three pairs, and ought to possess four pairs, of such legs, the first of which would be attached to the ventral surface of the carapace and not to the second thorax segment. Again, the first antennæ are represented as attached to either side of the "umbilical button" at the base of the frontal filament. They are half the length of the carapace, two-jointed, and free to their very base; in other words, the chalimus has no frontal plates. The posterior half of the body is cylindrical and five-jointed, the joints diminishing in size backward. The first of these joints carries the single pair of legs and, in addition, on its ventral surface:

On remarque, à l'extrémité d'un article fémoral, assez long, des lames plates, denticulées sur les bords et garnies de soies, qui sont destinées à favoriser les mouvements de propulsion et de natation, et, de chaque côté de l'anneau suivant, deux lames plates, denticulées, qui sont consacrées aux mêmes fonctions (p. 6).

^a Proc. U. S. Nat. Mus., XXVIII, p. 548.

What these "lames plates" could be would furnish something of a puzzle to the comparative anatomist.

Hesse then adds, under what he is pleased to call "Physiologie":

J'ai d'abord exprimé l'opinion que cet embryon pourrait bien être un mâle qui, joint à une femelle *adulte*, douée conséquemment de moyens de locomotion plus puissants que les siens, pouvait l'entraîner sur un autre poisson et aller ainsi, avec lui, fonder une autre colonie et contribuer par là à favoriser la reproduction et la dissémination de l'espèce (p. 31).

That is to say, a male, which is free swimming in all the *Nogaus* species, attaches itself to a female, which in every species of the Pandarinæ is fixed and helpless, in order to facilitate its locomotion from one fish to another.

Since in a description of this sort there is no hint of the family, to say nothing of the generic position of the larva, we are compelled to set it aside entirely and to get our knowledge of the development of the Pandarinæ from original sources.

THE NAUPLIUS as seen in the genera *Nesippus* and *Pandarus*.

Body an elongate ellipsoid, evenly rounded in front, but somewhat contracted posteriorly through the bases of the balancers.

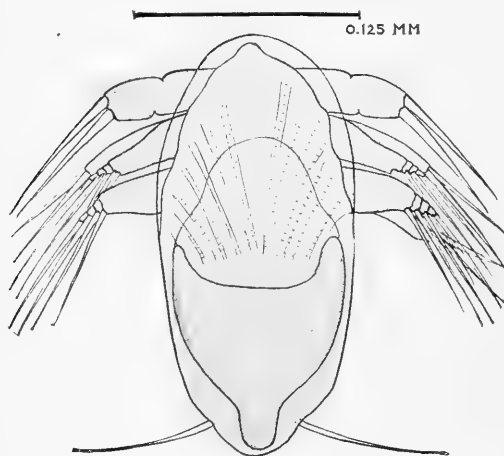


FIG. 5.—A NEWLY HATCHED NAUPLIUS OF *NESIPPUS ALATUS*.

The three pairs of appendages are bunched rather closely at the anterior end and are of the usual pattern. The balancers are fully one-third the entire length of the body, differing markedly in this respect from those found in the preceding subfamilies. In the *Nesippus* nauplius they take the form of simple, slightly curved, and acuminate spines; in the *Pandarus* nauplius

they are slightly S-shaped, with a double curve and contracted at a point one-fourth of their length from the base, as though jointed. In *Nesippus* the color is a uniform grayish brown, with a broad, transparent, and colorless margin, and without pigment spots or other markings. (See fig. 5.) In *Pandarus* the center of the body is olive green by transmitted light, appearing cinnamon-brown by reflected light in the egg strings, or even almost black.

The transparent margin is also very irregular in pattern and width, especially opposite the bases of the locomotor appendages.

The central mass of pigment reaches forward anteriorly in a long median, two-pronged projection and sends out branches also on either side opposite the second pair of appendages and the balancers. The anterior half of the body is more or less transparent and shows the muscles plainly, while the posterior part is opaque from the presence of yolk granules (see fig. 4).

Length, 0.25 mm.; width, 0.12 mm.

THE METANAUPLIUS as seen in the genus *Nesippus*.

On molting from the nauplius into the metanauplius the body becomes divided into regions consisting of a carapace, two free thorax segments, and a fusion of the genital segment and the abdomen (fig. 6). The carapace has an elongated acorn shape; the length twice the width, and squarely truncated posteriorly, with the corners produced into narrow lobes reaching to the center of the first free segment. The frontal plates are large and prominent, but folded under the anterior margin, so that very little of them can be seen in dorsal view. They are folded more evenly than in the *Alebion* larva and do not leave conical projections at the anterior corners. The eyes are situated even farther back than in *Alebion*, nearly half the distance from the anterior margin. They are quite large and not fused, although in contact on the mid-line.

The first free segment is evidently a fusion of the second and third thorax segments, as is indicated by the attachment of the legs. As these two segments are more or less fused in all the adults belonging to this subfamily, their fusion here in the metanauplius is what would naturally be expected.

The fused segment is nearly as wide as the carapace, and is furnished with broad lateral lobes at the sides over the bases of the legs. Such lateral lobes or plates are also characteristic of all the adults of both sexes, but in later development they become longer and nar-

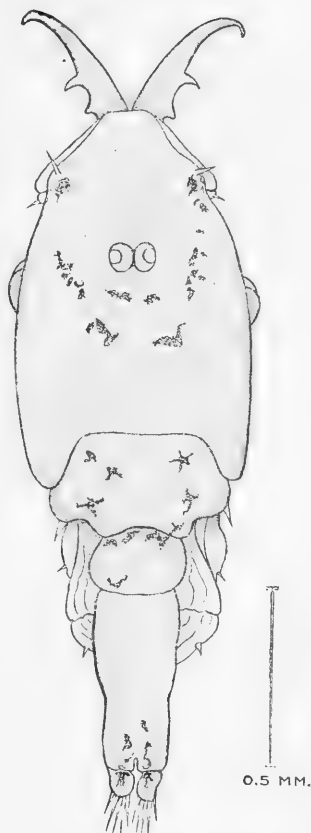


FIG. 6.—THE METANAUPLIUS OF *NE-SIPPUS ALATUS*.

rower. The second free, which is really the fourth thoracic, segment is just half as wide as the first, with strongly convex sides.

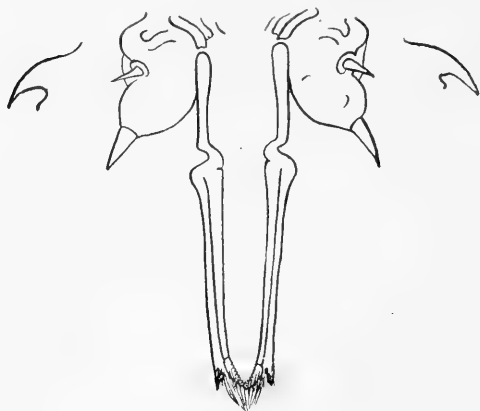


FIG. 7.—THE MOUTH TUBE, MAXILLÆ, AND MANDIBLES OF THE METANAUPLIUS OF NESIPPUS ALATUS.

out the plumose setæ found in both the Caliginæ and the Euryphorinæ. The second antennæ are similar to those of *Alebion*, but with two stout accessory spines on the inner margin near the base.

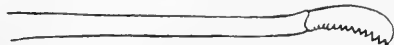


FIG. 8.—A MANDIBLE OF THE METANAUPLIUS OF NESIPPUS ALATUS.

The proboscis is also similar to that of *Alebion*, but is longer and of a more uniform width throughout (fig. 7). At its tip can be seen the mandibles, which are slender, somewhat enlarged, curved toward the free ends, and coarsely toothed along the inner concave margins. At this stage only the tips of the mandibles touch each other. Later, when the end of the mouth tube is compressed laterally, the entire toothed portion is interlocked (fig. 8).

The second maxillæ are close to the base of the mouth tube on either side, are simple, and consist of a stout conical base tipped with a short and straght spine. On the outer side of the base is another shorter spine, representing the rudimentary exopod; this rudiment is seemingly lost in later development. The first maxillipeds are slender and two-jointed,

The last segment, which is a fusion of the genital segment and abdomen, has the same width as the fourth thorax segment, but is three times as long and somewhat narrowed posteriorly.

The anal laminæ are relatively larger than in *Alebion*, but are tipped with much shorter setæ, five on each lamina.

The first antennæ are two-jointed, the terminal joint short and armed with small spines only, with-

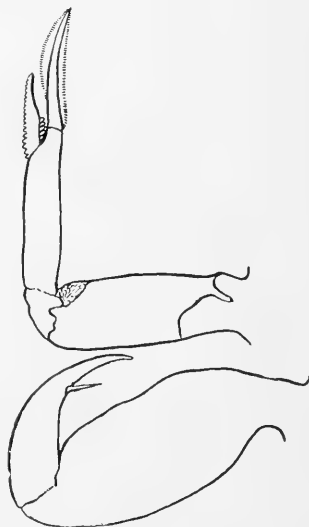


FIG. 9.—THE FIRST AND SECOND MAXILLIPEDS OF THE METANAUPLIUS OF NESIPPUS ALATUS.

the terminal joint narrower and longer than the basal, and tipped with two claws, the shorter ventral one with a few coarse teeth on the inner side at the base and a narrow-toothed flange along its outer margin (fig. 9). The dorsal claw is narrower and longer and has a narrow-toothed flange along either side.

The second maxillipeds are two-jointed, as in the adult, but are slender, with the terminal claw two-thirds the length of the basal joint, strongly curved, and with a small accessory spine on the inner margin near the tip.

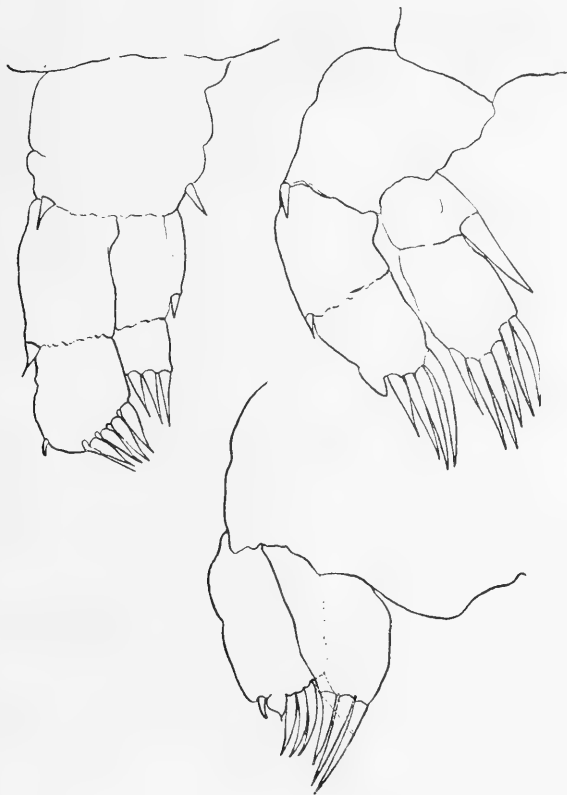


FIG. 10.—THE FIRST THREE PAIRS OF SWIMMING LEGS OF THE METANAUPLIUS OF NESIPPUS ALATUS.

There are three pairs of swimming legs, all biramose; the rami of the first two pairs are indistinctly two-jointed, while those of the third pair are one-jointed (fig. 10). The basal joint of each ramus has a single spine at its distal corner, on the outside in the exopod, on the inside in the endopod, while the terminal joint is tipped with a row of large and nearly straight setæ.

This metanauplius is of a yellowish horn color, quite transparent except through the center of the body. The pigment is scattering

and consists of a V-shaped string of small spots starting at the bases of the first antennæ on either side and extending obliquely backward to meet behind the eyes.

The two free segments have a few spots irregularly arranged, and there are a few more at the posterior end of the abdomen and in the anal laminae. These spots are all of a reddish purple color; the eyes are a deep purple with bright red lenses. Total length, including the second antennæ, 2.1 mm. Length of carapace, 1 mm. Width of same, 0.5 mm. Length of fused genital segment and abdomen, 0.51 mm.

This metanauplius stage was obtained from the gill filaments of the sharp-nosed shark, *Scoliodon terre-novæ*, at Beaufort, North Carolina, in company with two adult females and three males of the same species. The peculiar stag-horn antennæ give these larvæ a more secure hold upon their host than in the Euryphorinæ. With such organs of prehension it would also be more difficult for the larva to loosen its hold and move about. There is thus perhaps in this larval stage an indication of the greater subsequent fixity of the adult.

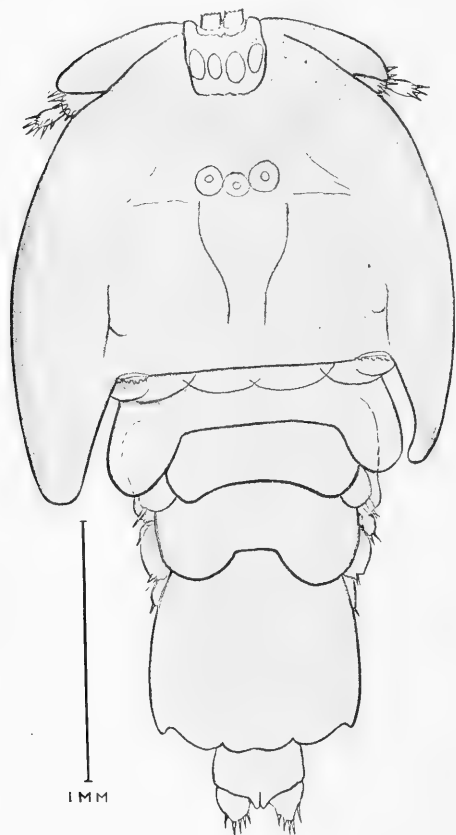


FIG. 11.—A CHALIMUS OF PERISSOPUS COMMUNIS.

THE CHALIMUS as seen in the genus *Perissopus*.

Only fully developed male chalimi were found, and they are described under the species *Perissopus communis* on page 357.

Single specimens of the female chalimus in three stages of development were obtained, measuring, respectively, 3, 4, and 4.5 mm. in length.

(1) In the chalimus 3 mm. long the carapace, including the posterior lobes, is semielliptical, longer than wide, and has strongly convex sides (fig. 11). The posterior lobes are long and wide, reaching back to the fourth segment, and are bluntly rounded at the tip. The frontal plates are narrow at the center and widened at the

distal ends. There are three large eyes in a transverse row just in front of the center of the carapace, the central one smaller than the other two and slightly posterior to them. The frontal gland and attachment filament secreted by it are very different from those found in the *Caliginæ*.

The gland is a huge quadrangular affair, filling the entire center of the front of the carapace. In place of the two large gland cells seen in the *Caliginæ*, we find here four, arranged in two pairs, one on either side of the mid line.

Each cell is ellipsoidal in form, the ones nearest the mid line being larger and farther back than the outer ones.

In place of the single slender and cylindrical filament produced in the *Caliginæ*, we find here in *Perissopus* two broad and ribbon-like filaments placed side by side. Each is strongly compressed dorso-ventrally, and is barely long enough to reach the fish's skin and obtain a firm hold. The chalinus is thus held with the frontal margin of the carapace almost in actual contact with the fish's skin, and its condition is very different from that of the *Caligus* chalinus which floats out at the tip of a filament as long as its own body.

When these double filaments disappear in the adult they leave a broad and well-defined sinus at the center of the frontal margin, between the frontal plates. In all the adult *Nogarus* males this central sinus and the remains of the frontal gland can be clearly seen, often with shreds of the frontal filaments still attached at the base of the sinus, but in the adult females the glands and sometimes the sinus disappear. In younger females, however, they can still be distinguished.

In the size, arrangement, and general appearance of the free thorax segments of this chalinus there is a striking resemblance to the male form (see p. 357). The latter sex, therefore, must be taken as the typical form in this subfamily, and from this the female degenerates on becoming fixed.

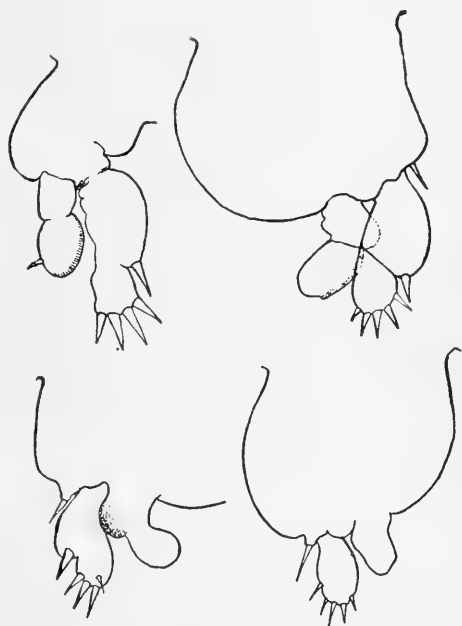


FIG. 12.—THE FOUR PAIRS OF SWIMMING LEGS OF THE CHALINUS SHOWN IN THE PRECEDING FIGURE.

On the posterior margin of the carapace just inside the posterior lobes is a small fold of skin on either side, similar to that found in the male. The second thorax segment does not fill the entire space between the posterior lobes of the carapace, but leaves an interval on either side as in the male.

The first dorsal plates appear as lateral lobes on the sides of this segment. The third segment a little more than fills the space between these lateral lobes of the second segment and overlaps them on either side. At this stage there is no trace of dorsal plates on the third segment.

The fourth thorax segment is wider than the third and slightly wider than the genital segment, and the dorsal plates on it appear as large circular lobes at its posterior corners.

The genital segment is sub-quadrangular, with slight rounded projections at the posterior corners and no median posterior sinus.

The abdomen is nearly half the width of the genital segment and projects for its entire length behind the latter; the anal laminae are triangular and armed with short and weak nonplumose spines. The swimming legs are like those of the adult in every particular except size (fig. 12). All the other appendages also are the same save the mouth tube; this is broader at the tip and closely resembles the form

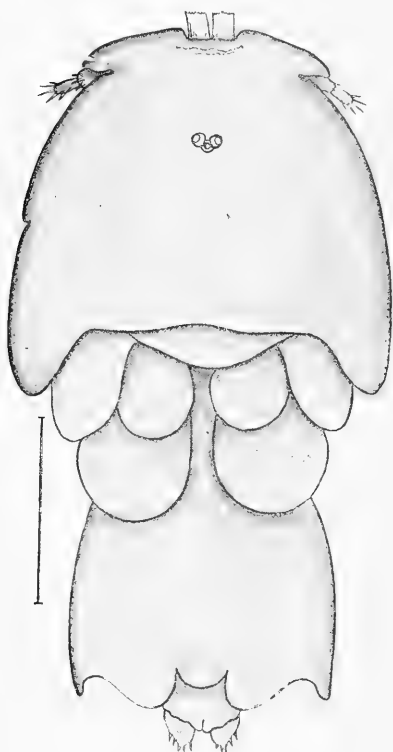


FIG. 13.—A CHALIMUS OF *PERISSOPUS COMMUNIS*. ONE-THIRD LARGER THAN THE ONE IN FIG. 11.

seen in the metanauplius.

The flexible lips have not yet rolled in around the mandibles and given the tube its final stiletto shape.

Total length, 3 mm.; length of carapace on mid-line, 1.35 mm.; width, 1.72 mm.; length of free segments, 0.72 mm.; length of genital segment, 0.77 mm.; width of same, 0.78 mm.

(2) The second chalinus, 4 mm. in length, differs from the first chiefly in the shortening of the posterior lobes of the carapace; in the development of the dorsal plates on the free thorax segments and the relative shortening of the segments themselves; in the enlarging of the genital segment and the formation of a deep and wide sinus

in the center of its posterior border, and in the partial migration of the abdomen to the ventral surface of the genital segment so that only a portion of it can be seen in dorsal view (fig. 13). This migration is apparent and not real; what actually happens is that the dorsal surface of the genital segment grows back over the abdomen, so that the latter appears to have moved forward along the ventral surface of the former.

Total length, 4 mm.; length of carapace on mid line, 1.66 mm.; width, 2.1 mm.; length of free segments, 0.75 mm.; length of genital segment, 1.40 mm.; width, 1.5 mm.

(3) The third chalinus has practically the adult form; there has been a still further shortening of the posterior lobes of the carapace and a corresponding widening of the carapace itself (fig. 14).

The dorsal plates now cover the entire surface of the free segments and overlap well onto the genital segment; the posterior portion of the first and third pairs is distinctly toothed.

There has been a further shortening of the free segments and a further enlarging of the genital segment, while the median posterior sinus of the latter has narrowed and deepened.

The abdomen has been entirely covered by the backward growth of the genital segment, so that the only thing which can be now seen in dorsal view is the tips of the anal laminae, and they are seen through the posterior sinus of the genital segment.

The reproductive organs are now well formed in the genital segment, especially those which have to do with the receiving and storing of the sperm. It is probable, therefore, that the sexes come together immediately at the close of this chalinus period, before the female has become permanently fixed.

Total length, 4.5 mm.; length of carapace on mid line, 2.05 mm.; width, 2.95 mm.; length of free segments, 0.75 mm.; length of genital segment, 1.8 mm.; width of same, 2.6 mm.

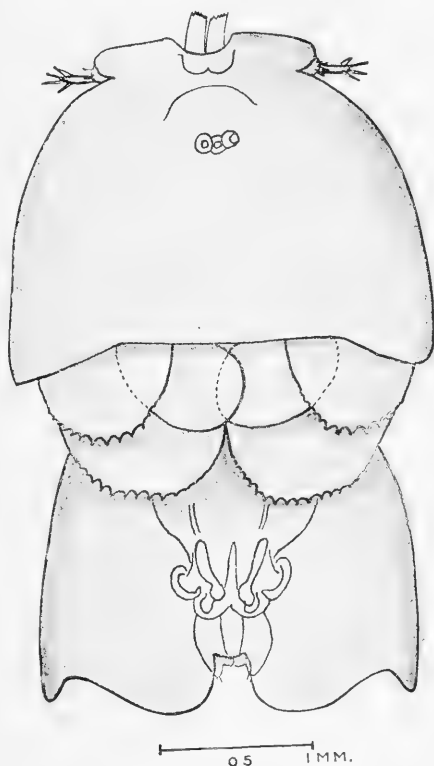


FIG. 14.—A CHALINUS OF *PERISSOPUS COMMUNIS*, FULLY DEVELOPED.

SUMMARY.

The life history of the genera belonging to this subfamily is similar to that of the Caliginæ and Euryphorinæ except in the following particulars:

(1) The pigment which develops in the nauplii takes the form of a large central mass rather than scattered spots, and is often so dense as to appear almost black.

(2) The balancers are slender and cylindrical, as in the Euryphorinæ, but they are attached nearer to the posterior end of the body of the nauplius, and point backward at an angle of about 45° to the central axis.

(3) In the metanauplius the first thorax segment is fused with the carapace as in the Euryphorinæ, but the first antennæ are like those of the adult and not dichotomously branched, nor even armed with long plumose setæ. The rami of the second maxillæ are fused and each consists of a stout basal joint tipped with a single spine. The swimming legs are laminate, but the separate joints are long and narrow, and they reach far back on the ventral surface.

(4) The chalimi are attached by frontal filaments, not single and cylindrical as in the Caliginæ, but double, each strand broad and ribbon-like; the two strands standing side by side and only long enough to reach the fish's skin, and allow the frontal margin of the chalimus's carapace to swing clear of it. These filaments have no enlargements at their bases like those seen in the Caliginæ, but are of uniform width throughout. The frontal glands developing these filaments are quadruple instead of double.

(5) The body form of the young female chalimus is almost exactly the same as that of the adult *Nogaus* male, the carapace having elongate posterior lobes, the free thorax segments being entirely distinct and almost uncovered by the dorsal plates, and the abdomen projecting its entire length behind the genital segment. We thus have visible and convincing proof of the relationship of the two sexes, and also of the fact that the female degenerates after becoming fixed.

(6) The appendages of the young chalimus are almost exactly like those of the adult; the second maxillipeds have not yet attained their proportionate size, but are small and the terminal joint is folded over against the basal joint.

(7) In subsequent development the posterior lobes of the carapace are shortened, the free thorax segments are telescoped together, and the dorsal plates are developed to cover them; the genital segment is increased in size, often becoming larger than the carapace, and in this increase it grows gradually back over the abdomen, so that the latter comes to lie on the ventral surface of the former, and is completely concealed in dorsal view.

SYSTEMATIC DISCUSSION.

Subfamily PANDARINÆ.

The first thorax segment only fused with the head, the others free; sexes quite dissimilar.

Female.—Carapace short and well rounded; frontal plates distinct. Eyes three in number, fused on the median line, the lenses arranged in the form of a triangle. One or more of the free thorax segments furnished with paired dorsal plates; genital segment enlarged and often covered with similar dorsal plates. Body stiff in consequence of these plates and not capable of much motion. Abdomen elongate, often with lateral processes; anal laminæ large and broad, with stout plumose setæ. Eggs numerous, uniseriate, and borne in straight cases, visible for their entire length and usually much longer than the body. Mouth-tube elongate and tapering to a sharp point; first maxillæ lacking, second pair simple flattened laminæ, tipped with short claws. Second maxillipeds massive and nodose. All four pairs of legs biramose; some or all of them lamellar and destitute of plumose setæ.

Male.—A typical *Nogaus* form. Carapace more elongate than that of the female and produced posteriorly into better defined lateral lobes. Free segments all well separated, of about the same length, but diminishing regularly in width, and none of them furnished with dorsal plates. Genital segment also without dorsal plates and enlarged but little. Abdomen two-jointed; anal laminæ large and foliaceous, furnished with long and stout plumose setæ. The adult males are as free swimmers as any of the Caliginæ and move about with as much ease over their host's body, thus affording a marked contrast to the fixed females. The young are attached by two broad and ribbon-like filaments, placed side by side and very short.

KEY TO THE GENERA.

- a. Females, first thorax legs uniramose, the other pairs biramose; only two pairs of dorsal plates. *Pholidopus*, new genus name, p. 347.
- a. Females, all four pairs of legs biramose; one, three, or four, but never two, pairs of dorsal plates; abdomen one-jointed and wholly concealed in dorsal view. b.
- a. Males, all four pairs of legs biramose and armed with long plumose setæ; no dorsal plates; abdomen one or two jointed, wholly visible. g.
- b. Rami of all the legs with the same number of joints, and all armed with long plumose setæ. c.
- b. Rami differing in the number of joints, and some or all of them destitute of plumose setæ, or even spines. d.
- c. Four pairs of dorsal plates; first and third pairs median, second and fourth pairs lateral; fourth pair on the genital segment, elongate, narrow, partly fused. *Lepimacrus* Hesse, 1883, p. 348.
- c. A single pair of small dorsal plates on the fourth segment; genital segment elongate, with a deep posterior incision; abdomen unsegmented.

Demoleus Heller, 1865, p. 349.

- d. Rami of second and third legs three-jointed, of first and fourth pairs two-jointed; no setæ on the fourth pair, those on the other pairs rudimentary..... *e.*
- d. Rami of first three pairs of legs two-jointed, with plumose setæ; of fourth pair one-jointed, setæ nonplumose..... *f.*
- d. Rami of second and third legs two-jointed; of fourth pair one-jointed; exopods of first pair one-jointed, endopods two-jointed.
Gangliopus Gerstaecker, 1854, p. 350.
- d. Rami of first and second legs two-jointed; of third and fourth pairs one-jointed and very rudimentary; three pairs of dorsal plates.
Perissopus Steenstrup and Lütken, 1861, p. 352.
- d. Rami of third legs two-jointed, of all the other legs one-jointed, lamellar and without spines or setæ..... *Laminiifera* Poche, 1902, p. 361.
- e. Dorsal plates on fourth segment large, covering half the genital segment or more; sixth segment not separated; exopods of second and third legs three-jointed, all the other rami two-jointed.
Echthrogaleus Steenstrup and Lütken, 1861, p. 362.
- e. Sixth segment distinctly separated as a median lobe or lamina, attached to the posterior sinus of the genital segment, and armed with a pair of dorsal plates and a rudimentary pair of swimming legs; both rami of the second and third legs three-jointed..... *Dinematura* Latreille, 1829, p. 374.
- f. Sixth segment distinctly separated as a rudimentary plate or lamina, attached to the posterior sinus of the genital segment; anal laminae transformed into horny conical processes; four pairs of dorsal plates, the fourth on the genital segment..... *Pandarus* Leach, 1816, p. 387.
- f. No sixth segment; anal laminae normal; second and third thorax segments fused *inter se*, and carrying a pair of good-sized lateral lobes; a single pair of dorsal plates, on the fourth segment, close together, and with their bases fused..... *Nesippus* Heller, 1865, p. 424.
- f. No sixth segment; anal laminae normal; second and third segments distinct, with small lateral lobes; a single pair of dorsal plates, on the fourth segment, feebly developed, and widely separated, their margins fringed with hairs..... *Prosartes*, new genus name, p. 439.
- g. Rami of all the swimming legs two-jointed..... *h.*
- g. Rami of fourth legs one-jointed, of all the others two-jointed..... *i.*
- g. One or both rami of the second and third legs three-jointed, of all the others two-jointed..... *k.*
- h. An accessory lobe on the posterior margin of the carapace just inside each posterior lobe; both the fifth and sixth legs visible on the genital segment; abdomen two-jointed, the joints equal..... *Pandarus* Leach, 1816, p. 387.
- h. Second maxillipeds not swollen, with ordinary terminal claws; anal laminae very large; no legs visible dorsally on the genital segment.
Demoleus Heller, 1865, p. 349.
- h. Second maxillipeds much swollen, with a long terminal claw; anal laminae medium size; no legs on the genital segment, or but one pair.
Perissopus Steenstrup and Lütken, 1861, p. 352.
- i. Free thorax segments two or three times as wide as long; fourth segment the longest; no legs visible on the genital segment; abdomen one-jointed.
Nesippus Heller, 1865, p. 424.
- i. Free thorax segments orbicular, all about the same width, second segment the longest, with large lateral wings; genital segment with one pair of legs at the posterior corners; abdomen two-jointed, basal joint the larger.
Gangliopus Gerstaecker, 1854, p. 350.

- i. Free thorax segments wider than long; second segment the longest, with small lateral wings; abdomen two-jointed, terminal joint the larger.

Perissopus Steenstrup and Lütken, 1861, p. 352.

- k. Exopods only three-jointed; fourth segment lunate, fitting down over the genital segment....*Echthrogaleus* Steenstrup and Lütken, 1861, p. 362.

- k. Both rami three-jointed; fourth segment orbicular, not overlapping the genital segment.....*Dinematura* Latreille, 1829, p. 374.

PHOLIDOPUS, new genus name.

Lepidopus DANA, 1852, p. 1373, pl. xcv, figs. 5 a—k.

Perissopus STEENSTRUP and LÜTKEN, 1861, p. 394 (part).—BASSETT-SMITH, 1899, p. 468 (part).

Female.—First thorax segment joined with the head to form the carapace, which is subquadrangular and widest posteriorly. Second and third thorax segments fused, and furnished with a single pair of large, rounded dorsal plates. Fourth segment free and armed with a similar pair of dorsal plates. Genital segment wider and longer than the carapace, its posterior margin bilobed, the two halves evenly rounded like the two pairs of dorsal plates on the free segments. Abdomen minute, attached to the ventral surface of the genital segment some little distance in front of the posterior margin, so as to be wholly concealed in dorsal view. Anal laminae short, tipped with small spines. Frontal plates well differentiated and larger than in the other Pandarinæ. Second antennæ three-jointed and uncinatæ, the terminal hook considerably longer than the basal joints, sickle-shaped and armed with two rows of teeth along its inner margin. Mouth-tube long and slender, as in *Pandarus*; mandibles with a straight tip, and the inner margin serrulate. Second maxillæ close to the base of the mouth-tube, composed of two short, well-rounded joints terminated by a small and nearly straight spine. Terminal joint of second maxillipeds widened and flattened into a broad lamina, covered with scales on its ventral surface, each scale terminating in a minute spine. First swimming legs slender, uniramous, and three-jointed, the terminal joint armed with five short setæ. Second, third, and fourth swimming legs biramous; second pair with slender basal segments and two-jointed rami; third and fourth pairs with the basal segments broadly lamellar, and the rami minute, rudimentary, one-jointed processes attached to the posterior edges of these lamellæ; setæ all very short. Nothing is known of the egg cases or eggs.

Male.—Unknown.

(*Pholidopus*, $\phi\omicron\lambda\acute{\iota}\varsigma$, a scale, and $\pi\omicron\upsilon\acute{\varsigma}$, foot.)

The new name given above is suggested in place of Dana's *Lepidopus*, which was preoccupied in 1770 by Gouan for a genus of fishes. That this is a valid genus and not a synonym for *Perissopus*, as suggested by Steenstrup and Lütken in 1861, by Brady in 1883, and again by Bassett-Smith in 1899, can be readily seen by the following comparison:

In *Perissopus* there are three free thorax joints, each carrying a pair of dorsal plates, of which the first pair is lateral, the second median, while the third extends entirely across the body; the genital segment is squarely truncated posteriorly, with sharp spines at the corners; the second antennæ are short, with a small terminal claw; all four pairs of swimming legs are biramose, with enlarged and lamellar basal joints; rami of the third and fourth pairs minute and rudimentary, the exopod differing from the endopod, and the third pair from the fourth pair.

In *Pholidopus*, on the contrary, the second and third thorax segments are fused together, and carry but a single pair of dorsal plates, which are like those on the fourth segment, extending entirely across the body; the genital segment is incised at the center posteriorly, each side being evenly rounded in a semicircle, without any spines; the second antennæ have short basal joints, with a very long sickle-shaped terminal claw, set with two rows of teeth; the first pair of legs is uniramose and three-jointed, the other pairs are biramose; but the basal joints of the first two pairs are narrow and slender, not lamellar; the last two pairs have lamellar basal joints, but all of their rami are just alike and armed with spines at their tips.

Genus LEPIMACRUS Hesse.

Lepimacrus jourdaini HESSE, 1883, p. 6, pl. IV, figs. 8-17.

Hesse described, in the above reference, a new genus and species based upon a single female specimen obtained from *Lamna cornubica*. The species has never been seen by any other writer, so that Hesse's description is all the knowledge we have of it. And although this description is faulty and the figures give us few reliable details, yet enough is shown to determine with reasonable certainty that the specimen really represented a new genus. Consequently it is here included and is differentiated as well as possible from the other genera in the following diagnosis.

Female.—Carapace elliptical, rather pointed anteriorly, the sides slightly emarginate; frontal plates prominent; eyes small and close together. Four pairs of dorsal plates on the thorax-segments, first and third pairs median, second and fourth pairs lateral. First two pairs subquadrangular; first pair fused at the base but separated for most of their length by a broad sinus; second pair widely separated, even at their bases. Last two pairs narrow and elongate; third pair separated at their bases but meeting at their tips on the midline; fourth pair on the genital segment, each plate semilunar, the convex sides toward each other and fused for some distance at the center. The tips of these plates are divergent; they project far behind the genital segment and are armed with stout spines; abdomen small, one-

jointed, and concealed beneath the genital segment; mouth-tube, appendages, and adhesion pads similar to those in other Pandarids.

Male.—Unknown.

(*Lepimacrus*, λεπίς, a scale, and μακρός, long, referring to the long and narrow dorsal plates on the genital segment.)

Genus DEMOLEUS Heller.

Caligus paradoxus OTTO, 1828, p. 352, pl. XXII, figs. 5, 6.

Nogagus grandis STEENSTRUP and LÜTKEN, 1861, p. 386, pl. x, fig. 14

Demoleus paradoxus HELLER, 1865, p. 199, pl. XIX, fig. 3.

In 1828 Otto described the male and female of a new species of copepod parasite which he named *Caligus paradoxus*. The male had the typical *Nogagus* form, but was much larger than other species, being 12.5 mm. in length. In 1865 Heller rediscovered the female of Otto's species and made it the type of a new genus, which he called *Demoleus*, and for which he gave the following genus diagnosis:

Cephalothorax emarginate posteriorly, two following segments free, fourth segment with dorsal plates (in the female); frontal plates prominent, first antennæ partly concealed by them, two-jointed. All the legs biramose, rami two-jointed, armed with plumose setæ, those of the first and fourth pairs minute, of the second and third pairs lamellar and enlarged. Genital segment elongate, abdomen very short, not jointed, covered with a foliaceous dorsal lamina, appendages large. Male of the typical *Nogagus* form.

With this description and the excellent figures published by Otto and Heller to guide us we can locate in this genus the form *Nogagus grandis*, described by Steenstrup and Lütken in 1861 from two specimens obtained in the warmer portion of the Atlantic, the definite locality and host not given. At the conclusion of their description these authors suggest: "If *Dinematura ferox* and *Nogagus grandis* could be proved to come from the same locality they might well be the male and female of the same species" (p. 387).

But in this they are mistaken, because neither the carapace, the fourth thorax segment, the swimming legs, nor the abdomen correspond with those found in *Dinematura* males, for the carapace in *Dinematura* is wider and its lateral margins are more strongly convex; the third segment is considerably larger, and the fourth segment carries a pair of rudimentary dorsal plates, which are entirely lacking in this *Nogagus*. The genital segment is relatively much wider in *Dinematura*, and has no posterior lobes; the abdomen is very much narrower and two-jointed, with the joints equal. But the essential difference is found in the swimming legs; in *Dinematura* males the rami of the second and third pairs are three-jointed like those of the female, while here in *Nogagus grandis* all the rami are two-jointed.

Furthermore, a careful comparison of this species with Otto's type male of *Caligus paradoxus* show the two to be identical.

They differ from all the other *Nogaus* types here given in their size, being from 13 to 16.5 mm. in length; in the relative size of the third thorax segment, which is much the smallest of the three free segments; in the semilunar shape of the fourth segment; in the segmentation of the abdomen, each joint of which is considerably wider than long, and in the huge size of the anal laminae, which, however, are armed with very small and rudimentary setae. These considerations render it fairly certain that *Nogagus grandis* is the male of *Demoleus paradoxus*, and we may revise the genus diagnosis as follows to include both sexes:

Female.—Carapace orbicular, about one-third the entire length; frontal plates narrow and distinct; eyes close together. Second and third thorax segments of the same width and just filling the space between the posterior lobes of the carapace; second segment with small lateral lobes; fourth segment less than half the width of the other two, and carrying a pair of small dorsal plates. Genital segment elongate, more than twice as long as wide, deeply incised posteriorly, with evenly rounded lobes. Sixth segment separated in the form of a circular plate concealed between the genital segment and the abdomen. Abdomen minute, triangular, and entirely concealed in dorsal view; anal laminae very large, projecting beyond the posterior margin of the genital segment, but armed with small and rudimentary setae. Second antennae small, with a weak terminal claw; second maxillipeds with a medium-sized claw. All the swimming legs biramose, the rami two-jointed and armed with plumose setae; basal joints of the first and fourth pairs small, of the second and third pairs enlarged and lamellar. Egg-strings looped once so as to give three strands.

Male.—Carapace similar to that of the female, about half the entire length; a pair of minute accessory lobes on the posterior border, just inside the posterior lobes. Lateral lobes on second thorax segment like those in the female; fourth segment without dorsal plates. Genital segment elongate, with short and well-rounded posterior lobes, but with no legs visible in dorsal view. Abdomen two-jointed, terminal joint the wider; anal laminae huge, but armed as in the female with small and rudimentary setae. Second maxillipeds not much swollen and armed with ordinary terminal claws. All the swimming legs biramose, the rami two-jointed and armed with large plumose setae.

(*Demoleus*, a Greek slain by Æneas before Troy.)

Genus GANGLIOPUS Gerstaecker.

Gangliopus pyriformis GERSTAECKER, 1854, p. 192, pl. VII, figs. 9–16.

Nogagus angustulus GERSTAECKER, 1854, p. 193, pl. VII, figs. 17, 18.

Both sexes of this genus were obtained together from the gill arches of a shark captured on the west coast of Africa, and were described by Gerstaecker in 1854. He recognized the female as the

type of a new genus which he named *Gangliopus*, but he classed the male with the genus "*Nogagus*," and gave it the name *N. angustulus*. The fact that they were found together did not suggest to Gerstaecker that they might be male and female of the same species, but such seems to be the case as evidenced by the following facts:

(1) Negative evidence: Each of the two forms is different from the other types of its own sex which belong to this subfamily. This is a necessary preliminary for the formation of any new genus, and the male should differ as well as the female, as we find it actually does in the present instance.

(2) Positive evidence: The frontal plates and first antennæ are very similar in the two forms; the carapace is relatively longer in the male, but this is what would naturally be expected. In both sexes the carapace is narrowed posteriorly.

Each sex shows three free thorax segments, diminishing in size backward; in the female they are armed with dorsal plates, but these are lacking in the male, which carries but a single pair of lateral lobes on the first segment.

The genital segment in each is enlarged and quadrangular; it is emarginate in the female and carries a pair of posterior lobes in the male. The four anterior pairs of legs are biramose, the rami of the first three pairs two-jointed, the fourth pair one-jointed. The relative sizes are what would be expected in the male and female of the same species, 9 mm. in the female and 7.5 mm. in the male.

In view of these facts "*Nogagus angustulus*" may be regarded with considerable certainty as the male of *Gangliopus pyriformis* and we shall have the following genus diagnosis for both sexes.

Female.—Carapace obovate, strongly narrowed posteriorly; the lateral areas divided by transverse grooves as in *Echthrogaleus*. Frontal plates prominent; posterior lobes short and triangular. A pair of small dorsal plates on each of the three free segments, all lateral, the first pair with a wide interval between their bases, the other two pairs meeting on the mid-line. Genital segment somewhat enlarged, quadrangular, with evenly rounded posterior corners. Sixth thorax segment well separated and carrying a pair of rudimentary legs as in *Dinematura*. Abdomen small and square, attached by one corner to the sixth segment; anal laminae minute, attached to the lateral corners of the abdomen, and destitute of setæ or spines. Swimming legs all biramose, rami small and laminate, those of the first three pairs two-jointed, of the fourth pair one-jointed. Rami of the first two pairs armed with adhesion pads; exopods all carrying short, nonplumose spines, endopods naked. Egg-tubes narrow and twice as long as the body.

Male.—Carapace obovate-elliptical; frontal plates prominent; posterior lobes long, narrow, and pointed. Free segments transversely

elliptical and widely separated, the first one carrying a pair of good-sized lateral lobes. Genital segment subquadrangular, with short and acute posterior lobes. Abdomen two-jointed, the basal joint the larger; anal laminae large, each armed with four plumose setae. Appendages as in the female: all the swimming legs biramose, the first three pairs of rami two-jointed, the fourth pair one-jointed.

(*Gangliopus*, γάγγλιον, a tumor or swelling, and πούς, foot, swollen-footed.)

Neither of these forms has been seen since Gerstaecker first described them, and there are several points with reference to their anatomy which need explanation.

In the female the exopod of the first swimming legs is represented as one-jointed and the endopod as two-jointed. But the arrangement of the spines on the exopod shows clearly that it is at least a fusion of two joints. And a more careful examination of fresh material would probably show that it is imperfectly segmented; accordingly it has been given here as two-jointed. Again, Gerstaecker says that the abdomen of the female is two-jointed, and that the basal joint carries at its posterior corners two oval laminae. Such appendages are not found on any Caligid, but their interpretation becomes easy if we regard them as rudimentary legs like those in *Dinematura*.

What he calls the basal joint of the abdomen will thus become the sixth thorax joint, well separated from the genital segment as in several other species. He does not mention any dorsal plate for this sixth segment, but such a plate might be easily overlooked when it was concealed between the genital segment and abdomen. The similar plate which exists in *Echthrogaleus* has escaped detection up to the present time.

For the male nothing is said in the text about the swimming legs and all information has to be taken from the figure given, which, however, does not show either the first or second pairs. Accordingly we have to fall back upon the supposition that these are the same as in all the *Nogaus* species or Gerstaecker would have noted the difference. This method is not very scientific, but it is all we have at present.

Genus PERISSOPUS Steenstrup and Lütken.

Perissopus dentatus, STEENSTRUP and LÜTKEN, 1861, p. 393, pl. XII, fig. 25.

Female.—Carapace wider than long, narrowed anteriorly; posterior lobes short, sometimes almost lacking. Frontal plates narrow but distinct, with a broad and well defined median incision. Eyes three in number, placed nearly in a row, the middle one the smaller. Three free thorax segments, each with a pair of dorsal plates, the first pair lateral and oblique, the second median and nearly horizontal, the third the largest, extending entirely across the body.

Genital segment considerably larger than the carapace, evenly rounded anteriorly, but almost squarely truncated posteriorly, with short and acute spines at the corners and a wide median incision. Fifth legs some distance from the margin on the ventral surface. Abdomen small and entirely hidden in dorsal view; anal laminae also small, with very short and nonplumose spines. Terminal joints of the second maxillipeds enlarged and fleshy, reniform, with a rough scaly surface. Legs all biramose; rami of third and fourth pairs minute and rudimentary. Egg-strings narrow and much longer than the body.

Male.—Carapace, including the posterior lobes, elliptical, slightly longer than wide, narrowed anteriorly; posterior lobes long and narrow; posterior margin between the lobes nearly straight. Eyes three in a row, the median one much smaller than the others. Free thorax segments about the same length, diminishing regularly in width. Genital segment small, subquadrangular, with the fifth legs very prominent at the posterior corners. Abdomen large, one-jointed; anal laminae large and armed with long plumose setae. Second antennae larger than in the female, but with the adhesion pad much reduced in size. Second maxillipeds with a stout, curved, terminal claw shutting down against a pair of corrugated knobs as in *Pandarus*.

Swimming legs all biramose, rami of fourth pair indistinctly segmented, of the other pairs two-jointed.

(*Perissopus*, *περίσσοπος*, more than the regular number or size, and *πούς*, foot, alluding to the enlarged second maxillipeds.)

KEY TO THE SPECIES.

- a. First pair of dorsal thorax plates bilobed; second pair not meeting at the mid-line; third pair fused.....(*Chlamys*) *incisus* Van Beneden, 1892, p. 354.
- a. None of the thorax plates bilobed; second and third pairs meeting at the mid-line, but not fused..... b.
- b. Carapace about half the size of the genital segment; its posterior lobes narrow, long, and overlapping the first dorsal plates; rami of third legs fused into a semicircular plate.
dentatus Steenstrup and Lütken, 1861, p. 353.
- b. Carapace more than four-fifths as large as the genital segment, its posterior lobes very short and wide; rami of third legs distinct and similar to those of the third pair.....*communis* Rathbun, 1887, p. 354.

This genus *Perissopus* was established by Steenstrup and Lütken in 1861 for a species which they named *P. dentatus*, and for which they gave the following genus diagnosis:

Cephalothorax undivided; abdominal segments free, carrying four or six dorsal plates; genital segment enlarged and a little widened, covering the short tail and the caudal stylets; abdominal feet destitute of plumose setae, rami of first and second pairs (at least in *P. dentatus*) two-jointed, the other rami not jointed, very rudimentary. Male unknown.

They wished to include in the same genus Dana's *Lepidopus*, and the above diagnosis was evidently made out with that in view.

And they also gave two species diagnosis, one for their new species *dentatus*, and the other for Dana's species *armatus*.

But in this they were mistaken, for Dana's genus *Lepidopus* can not be identified with *Perissopus* for reasons already mentioned (see p. 348). This leaves the genus with the original type species *dentatus*, the new species, *communis*, established by Rathbun in 1887, and a third species, *incisus*, described in 1892.

In that year Van Beneden published an account of a copepod parasite belonging to the present subfamily, which he made the type of a new genus, called *Chlamys*. He recognized its resemblance to Dana's *Lepidopus*, but was either unacquainted with, or had forgotten Steenstrup and Lütken's genus *Perissopus*, which it resembles even more closely. In fact there is little doubt that it is a species of *Perissopus*, as Bassett-Smith has suggested (1899, p. 468), and as such it is here included in the key. The only doubt as to its identity is found in the utter confusion of details characteristic of Beneden's figures and descriptions. In his ventral view of the female (Plate II, fig. 3) he pictures the first swimming legs as uniramous and two-jointed, while the other three pairs are biramous, with all the rami one-jointed. In the enlarged figure (fig. 9) of these same legs he shows them all biramous, each endopod one-jointed, and each exopod two-jointed. His description in the text (pp. 230 and 231) agrees with this last figure, except for the fourth legs, of which he says: "La quatrieme paire de pattes n'est pas biramée." In the face of such flat contradictions, one has to be guided chiefly by the general makeup of the body and the relation of its regions. These are so similar to those of *Perissopus* as to leave no doubt of generic identity.

PERISSOPUS COMMUNIS Rathbun.

PLATES XVII and XVIII.

Perissopus communis RATHBUN, 1887, p. 560, pls. XXIX, XXX.

Perissopus dentatus (part) BASSETT-SMITH, 1899, p. 468.

Female.—Carapace semielliptical, narrowed but little anteriorly, widest at or near the posterior angles; lateral margins slightly convex, sometimes nearly straight; posterior lobes short and angular; posterior margin straight or slightly concave, sometimes with a small spine on either side. Frontal plates narrow but distinct, frontal margin nearly straight, with a broad and shallow median incision. Eyes usually invisible in the adult, but distinct in the young, three in number and arranged in a transverse row, the central one slightly behind and a little smaller than the other two. Visible portion of the dorsal plates of the second thorax segment standing out at an angle of 45° to the central axis, and elliptical in outline, the longer diameter nearly

twice the length of the shorter one. The outer margin of these plates really extends forward to the reniform pads of the second maxillipeds, so that if removed from the body the plates are found to be spindle shaped, pointed at either end, about twice as long as wide and attached nearly at the center of the inner margin, leaving both ends free. A wide space between the bases of these plates and behind the posterior margin of the carapace is left uncovered or with a small central plate, as in some *Pandarus* species. Dorsal plates of the third thorax segment smaller than the first pair, also elliptical, but nearly horizontal or only slightly oblique, with their tips meeting and often overlapping a little on the mid-line. Dorsal plates of the third pair considerably enlarged, circular and extending across the entire width of the body, their inner margins overlapping on the mid-line, their posterior margins reaching some distance over the genital segment. The posterior margins of the first and third pairs of plates are scalloped, the points ending in short and sharp teeth; the margins of the second pair of plates are smooth. Genital segment about the same size as the carapace, evenly rounded anteriorly, its lateral margins convex, its posterior margin cut obliquely on either side, with small and sharp spines at the posterior corners and a wide and deep median sinus. The margin between the sinus and the corner spine on either side has a double or S-shaped curve, sweeping backward at the side of the sinus and forward close to the spine.

Abdomen small and plump, a little longer than wide, barrel-shaped, one-jointed, and entirely concealed beneath the genital segment. Anal laminae short, triangular, and armed with minute and irregular spines. First antennae small and two-jointed, the basal joint heavily, the terminal joint lightly, armed with setae. The basal joint is much wider than the terminal and twice as long, and its tip reaches well beyond the margin of the frontal plate. Second antennae also small and weak, the terminal claw as long as the rest of the appendage, but slender and not very strongly curved. Adhesion pads much smaller than in *Pandarus*, the first pair ovate, their long diameter inclined outward and forward at an angle of 45° to the body axis, the second pair much smaller, circular, and at the very base of the second antennae, on the ventral surface of the carapace, so that they can not be lowered against the fish's skin as in *Pandarus*.

Mouth-tube and mandibles of the usual form for this subfamily; second maxillae lamellar, each tipped with a long and narrow spine. In other genera these lamellae are attached along a line at right angles to the body axis, or one inclined outward and backward, so that the appendages when at rest against the surface of the carapace are parallel with the mouth-tube or turn inward and overlap it. But in the present genus the line of attachment is inclined backward and inward, parallel with the tapering margin of the mouth-tube, so that

when turned down against the carapace, the appendage points directly away from the proboscis nearly at right angles.

First maxillipeds of the usual pattern, the terminal claws rather stout, the external one considerably longer than the internal. Second maxillipeds swollen and fleshy, the terminal joint enlarged into a huge kidney-shaped adhesion pad, destitute of pinchers, knobs, or claws. This pad has exactly the same structure as those at the bases of the antennæ; the adhesion surface is tough and leathery, is surrounded by a raised margin, and is minutely corrugated and irregularly furrowed, but shows no traces of scales or anything of the sort even under a one-twelfth oil immersion lens. Opposite these large second maxillipeds the lateral margin of the carapace on either side is raised into a large spherical knob on the ventral surface, pointing downward and inward toward the base of the maxilliped, and even in contact with the latter in preserved specimens.

Swimming legs all biramose, each ramus of the first two pairs distinctly two-jointed, of the third pair partially, and of the fourth pair almost wholly, fused into a single joint. Exopods each armed with stout spines, of the same number and similarly arranged, one at the outer distal corner of the proximal joint and four in a row across the end of the distal joint. Endopods with portions of the surface covered with minute papillæ or spines. Outside of each exopod in the three posterior pairs is a small rounded knob, like a rudimentary third ramus, bearing on its summit a long and flexible spine.

The basal joints of each pair of legs are subrectangular in outline and increase rapidly in size from in front backward, those of the fourth pair being fully eight times the size of the first. In the first two pairs these basal joints are attached by their anterior margins, in the third pair by the antero-interior corners, and in the fourth pair by the centers of the interior margins, the rami in each case being borne on the posterior margins. In all the exopods the basal joint is considerably larger than the terminal; in the endopods of the first and second pairs the terminal joint is the larger, while in the third and fourth pairs it is reduced to a mere knob on the side of the basal joint. The fifth legs consist of a long papilla, broadly triangular at the base and strongly flattened, attached to the ventral surface of the genital segment halfway between the lateral margin and the mid-line, and armed with three slender spines.

Of the reproductive organs each egg tube is coiled once in the genital segment, and each of the three strands of the coil runs the entire length of the segment and fills its side out to the lateral margin. The vulva or oviduct opening is at the tip of a raised rectangular papilla, situated close to the base of the abdomen on either side. The spermatophores are club-shaped, narrow and elongate, and apparently jointed at the center. They are attached just outside the

valva papilla, in the angle between it and the ventral surface of the genital segment on either side, and their duct empties on the same side without crossing the mid-line, as in *Pandarus*.

Semen receptacle globular, a little wider than long and just in front of the base of the abdomen; its anterior margin is evenly rounded, its posterior one is split at the center, dividing the receptacle into two conical, widely divergent branches, which run out into the valva papilla on either side and there open into the oviduct. Cement glands almost invisible in preserved material, the only thing that could be made out with reference to them being their position on either side of and close to the mid-line, and their general shape that of parentheses marks.

External egg-sacs slender, one and a half to two times as long as the entire body; eggs small, strongly flattened and numerous, with very little pigment.

Total length 4 mm. Length of carapace 1.5 mm. Width 1.9 mm. Length of genital segment 1.6 mm. Width of same 1.8 mm. Length of egg-strings 6 to 8 mm.

Color a light yellowish white, without pigment, often turning brown in alcohol.

(*communis*, common).

Male.—No adult male has ever been obtained, not merely for this species, but for the whole genus. Two fully developed chalimus males, however, were obtained in company with chalimus females and young adults on a smooth dog-fish captured September 2, 1904, at Woods Hole. The following is a description of these males and would be correct for the adults except in size.

Carapace, including the posterior lobes, forming an ellipse, strongly narrowed anteriorly, its lateral margins moderately convex. Posterior lobes long and narrow and bluntly rounded at the tip; posterior margin between the lobes nearly straight, with the rudiments of accessory lobes on either side. Eyes large and prominent, a little in front of the center and close together, but not in actual contact. Frontal lobes large and prominent, narrow at the center but broad at the outer ends, where they cover most of the basal joints of the first antennæ. Free thorax segments diminishing regularly in width backward, the fourth one the same width as the genital segment, the first one considerably narrower than the distance between the posterior lobes of the carapace, leaving a wide open space on either side. Lateral processes of this first segment long, large, and curved outward at the tips.

Genital segment oblong, the anterior margin nearly straight, the lateral margins evenly rounded, the posterior margin concave.

The fifth legs appear as large and prominent papillæ at the postero-lateral corners, about one-fifth of the distance in front of the posterior

margin. It must be remembered that this is still a chalimus, and in the subsequent development of the genital segment these fifth legs may become partially or even wholly concealed on the ventral surface.

The large spherical sperm receptacles can be seen in the posterior portion of the segment, just in front of the fifth legs.

Abdomen half as wide as the genital segment, one-jointed; anal laminae small, triangular, each tipped with four large setae, three close together at the inner corner, and one removed a little distance at the outer corner. Outside of the latter there is also a minute spine. Appendages similar to those of the female, the second antennae somewhat larger, the terminal claw stouter and carrying an accessory claw on its ventral surface.

The adhesion pads at the bases of these antennae are reduced still more in size, and might easily be overlooked unless sought for particularly. The second maxillipeds are radically changed from the pad-form of the female and are tipped with a stout claw, well curved, which shuts down against a pair of corrugated cushions as in *Pandarus*. Swimming legs all biramose, the rami of the first three pairs two-jointed, of the fourth pair one-jointed. But from the arrangement of the spines and the indentation of the margins these fourth rami are each evidently a fusion of two joints, and possibly become as fully two-jointed in later development as in *Pandarus*.

The number and arrangement of the spines and setae are as follows: First exopod 1, 0; 4, III: endopod 0, 0; 0, III: second exopod 1, I; 4, V: endopod 0, I; 0, V: third exopod 1, I; 3, V: endopod 0, I; 0, V: fourth exopod 1, 0; 3, V: endopod 0, I; 0, IV.

Total length, 3 mm.; length of carapace, including lobes, 1.7 mm.; width, 1.55 mm.; length of free thorax segments, 0.92 mm.; length of genital segment, 0.56 mm.; length of abdomen, 0.4 mm. Color a light yellowish white without pigment.

Chalimus.—Female chalimi were secured in three different stages of development, which have already been described under the ontogeny (see p. 340). It only remains here to emphasize their specific characters. The smallest of the three is exactly the same length as the male just described, but is in an earlier stage of development. The similarity between the two is much closer than in the adults, and affords a striking proof that they are really the two sexes of the same species. The carapace of this female chalimus is almost exactly like that of the male, its posterior lobes being long and well rounded, very different from their shape in the adult. The frontal plates are also much more prominent than in the adult female, and are like those of the male. The eyes are visible in both sexes, are of the same size, and similarly placed.

Again, the second, third, and fourth thorax segments are visibly free in this young female, and are remarkably like those in the male.

The lateral plates of the first segment are just starting and correspond closely to the lateral processes of the same segment in the male. The second pair of plates have not started, while the third pair appear as two broad and short lobes on the fourth segment.

The genital segment is comparatively wider in the female, and the fifth legs are on the ventral surface instead of at the posterior corners. The abdomen is visible for its entire length behind the genital segment and is very similar to that of the male, having only a single joint. The anal laminae are also similar, and while the spines on them are non-plumose and very short, they are arranged similarly to those in the male.

The appendages in this young female, however, are like those of the adult of the same sex. The terminal joints of the second maxillipeds are in the form of adhesion pads. They have not yet assumed the reniform shape characteristic of the adult, but are otherwise the same. The swimming legs are exactly like those in the adult female, as can be seen from fig. 12, p. 341.

In the second chalimus, 4 mm. in length, we find the carapace approaching the adult form. The posterior lobes have shortened, and the carapace has widened. The free thorax segments have become more compactly joined, and the dorsal plates are all of good size. Those on the second segment, however, are now circular, and neither they nor the third pair meet at the center, but leave a wide median space between them (fig. 13, p. 342).

The genital segment has widened and approached more nearly to the size of the carapace. It has also grown backward over the abdomen, so that the posterior margin of the latter is just even with that of the former. Much of the dorsal surface of the abdomen is still visible, however, through the median sinus of the genital segment.

In the third chalimus, 4.5 mm. long, we find practically the same structure as in the adult. The carapace has widened and its posterior lobes have shortened. The eyes have moved nearer the anterior margin, and the frontal plates have become relatively much less prominent. On the thorax segments the dorsal plates have increased in size until they overlap on the mid-line, while the posterior margins of the first and third pairs are handsomely scalloped (fig. 14, p. 343).

The genital segment has now become a little larger than the carapace, while the abdomen has entirely withdrawn beneath it so that only the tips of the anal laminae are visible at the base of the median sinus.

Variety *stimpsoni*: Carapace wedge-shaped, one and a half times wider than long, strongly narrowed anteriorly as in *dentatus*, but **with** the sides nearly straight instead of strongly convex, and with very short posterior lobes. The under surface of the carapace shows

the same large raised knobs opposite the second maxillipeds as in the type species (figs. 20 and 21).

First pair of dorsal plates widely separated, their posterior margins reaching far behind those of the second pair, and far outside the lateral margins of the third pair. The posterior margins of the first and third pairs of plates are not toothed in any of the specimens at hand.

Genital segment much larger than the carapace, a little wider than long, the width greatest near the center and a little more than that of the carapace. Posterior angles reaching farther back than in the typical form, making the posterior margin more squarely truncated; median sinus narrow and shallower than in the type form. Appendages exactly like those of the type form except that they are larger. Egg-strings relatively narrower than in the type form and much longer.

Ten females belonging to this variety were obtained from a dusky shark, *Carcharhinus obscurus*, at Woods Hole. They are excellently preserved, and are of the same color as the type form, a light yellowish white. They are all fully developed females with egg-strings, are all exactly alike, and differ from the type in the above particulars, the most noticeable difference being the increase in size and in the length of the egg-strings.

Rathbun founded his variety on a single specimen which had been in alcohol many years and was of a dark brown color.

On comparing these fresh specimens with his, they are found to agree in every particular of structure, but are somewhat larger, and are of the same color as the type instead of being brown.

This species was established by Rathbun in 1887 upon six lots of specimens obtained from four different hosts. Two additional lots have since been obtained, one of which included the developmental stages and was obtained from a new host.

The U. S. National Museum collection now includes the following: From the dusky shark, *Carcharhinus obscurus*, Cat. No. 12685 from Vineyard Sound, Massachusetts; Cat. No. 8181 from Noank, Connecticut, and the variety *stimpsoni*, Cat. No. 4414 and Cat. No. 32775, both from Woods Hole, Massachusetts.

From the sharp-nosed shark, *Scoliodon terre-novæ*, Cat. No. 6085, taken at Pensacola, Florida, and Cat. No. 32776 taken at Beaufort, North Carolina. From the blue shark, *Carcharhinus milberti*, Cat. No. 8180 taken at Woods Hole. From the shovel-head shark, *Reniceps tiburo*, Cat. No. 8182 taken at St. Marys River, Florida. From the smooth dog-fish, *Mustelus canis*, Cat. No. 32777 taken at Woods Hole; this lot included the chalimi already described.

That this is a valid species and not a synonym of *Perissopus dentatus*, as Bassett-Smith would have us believe, may be seen in the following comparison:

In *Perissopus dentatus* the carapace is wedge-shaped, the posterior margin twice the width of the anterior, the posterior lobes one-third as long as the carapace on the mid-line; there are no lobes or knobs on the ventral surface. The first pair of dorsal plates are elliptical, not reaching forward to the bases of the first legs. The basal joints of the first two pairs of legs are attached by their postero-interior corners, with the rami attached to their exterior margins. The rami of the third legs are fused into a single semicircular lamella tipped with two minute spines. Rami of the fourth legs one-jointed exactly alike, but the exopod tipped with a single spine while the endopod has none.

In *Perissopus communis* the carapace is semielliptical, scarcely narrowed at all; the posterior lobes are less than one-seventh the length of the carapace on the mid-line, and are often virtually eliminated; there is a large hemispherical knob on the ventral surface of the carapace near the lateral margin on either side, opposite the reniform pad of the second maxilliped. The first dorsal plates reach forward to the base of the second maxillipeds. The basal joints of the first two pairs of legs are attached by their anterior margins, with the rami on the posterior margins. The exopods have each the same number of spines similarly arranged, one on the exterior margin and four in a row at the end; the rami of the third legs are as distinct as those of the other pairs; the endopods of the third and fourth pairs of legs are very different from the exopods.

Genus LAMINIFERA Poche.

Phyllophora MILNE EDWARDS, 1840, p. 471. (*Phyllophora cornuta* MILNE EDWARDS, 1840, p. 472, pl. XXXVIII, figs. 13, 14.—BASSETT-SMITH, 1899, p. 465.
Laminifera cornuta POCHE, 1902, p. 8.)

Female.—Carapace triangular, narrowed and rounded anteriorly, the lateral margins only moderately convex; posterior lobes widely divergent, as long as the entire carapace on the mid-line, broad and well rounded; posterior margin between the lobes very narrow. The three pairs of dorsal plates on the thorax developed into overlapping foliaceous wings, each pair considerably wider than the carapace. The first two pairs are widely divergent, like the posterior lobes of the carapace, and just meet on the mid-line; the third pair are horizontal, their inner margins overlapping considerably. Genital segment quadrangular with rounded corners and a squarely truncated posterior margin; sixth segment in the form of a dorsal rounded plate, as in *Pandarus*. Abdomen attached to the ventral surface of the genital segment, one-jointed, with modified anal laminae attached to its sides at the base, and a ventral plate as in *Pandarus*. Appendages similar to those in the other Pandarinæ; first antennæ three-jointed; second pair much enlarged, their terminal claws stout and not much

curved, reaching back to the thorax. Second maxillipeds swollen but little and ending in short claws. All the swimming legs biramose; basal joints of the first and fourth pairs not united across the mid-line; rami lamellar and destitute of setæ or spines, those of the third pair two-jointed, of the other pairs one-jointed; fifth legs on the ventral surface close to the base of the abdomen. Egg-strings narrow, a little longer than the body. Length, 22.5 mm.

(*Laminifera*, lamina and *fero*, to bear.)

Male.—Unknown.

This genus was founded by Milne Edwards in 1840 upon female specimens obtained near Tongatabu; the host is not given, but was probably a shark. Milne Edwards named the genus *Phyllophora*, but this name had been preoccupied three times previously, for a genus of birds in 1812, a genus of flies in 1838, and again for a genus of mammals in the same year; accordingly Poche suggested the name *Laminifera* in 1902.

Milne Edwards gives no genus diagnosis, but only a short description, from which and from the two excellent figures he published the above diagnosis has been deduced. There is some doubt on one point, and what are here given as the fifth legs may prove, on later investigation, to be the sixth pair, attached to a well differentiated sixth segment.

Genus ECHTHROGALEUS Steenstrup and Lütken.

Pandarus (part) MILNE EDWARDS, 1833.—JOHNSTON, 1835.

Dinematura (part) BURMEISTER, 1834.—GUÉRIN, 1837.

Dinemoura MILNE EDWARDS, 1840.—BAIRD, 1850.

Echthrogaleus STEENSTRUP and LÜTKEN, 1861, p. 380 (*Echthrogaleus coleoptratus* STEENSTRUP and LÜTKEN, 1861, p. 380, pl. VIII, fig. 15).

Female.—Carapace large and well rounded; frontal plates distinct but not prominent; posterior lobes long and blunt; dorsal surface with a longitudinal groove on either side, a transverse groove across the mid-line, and a short groove across the lateral area on either side; three small eyes, the lenses close together and arranged in the form of a triangle. Three free segments, each bearing a pair of dorsal plates; first two pairs rudimentary, first pair lateral, second pair median, third pair well developed and extending the entire width of the body.

Genital segments enlarged, sometimes wider than the carapace, with a deep posterior sinus and long rounded lobes. A small median lobe at the base of the sinus represents the sixth thorax segment, and corresponds to the similar lobes found in *Pandarus*, *Dinematura*, etc. It is on the ventral surface and entirely concealed between the genital segment and abdomen (*coleoptratus*), or on a level with the dorsal surface and visible (*denticulatus* and *torpedinis*). Abdomen small, one-jointed, concealed beneath the genital segment or partially visi-

ble in the base of the sinus; anal laminae large but armed with non-plumose setae.

Second maxillipeds tipped with stout claws; all the swimming legs biramose; rami of first pair two-jointed; exopods of second and third pairs three-jointed, endopods two-jointed, all with rudimentary plumose setae; fourth pair transformed into imperfectly jointed lamellae, destitute of setae. Egg-tubes very slender and several times the length of the body.

Male.—Carapace like that of the female but proportionally larger, frontal plates more prominent. Lateral lobes of the second thorax segment corresponding to the first pair of dorsal plates in the female; no lobes on the third segment; a rudimentary pair on the fourth segment, which are closely appressed to the anterior margin of the genital segment. The latter smaller than in the female, with one pair of legs at or just in front of the posterior corners. Abdomen small and two-jointed; anal laminae large and armed with plumose setae. Appendages as in the female.

(*Echthrogaleus*, ἐχθρόζ, an enemy, and γαλέος, a shark.)

KEY TO THE SPECIES.

- a. Females, third dorsal plates much enlarged, covering half the genital segment or more; genital segment also enlarged, sometimes to the size of the carapace; abdomen small, one-jointed, hidden..... b.
- a. Males, no dorsal plates or only the rudiments of them; genital segment scarcely enlarged; abdomen entirely free and two-jointed..... i.
 - b. Body more than twice as long as wide; third dorsal plates with rounded anterior corners, without spines..... c.
 - b. Body short and wide, length to width as 5 to 3; third dorsal plates with sharp spines at the anterior corners..... f.
- c. Carapace definitely wider than long; posterior lobes of genital segment parallel and not touching along the mid-line..... d.
- c. Carapace as long as, or longer than, wide; posterior lobes of genital segment convergent and overlapping on the mid-line..... e.
 - d. Carapace larger than the genital segment; fourth segment plates without transparent dots and covering more than half the genital segment.
braccatus Dana, 1852, p. 366.
 - d. Carapace much smaller than the genital segment; fourth segment plates covered with transparent dots and overlapping less than half the genital segment..... *coleoptratus* Guérin, 1837, p. 367.
- e. Carapace definitely longer than wide; abdomen small and entirely concealed, not even the anal laminae visible in dorsal view.
affinis Milne Edwards, 1840, p. 364.
- e. Carapace the same length and width; abdomen half as large as the genital segment and partly visible in dorsal view... *indistinctus* Kröyer, 1863, p. 364.
 - f. Posterior carapace lobes not touching the third dorsal plates; genital segment decidedly smaller than the carapace..... g.
 - f. Posterior lobes of the carapace overlapping the third dorsal plates; genital segment as large as or larger than the carapace..... h.
- g. Third dorsal plates covering more than half the genital segment and toothed on their posterior and inner margins; fifth legs projecting beyond the lobes of the genital segment; abdomen invisible..... *denticulatus* Smith, 1874, p. 369.

- g. Third dorsal plates covering less than half the genital segment, their margins smooth; fifth legs invisible; abdomen partly visible.

perspicax Olsson, 1869, p. 364.

- h. Third dorsal plates covering nearly the whole genital segment; no spines at their anterior corners; posterior lobes of the genital segment turned strongly inward and almost touching each other; fifth legs invisible.

torpedinis, new species, p. 371.

- h. Third dorsal plates covering about two-thirds of the genital segment, spines at their anterior corners; posterior lobes of the genital segment parallel and separated by a wide sinus; fifth legs visible beyond the tips of the lobe.

neozcalanicus Thomson, 1889, p. 365.

- i. Carapace three times the width of the genital segment; frontal plates broad and prominent; third thorax segment as wide as the fourth.

perspicax Olsson, 1869, p. 364.

- i. Carapace two and a half times the width of the genital segment; frontal plates very small and narrow; fourth thorax segment short, wider than the genital segment and semilunar. *neozcalanicus* Thomson, 1889, p. 365.

- i. Carapace twice the width of the genital segment; frontal plates wide and prominent; fourth thorax segment long and narrower than the genital segment.

braccatus Dana, 1852, p. 366.

This genus was established by Steenstrup and Lütken in 1861 to include, as they said, four species which had up to that time been classed with the genus *Dinematura*, namely *D. alata* Milne Edwards, *D. affinis* Milne Edwards, *D. coleoptrata* Guérin, and *D. braccata* Dana. These agree with each other and differ from the true *Dinematura* species in the following: (1) The first two free thorax segments are fused together; (2) the genital segment is broad and flat, not long and narrow; (3) the dorsal plates are larger and cover half the genital segment or more; (4) the abdomen is not jointed, it carries only a single dorsal plate, and it is often concealed beneath the genital segment; (5) the fourth swimming legs are small and their basal joints are not wing-like when developed; (6) the first three pairs of legs do not deserve the name of swimming legs, and their plumose setæ are poorly developed.

The authors might have added a seventh difference which would have been at least as valuable as any of the others. In *Dinematura* the sixth thoracic segment is well separated from the genital segment, and it bears a pair of dorsal plates and also a rudimentary pair of swimming legs. In *Echthrogaleus*, on the other hand, this sixth segment is reduced to a mere lobe attached to the base of the posterior sinus of the genital segment, and there is not even a trace of any dorsal plates or swimming legs. To this genus *Echthrogaleus* belong also the following five species, which have appeared since 1861:

"*Dinematura*" *indistincta*, described by Krøyer in 1863 (p. 183), but of which no figures have ever been published; rightly referred to the present genus by Bassett-Smith in 1899.

Echthrogaleus perspicax, described by Olsson in 1869; includes both sexes and is well illustrated.

Echthrogaleus denticulatus, described by S. I. Smith in 1874, but of which no figures have hitherto been published.

"*Dinematura*" *neozelandica*, described and figured by Thomson in 1889, and rightly referred to the present genus by Bassett-Smith in 1899.

Echthrogaleus torpedinis, new species (p. 371).

Dana's *Dinematura braccata* is possibly a young female of *Echthrogaleus coleoptratus* rather than of *E. affinis*, as Bassett-Smith would have us believe; eight valid species appear in the above key.

In 1833 Milne Edwards described a new species of parasitic copepod, to which he gave the name *Pandarus alatus*. Two years later Johnston published a description of what he claimed to be the same species, giving it Milne Edwards's name. On founding the present genus Steenstrup and Lütken decided that Johnston's species was the same as Guérin's "*Dinematura coleoptrata*," and that it was not identical with Milne Edwards's species. This latter decision is confirmed by the following differences: Milne Edwards's species shows: 1. No division of the lateral areas of the carapace. 2. No transparent spots on the dorsal plates of the fourth thorax segment. 3. Second maxillipeds armed with slender terminal claws and without accessory claws or spines. 4. Marked differences in the shape of the second antennæ, first maxillipeds, and maxillæ. 5. Both rami of the second and third pairs of legs three-jointed. 6. Rudimentary legs just in front of the abdomen.

Johnston's species, on the contrary, shows: 1. Distinct divisions of the lateral areas. 2. Transparent spots on the fourth segment plates. 3. Thick and stout terminal claws on the second maxillipeds, furnished with large accessory claws. 4. The rami of all the legs two-jointed. 5. No rudimentary legs in front of the abdomen. Such differences are rather too numerous and important to allow any assumption of the identity of the two species. Johnston's description does agree with that of Guérin and Steenstrup and Lütken in every particular, and his species may therefore be taken as a synonym of Guérin's *E. coleoptratus*.

As to the location of Milne Edwards's original "*Pandarus alatus*," it is difficult to decide. In the structure of the mouth-tube, maxillæ, and second maxillipeds, in the three-jointed endopods of the second and third legs and in the presence of rudimentary legs just in front of the abdomen it conforms to the genus *Dinematura* rather than *Echthrogaleus*. But in the fusion of the second and third thorax segments, in the broad shape of the genital segment, in the absence of any dorsal plates for the sixth segment, and in the small size of the fourth legs it conforms to *Echthrogaleus* and is unlike *Dinematura*.

Hence it can not be located with certainty according to available data; Milne Edwards's statements seem to favor its inclusion under

the present genus. But if so, it is a distinct species and is not a synonym of any of the known species.

Milne Edwards claimed to have both sexes, but the specimen he has figured as a male (Pl. VIII, figs. 2 and 3) was certainly a female without egg-strings. He says nothing about its size. If it were not fully developed some of the discrepancies, and possibly all, might be explained, for no development stage of any species of this genus has ever been seen.

In view of these facts, we are warranted in omitting the species for the present and awaiting further evidence.

ECHTHROGALEUS BRACCATUS Dana.

Dinematura braccata DANA, 1852, p. 1370, pl. xcv, fig. 4.

Echthrogaleus (*Nogagus*) *braccatus* HELLER, 1865, p. 197, pl. xx, fig. 3.

Nogagus braccatus BASSETT-SMITH, 1899, pp. 460, 464.

Dana, who first described this species in 1852, referred it to the genus *Dinematura*, but Steenstrup and Lütken in 1861 created a new genus *Echthrogaleus* out of several of the *Dinematura* species, including this one of Dana. Heller in 1865 described a *Nogagus* form as the male of this species, and Thomson recorded in 1889 the capture of the species at Auckland, New Zealand. Finally Bassett-Smith in 1899 made the species a synonym of *Echthrogaleus affinis*. After a careful examination of the evidence the present author can not agree with Bassett-Smith. Dana plainly states as his reasons for distinguishing the species from *affinis* the difference in the shape of the lateral plates on the second thorax segment, the size and position of the anal laminae, the relative size of the carapace and genital segment, and the size and shape of the third thorax segment. In Dana's species also the posterior sinus of the genital segment is very deep and the rudimentary sixth segment plate is not visible, while in *affinis* the sinus is much shallower and the sixth segment plate is visible at its enlarged base.

These reasons are sufficient to separate the two species when supported by such authorities as Steenstrup and Lütken and Heller.

When we come to compare Dana's species with *coleopratus*, however, the evidence is not as conclusive; still there are enough differences to prevent us from declaring the two species synonymous on present evidence. These differences are found in the shape of each of the three pairs of dorsal plates on the thorax segments, in the fact that the third pair of plates have no transparent dots in Dana's species, while these are very prominent in *coleopratus*, and in the relative size of the carapace and genital segment. Dana's species was without egg-strings; and if it was a young female, not fully matured, some, if not all, of these differences could be readily explained. But Dana gives the length as half an inch, which is larger than an adult *coleopratus*.

In 1865 Heller described a male which he referred to this species, giving the following diagnosis:

Cephalothorax half the length of the animal, of about the same length and width, posterior lobes elongate, with a border around the inner margin.

Frontal plates wide, with a sinus at the center of the frontal margin. Second abdominal segment winged on either side, wings truncated posteriorly, with a thin border on the inner side.

All the abdominal feet biramose, rami of the first and fourth pairs two-jointed, exopod of the second and third pairs three-jointed, endopod two-jointed. Genital segment almost quadrate, with rounded angles. Tail one-half shorter than the genital segment, two-jointed, second joint the longer, appendages elongate. Length of body 7 mm.

This shows plainly that the copepod is a male of the genus *Echthrogaleus*, and as it was found, according to Heller, in company with females of Dana's species, and as its anatomy agrees with that species, there is no reason to doubt its identity.

We are thus warranted in leaving the species as Dana and Heller published it, awaiting further evidence.

ECHTHROGALEUS COLEOPTRATUS Guérin.

PLATE XIX.

Dinematura coleoptrata GUÉRIN, 1837, pl. xxxv, fig. 6.

Dinematura alata GUÉRIN, 1837, pl. xxxv, fig. 7.

Pandarus alatus (MILNE EDWARDS) JOHNSTON, 1835, p. 202, two text figures.

Echthrogaleus coleoptratus STEENSTRUP and LÜTKEN, 1861, p. 380, pl. viii, fig. 15.

Female.—Body elongate, length more than twice the width; carapace orbicular, as wide as long, including the posterior lobes; lateral and frontal margins strongly convex, posterior margin slightly convex; posterior lobes long and narrow and curved inward at the tips, not reaching the anterior margin of the dorsal plates on the fourth segment by quite a distance. Lateral areas very narrow, the transverse suture at about their center; the transverse suture of the median area far forward and not straight, but zigzag.

Second thorax segment distinctly separated from the third with lateral plates like the lateral lobes in the male extending outward and backward; but not concealed by the carapace.

Second dorsal plates median and rudimentary, relatively wider than in *denticulatus*; the broad apron of the third legs visible at the sides of these plates in the space between the posterior lobes of the carapace and the fourth segment. Third dorsal plates much enlarged, trapezoidal in shape and covering a little less than half the genital segment. They fit very snugly to the genital segment and project only their own thickness beyond the lateral margins of the latter. They just meet on the mid line without overlapping, and their entire margin is free from teeth or spines. Their chief characteristic, and one which will distinguish the present species from all others, is the

tracery of transparent dots or points which are scattered over their dorsal surface. These dots are circular in outline, sharply defined, of a light yellowish color, and transparent, thus showing prominently against the dark-brown background of the general surface. They are not arranged in any definite pattern, differing in different individuals, but they are approximately symmetrical in the two plates of any specimen.

Genital segment much larger than the carapace, elliptical or spindle shaped, tapering considerably toward either end; posterior sinus two-fifths of the entire length, narrow and slit-like, and enlarged but little at the base; posterior lobes closely appressed but not overlapping; sixth segment lobe small and entirely concealed between the genital segment and abdomen, but plainly visible on the ventral surface after removing the abdomen.

Abdomen transversely elliptical, one-half wider than long, with evenly curved margins. On either side of the anterior margin is a small rounded knob which projects forward beneath the genital segment. Anal laminae large, each one as long as the abdomen and half as wide, tipped with three rudimentary setae at the center of the terminal margin, two small spines near the outer corner and one near the inner one.

First antennae slender and not prominent; second pair stout with a long terminal claw which is strongly curved. First pair of adhesion pads ovate and small; second pair angular and still smaller; on each half of the apron of the third legs two of the pads are in close contact near the lateral margin, while the third one is removed some little distance from them toward the median line. Mouth tube relatively short and slender; second maxillae boot-shaped and relatively large, their bases far forward in front of the base of the mouth tube. First maxillipeds slender, terminal joint longer than the basal, both claws with a fringe of setae. Second maxillipeds with a strongly swollen basal joint and a stout terminal claw, which shuts down against two large corrugated knobs.

The spines on the rami of the swimming legs are short and stout with toothed margins, while the setae are all rudimentary, except those at the tip of the endopod of the second legs. The arrangement is as follows: First exopod 0, I; 4, III: endopod 0, 0; 5, III: second exopod 0, 0; 1, I; 7, III: endopod 0, I; 5, III: third exopod 1, I; 1, I; 5, II: endopod 1, 0; 3, II: fourth exopod 3, VII: endopod 0, IV.

In the fourth leg joints the rami are fused indistinguishably, but the spines are scattered along the margin in such a way as to indicate that the ramus is a fusion and not a single joint, a fact still further attested in the endopod by indentations on the margin. Of the genital organs the oviducts are coiled once in each half of the genital

segment, passing back to the end of the posterior lobe, then forward to the anterior margin, and then back to the vulva, which opens between the abdomen and the genital segment. The vaginal openings are on the ventral surface, close together, one on either side of the mid line just in front of the base of the abdomen. From these may often be seen protruding the ends of the ducts of discharged spermatophores. The cement glands are very large, as would be expected when we remember that the egg strings are several times the length of the body. They occupy a large share of the ventral surface of the genital segment in front of the abdomen; each is in the shape of a figure 7 inverted.

Total length, 13 mm.; length of carapace on mid-line, 4 mm.; length of fourth segment plates, 4 mm.; length of abdomen, 6.5 mm.; width of carapace, 5 mm.; width of fourth segment plates, 6 mm.

Color, a dull grayish yellow, uniform and lighter on the ventral surface, darker on the dorsal surface, with the center of the carapace between the lateral grooves and the entire surface of the fourth segment plates a dark chestnut brown. The internal coils of the oviduct also show through the dorsal surface of the abdomen as light brown in color.

(*coleopratus*, κολεός, sheath and πτερόν, wing, the dorsal plates of the fourth thorax segment resembling the elytra of beetles.)

This is the type species upon which Steenstrup and Lütken founded the present genus and was identified by them from Guérin's figures and description. They gave as one of its synonyms "*Pandarus alatus*," described by Johnston in 1835; the latter believed his species to be identical with the "*Pandarus alatus*" published two years earlier by Milne Edwards.

Steenstrup and Lütken doubted this identity of the two species, and careful examination confirms their doubt. (See p. 365.) Hence the specific name used by Johnston can not stand, although it was published two years prior to that of Guérin.

There are three lots of specimens belonging to this species in the U. S. National Museum collection, Cat. No. 6185, from the back fin of *Isurus dekayi* at Woods Hole, Cat. No. 8179, from Cornwall, England, in exchange with A. M. Norman, no host given, and Cat. No. 12056, from a shark captured near Unalaska, Alaska.

ECHTHROGALEUS DENTICULATUS Smith.

PLATE XX.

Echthrogaleus denticulatus SMITH, 1874, p. 576.—RATHBUN, 1884, p. 488.

Female.—Carapace orbicular, a little wider than long; lateral and anterior margins strongly convex, posterior margin nearly straight.

Dorsal surface divided by two longitudinal grooves into a very wide median and narrow lateral areas similar to those in *Pandarus* males.

Median area with a transverse groove a little in front of its center; the three eyes close together and arranged in the form of a triangle, two in front of this groove and one behind it. Transverse grooves dividing the lateral areas placed far back, only a little in front of the posterior margin of the carapace and curved forward. Frontal plates narrow and showing but little in dorsal view.

Free segments short and telescoped together so that the posterior lobes of the carapace touch or overlap the third pair of dorsal plates. First dorsal plates lateral and nearly concealed beneath the carapace and its posterior lobes; but they extend forward under the carapace and each bears an adhesion pad on its anterior margin as in *Pandarus*. Second dorsal plates median and rudimentary, like those just starting in young females of *Pandarus* and *Perissopus*. Third dorsal plates enormous, as wide as the carapace, and covering two-thirds of the genital segment. Each is armed at its anterior corner with a short but stout spine; the plates do not quite meet at the mid-line and are armed along their entire median and posterior borders with sharp spines, thickly set. Genital segment elliptical, one-third narrower than the carapace, with wide and conical posterior lobes. From the tips of these lobes extend the modified fifth legs in the form of narrow pointed processes whose bases reach forward on the ventral surface to the base of the abdomen. Although every species thus far examined shows these fifth legs on the ventral surface, the present species and *neozelanicus* are the only ones in which they extend beyond the tips of the posterior lobes so as to become visible in dorsal view. The rudimentary sixth segment lobe is about half the width and length of the posterior lobes of the genital segment, and is evenly rounded. It is on a level with the dorsal surface of the carapace and is entirely visible from above.

Abdomen wedge-shaped, relatively large, but placed so far forward on the ventral surface of the genital segment that only the anal laminae are visible from above. These laminae are twice as long as wide and are each tipped with two or three rudimentary setae, short and non-plumose.

First antennae of the usual pattern, terminal joint slender and club-shaped. Second antennae stout and placed far back of the anterior margin, opposite the base of the mouth-tube; terminal claw short, strong, and well curved. First adhesion pads obovate, of medium size, and close to the lateral margin; second pair very small and nearly circular; third pair elliptical and larger than the second; fourth pair on the outer margins of the first dorsal plates as in *Pandarus*, elliptical and the same size as the third pair. In addition to these four pairs there are also adhesion pads on the basal joints of the first and third pairs of swimming legs. One pair on the first legs close together on

either side of the median line, three pairs on the third legs circular in form and arranged in a triangle at some distance from the median line on either side. There is also a median unpaired pad on the anterior margin of these legs, transversely elliptical in form.

Mouth-tube long and slender; second maxillæ laminate, rather narrow, and tapering to a rounded point. First maxillipeds stout, the anterior terminal claw more than twice the length of the posterior, both claws fringed with hairs. Second maxillipeds not much swollen, the terminal claw semicylindrical, the flat side shutting down against a pair of spherical knobs on the basal joint. All the swimming legs biramose; rami of the first pair two-jointed; basal joint of the exopod as long as both joints of the endopod; terminal joint circular in outline, half as long as the basal; endopod joints the same length.

Exopods of second, third, and fourth legs three-jointed, endopods two-jointed, the joints thoroughly fused in the fourth pair.

Endopod joints subequal in the three pairs; basal exopod joint of the second pair longer than the two (equal) terminal joints; basal joint in the third pair a little longer than either of the others; the three joints in the fourth pair subequal.

Setæ and spines arranged as follows: First exopod, 0, 1; 4, III: endopod, 0, 0; 4, 0: second exopod, 1, I; 1, I; 4, III: endopod, 0, 0; 3, 0: third exopod, 1, I; 1, I; 6, II: endopod, 0, 0; 3, IV: fourth exopod, 0, I; 0, I; 0, I: endopod, 0, 0; 0, 0.

Total length, 9 mm.; length of carapace on mid-line, 3.25 mm.; width, 4.57 mm.; length of free segments, 1.5 mm.; length of third dorsal plates, 2.85 mm.; length of genital segment, 4.3 mm.; width of third plates, 4.5 mm.

Color of preserved specimens a yellowish brown, probably discolored by the alcohol.

(*denticulatus*, armed with minute teeth, referring to the margins of the third dorsal plates.)

The U. S. National Museum collection contains a single specimen, the original type described by Smith in 1874. It was taken from Atwood's shark, *Carcharodon carcharias* captured in Vineyard Sound, Woods Hole and is numbered 6169. Smith gave a brief description of the species without any figures, and it has remained unrecognized.

The full description and figures here given should establish its validity. It can be readily recognized by the spines or teeth on the third dorsal plates and by the projecting fifth legs.

ECHTHROGALEUS TORPEDINIS, new species.

PLATE XXI.

Type.—Cat. No. 11350, U.S.N.M.

Female.—Body short and wide; length to width as 5 to 3. Carapace orbicular, considerably wider than long, even including the pos-

terior lobes; lateral areas of medium width, the transverse grooves crossing them nearly at the center; posterior lobes long and narrow, their tips extending under the third dorsal plates for some distance; posterior margin concave. Frontal plates not well defined nor prominent; eyes small and situated about two-fifths of the distance from the frontal margin.

The fused second and third thorax segments rather short; first dorsal plates large and extending out beneath the posterior lobes nearly to the lateral margins of the carapace. These plates are semi-circular and end in blunt spines at their anterior corners. Second dorsal plates rudimentary and narrow, leaving a space on either side between their lateral margin and the posterior lobe of the carapace. Third dorsal plates enormous, covering the entire genital segment except the very tips of the posterior lobes; each plate is one-half longer than the carapace on the mid-line, and together they are considerably wider than either the carapace or the genital segment, projecting far beyond the lateral margins of the latter. Their outer margins are strongly curved, their posterior margins nearly squarely truncated, and there is a wider space between their inner margins than in most species. They are smooth and without any trace of spines. Genital segment broadly elliptical, a little wider than the carapace, but longer than wide, its posterior lobes wide and bluntly rounded, and turned in toward each other but not overlapping. Posterior sinus one-third the entire length, much enlarged at the base, and showing plainly there the dorsal surface of the sixth segment lobe. This latter is much longer than in *coleoptratus* or *denticulatus*, with parallel sides and an evenly rounded posterior margin, and it extends backward about half the length of the sinus.

Abdomen relatively as large as in *denticulatus*, but much wider posteriorly, being subquadrangular; anal laminae large and broad, each tipped with a few coarse spines. The base of the abdomen reaches forward to the center of the genital segment and is about one-third the width of the latter, while the ends of the anal laminae just reach the tips of the posterior lobes.

First antennae slender and small; second pair large and stout, with a long and strongly curved terminal claw; the basal joint carries a stout spine behind the adhesion pad.

First two pairs of adhesion pads small, those on the base of the second antennae reduced to mere points. Two small circular pads on the basal joint of the first legs; the three pairs on the apron of the third legs arranged as in *coleoptratus*, two side by side on each half of the leg and one at a little distance, nearer the mid-line. Mouth tube exceptionally long and slender; second maxillae also long and relatively larger and wider than in the other species here described. The terminal joints of these maxillae are boot-shaped, and are folded over

inward toward each other, so that they lie across the mouth tube like a pair of folded hands. Further back on either side, opposite the base of the first maxillipeds, is a flattened spine, larger than the maxilla and pointing backward.

Second maxillipeds with a stout but rather short terminal claw, and two large corrugated knobs on the basal joint against which the claw shuts. Swimming legs biramose and of the usual pattern, but with the plumose setae on the terminal joints better developed than in *coleoptratus*. The arrangement of the spines and setae is as follows: First exopod, 0, 1; 6, 0: endopod, 0, 0; 3, 0: second exopod, 1, I; 1, I; 5, II: endopod, 0, 0; 4, III: third exopod, 0, I; 1, I; 6, III: endopod, 0, 0; 4, 0: fourth exopod, 0, I; 0, I; 0, VII: endopod, 0, 0; 0, 0.

Outside of the base of the exopod of the fourth legs and inside of the base of the endopod of the third legs is a small papilla armed with a long and flexible spine, similar to those found in *Perissopus*. The fifth legs are larger than in *coleoptratus*, but not as large as in *denticulatus*, and their tips just reach the margins of the posterior lobes.

The oviduct is coiled once in the usual fashion, the vulvæ opening just beneath the base of the abdomen. The cement glands are large and are arranged like parentheses marks on either side of the mid-line; their posterior ends are enlarged and bent inward nearly at right angles. The semen receptacle is just in front of the base of the abdomen, with the vaginae opening side by side at the mid-line. The spermatophores are fastened on either side of the genital segment, outside and in front of the vulva, and the duct from each crosses the mid-line and empties into the vagina on the opposite side of the body.

Total length, 13 mm.; length of carapace on mid-line, 4 mm.; width of same, 6.5 mm.; length of free segments, 2 mm.; length of third dorsal plates, 5.65 mm.; width of same, 8 mm.; length of genital segment, 7.38 mm.; width of same, 7 mm.; length of abdomen, without anal laminae, 2.5 mm.; length of egg-strings, 40 mm. Color a dark cinnamon brown, uniform over the entire body.

(*torpedinis*, the name of the host.)

The U. S. National Museum collection includes two lots, both obtained from the *Torpedo*, common along our Atlantic coast, *Torpedo occidentalis*. The first is Cat. No. 6187, U.S.N.M., and includes two females taken from one of the pectoral fins of a *Torpedo* captured at Woods Hole in 1875. The other lot is Cat. No. 11350, U.S.N.M., and includes seven females taken from the ventral fins of a *Torpedo* captured at Provincetown, Massachusetts, October 20, 1885.

Genus DINEMATURA Latreille.

Caligus (*C. productus*) MÜLLER, 1785, p. 132.

Dinemoura (*D. producta*) LATREILLE, 1829, p. 197.

Pandarus (*P. lamnæ*) JOHNSTON, 1835, p. 203.

Dinematura (*D. producta*) BURMEISTER, 1833, p. 284.

Female.—General body form elongate, the length more than twice the width. Carapace transversely elliptical, its lateral margins strongly arched, with narrow frontal plates and long well rounded posterior lobes; grooving similar to that in the *Caliginæ*; eyes invisible in the adult. Second thorax segment with large lateral wings; third segment narrow, with rudimentary dorsal plates, or entirely without them; fourth segment with plates of medium size, separated by a deep median fissure, and covering the anterior portion of the genital segment; fifth or genital segment oblong, with broad and well-rounded posterior lobes; *sixth segment distinct, separated from the genital segment, furnished with a pair of dorsal plates, and carrying ventrally a pair of rudimentary swimming legs*. Abdomen small, one-jointed, projecting but little behind the genital segment, with large anal laminae, carrying non-plumose setæ.

Two adhesion pads instead of one behind each first antenna, the posterior one the larger. Mouth-tube long and very slender; second maxillæ slender, three-jointed; first maxillipeds with a tuft of setæ, or a small setiferous third claw, between the usual two at its tip; second maxillipeds with a stout terminal claw which shuts down between two knobs on the basal joint.

All the swimming legs biramose; rami of first pair two-jointed, of second and third pairs three-jointed, of fourth pair enlarged, laminate, and one-jointed. First three pairs with plumose setæ, fourth pair without setæ or even spines. Egg-strings straight and several times the length of the body.

Male.—Carapace like that of the female but considerably wider than long; eyes visible and situated far forward. Lateral wings on second thorax segment small; third segment without any traces of dorsal plates; fourth segment with a rudimentary pair overlapping the genital segment a little. Genital segment oblong wedge shaped, widest posteriorly; sixth segment not distinctly separated as in the female, but indicated by an abrupt narrowing of the genital segment, and by notches in its lateral margins. Abdomen very narrow, two-jointed, the joints equal; anal laminae large and armed with long and stout plumose setæ. Appendages like those of the female; first maxillipeds with a tuft of hairs between the two terminal claws, corresponding to the middle claw in the female. All the swimming legs biramose; rami of first and fourth pairs two-jointed, of second and third pairs three-jointed; first three pairs with long plumose setæ, fourth pair with spines only.

(*Dinematura*, $\delta\iota\varsigma$, two, $\rho\acute{\eta}\mu\alpha$, thread, and $\delta\acute{\upsilon}\rho\alpha$, tail, that is a tail made up of two threads, the egg-strings.)

KEY TO THE SPECIES.

- a. Females, carapace only one-third the entire length and not much wider than the genital segment; rami of the fourth legs and anal laminae long and prominent; egg-strings four or five times the length of the body. b.
- a. Females, carapace half the entire length or more and much wider than the genital segment; rami of fourth legs and anal laminae short and partly concealed; egg-strings only twice the length of the body or less c.
- a. Males, carapace several times the size of the genital segment; dorsal plates reduced to mere stumps or entirely lacking; rami of fourth legs two-jointed and well armed with spines d.
- b. Lobe of sixth segment not projecting beyond the posterior lobes of the genital segment; sixth legs reduced to mere papillae; length 30 mm. or more... *ferox* Kröyer, 1863, p. 377.
- b. Lobe of sixth segment projecting half its length behind the posterior lobes of the genital segment; sixth legs as well developed as the fourth; length 18 to 20 mm *producta* Müller, 1785, p. 380.
- c. Carapace half the entire length or less, not quite twice the width of the genital segment; anal laminae broadly foliaceous. *latifolia* Steenstrup and Lütken, 1861, p. 383.
- c. Carapace two-thirds the entire length and four times as wide as the genital segment; anal laminae narrow oblong *hamiltoni* Thomson, 1889.
- d. Fourth thorax segment three times as long as wide; abdomen nearly square, one-jointed; anal laminae narrow-oblong *hamiltoni* Thomson, 1889.
- d. Fourth thorax segment considerably wider than long; abdomen oblong and two-jointed; anal laminae as broad as long. *latifolia* Steenstrup and Lütken, 1861, p. 383.

This genus was established by Latreille in 1829 for the species which Müller had described as *Caligus productus* in 1785. Latreille called his new genus *Dinemoura*, and fortunately gave the etymology of the new word, as so many of his associates have failed to do (see above). Acting upon this, Burmeister in 1833 changed the spelling of the name to *Dinematura* which certainly corresponds more correctly to the etymology and was at once adopted universally.

There was a great amount of confusion in the early descriptions, both in regard to the species and to their hosts, even among such careful investigators as Gerstaecker and Steenstrup and Lütken. As late as 1889 Thomson described four species which he referred to this genus; three of them really belong here, but the fourth is as unmistakably an *Echthrogaleus* species.

The simplest way to rectify this and other similar mistakes is to present a list of the 18 species which have been ascribed to this genus by the various investigators, with a proper identification for each, so far as this has been rendered possible:

Dinemoura affinis Milne Edwards, 1840, shown by Steenstrup and Lütken to belong to their new genus *Echthrogaleus*, and accordingly becomes *Echthrogaleus affinis*.

Dinemoura alata Milne Edwards, 1840, also shown by Steenstrup and Lütken to be a probable species of the genus *Echthrogaleus*.

- Dinematura braccata* Dana, 1852, shown on page 366 of the present paper to be still another species of *Echthrogaleus*.
- Dinematura carcharodonti* Thomson, 1889, one of the four species to which reference is made above, a genuine *Dinematura*, but apparently a synonym of *D. ferox* as suggested by Bassett-Smith.
- Dinemoura colcoptrata* Guérin, 1837, taken by Steenstrup and Lütken in 1861 as the type species of their new genus *Echthrogaleus*.
- Dinemoura elongata* Van Beneden, 1857, shown by Steenstrup and Lütken to be a synonym of *D. producta* (see also p. 382).
- Dinemoura ferox* Kröyer, 1838, valid (see p. 377).
- Dinematura hamiltoni* Thomson, 1889, valid (see p. 375).
- Dinematura gracilis* Burmeister, 1833, shown on page 452 of the present paper to be probably a young male of *Dinematura producta*.
- Dinematura indistincta* Kröyer, 1863, probably belongs to the genus *Echthrogaleus*, as suggested by Bassett-Smith, but only a brief description without figures has ever been published.
- Dinematura lamnæ* Kröyer, 1863, first described by Johnston in 1835 as *Panadarus lamnæ*, but really a synonym for *Dinematura producta*, as shown by Steenstrup and Lütken in 1861.
- Dinematura latifolia* Steenstrup and Lütken, 1861, valid (see p. 383).
- Dinemura musteli-lævis* Hesse, 1880, shown on page 386 of the present paper to be probably a *Demoleus* species.
- Dinematura neozcalanica* Thomson, 1889, another of the four species to which reference is made above, and one which certainly belongs to the genus *Echthrogaleus*, as suggested by Bassett-Smith.
- Dinemoura producta* Latreille, 1829, the species first described by Müller as *Caligus productus* in 1785, and taken by Latreille as the type species of his new genus *Dinemoura* (see p. 381).
- Dinematura serrata* Kröyer, 1863, shown by Horst in 1897 to be a new genus and named by him *Philorthragoriscus* (see p. 479).
- Dinematura sexsetacea* Burmeister, 1833, established to include the two species described by Otto, *Caligus heptapus* in 1821 and *Caligus paradoxus* in 1828. But the latter was used by Heller as the type of his new genus *Demoleus* in 1865, and hence Burmeister's species becomes a synonym of that genus.
- Dinematura thynni* Kollar, a name given by Kollar on the labels of certain specimens in the Vienna Museum. These specimens were made the types of a new genus, called *Arneus thynni* by Kröyer in 1863. They have since been identified with Gerstaecker's *Elytrophora brachyptera*, which was described in 1853.

We thus see that out of the eighteen species which have been ascribed to this genus only four prove valid, and they have been included in the key given above. Of the other fourteen, seven belong to the two new genera established by Steenstrup and Lütken and Horst, while the remaining seven are synonyms of other species.

The confusion in this genus has apparently arisen from a singular inability on the part of the different investigators to appreciate the significance of the structures found just behind the genital segment. It is easy to understand how Müller, Latreille, and Burmeister failed in this regard; they were pioneers in the work and accomplished wonders in the face of the greatest difficulties. Moreover, we must never forget that they dealt almost wholly with isolated material, and were thus deprived of those suggestions and explanations which

come from a broad survey and comparison of all the known genera and species.

But even with these advantages the recent writers have still failed to recognize the structures behind the genital segment as a sixth thorax segment with its dorsal plates and rudimentary swimming legs. These structures are plainly marked here in *Dinematura*, but are rudimentary or even lacking in the other genera. They are, of course, morphologically the same in all the genera, however rudimentary they may be, but have been very differently regarded by different investigators.

For instance, the dorsal process has been considered a process of the genital segment in the present genus, as the first segment of the abdomen in *Pandarus* and *Gangliopus*, as a foliaceous dorsal lamina of the abdomen in *Demoleus*, while it has been wholly overlooked in *Laminifera* and *Echthrogaleus*, in both of which, however, it exists and can be easily found.

One of the most recent investigators, Bassett-Smith, in his Enumeration of the Known Species of Parasitic Copepods (1899), describes this sixth segment as "a small median process (of the genital segment) partially covered by two narrow plates" (p. 463), while he regards the rudimentary swimming legs upon its ventral surface as lateral processes of the abdomen. But as soon as we realize that this is really a sixth segment we have recognized the most important characteristic of the genus *Dinematura* and one which will certainly distinguish it from all its relatives. This has been indicated in the diagnosis given above by the use of italics.

DINEMATURA FEROX Kröyer.

PLATE XXII.

Dinematura ferox KRÖYER, 1838, p. 40, pl. I, fig. 5.—MILNE EDWARDS, 1840, p. 465.—STEENSTRUP and LÜTKEN, 1861, pp. 376, 379, pl. VII, fig. 14.

Dinematura carcharodonti THOMSON, 1889, p. 360, pl. XXVI, fig. 2.

Female.—Body three times as long as wide, both the carapace and genital segment thick and strongly arched. Carapace, including the posterior lobes, nearly orbicular; lateral areas narrow, their transverse suture just in front of the posterior margin of the carapace, and forming a well-defined notch on each lateral margin; posterior lobes long, conical, and curved inward at their tips. Frontal plates very narrow and insignificant; median incision scarcely visible; eyes small and about one-third the distance from the anterior margin. The three free thorax segments about the same length, but diminishing regularly in width backward. Lateral plates on the second segment reaching back to and overlapping the plates on the fourth segment. No dorsal plates on the third segment; those on the fourth segment short and narrow, the same width as the genital segment and

two-fifths as long, the median sinus two-thirds the entire length, narrow and enlarged a little at the base.

Each plate is rounded in the form of a semicircle at its posterior end and at the anterior corner, the latter projecting prominently. Genital segment five-sevenths the width of the carapace, a little less than twice as long as wide, with parallel sides and wide, evenly rounded, but very short posterior lobes. The dorsal plates on this segment are a little narrower and shorter than the segment itself, their posterior ends cut off obliquely and separated by a short sinus.

Dorsal process of the sixth segment filling little more than half the entire space between the posterior lobes of the genital segment, but not reaching quite to their tips. Dorsal plates of this segment shorter and wider than the process, the median sinus less than one-third their length and enlarged a little at its base. Abdomen one-jointed, subtriangular, the anterior corners rounded, the posterior margin projecting slightly beyond the genital segment. Anal laminae huge, as long and two-thirds as wide as the dorsal plates on the fourth segment, and armed with short, nonplumose spines. Egg strings narrow and about four times the length of the body; eggs small and very numerous.

First antennae small, two-jointed, armed with but few setae, both joints visible in dorsal view. Mouth tube very long and narrow; maxillae curved in toward the base of the mouth tube and then out again, so as to assume the shape of a half moon. Each maxilla three-jointed, the two basal joints subequal, the terminal joint much shorter. First maxillipeds rather large, the two joints approximately the same length; the accessory claw on the posterior margin of the distal joint is removed some distance from the terminal claw. Both claws are flat and laminate and fringed along both margins with cilia; between them and nearer to the base of the terminal one is a rounded knob carrying a heavy tuft of setae.

Second maxillipeds not swollen as much as in some of the other species, and armed with an ordinary terminal claw which shuts down against two corrugated knobs on the basal joint.

All the swimming legs biramous and of the usual pattern; the proximal joint of the exopod of the first pair is enlarged more than in any other species, being more than five times the size of the distal joint. The arrangement of the spines and setae on the different legs is as follows: First exopod, 1, 0; 3, III: endopod, 0, 0; 0, III: second exopod, 1, I; 1, I; 3, IV: endopod, 1, I; 0, II; 0, VII: third exopod, 1, I; 1, I; 3, IV: endopod, 0, I; 0, II; 0, IV: fourth rami without spines or setae.

The legs on the sixth segment are reduced to mere stumps, attached to either side of the segment and projecting outward at right angles to the body axis. They are bluntly rounded at the tips which just

reach a level with the lateral margins of the abdomen. Of the reproductive organs, the cement glands are large and of the usual shape; they reach from the base of the sixth segment nearly to the anterior margin of the genital segment; the anterior ends are bluntly rounded, while the posterior ones are enlarged and somewhat angular. The semen receptacle is in the form of a semicircle, its ends enlarged and resting against the base of the sixth segment, while the curve is directed forward. The oviducts are each coiled once in the genital segment, the coil passing backward into the posterior lobe, then forward to the anterior margin, and then backward to the vulva which opens just in front of the base of the sixth segment on either side.

Total length, 32 mm.; length of carapace on mid-line, 7 mm.; width of same, 10 mm.; length of third dorsal plates, 6 mm.; length of genital segment, 13 mm.; width of same, 7 mm.; length of anal laminae, 5 mm.; length of egg strings, 120 mm.

Color (preserved material) a dark yellow tinged with brown, but without pigment markings.

(*ferox*, ferocious.)

Steenstrup and Lütken state that if it can be fairly proved that the present species and *Nogagus grandis* live in the same region, then it will be reasonably certain that they are the male and female of the same species (1861, p. 387).

After careful examination this does not seem probable for the following reasons: First, *Nogagus grandis* is not like the *Dinematura* males already determined in that its second and third legs are two-jointed instead of three-jointed, and its second maxillipeds are of the ordinary form instead of swollen.

In the second place, it is like the male form named *Caligus paradoxus* by Otto in 1828, and corresponds, in the structure of its appendages, with the female form presented at the same time and afterwards (1865) used by Heller as the type of his new genus *Demoleus*. For these reasons *Nogagus grandis* has been placed with the genus *Demoleus* (see p. 349).

The collection of the U. S. National Museum includes two lots of this species; one numbered 12036 and containing more than thirty females excellently preserved was obtained from the shark fishermen of Iceland; the other, Cat. No. 32783, contains six well-preserved females whose origin and host are unknown.

DINEMATURA PRODUCTA Müller.

PLATE XXIII.

Caligus productus MÜLLER, 1785, p. 132, pl. XXI, figs. 3 and 4.

Dinemoura producta LATREILLE, 1829, p. 197.

Pandarus lamnæ JOHNSTON, 1835, p. 203, fig. 22 (text).

Dinemoura lamæ BAIRD, 1850, p. 286, pl. XXXIII, fig. 8.

Nogagus productus, GERSTAECKER, 1853, p. 63, pl. IV, figs. 1 to 10.

Dinematura elongata VAN BENEDEN, 1857, p. 226; 1860, p. 149, pl. XXIV.

Dinematura producta STEENSTRUP and LÜTKEN, 1861, pp. 371, 374, pl. VII, fig. 13.

Female.—Carapace orbicular, a little wider than long; frontal plates wider and more prominent than in *ferox*, their anterior margin nearly straight, with a deep and well-defined central sinus.

Lateral areas wide, their transverse grooves far in front of the posterior margin of the carapace and making only small indentations on the lateral margins; posterior lobes short and wide, and curved inward strongly at the tips. Eyes not visible in any of the specimens examined. Free thorax segments very short but wide, filling the entire space between the posterior lobes of the carapace. Lateral plates on the second segment short and oblique; no plates on the third segment; those on the fourth segment narrow and nearly as long as the carapace on the mid-line, being more than twice as long as wide. Together, these plates are no wider than the genital segment, and are evenly rounded at their anterior corners, not projecting as in *ferox*; the posterior ends are also evenly rounded, while the median sinus extends about three-fourths the entire length and is somewhat enlarged at its base.

Genital segment oblong, a little more than half the width of the carapace, with short and rather narrow posterior lobes; dorsal plates covering this segment a little narrower and shorter than the segment itself, as in *ferox*. Their posterior ends are cut off obliquely but in a direction opposite to that of *ferox*, leaving a sharp corner at the inner, instead of the outer, angle; median sinus wide, fairly deep, and wedge-shaped, with a squarely cut base. Dorsal process of the sixth segment narrow and elongate, reaching far behind the genital segment and abdomen; dorsal plates covering the process also narrow and elongate, not quite as long as the process itself, divergent, and separated by a triangular sinus two-thirds of their entire length.

The base of this sinus is opposite the tips of the dorsal plates on the genital segment. Body of the sixth segment short and about the same width as the abdomen; sixth legs large and somewhat boot-shaped, with the heels turned outward. They reach back to the tip of the dorsal process, are armed with rudimentary spines like the fourth legs, and are plainly visible in dorsal view. Abdomen small and subquadrangular, projecting behind the genital segment, but entirely concealed in dorsal view by the process, legs, and dorsal

plates of the sixth segment. Anal laminae large and elliptical, articulated by their outer corners only to the outer corners of the abdomen; each armed with three terminal spines, and one on the outer margin. Egg-strings narrow and about twice the length of the body.

First antennae of medium size, their basal joints entirely concealed beneath the frontal plates; second pair enlarged with a short, sickle-shaped terminal claw. Mouth-tube as long as in *ferox* and a little wider; maxillae large and three-jointed, the basal joint much the largest and carrying on its outer margin two small processes, in contact with each other, and each tipped with a small spine. These are evidently the rudiments of the exopod; the endopod is made up of two cylindrical joints, the terminal one considerably the smaller.

First maxillipeds similar to those in *ferox*; second pair with the basal joint more swollen and armed with larger corrugated knobs; the terminal claw rather slender but of the usual pattern. Swimming legs similar to those in *ferox*, the basal joint of the first exopod not enlarged as much and more pointed.

The spines and setae are arranged as follows: First exopod, 1, 0; 3, III: endopod, 0, 0; 0, III: second exopod, 1, 0; 1, 0; 2, V: endopod, 0, 1; 0, 1; 0, VI: third exopod, 1, I; 1, I; 3, VI: endopod, 0, 0; 0, II; 0, VI. Fourth rami each with four rudimentary spines near their tips.

Total length, 17 mm.; length of carapace on mid-line, 5 mm.; width of same, 7 mm.; length of second and third thorax segments, 1 mm.; of genital segment, 8 mm.; of dorsal process of sixth segment, 3.5 mm.; of egg-strings, 40 mm.; width of genital segment, 4 mm. Color of preserved material a light brown without pigment spots.

(*producta*, elongated, drawn out.)

The present is the species described by Müller in 1785 as *Caligus productus*, and afterwards taken by Latreille as the type of the new genus *Dinemoura* which he established in 1829.

Neither Müller's nor Latreille's description was very satisfactory, but fortunately the specimens upon which these descriptions were founded were preserved in the museum in Copenhagen, and Steenstrup and Lütken were enabled to recognize Müller's species and to correct some of the errors in regard to it and to its hosts. Accordingly they have given us a history of this species up to 1861, which clears up many of the difficult puzzles and mistakes in identity and nomenclature. They declare in substance that the present species was described and figured first by Herbst in an article entitled "Beschreibung einer sehr sonderbaren Seelaus vom Hemorfische," published in *Schriften der Berlinischen Gesellschaft naturforschenden Freunde* for 1780, pp. 56 to 67. Herbst obtained his specimens from Pastor Chemnitz, of Copenhagen, who in turn had them from the Faroe Islands with the information that they had been fastened to

the tail of a "Hemorrhische," which was in all probability *Lamna cornubica*.

The Zoological Museum of the university at Copenhagen possesses several specimens of this species from the Faroe Islands which were taken from *Lamna cornubica*. The Physiological Museum of the same university possesses another particularly fine lot of females of *D. producta* fastened tightly to a piece of shark's skin. This piece of skin looks as if it came from *Scymnus glacialis*, and it has been so recorded by one or two investigators, but the scales on it show that it really belonged to a *Lamna cornubica*. Such a shark was captured and kept on exhibition for some time, and then purchased by the University Museum. It bore numerous marks of fish lice and the specimens fastened to it while on exhibition were all *D. producta*.

Müller was the next to describe the species in 1785; he does not state whence he obtained his specimens, but Steenstrup and Lütken think it probable that they came from the same Faroe Island collection. Müller's figures and description are less satisfactory than Herbst's, and he makes the serious blunder of including Fabricius's *Binoculus salmoneus*, which belongs to the genus *Lepeophtheirus*, with his "*Caligus productus*."

In 1829 Latreille, recognizing that this was not a *Caligus*, made of it a new genus which he called *Dinemoura*. He was content, however, to accept the descriptions already given and added almost nothing in the way of further information. Consequently his contribution consisted of little more than a change of name.

In 1835 Johnston described a British species which he called *Pandarus lamnæ*, and which was taken from a Beaumaris shark, *Lamna monensis*. Baird incorporated this in his Natural History of the British Entomostraca in 1850 under the name of *Dinemoura lamnæ*. He recognized that it was the same that Herbst had described, but singularly enough did not identify it with Müller's *Caligus productus*; the name he gave it therefore becomes another synonym of that given by Latreille.

P. J. Van Beneden in 1857 described and figured this species under the name *Dinemoura elongata*, still another synonym.

It might have been difficult to decide whether Beneden really had a new species or not, but Steenstrup and Lütken found that his specimens came from Copenhagen and that they were taken from the same piece of shark's skin already mentioned.

Their host, therefore, was *Lamna cornubica* and not *Scymnus glacialis*, as Beneden states, and the species is identical with those described before. Thirty-five years later, in 1892, Beneden presented what he claimed was the male of his *D. elongata*, still retaining his former name for it, although he acknowledges in so many

words that both Steenstrup and Lütken and Olsson had shown that it was a synonym of *D. producta*.

This male is figured very poorly; no frontal plates are shown; there are no dorsal grooves or markings of any kind upon the carapace, and the second and third thorax segments are hopelessly confused. But the general outline, the relative proportion of the various parts, and such of the details as can be made out correspond closely with those of the male of *latifolia* here for the first time shown (see p. 386). The rami of the second legs are three-jointed, as they should be, but he describes the basal joints of the third legs as fused across the mid-line into a broad apron wholly covering the fourth pair. The rami of these third legs are attached to the sides of the apron and appear to have only two joints in the figure given; nothing is said of the number of joints in the text.

In the *latifolia* male the basal joints of these legs are greatly enlarged and nearly meet on the mid-line, but the rami are attached to the posterior margins and are distinctly three-jointed. The first maxillipeds also in Beneden's specimen show no tuft of setæ between the two terminal claws, while the first swimming legs as he has represented them are unlike anything known amongst the parasitic copepods. They are cylindrical, uniramous, and one-jointed, with three plumose setæ attached to the anterior margin near the end and curved over the ventral surface; the end of one is split and armed with small spines; the other is entire and bluntly rounded. In the text these appendages are said to be the same as those of the female.

In the presence of such inconsistencies it is of course impossible to locate the species with accuracy, but the resemblance between this male and the one of *latifolia* about to be described seem to overbalance the differences, and the form Beneden has presented may be a *Dinematura* male as he claims.

The Museum collection contains three lots of this species; one, Cat. No. 12678 U.S.N.M., contains two females obtained from a large shark in Casco Bay, Maine. The second is Cat. No. 12679 U.S.N.M. and contains six females taken from a large shark captured at the surface in latitude 38° 07' N. and longitude 74° 21' W. on May 10, 1887, by the Bureau of Fisheries schooner *Grampus*. The third is Cat. No. 8106 U.S.N.M. and consists of a single female taken from a shark near Shetland; it was obtained by exchange.

DINEMATURA LATIFOLIA Steenstrup and Lütken.

PLATES XXIV AND XXV.

Dinematura latifolia STEENSTRUP and LÜTKEN, 1861, p. 378, pl. VIII, fig. 16.—

BRIAN, 1898, p. 14, pl. II, fig. 10. — BASSETT-SMITH, 1899, p. 463.

Female.—Carapace transversely elliptical, the width twice the length on the median line: frontal plates narrow but distinct, their

combined length not more than one-third the width of the carapace. Posterior margin almost straight and with a triangular flap on either side projecting backward over the lateral plates of the second thorax joint. Lateral areas wider than in *ferox* and *producta* and without any visible transverse grooves; posterior lobes wide, broadly rounded, and extending backward toward and somewhat overlapping the dorsal plates of the fourth segment. Thoracic area almost rectangular, more than half the entire width of the carapace and about half the length on the mid-line; cephalic area small and elliptical.

Second thorax joint much shorter than the third, but wider, and furnished with a pair of good-sized lateral plates, which fill the entire space between the posterior lobes of the carapace. Third joint wedge-shaped and without dorsal plates; fourth joint with a pair of large ones which extend out laterally nearly to the margin of the carapace and posteriorly over the basal third of the genital segment. These two plates are fused anteriorly, the narrow median sinus not reaching quite to their base; each is somewhat triangular in shape, the anterior, lateral, and inner margins being convex, while the posterior margin is slightly concave. Each plate has the same width and length, thus differing radically from those of the other two species already described. The fourth segment is much narrower than the third, and the base of the dorsal plates is contracted to about half the width of the third segment.

Genital segment elongate, nearly twice the length of the carapace on the midline, with wide and evenly rounded lobes at its posterior corners. Its dorsal plates are considerably narrower and shorter than the segment itself; their posterior ends are broadly rounded and separated by a triangular sinus whose sides are much more divergent than in *ferox* or *producta*.

Dorsal process of the sixth segment club-shaped or spatulate, and prolonged backward over the abdomen and the base of the anal laminae. Its two small dorsal plates are separated by a narrow median sinus; they do not reach the tip of the process and do not extend beyond its lateral margins, except at the base. Abdomen broad, heart or kidney shaped, about twice as wide as long, and entirely concealed in dorsal view. Its lateral margins are somewhat flattened, while to its postero-lateral margins are attached the huge anal laminae, each fully as large as the whole abdomen and tipped with four long plumose setae. Egg strings slender and about twice as long as the body of the copepod.

On the ventral surface of the carapace there are four adhesion pads on either side of the body and a single median one just behind the bases of the first swimming legs. These are similar to the pads found in *Pandarus*, and characterize the present genus as one of the *Pandarinæ*. The first two pairs of these pads lie posterior to the bases of

the first antennæ and outside the second antennæ. They are arranged on either side one behind the other, the posterior one being three or four times as large as the anterior and both being elliptical in shape. The third pair are nearly circular and lie on either side of the mouth tube at about its center; the fourth or posterior pair are formed on the edges of the lateral plates of the second thorax segment. They are elongated, irregular in outline, and inclined toward the central axis.

Of the appendages the first antennæ are very small and two-jointed, the joints not very well supplied with setæ; the second antennæ are large, three-jointed, and terminate in the usual claw, which has a double curve like the letter S. The mouth tube is very slender and pointed, and is fully twice the length of the second maxillæ. The latter consist of a thick conical basal joint terminating in a spherical knob, from which extend the two slender, cylindrical terminal joints, which are inclined outward at an angle of about 45°. The mandibles are slender, the two joints about the same length, and they end in a terminal claw strongly curved toward its tip and fully as long as the joints. On the outer margin of the terminal joint, near the base of this claw, is a shorter accessory claw, and between the two claws the usual tuft of long cilia; both these claws are also densely covered with short hairs.

The second maxillipeds are massive and nodose, exactly like those in *Pandarus*, and different from what we have seen in *ferox* and *producta*. The swimming legs are all biramose, the rami of the first pair two-jointed, of the second and third pairs three-jointed, of the fourth pair two-lobed and foliaceous.

There is a row of three large adhesion pads along the inner margin of each of the first legs, two of the pads being on the basal joint and the other on the first joint of the endopod.

The arrangement of the spines and setæ on the swimming legs is as follows: First exopod, 1, 0; 2, III: endopod, 0, 0; 0, III: second exopod, 1, I; 1, I; 3, V: endopod, 0, I; 0, II; 0, VI: third exopod, 1, I; 1, I; 4, III: endopod, 0, 0; 1, II; 0, IV. Both rami of the fourth legs have smooth edges without spines or setæ.

The sixth legs are well developed and are situated close to the mid-line just in front of the base of the abdomen, on the ventral surface of the genital segment. Each consists of a two-lobed foliaceous lamina, similar to those of the fourth legs, but considerably smaller.

Total length, 15 mm.; length of carapace on mid-line, 4 mm.; width of same, 7.9 mm.; length of genital segment, 7 mm.; width of same, 4.65 mm.; length of egg-strings, 30 mm.

Color a yellowish green, considerably darker in the thicker parts of the body, the dorsal plates and thin margins a clear yellow.

(*latifolia*, *latus*, wide, and *folia*, plates or wings.)

Male.—Carapace proportionally much enlarged and very evenly rounded, the width one and three-quarters times the length on the mid-line. All the thorax joints except the first free as in the female, and diminishing in size backward.

Dorsal plates on the fourth joint much smaller than in the female, scarcely overlapping the base of the genital segment, and bordered with fine hairs. Genital segment oblong, suddenly and considerably enlarged just back of the center, and then contracted abruptly to the base of the abdomen, with a deeply concave posterior margin. At its widest point it is only one-third the width of the carapace, and is about one-fourth longer than wide. Abdomen two-jointed, the terminal joint a little larger than the basal and wedge-shaped, the large anal laminae being attached to the inclined posterior margins. Each of them is fully as large as the joint itself, and carries three large and one small plumose setae.

The appendages are exactly like those in the female, with the exception of the fourth legs; here the rami have not been transformed into laminae, but are each two-jointed and armed with short plumose setae and spines, like the other legs.

Total length, 8.3 mm.; length of carapace on mid-line, 3 mm.; width of same, 5.2 mm.; length of genital segment, 2 mm.; width of same, 1.65 mm.; length of abdomen, 1.7 mm.

Color as in the female.

This species appears fairly common upon the large sharks along our Atlantic coast, and the U. S. National Museum collection includes five lots, all from the mackerel shark, *Lamna cornubica*. Cat. No. 32782 U.S.N.M., six females from a station 120 miles off Woods Hole; Cat. No. 32784, U.S.N.M., three males taken with the females of the preceding lot; Cat. No. 12676, U.S.N.M., six females, locality unknown; Cat. No. 12677, U. S. N. M., six females from Cox's Ledge, Massachusetts; Cat. No. 8107, U. S. N. M., a single female taken on the coast of England.

DINEMATURA MUSTELI-LÆVIS Hesse.

Dinemoura musteli-lævis HESSE, 1880, p. 5, pl. I, figs. 1 to 16.

The description of both sexes as given by Hesse, and the figures, make this an anomalous and entirely original form, unlike anything found in the entire group of parasitic copepods.

It is stated in the text that the female is 15 mm. long and 8 wide; both full-length figures of the female are a little more than three times as long as wide. The text further states that this sex has three free thorax segments in front of the genital segment, the third one bearing a pair of dorsal plates. The first antennae are four-jointed, the second pair six-jointed; the maxillae are also six-jointed and end in a long curved claw. The swimming legs are all biramose, but each ramus

contains only a single joint; the abdomen is entirely concealed beneath the genital segment, and there is not even a trace of any sixth segment. The egg-tubes come out of the posterior lobes of the genital segment, behind the tips of the anal laminae.

The male is even more wonderfully made; he possesses five free thorax segments in front of the genital segment, but there are only two pairs of swimming legs for the entire five segments.

The first antennae are three-jointed, the second pair four-jointed; the maxillae are five-jointed and terminate in a stout claw. The mouth-tube is jointed twice, and the three parts are of different diameters; the eyes are triangular. The swimming legs are all biramose and the rami are one-jointed, as in the female, while each anal lamina is furnished with a large sucker on its base, close to the anus.

Of course such a description takes away all possibility of locating the species accurately; the only thing we can affirm with certainty is that the species does not belong to the genus *Dinematura*, where Hesse has placed it. The size and shape of the female's body, especially when seen in dorsal view, suggests strongly the genus *Demo-leus*. But the male is a perfect enigma, in view of which we are obliged to leave the species unlocated and await further information.

Genus PANDARUS Leach.

Pandarus (*P. bicolor*) LEACH, 1816, p. 405.

Female.—Body an elongated oval or ellipse; cephalothorax semielliptical, usually narrowed anteriorly, and covered with a smooth carapace destitute of grooves; posterior lobes short, the margin between them armed with teeth or spines, or sometimes sinuate (fig. 15.) Eyes usually invisible in the adult, but visible in the young. Free thorax segments each furnished with a pair of dorsal plates, which are stiff and rigid, elytra-form; those on the second segment are lateral, the others median, the third pair overlapping to a greater or less extent the genital segment. This latter is considerably enlarged, elliptical, or sometimes narrowed posteriorly and prolonged backward into lobes at the posterior corners. The dorsal surface of this segment is hardened like the carapace, and in most species gives evidence of being a fusion of two plates, like those

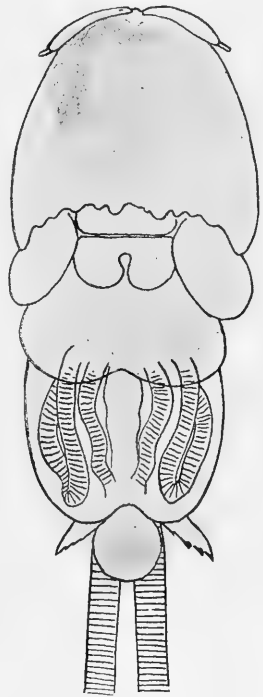


FIG. 15.—DORSAL VIEW OF A FEMALE *PANDARUS SINUATUS*, SHOWING THE PARTS OF THE BODY.

on the other thorax segments. Sixth segment represented by a median lobe or process attached to the base of the posterior sinus of the genital segment, and without dorsal plates or rudimentary legs. Abdomen short and broad, two-jointed, usually narrowed anteriorly and attached to the ventral surface of the genital segment. Abdomen covered dorsally by the rudimentary sixth segment lobe, ventrally by a plate, short and wide, and not reaching the posterior margin of the dorsal lobe.

Attached to either side of the ventral plate at its base, and to the side of the abdomen, is a peculiarly modified anal lamina; the two are usually divergent, with a thickened conical outer margin and two membranous wings, dorsal and ventral, on the inner margin. Four

pairs of adhesion pads on the ventral surface of the carapace, one pair at the base of the first antennæ, one at the base of the second antennæ, a third between the bases of the first maxillipeds, and the fourth on the lateral margins of the first pair of thorax plates, opposite the first legs.

Second maxillipeds much swollen and enlarged, armed with a pair of roughened, forceps-like knobs instead of a terminal claw. Four pairs of biramose swimming legs, the rami all laminate, indistinctly jointed, and usually armed with spines only. Egg tubes straight, uniseriate, close together, and usually much longer than the body.

Male.—The original type of the genus *Nogaus* (fig. 16). Carapace broad and well rounded; posterior lobes prominent, triangular, and usually turned inward; posterior margin straight and armed with a pair of secondary lobes, one on either side, close to the base of the posterior lobe; lateral grooves

distinct, turned sharply outward near the anterior end and extending to the margin of the carapace just behind the first antennæ. Frontal plates wide and prominent, anterior margin fairly straight and not deeply cut at the center; eyes often visible in the adults. Free thorax segments without dorsal plates, diminishing in width from in front backward, the first one (really the second segment) with a pair of lateral lobes extending diagonally backward and outward, the others without lobes.

Genital and sixth segments fused, considerably enlarged, and furnished with two pairs of rudimentary legs, one, the sixth, at the posterior corners, and the other, the fifth, on the lateral margins; both

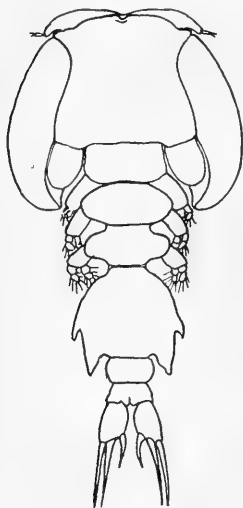


FIG. 16.—DORSAL VIEW OF A MALE OF *PANDARUS CRANCHII*: THIS IS THE "*NOGAUS LATREILLII*" UPON WHICH LEACH FOUNDED HIS GENUS *NOGAUS*. DRAWN BY EMERTON.

pairs prominent. Abdomen two-jointed, joints the same size; anal laminae large, well flattened, and armed with four large setae, of which the inner one is separated from the other three.

Ventral surface of the carapace with the same adhesion pads as in the female. Second maxillipeds enlarged, sometimes with a terminal claw and sometimes with pincher knobs, both varieties occurring in the same species. The four pairs of swimming legs biramous, all the rami two-jointed and armed with large plumose setae.

(*Pandarus*, the leader of the Lycians in the Trojan war.)

The distinguishing characters of a female *Pandarus* are the paired dorsal plates on the free thorax segments, the rudimentary sixth segment, and the peculiarly modified anal laminae (fig. 15). Of the dorsal thorax plates, the first pair extend diagonally backward over the lateral margins of the third pair and may even reach beyond the latter (*satyrus*).

In some species (*sinuatus*) they are short and plump, with well-rounded outlines; in others (*satyrus*) they are long and narrow, with their lateral margins comparatively straight.

Between their bases lies an unpaired median plate, which covers the remainder of this second segment and projects but a comparatively short distance behind the posterior margin of the carapace, either terminating in a straight line (*sinuatus*, *satyrus*, *cranchii*), broadly concave (*bicolor*) or convex (*smithii*), both the latter overlapping the third segment. The bases

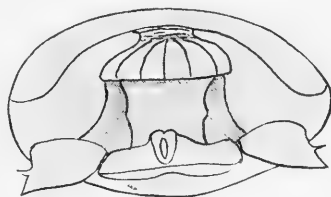


FIG. 17.—SECTION OF THE GENITAL SEGMENT OF *PANDARUS SINUATUS*, WITH THE SIXTH SEGMENT AND ABDOMEN STILL ATTACHED. END VIEW, SHOWING THE DISTANCE BETWEEN THE DORSAL PLATE AND THE ABDOMEN.

of this first pair of plates are furthermore separated by so wide an interval as to leave nearly the whole of the small second pair uncovered between them. These latter are much the smallest pair in every species, and are more or less fused at the median line, the sinus separating them being sometimes a mere notch at the center of the posterior edge of the fused plates (*cranchii*), or even entirely lacking, so that the plates seem like one (*brevicaudis*).

Anteriorly their articulation is usually concealed beneath the posterior border of the central plate of the second segment.

The third pair of plates are the largest of the three and they overlap the genital segment for a greater or less distance, sometimes nearly covering it (*armatus*, *smithii*, *satyrus*).

The rounded posterior extremity of the body is a second characteristic of the genus; this extremity is formed dorsally by a rudimentary lobe or process representing the sixth thorax segment, which is elliptical or oval in young females and does not completely fill the sinus of the genital segment, but in mature females it fits this sinus

exactly, leaving no space around its margin. That this is really the rudiment of a sixth thoracic lobe and not a part of the abdomen, as it has been hitherto regarded, is proven in several ways. First, by analogy, it corresponds exactly to the similar lobe found in *Dinematura* (see p. 374) and *Echthrogaleus* (see p. 362). Again, it is not connected with the abdomen, but is raised some distance above the dorsal surface of the latter (fig. 17). Furthermore, it is not a fusion of two plates, but is unpaired and median from the very beginning (see fig. 182). In the matured female it is always above the egg strings, while the abdomen is below them. If it is to be regarded as a dorsal abdominal plate, therefore, we have the anomaly of the egg strings passing through the abdomen, or at least beneath its dorsal plate. Some writers have claimed this very thing, but it is entirely without precedent, and would constitute an anatomical freak of the most capricious sort.

On the other hand, if this be the rudimentary sixth segment, everything is exactly as in the other genera; the egg strings come out from the ventral surface of the genital segment, beneath the sixth segment and above the abdomen exactly as they do in *Dinematura* and *Echthrogaleus*.

Finally, we have the testimony of the male, in every species of which, so far as known, a sixth pair of legs is prominent on the genital segment as well as a fifth pair.

Such cumulative evidence is convincing and fairly proves that the dorsal plate can not belong to the abdomen, but must represent the sixth segment.

The ventral plate, on the other hand, does remain in contact with the ventral surface of the abdomen to the very tip of the latter. As a consequence the terminal half of the abdomen is drawn down to the plate tightly and lies along its dorsal surface. As the two lobes at the tip of the abdomen on either side of the anus fuse with the ventral plate, the tips of the lobes themselves also fuse with each other and the anus ceases to be any longer terminal, but opens up dorsally from the surface of the ventral plate. When the genital segment is thickened by the maturing of the eggs and the coiling of the distended oviduct, the dorsal plate of the sixth segment and the ventral plate of the abdomen are separated some distance from each other, while the body of the abdomen lies between them (fig. 17).

When the eggs finally emerge into the egg strings, the latter are pushed through the spaces between the posterior lobes of the genital segment and the body of the abdomen, above the ventral plate of the latter. They do not, therefore, pass through the abdomen at all, but are entirely outside of it. In this way, although the openings of the oviduct are some distance apart, the egg strings are brought together on the mid line and carried backward side by side so close together as to be often in actual contact.

The anal laminæ next demand attention. They are modified so peculiarly as to have deceived many of the investigators who have examined only adult specimens. Leach, who founded the genus in 1816 upon two species, *Pandarus bicolor* and *P. boscii* (really two variations of the same species), described them as the notched apex of the "abdomen." But this term "abdomen" as he used it included the genital segment and the sixth segment, as well as the true abdomen, which latter he seems to have entirely overlooked, since no mention is made of it.

Many of the long list of observers since his day have likewise overlooked the anal laminæ altogether or have designated them as a part of the genital segment. Desmarest (1825), in his brief diagnosis of this genus, twice mentions the "deux soies" at the posterior end of the body. But since under the species diagnoses he states that these "soies" are from one and a half to two times as long as the body, he is evidently speaking of the egg strings, and no mention is made of the anal laminæ.

Milne Edwards (1840) says:

L'abdomen est court, et présente une structure très singulière: il se compose de deux segmens, dont le premier porte de chaque côté un appendice, et se trouve recouvert au dessus par le second qui naît près de son bord antérieur, et a la forme d'une lame caudale (p. 466).

He is thus the first to definitely recognize any appendages in this part of the body, but he evidently found considerable difficulty in the arrangement of the "two segments" of the abdomen, since what he calls the "second" arises from the anterior border of the "first" and lies directly over the latter. This would be a mistake, however we may regard the "appendages," since it would assign them to the "first" or basal segment, when they are plainly borne on the terminal segment in the young female (Plate XXXII, fig. 182).

Dana (1852) seems to be the first to recognize these appendages as actually anal laminæ. In his diagnosis of this genus he says:

Abdomen two to three jointed, second segment posteriorly rounded, and having on the sides the caudal stylets, last segment concealed below the second. * * * Caudal stylets styliform, acute, nearly naked (p. 1364).

In all his descriptions Dana regards the genital segment as the first segment of the abdomen, hence his "second segment" would be this dorsal plate or lobe, while his "last segment" would be the true abdomen.

He thus reverses the arrangement given by Milne Edwards and presents the segments in their true sequence, but the "caudal stylets" are not attached to the sides of the dorsal lobe, nor are they connected with it in any way; they arise from the sides of the true abdomen, his "last segment."

Heller (1865) gives as the conclusion of his genus diagnosis:

Annulus genitalis subquadratus, postice angustior, angulis posterioribus acutis cauda ovalis, styliis duplo longioribus.

In the text he speaks of these appendages as "die seitlichen Anhänge" (p. 204) and "die seitlichen Schwanzanhänge" (p. 206), but makes no attempt to explain them or their position. This, taken in connection with the fact that he is so particular to designate them as "seitlichen," would indicate that he did not recognize them as anal laminae.

Brady (1883), in his genus diagnosis, says clearly:

Abdomen two or three jointed, rounded behind; caudal stylets borne on the side of the abdomen, acute, styliform, nonsetiferous (p. 133).

This, together with Dana's clear statement, ought to have established the nature of these appendages, and yet we find Bassett-Smith as late as 1899 giving a genus diagnosis in which he says:

"Genital segment terminating in two minute points, and at the base of the abdomen are two lateral, sharp, dentate appendages" (p. 466).

Nothing further is said in reference to them, and we are left to interpret them as we please.

That they are really anal laminae is abundantly proven by an examination of the young of any species. In some of these the laminae are similar to those in other genera belonging to this subfamily, with the single exception that they are armed with nonplumose spines instead of plumose setae (see *sinuatus*, Plate XXXII, fig. 182).

As development proceeds the laminae change their position from the posterior margin to the base of the abdomen, at the same time becoming modified in form until

they finally reach the adult condition. In other species (*bicolor*, *cranchii*, etc.) the laminae are changed considerably, even in very young specimens, by a thickening of the outer margin and the addition of two wings, a dorsal and a ventral, on the inner margin (fig. 18).

As to the function of these specially modified anal laminae they may perhaps serve as a guide to the egg-strings while the latter are issuing from the genital segment. The openings of the oviducts are widely separated and relatively close to the lateral margins of the genital segment. Instead of passing directly back from their respective openings, and thus remaining some distance apart, the egg-

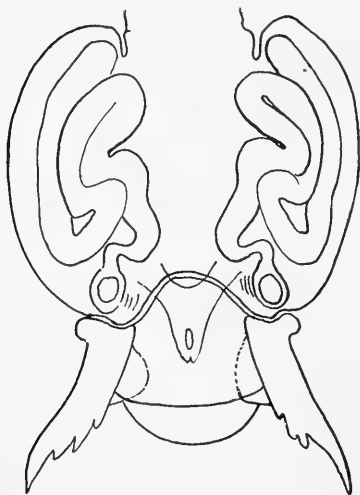


FIG. 18.—THE GENITAL SEGMENT AND ABDOMEN OF *PANDARUS CRANCHII*, SHOWING ANAL LAMINAE WITH TWO WINGS, DORSAL AND VENTRAL.

strings are bent inward as soon as they emerge from the genital segment and are brought together on the mid-line. They then turn backward side by side and so close together that they are usually in contact.

In those species whose anal laminae have well-developed wings on the inner margin the egg-strings pass backward between the two wings. This brings the thickened conical outer margin of the laminae outside the egg-strings and thus holds them in together.

The distinguishing characters of a male *Pandarus* are the large secondary lobes arising from the posterior border of the carapace inside the regular posterior lobes, the two pairs of rudimentary swimming legs on the genital segment, the two-jointed abdomen with the joints of equal length, and the fact that all the rami of the swimming legs are two-jointed.

Secondary lobes are found on the posterior margin of the carapace in some of the other genera also (*Perissopus*, *Nesippus*, etc.), but they are much smaller than in *Pandarus*, and are easily overlooked, while here they are prominent in all the species examined and one of the first characters that would be noticed.

In most of the other *Nogaus* males there are no rudimentary legs visible on the genital segment; here in each of the known species there are two pairs, well defined and prominent.

Their presence is indicative that the so-called genital segment is really a fusion of two segments, the fifth and sixth thoracic segments, each with its pair of legs. This idea has been already advanced by the author,^a and it receives particular confirmation here, where evidences of fusion are shown also in the genital segment of the female. Scattered testimony was furnished by the two pairs of legs on the genital segment of some *Caligus* species (for instance, *isonyx*, *pelamydis*, *stromatei*, etc.) and of many *Lepeophtheirus* species (for instance, *nordmannii*, *hippoglossi*, *edwardsi*, *dissimulatus*, etc.) and in the structure of the genital segment in the male of the genus *Homoiotetes*. Here among the Pandarinæ the segment itself is plainly differentiated in *Dinematura*, and is indicated by the rudimentary plate in *Pandarus* and *Echthrogaleus*.

With this accumulation of evidence we can no longer doubt that there are really six segments in the thorax of all the Caligidae, two of which, the fifth and the sixth, are ordinarily so thoroughly fused as to be indistinguishable. When only one pair of legs is visible on the genital segment it is usually the sixth pair at the posterior corners, instead of the fifth pair, as we have been calling them.

In 1861 Steenstrup and Lütken suggested that the genus *Pandarus* ought to be separated into two subdivisions—one to include the true genus *Pandarus*, made up of *Pandarus cranchii* as a type, together

^a Proc. U. S. Nat. Mus., XXVIII, p. 662.

with Dana's *brevicaudis*, *concinus*, and *satyrus*, and Milne Edwards's *dentatus*, *pallidus*, and *vulgaris*.

The other subdivision which was to constitute a new genus, differing from *Pandarus* as *Echthrogaleus* differs from *Dinematura*, was to have *Pandarus bicolor* for its type, and to differ from the true *Pandarus*, first, in the fact that the two anterior thorax segments are so far fused as to have a common four-parted dorsal plate; secondly, in the somewhat different, more elongated form of the thorax segments, and, lastly, in the fact that the anal laminæ are not spine-like, but laminate.

Under any conditions the authors would have to change their recommendation and leave *P. bicolor* the type of the true genus, because this is the species upon which Leach originally founded the genus *Pandarus*. But differences of the sort they mention would have to be far more pronounced than we actually find them in order to become of generic value, and also more constant.

Different specimens of *bicolor* show very different degrees of fusion in the first two thoracic plates, and different degrees of elongation in the thoracic segments; and in every species so far as known the anal laminæ are flattened and plate-like in the young, and tend to become spine-like on further development.

It is much preferable, therefore, with our present knowledge of the species, to keep them all in one genus.

KEY TO THE SPECIES.

- a. Females, free thorax and genital segments covered by paired dorsal plates; sixth segment as a rudimentary plate attached to the posterior sinus of genital segment; abdomen wide and very short, one-jointed; anal laminæ modified into dentate appendages on the sides of the abdomen near the base b.
- a. Males, carapace with accessory lobes on the posterior margin inside the posterior lobes; no dorsal plates; genital segment with two pairs of rudimentary legs; abdomen elongate, two-jointed, joints about the same length h.
- b. Lateral plates of second segment more or less fused with median ones of third segment, which lie between them and reach beyond their tips.... c.
- b. Lateral plates of second segment reaching far behind the tips of the median plates of third segment, which lie between them, but are entirely distinct..... e.
- b. Plates of second segment fused across the mid-line in front of those on third segment; the latter fused *inter se*, but distinct from the former.....
brevicaudis Dana, 1852, p. 397.
- c. Fused plates of second and third segments about the same size as those on the fourth and genital segments; sixth segment plate circular in outline d.
- c. Fused plates of second and third segments much shorter than those on the fourth and genital segments; the latter apparently fused; sixth segment plate elliptical in outline and nearly as large as the genital segment.....
affinis Beneden, 1892, p. 431.
- c. Fused plates of second and third segments the same size as those on the fourth segment, but much smaller than those on the genital segment; sixth segment plate wide, but nearly concealed.....*spinacii-achantias* Hesse, 1883, p. 458.

- d. Frontal plates projecting as a semicircular rostrum between the antennæ; sinuses between the dorsal plates very deep and slit-like; sixth segment plate half the width of the genital segment..... *unicolor* Hesse, 1883, p. 396.
- d. Frontal plates projecting as a semicircular rostrum between the antennæ; lateral plates of second segment linear; sixth segment plate only one-fourth the width of the genital segment..... *carcharii-glaucus* Hesse, 1883.
- d. Frontal plates scarcely projecting; frontal margin straight; plates on second segment as wide as those on third; sixth segment plate three-fifths the width of the genital segment..... *bicolor* Leach, 1816, p. 400.
- e. Dorsal plates on the free and genital segments approximately the same size; carapace wedge-shaped, not much narrowed anteriorly..... f.
- e. Dorsal plates quite unequal, at least one pair much enlarged or diminished; carapace much narrowed anteriorly, with strongly convex sides..... g.
- f. Frontal plates very narrow, especially on the mid line; dorsal plates on third and fourth segments more than twice as wide as long..... *cranchii* Leach, 1819, p. 403.
- f. Frontal plates wide, and widest at the center; dorsal plates on third and fourth segments about the same width and length, each armed with a stout spine on the dorsal surface..... *armatus* Heller, 1865.
- g. Plates of third segment much diminished and completely separated on the mid line; the other median sinuses deep and acute; plates on fourth and genital segments equal..... *lugubris* Heller, 1865.
- g. Plates of fourth segment much enlarged, nearly covering the genital segment; sinus between plates of third segment deep, often separating them entirely; other sinuses shallow; sixth segment plate strongly narrowed at its base..... *smithii* Rathbun, 1886, p. 410.
- g. Plates of genital segment enlarged, the others nearly equal; all the median sinuses very shallow; sixth segment plate as long as genital segment, narrowed but slightly at its base..... *satyrus* Dana, 1852, p. 415.
- g. Plates of fourth and genital segments enlarged, with broad and shallow sinuses; sinus between plates of third segment narrow and much deeper; sixth segment plate strongly narrowed at its base..... *sinuatus* Say, 1817, p. 417.
- h. Carapace longer than wide; free segments all as wide or wider than the genital segment; abdomen wider than long..... i.
- h. Carapace wider than long, the lateral margins strongly curved; fourth segment narrower than genital segment; abdomen decidedly longer than wide..... k.
- i. Carapace elliptical, strongly narrowed anteriorly and posteriorly; eyes distinctly visible; exopod of first legs twice the size of the endopod..... *brevicaudis* Dana, 1852, p. 397.
- i. Carapace orbicular, not visibly narrowed; eyes invisible; rami of first legs about equal; only one pair of adhesion pads, at base of first antennæ..... *smithii* Rathbun, 1886, p. 410.
- k. Length of carapace on mid line only one-third the entire length; both fifth and sixth legs large and prominent, triangular, and acuminate..... *cranchii* Leach, 1819, p. 403.
- k. Length of carapace on mid line two-fifths the entire length; fifth and sixth legs both small, inconspicuous, and bluntly rounded..... *sinuatus* Say, 1817, p. 417.
- k. Length of carapace on mid line three-eighths the entire length; sixth legs much smaller than the fifth and hardly visible..... *bicolor* Leach, 1819, p. 400.

All the species considered valid have been included in this key; the following have been omitted for the reasons stated: *P. alatus* described by Johnston in 1836 has been proved a synonym for *Echthrogaleus coleoptratus*. *P. boscii* Leach, 1816, becomes a synonym of *P. bicolor* of the same author and date. Dana's *P. concinnus* can not be distinguished, in the description he has given of it, from *P. cranchii*, and may therefore be left as a synonym of the latter until further described. The same may also be said of Milne Edwards' *P. dentatus*, which becomes another synonym of *P. cranchii*. The *P. fissifrons* of this latter author is probably a synonym of *P. bicolor*. *P. lamnæ*, Johnston, 1835, is a synonym of *Dinematura producta*.

No figures of *P. lividus* Frey and Leuckart, 1847, have ever been published, and it is impossible to distinguish it from *P. bicolor* by the author's description. Of Hesse's *P. musteli-lævis*, 1883, neither the description nor the figures given will warrant its inclusion in the genus *Pandarus*. The description says nothing whatever about the thoracic legs except that they are made up of a large femur, terminated by flat laminae, armed with rigid plumose setae. In the three figures given, two of which are the dorsal and ventral surface of the same specimen, there are so many discrepancies in essential details, even between the right and left sides of the same figure, that no definite information can be obtained. As figured and described, not one of the specimens can belong to the genus *Pandarus*.

