



SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

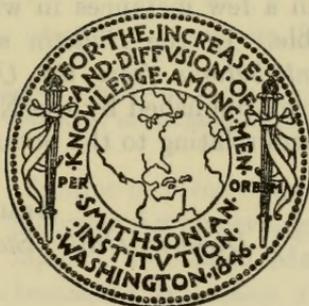
PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 103

NUMBERS 3311-3337



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1956

ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, are intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects.

The dates at which these separate papers are published are recorded in the tables of contents of each of the volumes.

The present volume is the hundred and third of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

REMINGTON KELLOGG,
Director, United States National Museum.

CONTENTS

	Pages
ABBOTT, R. TUCKER. Review of the Atlantic periwinkles <i>Nodilittorina</i> , <i>Echininus</i> , and <i>Tectarius</i> . Figures 55-57. Published March 23, 1954	449-464
ARNETT, ROSS H., JR. Beetles of the oedemerid genus <i>Vasaces</i> Champion. Figure 13. Published April 30, 1953.	87-94
New species: <i>Vasaces linearis</i> , <i>V. knulli</i> , <i>V. maculatus</i> , <i>V. elongatus</i> .	
———. A review of the beetle family Cephaloidae. Figure 20 and plate 5. Published May 15, 1953	155-161
———. Supplement and corrections to J. A. Hyslop's Genotypes of the elaterid beetles of the world. Published April 14, 1955	599-619
BANNER, ALBERT H. A supplement to W. M. Tattersall's Review of the Mysidacea of the United States National Museum. Published July 8, 1954	575-583
BERGER, ANDREW J. On the anatomy and relationships of glossy cuckoos of the genera <i>Chrysococcyx</i> , <i>Lampromorpha</i> , and <i>Chalcites</i> . Figures 69-71. Published January 19, 1955	585-597
BLAKE, DORIS HOLMES. The chrysomelid beetles of the genus <i>Strabala chevrolat</i> . Figure 17. Published June 5, 1953	121-134
New species: <i>Strabala rotunda</i> , <i>S. acuminata</i> , <i>S. colombiana</i> , <i>S. trinitatis</i> .	
New subspecies: <i>Strabala ambulans jamaicensis</i> , <i>S. a. puertoricensis</i> , <i>S. rufa floridana</i> , <i>S. acuminata teapensis</i> , <i>S. a. costaricensis</i> .	
CARRIKER, M. A., JR. Studies in Neotropical Mallophaga, XI: Bird lice of the suborder Amblycera, genus <i>Dennyus</i> Neumann. Figures 63, 64. Published May 21, 1954	533-549
New species: <i>Dennyus brevicapitis</i> , <i>D. intonsus</i> , <i>D. rotundocapitis</i> , <i>D. brunneitorques</i> , <i>D. similis</i> , <i>D. spininotus</i> , <i>D. limbus</i> .	
CARTWRIGHT, O. L. Scarabaeid beetles of the genus <i>Bradycinetulus</i> and closely related genera in the United States. Figures 14-16 and plates 3, 4. Published June 5, 1953	95-120
New genera: <i>Bolborhombus</i> , <i>Bolbocerastes</i> .	
New species: <i>Bradycinetulus rex</i> , <i>Bolbocerastes regalis</i> , <i>B. imperialis</i> , <i>Bolborhombus parvulus</i> .	
New subspecies: <i>Bolbocerastes imperialis kansanus</i> .	

- CARVALHO, JOSÉ C. M. Neotropical Miridae, LXIV: New bugs of the subfamily Cylapinae (Hemiptera). Figures 72-76 and plate 15. Published March 2, 1955 . . . 621-632
 Pages
- New genera: *Brachyfulvius*, *Peritropoides*.
 New species: *Brachyfulvius chapini*, *Peritropoides annulatus*,
P. quadrinotatus, *Vannius oculatus*, *Fulvius albonotatus*, *F. castaneous*, *F. ornatifrons*.
- GURNEY, ASHLEY B. Notes on the biology and immature stages of a cricket parasite of the genus *Rhopalosoma*. Figures 8, 9 and plate 1. Published March 10, 1953 . . . 19-34
- . Distribution, general bionomics, and recognition characters of two cockroaches recently established in the United States. Figure 10 and plate 2. Published March 10, 1953 39-56
- HERSHKOVITZ, PHILIP. Mammals of northern Colombia, preliminary report No. 7: Tapirs (genus *Tapirus*), with a systematic review of American species. Figures 58-62. Published May 18, 1954 465-496
- HYMAN, LIBBIE H. North American triclad Turbellaria, XIII: Three new cave planarians. Figures 65-68. Published June 14, 1954 563-573
- New species: *Phagocata cavernicola*, *Sphalloplana georgiana*,
Speophila hoffmasteri.
- KENK, ROMAN. The fresh-water triclad (Turbellaria) of Alaska. Figures 21-25 and plates 6-8. Published June 5, 1953 163-186
- New species: *Phagocata nivea*, *Polycelis borealis*, *Dendrocoelopsis piriformis*, *D. alaskensis*.
- LACHNER, ERNEST A. A revision of the goatfish genus *Upeneus* with descriptions of two new species. Plates 13, 14. Published May 18, 1954 497-532
- New species: *Upeneus asymmetricus*, *U. oligospilus*.
- LA RIVERS, IRA. Two new naucorid bugs of the genus *Ambrysus*. Figure 1. Published February 12, 1953 . . . 1-7
- New species: *Ambrysus thermarum*, *A. bispinus*.
- LAWRENCE, R. F. Two new scale-mite parasites of lizards. Figures 2-7. Published March 10, 1953 9-18
- New species: *Geckobia keegani*, *G. philippinensis*.
- MCDERMOTT, FRANK A. *Photuris bethaniensis*, a new lam-pyrid firefly. Published February 26, 1953 35-37
- New species: *Photuris bethaniensis*.

	Pages
MORRISON, J. P. E. The relationships of Old and New World melanians. Plate 11. Published April 20, 1954	357-394
PETTIBONE, MARIAN H. Marine polychaete worms from Point Barrow, Alaska, with additional records from the North Atlantic and North Pacific. Figures 26-39. Published May 21, 1954.	203-356
SCHULTZ, LEONARD P. Review of the Indo-Pacific anemone fishes, genus <i>Amphiprion</i> , with descriptions of two new species. Plates 9, 10. Published July 3, 1953	187-201
New species: <i>Amphiprion tricinctus</i> Schultz and Welander, <i>Amphiprion mauritensis</i> Schultz.	
— AND MARSHALL, N. B. A review of the labrid fish genus <i>Wetmorella</i> with descriptions of new forms from the tropical Indo-Pacific. Figures 52-54 and plate 12. Published April 21, 1954.	439-447
New species: <i>Wetmorella ocellata</i> , <i>W. albofasciata</i> , <i>W. triocellata</i> .	
New subspecies: <i>Wetmorella philippina bifasciata</i> .	
STURTEVANT, A. H. Nearctic flies of the family Periscelidae (Diptera) and certain Anthomyzidae referred to the family. Published June 16, 1954	551-561
New species: <i>Periscelis occidentalis</i> , <i>Cyamops imitata</i> .	
WHITE, THEODORE E. Preliminary analysis of the fossil vertebrates of the Canyon Ferry Reservoir area. Figures 40-51. Published May 28, 1954	395-438
New genus: <i>Kentrogomphios</i> .	
New species: <i>Kentrogomphios strophensis</i> , <i>Paradjidaumo spokanensis</i> , <i>Eumys cricetodontoides</i> , <i>E. latidens</i> , <i>E. spokanensis</i> .	
WIRTH, WILLIS W. Biting midges of the heleid genus <i>Stilobezzia</i> in North America. Figures 11, 12. Published May 15, 1953.	57-85
New species: <i>Stilobezzia</i> (<i>Neostilobezzia</i>) <i>stonei</i> , <i>S. (S.) beckae</i> , <i>S. (S.) punctipes</i> , <i>S. (S.) sybleae</i> , <i>S. (S.) thomsenae</i> .	
— American biting midges of the heleid genus <i>Monohalea</i> . Figures 18, 19. Published June 17, 1953	135-154
New species: <i>Monohalea</i> (<i>Monohalea</i>) <i>lanei</i> , <i>M. (M.) macfiei</i> , <i>M. (M.) texana</i> , <i>M. (M.) ornata</i> , <i>M. (M.) stonei</i> , <i>M. (M.) guianae</i> , <i>M. (M.) johannseni</i> .	

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3311

TWO NEW NAUCORID BUGS OF THE GENUS *AMBRYsus*

By IRA LA RIVERS¹

The following new *Ambrysi* were discovered after the manuscripts dealing with United States and Mexican species had been completed, and this paper is offered as a supplement to these treatments. Keys are included to allow the incorporation of the new species into the overall keys for the two regions.

Family NAUCORIDAE

Genus *Ambrysus* Stål, 1862

Ambrysus thermarum, new species

FIGURE 1, b, c

Description.—A small, pale species, nearly approaching *Ambrysus funebris* La Rivers, 1949, as the smallest species in the genus, and greatly resembling the latter in general conspectus; size 7.0–8.0 mm. long and 4.5–5.0 mm. wide. Dorsum bicolored, the scutellum and anterior portion yellowish, the posterior area (hemelytra) brownish. Venter brownish, contrasting strongly with the yellow-white appendages.

Head glistening, yellow, slightly roughened and weakly punctate, protuberant before eyes and with the faintest suggestion of truncation in front. Eyes blackish, slightly raised above general head sur-

¹ Department of Biology, University of Nevada, Reno, Nev.

face when viewed posteriorly. Head ratios are: Total length to width (including eyes) 19:28 (68 percent); anterior distance between eyes to posterior distance 12:17 (71 percent); anterior distance between eyes to inner eye-margin 12:11; posterior distance between eyes to greatest length of head posterior to this line 17:6 (35 percent).

Pronotum glistening, densely, shallowly punctate; color yellow to amber; lateral edges smoothly rounded, nonserrate, occasionally with some weak pilosity. Curvature 14 percent (average 25:4), postero-lateral angles well rounded. Dorsal ratios are: Width between anterior angles to greatest pronotal width 29:51 (57 percent); median length to greatest width 17:51 (33 percent); width between anterior angles to distance between anterior angle and posterior baseline of pronotum 29:25 (86 percent).

Scutellum yellow-amber, shiny; shagreened with dense, shallow, white-rimmed punctation; ratio of three sides 30:24:24.

Hemelytra uniformly brownish, yellowing medially and in embolar region; shagreened as is scutellum. Embolium about normal for the genus, length-to-width ratio 29:9 (31 percent), rarely with some sparse, occasional marginal pilosity. Hemelytra moderately exposing lateral connexival edges, which latter have some prominent, short yellow pilosity. Hemelytra just attaining abdominal apex.

Venter reddish brown, contrasting with the light-colored legs. Connexival posterolateral angles weakly acute-angulate, gradually enlarging posteriorly, not in the least spinose; connexival edges smooth, nonserrate, moderately pilose. Female subgenital plate apex simply concave, the concavity somewhat angular at its deepest point. Male genital process sharply right-angulate, tapering to apex, appearing much like a very thin foot, curving abruptly outward.

Leg I yellow-white, darkening to light amber on tibia-tarsus; ratio of length to greatest width of femur 27:16 (59 percent); combined tibia-tarsus, when closed, just attaining, or slightly surpassing, adjacent (proximal) end of femur.

Leg II yellow; ratio of femoral length to median width of ventral surface 25:5 (20 percent), length 1.9 mm.; tibia with distal end ventrally with one complete transverse terminal row of reddish spines set solidly across tip (remnants of the second, subterminal row, when complete and unbroken by use, extend about two-thirds of the width of tibia), ratio of length to width 22:2 (10 percent), length 1.75 mm.

Leg III yellow; ratio of length to femoral width 30:5.5 (18 percent), length 2.1 mm.; distal end of tibia ventrally with the same type of transverse spination as in mesotibia; ratio of length to width 37:2 (5 percent), length 3.0 mm.

Tibia has the characteristic spinate appearance in contrast to the smoother micro-armed femora, with the long, silky, swimming hairs on metatibia contrasting with the less hirsute appearance of the

mesotibia. All tarsi, except protarsi, 3-segmented; the first segment minute; the last two long and slender, terminating in two moderately curved claws.

Type and paratypes.—USNM 60987.

Type locality.—New Mexico, Sierra County, Hot Springs.

Material examined.—Holotype (male), allotype, and four paratypes, collected by Loew, September 11, 1874 (P. R. Uhler collection), in U. S. National Museum.

Remarks.—This unique little species, discovered during the course of checking the *Ambrysi* in the National collection, is probably an offshoot, as far as present material can indicate, of *Ambrysus mormon* stock. The female subgenital plate is mormonoid in structure, and the variable *mormon*-type male process could easily have given rise

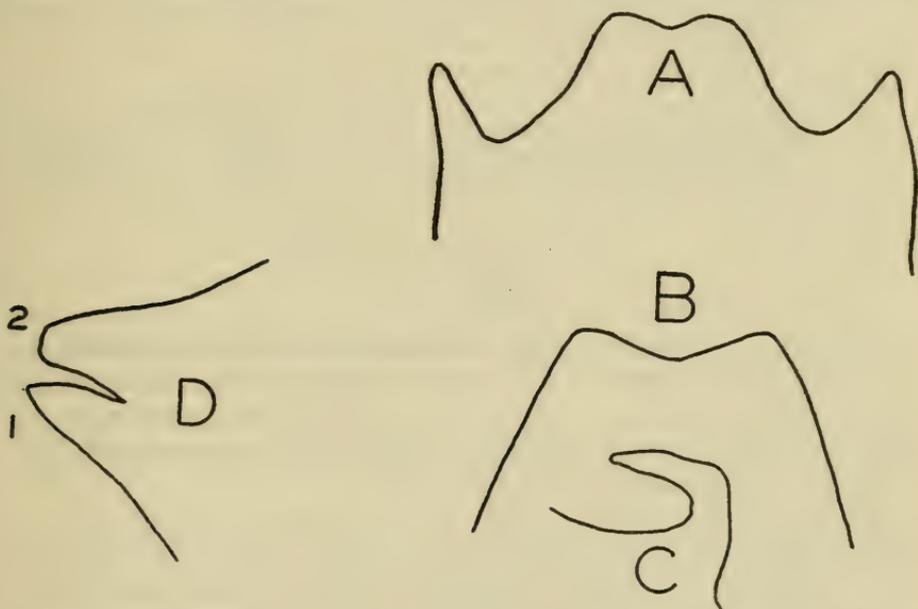


FIGURE 1.—Diagnostic characteristics of *Ambrysus bispinus* and *A. thermarum*: *a*, Apex of subgenital plate of *A. bispinus*, female holotype (visible only in ventral view), $\times 22$; *b*, apex of subgenital plate of *A. thermarum*, female allotype, $\times 22$; *c*, genital process on caudal edge of tergite V of *A. thermarum*, male holotype, $\times 22$; *d*, bispinate condition of left connexivum of abdominal sternite V of *A. bispinus*, female holotype, showing (1) anterior posterolateral angle and (2) posterior laterocaudal angle (ventral view, with caudal tip of abdomen oriented at the top of the field), $\times 22$.

to the distinctive male process of *A. thermarum*, which has evolved toward the *A. woodburyi* type to such an extent that, with only the male to examine, it would have been considered an aberrant *A. woodburyi*. At present, it is the most definitely adapted thermal ecad of the *A. mormon* type, but as nothing is known of the structure of the type locality, it is impossible to say whether this seems to be due to complete isolation or not.

The following modification of my key to United States *Ambrysi* (La Rivers, 1951) will satisfactorily compare *A. thermarum* with its closest relatives:

- 8 (7). Female subgenital plate simply, broadly, and smoothly concave apically, the lateral bordering angles sharp; concavity, measured in terms of depth of concavity against length between bordering lateral angles, never less than 20 percent; in clean material embolium nearly unicolorous, only very faintly lighter exteriorly, no contrasting colors present.

buanoi Usinger, 1946

Female subgenital plate, if simply concave, has (a) rounded lateral angles, or (b) if lateral angles are sharp, then depth of concavity is considerably less than 20 percent; in clean material embolium always sharply and contrastingly transversely bicolored, anterior two-thirds light yellow, posterior one-third blackish-brown----- 8A

- 8A (8). Male genital process narrowing to apex, strongly, abruptly and almost right-angularly turned outward, giving the appearance of a long, attenuated foot with a rather sharp heel; female subgenital plate simply concave at apex, somewhat angularly so.

thermarum, new species

Male genital process not definitely narrowing to apex, and not foot- or boot-shaped, although curving variably outward; female subgenital plate simply and roundly concave at apex-- **mormon** Montandon, 1909

Ambrysus bispinus, new species

FIGURE 1, a, d

Description.—A large, darkly mottled species, well rounded and convex; size 12.0–14.0 mm. long and 7.0–9.0 mm. wide. Dorsum not distinctly bicolored (i. e., anterior portion lighter than posterior area), more or less uniformly mottled. Venter yellow or brownish, unicolorous and lighter than dorsum.

Head glistening, yellow-brown, smooth, weakly and vaguely punctate, slightly and broadly protuberant, and truncate before the eyes. Eyes blackish, nearly flush with plane surface of head when viewed posteriorly. Head ratios are: Total length to width (including eyes) 34:54 (63 percent); anterior distance between eyes to posterior distance 26:33 (79 percent); anterior distance between eyes to inner eye-margin 26:25; posterior distance between eyes to greatest length of head posterior to this line, 33:8 (22 percent).

Pronotum glistening, yellowish with brown mottling, sparsely punctulate, rugulose behind head; lateral edges smooth, nonserrate, rounded, on one specimen with traces of faint pilosity which appears to have been rubbed off. Curvature 10 percent (average 52:5); posterolateral angles well rounded. Dorsal ratios are: Width between anterior angles to greatest pronotal width 53:73 (73 percent); median length to greatest width 39:73 (53 percent); width between anterior angles to distance between anterior angle and posterior baseline of pronotum 53:52.

Scutellum glistening, yellow medially and on posterior angle, yellow along lateral edges, reddish brown elsewhere; shagreened with dense, coarse, white-spotted punctures; ratio of three sides 70:50:50.

Hemelytra mottled brown and yellow, glistening; shagreened as is scutellum. Embolium slightly narrow for the genus, length-to-width ratio 60:18 (30 percent), with no detectable marginal pilosity in the specimens examined. Hemelytra moderately exposing connexival margins, which latter have sparse, short pilosity, concentrated somewhat at the posterolateral angles. Hemelytra just, to not quite, attaining abdominal tip.

Venter yellow to brown, the legs usually not markedly contrasting with the body in color. Connexival posterolateral angles acute-angulate, short, gradually increasing in size posteriorly, not in the least spinose; margins with some weak dentation, detectable only with considerable magnification, on all segments except I and II. Female segment V (the insect being oriented so that the abdominal tip is at the top of the field) possesses two posterolateral connexival processes; the exterior posterolateral angle and an interior, prominent, blacker, rather blunt elongation of the caudal margin of segment V lying adjacent to the posterolateral angle. I have referred to this in other species as the laterocaudal connexival angle. Tip of female subgenital plate strongly and distinctively quadrisinuate, the lateral terminal angles long and rather sharp, but not extending as far caudad as the median, paired sinuosities which lie close together as a doubly rounded, blunt process longer than the lateral spines. Character of the male genital process unknown.

Leg I amber; ratio of length to greatest femoral width 48:31 (65 percent); combined tibia-tarsus, when closed, just attaining adjacent (proximal) end of femur.

Leg II amber; ratio of length to median width of femur 46:10 (22 percent), length 3.4 mm.; tibia with distal end ventrally with one-and-one-half transverse rows of reddish spines, the terminal row complete, the subterminal row, as indicated above, only half complete; ratio of length to width 40:4.5 (11 percent), length 3 mm.

Leg III amber; ratio of length to median femoral width 57:11 (19 percent), length 4.2 mm.; tibia with same type of transverse terminal spination as in mesotibia, ratio of length to width 70:5 (7 percent), length 5.2 mm.

Tibia possesses the typical spinate appearance in contrast to the smooth femora; long, golden, silky, swimming hairs are present on the metatibia and lacking on the mesotibia. All tarsi, except protarsi, are 3-segmented, the first segment minute, the last two long and slender, terminating in two moderately curved claws.

Type and paratype.—USNM 60988.

Type locality.—México, Veracruz, Jalapa.

Material examined.—Holotype (female) and a single female paratype from México, Oaxaca, Camotlán, collected by W. S. Miller, April 14, 1944, in the U. S. National Museum.

Remarks.—In external appearance, *A. bispinus* is superficially indistinguishable from *A. cosmius* and, as such, has probably shared the latter's confusion as *A. signoreti* Stål, 1862, in collections. However, the structure of the female subgenital-plate apices is quite different in the two species. In this respect, *A. bispinus* most closely resembles *A. guttatipennis* Stål, 1876, but while the subgenital plates might not be able, alone, to separate all variables of both species, the possession of primary and secondary connexival angles on abdominal segment V, with present material, sharply sets *A. bispinus* off from all other Ambrysi of the *signoreti* group. These two angles are more specifically referred to as the posterolateral and laterocaudal connexival angles, and the laterocaudal is lacking in all other known members of the group. It has shown up in other, distant sections of the genus, being known in *A. parviceps* Montandon, 1897, *A. hungerfordi* Usinger, 1946 (both in the *pudicus* group), and *A. puncticollis* Stål, 1876 (a monotypic group). It is this character upon which the specific name of *A. bispinus* is based. In addition, the male genital process, when known, will furnish more evidence of the species' affiliations, either supplementing or diverting present indications.

The following couplets will enable the new species to be incorporated in my key to Mexican Ambrysi now in press:

- 24 (15). Female subgenital plate, viewed ventrally, asymmetrical on left side, where a prominent flap occupies the border beyond (laterad of) the left lateral angle; right border scarcely produced.

dilatatus Montandon, 1910

Female subgenital plate, viewed ventrally, not markedly or noticeably asymmetrical from one lateral border to the other..... 25

- 25 (24). Female possessing both primary and secondary posterolateral connexival spines on abdominal sternite V (i. e., the primary angle being the posterolateral angle proper, the secondary angle being the laterocaudal angle)..... **bispinus**, new species

Female lacking the secondary (laterocaudal) angle.

remaining Mexican species of the **signoreti** group

References

LA RIVERS, IRA

1949. A new species of *Ambrysus* from Death Valley, with notes on the genus in the United States (Hemiptera: Naucoridae). Bull. Southern California Acad. Sci., vol. 47 (1948), No. 3, pp. 103-110.
1950. The meeting point of *Ambrysus* and *Pelocoris* in Nevada. Pan-Pacific Ent. vol. 26, No. 1, pp. 19-21.
1951. A revision of the genus *Ambrysus* in the United States (Hemiptera: Naucoridae). Univ. California Publ. Ent., vol. 8, No. 7, pp. 277-338, illustr.
- The *Ambrysus* of Mexico (Hemiptera: Naucoridae). Univ. Kansas Sci. Bull. (In press.)

MONTANDON, A. L.

1897. Hemiptera cryptocerata.—Sous-fam. Cryptocricinae. Verh. zoöl.-bot. Ges. Wien, vol. 47, pp. 6-23.
1909. Naucoridae. Descriptions d'especes nouvelles. Bull. Soc. Roum. Sci., Bucharest, vol. 18, No. 1, pp. 43-61.

STÅL, CARL.

1876. Enumeratio Hemipterorum. Svenska Vetensk. Akad., vol. 14, pt. 5, No. 4.

USINGER, ROBERT L.

1946. Notes and descriptions of *Ambrysus* Stål with an account of the life history of *Ambrysus mormon* Montd. (Hemiptera: Naucoridae). Bull. Univ. Kansas, Sci. Bull., vol. 31, No. 1, pp. 185-210.

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3312

TWO NEW SCALE-MITE PARASITES OF LIZARDS

By R. F. LAWRENCE¹

Dr. G. W. Wharton, of Duke University, Durham, N. C., has kindly submitted to me for identification a number of scale mites from lizards of the families Gekkonidae and Iguanidae. The material, from the Philippine Islands, consists of one series taken from a lizard at Fort McKinley, Rizal, and another from the gecko *Hemidactylus frenatus* in a house at Manila. Both series consist of two quite different species of *Geckobia*. These are described in this paper as new and both of them have been taken at the two localities mentioned above. There is thus good reason for assuming that the hosts of the two series are the same and that the "lizard" of Fort McKinley is identical with the gecko *H. frenatus* from which scale mites were taken at Manila. All these parasites were collected by Dr. H. L. Keegan, Third General Medical Laboratory, at Fort McKinley, Rizal, Philippine Islands.

A further series, consisting of a large number of adults and larvae, were collected from the iguanid lizard *Sceloporus undulatus*, at Durham, N. C., by Dr. A. S. Pearse; these have been identified as Banks' New World pterygosomid *Geckobiella texana*.

Several species of the scale mite parasite *Geckobia* may live on the same host; Hirst (1925, p. 173) has already pointed this out, saying, "When more than one form of *Geckobia* is found on the same host, one lives beneath the ventral scales and is flattened, being considerably wider than long and having scales instead of hairs on the venter. The second form occurring on the same host is usually to be discovered between the claw and pad of the toes, between the laminae of the pad, or between the toes themselves; this form is practically spherical in shape and has hairs instead of scales on the venter." Although there

¹ Natal Museum, Pietermaritzburg, Union of South Africa.

is no definitive information that the two strikingly different species of *Geckobia* here described actually illustrate Hirst's observation, it will probably be found that the two forms live on different parts of the body of the same host.

Family PTERYGOSOMIDAE

Genus *Geckobia* Mégnin, 1873

Geckobia keegani, new species

FIGURES 2, 3

Material examined.—Three females, cotypes, from a lizard, Fort McKinley, Rizal, Philippine Islands, collected by H. L. Keegan, October 1948, USNM 1931; also nine females bearing same locality data

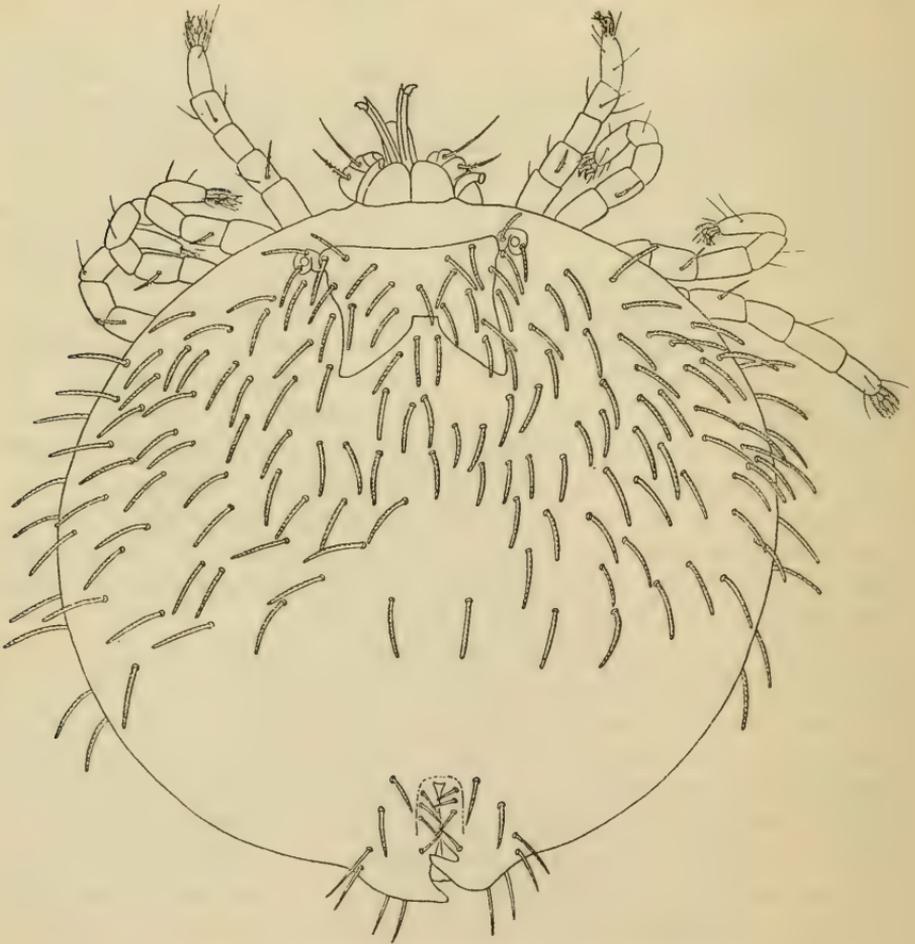


FIGURE 2.—*Geckobia keegani*, new species, dorsal surface.

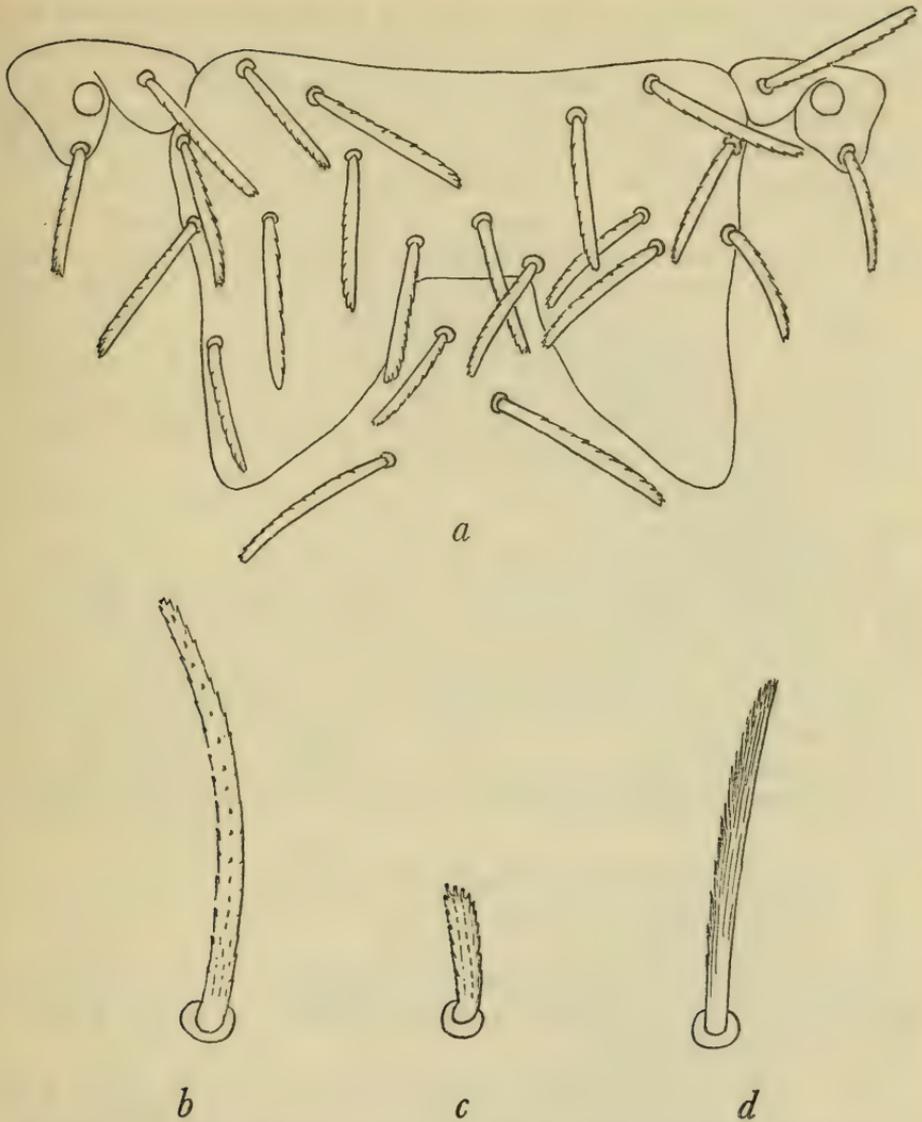


FIGURE 3.—*Geckobia keegani*, new species: *a*, Dorsal scute; *b*, peripheral dorsal hair; *c*, anterior ventral hair; *d*, posterior ventral hair.

as the cotypes, and five females from *Hemidactylus frenatus*, from Manila, Philippine Islands.

Body almost circular; dorsal surface as in figure 2, with fairly long, almost parallel-sided hairs differing very little in length, but posteriormost slightly longer than anteriormost. Dorsal scute well defined, with about 20 hairs differing very little in general appearance and size from the remaining dorsal hairs, though a little shorter than the longest of these.

Ventral surface with a density of hairs similar to that of the dorsal surface but reaching further back, almost to the anal field; the dis-

crepancy in the length of these hairs far greater than in those of the dorsal surface, anteriormost a little less than half as long as posteriormost, latter a little shorter than the longest dorsal hairs.

Mouth parts normal, pedipalps short and stout, both second and third segments above with a setiform hair, that of the second weakly barbed and only a little stouter than that of the third, which is smooth.

Legs equal-sized, rather small in proportion to the body. Posterior common coxa differing from most species of *Geckobia* in having two spurlike hairs on its anterior and only two, one, or even none on its posterior margin; usually only three or four hairs, instead of the normal five, are found on this coxa and these are comparatively small and weak. The basal segments of the legs without spurlike hairs ventrally; but the second segment in all legs with a rather long, slender, and weakly barbed hair above.

Dimensions.—Width of body 0.603 mm., length (including mouth parts), 0.632 mm.

Remarks.—The species closely resembles *Geckobia simplex* Hirst, 1926, described from *Hemidactylus leschenaulti*, Madras, India, in the shape of the hairs of the dorsal surface and in the form of the dorsal scute. It differs from this species in having only about half the number of hairs on the dorsal scute, these being also more similar to the remaining body hairs in length and thickness than is the case in *G. simplex*. It further differs in there being very little difference in the shape of the dorsal hairs of the second and third palpal segments.

***Geckobia philippinensis*, new species**

FIGURES 4, 5

Material examined.—Two females, cotypes, from a lizard, Fort McKinley, Rizal, Philippine Islands, collected by H. L. Keegan, October 1948, USNM 1932.

Body much wider than long, dorsal surface as in figure 4, with 9 or 10 large, wide hairs in the area usually occupied by the dorsal scute, those in the middle of the body much smaller, while towards the periphery posteriorly and laterally, the hairs become progressively more elongate and pointed. A single pair of centrally situated hairs much longer than the predominantly short hairs by which they are surrounded. Dorsal scute not defined.

Ventral surface as in figure 5, *a*, which represents a section in the middle line of the body extending from its anterior to its posterior margin; the transition from the small type of cylindrical hair to scales of lanceolate form, sudden and without intermediate types of hair; the scales toward the posterior periphery becoming progressively more elongate and narrow.

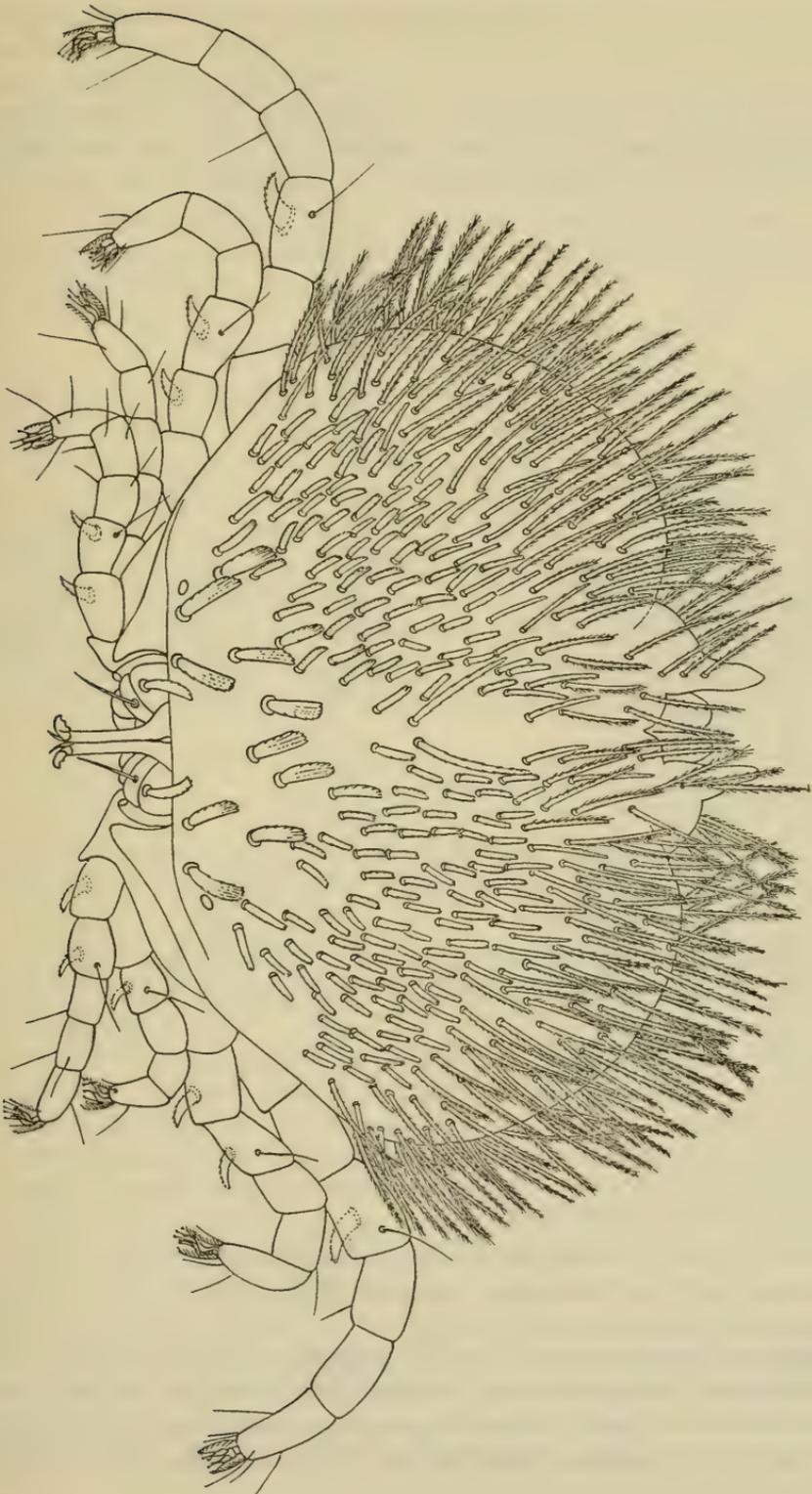


FIGURE 4.—*Geckobia philippinensis*, new species, dorsal surface.

Mouth parts normal, pedipalps short, with rounded segments, second segment above with a stout plumose hair several times thicker than that of the third segment, which is smooth and setiform.

Leg IV distinctly longer and a little stouter than the remaining ones; posterior common coxa as in figure 5, *e*, with five very large and distinct conical spurlike hairs; all legs with a fairly stout

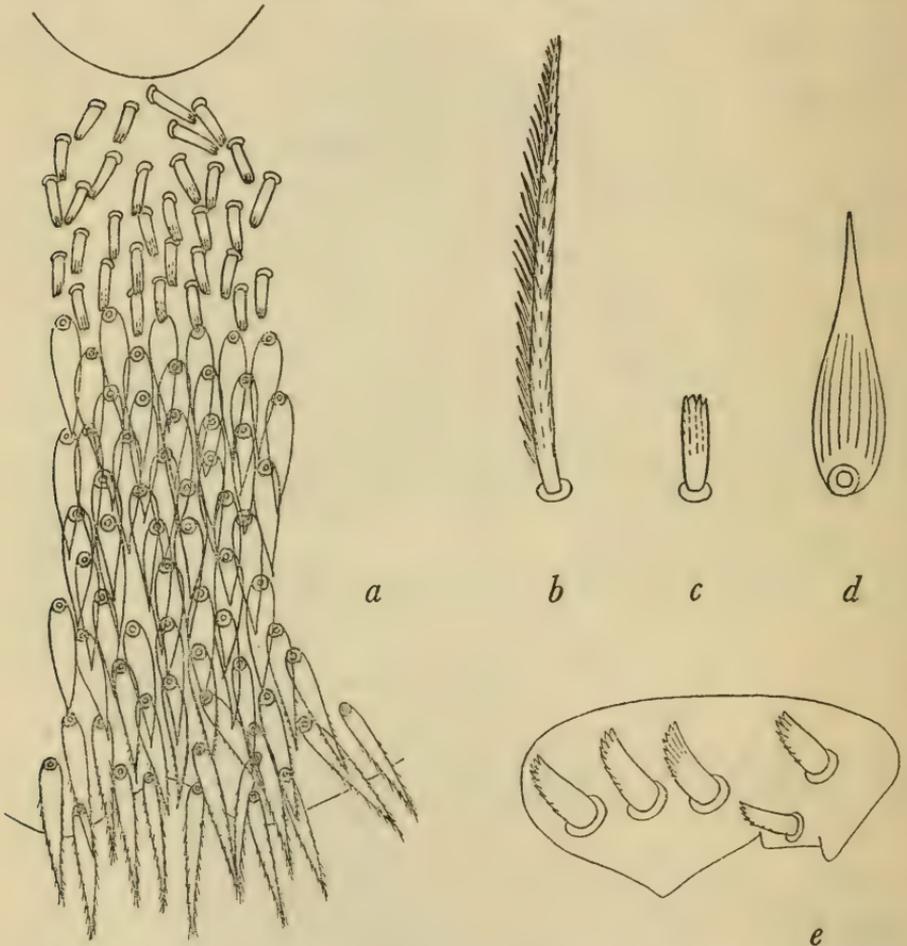


FIGURE 5.—*Geckobia philippinensis*, new species: *a*, Hairs of ventral surface in midline of body; *b*, peripheral dorsal hair; *c*, small hair from middle of dorsum; *d*, a scalelike ventral hair; *e*, posterior common coxa.

plumose hair on the ventral surface of segments 2 and 3 and a long setose hair on the dorsal surface of segment 3, that of leg IV weakly plumose.

Additional material examined.—Two females from the same host and locality as the types. Dr. Wharton sent with his material the lizard host from which the Manila specimens were taken. From the body scales of this gecko, *Hemidactylus frenatus*, I obtained a single female of the species described above.

Dimensions.—Width of body 0.400 mm., length (including mouth parts), 0.287 mm.

According to Hirst's key (1925, p. 174), this species would be bracketed with *Geckobia australis* Hirst, 1926, but in width of body and general form of dorsal hairs and ventral scales, it seems to resemble more closely *G. hindustanica* Hirst, 1926, described from *Hemidactylus leschenaulti*, Madras, India. It differs from *G. hindustanica* in the complete absence of a dorsal scute and in the relatively larger size of leg IV, as well as in other details.

Genus *Geckobiella* Hirst, 1917

This genus was erected by Hirst (1917, p. 138) for the scale mites of Iguanid lizards, and thus far its members have been found to occur only on species of the genus *Sceloporus*. It would be of great interest to know what types of scale mites occur on the other numerous genera of the family Iguanidae in the New World.

The eyes, which are not mentioned in the description of the genus, consist of a single pair situated in much the same position as those of *Geckobia* and *Zonurobia*, Lawrence, 1935, being located anteriorly near the lateral margin of the body. They are small, only a little larger than the ringlike sockets of the dorsal hairs (fig. 6, b).

Geckobiella texana (Banks), 1905

FIGURES 6, 7

Geckobia texana Banks, Proc. Ent. Soc. Washington, vol. 8, p. 134, 1905.

Geckobiella texana (Banks), Hirst, Ann. Mag. Nat. Hist., ser. 8, vol. 19, p. 138, 1917.

Material examined.—Numerous adults and larvae of this species collected by A. S. Pearse from *Sceloporus undulatus* at Durham, N. C., in January 1950.

Adult female.—Hirst (1925, p. 200, fig. 19) figured only the ventral surface of this species, and the opportunity is now taken to give an illustration of the dorsal surface (fig. 6). The dorsal hairs are much more numerous in some specimens than in others, there being probably a certain amount of variation in this respect.

The mouth parts are longer and more robust than in most genera of Pterygosomidae; the free portion of the peritremes reach to the distal end of the second palpal segment; the second palpal segment with a fairly long slender hair of equal thickness throughout, not pointed at the apex, with fine barbs; dorsal hair of the third palpal segment longer, pointed apically and smooth or almost so; fourth palpal segment with a single seta above, claw stout, conical, and somewhat curved.

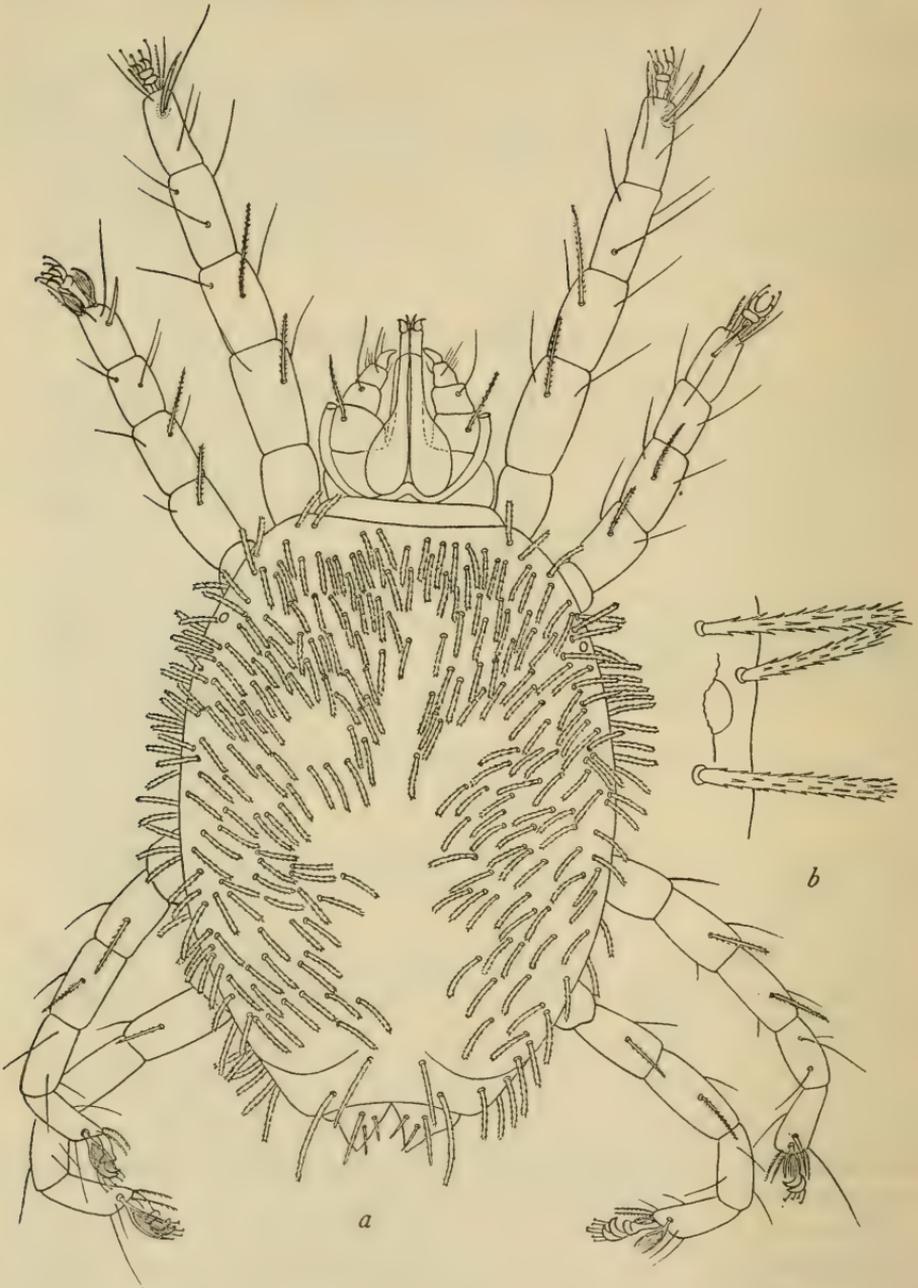


FIGURE 6.—*Geckobiella texana* (Banks): a, Dorsal surface of female; b, eye.

Leg I only a little longer than IV, distinctly stouter than the remaining legs; segments 2 and 3 of all legs with a setiform hair above, finely barbed.