P. pallidus Milne Edwards, 1840, is a synonym of *P. cranchii*, and *P. vulgaris* of the same author is probably a synonym of this species also. Hesse's *unicolor* has been left in the key, but it may be noted that he has made many wretched errors in describing it. He had what he called an adult female, a young female, and a young male; Plate VI on which the figures of this species are given evidently suffered a bad mixup in the arrangement of the numbers assigned to the several figures. The present author secured a reprint of the original paper, bearing Hesse's autograph, in which there has been a thorough correction (in ink) of the references and a rearrangement of the numbers. It is impossible to tell whether this was done by Hesse himself or by another, but the new numbers fit the description much better than those originally published.

And yet there are still so many discrepancies between text and figures that the species must be left on the doubtful list until further substantiated. And finally Brady presented in 1883 what he claimed as a new species, calling it *P. zygænæ* since it was found on *Zygæna malleus* near the Cape Verde Islands. After careful examination this proves to be a synonym of *P. satyrus* Dana (see p. 416).

PANDARUS BREVICAUDIS Dana.

PLATE XXXVI.

Pandarus brevicaudis DANA, 1852, p. 1368, pl. xcv, figs. 3 a-h.

Pandarus brevicaudatus BASSETT-SMITH, 1899, p. 467.

Nogagus validus DANA, 1852, p. 1363, pl. xciv, figs. 9 a-h.

This species includes the two sexes obtained from a shark taken in the Pacific Ocean, northeast of New Zealand, in the year 1840. The female Dana described under the name *Pandarus brevicaudis*, and the male under the name *Nogagus validus*.

No subsequent mention is made of the species until 1889, when Thomson includes it in his list of the parasitic copepods of New Zealand, on Dana's authority. He did not see any specimens himself, and he adds that Dana's description "is brief and unsatisfactory." In his Entomostraca from the Gulf of Guinea, published in 1894, Scott mentions a single specimen of *Nogagus validus* which was taken in a tow net gathering from a depth of 30 fathoms. And finally Bassett-Smith in his Enumeration of Known Species in 1899 mentions both *Nogagus validus* and Dana's three species of *Pandarus*. He calls the latter, however, "*Pandarus brevicaudatus*, *satyrus*, and *cocinnatus*," and says of them . . . "From Sharks in the Pacific Ocean: imperfectly described" (p. 467). His criticism would have had more weight if he had shown enough familiarity with Dana's descriptions to spell correctly the specific names which the latter used.

The descriptions Dana has given are brief, but they are also very accurate, and, taken with the excellent figures he published, they do not seem to deserve being called either unsatisfactory or imperfect. The following includes practically all that was given by Dana, with the addition of many new facts, especially with reference to the male.

Female.—Carapace, including the posterior lobes, slightly longer than wide, suboval, narrowed anteriorly. Frontal plates narrow and appressed closely to the carapace; scarcely enlarged at their outer ends, where they overlap two-thirds of the basal joints of the first antennæ. Posterior lobes remarkably long, half the length of the carapace on the mid-line and reaching back to the posterior margin of the third segment; triangular in shape with obtuse ends. Posterior margin of the carapace between the lobes smooth, with no trace of teeth or spines, and slightly concave. Eyes close together and about two-fifths of the length of the carapace from its anterior margin.

Dorsal plates on the second thorax segment fused across the mid-line by a band which is longer than the second or third pair of plates, and which causes the segment to resemble very closely the corresponding one in the male, the slightly oblique wings on the lateral margins answer-

ing to the lateral processes in the male. The second pair of dorsal plates are much shorter and fit inside the wings of the first pair; there is only a shallow emargination (no sinus at all) on their posterior border to indicate their dual origin. The third pair are more deeply incised, a trifle wider, and considerably longer; the sinus between them is broad and evenly rounded.

Genital segment subquadrate, narrowed a little posteriorly and armed with a minute spine on either side just in front of the posterior corners, which are obliquely truncated. The posterior margin of this segment, instead of having a single deeply rounded sinus at the center, as in most species, has two shallow sinuses, one on either side, meeting at the center in a point which projects backward over the abdomen. The anal laminae project from beneath the center of these sinuses and are about three times the length of the dorsal plate of the sixth segment.

They are only slightly divergent, with the outer margins straight, while the inner ones are armed with the usual wings, dentate near their posterior ends. Sixth segment plate wider than long, with an evenly rounded margin; abdomen very small, its ventral plate scarcely projecting behind its posterior border.

The two joints of the first antennae about equal; no setae on the basal joint and only a few on the terminal; second antennae stout, the terminal claw with a swollen base and a sharp curve close to the tip; no accessory spines. The adhesion pads relatively small, the first two pairs about the same size and shape, circular, the fourth pair narrow elliptical, twice as long as wide. Second maxillae triangular, short and very blunt; first maxillipeds stout and fleshy, the two joints of nearly the same length, as are also the two claws at the tip of the terminal joint. Second pair large and much swollen, with the distal knob of the pincher jaws several times the size of the proximal one. Basal joint of the first swimming legs subquadrate, exopod nearly twice the length of the endopod; basal joint of the exopod longer than the terminal; the two joints of the endopod the same length. Second and third legs with two-jointed rami, which are smaller than usual; spines confined to the tips of the terminal joints; rami of the fourth legs apparently one-jointed, exopod only with spines, endopod naked.

Total length, 6.2 mm.; length of carapace on mid-line, 3 mm.; width of same, 3.7 mm.; combined length of dorsal plates on the three thorax segments, 2 mm.; length of genital segment, 1.6 mm.

Male.—Carapace a little longer than wide, including the posterior lobes, ovate, the anterior portion considerably narrowed.

Frontal plates narrow, closely compressed to the carapace, not enlarged at the outer ends, but overlapping nearly the whole of the basal joints of the first antennae as in the female.

Posterior lobes broad, bluntly rounded, and exceptionally long, reaching back nearly to the fourth thorax segment; posterior margin between the lobes nearly straight; accessory lobes small, semi-elliptical, wider than long. Eyes close together and in approximately the same position as in the female. Three free thorax segments of about the same length, but the first one-half as wide again as the other two, which are nearly equal.

Lateral appendages of the second segment wide, divergent, bluntly rounded at the tip and reaching beyond the posterior margin of the third segment. Each is reenforced on its inner margin with a wide, transparent, membranous flap. Third and fourth segments the same width as the genital segment, with evenly rounded sides, and without lateral appendages.

Genital segment subquadrate, the sides slightly convex, the posterior angles prolonged a little into small rounded lobes, with a second pair of small lobes just in front of them on the lateral margins; both pairs of lobes are armed on their ventral surface with small spines.

Abdomen two-jointed, joints the same width, but the basal one not more than half the length of the terminal; the latter has its posterior angles obliquely truncated and the anal incision is deep and triangular. Anal laminae large, a trifle longer than wide, the posterior margins nearly straight and armed with four large plumose setae, evenly graded in length, the outer ones the longest. Joints of the first antennae the same length, setae longer than in the female; terminal claw of the second antennae also much longer and more slender, but the claw is bent similarly at a sharp angle near the tip.

First maxillipeds the counterpart of those of the female, except that the outer terminal claw is one-third shorter than the inner; second pair very large and swollen, the movable finger of the forceps jaws developed into a long curved claw, the stationary one a rounded knob. All the swimming legs biramose, the rami two-jointed, with the spines and setae arranged as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second exopod, 1, I; 3, VI: endopod, 0, I; 0, VI: third exopod, 0, I; 3, VI: endopod, 0, I; 0, VI: fourth exopod, 1, I; 0, VI: endopod, 1, I; 0, IV.

Total length, 7.5 mm.; length of carapace on mid-line, 3 mm.; width of same, 3.85 mm.; length of three free segments, 2.13 mm.; length of genital segment, 1.66 mm.

Color of both sexes (preserved material) a yellowish brown, darker along the mid-line, without pigment markings.

(*brevicaudis*, *brevis*, short, and *cauda*, tail.)

The U. S. National Museum Collection contains a male of this species with the following label: "*Nogagus validus* (Dana), No. 6822, on *Carcharias* between Papua and Japan, G. S. Brady, England, Acc. No. 14181, Exchange." This therefore is not one of Dana's original specimens, but was taken on the Challenger expedition and

identified by Brady with Dana's species, which came from exactly the same locality. It is now made the type male of *Pandarus brevicaudis*, the perfect agreement in anatomy being sufficient to identify the two specimens as male and female of the same species. Furthermore, Dana's original specimens of *Nogagus validus* and *Pandarus brevicaudis* were found together on the same fish.

PANDARUS BICOLOR Leach.

PLATE XXVII.

Pandarus bicolor LEACH, 1816, p. 405, pl. xx, 2 figs.

P. boscii LEACH, 1816, p. 406, pl. xx, 10 figs.

Caligus bicolor LAMARCK, 1818, p. 142.

Pandarus fissifrons MILNE EDWARDS, 1840, p. 470.

Female.—Body elongate, length more than twice the width; carapace semielliptical, one-third the entire length, widest across the posterior margin. Frontal plates wide and prominent, the groove between each frontal plate and the margin of the carapace S-shaped, the center of the carapace projecting as a knob on either side of the central incision between the frontal plates.

Posterior lobes short and broad; posterior margin a nearly uniform curve, the center of which is sinuate, but not toothed.

Dorsal plates of second thorax segment short and narrow, not reaching the tips of the plates on the third segment and fused across the mid-line, their posterior margins forming an evenly rounded semicircle, without any break that can be detected.

Second pair of plates nearly circular, with a deep and broad median incision, which is somewhat enlarged at its base. These plates reach back a little beyond the first pair. Third pair much enlarged, elliptical, as wide as the carapace, and overlapping the genital segment for about half its length. The central sinus is deep, broadly triangular, and rounded at its base.

Genital segment elliptical, one-fifth narrower than the carapace, with broadly rounded posterior lobes and a shallow sinus.

Sixth segment plate half the width of the genital segment, its posterior two-thirds the evenly rounded arc of a circle, its anterior third fitting into the sinus in the genital segment.

Abdomen medium size, its ventral plate quadrangular, with the free portion broadly rounded and the posterior margin slightly concave. Anal laminae triangular, as wide at the base as they are long, extending out at right angles to the median axis and so short that they scarcely reach the lateral margin of the genital segment. They are not toothed, but have smooth edges.

First antennae small, the whole basal and part of the terminal joint concealed beneath the frontal plates, neither joint heavily armed with setae. Second pair small, the basal joints not much

swollen, the terminal claw slender, with an accessory spine on the inner margin. The four pairs of adhesion pads all have their long diameters parallel with the body axis. The first two pairs are close together, those at the base of the first antennæ being elliptical and half as long again as the second pair, which are broadly obovate, the width and length being the same. The fourth pair are also elliptical, twice as long as wide, and considerably larger than the first pair.

Mandibles and mouth tube of the form usual in this genus; maxillæ biramose, the endopod more than twice the length of the exopod, each ramus armed with a short terminal spine.

First maxillipeds slender, the two joints about the same length, the longer terminal claw strongly curved, the shorter one nearly straight. Second pair much swollen, armed with a corrugated ridge having a spherical knob at either end, the knobs roughened on their inner surfaces and shutting together like forceps. The rami of all the swimming legs are indistinctly jointed; first pair small and weak, the exopod considerably longer than the endopod and bearing five spines, four on the outer end and one on the inner margin; no spines on the endopod. In the exopod the basal joint is much larger than the terminal, in the endopod it is much smaller; both rami are enlarged at their tips. The second, third, and fourth legs increase regularly in size, and particularly in the length of the rami.

In the second pair the two joints of the exopod are equal, the basal joint with a single spine at its outer distal corner, the terminal with a row of ten curved spines around its terminal and inner margins. The terminal joint of the endopod is four times the size of the basal and is armed with three spines, two in the position of a toe nail on the inner margin and one on the outer. In the third legs the terminal joints of both rami are much longer than the basal. The terminal joint of the endopod has two claw spines at the inner distal corner, while the entire tip of the exopod is covered with a row of spines.

In the fourth legs the endopod is apparently one-jointed, with a single spine at its inner distal corner, but in all probability it is really a fusion of two joints in conformity with the other species of the genus. The exopod carries a spine at the outer distal corner of the basal joint and two at the inner distal corner of the terminal joint.

Of the reproductive organs, the semen receptacle is V-shaped, the point of the V being anterior, with the two sides almost entirely separated from each other. Each side is short, straight, and slightly enlarged at the end. The oviduct is so densely coiled in the genital segment, especially in its posterior portion, as to effectually conceal the cement glands. These oviduct coils are wider than those in *cranchii* and more tightly packed.

Total length, 9 mm.; length of carapace on mid-line, 3 mm.; width of same, 3.65 mm.; length of first plates, 1 mm.; of second

plates, 1.375 mm.; of third plates, 1.65 mm.; width of third plates, 3.4 mm.; length of sixth segment plate, 1.65 mm.; length of egg-strings, 13 mm.

Color a rich creamy yellow, the dorsal surface of the carapace and of the second and third pairs of thoracic plates a deep chocolate brown, a light and transparent spot being left around the eyes, much the same as in *cranchii*.

(*bicolor*, *bi*, or *bis*, two, and *color*, colored.)

Male.—Carapace orbicular, a little more than one-third the entire length on the mid-line, wider than long. Frontal plates wide and prominent, with a broad and shallow central sinus; posterior lobes wide and bluntly rounded. Second thorax segment about filling the space between the posterior lobes; third and fourth segments narrowing regularly, the fourth segment of peculiar form, like an inverted flask, the anterior half twice the width of the posterior. Genital segment elliptical with two pairs of rudimentary legs, one at the posterior corners and the other some little distance in front of them on the lateral margins; the two pairs about the same size and similarly armed. Abdomen two-jointed, joints equal; anal laminae large and broad, armed with four setae, all about the same length. Terminal claws on the second antennae longer and more powerful than in the female, with two accessory spines. Second maxillipeds with a distinct claw in place of the knob-like forceps. All the legs biramose, the rami two-jointed and armed with stout plumose setae.

Total length, 6 mm.; length of carapace on mid-line, 2.1 mm.; width of same, 2.6 mm.; length of free thorax, 1.65 mm.; length of genital segment, 1.2 mm.

Color, yellow slightly tinged with brown.

This species possesses peculiar interest, because it is the one on which Leach founded the genus *Pandarus* in 1816. But he gave practically no distinctive characters for the two species which he presented, the only differences cited being a black pigment in the "shell and the middle of the abdominal lamellae" of *bicolor*, the first and therefore the type species, while *boscii*, the second species, had a pale body devoid of pigment. There was also a trifling difference in the length of the egg-tubes. From the figures given by Leach of these two species on Plate XX of his 1816 article it is evident that they are identical and that the species named *boscii* is simply a young female *bicolor* in which the pigment has not yet been formed.

This is shown by an identity of structure so great that Leach presents but a single set of figures to illustrate the appendages of the two species, and by a little difference in size, *bicolor* being larger and having longer egg-strings, as would naturally be expected. This same condition is often noticed in *sinuatus*, and, in fact, in all the pigmented species; the younger and immature forms usually have no

pigment, while the mature adults may be densely colored with it. Every lot of specimens containing more than a few individuals shows these variations. The U. S. National Museum Collection contains but a single lot of this species, Cat. No. 8120, U.S.N.M., obtained from a dogfish off the coast of Shetland.

Evidently this is a European species, since nearly every European author mentions it, while it has not yet been found on this side of the Atlantic.

PANDARUS CRANCHII Leach.

PLATE XXVIII.

Pandarus cranchii LEACH, 1819, p. 535.

Pandarus carchariae (?) LEACH, 1819, p. 535.

Pandarus pallidus MILNE EDWARDS, 1840, p. 468.

Pandarus vulgaris MILNE EDWARDS, 1840, p. 468.

Pandarus dentatus MILNE EDWARDS, 1840, p. 469, pl. xxxviii, fig. 19.

Nogaus latreillii LEACH, 1819, p. 536 (male).

Pandarus cranchii MILNE EDWARDS, Atlas du Regne animal, pl. lxxviii, figs. 2 a to d.

Female.—Body obovate, strongly narrowed posteriorly; carapace somewhat wedge-shaped, widest posteriorly, with the lateral margins only slightly rounded. Frontal plates wide and prominent at their outer ends, thin and linear toward the mid-line. Eyes situated far forward, visible in those specimens which have no pigment or in which there are large clear spaces at the center of the carapace; concealed in the heavily pigmented specimens.

Posterior margin of carapace a shallow reentrant curve, armed with seven to ten large spines or teeth along the center.

The posterior corners are short and wide and stand out prominently beyond the first pair of dorsal thoracic plates.

The teeth are separated a greater distance from one another than their own length and reach backward nearly to the posterior margin of the central plate of the second thorax segment.

Dorsal plates of second segment much enlarged, more than twice the length of those on the third segment, and reaching beyond the center of those on the fourth segment. They are slightly enlarged at the base, but the tip is also broad and evenly rounded.

Plates on the third segment nearly as long as the free portion of the following pair, with a broad and deep central sinus.

Plates on the fourth segment overlapping almost the whole of the genital segment, broad and evenly rounded with a shallow central sinus. In young females these plates do not reach much beyond the center of the genital segment; in mature adults they often reach its posterior margin.

Genital segment obovate, strongly narrowed posteriorly and produced into a long triangular point on either side of the sixth segment

plate. The latter is ovate, one-third longer than wide, and the posterior lobes of the genital segment reach about to its center. Its broad posterior end is evenly rounded with a smooth margin, while the narrowed anterior end is slightly reentrant on either side. The ventral plate of the abdomen is short and broad, its posterior margin straight or a little concave, and reaching nearly to the tip of the sixth segment plate (fig. 131).

The anal laminae point diagonally outward and backward at an angle of 45° with the central axis; their thickened outer margin is nearly straight and slightly enlarged where it joins the abdomen. In young females it is furnished with two wings, the ventral one triangular in shape and extending from the base to about the center of the lamina, the dorsal one of uniform width and extending the whole length of the appendage. This dorsal wing is cut diagonally at the distal end and furnished with one or two small teeth. In mature females the wings are more or less absorbed and the thickened margin becomes cylindrical, with two prominent teeth on its inner side.

The basal joint of the first antennae is large, heavily armed on its ventral surface with setae, and nearly covered by the frontal plate. The terminal joint is peculiar in that it is strongly flattened dorso-ventrally, and each edge is rolled over ventrally toward the center; this joint is also destitute of setae. The second antennae are comparatively very large; the basal joint is considerably larger than the pad connected with it; the terminal claw is also stout and armed with two accessory spines. The adhesion pads of the first pair are obovate, nearly twice as long as wide, with the outer margins straight. Those of the second pair are circular, their diameter the same as the width of the first pair; they are separated by a greater distance than is common in this genus. The third pair are club-shaped, three times as long as wide, and narrowed anteriorly to a long blunt point. The fourth pair are elliptical, twice as long as wide, and inclined at an angle of 30° to the body axis. The mouth-tube and mandibles show nothing peculiar; the second maxillae have a short and circular exopod and a long, tapering endopod, which reaches beyond the center of the tube; each ramus is tipped with a spine.

First maxillipeds of the usual pattern; second pair enlarged, but relatively smaller than in *bicolor*, the forceps knobs close together and standing prominently above the surface.

First swimming legs very small and rudimentary, the exopod boot or foot shaped, the leg and heel being thick and swollen, while the toe is long and slender. There is one spine at the heel, another on the bottom of the foot in the instep, and two on the joint of the great toe. The endopod is two-thirds as long as the exopod, with a well-defined incision on the inner margin, representing the groove between

the joints, and a single spine at the outer distal corner. The terminal joint of the endopod of the second legs is three times as long as the basal joint and slightly enlarged at the end; both joints without spines.

The exopod joints on these legs are the same length, but the terminal one is much the wider and is armed with a row of eight or nine large curved spines around its margin. The terminal endopod joint of the third legs is two and a half times the length of the basal joint and somewhat barrel-shaped, neither joint with spines. The exopod joints are the same size, the terminal one with a cluster of four or five spines at its tip.

The rami of the fourth legs are broad and laminate, the exopod twice the size of the endopod; the jointing is indistinct and the only spines are on the exopod, one on the outer margin and a cluster of three at the tip.

Of the reproductive organs the semen receptacle is horseshoe-shaped, the opening being posterior, and the two ends of the shoe being enlarged into spheres; in preserved specimens it is usually white and opaque. The cement glands can be seen on either side of the intestine near the ventral surface of the genital segment. They are shaped like parentheses marks, and in alcoholic material are dark brown and opaque, with no traces of cells or divisions. The spermatophores are large and are attached one on either side of the abdomen at its base; the long thread-like ducts cross each other on the mid-line and each empties the contents of its spermatophore into the genital opening on the opposite side of the body. The oviduct is usually coiled once in each half of the genital segment, the last section passing down alongside of, and close to, the intestine and then turning abruptly outward to the external opening (vulva) which is in the posterior lobe and just in front of the base of the anal laminæ.

Total length, 7.8 mm.; length of carapace on mid-line, 3.4 mm.; width of same, 4.5 mm.; length of first thorax plates, 2 mm.; of second pair, 1 mm.; of third pair, 1.2 mm.; of sixth segment plate, 1.6 mm.; of anal laminæ, 1.8 mm.; of egg strings, 8.5 mm.

Color, a light brownish yellow, more or less covered with dark brown-black pigment; the amount of this pigment is very various, but in the mature adult it usually covers the whole dorsal surface of the thoracic plates except a narrow border around their margins, and the whole center of the carapace, leaving a single large or two separate small spots near the eyes, and the whole of the posterior lobes free.

Male.—General shape broad and flat, not strongly arched, with a weak keel on the dorsal surface of the free and genital segments.

Carapace a little wider than long, even including the posterior lobes, one-half wider than long measured on the mid-line, trans-

versely elliptical, the sides and frontal margin forming a very even curve. Frontal plates considerably enlarged at the outer ends and nearly covering the basal joints of the first antennæ. Posterior lobes wide, triangular, quite sharply pointed, and curved strongly inward toward the free throat; their tips reach a little beyond the center of the third thorax segment, and if straight would probably reach its posterior margin.

Grooves separating the cephalic and lateral areas extending forward visibly to the anterior margin just behind the base of the first antennæ. Posterior margin between the lobes nearly straight, with no traces of spines or teeth; secondary lobes elliptical, considerably longer than wide. Eyes visible in the younger specimens close to the mid-line, one-third the distance from the anterior margin of the carapace; invisible in mature adults. The three free segments together one-fourth shorter than the carapace, the second segment one-third wider than the other two, which are about equal. The lateral appendages of this segment are very oblique and are partially covered by the accessory posterior lobes of the carapace.

The sides of the third and fourth thorax segments project a distance equal to half their length and are evenly rounded, giving the segments an elliptical form, transversely elongated.

Genital segment flat and somewhat elongate, narrowed into a neck anteriorly where it joins the fourth segment, and carrying two pairs of lobes posteriorly. The larger pair are triangular and situated at the posterior corners; the smaller pair are just in front of them, on the sides of the segment.

The latter are armed on their ventral and inner margins with small spines and setæ and are evidently the rudimentary fifth legs. The sixth legs, however, are not on the posterior lobes, but inside of them on the posterior margin of the segment, between the lobes and the abdomen. They are well shown in this position by both Steenstrup and Lütken and Kröyer.

Abdomen two-jointed, joints the same length, but the basal one is somewhat the wider, with strongly convex sides and a slight notch at the center of the posterior margin. Terminal joint with an anal incision which reaches nearly to its base, and with its posterior margin straight or only slightly oblique.

Anal laminae large, four-fifths as long as the entire abdomen and three-fifths as wide, each armed with four setæ, of which the inner one is considerably the smaller, is removed a little from the other three, and is abruptly curved inward near its base.

First antennæ minute and not heavily armed with setæ; the terminal claw of the second pair abruptly bent near its tip and armed with two accessory claws on its inner surface.

Adhesion pads similar to those in the female, but smaller, the pair on the margins of the lateral lobes of the second thorax segment especially well developed.

Second maxillæ peculiar in being bent outward away from the base of the mouth tube nearly in a half circle. Krøyer, in speaking of these appendages, says that they are small and indistinct, so that he could not make them out with certainty. He therefore refrains from describing them, but Steenstrup and Lütken show them in their figure of the ventral surface of this species. This figure, however, is very small and can not show details, and all they say of these appendages in the text is simply that they are of the usual form. Fig. 133 gives the details of their structure, and it can be seen that they consist of an enlarged basal joint, and a slender terminal spine pointed away from the mouth tube. First maxillipeds rather small and slender; terminal claw on the second pair also slender but long, the interval between the base of the claw and the immovable knobs being very wide.

The spines and setæ on the swimming legs are arranged as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second endopod, 1, I; 4, VI: endopod, 0, I; 0, VIII: third exopod, 1, I; 3, IV: endopod, 0, I; 0, VI: fourth exopod, 3, I; 4, V: endopod, 0, I; 0, V.

Total length, 9.6 mm. Length of carapace on mid-line, 3.2 mm. Width of same, 4.8 mm. Length of three free segments, 2.4 mm.; of genital segment, 2.2 mm.; of abdomen, 1.6 mm.

Steenstrup and Lütken give their largest specimen as 11 mm. long; Krøyer states that of the four specimens examined by him the largest was over four lines (9 mm.), the two next in size a little over three lines (6.75 mm.), while the fourth was smaller. Color a uniform yellowish horn color, transparent in living specimens, and often nearly so in preserved material.

(*cranchii*, a proper name, see below.)

In 1892 Van Beneden published a description with figures of a *Nogaus* which he claimed to be the male of the present species. For a discussion of this form, see page 450.

Again, in 1899 Bassett-Smith suggested that Heller's *Nogaus elongatus* was the male of *Pandarus dentatus*, the latter being one of the synonyms of the present species. This *Nogaus* will be found discussed on page 451.

The true male described above was the type on which Leach founded in 1819 his new genus *Nogaus*. The genus itself is discussed elsewhere (p. 439). We wish to note here only the description which he gave of this type species:

Nogaus latreillii. Couleur pâle, sans tache. Découverte par Cranch, latitude sud, 1; longitude, est, 4; méridien de Londres (p. 535).

This Cranch is evidently the same person who found the females of the present species, and for whom it was named; in all probability the two were discovered together on the same fish although there is no definite testimony to that effect. Of course such a description as this of Leach's is absolutely worthless for purposes of identification, but fortunately Milne Edwards had an opportunity to examine Leach's original specimen in the British Museum, and he published a much better account of it in his History of the Crustacea in 1840 (p. 459). The description is not very long, but it contains two details which practically identify the species. The first is as follows:

Carapace très large et offrant de chaque côté sur le bord postérieur, tout près de son angle latéro-postérieur, un lobule arrondi qui semble appartenir au premier anneau thoracique.

This secondary lobe is one of the principal characters of *Pandarus* males, and would suggest that the species belongs to that genus.

The second detail is italicized by Milne Edwards as constituting the principal character for identification. He says:

Le dernier anneau du thorax (the genital segment) grand est armé de chaque côté de deux grands prolongements coniques dirigés obliquement en arrière.

This, with the added information "abdomen très-court, composé de deux articles, et terminé par des lames natatoires assez grandes," is sufficient to identify the species beyond question. But the figure which Milne-Edwards published^a was lacking in many particulars. It was therefore fitting for Steenstrup and Lütken in 1861, and for Krøyer in 1863, to supply the missing details and supplement the description.

Their combined account is the same as that here given, and has been freely used for suggestions and comparisons. The only thing they lacked was the definite location of the species as the male of *Pandarus cranchii*. Steenstrup and Lütken record their specimens as taken on the African coast along with females of the present species. Krøyer obtained his specimens from a large *Carcharias* taken in the open Atlantic, and found what he took to be females along with the males.

It is shown elsewhere (p. 441) that these females were really the young of the genus *Nesippus*, and not related in any way to the males. The true females of the present species have a complex history. Leach described in 1819 (p. 535) two new species of the genus *Pandarus* which he had founded three years before.

And he repeated the same mistake then made, for just as his two original species, *bicolor* and *boscii*, prove to be identical, so are these other two, *carchariæ* and *cranchii*, in all probability one and the same, as was recognized by Steenstrup and Lütken in 1861 and by all sub-

^a Atlas du Règne animal de Cuvier, Crustacés, pl. LXXVIII, fig. 1.

sequent authors. In Leach's paper the species *carchariæ* is given first and by the law of priority ought to be taken for the name of the species, while *cranchii* became a synonym. But unfortunately the type of *carchariæ* has never been seen by any other investigator, and hence the species can not be identified with certainty. On the other hand, the original type of *cranchii* has been examined and figured^a by Milne Edwards and others and can be identified accurately. Therefore preference in the present instance is given to that name which is open to the least doubt.

In 1840 Milne Edwards published three species, *pallidus*, *vulgaris*, and *dentatus*, which so far as can be made out from the descriptions he gave, and also from his figures of the last-named species, are identical with *cranchii*. At all events they do not deserve to be made anything more than varieties.

In 1852 Dana published the species *concinuus*, which like Milne Edwards's *pallidus* appears to be the young of the present species before they have acquired the dark pigment which colors the carapace and dorsal plates so conspicuously in more mature specimens.

Dana says nothing of the color of his species, but he does say "body translucent or subtransparent," which certainly could not be the case if the pigment were present. Neither author gives the details of the appendages, and judgment must be based upon the general make-up of the body and the relative shape and proportion of its various parts. As these are practically identical, *concinuus* must be placed as a synonym of the present species until proven to be distinct.

The U. S. National Museum Collection has a fine set of specimens illustrating this species. We may refer again to the fact that Cranch, for whom the species is named, found both males and females probably on the same fish. Steenstrup and Lütken record two similar instances in which Captain Hygom obtained the sexes together.

And here in the National Museum Collection there are three additional lots in which both sexes came from the same fish.

Of the female specimens we find Cat. Nos. 6019 and 6020, U.S.N.M., from *Carcharhinus obscurus*, taken at Station 1142 off Marthas Vineyard, and containing one and two females respectively. A single male was obtained at the same time and is Cat. No. 6031, U.S.N.M.

A second lot, consisting of six males, Cat. No. 8640, U.S.N.M., and five females, Cat. No. 8641, U.S.N.M., was obtained from a large shark at the surface at Station 2237 by the *Albatross* in 1884.

The third lot contains ten females, Cat. No. 10746, U.S.N.M., two young females, Cat. No. 32741, U.S.N.M., and a single male, Cat. No. 32752, U.S.N.M., obtained from a 10-foot shark at Station 2422 by the *Albatross* in 1884.

^a Atlas du Règne animal de Cuvier, Crustacés, pl. LXXVIII, figs. 2, 2 a.

There is also a single female, Cat. No. 8118, U.S.N.M., collected by Francis Day from *Lamna cornubica*, and another female, Cat. No. 6831, U.S.N.M., from a species of *Carcharhinus* between Papua and Japan, obtained by exchange from G. S. Brady, and collected during the *Challenger* Expedition.

PANDARUS SMITHII Rathbun.

PLATES XXIX and XXX.

Pandarus smithii RATHBUN, 1886, p. 315, pl. v, fig. 3; pl. vii, fig. 9.

Female.—Carapace ovate, a little wider than long, the anterior margin evenly rounded, the lateral margins convex; posterior lobes short, wide, and bluntly rounded; posterior margin between the lobes sinuate and wrinkled, each wrinkle ending in a sharp, spine-like tooth. Frontal plates broad and prominent, much wider at the outer ends than near the median line, and covering nearly the whole of the basal joints of the first antennæ. Eyes nearly always concealed by the dark pigment of the carapace, but sometimes visible two-fifths of the length of the carapace from the frontal margin.

Three distinct dorsal plates on the second thorax segment, the lateral pair elongate, elliptical, or ovate, about twice as long as wide, and strongly divergent. The odd plate median semielliptical or subtriangular, and about half the length of the lateral plates. Dorsal plates of the third segment almost circular in outline, less than half the length of the first pair, and completely separated to their base, often leaving a wide, open space between their inner margins. Dorsal plates of the fourth segment much enlarged, broadly rounded, and separated by a triangular posterior sinus of medium depth. These plates overlap the genital segment at least beyond its center, and often nearly to its posterior margin.

Genital segment obovate to elliptical, narrower than the plate on the fourth segment, and ending posteriorly in a short, rounded knob at either corner. Sixth segment plate ovate, strongly narrowed anteriorly, projecting for two-thirds of its length back of the genital segment, with an evenly rounded margin.

Abdomen small, its ventral plate of the usual shape, but not reaching beyond the center of the sixth segment plate; anal laminae the same length as the sixth segment plate, diverging at an angle of 45° to the body axis, so that almost the entire lamina is visible from above. Of the two wings on the inner margin, the dorsal runs the entire length of the lamina and is of the same width throughout; it is cut off obliquely at the tip, and the cut edge is more or less lacerated and armed with two or three small spines. The ventral wing is semi-circular in shape and occupies only the basal half of the lamina; its margin is smooth and without spines. The combined width of the

two egg-strings is three-fifths that of the sixth segment plate, while they are two-thirds as long again as the body.

First antennæ short, the basal joint as wide as long, and heavily armed with setæ, the terminal joint club-shaped, with a cluster of setæ at the tip. Second antennæ small and rather weak, the terminal claw of medium size and bent abruptly near the center. Its basal half is flattened and laminate, while the terminal portion beyond the angle is slender and cylindrical. The second joint has a wide laminate ear or flap projecting from its ventral surface toward the fleshy adhesion pad.

The first pair of these adhesion pads are large and broadly elliptical, one-fifth longer than the second pair; the latter are obovate, their widest (anterior) diameter equaling their length.

The fourth pair are especially long and narrow, their length fully two and a half times their width, and half as long again as the first pair. Mouth-tube of the usual pattern, inclosing the mandibles, which are very slender and armed with eight teeth at their tips on the inner margin. Second maxillæ with a thick and swollen base, a fleshy second joint, and a short terminal spine, which is stout and curved like a claw.

First maxillipeds slender and weak, the two joints about the same length, the dorsal terminal claw twice as long as the ventral, the latter with a short accessory spine at its base. Second maxillipeds much swollen, the terminal joint fully as wide and thick as it is long, and furnished with a movable claw, which shuts down against a raised, tabular knob. The claw is wide and thick, especially at the base, where it is armed with a large spherical knob at the posterior corner and a long slender accessory spine on the ventral surface. The raised knob, against which the claw shuts, has a flat, semicircular top, which is roughly corrugated, to afford a better hold against the skin of the host.

First swimming legs small and weak, the basal joint scarcely as wide as the exopod; both rami two-jointed, the joints in the exopod not as distinct as in the endopod. Second legs stouter, especially the basal joint, but still rather weak; third and fourth pairs with basal joints increasing regularly in size, their rami flat, laminate, and boot-shaped; those of the second and third legs distinctly two-jointed, those of the fourth legs with the jointing indicated only by marginal notches. The rami of these fourth legs are, as Rathbun writes, considerably longer than those of *cranchii*, and are also somewhat longer than even the longest of those found in *sinuatus*. There are no setæ, and the spines are arranged as follows: First exopod, 1,5; endopod, 0,3; second exopod, 0,10; endopod, 0,3; third exopod, 1,4; endopod, 0,2; fourth exopod, 1,5; endopod, 0,0.

The oviducts are coiled once in the genital segment, the three strands of the coil running the entire length of the segment. The semen receptacles are very similar to those of *bicolor*, horseshoe-shaped, with the ends somewhat enlarged.

The cement glands can not be seen in mature females on account of the pigment on the dorsal surface of the segment and in the eggs that fill the coiled oviduct, but they can be distinguished in young females. They are narrow and rod-like, close to the intestine on either side, and more or less sinuate; the component cells are very short and flattened like the eggs in the egg-strings.

Total length, 9 mm.; length of carapace on mid-line, 3.5 mm.; width across posterior margin, 4.5 mm.; length of first dorsal plates, 2 mm.; of second plates, 0.85 mm.; of third plates, 2 mm.; of sixth segment plate, 1.5 mm.; of egg-strings, 15 mm.

Color a rich brownish black, the margins of the carapace and of the dorsal plates, and a semicircular spot through the eyes much lighter and yellowish or reddish. The anal laminae are also without pigment. (*smithii*. Named for Prof. S. I. Smith, of Yale University.)

Young females.—In a young female only 3 mm. long the carapace is strongly wedge-shaped, the posterior margin twice the width at the frontal plates, the teeth along its central portion comparatively larger and blunter than in the adult. The lateral margins are nearly straight and show a well-defined notch, armed with two minute teeth, about three-fifths of the distance from the frontal plates. This notch evidently indicates the point of junction of the cephalic and thoracic portions of the carapace. The eyes are also plainly visible close to the mid-line, in the anterior third of the carapace.

The dorsal plates of the thorax are in a rudimentary condition; the first two pairs are about the same size and the third pair a trifle larger; the first pair does not quite touch the anterior margin of the third pair, and only the extreme tips of the second pair overlap the third.

The genital segment is thus left almost entirely free dorsally; on its ventral surface just in front of the openings of the oviducts may be seen the rudiments of a pair of swimming legs, in the form of two spines on either side, close together, the inner one broadly triangular, the outer one minute and very slender.

These afterwards disappear, or at least they can not be distinguished in the adult.

The sixth segment plate is circular and one-third the width of the genital segment; the anal laminae are much longer than this plate, comparatively slender, and the wings are not yet fully formed along their inner margins, which are armed at this stage with three small spines. The ventral plate of the abdomen reaches nearly to the posterior margin of the sixth segment plate and is much broader than the latter, more than half the width of the genital segment. The append-

ages and the legs are very similar to those in the adult, the segmentation and the spines being much cleaner and more distinct; they verify in every particular what has already been given for the adult.

In another developmental stage, 4.5 millimeters long, we find the same general shape and proportion of the various body regions as in the adult. The dorsal plates are now well formed and overlap, so that there are no spaces between them; the third pair are much enlarged and reach to the center of the genital segment; the sixth segment plate has increased to its normal proportions. But as no pigment has yet appeared the internal anatomy can be seen quite distinctly; in particular the ovaries and oviducts are manifest, and the beginning of the coils in the latter may be distinguished at the posterior end of the genital segment. This absence of pigment, together with the differences in the details of the appendages and dorsal plates make these young females appear like distinct species. And it is probably similar differences which led to the differentiation of *boscii* from *bicolor* by Leach in his original description of the genus, and also to the separation of *pallidus* from *cranchii* by Milne-Edwards in 1840.

Male.—Carapace elliptical, a little longer than wide, with the lateral margins only slightly curved; posterior lobes wide and bluntly rounded at the tips, extending straight backward; accessory lobes small, much wider than long and attached close to the base of the posterior lobes. Lateral grooves somewhat S-shaped, the curve at the anterior end being much more pronounced than at the posterior end. Eyes prominent and situated far forward. Carapace narrowed but little anteriorly; frontal plates wide and prominent, covering nearly the whole of the basal joints of the first antennæ. Free segments diminishing a little in width, but increasing in length from in front backward, their sides plumply rounded; the second segment filling the entire space between the carapace lobes, the fourth segment wider than the genital segment. Lateral lobes on the second segment broad and bluntly rounded, reaching back to the posterior margin of the third segment. Genital segment subquadrangular, a little wider than long, its sides only slightly rounded; the papillæ of the fifth legs small, blunt, and situated far back close to the posterior corners, those of the sixth pair larger and more pointed. Abdomen half as wide as the genital segment, much wider than long, somewhat the shape of an hourglass, the sides being reentrant at the groove between the two joints. The terminal joint twice the length of the basal and protruding somewhat at the anus between the bases of the anal lamellæ; the latter of about the same length and width, tipped with four large setæ, the inner one of which is separated a short distance from the others. The first antennæ have a long basal joint which is almost entirely concealed beneath the distal end of the

frontal plates. In the second pair the middle joint is considerably swollen, while the terminal claw is rather slender and weak. There is only one pair of adhesion pads, situated just behind the bases of the first antennæ and close to the edge of the carapace. The pair that usually accompanies the second antennæ have degenerated into minute disks, too small to be of any service for prehension.

The mouth-tube and second maxillæ are similar to those in the male of *sinuatus*; the first maxillipeds are stout, both joints considerably swollen, the terminal claw straight and more than twice the length of the secondary one. The second pair are also much swollen, and are armed with a strong forceps made of two stout knobs whose inner surfaces are flattened where they come together. The arrangement of the spines and setæ on the swimming legs is as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second exopod, 1, I; 4, IV: endopod, 0, I; 0, VIII: third exopod, 1, I; 4, V: endopod, 0, I; 0, V: fourth exopod, 1, 0; 4, V: endopod, 0, I; 0, IV.

Total length, 7.57 mm.; length of carapace to tips of lateral lobes, 4.43 mm.; width of same, 4.23 mm.; length of free segment, 2 mm.; length of genital segment, 1.4 mm.

Color (preserved material) a uniform yellowish brown without pigment markings.

This species was established by Rathbun in 1886 upon two specimens taken from a dusky shark, *Carcharhinus obscurus*, Cat. No. 6198, U.S.N.M. Another specimen, Cat. No. 8119, U.S.N.M., was found upon an undetermined shark, taken in Vineyard Sound, and four specimens, Cat. No. 6022, U.S.N.M., upon a sand shark, *Carcharias littoralis*, from the same locality. Since the publication of the species five other lots have been secured; two of these, were obtained from sand sharks at Woods Hole; one, Cat. No. 32734, U.S.N.M., includes five young females in different stages of development; the other, Cat. No. 32732, U.S.N.M., includes a single male which is made the type of the species. Another lot, Cat. No. 6195, U.S.N.M., containing two females was found on Atwood's shark, *Carcharodon carcharias*; a second lot of three females, Cat. No. 11614, U.S.N.M., was found on a "Gray" shark in Vineyard Sound; a third lot of four females, Cat. No. 32754, U.S.N.M., from the back of a small shark (species not given) taken in the Gulf of Mexico.

The chief variation in these specimens is in the amount of pigment on the carapace and dorsal plates and in the relative size of the third pair of plates; similar variations are found in all pigmented species.

PANDARUS SATYRUS Dana.

PLATE XXXI.

Pandarus satyrus DANA, 1852, p. 1368, pl. xcv, figs. 2 a-c.

Pandarus zygaenæ BRADY, 1883, p. 134, pl. LV, fig. 3.

Female.—General body outline short and wide; carapace widening posteriorly until it becomes broader than long, the posterior lobes short and blunt; posterior margin nearly straight and armed with eight or ten small spines or teeth. Frontal plates narrow at the center, wider at the ends, covering most of the basal joints of the first antennæ. Eyes concealed in mature specimens by the dark pigment of the carapace.

Thorax plates of the second segment elliptical, strongly divergent, wide and long, reaching beyond the center of those on the fourth segment; central plate between their bases narrow. Plates of the third segment small, nearly circular in outline, with a shallow median sinus; those of the fourth segment also circular, with a wide but not very deep median sinus; they overlap the genital segment beyond its center.

Genital segment ovate, two-thirds as wide as the carapace, and produced posteriorly into a slender conical process on either side of the sixth segment plate and directly over the bases of the anal laminae. Abdomen short and wide, the dorsal or body portion the same length as the ventral plate and reaching about to the center of the sixth segment plate. Anal laminae wide and longer than the sixth segment plate, their outer margins considerably thickened, the inner wings strongly divergent and irregularly toothed. Sixth segment plate ovate or elliptical, from one-half to two-thirds as long as the genital segment.

First antennæ long and slender, the terminal joint club-shaped, as long as the basal joint, and bluntly rounded, both joints well armed with short setæ. Second pair small with a weak terminal claw and one accessory spine. First adhesion pads semielliptical, their outer margins nearly straight, their anterior ends projecting beyond the margin of the carapace; second pair nearly circular, their diameter one-third less than the length of the first pair; third pair small and elliptical; fourth pair also elliptical and a little longer than wide.

First maxillipeds of the usual pattern but stout, the two joints of the same length, the terminal claws corrugated; second pair swollen and armed with a single pair of forceps knobs, close together at the center of the ventral surface.

First swimming legs small and weak, very similar to those of *cranchii*, the base of the terminal joint in the exopod and its tip in the endopod being covered with a large spiny pad or cushion. Second legs also weak, the rami the same size and their joints the same

length, the terminal joint of the exopod tipped with five, that of the endopod with three, curved spines or claws.

Third pair with a large basal joint, carrying at its outer distal corner a spiny pad and two boot-shaped rami, indistinctly two-jointed, the exopod armed with a single spine on the basal joint and a group of five or six large curved spines or claws at the tip of the terminal joint. Fourth legs also with a swollen basal joint and two boot-shaped rami, the endopod without spines, the exopod with one spine on the basal joint, and a group of four on the tip of the terminal joint larger than those on the third legs and curved. No legs visible on the genital segment.

Total length, 8.5 mm.; length of carapace on mid-line, 3 mm.; width of same, 4.2 mm.; length of dorsal plates of second segment, 2.1 mm.; of third segment, 0.8 mm.; of fourth segment, 1.2 mm.; of sixth segment plate, 1.4 to 1.8 mm.; egg-strings unknown.

Color a dark reddish yellow marked with a chocolate-brown blotch covering the center of the carapace, having a light spot on either side of the mid-line in the region of the eyes. There are similar chocolate-brown blotches on each of the dorsal plates, including the sixth segment plate, leaving the margins and angles reddish yellow. In some specimens the pigment is so dense and covers so much of the body that the copepod seems nearly black. The "opaque, dirty white or yellowish white" specimens spoken of by Dana were evidently immature, and their pigment had not yet been formed.

(*satyrus*, a satyr.)

The U. S. National Museum collection includes a single lot of fifteen females of this species, Cat. No. 32753, U.S.N.M., taken from the sides and pectoral fins of a blue shark, *Prionace glauca*, by the Fisheries steamer *Albatross* during the Hawaiian explorations in 1902.

These agree in every particular with the figures and description given by Dana, except that the third pair of dorsal thorax plates in his specimens were relatively shorter. But this is a difference that is likely to occur in any species, and is not therefore of any value. *Pandarus zygænæ* has been given above as a synonym of the present species after a careful examination and comparison of the two. There are two females of *P. zygænæ* in the National Museum collection which were obtained by exchange from G. S. Brady, the author of the species. They are Cat. No. 6857, U.S.N.M., and were taken on *Sphyrna zygaena* at St. Vincent, Cape Verde Islands. Brady's description of this species in the Challenger Expedition Report^a is very short and says nothing whatever of the appendages. Nor is any hint of the latter given in the single figure he published, which he labeled "An adult male, seen from above." He certainly mistook the sex, for his figure and description are those of a female without

^a Vol. VIII, p. 134, pl. LV, fig. 3.

egg-strings and not of a male. Furthermore, the deep cracks in the posterior portion of the genital segment on either side in his figure are more likely to be cracks due to the brittleness of preservation than they are to indicate a normal structure. The species has not been noted by other investigators, the only mention of it being in the list published by Bassett-Smith in 1899. The two specimens mentioned above were evidently covered with fish slime when preserved, and this has become so incrustated around the appendages as to conceal many of the details. Enough can be made out, however, to show the identity of Brady's species with that of Dana, which had been described thirty years before, and hence it must stand as a synonym of the latter. Brady's specimens were a little shorter than Dana's, and were lighter in color, the plates on the third segment and the genital segment being without pigment. This would indicate that they were not fully mature, which is further evidenced by the fact that they had no egg-strings.

PANDARUS SINUATUS Say.

PLATES XXXII and XXXIII.

Pandarus sinuatus SAY, 1817, p. 436.—MILNE EDWARDS, 1840, p. 471.—SMITH, 1874, p. 576, pl. VII, fig. 31.—RATHBUN, 1886, p. 310, pls. V-VII.

Female.—Carapace semielliptical to ovate, broader behind than in front, and a little more than one-third the entire length; width to length as 6 to 5; posterior lobes short, more or less acute, and turned inward at the tips; posterior margin when perfect with a rounded median projection bordered on either side by three or four short and sharp teeth. Usually, however, all the projections are bluntly rounded and irregular, making the margin jagged and sinuate, as in figure 172. Frontal plates narrow and but little prominent, not covering more than half the basal joints of the first antennæ. Eyes invisible in the adults, visible in the young, one-third the distance from the anterior margin, and close together on either side of the mid-line.

Paired dorsal plates of second segment broadly elliptical to oval, one-half longer than wide, diverging at an angle of about 30° from the central axis; their inner margins are sometimes nearly straight or may even be concave; they are widely separated and scarcely touch the second pair, but reach back to the center of the lateral margins of the third pair. The unpaired median plate of this second segment is very wide, comparatively short, with a straight posterior margin without teeth or spines.

Dorsal plates of the third segment small, nearly circular and separated by a deep sinus, which is slightly enlarged at its base; owing to the wide separation of the first plates this second pair are entirely

visible in dorsal view. Dorsal plates of the fourth segment considerably enlarged, wider than the genital segment and covering its anterior third or two-fifths, thoroughly fused with only a broad and very shallow posterior sinus.

Genital segment elliptical, one-fifth longer than wide; posterior lobes broad and evenly rounded, with a shallow median sinus.

Sixth segment plate small, its margin forming four-fifths of a perfect circle, the remaining fifth narrowed into an anterior stem or neck where it joins the genital segment. It projects behind the lobes of the genital segment for a half or two-thirds of its length. Anal laminae rather narrow and slender, as long as the sixth segment plate, acute at the tips and armed with two or three small spines irregularly placed on the inner margin; wings entirely lacking in the adult. Ventral plate of the abdomen much wider than the sixth segment plate, its posterior margin usually evenly rounded.

First antennae slender, the basal joint three times the length of the terminal, its distal end enlarged, the anterior margin and corner evenly rounded and well armed with setae; terminal joint club-shaped, with a tuft of setae at the tip.

Second antennae slender, the second joint with a small fleshy lamina on its ventral surface, the terminal claw short and weak.

First adhesion pads elliptical, three-fourths longer than wide; second pair obovate, one-half longer than wide, but much shorter than the first pair; fourth pair elliptical, a little more than twice as long as wide, and longer than the first pair.

Mouth-tube of the usual shape, narrower and longer than in *bicolor*; mandibles like those of *smithii*; second maxillae short and broad, the basal joint twice as wide as long, the second joint as wide as long and ending in a slender and sharp spine which is nearly straight. First maxillipeds slender, the basal joint half as long again as the terminal; the latter armed with a terminal curved claw, nearly as long as the joint itself, a shorter and straighter accessory claw, toothed along both margins, on its ventral surface, and a short and straight spine on the inner margin, both the latter being inserted at the base of the terminal claw.

Second maxillipeds much swollen, armed with a pair of knobs acting like forceps; knobs oblong, the ends where they come together being flattened and corrugated.

Basal joints of the swimming legs increasing in size from in front backwards, all biramose and the rami two-jointed, but the joints on the fourth pair are thoroughly fused, and the jointing is only indicated by marginal notches. The arrangement of the spines (there are no true setae) on the different legs is as follows: First exopod, 1, 5; endopod, 0, 3; second exopod, 1, 9; endopod, 0, 5; third exopod, 1, 4 to 8; endopod, 0, 3; fourth exopod, 1, 3 to 5; endopod, 0, 0. The

relative size and shape of the four pairs of legs and their joints are shown in Plate XXXII, figs. 177 to 180, the magnification being the same for each.

Of the reproductive organs the oviducts are usually coiled once in the genital segment, each strand of the coil reaching the entire length of the segment. But sometimes there is a short extra coil in the extreme anterior portion of the segment. The cement glands are exceptionally large and broad and arranged like parenthesis marks on either side of the intestine; the basal third of each is enlarged to twice the width of the oviduct, is more or less rounded, and extends outward and forward at an angle of 45° to the central axis. The remaining portion, or body of the gland, is once and a half the width of the oviduct, curves around inward toward the intestine, and extends almost to the anterior border of the segment; the compound cells are short and flattened like the eggs. The semen receptacle has the shape of a spear or lance head, with a narrow tapering central sinus. The two halves are joined anteriorly at the point of the spear, and each has on its outer margin a rounded point or knob, corresponding to the barb.

Total length, 7 to 8 mm.; length of carapace on mid-line, 2.75 mm.; width at posterior margin, 3.3 mm.; length of first dorsal plates, 1.5 mm.; of second pair, 0.75 mm.; of third pair, 1.25 mm.; of sixth segment plate, 1 mm.; of abdomen, 2.25 mm.

Color dull yellow or yellowish white, with a spot on either side near the frontal margin of the carapace, or with the spots fused across the mid-line into a horseshoe-shaped blotch opening posteriorly. There is also a central irregular blotch on the third pair of dorsal plates. In mature females the pigment of the eggs in the coiled oviducts give the genital segment a grayish or brownish tinge. From this mean the color varies in both directions. In specimens from the Smooth Dogfish the brown or black markings often cover most of the carapace, all of the fourth segment plates, and a part of those on the second and third segments. On the other hand, specimens taken from Atwood's Shark and immature specimens from whatever source show no pigment at all, or only the faintest traces of it.

(*sinuatus*, sinuate, alluding to the posterior margin of the carapace.)

Male.—Carapace orbicular, wider than long, with the lateral margin evenly rounded; posterior lobes broadly triangular and curved a little inward toward the mid-line; supplementary lobes very short, at least three times as wide as long and close to the bases of the posterior lobes. In preserved material these secondary lobes often turn white or whitish and become opaque. Lateral grooves bent sharply outward at the anterior ends, nearly at right angles to the longitudinal axis, and terminating just behind the sucking disks.

Frontal plates nearly as wide as the carapace, projecting over the bases of the first antennæ and thus very prominent.

Free thorax segments about the same length but diminishing rapidly in width from in front backwards. The second segment does not entirely fill the space between the posterior lobes of the carapace and only slightly overlaps the inner margins of the secondary lobes; its lateral plates are broad and enlarged at the tip into a spatulate form, the posterior margin being nearly straight. Fourth segment one-fifth narrower than the genital segment, its lateral margins with a narrow, sharp curve at the center. Genital segment elliptical, much longer than wide, with evenly rounded corners. Fifth legs small and blunt, slightly enlarged at the tips and carried forward some distance in front of the sixth pair; the latter are a little longer, are situated at the posterior corners, and nearly always curve inward toward the mid-line. Inside of each and close to its base, on the posterior margin of the genital segment, is a single large spine. Abdomen elongate, longer than wide, the two joints of the same length; the basal one spindle-shaped, the terminal one wedge-shaped, with no protuberance between the bases of the anal laminae; the latter are nearly twice as long as wide, with the ends rounded diagonally, the outer margin being the longer. Each is armed with four setæ, the inner of which is removed some distance from the others.

The first antennæ are the normal size and shape, the basal joints being almost wholly covered by the projecting ends of the frontal plates. The first adhesion pads are ovate, with their longitudinal diameters inclined at an angle of 45° to the body axis. They are placed so near the edge of the carapace behind the first antennæ that nearly half the pad projects beyond the carapace and is visible in dorsal view, affording a good secondary means of identification of the species. The second pair is just outside the bases of the second antennæ, elliptical in form, with their long diameters parallel to the body axis.

The third pair are egg-shaped and in the usual position between the first maxillipeds; the fourth pair are elongate-elliptical, on the lateral margins of the second segment lobes, and parallel with the body axis. The first and second pairs are much smaller in the male than in the female, which would show that they do not function as clasping organs.

The second antennæ are larger than in the female; the two basal joints are considerably swollen besides sharing in the formation of the adhesion pad. The terminal claw is large and stout and is armed on its outer margin with two large accessory spines, one near the base and the other at the center.

The first maxillipeds have a stout basal joint and a short and slender terminal joint, with two accessory claws on its inner margin

close to the base of the terminal claw. The ventral of these two claws is more than twice the size of the dorsal. The second maxillipeds are much enlarged, relatively more so than in the female, and evidently they, with the second antennæ, form the chief clasping organs. They are armed with a stout and well-developed terminal claw, which shuts down against a group of three tuberculated knobs placed side by side on the basal joint. This combination of claw and forceps pinchers gives these copepods a very firm hold upon their host.

The arrangement of the spines and setæ on the swimming legs is as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second exopod, 1, I; 4, VI: endopod, 0, I; 0, VIII: third exopod, 1, I; 4, V: endopod 0, I; 0, V: fourth exopod, 1, I; 4, V: endopod, 1, I; 0, V. The sperm duct is coiled into a large bunch near the center of the genital segment on either side, and its posterior end then opens into a boot-shaped spermatophore receptacle which lies between the bunch and the posterior end of the genital segment, and whose long diameter is inclined at an angle of 45° to the central axis. The anterior end of this receptacle is narrowed into a sort of pointed appendix which curves around forward and inward. The posterior end is bluntly rounded and from it a short tube leads to the genital opening, which is near the posterior corner of the genital segment.

Total length, 7.23 mm.; length of carapace on the mid line, 3 mm.; width of same, 4 mm.; length of free segments, 1.63 mm.; of genital segment, 1.72 mm.; of abdomen, 1 mm.

Color the same as that of the female except that there are no pigment spots or blotches and the body is quite transparent.

Young females.—The smallest female thus far obtained is a little less than 5 mm. in length (fig. 182). In this the carapace is nearly half the entire length, as long on the mid-line as it is wide, with narrow lateral areas and short triangular posterior lobes. The posterior margin between these lobes is very wide and irregularly sinuate, the general direction being nearly straight. Eyes plainly visible one-third the distance behind the frontal margin, three in number, arranged in a triangle, the middle one posterior. Frontal plates wide and prominent and covering the whole of the basal joints of the first antennæ. Lateral areas divided considerably behind their center by a transverse groove representing the boundary line between the head and the first thorax segment. Second segment filling the entire space between the posterior lobes of the carapace, its lateral plates short, broad, and well rounded at their tips. The median plate of this segment has not yet been differentiated, but the two lateral plates are fused in a wide band across the mid-line. The dorsal plates of the third and fourth segments have just started and overlap the segments following them scarcely at all. The genital segment is elliptical, much smaller than in the adult female (less than half the width and

length of the carapace); its posterior sinus is very broad, with a squarely truncated base, while the posterior lobes are narrow and short. The abdomen projects nearly its whole length behind the sinus of the genital segment, and is plainly visible in dorsal view. The sixth segment plate has only just started, and covers less than half the dorsal surface of the abdomen. Anal laminae of the same pattern as in other genera of this subfamily, narrow and long, each tipped with four plumose setae. Appendages like those of the adult with the exception of the fourth swimming legs, in which the rami are much smaller, less laminate, and the exopod is armed with claws similar to those on the third legs, and is indistinctly jointed. The fourth endopod, however, even at this early stage is wholly devoid of spines or setae, and shows no signs of segmentation.

The *Nauplius* has already been described on page 336; owing to the inability of the female to move about when placed in an aquarium, the eggs always die unless they were just on the verge of hatching when obtained. This makes it difficult to secure the nauplii, and explains how it happens in a genus as common as *Pandarus* that they have not been seen and described oftener.

This species was first described by Say in 1817, from specimens taken from the dog-fish, *Squalus canis* Mitchill, and preserved in the cabinet of the Academy of Natural Sciences in Philadelphia. The original description was brief and lacked many details, but enough was presented to identify the species, and the missing details were supplied in an excellent description given by Rathbun in 1884. But neither author found the male, and that sex is here presented for the first time, together with additional information upon the anatomy of the female. The abundance of the species upon the sharks common along our Atlantic coast is proven by the following list of the specimens in the U. S. National Museum. Most of these were found upon the fins of the sharks, attached in such a way that the egg-cases would float free from the margin of the fin in the clear water (fig. 1). Hence the *Pandarus* always has its head toward the head of the shark; when more than one are found on the same fin they are attached side by side and strictly parallel, often as many as eight being found on one side of a single fin, and as many on the other side. Usually these females have algæ and protozoa of various kinds growing upon their carapace and dorsal plates; these are fastened to the margins and angles of the plates and float back in the water around the egg-strings.

Often the female will be so completely covered that none of the dorsal surface can be seen (fig. 1). The fins most commonly chosen are the dorsal, the anal, and the ventral. Specimens are less often found on the pectorals or the tail.

All the following specimens were taken at Woods Hole or in the immediate vicinity, unless otherwise stated:

From Atwood's shark, *Carcharodon carcharias*, Cat. No. 6172 U.S.N.M. (20 females); Cat. No. 6195, U.S.N.M. (2 males); Cat. No. 32756, U.S.N.M. (1 adult and 5 young females).

From sand shark, *Carcharias littoralis*, Cat. No. 6021, U.S.N.M. (25 females); Cat. No. 6023, U.S.N.M. (1 male); Cat. No. 6028, U.S.N.M. (8 females); Cat. No. 6029, U.S.N.M. (5 males); Cat. No. 6030, U.S.N.M. (3 young females); Cat. No. 6034, U.S.N.M. (15 females); Cat. No. 6041, U.S.N.M. (1 female); Cat. No. 6042, U.S.N.M. (2 males taken with Cat. No. 6041, U.S.N.M.); Cat. No. 6075, U.S.N.M. (2 males and 2 females, 1 pair in coition); Cat. No. 6202, U.S.N.M. (3 females); Cat. No. 6206, U.S.N.M. (2 males); Cat. No. 6208, U.S.N.M. (1 female); Cat. No. 8121 U.S.N.M. (6 females); Cat. No. 8128, U.S.N.M. (2 males); Cat. No. 10744, U.S.N.M. (20 females); Cat. No. 12227, U.S.N.M. (2 females); Cat. No. 12674, U.S.N.M. (5 females); Cat. No. 12675, U.S.N.M. (10 females); Cat. No. 32730, U.S.N.M. (5 young females); Cat. No. 32745, U.S.N.M. (2 males); Cat. No. 32746, U.S.N.M. (a young female); Cat. No. 32748, U.S.N.M. (20 females very pale in color without pigment); Cat. No. 32749, U.S.N.M. (a male and female in coition); Cat. No. 32750, U.S.N.M. (a male); Cat. No. 32751, U.S.N.M. (4 young females and 2 males); Cat. No. 32755, U.S.N.M. (5 females); Cat. No. 32759, U.S.N.M. (10 females and 2 males, 1 pair in coition); Cat. No. 32762, U.S.N.M. (5 females); Cat. No. 32763, U.S.N.M. (10 females and 5 males); Cat. No. 32764, U.S.N.M. (5 females); Cat. No. 32766, U.S.N.M. (25 females); Cat. No. 32767, U.S.N.M. (25 females); Cat. No. 32768, U.S.N.M. (5 females); Cat. No. 32769, U.S.N.M. (5 females); Cat. No. 32770, U.S.N.M. (20 females); Cat. No. 32774, U.S.N.M. (30 females and 3 males); Cat. No. 32755, U.S.N.M. (5 females).

From smooth dogfish, *Mustelus canis*, Cat. No. 6046, U.S.N.M. (5 females); Cat. No. 6199, U.S.N.M. (5 females); Cat. No. 6203, U.S.N.M. (3 females); Cat. No. 6207, U.S.N.M. (1 female); Cat. No. 8124, U.S.N.M. (1 female); Cat. No. 8125, U.S.N.M. (1 male taken with Cat. No. 8124, U.S.N.M.); Cat. 8126, U.S.N.M. (2 young females); Cat. No. 10745, U.S.N.M. (3 females); Cat. No. 16090, U.S.N.M. (3 females and 1 male, taken off Avon, N. J.); Cat. No. 32733, U.S.N.M. (2 young females and 1 male); Cat. No. 32758, U.S.N.M. (2 females); Cat. No. 32760, U.S.N.M. (8 females); Cat. No. 32761, U.S.N.M. (3 females).

From dusky shark, *Carcharhinus obscurus*, Cat. No. 6031, U.S.N.M. (1 male); Cat. No. 6032, U.S.N.M. (1 male); Cat. No. 32747, U.S.N.M. (3 females and 1 male); Cat. No. 32773, U. S. N. M. (3 females).

From mackerel shark, *Lamna cornubica*, Cat. No. 32765, U.S.N.M. (75 females).

From sharp-nosed shark, *Scoliodon terræ novæ*, Cat. No. 32771 U.S.N.M. (2 females, taken at Beaufort, North Carolina).

From the outside of a menhaden, Cat. No. 32734, U.S.N.M. (1 male).

From "Shark," no species given, Cat. No. 8640, U.S.N.M. (6 males taken at station 2237, steamer *Albatross*, 1884); Cat. No. 12670, U.S.N.M. (35 females); Cat. No. 32757, U.S.N.M. (1 male).

No locality or host given, Cat. No. 6028, U.S.N.M. (1 female).

Genus NESIPPUS Heller.

Nesippus (*N. orientalis*) HELLER, 1865, p. 193.

Nogaus (*N. augustatus*) VAN BENEDEN, 1892, p. 246.

Female.—Carapace transversely elliptical, much wider than long, with broad lateral areas and posterior lobes. Frontal plates distinct, prominent, covering the basal joints of the first antennæ. Eyes small, three in number, in a triangle near the anterior margin. Second and third thorax segments fused together, and carrying a single pair of more or less rectangular plates or lobes on their sides. Fourth segment free, with no dorsal plates, or with a very small pair scarcely overlapping the genital segment. The latter elliptical, much longer than wide, with an evenly rounded outline; no posterior lobes. Abdomen small, attached to the ventral surface of the genital segment, and nearly hidden in dorsal view; anal laminae of medium size, wholly visible, each armed with four large setæ.

First antennæ like those of *Pandarus*; second pair uncinatè; first adhesion pads much larger than the second, the two quite a distance apart. Mouth tube similar to that of *Pandarus*; second maxillæ three-jointed, with swollen basès and small terminal claws.

Second maxillipeds much swollen, with a flattened terminal claw. All the swimming legs biramous; rami of the first three pairs two-jointed, of the fourth pair one-jointed, all armed with plumose setæ. Egg tubes slender, straight, much longer than the body.

Male.—Body a typical *Nogaus* form; carapace elongate with narrow lateral areas and posterior lobes; no accessory lobes, as in the *Pandarus* males, but sometimes a large spine on the posterior margin, at the base of the posterior lobe on either side. Frontal plates narrow and not very prominent; eyes three in number, in about the same position as in the female; in front of the eyes there is often a pair of rounded knobs (*Dana's conspicilla*) rising above the surface of the carapace. Free thorax segments the same length but diminishing rapidly in width from in front backward, the fourth as wide as the genital segment; the second segment only with lateral lobes. Genital segment elongate, more or less angular, without lobes or rudimentary swimming legs, or with the latter reduced to small spines. Abdomen small, one-jointed, wider than long, more or less triangular, anal laminae small, but armed with large plumose setæ.

concealed. If it be compared with the figure here given (Plate XXXIV, fig. 205) of a young female *alatus*, its identity is manifest at once.

Beneden made the same mistake in 1892 with his *Nogagus angustatus*, which is shown on page 431 to be a *Nesippus*. He described a young female as a male of the species. Krøyer in 1863 erred in another direction. He found a young female *Nesippus* and a *Nogagus latreillii* upon the same fish and described the two as the male and female of *Nogagus latreillii* (see p. 441).

The true male of the genus has never before been described. This is probably due to the fact that the male stays on the outside surface of the shark's body, in company, usually, with one or both sexes of some of the other genera. The young female stays in the same place, or in the gill cavity close to the surface, until after union with the male, which takes place very early in development, as in all the parasitic copepods, and then she crawls down into the shark's throat out of sight and remains there fastened to the inside of the gill arches. In the examination of several scores of sharks by the present author, a male has never yet been found in company with one of these mature females in the shark's throat, but many have been taken on the fins and in the gill cavity, some of which were in union with young females.

It was difficult, therefore, to locate the two sexes at first and required long continued search before they were definitely determined. This leaves Heller's two species, *orientalis* and *crypturus*, composed of females alone with the male unknown, while Dana's *curticaudis* and Steenstrup and Lütken's *borealis* are known only in the male sex. Dana's species was taken "from the body of a shark, northeast of New Zealand," while both of Heller's species came from Java. These localities are near enough together, especially when we remember that the hosts are large sharks, for it to be at least possible that future investigation will find two of the species more closely related.

NESIPPUS ALATUS Wilson.

PLATES XXXIV and XXXV.

Nesippus alatus WILSON, 1905, p. 130.

Nogagus tenax (?) STEENSTRUP and LÜTKEN, 1861, p. 388, pl. x, fig. 20.

Female.—Carapace transversely elliptical, the width once and three-quarters the length; frontal plates distinct, and, together with a portion of the cephalic area, projecting in a half circle from the anterior margin; deeply incised at the center. Posterior lobes short, scarcely overlapping the lateral lobes of the second and third segments; thoracic area quadrilateral, arched a little above the surrounding surface; lateral areas very wide; cephalic area small. Eye distinctly tripartite, appearing as three separate circular lenses arranged in a tri-

angle at the center of the carapace, about one-third the distance from the anterior margin. Second and third thorax segments fused together and carrying a single rectangular lobe or plate on either side, which extends obliquely backward nearly to the tips of the posterior lobes of the carapace. Fourth segment free, considerably narrower than the second and third segments and covered with a pair of fused dorsal plates. Each of these is nearly a perfect circle in outline, in strong contrast to the angular pair on the second and third segments. They do not extend out as far as the latter, but are about the same width as the genital segment, over whose anterior margin they extend for a little distance. Genital segment elliptical, or slightly ovate, with an evenly rounded margin, the length to the breadth in the proportion of 8 to 5. Abdomen invisible in dorsal view, but the two large anal laminae project nearly their entire length behind the posterior margin of the genital segment. Each of them is as wide as long, and as large as the entire abdomen, and is armed with four slender plumose setae. Seen ventrally, the abdomen is small, triangular in shape, and attached about its own length in front of the posterior margin of the genital segment. The apex of the triangle is represented by the narrow neck where the abdomen joins the genital segment while the broad base is at the posterior margin where the anal laminae are attached.

The first antennae are short and stout, the basal joint nearly twice the diameter of the terminal and thickly studded with setae, the terminal joint furnished with setae along its posterior margin as well as at the tip; second antennae large, with a long and stout terminal claw. First adhesion pads elliptical, close to the margin of the carapace, and more than twice the size of the second pair; the latter nearly circular and removed some distance from the first ones. In the young female these pads appear as short and slightly curved claws, and are then like the corresponding first maxillae in the *Caliginae*. In the adults they are transformed into large pads, fastened for their entire length to the ventral surface of the carapace. Similarly the pads at the bases of the first maxillipeds are straight spines in the young.

The second maxillae are close beside the base of the mouth-tube and are apparently two-jointed; the basal joint is large and swollen, twice as long as wide; the terminal joint is a short curved claw.

The mouth-tube is long and pointed; the framework consists of a slender rib along either side extending from the base to the tip and almost perfectly straight, with the ends somewhat enlarged; the ends at the tip are joined by their inner margins, while those at the base are joined by a chain of three circular plates, the central one being considerably larger than the other two.

From the two side plates a pair of secondary ribs extend forward and inward, each pointing toward the tip of the maxilla on the opposite side. The mouth opening is terminal and heavily fringed with hairs. First maxillipeds of the usual form, the secondary terminal claw very short and conical; second pair large and swollen, the basal joint almost twice as wide as long and considerably flattened dorso-ventrally. The terminal joint is shaped like a flexible finger or thumb, and is attached transversely along the outer end of the basal joint.

The four pairs of swimming legs are all biramose, rami of the first three pairs two-jointed, of the fourth pair one-jointed.

The exopods of the first and fourth pairs are longer than the endopods; in the second and third pairs the rami are about equal; the basal joints of the first and fourth pairs are widened, but not more than half as much as those of the second and third pairs. None of these basal joints carry spines or setae except the third pair, in which a very large seta projects diagonally backward from the inner corner. The fifth legs are entirely lacking; the arrangement of the spines and setae on the other four pairs is as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, IV: second exopod, 2, I; 4, V: endopod, 0, I; 0, VI: third exopod, 1, I; 4, IV: endopod, 0, I; 0, IV: fourth exopod, 5, IV: endopod, 0, IV.

The ovaries are large and elliptical in form; they can be seen just above the digestive tract near the anterior margin of the thoracic area of the carapace. The oviduct leads back in the usual way to the genital segment, where it is coiled in three parallel strands running lengthwise along either side of the segment. It finally opens to the exterior on the ventral surface just in front of the abdomen. The cement glands are long and narrow, the cells in each being nearly as long as wide; they lie just beneath the inner coils of the oviduct and are slightly curved, the concave sides toward each other. The semen receptacle is large and crescent shaped; it consists essentially of three spherical pockets or sacs, one on either side below the opening of the oviduct, and the third at the center connecting the two. The duct leading from these lateral sacs is carried past the point where it opens into the oviduct, and is coiled into a blind pointed sac, which turns forward alongside the outer margin of the sperm receptacle (fig. 204).

Total length, 7 mm.; length of carapace, 2.8 mm.; width of same, 3.8 mm.; length of genital segment, 2.7 mm.; width of same, 1.7 mm.; length of egg strings, 13.5 mm.

Color a light yellowish white, fairly transparent and not showing very distinctly against the white background of the shark's throat.

The coils of the oviduct in the genital segment are a darker yellow and opaque; the egg-strings are almost pure white.

Male.—Carapace semielliptical, a trifle wider than long, squarely truncated posteriorly, with a long and narrow lobe at each of the posterior corners. Second and third thorax segments not fused, but distinct, of the same length as the fourth segment, the three diminishing regularly in width, and none of them bearing dorsal plates. Genital segment small, a little narrower than the fourth segment, of about the same length and width, with reentrant corners. Abdomen very short, the basal joint hardly visible beneath the posterior border of the genital segment. The anal laminae are no larger than in the female, but the plumose setae are considerably longer.

The appendages are like those of the female, with the usual sexual modifications in the second antennae and the second maxillipeds. There is a greater difference in size between the adhesion pads of the first two pairs than in the female, the first pair being enlarged. The mouth tube is the same, but the second maxillae are three-jointed, counting the terminal claw; this makes it practically certain that these appendages in the female are also three-jointed, although the two basal joints are usually fused, and they are so designated in the genus diagnosis.

The arrangement of the spines and setae on the swimming legs is as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second exopod, 1, I; 4, V: endopod, 0, I; 0, VIII: third exopod, 1, I; 3, IV: endopod, 0, I; 0, IV: fourth exopod, 4, III: endopod, 0, IV. The basal joints of the second and third pairs carry a medium spine on their outer corner.

Total length, 4.55 mm.; length of carapace, 2 mm.; width of same, 2.3 mm.; length of genital segment, 0.88 mm.

The male is darker in color than the female and usually becomes a deep brown in alcohol; this color is uniformly distributed without pigment spots.

(*alatus*, furnished with wings. None of the other species have dorsal plates of any size.)

Young female.—General body form similar to that of the adult; the carapace is proportionally as wide, with broad and well-rounded posterior lobes and prominent frontal plates. The second and third thorax segments fused, with their single pair of lateral plates even more angular than in the adult, for the external margin of these plates is concave, thereby making the corners acute. No plates on the fourth segment as yet; the genital segment very small and elliptical, the same width as the fourth segment, and one-half longer than wide. Abdomen entirely visible, one-jointed, with reentrant sides and a convex posterior margin; anal laminae larger and the plumose setae longer than in the adult.

The only differences in the appendages are such as are common to young forms; the joints are relatively smaller, while the spines and

setæ are longer; this causes these young females to look much like males, and it deceived even so good an observer as Kröyer. But a careful examination of the genital segment reveals the presence of cement glands and sperm receptacles, and thus precludes any idea that these are males.

This species is found upon the gill arches of the common sand shark, *Carcharias littoralis*, rarely upon the floor or roof of the mouth. In nearly every instance it is solitary, a single female being fastened to either the fifth or the fourth arch on the posterior side, so that all one can see of it on looking down the shark's throat is the white or brownish egg-strings.

They are fastened rather more securely than *Pandarus*, by means of their second maxillipeds, and it requires considerable effort to dislodge them. On being removed to an aquarium it is found that the females can not swim, but are fully as helpless as the other genera in this subfamily, lying upon their backs and keeping their swimming legs in constant motion. They can be kept alive for a longer period than *Pandarus*, however, and seem much more hardy. The anterior portion of the body, including the carapace and free thorax segments, is very transparent and colorless. Hence it would be difficult to distinguish the animal against the white background of the shark's throat were it not for the fact that the digestive tube is dark colored, the coiled oviduct in the genital segment is brown, and the egg-tubes are also brown. The latter are long and slender and appear fragile, looking as if they would pull apart on slight provocation; but the very reverse is found to be true. Indeed they are so tough that the body of the female will pull apart at the fourth segment before the egg-strings will break.

In the living copepod these egg-strings are always encased in a heavy layer of mucus obtained from the shark's gills, and they often have in addition a growth of algæ or other foreign matter mixed with the mucus. When these substances extend up onto the genital segment of course they help to hold the egg-strings in place. But it not unfrequently happens that they fail to reach the genital segment, and in that case the egg-strings have to hold the entire mass in place. As the copepod is almost always found on the inside of the gill arches, or at least with the posterior part of the body and egg-strings on the inside, it must be subjected to more or less friction from the convulsive movements of the living fish upon which the shark feeds.

The utility, therefore, both of the heavy coating of mucus over the egg-strings, and of their secure attachment to the genital segment, becomes very apparent. The males are good swimmers and very active, like other *Nogaus* species, and in the aquarium they move about restlessly.

This can not be regarded as an abundant species, since in only one or two instances has more than a single adult female been found on the same fish. But it may be said to be common, since nearly every shark so far examined has yielded its specimen.

The U. S. National Museum collection includes the following, all from Woods Hole and vicinity unless otherwise stated:

From the sand shark, *Carcharias littoralis*, Cat. No. 6029, U.S.N.M. (5 males); Cat. No. 8127, U.S.N.M. (5 males); Cat. No. 32744, U.S.N.M. (1 male); Cat. No. 32788, U.S.N.M. (2 females); Cat. No. 32793, U.S.N.M., (2 females); Cat. No. 32795, U.S.N.M. (young female); Cat. No. 32834, U.S.N.M. (5 males).

From gray shark, Cat. No. 8183, U.S.N.M. (2 females).

From dusky shark, *Carcharhinus obscurus*, Cat. No. 6033, U.S.N.M. (7 males).

From flounder, Cat. No. 32740, U.S.N.M. (1 male).

From caudal peduncle of *Fundulus majalis*, Cat. No. 32743, U.S.N.M. (1 male).

From man-eater shark, Cat. No. 32786, U. S.N.M. (2 females).

From smooth dogfish, Cat. No. 32787, U.S.N.M. (1 male).

From sharp-nosed shark, *Scoliodon terre-novæ*, Cat. No. 32790, U.S.N.M. (1 female); Cat. No. 32792, U.S.N.M. (7 females).

From *Sphyrna tiburo*, at Beaufort, North Carolina, Cat. No. 32791, U.S.N.M. (1 female).

From *Sphyrna zygaena*, also at Beaufort, North Carolina, Cat. No. 32794, U.S.N.M. (10 females).

NESIPPUS ANGUSTATUS Van Beneden.

Nogagus angustatus VAN BENEDEN, 1892, (b), p. 245. pl. I, figs. 5-10.

Pandarus affinis VAN BENEDEN, 1892, (a) p. 226, pl. I, figs. 5 and 7-11 (the male form only).

In 1892 Van Beneden described The Male of Certain Caligids and a new Genus of the Family.^a The second male described was given the name *Pandarus affinis*. Beneden says that this new species was obtained "sur des *Squalus* non déterminés de la baie de Dakar: nous en possédons les deux sexes; une femelle et deux mâles. Le corps de la femelle a une longueur de 6 millimètres; les ovisacs, 10 millimètres; les appendices, en général, sont complètement les mêmes dans les deux sexes, aussi bien ceux de la tête que ceux du thorax."

Then follows a description of the two sexes which is sadly lacking in just those particulars most essential for the determination of the species, namely in the details of the appendages.

The only appendages described for the female are the first antennæ; of the male, nearly all the appendages are mentioned, but no definite data are given for any of them. In the figure showing a dorsal view

^aBulletins de l'Académie royale de Belgique (3), XXIII, No. 3, pp. 220-235.

of the male the rami of the third legs are two-jointed on one side and one-jointed on the other, while those of the fourth legs are both one-jointed. In the ventral view both rami of the fourth legs, and the endopods of the third legs are one-jointed; all the other rami are two-jointed.

Such data are hardly sufficient to decide whether the two specimens are the male and female of the same species or not, nor even that they certainly belong to the genus *Pandarus*.

None of the genera here considered have one-jointed endopods in the third pair of swimming legs. But this is manifestly an error on Beneden's part, and the ramus should have two joints like the exopod. With this one correction, assuming that all the details are accurately stated, the appendages, the general body form, the relative size, and shape of the different segments, and particularly the narrow and elongated posterior lobes of the carapace, correspond exactly with those found in *Nesippus* males.

And at the same time they are radically different from those of *Pandarus* males; in particular the present species lacks the accessory lobes on the posterior margin of the carapace, there are no legs visible on the genital segment, and the abdomen has but a single joint. Furthermore *Nesippus* males are usually found in company with both sexes of other genera on the outside of the host, while the adult females are confined to the gill arches in the throat. We may reasonably conclude, therefore, that while the female undoubtedly belongs to the genus *Pandarus*, the male is not a *Pandarus* at all, but a *Nesippus*.

Later in the same year Beneden published another paper, entitled Some new Caligids from the Coast of Africa and the Azores Archipelago, in the same periodical.^a

The second of the new forms described he calls *Nogagus angustatus*, of which he claims to have found both sexes.

But his mistakes here are even worse than those of the former paper; in the first place his species is not identical with Gerstaecker's *Nogagus angustulus*, as he claims. The difference in spelling is accounted for by the fact that in Gerstaecker's paper (1854) the specific name is spelled "*angustulus*" in the text, and "*angustatus*" in the explanation of the plates. The former was evidently the one intended by Gerstaecker, and it is quoted by Steenstrup and Lütken, and by Bassett-Smith. If any reliance can be placed upon Beneden's figures, there are enough differences, even in a dorsal view, to distinguish the two species at a glance. (See *N. angustulus*, p. 351.)

Again, supposing the male had been the same as Gerstaecker's species, it was long ago proved that the entire genus *Nogagus* is made

^a Pages 241 to 262.

up of the males of other genera, and must wholly disappear as our knowledge of these parasites becomes more complete.

The thing to do, therefore, is not to refer the female to the genus of the male, for the male has no genus, but to do exactly the reverse, take the male out of this heterogeneous collection known as "*Nogagus*" and place him in a valid genus to which the female belongs. Hence, the question to determine is, to what genus does the female described by Beneden belong?

Bassett-Smith suggests (1899, p. 459) that it is a species of *Dysgamus*, but unfortunately no female of this genus has ever been described, so that we have no type with which to compare it.

The *Dysgamus* male, as described by Steenstrup and Lütken, the founders of the genus, is not a *Nogaus* form at all, but one in which the first three segments of the thorax are all united with the head to form the carapace, the fourth segment only being free.

A furca is present, and the details of the appendages, especially the swimming legs, are very different from what we find here.

The female, when found, must belong to the Euryphorinæ, while this female described by Beneden is evidently one of the Pandarinæ. Moreover it presents exactly the characters here given to the genus *Nesippus*; the carapace is wider than long; the second and third thorax segments are fused together and furnished with a single pair of lateral lobes; the frontal plates are conspicuous; the genital segment is elongated; the abdomen is short and one-jointed; the anal laminae are relatively small, but armed with large setæ; the swimming legs are all biramose, the first three pairs are two-jointed, the fourth pair one-jointed.

This "*Nogagus*," therefore, is really a female *Nesippus*, and the species must be called *Nesippus angustatus* Van Beneden, since it is different from those heretofore described.

Beneden made his third mistake in supposing that he had two sexes; what he describes as a male is really not a *Nogaus* form, but a young female, with the egg-strings as yet undeveloped (see p. 444). The true male of this species is probably the form mentioned above, which Beneden described as the male of *Pandarus affinis*. We have already shown that this was not a *Pandarus* but a *Nesippus* male; it came from exactly the same locality, the Bay of Dakar, was collected by the same man, M. Chevreux, and was sent to Beneden in the same lot with the female specimens.

Moreover it corresponds exactly in body form and in so much of the anatomy as can be made out from Beneden's data. We may conclude, therefore, 1, that the female of Beneden's *Pandarus affinis* was a true *Pandarus*, and as such it has been included in the key on page 394; 2, that what he described as the male of the same

species was really the male of *Nesippus angustatus*; 3, that his *Nogagus angustatus* was not the same as Gerstaecker's *N. angustulus*; 4, that it was not a *Nogagus* at all, nor did it even include the male sex, but was made up of two females, an adult with egg strings which he recognized as a female, and an immature female without egg strings, which he called a male. Both sexes of this new *Nesippus* species have been included in the key on page 425.

NESIPPUS CURTICAUDIS Dana.

PLATE XXXVI.

Specilligus curticaudis DANA, 1852, p. 1375, pl. xcv, figs. 6 a-h.—CLAUS, 1875, p. 352, pl. xxiv, fig. 32.—THOMSON, 1889, p. 365.

Nogagus curticaudis STEENSTRUP and LÜTKEN, 1861, pp. 383 and 390.

Male.—Carapace elliptical, a trifle wider than long, excluding the posterior lobes, with an evenly rounded anterior margin and a slightly concave posterior margin between the lobes.

Frontal plates narrow-linear and following closely the contour of the frontal margin of the carapace, not appreciably enlarged at the ends as in *borealis*. Posterior lobes very narrow, reaching nearly to the posterior margin of the third thorax segment, and turned outward a little. Eyes visible with difficulty, on the median line in the usual position; just in front of them and separated a little are the large prominent conspiciilla noted by Dana (see below), one on either side of the body axis.

The three free thorax segments are about the same length, but decrease regularly in width, the fourth being five-eighths as wide as the second. The lateral lobes of the second segment are narrow and extend diagonally backward as far as the posterior border of the third segment.

Genital segment the same width as the fourth segment, elliptical, a little wider than long, and squarely truncated both anteriorly and posteriorly. Its sides are evenly rounded and each shows just in front of the posterior corner a small papilla armed with a single spine. There is a well-defined furrow on either side of the dorsal surface, about one-fourth the width from the lateral margin. The surface between these grooves in the center of the segment is more strongly arched than that of the margins. The abdomen is triangular, considerably wider than long, with the apex projecting between the anal laminæ and deeply incised. Anal laminæ also triangular, reaching a little beyond the tip of the abdomen, and each armed with three large setæ. First antennæ rather slender, but both joints armed with long and bushy plumose setæ; second pair stout, the basal joint armed with a large roughened knob on its posterior margin, the terminal claw rather short, but stout and strongly curved. Mouth-tube long and slender, with the mandibles protruding at the

tip; mandibles of the shape usual in the Pandarinae, the interlocking teeth along the inner margins being minute and triangular. Second maxillæ with the basal joint not enlarged as much as in *alatus*, the terminal spine long, pointed inward toward the mouth-tube, and somewhat enlarged at its base on the outer side. First maxillipeds with a terminal claw fully as long as the joint which bears it, and strongly curved. The accessory claw arises from the posterior border close to the base of the terminal claw, and is about half the size of the latter. Second maxillipeds much swollen, the very broad basal joint with a pair of knobs on its ventral margins, while the knoblike pinchers of the terminal joint cover the whole of that portion of the surface.

The spines and setæ on the swimming legs are arranged as follows: First exopod, 1, 0; 3, III: endopod, 0, 0; 0, III: second exopod, 0, I; 4, VI: endopod, 0, I; 0, VII: third exopod, 1, 0; 3, V: endopod, 0, I; 0, IV: fourth exopod, 4, IV: endopod, 0, IV.

Total length, 6.53 mm.; length of carapace on mid-line, 2.5 mm.; width of same, 2.7 mm.; length of free segments, 2.1 mm.; length of genital segment, 1.33 mm.

Color (preserved material) a uniform brownish yellow without pigment spots; the pigment of the paired eyes a deep blue, of the unpaired eye a bright red.

(*curticaudis*: *curtus*, short, and *cauda*, tail.)

This species was originally described by Dana in 1852 and made the type of a new genus called "*Specilligis*" from the lenticular bodies or conspicilla situated in front of the eyes. In his genus diagnosis Dana says: "The essential point of difference between this genus and *Nogagus* is the existence of two large transparent cornæ (conspicilla) exactly like those of the Sapphirinae. These conspicilla are attached to the exterior shell, but with some difficulty may be separated. On pressure they proved to be brittle, though rather hard."

We now know that similar conspicilla are present in other *Nesippus* and *Perissopus* males, and occasionally in those belonging to some of the other genera. Being common to several genera, therefore, they would have no generic value; furthermore, they are not found at all in the females of any genus.

These two facts entirely destroy Dana's distinctions and leave us simply the problem of locating this male among the genera belonging to the Pandarinae.

Steenstrup and Lütken in 1861 call attention to the fact that this species was taken in company with Dana's *Nogagus validus* and *Pandarus brevicaudis*, on the same day and spot, and presumably from the same fish. They also call the species *Nogagus* instead of *Specilligis*, but offer no explanation for the change.

We have already shown that *Nogagus validus* and *Pandarus brevicaudis* are probably the male and female of the same species, and hence the fact that the present species was found with them would not be specially significant.

Claus in 1875 mentions a similar form found in the Mediterranean, and concludes that Dana's *Specilligus* is really a *Nogagus* male of some genus belonging to the Pandarinæ. He only mentions the genera *Dinematura*, *Echthrogaleus*, and *Pandarus*, but if we interpret his meaning aright these are given rather as samples than as comprising the only genera to which *Specilligus* could belong.

Gerstaecker in Brohn's Thierreich considered that this genus of Dana's was very closely related to if not identical with *Nogagus*. Thomson mentions the species in his Parasitic Copepoda of New Zealand (1889), but adds nothing new in the way of description or identification.

Bassett-Smith in 1899 makes "*Nogagus curticaudatus*" a synonym of *Gangliopus pyriformis*, referring to Steenstrup and Lütken for his authority. But he made a bad mistake both in his spelling of the specific name and in his reading of the Danish paper referred to. Steenstrup and Lütken declare that Gerstaecker's *Nogagus angustulus*, and not the present species, was taken on the same fish with *Pandarus dentatus* Edwards and *Gangliopus pyriformis* Gerstaecker. The statement they make in reference to Dana's species has already been given.

It is therefore practically certain that the present species is a *Nogagus* form, that it does not belong to any of the genera just mentioned, and that it does conform in all its details with the male of the genus *Nesippus*. Dana's description, though brief, is very accurate and his figures are excellent, but as the Museum collection contains several fine specimens of the species a more complete description has been given to accompany this definite location in the genus *Nesippus*. There are two lots of specimens, one, Cat. No. 6917, U.S.N.M., taken from a *Carcharias* between Papua and Japan on the Challenger Expedition, and obtained through exchange with G. S. Brady, of England; the other, Cat. No. 32742, U.S.N.M., contains five males taken from a 10-foot shark at Station 2422 by the Fisheries steamer *Albatross* in 1885. With reference to the conspicilla they show plainly in some specimens, while in others from the same bottle they can be seen only under strong light, transmitted through the body of the specimen. They evidently belong to the internal anatomy and bid fair, on further examination, to be closely related to the frontal attachment gland.

NESIPPUS BOREALIS Steenstrup and Lütken.

PLATE XXXVII.

Nogagus borealis STEENSTRUP and LÜTKEN, 1861, p. 387, pl. XI, fig. 21.—BASSETT-SMITH, 1899, p. 460.

Male.—Carapace strongly arched dorsally, about the same length and width, exclusive of the posterior lobes; narrowed anteriorly to a broad and rounded knob which projects over and some distance in front of the proximal ends of the frontal plates. Eyes large, placed far forward on either side of the median line, in contact with each other, but not fused. The frontal plates are enlarged at their distal ends and evenly rounded, and they cover the basal joints of the first antennæ. Posterior lobes narrow and reaching a little beyond the center of the second thorax segment; posterior margin between the lobes slightly concave and perfectly smooth. The projection of the carapace forward and the comparative shortness of these lobes is probably due to shrinkage in the alcohol, and is not the normal condition. The entire body of the copepod is perceptibly curled over ventrally, bringing the large conspiciilla in front of the eyes on the very margin in a dorsal view.

Free thorax segments, chiefly noticeable for their great length and contracted width, the two combining to produce an exceptionally elongated appearance. Some of this is no doubt due to the same shrinkage just mentioned, for the segments are all strongly arched and the lateral processes on the first one are turned over toward the ventral surface so as to be nearly invisible dorsally. But the shrinkage can have practically nothing to do with the length of the segments, so that the species is an elongate one under any conditions. In the figure given by Steenstrup and Lütken there has evidently not been as much shrinkage as in the present specimen.

The first free segment is seen to be considerably wider than the two following ones, with nearly straight sides and very small, triangular lateral lobes. The free segments together are the same length as the carapace on the mid-line, and the fourth one is three-fifths the width of the second and the same width as the genital segment.

The latter is longer than wide, with rather sharp corners and slightly convex sides. There are no traces of rudimentary legs either on the lateral margins or the posterior corners.

Posteriorly where it joins the abdomen the segment is narrowed into a sort of neck, and is traversed, on both the dorsal and ventral surfaces, by a pair of longitudinal furrows, one on either side, a short distance from the lateral margin. The ventral surface is flat throughout, while the dorsal surface between the furrows is strongly arched.

Abdomen one-jointed and triangular, with well-rounded angles, one of which, slightly incised, points backward between the anal laminae.

These latter are broad but short and occupy nearly the whole of the free sides of the abdomen; each is armed with four large setæ, one near the anterior margin and the other three bunched together on the posterior margin.

Both joints of the first antennæ are well armed with setæ, some of which are much longer than usual; neither joint has such bushy setæ as portrayed by Steenstrup and Lütken, but they are much better supplied than usual. There is a circular adhesion pad behind each antenna close to the margin of the carapace.

The second antennæ arise near the base of the mouth-tube, are of the usual shape, and end in a powerful claw, strongly curved. The second maxillæ have a stout basal joint, while the terminal spine is long and slender; the same is also true of the first maxillipeds, whose slender claw is nearly as long as the terminal joint. Close to the base of the claw can be seen the spindle-shaped finger mentioned by Steenstrup and Lütken as going out at right angles to the posterior border of the terminal joint, and a group of spines between the finger and the terminal claw and around the base of the latter. The long terminal claw is also fringed with fine spines as in their specimens.

The second mixillipeds have a single knob on the ventral surface of the swollen basal joint, and a pair of pincher-like knobs on the terminal joint. Steenstrup and Lütken give this appendage armed with a long claw instead of the pincher-like jaws, but this is no more of a variation than is commonly found in other species of this genus. As noted on page 330 the second maxillipeds of the males of *alatus* are sometimes furnished with claws and sometimes with pincher-like knobs.

The arrangement of the spines and setæ on the swimming legs is as follows: First basipod, 2 spines: exopod, 1, 0; 3, IV: endopod, 0, 0; 0, III: second basipod, 1 seta: exopod, 1, I; 3, V: endopod, 0, I; 0, VII: third basipod, 1 seta: exopod, 1, 0; 1, V: endopod, 0, I; 0, IV: fourth basipod, naked: exopod, 2, IV: endopod, 0, IV.

Total length, 8.2 mm.; length of carapace, including posterior lobes, 3.8 mm.; width of same, 3.2 mm.; length of free thorax, 2.8 mm.; length of genital segment, 2.1 mm.

Color (preserved material) a uniform yellowish brown, much darker on the genital segment and abdomen, but without pigment.

(*borealis*, northern, all the specimens having come from the far north.)

The U. S. National Museum Collection contains a single specimen of this species Cat. No. 32789, U.S.N.M., which came from an Alaska collection made by Dr. W. H. Dall. The size of this male and of those recorded by Steenstrup and Lütken, which were 11 mm. long, indicates that the female must also be larger than the ones already described.

Genus *PROSÆTES*, new genus name.

Stasiotes rhinodontis WRIGHT, 1874, p. 583, pl. xxxv, figs. 1 to 4.

In the above year E. P. Wright published an account of a new genus belonging to the Pandarinæ, which he named *Stasiotes*.

As this name had been employed by Jan for a snake genus in 1862, the name *Prosætes* is suggested in its place.

The parasites, to the number of 40 or 50, all females, were obtained from the gills of a huge shark, *Rhinodon typicus* Smith, at the Seychelles Islands. This is one of the largest and least known of the sharks, thus explaining the fact that this parasite has not been seen by any other investigator.

Female.—Carapace as broad as long; frontal plates distinct, but not prominent; lateral areas wide and divided by transverse grooves as in *Echthrogaleus*; posterior lobes wide and evenly rounded.

Second thorax segment short, with broad lateral lobes; third segment longer, but without dorsal plates or lobes; fourth segment very small, with a rudimentary pair of dorsal plates fringed with bristles. Genital segment orbicular, wider than long, with a shallow posterior sinus; a pair of legs visible at the posterior corners. Abdomen wedge-shaped, one-jointed, and wholly concealed beneath the genital segment; anal laminae long, narrow, and projecting beyond the posterior margin of the genital segment.

Appendages like those of *Nesippus*; second maxillipeds not swollen, armed with a long terminal claw, both the claw and the joint which carries it furnished with a large spine.

All the swimming legs biramous, rami of the first three pairs two-jointed, with plumose setæ, of the fourth pair with fused joints and non plumose setæ. Egg-strings unknown.

(*Prosætes*, *προσάιτης*, a beggar who is very persistent.)

Genus *NOGAUS* Leach.

This genus furnishes one of the best examples of a potpourri that has ever appeared on the pages of science.

Originally founded by Leach in 1819 upon a single male specimen which he called *Nogaus latreillii*, it quickly grew into a group of a dozen or more species. Nor did these additions cease when it became known that the genus as such could not stand, but new species have appeared at intervals up to the very beginning of the present century. In consequence there are now about twenty of these forms heterogeneously grouped about an imaginary type known as "*Nogagus*."^a

^a Milne Edwards substitutes this spelling for that originally given by Leach, Desmarest, and Burmeister without a word of explanation or justification. Subsequent writers have followed him rather than the founder of the genus.

The genus was very poorly described by its author and by the others who immediately followed him, and to this defect, no doubt, is partly due the confusion which has ensued ever since.

Leach's description is as follows:

Deux courtes soies à la queue, portant plusieurs styles à leur extrémité: les trois premières pièces de l'abdomen ont les côtés arrondis, tandis que le quatrième et le cinquième les ont terminés en pointe: tête en forme de fer à cheval (1819, p. 535).

Desmarest in 1825 copied Leach's description, but made a curious blunder in endeavoring to explain the "deux courtes soies."

For he wrote in his genus diagnosis of *Nogaus*:

Deux courtes soies ou tubes ovifères à la queue, portant plusieurs styles à leur extrémité (p. 340).

Egg-tubes carrying styles at their tip would be an anomaly indeed. Burmeister repeated this blunder in 1833 by declaring:

Ausserdem gehören noch die beiden von Desmarest erwähnten Gattungen *Nogaus* Leach. und *Risculus* Leach. heigher (Caligina), welche sich durch Anhänge am Ende der Eierhalter von allen unterscheiden (p. 331).

These mistakes become doubly ridiculous when we remember that Leach's original specimen, which as yet remained the only one described, was a *male*.

Only a few details were added by other writers and even so good a systematist as Milne Edwards was content to say when defining this genus in his great work on the Crustacea published in 1840:

Il est caractérisé principalement par la structure des pates postérieures, lesquelles, au lieu d'être simples et subambulatoires comme chez les Caliges, sont biramées et natatoires comme celles des paires précédentes (p. 459).

As though this were not common, also, to every genus of the Pandarinæ. Indeed Milne Edwards himself, in describing the genera of the Pandarinæ, states under nearly every one, "Les pates sont conformées comme chez les Nogagues."

He then adds under *Nogagus*:

Le thorax se compose de quatre grands articles bien distincts; et le premier de ces articles (correspondant au second anneau thoracique, le premier anneau étant toujours confondu avec la tête) présente de chaque côté un petit prolongement lamelleux. Enfin, les deux petites lames natatoires qui terminent l'abdomen sont un peu plus développées que chez la plupart des Caligiens (p. 459).

In making this last statement he substituted one error for another; the anal laminae are most certainly not "tubes oviferes," as he recognized, but neither can they be regarded as "lames natatoires."

With regard to their size he evidently failed to consider the fact that he was speaking exclusively of males. The anal laminae in this sex are always larger than in the females, and those possessed by *Nogaus* species are no larger than would naturally be expected.

With reference to his first statement, in spite of the fact that the thorax segments are separate and free, only the first one being joined with the head, nevertheless he places the genus under the "Caligidæ," and not under the "Pandaridæ," where it would legitimately belong. To judge from his tabular key to the various genera this location of *Nogaus* was based upon the fact that none of the species (which he now increases to three) possesses any dorsal plates upon the free thorax.

But again he forgets that these three species are made up exclusively of males, upon whose free thorax there would naturally be no dorsal plates, while the genera which he placed under the Pandaridæ are made up just as exclusively of females, who are the usual plate-bearers. A little reflection also would show that this absence of dorsal plates is more than overbalanced by the freedom of the thorax segments, and particularly by the structure and position of the mouth-parts.

These latter Milne Edwards entirely ignores, when even a cursory examination would have shown that they are like those found in *Pandarus* and allied genera, and considerably different from those of *Caligus* and its near relatives.

The genus being thus founded exclusively upon the characters of the male sex, there has been a constant effort to discover, if possible, a female of some of the species, in order that the genus diagnosis might be completed.

Gerstaecker published in 1853 the first account of a *Nogaus* female, which he called *Nogagus productus*. In discussing the synonymy he makes Müller's *Caligus productus*, Otto's *Caligus paradoxus*, and Nordmann's *Binoculus scxsetaceus* synonyms of his *Nogagus*, and claims that the latter name must stand by priority.

Müller's *Caligus productus* has been proved to be a *Dinematura*, the genus established for it in 1829 by Latreille, while Otto's *Caligus paradoxus* was made the type of the genus *Demoleus* by Heller in 1865. Nordmann's *Binoculus* becomes a synonym of this latter genus. Gerstaecker thus made two mistakes, first in supposing that Müller's female and Otto's male were the two sexes of the same species, and, second, in assuming that Otto's male belonged to the same genus as *Nogaus latreillii*, Leach's original type. These mistakes render his paper of no value so far as the present genus is concerned, for the female which he presents is not a *Nogaus* at all, but a *Dinematura*.

The second attempt at finding a *Nogaus* female was made by Kröyer in 1863. He described (p. 168) several specimens of two kinds of these parasites which had been secured from the outside surface of a large *Carcharias* taken in the open Atlantic.

The larger of the two forms he found to be males, identical with Leach's *Nogaus latreilli*; the smaller ones were females, and he considered them as the females of the same species.

The only reasons actually given for this opinion were that the two forms were found on the same fish and were of the same color.

The statement was also made that a detailed examination confirmed this view, but no details were given.

This assumption of the identity of the two sexes led Kröyer to the further declaration (p. 173) that Dana's *Nogagus validus* and *Specilligus curticaudis*, which were taken together upon one fish, are probably the two sexes of the same species.

Nogagus tenax (Steenstrup and Lütken, 1861) and *Nogagus gracilis* (Burmeister, 1832) he also regarded as females of the same genus.

In fact, Kröyer regarded the two groups into which Steenstrup and Lütken had divided their *Nogagus* species as made up, the one group of males and the other of females.

A careful examination of Kröyer's description, and especially of his excellent figures, makes it reasonably certain that the smaller forms which he called the females of *Nogagus latreilli*, and which were stated to be immature, are really young females of the genus *Nesippus*. If his figures be compared with figure 205 of the present paper, which is certainly an immature *Nesippus*, it will be found that they are so similar as to leave little doubt that they belong to the same genus.

Furthermore, there are in the collection of the U. S. National Museum several lots of specimens obtained by the steamer *Albatross* of the Bureau of Fisheries. Each lot includes the species obtained from a single fish, and in three instances these embrace specimens of *Nogaus latreilli* and *Nesippus alatus*.

The two have been obtained together on the same fish by the author also on several occasions.

As to Dana's two species, *Nogagus validus* and *Specilligus curticaudis*, which have been personally examined and are described on pages 397 and 434, they are both certainly males, and therefore could not very well be the two sexes of the same species. This is also true of all the *Nogaus* species described by Steenstrup and Lütken which have come under the author's observation. They are all males and are clearly so described by those authors.

As the search for a *Nogaus* female progressed it became more and more evident that the forms grouped under the genus name "*Nogagus*" were in reality the males of several different genera.

As early as 1861 Steenstrup and Lütken, in speaking of the Pandarinae, after deploring the fact that both sexes were known of but a single species in the entire subfamily, ask the question, "May not the forms included in the genus *Nogagus* be the true males of those females belonging to the genera *Dinemura*, *Phyllophorus*, *Pandarus*, *Ganglio-*

pus, and *Lepidopus*?" Not being able to answer the question definitely, they concluded to classify all male forms as "*Nogagus*" species, while the females were placed in the other genera. They then divided the "*Nogagus*" forms into two groups and the same division was subsequently adopted by Gerstaecker in Broun's Thierreich. In the latter publication Gerstaecker even names his second subfamily after this genus, calling it the *Nogagina*. The two groups as given by Steenstrup and Lütken are: A, those having the fourth legs biramose, the rami two-jointed, and the "tail" (abdomen) two-jointed; B, those having the fourth legs biramose, the rami one-jointed, and the "tail" also one-jointed.

A comparison of the data given on the following pages will show that this was really the first step toward a separation of the different genera included in this imaginary genus. Under the first group (A) would come the males of *Pandarus*, *Echthrogaleus*, and *Dinematura*, while in the second group (B) would be included the males of *Nesippus* and *Perissopus*. But there are two genera which were not included in either group, *Demoleus*, which belongs in the first group and is the largest of all the *Nogaus* forms, and *Gangliopus*, in the males of which the abdomen is two-jointed, but the rami of the fourth legs have only a single joint.

Gerstaecker reverses the order of the two groups and says nothing about the joints of the abdomen.

Steenstrup and Lütken and Heller place the "*Nogagus*" species under the Pandarinæ; Gerstaecker makes of them a third subfamily, distinct from both the Caliginæ and Pandarinæ, calls it, as noted above, the *Nogagina*, and includes in it along with "*Nogagus*" the genera *Nesippus*, *Demoleus*, *Dysgamus*, *Euryphorus*, *Trebius*, *Elytrophora*, *Alebion*, *Dinematura*, and *Echthrogaleus*.

Most other writers place the *Nogaus* forms under the Caliginæ, even so recent a writer as Bassett-Smith (1899) putting them there. That they really belong with the Pandarinæ was well argued by Hesse in 1883, who gave the following reasons for such a classification: (1) The grooves separating the areas on the dorsal surface of the carapace are not like those in the Caliginæ. This is due to the fact that (2) only one thorax segment is fused with the head, all the others being free, while in the Caliginæ three of the segments are fused with the head and only one is free. (3) The anal laminae are larger and flatter than those in the Caliginæ, and are similar to those in the Pandarinæ. (4) The eyes are not fused on the mid-line, but are separated after the manner of the Pandarinæ, and there is a third eye similar to that in many of the latter. (5) There are no lunules, furca, nor first maxillæ. (6) The mouth-tube is elongated and narrow-conical, terminating in a lanceolate point exactly like that of *Pandarus*, but very different from the short and wide tube of the Caliginæ, which is bluntly rounded at

the tip. (7) The structure of the third legs is radically different from that of the Caliginæ and similar to that of the Pandarinæ (p. 29).

These reasons are well stated and convincing, but unfortunately Hesse made such serious blunders, both morphological and physiological, in this same paper that they have virtually annulled the force of his systematic argument. Some of these errors have already been discussed elsewhere.^a It is sufficient to state here that Hesse describes his "*Nogagus spinacii-achantias*" as a female, with the male unknown. His attempt, therefore, to establish a female *Nogaus* is the third in chronological order. His only apparent reason for considering his specimen a female is the fact that he found a chalimus embryo attached to its carapace.

He accordingly assumes that the adult is the mother and the chalimus is her offspring.

Both the description and the figures which Hesse gives show that the adult is a male and not a female, and in all probability it is the male of "*Pandarus spinacii-achantias*," which Hesse obtained from the same fish and in company with the "*Nogagus*" (see p. 458).

The fourth attempt to find a *Nogaus* female was the publication by Beneden in 1892 of the two sexes of "*Nogagus angustatus*." Beneden states that he considers this the same as Gerstaecker's "*Nogagus angustulus*," the male of which was published in 1854. The difference in the spelling of the two species names is accounted for by a printer's error in Gerstaecker's paper. In the text the name appears as *angustulus*, but in the explanation of the plates it is changed to *angustatus*. But Beneden also made two mistakes here; in the first place the male of his species is quite different from that described by Gerstaecker, (a) in the relative size of the carapace, (b) in the fusion of the second and third thorax segments, which are entirely distinct in Gerstaecker's male, (c) in the size and more especially the shape of the genital segment, (d) in the abdomen, one-jointed and very short in Beneden's specimen, but two-jointed and two-thirds as long as the genital segment in Gerstaecker's species (see pp. 351 and 431).

The second error was in naming the female from the male; if Beneden's figure of the female is at all accurate, it belongs to the genus *Nesippus*. And hence his male becomes a male *Nesippus* instead of the female becoming a female *Nogaus*.

This latter genus is therefore left as it was at the beginning, without a single female representative of any of the species. Indeed, the only female which could possibly bear the genus name *Nogaus* would be the female of Leach's original type *Nogaus latreillii*. But this female is now found to be the form described by Leach in the same paper on the preceding page under the name *Pandarus cranchii*. This genus

^a Proc. U. S. Nat. Mus., XXVIII, pp. 547-548.

Pandarus was established three years previously by the same author, and hence the genus name *Nogaus* becomes a synonym of *Pandarus* and must be dropped.

Such being the condition, it becomes necessary to assort the various *Nogaus* species and connect them as the male sex with the proper females described in other genera. Several efforts have already been made in this direction, but there has been such an utter abandon of even the simplest rules of systematization that it would be deplorable if it were not so ridiculous.

With one or two exceptions, the only reason which an author has offered for considering a *Nogaus* form as the male of any species has been the simple fact that it was found with the female of that species upon the same fish. And some have not even taken the trouble to go thus far, but have considered a similarity of geographical distribution sufficient evidence of probable identity in the two sexes.

Geographical distribution certainly counts for something, and the finding of the two sexes upon the same fish counts for more, but neither of them has any weight at all when compared with morphological details, except in confirmation of the latter.

And yet these morphological details are the very things which have been most neglected. In the preparation of the present paper the author has had occasion to examine in minute detail the various genera which compose the subfamily Pandarinae.

And along with the others came an extended study of this group known as the genus "*Nogagus*." An earnest endeavor has been made to separate these forms upon a morphological basis, and to connect each of the types with the genus which is its morphological counterpart. In this effort the author has been greatly assisted by the fact that he has himself taken three of the types in actual copulation with females of as many different genera. And about the same number have been recorded by other writers who have dealt with the Pandarinae.

The parts of special importance in comparing the various species are the second maxillae, the second maxillipeds, the rami of the swimming legs, the relative size and shape of the genital segment and abdomen, and the presence or absence of the fifth and sixth pairs of legs and of the lens-like protrusions called by Dana (1852) "conspicilla" on the dorsal surface of the carapace.

Using these morphological details as a basis of comparison, we may separate the *Nogaus* forms into the following genus types:

Genus Pandarus.—Carapace broad and well rounded, without conspicilla, but with accessory posterior lobes; genital segment enlarged, showing both the fifth and sixth legs; abdomen two-jointed, joints about the same size; legs all biramose, rami two-jointed; second

maxillæ flattened and laminate; second maxillipeds much enlarged and armed with both claws and knobs. Here belong—

Certainly: *Pandarus bicolor* Scott, 1900.

Nogaus latreillii Leach, 1819.

Nogagus validus Dana, 1852.

Pandarus sinuatus, new male type.

Pandarus smithii, new male type.

Probably: *Nogagus spinacii-achantias* Hesse, 1883.

Genus Demoleus.—Carapace large, orbicular, without conspicilla or accessory lobes; genital segment elongate, no legs visible dorsally; abdomen two-jointed, joints unequal; anal laminae very large; legs all biramose, rami, two-jointed; second maxillæ narrow and spine-like; second maxillipeds not swollen, with a normal terminal claw and no knobs. Here belong—

Certainly: *Caligus paradoxus* Otto, 1828.

Nogagus grandis Steenstrup and Lütken, 1861.

Probably: *Dinematura musteli-lævis* Hesse, 1880.

Genus Perissopus.—Carapace elongate-elliptical, with conspicilla and with minute accessory lobes; genital segment not enlarged, one pair of legs visible in young specimens; abdomen one-jointed; anal laminae small; legs all biramose, rami of first three pairs two-jointed, of fourth pair one-jointed; second maxillæ short, slender, spine-like; second maxillipeds much swollen, with a short, curved claw and corrugated knobs. Here belong—

Certainly: *Perissopus communis*, new male type.

Probably: *Nogagus caelebs* Heller, 1865.

Pandarus cranchii Beneden, 1892 a.

Nogagus elongatus Heller, 1865.

Nogagus lunatus Steenstrup and Lütken, 1861.

Nogagus socialis Olsson, 1869.

Genus Nesippus.—Carapace acorn-shaped, short and wide, with conspicilla, without accessory lobes; genital segment slightly enlarged, elliptical, no legs visible dorsally; abdomen one-jointed; legs all biramose, rami of first three pairs two-jointed, of fourth pair one-jointed; second maxillæ with enlarged and flattened basal joint and slender terminal joint; second maxillipeds much enlarged, the terminal claw flattened and laminate; or with knobs only. Here belong—

Certainly: *Nogagus angustatus* Beneden, 1892 b.

Nesippus alatus Wilson, 1905.

Nogagus borealis Steenstrup and Lütken, 1861.

Specilligus curticaudis Dana, 1852.

Nesippus orientalis Heller, 1865.

Probably: *Pandarus affinis* Beneden, 1892 a.

Nogagus tenax Steenstrup and Lütken, 1861.

Nogagus brevicaudatus Milne Edwards, 1840.

Genus Gangliopus.—Carapace elongate-elliptical, without conspici-
cilla; genital segment enlarged, quadrangular, showing one pair of
legs; abdomen two-jointed, joints equal; anal laminæ small; legs all
biramose, rami of the first three pairs two-jointed, of the fourth pair
one-jointed; second maxillæ narrow and spine-like; second maxilli-
peds swollen, but whether with knobs or claws is not known. Here
belongs probably Gerstaecker's *Nogagus angustulus* found with females
of *Gangliopus pyriformis*.

Genus Echthrogaleus.—Carapace wide elliptical, without conspici-
lla or accessory lobes; second and fourth thorax segments lunate, the
fourth fitting down over the rounded anterior end of the genital seg-
ment; the latter oblong, enlarged, showing one pair of legs; abdomen
two-jointed, basal joint much the smaller; anal laminæ medium sized;
legs all biramose, exopods of the second and third pairs three-jointed,
other rami two-jointed; second maxillæ narrow and spine-like; second
maxillipeds not much swollen, with terminal claw only. Here
belong—

Certainly: *Echthrogaleus braccatus* (male) Heller, 1865.

Echthrogaleus perspicax (male) Thomson, 1889.

Dinematura neozealanica (male) Thomson, 1889.

Probably: *Pandarus armatus* (male) Thomson, 1889.

Genus Dinematura.—Carapace wide orbicular, without conspici-
lla or accessory lobes; genital segment enlarged, oblong, no legs visible;
abdomen two-jointed, joints equal; anal laminæ large; all the legs
biramose, rami of the first and fourth pairs two-jointed, of the second
and third pairs three-jointed; second maxillæ slender, elongate, spine-
like; second maxillipeds moderately swollen, with a terminal claw
only, no knobs. Here belong—

Certainly: *Nogagus productus* Gerstaecker.

Dinematura latifolia, new male type.

Dinematura hamiltoni (male) Thomson.

Probably: *Dinematura elongata* Beneden.

Nogagus gracilis Burmeister.

Indeterminate.—*Nogagus luetkeni* Norman; *Pandarus musteli-*
lævis (male) Hesse; *Pandarus unicolor* (male) Hesse; *Pandarus*
spinacii-achantias (male) Hesse.

Belonging to the Euryphorinæ.—*Nogagus errans* Kröyer; *Nogagus*
murrayi Brady.

In order to complete this review of the *Nogagus* species so far as
present data will allow, each of the thirty-four forms just located
is taken up alphabetically in the following pages, and all available
information with reference to it is given. The five new male types
have, of course, never been referred to the genus *Nogagus*.

PANDARUS AFFINIS (Nogaus male) Beneden.

Pandarus affinis BENEDEN, 1892 a, p. 224, pl. 1, figs. 5 to 11.

The male of *Nesippus angustatus* Beneden (see p. 431).

NOGAGUS ANGUSTATUS Beneden.

Nogagus angustatus BENEDEN, 1892 b, p. 245, pl. 1, figs. 5 to 10.

Two females, adult and young, the latter Beneden's—"male," both belonging to the genus *Nesippus*, species *angustatus* (see p. 432).

NOGAGUS AUGUSTULUS Gerstaecker.

Nogagus augustulus GERSTAECKER, 1854, p. 193, pl. VII, figs. 17 to 18.

The male of *Ganghiopus pyriformis* described in the same paper (see p. 350).

PANDARUS ARMATUS (Nogaus male) Thomson.

Pandarus armatus (male) THOMSON, 1889, p. 363, pl. XXVII, figs. 1 a to f.

In describing this species among the parasitic copepods of New Zealand in 1889, Thomson gives the figure and description of a specimen taken along with the females, which he assumed must be the male of the species. But, on comparing this figure and description with the one given in the same paper for the male of his new species, *Dinematura* (*Echthrogaleus*) *neozealanica*, it is at once evident that they are identical. Both were obtained, to quote his own language, which is the same in the two cases, "by the captain of the whaling barque *Splendid*, presumably off a shark." They agree exactly in size, in the proportions and shape of the various body parts, and in the details of the appendages. This agreement is most noticeable in the fourth legs, which in both forms have a two-jointed endopod and a three-jointed exopod, unlike all the other *Nogaus* species. With this single exception they both conform exactly to the type here established for *Echthrogaleus* males, and may be referred to that genus.

PANDARUS BICOLOR (Nogaus male) T. Scott.

Pandarus bicolor T. SCOTT, 1900, p. 157, pl. VI, figs. 33 to 38.

This author, who has done a large amount of excellent work upon fish parasites, particularly in Scottish waters, and who has published many valuable papers, described in the Eighteenth Annual Report of the fishery board of Scotland, a *Nogaus*-like copepod which he considered as the male of *Pandarus bicolor*.

On examination of his description and the figures which accompany it, this *Nogaus* is found to conform in every detail with the other *Pandarus* males, and it may therefore be accepted as the male of the species to which Scott refers it.

The carapace has broad posterior lobes; the genital segment is enlarged and shows a pair of sixth legs at its posterior corners, and a pair of fifth legs just in front of the corners on the lateral margins; the abdomen is two-jointed, the joints equal; the antennæ and mouth parts are like those of the female *bicolor*, and the rami of the swimming legs are all two-jointed.

NOGAGUS BOREALIS Steenstrup and Lütken.

Nogagus borealis STEENSTRUP and LÜTKEN, 1861, p. 387, pl. XI, fig. 21.

This species was first described by the above authors from five specimens, three of which had been taken on a voyage to the West Indies and the other two on a voyage to Greenland, the exact localities being given for the latter only. They show the following characteristics: Carapace oval, considerably less than half the entire length, with short and narrow posterior lobes; three free segments diminishing regularly in width, but about the same length; genital segment rectangular, twice as long as wide, with two longitudinal furrows on both dorsal and ventral surfaces.

Abdomen one-jointed, anal laminae short and very wide. First antennæ with long and bushy setæ; first maxillipeds with stout terminal claw and small accessory claw, both armed with short hairs, and with a small bunch of hairs between their bases. Rami of the first three pairs of legs two-jointed, of the fourth pair one-jointed. These characters are the same as those of the single specimen described on page 437 and warrant the placing of this species under the genus *Nesippus*.

ECHTHROGALEUS BRACCATUS (Nogaus male) Heller.

Echthrogaleus braccatus HELLER, 1865, p. 197, pl. XX, fig. 3.

A male *Echthrogaleus* (see p. 366).

NOGAGUS BREVICAUDATUS Milne Edwards.

Nogagus brevicaudatus MILNE EDWARDS, 1840, p. 460.

Milne Edwards has given us the only description ever published of this species, a short and very incomplete one, as follows: "Espèce très voisine du *Nogague grêle* (*N. gracilis*), mais ayant l'abdomen plus court et composé d'une seule pièce subtriangulaire. Trouvé aux environs de Ténériffe."

There are no figures with this description, and thus while it is probable that the species is identical with Steenstrup and Lütken's *Nogagus tenax*, as those authors suggest, there is no possible way to prove this, and we must wait for further data before becoming able to locate it definitely.

NOGAGUS CÆLEBS Heller.

Nogagus cælebs HELLER, 1865, p. 208, pl. xx, fig. 4.

Like the preceding, only a single description of this species has ever been published, but that was so accurate, and the figures accompanying it so clear, that we have little difficulty in locating the species in the genus *Perissopus*.

It shows distinctly the narrow lateral lobes of the carapace, separated from the central portion by well-defined grooves; the characteristic conspicilla almost touching each other on the mid-line near the frontal plates; the short and very wide second thorax segment, with its lateral lobes directed backward; the third and fourth segments diminishing in width but increasing in length, the wide and short, one-jointed abdomen with large anal laminae.

The mouth-parts and maxillipeds are very similar to those in the female *Perissopus*, while the details of the swimming legs are almost identical with those of the latter species.

The only difference is found in the genital segment, which is trapezoidal, widened posteriorly with rounded angles, each armed with a large spine and a seta. But this may well be a specific difference and only serve to emphasize the resemblances.

The species is rather small (4 mm. long) for either *Pandarus* or *Nesippus*, but is just right for the genus *Perissopus*, where it undoubtedly belongs.

PANDARUS CRANCHII (Nogaus male) Beneden.

Pandarus cranchii BENEDEN, 1892 a, p. 221, pl. I, figs. 1-5.

In the same paper in which he described *Pandarus affinis* (see p. 444) Beneden also presented a *Nogaus* form which he claimed to be the male of *Pandarus cranchii*. Although the description in the text is no better than for *affinis*, yet the author has given for this species a view of the ventral surface, showing all the appendages. From this we can gather enough data to show clearly, in connection with the general body form, that the copepod is not a *Pandarus* at all, but belongs either to the genus *Nesippus* or *Perissopus*. The carapace is narrow and elongated, with narrow posterior lobes, and without accessory lobes; the three free segments and the genital segment are all about the same width; the latter is very small and shows no traces of legs on its sides or posterior corners; the abdomen is one-jointed, very small and triangular, and is armed with small and triangular anal laminae; the second maxillipeds are armed with forceps knobs and not with claws; the rami of the fourth legs have but a single joint.

Further along in the same paper Beneden describes what he calls a new genus, and to which he gives the name *Chlamys incisus*; Bassett-

Smith, in 1899, recognized this as a *Perissopus* and relocated it correctly under that genus.

Beneden gives us absolutely no data as to the size of either the *Nogaus* male or the female *Chlamys*, nor as to the hosts upon which they were found. We learn incidentally that they both came from the Archipelago of the Azores, and the *Chlamys* is further located from the Bay of Dakar. Since this *Chlamys* proves to be a *Perissopus* female, and since the *Nogaus* male conforms in its anatomy to the type of *Perissopus* males, it is possible that it will prove to be the male of this *Perissopus* (*Chlamys*) *incisus*.

At all events it is not a *Pandarus* male, and least of all that of the species *cranchii*, the true male of which is described on page 405.

SPECILLIGUS CURTICAUDIS Dana.

Specilligus curticaudis DANA, 1852, p. 1375, pl. xcv, figs. 6 a to h.

A male *Nesippus* (see p. 434).

DINEMATURA ELONGATA (Nogaus male) Beneden.

Dinemoura elongata BENEDEN, 1892 a, p. 231, pl. II, figs. 11 to 13.

Probably a *Dinematura* male (see p. 382).

NOGAGUS ELONGATUS Heller.

Nogagus elongatus HELLER, 1865, p. 206, pl. XX, fig. 5.

This was described as a new species by Heller, but he added the statement that it was found in company with *Pandarus dentatus* and was probably the male of this latter species.

Bassett-Smith, in 1899, accepted this statement and gave the name as a synonym of *Pandarus dentatus*, but with a question mark after it. A careful examination of the description and figures given by Heller render it probable that this species is not a *Pandarus* male, but that it belongs to the genus *Perissopus* for the following reasons: The carapace is much longer than wide with very long and narrow posterior lobes; well-defined conspicilla are present near the anterior border and there are no accessory lobes.

The swimming legs have long and slender rami instead of short and stocky ones; the pattern of the legs and the number and arrangement of the setæ conforms more closely to the type seen in *Perissopus* than to that seen in *Pandarus*; the fourth legs have but a single joint in each ramus. The genital segment is not enlarged, but is short and small, and shows no traces of either the fifth or sixth legs. The abdomen is small and contains but a single joint, instead of the two found in *Pandarus* males.

It has therefore been placed under the genus *Perissopus* awaiting further evidence.

NOGAGUS ERRANS Kröyer.

Nogagus errans KRÖYER, 1863, p. 173, pl. x, fig. 3 a to h.

This species is based upon a single specimen captured in a tow-net while swimming freely at the surface in the Atlantic Ocean near Porto Santo. At the close of his description Kröyer states: "It is clear that this animal, in spite of its four free thorax segments, differs significantly from *Nogagus* forms in the shape of the rostrum, the presence of a furca, the rudimentary condition of the endopod of the first legs, and the absence of this ramus in the fourth legs. Consequently it forms a connecting link with the Caliginæ, but does not belong to any of the established genera in that group, as far as I can see.

It would therefore be justifiable to make of it a new genus, but I am not so inclined on account of the scarcity of material (only *one* specimen), and so will leave it for the present under *Nogagus*." This species evidently belongs to the *Euryphorinæ* instead of the *Pandarinæ*, and is closely related to *Dysgamaus*, *Euryphorus*, and especially to the new genus, *Dissonus*, recently established by the present author upon material obtained from Ceylon.^a It certainly does not belong to any of the *Nogaus* types here established, and consequently should not, even temporarily, find shelter in the much-abused genus "*Nogagus*."

DINEMATURA GRACILIS (*Nogaus* male) Burmeister.

Dinematura gracilis BURMEISTER, 1833, p. 284, pl. XXIII, fig. 1.

Nogajus gracilis MILNE EDWARDS, 1840, p. 460.

This species was first described by Burmeister under the name *Dinematura*, in the belief that it was a male of that genus. Milne Edwards changed the name to *Nogagus*, but without giving any reasons for so doing, and without adding anything in the way of description. Frey and Leuckart, in their large work on the Wirbelloser Thiere, published in 1847, examined other specimens of this species and say of them (p. 166), that they could only find two segments in the abdomen instead of three as reported by Burmeister. The terminal segment showed a median posterior incision, and appeared to be made up, through the contraction of the basal joints of a pair of legs metamorphosed into swimming lappets; each of the latter was armed with four setæ instead of three. The posterior lobes of the carapace were longer and narrower than in Burmeister's specimen, and overlapped the following segment, whose lateral lobes were only feebly developed. At the close of his description Burmeister declares that he has but a single specimen, taken from a *Squalus acanthias*. And he can not, therefore, affirm with certainty

^a Report to the Government of Ceylon on the Pearl-Oyster Fisheries, Supplementary Report, XXXIV, p. 198, pl. iii.

that it is a new species, since the female is unknown. In his description he has mistaken the large glands connected with the double frontal filament for eyes; he also speaks of two "braune Knopfchen" situated farther back on the dorsal surface of the carapace. He gives but a single figure for the last three pairs of swimming legs, which he declares are just alike, even to the number of spines and setæ borne on the different joints of the rami. If this be true, the species can not possibly be a *Dinematura*, since in that genus the male, like the female, has the rami of the second and third legs three-jointed. In *Echthrogaleus* also the exopods of these legs are three-jointed, while the endopods are two-jointed.

On the other hand, Burmeister's species can not be a *Nesippus* or *Perissopus* male, because the rami of the fourth legs and the abdomen in those genera have each but a single joint.

Furthermore the statement of Beneden (1892 *a*, p. 220) that Burmeister's *Dinematura gracilis* and Leach's *Pandarus carchariæ* are the male and female of the same species is obviously wrong.

For *Dinematura gracilis* lacks the accessory lobes on the posterior margin of the carapace, there are no legs visible on the genital segment, and while the abdomen is two-jointed the joints are very unequal. In *Gangliopus* the rami of the fourth legs are one-jointed, and the abdomen is like that of *Pandarus*, two-jointed with the joints equal. This leaves us the single genus *Demoleus* amongst those whose males are known, and to this we find the present species corresponding in every particular except size.

But here the discrepancy is a serious one, for Burmeister's species is only half the size of the other males of the genus.

There is also the possibility that Burmeister did not examine the second and third legs very closely; indeed his statement that they are just like the fourth pair, even in the number of spines and setæ, would imply as much, for no *Nogaus* male has yet been discovered of which this would be true.

If he did not examine them closely, or if his specimen was immature and the segmentation not fully completed, then there is an agreement in every particular, even size, with the males of the genus *Dinematura*, and Burmeister located his species correctly.

His specimen was a little over 6 mm. in length; the adult males of *Dinematura* are 8 or 9 mm. long.

It is, of course, impossible to decide definitely in such a case, since the very data essential to a decision are lacking, but the presumption seems to be in favor of the latter proposition.

NOGAGUS GRANDIS Steenstrup and Lütken.

Nogagus grandis STEENSTRUP and LÜTKEN, 1861, p. 386, pl. x, fig. 19.

Probably a male *Demoleus* (see p. 349).

DINEMATURA HAMILTONI (Nogaus male) Thomson.

Dinematura hamiltoni THOMSON, 1889, p. 357, pl. xxv, figs. 1 a to j.

This species described by Thomson in 1889 included both sexes, and their anatomy conforms so closely as to leave no doubt of their identity. The male also corresponds in every detail given with the type here established for the genus *Dinematura*, and it may therefore be accepted as originally published.

NOGAUS LATREILLII Leach.

Nogaus latreillii LEACH, 1819, p. 536.

The male of *Pandarus cranchii* (see p. 405). For the form which Krøyer claims to be the female of this species see page 442.

NOGAGUS LUETKENI Norman.

Nogagus luetkeni NORMAN, 1869, p. 300.

This species was described briefly in the Shetland Final Dredging Report, in 1869, by the Rev. Canon A. M. Norman, and was apparently based upon a single specimen obtained from a skate.

Its carapace was orbicular with large and incurved posterior lobes; the genital segment enlarged, longer than broad, and without rudimentary legs; abdomen two-jointed, the joints unequal; anal laminae large and armed with large setae. But as absolutely nothing is said with reference to the size of the creature, or to the structure of the swimming legs, it is impossible to locate it definitely.

NOGAGUS LUNATUS Steenstrup and Lütken.

Nogagus lunatus STEENSTRUP and LÜTKEN, 1861, p. 389, pl. ix, fig. 17.

The above-named authors give the following for this species:

"Two specimens were taken by Captain Hygom on the same voyage and in the same latitude and longitude as *Echthrogaleus coleoptratus*, and so probably together with them. Whether they are possibly the males of that species we do not venture even a conjecture." In this respect they are wiser than Claus, who, in describing his new genus *Luetkenia* in 1864, says there is the same difference between the sexes in the posterior part of the body as there is between *Echthrogaleus coleoptratus*, Guérin and *Nogagus lunatus*, Steenstrup and Lütken, and ventures the conjecture that these latter are the two sexes of the same species.

Two things are very evident here, first, that the host of this *Nogagus lunatus* is not known, and it is therefore conjectural whether it came from the same fish as the *Echthrogaleus* or from a different one. In the second place there was evidently not enough agreement in the anatomy of the two forms to warrant even a conjecture on the part of the original describers as to their relationship. This indicates that

they are not likely to be the two sexes of the same species, and we find that their anatomy confirms such a conclusion.

The shape of the grooving of the carapace in the *Nogaus* form is radically different from that in the female of *Echthrogaleus coleoptratus*, and also from that of such of the males of this genus as are known. The fourth and genital segments are also very different from those in *Echthrogaleus* males in their relative size and shape. The second and third legs have only two joints in the exopods, while the rami of the fourth legs are one-jointed. The second maxillipeds are much swollen and are armed with short curved claws and corrugated knobs.

In all these particulars and in its size the species corresponds closely with *Nogagus cælebs* and *Nogagus elongatus*, and may therefore be temporarily assigned a place in the genus *Perissopus* instead of *Echthrogaleus*.

NOGAGUS MURRAYI Brady.

Nogagus murrayi BRADY, 1883, p. 136, pl. LV, fig. 1.

Brady's description in the Report on the Copepoda of the Challenger Expedition is as follows:

Length, 4 mm. Cephalothorax ovate, much longer than broad and nearly twice as long as the abdomen; frontal margin rounded, lateral margins somewhat sinuous, posterior angles moderately produced backward and rounded off. First abdominal (genital) segment about as long as broad, margins round; angles not at all produced nor acute. Two posterior abdominal segments much broader than long, the last pentagonal in shape, and produced backwards between the caudal lamellæ into two obtuse points; caudal lamellæ about as broad as long, subquadrate, each bearing four finely plumose setæ.

Taken in the open sea off Rio de Janeiro, and in the North Atlantic (about lat. 25° N.), April 28, 29, 1876. Very similar to *Nogagus errans* Krøyer, which, however, differs decidedly in the shape of the last abdominal and two posterior thoracic segments.

In the figure which accompanies this description and which is labeled "Adult female (?) seen from below," only two pairs of legs are shown, the third and fourth pairs, in both of which the rami are represented as one-jointed. No adhesion pads are shown at the bases of either pair of antennæ, nor anywhere else on the ventral surface. The mouth-tube is short, broad, and well rounded at the tip, and there is a very well-defined furca on the mid-line between the bases of the second maxillipeds.

These last details, if reliable, prove that the copepod is not a *Nogaus* at all, but one of the Euryphorinæ, resembling, perhaps, the genus *Dysgamus* more than any of the others.

PANDARUS MUSTELI-LÆVIS (Nogaus male) Hesse.

Pandarus musteli-lævis HESSE, 1883, p. 23, pl. VI, figs. 6-8, 14, 18, and 21-23.^a

This *Nogaus* form is another of Hesse's fabrications, his new species being founded on a single male and a young female.

Enough data can not be obtained from Hesse's text and figures to determine where this species belongs; the figures he presents are wretched, badly confused, and highly contradictory, while the text gives none of those data which are essential in accurate systematization. In fig. 6, which is a dorsal view of the male, the second legs are each uniramose and one-jointed; in fig. 7, which is a ventral view of the same specimen, the second legs are each biramose, the rami of the left one being one-jointed, while the right one has a two-jointed exopod and a three-jointed endopod. The first legs are similar to those described for his *Nogagus spinacii-achantias* (see p. 458), and are radically different from anything ever seen. The rami of the fourth legs as seen in dorsal view are one-jointed, while in ventral view they are two-jointed. The abdomen in dorsal view is two-jointed, the terminal joint extending out over the bases of the anal laminae in two broad, rounded lobes; in ventral view it is three-jointed, the terminal joint triangular and contracted nearly to a point between the anal laminae. The species as it stands, therefore, can not be located anywhere with even reasonable probability.

DINEMATURA MUSTELI-LÆVIS (Nogaus male) Hesse.

Dinemoura musteli-lævis HESSE, 1880, p. 5, pl. I, figs. 1-16.

Probably belongs to the genus *Demoleus* (see p. 386).

DINEMATURA NEOZEALANICA (Nogaus male) Thomson.

Dinematura neozealanica THOMSON, 1889, p. 359, pl. XXV, fig. 2.

Thomson here described both sexes of a new species which he placed in the genus *Dinematura*; they agree so fully in their anatomical details as to leave no doubt of their identity.

But as Bassett-Smith pointed out in 1899 they belong to the genus *Echthrogaleus* rather than *Dinematura*. The male (and incidentally the female also) corresponds in every essential detail with the types established for the genus *Echthrogaleus*, and thus the species will stand as the New Zealand representative of that genus.

^a The figures as published by Hesse were numbered incorrectly (see p. 396); figs. 4 and 6 should be interchanged, as also figs. 17 and 23.

NESIPPUS ORIENTALIS (Nogaus male) Heller.

Nesippus orientalis HELLER, 1865, p. 194, pl. XVIII, figs. 2, 3.

After establishing his new genus *Nesippus* in 1865, Heller describes two species, *orientalis* and *crypturus*.

For the first of these, which would become the type of the new genus, he presents the female and a form which he claims to be the male, and gives admirable descriptions and figures of each.

But the "male" differs from the female only in being smaller, in having a sharp terminal claw on the second maxillipeds, longer plumose setæ on the swimming legs, and in the abdomen being visible in dorsal view. If the figure of the young female of the species *alatus* given in the present paper (Plate XXXIV, fig. 205) be compared with that of the adult female (fig. 194), exactly the same differences will be found, while the true male (fig. 206) has a very different carapace, and the second and third thorax segments are free instead of being fused as in the young female (see p. 429). This "male" of Heller's therefore was almost certainly a young female similar to those repeatedly found by the present author in company with the adults of *alatus*.

CALIGUS PARADOXUS (Nogaus male) Otto.

Caligus paradoxus OTTO, 1828, p. 352, pl. XXII, figs. 5, 6.

The male of *Demoleus paradoxus* (see p. 349).

ECHTHROGALEUS PERSPICAX (Nogaus male) Olsson.

Echthrogaleus perspicax OLSSON, 1869, p. 18, pl. I, figs. 6, 7.

The description and figures of this species are found to correspond in every particular with those of the other males of the genus, and the species will therefore stand as originally described.

NOGAGUS PRODUCTUS Gerstaecker.

Nogagus productus GERSTAECKER, 1853, p. 63, pl. IV, figs. 1-10.

This proves to be a female *Dinematura*, Gerstaecker wrongly substituting the name *Nogagus* on the ground of priority (see p. 441).

NOGAGUS SOCIALIS Olsson.

Nogagus socialis OLSSON, 1869, p. 16, pl. I, fig. 5.

Found on the body of *Acanthias vulgaris* in the Sea of Skagerrack, together with both sexes of *Echthrogaleus perspicax*.

From the excellent description and figures given by Olsson we find that the carapace is elliptical with narrow posterior lobes; the genital segment is not enlarged; one pair of legs are visible at its posterior corners; the abdomen is one-jointed, with small anal laminæ; the

second maxillipeds have a short, curved claw and corrugated knobs; the rami of the first three pairs of legs are two-jointed, of the fourth pair one-jointed.

This locates the species in the genus *Perissopus*, and on comparing it with Heller's *Nogagus cælebs* and *Nogagus elongatus*, the three are seen to be so nearly alike that it even seems probable they are but variations of the same species. At all events they are very closely related forms of the same genus.

NOGAGUS SPINACII-ACHANTIAS Hesse.

Nogagus spinacii-achantias HESSE, 1883, p. 1, pl. IV, figs. 1-7.

Pandarus spinacii-achantias HESSE, 1883, p. 10, pl. VI, fig. 9.

This species was described as a female by Hesse, and was based upon several specimens obtained from the head of a *Spinax achantias*; the male was said to be unknown. We have already given Hesse's reason for considering these specimens females (see p. 335). There can be no doubt that they are really males, but almost no dependence can be placed upon the figures and description given by Hesse. For example, in the dorsal view the second legs have a three-jointed exopod, while the endopod is not visible; in an enlarged figure of the same legs they are represented with a three-jointed endopod and a two-jointed exopod, while in the ventral view both rami are distinctly two-jointed. The text says nothing whatever about these legs.

In the face of these and many other similar discrepancies it would seem almost hopeless to attempt to locate the species.

But Hesse is at least consistent, and after a time we can learn what to expect and can make rational allowances.

A comparison of the figures and description he has given of the present species and of a new *Pandarus*, found upon the same fish, and named similarly *Pandarus spinacii achantias*, leaves not much doubt that they are the male and female of the same species.

First the relative sizes are correct, 5 or 6 mm. for the *Nogaus* and 6 or 7 mm. for the *Pandarus*.

In the second place, the new *Pandarus* is evidently located correctly, as is shown by the number and arrangement of the dorsal plates and by the appendages. Hesse, however, gives it but three pairs of swimming legs, describing in place of the first pair what he calls—

Appareil de fixation, qui est placé transversalement à la base du bouclier céphalique et représenté par un tige qui émet, de chaque côté, des appendices recourbés ainsi que de petits crocs, destinés à saisir et accrocher les objets et est terminé par une longue griffe qui contourne une ventouse cupuliforme placée à l'extrémité externe du bouclier céphalothoracique.

None of the known species of *Pandarus* has any such a prehensile apparatus as this, nor is there any genus of crustacea in which the first legs have disappeared, leaving the other three present and fully developed. If this structure be as Hesse has represented it, his specimens will have to be made the types of a new genus. But again he is consistent, for, in speaking of the new *Nogaus*, after describing the second maxillipeds which he calls the "third thoracic feet," he says:

Au-dessous de celles-ci on aperçoit, placée horizontalement, une patte très étroite fixée par son centre au bouclier céphalique et terminée à son extrémité par deux petits articles, dont le dernier est recourbé en forme de griffe.

This evidently corresponds to the fixation apparatus of the female and makes the analogy between the appendages just what would be expected in the two sexes of a species.

Finally the general make-up of the body in this *Nogaus* is similar to that in the *Pandarus* males. There is the same broad carapace with what are evidently accessory posterior lobes, partially concealing the second segment; a considerably enlarged genital segment with large posterior processes, and a two-jointed abdomen with good sized anal laminae. There is thus considerable probability that we have here the two sexes of a species of *Pandarus*; whether it is a new species can not be determined without further data.

Hesse begins his description of the *Pandarus* species with the words "Mâle inconnu" (p. 10), but further along (p. 15), and in his figures (Plate VI, fig. 9) he has presented what he calls a "jeune mâle (?)." If this were really a young male of the species in question, it ought to correspond with other *Pandarus* males. But no details are given in the text, and those to be deduced from the figure are decidedly against the probability that the creature belongs to the genus *Pandarus*.

NOGAGUS TENAX, Steenstrup and Lütken.

Nogagus tenax STEENSTRUP and LÜTKEN, 1861, p. 388, pl. x, fig. 20.

This species was described by the above authors as follows: It outwardly resembles *Nogagus borealis*, but is smaller (6 mm. long), and less elongate; eyes distinct and near the anterior border. First free thorax segment broadly quadrangular with wide lateral lobes; the second one smaller and somewhat six-sided; the third the smallest and broadly eight-sided.

Genital segment not much longer than wide, the posterior corners projecting slightly and armed with spines. Abdomen triangular and bearing triangular anal laminae. Second maxillipeds sometimes showing an end claw and sometimes a forceps structure like

that in *Pandarus*. Rami of fourth legs one-jointed, of all the others two-jointed.

They give *Nogagus brevicaudatus*, Milne Edwards, as a synonym of this species and say that it is probable when it becomes better known it will be found identical with *tenax*. They then add in closing:

Since *N. tenax* is smaller than *N. borealis*, and is found farther south in the Atlantic, it would seem probable that it is the male of the smaller and more southern *Dinematura* described by us, *D. latifolia*. Still this is nothing more than a conjecture.

It has already been shown in the present paper (see p. 449) that the morphology of *Nogagus borealis* renders it probable that it is a *Nesippus* male rather than one of the genus *Dinematura*.

Moreover, there will be found described on page 386 the true male of *Dinematura latifolia* which is very different from the two species here mentioned. *Nogagus tenax* therefore is probably a *Nesippus* male, and so far as can be seen is identical with the one described on page 429 as the male of *Nesippus alatus*. There are slight differences in the angularity of the thoracic segments of *tenax* and the rounded outlines of *alatus*, but Steenstrup and Lütken's material had been in alcohol a long time, while the drawings in the present paper were made from living males.

Furthermore, this same species (*tenax*) has been reported by S. I. Smith upon Atwood's shark (*Carcharias atwoodi*) in Vineyard Sound. It was found in company with "*Nogagus latreillii*," a species of *Pandarus*, and *Echthrogaleus denticulatus*. Smith recognized that it was very different from *N. latreillii* and probably belonged to a different genus. He suggested *Echthrogaleus*, but the structure of the second and third legs prohibits this. No specimens of *Nesippus alatus* females have yet been obtained from Atwood's shark, but they are so common in Vineyard Sound on other sharks that the presence of a free swimming male on this particular species can be readily understood.

Again *tenax* is represented with small sharp spines near the posterior corners of the genital segment; similar specimens have been found among the males of *alatus*, but the outlines given in fig. 206 are more common. In all other particulars the two are practically identical, and accordingly *Nogagus tenax* has been given as a synonym under *Nesippus alatus* (see p. 426).

PANDARUS UNICOLOR (Nogagus male) Hesse.

Pandarus unicolor HESSE, 1883, p. 20, pl. VI, fig. 5.

This species was described in the same paper with *Pandarus musteli-lævis* and *Nogagus spinacii-achantias* and in a similar manner. The discrepancies in the appendages of the male are similar to those enumerated for the other species, but here the swimming legs are

all represented with rami having but a single joint. This species, therefore, like the others, can not be located with any reasonable probability.

NOGAGUS VALIDUS Dana.

Nogagus validus DANA, 1852, p. 1363, pl. XCIV, figs. 9a to h.

The male of *Pandarus breviceaudis* (see p. 398).

Part 4.—THE CECROPINÆ.

ECOLOGY.

This new subfamily is made to include at the present time four genera which closely agree with each other in habits and morphology, and which differ very markedly from the genera included in the Pandarinæ. As the latter were shark parasites, so the present genera may be said to belong to the family of Head-fishes or Sunfish (Molidæ), although they are occasionally found on other fish. Two of the genera are so closely confined to the common Sunfish (*Orthogoriscus*, or *Mola, mola*) that they have been given generic names derived from that of their host, *Orthogoriscicola* and *Philorthogoriscus*, respectively.

A third genus, *Cecrops*, makes the sunfish its chief host, but has been found also on species of *Diodon*, *Thynnus*, and *Pleuronectes*, while the fourth genus, *Luethenia*, lives upon *Asterodermus*, *Luarus* and several shark species.

These parasites are more gregarious than the Pandarinæ and are found in bunches of fifteen to thirty or more, attached to the outside skin and gills of the fish. The combined laceration of their claws often produces a large pit or sore, in the bottom of which they cling tightly. This peculiarity has been noted by A. Scott (1892, p. 266), who describes *Orthogoriscicola* as burrowing in pits formed in the flesh of the fish behind the anal fin. Nothing of this sort is found among the Pandarinæ for two reasons—first, they do not collect in such numbers, and then they cling partly if not chiefly by means of their adhesion pads. Hence when several of them do get together, as often happens on a shark's fin, there is very little laceration and no bunch or sore is formed.

Not only the females of the present subfamily, but the males as well remain fixed in one position upon their host, and both sexes are incapable of swimming. As already noted (see p. 327), this constitutes the last step in degeneration as exhibited in the Caligidæ. The female became a fixed form in one of the Caliginæ (*Echetus*), in several of the Euryphorinæ, and in all the Pandarinæ, but the progress of degeneration was very slow, and the swimming legs were retained in their normal form and armed with plumose setæ through all the

Caliginæ and Euryphorinæ. But in the Pandarinæ the fourth legs become transformed into lamellæ and lose their swimming setæ, the abdomen at the same time being transferred to the ventral surface of the genital segment. While the female has been thus gradually yielding to degenerative influences, the male has successfully resisted them, and even in the *Nogaus* form characteristic of the Pandarinæ there has been no loss in morphological details or functional activity. When the male at last yields, however, the change is not only abrupt, but is also far reaching; the intervening stages are passed over entirely and it changes directly from a condition as active and agile as that of *Caligus* into one more degenerate than that of any female among the Pandarinæ. The fourth legs are enlarged into enormous lamellæ, the third legs are as degenerate as the fourth pair in the Pandarinæ, and there is not a plumose seta to be seen on any one of the four pairs in *Orthagoriscicola*. The abdomen also has been partially transferred to the ventral surface of the genital segment, and there has been a fusion of the frontal plates with the carapace. In short, although the male retains to the full its structure and functions until the female has become thoroughly degenerate, yet the first change in the male makes it as degenerate as the female with which it is associated, and there are no intermediate stages.

This abrupt transition and the consequent degenerate character of the male forms one of the chief characteristics of the subfamily, and of itself is sufficient to distinguish the members of this subfamily from all the other Caligidæ.

The only locomotion possible to either sex is such as can be accomplished by loosening one set of prehensile organs and obtaining a new hold by stretching the body, while still keeping a second set securely fastened. When once placed, with the second antennæ buried in the flesh of the host, it is probable that the female does not subsequently change her position. The male is usually found attached to the female, the front margin of its carapace burrowed beneath the apron of her third swimming legs, and its second antennæ clasped around her fourth thorax segment. And when he has once gained this position the male probably does not change it during life.

The organs of prehension are similar to those in the Pandarinæ. The chief hold is maintained by the second antennæ, which are buried for their entire length in the skin and underlying flesh of their host. During life the body of the copepod frequently trails off in the water, with no attachment to the host except these antennæ, which gives it the appearance of being fastened by a frontal filament.

Usually, however, the antennæ are reenforced by the second maxillipeds and the adhesion pads. The latter are similar to those in the Pandarinæ, but there are two of them behind each first antenna, while there is none on the base of the second pair.

Neither these nor the ones on the bases of the swimming legs seem as well formed and efficient as those of the preceding subfamily, and they are evidently not of much service in prehension.

The attachment of the parasite to its host being thus accomplished entirely by means of stout claws buried in the fish's flesh, it follows that there can be no loosening of the hold after the death of the fish. These parasites certainly never drop off into the boat or anywhere else, as was claimed for the genera in the preceding subfamily. Both the antennæ and the maxillipeds are set so firmly in position that they can not be loosened without breaking them. And even after the death of the parasite it is usually necessary to cut around these appendages if one would remove the animal entire.

On being placed in an aquarium they are more helpless than the Pandarinæ, and both sexes can only lie in the place where they are put, with an occasional weak and spasmodic movement of the swimming legs. Hence they can be kept alive only a very short time, shorter even than in the case of the Pandarinæ.

Although they resemble the preceding subfamily in that the carapace is not arched and converted into a disk to retain moisture after the skin of the host may have dried, yet they are kept alive by another means for quite a period. It has already been noted that they are gregarious and gather together in colonies, whose combined lacerations form a deep pit extending through the skin and into the flesh of the host. Such a pit does not dry as quickly as other portions of the surface of the host's body, and the parasites, being fastened in its very bottom, are not only protected from abrasion, but are also kept moist long after the fish's skin has become dry and parched.

In this way they may sometimes be found alive on sunfish brought in by the fishermen.

MORPHOLOGY.

The chief differences in the morphological details of the present subfamily are such as result from a further degeneration in consequence of the fixed position of both sexes, and they are clearly brought out in the diagnosis which follows.

ONTOGENY.

The development of this subfamily has never been observed, but it must be similar to that of the Pandarinæ, if we may judge from the size, shape, and coloration of the eggs and from the chalimus of *Orthagoriscicola*, described on page 476.

We find in the latter a pair of broad and ribbon-like frontal filaments exactly like those on the chalimus of *Perissopus*. In this case, also, it was the male which was thus found, indicating that the two sexes mature at different periods.

Hesse, in the thirty-seventh article of his series entitled *Crustacés rares ou nouveaux des Côtes de France*^a makes the following statements in regard to the issuing nauplius of *Cecrops*:

The latter, on issuing from the egg, are furnished with three pairs of legs, of which the first is simple and the two others biramous (p. 348).

Further along he says, while comparing *Cecrops* with "*Læmargus*:"

In *Cecrops* the two sexes, and even the young, are very remarkable for the two prolongations, lamellar and rounded, which precede the frontal margin of the carapace. Also for the lack of eyes in the adult and especially in the embryos. (P. 356).

He adds in a footnote at the bottom of the page:

This exception, which, I believe, is unique in its kind, is, moreover, the more inexplicable because if these organs are indispensable in the adults, they are of still greater use to the young, which have to search for a position in which they can be sheltered from dangers, and where they can procure the food necessary to their existence.

Whether it be true, as Hesse states, that these nauplii have no eyes remains to be proved by other investigators. In view of the serious mistakes which he has made in the same paper, it can not be accepted on his authority alone. It is unfortunate that he is apparently the only one who has ever seen these nauplii.

Subfamily CECROPINÆ.

The first thorax segment fused with the head, the second and third segments more or less fused inter se; the fourth segment with a pair of dorsal plates in both sexes, overlapping the genital segment. Sexes very similar.

Female.—Carapace orbicular and strongly arched; frontal plates more or less completely fused with the carapace and not distinct; grooving similar to that in the Pandarinæ. Three free thorax segments, the first two of which are usually fused and furnished with a single pair each of dorsal plates and lateral lobes; the third segment carries a pair of enlarged dorsal plates, which cover the anterior portion of the genital segment.

The latter is as large as or considerably larger than the carapace and furnished with a pair of dorsal plates which entirely cover this segment, as well as the abdomen.

Abdomen one-jointed, with large anal laminae armed with spines instead of setæ; abdomen sometimes with broad wings extending to the lateral margins of the genital segment, in which case the egg-strings are concealed between these wings and the ventral surface of the genital segment (*Orthagoriscicola* and *Cecrops*); sometimes without wings, in which case the egg-strings are long, straight, and visible like those of the Pandarinæ (*Philorthagoriscus* and *Luetkenia*). First antennæ usually two-jointed, rarely three-jointed (*Orthagoriscicola*); second maxillipeds with terminal claws. All the legs biramous, rami of first three pairs two-jointed, of fourth pair one-jointed and usually enlarged into broad lamellæ, armed only with spines.

^a Ann. des. Sci. Nat. (7), V.

Male.—A fixed form like that of the female and incapable of locomotion; carapace and thorax segments similar to those of the female, the dorsal plates of the fourth segment being reduced in size. Genital segment also much smaller, with the abdomen partially visible beyond its posterior margin; abdomen without wings in all the genera. Second antennæ and second maxillipeds with stout prehensile claws; all the feet biramous, rami as in the female, except that those of the fourth pair are not much enlarged in any genus but *Orthagoriscicola*; rami of first three pairs with plumose setæ in *Philorthagoriscus* and *Luetkenia*, the fourth pair and all the rami in other genera without them.

Chalimus attached by two broad, ribbon-like frontal filaments very short and parallel.

KEY TO THE GENERA.

- a*, Females, third dorsal plates of medium size, covering quite a portion of the genital segment; the latter as large as the carapace or much larger *b*.
a, Males, third dorsal plates small, overlapping the genital segment but little; the latter much smaller than the carapace *c*.
b, Abdomen with broad wings between which and the genital segment the long egg-strings are entirely concealed; genital segment much larger than the carapace.....
b, Abdomen without wings; egg-strings long and entirely visible; genital segment a little smaller than the carapace *d*.
c, First antennæ two-jointed, not prominent; second antennæ hidden; posterior border of carapace deeply concave; margin of carapace and dorsal plates smooth *Cecrops* Leach, 1816, p. 466.
c, First antennæ three-jointed, prominent; second pair projecting beyond the carapace margin; posterior border of carapace slightly concave; margin of carapace and dorsal plates coarsely toothed. . . *Orthagoriscicola* Poche, 1902, p. 472.
d, Margins of the carapace and dorsal plates finely toothed; third dorsal plates covering three-fifths of the genital segment; rami of first swimming legs normally developed *Philorthagoriscus* Horst, 1897, p. 478.
d, Margins of carapace and dorsal plates smooth; third plates scarcely overlapping the genital segment; endopod of first legs very rudimentary (male) or entirely lacking (female)..... *Luethenia* Claus, 1864, p. 464.
e, Third dorsal plates relatively as large as in the female; grooving of the carapace nearly invisible; abdomen almost or quite concealed *f*.
e, Third dorsal plates very much reduced; grooving of the carapace distinct; abdomen largely visible..... *g*.
f, First antennæ two-jointed; second and third thorax segments fused inter se and furnished with a pair of broad lateral plates, concealed beneath the carapace; abdomen also entirely concealed . . . *Cecrops* Leach, 1816, p. 466.
f, First antennæ three-jointed; second and third thorax segments distinct and entirely visible, without plates; abdomen partly visible; margins of plates on fourth and genital segments coarsely toothed.
Orthagoriscicola Poche, 1902, p. 472.
g, Second antennæ much enlarged and projecting beyond the carapace; first dorsal plates large; genital segment with large spines at the posterior corners; first swimming legs normally developed..... *Philorthagoriscus* Horst, 1897, p. 478.
g, Second antennæ smaller and concealed; all the dorsal plates very small; genital segment with smoothly rounded posterior corners; endopod of first swimming legs scarcely visible..... *Luethenia* Claus, 1864, p. 464.

SYSTEMATIC DISCUSSION.

Genus CECROPS Leach.

Cecrops (*C. latreillii*) LEACH, 1816, p. 405, pl. xx, 8 figures.

Female.—Carapace oval, stout, strongly arched, and deeply notched posteriorly; frontal plates fused with the carapace; cephalic and thoracic portions of the lateral areas separated by a transverse groove. Second thorax segment with large lateral lobes; third segment with a pair of small dorsal plates; fourth segment with a pair of larger plates; genital segment small, but carrying a pair of dorsal plates larger than the carapace, and extending back beyond the tips of the anal laminae, forming the dorsal half of the bag in which the eggs are carried. Abdomen ventral and as large as the genital segment in front of its base, strongly flattened dorso-ventrally; its ventral surface produced laterally and anteriorly into large lobes, forming the ventral surface of the egg bag.

Egg-strings very narrow, twenty or thirty times the length of the body, irregularly convoluted and entirely hidden in the above-mentioned bag. First antennae two-jointed; second pair and second maxillipeds stout and furnished with strong curved claws for prehension. Maxillae huge, club-shaped, two-jointed, the terminal joint covered with small spines. Legs all biramose, rami of first three pairs two-jointed, of fourth pair one-jointed and enlarged into flattened laminae with a large fold of skin on the ventral surface.

Male.—A fixed and degenerate form, similar in all respects to the female, except as follows: Genital segment without dorsal plates, but covered by those of the fourth segment, which also reach nearly to the end of the abdomen. The latter is plump, not flattened, twice as wide as long, and without lateral lobes; anal laminae close together, armed with good-sized setae.

Fourth legs but little enlarged, rami one-jointed, but without the ventral fold of skin; plumose setae on the first three pairs of legs less rudimentary than in the female.

(*Cecrops*, the fabulous first king of Athens.)

This genus was established by Leach in 1816, who gave a fairly good description of the female with figures of both sexes. The figures are good for their time, but are too small to give details. In the ninety years since the above date the genus with its single species has been noted by nearly every investigator who has dealt with the parasitic copepods. But only in a very few instances have any figures been given. Guérin published a single figure, the dorsal view of a female, in 1817; Desmarest in 1825 published a set of figures almost exactly like those of Leach, but in which the details are more clearly shown. Latreille gave similar figures in 1835, and Baird a single

dorsal view of the female in 1850. Hoeven in 1857 published a paper on *Cecrops* and "*Læmargus*," which contains the only really good figures that have ever appeared; but even these show many mistakes and imperfections.

In 1883 Hesse presented what he claimed was a new species of *Cecrops*, and which he named *C. achantii-vulgaris*. The name is certainly wrong for the shark genus on which Hesse's specimens were found is *Acanthias* (from *ἄκανθας*) and not *Achantius*, and even if Latinized the genitive would not be spelled as Hesse has given it. Furthermore, this so-called species is based upon a single female specimen, which, from Hesse's description and the little that can be learned with certainty from his figures, can not possibly belong to the genus *Cecrops*.

He has represented the first three thorax segments fused with the carapace; neither the genital segment nor the abdomen are mentioned in the text, nor can they be made out in the figures.

The swimming legs also are not mentioned in the text, and even a chirographic expert could not decipher them in the figures.

And finally, the second maxillipeds with their "thumb" in the form of a peduncled ball, shutting down into a cavity, are entirely unlike those of *Cecrops*. The size of Hesse's specimen, 6 mm. in length, the fact that it had no egg-strings, and the general appearance of the body, suggest that it is probably a very young female. But its true location must be left for future investigation; all we can decide at present is that the species, as Hesse has described and figured it, does not belong in the genus *Cecrops*.

Five years later, in 1888, Hesse published his thirty-seventh paper on New and Rare Crustacea of the Coast of France, which is entirely concerned with these two genera, *Cecrops* and "*Læmargus*."

The paper is profusely illustrated, but not a single one of the 25 figures representing *Cecrops latreillii* is correct, and all of them which show the entire animal are wretchedly confused. If compared with similar views given by the other authors mentioned, it would never be guessed that they were intended to represent the same animal. The third legs of the female, visible for the entire width of the body in dorsal view, the "plaque" (really the dorsal plates of the fourth segment) with its wonderful design of the cross and crown, and the two large lobes of the genital segment, "whose margins are rolled up in the form of a volute," are especially bizarre.

In the following year, 1889, Thomson gave several figures of *Cecrops* in his Parasitic Copepods of New Zealand, the most valuable of them being enlarged views of the four pairs of swimming legs. There are thus three sets of figures, those originally given by Leach, the excellent ones by Hoeven, and these by Thomson, which represent all that is known of the genus up to date. It is hoped that the figures

here shown may supply many of the missing details, particularly with reference to the structure of the abdomen, the formation of the case or bag in which the eggs are carried, and the details of the antennæ, mouth tube, mouth parts, and maxillipeds.

CECROPS LATREILLII Leach.

Plates XXXVIII and XXXIX.

Cecrops latreillii LEACH, 1816, p. 405, pl. XX, figs. 1 to 5.—HÆVEN, 1857, p. 67, pls. III, IV.—THOMSON, 1889, p. 362, pl. XXVI, figs. 3 a to f.

Female.—Carapace oval, as wide as long, with a prominent frontal margin and a deep triangular posterior sinus. Frontal plates almost entirely fused with the carapace, separated by a wide and deep median sinus. On the lateral margins just behind the frontal plates is a well-defined notch on either side, in the base of which the first antennæ are attached. Another notch a little farther back on the lateral margins is caused by the transverse groove which separates the cephalic from the thoracic portion of the lateral areas. This groove is situated far forward, and in consequence the cephalic portion in front of it is small and triangular, while the thoracic portion behind it is nearly four times as large and trapezoidal in form. The second and third thorax segments are fused together and furnished with a single pair of lobes and a single pair of dorsal plates. The broad lateral lobes apparently belong to the second segment, and reach well out beneath the posterior lobes of the carapace.

The small dorsal plates belong to the third segment and overlap the following segment a little; the fourth segment has a pair of medium-sized plates which reach about to the center of those on the genital segment; each of them is triangular in shape with well-rounded corners. The genital segment with its dorsal plates is enlarged to nearly twice the length of the carapace and is elliptical in form, about one-fourth longer than wide, with the sides very evenly curved. It is covered by a pair of dorsal plates, whose edges are softened and project far beyond the lateral and posterior margins of the segment. These soft edges are rolled over ventrally into large scrolls which completely cover the sides and posterior end of the segment and lap quite a distance onto the ventral surface, completely concealing the abdomen, anal laminae, and egg-strings in dorsal view. The posterior sinus between these plates is sharply triangular and about one-fourth the entire length of the plates.

Abdomen semielliptical and fully as large as or often larger than that portion of the genital segment which precedes it. Its ventral surface is produced into a large lobe or lamina on either side, which extends outward laterally beneath the turned-over edge of the dorsal plates of the genital segment (Plate XXXIX, fig. 253).

When the female is without egg-strings, the lateral and anterior margins of these laminae are turned upward into scrolls, similar to those formed by the dorsal plates of the genital segment, and inside of them. The lateral margin is also caught inward in a large fold on either side about one-fourth the distance from its anterior end. This gives the ventral aspect of the abdomen a peculiar T shape, the upright portion being more than twice the width of the arms. When the egg-strings are extruded, these folds and the scrolls along the lateral margins are straightened out and each lamina rests flatly upon the ventral surface of the coiled egg-strings, completely concealing them in ventral view (fig. 254). The scrolls along the anterior margin are never entirely straightened, but the lamina on either side curls up over the eggs at that point and holds them securely in place. The anal laminae are small, orbicular, and attached close to the anus on either side; they are armed with short and stout spines and have no plumose setae.

The first antennae are two-jointed, the basal joint much the longer, each joint armed with a few short spines. Second pair large and powerful, the principal organs of prehension, three-jointed, the terminal joint a strong sickle-shaped claw, which is buried in the flesh of the host. The terminal joint of the first maxillipeds is much shorter and more slender than the basal; the terminal claw is nearly as long as the joint itself and only slightly curved; the accessory claw is much shorter, while both claws have serrate edges. The second maxillipeds are stout, but not swollen, as in the Pandarinae, the curved terminal claw nearly as long as the basal joint and shutting down between two large corrugated knobs on the ventral surface of the latter.

Mouth tube and maxillae peculiar, the former conical with a wide and swollen base, tapering rapidly to a fairly sharp tip, from which protrude the ends of the mandibles. These latter are straight and coarsely toothed along their inner margins, the teeth being more or less rectangular. Maxillae enormous and club-shaped, each one as large as the whole mouth tube and two-jointed, its hemispherical terminal joint covered with small curved spines. On the ventral surface of each maxilla, at the base of the terminal joint, is a small knob representing the rudiments of the exopod.

Swimming legs biramose, rami two-jointed, except those of the fourth pair, which are modified into large laminae with indistinguishable joints. The basal joints of the exopods of the first two pairs are much larger than the terminal joints and are armed with a stout spine at their outer distal corners, the one on the second legs being exceptionally large. The segments of the third legs are all the same size, while in the fourth legs the rudimentary endopod is several times larger than the exopod. In these latter legs there is also a large fold of skin caught up on the ventral surface of each basal joint.

When the legs are in place, this fold fits into the groove between the abdomen and genital segment, and doubtless assists materially in holding the egg masses in place.

The arrangement of the spines and setæ is as follows: First exopod, 1, 0; 4, II: endopod, 0, 0; 0, III: second exopod, 1, 0; 4, V: endopod, 0, 0; 0, VII: third exopod, 1, 0; 0, V: endopod, 0, 0; 0, V: fourth exopod, 5, 0: endopod, 4, 0. All the setæ are extremely rudimentary, and their plumes are easily overlooked.

Of the reproductive organs the oviducts are coiled in the anterior part of the genital segment. They do not extend back of the vulva, which is situated in the groove between the abdomen and genital segment. The external coils are intricate and very irregular, and it is absolutely impossible to straighten them out, so we can only estimate their total length, which must be at least twenty-five times the length of the body. The strings are very narrow for so large a copepod, and the eggs themselves are thin, so that there are several thousands in each string.

They are held securely in place between the dorsal plates of the genital segment and the lateral lobes of the abdomen until they hatch, the nauplii escaping at the posterior end of the egg bag. The cement glands are narrow and sickle-shaped, arching out on either side parallel with the lateral margin of the segment. The tip of each gland is evenly rounded, and there are no signs of cells or other divisions.

The semen receptacle is situated just in front of the base of the abdomen, but its exact shape could not be determined in any of the available specimens. The spermatophores are fastened to the ventral surface of the genital segment just in front of the abdomen and lie close together on either side of the mid-line, and the duct leading from each can be traced to the vagina on the opposite side, where it opens close to the base of the abdomen.

All the internal organs of the genital segment are thus confined to the short space in front of the abdomen, and this is practically the limit of the segment itself. But the cavity of the segment extends much farther back, as can be readily proved by injecting water into its anterior portion.

In this genus, therefore, as in the others belonging to the subfamily, the abdomen is really fastened to the ventral surface of the genital segment.

Total length, 25 to 30 mm.; length of carapace on mid-line, 8 to 10 mm.; width of same, 12.25 mm.; length of genital segment plates, 17.75 mm.; width of same, 15.5 mm.

Color, a uniform yellowish white, deepening in alcohol to an orange brown in the center of the different carapace areas and the

dorsal surface of the genital segment. The anterior ventral surface of the abdomen and the edges of the dorsal plates of the genital segment have a few spots of light brown pigment.

Egg masses a deep orange brown.

Male.—Carapace similar to that of the female, and with the same grooving on its dorsal surface. The cephalic and thoracic portions of the lateral areas do not differ as much in size as in the other sex, and the posterior sinus is rather deeper. The lateral lobes on the second segment and the dorsal plates on the third and fourth segments correspond closely with those in the female, the last mentioned covering the whole of the genital segment and the most of the the abdomen.

Genital segment transversely elliptical, nearly twice as wide as long, narrowed into a neck where it joins the fourth segment.

Abdomen also transversely elliptical and terminal, a little more than half the diameter, but much less than half the length of the genital segment. Anal laminae terminal, small, and close to the anus on either side; the setae which they carry are plumose, but rudimentary. Appendages similar to those of the female, with the usual sex distinctions manifested in the larger size of the second antennae, maxillae, and second maxillipeds, and in an increase in the number and length of the plumose setae on the swimming legs. The fourth legs have large laminate basal joints and one-jointed rami, but there is no fold of skin in the basal joints, and the rami are not as large and rudimentary as in the female. The testes are large and very apparent in well-preserved specimens; the spermatophore receptacles in the genital segment are circular in outline and so large as to nearly fill the entire segment.

Total length, 14 to 17 mm.; length of carapace on mid-line, 8 mm.; width of same, 11 mm.; length of fourth segment plates, 4 mm.; width of same, 6 mm.; length of genital segment, 3 mm.; of the abdomen, 1.8 mm.

Color as in the female, but rather lighter and more transparent, and without pigment spots on the ventral surface.

(*latreilli*, in honor of Pierre André Latreille.)

The U. S. National Museum collection contains three lots of this species, all from the gills of *Mola mola*: one taken at Woods Hole, Cat. No. 6017, U.S.N.M., contains females only; the second, also taken at Woods Hole, and Cat. No. 32796, U.S.N.M., contains both sexes; the third was taken by the Fisheries steamer *Albatross* on the Pacific coast at Station 4345, and is Cat. No. 32797, U.S.N.M.; it also contains both sexes.

Genus ORTHAGORISCICOLA Poche.

Læmargus (*L. muricatus*) KRÖYER, 1837, p. 487.

Orthagoriscicola (*O. muricata*) POCHE, 1902, p. 13.

Female.—Carapace trapezoidal or wedge-shaped, one-fourth wider than long, much narrowed anteriorly, posterior margin scarcely reentrant; posterior lobes very broad and evenly rounded; eyes invisible; grooving on the dorsal surface indistinct; lateral margins of the carapace coarsely toothed; its dorsal surface sparsely covered with spines. Frontal plates fused with the carapace, but their outlines indicated by well-defined grooves. Second and third thorax segments distinct; free, without dorsal plates, and forming a narrow waist joining the carapace and genital segment. Fourth segment with a pair of dorsal plates covering half the genital segment, their margin serrate. Genital segment enlarged, its dorsal plates wider and longer than the carapace, and overlapping each other along the mid-line, their margins serrate. Abdomen on the ventral surface of the genital segment and entirely concealed, its lateral margins prolonged into broad laminæ similar to those of *Cecrops*. Egg-tubes carried between these laminæ and the dorsal plates of the genital segment as in *Cecrops*, irregularly coiled and many times the body length. First antennæ three-jointed; second pair stout and uncinatæ; maxillæ much smaller than in *Cecrops*; mouth-tube about the same; second maxillipeds stout and with a large terminal claw. All the swimming legs biramous, but rudimentary and destitute of plumose setæ; rami of first two pairs two-jointed, of third and fourth pairs one-jointed and enlarged into huge flattened laminæ.

Male.—Carapace similar to that of the female, but relatively shorter and wider; thorax segments also similar; genital segment much smaller, only two-thirds the size of the carapace, its dorsal plate fused along the mid-line with a wide and shallow posterior sinus through which the abdomen shows. The latter is small and subquadrangular; anal laminæ narrow and oblong. Appendages similar to those of the female; second antennæ and second maxillipeds longer and stouter; third legs like the first two pairs, with two-jointed rami, but the fourth pair are one-jointed and enlarged as much as in the female.

(*Orthagoriscicola*, *Orthagoriscus*, the generic name of its host, and *cola*, inhabiting or dwelling upon.)

This genus was established by Krøyer in 1837 upon a few female specimens obtained from the sunfish, *Mola mola*. He called the genus *Læmargus*, but that name had just been used earlier in the same year for a fish genus, and so Poche in 1902 proposed as a substitute *Orthagoriscicola*, with a consequent change in the gender of the specific name.

This genus has been more fully described by the different investigators than the preceding and also better illustrated. Krøyer (1837),

Baird (1850), Hoeven (1857), Beneden (1861), A. Scott (1892), and T. Scott (1900) have all given good figures, but with the exception of those published by Hoeven they have been almost entirely of the female sex, the male having received very little attention. And yet the male is common and almost every group of these parasites yields several specimens.

From this list of names it will readily be understood that the descriptions given have been more accurate than those of *Cecrops* and there is very little to add. For the female little more has been done than to accumulate the facts given by the various authors, with the addition of some details in reference to the reproductive organs. For the male several changes in statement have been found necessary, and much has been added in the way of description, while the chalimus stage of development is entirely new.

Only a single species of the genus has been described up to the present time, but if we accept the statements and figures given by Hesse for what he has called "*Læmargus muricatus*" in the paper already referred to (p. 467), we must conclude that his specimens did not belong to the present species but were new.

The general body form is radically different, especially in the male, and there is not a single appendage described or figured by Hesse whose details agree with those of *muricatus*.

To be sure he made similar mistakes in describing *Cecrops*, but not so many of them, and while his general inaccuracy is well enough known to prevent the establishment of a new species upon his authority alone, yet it does not seem likely that he would have fallen into error in every particular. It will not be surprising, therefore, if future investigation shows that he had a new species, instead of *muricatus* as he claimed.

ORTHAGORISCICOLA MURICATA Kröyer.

PLATES XL and XLI.

Læmargus muricatus KRÖYER, 1837, p. 487, pl. v, figs. A to E.—BAIRD, 1850, p. 295, pl. xxxiv, figs. 3 and 4.—HOEVEN, 1857, p. 11, pl. iv, figs. 1 to 10, 12, 14, and 15.—BENEDEN, 1861, pp. 129, 149, pl. xix, figs. 1 to 4.—A. SCOTT, 1892, p. 266, pl. iii.—T. SCOTT, 1900, p. 158, pl. vi, figs. 39 to 42.

Orthagoriscicola muricata POCHE, 1902, p. 13.

Female.—Carapace trapezoidal or wedge-shaped, much narrowed anteriorly, with well rounded posterior lobes and a very shallow sinus.

Frontal plates fused with the carapace; eyes invisible in the adults; lateral margins set with fine conical teeth; grooves on the dorsal surface indistinct but separating a lateral area on either side, which is again divided into a very small cephalic, and a much larger thoracic, portion. The entire dorsal surface is sparsely covered with spines, which are coarser and more prominent on the ridges alongside the grooves. Second, third, and fourth thorax segments free, the first two with a pair of narrow, spine-like projections in the place of lateral

lobes, all three of the same width. The third segment has no dorsal plates; the fourth has a pair whose combined area is greater than that of the carapace, and which are separated by a deep posterior sinus, often a trifle enlarged at its base. Genital segment transversely elliptical, as large as the carapace, one-half wider than long, and covered with a pair of huge dorsal plates, which overlap each other along the mid-line, and extend back beyond the tip of the abdomen. The posterior and the postero-lateral borders of these plates and of those on the fourth segment are toothed, the teeth on the genital segment plates being considerably the larger and coarser. These genital segment plates do not round over ventrally in a scroll like those of *Cecrops*, but are flattened to the very edge.

Abdomen similar to that in *Cecrops*, the lateral lobes being prolonged sidewise and backward so that their edges coincide very nearly with those of the genital segment plates. The length of the abdomen plus these plates is about twice that of the genital segment in front of the abdomen. The lobes are also set with fine teeth along their margins, and are not rolled at the edges, but flat. In consequence, the space between them and the genital segment, in which the egg-strings are coiled, is not as thick dorso-ventrally, but is wider than in *Cecrops*, and thus accommodates about the same length of egg-strings, twenty or thirty times the length of the body. The strings are about the same diameter and the eggs fully as numerous.

First antennæ three-jointed, the joints diminishing regularly in diameter and in length from the base outward; they are very sparsely armed with setæ. Second antennæ large, three-jointed, and projecting well in front of the carapace; the terminal joint is a very powerful and strongly curved claw, which is buried its entire length in the flesh of the host.

Mouth-tube broadly conical, similar to that in *Cecrops*, the mandibles projecting through the opening at its tip, armed with square teeth on their inner margins only. Second maxillæ in the form of short conical knobs, apparently without joints, spines, or rudimentary exopods. In size they are in sharp contrast with those of the preceding genus, being less than one-fourth of the length of the mouth-tube. First maxillipeds two-jointed, both joints exceptionally stout, the terminal one slightly the longer. The terminal claw is short and wide and heavily fringed with stout spines; the accessory claw is in the form of a large spine. On the ventral surface of the joint opposite the accessory claw is a raised knob covered with small spines. Second maxillipeds swollen, the basal joint much longer than the terminal claw; on its inner surface are two pairs of knobs, one near the base of the terminal claw, and the other near its own base; the claw when closed lies between the two knobs of each pair. Legs all biramose, the rami transformed into flattened

laminæ, destitute of plumose setæ; those of the first two pairs are two-jointed, while the third and fourth pairs show but a single joint. The spines are arranged as follows: First exopod, 1, 3, endopod, 0, 0; second exopod, 0, 4, endopod, 0, 1; third exopod, 3, endopod, 0; fourth exopod, 6, endopod, 0. Of the reproductive organs the oviducts are coiled very tightly and in hopeless confusion in either half of the genital segment. In general the coils are narrower and more tightly wound in the anterior portion of the segment. The final coils are in the shape of a large S on either side of, and close to, the median line, the openings to the exterior being just in front of the base of the abdomen.

The cement glands are narrow and very long, and are bent into a sickle shape, the curve reaching backward on either side beneath the ventral lobe of the abdomen. The semen receptacle could not be distinguished with sufficient clearness to determine its exact shape, but it is situated in the usual position, just in front of the base of the abdomen. The spermatophores are ellipsoidal, twice as long as wide, and curved like a couple of parentheses marks; the ducts leading from them cross in the usual manner, and each empties into the vagina on the opposite side of the body. This genus, therefore, is unlike *Cecrops* in that the organs within the genital segment extend far behind the base of the abdomen; there is thus no doubt that the abdomen is fastened to the ventral surface of the genital segment and is not terminal. The certainty in this case increases the probability in the case of *Cecrops*, where it is not easy to decide.

Total length, 20 mm.; length of carapace on mid-line, 5.34 mm.; width of same, 7.1 mm.; length of fourth segment plates, 5.56 mm.; of genital segment plates, 8.35 mm.; width of latter, 9.5 mm.

Color a uniform light yellow without any pigment markings; the claws and chitin ribs which strengthen the carapace are darkened to a brownish hue.

Male.—Carapace similar to that of the female, but relatively a little shorter and wider; grooving on the dorsal surface indistinct; eyes invisible in the adult; no teeth along the lateral margins of the carapace. Fourth segment plates nearly circular, their combined area considerably less than the carapace, but covering more than half of the genital segment plates; their posterior margins are thickly set with teeth. They project forward at the anterior corners in a broad and rounded shoulder on either side.

Genital segment small, two-thirds the size of the carapace, orbicular in outline and strongly flattened dorso-ventrally, its dorsal plates fused along the mid-line for their anterior half, but separated for their posterior half, the posterior margins thickly set with teeth. Abdomen very small and weak, subquadrangular, fastened to the ventral surface of the genital segment so that its posterior margin

coincides with that of the latter; anal laminae narrow and oblong, nearly three times as long as wide, each armed with four small setae. Dorsal surface of the abdomen and anal laminae visible through the posterior sinus between the dorsal plates of the genital segment.

Appendages the same as in the female, the only differences being that the second antennae and second maxillipeds are larger, and there are more spines on the swimming legs. The fourth legs are fully as degenerate as in the female, being enlarged into broad laminae, with no signs of segmentation. The third legs are like the second pair and are not enlarged; each ramus is two-jointed, the joints about the same size, but those of the exopod nearly three times the size of those in the endopod.

The terminal joint of the endopod in these third legs is armed with a single long spine or claw, curved strongly outward, which seems to be characteristic of the genus. There are no plumose setae on the swimming legs, the spines being arranged as follows: First exopod, 0, 1, endopod, 0, 0; second exopod, 1, 5, endopod, 0, 5; third exopod, 1, 6, endopod, 0, 4; fourth exopod, 3, endopod, 1.

The spermatophore receptacles are very large and elliptical in outline; they are situated in the posterior portion of the genital segment, and are inclined at an angle of about 45° to the central axis; the ducts at their anterior ends are large and profusely coiled.

Cólor as in the female, but the spermatophore receptacles are a deep purple, and the ducts leading to them a lighter purple.

Total length, 10 to 15 mm.; length of carapace on mid-line, 5 to 7 mm.; width of same, 6.5 to 8 mm.; length of fourth segment plates, 4.25 mm.; width of same, 6.75 mm.; length of genital segment, 6.75 mm.; width of same, 5.75 mm.

Chalimus.—A male *chalimus* 8 mm. in length was among the specimens examined, and the following description shows the points in which it differs from the adult.

Carapace the same shape as that of the adult, but much more prominent anteriorly, relatively larger, and showing on its dorsal surface areas similar to those in the *Pandarinae*; no eyes visible.

The entire front of the carapace is occupied by the large attachment gland, which is acorn-shaped, one-third the entire length of the carapace, and as wide as long. It gives origin to two broad, flat, ribbon-like frontal filaments, similar to those found on the *Perissopus chalimus*, the stumps of which can be plainly seen at the center of the frontal margin.

Second and third thorax segments narrower and longer than in the adult, with the lateral lobes hardly appearing on their sides.

Fourth segment plates divided to their very base; genital segment and its dorsal plates the same as in the adult, except that the posterior sinus is much broader and shallower.

The appendages are similar to those already described, except that the swimming legs are more plainly segmented and armed with larger spines. In the second and third pairs also there is a good-sized spine on the basal joint just outside of the base of the exopod. In the third legs there is the same difference in size between the exopod and endopod, and the terminal joint of the latter is armed with a similar large and strongly curved claw.

Total length, 8 mm.; length of carapace on mid-line, 3.75 mm.; width of same, 4.35 mm.; length of second and third segments, 1.15 mm.; of fourth segment plates, 2 mm.; of genital segment, 3 mm.; width of latter, 3 mm.

Color a uniform yellowish white, similar to that of the female and male already described.

(*muricata*, with sharp points or spines.)

This species is confined almost exclusively to the Sunfish, so that Poche's generic name is eminently fitting. But while *Cecrops* is usually found upon the gills, the present species frequents the outer surface of the body, the vicinity of the anal fin being a favorite locality. It is furthermore gregarious in habits, and from ten to twenty individuals gather together in bunches. The combined laceration of their sharp claws and probosces within so small an area quickly penetrates even the thick skin of the Sunfish. The groups of parasites thus come to lie in the bottom of depressions or pits which are eaten through the skin of the fish and into the raw flesh beneath; the edges of the pits are raised slightly above the surrounding surface and calloused. (See A. Scott, 1892, p. 266.)

With the claws of their second antennæ and second maxillipeds sunk deeply into the flesh of their host in the bottom of these pits, they are secure from friction and many of the other evils that come from living on the outside of the host's body.

But while thus protected from some dangers, their fixed habit renders them peculiarly liable to others. Chief among these is the fact that their bodies, and especially the chitinous plates which cover its dorsal surface, furnish admirable anchorage for many of the other fixed forms, animal and vegetable, which live in the ocean. It thus happens that we frequently find the dorsal surface of one of these parasites covered with algæ, infusoria, hydrozoa, or even barnacles. Of the latter the striped barnacle, which is found also upon *Pennella*, is the most common, and specimens of *Orthogoriscicola* may be found carrying a huge *Lepas* larger than their own bodies. Two such specimens are figured by Hoeven in the paper already cited, 1857, Plate IV, fig. 10.

Although this can not be regarded as a case where "Greek meets Greek," since the *Lepas* is not in any sense a parasite, yet the fastening of its heavy weight upon the back of the copepod must be a sore burden to the latter.

The collection of the U. S. National Museum includes the following lots, which are excellently preserved and especially rich in specimens of the male sex. They were all taken from the Sunfish, *Mola mola*, with the single exception mentioned. Cat. No. 3693, U.S.N.M., from Jeffreys Bank by the schooner *Paul Revere*, includes two females.

Cat. No. 12913, U.S.N.M., from Woods Hole in 1886, contains thirty females and seven males; Cat. Nos. 32783, 32784, and 32786, U.S.N.M., were obtained by the schooner *Grampus* 120 miles off Woods Hole in 1900; the first and last contain about thirty females each, the second one contains ten males. Cat. No. 32785, U.S.N.M., contains two males and one female and was obtained from the gills of a Moonfish, *Selene vomer*, at Woods Hole in 1905.

Genus PHILORTHRAGORISCUS Horst.

Dicnatura (*D. serrata*) KZÖYER, 1863, p. 176.

Philothragiciscus (*P. serratus*) HORST, 1897, p. 137.

Female.—Carapace well rounded, a little wider than long. First thorax segment only fused with the head; second and third segments fused inter se and furnished with a pair of small lateral plates; fourth segment with a pair of large dorsal plates, fully as wide as the carapace, and overlapping three-fifths of the genital segment. This latter nearly the size of the carapace and covered by a pair of large dorsal plates, whose margins are finely serrated. Abdomen small, considerably wider than long, one-jointed and attached to the ventral surface of the genital segment so far forward as to be almost entirely concealed in dorsal view. Anal laminae large, foliaceous, divergent, each armed with four short spines. Frontal plates well fused with the carapace; first antennae long and two-jointed; second pair three-jointed and uncinatè. Mouth-tube long and pointed; mandibles with very wide and blunt teeth; second maxillae short, jointed, and simple; second maxillipeds large, with a stout terminal claw.

All the swimming legs biramous; rami of first three pairs two-jointed and armed with both spines and plumose setae, rami of fourth pair one-jointed, bearing short spines only; fifth pair entirely lacking. Egg-tubes straight or coiled outside the body, several times the body length; eggs as in the *Pandarinæ*.

Male.—Carapace much larger than the rest of the body, wider than long, its dorsal surface grooved as in the *Pandarinæ*; no eyes visible. Second and third thorax segments fused inter se, and furnished with a pair of small lateral plates; fourth segment with a pair of very small and rudimentary dorsal plates which scarcely overlap the genital segment at all. Genital segment subquadrangular, with slightly rounded sides; covered with two dorsal plates thoroughly fused along the mid-line, with a posterior margin and sinus exactly like that in *Perissopus*.

Abdomen the same shape as in the female, but more of it visible behind the genital segment; anal laminae narrower and smaller than in the other sex, each armed with three good-sized setae.

First antennae relatively longer than in the female; second pair also enlarged, their terminal claws projecting well in front of the carapace. Other appendages similar to those of the female, except that on all of them the claws and spines are longer and sharper.

(*Philorthrageriscus*, $\varphi\lambda\epsilon\omega$, to love, and *Orthrageriscus*, the old generic name of its host.)

In 1863 Kröyer described a new species, which he referred to the genus *Dinematura* and called *D. serrata*. The present author obtained numerous specimens of both sexes of this species while at Woods Hole in 1904. On examination it was found that they could not belong to the genus *Dinematura* for the following reasons: First the general body make-up is entirely different; the body is too short; the genital segment is not elongated enough; the dorsal plates of the fourth segment are many times too large; the abdomen is much too large and in the wrong position. Again, there is no trace in the present species of the adhesion disks found on the ventral surface in *Dinematura*. In the third place there is no trace here of that sixth segment which is the characteristic of *Dinematura*, with its rudimentary legs and dorsal plate. And finally in *Dinematura* all the legs are biramous, the rami of the first pair are two-jointed, those of the second and third pairs three-jointed, while the rami of the fourth pair are enlarged into laminae in which there is almost no trace of jointing. Here the rami of the first three pairs are two-jointed, while those of the fourth pair are rudimentary, very much reduced in size, and one-jointed.

Accordingly a new generic name was given to the species, but fortunately the author afterwards found Horst's paper (1897), in which he had already renamed the species as given above.

Kröyer and Horst are the only two who have ever described the species. Kröyer had no specimens of the male sex and Horst had but a single one, of which he gives only one small figure, a dorsal view.

For this reason the male has been fully described and figured in the following account:

PHILORTHRAGORISCUS SERRATUS Kröyer.

PLATES XLII AND XLIII.

Dinematura serrata KRÖYER, 1863, p. 176, pl. VIII, figs. 4 a to i.

Philorthrageriscus serratus HORST, 1897, p. 137, pl. VII.

Female.—Carapace well rounded, about one-sixth wider than long, with large acuminate teeth along the lateral and posterior margins. Frontal plates wide and fairly distinct; but still fused with the carapace;

frontal margin smooth and slightly curved, with a small incision at the center. Dorsal surface of the carapace with well-defined grooves marking it off into areas similar to those in the Pandarinæ. The two longitudinal grooves are strongly concave toward each other, like parenthesis marks, the space between them being nearly two-thirds of the entire width. The lateral areas outside of these grooves are wider posteriorly, and are prolonged backward on either side in a large lobe which extends nearly to the anterior margin of the dorsal plates of the fourth thorax segment. Each of these lateral areas is divided by a transverse groove which starts from a deep sinus in the lateral margin and curves inward and backward to the longitudinal groove. The posterior or thoracic portion of the area is thus shorter but wider than the anterior portion, and has somewhat the appearance of a lateral plate attached to the posterior portion of the carapace.

The second and third thorax segments are fused together and furnished with a single pair of lateral plates, one on either side beneath the posterior carapace lobe and nearly concealed by it. The fourth thorax segment is considerably narrower than the second and third, but carries a pair of large dorsal plates which extend outward on either side to a level with the lateral margins of the carapace and backward until they overlap half the genital segment. The two plates are entirely fused anteriorly for about one-quarter of their length; the combined anterior margin is a nearly perfect arc of a large circle which terminates at either end in a short and sharp spine. Each plate is nearly circular in outline and is bordered by acuminate spines similar to those on the carapace, but not quite as large.

The sinus between the plates is wide and well rounded at the base, but farther back its sides approach until they are in actual contact. The combined dorsal plates of the fourth and genital segments are about the same size as the carapace, and inversely the same shape. As the abdomen is hidden, this gives the copepod a regular elliptical outline, broken across the short diameter by the waist between the carapace and fourth segment.

The joint between the third and fourth segments seems to be the only one which is really flexible, and the anterior half of the body is frequently folded over ventrally against the posterior half. The dorsal surface of the genital segment is also covered by a pair of plates similar to those on the fourth segment and finely serrate around the margins. The posterior sinus between these plates is deeply cut and is similar to that between the fourth segment plates.

The abdomen is of medium size, considerably wider than long, and unsegmented; it is attached to the ventral surface of the genital segment just in front of the base of the sinus, between the dorsal plates of the latter. Its own posterior margin is slightly reentrant on either side where the lamina is attached; these laminae are small, foliaceous,

and furnished with four short spines. The laminae vary considerably in length, but they usually project somewhat behind the genital segment.

The egg-strings are narrow and two and a half to three times as long as the whole body; the eggs are small and similar to those in the Pandarinæ. The first antennæ are large and appressed close to the margin of the carapace; the two joints are nearly the same length, but the basal has twice the diameter of the terminal; both are well armed with setæ.

The second antennæ are large and three-jointed, and terminate in a stout curved claw, which has an accessory spine on its inner margin. When the antennæ are turned forward these claws project beyond the anterior margin of the carapace; they are prehensile in function, and with the second maxillipeds are driven deeply into the flesh of the host. There are no first maxillæ; the second pair are close beside the mouth-tube and only about one-third its length; they are simple and terminate in a short, blunt spine, directed outward.

The mouth-tube is very long and conical in shape; the base is wide, but at about the level of the tips of the second maxillæ it narrows rapidly to a slender tip. The mouth-opening is terminal and fringed with long hairs, through which may be seen the tips of the mandibles. These are slender and toothed for some distance along their inner margins at the tip; the teeth are wide and blunt, and quite different from those in the Pandarinæ. The first maxillipeds are small and weak, the terminal joint about the same length as the basal, and ending in two claws the same size and covered with stiff hairs.

The second maxillipeds are considerably larger and stouter, with the terminal claw about three-quarters the length of the basal joint. On the inner surface of the latter, opposite the tip of the claw, is a pair of long, blunt spines; they are some distance apart and so situated that when the claw closes down upon the basal joint it shuts in between them and is locked securely in place. All four pairs of legs are biramose, the rami of the first three pairs two-jointed, of the fourth pair one-jointed. In the first pair the exopod is considerably larger than the endopod; its basal joint is three times the length of the terminal and nearly twice as wide; the endopod joints are about equal. In the second and third legs the basal joints are enlarged and connected across the mid-line by a wide lamina, larger in the third pair than in the second. The rami of the second pair are about the same size, but the joints are unequal; in the exopod the basal joint is twice the size of the terminal, while in the endopod the terminal joint is more than twice the size of the basal. The rami of the third legs are also equal and the four joints are nearly the same size. In the fourth legs the basal joints are well separated and have

no connection across the mid-line; the rami are one-jointed and rudimentary, the exopod being three times the size of the endopod; they are both armed with short spines and have no plumose setæ.

The arrangement of the spines and setæ on these legs is as follows: First exopod, 1, 0; 4, III: endopod, 0, 0; 0, III: second exopod, 1, I; 4, V: endopod, 0, I; 0, VII: third exopod, 1, 0; 2, IV: endopod, 0, 0; 0, IV: fourth exopod, 5: endopod, 2.

Of the reproductive organs the oviducts are coiled inside the genital segment as in the other genera; in early stages the coils do not extend much back of the base of the abdomen, but later one fold on either side pushes down into the very tip of the genital segment. The cement glands are considerably darker in color than the egg-tubes, and are bent into a sickle shape, the concave sides facing each other; the ducts leading from their posterior ends into the oviducts are very short.

The spermatophores are elliptical or slightly egg-shaped, the larger end being posterior, and from it a tube leads into the vulva. At first these tubes cross each other as in the other genera, but as the sperms are extruded into the sperm receptacle of the female, the spermatophores gradually shrivel up and each pulls across the mid-line to the opposite side, so that later they present the appearance seen in fig. 287. Each now stands up from the surface of the genital segment in a corkscrew coil, the tip of which is nearly snow white. The semen receptacle is situated just in front of the base of the abdomen; it is short, curved a little, with the concave side posterior, and slightly enlarged at the ends.

Total length, 7 mm.; length of carapace on mid-line, 2.75 mm.; width of same, 4.5 mm.; length of genital segment, 3 mm.; width of same, 4.4 mm.; length of abdomen, 1 mm.; of egg-strings, 15 mm.

Color, a mixture of yellow and gray, sometimes the one color predominating, sometimes the other.

Male.—Carapace proportionally much larger, more than twice the width of the rest of the body, and about the same length; grooves and divisions as in the female. Lateral plates on the fused second and third segments plainly visible just inside the posterior lobes of the carapace. Dorsal plates on the fourth segment very rudimentary, no larger than the lateral plates just mentioned, and barely overlapping the base of the genital segment.

The latter is subquadrangular, with slightly rounded sides, and the posterior angles armed with sharp spines; the posterior margin has a wide central sinus with divergent sides, showing most of the dorsal surface of the abdomen. The margin on either side of the sinus takes the shape of the letter S, almost exactly like that in the genus *Perissopus*. The abdomen is similar to that in the female, as also are the anal laminæ.

The first antennæ are longer than in the female and more densely armed with setæ; the second antennæ are much enlarged and the terminal claw projects well in front of the carapace.

The other appendages are similar to those of the female except that in all of them the spines and claws are longer and sharper.

The basal joint of the exopod of the first legs is somewhat swollen and armed along its outer margin and the adjacent ventral surface with stout curved spines pointing backward. The claw at the outer corner of this joint and those on the terminal joint are enlarged and furnished along their margins with a row of stout teeth. Of the reproductive organs the testes are of good size and quite prominent; the spermatophore receptacles in the genital segment are very large, filling almost the entire segment. The posterior part where the ripe spermatophores are lodged is club-shaped and fills nearly the whole half diameter of the segment. It is narrowed anteriorly where the duct from the testis enters it, but is not coiled as much as in most genera.

Total length, 5 mm.; length of carapace on mid line, 2 mm.; width of same, 4 mm.; length of genital segment, 1.58 mm.; width of same, 1.4 mm.

Color the same as in the female.

(*serratus*, toothed like a saw, alluding to the margins of all the body regions.)

The males and females of this species are found together and in company with those of *Cecrops* and *Orthagoriscicola* on the Sunfish. The collection of the U. S. National Museum includes five lots, all obtained from the Sunfish, *Mola mola*; Cat. No. 941, U.S.N.M., taken in Casco Bay in 1873; Cat. No. 32779, U.S.N.M., taken by the Fisheries steamer *Albatross* in September, 1886; Cat. Nos. 32778 and 32780, U.S.N.M., obtained by the schooner *Grampus* about 120 miles off Woods Hole; Cat. No. 32781, U.S.N.M., from a Sunfish taken at the surface in Vineyard Sound.

BIBLIOGRAPHY.

The following are the papers to which reference is made in the text:

- BAIRD, W. The Natural History of the British Entomostraca. Printed for the Ray Society, London, 1850.
- BASSETT-SMITH, P. W. A Systematic Description of Parasitic Copepoda found on Fishes, with an enumeration of the known Species. Proceedings of the Zoological Society of London, 1899.
- BENEDEN, P. J. VAN. Sur les vers parasites du poisson-lune (*Orthogoriscus mola*) et le *Cecrops latreillii*, qui vit sur ses branchies. Bulletin de l'Académie Royale de Belgique, XXII, Part 2, 1855.
- . Recherches sur la Faune Littorale de Belgique; Crustacés. Mémoires de l'Académie Royale de Belgique, XXXIII, 1861.
- . Le Mâle de certains Caligidés et un nouveau Genre de cette Famille. Bulletin de l'Académie Royale de Belgique (3), XXIII, No. 3, 1892.
- . Quelques nouveaux Caligidés de la Côte d'Afrique et de l'Archipel des Açores. Bulletin de l'Académie Royale de Belgique (3), XXIV, 1892.
- BRADY, GEORGE STEWARDSON. Report on the Copepoda. Challenger Expedition, Zoology, VIII, 1883.
- BURMEISTER, HERMANN. Beschreibung einiger neuen oder weniger bekannten Schmarotzkerkrebse, nebst allgemeinen Betrachtungen über die Gruppe, welcher sie angehören. Acta, Verhandlungen der Leopoldinisch-Carolinischen Akademie der Naturforscher, XVII, Part 1, 1833.
- CLAUS, CARL. Beiträge zur Kenntniss der Schmarotzkerkrebse. Zeitschrift für wissenschaftliche Zoologie, XIV, 1864.
- . Neue Beiträge zur Kenntniss parasitischer Copepoden, nebst Bemerkungen über das System derselben. Zeitschrift für wissenschaftliche Zoologie, XXV, 1875.
- DANA, JAMES DWIGHT. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, and 1842, under the Command of Charles Wilkes, U. S. N., Vol. XIII, Crustacea, 1852.
- DESMAREST, ANSELME GAETAN. Considérations générales sur le classe des Crustacés. Paris and Strasbourg, 1825.
- FREY, HEINRICH, and LEUCKART, RUDOLPH. Beiträge zur Kenntniss wirbelloser Thiere mit besonderer Berücksichtigung der Fauna des Norddeutschen Meeres. Braunschweig, 1847.
- GERSTAECKER, A. Ueber eine neue und weniger gekannte Siphonostomen-Gattung. Wiegmann's Archiv für Naturgeschichte, XIX, 1853.
- . Beschreibung zweier neuer Siphonostomen-Gattungen. Wiegmann's Archiv für Naturgeschichte, XX, 1854.
- GUÉRIN-MÉNEVILLE, FÉLIX ÉDOUARD. Iconographie du Règne Animal. Paris. Published in livraisons 1829 to 1844. The plate containing parasitic copepods is numbered XXXV and bears the date March, 1837.
- HELLER, CAMIL. Reise der Oesterreichischen Fregatte Novara. Wien, 1865.
- HESSE, EUGÈNE. Description de deux Crustacés nouveaux, mâle et femelle du genre Dinemoura, décrits et peints sur des individus vivants. Revue des Sciences Naturelles, Montpellier (2), II, 1880.
- . Crustacés rares ou nouveaux des Côtes de France, 33^{me} Article. Annales des Sciences Naturelles (6), XV, 1883.
- . Crustacés rares ou nouveaux des Côtes de France, 37^{me} Article. Annales des Sciences Naturelles (7), V, 1888.

- HOEVEN, J. VAN DER. Note sur les genres *Cecrops* et *Læmargus*. Mémoires d'entomologie publiées par la Société Entomologique des Pays-Bas, I, 1857.
- . Over *Cecrops* en *Læmargus*, twee geslachten van parasitische schaaldieren. Tijdschrift voor entomologie. Leyden, I, 1858.
- HORST, R. *Philorthragoriscus serratus*, Kröyer (*Dinematura serrata* Kr.). Notes from the Leyden Museum, XIX, 1897.
- JOHNSTON, GEORGE. Illustrations in British Zoology. Loudin's Magazine of Natural History, VIII, 1835.
- KRÖYER, HENRIK. Om *Snyltekrebsene*, isaer med Hensyn til den Danske Fauna. Naturhistorisk Tidsskrift, I and II, 1837 and 1838.
- . Bidrag til Kundskab om *Snyltekrebsene*. Naturhistorisk Tidsskrift, 1863.
- LAMARCK, JEAN BAPTISTE PIERRE. Histoire naturelle des animaux sans vertèbres. Paris, 1818.
- LATREILLE, PIERRE ANDRÉ. Le Règne Animal, IV, Crustacés, Paris, 1829.
- LEACH, WILLIAM ELFORD. Annulosa. Supplement to the Fourth, Fifth, and Sixth Editions of the Encyclopedia Britannica, I, 1824 (really published in 1816).
- . Entomostracés. Dictionnaire des Sciences Naturelles, XIV, 1819.
- MILNE EDWARDS, HENRI. Mémoire sur l'organisation de la bouche chez les Crustacés suceurs. Annales des Sciences Naturelles, XXVIII, 1833.
- . Histoire Naturelle des Crustacés. Paris, 1840.
- MÜLLER, OTHO FREDRICUS. Entomostraca, seu Insecta testacea. Lipsiæ et Hafniæ, 1785.
- NORMAN, REV. ALFRED MERLE. Last Report on Dredging among the Shetland Isles. Report of the British Association for the Advancement of Science for 1868.
- OLSSON, DR. PETRUS. Prodrömus faunæ Copepodorum parasitantium Scandinaviæ. Acta Universitatis Lundensis, 1868.
- OTTO, DR. A. W. Beschreibung einiger neuen, in den Jahren 1818 und 1819 im Mittelländischen Meere gefundener Crustaceen. Verhandlungen der Leopoldinisch-Carolinischen Akademie der Naturforscher, XIV, 1828.
- POCHE, FRANZ. Bemerkungen zu der Arbeit des Herrn Bassett-Smith: "A Systematic Description of Parasitic Copepoda found on Fishes, with an Enumeration of the known Species." Zoologischer Anzeiger, XXVI, 1902.
- RATHBUN, RICHARD. Descriptions of Parasitic Copepoda belonging to the genera *Pandarus* and *Chondracanthus*. Proceedings of the U. S. National Museum, IX, 1886.
- . Description of New Species of Parasitic Copepods belonging to the genera *Trebius*, *Perissopus*, and *Lernanthropus*. Proceedings of the U. S. National Museum, X, 1887.
- SAY, THOMAS. An account of the Crustacea of the United States. Journal of the Academy of Natural Sciences at Philadelphia, I, 1818.
- SCOTT, A. Notes on *Cecrops latreilli* Leach, and *Læmargus muricatus* Kröyer. Transactions of Natural History Society, Glasgow, III, 1892.
- SCOTT, THOMAS. Notes on some Crustacean Parasites of Fishes. Eighteenth Annual Report of the Fishery Board for Scotland, Part III, 1900.
- SMITH, SIDNEY I. Invertebrate Animals of Vineyard Sound. Report of Commissioner of Fish and Fisheries for 1871 and 1872.
- STEENSTRUP, JAPETUS, and LÜTKEN, CHRISTIAN. Bidrag til Kundskab om det aabne Havs *Snyltekrebs* og *Lernæer*. Kongelige Danske Videnskabernes Selskabs Skrifter, 5te Række, V, 1861.
- THOMSON, GEORGE M. Parasitic Copepoda of New Zealand. Transactions of the New Zealand Institute, XXII, 1889.
- WILSON, CHARLES B. New Species of Parasitic Copepods from the Massachusetts Coast. Proceedings of the Biological Society of Washington, XVIII, 1905.
- WRIGHT, EDWARD P. On a new Genus and Species belonging to the family *Pandarina*. Proceedings of the Royal Irish Academy of Science (2), II, 1877.

EXPLANATION OF THE PLATES.

PLATE XVII. *Perissopus communis* Rathbun, and variety *stimpsoni* Rathbun.

Fig. 19, Dorsal view of female of *communis*; fig. 20, Dorsal view of variety *stimpsoni*; fig. 21, Ventral view of carapace, showing large knob opposite first maxillipeds; fig. 22, Mouth tube and second maxilla; figs. 23 to 25, First, second, and third swimming legs; fig. 26, Rami of third leg, enlarged; fig. 27, Fourth swimming leg; fig. 28, Rami of same, enlarged; fig. 29, Fifth swimming leg; fig. 30, Ventral view of genital segment and abdomen, showing abdomen (*a*), cement glands (*c. g.*), spermatophores (*s*) in position, and semen receptacle (*s. r.*); fig. 31, A single spermatophore, enlarged.

PLATE XVIII. Male chalimus of *Perissopus communis* Rathbun.

Fig. 32, Dorsal view; note especially the eyes and the large gland at the base of the frontal filaments; fig. 33, Ventral view of carapace, showing first and second antennae and their adhesion pads; figs. 34 and 35, First and second maxillipeds; figs. 36 to 39, First, second, third, and fourth swimming legs.

PLATE XIX. The female of *Echthrogaleus coleoptratus* Guérin.

Fig. 40, Dorsal view; fig. 41, First antenna; fig. 42, Mouth tube and second maxillae; figs. 43 and 44, First and second maxillipeds; figs. 45 to 48, First, second, third, and fourth swimming legs; fig. 49, Ventral view of genital segment and abdomen, showing abdomen (*a*), cement glands (*c. g.*), and sperm receptacles (*s. r.*); fig. 50, Ventral view of genital segment with abdomen removed, showing sixth segment plate and fifth legs.

PLATE XX. The female of *Echthrogaleus denticulatus* Smith.

Fig. 51, Dorsal view; fig. 52, Second antenna; fig. 53, Mouth tube and second maxilla; figs. 54 and 55, First and second maxillipeds; figs. 56 to 59, First, second, third, and fourth swimming legs; fig. 60, Ventral view of genital segment and abdomen.

PLATE XXI. The female of *Echthrogaleus torpedinis*, new species.

Fig. 61, Dorsal view, egg strings 40 mm. in length; fig. 62, Second antenna; fig. 63, Mouth tube, second maxillae, and the large spines posterior to the latter; fig. 64, Second maxilliped; figs. 65 to 68, First, second, third, and fourth swimming legs; fig. 69, Ventral view of genital segment with abdomen removed, showing the sixth segment plate and rudimentary fifth legs.

PLATE XXII. The female of *Dinematura ferox* Kröyer.

Fig. 70, Dorsal view, egg strings 120 mm. in length; figs. 71 and 72, First and second maxillipeds; fig. 73, Mouth tube and second maxillae; figs. 74 to 77, First, second, third, and fourth swimming legs; fig. 78, Ventral view of genital segment and abdomen, showing abdomen (*a*), cement glands (*c. g.*), semen receptacle (*s. r.*), and sixth segment (*x*), with its rudimentary legs.

PLATE XXIII. The female of *Dinematura producta* Müller.

Fig. 79, Dorsal view, egg strings 40 mm. in length; fig. 80, Second antenna; fig. 80a, Mouth tube and second maxillæ; fig. 81, Second maxilla, enlarged; fig. 82, Second maxilliped; figs. 83 to 86, First, second, third, and fourth swimming legs; fig. 87, Ventral view of genital segment and abdomen, showing the abdomen (a), and sixth segment (x) with its rudimentary legs (l).

PLATE XXIV. The female of *Dinematura latifolia* Steenstrup and Lütken.

Fig. 88, Dorsal view, egg strings 30 mm. in length; figs. 89 and 90, First and second maxillipeds; figs. 91 to 94, First, second, third, and fourth swimming legs; fig. 95, Fourth swimming leg of male; fig. 96, Ventral view of genital segment and abdomen, showing cement glands (c. g.), spermatophores (s) in position, sixth segment (x) with its rudimentary legs (l) and the abdomen (a).

PLATE XXV. The male of *Dinematura latifolia* Steenstrup and Lütken.

Fig. 97, Dorsal view; fig. 98, Second antenna; fig. 99, First maxilliped; fig. 100, Mouth-tube and second maxillæ; figs. 101 to 103, First, second, and third, swimming legs; fig. 104, Mandible; fig. 105, Ventral view of genital segment, showing spermatophore receptacles.

PLATE XXVI. The male of *Pandarus brevicaudis* Dana.

Fig. 106, Dorsal view; fig. 107, Second antenna; fig. 108, Second maxilliped; fig. 109, First maxilliped; figs. 110 to 113, First, second, fourth, and third swimming legs.

PLATE XXVII. The female of *Pandarus bicolor* Leach.

Fig. 114, Dorsal view, egg-strings 13 mm. in length; fig. 115, Ventral view of carapace, showing first and second antennæ and their adhesion pads; fig. 116, Mouth-tube and second maxillæ; figs. 117 and 118, First and second maxillipeds; figs. 119 to 122, First, second, third, and fourth swimming legs; fig. 123, Ventral surface of genital segment and abdomen, showing adomen (a), short anal laminæ (a. l.), spermatophores (s) in position and semen receptacle (s. r.).

PLATE XXVIII. The female and male of *Pandarus cranchii* Leach.

Fig. 124, Dorsal view of female; egg-strings 8.5 mm. in length; fig. 125, Second antenna; fig. 126, Second maxilliped; figs. 127 to 130, First, second, third, and fourth swimming legs; fig. 131, Ventral view of genital segment and abdomen, showing the abdomen (a), the anal laminæ (a. l.), spermatophores (s) in position, and the horse-shoe-shaped semen receptacle (s. r.); fig. 132, Dorsal view of male; fig. 133, Mouth-tube and second maxillæ; figs. 134 and 135, First and second maxillipeds; figs. 136 to 139, First, second, third, and fourth swimming legs.

PLATE XXIX. The female of *Pandarus smithii* Rathbun.

Fig. 140, Dorsal view, egg-strings 15 mm. in length; fig. 142, Second antenna; figs. 143 and 144, First and second maxillipeds; figs. 145 to 148, First, second, third, and fourth swimming legs; fig. 149, Mouth-tube and second maxillæ; fig. 150, Dorsal view of young female, 3 mm. in length; fig. 151, Ventral view of abdomen and part of genital segment.

PLATE XXX. The male of *Pandarus smithii* Rathbun.

Fig. 152, Dorsal view; fig. 153, Ventral view of carapace, showing first and second antennæ and their adhesion pads; figs. 154 and 155, First and second maxillipeds; fig. 156, Mandible; figs. 157 to 160, First, second, third, and fourth swimming legs; fig. 161, Dorsal view of young female 4.5 mm. in length.

PLATE XXXI. The female of *Pandarus satyrus* Dana.

Fig. 162, Dorsal view, egg-strings not fully developed; fig. 163, Second antenna; figs. 164 and 165, First and second maxillipeds; fig. 166, Mouth-tube and second maxillæ; figs. 167 to 170, First, second, third, and fourth swimming legs; fig. 171, Ventral view of genital segment and abdomen, showing folding of internal oviducts, the semen receptacle, spermatophores in position, and anal laminae.

PLATE XXXII. The female of *Pandarus sinuatus* Say.

Fig. 172, Dorsal view, egg-strings 15 mm. in length; fig. 173, Second antenna; fig. 174, Mouth-tube and second maxillæ; figs. 175 and 176, First and second maxillipeds; figs. 177 to 180, First, second, third, and fourth swimming legs; fig. 181, Ventral surface of genital segment and abdomen, showing abdomen (*a*), anal laminae (*a. l.*), cement glands (*c. g.*), and semen receptacle (*s. r.*); fig. 182, Dorsal view of young female, 4.5 mm. in length.

PLATE XXXIII. The male of *Pandarus sinuatus* Say.

Figs. 183 and 184, Dorsal and ventral views of the abdomen of a young female, showing the sixth segment plate just beginning to grow; fig. 185, Dorsal view of male; fig. 186, Second antenna; figs. 187 and 188, First and second maxillipeds; figs. 189 to 192, First, second, third, and fourth swimming legs; fig. 193, Ventral surface of genital segment, showing spermatophore receptacles and their coiled ducts.

PLATE XXXIV. The female of *Nesippus alatus* Wilson.

Fig. 194, Dorsal view, egg-strings 13.5 mm. in length; fig. 195, First antenna and adhesion pad; fig. 196, Second antenna; fig. 197, Mouth-tube and second maxillæ; figs. 198 and 199, First and second maxillipeds; figs. 200 to 203, First, second, third, and fourth swimming legs; fig. 204, Ventral surface of genital segment and abdomen, showing cement glands and semen receptacle; fig. 205, Dorsal view of young female 4 mm. in length.

PLATE XXXV. The male of *Nesippus alatus* Wilson.

Fig. 206, Dorsal view; fig. 207, First antenna, and its adhesion pad; fig. 208, Second antenna; fig. 209, Mouth-tube and second maxillæ; fig. 210, First maxilliped; figs. 211 to 214, First, second, third, and fourth swimming legs.

PLATE XXXVI. The male of *Nesippus curticaudis* Dana.

Fig. 215, Dorsal view; fig. 216, Second antenna; fig. 217, Mouth-tube and second maxillæ; figs. 218 and 219, First and second maxillipeds; figs. 220 to 223, First, second, third, and fourth swimming legs.

PLATE XXXVII. The male of *Nesippus borealis* Steenstrup and Lütken.

Fig. 224, Dorsal view; fig. 225, Second antenna; fig. 226 First maxilliped; fig. 227, Second maxilliped; figs. 228 to 231, First, second, third, and fourth swimming legs.

PLATE XXXVIII. The female of *Cecrops latreillii* Leach.

Fig. 232, Dorsal view; fig. 233, Mouth-tube and second maxillæ; fig. 234, Mandible; fig. 235, Second maxilliped; figs. 236 to 240, First, second, third, and fourth swimming legs; fig. 240, Ventral view of the fourth leg, showing fold of tissue which assists in keeping the external egg-strings in place; fig. 241, Ventral view of genital segment and abdomen in a young female; fig. 242, Dorsal view of young female 12 mm. in length.

PLATE XXXIX. The male of *Cecrops latreillii* Leach.

Fig. 243, Dorsal view; figs. 244 and 245, First and second antennæ; fig. 246, Mouth-tube and second maxillæ; figs. 247 and 248, First and second maxillipeds; figs. 249 to 252, First, second, third, and fourth swimming legs; fig. 253, Ventral surface of genital segment and abdomen of female, showing cement glands, spermatophores in position, and the peculiar rolling of the lateral laminae of the abdomen; fig. 254, Ventral surface of female with external egg-cases, showing how the laminae of the abdomen are unfolded and straightened out over the ventral surface of the external egg-cases.

PLATE XL. The female of *Orthagoriscicola muricata* Kröyer.

Fig. 255, Dorsal view; fig. 256, Second antenna; fig. 257, Mouth-tube and second maxillæ; fig. 258, Mandible; figs. 259 and 260, First and second maxillipeds; figs. 261 to 264, First, second, third, and fourth swimming legs; fig. 265, Ventral surface of genital segment and abdomen, showing the coiling of the internal oviducts, spermatophores in position, and the lateral laminae of the abdomen.

PLATE XLI. The male and a chalimus of *Orthagoriscicola muricata* Kröyer.

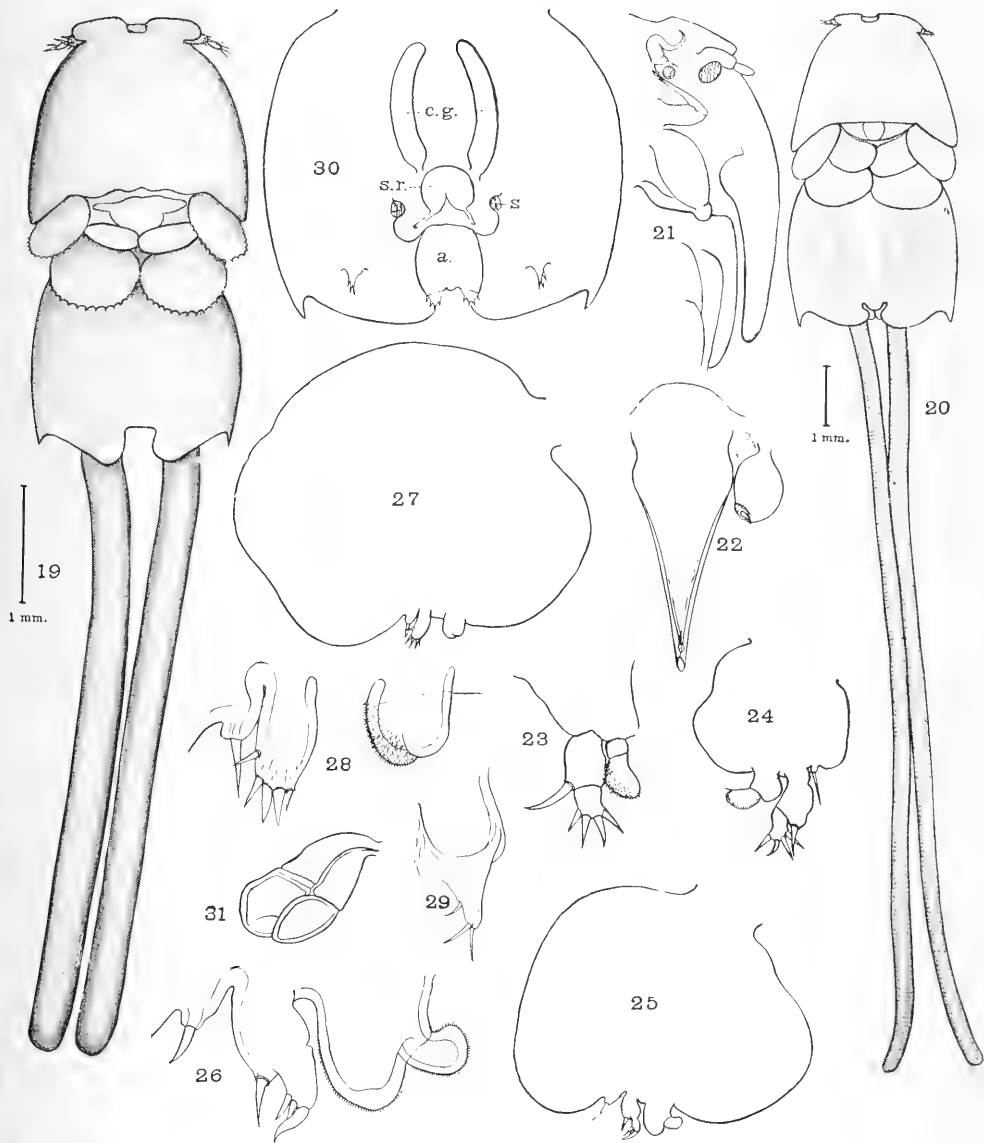
Fig. 266, Dorsal view of male; fig. 267, Second maxilliped; figs. 268 to 271, First, second, third, and fourth swimming legs; figs. 272 and 273, Dorsal and ventral surfaces of genital segment; fig. 274, Dorsal view of chalimus; figs. 275 to 278, First, second, third, and fourth swimming legs.

PLATE XLII. The female of *Philorthagoriscus serratus* Kröyer.

Fig. 279, Dorsal view; fig. 280, Mouth-tube and second maxillæ; fig. 281, Mandibles; fig. 282, Second maxilliped; figs. 283 to 286, First, second, third, and fourth swimming legs; figs. 287 and 288, Ventral and dorsal views of the genital segment and abdomen; fig. 289, Spermatophores in position.

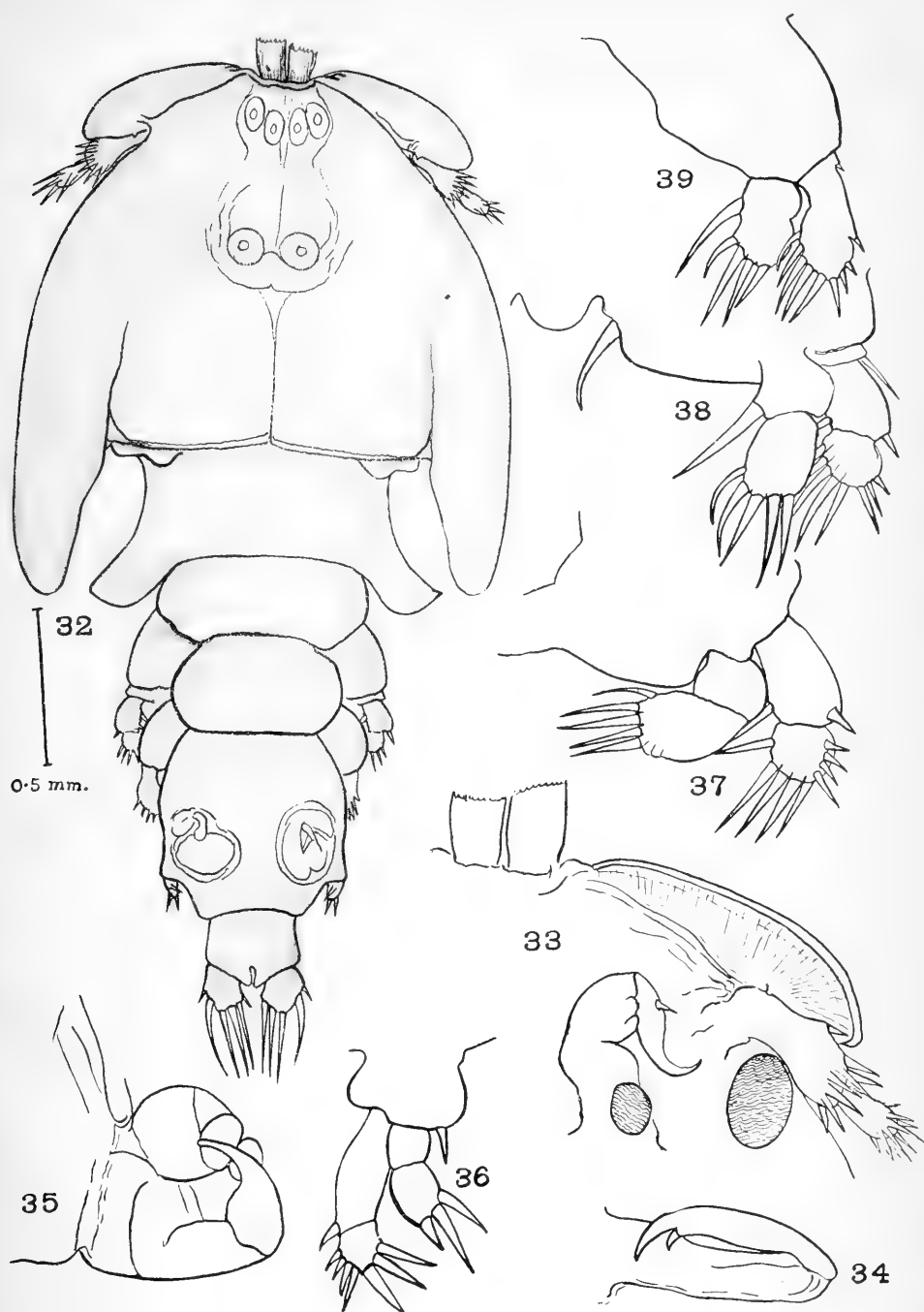
PLATE XLIII. The male of *Philorthagoriscus serratus* Kröyer.

Fig. 290, Dorsal view; fig. 291, Second antenna; figs. 292 and 293, First and second maxillipeds; fig. 294, Exopod of first swimming leg enlarged; figs. 295 and 296, Second and third swimming legs.

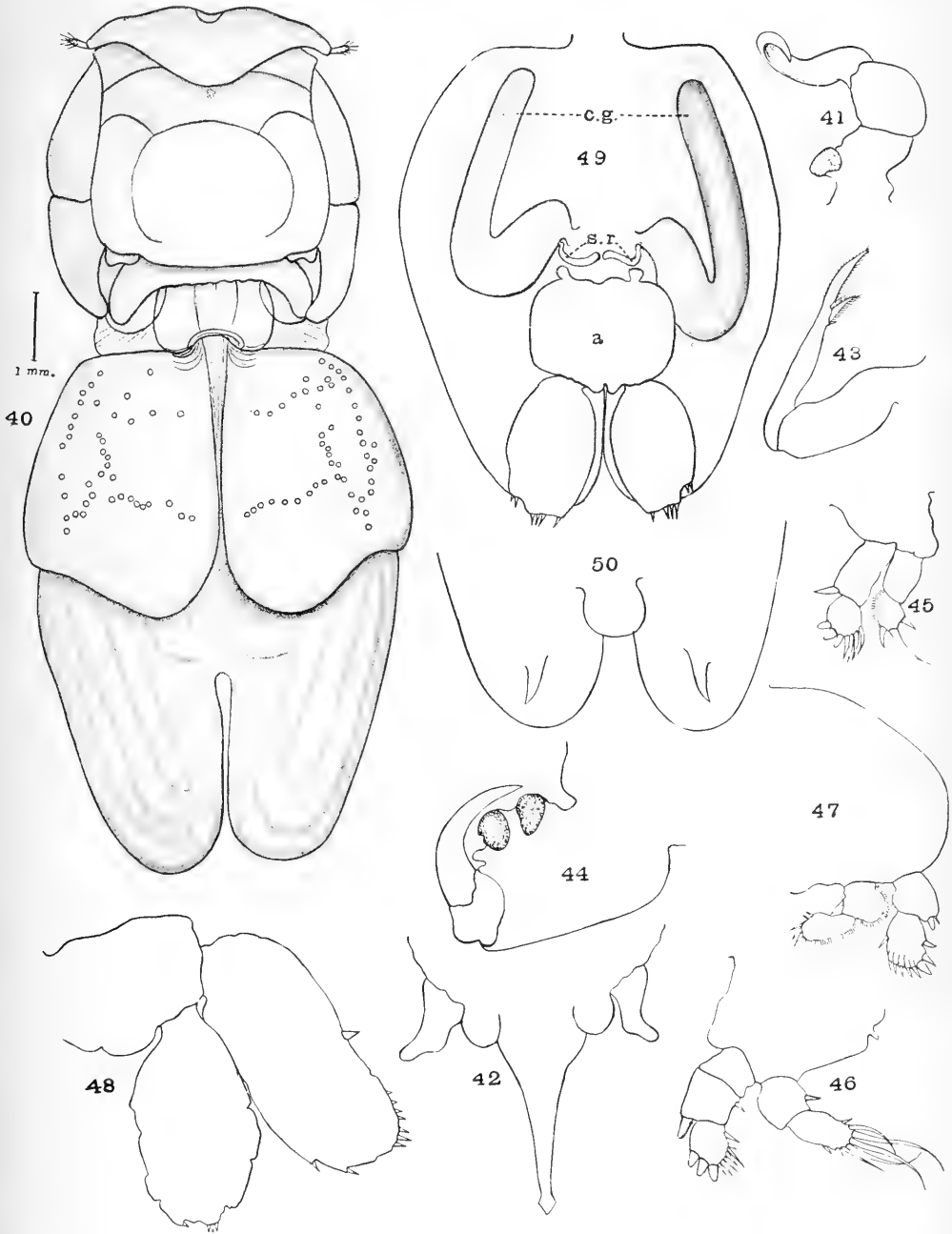


THE FEMALE OF *PERISSOPUS COMMUNIS*, AND THE VARIETY *STIMPSONI*.

FOR EXPLANATION OF PLATE SEE PAGE 487.

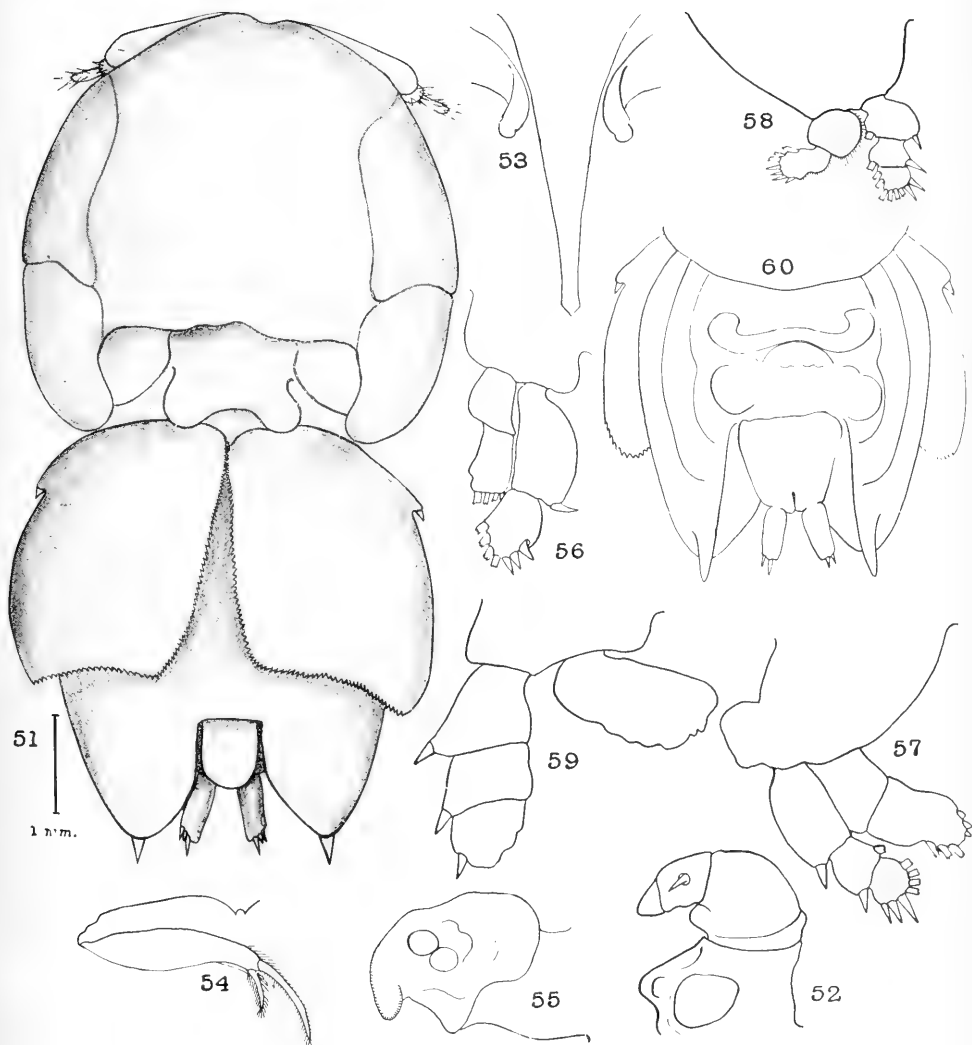
THE MALE OF *PERISSOPUS COMMUNIS*.

FOR EXPLANATION OF PLATE SEE PAGE 487.



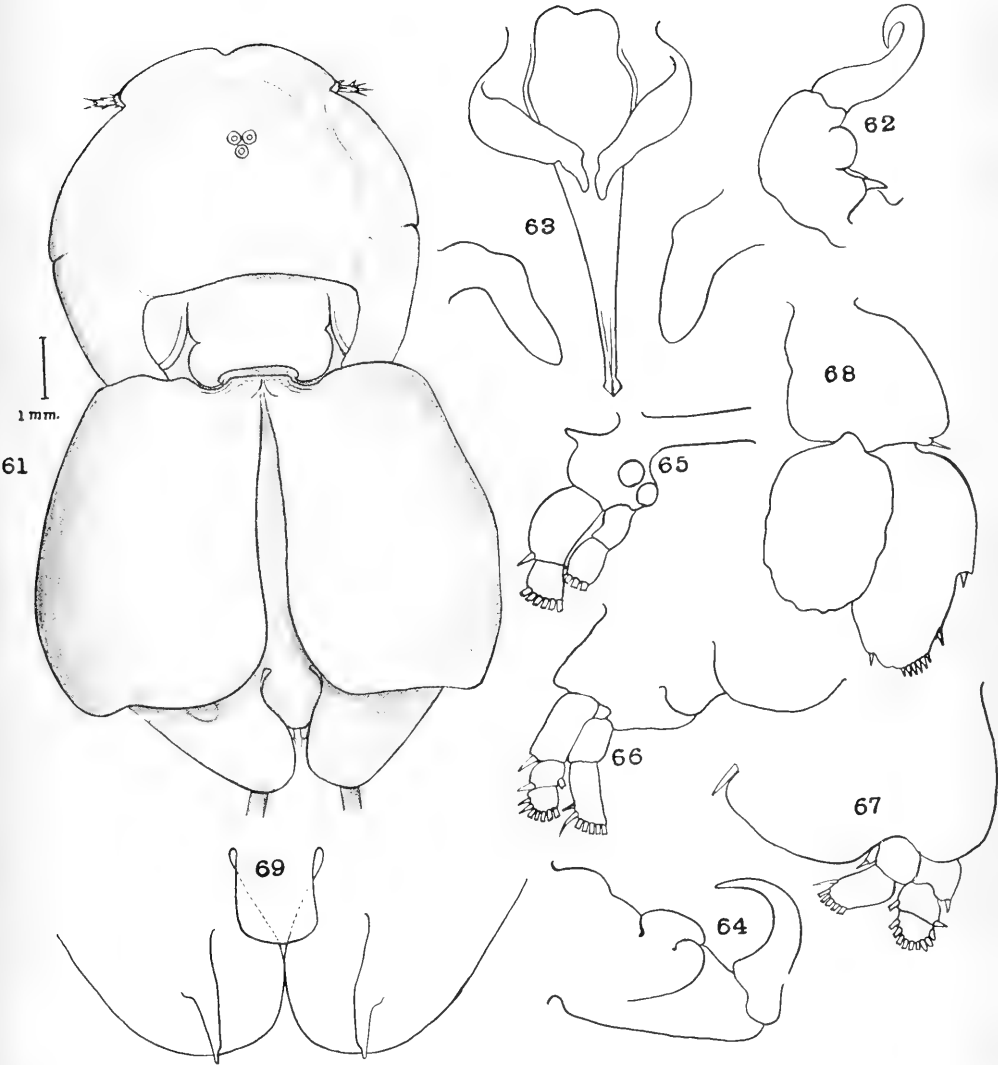
THE FEMALE OF ECHTHROGALEUS COLEOPTRATUS.

FOR EXPLANATION OF PLATE SEE PAGE 487.



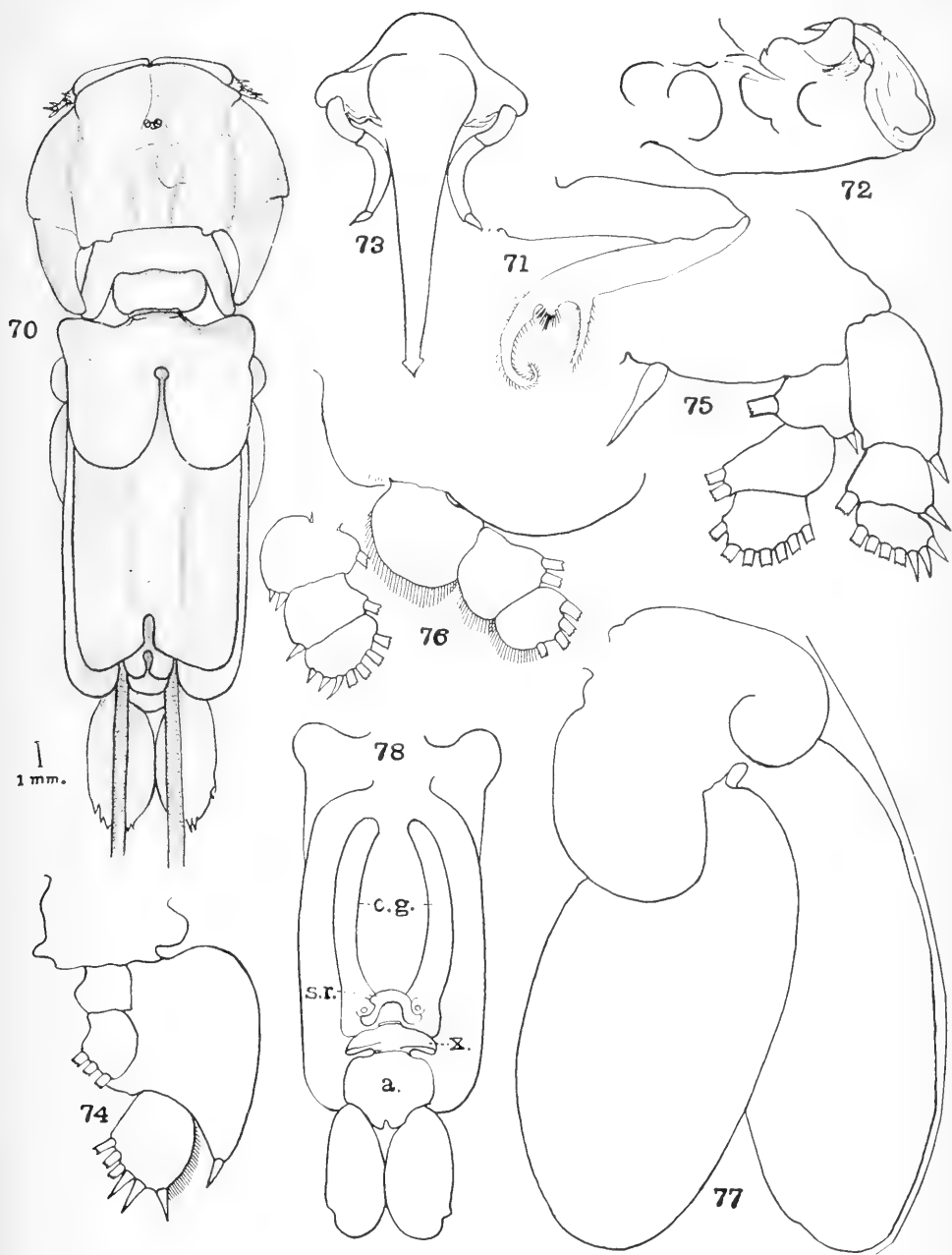
THE FEMALE OF ECHTHROGALEUS DENTICULATUS.

FOR EXPLANATION OF PLATE SEE PAGE 487.



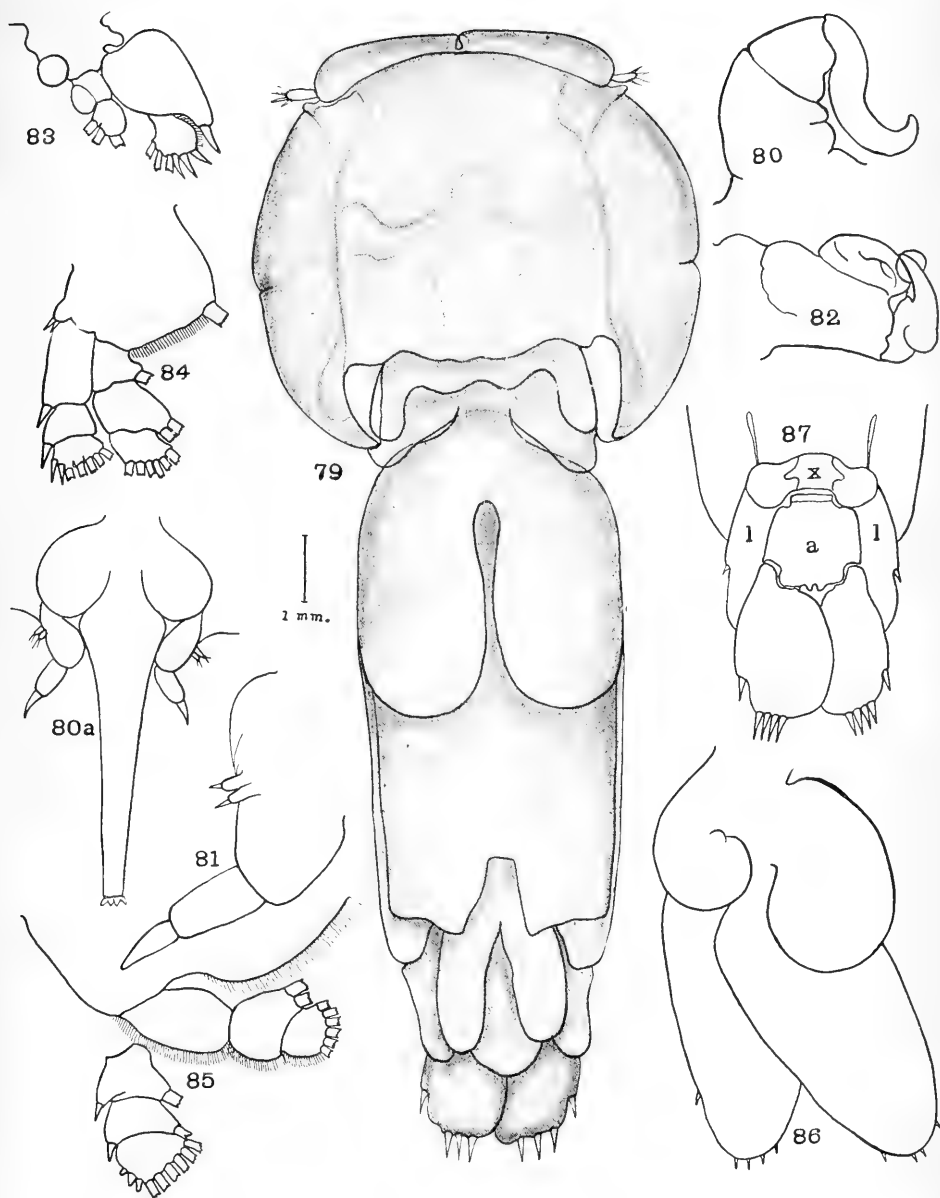
THE FEMALE OF *ECHTHROGALEUS TORPEDINIS*.

FOR EXPLANATION OF PLATE SEE PAGE 487.



THE FEMALE OF *DINEMATURA FEROX*.

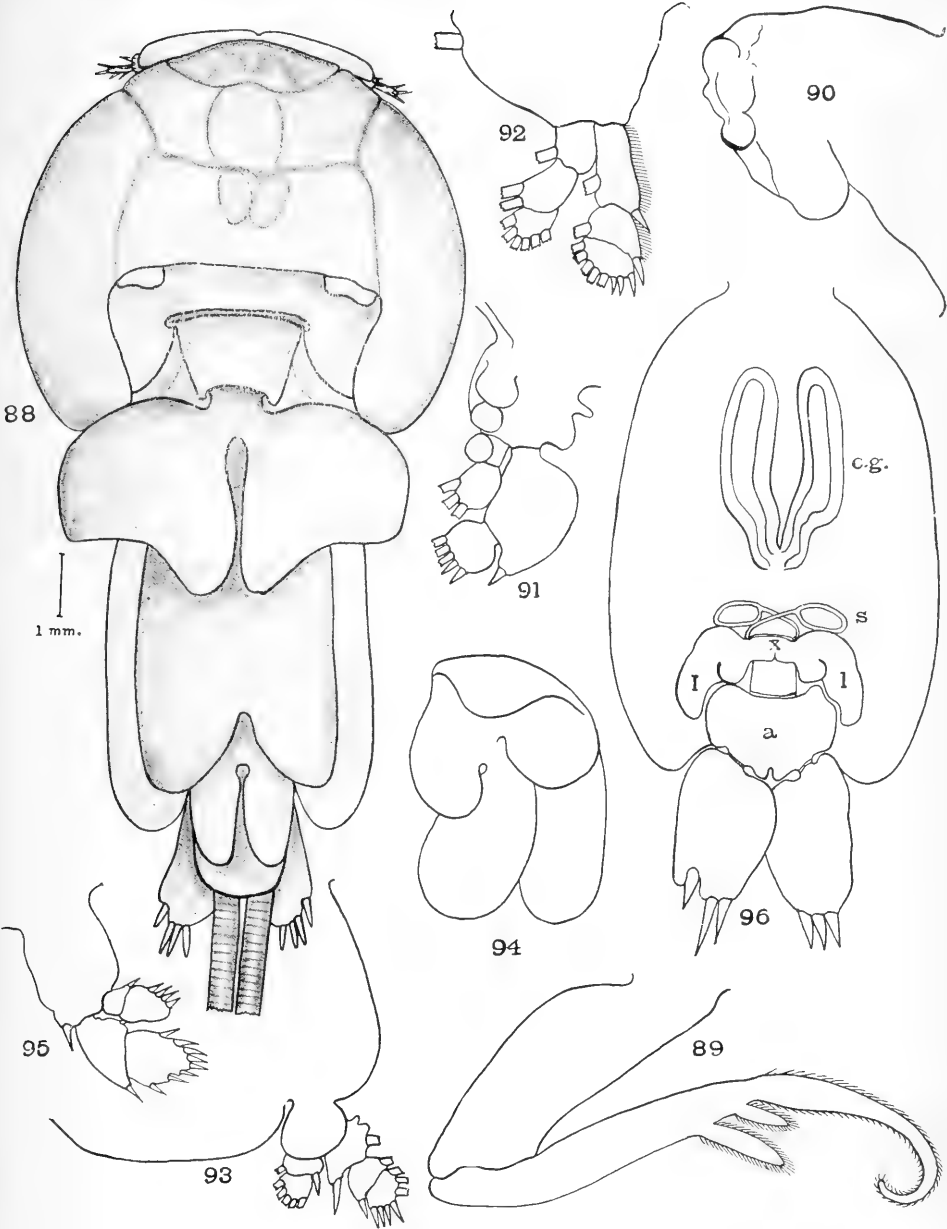
FOR EXPLANATION OF PLATE SEE PAGE 487.



THE FEMALE OF *DINEMATURA PRODUCTA*.

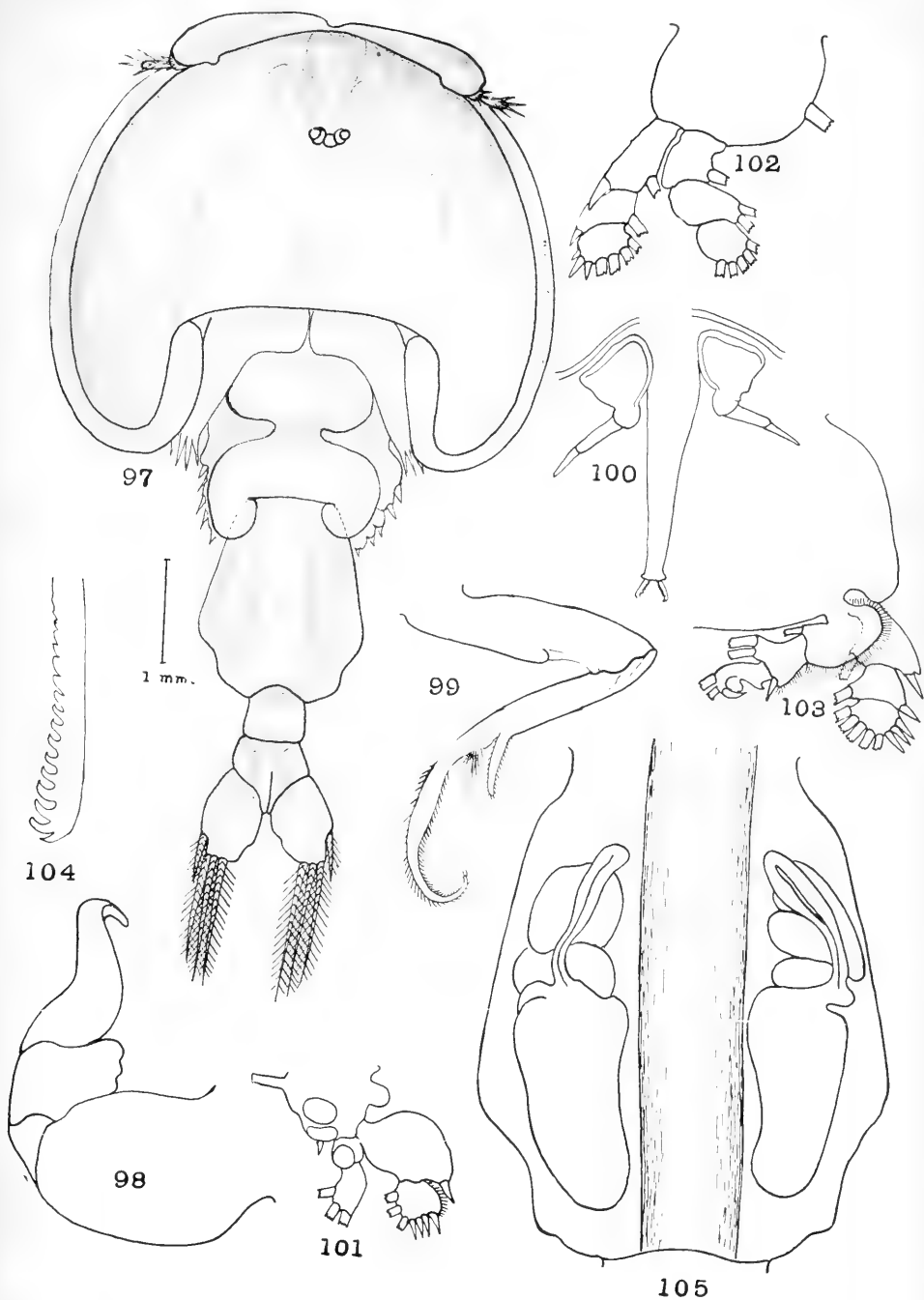
FOR EXPLANATION OF PLATE SEE PAGE 488.





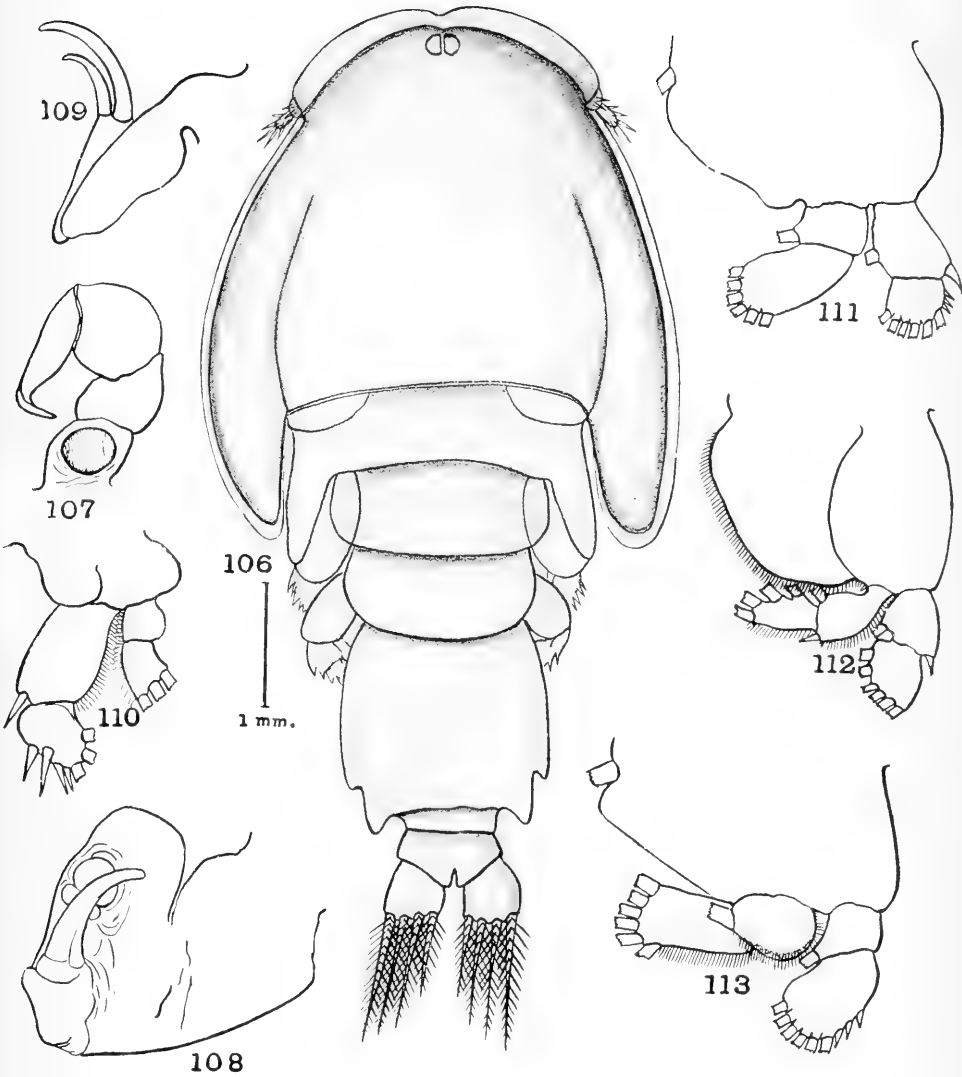
THE FEMALE OF *DINEMATURA LATIFOLIA*.

FOR EXPLANATION OF PLATE SEE PAGE 488.



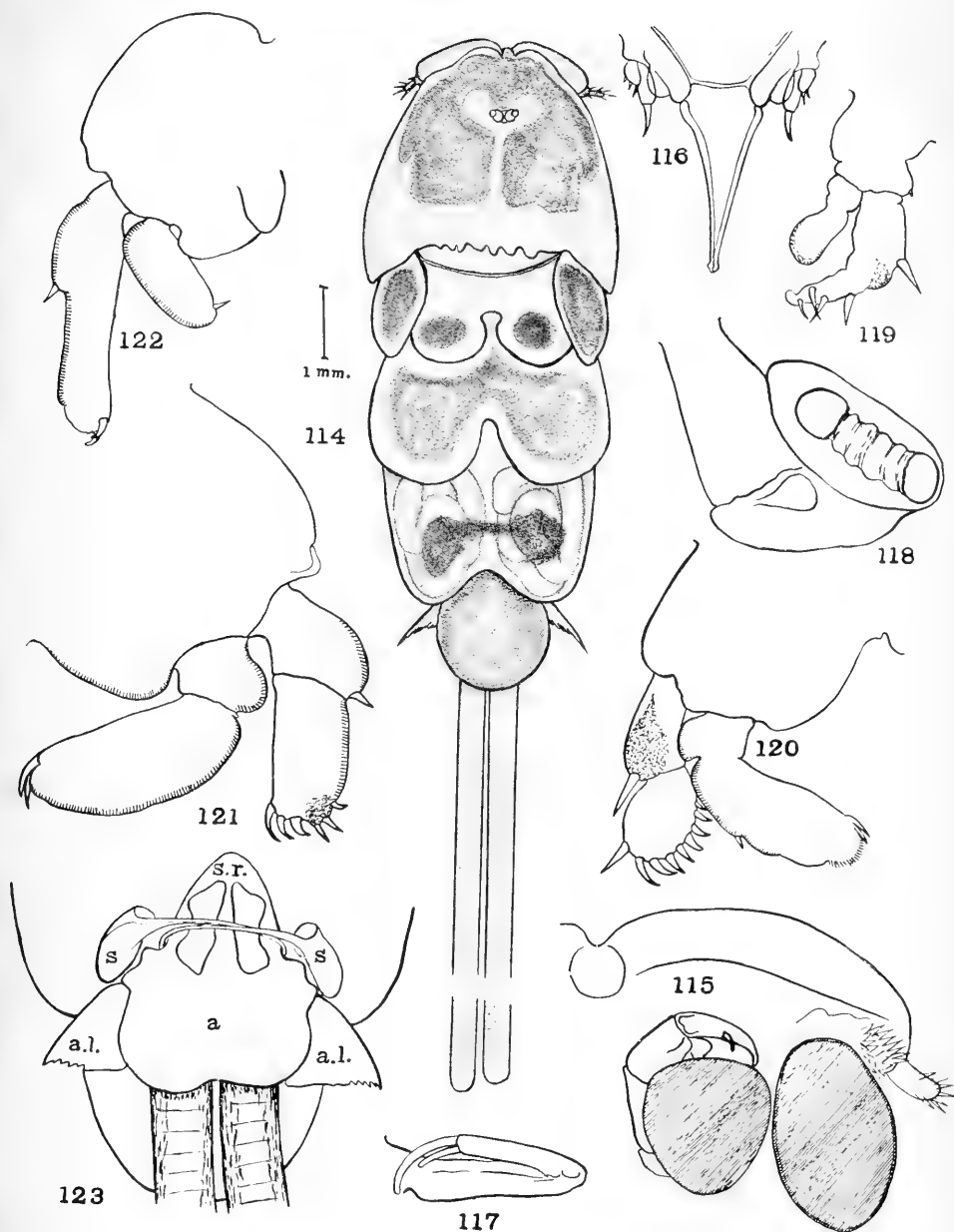
THE MALE OF *DINEMATURA LATIFOLIA*.

FOR EXPLANATION OF PLATE SEE PAGE 488.



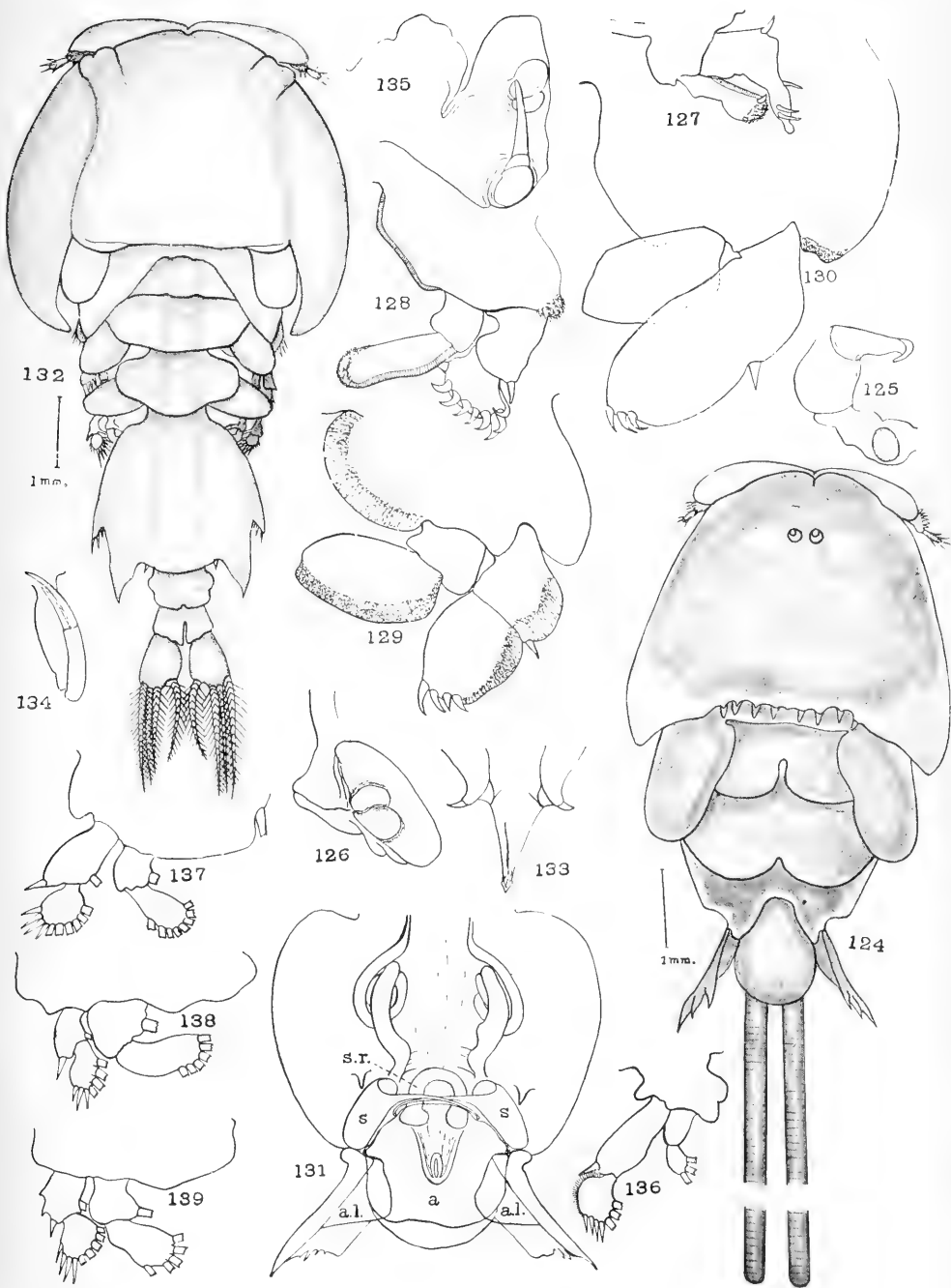
THE MALE OF *PANDARUS BREVICAUDIS*.

FOR EXPLANATION OF PLATE SEE PAGE 488.



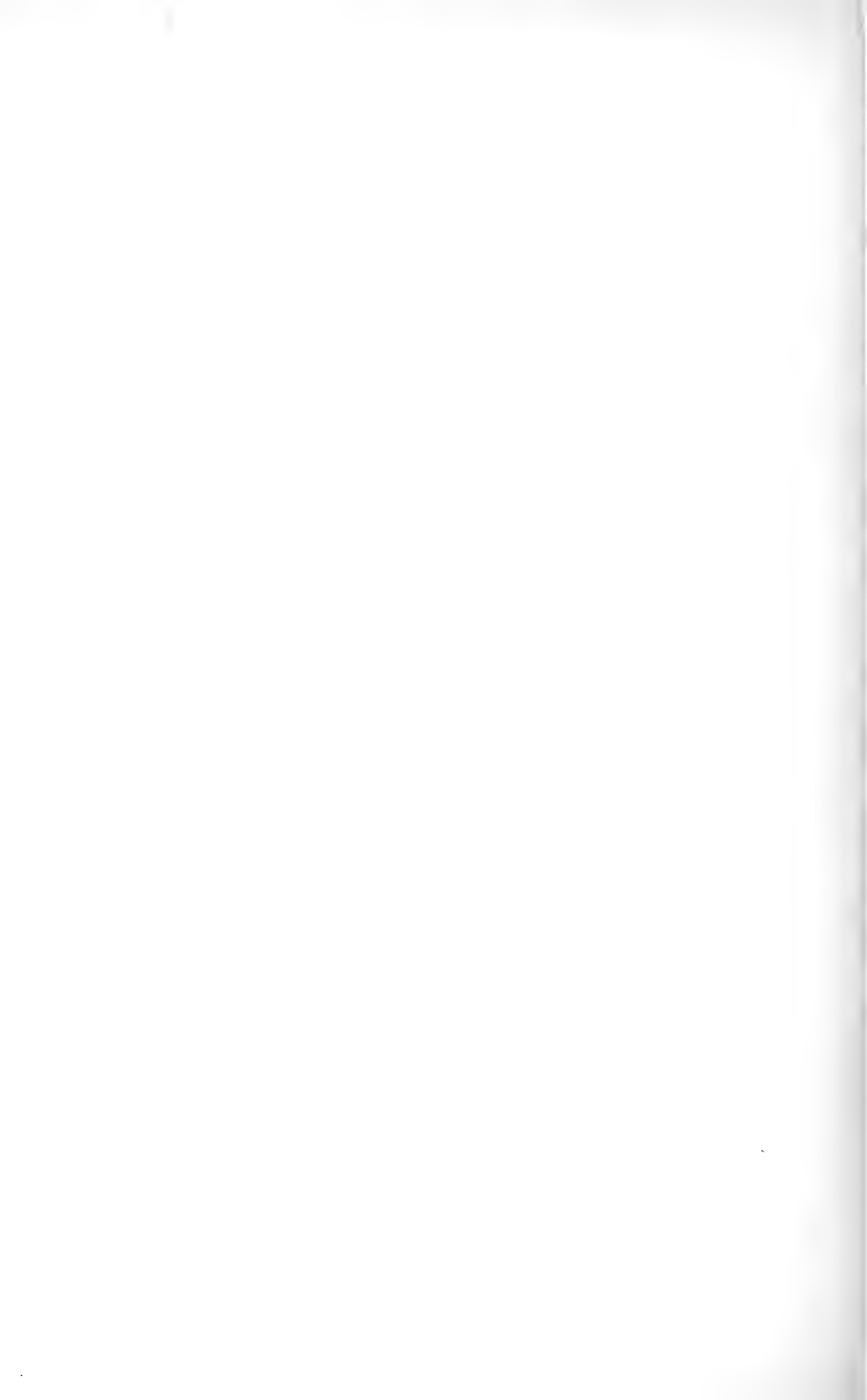
THE FEMALE OF *PANDARUS BICOLOR*.

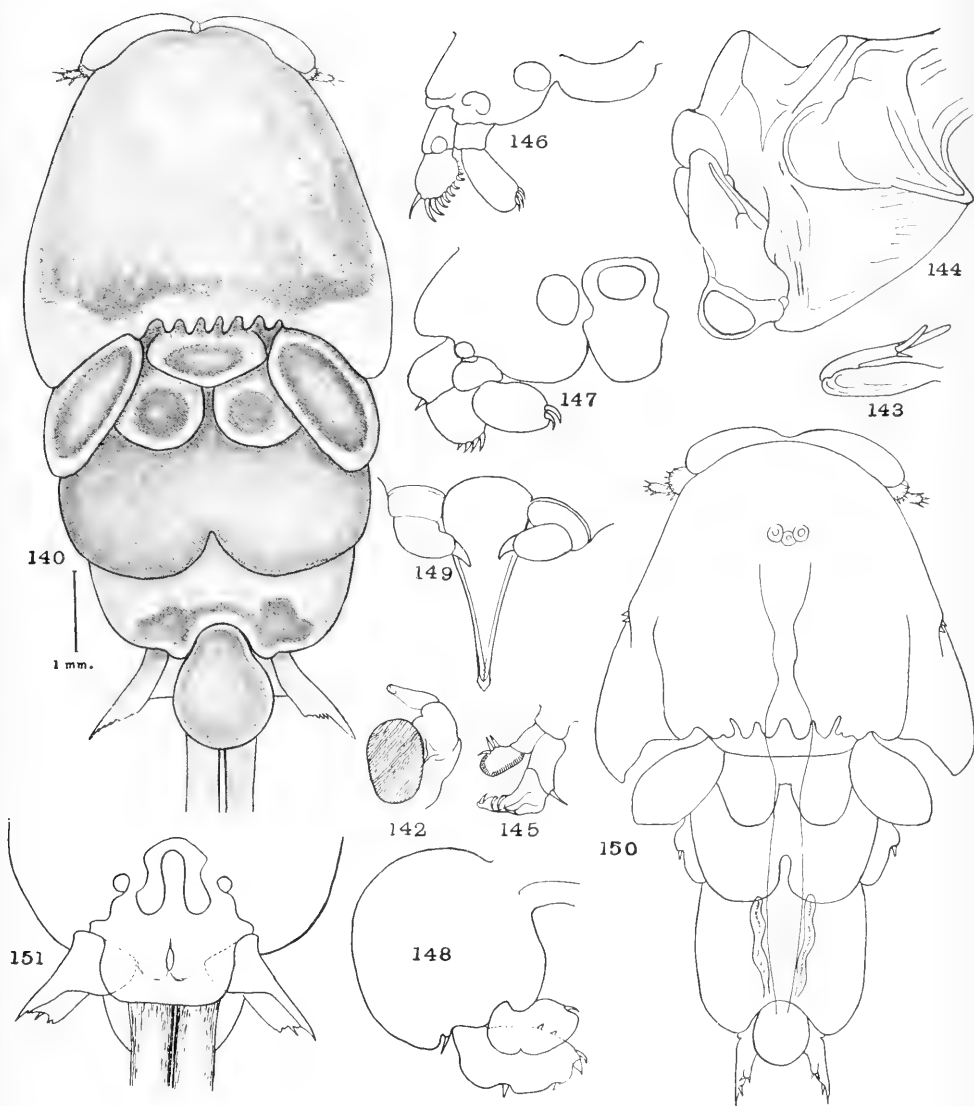
FOR EXPLANATION OF PLATE SEE PAGE 488.



THE MALE AND FEMALE OF *PANDARUS CRANCHII*.

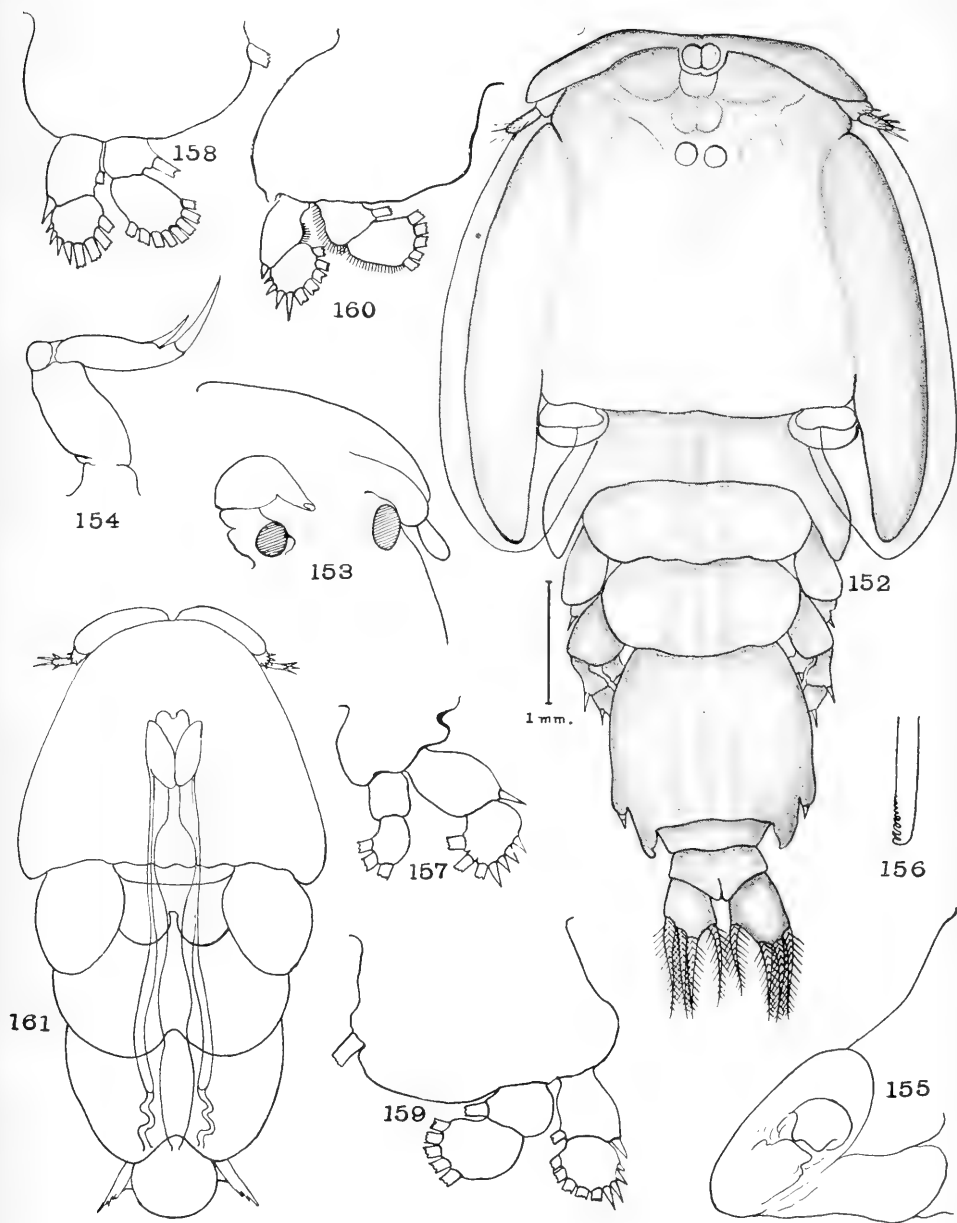
FOR EXPLANATION OF PLATE SEE PAGE 488.





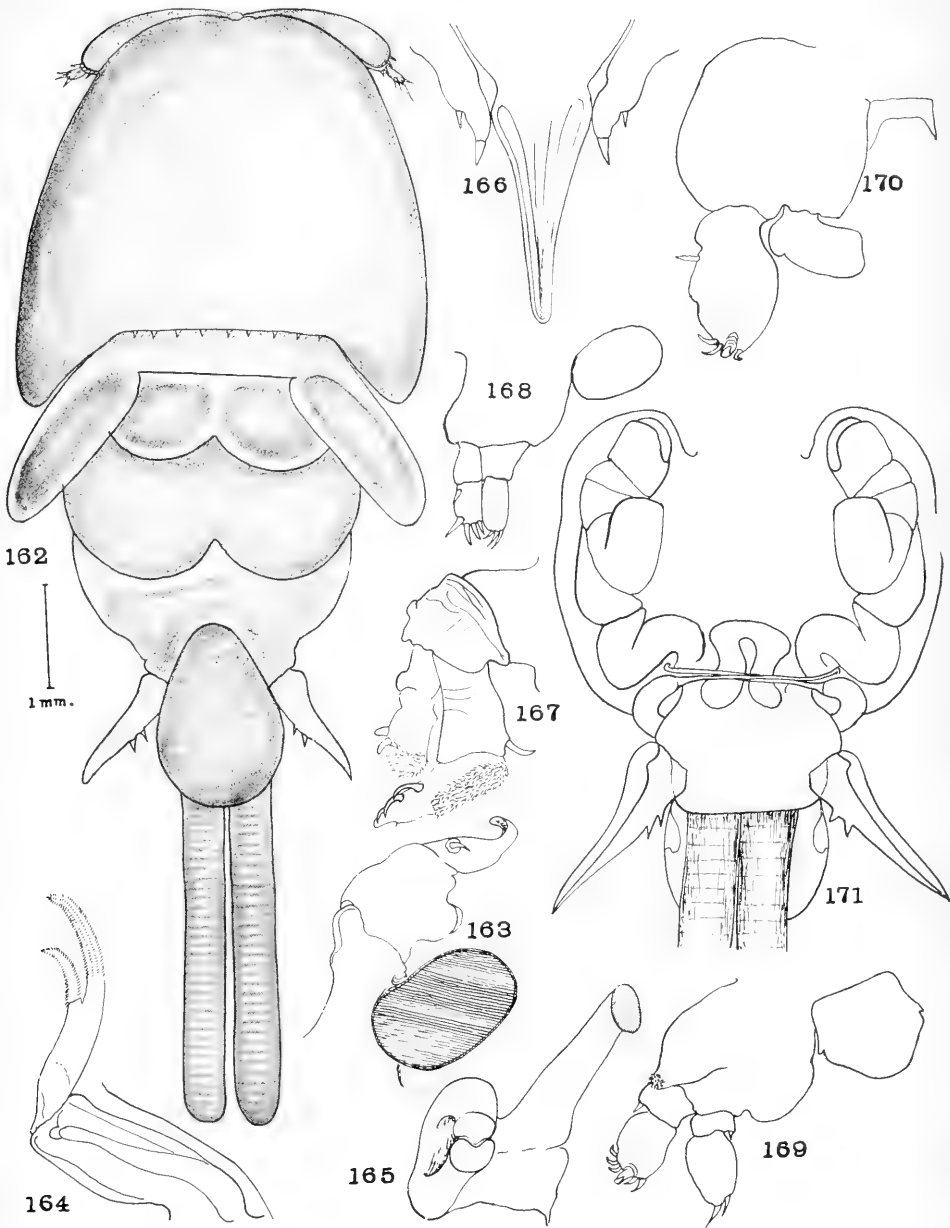
AN ADULT AND A YOUNG FEMALE OF *PANDARUS SMITHII*.

FOR EXPLANATION OF PLATE SEE PAGE 488.



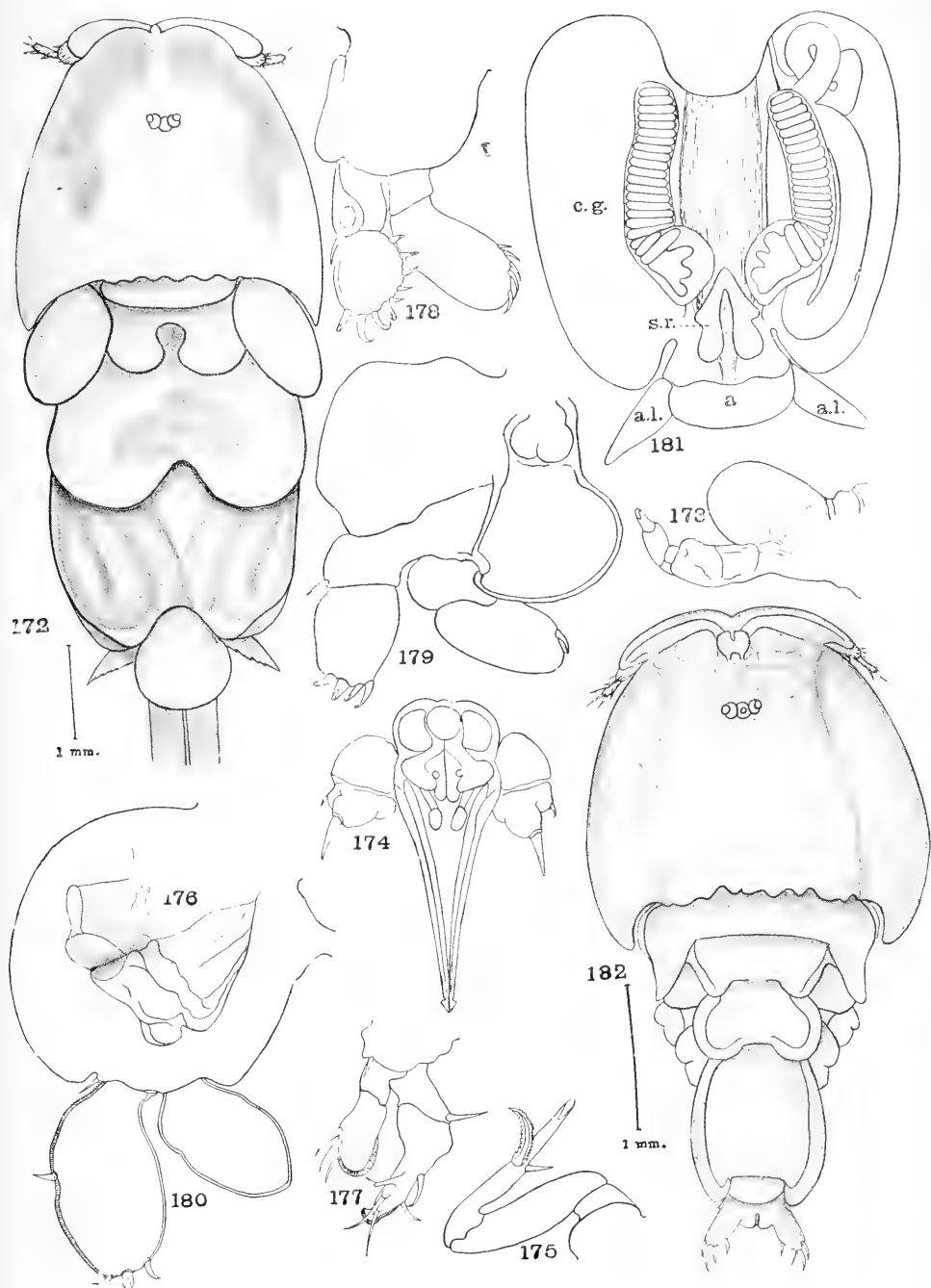
THE MALE AND A YOUNG FEMALE OF *PANDARUS SMITHII*.

FOR EXPLANATION OF PLATE SEE PAGE 488.



THE FEMALE OF *PANDARUS SATYRUS*.

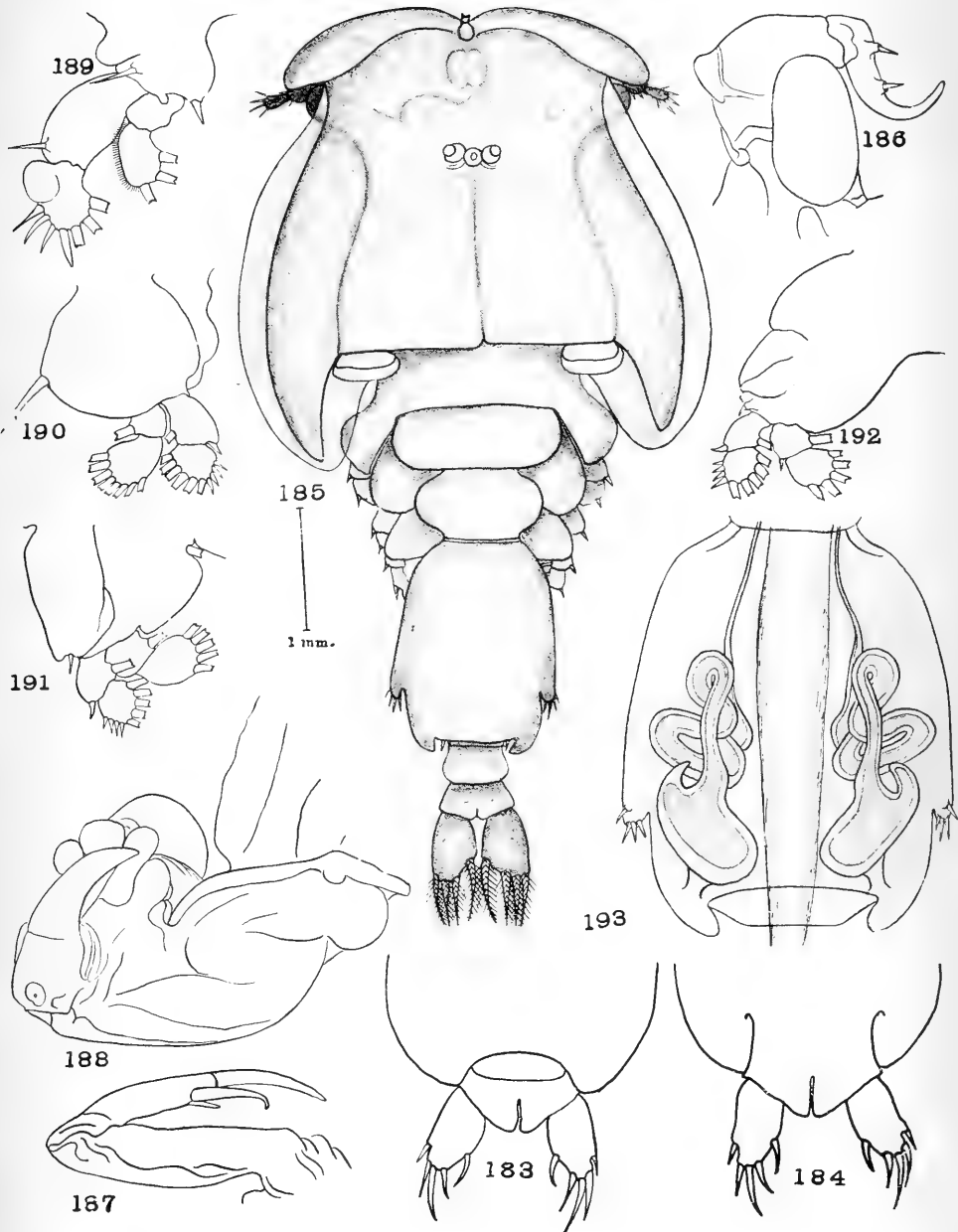
FOR EXPLANATION OF PLATE SEE PAGE 489.



THE FEMALE OF *PANDARUS SINUATUS*.

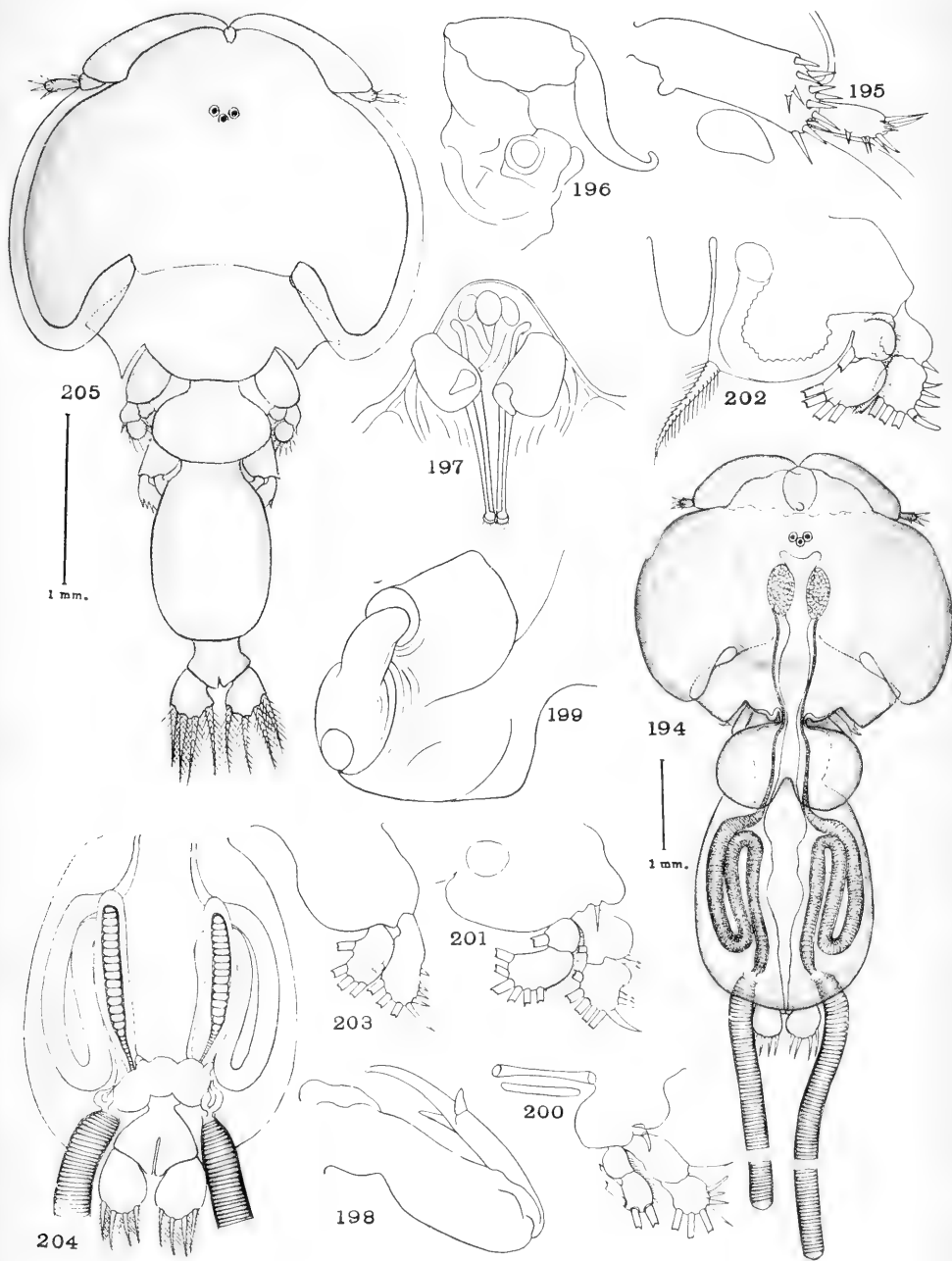
FOR EXPLANATION OF PLATE SEE PAGE 489.





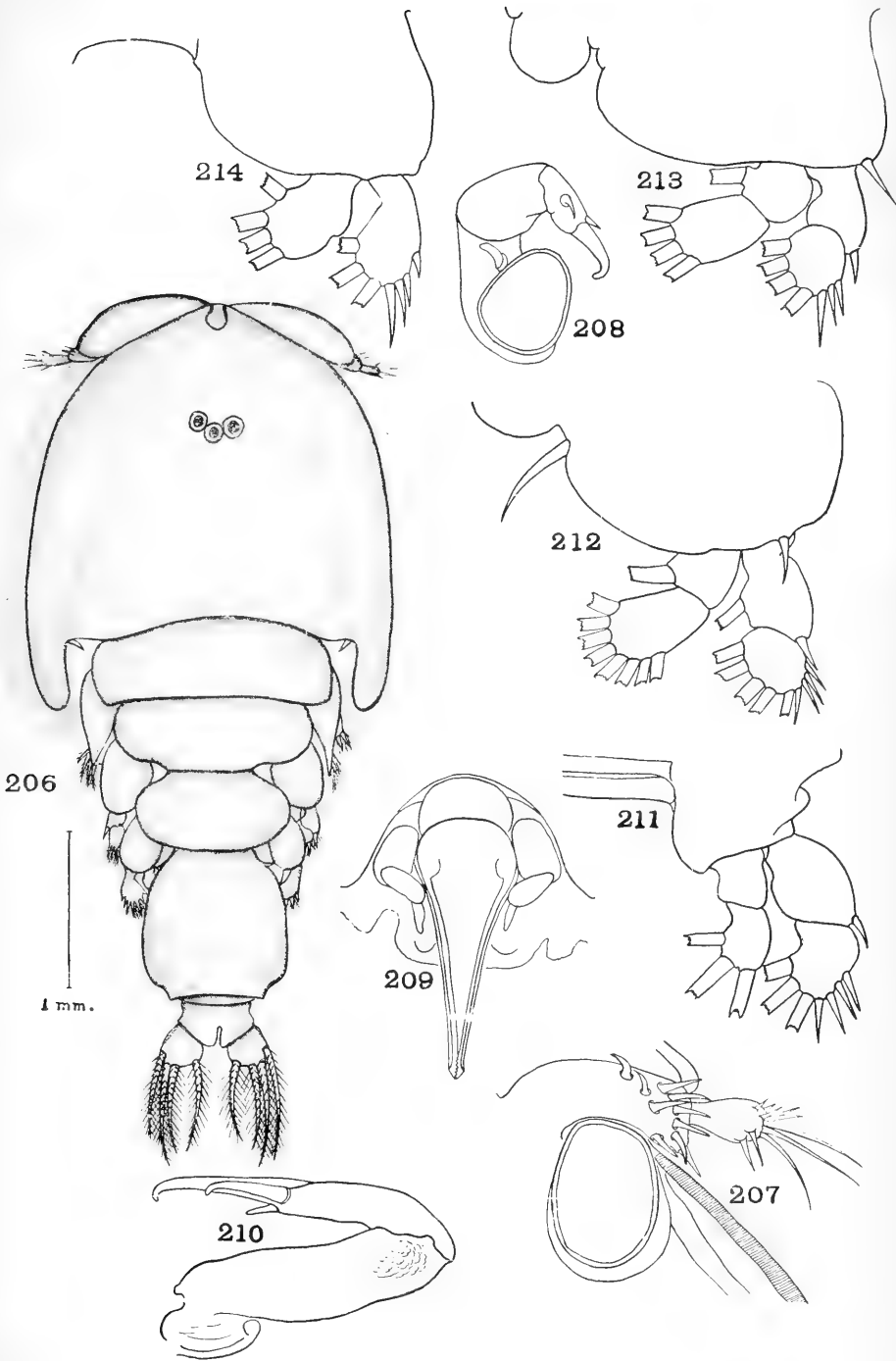
THE MALE OF PANDARUS SINUATUS.

FOR EXPLANATION OF PLATE SEE PAGE 489.



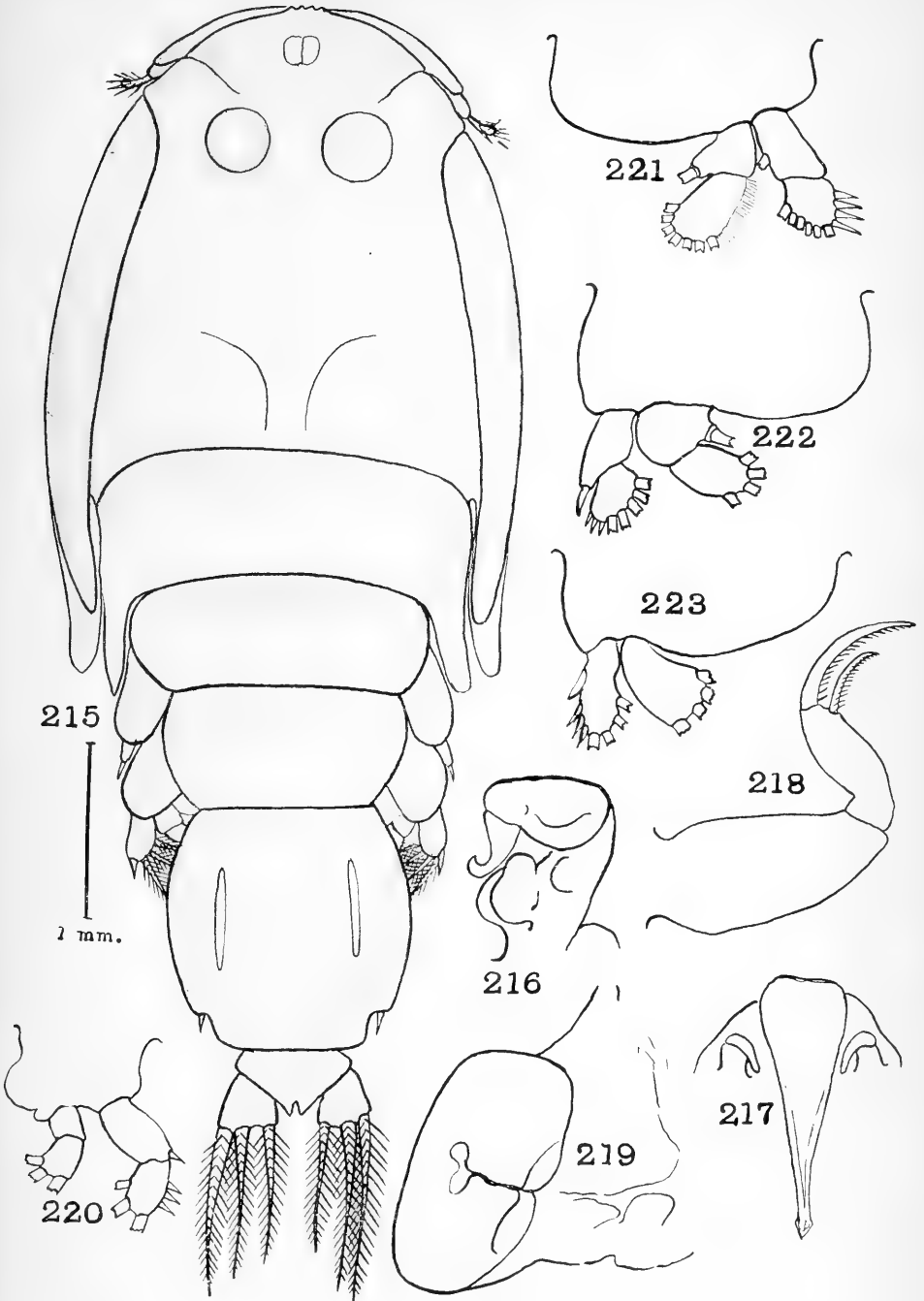
AN ADULT AND A YOUNG FEMALE OF *NESIPPUS ALATUS*.

FOR EXPLANATION OF PLATE SEE PAGE 489.



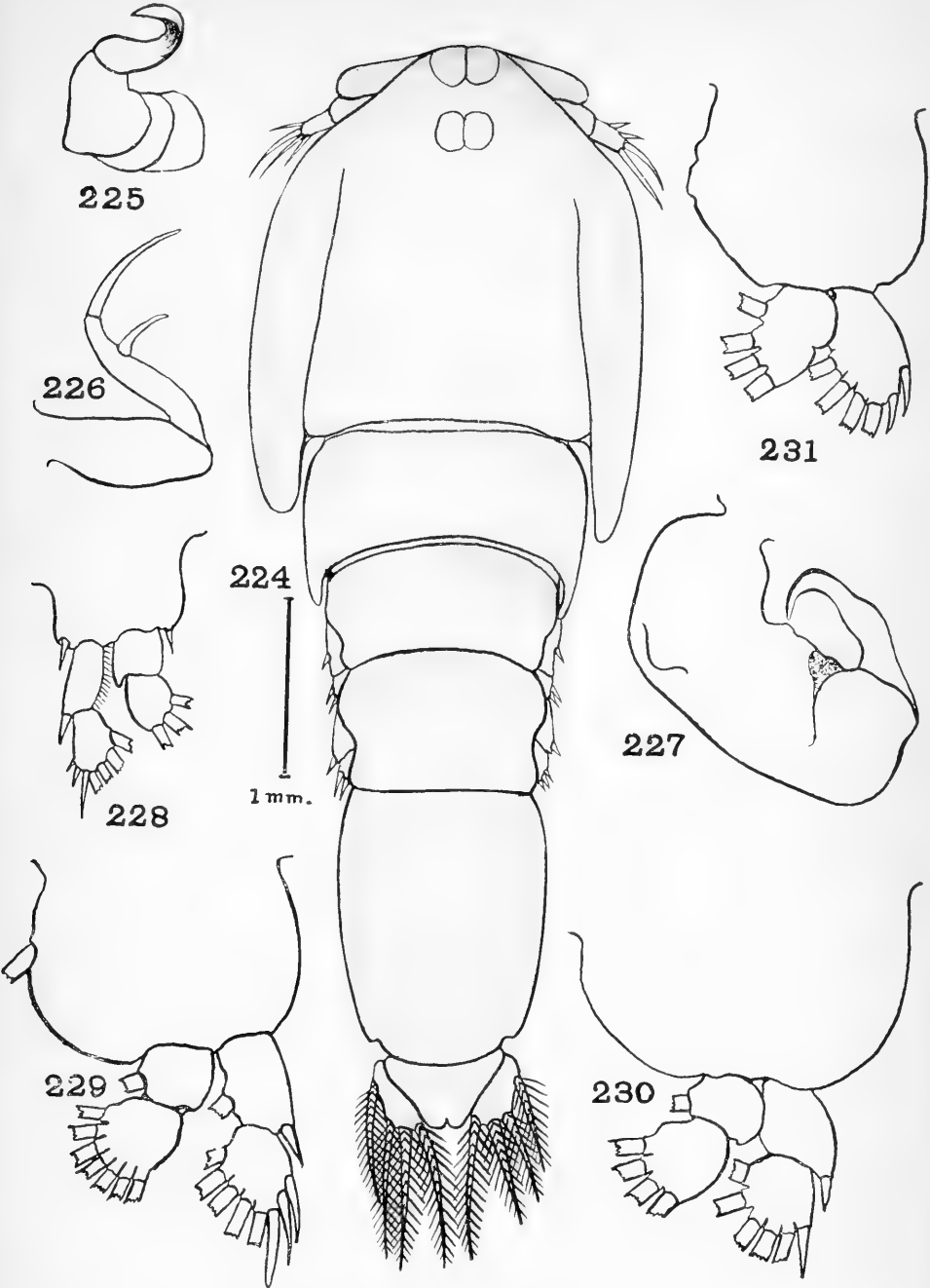
THE MALE OF NESIPPUS ALATUS.

FOR EXPLANATION OF PLATE SEE PAGE 489.