Adult male.—The single specimen which appears to be an adult male is considerably smaller than the female and with far fewer hairs

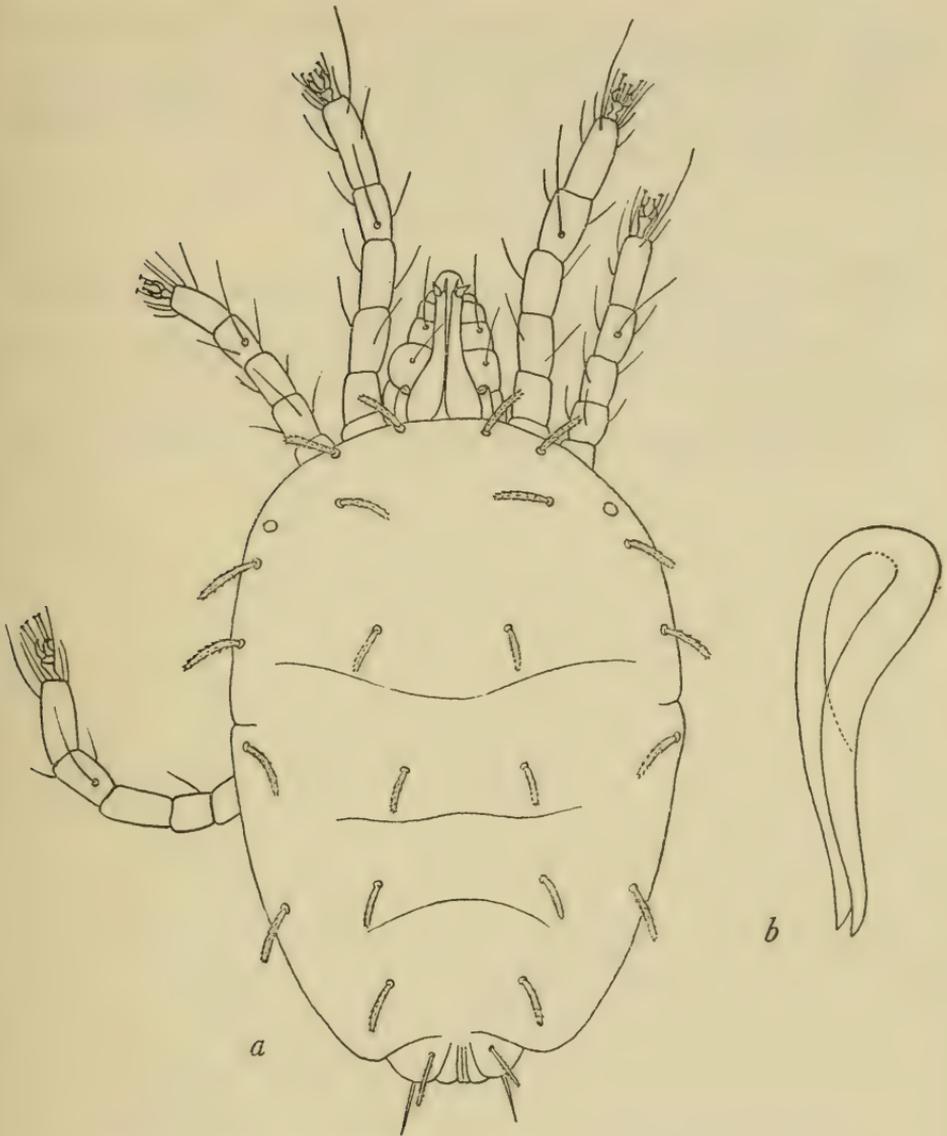


FIGURE 7.—*Geckobiella texana* (Banks): *a*, Dorsal surface of larva; *b*, penis (?).

on the dorsal surface; otherwise it does not differ from the female; the chitinous genital structures are rather ill-defined, the large penis (?) (fig. 7,*b*), projecting slightly from the genital aperture at the posterior extremity of the body.

Larva.—Dorsal surface with very few symmetrically disposed hairs, as in figure 7, *a*. Eyes present in the same position as the adult. Ventral surface entirely without hairs or setae except for a single seta at the base of legs I and III. Mouth parts closely resembling those of the adult, but the peritremes much shorter, reaching to a little below

the base of the second palpal segment, and the claw of the palp more slender. Legs shorter than in the adult.

Dimensions.—Female: Length of body 0.913 mm.; width, 0.487 mm. Male: Length of body 0.652 mm.; width, 0.326 mm. Larva: Length of body 0.740 mm.; width, 0.413 mm.

References

HIRST, ARTHUR STANLEY

1917. On some new mites of the suborder Prostigmata living on lizards. *Ann. Mag. Nat. Hist.*, ser. 8, vol. 19, p. 136.

1925. On parasitic mites of the suborder Prostigmata (Trombidioidea), on lizards. *Journ. Linnaean Soc. London*, vol. 36, p. 173.

LAWRENCE, R. F.

1935. The prostigmatic mites of South African lizards. *Parasitology*, vol. 27, No. 1, p. 6.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1953

No. 3313

NOTES ON THE BIOLOGY AND IMMATURE STAGES OF A
CRICKET PARASITE OF THE GENUS RHOPALOSOMA

By ASHLEY B. GURNEY¹

Introduction

For more than three-quarters of a century wasps of the genus *Rhopalosoma* Cresson, 1865, have attracted the interest of hymenopterists because characters of the adult have left doubt regarding family relationships. Although the family Rhopalosomatidae² was proposed for the genus in 1896, there remains uncertainty as to what other genera are to be included in the family.³ Neither is it clear which of the related families is most closely allied to the Rhopalosomatidae. Biological studies of *Rhopalosoma* together with a critical examination of the immature stages may be helpful in clarifying these matters. Until now the only original published information concerning the biology and immature stages is that by Hood (1914). He collected a larva which was reared to maturity and identified as *R. poeyi* Cresson, which is currently referred to *R. nearcticum* Brues. Hood's account is brief and, while it is a good general indication of the biology, contains no detailed morphological descriptions. The recent capture of a larva of *Rhopalosoma* at Falls Church, Va., has given

¹ Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

² Originally given as Rhopalosomidae by Ashmead (1896). An adult specimen of the genus has been illustrated by Westwood (1874, pl. 24, fig. 9). The species shown there is *Rhopalosoma aenigmaticum* (Westwood) of Hispaniola.

³ Readers are referred to Brues and Melander (1932, p. 499), Brues (1943), and Krombein (1951).

impetus to the gathering of biological data, and the material at my disposal has also permitted morphological studies to be made on several of the immature stages.

I am much indebted to Dr. Henry K. Townes, of the North Carolina State College (in absentia), for lending specimens of *Rhopalosoma* and for supplying collecting records and giving helpful suggestions. My colleagues Dr. B. D. Burks, K. V. Krombein, and Dr. W. H. Anderson have also advised me generously. David G. Shappirio, of Harvard University, and Dr. T. H. Hubbell, of the University of Michigan, have kindly supplied data on parasitized crickets preserved at the University of Michigan Museum of Zoology.

Biological observations

The larva found at Falls Church⁴ was in the fourth instar, attached to the left side of an adult female of *Hapithus agitator* Uhler. While I was beating deciduous underbrush for psocids, on September 30, 1950, the cricket was knocked into a collecting umbrella. The left hind leg was held at an unnatural angle with the body and the cricket was rather inactive and easily picked up. Leaves and other organic material were added to the jar in which the insect was placed, but the cricket was not seen to feed. The next day it scarcely changed its position, though the antennae occasionally moved. Meanwhile, the ventral surface of the parasite remained securely attached to the cricket and no movement was noticed. At 7 p.m. on the evening of October 2 the larva was beginning to shed its skin, as shown by the appearance of the white integument of the fifth instar where the fourth instar skin had split lengthwise along the middle of the dorsum. The cricket had then lost its foothold and was dying on its side, though its antennae still moved.

By 8:30 p.m. the larva (which was entirely white except for traces of pale brown about the mandible) had left the dead cricket and had moved an inch or so away. The larva was placed in a pill box of soil where it gradually darkened to a creamy yellow color. On the day following the molt the larva made frequent twisting contractions as if trying to burrow. The head was directed downward most of the time and one silk strand coming from the mouth was noticed. The larva did not succeed in becoming completely covered with soil; during the next day it was relatively inactive, with the head uppermost

⁴ Generic identification of the parasite is primarily based on the very close agreement with the situation reported by Hood (1914). It may eventually be shown that more than one nominal form of *Rhopalosoma* inhabits the United States and that some specimens from the vicinity of Washington, D. C., are distinct from *R. nearcticum*, the type locality of which is Kissimee, Fla.

and showing occasional movements of the mouth parts. By the morning of October 5, it was decidedly quiescent and evidently dying, and by noon it had died and so was preserved in alcohol (pl. 1). If several inches of fine sand had been provided instead of heavy garden loam, perhaps the insect would have entered the soil and successfully spun a cocoon.

The present larva was attached to the cricket on the membrane between the terga and sterna of abdominal segments 1 to 5. After the fifth instar had left, the cricket (pl. 1) bore three exuviae visible from above, representing the second, third, and fourth instars. In each the head was directed posteriorly and located farther posteriorly on the cricket than that of the previous instar. The strongest single point of larval attachment was apparently just anterior to the parasite's modified anus; there the attachment was quite secure. The larval body was noticeably curled, but the entire ventral surface was closely appressed to the cricket. The exuviae of larval instar 1 was situated transversely on the ventral surface of the cricket, in a groove just behind the left hind coxa. The head end of the skin was directed mesally on the cricket and extended almost to the sternal plate of the first abdominal segment, while the posterior end was beneath the ends of succeeding exuviae. Remnants of the eggshell occurred with the exuviae of the first instar. On the body of the cricket, in part beneath the cast skins and also directly adjacent to them and extending briefly onto the left tegmen (front wing), was an accumulation of dried mucus or similar material. This was scalelike in appearance and I first mistook it for exuviae. The larval head was not inserted through the cricket's body wall, nor was there any definite opening, but the membrane where the last feeding mandibles (fourth instar) were applied showed signs of having been pierced. The points of contact for the mandibles of the second and third instars were covered with the exuviae of later instars.

A second larva of *Rhopalosoma* in the U. S. National Museum was collected on a last instar male nymph of *Hapithus* sp. at Marietta, Ga., August 9, 1947. The larva is in the fifth instar, though it probably was captured in an earlier stage since the host cricket is also preserved. The exuviae which were attached to the left side of the cricket agree with those of the Falls Church specimen so far as has been noted.

The third larva of *Rhopalosoma* examined (fig. 9, *e, f*) was preserved in the fourth instar after having been collected on an adult female of *Hapithus agitator* at Fuguay, N. C., September 12, 1950, by Townes, Rabb, and Howden (North Carolina State College collection) (pl. 1). The head of the final feeding stage of the larva was on the cricket's fifth abdominal segment, with the mandibles applied to the membrane close to the spiracle and nearer the tergum than to the

sternum. A crust of a dried secretion was present, as in the case of the Falls Church larva. Though a crust may have been associated with the Marietta, Ga., material, none was seen. The eggshell and first larval exuviae of each of the three larvae occurred immediately behind the hind coxa of the cricket. Likewise, the hind leg of each cricket, adjacent to the parasite, was held outward as shown in the photographs.

A fourth larva examined is one of several which Dr. Townes has told me of finding on *Hapithus* and *Orocharis*. Of this particular larva he has written, "On September 12, 1950, I collected (at Fuguay, N. C.) a large *Orocharis* nymph with a one-third grown larva on it. I kept the cricket in a jar and its parasite prospered. On September 17 I found the remains of the demolished nymph in the jar and the *Rhopalosoma* larva, now creamy white with a large head and projecting mandibles, busily hitching itself along with its mandibles. It was very restless, so I put it in some damp sand. The larva promptly worked into the sand and came to rest in one corner of the jar, under the sand. Three days later it had completed an elongate, castaneous cocoon."

The cocoon was kept indoors by Dr. Townes, at a temperature in the neighborhood of 55° F. In late February he mailed it to me and suggested that dissection to determine whether pupation had occurred might be advisable. The parchmentlike cocoon was 14 millimeters long, about 5 millimeters in diameter, and rounded at the ends. The inner surface was a lighter chestnut color than the outside and scarcely any individual threads of silk were apparent except on the outside. When the cocoon was opened on February 23, the larva was doubled up in the middle of it with about one-fourth of the cocoon's length empty at each end. Pupation had not occurred, nor had there been any casting of larval skins or passing of fecal material, but the larva appeared perfectly healthy. After preservation it was 6 millimeters long. The mandibles bore no teeth.

The original observations of Hood (1914) were based on a larva taken at Plummer's Island, Md., October 6, 1912. The host, *Orocharis saltator* Uhler, was quite active when found, as it was said to be "scampering over the forest floor as rapidly as a large abdominal protuberance and a nearly functionless hind leg would permit." The anterior end of the parasite was at the host's eighth abdominal segment. This specimen grew rapidly, left the cricket three days after capture and entered the soil, emerging indoors as an adult about March 1, 1913. The information Hood gave concerning the exuviae and the quiescent state of the host just prior to the parasite's final visible molt agrees fully with my findings. The cocoon from which the adult emerged has recently been opened and the fifth instar exuviae

were relaxed and studied. The mandibles of the exuviae differ somewhat in shape from those of the Falls Church larva and they bear no teeth.

In the University of Michigan Museum of Zoology are at least 20 pinned cricket specimens bearing parasitic larvae presumed to be of one or more species of *Rhopalosoma*. I have not examined them, but detailed host data have been furnished me, together with the statement that the larvae vary considerably in size and that all are brown. The specimens were collected by Dr. T. H. Hubbell and several associated collectors and former students. The hosts, with the number of parasitized specimens, States where collected, and generalized dates of collection are as follows: *Hapithus agitator agitator* Uhler, seven specimens, southeastern Indiana, central Missouri, Mississippi, Tennessee, all collected in the last half of August; *H. agitator quadratus* Scudder, four specimens, Florida, late July to early September; *H. brevipennis* Saussure, four specimens, Florida, late July to mid-November; *Orocharis saltator* Uhler, four specimens, July 4 to July 29. The host associated with an additional larva from Florida is not recorded. These records represent the parasitism of this type occurring among several hundreds of *Hapithus* and *Orocharis* specimens.

The specimen of *Hapithus agitator* on which the Falls Church larva was parasitic was preserved in alcohol and later dissected to determine the condition of its internal organs. Scarcely any traces of food were in the digestive tract, none of recent ingestion. Reproductive organs were evidently intact, but there were no well-developed eggs or other signs of normal functioning of the organs.

The impression created was that the cricket had been weakened to a point where the drain on its vitality finally caused death, though there had been no mechanical destruction of organs.

Various details of the biology remain to be clarified, but the main outline seems evident. Upon hatching, the larva probably crawls part way from the eggshell and starts its development in a more or less transverse position. At the first molt the larva apparently shifts the anterior part of the body so that it extends longitudinally along the side of the cricket, though keeping the same place of anal attachment. The third and fourth instars each move the head posteriorly on the cricket at molting time. Sharp mandibles occur in the second, third, and fourth instars, and these apparently pierce the cricket's integument and permit fluids to be taken into the mouth. Definite mouth parts of the first instar have not been seen, but may occur. The fifth instar does not feed but is an inactive stage that leaves the host and spins a cocoon in the soil. Pupation is evidently delayed, perhaps until near emergence time of the adult.

Regarding habits of *Rhopalosoma* adults, Dr. Townes has furnished the following notes: "I have seen the adults on several occasions and usually was fortunate to catch them when seen. I should say that in the Upper and Lower Austral Zones of the Atlantic States they are widespread and not uncommon in the right habitat. This appears to be places of dense, shrubby vegetation where there is considerable humidity, as along stream bottoms and seashores, or, in other words, the same sorts of places where *Hapithus* and *Orocharis* abound. The adults may be flushed from the bushes. They fly up and alight again like an ophonine ichneumonid. They may be distinguished from ophonines in flight only by a slightly stockier appearance. At Long Beach, North Carolina, at twilight on July 9, 1949, I saw about 10 all together in normal flight, cruising in a rather slow but erratic manner just over the beach shrubbery, again like an ophonine ichneumonid in its twilight flight. They were flying until no longer visible in the gathering dark. I could catch only two of these and they were both males."

The following collection dates accompanying specimens identified as *Rhopalosoma nearcticum* are available as an indication of when adults are active: Maryland: Mayo Beach, September 14, 1947, female (Townes); Berlin, July 19, 1932, female. North Carolina: Long Beach, July 9, 1949, two males (Townes); Wallace, August 2, 1949, female (Townes). South Carolina: Greenville, September 2, 1940, male (H. and M. Townes). Georgia: Stone Mountain, August 13, 1949, female (Fattig); Atlanta, August 11, 1946, female. Florida: About a dozen specimens, essentially all reported by Brues (1943), ranging from June 9 to August 13, but mostly collected in June and July.

In addition to the foregoing States, *nearcticum* has been recorded from Missouri and Kentucky by Krombein (1951).

The known hosts of *Rhopalosoma* in the United States are *Orocharis saltator* Uhler and *Hapithus agitator* Uhler. Judging from the records of parasitized crickets preserved in the University of Michigan Museum of Zoology, *Hapithus brevipennis* Saussure appears to be a host also. The distribution of *O. saltator*, as stated by Hebard (1931, p. 217), covers the entire southeastern United States, extending northward to southeastern Pennsylvania, Illinois, and Missouri, and undoubtedly to eastern Texas in the Southwest. In southern Florida a primarily West Indian species, *Orocharis gryllodes* (Pallas), occurs. *H. agitator* occurs as far northeast as Long Island, and otherwise is largely comparable to *O. saltator* in distribution (Blatchley, 1920, p. 740; Hebard, 1931, 1938; Rehn and Hebard, 1916, pp. 308-310). Two geographic subspecies are recognized, the southeastern one, *H. agitator quadratus* Scudder, living from the Atlantic Coast to Browns-

ville, Tex., and in the East apparently merging with typical *H. agitator* in central Georgia and along the "fall line" in North Carolina. *H. brevipennis* inhabits Florida, Georgia, and Louisiana, and doubtless other southeastern States. It may be that any of the crickets mentioned above are satisfactory hosts of *Rhopalosoma*. In southeastern Pennsylvania adults of both *Orocharis* and *Hapithus* begin to appear by early August, and in all of the more northern States the crickets pass the winter as eggs, and adults persist until frost time in the fall. Blatchley (1920) reported finding hibernating adults of *H. agitator* in Florida and suggested that they represented a fall generation. The subfamily Eneopterinae, to which *Hapithus* and *Orocharis* belong, is primarily tropical, and various genera are well represented in the Neotropical Region, from which Brues (1943) has recognized four species of *Rhopalosoma*.

Morphological descriptions

Mature larva (fifth instar from Falls Church, Va.).—General shape as in plate 1; strongly mandibulate; legs entirely absent; abdominal segments moderately well demarked, less so posteriorly, those beyond segment 8 not readily separated; two thoracic and eight abdominal pairs of spiracles.

Head in frontal view as in figure 8, *f*; occipital border broadly and evenly rounded (asymmetrical in the figure because it is bordered by uneven cervical folds); vertex and frons not individually demarked, the integument shiny, slightly irregular, not noticeably punctate; no frontal arms evident; paired conspicuous spots (ey), presumed to be vestigial eyes, just above base of clypeus; antenna reduced to sensory pit with traces of facetlike division, situated well to the side of frons, no apparent projecting sensilla; a presumed sensory area represented by about nine poorly defined, pigmented spots (sa), with tiny seta at lateral margin of group; frons and vertex with very sparse, short setae, grouped as illustrated; six strong clypeal setae; labrum conspicuously bilobed, each lobe with two major setae, lateral and anterior margins with microsetae, an irregular row of pits across each lobe, some bearing short setae; mandibles heavily sclerotized, apex prominent and narrowly rounded, basal third swollen laterally and with a single seta, biting margin thin, demarked from main mandibular structure by groove, and sharply but delicately toothed. (Left mandible with four well-spaced teeth along middle third of biting margin, followed by closely set group of four; right mandible with two teeth, others perhaps lost by breakage.) Maxilla with several medium-sized setae as illustrated, apex near tip of mandible sharply rounded and with asperities, maxillary palpus barrel shaped, galea

equally elongate but of smaller diameter; labium with palpi subequal to galeae, area of sericteries with two angular projections posterior to weakly sclerotized nonsegmented elongate appendages of uncertain homology; apparent opening of silk duct (sd) between bases of latter appendages.

Anterior spiracle on posterior third of prothorax; second spiracle barely anterior to groove separating meso- and metathorax; abdominal spiracles on segments 1 to 8, slightly more dorsad than thoracic ones, situated near anterior margin of the respective segments; each spiracle unspecialized so far as visible under 72-power magnification, consisting of circular disk with central aperture (internal structures not studied); no setae on thorax or abdomen apparent; no apparent specializations for crawling or clinging; vestigial anus transverse, at posterior margin of segment 10.

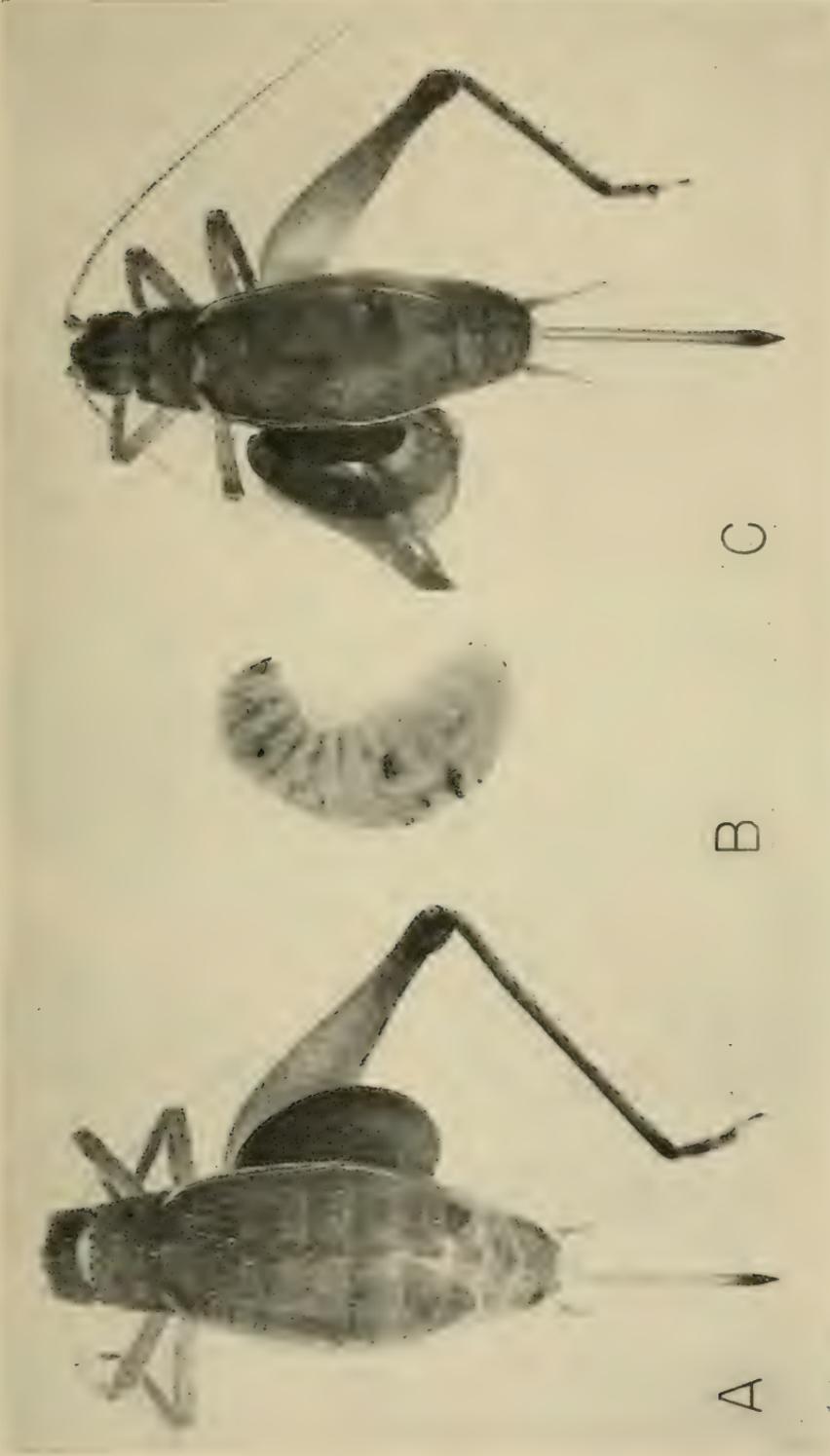
COLORATION: General color creamy yellow, darker on head (conspicuous black areas on body shown in photograph are necrotic spots developed at time of death). Vertex, frons, and clypeus yellowish; eye spots, sensory areas, antennae, and pits at bases of setae pale brownish; a darkened area anterior to sensory area; a somewhat darkened indefinite band across base of clypeus connecting bases of mandibles; labrum colorless, except for brown setae and pits; mandibles marked as illustrated with rich, dark brown; maxillary and labial palpi and galeae dark brown; labium white, elongate appendages in area of sericteries tinged with yellowish; spiracles yellowish; no special pigmented areas about nonfunctional anus or elsewhere on thorax and abdomen.

Measurements (in millimeters): Length 8 (would actually be slightly longer if body not curved); greatest width of body 3.2; greatest width of head capsule 1.3.

COMMENTS: Fifth instar from Marietta, Ga., more robust than larva from Falls Church, Va.; setae on frons and vertex smaller, scarcely noticeable; teeth on mandibles lacking. Measurements (in millimeters): Body length 8.5; greatest width 4; greatest width of head capsule 1.6.

Penultimate stage larva (fourth instar from Fuguay, N. C.).—General appearance typically hymenopteriform (fig. 9, *e, f*); head capsule and mouth parts not so highly developed as in fifth instar; legless; 10 pairs of spiracles; modified anus apparently specialized as a hold-fast organ.

Head capsule (fig. 8, *e*) rather masklike in contrast with that of fifth instar, integument very rough and irregularly rugose, a conspicuous transverse ridge (epistoma) dorsad of labrum; two pairs of blunt protuberances on upper part of face, the median pair (mt) broad and



A, *Hapithus agitator* Uhler, with attached fourth instar of *Rhopalosoma* before its removal, Fuguay, N. C.; B, Fifth instar of *Rhopalosoma* from cricket in figure C.; C, *Hapithus agitator* Uhler, with exuviae of *Rhopalosoma*, Falls Church, Va.

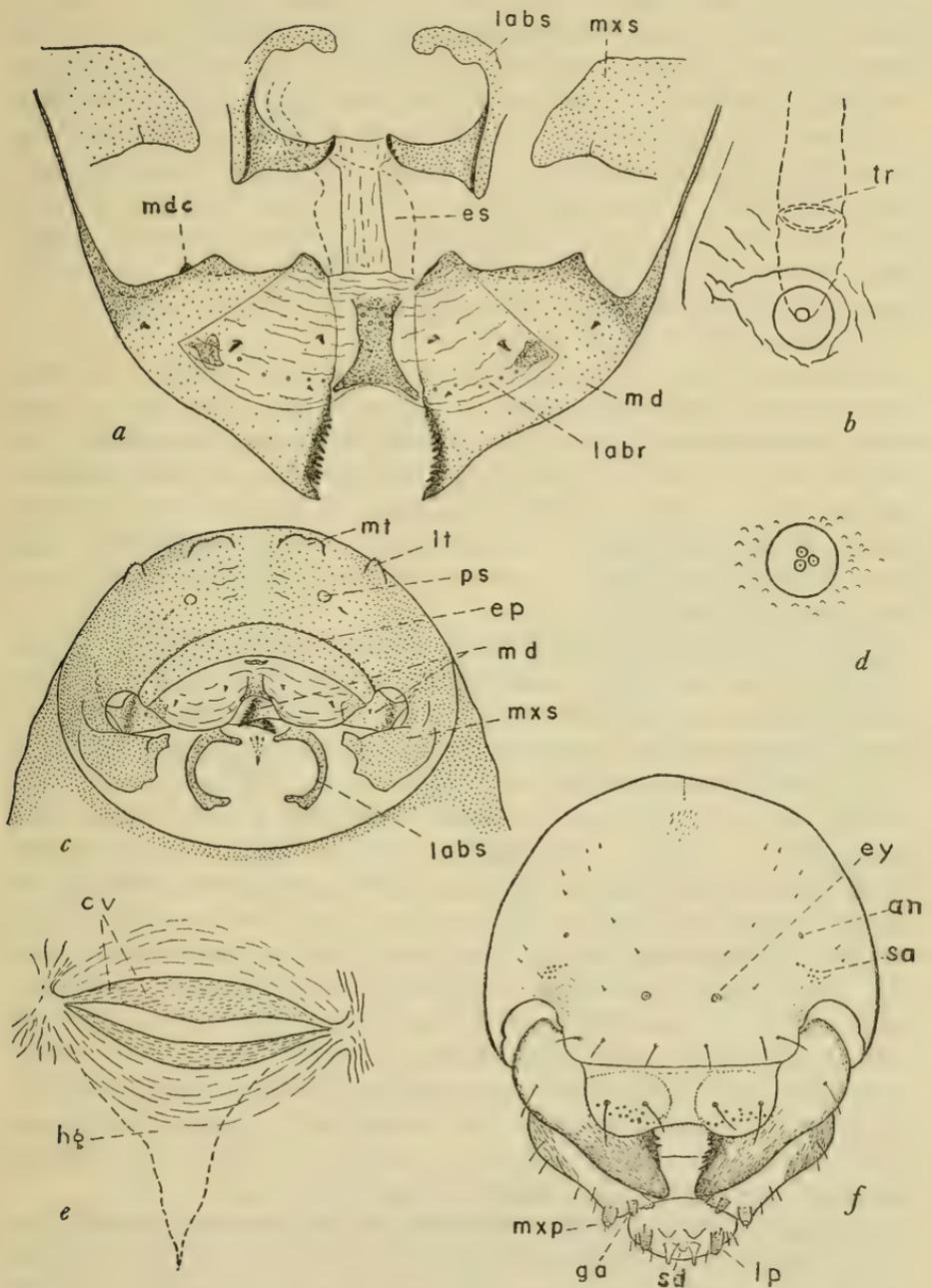


FIGURE 8.—The genus *Rhopalosoma* Cresson, 1865: *a*, Mouthparts of fourth instar exuviae; *b*, external view of sixth abdominal spiracle of fourth instar exuviae; *c*, front view of head, fourth instar alcoholic specimen; *d*, antenna of fourth instar exuviae; *e*, anal region, fourth instar exuviae; *f*, front view of head, fifth instar alcoholic specimen; (*c* made from Fuguay, N. C., specimen, all others from Falls Church, Va., material).

irregularly rounded, lateral pair (lt) narrow and evenly rounded; antennal socket (an, fig. 9, *e*) circular, minute, traces of sensilla scarcely visible under 72-power magnification; labrum membranous except mesally and at lateral extremities, strongly bilobed, each lobe bearing two small setae about equidistant from center and a minute seta near anteromesal margin; exposed apical fourth of overlapping mandibles triangular, the apex sharply acute, about seven sharp teeth; approximate basal third of each mandible exposed near end of epistoma, bearing a single, minute seta; a long tapering apodeme extending dorso-laterally within head capsule; maxillary sclerome (mxs) anterior to base of mandible, shaped as illustrated; labial sclerome (labs) an irregular, incomplete circle.

Abdomen with 10 apparent segments; spiracles located as in fifth instar; entire dorsal area glabrous; venter of prothorax and cervical region bearing minute asperities; dorsal and lateral integument appearing as if covered with closely appressed scales (see later description of exuviae); eight abdominal segments with ventral, transverse groups of small platelets; hold-fast organ at posterior margin of segment 10, transverse, weakly crescent-shaped, with short membranous flap extending posteriorly.

COLORATION: General color dark blackish-brown; ventral region (unstippled areas on fig. 9, *e, f*) unpigmented; a white middorsal line (where split occurs at subsequent molt) extending entire length of body; head considerably darker than thorax or abdomen; region of frons lighter colored than main epicranial region, two darker pigmented spots (ps) anterior to median tubercles, a wide longitudinal white stripe on frons, interrupted on anterior portion of vertex and resumed as narrow line on occiput; labrum unpigmented except at lateral extremities, on a slender transverse basal median sclerite, and mesally at the junction of the lobes; mandibles and scleromes of maxillae and labium pigmented with brown as illustrated. Abdomen with paired unpigmented spots dorsad of spiracles 3 to 8, and in a similar position on abdominal segment 9 (which bears no spiracle); transversely grouped platelets of ventral surface pale brown, also closing sclerites of hold-fast organ and immediately adjacent membrane.

MEASUREMENTS (in millimeters): Length of body 5.7; greatest width of body 2.2; greatest width of head capsule 1.4.

COMMENTS: Slide-mounted preparations of the cast skin of the fourth instar from Falls Church, Va., permitted structures to be observed in much greater magnification than was possible with the preserved alcoholic larva from Fuguay, N. C. While no significant differences in these individual fourth stage larvae apparently occur, it is important that the features illustrated and described be attributed to the correct specimens.

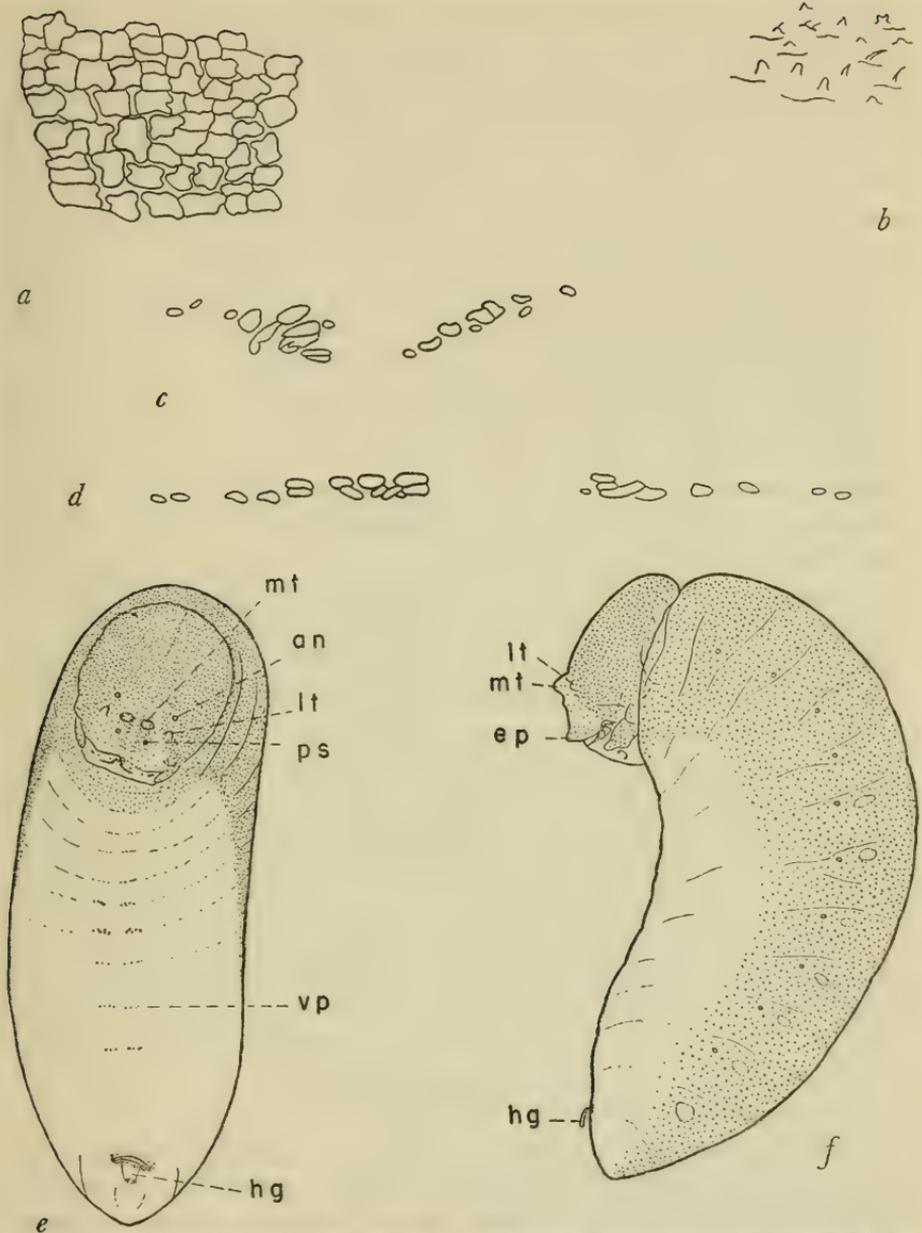


FIGURE 9.—The genus *Rhopalosoma* Cresson, 1865: *a*, Section from lateral area of thorax, showing closely grouped platelet structure, fourth instar exuviae; *b*, integumental asperities on ventral surface of prothorax, fourth instar exuviae; *c*, *d*, specialized platelets on ventral surface of fourth and fifth abdominal segments, respectively, fourth instar exuviae; *e*, *f*, ventral and lateral views, respectively, of fourth instar alcoholic specimen; (*e*, *f*, from Fuguay, N. C., specimen, others from Falls Church, Va., material).

an—antenna
 cv—closing valves
 ep—epistoma
 es—esophagus
 cy—eye
 ga—galea
 hg—hind gut

lab—labial sclerome
 labr—labrum
 lp—labial palpus
 lt—lateral tubercle
 md—mandible
 mdc—mandibular condyle
 mt—median tubercle

mxp—maxillary palp
 mxs—maxillary sclerome
 ps—pigment spots
 sa—sensory area
 sd—opening of silk gland
 or sericteries
 tr—tracheal ring
 vp—ventral platelets

Exuviae split lengthwise on dorsum, from epistoma to tenth abdominal segment; presumed antenna consisting of circular socket (fig. 8, *d*) with three tiny unpigmented circles in center, each bearing a central spot of pigment; mouth parts (fig. 8, *a*) with mandibles the most characteristic and best preserved of the parts; mandible thin, much flattened, biting margin with large apical tooth and about 10 acute smaller teeth in a single row along apical third, an emargination a little posterior to the teeth, portion of margin overlaid by labrum scarcely pigmented, a well-sclerotized and pigmented region at base of mesal margin; posterior margins of mandible with a prominent black ventral condyle, a small seta near base of long lateral apodeme (presumed mesal apodeme for muscle attachment missing in available material); labrum largely membranous, with irregular transverse wrinkles, a constricted pigmented sclerite mesally, about five subapical minute pits arranged transversely on each lateral half; a poorly defined, somewhat striated organ leading posteriorly to labial sclerome from base of labrum, dorsad of remnants of apparent esophagus (*es*); labial and maxillary scleromes showing somewhat different shape in flattened aspect than in natural position on alcoholic larva.

Integument of most of thorax and abdomen smooth, microscopically marked into platelets of different shapes on various areas of the body, averaging transversely elongate ventrally, irregularly quadrate (fig. 9, *a*) dorsally on thorax and anterior half of abdomen; ventral region of neck and prothorax bearing minute asperities of varied character (fig. 9, *b*), some setiform, others in form of sharp rugosities; less developed asperities on ventral surface of abdomen; specialized platelets on venter of abdominal segments 1 to 8 (poorly developed on 1 to 3 and 8, well developed on 4 to 7), of irregular grouping on 4 and 5 (fig. 9, *c*), others transverse (fig. 9, *d*). Spiracles each surrounded by narrow irregular area of membrane, the external portion a circular flattened disk with small central opening; trachea tapering to spiracular opening, with internal ring (*tr*, fig. 8, *b*) which may function as closing apparatus. Modified anus (fig. 8, *e*) with well-sclerotized and pigmented closing valves (*cv*), integument at lateral extremities wrinkled, that posterior and anterior to valves moderately pigmented, a short section of membrane on internal surface an apparent remnant of hind gut (*hg*).

Exuviae of the first three instars are very closely appressed to each other along the posterior half of their abdominal sterna, so much so that they can scarcely be separated without injury to the specimens. The closest attachment appears to be a little anterior to the modified anal opening (hold-fast organ). The platelets comprising the microstructure of the integument on the lateral and dorsal surfaces of

thorax and abdomen, which in the fourth instar vary from tightly grouped on the side of the thorax (fig. 9, *a*) to narrowly separated on the abdomen, are much less closely grouped in the third and second instars, while they are so distant and reduced in size in the first instar as to resemble very widely spaced spiculelike spots of pigment. Mandibles of the third and second instars roughly resemble those of the fourth, and bear sharp teeth, there being at least six to eight in the third and apparently fewer in the second. The epicranium of the first instar has about two pairs of rather large areas of darker pigment, but no mouth parts have been observed, though they may have escaped detection. There are 10 pairs of spiracles in the third and second instars, with the pre-spiracular tracheal ring poorly defined. Only six pairs of spiracles have been found on the exuviae of the first instar, and the posterior one is poorly developed. Each of the three early instars is brown, darker on the head. The venter is pale in the third and second instars. Approximate lengths of the exuviae of the Falls Church, Va., larva are as follows (in millimeters): Fourth 6.5; third 3.6; second 2.3; first 1.2. Those of the Marietta, Ga., larva are almost identical, but the Fuguay, N. C., larva is larger, the three exuviae measuring as follows: Third 4.4; second 2.6; first 1.3.

Eggs apparently are broadly elongate-oval; fragments are about 1.4 millimeters long.

A basic paper on the larval head of parasitic Hymenoptera is that of Vance and Smith (1933). Among the more specialized papers, those of G. C. Wheeler (1943) and Beirne (1941) have aided me most while studying the anatomy of fifth- and fourth-instar heads, respectively, of *Rhopalosoma*. The book by Clausen (1940) is a valuable aid toward understanding the biology and morphology of related families, and it should be consulted for references to the important work of J. C. Bridwell, F. A. Fenton, R. C. L. Perkins, F. X. Williams, F. van Emden, and others.

Summary and discussion

Among the biological data additional to those brought out by Hood (1914) is the fact that *Hapithus agitator* is an acceptable host for *Rhopalosoma* in the eastern United States. The effect of the parasite on the internal organs of the host, unfortunately based on only one dissected cricket, has been described. Details concerning the position of the parasite egg and various larval stages have been given. Notes on adult habits, essentially lacking previously, make it clear that in parts of the Southeast specimens of *Rhopalosoma* are not nearly so scarce as has been supposed. Like many another rarity in collections, these insects can doubtless be taken in numbers by those familiar with

their appearance, time of occurrence, and favored habitats. It is noteworthy that on a single day, September 12, 1950, Dr. Townes and his associates found two larvae, one on *Hapithus*, the other on *Orocharis*. Specimens belonging to the University of Michigan show that on three other occasions, once in Indiana and twice in Florida, a collector has found two instances of parasitism in a single day.

There remain many unanswered questions concerning the biology of the species of *Rhopalosoma*, some of which may require controlled cage studies. Stages earlier than the fourth instar are still known from exuviae and fragments of eggshell, and first instar specimens are especially desirable for morphological study.

More study material, including specimens from northern and southern States, may show that more than one form of *Rhopalosoma* occurs in the United States. Adults of *nearcticum* were distinguished from their Neotropical congeners by Brues (1943) on rather minor morphological features, and differences correlated with geographic distribution might be better represented in larvae than adults. Of the four fifth-instar specimens examined, the ones from Georgia and North Carolina and the exuviae of Hood's Maryland specimen lack teeth on the mandibles, while the larva from Virginia apparently has a full complement of teeth on the left mandible but only a few basal ones on the right mandible. It is not known whether occasional breakage of teeth occurs while the larvae are burrowing in soil prior to cocoon formation. Some breakage of the teeth of the Virginia larva may have resulted from my manipulation of the mandibles with needles before I realized the existence of teeth. The three fifth-stage larvae have been measured for maximum head width and length of mandibles. The ratio of head width to length of mandible is 1.68, 1.86, and 2.0 for the larvae from Virginia, North Carolina, and Georgia, respectively.

Brief examination of a few examples of other families has suggested certain characters which deserve careful attention in subsequent work of a comparative nature. A chrysidid larva (*Chrysis*) has the second thoracic spiracle located behind the groove separating meso- and metathorax, while the corresponding spiracle of *Rhopalosoma* is slightly in front of the groove. Unlike the condition in *Rhopalosoma*, the second spiracle of a tiphiid larva (*Cosila*) is smaller than adjacent ones. This tiphiid larva has two maxillary appendages, and there are two prominent angular projections on the labium in the area of the sericteries. As more details of rhopalosomatid life histories become available, comparisons with the situation in the Tiphiidae, such as has been discussed by Clausen, King, and Teranishi (1927), will perhaps be instructive.

A larva of one of the Larridae (*Larra analis* Fabricius, which attacks mole crickets) has the head proportionately smaller than

Rhopalosoma, but as in the latter the maxilla and labium have two pairs of appendages each. A conspicuous difference is that the mandible of *Larva* has a single preapical tooth in the incisor area, and basally on a lower lever there are two heavy molar teeth, or "prosthecae." The mesal pair of elongate labial appendages of *Rhopalosoma* has apparent homologues in this larrid.

The mouth parts of those few larvae of Bethyridae and Dryinidae that I have seen are much reduced or otherwise specialized. Illustrations of dryinid larvae on the bodies of leafhoppers, such as those of Haupt (1916), show that the parasite larva sometimes remains associated with its exuviae in a manner suggestive of *Rhopalosoma*. The genus *Harpagocryptus* Perkins, based on a species that Perkins (1908) described from Queensland, is of interest in this connection because the larva was said to form "a sac on the sides of the abdomen of small crickets (Trigonidiidae)." Although originally referred by Perkins to the Dryinidae, Bischoff (1927, p. 407) called *Harpagocryptus* a bethyrid, and Reid (1939) suggested that it may be a psammocharid. As with *Rhopalosoma*, a knowledge of the immature stages of *Harpagocryptus* might prove of great value when adequate comparative studies eventually are possible.

References

- ASHMEAD, WILLIAM H.
1896 Rhopalosomidae, a new family of fossorial wasps. Proc. Ent. Soc. Washington, vol. 3, pp. 303-309.
- BEIRNE, BRYAN P.
1941 A consideration of the cephalic structures and spiracles of the final instar larvae of the Ichneumonidae (Hym.). Trans. Soc. British Ent., vol. 7, pp. 123-190, 31 figs.
- BISCHOFF, H.
1927 Biologie der Hymenopteren. 598 pp., 224 figs. Berlin.
- BLATCHLEY, W. S.
1920 Orthoptera of Northeastern America. 784 pp., 246 figs. Indianapolis.
- BRUES, CHARLES T.
1921 Correlation of taxonomic affinities with food habits in Hymenoptera, with special reference to parasitism. Amer. Naturalist, vol. 55, pp. 134-164.
1943 The American species of *Rhopalosoma*. Ann. Ent. Soc. Amer., vol. 36, pp. 310-318, 9 figs.
- BRUES, CHARLES T., AND MELANDER, A. L.
1932 Classification of insects. Bull. Mus. Comp. Zool., vol. 73, pp. 1-672, 1121 figs.
- CLAUSEN, CURTIS P.
1940 Entomophagous insects. 688 pp., 257 figs.
- CLAUSEN, CURTIS P., KING, J. L., AND TERANISHI, CHO
1927 The parasites of *Popillia japonica* in Japan and Chosen (Korea), and their introduction into the United States. U. S. Dep. Agr. Dep. Bull. 1429, 1-55 pp., 1 pl., 35 figs.

CUSHMAN, R. A.

- 1926 Some types of parasitism among the Ichneumonidae. *Proc. Ent. Soc. Washington*, vol. 28, pp. 29-51, 51 figs.

HAUPT, H.

- 1916 Beiträge zur Kenntnis der Cicadinenfeinde. *Zeitschr. Wiss. Insekt-enb.*, vol. 12, pp. 217-223, fig. 13.

HEBARD, MORGAN

- 1931 The Orthoptera of Kansas. *Proc. Acad. Nat. Sci. Philadelphia*, vol. 83, pp. 119-227, 2 figs.
1938 Where and when to find the Orthoptera of Pennsylvania, with notes on the species which in distribution reach nearest this state. *Ent. News*, vol. 49, pp. 97-103.

HOOD, J. DOUGLAS

- 1914 Notes on the life history of *Rhopalosoma poeyi* Cresson. *Proc. Ent. Soc. Washington*, vol. 15 (1913), pp. 145-147, fig.

KROMBEIN, K. V.

- 1951 [Rhopalosomatidae] in Muesebeck, et al., *Hymenoptera of America north of Mexico*. U. S. Dep. Agr. Monogr. 2, pp. 773-774.

PERKINS, R. C. L.

- 1908 Some remarkable Australian Hymenoptera. *Proc. Hawaiian Ent. Soc.*, vol. 2, pp. 27-35.

REHN, J. A. G., AND HEBARD, MORGAN

- 1916 Studies in the Dermaptera and Orthoptera of the Coastal Plain and Piedmont region of the southeastern United States. *Proc. Acad. Nat. Sci. Philadelphia*, vol. 68, pp. 87-314, 3 pls.

REID, J. A.

- 1939 On the relationship of the hymenopterous genus *Olixon* and its allies, to the Pompilidae (Hym.). *Proc. Ent. Soc. London*, ser. B, vol. 8, pp. 95-102, 2 figs.

VANCE, A. M., AND SMITH, H. D.

- 1933 The larval head of parasitic Hymenoptera and nomenclature of its parts. *Ann. Ent. Soc. Amer.*, vol. 26, pp. 86-94, 3 figs.

WESTWOOD, J. O.

- 1874 *Thesaurus entomologicus Oxoniensis*. 205 pp., 40 pls.

WHEELER, GEORGE C.

- 1943 The larvae of the army ants. *Ann. Ent. Soc. Amer.*, vol. 36, pp. 319-332, 2 pls., 2 figs.
1948 The larvae of the fungus-growing ants. *Amer. Midl. Nat.*, vol. 40, pp. 664-689, 3 pls., 3 figs.

WHEELER, WILLIAM MORTON

- 1919 The parasitic Aculeata, a study in evolution. *Proc. Amer. Philos. Soc.*, vol. 58, pp. 1-40.

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3314

PHOTURIS BETHANIENSIS, A NEW LAMPYRID FIREFLY

By FRANK A. McDERMOTT

In August 1949, at Bethany Beach in southern Delaware, some observations were made on the few lampyrids then still flying. A single specimen of *Photinus pyralis* (Linnaeus, 1767) and one of *Photuris versicolor* (Fabricius, 1798) were observed, and a very few instances of a double greenish flash were noted over grass in a large vacant area at the north end of the town and perhaps 1,000 feet from the ocean front. The insects giving this flash were not captured, however, in spite of much pursuit, but another insect was seen to fly into the grass while giving the frequently repeated, rather dim flash characteristic of females of *Photuris*. This one was taken and proved to be a rather small female *Photuris* with a distribution of the black pigmentation on the pronotum different from any previously seen. Previous visits to Bethany Beach earlier in the year had yielded nothing notable, except the relative scarcity of lampyrids. In July 1951 I again spent a few days at Bethany Beach, and again saw the double greenish flash. This was considerably later than the usual period of prevalence of *P. versicolor*, and it seemed probable that this flash was that of a different species. Several males were taken, and one female, the latter unfortunately lost by accident, but it may be noted that the females are apparently relatively scarce.

It differs from other photurids so far found in Delaware by the relatively small size, the distribution of the pronotal pigmentation, and the rather distinctly different flash of the male. The pronotal black pigmentation, while rather variable, has a distinct tendency to be enlarged toward the apical margin, and in none of the specimens did this spot show the forms characteristic of those of *P. versicolor*,

P. lucricrescens Barber, 1951, or *P. hebes* Barber, 1951, all of which had been collected during the same summer in northern Delaware. The characteristic male flash is much like that of *Photinus consanguineus* LeConte, 1851, two short, bright coruscations separated by a distinct interval perhaps somewhat longer than that of a single coruscation, but is quite greenish as compared with the yellow light of *consanguineus*. Occasionally the second coruscation may be much less bright than the first, even with the same specimen, and a few apparently gave only a single flash but were indistinguishable from those giving the double flash.