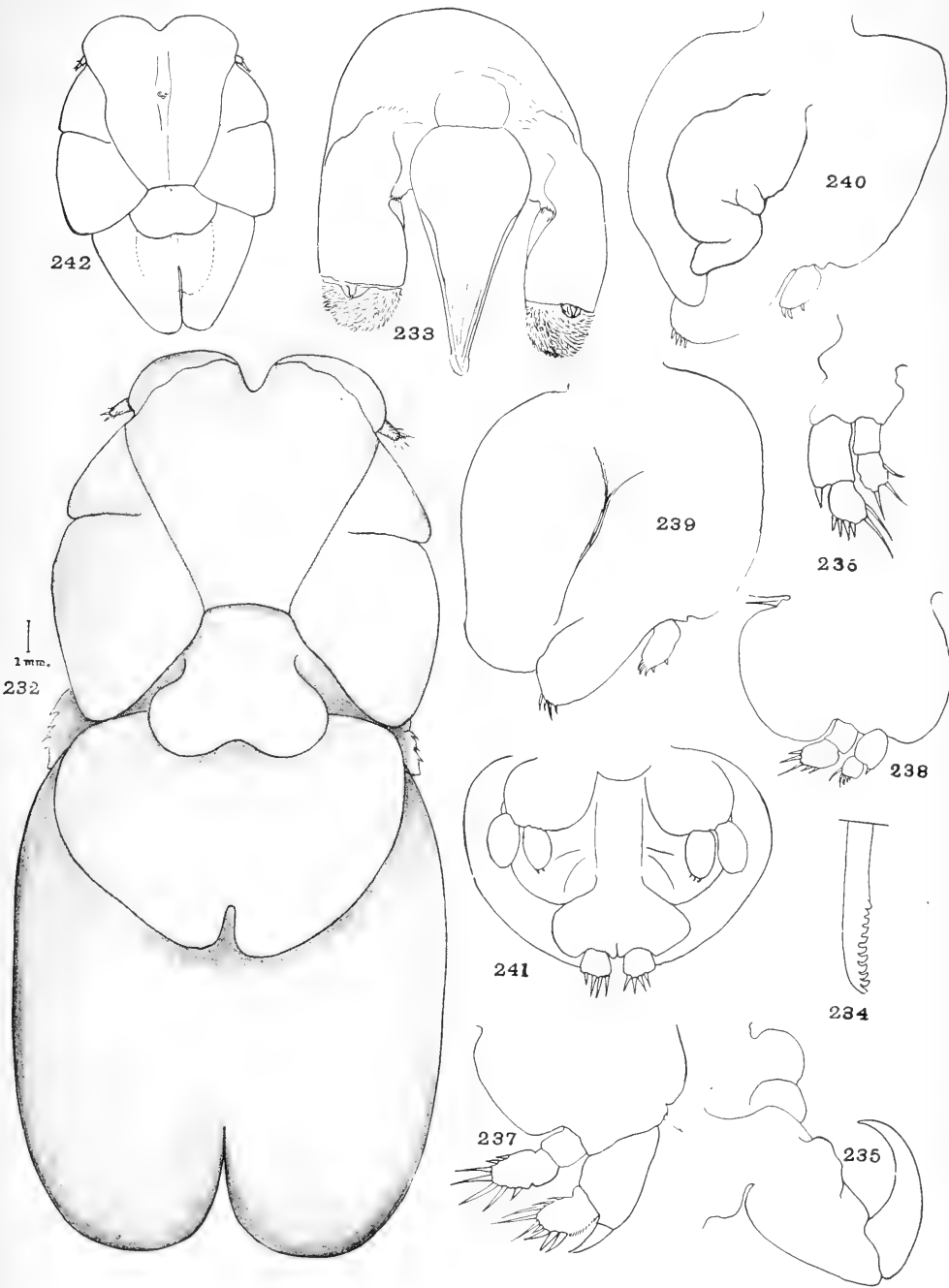
THE MALE OF NESIPPUS CURTICAUDIS.

FOR EXPLANATION OF PLATE SEE PAGE 489.



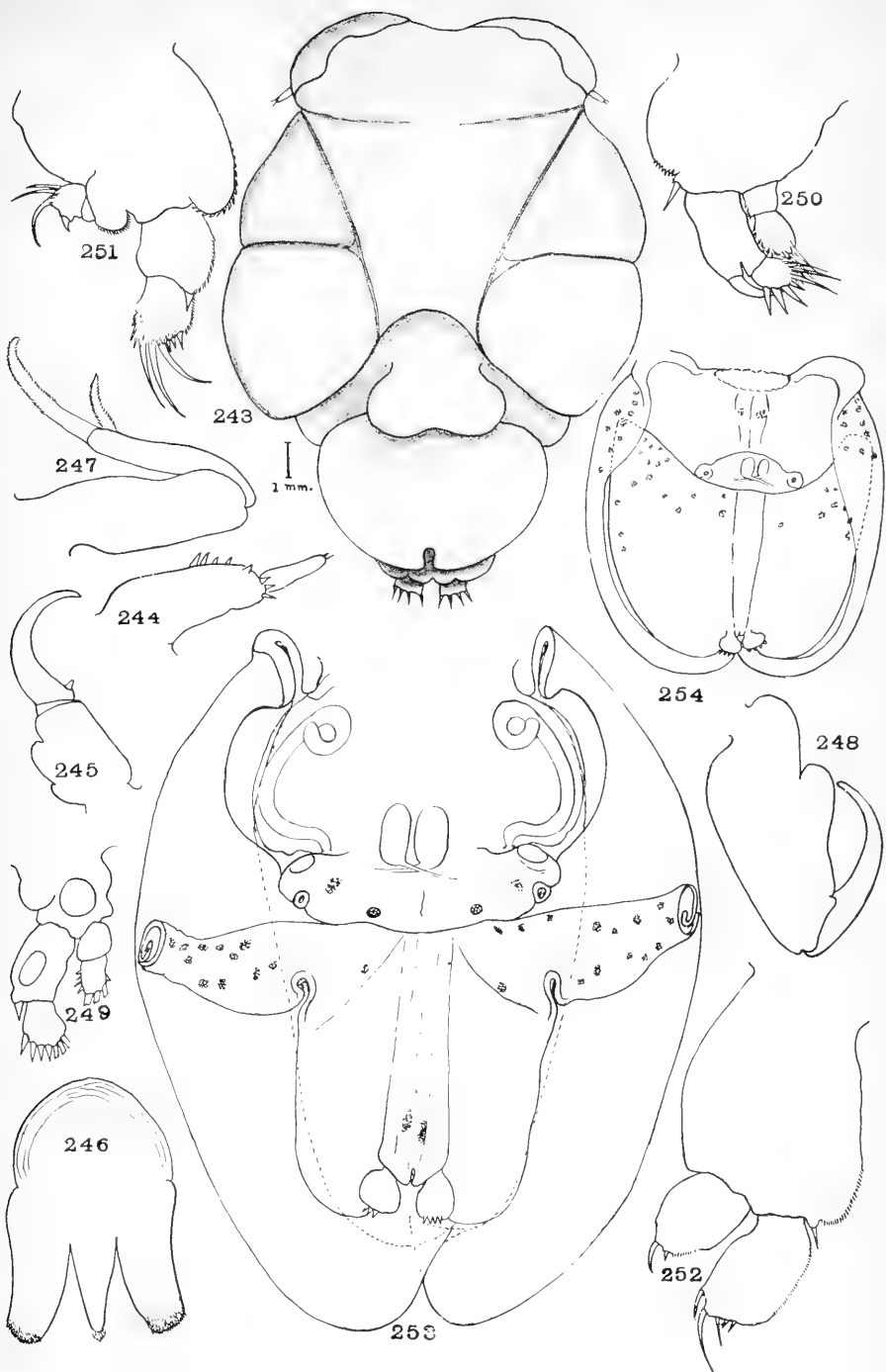
THE MALE OF NESIPPUS BOREALIS.

FOR EXPLANATION OF PLATE SEE PAGE 489.



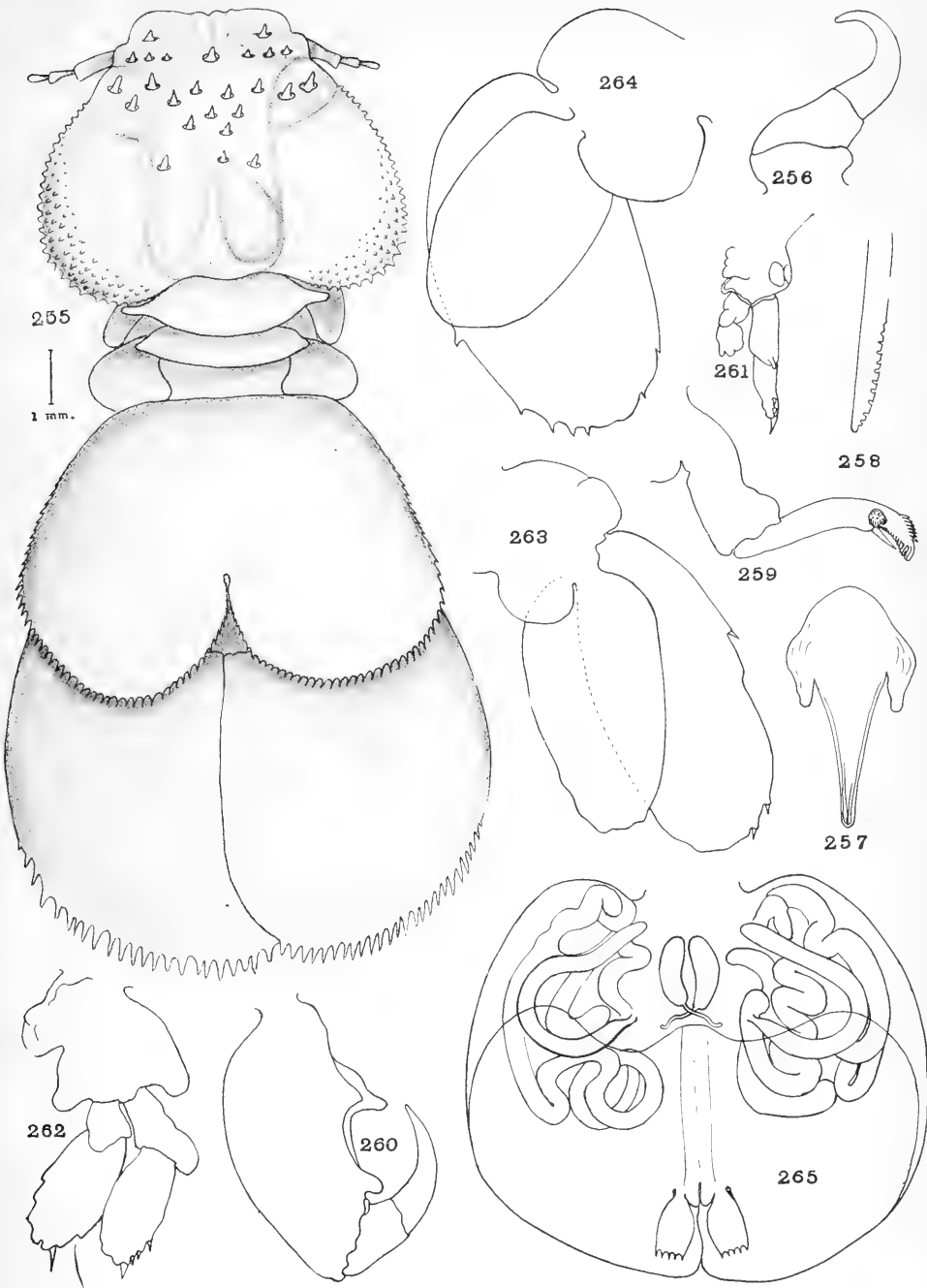
THE FEMALE OF *CECROPS LATREILLII*.

FOR EXPLANATION OF PLATE SEE PAGE 489.



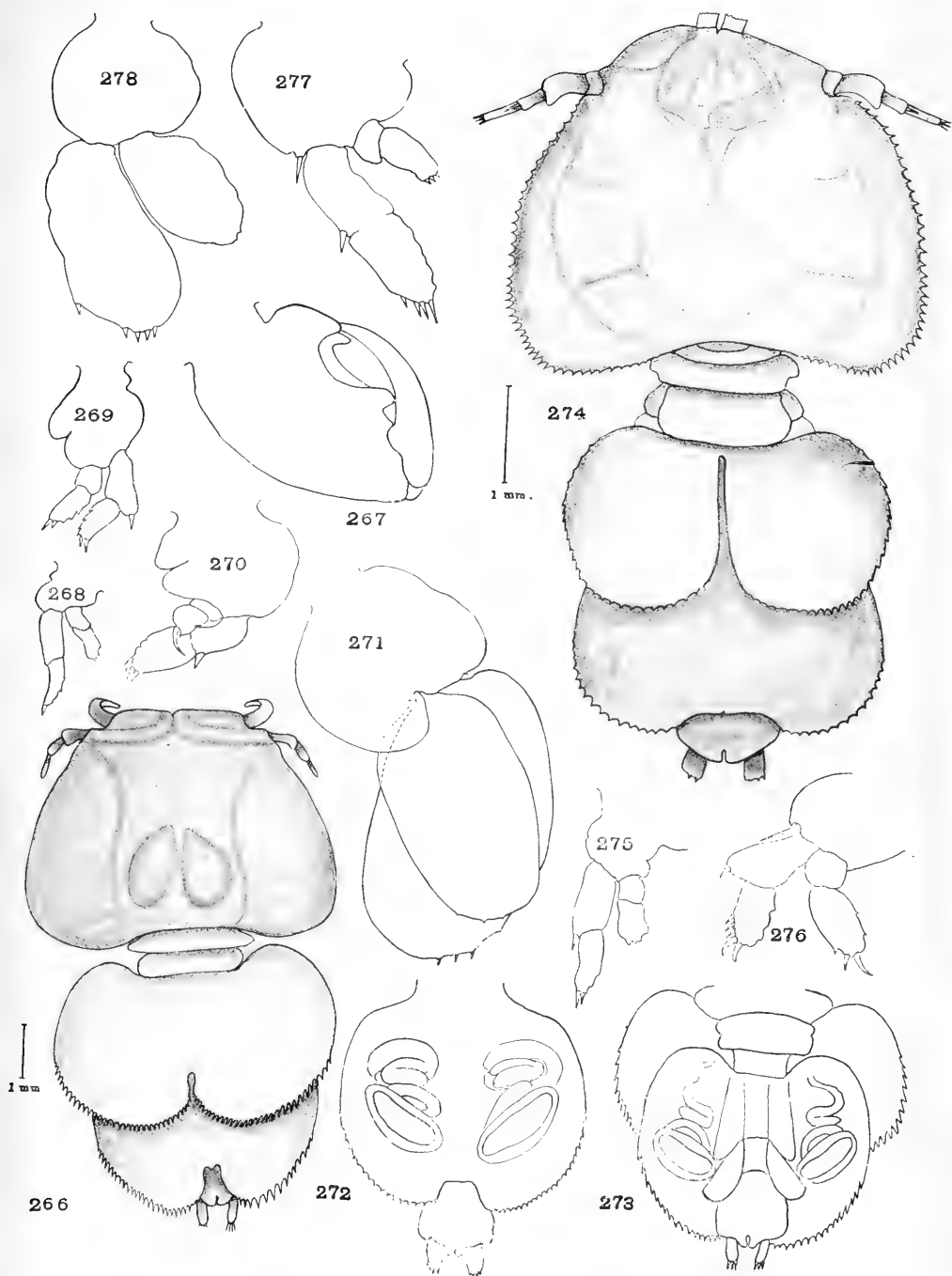
THE MALE OF CECROPS LATREILLII.

FOR EXPLANATION OF PLATE SEE PAGE 480.



THE FEMALE OF *ORTHAGORISCICOLA MURICATA*.

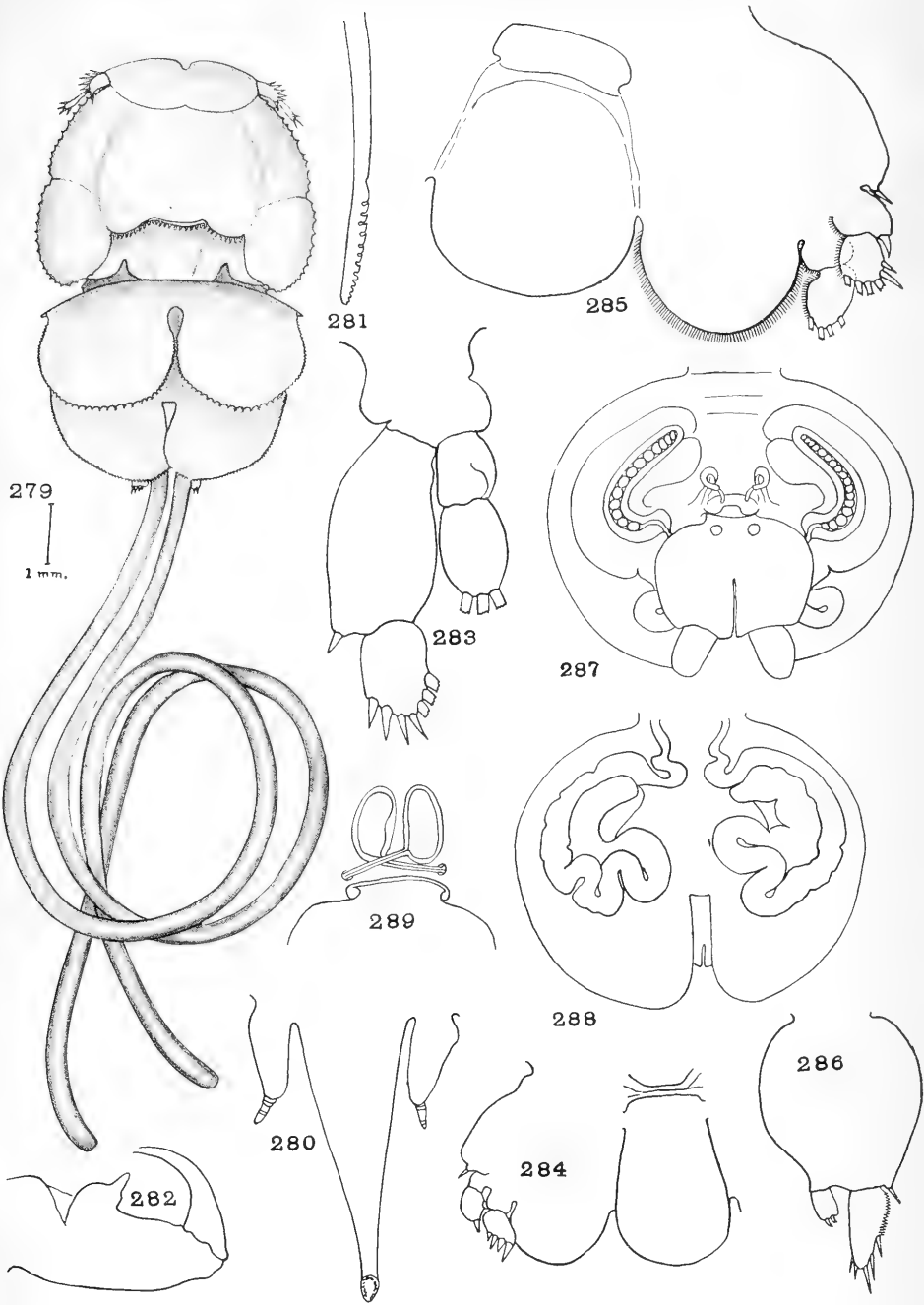
FOR EXPLANATION OF PLATE SEE PAGE 490.



THE MALE AND A CHALIMUS OF *ORTHAGORISCICOLA MURICATA*.

FOR EXPLANATION OF PLATE SEE PAGE 490.

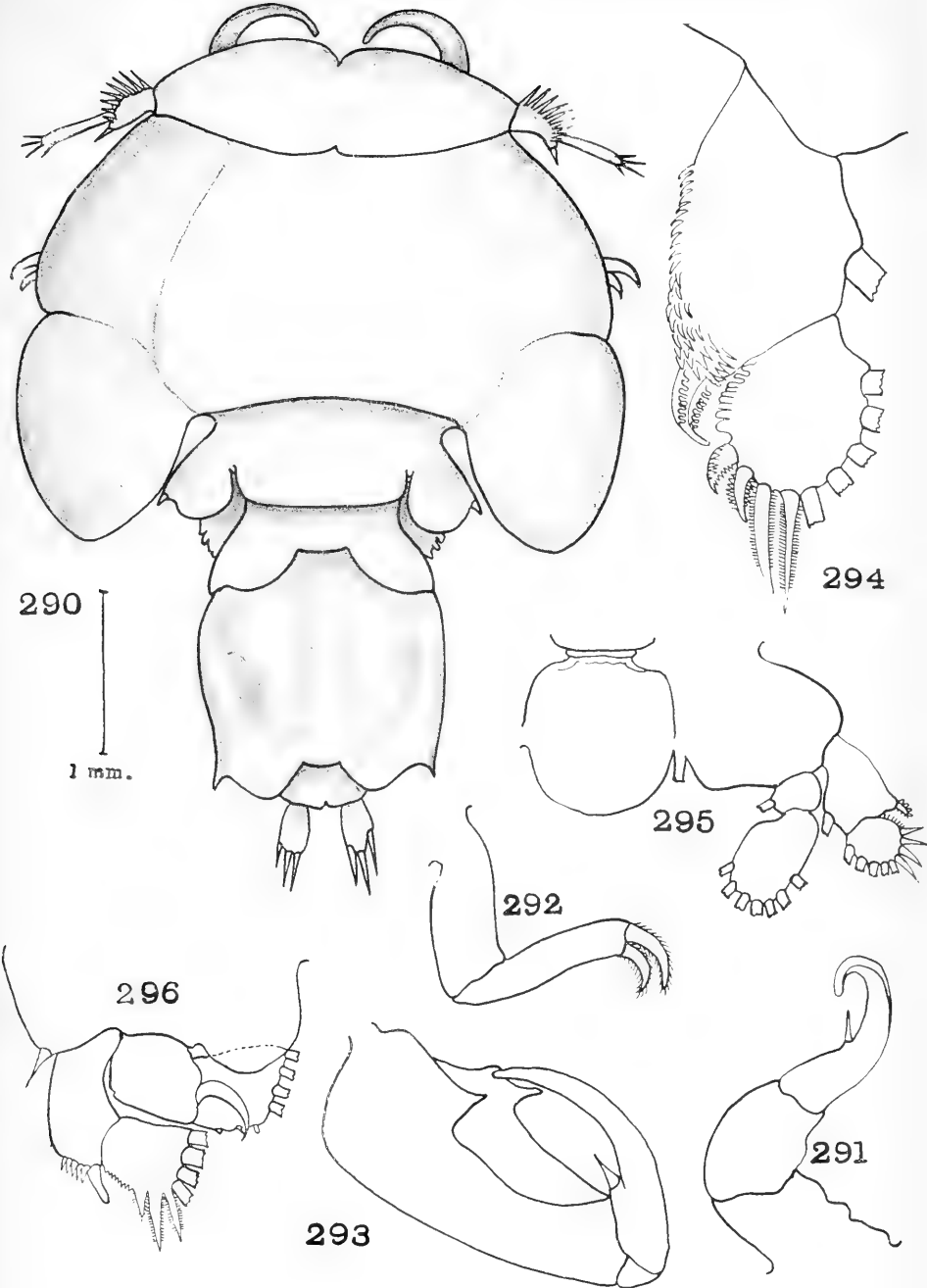




THE FEMALE OF *PHILORTHRAGORISCUS SERRATUS*.

FOR EXPLANATION OF PLATE SEE PAGE 490.





THE MALE OF *PHILORTHRAGERISCUS SERRATUS*.

FOR EXPLANATION OF PLATE SEE PAGE 490.

THE PYRAMIDELLID MOLLUSKS OF THE OREGONIAN FAUNAL AREA.

By WILLIAM HEALEY DALL and PAUL BARTSCH.

Of the Division of Mollusks, U. S. National Museum.

INTRODUCTION.

The completion of the monograph of West American Pyramidellidæ upon which the authors of the present paper have for some years been at work, being delayed by various causes—though in large part long ready for the printer—it was thought best to select from it, for immediate publication, the portion relating to the Oregonian fauna, which to a considerable extent is complete in itself, pending the completion of details relating to other faunal areas of the coast.

For the purposes of the present paper, subject to future modification with greater knowledge, the fauna here named Oregonian extends from the northern limit of the Alexander Archipelago southward along the coast to Point Conception, California. The limits of any fauna are never quite absolute, there is always a partial merging of the peripheral population with that of the adjacent faunal areas, but the proportion of Pyramidellid species in the present case, which are held in common with the faunas northwest and southeast of that here called Oregonian, is noticeably small.

Attention is called to the fact that it is a Pyramidellid fauna which is here discussed. The general molluscan fauna, still more the general invertebrate fauna of the coast in question, may or may not eventually be found to agree in distribution with our Pyramidellids. That is a question which we are not ready to decide at the present time and which will demand much more time and study than it has yet been possible to give to it.

Collections over this long stretch of coast, comprising some 22 degrees of latitude, or more than 1,300 geographical miles, have naturally been concentrated at the most accessible points, while there are long stretches of coast without harbors where as yet no collections whatever have been made. Neglecting the deep-sea dredgings, which have

afforded hardly any Pyramidellids in the area under consideration, the principal localities where collections have been made are: Sitka; the region about the eastern end of Vancouver Island, including the Straits of Fuca, the Gulf of Georgia, and Puget Sound; the vicinity of San Francisco, California; and Monterey Bay.

It is well to note that in the great archipelago extending from Fuca Strait to Cross Sound there is a marked difference between the fauna of the inner channels, which have their waters chilled by the discharges from a multitude of glacial streams, and that of the outer coast, which is washed by the comparatively warmer waters of the Pacific Ocean. Many southern forms creep up along the outer coast which are unknown from the inland bays and channels.

From the paucity of information in regard to a considerable part of the coast referred to, generalizations as to distribution at present can at best be of a purely tentative character, and are therefore submitted with due reserve.

The recognition of new species and the distribution by collectors of their discoveries under the new manuscript names has been going on for several years, and it seems essential that the publication of the data should be made with as little delay as possible, in order that these names may be used in local lists and other places without leading to confusion.

The junior author has prepared the text of this paper, with the exception of this introduction, and the part of the senior author has been chiefly the collecting of material for study and an editorial supervision of details, including the text herewith. The drawings of the species were in part prepared by the late Dr. J. C. McConnell and, since his death, chiefly by Miss Evelyn Mitchell.

Genus *TURBONILLA* Risso.^a

Turbonilla Risso, Hist. Nat. Eur. Mer., IV, 1826, p. 224=*Euturbonilla* SEMPER, Arch. Nat. Fr. Meck., 1861, pp. 354-361.

Shell with sinistral apex, cylindro-conic, many whorled, generally slender; with a single columellar fold which varies in strength and frequently is not visible in the aperture.

Type.—*Turbonilla typica* Dall and Bartsch.

^aIn the preparation of the present diagnoses the following terminology is used:

"Axial sculpture," the markings which extend from the summit of the whorls toward the umbilicus.

The axial sculpture may be—

"Vertical," when the markings are in general parallelism with the axis of the shell.

"Protractive," when the markings slant forward from the preceding suture.

"Retractive," when the markings slant backward from the suture.

"Spiral sculpture," the markings following the directions of the coils of the whorls.

The following 6 of the 23 recognized subgenera are represented in the present faunal area: *Turbonilla* s. s., *Chemnitzia*, *Strioturbonilla*, *Pyrgolampros*, *Pyrgiscus*, and *Mormula*.

KEY TO SUBGENERA OF TURBONILLA.

Shell with spiral sculpture:

Varices present.....*Mormula* p. 510.

Varices absent.

Spiral sculpture consisting of many very fine incised striations.

Aperture subquadrate.....*Strioturbonilla* p. 495.

Aperture oval.....*Pyrgolampros* p. 498.

Spiral sculpture consisting of strong, incised spiral grooves...*Pyrgiscus* p. 504.

Shell without spiral sculpture:

Ribs interrupted at the periphery.....*Chemnitzia* p. 494.

Ribs continuing over the base.....*Turbonilla* p. 493.

Subgenus **TURBONILLA** Risso, s. s.

Turbonilla Risso, Hist. Nat. Eur. Mer., IV, 1826, p. 224; = *Euturbonilla* SEMPER (part), Arch. Nat. Fr. Meck., 1861, pp. 354-361.

Turbonillas without spiral sculpture, having prominent vertical ribs which extend from the summits of the whorls to the umbilical region; the same is true of the intercostal spaces. Usually both ribs and intercostal spaces are less strongly defined on the base, below the periphery, than on the exposed portion of the whorls above it. Columella straight or slightly twisted. All our West Coast forms belonging to this subgenus are small and slender, of semitranslucent bluish-white to milk-white color.

Type.—*Turbonilla typica* Dall and Bartsch, *T. plicata* Risso, 1826, not *Turbo plicatus* Brocchi, 1814.

TURBONILLA (TURBONILLA) GILLI, new species.

Plate XLIV, fig. 5.

Shell small, rather stout, inflated, dirty white. Nuclear whorls decollated, early post-nuclear whorls well rounded, later ones flat, broader at the summit than at the suture; sculpture of about fourteen strong, almost vertical, scalariform axial ribs on the second, and sixteen quite protractive ones on the succeeding whorls; on the penultimate turn, however, they are less oblique than on those preceding it. These ribs are very strongly developed at the summit of the whorls and render the deeply channeled suture decidedly coronated. Intercostal spaces deep, of about double the width of the ribs, interrupted suddenly at the decidedly angulated (almost keeled) periphery of the last whorl beyond which they reappear. Base strongly contracted, quite short, marked by the faint continuations of the axial ribs which extend to the umbilical region. Outer lip fractured; aperture? columella very strong, somewhat curved and revolute, provided with a subobsolete oblique fold.

The type and another specimen (Cat. No. 163009, U.S.N.M.) were collected by Mr. H. Hemphill at San Diego, California. The type has eight post-nuclear whorls, and measures: Length 3.3 mm., diameter 1.1 mm.

Two other lots belonging to the University of California have been examined—one, a single specimen, comes from Station 30 off Catalina Island. The other three specimens were obtained at Station 47, San Diego, California.

TURBONILLA (TURBONILLA) GILLI DELMONTENSIS, new subspecies.

Plate XLIV, fig. 7.

Shell, similar to *T. gilli*, but much more stout and less turreted, with the ribs less strongly developed and the peripheral thickening only weakly represented. The type has lost the nuclear whorls, the eight remaining measure: Length 3.4 mm., diameter 1.2 mm.

Type.—Cat. No. 195921, U.S.N.M. It was collected by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California.

Subgenus CHEMNITZIA D'Orbigny.

Chemnitzia D'ORBIGNY, Hist. Nat. Iles Canaries, 1839, p. 77; =*Euturbonilla* SEMPER (part), Archiv. Nat. Fr. Meck., 1861, pp. 354-361; =*Microbeliscus* SANDBERGER, 1874.

Turbonillas without spiral sculpture, having prominent axial ribs which fuse or terminate at the periphery. The intercostal spaces are deep and sunken and terminate at or a little above the periphery, extending upward to the summits of the whorls. Base smooth, devoid of all sculpture. Columella straight. All our West American species belonging to this group are small, slender, forms of semitranslucent bluish-white to milk-white color.

Type.—*Melania campanellæ* Philippi.

KEY TO SPECIES OF CHEMNITZIA.

Shell large, length 10 mm. or more..... *montereyensis*.
Shell small, length 5 mm. or less..... *muricatoides*.

TURBONILLA (CHEMNITZIA?) MONTEREYENSIS, new name.

=*Turbonilla gracillima* GABB, Proc. Cal. Acad. Sci., 1865, p. 186; not *Chemnitzia gracillima* CARPENTER, Cat. Maz. Shells, 1856, p. 431.

Mr. Gabb's description is as follows:

Shell small, very slender, long, white; vertex broken; whorls eleven or more, flattened on the sides; sutures strongly impressed, ribs about 23, large, obtuse, running from the suture to the margin of the base, base convexly truncated, smooth, aperture subcircular; columella thick. Length 10 mm., diameter 3.3 mm.

Habitat, Monterey, California; Dr. J. G. Cooper collector. This shell can be readily distinguished by its extremely slender form and the strong, slightly oblique ribs.

The type, according to Mr. Gabb, is in the collection of the California Geological Survey,^a but appears to have been misplaced or lost. From the description we are led to believe that it is a form similar to *T. torquata*, but of considerably broader spire.

TURBONILLA (CHEMNITZIA) MURICATOIDES, new species.

Plate XLIV, figs. 2, 2a.

Shell small, slender, subdiaphanous to milk white; nuclear whorls $2\frac{1}{2}$, helicoid but slightly elevated, well rounded, having their axis at right angles to the axis of the post-nuclear turn. Post-nuclear whorls smooth, rather high between the sutures, moderately rounded, marked by strong sublamellar axial ribs, which are about half as wide as the spaces that separate them, and extend strongly to the very summit of the whorl where they render the well-marked sutures crenulate. There are 14 of these ribs upon the first, 18 upon the fifth, and 20 upon the penultimate turn. The depressed intercostal spaces terminate abruptly at the periphery. Base of the last whorl well rounded, smooth, without sculpture. Aperture: (outer lip fractured), columella slender, slightly twisted.

The type has seven post-nuclear turns and measures: Length 3.0 mm., diameter 1.0 mm. It is Cat. No. 195942, U.S.N.M., and comes from Monterey, California. Another specimen, Cat. No. 160488, U.S.N.M., was collected by Doctor Dall at the same place.

Subgenus STRIOTURBONILLA Sacco.

Strioturbonilla Sacco, I Moll. del Piemonte e della Liguria, 1892, p. 94.

Shell as in *Turbonilla* and *Chemnitzia* but finely and closely spirally striated on the spire and base.

Type.—*S. alpina* Sacco.

All our West American species, with the exception of *T. affinis* and *T. smithsoni*, are of bluish-white to milk-white color; the two exceptions being of a yellowish cast.

KEY TO SPECIES OF STRIOTURBONILLA.

Whorls overhanging, shell stout.....*vancouverensis*.

Whorls not overhanging, shell slender

Whorls strongly rounded, ribs sinuous.....*stylina*.

Whorls almost flattened, ribs straight.....*serræ*.

TURBONILLA (STRIOTURBONILLA) VANCOUVERENSIS Baird.

Plate XLIV, fig. 1.

Chemnitzia vancouverensis BAIRD, Proc. Zool. Soc., 1863, p. 67.

Shell solid, rather broad and stout, subdiaphanous, bluish to milk-white. Nuclear whorls two, large, helicoid, partly obliquely immersed in the first of the later turns. Post-nuclear whorls well rounded, with

^aProc. Cal. Acad. Sci., 1865, p. 183.

the greatest convexity on the lower half of the exposed portion; ornamented by about 10, very broad, strong, slightly protractive axial ribs on the second, 14 on the fifth, 16 on the eighth, and 18 on the penultimate whorl. These ribs terminate before they reach the periphery of the whorl, leaving a plain band above the suture, as in *T. torquata* Gould, but not as broad as in that species. Intercostal spaces deep, narrower than the ribs. Sutures well marked by the shouldering at the summit and the sudden sloping of the ribs just above the periphery of the whorls. Aperture subovate; lip thin, joining the short, somewhat revolute columella in a gentle, even curve. Entire surface marked by faint wavy spiral striations. The specimen figured has 10 post-nuclear whorls and measures: Length 6.0 mm., diameter 1.8 mm. Another specimen from the same locality, which has 12 post-nuclear whorls, but is minus the nucleus and probably the first of the succeeding turns, measures: Length 9.2 mm., diameter 2.5 mm.

This species resembles *T. torquata* Gould, but can easily be distinguished from it by its broader base, its large, partly immersed, slanting nucleus, and the robust character of its whorls and ribs, the latter being fewer and much broader; the intercostal spaces being comparatively narrower. Doctor Baird's type was collected at Esquimalt Harbor, Vancouver Island, British Columbia.

Specimens examined.

2. Kadiak Island, Alaska. 13 fathoms. W. H. Dall. Cat. No. 160489, U.S.N.M.
1. Lituya Bay, Alaska. 8 fathoms. W. H. Dall. Cat. No. 160490, U.S.N.M.
1. Port Etches, Alaska. W. H. Dall. Cat. No. 160993, U.S.N.M.
4. Victoria, Vancouver Island, British Columbia. C. F. Newcombe, Cat. No. 126670, U.S.N.M.
1. Puget Sound, Washington. Doctor Kennerley. Cat. No. 44938, U.S.N.M.
1. Monterey, California. 28 fathoms. S. S. Berry. In Mr. Berry's collection.
1. Carter Bay, British Columbia. Rev. G. W. Taylor. Cat. No. 196184, U.S.N.M.
1. Carter Bay, British Columbia. Rev. G. W. Taylor. Rev. G. W. Taylor collection.
3. Port Simpson, British Columbia. Rev. G. W. Taylor. Cat. No. 196183, U.S.N.M.
11. Port Simpson, British Columbia. Rev. G. W. Taylor. Rev. G. W. Taylor collection.
2. West of Rose Spit, Queen Charlotte Island, British Columbia. Rev. G. W. Taylor. Rev. G. W. Taylor collection.
1. Alert Bay, British Columbia. Rev. G. W. Taylor. Rev. G. W. Taylor collection.
20. Departure Bay, British Columbia. Rev. G. W. Taylor. Rev. G. W. Taylor collection.
5. Departure Bay, British Columbia. Rev. G. W. Taylor. Cat. No. 196185, U.S.N.M.

TURBONILLA (STRIOTURBONILLA) STYLINA Carpenter.

Plate XLIV, figs. 11, 11a.

Chemnitzia (?*torquata* var.) *stylina* CARPENTER, Ann. Mag. Nat. Hist., 3rd ser., XV, 1865, p. 396.*Turbonilla* (*Strioturbonilla*) *torquata stylina* DALL and BARTSCH, Mem. Cala. Acad., III, 1903, p. 272, in part.

Shell slender, subdiaphanous to milk-white. Nuclear whorls two, smooth, depressed, helicoid, scarcely extending beyond the outline of the spire and having their axis at right angles to the axis of the succeeding turns. Post-nuclear whorls well rounded, separated by strongly constricted sutures, rather high, ornamented by rather low, broad, rounded, sinuous, oblique axial ribs, of which there are 16 upon the first, 20 upon the fifth, and 28 upon the penultimate turn. Intercostal spaces moderately depressed, about as wide as the ribs, terminating a short distance above the sutures, thus leaving a narrow smooth band between the termination of the ribs and the suture as in *T* (*Strioturbonilla*) *torquata* Gould, but not quite as wide as in that species. Periphery of the last whorl well rounded. Base rather short, well rounded. Entire surface marked by very fine wavy spiral striations. Aperture subovate, outer lip thin, columella slender, moderately long, slightly twisted, almost vertical. The specimen described and figured (Cat. No. 56429, U.S.N.M.) was collected by Doctor Dall in 8 or 10 fathoms at Monterey, California. It has 11 post-nuclear whorls and measures: Length 6.5 mm., diameter 1.7 mm. (not 8 and 1.9 mm., as erroneously stated in the last-cited reference). Another specimen was dredged in 12 fathoms off Del Monte, Monterey, by Mr. S. S. Berry (Cat. No. 165199, U.S.N.M.). Two specimens (Cat. No. 163249, U.S.N.M.), both immature, dredged by the Bureau of Fisheries steamer *Albatross* at station 2932 in 50 fathoms off Coronado Island, are provisionally referred to this form.

TURBONILLA (STRIOTURBONILLA) SERRÆ, new species.

Plate XLIV, figs. 8, 8a.

Shell slender, very elongate-conic, subdiaphanous to milk-white. Nuclear whorls decollated. Post-nuclear whorls very high between the sutures, moderately rounded, slightly contracted at the periphery and somewhat shouldered at the summit, rendering the sutures subchannelled. The whorls are marked by subequal and subequally spaced, rather broad, rounded, almost vertical axial ribs, which are a little wider than the intercostal spaces; the depressed portion of the latter terminating a little above the suture. In the type, which has lost the nucleus and probably the first two post-nuclear turns, there are 16 ribs on the third of the remaining whorls, 20 on the eighth, 22 upon

the eleventh, and 34 upon the next, the penultimate turn. On this whorl the axial ribs are less regular and less strongly developed, showing senile degeneration. Periphery of the last whorl well rounded. Base short, well rounded, marked by slender continuations of the axial ribs which extend feebly to the insertion of the columella. Entire surface of spire and base crossed by numerous closely placed spiral striations. Aperture subquadrate, posterior angle obtuse, outer lip thin, columella rather strong, somewhat oblique, and slightly revolute, without apparent fold in the aperture. The type has 13 whorls and measures: Length 7.7 mm., diameter 1.4 mm.

The type and seven specimens were collected by Mr. S. S. Berry, in 12 fathoms off Del Monte, Monterey, California, five of these are in Mr. Berry's collection, the type and one other form Cat. No. 196198, U.S.N.M. Cat. No. 196200, U.S.N.M., contains a specimen from 40 fathoms off Pacific Grove, Monterey, California, dredged by Mr. Berry. Another specimen in Mr. Berry's collection was dredged in shelly sand at Monterey, California, at a depth of 29 fathoms.

This species is nearest related to *Strioturbonilla stylina* Carpenter, but can readily be distinguished from it by its less rounded whorls, straighter and much stronger ribs, and by having the ribs continuing over the base and scarcely any space showing between the termination of the intercostal spaces and the suture.

Subgenus **PYRGOLAMPROS** Sacco.

Pyrgolampros Sacco, I. Moll. del Piemonte e della Liguria, 1892, p. 85.

Turbonillas with low, broad, rounded vertical ribs which almost always disappear as they pass over the periphery and base of the last whorl, and many very fine, faint, wavy spiral striations; surface covered by a thin epidermis. Columella usually somewhat flexuose.

Type.—*P. mioperplicatulus* Sacco.

All our west American species are of a light-yellow to chocolate-brown color. The intercostal spaces are not depressed as in *Chemnitzia*, but appear as simple shallow undulations between the axial ribs. The spiral striations, in perfect specimens, appear as if they were situated beneath the light-colored epidermis and were shining through it.

KEY TO SPECIES OF PYRGOLAMPROS.

Vertical ribs present

Shell large, adult more than 10 mm. long (dark brown).....*taylori*.

Shell less than 10 mm. long when adult.

Shell very slender, brown banded.

Space between the sutures dark brown with two light brown bands.
berryi.

Space between the sutures white on the posterior half and brown on the anterior half.....*lyalli*.

Shell rather stout, yellow.	
Whorls concave between the sutures.	<i>victoriana</i> .
Whorls not concave between the sutures.	
Shell stout and stubby.	<i>valdezi</i> .
Shell broadly conic.	
Uniformly golden-yellow.	<i>aurantia</i> .
Anterior half between the sutures yellow, posterior half white.	<i>newcombei</i> .
Vertical ribs obsolete.	<i>oregonensis</i> .

TURBONILLA (PYRGOLAMPROS) TAYLORI, new species.

Plate XLIV, figs. 9, 9a.

Shell very regularly elongate-conic, purplish-brown. Entire surface marked by numerous closely placed minute spiral striations. Nuclear whorls small, depressed helicoid, smooth, scarcely at all immersed, having their axis at a right angle to that of the later turns, the sides not projecting beyond the outline of the spire. Post-nuclear whorls quite high between the sutures, only slightly contracted toward the periphery and very weakly beveled at the appressed summits, marked by low, broad, retractive axial ribs, which are much more numerous and less strongly defined on the early whorls than on those succeeding. There are about 36 on the second, 30 upon the third, 24 upon the fourth, and 26 upon the antepenultimate post-nuclear turn. On the last whorl they become irregular and irregularly spaced, showing senility. The ribs become flattened and less strongly defined toward the summit and the periphery, disappearing at the well-rounded periphery. Sutures well marked. Base short, inflated, rounded. Aperture suboval, somewhat effuse anteriorly; posterior angle acute; outer lip thin, white edged, chestnut brown within except at the very base, which is white; columella slender, twisted, and slightly revolute anteriorly.

The above description is based upon two cotypes (Cat. No. 196210, U.S.N.M.): one, an immature specimen having the nucleus and 9 post-nuclear whorls measures: length 6.5 mm., diameter 1.9 mm., the other an adult individual having 10 whorls (is minus the nucleus and probably the first five post-nuclear turns) and measures: length 11.5 mm., diameter 3.1 mm.

The two cotypes and 30 specimens were collected by the Rev. G. W. Taylor at Departure Bay, British Columbia. The cotype and five specimens are in the U. S. National Museum (Cat. No. 196210). The rest are in the Taylor collection.

This species was collected at five additional stations in British Columbia by the Rev. Doctor Taylor, all the specimens being in his collection except where otherwise stated. One specimen at Carter Bay; 3 at Port Simpson, 1 of which is Cat. No. 196211, U.S.N.M.; 11 at Banks Island, 3 of which are Cat. No. 196212, U.S.N.M.; 6 at Alert Bay, 2 of which are Cat. No. 196213, U.S.N.M.

TURBONILLA (PYRGOLAMPROS) BERRYI, new species.

Plate XLIV, figs. 10, 10a.

Shell slender, very regularly acutely conic, bright-chestnut brown, with two narrow spiral bands of a lighter shade; one, the narrower of the two, is at the periphery, the other has its posterior edge at about the middle of the exposed portion between the sutures. Nuclear turns $2\frac{1}{2}$, smooth, depressed, helicoid, not immersed, having their axis at a right angle to the axis of the later whorls, their sides projecting slightly beyond the outlines of the spire. Postnuclear whorls very high between the sutures, slightly beveled at the summit and moderately constricted at the periphery, ornamented by well-developed, acute, retractive axial ribs, of which there are about 20 upon the second, 24 upon the fifth, and 26 upon the penultimate turn. These ribs extend quite strongly to the summit, where they feebly crenulate the well-impressed sutures. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs, which gradually disappear as they cross the base. Entire surface marked by numerous very fine, closely spaced, wavy, spiral striation. Aperture suboval, somewhat effuse anteriorly; posterior angle acute; columella oblique, very slightly twisted and weakly revolute at its outer extremity.

The type (Cat. No. 196223, U.S.N.M.) has 9 post-nuclear whorls and measures: Length 8 mm., diameter 2.2 mm. It and another specimen in Mr. S. S. Berry's collection were dredged by him in 39 fathoms on sandy bottom in Monterey Bay.

Another specimen (Cat. No. 196225, U.S.N.M.) was dredged by the Bureau of Fisheries steamer *Albatross*, at Station 4564, in 9 to 10 fathoms, rocky bottom, with a temperature of 59° , 2 miles off Santa Cruz Light, Monterey Bay, California.

A fourth shell (Cat. No. 196224, U.S.N.M.) was dredged in 52 fathoms, off Catalina Island, California.

TURBONILLA (PYRGOLAMPROS) LYALLI, new species.

Plate XLIV, figs. 4, 4a.

Shell small and slender with strong sculpture, whitish with a broad chestnut band which extends almost halfway over the exposed portion of the whorls above the periphery and an equal distance anteriorly over the base below the periphery. Nuclear whorls two, closely appressed to each other, forming a polished depressed helicoid spire, which does not extend beyond the outline of the post-nuclear spire, is not at all immersed and has its axis at right angles to the axis of the succeeding turns. Post-nuclear whorls decidedly flattened, moderately contracted at the periphery, and slightly shouldered at the

summit, ornamented by strongly elevated, moderately broad, rounded retractive axial ribs, which become somewhat flattened toward the summit and periphery of the turns. There are about 22 ribs upon the second, 20 upon the fifth and the penultimate turn. Upon the first they are very weakly expressed. Intercoastal spaces broad, almost double the width of the ribs. Sutures strongly impressed. Periphery and base of the last whorl well rounded, marked by the continuations of the axial ribs which extend feebly to the umbilical region. Entire surface marked by numerous closely placed spiral striations. Aperture pyriform, posterior angle acute, columella almost straight, obliquely inserted, slightly revolute.

The unique type (Cat. No. 196221, U.S.N.M.) was collected by Rev. G. W. Taylor at Banks Island, British Columbia. It has 9 post-nuclear turns and measures: Length 5.7 mm., diameter 1.4 mm.

TURBONILLA (PYRGOLAMPROS) VICTORIANA, new species.

Plate XLIV, fig. 6.

Shell elongate-conic, wax yellow to light brown. Nuclear whorls and the early succeeding turns eroded in all the specimens examined. Post-nuclear whorls quite high between the sutures, somewhat concave in the posterior two-thirds of the exposed portion, only slightly contracted toward the periphery and faintly shouldered at the summit; ornamented by low, rounded, somewhat sinuous axial ribs, which are about as wide as the shallow intercoastal spaces. Sutures well marked. Periphery and base of the last whorl somewhat inflated, marked by weak continuations of the axial ribs which extend feebly to the umbilical region. Entire surface crossed by numerous, wavy spiral striations. Aperture rather elongate, oval, outer lip thin; columella moderately long, decidedly twisted and somewhat revolute in its free anterior portion; the twist at its insertion appearing as a fold.

The type (Cat. No. 126660a, U.S.N.M.) was collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia. It has the last seven and a half whorls and measures: Length 7 mm., diameter 2.1 mm. Ten additional specimens were collected by Rev. G. W. Taylor, at Departure Bay, Vancouver Island, British Columbia, 4 of which form Cat. No. 196220, U.S.N.M.

This species appears nearest related to *Turbonilla* (*Pyrgolampros*) *newcombei* Dall and Bartsch, but is readily distinguished from that form by its concave whorls.

TURBONILLA (PYRGOLAMPROS) VALDEZI, new species.

Plate XLIV, figs. 3, 3a.

= *Turbonilla (Pyrgolampros) gibbosa* DALL and BARTSCH, Mem. Cala. Acad. Sci., III, 1903, pp. 27-9, pl. 1, figs. 2, 2a, not *Chemnitzia gibbosa* CARPENTER, Cat. Maz. Shells, 1857, p. 430, No. 525.

Shell inflated, robust, broad and stumpy, of light, fulvous coloration. Nuclear whorls decollated in the type. Post-nuclear whorls flattened, somewhat contracted at the periphery and rounded at the summit, traversed by broad, coarse, irregularly slanting axial ribs, which extend over the inflated periphery of the last whorl to the umbilical region, appearing less prominent on the base. About 16 of these ribs occur upon the second, 18 upon the fifth, and 24 upon the penultimate post-nuclear whorl. Entire surface of the shell crossed by very minute, close spiral striation. Suture subchanneled and wavy. Aperture ovate, outer lip thin, joining the twisted and revolute columella in a broad curve.

The type (Cat. No. 32273, U.S.N.M.) was collected at Monterey, California. It has 7 post-nuclear whorls and measures: Length 5.6 mm., diameter 2.1 mm.

Another specimen, not quite adult (Cat. No. 176624, U.S.N.M.), comes from Pacific Grove, California. This has the nuclear whorls preserved, which are two, depressed helicoid, smooth, obliquely about one-fourth immersed in the first of the succeeding turns, and having their axis at right angles to that of the later whorls. The left side of its nucleus projects slightly beyond the outline of the spire.

The present form is in every way much more robust than *T. (P.) gibbosa* Carpenter, which was described from Mazatlan, Mexico.

TURBONILLA (PYRGOLAMPROS) AURANTIA Carpenter.

Plate XLV, fig. 5.

Chemnitzia (? var.) *aurantia* CARPENTER, Journ. de Conch., XII, 1865 (3d ser., V.), p. 147.

Shell similar to *T. (P.) chocolata* Carpenter, but much broader, with the close spiral striation a little more pronounced than in that species, covered by a golden-yellow epidermis. Nuclear whorls decollated in all our specimens. Post-nuclear whorls moderately rounded, but little contracted at base and but very slightly shouldered at the summit, ornamented by about 22 moderately developed, slightly retractive axial ribs on each of the whorls. These ribs become quite obsolete as they pass over the well-rounded periphery and base of the last whorl. Intercostal spaces weak, much narrower than the ribs. Sutures quite prominent, simple. Aperture large, broadly ovate, posterior angle obtuse, somewhat effuse at base; outer lip thin, columella slender, quite oblique, twisted, and revolute.

Doctor Carpenter's type (Cat. No. 4493*b*, U.S.N.M.), upon which the description is based, has 6 post-nuclear whorls and measures: Length 5.8 mm.; diameter 2.4 mm. It bears the two localities Puget Sound and Santa Barbara, and probably comes from Puget Sound.

Three other specimens (Cat. No. 126660, U.S.N.M.) were collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia, and five more by the Rev. G. W. Taylor at Departure Bay, British Columbia, one of which is Cat. No. 196205, U.S.N.M., the others being in the Taylor collection. This one has 9 whorls remaining and measures: Length 9.5 mm.; diameter 2.8 mm.

TURBONILLA (PYRGOLAMPROS) NEWCOMBEI, new species.

Plate XLV, fig. 6.

Shell regularly, broadly conic, white on the posterior half and light brown on the anterior half of the exposed portion of the whorl; base white. Nuclear whorls decollated in all the specimens seen. Post-nuclear whorls somewhat overhanging, decidedly contracted toward the periphery from the anterior fifth of the exposed part; almost flattened posterior to this, and closely appressed at the summit, separated by strongly marked sutures. Ribs about 18 upon all the turns, almost vertical, moderately elevated, rounded in the middle, decidedly flattened and widened at the summit, disappearing at the periphery. Intercostal spaces not depressed below the general surface, a little wider than the ribs. Periphery and the moderately long base well rounded, smooth, excepting the fine spiral striation which covers the entire surface of the shell. Aperture subquadrate, posterior angle acute; outer lip thin, showing the color bands within; columella slender, oblique and slightly revolute.

The type (Cat. No. 126660, U.S.N.M.) was collected by Dr. C. F. Newcombe, at Victoria, Vancouver Island, British Columbia. It has 7 post-nuclear whorls which measure: Length 5.4 mm., diameter 2.1 mm. Eighteen additional specimens were collected by Rev. G. W. Taylor at Port Simpson, British Columbia, 12 of which are in his collection, the other 6 form Cat. No. 196214, U.S.N.M.

TURBONILLA (PYRGOLAMPROS) OREGONENSIS, new species.

Plate XLV, fig. 2.

Shell elongate-conic, wax-yellow, with two yellowish-brown spiral bands, the posterior one of which encircles the turns a little above the periphery, while the anterior one, which is a little wider, is immediately posterior to it, the two being separated by a space about as wide as the posterior band. Nuclear whorls decollated in all our specimens. Post-nuclear turns very slightly rounded, moderately contracted at the periphery and closely appressed to the preceding turn

at the summit. There are no well-defined ribs, the axial sculpture being reduced to mere lines of growth with here and there a weakly impressed area, probably representing an obsolete intercostal space. Sutures strongly impressed. Periphery of the last whorl faintly angulated. Base short, well rounded. Entire surface marked by fine, regular, close, spiral striation. Aperture pyriform, posterior angle acute; outer lip thin, columella somewhat twisted, scarcely revolute at its free end.

The type has $8\frac{1}{2}$ whorls remaining which measure: Length 8.5 mm., diameter 2.7 mm. It and another specimen (Cat. No. 181112, U.S.N.M.) were dredged by the United States Bureau of Fisheries steamer *Albatross* at Station No. 2885 off Oregon, in 30 fathoms, with a bottom temperature of 49° .

Another specimen (Cat. No. 196222, U.S.N.M.) was dredged at Station No. 2868, off the coast of Washington, in 31 fathoms on gray sand with a bottom temperature of 46.9° .

The absence of ribs differentiates this form from all the other *Pyrgolampros* mentioned in this paper. It is allied to two species not yet described, one of which belongs to the Californian and the other to the Alaskan fauna.

Subgenus PYRGISCUS Philippi.

Pyrgiscus PHILIPPI, Wieg. Arch., I, 1841, p. 50. = *Pyrgostelis* MONTEROSATO, *Conch. Medit.*, 1884, p. 89. = *Ortostelis* ARADAS, *Atti Dell Acad. Giov. di Catania*, 1843, XX.

Turbonillas having prominent vertical ribs and deeply incised spiral lines, but no varices or internal lirations on the outer lip. Columella usually somewhat flexuous.

Type.—*Melania rufa* Philippi.

KEY TO SPECIES OF PYRGISCUS.

Axial ribs terminating at the periphery.....	<i>canfieldi</i> .
Axial ribs passing feebly over the periphery and base of the last whorl.	
Periphery of the last whorl angulated.	
Ribs retractive	<i>morchii</i> .
Ribs vertical	<i>antestriata</i> .
Periphery of the last whorl well rounded.	
Adult shell more than 10 mm. long.....	<i>eucosmobasis</i> .
Adult shell less than 7 mm. long.....	<i>tenuicula</i> .
Axial ribs extending prominently over the periphery and base of the last whorl.	
	<i>castanea</i> .

TURBONILLA (PYRGISCUS) CANFIELDI, new species.

Plate XLVII, figs. 4, 4a.

Shell slender, elongate-conic, with the posterior half of the exposed portion of the whorls on the spire white and the anterior half chestnut brown, base white. Nuclear whorls $2\frac{3}{4}$, large, smooth, forming a

depressed helicoid spire whose axis is at right angles to the axis of the succeeding turn; not immersed and extending slightly beyond the outline of the spire on both sides. Post-nuclear whorls very slightly rounded, weakly roundly shouldered at the summit and very moderately contracted at the periphery, ornamented by very strong, broad, low, rounded, almost vertical axial ribs of which there are 22 upon the first, 24 upon the antepenultimate, and 28 upon the penultimate turn. These ribs extend prominently to the summit and crenulate the subchannelled sutures. Intercostal spaces narrow, not more than half the width of the ribs, crossed by 19 incised spiral lines which are of almost equal width and subequally spaced with the following exceptions, the seventh, eleventh, and the last three above the periphery are much wider, appearing as quadrangular pits in the intercostal spaces, the eleventh falling on about the middle of the exposed portion of the whorl on the spire, and the seventh about halfway between this and the summit. Periphery and base of the last whorl well rounded, the latter marked by the feeble continuations of the axial ribs which gradually disappear after crossing the periphery, and about 16 subequally spaced incised spiral lines. Aperture oval, somewhat effuse anteriorly, columella oblique, somewhat twisted with a weak oblique fold a little anterior to its insertion.

The type (Cat. No. 196229, U.S.N.M.) was dredged by Mr. S. S. Berry in 12 fathoms off Del Monte, Monterey, California. It has 10 post-nuclear whorls and measures: Length 6.3 mm., diameter 1.2 mm.

TURBONILLA (PYRGISCUS) MORCHI, new species.

Plate XLV, figs. 1, 1a.

Shell broadly elongate-conic, the posterior third of the exposed portion of the whorls on the spire and a narrow area about the umbilical region flesh-colored, the rest of the shell light chestnut brown. Nuclear whorls $2\frac{1}{2}$, small, smooth, forming a depressed helicoid spire which has its axis at right angles to the axis of the succeeding turns and is about one-fifth immersed in the first of them. Exposed portion of the post-nuclear whorls flattened in the middle, posterior fourth sloping gently toward the summit, which is closely appressed to the preceding turn; the anterior portion slopes more abruptly, roundly toward the periphery. The whorls are ornamented by strong rather distantly spaced, moderately acute, slightly protractive axial ribs, of which 18 occur upon the first three, 16 on the next three, 18 on the seventh, and 20 upon the penultimate turn. The ribs weaken slightly and become somewhat flattened as they approach the constricted sutures. Intercostal spaces broad, almost double the width of the ribs, crossed by 7, equal and equally spaced, deeply incised spiral lines, which extend up on the sides of the ribs and feebly across

them. The space between the second and third lines appears slightly nodulose on the ribs. Periphery of the last turn angulated, crossed by the continuations of the ribs, which disappear as they pass on to the short and well-rounded base. Base marked by 13 continuous incised spiral lines of about equal strength which are much more closely spaced near the umbilicus than the periphery, the distance between the succeeding striations diminishing in regular ratio from the periphery to the umbilical area, the first two below the periphery being considerably more distantly spaced than the rest, the spaces inclosed between them being about equal to the space inclosed between the spiral lines on the spire. Aperture subquadrate, posterior angle acute, outer lip thin, showing the external sculpture within; columella slender, oblique, somewhat twisted and slightly revolute.

The type (Cat. No. 173081, U.S.N.M.) has 9 post-nuclear whorls and measures: Length 6.4 mm., diameter 2 mm. It was collected by Mr. H. N. Lowe at Long Beach, California. Another specimen is in the collection of the University of California from Station No. 122, near Redondo. Another (Cat. No. 176622, U.S.N.M.) was dredged by Mr. John Paine in 8 fathoms off Catalina Island. Five (Cat. No. 196230, U.S.N.M.) were collected by Mr. H. N. Lowe at San Diego, and four additional specimens from the same locality are in Mr. Lowe's collection. One, collected at Station No. 83, off San Diego, is in the collection of the University of California.

A specimen collected by Mr. S. S. Berry in 29 fathoms off New Monterey, Monterey Bay, California, is provisionally placed here until more material can be examined. It agrees with *T. (P.) morchi* in general form and type of sculpture, but is much more slender and has more ribs.

This species is nearest related to *Turbonilla (Pyrgiscus) latifundia* Dall and Bartsch, from the post-Pliocene of San Pedro, California.

TURBONILLA (PYRGISCUS) ANTESTRIATA, new species.

Plate XLV, figs. 4, 4a.

Shell large and strong, light brown. Nuclear whorls $2\frac{1}{2}$, small, smooth, forming a depressed rounded helicoid spire, which projects somewhat beyond the left side of the outline of the spire of the later whorls and has its axis at a right angle to the axis of these, being about one-fourth immersed in the first turn. Post-nuclear whorls slightly rounded, ornamented by low, rounded, narrow, vertical axial ribs which become decidedly flattened and enfeebled near the summit of the turns; there are 9 of these ribs on the second, 20 upon the fifth, and 28 upon the penultimate post-nuclear turns. Intercostal spaces about double the width of the ribs, shallow, rounded, crossed by 6 equal and equally spaced, strongly incised, spiral lines which extend

stronger upon the sides of the ribs and feebly over their summits. In addition to this sculpture, the spire is marked by many fine lines of growth and many fine spiral striations between the incised lines. Sutures well marked, simple. Periphery of the last whorl subangulated, marked by the feeble continuations of the axial ribs, which disappear at the periphery. Base short, marked by 11 continuous, equal, strong, incised spiral lines which are more closely spaced above the umbilical area than at the periphery; the space between the first basal incised line and the first suprapерipheral one being a little wider than the space inclosed between the spiral lines on the spire. Aperture subquadrate, outer lip thin, showing the external sculpture within; columella almost straight and vertical, slightly revolute.

The above description is based upon 2 cotypes. One, an adult shell (Cat. No. 168867, U.S.N.M.), has the last 10 whorls, having lost the nucleus and probably the first two and one-half post-nuclear turns, and measures: Length 9.7 mm., diameter 2.8 mm. It was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at Station No. 3194 in 92 fathoms, on gray sand, bottom temperature 45.0° 9, off Esteros Bay, California. The other (Cat. No. 196232 U.S.N.M.) was collected by Mrs. Oldroyd at San Pedro, California, and has the nucleus and 9 post-nuclear turns, and measures: Length 5.5 mm., diameter 1.8 mm. Three specimens (Cat. No. 196233, U.S.N.M.) were dredged by the Fisheries steamer *Albatross* at Station No. 2902 in 53 fathoms, fine gray sand and mud bottom, temperature 45°, off Santa Rosa Island. One in the collection of the University of California comes from Station No. 122, near Redondo; another in the same institution was dredged at Station No. 12, off Point Vincent. Two (Cat. No. 196231, U.S.N.M.) were dredged in 12 fathoms at San Pedro by Mr. H. N. Lowe. Another specimen was dredged by the University of California at Station No. 30, off Catalina Island, and two at Station No. 58, off San Diego, California, the last two lots being in the University collection.

TURBONILLA (PYRGISCUS) EUCOSMOBASIS, new species.

Plate XLV, figs. 8, 8a.

Shell quite large, of very regular outline, creamy white. Nucleus rather small, composed of $2\frac{1}{2}$ whorls, helicoid with much depressed spire, somewhat obliquely about one-third immersed in the first of the succeeding turns, the axis of the nuclear spire being almost at a right angle to the axis of the later whorls. Post-nuclear whorls moderately rounded, widest a little above the suture, sloping gently toward the summit and more abruptly toward the base, ornamented by moderately strong, rounded, somewhat flexuous, axial ribs, of which about 18 appear upon the second, 20 upon the seventh, 22 upon the eighth, and

27 upon the penultimate whorl. Intercostal spaces only moderately deep, a little wider than the ribs, marked by 6 strong incised spiral lines which extend up on the sides of the ribs and frequently pass over their summits; the uppermost or posterior one of these incised lines is least pronounced, the second one above the suture, and the third one about half again as far apart as the remaining, which are equally spaced. In addition to these the shell is marked by many faint wavy spiral striations between the deep ones. Sutures plain, well defined. Base of the last whorl very short, well rounded, marked by the faint continuations of the axial ribs and about 15 well defined more or less equally spaced deep spiral striations with fainter ones between them as on the exposed portion of the whorls of the spire; the first deep basal spiral striation and the one above the suture are some little distance apart and mark a plain band excepting the fainter sculpture. Aperture quite large, subquadrate; columella short, somewhat twisted, revolute.

The type (Cat. No. 162679, U.S.N.M.) was dredged by the U. S. Bureau of Fisheries steamer *Albatross* at Station No. 2902, off Santa Barbara, California, in 53 fathoms. It has 12 post-nuclear whorls which measure: Length 11.2 mm.; diameter 2.8 mm.

Another specimen (Cat. No. 162680, U.S.N.M.) was dredged at Station No. 3195, in 252 fathoms, on green mud, bottom temperature $43^{\circ}.2$, in San Luis Obispo Bay, California. Four specimens (Cat. No. 162681) were dredged at Station No. 2901 on grey sand and mud bottom, at a depth of 48 fathoms, temperature $55^{\circ}.1$, off Santa Rosa Island. The University of California has two lots, one specimen dredged at Station No. 32, off Catalina Island, and two from Station No. 59, off San Diego, California.

TURBONILLA (PYRGISCUS) TENUICULA Gould.

Plate XLV, figs. 3, 3a.

Chemnitzia tenuicula GOULD, Bost. Jour. Nat. Hist., VI, 1853, pp. 383, 384, pl. xiv, fig. 15.

Turbonilla (Pyrgiscus) tenuicula GOULD, Mem. Cala. Acad., III, 1903, pp. 275-276, pl. II, figs. 7, 7a.

Shell small, elongated, lanceolate, turritid, rather solid, shining, wax yellow, a little dusky below the suture; whorls 10, flat, slightly shouldered above, marked by about 20 direct, longitudinal folds, the summits of which are cut by numerous fine revolving striæ, deeper in the interstices, which also extend over the base of the shell, though the folds terminate at the periphery, or are extended in delicate furrows; aperture narrow, ovate; lip sharp; revolving striæ apparent within.

Dimensions.—Length 7.5 mm.; diameter 1.3 mm.

Found at Santa Barbara.

The above is the original description by Gould. *Turbonilla* (*Pyrgiscus*) *tenuicula* Gould is the most abundant and most variable species of all the west American forms, presenting many varieties or incipient species; to describe these would not aid science or the collector, but would only add to the confusion which this paper is intended to dispel. The following comprehensive description will embrace, we believe, all the forms coming under this name:

Shell slender to somewhat stubby and inflated, varying in color from milk-white to waxy yellow or to dark brown, variously banded or plain monocolored; nuclear whorls three, moderately large, planorboid, slightly slantingly immersed; post-nuclear whorls rounded to flattened, contracted at base and strongly shouldered at the summit, traversed by 18 to 28 strong vertical ribs, which are excurved and usually somewhat thickened, and connected at their summits, which appear beaded; these ribs extend feebly over the rounded base of the last whorl; the entire shell is crossed by incised spiral lines, 10 to 16 or more of which appear on the exposed portion of the whorls, and more, closer placed, wavy ones on the base of the last whorl; the suture is deep, subchanneled and wavy; aperture ovate, produced at base; outer lip thin, meeting the oblique, slightly curved and revolute columella in a broad curve; a faint callus connects the posterior angle of the aperture with the insertion of the columella.

Dimensions.—Length 6.5 mm.; diameter 1.9 mm.

The specimen figured is from Todos Santos Bay, Lower California, and has 9 post-nuclear whorls. One of the same number of whorls from San Pedro measures: length 6.2 mm.; diameter 1.7 mm.

The U. S. National Museum contains the following specimens:

Specimens of Turbonilla (Pyrgiscus) tenuicula Gould.

Number of specimens.	Locality.	Collector.	Catalogue No.
2	Monterey, California.....	P. P. Carpenter	32245
1	Santa Barbara, California.....	Colonel Jewett	a 16267
2	San Pedro, California.....	E. W. Roper	151724
1	do	Mrs. T. S. Oldroyd	196227
25	do	do	196226
2	do	Mrs. Johnston	152198
1	do	do	160480
7	do	F. L. Button	191547
1	Pacific beach, San Diego	H. Hemphill	192228
3	San Diego	Stearns collection	46504
7	San Diego, ocean beach.....	F. W. Kelsey	153065
2	San Diego	do	b 153049
5	do	C. R. Orcutt	60933
1	Point Abreojos, Lower California.....	H. Hemphill	160481
2	do	do	105585
7	Todos Santos Bay, Lower California.....	Stearns collection	106510 32284

TURBONILLA (PYRGISCUS) CASTANEA, new species.

Plate XLVII, fig. 7.

Shell very large, stout and heavy, chestnut brown. Nuclear whorls decollated. Post-nuclear whorls well rounded, ornamented by many broad, flattened, more or less regular, and evenly placed retractive axial ribs, of which about 22 appear upon the third, 26 upon the fifth, and

40 upon the seventh whorl. On the penultimate and antepenultimate whorls they are more or less irregular in form, number, and spacing. Intercoastal spaces much narrower than the ribs. The spiral sculpture consists of 8 deep, quite regularly spaced lines of pits which are very pronounced in the intercoastal spaces and on the sides of the ribs, but do not appear to cross their summits except on the penultimate and the last whorl. Sutures well defined, simple. Periphery and base of the last whorl evenly rounded, the latter ornamented by the prolongation of the axial ribs and quite a number of continuous well-impressed spiral lines with faint spiral striation between them. Aperture sub-oval, somewhat effuse anteriorly, posterior angle obtuse (outer lip fractured, very thick); columella strong, slightly curved and strongly revolute with a weak, very oblique internal fold near its insertion; parietal wall and umbilical region covered by a weak callus. Columella and extreme anterior portion of the aperture white.

The type (Cat. No. 74000, U.S.N.M.) belongs to the Stearns collection and was obtained at Monterey, California. It has 10 post-nuclear whorls (the nucleus and perhaps the first three being lost), and measures: Length 13.5 mm., diameter 3.7 mm.

This species is remarkable for being the largest known member of the section *Pyrgiscus* on the west coast of America.

Subgenus **MORMULA** A. Adams.

Mormula A. ADAMS, Journ. Linn. Soc. London, VII, 1864, p. 1; = *Pyrgostylus* MONTEROSATO, Il. Nat. Hist. Sicil., 1884, p. 90.

Turbonillas having vertical ribs and deeply incised spiral lines; also irregularly disposed varices on the outer surface, which usually mark internal lirations on the outer lip. Sculpture never nodulose.

Type.—*Mormula rissoina* A. Adams.

KEY TO SPECIES OF MORMULA.

- Adult shell more than 20 mm *lordi*.
 Adult shell less than 15 mm.
 Deeply incised lines on the whorl between the sutures: 5 *tridentata*.
 Deeply incised lines on the whorl between the sutures: 12 *eschscholtzi*.

TURBONILLA (MORMULA) LORDI E. A. Smith.

Plate XLV, figs. 7, 7a.

Chemnitzia lordi E. A. SMITH, Ann. Mag. Nat. Hist., VI, 1880, p. 288.

Shell very large, light brown to pale yellowish-white, variously banded. Nuclear whorls two, smooth, helicoid, moderately elevated, having their axis at right angles to the axis of the succeeding turns and about one-fourth immersed in the first of them. Postnuclear whorls well rounded, ornamented by heavy, broad, low axial ribs, of which about 14 occur upon the second, 16 upon the eighth, 22 upon

the eleventh, and 30 upon the penultimate whorl. Intercoastal spaces not deeply depressed, about as wide as the ribs, ornamented by about 12 to 15 irregularly spaced spiral striations between the sutures; those near the summit of the whorls are closer and more feeble than those near the periphery of the whorls. Sutures strongly impressed, somewhat wavy. Periphery of the last whorl somewhat angulated in young specimens, moderately well rounded in adults. Base rather short, marked by faint continuations of the axial ribs and faint wavy spiral striation. Aperture subrhombic, posterior angle obtuse, outer lip thin, showing the external sculpture and banding within; columella stout, slightly twisted and revolute, provided with an oblique internal fold. The color markings in the specimen here described and figured consist of a pale yellowish-brown band, about a quarter of the width of the whorl between the sutures, covering the posterior part, followed by a narrow band of the yellowish-white ground color, which is followed by a band of brown a little darker than the first and about as wide as the last-named white band; then a broad pale white band, lastly a narrow pale yellow one above the periphery finishes the marking between the sutures. The periphery is marked by a narrow band of white followed by a deep brown one which shades gradually to the white about the umbilical region.

The characters which ally this species to *Mormula* are only feebly developed, now and then two ribs become fused and suggest a varix; the internal lirations, too, are only very feebly expressed and appear in the aperture of only one specimen. The specimen figured has 14 post-nuclear whorls and measures: Length 20.8 mm., diameter 5.1 mm.; it was collected in 12 fathoms at Sitka Harbor, Alaska, and is Cat. No. 160492, U.S.N.M. No. 160069, U.S.N.M., contains 7 individuals from the same locality; No. 133234, U.S.N.M., has 2 from Port Orchard, Washington, and No. 4480, U.S.N.M., 1 from Puget Sound, Washington. Seven specimens were collected by Rev. G. W. Taylor at Banks Island, British Columbia. One of these, a young individual, Cat. No. 196234, U.S.N.M., has furnished the description of the nucleus. It has 9 post-nuclear whorls and measures: Length 5.2 mm., diameter 2.1 mm.

This is the largest species known from the west coast of America.

TURBONILLA (MORMULA) TRIDENTATA Carpenter.

Plate XLV, fig. 9.

Chemnitzia tridentata CARPENTER, Jour. de Conch., XIII (3d ser., V), 1865, p. 147.—
Turbonilla (Lancea) tridentata DALL and BARTSCH, Mem. Cala. Acad., III,
p. 273, 1903, pl. II, figs. 1, 1a.

Shell large, broad; chestnut colored, obscurely banded; nuclear whorls three, helicoid, about one-third immersed, scarcely extending beyond the margin of the spire, their axis being at a right angle to the

axis of the later whorls. Post-nuclear whorls slightly convex, somewhat contracted at the periphery and slightly shouldered at the summit; traversed by about 20 to 24 strong, well-rounded, somewhat oblique axial ribs, which continue faintly over the decidedly angular periphery of the last whorl and the base to the umbilical region; these ribs are considerably enfeebled on the last whorl of old shells and frequently become almost obsolete on these. The exposed portion of the whorls is traversed by five spiral grooves, which appear most prominently in the shallow and broad intercostal spaces, and less so on the ribs; these deep spiral lines are regularly spaced, leaving a broader interval on the middle of the exposed portion of the whorl; the base of the last whorl is likewise ornamented by spiral grooves, but here they appear less developed than on the spire. In addition to this the entire surface of the shell is marked by numerous very fine, somewhat wavy, spiral and axial striæ, which show most prominently on the last whorl and base, and give the shell a very minutely reticulated secondary sculpture. At irregular intervals the whorls are marked by thick callous varices, which are usually of a lighter color than the remainder of the shell. Aperture large, subquadrate; posterior angle acute; outer lip thin, having three strong internal lirations, joining the whitish, short, straight, revolute columella at a little less than a right angle. By transmitted light two spiral, light color-bands become apparent on the inside of the lip, each of which is bordered by a zone of a darker color than the remaining shell. The general color effect of the exterior is that of a flesh-colored shell, covered by a dark epidermis, which is stretched tight over the ribs, permitting the lighter color beneath to shine through it at their summits.

Doctor Carpenter's type (Cat. No. 15315*b*, U.S.N.M.) was collected at Monterey, California. It has 11 post-nuclear whorls and measures: Length 11.1 mm., diameter 3.2 mm. The specimen figured (Cat. No. 150983, U.S.N.M.) is from San Pedro, California. It has 13 post-nuclear whorls and measures: Length 12.8 mm., diameter 3.6 mm.

The U. S. National Museum has five lots of this species: Cat. No. 15315*b* is the type from Monterey, California; Cat. No. 196239, four specimens dredged by the Bureau of Fisheries steamer *Albatross* at station No. 2902, off Santa Rosa Island, in 53 fathoms, fine gray sand and mud, with a bottom temperature of 45°; Cat. No. 196240, ten specimens from San Pedro, collected by Mrs. T. S. Oldroyd; Cat. No. 150983, three individuals, one of which is figured, dredged by Mrs. Oldroyd in 4 fathoms, at San Pedro; Cat. No. 46505, two shells from San Diego in the Stearns collection. In addition to these, specimens have been determined for Mr. Berry, from Monterey, 12 to 39 fathoms; University of California, off Catalina Island; Mrs. Oldroyd and Mr. Lowe, at San Pedro; Mr. Kelsey and Mr. Arnold, from San Diego.

TURBONILLA (MORMULA) ESCHSCHOLTZI, new species.

Plate XLV, fig. 10.

Shell large, elongate-conic, brown, having three obscure bands of dark brown, one of which is at the summit, another at the periphery, while the third is halfway between these on the exposed portion of the whorl of the spire. Nuclear whorls decollated. Post-nuclear turns moderately rounded, ornamented by low, rounded, rather distantly spaced, slightly protractive axial ribs which become weakened and somewhat flattened as they approach the appressed summit, and many fine lines of growth both on the ribs and in the intercostal spaces. In addition to the axial sculpture the whorls are crossed by twelve deeply incised, somewhat irregularly spaced spiral lines, the raised spaces between which are again divided by many fine striæ. All the spiral markings pass over the intercostal spaces and the ribs. Periphery of the last whorl obscurely angular, marked by the feeble continuations of the ribs which vanish immediately below the periphery and the usual fine lines of growth and spiral striation. Base rather short, well rounded, brown, with a narrow whitish band about the umbilicus, marked by closely spaced continuous wavy spiral striation, which varies in strength, several finer striæ alternating with the stronger. Aperture subquadrate, outer lip thin, showing four narrow dark-brown bands within, upon a lighter background—these are the three already referred to—and a fourth one on the base adjoining the periphery: columella almost vertical, slightly twisted and revolute.

The type (Cat. No. 196241, U.S.N.M.) was collected by Rev. G. W. Taylor, at Carter Bay, British Columbia; it has 11 post-nuclear whorls (the nucleus and probably three of the post-nuclear whorls being lost), and measures: Length 13.3 mm., diameter 4 mm. Another specimen from the same locality is in the Taylor collection. Three additional lots were collected by him in British Columbia; one, a fragment, from west of Rose Spit, Queen Charlotte Islands; 6 at Departure Bay, one of which is Cat. No. 196242, U.S.N.M.; 15 at Port Simpson, 5 of which are Cat. No. 196243, U.S.N.M. No. 196242 is the largest specimen, it has 12½ whorls, having lost the nucleus and probably the first three of the succeeding turns and measures: Length 17.8 mm., diameter 4.5 mm.

Genus ODOSTOMIA Fleming.

Odostomia FLEMING, Edinburgh Encyc., VII, 1813, Pt. 1, p. 76—*Odontostomia* JEFFREYS, Mal. and Conch. Mag., 1839, p. 33.—*Turritostomia* SACCO, Moll. del Piemonte e del Liguria, 1892, p. 41.

Shell with sinistral apex, usually short, few whorled, subconic or ovate, with a single columellar fold which varies in strength and sometimes is not apparent at the aperture.

Type.—*Turbo plicatus* Montagu.

The following 6 of the 41 subgenera and sections of *Odostomia* are represented in the present faunal area: *Chrysallida*, *Ividia*, *Iolaea*, *Menestho*, *Evalea*, and *Amaura*.

KEY TO SUBGENERA OF ODOSTOMIA.

- Sculpture nodulose.....*Chrysallida*, p. 514.
 Sculpture consisting of axial and spiral lamellæ.....*Ividia*, p. 517.
 Sculpture consisting of spiral lirations and slender axial threads in the depressed spaces:
 Shell umbilicated.....*Iolaea*, p. 518.
 Shell not umbilicated.....*Menestho*, p. 520.
 Sculpture consisting of spiral striation only:
 Shell very large.....*Amaura*, p. 528.
 Shell small.....*Evalea*, p. 522.

Subgenus **CHRYSTALLIDA** Carpenter.

Chrysallida CARPENTER, Cat. Maz. Shells, 1857, p. 416.—*Noemia* DE FOLIN, Fonds de la Mer, 1873, p. 314, not *Noemia* PASCO, 1857.—*Noemiamca* DE FOLIN, Zool. Rec., 1885, p. 94 (Mollusca).

Odostomias having strong axial ribs crossed by equally strong spiral keels between the sutures, the intersection of these two elements forming nodules. The axial ribs pass only faintly over the base, while the spiral sculpture remains quite prominent.

Type.—*Chrysallida communis* Carpenter.

KEY TO SPECIES OF CHRYSTALLIDA.

- Spiral keels between the sutures 4.
 Sutures deeply channelled.
 Base with 7 narrow and slender spiral keels.....*astriata*.
 Base with 8 broad and rounded spiral keels.....*cooperi*.
 Sutures not channelled.....*montereyensis*.
 Spiral keels between the sutures on the last whorl more than 5.....*oregonensis*.

ODOSTOMIA (CHRYSTALLIDA) COOPERI, new species.

Plate XLVI, fig. 7.

Shell broadly conic, white. Nuclear whorls smooth, largely obliquely immersed in the first of the succeeding turns above which only about half of the last turn projects. Postnuclear whorl moderately rounded, slopingly shouldered at the summit, the shoulder bearing the first of the four stronger tuberculate spiral ridges. The connections which join the tubercles in the spiral series are a little more strongly developed than those which link them vertically, the spaces inclosed between them being deep squarish pits. The tubercles are very prominent and rounded, there are about 16 upon the second, 20 upon the third, and 26 upon the penultimate turn. The axial series slants retractively from the posterior suture. Sutures deep and broad, considerably wider than the spaces between the keels. Periphery of the last whorl deeply channelled, the channel marked by a

weak extension of the axial bars which terminate at the first supra-peripheral keel. Base prolonged, well-rounded, marked by seven strong moderately raised, spiral keels which, like the channels that separate them, diminish regularly in width from the periphery to the umbilical area; the last, the eighth, immediately behind the columella, being less distinct and considerably broader than the rest. The channels between the keels are about equal to the keels in width and are crossed by numerous very slender raised threads, which extend up on the sides of the keels but do not cross them. About five of these threads fall in the space between two tubercles on the spire, in the first supra-peripheral groove. Aperture oval, large, effuse anteriorly, posterior angle obtuse, outer lip rather thick, not showing the external sculpture within; columella somewhat twisted, revolute anteriorly, reenforced by the attenuated base, and provided with a weak fold at its insertion; parietal wall covered by a callus which joins the columella with the posterior angle of the aperture and renders the peristome almost complete.

The type (Cat. No. 162771, U.S.N.M.) was collected by Doctor Dall at Monterey, California. It has five postnuclear whorls and measures: Length, 3.1 mm.; diameter, 1.4 mm.

ODOSTOMIA (CHRYSTALLIDA) ASTRICTA, new species.

Plate XLVI, fig. 1.

Shell elongate-conic, bluish-white. Nuclear whorls decollated. Post-nuclear whorls very slightly rounded, separated by deeply channelled sutures. In this species the vertical ribs exceed the four spiral keels in strength, their junction forming elongated tubercles the long axis of which coincides with the spiral keels. The vertical ribs, of which there are 16 upon all of the turns, slant decidedly backward toward the aperture. They are rather distantly spaced and the spaces inclosed between them and the spiral keels are deep oblong pits, the long axis of which coincides with the spiral sculpture. Periphery of the last whorl marked by a deep, wide channel across which the ribs extend feebly to the first subperipheral keel. Base rather long and well rounded, marked by seven rather narrow, slender spiral keels which successively decrease in strength from the periphery to the umbilical area, the anterior ones being only faintly indicated; the spaces which separate the keels are about twice as wide as the keels and are crossed by many very slender raised vertical threads. Aperture oval, outer lip rather thick, columella twisted, reenforced by the attenuated base and provided with a moderately strong fold at its insertion; parietal wall covered by a strong callus.

The type (Cat. No. 196280, U.S.N.M.) was collected by Mr. F. L. Button at Monterey, California; it has the 6 last whorls remaining, having lost the nucleus and probably the first post-nuclear turn, and measures: Length, 2.9 mm.; diameter, 1.2 mm.

ODOSTOMIA (CHRYSTALLIDA) MONTEREYENSIS, new species.

Plate XLVI, fig. 4.

Shell broadly conic, milk-white to subdiaphanous. Nuclear whorls smooth, largely immersed in the first of the succeeding turns, above which only half of the last whorl projects. Postnuclear whorls separated by broad, deep sutures; well rounded between the sutures where they are ornamented by four strongly tuberculate spiral ridges, the spiral connections between the tubercles are equal to the axial connections or ribs, of which 16 appear upon the second, 18 upon the thirtieth, and 20 upon the penultimate whorl. The spaces inclosed between the axial ribs and the spiral connections which join the rounded tubercles are deep squarish pits. The axial ribs extend strongly across the deep peripheral channel and stop at the first subperipheral keel. Base moderately long, well rounded, marked by 5 equal and subequally spaced, well raised, strong, spiral keels, and a sixth, much broader, low, and rounded at the columellar margin. The grooves between the keels are equal to the width of the keels near the periphery, but diminish in breadth successively from the periphery to the umbilical area. They are crossed by numerous slender raised axial threads, which extend up on the sides of the spiral keels, but do not cross them. There are about 5 of these threads between each two ribs in the first subperipheral channel; aperture oval, somewhat effuse anteriorly; posterior angle acute; columella reenforced by the attenuated base, against which it appears like a thickened callus, provided with a moderately strong oblique fold at its insertion; parietal wall covered by a thick callus, which joins the columella with the posterior angle of the aperture.

The type (Cat. No. 196281, U.S.N.M.) has 5 postnuclear whorls and measures: Length, 3.0 mm.; diameter, 1.3 mm. It was collected by Mr. S. S. Berry, in 12 fathoms, off Del Monte, Monterey Bay, California. Three specimens from the same station are in Mr. Berry's collection. Another specimen (Cat. No. 74003, U.S.N.M.) was collected by Doctor Canfield at Monterey, and a sixth (Cat. No. 196282, U.S.N.M.) by Mr. F. L. Button at the same place. A seventh (Cat. No. 162767, U.S.N.M.) was collected by Mrs. T. S. Oldroyd at San Luis Obispo, California.

ODOSTOMIA (CHRYSTALLIDA) OREGONENSIS, new species.

Plate XLVI, figs. 10, 10a.

Shell elongate-conic, slender, subdiaphanous to milk-white. Nuclear whorls immersed, the last one only being visible. This is somewhat tilted and marked by three strong narrow spiral keels and many slender raised axial threads which cross the grooves between

the keels. Postnuclear whorls well rounded, slopingly shouldered at the summit and separated by constricted sutures, ornamented by almost equal and equally spaced spiral keels and axial ribs between the sutures on the spire. There are 4 spiral keels on the first, second, and third whorls, 6 on the fourth, and 7 upon the penultimate whorl. The first of these keels is on the shoulder of the whorl near the summit and is somewhat less developed than the rest. The axial ribs are best developed on the early whorls, where they extend equally strong from the summit to the periphery; on the antepenultimate and penultimate turns they become somewhat enfeebled from the middle of the whorl between the sutures to the periphery. There are about 16 of these ribs on the first, 18 on the third, 20 upon the fourth, and 22 upon the penultimate turn. The intersections of the ribs and spiral keels form low elongated tubercles, the long axis of which coincides with the spiral sculpture. The meshes inclosed by the keels and ribs are deeply impressed squarish pits. Periphery and base of the last whorl well rounded, the latter somewhat inflated and marked by 6 spiral cords which are successively closer spaced and a little less strongly developed from the periphery to the umbilical area. The channels between the cords are crossed by many very slender raised vertical threads. Aperture oval, slightly effuse anteriorly; outer lip thin; columella reenforced on its posterior two-thirds by the attenuated base, free and somewhat revolute anteriorly; parietal wall glazed by a thin callus.

The type has 6 postnuclear whorls and measures: Length 3.3 mm., diameter 1.2 mm. It and 9 additional specimens are Cat. No. 107690, U.S.N.M., and were collected by Dr. C. F. Newcombe at Cumshewa Inlet, Queen Charlotte Island, British Columbia, in 10 fathoms. Two other lots of one specimen each come from Monterey, Cat. No. 73998, U.S.N.M., in the Stearns collection, and Cat. No. 196283, U.S.N.M., collected by Mr. F. L. Button.

Subgenus IVIDIA Dall and Bartsch.

Ividia DALL and BARTSCH, Proc. Biol. Soc., Washington, 1904, XVII, p. 11.

Shell sculptured with lamellose axial ribs and spiral keels, their intersections not nodulose.

Type.—*Parthenia armata* Carpenter.

ODOSTOMIA (IVIDIA) NAVISA, new species.

Plate XLVI, figs. 2, 2a.

Shell of medium size, strongly sculptured, subdiaphanous to milk-white. Nuclear whorls at least 2, obliquely a little more than half immersed. Postnuclear whorls strongly shouldered, subtabulated, with a strong broad spiral keel limiting the anterior edge of the shoul-

der and an acute raised keel on the middle of the whorls between the sutures, while a third equally acute keel marks the periphery of the last whorl. Two other keels ornament the base, the anterior one of which is not quite as strong as its neighbor. The axial sculpture consists of narrow, more or less lamellar, almost vertical ribs, which render the intersection with the spiral keels somewhat thickened but not nodulose. These axial ribs extend over the periphery and base of the last whorl to the umbilical region, gradually growing weaker as they approach this point. There are about 18 on the second and 20 upon the penultimate whorl. The spaces between the ribs and keels appear as concave quadrangular depressions. Umbilicus narrowly perforated. Suture deeply channeled by the shouldered whorl. Aperture suboval, posterior angle decidedly obtuse; outer lip thick, marked by 5 projections, corresponding to the 5 keels; columella almost straight, strongly revolute with a conspicuous oblique fold near its insertion; parietal wall covered by a faint callus showing both basal keels, the anterior faint and just posterior to the insertion of the columella and the next on the middle of the wall.

The type has 5 postnuclear whorls and measures: Length 2.7 mm., diameter 1.3 mm. It and 3 additional specimens (Cat. No. 106502, U.S.N.M.) were collected by Mr. Henry Hemphill at Scammons Lagoon, Lower California. Three additional lots are in the U. S. National Museum collection: Cat. No. 129336, 30 specimens collected by Mrs. T. S. Oldroyd in the drift at San Pedro; Cat. No. 162843, 3 specimens also from San Pedro by the same donor; Cat. No. 62844, 1 specimen collected by Mr. Henry Hemphill at Ocean Beach, San Diego, California.

ODOSTOMIA (IVIDIA) NAVISA DELMONTENSIS, new subspecies.

Plate XLVI, figs. 3, 3a.

Shell similar to *O. (I.) navisa* but more elongate, and in every way more delicate with the lamellose sculpture reduced almost to raised cords and with stronger shouldered summits and more open umbilicus.

The type (Cat. No. 196297, U.S.N.M.) was collected by Mr. S. S. Berry in 12 fathoms, off Del Monte, Monterey Bay, California. It has 5 postnuclear whorls and measures: Length 3.2 mm., diameter 1.3 mm.

Subgenus IOLAEA A. Adams.

Iolaea A. ADAMS, Proc. Zool. Soc., 1867, p. 310.—*Iole* A. ADAMS, Ann. Mag. Nat. Hist., 3d ser., V, 1860, p. 300, not *Iole* BLYTH, Journ. Asiat. Soc. Beng., XIII, Pt. 1, 1844, p. 386.

Shell umbilicated, marked by spiral cords, and axial riblets which cross the grooves between them.

Type.—*Iole scitula* A. Adams.

ODOSTOMIA (IOLAEA) AMIANTA, new species.

Plate XLVI, figs. 9, 9a.

Shell broadly conic, yellowish-white. Nucleus small, of two whorls which increase extremely rapidly in size and are obliquely placed. Postnuclear whorls very strongly shouldered, marked by 3 very strong lamellar spiral keels on the first and second and 4 on the succeeding whorls between the sutures. The posterior keel marks the limit of the broad, sloping shoulder and is much the strongest. It is also placed a little farther apart from the next spiral keel than that is from its anterior neighbor. Base of the last whorl well rounded; ornamented by 8 spiral ridges, which are less elevated and much more closely and regularly spaced than those between the sutures. The peripheral groove is about equal in width to the one anterior to the posterior keel. The entire shell is marked by fine, sublamellar, regularly spaced, retractive axial ribs, which render the spiral keels somewhat crenulated at their meeting points and break the spaces between them into small squares or oblongs. These riblets extend from the sutures to the small umbilicus. Aperture subovate, posterior angle obtuse; outer lip thin, somewhat wavy, showing the external sculpture within; columella moderately stout, somewhat curved and strongly revolute, having an oblique fold near its insertion which is barely visible when the aperture is viewed squarely; parietal wall covered by a fairly thick callus.

The type and another specimen (Cat. No. 105483, U.S.N.M.) were collected at Point Abrejos, Lower California, by Mr. Henry Hemphill. It has 6 post-nuclear whorls and measures: Length 4.4 mm., diameter 2.3 mm.

Specimens of Odostomia (Iolaea) amianta Dall and Bartsch.

No. of specimens.	Locality.	Collector.	Catalogue No.
1	Monterey Bay	Rev. G. W. Taylor.....	No. 37253 U.S.N.M.
6	Monterey, off Del Monte (12 fathoms).	S. S. Berry.....	S. S. Berry's collection.
1	do	W. H. Dall.....	No. 168683 U.S.N.M.
1	San Pedro	Mrs. T. S. Oldroyd.....	No. 168684 U.S.N.M.
1	San Pedro, Long Beach	H. N. Lowe.....	No. 196298 U.S.N.M.
1	San Pedro, station 83.....	University of California.....	University of California collection.
1	Off Catalina Island, station 28.	do	Do.
6	Off Catalina Island, station 30.	do	Do.
11	San Diego, station 47.....	do	Do.
2	do	F. W. Kelsey.....	No. 160115 U.S.N.M.
1	do	Henry Hemphill	No. 105469 U.S.N.M.
1	Off Coronado Island, 20 fathoms; bottom temperature 55°.	U. S. F. C. station (2932).....	No. 168685 U.S.N.M.
2	Point Abrejos, Lower Cal ...	Henry Hemphill	No. 105483 U.S.N.M. (1=type).

Subgenus **MENESTHO** Möller.*Menestho* MÖLLER, Ind. Moll. Greenl., 1842, p. 10.

Shell not umbilicated, marked by moderately well-developed and usually equally spaced spiral cords; axial sculpture reduced to mere lines of growth which frequently appear as *very slender* raised threads in the grooves between the cords.

Type.—*Turbo albulus* Fabricius.

KEY TO SPECIES OF MENESTHO.

Spiral sculpture very regular and equally spaced.

Shell large, adult over 3.5 mm. in length *exara*.

Shell very small, adult under 2.5 mm. in length *pharcida*.

Spiral sculpture irregular, not equally spaced *harfordensis*.

ODOSTOMIA (MENESTHO) PHARCIDA, new name.

Plate XLVI, fig. 8.

Mumiola tenuis DALL, Bull. Nat. Soc. Brit. Col., 1897, p. 14, pl. I, fig. 10. *Not*
Odostomia tenuis CARPENTER, 1856; *not Odostomia tenuis* JEFFREY, 1884.

Shell small, subcylindric, yellowish-white. Nuclear whorls deeply immersed, a portion of the last and the penultimate only appear when viewed from the side; this gives the shell a truncated appearance. Post-nuclear whorls moderately well-rounded, rather wide between the sutures, and somewhat shouldered at the summits; ornamented by strong, low, rounded spiral cords, which are separated by moderately deep, narrow, depressed channels. Six of these cords occur upon the first, 7 upon the second to the penultimate whorl between the sutures; the posterior cord is a little broader and less elevated than the rest, while some of those on the penultimate turn show a tendency to divide, that is, a faint spiral line is apparent on the middle of some of these cords. Sutures well impressed. Periphery and base of the last whorl well rounded, the latter ornamented by 8 rounded spiral cords similar to those between the sutures. The spaces between the spiral ridges on the base and between the sutures are marked by closely placed, exceedingly slender, raised axial threads. Aperture pyriform, somewhat effuse anteriorly, posterior angle acute; columella short, curved, reenforced by the attenuated base, free only at its extreme anterior end, with an oblique fold near its insertion; parietal wall covered by a thin callus.

The type (Cat. No. 107440, U.S.N.M.) was dredged by Dr. C. F. Newcombe, in 10–15 fathoms, at Cumshewa Inlet, Queen Charlotte Island, British Columbia. It has 4 postnuclear whorls, which measure: Length 2.2 mm., diameter 0.9 mm.

ODOSTOMIA (MENESTHO) HARFORDENSIS, new species.

Plate XLVI, fig. 5.

Shellelongate-ovate, bluish-white. Nuclear whorls smooth, obliquely immersed in the first of the succeeding turns, only two-thirds of the last volution projects above them. Post-nuclear whorls well rounded, and somewhat inflated, marked by numerous incremental lines and 5 equally strong, but irregularly distributed, punctate, incised, spiral lines between the sutures. The two near the summit are placed closer to each other than any of the others, the space between the summits and the second line being about equal to the space inclosed between the first and second supra-peripheral lines. The third line falls on about the middle of the exposed portion of the whorls and is a little nearer to the second line than the one anterior to it. In addition to these 5 strongly incised lines there are numerous very fine and closely spaced spiral striæ which cross all parts of the surface of the shell. Periphery and base of the last turn inflated, the latter marked by lines of growth and 8 strongly incised, punctate spiral lines, which are a little less strongly impressed and a little more closely spaced at the umbilical area than at the peripheral part of the base. These lines equal those of the spire in strength. Sutures constricted. Aperture very large, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella curved, reinforced by the attenuated base and provided with a strong fold and its insertion; parietal wall covered by a thin callus.

The type (Cat. No. 196299, U.S.N.M.) was collected by Mrs. Merrihew, at Port Harford, California. It has 5 post-nuclear whorls and measures: Length 3.2 mm., diameter 1.8 mm.

ODOSTOMIA (MENESTHO) EXARA, new species.

Plate XLVI, fig. 6.

Shell elongate-ovate, subdiaphanous. Nuclear whorls smooth, deeply immersed in the first of the succeeding turns, only a part of the last one appearing above it. Post-nuclear whorls somewhat inflated, well rounded, marked on the first whorl by 8, on the second by 12, on the third by 14, and on the penultimate between the sutures by 20 subequal and equally spaced, low, depressed spiral cords which are separated by narrower channels. Periphery and base of the last whorl inflated, sculptured like the spire by probably 20 spiral cords. In addition to the spiral sculpture the entire surface is marked by fine incremental lines which are best marked in the spaces between the cords. Aperture oval, somewhat effuse anteriorly; posterior angle acute; outer lip thin, showing the external sculpture within; columella

decidedly curved, reenforced by the attenuated base, free only at its anterior extremity, where it is somewhat revolute, provided with a prominent fold at its insertion which appears as the thickened inflection of the columella; parietal wall covered by a thin callus

The type (Cat. No. 196250, U.S.N.M.) comes from Pacific Grove, Monterey, California. It has 5 post-nuclear whorls and measures: Length 3.9 mm., diameter 2.1 mm.

Subgenus *EVALEA* A. Adams.

Evalea A. ADAMS, Ann. Mag. Nat. Hist., VI, 1860, p. 22; + *Ondina* DE FOLIN, Fonds de la Mer, 1870, p. 214; + *Auriculina* GRAY, Proc. Zool. Soc., 1847, p. 159; + *Ptychostomon* LOCARD, Prod. de les Moll. de France, 1886, p. 228.

Odostomias having the surface marked by fine incised spiral lines.
Type.—*Evalea elegans* A. Adams.

KEY TO SPECIES OF *EVALEA*.

- Shell umbilicated *tillamookensis*.
- Shell not umbilicated.
 - Periphery of the last whorl decidedly angulated *angularis*.
 - Periphery of the last whorl subangulated.
 - Spiral sculpture uniform *jewetti*.
 - Spiral sculpture consisting of weak and strong lirations *inflata*.
 - Periphery of the last whorl well rounded.
 - Shell elongate-conic.
 - Adult shell more than 8 mm. long *columbiana*.
 - Adult shell less than 5 mm. long *deliciosa*.
 - Shell ovate.
 - Spiral sculpture uniform over the entire surface.
 - Diameter of adult shell 2.5 mm *tacomaensis*.
 - Diameter of adult shell 1.3 mm *valdezi*.
 - Spiral sculpture strongly developed on the early whorls, obsolete on the last.
 - Shell white, porcellaneous *phanea*.
 - Shell straw-colored *tenuisculpta*.

ODOSTOMIA (EVALEA) TILLAMOOKENSIS, new species.

Plate XLVII, fig. 1.

Shell elongate-conic, thin, yellowish-white. Nuclear whorls sur rounded by the first of the succeeding turns and so immersed as to give the apex a broadly truncated appearance. Post-nuclear whorls inflated, evenly strongly rounded, very slightly shouldered at the summit, separated by well-marked sutures. Periphery and base of the last whorl well rounded, the latter inflated, narrowly openly umbilicated. Entire surface marked by numerous fine, wavy, subequal, weakly incised spiral lines, of which about 35 occur between the summit and the periphery of the last whorl and about an equal number on the base. Aperture oval; outer lip thin; columella slender, evenly gently curved, and slightly revolute, free, not reen-

forced at the base, provided with a slender fold at its insertion, which is not visible when the aperture is viewed squarely.

The type (Cat. No. 196244, U.S.N.M.) has four post-nuclear whorls, and measures: Length 4.1 mm., diameter 2.2 mm. It was dredged by the U. S. Fisheries steamer *Albatross*, at Station No. 3346, off Tillamook, Oregon, in 786 fathoms, green mud, bottom temperature 37°.3.

ODOSTOMIA (EVALEA) ANGULARIS, new species.

Plate XLVII, fig. 2.

Shell very regularly elongate-conic, subdiaphanous to milk-white. Nuclear whorls small, deeply obliquely immersed in the first of the succeeding turns above which the tilted edge of the last turn only is visible. Post-nuclear whorls slightly rounded, separated by constricted sutures, marked by numerous slender, wavy, subequal and subequally closely spaced spiral striations, of which about 33 occur upon the last turn between the summit and the periphery. Periphery of the last whorl marked by a slender raised keel, decidedly angulated. Base short, moderately rounded, narrowly attenuated anteriorly to reinforce the columella, sculptured like the posterior portion of the whorls. Aperture ovate, very broad, slightly effuse anteriorly; posterior angle acute; columella very slender, evenly curved, closely appressed to the attenuated base, with a strong fold at its insertion which is barely visible when the aperture is viewed squarely.

The type has 7 post-nuclear whorls and measures: Length 5.6 mm., diameter 2.8 mm. It and four additional specimens (Cat. No. 150565, U.S.N.M.) were collected by Rev. G. W. Taylor at Nanaimo, British Columbia.

Five other lots are in the collection of the U. S. National Museum; Cat. No. 159474, one, collected by Doctor Dall at Sitka Harbor, Alaska; Cat. No. 126664, three specimens collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia; Cat. No. 43384, one specimen from Puget Sound; Cat. No. 161624, four from Port Harford, California, collected by Mrs. Merrihew; Cat. No. 196300, one, dredged by the Bureau of Fisheries steamer *Albatross* at Station No. 3194, off the California coast, in 92 fathoms, gray sand, bottom temperature 45°.9; 18 specimens were determined for Mr. S. S. Berry from 12 fathoms off Del Monte, Monterey Bay, California.

ODOSTOMIA (EVALEA) JEWETTI, new species.

Plate XLVII, fig. 3.

Odostomia inflata CARPENTER, part, Ann. Mag. Nat. Hist., XV, 1865, p. 394.

Shell elongate-ovate, white. Nuclear whorls very small, smooth, obliquely immersed in the first of the succeeding turns, above which only the last one is visible. Post-nuclear whorls well rounded, a little

more abruptly so on the posterior third between the sutures. Summit very narrowly flattened which renders the sutures well marked. Periphery of the last whorl slightly angulated. Base slightly contracted, moderately rounded between the periphery and umbilical area, narrowly produced to reinforce the columella. Entire surface marked by numerous somewhat wavy, subequal and subequally spaced minute slender spiral lirations, of which there are about 35 between the summit and the periphery and an equal number between the periphery and the base on the last turn. Aperture large, patulous anteriorly; posterior angle acute, outer lip thin at the edge, thick within; columella curved, somewhat reflected, reinforced by the attenuated base, and provided with a strong oblique fold at its insertion.

The two cotypes (Cat. No. 15521*c*, U.S.N.M.) were collected by Colonel Jewett at Santa Barbara, California. One is a young specimen consisting of the nucleus and three post-nuclear whorls; the other has lost the nucleus and probably the first two post-nuclear turns; the five which remain measure: Length 6.1 mm., diameter 3.3 mm.

ODOSTOMIA (EVALEA) INFLATA Carpenter.

Plate XLVII, fig. 8.

Shell ovate, white. Nuclear whorls decollated. Post-nuclear whorls inflated, gently curved over the anterior two-thirds of the whorl between the sutures and more strongly so on the posterior third, this portion forming an evenly curved shoulder. Extreme summit of the whorl slightly flattened and narrow, rendering the sutures well marked. Periphery of the last whorl subangulated. Base attenuated, rather suddenly contracted below the periphery, which gives the space between the periphery and the umbilical area a concave aspect. Entire surface marked by fine lines of growth and many fine, closely placed spiral lirations, five of which are a little stronger than the rest and divide the space between the sutures into subequal areas. There are about 30 of these threads upon the last turn between the summit and the periphery and about 60 on the base. Aperture very large, patulous anteriorly; outer lip thin at the edge but very thick within; columella decidedly curved, and revolute, reinforced to the very edge by the attenuated base, provided with a strong oblique fold at its insertion.

The type and a young individual (Cat. No. 15521*b*) were collected by J. G. Swan at Neah Bay, Washington. It has the last four whorls (the nucleus and probably the first post-nuclear turn being lost) and measures: Length 6.2 mm., diameter 3.8 mm.

ODOSTOMIA (EVALEA) COLUMBIANA, new species.

Plate XLVII, fig. 9.

Shell large, elongate-conic, white. Nuclear whorls small, vitreous, planorboid, deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last volution is visible. Post-nuclear whorls increasing regularly in size, well rounded, very narrowly roundly shouldered at the summits, which renders the sutures well marked. Periphery of the last whorl somewhat inflated. Base well rounded, attenuated anteriorly to reenforce the columella. Entire surface covered by numerous somewhat wavy, subequal and subequally closely placed spiral lirations, of which about 40 occur between the summit and the periphery and about an equal number on the base of the last whorl. Aperture large, decidedly patulous anteriorly; posterior angle acute; outer lip thin at the edge, very thick within; columella curved and strongly reflected, free only at its anterior extremity, provided with a strong oblique fold at its insertion.

The type and 5 specimens (Cat. No. 126658, U.S.N.M.) were collected by Dr. C. F. Newcombe at Victoria, Vancouver Island, British Columbia. It has 6 post-nuclear whorls and measures: Length 8.3 mm., diameter 4.2 mm. Three other specimens (Cat. No. 196245, U.S.N.M.) were dredged by the Bureau of Fisheries steamer *Albatross* at Station No. 4213, off Port Townsend, Washington, in 23 to 25 fathoms, gray sand and broken shell, bottom temperature 51°. Another (Cat. No. 196246, U.S.N.M.) at Station No. 4203, at Fort Rupert, Vancouver Island, British Columbia, in 25 to 30 fathoms, volcanic sand and gravel and broken shell and sponge, bottom temperature 49.1°.

ODOSTOMIA (EVALEA) DELICIOSA, new species.

Plate XLVII, fig. 5.

Shell small, elongate-conic, translucent to milk-white. Nuclear whorls small, deeply immersed in the first of the succeeding turns above which only a portion of the last turn is visible. Post-nuclear whorls moderately rounded, very weakly roundly shouldered at the summit, separated by strongly marked sutures; a narrow band appears about the summit showing its junction with the preceding turn. Periphery and base of the last whorl inflated and well rounded. Entire surface of base and spire marked by very fine lines of growth and numerous microscopic wavy spiral striations. Aperture rather large, somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella rather stout, strongly curved, and revolute, reenforced by the attenuated base, and covered with a strong fold at its insertion. This fold can be seen through the transparent shell as a quite strong lamella on the pillar of the turns.

The type (Cat. No. 46492, U.S.N.M.) is from Monterey, has $6\frac{1}{2}$ post-nuclear whorls and measures, length 4 mm., diameter 1.9 mm. Another specimen (Cat. No. 196301, U.S.N.M.) also comes from Monterey, California.

ODOSTOMIA (EVALEA) TACOMAENSIS, new species.

Plate XLVII, fig. 10.

Shell ovate, yellowish. Nuclear whorls small, deeply immersed in the first of the succeeding turns. Post-nuclear whorls well rounded, faintly roundly shouldered at the extreme summits. Periphery of the last whorl rounded. Base inflated, well rounded, somewhat attenuated anteriorly. Surface covered by numerous equal and equally closely spaced slender wavy spiral striations of which there are about 40 between the summit and the periphery of the last whorl. Base marked like the space posterior to it. In addition to the spiral sculpture the entire surface of the shell is crossed by numerous fine lines of growth. Aperture moderately large, oval, well rounded anteriorly; posterior angle acute; outer lip thin; columella curved, slightly reflected, reenforced, except at its extreme anterior end, by the attenuated base and provided with a strongly oblique fold at its insertion.

The type (Cat. No. 159267, U.S.N.M.) has 5 post-nuclear whorls, and measures: length 4.3 mm., diameter 2.5 mm. It was collected by Mr. Fisher at Tacoma, Washington.

ODOSTOMIA (EVALEA) VALDEZI, new species.

Plate XLVIII, fig. 2.

Shell small, thin, very elongate-oval, subdiaphanous to milk-white, having the entire surface marked by rather strong lines of growth and numerous microscopic spiral striations. Nuclear whorls deeply obliquely immersed in the first of the succeeding turns, above which only the tilted edge of the last turn is visible. Post-nuclear turns rather high between the sutures, well rounded, with narrowly roundly shouldered summits. Periphery and base of the last turn inflated and well rounded, the latter with a very narrow umbilical chink. Aperture moderately large, oval; posterior angle acute; columella strongly curved, reenforced by the attenuated base and provided with a moderately strong fold opposite the umbilical chink.

The type has 5 post-nuclear whorls, and measures: length 3 mm., diameter 1.3 mm. It and another specimen (Cat. No. 196249, U.S.N.M.) were collected by Mr. S. S. Berry in 12 fathoms, off Del Monte, Monterey, California. Two additional specimens from the same station are in Mr. Berry's collection.

ODOSTOMIA (EVALEA) TENUISCUPTA Carpenter.

Plate XLVII, fig. 6.

Odostomia tenuisculpta CARPENTER, 2nd Rept. Brit. Assoc. Adv. Sci., 1864, p. 659; Ann. Mag. Nat. Hist., XV, 1865, p. 30.

Shell elongate-ovate, yellowish, with the early whorls spirally lirate and the later ones only obsoletely so. Nuclear whorls small, smooth, obliquely almost completely immersed in the first of the succeeding turns. Post-nuclear whorls evenly well-rounded with appressed summits. The first three marked between the sutures by many subequal liræ of which there are about 15 on the second turn. On the last two turns these lirations become quite obsolete. Periphery and base of the last whorl inflated and well-rounded, marked by very feeble spiral striation and lines of growth. Aperture moderately large, oval; somewhat effuse anteriorly; posterior angle acute; outer lip thin; columella strongly curved, reenforced partly by the attenuated base, moderately reflected anteriorly bearing a strong fold at its insertion which appears as if it were the inflected termination of the columella.

Doctor Carpenter's type (Cat. No. 15520, U.S.N.M.) is a young individual. It was collected by J. G. Swan at Neah Bay, Washington, has 3 post-nuclear whorls, and measures: length 2.3 mm., diameter 1.7 mm. The adult characters were described from two specimens (Cat. No. 46483, U.S.N.M.), collected by J. G. Swan at Neah Bay, Washington. One of these, the one figured, has 6 post-nuclear whorls and measures: length 5.3 mm., diameter 2.9 mm. A specimen collected by Merrihew (Cat. No. 196247, U.S.N.M.), at Port Harford, California, bears a slender raised cord on the periphery of the whorl.

The large series of specimens in the U. S. National Museum proves conclusively that *O. straminea* Carpenter is the smooth southern representative of the species.

The U. S. National Museum has the following material:

Specimens of Odostomia (Evalea) tenuisculpta Carpenter.

No. of specimens.	Locality.	Collector.	Catalogue No.
1	Neah Bay, Washington.....	J. G. Swan.....	15520 U.S.N.M.
2	.....do.....	.....do.....	46483 U.S.N.M.
75	Little River, Mendocino County, California.....	G. W. Harford.....	46486 U.S.N.M.
6	Gualala, Mendocino County, California.....	Stearns collection.....	101945 U.S.N.M.
2	San Francisco Bay, California.....	Doctor Hewston.....	74006 U.S.N.M.
30	Monterey, California.....	Stearns collection.....	46482 U.S.N.M.
30	.....do.....	.....do.....	46485 U.S.N.M.
30	.....do.....	.....do.....	46493 U.S.N.M.
21	.....do.....	.....do.....	46489 U.S.N.M.
2	.....do.....	.....do.....	46491 U.S.N.M.
4	.....do.....	P. P. Carpenter.....	46476 U.S.N.M.
1	.....do.....	W. H. Dall.....	159475 U.S.N.M.
17	.....do.....	.....do.....	159477 U.S.N.M.
5	.....do.....	.....do.....	159478 U.S.N.M.
13	.....do.....	.....do.....	159479 U.S.N.M.
1	.....do.....	.....do.....	159480 U.S.N.M.

ODOSTOMIA (EVALEA) PHANEA, new species.

Plate XLVIII, fig. 7.

Odostomia (Evalea) gouldi DALL and BARTSCH, Mem. Cala. Acad., 1903, p. 282, pl. 1, fig. 15, not *Odostomia* (? var.) *gouldii* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 30 (= *Odostomia (Amaura) gouldi* CARPENTER, of the present paper).

Shell elongate-ovate, subdiaphanous to milk-white, stout and shining. Nuclear whorls small, deeply immersed in the first of the succeeding turns. Post-nuclear whorls rather high between the sutures, well rounded with scarcely an indication of a shoulder at the summit, separated by well-marked sutures. Periphery and the rather long base of the last whorl well rounded. The first two whorls are regularly closely spirally striated, in the third the striation becomes enfeebled and on the penultimate decidedly obsolete, while the base is smooth. About 18 of the striae are visible on the third turn. Aperture large, oval, somewhat effuse anteriorly; columella decidedly curved and reflected, reenforced by the attenuated base, provided with a strong oblique fold at its insertion.

The type has 5 post-nuclear whorls and measures: Length 4.8; diameter 2.6 mm. It and another specimen (Cat. No. 46408, U.S.N.M.) belong to the Stearns collection and come from Monterey, California.

There are 4 other lots in the collection of the U. S. National Museum, all from Monterey. Cat. No. 46496, one specimen belongs to the Stearns collection; Cat. Nos. 46474 and 46479, one specimen each collected by Doctor Canfield, and Cat. No. 159459, two collected by Doctor Dall.

Subgenus AMAURA Möller.

Amaura MÖLLER, Index Moll. Groenlandica, 1842, p. 7.

Very large, usually inflated Odostomias, the sculpture of which consists of very fine lines of growth and still finer wavy closely placed spiral striations.

Type.—*Amaura candida* Möller.

KEY TO SPECIES OF AMAURA.

Shell umbilicated:

Adult shell large, 10-mm. long *kennerleyi*.

Adult shell medium size, 7 mm. or less long *satura*.

Shell not umbilicated:

Whorls with the summit appressed—

Shell shortly ovate *nuciformis*.

Shell elongate-ovate *avellana*.

Whorls with the summits shouldered—

Adult shell more than 9 mm. long *montereyensis*.

Adult shell less than 7 mm. long *gouldii*.

ODOSTOMIA (AMAURO) KENNERLEYI, new species.

Plate XLVIII, figs. 8, 8a.

Shell large, very thin, broadly conic, umbilicated, yellowish-white; marked by subobsolete, subequal, and subequally spaced spiral wrinkles, about 15 of which may be seen on the body and base of the last whorl. In addition to these wrinkles, many faint, closely-placed spiral and vertical striae are present. Nuclear whorls small, about $2\frac{1}{2}$ forming a depressed spire which is deeply immersed, the axis of which is almost at right angles to the axis of the latter whorls. Post-nuclear whorls very wide, inflated, well rounded, faintly shouldered at the summit. Sutures well marked, simple. Periphery and base of the last whorl inflated, well rounded, the latter decidedly contracted and narrowly umbilicated. Aperture large, suboval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thin; columella straight, obliquely inserted, revolute, not reenforced by the base, with an oblique weak fold near its insertion; parietal wall apparently without a callus.

The type (Cat. No. 150564, U.S.N.M.) was collected by Rev. G. W. Taylor at Nanaimo, British Columbia. It has 6 post-nuclear whorls which measure: Length 10.2 mm., diameter 6 mm.

Two other specimens (Cat. No. 44933, U.S.N.M.) were collected by Doctor Kennerley at Puget Sound, Washington, and another (Cat. No. 129121) by Prof. O. B. Johnson, at Seattle, Washington.

ODOSTOMIA (AMAURO) SATURA Carpenter.

Plate XLVIII, figs. 5, 5a.

= *Odostomia satura* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 29.

+ var. *pupiformis* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 29.

Shell of medium size, broadly conic, white. Nuclear whorls at least two, forming a depressed spire, the axis of which is almost at a right angle to the axis of the later whorls, and which is deeply, somewhat obliquely immersed in the first post-nuclear turn. Post-nuclear whorls moderately well rounded, faintly shouldered at the summit, marked all over by irregular rough, low, tumescences, which simulate obsolete vertical ribs. Sutures simple, well marked. Periphery of the last whorl well rounded. Base quite short, decidedly rounded, and umbilicated. Umbilicus partly covered by the revolute columella. Aperture large, very broadly oval, somewhat effuse anteriorly; posterior angle obtuse; outer lip thick; columella moderately strong, oblique, decidedly curved, with a decided oblique fold, situated considerably anterior to its insertion; parietal wall covered by a fairly thick callus.

The type (Cat. No. 15520, U.S.N.M.) was collected by J. G. Swan at Neah Bay, Washington. It has $5\frac{1}{2}$ whorls which measure: Length 6.4 mm., diameter 3.5 mm.

The specimen upon which Doctor Carpenter fixed the name *pupiformis* (Cat. No. 15520a, U.S.N.M.) collected by J. G. Swan at Neah Bay, Washington, is not worthy of a varietal name. It is a freak, having the spire less elevated, which is, perhaps, due to some injury received at an early date, evidence of which seems present. It agrees perfectly in every detail with the type of *satura* excepting the shape of the spire.

ODOSTOMIA (AMAURA) NUCIFORMIS Carpenter.

Plate XLVIII, figs. 3, 3a.

Odostomia nuciformis CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 30.

Shell large, shortly ovate, yellowish to milk-white. Nuclear whorls deeply immersed; only half of the last turn is seen in tilted position when viewed from above. Post-nuclear whorls increasing rapidly in size, well rounded, having their summits closely appressed to the preceding whorl. Sutures moderately well impressed. Periphery and base of the last whorl well rounded. Aperture rather large, ovate, white within; posterior angle acute; outer lip moderately thin at the edge, thicker within; columella short, strongly curved, with a strong oblique fold at its insertion; reenforced by the attenuated base; parietal wall covered by a weak callus.

The type (Cat. No. 15517a, U.S.N.M.) comes from Neah Bay, Washington. It has 5 post-nuclear whorls which measure: Length 7.7 mm., diameter 4.4 mm.

Odostomia (Amaura) nuciformis Carpenter differs from its subspecies in having the spire more depressed than either of them. It is a short, stubby inflated, ovoid shell, having the summit of the whorls closely appressed.

ODOSTOMIA (AMAURA) NUCIFORMIS AVELLANA Carpenter.

Plate XLVIII, figs. 1, 1a.

Odostomia (? var.) *avellana* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 30.

Shell large, elongate-ovate, yellowish to milk-white. Nuclear whorls deeply vertically immersed; only part of the last volution is visible when viewed from above, their axis evidently being at a right angle to the axis of the later whorls. Post-nuclear whorls increasing rapidly in size, early ones well rounded, later ones less so, their summits being closely appressed to the preceding whorl. Sutures well impressed, simple. Periphery and base of the last whorl well rounded, the latter

somewhat elongated. Aperture large, ovate, somewhat effuse anteriorly, milk-white within; posterior angle acute; outer lip thin at the edge, thick within; columella short curved, reenforced partly by the attenuated base, having a strong oblique fold at its insertion; parietal wall covered by a moderately strong callus.

The type (Cat. No. 15517b, U.S.N.M.) comes from Neah Bay, Washington. It has 5 post-nuclear whorls and measures: Length 8.3 mm., diameter 4.3 mm.

The present subspecies differs from *O. (A.) nuciformis* Carpenter chiefly in having the spire much more elongated.

ODOSTOMIA (AMAURO) MONTEREYENSIS, new species.

Plate XLVIII, figs. 6, 6a.

Shell large, similar in form to *O. (A.) n. avellana*; white, shining. Nuclear whorls 3, helicoid, quite elevated, deeply immersed in the first of the succeeding whorls, having their axis at a right angle to the axis of the later whorls. Post-nuclear whorls well rounded, with a beveled shoulder at the summits. Sutures well marked, simple. Periphery and base of the last whorl well rounded and inflated, the latter somewhat elongated. Aperture subovate, somewhat effuse anteriorly; posterior angle acute; outer lip thin at the edge, thick within; columella curved and somewhat revolute, having a prominent oblique fold near its insertion; parietal wall covered by a thin callus.

The type (Cat. No. 46473, U.S.N.M.) is from Monterey, California. It has 6 post-nuclear whorls which measure: Length 9.6 mm., diameter 5.1 mm.

In addition to these others have been named for the University of California from Monterey; for Mr. S. S. Berry from 12 fathoms off Del Monte, Monterey Bay; for Mrs. Oldroyd from San Pedro, and for Mr. Kelsey from San Diego, California.

This species resembles *O. (A.) n. avellana* Carpenter, but differs markedly from that form by having the summits of the whorls shouldered.

ODOSTOMIA (AMAURO) GOULDII Carpenter.

Plate XLVIII, fig. 4.

Odostomia (? var.) *gouldii* CARPENTER, Ann. Mag. Nat. Hist., 3d ser., XV, 1865, p. 29.

Shell of medium size, elongate-conic, yellowish-white, the exterior surface marked by irregular tumescences, giving it a much worn appearance. Nuclear whorls three, deeply immersed, having their axis at about a right angle to the axis of the succeeding turns. Post-nuclear whorls moderately well rounded, faintly shouldered at the

summit. Sutures simple, well marked. Periphery and base of the last whorl well rounded, the latter somewhat elongated. Umbilicus faint. Aperture quite large, pyriform, posterior angle obtuse, outer lip moderately thick; columella very oblique, fairly strong, revolute, with a strong fold somewhat anterior to its insertion; parietal wall covered with a fairly strong callus.

The type (Cat. No. 22821, U.S.N.M.) comes from Neah Bay, Washington. It has 6 post-nuclear whorls and measures: Length 6.1 mm., diameter 3.1 mm.

EXPLANATION OF PLATES.

In some instances the very fine, closely crowded striation has been omitted, while in other cases where shown it has been exaggerated by the artist. Attention is called to this under the explanation of the figures. The measurements cited after the names refer to the axial length of the specimen.

PLATE XLIV.

- FIG. 1. *Turbonilla* (*Strioturbonilla*) *vancouverensis* Baird; 6.2 mm.; p. 495. The fine spiral markings have been omitted in this figure.
2. *Turbonilla* (*Chemnitzia*) *muricatoides*, new species; type; 3 mm.; p. 495. The fine spiral markings have been omitted in this figure.
- 2a. Nucleus of same, lateral view, much enlarged.
3. *Turbonilla* (*Pyrgolampros*) *valdezi*, new species; type; 5.6 mm.; p. 502. The fine spiral markings have been omitted in this figure.
- 3a. Nucleus of same, seen from above, much enlarged.
4. *Turbonilla* (*Pyrgolampros*) *lyalli*, new species; type; 5.7 mm.; p. 500. The fine spiral markings have been omitted in this figure.
- 4a. Nucleus of same, lateral view, much enlarged.
5. *Turbonilla* (*Turbonilla*) *gilli*, new species; type; 3.6 mm.; p. 493.
6. *Turbonilla* (*Pyrgolampros*) *victoriana*, new species; type; 7 mm.; p. 501. The fine spiral markings have been omitted in this figure.
7. *Turbonilla* (*Turbonilla*) *gilli delmontensis*, new subspecies; type; 3.4 mm.; p. 494.
8. *Turbonilla* (*Strioturbonilla*) *serreæ*, new species; type; 7.7 mm.; p. 497. The fine spiral markings have been omitted in this figure.
- 8a. Nucleus of same, lateral view, much enlarged.
9. *Turbonilla* (*Pyrgolampros*) *taylori*, new species; type; 11.5 mm.; p. 499. The fine spiral markings have been omitted in this figure.
- 9a. Nucleus of same, lateral view, much enlarged.
10. *Turbonilla* (*Pyrgolampros*) *berryi*, new species; type; 8 mm.; p. 500.
- 10a. Nucleus of same, lateral view, much enlarged.
11. *Turbonilla* (*Strioturbonilla*) *styliua* Carpenter; 6.5 mm.; p. 497. The fine spiral markings have been omitted in this figure.
- 11a. Nucleus of same, lateral view, much enlarged.

PLATE XLV.

- FIG. 1. *Turbonilla* (*Pyrgiscus*) *morchii*, new species; type, 6.4 mm.; p. 505.
- 1a. Nucleus of same, lateral view, much enlarged.
2. *Turbonilla* (*Pyrgolampros*) *oregonensis*, new species; type; 8.5 mm.; p. 503. The fine spiral markings have been omitted in this figure.
3. *Turbonilla* (*Pyrgiscus*) *tenuicula* Gould; 6.1 mm.; p. 508.
- 3a. Nucleus of same, lateral view, much enlarged.
4. *Turbonilla* (*Pyrgiscus*) *antestriata*, new species; type; 9.7 mm.; p. 506.
- 4a. Nucleus of same, lateral view, much enlarged.
5. *Turbonilla* (*Pyrgolampros*) *aurantia* Carpenter; type; 6.2 mm.; p. 502. The spiral markings have been exaggerated in this figure.
6. *Turbonilla* (*Pyrgolampros*) *newcombei*, new species; type; 5.4 mm.; p. 503.
7. *Turbonilla* (*Mormula*) *lordi* Smith; 21 mm.; p. 510.
- 7a. Nucleus of same, lateral view, much enlarged.
8. *Turbonilla* (*Pyrgiscus*) *eucosmobasis*, new species; type; 11.2 mm.; p. 507.
- 8a. Nucleus of same, lateral view, much enlarged.
9. *Turbonilla* (*Mormula*) *tridentata* Carpenter; 12.8 mm.; p. 511.
10. *Turbonilla* (*Mormula*) *eschsoltzi*, new species; type; 13.3 mm.; p. 513.

PLATE XLVI.

- FIG. 1. *Odostomia* (*Chrysallida*) *astricta*, new species; type; 2.9 mm.; p. 515.
2. *Odostomia* (*Iridia*) *navisa*, new species; type; 2.9 mm.; p. 517.
2a. Nucleus of same, lateral view, much enlarged.
3. *Odostomia* (*Iridia*) *navisa delmontensis*, new subspecies; type; 3.2 mm.; p. 518.
3a. Nucleus of same, lateral view, much enlarged.
4. *Odostomia* (*Chrysallida*) *montereyensis*, new species; type; 3 mm.; p. 516.
5. *Odostomia* (*Menestho*) *harfordensis*, new species; type; 3.2 mm.; p. 521.
6. *Odostomia* (*Menestho*) *exara*, new species; type; 3.9 mm.; p. 521.
7. *Odostomia* (*Chrysallida*) *cooperi*, new species; type; 3.1 mm.; p. 514.
8. *Odostomia* (*Menestho*) *pharcida*, new name; type; 2.2 mm.; p. 520.
9. *Odostomia* (*Iolaea*) *amianta*, new species; type; 4.5 mm.; p. 519.
9a. Nucleus of same, seen from above, much enlarged.
10. *Odostomia* (*Chrysallida*) *oregonensis*, new species; type; 3.3 mm.; p. 516.
10a. Nucleus of same, lateral view, much enlarged.

PLATE XLVII.

- FIG. 1. *Odostomia* (*Evalea*) *tillamookensis*, new species; type; 4.1 mm.; p. 522. The spiral sculpture is somewhat exaggerated in this figure.
2. *Odostomia* (*Evalea*) *angularis*, new species; type; 5.6 mm.; p. 523. The spiral sculpture is somewhat exaggerated in this figure.
3. *Odostomia* (*Evalea*) *jewetti*, new species; type; 6.1 mm.; p. 523. The spiral sculpture is somewhat exaggerated in this figure.
4. *Turbonilla* (*Pyrgiscus*) *canfieldi*, new species; type; 6.3 mm.; p. 504.
4a. Nucleus of same, lateral view, much enlarged.
5. *Odostomia* (*Evalea*) *deliciosa*, new species; type; 4 mm.; p. 525. The fine spiral markings have been omitted in this figure.
6. *Odostomia* (*Evalea*) *tenuisculpta* Carpenter; 5.3 mm.; p. 527. The fine spiral markings have been omitted in this figure.
7. *Turbonilla* (*Pyrgiscus*) *castanea*, new species; type; 13.5 mm.; p. 509.
8. *Odostomia* (*Evalea*) *inflata* Carpenter; type; 6.2 mm.; p. 524. The fine spiral sculpture has been somewhat exaggerated in this figure.
9. *Odostomia* (*Evalea*) *columbiana*, new species; type; 8.3 mm.; p. 525. The fine spiral sculpture has been somewhat exaggerated in this figure.
10. *Odostomia* (*Evalea*) *tacomensis*, new species; type; 4.3 mm.; p. 526. The fine spiral sculpture has been somewhat exaggerated in this figure.

PLATE XLVIII.

- FIG. 1. *Odostomia* (*Amaura*) *nuciformis avellana* Carpenter; type; 9.1 mm.; p. 530.
1a. Nucleus of same, seen from above, much enlarged.
2. *Odostomia* (*Evalea*) *valdezi*, new species; type; 3 mm.; p. 526. The fine spiral sculpture has been omitted in this figure.
3. *Odostomia* (*Amaura*) *nuciformis* Carpenter; type; 7.7 mm.; p. 530.
3a. Nucleus of same, seen from above, much enlarged.
4. *Odostomia* (*Amaura*) *gouldii* Carpenter; type; 6.1 mm.; p. 531.
5. *Odostomia* (*Amaura*) *satura* Carpenter; type; 6.5 mm.; p. 529.
5a. Nucleus of same, seen from above, much enlarged.
6. *Odostomia* (*Amaura*) *montereyensis*, new species; type; 9.6 mm.; p. 531. The fine spiral sculpture is somewhat exaggerated in this figure.
6a. Nucleus of same, seen from above, much enlarged.
7. *Odostomia* (*Evalea*) *phanea*, new species; type; 4.8 mm.; p. 528.
8. *Odostomia* (*Amaura*) *kennerleyi*, new species; type; 10.2 mm.; p. 529.
8a. Nucleus of same, seen from above, much enlarged.



1



2



3



4



2a



5



6



7



4a



8a



9a



11a



10a



3a



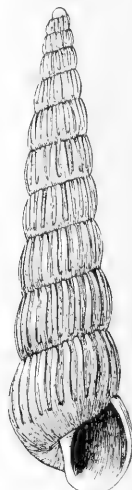
8



9



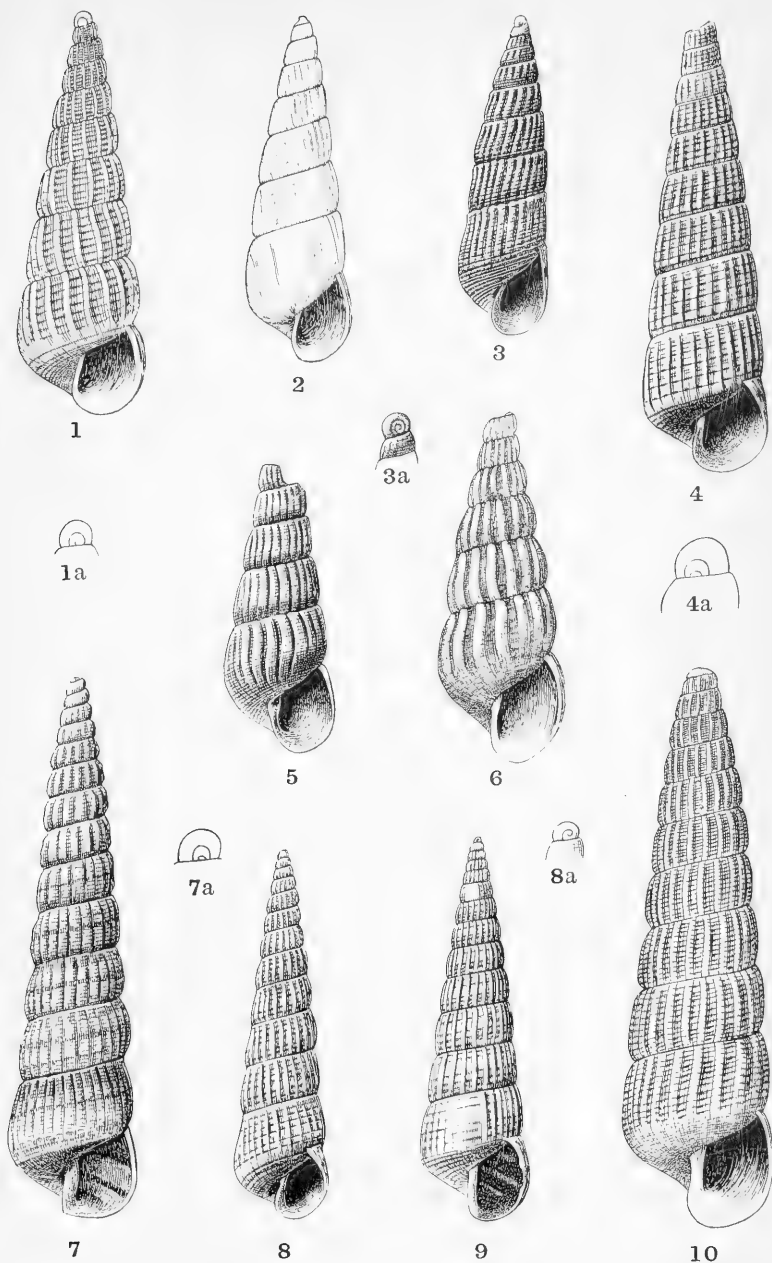
10



11

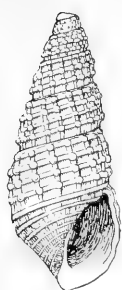
WEST AMERICAN TURBONILLA.

FOR EXPLANATION OF PLATE SEE PAGE 533.



WEST AMERICAN TURBONILLA.

FOR EXPLANATION OF PLATE SEE PAGE 533.



1



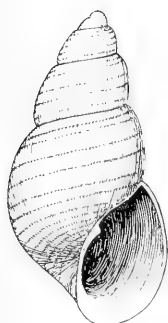
2



3



4



5



3a



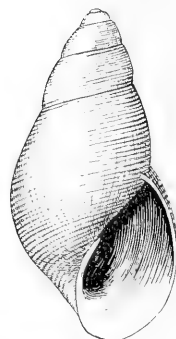
2a



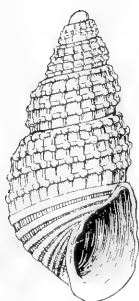
9a



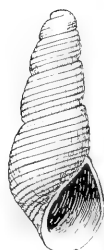
10a



6



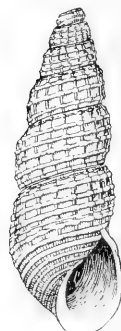
7



8



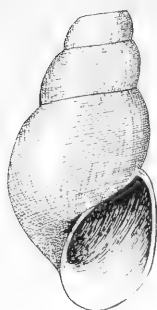
9



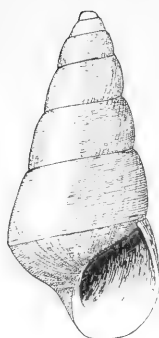
10

WEST AMERICAN ODOSTOMIA.

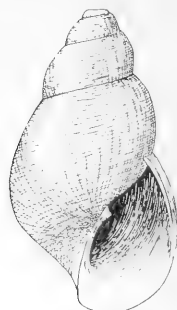
FOR EXPLANATION OF PLATE SEE PAGE 534.



1



2



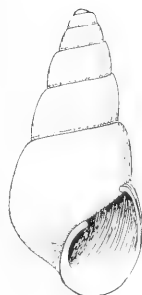
3



4



4a



5



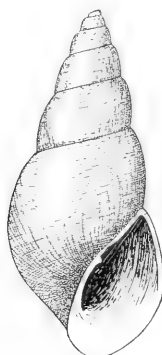
6



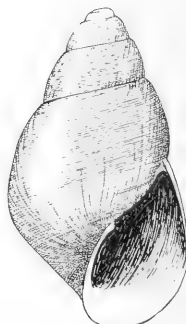
7



8



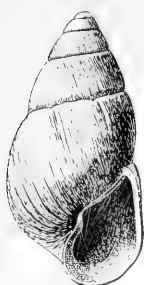
9



10

WEST AMERICAN PYRAMIDELLIDÆ.

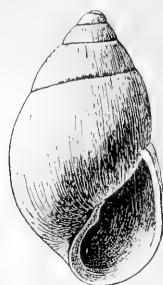
FOR EXPLANATION OF PLATE SEE PAGE 534.



1



2



3



4



3a



6a



8a



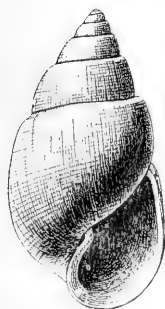
5



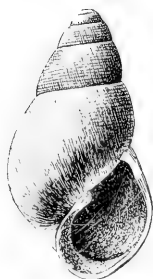
1a



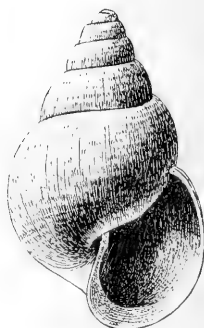
5a



6



7



8

WEST AMERICAN ODOSTOMIA.

FOR EXPLANATION OF PLATE SEE PAGE 534.

LIST OF FISHES COLLECTED IN THE RIVER AT BUYTEN-
ZORG, JAVA, BY DR. DOUGLAS HOUGHTON CAMPBELL.

By DAVID STARR JORDAN and ALVIN SEALE,
Of Stanford University.

In the summer of 1906, Dr. Douglas Houghton Campbell, professor of botany in Stanford University, made a visit to the famous botanic garden at Buytenzorg, in Java. While there he obtained a small but finely preserved collection of the river fishes, recorded in the present paper. A series of specimens is in the United States National Museum and in the museum of Stanford University. One species is apparently new to science, *Glossogobius campbellianus*.

Family MONOPTERIDÆ.

1. MONOPTERUS ALBUS (Zuiewu).

Length of head, 10.20 in distance between tip of snout and vent; length of tail, 2.50 in distance anterior of vent; eye 8 in head, midway between tip of snout and angle of mouth; teeth small, conical, in bands tapering toward angle of mouth; palatine teeth similar to those of jaw; tail tapering and narrow: origin of dorsal above vent; color in spirits, greenish above, lighter below, some small dark specks on head. One specimen, length 12.50 inches.

Family CLARIIDÆ.

2. CLARIAS MAGUR (Buchanan-Hamilton).

Macropteronotus magur BUCHANAN-HAMILTON, Fishes, Ganges, pp. 146, 374, pl. XXVI, fig. 45.

Clarias magur CUVIER and VALENCIENNES, Poiss., XV, p. 283.—GÜNTHER, Cat., V, p. 17.

Clarias batrachus BLEEKER, Atl. Ich., II, p. 103, pl. xcvi, fig. 2; Java (not *Silurus batrachus* Linnæus, which is *Clarias fuscus* Lacépède).

Head 5 in length to base of caudal; depth 6.50; eye 9 in head. D. 64; A. 52; dorsal fin not attached to caudal; vomerine teeth in united band; maxillary barbel extending to posterior third of pectoral or beyond.

Four specimens, length, 2.5 to 8 inches.

Family SILURIDÆ.

3. OMPOK BIMACULATUS (Bloch).

Silurus bimaculatus BLOCH, Ausl. Fisch., VIII, p. 24, pl. CCCLIV (Malabar).

Ompok siluroides LACÉPÈDE, Poiss., V, p. 50.

Callichrous bimaculatus BLEEKER, Atl. Ich., p. 84, pl. LXXVII, fig. 3 (Java).—

DAY, Fishes of India, p. 476, pl. CX, figs. 4 and 5.—GÜNTHER, Cat., V, p. 45.

Head 4.60; depth 4.50; eye 5.50 in head; snout 4; D. 4; A. 62; V., 8; bands of fine, sharp-pointed teeth in jaws; vomerine teeth in a single small patch on each side; maxillary extending to anterior margin of eye, lower jaw projecting; a single maxillary barbel on each side, the tip of which extends to near posterior end of pectoral fin; origin of dorsal fin directly above origin of ventrals; distance from tip of snout to origin of dorsal, 2 in distance from origin of dorsal to end of caudal vertebræ.

Color in spirits, a dull grayish, a round dusky spot on anterior of body slightly posterior to origin of lateral line.

Two specimens, length 7.20–8.20 inches.

The name *Ompok* has priority over *Callichrous*.

4. HYPSELOBAGRUS MACRONEMUS (Bleeker).

Bagrus macronemus, *singaringan*, and *heterurus* BLEEKER, Verh. Bat. Gen., XXI, 1 Silur., 1846, p. 22 (Java).

Hypselobagrus macronema BLEEKER, Atl. Ich., II, p. 58, pl. LXXIII (Java).

Head 4.50; depth 4.20; eye 4 in head; snout 2.40; interorbital 3; D.; I. 7; A. 11; adipose fin very long, its base 2.14 in length without caudal; 4 barbels to each side, the maxillary barbels extending to origin of anal fin; vomerine teeth united in a single band, similar to teeth in jaws; origin of ventrals on a line with origin of adipose dorsal; first spine of pectorals slightly serrate.

One specimen, length 8.20 inches.

5. HEMIBAGRUS PLANICEPS (Kuhl and Van Hasslt).

Bagrus planiceps CUVIER and VALENCIENNES, Nat. Hist. Poiss., XIV, p. 421 (Java).

Hemibagrus planiceps BLEEKER, Atl. Ich. Silur., p. 56, pl. LXXI (Java).

Macronus planiceps GÜNTHER Cat., V, p. 81 (Java and Sumatra).

Head 4; depth 6.10; eye 6 in head; snout 2.75; interorbital 3; D. I, 8; A., 13; base of adipose fin, 1.50 in head; barbels, 4 on each side, maxillary barbels extending to dorsal fin; vomerine teeth in a united band; first spine of pectoral serrate; first dorsal spine slightly serrate.

Color in spirits, grayish, an indistinct dusky spot on sides near origin of lateral line.

Six specimens, length 5 to 9.75 inches.

Family COBITIDÆ.

6. *NEMACHEILUS FASCIATUS* (Kuhl and Van Hasselt).

Nemacheilus fasciatus KÜHL and VON HASSELT, Algem. Konst. Letterb., XI, 1833, p. 133.—BLEEKER, Atl. Ich., p. 70, pl. CIII, fig. 7.—GÜNTHER, Cat., VII, p. 349 (Java).

Cobitis fasciata CUVIER and VALENCIENNES, Poiss., XVIII, p. 18.

Head 4.50; depth 5; eye 4.10 in head; snout 2.45; interorbital 2.45; D. 12; A. 7; barbels 5, the maxillary pair scarcely reaching opercle; origin of dorsal in line with origin of ventrals.

Color in spirits, body with 15 to 20 vertical yellowish bands; base of caudal with dark blotch or band; some specimens with a dusky spot on anterior of dorsal.

Twenty-six specimens, length 1.25 to 2.50 inches.

7. *LEPIDOCEPHALICHTHYS HASSELTII* (Cuvier and Valenciennes).

Cobitis hasseltii CUVIER and VALENCIENNES, Poiss., XVIII, p. 56.

Lepidocephalichthys hasseltii BLEEKER, Atl. Ich., III, p. 13, pl. CIII, fig. 2 (Buytenzorg, Java).

Head 5; depth 5.25; eye 3.50 in head; snout 2.75; D. 8; A. 7; caudal truncate; barbels present.

Color, in spirits, yellowish, mottled with brownish blotches above; a narrow dusky median line on sides; dorsal and caudal with fine dots; a dusky line on side of snout.

Family CYPRINIDÆ.

8. *CYPRINUS CARPIO* (Linnæus).

Three specimens of the common carp. A second specimen seems to belong to the variety called *Cyprinus flavipinna* by Doctor Bleeker.^a

Head 3.20; depth 3; eye 5 in head; snout 2.85; interorbital 2.85; D. 20; A. 8; scales 6-34-5.

Color in spirits, yellowish, darker above.

9. *HAMPALA MACROLEPIDOTA* (Kuhl and Van Hasselt).

Capoeta macrolepidota CUVIER and VALENCIENNES, Poiss., XVI, p. 280, pl. CCCCLXXVII.

Hampala macrolepidota BLEEKER, Atl. Ich., III, p. 112, pl. XXXVIII, fig. 2 (Java).

Barbus hampal GÜNTHER, Cat., VII, p. 139.

Head 3.50; depth 4; eye 4.85 in head; snout 3.30; interorbital 3.50; scales 4-28-5; D. 12; A. III, 5.

^a Atl. Ich., III, p. 74, pl. CVIII, fig. 3.

Color in spirits dull yellowish; upper and lower margin of caudal black; front margin of dorsal black; a large dusky blotch on sides below anterior portion of dorsal.

Three specimens, length 3 to 7.50 inches.

This species belongs to the genus or section *Hampala*, distinguished by the form of the mouth, which is larger than usual in *Puntius* and *Capoeta*.

10. **BARBODES RUBRIPINNIS** (Kuhl and Van Hasselt).

Barbus rubripinnis (KUHLE and VAN HASSELT), CUVIER and VALENCIENNES, Poiss., XVI, p. 149.—GÜNTHER, Cat., VII, p. 116.

Puntius rubripinnis BLEEKER, Atl. Ich., III, pl. CXXXIV, fig. 3.

Head 4.20; depth 2.60; eye 4.50 in head; snout 3.40; interorbital 2.10; D. 11; A. 9; third dorsal ray strong and serrate behind; scales 5-32-5; barbels 4; the upper pair one-half length of lower; lips smooth.

Color in spirits, yellowish, slightly darker above; an indistinct dusky blotch on caudal peduncle.

Two specimens, length 3.25 to 7 inches.

Barbodes is distinguished from *Puntius* (*Systomus*) by the presence of four barbels.

11. **BARBODES OBTUSIROSTRIS** (Van Hasselt).

Barbus obtusirostris (VAN HASSELT) CUVIER and VALENCIENNES, Nat. Hist. Poiss., XVI, p. 167 (Java).—GÜNTHER, Cat., VII, p. 121 (Java).

Puntius obtusirostris BLEEKER, Atl. Ich., IV, p. 106, pl. CXXXIII, fig. 1.

Head 4.10; depth 2.60; eye 3.25 in head; snout 3.30; interorbital 2.75; D. 11; A. 12; scales 5-26-3; origin of dorsal on a line with origin of ventral; third dorsal ray strong and denticulate. Color in spirits, yellowish, slightly darker above tip of dorsal and margin of caudal dusky.

Four specimens, length 4.25 to 5 inches.

12. **BARBODES BINOTATUS** (Kuhl).

Barbus binotatus and *B. maculatus* CUVIER and VALENCIENNES, Poiss., XVI, pp. 168-195 (Java).

Barbus maculatus GÜNTHER, Cat., VII, p. 123.

Barbus microps GÜNTHER, Cat. VII, p. 124 (Java).

Head 3.10; depth 3.10; eye 3 in head; snout 4; D. 11; A. 8; scales 5-22-3; barbels 4; origin of dorsal over origin of ventrals.

Color in spirits, yellowish white, darker above; a round black spot on middle of caudal peduncle, another at anterior base of dorsal, and one at anterior base of anal; a broken indistinct dusky line along middle of sides, this line made up of more or less numerous black dots. These markings disappear more or less completely with age.

Numerous specimens, length $1\frac{1}{4}$ to 3 inches.