The first male specimens were taken on July 11, 1951, over the same field where the single female was taken in 1949, and where they were still scarce, but two days later a large colony was found flying over the vegetation, largely bayberry, on both sides of the road leading south from the town, at about two miles. Trips to areas a mile or so inland from the beach yielded only *Photinus pyralis*, here very abundant at the time, and an occasional stray *Photuris versicolor*, so the new species seems to be a rather strictly seacoast, almost a sand-dune, form. It has not been seen in several visits along the southern New Jersey coast, particularly at Stone Harbor, but it would be somewhat surprising if it were not present there.

In view of these circumstances, this insect is here described from the males collected in 1951, and the single female of 1949, as a new species.

Photuris bethaniensis, new species

Description.—A rather small lampyrid for a *Photuris*, 9.0–10.75 mm. long by 3.5–4.0 mm. wide, with a black pronotal mark tending to be densest toward the apical edge. The characteristic male flash is two greenish coruscations separated by a short interval.

HEAD: Width across eyes 2.1–2.45 mm. in male, 1.8 mm. in female; eye length 1.15–1.3 mm. in male, 0.85 mm. in female. Frons ivory to yellow, about 0.8–1.0 mm. wide; interocular margins usually rather divergent. Mandibles fairly large, 0.65–0.8 mm. across in closed position; proportionately larger in the female. Maxillary palpi dark brown, apical joint conoidal; labial palpi lighter brown, apical joint mitten-shaped. Clypeus dark brown, more or less tridentate.

ANTENNAE: Dark brown, 5.0–6.25 mm. long in male, 4.25 mm. in female; joints may all have pale bases, or this may be limited to basal three joints in the female.

PRONOTUM: Scutate, sometimes extended apically, 2.0–2.5 by 2.55–3.0 mm.; rounded posterior angles may or may not be appreciably produced; red pigmentation may extend to the basal edge; black spot of variable shape, and characteristically mainly toward the apex, or

at least the larger portion of it apical, the longitudinal portion being usually merely an irregular and sometimes interrupted line, and but little developed along the basal margin.

SCUTELLUM AND MESONOTAL PLATES: White or yellow.

ELYTRA: 7.0–8.0 by 1.6–2.0 mm.; ground color brown to nearly black; on each a white to yellow vitta, oblique, usually extending to about three-quarters the elytral length; wide yellowish lateral borders which give a slightly oval contour; narrow sutural borders.

VENTRAL THORACIC SURFACE: Brown.

TERGITES: Tergites 1 to 6 brown; tergite 7 lighter or only partially infuscate; tergite 8 pale to white.

STERNITES: 2 to 5 usually brown, sometimes becoming darker in this order; sternite 5 may be yellow; sternites 6 and 7 luminous in the male; and sternite 8 with a median posterior point, which may be very short. The luminous area in the female differs from the pattern seen in *versicolor*, being a transverse bilobed area medially very narrow, on segment 6, and a relatively large elliptical area on segment 7.

LEGS: Long; tibial spurs long, pattern 0–2–2.

AEDEAGUS: In the one dissected, 2.25 mm. long, identical in appearance with that of *P. lucicrescens* and the other photurids described by Barber.¹

Type and paratypes.—USNM 61469.

Type locality.—Bethany Beach, Del.

Material examined.—Holotype (male) and five paratypes, collected by McDermott at type locality, July 11, 1951; paratype (female), collected by McDermott at type locality, August 1949.

Remarks.—*Photuris bethaniensis* is probably a seacoast form; it has not been noted elsewhere. The flash suggests *P. fairchildi* Barber, 1951, but the latter is a larger species with narrow elytral borders.

¹ Barber, H. S. North American fireflies of the genus *Photuris*. Smithsonian Misc. Coll., vol. 117, No. 1, pp. 1–58, 3 figs., 1951.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3315

DISTRIBUTION, GENERAL BIONOMICS, AND RECOGNITION
CHARACTERS OF TWO COCKROACHES RECENTLY ESTAB-
LISHED IN THE UNITED STATES

By ASHLEY B. GURNEY¹

Introduction

In contrast to the large numbers of cockroach species that occur in a great variety of natural habitats in most tropical countries, only about 55 are now recorded from the entire United States. With the exception of those occurring in a few localities, mainly in the Southwestern States, our roaches are well known to entomologists. In the northern third of the country there are few native roaches living in fields or woodlands, and most of the better-known species are established adventives which are rather closely associated with human habitations, having been brought there by artificial means. The recent establishment in the Northeastern States of two potentially important roaches new to this country is therefore of decided interest.

Beginning in 1948 and continuing each subsequent year, specimens of *Ectobius livens* (Turton), the spotted Mediterranean roach,² have been collected at Falmouth, Mass., under outdoor conditions, coming to houses at night and also occurring on fresh vegetables. Because of these habits and the wide natural occurrence of this roach in Europe and adjacent areas, it seems quite probable that a slow spread in the United States may take place, and that from time to time questions regarding its identity and importance will arise.

¹ Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

² No generally accepted common name seems to be applied to *E. livens* in Europe, and this name is considered suitable for American use in view of the species' appearance and the region of its dominant Old World occurrence.

A second species not previously known to breed in the United States is *Leucophaea maderae* (Fabricius), the Madeira roach. Unlike the spotted Mediterranean roach, *L. maderae* is well known because it is frequently transported with articles of commerce in tropical countries. It has many times been intercepted by quarantine inspectors at United States ports and has occasionally been carried to inland cities, where it failed to survive. In the autumn of 1950 it was found to be established in the basements of New York City buildings occupied by people who had come from Puerto Rico. Although its native home is evidently West Africa, it apparently was introduced to the West Indies more than 100 years ago. The Madeira roach could probably live outdoors in tropical Florida and perhaps at the other southern extremities of the United States, but it is more likely to be important as a domestic pest in the well-heated buildings of our larger cities. One has only to recall the increasing importance of the brown-banded roach *Supella supellectilium* (Serville) in this country during comparatively recent years to realize the potential importance of *Leucophaea maderae*. Apparently a native of Africa that has been spread by commerce to most of the warmer parts of the world, *S. supellectilium* was first reported from the United States in 1903, based on specimens from Key West, Fla. It was not noted as a pest here until found in a private home in Nebraska in 1929, but since then has rapidly gained recognition as one of our principal pest roaches (see Back, 1937, and Gould and Deay, 1940).

This paper is intended to aid in the identification of these two roaches and to supply such available information on distribution and habits as is likely to be helpful to subsequent studies of these species in the United States. A third species, *Nauphoeta cinerea* (Olivier), was found to be established in Florida after this manuscript was prepared. It is briefly noted on page 46.

Genus *Ectobius* Stephens, 1835

Ectobius livens (Turton), 1800? (spotted Mediterranean roach)

FIGURE 10, *a-d*: PLATE 2, FIGURES 3-6

Blatta livida Fabricius, *Entomologia systematicae*, vol. 2, p. 10, 1793. (Pre-occupied by *Blatta livida* De Geer, *Memoirs pour servir à l'histoire des Insectes*, vol. 3, p. 538, pl. 44, fig. 6, 1773.)

Blatta livens Turton. *A general system of nature . . .*, vol. 2, p. 529, 1800? (New name for *Blatta livida* Fabricius.)

Ectobius lividus Fabricius, Stephens, *Illustrations of British entomology*, *Mandibulata*, vol. 6, p. 48, 1835.

Ectobius livens (Turton), Ramme, *Mitt. Zool. Mus. Berlin*, vol. 27, pp. 34-45, pl. 10, fig. 3, 1951.

Nomenclatural comments.—Until 1951 *Ectobius lividus* was usually applied to this species. The name *E. livens* has been resurrected by

Ramme (1951, p. 34) who says that Dr. K. Princis of Lund, Sweden, informed him that *livida* Fabricius was preoccupied and that Turton proposed *livens* on page 526, vol. 2, of his 1806 edition of Linné's *Systema Naturae*. Turton published two editions of an English translation of the thirteenth (Gmelin) edition of this work. These editions are listed in the 1903-1915 Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History) (vol. 3, 1910, p. 1128). I have verified their dates and contents by an examination of the entire 7-volume 1806 edition in the Library of Congress and of volume 2 of the 4-volume first edition in the library of the U. S. National Museum. The first Turton edition appeared from 1800 to 1802. Volume 2, containing the genus *Blatta*, is dated 1800 and is reasonably sure to have appeared no later than 1802. The second Turton edition appeared in 1806, the first 4 volumes being re-issues of the former edition with slight changes of the title pages. On the page indicated by Ramme (p. 526) *Forficula livida*, an earwig, is treated.

Prior to Ramme's monograph, the identities of the British species of *Ectobius* were confused. Thus the species treated by Lucas (1920, p. 78) as *perspicillaris* Herbst is in reality *livens*. This has been clarified by Blair (1934, 1935). Princis (1936) has explained that a Lapland record of *lividus* (i. e., *livens*) actually was based on material of *lapponicus* (Linnaeus). Hebard (1943, p. 12) states that Australian records of *lividus* are incorrect. Taxonomists now differentiate the species of *Ectobius* on rather minute characters, especially on the basis of the dorsal abdominal gland and genitalia of males. Ramme (1949) has described *E. siculus* from Sicily, differing from *livens* in having black legs and antennae. *E. finoti* Chopard of Algeria (see Chopard, 1943, p. 21) is much like *livens*, having the small tegminal spots between the veins and with the dorsal gland bearing a rounded tubercle. The genus *Ectobius* (genotype: *lapponicus*) in a modern sense is much more restricted than formerly. In the older literature, species of *Ectobius* were reported from many parts of the world. Certain of these are now known to belong to other genera. For instance, many years ago several Nearctic roaches were referred to *Ectobius*. Rehn (1931, pp. 306-374) and Hebard (1943) have discussed the generic limits of *Ectobius*: Rehn (p. 308) has explained the nature of the toothed tarsal claws; the teeth were evidently overlooked by Hebard (p. 12).

Recognition features.—The most important features enabling recognition of *Ectobius livens* are: (1) Small size, over-all length about 8 to 9 millimeters; (2) small, dark spots on the veins of the front wing (tegmen); (3) conspicuous intercalated triangle at apex of wing (itr, fig. 10, *b*); (4) claws of unequal length, the posterior claw of each pair much longer than anterior one; (5) in males the characteristic shape of the dorsal abdominal glandular depression and the sub-

genital plate (fig. 10, *a, c*); (6) conspicuous spines on ventroposterior margin of each femur.

Of the foregoing features, the second and fifth are specific for the separation of this roach from other species occurring in the United States and the others are highly confirmatory when in combination.

The native Nearctic species most likely to be mistaken³ for *E. livens* are *Chorisonera texensis* Saussure and Zehntner, of Texas and the Southeast, and members of the genus *Cariblatta*. Both have claws of equal length, and *Cariblatta* lacks a well-developed, intercalated triangle. *C. texensis* has a large intercalated triangle, but has no conspicuous spines along the posterior margins of the femora. The best-known outdoor roaches of the Eastern States belong to the genus *Parcoblatta*; all are larger than *livens* and lack an intercalated triangle.

Identification of the Massachusetts specimens of *livens* was aided by comparisons made at the Academy of Natural Sciences of Philadelphia with authentic French and Swiss material, given to the Academy by the Swiss entomologist Henri de Saussure.

Description.—ADULTS: General form as in plate 2, figure 6; tegmina and wings covering abdomen; width between eyes on vertex about $1\frac{1}{2}$ times length of first antennal segment (female), slightly less in male; all femora with conspicuous spines on ventroposterior margins; ventroposterior margin of front femur with three or four well-spaced, strong spines along part slightly basad of middle, the more apical one often smaller than others, followed by 10 to 15 small, delicate spines (some of which are frequently broken) extending in a regular row nearly to apex, a long curved apical spine closely preceded by a straight subapical one about three-fourths as long; tarsal segments one to four each with a tiny, round pulvillus (membranous pad); segment 5 with large, broad apical arolium between conspicuously unequal tarsal claws, anterior claw about two-thirds length of posterior one, longer claw with about four spinelike inner teeth along basal half, teeth on smaller claw poorly developed. Tegmen with costal veins simple, cubital veins (discoidal sectors) strongly oblique, apex rather sharply rounded. Wing with distinctive intercalated triangle (itr, fig. 10, *b*).

General color pale yellowish; tegmina and marginal area of pronotum transparent, marked with reddish brown spots, on the tegmen these spots located on the veins; eyes dark brown to black; face yellow to reddish orange; vertex and upper part of face usually with several spots of darker orange; coxae and femora unspotted; tibiae with dark brown at bases of some spines; venter of abdomen with poorly

³ The standard taxonomic reference on Nearctic Blattaria is that of Hebard (1917). A recent key to genera is by John W. H. Rehn (1950). The European species of *Ectobius* were reviewed by Ramme (1923).

developed longitudinal rows of dark brown submarginal and median spots.

Measurements (in millimeters) of representative specimens: Overall length, including folded tegmina, female 9, male 8.5; pronotum, female 2.1, male 1.9; tegmen, female 7, male 7.2. Width of pronotum, female 3, male 2.9. No significant size variation has been noted.

NYMPHS: Nymphs (pl. 2, figs. 3, 4) ranging in body length from 2.5 to 4.5 millimeters have been examined. They are yellow, with conspicuous dark reddish brown spots on the dorsal surface and on the vertex and upper part of the face. Dark submarginal longitudinal streaks appear on the thorax. The venter of the abdomen is dark brown submarginally and medially.

OÖTHECAE: Two oöthecae have been examined (pl. 2, fig. 5). They are dark brown and measure 2.3 millimeters in length. The convex margin is weakly crenulate and there are faint transverse indications of the eggs contained.

Distribution.—Three American localities are known for *Ectobius livens*, all in Massachusetts: Falmouth, Manomet, and Plymouth. Falmouth, the first site discovered here, is situated near Woods Hole and the Cape Cod Canal, on the southern side of the base of Cape Cod. In October 1951, after this manuscript had been prepared, I examined 3 males and 4 females of *livens* collected at Manomet, Plymouth County, Mass., by Mrs. S. P. Graeff and submitted by Dr. Ellsworth H. Wheeler of the University of Massachusetts. Manomet is on the coast of Cape Cod, about 20 miles north of Falmouth. The specimens were collected before August 13, 1951, apparently just prior to that date. Mrs. Graeff wrote, "Our summer cottage is pretty well overrun with them. Painters told me they were even on the roof. The cottage is in the woods and the underbrush is close. I think this is the third summer we have had them. I suspect they like damp spots, they scurry under shingles."

An adult of *livens* was submitted July 28, 1952, by a Plymouth housewife who reported that her house and shrubbery were becoming infested.

This roach is widely distributed in the southern and central portions of western Europe, occurring in Germany, the Netherlands, Belgium, France, Switzerland, Italy, Portugal, Spain, and southern England. It has also been reported as far eastward in the Mediterranean area as Asia Minor, but the records I have seen were published prior to the modern work dating from Ramme's 1923 monograph of *Ectobius* and are not dependable. Chopard (1943, p. 21) has reported it from Algeria and Tunisia. I have found no records of its occurrence in the Azores. Fabricius originally described the species from France, and, in the absence of type material, Ramme in 1923 designated a male

neotype from Montpellier in southern France. Two varieties of *livens* have been recognized, *chopardi* Adelung described from France in 1916, and *minor* Ramme described from the Island of Elba in 1923. These varieties are based primarily on the amount of dark color on the lower surface of the abdomen, *minor* being quite dark except near the lateral margins, only the submarginal dark spots being well developed in *chopardi*, and the submarginal spots being poorly or moderately developed in typical *livens*. The species of *Ectobius* are well known for color variation, the color of tegmina and abdomen often being recessive (pale) or intensive (dark). In view of this situation, it remains to be proved whether *chopardi* and *minor* are valid subspecies or if they are forms without real significance. The center of distribution for the genus *Ectobius*, as outlined by Rehn (1931, pp. 314-318), was apparently the Mediterranean Basin, with a secondary center developed in Africa south of the Sahara Desert.

Biology.—The original Massachusetts specimens of *Ectobius livens* examined consist of 2 males, 16 females, 9 nymphs, and 2 oöthecae. The males were taken June 21, 1948, and the other specimens in late August and September 1950.⁴ It may be significant that males were found only in the spring and early summer. Lucas (1928) reported that in England males of *E. lapponicus* disappeared about midsummer, the females persisting longer than males, and nymphs appearing in late summer and fall preparatory to hibernation. No detailed life history studies of *livens* in Europe have come to my attention. Brown (1952) has reported observations on the related *E. panzeri* Stephens in England, which occurs there mainly on sand dunes near the coast. Adults die in the fall, the males disappearing first, but nymphs overwinter and do not reach full maturity until early August of the following year.

The Falmouth collections were made on a farm located beside a small salt river about a mile from the shore. Mr. Flint found specimens in a large variety of situations, specimens occurring most consistently beneath loose lichens on oak trees, and crawling on trees and houses at night—the latter in the vicinity of lights. Some were found under baskets, in buckets, or on Swiss chard and other vegetables, or were taken by general sweeping (see Flint, 1951).

In England *E. livens* occurs only in the extreme southern counties—there found on trees, among bracken ferns, under dead leaves, and flying actively in hot sunshine (Lucas, 1920, p. 80; Burr, 1936, p. 44). Chopard (1947, p. 37) says *livens* is very common in the French woods, and he gives a colored illustration (pl. 2, fig. 28).

⁴ All of this material was collected by Oliver S. Flint, Jr., a student at the University of Massachusetts. I am much indebted to Mr. Flint for the enthusiasm with which he sought additional material once the character of his initial captures was pointed out to him, as well as for his diligence in seeking clues to the origin of the introduction.

Source of introduction.—The Massachusetts colony of *Ectobius livens* is probably the result of an accidental introduction from western Europe or the Mediterranean area. A good many people of Portuguese ancestry live in Falmouth and the vicinity, and visits to Portugal and the Azores are frequent. Seeds and occasional shipments of fruit are brought back, but quarantine regulations prevent widespread movements of plant products. Since *livens* occurs in Portugal, as reported by Seabra (1942, p. 19), the possibility of an introduction from that part of the Mediterranean seems the most likely.

Probable importance.—*Ectobius livens* is not likely to develop into a major pest or to live in buildings except occasionally. As a nuisance pest in the vicinity of gardens and dwellings, it may be expected to attract attention at intervals and to be submitted to entomologists for identification and advice, as is now true of male specimens of *Parcoblatta* which are attracted to lights and which occasionally remain in houses for short periods.

So far as known, species of *Ectobius* are not economically important in Europe. *E. lapponicus* has often been stated to be a pest of dried fish in Swedish Lapland, but Gaunitz (1935, 1936) found that *lapponicus* does not occur indoors and probably feeds on vegetable matter.

Genus *Leucophaea* Brunner, 1865

Leucophaea maderae (Fabricius), 1793 (Madeira roach)

FIGURE 10, *c-h*; PLATE 2, FIGURES 1, 2

Blatta maderae Fabricius, Entomologia systematicae, vol. 2, p. 6, 1793.

Leucophaea maderae (Fabricius), Rehn, Trans. Amer. Ent. Soc., vol. 29, p. 283, 1903.

Nomenclatural comments.—The name *Rhyparobia maderae* is currently used by certain workers, especially Europeans, as exemplified by Chopard (1943, p. 45) in his monograph of North African Orthoptera. *Leucophaea* was proposed by Brunner (1865, pp. 272, 278) as a subgenus of *Panchlora*, with four included species. One of the four, *maderae*, was designated type of *Leucophaea* by Rehn (1903, p. 282). *Rhyparobia* was proposed by Krauss (1892, p. 165), monotypic for *maderae*. Thus *Rhyparobia* is an isogenotypic synonym of *Leucophaea*. The use of *Rhyparobia* was doubtless encouraged by the action of Kirby (1904, pp. 150–151) who, evidently unaware of Rehn's 1903 designation, designated *Blatta surinamensis* Linnaeus type of *Leucophaea*. As explained by Hebard (1917, p. 309), Kirby also apparently objected to the name *Pycnoscelus* Scudder, 1862, to which *surinamensis* belongs, because it was originally based on an immature specimen. Kirby's latter view is not supported by the rules of nomen-

clature but, regardless of that aspect of the matter, the validity of *Leucophaea*, with *maderae* its type, is clear.

Recognition features.—The most important features in the recognition of *Leucophaea maderae* are: (1) Large size, overall length about 38 to 53 millimeters; (2) pronotal shape, and general color markings as illustrated (pl. 2, figs. 1, 2); (3) no strong spines along posterior margins of femora except one short apical spine on each hind and middle femur; (4) in males the characteristic shape of the specialized organ on the dorsal surface of the second abdominal segment and of the subgenital plate (fig. 10, *e, h.*).

Relatively few Nearctic roaches are as large as *L. maderae*, and none of them is likely to be confused with it. *Blaberus craniifer* Burmeister, illustrated by Hebard (1917, pl. 8, fig. 6), is the largest roach in the United States, being much larger than *maderae*. The species of *Periplaneta* are quite differently marked, and have numerous heavy spines on the posterior margins of the femora. Both *Eurycotis floridana* (Walker), of the Southeast, and *Hemiblabea tenebricosa* Rehn and Hebard,⁵ of the Florida Keys, have short, lobate tegmina and wings which are vestigial or lacking.

A relative of *L. maderae* recently established in Florida is *Nauphoeta cinerea* (Olivier). It superficially resembles *maderae*, though it is smaller, its average length being about 23 millimeters. The femora are proportionately stouter and the tegmina scarcely extend beyond the apex of the abdomen, while the posterior margin of the pronotum is transversely subtruncate, a median projection being scarcely evident. Zimmerman (1948, p. 94) and Rehn (1945, p. 274) have given photographs of *cinerea*. This species is apparently a native of East Africa now widely distributed in the Tropics by commerce and often intercepted at United States ports. Its potential importance is suggested by Illingworth (1942), who described its occurrence in alarming numbers about the feed room of the poultry plant at the University of Hawaii. He also mentioned its occurrence in heated buildings in England and Germany, though no records of permanent establishment in those countries have come to my attention.

In early December 1951 material of *cinerea* was received from Joseph Gross of Tampa, Fla., who stated that it was widely and thoroughly established about Tampa, especially in feed mills. Later, in August 1952, Mr. Gross contributed a series of 34 adults and 32 nymphs

⁵ *Hemiblabea tenebricosa* was described from the West Indies, including Nassau in the Bahamas, by Rehn and Hebard (1927, p. 271). Caudell (1931) recorded an adult pair collected at Key Largo, Fla., by E. A. Popenoe in 1896. Caudell's unpublished notes disclose subsequent discussions of this record with Mr. Popenoe's son, who explained that his father was collecting insects primarily for Kansas State College during the 1896 trip and that in view of conditions at Key Largo at that time this roach was probably an established species rather than an intercepted adventive. A number of roaches are now known to be native to the northern Bahamas and extreme tropical Florida, so the occurrence of *tenebricosa* in the Florida Keys is not illogical.

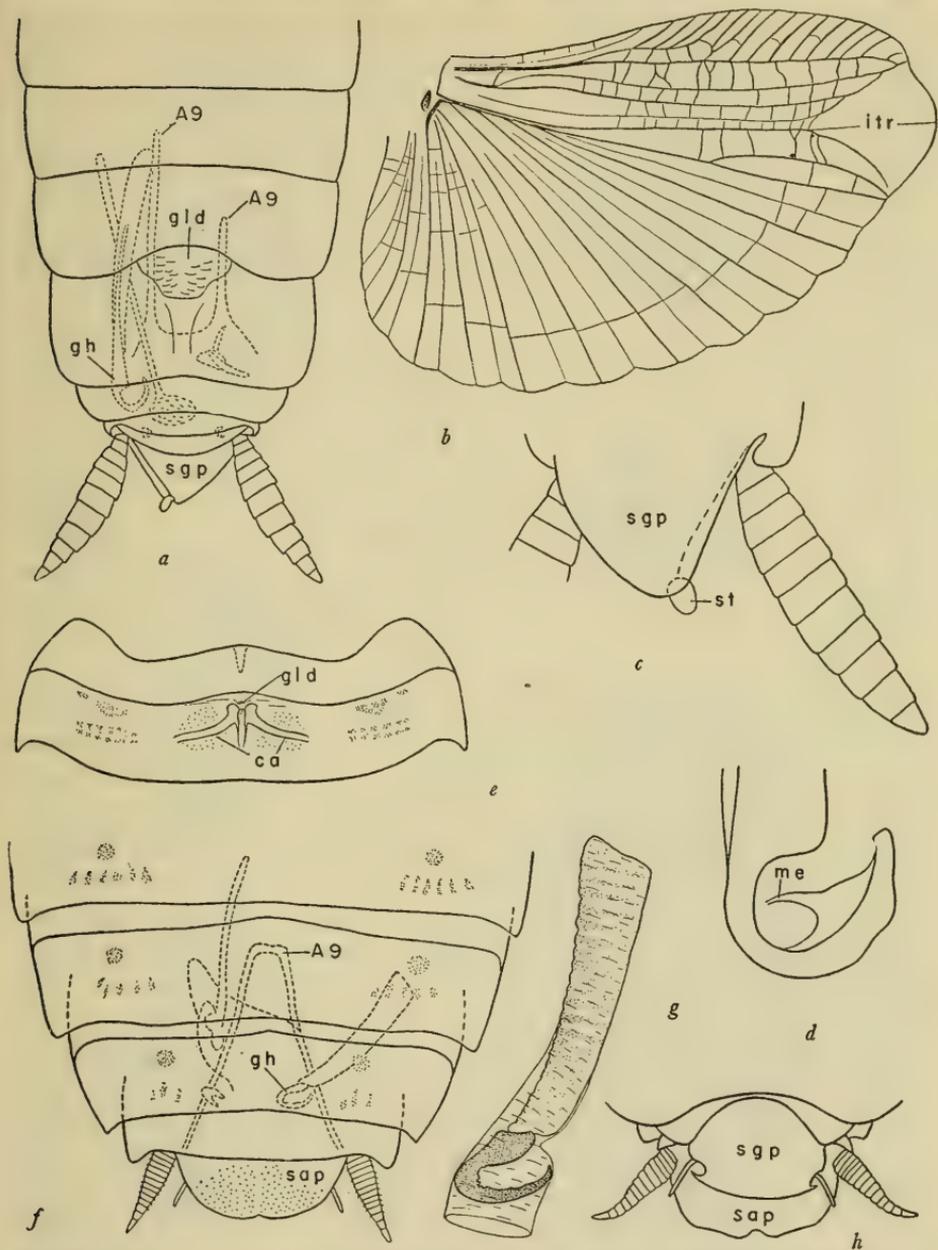
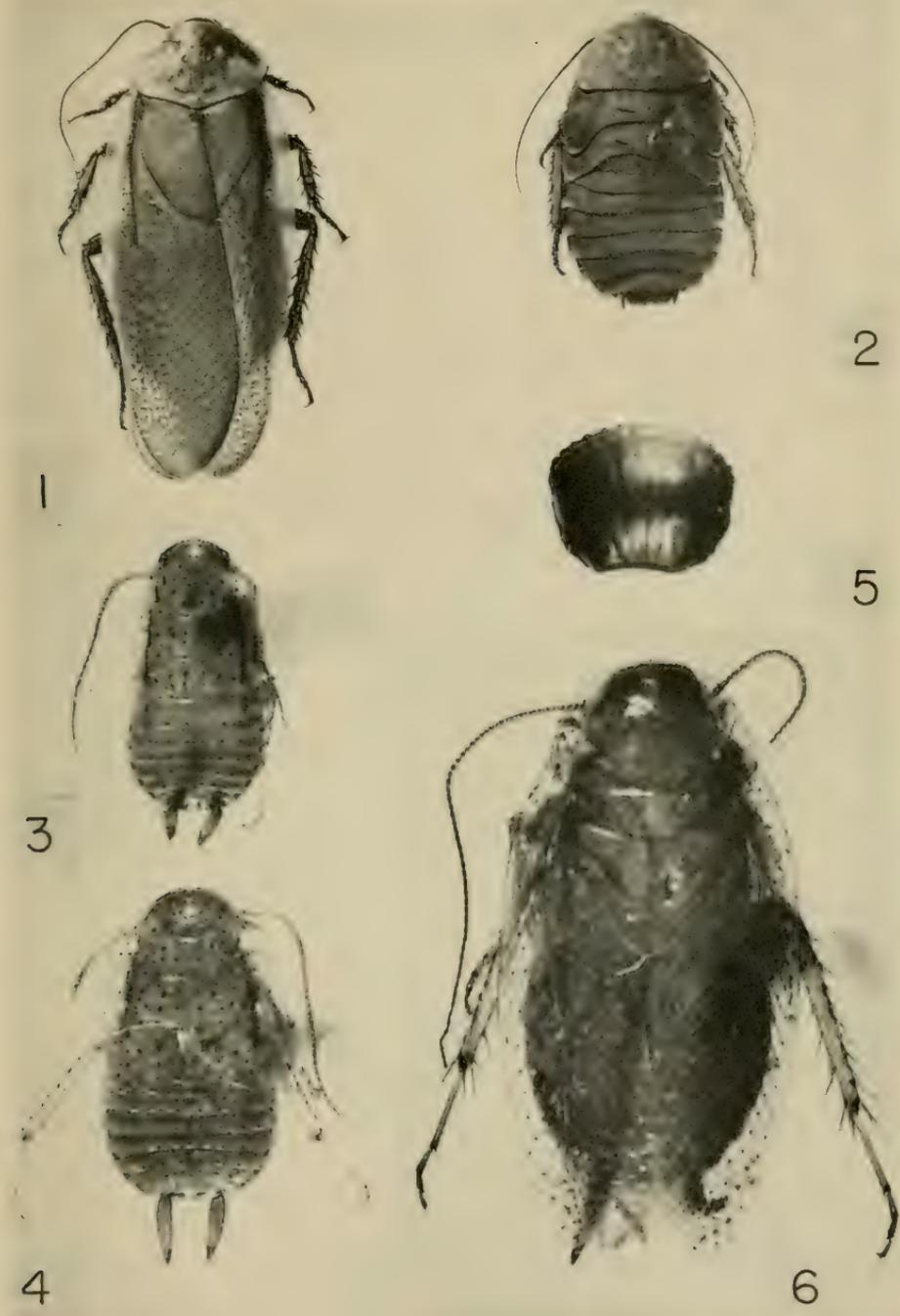


FIGURE 10.—Structural details of *Ectobius livens* (Turton) and *Leucophaea maderae* (Fabricius). *a-d*, *E. livens*: *a*, Dorsal view of apical half of cleared male abdomen; *b*, wing; *c*, ventral view of subgenital plate and associated cerci, male; *d*, apical portion of genital hook, male. *e-h*, *L. maderae*: *e*, Dorsal view of second abdominal segment, male, cleared and in alcohol; *f*, dorsal view of apical half of cleared male abdomen; *g*, genital hook of male, enlarged; *h*, ventral view of subgenital plate and associated structures, male, dry preparation. Drawn from specimens as follows: *a-d*, from Massachusetts specimen; *e*, from Puerto Rico specimen; *f* and *g*, from specimen collected in a Tampa, Fla., warehouse; *h*, from New York City specimen. (A-9, apodemes of sternum 9; ca, oblique carinae of glandular specialization; gh, genital hook; gld, glandular depression; itr, intercalated triangle; me, mesal extension; st, stylus; sap, supra-anal plate; sgp, subgenital plate.)

to the U. S. National Museum. I inquired especially as to the apparent permanence of the infestation, and on June 24, 1952, a colleague of Mr. Gross', W. B. Gresham, Jr., replied, "It seems evident to us that *Nauphoeta* is in Florida to stay. They appear to be well adapted and quite numerous in the locations where we have noted them. All infestations noted have been within commercial buildings engaged in the manufacture of animal feeds. I myself have not noted any out of doors." Notes on the Florida infestations by Ratcliffe (1952) and Gresham (1952) have appeared.

Description.—ADULTS: General form as in plate 2, figure 1; tegmina and wings extending beyond apex of abdomen about one-fifth their length; width between eyes on vertex about two-thirds length of first antennal segment; a shallow, scarcely wrinkled transverse depression in interocular area where eyes are closest; ventroposterior margin of middle and hind femur each with short, apical spine; conspicuous spines on posterior femoral margins otherwise lacking; ventroposterior margin of front femur with continuous row of delicate, seta-like spines, these slightly shorter toward apex of femur and a few noticeably longer ones near base; front tibia with two elongate groups of setae along margins; pulvillus on each tarsal segment, elongate on segments 1 and 5; claws equal, unarmed ventrally, with sparse setae dorsally; pronotum obtusely angulate laterally, posterior margin with rounded median production; tegmen with cubital veins (discoidal sectors) oblique; wing (see J. W. H. Rehn, 1951, pl. 9, fig. 102) with well-developed axillary and cubital fields, intercalated triangle lacking. Dorsal surface of abdomen simple in female, specialized in male; second tergum of male (fig. 10, *e*) with median glandular development consisting of paired oblique carinae (ca) and a brief longitudinal carina centered on a trifold papilla which largely covers a small glandular depression (gld); supra-anal plate transverse, with median emargination of posterior margin, general shape more quadrate when dry (fig. 10, *h*) than when preserved in alcohol (fig. 10, *f*); subgenital plate unspecialized in female, slightly asymmetrical in male, with recurved lateral hooks near styli; cleared male abdomen with apodemes of sternum 9 (subgenital plate) (A9) united anteriorly, genital hook (gh) and additional sclerotized elongate rod associated with an irregular genital mass; genital hook (fig. 10, *g*) enclosed in a membranous sheath.

General color pale brown, the tegmen and pronotum marked with dark brown as illustrated (pl. 2, fig. 1); remainder of body and appendages largely dark brown; clypeus and most of labrum pale; abdominal sterna with oblique submarginal marks of brownish-black; terga with more heavily pigmented areas as shown (fig. 10, *f*). Base of genital hook with pigmented transverse lines, the apical portion much darker.



1, 2, *Leucophaea maderae* (Fabricius); 1, Adult female, collected in Manila, Philippine Islands (length, 47 mm.); 2, last nymphal stage, intercepted at Washington, D. C.
 3-6, *Ectobius livens* (Turton), all from Falmouth, Massachusetts: 3, 4, Nymphal stages; 5, oötheca; 6, adult female (length, 9 mm.).

Measurements (in millimeters): Overall body length, including folded tegmina, female 45 to 53, male 38 to 45; pronotum, female 9 to 10.3, male 7.5 to 8.5; tegmen, female 37 to 46, male 32 to 38.5. Width of pronotum, female 13.3 to 16, male 11.5 to 14.

NYMPHS: Nymphs (pl. 2, fig. 2) ranging from 7.5 to 32 millimeters in body length have been examined. The dorsal surface of the thorax and abdomen is sharply rugose, with short, microscopic spines, these especially conspicuous along the posterior margins of segments; much smaller and less evident spines on ventral surface of abdomen. General color reddish brown; each tergum with a submarginal dark spot near the base, the basal half of the exposed lateral margin blackish and the apical third yellowish.

Distribution.—In the United States *Leucophaea maderae* is known to be established only in the Harlem section of New York City.⁶ Many times each year inspections made at shipping centers detect the species with plant products and other articles coming both from the American Tropics and the Old World. The distribution of *maderae* in warm countries is very wide, but somewhat irregular, depending upon the vagaries of commerce. The specific and the common names are derived from the fact that this roach was first described from Madeira, a small island now belonging to Portugal and located in the Atlantic Ocean about 400 miles west of Morocco. Rehn (1937, pp. 56–58; 1945, p. 273) has reasoned (by a detailed analysis of the present occurrence of *maderae* and its congeners) that West Africa is the native home, from which commerce (in early centuries—that of the slave trade in particular) has carried it to Madeira, the West Indies, Brazil, and elsewhere. Ecuador, Colombia, Venezuela, the Guianas, Brazil, and Argentina are known to have established colonies of *maderae*, as well as Panamá, Costa Rica, and most of the West Indian islands. Old World distribution outside of Africa is more spotty and, to my knowledge, the species is not yet recorded from India or Australia—even though it is known from Java, the Philippines, Hawaii, and Fiji. Doubtless, *maderae* now breeds in many coastal areas from which there are no records and it will continue to spread as conditions permit.

Biology.—In New York City *Leucophaea maderae* has been “found in some abundance in the basement of an apartment of the Harlem section,” and an observer also writes⁷ “From their abundance and the presence of all stages of the insect . . . I would conclude that they

⁶ Davis (1940) reported at a meeting held December 15, 1938, that a specimen of *L. maderae* taken in the Bird House of Bronx Park, New York City, was the first record of this species in New York State. In the absence of further information, there is a strong likelihood that the specimen in question was an escaped adventive.

⁷ Specimens from the described infestation were submitted by Ralph E. Heal, Technical Director of the National Pest Control Association. Grateful acknowledgment is made of Dr. Heal's cooperation in obtaining information on the Harlem infestation.

are breeding in this house." It was also noted that the Harlem roaches appeared rather sluggish in their movements.

In the absence of biological studies of *L. maderae* in this country it is instructive to review the observations of life history and habits that have been made elsewhere, particularly the papers of Illingworth (1915), Sein (1923), and Pessoa and Correa (1928).

As is true of species of *Periplaneta*, growth in the Madeira roach is slow. The first molt may occur 1 to 4 months after birth. Pinned nymphs reared by Illingworth in Hawaii and now deposited in the U. S. National Museum suggest that there are six nymphal stages, though the number is likely to vary, and in cultures it may sometimes be difficult to observe because exuviae reportedly are eaten immediately after each molt. Pessoa and Correa report only four "metamorphoses," but that number of molts is almost certainly too small for a normal growth cycle. The body length in millimeters of specimens of various ages collected by Illingworth is as follows: 1 day, 7.5; 1 month, 7.5; 4 months, 16; 5 months, 18.5; 6 months, 24.5; 7 months, 29; 8 months, 30.7; 9 months, 32. Food and environmental conditions are doubtless important influences on growth. Sein notes maturity being attained in 220 days, but that a year is often required, while Pessoa and Correa indicate that adults are obtained in a year, with 16 to 18 months the longest observed time. In Sein's cultures the first nymphs appeared 4 months after their parents matured. Immediately following birth, nymphs usually hide beneath the mother during the day. According to Pessoa and Correa, this makes the adult restless and active in contrast to its usual slow gait.

In a general paper emphasizing the adaptability and value of *Leucophaea maderae* as an experimental animal, Scharrer (1951) comments that it thrives on a diet of apples, carrots, and dogfood. She reports that there are 30 to 35 young every 3 months, that there is an average of 8 molts, and that life expectancy is up to 2½ years. Dr. Scharrer has observed that tumors which resemble malignant cancer of higher animals develop in various parts of the roach body following the removal of the corpora allata and the corpora cardiaca. That such an injury to the nervous system has produced tumors has very interesting and practical implications for further research. The name "woodroach" that Dr. Scharrer applied to *maderae* is a questionable choice, since the name is most often used for native Nearctic species of *Parcoblatta*.

Leucophaea is one of several roach genera which are viviparous; that is, the eggs are enclosed in a delicate membranous sac which normally ruptures before extrusion from the mother's body, or immediately thereafter, so that, in effect, the young are born alive. This is in contrast to the habit of most roaches which form a heavily-sclerotized, dark-colored capsule or oötheca, usually of characteristic shape,

which may be carried protruding from the body for some time prior to hatching, or be deposited loosely or surrounded with a matrix.

The viviparity exhibited generally takes a special form known as ovoviviparity. This occurs in several well-known genera, especially *Panchlora*, *Pycnoscelus*, *Nauphoeta*, and *Leucophaea*, and Chopard (1938, p. 218) notes six subfamilies of roaches (according to the long-used classification) in which viviparity occurs. J. W. H. Rehn (1951) has recently proposed a new classification, based on wings, and it is significant that many of the viviparous genera fall in what he terms the epilamproid complex. In addition to Chopard, Shelford (1907), Karny (1924, pp. 3-10), and Rau (1941) have discussed viviparity among roaches. Hagan (1941; 1951) has described the female reproductive system of the viviparous *Diploptera*, and Chopard (1950), that of *Gromphadorhina*.

Illingworth and Sein both recognized that *Leucophaea maderae* is viviparous, but it appears that Pessoa and Correa observed unusual or abnormal instances of the egg sac being deposited, as they wrote of a capsule being placed in the darkest corner of a rearing box and the first young appearing 20 days later. In the following paragraphs I have attempted to explain this apparent lack of agreement.

Several preserved adult females of *L. maderae* received for identification during recent years have exhibited an elongate sac about 20 millimeters long protruding from the end of the abdomen. In certain cases the eggs (varying up to about 40 in number), directed transversely with respect to the mother's body and arranged in two rows, were undeveloped, but in others nymphs ready for hatching were visible—in fact, rupturing of the sac had sometimes occurred. Rehn (1937, p. 62) has described his experience in the Belgian Congo with the related *L. grandis* (Saussure). A female confined in a bottle gave birth to 20 living young. The number of young of *maderae* produced at one time, according to published records, ranges from 25 to 32.

The related *Pycnoscelus surinamensis* (Linnaeus) is known to be viviparous, but the literature concerning its habits suggests a lack of uniformity in birth or hatching. Watson (1929, p. 58) commented on an egg capsule being deposited but the eggs failing to hatch. Caudell (1925) also maintained cultures of *P. surinamensis*, and mentioned young born alive and oöthecae seldom if ever protruding from the female abdomen. In a somewhat fuller account, Zappe (1918) gave the opinion that young of *surinamensis* are either born alive or hatch from eggs within 24 hours. Eggs were often laid in soil, but were not observed to hatch. When females were injured or excited, they often deposited poorly developed egg masses that did not hatch. Similarly, Illingworth (1942) reported that the eggs of *Nauphoeta cinerea* were usually kept in the body until living young appeared, but that confined individuals sometimes produced aborted egg masses that were ex-

truded but which dried up without hatching when the delicate enclosing membrane was exposed to the air. These experiences suggest that some of the protruding eggs of *L. maderae* that I have noted are the result of handling when the specimens were collected and that occasional egg masses may be deposited under certain conditions by this ordinarily viviparous species.

In his important recent paper, Chopard (1950) has discussed the anatomy and development of *Gromphadorhina laevigata* Saussure and Zehntner, of Madagascar. He observed, in the course of rearings conducted in Paris, that the female of this viviparous species extrudes the soft oötheca nearly to its full extent, then it is drawn into an incubating pouch where the eggs undergo incubation for approximately 70 days prior to the appearance of the young. Occasionally the oötheca is completely extruded, with the result that desiccation occurs and no hatching takes place. I am indebted to my colleague R. E. Snodgrass for pointing out the significance of Chopard's observations. They explain how the oötheca is transferred from the uterus to the incubating chamber in the case of *Gromphadorhina*. Possibly the same habit occurs in certain other viviparous genera, and some protruding oöthecae that have been seen may represent a stage in this normal act. In discussing the transfer of the developing eggs in the viviparous *Diploptera*, Hagan (1951, p. 299) states that the oöcytes pass from the ovarioles to the lower end of the common oviduct, where "they are directed by the ovipositor from the genital chamber ventrally into the open end of the uterus."

In Brazil, mating of *Leucophaea maderae* occurs mainly during the warm and rainy season, according to Pessoa and Correa, who say that copulation may occupy 20 to 30 minutes and takes place with the pair end to end facing in opposite directions. Prior to mating, the female is described as opening her wings and drawing them along the ground, at the same time producing a sound by vibrating them. The scent gland on the dorsum of the male presumably is attractive to the female at mating time, but its function is not definitely known.

Illingworth stated that when disturbed the Madeira roach stridulates very noticeably, and he believed the sound is produced by rubbing the posterior margin of the pronotum over the mesonotum. According to Chopard (1938, p. 286), several roaches stridulate delicately by rubbing the border of the pronotum upon the mesonotum or upon the strongly denticulate base of the costal vein of the tegmen. To test the possibilities of stridulation, I have relaxed dry specimens of both sexes of *L. maderae*, then manipulated the body parts with my fingers. A low, squeaking sound is consistently obtained in either sex by rubbing the lateroposterior margin of the pronotum on the basal costal margin of the tegmen. Both surfaces are heavily sclerotized, turned to oppose

each other, nonpubescent, and are finely rugose so as to make stridulation possible.

In tropical regions where it is established, *L. maderae* is definitely a domiciliary species, though, like certain other roaches often associated with man, it is capable of living apart from him in a purely wild state. From available records, however, it is not clear how frequently it has been collected entirely unassociated with man-made surroundings. According to Alfken (1904, p. 565) more than 50 years ago a German collector, H. Schauinsland, in 1896 or 1897 found *maderae* in native huts on the Hawaiian Island of Molokai, commerce already having carried it to certain Pacific areas. However, in spite of this long establishment in the Hawaiian group, no mention of its occurrence in fields is made by Williams (1931). In July 1950, in the Venezuelan State of Aragua, Dr. Ernst Schwarz³ collected it coming to lights in fair numbers, but whether it was breeding in the adjacent forest or associated with nearby habitations is not known. Likewise, specimens collected by the late C. F. Baker in the Philippines before 1927 bear the collecting label "Mt. Maquiling," and they may have bred under entirely natural surroundings. However, as I saw during my visit to Mt. Maquiling in 1945, at the base and on the lower slopes there are ample opportunities for this roach to remain associated with man. The species frequently flies actively and has often been taken at lights, including those on porches, in field camps, or of automobiles. On the other hand, Sein states that *Leucophaea maderae* does not fly much when indoors at night as part of an infestation. *L. puerilis* Rehn, considered its closest relative, is a strictly endemic, forest type in West Africa.

Source of introduction.—The New York City infestation is reported to be localized in apartment buildings occupied by people from Puerto Rico and, since there has been a good deal of movement—much of it by air—from that island in the past few years, there is little doubt that Puerto Rico is the source of the infestation.

Probable importance.—In Puerto Rico the Madeira roach most often occurs in fruit stores and markets. It is especially fond of grapes. It is considered very gregarious and develops large, localized colonies. Wolcott (1950, p. 43) records about a bushel having been swept from one store. Warehouses and other buildings are often infested. When handled or otherwise disturbed, *Leucophaea maderae* produces an odor described as especially offensive. Houses infested by the species usually do not contain *Periplaneta* or *Blattella*. There is a strong possibility that *maderae*, if allowed to spread, will gradually develop into a serious pest in our larger cities. In the light of its wide occurrence in the Bahamas and other West Indian islands, tropical Florida would probably be a suitable habitat, either outdoors or in buildings without central heating.

³ Associated with the Venezuela Plague Mission (Commander J. M. Amberson, U.S.N., Dr. Ernst Schwarz, and Mrs. Schwarz).

References

ALFKEN, JOHANN D.

1904. Beitrag zur Insectenfauna der Hawaiischen und Neuseelandischen Inseln. Zool. Jahrb., System., vol. 19, pp. 561-628, 1 pl.

BACK, ERNEST A.

1937. The increasing importance of the cockroach, *Supella supellectilium* Serv., as a pest in the United States. Proc. Ent. Soc. Washington, vol. 39, pp. 205-213, 2 pls., 2 figs.

BLAIR, KENNETH G.

1934. A note on the British species of *Ectobius* Steph. Ent. Monthly Mag., vol. 70, pp. 157-159.
 1935. [British species of *Ectobius*.] Proc. South London Ent. Nat. Hist. Soc., 1934-35, p. 5.

BROWN, E. B.

1952. Observations of the life-history of the cockroach *Ectobius panzeri* Stephens (Orth., Blattidae). Ent. Monthly Mag., vol. 88, pp. 209-212.

BRUNNER DE WATTENWYL, CHARLES

1865. Nouveau système des Blattaires. 426 pp., 13 pls., Vienna.

BURR, MALCOLM

1936. British grasshoppers and their allies. 164 pp., 6 pls., 56 figs., 40 maps, London.

CAUDELL, ANDREW N.

1925. *Pycnoscelus surinamensis* Linnaeus (Orthoptera); on its nymphs and the damage it does to rose bushes. Proc. Ent. Soc. Washington, vol. 27, pp. 154-157, 2 figs.
 1931. Notes on Blattidae, adventive to the United States. Ent. News, vol. 42, p. 204.

CHOPARD, LUCIEN

1938. La biologie des Orthoptères. Encyclopedie entomologique, ser. A, vol. 20, pp. 1-541, 4 pls., 453 figs. Paris.
 1943. Orthoptéroïdes de l'Afrique du Nord. Faune Empire Français, vol. 1, pp. 1-450, 658 figs., Paris.
 1947. Atlas des Aptérygotes et Orthoptéroïdes de France. Nouvel atlas d'entomologie, vol. 2, pp. 1-111, 12 pls., 12 figs. Paris.
 1950. Sur l'anatomie et le développement d'une blatte vivipare. Proc. 8th Int. Cong. Ent., Stockholm, 1948, pp. 218-222, 6 figs.

DAVIS, WILLIAM T.

1940. [*Leucophaea* recorded.] Bull. Brooklyn Ent. Soc., vol. 35, p. 35.

FLINT, OLIVER S.

1951. A new cockroach record from the United States. Bull. Brooklyn Ent. Soc., vol. 46, p. 53.

GAUNITZ, C. B.

1935. Till frågan om *Ectobius lapponicus* L. förmente skadegörelse inomhus i Lappland. Ent. Tidskr., vol. 56, pp. 138-150.
 1936. *Ectobius lapponicus* L. als Vorratsschadling in Lappland, eine alte sicher unrichtige Vermutung in neuer Beleuchtung. Konowia, vol. 15, pp. 162-166.

GOULD, GEORGE E., and DEAY, H. O.

1940. The biology of six species of cockroaches which inhabit buildings. Purdue Agr. Exp. Stat. Bull. 451, pp. 1-31, 13 figs.

GRESHAM, WILLIAM B.

1952. [Note on *Nauphoeta* in Florida.] Florida Ent., vol. 35, p. 77.

HAGAN, HAROLD R.

1941. The general morphology of the female reproductive system of a viviparous roach, *Diploptera dytiscoides*. Psyche, vol. 48, pp. 1-9, 1 pl., 2 figs.

1951. Embryology of the viviparous insects. 472 pp., 160 figs., New York.

HEARD, MORGAN

1917. The Blattidae of North America north of the Mexican boundary. Mem. Amer. Ent. Soc., No. 2, pp. 1-284, 10 pls., 1 fig.

1943. Australian Blattidae of the subfamilies Chorisonaurinae and Ectobiinae. Monogr. Acad. Nat. Sci. Philadelphia, No. 4, pp. 1-129, 14 pls.

ILLINGWORTH, JAMES F.

1915. Notes on Hawaiian roaches. Proc. Ent. Soc. Hawaii, vol. 3, pp. 136-140.

1942. An outbreak of cockroaches, *Nauphocta cinerea* (Olivier), in Hawaii. Proc. Ent. Soc. Hawaii, vol. 11, pp. 169-170.

KARNY, HEINRICH H.

1924. Beiträge zur malayischen Orthopterenfauna. Treubia, vol. 5, pp. 1-234, 1 pl., 85 figs.

KRAUSS, HERMANN

1892. Systematische Verzeichnis der Canarischen Dermapteren und Orthopteren mit Diagnosen der neuen Gattungen und Arten. Zool. Anz., vol. 15, pp. 163-171.

LUCAS, WILLIAM J.

1920. A monograph of the British Orthoptera. Ray Soc., Monogr. 104, 264 pp., 25 pls., 25 figs., London.

1928. Notes on British Orthoptera, including Dermaptera, in 1927. Entomologist, vol. 61, pp. 78-81.

PESSOA, SAMUEL B., and CORREA, CLOVIS

1928. Notas sobre a biologie de *Rhyparobia maderae*, Fabr. Rev. Biol. Hyg., São Paulo, vol. 1, pp. 83-87, 1 pl., 3 figs.

PRINCIS, K.

1936. Ergänzungen und Berichtigungen zur Orthopterenfauna Lettlands, I. Folia Zool. Hydrobiol., vol. 9, pp. 90-92.

RAMME, WILLY

1923. Vorarbeiten zu einer Monographie des Blattidengenus *Ectobius* Steph. Arch. Naturg., Berlin, ser. A, vol. 89, pp. 97-145, 2 pls, 55 figs.

1949. Ein neuer *Ectobius* vor Sizilien (Blatt.) Opuscula Ent., vol. 14, p. 158, 1 fig.

1951. Zur systematik faunistik und biologie der Orthopteren von Südost-Europa und Vorderasien. Mitt. Zool. Mus. Berlin, vol. 27, pp. 1-431, 39 pls., 134 figs.

RATCLIFFE, JACK

1952. Lobster roach. Pest Control, vol. 20, pp. 44, 54.

RAU, PHIL

1941. Cockroaches: The forerunners of termites. Ent. News, vol. 52, pp. 256-259.

REHN, JAMES A. G.

1903. Studies in American Blattidae. Trans. Amer. Ent. Soc., vol. 29, pp. 259-290.

1931. African and Malagasy Blattidae, Part I. Proc. Acad. Nat. Sci. Philadelphia, vol. 83, pp. 305-387, 5 pls.

1937. African and Malagasy Blattidae, Part III. Proc. Acad. Nat. Sci. Philadelphia, vol. 89, pp. 17-123, 4 pls.

REHN, JAMES A. G.—Continued

1945. Man's uninvited fellow traveler—the cockroach. *Sci. Monthly*, vol. 61, pp. 265-276, 11 figs.

REHN, JAMES A. G., and HEBARD, MORGAN

1927. The Orthoptera of the West Indies, No. 1. Blattidae. *Bull. Amer. Mus. Nat. Hist.*, vol. 54 (Art. 1), pp. 1-320, 25 pls.

REHN, JOHN W. H.

1950. A key to the genera of North American Blattaria, including established adventives. *Ent. News*, vol. 61, pp. 64-67.
1951. Classification of the Blattaria as indicated by their wings. *Mem. Amer. Ent. Soc.* No. 14, pp. 1-134, 13 pls., 5 figs.

SCHARER, BERTA

1951. The woodroach. *Sci. American*, vol. 185, no. 6, pp. 59-62, 5 figs.

SEABRA, A. F. DE

1942. Contribuicoes par o inventario da fauna lusitânica. *Insecta Orthoptera*. *Mem. Mus. Zool. Univ. Coimbra, Portugal*, vol. 127, pp. 1-26.

SEIN, FRANCISCO

1923. Cucarachas. Puerto Rico Estac. Exp. Insul., *Circ.* 64, pp. 1-12, 9 figs.

SHELFORD, ROBERT W. C.

1907. Viviparity amongst the Blattidae. *Trans. Ent. Soc. London*, 1906, pp. 509-514.

WATSON, JOHN R.

1929. [Rearing of *Pycnoscelus*.] *Univ. Florida Agr. Exp. Stat., Ann. Rep.* 1929, p. 58.

WILLIAMS, FRANCIS X.

1931. Handbook of the insects and other invertebrates of Hawaiian sugar cane fields. 400 pp., 41 pls., 190 figs., Honolulu.

WOLCOTT, GEORGE N.

1950. The insects of Puerto Rico. *Journ. Agric., Univ. Puerto Rico*, vol. 32 (1948), pp. 1-224, illus.

ZAPPE, MAX P.

1918. A cockroach pest of greenhouses. *Connecticut Exp. Stat. Bull.* 203, pp. 302-313.

ZIMMERMAN, ELWOOD C.

1948. *Insects of Hawaii*, vol. 2, pp. 1-475, 228 figs., Honolulu



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1953

No. 3316

BITING MIDGES OF THE HELEID GENUS *STILOBEZZIA* IN
NORTH AMERICA

By WILLIS W. WIRTH¹

Stilobezzia Kieffer, 1911, is a rather large, widespread genus of predaceous midges which has reached its greatest development in the warmer parts of the New World. For North America 11 species are listed in Johannsen's recent list (1943b); this total is now raised to 18 by the present new records and species, and no doubt many more await discovery. The species of *Stilobezzia* are rather easily characterized, and all the Nearctic species known to Johannsen were correctly placed by him, with the exception of *S. uncinata* Johannsen, 1943, which I believe to represent the female of *Parabezzia petiolata* Malloch, 1915.

The types of the species described here are in the U. S. National Museum, the collections of which furnished the bulk of the material studied. I am indebted to Dr. Henry K. Townes, of North Carolina State College, for the loan of specimens from his collection, and to Mrs. Elisabeth C. Beck and J. A. Mulrennan, of the Florida State Department of Health, for their kindness in sending a large series of light trap collections from which I sorted most of the Florida specimens.

Family HELEIDAE

Genus *Stilobezzia* Kieffer, 1911

Diagnosis.—Body rather slender and nearly bare. Eyes bare. Female antenna with segments 3–10 oval, 11–15 long and cylindrical;

¹ Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

male antenna with well-developed plumes. Mesonotum usually with few or no long bristles; humeral pits present but usually inconspicuous. All legs slender; femora without spines or (in *Eukraiohelea*) with a few on forelegs; basitarsus and fifth segment with or without ventral spines; fourth segment cordiform, fifth not enlarged; female claws large and very unequal or a single long claw with basal barb on each leg, male claws small and equal; empodium absent. Wing rather long; microtrichiae present; macrotrichiae present toward tip (in *Neostilobezzia*) or absent; costa extending to two-thirds wing length or more; usually two radial cells, second much larger than first, which may be entirely absent (in *Eukraiohelea*) or greatly reduced; intercalary fork distinct; crossvein r-m more or less oblique; median fork with long petiole, M_2 not interrupted at base; anal vein straight, not interrupted in middle. Male genitalia with basistyles simple or with lobe on inner margins; dististyles long; ninth sternite very short; ninth tergite usually rounded caudad with setigerous apicolateral lobes; aedeagus reduced to a pair of oblique lateral sclerites; parameres a pair of large, highly sclerotized, greatly modified, submedian processes with flaring basal apodemes.

Keys to the Nearctic species of *Stilobezzia*

Females

1. Only one long radial cell present; fore femur with 2 or 3 ventral spines (subgenus *Eukraiohelea*)----- 1. **elegantula** (Johannsen)
Two radial cells present; fore femur unarmed----- 2
- 2 (1). Wing with macrotrichiae at tip (subgenus *Neostilobezzia*)----- 3
Wing entirely bare (subgenus *Stilobezzia*)----- 5
- 3 (2). Body hairs very strong and erect; wings hyaline; legs, scutellum, and halteres yellow----- 3. **lutea** (Malloch)
Body hairs soft and decumbent; midlegs and hind legs brown----- 4
- 4 (3). Wing infuscated brown; scutellum and halteres yellowish.
4. **stonci**, new species
Wing hyaline; scutellum and halteres brownish... 2. **fuscula** Wirth
- 5 (2). Wing with 2 or 3 dark spots on anterior margin----- 6
Wing hyaline, unmarked----- 9
- 6 (5). Shining yellow; mesonotum polished yellow, with pair of longitudinal brown bands, anterior spine absent; legs yellow, narrow apices of hind femur and tibia brown; wing hyaline, with brown spots at crossvein and apex of second radial cell----- 9. **coquilletti** Kieffer
Mesonotum brown with silvery, pruinose areas and prominent anterior spine; legs extensively brown banded or punctate; wing brownish, anterior margin with 2 or 3 dark spots----- 7
- 7 (6). Femora and tibiae extensively yellow, with small brown spots at bases of hairs; wing hyaline, with two brown spots; abdomen mostly yellowish above----- 14. **punctipes**, new species
Femora and tibiae brown with yellowish rings; wing infuscated, with 2 or 3 brown spots and a subapical pale area; abdomen black above with narrow, distal, silvery pruinose, segmental bands----- 8

- 8 (7). Three dark wing spots including one at apex of first radial cell; fifth tarsal segment with ventral batonnets..... 15. **rabelloi** Lane
Two dark wing spots, none at apex of first radial cell; fifth tarsal segment without ventral batonnets..... 6. **beckæe**, new species
- 9 (5). Mesonotum entirely polished black..... 10
Mesonotum yellow, green, or brown, not entirely black..... 13
- 10 (9). Abdomen polished black..... 11
Abdomen green..... 12
- 11 (10). Midfemora and hind femora black except at extreme bases.
5. **antennalis** (Coquillett)
Legs uniformly yellow..... 7. **bicolor** Lane
- 12 (10). Fifth tarsal segment with ventral batonnets...10. **diversa** (Coquillett)
Fifth tarsal segment without ventral batonnets.
12. **pallidiventris** (Malloch)
- 13 (9). Shining green; third or fourth abdominal tergites extensively black.. 14
Yellow or brown, not green; abdomen without black bands or spots.. 15
- 14 (13). Mesonotum uniformly pale green; distal fourth of hind femur black.
18. **viridis** (Coquillett)
Mesonotum largely dark brown; hind femur with only spot at apex black..... 11. **glauca** Macfie
- 15 (13). Mesonotum shining brown; wing with a beadlike swelling near apex of second radial cell..... 16. **sybleæe**, new species
Mesonotum pruinose brown; wing venation normal..... 16
- 16 (15). Mesonotum dark brown, with pattern of large pruinose gray spots; scutellum dark; tibiae with sub-basal pale rings...13. **pruinosa** Wirth
Mesonotum uniform light grayish brown; tibiae unbanded..... 17
- 17 (16). Scutellum and femora yellow..... 8. **bullæ** Thomsen
Scutellum and femora brown..... 17. **thomsenæe**, new species

Male genitalia

1. Lateral sclerites of aedeagus greatly reduced or absent, instead a transverse sclerite between inner margins of basistyles beyond base..... 2
Lateral sclerites of aedeagus well developed and oblique, with bases at inner ventral margins of basistyles..... 3
- 2 (1). A large rounded lobe at distal third of inner margins of basistyles; transverse sclerite with pointed, curved ends; apicolateral lobes of ninth tergite widely spaced and triangular..... 8. **bullæ** Thomsen
Basistyles simple; transverse sclerite with blunt ends; apicolateral lobes fingerlike and close together..... 17. **thomsenæe**, new species
- 3 (1). Lateral sclerites of aedeagus sinuate, irregularly bent, or apex forked; basistyle without lobe, or if one present it bears a strong spine; apicolateral lobes of ninth tergite usually slender and close together..... 4
Lateral sclerites of aedeagus straight, at least on distal half; basistyle with mesal lobe; apicolateral lobes usually low and rounded..... 10
- 4 (3). Basistyle with a strong spine midway on inner margin, arising from a low lobe also bearing a fine hair; aedeagus with strong subapical tooth on outer side, appearing forked at end; parameres long and slender with long pointed tips..... 2. **fuscula** Wirth
Basistyle simple; aedeagal sclerites without strong tooth..... 5

- 5 (4). Parameres greatly expanded from bases, with obliquely truncated apices bearing a short lateral tooth and a long, curved, distal tooth.
4. **stonei**, new species
Parameres broadest at bases or without truncated apices..... 6
- 6 (5). Stems of parameres very slender and rodlike..... 7
Stems of parameres bladelike..... 9
- 7 (6). Apices of parameres slightly expanded, palplike; aedeagal sclerites sinuate, stouter toward apices; ninth sternite with deep, quadrate, mesal notch; dististyles very broad, with truncate apices.
1. **elegantula** (Johannsen)
Apices of parameres sharp-pointed and bent ventrad; aedeagal sclerites bent more than twice..... 8
- 8 (7). Membrane of ninth sternite bare; tips of aedeagal sclerites recurved hooklike; dististyles very slender..... 6. **beckae** new species
Membrane spiculate; tips of aedeagal sclerites snoutlike and crossing each other; dististyles stout..... 14. **punctipes**, new species
- 9 (6). Parameres with an extra lateral pair of straight, bladelike arms half as long as inner arms; membrane of ninth sternite bare.
15. **rabelloi** Lane
Parameres simple, without lateral arms, expanded subapically, with tips abruptly narrowed; membrane spiculate..... 3. **lutea** (Malloch)
- 10 (3). Parameres with knobbed apices over twice as broad as the very slender, stalklike stems; basistyles very large and globular; dististyle very slender to base..... 18. **viridis** (Coquillett)
Parameres otherwise, without knobbed apices..... 11
- 11 (10). Parameres with greatly swollen, conical bases and very slender, tapered apices..... 12
Parameres with stems of subequal diameter or swollen towards apices..... 13
- 12 (11). Parameres with basal 0.6 swollen, the pointed apices abruptly bent towards base on outer side..... 10. **diversa** (Coquillett)
Parameres with only basal 0.2 swollen, distal portions consisting of very slender, curved, saber-shaped blades crossing each other in middle.
16. **sybleae**, new species
- 13 (11). Parameres nearly straight, with apices abruptly narrowed and bent over..... 14
Parameres sinuate or with broad, toothlike, lateral, subapical expansions..... 15
- 14 (13). Parameres with apices bent outward..... 7. **bicolor** Lane
Parameres with apices bent inward..... 11. **glauca** Macfie
- 15 (13). Lobe of basistyle quadrate, as long as broad; parameres slender and markedly sinuate; dististyles greatly curved.
5. **antennalis** (Coquillett)
Lobe of basistyle consisting of only a hump on inner margin; parameres very broad and stout; dististyle nearly straight..... 16
- 16 (15). Each paramere with broad, toothlike, lateral, subapical expansion about half as broad as length of dististyle, with a slender, ventrally curved spine from apex on inner margin; dististyle tapered.
9. **coquilletti** Kieffer
Each paramere swollen slightly midway to apex without subapical lateral expansion; dististyle with broad, blunt apex... 13. **pruinosa** Wirth

TABLE 1.—Proportions of segments of hind legs of female *Stilobezzia* species.

Species	Cx	Tr	F	Ti	T ₁	T ₂	T ₃	T ₄	T ₅
1. <i>elegantula</i>	20	10	60	60	30	10	5	4	12
2. <i>fuscula</i>	25	10	60	65	32	15	6	4	8
3. <i>lutea</i>	40	15	90	90	40	20	9	6	15
4. <i>stonei</i>	25	10	70	70	30	18	7	5	10
5. <i>antennalis</i>	20	12	55	55	28	12	3	3	8
6. <i>beckae</i>	30	15	75	75	40	18	6	5	8
7. <i>bicolor</i>	15	7	40	35	17	10	4	3	10
8. <i>bulla</i>	15	7	35	35	15	8	3	2	5
9. <i>coquilletti</i>	30	15	80	85	40	18	5	5	13
10. <i>diversa</i>	13	6	35	32	16	6	3	3	5
11. <i>glauca</i>	20	10	65	70	33	15	4	4	10
12. <i>pallidiventris</i>									
13. <i>pruinosa</i>	20	10	50	50	28	10	4	4	8
14. <i>punctipes</i>	30	15	80	80	40	20	6	4	10
15. <i>rabelloi</i>	40	15	85	95	45	25	10	5	15
16. <i>sybleae</i>	15	7	45	50	25	12	3	2	5
17. <i>viridis</i>	20	10	55	55	28	12	3	3	8

Subgenus *Eukraiohelea* Ingram and Macfie, 1921

Eukraiohelea Ingram and Macfie, Ann. Trop. Med. Parasit., vol. 15, p. 347, 1921.—Johannsen, Arch. Hydrobiol., Suppl., vol. 9, p. 430, 1931; Journ. New York Ent. Soc., vol. 42, p. 344, 1934.—Macfie, Ann. Trop. Med. Parasit., vol. 34, p. 22, 1940.—Tokunaga, Tenthredo, vol. 3, p. 344, 1940.—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943; Bull. Bishop Mus. No. 189, p. 190, 1946. (Genotype, *Eukraiohelea africana* Ingram and Macfie, 1921; designated by Macfie, 1940.)

Diagnosis.—First radial cell absent, the r-m crossvein nearly forming a straight line with R₁, the latter arising just a little more toward base of wing; fore femora with 2 or 3 ventral spines but not swollen; male aedeagus with hyaline posterior membrane, parameres long and very slender.

Discussion.—Johannsen (1934) placed *Eukraiohelea* as a subgenus of *Parabezzia* Malloch, 1915. However, as shown by a comparison of the male genitalia of *P. petiolata* Malloch, 1915, with those of the four species of *Eukraiohelea* whose males have been described, the latter are much more closely related to *Stilobezzia*. The following species have been correctly placed in *Eukraiohelea*: *E. africana* Ingram and Macfie, 1921, *E. versicolor* Ingram and Macfie, 1921, and *E. foyi* Ingram and Macfie, 1922, all from West Africa; *Stilobezzia (Eukraiohelea) aberrans* Johannsen, 1931, from Java; *S. (E.) esakiana* Tokunaga, 1940, from the Caroline Islands; and *Eukraiohelea amnigena* Macfie, 1935, from Brazil. *Eukraiohelea inusitata* Johannsen, 1946, from

Guam is apparently a synonym of *esakiana* Tokunaga. *Palpomyia dorsofasciata* Lutz, 1914, from Brazil was correctly referred to *Eukraiohelea* by Macfie (1935). *Parabezzia poikiloptera* Ingram and Macfie, 1922, from West Africa should be referred to *Eukraiohelea* as tentatively suggested by Johannsen (1946), but the position of *S. ugandae* Ingram and Macfie, 1923, from East Africa, which Johannsen also believed to belong here, is more doubtful. De Meillon (1938), moreover, states that *versicolor* and *poikiloptera* should be placed in the subgenus *Stilobezzia*, since material he determined as these two species from Lourenço Marques, Mozambique, possessed a small but distinct first radial cell.

1. *Stilobezzia (Eukraiohelea) elegantula* (Johannsen), 1908, new combination

FIGURE 11, *g*

Bezzia elegantulus Johannsen, Kansas Univ. Sci. Bull., vol. 4, p. 109, 1907 (♀, Kansas).

Probezzia elegantula, Malloch, Proc. Biol. Soc. Washington, vol. 27, p. 137, 1914.

Parabezzia elegantula, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 359, 1915.—Johannsen, Journ. New York Ent. Soc., vol. 42, p. 345, 1934.

Eukraiohelea elegantula, Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—FEMALE: Length 2.0 mm., wing 1.5 mm. by 0.7 mm. A yellowish species, some specimens with a greenish tinge; antennae brown, pedicel and narrow bases of flagellar segments yellow; palpi dark brown. Mesonotum deep yellow, with broad sublateral brown bands; scutellum yellow in center, ends brown; postscutellum brown; pleura grayish, a large black spot on mesopleuron. Legs yellow; coxae dark below; trochanters brown; apex of hind femur, base of hind tibia, apices of all tibiae and narrow apices of all tarsal segments brown. Wings, including veins, grayish hyaline; halteres yellow, sides of knobs black, flat end of knobs pale green. Abdomen dark grayish brown, apices of tergites with narrow white bands.

Antennae very long and slender. Mesonotum with long black hairs in rows; scutellum with four long black marginal bristles and a few short hairs. Legs with hairs fine except on hind tibia where they are long and black; proportions of segments of hind leg as in table 1; fore femur with two or three small black spines midway on inner margin; basitarsus with a long black basal and a smaller distal spine on midlegs and hind legs; fifth tarsal segment with two pairs of long black ventral batonnets; claws slender and unequal, the outer claw as long as fifth segment, the other about a third as long. Wing without macrotrichiae; first radial cell absent, r-m crossvein and R_1 nearly forming an oblique line, lengths of the two sections of costa in ratio of 0:6; petiole of media as long as r-m crossvein.

MALE: Ninth sternite nearly four times as broad as long, with deep quadrate emargination three-fourths way to base on mesal third, with spiculate margins, the posterior membrane bare; ninth tergite rounded, with a pair of very small fingerlike setigerous apicolateral lobes. Basistyles simple, about twice as long as broad; dististyles about two-thirds as long as basistyles, very broad with truncate tips. Aedeagus with an oblique pair of rather stout, slightly sinuate, sclerotized bars with pointed apices; an irregular hyaline membranous lobe from posterior margins. Parameres very long, slender and rodlike, with slender lateral apodemes; stems about a fourth again as long as basistyles, subparallel, the apices slightly swollen, palplike, and bent ventro-laterad.

Type.—In Snow collection, University of Kansas, ♀, Kansas, Douglas County, Lawrence.

Material examined.—Florida: Crystal River, Citrus County, July 7, 1949, Sept. 18, 1950, Hudson, 2 ♀♀, Miami, Dade County, Oct. 15, 1947, Buren, 1 ♀; Panama City Beach, Bay County, July 2, 1950, McElvey, 1 ♂

Louisiana: Baton Rouge, Apr. 30, 1947, Wirth, 1 ♀.

Jamaica: Newport, Feb. 22, 1937, Chapin and Blackwelder, 1 ♀.

Remarks.—*S. (E.) africana* Ingram and Macfie, from West Africa, the genotype of *Eukraiohelea*, is almost identical with *elegantula*, but is smaller and the male genitalia differ markedly; the ninth sternite does not have the mesal excavation, the dististyles have the apices slenderer and rounded, the apices of the parameres are straight and pointed, and the membrane of the aedeagus is prolonged mesad in a sharp cone.

Subgenus *Neostilobezzia* Goetghebuer

Neostilobezzia Goetghebuer, in Lindner, Die Fliegen der Palaearktischen Region, Lief. 78, p. 53, 1934. (Genotype, *Ceratopogon ochraceus* Winnertz, 1852, by present designation.)

Discussion.—Goetghebuer (1934) distinguished this subgenus from *Stilobezzia* by the presence of macrotrichiae at the end of the wing, the wing of *Stilobezzia* being entirely bare. In addition, all the species known to me are yellowish or brown in ground color, varying from almost whitish to almost black, and the male genitalia have the aedeagal sclerites decidedly bent or humped in the middle and the basistyle lacks the inner lobe. Species with these characters are widely distributed around the world. It is especially significant that most of the species described from the temperate regions belong to this subgenus, while the tropical species are predominantly the subgenus *Stilobezzia*.

2. *Stilobezzia* (*Neostilobezzia*) *fuscula* Wirth, 1952

FIGURE 11, e

Stilobezzia fuscula Wirth, Univ. California Publ. Ent., vol. 9, p. 204, 1952 (♀, California).

Diagnostic characters.—This species resembles *S. (N). lutea* (Malloch), 1918, in its uniformly yellowish color, unmarked wings with macrotrichiae, and mesonotum with indistinctly darker vittae; but differs in being somewhat duller and darker, with dark antennal pedicel and halteres, and in having the body hairs much softer.

Description.—FEMALE: Length 1.4 mm., wing 1.5 mm. by 0.5 mm. Head grayish brown pruinose, pedicel of antennae and palpi brown, antennal flagellum yellowish brown; segments in proportion of 20:12:12:12:12:12:12:20:20:20:30. Palpal segments in proportion of 4:8:15:10:10, third segment with three long, stalked sensillae.

Mesonotum dull yellowish brown, with coarse pruinosity, a narrow median longitudinal vitta and a broad patch on each side from humeral pits to wing base darker brown; most of bristles removed, but those few remaining long and dark brown. Scutellum bright yellow in middle, brownish on sides, apparently with four marginal bristles. Postscutellum and pleura yellowish brown pruinose. Legs dull dark yellowish; hairs short, except row of long bristles on outer edge of hind tibia; inner claw as long as fifth tarsal segment.

Wings grayish hyaline, anterior veins brownish; second anterior radial cell about five times as long as first; macrotrichiae thick at apex of cell R_5 and along and beyond intercalary fork, a few also along tip of veins M_1 and M_2 and at apex of cell M_1 . Halteres brown, flat end of knob dull yellowish.

Abdomen dull dark brown, a patch of long brown hairs on sides of first segment. Spermathecae two, oval, with ducts sclerotized a short distance; a rudimentary third spermatheca present.

MALE: Similar to the female but with the usual sexual differences; antennal plumes light brown; thorax and abdomen infuscated light brown; scutellum yellow.

Ninth sternite about three times as broad as long, with mesal posterior excavation halfway to base, posterior membrane bare; ninth tergite rather long and rounded, with a pair of long, rounded, setigerous, apicolateral lobes. Basistyle nearly three times as long as broad, with a black spine borne on a small lobe with a long fine hair about midway of mesal margin; dististyle as long as basistyle, slender and slightly curved to apex. Aedeagus with a pair of oblique, lateral, sclerotized bars with median apices forked, the inner arm in line with base and longer than the other arm. Parameres with slender

basal apodemes, stems long and slender, with bases slightly swollen, each with apex gradually narrowed to a fine apical filament abruptly bent and recurved on distal fourth.

Type.—USNM 59946, ♀, California, Tulare County, 6 miles east of Orosi. (In the original publication the sex was erroneously given as ♂.)

Material examined.—California: 6 miles east of Orosi, Tulare County, July 8, 1947, Wirth, 2 ♀♀ (type and paratype).

Utah: Moab, June 8, 1948, Knowlton, Harmston, and Wood, at light, 1 ♂.

Remarks.—The male genitalia of *S. fuscula* are practically identical with those of *S. macfieii* Lane, 1947, from Brazil. However, the latter species has the mesonotum polished black, with lighter areas, and under certain light a spot on each side before wing base has purplish reflections. Moreover, the absence of macrotrichiae on the wings would place *S. macfieii* in the subgenus *Stilobezzia*.

3. *Stilobezzia* (*Neostilobezzia*) *lutea* (Malloch), 1918

FIGURE 11, b

Hartomyia gilva Malloch, not Coquillett (misidentification), Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 343, 1915.

Hartomyia lutea Malloch, Bull. Brooklyn Ent. Soc., vol. 13, p. 18, 1918, (♀, Illinois).

Stilobezzia lutea, Johannsen, Ann. Ent. Soc. Amer. vol. 36, p. 781, 1943.

Stilobezzia mallochi Hoffman, Ent. News, vol. 35, p. 283, 1924, (♂, ♀; New York, Pennsylvania).—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943 (eastern United States). (New synonymy.)

Description.—FEMALE: Length 2.5 mm., wing 1.9 mm. by 0.7 mm. Yellow, including anterior wing veins, antennae, and legs; mesonotum, except humeri, and apex of abdomen rufous brown. Vestiture of very long coarse brown bristles, those on scutellum as long as breadth of scutellum.

MALE: Ninth sternite nearly three times as broad as long, with a very broad, shallow, posterior emargination, the membrane spiculate; ninth tergite conical, with a prominent, submedian pair of long, fleshy, setose lobes. Basistyles simple, twice as long as broad; dististyles slightly longer than basistyles, curved, and gradually attenuated, with pointed apices. Aedeagus with a pair of oblique sinuate sclerites, bases of which are articulated with ventral root of basistyle, apices close together, pointed, and bent ventrad. Parameres with stout basal apodemes, the stems close together and slightly sinuate, flattened and slightly expanded past middle, with apices pointed and somewhat curved ventrad.

Type.—In collection Illinois Natural History Survey, ♀, Illinois, Elizabeth.

Material examined.—New Hampshire: Center Harbor, July 9, Dyar, 1 ♀; Franconia, Slosson, 1 ♂.

Connecticut: Green Falls, June 31, 1935, Chapman, 1 ♂, 1 ♀.

Rhode Island: Westerly, June 10, 1936, Chapman, 1 ♂.

New York: Armonk, Bemus Point, Canadarago Lake, Kast Bridge, Millwood, Poughkeepsie, Rome, June, July 1934–36, H. K. Townes, 12 ♂♂, 7 ♀♀.

New Jersey: Moorestown, June 6, 1936, H. and M. Townes, 1 ♀; Riverside, June 18, 1939, H. K. Townes, 1 ♂.

Delaware: Smyrna, June 8, 1937, Bradley, 1 ♂.

Maryland: Cabin John, June 18, 1920, Aldrich, 1 ♀; Glen Echo, July 1, 1923, Malloch, 1 ♀; Plummer's Island, June 18, 1914, Shannon, 1 ♀.

District of Columbia: Rock Creek Park, June 17, 1920, Aldrich, 1 ♂.

Virginia: Dead Run, June 6, 1914, Shannon, 1 ♀; Falls Church, June 7, 1914, Shannon, 2 ♀♀, and July 4, 8, 1950, Wirth, 4 ♂♂, 7 ♀♀; Glencarlyn, June 7, 1935, Malloch, 1 ♂, 1 ♀.

South Carolina: Greenville, June 4, 1933, H. K. Townes, 1 ♂.

Indiana: Lafayette, June 26, 1916, Aldrich, 1 ♂, 4 ♀♀.

Illinois: Elizabeth, July 7, 1917, Malloch, 1 ♀ (type of *Hartomyia lutea* Malloch).

Michigan: Cheboygan County, July 17, 1942, Sabrosky, 1 ♀.

Iowa: Maquoka Caves State Park, Jackson County, July 3, 1949, Laffoon, 1 ♀; Pikes Peak State Park, Clayton County, July 4, 1949, Laffoon, 1 ♀; Sioux City, June, July 1949–50, Slater and Laffoon, 6 ♂♂, 11 ♀♀.

Remarks.—Malloch had misidentified the male of this species as *Hartomyia gilva* (Coquillett), which is an *Atrichopogon*, in 1915, and in 1918 described the female of the same species as *Hartomyia lutea*, new species. Hoffman discovered that Malloch's determination of *gilva* was incorrect and described the species as *Stilobezzia mallochii*, 1924, in part from Malloch's material. Since Hoffman made no mention of Malloch's description of *lutea*, he may have been unaware of it, or he may not have been able to recognize Malloch's species. The present synonymy has been made after an examination of the type of *lutea* and specimens determined as *gilva* by Malloch in the Illinois Natural History Survey through the kindness of Dr. H. H. Ross, and of specimens in the U. S. National Museum determined by Hoffman as *mallochii*. Hoffman's detailed description of this species needs no elaboration except for the characters of the male genitalia.

4. *Stilobezzia* (*Neostilobezzia*) *stonei*, new species

FIGURE 11, c

Diagnostic characters.—A large brownish species; mesonotum and scutellum dull yellowish; legs yellowish; midfemora, hind femora, and tibiae dark brown; wings grayish brown; halteres dull yellow.

Description.—FEMALE: Length 1.8 mm., wing 1.8 mm. by 0.7 mm. Head dull brownish, including antennae and palpi, with a few long black hairs. Antenna as long as head and thorax combined; flagellar segments in proportion of 20:15:15:15:15:16:17:18:25:25:25:25:30. Palpal segments slender, in proportion of 5:10:12:6:10, third segment slightly swollen on basal two-thirds, with a small pit at distal fourth.

Thorax dull brown, mesonotum and scutellum dull yellowish, postscutellum and pleura dark brown. Mesonotum with moderate to long brown hairs in rows; scutellum with about ten long brown marginal hairs. Legs dull brown, usually all of forelegs, midtarsus and hind tarsus yellowish. Proportions of segments of hind leg as in table 1; legs moderately slender, hairs fine, not very long except those on hind tibia about twice the diameter of segment; basitarsi with ventral spines, three or four on basal half on forelegs and midlegs, one at base on hind leg; claws unequal, rather strong and curved, the longer nearly as long as fifth segment, the other about half as long.

Wings evenly infuscated, the veins slightly darker, a few macrotrichiae at apices of cells R_5 and M_1 . First radial cell large, about a third the length of second; costa extending to 0.8 wing length; crossvein r-m faint in middle, oblique; petiole of media as long as crossvein. Halteres yellow. Abdomen dark brown with short fine hairs; two large, slightly unequal ovoid spermathecae and a vestigial third present, ducts not sclerotized.

MALE: Similar to the female but with the usual sexual differences; antennal plumes brownish, knees quite dark. Ninth sternite about three times as broad as long, with broad posterior excavation more than halfway to base, the membrane bare; ninth tergite rounded, with small, submedian, setose, apicolateral lobes. Basistyles simple, twice as long as broad; dististyles 0.9 times as long as basistyles, slender and nearly straight, their apices slightly knobbed. Aedeagus with an oblique pair of slightly curved sclerites with distal ends close together, sharp-pointed, and bent ventrad; apparently bearing a pair of hyaline membranous lobes on posterior margins and attached to membrane connecting dorsal roots of basistyles on ventral side of parameres. Parameres with broad, platelike, basal apodemes; stems very broad and flattened, gradually expanded distad with a short lateral point and a longer, slenderer, ventrally bent, distal point, their distal margins obliquely truncated.

Types.—USNM 60964, holotype, ♂, and allotype, Falls Church, Va., July 8, 1950, Wirth. Paratypes: Virginia: 16 ♂♂, 24 ♀♀, same data as type. Georgia: 2 ♂♂, 17 ♀♀, Thomasville, May 1949, Palmer. Florida: 2 ♀♀, Innerarity Point, May 4, 1950, Rathert; 1 ♀, Panama City Beach, May 6, 1949, McElvey.

Remarks.—Related to *S. lutea* (Malloch) in general features, but readily distinguished by the more extensive brown coloration, finer vestiture and the characteristic broad, obliquely truncated, two-pointed, platelike, male parameres. This species is named in honor of Dr. Alan Stone.

Subgenus *Stilobezzia* Kieffer, 1911

- Stilobezzia* Kieffer, Rec. Indian Mus., vol. 6, p. 118, 1911, and vol. 9, p. 184, 1913; Bull. Ent. Soc. France, p. 192, 1919.—Goetghebuer, Mem. Mus. Hist. Nat. Belgique, vol. 8, p. 59, 1920.—Carter, Ingram, and Macfie, Ann. Trop. Med. Parasit., vol. 15, p. 324, 1921.—Edwards, Trans. Ent. Soc. London, vol. 74, p. 411, 1926; Notulae Ent., vol. 9, p. 9, 1929.—Johannsen, Arch. Hydrobiol., Suppl., vol. 9, p. 430, 1931; Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.—Ingram and Macfie, The Diptera of Patagonia and southern Chile . . . , pt. 2, fasc. 4, p. 191, 1931.—de Meillon, Proc. Ent. Soc. London, ser. B, vol. 7, p. 266.—Tokunaga, Philippine Journ. Sci., vol. 72, p. 155, 1940.—Lane, Rev. Ent., vol. 18, p. 197, 1947.—Lee, Proc. Linn. Soc. New South Wales, vol. 72, p. 345, 1948.—Wirth, Univ. California Publ. Ent., vol. 9, p. 202, 1952. (Genotype, *Ceratopogon notatus* de Meijere, as *Stilobezzia festiva* Kieffer; original designation.)
- Hartomyia* Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 339, 1915. (Genotype, *Ceratopogon pictus* Coquillett; original designation.)

Diagnosis.—Two radial cells present; wing without macrotrichiae at apex.

5. *Stilobezzia* (*Stilobezzia*) *antennalis* (Coquillett), 1901

FIGURE 12, *e*

- Ceratopogon antennalis* Coquillett, Proc. U. S. Nat. Mus., vol. 23, p. 606, 1901 (♀, District of Columbia).
- Ceratophus antennalis*, Kieffer, Genera insectorum, fasc. 42, p. 60, 1906.
- Johannseniella antennalis*, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 227, 1914.
- Hartomyia antennalis*, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 343, 1915 (♂; Illinois, Indiana).
- Stilobezzia antennalis*, Johannsen, Ann. Ent. Soc. Amer., 36: 781, 1943.

Description.—FEMALE: Length 1.5 mm., wing 1.6 mm. by 0.6 mm. Head, thorax, and abdomen polished black; antennae and legs yellow, midfemur and hind femur black except at extreme bases. Wings bare and hyaline, anterior veins yellowish, knob of halteres black. Palpi and last five flagellar segments slightly infuscated, flagellar segments in proportion of 18:11:11:11:11:11:11:15:25:25:25:25:30. Palpal segments in proportion of 4:8:14:8:15, third segment not swollen, pit absent. Proportions of segments of hind leg as in table 1; basitarsi without spines, fifth segment with a pair of long ventral batonnets; claws long, simple, and very unequal, the short claw fused with base of and about a third as long as the other. First radial cell about a fourth as long as second; r-m crossvein vertical, petiole of media to a

third the length of M_1 . Spermathecae two, the larger oval, the smaller subspherical and a third the diameter of other, a minute vestigial third present.

MALE: Similar to the female but with the usual sexual differences; plumes of antennae brown. Ninth sternite a narrow transverse anterior band, the membrane spiculate; ninth tergite evenly rounded caudad, the apicolateral lobes not prominent. Basistyle with large irregular lobe on inner side to distal third; dististyle rather strongly bent past middle and tapered to pointed tip. Aedeagus with a pair of oblique, straight, sclerotized bars with distal apices scarcely meeting. Parameres a pair of strongly sclerotized, large, strongly sinuate rods with pointed apices and large basal knobs.

Type.—USNM 5481, ♀, District of Columbia.

Material examined.—New York: Ithaca, June 11, 1935, H. K. Townes, 1 ♀; Rome, June 24, 1934, H. K. Townes, 1 ♂.

New Jersey: Moorestown, June 6, 1939, H. and M. Townes, 1 ♂.

Maryland: Dorchester, July 10, 1907, Barber, 1 ♀; Mayo, July 22, 1950, Wirth, 2 ♂♂, 1 ♀; Plummer's Island, June 30, 1914, Shannon, 1 ♀, and Aug. 18, 1913, Viereck, 1 ♀.

District of Columbia: June, 1 ♀ (type); Benning's, July 21, Aldrich, 2 ♀♀.

Virginia: June 16, 1903, Pergande, 2 ♂♂, 3 ♀♀; Dead Run, June 22, 1915, Shannon, 1 ♀, Falls Church, July 4, 8, 1950, Wirth, 3 ♂♂, 4 ♀♀.

Michigan: Midland County, July 17, 1944, Dreisbach, 1 ♀; Traverse City, June 17, 1943, Sabrosky, 1 ♂.

Illinois: Freeport, July 4, 1917, Malloch, 3 ♂♂; Galena Junction, July 8, 1917, Malloch, 1 ♀; White Heath, June 4, 1939, Dirks, 1 ♀.

Tennessee: Knoxville, May 25, Aldrich, 1 ♀.

Mississippi: West Point, Aug. 11, 1904, Barber, 1 ♂.

Louisiana: Baton Rouge, May 4, 16, 1947, Wirth, 4 ♂♂, 8 ♀♀.

6. *Stilobezzia (Stilobezzia) beckae*, new species

FIGURE 11, f

Diagnostic characters.—A large, dark brown species with silvery pruinose pattern on mesonotum and abdomen; wing with two darker and one lighter spots on anterior margin; knobs of halteres black; mesonotum with strong anterior tubercle; fifth tarsal segment unspined.

Description.—**FEMALE:** Length 2.5 mm., wing 1.8 mm. by 0.7 mm. Head black with dense whitish pruinosity, antennae brown, bases of flagellar segments 3 to 10 yellowish; palpi dark brown. Flagellar segments of antenna in proportion of 16:12:15:20:20:20:20:22:28:

30:32:32:42. Palpal segments in proportion of 5:12:15:8:12, third segment slightly swollen, with large, shallow sensory pit near apex.

Thorax dark reddish brown, with dense silvery pruinescence in irregular patches; mesonotum long, with prominent, conical, anterior spine, the anterior portion markedly sloping, posterior portion flattened between wing bases; covered with sparse, long, brown hairs; scutellum with four long, fine, brown hairs. Legs dark brown, all femora and fore tibiae with obscure broad median light bands, mid-tibia and hind tibia with narrow sub-basal light rings, tarsi yellow except fifth segment of each brown. Proportions of segments of hind leg as in table 1; legs with moderately long, black hairs, which are stronger on hind tibia; basitarsi with three ventral spines on foreleg, four on midleg, and one at base on hind leg; fifth segment without ventral batonnets; claws very slender and slightly unequal, the longer as long as fifth segment, the other about 0.6 to 0.8 as long.

Wing hyaline, without macrotrichiae, veins infuscated, a large brownish spot over first radial cell from vein R_1 to crossvein r-m; apex of second radial cell with brown spot, then a short white area with apex of wing weakly infuscated. First radial cell well developed, one-fourth as long as second; r-m crossvein faint in middle, forming an oblique line with R_1 , petiole of media as long as crossvein. Knobs of halteres black.

Abdomen black, distal half of tergites 1 to 3 and narrow distal margins of remaining tergites with silvery, pruinose bands. Spermathecae two, subequal, pyriform.

MALE: Similar to the female but with the usual sexual differences; antennal plumes golden. Ninth sternite over twice as broad as long, with caudal excavation to half its length, the membrane bare; ninth tergite rounded with a pair of membranous, setigerous, apicolateral lobes. Basistyles simple, about 2.5 times as long as broad; dististyles slender, nearly as long as basistyles, gently curved, with pointed incurved apices. Aedeagus with a pair of heavy, oblique, crooked, lateral sclerites meeting mesad subapically, with apices pointed and abruptly bent ventrolaterad. Parameres with heavy, platelike, V-shaped, basal apodemes; stems straight and contiguous mesad, slightly expanded midway, with lateral wall folded ventrad and mesad and apparently fusing on midline on distal third; extreme apices slender, flattened dorsoventrally and abruptly bent ventrad.

Types.—USNM 60695, holotype, ♂, and allotype, Crystal River, Citrus County, Fla., June 7, 1950, Hudson, light trap. Paratypes: Florida: 10 ♂♂, 17 ♀♀, same data as type except dates, June 5–July 17, 1949–50; 6 ♀♀, Grayton Beach, Walton County, May 10, 1949, Butler; 15 ♀♀, Santa Rosa, Walton County, June 7, 1949, Peterson. Mississippi: 4 ♀♀, Horn Island, June, July, 1944, Richmond.

Additional material examined.—Perú: Iquitos, March, April 1931, Shannon, 1 ♀.

Remarks.—Closely allied to *S. paulistensis* Lane, 1947, from Brazil which differs, however, in having the legs yellowish rather than blackened, in lacking the dark spot at apex of second radial cell, and in having the lateral sclerites of the male aedeagus shorter, with apices capitate and bent mesad rather than slender and bent laterad. *S. rabelloi* Lane, 1947, is also closely related, but is a larger, hairier species with three dark wing spots, including one at apex of first radial cell, and has several pairs of batonnets on fifth tarsal segment. I am happy to name this species for Mrs. Elisabeth C. Beck of Arlington, Fla., who has kindly sent me so many interesting Florida heleids.

7. *Stilobezzia* (*Stilobezzia*) *bicolor* Lane, 1947

FIGURE 11, *i*

Stilobezzia bicolor Lane, Rev. Ent., vol. 18, p. 208, 1947 (♂, Brazil).

Description.—FEMALE: (Here described for the first time.) Length 1.5 mm., wing 1.5 mm. by 0.6 mm. Head dark brown, antennal pedicel, clypeus, and palpi yellowish. Thorax and abdomen polished black, with metallic bluish violet reflections. Mesonotum rather broad and flat, with sparse, long, brown hairs, scutellum with four marginal bristles. Midecoxa and hind coxa black, rest of legs yellow, except knees and fifth tarsal segments dark. Legs with fine hairs; proportions of segments as in table 1; basitarsi unspined; fifth segment with a pair of long black batonnets at base; claws slender and unequal, the outer claw as long as fifth segment, the inner about a third as long. Wing hyaline, with violet reflections, anterior veins yellow; macrotrichiae absent. First radial cell distinct, a sixth as long as second; petiole of media about twice as long as crossvein r-m. Halteres black. Abdomen convex above, somewhat petiolate, with a row of long, brown hairs across each tergite.

MALE: As in the female but with the usual sexual differences; plumes of antennae brown. Ninth sternite a narrow anterior band, the posterior membrane spiculate; ninth tergite rounded, with inconspicuous, rounded, setigerous, apicolateral lobes. Basistyle with a small lobe at half the length of inner margin; dististyle about as long as basistyle, tapered to slender tip. Aedeagus with an only slightly oblique pair of sclerotized bars, stout in the Texas specimen figured, but slenderer in the tropical specimens. Parameres with lateral apodemes bent caudad; stems straight, stout and rodlike, with beak-like apices abruptly bent laterad.

Type.—In collection University of São Paulo, Brazil, ♂, Brazil, São Paulo, Osasco.

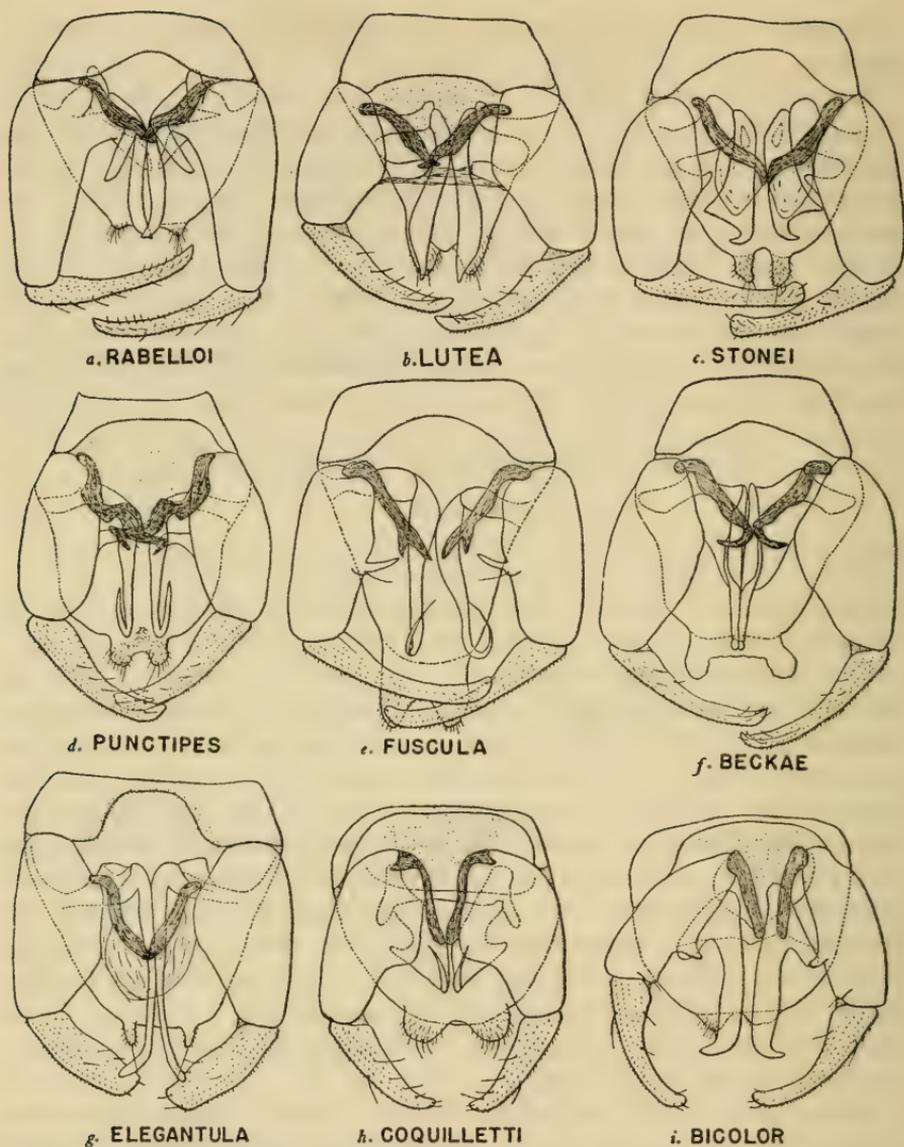


FIGURE 11.—Male genitalia of *Stilobezzia* species: a, *S. (S.) rabelloi* Lane; b, *S. (N.) lutea* (Malloch); c, *S. (N.) stonei*, new species; d, *S. (S.) punctipes*, new species; e, *S. (N.) fuscula* Wirth; f, *S. (S.) beckae*, new species; g, *S. (E.) elegantula* (Johannsen); h, *S. (S.) coquilletti* Kieffer; i, *S. (S.) bicolor* Lane.