There seems to be no important reason for separating the Java species, *Barbodes microps* (Günther), from the common East Indian species of this type, for which the oldest name seems to be *binotatus*.

13. *ANEMATICHTHYS APOGON* (Kuhl).

Barbus apogon CUVIER and VALENCIENNES, Poiss., XVI, p. 392 (Java).—GÜNTHER, Cat., VII, p. 150 (Java).

Cyclocheilichthys apogon BLEEKER, Atl. Ich., III, pl. cxxxI, fig. 3 (Java).

Head 3.50; depth 2.80; eye 3.30 in head; snout 3.30; interorbital 3; D. 12; A. 8; scales 34; origin of dorsal behind origin of ventrals; osseous dorsal ray serrate, its length about equal to head; no barbels.

Color in spirits, yellowish, indistinct dusky streaks on back and indistinct dusky blotch on caudal peduncle.

Numerous specimens, length 1–5 inches.

Anematichtys differs from *Cyclocheilichthys* in having no barbels.

14. *OSTEOCHILUS HASSELTII* (Cuvier and Valenciennes).

Rohira hasseltii CUVIER and VALENCIENNES, Poiss., XVI, p. 274.—BLEEKER, Atl. Ich., III, p. 66, pl. cxv, fig. 1 (Java).

Osteochilus hasseltii GÜNTHER, Cat., VII, p. 41 (Java).

Head 4.25; depth 3; eye 4 in head; snout 2.75; interorbital 2; D. 17; A. III, 5; scales 6–35–5; barbels 4; lips fringed.

Color in spirits, yellowish, a dusky line along each row of scales, a round dusky spot on caudal peduncle.

Two specimens, length 3.75–5.50 inches.

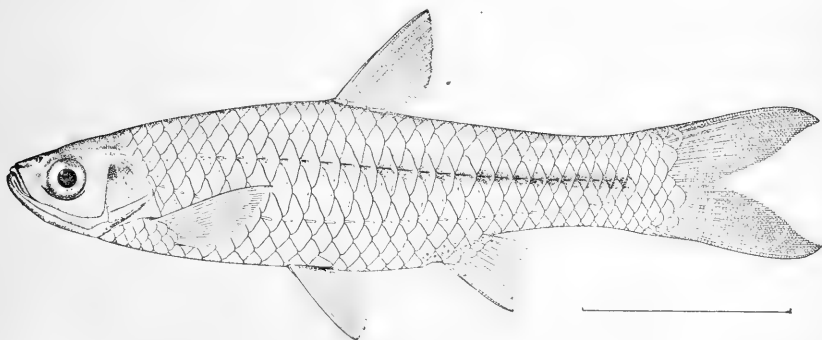


FIG. 1.—*RASBORA LATERISTRIATA*.

15. *RASBORA LATERISTRIATA* (Van Hasselt).

Leuciscus lateristriatus VAN HASSELT, Konst. Allg. Letterb., 1823, II, p. 132.

Rasbora lateristriata BLEEKER, Atlas Cyprin., p. 121, pl. xvii, fig. 2 (Java and Sumatra).—GÜNTHER, Cat., VII, p. 195.

Head 4.50 in length to base of caudal; depth 3.75; eye 3.30 in head; snout 3.50; interorbital 2.40; D. 9; A. 7; scales 5–30–2; lateral line low; mouth oblique, the maxillary scarcely extending to eye; no bar-

bels; gill rakers short, less than 10 on lower limb; origin of dorsal behind ventrals, slightly nearer tip of snout than base of caudal; longest dorsal ray 2.50 in distance from tip of snout to origin of dorsal; origin of anal nearer to origin of ventral than base of caudal; base of anal 2.50 in head; ventrals midway between posterior margin of opercles and origin of anal, their length 1.30 in head; pectorals about equal to length of head; caudal emarginate, slightly longer than head.

Color in spirits, yellowish white, a brown stripe on middle of sides, broad and distinct on posterior half of body and fading out anteriorly, scarcely showing on anterior third of body; fins uniform. None of our specimens show any trace of a dark spot above the vent. This is probably to be seen on adults only. Nineteen specimens, length 1.25 to 3.75 inches.

Family PECILIIDÆ.

16. APLOCHEILUS PANCHAX (Buchanan-Hamilton).

Esox panchax BUCHANAN-HAMILTON, Fishes, Ganges, pp. 211, 380, pl. III, fig. 69.

Panchax buchanani CUVIER and VALENCIENNES, Poiss. XVIII, p. 283.—BLEEKER,

Atl. Ich., III, p. 141, pl. XLIII, fig. 3 (Buytenzorg, Java).

Haplochilus panchax GÜNTHER, Cat., VI, p. 311.

Head 3.10; depth 4; eye 3.10 in head; snout 2.50; interorbital 2; D. 7; A. 14; scales 24; fine teeth in jaws; snout flat and somewhat spatulate.

Color in spirits, yellowish brown, a large distinct black ocellus on base of dorsal, caudal rounded.

Numerous specimens, length 1–1.40 inches.

Family EXOCETIDÆ.

17. DERMATOGENYS FLUVIATILIS (Bleeker).

Hemirhamphus fluviatilis BLEEKER, Nat. Tydschr. Ned. Ind., I, p. 95.—GÜNTHER, Cat., VI, p. 275.

Head 4; depth 7.50; eye 4 in head; snout 2.50; its length greater than width, length of the projecting under jaw from tip of upper 1.75 in head; D. 9; A. 14; origin of dorsal over 5th ray of anal.

Ten specimens, very young, length 1 to 2 inches.

Family OPHICEPHALIDÆ.

18. OPHICEPHALUS STRIATUS Bloch.

Ophicephalus striatus BLOCH, Ichth., p. 359.—BLEEKER, Atl. Ich., IX, pl. CCCXCIX, fig. 1.—GÜNTHER, Cat., III, p. 474 (Java).

Head 3.10; depth 5.75; eye 8 in head; snout 5.50; interorbital 4; D. 42; A. 27; scales 5–57–8.

Color in spirits whitish below, brownish gray above; a dusky stripe back from angle of mouth; vertical fins with more or less distinct oblique stripes.

Three specimens, length, 5 to 8.25 inches.

19. *OPHICEPHALUS GACHNA* (Buchanan-Hamilton).

Ophicephalus gachna BUCHANAN-HAMILTON, Fishes Ganges, p. 68, pl. XXI, fig. 21.—GÜNTHER, Cat., III, p. 471.

Head 4; depth 6; eye 7.50 in head; snout 5; interorbital 3.20; D. 33; A. 22; scales 5–43–6.

Color in spirits, brownish, indications of darker bands over back; vertical fins margined with white; pectorals with dusky stripes.

Six specimens, length 2.25 to 6 inches.

Family ANABANTIDÆ.

20. *ANABAS SCANDENS* (Daldorff).

Perca scandens DALDORFF, Trans. Linn. Soc., III, p. 62.

Anabas scandens GÜNTHER, Cat., III, p. 375.—DAY, Fishes of India, p. 370, pl. LCVIII, fig. 3.

Head 3; depth 3; eye 4.10 in head; snout 5; D. XVII, 8; A. IX, 9; scales 30.

Color in spirits, brownish, black at posterior margin of opercle. One specimen, length 4.50 inches.

Family OSPHROMENIDÆ.

21. *OSPHROMENUS STRIATUS* (Bleeker).

Trichopus striatus BLEEKER, Batav. Gen., XXIII, p. 11.

Osphromenus striatus GÜNTHER, Cat., III, p. 386.

Head 2.50; depth 3; eye 3.30 in head; snout 3; D. III, 6; A. VII, 25; scales 28; outer rays of ventrals greatly prolonged.

Body with four longitudinal dusky bands; in some specimens the two median bands are more distinct than in others, the bands broadening into a dusky blotch at upper part of opercles, a dusky spot on caudal peduncle.

Fifty-seven specimens, length 1 to 2 inches.

22. *OSPHROMENUS TRICHOPTERUS* (Pallas).

Labrus trichopterus PALLAS, Spicilegia, VIII, p. 45.

Osphromenus trichopterus GÜNTHER, Cat., III, p. 384 (Java).

Head 3.50; depth 2.60; eye 3.50 in head; snout 4; interorbital 2.75; D. VII, 6; A. XI, 36; scales 40; ventrals consisting of two long filaments which extend to caudal fin.

Color in spirits, yellowish brown, a black spot on middle of sides, another on sides of caudal peduncle; caudal anal soft; anal with white spots.

Ten specimens, length 1.50 to 3.25 inches. This is the variety called *koelreuteri* by Cuvier and Valenciennes.^a

Family GOBIIDÆ.

23. GLOSSOGOBIUS TAMBUJON (Bleeker).

Gobius tambujon BLEEKER, Banten, p. 319 (Java).

Gobius tambujon GÜNTHER, Cat., III, p. 32.

Head 3.30; depth 4.75; eye 3 in head; snout 4; D. VI-7; A. 7; scales 24; head naked; maxillary extending to a line with anterior part of eye; tongue emarginate; width of head greater than its depth; depth of head 1.50 in its length; interorbital space equal to width of pupil; teeth minute.

Color whitish, with five indistinct dusky bands over back—equal in width to the interspaces, five dusky blotches on sides alternating with the bars of back, dusky lines radiating from eye.

Forty-one specimens, length 1-1.50 inches.

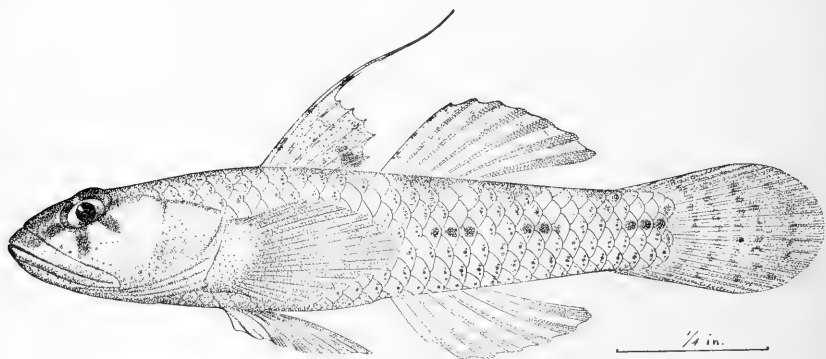


FIG. 2.—GLOSSOGOBIUS CAMPBELLIANUS.

24. GLOSSOGOBIUS CAMPBELLIANUS (Jordan and Seale, new species).

Head 3 in length to base of caudal; depth 5; eye 4 in head; D. VI-6; A. 7; scales 23; tongue notched; cheeks tumid; maxillary about 2 in head, extending to posterior margin of eye; interorbital narrow; head naked, its width 1.20 in its length, its depth 2; mouth wide, oblique, lower jaw slightly projecting; lips narrow; snout blunt, its length 4.20 in head; isthmus very narrow, teeth small, sharp-pointed, no canines; the gill openings wide; 2 longitudinal rows of small warts on cheeks, about 3 vertical rows on opercles; top of head smooth and

^aNat. His. Poiss., pl. cxcix.

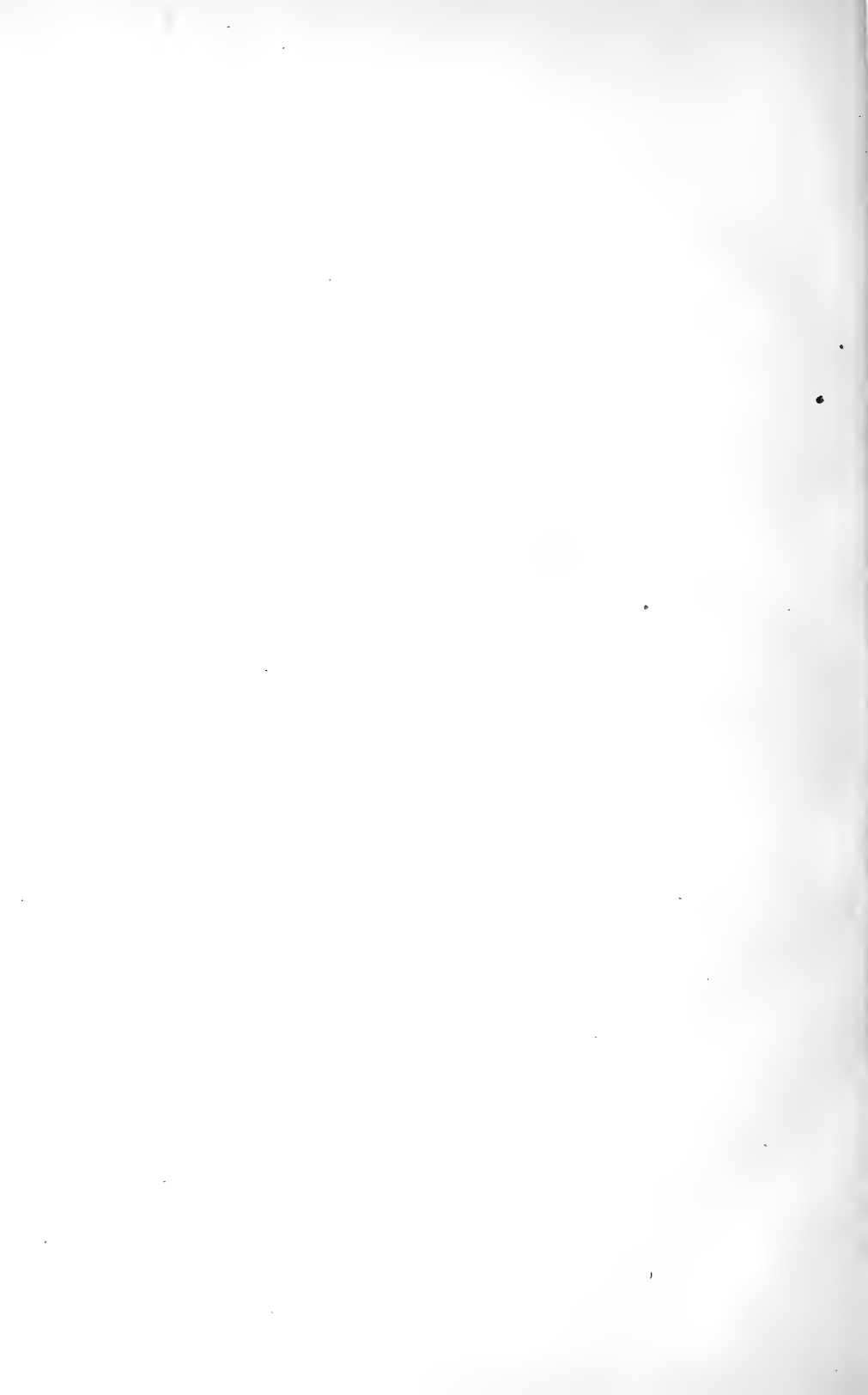
flat; origin of dorsal slightly posterior to axis of ventral; second dorsal spine long and thread-like, extending to behind second dorsal; base of second dorsal 2.50 in head, its longest ray 1 in head; origin of anal midway between posterior end of maxillary and base of caudal, its longest ray 1.75 in head; tip of ventral scarcely reaching origin of anal, its longest ray 1.20 in head; pectoral 1.15 in head, no free rays; caudal rounded, its length 1.10 in head.

Color in spirits, greenish; five dusky bars over back which extend obliquely forward on sides, a row of five dusky elongate spots on median line; three or four short dusky lines radiate from eye; caudal with about six dusky vertical lines, other fins washed with dusky.

Two specimens, length 1.10 to 1.50 inches.

The type is No. 61051 U. S. N. M. Cotype is No. 20160 Stanford University, from Buytenzorg, Java, collected by Dr. D. H. Campbell.

This species seems to belong to *Glossogobius*, having the large mouth, notched tongue, and narrow isthmus of *Glossogobius brunneus* and *G. giuris*. The scales are, however, much larger than in the latter species, and the soft dorsal and anal shorter. *Gobius melanurus* Bleeker, scantily described by Bleeker, agrees with this species in scales and fin rays. The color is different, however, and the mouth is not described.



A NEW GECKOID LIZARD FROM THE PHILIPPINE ISLANDS.

By LEONHARD STEJNEGER,

Curator, Division of Reptiles and Batrachians, U. S. National Museum.

During a visit to some of the islands north of Luzon, composing the Babuyan group, Mr. R. C. McGregor, of the Science Bureau, Manila, collected on the islands of Fuga and Calayan a series of lizards which he kindly donated to the United States National Museum.^a As might be expected, they belong to the families Gekkonidæ and Scincidæ, the latter being represented by numerous specimens of *Mabuya multicarinata*, *Dasia smaragdina*, and *Sphenomorphus jagorii* from both islands, besides a single *Emoia atrocostata* from Fuga. Of the geckos the collection contains *Hemidactylus frenatus* from both islands, *Gekko monarchus* from Calayan, and an undescribed species from the latter island. This new species evidently belongs to the genus *Luperosaurus*, and I take great pleasure in dedicating it to its discoverer, who has contributed so much to our knowledge of Philippine zoology.

LUPEROSAURUS MACGREGORI, new species.

Diagnosis.—No cutaneous fold along the sides of the body and very slight ones along the legs; tail not keeled laterally, nor flattened underneath.

Habitat.—Calayan Island, Philippine Archipelago.

Type.—Cat. No. 36191, U.S.N.M.; Calayan Island, Babuyan group; R. C. McGregor, collector.

Description of type specimen.—*Male.* Eye nearer the ear than the tip of the snout, its diameter about two-thirds of its distance from the latter; forehead slightly concave; ear-opening small, obliquely elliptic; digits half webbed; a very narrow dermal fold on each side of the legs, slightly better developed along the posterior side of the

^a For an account of the trip and the islands see The Birds of Calayan and Fuga, Babuyan Group, by Richard C. McGregor, in Bull. Philippine Museum, No. 4, May 15, 1904, pp. 3-6.

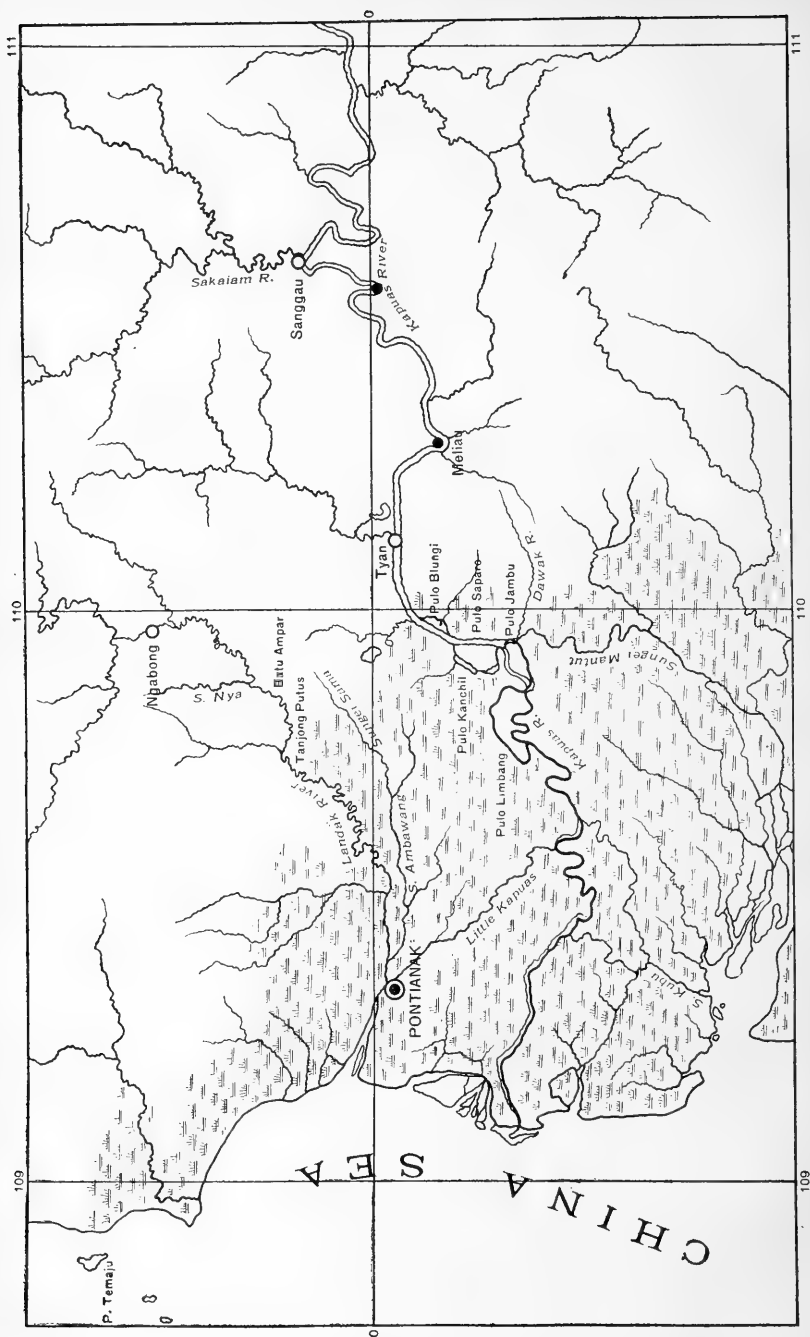
femur, but not a trace of fold on sides of body or tail; tail not longer than body (without head), narrow, slightly depressed, not more flattened underneath than above; body and extremities above and below covered with minute granules, those on the underside of the tail slightly larger; rostral broad, rectangular, with a median triangular process above, in touch with a small median internasal between two wide supranasals; nostril between rostral, first supralabial, one small postnasal and two supranasals, the anterior of which are very wide and nearly meeting behind the rostral; 15 upper (14 on right side) and 14 lower labials; mental small, not distinguishable by size or shape from the other labials; no chin-shields, but the throat granules increase gradually in size toward the labials; a transverse group of somewhat enlarged granules a short distance in front of the vent, the posterior row bearing an uninterrupted series of 16 pores; tail above slightly annulate, each annulus marked posteriorly on the side by a slightly enlarged spine-like scale. Color (in alcohol) above dull russet clouded with indistinct dusky markings which are more or less longitudinal; underside whitish, slightly washed with russet.

Dimensions.

	<i>Mm.</i>
Total length (tail broken).....	50
Tip of snout to eye.....	4.5
Tip of snout to ear.....	10
Tip of snout to vent.....	35
Diameter of eye.....	3
Tail from vent (broken).....	15
Fore leg.....	8
Hind leg.....	11

Remarks.—Besides the one described above, Mr. McGregor captured in the same place a very young specimen which in all essentials agrees with it. The tail is complete and equals the distance between the head and the vent. The chief difference in the scutellation consists in the large anterior supranasals being abbreviated by the separation of a small scale at the inner end, there being thus three internasals in touch with the rostral instead of one. The color is also essentially the same, but the russet color of the upper side, instead of gradually fading into a pale wash on the abdomen, invades the latter in the form of well-defined, but narrow, transverse, and somewhat wavy lines.

The present species seems to differ from the type of the genus *Luperosaurus cumingii* chiefly in the differently shaped tail and the total absence of a fold along the sides of the body. The latter is not specifically mentioned by Boulenger in his description (Cat. Liz. Brit. Mus., I, p. 181), but it is plainly shown in the figure (Plate XV, fig. 2).



SKETCH MAP OF LOWER KAPUAS RIVER, WESTERN BORNEO.

MAMMALS COLLECTED IN WESTERN BORNEO BY DR.
W. L. ABBOTT.

By MARCUS WARD LYON, JR.,
Assistant Curator, Division of Mammals, U. S. National Museum.

INTRODUCTION.

From about the middle of June until the end of September, 1905, Dr. W. L. Abbott occupied himself in exploring western Borneo, where some three hundred specimens of mammals were collected, all of which he presented to the United States National Museum. A few preliminary notices ^a of these have been published, but the collection as a whole is treated of for the first time in the following pages.

After collecting in the vicinity of Pontianak and along the Sungei Sama, Doctor Abbott ascended the Landak River to about Ngabong, making collections along the shores as he returned down that stream. He next ascended the Kapuas River as far as Sanggau, where the Sakaïam River, or Sungei Sakaïam, flows into the Kapuas. From Sanggau Doctor Abbott ascended the Sakaïam for 105 miles, reaching Mrowi, near the Sarawak frontier. As this trip was made in a small boat, no attempt was made to collect animals, his efforts being directed toward securing ethnological objects from the Dyaks. Collections of mammals were, however, made on the trip down the Kapuas from Sanggau.

The maps published on the region of western Borneo show that the lower courses of the Landak and Kapuas rivers pass through an area of lowland swamps, as would be inferred from the tortuous courses of the rivers and their numerous mouths. The upper courses of the

^a Pigmy Squirrels of the *Nannosciurus melanotis* group, Proc. Biol. Soc. Washington, XIX, pp. 51-56, May 1, 1906.

Notes on the Slow Lemurs, Proc. U. S. Nat. Mus., XXXI, pp. 527-538, pl. XIII, November 9, 1906.

Mammals of Banka, Mendanau, and Billiton, islands between Sumatra and Borneo, Proc. U. S. Nat. Mus., XXXI, pp. 575-612, December 18, 1906. Mention of *Rusa brookei*, *Muntiacus pleiharicus*, *Nannosciurus borneanus*, and *Cynopterus brachyotis*.

Notes on some squirrels of the *Sciurus hippurus* group, with descriptions of two new species, Smithsonian Misc. Coll., L, Pt. 1, pp. 24-29, April 8, 1907.

rivers traverse a country characterized by low hills. See map, frontispiece, where most of the points visited by Doctor Abbott are shown.

Doctor Abbott's remarks on the places visited by him follow:

The Sungei Sama is one of the two branches of the Ambawang which flows into the Landak River, 2 miles above Pontianak. This river is inhabited by Dyaks, who have been accustomed to shoot for naturalists at Pontianak, and that is the reason for my comparative success during my short stay. I stayed at the Kampong of the Mankoh (headman), 18 miles from Pontianak. The district is all swampy, and the big jungle is cleared immediately along the river for a half mile back. There are many sago plantations. Beyond a half mile from the river bank is heavy forest. The headwaters of the Sama are on some hills, and here is where the two Orangs were shot. The Dyaks live in the regular long houses (Rumah Panjang) of the Dyaks, but are otherwise much Malayified.

The country along the Landak River for the lower 50 miles of its course is swampy and still mostly heavy forest. The last kampong (village) is about 14 miles from Pontianak, and from here, to Batu Ampar the banks are mostly heavy forest. Above this point the banks become higher and the country largely covered with scrub jungle and lalang, and is inhabited by a considerable population of Dyaks. A good many Malays inhabit the district about Ngabong and along the river.

About Sanggau the country is mostly rolling, with low hills. Not much heavy forest is left, mostly scrub jungle and lalang with small patches of heavier forest. The Sakaia River flows into the Kapuas at this point, coming down from the borders of Sarawak. There is a considerable population of Malays along the bank and many Dyaks in the district. I went up the Sakaia as far as Mrowi, about 105 miles. Scarcely any heavy forest is left near the river; all scrub and lalang. A good deal of heavy forest remains along its affluent, the Kumbaia River. Along its upper course, but not upon its banks, are many hills which are still forest clad, especially near the Sarawak border. I was told much rimba (virgin forest) exists along the Jangko, the first branch of the Sakaia above Sanggau.

What I saw of Borneo up the Kapuas was a poor place for collecting. Down the river in the swampy forests there were some animals, the inhabitants being Malays or Dyaks who did not eat monkeys. But every Dyak has a gun in Borneo, and up river everything having fur, fin, or feather is devoured. Sarawak being a native State, the natives are allowed firearms, and as a consequence guns and ammunition drift across the frontier all over Dutch Borneo. The Dutch authorities complain very much about it. In Sumatra one may occasionally see an old gun, but ammunition is almost unobtainable.

SYSTEMATIC LIST OF SPECIES.

The mammals collected by Doctor Abbott represent thirty-eight species or subspecies, five of which were previously unknown to science, two of them being here described for the first time. A systematic list of all the species collected, accompanied by tables giving the precise localities and measurements of the individual specimens, with Doctor Abbott's field observations, follows:

MANIS JAVANICA Desmarest.

1822. *Manis javanica* DESMAREST, Mammalogie, Pt. 2, p. 377.

Two specimens from Pontianak, a young and an adult male. The skull of the adult appears to be the oldest *Manis* skull in the United States National Museum. The zygomatic arch is complete and bony

on each side, and is formed by the backward extension of the maxilla meeting the forward extension of the squamosal. The skull is shorter and heavier, especially about the rostrum, than somewhat younger skulls from the Malay Peninsula. The scales of the adult are large and heavy, with the markings conspicuous. Many of the scales are scarred and broken.

Measurements of the adult male, Cat. No. 142460, U.S.N.M.; head and body (to anus), 500 mm.; tail (from anus), 510; greatest length of skull, 104.3 mm.; zygomatic width, 39. The weight was $16\frac{1}{2}$ pounds [7.48 kilos].

TRAGULUS HOSEI (Bonhote).

1903. *Tragulus kanchil hosei* BONHOTE, Ann. Mag. Nat. Hist., 7th ser., XI, p. 239. March 1903 (received at library of U. S. National Museum, March 16, 1903).

1903. *Tragulus virgicollis* MILLER, Proc. Biol. Soc. Washington, XVI, p. 37. March 19, 1903.

Skin and skull of an adult female, from the Kapuas River below Tyan. In point of color and markings this specimen is indistinguishable from *Tragulus kanchil* of Sumatra, differing from that species only in the greater length of the hind foot and somewhat greater size of the skull. In most respects, it resembles the type of *T. virgicollis* (= *T. hosei*), but differs from it conspicuously in the absence of the narrow, well-defined nape stripe. With but one skin from the Kapuas River, it does not seem advisable, for the present at least, to recognize two distinct races of the *kanchil* group on Borneo. (For measurements, see table herewith.)

External and cranial measurements of *Tragulus* from western Borneo.

Name.	Locality.	Number.	Sex.	Age.	Head and body, ^a	Tail vertebrae, ^a	Hind foot.	Weight, ^a	Greatest length of skull.	Condyle - basal length.	Basal length.	Palatal length.	Interorbital constriction.	Zygomatic breadth.	Mandible, condyle to front of symphysis.	Maxillary tooth-row (alveoli).	Mandibular tooth-row (alveoli).
<i>T. borneanus</i>	Opposite Pulo Jambu, Kapuas River.	b 4772	Male	Adult	mm.	mm.	mm.	kilos.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Do.....	Opposite Pulo Saparo, Kapuas River.	142345	do.	do.	545	85	138	4.536	104.2	96.9	90.2	65.5	26.9	48.7	81.4	36.6	43.3
Do.....	Ten miles below Tyan, Kapuas River.	142346	Female	do.	482	.....	135	2.155	108.2	101.0	94.0	68.5	25.5	49.6	85.0	37.3	42.8
<i>T. hosei</i>	Below Tyan, Kapuas River.....	142348	do.	do.	.....	.....	.....	.....	95.3	88.2	81.9	57.5	27.8	43.3	72.4	34.0	39.0

^b Skeleton.

^a Collector's measurements.

TRAGULUS BORNEANUS Miller.

1902. *Tragulus borneanus* MILLER, Proc. Biol. Soc. Washington, XV, p. 174, August 6, 1902.

Two skins with skulls and one skeleton from the Kapuas River. The skins are practically indistinguishable in coloration from specimens of *Tragulus napu* from Sumatra. The Bornean animals are somewhat smaller. (For measurements, see page 549.)

RUSA BROOKEI (Hose).

1893. *Cervus brookei* HOSE, Ann. Mag. Nat. Hist., 6th ser., XII, p. 206.
1906. *Rusa brookei*, LYON, Proc. U. S. Nat. Mus., XXXI, p. 585, December 18, 1906.

Two specimens from along the Kapuas River, the antlers of an adult male, Cat. No. 142356, U.S.N.M., and the skull of a nearly adult male, Cat. 142357, U.S.N.M.

Measurements of these specimens respectively: Length of antler along convexity of curve, 462, 325; burr to tip of frontal tine along convexity, 160, 136; circumference of antler above frontal tine, 132, 84; tip of apical tine to its angle with main trunk of antler, 50, 33. The basal length of the skull of Cat. No. 142357, U.S.N.M., is 332 mm., maxillary toothrow (alveoli) 105 mm.

MUNTIACUS PLEIHARICUS (Kohlbrugge).

1896. *Cervulus pleiharicus* KOHLBRUGGE, Natuurkundig Tijdschrift Nederlandsch-Indië, LV, 1896, p. 192, plate facing p. 260.
1906. *Muntiacus pleiharicus*, LYON, Proc. U. S. Nat. Mus., XXXI, p. 583, December 18, 1906.

Represented by the frontlet and antlers of an adult male from the Sakaiam River, Cat. No. 142358, U.S.N.M.

Measurements: Burr to tip of antler along convex curve, left 112 mm., right 97; tip of frontal tine to angle with main trunk of antler, left 26, right 27; distance between the angles of the pedicles with skull, 56; distance from angle of pedicle with skull to posterior edge of burr, left 83, right 83.

SUS BARBATUS Müller.

1839. *Sus barbatus* MÜLLER, Tijdschrift voor Natuurlijke Geschied. en Physiologie, V, p. 149.
1906. *Sus barbatus*, MILLER, Proc. U. S. Nat. Mus., XXX, p. 739, June 13, 1906.

Six skulls, without skins, obtained from the natives along the Landak River. Cranial measurements are given in the table below, the points between which they are taken being the same as those used by Miller in his Notes on Malayan Pigs.^a Of the six skulls, five are evidently males and one a female. They are all skulls of adult or

^a Proc. U. S. Nat. Mus., XXX, pp. 755, 756, June 13, 1906.

nearly adult animals. Cat. No. 142355, U.S.N.M., is the youngest, the last upper molar is just through the alveolus, and is entirely unworn. Cat. No. 142353, U.S.N.M., is of about the same age. Cat. No. 142350, U.S.N.M., the female, is a little older than the two preceding, as the last upper molar is beginning to show wear. The last upper molar in Cat. No. 142354, U.S.N.M., shows more wear than any of the foregoing, but not so much as the remaining two, Cat. Nos. 142352 and 142351, U.S.N.M., which are fully adult boars. The teeth of No. 142351, U.S.N.M., show considerable wear. The lower jaw sent in with this specimen evidently came from another individual, as it does not fit the skull accurately. However, it is the lower jaw of a male of about the same age, or perhaps a trifle older, and from an animal about the same size.

Cranial measurements of Sus barbatus from western Borneo.

Dimensions.	Cat. No. 142355, male, nearly adult.	Cat. No. 142353, male, nearly adult.	Cat. No. 142350, female, adult.	Cat. No. 142354, male, adult.	Cat. No. 142352, male, adult.	Cat. No. 142351, male, adult.
	mm.	mm.	mm.	mm.	mm.	mm.
Upper length.....	395	430	418	473		487
Basal length.....	300			401		
Basilar length.....	338			377		
Palatal length ^a	278	294	284	323	312	333
Width of palate at pm^1	40	42.5	32.2	45	40	43
Width of palate, including m^3	68.2	79.3	66.6	67	69	75
Least width of palate at front of m^4	25	27	24.5	24	27.5	31
Zygomatic breadth.....	128	155	138	160	158	172
Least interorbital breadth.....	58	69	66	65	76.5	69
Parietal constriction.....	14.6	12.7	17.7	10.5	17.5	20.8
Nasal breadth at posterior extremity of premaxillary.....	20.2	32.5	32.4	30.7	33.6	36
Length of nasals.....	200	222	212	250		267
Occipital depth to basion.....	115			141		
Mandible.....	315	327	306	350	349	376
Maxillary tooththrow (alveoli).....	129.5	129	126.4	129	132	138
	23	24.5	23	22.5	23.5	25
Second upper molar.....	X	X	X	X	X	X
	20	20	18.5	18.5	19.5	20
	34	33	33.5	33.5	35.5	36
Third upper molar.....	X	X	X	X	X	X
	20.5	21.5	20.5	20.5	21	20.5
Mandibular tooththrow (alveoli).....	127	123	128	125	136	138
	22.5	23.5	22	23	23	25
Second lower molar.....	X	X	X	X	X	X
	17	16	15	15	17	17.5
	38	36	38	27.5	41	45
Third lower molar.....	X	X	X	X	X	X
	18	17.5	17.5	17	19	20

^a Palatal length measured from the most anterior portion of the posterior edge of the lateral halves of the palate, and not from the notch between the two halves of the palate. The latter point seems to be variable and becomes pushed farther backward with advancing age.

[I did not see a single live pig in Borneo. Judging from the tusks, the Dyaks keep the lower jaws only, some of the boars must be enormous.—W. L. Abbott.]

SCIURUS BORNEOENSIS BORNEOENSIS (Müller and Schlegel).

1839-44. *Sciurus rafflesii* var. *borneoensis* MÜLLER and SCHLEGEL, Verhandl. Natur. Geschied. Nederland. Overz. Bezitl. Leiden, p. 86.

Ten of the *prevostii* squirrels collected by Doctor Abbott in western Borneo may be referred to this form. For a list of them, with exact localities, see table of measurements, page 556. *Sciurus borneoensis* appears to be a very variable species, inhabiting western Borneo north of the Kapuas River. South of that river a very different *prevostii* squirrel occurs, which is described on page 554. The squirrels north of the river fall into two distinct forms, the typical red-shouldered *borneoensis*, apparently confined to the uplands, and a dark-bellied black-shouldered form, described below as a new subspecies, confined to the swampy lands near the mouths of the rivers. Above Tanjong Putus, on the Landak River, and above Pulo Saparo, on Kapuas River (see map, frontispiece), Doctor Abbott collected the red-shouldered form, while below these points the specimens all have blackish shoulders. Three skins from Tanjong Putus, collected on July 15, are referable to the typical form, while two others also marked Tanjong Putus, collected on July 16, are referable to the dark-shouldered variety. As Doctor Abbott collected while descending the rivers, the two skins obtained on July 16 are probably from a slightly lower point on the river than the three taken on the previous day.

While visiting the Leyden Museum, Mr. Gerrit S. Miller, jr., made the following notes on the cotypes of *Sciurus borneoensis*.

Cotypes, three [lettered: *o*, *p*, and *q*], all from Pontianak. They are very uniform in color, all showing the strongly grizzled sides above the pale lateral stripe, the clear black area on shoulders being reduced to 20-25 mm. Most of the caudal hairs, except at base and pencil, with cream buff tips about 10 mm. long. In one specimen the feet are red, in the others they are black sprinkled with red hairs. Red area rufous, darkening to chestnut. Cheek and sides of neck a mixture of black, red, and white, each color slightly predominating in one specimen. Whitish spot below eye distinct but very small; whitish patch at base of whiskers conspicuous. Measurements: *o* (300) [head and body] 250 [tail vertebrae] 60 (55) [hind foot with and without claws], *p* (280) [head and body] 250 [tail vertebrae] 58 (53) [hind foot with and without claws], *q* (290) [head and body] 280 [tail vertebrae].

The three specimens taken on July 15 at Tanjong Putus, on the Landak River, about 25 to 30 miles above Pontianak, agree very well with the above account. Cat. No. 142307, U.S.N.M., from the north bank of the Kapuas at Sanggau, agrees most closely with the published figure^a of *S. borneoensis* in respect to general coloration. It lacks the conspicuous white spot at base of whiskers, however, and the white lateral stripe is not subtended by a conspicuous black stripe. None of the squirrels of this species collected by Doctor Abbott either of the typical form or not, has a conspicuous white patch at

^a Nederland. Tijds. Dierkunde, I, pl. 1, fig. 3.

base of whiskers, but some of the nontypical forms do show small whitish areas at base of whiskers. The present material indicates that *Sciurus borneoensis* is a very variable species. Including in the species the lowland form described below, the following are some of the more striking variations, but all sorts of intermediate conditions are found between the extremes:

Base of whiskers whitish to bright ferruginous; cheeks and sides of neck and shoulders black with slight grizzling of whitish, to conspicuous grizzling with buffy and reddish, to almost a clear bright ferruginous; area above pale lateral stripe pure black grizzled with white or ochraceous or both in varying mixtures; feet, pure black, or bright rufous or various mixtures of these, or black with slight grizzling of buffy; underparts bright rufous to a general effect of seal-brown, the latter caused by a mixture of dark chestnut and blackish.

SCIURUS BORNEOENSIS PALUSTRIS, new subspecies.

Type.—Adult male, skin and skull, Cat. No. 142330, U.S.N.M. Collected on the north bank of the Kapuas River, below Pulo Limbang, western Borneo, September 22, 1905, by Dr. W. L. Abbott. Original number 4467.

Diagnostic characters.—Similar to *Sciurus borneoensis borneoensis*, but no red or rufous color appearing on cheeks, sides of neck, or shoulders.

Color.—Top of head, top of neck for a width of about 20 mm., back for a width of 25–30 mm. over shoulders, 50–60 mm. in the middle portion, narrowing to 20 mm. on the rump, base of the tail above and terminal hairs of the tail above and below, black; lateral stripe, about 100 mm. long, extending from behind the shoulder where it is 5 mm. wide, to front of thigh, where it is 15 mm. wide, and an inconspicuous spot under the eye, white; sides of neck, shoulder, outer side of upper arm, side of body between the white lateral stripe and the black back, a fine and equal grizzle of black and white, becoming a coarse grizzle of black and white, the latter color in excess, on the sides of the rump above the thigh; sides of head, upper surface of feet, outer side of forearm, and ears, black, finely grizzled with inconspicuous white; base of whiskers and area around lips, buffy; underparts of body and inner sides of legs, an equal grizzle of black and ferruginous; underside of tail, between the black basal portion and the black pencil, a coarse mixture of black and white.

Variations from the type.—Some specimens have more black in the underparts, so that the general effect is almost seal brown. One skin from Pulo Saparo, Cat. No. 142324, U.S.N.M., and one from Pulo Kanchil, Cat. No. 142319, U.S.N.M., have more extensive black backs and no grizzling appears between the pure black back and the white lateral stripe. The amount of light grizzling above the shoulder is variable. Two skins, Cat. No. 142321, U.S.N.M., opposite Pulo

Jambu, and Cat. No. 142322, U.S.N.M., opposite Pulo Saparo, show very slight traces of the red about the shoulder, which becomes such a conspicuous feature of *Sciurus borneoensis borneoensis*. In about half the specimens the white side stripe is subtended by a fairly well, marked black stripe. This black stripe is not very evident in the type. The white is often so arranged on the tail that in certain lights it appears black and white ringed.

Skull and teeth.—These show no characters by which they may be distinguished from those of the typical form or other species of the same size.

Measurements.—For measurements of the type and series see table, page 556.

Specimens examined.—Fifteen. See table, page 556.

Remarks.—*Sciurus borneoensis palustris* appears to be a dark-shouldered, dark-bellied form of *S. borneoensis* confined to the low swampy lands near the sea. No single specimen in the present series shows a complete intergradation with the typical form, but by picking out various specimens in the two series and using only homologous characters complete intergradation may be found from any style of one to any style of the other form.

SCIURUS SANGGAUS, new species.

Type.—Adult female, skin and skull, Cat. No. 142296, U.S.N.M. Collected at Sanggau, western Borneo, south bank of Kapuas River, August 21, 1905, by Dr. W. L. Abbott. Original number, 4357.

Diagnostic characters.—A member of the *Sciurus prevostii* group, most like *Sciurus carimatae* Miller,^a but shoulder darker, a grizzle of black and buff, and the white area of thigh finely mixed with black.

Color of type.—Nose, top of head, entire upper parts of body, and entire tail, black; entire underparts, inner side of legs, and upper surfaces of feet, ferruginous to orange-rufous; base of whiskers, small spot under eye, lateral stripe 100 mm. long by 10 wide, from just behind shoulder to front of thigh, white; outer side of thigh a coarse grizzle of black and white; sides of head and neck a fine grizzle of black and white, the black in excess; region of shoulder a grizzle of black and pale ochraceous or buff blending in with the ochraceous of the upper arm.

Variations in the series.—With the exception of two specimens from Pulo Kubu (opposite Pulo Limbang), no noteworthy variations in color are found in the series. In some individuals the cheeks are grayer than they are in the type. One or two specimens show the shoulder area nearly clear gray while in others a light ochraceous predominates. Compared with the series taken on the north bank of the Kapuas, the squirrels south of that river are remarkably uniform.

^aProc. U. S. Nat. Mus., XXXI, p. 57, July 23, 1906.

The two skins from Pulo Kubu (Cat. Nos. 142327, and 142328, U.S.N.M.) differ from the rest of that series in being slightly larger and in having the shoulder area tawny-ochraceous and the white on the thighs with scarcely any admixture of black.

Skull and teeth.—Apparently there are no constant differences by which skulls of *Sciurus sanggaus* may be distinguished from those of related species.

Measurements.—See table, page 556. *Sciurus sanggaus* averages slightly smaller than *S. borneensis*.

Specimens examined.—Twenty-one; see table, page 556.

Remarks.—It is possible the two specimens from Pulo Kubu may represent a race distinct from the typical form. They average slightly larger than the rest of the series and differ somewhat in color as already noted. Except for a slightly smaller size they are practically indistinguishable from specimens of *Sciurus bangkannus*.

[The *Sciurus rafflesii* [or *prevostii*] class was particularly interesting and there is a large series. All those from the left bank of the Kapuas (facing sea) have black tails and all from the right bank and its adjacent islands have gray tails and are much more variable.—W. L. Abbott.]

SCIURUS DULITENSIS (Bonhote).

1901. *Sciurus vittatus dulitensis* BONHOTE, Ann. Mag. Nat. Hist., VII, May, 1901, p. 451.

Doctor Abbott secured nine plantain squirrels in western Borneo which may be referred to this species. I have seen no examples from Mount Dulit, but Doctor Abbott's specimens do not differ essentially from plantain squirrels from Sarawak, though they apparently have less yellow on cheeks, sides of neck, and forearm. In color of the underparts, size and distinctness of the lateral stripes, the west Borneo squirrels show considerable variation, but it does not seem to be correlated with definite areas as in the case of the *prevostii* group of squirrels. For measurements see table, page 557.

Measurements of the squirrels of the *Sciurus prevostii* group in western Borneo.

Name.	Locality.	Number.	Sex and age.	Head and body. ^a	Tail vertebra. ^a	Hind foot with claws. ^a	Greatest length of skull.	Interorbital constriction.	Zygomatic breadth.
<i>S. sanggaus</i>	Pulo Kubu, south bank of Kapuas.	142327	Male adult.....	mm. 245	mm. 252	mm. 61	mm. 57.0	mm. 20.6	mm. 33.8
Do.....	do.....	142328	Female adult.....	270	240	63	57.5	23.1	34.6
Do.....	Op. Pulo Saparo, south side of Kapuas.	142313	Male adult.....	245	235	61	53.4	22.6	33.8
Do.....	do.....	142314	do.....	250	248	62	56.0	21.9	34.0
Do.....	do.....	142315	do.....	235	245	61	54.9	21.8	32.9
Do.....	do.....	142316	do.....	253	230	61	55.7	21.9	34.6
Do.....	do.....	142317	Female adult.....	255	255	62	57.4	23.4	34.9
Do.....	Sanggau, south bank of Kapuas.	142293	Male adult.....	255	195	64	54.5	21.4	33.8
Do.....	do.....	142294	do.....	235	210	60	.....	20.2	.....
Do.....	do.....	142295	do.....	240	220	61	53.0	21.6	32.0
Do.....	do.....	142296 ^b	Female adult.....	244	238	60	56.3	23.5	35.8
Do.....	do.....	142297	do.....	241	235	60	55.6	21.5	34.0
Do.....	do.....	142298	do.....	245	235	60	54.6	22.2	33.3
Do.....	do.....	142299	do.....	240	.....	62	54.9	20.8	32.4
Do.....	do.....	142300	do.....	245	240	61	53.9	20.9	32.3
Do.....	do.....	142301	do.....	251	238	63	55.6	23.5	34.2
Do.....	do.....	142302	do.....	280	225	62	55.8	21.7	34.0
Do.....	do.....	142303	Male adult.....	245	245	60	55.2	21.6	33.0
Do.....	do.....	142304	do.....	240	225	61	55.4	23.2	34.4
Do.....	do.....	142305	Female juv.....	228	250	60	53.1	20.2	31.7
Do.....	do.....	142306	Female adult.....	254	240	64	54.9	22.6	.....
<i>S. borneensis palustris</i> .	Sungei Sama, near Pontianak	142286	do.....	265	255	64	58.8	24.3	35.9
Do.....	Tg. Putus, Landak River.	142290	Male adult.....	255	240	65	54.5	24.4	35.0
Do.....	do.....	142291	do.....	248	253	64	54.6	.....	32.4
Do.....	Below Pulo Limbang, north side of Kapuas.	142329	do.....	268	.....	65	57.5	22.0	33.7
Do.....	do.....	142330 ^b	do.....	260	270	65	58.7	22.6	34.6
Do.....	do.....	142331	do.....	255	245	65	58.6	23.3	34.8
Do.....	Op. Pulo Jambu, north side of Kapuas.	142320	do.....	245	277	65	.....	23.2	33.5
Do.....	do.....	142321	Female adult.....	263	257	64	58.0	23.3	35.6
Do.....	do.....	142323	do.....	260	245	62	57.5	23.0	34.9
Do.....	Op. Pulo Saparo, north side of Kapuas.	142322	do.....	260	260	64	59.3	22.3	35.4
Do.....	Pulo Saparo, north side of Kapuas.	142324	do.....	255	260	63	56.2	21.2	33.8
Do.....	do.....	142325	do.....	265	255	65	56.6	21.5	33.8
Do.....	do.....	142326	do.....	265	247	61	57.6	22.0	34.5
Do.....	Pulo Kanchil, north side of Kapuas.	142319	do.....	243	237	62	54.9	21.7	32.8
Do.....	do.....	142318	Male adult.....	238	250	62	56.9	23.7	35.5
<i>S. borneensis borneensis</i> .	10 miles below Tyan, north bank of Kapuas.	142309	do.....	240	250	60	53.8	21.4	32.3
Do.....	do.....	142310	do.....	240	260	63	58.0	22.2	35.0
Do.....	do.....	142311	Female adult.....	235	240	60	54.3	21.0	33.9
Do.....	do.....	142312	do.....	254	248	64	.....	22.3	.....
Do.....	Sanggau, north bank of Kapuas.	142307	Male adult.....	237	235	55	55.5	23.4	34.3
Do.....	do.....	142308	do.....	240	240	55	54.0	21.0	33.0
Do.....	Sungei Nya, Landak River.	142292	Female adult.....	240	225	60	54.5	22.7	33.9
Do.....	Tg. Putus, Landak River.	142287	Male adult.....	250	235	64	56.5	21.7	35.0
Do.....	do.....	142288	do.....	245	245	62	57.0	22.0	34.7
Do.....	do.....	142289	do.....	245	250	63	54.0	22.9	.....

^a Collector's measurements.^b Type.

SCIURUS HIPPURELLUS Lyon.

1907. *Sciurus hippurellus* LYON, Smithsonian Misc. Coll., L, p. 27, April 8, 1907.

Three specimens, two from the Landak River and one from the Kapuas River below Tyan. For measurements, see table below.

Measurements of squirrels from western Borneo.

Name.	Locality.	Number.	Sex and age.	Head and body. ^a	Tail vertebrae. ^a	Hind foot with claws. ^a	Greatest length of skull.	Zygomatic width.	Interorbital constriction.
<i>S. dultensis</i>	Pontianak.....	142275	Male, immature.	mm. 205	mm. 195	mm. 52	mm. 49.4	mm.	mm. 17.4
Do.....	Sungei Sama.....	142276	Male, adult.....	210	208	51	49.0	29.0	17.5
Do.....	Sanggau.....	142277	.....do.....	213	182	53	50.2	28.8	16.7
Do.....	.....do.....	142278	.....do.....	200	195	52	49.4	29.9	17.3
Do.....	Kapuas River below Pulo Limbang.	142279	.....do.....	225	195	55	52.3	30.0	17.3
Do.....	Kwala Pontianak.....	142280	Female, adult..	217	180	53	51.0	31.7	18.3
Do.....	.....do.....	142281	Female, young..	190	180	50	48.4	27.8	16.6
Do.....	Sungei Sama.....	142282	.....do.....	195	195	52	48.7	28.3	17.4
Do.....	Sanggau.....	142283	.....do.....	201	145	52	49.0	29.0	16.0
<i>S. hippurellus</i> ..	Kapuas River below Tyan.	142272	Male, adult.....	250	250	61	55.7	34.2	18.2
Do.....	Landak River, Ngabong.	142273	Female, adult..	240	260	61	56.1	34.2	19.5
Do.....	Landak River, Batu Ampar.	142274	Female, old.....	250	280	63	58.5	35.7	19.7
<i>R. ephippium</i> ..	Sanggau.....	142332	Male, adult.....	345	425	88	65.5	43.4	28.3
Do.....	North bank of Kapuas.	142333	.....do.....	330	385	83	64.4	40.4	25.7
Do.....	Sanggau district, Sungei Sakaiaim.	142334	Female, adult..	370	445	90	68.0	42.0	29.0
Do.....	Kapuas River, opposite Pulo Jambu.	142335	Female, nearly adult.	320	415	82	63.9	38.4	25.1

^a Collector's measurements.

RATUFA EPHIPIUM (Müller).

1838-39. *Sciurus ephippium* MÜLLER, Tijds. Natuur. Geschied. Physiol., V, p. 147.

Four specimens collected by Doctor Abbott in western Borneo agree fairly well with the original description, with the published figure,^a and with notes made on the type in Leiden in 1904 by Mr. Gerrit S. Miller, jr., who remarks: "No locality can be given beyond southeastern Borneo in the low country," and further: "The plate^a is a good representation of this specimen, except that color is a little too light, especially on cheeks, neck, feet, and along the sides, and the dark dorsal area does not come down far enough on the hips."

Of Doctor Abbott's specimens, Cat. No. 142334, U.S.N.M.; from Sungei Sakaiaim agree best with Müller's figure as modified by Mr. Miller's statement. The other three specimens are lighter and duller colored; especially along the sides and thighs, where they are even lighter in color than Müller's figure. The skulls show no essential differences from Müller's figures, although in general the rostrum is less pointed; but this may be accounted for by a certain degree of immaturity in the skull figured by him, which shows a distinct fronto-parietal suture which is always lacking in fully adult skulls.

^a Verhandl. Natuur. Geschied. Nederl., 1839-1844, p. 91, pl. xiii.

Thus Cat. No. 142335, U.S.N.M., a nearly mature female, has a much more pointed rostrum than No. 142334, U.S.N.M., an old female. For measurements, see table, page 557.

NANNOSCIURUS BORNEANUS Lyon.

1906. *Nannosciurus borneanus* LYON, Proc. Biol. Soc. Washington, XIX, p. 54, May 1, 1906.

Thirteen specimens as follows: One skin and skull from Sungei Sama; five skins and skulls and one alcoholic from Tanjong Putus, Landak River; five skins and skulls and one alcoholic from the Kapuas River. (For table of measurements of these and related species, see Lyon, Proc. U. S. Nat. Mus., XXXI, 1906, p. 594.)

NANNOSCIURUS EXILIS (Müller).

One skin and skull, an adult male, from Sanggau. Collector's measurements: Head and body, 77 mm.; tail vertebrae, 50; hind foot, 25.

MUS EPHIPPIMUM Jentink.

1880. *Mus ephippium* JENTINK, Notes Leyden Museum, II, p. 15.

1894. *Mus ephippium*, THOMAS, Ann. Mag. Nat. Hist., 6th ser., XIV, p. 453.

Nine small rats, most of them immature, from various localities, may be referred to this species. They are somewhat smaller and have darker bellies and narrower audital bullae than a specimen that seems to be *Mus ephippium* from Tarussan Bay, Sumatra, but the material is not sufficient to determine their status satisfactorily.

For measurements see table below.

[Caught in Dyak houses.—W. L. Abbott.]

MUS RAJAH Thomas.

1894. *Mus rajah* THOMAS, Ann. Mag. Nat. Hist., 6th ser., XIV, p. 451.

One specimen, a young adult male, from the Kapuas River below Tyan. The single specimen is somewhat smaller than specimens of *Mus rajah* in the U. S. National Museum from the Natuna Islands, perhaps owing to its immaturity.

For measurements, see table below.

Measurements of *Mus* from western Borneo.

Name.	Locality.	Number.	Sex.	Age.	Head and body. ^a	Tail. ^a	Hind foot with claws.	Greatest length of skull.
					mm.	mm.	mm.	mm.
<i>Mus ephippium</i> ..	Sungei Sama.....	b 142250	Male.....	Young adult..	115	112	23	27.6
Do.....	do.....	b 142251	Female.....	Adult.....	123	125	25	29.5
Do.....	do.....	b 142252	do.....	do.....	125	121	24	30.0
Do.....	Pulo Jambui.....	c 142253	do.....	Young adult..	110	115	24	28.5
Do.....	do.....	c 142257	do.....	do.....	114	122	24	.....
<i>Mus rajah</i>	Kapuas River below Tyan.	c 142248	Male.....	do.....	162	158	42	41.7

^aCollector's measurements.

^bAlcoholic.

^cSkin and skull.

FELIS BENGALENSIS of Authors.

One specimen from Ngabong, Landak River, a young female, with none of the permanent teeth in place.

Measurements: Cat. No. 142343, U.S.N.M.; head and body, 387 mm.; tail, 158; hind foot, 88; greatest length of skull, 69; zygomatic breadth, 47.5.

ARCTOGALIDIA STIGMATICA (Temminck).

An adult male from the Landak River. Cat. No. 142341, U.S.N.M.

Measurements: Head and body, 555 mm.; tail, 660; hind foot, 96; weight, 7½ lbs. (3.29 kgs.); greatest length of skull, 110; basal length, 105.6; basilar length, 103.5; zygomatic width, 67.7; interorbital constriction, 13.7; front of canine to back of last upper molar, 41.

PARADOXURUS PHILIPPINENSIS Jourdan.

1885. *Paradoxurus philippinensis*, BLANFORD, Proc. Zool. Soc. London, p. 800.

Two specimens of *Paradoxurus*, collected by Doctor Abbott in western Borneo, do not appear essentially different from two skins collected by Dr. E. A. Mearns in the Philippine Islands.

Measurements: Adult male, Pontianak, Cat. No. 142338, U.S.N.M., and adult male, Sanggau, Cat. No. 142339, U.S.N.M., head and body, 500, 470 mm.; tail, 443, 375; hind foot, 85, 84; greatest length of skull, 101.4, 100.5; basal length, 95.7, 92.4; basilar length, 93.5, 91.5; front of canine to back of last upper molar, 36.5, 35.7.

[Brought alive by a Malay, very thin.—W. L. Abbott.]

HERPESTES SEMITORQUATUS Gray.

1846. *Herpestes semitorquatus* GRAY, Ann. Mag. Nat. Hist., XVIII, 1846, p. 211.

1879. *Herpestes semitorquatus*, ANDERSON, Zool. Western Yunnan, p. 191, pl. ix, figs. 1, 2.

I refer a young male mongoose from Sanggau to this species with some hesitation. It is a very immature individual, and while the characters of the skin answer in a general way to the description of that of *Herpestes semitorquatus*, the appearance of the skull suggests that at maturity it would more nearly resemble that of *H. vitticollis*.^a The light area on the sides of the neck is not at all conspicuous, as the description of *H. semitorquatus* indicates. The back and upper sides are not "finely marked with yellow," but most of the long hairs of those regions have a rather wide yellow subterminal band.

Measurements: Cat. No. 142340, U.S.N.M., immature male, head and body, 370 mm.; tail, 235; hind foot, 82; greatest length of skull, 78; zygomatic width, 43.

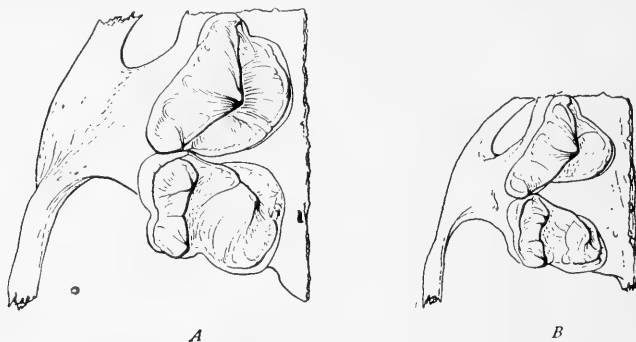
^a Anderson, Zool. West. Yunnan, p. 191, pl. ix, figs. 3, 4.

LUTRA LOVII Günther.

1876. *Lutra loyii* GÜNTHER, Proc. Zool. Soc. London, p. 736. (Type-locality, Borneo, opposite island of Labuan.)

1905. *Lutra loyii*, WILLINK, Natuurkundig Tijdschrift Nederlandsch Indië, LXV, p. 222.

Two small hairy-nosed otters may be referred to this species, which is almost an exact miniature of the large *Lutra barang* of the Malay region. The color of *Lutra loyii* is generally darker throughout, both above and below. The light area on the throat is more restricted and more contrasted with the general dark color of the animal. The tail is relatively much larger than it is in the *Lutra barang* and considerably longer (about 4 inches = 100 mm.) than the published measurements (11 inches) of *Lutra loyii*. The skull of *Lutra loyii* has about the same general size as that of the clawless otter, *Aonyx*



A. LAST TWO MAXILLARY TEETH (RIGHT SIDE) OF *LUTRA BARANG*, ADULT FEMALE, CAT. NO. 104437, U.S.N.M., PULO LANKAWI, $\times 1\frac{1}{2}$. B. LAST TWO MAXILLARY TEETH OF *LUTRA LOYII*, ADULT FEMALE, CAT. NO. 142337, U.S.N.M., PULO SAPARO, IN KAPUAS RIVER, WESTERN BORNEO, $\times 1\frac{1}{2}$.

cinerea, but in shape and in relative proportions it is almost an exact counterpart of that of *Lutra barang*. In addition to the differences in size between the skulls of *Lutra loyii* and *L. barang* may be mentioned the enlarged bullæ of the smaller species, the distinctly smaller foramina along the inner side of the bullæ and the reduction of the inner segment of the upper carnassial tooth.

The marked differences between the carnassial teeth of the small *Lutra loyii* and the large *L. barang* are well shown in the figure above, and require no detailed description. They may indicate more than a specific difference.

The two adult females collected by Doctor Abbott measure as follows: Cat. No. 142336, U.S.N.M. (near Pontianak), and No. 142337, U.S.N.M. (Pulo Saparo); head and body, 615, 575 (585)^a mm; tail, 385, 375 (280); hind foot with claws, 107, 103; greatest length of skull, 101, 100.2; basal length, 94.3, 91.4; upper length, 85, 83.7

^a See foot note on page 561.

[about 90];^a mastoid breadth, 51.4, 53 [about 55]; zygomatic breadth, 58, 58.9[—]; interorbital constriction, 11.4, 13.7 [—]; upper tooth row to front of canine, 30.5, 30.7 [32.4]; lower tooth row to front of canine, 38, 38 [42.4].

Mr. Gerrit S. Miller, jr., writes that the type of *Lutra lovii* in the British Museum is "a young hairy-nose with milk canine and next to last premolar in place. Skull broken away behind." It will be seen from the above measurements that Doctor Abbott's two small otters have much longer tails than has the type of *L. lovii*, and slightly smaller skulls; and it is not at all unlikely that they represent a different race. As the type of *L. lovii* is young and of the opposite sex from Doctor Abbott's two specimens, it does not seem advisable for the present to name the Bornean form.

HELARCTOS EURYSPILUS Horsfield.

1826. *Helarctos euryspilus* HORSFIELD, Zool. Journ., II, pp. 221-234, pl. VII.

A single skull, Cat. No. 142344, U.S.N.M., without lower jaw, from the Landak River, may be referred to *Helarctos euryspilus*, which most authors have regarded as a synonym of *H. malayanus*, and not without reason, for Horsfield's description of *Helarctos euryspilus* was based on a living example in London, and no characters are given to differentiate the two forms. In 1903 Doctor Abbott collected a full-grown male of the Sumatran *Helarctos malayanus* along the Kateman River, eastern Sumatra. A comparison of its skull with the Bornean skull shows well-marked differences between the two insular forms. It should be noted, however, that the type of *H. malayanus* came from Bencoolen, some little distance from the Kateman River, and that no locality in Borneo is mentioned for *H. euryspilus*, so that the following comparison may not be made between typical examples of the two species. Both skulls are fully adult and of nearly equal age, although the Sumatra one is the older. The sex of the Bornean skull is unknown, but judging from the large size of the canine and other teeth it is without question not different in sex from the Sumatran skull.

In addition to the difference in size shown in the following table may be mentioned the greater relative size of the maxillary teeth in the Bornean bear, which are actually as large as in the Sumatran species; the relatively wider palate and its greater posterior extension behind the toothrow in *Helarctos malayanus*, relatively larger bullæ in *H. euryspilus*, and the very large expansion of that portion of the mastoid applied to the posterior aspect of the auditory canal in the Sumatran species.

^a Measurements in parentheses are those given in the original account of *Lutra lovii* (Proc. Zool. Soc. London, 1876, p. 736), and those in brackets measurements of the type skull of *Lutra lovii* made by Mr. Gerrit S. Miller, jr.

Cranial measurement of Sumatran and Bornean sun-bears.

Dimensions.	<i>Helarctos malayanus</i> , Cat. No. 123138, Kate- man River, eastern Su- matra.	<i>Helarctos curyspilus</i> Cat. No. 142344, Lan- dak River, Borneo.
	mm.	mm.
Basal length.....	215	189.5
Basilar length.....	210	186
Condyllo-basal length.....	234	205
Palatal length.....	117	102.3
Greatest length.....	256	222
Zygomatic width.....	208	176.4
Mastoid width.....	156	134.5
Width of braincase above zygomata.....	104	91.8
Width at postorbital processes.....	87.5	74.6
Least interorbital width.....	69	60
Least width of palate between last upper molars.....	41	36
Posterior edge of last upper molar (alveolus) to palation.....	36	28
Posterior edge of last upper molar (alveolus) to tip of pterygoid.....	66	60
Alveolar length of last three upper cheek teeth combined.....	44	44.5
Antero-posterior diameter of canine at alveolus.....	25	22.5

TUPAIA DORSALIS Schlegel.

1857. *Tupaia dorsalis* SCHLEGEL, Handl. beoef. Dierkunde, Pt. 1, p. 59, pl. III, fig. 31.

1890. *Tupaia dorsalis*, JENTINK, Notes Leyden Museum, XII, p. 228.

Skin and skull of adult female from the Kapuas River opposite Pulo Saparo. Region of that river is the type-locality.

Measurements, Cat. No. 142247, U.S.N.M.: Head and body, 175 mm.; tail vertebrae, 145; hind foot 43; greatest length of skull, 49; zygomatic width, 22.4; interorbital constriction, 12.8.

[Snared by Malay.—W. L. Abbott.]

TUPAIA SPECIOSA (Wagner).

1840. *Cladobates* *speciosus* WAGNER, Schrebers Säugthiere, Supplementband von J. A. Wagner, II, p. 43.

Two specimens, an adult male from the Kapuas River opposite Pulo Jambu and a young male from the Tyan district. Owing to the general distinctness of species in related groups from Borneo and Sumatra, I have used the name *Tupaia speciosa* (type-locality, Borneo) in preference to the usual name *T. tana* (type-locality, Sumatra). The adult, Cat. No. 142247, U.S.N.M., measures: Head and body, 229 mm.; tail, 196; hind foot, 55; greatest length of skull, 64; zygomatic width, 29.3; interorbital constriction, 16.6.

CYNOPTERUS BRACHYOTIS (Müller).

1839. *Pachysoma brachyotis* MÜLLER, Tijdschrift Natuur. Geschied. Physiol., V, p. 146.

Twenty-five specimens, 2 skins with skulls and 23 in alcohol, all from the Kapuas River, Sanggau district.

For external measurements of ten adults see table, page 564. Nearly all of the specimens are pregnant females.

RHINOLOPHUS TRIFOLIATUS Temminck.

- 1835–1841. *Rhinolophus trifolius* TEMMINCK, Monogr. Mammalogie, II, p. 27, pl. xxxi. (Java, type-locality.)
 1878. *Rhinolophus trifolius*, DOBSON, Cat. Chirop. British Mus., p. 106, pl. vii, fig. 3.
 1905. *Rhinolophus trifolius*, ANDERSEN, Ann. Mag. Nat. Hist., 7th ser., XVI, August, 1905, p. 249, and table opposite p. 256, and figs. 2 and 2a, p. 245.

One specimen, an adult male, Cat. No. 142384, U.S.N.M., preserved, in alcohol from Pulo Kanchil, Kapuas River. The type of *Rhinolophus trifolius* came from Java, but I quite agree with Andersen, in the absence of specimens, in using Temminck's name for the Bornean animal, although, as Andersen has pointed out, there are some discrepancies between Temminck's natural-size illustration and Bornean specimens. The example secured by Doctor Abbott is a large-sized individual, agreeing in most respects with Andersen's maximum measurements.

For external measurements see table, page 564. The principal cranial measurements are: Total length, 24.9 mm.; mastoid width, 11.1; zygomatic width, 12.4; width of nasal swellings, 6.5; maxillary tooththrow, 9.4; mandibular tooththrow (not including incisors), 9.9.

MYOTIS MURICOLA (Hodgson).

Seven specimens from Sanggau, an adult male, four adult females, and two young, all in alcohol.

For external measurements see table, page 564.

[Caught roosting in the plantain leaves.—W. L. Abbott.]

GLISCHROPUS TYLOPUS (Dobson).

1875. *Vesperugo (Glischropus) tylopus* DOBSON, Proc. Zool. Soc. London, p. 473 (type-locality, northern Borneo).
 1907. *Glischropus tylopus*, MILLER, Bull. 57, U. S. Nat. Mus., p. 205, June 29, 1907.

Doctor Abbott secured 56 specimens of this interesting bat, all preserved in alcohol from the following localities: Sungei Sama, near Pontianak, 38; Kapuas River opposite Pulo Jambu, 11, and on Pulo Jambu, 7.

For external measurements see table, page 564.

[Caught in banana leaves, caught in a hollow bamboo.—W. L. Abbott.]

KERIVOULA HARDWICKII (Horsfield).

One specimen, an adult female, from along the Kapuas River. For external measurements see table, page 564. The skull of this specimen is a trifle smaller than two Javan skulls of *Kerivoula hardwickii* in the U. S. National Museum collection, but one of the latter is almost as much smaller than the other as the Bornean skull is smaller than it. There are no appreciable differences externally.

External measurements of bats from western Borneo.

Name.	Locality.	Number.	Sex.	Ear from crown.	Tail.	Forearm.	Second finger.	Third finger.	Fourth finger.	Fifth finger.	Tibia.	Foot.
<i>Cynopterus brachyotis</i>												
Do.	Kapuas River, near Sanggau.	142382	Male.	13.5	7	mm.	41	99	81	75	mm.	mm.
Do.	do.	142383	do.	14	7.5	60	42	96	80	76	25	16
Do.	do.	142361	Female.	15	8.5	61	41	98	80	74	24	14
Do.	do.	142364	do.	14	10	61	42	96	82	78	24	14
Do.	do.	142368	do.	16	9	64	43	100	86	84	25	13
Do.	do.	142370	do.	15	8	65	42	98	85	84	23	13.5
Do.	do.	142373	do.	14	9	65	41	96	81	81	25	14
Do.	do.	142374	do.	15	11	64	44	100	83	81	25.5	14.5
Do.	do.	142375	do.	13.5	9	62	40	96	82	79	25	14
Do.	do.	142377	do.	14	8	63	41	98	80	79	24	14.5
Do.	do.	142384	Male.	22	33	50	37	77	66	70	25	11
<i>Rhinophus trifolatus</i>	Kapuas River, Pulo Kanchil.	142387	do.	7.5	32	27.5	8	53	45	40	13	5
<i>Glischropus tylops</i>	Sungei Sama, near Pontianak.	142393	do.	7.5	34	27.5	8	52	45	37	13	6
Do.	do.	142396	do.	8	31	28.5	8	52	44	39	13.5	5.5
Do.	do.	142407	do.	8	32	28	8	52	45	37	13	6
Do.	Kapuas River, Pulo Jambu.	142408	do.	8	32	27.5	8	53	44	38	13	6.2
Do.	do.	142409	do.	8	32	27.6	8	55	47	38	13.5	6.5
Do.	Sungei Sama, near Pontianak.	142417	Female.	7.5	31	27	8	53	43	39	13	6.5
Do.	do.	142420	do.	7	31	28	8	54	47	40	13.5	6
Do.	do.	142428	do.	7.5	33	28	8	51	45	39	13.5	6.2
Do.	Kapuas River, opposite Pulo Jambu.	142446	do.	8	32	29	8	57	47	42	13.5	6
Do.	do.	142451	do.	7.5	30	28.4	8	56	47	38	13	6.2
Do.	do.	142452	do.	8	30	29.5	8	57	48	43	13.7	8.5
Do.	Kapuas River.	142455	do.	10	37	32.5	10	63	52	48	17	8.5
<i>Kerivoula hardwickii</i>	Kapuas River, Sanggau.	142462	Male.	9.5	34	32.5	9.34	67	47	43	16.5	6
<i>Myotis muricola</i>	do.	142442	Female.	10	38	34.5	10	62	50	46	16	6.5
Do.	do.	142444	do.	10	34	33	10	60	50	43	16	7

TARSIVS TARSIER (Erxleben).

Four specimens of Tarsiers from western Borneo may be referred to this species provisionally. The only skin preserved, a female, is practically indistinguishable from a Philippine skin (Cat. No. 105475, U.S.N.M.), from Mindanao. The skulls of the Bornean specimens are larger, with heavier teeth and more inflated bullæ than has the Philippine skull.

[Dyak name Lingseng.—W. L. Abbott.]

Measurements of Tarsius tarsier from western Borneo.

Locality.	No.	Sex and age.	Head and body.	Tail.	Hind foot.	Greatest length of skull.	Greatest width of skull.	Greatest breadth of brain case.
			<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Pontainak.....	142243	Female, adult	<i>a</i> 145	<i>a</i> 208	<i>a</i> 67	39.5	35.5	23.7
Do.....	142244	Female, young	<i>a</i> 95	<i>a</i> 125	<i>a</i> 52	30	-----	21.6
Sakaïam River ..	142241	Male, adult.....	<i>a</i> 155	<i>a</i> 215	<i>a</i> 71	38.8	35.3	23.4
Landak River....	142242	Female, immature..	<i>b</i> 120	<i>b</i> 190	<i>b</i> 69	36.5	30	23.8

a Measurements by writer from alcoholic specimens.

b Measurements in the flesh by collector.

NYCTICEBUS BORNEANUS Lyon.

1906. *Nycticebus borneanus* LYON, Proc. U. S. Nat. Mus., XXXI, p. 535, November 9, 1906.

Five specimens from Sanggau, one from Tyan, one from the Landak River, and two from the Sakaïam River. For measurements of this and other species see Proceedings of the U. S. National Museum, XXXI, page 537. In his notes Doctor Abbott says: "Brought in alive by Malays. Many of these animals are caught at this season (August) when the jungle is being felled for *ladangs* (clearings for paddy)."

MACACA FASCICULARIS (Raffles).

One skin and skull of an adult male, Cat. No. 142225, U.S.N.M., from Sungei Sama, near Pontianak.

Measurements: Head and body, 445 mm.; tail, 570; hind foot, 140; greatest length of skull, 119; zygomatic width, 77; maxillary tooth row, 37.5; mandibular tooth row, 41.3.

MACACA NEMESTRINA (Linnæus).

It is with much hesitation that I refer three skulls, without skins to *Macaca nemestrina*. They were obtained by Doctor Abbott from the natives, one from the Landak and two from the Sakaïam River. Either the species is represented at these two places by two forms or else the range of individual variation is considerably greater than the specimens studied by Mr. Miller^a would indicate.

^a The monkeys of the *Macaca nemestrina* group, Proc. U. S. Nat. Mus., XXIX, pp. 555-563, pls. xiii-xx, February 3, 1906.

The two skulls from the Sakaïam River are almost exactly alike and show no appreciable differences from skulls of *Macaca nemestrina* from Sumatra. See table of measurements below, and the measurements given by Mr. Miller, place cited, page 562. The skull from the Landak River more nearly resembles the type skull of *Macaca broca* Miller (page 558, place cited), but the zygomatic width is not as great (see table below), and the angle of the plane of the orbits with the plane of the nasals is not so well marked. In many ways the Landak skull is an intermediate between the type skull of *Macaca broca* and the Sakaïam skull or skulls from Sumatra, but rather nearer the *Macaca broca* type. It is possible that more than one form of the *Macaca nemestrina* group should occur in Borneo, but at present specimens are too few to determine this fact satisfactorily or to map out their ranges. For the present it seems best to consider the three skulls from western Borneo as being *Macaca nemestrina*, or very near that, and still consider that *Macaca broca* Miller, from northern Borneo, is a well-marked form.

It may be noted in this connection that the description of the color of *Macaca broca*, quoted by Mr. Miller from Hose's Mammals of Borneo, was not written by Mr. Hose, but copied by that author verbatim from the account of *Macaca nemestrina* as written by Anderson in his Western Yunnan Report in 1878. Many of Hose's descriptions seem to have been taken from earlier writers, such as Anderson and Blanford.

[On one occasion, at Sintass, a Dyak Kampong away up the Sakaïam River, near Sarawak frontier, I saw 21 broks (*Macaca nemestrina*), all brought in together one evening and eaten. A drove was surrounded in a clearing, and all killed.—W. L. Abbott.]

Measurements of five skulls belonging to adult males of the Macaca nemestrina group.

Dimensions.	<i>Macaca broca</i> , type Cat. No. U. S. N. M. 34830, Supagaya River, northeast Borneo.	<i>Macaca nemestrina</i> Cat. No. U. S. N. M. 142226, Landak River, west Borneo.	<i>Macaca nemestrina</i> , Cat. No. U. S. N. M. 142227, Sakaïam River, west Borneo.	<i>Macaca nemestrina</i> , Cat. No. U. S. N. M. 142228, Sakaïam River, west Borneo.	<i>Macaca nemestrina</i> , Cat. No. U. S. N. M. 141143, Tarusan Bay, Sumatra.
	mm.	mm.	mm.	mm.	mm.
Condyllo-basilar length.....	111.0	112.5	121.0	121.0	115.0
Basilar length.....	100.0	104.0	108.0	107.0	103.0
Greatest length.....	145.6	153.0	160.0	154.0	153.0
Palatilar length.....	60.0	62.0	64.0	66.0	62.0
Orbit to gnathion.....	59.0	68.5	68.8	68.0	66.8
Front of orbit to posterior point of brain case.....	96.0	96.0	100.0	96.0	100.0
Zygomatic breadth.....	104.0	96.0	95.0	96.0	102.0
Breadth of brain case above roots of zygomata.....	71.0	74.3	70.0	68.0	73.0
Depth of brain case from posterior extremity of frontal to lower edge of occipital condyle.....	63.0	63.0	58.0	57.0	a 62.0
Maxillary tooththrow (alveoli).....	47.4	49.0	51.5	50.7	48.5
Mandible, back of condyle to front of symphysis.....	110.4	111.0	115.4	114.0	110.0
Mandibular tooththrow (alveoli).....	54.4	55.5	58.8	56.8	58.9

a This measurement in Cat. No. 123143 U. S. N. M. from Kateman River, Sumatra, is only 56 mm. a trifle less than in the two flat-headed Bornean skulls.

PRESBYTIS CHRYSOMELAS (Schlegel).

1838-39. *Semnopithecus chrysomelas* SCHLEGEL, Tijdschrift Natuur. Geschied. Physiol., V, p. 138. (Type-locality, Pontianak, western Borneo.)

1839-1844. *Semnopithecus chrysomelas*, MÜLLER and SCHLEGEL, Verhandl. Natur. Geschied. Nederlandsch Bezittingen, p. 71, pl. x, figs. 1 and 2; pl. xi, figs. 2, 3.

Nine specimens, seven skins with skulls, one skin without skull, and one skull without skin, all of them practically topotypes of *Presbytis chrysomelas* (Schlegel). For list of the specimens and measurements see table on page 568. In addition to the eight mentioned in the table is Cat. No. 143628, U.S.N.M., adult male, skin without skull, no measurements taken by collector, from 10 miles below Pulo Limbang.

The color of these specimens is very similar to that of the figure of the male shown in Müller and Schlegel's plate (fig. I, pl. x, volume cited) except that the underside of the tail for its basal half or three-quarters is white or whitish in Doctor Abbott's series, instead of yellowish, as in the plate. Doctor Abbott's series shows no difference in color between the two sexes. The white on the underside of the tail is a very conspicuous marking, so that the basal portion of that organ is sharply bicolor. The lower belly, a narrow line down the inner side of the thigh and legs, are whitish, while a spot on the breast, a line on the throat, and a line down the arms and forearms are gray. The rest of the animal, whether male or female, is black or blackish.

The chief difference in color between *Presbytis chrysomelas* and *P. sumatranus* appears to be in the clearer and more contrasted white markings of the Bornean form. The skulls of the two species appear to have slight if any differences, the most conspicuous being the greater inflation of the cranium, just below the lambdoid suture in *P. chrysomelas*, and slightly narrower opening of the anterior nares in *P. sumatranus*.

[The commonest *Semnopithecus* along the Kapuas was a black one with whitish belly and under the tail. The black was deep and dull, not like *sumatranus*, and entirely different from *Semnopithecus hosei* and *everetti*, both of which are in the museum here [Singapore]. I did not meet with the red form [*Presbytis rubicundus*], but the natives said it was common in the hills.—W. L. Abbott.]

External and cranial measurements of Presbytis chrysomelas (Schlegel).

Locality.	Number.	Sex and age.	Head and body. ^a	Tail. ^a	Hind foot. ^a	Weight. ^a	Weight.	Basal length of skull.	Front of canine to back of m ³ .	Zygomatic width.
			mm.	mm.	mm.	lbs.	kilos.	mm.	mm.	mm.
Near Pontianak.....	142203	Male adult.....	490	695	175	14	6.350	61.9	28.0	71.1
Do.....	142204	do.....	460	725	180	14	6.350	64.2	29.6	71.0
Landak River, at Batu Ampar.....	142205	do.....	460	765	184	14	6.350	62.0	28.7	69.8
Landak River.....	142206	do.....	515	750	171	15½	7.144	61.2	28.6	70.0
Kapuas River below Tyan.....	142207	do.....	470	695	170	13	5.897	58.8	27.5	67.5
Kapuas River below Pulo Limbang.....	142208	do.....	480	725	185	15½	7.031	64.5	30.8	71.4
Near Pontianak.....	142209	Female adult.....	465	695	173	15½	6.917	58.4	26.5	67.7
Kapuas River.....	^b 142211	do.....						63.3	29.7	67.2

^a Collector's measurements taken in the flesh.^b Skull only, no skin.**PRESBYTIS CRISTATA (Raffles).**

1822, *Simia cristata* RAFFLES, Trans. Linn. Soc. London, XIII. p. 244. (Type-locality, Sumatra).

There seems to be no essential differences between specimens of *Presbytis cristata* from Sumatra, Banka,^a and Borneo, as is so often the case with other groups of species of mammals. Doctor Abbott secured two skins with skulls. These specimens with their measurements are: Cat. No. 142212 U.S.N.M., adult male, from Kwala Pontianak, and Cat. No. 142213 U.S.N.M., an adult female from Sanggau; head and body, 540, 530 mm.; tail 760, 660; hind foot, 174, 152; weight 14½ lbs. (6.577 kgms.), 13½ lbs. (6.124 kgms.); basal length of skull, 72, 65; front of canine to back of m³, 33, 30; zygomatic width, 74, 68.7.

As most of the writers on monkeys have paid but little attention to the skull characters and devote considerable attention to the physiognomy it may not be without interest to point out some of the rather striking cranial differences between the *Presbytis chrysomelas* and *P. cristata* groups of monkeys, which may be tabulated thus:

Presbytis cristata.

Anterior nares gradually tapering to a point antero-inferiorly.

Supercilliary ridge well marked.

No well-marked arch under malo-maxillary suture.

Constriction behind orbits considerable.

No prominent swelling of braincase just beneath lambdoid suture.

Palate longer.

Rostrum more pronounced.

Ramus of mandible deep, and angular process enlarged.

Presbytis chrysomelas.

Anterior nares suddenly contracted to a point antero-inferiorly.

Supercilliary ridge barely indicated.

A well-marked arch under malo-maxillary suture.

Constriction behind orbits less well marked.

A well-marked swelling of braincase just beneath lambdoid suture.

Palate shorter.

Rostrum less pronounced.

Ramus of mandible shallow, and angular process not unusually enlarged.

^a Lyon, Proc. U. S. Nat. Mus., XXXI, 1906, p. 607.

NASALIS LARVATUS (Wurmb).

Of this handsome and strikingly marked monkey, Doctor Abbott secured nine skins with skulls, and one odd skull. The skins are quite uniform in color and markings. Cat. No. 142418, U.S.N.M., has the legs grayer than the average and is slightly more gray across the shoulders than the majority of specimens. Cat. No. 142219, U.S.N.M., an adult male, is distinctly gray across the shoulders, and is further different from the other specimens in having the diamond-shaped rump patch smoky gray instead of cream color, as have all the other specimens except Cat. No. 142222, U.S.N.M., an immature female, where the color is likewise smoky gray. In Cat. Nos. 142221 and 142224, U.S.N.M., adult females, the rump patch is intermediate in color between cream color and smoky gray. The dorsal neck stripe is most pronounced in the adult males.

Compared with a mounted specimen in the United States National Museum, from northern Borneo, the present series is distinctly brighter in color, but the pattern is everywhere the same. This difference is probably due to fading in the mounted specimen, or to the action of pickling fluids. For external and cranial measurements see table below. The difference in size between the two sexes is very marked. The skins of the females have the hair softer and more immature looking than do the skins of males. The oldest female has less than half the weight of adult males which are not quite so old.

External and cranial measurements of Nasalis larvatus from western Borneo.

Locality.	Number.	Sex	Age.	Head and body. ^a	Hind foot. ^a	Tail. ^a	Weight. ^a	Weight.	Basal length.	Zygomatic width.	Front of canine to back of m ³ .
Sungei Sama near Pontianak.	142214	Male	Adult	mm. 690	mm. 220	mm. 670	lbs. 38	kilos. 17.24	mm. 91.0	mm. 92.0	mm. 42.3
Do.	142215	do	do	700	240	660	44	19.95	92.3	94.9	40.4
Sungei Nya.	142216	do	Immature ^b	700	225	700	45	20.41	91.8	94.0	40.0
Kapuas River below Tyan.	142217	do	Adult	705	232	725	52	23.58	93.2	93.3	40.8
Do.	142218	do	do	700	235	675	46	20.86	91.9	91.7	43.5
Pulo Kanchil.	142219	do	do	700	225	700	45	20.41	91.8	94.0	42.3
Kapuas River below Pulo Limbang.	142220	do	do	700	235	675	48	21.77	94.0	90.0	40.0
Sungei Sama near Pontianak.	142221	Female	Old	605	203	620	23	10.43	79.0	77.7	35.0
Kapuas River below Tyan.	142224	do	Adult	540	182	570	22	9.98	72.8	77.0	37.0
Do.	142222	do	do	505	175	530	16	7.26			

^a Collector's measurements.

^b Skull only; milk teeth all shed but permanent teeth not quite fully in place.

HYLOBATES LEUCISCUS (Schreber).

1800. *Simia leucisca* SCHREBER, Säugethiere Suppl., pl. III B. No description or locality. For date of this plate see Sherborn, Proc. Zool. Soc. London, 1891, p. 590. (The locality of the specimen from which the plate was made is given by Matschie as northwestern Borneo, Sitz.-Ber. Gesellsch. naturforsch. Freunde, Berlin, 1893-1894, pp. 60-62.)

1876. *Hylobates concolor* SCHLEGEL,^a Mus. d'hist. nat. Pays-Bas. Simiæ, p. 20.

1904. *Hylobates leuciscus*, TROUESSART, Catalogus Mammalium, Suppl., p. 5.

Six skins with skulls and one odd skull from the Landak and Kapuas rivers. In point of color the six skins agree remarkably well with Schreber's plate of this species. The general color is a drab or smoke gray. On the rump this color becomes lighter and has a buffy cast. On one individual, Cat. No. 142178, U.S.N.M., the greater portion of the body is of this lighter color. The underparts of the body are lighter in color than the upper parts, except for a narrow collar of about the same color as are the upper parts, extending from one axilla to the other. The naked or nearly naked portions of the face are blackish, as well as a narrow band of hair adjoining the naked portion. This ill-defined blackish band is succeeded by a narrow, not very well marked band, lighter and more buffy in color than the rest of the head. The naked portions of the hands and feet are black, and in a few specimens the hair on the backs of the fingers is somewhat darker than the color of the arm.

External and cranial measurements of Hylobates leuciscus from western Borneo.

Locality.	Number.	Sex.	Age.	Head and body. ^a		Hind foot. ^a	Weight. ^a	Weight.	Basal length.	Zygomatic width.	Front of canine to back of m ³ .
				mm.	mm.	lbs.	kilos.		mm.	mm.	mm.
Landak River, Sungei Nya..	142172	Male	Adult..	497	152	14.25	6.463		73.2	67.0	33.0
Do.	142173	do	do	460	145	14	6.350		76.3	70.7	36.5
Kapuas River below Tyan..	142174	do	Old..	475	150	14	6.350		77.5	72.6	35.3
Do.	142175	do	do	480	150	13	5.896		71.3	66.1	34.7
Pontianak..	142176	Female ^b	Young.						53.6	53.7	
Kapuas River below Tyan..	142177	do	Adult..	465	151	13.25	6.010		73.2	69.0	31.0
Do.	142178	do	Old..	465	158	12.25	5.557		73.0	68.3	32.2

^a Collector's measurements.

^b Skull only, very young, last teeth in place are the first permanent molars.

[Only one sort of Gibbon was seen, *H. leuciscus*, common all along the river except in the islands of the Delta. Some of the specimens,

^a Not of Harlan, Journ. Acad. Nat. Sci. Phila. V, 1827, p. 231, which was evidently a young *Symphalangus*. Containing only its milk dentition it was almost as large as adults of *Hylobates leuciscus*.

particularly one female, had the second and third toes joined in the manner of *Symphalangus*, but neither in voice nor appearance was there any other resemblance.—W. L. Abbott.]

PONGO PYGMÆUS PYGMÆUS (Linnæus).

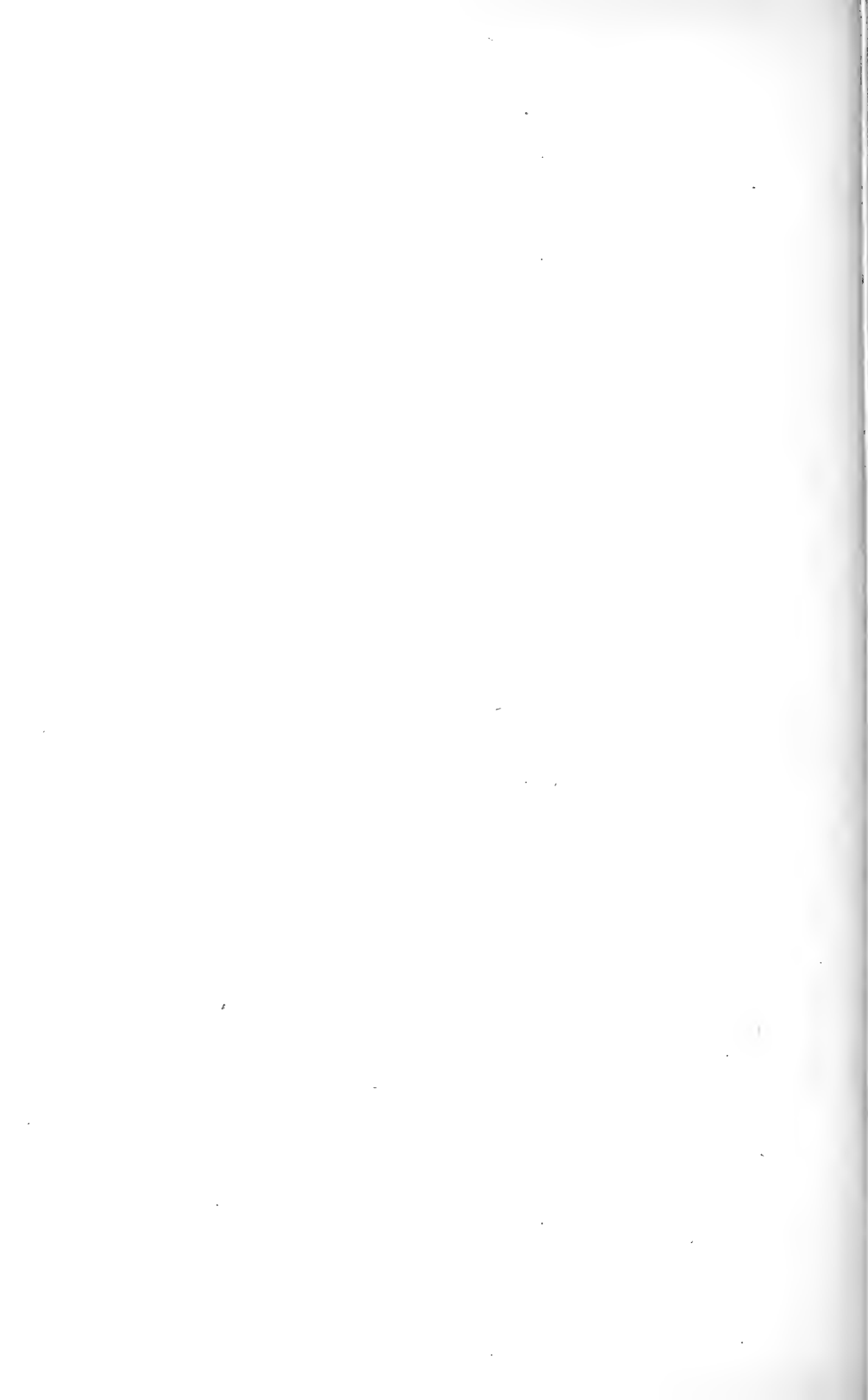
1763. *Simia pygmæus* LINNÆUS, *Amœnitates Academicæ*, VI, p. 68.

1904. *Pongo pygmæus pygmæus*, ROTHSCILD, *Proc. Zool. Soc. London*, 1904, II, p. 438.

Twenty-six specimens, namely, three skins with skulls from Sungei Sama, and twenty-three skulls without skins from along the Sakaïam River. The odd skulls were obtained from the dwellings of natives (Dyaks) who had used the animals for food. This collection of skulls has been very carefully studied by Dr. Aleš Hrdlička,^a Assistant Curator, Division of Anthropology, United States National Museum, and no remarks on them are here necessary. The general color of the skins is nearest Ridgway's chestnut or burnt sienna, darkest on the head and back; in places, as at the extremities, and especially around the buttocks, the color passes into ferruginous. The scant hairs on the underparts are not different in color from those of the back. Cat. No. 142170, U.S.N.M., has the hairs under the chin ferruginous. The three skins are somewhat darker in color than are skins from Sumatra in the United States National Museum. The hair is long, coarse, and shaggy, attaining its greatest length (120–130 mm.) on the back. External measurements of the two adult females, Cat. Nos. 142169 and 142170, U.S.N.M.: Head and body, 720, 785 mm.; hind foot, 290, 283; weight, 70 lbs. (31.75 kg.) "guttled," 75 lbs. (34 kg.).

[It was apparently the wrong time for oranges along the lower Kapuas. No wild fruit, but the natives said there were plenty during the rains of January, etc., and especially when the durians and rambutans were ripe, said they were close to the kampongs [villages]. Up the Sakaïam they were scarce. I saw many old sarongs up the Landak, about 50 miles above Pontianak, but no oranges. Was afterwards sorry I did not make a longer stay there, as the country thereabouts was magnificent forest, with scarcely any inhabitants.—W. L. Abbott.]

^a *Proc. U. S. Nat. Mus.*, XXXI, 1906, pp. 539–568.



TWO NEW SPECIES OF TOADS FROM THE PHILIPPINES.

By LEONHARD STEJNEGER,

Curator, Division of Reptiles and Batrachians, U. S. National Museum.

Among the batrachians collected by Dr. E. A. Mearns in the Philippines there are two small engystomid toads which apparently belong to the genera *Kalophrynus* and *Phrynixalus*, the latter hitherto not known from the archipelago.

The type species of *Phrynixalus* is said to have a sharp, doubly-arched ridge across the palate formed by the palatine bones, but I do not feel justified in forming a new genus on the absence of this character in the Philippine species, as it may be due to the age of the specimen. The shape of the pupil is almost round, but in one eye it is more nearly elliptic in shape with the longer axis horizontal. In all other respects it agrees with the original diagnosis of the genus. Even the "*Ixalus*-like habitus" is very pronounced and before I had examined the interior of the mouth and the underside of the digits I suspected that I had an undescribed species of *Cornufer* before me.

The genus *Kalophrynus* has been diagnosed as possessing "a denticulated dermal ridge across the palate between the choanæ, and another in front of the œsophagus." This characteristic was evidently drawn up from specimens of *Kalophrynus pleurostigma* only, and the fact that the dermal ridges are somewhat differently arranged in the species to be described below does not seem to necessitate the establishment of a new genus for its reception. As it has a perfect, though slender, precoracoid parallel with the broad coracoid, and in other respects also conforms to the characters assigned to *Kalophrynus*, its reference to that genus seems warranted.

PHRYNIXALUS ANULATUS, new species.

Diagnosis.—Toes entirely free; first finger very much shorter than second, only slightly dilated at tip; interorbital space nearly twice as wide as upper eyelid; tympanum about half the diameter of eye.

Habitat.—Mindanao, Philippine Islands.

Type.—Cat. No. 35399, U.S.N.M.; Davao, Mindanao; Dr. E. A. Mearns, collector.

Description of type-specimen.—No vomerine teeth; no ridge between or behind the choanæ which are large, but nearly concealed by the overhanging lip; an indistinct, smooth dermal ridge between the eustachian tubes, and a well-marked denticulated one behind them; tongue large, rounded behind, extensively free (about one-half) behind and on sides; snout somewhat acuminate, projecting; nostrils much nearer tip of snout than eyes; distance from tip of snout to eye greater than diameter of latter; interorbital space nearly twice as wide as upper eyelid; canthus rostralis rounded; lores concave; tympanum rather distinct, its diameter about one-half that of the eye; fingers free, club-shaped, first very much shorter than second, much less widened at the tip than the others, the tips of which are nearly truncate; toes entirely free, the tips dilated, but not quite so much as the fingers; no subarticular tubercles and no metatarsal tubercles; outer metatarsals united; skin smooth above; upper eyelid granular with a larger and more prominent tubercle near the middle of the palpebral edge; underside smooth, except belly, which is faintly areolated, and the preanal region, which is granular. Color (in alcohol) dark brown above, with an indistinct pale band between the anterior half of the upper eyelids followed by a dusky cross-bar; on the shoulders a large, indistinct, W-shaped, dusky mark, the outer arms of which anteriorly reach to the posterior corner of the eyes; an indistinct, large, pale spot on each side of the sacrum; an oblique, pale, dusky-edged line from eye to fore leg; underside paler brown, minutely dotted with whitish; limbs like the body, faintly mottled with dusky, but without distinct cross bars; fingers and toes with a very distinct dusky ring behind the expanded tip or disk, followed by an equally distinct ring of whitish color.

Dimensions.

	<i>mm.</i>
Total length, tip of snout to vent.....	14.5
Tip of snout to tympanum.....	4.5
Width of head.....	5.0
Length of fore leg.....	8.5
Length of hind leg from vent to tip of longest toe.....	20.0
Length of tibia.....	6.0

Remarks.—Another specimen, very much smaller, and apparently just through its transformation was collected by Doctor Mearns at Todaya, Mount Apo, Mindanao, about 4,000 feet altitude, during the early part of July, 1904. As far as can be made out it agrees in all essential features with the type.

The color pattern of *Phrynxalus anulatus*, although somewhat obscure on account of the dark ground color, is essentially that of *Oreophryne celebensis*. The toes of the latter are described by Bou-

lenger as being free, and if so the only external distinction between the genera *Phrynilaxalus* and *Oreophryne* would seem to vanish. An examination of the skull of the type is impracticable, so that the reference of this species to the genera of this group as based by Méhely on the osteological characters must be delayed till further material becomes available.

KALOPHRYNUS STELLATUS, new species.

Diagnosis.—Tympaum distinct; tongue elliptic; subarticular tubercles strong; fingers well developed, fourth much shorter than second; toes less than one-third webbed; a smooth ridge behind the choanæ, and two ridges between the eustachian tubes, the posterior one strongly denticulated; a round black spot on each side of the sacral region.

Habitat.—Basilan, Philippine Islands.

Type.—Cat. No. 37375, U.S.N.M.; Basilan; February, 1906; Dr. E. A. Mearns, collector.

Description of type-specimen.—No vomerine teeth; an almost continuous, nearly straight, smooth, dermal ridge across the palate behind the choanæ, which are large, very lateral, almost concealed under the overhanging maxilla; a very distinct and strongly denticulated, straight ridge in front of the œsophagus between the very lateral eustachian tubes, and a less elevated, smooth, arched ridge, with the convexity forward, in front of the denticulated ridge; tongue elliptic, entire and extensively free behind; interorbital space nearly twice as wide as upper eyelid; canthus rostralis rounded; lores vertical; tympanum very distinct, exceedingly close to the eye and about two-thirds the diameter of the latter; fingers free, first slightly shorter than second, which is much longer than the very short fourth finger; toes webbed at base, less than one-third; tips of digits not swollen, or dilated; subarticular tubercles very strongly developed; the inner metatarsal tubercle weak, elliptic; tibio-tarsal articulation of adpressed hind leg reaches eye; skin above and below granular, more coarsely on lower abdomen and under the thighs; no dorsal, dorso-lateral, or supratympanic glandular ridges. Color (in alcohol) above pale raw umber, darker on the flanks, densely sprinkled with small star-shaped pale or whitish dots; a dark brown line from lores, through eye, above tympanum, and along the sides to the groin; along its upper edge the whitish dots are more numerous, so as to almost form a continuous line; a round black spot as large as tympanum and surrounded by a line of similarly crowded light dots on each side of the sacral region; underside pale brown, with obscure marblings of darker, formed by innumerable minute, dust-like specks of dark brown; no definite cross bands observable on the legs; underside of foot and metatarsus dark brown.

Dimensions.

	<i>mm.</i>
Total length, tip of snout to vent.....	24
Width of head.....	9
Length of fore leg.....	13
Length of hind leg from vent to tip of longest toe.....	31
Length of tibia.....	10

Remarks.—The differences in the arrangement of the palatal ridges as pointed out above as well as the much smaller amount of web between the toes easily distinguish this species from *Kalophrynus pleurostigma*. *K. acutirostris* differs in the subcircular tongue, the pointed snout, the shorter hind legs, and the absence of the sacral spots. The other two species are still further removed by the different proportions of their digits, besides other important characteristics.

THE PULQUE OF MEXICO.

By WALTER HOUGH.

Assistant Curator Department of Anthropology, U. S. National Museum.

Pulque is a fermented liquid made from the sap of the maguey, or agave, commonly known to English speaking people as the century plant. The production of the beverage is confined to Mexico and to those parts of that country where species of the agave suitable for making pulque are found.

Some years ago the writer, at the instance of Dr. G. Brown Goode, began a study of the beverages of mankind, and one paper, relating to kava drinking,^a has been published.

The study of pulque was prosecuted during an extended journey through Mexico in 1899 in company with Dr. J. N. Rose, who was engaged in the collection of botanical data of the agaves. This field work was supplemented by an examination of the specimens in the United States National Museum, collected by Dr. Edward Palmer, to whom the writer is much indebted for information concerning them.

The agaves flourish in the warm southwestern portions of the United States and range from the temperate to the tropical zone in Mexico. There are numerous species, distributed in diverse situations with regard to elevation, temperature, moisture, and soil. Originally, it appears, the cultivated agave was a desert form, inhabiting rocky, sterile places or dry sandy plains, as shown by the fleshy, thorn-armed leaves having chitinous epidermis which resists evaporation.

Botanically, the species are difficult of classification, this genus being easy of modification through change of environment and cultivation. It is perhaps impossible to determine accurately the original forms of the highly cultivated species, which may have differentiated as much as maize from its wild ancestor. It is likely that the ancestor of the pulque agave is represented by a wild form growing in the mountains of Mexico; but taking the cultivated agaves as a whole, they are derived from a number of species. Most of the agaves, both wild and cultivated, have many uses other than

^a Kava Drinking as Practiced by the Papuans and Polynesians. Smithsonian Miscellaneous Collections (Quarterly issue), XLVII, Aug. 6, 1904, pp. 85-92.

the preparation of a beverage. The agave is a wonder of the vegetable kingdom, ranking with the palm as a foster mother of tribes struggling upward with her help. When one recognizes the benefits the agave confers on man, there seems good ground for the generalization that without this plant the great population and the civilization of the high plateau of Mexico would have been impossible; for with the agave a civilization without cereals was feasible which was attended with economics of the highest value for promoting advancement. What wire is to modern civilization the fiber of the agave was to ancient Mexican culture. No country had a greater variety of material for cordage or textiles than was furnished to the Mexican tribes by the agave and related indigenous plants. With every step



FIG. 1.—REGION NEAR TUNOL, DURANGO, MEXICO; AGAVES IN FOREGROUND, PRICKLY PEAR IN MIDDLE GROUND.

in advance this plant became more useful, and in the stage of the cultivation of cereals to which the Mexicans had attained, the agave was, as it is now, indispensable to the well-being of Mexico. The benefits of the agave require too much time to enlarge upon in this place, however interesting, and must be hinted at by examples during the course of this paper.

While the agaves are, as a rule, scattered as solitary individuals or exist in groups of individual plants among other vegetation, there are in some localities vast natural fields, self-planted and self-perpetuating. Such fields may be observed around San Luis Potosi and in Durango, where the Agave, *Opuntia*, *Echinocacti*, and *Mamillaria* form a remarkable characteristic vegetation. There, primitive fields,

especially where they lie contiguous to markets, are now utilized to some extent for pulque, fiber, fruit, and confections of the tuna or prickly pear, etc., and are very profitable. In these natural fields began the utilization of the agave, their abundance rendering them of great economic value; but the products of the wild plants are inferior to those of the cultivated. The selection and cultivation of the economic variety appears to have begun with the agave grown for family use around the native jacals, where conditions of fertilization and care led to the development of large, thrifty, quick-maturing specimens, and this is the history of the adoption of valuable vegetal forms by man. Many of the native pueblos of Mexico still present this early



FIG. 2.—NATURAL GROWTH OF AGAVE, PRICKLY PEAR, AND CACTI ON HILLS NEAR TUNOL, DURANGO, MEXICO. WORKMAN WITH LEVER ON SHOULDER.

stage of plant domestication. They consist of numerous contiguous house plots, bounded by hedges of useful plants or loosely laid up stone walls, and in these gardens plants were tested and modified, and here were the early steps in agriculture. Within the first generation after Cortez conquered Mexico the Spaniards sought the commercial exploitation of the country, and the large grants of land made for various services to the crown were put to a wider use under a more compact organization of labor and transportation than had ever been accomplished by the native tribes.^a (Figs. 1-2.)

^aThe Humboldt Codex has a representation of the pulque industry under Spanish management. Seler in Bull. 28, Bur. Amer. Ethnol., 1904, p. 210.

To European business methods we must attribute the vast tracts of cultivated agave, whose strange appearance excites the wonder of travelers. One sees on every hand prosperous haciendas devoted to the production of pulque. (See fig. 3.)

The haciendas in the pulque districts are indeed models of careful agricultural methods. The enormous and sure returns from pulque manufacture and the abundance and cheapness of the resident labor are apparent in the great and expensive buildings of the hacienda. For laborers there are a church, a school, a store, and a village of barracks; for the owner, an elaborate villa; and for the industry, a great tinacal, or vat house and various stables, grain houses, and storehouses, together forming an imposing group of buildings located among the fields of agave.

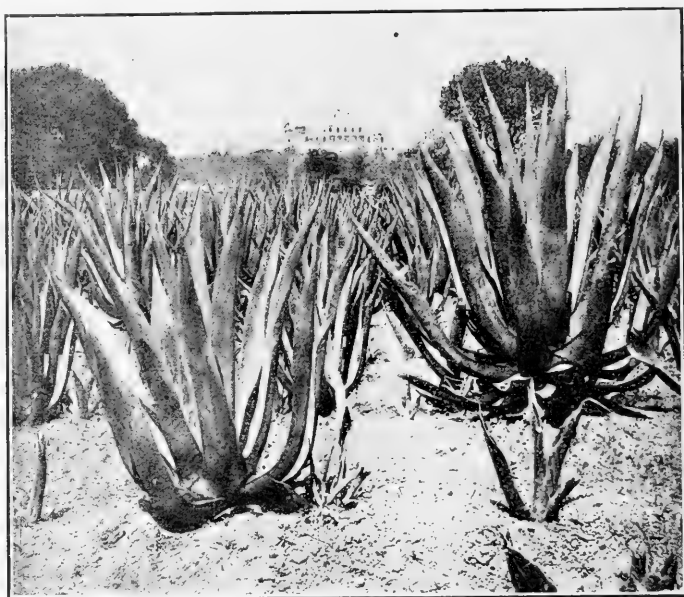


FIG. 3.—AGAVE PLANTATION NEAR CITY OF MEXICO; CHAPULTEPEC IN THE DISTANCE.

There is not space here to enter upon a detailed description of agave culture. In general, plants two years old are taken from the "seed beds" (as the close set plantations of suckers are called) and set out 8 or 10 feet apart, and for several years the spaces between the rows are sown with other crops. At times irrigation is required, but there is division of opinion as to its effect on the quality of the pulque. In about seven years the more forward plants, sometimes attaining a weight of 2 tons, are ready to bloom, and there are certain signs by which those who are skilled may detect the approach of this period. The size and age of the individuals, the brown spots which appear on the basal leaves, and the erect and bristling central leaves are prime

indications—the maculation appearing a year or more before the plant is ready to bloom. The workman, having selected the maturing plants, performs upon them the operation of *capar*. He attacks the *chevaux-de-frise* of the great agave by cutting the outer leaves with a pointed knife or a machete, taking out long slices and bending them over and away. One leaf near the ground he truncates, leaving the stump for a step, and he clears off the spines where they are in the way. When the cone of close-folded



FIG. 5.—MACHETE.
HANDLE OF HORN
RIVETED TO IRON
BLADE.

leaves in the center is unmasked, he drives in his knife at the base and strips off the new white leaves, portions of which he impales on the adjoining



FIG. 4.—LARGE AGAVE PLANT PREPARED FOR INCUBATION. NEAR CITY OF MEXICO.

terminal thorns to act as *bandera*, or indicators. The plant is now left for a year, when a cavity is scooped out in its heart for the collection of sap. Descriptions of this operation usually fail to mention the year of incubation following *capar*, and give the impression that the collection of sap is begun at once. (Fig. 4.)

The dexterity of the workmen in preparing the plants with the aid of a medium size knife is remarkable. In Durango a stout oak *palanca*, or lever (see fig. 2), 54 inches long, is used to pry away the leaves in order to get at the heart of the plant, and the machete (see fig. 5) is used to cut the leaves. The lever probably points to a period before the introduction of the iron machete (such an implement being necessary to manage the fully-armed plant). Generally, the old leaves standing against the prevailing wind are left untouched, to furnish a screen against the dust which might otherwise blow into the cavity when the sap collects. Two or three hours after the cavity has been prepared, it fills up with a clear sweet liquid having somewhat the taste of milk from a young cocoanut. This fluid is called

aguamiel. The sugar-secreting quality of the agave, greatest at the time of flowering, renders the sap at once available for fermentation.



FIG. 6.—HUGE AGAVE SHOWING BANDERA IMPALED ON POINT OF A LEAF. COLLECTOR AT WORK WITH SIPHON AND SKIN SACK.

The reason for the flow of sap is that the plant juices secreted in order to build up the large flower stalk (sometimes 25 feet in height

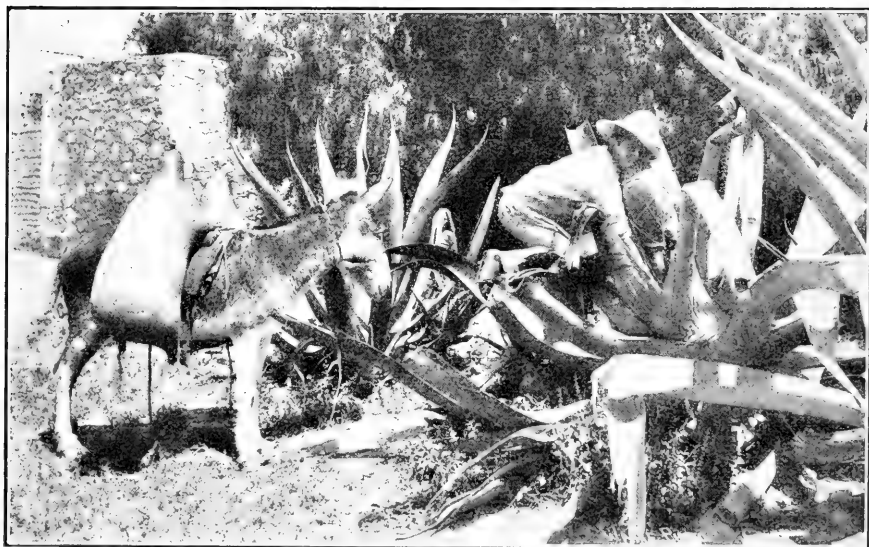


FIG. 7.—COLLECTOR OF AGUAMIEL AT WORK WITH SIPHON. IN THIS CASE TRANSPORTATION IS BY BURRO.

and 6 inches in diameter) are diverted into the cavity excavated in the heart. Wherever in Mexico the agave is grown for the produc-

tion of pulque, a curious apparatus is used in drawing the sap from the cavity, called "milking" the agave. It is a long, slender gourd, bulbous at one extremity, having the small end cut off and a small orifice at the summit of the bulb or in the side. It is placed, small end down, in the liquid, and the collector applying his lips to the orifice in the larger end and suddenly exhausting the air from the gourd, draws up the sap into it, closes the tube with his finger before the mouth is removed from the upper orifice, and turns the sap into a skin sack which he carries on his back. The gourd, which is called *ococote*, or *venencia* (meaning "siphon"), is mainly grown near Pachuca, whence it is distributed to the agave plantations. The "siphon" differs in various regions in Mexico. Generally the orifice is at the apex instead of on the side of the bulb. In Durango the tubular end is shod with horn, and sometimes "siphons"



FIG. 9.—SIPHON MADE OF TIN. DURANGO, MEXICO.

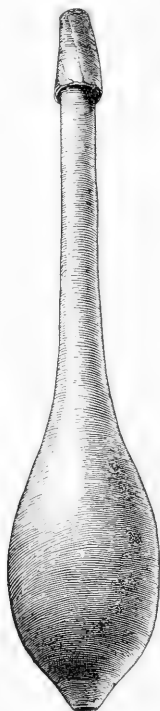


FIG. 8.—GOURD SIPHON SHOD WITH HORN. MUSQUITEC INDIANS.

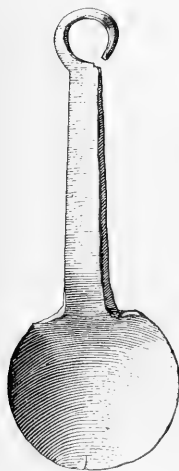


FIG. 10.—SCRAPER OF WROUGHT IRON. DURANGO, MEXICO.

made of tin are employed. After emptying the cavity, the gatherer takes an implement of iron called *raspador*, shaped somewhat like a spoon, but with a deep bowl and sharp rim, and pares off a thin slice from the interior surface of the basin for the purpose of causing a renewal of the flow of the liquid. It is necessary to repeat this after each collection. (Figs. 6–10.)

The method of making the sack (fig. 11) employed in transporting pulque is very interesting, as it illustrates an ancient industry and the preparation of a vessel still used in the East as well as in some European countries. A full-grown goat is killed; the head, feet, and tail are removed; the skin is loosened from the neck

with a knife, which is used only for this purpose. A wedge-shaped piece of horn about 4 inches long and 2 inches broad, with a sharp edge, is held in the fingers of the right hand and rapidly thrust between the flesh and the hide. When the legs are reached, they are separated

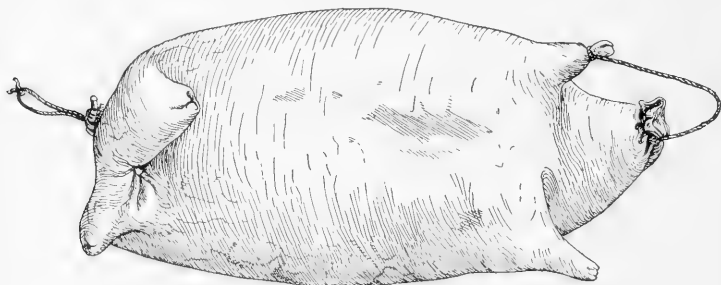


FIG. 11.—SKIN SACK FOR TRANSPORTING AGUAMIEL. IT IS USUALLY CARRIED IN A NET MADE OF AGAVE CORD. CHAUTLA, PUEBLA, MEXICO.

from the hide and pulled inside. In a short time the carcass can be drawn out at the neck, though sometimes one leg is cut off and the carcass drawn through that opening. Studs of willow wood are tied in

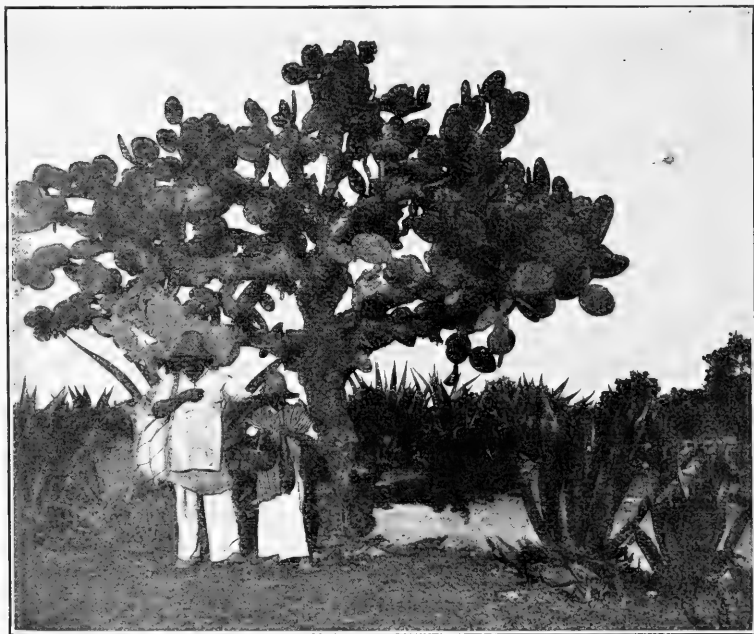


FIG. 12.—COLLECTORS OF AGUAMIEL. ZUMPANGO, MEXICO. SKIN SACK CARRIED IN A NET.

the orifice and the hide turned. A tube is now fastened in the neck and the skin is filled with air and by kneading is inflated to its utmost capacity. While in this state it is allowed to dry in the shade. These skin vessels are used for transporting other liquids besides pulque.

When the sack is full the collector transports it either on his own back or upon a burro to the brewery. (See figs. 7, 12 and 13.) Many haciendas, however, have lines of tramways running through the fields, over which the *aguamiel* may be brought in more expeditiously. The majority of owners of agave plantations have the sap gathered three times daily, at sunrise, noon, and sunset. The yield continues for three months, when the plant dies and becomes only useful as fuel. A large plant will yield 45 gallons of sap during the season. Humboldt says: "A very vigorous plant occasionally yields the quantity of 454 cubic inches in a day for four or five months."^a This seems to be an overestimate. A single man may attend 300 plants three times



FIG. 13.—TRANSPORTATION OF AGUAMIEL IN JARS SLUNG ON THE BACK. TEPEACA, MEXICO.

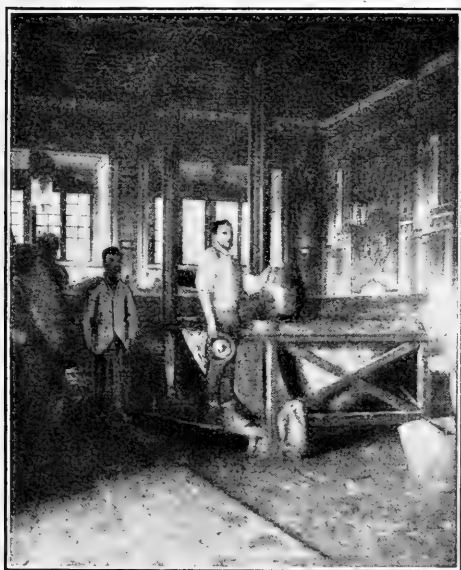


FIG. 14.—VAT HOUSE AND WORKMEN, HACIENDA DE SAN ANTONIO. OMETUSCO, MEXICO.

daily and receives 15 to 20 cents wages, with corn for his sustenance.

The chief building in which all of the interests of the hacienda center is the *tinacal* (*tina*, a vat; *hacal* Mexican, *calli*, a house). It is of one story, with numerous windows, and is usually of great extent filled with rows of shallow leather vats formed by stretching the hide of a bullock over a square frame supported on four short posts. Formerly, small owners laced a bullock's skin by its edges to four stout poles forming a frame. These were set up under a shelter in or near

the fields. A sieve made of horsehair is used to remove insects and litter from the *aguamiel*. (See figs. 14-16). *

^a Travels. Edinburgh, p. 330.

Perhaps the most important spot in the pulque hacienda is the cool and clean darkened room where the *semilla* is kept. *Semilla* is the

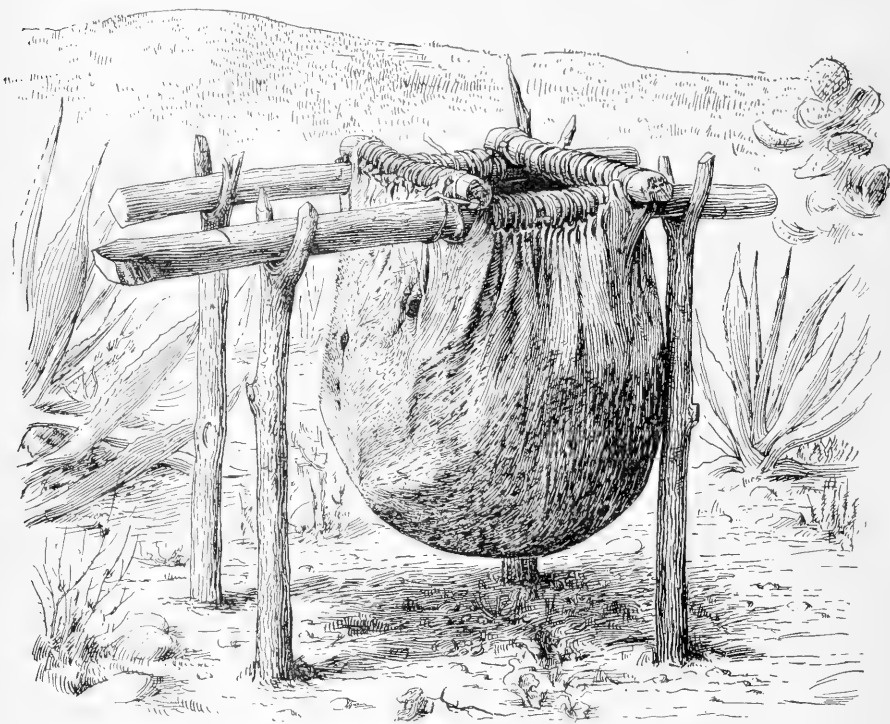


FIG. 15.—FIELD VAT FOR PREPARATION OF PULQUE. THE PULQUE IS DRAWN OFF BY MEANS OF HOLES IN THE SKIN.

yeast for fermenting the *aguamiel*, prepared by “setting” in a vat *aguamiel* to which has been added a pure culture of the ferment. This slowly ripens and is prevented from souring by the addition from time to time of fresh *aguamiel*. Portions of the *semilla* are added to the vats of *aguamiel* in the *tinacal*, or vat room, to produce strong steady fermentation. *Semilla* is thick and white and is made up of glistening globules like small tapioca. It is true that the yeast germs remaining in the pores of the hide vats and in the air of the *tinacal* will suffice to ferment fresh *aguamiel*

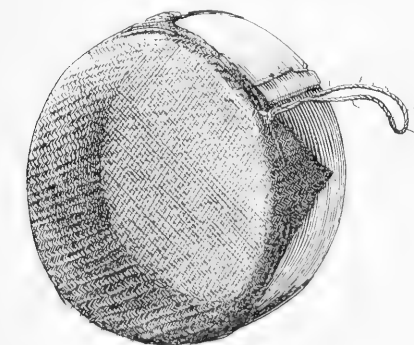


FIG. 16.—SIEVE FOR STRAINING AGUAMIEL. DURANGO, MEXICO.

poured into the vat, but in practice the process is too slow and uncertain. The fermentation is regulated and watched with great care

and corrected by the addition of fresh *aguamiel* when required. In a few hours the fermentation has gone through its various stages to the finished product, ready for the market, consisting of a turbid whitish liquid smelling like very old sour milk. It is barreled and hurried to the points of consumption with the greatest dispatch, since the liquid is perishable and the supply must be received daily. Special trains on the railroads in the pulque region are run for the distribution of this beverage, and transportation by wagon, mule back, canal boats, bearers, etc., is thoroughly organized.

While the present pulque industry is pursued on practically the same lines as in ancient times, the apparatus has changed in some respects since the Conquest. In the aboriginal period skins of large animals for vats and collecting bags were lacking and the fermentation and collecting was in pottery vessels and large gourds, as the writer has observed among the Indians of San Luis Potosi. Iron also was lacking and the knife and rasp were supplied by flakes and chipped implements of obsidian, and the great leaves of the plant were pried away with a heavy pole having a sharpened end like a chisel. It is not known whether the "siphon" was anciently used—a gourd or pottery dipper may have served for that purpose. Since the industry was local and domestic, there may have been other modifications of apparatus and processes due to environment and custom as there is at present in isolated portions of Mexico.

The pulquerias, which exist in great numbers, open up another phase of the question, full of interest to the student of sociology. The pulquerias (fig. 17) are foul-smelling resorts decorated in barbaric art, with a patronage of the lowest order hanging about in various stages of stupefaction. Pulque is the drink of the masses, and there is connected with it in the minds of the people much folk-lore and custom, and among these may be found survivals of cult beliefs and practices.

Pulque is very perishable, and various methods for preserving it have been tried, such as freezing, compression, and bottling, but with no practical success. Adulteration is frequent, and in this connection the roots of *Acacia folicina*, sold in the markets under the name of *timbe* (Mexican: *opactli*) has caused no little discussion. In the *Leyes de Indias*, Mexico, 1794, there is an old law (lib. VI, Tit. I; Ley 37; f. 192) prohibiting the adulteration of pulque, and it is there stated, "they mix with it certain roots, boiling water and lime, which gives it such force that it takes away the senses." A long list of the deleterious effects of the beverage follows, but *timbe* is not specifically mentioned. Bundles of the root are figured on plate 73, of the *Book of Life of the Ancient Mexicans*, edited by Mrs. Zelia Nuttall, and published by the University of California, in 1903. *Timbe* or *ocpatli* is described as "Raiz con que gozian el vino que se llama ocpatli." The late Dr. José Ramirez was of the opinion that the tannic acid of

the *timbe* is an efficient aid in stopping fermentation and that that is the cause of its use. There is no question, however, that this root was anciently used, and the impression has been that its purpose was to supply a ferment and make the liquid stronger; but Doctor Ramirez has here advanced what seems to be a scientific and adequate explanation. Pulque is the basis of a number of compound drinks, and various means are employed to modify its flavor. Pulque prepared with special care for use of the haciendas is quite palatable com-



FIG. 17.—PULQUE SHOP NAMED FOR QUEEN XOCHITL. CUERNAVACA, MEXICO.

pared with the commercial product sold in the cities. It has a sub-acid taste like the juice of an apple, a heavy body, and a very slight alcoholic flavor. In this form it is an agreeable and apparently nourishing beverage. Taken in large quantities pulque is intoxicating, but the effect of habitual stimulation with it is not worse than that produced by lager beer. The repellent odor and taste of the liquor, however, take it out of the category of beverages which appeal to the higher gustatory sense and mark it as one solely drunk for its after

effect. When the agave sap is mixed with water and sugar and allowed to ferment, a more agreeable beverage called *tepache* results, which is sold in a characteristic way. (Fig. 18.)

To a certain extent, distillation has been practiced in connection with the pulque industry. Pulque distilled yields *mescal de pulque*, a spirit of little value and not to be compared with mescal like that of Tequila, which is distilled from the fermented saccharine product of the roasted agave. Largely because the distillation of pulque

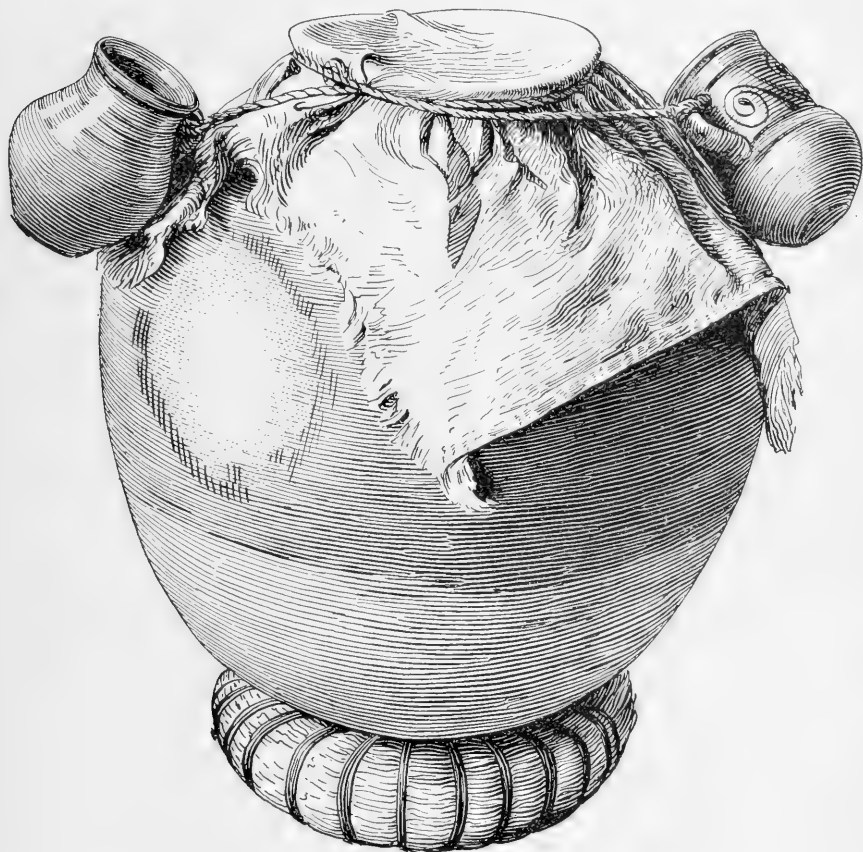


FIG. 18.—TEPACHE VENDOR'S OUTFIT CONSISTING OF AN OLLA, OLLA RING, AND TWO CUPS. DURANGO, MEXICO.

low in alcoholic content is not profitable, and because roasted agave and highly fermented fluids of different classes yielding better spirit are common, *mescal de pulque* is not often made. The fact, however, that pulque was distilled is interesting in connection with the distillation of palm wine. Like wines, pulque is distinguished by the regions in which it is produced, and the output of a certain hacienda often enjoys a reputation for flavor and quality. The pulque of Apan in Tlaxcala, on whose vast plain agave fields stretch away as far

as the eye can reach, is classed as *pulque fino*, and is the standard of excellence. That produced in the valley of Mexico, Toluca, and other parts, is known as *pulque coriente*, or *tlachique* in the Nahuatl tongue. The larger part of the pulque produced in Mexico is *tlachique*, which differs chiefly from the *pulque fino* in that it is sweet and has little flavor. At the hacienda de San Antonio de Ometusco, through the courtesy of the proprietor, the writer had every facility for studying the manufacture of the highest grade of pulque, and the description above is largely the result of observations made there, at least in so far as reference is made to the modern organized pulque industry.

Much has been said concerning the nourishing qualities of pulque. An analysis shows that, while *aguamiel* contains 12 per cent of nourishment, pulque contains only 2 per cent and about $3\frac{1}{2}$ per cent of alcohol, the remainder being water. A substance called *agavin*, which is supposed to have medicinal properties, has been isolated from pulque. An analysis of *aguamiel* and pulque shows:

Constituents.	Aguamiel.	Pulque.
Albuminoid substances, gum and resin.....	2.54	1.26
Sugar.....	9.55	.82
Salts.....	.73	.22
Alcohol.....	None.	3.68
Water, gas, and loss.....	87.18	94.02
	100.00	100.00

Tribes in the lowest known stages of culture are found to have at least a rudimentary understanding of the process of fermentation, which may have been occasionally used in the period when man lived upon the natural products of the earth. The juice of sweet fruits, either of fruit gathered and stored for a short time or prepared by cooking or pulping, might easily reveal the working of fermentation, which is one of the steps toward decay. An intimate acquaintance with the vegetable world was one of the first lessons of mankind and it brought to him many useful arts bearing the seeds of development for subsequent periods. In turn came the cultivation of root crops and grain crops, a knowledge of fermented beverages spread widely and, in course of time, though much later, this branch of domestic chemistry was completed by the invention of distillation. Side by side with these arts that sprung from agriculture were retained the earlier valuable arts growing from the economic uses of plants, as exemplified by pulque and palm wine.

The legend of the origin of pulque, according to Lobato, is as follows: About the year 1042, when Tepancaltzin became chief of the Toltecs—the eighth among those who held that office—there came to

visit him a prominent man named Papantzin, accompanied by his beautiful daughter Xochitl. The maiden presented to the chief a jar of pulque, of which he and his attendants drank and were pleased with the effects which followed. Xochitl told Tepancaltzin that the beverage was obtained from the maguey plant, from which a whitish and sweet juice was extracted and on fermentation became pulque. Tepancaltzin, intoxicated by the pulque prepared by Papantzin's daughter, and infatuated with her beauty, fell in love with her and married her. Thus Xochitl became queen of Tollan, and she bore Tepancaltzin a child who was called Meconetzin, "the son of the pulque," a name given him to commemorate the discovery and invention of the pulque made by his mother, Xochitl. It is said that Tepancaltzin and Xochitl were killed in a battle when the Toltecs were destroyed, and Meconetzin, the last chief, never came to his own.^a

Like most aboriginal legends, it may contain a kernel of truth and refer to some historical event, long subsequent, however, to the actual knowledge of the fermented sap of the agave, which was acquired at some stage of the utilization of the plant.

There was great scarcity of animal food on the plateau of Mexico, and to satisfy the craving for such food, fly larvæ from the lake, lizards and the like, were eaten. Especially prized and sought were the larvæ of an insect which bores the fleshy leaves of the agave, a fat white grub about 1 inch long whose scientific name is *Acentrocne mekollari* Felder, called by the Mexicans *guson*, and in Nahuatl *mescuilin*. It is figured in the Troano manuscript^b (fig. 19), and its characteristic is seen to be the gnawing apparatus by which it tunnels the agave. Gusones to this day are collected in April, boiled, wrapped in the epidermis of the agave, sold on the streets of Mexico and are eaten with avidity. To all appearances they are nourishing and palatable, and it is said that connoisseurs prefer them to oysters or swallows' nests.

The writer believes that the discovery of the sap-yielding quality of the agave was through search for these larvæ.

The search for fiber also no doubt brought about an early acquaintance with the agave, which may have led to the knowledge of its stores of sap. The finest whitish fiber is found in the young unsheathed leaves of the central spike, and the removal of these previous to the flowering under certain conditions might have taught the important lesson.



FIG. 19.—GUSONO GNAWING THE AGAVE. MEXICAN PICTURE WRITING.

^a Extracted from Etudio Quimico Industrial de los Varios Productos del Maguey Mexicano. Jose G. Lobato, Mexico, Government, 1884.

^b Cyrus Thomas, Maya Codices, 6th Ann. Rep. Bur. Amer. Ethnol., p. 351.

Another conjecture is that the Mexican tribes were instructed in the method of tapping the agave by some one who was familiar with the art of tapping the palm, which has been practiced in the Orient from time immemorial. This seems going rather far afield for an explanation. If there is anything the Indian understands it is his plants, and in a multitude of ways he proves this familiarity and illustrates their nearness to him above all other things in nature. Still, since the tapping of the agave is a complicated operation not likely to have been arrived at in a haphazard manner, it is possible that the idea may have come from a foreign source.

It is interesting in this connection to mention that the beverages of the tribes of mankind include but two prepared by fermenting the sap obtained by tapping plants—pulque and palm wine—and that with them is connected primitive distillation.

NORTH AMERICAN PARASITIC COPEPODS: NEW GENERA AND SPECIES OF CALIGINÆ.

By CHARLES BRANCH WILSON,

Department of Biology, State Normal School, Westfield, Mass.

During the summer of 1905 it was the author's good fortune to enjoy two months' study of the parasites which infest our Southern fishes. The work was carried on during the months of July and August at the laboratory of the Bureau of Fisheries at Beaufort, North Carolina.

For this valuable opportunity the author is indebted to the courtesy of the Hon. George M. Bowers, U. S. Commissioner of Fish and Fisheries, to whom acknowledgment is gratefully made.

Thanks are also due to Dr. Caswell Grave, the director of the laboratory, for placing at easy disposal every facility which the laboratory afforded.

A good idea of the value and abundance of the material thus gathered may be obtained from the present paper, which includes only those forms belonging to the subfamily Caliginæ, the others being reserved for future publication. This paper may be considered as the supplement of the more extensive one already published upon the same subfamily.^a

It also represents the first collected work upon the copepod parasites of our Southern fishes. Isolated forms have been reported from the middle Atlantic by Leidy in 1855; from the southern Atlantic by Say in 1818; by Dana in 1854, and by Rathbun in 1884, and from the Danish West Indies by Krøyer in 1863. But all of these accounts include scarcely a dozen species, fully two-thirds of which were described by Krøyer alone.

While his descriptions are nearly always accurate enough for purposes of classification, yet they were all made from preserved material, and therefore of necessity give us nothing in regard to the coloration or habits. And only one or two of the species have ever been seen since their original description.

^aProc. U. S. Nat. Mus., XXVIII, 1905, p. 479.

These are sufficient reasons to warrant a redescription of any of the species on obtaining fresh material. Two such redescriptions are here included, those of *Caligus haemulonis* and *Lepeophtheirus monacanthus*, and others will follow in future papers.

The other five species are new to science, and are particularly interesting because two of them are the types of new genera which stand as connecting links between some of the older forms and serve to emphasize their close relationship. A third species, *Parapetalus occidentalis*, is a new representative of a genus which previously had but a single species, and it changes the old generic diagnosis in many important particulars.

The drawings are all original and made from living material.

CALIGUS HÆMULONIS Kröyer.

Plate XLIX.

Caligus haemulonis KRÖYER, 1863, p. 48, pl. IV, figs. 3a-d.—BASSETT-SMITH, 1899 p. 448.

Female.—Carapace orbicular, as wide as long, somewhat narrowed anteriorly, considerably less than half (0.4) the entire length. Frontal plates distinct, half as wide as long, with an emarginate frontal border and a deep incision at the center. Lunules orbicular and occupying the entire width of the plates, but not projecting anteriorly. Eyes large, with prominent lenses, and situated well forward. Posterior sinuses broadly U-shaped and comparatively deep. Median lobe three-sevenths as wide as the carapace, squarely truncated posteriorly and not projecting beyond the lateral lobes. Thoracic area large, its outline almost a perfect half circle; digestive glands large and horseshoe shaped, filling the entire width of the median lobe.

Free segment three-fifths as wide as the genital segment and comparatively long, showing a strong constriction anteriorly where it joins the carapace.

Genital segment oblong, half the width of the carapace, its width to its length as 5 to 7. Its posterior corners are evenly rounded and without lobes; its posterior margin is slightly concave.

Abdomen narrow and elongate, one-jointed, less than half the width of the genital segment, its length 2.4 times its width.

It is widest at the center and slightly narrowed toward each end; anal laminae small, each carrying three large terminal setae, and a short spine on the outer margin.

Egg strings as wide as the abdomen and reaching but little beyond the tips of the setae; eggs large and only 15 or 18 in each string.

Of the appendages the second antennae are small, with the terminal claw but slightly curved; the basal joint is armed posteriorly with a blunt spine half as long as the terminal claw.

First maxillae as long as the claw of the second antennae and bent sharply at a right angle near their center.

Mouth tube three-fifths as wide as long, with a bony framework considerably like that in *Caligus rapax*.

Second maxillæ only about half the length of the mouth tube, simple, slightly curved, and blunt; exopod papilla comparatively large, with a spine actually longer than the endopod.

Furca large; branches stout and a little curved like parentheses marks. Second maxillipeds with a weak terminal claw about half the length of the basal joint.

The first swimming legs carry a short, stout spine on the posterior border of their basal joint and a long, slender one at its anterior distal corner. Terminal joint with the usual three claws and a spine, but without any trace of the plumose setæ on the posterior border. Spines on the exopods of the second legs very long and slender, those at the tip of the terminal joint with a wide, membranous flange along both sides.

The seta next to these claws also has a narrow membranous flange along its outer side.

Rami of the third legs well separated; claw at the base of the exopod large, slightly curved, and blunt.

Fourth legs stout and three-jointed, with five claws, the terminal one at the inner corner about twice as long as the others. Fifth legs invisible dorsally and almost so ventrally, consisting of very small papillæ, each with a single seta and situated on the ventral surface at the posterior corners of the genital segment.

Oviducts not very densely coiled inside the genital segment; cement glands comparatively large and inclined somewhat away from the central axis, the cellular portion wide and club-shaped.

Total length, 3.75 mm.; carapace, 1.6 mm.; genital segment, 1 mm.; abdomen, 0.86 mm.; width of carapace, 1.6 mm.; egg strings, 1.2 mm.

Male.—Carapace more than half the entire length, but otherwise as in the female. Free segment very short and as wide as the genital segment; the latter oblong, one-half longer than wide, and only one-fourth the width of the carapace.

Abdomen four-fifths as long as the genital segment, two-jointed, the terminal joint twice the length of the basal.

Second antennæ small with a broad and spatulate terminal claw, which is bent in a half circle. These antennæ are not branched as in most *Caligus* males, but the base of the claw is armed with a knob of corrugated chitin on its inner surface.

First maxillæ actually longer than the second antennæ, slender and acuminate, and like the antennæ bent in a half circle.

Second maxillæ as long as the entire mouth tube, their base broadly triangular and carrying a large exopod papilla tipped with two short spines. Branches of the furca curved considerably more than in the female, leaving an elliptical sinus in the center. Base of the second

maxillipeds armed with a long and stout spine which overlaps the tip of the terminal claw. Body of the semen receptacles in the genital segment of medium size, situated close to the posterior margin of the segment, with a tube running the whole length of the segment and intricately convoluted. Fifth legs visible dorsally and appearing on the lateral margins of the genital segment about one-third the distance from its posterior end.

Total length, 2.2 mm.; carapace, 1.2 mm.; genital segment, 0.5 mm.; abdomen, 0.4 mm.; width of carapace, 1.1 mm.

Color of both sexes a uniform yellowish pink, thickly penciled on both the dorsal and ventral surfaces of the body and the two median pairs of swimming legs with spots and lines of a bright rust-colored pigment. The eyes are exceptionally clear, so clear in fact that they stand out plainly to the naked eye in spite of the minute size of the copepod. They are assisted in this by their deep reddish-brown color, which contrasts strongly with the pink of the body.

The species is readily distinguished by these large eyes and by the absence of any plumose setæ on the first swimming legs.

(*hæmulonis*, the generic name of their host.)

Several males and females of this species were obtained, some from the mouth of the blackfish, *Centropristes striatus*, others from the mouth of the catfish, *Hexanematichthys felis* and still others from the mouth of the seacat, *Felichthys marinus*. Those from the blackfish are Cat. No. 32816, U. S. N. M. collection, those from the catfish are Cat. No. 32815, U. S. N. M., and those from the seacat, Cat. No. 32813, U. S. N. M.

Krøyer obtained only three specimens, two females and a male, all from *Hæmulon elegans* Cuvier in the Danish West Indies.

The finding of the present specimens, therefore, adds three new hosts and extends the habitat of the species well up along the Atlantic coast. There can be no doubt that this is Krøyer's species, since it agrees in every essential particular with the description he has given except in the shape of the frontal plates and the genital segment. With reference to the latter it is enough to say that the females obtained by the present author were smaller (and younger?) than the one whose dimensions he has given. And the discrepancy is no greater than would ordinarily be expected between such different stages of maturity.

In regard to the projecting frontal plates the case is different. Krøyer had two females which presumably agreed in this particular, but they had both been preserved for some time while the present specimens were examined while alive.

We can only conclude that the absence of plumose setæ on the first legs is of more specific value than the shape of the frontal plates.

With reference to the habits of the species it may be said that their activity is in inverse ratio to their size. Both sexes, but particularly

the male, are very lively, moving about rapidly on the inside of the fish's mouth, so that they are difficult to catch uninjured. When transferred to an aquarium they swim about as constantly and as restlessly as *Caligus rapax*. But so far as observed neither sex manifested any desire to crawl up out of the water like so many other species.

CALIGUS RUFUS, new species.

Plate I.

Types.—Cat. No. 32812, U. S. National Museum.

Female.—Body elongate and narrow in all its parts; carapace elliptical, considerably narrowed anteriorly and posteriorly, six-elevenths of the entire length, and nearly one-half longer than wide; frontal plates exceptionally wide and prominent; lunules large, widely separated, and not projecting; frontal margin with a slight curve and a shallow incision at the center, in which can be seen the remains of the frontal filament.

Posterior sinuses narrow, triangular, and shallow; median lobe five-eighths the width of the carapace and projecting far behind the lateral lobes, its sides tapering rapidly, its posterior margin evenly rounded; thoracic area nearly half the entire length, with a wide and squarely truncate anterior margin; eyes comparatively large and situated far forward, close to the frontal plates.

Free segment short and only half the width of the genital segment; the latter oblong with straight sides and evenly rounded corners; fifth legs invisible dorsally.

Abdomen one-jointed, two-fifths as wide and two-thirds as long as the genital segment, tapering considerably; anal laminae long and narrow and inclined toward each other; terminal setae nearly as long as the whole abdomen; egg strings about three-fourths as wide as the abdomen and three-fifths of the entire body length; 30 to 40 eggs in each string.

Second antennae rather small, three-jointed, the basal joint carrying a large spine on its ventral surface, the terminal claw stout and strongly curved; first maxillae small and rudimentary, consisting principally of a swollen base on which are borne two papillae, each tipped with two setae, in addition to the short, slender, and nearly straight terminal portion.

Second maxillae slender and elongate, with a triangular base carrying on its anterior corner a large papilla armed with two setae. These maxillae curve outward slightly and reach nearly to the end of the mouth tube.

This latter, the mouth tube, is of an unusual pattern for the Caliginæ and resembles that found among the Pandarinæ more than in any species thus far described. It is narrow and fully four

times as long as wide, with a very simple bony framework indistinctly jointed near the center. The framework consists of four long bones, one on either margin of the upper and under lips. These bones are jointed to other short oblique ones, which are fastened to the ventral surface at the proximal end of the mouth tube. At the distal end they are connected by a series of transverse bones very similar to those found in *Caligus curtus*. The mouth opening is terminal and reaches nearly the whole diameter of the tube. It is surrounded with the usual fringe of long hairs.

The terminal claws of the first maxillipeds have a narrow membranous fringe along both margins. The second maxillipeds have a stout and swollen basal joint, while the terminal claw is much shorter, but strong and well curved. On the inner surface of the basal joint near its proximal end there is an elevation, at the top of which is a circular cup or pit, as though it were for the reception of the terminal claw, but the latter is not long enough to reach it. The furca is entirely lacking.

The first legs are small and weak, the basal joint with a small spine on its posterior border, the outer terminal claw twice as long as the other two. The second legs are large and stout with especially long and strong plumose setæ. The spine at the tip of the basal joint of the exopod is toothed along its inner margin, while the one on the second joint is toothed along both margins. The apron of the third legs is much longer than usual, making with the long setæ of the second legs powerful swimming organs. The rami of these third legs are very widely separated, the exopod three-jointed and approximated closely to the margin of the apron, but even then it does not cover half the distance to the two-jointed endopod.

The fourth legs are small and weak, three-jointed with five spines, the four outer ones about the same length, the one at the inner corner somewhat longer. The fifth legs are near the posterior margin of the genital segment on the ventral surface, and each shows two distinct papillæ standing side by side, the outer one carrying a single seta, the inner and larger one carrying two.

In fig. 24, showing the ventral surface of the genital segment, the oviducts are just beginning to coil, and their entire contents are granular. This specimen, therefore, is a young female which had never borne eggs. The cement glands are narrow, parallel to each other, and close to the mid line. The cellular part extends nearly to the base of the glands, leaving only a very short and inflated duct. The semen receptacles are of the usual spindle shape, comparatively small and slender.

On the external surface can be seen two spermatophores discharging their contents into the sperm receptacles through the sexual openings.

The ovaries and musculature of the carapace are peculiar, as is shown in fig. 25. The ovaries (*o*) are narrow and semilunar, the convex sides facing each other and almost touching at the mid line; they are somewhat narrower at the center and enlarged at either end, their posterior third lying within the thoracic area. The muscles of the carapace, instead of being narrow and separate, as in most species, are fused into broad sheets.

This fusion necessarily modifies the direction in some instances; for the fused sheet can extend in but a single direction, while the separate muscles nearly always diverge or may even be curved.