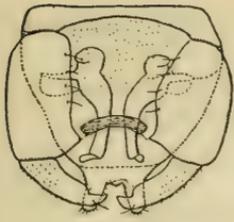
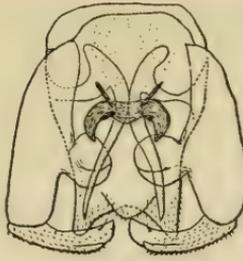
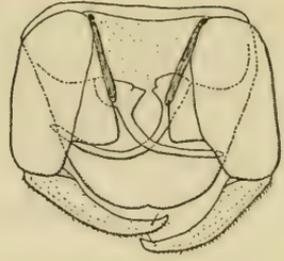
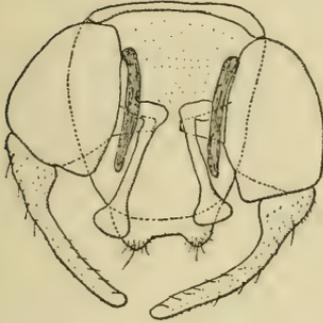
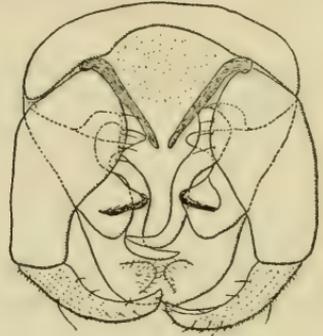
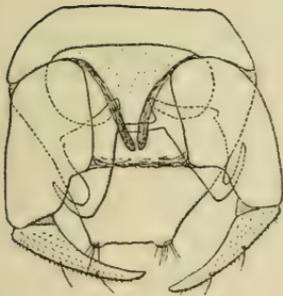
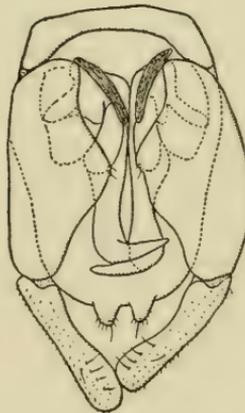
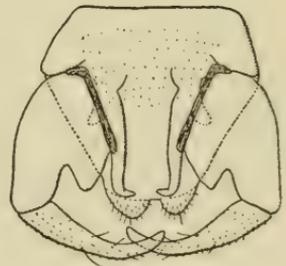
**a. THOMSENÆ****b. BULLA****c. SYBLEÆ****d. VIRIDIS****e. ANTENNALIS****f. DIVERSA****g. PRUINOSA****h. GLAUCA**

FIGURE 12.—Male genitalia of *Stilobezzia* species: a, *S. (S.) thomsenae*, new species; b, *S. (S.) bulla* Thomsen; c, *S. (S.) sybleae*, new species; d, *S. (S.) viridis* (Coquillett); e, *S. (S.) antennalis* (Coquillett); f, *S. (S.) diversa* (Coquillett); g, *S. (S.) pruinosa* Wirth; h, *S. (S.) glauca* Macfie.

- Material examined*.—Texas: San Antonio, Apr. 8, 1907, Pratt, 1 ♂.
 Costa Rica: Higuito, Schild, 2 ♂♂, 10 ♀♀.
 Puerto Rico: Anasco, Apr. 22, 1933, Faxon, Mills, and Anderson,
 1 ♂, 4 ♀♀. Bayamon, Jan. 28, 1934, Lesesner and Anderson, 1 ♀.
 Panamá: Summit, Canal Zone, November 1946, Krauss, 2 ♂♂, 1 ♀.

8. *Stilobezzia (Stilobezzia) bulla* Thomsen, 1935

FIGURE 12, b

Stilobezzia bulla Thomsen, Journ. New York Ent. Soc., vol. 43, p. 289, 1935
 (♂, ♀; New York); Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—**FEMALE**. Length 1.0 mm., wing 0.8 mm. by 0.4 mm. Pruinose grayish brown; scutellum and legs yellowish; halteres white; wings clear, veins stramineous. Antennal segments in proportion of 12:8:9:10:10:10:10:10:13:15:15:15:20. Palpi short and slender, segments in proportion of 5:7:7:5:7, third segment not swollen, pit absent. Basitarsi and fifth segment without spines; claws simple, slender and unequal, the longer as long as fifth segment, the other a third as long. Wings clear, macrotrichiae absent. Spermathecae two, oval, slightly unequal, with ducts sclerotized a very short distance.

MALE: Ninth sternite a narrow anterior ribbon, the membrane spiculate; ninth tergite tapered to a pair of prominent, slender, setose, apicolateral lobes, truncate between their bases. Basistyle slender, with a prominent, heavily sclerotized, platelike lobe articulating with the median sclerite (? of aedeagus); dististyle about half as long as basistyle, rather stout and nearly straight, tip bluntly pointed, with a distinct subapical tooth on ventral face of outer edge. Aedeagus with basal sclerites reduced to very small, narrow bars, connected at right angles by a pair of short, barlike sclerites to a more dorsal, large, heavily sclerotized, transverse sclerite shaped like a pair of buffalo horns, with points articulating with inner lobes of basistyles. Parameres with slender, hook-shaped, basal apodemes, stems rodlike, slender and nearly straight, gradually tapered to long, simple, fine tips reaching nearly to apices of lobes of ninth tergite.

Types.—In collection Cornell University, holotype, ♂, and allotype, New York, Ithaca, McLean Bogs.

Material examined.—Maryland: Dorchester, July 10, 1907, Barber, 1 ♂.

District of Columbia: Bennings, July 21, Aldrich, 1 ♀.

Virginia: Falls Church, July 4, 8, Aug. 6, 1950, Wirth, 18 ♂♂, 24 ♀♀.

Georgia: Thomasville, May 15–30, 1949, Palmer, 1 ♀.

Florida: Crystal River, Sept. 18, 1950, Hudson, 1 ♀.

Louisiana: Baton Rouge, Apr. 19, 1947, Wirth, 1 ♂; Kilbourne, May 10, 1947, Wirth, 1 ♀.

9. *Stilobezzia* (*Stilobezzia*) *coquilletti* Kieffer, 1905

FIGURE 11, *h*

Ceratopogon pictus Coquillett, Journ. New York Ent. Soc., vol. 13, p. 60, 1905 (♀, Virginia).

Hartomyia picta, Malloch, 1915, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 341, 1915 (♂, Illinois).

Stilobezzia coquilletti Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 308, 1917 (new name for *C. picta* Coquillett not Meigen).—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—FEMALE: Length 2.0 mm., wing 2.0 mm. by 0.8 mm. Yellow, in some specimens with greenish tinge; with a pair of widely separated, narrow brown lines from anterior median point of mesonotum to ends of scutellum; also, narrow center of scutellum, palpi, mesopleuron and midcoxa, narrow apices of hind femur and tibia, fifth tarsal segment, and fore, lateral, and hind margins of abdominal tergites 3 to 7, brown. Wing bare and hyaline, all veins brownish, a brown spot over first radial cell including R_1 and r-m crossvein; a second spot over apex of second radial cell and below halfway across cell R_5 ; knobs of halteres brown.

Flagellar segments of antenna in proportion of 25:15:15:15:15:15:17:18:28:28:30:30:60. Palpal segments in proportion of 4:15:20:10:22, third segment not swollen, pit absent. Mesonotum and abdomen with coarse, dark bristles. Proportions of segments of hind leg as in table 1; basitarsi without spines, fifth segment with a pair of long, black batonnets at basal third; claws slender and unequal, the longer as long as fifth segment, the other about half as long. Spermatheca one, large and ovoid, the duct not sclerotized. Wing with macrotrichiae absent; first radial cell very small and narrow, about a seventh as long as second, latter to 0.8 wing length; crossvein r-m forming an oblique line with vein R_1 ; media petiolate for 0.23 its length.

MALE: Similar to the female but with the usual sexual differences; body more or less greenish with black markings as in female, antennal plumes yellow at bases, black on distal halves. Ninth sternite a narrow, transverse, anterior band, posterior membrane spiculate; ninth tergite full and rounded, with a pair of low, rounded, setigerous, apicolateral lobes. Basistyle about twice as long as broad at base, abruptly narrowed about midway on inner side, forming a low, mesal lobe connected by an irregular membrane to ventrolateral margins of ninth tergite; dististyle about 0.7 as long as basistyle, stout, slightly incurved, with bluntly pointed tip. Aedeagus with an oblique pair of spatulate sclerites with bases abruptly bent laterad around bases of basistyles. Parameres a pair of broad, flattened, sclerotized plates, bases connected across midline by a highly sclerotized band from outer anterolateral

margins of basistyles; base of each paramere with a prominent lateral spur projecting caudad along inner margin of basistyle; distal half greatly expanded, with a large, sharp, lateral tooth; inner margins contiguous at apices, each with a very slender, pointed spine abruptly bent ventrad and cephalad.

Type.—USNM 8356, ♀, Virginia.

Material examined.—Maryland: Shadyside, July 6, 1925, Aldrich, 1 ♀.

Virginia: June 16, Pergande, 1 ♀ (type).

Illinois: Urbana, May 20, 1914, Aldrich, 1 ♂, 1 ♀.

Louisiana: Baton Rouge, Apr. 13, 25, 1947, Wirth, 3 ♂♂, 3 ♀♀.

México: Ciudad Monte, Tamaulipas, Nov. 23–Dec. 1, 1943, Brookman, 29 ♂♂, 35 ♀♀; Tamazanchale, San Luis Potosí, March 11, 1944, Brookman, 1 ♀; Tapachula, Chiapas, Sept. 20, 1944, Brookman, 1 ♀.

Puerto Rico: Arecibo, Apr. 5, 1932, Faxon and Anderson, 1 ♂, 1 ♀; San Juan, June 14, 1933, Harlan, 1 ♀.

Jamaica: Bath, St. Thomas, Chapin and Blackwelder, 4 ♀♀; Spanish Town, Feb. 2, 1937, Chapin and Blackwelder, 3 ♀♀.

Panamá: Sabanas, Apr. 20, 1923, Shannon, 1 ♀.

Remarks.—*S. fiebrigi* Kieffer, 1917, from Paraguay and Brazil, resembles *S. coquilletti* very closely except for the abdominal markings, with a pair of large lateral brown spots on the first tergite and a large median brown spot on the second, and tergites 3 to 7 with dark markings on the disc rather than on the margins. In the male genitalia of *fiebrigi* the basistyles bear a prominent mesal lobe, the dististyles are slenderer at the apices, the lateral bars of the aedeagus are slender without capitate tips, and the parameres are not so broad and the lateral tooth is not so prominent.

10. *Stilobezzia (Stilobezzia) diversa* (Coquillett), 1901

FIGURE 12, *f*

Ceratopogon diversus Coquillett, Proc. U. S. Nat. Mus., vol. 23, p. 607, 1907 (♀, New Jersey).

Ceratolophus diversus, Kieffer, Genera insectorum, fasc. 42, p. 60, 1906.

Johannseniella diversa, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 227, 1914.

Hartomyia diversa, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 344, 1915.

Stilobezzia diversa, Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—FEMALE: Length 1.5 mm., wing 1.4 mm. by 0.6 mm. Head brown, antennae and palpi yellow; thorax shining black; abdomen and coxae light green; legs yellow, fifth tarsal segment brownish; wings hyaline, anterior veins yellow, halteres yellowish. Antennae as long as entire body; palpi slender, third segment not swollen. Wing

with first radial cell a fifth as long as second; petiole of media a fourth as long as distal portion. Legs slender, nearly bare, proportions of segments of hind leg as in table 1; basitarsi unspined, fifth segment with a pair of ventral batonnets.

MALE: Similar to the female but with the usual sexual differences; plumes of antennae yellow. Ninth sternite about four times as broad as long, with a very shallow, broad, posterior excavation, the posterior membrane spiculate; ninth tergite tapered, much longer than basistyles, with very short, setigerous, apicolateral lobes. Basistyles broad at bases, attenuated distad, simple, with an irregular, hyaline membrane connecting the inner margins about two-thirds way to apices; dististyles about as long as basistyles, slightly curved and tapered to a slender, pointed tip. Aedeagus with a pair of slender, sclerotized, oblique rods with straight apices, the curved bases continuous with anterior margins of basistyles. Parameres with bases very stout and conical, and with greatly narrowed apices recurved ventrolaterad, the bases connected by a narrow, sclerotized band.

Type.—USNM 5482, ♀, New Jersey, Riverton.

Material examined.—New Jersey: Riverton, July 3, Johnson, 1 ♀ (type).

Virginia: Falls Church, July 4, Aug. 6, 1950, Wirth, 4 ♂♂, 3 ♀♀.

Georgia: Thomasville, May 15–30, 1949, Palmer, 1 ♂, 2 ♀♀.

11. *Stilobezzia (Stilobezzia) glauca* Macfie, 1939

FIGURE 12, h

Stilobezzia glauca Macfie, Rev. Ent., vol. 10, p. 204, 1939 (♂, Brazil).—Lane, Rev. Ent., vol. 18, p. 207, 1947 (♀).

Diagnostic characters.—A rather small, bright, pale green species with whitish antennae, legs, wings, and halteres; mesonotum extensively dark, shining brown; abdomen with black band across third tergite and lateral spots on fifth.

Description.—**FEMALE:** Length 1.8 mm., wing 1.7 mm. by 0.6 mm. Head yellowish brown, antennae whitish at bases, last five segments and palpi pale brownish. Flagellar segments in proportion of 25:15:15:15:16:17:18:20:40:40:35:35:45. Palpi long, segments in proportion of 4:7:15:8:12; third segment not swollen, pit absent.

Thorax pale green; mesonotum with median third of anterior margin shining brownish black, forming a broad, V-shaped mark caudad, the sides of mesonotum broadly dark to ends of scutellum, and the median area between the dark bands yellowish. Vestiture consisting of a few long, brown bristles; scutellum with four weak, marginal bristles. Postscutellum and a faint pleural spot brown. Legs whitish, hind femur and tibia with very faint dark, apical spot. Proportions of segments of hind leg as in table 1; basitarsus without spines, fifth seg-

ment with a pair of long, dark batonnets at basal fourth; claws very slender and unequal, the longer claw as long as fifth segment, the other a third as long.

Wings hyaline, anterior veins yellowish; first radial cell small, a seventh as long as second; petiole of media a fifth way to apex of wing. Halteres yellowish white.

Abdomen pale green; two dark spots present on sides of first and second tergites; third tergite with broad, black band; fifth tergite with a pair of small, lateral, black spots. Spermatheca one, slightly oval, the duct not sclerotized.

MALE: Similar to the female but with the usual sexual differences; antennal plumes bright yellow. Ninth sternite broad and not strongly sclerotized, with spiculate membrane; ninth tergite rounded with membranous, setigerous, apicolateral lobes. Basistyle with distal portion slender, base stout, a large unsclerotized lobe about halfway along inner margin, connected on dorsal side to margin of ninth tergite; dististyle about as long as basistyle, tapered and curved to a slender, bluntly pointed tip. Aedeagus with an oblique pair of long, straight, slender, sclerotized bars. Parameres with stout basal knobs, a pair of inner apodemes joined mesad by a membrane from their anterior margins; stems stout, slightly curved, with apex abruptly narrowed, pointed, and bent mesad in the form of a short claw.

Type.—In collection British Museum (Natural History), ♂, Brazil, Nova Teutonia.

Material examined.—Virginia: Falls Church, July 4–29, 1950, Wirth, 9 ♂♂, 16 ♀♀.

South Carolina: Greenville, June 20, 1940, H. and M. Townes, 1 ♂.

Louisiana: Baton Rouge, May 1947, Wirth, 2 ♂♂.

Remarks.—Very similar to *S. viridis* (Coquillett), 1901, in the general green color with black-banded abdomen, but readily distinguished from that species by the dark-banded mesonotum, unbanded legs, pale wings, and in the male by the yellowish antennal plumes. One female from Falls Church is atypical, with the abdomen entirely dark.

12. *Stilobezzia* (*Stilobezzia*) *pallidiventris* (Malloch), 1915

Hartomyia pallidiventris Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 344, 1915 (♀; Illinois, Indiana).

Stilobezzia pallidiventris, Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—FEMALE (from original description): Length 1.0 mm. Shining black; head, antennae, palpi, legs, and abdomen yellow; abdomen may be darkened; wings hyaline; halteres white. Antennae as long as entire body; legs slender; basitarsi longer than segments 2 to 5 combined; fifth segment without ventral batonnets; claws slender, inner half as long as outer. First radial cell a fifth as long as second.

Type.—In collection Illinois Natural History Survey, ♀, Illinois, Urbana.

Remarks.—Very near *S. (S.) diversa* (Coquillett), but much smaller, the abdomen yellowish rather than green, and fifth tarsal segment of female without ventral batonnets.

13. *Stilobezzia (Stilobezzia) pruinosa* Wirth, 1952

FIGURE 12, *g*

Stilobezzia pruinosa Wirth, Univ. California Publ. Ent., vol. 9, p. 203, 1952 (♂, ♀; California).

Description.—FEMALE: Length 1.0 mm. Pruinose brown, with broad, short, unmarked wings and a marked, pruinose gray pattern on the mesonotum; legs with narrow sub-basal pale rings on tibiae; halteres white. Proportions of segments of hind leg as in table 1; basitarsi and fifth segment without ventral spines. Spermathecae two, slightly unequal, slightly ovoid, with a few minute perforations; the ducts sclerotized a very short distance.

MALE: Ninth sternite transverse; ninth tergite long and rounded caudad with a subapical pair of low, rounded, setigerous lobes. Basistyles tapered, the inner margins with low hump bearing a few setose tubercles; dististyles very stout, with blunt apices. Aedeagus with a pair of small, oblique, sclerotized bars. Parameres a pair of highly sclerotized, heavy plates; basal apodemes winglike and bilobed; inner margins of stems nearly straight, slightly expanded on outer sides about halfway to apices; apices abruptly narrowed and bent ventromesad on about distal fourth. The apices of the parameres are somewhat longer in the Florida specimens figured than in the type from California.

Types.—USNM 59945, holotype, ♂, allotype, California, San Luis Obispo County, Arroyo Seco Ranger Station.

Material examined.—California: Arroyo Seco Ranger Station, San Luis Obispo County, July 1, 1948, Wirth, 3 ♂♂ (type, 2 paratypes), 1 ♀ (allotype); Pollack Pines, Eldorado County, July 7, 1948, Wirth, 1 ♂; Snowline Camp, Eldorado County, July 8, 1948, Wirth, 1 ♂.

Florida: Gainesville, Alachua County, June 2, 1950, Bidlingmayer 1 ♂, 1 ♀; Grayton Beach, Walton County, May 10, 1949, Butler, 1 ♀

14. *Stilobezzia (Stilobezzia) punctipes*, new species

FIGURE 11, *d*

Diagnostic characters.—A large, yellowish species with brown thorax and brown-punctate legs; abdomen with narrow segmental dark bands; wings with two small black spots.

Description.—FEMALE: Length 2.4 mm., wing 1.9 mm. by 0.9 mm. Head pruinose brown; antennae yellow, apices of segments 3 to 10 and all of last five segments brown; palpi black. Flagellar segments in proportion of 28:18:18:18:18:18:20:20:38:38:40:40:55, last segment with very slender pointed tip. Papal segments in proportion of 5:10:16:8:20, third segment slightly swollen with a small, round, subapical pit.

Thorax pruinose brown, margins of mesonotum, broad center of scutellum, and upper half of pleura yellow. Mesonotum with irregular, silvery pruinose patches, a few long, brown bristles; scutellum with four long, marginal bristles. Coxae and trochanters dark brown, rest of legs yellow; fore femur with broad sub-basal, midfemur with narrow basal, and hind femur with narrow apical brown bands; all tibiae narrowly brown at apices; rows of small, round, brown punctations at bases of hairs on all femora and tibiae, these hairs long and dark on hind tibia. Proportions of segments of hind leg as in table 1; basitarsus with three black ventral spines on forelegs, two on midlegs and one at base on hind legs; fifth tarsal segment without batonnets; claws slender and unequal, the longer claw as long as fifth segment, the other two-thirds as long.

Wing hyaline, anterior veins yellowish; a brown spot over r-m crossvein and a very small one over vein R_{2+3} ; macrotrichiae absent. First radial cell large, one-fourth as long as second, latter to 0.8 wing length; petiole of media as long as r-m crossvein. Halteres brown.

Abdomen dull, pruinose yellowish, tergites with irregular brown bands in middle of segments, pleura dark. Spermathecae three, the two larger subequal and oval with short, sclerotized ducts, the third about two-thirds as large and subspherical, without sclerotized duct.

MALE: Similar to the female but with the usual sexual differences; plumes of antennae golden brown. Ninth sternite a very narrow band, the posterior membrane spiculate; ninth tergite rounded, with small, submedian, setigerous lobes at apex. Basistyle simple, twice as long as broad; dististyle as long as basistyle and rather stout to apex, slightly bent on distal third. Aedeagus with an oblique pair of heavy twice-sinuate sclerites with apices snoutlike and crossing each other mesad. Parameres very slender, the lateral apodemes evenly curved and slender, stems nearly straight with bases slightly enlarged, gradually tapered to sharp, hooked tips abruptly bent ventrocephalad at two-thirds total length.

Types.—USNM 60966, holotype, ♀, Crystal River, Citrus County, Fla., June 7, 1949, Hudson, light trap; allotype, same data except date, Oct. 6, 1949. Paratypes: Florida: 11 ♂♂, 23 ♀♀, same data as type except dates, May-October 1949-50; 1 ♂, 3 ♀♀, Leesburg, Lake County, Aug. 7, 1949, Braddock; México: 4 ♀♀, Ciudad Monte, Tamaulipas, Nov. 22, 1943, Brookman.

Most closely related to the Neotropical species *S. (S.) punctulata* Lane, 1947, and *S. (S.) kiefferi* Lane, 1947, which it resembles in its spotted wings and punctate legs. Both related species, however, have the abdomen reddish, the former species differing in having three dark wing spots, the third over tip of second radial cell, while the second species has the first radial cell half as long as the second, yellowish coxae, whitish halteres, and the fore femur and midfemur lack the basal dark bands.

15. *Stilobezzia (Stilobezzia) rabelloi* Lane, 1947

FIGURE 11, a

Stilobezzia rabelloi Lane, Rev. Ent., vol. 18, p. 203, 1947 (♂, ♀; Brazil).

Diagnostic characters.—A large, brown species with irregular, silvery, pruinose markings; wing brownish, infuscated with three darker and one lighter spots on anterior margin; body hairs dense and strong; fifth tarsal segment with 3 or 4 pairs of ventral batonnets.

Description.—FEMALE. Length 3.0 mm., wing 2.2 mm. by 0.8 mm. Head pruinose brown, narrow bases of flagellar segments yellow, palpi black. Antenna with flagellar segments in proportion of 22:15:15:15:18:20:24:24:40:42:50:?:? (last two segments broken, not measured). Palpal segments in proportion of 8:15:25:15:20, third segment slightly swollen, densely set with strong hairs, a small, round pit near apex.

Mesonotum with strong, conical, anterior spine, the sides sloping, flattened only in prescutellar area; color dark brown with irregular silvery pruinose markings, usually three sublateral pairs of small, rounded, polished spots on disc; humeral corners yellowish; a few long, brown hairs in row. Scutellum brown, yellowish in middle, with 4 or 5 long, brown, marginal bristles. Postscutellum and pleura dark, pollinose brown. Legs including coxae dark brown; fore femur and midfemur with narrow sub-basal and subapical and broad median yellowish bands; hind femur with narrow, light band at apex; fore tibia and midtibia with narrow sub-basal and broad median yellowish bands; first four tarsal segments yellowish. Proportions of segments of hind leg as in table 1; leg hairs strong and spinose, especially long on hind tibia; basitarsus with strong black basal and apical spines, a third spine in middle on forelegs; fifth segment with 3 or 4 pairs of ventral batonnets; claws very slender and unequal, the longer claw as long as fifth segment, the other a third as long.

Wing brownish hyaline, extensively infuscated along the veins; three dark brown spots, first over r-m crossvein, second over vein R_{2+3} , and the third over distal third of second radial cell and extending halfway through cell R_5 at same level; a light area just beyond tip

of costa as large as third brown spot, the apex of the wing beyond lightly infuscated. First radial cell nearly half as long as second, the latter ending at about 0.7 wing length; petiole of media about as long as first radial cell. Halteres brown except at extreme bases of stems.

Abdomen dark brown, tergites with narrow, apical, segmental, silvery pruinose bands; vestiture very dense, consisting of long, stout, brown hairs. Spermathecae two, ovoid, subequal, with ducts sclerotized a short distance, and a rudimentary third present.

MALE: Similar to the female but with the usual sexual differences; plumes of antennae brown. Ninth sternite about three times as broad as long, with shallow, mesal, posterior excavation, and the membrane bare; ninth tergite short and rounded with very short, setigerous, apicolateral lobes. Basistyles simple, very long, slender and tapered to tips, about three times as long as broad; dististyles about 0.8 as long as basistyles, slightly incurved, slender, with pointed apices. Aedeagus with an oblique pair of double-sinuate sclerites with mesal tips snoutlike. Parameres strongly sclerotized with broad, winglike, lateral apodemes at bases, a lateral pair of L-shaped or boomerang-shaped lateral plates with blunt apices directed latero-caudad, and a submedian pair of nearly straight processes of same thickness, but about twice as long, with pointed apices.

Type.—In collection University of São Paulo, Brazil, ♂, Brazil, Rio de Janeiro, Estrada Rio-São Paulo, km. 47.

Material examined.—Georgia: Thomasville, May 15–30, 1949, Palmer, 1 ♀.

Florida: Leesburg, Lake County, Aug. 7, 1949, Braddock, 2 ♀♀; Panama City Beach, May 6, 1949, McElvey, 3 ♂♂, 1 ♀; Santa Rosa Island, Escambia County, June 7, 1949, Butler, 1 ♂, 1 ♀.

Louisiana: New Orleans, May 27, 1947, Van Beeck, 6 ♂♂.

Honduras: La Ceiba, Aug. 6, 1916, Dyer, 1 ♂.

Surinam: Moengó, Nov. 10, 1947, Stage, 1 ♀.

Remarks.—Closely related to *S. (S.) beckae*, new species, which it resembles closely in the brown mesonotum with silvery pruinosity and strong anterior spinose tubercle and brownish infuscated and spotted wings, but *beckae* differs in lacking the third dark spot at apex of first radial cell and the ventral batonnets on fifth tarsal segment, and the body hairs are not nearly so well developed.

16. *Stilobezzia (Stilobezzia) sybleae*, new species

FIGURE 12, c

Diagnostic characters.—A small, shining, brown species with dusky, yellow legs; wing hyaline with a prominent beadlike swelling of vein R_{4+5} near apex of second radial cell; hind tarsi with fifth segment and claws greatly reduced.

Description.—FEMALE: Length 1.5 mm., wing 1.3 mm. by 0.5 mm. Head shining brown, clypeus and antennal pedicel yellowish, antennal flagellum and palpi dusky. Thorax polished brown, mesonotum with sparse black hairs in rows; scutellum with four marginal hairs. Pleura, coxae, midfemur, hind femur, and tibiae dusky, yellowish brown; all of forelegs, midtarsus, and hind tarsus lighter yellowish. Proportions of segments of hind leg as in table 1; basitarsi unspined; fifth segment with a pair of black ventral batonnets near base; claws slender and unequal, normal on forelegs and midlegs with outer claw as long as fifth segment, the inner a third as long, on hind legs with fifth segment half as long and claws only a fourth as long as on forelegs and midlegs.

Wings grayish hyaline, without macrotrichiae, anterior veins brownish yellow. First radial cell a fourth as long as second, latter to five-eighths wing length; vein R_{4+5} on distal half of second radial cell with an oval beadlike swelling; crossvein r-m short, petiole of media about three times as long as crossvein. Halteres brown. Abdomen shining brown, very convex dorsally and somewhat petiolate at base.

MALE: Ninth sternite a slender anterior band, the posterior membrane spiculate; ninth tergite rounded, the apicolateral lobes reduced. Basistyle broad, with a large triangular, flattened, sclerotized lobe about midway of mesal margin; dististyle nearly as long as basistyle, incurved, gradually tapered to slender apex. Aedeagus with a pair of slightly oblique, long, very slender, sclerotized bars. Parameres with basal knoblike apodemes fused with anteromesal margins of inner lobes of basistyles, with slender, long, curved, sicklelike posterior blades.

Types.—USNM 60967, holotype, ♀, and allotype, Falls Church, Virginia, July 4, 1950, Wirth.

Remarks.—This species is very similar to *S. (S.) antennalis* (Coquillett), but the highly modified posterior branch of the radius and hind fifth tarsal segment and claws are quite distinctive. The West African species *S. limnophila* Ingram and Macfie, 1922, is very similar in coloration and in the structure of the male genitalia, but since the female is unknown, the wing and tarsal features cannot be compared with those of *sybleae*. *Parabezzia poikiloptera* Ingram and Macfie, 1922, from West Africa, which is a *Stilobezzia* of the subgenus *Eukraiohelea*, has a remarkable thickening of the radius almost exactly like that of *sybleae*, indicating that this character is not just an aberration. This species is named for my wife, Syble Austin Wirth.

17. *Stilobezzia (Stilobezzia) thomsenae*, new species

FIGURE 12, a

Diagnostic characters.—Very closely related to, and almost indistinguishable from, *bulla* Thomsen, except for the very characteristic male genitalia.

Description.—FEMALE: Length 1.0 mm.; wing 0.8 mm. by 0.4 mm. Apparently somewhat darker brown than *bullae*, the mesonotum and scutellum concolorous; femora brownish. Otherwise as in *bullae*.

MALE: Genitalia broader than long, parts very broad and stout. Ninth sternite a narrow, anterior band, posterior membrane spiculate; ninth tergite rounded, with a submedian pair of fingerlike setose lobes about twice as long as broad. Basistyles simple, about twice as long as broad, set far apart, no inner lobes; dististyles short and stout, two-thirds as long as basistyle, with abruptly narrowed, pointed, clawlike apices. Aedeagus with anterior arms vestigial, the dorsal median sclerite a crescent-shaped, transverse bar connecting distoventral angles of basistyles. Parameres stout, with broad, lateral, winglike, basal apodemes, stems slightly knobbed at bases, stout and slightly out-curved toward apices, which are slightly flattened, expanded, rounded, and bent ventrad.

Type.—USNM 60968, holotype, ♂, Everglades City, Collier County, Fla., Feb. 7, 1950, Davidson, light trap.

Remarks.—One female from Crystal River, Citrus County, Fla., Sept. 18, 1950, Hudson, is provisionally referred to *S. (S.) thomsenae*, since it resembles the male in coloration, although it may prove to be a dark specimen of *S. (S.) bullae*. This species is named in honor of Dr. Lillian Thomsen, who has contributed much to the study of North American Heleidae.

18. *Stilobezzia (Stilobezzia) viridis* (Coquillett), 1901

FIGURE 12, *d*

Ceratopogon viridis Coquillett, Proc. U. S. Nat. Mus., vol. 23, p. 607, 1901 (♀, New Jersey).

Ceratolophus viridis, Kieffer, Genera insectorum, fasc. 42, p. 61, 1906.

Johannseniella viridis, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 227, 1914.

Hartomyia viridis, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 342, 1915.

Stilobezzia viridis, Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.

Description.—FEMALE: Length 2.0 mm., wing 1.9 mm. by 0.6 mm. A bright, pale-green species; antennae and legs yellow, apex of antenna dark; distal fourth of hind femur and narrow apex of hind tibia black; abdomen with a black band across distal half of third tergite and a pair of large black spots on fifth tergite. Wings brownish hyaline, anterior veins infuscated. Proportions of segments of hind leg as in table 1; basitarsi without spines; fifth segment with a pair of long, black batonnets at basal fourth; claws slender and very unequal, the longer as long as fifth segment, the other about half as long.

MALE: As in the female but with the usual sexual differences,

plumes of antennae dark. Genitalia very large and bulbous. Ninth sternite reduced, the posterior membrane spiculate; ninth tergite large, convex, apex rounded with low, rounded, setigerous, apicolateral lobes. Basistyle short and very broad, nearly as broad as long; dististyle about 1.2 times as long as basistyle, extreme base bulbous, distal portion very slender, irregularly bent inward, with blunt apex slightly bent outward. Aedeagus with a pair of slender, nearly straight, barlike sclerites. Parameres with reduced basal sclerotization, stems slender and slightly crooked, apices greatly expanded in a rounded lobe.

Type.—USNM 5483, ♀, New Jersey, Riverton.

Material examined.—New Jersey: Riverton, June 16, Johnson (type).

Maryland: Cabin John, May 26, 1943, Cortes and Townes, 2 ♂♂; Glen Echo, June 30, 1929, Bridwell, 1 ♂.

Florida: Leesburg, Lake County, Aug. 7, 1949, Braddock, 1 ♀.

Texas: Kirbyville, May 20, 1908, Tucker, 1 ♂.

Remarks.—*S. glauca* Macfie from Brazil and the southeastern United States is closely related to *viridis*, but has the antennae and wings infuscated, the mesonotum dark, and lacks the apical black markings on the hind femur.

References

GOETGHEBUER, M.

1934. Heleidae (Ceratopogonidae). In Lindner, Die Fliegen der Palarktischen Region, Lief. 78, pp. 49-94.

JOHANNSEN, O. A.

1934. New species of North American Ceratopogonidae and Chironomidae. Journ. New York Ent. Soc., vol. 42, pp. 343-353.

1943a. Two new species of American Ceratopogonidae (Diptera). Ann. Ent. Soc. Amer., vol. 36, pp. 761-762.

1943b. A generic synopsis of the Ceratopogonidae (Heleidae) of the Americas, a bibliography, and a list of the North American species. Ann. Ent. Soc. Amer., vol. 36, pp. 763-791.

1946. Some new species of Nemocerous Diptera from Guam. Bull. Bishop Mus., No. 189, pp. 189-193.

LANE, J.

1947. Espécies Brasileiras de *Stilobezzia* (Dipt., Ceratopogonidae) e *Zygoneura stonei* nov. nom. (Dipt., Mycetophilidae). Rev. Ent., vol. 18, pp. 197-214, 9 figs.

MACFIE, J. W. S.

1935. Ceratopogonidae (Dipt.) from the river Amazon. Stylops, vol. 4, pp. 49-56, 2 figs.

MEILLON, B. DE

1938. Notes on African Ceratopogonidae (Diptera). Proc. Ent. Soc. London, ser. B, vol 7, pp. 266-270.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3317

BEETLES OF THE OEDEMERID GENUS *VASACES*
CHAMPION

By ROSS H. ARNETT, Jr.¹

Champion (1889) described the genus *Vasaces* for three species from Central America. One species, *Vasaces aeneipennis*, was described from material from México, and the other two, *Vasaces sordidus* and *Vasaces costatus*, were described from Guatemala.

Since the completion of my revision of the Nearctic Oedemeridae (Amer. Midl. Nat., vol. 45, pp. 257-391, 1951), I have seen several specimens of *Vasaces* collected by J. N. Knull in Arizona and Texas. This genus has not previously been recorded from North America, north of México. In addition, a few specimens from Central America, in the collections of the U. S. National Museum and the Museum of Comparative Zoology, have been available to me for study.

The present paper, based on all available material, with the exception of the Champion type specimens, adds four new species to the genus. A key to the species is included, and the position of the genus in relation to other oedemerid genera is discussed.

I wish to thank Mr. J. N. Knull, Ohio State University, and Dr. P. J. Darlington, Museum of Comparative Zoology, for the loan of material used in this study.

¹Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Genus *Vasaces* Champion, 1889

Vasaces Champion, *Biologia Centrali-Americana*, Coleoptera, vol. 4, pt. 2., p. 111, 1889 [no included species] and p. 128, pl. 6, figs. 7 and 7, a-c, 1890 [first included species].—Arnett, *Journ. Washington Acad. Sci.*, vol. 40, p. 225, 1950. (Genotype, *Vasaces aeneipennis* Champion, 1890; designated by Arnett, 1950.)

This genus belongs in the subfamily Oedemerinae as treated in my paper on the Nearctic species. The apical segment of the maxillary palpus is triangular or cultriform and the fore tibia has two apical spurs. It is tentatively placed in the tribe Asclerini, as I have previously defined it. However, studies of certain other genera have led me to revise somewhat my views on the oedemerid tribes, and when more groups have been restudied some rearrangement may be necessary. *Vasaces* Champion will key to couplet 7 of my key to the genera of Asclerini. The slightly emarginate eyes separate it from *Heliocis* Arnett, and the triangular or cultriform apical segment of the maxillary palpus will separate it from the genus *Sisenes* Champion. In *Sisenes* Champion the apical segment of the maxillary palpus is small, hardly triangular. In addition, many *Sisenes* species resemble lycids and have the antennal segments somewhat flattened, a condition which is not found in *Vasaces*. In the key to the male genitalia, this genus runs to couplet 3, where it may be separated from the genera *Eumecomera* Arnett and *Sisenes* on the basis of the structure of the ninth abdominal sternite. In *Vasaces* the apical portion of the ninth sternite of both *Eumecomera* and *Sisenes* consists of two separate rods united only by thin membrane. The ninth sternite of *Vasaces* resembles somewhat that of *Heliocis* except that the base is two distinct rods instead of the Y-shaped piece found in *Heliocis*.

It appears that the genus *Sisenes* is a close relative of *Vasaces*, both on characters of external morphology and those of the male genitalia. However, in the studied forms, the two genera can be adequately separated using the characters mentioned above. In gross appearance, the two genera are very distinct. The species of *Vasaces* are for the most part dark, somewhat metallic, elongate beetles, quite different from the brilliantly colored, lycidlike species of *Sisenes*.

Generic diagnosis.—Head moderate or elongate, usually constricted behind the eyes. Eyes somewhat emarginate, large. Antenna slender, 11-segmented, inserted between the eye and the base of the mandible, distinctly separated from the margin of the eye and the base of the mandible. Second segment of the antenna large, over one-half the length of the fourth and sometimes nearly the length of

the third. Both mandibles with the apex of each bifid. Apical segment of the maxillary palpus large, triangular or cultriform, widest at the base or near the center. Thorax slightly longer than broad, usually only slightly expanded apically and only slightly constricted at the base. Legs slender, claws simple; all tarsi with only the penultimate segment of each spongy beneath. Elytra distinctly costate, sometimes markedly so.

MALE GENITALIA: Median lobe short, base wider, without processes, tapering towards apex, without apical enlargements. Paramere a troughlike plate, wide basally, without basal processes, narrowed toward apex; apex V-shaped, emarginate; tegminate large, spatulate. Ninth abdominal sternite hood-shaped, with two basal tails; apex expanded, with basally projecting lateral flanges. Ninth tergite two parallel rods, apically expanded and united by membrane. Eighth abdominal sternite and tergite each bilobed, the sternite larger. Setae present on the apical lobes of the eighth abdominal segment.

Biology.—Unknown.

Distribution.—Known only from Central America and the extreme southwestern part of the United States.

Key to the species of Vasaces

1. Apical segment of the maxillary palpus cultriform (fig. 13,g), its outer edge sinuate.....2
- Apical segment of the maxillary palpus triangular (fig. 13,h).....4
2. Costae, suture, and margins of elytra fusco-piceous, intervals pale; antennae uniformly dark except for small pale areas at the joints; legs dark, slightly paler at joints.....**linearis**, new species
- Elytra with uniform coloration.....3
3. Elytra uniformly brassy.....**costatus** Champion
- Elytra dark.....**knilli**, new species
4. Pale testaceous; elytra with costae and suture each with an indistinct, interrupted row of fine, oblong streaks on either side.....**sordidus** Champion
- Dark species, otherwise marked.....5
5. Pronotum orange with black maculations, head short...**maculatus**, new species
- Pronotum dark, head elongate.....6
6. Pronotum with sides nearly parallel.....**elongatus**, new species
- Pronotum distinctly sinuate laterally.....**acnipennis**, Champion

***Vasaces linearis*, new species**

FIGURE 13, c, e-g, j-l, m, n

Diagnostic characters.—The light brassy color, with the dark brown, prominent elytral costae, readily differentiates this species from the others. It is most closely related to *V. costatus* since the shape of the apical segment of the maxillary palpus is similar.

Description.—(Based on male holotype.) Antenna long, nearly as long as the body, second segment subequal to the third. Apical segment of the maxillary palpus large, distinctly cultriform, outer margin arcuate. Vertex of head transversely elevated between the eyes, and with a slight median groove from the base of the antenna to the summit of the vertex. Pronotum somewhat longer than broad, widest near anterior margin, slightly narrower at base, surface irregular, laterally with slight elevations, median line somewhat impressed, and with a slight V-shaped elevation on anterior half. Elytron long and narrow, with four prominent costae and the suture and margin prominently elevated, and a short, basal, spurious costa uniting with the inner margin.

Entire insect clothed with fine, short, sparse, whitish hairs. Color: in general pale brassy; head with a darker area on front; mouthparts, except for maxillary palpi, paler. Antennae and maxillary palpi dark. Thorax dark except for irregular paler areas near base and apex. Elytra uniformly pale brassy except for dark brown costae, suture, and margins. Ventral surface and legs dark. Surface irregularly rugose-punctate. Length: 8 mm.

MALE GENITALIA: Described in the generic diagnosis. The seventh sternite has a slight angular emargination which is probably a secondary sexual character.

Type.—Holotype, male, Ohio State Univ. coll., Arizona, Huachuca Mountains, Cochise County, June 9, 1935, J. N. Knull.

Distribution.—Known only from this single male type specimen from Arizona.

Vasaces costatus Champion, 1890

Vasaces costatus Champion, *Biologia Centrali-Americana*, Coleoptera, vol. 4, pt. 2, p. 129, pl. 6, fig. 8, 1890.

This species is also known only from one male, the type, from Guatemala, at Cerro Zunil (4,000 feet), collected by Champion, and is in the British Museum (Natural History). It is much smaller than the genotype, but a little larger (9.5 mm.) than the preceding species. The elytra are uniformly brassy in color, lacking the dark brown costal, sutural, and marginal markings. The seventh sternite of the male is deeply emarginate.

Vasaces knulli, new species

FIGURE 13, b

Diagnostic characters.—The small size, dark color, and lack of brassy tints serve to separate this species from the other two having the apical segment of the maxillary palpus cultriform. It is most closely allied to *V. costatus*.

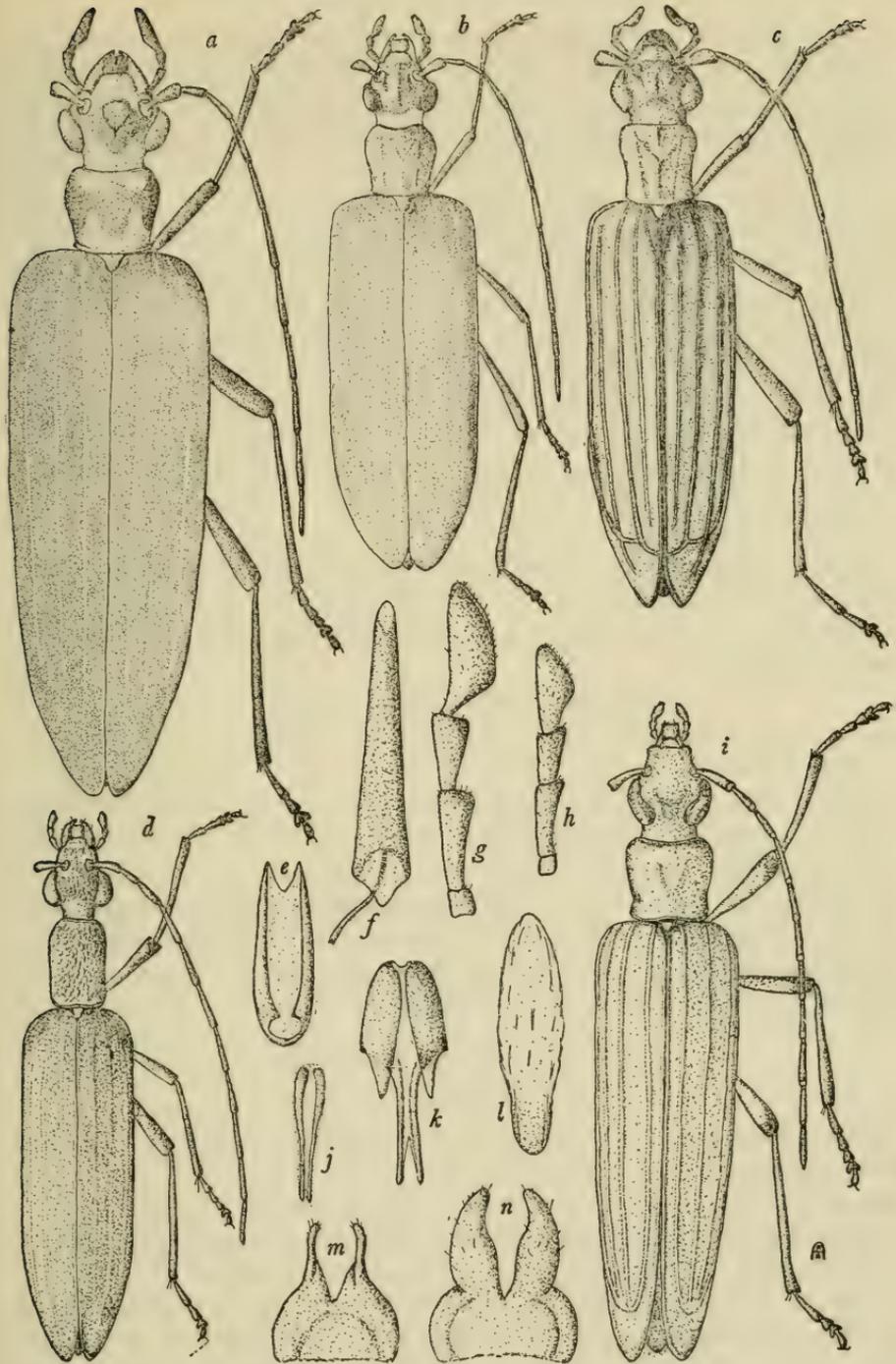


FIGURE 13.—Adults and male genitalia of the genus *Vasaces*: *a*, *Vasaces maculatus*, new species, ♀; *b*, *V. knullii*, new species, ♀; *c*, *V. linearis*, new species, ♂; *d*, *V. elongatus*, new species, ♀, *e*, *f*, ♂ genitalia, *V. linearis*, new species; *e*, paramere; *f*, median lobe; *g*, *h*, maxillary palpi; *g*, *V. linearis*, new species, ♂; *h*, *V. elongatus*, new species, ♀; *i*, *V. aeneipennis* Champion, ♀; *j*–*n*, *V. linearis*, new species, ♂; *j*, ninth tergite; *k*, ninth sternite; *l*, tegminite; *m*, eighth tergite; *n*, eighth sternite.

Description.—(Based on female holotype.) Antennae short, not extending over two-thirds the length of the elytra, second and third segments equal in length, each about three-fourths the length of the fourth segment. Apical segment of the maxillary palpus large, cultriform, outer edge slightly arcuate. Head shorter than that of the other species; front with a slight depression near the bases of the antennae on the inner side; a moderately deeply impressed median line on the front. Pronotum with surface very irregular and with a moderately prominent V-shaped ridge on the anterior half and an interrupted lateral ridge on each side; longer than broad, widest anteriorly just beyond the middle, constricted behind. Elytra narrow, long; costae present but obscure. Surface covered with fine, short, sparse, whitish hairs. Color: dark, mouthparts, underside of head, neck, coxae, bases of femora, tarsi at joints, and small area at joints of the segments of the antennae paler. Surface finely rugose-punctate. Length: 7 mm.

Type.—Holotype, female, Ohio State Univ. coll., Arizona, Huachuca Mountains, Cochise County, June 9, 1935, J. N. Knull.

Distribution.—This species is known only from the type, which is from Arizona.

***Vasaces sordidus*, Champion, 1890**

Vasaces sordidus Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 2, p. 129, 1890.

This species is known from one female only, the type, from Capetillo, Guatemala, collected also by Champion, which is in the British Museum (Natural History). It is smaller than the preceding species (8.5 mm.); the apical segment of the maxillary palpus is smaller, and triangular instead of cultriform. The color is pale testaceous. The costae and suture are conspicuous, and each has an indistinct, interrupted row of fine oblong streaks on either side.

***Vasaces maculatus*, new species**

FIGURE 13, a

Diagnostic characters.—The dark orange pronotum with a median and two lateral spots is unique among the species of this genus. It is the largest known species in the genus and is most closely related to *V. sordidus* but has the orange markings which are lacking in that species.

Description.—(Based on female holotype.) Antennae short, reaching to about two-thirds the length of the elytra, second segment short, about two-thirds as long as the third. Apical segment of the maxillary palpus large, elongate triangular, widest near basal third, outer margin straight. Front of head irregular, with a circular depression extending from the inner side of the base of the antenna basad about half the distance to the pronotum. Pronotum quadrate, widest

anteriorly, only slightly constricted posteriorly, surface irregular but without prominent ridges or depressions except for a slight depression on either side near the anterior lateral angle. Elytra long, narrower apically, about twice as broad as thorax; costae present, flat, not prominent.

Entire insect clothed with very fine, short, sparse, golden hairs. Surface finely rugose-punctate. Head with punctures larger, more distinct, with a stouter recumbent hair arising near each. Color: Head orange, with a large dark spot on front; antennae and palpi dark; thorax orange except for a large central dark spot which connects with two large lateral spots; legs with coxae and bases of femora pale, remainder dark; abdomen and elytra uniformly dark. Length: 10 mm.; of paratype, 11 mm.

Types.—Holotype, female, USNM [61112, Arizona, Chiricahua Mountains, June 8. Hubbard and Schwarz. Paratype, female, same data as type except date, June 11.

The paratype agrees with the type except that the black markings of the thorax are less extensive.

Distribution.—Known only from the two type specimens from Arizona.

Vasaces elongatus, new species

FIGURE 13, *d, h*

Diagnostic characters.—The uniform dark color, elongate head and thorax, and parallel sides of the pronotum are characteristic of this species. It is very different in general habitus from the other members of this genus, but is probably most closely related to *V. aeneipennis*.

Description.—Head elongate, over twice as long as wide at bases of antennae, hardly constricted behind the eyes. Antennae reaching beyond apical third of elytra, apical segment of the maxillary palpus triangular, widest at middle, outer edge straight. Front of head smooth, without elevations or depressions. Pronotum longer than broad (7:4), surface irregular but without distinct ridges or depressions, sides only slightly sinuate. Elytra broad, twice the width of the thorax, tapering behind. Legs long and slender, costae distinct, flat.

Entire insect clothed with short, fine, white hairs, those of the head and thorax sparser, but longer and coarser than those of the rest of the body. Surface of head smooth and shiny with large distinct punctures which are sparser on the vertex; thorax coarsely rugose; remainder of body finely rugose. Color: dark fuscous; neck, under surface of head, mouthparts, and coxae paler. Length: 8 mm.

Type.—Holotype, female, Ohio State Univ. coll., Texas, Chisos Mountains, Brewster County, June 9, 1939, D. J. and J. N. Knull.

Distribution.—Known only from the female type.

Vasaces aeneipennis ChampionFIGURE 13, *i*

Vasaces aenipennis Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 2, p. 128, 1890.

This is apparently the least rare of the species in this genus and is one of the largest of the known species. The triangular apical segment of the maxillary palpus, the elongate head, and the uniform brassy color distinguish it from the other species.

Champion described this species from two specimens (a male and a female) from Totosinapan, México, in the Sallé collection (location unknown). The U. S. National Museum collection contains two females from Guatemala, and the Museum of Comparative Zoology has one female from Honduras. A detailed description of one female from Guatemala follows:

Description.—(Based on female, from Guatemala). Head elongate, about twice as long as wide at bases of antennae. Antennae long, reaching nearly to apical third of the elytra, second segment about two-thirds the length of the third. Apical segment of the maxillary palpus triangular, widest at middle, outer edge straight. Dorsal surface of head irregular, but without distinct ridges or depressions. Pronotum nearly quadrate, widest anteriorly, sides distinctly sinuate, surface irregular. Elytra long and narrow, tapering at apex; costae distinct, flat, both edges of costae outlined by a very fine, irregular, impressed line, somewhat darker in color, giving in gross appearance the impression that the costae are double.

Surface clothed with extremely fine, very short, sparse, golden hairs which are somewhat larger on the thorax and dorsal surface of the head. Surface rugose, that of the thorax and head indistinctly rugose-punctate. Color: uniformly brassy, dorsal surface of the head and ventral surface of the thorax and abdomen darker. Length: 15 mm.

Variation: The surface of the head and thorax varies from rugose-punctate to shiny smooth with sparse punctures. The length varies from 10 to 16 mm. The color is darker in some specimens than in others.

Distribution.—Known only from the types from México and the above-mentioned specimens from Guatemala and Honduras (Rosario San Juancito).

Material examined.—Female, USNM coll., Guatemala, Santa María, W. Schaus.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1953

No. 3318

SCARABAEID BEETLES OF THE GENUS *BRADYCINETULUS*
AND CLOSELY RELATED GENERA IN THE UNITED STATES

By O. L. CARTWRIGHT

The group of beetles reviewed in this paper have long been known under the name *Bolboceras*. The species found in the United States were last revised by Charles Schaeffer, 1906 (Trans. Amer. Ent. Soc., vol. 32, pp. 249-254). At that time five species were placed in Horn's genus *Bradycinetus*, later incorrectly synonymized under *Bolboceras* (see synonymy under *Bradycinetulus*), and three were assigned to *Bolboceras*. Of these three, *Scarabaeus lazarus* Fabricius had been placed in *Eucanthus* by Westwood, 1848 (Proc. Linn. Soc. London, vol. 1, p. 387), and *Bradycinetus hornii* Rivers and *B. minor* Linell were later removed to *Kolbeus* by Chapin (see synonymy under *Bolbelasmus*).

With the exception of the species *Eucanthus* and *Bolbocerosoma*, here considered correctly placed in recent usage, all of the United States species listed by Schaeffer have been reexamined in this study and reassigned to genera as required by the literature on the group. Also included in this paper are the one species described since Schaeffer's time, *Bolboceras angulus* Robinson; a Mexican species discovered in the United States; another which may eventually be found inside our borders; and four new United States species. Two new genera are proposed. A key, based in part on that by Boucomont, is presented for the genera of the Bolboceratini found in the United States. The genera *Kolbeus*, *Bolbelasmus*, *Bradycinetulus*, and the two new genera *Bolbocerastes* and *Bolborhombus* are discussed, synonymy listed, and a key to the species given. Pertinent references, the type locality and location of the type, and notes on distribution follow for each species. Distribution is also shown on the maps, figures 15 and 16. The genus

Bolbocerosoma, revised by Dawson and McColloch, 1924 (Canadian Ent., vol. 56, pp. 9-15), is not included, nor is the true *Bolboceras*, which was revised under the name *Odontaeus* by J. B. Wallis, 1928 (Canadian Ent., vol. 60, pp. 119-128, 151-156, 168-176).

The number of specimens available for study was greatly increased by material borrowed from museum and private collections. I am grateful for the opportunity to study these added specimens and thank the following who loaned museum specimens: R. H. Beamer, Snow Museum, University of Kansas (KAN); E. C. Becker, Canadian Department of Agriculture (CDA); M. A. Cazier, American Museum of Natural History (AMNH); P. J. Darlington, Museum of Comparative Zoology (MCZ); Henry Dietrich, Cornell University (CU); T. H. Hubbell, University of Michigan (MICH); P. D. Hurd, University of California (CAL); J. N. Knull, Ohio State University (OSU); Hugh B. Leech, California Academy of Sciences (CAS); L. M. Martin, Los Angeles County Museum (LAC); H. J. Reinhard, A. & M. College of Texas (TEX); V. D. Roth, Oregon State College (ORE); M. W. Sanderson, Illinois Natural History Survey (INHS); and G. E. Wallace, Carnegie Museum, Pittsburgh (CARN). My thanks are extended also to those who loaned specimens from their private collections: R. H. Arnett, D. K. Duncan, C. A. Frost, P. C. Grassman, Henry Howden, A. T. McClay, G. H. Nelson, F. H. Parker, Mark Robinson, E. C. VanDyke, and F. G. Werner. I am especially grateful to Henry Howden who examined my types, compared specimens with them and later furnished those records marked with an asterisk. The few records of the eastern *Bradycinetulus ferrugineus* (Palisot de Beauvois) taken from the literature are marked with a double asterisk. Florida records from the literature are from Blatchley (Florida Ent., vol. 12, p. 29, 1925), Alabama records from Löding (Geol. Surv. Alabama Monogr. 11, p. 101, 1945), and North Carolina records from Brimley (The insects of North Carolina, p. 201, 1938).

All other distribution records were copied from labels attached to specimens I examined.

Key to the genera of Bolboceratini

- | | |
|--|---|
| 1. Eye entirely divided by ocular canthus..... | 2 |
| Eye not completely divided by ocular canthus..... | 3 |
| 2. Middle coxae narrowly separated; the intercoxal process with a vertical tooth-like elevation in front of the coxae; species usually bicolored... Bolbocerosoma | |
| The intercoxal process without toothlike elevation; species not bicolored; males usually with long cephalic horn..... Bolboceras ¹ | |
| 3. Middle coxae subcontiguous; metasternum linear between the coxae..... | 4 |
| Middle coxae separated by the anterior lobe of the metasternal plate, which is never linear between the coxae..... | 5 |

¹ *Odontaeus* is a synonym. See Introduction and also discussion under *Bradycinetulus*.

4. Elytra with 5 discal striae..... **Eucanthus**
 Elytra with 7 discal striae..... **Bolbelasmus**
5. Base of elytra margined, metasternal plate pyriform in outline, pronotum without postapical carina, first elytral stria interrupted by scutellum.... 6
 Base of elytra not margined, metasternal plate rhomboid in outline, pronotum with postapical carina, first two elytral striae interrupted by scutellum.
Bolborhombus, new genus
6. Apex of tibia of middle and hind legs deeply emarginate on outer side, the angle adjacent to spurs appearing almost as a fixed spur; without prosternal spine..... **Bradycinetulus**
 Apex of tibia of middle and hind legs obliquely truncate; prosternal spine behind anterior coxae transverse, doubly pointed, and remote from acutely angled intercoxal piece..... **Bolbocerastes**, new genus

Genus *Bolbelasmus* Boucomont, 1911

Bolbelasmus Boucomont, Ann. Soc. Ent. France, vol. 79 (1910), p. 335, 1911.

Kolbeus Boucomont, Ann. Soc. Ent. France, vol. 79 (1910), p. 335, 1911.—Chapin, Proc. Biol. Soc. Washington, vol. 59, p. 79, 1946.

Chapin, 1946, placed *Bradycinetus hornii* Rivers and *B. minor* Linell in the genus *Kolbeus*, basing his action on their close relationship to *Kolbeus arcuatus* (Bates). Examination of specimens of these species in comparison with *Bolbelasmus gallicus* (Mulsant) and *B. unicorne* (Shrank), and in the light of Boucomont's key to the genera, places *B. minor* Linell and *B. hornii* Rivers in *Bolbelasmus* rather than in *Kolbeus*.

The genus *Kolbeus* was erected without a genotype by Boucomont, 1911, for the species *Bolboceras arcuatus* Bates and *B. coreanus* Kolbe. Lucas, 1920 (Catalogus . . . Coleopterorum, p. 356), selected *B. coreanus* Kolbe, a species found in Korea and China, as the genotype. The species *B. arcuatus* Bates almost exactly duplicates *Bolbelasmus minor* (Linell) except for the slightly narrower scutellum and lack of a marginal line over the middle half of the base of the pronotum. Since a direct comparison of specimens shows such minor differences, I transfer *arcuatus* Bates to the genus *Bolbelasmus*. Whether the genus *Kolbeus* should be synonymized with *Bolbelasmus* will depend upon an examination of its genotype, a species not available for study at present. Further basis for placing *arcuatus* in *Bolbelasmus* is found in similarity of the aedeagi (see fig. 14).

Genotype.—*Scarabaeus gallicus* Mulsant, Histoire naturelle des Coléoptères de France, Lamellicornes, p. 350, 1842. (Present designation.)

Key to the species of *Bolbelasmus*

1. Base of pronotum not margined over middle half; length 7 to 9 mm. (California, México)..... **arcuatus** (Bates)
 Base of pronotum completely margined..... 2

2. Elytral striae coarsely, deeply punctate as in *Eucanthus*; genae obtusely rounded; surface of head and clypeus similarly densely, coarsely punctate in male; frontal carina weakly tri-tuberculate in female; length 7 to 10 mm. (Texas).

minor (Linell)

Elytral striae finely to moderately punctate; genae angulate externally; surface of clypeus roughly, densely, coarsely punctate, remaining surface of head much smoother and more finely punctate in the male; frontal carina not trinodose in female; length 14 mm. (California)----- **hornii** (Rivers)

***Bolbelasmus arcuatus* (Bates), new combination**

FIGURE 14, l

Bolboceras arcuatus Bates, *Biologia Centrali-Americana*, Coleoptera, vol. 2, pt. 2, p. 111, 1887.

Kolbeus arcuatus Boucomont, *Ann. Soc. Ent. France*, vol. 79 (1910), p. 336, 1911.—Chapin, *Proc. Biol. Soc. Washington*, vol. 59, p. 79, 1946.

Bolbelasmus arcuatus (Bates) is a small, dark red-brown, shining species, 7 to 9 mm. in length, readily recognized through the lack of basal margins on both pronotum and elytra. The labrum is widely, shallowly emarginate in front; the clypeus is almost evenly arcuate from side to side; the clypeal suture is distinct; the anterior angles of the pronotum are sharply right angled; the scutellum is elongate; the striae punctures are coarse, in the outside row at the apex very coarse and unusually deep, practically perforating the elytra; the elytra have a row of widely spaced, long, bristlelike hairs near the margin; the male has a single median conical cephalic horn and a low, wide, median thoracic prominence and anterior shallow depression on each side; the female has a wide, more-or-less tri-tuberculate carina on the head and a simple, fine, sharp, transverse carina on the pronotum.

Type.—Type probably among the *Biologia* specimens in the British Museum (Natural History).

Type locality.—Not designated among the localities originally listed, "Mexico, Cordova, Toxpan, Playa Vicente (Sallé), Colima City (Höge); Nicaragua, Chontales (Belt, Janson)."

Specimens examined.—19.

Distribution.—Costa Rica: Tilarán (Guanacaste), San Pedro de Montes de Oca, San José, and *Dominical. Guatemala. México: Colima, El Sabino, Compostela, Mazatlán, Monterey, *Monclova, and *Guadalajara. United States: a single specimen labeled "Los Angeles, California, H. Klages Coll.," in the Carnegie Museum, Pittsburgh, Pa.

FIGURE 14.—Ventral and lateral views of the aedeagi of *Bradycinetulus* and closely related species: a-c, Species of *Bolborhombus*: a, *parvulus*, new species; b, *angulus* (Robinson); c, *schaefferi* (Boucomont). d-g, Species of *Bolbocerastes*: d, *peninsularis* (Schaeffer); e, *regalis*, new species; f, *serratus* (LeConte); g, *imperialis*, new species. h-j, Species of *Bradycinetulus*: h, *ferrugineus* (Palisot de Beauvois); i, *rex*, new species; j, *fossatus* (Haldeman). k-n, Species of *Bolbelasmus*: k, *gallicus* (Mulsant); l, *arcuatus* (Bates); m, *hornii* (Rivers); n, *minor* (Linell).

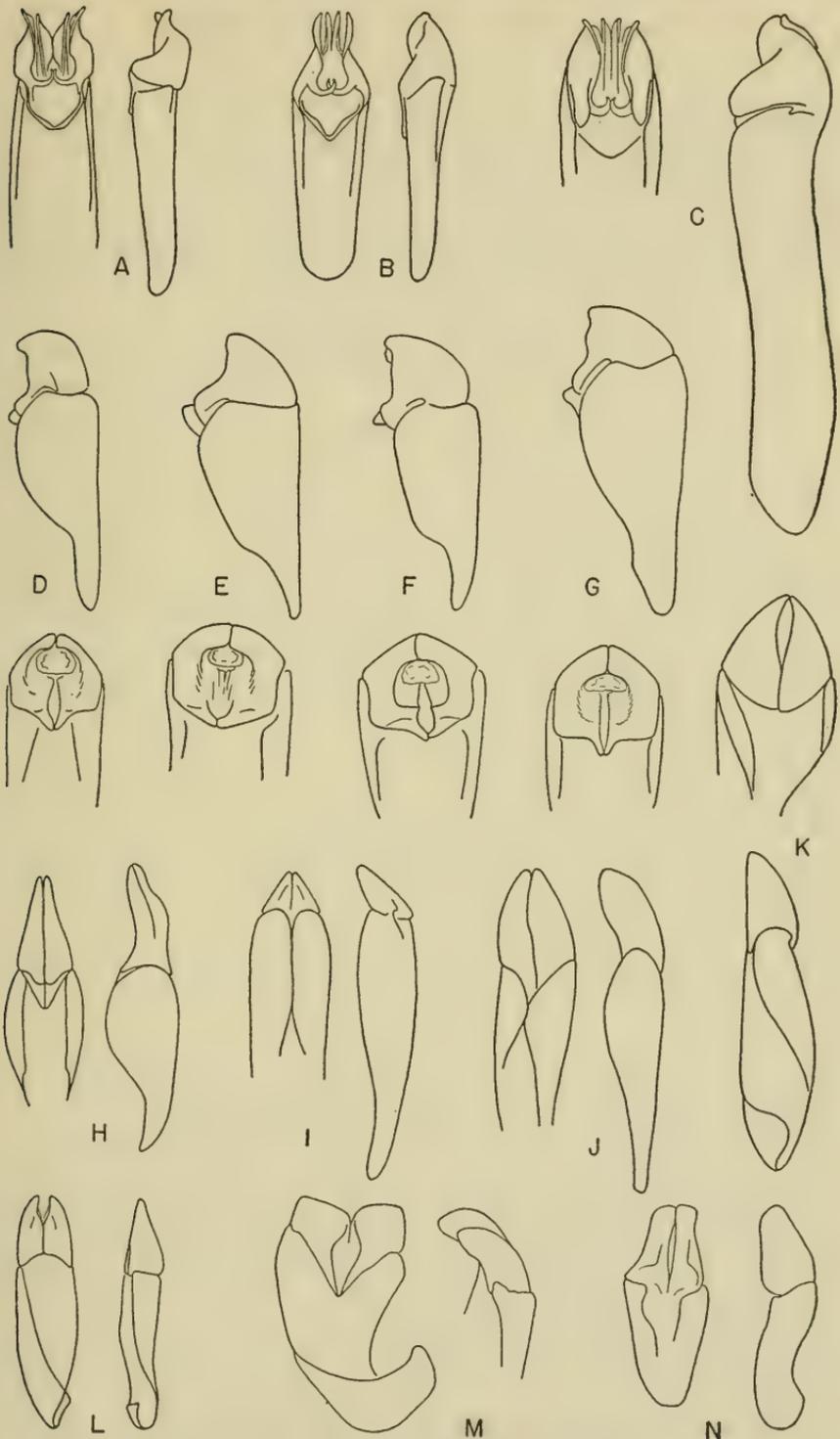


FIGURE 14.—(For explanation see facing page.)

***Bolbelasmus minor* (Linell), new combination**FIGURE 14, *n**Bradycinetus minor* Linell, Proc. U. S. Nat. Mus., vol. 18, p. 723, 1895.*Bolboceras minor* Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 253, 1906.*Kolbeus minor* Chapin, Proc. Biol. Soc. Washington, vol. 59, p. 79, 1946.

Bolbelasmus minor (Linell) almost exactly duplicates *B. arcuatus* (Bates) except that it averages slightly larger, the punctures are coarser throughout, and the pronotum is completely and distinctly margined basally. It is a small, dark red-brown, shining species, 7 to 10 mm. in length; the labrum is widely, shallowly emarginate in front; the clypeus is almost evenly arcuate from side to side; the clypeal suture is distinct; the anterior angles of the pronotum are sharply right angled; the scutellum is elongate; the strial punctures are very coarse, those at the apex of the elytra being tubular and so deep as to nearly perforate the elytra; near the margin of the elytra is a row of widely spaced, long, bristlelike hairs; the male has the head and clypeus similarly densely punctate, the head bears a median, conical horn, and the pronotum has a low, wide, median prominence with anterior, shallow depressions each side; the female has a wide, transverse, tri-tuberculate carina on the head and a simple, fine, transverse carina on the pronotum.

Type.—Holotype female, USNM 562.

Type locality.—San Diego, Tex.

Specimens examined.—21.

Distribution.—Texas: Hidalgo County, Weslaco, Brownsville, Kingsville, and San Diego.

Season.—May 16 to June 16.

***Bolbelasmus hornii* (Rivers), new combination**FIGURE 14, *m**Bradycinetus hornii* Rivers, Bull. California Acad. Sci., vol. 2, p. 61, 1886.*Bolboceras hornii* Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 253, 1906.*Bradycinetulus hornii* Cockerell, Ent. News, vol. 17, p. 242, 1906.*Kolbeus hornii* Chapin, Proc. Biol. Soc. Washington, vol. 59, p. 79, 1946.

Bolbelasmus hornii (Rivers) is quite similar to *B. minor* (Linell) but is considerably larger, lighter in color, and has much finer strial punctures. The scutellum is not so elongate, being nearly an equilateral triangle with arcuate sides. Other characters given in the key should readily identify this species.

Type.—Location of type unknown to me. (According to Dr. VanDyke the entire Rivers Collection was purchased by Dr. Walther Horn and it is presumably in the Berlin-Dahlem collection.)

Type locality.—"Sonora, Tuolumne Co., Cal. Found also in Sacramento Co."

Specimens examined.—349.

Distribution.—California: Sequoia National Park, Napa, Kaweah, Camp Greely (Tulare County), Mendocino, Mokelumne Hill, Camp Greely (Fresno County), Three Rivers, El Dorado County, Coulterville, Sonoma County, Potwisha, San Joaquin Experiment Station (Madera County), Mount Diablo, Sacramento, Mineralking, La Jon Pass, Rattlesnake (Placer County), *Calaveras County, and *O'Neals (Madera County). Baja California: Hamilton Ranch.

Season.—January 19 to May 8, with greatest number in April.

Genus *Bradycinetulus* Cockerell, 1906

Bolboceras Kirby (in part), Trans. Linn. Soc. London, vol. 12, pt. 2, p. 459, 1818.

(Type not designated.)

Amechanus Horn (not Thomson, 1864), Trans. Amer. Ent. Soc., vol. 3, p. 48, 1870.

Bradycinetus Horn (not Sars, 1865), Trans. Amer. Ent. Soc., vol. 3, p. 334, 1871.

Bradycellus Schaeffer (not Erichson, 1837), Trans. Amer. Ent. Soc., vol. 32, p. 249, 1906.

Bradycinetulus Cockerell, Ent. News, vol. 17, p. 242, 1906. (Type not designated.)

The genus *Bolboceras* was erected by Kirby in 1818 for the eight species *Scarabaeus mobilicornis* Linnaeus, *S. mobilicornis* var. *testaceus* Fabricius, *S. quadridens* Fabricius, *S. farctus* Fabricius, *S. lazarus* Fabricius, *S. cyclops* Olivier, *S. cephus* Fabricius, and *Bolboceras australasiae* Kirby. Technically no genotype was designated although he wrote, "My details of *Bolboceras* were taken from *B. quadridens*." Nearly all of the species mentioned have since been moved to other genera. Curtis, 1829 (British Ent., vol. 1, pt. 1, p. 74), selected the species *Scarabaeus mobilicornis* Fabricius as the type of *Bolboceras*. Therefore, since our species of *Odontaeus* are congeneric with *mobilicornis*, they now take the generic name *Bolboceras* and it becomes necessary to find an available name for those species we have formerly placed in *Bolboceras*. A search of the literature indicates that name must be *Bradycinetulus*, as shown in the synonymy.

Characters for *Bradycinetulus*, in addition to those listed in the key to genera, include the following: The mandibles are evenly arcuate externally; the median prominence of the pronotum is developed into a pair of horns in the male; the scutellum is wider than long and distinctly punctate with fine to moderate punctures; and the posterior vertical face of the prosternal intercoxal piece is wide and flat, with the ventral edge evenly arcuate or slightly angulate at middle. The three species placed here are all large, 17 to 21 mm. in length by 10 to 12 mm. in width. They are sufficiently differentiated in the following key.

Genotype.—*Scarabaeus ferrugineus* Palisot de Beauvois, 1809. (Present designation.)

Key to the species of *Bradycinetulus*

1. Eye canthus nearly straight edged laterally, wide clypeal horn of male bisinuate apically, the external angles projecting forward, acute, and scarcely thicker than the adjacent edges, which converge posteriorly; median thoracic horns heavy, directed upward, their sharply rounded tips recurved posteriorly (North Carolina to Florida and Mississippi).

ferrugineus (Palisot de Beauvois)

Eye canthus notched or emarginate, not straight edged laterally-----2

2. Wide clypeal horn of male distinctly trinodose apically, the external angles not projecting beyond median point, lateral edges parallel; median thoracic horns heavy, projecting forward and outward, sharply rounded and very little recurved (Nebraska to Texas and Arkansas)----**fossatus** (Haldeman)

Apex of clypeal horn of male widely truncate, straight across, the external angles slightly nodose, lateral edges parallel over apical two-fifths, then diverging to base; median thoracic horns slender, directed forward and upward, basally flattened in front and behind (Texas)----**rex**, new species.

Bradycinetulus ferrugineus (Palisot de Beauvois), 1809

FIGURE 14, *h*: PLATE 3

Scarabaeus ferrugineus Palisot de Beauvois, Insectes recueillis en Afrique et en Amérique, livr. 6, p. 90, 1809.

Bolboceras lecontei Dejean, Catalogue des Coléoptères . . ., ed. 3, vol. 3, p. 149, 1833.

Athyreus ferrugineus Klug, Abh. Berlin Acad., 1843, p. 22.

Bolboceras ferrugineus Lacordaire, Histoire naturelle des insectes, vol. 3, p. 143, 1856.

Amechanus ferrugineus Horn, Trans. Amer. Ent. Soc., vol. 3, p. 48, 1870.

Bradycinetus ferrugineus Horn, Ent. Amer., vol. 1, p. 89, 1885.

Athyrcus (Bradycinetus) ferrugineus Boucomont, in Wyttsmann, Genera insectorum, fasc. 7, p. 8, 1902.

Bradycinetus ferrugineus Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 250, 1906.

Bradycinetulus ferrugineus Cockerell, Ent. News, vol. 17, p. 242, 1906.

Bolboceras (Amechamus) ferrugineus Boucomont, Ann. Soc. Ent. France, vol. 79, p. 341, 1910.

Type.—Location of type unknown to me.

Type locality.—South Carolina.

Specimens examined.—107.

Distribution.—North Carolina: West End, Southern Pines, **Beaufort, *Hamlet, *Carolina Beach, and **Tarboro. South Carolina: Meredith, Florence, Windsor, Johns Island, and Bulls Island. Georgia: Bainbridge, Spring Creek (Decatur County), and Augusta. Florida: Port Saint Joe, Kissimmi, Orlando, Sanford, Enterprise, Miami, Crescent City, Indian River, Cedar Keys, *Lutz, *Wacissa, *Gainesville, **Saint Augustine, **LaGrange, and **Dunedin. Alabama: **Lee County, and **Mobile County. Mississippi: Ocean Springs, Biloxi, and Leakesville.

Season.—March 11 to September 23, with the largest number of records in June and July.

Bradycinetulus fossatus (Haldeman), 1853FIGURE 14, *j*; PLATE 3

Bolboceras fossatus Haldeman, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 362, 1853.

Amechanus fossatus Horn, Trans. Amer. Ent. Soc., vol. 3, p. 48, 1870.

Bradycinetulus fossatus Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 250, 1906.

Bradycinetulus fossator Cockerell, Ent. News, vol. 17, p. 242, 1906.

Bolboceras (*Amechanus*) *fossatus* Boucomont, Ann. Soc. Ent. France, vol. 79, p. 341, 1910.

In a few male specimens of *Bradycinetulus fossatus* (Haldeman) the outer cariniform edges bordering the thoracic fossae show a slight tendency to break near the upper end to form a second inner carina, a step toward the condition found in *Bolbocerastes*.

Type.—In LeConte collection, MCZ.

Type locality.—Texas.

Specimens examined.—102.

Distribution.—Nebraska: Imperial. Kansas: Reno County, Me-dora, and Sylvia. Oklahoma: Noble County, Cleveland County, Payne County, Thomas, Cleo Springs, Ferris, and *Alva. Arkansas: Pine Bluff. Texas: Fedor, Henrietta, Tyler, Jacksonville, Gold-thwaite, Robinson, Lexington, Jefferson, College Station, Lindale, Bexar County, Dallas, Victoria, Columbus, Paris, Austin, San Antonio, and Morris County.

Season.—May 16 to August, with most records in June.

Bradycinetulus rex, new speciesFIGURE 14, *i*; PLATE 3

Holotype male, length 21 mm., width 13 mm. In general appearance very similar to *Bradycinetulus ferrugineus* (Palisot de Beauvois) and *B. fossatus* (Haldeman), rufo-testaceous, moderately shining, densely hairy beneath. Clypeus perpendicular in front, the nearly flat, vertical face extending upward to form a broad truncate horn about one-fourth wider than high. The face and sides of the horn reticulate, the enclosed spaces concave, shallow, and coarse; the truncate apex scarcely thickened, with the external angles very slightly nodose; the sides parallel over apical two-fifths, diverging posteriorly; margin thin, irregularly serrated, elevated just before the eye canthus to a very moderate right-angled prominence, the posterior edge of which continues posteriorly as a low, sharp carina separating the eye canthus from the flattened discal surface of the head. Canthus sloping away from the discal level of head; anterior and lateral margins sinuate to

the rounded, elevated, anterior angle, surface ridged inward from the angle, depressed along anterior edge and in posterior angle. Margin of head along inner edge of the eye with a reflexed carina, which gradually curves away from the eye, increases to a maximum height, then angles sharply inward and backward and sharply descends to general level of head; head surface, including eye canthi, reticulate-tuberculate-punctate, very rough anteriorly on the concave posterior of the clypeal horn, gradually smoother over discal area, which is bounded posteriorly by a low, rounded ridge between the eyes; the reticulation and tubercles of the discal area flatten until the outlines of the coarse, shallow punctures are barely traceable; head behind the ridge smooth at middle but gradually roughened near the eyes.

Pronotum similar to that of *B. ferrugineus* (Palisot de Beauvois) but with the horns of the median prominence and the high lateral edges of the depressions much farther forward. The anterior edge of the pronotum very finely margined, the middle third arching slightly over the base of the head, each outer third without a curve, straight, diverging anteriorly to the right-angled anterior angles, slightly concave close along these straight edges, then very obtusely convex and rounding into the deep lateral depressions, the middle third with a smaller, closer, parallel convexity and a moderate concavity at each end; pronotum laterally with two very large deep fossae on each side, the lower wider and less deep, widely sinuating the lateral margin from middle to near the anterior angles, the upper very deep, the outer edge thrown up in a high, thin, curving edge which descends to the posterior boundary of the lower cavity; posterior angles distinct but obtusely rounded; sides and base margined, the edge rather finely serrate laterally; pronotum convex basally; disc forming a broad median prominence with a sharp horn pointing upward on each side, the horns being rather sharply undercut below and basally flattened in front and behind; a deep median line from base forward over the median prominence and down between the horns. Surface of the pronotum alutaceous and finely scabrous back of the anterior margin, especially at the sides, then shallowly, coarsely punctate over the inner lower surface of the lateral fossae; posterior angles similarly finely alutaceous and closely, coarsely, shallowly punctate; elsewhere finely to minutely, sparsely punctate throughout, except for the very smooth surface of the deeper fossae; and with a large group of close very coarse punctures on each side back of the horn and above the deeper fossa, another group following the median line and spreading anteriorly to bases of the horns.

scutellum finely punctate. Elytra not strongly shining; minutely

alutaceous under high magnification; margined at base; striae moderately impressed, the strial punctures fine, moderately deep; first stria interrupted at scutellum; the second indistinct near scutellum.

Metasternal lobe separating the middle coxae half as wide as the plate behind the coxae; lateral edges sharply carinate.

Female unknown.

Type.—Holotype male, USNM 61455.

Type locality.—Sarita, Tex. Holotype collected on bare sand, Nov. 30, 1911.

Paratypes.—One male, CAS, Corpus Christi, Tex., June 28, 1942, E. S. Ross; one male, in Mark Robinson collection, Kingsville, Tex., C. T. Reed.

Remarks.—*Bradycinetulus rex* may be readily separated from the two closely allied species *B. ferrugineus* (Palisot de Beauvois) and *B. fossatus* (Haldeman) by the obvious differences in the clypeal and thoracic horns. It may be noted also that the last two species have only a single deep fossa on each side of the pronotum, while in *B. rex* this is doubled, the lower cavity sinuating the lateral margin.

***Bolbocerastes*, new genus**

This genus is closely allied to *Bradycinetulus* but differs in that the apex of the tibia of the midleg and hind leg is obliquely truncate, the scutellum is smooth or minutely punctate, the mandibles are parallel, nearly straight sided and bent sharply inward anteriorly, the sides and anterior edges forming a rectangle, the median prominence of the pronotum is without horns, two elevated carinae are present on each side of the pronotum, the prosternal spine behind the anterior coxae is transverse, doubly pointed and remote from the acutely angled intercoxal piece, and the aedeagus of the male is of a characteristic form (see fig. 14).

Genotype.—*Bolbocerastes regalis*, new species.

Key to the species of *Bolbocerastes*

1. Anterior clypeal horn of male widely truncate; anterior and median horns of female usually equal in width, smooth back of median horn (Arizona, Nevada, California)----- **regalis**, new species
- Anterior clypeal horn of male narrowly truncate or rounded; anterior horn narrower than median horn in female, punctate back of median horn. 2
2. Dull, dark reddish brown; elytral striae extremely fine, not impressed, the intervals completely flat even in reflected light, strial punctures very fine; fully developed male with the anterior clypeal horn narrowly rounded and very little advanced, much closer and more nearly in line with the strongly developed lateral horns than in *serratus* and *imperialis* (California, Baja California)----- **peninsularis** (Schaeffer)
- Elytral striae fine to moderate, usually at least slightly impressed, the intervals weakly convex in reflected light; fully developed males not as above--- 3

3. Lateral serrations of pronotum arising between the two edges of a doubly carinate margin; elytral striae moderately impressed, striae punctures distinct; color reddish brown, usually quite strongly shining; tip of clypeal horn rounded in male, inner thoracic carina without secondary angle at upper end; female cephalic horn rarely higher than clypeal horn, carina extending back from clypeal horn on each side sharp, strong, usually dark colored, lateral secondary horns nearer midway between clypeal and cephalic horns than to the cephalic horn, discal area of head distinctly punctate throughout, fine punctures of median thoracic prominence distinct and noticeable (Kansas, Oklahoma, Texas, New Mexico) *serratus* (LeConte)
Pronotum without or with only traces of a doubly carinate margin laterally, the serrations appearing as thickenings of a single sharp edge; well developed males with a secondary angle at upper end of inner thoracic carina. . . . 4
4. Elytral striae much less distinct, the elytra smoother in appearance, nearly as in *peninsularis*, color lighter, more yellow-brown, less strongly shining; fully developed male with tip of clypeal horn narrowly truncate and well forward from the lateral horns, upper lateral thoracic carina of the male frequently with a noticeable secondary angle at upper end; female median cephalic horn often very high, usually higher than clypeal horn, carina extending back to lateral secondary horn weak, sometimes obliterated, not darker in color, the lateral secondary horns weak, usually much farther back, more nearly in line with the cephalic horn, discal area of head usually with only scattered punctures behind median horn (Baja California, California, Arizona, western Texas) *imperialis*, new species
Elytral striae deeper, color red-brown, more strongly shining as in *serratus*, otherwise as above (Kansas) *imperialis kansanus*, new subspecies

***Bolbocerastes regalis*, new species**

FIGURE 14, e; PLATE 4

Holotype male, length 18 mm., width 11.5 mm. In general appearance closely similar to *Bolbocerastes serratus* (LeConte), ferruginous, shining, densely hairy beneath. Clypeus perpendicular in front, the flat vertical face extending upward to form a broad truncate horn, the vertical height subequal to base, the lateral edges arcuate from base to upper edge, narrowing at basal third to half the basal width then expanding to three-fourths, the upper edge weakly emarginate and subparallel with base, shining black in color, rounded and knoblike at each end; the sharply defined lateral triangular faces of the horn concave and posteriorly elevated from base into secondary horns half as high; posteriorly the broad curving slope of the clypeal horn merges into the flattened upper surface of the head, this quadrangular surface with a secondary horn at each anterior angle and with sharply defined carinalike subparallel lateral margins from which the prominent, widely explanate eye canthus slopes downward and outward. Occipital area smooth; gradually, finely, closely, shallowly punctate anteriorly; anterior and lateral faces of clypeal horn, labrum, eye canthi, and upper surface of mandibles finely reticulate-scabrous.

Broadly rounded labrum twice as wide as long. Upper surface of mandibles concave, sides straight, bent at right angles in front.

Pronotum retuse in front; the deeper lateral impressions extending upward on each side of the median prominence and bounded laterally by two carinae on each side; the lower external carina starting near the serrate lateral thoracic margin and extending upward parallel with the basal thoracic margin for a distance equal to half the length of the lateral margin; the upper carina starting inside the upper end of the lower and extending upward for a slightly shorter distance; viewed from the side the lower carina is nearly straight, the upper end with a gentle downward curve, the lower end with a noticeable but low toothlike elevation; in outline the upper carina is half as high as long, sloping upward from a sharp basal curve to a rounded right-angled peak, then down on a concave curve to a noticeable secondary angle. The median pronotal prominence sharply declivous in front, upper surface divided by an anteriorly increasingly depressed median line, the parallel sides with sharply rounded edges anteriorly; retuse front impunctate except for a subapical line of close, weak-to-obsolete punctures; median prominence with fine, close punctures shading to minute punctation across base; a few obsolete moderate punctures in the shallow lateral depressions outside the carinae; basal bead distinct. Lateral edges strongly serrate, as in *Bolbocerastes serratus* (LeConte).

Elytra not strongly shining; striae scarcely impressed; strial punctures fine, moderately close, intervals practically flat, very minutely punctulate.

Metasternal lobe separating middle coxae half as wide as plate behind the coxae.

Female allotype, length 21 mm., width 10 mm. Similar to the male except that the thoracic prominences are much less developed and the head is different. The vertical face of the clypeus is only half as high as the basal length, the upper edge less than half the basal length, and from each end a curving carina extends outward to top of the secondary horn or tubercle; from the flattened area back of and about twice as high as the secondary tubercles arises a widely truncate median horn; anterior to this median horn the surface is reticulate-scabrous, posteriorly it is smooth.

Type.—Holotype male, USNM 61076.

Type locality.—The holotype bears the following label data: "3206. Colo. R. bottom. Monument 204. Mex. Bd. line Mar. 20-31, '94. USNM Acc. No. 28133 Dr. E. A. Mearns." Monument 204 is approximately 20 miles south of Yuma, Ariz., near San Luis, México, its exact location being lat. $32^{\circ} 29' 03.59''$, long. $114^{\circ} 46' 44.79''$.

Allotype and paratypes.—Allotype and 97 paratypes bear data as follows: Nevada: 1, Hawthorn, June 8, 1943, Wallace; 1, Mount Charleston, 8,000–10,000 feet, Aug. 6, 1944, Zinn.

California: 2, Baker, Mar. 27, 1935, and April 1935, Saylor; 1, California (State label only); 3, Coachella, May 12, 13, 17, 1927, Van Duzee; 3, Coachella, Riverside County, Apr. 28, 1928, May 9, 1927, July 15, 1927, Wymore; 2, Coachella Valley, May 9, 1927, Van Dyke, Aug. 20, 1949, v. d. Bosch; 1, Coyote Wells, Imperial County, June 5, 1949, Hurd; 1, Essex, Apr. 29, 1937; 1, Holtville, June 28, 1936, Cazier; 14, Imperial County, Carrizo Light, Mar. 14, 17, 18, 22, 1928, Searl; 1, Indian Wells, Riverside County, Apr. 25, 1939, Martin; 8, junction of Highways 78 and 99, Imperial County, Apr. 15, 1944, Tieman; 4, Mecca, Mar. 25, 1922, Benedict; 3, Murrays Dam, San Diego County, Cottle; 1, Needles, Apr. 1, 1941, Linsley; 2, Palm Springs, May 20, 1905, May 9, 1932; 2, San Clemente Island, Apr. 2, 3, 1939, Channel Islands Biological Survey, Von Bloeker; 1, San Diego County, Mar. 10, 1928, light, Well; 7, Yermo, San Bernardino County, Apr. 11, 1936, Comstock, Sept. 6–30, 1939, Pierce.

Arizona: 7, Arizona (State label only); 4, Ehrenberg, Oct. 18, 1938, Mar. 21, 23, 30, 1939, Parker; 6 (includes allotype), Gila Bend, Mar. 1, 1930, Lebart; 1, Holbrook, May 5, 1941, Dukes; 1, Navaho County, Duncan; 1, Phoenix; 1, Red Rock, Spring 1930, Burdett; 1, Tucson, April 192–, Duncan; 11, Yuma, February 1910, Carlson, Mar. 12, 18, 1912, Slevin, May 15, 1939, Aitken.

México, Sonora: 1, Choya Bay, Mar. 27, 1949, Bradt; 1, 30 miles southwest of Sonoyta, 500 feet, Mar. 31, 1949, Bradt; 4, Puerto Libertad, Mar. 15, 1939, Parker.

Paratypes in AMNH, CAS, LAC, KAN, MCZ, CAL, CU, OSU, MICH, INHS, USNM, and the private collections of Mark Robinson, Henry Howden, C. A. Frost, A. T. McClay, F. H. Parker, D. K. Duncan, and R. H. Arnett.

Remarks.—*Bolbocerastes regalis* varies from 16 to 20 mm. in length and from 10 to 12.5 mm. in width. It is closely similar to *B. serratus* (LeConte) but the males differ noticeably in having a higher, wide, truncate clypeal horn, smoother, less punctate pronotum, and on each side a doubly angulate inner pronotal carina which is always higher in the middle. In *B. serratus* (LeConte) the anterior clypeal horn is bluntly rounded, the pronotal punctures are more evident throughout, and the inner lateral pronotal carina is not doubly angulate or higher in the middle. The truncated tops of the anterior and median horns are about equal in width in females of *B. regalis* and the whole anterior part of the head, including clypeal and cephalic horns, appears higher than the posterior part, like an elevated snout. The lateral horns are most prominent in this species.

Bolbocerastes imperialis, new species

FIGURE 14, g; PLATE 4

Holotype male, length 19 mm., width 11 mm. Very similar to *Bolbocerastes serratus* (LeConte); ferrugineous; moderately shining; hairy beneath. Vertical face of clypeal horn inclined forward about 30 degrees from perpendicular, slightly convex when viewed from side, height seven-tenths width at base, width of the truncate apex slightly less than half the basal width, the apex arcuate posteriorly at each side; the posterior face of the horn concave from side to side between the weakly carinate edges, which converge very slightly from apex to base. General level of the head slightly more than half the height of the clypeal horn above the wide, truncate labrum; this flattened area sloping upward posteriorly and bounded by a ridge or carina deeply arcuate posteriorly from the anterior edge of one eye to the other and continuing forward on each side to the tips of the weakly elevated, right-angled, secondary horns, then converging to the anterior edge of the clypeal horn and forming the upper edge of the triangular lateral area at base of the horn; flattened area of head slightly depressed laterally above the prominent quadrangular eye canthus, which slopes arcuately downward, outward, and finally upward at the outer angles; entire surface in front of the curving posterior ridge densely, roughly punctate, smooth back of the ridge. Mandibles concave dorsally; strongly angled front and back.

Pronotum retuse in front and with serrate lateral margins as in *B. serratus* (LeConte) and *B. regalis*; the median prominence and lateral carinae nearly as in *B. regalis* but with the outer carina with the upper end curving slightly away and not quite parallel with the basal margin when viewed from the side; the inner lateral carina, viewed from the side, with the lower end rising abruptly to a right angle, then sloping evenly upward to a right-angled peak at middle, then down in a strongly sinuate in-and-out curve; both carinae, viewed from directly in front, evenly arcuate, with the peak angle of the inner carina strongly bent inward; the median prominence slightly constricted toward the base, with the sides weakly angulate in front of the constriction and the surface more broadly and less deeply concave from side to side than in *B. regalis* and evenly arcuate from front to back; a distinct median line evident basally; the apical and deeper lateral pronotal depressions extending upward between the lateral carinae; the median prominence impunctate except for half a dozen or so close, moderate punctures on each side at base of the vertical sinus; above these about twenty or so scattered fine punctures on the inner slope of the vertical sinus, and a very few fine punctures indicating a sub-apical line; median prominence and lateral basal area back of the

carinae closely, finely punctate; smoother and more finely punctate across base at middle; groups of moderate punctures in the depressions back of the carinae and an irregular row of close moderate punctures just inside the basal bead.

Scutellum closely, minutely punctate. Elytra one-sixth wider than long; extremely, finely alutaceous under moderate magnification; striae scarcely impressed; strial punctures fine, distant about four diameters; intervals with very minute scattered punctures.

Metasternal lobe separating middle coxae one-third as wide as the plate behind the coxae.

Allotype female, length 14 mm., width 9 mm. Similar to the male except that the pronotal prominences are less strongly developed and the head is different. The vertical face of the clypeus is one-third as high as basal length; its upper truncate edge also one-third the length of the base; the concave triangular sides of the clypeal horn with the upper edge about twice as long as the anterior edge; the wide truncate frontal horn is about three-fourths as high as wide and about four times as high as the low secondary lateral horns, or tubercles.

Type.—Holotype male, USNM 61077.

Type locality.—Imperial County, Calif., "on the Experiment Farm," June 1912, J. C. Bridwell.

Allotype and paratypes.—Allotype female and 210 paratypes bear the following data: Texas: 1, Castolon, June 1, 1928, Bibby; 1, Tornilla Flat, Big Bend National Park, July 12, 1948, desert, 3,650 feet, at light, Werner and Nutting; 2, Boquillas, Brewster County, July 7, 1948, C. and P. Vaurie; 1, Marathon, June 14, 1948, D. Rockefeller Expedition, Cazier; 1, Reeves County, June 10, 1939, Robinson.

New Mexico: 1, Artesia, July 29, 1937, D. J. and J. N. Knull; 1, White Sands, July 23, 1933, Benedict.

Arizona: 4, Agua Fria, Aug. 6, 1917, Bequaert, June 26, 1938, Duncan; 2, Aquila, Maricopa County, Aug. 21, 22, 1927, CU lot 542, sub 330; 2, Arlington, July 25, 1948, Anderson; 15, Arizona (State label only); 5, Avondale Ranch, Agua Fria River, Aug. 7, 1917, Wheeler leg.; 4, Baboquivari Mountains, July 24, 1941, Beamer, July 24, 1941, Todd; 2, Buckeye, July 30, 31, 1935, at light, Christenson; 1, Cashion, Maricopa County, Aug. 25, 1949, at light, Werner and Nutting; 5, Cibola, August 1911; 1, Continental, Pima County, July 29, 1948, Ball; 1, Coyote Mountains, Aug. 4, 7, 1916; 1, Dome, July 21, 1924, Van Duzee; 4, Ehrenberg, July 20, 1946, June 12, 1943, Grassman, July 18, 1939, Stager, June 21, 1938, Parker; 10, Globe, Duncan, Sept. 8, 1930, July 11, 1931, July, August, Duncan and Parker; 7, Hope, Yuma County, Aug. 12, 1948, greasewood desert, 1,400 feet, at light, Werner and Nutting; 1, Hot Springs, July 16 (year not given), at light, Morrill; 2, Huachuca Mountains; 2, Kits

Peak, Rincon, Baboquivari Mountains, Aug. 1, 4, 1916, about 1,050 feet; 1, Littlefield; 1, Marinette, Aug. 4, 1918, Schiffel; 1, Olberg, Sept. 13, 1936, Crandall; 1, Palmerlee; 8, Phinax (sic), September and November 1921; 17, Phoenix, Sept. 12, 1935, Crandell, May 12, 1934, Parker, May 29, 1922, Odell, Aug. 2, 1917, CU Biol. Expedition, May 17, 1944, Parker, Apr. 29, 1941, Parker, May 7, 1918, Bradley, Sept. 12, 1926; 1, Pima County, Sept. 1, 1925, Marsh; 1, Prescott; 2, Sacaton, Gilman; 1, Safford, September (no date given), Duncan; 2, San Bernardino Ranch, Cochise County, 3,600 feet, sycamore-willow in valley at light, July 25, 1949, Werner and Nutting, July 16, 1949, light, Parker; 1, San Luis, Yuma County, Aug. 11, 1940; 1, Talklai, Pollock; 20, Tucson, July 21 (no year given) Hubbard and Schwarz, July 30, 1937, Parker, August 1912, Breitenbecker, Aug. 20, 1932, Flock, August 1935, Wharton, October 1927, Hamilton (2,500 feet), July 10, 1950, Aug. 8, 1950, Bradt, Oct. 14, 1919; 3, Wellton, June 13, 1939, at light, Stitt; 1, Welton, Aug. 9, 1917, Wheeler leg.; 1, Yuma.

California: 7, Blythe, May 19, 1942, Allen, Aug. 26, Hurd, April 16, 1945, Constantine, May 19, 1943, Vargas, July 22, 1947, July 8, 1947; 4, Blythe, Riverside County, July 24, 1947, Aug. 24, 1947, MacSwain; 2, California (State label only); 29, Coachella, Riverside County, Apr. 28, 1927, May 9, 12, 17, 28, 1927, Wymore, May 22, 1928, Van Dyke, May 13, 1917, Van Duzee; 2, Coachella Valley, Sept. 8, 1929, Comstock, Aug. 20, 1949, v. d. Bosch; 1, El Centro, Aug. 28, 1948, light trap; 8, Holtville, June 1936, Ross, August (no date given), Craig, June 28, 1936, Cazier, June 27, 1936, July 15, 1936; 16 (includes allotype), Imperial County, June 1912, on Experiment Farm, Bridwell; 4, Imperial County, June 1925, Field, July 1, 1925, Gehring; 2, Indio, July 17, 1923, Benedict, May 23, 1919, Slevin; 2, Meloland, June 4, 7, 1949, v. d. Bosch; 1, Needles, June 12, 1940, Barr; 1, Neighbors, Apr. 27, 1930, Hornung; 1, Palo Alto, July 28, 1916; 1, Vallecito, San Diego County, Sept. 15, 1945, at light, Martin; 2, Warners, June 18, 1925.

México: 3, 10 miles south of Catavina, Baja California, July 29, 1938, Michelbacher and Ross.

Paratypes in CAS, LAC, AMNH, CARN, INHS, CAL, OSU, CU, MICH, TEX, KAN, CDA, USNM, and the private collections of R. H. Arnett, D. K. Duncan, C. A. Frost, P. C. Grassman, Henry Howden, A. T. McClay, Gayle H. Nelson, F. H. Parker, Mark Robinson, and F. Werner.

Remarks.—Males of *B. imperialis* vary from 11 to 19 mm. in length, and from 7 to 11 mm., in width. In lesser developed males the punctures become fewer and weaker over the posterior third inside the arcuate carina at back of the head, anteriorly they persist strongly;

the clypeal horn decreases in height and its apex becomes narrow, sometimes rounded, but usually evidently truncate, and the anterior face vertical or sloping slightly backward; the median pronotal prominence is usually not constricted or narrowed basally.

B. imperialis is allied to *B. serratus* (LeConte), *B. regalis* Cartwright, and to *B. peninsularis* (Schaeffer), which I believe is a distinct species. Well-developed males of *B. imperialis* are separated from the other species by the anterior clypeal horn being relatively farther forward from the lateral horns, the triangle formed by the tips of the three horns approaching an equilateral triangle much more closely than in the other species. The apex of the clypeal horn is much narrower than in *B. regalis*, and usually truncate rather than rounded as in *serratus* and *peninsularis*; in fully developed males the inner lateral carina is doubly angulate as in *regalis* but has the high middle peak bent inward, while in specimens of *serratus* and *peninsularis* this carina is not higher or angulate at middle. The color of *serratus* and *peninsularis* is dark red-brown, of *imperialis*, a more yellow brown.