This is particularly true in the thoracic area. In the present species we find but four of these muscle sheets on either side, very simply arranged, in place of the complicated pattern assumed by the numerous (twelve or more) individual muscles in *Caligus curtus*^a and allied species.

The muscles which run from the thoracic area back into the free and genital segments, as well as those in the two latter segments, are of the usual pattern.

Total length, 4.4 mm.; carapace, 2.35 mm.; genital segment, 1.1 mm.; width of carapace, 1.7 mm.; width of genital segment, 1 mm.

Color, a bright orange yellow, thickly penciled above and below with lines and spots of a brilliant reddish-brown or rust color.

In some specimens the color is confined to separate spots without any penciling. By transmitted light this is the most highly-colored *Caligus* thus far described, since a wash of the rust-colored pigment fills the tissues of the carapace in the immediate vicinity of the spots much as though the color had "run." This bright color, which appears upon the ventral surface and the appendages as well as upon the dorsal surface, is alone enough to differentiate the species.

(*rufus*, rust colored).

Chalimus.—Carapace elliptical, one-fifth longer than wide; second and third thorax segments not yet fused with the head, but free, and, with the fourth segment, diminishing regularly in size.

Eyes large and of a deep brown color with prominent reddish lenses; situated about in the center of the carapace.

Genital segment and abdomen still united and comparatively short; anal laminae large, and each of them armed with six setae. First antennae fully developed; second pair with a weak and nearly straight terminal claw. Mouth parts like those of the adult in miniature; mouth tube already very long and narrow.

Swimming legs rudimentary, the first and second pairs better developed than the third and fourth. First two pairs biramose, the rami simple and armed with nonplumose setae.

^a See Proc. U. S. Nat. Mus., XXVIII, p. 518, fig. 24.

The endopod of the first pair is much shorter than the exopod and is without setæ. The rami of the second pair are about equal in size. The third pair have no endopod but only a slight swelling where it will later appear. The fourth pair are simple and very short.

Total length, 1 mm.; length of carapace, 0.56 mm.; width of carapace, 0.47 mm.

Groundwork colorless but with the entire dorsal surface thickly sprinkled with rust-colored spots and lines. This fact, together with the shape of the mouth tube, is sufficient to identify the chalimus, since in other species this stage has a very limited amount of pigment.

This species was found upon the outer surface and in the gill cavity of the sea catfish, *Felichthys marinus*, the chalimus being found fastened to the pectoral fin. The female is lively, swims about actively, and lives a long time in captivity. It is singularly free, for a *Caligus*, from the pernicious habit of crawling up out of the water and remaining there till dried.

The distinguishing characters are the color, the long and narrow mouth tube, the weak first and fourth legs, and the wide separation of the rami of the third legs. The toothed spines on the exopods of the second legs are also peculiar.

LEPEOPHTHEIRUS MONACANTHUS Heller.

Plate LI.

Lepeophtheirus monacanthus HELLER, 1865, p. 183, pl. XVI, fig. 3—BASSETT-SMITH, 1896, p. 456.

Female.—Carapace ovate, considerably more than one-third the entire length and a trifle wider than long. Anterior margin of the frontal plates nearly straight and incised but little at the center. They are also not distinctly separated from the carapace but the two are fused more than in other species.

Posterior sinuses narrow, shallow, and inclined considerably toward the central axis. Median lobe about half the entire width, not projecting beyond the lateral lobes, and emarginate posteriorly. Thoracic area small, two-fifths of the length of the carapace, its outline the arc of an almost perfect circle.

Digestive glands small, shaped like a beehive, with the rounded ends inclined inward toward each other. Eyes small and placed far forward, with inconspicuous otocysts.

Free segment as long as wide, half the width of the genital segment with both ends convex and projecting into the carapace and genital segment, respectively.

Genital segment ovate, six-sevenths as long as the carapace, with evenly curved sides and short rounded lobes at the posterior corners. Fifth legs not visible in dorsal view. Abdomen conical, about the same width at its base as the free segment, but tapering rapidly

toward the tip. In preserved specimens there is a constriction on either side just back of the center, but living specimens show no joint here.

Anal laminae fairly large, inclined toward each other, each tipped with three short setae. Egg strings wide and considerably longer than the entire body, with 50 or 60 eggs in each string.

Of the appendages the second antennae are long and slender, with the terminal claw bent in a half circle near the tip. No first maxillae could be found but there is a small spine on either side in just about the position of these maxillae which may be their rudiment.

The second maxillae are close to the mouth tube, with a broad and swollen base and an abruptly narrowed, slender, and acuminate tip. Upon the base is borne a papilla armed with two setae, representing the rudimentary endopod.

The first maxillipeds are of the usual pattern; the second pair are long and slender, the two joints about the same length, the terminal claw bent in a half circle which embraces its entire length. The furca is long and narrow, the central sinus U-shaped, the branches slender and slightly enlarged at their tips.

The first swimming legs are peculiar in having only a single terminal claw, which, however, is longer than the entire terminal joint and two-thirds as wide, with a blunt tip.

The basal joint carries a spine on both the anterior and posterior margins at the distal end. The second joint has a single small spine at the distal end on the anterior margin.

The spines on the exopods of the second legs are unusually large. The rami of the third legs are close together and chiefly noticeable on account of a lack of plumose setae, each ramus having but three. In addition the endopod carries two spines while the exopod has five. The fourth legs are three-jointed with five spines, the four on the terminal joint being nearly in a row at the end and all about the same size.

Total length, 4 mm.; carapace, length, 1.55 mm.; free segment, 0.5 mm.; genital segment, 1.15 mm.; abdomen, 0.80 mm.; width of carapace, 1.66 mm.; width of genital segment, 1 mm.

Color, a transparent horn color, sometimes quite yellow, with small dark purple spots evenly distributed over the dorsal surface.

(*monacanthus*, *μόνος* one and *ἀκάνθη* a spine, in allusion to the single spine at the tip of the first legs.)

Young female.—Carapace nearly half the entire length, broadly ovate, wider than long, narrowed considerably anteriorly. Frontal plates wide, distinct, and very prominent; frontal margin with a slight incision at the center, its lateral ends showing a broad curve sweeping forward almost to the edge of the transparent border. The latter is corrugated in fine lines on either side of the curve and apparently acts

as a sort of sucker, like the lunules in *Caligus*. Nothing like this has ever been noticed in other species of *Lepeophtheirus*.

About half way between this lateral curve and the central incision is a single flagellum on either side, which reaches beyond the edge of the transparent border and is evidently sensory. The median sucker on the ventral surface at the base of the frontal filament seems especially well developed in this young form. The remainder of the carapace is similar to that of the adult. The free segment is relatively larger than in the adult, being three-quarters as long as the genital segment, and at the center, through the bases of the fourth legs, once and a half its width.

The genital segment is a narrow oblong, only one-fifth as wide as the carapace and two-fifths as long, with parallel sides. At the posterior corners where it joins the abdomen the beginnings of the sexual organs can be plainly seen. On the dorsal surface at either side is the *os uteri*, or opening of the oviduct to the exterior. This takes the form of a large, broad, and blunt papilla projecting from the angle of the genital segment, on a level with and alongside the dorsal surface of the abdomen.

Inside the genital segment can be seen the posterior end of the oviduct, coiled irregularly, enlarged somewhat, and easily mistaken for the semen receptacles of the male.

On the ventral surface can be seen the fifth legs as a pair of large and blunt papillæ, with tiny setæ at their tips. Just in front of these legs a joint can be plainly seen extending across the ventral surface of the genital segment, as though the fifth legs were to be separated from the rest of the segment. This joint also appears indistinctly upon the dorsal surface, but would never be noticed if it were not first discovered on the ventral surface. In front of the fifth legs on the ventral surface may be seen the cement glands, already well formed and with the division of the central lumen into cells plainly visible. In the posterior portion of the abdomen the respiratory muscles extending from the abdomen wall to the cloacal portion of the intestine show that this mode of respiration persists at least for a time after the molt from the chalimus into the adult form.

Several interesting facts may be learned from this study of the young female. Perhaps the most important one is the necessity for great care in distinguishing between young females and males. The specimens under consideration were judged at first to be males; they were of the right size; the proportions of the body regions were those of ordinary *Lepeophtheirus* males, and the coiling of the oviducts at the posterior end of the genital segment looked much like a pair of semen receptacles. But on examining them under high magnification, in order to explain the curious structures in the genital segment,

well-developed cement glands were found which proved the sex beyond a doubt. A second fact, therefore, would be that these glands develop first in the growth of the sexual organs and furnish a sure method of distinguishing the sexes.

A third inference is in regard to the so-called fifth legs; if there is a joint extending across the genital segment in front of them then they must be the rudiments of the sixth rather than the fifth pair of legs. When two pairs are visible upon the genital segment we call the posterior pair the sixth and the anterior pair the fifth. But this young female would seem to show that when only one pair are present they are as likely to be the sixth as the fifth pair. A genital segment which shows no signs of division in the adult may have been divided in the young with sufficient clearness to indicate beyond a doubt which pair of legs it is that are present.

Total length, 3.3 mm.; length of carapace, 1.7 mm.; length of free segment, 0.5 mm.; length of genital segment, 0.7 mm.; length of abdomen, 0.7 mm.; width of carapace, 1.7 mm.; width of genital segment, 0.4 mm.

Nauplius.—Body ovate, evenly rounded anteriorly but quite squarely truncated posteriorly between the balancers. Appendages proportionally longer than usual, but otherwise of the ordinary form. The entire center of the body filled with a mass of opaque yellowish yolk granules, which extend forward in three lobes the median of which is wider and blunter than the two lateral ones. The balancers are long, cylindrical, and quite strongly curved; they start out from the posterior corners at an angle of 45 degrees, but curve forward so much that their terminal halves are in the same straight line which is at right angles to the body axis. The pigment is of a peculiar deep Prussian blue and is distributed in the form of spots along either margin of the body outside the yolk. There is a large spot at the base of each balancer, and the two fuse across the mid line. The eye spot is also large and covers the entire space between the bases of the first antennæ.

Total length, 0.22 mm.; width of body, 0.12 mm.

This species was established by Heller in 1865 from specimens found on the gills of "*Pimelodus maculatus*," a catfish common in Brazil. The species has not been seen since, or at least has not appeared in any published writings. In the redescription as here given many interesting details have been added.

The present specimens were obtained from two species of the same family of catfish, namely *Hexanematichthys felis* Linnæus and *Felichthys marinus* Mitchill. The former lot of specimens is Cat. No. 32804, U. S. N. M., the latter Cat. No. 2800, U. S. N. M. On both fish the copepods were found in the gill cavity and on the inside of the operculum, rarely more than three or four on the same fish. But

they were fairly common and every haul of the fish yielded several specimens. Heller did not find any males and the most persistent search in the present instance throughout the entire summer also failed to yield any of that sex. There must be something peculiar in their habits or in the conditions by which they are surrounded to account for such a widespread disappearance of the males immediately after the breeding season.

The females, especially the young and such of the adults as are without their egg strings, are very lively when placed in an aquarium. They swim about rapidly and persistently, and rival the most pernicious of the *Caligus* species in crawling up above the surface of the water. They also move about over the skin of their host more rapidly than is usual in a *Lepeophtheirus*.

LEPEOPHTHEIRUS LONGISPINOSUS, new species.

Plate LII.

Types.—Cat. No. 32810, U. S. National Museum.

Female.—Carapace orbicular, about as wide as long and half the entire length. Frontal plates wide and distinct, their anterior margin nearly straight with a shallow incision at the center, in the bottom of which can be seen the remains of the frontal filament. Posterior sinuses wide and U-shaped, inclined somewhat toward each other. Median lobe half the entire width and projecting half its length behind the lateral lobes, with a slightly concave posterior margin. Thoracic area semicircular, but much less than half the entire length, owing chiefly to the shortness of the median lobe. Eyes large and situated far forward.

Free segment short and less than one-third the width of the genital segment, with concave sides and scarcely any thickening through the bases of the fourth legs.

Genital segment orbicular, with very evenly curved sides, the posterior lobes short, wide, and blunt, the posterior margin concave.

Abdomen the same width as the free segment, one-jointed, and about four-sevenths as long as the genital segment. Anal laminae large and oblong, tipped with three long plumose setae, with two shorter ones on the outer margin. Egg strings wider than the abdomen and three-quarters the entire length of the body, each with 25 or 30 eggs.

Second antennae with an unusually long and slender terminal claw, sharply bent near the tip; the basal joint is armed with a slender spine two-thirds as long as the terminal claw.

The first maxillae have a swollen circular base on which are two papillae armed with spines, the rudiments of the endopod. The tips of these maxillae are slender, slightly curved, and nearly as long as the terminal claw of the second antennae, which is exceptional even in a male of this genus.

The second maxillæ are elongate and triangular, the base but little enlarged, opposite the center of the mouth tube, and some little distance from it. Their tips are slender, straight, and simple, the entire appendage being somewhat longer than the mouth tube. The mandibles are slender with a curved terminal joint, armed with coarse rounded teeth on the concave margin and fine pointed teeth on the convex margin, another exceptional feature in this genus.

The mouth tube is short, two-thirds as wide as long, with a bony framework very similar to that in *Lepcophtheirus hippoglossi*, the soft flap at the tip of the upper lip being relatively wider, and the fringe of hairs around the mouth opening longer and denser.

The first maxillipeds are long and slender, and the basal joint is but little swollen; the terminal joint, including the claw, is twice the length of the basal and ends in a single claw which is strongly curved near its tip. At the base of this claw are two medium sized spines, one on the inner and the other on the ventral margin. The claw itself is branched, giving off two small accessory spines on its outer margin; so far as known this has never before been reported in this genus.

The second maxillipeds are large and stout and of peculiar structure; the basal joint is swollen and of normal form, the terminal claw is short and not much curved. From the base of this claw on the inner margin arises a stout conical spine, half the length of the claw and as wide at the base as it is long. The use of this spine is problematical, since from its size and position it must prevent the terminal claw from closing down on the basal joint in the usual manner.

The furca is large and relatively the longest of any yet described; its base is in the usual position, but when closed down against the ventral surface the tips of its branches reach beyond the posterior margin of the first legs.

These branches are wide and stout, with spathulate tips, and they diverge in the shape of a broad V. Each carries a slender, pointed secondary branch upon its inner margin near the base. These secondary branches are two-thirds as long as the primary ones, are parallel with each other, and leave the central sinus of a broad U-shape.

The basal joints of the first legs are each armed with two spines on the posterior margin, the outer one wider and longer than the inner. The second joint carries a short and blunt spine at its distal anterior corner. The terminal claws decrease regularly in size from in front backwards.

The second legs are of the ordinary pattern; the rami of the third legs are so close together as almost to touch on their adjacent margins. Each ramus is two-jointed; the basal spine on the exopod is large and nearly straight. The fourth legs are three-jointed with

four spines, the basal joint slender and one-third longer than the two terminal joints. The second and third joints are the same length; the inner terminal claw is slender and two and a half times as long as the others, equaling the combined length of the second and third joints. The fifth legs are entirely lacking.

The oviducts are rather loosely coiled in the genital segment, and very small compared with the size of the external egg cases. The cement glands are short and wide, somewhat club-shaped, and they reach scarcely beyond the center of the genital segment. Their constituent cells are thin, while the duct is enlarged and bent abruptly just as it leaves the cellular portion. The semen receptacle is narrow, about the same width throughout, and curved slightly forwards.

Total length, 3.2 mm.; length of carapace, 1.65 mm.; length of genital segment, 1 mm.; length of abdomen, 0.55 mm.; width of carapace, 1.6 mm.; length of egg strings, 2.15 mm.

Color a uniform light gray without pigment except in the eyes.

(*longispinosus*, *longus*, long and *spinosus*, armed with spines.)

This species was found on the gills of the Hammer-head shark, *Sphyrna zygaena*. It is chiefly remarkable for the length and slenderness of its spines and maxillæ, and also for the form and length of its furca. Specimens were secured from two sharks taken at different times and in different localities. These were all the sharks of this species that were obtained, and of course are not enough to decide whether the parasite is common or not.

Genus PARAPETALUS Steenstrup and Lütken.

New diagnosis.—First three thorax segments united with the head and covered by a rounded and shield-shaped carapace. Frontal plates with lunules as in *Caligus*. Fourth segment free, much narrower than the genital segment, and without dorsal plates or processes.

Genital segment enlarged nearly to the size of the carapace; its ventral surface produced on either side into a large membranous wing which reaches well beyond the lateral margin of the segment and curls up dorsally at the edge. Each wing is also produced posteriorly into a broad rounded lobe which reaches nearly to the tip of the abdomen. The genital segment is also produced on its ventral surface posteriorly into two short flattened lobes lying side by side at the median line between the bases of the wing lobes and under the origin of the egg tubes.

Abdomen narrow and elongate; its dorsal surface produced on either side into a wide membranous wing similar to those on the genital segment, but which curls downward at the edges around the egg strings. First and fourth swimming legs uniramous; second and third pairs biramous. Fused median eye and furca as in *Caligus*. Anal laminae medium size with short setæ.

PARAPETALUS OCCIDENTALIS, new species.

Plate LIII.

Types.—Cat. No. 32808, U. S. National Museum.

Female.—Carapace one-third the entire length, ovate, considerably wider than long, and quite squarely truncated posteriorly. Frontal plates wide and prominent, with a slight incision at the center; lunules medium sized, widely separated, and projecting half their diameter. Posterior sinuses broad and shallow, the median lobe almost exactly one-third the entire width and not projecting behind the lateral lobes. The latter are squarely truncated posteriorly and slightly curved inward. Thoracic area less than one-fourth the entire length and semicircular in outline. Eyes small and fused on the mid line.

Fourth (free) segment two-fifths as wide as the carapace, and narrowed anteriorly where it joins the latter. It is entirely without dorsal plates, processes, or appendages except the fourth legs. Genital segment orbicular and only five-sixths as long as wide, while it is three-quarters the width of the carapace. It is produced on its ventral surface into two large membranous wings, which project well beyond the lateral margin on either side and curl up dorsally at the edges.

Each wing is considerably thickened at its base, where it also projects in front of the genital segment and comes up against the side of the fourth segment; but it thins rapidly and becomes very delicate and pliable toward the margins. Each wing, furthermore, is prolonged posteriorly into a well-rounded lobe, which reaches backward nearly to the posterior end of the abdomen. Between the bases of these large lobes the genital segment itself is prolonged backward into very much smaller, flattened lobes, which lie side by side at the median line under the bases of the egg strings. In young females the two are entirely separate, but later they often fuse into a single semicircular and laminate flap or lobe.

The abdomen is half as long again as the genital segment, and its dorsal surface for the entire length on either side is produced into a membranous wing which extends out a little beyond the lateral margin of the genital segment and then curls over ventrally around the egg strings. These two wings also project posteriorly a little beyond the tips of the anal laminae.

On the posterior margin there is quite a deep incision at the middle for the anus. The anal laminae stand close to this incision, are of medium size, somewhat enlarged at the tip, and terminate in four short setae of about the same length.

The egg strings are wide, a little longer than the combined genital segment and abdomen, and each contains 60 or 70 eggs.

The second antennæ have a stout basal joint with a long and slender terminal hook. The mouth tube is about twice as long as wide, with the mouth opening circular, subterminal (a little more on the ventral side), and surrounded with a fringe of long hairs. The tube is constricted somewhat sharply on either side at about the center. The details of the bony framework supporting the lower lip are shown in Fig. 58, and of course differ from those shown in other genera of the Caliginæ.

There are first at the base a pair of long and wide bones (*a*) flattened dorso-ventrally, lying side by side along the mid line.

At their proximal ends these bones articulate with the ventral surface of the carapace, at their distal ends with two other pairs of bones (*b*) much smaller and cylindrical, also lying along the median line. The distal ends of this last pair articulate with the curved bones (*c*) surrounding the mouth. Outside the first pair are two irregular bones (*d*) on either side along the lateral margin; outside the second pair a single triangular bone (*e*) on either side, its broad base articulating with the distal ends of the first median pair and the marginal bones outside of them, its apex joining the bony framework around the mouth close to the distal ends of the second median pair.

Still outside of these triangular bones and along the lateral margin of the distal portion of the lip is a long bone curved outward quite strongly (*f*). The proximal end of this bone articulates with the outer proximal angle of the triangular bone just at the constriction in the lateral margin of the lip. Its distal end is bifid, the two branches joining the sides of the bony circle around the mouth.

The entire bony framework of the lip is thus definitely jointed along a line joining the constrictions in the lateral margins of the lip. This jointing constitutes the most essential difference between the structure of the tube in the present genus and that in *Caligus* and *Lepeophtheirus*.

The mandibles inclosed within the tube are similar to those in the two genera named. They are curved in toward each other at their tips, with coarse teeth along the inside of the curve and finer ones along the outside.

The first maxillæ are close to the tips of the second antennæ; they are rather small, with swollen bases and narrow, elongate, and blunt tips. The second maxillæ lie close to the mouth tube; they are simple and triangular, with broad bases and short, stout tips, slightly curved. From the ventral surface of the base arises a stout papilla, representing the endopod and tipped with two setæ. The outer of these is three times the length of the inner one and is jointed once near its base.

The first maxillipeds are like those usually found in the Caliginæ; the second pair have a large and stout basal joint furnished with powerful muscles and a long, slender, and strongly curved terminal claw. There are upon the inner surface of the basal joint a pair of stout

chitin knobs, one on either side of the mid line, and the tip of the terminal claw shuts in between these when it is closed. Between the bases of these second maxillipeds and the first pair of swimming legs is the furca. Its branches are broadly U-shaped, its base the shape of an ox yoke extending transversely across the median line.

The base of the U is connected with the center of the yoke by a narrow stem or petiole.

The first swimming legs are of the usual pattern with a stout blunt spine on the posterior margin of the basal joint; the plumose setæ on the terminal joint are short and weak.

In the second legs the basal joint of the endopod is very broad and overlaps the exopod considerably, while the spines on the exopod are also large and curved. The rami of the third legs are close together and stand out prominently; the claw at the base of the exopod is very large and stout and strongly curved.

The fourth legs are four-jointed with five spines; the basal joint is stout and as long as the other three; the spines are all of the same length, except the inner terminal one, which is half as long again as the others.

The digestive canal is similar to that in the other genera of this family, but the reproductive organs present marked differences.

The shell glands are comparatively large and of the usual club-shape, the distal three-fifths twice the diameter of the basal two-fifths; but the lumen of the glands shows no signs of a division into cells; on the contrary, it is milky white in color, rather opaque, and homogeneous throughout.

The semen receptacles and the arrangement for the reception of the spermatophores are also peculiar, as can be seen in fig. 67.

The semen receptacles are situated at the bases of the median lobes of the genital segment. Each is much enlarged into a flask shape at its inner end next to the median line, the posterior margins of the flasks being connected across the mid line by a narrow tube. Each flask also sends out posteriorly into the lobe of the genital segment a wide, nipple-shaped process.

From the tip of the nipple a slender, thread-like tube runs back to the posterior margin of the lobe. The spermatophores are fastened to the posterior ends of the lobes, and their contents are discharged through these tubes into the semen receptacles.

Total length, 6 mm.; length of carapace, 2 mm.; width of carapace, 2.3 mm.; length of genital segment, 1.5 mm.; length of abdomen, 2 mm.; width of ventral plates on genital segment, 3 mm.; length of egg strings, 5 mm.

Color a milky white, the plates on the genital segment and the lateral wings of the abdomen showing mottled by transmitted light, due to opaque spots in the inner tissues; egg strings showing spots of reddish purple when approaching maturity.

(*occidentalis*, belonging to the Occident or Western Hemisphere, the only other species being from the Indian Ocean and bearing the name *P. orientalis*.)

Nauplius.—Body an elongated ellipse, more than twice as long as wide, with evenly rounded ends. Pigment a beautiful reddish purple, distributed in a large irregular eye spot at the anterior end, a narrow line along either side halfway between the margin and the mid line, and a row of irregular spots across the posterior end. Balancers long and of the usual spathulate form, the cylindrical base being fully two-fifths of the entire length.

Total length, 0.4 mm.; width of body, 0.16 mm.

This new species was found upon the inside of the operculum of the cobia, *Rachycentron canadus* Linnæus. They seem to prefer the dorsal angle, four or five individuals being found there on either side, huddled close together. In addition to the types recorded above, a second lot, Cat. No. 32809, U. S. N. M., was obtained from the gill cavity of the same fish.

On being removed and placed in water they are found to be quite active, swimming about freely, though not with the rapidity of *Caligus* or *Lepeophtheirus*. They have a very marked propensity for coming to the surface of the water and lying there for hours at a time. They seem to hold themselves in position by getting a little air under the edges of the membranous wings and thus buoying themselves up. These wings are so thin and pliable, however, that they are constantly getting wrinkled and snarled up; and if left for any time in an aquarium the chances are that the wings will require considerable straightening before preservation.

This is the first species that has been obtained since Steenstrup and Lütken founded the genus in 1861. They did not succeed in finding any males, and a most careful search for them in the present instance was also without success.

There are now two clearly defined species of this genus, each of which is represented by females only.

Heller (1865) and Bassett-Smith (1899) noted the genus, but the account which each of them gives is evidently taken directly from the original description without the examination of any specimens.

The discovery of a second species would ordinarily modify the original genus diagnosis somewhat, but in the present instance it makes such radical changes that only a little of the original is left.

Steenstrup and Lütken evidently had a limited supply of specimens, all of which had been preserved in the East Indies and sent home.

They therefore content themselves with a genus diagnosis of two lines and a half, and a species description of only ten lines in length. Their diagnosis simply states that this genus differs from *Caligus*

and its near relatives in having the genital segment "girded with a membranous wing and the tail (really the abdomen) furnished with two elongate, retrovert wings which are in the form of a half moon."

Heller records the finding of the parasite on a new host in the Indian Ocean, but makes not attempt at a description.

Bassett-Smith, the most recent authority, gives the following genus diagnosis, presumably made up from Steenstrup and Lütken's text and figures:

Carapace rounded, scutiform. Frontal border with lunulæ. First and fourth pairs of thoracic limbs uniramous, second and third biramous. Genital segment of large size, covered over by two dorsal plates; also with two elongated flattened processes projecting backwards from the posterior border and origin of abdominal portion, which latter is biarticulate, terminating in two small caudal plates. (1899, p. 445.)

There are at least five serious errors in this diagnosis, brief as it is, besides some equally serious omissions.

The genital segment is not "covered over" by anything; its dorsal surface is uncovered except at the posterior end where the abdominal wings overlap it somewhat. Furthermore the covering of its ventral surface can not be called "plates;" they are rather membranous wings like those on the abdomen, as Steenstrup and Lütken call them. The most noticeable thing about them is that they are turned up dorsally at the edges in a perfect saucer shape, the genital segment lying in the bottom of the saucer. Nothing is said of this by any of the previous authors.

Again the "elongated flattened processes projecting backwards" are a part of the ventral wings and not a portion of the segment itself, as can be plainly seen in Steenstrup and Lütken's figure as well as in those here given. Their size, their shape, and above all their attachment prove this beyond a doubt.

The genital segment of the present species does have two flattened processes, but they are very short instead of elongate, ventral instead of dorsal, and they are not mentioned at all by Steenstrup and Lütken. In their preserved material, however, these tiny processes could have been easily overlooked.

Another error is in the statement that the abdomen is "biarticulate." Steenstrup and Lütken neither in their figures nor in their text give it as such; but they make no definite statement with reference to it. In their figure, however, as in the present species it is certainly one-jointed.

And, lastly, Bassett-Smith's diagnosis neglects to notice the large wings on either side of the abdomen, which are one of the chief characteristics of the genus.

Steenstrup and Lütken speak in their species description of the wings on the genital segment as "a thin marginal border, considerably widened posteriorly." This, taken in connection with the fact

that their figure is not shaded so as to show the relative positions of the two pairs of wings, and that they make no definite statement in this respect, leaves it not only possible but even probable that the arrangement in their species was just like that in the present one. Both species are transparent enough to show most of the details right through the wings.

And if their figure be compared with the one here presented it will be seen that a little shading would make the two identical as regards this wing arrangement. The absence of such shading made possible the errors in Bassett-Smith's diagnosis.

ABASIA, new genus.

Genus diagnosis.—Body elongate, with regions distinctly marked; first three thorax segments united with the head and covered by a rounded carapace. This latter is deeply notched on either side anteriorly, the portion between the notches being produced into a sort of broad rostrum one-third as long as the rest of the carapace. Frontal plates borne on the anterior end of this rostrum, distinct, and without lunules. Sides of the carapace folded over ventrally, as in *Lernanthropus*. Cephalic and thoracic portions more strongly arched and much thicker than the lateral areas. Fourth segment as in *Caligus*, small and without dorsal plates. Genital segment elongate acorn-shaped, nearly as large as the carapace, and without lobes or appendages. Abdomen two-jointed, the first joint many times larger than the second; anal laminae minute. Second antennae in the female and second maxillae in both sexes rudimentary; first maxillae and furca entirely wanting. Thoracic legs as in *Caligus*. Eggs comparatively large.

Type of genus.—*Abasia pseudorostris*.

(*Abasia*, from Abas, the son of Metanira, changed by Ceres into a lizard because he mocked the goddess.)

ABASIA PSEUDOROSTRIS, new species.

Plate LIV and Plate LVI, fig. 100.

Type.—Cat. No. 32811 U. S. National Museum.

Female.—Carapace orbicular, less than one-third the entire length as wide as long; deeply notched on either side close to the anterior margin. The portion on the mid line, included between these notches, forms a broad rostrum, one-third the entire width of the carapace, and projecting considerably in front of the latter. Frontal plates distinct, but short and narrow, the two together only as wide as the rostrum. Frontal margin deeply notched at the center and showing at the base of this notch the remains of a frontal filament; no lunules.

Central portion of the carapace, including the cephalic and thoracic areas, strongly arched and raised considerably above the lateral areas. To increase this difference the sides of the carapace are folded over ventrally around the appendages as in *Lernanthropus*. Posterior sinuses broadly triangular and shallow; median lobe only one-third the entire width and not projecting behind the lateral lobes. Thoracic area the smallest yet observed in any of the Caliginæ, only one-third the width and one-fourth the length of the carapace; cephalic area correspondingly large. Free segment short and less than one-third the width of the carapace, without plates or processes.

Genital segment the shape of an elongated acorn, not quite as wide as the carapace but longer, thus making its area about the same. Its sides are evenly curved and its posterior margin is squarely truncated without lobes or processes.

The abdomen is seven-eighths as long as the genital segment and two-jointed. The basal joint is elliptical, two-thirds as wide as the genital segment, and more than four times as long as the terminal joint, with evenly-curved sides. The terminal joint is less than half the width of the basal, and carries a pair of small and widely separated anal laminae, each tipped with four short setae. The egg strings are the same width as the terminal abdomen joint and two-thirds as long as the entire body; eggs comparatively large, 40 to 50 in each string.

The first antennae are two-jointed like those in *Caligus* and relatively as large, but the second pair are rudimentary. They are situated at the base of the rostrum, are three-jointed, the last joint terminated by a minute claw, and the whole appendage is only half the size of the terminal joint of the first antennae.

The first maxillae and furca are entirely lacking; the second maxillae are reduced to mere points and are situated close to the sides of the mouth tube at its base. They are so small as to be easily overlooked.

The mouth tube is short and wide, with a framework similar to that in *Lepeophtheirus hippoglossi*. The mouth opening is terminal and surrounded by a fringe of long hairs. The mandibles are inclosed in the mouth tube and are of the same general shape as in the other Caliginæ, with teeth along both margins.

The first maxillipeds are comparatively large and stout, and are situated far forward, their bases anterior to the center of the mouth tube and close to it. In fact, they occupy nearly the position usually taken by the second maxillae. (See fig. 74.)

The two joints are about the same length, the terminal one ending in two claws, of which the inner is more than twice the length of the outer.

The second maxillipeds are much enlarged,^a the terminal claw about the same length as the basal joint and strongly curved near the tip, with a minute accessory seta on the ventral surface near the base. Both joints are very strong and plentifully supplied with powerful muscles.

The swimming legs are similar to those in *Caligus*, but much reduced in size. The first pair have a comparatively small basal joint carrying one large spine on its posterior border; the middle joint is of the same size as the basal with a small spine at its anterior distal corner; the terminal joint is only two-thirds as large and tipped with the usual three claws and the long spine at the inner distal corner, but there are no plumose setae on the posterior margin of this joint.

The second legs are of the usual pattern, with large and prominent spines on the exopod. The apron of the third legs is so reduced as to be smaller than the second pair. Hence in a ventral view the third legs do not project behind the second but are covered by the latter. Their rami are so close together that they overlap; the exopod is three-jointed with a relatively large basal spine, but with very few plumose setae; the endopod is two-jointed, each joint with a single plumose seta.

The fourth legs are three-jointed, with four spines; the basal joint about as long as the other two; the inner terminal spine one-half longer than the other three, which are about equal. The fifth legs are entirely wanting in this species. The reproductive organs and musculature are similar to those in *Caligus*. The oviducts are coiled somewhat differently in the genital segment, as can be seen in fig. 80. The cement glands are rather large and extend well up toward the anterior margin of the segment. The cellular portion is somewhat club-shaped, with twelve to fifteen cells; the duct is enlarged into a sort of reservoir at its base where it leaves the cellular portion, and also bent outward, terminating very close to the base of the egg tubes. The semen receptacle is peculiar in that it is enlarged at either end instead of at the center.

There is also apparently a large accessory lobe connected with the enlargement at either end, a condition which has not been reported for any other genus.

Total length, 5.22 mm.; length of carapace, 1.67 mm.; length of genital segment, 1.8 mm.; length of abdomen, 1.6 mm.; width of carapace, 1.67 mm.; length of egg strings, 3.55 mm.

Color, a transparent cartilage groundwork beautifully penciled on the dorsal surface and the appendages with dichotomously-branched lines of wine-red. Pigment most conspicuous in the thoracic area, the genital segment, and at the posterior end of the abdomen.

^a In Plate LIV these maxillipeds are magnified only half as much as the other appendages.

Male.—Carapace orbicular as in the female, but slightly longer than wide and fully three-fifths the entire length. Rostrum and carapace areas as in the female. Free segment short, five-ninths as wide as the genital segment; the latter elliptical, a little longer than wide, with evenly rounded sides; fifth legs not visible dorsally.

Abdomen only two-thirds the length of the genital segment, the same width as the free segment and two-jointed. But the joints are not as distinct as in the female and the basal one is only one-fourth as long as the terminal. The anal laminae are large, widely separated, and each is armed with two long plumose setae and three short spines.

Appendages as in the female, except that all, and particularly the swimming legs, are larger and better developed. But the chief difference lies in the second antennae; in the female these were degenerated to mere stumps, entirely useless. But in the male we find a pair of large and strong organs tipped with powerful pinchers, and evidently used for clasping organs. They are not only nondegenerate, but are actually better developed than in the males of other genera. They are three-jointed, the basal and second joints about the same size, the latter with a sharp projection on the inner margin at the distal end which forms a chela with the small and strongly curved end claw.

Reproductive organs as in *Caligus*, the testes rather small and situated far back, just in front of the groove separating the cephalic and thoracic areas. The *vas deferens* can be easily followed back to the semen receptacles which fill nearly the whole of the genital segment on either side of the intestine.

Inside the receptacles can be seen the large spermatophores, with their short coiled tubes through which the contents are emptied into the semen receptacles of the female after the spermatophores have been fastened to the outside of the female's genital segment during coition.

Total length, 2.34 mm.; length of carapace, 1.4 mm.; length of genital segment, 0.55 mm.; length of abdomen, 0.36 mm.; width of carapace, 1.3 mm.

Color as in the female, the reddish pigment rather more prominent.

Nauplius.—Body wide, spindle shaped, the frontal margin broad and but slightly curved with prominent lateral angles. Posterior end narrowed considerably more than the anterior, but with prominent angles at the bases of the balancers. Eye spot large and projecting from the anterior margin, deep wine-red in color. (Fig. 100.)

Pigment rust-colored with the red prominent, arranged in a narrow line parallel with either side of the body close to the margin, and extending from the balancers almost to the eye spot.

The outer margins of these lines are quite regular, but the inner margins are broken and ragged. Each line is enlarged at the anterior

end, while at the base of the balancers it forms a well-defined and quite regular ring just inside the margin.

The posterior half of the body inside of the pigment lines is filled with semiopaque yolk granules of a pale yellow color.

The balancers are one-fourth the length of the body, slightly curved outward, cylindrical at the base, with a flattened spatulate tip.

Total length, 0.4 mm.; width of body, 0.23 mm.

The colors of this nauplius blend finely and make it one of the most beautiful yet seen.

(*pseudorostris*, *pseudo*, false and rostrum.)

This new genus was obtained from the mouth of the lizard fish, *Synodus fatens* Linnaeus. The frontal plate, rostrum, and anterior portion of the carapace were buried just beneath the skin of the roof of the mouth, while the large second maxillipeds were sunk through the skin and into the underlying tissue. This method of fastening is significant, taken in connection with the fact that the sides of the carapace are folded over ventrally as in *Lernanthropus*, and the apron of the third legs is so much reduced that it can not fill the gap at the posterior end of the carapace and thus function as a sucker.

It means that we have here a genus undoubtedly belonging to the Caliginæ, but one which has so far degenerated as to have given up those structures which in the other genera function as organs of adhesion. The lunules on the frontal plates, the thin pliable margin around the carapace, and the large apron of the third legs have all disappeared. And what is still more remarkable, in view of these facts, the second antennæ, which play such an important part in the other genera as grasping organs, have practically disappeared in the female. And the creature is thus thrown back upon the second maxillipeds alone for retaining its position upon its host. This is a condition obtaining only in the lower families of parasites, and furnishes an excellent example of a reversal of ordinary development. In many of the specific problems of development which have been so admirably worked out by various scientists, we find prophecies of future advancement. Old organs take new forms, new organs appear, or there is a different arrangement of the various parts of the body which amounts to very little in the creature under immediate consideration, but which in subsequent development, or in other and higher animals that appear later, becomes an important and essential character. Feathers did not mean very much to the flying lizards upon whose tails they first appeared, but they play an important part in the life of an ordinary bird. So here in degeneration or the reversal of development we find similar prophecies of future disappearance and loss.

The habits of the genus are very different from those of the rest of the Caliginæ, as would be expected from its structure.

The female can not swim, nor does she move about ordinarily on the body of the host, but remains fixed in one place.

The male, on the other hand, can swim a little and contrives to wriggle about over the fish's skin by a sort of jump-and-catch method, using the second maxillipeds and swimming legs.

Both sexes, when placed in an aquarium, lie most of the time upon their backs, with the swimming legs vibrating rapidly back and forth like the abdominal appendages of the Phyllopoets. But in the present instance this is probably not a respiratory movement, for even the adults show distinctly the set of muscles used for cloacal respiration, as already described in other genera. The females have also the habit of raising the carapace or bending it to one side till it stands nearly at right angles to the rest of the body, the flexure taking place between the carapace and the genital segment. So constantly is this practiced that it is difficult to get one killed with the body straight. There is also more or less folding and unfolding of the sides of the carapace, very different from *Lernanthropus*, in which the carapace sides seem incapable of much voluntary motion.

TUXOPHORUS, new genus.

Genus diagnosis.—First three thorax segments united with the head and covered by a shield-shaped carapace. Frontal plates prominent and furnished with lunules as in *Caligus*. Eyes small with prominent lenses. Second antennæ small and weak. Second maxillæ articulate at the base, the rudimentary endopod borne on the basal joint. The other mouth parts and the mouth tube as in *Caligus*. Furca compound, its terminal branches bifid. Swimming legs as in *Caligus*.

Free segment short and wide, covered by two dorsal plates, which overlap the genital segment and project outward over the bases of the fourth legs. Genital segment enlarged, without plates or processes. Abdomen narrow, one-jointed; anal laminae large and well armed with setæ. Egg tubes wider than the abdomen and nearly as long as the entire body. Eggs and development as in *Caligus*.

Type of genus.—*Tuxophorus caligodes*.

(*tuxophorus*, $\pi\tau\nu\tilde{\epsilon}$, a plate and $\phi\omicron\rho\acute{\epsilon}\omega$ to bear.)

TUXOPHORUS CALIGODES, new species.

Plate LV and Plate LVI, figs. 93-99.

Types.—Cat. No. 32805, U. S. National Museum.

Female.—Carapace ovate, narrowed but little anteriorly, as wide as long, and about half the entire length. Frontal plates prominent and furnished with large hemispherical lunules similar to those on *Caligus*. These lunules are widely separated and project hardly at all from the anterior margin. Posterior sinuses narrow and shallow; median lobe a little less than half the entire width, projecting only a trifle beyond the lateral lobes and quite squarely truncated posteriorly with promi-

ment corners. Lateral lobes broad and curved inward at the tips. Thoracic area in the shape of a spherical triangle about half the entire length of the carapace, with a blunt rounded point at the median line anteriorly. Eyes small with prominent lenses, situated about one-third the distance from the anterior margin.

Free segment short and relatively wide, covered by a pair of broad wings which extend outward to a level with the lateral margins of the genital segment and backward for some distance over the base of the latter. Their anterior margins are straight and inclined slightly backward, while the posterior margins are strongly curved and do not meet at the midline, leaving a space between them two-thirds of their own diameter. These wings are thus very similar to those on *Albion* and *Gloiopotes*, except that in the latter the two are fused on the midline.

Genital segment acorn-shaped, considerably narrowed anteriorly where it joins the free segment, with short, wide, and well-rounded lobes at the posterior corners. On the ventral surface of these lobes are the rudimentary fifth legs, whose tips project a little beyond the posterior margins of the lobes, so as to be visible in dorsal view.

Abdomen at its base one-fourth the width of the genital segment; tapering toward the tip; one-jointed. Anal laminae long, narrow, and well-rounded at the ends, each carrying three long terminal setae and two small spines on the outer margin. Egg tubes wider than the base of the abdomen, three-fourths as long as the body, each containing about 50 eggs.

Of the appendages the first antennae are two-jointed, the basal joint longer than the terminal, and both joints heavily armed with setae and spines. The lunules are huge, semicircular, projecting well in front of the bases of the antennae, and reaching back nearly to the groove between the frontal plates and the carapace. The second antennae are rather small and weak, with a slender but strongly curved terminal claw. This claw carries on its inner margin near the base two accessory spines close together and borne on small basal papillae.

The basal joint carries a broad laminate spine on its posterior outer corner. The first maxillae are comparatively large and pushed forward until their base is actually in front of that of the second antennae. The whole maxilla is wide and stout and is curved strongly, especially near the tip. It is as large as the terminal claw of the second antennae and bears on its ventral surface near the center two small knobs or papillae, one on either side.

The second maxillae are also much larger than in *Caligus* and *Lepeophtheirus*. They are simple like those of the former, broad, stout, and curved away from each other, with blunt ends and a small flange on the convex margin. Each is jointed to the ventral surface

about opposite the tip of the mouth tube, so as to be freely movable, which is not the case in the genera just named. Moreover, the large papilla tipped with two spines and representing the rudimentary endopod, is in this case borne, not on the base of the exopod, but on the ventral surface of the carapace anterior to the joint. We have in these maxillæ, therefore, a basal joint fused to the surface of the carapace upon which is borne a freely movable exopod, the maxilla itself, and a rudimentary endopod much larger than usual.

The mouth tube is similar to that found in *Caligus*. As will be seen from fig. 83 the bony framework is more nearly like that of *Lepeophtheirus hippoglossi* than of any other species yet described, while the mouth opening itself is like that in *Caligus rapax*. There are rods running along either side of the mouth tube, with their proximal ends turned downward and outward toward the ventral surface just as in *L. hippoglossi*.^a To these are attached near the base of the tube a pair of short rods arranged like the sides of the letter V, with the point turned toward the tip of the tube instead of toward the base as in *C. rapax*. Between the tips of these lateral rods in the lower lip is a series of small transverse rods similar to those in *C. curtus*. And the upper lip also ends in a soft flap like that in *C. curtus* and *L. edwardsi*, but not of the same shape.

Inside the mouth tube may be seen the mandibles, which are narrow, curved strongly at the tip, and toothed along the concave margin. The first maxillipeds are of the usual pattern, the two joints about the same length, the inner terminal claw twice the length of the outer, and both claws well curved. The second maxillipeds are comparatively weak, smaller, or at least no larger, than the second antennæ, with a terminal claw little more than half the length of the basal joint. This claw is not much curved and carries a slender accessory seta on the inside near its base.

The furca is peculiar in two respects; the furca itself is double and its branches are bifurcate. Krøyer reports a species of *Caligus* (*C. fallax*) in which the furca is double, while there are at least three species of *Lepeophtheirus* in which the branches are bifid (*L. hippoglossi*, *robustus*, and *bifurcatus*).

The present species, so far as known, is the first to show a combination of the two. But it does not show two complete furcæ, as Krøyer figures for *C. fallax*, neither is the division of the branches anything like that of the three *Lepeophtheirus* species named. The median sinus of this furca is broadly U-shaped; each branch is divided for about half its length, the inner branchlets parallel and forming the sides of the U, the outer one turned almost at a right angle. Both pairs of branchlets are broad, of the same diameter throughout, and with bluntly rounded ends. On either side of the base of the furca

^a Proc. U. S. Nat. Mus., XXVIII, p. 500, fig. 6a.

another pair of branches are given off at right angles to the median axis. These are the same size and shape as the branchlets at the tip. The first legs are three-jointed, the basal joint carrying a small spine on its posterior border, a much larger one at the anterior distal corner, and a broad spathulate spine in the middle of the ventral surface at the distal end. The terminal joint has three short and stout terminal claws and the usual plumose setæ on its posterior border.

The second legs are like those of *Caligus*, the spines on the exopod being rather stout. The rami of the third legs are so close together that they almost touch, the exopod three-jointed, the endopod two-jointed. There is the usual large spine at the base of the exopod, a very small one at the outer distal corner of the second joint and three along the outer border of the terminal joint.

The fourth legs are four-jointed with five spines, the inner terminal one somewhat longer than the others, which are all about the same size. The basal joint is stout and longer than the other three, which are rather slender.

Both the fifth and sixth legs are visible at the posterior margin of the genital segment, the former on the ventral surface a little in front of the posterior end, the latter dorsal to them, but farther back at the extreme tips of the posterior lobes.

The reproductive organs and muscular system are similar to those in *Caligus*. The ovaries are paired and situated over the œsophageal portion of the digestive tract. The oviduct leads back to the genital segment, where it is coiled similarly to the condition in all the Caligidae, but the coils are shorter than is usual in *Caligus* and *Lepeophtheirus*.

In the young females obtained from the pilot fish the condition and coiling of these oviducts is peculiar (see fig. 91).

In the posterior portion of the fourth or free segment the oviducts enlarge more abruptly and to a greater diameter than is usual in the Caligidae. In fact, on entering the genital segment the two oviducts fill nearly its entire diameter for the anterior third of its length. They then narrow considerably, so that in the posterior half of the segment there is room for three coils on either side. These oviducts are filled for their entire length with a black granular and homogeneous mass which is wholly opaque. Anteriorly the mass is divided into short and wide segments, corresponding to the future eggs, while posteriorly, where the oviducts are much narrower, the segments at the same time increase in length. Their cubical contents are thus approximately the same throughout the entire oviducts. The cement glands are white in color, situated far forward in the genital segment, and quite strongly curved parallel with the margin of the segment, thus giving them the shape of ordinary parentheses marks. The glands themselves are wide, and the ducts leading from them are considerably

enlarged just before their entrance into the oviduct. Both glands and ducts are surrounded by a thick envelope which reaches forward nearly to the anterior margin of the genital segment and which covers a large portion of the oviduct coils.

The gland cells are wide and extend well back toward the posterior end, leaving a comparatively short and wide duct. In some of the young females the grooves separating the cells are invisible in the living animal, and the entire duct and gland have a uniform white color.

The semen receptacle is at the extreme posterior margin of the genital segment and of the usual spindle shape.

Total length, 5.67 mm.; length of carapace, 2.67 mm.; length of genital segment, 1.8 mm.; length of abdomen, 1 mm.; width of carapace, 2.65 mm.; length of egg strings, 4.33 mm.

Color a light gray, spotted on the dorsal surface along the ridges and grooves with a rich red-brown pigment. In young females the color is that of transparent cartilage, sprinkled over the entire dorsal surface, and on the ventral surface around the bases of the appendages with profusely branched blotches of a pale indigo blue. Sparsely scattered amongst these on both surfaces are smaller and less-branched spots of rose purple, the whole appearing, however, a uniform gray to the naked eye.

(*caligodes*, *caligus*, and the ending *εἶδος* denoting likeness or similarity.)

Male.—Carapace elliptical, slightly longer than wide, and not much narrowed anteriorly. Frontal plates prominent, but narrow; lunules as large as in the female and widely separated; front border emarginate. Posterior sinuses shallow, U-shaped, their sides parallel to the median axis; the median lobe not projecting and with sharp posterior corners.

Thoracic area relatively smaller than in the female and nearly semicircular.

Free segment short, but with rudimentary wings covering the bases of the fourth legs, which make it wider than the genital segment.

Genital segment ovate, with a concave posterior border and showing both the fifth and sixth legs plainly in dorsal view, the former on the lateral margins one-third the distance from the posterior end, the latter at the tips of the posterior lobes.

Abdomen less than half the width of the genital segment, but considerably longer; anal laminae large, almost as long as the abdomen proper and each tipped with three long plumose setae and carrying a smaller one on the outer margin.

Appendages as in the female, the only differences of note being the second antennae and second maxillipeds. The former are much enlarged with a swollen basal joint, a still larger second joint, and a

short but stout terminal claw bent into a half circle. The distal end of the basal joint and the whole ventral surface of the second joint are covered with a corrugated network of chitin ridges. At the distal end of the corrugation on the second joint a wide triangular spine extends downward on either side from the ventral surface and curves over toward its fellow on the opposite side until their tips almost meet. This is evidently the clasping organ used during the breeding season. The second maxillipeds are also somewhat larger and stouter than in the female.

The fifth and sixth legs are as plainly differentiated as in *Homoioetes palliata* (fig. 96). The former are large papillæ on the sides of the genital segment extending on the ventral surface well in toward the mid-line. The latter include the entire posterior lobes, and their inner margins extend forward nearly to the center of the genital segment.

The semen receptacles are of medium size and situated in the bases of the posterior lobes. The ducts leading to them are exceptionally large, in fact, nearly the diameter of the receptacles themselves, and much convoluted, and they fill the entire cavity of the genital segment outside the intestine.

Total length, 3.6 mm.; length of carapace, 2.16 mm.; length of genital segment, 0.75 mm.; length of abdomen, 0.74 mm.; width of carapace, 1.98 mm.

Color similar to the female, but paler, a light brownish gray to the naked eye, but showing under magnification the spots of blue and purple.

Chalimus.—Body elongate and spindle-shaped, the entire anterior margin of the carapace prolonged into a wide, triangular rostrum which projects in front of the first antennæ a distance equal to two-thirds of the length of the carapace behind the antennæ.

From the apex of this triangle extends the attachment filament, which is wider and stouter than in any chalimus yet examined, and its surface is wrinkled or corrugated transversely.

The sides of the triangular rostrum are slightly concave and at its base where it joins the carapace proper there is a deep reentrant angle on either side, out of which project the first antennæ. In consequence of the elongate rostrum the eyes appear back of the center, three-fifths of the length from the anterior end. But judged with reference to the first antennæ they are in about their usual position.

The posterior margin of the carapace is slightly concave.

The second and third thorax segments are fused together and considerably narrowed. The fourth segment is still narrower, and at its posterior corners may be seen the rudiments of the future dorsal lobes. With these lobes it is a little wider than the last segment, which is a fusion of the genital segment and abdomen. The future

separation of these two is indicated by a shallow constriction on either side. This fused segment tapers posteriorly and terminates in a pair of small anal laminae, nearly twice as wide as they are long. Each is armed with five setae, one of which, the second from the inner edge, is several times longer than the others. The first antennae are two-jointed, the joints of the same size, the terminal one only with setae. The second antennae are three-jointed, the terminal claw being slender and weak. The mouth parts are practically the same as in the adult; the terminal joint of the second maxillae is separated from the basal even thus early by a well defined groove, and the rudimentary endopod is carried on the basal joint.

There are only two pairs of legs present, both biramose, with the rami one-jointed. The endopod of the first pair is much smaller than the exopod and destitute of setae; the two rami of the second pair are the same size, but the endopod carries only a single seta. Rudiments of the third and fourth legs appear as slight projections on the ventral surface behind the first and second pairs.

Total length, 0.76 mm.; length of carapace, 0.5 mm.; greatest width, 0.3 mm.

Color a pale brownish gray, spotted over the entire dorsal surface with brownish or purple pigment. The spots along the sides of the digestive tube are fused into two prominent longitudinal lines, which extend from the eyes nearly to the anus.

This genus was obtained from the outside surface of the common cobia or crabeater, *Rachycentron canadus*, and the outside surface of the shark sucker *Echeneis naucrates*. The former specimens are taken as the types since they include both sexes. The latter specimens are Cat. No. 32806, U. S. N. M.

Eight specimens of the chalimus were obtained from the fins of a silver gar, *Tylosaurus marinus*, and are Cat. No. 32807, U. S. N. M. The majority of these latter were on the tail fin, but one was taken from the dorsal fin, another from the anal, and a third from one of the pectorals. In each of these specimens the dorsal plates on the fourth segment were formed and projected from its lateral margins.

The habits of the genus are quite similar to those of *Caligus*, with which the presence of lunules in the frontal plates still further allies it. But the females are not nearly as lively as those of *Caligus* and *Lepeophtheirus*, and swim about very little, preferring to lie quietly at the surface or near the bottom. The males, however, are very active and move about restlessly all the time. Both sexes are hardy and live well in confinement.

The genus is of peculiar interest in that it forms another connecting link between the Caliginæ and the Euryphorinæ.

The presence of lunules and the simple form of the second maxillae are characters of the genus *Caligus*. The divided furca and the clear

differentiation of the fifth and sixth legs in both sexes are characters of the genus *Lepeophtheirus*. The presence of well developed plates on the dorsal surface of the fourth segment and their rudiments even in the male, the structure of the second antennæ, and the jointing of the second maxillæ with the rudimentary endopod on the basal joint are characters of the Euryphorinæ.

If we classify this genus with the Caliginæ it will be the only one possessing any of these characters belonging to the Euryphorinæ. On the other hand, if we classify it with the latter subfamily it will stand equally alone in the possession of lunules and in the structure of the mouth tube.

That it really belongs with the Caliginæ is clearly indicated when we come to consider its ontogeny. Both sexes show plainly, even in the adult, the glands and remains of the frontal filament by which the chalimus is fastened during its transition to the adult form.

With the other characters somewhat evenly divided this would turn the decision, even if it did not possess greater value than they. We have here, then, a genus undoubtedly belonging to the Caliginæ, as its development and general makeup clearly indicate, yet possessing several of the essential characters of the Euryphorinæ. While embraced within the first subfamily, therefore, it must be recognized as standing on the border line between the two. It is another of those instances which show that even the best efforts of the systematist can not hope to clearly differentiate all the forms that present themselves for consideration.

In addition to the foregoing new and rediscovered species belonging to the Caliginæ, many others were found.

The simplest method of recording these is to present an alphabetical list of the fish examined with the parasites found on each. They were all obtained in the immediate vicinity of Beaufort.

Archosargus probatocephalus WALBAUM. The Sheepshead.

An undescribed species of *Bomolochus* from the walls of the gill cavity, and an undescribed species of *Lernanthropus* from the gill filaments.

Bairdiella chrysura LACÉPÈDE. Mademoiselle: Yellow-tail.

An undescribed species of *Lernanthropus* from the gills.

Brevoortia tyrannus (LATROBE) GOODE. The Menhaden.

Lernæenicus radiatus Rathbun, imbedded in the flesh, mostly along the back. *Lernanthropus brevoortiae* Rathbun, fastened to the gill filaments. *Anchorella scombri* Kröyer, fastened to the gill arches.

Carcharias obscurus LE SEUR. Dusky Shark.

Pandarus cranchii Leach, on the outside skin near the lips.

Centropristes striatus LINNÆUS. The Blackfish.

Caligus hæmulonis Kröyer, on the walls of the mouth cavity.

Chilomycterus schœpfi WALBAUM. The Swell-toad.

Tucca impressa Kröyer, fastened to the fins.

Coryphæna equisetis LINNÆUS. The Small Dolphin.

Caligus belones Kröyer, on the outside surface, and an undescribed species of *Lernæenicus* fastened to the fins.

Echeneis naucrates LINNÆUS. The Shark-sucker.

Tuxophorus caligodes Wilson, on the outside surface.

Epinephelus morio CUVIER and VALENCIENNES. The Red Grouper.

Lepeophtheirus dissimulatus Wilson, on the outside surface.

Felichthys marinus MITCHILL. The Sea-cat: Gaff Topsail.

Lepeophtheirus monacanthus Heller, on the walls of the gill cavity and the mouth. *Caligus rufus* Wilson, on the outside skin.

Caligus hæmulonis Kröyer, on the walls of the mouth cavity.

Fundulus heteroclitus LINNÆUS. The Common Killifish.

Argulus funduli Kröyer, on the outside skin and the fins. *Caligus rufimaculatus* Wilson, on the outside skin.

Gymnosarda pelamys LINNÆUS. The Bonito.

Caligus bonito Wilson, on the walls of the mouth and the gill cavity.

Hexanematichthys felis LINNÆUS. The Sea Catfish.

Lepeophtheirus monacanthus Heller, on the walls of the gill cavity.

Caligus hæmulonis Kröyer, on the walls of the mouth.

Leiostomus xanthurus LACÉPÈDE. The Spot or Goody.

Lernæenicus radiatus Le Seur, imbedded in the muscles, usually in the vicinity of the fins.

Menidia menidia LINNÆUS. The Southern Silversides.

An undescribed species of *Bomolochus* on the gill filaments.

Merone americana GMELIN. The White Perch.

An undescribed species of *Lernanthropus* on the gill filaments:

This is the same as that found on the Mademoiselle.

Micropogon undulatus LINNÆUS. The Croaker.

An undescribed species of *Anchorella* on the gill arches.

Mugil cephalus LINNÆUS. The Common Mullet.

Anchorella lizæ Kröyer, fastened to the gill arches. *Brachiella oblonga* Della Valle, fastened to the pectoral fins. *Caligus curtus* Müller, on the outside surface of the body. An undescribed species of *Bomolochus* on the gill filaments. An undescribed species of *Lernæenicus* fastened to the outside of the operculum.

Orthopristis chrysopterus LINNÆUS. The Hogfish.

An undescribed species of *Lernanthropus* on the gill filaments.

Paralichthys lethostigmus JORDAN and GILBERT. Southern Flounder.

Lepeophtheirus edwardsi Wilson, on the outside surface.

Prionotus tribulatus CUVIER. The Big-headed Gurnard.

An undescribed species of *Lernanthropus* on the gill filaments.

Pteroplatea maclura LE SEUR. The Butterfly Ray.

Argulus laticauda Smith, on the outside surface.

Rachycentron canadus LINNÆUS. The Crab-eater or Cobia.

Parapetatus occidentalis Wilson, on the inside surface of the operculum. *Tuxophorus caligodes* Wilson, on the outside of the body.

Scoliodon terræ novæ Richardson. The Sharp-nosed Shark.

Nesippus alatus Wilson, fastened to the inside of the gill arches.

Pandarus cranchii Leach, on the outside skin and the fins.

Perissopus communis Rathbun, on the outside of the body, especially around the lips. An undescribed species of *Nemesis* on the gill filaments.

Seriola lalandi CUVIER and VALENCIENNES. The Amber Jack.

An undescribed species of *Lernanthropus* on the gill filaments.

Sphyrna tiburo LINNÆUS. The Shovel-head Shark.

Nesippus alatus Wilson, on the inside of the gill arches. *Eudactylina nigra* Wilson, on the gill filaments. An undescribed species of *Bomolochus* on the outside skin near the anus.

Sphyrna zyggæna LINNÆUS. The Hammer-head Shark.

Nesippus alatus Wilson, on the inside of the gill arches. *Lepeophtheirus longispinosus* Wilson, on the inside of the gill cavity. An undescribed species of *Nemesis* on the gill filaments.

Synodus fœtans LINNÆUS. The Lizard Fish.

Abasia pseudorostris Wilson, on the walls of the mouth cavity.

Trichiurus lepturus LINNÆUS. The Cutlass Fish.

Caligus chelifer Wilson, on the outside surface of the body. *Caligus rapax* Milne Edwards, also on the outside surface.

Tylosurus acus LACÉPÈDE. The Hound Fish.

Tuxophorus caligodes Wilson, a chalimus on one of the dorsal fins.

An undescribed species of *Lernanthropus* on the gill filaments: this is the same as that found on the Garfish. An undescribed species of *Bomolochus* from the gill filaments.

Tylosurus marinus WALBAUM. The Garfish or Billfish.

Lepeophtheirus edwardsi Wilson, on the outside surface. An undescribed species of *Lernanthropus* on the gill filaments. *Tuxophorus caligodes* Wilson, several chalimi on the fins.

Upeneus maculatus BLOCK. The Red Goatfish.

An undescribed species of *Lernænicus* fastened to the outside of the operculum and in the muscles along the back.

EXPLANATION OF THE PLATES.

Plate XLIX. *Caligus hæmulonis* Kröyer.

Fig. 1, dorsal view of female; fig. 2, dorsal view of male; fig. 3, second antenna and first maxilla of female; fig. 4, same of male; fig. 5, mouth and second maxilla; fig. 6, furca; fig. 7, second maxillipeds of female; fig. 8, same of male; figs. 9 to 12, first, second, third, and fourth swimming legs; fig. 13, genital segment of female, ventral view; fig. 14, genital segment of male, ventral view.

Plate L. *Caligus rufus*, new species.

Fig. 15, dorsal view of female; fig. 16, second antenna and first maxilla; above and to the left is an enlarged drawing of the maxilla; fig. 17, mouth and second maxillæ; fig. 18, first maxilliped; fig. 19, second maxilliped; figs. 20 to 23, first, second, third, and fourth swimming legs; fig. 24, genital segment of female, ventral view; fig. 25, carapace of female, enlarged, showing ovaries and musculature; fig. 26, dorsal view of chalimus; fig. 27, second antenna of same; fig. 28, second maxilliped; figs. 29 to 31, first, second, third, and fourth swimming legs.

Plate LI. *Lepeophtheirus monacanthus* Heller.

Fig. 32, dorsal view of female; fig. 33, dorsal view of very young female; fig. 34, second antenna; fig. 35, second maxilla; fig. 36, furca; fig. 37, second maxilliped; figs. 38 to 41, first, second, third, and fourth swimming legs; fig. 42, genital segment of female, ventral view; fig. 43, newly hatched nauplius.

Plate LII. *Lepeophtheirus longispinosus*, new species.

Fig. 44, dorsal view of female; fig. 45, second antenna and first maxilla; fig. 46, mouth tube; fig. 47, second maxilla; fig. 48, furca; fig. 49, first maxilliped; fig. 50, second maxilliped; figs. 51 to 54, first, second, third, and fourth swimming legs; fig. 55, genital segment of female, ventral view.

Plate LIII. *Parapetalus occidentalis*, new species.

Fig. 56, dorsal view of female; fig. 57, second antenna and first maxilla; fig. 58, mouth tube; fig. 59, second maxilla; fig. 60, furca; fig. 61, second maxilliped; figs. 62 to 65, first, second, third, and fourth swimming legs; fig. 66, genital segment of female, ventral view; fig. 67, posterior lobes of genital segment, enlarged, showing semen receptacle, ducts, and spermatophores; fig. 68, ventral view of genital segment and abdomen of very young female.

Plate LIV. *Abasia pseudorostris*, new genus and species.

Fig. 70, dorsal view of female; fig. 71, dorsal view of male; fig. 72, rostrum, first and second antennæ of female; fig. 73, same of male; fig. 74, mouth tube, second maxillæ, and first maxilliped, showing relative position of latter; fig. 75, second maxilliped; figs. 76 to 79, first, second, third, and fourth swimming legs; fig. 80, genital segment of female, ventral view.

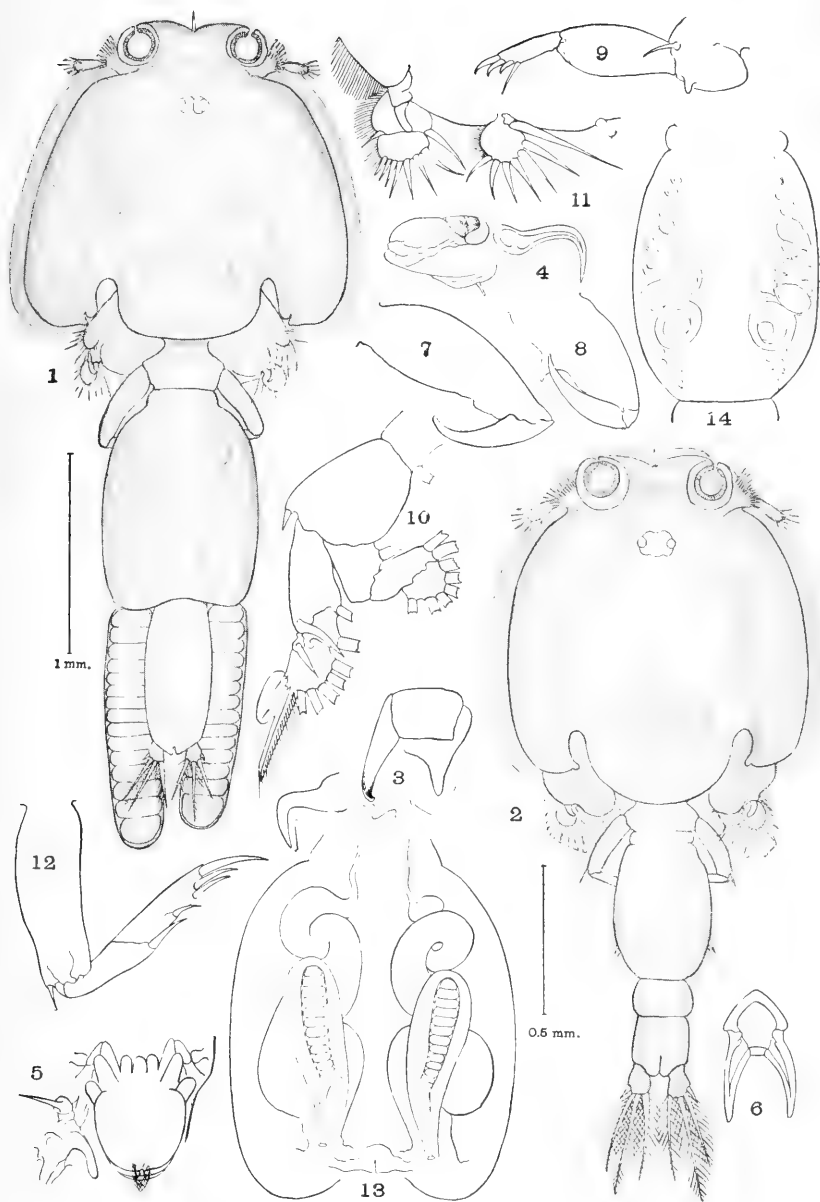
Plate LV. *Tuxophorus caligodes*, new genus and species.

Fig. 81, dorsal view of female; fig. 82, second antenna and first maxilla; fig. 83, mouth tube and second maxillæ; fig. 84, mandible; fig. 85, first maxilliped; fig. 86, furca; figs. 87 to 90, first, second, third, and fourth swimming legs; fig. 91, dorsal view of genital segment and abdomen of very young female; fig. 92, ventral view of genital segment of adult female.

Plate LVI. *Tuxophorus caligodes*, continued.

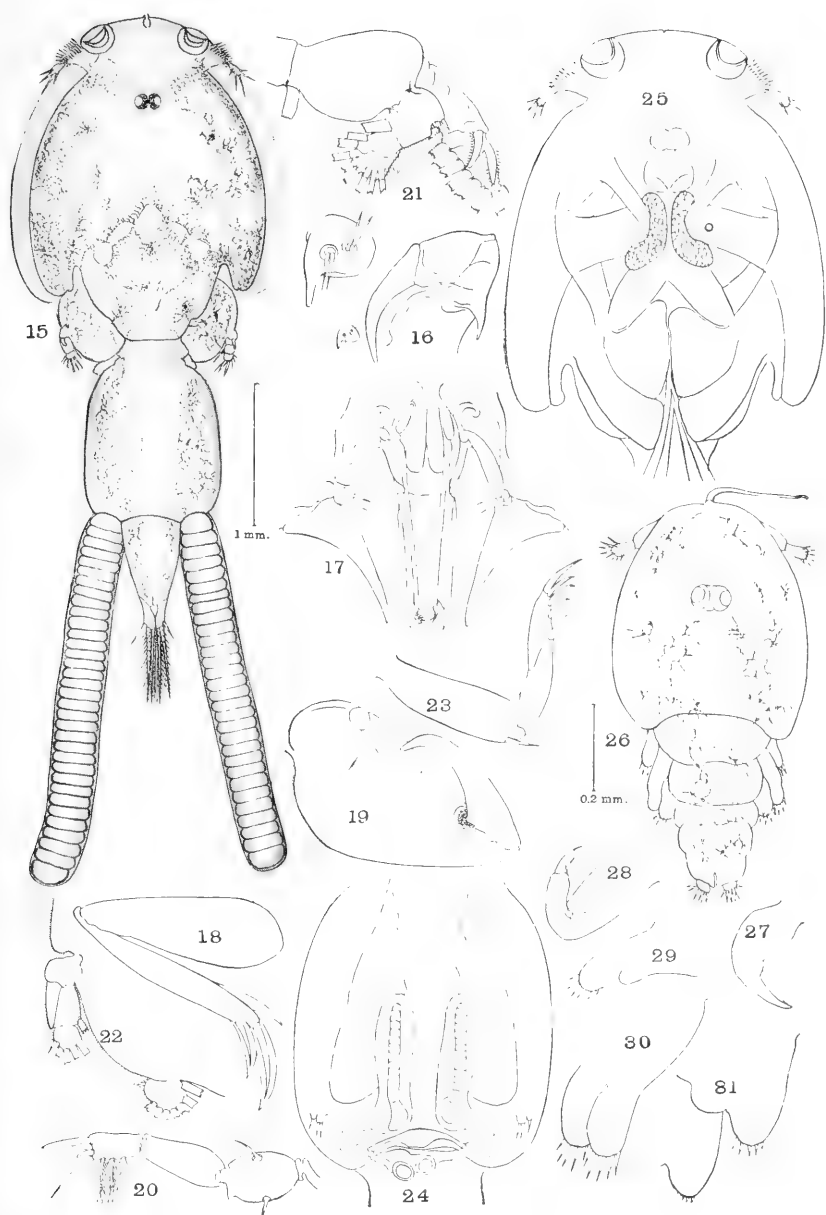
Fig. 93, dorsal view of male; fig. 94, second antenna and first maxilla; fig. 95, second maxilliped; fig. 96, ventral view of genital segment, enlarged; fig. 97, dorsal view of chalimus; figs. 98 and 99, first and second swimming legs of same; fig. 100, newly hatched nauplius of *Abasia pseudorostris*.





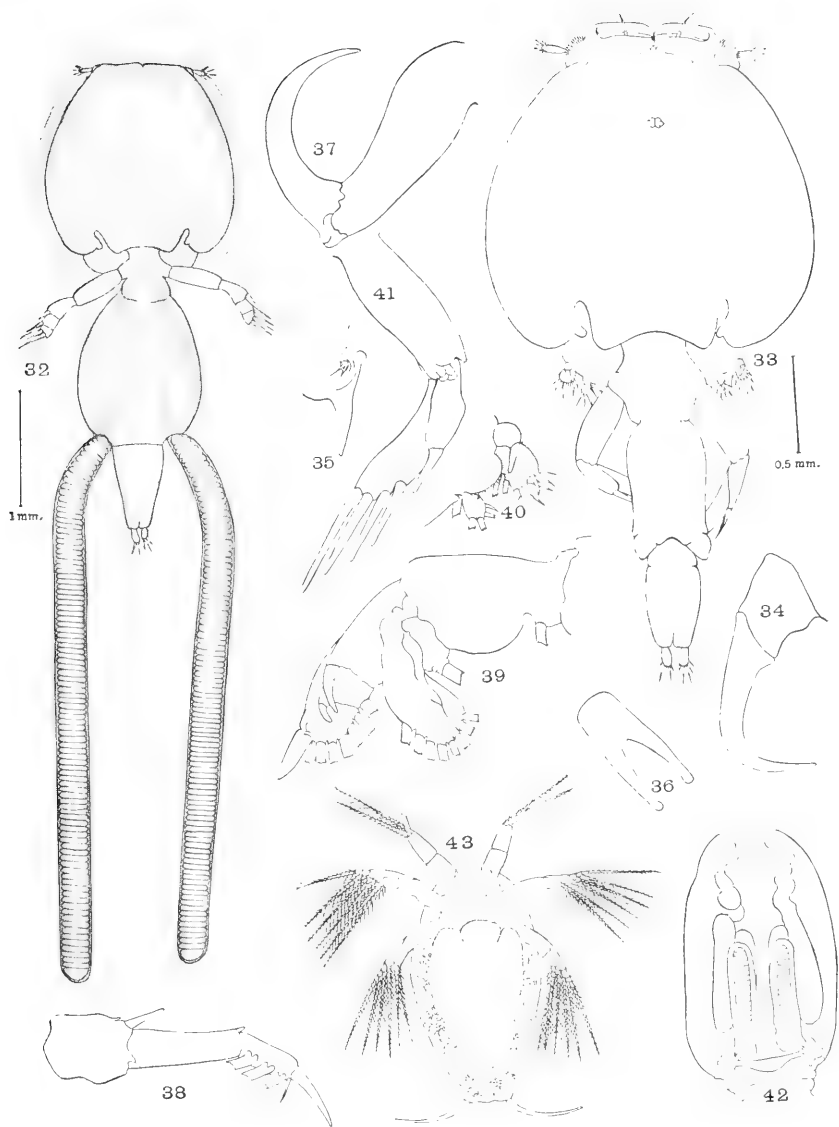
THE MALE AND FEMALE OF CALIGUS HÆMULONIS.

FOR EXPLANATION OF PLATE SEE PAGE 627.



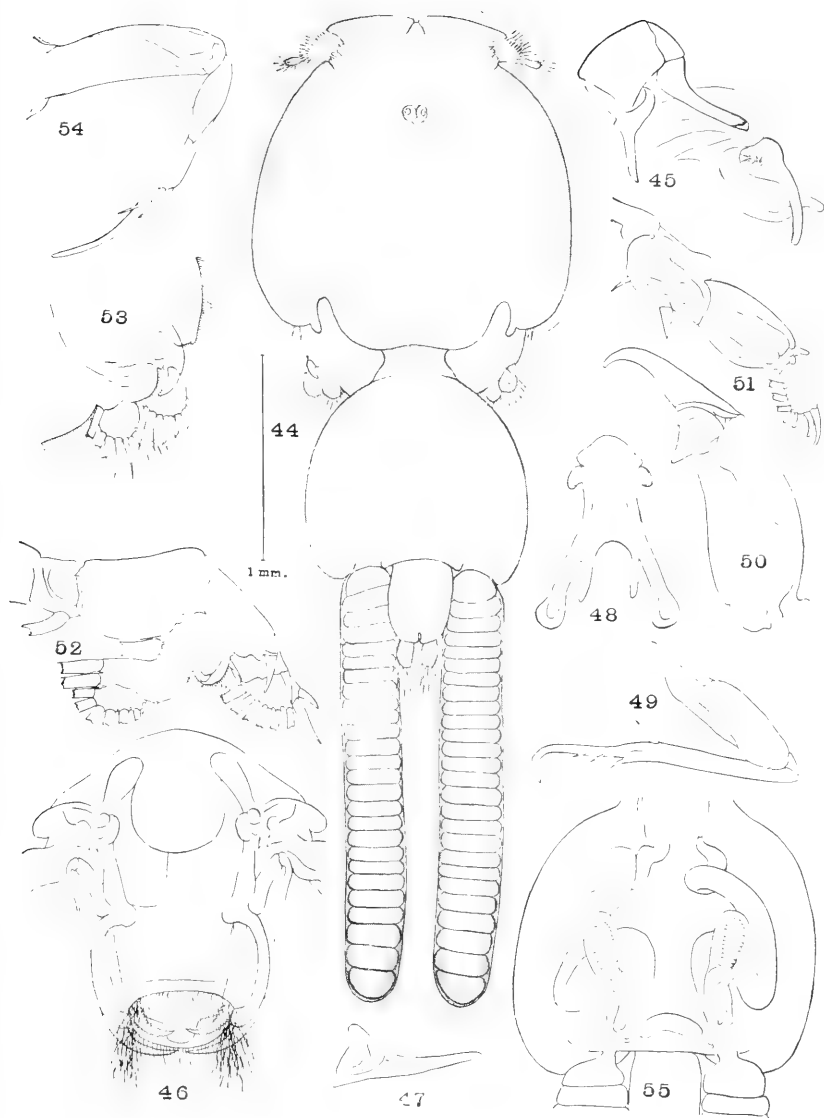
THE FEMALE OF *CALIGUS RUFUS*, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.



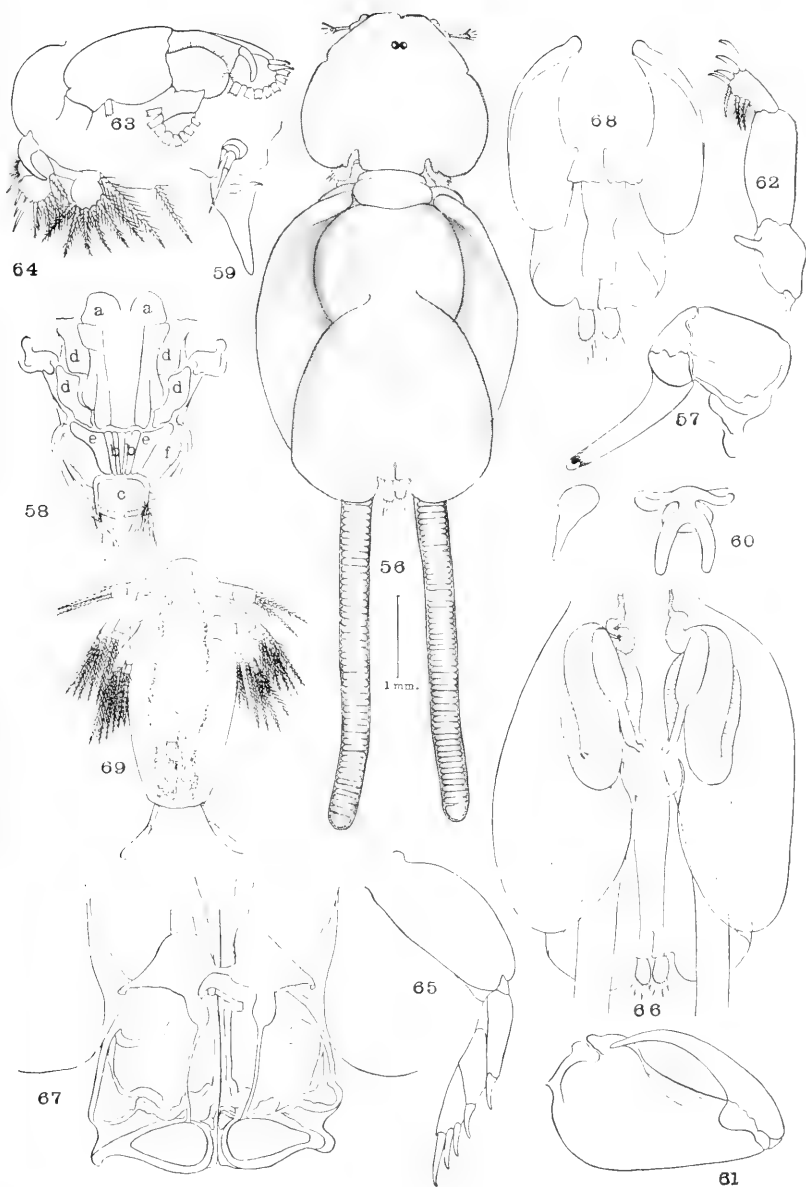
THE FEMALE OF *LEPEOPHTHEIRUS MONACANTHUS*.

FOR EXPLANATION OF PLATE SEE PAGE 627.



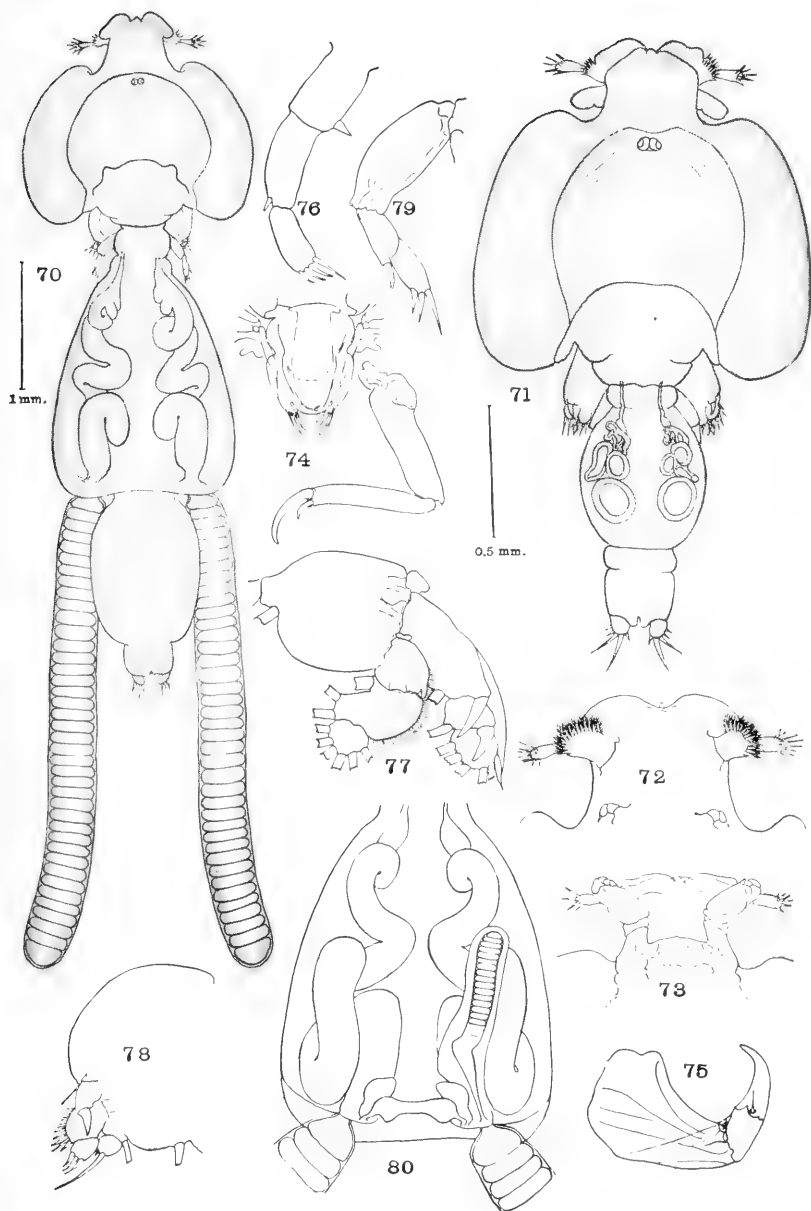
THE FEMALE OF *LEPEOPHTHEIRUS LONGISPINOSUS*, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.



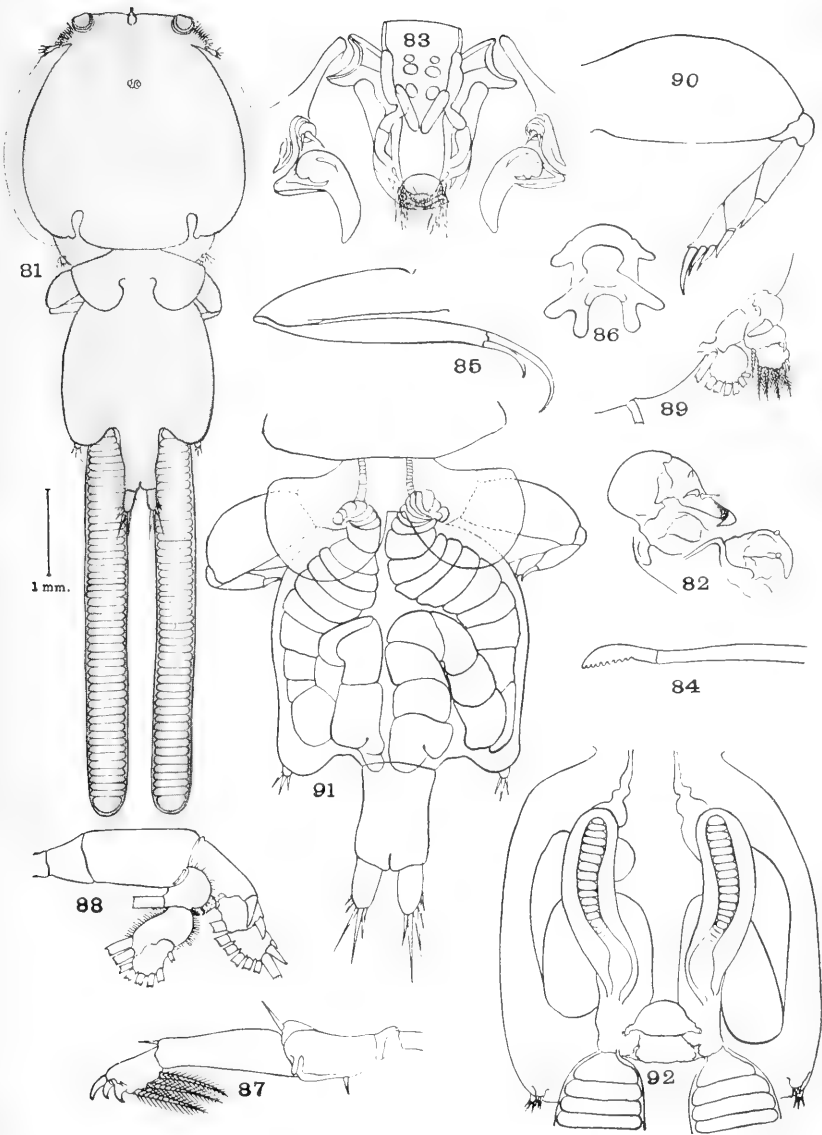
THE FEMALE OF *PARAPETALUS OCCIDENTALIS*, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.



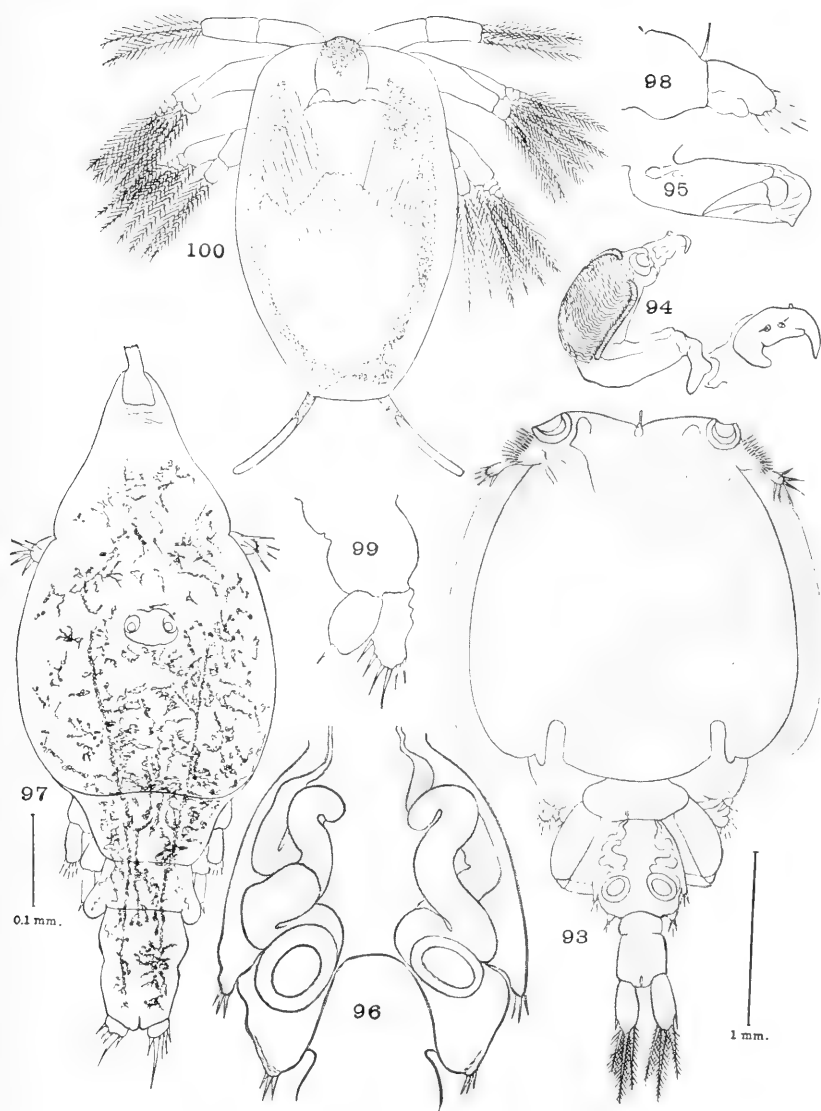
THE MALE AND FEMALE OF *ABASIA PSEUDOROSTRIS*, NEW GENUS AND SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.



THE FEMALE OF *TUXOPHORUS CALIGODES*, NEW GENUS AND SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.



THE MALE OF *TUXOPHORUS CALIGODES*, NEW GENUS AND SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 627.

A REVIEW OF THE FLAT-HEADS, GURNARDS, AND OTHER MAIL-CHEEKED FISHES OF THE WATERS OF JAPAN.

By DAVID STARR JORDAN and ROBERT EARL RICHARDSON,
Of Stanford University.

In earlier volumes of these Proceedings the Japanese representatives of certain families of Scleroparei, or Mail-cheeked fishes (Scorpenidæ, Hexagrammidæ, Cottidæ, Agonidæ, Liparidæ, and Cyclopteridæ), have been described by Messrs. Jordan and Snyder and by Messrs. Jordan and Starks. In the present paper the remaining families of this group are considered. The specimens examined were collected in 1900 by Professors Jordan and Snyder. Series of these specimens are in the United States National Museum and in the museum of Stanford University. The accompanying illustrations are the work of Mr. William S. Atkinson.

Family PLATYCEPHALIDÆ.

THE FLATHEADS.

Head flattened and more or less armed with spines and serratures, scaly posteriorly; body depressed anteriorly, subcylindrical posteriorly, covered closely everywhere with ctenoid scales; lateral line present; two dorsal fins, the first preceded by a short detached spine; ventrals I, 5, thoracic, inserted wide apart, and well behind pectorals; lower rays of pectorals more or less free at tips; no pectoral appendages; jaws, vomer, and palatines with bands of villiform teeth, some of the teeth sometimes enlarged and more or less canine-like; tongue free at tip; no air bladder; pyloric appendages in moderate number.

Japan and the northwest Pacific, and all Indian, Polynesian, and Australian seas, to the eastern coast of Africa. Species about 40; genera 4. Three genera and 7 species found in the waters of Japan. They are abundant market fishes and in common with the larger

species of *Callionymus*, which they resemble in form, color, and habits, they are known as "Kochi."

KEY TO GENERA.

- a. A stout antrorse spine on the lower face of the preopercle; margin of iris entire; no ocular cirri; scales 50; lateral line nearly smooth.....*Rogadius* a1
- aa. Preopercle without antrorse spine; ocular cirri present and margin of iris fringed in some species; scales 40 to 120.
 - b. Head more or less strongly armed with spines and serratures; teeth in villiform bands on jaws, vomer, and palatines, the vomerine bands separate, paired, and set lengthwise of the shaft of the bone; scales 40 to 90; lateral line armed or not*Thysanophrys* b2
 - c. Ocular cirrus wanting.....*Insidiator*
 - bb. Head entirely or nearly smooth; vomer with small canine-like teeth, in a crescentic band, set at right angles to the shaft of the bone; palatines with a single most prominent row of canine-like teeth; scales very small, usually more than 100; lateral line smooth.....*Platycephalus* c3

1. ROGADIUS Jordan and Richardson, new genus.

Head rather longer and less depressed than in most species of *Insidiator*, and much more so than in *Platycephalus*, well armed with spines and small serratures; a stout antrorse spine on the lower face of the preopercle and 3 spines at the angle, directed backward; cornea without cirri or lappets; scales moderate, about 50 in lateral line, which is smooth except anteriorly; teeth as in *Thysanophrys*.

A single species is found in the seas of China and Japan.

(*rogad*, Arabian name of *Platycephalus indicus*.)

Type of genus.—*Rogadius asper*.

1. ROGADIUS ASPER (Cuvier and Valenciennes.)

- Platycephalus asper* CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 257 (Japan).—RICHARDSON, Ichth. China and Japan, 1846, p. 217 (Canton).—TEMMINCK and SCHLEGEL, Faun. Japon., Pisc., 1843, p. 40, pl. xvi, figs. 4 and 5 (after Cuvier and Valenciennes).—GÜNTHER, Cat. Fishes, II, 1860, p. 190 (China).—ISHIKAWA, Cat. Fishes, Imp. Mus. Tokyo, 1897, p. 48 (Kagoshima).
(?) *Platycephalus macrolepis* NYSTRÖM, Svensk. Vet.-Akad. Handl., 1887, p. 13, IV, No. 4, p. 26 (Nagasaki) (not of Bleeker):

Habitat.—Sandy coasts of southern Japan and southern China.

a In addition to the single species (*R. asper*) found in the waters of Japan. *Platycephalus pristiger* Cuvier and Valenciennes and *P. polyodon* Bleeker may be referred to this genus.

b In addition to the Japanese species, the following may be regarded as belonging to the genus *Thysanophrys*: *scaber* Linnæus, *neglectus* Troschel, *detrusus* Jordan and Seale, *malabaricus* Cuvier and Valenciennes, *isacanthus* Cuvier and Valenciennes, *malayanus* Bleeker, *bosschei* Bleeker, *bataviensis* Bleeker, *rodericensis* Cuvier and Valenciennes, *borboniensis* Cuvier and Valenciennes, *bobossok* Bleeker, *sundaicus* Bleeker, *macracanthus* Bleeker, *celebicus* Bleeker, *pristis* Peters, *cirronasus* Richardson, etc.

c The following extra-Japanese species may be retained in the genus *Platycephalus*: *P. fuscus* Cuvier and Valenciennes, *tasmanius* Richardson, *lævigatus* Cuvier and Valenciennes, *inops* Jenyns, *grandispinis* Cuvier and Valenciennes, *bassensis* Cuvier and Valenciennes, *proximus* Castelnau, *richardsoni* Castelnau, *castelnaui* Macleay, *cincereus* Günther, *grandis* Castelnau.

Head 2.4 in length without caudal; depth 6.5; depth of head 3 in its length; width of head 1.9; eye 3.6; interorbital space 5 in eye; maxillary 2.5 in head; nose 3.3; D. I-VII—11; A. 11; scales 54; first 2 or 3 scales of lateral line with short spines.

Head rough, angular; superorbital and suborbital ridges finely serrated for their entire length; a stout spine in front of each orbit; top of head with low spines; opercular, scapular, and humeral spines sharp; preopercle furnished posteriorly with 3 spines, the upper spine strong, reaching to the opercular margin; a stout curved spine on the inferior face of the preoperculum, directed forward; opercular membrane under preopercular spines entire; eye without tentacle or cirrose lappet; jaws with broad bands of villiform teeth; vomerine and palatine bands with many of the teeth sharp and longer than the rest, canine-like; tongue convex at tip.

Spinous dorsal slightly lower than soft dorsal, the longest spine 2.75 in head; anal inserted under third ray of soft dorsal; pectorals 2 in head; ventrals 1.75; caudal rounded behind, squarish at upper and lower corners.

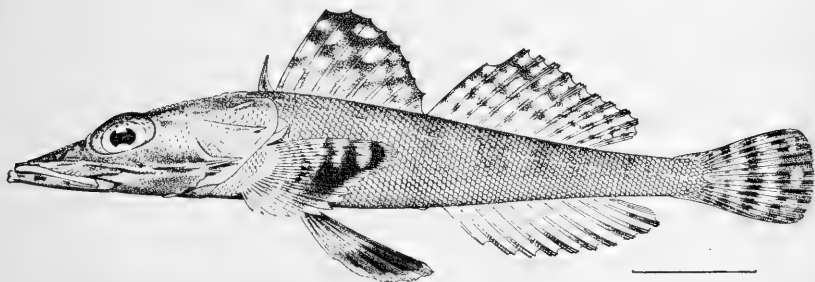


FIG. 1.—*ROGADIUS ASPER*.

Color in spirits grayish brown, tinged with purplish; back obscurely banded with dusky; spinous dorsal mottled in the membranes; soft dorsal with spots on the rays, forming rows; caudal indefinitely cross-banded and mottled with dusky; upper pectoral rays specked with dusky; lower half of pectorals blackish with an outer whitish edge; ventrals pale toward base, blackish outwardly, with a narrow pale margin; anal pale.

Here described from a single specimen, $5\frac{3}{4}$ inches long, taken at Swatow, China. It was not found by Jordan and Snyder in Japan.

(*asper*, rough).

2. *THYSANOPHRYS* Ogilby.

Thysanophrys OGILBY, Proc. Linn. Soc. N. S. W., 1898, XXIII, p. 40 (*cirronasus*).

Insidiator JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 368 (*rudis*=*meerdervoortii*).

Grammoplites FOWLER, Journ. Ac. Nat. Sci. Phila., XII, 1904, p. 550 (*scaber*).

Head broad and much depressed, although less so than in *Platycephalus*, well armed with spines and serratures; angle of preopercle

with 2 or 3 spines, the upper of which is longest; no spine on lower face of preopercle; teeth in villiform bands on jaws, vomer, and palatines, the vomerine bands 2, separate, and set lengthwise of the shaft of the bone; ocular cirri absent or present; scales large or small, 40 to 90 in the lateral line, which is variously smooth or armed, partially or for its whole length.

Species numerous, in sandy bays in the East Indian, Chinese, and Japanese seas, five species found in Japan. This genus was originally separated from *Platycephalus* by the minor character of the ocular cirrus. We are unable to separate from *Thysanophrys*, the subgenera *Insidiator*, based on the large scales, and *Grammoplites* based on the spinous armature of the lateral line.

(*εὐσανος*, fringe; *ὄφρυς*, eyebrow.)

KEY TO THE SPECIES OF THE GENUS THYSANOPHRYS FOUND IN JAPAN.

- a. *Insidiator*, scales relatively large, about 40 in the lateral line; a small cirrose lap-pet on upper rim of cornea; preopercular spines 3; D. I-VIII-11 or 12.
- b. Lateral line armed; ventrals reaching past front of anal; color dark grayish brown, the back crossed with about four indefinite broad bars; pectorals specked above, their lower half blackish; ventrals pale at base and tip, the middle blackish.
 - spinosus*, 2
- bb. Lateral line smooth; ventrals not quite to front of anal; color light yellowish brown, with vague dusky bars; pectorals and ventrals specked in the rays.
 - macrolepis*, 3
- aa. Scales smaller, 70 to 90 in lateral line.
 - c. Preopercular spines 3; scales 75; lateral line smooth; D. I-VIII-11; A. 11; no cirri; color grayish, with small spots of dusky on head and trunk forward; caudal crossed by vague broad bars of dusky.....*meerdervoortii*, 4
 - cc. Preopercular spines 2.
 - d. Ocular cirri present. (*Thysanophrys*, *Platycephalus longiceps* Cuvier and Valenciennes) *nematophthalmus* Günther, *tentaculatus* Rüppell, *cirronasus* Richardson, etc., of the East Indies.)
 - dd. Ocular cirri absent.
 - e. Lateral line armed for its entire length. (*Platycephalus scaber* Linnæus, type of *Grammoplites* Fowler, and other East Indian species.)
 - ee. Lateral line smooth, or armed only anteriorly.
 - f. Opercular membrane under preopercular spines with a conspicuous tongue-like flap, behind which is an acute notch; scales 70-80; D. I-VIII-12; A. 12; color, reddish brown, with 6 vague cross bands; no spots; rays of both dorsals and of pectorals speckled, the membranes clear; caudal with numerous small spots.....*japonicus*, 5
 - ff. Margin of opercular membrane below preopercular spines entire; scales 90; D. I-VII or VIII-11; A. 11; color, dark purplish gray with 4 or 5 broad cross-bands; back, sides; top of head, and muzzle with numerous small black spots; spinous dorsal blackish outward; soft dorsal with rather large spots, extending into the membranes; caudal with a few large spots and band-like splashes.....*crocodilus*, 6

2. THYSANOPHRYS SPINOSUS (Temminck and Schlegel).

ONIGOCHI, Devil Kochi.

Platycephalus spinosus TEMMINCK and SCHLEGEL, Faun. Jap., Pisc., 1843, p. 40, pl. XVI, figs. 1, 2 (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 217 (Canton).—BLEEKER, Nieuwe Nalez. Ichth. Japan, 1857, p. 77 (Nagasaki).—GÜNTHER, Cat. Fishes, II, 1860, p. 190 (Japan).—ISHIKAWA, Cat. Fishes Imp. Mus. Tokyo, 1897, p. 48 (Izu).

Insidiator macrolepis SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 487 (Kagoshima; Yamagawa). (Not *Platycephalus macrolepis* of Bleeker.)

Habitat.—Southern Japan from Suruga Bay to Southern China.

Head, 2.6 or 2.7 in length without caudal; depth, 6.3; depth of head, 2.5; width of head, 1.3; eye, 4 to 4.2; interorbital space, 3 to 3.2 in eye; maxillary, 2.5; nose, 3.5; D. I–VIII–11 or 12; A. 12; scales, 40; scales of anterior third or half of lateral line armed with short but sharp spines.

Head much roughened with spines and serrated ridges; supercilary ridges with about 12 close serratures extending their entire

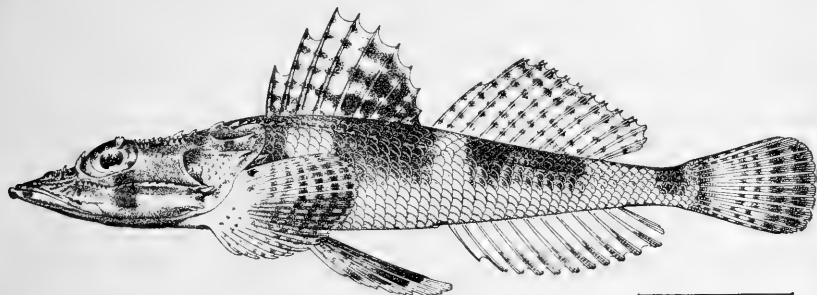


FIG. 2.—THYSANOPHRYS SPINOSUS.

length; a spine and 2 or 3 smaller serratures in front of each orbit; infraorbital ridges serrated closely for their entire length, being interrupted by a slightly deeper notch opposite pupil; post-orbital, parieto-occipital, opercular, scapular, and humeral spines well developed; preopercular spines 3, the upper stout, reaching more than halfway to the opercular margin; a shallow notch in the margin of the opercular membrane under the preopercular spines; a cirrose lappet on cornea above pupil; teeth villiform, in bands on jaws, vomer, and palatines; vomerine bands set lengthwise; no canines; tongue trilobed (emarginate, with a secondary median convexity).

First dorsal somewhat higher than second, the longest spine 2.1 or 2.2 in head; anal inserted slightly behind soft dorsal; soft dorsal and anal margin scarcely notched between the rays; pectorals, 1.8 to 2 in head; ventrals, 1.4; caudal subtruncate, but slightly rounded.

Color in alcohol dark grayish-brown above, the back crossed with 4 to 6 indefinite bands of darker color (there being typically 4 bands,

the middle two of which are broader than the others and show a tendency to split up into narrower bars); belly yellow; soft dorsal and caudal with specks on the rays, forming rows; spinous dorsal with the rays specked and with the membranes clouded with dusky, especially posteriorly; ventrals pale at base and tips, with a blackish band across the middle; upper half of pectorals specked in the rays, the membrane pale; lower half of pectorals blackish; anal pale.

Of this species we have 34 specimens from Nagasaki, 2 to $4\frac{1}{2}$ inches. Here described from two specimens from Nagasaki, $4\frac{1}{2}$ inches long. (*spinosus*, spinous.)

3. THYSANOPHRYS MACROLEPIS (Bleeker.)

ONESAGOCHI, Eldest Kochi.

Platycephalus macrolepis BLEEKER, Nieuw Nalez. Ichth. Japan, 1857, p. 76, pl. IV, fig. 1 (not good) (Nagasaki).—GÜNTHER, Cat. Fishes, II, 1860, p. 188.—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 260 (Tokyo).

Insidiator hosokawae SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 486, fig. 8 (Urado, island of Shikoku).

Habitat.—Southern Japan, north to Tokyo.

Head, 2.8 in length without caudal; depth 6.5; depth of head, 2.65 in its length; width of head, 1.4; eye, 4.1 or 4.2; interorbital space, 2.6; maxillary, 2.5; nose, 3.3; D. I–VIII–11 or 12; A. 12; scales, 38 to 40; lateral line smooth.

Head less strongly armed than in *T. spinosus*; superciliary ridges serrated behind middle of eye; a short bluntish spine in front of each orbit; infraorbital ridges serrated closely for their whole length, the number of teeth about 12; a deep semicircular notch in the infraorbital ridge under middle of pupil; two opercular spines terminating low, short ridges; two scapular spines, the anterior one highest; post-orbital and parieto-occipital spines low; preopercular spines, 3, the upper reaching more than halfway from the notch under it to the margin of the operculum; lower preopercular spines short, the third often scarcely developed; lower margin of opercular membrane entire; a cirrose lappet on cornea above pupil; jaws, vomer, and palatines with bands of villiform teeth; vomerine bands short, placed lengthwise; no canines; tongue emarginate, with a slight median convexity.

First dorsal slightly higher than second, the longest spine 2.16 in head; anal inserted slightly behind soft dorsal; margin of anal and soft dorsal not noticeably notched between the rays; pectorals, 2.2 in head; ventrals, 1.6; caudal subtruncate, scarcely rounded.

Color in spirits light yellowish brown, the back crossed by 4 or 5 indistinct dusky bars; belly yellowish; dorsals, caudal, pectorals, and ventrals with black specks on the rays, arranged more or less in rows; last membranes of spinous dorsal faintly clouded with dusky; anal pale.

Of this species we have 55 specimens from Nagasaki, $2\frac{1}{2}$ to 4 inches long.

Here described from 2 specimens from Nagasaki, 4 inches long. (*μακρός*, large: *λεπís*, scale.)

4. THYSANOPHRYS MEERDERVOORTII^a (Bleeker).

ONAGOCHI (Woman Kochi, MAGOCHI Big-eyed Kochi).

Platycephalus meerdervoortii BLEEKER, Acta Soc. Sci. Indo-Nederl., VIII, 1860, pl. i, fig. 3 (Nagasaki; Yedo).—BLEEKER, Enum. Poiss. Japon., 1879, p. 12 (Nagasaki; Yedo; Tokyo).

Platycephalus rudis GÜNTHER, Shore Fishes, Challenger, 1880, p. 66, pl. XXIX, fig. B (Yokohama).—STEINDACHNER and DÜDERLEIN, Beitr. Kennt. Fische Japan's, IV, 1887, p. 260 (Tokyo).

Insidiator rudis JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 368 (Tokyo).

Habitat.—Southern Japan, north to Tokyo.

Head 2.8 in length without caudal; depth 7.75; depth of head 3.25 in its length; width of head 1.5; eye 4.2; interorbital space 3 in eye; maxillary 2.5; D. I–VIII–11; A. 11; scales 75; lateral line smooth.

Head moderately armed; superciliary ridges each with about 6 low and rather closely approximated serratures, in front of and behind each ridge a single higher spine; infraorbital ridges with 5 distant spines, the last one just in front of the base of the long preopercular spine; two smooth ridges on upper part of opercle, each terminating behind in an inconspicuous spine; scapular ridges short, each with two spines; parietooccipital region with a pair of low ridges, each terminating in a moderate spine; post-orbital ridges ill-defined, each with two low spines; preopercular spines 3, the upper more than twice the length of the second, and reaching almost to the gill-opening, third spine about half as long as second; a slight but sharp notch on the opercular membrane, under the second spine; anterior nostril with a short dermal flap; teeth in fine villiform bands on jaws, vomer, and palatines, the vomerine bands short, and disposed lengthwise, scarcely reaching past front of palatines; no canines; tongue emarginate, with a very slight median convexity. No ocular cirrus.

Spinous and soft dorsals of about equal height; longest dorsal spine 2.2 in head; soft dorsal inserted slightly in front of anal; the margin of the fin notched to a depth (measured on ray forming hinder boundary of notch) equal to two-fifths of the diameter of the orbit; pectorals 2 in head, reaching to opposite sixth ray of spinous dorsal;

^a A nominal point of difference between Bleeker's figure of this fish and Günther's figure of *P. rudis* consists in the absence in the figure of Bleeker of the third (lowest) preopercular spine. In view of the perfect agreement of the figures in all other essential particulars, it appears that the point may be waived with entire safety.

ventrals 1.4, their tips to a vertical from second ray of soft dorsal; caudal rounded posteriorly, with the upper and lower angles rather squarish.

Color (in alcohol) grayish, with black dots on the sides forward and on cheeks and opercles; spinous dorsal clouded with blackish, being darkest behind, especially between the fifth and seventh spines; rays of soft dorsal specked with black; pectorals with the rays specked with black and also with some dusky in the membranes; ventrals blackish except near base and at tips; anal pale; caudal crossed by broad bars of dusky, one near base, a narrower one midway, and a broad one across tip.

Specimens: Wakanoura, 1 specimen, $2\frac{3}{4}$ inches; Shimizu, on Suruga Bay, 1 specimen, $5\frac{3}{4}$ inches.

The above description is from a Suruga specimen, $5\frac{3}{4}$ inches in length.

(Named for J. C. L. Pompe van Meerdervoort).

5. THYSANOPHRYS JAPONICUS (Tilesius).

(?) *Silurus inermis*^a HOUTTUYN, Verhandl. Haarlem, XX, 1782 (2), p. 450 (Nagasaki).

Platycephalus japonicus TILESIIUS, Krusenst. Reise, 1812, pl. LIX, fig. 1 (Nagasaki).—CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 256 (after Tilesius).—(?) RICHARDSON, Ichth. China and Japan, 1846, p. 217 (Canton).—TEMMINCK and SCHLEGEL,^b Faun. Japon., Pisc., 1843, p. 40, pl. XVI, fig. 3 (Nagasaki).—BLEEKER, Nieuwe Nalez. Ichth. Japan, 1857, p. 78 (Nagasaki).—GÜNTHER, Cat. Fishes, II, 1860, p. 181 (China and Japan); Shore Fishes, Challenger, 1880, p. 55 (Hongkong).—MACLEAY, Cat. Austral. Fishes, I, 1881, p. 220 (Port Darwin).—STEINDACHNER^b and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 260 (Tokyo).—SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 486 (Kochi; Kagoshima).

Platycephalus crocodilus JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 368 (Tokyo) (not *P. crocodilus* of Tilesius).—SCHMIDT, Pisc. Mar. Orient., 1904, p. 368 (Fusan, Korea).

^a We give here a translation of Houttuyn's description of *Silurus inermis*: No barbels or serrated pectoral spine. Body terete, scaled. Head very flat, with large eyes, close together, as in the Stargazer. Opercle with two fine spines. D. VII-11; P. 20; V. 6; A. 10; C. 13. Caudal fin roundish, black and white spotted, like all the other fins. Body reddish. Jaws without teeth. Length, 6 inches. It seems more probable that Houttuyn may have made a miscount (under) of the dorsal and anal rays than that he would have omitted mention of the spotting, if his specimen had been an *T. crocodilus*. The description of the color fits well *T. japonicus*, and it may be that the species should stand as *Thysanophrys inermis*.

^b The fullness and accuracy of Doctor Steindachner's description, together with the fact that he had a specimen of *P. japonicus* from Schlegel for comparison, seems to establish beyond serious question the identity of the specimens of Schlegel and Steindachner with *P. japonicus* of Tilesius. Certain essential points of Doctor Steindachner's description follow (in translation): "Dorsal 1/8/12-13; scales 65-70, not 100, as stated by Doctor Günther; * * * a well-developed membranous flap below the preopercular spines; color gray, with obscure bands and blotches; dorsals and pectoral with rows of brown spots."

Habitat.—Southern Japan and China, north to Tokyo.

Head, 2.8 in length without caudal; depth, 7.5 to 9; depth of head, 3.5 in its length; width of head, 1.6; eye, 4.6 to 4.8; interorbital space, 2.5 to 3 in eye; maxillary, 2.5; D. I–VIII–12; A. 12; scales, 70 to 80; lateral line smooth except for the first 3 or 4 scales, which may bear small spines.

Head moderately armed; superciliary ridges each with about 6 low spine-like serratures, all behind middle of eye; a sharp spine in front of and behind each superciliary ridge; infraorbital ridges with two distant spines, one under middle of pupil, the other under back of orbit; an upper short and a median long, smooth ridge on opercles, each ending in a good spine; a short (anterior) and a long (posterior) scapular spine on each side of nape; parieto-occipital ridges low, beginning and ending with a rather low spine; 3 moderate post-orbital spines on each side, without a continuous ridge; preopercular spines 2 (with sometimes a minute third spine), both short, the upper being about twice the length of the lower and contained 3 or

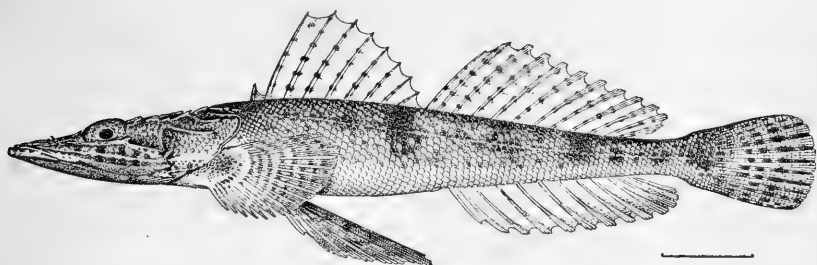


FIG. 3.—*THYSANOPHRYS JAPONICUS*.

more times in the diameter of orbit; a sharp and deep notch on the edge of the opercular membrane directly under the preopercular spines, the membrane in front of the notch produced in a V-shaped, tongue-like flap, which is as long as the upper preopercular spine; jaws, vomer, and palatines with bands of fine villiform teeth; vomerine bands short, obovate, placed lengthwise and reaching scarcely past front of palatines; no canine teeth; tongue emarginate, sometimes with a very slight median convexity.

Spinous dorsal noticeably higher than soft dorsal fin, the longest spine 2.3 in head and about 1.25 times length of highest ray; anal fin inserted under second ray of soft dorsal; margin of anal and soft dorsal moderately notched to a depth (measured on ray forming hinder boundary of notch) equal to nearly two-fifths of diameter of orbit; pectorals 2 in head; ventrals 1.4, reaching a vertical from third soft dorsal ray; caudal rounded.

Color in alcohol, grayish-brown above, the back crossed by 6 obscure and ill-defined bands of darker; head obscurely and finely specked and vermiculated; cheeks below the suborbital ridge crossed transversely by alternating obscure light and dark band-like mark-

ings, which are continued for a short distance underneath; exposed upper edges of mandible finely banded and vermiculated with pale and dusky; under parts yellowish; dorsals and pectorals with the membranes pale, the rays being specked with black, the spots forming rows; caudal with dark spots in the membranes, the anterior ones small and roundish and forming indistinct rows; the spots toward back of fin larger and more or less in the form of elongate lengthwise splashes.

Specimens.—Tokyo, 4 specimens, $7\frac{1}{2}$ to 8 inches; Misaki, 1 specimen, 6 inches; Tsuruga, 1 specimen, 7 inches; Nagasaki, 34 specimens, 4 to 8 inches; Wakanoura, 19 specimens, 4 to $6\frac{1}{2}$ inches.

Here described from 2 specimens, $7\frac{1}{2}$ and 8 inches long, from Tsuruga and Tokyo, respectively.

The species is generally common in the markets of southern Japan.

6. THYSANOPHRYS CROCODILUS (Tilesius).

INEGOCHI, Rice Kochi.

Platycephalus crocodilus TILESIIUS, Krusenstern's Reise, 1812, pl. LIX, fig. 2 (Nagasaki).—CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 256 (after Tilesius).

Platycephalus punctatus CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 243 (Hindustan, Voy. Peron).—GÜNTHER, Cat. Fishes, II, 1860, p. 180; Shore Fishes, Challenger, 1880, p. 66 (Inland Sea of Japan).—DAY, Fishes India, I, 1878-1888, p. 277, pl. LX, fig. 3 (Indian seas).—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, 1887, p. 25 (Nagasaki).—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 259 (Tokyo).—SAUVAGE, Poiss. Madagascar, 1891, p. 307, pl. XXXVI, figs. 5 and 5a. —ISHIKAWA, Cat. Fishes Imp. Mus. Tokyo, 1897, p. 48 (Suruga).—SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 486 (Yamagawa).—JORDAN and SEALE, Bull. U. S. Fish. Comm., XXVI, 1906, p. 38 (Cavite, Philippine Islands).

Platycephalus guttatus CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 244 (Japan).—TEMMINCK and SCHLEGEL^a, Faun. Japon., Pisc., 1843, p. 39, pl. xv, fig. 2 (Bay of Nagasaki).—(?) RICHARDSON, Ichth. China, 1846, p. 217 (Canton).—NAMIYE, Class. Cat., 1881, p. 104 (Tokyo).

^a In the figure of Temminck and Schlegel the number of dorsal bands is incorrectly represented, being 8 and not 5, as in specimens; and the number of soft dorsal rays is stated in the description to be 12, "and not 10, as said by Cuvier." In all our specimens we find 11 soft dorsal rays, the last one being split fully to the base. Enumerating, on the other hand, the points of agreement between our specimens (one of which is 14 inches long) and both the figure and description of Temminck and Schlegel, we find the following:

(1) General color, grayish to reddish-brown, with purplish tinge.

(2) Distribution of spotting: On back, top of head, interorbital space, muzzle, and under eyes.

(3) Spotting of spinous dorsal: The spots in three obscure series, and extending into the membranes. (The young have the outer half of the fin blackish. Schlegel's specimen was 20 inches long.)

(4) Coloration of soft dorsal.

(5) "Adipose," club-like tips of anal rays.

In all of the points enumerated the present species differs markedly from *T. japonicus*.

Habitat.—Southern Japan to the East Indies north to Tokyo.

Head 3 in length without caudal; depth 9; depth of head 3.5 to 4 in its length; width of head 1.6 or 1.7; eye 4.5 to 5.2; interorbital space 2.5 in eye; maxillary in head 2.5 to 2.7; D. VII or VIII, 11; A. 11; scales 90; lateral line smooth.

Size and arrangement of spines on top of head about as in *T. japonicus*; 5 or 6 superciliary serratures, all behind center of orbit; a sharp spine at the upper anterior corner of each orbit; infraorbital ridge with 3 distant spines, one under back of orbit, one below anterior third of pupil, and a third (not found in *T. japonicus*) nearly opposite posterior nostril, upper part of opercle with two low smooth ridges, each ending in a short blunt spine; scapular ridges each with two spines; parieto-occipital ridges low, with two short spines; 3 post-orbital spines on each side, not connected by a continuous ridge; preopercular spines 2, longer than in *T. japonicus*, the upper contained less than $2\frac{1}{2}$ times in the diameter of the orbit, the lower less than half the length of the upper; opercular membrane not notched nor provided

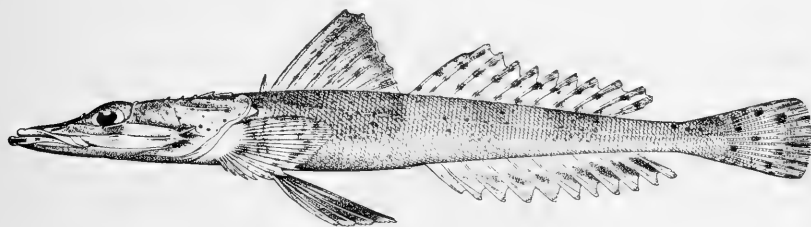


FIG. 4.—*THYSANOPHRYS CROCODILUS*.

with a flap under angle of preoperculum; bands of fine villiform teeth; vomerine bands short, as in *T. japonicus*; no canine teeth; tongue emarginate, occasionally with a very slight median convexity.

Highest dorsal spine $1\frac{2}{3}$ times height of longest soft ray; margin of soft dorsal and anal behind middle of fins deeply notched, the fin-membrane joining the anterior edge of the rays about midway of their length; free ends of soft dorsal rays expanded (by branching) and brush-like; anal rays similarly expanded outwardly, and covered with rather thick skin; pectorals 2 to 2.2 in head; ventrals 1.4 to 1.6; caudal margin convexo-truncate.

Color (in alcohol) reddish-brown, tending to purplish, back, sides, back and top of head, muzzle, cheeks, and opercles with numerous small roundish black spots; similar spots between the eyes, below them, and on the upper third of each eye itself; back crossed with 4 or 5 broad bars of dusky, the last three directed obliquely forward, and all subject to fading and disintegration with age; under parts

whitish forward, dusky behind ventrals; spinous dorsal in young specimens with its outer half or third blackish; in adults (specimen 14 inches) the darker color fading and breaking into more or less recognizable black spots, which form indistinct rows, but are not confined to the rays as in *T. japonicus*; soft dorsal with large spots, encroaching on the membrane, and forming, on the posterior half of the fin, 3 rows; membranes of anal blackish, in a broad and long splotch between each two rays, pectorals and ventrals dusky, the upper pectoral rays with the spots forming obscure rows; caudal in young with spots and wide longitudinal band-like splashes of blackish, which break up more or less in old specimens.

The color alone sufficiently distinguishes this species from *I. japonicus*. Other more or less important differences are: The absence in the present species of the tongue-like flap on the opercular membrane; the deeper notching of the margins of the soft dorsal and anal; the longer spines of the preopercle; and the thickened, "adipose" anal rays.

Specimens.—Tokyo, 3 specimens, 6 to 8½ inches; Onomichi, 1 specimen, 4½ inches; Hiroshima, 1 specimen, 7 inches; Nagasaki, 2 specimens, 9 inches and one 14 inches; Wakanoura, 4 specimens, 7 to 8½ inches.

Here described from measurements made on a specimen 8 inches long from Wakanoura and one 14 inches long from Nagasaki.

It is common in southern Japan, and southward to India and the Philippines.

(*crocodilus*, crocodile.)

3. PLATYCEPHALUS Bloch.

Platycephalus BLOCH, Ichth., XII, 1795, p. 90 (*spathula*=*insidiator*=*indicus*).

Calliomorus LACÉPÈDE, Hist. Poiss., II, 1800, p. 343 (*indicus*).

Neoplatycephalus CASTELNAU, Proc. Zool. Soc. Victoria, I, 1872, p. 87, (*grandis*).

Head broad and extremely depressed, being smooth or scarcely armed; angle of preopercle with 2 spines, subequal, or the lower one longest; lower face of preopercle without spine; vomer with small canine-like teeth, in a crescentic band, which is placed at right angles to the shaft of the bone; palatines with a single most prominent row of canine-like teeth, teeth in jaws in broad villiform bands; no ocular cirri; scales very small, more than 100 in typical species; lateral line smooth.

East Indies, Chinese and Japanese seas, Red Sea, Cape of Good Hope, and Australia. Species less numerous than those of *Thysanophrys*; a single one is known from Japan, the center of distribution of the genus being apparently Australia.

(*πλατύς*, flat; *κεφαλή*, head.)

7. *PLATYCEPHALUS INDICUS* (Linnæus.)**KOCHI, MAKOCHI** (True Kochi), **GINGOCHI** (Silver Kochi).*Callionymus indicus* LINNÆUS, Syst. Nat., 10th ed., 1758, p. 250; 12th ed., 1766, p. 434; ("habitat in Asia").*Calliomorus indicus* LACÉPÈDE Hist. Poiss., II, 1800, p. 343.*Platycephalus spathula* BLOCH, Ichth., XII, 1795, p. 90, pl. ccccxiv (Tranquebar).*Cottus insidiator* FORSKÅL, Descr. Animal., Pisc., 1775, p. X (Red Sea).*Cottus rogad; insidiator* FORSKÅL, Descr. Animal., Pisc., p. 25.*Platycephalus insidiator*, CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 227 (Pondicherry; Moluccas).—TEMMINCK and SCHLEGEL, Faun. Jap., Pisc., 1843, p. 39, pl. xv, fig. 1 (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 216 (Canton).—GÜNTHER, Cat. Fishes, II, 1860, p. 177 (China; Japan; India; Red Sea; Cape of Good Hope; N. W. Australia).—Shore Fishes, Challenger, 1880, p. 66 (Yokohama Bay).—NAMIYE, Class. Cat., 1881, p. 104 (Tokyo).—DAY, Fishes India, 1878–1888, p. 276.—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, 1887, No. 4, p. 25 (Nagasaki).—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV) 1887, p. 259 (Tokyo; Kochi; Kagoshima).(?) *Platycephalus angustus* STEINDACHNER, Sitzber. Ak. Wiss. Wien., LIII, 1866, p. 213, pl. i, fig. 4 (Surinam, error in locality).*Platycephalus indicus* BLEEKER, Atlas, IX, 1878, Platy., pl. i, fig. 3.—SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 486 (Kagoshima).*Habitat*.—East Indies to India and the Red Sea, and north to Japan.

Head 3.2 to 3.4 in length without caudal; depth 9 to 10; depth of head 3.7 to 4 in its length; width of head 1.5; eye 7 to 9; inter-orbital space twice diameter of eye, maxillary 2.6 in head, D. I–VII–13; A. 13; scales about 120, lateral line entirely smooth.

Head smooth, except for the low superciliary, parieto-occipital, scapular and preopercular ridges, none of which is provided with any spines or serratures; a low blunt spine with a broad base in front of the upper anterior orbital angle; preoperculum ending in two robust spines, of almost equal length, both slightly upturned, and the lower one reaching about half way to the margin of the opercle; a tongue-like flap on the opercular membrane under the preopercular spines; vomerine teeth canine-like, the bands bearing them semicrescentic in form and set nearly transversely to the vomerine shaft; palatines with a single most prominent row of canine-like teeth; jaws with villiform teeth in broad bands; tongue as a rule convex in front, sometimes (in large specimen) showing a very slight emargination.

Highest dorsal spine scarcely equal to longest soft ray; posterior margin of soft dorsal and anal cleft deeply between the rays, the membrane joining the front edge of the rays below their middle; free ends of the rays well branched; pectorals 2 in head in young (2.4 in a specimen 14½ inches long); ventrals 1.5 to 1.7; caudal subtruncate posteriorly.

Color in spirits brownish, with 8 or 9 obscure dusky, cloud-like bands over back; back and top of head and muzzle everywhere vaguely

mottled in fine pattern, the spots on the head of a more or less roundish form and encircled with a ring of pale; bars and mottlings tending to become obsolete in old specimens; underparts yellowish; fins, except caudal, with rows of dusky spots on the rays; caudal with a median longitudinal black band, above and below which are two oblique ones, the upper band being shorter than the other two.

Specimens.—Nagasaki, 2 specimens, 7 to 8 inches; Wakanoura, 3 specimens, 9 to 10½ inches; Tsuruga, 2 specimens, 8½ inches; Tokyo and Misaki, 5 specimens, 8 to 9 inches. It was also seen at Tsuruga, Kobe, Hiroshima, and Onomichi.

Here described from measurements made on a specimen 10 inches long from Wakanoura and one 14½ inches long from Hongkong, China. This species is a common market fish from Tokyo southward, the largest member of the family in Japan, and by far the most abundant. It is known at once by the flat, smooth head, and by the coloration of the caudal fin.

(*indicus*, Indian.)

Family BEMBRIDÆ.^a

Head not greatly depressed, armed and scaly on the sides; body covered with scales of large or rather small size; a lateral line; 2 dorsal fins, the first with 6 to 11 spines; ventrals thoracic, but inserted a little before the pectorals, I, 5; no pectoral appendages; villiform teeth in the jaws, on the vomer, and on palatines; branchiostegals 7; no air-bladder.

Waters of Hawaii^b and Japan. Four genera and 4 species, 3 of these inhabiting waters of Japan.

KEY TO GENERA.

- a. Anal fin long, of 14 or 15 rays.
- b. First dorsal of 11 spines; top of head with spines and ridges; lateral line traversing middle of side; jaws subequal; scales 55.....*Bembras*, 4.
- bb. First dorsal of 6 spines; top of head smooth; lateral line (not described); lower jaw projecting (as in *Parabembras*); scales 40.....*Bambradon*, 5.
- aa. Anal fin short, of 8 rays, lateral line above middle of side, running parallel with the back; lower jaw projecting, scales about 47 (figure).....*Parabembras*, 6.

4. BEMBRAS Cuvier and Valenciennes.

Bembras CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 282 (*japonicus*).

Dorsal spines XI; anal fin long, of 14 or 15 rays; lateral line traversing middle of side; top of head with spines and ridges. Characters otherwise those of the family.

A single species, from Japan.

(βεμβράς, a grasshopper.)

^aAccording to Prof. Henry R. Fairclough, of Stanford University, it is good usage in Latin to omit one *d* in patronymics in which two *d*'s occur together, in the interest of euphony. Thus *Liparidæ* should be preferred to *Liparididæ*.

^b*Bembradium roseum* Gilbert; D. IX-12; A. 11; scales 28; lateral line near middle of body; lower jaw included. Hawaii.

8. *BEMBRAS JAPONICUS* Cuvier and Valenciennes.

Bembras japonicus CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 282, pl. LXXXIII (Japan, Coll. Langsdorf).—TEMMINCK and SCHLEGEL, Faun. Japon., Pisc., 1843, p. 41, pl. XVI, fig. 8 (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 217.—GÜNTHER, Cat. Fishes, II, 1860, p. 191 (Japan, stuffed specimen).—BLEEKER, Enum. Poiss. Japon., 1879, p. 12 (Nagasaki).—ISHIKAWA, Cat. Fishes Imp. Mus., Tokyo, 1897, p. 48 (Boshu).—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 261 (Tokyo Bay).—SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 488 (Susaki; Urado; Kochi).

Habitat.—South Japan and north to Tokyo.

Head 3.5 in length; D. VI-12; A. 14; scales 55; muzzle longer than eye; jaws subequal; infraorbital ridge with 4 denticulations, directed backward.

Color clear red, more or less mottled or spotted; the dorsal fins with greenish spots.

We have no specimens of this rare species. The above description is condensed from the accounts of Schlegel and Cuvier. The senior writer has, however, examined a specimen from Boshu in the Imperial Museum at Tokyo. It was brick red with distinct spots, D. X-12, A. 14.

(*japonicus*, Japanese.)

3. *BAMBRADON* Jordan and Richardson, new genus.

Dorsal spines VI; anal rays 14 or 15; lateral line probably traversing middle^a of side, as in *Bembras* and *Bembradium*, with which this genus is apparently more closely allied than with *Parabembras*; top of head smooth, without spines or ridges.

A single species, from the waters of Japan.

(βαμβραδών, a grasshopper.)

Type of genus.—*Bambradon lævis*.

9. *BAMBRADON LÆVIS* (Nyström.)

Bembras lævis NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, 1887, No. 4, p. 26 (Nagasaki).

Upper part of head wholly without spines and ridges; body slenderer than in *Bembras japonicus*; breadth behind head somewhat greater than the depth; D. VI-14; A. 15; P. 23; scales 40; eye 4 in head; snout 3 in head; lower jaw projecting considerably beyond upper; second dorsal spine longest, somewhat longer than body's depth; anal slightly longer than soft dorsal; scales thin, ctenoid.

Color brownish, with a row of dusky spots along body's lower edge; under parts dirty white; a black blotch at front of spinous dorsal; anal pale, with a dusky band at base; pectorals brownish, without spots or bands.

^a Direction of lateral line not stated by Nyström.

This species has not been taken since originally described by Nyström in 1887. The above description is condensed from the original description by Nyström.

(*lævis*, smooth.)

6. PARABEMBRAS Bleeker.

Parabembras BLEEKER, Versl. Ak. Amst. (2), VIII, 1874, p. 370 (*curtus*).

Lateral line high, parallel with the back; anal fin short, of 2 spines and 6 rays (figure of *P. curtus* Temminck and Schlegel); lower jaw strongly projecting.

A single species, known only from Japan.

(*παρά*, near *bembras*.)

10. PARABEMBRAS CURTUS (Temminck and Schlegel).

Bembras curtus TEMMINCK and SCHLEGEL, Faun. Japon., Pisc., 1843, p. 42, pl.

XVI, figs. 6, 7 (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 217

(after Schlegel).—GÜNTHER, Cat. Fishes, II, 1860, p. 191 (after Schlegel).

Parabembras curtus BLEEKER, Versl. Ak. Amst. (2), VIII, 1874, p. 370.

Habitat.—Island of Kiusiu.

Head, 2 in length of trunk (figure of Temminck and Schlegel); depth 6; D. IX-9; A. 8; P. 21; scales about 47 (figure); muzzle short (shorter than eye in fig.); lower jaw projecting; opercular and subopercular spines feeble; teeth much finer than in *Bembras japonicus*; infraorbital ridge with 3 denticulations.

Color uniform reddish in the dried specimen.

This species appears not to have been taken since it was originally described by Temminck and Schlegel in 1843 from a dried specimen.

(*curtus*, short.)

Family HOPLICHTHYIDÆ.

Head broad and flattened, strongly armed, with upper surface and sides bony; back and sides covered with bony plates; belly and breast naked; two dorsal fins; ventrals I, 5 set at a moderate distance apart, as in *Triglidæ*, but somewhat in front of pectorals; 3 detached pectoral rays, as in *Triglidæ*; jaws, vomer, and palatines with minute teeth; no air-bladder; pseudobranchiæ present.

Japanese and Hawaiian seas; a single genus known, with four species, two of which belong to Japan.

The affinities of these fishes seem to be with the *Triglidæ* rather than the *Platycephalidæ*.

7. HOPLICHTHYS Cuvier and Valenciennes.

Hoplichthys CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, table of contents (*langsдорffii*).

Oplichthys CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 266 (*langsдорffii*).

Characters those of the family. Two species known from Japan.
(ὄπλον, armature; ἰχθύς, fish.)

KEY TO SPECIES.

- a* Anal rays 16; longest pectoral appendage reaching tip of pectoral; a tuft of strong spines on the under side of the head at the outer posterior angle of each mandible; lateral facial edges rather strongly lobed and furnished with strong curved spines; color light grayish brown, the back with 4 obscure crossbars: *langsдорφii*, 11
aa Anal rays 17 or 18; longest pectoral appendage one eye-width short of tip of pectoral; no spines on under side of head; lateral facial edges scarcely lobed, rather weakly serrated except posteriorly; color grayish, the back crossed by 4 dusky crossbars: *gilberti*, 12

11. HOPLICHTHYS LANGSDORFII Cuvier and Valenciennes.

Optichthys langsдорφii CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 264, pl. LXXXI (Japan). (*Hoplichthys* in table of contents; not *Hoplichthys langsдорφii* Temminck and Schlegel.)^a—(?)^b SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 487 (Urado; Kagoshima).

Hoplichthys langsдорφii GÜNTHER, Cat. Fishes, II, 1860, p. 191 (China, Japan).—(?) ISHIKAWA, Cat. Fishes Imp. Mus. Tokyo, 1897, p. 48 (Boshu; Tosa).

Hoplichthys langsдорφii (?) NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, 1887, No. 4, p. 25 (Nagasaki).—(?) STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 261 (Tokyo Bay).

Hoplichthys pusillus (?) BLEEKER, Enum. Poiss. Japon., 1879, p. 13 (Nagasaki), (after *Aspidophorus pusillus* Langsdorff, mss.).

Habitat.—Seas of Japan, north to Tokyo.

Head, 3.7 in length to base of caudal; depth, 12.5, depth of head, 3.75 in its length; width of head, 1.3; eye, 3.6; interorbitalspace, 4.2 in eye; maxillary, 3 in head; nose, 3.6; D. VI–15; A. 16; lateral scutes, 28.

Body without scales or plates except for an upper dorso-lateral row of keeled scutes on each side, the dorsal wings of which overlap antero-posteriorly and extend inward nearly to the base of the dorsal rays, forming an almost complete coat of mail for the back; the keel of each scute terminating behind in a sharp, backwardly-directed spine, below which, on the free hinder margin of the scute, is a very small obscure spine; head roughened with a few short spines and many low serrated ridges; free lateral margins of preorbitals, suborbitals, and preopercles, forming a thin edge, which is notched into lobes bearing long, sharp, spine-like serratures; a noticeably broad, shallow notch in the suborbital edge under the front of the pupil, bounded by 2 curved spines, pointing toward each other; angle of preoperculum with 2 long curved spines, the inner and posterior one

^a For a discussion of the identity of the specimen of Temminck and Schlegel see the conclusion of the present description.

^b The synonyms in this list which are preceded by an interrogation point are unaccompanied by any descriptive matter, and may not refer to *Hoplichthys langsдорφii* Cuvier and Valenciennes. See conclusion of present description.

twice as long as the outer and reaching to the base of the pectoral fin; a tuft of small curved spines on the under side of the head at each outer posterior angle of the mandibula; teeth in villiform bands on jaws, vomer, and palatines; tip of tongue convex.

Spinous dorsal (in male ?) relatively high, the fin when depressed reaching to the second ray of the soft dorsal; longest dorsal spine 1.6 in head; soft dorsal highest posteriorly, without filamentous rays, its longest ray 1.3 in head; soft dorsal and anal nearly opposite, both very long, the anal base being nearly twice head; pectoral, 1.4 in head; 3 detached pectoral rays, the longest extending fully to tip of pectorals, 1.3 in head; ventrals, 1.8; caudal rounded.

Color in spirits yellowish brown, the back crossed with 4 obscure cross-bars of dusky, and with many fine punctulations in small, vaguely outlined clusters; belly pale; spinous dorsal with obscure spots of dusky, forming rows across both rays and membranes; soft

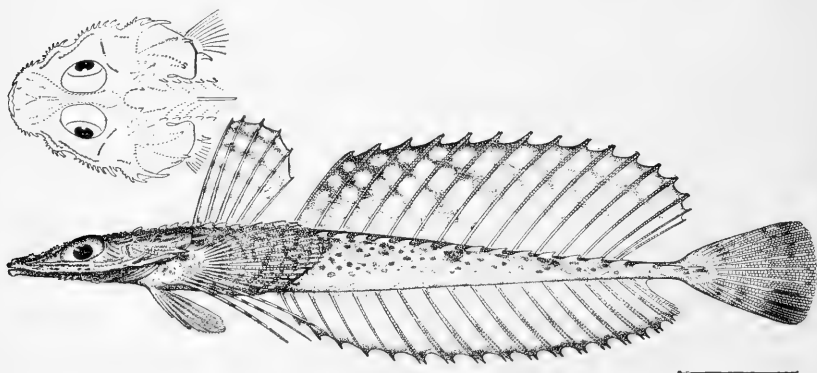


FIG. 5.—*HOPLICHTHYS LANGSDORFFII*.

dorsal mottled, the light color in roundish spots between the rays; caudal and pectorals with the rays specked and with the membranes clouded with dusky; anal pale except for a narrow outer edging of blackish.

This species differs from *Hoplichthys gilberti* and from *Hoplichthys citrinus* Gilbert in having fewer (only 16) rays in the anal fin, in its much longer pectoral appendages, and in the presence of a tuft of spines on the under side of the head at the outer posterior edge of each mandible. The representation of two well-developed spines at the angle of each lateral scute in the figure of Cuvier and Valenciennes is doubtless fallacious, the figure correctly showing, however, practically all of the remaining essential features of Cuvier's description and of our own specimen, including the tuft of spines under each jaw. The fins of Cuvier's specimen were damaged and no certain value can be attached to the rendering of their form. The number of anal rays,

figured as 17, but stated by Cuvier to be 16, is likewise 16 in our specimen, and was found by Doctor Günther to be 16 in several specimens from China and Japan. The larger number of anal rays in Schlegel's specimens, stated in the description to be 17 or 18, and the much lower spinous dorsal and shorter pectoral appendages, as shown in the figure, make it almost certain that it represents a species distinct from *H. langsdorfi* Cuvier and Valenciennes, and probably identical with *Hoplichthys gilberti*, next described.

Here described from a single specimen $5\frac{3}{4}$ inches long, obtained at Kagoshima and presented to Stanford University by Professor Mitsukuri.

(Named for M. Langsdorf, who brought the first specimens from Japan.)

12. **HOPLICHTHYS GILBERTI** Jordan and Richardson, new species.

Hoplichthys langsdorfi TEMMINCK and SCHLEGEL, Faun. Jap. Pisc., 1845, p. 156, pl. LXXIX, fig. 2 (not *Hoplichthys langsdorfi* Cuvier and Valenciennes) (Nagasaki).—GILBERT, Bull. U. S. Fish Comm., XXIII, 1903, Pt. 2, p. 641 (Suruga Bay, off Ose Point).

Hoplichthys langsdorfi JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902, p. 593 (Suruga Bay, off Ose Point).

Habitat.—Seas of Japan, north to Suruga Bay, in deep water.

Head 3.4 in length to base of caudal; depth 13; depth of head 3.6 in its length; width of head 1.3; eye 3.6; interorbital space 4 in eye; maxillary 3.2 in head; nose 3.3, longer than eye; D. VI-15; A. 17; scutes 27.

Back and sides with an incomplete coat of mail formed of two rows of keeled scutes, as in *Hoplichthys langsdorfi*; each keel ending in a strong spine, below which is a small concealed one, as in that species; top of head with low serrated ridges; lateral facial edge less spinous than in *Hoplichthys langsdorfi*, and with much less distinct lobes, the notch under pupil scarcely noticeable, being nearly continuous with the weakly serrated edge in front of and immediately behind it; angle of preoperculum with 2 long curved spines, as in *Hoplichthys langsdorfi*; spines on under side of head rather weaker than in *Hoplichthys langsdorfi*; villiform teeth in bands on jaws, vomer, and palatines; tip of tongue slightly emarginate.

Spinous dorsal (in female) low, its longest spine 3 in head, the depressed fin falling well short of the second fin; soft dorsal long and low, without filamentous rays, its longest ray (anterior) 2.2 in head; soft dorsal and anal about opposite; pectoral 1.4 in head, the 3 detached pectoral rays much shorter than in *Hoplichthys langsdorfi*, the longest 1.7 in head, failing of reaching tip of pectoral by a distance nearly equal to diameter of eye; ventrals rather short 2.25 in head; caudal slightly emarginate.

Color in spirits grayish, with dark specks and small clusters of punctulations; back with 4 dusky cross bands; belly whitish; spinous dorsal dusky in the membranes posteriorly, the tips of the rays whitish; rays of soft dorsal specked at broad intervals with dusky; caudal rays specked outwardly, the base of the fin with a diffuse blotch of dusky; latter third of anal with a subedging of dusky, in the membrane; pectorals specked in both rays and membranes.

(Named for Dr. Charles Henry Gilbert, of Stanford University.)

This species differs from *Hoplichthys langsdorfi* in its greater number of anal rays, shorter pectoral appendages, shorter ventrals, longer nose, less lobed and less spinous lateral facial profile. The figure of *Hoplichthys langsdorfi* in Temminck and Schlegel, which is evidently inaccurate in several particulars, whether it be intended to represent *H. langsdorfi* or the present species, may with some reservation be referred to *H. gilberti*, with which it agrees in the short pectoral appendages and in the larger number of anal rays. The fact that those

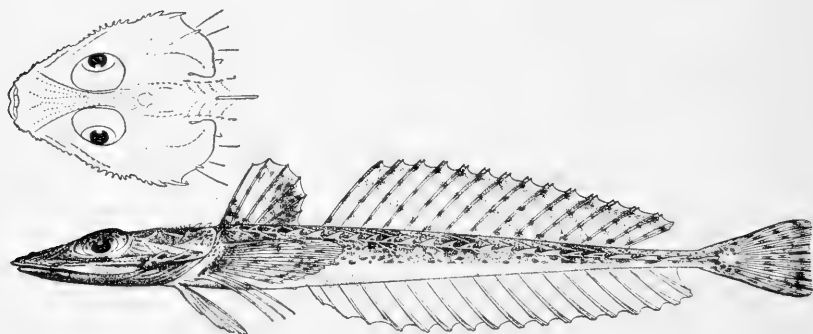


FIG. 6.—HOPLICHTHYS GILBERTI.

authors say in their description that their specimen had 17 or 18 anal rays would alone seem to leave little question that they were at least not the same as *Hoplichthys langsdorfi* Cuvier and Valenciennes.

Hoplichthys citrinus Gilbert, recently described from Hawaii, is close to the present species, differing from it chiefly in the more marked lobing and spination of the lateral facial edges, and in the yet shorter pectoral appendages, the longest of which is contained 2.2 in head (female).

Known and here described from 9 specimens, 3 to 6.50 inches long, taken by the United States Bureau of Fisheries steamer *Albatross* in 75 to 100 fathoms off Ose Point, Suruga Bay, in 1900, and one specimen 5.25 inches long from station 5070, Suruga Bay, in 1906, *Albatross* expedition of 1906, in 108 fathoms.

Type.—The last-named, Cat. No. 51271 U.S.N.M., is the type of the species. The figure is taken from it.

Family TRIGLIDÆ.

THE GURNARDS.

Body elongate, usually more or less fusiform, covered with scales or bony plates; head externally bony, entirely cuirassed with rough, bony plates, some of which are armed with spines; eyes high; mouth terminal or subinferior; premaxillaries protractile; maxillary without supplemental bone, slipping under the preorbital; teeth very small, in bands in the jaws, and usually on vomer and palatines; gills 4, a large slit behind the fourth; pseudobranchiæ present; gill rakers various; gill membranes free from the isthmus; ventral fins thoracic, wide apart, separated by a flat area, their rays I, 5; spinous dorsal present, short; soft dorsal similar to the anal, which is without spines; caudal narrow, few-rayed; pectoral large, with broad base, with 3 lower rays detached, forming feelers, which are used chiefly in the search for food, in turning over stones, exploring shells, etc.; air bladder present; pyloric cæca usually present, few in number. Singular looking fishes, found in all warm seas. Species about 40, some of them in rather deep water, these red in color, the others living about rocks; 3 genera and 7 species known from the waters of Japan.

KEY TO THE GENERA OF JAPANESE TRIGLIDÆ.

- a. Lateral line unarmed; no teeth on palatines.
 - b. Scales relatively large, about 50 to 65 in number: a row of spinous bucklers along base of dorsal..... *Lepidotrigla*, 8
 - bb. Scales relatively small, more than 100 in the lateral line.
 - c. Base of both dorsals with a series of shields, each ending in a sharp spine directed backward; opercular spine small; soft dorsal and anal long; dorsal rays IX-16; anal 15: no anal spine..... *Chelidonichthys*, 9
 - cc. Back with blunt shields along base of spinous dorsal only; base of soft dorsal unarmed; opercular spine very long; soft dorsal and anal short; dorsal rays VIII-10; anal 11; anal spine distinct..... *Otohime*, 10

8. LEPIDOTRIGLA Günther.

Lepidotrigla GÜNTHER, Cat. Fishes, II, 1860, p. 196 (*aspera*=*capillone*).

Scales moderate, about 45 to 55 in number, being much larger than in *Chelidonichthys*; teeth on vomer; no teeth on palatines; a row of spinous bucklers along base of dorsal fin; characters otherwise those of the family.

East Indies, South Seas, and Japanese and Chinese seas; 5 species known from the waters of Japan.

(*λαπίς*, scale; *τριγλα*, *Trigla*, classical name for *Mullus barbatus*, the name *Trigla* transferred to these fishes, for no evident reason.)

KEY TO SPECIES.

- a. Pectorals short, not reaching middle of dorsal.
 - b. Nasal prominences long, pointed, and divergent, the distance between them at tips usually more than $1\frac{1}{2}$ times interorbital distance; dorsal IX-16 or 17; anal 16; scales 63; no dorsal blotch..... *alata*, 13

- bb. Nasal prominences less developed, pointed or not, the notch between them shallow and the distance between their outer tips little more than the interorbital distance, if any.
- c. Upper detached pectoral ray falling short of tip of ventral by a distance about equal to diameter of eye; dorsal VIII or IX—15 to 17; anal 15 to 17; scales more than 60; a dark blotch between fourth and seventh spines of dorsal fin *microptera*, 14
- cc. Upper detached pectoral ray reaching almost or quite to tip of ventral; spinous dorsal without a dark blotch.
- d. Second dorsal spine much elongated, its length $1\frac{1}{2}$ times that of third spine, and its anterior edge strongly serrate nearly to tip; dorsal VII—16; anal 16; scales 61; spinous dorsal without permanent blotch; though there may be some specks present *güntheri*, 15
- dd. Second dorsal spine but very little longer than third, its anterior edge smooth or very weakly serrate; dorsal VIII—15; anal 15; scales 56; no dorsal blotch *abyssalis*, 16
- aa. Pectorals very long, reaching nearly to end of dorsal; dorsal VIII—15; anal 15; scales 55; no dorsal blotch *japonica*, 17

13. LEPIDOTRIGLA ALATA (Houttuyn).

KANAGASHIRA, Metal Head.

Trigla alata HOUTTUYN, Verhandl. Hollandsch. Maatsch. Weetensch., Haarlem, XX, Deel 2, 1782, p. 320 (ca.), (Nagasaki).