In *Bolbocerastes peninsularis*, represented by 13 specimens, 3 of them cotypes, the male clypeal horn is rounded as in *B. serratus* but is much farther back relative to the lateral horns, which are nearly as high as the clypeal horn. The female is more heavily punctate, as in *serratus*, and the area back of the median horn is much more noticeably punctate than in *imperialis*.

***Bolbocerastes imperialis kansanus*, new subspecies**

Holotype male, length 17 mm., width 11 mm. Very similar to *B. imperialis*; moderately shining; darker in color; hairy beneath. Anterior face of the narrowly truncate clypeal horn vertical; lateral secondary horns more prominent; surface back of the clypeal horn with a noticeable swelling on each side and diagonally backward from the posterior ridges of the horn to a point even with the forward edge of the eye canthus, leaving between them a widening depressed area which merges with the general posterior level of the head; surface anterior to the arcuate ridge between the eyes more concave and much smoother than in typical *imperialis*; occiput smooth; eye canthus with a swelling diagonally inward from outer anterior angle.

Pronotum more coarsely punctate throughout; lateral edges of the median prominence more nearly cariniform and not constricted basally; median peak of upper lateral carina not bent inward; the depression back of the anterior angles at bottom of the lateral sinuses deeper, more noticeable, and distinct; serrations of the lateral margin appearing as thickenings of a single sharp edge; otherwise similar to typical *imperialis*.

Elytral striae deeper, nearly as in *B. serratus* (LeConte); the second stria basally indistinct over twice the length of the scutellum.

Aedeagus as in *imperialis*.

Allotype female, length 16 mm., width 11 mm. Similar to typical *B. imperialis* except that punctures are coarser throughout; foveae are deeper; elytral striae are deeper; and the eye canthus has a convex swelling diagonally inward from the anterior angle.

Type.—Holotype male, in Canadian Department of Agriculture collection.

Type locality.—Rush County, Kan.

Allotype and paratypes.—Allotype and 6 paratypes bear data as follows: Kansas: 4 (including allotype female), Rush County, Aug. 5, 1920; 2, Ness County, Aug. 5, 1920; 1, Ness County, 2,260 feet, July 5, 1912, Williams. Paratypes vary from 13 to 17 mm. in length, and 8 to 11 mm. in width.

Paratypes in CDA, KAN, and USNM.

Remarks.—*Bolbocerastes imperialis kansanus* may be separated from *B. serratus* (LeConte) by the doubly angulate upper lateral thoracic carina in well-developed males, by the diagonal convexity of the eye canthus, by the lateral serrations of the pronotum appearing as thickenings of a single sharp margin, and by the second elytral stria all but disappearing at twice the length of the scutellum. In *serratus* the serrations of the pronotal margin arise between the two edges of the doubly carinate margin and the second elytral stria becomes indistinct opposite the apex of the scutellum.

Bolbocerastes serratus (LeConte), new combination

FIGURE 14, *f*; PLATE 4

Athyreus serratus LeConte, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 80, 1854.

Amechanus serratus Horn, Trans. Amer. Ent. Soc., vol. 3, p. 48, 1870.

Bradycinetus serratus Horn, Proc. California Acad. Sci., ser. 2, vol. 4, p. 334, 1894.

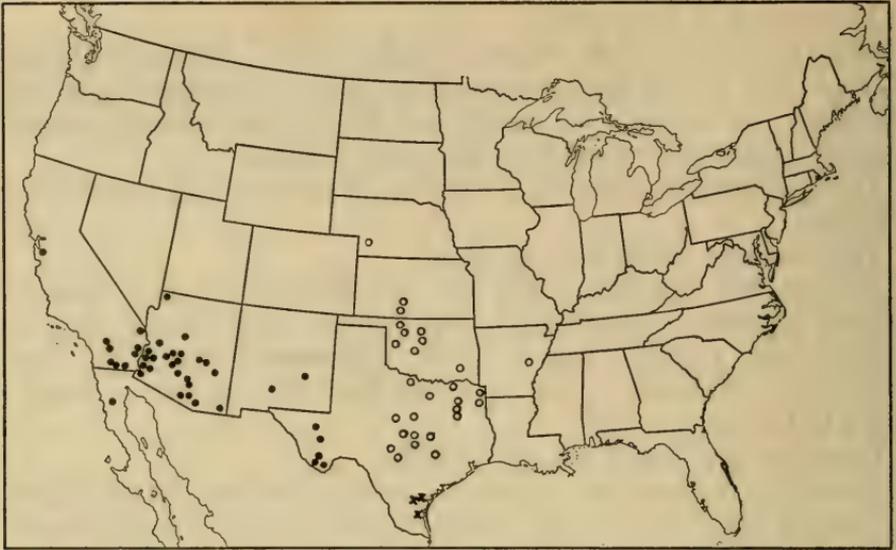
Athyreus (*Bradycinetus*) *serratus* Boucomont, in Wyttsmann, Genera insectorum, fasc. 7, p. 8, 1902.

Bradycinetus serratus Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 251, 1906.

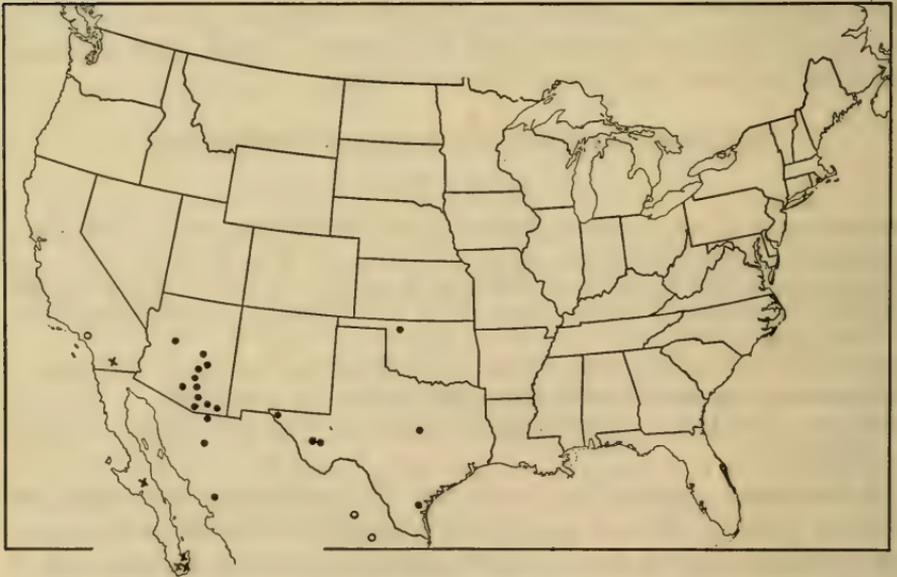
Bradycinetulus serratus Cockerell, Ent. News, vol. 17, p. 242, 1906.

Bolboceras (*Amechanus*) *serratus* Boucomont, Ann. Soc. Ent. France, vol. 79, p. 341, 1910.

Bolbocerastes serratus (LeConte) and *B. imperialis* Cartwright, except for fully developed males, are frequently difficult to separate. The locality label will help in most cases since *serratus* is found east of New Mexico, while *imperialis* is found in California, Arizona, and rarely into west Texas. The maps (figs. 15 and 16) show the known distribution. In doubtful cases the male genitalia will separate the two (see fig. 14, *f* and *g*). In *serratus*, the basal side or floor of the cavity is formed by the two sides approaching each other with knife-edges, sharply angulate near the outside margin (in *Bolbocerastes* the aedeagus of the male is hooded apically by the two sides coming together

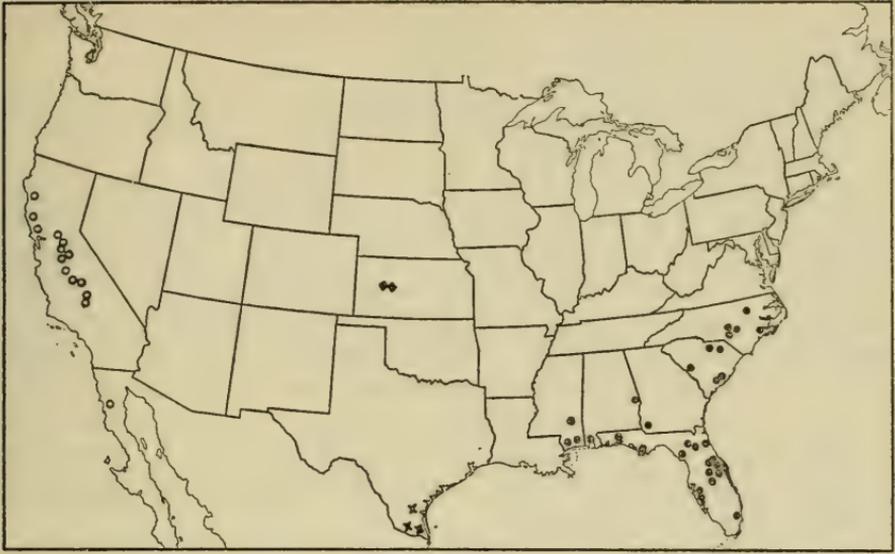


- *Bolboerastes imperialis* Cartwright x *Bradycinetulus rex* Cartwright
 ○ *Bradycinetulus fossatus* (Haldeman)

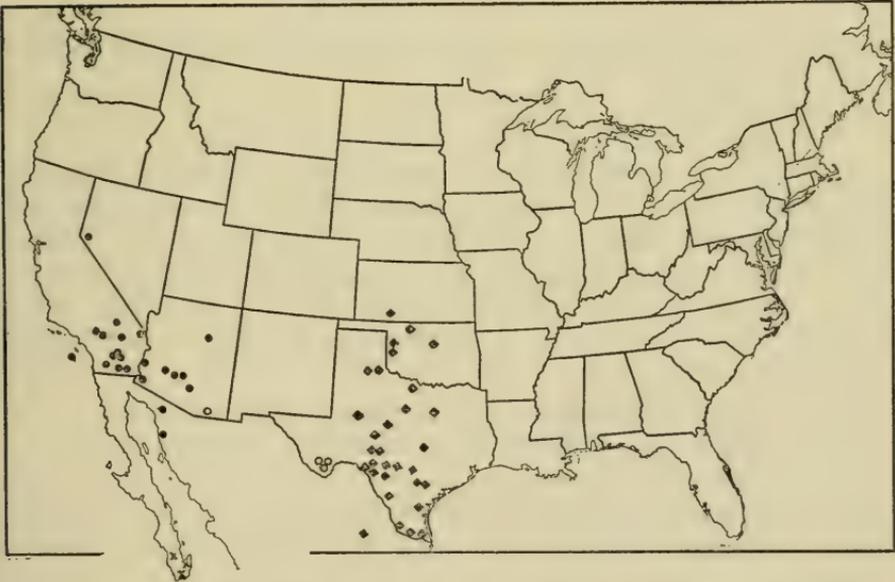


- *Bolborhombus schaefferi* (Boucomont) ○ *Bolbelasmus arcuatus* (Bates)
 x *Bolboerastes peninsularis* (Schoaffer)

FIGURE 15.—Distribution of species of *Bradycinetulus* and closely related species.



- *Bolbelasmus horni* (Rivers)
- *Bradycinetulus ferrugineus* (Palisot de Beauvois)
- × *Bolbelasmus minor* (Linell)
- ◆ *Bolbocerastes Imperialis kansanus* Cartwright



- *Bolbocerastes regalis* Cartwright
- *Bolborhombus angulus* (Robinson)
- ◆ *Bolbocerastes serratus* (Leconte)
- × *Bolborhombus parvulus* Cartwright

FIGURE 16.—Distribution of species of *Bradycinetulus* and closely related species.

to form a deep cavity); in *imperialis*, these edges are rounded and lead straight in without a break or angle.

Type.—In LeConte collection, MCZ.

Type locality.—Mexican Boundary, Laredo to Ringgold Barracks.

Specimens examined.—181.

Distribution.—Kansas: Clark County. Oklahoma: Taloga, Cheyenne, *Alva, and *Payne County. Texas: Brownsville, *Beeville, Burnet County, Cypress Mills, Comal County, Cameron County, Caterina, Colorado City, Cotulla, Childress, Dimit County, Dallas, Dallas County, Edinburg, Eagle Pass, Fedor, Forestburg, Frio State Park, Goldthwaite, Hidalgo County, Kingsville, Laredo, Memphis, Menard, *Mineral Wells, New Braunsfels, Oakville, Plesanton, Reeves County, Round Mountain, Sabinal, Taloga, Uvalde, Weslaco, and Zavalla County. New Mexico: State label only (H. W. Wenzel collection). México: La Gloria, south of Monclova, Coahuila; and Rancho Preso, Nuevo León.

Season.—April 28 to September 25, with largest numbers collected in May, June, and September.

***Bolbocerastes peninsularis* (Schaeffer), new combination**

FIGURE 14, *d*; PLATE 4

Bradycinetus serratus var. *peninsularis* Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 252, 1906.

Bolboceras serratus var. *peninsularis* Boucomont, in Schenkling, Coleopterorum catalogus, pt. 46, p. 13, 1912.

All specimens of this species examined have been dull, smooth, and of a uniform very dark red-brown color. The male is quite distinctive (see pl. 4, lower right). In the female the moderately high cephalic horn is twice the width of the tip of the clypeal horn and the secondary lateral horns or tubercles are usually more prominent than in *B. imperialis*. The carinae between these and the clypeal horn are strong and well marked.

Type.—Lectotype male, present selection, USNM 42568.

Type locality.—Santa Rosa, Baja California, México.

Specimens examined.—13.

Distribution.—California: 2, State label only, CARN. México: Santa Rosa, San Felipe, La Paz, and San Ignacio, all in Baja California.

Season.—July 27 to October 1.

***Bolborhombus*, new genus**

Mandibles arcuate externally. Head, male and female, without median frontal horn. Pronotum serrate laterally; apex with a carina paralleling anterior margin, the interspace interrupted behind each

eye by a distinct rather deep foveola; base margined. Scutellum triangular, with base straight, sides arcuate. Elytra not margined at base; seven discal striae, the first two interrupted by the scutellum, the second sometimes indistinctly forked opposite the apex of scutellum. Two prosternal spines in tandem behind anterior coxae, the posterior more or less hastate. Metasternal plate rhomboid in shape, the posterior angle acute and with adjacent edges cariniform, the lateral angles with adjacent edges rounded; the intercoxal lobe deeply concave and with strong cariniform lateral edges.

Genotype.—*Bradycinetus carinatus* Schaeffer, 1906 = *Bolboceras schaefferi* Boucomont.

Key to the species of *Bolborhombus*

1. Clypeus of male carinately margined in front, the very wide clypeal horn arcuate anteriorly, a low sharp carina arcuate in opposite direction behind the clypeal horn, which is midway between this and the carinate anterior margin; female unknown.....**angulus** (Robinson)
 Male clypeus not distinctly carinate along anterior edge but with parallel carinae extending back from anterior angles to the external angles of the tip of the horn.....2
2. Postapical carina of pronotum sharp and slightly undercut; male with short, distinct carina back of clypeal horn arcuate anteriorly, in same direction as clypeal horn; female smoother back of corresponding carina than in front of it; small shining species; 8 to 10 mm. (Baja California).
parvulus new species
 Postapical carina of pronotum rounded; male without carina or with faint indication of two low obscure tubercles back of clypeal horn; female equally rough behind and in front of carina; usually dull or only moderately shining (excepting some very large specimens, which may represent a subspecies); larger species, 11 to 18 mm.....**schaefferi** (Boucomont)

Bolborhombus angulus (Robinson), new combination

FIGURE 14, b

Bolboceras angulus Robinson, Trans. Amer. Ent. Soc., vol. 73, p. 170, 1947.

Bolborhombus angulus (Robinson) is a small rufotestaceous species, 7 to 11 mm. in length, readily recognized by the form of the head and clypeus. The wide straight anterior edge of the clypeus is strongly carinately margined. Behind this, from side to side and almost in line with the anterior edges of the ocular canthi, is a moderately high anteriorly arcuate ridge or horn, and still farther back a lower posteriorly arcuate sharp carina. The median horn tends to become somewhat nodose at the ends and is approximately midway between the posterior carina and the carinate anterior edge of the clypeus. In other characters *angulus* is very similar to *B. parvulus* and to small specimens of *B. schaefferi* (Boucomont).

Type.—In Mark Robinson collection, Philadelphia, Pa.

Type locality.—Dog Canyon, Brewster County, Tex.

Specimens examined.—4, including the holotype.

Distribution.—Texas: Dog Canyon, Glenn Spring, and Boquillas, all in Brewster County. Arizona: Miller Canyon, Huachuca Mountains.

Season.—July 7 to 29.

Bolborhombus parvulus, new species

FIGURE 14, a

Holotype male, length 9 mm., width 6 mm. Shiny, rufotestaceous, densely hairy beneath. Clypeus extending obliquely upward and backward to top of clypeal horn; the anterior face practically flat, its surface closely, very coarsely punctate, with the forward edge convex and deeply reticulate-punctate, the lateral edges parallel and sharply cariniform; upper edge of the horn shallowly emarginate, the external angles only slightly tuberculiform, from them a moderately high, sharp carina curving back each side and ending somewhat abruptly close to the innermost edge of the eye; surface of head back of horn uneven, with close, mixed fine and coarse punctures and with a short, elevated, transverse, anteriorly arcuate carina midway between the similarly punctate, sharply edged, concave, depressed ocular canthi; the carina about one-third as long as the width of the clypeal horn; the punctures back of the carina not quite as close as in front; the occiput smooth, closely, minutely punctate.

Pronotum with three rather deep foveae close behind the finely margined anterior edge, one median, the others opposite inner eye margin on each side; a sharp postapical carina, slightly undercut on posterior side, starting on each side of the middle fovea and passing close behind the lateral foveae toward but not quite reaching the serrate side margin at about anterior third; a second short, similar carina on each side straight back from near the end of the postapical carina to the inner anterior edge of a strong lateral fovea; a shallow, coarsely punctate groove half way across the pronotum upward and backward from each of the three anterior foveae; a row of close coarse punctures in the lateral and basal marginal line, a few in the basal half of median line, and scattered coarse punctures on both sides of the lateral carina and continued upward to opposite the humerus, with mixed fine and minute punctation throughout; anterior angles slightly more than a right angle; posterior angles obtusely rounded; base distinctly margined. Scutellum with mixed, very fine and minute punctation.

Elytra not margined basally; striae weakly impressed; strial punctures fine; first two striae interrupted by the scutellum; intervals weakly convex; the surface minutely punctate, very finely alutaceous under moderately high magnification.

Metasternal plate twice as wide as the lobe between the middle coxae, roughly punctate, and hairy along posterior edges. Prosternal spine 4-cornered, with the anterior angle curving down to a sharp point between the coxae and with the lateral angles on a transverse level and the posterior curving downward to form a sharp spine.

Allotype female, length 9 mm., width 6 mm. Apparently identical with the male in every way except in characters of the head. Clypeus rising steeply at somewhat less than a right angle to a sharply carinate edge seven-eighths as wide and parallel to the turned-under anterior margin; the flat face enclosed being a little less than one-third as high as long, then dropping sharply and gradually up again with the lateral edges slightly diverging to the top of the very wide median horn, which is widely and deeply emarginate at middle, leaving the two ends, or external angles, as rounded, thickened, backward-sloping prominences; back of the emargination, on the same level, and at a point midway between the ocular canthi, is a very short arcuate carina or elongate tubercle, behind which the general level of the head is noticeably lower; surface in front of the horn deeply, coarsely punctate-reticulate, between the horn and the tubercle roughly coarsely punctate, and behind the tubercle much smoother, with dispersed, mixed fine and shallow, coarse punctures; occiput smooth, practically impunctate.

Type.—In California Academy of Sciences collection.

Type locality.—Triunfo, Baja California, México. Holotype male collected Aug. 7, 1938, Michelbacher and Ross.

Allotype and paratypes.—Allotype female, CAS, and paratype male, USNM 61656, San Venancio, Baja California, México, Oct. 8, 1941, Ross and Bohart; paratype female, USNM 61656, Santa Rosa, Baja California, México, Charles Schaeffer collection.

Remarks.—*Bolborhombus parvulus* is very near *B. angulus* (Robinson) and is about the same size. The four specimens vary in length from 8½ mm. for the smaller male to 10½ mm. for the larger female. The anterior edge of the clypeus, described as margined in *angulus*, is almost exactly the same as in the female of *parvulus*.

***Bolborhombus schaefferi* (Boucomont), new combination**

FIGURE 14, c

Bradycinetus carinatus Schaeffer, Trans. Amer. Ent. Soc., vol. 32, p. 251, 1906.
Bolboceras schaefferi Boucomont, Ann. Soc. Ent. France, vol. 79, p. 347, 1910.

Bolborhombus schaefferi (Boucomont) averages much larger than *B. parvulus* and *B. angulus*, measuring 11 to 18 mm. in length, but it is very similar in all characters except those of the head, clypeus, and aedeagus. Males show considerable variation in the clypeal horn.

In smaller specimens the clypeus slopes upward and backward from the wide straight anterior edge to the narrower but moderately wide and somewhat anteriorly arcuate apex of the horn, the external angles of which are thickened to slightly nodose. In large specimens the external angles of the horn become strongly elevated tubercles, in some individuals wide apart, in others relatively close together. The head back of the horn is densely, quite coarsely punctate, occasionally with a short, obscure, anteriorly arcuate carina or very low binodose tubercle. In the female the anterior edge of the clypeus is nearly vertical to the sharply carinate margin. Well back and nearly in line with the anterior edges of the ocular canthi are two widely separated, conical tubercles with a fine anteriorly angulate carina between them and a low median swelling or tubercle close behind them. The tubercles are usually strongly developed but occasionally in small specimens may appear only as slight thickenings of the ends of the angulate carina.

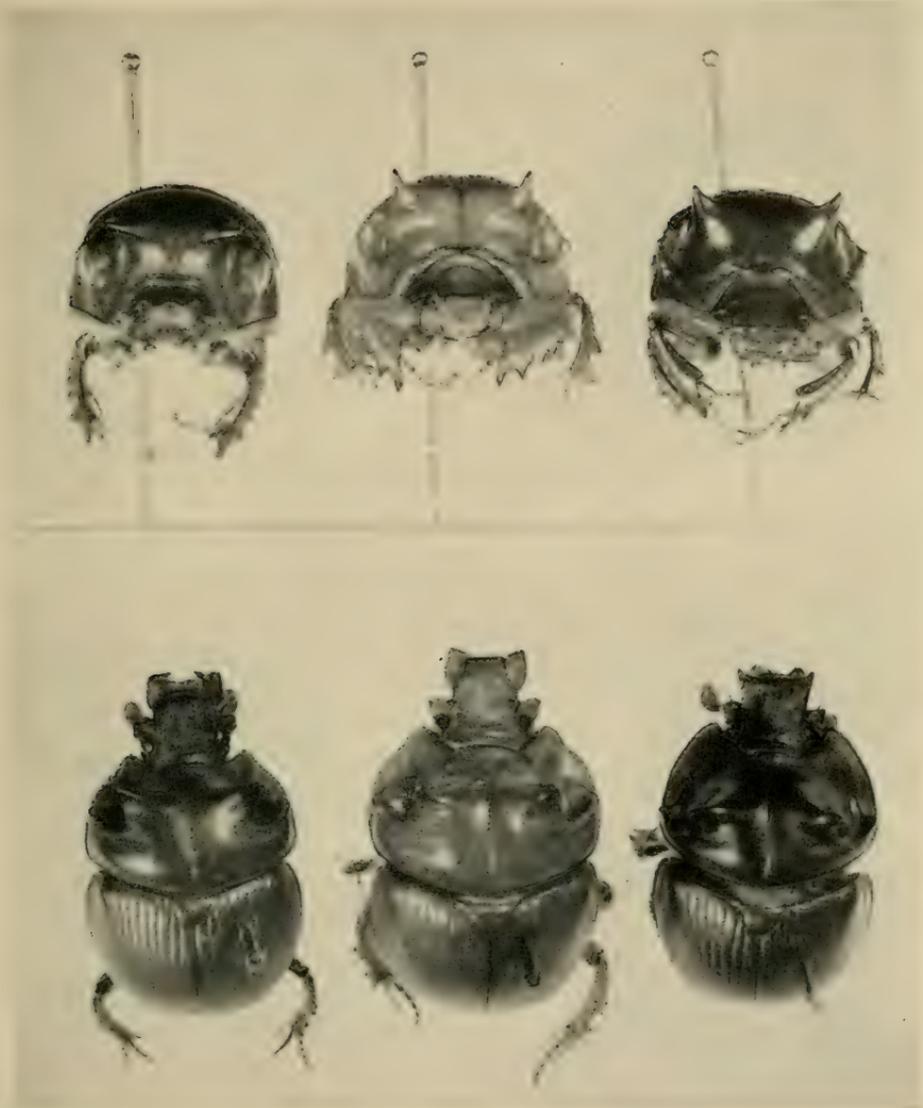
Type.—Lectotype male, present selection, USNM 42569.

Type locality.—Palmerlee, Cochise County, Ariz.

Specimens examined.—104.

Distribution.—Arizona: Cave Creek and Pinery Canyon (Chiricahua Mountains, Cochise County), Dewey, Douglas, Globe, Huachuca Mountains, Fort Huachuca, Kits Peak (Rincon, Baboquivari Mountains), Nogales, *Oracle, Palmerlee, Patagonia, Prescott, Reddington, Madera Canyon (Santa Rita Mountains), and Tucson. Texas: *Alpine, El Paso, *Fort Davis, Kingsville, and Round Mountain. México: Alamos (Sonora), Venedio (Sinaloa), Oaxaca (Oaxaca), Santa Rosa (Baja California), Naco (Sonora), Tlahualilo, and Río Mayo.

Season.—July 1 to October 10, with largest numbers in July and August.



Front and dorsal views of three species of *Bradycinetulus*: Left, *B. fossatus* (Haldeman); middle, *B. rex*, new species; right, *B. ferrugineus* (Palisot de Beauvois).



Differences in the clypeal horn in *Bolbocerastes*: Upper left, *B. serratus* (LeConte); upper right, *B. regalis*, new species; lower left, *B. imperialis*, new species; lower right, *B. peninsularis* (Schaeffer).

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3319

THE CHRYSOMELID BEETLES OF THE GENUS
STRABALA CHEVROLAT

By DORIS HOLMES BLAKE

Introduction

The first species of this chrysomelid genus was described by Illiger¹ in 1807 as *Haltica rufa* from Pennsylvania, Melsheimer collector. A year later, Olivier² described *Altica ferruginea* from Santo Domingo, Palisot de Beauvois collector, and *Altica scutellaris* from southern France. Of this latter locality von Harold³ said that there was no *Altica* colored anything like this in southern France and that the locality was evidently an error. In 1837, in the Dejean catalogue, Chevrolat⁴ listed under the new generic name *Strabala* (στράβαλα, having a form thick and contracted) six specific names of Dejean without descriptions or references. Four of them are pure nomina nuda; for the two others, *S. scutellata* Dejean and *S. dominicensis* Dejean, the names (*Altica*) *scutellaris*? Olivier and (*A.*) *ferruginea*? Olivier, respectively, are given as doubtful synonyms. The generic name is consequently not published here. Chevrolat changed the locality for *scutellata* to America Borealis. Of these six names only one has since been used; *S. intermedia*, whose locality in this catalogue was given as Cuba, was adopted by Jacquelin Du Val⁵ in 1857 for a

¹ Illiger, Mag. Insekt., vol. 6, p. 152, 1807.² Olivier, Entomologie, . . . vol. 6, pp. 697, 699, 1808.³ von Harold, Coleopterologische Hefte, vol. 14, p. 20, 1875.⁴ Chevrolat, in Dejean, Catalogue de la collection de Coléoptères . . . ed. 3, p. 413, 1837.⁵ Jacquelin Du Val, in Ramón de la Sagra, Historia . . . de la Isla de Cuba (Spanish ed.), vol. 7, p. 129, 1857.

Cuban species. In d'Orbigny's Dictionnaire, Chevrolat⁶ in 1848 listed *scutellaris* and *ferruginea* under *Strabala* without the question marks, as well as the four nomina nuda he had given in 1837, thus establishing the genus.

In 1868 Suffrian⁷ described *Haltica ambulans* from Cuba which he said belonged to Chevrolat's genus *Strabala*, a genus that Erichson⁸ had earlier merged with *Lactica*. Suffrian was not convinced, however, that these specimens having so poorly developed a basal sulcus on the prothorax really belonged to the genus *Lactica*. He stated that although there was an ill-defined basal sulcus, the beetles were smaller than most species of *Altica* and proportionately broader, and that the color was not blue but a deep reddish brown. This Cuban species that he had did not entirely correspond in coloring to Olivier's description of *scutellaris* or to Jacquelin Du Val's *intermedia*, both of which were paler beneath than the dark colored undersurface of his beetles.

Boheman⁹ described under the genus *Strabala*, two species, *nigriceps* from Buenos Aires and *languida* from Java, both of which have been referred to *Lactica*. Although I have not examined the types, the description of *nigriceps* as having the anterior angles of the prothorax truncate seems to exclude it from *Strabala*, and the description of *languida* is quite different from that of any of the group. Fall,¹⁰ in describing *Altica testacea* from Texas, compared it with *rufa*, noting that "*rufa* is much broader and less convex and has black legs and antennae." Fall's species, also, does not belong in *Strabala*. It differs in general shape, the prothorax has quite different anterior angles, and the scutellum is small and inconspicuous.

Jacoby,¹¹ who had put *scutellaris* under *Lactica*, in the Supplement says of Horn, "Dr. Horn remarks that *Lactica scutellaris* would be better placed in the genus *Haltica* and that it is congeneric (and probably also specifically identical) with *Haltica rufa* Illiger." But Jacoby "could not agree with this opinion" and kept *scutellaris* under *Lactica*.

The British Museum (Natural History) specimens, therefore, are under *Lactica*, and in the U. S. National Museum, following Horn, they are under *Altica*. Henshaw¹² lists *rufa* under *Disonycha*. Gemminger and Harold¹³ list *rufa* under *Disonycha* and *scutellaris* under *Lactica*. Heikertinger,¹⁴ in the Junk catalogue, nicely balances

⁶ Chevrolat, in d'Orbigny, Dictionnaire universel d'histoire naturelle, vol. 12, p. 52, 1848.

⁷ Suffrian, Arch. Naturg., vol. 34, p. 182, 1868.

⁸ Erichson, Arch. Naturg., vol. 13, p. 173, 1847.

⁹ Boheman, Kongliga Svenska Fregatten *Eugenies* Resa . . . , vol. 2, Zoologi, pt. 1, Insecta, pp. 139, 190, 1850.

¹⁰ Fall, Trans. Amer. Ent. Soc., vol. 36, p. 157, 1910.

¹¹ Jacoby, Biologia Centrali-Americana, Coleoptera, vol. 6, pt. 1, p. 273, 1884; Supplement, p. 259, 1891.

¹² Henshaw, List of the Coleoptera of America, north of Mexico, p. 112, 1885.

¹³ Gemminger and von Harold, Catalogus coleopterorum . . . , vol. 12, p. 3497, 1876.

¹⁴ Heikertinger, Coleopterorum catalogus, pars 166, pp. 241, 259, 1939.

the dispute by synonymizing *scutellaris* and *ambulans* with *rufa* and placing them under *Haltica* and at the same time placing *ferruginea* and *intermedia* as separate species under *Lactica*. Mr. G. E. Bryant pointed out to me the specimens labeled *Lactica scutellaris* in the British Museum and said, "What are these doing here?" I agreed that it was high time to restore the original Chevrolat generic name *Strabala* for this group of very similarly colored species that no one has known exactly what to do with. On my return to America, after a considerable search for the specimens of this species that had long been removed from the regular collection, I found that H. S. Barber had also labeled them *Strabala*.

The species of this genus differ in color among themselves little more than do those of the genus *Altica*, but instead of being metallic blue they are a deep reddish or orange brown with dark or partly dark legs, dark scutellum (usually), dark antennae, and more or less dark under-surface. Like *Altica* they have no spots, vittae, or other markings; and the variation in the dark coloration is slight. In practically all the North American specimens from Massachusetts to Panamá, the amount of dark coloration is very much the same, that is, the under-surface and femora are only partly dark. Hence the tendency has been to follow Horn,¹⁵ who wrote that "*Haltica rufa* occurs from Massachusetts to Illinois, Florida and Texas, extending through Mexico to South America." There are, however, slight differences in the extent of the dark coloration, in the punctation, and in the shape of the aedeagus. In Eastern United States from New Hampshire to the Gulf and west to the Mississippi, Louisiana, and northern Texas, the species known as *rufa* Illiger presents little variation. It is a conspicuously punctate, deep reddish brown species. In Florida occurs a race that, in dried specimens, at least, is always a pale yellow-brown, in contrast to the reddish color of *rufa*. It has also a distinctly alutaceous surface and is less distinctly punctate than *rufa*. In the specimens from Brownsville, Texas, to Panamá, which are shining and almost impunctate, in our limited collections are two groups with entirely differently shaped aedeagi—those that are narrowed at the tip and those with a wide, rounded tip. From the external appearance I cannot distinguish the beetles at all. H. S. Barber has labeled one lot, with round-tipped aedeagi, as a new species and the other as *scutellaris*. It seems to me that the name *scutellaris* cannot be applied to any species of *Strabala* with any certainty. To begin with, Olivier's locality of southern France, apparently erroneous, leaves us without any type locality in the western hemisphere. Species corresponding in coloration to Olivier's description occur in Cuba and Central America as well as North America. Therefore I propose to drop the name

¹⁵ Horn, Trans. Am. Ent. Soc., vol. 16, p. 232, 1889.

scutellaris entirely, as retaining it would only promote confusion. Among the specimens from Central America with the aedeagus narrowed at the tip there is a wide variation in the acuteness and in the width of the tip. I think there are probably a number of species, but since the coloring is so nearly uniform and the variation in the aedeagi only a matter of degree, I hesitate to give them specific names and am calling them only subspecies.

In the Bowditch collection at the Museum of Comparative Zoology (MCZ) are seven specimens from South America (two from Venezuela and the rest from Colombia) that are uniformly somewhat larger than the others of the genus and, unlike the North and Central American specimens, are dark beneath, as in the majority of the West Indian specimens. In the British Museum is a series from Trinidad, collected by G. E. Bryant, also dark beneath but smaller, paler, and with a more rounded tip to the aedeagus.

In the West Indies the prevailing color of the legs and undersurface of the specimens is entirely dark, but in one species, at least, the posterior femora are partly reddish, as in the continental species. In another species from Hispaniola, the scutellum is not black but reddish like the elytra, the only one so colored that I have examined. Jacoby wrote of specimens with a red scutellum from Juquila, México, of which he had three. One specimen from Juquila in his collection is a yellow *Lactica* with a pronounced basal sulcus on the prothorax, typical of *Lactica*, and a pale scutellum. This may not be the one to which he referred. These slight differences in coloration of the specimens from the different islands of the West Indies are accompanied by a slightly different aedeagus. Still, as in the case of the Central American specimens, I hesitate to give them specific names and am calling them only subspecies. Much more work should be done on the group and many more specimens should be studied. Here I attempt to assemble the species that in the catalogues are divided among two or three genera and to call attention to their points of difference.

The group is closer to *Disonycha* than to either *Altica* or *Lactica*. The head, while similar to *Disonycha*, has the circle of punctures nearer to the tubercles and the carina shorter and broader than in most species of *Disonycha*. The antennal joints are similar in being robust and rather short, but differ in having the third joint a little longer than the fourth, instead of the fourth longer than the third. The prothorax is much like that of *Disonycha* except that below the apical angle there is a tiny V-shaped notch which does not occur in *Disonycha*. The basal depression over the scutellum, often found in *Disonycha* too, is longer and more pronounced in *Strabala*. The elytra are distinctive in being more convex and oval than in *Lactica*, *Altica*, or *Disonycha*.

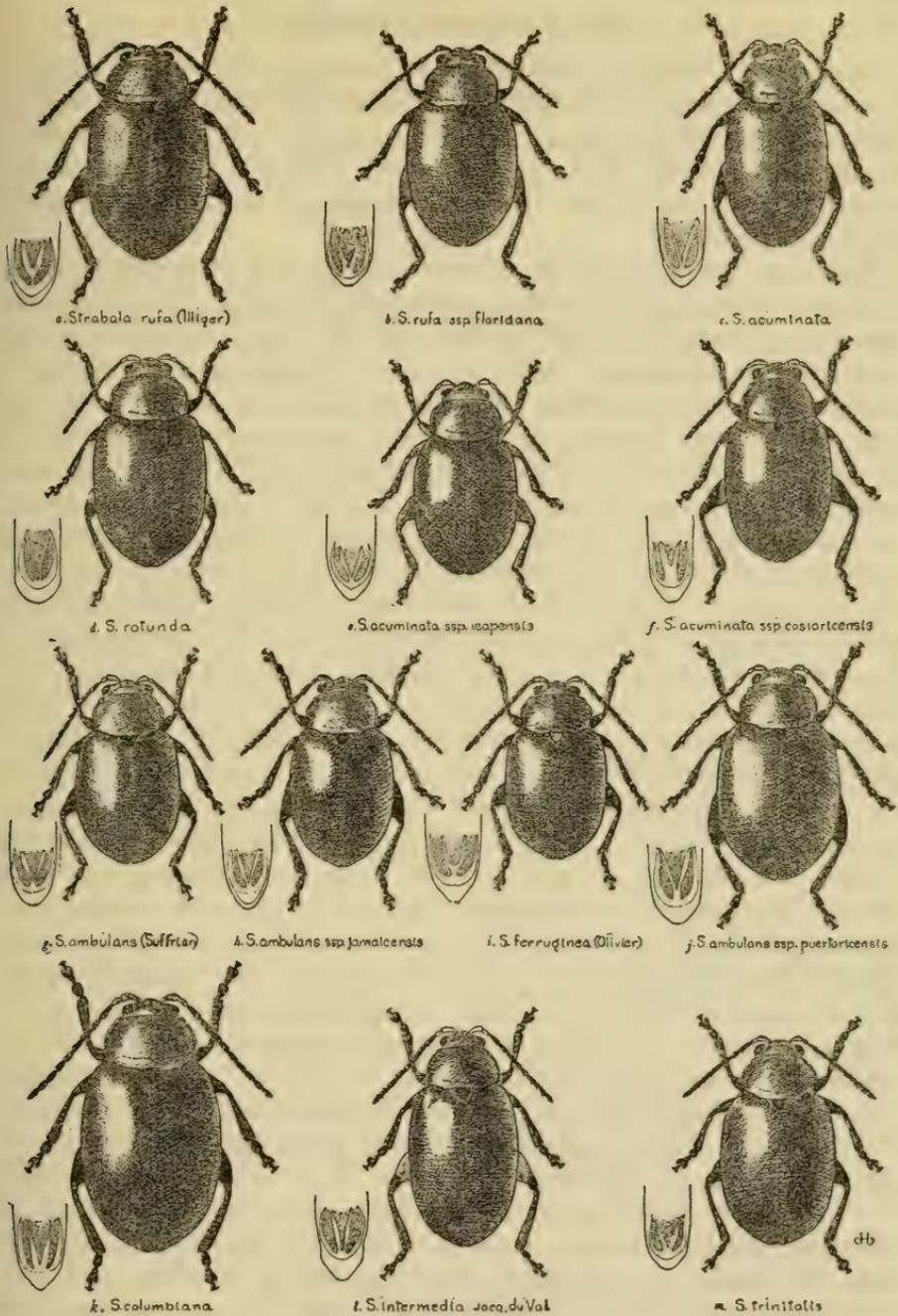


FIGURE 17.—Species of *Strabala* Chevrolat: *a*, *rufa* (Illiger); *b*, *rufa floridana*, new subspecies; *c*, *acuminata*, new species; *d*, *rotunda*, new species; *e*, *acuminata teapensis*, new subspecies *f*, *acuminata costaricensis*, new subspecies; *g*, *ambulans* (Suffrian); *h*, *ambulans jamaicensis*, new subspecies; *i*, *ferruginea* (Olivier); *j*, *ambulans puertoricensis*, new subspecies; *k*, *columbiana*, new species; *l*, *intermedia* Jacquelin Du Val; *m*, *trinitatis*, new species.

Genus *Strabala* Chevrolat

Description.—Between 3.5 and 6 mm. in length, oval, deep yellowish or orange brown or reddish brown, with antennae dark, legs and under-surface more or less dark, and scutellum usually conspicuously dark; moderately shining, most species very minutely and confusedly punctate, only the North American species, *S. rufa* (Illiger), very distinctly punctate.

Head, except for mouth parts that are usually a little darker, deep yellowish or reddish, eyes entire and widely separated, the interocular space being more than half the width of the head; occiput smoothly rounded down to tubercles, with scattered and not very dense or coarse punctures; at the base of occiput, not visible except when the head is a little protruded, a groove running from behind one eye to the other; on either side above the frontal tubercles and near the eye a depression consisting of a large fovea, or more frequently a circle of punctures; frontal tubercles plainly marked, a broadly rounded and somewhat produced area between antennal sockets that extends and widens down the front nearly to the labrum, area under sockets a little depressed and on sides below eyes the cheeks rounded out and densely punctate. Antennae rather stout, not quite reaching the middle of the elytra, first two joints swollen, usually paler, remainder piceous, third joint a little longer than fourth, fourth and fifth about equal. Prothorax not quite twice as wide as long, with rounded sides and narrow margin, the apical angle resembling that of *Disonycha* except that it is separated from the rest of the margin by a distinct though tiny V-shaped indentation, basal angle with a small tooth and obliquely cut, disk smooth and rather flat, with more or less of a depression along base and not distinctly limited at the ends as in *Lactica*. Scutellum large, usually conspicuously dark, contrasting with the reddish elytra. Elytra broader than prothorax, moderately convex, with small humeri and narrow margin, not depressed; surface usually smooth, not distinctly punctate except in *S. rufa*, entirely yellowish or reddish brown. Epipleura broad, gradually diminishing and not quite reaching the apex. Body beneath variable in color, the prosternum reddish, the breast and abdomen and legs in West Indian species usually but not always dark, in North American species the breast dark on the sides, the femora pale except in apical half or sometimes entirely pale, the tibiae and tarsi dark, the sides and apex of the abdomen sometimes also dark; in Trinidad and South American species, the coloring beneath dark as in the West Indian specimens. Anterior coxal cavities open, front coxae narrowly separated, legs rather short, hind femora moderately thickened, the tibiae as in *Disonycha* with a slight ridge, a spur at the end of posterior tibiae, claws appendiculate.

deep reddish brown above, with entirely dark antennae, dark scutellum, often entirely dark anterior legs, dark apical end of the posterior femora, dark breast, and sometimes also dark abdomen. Throughout its range over the country east of the Mississippi and in Louisiana and Texas, there seems to be very little variation except for the paler, less distinctly punctate race that occurs in Florida. The type locality is Pennsylvania, collected by Melsheimer.

Distribution.—New Hampshire: Hampton, S. A. Shaw. Massachusetts: Holyoke, Chicopee, F. Knab. Connecticut: Hartford, F. Knab. Rhode Island: Watch Hill, W. Robinson. New York: West Point, W. Robinson. New Jersey: Boynton. Illinois: C. Thomas. Michigan: Detroit, Hubbard and Schwarz. Maryland: Washington, D. C. Virginia: Fredericksburg, Clifton, J. C. Bridwell; Nelson County, W. Robinson; Stone Creek, Lee County, Hubbard and Schwarz; Vienna, J. C. Bridwell; West Falls Church, E. A. Chapin. West Virginia: Aurora. Kentucky: H. Soltau. Tennessee: Memphis, H. Soltau. North Carolina: Graybeard Mountain. South Carolina: Florence. Georgia: Savannah. Alabama: Coleta, H. M. Smith. Mississippi: Greenwood, T. H. Parks. Louisiana: Baton Rouge, T. H. Jones; Port Allen, J. L. Lauderdale; New Orleans, H. Soltau. Texas: Liberty, R. A. Vickery. Two specimens, both females, USNM (Brooklyn Museum collection), labeled simply "Mexico," are apparently this species.

Strabala rufa floridana, new subspecies

FIGURE 17, b

This race differs from the reddish brown one found elsewhere in eastern United States by being (in dried specimens) pale yellow-brown with the dark markings as in typical *rufa*. The elytra are less distinctly punctate than in *rufa* and distinctly alutaceous.

Type.—Holotype male and 7 paratypes, USNM 61202, labeled simply "Fla.," collector F. Knab.

Distribution.—Florida: Lake Ashby, Capron, Indian River, all collected by Hubbard and Schwarz; Lake Wales, Lakeland, E. M. Craighead; Jacksonville, Ashmead; Sanford, Van Duzee; St. Petersburg (on sweet corn); Ft. Myers (on sweet and white potato); Oneco (on spinach); Homestead (on string beans); West Palm Beach (on sweet potato and lima beans).

Strabala acuminata, new species

FIGURE 17, c

From 4.5 to 5.5 mm. in length, oval, shining, orange-brown, with dark antennae, dark scutellum, darkened sides to breast, and dark anterior legs and apical part of posterior femora, tibiae, and tarsi.

Head shiny, only a few scattered punctures over occiput besides the fovea or circle of depressed punctures near the eye; mouth parts frequently edged with deeper brown. Antennae deep brown, with the three basal joints frequently paler. Prothorax shiny, almost impunctate, only under high magnification are very fine punctures visible; basal sulcus usually not very long or pronounced, but somewhat variable in different specimens, as is usual in the genus. Scutellum dark. Elytra mirror smooth, shining, impunctate, sometimes very indistinctly alutaceous. Body beneath with sides of breast, anterior legs, apical part of posterior femora, tibiae, and tarsi dark. Length 4.4 to 5.5 mm.; width 2.4 to 3 mm.

Type.—Holotype male and 2 paratypes, USNM 61203 (Brooklyn Museum collection), collected at the Esperanza Ranch, Brownsville, Texas, August 18 (no year given).

Other localities.—Texas: Brownsville, R. A. Vickery; another specimen, from same locality (on string bean leaves); San Benito (on bean foliage); Hidalgo (on black-eyed-pea leaf).

Remarks.—The shiny, almost impunctate surface with little evidence of alutaceous dullness at once differentiates this from *Strabala rufa* (Illiger). There are no records of it farther north than the Brownsville region.

Strabala acuminata teapensis, new subspecies

FIGURE 17, e

Lactica scutellaris Olivier, Jacoby (part), *Biologia Centrali-Americana*, vol. 6, pt. 1, p. 273, 1884.

This differs from the Brownsville, Texas, race in having less dark coloring, the femora all being deep reddish, the tibiae and tarsi only dark, and the sides of the breast not so dark. The upper surface is a shining deep reddish brown. The aedeagus has a somewhat truncate tip.

Type.—Holotype male, in the British Museum (Natural History), from the *Biologia Centrali-Americana* material, labeled by Jacoby *Lactica scutellatis* Olivier, from Teapa, Tabasco, México, collected in March by H. H. Smith; 1 paratype in U. S. National Museum, USNM 61204; and 2 paratypes in Museum of Comparative Zoology from same series.

Strabala acuminata costaricensis, new subspecies

FIGURE 17, f

Lactica scutellaris Olivier, Jacoby (part), *Biologia Centrali-Americana*, vol. 6, pt. 1, p. 273, 1884.

This differs from the Brownsville, Texas, and Teapa, México, races by having a still wider truncate tip to the aedeagus. In coloring, it

is somewhat deeper red than the Brownsville specimens and differs from the Teapa specimens in having the anterior femora and apical part of the posterior femora as well as the sides of the breast dark.

Type.—Holotype male and 1 paratype, USNM 61205, collected at Vara Blanca, Costa Rica, 1,700 meters, July 7, 1928, by F. Nevermann; 1 paratype in British Museum (Natural History).

Other localities.—Costa Rica: San José, 1,000–2,000 meters, Aug. 25, 1928, F. Nevermann. Guatemala: Yepocapa, August 1948, H. T. Dalmat; Cobán, Alta Vera Paz, May 1926, J. M. Aldrich; Purula, Champion

Strabala rotunda, new species

FIGURE 17, d

Lactica scutellaris Olivier, Jacoby (part), *Biologia Centrali-Americana*, vol. 6, pt. 1, p. 273, 1884.

From 4 to 5.5 mm. in length, oval, shining although faintly alutaceous, very finely punctate, yellowish or reddish brown with dark antennae, dark apex to femora, dark tibiae and tarsi, and the breast and abdomen often darkened on the sides, varying to entirely dark (rare).

Head reddish, with the mouth parts usually deeper brown; finely punctate over occiput, with the usual fovea or circle of depressed punctures. Prothorax shiny and very finely punctate with a sulcus along the base well developed. Scutellum dark. Elytra faintly alutaceous and finely punctate. Body beneath varying in color from having the sides of breast and abdomen deeper brown to being entirely dark, the latter rare; femora with apical half dark, tibiae and tarsi dark. Length 4 to 5.4 mm.; width 2.6 to 3 mm.

Type.—Holotype male, USNM 61206, and 3 paratypes in British Museum (Natural History) collected at Volcán de Chiriquí, Panamá, by Champion.

Other localities.—Panamá: Panamá, Aug. 13, 1946, by N. L. H. Krauss; Almirante, Sept. 4, 1938, H. Dybas; Bella Vista, Aug. 7, 1924, N. Banks; Mindi Dairy (on para grass), Mindi, Canal Zone, July 1918, H. F. Dietz and J. Zetek; Plantation Borracho, Canal Zone (swept from grass under papaya trees), July 1918, H. F. Dietz and J. Zetek; Bugaba, Champion (in British Museum). Guatemala: Trece Aguas, Alta Vera Paz, May (date not given), H. S. Barber and E. A. Schwarz. México: In bananas from México taken at Mobile, Alabama, July 19, 1929; with orchids from Guerrero (State), taken at Laredo, Texas, Feb. 28, 1940; with orchids from Tamazunchale, San Luis Potosí, taken at Laredo, Texas, Feb. 28, 1940; with tomatoes from El Mante, Tamaulipas, taken at El Paso, Aug. 1, 1947; Colima,

Höge and Conradt; Jalapa, Höge; on green peppers from Manuel, Tamaulipas, taken at Laredo, Texas, Jan. 7, 1935.