Trigla bürgeri TEMMINCK AND SCHLEGEL, Faun. Japon., Pisc., p. 35, pl. xiv, figs. 1 and 2 (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 218 (coasts of China and Japan).—GÜNTHER, Cat. Fishes, II, 1860, p. 198 (Japanese and Chinese seas).—BLEEKER, Nieuwe Nalez. Ichth. Japan, 1857, p. 73 (Nagasaki); Enum. Poiss. du Japon, 1879, p. 13 (Nagasaki; Shimoda).—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, 1887, p. 21 (Nagasaki).—STEINDACHNER and DÖDERLEIN, Fische Japan's, 1887, IV, p. 261 (Tokyo; Nagasaki).—ISHIKAWA, Cat. Fishes Imp. Mus. Tokyo, 1897, p. 47 (Nagasaki).

Lepidotrigla alata JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902, p. 596 (shores of southern Japan).

Habitat.—South Japan, and north to Tokyo; China.

Head 3.2 to 3.5; depth 4 to 4.3; D. IX—16 or 17; A. 16; scales 63; eye 3.2 to 3.3; snout 2.1 to 2.2; maxillary 2.5; interorbital space 3 to 3.25; second dorsal spine 1.8 to 2; pectoral 1; ventral 1.2.

Snout with two long, pointed, divergent processes, the distance between their apices nearly or quite twice the diameter of the pupil, and the depth of the emargination equal to or greater than the width of the pupil; interorbital space concave; pre- and postocular spines obsolete; an extremely small postocular cross groove; nuchal spine short; opercular spine barely crossing gill-opening, humeral spine quite long and sharp, reaching the vertical from the sixth dorsal spine; second and third dorsal spines subequal, both shorter than in other Japanese *Lepidotriglae*; pectoral reaching vertical from third ray of soft dorsal; upper pectoral appendage reaching about to tip of ventral; dorsal scutes rather small, ending in sharp points.

Color in life clear red, with pale edgings; "brick red * * *; belly, anal, and membranes of ventrals whitish; pectorals greenish yellow with reddish borders." (Schlegel.) "Pectorals for the most

part milk-white externally, inside dusky violet with the exception of the upper and the three undermost rays, which show a yellow shade." (Steindachner.)

This abundant species is readily recognized by its long, diverging nasal prominences, and short spinous dorsal.

(*alata*, winged.)

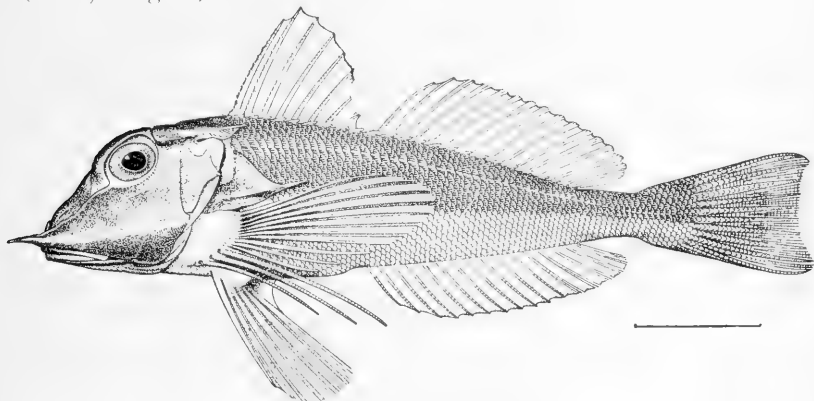


FIG. 7.—LEPIDOTRIGLA ALATA.

In the Museum of Stanford University are specimens as follows: Nagasaki, 40 specimens, 3 to 8 inches; Wakanoura, 18 specimens, 3 to 4½ inches; Misaki, 1 specimen, 3¾ inches; Kobe, 5 specimens, 2½ to 3½ inches; Tsushima, 1 specimen, 3 inches. It was also seen at Tsuruga and Onomichi.

The above description is based on 2 specimens, 6 and 6½ inches long, from Nagasaki.

14. *LEPIDOTRIGLA MICROPTERA* Günther.

Lepidotrigla microptera GÜNTHER, Ann. and Mag. Nat. Hist., 1873, p. 241 (Shanghai).—GÜNTHER, Shore Fishes Challenger, 1879, p. 67 (Inland Sea of Japan).—NAMIYE, Class. Cat., 1881, p. 101 (Tokyo).—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's (IV), 1887, p. 263 (Tokyo; Hakodate; Shanghai).—JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902, p. 595 (localities at conclusion of present description).

Lepidotrigla strauchi STEINDACHNER, Ich. Beitr., V, 1876, p. 166 (Hakodate).

Lepidotrigla serridens HILGENDORF, Ges. Naturf. Freunde, 1879, p. 107 (Tokyo).—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, 1887, p. 21 (Nagasaki).

Lepidotrigla smithii REGAN, Ann. and Mag. Nat. Hist. (7), XV, 1905, p. 22, (Inland Sea of Japan).

Habitat.—Japan, north to Hakodate; China.

Head 3.4; depth 4.5 D.^a VIII or IX, 15 to 17; A.^b 15 to 17; scales^c more than 60 (as a rule about 65); eye 3.5; snout 2.25;

^a Of 15 specimens examined (various localities), three had VIII–15, five VIII–16, two VIII–17, one IX–16, three IX–17, and one IX–18.

^b A. 17, Günther; 16–18, Steindachner; 14, Regan (young specimens). Of 14 examined, three (young) had A. 15, five 16, and six 17.

^c Lat. line 75, Günther; 65–66 (adults), 59–60 (young), Steindachner; 58–63, Regan (young).

maxillary 2.3 to 2.6; interorbital space 3.4 to 3.6; second dorsal spine 1.4; pectoral 1; ventral 1.2.

Snout moderately emarginate, the lateral prominences short and sharp, consisting typically of a single spine on each side, or (in adults) of a single prominence (or two) longer than the rest; preocular spines very small, nearly obsolete; nuchal spine reaching past base of second dorsal spine; opercular spine extending on anterior fifth of base of humeral spine; humeral spine long and sharp, reaching nearly to base of fifth dorsal spine; second dorsal spine but little (about one-eighth) longer than third and very weakly serrated, being as a rule smooth for the outer fourth of its anterior edge; pectoral to vertical from fifth ray of soft dorsal; upper detached pectoral ray short, missing the tip of the ventral by a distance about equal to diameter of eye; dorsal scutes moderately developed, their spines short and not very sharp.

Life color, bright brick red above, the belly abruptly white, the junction marked by a silver line; fins red, or with some creamy white; a black blotch on the spinous dorsal between the fourth and seventh spines; no blue. In preserved material the dorsal blotch shows most plainly in young specimens (under 4 inches). In adults it is sometimes almost wholly wanting.^a

This species differs plainly from both *L. güntneri* and *L. abyssalis* in its shorter detached pectoral rays and in the presence of the (usually) prominent dark blotch between fourth and seventh spines of first dorsal. There appears to be no doubt that *L. smithii* Regan is the young of this species. Young specimens in our collections from Nagasaki and Wakanoura have D. VIII-15 and A. 15. In one of these the first (rudimentary) anal ray is but three-eighths of the second, and the second only two-thirds of the third. Regan's figure shows the first spine fully five-sixths of the second, a condition we have not observed in any specimen. As his specimens were all small (7 to 9 cm.) it seems not impossible that he may have overlooked a rudimentary spine. The dark longitudinal bar on the soft dorsal, described by Regan, is a characteristic of young specimens, appearing in two young individuals 4½ inches long in our collection from Aomori.

(μικρός, small; πτερόν, wing, i. e., fin).

Specimens in the Stanford University Museum are from localities as follows: Tokyo, 3 specimens, 6½ to 8 inches; Hakodate, 6 specimens, 3½ to 7½ inches; Kobe, 3 specimens, 3 to 4 inches; Wakanoura, 1 specimen, 3 inches; Nagasaki, 21 specimens, 3 to 4 inches; Aomori, 13 specimens, 3 to 7½ inches; Hiroshima, 1 specimen, 3 inches; Tsuruga, 115 specimens, 2 to 3½ inches; Matsushima Bay, station 3770, in 42 to 45 fathoms, 1 specimen, 8½ inches; Suruga

^aSteindachner says that the spot was wanting in adult specimens described by him as *L. strauchii*.

Bay, station 3715, off Ose Point, in 64 to 65 fathoms, 1 specimen, 5 inches.

This is the commonest species of the genus in Japan, except about Nagasaki, where *Lepidotrigla alata* is more abundant. It extends its range well to the northward. It is commonest about the shores, although running also into deeper water.

The above description is based on two specimens, 7½ and 8 inches long, taken at Aomori and Tokyo.

15. *LEPIDOTRIGLA GÜNTHERI* Hilgendorf.

Lepidotrigla güntheri HILGENDORF, Ges. Naturf. Freunde, 1879, p. 106 (Tokyo).—

JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902, p. 594. (Localities given below.)

Lepidotrigla longipinnis STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's, 1887, IV, p. 262, pl. IV, fig. 1 (Tokyo).

Habitat.—Japan, north to Tokyo.

Head, 3.25; depth, 4.4 to 4.6; D. VIII–15 or 16; A. 15 or 16; scales, 56–58; eye, 3 (young) to 3.4; snout, 2.2; maxillary, 2.4; interorbital space, 3.8 to 4; second dorsal spine, 1.25 (young) to 1.5; pectoral, 1.2; ventral, 1.3.

Snout moderately emarginate, the lateral prominences rather broad and unevenly serrated; interorbital space quite concave in young, in adults the excavation forming a broad, almost flat-bottomed groove; two small preocular spines; a low post ocular spine with a cross furrow behind it; nuchal spine reaching to base of second dorsal spine, its inner edge rather strongly serrate; opercular spine reaching but little past opercular opening, humeral spine sharp, reaching past fourth dorsal spine; pectoral reaching to vertical from base of fourth soft dorsal ray; upper detached pectoral ray extending nearly to tip of ventral; dorsal scutes strong, with long and sharp spines, these becoming increasingly sharp posteriorly.

Color brown, with 3 brown cross shades, one under each dorsal and one at base of caudal, these becoming fainter with age; young with a blackish bar at tip of caudal; pectoral black within; back mottled; no black dorsal spot, but sometimes a dusky cross shade on dorsal; no sharp line on side bounding the pale color of belly.

This species is readily distinguished from *L. microptera* by its different coloration, by its long, saw-edged second dorsal spine, better developed cephalic armature, longer and sharper dorsal scutes, and longer pectoral appendages. For the differences between it and *L. abyssalis* see the description of that species.

(Named for Dr. Albert Günther.)

We have examined specimens from the following localities: Northwest Pacific, station 5070, Suruga Bay (*Albatross*, 1906), 108 fathoms, 1 specimen, 3 inches; Northwest Pacific, station 4876, Tsushima Strait (*Albatross*, 1906), 59 fathoms, 9 specimens, 1½ to 4½ inches;

Tokyo, 1 specimen, 8 inches; Suruga Bay, off Ose Point, several specimens, under 5 inches, taken in depths of from 60 to 500 fathoms; Totomi Bay, station 3727, under 5 inches; Yokohama, market, 1 specimen, nearly a foot in length.

Measurements used in above description made on two specimens 8 and 5 inches long, taken at Tokyo and in Suruga Bay.

16. *LEPIDOTRIGLA ABSYSSALIS* Jordan and Starks.

Lepidotrigla japonica NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, 1887, p. 23 (Nagasaki). (Name preoccupied.)

Lepidotrigla abyssalis JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902, p. 595, fig. (Suruga Bay).

Habitat.—Japan, north to Tokyo, in rather deep water.

Head 3; depth 4.2; D.VIII-15; A.15; scales 56; eye 3.16 in head; snout 2.5; maxillary 2.75; interorbital space 4; first dorsal spine 2.1; second dorsal spine 1.75; pectoral 1.1; ventral 1.25.

Snout almost truncate at tip, a sharp spine slightly projecting at each angle; interorbital space rather deeply concave; a short narrow cross furrow above posterior margin of eye, as in *L. Güntheri*; nuchal spines and ridges little developed; humeral spine moderately strong, reaching vertical from third dorsal spine; second dorsal spine somewhat longer than third, but more slender and much less elevated than in *L. Güntheri*; upper detached pectoral ray reaching tip of ventral, which reaches to base of second anal ray, pectoral reaching to vertical from base of fifth ray of soft dorsal.

Color mottled red; pectoral bluish black, other fins without markings; no traces of a spot on spinous dorsal.

In its long pectoral appendages, postorbital furrow, and plain colored spinous dorsal this species resembles *L. Güntheri*. From that species it differs, however, in its more slender dorsal spines and shorter second spine, which is also not strongly serrated.

(ἄβυσσος, an abyss; in allusion to the deep water habitat of this species.)

We have examined specimens from the following localities: Station 4904, *Albatross*, 1906, 107 fathoms. One specimen, 4 inches (head not as smooth as in type of *L. abyssalis*; otherwise identical); Suruga Bay, station 5713, 50 to 60 fathoms, one specimen, 3½ inches.

The above description is condensed from the original description by Jordan and Starks, who first described it from Cat. No. 51440, U.S.N.M. This is apparently the species named *japonica* by Nyström, but there was already a *japonica* in this genus.

17. *LEPIDOTRIGLA JAPONICA* (Bleeker).

Prionotus japonicus BLEEKER, Nieuwe Nalez. Ichth. Japan, 1857, p. 75, pl. v, fig. 1 (Japan).—GÜNTHER, Cat. II, 1860, p. 196.

Lepidotrigla japonica STEINDACHNER and DÖDERLEIN, Fische Japans, 1887, IV, p. 264 (Oshima; Kagoshima).—JORDAN and STARKS, Bull. U. S. Fish Com., XXII, 1902, p. 596, fig.: (Misaki). (Not of Nyström).

Habitat.—South Japan, north to Tokyo.

Head 3.3; depth 4.2; D.IX-15; A.14; scales 57; eye 3.25; snout 2.2; maxillary 2.3; interorbital space 3.75; first dorsal spine 1.4; second dorsal spine 1.5; pectoral 0.6; ventral 1.0.

Snout moderately emarginate, with a small secondary notch at center, the angles without spine-like prominences; interorbital space deeply concave; pre- and post-ocular spines little developed; a deep postocular groove on each side; nuchal spine nearly to base of third dorsal spine; opercular spine scarcely crossing gill opening; humeral spine reaching past vertical from fourth dorsal spine; pectorals very long, reaching to the eleventh or twelfth ray of soft dorsal; ventrals past fourth anal ray; pectoral appendages short, the upper one missing tip of ventral by a distance nearly equal to diameter of eye; dorsal scutes moderately developed, with broad, flattish (not spine-like) points.

Preserved specimens show a rather sharp line separating the upper (darker) part of side from the lower silvery portion; spinous dorsal with a diffused blotch between the fourth and seventh spines, and with more or less dusky shade forward, especially near margin of fin; soft dorsal with cross rows of faint dusky spots; pectoral black inside, with scattered lighter spots; pectoral appendages with some dark pigment midway of their length.

(*japonicus*, Japanese.)

The long pectoral fins of this species separate it unmistakably from the other species of *Lepidotrigla* found in Japan.

Specimens have been examined from the following localities: Nagasaki, market, 1 specimen, 4 inches (1906); Misaki, 1 specimen, 4½ inches; Wakanoura, 4 specimens, 3 to 4 inches.

The above measurements were made on a Misaki specimen, 4½ inches.

9. CHELIDONICHTHYS Kaup.

Chelidonichthys KAUP, Archiv. f. Naturgeschichte 1873, p. 87 (*hirundo*).

Scales small, no long shields along lateral line.

Each dorsal fin with a series of spine-tipped shields along its base; opercular spine small; dorsal rays IX-16; anal 15; anal spine wanting. This genus, like the next (*Otohime*) differs markedly from *Lepidotrigla* in the smaller scales. From the closely related European genus, *Trigla*, this genus differs in the unarmed lateral line. The American genus, *Prionotus*, has palatine teeth, these being wanting in the old-world gurnards. Characters otherwise those of the family.

The numerous species abound on the coasts of Europe, Africa, and India; ranging north to Japan.

(χελιδὼν, swallow; ἰχθύς, fish.)

18. CHELIDONICHTHYS KUMU (Lesson and Garnot.)

HOKO (Sword), KUROHOB0 (Black Gurnard).

Trigla kumu LESSON and GARNOT, Voy. Coquille, Poiss., 1830, p. 214, pl. XIX (New Zealand, "le grande Baie des Iles").—CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 50 (advance printing of description of Lesson and Garnot).—JENYNS, Zool. Beagle, Fishes, 1842, p. 27 (New Zealand; Bay of Islands).—TEMMINCK and SCHLEGEL, Faun. Japon. Pisc., 1843, p. 37, pl. XIV (seas of Japan).—BLEEKER, Nieuwe Nalez. Ichth. Japan, 1857, p. 74 (Nagasaki).—GÜNTHER, Cat. Fishes, II, 1860, p. 204 (New Zealand to coast of China).—NAMIYE, Class. Cat., 1881, p. 101 (Tokyo).—MACLEAY, Cat. Austral. Fishes, I, 1881, p. 225 (Port Jackson).—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, 1887, p. 21 (Nagasaki).—STEINDACHNER and DÖDERLEIN, Beitr. Kennt. Fische Japan's, 1887, IV, p. 265 (no locality).—ISHIKAWA, Cat. Fishes Imp. Mus. (Tokyo), 1897, p. 47 (Tokyo).

Trigla spinosa McCLELLAND, Calc. Journ. Nat. Hist., IV, p. 396, pl. XXII, fig. 2 (China).—RICHARDSON, Ichth. China and Japan, 1846, p. 218 (Chusan).

(?) *Trigla pictipinnis* KAUP, Archiv. für Naturgesch., 1873, p. 87 (Barbados) (locality erroneous).

Trigla kumu dorsomaculata STEINDACHNER, Ich. Beitr., V. p. 168, 1876 (Chi-fu).

Habitat.—Japan, north to Aomori; China; also from Australia and New Zealand, where it is one of the common food fishes.

Head, 3.3; depth, 5.25 to 5.60; D. IX-16; A. 15 or 16; eye, 4.5 to 4.6; interorbital^a space, 5.8 to 6; snout, 2.2; maxillary, 2.3; second dorsal spine, 1.8; pectoral, 0.6 to 0.8; ventral, 1.2.

A full comparison of Japanese and Australian specimens is shown in the following table:

Dimensions.	Port Jackson, 5 to 8½ inches.	Misaki Sagami, 7½ inches.	Tokyo, 9 inches.
Head	3.50	3.30	3.25
Depth	5.00	5.25	5.60
Dorsal	IX-15	IX-16	IX-16
Anal .....	.15	.16	.15
Scales			
Eye	4.33	4.50	4.60
Interorbital space	7.10	6.00	5.80
Snout	2.25	2.16	2.20
Maxillary	2.20	2.30	2.30
Second dorsal spine	1.66	1.80	1.80
Pectoral	0.75	0.60	0.80
Ventral	1.16	1.16	1.20

Snout rather long, as a rule, with an evident emargination in front, the angles serrated and produced over the maxillaries a distance about equal to their width (toothed portion); interorbital space concave,

^a Japanese and Australian specimens varied as follows in width of interorbital space: Six specimens, Tokyo: 5.80, 6.10, 6.20, 6.30, 6.30, 6.50 (5 to 8 inches); 2 specimens, Port Arthur: 6.3: 6.6 (8 inches); 2 specimens, Tsuruga: 6.2, 6.3 (5 inches); 1 specimen, Misaki: 6.3, 6.6 (7 inches); 1 specimen, Port Jackson: 7.10 (8½ inches); 1 specimen, Port Jackson: 7 (5 inches); 1 specimen, Port Jackson: 6.50 (6¼ inches).

rather wider than in specimens of *C. kumu* from Australia; two short but strong preocular spines, a low postocular spine, with a very shallow cross-furrow behind it; nuchal spine not reaching to front of dorsal; opercular spine barely crossing gill opening; humeral spine about to vertical from fourth dorsal spine; second and third dorsal spines subequal; posterior margin of spinous dorsal nearly straight; pectoral to tenth ray of soft dorsal; upper pectoral appendage missing tip of ventral by a distance equal to two-thirds diameter of eye; dorsal scutes moderate, their points not long and sharp.

Color in life olivaceous, the deep lustrous blue of the inner side of the pectoral fins very conspicuous; preserved specimens have the back (in adults) more or less coarsely mottled or blotched; a plain line separates the upper color from the paler whitish (silvery) of the belly; young specimens have the back crossed with three or four broad, obliquely disposed, and rather obscure cross-bands; spinous dorsal in adults with some dusky on outer margin; soft dorsal with its outer third dusky; caudal with a diffused dark blotch posteriorly; pectoral inky blue inside, with a narrow pale outer margin, and with its inner lower third, or entire lower half, darker in color than the rest of the fin and marked with from 6 to 20 light-colored spots.

(*kumu*, the native Maori name of this fish in New Zealand.)

We are unable to separate this common Japanese fish from the species *Kumu*, which is one of the best known food fishes of New Zealand and Australia.

Specimens of this species from Port Jackson (Sydney) differ from the Japanese form in having the snout less emarginate and its angles less produced, scarcely extending over the retracted maxillaries; in Port Jackson specimens the interorbital space is slightly narrower (7 to 7.10 in head) than in Japanese individuals; a single specimen from Sydney ($6\frac{1}{4}$ inches long) has the interorbital space as broad as in some Japanese specimens (6.50 in head). The coloration of the pectoral fins varies in these specimens, the one just noted and the small one from Port Jackson having only 8 to 12 spots, gathered in a dark blotch on the lower inner third of the fin, as in the figure of Lesson; while the larger Port Jackson specimen has the spots 18 or 20 in number and scattered over the lower two-thirds of the fin. This amount of variation in the markings of Australian specimens would seem to break down the distinction between *kumu* and *spinosus* as made out by Günther (Cat., II, p. 204), following McClelland. If a separate species or subspecies (*spinosus*) is to be made of the Japanese-Chinese form it is evidently impossible to establish it in color markings. Nevertheless, we shall not be surprised if slight but permanent differences in form should be made out, in which case the Japanese species will stand as *Chelidonichthys spinosus*.

We have examined specimens from localities as follows: Kobe, 7 specimens, $4\frac{1}{2}$ to $5\frac{1}{2}$ inches; Tokyo, 15 specimens, 5 to $8\frac{1}{2}$ inches; Tokyo, market, 6 specimens, 5 to 6 inches; Nagasaki, 4 specimens, 5 to 6 inches; Kagoshima, 1 specimen, 6 inches; Kawatana, 1 specimen, $5\frac{1}{2}$ inches; Misaki, 2 specimens, 6 to 7 inches; Aomori, 29 specimens, 2 to 3 inches; Tsuruga, 6 specimens, $3\frac{1}{2}$ to 5 inches.

Here described from two specimens, $7\frac{1}{2}$ and 9 inches long, from Misaki and Tokyo, respectively. Jordan and Snyder observed specimens also at Wakanoura, Hakodate, and Matsushima.

10. OTOHIME Jordan and Starks.

Otohime JORDAN and STARKS, Proc. U. S. Nat. Mus., XXXII, 1907, p. 13, (*hemisticta*.)

Back with blunt shields along base of spinous dorsal; base of soft dorsal unarmed; opercular spine very long; dorsal rays VIII-10; anal 11; a distinct anal spine; scales small as in *Chelidonichthys*, with no transverse bony plates along lateral line; no palatine teeth, characters otherwise those of family.

(*Otohime*, a goddess of fishes, in Japanese folk-lore.)

19. OTOHIME HEMISTICTA (Temminck and Schlegel).

KANADO, Metal Fish.

Trigla hemisticta TEMMINCK and SCHLEGEL, Faun. Japon. Pisc., 1847, p. 36, pl. XIV, figs. 3 and 4; pl. XIV B (Nagasaki).—RICHARDSON, Ichth. China and Japan, 1846, p. 218 (Canton).—GÜNTHER, Cat. Fishes, II, 1860, p. 201 (after Schlegel).—NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, 1887, No. 4, p. 21 (Nagasaki).

Otohime hemisticta, JORDAN and STARKS, Proc. U. S. Nat. Mus., XXXII, 1907, p. 132, fig. (Misaki or Awa, outside bay of Tokyo).

Head (without opercular or rostral spines), 2.75; depth at occiput 4.50; eye 3 in head; maxillary 2; D.VIII-10; A.I,11; scales 105.

General form of body as in the species of *Chelidonichthys* and *Lepidotrigla*, the scales being very small, as in the former genus; opercular spine very long; fourth dorsal spine longest; pectoral reaching to opposite base of third anal ray; longest detached pectoral ray not reaching to tip of ventral.

Color, in alcohol, gray above, clouded or vaguely blotched and specked with dark; lower portion of sides and belly abruptly white; spinous dorsal with a large and well-defined dark spot between the fourth and sixth spines.

This species has very recently been fully redescribed by Messrs. Jordan and Starks on the basis of a specimen brought from Yokohama by Mr. Pierre Louis Jouy, and probably caught at Misaki or Awa, outside the bay of Tokyo. Its generic characters, together with the

above brief description, which is condensed from that of Jordan and Starks, are sufficient for its recognition.

(ἡμι, half; στικτός, speckled.)

A single specimen, from Misaki or Awa, 8 inches. Cat. No. 56432, U.S.N.M.

Family PERISTEDIIDÆ.

Body elongate, fusiform, covered with bony plates, each of which is armed with a strong spine; head bony; each preorbital produced into a long, flat process, which projects more or less beyond the mouth; mouth small, inferior, like that of a sturgeon; teeth none; lower jaw provided with barbels; gill membranes separate, narrowly joined to the isthmus anteriorly; gill rakers slender; dorsal fin continuous or divided; pectoral fin short, with the 2 lower-most rays detached; ventrals I, 5, separated by a broad, flat area; air bladder simple; pyloric caeca about 10; color generally red. Deep-sea fishes, bearing some resemblance to young sturgeons.

Two genera, with about a dozen species. Mediterranean, tropical Atlantic, East Indian, and Chinese and Japanese seas. One genus and 3 species known from Japan.

11. PERISTEDION Lacépède.

Peristedion LACEPEDE, Hist. Nat. Poiss., III, 1802, p. 368 (*malarimat*=*cataphractum*).

Peristethus KAUP, Proc. Zool. Soc. Lond., 1859, p. 103 (*cataphractus*); amended spelling.

Barbels large, forming large fringed tufts at angles of mouth and on lower jaw; dorsal fins 2; characters otherwise included above.

(Ἰσπί, around; στῆθιον, diminutive of στῆθος, breast; the breast being mailed.)

Three species known from the waters of Japan.

KEY TO SPECIES.

- a. No spine above muzzle or in middle of forehead; caudal peduncle with 2 series of plates underneath.
 - b. Dorsal VIII-20; anal 20; head narrow, its width 2.2 in its length; nasal processes 3.75 to 4.25 in head; longest barbel less than one-third of head; preopercular angle blunt, without spine; color reddish brown, the back with conspicuous blackish vermiculations; pectorals with 2 or 3 black cross bars; spinous dorsal edges with black.....*orientale*, 20
 - bb. Dorsal VI-20; anal 22; head broad, its width 3.25 in the length to base of caudal; nasal processes 6.5; short; longest barbel two-thirds of head; preopercular shield ending behind in a long spine; color brownish (probably red in life), without black spots or marblings; pectoral and spinous dorsal black.....*amiscus*, 21
- aa. A single spine in middle of forehead; under side of caudal peduncle with 4 series of plates; D.VI-19; A.17; head, back, and sides with small round dots; spines and rays of dorsals dotted with brown.....*rieffeli*, 22

20. PERISTEDION ORIENTALE Temminck and Schlegel.

KIHOB0 (Yellow Gurnard), TSUNO KANAGASHIRA (Horned Metal-head).

Peristedion orientale TEMMINCK and SCHLEGEL, Faun. Japon. Pisc., 1843, p. 37, pl. XIV, figs. 5 and 6; pl. XIV A, figs. 1 and 2 (Nagasaki).—JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902, p. 593, fig. — (Suruga Bay).
Peristethus orientale KAUP, Proc. Zool. Soc. Lond., 1859, p. 105, pl. VIII, fig. 2.—GÜNTHER, Cat. Fishes, II, 1860, p. 219 (after Schlegel).—NAMIYE, Class. Cat., 1881, p. 101 (Tokyo).—ISHIKAWA, Cat. Fishes Imp. Mus. Tokyo, 1897, p. 47 (Tokyo; Ajiro).

Habitat.—Japan, north to Tokyo, in deep water.

Head 2.66 in length without caudal; depth 6.5; width of head 2.2 in its length; eye 4.8 to 5.2; interorbital space = eye; snout 1.66 in head; nasal processes 3.75 to 4.25 (adult); longest barbel 3.8; D. VIII-20; A. 20; pectoral 2.3 in head; ventral 2.16; plates in upper lateral series 34 or 35.

Body about as wide as the head anteriorly, rather long, gradually tapering; 4 rows of long scutes on each side, each ending in a spine; spines of ventral and dorsal row of scutes becoming gradually smaller backward, those of the ventral series obsolete on the last 10 or 12 scutes; head little wider than front of body; nasal processes always somewhat divergent, the distance between their tips sometimes nearly twice their distance apart at base, even when the opercles are completely closed; lower lateral rim of cephalic shield narrow, shelf-like, its margin nearly straight, except for slight serrations, from the base of the nasal process to the angle of the preopercle, which is rounded and wholly without projecting spine; opercle with a blunt spine, preceded by a low minutely serrated ridge; no spine in front of eye; two blunt postorbital points, and two short occipital spines, with blunt points; no spines on muzzle; each lower jaw with a branched, brush-like barbel at its outer angle, inside of and behind which are many shorter single barbels, in a tuft-like cluster; the branched barbel reaching half way to base of pectorals.

Spinous dorsal beginning immediately behind first (fused) pair of dorsal scutes; the depressed fin reaching to base of second ray of soft dorsal; anal inserted under third ray of soft dorsal and extending about one plate behind it; pectoral reaching to tip of spine of tenth upper lateral scute; longest free pectoral ray extending slightly beyond pectoral; ventrals barely reaching vent; caudal emarginate.

Body and head covered with vermiculations of dark brown; pectoral with 2 or 3 dark cross bars and a blotch on the upper base; a dark marginal streak of blackish on spinous dorsal; soft dorsal with 2 rows of dark dots, the upper row forming a more or less continuous, submarginal streak on both rays and membranes; lower parts pale, yellowish.

(*orientalis*, eastern.)

Of this species we have examined specimens from localities as follows: Misaki, 1 specimen, 7 inches; Tokyo, 1 specimen, 7 inches, and 1 specimen, 2½ inches; off Tokyo Bay, 2 specimens, 7 inches; Station 3707, Suruga Bay, off Ose Point, 68 to 70 fathoms, 1 specimen, 8¾ inches, and 4 specimens, 4 to 6 inches; Station 3708, Suruga Bay, off Ose Point, 65 to 125 fathoms; Station 3715, Suruga Bay, off Ose Point, 64 to 65 fathoms, 2 specimens, 4 to 6 inches; Stations 3716 and 3717, Suruga Bay, off Ose Point, 65 to 125 fathoms; Station 5070, Suruga Bay (Albatross 1906), 1 specimen, 4½ inches.

Here described from measurements made on a specimen from Station 3707, Suruga Bay, 8¾ inches long, and 2 specimens, 7 inches long, from Tokyo and Misaki.

21. PERISTEDION AMISCUS Jordan and Starks.

Peristedion amiscus JORDAN and STARKS, Bull. U. S. Fish Comm., XXII, 1902, p. 593, pl. III, figs. 1 and 2 (Sagami Bay).

Habitat.—Japan (Sagami Bay), in deep water.

Head 2.5 in length to base of caudal; depth 5.5; width of head 3.25; eye 4.25; snout 1.83; nasal prominences 6.5; longest barbel 1.33; D. VI–20; A. 22; pectoral 1.83; ventral 2.5; plates 36.

Body fusiform, tapering, with 4 rows of bony scutes on either side, each ending in a hooked spine; ventral row with spines much smaller except anteriorly; along posterior part of anal the spine is very low but evident; lower lateral row beginning just anterior to tip of pectoral and ending at base of lower caudal rays; dorsal row beginning at nape just within the large parietal spine and ending at base of upper caudal rays.

Head very broad, depressed, and expanded around the edges; anterior processes much divergent and tapering, the distance between their tips twice the length of one process; lateral wing of cephalic shield with two blunt spines, 1 opposite anterior and 1 opposite posterior orbital margin; preopercle with a long spine, two-thirds length of eye, preceded by a sharp ridge and extending posteriorly to all other parts of the head; opercle with a small, short, sharp spine, preceded by a low, sharp ridge; a small spine over front of eye, over posterior part of it a high spine; a very high and sharp occipital spine, two-thirds diameter of eye; no spines above muzzle; lower jaw with many barbels, the outermost a long, branched, brush-like appendage over two-thirds the length of the head and reaching nearly to the vent.

Spinous dorsal beginning between second and third spines of dorsal series of plates; tips of dorsal spines when depressed reaching to base of second dorsal ray; anal extending posteriorly beyond soft dorsal, its origin opposite that of the latter; tip of pectoral reaching fifteenth

spine of upper lateral series of plates; ventrals reaching just past middle of vent; caudal concave, its length 2.75 in head.

Color brown, probably red in life, with no black spots or marblings except a spot behind eye and a few dark edgings on ridges of head; pectoral black, pale-edged below; spinous dorsal black; soft dorsal, caudal, and ventral mottled; a dusky shade below last rays of soft dorsal; outer barbels of mouth black on distal half. (After Jordan and Starks.)

One specimen, the type, Cat. No. 51428, U.S.N.M., from Station 3698, off Manazuru Point, Sagami Bay, in 153 fathoms.

(*ᾰμίσκος*, a diminutive of *ᾰμνη*, shovel.)

22. PERISTEDION RIEFFELI (Kaup).

Peristethius rieffeli KAUP, Proc. Zool. Soc. Lond., 1859, p. 106, pl. VIII, fig. 3 (Chinese insect boxes?).—GÜNTHER, Cat. Fishes, II, 1860, p. 219.

Peristedion rieffeli SMITH and POPE, Proc. U. S. Nat. Mus., XXXI, 1906, p. 488 (Urado, Uchinoura Bay, Kagoshima).

Habitat.—Southern Japan, Uchinoura Bay, Kagoshima, Urado, to China.

Head $2\frac{1}{3}$; D. VI-19; A. 17; lateral line 32; preorbital processes $2\frac{1}{3}$ in distance from their extremities to the anterior margin of orbit; a single spine in the middle of the forehead, a pair of obtuse ones above the posterior angle of the orbit, and another pair of larger ones on the posterior extremity of the occipital bones; anterior ventral plates irregularly shaped, longer than broad; lateral ridge of head (preopercle?) terminating posteriorly in a very long, flat spine; length of snout, without preorbital processes, equal to that of remainder of head; two pairs of barbels; lower side of tail with two additional series of plates, separated by the anal fin; pectoral reaching to fifth plate of dorsal series; ventral to third abdominal plate; very small round dots visible on the head, back, and sides; spines and rays of dorsal fins dotted with brown (condensed from description of Günther.)

This species should be readily distinguished from *Peristedion orientale* by the single spine on the upper surface of the snout (not shown in Kaup's figure, however), by the difference in color, and by the presence of the two additional series of plates below the base of the caudal fin.

We have no specimens of this rare species. Since the time of its original description by Kaup in 1859 no specimens came to the notice of ichthyologists until 1903, when Smith obtained a single specimen at Urado and found two others in the Commercial Museum at Kagoshima.

(Named by Kaup for "my true and excellent friend, De Rieffel.")

Family CEPHALACANTHIDÆ.

THE FLYING GURNARDS.

Body elongate, subquadrangular, tapering behind; head very blunt, quadrangular, its surface almost entirely bony; nasals, preorbitals, suborbitals, and bones of top of head united into a shield; nuchal part of shield on each side produced backward in a bony ridge, ending in a strong spine, which reaches past front of dorsal; interocular space deeply concave; preorbitals forming a projecting roof above the jaws; preopercle produced in a very long rough spine; cheeks and opercles with small scales; opercle smaller than eye; gill openings narrow, vertical, separated by a very broad, scaly isthmus; pseudo-branchiæ large; gill rakers minute; mouth small, lower jaw included; jaws with granular teeth; no teeth on vomer or palatines; scales bony, strongly keeled; 2 serrated, knife-like appendages at base of tail; first dorsal of 4 or 5 rather high flexible spines, in some forms preceded by 1 or more free spines; an immovable spine between the dorsals; anal and second dorsal short, of slender rays; caudal small, lunate; pectoral fins divided nearly to the base, into 2 parts, the anterior portion about as long as the head, of about 6 rays, closely connected; the posterior and larger portion more than twice length of head, reaching nearly to caudal in the adult; much shorter in the young; these rays very slender, simple, wide apart at tip; ventral rays I, 4, the long fins pointed, their bases close together, the inner rays shortest; air bladder with 2 lateral parts, each with a large muscle; pyloric caeca numerous; vertebrae $9+13=22$; myodome undeveloped, the cranial cavity mostly closed in front by expansions from the subtectals, suturally connected with corresponding expansions of the prootics and the parasphenoid; proethmoid and anteorbitals entirely disconnected, leaving a capacious rostral chamber opening backward mesially into the interorbital region; infraorbital chain with its second and third bones crowded out of the orbital margin by junction of the first and fourth, and leaving a wide interval between the suborbitals and preoperculum; the first very long and extending backward, the second under the fourth, and the third developed as a small special bone (pontinal) bridging the interval between the second suborbital and the antero-interior angle of the preoperculum; post-temporal suturally connected with the posterior bones of the cranium, and with the upper surface forming a large part of the roof of the head; intermaxillaries with well-developed ascending pedicles gliding into the cavity between the anteorbitals and proethmoids; postero-temporal distant from the proscapula, and manifest as an ossicle on the edge of the post-temporal.

Warm seas, in both oceans; 4 genera and 4 species known from the waters of Japan.

A KEY TO GENERA ^a OF FAMILY CEPHALACANTHIDÆ.

- a. Lateral line wanting.
 b. Occiput without elongate ray-like free spine; continuous spinous dorsal preceded by two semi-paired rays, which fold backward on either side of the fin.
Cephalacanthus (Atlantic species)
 bb. Occiput with an elongate ray-like free spine.
 c. A detached finlet of one spine, between elongate spine at occiput and the spinous dorsal proper.....*Dactyloptena*, 12
 cc. No detached finlet in front of spinous dorsal and behind occipital spine.
Daicocus, 13
 aa. Lateral line developed; occipital spine and detached dorsal finlet present.
Ebisinus (Species East Indian)

^a In view of the introduction of new generic distinctions in this paper, we here include reference to all the known genera and species of this interesting family.

CEPHALACANTHUS Lacepede.

Cephalacanthus LACÉPÈDE, Hist. Nat. Poiss., VI, 1802, p. 5 (*spinarella*=*volitans*).

Dactylopterus LACÉPÈDE, Hist. Nat. Poiss., VI, 1802, p. 8 (*pirapeda*=*volitans*).

Cephacandia RAFINESQUE, Anal. de Nat., 1815, p. 85 (substitute for *Cephalacanthus*).

Head with its upper surface and sides entirely bony; the scapular shield and the angle of the preoperculum produced backward as long spine-like processes; body covered with scales, those on the sides and back strongly keeled; lateral line absent; two dorsal fins, the first two rays of the spinous dorsal nearly detached and inserted paired-wise in front of the first true spine so that they may be folded backward one on each side of the fin; pectoral fins very long; no ray-like filament on occiput.

(κεφαλή head; ἄκανθα, a spine).

Atlantic and neighboring seas; one species known.

CEPHALACANTHUS VOLITANS (Linnæus).

Trigla volitans LINNÆUS, Syst. Nat., 10th ed., I, 1758, p. 296 ("Mari Mediterraneo Oceanio, Pelago inter tropicos, in Asia ad Cap. b. Spei").—CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 138.

Gasterosteus spinarella LINNÆUS, Syst. Nat., 10th ed., X, Pt. 1, 1758, p. 297 ("habitat India" error in locality; should be Surinam. See Cuvier and Valenciennes, IV, p. 138).

Cephalacanthus spinarella LACÉPÈDE, Hist. Nat. Poiss., VI, 1802, p. 5.—CUVIER and VALENCIENNES, Hist. Nat. Poiss., IV, 1829, p. 138, pl. LXXVII.—STEINDACHNER, Ichth. Span. u. Portugal, IV, 1867, pp. 91-92, pl. II, fig. 2; pl. IV, fig. 2.—LUTKEN, Spol. Atl., Fiske, 1880, pp. 417-428 and 590-591, pl. I, figs. 1-5.

Dactylopterus pirapeda LACÉPÈDE, Hist. Nat. Poiss., VI, 1802, p. 8.

Dactylopterus volitans GÜNTHER, Cat. Fishes, II, 1860, p. 221.

Cephalacanthus volitans JORDAN and EVERMANN, Bull. U. S. Nat. Mus., No. 47, II, 1898, p. 2183, pl. CCCXXIII, fig. 778.

Atlantic Ocean and Mediterranean.

EBISINUS Jordan and Richardson, new genus.

Ebisinus JORDAN and RICHARDSON, new genus of *Cephalacanthidæ* (*cheirophthalmus*).

This genus differs from *Cephalacanthus*, *Dactyloptena*, and *Daicocus* in the presence of a well-developed lateral line. The spinous dorsal is preceded by a single detached

12. DACTYLOPTENA Jordan and Richardson, new genus.

This genus differs from *Cephalacanthus*^a in having the spinous dorsal fin preceded by a detached finlet, consisting of one spine and a fully developed posterior membrane. With that genus and with *Daicocus* it agrees in possessing no lateral line. A long ray-like filament behind the occiput. Characters otherwise those of the family.

(δάκτυλος, finger; πτενός, winged.)

Japan, Hawaii, and the East Indies; a single species known.

Type of genus.—*Dactyloptena orientalis*.

spine and there is a long occipital ray as in *Dactyloptena*, to which the present genus seems most nearly related.

(*Ebisu*, the Japanese fish-god, god of the fish markets, from *Ebisu* a barbarian or foreigner.)

East Indies and Philippines; a single species known; a second (as yet undescribed) taken by Gilbert and Snyder at Nagasaki.

EBISINUS CHEIROPHthalmus (Bleeker).

Dactylopterus cheirophthalmus BLEEKER, Nat. Tyds. Ned. Ind., VII, Oct. 1854, p. 494 (Banda Neira).

Dactylopterus macracanthus BLEEKER, Bijdr. Ichth. Celebes, VI, Nov. 1854, p. 449 (Macassar in mari.—GÜNTHER, Cat. Fishes, II, 1860, p. 223 (Molucca Sea) (after Bleeker).

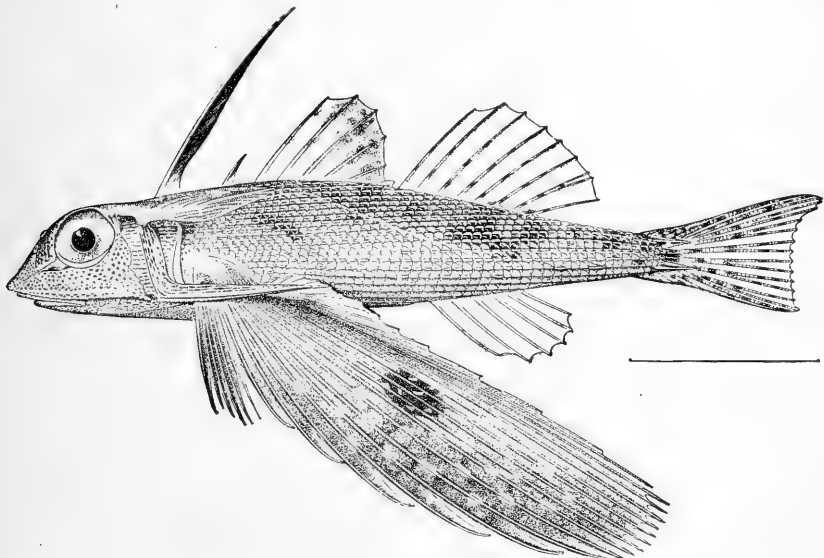


FIG. 8.—EBISINUS CHEIROPHthalmus.

Dactylopterus cheirophthalmus GÜNTHER, Cat. Fishes, II, 1860, p. 223 (Sea of Banda Neira) (after Bleeker). (Amended spelling).

Cephalacanthus macracanthus, JORDAN and SEALE, Bull. U. S. Fish Comm., XXVI, 1906, p. 40 (Manila, Cavite, Panay).

Molucca and Philippine Seas.

^a Characters of the genus to be found in footnote to key to genera of family Cephalacanthidae, preceding.

23. *DACTYLOPTENA ORIENTALIS* (Cuvier and Valenciennes.)

SEMIHOBO (Cicada Square-head, or Gurnard.)

- Dactylopterus orientalis* CUVIER and VALENCIENNES, *Ilust. Nat. Poiss.*, IV, 1829, p. 134, pl. LXXVI (Indian Ocean).—TEMMINCK and SCHLEGEL, *Faun. Japon. Pisc.*, 1843, p. 37, pl. xVA (seas of Japan and China).—RICHARDSON, *Ichth. China and Japan*, 1848, p. 218 (Japanese and Chinese seas).—GÜNTHER, *Cat. Fishes*, II, 1860, p. 222 (China; Japan; Amboyna; Cape seas).—Shore Fishes Challenger, 1880, p. 42 (Arafura Sea).—NAMIYE, *Class. Cat.*, 1881, p. 101 (Tokyo).—ISHIKAWA, *Cat. Fishes Imp. Mus. Tokyo*, 1897, p. 47 (Kagoshima).
Dactylopterus japonicus BLEEKER, *Nat. Tyds. Ned. Ind.*, VII, 1854, p. 396 (Waka, Japan).—Nieuwe Nalez. *Ichth. Japan*, 1857, p. 72 (Nagasaki, in mari).
Cephalacanthus orientalis JORDAN and EVERMANN, *Bull. U. S. Fish Comm.*, XXIII, 1905, Pt. I, p. 473, fig. 208 (Hawaiian Islands).

Habitat.—South Japan, East Indies, and Hawaii.

Head, 4.10 in length; depth, 5.50; snout, 2.75 in head; eye, 3.33; maxillary, 2.25; interorbital space, 2; D. I–I, V, 1–8; A., 7; P., 33; V. 5; scales, 47 in longitudinal and 21 in transverse series to edge of belly.

Body elongate, depressed, the lower surface flattened, head broad, depressed, squarish in cross section; interorbital space concave, its depth at middle equal to the width of the pupil; eye slightly nearer to end of snout than to upper corner of gill opening; side of head above produced backward in a long bony shield, ending in a keeled point opposite the base of the second spine of the continuous spinous dorsal; the distance between the apices of the scapular processes contained about $1\frac{1}{2}$ times in the depth of the notch between them, which forms an acute angle; preopercle with a backwardly directed spinous process, whose tip reaches barely to base of ventrals in adults, but is somewhat longer in young; first (detached) spinous ray of dorsal fin originating just behind occiput, and greatly elongated, its tip reaching nearly to the back of the continuous spinous dorsal; second detached ray forming a spinous finlet with a well developed membrane, inserted directly in front of the continuous spinous dorsal, and of about half its height; spinous dorsal (the continuous fin) slightly higher than soft dorsal; a short keel-like spine in the space between the two fins; origin of anal about midway between base of caudal and gill-opening; caudal truncate; pectorals large and greatly elongated, their tips reaching past the base of the caudal and sometimes to its tip, the ends of the long median rays prolonged more or less as short filaments; caudal peduncle long and depressed, its length nearly equal to head; lower side of posterior part of trunk with 4 of the keel-like scales enlarged and movable, the first enlarged scale being opposite vent; base of caudal fin furnished with two pairs of movable keeled scales, one upper and one lower; lateral line wanting.

Color in alcohol dull purplish brown, with rather large dark round spots on the back of about size of pupil, and with lower surface whit-

ish; rays of spinous and soft dorsal and pectorals banded from the base outward with alternating pale and dusky; pectoral membranes blackish with irregular grayish spots; tips of pectoral rays whitish.

Color in life (Hawaii), drab above, white below; orange spots, smaller than pupil over top of head and back; caudal with 4 golden bands, pectoral covered with spots of dusky golden, larger posteriorly; a yellow band on upper part of spinous dorsal, curved with the concave side toward base; spinous dorsal with spots of dusky golden; soft dorsal transparent, with alive shades on rays; ventrals golden; anal transparent, golden-shaded.

(*orientalis*, eastern.)

We have examined specimens from localities as follows: Nagasaki, 9 specimens, 3 to 4 inches; Wakanoura, 4 specimens, 3 to 5 inches; Hawaii, 10 specimens. There seems to be no specific differences separating the latter from the Japanese form.

Described from 3 adult specimens, 8 to 10 inches long, taken at Hilo, Hawaiian Islands.

13. DAICOCUS Jordan and Richardson, new genus.

This genus agrees with *Cephalacanthus* and *Dactyloptena* in the absence of the lateral line, and with the last-named genus in possessing a long filamentous spine on the occiput. It differs from both of those genera in lacking a detached spine in front of the spinous dorsal. Characters otherwise those of the family.

Seas of Japan; one species.

(Named for Daikoku, the luck-god, the inseparable companion of Ebisu, the fish-god in Japanese folklore).

Type of genus.—*Daicocus peterseni*.

24. DAICOCUS PETERSENI (Nyström).

HOB0 (Square-head.)

Dactylopterus peterseni NYSTRÖM, Svensk. Vet.-Akad. Handl., 13, IV, No. 4, p. 24 (Nagasaki).

Habitat.—South Japan, Misaki to Nagasaki.

Head 3.80 in length; depth 5; snout 2.60 in head; eye 3.60; maxillary 2.50; interorbital space 2; D. I-V-I-8; A. 6; P. 33; V. 5; scales 46-20.

Body elongate, depressed, belly flattened; head broad and depressed, squarish in section; interorbital space less concave than in *Dactyloptena orientalis*, the depth in middle being only about two-thirds width of pupil; eye almost exactly equidistant between tip of snout and upper corner of gill opening; distance between apices of scapular shields contained $1\frac{1}{2}$ times in the depth of the notch between them, which is acute; tips of shields reaching to opposite second ray of spinous dorsal; preopercular process reaching scarcely past base

of ventrals; an elongated filament-like spinous ray on occiput, its tip reaching to the back of the continuous spinous dorsal; spinous dorsal not preceded by a short detached ray or finlet directly in front of its base; spinous and soft dorsals of about equal height, with a strong but short keel-like spine situated in the interval between them; origin of anal fin slightly nearer to base of caudal than to gill opening; caudal lunate; pectorals elongated, their tips reaching base of caudal; the long pectoral rays free at tip, somewhat filamentous; caudal peduncle as long as head, depressed, and broad and flat above anteriorly; 3 pairs of enlarged keeled scales along ventro-caudal edge, the first pair opposite middle of anal; base of caudal with an upper and lower pair of similar enlarged scales; no lateral line.

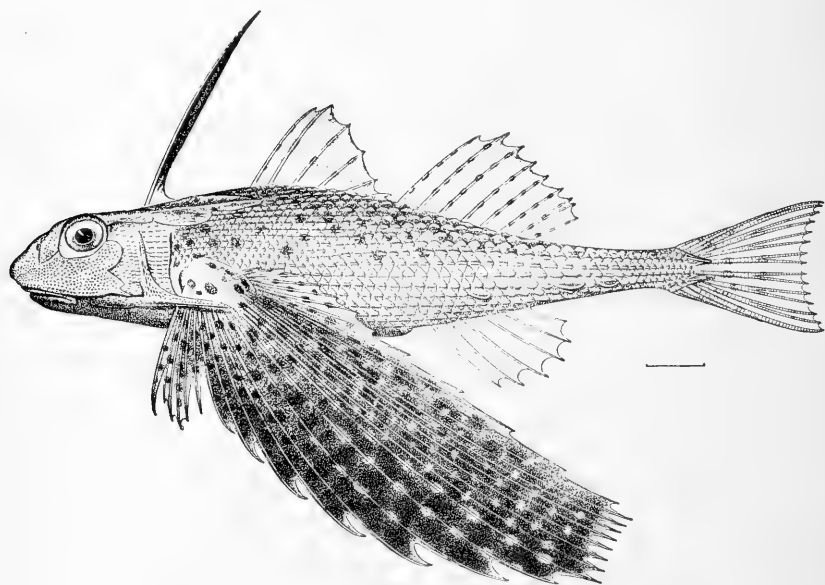


FIG. 9.—DAICOCUS PETERSENI.

Color in alcohol yellowish brown, the back and top of head with numerous roundish black spots, which are of smaller size than the spots of *Dactyloptena orientalis*; belly dirty white, the scales bearing considerable pigment in the form of fine punctulations; single rays of spinous and soft dorsal of alternating light and dark color from base to tip; pectoral membranes chiefly dark, but more or less streaked and spotted with whitish; the rays mostly pale, but blotched or banded at intervals with dusky. Life colors not recorded.

Here described from a single specimen 11 inches long, taken at Misaki.

(Named by Nyström for "J. V. Petersen i Japan.")

SUMMARY.

Family PLATYCEPHALIDÆ.

1. *Rogadius* Jordan and Richardson, 1908.1. *asper* (Cuvier and Valenciennes), 1829.2. *Thysanophrys* Ogilby, 1898.§ *Insidiator* Jordan and Snyder, 1900.2. *spinosus* (Temminck and Schlegel), 1843; Nagasaki.3. *macrolepis* (Bleeker), 1857; Nagasaki.§ *Grammoplites* Fowler, 1904.4. *meerdervoortii* (Bleeker), 1860; Wakanoura; Shimizu.5. *japonicus* (Tilesius), 1812; Tokyo; Misaki; Tsuruga; Wakanoura; Nagasaki.6. *crocodilus* (Tilesius), 1812; Tokyo; Wakanoura; Onomichi; Hiroshima; Nagasaki.3. *Platycephalus* Bloch, 1795.7. *indicus* (Linnæus), 1758; Tokyo; Tsuruga; Wakanoura; Enoshima; Misaki; Nagasaki; Tsuruga; Kobe; Hiroshima; Onomichi.

Family BEMBRIDÆ.

4. *Bembras* Cuvier and Valenciennes, 1829.8. *japonicus* Cuvier and Valenciennes, 1829; Boshu.5. *Bambradon* Jordan and Richardson, 1908.9. *lævis* Nyström, 1887.6. *Parabembras* Bleeker, 1874.10. *curtus* (Temminck and Schlegel), 1843.

Family HOPLICHTHYIDÆ.

7. *Hoplichthys* Cuvier and Valenciennes, 1829.11. *langsdorfi* Cuvier and Valenciennes, 1829; Kagoshima.12. *gilberti* Jordan and Richardson, 1908; Suruga Bay.

Family TRIGLIDÆ.

8. *Lepidotrigla* Günther, 1860.13. *alata* (Houttuyn), 1782; Nagasaki; Wakanoura; Misaki; Kobe; Tsushima; Tsuruga; Onomichi.14. *microptera* Günther, 1873; Hakodate; Aomori; Hiroshima; Tsuruga; Matsushima Bay; Suruga Bay; Kobe; Wakanoura; Tokyo; Nagasaki.15. *güntheri* Hilgendorf, 1879; Tokyo; Suruga Bay; Totomi Bay; Yokohama.16. *abyssalis* Jordan and Starks, 1902; Suruga Bay.17. *japonica* (Bleeker), 1857; Nagasaki; Misaki; Wakanoura.9. *Chelidonichthys* Kaup, 1873.18. *kumu* (Lesson and Garnot), 1830; Aomori; Tsuruga; Misaki; Kawatana; Kagoshima; Nagasaki; Tokyo; Kobe.

10. *Otohme* Jordan and Starks, 1906.

19. *hemisticta* (Temminck and Schlegel), 1847; Misaki or Awa.

Family PERISTEDIIDÆ.

11. *Peristedion* Lacépède, 1802.

20. *orientale* Temminck and Schlegel, 1843; Misaki; Tokyo; Suruga Bay.

21. *amiscus* Jordan and Starks, 1902; Sagami Bay.

22. *rieffeli* (Kaup) 1859.

Family CEPHALACANTHIDÆ.

12. *Dactyloptena* Jordan and Richardson, 1908.

23. *orientalis* (Cuvier and Valenciennes), 1829; Nagasaki; Wakanoura.

13. *Daicocus* Jordan and Richardson, 1908.

24. *peterseni* (Nyström); Misaki.

INFRABASALS IN RECENT GENERA OF THE CRINOID FAMILY PENTACRINITIDÆ.

By AUSTIN HOBART CLARK,
Assistant, Bureau of Fisheries.

Although so long ago as 1885 Wachsmuth and Springer showed that *Isocrinus* and *Metacrinus* are constructed upon the dicyclic principle, infrabasals have as yet never been detected in any species of *Metacrinus* nor in any recent species of *Isocrinus*. It is now known that all recent crinoids, with the single exception of *Hyocrinus*, are dicyclic; but infrabasals have never been actually demonstrated except in two species, in *Antedon bifida* by Bury, and in *Calamocrinus diomedæ* by Alexander Agassiz.

Dr. P. H. Carpenter in his monograph on the "Comatulæ" criticizes rather sharply the so-called law of Wachsmuth and Springer for determining by the orientation of the stem whether the infrabasals are present or not in a given species, and positively asserts that they do not exist in the recent Pentacrininitidæ, although he admits that they occur in the liassic genus *Pentacrinus* (i. e., "*Extracrinus*").

The discovery of infrabasals in *Isocrinus* was made by the distinguished palæontologist P. de Loriol who, in 1894, described a new species of the genus, *Isocrinus leuthardi*, and published figures of it showing the five small radially situated infrabasals occupying a position in the center of the star-shaped figure formed by the elongate basals.

With the idea of determining whether the condition shown by de Loriol in *Isocrinus leuthardi* was repeated in the recent members of the genus and in *Metacrinus*, preparations were made of *Isocrinus decorus* and *Metacrinus rotundus* by carefully removing the upper stem joints so as to lay bare the entire dorsal surface of the basals, and it was with considerable surprise that in both species prominent infrabasals were revealed, those of *Metacrinus rotundus* especially being so noticeable that it is considerable of a mystery how they could possibly have escaped the notice of such a careful worker as Doctor Carpenter.

Two specimens of *Isocrinus decorus* were dissected, one being a small, immature example, the other full grown, and apparently mature.

In the former (fig. 1) the infrabasals are five small rounded plates, quite distinct from each other, set close together in a five-lobed rosette in the middle of the star-shaped figure formed by the basals, exhibiting practically the same condition as in the specimen of *I. leuthardi* figured by de Loriol.^a Their protrusion beyond the dorsal surface of the basals is relatively great; they have a strongly convex dorsal surface, and show no tendency toward degeneration or resorption, as is the case with the quinquelobular rosette representing the fused infrabasals of *Calamocrinus diomedæ*. In the figure only the two infrabasals in the lower and lower left-hand portion are shown entire, the others being more or less covered by portions of the upper stem joints, which could not be removed without risking the specimen.



FIG. 1.—RADIALS, BASALS, AND INFRABASALS OF *ISOCRINUS DECORUS* (A YOUNG SPECIMEN).

In the adult example figured (fig. 2) the infrabasals are flatter, and appear as roughly triangular plates, with a marked depression forming a notch in the outer edge, the rounded ridge on each side of this depression being a continuation of the lateral ridges on the basals, which bear the dentate processes.

In *Metacrinus rotundus* (fig. 3) the infrabasals are rounded triangular plates, with a flatter dorsal surface than in *Isocrinus decorus*, so that their dorsal surface is even with that of the basals. As in the adult specimen of *Isocrinus decorus*, the petaloid markings are continued onto them, in the form of a prominent U-shaped ridge.

The topmost columnar of this last specimen appears to be much younger than any heretofore noticed in the Pentacrininitidæ (fig. 4); it is composed of a delicate calcareous network, approximately semicircular, bearing two radiating lobes of unequal size, composed of exceedingly delicate calcareous meshes. It was unfortunately impossible to discover the orientation (in reference to the plane of symmetry of the disk) of the larger lobe. Judging from the condition of this stem joint, the columnars arise at a point close to the axial cord, the growth being in each direction around (and close to) the central opening; when this growing calcareous band reaches the median line of a basal, a radiating lobe is formed which increases very rapidly in height, building up with a much more open structure than the original band. Thus we get the condition shown by this first (i. e., top-



FIG. 2.—RADIALS, BASALS, AND INFRABASALS OF *ISOCRINUS DECORUS* (A MATURE SPECIMEN).

^a Revue Suisse de Zool., II, 1894, pl. xxiv, fig. 12a.

most) columnar, which has two of the primitive lobes, which will eventually become the angles of the stem, well developed, while the primitive ring is as yet barely a semicircle. It is noticeable also in stem joints which have the lobes well developed that the ring immediately around the central canal is always much more dense than the extremely delicate lobes. This points to the conclusion that the pentagonal character of the stem, at least in the Pentacrinitidæ, is derived from an ancestral type, in which the stem is composed of circular columnars, as in *Encrinus*; for, were this not so, we should expect the lobes to be developed at the same time as the inner ring, instead of being merely a delicate network of delicate calcareous threads when the latter is well developed and composed of a comparatively dense deposit.

The second columnar in this specimen consists of a calcareous ring, bearing five unequal lobes of very delicate structure, much more delicate than the comparatively solid ring upon which they are borne; the specimen figured by Doctor Carpenter^a on Plate XXIII, fig. 1, is very similar, but is somewhat more advanced in growth; the third columnar is similar, but shows a marked thickening all around (see same reference, Plate XXIII, fig. 2), while the fourth has the lobes of almost equal size, and the raised edges of the sectors with the dentate processes are beginning to form (see same reference, Plate XXIII, fig. 3).

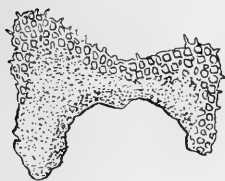


FIG. 4.—UPPERMOST COLUMNAR OF METACRINUS ROTUNDUS.

Encouraged by my success in the demonstration of the infrabasals in *Isocrinus decorus* (Wyville Thomson) and *Metacrinus rotundus* P. H. Carpenter, I decided to carry my investigations still further, and to endeavor to point them out in all the species of both genera of which I could obtain material. I also wished to isolate the infrabasals, if possible, and to determine their size and their relations to the basals. This I did not consider myself justified in doing before, and the specimens figured, therefore, were mounted on glass slides exactly in the state in which they were figured, and have now become part of the collection of recent crinoidea belonging to the U. S. National Museum, where they will be available for future study.

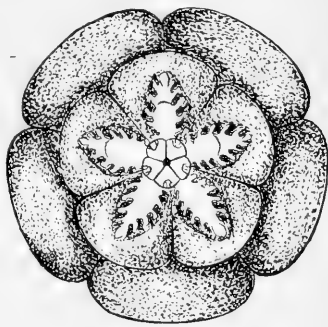


FIG. 3.—RADIALS, BASALS, AND INFRABASALS OF METACRINUS ROTUNDUS.

^a Challenger Reports, XI, Zoology, 1884.

In a large jar containing fragments of arms and stems of *Metacrinus rotundus*, *M. angulatus*, and *M. superbus*, all from the Eastern Sea near Kagoshima, I found the upper part of a stem of *Metacrinus superbus* with part of the calyx attached, and it is on this specimen that the following observations have been based.

The method used in disintegrating the specimen was this: The stem was clipped off as near the basals as possible, and then the stump pared down with a knife as much as could be done without danger of injury to the basals, so as to leave a minimum of work to be done by the caustic. A small cavity was scooped out of the small portion of the stem remaining, and the specimen was then dried. The drying is to insure localization of the action of the caustic; for if the specimen be wet the caustic will rapidly infiltrate through the sutures and articulations, weakening the specimen so that successful manipulation is rendered very difficult; in a dry specimen, on the other hand, the infiltration is comparatively slow, and the action of the caustic may be to some extent gauged by the amount of moistening (and consequent darkening) of the exterior of the specimen. The interior infiltration appears to be more rapid than the spread of the moist area on the exterior, so that, by the time the basals are moistened all over, the specimen is ready for dissection. Dissection is accomplished under a dissecting microscope, using a lens of as strong magnification as can be employed without hindering the work by too great a diminution of the working distance and field of vision. The caustic is applied in the form of a small lump, and is allowed to deliquesce, the solution thus formed passing down the central lumen of the remaining stem joints and infiltrating out between them. When the disintegration is believed to have proceeded far enough, the specimen is soaked in water to remove the caustic, and is then ready for dissection. It will be found that the first few stem joints, being large and thick, are quite difficult of removal, and must be broken up and taken out piecemeal; but the smaller interior joints are perfectly free. If too great difficulties are encountered, as much should be removed as is possible without danger to the specimen, and the caustic applied again for a short time. There are two dangers to guard against; usually, after dissecting away the rapidly decreasing stem joints, until an exceedingly small one is reached, which is also removed, apparently the entire dorsal surface of the basals is laid bare, showing no trace whatever of infrabasals. This, however, is not the case; the appearance is produced by a stem joint nearly full size, and so intimately connected with the basals along the edge that it is practically indistinguishable from them. By inserting the point of the needle into the central lumen and carefully prying upward, this joint may be broken away, when another series of small joints will be exposed. The infrabasals are so patent that it is impossible to overlook them;

if they are not seen, then it is a stem joint that is exposed to view, and not the true dorsal surface of the basals. I believe that it was this mistaking of a stem joint for the dorsal surface of the basal which prevented Dr. P. H. Carpenter from detecting the underbasals in the recent *Pentacrinitidæ* during his work on the *Challenger* collection. The other danger is that sometimes, when it appears to be a moral certainty that "bottom" has been reached, the infrabasals may be obscured or entirely hidden by a stem joint which is just beginning to form, and is composed of almost invisible limy reticulations, not invisible enough, however, to prevent the detection of the infrabasals through it. After a stem joint has in its growth completely encircled the central lumen, it is obvious enough; but joints consisting of merely two or three exceedingly delicate lobes are very difficult to see. If Doctor Carpenter's specimens were reexamined, I think it would be found that this was also a source of error, as well as the mistaking of a stem joint for

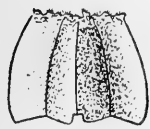


FIG. 6.—ISOLATED INFRABASALS OF *METACRINUS SUPERBUS*.

the basals. I have found *Metacrinus* much easier to handle than *Isocrinus*; but all my specimens of the former are fresh and well preserved (taken in August, 1906), while those of the latter are more than twenty years old, so that possibly the difference may be due to a difference in the state of preservation.

The infrabasals of *Metacrinus superbus* are apparently identical with those of *M. rotundus*, so that the figure published of the latter (fig. 3) will also serve to show the conditions in the former. After a study of the dorsal surface of the basals and infrabasals in place, by very delicate manipulation three of the basals were removed, leaving the infrabasals in place adhering to the other two. A sketch of the conditions found was immediately made, and is reproduced in fig. 5. The infrabasals themselves were then removed and figs. 6, 7, and 8 were made from them.

The infrabasals are long truncated-pyramidal plates, equal in length to the entire height of the inner ends of the basals. A side view of the five infrabasals together is shown in fig. 6: they form a truncated, dome-shaped, sharply angular mass, somewhat broader than high, the angles, of course, extending into the sutures between the basals. Near the bottom (i. e., the dorsal side) the sides curve in somewhat abruptly and the carination ceases, so that in a dorsal view (fig. 8) we get no suggestion of it, the outer edges of the infrabasals then appearing rounded. The sharp notch shown in the central infrabasal in fig. 6

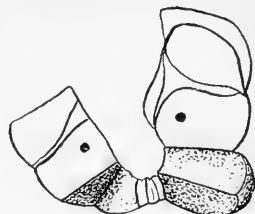


FIG. 5.—SECTION OF CALYX OF *METACRINUS SUPERBUS*, SHOWING THE INFRABASALS IN POSITION.



FIG. 7.—VENTRAL VIEW OF ISOLATED INFRABASALS OF *METACRINUS SUPERBUS*.

is the end view of the U-shaped ridge and resulting central concavity formed by the extension of the petaloid sectors of the basals onto the infrabasals, as shown in fig. 8. The ventral (upper) end of the circlet of infrabasals is, in common with the adjoining surface of the basals, more or less honeycombed and disintegrated, but this condition does not extend very far down; most of the infrabasals is as solid in structure as the basals, and, so far from being degenerate, they are remarkably well developed, when the very large size of the basals in the specimens dissected is considered.



FIG. 8.—DORSAL
VIEW OF ISO-
LATED INFRA-
BASALS OF
METACRINUS
SUPERBUS.

A ventral view (fig. 7) shows that the edges of the infrabasals are sharp and clear-cut, and the sutures very distinct; the outer sides are raised into a sharp angle; the ventral surface is somewhat rough and irregular, while the central canal is comparatively small, and

quinelobate.

The dorsal view (fig. 8) does not differ from that figured for the infrabasals of *M. rotundus* (fig. 3). The surface, while smooth, is raised into U-shaped ridges, forming an inward extension of the ridges on the basals, the outer edges are rounded, and the central canal is much larger than in the ventral view, and is round.

A NEW SPECIES OF FLYING LIZARD FROM THE PHILIPPINE ISLANDS.

By LEONHARD STEJNEGER,

Curator, Division of Reptiles and Batrachians, U. S. National Museum.

The genus *Draco*, which constitutes a very characteristic part of the Malayan element in the fauna of the Philippine Archipelago, has hitherto been known to be represented there only by species having the nostrils lateral and turned outward. It is therefore very interesting to find in a shipment recently received from Dr. Edgar A. Mearns, U. S. Army, whose collecting has resulted in so many important additions to the Philippine biota, two fine specimens of a new species of *Draco* belonging to the other section of the genus in which the nostrils are directed upward and perfectly vertical.

DRACO MINDANENSIS, new species.

Diagnosis.—Nostril directed upward, vertical; tympanum scaly; head-scales subequal, without a Y-shaped series of scales on forehead; hind leg when adpressed forward extending beyond axilla; wing membranes pale brown above, without dark cross bands; male's gular appendage, broad, triangular, slightly longer than length of head.

Habitat.—Island of Mindanao, Philippine Archipelago.

Type.—Cat. No. 37388, U.S.N.M.; Datu Anib's place, near Catagan, northwest Mindanao, at base of Malindang Mountain, 1,100 feet altitude; May 11, 1906; Dr. E. A. Mearns, collector.

Description of type specimen.—*Adult male.* Snout as long as diameter of orbit; rostral wide and low, more than twice as wide as high, bordered behind by seven subequal, nearly regularly pentagonal scales and slightly in contact with first supralabial; nostril directed upward, perfectly vertical, separated from rostral by three rows of scales and from supralabial by three or four scales; interorbital space narrow; scales on top of head small, more or less keeled, with a slightly developed median series of larger, keeled scales on top of snout, but without any posterior, diverging branches; about five small scales in a line across the middle of the interorbital space

and about thirteen across the supraocular region, the outer ones being almost granules, the median ones larger, irregular hexagonal; a small, blunt spine at posterior end of superciliary margin; occipital shield scarcely differentiated, surrounded by subequal, keeled scales; tympanum hidden by small scales; fifteen supralabials; mental large, nearly as wide as rostral, triangular; a nuchal fold, but no median series of enlarged scales; upper surface of body covered with small, keeled scales, largest on the middle portion of the back, becoming gradually smaller on the sides toward the parachute, the larger about the same size as the ventrals; a few dorso-lateral enlarged scales barely indicated; the gular appendage broadly triangular, with posterior outline nearly straight, slightly longer than the head, the scales elongate, somewhat increasing in length toward the tip, where they almost reach the size of the ventrals; lateral neck fans very large, with rounded outline, the peripheral scales large and elongate above; fore legs long and slender, the wrist extending to the tip of the snout; extended hind leg reaches to the shoulder; posterior edge of tibia and femur strongly serrate, with a group of three large scales at the upper end near the body; tail nearly twice as long as head and body together. Color (in alcohol) above dull grayish brown, almost sepia, with pale rounded spots; on the back about five transverse series of whitish round spots alternating with four transverse series of larger, more conspicuous spots consisting of a median nearly lozenge-shaped spot with a large circular spot on each side; upper side of parachute slightly paler than the back and somewhat more reddish especially posteriorly, with numerous longitudinal whitish lines narrow and of uneven width, like very elongate beads on fine threads; underside whitish; throat brownish gray with indistinct paler spots; gular appendage pale yellow, with a fine dusky line on each scale on the anterior margin; no spots on underside of parachute; limbs and tail above cross-barred, dark grayish brown and whitish in strong contrast.

Dimensions.

	<i>mm.</i>
Total length.....	261
Tip of snout to vent.....	90
Vent to tip of tail.....	171
Width of head.....	13
Fore leg.....	45
Hind leg.....	55
Tip of snout to posterior end of jaws.....	19
Gular appendage.....	18

Remarks.—Another specimen (Cat. No. 37387, U.S.N.M., same locality and collector), also an adult male, agrees in all essential respects with the type, but the occipital scale is much better differen-

tiated, being a rounded plate almost as large as the nasal. The gular appendix is also a few millimeters longer. The color is also nearly identical, but there is a very distinct whitish line on the middle of the forehead and another across the supraocular region.

The present species is related both to *Draco quinquefasciatus* and to *Draco maximus*. It has the size of the former, and consequently is smaller than the latter. From the former it differs chiefly in the longer limbs, the differently shaped gular appendage of the male, and in coloration, lacking entirely, as it does, the dark cross bars on the parachute. From the latter it differs, besides in size, in the absence of the Y on the forehead, the fewer scales on the interorbital space, the shorter gular appendage, and in the paler color of the upper side of the parachute.

A NEW FRESH-WATER BIVALVE (CORNEOCYCLAS) FROM THE MOUNTAINS OF ECUADOR.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

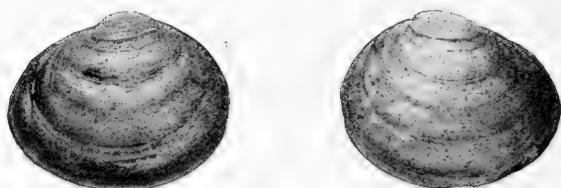
The species described herewith was collected by Dr. S. Austin Davis, of 61 Buena Vista avenue, Yonkers, New York, in the valley of the Chanchan River, Ecuador, South America, at an altitude of about 7,000 feet. Of the specific locality Doctor Davis says:

The Chanchan cuts through the western Cordillera and empties into the Chimbo at the base of the western foothills, at a station on the Guayaquil and Quito Railway called Bucay. The Chimbo, after about 55 miles, enters the Guayas River a short distance above Guayaquil. The Guayas waters flow to the Pacific Ocean. The tiny stream in which the mollusks were found falls into the Chanchan at about 4,000 feet elevation above the sea (20 miles above Bucay) and takes its rise high up the mountain side, some 3,000 or more feet above the entrance to the Chanchan. It is quite a stiff climb to get there from the valley bottom, and in its course there are two or three vertical falls.

CORNEOCYCLAS DAVISI, new species.

Shell of medium size, moderately oblique, well inflated, greyish horn-colored with straw-colored ventral margin, having the nepionic portion somewhat constricted off from the post-nepionic part of the shell. Umbones scarcely projecting above the hinge line. Posterior dorsal margin sloping a little more abruptly than the anterior and only about two-thirds as long. Area below the posterior dorsal margin well inflated, that below the anterior dorsal margin somewhat compressed. Posterior border well rounded and evenly curved. Anterior border somewhat produced in the middle and therefore decidedly less evenly arched than the posterior. Ventral margin forming an even sweeping curve. Entire outer surface marked by deeply incised concentric grooves which are somewhat variable in strength, those on the initial portion of the nepionic shell being finer than those on its margin. The post-nepionic part of the shell is divided

into a number of stages formed by the variation in the strength of the incised lines. In the type there are five, the first being immediately below the nepionic portion, while the rest divide the remaining part into equal segments. The narrow darker bands, represented by irregular stronger sculpture, may mark resting periods. In addition to the incised concentric sculpture the entire surface is marked by microscopic crinkling, especially in the grooves. Interior bluish-white. Hinge slight, long, curved. Ligament rather short, partly internal. Cardinals: in the right valve one, decidedly curved and much stronger and more elevated posteriorly where it bends downward over the hinge plate; in the left valve two, the upper slen-



CORNEOCYCLUS DAVISI BARTSCH. MAGNIFIED $\frac{5}{8}$.

der and obliquely curved and but slightly elevated, the lower small, somewhat triangular and a little more elevated than the upper. Laterals: double in the right valve, slender, curved, lamelliform, the ventral considerably more strongly developed than the dorsal; single in the left valve, the anterior one bearing a cusp-like projection on its middle, while the posterior one is best developed at its posterior extremity.

The shells of fresh specimens, when viewed by transmitted light, appear uniformly very minutely dotted as if finely punctured.

The type measures: Length 5.0 mm.; height 4.0 mm.; diameter 2.7 mm. The largest specimen, a single valve, measures: length 6.0 mm.; height 4.9 mm.

The lot, consisting of the type and two complete specimens and two single valves, is entered as Cat. No. 198053, U.S.N.M.

THE CRINOID GENUS COMATULA LAMARCK: WITH A NOTE ON THE ENCRINUS PARRÆ OF GUERIN.

By AUSTIN HOBART CLARK,
Assistant, Bureau of Fisheries.

In a previous paper ^a I published a preliminary notice of a revision of the unstalked crinoids, paying particular attention to the group called collectively "*Antedon*" by Dr. P. H. Carpenter. I had not at the time been able to arrive at a satisfactory conclusion in regard to the genus *Comatula* (= *Actinometra* P. H. Carpenter), but I have since taken up the question again and, after reexamining my old material, and studying a very considerable amount of new, have succeeded in resolving *Comatula* into two apparently homogeneous component types. My study was based, so far as possible, upon ten-armed specimens, and I have paid particular attention to the young whenever I have been able to get them.

The authorities of the U. S. National Museum have, as in the past, most generously placed at my disposal their entire collection of recent crinoids, and it is on this collection that my studies have been mainly based.

I wish further to express my deep appreciation of the kindness and generosity of Mr. Alexander Agassiz, who has permitted me to make use of his magnificent collection of recent crinoids, which contains many species which otherwise would have been inaccessible to me, including a considerable number of undescribed forms. I am also greatly indebted to Prof. Hubert Lyman Clark, of Harvard University, and to Prof. A. E. Verrill, of Yale, for many courtesies received during my visits to those institutions. Professor Clark especially, through his minute and exhaustive knowledge of the other Echinoderm groups, has suggested to me many interesting points in the morphological as well as the anatomical and systematic relations of the species upon which to work in the future.

^a Smiths. Misc. Coll. (Quarterly Issue), L, pp. 343-364.

Doctor Carpenter, in his report on the "Comatulæ" of the *Challenger* expedition, divided *Comatula* (= *Actinometra*) as follows:

- SERIES I; the two outer radials and the first two brachials united by syzygy:
 Ten arms-----*Solaris* group.
 Two distichals united by syzygy-----*Paucicirra* group.
 Three distichals, the axillary a syzygy-----*Typica* group.
- SERIES II; the two outer radials articulated: Ten arms-----*Echinoptera* group.
- SERIES III; two articulated distichals:
 Palmars and post-palmars like distichals; but first two brachials united
 by syzygy-----*Stelligera* group.
 First arm-syzygy in the third brachial-----*Valida* group.
- SERIES IV; three distichals, the first two articulated, and the third axillary
 with a syzygy.
 First arm-syzygy in the second brachial-----*Fimbriata* group.
 First arm-syzygy in the third brachial-----*Parvicirra* group.

This arrangement of the species was merely intended as a convenient guide to their identification, and nothing more was claimed for it. Its artificial character may be judged from a single species, the *Alecto parvicirra* of Johannes Müller 1841 (= *Actinometra parvicirra* of Carpenter), the type species of Carpenter's last group. This species is not infrequently ten-armed, therefore falling in the "*Echinoptera* group;" again, it may have all the distichal series of two articulated segments, the first arm-syzygy falling in the "third brachial," in which case it belongs with the "*Valida* group" according to Carpenter's scheme; yet the species is made the type of a third group, the "*Parvicirra* group." The groups themselves, contrary to what was the case in the various "groups" and "series" of "*Antedon*," are, with a single curious exception, the "*Typica* group," fairly homogeneous. Carpenter gives four species as belonging to this group, *distincta*, *typica*, *novæ-guinææ*, and *multibrachiata*, and a fifth, *gracilis*, has since been described. In *distincta* and *multibrachiata*, the costals are united by syzygy; according to the descriptions of these species, the distichals are 4 (3+4), and the palmars 2 (1+2); but on Plate LV and Plate LVI quite a different arrangement is found; while the palmars are 2 (1+2), the distichals are 4 (1+2; 3+4); in other words the distichals, instead of being "three, the axillary a syzygy" are *four, united in two syzygial pairs*. This simplifies matters considerably, as will be seen further on. Now, in *typica* and *gracilis*, and in *novæ-guinææ* as well as I can judge from the figure, the costals and first two distichals are *not* united by syzygy; while the union is very close, it is of the same type as that between the costals in such species as Carpenter's *Actinometra robustipinna* and Müller's *Alecto parvicirra* and *Alecto trichoptera*. We find, then, that three of the five species of the "*Typica* group," including *typica* itself, fall in "Series IV," while the other two do not belong in Carpenter's scheme at all.

The genus *Comatula* falls naturally into two divisions, species in which the costals are united by syzygy, and species in which the costals are articulated. Each of these divisions is a homogeneous unit, which can not, with our present knowledge of the species, be advantageously subdivided. For the first division the name *Comatula* (type *Comatula solaris* Lamarck) is available. Two generic names, *Comaster* L. Agassiz, 1836, and *Phanogenia* Lovén, 1866, have been based on species of the second group, of which *Comaster* (with the type, *Comatula multiradiata* Lamarck = *Asterias multiradiata* Linnæus, not *Comatula multiradiata* Goldfuss [= *Alecto nova-guineæ* Müller] as has been stated by various authors, following Müller), being the earlier, will have to be used.

COMATULA Lamarck, 1816.

A genus of Comatulidæ (= Actinometridæ) in which the costals are united by syzygy, the distichals are 2 (1+2) or 4 (1+2; 3+4), and the palmars 2 (1+2).

Type of the genus.—*Comatula solaris* Lamarck, 1816.

Distribution.—Australia northward, throughout the East Indies, to Japan. ? Madagascar. ? Society Islands.

The known species belonging to this genus as here restricted are:

<i>Comatula distincta</i> (P. H. Carpenter).	<i>Comatula paucicirra</i> (Bell).
<i>Comatula multibrachiata</i> (P. H. Carpenter).	<i>Comatula pectinata</i> (Linnæus).
	<i>Comatula serrata</i> A. H. Clark.
<i>Comatula notata</i> (P. H. Carpenter).	<i>Comatula solaris</i> Lamarck.

COMASTER L. Agassiz, 1836.

A genus of Comatulidæ in which the costals are united by bifascial articulation, the distichals being 2 or 4 (3+4) or both, rarely irregular.

Type of the genus.—*Asterias multiradiata* Linnæus, 1758, and of Retzius, 1783 (not *Asterias multiradiata* Gray, 1840=type of the genus *Heliaster*).

Distribution.—Intertropical; north to the Bay of Biscay, South Carolina, southern Japan, and Korea, south to southern Brazil, Peru, Australia, and the Cape of Good Hope; the headquarters are in the East Indian region.

The described species of the genus are as follows. In addition to these I have examined a number of others, mainly from the West Indies:

- | | |
|--|---|
| <p>(1) <i>Comaster alata</i> (Pourtalès).
 <i>Comaster alternans</i> (P. H. Carpenter).
 <i>Comaster belli</i> (P. H. Carpenter).
 <i>Comaster bennetti</i> (J. Müller).
 <i>Comaster bornensis</i> (Grube).
 <i>Comaster briareus</i> (Bell).
 <p>(2) <i>Comaster carpenteri</i> A. H. Clark.
 <i>Comaster coppingeri</i> (Bell).
 <i>Comaster discoidea</i> (P. H. Carpenter).
 <i>Comaster divaricata</i> (P. H. Carpenter).
 <i>Comaster duplex</i> (P. H. Carpenter).
 <i>Comaster echinoptera</i> (J. Müller).
 <i>Comaster elongata</i> (P. H. Carpenter).
 <i>Comaster fimbriata</i> (Lamarek).
 <i>Comaster gracilis</i> (Hartlaub).
 <i>Comaster grandicalyx</i> (P. H. Carpenter).
 <i>Comaster iowensis</i> (Springer).
 <i>Comaster lineata</i> (P. H. Carpenter).
 <i>Comaster japonica</i> (J. Müller).
 <i>Comaster littoralis</i> (P. H. Carpenter).</p> </p> | <p><i>Comaster macrobrachius</i> (Hartlaub).
 <i>Comaster maculata</i> (P. H. Carpenter).
 <i>Comaster magnifica</i> (P. H. Carpenter).
 <i>Comaster marie</i> (A. H. Clark).
 <i>Comaster meridionalis</i> (Agassiz and Agassiz).
 <i>Comaster multiradiata</i> (Linnæus).
 <i>Comaster nobilis</i> (P. H. Carpenter).
 <i>Comaster nova-guinæe</i> (J. Müller).
 <i>Comaster orientalis</i> (A. H. Clark).
 <i>Comaster parvicirra</i> (J. Müller).
 <i>Comaster peronii</i> (P. H. Carpenter).
 <i>Comaster quadrata</i> (P. H. Carpenter).
 <i>Comaster regulis</i> (P. H. Carpenter).
 <i>Comaster robustipinna</i> (P. H. Carpenter).
 <i>Comaster rotalaria</i> (Lamarek).
 <i>Comaster rubiginosa</i> (Pourtalès).
 <i>Comaster schlegelii</i> (P. H. Carpenter).
 <i>Comaster sentosa</i> (P. H. Carpenter).
 <i>Comaster solaster</i> (A. H. Clark).
 <i>Comaster stelligera</i> (P. H. Carpenter).
 <i>Comaster trichoptera</i> (J. Müller).
 <i>Comaster typica</i> (Lovén).
 <i>Comaster valida</i> (P. H. Carpenter).
 <i>Comaster variabilis</i> (Bell).</p> |
|--|---|

1. COMASTER ALATA (Pourtalès).

"*Actinometra pulchella* (Pourtalès)" was invariably used by Doctor Carpenter for the species which had previously been named *alata* by Poutalès, because he considered the name more appropriate, and subsequent authors have persisted in following him. Not only is *Antedon pulchella* of Poutalès^a preceded by *Antedon alata* of the same author^b for the same species, but *Antedon pulchella* Poutalès, 1878, is preoccupied by *Ganymeda* (= *Antedon*) *pulchella* Gray, 1834.^c

2. COMASTER CARPENTERI, new name.

Doctor Carpenter in 1888^d described a species of *Comaster* as *Actinometra multifida*, referring the name to Johannes Müller; but Müller, according to his own statement,^e proposed the name *multifida*

^a Bull. Mus. Comp. Zool., V, No. 9, p. 216.

^b Idem., p. 215.

^c Proc. Zool. Soc. London, 1834, Pt. 2, No. 14, p. 15.

^d Challenger Reports, XXVI, Zoology, p. 330.

^e Archiv für Naturgesch., 1841, I, p. 147.

merely as a substitute for Lamarek's *multiradiata*. His idea was that, two quite different species having been called *multiradiata*—one by Lamarek^a and one by Goldfuss,^b but Lamarek's description being quite worthless, whereas Goldfuss's is accompanied by an excellent figure—the name should hold for the form with the recognizable diagnosis, so he restricted it to Goldfuss's form. Subsequently he examined Lamarek's original types, and from them drew up his diagnosis of *multifida*. Now, thanks to Doctor Carpenter's investigations, we know what Lamarek's *multiradiata* really is, and (as it is the same as the Linnæan and Retzian *Asterias multiradiata*) of course the specific name *multiradiata* must be retained for it. Doctor Carpenter realized this, but he resurrected *multifida* for a specimen which was among Lamarek's types, and differed both from the *multiradiata* of Lamarek and the *multiradiata* of Goldfuss; but *multifida* is a pure synonym of *multiradiata* Lamarek and can not be used for any other species. The form may be renamed *Comaster carpenteri*.

ISOCRINUS PARRÆ (Guérin).

In his monograph on the recent stalked crinoids, Doctor Carpenter makes no mention of the species described as *Encrinus parre* by Guérin in 1835.^c Guérin, under the heading *Encrinus*, speaks of the "*Encrinus caput-medusæ*" described by Guettard and by Ellis (= *Isis asteria* Linnæus), and then goes on to say that the "Palma animal" described and figured by Parra in 1787^d appears to represent another species. He describes this species in detail under the name of *Encrinus parre*, taking his description from Parra, and he also reproduces Parra's plate. Except for the fact that the animal is represented as growing on the seashore like a palm tree, the reproduction is very good. Doctor Carpenter mentions the reference to Parra in his account of *Isocrinus asteria*, but says he was unable to consult it. Besides Guérin, Oken in 1815 and again in 1835 copied Parra's figure, and Gervais refers to *Encrinus parre*, and it seems as if one of the four must have been accessible to Doctor Carpenter. A glance at Parra's figure shows that the species he had was the same one which was described by Örsted in 1856^e as *Pentacrinus mülleri*; the short internodes (four to six) and consequent crowding of the cirri, combined with the stout stem, preclude the possibility of its being any other West Indian species. There can, therefore, be but

^a Hist. Nat. des Animaux sans Vertèbres, II, 1816, p. 533.

^b Petrefacta Germaniæ, I, p. 202, pl. LXI, figs. 2a-s.

^c Dict. d'Hist. Nat., III, p. 49, pl. CXLVII, fig. 1.

^d Description de diferentes piezas de Historia Natural, Havana, 1787, p. 191, pl. LXXI.

^e Forhandl. Skand. Naturf. 7de Møde i Christiania, p. 202.

one course; the species now known as *Isocrinus mülleri* (Örsted, 1856) must in the future be known as *Isocrinus parva* (Guérin, 1835).

There is still another name based on a recent West Indian *Isocrinus* which is not mentioned by Carpenter, although in his bibliography he cites the paper in which it occurs. In 1828^a the Rev. Lansdown Guilding described under the name of *Encrinus milleri* an *Isocrinus* brought up from the deep water off St. Vincent, where he then lived. The species is, however, quite unrecognizable, so that the name can never become available; besides, is is preoccupied by the fossil *Encrinites milleri* of von Schlotheim, 1822.

^a Zoological Journal, IV, p. 175.

ON SOME ISOPODS OF THE FAMILY DAJIDÆ FROM
THE NORTHWEST PACIFIC OCEAN, WITH DESCRIPTIONS OF A NEW GENUS AND TWO NEW SPECIES.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates, U. S. National Museum.

The following descriptions are of some Dajidæ which were collected by the U. S. Bureau of Fisheries steamer *Albatross* during its cruise to the northwest Pacific Ocean in the summer of 1906. A new genus is added to the family, and *Holophryxus giardi* and *Holophryxus californiensis*, new species, are described.

The number of Dajidæ genera is rapidly increasing, so that the family now contains the following: *Dajus* Krøyer, *Notophryxus* Sars, *Aspidophryxus* Sars, *Heterophryxus* Sars, *Branchiophryxus* Caullery, *Prodajus* Bonnier, *Zonophryxus* Richardson, *Holophryxus* Richardson, and *Arthropfryxus*, new genus.

LIST OF REFERENCES.

- BONNIER, JULES. Sur deux types nouveaux d'Épicarides parasites d'un Cumacé et d'un Schizopode, Comptes Rendus, CXXXVI, 1903, pp. 102-103. Paris.
- CAULLERY, MAURICE. Branchiophryxus nyctiphane, n. g., sp., Épicaride nouveau de la famille des Dajidæ, Journ. R. Micr. Soc. London, 1897, Pt. 3, p. 204. Also in Zool. Anzeiger, XX, 1897, pp. 88-92. Leipsic.
- KRØYER, HENRIK. Voyages en Scandinavie, en Laponie, au Spitsberg et aux Féroë, Zoologie, Crustacea. (Published under the direction of M. Paul Gaimard.) Atlas, pl. xxviii, figs. 1-2, pl. xxix, fig. 1. Paris, 1849.
- RICHARDSON, HARRIET. Isopods collected at the Hawaiian Islands by the U. S. Fish Commission steamer *Albatross*, Bull. U. S. Fish Commission, 1903, pp. 51-53. Washington.
- . Isopods of the Alaska Salmon Investigation, Bull. U. S. Bureau of Fisheries, XXIV, 1904, pp. 220-221. Washington, 1905.
- SARS, GEORGE O. Crustacea of Norway, II, 1899, pp. 223-224. Bergen.
- . Crustacea of the Norwegian North Atlantic Expedition, 1876-1878. Christiania, 1883.
- . Report on the Schizopoda, *Challenger* Report, XIII, 1885, Pt. 37, pp. 220-221. London.
- TATTERSALL, W. M. The Marine Fauna of the Coast of Ireland, Pt. 5, Isopoda, Fisheries, Ireland, Sci. Invest., 1904, II, 1905, pp. 77-78, pl. xi, figs. 1-4.

HOLOPHRYXUS GIARDI, new species.

Body of female oblong-ovate, 17 mm. by 39 mm., without any trace of segmentation. (See fig. 1.) Color uniformly light yellow.

Head represented by a bilobed prominence, which is surrounded by a wide, squarish ridge projecting anteriorly and laterally. Eyes wanting.

The thorax is wider anteriorly than posteriorly, being gradually restricted posteriorly. The lateral parts are not greatly swollen. There are no traces of segmentation on the dorsal surface.

The abdomen is narrower than the thorax, and tapers to a rounded extremity. There is no trace of segmentation, but a slight incision on either side indicates the place of coalescence of the first segment.

The abdomen is devoid of appendages, both uropoda and pleopoda being entirely wanting.

On the ventral side the oral area is not contracted behind. It is bounded anteriorly by the projecting ridge and mouth parts, and laterally by the two rows of coxal plates. Situated just within the two rows of coxal plates are five pairs

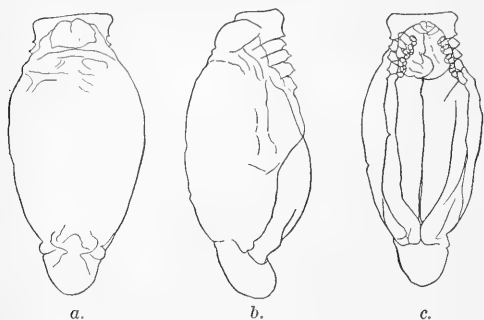


FIG. 1.—HOLOPHRYXUS GIARDI. ADULT FEMALE. a. DORSAL VIEW. b. LATERAL VIEW. c. VENTRAL VIEW. $\times 2\frac{1}{2}$.

of legs, surrounding the oral area. From the bases of the five pairs of legs arise five pairs of incubatory plates. Only the first and fifth pairs are visible, the other three pairs being hidden by the overlapping fifth pair. The fifth pair of plates are the largest, and meet along the middle ventral line of the body; they extend almost the entire length of the thorax.

In a lateral view four segments of the thorax are represented by four coxal plates, bounding the outer extremity of the oral area. The first coxal plate is coalesced with the cephalic ridge, but is indicated on either side at the posterior extremity of the ridge by a little pointed projection.

One adult female was taken by the U. S. Bureau of Fisheries steamer *Albatross* at Station 4793, Toporkov Island, Harbor of Nikol'ski, Bering Island, north 58° east, 44 miles ($54^{\circ} 48'$ north, $164^{\circ} 54'$ east), at a depth of 2,700 fathoms.

Description of immature female.—The body is oblong-ovate, 3 mm. by 8 mm., decreasing gradually in width from the anterior to the posterior extremity. (See fig. 3.)

The head is large and is surrounded anteriorly and laterally by a wide marginal border or ridge. There are no eyes. The three divisions of the body—the head, thorax, and abdomen—are well defined. The segments of the thorax are also well marked, the coxal plates occupying the lateral margins. There are six distinct segments, with six pairs of coxal plates. The first segment is coalesced with the head. The first coalesced segment bears the first pair of legs. The following five segments bear each a pair of legs, so that altogether there are six pairs of legs. The last free (sixth) segment bears a pair of modified appendages.^a

The abdomen is narrower than the thorax, and tapers to a rounded extremity. It is unsegmented and is devoid of appendages.

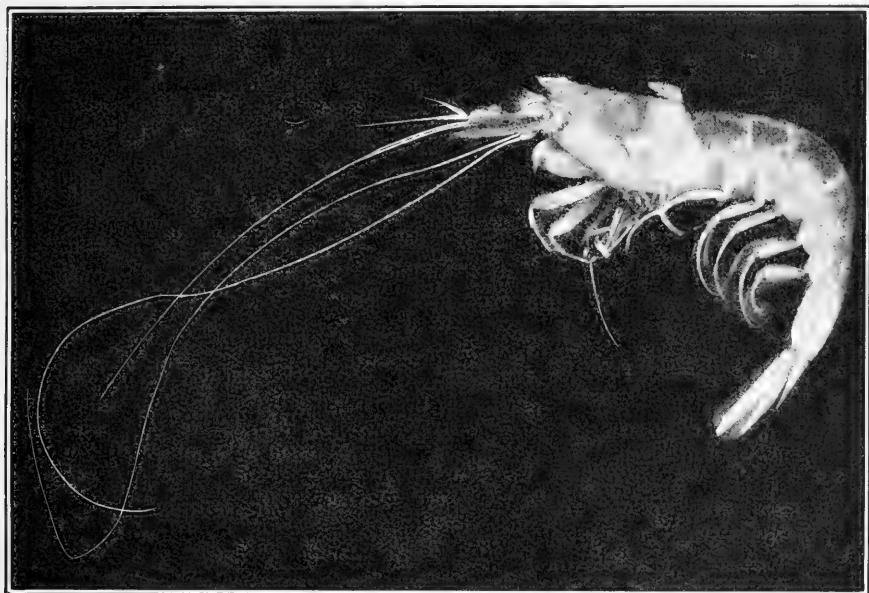


FIG. 2.—*HOLOPHRYXUS GIARDI*. IMMATURE FEMALE AND HOST.

Only one immature female was taken at Station 4793, Toporkov Island, Harbor of Nikolski, Bering Island, north 58° east, 44 miles ($54^{\circ} 48'$ north, $164^{\circ} 54'$ east), at a depth of 2,700 fathoms. It was attached to the dorsal surface of the carapace of the host, *Gennadas borealis* Rathbun, with the head directed posteriorly. The photograph (fig. 2) is of the immature female and its host.

^a They may be analogous to or homologous with the fifth pair of appendages of *Heterophryxus appendiculatus* Sars. (*Challenger* Report, XIII, 1885, Pt. 37, pp. 220–221, pl. xxxviii, figs. 8–14.) See Tattersall for description and figures of this form. (Fisheries, Ireland, Sci. Invest., 1904, II, 1905, pp. 77–78, pl. xi, figs. 1–4.) Or, this segment may be considered the first abdominal segment with its appendages.

The adult female is about four and a half times longer than the immature female. The stage represented by the immature female must be a stage younger than the one described by G. O. Sars,^a for *Dajus mysidis* Krøyer. It must be a stage intermediate between that and the cryptoniscian stage, because of the presence of the six pairs of legs. The stage represented by Sars has only five pairs of legs, as in the two succeeding stages and in the adult stage.

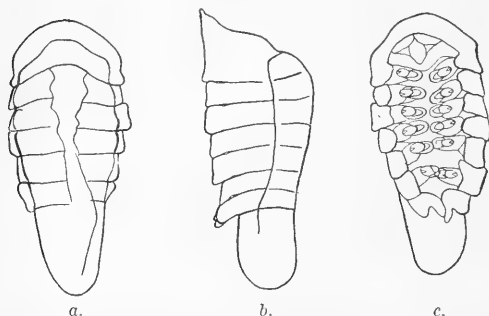


FIG. 3.—*HOLOPHRYXUS GIARDI*. IMMATURE FEMALE. a. DORSAL VIEW. b. LATERAL VIEW. c. VENTRAL VIEW. $\times 14\frac{1}{2}$.

No males were found. After the photograph was made the parasite was removed from the host for the purpose of study.

This species differs from the type species of the genus, *Holophryxus alasensis* Richardson, in the form of the body, which is more tapering, the thorax not being so greatly swollen and the abdomen not so abruptly narrower, as in

that species; in having the head surrounded by a wide marginal squarish ridge or border anteriorly and laterally; in the difference in the shape and the position of the marsupial plates; and in having the first segment of the abdomen indicated by a slight incision on either side of the terminal segment.

The species is named for Prof. Alfred Giard.

The type from Toporkov Island, Bering Island, is in the U. S. National Museum, Cat. No. 38337.

HOLOPHRYXUS CALIFORNIENSIS, new species.

Locality.—One fine specimen of this interesting species was collected in Santa Barbara Channel, California, in green mud at a depth of 280 fathoms. It is described on the label which accompanies it as a parasite, but the host is not given. Its color in life is mentioned as being canary yellow.

Another specimen comes from Station 4753 on the way from Yes Bay to Seattle at Bushby Point at a depth of 150–280 fathoms. This adult female was attached. The photograph (fig. 4) shows the parasite attached to the dorsal side of the carapace of the host, *Pasiphaea pacifica* Rathbun with the head directed posteriorly. This species is similar to the preceding species in the elongated form of the body, but differs in lacking the wide anterior ridge, and in not

^aCrustacea of Norway, II, 1899, pp. 223–224, pl. xciv, ♀ juv.²

having the first abdominal segment indicated by incisions in the lateral margins. It also has the anterior part of the body more strongly convex and not so depressed as in *H. giardi*.

One male accompanies the specimen from Santa Barbara Channel.

Description of male.—The male is about three times longer than wide, being 2 mm. in width and 6 mm. in length. The head is very

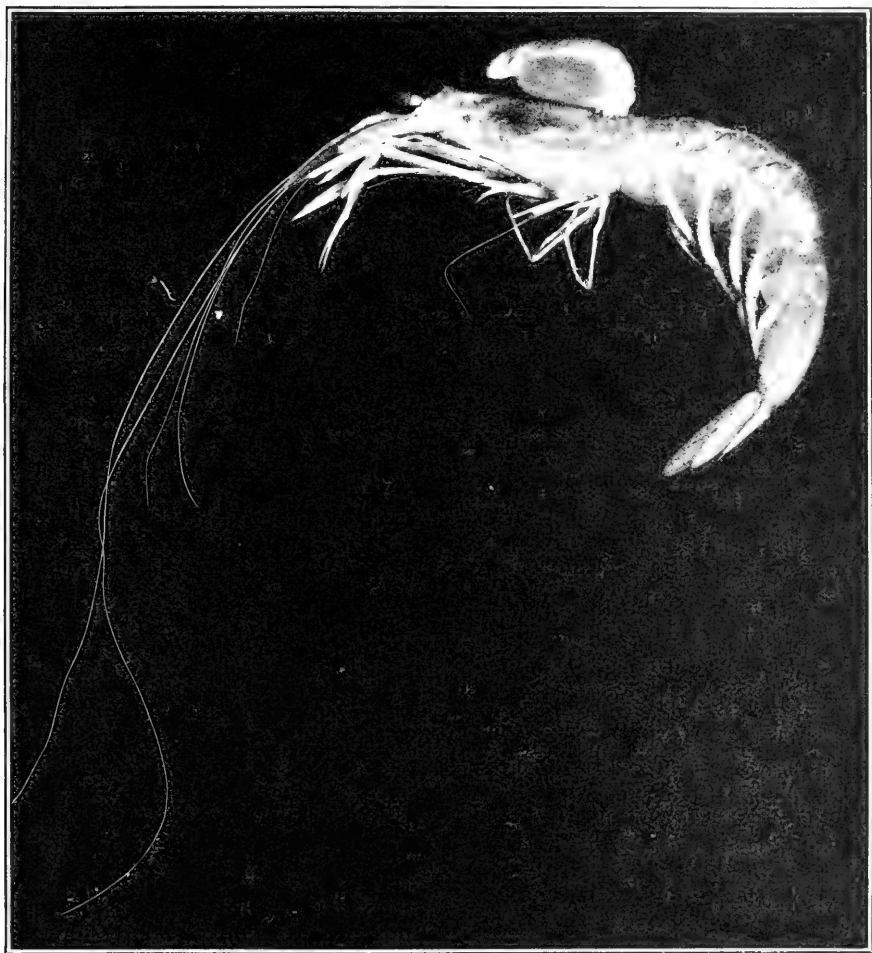


FIG. 4.—*Holophryxus californiensis*. ADULT FEMALE AND HOST.

large, rounded in front and completely fused with the first thoracic segment. There are no eyes. The first pair of antennae are small and composed of only a few articles. The second pair of antennae are rather long, extending to the posterior margin of the head, and are composed of about seven articles. The antennae are inconspicuous from a dorsal view.

The six free segments of the thorax are distinctly separated from each other, are subequal in length, and are produced at the sides in rounded lobes. The seven pairs of legs are prehensile.

The abdomen is narrow, elongate, about twice as long as wide, with all the segments completely fused. There are no uropoda and no pleopoda. (See fig. 5.)

The type from Station 4753 has Cat. No. 38527, U.S.N.M.

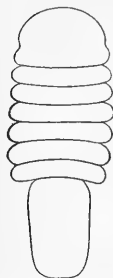


FIG. 5.—HOLOTYPE
P R Y X U S
CALIFORNIEN-
SIS. MALE.
× 20½.

The fact that these Dajidae are found parasitic on shrimps, decapodous crustacea, and not on Schizopoda, the hosts on which they have previously been found, gives additional evidence, in respect to the relation of host and parasite, showing that families founded on such a basis, as well as genera and species, cannot be maintained. Giard and Bonnier have arranged a classification of the Epicaridea whereby the families of parasites are restricted to certain orders of hosts, but Sars has already pointed out the error of such an arrangement. The evidence furnished herein proves that one family of parasite can infest two different orders of host.

ARTHROPHYXUS, new genus.

Body of adult female irregular in outline, with lateral parts expanded, and not projecting in front of the head.

Head large and well defined from the thorax.

The middle part of the dorsal surface of the thorax segmented into five rather distinct segments.

The abdomen is also distinctly segmented into five segments, the terminal one being posteriorly triangular in shape.

There are no uropoda or pleopoda.

The oral area is small, rounded, but not greatly contracted behind. The five pairs of legs are closely crowded together, and are bounded by the five pairs of coxal plates. There are five pairs of incubatory lamellæ, the last pair being the largest, the two plates meeting along the middle ventral line.

The adult male has the head large, without eyes, the thorax composed of six distinct segments, the first being fused with the head. There are seven pairs of legs. The abdomen is indistinctly segmented into about six segments, the last one of which is minute and posteriorly triangular. The body is hunched and the abdomen considerably curved under the thorax.

There are no uropoda, and the pleopoda seem to be wanting.

The type of the genus is *Arthropryxus beringanus*, the description of which follows:

ARTHROPHRYXUS BERINGANUS, new species.

The body of the adult female (fig. 6) is irregular in outline, oblong oval in shape, broadest in front, and slightly narrower behind. It is 14 mm. long and 9 mm. wide at its greatest breadth. The lateral parts of the body are expanded, but do not project beyond the head.

The head is very large, with the anterior margin irregular in outline and with a transverse fold about the middle. It is well defined from the thorax. There are no eyes.

The middle portion of the thorax is distinctly segmented into five segments.

The abdomen is distinctly segmented into five segments, the terminal one being minute and triangular in shape posteriorly.

There are no uropoda or pleopoda.

On the ventral side of the body the oral area is small, rounded, but not contracted behind. There are five pairs of legs, on the outside of which are the five pairs of coxal plates. Issuing from the bases of the five pairs of legs are the five pairs of incubatory lamellæ, partly overlapping each other, the last pair being the largest, meeting along the middle ventral line of the body.

The adult male has the head large, without eyes, the thorax divided into six distinct segments, the first being fused with the head. There are seven pairs of prehensile legs, the first pair being attached to the first segment, which is coalesced with the head. The abdomen is indistinctly divided into about six segments, the last segment being minute and triangular posteriorly. (Fig. 7.)

There are no uropoda and apparently no pleopoda. Owing to the fact that the body is hunched and the abdomen is curved under the thorax, it was difficult to place the male in a position to draw the dorsal surface.

Only the female and one male were taken at Station 4793, Toporokov Island, harbor of Nikolski, Bering Island, north 58° east, 44 miles ($54^{\circ} 48'$ north, $164^{\circ} 54'$ east), at a depth of 2,700 fathoms. It is parasitic on *Eucopia australis* Dana.

The type is in the U. S. National Museum. Cat. No. 38338.

In the segmental character of the abdomen of the male this genus is closer to *Aspidophryxus* Sars than to any other of the Dajidæ

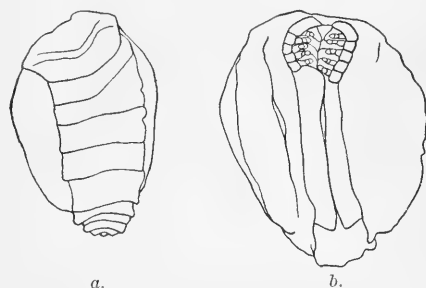


FIG. 6.—ARTHROPHRYXUS BERINGANUS. ADULT FEMALE. a. DORSAL VIEW. b. VENTRAL VIEW. $\times 6\frac{1}{2}$.

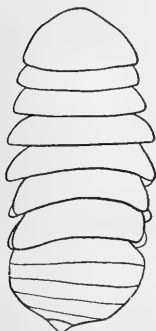


FIG. 7.—ARTHROPHRYXUS BERINGANUS. ADULT MALE. $\times 41$.

genera. The female differs from the female of *Aspidophryxus* in having the abdomen segmented, in the larger and differently shaped head, in not having the lateral parts of the thorax projecting in front of the head, and in having five pairs of incubatory plates, there being only one pair distinctly developed in *Aspidophryxus*.

Bonnier says of the male of *Prodajus lobiancoi* that the abdomen is "à peine segmenté sur les bords et terminé par une paire de longs uropodes digitiformes." Uropoda are also present in the male of *Aspidophryxus* Sars. The male of *Arthropryxus* is without uropoda.

NOTES ON THE FRESH-WATER MOLLUSK *PLANORBIS* *MAGNIFICUS* AND DESCRIPTIONS OF TWO NEW FORMS OF THE SAME GENUS FROM THE SOUTH- ERN STATES.

By PAUL BARTSCH,

Assistant Curator, Division of Mollusks, U. S. National Museum.

Early in November, 1906, the writer made a trip to Wilmington, North Carolina, in quest of that magnificent member of the genus *Planorbis*, *Planorbis (Pierosoma) magnificus*; which was described by Dr. H. A. Pilsbry in the *Nautilus*.^a

The locality cited was lower Cape Fear River. An examination of the type lot at the Philadelphia Academy of Sciences created some doubt in my mind about this being a fluviatile species. The thin texture of the large shell appeared to me as indicating evidence of a lacustrine form.

Inquiry as to the larger lakes about Wilmington resulted in the location of Greenfield Pond, about a mile and a half south of the city. This pond is formed by a broad earthen milldam, about 20 feet high, which banks up the water between sand dunes, inundating the low-lying ground, and transforming it into a lake, the digitations of which extend back for some 3 miles. Its greatest width probably does not exceed 400 feet. A large portion is fringed with cypress trees, and there are several cypress-covered islands in it. The trees are not large, hardly more than a foot in diameter, and are all draped with large festoons of Spanish moss. The water of the lake comes from springs, is unpolluted, and contains an interesting fauna and flora. Conspicuous among the plants were long strings of *Potamogeton* and several species of pond lilies, the leaves of which extend over the surface of the water. After a half hour's sifting of bottom material and vegetation, I succeeded in finding many small mollusks and the first fragment of the desired *Planorbis*. The sieve was discarded for a time and a systematic search among the heavier aquatic vegetation begun, which resulted shortly in discovering the first perfect living *magnificus*. The search continued all day, when, gathering

^a November, 1903, XVII, p. 75.

the results of my labor, I found myself the possessor of 29 fine *Planorbis*. These were carefully packed in Spanish moss to prevent injuring their delicate edges and taken to the hotel. The following day was spent in further searching, and ended by increasing the number of specimens found to 46.

Most of the specimens of *Planorbis magnificus* found were attached to the underside of the expanded leaves of the larger species of the white pond lily, probably a *Castalia*, though many were obtained from the heavy banks of *Potamogeton* growing in dense masses a short distance offshore. By pulling these masses and shaking them the mollusks were dislodged and rose to the surface for a moment before sinking to the bottom. I was able to find them only along the border of the south side of the lake, the shore line of which consists of a series of loops, and then only off the west side of the extreme points of each loop. It is quite possible that the shells live in greater numbers in deeper parts of the lake, and that they are driven inshore with dislodged vegetation by northwest winds. (See Plate LVII, figs. 7-9.)

Other lakes about Wilmington, as well as the river, were explored during my visit, but none yielded this large shell nor the new species described below, which so far confines the distribution of the two to this lake.

There are many interesting features about the very profuse molluscan life of this lake. I found among other forms a new *Liogyra* and probably also a new *Limosina*, the latter, I believe to be the most northern record for that genus. I observed also a curious habit of the white pond lily of forming a circlet of fleshy roots on the stem, about a foot below the expanded leaves. Many of these were floating free near the edge of the pond, where they undoubtedly become anchored and start a new plant by this natural slipping process.

The specimens collected were brought home alive; some were preserved in alcohol, but the greater number were placed in aquaria, where it was soon discovered that *Planorbis magnificus* had other interesting features besides being our largest form. They were entirely blind. Not one of the lot showed even the trace of an eye. Rudiments of this organ, however, may be seen in microscopic sections, where it appears as if it had been covered by the thickened cuticle.

I was anxious to note if the species would reproduce itself in captivity. Up to June 15, 1907, when I left on my vacation, this had not taken place. Large appetite, slow growth, and a great mortality sum up the events to that time. The mortality appears to have continued until only a few of the mollusks remained. When I returned to Washington in September and examined the aquaria, I found several young specimens of one and a half whorls which had been

born during my absence, and these, like well-behaved *Planorbis*, have small but well-defined eyes on the inner side, at the base of the tentacles.

Figures 7, 8, and 9 represent three views, profile, bottom and top, of the largest specimen, all natural size. This shell (Cat. No. 193321, U.S.N.M.) measures: Greatest diameter, 37 mm.; lesser diameter, 26 mm.; altitude, 25 mm., and is the largest specimen on record up to date.

PLANORBIS EUCOSMIUS, new species.

Plate LVII, figs. 1-3.

Shell resembling *Planorbis bicarinatus* Say in outline but much smaller than that species, of yellowish horn color with two rather broad, bright chestnut bands.

Shell biconcave. Entire surface marked by very strong lines of growth and numerous fine spiral lirations. Upper surface strongly umbilicated, showing a little more than three and one-half whorls. A moderately strong carina is situated about halfway between the periphery and the suture. The upper surface is marked by the two chestnut bands which are of about equal width, a little more than one-third as wide as the space between the dorsal carina and the suture. The posterior of these bands is a little nearer the suture than the carina, and the anterior one is about as far anterior to the carina as the other is posterior to it. Periphery well rounded. Base broadly umbilicated, showing a little more than three and one-half turns. Outer limiting angle of the umbilicus marked by an obtuse carina. Aperture decidedly oblique, with somewhat expanded, black edged peristome; slightly angulated at the posterior carina and more strongly so at the basal one; outer lip reenforced within by a moderately thick white callus. Parietal wall covered with a thin callus.

The type (Cat. No. 193890a, U.S.N.M.) measures: Greater diameter, 6.6 mm.; lesser diameter, 5.1 mm.; altitude, 3.1 mm.

The type and 46 specimens (Cat. No. 193890, U.S.N.M.) were collected by the author in Greenfield Pond, near Wilmington, North Carolina.

PLANORBIS EUCOSMIUS VAUGHANI, new subspecies.

Plate LVII, figs. 4-6.

Similar to *Planorbis eucosmius*, but with much narrower and deeper basal umbilicus, with the basal carina much stronger and with the last whorl considerably more expanded toward the aperture. The spiral sculpture and the lines of growth are less strongly developed than in *eucosmius*. The present form is also considerably higher than *Planorbis eucosmius*. Three specimens of this subspecies (Cat. No.

125719, U.S.N.M.), were collected by Dr. T. Wayland Vaughan, at Burkes Place, Louisiana. The type shows three and one-half whorls in the umbilicus and measures: Greater diameter, 6.7 mm.; least diameter, 5.1 mm.; altitude, 3.3 mm.

EXPLANATION OF PLATE LVII.

FIGS. 1-6 are enlarged four diameters; figs. 7-9 are natural size.

FIG. 1. *Planorbis eucosmius*, top view. Type. Page 699.

2. *Planorbis eucosmius*, bottom view. Type.

3. *Planorbis eucosmius*, profile. Type.

4. *Planorbis eucosmius vaughani*, top view. Type. Page 699.

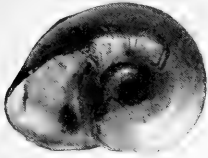
5. *Planorbis eucosmius vaughani*, bottom view. Type.

6. *Planorbis eucosmius vaughani*, profile. Type.

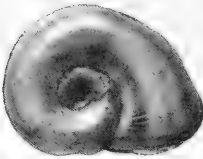
7. *Planorbis magnificus*, profile. Page 698.

8. *Planorbis magnificus*, bottom view.

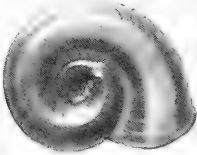
9. *Planorbis magnificus*, top view.



5.



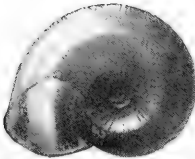
4.



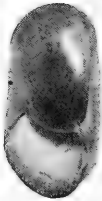
1.



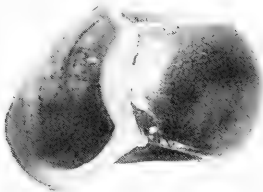
6.



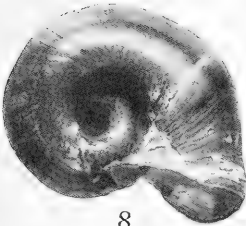
2.



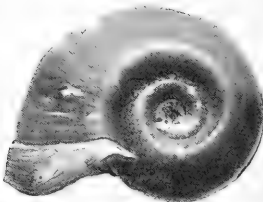
3.



7.



8.



9.

SPECIES OF PLANORBIS FROM NORTH CAROLINA AND LOUISIANA.

FOR EXPLANATION OF PLATE SEE PAGE 700.

ON CTENOLUCIUS GILL, A NEGLECTED GENUS OF CHARACIN FISHES, WITH NOTES ON THE TYPICAL SPECIES.

By BARTON A. BEAN,

Assistant Curator, Division of Fishes, U. S. National Museum.

In a footnote to his Catalogue of the fishes of the east coast of North America, Greenland to Georgia, inserted at the end of the Proceedings of the Academy of Natural Sciences of Philadelphia, XIII, for 1861 (1862), page 8, Dr. Theodore N. Gill proposed the name *Ctenolucius* for fishes closely allied to the *Xiphostomas* of Spix, but having the dorsal fin placed far back, the scales very strongly ctenoid, etc. I quote Doctor Gill's note in full:

In a species preserved in the Museum of the Smithsonian Institution, nearly allied to the *Xiphostomas* of Spix, and especially to the *Xiphostoma hujeta* of Valenciennes, the scales are covered with numerous closely approximated ridges abruptly commencing at the bases of their exposed surfaces and terminating in as many strong teeth on the posterior margin. Valenciennes has not described the structure of the scales in the species of *Xiphostoma* known to him. But he, as well as Müller and Troschel in the "Horæ Ichthyologicæ," have mentioned them as being of moderate size. The ridges and pectinated margins of those of our fish are so strongly marked that it is scarcely possible that they should have been overlooked if they occurred in the species known to the very excellent naturalists above mentioned.

The dorsal fin of our fish is more posterior than in the typical *Xiphostomas*, being above the anal; the anus is under the anterior rays of the dorsal. In this respect it resembles *Xiphostoma maculatum* and *X. hujeta* of Valenciennes.

Three specimens of the species were collected at Truando by Mr. Arthur Schott on Lieutenant Michler's expedition to the Atrato River. They will be described under the generic name of *Ctenolucius*. It must remain undecided whether the two species of *Xiphostoma* of Valenciennes, agreeing in the position of the dorsal and anal fins, are really congeneric.

In 1878, in his paper entitled *Zur Fisch-Fauna des Magdalenen-Stromes*, Dr. Franz Steindachner described a species of Characin from the Magdalena River under the generic name *Luciocharax*, with the following characterization: Form of body and snout essentially as in *Xiphostoma*. Intermaxillary and lower jaw very long, the former beset anteriorly with two rows of larger teeth. The palatine teeth numerous and very small. Dorsal and anal inserted far back-

ward. Scales of the body considerably larger than in *Xiphostoma*. Lateral line incompletely developed.

An excellent figure is given by Doctor Steindachner in the paper cited above (Plate XIII, fig. 2), and the species, which is called *insculptus*, is fully described on pages 51–53. It is very similar to *hujeta*, differing mainly in the depth of body, and may be identical with that species.

C. maculatus, another species of this group, has 88 scales in the lateral line, being intermediate in this respect between *C. hujeta* and the many-scaled species *cuvieri* and *ocellatum*, which have 105 to 106 scales.

The following genera are now included in the subfamily *Xiphostominae*:

Xiphostoma SPIX, Pisces Brasilienses, 1829, pp. 78–79. Type, *X. cuvieri*.

Ctenolucius GILL, Proc. Acad. Nat. Sci. Phila., 1861, p. 8 of appendix. Type, *C. hujeta*.

Luciocharax STEINDACHNER (a synonym of *Ctenolucius*), Zur Fisch-Fauna des Magdalenen-Stromes, 1878, pp. 51–53. Type, *L. insculptus*.

Boulengerella EIGENMANN (similar to or identical with *Ctenolucius*), Smith. Mis. Col., XLV, 1903, p. 147. Type, *Xiphostoma lateristriga* Boulenger.

Belonocharax FOWLER (a synonym of *Ctenolucius*), Proc. Acad. Nat. Sci. Phila., LVIII, Pt. 3, Oct., 1906, pp. 464–466. Type, *B. beani*.

Judging from the illustration of *Xiphostoma cuvieri*, in Spix's Pisces Brasilienses, Plate XLII, all species coming under the subfamily *Xiphostominae* probably have pectinate scales. In a recent letter, Dr. C. H. Eigenmann says that there is no doubt that the genera *Ctenolucius*, *Luciocharax*, and *Belonocharax* are identical. He examined the types of *hujeta* and *insculptus* while in Europe last summer, and has little doubt that they represent the same species.

The following notes are taken from two specimens of *Ctenolucius hujeta* preserved in the collections of the U. S. National Museum, being the examples mentioned by Doctor Gill in 1861:

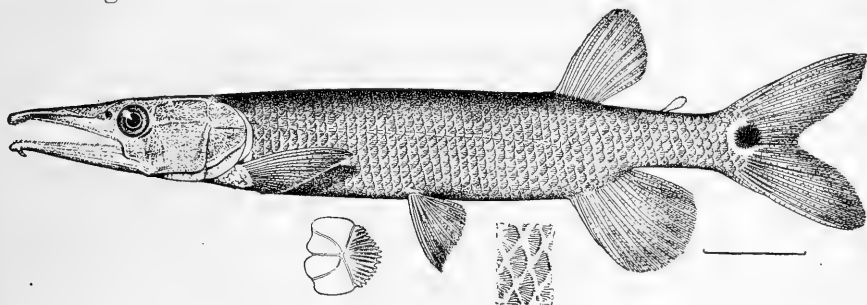
Description.—A male, 9 inches long, Cat. No. 1658, U.S.N.M., taken in the Truando River, a tributary of the Atrato River, United States of Colombia, winter of 1857 and 1858, A. Schott, collector:^a

Head 3; depth 7; eye 3 in snout, 7 in head; D. 10; A. 12 (3, 9); V. 1, 7; scales 49, 5/1/6.

Body elongate, pike-shaped, entirely covered with strongly pectinate scales; teeth of the jaws in a single series, very regular, pointed and curved backward; a few strong palatine teeth; mandibular barbels present, one on either side near tip of lower jaw; upper jaw strongly curved in anterior part and slightly projecting over the

^a Survey for Interoceanic Ship Canal via the Atrato and Truando Rivers, Dec. 1, 1857, to Mar. 23, 1858. Senate Doc. 9, 2d sess., 36th Cong., VII, Pt. 1, 1860–61.

lower jaw, the latter when closed fitting snugly into the upper; head entirely covered with flat, finely sculptured, bony processes; fins all well developed; pectorals rather less than half length of head; dorsal fin situated far back, its origin being but slightly in advance of that of the anal, the extended rays of the latter almost reaching to the caudal fin; caudal deeply emarginate; the anal fin of the male specimen much enlarged; caudal peduncle elongate, its length measured from anal fin to origin of middle caudal rays, being about equal to the length of the snout.



CTENOLUCIUS HUJETA.

Color in spirits: Upper parts rusty (brownish) with faint horizontal lines extending on the body from head to caudal; lower parts lighter, silvery; opercular flap silvery; eye dark on top, golden around the jet-black iris, pupil a rusty yellow; dorsal, anal, and caudal slightly dusky; pectorals and ventrals plain; the black ocellus at origin of caudal very conspicuous.

Another example, a female 8 inches long, from the same source as the foregoing, has slenderer jaws and a much smaller anal fin. A third example from this lot was sent years ago to the Academy of Natural Sciences of Philadelphia, where it is now preserved.

FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

By JOSEPH A. CUSHMAN,

Of the Boston Society of Natural History.

It is a well-established fact that the fauna of the eastern coast of boreal North America is very closely related to that of northern Europe in many ways. An additional evidence of this will be given here from the relationships of the minute fresh-water crustacea. Of the seven species of Cladocera, for instance, all are found in northern Europe. Certain of these are Arctic species, and in Europe are found only at higher latitudes, but that is simply an additional proof of the boreal character of our Labrador coast. As an example of this, *Eurycerus glacialis* is found only in the extreme northern border of Europe, very much farther north than the localities from which the present material came. *Macrothrix hirsuticornis* is recorded here for the first time from the Western Hemisphere. A single species of Ostracoda was obtained, but that in considerable numbers. It seems not to have been previously described, but is related to certain European species. The single species of Copepoda is also a species common to Europe and America.

The material on which the present paper is based has been presented to the U. S. National Museum. It was in six separate lots, five collected on the eastern coast of Labrador at about latitude 52° north, by Dr. Glover M. Allen. The other material was from Funk Island, a small island a considerable distance off the coast of Newfoundland and in about latitude 49° north. It was collected by Mr. Owen Bryant.

The data for these collections are as follows:

1. From St. Marys River, running into Lewis Inlet, Labrador, July 12, 1906. "Among grass with scum and Sphagnum."
2. From fresh-water pools on island, Battle Harbor, Labrador. July 14, 1906.
3. From two fresh-water pools on island, Battle Harbor, Labrador. July 14, 1906.

4. From small pond on the barren summit of Great Caribou Island, opposite Battle Harbor, Labrador. July 14, 1906.

5. From fresh-water pool, Battle Harbor, Labrador. August 1, 1906.

These five lots of material were collected by Dr. Glover M. Allen.

6. From fresh water or very slightly brackish pond, Funk Island, about 30 miles off the northern coast of Labrador. May, 1906. This last lot was collected by Mr. Owen Bryant.

Order OSTRACODA.

Family CYPRIDIDÆ.

Subfamily HERPETOCYPRIDINÆ.

Genus HERPETOCYPRIS Brady and Norman, 1889.

HERPETOCYPRIS TESTUDINARIA, new species.

Plate LVIII, figs. 1-10.

Length 2.10 mm.; height 1 mm.; breadth 0.80 mm.

Shell nearly twice as long as high, the greatest height behind the middle, the width somewhat less than the height (Plate LVIII, figs. 1 and 2). Surface of the shell with short scattered hairs (Plate LVIII, fig. 3), the anterior border minutely crenulated and thickly set with slender hairs. The lucid spots are eight in number, mostly very much longer than wide (Plate LVIII, fig. 4).

The antennula (Plate LVIII, fig. 5) has a single short spine on the second joint, two on the third joint, and on the fourth two long and two short setæ. The last three joints have each three long setæ.

The antenna (Plate LVIII, fig. 6) has the group of swimming setæ of the second joint shortened as is usual in this genus. The third joint has two setæ at the middle of the outer border and four on the opposite border. The arrangement of the other setæ is shown in the figure.

The first foot (Plate LVIII, fig. 7) has a single spine on each of the three joints above the last, that one having two spines and the long claw characteristic of this appendage.

The second foot (Plate LVIII, fig. 8) has a short last joint with a beak-shaped short claw and a single spine. The penultimate joint has a single spine at the middle. The antepenultimate joint has a single spine near the distal end and the basal joint has two spines at its distal end. The abdominal furca (Plate LVIII, fig. 9) is smooth throughout. At the base of the proximal one of the two claws is a short spine (Plate LVIII, fig. 10).

Specimens of this species were collected in May, 1906, by Mr. Bryant at Funk Island, Newfoundland.

Type.—Cat. No. 38339, U.S.N.M.

Order CLADOCERA.

Family DAPHNIDÆ.

Genus DAPHNIA O. F. Müller, 1783.

DAPHNIA PULEX (DeGeer.)

Plate LIX, figs. 1-3.

Monoculus pulex DE GEER, Memoires pour servir a l'histoire naturelle des Insectes, VII, 1778, p. 442, pl. xxvii, figs. 1-8.

Daphnia pulex BAIRD, British Entomotraca, 1850, p. 89, pl. vi, figs. 1-3; pl. ix, fig. 5.—LILLJEBORG, Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 79, pl. ix, fig. 8; pl. x, figs. 1-9; pl. xi, figs. 1-11; pl. xii, figs. 1-13.

Length of female about 3.5 mm.

The outline of the females of this and other species varies according to the condition of the ephippium. A typical outline is shown in Plate LIX, fig. 1. The shell sculpture consists of two sets of straight lines at an oblique angle, forming a network with four-sided meshes. The outline of the head, (Plate LIX, fig 2,) has the rostrum more or less acuminate, by which it differs from its close ally, *D. atkinsoni* Baird. The basal line of the post-abdomen is nearly straight, thus easily separated from *D. magna* Strauss, which is very sinuate in outline. From the two common species, *D. hyalina* Leydig and *D. longispina*, O. F. Müller, it may be distinguished by the spines at the base of the furcal claws. (Plate LIX, fig. 3.)

This species was common in the material from Labrador, being found in four of the five lots of material. St. Marys River, July 12, 1906, common. Great Caribou Island, July 14, 1906, few. Battle Harbor, July 14, 1906, few. At this last place a little later in the season, August 1, 1906, the species was abundant and the young in all stages of development were found. No males were found in any of the material. This species is widely distributed both in the Old World and in America.

Genus SIMOCEPHALUS E. Schoedler, 1838.

SIMOCEPHALUS SERRULATUS (Koch).

Plate LIX, figs. 4, 5.

Daphnia serrulata KOCH, Deutschlands Crustaceen, Myriapoden und Archiniden, 1841, Heft 35, pl. xiv.

Simocephalus serrulatus E. SCHOEDLER, Die Branchipoden der Umgegend von Berlin, Jahresbericht über die Louisenstadtische Realschule, Berlin, 1858, p. 22.—LILLJEBORG, Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 179, pl. xxvi, figs. 9-16.

Length of females about 2.5 mm.

As in *Daphnia*, this species varies greatly in outline. In the specimen of which an outline is given (Plate LIX, fig. 4), there were several eggs in the ephippial sac, causing a distention of the body at the

upper posterior angle. This species may at once be distinguished from the other two common species, *S. retulus* (O. F. Müller) and *S. expinosus* (Koch), by the head, which is decidedly angled below and has many small spines (Plate LIX, fig. 4). The sculpture of the shell consists of nearly parallel lines (Plate LIX, fig. 5), but anastomosing here and there and in certain parts of the shell making an irregular network.

This species was found in but one of the lots of material, that collected at St. Marys River, Lewis Inlet, Labrador, July 12, 1906. In this lot of material it was fairly well represented. No males were found. The distribution of this species includes Europe and both North and South America.

Family LYNCODAPHNIDÆ.

Genus OPHRYOXUS G. O. Sars, 1861.

OPHRYOXUS GRACILIS G. O. Sars.

Plate LIX, fig. 6; Plate LX, figs. 1-4.

Ofryoxus gracilis G. O. Sars, Om de i Omegnen af Christiana forekommende Cladocerer, Christiana Vidensk. Selsk. Forhdl., 1861, p. 16.

Ophryoxus gracilis G. O. Sars, Oversigt af Norges Crustaceer (Branchiopoda, Ostracoda, Cirripedia), Christiana Vidensk. Selsk. Forhdl., 1890, No. 1, p. 45.—LILLJEBORG, Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 311, pl. LI, figs. 6-11; pl. LII, figs. 1-10.

Length of females about 1.80 mm.

The outline of a female specimen of this species is shown in Plate LX, fig. 1. There is less variation in the outline of this species than in the two previously noted. The pigment fleck is small and close to the insertion of the antennula. The antennula (Plate LIX, fig. 6) is an organ of complicated structure. There is a double row of setæ along the proximal half of the inner margin, the distal portion being only slightly spinose, as is the whole of the outer margin. Very near the upper end is the sense seta, longer and somewhat stouter than the setæ of the inner margin. Close to this is a large pigment fleck which, in these specimens, seemed to be larger than those usually found in this species. At the distal end of the antennula are three lanceolate projections and several shorter, smaller ones. One point which has not been particularly noted is the peculiar median constriction in the lanceolate spines. This is shown in Plate LIX, fig. 6.

The post-abdomen (Plate LX, fig. 2) has, besides the strong terminal claws, a series of smaller projections. These are not smooth as usually shown but, as may be seen in the enlargement of the fourth projection (Plate LX, fig. 3), are fringed on the posterior border by filamentous projections decreasing in length toward the base. The various appendages have a complicated structure, as may be seen from the figure of the second foot (Plate LX, fig. 4).

This species was found in but one of the lots of material, that from St. Marys River, Labrador, July 12, 1906. But few specimens were present. The small number of specimens found is surprising, as this species is a northern one, being found in the northern part of Europe and America.

Genus *MACROTHRIX* Baird, 1843.

MACROTHRIX HIRSUTICORNIS Norman and Brady.

Plate LX, figs. 5-7; Plate LXI, fig. 1.

Macrothrix hirsuticornis NORMAN and BRADY, A Monograph of the British Entomostraca, Nat. Hist. Trans. of Northumberland and Durham, I, 1867, p. 10, pl. XXIII, figs. 6, 7.—LILLJEBORG, Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, p. 346, pl. v, figs. 6-14.

Length of females a little less than 1 mm.

The general appearance of this species is shown in Plate LX, fig 5. The pigment fleck is nearly as large as the eye and is directly below it. The antennula (Plate LX, fig. 6) is long and club-shaped with a long sensory seta near the proximal end. The anterior margin has several rows of short setæ increasing in number in the rows as the distal end is approached. The posterior margin is nearly smooth. At the distal end of the antennula are two long lanceolate projections and several shorter more slender ones.

The antenna (Plate LXI, fig. 1) has the outer two joints of each ramus with a series of short setæ. The three-jointed ramus has a long process from the basal joint with short spines instead of the ciliary setæ of the others. The post-abdomen is shown in Plate LX, fig. 7.

A few specimens of this species were found in the material from Funk Island, Newfoundland, collected by Mr. Bryant, May, 1906.

This species is widely distributed in the Old World but has not previously been reported from America. In some of its characters this approaches the more northern forms of the species.

Genus *ACANTHOLEBERIS* W. Lilljeborg, 1853.

ACANTHOLEBERIS CURVIROSTRIS (O. F. Müller).

Plate LXI, figs. 2-4.

Daphne curvirostris O. F. MÜLLER, Zoologiæ Danicæ Prodrömus, 1776, p. 200, No. 2403.

Acantholeberis curvirostris LILLJEBORG, De Crustaceis ex ordinibus tribus; Cladocera, Ostracoda, et Copepoda, in Scania occurrentibus, 1853, p. 52, pl. IV, figs. 5-7; pl. XXIII, figs. 10, 11; Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 375, pl. LVII, fig. 17; pl. LVIII, figs. 1-17.

Length of females about 1.5 mm.

The outline and general appearance of this species is shown in Plate LXI, fig. 2. The eye is large and the pigment fleck very small

and close to the point of the rostrum. The antennula (Plate LXI, fig. 3) is claviform with the anterior border set with short spines throughout its length. The sensory seta is near the proximal end. The distal end of the antennula is obliquely truncate, slightly spinose, especially on the posterior angle, and with about nine lanceolate processes of varying lengths. The antennæ (Plate LXI, fig. 4) have the margins of the joints spinose. From the basal joint of the three-jointed ramus is a long process, longer than any of the others and much stouter. The outer joint of this is armed with short, stout spines.

A few specimens of this species were found in the material from Great Caribou Island, opposite Battle Harbor, Labrador, July 14, 1906. This species is widely distributed in Europe and North America.

Family LYNCEIDÆ.

Genus EURYCERCUS Baird, 1843.

EURYCERUS GLACIALIS Lilljeborg.

Plate LXI, fig. 5; Plate LXII, figs. 1-3.

Eurycercus glacialis LILLJEBORG, Contributions to the Natural History of the Commander Islands, On the Entomostraca collected by Mr. Leonhard Stejneger, on Bering Island, 1882-83, Proc. U. S. Nat. Mus., X, 1887, p. 154; Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 393, pl. LX, fig. 11, pl. LXI, figs. 1-13.

Length of females about 4.5 mm.

This is the largest species in the collections and one of the largest of the Cladocera. The outline and general appearance is shown in Plate LXII, fig. 1. The pigment fleck is small and placed some distance back from the rostrum. The ornamentation of the shell is made up of a network of irregular polygonal meshes (Plate LXII, fig. 3). The antennula (Plate LXI, fig. 5) is broadest near the basal portion and then gradually tapers toward the outer end. It is marked by rows of fine setæ arranged in three rows as seen from one side. The distal end has a number of short spinose projections, and at the end of the antennula are inserted a number of elongated projections. The sense seta is close to the distal end of the antennula, thus differing from *E. lamellatus* (O. F. Müller), which has it at about the middle and broadest part. The post-abdomen (Plate LXII, fig. 2) is large and bordered by a row of closely set teeth. The borders of this part of the animal are much thicker and darker in color than in the common species *E. lamellatus* (O. F. Müller).

A number of specimens of this species were found by Doctor Allen at Battle Harbor, Labrador, on July 14 and August 1, 1906, and on Great Caribou Island July 14, 1906.

This species was originally described from Bering Island, one of the Commander Islands off Alaska. It has also been found in Greenland, Nova Zembla, and along the Arctic coast of northern Europe. It is clearly an Arctic species and its occurrence in southern Labrador is only an added indication of the boreal conditions there, although so much farther south than most of the previous records.

Genus CHYDORUS Leach; Baird 1843.

CHYDORUS SPHÆRICUS (O. F. Müller).

Plate LXII, fig. 4.

Lyneus sphericus O. F. MÜLLER, Entomostraca seu Insecta testacea, quæ in aquis Daniæ et Norvegiæ reperit, descripsit, et iconibus illustravit, 1785, p. 71, pl. IX, figs. 7-9.

Chydorus sphericus BAIRD, British Entomostraca, 1850, p. 126, pl. xvi, fig. 8.—LILLJEBORG, Cladocera Sueciæ, Nova Acta Reg. Soc. Sc. Upsala, 3d ser., XIX, 1900, p. 561, pl. LXXVII, figs. 8-25.

Length of females about 0.40 mm.

This small species is to be looked for in every collection of Cladocera, as it has a worldwide distribution, being found in North and South America, Europe, Africa, Asia, and Australia. It is found far inside the Arctic Circle in Spitzbergen and Nova Zembla, and in warmer regions such as Algiers and Senegal. A number of specimens were obtained at Funk Island, Newfoundland, by Mr. Bryant in May, 1906. It was not obtained at Labrador, probably because no bottom material was taken, the forms being all surviving species and taken with a net. The post-abdomen is shown in Plate LXII, fig. 4.

Order COPEPODA.

Family CALANIDÆ.

Genus DIAPTOMUS Westwood, 1836.

DIAPTOMUS EISENI Lilljeborg.

Plate LXII, figs. 5, 6.

Diaptomus eiseni LILLJEBORG, in De Guerne, J., and Richards, J.; Revision des Calanides d'eau douce, Mém. Soc. Zool. Fr., II, 1889, p. 96, pl. I, figs. 19, 20, 33.

Length of males about 3.5 mm.

The fifth feet of the male of this species are shown in Plate LXII, fig. 6, and the tip of one of the stylets in fig. 5. This is a comparatively large species and was found in considerable numbers by Doctor Allen at Battle Harbor, Labrador, July 14, 1906. The species is common to Europe and America, and is widely distributed in this country. For help in the identification of this species I am indebted to Mr. A. S. Pearse, to whom specimens were submitted.

EXPLANATION OF PLATES.

PLATE LVIII.

Herpetocypris testudinaria, new species.

- Fig. 1. Shell from side. $\times 20$.
2. Shell from below. $\times 20$.
3. Anterior border of shell. $\times 45$.
4. "Lucid spots" of shell. $\times 45$.
5. Antennula. $\times 75$.
6. Antenna. $\times 75$.
7. First foot. $\times 75$.
8. Second foot. $\times 75$.
9. Abdominal furca. $\times 75$.
10. Tip of furca. $\times 100$.

PLATE LIX.

Daphnia pulcx (De Geer).

- Fig. 1. Outline of female from side. $\times 25$.
2. Outline of head of female from side. $\times 55$.
3. Furca of female. $\times 55$.

Simocephalus serrulatus (Koch).

4. Outline of female from side. $\times 25$.
5. Shell sculpture. $\times 25$.

Ophryoxus gracilis G. O. Sars.

6. Antennula of female. $\times 125$.

PLATE LX.

Ophryoxus gracilis G. O. Sars.

- Fig. 1. Outline of female from side. $\times 25$.
2. Furca of female. $\times 125$.
3. Fourth small claw of furca. $\times 240$.
4. Second foot of female. $\times 125$.

Macrothrix hirsuticornis Norman and Brady.

5. Outline of female from side. $\times 55$.
6. Antennula of female. $\times 125$.
7. Furca of female. $\times 90$.

PLATE LXI.

Macrothrix hirsuticornis Norman and Brady.

- Fig. 1. Antennæ of female. $\times 90$.

Acantholcberis curvirostris (O. F. Müller).

2. Outline of female from side. $\times 55$.
3. Antennula of female. $\times 240$.
4. Antenna of female. $\times 55$.

Euryceerus glacialis Lilljeborg.

5. Antennula of female. $\times 125$.

PLATE LXII.

Euryceerus glacialis Lilljeborg.

- Fig. 1. Outline of female from side. $\times 20$.

2. Post abdomen of female. $\times 40$.

3. Shell sculpture. $\times 55$.

Chydorus sphaericus (O. F. Müller).

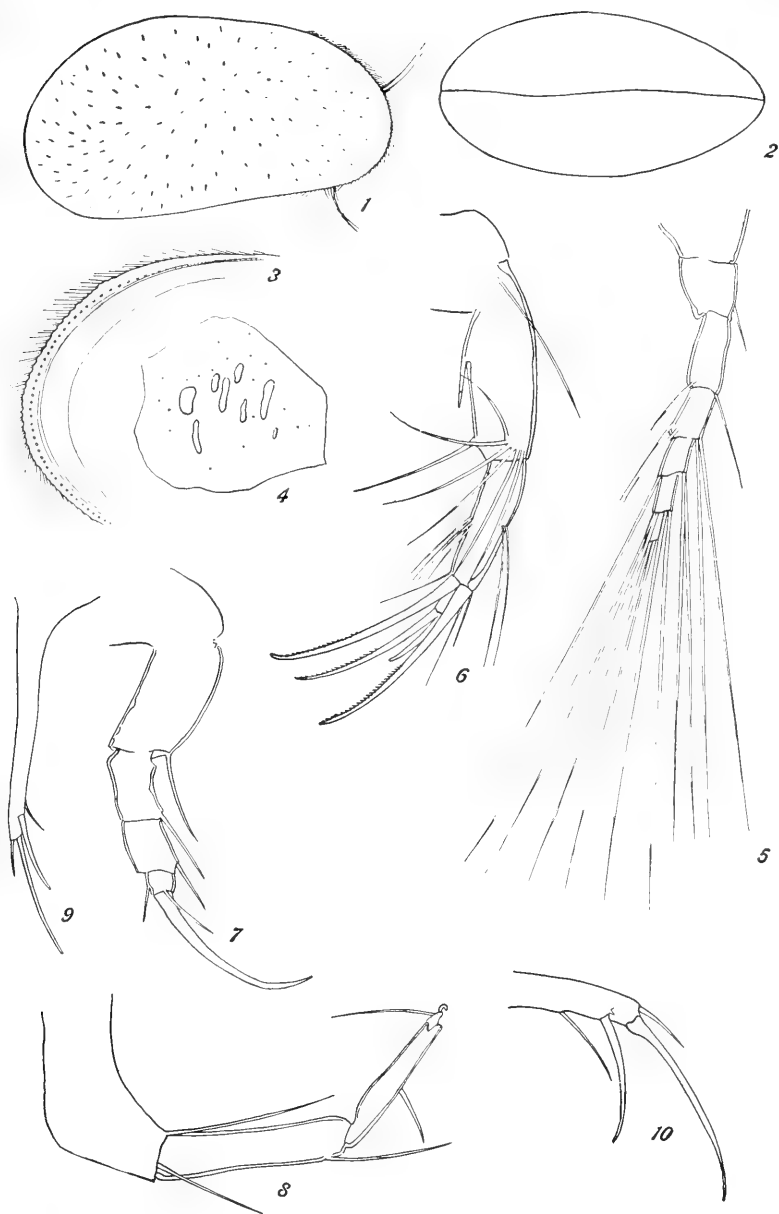
4. Furca of female. $\times 240$.

Diaptomus eiseni Lilljeborg.

5. Caudal stylet of male. $\times 55$.

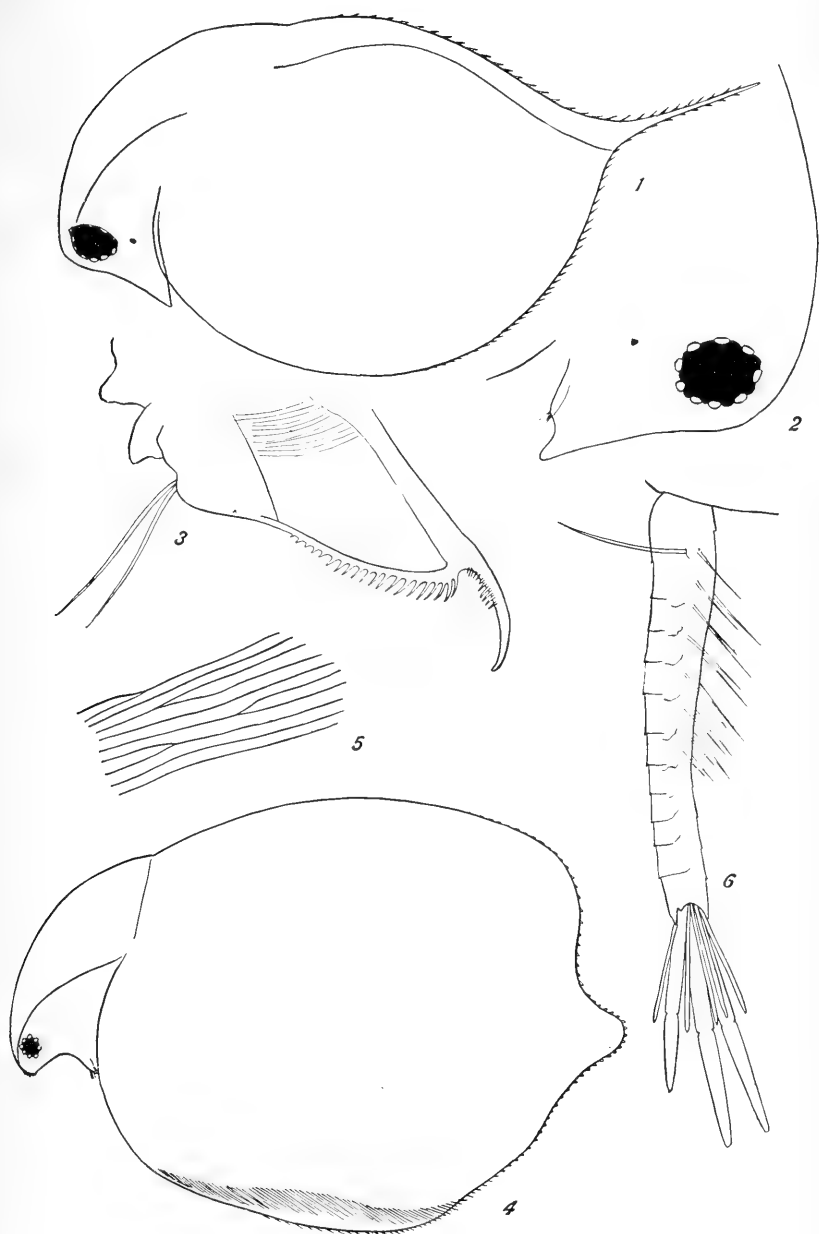
6. Fifth feet of male. $\times 55$.





FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

FOR EXPLANATION OF PLATE SEE PAGE 712.



FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

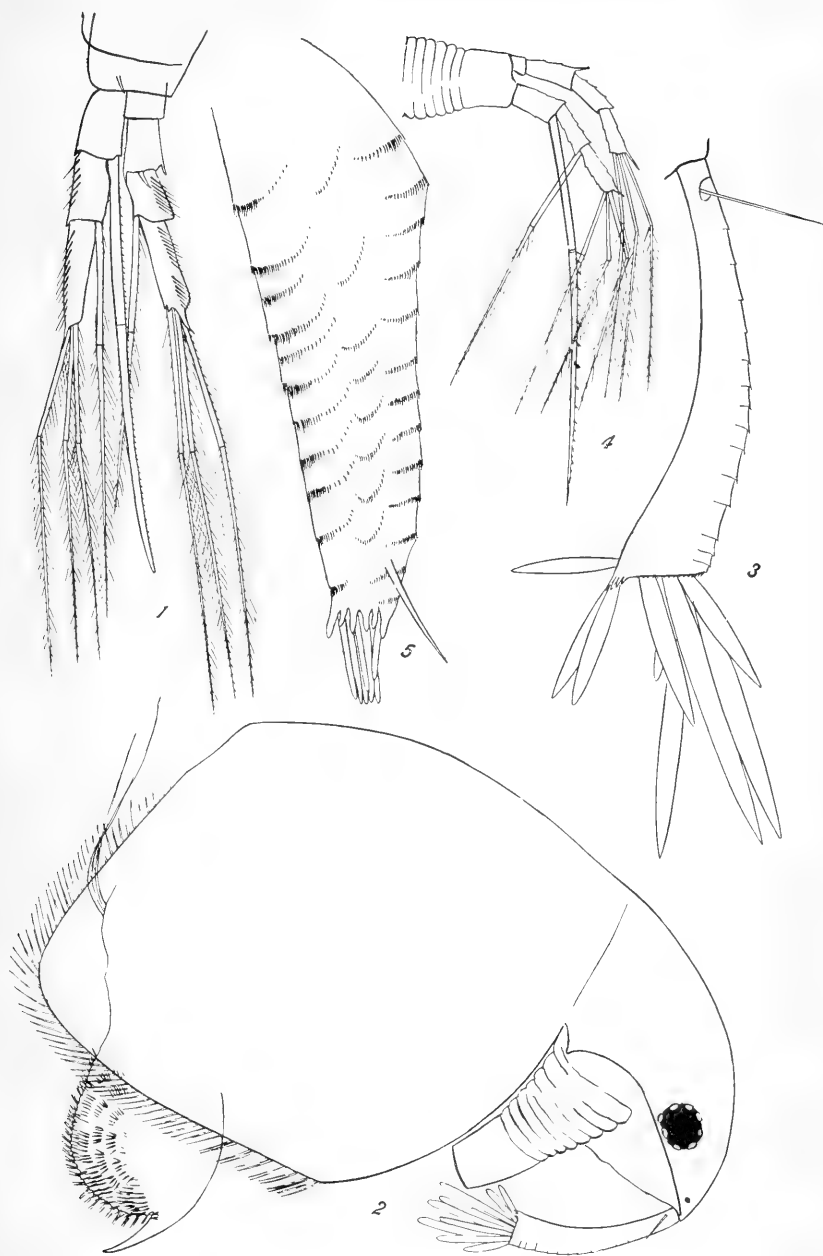
FOR EXPLANATION OF PLATE SEE PAGE 712.





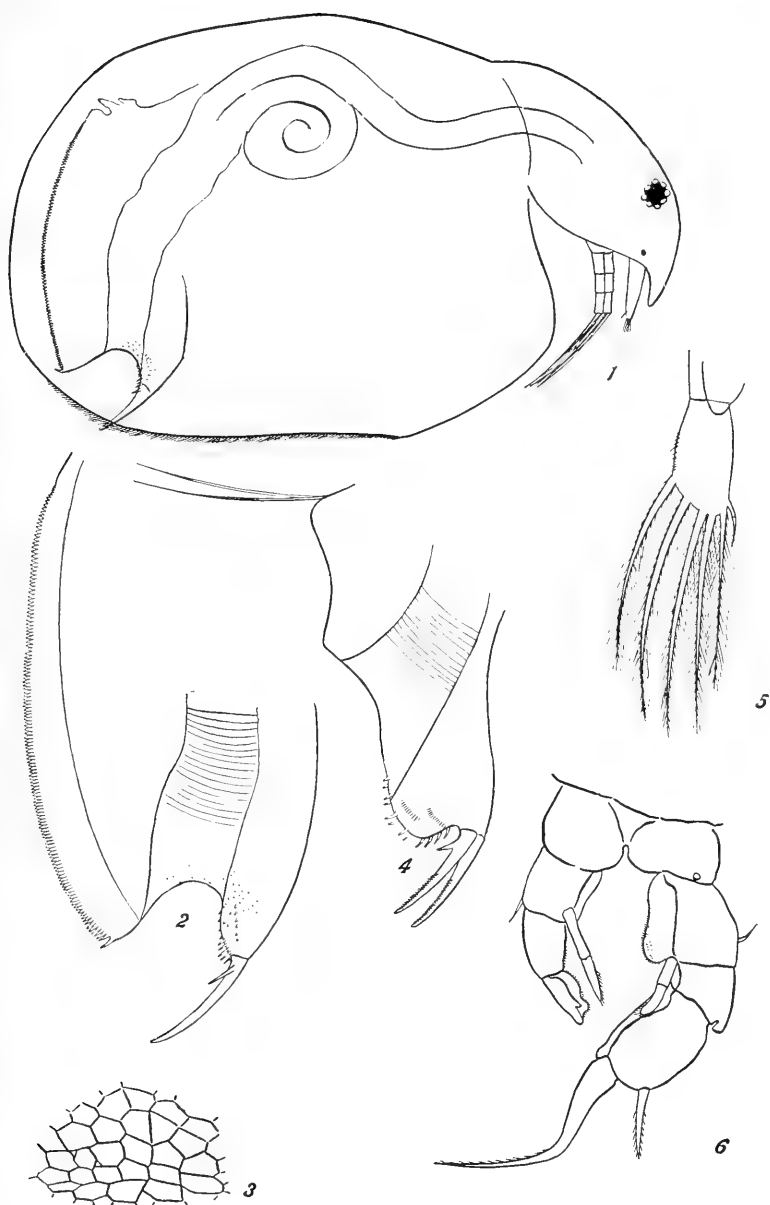
FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

FOR EXPLANATION OF PLATE SEE PAGE 712.



FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

FOR EXPLANATION OF PLATE SEE PAGES 712-713.



FRESH-WATER CRUSTACEA FROM LABRADOR AND NEWFOUNDLAND.

FOR EXPLANATION OF PLATE SEE PAGE 713.



ON A COLLECTION OF THYSANOPTEROUS INSECTS FROM BARBADOS AND ST. VINCENT ISLANDS.

By HENRY JAMES FRANKLIN,
Of the Massachusetts Agricultural College, Amherst.

Most of the specimens on which this paper is based were collected in different parts of Barbados Island during the summer of 1905 by Mr. C. C. Gowdey, a student in the Massachusetts Agricultural College. The facts concerning localities, food, plants, dates of capture, etc., were also supplied by Mr. Gowdey.

Of the eleven districts in the island, three, namely, St. Michael, St. Thomas, and St. Peters are represented, there being in all 316 specimens from Barbados, representing 9 species of which 4 appear to be new to science. Thirty-four specimens of *Heliothrips* are from the island of St. Vincent, having been collected there in March, 1905, by Mr. H. A. Ballou, Government Entomologist, British West Indies. As the Thysanoptera in this part of the world have received little attention the collection is interesting, not only on account of the new forms which it contains but also because of the added knowledge which it furnishes concerning the distribution of those already known. Two of the species more commonly found here are most closely allied with very well-known and common European forms. It may also be mentioned that *Heliothrips hæmorrhoidalis*, so abundant in a large portion of the world, is represented by numerous specimens, and three species, so far as known, restricted to the Western Hemisphere, are also present.

Family ÆOLOTHRIPIDÆ.

Of this family there is but a single immature specimen which I have been unable to determine with certainty.

Family THRIPIDÆ.

This family is represented by four species, as follows:

1. EUTHRIPS INSULARIS, new species.

Plate LXIII, figs. 1, 2, 3, 5, 6, 7; Plate LXV, figs. 19, 24.

Female.—Length, 1.43 mm. to 2.12 mm.; width of mesothorax, 0.31 mm. to 0.43 mm.; greatest width of abdomen, 0.33 mm. to 0.45 mm. General color brown.

Head from $1\frac{2}{3}$ to $1\frac{1}{2}$ times as wide as it is long; widest across the eyes, very slightly narrowed behind; square in front. Vertex slightly elevated between the bases of the antennæ. A rather conspicuous ridge runs transversely across the back of the head at some distance behind the eyes. There are, besides this, a few other similar but much less conspicuous ridges running parallel with it on the same general part of the head. Eyes large (occupying together about two-thirds the width of the head), conspicuous and with a slight tendency to protrude. Ocelli fully as large as the facets of the eye, and well separated; the two posterior ones almost touching the margins of the eyes; yellow in color and bordered with dark reddish crescents. Cheeks nearly straight, bulging but slightly. Spines between ocelli on each side long and conspicuous; postocular spines shorter but yet very prominent. Face (ventral view of head, fig. 5) with a large and conspicuous spine on each side of the middle at some distance behind the eyes also with a rather conspicuous pair, the two nearer the middle line especially so, between the eyes and placed at some distance back from the bases of the antennæ. On each side of the head, behind the eye, there is also a rather noticeable spine. On each side, in front of the anterior ocellus, there is a small but characteristic spine. There are other spines on the head, both above and below, but these are the most remarkable. Mouth cone pointed and rather slender, reaching back two-thirds across the prosternum; maxillary palpi three segmented, the basal segment being fully twice as thick as the apical one. Antennæ about as long as the head and prothorax taken together, inserted a little below the margin, their bases separated by little more than one-fourth the thickness of the basal segment; relative lengths of segments as follows:

Number of segment.....	1	2	3	4	5	6	7	8
Spaces of micrometer covering it.....	9.5	13.8	20.3	19.9	15	20	4.7	5.1

The three basal segments thickest, the first being thicker than the second and the second thicker than the third; fifth and sixth subequal. First segment rounded conical in form, somewhat thicker than long; second cup-shaped, the third and fourth fusiform. Spines on the antennæ for the most part quite strong and conspicuous, dark colored. Sense organs well developed; cones on segments three and four forked. Color of segment one and two brown; three and four yellow, four slightly tinged with brown on its apical half; five yellow at base, light grayish brown at apex; six, seven, and eight grayish brown.

Prothorax rounded, one and one-half times as broad as long; about one and one-fourth times as wide as the head; from 1.15 to 1.3 times as long as the head; bearing a pair of long stout spines at each angle of the notum; also one short anteriorly directed spine standing close to

the lower one of each anterior pair. Between the upper spines of the anterior pairs there are two much smaller ones near the anterior border of the prothorax, one on each side of the middle line. Between the two upper spines of the pairs on the posterior angles a row of shorter ones runs along the hind border; of these the second from the median line on each side is much the stoutest and longest. Color of prothorax a somewhat lighter brown than that of the head, about like that of the pterothorax and abdomen. Mesothorax about one and one-half times as wide as the prothorax; mesonotal plate with one strong and conspicuous spine on each lateral angle and with one median and two lateral spines on each side near the posterior margin. Mesosternum with one long conspicuous spine on each side, placed near the lateral angle. Metathorax tapering slightly but distinctly posteriorly, distinctly narrower than mesothorax; width at posterior end only about four-fifths the greatest width of the mesothorax. Endothoracic invagination of metathorax Y shaped. Metasternum with a long conspicuous spine somewhat behind the middle on each side. Metanotal plate bearing four spines at the anterior edge, the middle pair being very much more stout and conspicuous.

Wings about reaching the anterior margin of the seventh abdominal segment; breadth at middle about one-twelfth their length; somewhat shaded with brown except the basal fourth which is clear; scale often shaded somewhat as well as the costa at the base; fringes of both the fore and hind wings rather strongly stained with brown. Each fore wing has two longitudinal veins extending from base to tip which bear spines at regular intervals as follows: Costa 22 to 28; fore vein 20 to 23; hind vein 15 to 18; scale 5, besides a pair at the tip; a light sparse fringe on costal border of each wing; posterior fringes long, heavy, and with the individual hairs quite crinkly in the middle. Wings bearing, besides the spines and fringes, numerous minute spines arranged in rows which run lengthwise of the wing. General surface of the legs with a considerable number of spines; each tibia with a pair at its extremity; posterior tibiae each with a conspicuous longitudinal comb-like row of seven or eight rather stout spines on the inner side; posterior tarsi with the basal segment of each bearing several spines at its distal end. Coxae and femora brown, sometimes very light, the anterior pair tipped slightly with yellow. Fore tibiae yellow, middle and hind tibiae deep brown, sometimes slightly tipped with light yellow; all the tarsi light yellow, with a small but conspicuous dark spot on their inner sides toward their tips.

Abdomen elongate ovate in general outline, at base only about three-fourths as wide as the metathorax, widest at fifth and sixth segments, pointed at apex, two and one-half to three times as long as broad, brown and with brown spines, those toward the tip being long

and heavy, tenth segment with apical three-fourths split above. Each ventral abdominal plate in front of the base of the ovipositor, except segments one and two, with a transverse row of six prominent spines on the posterior border, three on each side of the middle line. Posterior border of the eighth dorsal plate denticulate. Ventral pleural plates strongly denticulate behind. Each dorsal pleural plate with a strong spine on its lower posterior corner.

Type.—Cat. No. 11360, U.S.N.M.

Described from fifteen females (cotypes), of which six (one slide) are deposited in the collection of the United States National Museum and the remaining nine (three slides) in the collection of the Massachusetts Agricultural College. There are also numerous paratypes in the collection of the latter institution.

Male.—Length, 0.96 mm. to 1.5 mm.; width of head, 0.17 mm. to 0.22 mm.; width of prothorax, 0.18 mm. to 0.28 mm.; width of mesothorax, 0.23 mm. to 0.38 mm.; greatest width of abdomen, 0.21 mm. to 0.32 mm. Color gray-brown to brown, generally lighter than the female; head and apical segments of the abdomen the darkest portions; pterothorax generally lightest. Antennæ about two and one-third times as long as the head; relative lengths of segments as follows:

1	2	3	4	5	6	7	8
$\frac{1}{7.8}$	$\frac{2}{9.8}$	$\frac{3}{15.2}$	$\frac{4}{15.2}$	$\frac{5}{11.4}$	$\frac{6}{14.4}$	$\frac{7}{3.1}$	$\frac{8}{3.8}$

Wings reaching but little beyond the anterior border of the seventh abdominal segment.

The third to seventh, inclusive, ventral abdominal plates each with a transverse sole-shaped marking in the middle, this marking being about one-half as long as the plate is wide. Abdomen widest at the fourth segment. Anterior femora thickened, about two-fifths as wide as the head, proportionally thicker than in the female. On the middle of each side and on each posterior angle of the ninth abdominal segment is a very large strong spine, and a similar one is present on each posterior dorsal angle of the tenth segment. All these spines, as well as most of the others of any prominence on the apical segments, are dark colored.

Described from thirteen specimens (cotypes) of which four (two slides—one of these being the slide which has the female type specimens) are deposited in the collection of the United States National Museum and the remaining nine (five slides) in the collection of the Massachusetts Agricultural College.

Food plants.—Black willow, *Bonaviste* (a legume), eddoe (a variety of yam), bean, roses (several varieties), guinea grass, potato, papaw, pepper, tobacco, white wood, *Cordia* (red), woolly pyrol, *Convolvulus*, ground nut, arrow root, yam, flamboyant. Usually found on flowers and in colonies.

Specimens taken at Glendor, St. Michael; Newstead, St. Peters; Cane Garden, St. Thomas; Spring, St. Thomas; St. Anns, St. Michael; Belle, St. Michael; Bellevue, St. Michael; Walmoral Lodge, St. Michael. Dates of capture range from July 20 to September 5.

This species is most closely allied to the European *Euthrips vulgarissimus* (Haliday). It may, however, be separated from that species by the presence of postocular bristles and by the color of the males. This appears to be the most common species in Barbados, as it is represented in the collection by 135 females and 47 males.

An unusual deformity is the double front ocellus seen in one of the males.

2. EUTHRIPS TRITICI (Fitch).

Of this species there are 64 females and 20 males in the collection. It seems to be the second most abundant species in the island. In Barbados this insect was taken on the following new food plants: Black willow, tomato, frangipani, papaw, watermelon, cotton, horse-radish tree, *Hibiscus*, *Crotolaria*, white wood, bean, *Ipomea*, Bermuda lilies, and eddoe (a variety of yam).

Specimens taken at St. Anns, Belle, Glendor, Bellevue, Waterford, Pine Estate, and Walmoral Lodge, St. Michael; Cane Garden and Spring, St. Thomas; Newstead, St. Peters. On flowers and leaves, often in colonies. Dates of capture ranging from July 12 to August 22.

3. HELIOTHRIPS HÆMORRHOIDALIS (Bouché).

This species is represented by 27 females and several larval specimens. A common greenhouse pest in Europe and the United States, and in those parts of the world confined almost entirely to greenhouses. This species is found in the open in St. Vincent and Barbados. It is evidently a tropical species. Some of its food plants in St. Vincent are cacao, and kola, and in Barbados it is found on date palms.

Specimens taken on St. Vincent and at Glendor, St. Michael, Barbados. Insects found in colonies on leaves and flowers.

The larvæ of this species, at least as they approach maturity, are yellow in color and have the abdomen for the most part covered over with small, wart-like elevations. Most of the hairs on the body, except at the tip of the abdomen, are knobbed. The apical abdominal segments are somewhat tubular, and thus present an appearance similar to that seen in the Phlæathripidae. These apical segments are usually slightly stained on the sides with brown.

4. HELIOTHRIPS RUBROCINCTUS (Giard).

Plate LXIV, figs. 10, 14; Plate LXV, figs. 17, 20, 21.

Female.—Length, 0.92 mm. to 1.42 mm.; width of head, 0.16 mm. to 0.23 mm.; width of prothorax, 0.20 mm. to 0.25 mm.; width of

mesothorax, 0.31 mm. to 0.36 mm.; greatest width of abdomen, 0.38 mm. to 0.41 mm. Color of head and thorax rather light brown, abdomen usually very dark brown, in some specimens almost black, at tip much lighter. Entire body, together with the legs, showing reticulating chitinous thickenings over a good share of its surface. These are heaviest on the head, the sides of the pterothorax, the sides of the dorsum of the abdomen, and on the femora. Head fully one and one-half times as wide as long, outline very irregular and rough; cheeks rather bulging behind the eyes, slightly notched a little behind the middle. Eyes protruding somewhat, the two together occupying nearly one-half the width of the head. Ocelli large and yellow in color, the posterior pair widely separated from the borders of the eyes; all margined inwardly by dark reddish crescentric pigmentation. Dorsal surface of head with a rather strong conspicuous spine in front of each posterior ocellus; there are three other less conspicuous spines on each side of the dorsal surface behind the eyes, and the extreme sides of the head bear still others. Dorsal surface of head strongly reticulated except toward the posterior margin. Frons not reticulated; bearing a considerable number of rather conspicuous spines; in front there is a single spine on each side not far from the base of the antenna; on each side, almost straight behind these, there is a single similar one not quite back to the middle of the eye; behind these, on each side close to the margin of the eye, there are two similar spines; several others like these are present toward the posterior margin of the frons. Mouth cone not reticulated, pointed, but with broadly rounded labium, reaching to the anterior border of the mesosternum. Maxillary palpi two segmented, the second segment nearly twice as long as the first. Antennæ about two and one-fifth times as long as the head, their bases separated by about twice the thickness of the basal segment. Relative lengths of segments as follows:

1	2	3	4	5	6	7	8
5.7	11	14	17.8	10.8	7.3	3.3	7.5

Segment one short cylindrical; two much the thickest, reticulated and constricted at the base; three and four modioliform; five narrow at base but broad at distal end where it is quite squarely cut off; six abruptly constricted at base, narrowest at distal end; seven considerably thicker at base than at apex; eight slender and tapering gradually to apex, where it bears a single very long slender bristle. Segments one and two brown; three light translucent, slightly tinged with grayish brown on the distal half; four light translucent, slightly tinged with grayish brown about the middle; basal half of five light translucent, shading into brown on distal half; six brown; seven and eight light grayish brown.

Spines on the six basal segments for the most part very long, dark colored and conspicuous; those on the third, fourth, and fifth segments especially so; the conspicuous spines on these three segments arise from somewhere near around the middle of the segments. The third and fourth segments each bear prominent and well-developed forked sense cones.

Prothorax transverse, only about two-thirds as long as the head but from two to two and two-thirds times as wide as it is long; rounded at the angles; rather suddenly constricted in front; surface finely cross striated; on the extreme sides of the anterior margin there is a single noticeable rather short curved spine on each side; also near this margin, on each side of the dorsum, there is a single noticeable spine at some little distance from the middle line; near each posterior angle there is another similar spine, and near the hind margin on each side of the middle line there is still another. Mesothorax strongly reticulated on the sides; mesoscutum with a pair of noticeable spines on each side, placed toward the extreme sides, the hinder one of each pair being somewhat the smaller; on each side of and at some distance from the middle there is another pair of spines, the hinder spine of each pair being stronger than the anterior one and placed at a greater distance from the middle line. Surface of mesoscutum finely cross striate like the pronotum; mesosternum not reticulated except on its extreme sides; metathorax slightly narrower than mesothorax; metascutum strongly reticulated with a small but noticeable spine on each side almost on the anterior margin and not very far from the angles; there is also a pair of very conspicuous spines, one on each side, at about the middle of the median triangular portion. Sides of metathorax strongly reticulated; metasternum not reticulated except on extreme sides. Endothoracic invaginations of metathorax extending forward slightly into the mesothorax. Fore wings uniform brown in color, reaching to or beyond the end of the abdomen; rather slender (about thirteen times as long as they are wide in the middle) but apparently quite powerful; hind fringes very long, more than one-half as long as the wings themselves, concolorous with the wings as are also the scales.

Spines on veins long and stout, dark colored and set at uniform distances except toward the tip of the wing where they are less regular and farther apart; the costa bears thirteen or fourteen, fore vein ten to twelve, hind vein ten or eleven, scale three or four besides a pair at its tip. Anterior fringe of fore wings of strong but not very long hairs, concolorous with the spines on the veins, much darker brown than the wings themselves. Hind wings with their outer halves strongly tinged with brown but with their basal halves light and clear; with a very noticeable vein of a darker color than the remainder of the wing running down the middle of each; both fore

and hind fringes very strong, concolorous with the hind fringes of the fore wings. Legs rather short and thick, the fore pair shortest and hind pair longest. Coxæ and femora brown; tibiæ brown at base but shading out more or less to very light translucent yellow at distal ends; posterior tibia armed with a pair of stout spines at the tip; tarsi all light colored; coxæ, femora, and tibiæ all reticulated, the femora very strongly so, and bearing strong spines.

Abdomen rather elongate-ovate, pointed at tip; reticulated but little on the middle of the dorsal segments but very strongly so on the sides and on the pleural plates; ventral surface not reticulated. Across each of the second to eighth dorsal plates, inclusive, somewhat back from its anterior margin, runs a very noticeable irregular thickening. On the hinder margin of the eighth dorsal plate is a transverse row of long comb-like teeth, which, on account of their color, are very inconspicuous and can only be seen with difficulty even with the high powers of the microscope. On each side of each of the second to eighth ventral plates inclusive are three very noticeable spines, placed at about the middle of the segment. There are conspicuous spines on nearly all the dorsal segments; those on segment ten being for the most part small and weak; while those near the posterior dorsal margin of segment nine are very large and strong. The areas on the dorsal plates, which are not reticulated, bear numerous minute spines. Abdomen much darker colored than head or thorax, usually with the tip much lighter, the apical segment being about as light as the thorax. In many specimens a band of bright red hypodermal pigmentation is to be seen in segments one, two, and three of the abdomen; in nearly all specimens a small patch of similar pigment is noticeable at the tip of segment ten and usually protruding somewhat from it. Redescribed from seven specimens. I have redescribed this sex as Giard's description does not seem to be sufficiently complete.

Male.—Length, 1.07 mm.; width of head, 0.18 mm.; width of prothorax, 0.17 mm.; width of mesothorax, 0.28 mm.; width of metathorax, 0.25 mm.; greatest width of abdomen, 0.24 mm. General color much like that of female. Relative lengths of antennal segments:

$$\begin{array}{cccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ \hline 5 & 10 & 13 & 15.5 & 8.5 & 7 & 4 & 9 \end{array}$$

Wings relatively shorter than in the female, not reaching the end of the abdomen. Abdomen blunt at the end, with two pairs of very large and characteristic dark-colored spines on the posterior part of the dorsum of the ninth segment, the smaller of these two is situated immediately behind the larger and the spines of both pairs are close together, one on each side of the middle line of the abdomen.

On each of the third to seventh ventral abdominal plates, inclusive, there is a single round very noticeable median spot or marking of a slightly lighter color than that of the surrounding integument located near the anterior margin of the segment. The abdomen is constricted slightly and broadly in front of the ninth segment. The reticulated areas on the abdomen have about the same arrangement as in the female.

Described from a single specimen (presumably the type of this sex, as Giard appears to have described only the female) deposited in the collection of the Massachusetts Agricultural College.

Specimens taken on St. Vincent Island, British West Indies, on cacao and kola. Found in colonies on leaves and flowers.

Larva.—At least in their later stages the larvæ are bright yellow with a wide bright red hypodermal pigment band running across the base of the abdomen on the upperside and with the abdomen tipped with bright red on account of the hypodermal pigment. The posterior corners of some of the intervening segments are also often touched slightly with red. Head also usually irregularly mottled more or less, especially about the eyes with reddish or orange pigment.

Mature nymph.—Length, about 0.92 mm.; width of thorax, about 0.27 mm.; greatest width of abdomen, about 0.37 mm. Colored in general like the adult insect but lighter as a rule, especially the abdomen; the band of red pigment at the base of the abdomen is quite noticeable. Shape more chunky than that of the adult, the segments of the body being drawn closely together. Wings rather darker than in adult. Red pigment at apex of abdomen conspicuous. The wing pads reach to about the seventh segment.

This species was originally described by Giard as *Physopus rubrocincta*, but its structure places it very clearly in the genus *Heliothrips*. It is a great pest on cacao in the West Indies, having been reported from Grenada, St. Lucia, Dominica, and Guadeloupe. It is said to have the cashew tree, the guava, and the Liberian coffee among its food plants. While apparently closely allied it does not seem to be the same species of Thrips, which has been reported as injurious to cacao in Ceylon. The following references concerning this insect are important:

1. Giard, A., Bull. Soc. de France, 1901, pp. 263–265. (Original description.)
2. West Indian Bulletin, II, 1901, pp. 175–180. (Figs. 1, 2.) (Treatment discussed.)
3. West Indian Bulletin, II, 1901, pp. 288–289.
4. Ballou, H. A., West Indian Bulletin, VI, 1906, pp. 94–97.
5. Elot, A., Compt. Rend. Soc. Biol. Paris, LIX, pp. 100–102.

Family PHOEOTHIRIPIDÆ.

Five species represent this family, as follows:

1. ANTHOTHRIPS GOWDEYI, new species.

Plate LXIII, fig. 8; Plate LXIV, figs. 15, 16; Plate LXV, fig. 23.

Female.—Length, 1.01 mm. to 1.73 mm.; width of head, 0.14 mm. to 0.20 mm.; width of mesothorax, 0.21 mm. to 0.33 mm.; greatest width of abdomen, 0.21 mm. to 0.35 mm. General color deep brown, appearing irregularly mottled more or less with dark reddish or purple hypodermal pigmentation, especially the thorax.

Head of about equal length and breadth, yet often somewhat wider behind than in front; cheeks straight or very slightly bulging behind the eyes. Vertex somewhat elevated between the bases of the antennæ. Dorsal surface finely cross striated. Eyes small, finely faceted; ocelli quite large, much larger than the facets of the eyes, and well separated, bordered medially by dark red pigment crescents; anterior ocellus placed far forward, almost touching the bases of the antennæ; posterior ocelli touching margins of eyes. Post-ocular bristles long and knobbed at the end. Mouth cone reaching to the middle of the prosternum, pointed, but with bluntly rounded labium. Antennæ about one and one-half times as long as the head, with bases set very closely together. Relative lengths of segments as follows:

1	2	3	4	5	6	7	8
6.8	9.8	10.8	12.2	11.8	9.3	8.9	6.4

Most of the segments quite thick for their length, the fourth being slightly thicker than any of the others, the third next thickest. Segment one truncate, conical; two constricted toward the base into a broad stalk, cut off squarely at end; three slenderly stalked at base, rather broadly rounded; four elliptical in general form, constricted at base to form a broad stalk; five and six oval in outline and also constricted at bases to form stalks; seven barrel-shaped; eight conical. Segments one and two deep brown; three and four yellow; five yellow but slightly tinged with brownish on distal half; six light brownish yellow; lighter at base; seven and eight deep brown, concolorous with the two basal segments. Spines weak; sense cones short, but mostly rather sharp pointed.

Prothorax subequal in length with the head; broader behind than in front; fore and hind margins nearly parallel, gently curved; pronotum bears on each side of its front part a pair of spines; of its middle portion, a single spine; of its hind portion, a pair of spines; all these are conspicuous and knobbed. Mesothorax somewhat wider than prothorax; sides of pterothorax nearly straight, but metathorax

narrowing slightly posteriorly; fully as wide as it is long. Legs rather long and slender; fore femora only slightly thickened; fore tarsi one segmented and armed with a tiny tooth within. All the coxæ and femora and the middle and hind tibiæ and tarsi are brown in color, the tarsi being, however, somewhat lighter than the other segments; anterior tibiæ brown at base but shading to yellow at apex; fore tarsi yellow but with a dark colored spot on the inside of the apical portion. Near the base of each posterior and middle femur below and of each anterior femur in front is a single long slender spine. Wings present, narrowed in middle, transparent; the fore pair slightly stained with brownish or yellowish at the base, where they bear three long, knobbed spines on the remnant of the single median vein. Scale light brown. Fringes long, single, except near end of hind fringe of fore wing where it is double for five or six hairs. The front fringes of the fore wings are if anything longer than their hind fringes, and the hind fringes of the hind wings are longer than their front fringes.

Abdomen at base slightly wider than the pterothorax to which it is broadly joined, widest at base, tapering gradually to the tube. Tube about two-thirds as long as the head, tapering slightly; somewhat more than one-half as wide at the apex as it is at the base; on the ventral side of the abdomen a strong chitinous rod runs forward a short distance from the base of the tube; some of the hairs at the end of the tube as long or longer than the tube itself. Spines on abdomen, for most part, slender, rather faint and inconspicuous, not knobbed; abdomen as a rule lighter brown in color than the rest of the body.

Type.—Cat. No. 11361, U.S.N.M.

Described from 21 females (cotypes), of which 10 (three slides) are deposited in the collection of the United States National Museum and 11 (three slides), besides numerous paratypes, in that of the Massachusetts Agricultural College. Of this species there were 31 specimens in all in the collection, all females. Male unknown.

Food plants.—*Euphorbia*, date palm, *Crotolaria*, morning glory. Usually on flowers, often in colonies.

Specimens taken at Glendor, Belle, and Bellevue, St. Michael, and Cane Garden, St. Thomas, Barbados. Dates of capture ranging from July 21 to August 24. This species appears to have its closest ally in *A. aculeata* (Fabricius) of Europe.

2. TRICHOTHRIPS NIGER, new species.

Plate LXIII, figs. 4, 9; Plate LXIV, fig. 11; Plate LXV, figs. 18, 22.

Female.—Length, 2.19 mm.; width of head, about 0.27 mm.; width of mesothorax, about 0.47 mm.; greatest width of abdomen,

about 0.60 mm.; width of tube at anterior end, about 0.098 mm., at posterior end, about 0.047 mm. General color dark brown; abdomen, except toward base and at tip of tube, black.

Head between one and one-fifth and one and one-sixth times as long as it is wide; somewhat widest just behind the eyes, nearly as wide at the posterior end, squarish in front; cheeks nearly straight, slightly bulging, set with scattered small, stout spines borne upon small warts; frons slightly elevated between the bases of the antennæ; post-ocular bristles present and of good length, acute. Eyes small, finely faceted, not pilose, rounded, black by transmitted but dark red by reflected light; ocelli present, well separated, placed far forward on the head, distinctly larger than the facets of the eyes. Mouth cone reaching nearly to the posterior edge of the prosternum; labium broadly rounded at the end; maxillary palpi two segmented, the basal segment very short and rounded. Antennæ eight segmented, with joints all distinct; nearly one and three-fourths times as long as the head. Relative lengths of segments as follows:

$$\frac{1}{10} \quad \frac{2}{14} \quad \frac{3}{24.2} \quad \frac{4}{24.9} \quad \frac{5}{22} \quad \frac{6}{16.3} \quad \frac{7}{11.4} \quad \frac{8}{9}$$

Segment one cylindrical, truncate; two constricted toward base into a broad stalk, cut off squarely at end; three to six clavate; seven cylindrical ovate; eight conical. Color of one and two brown, the latter lighter toward the apex; three yellow; four yellowish brown at base, shading into darker brown toward the apex; five brown, lightest at base; six, seven, and eight very dark brown. Sense cones fairly long; spines, for most part slender and weak.

Prothorax about three-fifths as long as the head; fore coxæ projecting considerably beyond posterior angles and forming what appear to be the prominent sides of the prothorax. On account of the dark color of the type specimen it is difficult to make out exactly where the prominent spines are placed on the pronotum, but it is certain that there is one on each side, somewhat removed from the middle line, close to the anterior margin; there is also a very prominent one on each posterior angle; somewhat in front of the hind margin, about half way from the corner to the middle line on each side is still another; yet another is situated on each side somewhat in front of the middle and well toward the side margin; almost directly in front of this, on each side somewhat back from the front margin, another is noticeable. Mesothorax distinctly wider than the prothorax. Pterothorax concolorous with the prothorax, somewhat lighter than the head. Mesoscutum, metascutum, metascutellum, and pleuræ somewhat reticulated. Legs rather long and slender, the middle pair much the smaller; each fore coxa bears a single long and rather stout spine on its outer side; fore femora rather strongly en-

larged; each fore and middle femur bears a single very long erect and slender spine in front near its base; each hind and middle tibia bears a similar long, slender, erect spine on its outer side toward its apex; each fore tibia bears two or three such spines, similarly located; fore tarsi armed with a strong tooth. All the coxæ and femora and the middle and hind tibiæ deep brown in color; posterior tarsi lighter brown than tibiæ; middle tarsi light yellowish brown; fore tibiæ light brown at base and quickly shading out into yellow; fore tarsi yellow with a noticeable dark spot on the inside of the apical portion; middle tarsi with a similar dark spot on the inside of the apical portion. Wings with their fringes not reaching the base of the tube; fringes long and heavy, rather dark brown in color, double for several hairs on hind border of fore wing near the tip. Wings clear transparent.

Abdomen broad and heavy, elongate ovate in outline, considerably wider at the middle than at the base, widest at the fourth segment; segments telescoped about two-fifths. Tube nearly as long as the head, some of the terminal spines nearly as long as the tube. Spines on apical segments as a whole long, rather slender, yellowish. The sides of the tube bear at intervals rather minute but conspicuous dark-colored spines.

Described from one female (the type) deposited in the collection of the Massachusetts Agricultural College.

Male unknown.

Specimen taken at Newstead, St. Peters, Barbados, on flower of La France rose, July 31.

3. CEPHALOTHRIPS YUCCÆ Hinds.

This species has heretofore been reported only from Amherst, Massachusetts, and Washington, District of Columbia. There are two specimens in the collection from Barbados collected July 10 on flowers of *Hibiscus* at Pine Estate, St. Michael.

4. CRYPTOTHRIPS ASPERSUS Hinds.

This has, up to this time, been recorded from Amherst, Massachusetts, only. In the collection from Barbados it is represented by eight females and five males. These were collected on July 21 and 22 at Glendor and Bellevue, St. Michael, and Cane Garden, St. Thomas, on *Solanum*, morning glory, and *Crotolaria*; for the most part from the flowers, where they were solitary.

5. CRYPTOTHRIPS FASCIAPENNIS, new species.

Plate LXIV, figs. 12, 13.

Female.—Length, 1.96 mm.; length of head, 0.19 mm.; length of antenna, 0.35 mm.; width of head, 0.19 mm.; width of mesothorax,

0.33 mm.; width of abdomen, 0.34 mm. General color brown; body irregularly mottled more or less with dark reddish hypodermal pigmentation, especially in the head and thorax.

Head squarish, slightly narrower in front than behind; cheeks straight; front produced considerably between the bases of the antennæ; post-ocular bristles absent; frons bearing a very long spine on each side at about the middle of the eye and not far removed from its border; eyes rather small, together occupying about one-half the width of the head; ocelli present, the lateral ones placed rather closely to the margins of the eyes and not larger than their largest facets, anterior one not on the apex of prolonged vertex of head; mouth cone short, blunt and thick, reaching somewhat beyond the middle of the prosternum; labium broadly rounded; maxillary palpi two segmented, the basal segment being short and cylindrical and the apical one rather long and slender. Antennæ borne on somewhat produced front of head; their bases separated by about one-half the width of their basal segment. Relative lengths of segments as follows:

1	2	3	4	5	6	7	8
10.5	12	20	18	16	15	10	10.1

Second, fourth, and fifth segments thickest; one cylindrical; two constricted somewhat at base, truncate at apex; three very narrow at base, clavate; four, five, and six clavate; seven cylindrical; eight long conical. The four basal segments yellow; five yellow at base but somewhat shaded with brown at apex; six yellowish brown at base, apical two-thirds strongly shaded with brown; seven and eight deep brown. Spines slender and weak; sense cones simple, one on segment three and two each on segments four and five, rather long and blunt pointed.

Prothorax considerably wider than and about two-thirds as long as the head. On or near each anterior and posterior angle there is a rather short but conspicuous knobbed spine; all other spines inconspicuous. Pterothorax with sides nearly straight and parallel. Legs medium to rather long and slender; fore pair the shortest, hind pair the longest; fore femora somewhat thickened; fore tarsi unarmed; each fore femur with a long, slender, erect spine toward the base within. Wings rather short and weak but with long, heavy, dark colored fringes; fore pair light brown in color with a transparent cross band somewhat before the middle and another similar one just before the tip; hind wings apparently entirely clear.

Abdomen rather long and slender, cylindrical to about the anterior margin of the seventh segment, from which it tapers to the tube. Tube slightly more than two-thirds as long as the head, swollen somewhat toward the base; some of the terminal hairs nearly as long as the tube. Spines on sides and toward the tip of abdomen long, rather

slender, knobbed, very conspicuous, and toward the base of abdomen shorter and less prominent. There are two of these knobbed spines on each side of segments two to nine, inclusive; on the posterior segments these spines are rather close together, but on the anterior ones rather widely separated, the inner ones being placed more than half way from the extreme sides to the middle line; on each side of the middle line of dorsal segments two to six, inclusive, is placed a single, rather short, conspicuous, acute, double-curved spine. The surface of dorsal segments two to seven, inclusive, is reticulated.

Described from one specimen (the type) deposited in the collection of the Massachusetts Agricultural College.

Male unknown.

Specimen captured at Glendor, St. Michael, on leaf of lime, July 15.

This species is, in some ways, rather abnormal for *Cryptothrips*, and possibly a new genus should be erected for it, but I think it better for the present at least to leave it as a member of that genus.

Herr H. Karny, in his paper Die Orthopterenfauna des Küstengebietes von Österreich-Ungarn,^a has incorrectly used the genus name *Physapus*. This name can not be applied to species of Thysanoptera, as it was first used by Leach for a genus of the Neuroptera as Doctor Hinds has made clear. He has further erred in using the name *ater* for *E. vulgatissimus* (Haliday), as *ater* was used by Degeer not as a specific name but as a part of a description.

^a Berl. Entom. Zeitschr., LII, 1907.

EXPLANATION OF PLATES.

PLATE LXIII.

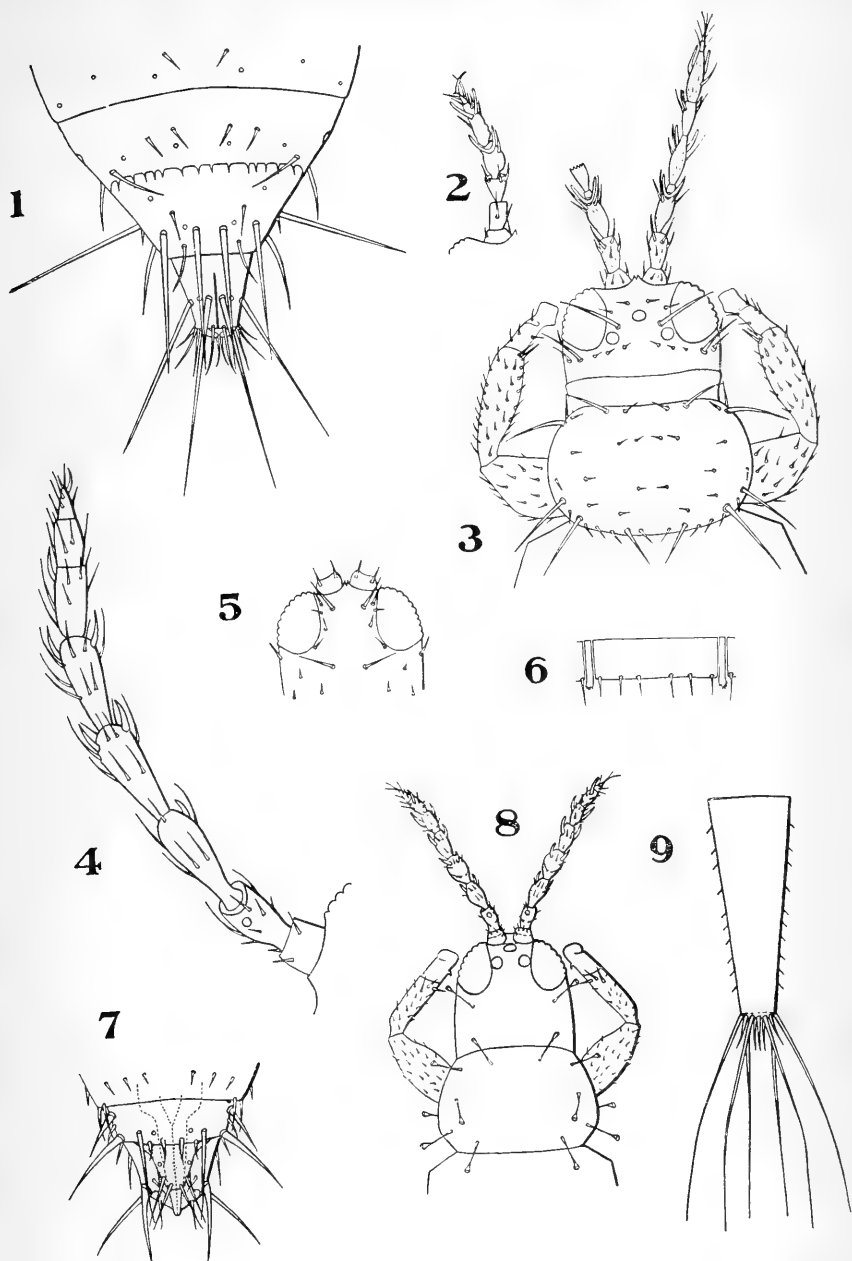
- Fig. 1. *Euthrips insularis*, new species. Dorsal view of end of abdomen of female. $\frac{1.5.8}{1}$.
2. *Euthrips insularis*, deformed antenna of female. $\frac{1.0.9}{1}$.
3. *Euthrips insularis*, head, prothorax, antennæ, and forelegs of female. $\frac{1.0.9}{1}$.
4. *Trichothrips niger*, new species. Antenna of female. $\frac{1.5.8}{1}$.
5. *Euthrips insularis*, face of female. $\frac{9.9}{1}$.
6. *Euthrips insularis*, fifth ventral abdominal segment of female. $\frac{5.8}{1}$.
7. *Euthrips insularis*, end of abdomen of male. $\frac{1.5.8}{1}$.
8. *Anthothrips gowdeyi*, new species. Head, prothorax, antennæ, and forelegs of female. $\frac{1.5.8}{1}$.
9. *Trichothrips niger*, tube of female. $\frac{1.0.9}{1}$.

PLATE LXIV.

- Fig. 10. *Heliothrips rubrocinctus* (Giard). Head, prothorax, antennæ, and forelegs of female. $\frac{1.0.5}{1}$.
11. *Trichothrips niger*, foreleg of female. $\frac{1.0.5}{1}$.
12. *Cryptothrips fasciapennis*, new species. Head and antennæ of female. $\frac{1.0.5}{1}$.
13. *Cryptothrips fasciapennis*, end of abdomen of female. $\frac{1.0.5}{1}$.
14. *Heliothrips rubrocinctus*, left fore wing of female. $\frac{7.3}{1}$.
15. *Anthothrips gowdeyi*, left fore wing of female. $\frac{7.3}{1}$.
16. *Anthothrips gowdeyi*, dorsal view of end of abdomen of female. $\frac{1.0.5}{1}$.

PLATE LXV.

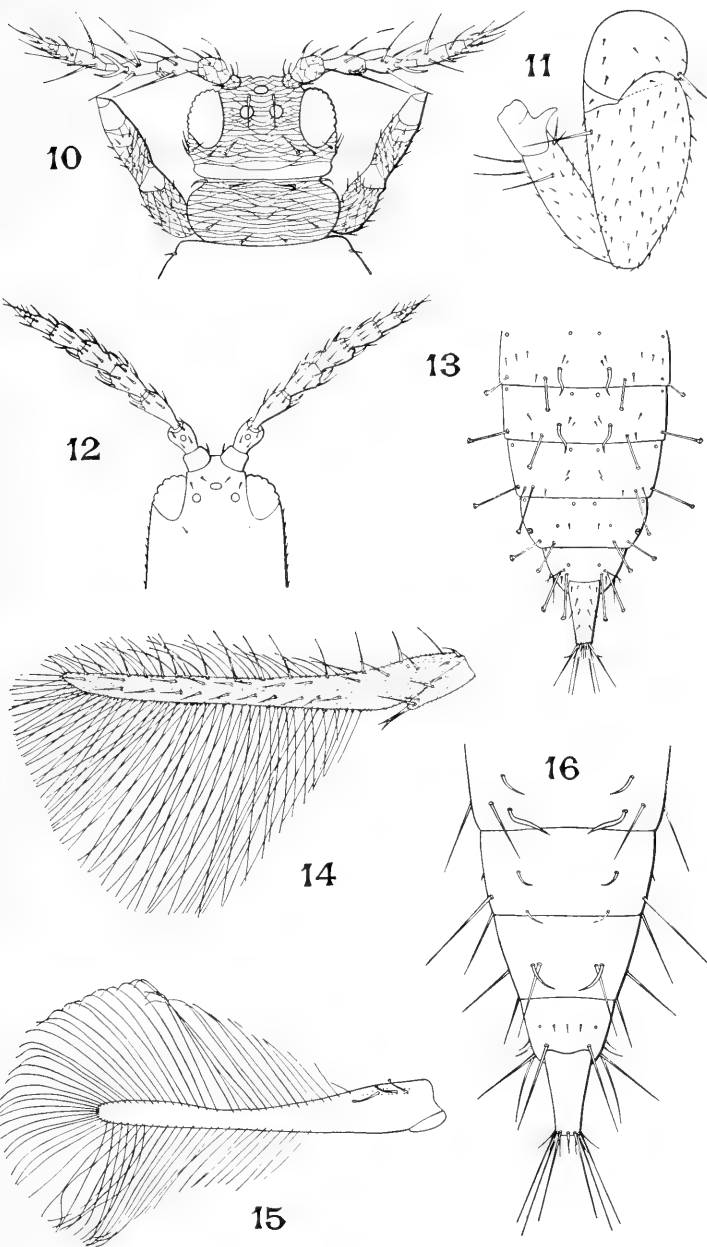
- Fig. 17. *Heliothrips rubrocinctus*, ventral view of pterothorax of female. $\frac{1.0.5}{1}$. *e*, endothoracic invaginations; *m*, mesosternum; *t*, metasternum.
18. *Trichothrips niger*, ventral view of pterothorax of female. $\frac{7.3}{1}$. *e*, endothoracic invaginations; *m*, mesosternum; *t*, metasternum.
19. *Euthrips insularis*, right fore wing of female. $\frac{7.9}{1}$.
20. *Heliothrips rubrocinctus*, dorsal view of end of abdomen of female. $\frac{1.0.5}{1}$.
21. *Heliothrips rubrocinctus*, dorsal view of end of abdomen of male. $\frac{1.0.5}{1}$.
22. *Trichothrips niger*, head of female. $\frac{7.3}{1}$.
23. *Anthothrips gowdeyi*, ventral view of pterothorax of female. $\frac{1.0.5}{1}$. *e*, endothoracic invaginations; *m*, mesosternum; *t*, metasternum.
24. *Euthrips insularis*, ventral view of pterothorax of female. $\frac{1.0.5}{1}$. *e*, endothoracic invaginations; *m*, mesosternum; *t*, metasternum.



WEST INDIAN THRIPS.

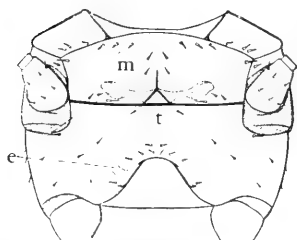
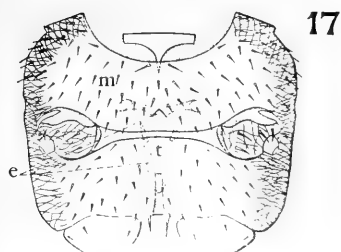
FOR EXPLANATION OF PLATE SEE PAGE 730.





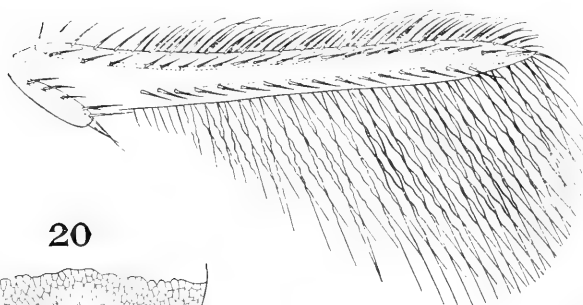
WEST INDIAN THRIPS.

FOR EXPLANATION OF PLATE SEE PAGE 730.

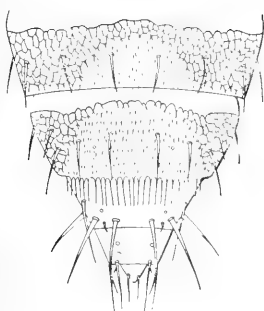


19

18



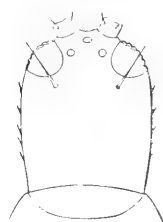
20



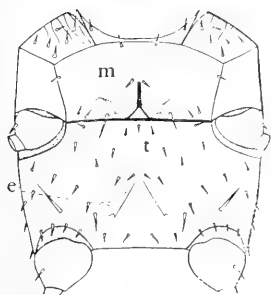
21



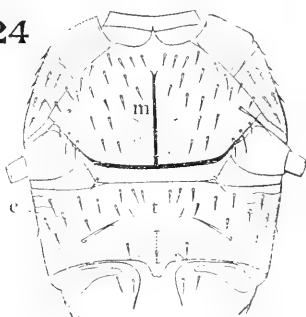
22



23



24



WEST INDIAN THRIPS.

FOR EXPLANATION OF PLATE SEE PAGE 730.

INDEX.

	Page.		Page.
Abasia	612	American Parasitic Copepods; New Genera and Species of Caliginae. North, by Charles Branch Wilson.....	593
pseudorostris.....	612, 626	Amia fasciata.....	242
Abbott, Mammals Collected in Western Borneo by Dr. W. L., by Marcus Ward Lyon, jr.....	547	orbicularis.....	242
Abudefduf artjerius.....	245	Anabantidae.....	541
saxatilis.....	101	Anabas scandens.....	541
septem fasciatus.....	245	Anacirtus limasquamis.....	32
Acacia filicina.....	587	Anchorella.....	625
Acanthias vulgaris.....	457	lizæ.....	625
Acanthocephala.....	88	seombri.....	624
Acantholeberis.....	709	Anchovia boelama.....	239
curvirostris.....	709	Anemathichthys apogon.....	539
Acanthuridae.....	247	Angelichthys ciliaris.....	114
Acanthurus annulatus.....	247	Anguilla mauritiana.....	239
litturatus.....	247	Anguillidae.....	239
marginatus.....	247	Anisogomphus.....	274, 298
tuberosus.....	247	occipitalis.....	298
Acentrocneme kollari.....	591	Anisoptera.....	271
Acestrorhamphus jenynsii.....	35	Ankyroderma jeffreysii.....	52
Acestrorhynchus falcatus.....	34	roretzii.....	52
falcirostris.....	35	Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species, by Carl H. Eigenmann and Fletcher Ogle.....	1
ferox.....	35	Anodus latior.....	4
lacustris.....	35	Anormogomphus.....	275, 298
Actinometra.....	683	heteropterus.....	299
multifida.....	686	Anostomus borellii.....	7
parvicirra.....	684	fasciatus.....	7
pulchella.....	686	isognathus.....	7
robustipinna.....	684	Anotogaster.....	276
simplex.....	155	Antedon.....	70, 127, 683
Æolothripidae.....	715	abbotti.....	130, 148
Aeshnidae.....	271	aculeata.....	142
Aeshninae.....	271	alata.....	680
Agonidae.....	264	albollava.....	129, 145
Albatross in 1903. The Holothurians of the North Pacific Coast of North America Collected by the, by Charles Lincoln Edwards.....	49	anthus.....	128, 129, 136, 137
Alebiön.....	618	arctica.....	71, 82, 83
glaber.....	326	asprerrima.....	70, 73
Alectis ciliaris.....	242	aster.....	129, 145
Alecto parvicirra.....	155, 684	bifida.....	671
trichoptera.....	684	bimaculata.....	131, 150
Allogaster.....	276	boversi.....	130, 148
basalis.....	276	brachymera.....	71, 77
Amaura.....	514, 528	briseis.....	71, 83
candida.....	528	callista.....	128, 132, 135
Ambassidae.....	242	ciliata.....	71, 81
America. New Marine Mollusks from the West Coast of, by Paul Bartsch.....	177	claræ.....	131
American Mollusks of the Genus Triphoris. West, by Paul Bartsch.....	249	clio.....	71, 79
		cubensis.....	155

	Page.		Page.
Antedon delicatissima	130, 131, 149, 150	Argulus funduli	625
diadema	129, 144	laticauda	326
diomedea	130, 132, 146	megalops	326
disciformis	131	Arthrædetus	171
erythrizon	71, 79	barberi	171, 172
eschrichtii	70, 75	Arthropryxus	689, 694
var. maxima	69	beringanus	694, 695
flavopurpurea	128, 131, 134	Ascaris	90
fragilis	71, 80	Asia. Descriptions of New Species of Recent	
garrettiana	129, 130, 142	Unstalked Crinoids from the Coasts of	
hana	128, 137	Northeastern, by Austin Hobart Clark	127
hartlaubi	70, 72, 151	Aspidogaster ringens	104
hawaiiensis	128, 152	Aspidophorus pusillus	645
hepburniana	129	Aspidophryxus	689
hondoensis	71, 78	Asterias multiradiata	685, 687
incisa	140	Asterodermus	461
inexpectata	70, 75	Astyanax	18
isis	71, 82	abramis	28
laodice	70, 75	atratoensis	28
lata	129, 140	bimaculatus	27
latipinna	129	lineatus	27
longicirra	136	carolinæ	22
macropoda	128, 129	caucanus	28
macropygus	84	cuvieri	19
manca	131	emperador	3, 26
mariae	71, 77	fasciatus	19
minor	129, 144	fischeri	26
multicolor	128, 130, 131, 132, 150, 152	iheringii	19
nana	84	megalops	3, 29
orion	129, 130, 143	mexicanus	25
perplexa	70, 74	multiradiatus	29
propinqua	128, 133	orthodus	3, 27
pubescens	129, 138	phœnicopterus	18
pulchella	686	rutilus	18, 19, 23
pusilla	144	æneus	24
quinquecostata	129, 143, 145	nicaraguensis	3, 23
rara	70, 72	stilbe	28
rathbuni	70, 76	Atelecrinus balanoides	130, 131, 155
ruber	130, 146	cubensis	155, 156
rubroflava	130, 150	pourtalesi	155, 156
scalaris	129, 141	rubroflava	127
separata	128, 133	stylifer	127
serratissima	71, 77	Atherina harringtonensis	120
spinifera	152	lacunosa	240
stylifer	130, 149	Atherinidæ	240
tanneri	69	Avicula elegantula	48
tenelloides	70, 73	Aviculipecten kazanensis	48
tenuis	71, 80	richthofeni	47
thetis	128, 151	Bagrus heterurus	536
tigrina	130, 147	macronemus	536
versicolor	128, 132	planiceps	536
villosa	128, 129, 138	singaringan	536
Anthothrips gowdeyi	724	Bairdiella chrysura	624
Aonyx cinerea	560	Balistes carolinensis	99, 109, 117, 120
Aphyocharax alburnus	11	verrucosus	248
anisitsi	10	vetula	101
rathbuni	2, 10	Balistidæ	248
stramineus	2, 11	Bambradon	642, 643
Aplocheilus panchax	540	lævis	643
Aplodactylidæ	157	Barbados and St. Vincent Islands. On a	
Aplodactylidæ	163	Collection of Thysanopterous Insects	
Apogonichthyidæ	242	from, by Henry James Franklin	715
Aræocerus fasciculatus	203	Barber. On Some Earwigs (Forficulidæ)	
Archamia lineolata	242	collected in Guatemala by Messrs. Schwarz	
Archosargus probatocephalus	624	and, by Andrew Nelson Caudell	169
Aretogalidia stigmatica	559	Barbodes binotatus	538

	Page.		Page.
Barbodes microps.....	539	Blastobasidæ.....	199
obtusirostris.....	538	Blastobasidæ. Descriptions of New North	
rubripinnis.....	538	American Tineid Moths, with a Generic	
Barbus apogon.....	539	Table of the Family, by Lord Walsingham	197
binotatus.....	538	Blastobasis.....	202, 204
hampal.....	537	aphidiella.....	205
maculatus.....	231, 538	citricolella.....	202
microps.....	538	citriella.....	202
obtusirostris.....	538	coccivorella.....	204
quinquemaculatus.....	229	fluxella.....	209
rubripinnis.....	538	fractilinea.....	202
Bartsch, Paul, A New Fresh-Water Bivalve		iceryaeella.....	210
(Corneocyclus) from the		nubilella.....	201
Mountains of Ecuador.....	681	retectella.....	201
New Marine Mollusks from		subtractella.....	198
the West Coast of America.....	177	Bodianus fulvus punctatus.....	89, 91, 102, 105, 116
Notes on the Fresh-Water		Bolo Case from Basilan Island. Basketry,	
Mollusk Planorbis Magnificus		by Otis T. Mason.....	193
and Descriptions of		Bomolochus.....	625, 626
Two New Forms of the		Borneo, by Dr. W. L. Abbott. Mammals	
Same Genus from the		collected in Western, by Marcus Ward	
Southern States.....	697	Lyon, jr.....	547
The West American Mol-		Boulengerella.....	702
lusks of the Genus Tri-		Brachiella oblonga.....	625
phoris.....	249	Brachiopoda.....	45
and William Healey Dall,		Brachylabis nigra.....	172
The Pyramidellid Mol-		Bramocharax bransfordii.....	32
lusks of the Oregonian		Branchiophryxus.....	689
Faunal Area.....	491	Brevoortia tyrannus.....	112, 624
Basilan Island. Basketry Bolo Case from,		Brycinus macrolepidotus.....	29
by Otis T. Mason.....	193	nurse.....	29
Basketry Bolo Case from Basilan Island, by		Brycon dentex.....	30
Otis T. Mason.....	193	hilarii.....	30
Bathystoma striatum.....	102, 105, 119	reinhardtii.....	30
Batostomella meekana.....	43	striatulus.....	30
Bean, Barton, On Ctenolucius Gill, a Neg-		Bryconathiops microstoma.....	30
lected Genus of Characin		Bryozoa.....	41
Fishes, with Notes on the		Bucculatrix.....	221
Typical Species.....	701	eurotiella.....	221
and Alvin Seale, On a Col-		Burma and Lower Siam—II. Subfamilies	
lection of Fishes from the		Cordulegasterinæ, Chlorogomphinæ, and	
Philippine Islands, Made		Gomphinæ. The Dragonflies (Odonata) of,	
by Maj. Edgar A. Mearns,		by Edward Bruce Williamson.....	267
Surgeon, U. S. Army, with		Burmagomphus.....	275, 298, 300
Descriptions of Seven New		vermiculatus.....	300, 301
Species.....	292	Buytenzorg, Java, by Dr. Douglas Hough-	
Belonidæ.....	240	ton Campbell. List of Fishes Collected in	
Belonocharax.....	702	the River at, by David Starr Jordan and	
Bembras.....	642	Alvin Seale.....	535
curtus.....	644	Cæsius erythrogaster.....	243
japonicus.....	643	lunaris.....	243
Bembridge.....	642	Calamocerinus diomedæ.....	671, 672
Bermuda Fishes. Notes on Parasites of, by		Calamus calamus.....	89, 103, 104, 105, 106
Edwin Linton.....	85	Calanidæ.....	711
Binoculus salmoneus.....	382	California. Description of a New Species of	
sexsetaceus.....	441	Killifish, Lucania Browni, from a Hot	
Bittium esuriens.....	179	Spring in Lower, by David Starr Jordan	
multifilosum.....	179	and Robert Earl Richardson.....	319
quadrifilatum.....	180	Caligidæ. North American Parasitic Cope-	
ingens.....	180	pods belonging to the Family: A Revision	
(Stylidium) eschrichti icelum.....	178	of the Pandarinæ and the Cecropinæ, by	
monterey- ensis.....	178	Charles Branch Wilson.....	323
tumidum.....	179	Caliginæ. North American Parasitic Cope-	
Bivalve (Corneocyclus) from the Mountains		pods. New Genera and Species of, by	
of Ecuador. A New Fresh-Water, by Paul		Charles Branch Wilson.....	593
Bartsch.....	681	Caligus belones.....	625
		bicolor.....	400

	Page.		Page.
<i>Caligus bonito</i>	625	<i>Cephalopholis urodelus</i>	243
<i>chelifer</i>	626	<i>Cephalothrips yuccæ</i>	727
<i>curtus</i>	598, 625	<i>Cerithiopsis assimilata</i>	178
<i>fallax</i>	619	<i>cosmia</i>	180
<i>hæmulonis</i>	594, 624, 625	<i>pedroana</i>	181
<i>paradoxus</i>	349, 379, 441, 446, 457	<i>Cervulus pleiharicus</i>	550
<i>productus</i>	374, 375, 380, 381, 382, 441	<i>Cervus brookei</i>	550
<i>rapax</i>	326, 597, 626	<i>Cestoda</i>	97
<i>rufimaculatus</i>	625	<i>Cestode larvæ, cysts</i>	102
<i>rufus</i>	597, 625	<i>Chaenogobius macrogathos</i>	266
<i>Callichrous bimaculatus</i>	536	<i>Chalcinus angulatus</i>	31
<i>Calliomorus</i>	640	<i>Chanidæ</i>	239
<i>indicus</i>	641	<i>Chanos chanos</i>	239
<i>Callionymus indicus</i>	641	<i>Characidium fasciatum</i>	9
<i>Callyodon latifasciatus</i>	237	<i>Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species. An Annotated List of, by Carl H. Eigenmann and Fletcher Ogle</i>	1
<i>macrorhinus</i>	246	<i>Characin Fishes, with Notes on the Typical Species. On Ctenolucius Gill, A Neglected Genus of, by Barton A. Bean</i>	701
<i>nigra</i>	246	<i>Charax atratoensis</i>	3, 33
<i>rivulatus</i>	246	<i>gibbosus</i>	32
<i>zonularis</i>	246	<i>limæsquamis</i>	33
<i>Calopteryx angustipennis</i>	268	<i>sanguineus</i>	32
Campbell, List of Fishes Collected in the River at Buytenzorg, Java, by Dr. Douglas Houghton, by David Starr Jordan and Alvin Seale.....	535	<i>squamosus</i>	33
<i>Canthigaster compressus</i>	248	<i>Cheilinus chlorurus</i>	245
<i>Capoeta macrolepidota</i>	537	<i>triobatus</i>	245
<i>Carangidæ</i>	241	<i>Chelio inermis</i>	245
<i>Caranx carangus</i>	242	<i>Cheilodactylus gibbosus</i>	166
<i>sexfasciatus</i>	241	<i>vittatus</i>	167
<i>speciosus</i>	241	<i>zebra</i>	166
<i>Carcharias</i>	441	<i>zonatus</i>	164
<i>atwoodi</i>	460	<i>Cheirodon insignis</i>	9
<i>littoralis</i>	423, 430, 431	<i>interruptus</i>	9
<i>obscurus</i>	624	<i>micropterus</i>	2, 9
<i>Carcharhinus obscurus</i>	326, 360, 409, 423, 431	<i>monodon</i>	9
<i>Carcharodon carcharias</i>	371, 414, 423	<i>pequira</i>	10
<i>Carnegia</i>	40	<i>ribeiroi</i>	2, 9
<i>bassleri</i>	40	<i>Chelidonichthys</i>	649, 655
<i>Catacypsis</i>	206	<i>kumu</i>	656, 657
<i>fluxella</i>	209	<i>spinus</i>	657
<i>inconspicua</i>	208	<i>Chemnitzia</i>	494
<i>irenica</i>	208	<i>aurantia</i>	502
<i>morrisoni</i>	209	<i>lordi</i>	510
<i>nucella</i>	206	<i>tenuicula</i>	508
<i>stygna</i>	207	<i>tridentata</i>	511
<i>ursella</i>	207	<i>vancouverensis</i>	495
Caudell, Andrew Nelson, On Some Earwigs (Forficulidæ) Collected in Guatemala by Messrs. Schwarz and Barber.....	169	<i>Chilomycterus schœpfi</i>	625
<i>Cecropinæ</i>	461, 464	<i>China. Descriptions of New Species of Upper Paleozoic Fossils from, by George H. Girty</i>	37
<i>Cecropinæ, A Revision of the Pandarinæ and the North American Parasitic Copepods belonging to the Family Caligidæ, by Charles Branch Wilson</i>	323	<i>Chiridota albatrossi</i>	49, 50
<i>Cecrops</i>	466	<i>levis</i>	49, 50, 51, 52
<i>achantii-vulgaris</i>	467	<i>œoliticum</i>	53
<i>latreillii</i>	466, 467, 468	<i>Chlamys incisus</i>	450
<i>Centropistes striatus</i>	596, 624	<i>Chloëa castanea</i>	266
<i>Cephacandia</i>	664	<i>nakamura</i>	265
<i>Cephalacanthidæ</i>	663	<i>sarchynnis</i>	266
<i>Cephalacanthus</i>	664	<i>Chlorogomphinæ</i>	272, 277
<i>spinarella</i>	664	<i>Chlorogomphinæ and Gomphinæ. The Dragonflies (Odonata) of Burma and Lower Siam—II Subfamilies Cordulegasterinæ, by Edward Bruce Williamson</i>	267
<i>Cephalopholis maculatus</i>	235	<i>Chlorogomphus</i>	272, 277
<i>obtusauris</i>	243		
<i>sonnerati</i>	243		

	Page		Page
<i>Chærops macrodon</i>	245	<i>Coleophora vagans</i>	217
<i>zamboangæ</i>	236	Collection of Fishes from Echigo, Japan,	
<i>Chrysallida</i>	514	by David Starr Jordan and Robert Earl	
<i>communis</i>	514	Richardson.....	263
<i>Chydorus</i>	711	Collection of Fishes from the Philippine	
<i>sphæricus</i>	711	Islands, made by Maj. Edgar A. Mearns,	
<i>Cirrhites alternatus</i>	159	Surgeon, U. S. Army, with Descriptions	
<i>aureus</i>	161	of Seven New Species, by Alvin Seale	
(<i>Cirrhichthys</i>) <i>maculatus</i>	159	and Barton A. Bean.....	229
<i>fasciatus</i>	161	Collection of Thysanopterous Insects from	
<i>maculosus</i>	159	Barbados and St. Vincent Islands, by	
<i>marmoratus</i>	159	Henry James Franklin.....	715
<i>Cirrhichthys</i>	158, 161	<i>Comaster</i>	686
<i>aureus</i>	161, 162	<i>alata</i>	686
<i>bleekeri</i>	161	<i>alternans</i>	686
<i>maculatus</i>	159	<i>bennetti</i>	686
<i>Cirrhitidae</i>	157	<i>belli</i>	686
<i>Cirrhitoid Fishes of Japan. A Review of</i>		<i>borneensis</i>	686
<i>the, by David Starr Jordan and Albert</i>		<i>briareus</i>	686
<i>Christian Herre</i>	157	<i>carpenteri</i>	686, 687
<i>Cirrhitopsis</i>	161	<i>coppingeri</i>	686
<i>Cirrhitus</i>	158, 159	<i>discoidea</i>	686
<i>maculatus</i>	159	<i>divaricata</i>	686
<i>marmoratus</i>	159	<i>duplex</i>	686
<i>Cladobates speciosus</i>	562	<i>echinoptera</i>	686
<i>Cladocera</i>	707	<i>elongata</i>	686
<i>Clark, Austin Hobart, Descriptions of New</i>		<i>fimbriata</i>	686
<i>Species of Recent</i>		<i>gracilis</i>	686
<i>Unstalked Cri-</i>		<i>grandicalyx</i>	686
<i>noids from the</i>		<i>iowensis</i>	686
<i>Coasts of North-</i>		<i>japonica</i>	686
<i>eastern Asia</i>	127	<i>lineata</i>	686
<i>Descriptions of New</i>		<i>littoralis</i>	686
<i>Species of Recent</i>		<i>macrobrachius</i>	686
<i>Unstalked Cri-</i>		<i>maculata</i>	686
<i>noids from the</i>		<i>magnifica</i>	686
<i>North Pacific</i>		<i>marie</i>	686
<i>Ocean</i>	69	<i>meridionalis</i>	686
<i>Infrabasals in Re-</i>		<i>multiradiata</i>	686
<i>cent Genera of the</i>		<i>nobilis</i>	686
<i>Crinoid Family</i>		<i>novæ-guineæ</i>	686
<i>Pentacrinidae</i>	671	<i>orientalis</i>	686
<i>The Crinoid Genus</i>		<i>parvicirra</i>	686
<i>Comatula La-</i>		<i>peronii</i>	686
<i>marek, with a</i>		<i>quadrata</i>	686
<i>Note on the En-</i>		<i>regalis</i>	686
<i>crinus Parre of</i>		<i>robustipinna</i>	686
<i>Guerin</i>	683	<i>rotalaria</i>	686
<i>Clarias batrachus</i>	535	<i>rubiginosa</i>	686
<i>magur</i>	535	<i>schlegelii</i>	686
<i>Clariidae</i>	535	<i>sentosa</i>	686
<i>Clupea melanura</i>	239	<i>solaster</i>	686
<i>Clupeidae</i>	239	<i>stelligera</i>	686
<i>Coast of America. New Marine Mollusks</i>		<i>trichoptera</i>	686
<i>from the West, by Paul Bartsch</i>	177	<i>typica</i>	686
<i>Cobitidae</i>	263, 537	<i>valida</i>	686
<i>fasciata</i>	537	<i>variabilis</i>	686
<i>hasseltii</i>	537	<i>Comatula</i>	683, 684, 685
<i>Cœlenterata</i>	37	<i>Comatula Lamarck, with a Note on the En-</i>	
<i>Cœlopora</i>	217	<i>crinus Parre of Guerin. The Crinoid Ge-</i>	
<i>glutinosi</i>	217, 218	<i>nus, by Austin Hobart Clark</i>	683
<i>Coleophora</i>	216	<i>Comatula marie</i>	153
<i>lapidicornis</i>	216	<i>multiradiata</i>	685
<i>occidentalis</i>	216	<i>orientalis</i>	155
<i>pruniella</i>	216	<i>parvicirra</i>	155

	Page.		Page.
Comatula serrata.....	154	Cyclocheilichthys apogon	539
solaris.....	685	Cyclogomphus.....	274, 296
solaster.....	153	minusculus.....	296
Conchologist. Supplementary Notes on		vesiculosus.....	297
Marty's Universal, by William Healey		Cylindrogaster diplatyoides.....	170
Dall.....	185	Cymothoa oestrum.....	120
Copepoda.....	711	Cynopotamus argenteus.....	32
Copepods belonging to the Family Caligi-		limæsquamis.....	34
dæ. North American Parasitic; A Revi-		magdalenæ.....	33
sion of the Pandarinæ and the Cecropinæ,		squamosus.....	33
by Charles Branch Wilson.....	323	Cynopterus brachyotis.....	562
Cordulegasterinæ.....	272, 276	Cynotes.....	210
Cordulegasterinæ, Chlorogomphinæ, and		iceryæella.....	210
Gomphinæ. The Dragon Flies (Odonata)		Cyprididæ.....	706
of Burma and Lower Siam—II Subfami-		Cyprinidæ.....	229, 537
lies, by Edward Bruce Williamson.....	267	Cyprinus carpio.....	537
Corneocyclas davisii.....	681	flavipinna.....	537
(Corneocyclas) from the Mountains of Ecu-		Cypsilurus altipinnis.....	240
ador. A New Fresh-Water Bivalve, by Paul		Cyrtocharax.....	32
Bartsch.....	681	Dacnitis esuriens.....	93
Coryphæna equisetis.....	112, 625	Dactyloptena.....	664, 665
hippurus.....	112	orientalis.....	665, 667, 668
Corythoichthys bleekeri.....	240	Dactylopterus.....	664
Cottus insidiator.....	641	cheirophthalmus.....	665
rogad.....	641	macracanthus.....	665
Crinoid Family Pentacrinidæ. Infrabasals		peterseni.....	667
in Recent Genera of the, by Austin Ho-		pirapeda.....	664
bart Clark.....	671	volitans.....	664
Crinoid Genus Comatula Lamarek, with a		Dactylosparus carponemus.....	163
Note on the Encrinus Parre of Guerin, by		Daicocus.....	664, 667
Austin Hobart Clark.....	683	peterseni.....	667
Crinoids from the Coasts of Northeastern		Dajidæ from the Northwest Pacific Ocean	
Asia. Descriptions of New Species of Re-		with Descriptions of a New Genus and	
cent Unstalked, by Austin Hobart		Two New Species. On some Isopods of the	
Clark.....	127	Family, by Harriet Richardson.....	689
Crinoids from the North Pacific Ocean. De-		Dajus.....	689
scriptions of New Species of Recent Un-		mysidis.....	692
stalked, by Austin Hobart Clark.....	69	Dall, William Healey, Supplementary Notes	
Crotalaria.....	719, 725	on Marty's Uni-	
Crustacea from Labrador and Newfound-		versal Conchologist.....	185
land. Fresh-Water, by Joseph A. Cush-		and Paul Bartsch, The	
man.....	705	Pyramidellid McI-	
Cryptothrips aspersus.....	727	luskus of the Orego-	
fasciapennis.....	727	nian Faunal Area.....	491
Ctenolucius.....	701	Daphne curvirostris.....	709
Ctenolucius Gill, A Neglected Genus of Char-		Daphnia.....	707
acin Fishes, with Notes on the Typical		atkinsoni.....	707
Species. On, by Barton A. Bean.....	701	hyalina.....	707
Ctenolucius hujeta.....	702	longispina.....	707
maculatus.....	702	magna.....	707
Cucumaria calcigera.....	54	pulex.....	707
chronhjelmi.....	59	serrulata.....	707
frondosa.....	59	Daphnidæ.....	707
japonica.....	61	Dasia smaragdina.....	545
koreni.....	54	Dasyatidæ.....	239
vegæ.....	59	Dasyatis kuhli.....	239
Curimatus.....	3	Davidius.....	273, 286
albula.....	3	fruhstorferi.....	286
bimaculatus.....	3	Decametrocercinus.....	70, 127
boulengeri.....	2, 3	borealis.....	70, 71
brevipes.....	2, 3	Demoleus.....	346
gilberti.....	3	paradoxus.....	349, 350
knerii.....	4	Dermatogenys fluviatilis.....	540
leuciscus boliviæ.....	2, 4	Description of a New Species of Killifish,	
leucostictus.....	3	Lucania Browni, from a Hot Spring in	
platanus.....	3	Lower California, by David Starr Jordan	
Cushman, Joseph A., Fresh-Water Crus-		and Robert Earl Richardson.....	319
tacea from Labrador and Newfoundland..	705		

	Page.		Page.
Descriptions of a New Genus and Two New Species. On some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with, by Harriet Richardson.....	689	Distomum macrocotyle.....	107
Descriptions of New North American Tineid Moths, with a Generic Table of the Family Blastobasidae, by Lord Walsingham.....	197	monticellii.....	104
Descriptions of New Species of Recent Unstalked Crinoids from the Coasts of North-eastern Asia, by Austin Hobart Clark.....	127	nitens.....	107
Descriptions of New Species of Recent Unstalked Crinoids from the North Pacific Ocean, by Austin Hobart Clark.....	69	oculatum.....	110
Descriptions of New Species of Upper Paleozoic Fossils from China, by George H. Girty.....	37	subtenue.....	106
Descriptions of Seven New Species. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with, by Alvin Seale and Barton A. Bean.....	229	tomex.....	112
Descriptions of Two New Forms of the Same Genus from the Southern States. Notes on the Fresh-Water Mollusk Planorbis Magnusificus and, by Paul Bartsch.....	697	trulla.....	109
DiaCOPE sebæ.....	243	vitellusum.....	105, 118
Diaptomus.....	711	Dorosomatidæ.....	239
eiseni.....	711	Draco.....	677
Dielasmas.....	46	maximus.....	679
Dinematura..... 362, 374, 441, 478		mindanensis.....	677
affinis.....	364	quinquefasciatus.....	679
alata.....	364, 367	Dragonflies (Odonata) of Burma and Lower Siam—II. Subfamilies Cordulogasterinæ, Chlorogomphinae, and Gomphinae, by Edward Bruce Williamson.....	267
braccata.....	364, 365, 366	Drombus packyi.....	248
carcharodonti.....	377	Earwigs (Forficulidæ) Collected in Guatemala by Messrs. Schwarz and Barber, by Andrew Nelson Caudell.....	169
coleoptrata.....	364, 365, 367	Ebisinus.....	664
(cethrogaleus) neozealanica.....	448	cheirophthalmus.....	665
elongata.....	380, 447, 451	Echeneis naucrates.....	623, 625
ferox.....	349, 377	Echigo, Japan. On a Collection of Fishes from, by David Starr Jordan and Robert Earl Richardson.....	263
gracilis.....	453	Echinopsalis.....	171
hamiltoni.....	447, 454	brevibractea.....	171
indistincta.....	364	Echinoptera.....	684
latifolia.....	383, 447, 460	Echinorhynchus medius.....	88
musteli-lævis.....	386, 446, 456	pristis.....	89
neozealanica.....	365, 447, 456	Echthrogaleus..... 352, 362	
producta.....	374, 380, 382, 383	affinis.....	366, 375
serrata.....	478, 479	braccatus.....	366, 447, 449
Dinemoura..... 362, 374		coleoptratus.....	365, 367, 396, 454, 455
affinis.....	375	denticulatus.....	324, 365, 369, 460
alata.....	375	perspicax.....	364, 447, 457
elongata.....	382	torpedinis.....	324, 365, 371
lamæ.....	380, 382	Ecuador. A New Fresh-Water Bivalve (Corno-cyclas) from the Mountains of, by Paul Bartsch.....	681
musteli-lævis.....	386	Edwards, Charles Lincoln, The Holothurians of the North Pacific Coast of North America Collected by the Albatross in 1903.	49
producta.....	374, 380	Eigenmann, Carl H., and Fletcher Ogle. An Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species.....	1
Diodon.....	461	Eleotris ophiocephalus.....	248
Diplatys jansonii.....	169	Elopomorphus elongatus.....	4
severa.....	169	Emoia atrocostata.....	545
Diplodus sargus.....	94, 100, 104	Encotyllabe.....	103
Discocephalum plicatum.....	97	Enerinus.....	673
Distichodus brevipinnis.....	4	caput-medusæ.....	687
fasciolatus.....	4	milleri.....	688
Distomum.....	103	parre.....	687
fenestratum.....	111	Enerinus Parre of Guerin. The Crinoid Genus Cornatula Lamarek, with a Note on the, by Austin Hobart Clark.....	683
gyrinus.....	107	Engraulidæ.....	239
læve.....	105	Epinephelus fasciatus.....	242
lamelliforme.....	108	maculatus.....	98
levenseni.....	110	maculosus.....	90, 91, 96, 99, 101, 110
		merra.....	242
		morio.....	90, 625

	Page		Page.
<i>Epinephelus striatus</i>	90,	<i>Fistulipora parasitica</i>	44
91, 92, 96, 98, 99, 101, 111, 113, 120		<i>waageniana</i>	44
<i>tauvina</i>	242	<i>willisiana</i>	41
<i>undulosus</i>	242	Flatheads.....	629
<i>Equulidae</i>	242	Flatheads, Gurnards, and other Mail-	
<i>Eriodycteon glutinosum</i>	218, 219	checked Fishes of the Waters of Japan. A	
<i>Esox panchax</i>	540	Review of the, by David Starr Jordan and	
<i>Ethmia</i>	199	Robert Earl Richardson.....	629
<i>albitogata</i>	199	Flying Gurnards.....	663
<i>Eucopia australis</i>	695	Flying Lizard from the Philippine Islands.	
<i>Eudactylina nigra</i>	626	A New Species of, by Leonhard Stejneger..	677
<i>Euelatichthys crassispinus</i>	244	<i>Forficula cacaoensis</i>	175
<i>Euphorbia</i>	725	<i>lugubris</i>	176
<i>Eupomacentrus fuscus</i>	102	<i>metrica</i>	176
<i>Eurotia canata</i>	221	<i>Forficulidae</i> Collected in Guatemala by	
<i>Euryceerus</i>	710	Messrs. Schwarz and Barber. On Some	
<i>glacialis</i>	705, 710	Earwigs, by Andrew Nelson Caudell.....	169
<i>lamellatus</i>	710	Fossils from China. Descriptions of New	
<i>Euthrips insularis</i>	715	Species of Upper Paleozoic, by George H.	
<i>tritici</i>	719	Girty.....	37
<i>vulgatissimus</i>	729	Franklin, Henry James, On a Collection of	
<i>Evalea</i>	514, 522	Thysanopterous Insects from Barbados	
<i>Evermannolus</i>	2	and St. Vincent Islands.....	715
<i>Exocetidae</i>	240, 540	Fresh-Water Bivalve (<i>Corneocyclus</i>) from	
Family <i>Blastobasidae</i> . Descriptions of New		the Mountains of Ecuador. A New, by	
North American Tineid Moths, with a		Paul Bartsch.....	681
Generic Table of the, by Lord Walsing-	197	Fresh-Water Crustacea from Labrador and	
ham.....		Newfoundland, by Joseph A. Cushman....	705
Family <i>Dajidae</i> from the Northwest Pacific		Fresh-Water Mollusk <i>Planorbis Magnificus</i>	
Ocean, with Descriptions of a New Genus		and Descriptions of Two New Forms of the	
and Two New Species. On Some Isopods of		Same Genus from the Southern States.	
the, by Harriet Richardson.....	689	Notes on the, by Paul Bartsch.....	697
Faunal Area. The <i>Pyramidellid</i> Mollusks of		<i>Fundulus heteroclitus</i>	95, 625
the Oregonian, by William Healey Dall		<i>majalis</i>	431
and Paul Bartsch.....	491	<i>Gangliopus</i>	350, 377
<i>Felichthys marinus</i>	596, 600, 625	<i>pyriformis</i>	324, 350, 351, 436, 447, 448
<i>Felis bengalensis</i>	559	<i>Gasteropelecus stellatus</i>	31
Fishes Collected in the River at Buytenzorg,		<i>sternicla</i>	30
Java, by Dr. Douglas Houghton Campbell.		<i>Gasterosteus spinarella</i>	664
List of, by David Starr Jordan and Alvin		<i>Gasterostomum</i>	119
Seale.....	535	<i>arcuatum</i>	119
Fishes from Echigo, Japan. On a Collection		<i>baculatum</i>	119
of, by David Starr Jordan and Robert		<i>Gasterotokens biaculeatus</i>	240
Earl Richardson.....	263	Geckoid Lizard from the Philippine Islands,	
Fishes from the Philippine Islands, made by		by Leonhard Stejneger.....	545
Maj. Edgar A. Mearns, Surgeon, U. S.		<i>Geinitzella chinensis</i>	42
Army, with Descriptions of Seven New		<i>Gekko monachus</i>	545
Species. On a Collection of, By Alvin Seale		<i>Gelechia glandulella</i>	200, 201
and Barton A. Bean.....	229	<i>laudatella</i>	197
Fishes in the United States National Mu-		<i>sexnotella</i>	219
seum and the Museum of Indiana Uni-		<i>subtractella</i>	198
versity, with Descriptions of New Species.		<i>Gelechiadae</i>	197
An Annotated List of Characin, by Carl H.		Genera of the Crinoid Family <i>Pentacrinu-</i>	
Eigenmann and Fletcher Ogle.....	1	<i>idae</i> . Infrabasals in Recent, by Austin	
Fishes. Notes on Parasites of Bermuda		Hobart Clark.....	671
by Edwin Linton.....	85	Generic Table of the Family <i>Blastobasidae</i> .	
Fishes of Japan. A Review of the <i>Cirrhitoid</i> ,		Descriptions of New North American	
by David Starr Jordan and Albert Chris-		Tineid Moths, with a, by Lord Walsing-	
tian Herre.....	157	ham.....	197
Fishes of the Waters of Japan. A Review of		Genus and Two New Species. On Some Iso-	
the Flatheads Gurnards, and other Mail-		pods of the Family <i>Dajidae</i> from the	
checked, by David Starr Jordan and		Northwest Pacific Ocean, with Descrip-	
Robert Earl Richardson.....	629	tions of a New, by Harriet Richardson....	689
Fishes, with Notes on the Typical Species.		Genus <i>Comatula</i> Lamarck, with a Note on	
On <i>Ctenolucius</i> Gill, A Neglected Genus of		the <i>Enericus</i> Parre of Guerin. The Crinoid,	
Characin, by Barton A. Bean.....	701	by Austin Hobart Clark.....	683

	Page.		Page.
Genus of Characin Fishes, with Notes on the Typical Species. On <i>Ctenolucius</i> Gill, A Neglected, by Barton A. Bean.....	701	<i>Hæmulon carbonarium</i>	92, 95
Gerridae.....	244	<i>elegans</i>	596
Gilbertolus.....	2	<i>flavolineatum</i>	90, 102, 105, 119
Gill, A Neglected Genus of Characin Fishes, with Notes on the Typical Species. On <i>Ctenolucius</i> , by Barton A. Bean.....	701	<i>Hagenius</i>	286
Girty, George II., Descriptions of New Species of Upper Paleozoic Fossils from China.....	37	<i>Halicometra</i>	117
<i>Glischropus tylopus</i>	563	<i>Hampala macrolepidota</i>	537
<i>Gloiopotes</i>	618	<i>Haplochilus panchax</i>	540
<i>Glossogobius brunneus</i>	543	<i>Harengula moluccensis</i>	239
<i>campbellianus</i>	535, 542	<i>Harpe rufa</i>	93, 106
<i>giuris</i>	543	<i>Helaretos euryaspilus</i>	561
<i>melanurus</i>	543	<i>malayanus</i>	561
<i>tambujon</i>	542	<i>Heliothrips</i>	715
<i>Gnatholepis sternbergi</i>	248	<i>hæmorrhoidalis</i>	715, 719
Gobiidae.....	248, 265, 542	<i>rubrocinctus</i>	719
<i>Gobius tambujon</i>	542	<i>Hemibagrus planiceps</i>	536
Gomphidia.....	272, 281	<i>Hemidaetylus frenatus</i>	545
<i>abbotti</i>	282	<i>Hemigrammus</i>	11
<i>confluens</i>	281	<i>anisitsi</i>	2, 14, 16
<i>javanica</i>	281	<i>bellottii</i>	14
<i>kirschii</i>	281	<i>boulengeri</i>	2, 13, 15
<i>maculachlani</i>	282	<i>callistus</i>	12
Gomphinae.....	272, 278	<i>compressus</i>	14
Gomphinae. The Dragonflies (Odonata) of Burma and Lower Siam—II. Subfamilies Cordulegasterinae, Chlorogomphinae, and, by Edward Bruce Williamson.....	267	<i>elegans</i>	12
Gomphus.....	275, 304	<i>gracilis</i>	13, 15
(<i>Aeshna</i>) <i>thomassoni</i>	305	<i>heterorhabdus</i>	14
<i>ceylonicus</i>	305	<i>inconspicuous</i>	3, 14, 17
<i>kelantanensis</i>	304	<i>interruptus</i>	16
<i>personatus</i>	308	<i>kennedyi</i>	14
<i>promelas</i>	305	<i>lütkeni</i>	14, 16
<i>pryeri</i>	308, 311	<i>micropterus</i>	13, 15
<i>scissus</i>	308	<i>nanus</i>	12, 15
<i>vermiculatus</i>	298, 304	<i>riddlei</i>	13
<i>xanthanatus</i>	305, 308	<i>robustus</i>	147
Goniistius.....	163	<i>santæ</i>	2, 16
<i>quadricornis</i>	167	<i>schmardæ</i>	13
<i>vestitus</i>	166	<i>tridens</i>	2, 13, 15
<i>vittatus</i>	163, 166, 167	<i>ulreyi</i>	13
<i>zebra</i>	163, 164, 165, 166, 167	<i>unilineatus</i>	12
<i>zonatus</i>	164	<i>Hemiodus othonops</i>	4
Gorgoderinae.....	111	<i>Hemipterychina</i>	46
Grammoptiles.....	631	<i>Hemirhamphus fluviatilis</i>	540
Guatemala, by Messrs. Schwarz and Barber. On Some Earwigs (Forficulidae) collected in, by Andrew Nelson Caudell.....	169	<i>Hepatus celebius</i>	247
Guerin. The Crinoid Genus <i>Comatula</i> Lamarck, with a Note on the <i>Encrinurus</i> Parré of, by Austin Hobart Clark.....	683	<i>dussummieri</i>	247
Gurnards.....	649	<i>Herpestes semitorquatus</i>	559
Gurnards, and other Mail-cheeked Fishes of the Waters of Japan. A Review of the Flat-heads, by David Starr Jordan and Robert Earl Richardson.....	629	<i>Herpetocypridinae</i>	706
<i>Gymnocranius lethrinoides</i>	243	<i>Herpetocypris</i>	706
<i>Gymnosarda pelamys</i>	625	<i>testudinaria</i>	706
<i>Gymnothorax fimbriata</i>	239	<i>Herre, Albert Christian, and David Starr Jordan, A Review of the Cirrhitoid Fishes of Japan</i>	157
<i>singleenoides</i>	239	<i>Heterarina</i>	268
<i>Hemulidae</i>	243	<i>Heterakis</i>	95
		<i>foveolata</i>	93
		<i>Heterogomphus</i>	276, 315
		<i>icterops</i>	316
		<i>naninus</i>	314, 316
		<i>sumatranus</i>	316
		<i>unicolor</i>	316
		<i>Heterophryxus</i>	689
		<i>appendiculatus</i>	691
		<i>Hexanemathichthys felis</i>	596, 603, 625
		<i>Hibiscus</i>	719
		<i>Hippocampidae</i>	240
		<i>Hippocampus kuda</i>	240
		<i>Holcocera</i>	204
		<i>aphidella</i>	205

	Page.		Page.
Holococera chalcopfrontella.....	208	Indiana University, with Descriptions of	
fluxella.....	209	New Species. An Annotated List of Chara-	
fractilinea.....	202	cin Fishes in the United States National	
glandulella.....	201	Museum and the Museum of, by Carl H.	
iceryacella.....	210	Eigenmann and Fletcher Ogle.....	1
nigrostriata.....	204	Infrabasals in Recent Genera of the Crinoid	
nubillela.....	201	Family Pentacrinitidae, by Austin Hobart	
purpureocomella.....	207	Clark.....	671
retectella.....	201	Insects from Barbados and St. Vincent Is-	
triangularisella.....	201	lands. On a Collection of Thysanopterous,	
Holocentridae.....	241	by Henry James Franklin.....	715
Holocentrus ascensionis.....	94, 105	Insidiator.....	630, 631
caudimaculatum.....	241	hosokawae.....	634
cornutus.....	241	macrolepis.....	633
Holophryxus.....	689	rudis.....	635
alascensis.....	962	Iolaea.....	514, 518
californiensis.....	689, 692	Iole scitula.....	518
giardi.....	689, 690, 693	Ipomea.....	719
Holopristes ocellifer.....	11	Iridio bivittatus.....	106
riddlei.....	2, 11	radiatus.....	93, 104
Holothuria floridana.....	63	Irona nana.....	120
Holothurians of the North Pacific Coast of		Isobuna.....	158
North America collected by the Albatross		japonica.....	158
in 1903, by Charles Lincoln Edwards.....	49	Isoerinus.....	671
Homoiotes palliata.....	622	asteria.....	687
Homonymus.....	228	decorus.....	672, 673
coloradellus.....	228	leuthardi.....	671, 672
Hoplerythrinus uniteniatus.....	36	mülleri.....	688
Hoplias malabaricus.....	36	parre.....	687, 688
Hoplichthyidae.....	644	Isopods of the Family Dajidae from the	
Hoplichthys.....	644	Northwest Pacific Ocean, with Descrip-	
citrinus.....	646, 648	tions of a New Genus and Two New Spe-	
gilberti.....	646, 647, 648	cies. On Some, by Harriet Richardson.....	689
langsdoerfi.....	647	Ividia.....	514, 517
langsdoerfi.....	645, 647, 648	Japan. A Review of the Cirrhitoid Fishes of,	
pusillus.....	645	by David Starr Jordan and Albert Chris-	
Hot Spring in Lower California. Description		tian Herre.....	157
of a New Species of Killifish, Lucania		Japan. A Review of the Flat-heads, Gur-	
Browni, from a, by David Starr Jordan		nards, and other Mail-cheeked Fishes of the	
and Robert Earl Richardson.....	319	Waters of, by David Starr Jordan and	
Hough, Walter, The Pulque of Mexico.....	577	Robert Earl Richardson.....	629
Hydrocyon forskalii.....	31	Japan. On a Collection of Fishes from Echi-	
Hydrocyon pectoralis.....	31	go, by David Starr Jordan and Robert	
Hylobates concolor.....	570	Earl Richardson.....	263
leuciseus.....	570	Java. List of Fishes collected in the River at	
Hyocerinus.....	671	Buytenzorg by Dr. Douglas Houghton	
Hypatopa.....	211	Campbell, by David Starr Jordan and	
conia.....	212	Alvin Seale.....	535
episcia.....	211	Jordan, David Starr, and Albert Christian	
fasciata.....	213	Herre, A Review of	
orites.....	213	the Cirrhitoid	
texanella.....	208, 211	Fishes of Japan ...	157
Hyponomeuta.....	220	and Alvin Seale, List	
diaphorus.....	220	of Fishes Collected	
Hyponomeutidae.....	216	in the River at Buy-	
Hypselobagrus macronema.....	536	tenzorg, Java, by	
Ichthyoborus microlepis.....	31	Dr. Douglas	
Ichthyonema.....	96	Houghton Camp-	
globiceps.....	96	bell.....	535
Ictinus.....	272, 278	and Robert Earl	
decoratus.....	279	Richardson, A Re-	
melenops.....	279, 280	view of the Flat-	
pertinax.....	281	heads, Gurnards,	
rapax.....	279	and other Mail-	
tenax.....	278	cheeked Fishes of	
Immature nematodes.....	91, 93	the Waters of Ja-	
		pan.....	629

	Page.		Page.
Jordan, David Starr, and Robert Earl Richardson, Description of a New Species of Killifish, <i>Lucania Browni</i> , from a Hot Spring in Lower California	319	<i>Lepidopus</i>	324, 347
and Robert Earl Richardson, On a Collection of Fishes from Echigo, Japan	263	<i>Lepidotrigla</i>	649
<i>Kalophrynus</i>	573	<i>abyssalis</i>	652, 654
<i>acutirostris</i>	576	<i>alata</i>	650
<i>pleurostigma</i>	573, 576	<i>güntheri</i>	652, 653
<i>stellatus</i>	575	<i>japonica</i>	654
<i>Kerwoula hardwickii</i>	563	<i>longipinnis</i>	653
Killifish, <i>Lucania Browni</i> , from a Hot Spring in Lower California. Description of a New Species of, by David Starr Jordan and Robert Earl Richardson	319	<i>microptera</i>	651
<i>Konosirus nasus</i>	239	<i>serridens</i>	651
<i>Kuhlia malo</i>	242	<i>smithii</i>	651, 652
<i>rupestris</i>	242	<i>strauchi</i>	651
<i>Kuhliidae</i>	242	<i>Lepimaerus</i>	348
<i>Labia arcuata</i>	173	<i>jourdaini</i>	348
<i>bilineata</i>	173, 174	<i>Leporinus affinis</i>	9
<i>breviroceps</i>	174	<i>frederici</i>	7
<i>cacaoensis</i>	171	<i>megalepis</i>	7
<i>schwarzi</i>	173	<i>myuscorum</i>	7
Labrador and Newfoundland. Fresh-Water Crustacea from, by Joseph A. Cushman ..	705	<i>nattereri</i>	8
<i>Labridae</i>	245	<i>paræ</i>	2, 8
<i>Labrus marmoratus</i>	159	<i>reinhardtii</i>	7
<i>trichopterus</i>	541	<i>steindachneri</i>	2, 9
<i>Lachnolaimus maximus</i>	90, 106, 120	<i>striatus</i>	7
<i>Lactophrys tricornis</i>	108, 109	<i>tæniatus</i>	8
<i>trigonus</i>	108, 109	<i>trifasciatus</i>	7
<i>Læmargus</i>	330	<i>Leptogomphus</i>	273, 291, 304
<i>muricatus</i>	473	<i>assimilis</i>	291
Lamarek, with a Note on the <i>Enerinus</i> Paræ of Guérin. The Crinoid Genus <i>Comatula</i> , by Austin Hobart Clark	683	<i>gestroi</i>	291, 294
<i>Laminifera</i>	361, 377	<i>gracilis</i>	291
<i>cornuta</i>	361	<i>inclitus</i>	291, 293
<i>Lamna cornubica</i>	382, 386, 410, 423	<i>kelantanensis</i>	291
<i>monensis</i>	382	<i>lansbergei</i>	291
<i>Lanthus</i>	299	<i>maculivertex</i>	295
Larval <i>Libothria</i>	102	<i>nietneri</i>	295
<i>Lefua echigonia</i>	263	<i>Lernæenicus</i>	626
<i>nikkonis</i>	264	<i>radiatus</i>	624, 625
<i>Leiognathus dussumieri</i>	242	<i>Lernanthropus</i>	613, 616, 617
<i>edentula</i>	242	<i>brevooortia</i>	624
<i>Leiostomus xanthurus</i>	625	<i>Lethrinus harak</i>	244
<i>Lepeophtheirus</i>	382	<i>mashenoides</i>	244
<i>bifurcatus</i>	619	<i>miniatus</i>	244
<i>dissimulatus</i>	120, 625	<i>richardsoni</i>	244
<i>edwardsi</i>	326, 625, 626	<i>xanthotænia</i>	244
<i>hippoglossi</i>	605, 613, 619	<i>Leuciscus lateristriatus</i>	539
<i>longispinosus</i>	604, 626	<i>Libellulidae</i>	271
<i>monacanthus</i>	594, 600, 625	<i>Limosnia</i>	698
<i>robustus</i>	619	Linton, Edwin, Notes on Parasites of Bermuda Fishes	85
<i>Lepidaplois bilunulatus</i>	245	<i>Liogyra</i>	698
<i>Lepidocephalichthys hasseltii</i>	537	List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species. An Annotated, by Carl H. Eigenmann and Fletcher Ogle	1
		List of Fishes collected in the River at Buytenzorg, Java, by Dr. Douglas Houghton Campbell, by David Starr Jordan and Alvin Seale	535
		<i>Lithocolletis</i>	221
		<i>bifasciella</i>	223
		<i>ceriferæ</i>	222
		<i>cervina</i>	221
		<i>leucothorax</i>	223
		<i>Liza amarula</i>	240
		<i>troscheli</i>	240
		<i>wagiensis</i>	240

	Page.		Page.
Lizard from the Philippine Islands. A New Geckoid, by Leonhard Stejneger.....	54	Mason, Otis T., Basketry Bolo Case from Basilan Island.....	193
Lizard from the Philippine Islands. A New Species of Flying, by Leonhard Stejneger.....	677	Mearns, Surgeon, U. S. Army, with Descriptions of Seven New Species. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A., by Alvin Seale and Barton A. Bean.....	229
Lonsdaleia chinensis.....	37	Mearnssella.....	231
Lower California. Description of a New Species of Killifish, Lucania Browni, from a Hot Spring in, by David Starr Jordan and Robert Earl Richardson.....	319	alestes.....	231
Lower Siam—II. Subfamilies Cordulegasterinae, Chlorogomphinae, and Gomphinae. The Dragonflies (Odonata) of Burma and, by Edward Bruce Williamson.....	267	Megalaspis cordyla.....	242
Lucania browni.....	319	Melania campanella.....	494
Lucania Browni, from a Hot Spring in Lower California. Description of a New Species of Killifish, by David Starr Jordan and Robert Earl Richardson.....	319	rufa.....	504
Luciocharax.....	701, 702	Menestho.....	514, 520
Luettkenia.....	461	Menestomorpha.....	214
Luprosaurus.....	545	oblongata.....	214, 215
cumingii.....	546	Menidia menidia.....	625
macgregori.....	545	Merogomphus.....	276, 316
Lutianidae.....	243	Merone americana.....	625
Lutianus chrysotaenia.....	243	Metacrinus.....	671
fulvillamma.....	243	angulatus.....	674
gibbus.....	243	rotundus.....	671, 672, 673, 674, 675, 676
kasmira.....	243	superbus.....	674, 675
marginatus.....	243	Metaxia diadema.....	182
monostigma.....	243	metaxae.....	183
rivulatus.....	243	Metynnis hypsauchen.....	35
vitta.....	243	Mexico, The Pulque of, by Walter Hough.....	577
Lutra barang.....	560	Michelinea concinna.....	39
lovii.....	560	favositoides.....	38, 39
Luvatus.....	461	Micralestes interruptus.....	50
Lycodontis moringa.....	94, 96, 112	Microcotyle.....	103
Lyceidae.....	710	Microgomphus.....	273, 295
Lyceus sphericus.....	711	chelifer.....	295
Lyncodaphnidae.....	708	Micropogon undulatus.....	104, 625
Lyon, Marcus Ward, jr., Mammals collected in Western Borneo, by Dr. W. L. Abbott.....	547	Mola.....	461
Mabuya multicarinata.....	545	mola.....	471, 478, 483
Macaca broca.....	566	Mollusk Planorbis Magnificus, and Descriptions of Two New Forms of the Same Genus from the Southern States. Notes on the Fresh-Water, by Paul Bartsch.....	697
fascicularis.....	565	Mollusks from the West Coast of America. New Marine, by Paul Bartsch.....	177
nemestrina.....	565, 566	Mollusks of the Genus Triphoris. The West American, by Paul Bartsch.....	249
Macrogomphus.....	273, 287, 290	Mollusks of the Oregonian Faunal Area. The Pyramidellid, by William Healey Dall and Paul Bartsch.....	491
Maerones planiceps.....	536	Molpadia borealis.....	53
Macropteronotus magur.....	535	Mompha sexnotella.....	219
Macrothrix.....	709	Monoculus pulex.....	707
hirsuticornis.....	705, 709	Monopteride.....	535
Mail-cheeked Fishes of the Waters of Japan. A Review of the Flat-heads, Gurnards, and other, by David Starr Jordan and Robert Earl Richardson.....	629	Monopteris albus.....	535
Mammals collected in Western Borneo by Dr. W. L. Abbott, by Marcus Ward Lyon, jr.....	547	Monostomum.....	118
Manis javanica.....	548	vinal-edwardsii.....	118
Mapo fuscus.....	248	Mormula.....	510
Marine Mollusks from the West Coast of America. New, by Paul Bartsch.....	177	rissoina.....	510
Markiana nigripinnis.....	30	Moths. Descriptions of New North American Tineid, with a Generic Table of the Family Blastobasidae, by Lord Walsingham.....	197
Martyn's Universal Conchologist. Supplementary Notes on, by William Healey Dall.....	185	Mountains of Ecuador. A New Fresh-Water Bivalve (Corneocyclus) from the, by Paul Bartsch.....	681
		Mugil cephalus.....	625
		Mugilidae.....	240
		Mullidae.....	245
		Mullus barbatus.....	649

	Page.		Page.
<i>Mumiola tenuis</i>	520	New Marine Mollusks from the West Coast of America, by Paul Bartsch.....	177
<i>Muntiacus pleiharius</i>	550	New North American Tineid Moths, with a Generic Table of the Family Blastobasidae. Descriptions of, by Lord Walsingham.....	197
<i>Muræridæ</i>	239	New Species, An Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of, by Carl H. Eigenmann and Fletcher Ogle.....	1
<i>Mus ephippium</i>	558	New Species of Flying Lizard from the Philippine Islands, by Leonhard Stejneger.....	677
Museum of Indiana University, with Descriptions of New Species. An Annotated List of Characin Fishes in the United States National Museum and the, by Carl H. Eigenmann and Fletcher Ogle.....	1	New Species of Killifish, <i>Lucania Browni</i> , from a Hot Spring in Lower California. Description of a, by David Starr Jordan and Robert Earl Richardson.....	319
Mush rajah.....	558	New Species of Recent Unstalked Crinoids from the Coasts of Northeastern Asia. Descriptions of, by Austin Hobart Clark.....	127
<i>Mustelus canis</i>	423	New Species of Recent Unstalked Crinoids from the North Pacific Ocean. Descriptions of, by Austin Hobart Clark.....	69
<i>Mycteroperca apua</i>	89, 90, 91, 92, 94, 97, 98, 105, 119, 120	New Species of Toads from the Philippines. Two, by Leonhard Stejneger.....	573
<i>Myletes baremose</i>	29	New Species of Upper Paleozoic Fossils from China. Descriptions of, by George H. Girty.....	37
<i>dentex</i>	29	New Species. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with Descriptions of Seven, by Alvin Seale and Barton A. Bean.....	229
<i>Myleus levis</i>	36	New Species. On Some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with Descriptions of a New Genus and Two, by Harriet Richardson.....	689
<i>Mylossoma albigobius</i>	56	<i>Nogagus angustulus</i>	350, 357, 424, 426, 432, 446, 447, 448
<i>Myotis muricola</i>	563	<i>borealis</i>	437, 446, 448, 459
<i>Myrica cerifera</i>	222	<i>braccatus</i>	366
<i>Myripristis macrolepis</i>	241	<i>brevicaudatus</i>	446, 448, 460
<i>murdjan</i>	241	<i>caelebs</i>	446, 448, 455, 458
<i>Nannæthiops unitæniatus</i>	29	<i>curticaudis</i>	434, 436
<i>Nannosciurus borneanus</i>	558	<i>elongatus</i>	407, 446, 455, 458
<i>exilis</i>	558	<i>errans</i>	447, 452, 455
<i>Nasalis larvatus</i>	569	<i>gracilis</i>	442, 447, 452
National Museum and the Museum of Indiana University, with Descriptions of New Species. An Annotated List of Characin Fishes in the United States, by Carl H. Eigenmann and Fletcher Ogle.....	1	<i>grandis</i>	349, 350, 379, 446, 453
Neglected Genus of Characin Fishes, with Notes on the Typical Species. On <i>Ctenolucius Gill</i> , A, by Barton A. Bean.....	701	<i>latreillii</i>	407, 426, 442, 460
<i>Nemacheilus fasciatus</i>	537	<i>luetkeni</i>	447, 454
<i>Nematoda</i>	90	<i>lunatus</i>	446, 454
<i>Neolobophora ruficeps</i>	175	<i>murrayi</i>	447, 455
<i>Neomænis apodus</i>	92	<i>productus</i>	380, 441, 447, 457
<i>griseus</i>	90, 92, 94, 96, 98	<i>socialis</i>	446, 457
<i>hastingsi</i>	90	<i>spinacii-achantias</i>	446, 458, 460
<i>synagris</i>	98, 102, 118	<i>tenax</i>	426, 442, 446, 448, 459, 460
<i>Neoplatycephalus</i>	640	<i>validus</i>	397, 399, 400, 435, 436, 442, 446, 461
<i>Nerocila acuminata</i>	120	<i>Nogaus</i>	439
<i>Nessipus</i>	330, 424	<i>latreillii</i>	439, 444, 446, 454
<i>alatus</i>	324, 426, 442, 446, 460, 626	<i>North America</i> , collected by the Albatross in 1903. The Holothurians of the North Pacific Coast of, by Charles Lincoln Edwards.....	49
<i>angustatus</i>	431, 432, 433, 434, 448	<i>North American Parasitic Copepods</i> belonging to the Family Caligide. A Revision of the Pandarinæ and the Cecropinæ, by Charles Branch Wilson.....	323
<i>borealis</i>	437	<i>North American Parasitic Copepods</i> , New Genera and Species of Caliginæ, by Charles Branch Wilson.....	593
<i>curticaudis</i>	434		
<i>orientalis</i>	424, 446, 456		
New Forms of the same Genus from the Southern States. Notes on the Fresh-Water Mollusk <i>Planorbis Magnus</i> and Descriptions of Two, by Paul Bartsch.....	697		
Newfoundland. Fresh-Water Crustacea from Labrador and, by Joseph A. Cushman.....	705		
New Fresh-Water Bivalve (<i>Corneocyclus</i>) from the Mountains of Ecuador, by Paul Bartsch.....	681		
New Geckoid Lizard from the Philippine Islands, by Leonhard Stejneger.....	545		
New Genera and Species of Caliginæ. North American Parasitic Copepods, by Charles Branch Wilson.....	593		
New Genus and Two New Species. On Some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with Descriptions of a, by Harriet Richardson.....	689		

	Page.		Page.
North American Tineid Moths, with a Generic Table of the Family Blastobasidae. Descriptions of New, by Lord Walsingham.....	197	<i>Odostomia</i> (<i>Evalea</i>) <i>phaneá</i>	528
Northeastern Asia. Descriptions of New Species of Recent Unstalked Crinoids from the Coasts of, by Austin Hobart Clark....	127	<i>tacomaensis</i>	526
North Pacific Coast of North America collected by the Albatross in 1903. The Holothurians of the, by Charles Lincoln Edwards.....	49	<i>tenuisculpta</i>	527
North Pacific Ocean. Descriptions of New Species of Recent Unstalked Crinoids from the, by Austin Hobart Clark.....	69	<i>tillamookensis</i>	522
Northwest Pacific Ocean, with Descriptions of a New Genus and Two New Species. On Some Isopods of the Family Dajidae from the, by Harriet Richardson.....	689	<i>valdezi</i>	526
Note on the <i>Encrinus</i> Parrae of Guerin. The Crinoid Genus <i>Comatula</i> Lamarck, with a, by Austin Hobart Clark.....	683	<i>inflata</i>	523
Notes on Martyn's Universal Conchologist. Supplementary, by William Healey Dall..	185	(<i>Iolaea</i>) <i>amianta</i>	579
Notes on Parasites of Bermuda Fishes, by Edwin Linton.....	85	(<i>Ividia</i>) <i>navisa</i>	517, 518
Notes on the Fresh-Water Mollusk Planorbis Magnificus and Descriptions of Two New Forms of the same Genus from the Southern States, by Paul Bartsch.....	697	<i>delmon tensis</i>	518
Notes on the Typical Species. On <i>Ctenolucius</i> Gill, A Neglected Genus of Characin Fishes, with, by Barton A. Bean.....	701	(<i>Menestho</i>) <i>exara</i>	521
<i>Notogomphus</i>	300	<i>harfordensis</i>	521
<i>Notophryxus</i>	689	<i>pharcida</i>	520
<i>Nototheniidae</i>	248	<i>nuciformis</i>	530
<i>Notothyris djoulfensis</i>	47	<i>satura</i>	529
<i>inflata</i>	47	<i>straminea</i>	527
<i>willisiana</i>	46	<i>var. gouldi</i>	531
<i>Nycticebus borneanus</i>	565	<i>Oecophora inunctella</i>	211
<i>Ocyurus chrysurus</i>	90, 100, 102, 109, 118	<i>Oecophoridae</i>	199
<i>Odonata</i>	271	<i>Ofryoxus gracilis</i>	708
(<i>Odonata</i>) of Burma and Lower Siam—II Subfamilies <i>Cordulegasterinae</i> <i>Chlorogomphinae</i> , and <i>Gomphinae</i> . The Dragonflies, by Edward Bruce Williamson.....	267	Ogle, Fletcher, and Carl H. Eigenmann, An Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University, with Descriptions of New Species.....	1
<i>Odontobutis obscurus</i>	248	<i>Ompox bimaculatus</i>	536
<i>Odontonectes</i>	243	<i>siluroides</i>	536
<i>Odontostilbe microcephalus</i>	2, 10	On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with Descriptions of Seven New Species, by Alvin Seale and Barton A. Bean.....	229
<i>Odostomia</i>	513	On some Earwigs (<i>Forficulidae</i>) Collected in Guatemala by Messrs. Schwarz and Barber, by Andrew Nelson Caudell.....	169
(<i>Amaura</i>) <i>gouldi</i>	528, 531	<i>Onychogomphus</i>	269, 275, 305, 308, 313, 316
<i>kennerleyi</i>	529	<i>annularis</i>	308, 312
<i>montereyensis</i>	531	<i>biforceps</i>	308
<i>nuciformis</i>	530, 531	<i>bistrigatus</i>	309
<i>avellana</i>	530, 531	<i>camelus</i>	309
<i>satura</i>	529	<i>cerastis</i>	309
<i>avellana</i>	530	<i>circularis</i>	309, 312
(<i>Chrysallida</i>) <i>astriata</i>	515	<i>flexuosus</i>	314
<i>cooperi</i>	514	<i>frontalis</i>	309
<i>montereyensis</i>	516	<i>geometricus</i>	309
<i>oregonensis</i>	516	<i>grammivus</i>	309
(<i>Evalea</i>) <i>angularis</i>	523	<i>inscriptus</i>	309
<i>columbiana</i>	525	<i>lineatus</i>	309
<i>deliciosa</i>	525	<i>maclachlani</i>	310, 313
<i>gouldi</i>	528	<i>m-flavum</i>	310
<i>inflata</i>	524	<i>modestus</i>	310
<i>jewetti</i>	523	<i>nigrescens</i>	310
		<i>reinwardtii</i>	310
		<i>saundersii</i>	311, 312, 314
		<i>thomassoni</i>	311
		<i>Ophicephalidae</i>	540
		<i>Ophicephalus gachna</i>	541
		<i>striatus</i>	540
		<i>Ophryoxus gracilis</i>	708
		<i>Opisthocosmia americana</i>	175
		<i>Oplichthys</i>	644
		<i>langsdorffii</i>	645
		Oregonian Faunal Area. The Pyramidellid Mollusks of the, by William Healey Dall and Paul Bartsch.....	491
		<i>Orcophryne celebensis</i>	574
		<i>Ornix</i>	224

	Page.		Page.
Ornix innotata	224	Pandarus unicolor	447, 460
Orogomphus	272, 277	vulgaris	396, 403
speciosus	278	zygaene	396, 415, 416
splendidus	277, 278	Pannychia moseleyi	62
Orthagorisciola	461, 472	var. henrice	62
muricata	472, 473	wood-masoni	63
Orthopristis chrysopterus	625	Parabembras	642, 644
Orthagoriscus	461	curtus	644
Osphromenide	541	Paracirrhites	158
Osphromenus striatus	541	japonicus	158
trichopterus	541	Paradoxurus philippinensis	559
Osteochilus hasseltii	539	Paralichthys lethostigmus	625
Ostracoda	706	Paranthias fureifer	92, 99, 101, 102, 117
Otobothrium crenacolle	99	Paraperis cylindrica	248
penetrans	100	Parapetalus	606
Otohime	649, 655, 658	occidentalis	594, 607, 626
hemisticta	658	Parasites of Bermuda Fishes. Notes on, by	
Pachysoma brachyotis	562	Edwin Linton	85
Pacific Coast of North America collected by		Parasitic Copepods	120
the Albatross in 1903. The Holothurians		Parasitic Copepods belonging to the Family	
of the North, by Charles Lincoln Edwards	49	Caligidae. North American, A Revision of	
Pacific Ocean. Descriptions of New Species		the Pandarinae and the Cecropinae, by	
of Recent Unstalked Crinoids from the		Charles Branch Wilson	323
North, by Austin Hobart Clark	69	Parasitic Copepods, North American, New	
Pacific Ocean, with Descriptions of a New		Genera and Species of Caliginae, by Charles	
Genus and Two New Species. On Some		Branch Wilson	593
Isopods of the Family Dajidae from the		Parodon affinis	6
Northwest, by Harriet Richardson	689	paraguayensis	2, 6
Paederus laetus	169	piracicabae	2, 6
Pagrus major	165	Parrae of Guerin. The Crinoid Genus Coma-	
Paleozoic Fossils from China. Descriptions		tula Lamarek, with a Note on the Ecerinus,	
of New Species of Upper, by George H.		by Austin Hobart Clark	683
Girty	37	Parthenia armata	517
Pallasina aix	265	Pasipheea pacifica	692
barbata	264, 265	Pegasidae	240
eryngia	264	Pelecypoda	47
Panchax buehanani	540	Pennella	477
Pandarinæ	325, 345	Pentacrinitidae. Infrabasals in Recent Ge-	
Pandarinæ and the Cecropinae. A Revision		nera of the Crinoid Family, by Austin	
of North American Parasitic Copepods		Hobart Clark	671
belonging to the Family Caligidae, by		Pentacrinus	671
Charles Branch Wilson	323	mülleri	687
Pandarus	362, 374, 387	Pentacta calcigera	54
affinis	431, 433, 446, 448, 450	Pentapus nemurus	244
alatus	365, 367	Perca scandens	541
armatus	448	Perissopus	347, 352
bicolor	324, 387, 394, 396, 400, 446, 448	communis	340, 354, 361, 446, 626
bosci	400	dentatus	352, 353, 354, 361
brevicaudatus	397	Peristediidae	659
brevicaudis	397, 400, 435, 436, 461	Peristedion	659
carehariae	403, 453	amicus	661
cocinnatus	397	orientale	660
concinnus	396	rieffeli	662
cranchii	393,	Peristethus	659
396, 403, 444, 446, 450, 454, 624, 626		orientale	660
dentatus	403, 407, 436, 451	rieffeli	662
fissifrons	400	Petalurinae	272
lamnae	374, 380, 382, 396	Phenacogrammus	3, 30
latreillii	403	Philippine Islands. A New Geckoid Lizard	
lividus	396	from the, by Leonhard Stejneger	545
musteli-levis	396, 447, 456, 460	Philippine Islands. A New Species of Flying	
pallidus	403	Lizard from the, by Leonhard Stejneger	677
satyrus	396, 397, 415	Philippine Islands, made by Maj. Edgar A.	
sinuatus	417, 446	Mearns, Surgeon, U. S. Army, with De-	
smithii	410, 446	scriptions of Seven New Species. On a Col-	
spinacii-achantias	444, 447, 458	lection of Fishes from the, by Alvin Seale	
		and Barton A. Bean	229

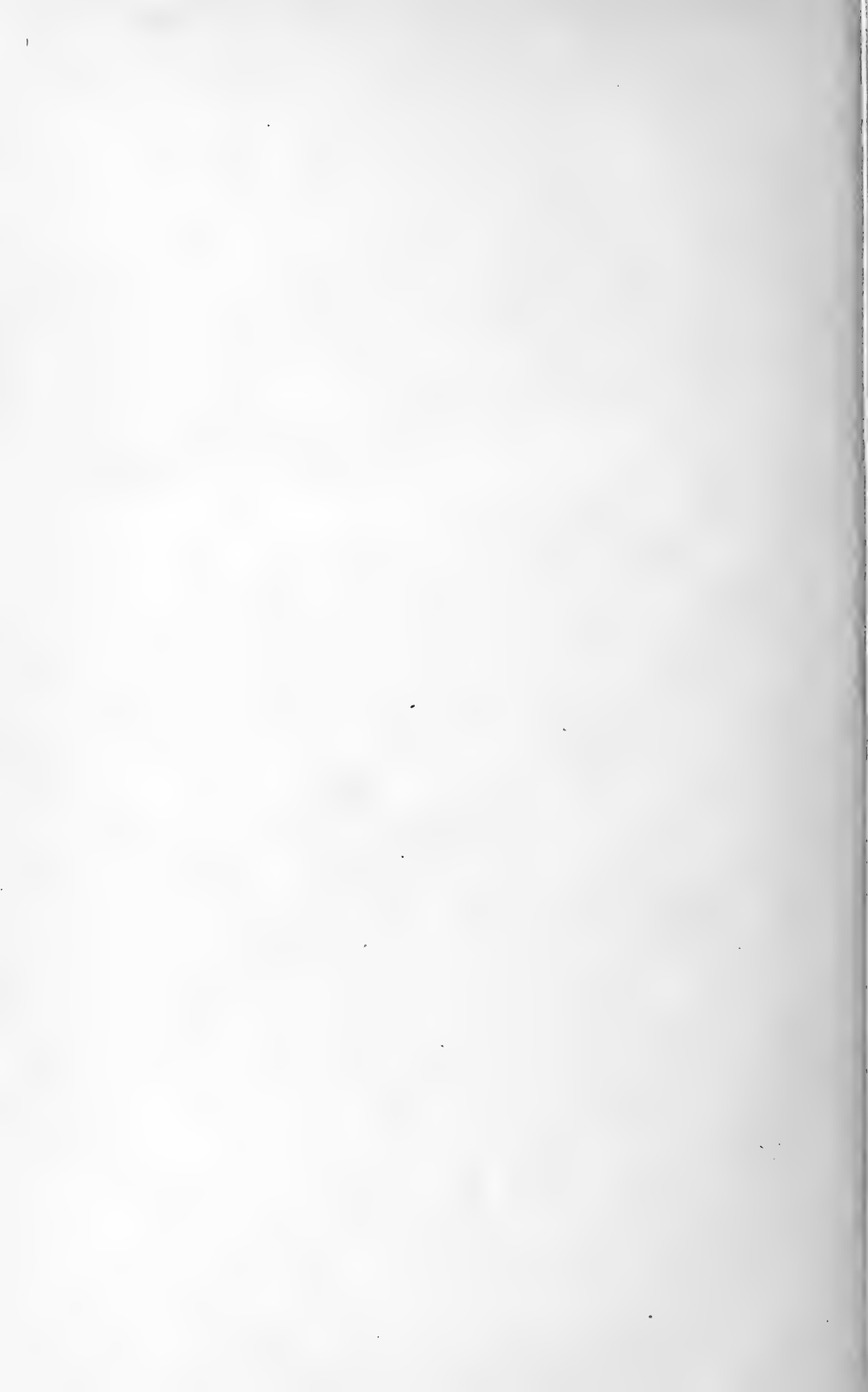
	Page.		Page.
Philippines. Two New Species of Toads from the, by Leonhard Stejneger.....	573	Prionæe glauca.....	416
Philorthagoriscus.....	461, 478	Prionotus japonicus.....	654
serratus.....	478, 479	tribulatus.....	626
Phoeothripidae.....	724	Priopis lungi.....	242
Pholidopus.....	324, 347	urotenia.....	242
Phrynixalus.....	573	Pristipoma hasta.....	244
anulatus.....	573, 574	Prochilodus beani.....	2, 5
Phyllodistomum.....	119	insignis.....	5
Phyllophora.....	361	scrofa.....	6
cornuta.....	361	vimboides.....	5
Physapus.....	729	Prodajus.....	689
rubrocineta.....	723	loblanceol.....	696
Piabucina panamensis.....	31	Prosætes.....	459
Piabucus melanostomus.....	31	Prunus serotinus.....	216
Piactus brachypomus.....	36	Psalis.....	172
Pimelodus maculatus.....	603	Psectrogaster auratus.....	3
Planorbis.....	697	curviventris.....	3
bicarinatus.....	699	Pseudoxylesthia.....	226
eucosmius.....	699	angustella.....	226
vaughani.....	699	Pseudupeneus moana.....	245
magnificus.....	698	Pteroplatea maclura.....	626
Planorbis Magnificus and Description of Two New Forms of the same Genus from the Southern States. Notes on the Fresh- Water Mollusk, by Paul Bartsch.....	697	Pulque of Mexico, by Walter Hough.....	577
Planorbis (Pierosoma) magnificus.....	697	Puntius obtusirostris.....	558
Platacidae.....	246	rubripinnis.....	558
Platax orbicularis.....	246	Pygocentrus altus.....	35
Platycephalidae.....	629, 644	nattereri.....	35
Platycephalus.....	640	scapularis.....	35
angustus.....	641	Pyragra chontalia.....	171
asper.....	630	Pyramidellid Mollusks of the Oregonian Faunal Area, by William Healey Dall and Paul Bartsch.....	491
crocodilus.....	636, 638	Pyrgiseus.....	504
fuscus.....	630	Pyrgolampros.....	498
guttatus.....	638	mioperplicatulus.....	498
insidiator.....	641	Rachycentron canadus.....	610, 623, 626
japonicus.....	636	Rashora lateristriata.....	539
macrolepis.....	630, 634	punctulatus.....	232
meerdervoortii.....	635	Ratufa ephippium.....	557
polyodon.....	630	Recent Genera of the Crinoid Family Penta- crinitidae. Infrabasals in, by Austin Ho- bart Clark.....	671
pristiger.....	630	Recent Unstalked Crinoids from the Coasts of Northeastern Asia. Descriptions of New Species of, by Austin Hobart Clark.....	127
punctatus.....	638	Recent Unstalked Crinoids from the North Pacific Ocean. Descriptions of New Species of, by Austin Hobart Clark.....	69
rudis.....	635	Reticularia lineata.....	45
spathula.....	641	Reticularias pseudolineata.....	45
spinous.....	633	Review of the Cirrhitoid Fishes of Japan, by David Starr Jordan and Albert Christian Herre.....	157
Platygomphus.....	275, 303	Review of the Flat-heads, Gurnards, and other Mail-checked Fishes of the Waters of Japan, by David Starr Jordan and Robert Earl Richardson.....	629
dolabratus.....	303	Revision of the Pandarinæ and the Cæro- pina. North American Parasitic Copepods belonging to the Family Caligidae, by Charles Branch Wilson.....	323
feæ.....	303	Rhaphiodon vulpinus.....	31
? ocellatus.....	303	Rhinocypha.....	268
Plectrothynchus hematochir.....	244	Rhinodon typicus.....	439
Pleuronectes.....	461	Rhinolophus trifoliatus.....	563
Plotosidæ.....	239	Rhombopora lepidodendroides.....	43
Plotosus anguillaris.....	239	obliqua.....	43
Pocillidae.....	540		
Polydactylus opercularis.....	234		
plebeius.....	241		
zophomus.....	241		
Polynemidæ.....	234		
Pomacentridæ.....	245		
Pomo pygmaeus pygmaeus.....	571		
Presbytis chrysomelas.....	567, 568		
cristata.....	568		
rubicundus.....	567		
sumatranus.....	567		
Priacanthus arenatus.....	120		

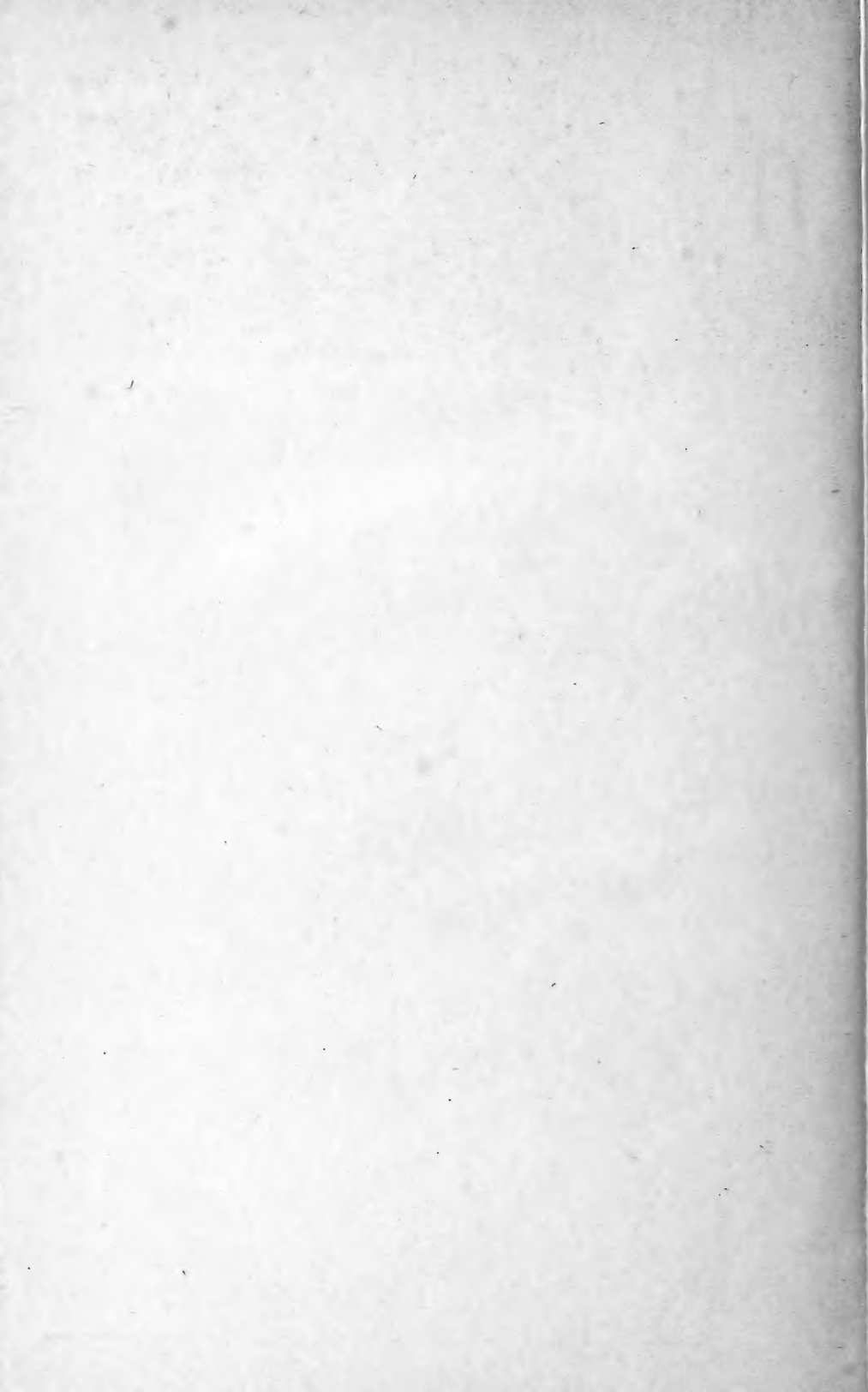
	Page		Page
Rhombopora polyporata.....	43	Seymnus glacialis.....	382
Rhynchobothrium bisulcatum.....	100	Seale, Alvin, and Barton A. Bean, On a Col- lection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Sur- geon, U. S. Army, with De- scriptions of Seven New Species.....	229
speciosum.....	98, 99	and David Starr Jordan, List of Fishes Collected in the River at Buytenzorg, Java, by Dr. Douglas Houghton Campbell.....	535
spiracornutum.....	98	Seila montereyensis.....	177
Rhytidodus microlepis.....	4	Scelene vomer.....	478
Richardson, Harriet, On Some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with Descriptions of a New Genus and Two New Species.....	689	Semnopithecus chrysomelas.....	567
Richardson, Robert Earl, and David Starr Jordan, A Review of the Flat-heads, Gur- nards, and other Mail-checked Fishes of the Waters of Japan.....	629	Seriola dumerilii.....	114
Description of a New Species of Killifish, <i>Lucania Browni</i> , from a Hot Spring in Lower Cali- fornia.....	319	fasciata.....	113
On a Collection of Fishes from Echigo, Japan.....	263	lalandi.....	626
River at Buytenzorg, Java, by Dr. Douglas Houghton Campbell. List of Fishes Col- lected in the, by David Starr Jordan and Alvin Seale.....	535	Serranidae.....	235, 242
Ræboides myersi.....	32	Serrasalmo brandti.....	35
prognathus.....	32	marginatus.....	35
xenodon.....	32	spilopleura.....	35
Rogadius.....	630	Seven New Species. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with Descriptions of, by Alvin Seale and Barton A. Bean.....	229
asper.....	630	Siam—II. Subfamilies Cordulegasterinae, Chlorogomphinae, and Gomphinae. The Dragonflies (Odonata) of Burma and Lower, by Edward Bruce Williamson.....	267
Rohira hasseltii.....	539	Sieboldius.....	272, 285
Rusa brookei.....	550	japonicus.....	285
Salaminus maxillosus.....	34	Siganidae.....	247
Salariichthys textilis.....	118	Siganus fuscescens.....	247
Sarcodaces odoe.....	36	virgatus.....	247
Scardia.....	225	Sillaginidae.....	245
anatomella.....	226	Sillago maculato.....	245
gracilis.....	225	Siluridae.....	536
Scarichthyidae.....	236, 245	Silurus batrachus.....	535
Scarichthys auritus.....	245	bimaculatus.....	536
cæruleopunctatus.....	245	inermis.....	636
Scatophagidae.....	246	Simia cristata.....	568
Scatophagus argus.....	246	leucisca.....	570
Schizodon fasciatus.....	7	pygmaeus.....	571
Schwarz and Barber. On Some Earwigs (Forficulidae) Collected in Guatemala by Messrs. Andrew Nelson Caudell.....	169	Simocephalus.....	707
Scienidae.....	245	expinosus.....	708
Sciurus bangkanus.....	555	serrulatus.....	707
borneoensis.....	552, 555	vetulus.....	708
borneoensis.....	552, 553	Southern States. Notes on the Fresh-Water Mollusk Planorbis Magnificus and De- scriptions of Two New Forms of the same Genus from the, by Paul Bartsch.....	697
palustris.....	553, 554	Sparatta flavipennula.....	173
prevostii.....	552	minuta.....	172
dulitensis.....	555	Sparidae.....	244
ephippium.....	557	Species of Caliginæ. North American Para- sitic Copepods, New Genera and, by Charles Branch Wilson.....	593
hippurellus.....	557	Species of Flying Lizard from the Philippine Islands. A New, by Leonhard Stejneger.....	677
prevostii.....	554	Species of Killifish, <i>Lucania browni</i> , from a Hot Spring in Lower California. Descrip- tion of a New, by David Starr Jordan and Robert Earl Richardson.....	319
rafflesii var. borneoensis.....	552		
sanggaus.....	554, 555		
vitatus dulitensis.....	555		
Seolex polymorphus.....	101		
Scoliodon terræ-novæ.....	360, 424, 431, 626		
Scolopsis bimaculatus.....	244		
cancellatus.....	244		
Scomber macrolepidotus.....	241		
Scombridae.....	241		
Scombroides tala.....	241		
toloo-parah.....	241		
Scorpenidae.....	248		

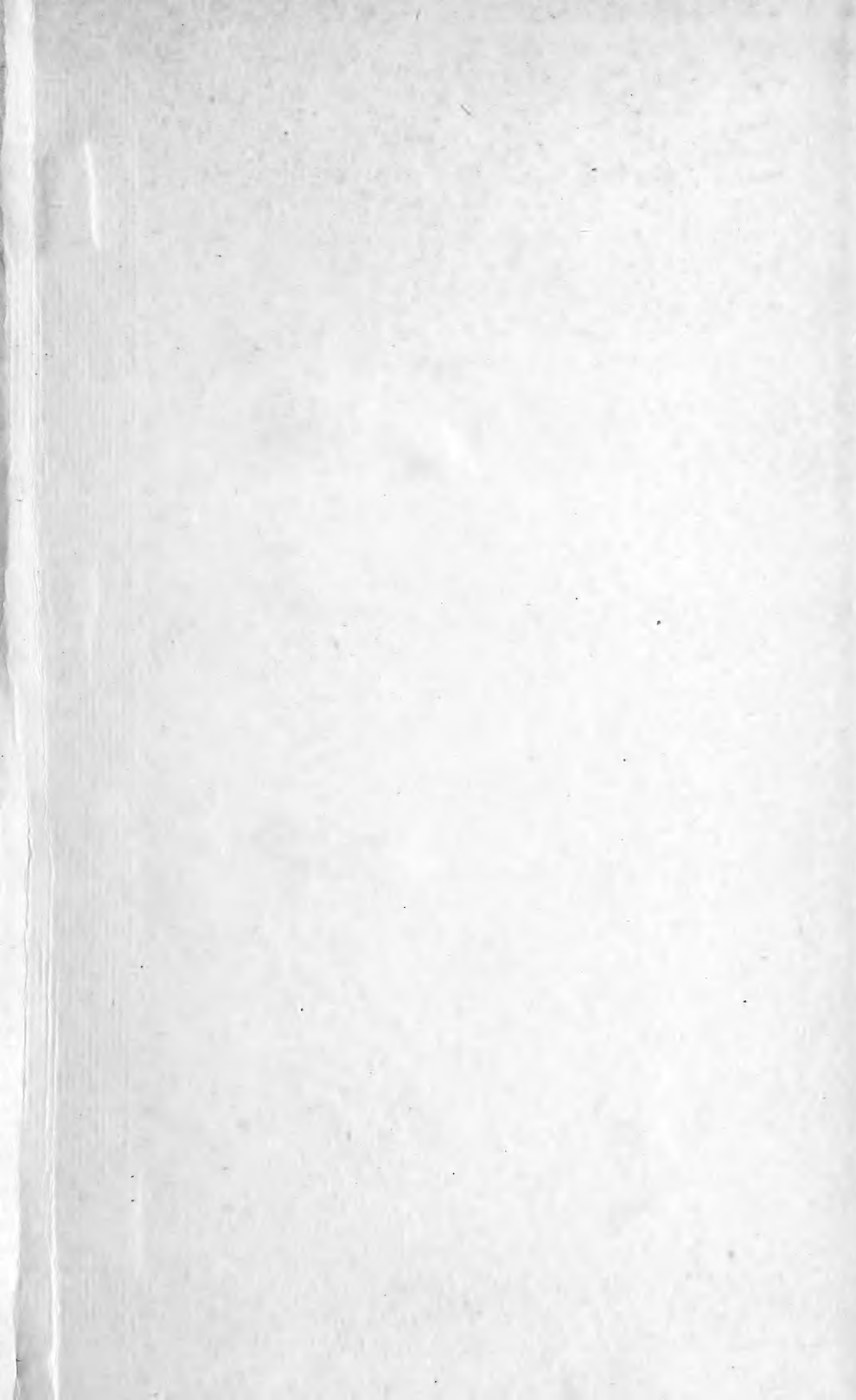
Page.	Page.
Species of Recent Unstalked Crinoids from the Coasts of Northeastern Asia. Descriptions of New, by Austin Hobart Clark.....	127
Species of Recent Unstalked Crinoids from the North Pacific Ocean. Descriptions of New, by Austin Hobart Clark.....	69
Species of Toads from the Philippines. Two New, by Leonhard Stejneger.....	573
Species of Upper Paleozoic Fossils from China. Descriptions of New, by George H. Girty.....	37
Species. On a Collection of Fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with Descriptions of Seven New, by Alvin Seale and Barton A. Bean.....	229
Species. On Some Isopods of the Family Dajidae from the Northwest Pacific Ocean, with Descriptions of a New Genus and Two New, by Harriet Richardson.....	689
Specilligus curticaudis.....	434, 442, 446, 451
Sphenomorphus jagorii.....	545
Spheroides lunaris.....	248
Sphingolabis linearis.....	175
Sphyræna obtusata.....	241
sphyræna.....	116
Sphyræniidae.....	241
Sphyrna tiburo.....	431, 626
zygæna.....	416, 431
Spinax achantias.....	458
Spirifer blackwelderi.....	45, 46
lineatus.....	45
radiatus.....	46
Spirigera prouti.....	45
Spongophora pygmaea.....	174, 175
Spring in Lower California. Description of a New Species of Killifish, <i>Lucania Browni</i> , from a Hot, by David Starr Jordan and Robert Earl Richardson.....	319
Squalus achantias.....	452
canis.....	422
Stagmatophora.....	219
argyroela.....	220
sexnotella.....	219
Stasiotes.....	325
rhinodontis.....	439
Stejneger, Leonhard, A New Geckoid Lizard from the Philippine Islands.....	545
A New Species of Flying Lizard from the Philippine Islands.....	677
Two New Species of Toads from the Philippines.....	573
Stenomatidae.....	214
Stichopus californica.....	64
challengeri.....	65
japonicus.....	63
Strioturbonilla.....	495
alpina.....	495
styliana.....	498
St. Vincent Islands. On a Collection of Thysanopterous Insects from Barbados and, by Henry James Franklin.....	715
Subfamilies Cordulegasterinae, Chlorogomphinae, and Gomphinae. The Dragonflies (Odonata) of Burma and Lower Siam, by Edward Bruce Williamson.....	267
Supplementary Notes on Martyn's Universal Conchologist, by William Healey Dall.....	185
Sus barbatus.....	550
Synandrium horridum.....	248
Synapta rotifera.....	50
Syngnathidae.....	240
Syngnathus schlegelii.....	240
Synodus foetens.....	105, 616, 626
saurus.....	105
Table of the Family Blastobasidae. Descriptions of New North American Tineid Moths, with a Generic, by Lord Walsingham.....	197
Tarsius tarsier.....	565
Temnopithecus hosei.....	567
Terapon jarbua.....	243
theraps.....	243
Tetragonopterus argenteus.....	18
bellottii.....	9
fasciatus interruptus.....	9, 45
rivularis interrupta.....	16
Tetraodon immaculatus.....	248
patoca.....	248
reticulatus.....	248
Tetraodontidae.....	248
Tetrarhynchus bisulcatus.....	100
Teuthis cœruleus.....	118
Thecagaster.....	276
brevistigma.....	277
Thoracocharax.....	31
Thripidae.....	715
Thynnus.....	461
Thysanophrys.....	630, 631
crocodilus.....	636, 638
inermis.....	636
japonicus.....	636, 639, 640
macrolepis.....	634
meerervoortii.....	635
spinus.....	633
Thysanopterous Insects from Barbados and St. Vincent Islands. On a Collection of, by Henry James Franklin.....	715
Tinea.....	227
sparsipunctella.....	227
Tineid Moths, with a Generic Table of the Family Blastobasidae. Descriptions of New North American, by Lord Walsingham.....	197
Tineidae.....	221
Tischeria.....	224
albostraminea.....	224
Toads from the Philippines. Two New Species of, by Leonhard Stejneger.....	573
Torpedo occidentalis.....	373
Toxotes jaculatrix.....	245
Toxotidae.....	245
Trachurops crumenophthalmus.....	120
Trachynotus carolinus.....	104
Tragus borneanus.....	550
hosei.....	549
kanchil hosei.....	549

	Page.		Page.
<i>Tragulus napu</i>	550	<i>Turbonilla (Pyrgolampros) lyalli</i>	500
<i>virgicollis</i>	549	<i>newcombei</i>	501, 503
<i>Trebius</i>	330	<i>oregonensis</i>	503
<i>Trematoda</i>	103	<i>taylori</i>	499
<i>Trichiurus lepturus</i>	626	<i>valdezi</i>	502
<i>Trichopus striatus</i>	541	<i>victoriana</i>	501
<i>Trichostomum dichotoma</i>	220	(<i>Stricturbonilla</i>) <i>serre</i>	497
<i>Trichothrips niger</i>	725	<i>styliana</i>	497
<i>Triforis adversa</i>	249, 252	<i>vancouverensis</i>	495
<i>Trigla</i>	655	<i>torquata</i>	495, 496
<i>alata</i>	650	(<i>Turbonilla</i>) <i>gilli</i>	493
<i>bürgeri</i>	650	<i>delmontensis</i>	494
<i>hemisticta</i>	658	<i>typica</i>	492
<i>kumu</i>	656	<i>Tuxophorus</i>	617
<i>dorsomaculata</i>	656	<i>caligodes</i>	617, 625, 626
<i>pictipinnis</i>	656	Two New Forms of the same Genus from	
<i>spinosa</i>	656	the Southern States. Notes on the Fresh-	
<i>volitans</i>	664	Water Mollusk <i>Planorbis Magnificus</i> and	
<i>Triglidae</i>	644, 649	Descriptions of, by Paul Bartsch.....	697
<i>Triphoris adamsi</i>	261	Two New Species of Toads from the Philip-	
<i>alternatus</i>	249, 259	pines, by Leonhard Stejneger.....	573
<i>callipyrgus</i>	251, 261	Two New Species. On Some Isopods of the	
<i>carpenteri</i>	252	Family <i>Dajidae</i> from the Northwest Pa-	
<i>catalinensis</i>	253	cific Ocean, with Descriptions of a New	
<i>chathamensis</i>	261, 262	Genus and, by Harriet Richardson.....	689
<i>dalli</i>	257	<i>Tylosurus acus</i>	96, 100, 115, 626
<i>excolpus</i>	255	<i>leiuroides</i>	240
<i>galapagensis</i>	260	<i>leiurus</i>	240
<i>hemphilli</i>	253	<i>marinus</i>	626
<i>inconspicuus</i>	249, 258	Typical Species. On <i>Ctenolucius</i> Gill, a Neg-	
<i>infrequens</i>	249	lected Genus of Characin Fishes, with	
<i>montereyensis</i>	249	Notes on the, by Barton A. Bean.....	701
<i>panamensis</i>	256	<i>Umbrina dussumieri</i>	245
<i>pedroanus</i>	250	Undetermined Distomes.....	113
<i>peninsularis</i>	255	Undetermined Trematode.....	119
<i>stearnsi</i>	254	United States National Museum and the	
<i>Triphoris</i> . The West American Mollusks of		Museum of Indiana University, with De-	
the Genus, by Paul Bartsch.....	249	scriptions of New Species. An Annotated	
<i>Trochostoma antarcticum</i>	53	List of Characin Fishes in the, by Carl H.	
<i>boreale</i>	53	Eigenmann and Fletcher Ogle.....	1
<i>ooliticum</i>	53	Universal Conchologist. Supplementary	
<i>Tucca impressa</i>	625	Notes on Martyn's, by William Healey	
<i>Tupaia dorsalis</i>	562	Dall.....	185
<i>speciosa</i>	562	Unstalked Crinoids from the Coasts of North-	
<i>tana</i>	562	eastern Asia. Descriptions of New Species	
<i>Turbo albulus</i>	520	of Recent, by Austin Hobart Clark.....	127
<i>plicatus</i>	493, 513	Unstalked Crinoids from the North Pacific	
<i>Turbonilla</i>	492	Ocean. Descriptions of New Species of	
(<i>Chemnitzia</i>) <i>montereyensis</i>	494	Recent, by Austin Hobart Clark.....	69
<i>muricatoides</i>	495	<i>Upeneus maculatus</i>	93, 626
<i>gilli</i>	494	<i>vittatus</i>	245
<i>gracillima</i>	494	Upper Paleozoic Fossils from China. De-	
(<i>Mormula</i>) <i>eschscholtzi</i>	513	scriptions of New Species of, by George	
<i>lordi</i>	510	H. Girty.....	37
<i>tridentata</i>	511	<i>Valentina</i>	200
<i>plicata</i>	493	<i>fractilinea</i>	202
(<i>Pyrgiscus</i>) <i>antestriata</i>	506	<i>glandulella</i>	201, 208
<i>canfieldi</i>	504	<i>nothrotres</i>	202
<i>castanea</i>	509	<i>retectella</i>	201
<i>eucosmobasis</i>	507	<i>Vesperugo (Glichropus) tylopus</i>	563
<i>latifundia</i>	506	Walsingham, Lord. Descriptions of New	
<i>morchi</i>	505	North American Tineid Moths, with a	
<i>tenuicula</i>	508	Generic Table of the Family Blastobasidae.....	197
(<i>Pyrgolampros</i>) <i>aurantia</i>	502	Waters of Japan. A Review of the Flat-	
<i>berryi</i>	500	heads, Gurnards, and other Mail-checked	
<i>chocolata</i>	502	Fishes of the, by David Starr Jordan and	
<i>gibbosa</i>	502	Robert Earl Richardson.....	629

	Page.		Page.
West American Mollusks of the Genus Triphoris, by Paul Bartsch.....	249	Wilson, Charles Branch, North American Parasitic Cope-	
West Coast of America. New Marine Mol-		pods, New Gen-	
lusks from the, by Paul Bartsch.....	177	era and Species	
Western Borneo, Mammals collected in, by		of Caliginæ....	593
Dr. W.L. Abbott, by Marcus Ward Lyon, jr.	547	Xiphostoma hujeta.....	701
Williamson, Edward Bruce, The Dragon-		maculatum.....	701
flies (Odonata) of Burma and Lower		Xiphostomas.....	701
Siam—II. Subfamilies Cordulegaster-		Xyloryctidæ.....	214
inæ, Chlorogomphinæ, and Gomphinæ..	267	Xystisma kapas.....	244
Wilson, Charles Branch, North American		oyena.....	244
Parasitic Cope-		punctatum.....	244
pods belonging		Zalises draconis.....	240
to the Family		Zenarchopterus dispar.....	240
Caligidæ, A Re-		philippinus.....	240
view of the		Zeodrius.....	163
Pandarinæ and		Zonophryxus.....	689
the Cæcropinæ.	323	Zygana malleus.....	396







SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01003 7588