Remarks.—H. S. Barber has attached a specific name from the Mexican localities to this species, but since the range is as far south as Panamá, his name would be somewhat misleading. The rounding of the tip of the aedeagus varies considerably but the slight constriction behind the tip is always present, and sets the species apart from the rest. The only other species with a similar aedeagus tip in the group is *Strabala intermedia* Jacquelin Du Val, from Cuba. In all, 15 specimens of *S. rotunda* have been taken on orchids from México at the port of entry to this country.

Strabala ambulans (Suffrian)

FIGURE 17, *g*

Haltica ambulans Suffrian, Arch. Naturg., vol. 34, p. 182, 1868.

Specimens from Cuba agree with Suffrian's detailed description of his Cuban *H. ambulans*. The upper surface is faintly alutaceous and finely punctate, in color a deep reddish brown with dark scutellum and dark legs, breast, and abdomen.

Distribution.—Cuba: Cayamas, E. A. Schwarz; Central Jaronú, L. C. Scaramuzza; Baragua, L. C. Scaramuzza, L. D. Christenson (MCZ); upper Yara Valley, Oct. 18, 1928, L. C. Scaramuzza (MCZ); Soledad, Cienfuegos, Nov. 7, 1926, P. J. Darlington (MCZ); Aguada (MCZ); Mountains north of Imias, eastern Oriente Province, July 25–28, 3–4,000 feet, P. J. Darlington (MCZ).

Strabala ambulans jamaicensis, new subspecies

FIGURE 17, *h*

Between 3.5 and 4.5 mm. in length, oval, faintly shining, indistinctly alutaceous, very finely punctate, reddish brown, the mouth parts, antennae, legs, breast, and abdomen dark.

Head with scattered punctures, the usual fovea or circle of punctures between eye and frontal tubercle on each side. Antennae with the basal joints a little paler. Prothorax having a distinct sulcus along the base. Scutellum dark. Elytra very faintly punctate. Body beneath with breast, abdomen, and legs dark. Length 3.5 to 4.5 mm.; width 2 to 2.3 mm.

Type.—Holotype male and 10 paratypes, USNM 61207, collected at Manchioneal, Jamaica, Jan. 30, 1939, by E. A. Chapin and R. E. Blackwelder.

Other localities.—Jamaica: Roaring River Falls, St. Ann's Parish, Sept. 13, 1917, H. Morrison; Fern Gully, St. Ann's Parish, Sept. 14,

1917, H. Morrison; Mandeville, Van Duzee, A. E. Wight (MCZ); Montego Bay, Mar. 2, 1911; Balaclava (MCZ).

Remarks.—This subspecies differs only slightly from the Cuban race in having a more acute though still rounded tip to the aedeagus.

Strabala ambulans puertoricensis, new subspecies

FIGURE 17, *j*

Between 4.5 and 5 mm. in length, oval, shiny, elytra not alutaceous, very indistinctly punctate, reddish brown, antennae, mouth parts, legs, breast and abdomen dark.

Head with scattered punctures and a fovea or circle of punctures near the eyes. Antennae with paler basal joints. Prothorax not at all clearly depressed along the base. Scutellum dark. Elytra quite shiny, not alutaceous, very finely and indistinctly punctate. Body beneath dark except the prosternum. Length 4.5 to 5 mm.; width 2.5 to 3 mm.

Type.—Holotype male and 1 paratype, USNM 61208; 1 paratype in Museum of Comparative Zoology, taken at Adjuntas, Puerto Rico, Nov. 1, 1932, by R. G. Oakley.

Other localities.—Puerto Rico: Lares, September 1921, G. N. Wolcott; Arecibo, June 17, 1932 (on eggplant leaf), Anderson and Mills; Mayagüez, January 1899, A. Busck; Villalba, June 18, 1934, C. M. Matos (MCZ); Mayagüez, December 1932, V. Alexandrina (MCZ).

Remarks.—The shiny, not alutaceous elytra, the larger size, and the broad, almost truncate tip of the aedeagus are unlike the Cuban and Jamaican races of the species.

Strabala ferruginea (Olivier)

FIGURE 17, *i*

Altica ferruginea Olivier, Entomologie . . . , vol. 6, p. 697, 1808.

Strabala ferruginea Chevrolat, in d'Orbigny, Dictionnaire universel d'histoire naturelle, vol. 12, p. 52, 1848.

Olivier's description of the scutellum of this species as ferrugineous would differentiate it from the rest of the West Indian species even if he had not given the type locality as Santo Domingo. He described the color of the undersurface as black and this agrees with many of the specimens, but there is a certain variation in the coloring, some specimens being entirely ferrugineous beneath, others with dark legs and reddish breast and abdomen, others with dark legs, breast, and abdomen. Moreover the pronotum and elytra are finely and a little more distinctly punctate than in Cuban and Jamaican species and not at all alutaceous. The aedeagus, having a truncate tip, resembles the Puerto Rican specimens more than the Cuban or Jamaican.

Distribution.—Haiti: La Vanneau, June 1920, Bizotan, Nov. 3, 1925, Diguini, Apr. 14, 1925, all collected by W. A. Hoffman; Grande Rivière, W. M. Mann; Ile de la Tortue, April 1929, E. C. and G. M. Leonard; Port-au-Prince and vicinity, October 1934, P. J. Darlington (MCZ); Miragoâne, October, November, P. J. Darlington (MCZ); Carrefour, May 1–3, 1908, M. Cameron (British Museum). Dominican Republic: August Busck; Macoris, Mar. 26, 1913, P. G. Russell; Puerto Plata, Hurst (MCZ); Santiago, 1938, P. J. Darlington (MCZ) Sánchez, July 1938, P. J. Darlington (MCZ).

Strabala intermedia Jacquelin Du Val

FIGURE 17, l

Strabala intermedia Jacquelin Du Val, in Ramón de la Sagra, Historia . . . de la Isla de Cuba (Spanish ed.), vol. 7, p. 129, 1857.

In coloring, three old specimens in the Museum of Comparative Zoology labeled "Cuba" resemble Jacquelin Du Val's short description. They are deep yellowish brown with dark antennae, dark scutellum, dark tibiae and tarsi; the anterior femora and the apex of the posterior femora are dark. In size they are slightly larger than the measurements given for *S. intermedia*; instead of being $3\frac{3}{4}$ mm. they are 4.5 to 5.5 mm. in length. In two, both females, the basal thoracic sulcus is pronounced, almost like that of a true *Lactica*, but in the third specimen, a male, the depression along the base is less marked. The surface is faintly alutaceous and finely punctate. In all three specimens the head is rather densely punctate in addition to the circle of depressed punctures near the eye. The coloring of these specimens is more like that of the North American species. The aedeagus, although essentially the same as in all the others, is distinctive in being slightly constricted behind the tip as in the Mexican and Central American species *S. rotunda*, but differs in having a more acute tip.

Strabala colombiana, new species

FIGURE 17, k

From 5 to 6 mm. in length, oblong oval, deep reddish brown, the antennae, breast, abdomen, and legs dark, shining, not alutaceous, very finely, and the elytra rather densely, punctate.

Head usually entirely deep reddish brown, shining, with scattered fine punctures over occiput and the usual depressed circle of punctures or fovea near eye. Antennae short, dark, the two basal joints paler. Prothorax shiny, finely punctate, a depressed line near base. Scutellum dark. Elytra shiny, very finely and indistinctly punctate. Body beneath with breast and abdomen deep piceous, legs dark. Length 5 to 6 mm.; width 2.8 to 3.2 mm.

Type.—Holotype male, in Museum of Comparative Zoology, and 1 paratype, USNM 61209, from Bogotá, Colombia, from the Bowditch collection, Jacoby's second collection.

Other localities.—Colombia; Nueva Granada; Venezuela; and Caracas; all in the Bowditch collection, Jacoby's second collection.

Remarks.—Among the material presented to the U. S. National Museum from the Bowditch collection is a single old specimen of *Strabala* sp. with the label "*Lactica=Strabala haematina* Dej" from "Nov. Granad." This may be one of the specimens listed in the Dejean Catalogue from Cartagena since it bears the old Dejean Catalogue name. The aedeagus of this old specimen has a rounded tip quite unlike the one from Bogotá with its acute tip, and is probably not the same species.

Strabala trinitatis, new species

FIGURE 17, *m*

From 4 to 4.9 mm. in length, oval, shiny, not alutaceous, finely but distinctly punctate, yellowish or reddish brown with darker antennae, scutellum, legs, breast and abdomen.

Head entirely reddish, shiny, finely punctate over occiput. Antennae dark, with the first two or three joints paler. Prothorax shiny, finely punctate, with a moderately developed sulcus over the scutellum. Elytra distinctly and rather densely punctate, shiny, not at all alutaceous. Body beneath with breast, abdomen, and legs deep reddish brown. Length 4 to 4.9 mm.; width 2.5 to 2.7 mm.

Type.—Holotype and 4 paratypes, British Museum, and 1 paratype, USNM 61210, collected in Trinidad in 1903 by G. E. Bryant.

Other localities.—Two specimens (USNM) collected by A. Busck on June 12 at Montserrat, Trinidad.

Remarks.—The specimens in this series, although of the coloration of the ones from Colombia and Venezuela, are smaller, more oval, and distinctly though finely punctate. The tip of the aedeagus is truncate and not at all acute as in the single male specimen from Bogotá.

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3320

AMERICAN BITING MIDGES OF THE HELEID GENUS
MONOHELEABy WILLIS W. WIRTH¹

The genus *Monohelea* was founded by Kieffer (1917) for a new species, *hieroglyphica*, from Paraguay, and three other American species were included: *Ceratopogon sequax* Williston, 1896; *C. maculipennis* Coquillett, 1905; and *C. nebulosa* Coquillett, 1901. Since then a number of species have been added to the genus, including representatives from each of the world's zoogeographic regions. However, with the exception of Lee's (1948) treatment of the eight Australasian species, no comprehensive paper on the genus has yet appeared.

A study of the American *Monohelea* has resulted in the recognition of 7 undescribed species, bringing the total for the hemisphere to 13. No doubt many more await discovery. These American species fall in four distinct groups, each with characteristic wing and leg markings. Within these groups the species are rather difficult to separate, for the characters which prove useful in one group may be valueless in others. These groups may also be recognized by characters of the male genitalia, which offer in addition good specific characters.

The generic position of *Ceratopogon sequax* Williston, based on a male from St. Vincent, cannot be determined with certainty until the male genitalia or the female are studied. According to the original description, *sequax* would probably fit as well in *Stilobezzia*. Similarly, the male recorded as *Monohelea* sp. by Floch and Abonnenc (1942) from French Guiana could be either *Monohelea* or *Stilobezzia*, since in their figure of the male genitalia the aedeagus is omitted.

The types of five of the new species, as well as most of the specimens studied, are in the U. S. National Museum. For the loan or donation

¹ Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

of other specimens examined I am deeply grateful to Paul Freeman, of the British Museum (Natural History), to Henry Dietrich, of Cornell University, and to John Lane, of the University of São Paulo. For the generous gift or loan of still other specimens I wish to thank Mrs. Elisabeth C. Beck and J. A. Mulrennan of Jacksonville, Florida, Bernard Brookman of San Francisco, California, Jean A. Laffoon of Ames, Iowa, and Henry K. Townes of Raleigh, North Carolina.

The figures of the wings and legs were made with the aid of a microprojector and those of the male genitalia with the aid of an ocular reticule disc and squared paper. No consistent scale was used.

Family HELEIDAE

Genus *Monohelea* Kieffer, 1917

Diagnosis.—Body short, not very hairy. Eyes bare. Mesonotal pits present but small. Forelegs and midlegs unmodified; fourth tarsal segments cylindrical and claws small and equal in both sexes; hind leg with femur and tibia more or less thickened, but without spines, basitarsus with a spine at tip, fourth segment cylindrical, fifth segment in female with one very long claw, the other absent or very short, male claws small and equal except hind claw as in female in *tessellata* group; empodium absent. Wings with fine microtrichiae, a few macrotrichiae at wing tip; costa extending well beyond middle of wing; two radial cells, second longer than first; intercalary fork fairly distinct; crossvein r-m vertical; median fork with short stem, M_2 sometimes interrupted at base; anal vein thickened in middle, but without fold at thickening. Male genitalia with ninth tergite tapered, the caudal margin truncate or broadly bilobed; aedeagus usually with a pair of sharp-pointed, tapered, lateral sclerites and an accessory, dorsomedian, posterior lobe; parameres consisting of paired, submedian sclerites of irregular shapes.

Key to the American species of *Monohelea*

1. Wings without markings; mesonotum shining black (subgenus *Schizohelea*).
 1. *leucopeza* (Meigen)
Wings with pronounced dark markings; mesonotum pruinose, often with markings (subgenus *Monohelea*)..... 2
2. Hind femur and tibia yellow, with dark brown rings (*hieroglyphica* group) - 3
Hind femur and tibia shining black, only knee spot yellow..... 9
3. Forelegs and midlegs with distinct dark brown bands; wings often with extensive macrotrichiae..... 4
Forelegs and midlegs yellowish, without distinct bands; wings with macrotrichiae only at extreme distal margin..... 6
4. Wings with macrotrichiae over distal third; wing markings extensive.... 5
Wing without apparent macrotrichiae; wing markings reduced, X-shaped marking in cells M_1 and M_2 broken up into 3 discrete spots.

6. *texana*, new species

5. Wing with about 20 small, scattered, black dots in addition to the irregular, diffuse gray markings; fore tibia and midtibia dark only at apices; scutellum uniformly whitish..... 8. **brasiliensis** Lane
Wing with uniformly gray, irregular markings, without small, black dots; fore tibia and midtibia entirely dark; scutellum dark in middle.
7. **ornata**, new species
6. Hind femur brown on basal third; scutellum dark in middle; wing markings not whitish bordered..... 7
Hind femur with broad yellow band on sub-basal fourth; scutellum uniformly dull whitish; wing markings bordered with whitish pruinosity.
3. **maculipennis** (Coquillett)
7. Basal and median brown bands on hind tibia joined with brown, at least on ventral side; male parameres each with 2 or 3 distal lobes..... 8
Basal and median brown tibial bands separated by a broad yellow band; male parameres each with simple, bladeliike apex..... 5. **macfieii**, new species
8. Sinuate, dark, wing marking in cells M_1 and M_2 entire; male parameres with broad, rounded distal lobes..... 4. **lancki**, new species
Sinuate, dark, wing marking broken into 3 or 4 separate spots; male parameres with slender, pointed, distal lobes..... 2. **hieroglyphica** Kieffer
9. Scutellum yellow, brown in middle; wing with 2 prominent, small, black spots, spot absent in basal cell; hind basitarsus about 2.5 times as long as second segment; mesonotum yellowish, with tiny brown dots (*multilineata* group) 10
Scutellum entirely dark brown or yellow only in middle; wing with two prominent anterior spots plus a spot in basal cell; hind basitarsus 1.3 to 2.0 times as long as second segment (*tessellata* group)..... 12
10. Ninth sternite of male with 4 long hairs arising from tubercles in a row at base of median lobe..... 11
Ninth sternite of male with 2 long hairs arising from base of median lobe; parameres not connected, with irregular, twisted apices; female abdomen pruinose gray above, with small, lateral, shining brown spots.
9. **stonei**, new species
11. Male aedeagus with broad, bilobed apex; parameres not connected, recurved apices long and scimitar shaped; female abdomen pruinose gray above, with narrow, shining brown bands broadening at margins of segments.
10. **multilineata** (Lutz)
Male aedeagus cleft one-third way to base, with a pair of long, slender, apical points; parameres broadly connected at bases, recurved apices with broadly rounded lobes..... 11. **guianae**, new species
12. Mesonotum pruinose gray with dark-brown spots or irregular patches; scutellum yellow in middle, with about 8 marginal hairs; wing bands distinct to hind margin, usually strongly interconnected... 12. **nebulosa** (Coquillett)
Mesonotum dark brown with irregular, pruinose, gray spots; scutellum usually entirely black, with 4 marginal hairs; wing bands faint behind vein M_1 , usually rather well separated..... 13. **johannseni**, new species

Subgenus *Schizohalea* Kieffer, 1917

- Schizohalea* Kieffer, Ann. Mus Nat. Hungarici, vol. 15, p. 295, 1917, vol. 16, p. 57, 1918, and vol. 17, p. 89, 1919.—Goetghebuer, Mem. Mus. Hist. Nat. Belgique, vol. 8, p. 65, 1920.—Edwards, Trans. Ent. Soc. London, vol. 74, p. 411, 1926.—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 782, 1943. (Genotype, *Ceratopogon copiosus* Winnertz; monobasic.)
Allohelea Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 364, 1917. (Genotype, *Sphaeromyas pulchripennis* Kieffer; original designation.)

Following Goetghebuer (1934), I regard *Schizohalea* as a subgenus for *leucopeza* Meigen.

Diagnosis.—This species differs rather markedly from the other species of *Monohelea* in having the second branch of the media broadly interrupted at the base, basitarsus without apical spine, and male genitalia with emarginate sternite and arched aedeagus.

1. *Monohelea (Schizohalea) leucopeza* (Meigen), 1804

FIGURE 18, m

Ceratopogon leucopeza Meigen, *Klassifikation und Beschreibung . . . Insekten*, vol. 1, p. 29, 1804.

Ceratolophus leucopeza, Kieffer, *Genera insectorum*, fasc. 42, p. 60, 1906.

Schizohalea leucopeza, Edwards, *Trans. Ent. Soc. London*, vol. 74, p. 411, 1926.—Séguy, *Faune de France*, pt. 8, p. 70, 1937.

Monohelea (Schizohalea) leucopeza, Goetghebuer, in Lindner, *Die Fliegen der Palaearktischen Region*, Lief. 78, p. 53, 1934.

Ceratopogon albitarsis Wiedemann, *Zool. Mag.*, vol. 1, p. 67, 1817.

Ceratopogon copiosus Winnertz, *Linn. Ert.*, vol. 6, p. 56, 1852.

Ceratolophus copiosus, Kieffer, *Genera insectorum*, fasc. 42, p. 60, 1906.

Schizohalea copiosa, Kieffer, *Ann. Mus. Nat. Hungarici*, vol. 15, p. 295, 1917; idem, vol. 16, p. 57, 1918; idem, vol. 17, p. 89, 1919.—Goetghebuer, *Mem. Mus. Hist. Nat. Belgique*, vol. 8, p. 66, 1920.—Kieffer, *Faune de France*, pt. 11, p. 116, 1925.

Ceratopogon politus Coquillett, *Proc. U. S. Nat. Mus.*, vol. 23, p. 606, 1901 (♀, Massachusetts).

Ceratolophus politus, Kieffer, *Genera insectorum*, fasc. 42, p. 61, 1906.

Johannseniella polita, Malloch, *Bull. Illinois State Lab. Nat. Hist.*, vol. 10, p. 227, 1914.

Johannsenomyia polita, Malloch, *Bull. Illinois State Lab. Nat. Hist.*, vol. 10, p. 335, 1915 (New York).

Sphaeromyias polita, Kieffer, *Ann. Mus. Nat. Hungarici*, vol. 15, p. 364, 1917.

Allohelea polita, Kieffer, *Ann. Mus. Nat. Hungarici*, vol. 15, p. 364, 1917.

Schizohalea polita, Johannsen, *Ann. Ent. Soc. Amer.*, vol. 36, p. 782, 1943 (? = *leucopeza* Meigen).

Bezzia stecki Kieffer, *Brotéria*, Ser. Zool., vol. 13, p. 65, 1915.

Description.—FEMALE: Length 1.5 mm., wing 1.2 mm. by 0.5 mm. Entirely shining black, only the tarsi, wings, and halteres white. Antennae quite short, the distal segments scarcely elongated. Mesonotum with scattered, erect, long, black hairs; scutellum with six long marginal hairs. Second radial cell half again as long as the first, M_2 broadly interrupted at base. Spermathecae two, subequal, rather small and subspherical, the ducts sclerotized a short distance.

MALE (based on specimen from Suffolk, England): Ninth sternite about three times as broad as long, with a shallow, round emargination in middle of caudal margin, not spiculate; ninth tergite narrow, surpassing basistyles, distal half with margins subparallel, apex truncate with setose apicolateral corners, the inner surface coarsely spiculate. Basistyles broad at base, each with a distinct lobe bearing three setose tubercles on inner side; abruptly narrowed on distal half; dististyles

TABLE 1.—Proportions of segments of hind legs of female *Monohelea* species

Species	Cx	Tr	F	Ti	T ₁	T ₂	T ₃	T ₄	T ₅
1. <i>leucopeza</i>	25	10	65	65	30	12	10	8	12
2. <i>hieroglyphica</i>	30	10	80	72	40	16	9	8	8
3. <i>maculipennis</i>	20	10	55	50	24	11	8	6	4
4. <i>lanei</i>	25	10	65	60	35	17	10	8	8
5. <i>macfieii</i>	20	10	60	55	30	15	10	7	7
7. <i>ornata</i>	24	8	72	68	33	16	9	7	7
9. <i>stonei</i>	30	10	80	70	50	20	12	8	10
10. <i>multilineata</i>	28	12	88	80	50	20	12	8	8
12. <i>nebulosa</i>	28	12	80	70	24	12	6	8	8
13. <i>johannseni</i>	25	10	70	65	25	12	8	10	10

nearly as long as basistyles, rather strongly curved. Aedeagus in form of a slender, rounded arch nearly as long as broad at base, with a pair of short, pointed, submedian plates projecting dorsocaudad at apex. Parameres with stout, lateral apodemes at bases; stems stout and gently curved, contiguous at midlength, their apices pointed and abruptly bent ventrocephalad on about distal fourth.

Type.—Presumably in the Meigen collection in the Muséum National d'Histoire Naturelle in Paris.

Material examined.—Massachusetts: N. Amherst, June 1940, 4 ♀♀.

New York: Mecklenburg, June 2, 1940, A. Stone, 10 ♀♀; North Ridgeway, June 22, 1940, S. C. Mendall, 1 ♀.

Michigan: St. Joseph, May 30, 1938, C. W. Sabrosky, 6 ♀♀.

England: Corriegills, Arran, June 2-4, 1919, F. W. Edwards, 2 ♀♀; Mildenhall, Suffolk, May 22, 1909, Yerbury, 1 ♂.

Remarks.—This species is found in Europe, West Africa, and northeastern North America.

Subgenus *Monohelea* Kieffer, 1917

Monohelea Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 295, 1917.—Goetghebuer, Mem. Mus. Hist. Nat. Belgique, vol. 8, p. 63, 1920.—Ingram and Macfie, Ann. Trop. Med. Parasit., vol. 15, p. 344, 1921.—Edwards, Trans. Ent. Soc. London, vol. 74, p. 410, 1926.—Tokunaga, Tenthredo, vol. 3, p. 156, 1940.—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943—Lane, Arq. Fac. Hig. Saude Univ. São Paulo, vol. 1, p. 225, 1948.—Lee, Proc. Linn. Soc. New South Wales, vol. 72, p. 350, 1948. (Genotype, *Monohelea hieroglyphica* Kieffer; original designation.)

Diagnosis.—Wings with prominent markings; body with pruinose pattern; ninth sternite of male spiculate and transverse or lobed, not emarginate.

hieroglyphica—group

Diagnosis.—Hind legs conspicuously banded, not markedly swollen; hind tarsi slender; wings with extensive irregular markings; male aedeagus broad, with median, anterior notch and triangular, lateral sclerites with converging, sharp-pointed apices.

2. *Monohalea (Monohalea) hieroglyphica* Kieffer, 1917

FIGURE 19, *g*

Monohalea hieroglyphica Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 312, 1917 (♂, ♀, Paraguay).

Monohalea hieroglyphica, Lane, Arq. Fac. Hig. Saude Pub. Univ. São Paulo, vol. 1, p. 225, 1948 (Brazil).

Discussion.—This is the genotype of *Monohalea*. Macfie's (1937, 1940a) records of this species from Trinidad and British Guiana must, I believe, be referred to *macfiei*, new species, described (see. p. 143), from Louisiana.

Through the kindness of John Lane I have examined a female from km. 47, estrada Rio-São Paulo, Rio de Janeiro, Brazil, collected in February 1945 by P. Wygodzinsky. This is from the same locality as the male described and figured by Lane. Externally this species is almost inseparable from *M. (M.) lanei*, new species (see p. 142), from Florida, but the male genitalia are very close to those of *M. (M.) maculipennis*. A sketch of the male parameres (after Lane) is included here for comparison with those of *maculipennis*.

Types.—In the Musei Nationalis Hungarici in Budapest, ♂, ♀, Paraguay.

3. *Monohalea (Monohalea) maculipennis* (Coquillett), 1905

FIGURES 18, *a, i*; 19, *f*

Ceratopogon maculipennis Coquillett, Journ. New York Ent. Soc., vol. 13, p. 64, 1905 (♀, Florida).—Kieffer, Genera Insectorum, fasc. 42, p. 51, 1906.

Monohalea maculipennis, Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 312, 1917.—Johannsen, Ann. Ent. Soc. Amer. vol. 36, p. 781, 1943.

Diagnostic characters.—A yellowish gray, pruinose species with faint, brown, mesonotal dots, pale yellowish scutellum; hind legs with narrow, dark rings and wings with extensive, irregular, grayish maculations bordered with whitish pruinosity.

Description.—FEMALE: Length 1 mm., wing 1 mm. by 0.4 mm. Head pale yellowish, antennae and palpi brown; proportions of flagellar segments of antennae 12:10:10:12:12:12:12:12:16:16:18:18:24. Palpal segments in proportion of 5:7:10:5:10.

Mesonotum grayish pruinose, with many scattered, small, brown dots at the bases of the dark mesonotal hairs; humeri and sides extensively yellow. Scutellum pruinose, yellowish white, with four marginal hairs, the middle pair quite close together. Postscutellum and pleura pruinose brown, the latter with several indistinct, transverse, darker lines. Legs yellowish, coxae and trochanters brown, upper fourth of midcoxa and hind coxa yellowish; fore femur and midfemur and tibiae unbanded; hind femur (figure 18, *i*) brown at extreme base, two narrow oblique dark rings in middle and a dark, preapical, ventral spot; hind tibia with narrow sub-basal, median, and apical rings; tarsi narrowly

dark at apices of segments. Proportions of segments of hind legs as in table 1.

Wing whitish hyaline, with irregular maculations, grayish by transmitted light, yellowish brown with narrow, whitish pruinose borders by reflected light. Markings composed of a broad, irregular band across wing at level of first radial cell, filling basal half of medio-cubital fork, with a prominent, omega-shaped spur in base of cell R_5 ; a small spot before middle of second radial cell; a more or less quadrate to X-shaped mark across cell R_5 at apex of second radial cell; a sigmoid, subapical mark across cells M_1 and M_2 , often connected by very narrow lines in these cells to mesal band; small, irregular spots across wing near base and a small spot past middle of basal cell. First radial cell about half as long as second, a very few macrotrichiae at apices of cells R_5 and M_1 . Halteres dull white, a black dot on anterior side.

Abdomen dull whitish, sides with irregular, dark patches. Spermathecae two, very unequal, subspherical, each with short sclerotized duct.

MALE: Ninth sternite about twice as broad as long, spiculate, posterior margin transverse, abutting against base of aedeagus, with four long hairs arising from tubercles in a curved row; ninth tergite greatly constricted, with sides subparallel on distal half, apex truncate, apicolateral processes short. Basistyles narrowed on distal halves; dististyles curved to slender, pointed apices. Anterior margin of aedeagus broad, slightly concave, with a small median notch; aedeagus bearing a pair of triangular, submedian sclerites, the bladelike apices of which converge before level of the irregular bilobed apices of an accessory pair of dorsal sclerites. Parameres with flaring, winglike, bilobed, basal apodemes, more or less connected at midlength by a pair of stout mesal lobes, apices each with a straight, long, slender stem bearing a dorsolateral lobe about half as long and of same thickness, just beyond level of mesal bridge.

Type.—USNM 8366, ♀, Florida, Jacksonville.

Material examined.—Florida: Crystal River, Citrus County, July 17, 1950, Hudson, 4 ♀♀; Everglades City, Collier County, Feb. 7, 1950, Davidson, 1 ♂, 9 ♀♀; Fort Myers, Lee County, Feb. 2, 1949, Brechtel, 1 ♂; Islamorada, Monroe County, June 7, 1949, Smith, 1 ♂, 2 ♀♀; Jacksonville, date not given, Slosson, 1 ♀ (type).

México: Ciudad Monte, Tamaulipas, Nov. 22, 1943, Brookman, 1 ♂, 3 ♀♀.

Guatemala: Rio Dulce, Mar. 21, 1906, Schwarz and Barber, 1 ♀.

Panamá: Rio Trinidad, June 9, 1902, Busck, 1 ♀.

Remarks.—Formerly all the North American *Monohalea* with the type of wing pattern characteristic of *hieroglyphica* were called *maculipennis*. Thus in my (1952) paper on California Heleidae, I

erroneously included a California record of *maculipennis* and also cited several eastern records of this species in error. I have now studied the *hieroglyphica* group more intensively and believe I have correctly identified several component species on the basis of male genitalia supported by several rather difficult but constant external characters of the female. In addition to *hieroglyphica* and *maculipennis* there appear to be four or more undescribed species in this complex. Although my California specimen and that reported as *Monohelea* sp. by Johannsen (1943) do not fit any of those described below, probably falling closest to *hieroglyphica* in wing markings, a positive diagnosis of the species must await the collection of the male.

4. *Monohelea (Monohelea) lanei*, new species

FIGURES 18, b, j; 19, e

Description.—FEMALE: Length 1.3 mm., wing 1.1 mm. by 0.4 mm. As in *M. (M.) maculipennis* (Coquillett), but darker and slightly larger. Mesonotum light brown pruinose with faint brown punctures; scutellum brownish in middle. Markings on hind legs stronger; basal third of hind femur brown, a narrow, diagonal band just past middle, then a small, brown, ventral spot and a strong preapical band; basal and median bands on hind tibia broad and joined on ventral side, the distal band broad. Proportions of segments of hind leg as in table 1.

Wing markings darker and more extensive than in *maculipennis*, the omega-shaped mark entirely closed behind by a broad extension of the mesal band, the X-shaped mark in cell R_5 greatly constricted in middle and much broader behind. Macrotrichiae sparse and confined to wing margin; first radial cell about two-thirds as long as second.

Abdomen brown above, yellowish on sides in front and on three distal segments. Spermathecae two, large, very unequal and subspherical.

MALE: Ninth sternite with posterior margin convex in middle, spiculate; ninth tergite tapered to a pair of blunt, triangular, submedian, caudal lobes. Basistyles narrow, nearly straight; dististyles slender, curved, with sharp, incurved points. Aedeagus with basal halves broadly separated by a deep notch in middle of anterior margin, lateral sclerites with broad, triangular bases, the slender, pointed, posterior portions directed caudomesad and meeting each other over tips of a pair of sharp-pointed, dorsal processes. Parameres a pair of irregular, sublateral sclerites joined by an indistinct transverse bridge at a third of the distance from bases; basal apodemes trilobed, directed laterocephalad to bases of basistyles; posterior portions with subparallel inner margins, tips each with apical, knoblike, sclerotized lobe with slightly longer, flattened, roundly flaring, ventral expansions.

Types.—Holotype, ♂, USNM 61091, Miami, Florida, Mar. 25, 1944, Wirth. Allotype with same data as type except date, October 1943. Paratypes: Florida: 2 ♂♂, 5 ♀♀, same, except date, October 1943 to April 1944; 1 ♀, Welaka, June 17, 1946, Bellamy; 1 ♀, Everglades City, Feb. 7, 1950, Davidson.

5. *Monohalea (Monohalea) macfie*, new species

FIGURES 18, c, h; 19, h

Monohalea hieroglyphica, Macfie, not Kieffer (misidentification), Ann. Mag. Nat. Hist., ser. 10, vol. 20, p. 18, 1937 (♀, Trinidad); Ent. Monthly Mag., vol. 76; p. 30, 1940 (♂, British Guiana, genitalia figured).

Description.—FEMALE: Length 1.2 mm., wing 1.4 mm. by 0.5 mm. As in *M. (M.) maculipennis* (Coquillett), but the mesonotum with a pronounced, broad, median, anterior band and a large area between wing bases in front of scutellum uniform brown, the scutellum with a more or less brownish median area. Abdomen suffused, grayish brown above. Legs as figured by Macfie (1937), brown bands on hind legs quite distinct; on hind femur a band on basal third, a diagonal band past middle, and a narrow band subapically; on hind tibia, narrow basal, median, and apical rings; all tarsal segments with narrow apical bands.

Wing as in figure 18, c, the dark areas in the first basal and anal cells quite extensive, the X-shaped mark in cell R₅ large, with the caudo-distal arm more prolonged than shown by Macfie and the distal sigmoid mark in cells M₁ and M₂ connected by broad lines in these cells to the broad median crossband. All wing markings brown by reflected light, gray by transmitted light; a few macrotrichiae at apex of wing.

MALE: The resemblance of the Louisiana male to the male from British Guiana figured by Macfie (1940a) is remarkable. The slender, sinuate, bladelike parameres connected by a narrow bridge at midlength are the most distinctive difference.

Types.—Holotype, ♂, USNM 61092, allotype, Kilbourne, Louisiana, May 10, 1947, Wirth. Paratypes: Louisiana: 2 ♀♀, with same data as type; 1 ♀, Baton Rouge, May 16, 1947, Wirth.

6. *Monohalea (Monohalea) texana*, new species

FIGURE 19, d

Description.—MALE: Wing 1.1 mm. long. Badly damaged, antennae, all of legs but fore femur, midfemur, and tibiae gone. Mesonotum appears discolored, all dark except large quadrate yellow patches on humeri; scutellum light yellow, a minute brown spot in middle of anterior surface. Forelegs and midlegs yellow, narrow basal, median, and subapical faint brown rings on fore femur; narrow basal and

broader median and apical brown rings on fore tibia; broad basal and narrow median brown rings on midfemur and faint median and broad, dark-brown apical rings on midtibia. Wings marked as in *M. (M.) hieroglyphica* Kieffer, the median band broad, the omega-shaped spur distinct and open below, the spot in cell R_5 narrow with the right-hand arms of the X absent, the sinuate mark in cells M_1 and M_2 reduced to three discrete spots; macrotrichiae reduced to a few at wing margin. Halteres yellow with flat ends and a spot on anterior surfaces of knobs dark.

Ninth sternite spiculate, posterior margin broadly convex in middle, with four long hairs arising from bases in an arched row; ninth tergite tapered, with a pair of prominent, apicolateral processes. Aedeagus with basal halves narrowly separated by a deep notch in middle of anterior margin, lateral sclerites with broad, triangular bases, the slender, pointed posterior apices meeting each other at about level of tip of ninth tergite; the dorsal accessory structure bifid a third the way to base of aedeagus, with a pair of very slender lobes with pointed apices curved ventrad and surpassing apices of lateral sclerites. Parameres joined together broadly near middle, each with well-developed basal and lateral arms, stems abruptly bent laterad two-thirds the way to apices, then abruptly bent ventrad, with pointed apices directed mesocaudad.

Type.—Holotype, ♂, Cornell Univ. Type 2787, Limpia Canyon, Davis Mountains, Texas, July 7, 1917, Bradley.

Remarks.—The male genitalia are most distinctive, the simple apices of the parameres allying *M. (M.) texana* with *M. (M.) macfieii*, new species. However, the external features, as nearly as can be ascertained from the badly damaged specimen, are closer to other species, the wing markings being nearly like those of *M. (M.) hieroglyphica* Kieffer, while the front legs and midlegs are banded as in *M. (M.) ornata*, new species, and *M. (M.) brasiliensis* Lane.

7. *Monohelea (Monohelea) ornata*, new species

FIGURE 18, d

Description.—FEMALE: Length 1.2 mm., wing 1.2 mm. by 0.5 mm.

Head pruinose brown, vertex yellowish; antennae broken, pedicel brown; palpi brown. Mesonotum pruinose gray, humeri yellowish; a broad, median, longitudinal band and broad patches above wings rich, velvety brown. Scutellum pruinose, grayish yellow, brown in middle; postscutellum and pleura pruinose dark brown. Fore femur and midfemur dull yellow, with faint median brown bands; fore tibia and midtibia brown; hind femur dark brown on basal third, a broad, diagonal, brown ring past middle and a narrow preapical brown ring;

hind tibia with broad basal and apical rings, and a band just before middle, brown; tarsi dull yellowish. Proportions of segments of hind legs as in table 1; hind femur and tibia with rather long hairs; hind basitarsus with strong basal spine. Claws on forelegs long and equal, nearly as long as fourth and fifth segments combined; midtarsi broken; on hind leg a single long claw half again as long as fifth segment.

Wing grayish hyaline, with very extensive gray maculations as in figure; maculations of *hieroglyphica* type, but much more extensive, with an extra distal, separate spot narrowly connected to the X-shaped mark in cell R_5 , and the subapical mark in cells M_1 and M_2 quite broad. First radial cell about half as long as second; macrotrichiae very extensive, sparsely covering distal third of wing and including most of cell M_{3+4} and anal cell. Halteres not visible. Abdomen uniformly dark, pruinose brown, spermathecae not examined.

Types.—Holotype, ♀, USNM 61093, Santa Rosa Island, Escambia County, Florida, Oct. 10, 1949, Butler.

Remarks.—The wing, mesonotal, and leg markings are so distinctive that I do not hesitate to describe *M. (M.) ornata* from the single female.

8. *Monohelea (Monohelea) brasiliensis* Lane, 1948

Monohelea brasiliensis Lane, Arq. Fac. Hig. Saude Pub. Univ. São Paulo, vol. 1, p. 226, 1948 (♀, Brazil).

Description.—I have not seen this species, which is known only from the type female. Length 1.2 mm., wing 1.3 mm.; mesonotum chestnut, yellowish on sides and in prescutellar depression; scutellum whitish. Legs yellowish, fore femur dark at base, midfemur dark on basal half; fore tibia and midtibia dark at apices; hind femur with two dark rings, one at apex of basal third and one in middle, hind tibia dark at base and apex and indistinctly so in middle. Hind basitarsus 1.8 times as long as second segment. Wing with about 20 black dots in addition to irregular grayish markings; macrotrichiae numerous on distal third of wing; first radial cell slightly over half as long as second (from original description).

Type.—In collection of University of São Paulo, Brazil, No. 6781, ♀, Brazil, Rio de Janeiro, Estrada Rio-São Paulo, km. 47.

multilineata—group

Diagnosis.—Wings with two large anterior dark patches and other fainter irregular markings; scutellum dark in middle; legs dark with yellow knee spots; hind legs slender, the tarsi long and unspined; ninth sternite of male with median, convex lobe and several long hairs, aedeagus long and narrow, parameres very long, with sharp apices.

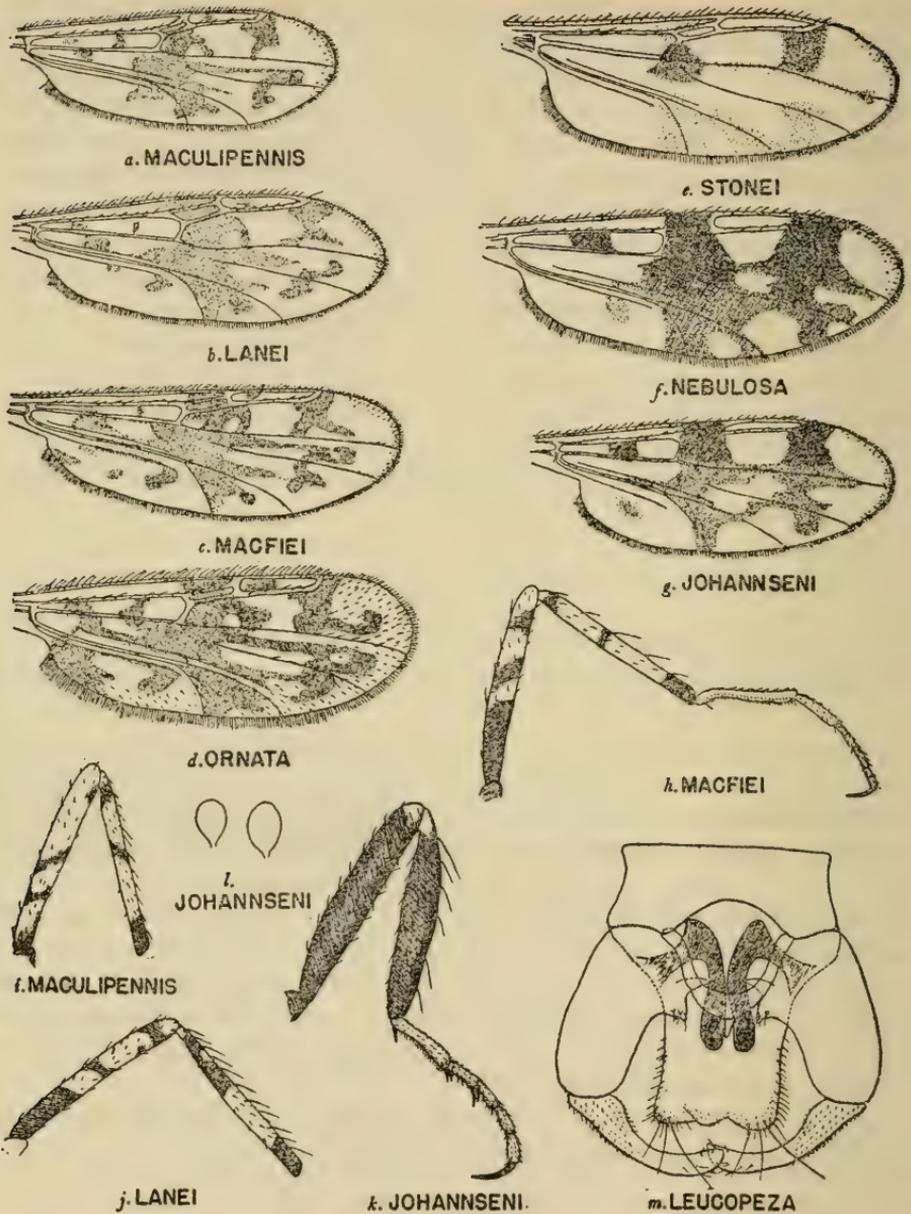


FIGURE 18.—Species of *Monohelea*: a-g, Wings: a, *maculipennis* (Coquillett); b, *lanei*, new species; c, *macfiei*, new species; d, *ornata*, new species; e, *stonei*, new species; f, *nebulosa* (Coquillett); g, *johannseni*, new species. h-k, Hind legs of females: h, *macfiei*, new species; i, *maculipennis* (Coquillett); j, *lanei*, new species; k, *johannseni*, new species. l, Spermathecae, *johannseni*, new species. m, Male genitalia, *leucopeza* (Meigen).

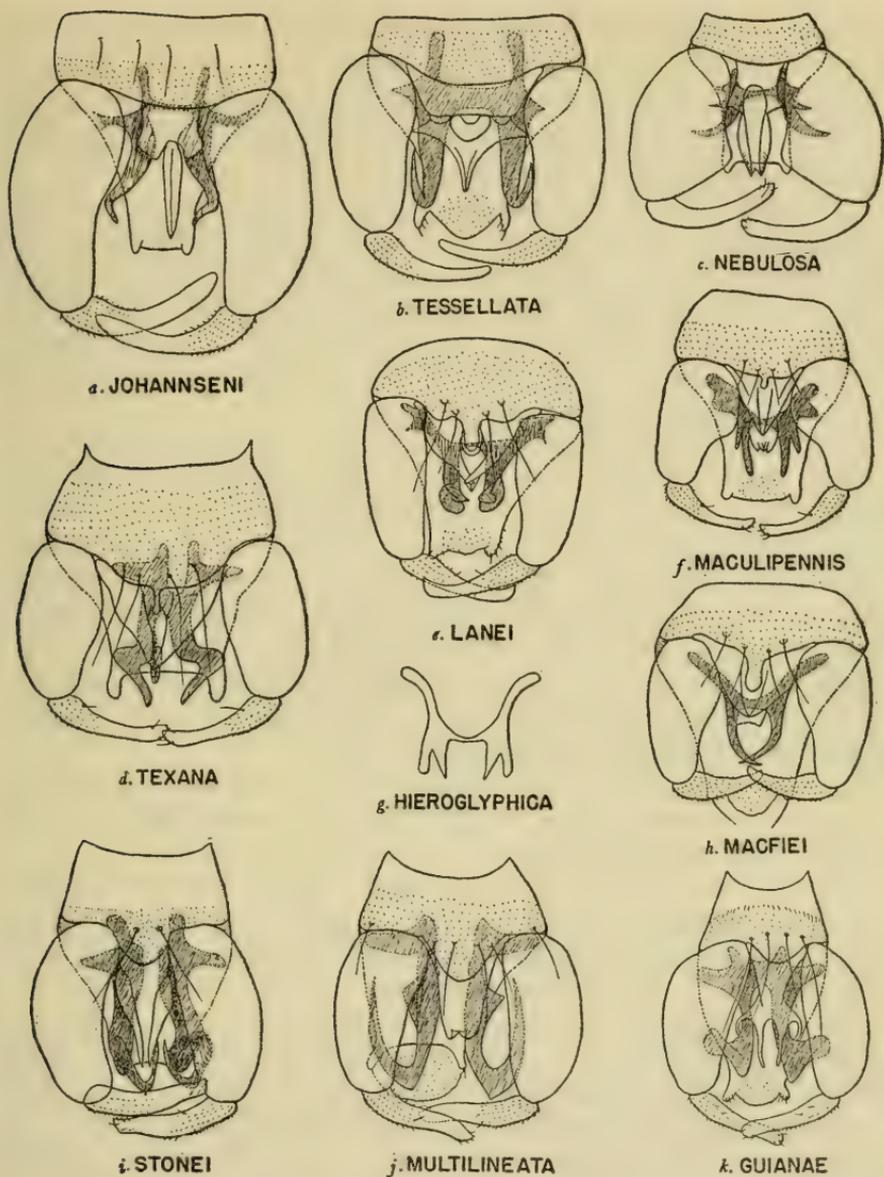


FIGURE 19.—Species of *Monohelea*, male genitalia: *a. johannseni*, new species; *b. tessellata* (Zetterstedt); *c. nebulosa* (Coquillett); *d. texana*, new species; *e. lanei*, new species; *f. maculipennis* (Coquillett); *g. hieroglyphica* Kieffer; male parameres (after Lane); *h. macfiei*, new species; *i. stonei*, new species; *j. multilineata* (Lutz); *k. guianae*, new species.

9. *Monohelea (Monohelea) stonei*, new species

FIGURES 18, e; 19, i

Diagnostic characters.—A yellowish gray, pruinose species with maculate wings; scutellum yellow with brown center; legs dark, abdomen dull gray pruinose above.

Description.—FEMALE: Length 2.0 mm., wing 1.5 mm. by 0.7 mm. Head yellowish, vertex pruinose, pale gray; antenna with pedicel and bases of flagellar segments yellow, apices of short segments and all of long distal segments and palpi brown; proportions of flagellar segments 15:10:10:10:10:10:12:12:18:18:18:18:24. Palpal segments in proportion of 5:8:15:10:15, third segment scarcely swollen, with a rather large sensory pit at midlength.

Mesonotum yellowish gray pruinose, with tiny brown dots at the bases of the brownish mesonotal hairs. Scutellum yellow, brown in middle, with four moderate marginal hairs and a few fine setae. Postscutellum and pleura pruinose dark brown. Coxae brown; trochanters, femora, and tibiae light brown on forelegs and midlegs, black on hind legs; all knees prominently yellowish, tarsi yellow. Hind femur and hind tibia moderately thickened; basitarsus with a slender spine at base, distal tarsal segments on hind legs each with a fine apical spine; a single long claw on each hind leg. Proportions of segments of hind leg as in table 1.

Wing grayish hyaline, with two prominent, black spots and fainter posterior infumation as figured; first radial cell about half as long as second. Halteres infuscated.

Abdomen dark brown, entire dorsum pruinose gray except for a pair of small lateral spots and a pair of submedian sensory dots on each segment, polished brown. Spermathecae two, subequal, ovoid, each with a very short sclerotized duct.

MALE: Similar to the female, with the usual sexual differences; antennal plume golden at base, dark brown toward apex. Ninth sternite three times as broad as long, with a narrow, median, posterior lobe bearing two long hairs extending into the concave base of the aedeagus; sternite spiculate on posterior half; ninth tergite as long as basistyles, tapered to the truncated apex, bearing a pair of short, rounded, apicolateral processes. Basistyles about twice as long as broad, simple, very convex on outer sides; dististyles about 0.7 as long as basistyles, nearly straight and stout to apices. Aedeagus with base as broad as the lobe of ninth sternite, a slight sub-basal swelling, a second swelling at midlength, with distal half cleft into a pair of attenuated, submedian, pointed blades attaining 0.8 length of basistyles. Parameres consisting of a pair of very irregular processes,

bases of each with a large anterior and lateral apodeme, stem rather stout and crooked, distal portion abruptly bent ventrocephalad, then greatly attenuated and bent ventrocaudad to a sharp point.

Types.—Holotype, ♀, USNM 61094, Baton Rouge, Louisiana, May 16, 1947, Wirth. Allotype with same data as type except date, May 3, 1947. Paratypes: Louisiana: 6 ♂♂, 3 ♀♀, with same data as type except date, May 6–20, 1947. Mississippi: 4 ♂♂, 10 ♀♀, Horn Island, June and July 1944, E. A. Richmond. Florida: 11 ♀♀, Grayton Beach, Walton County, May, Sept., 1949, Butler; 1 ♀, Santa Rosa, Walton County, July 19, 1949, Peterson; 8 ♂♂, 21 ♀♀, Innerarity Point, Escambia County, May, 1950, Rathert; 8 ♀♀, Santa Rosa Island, Escambia County, July 7, 1949, Butler; 5 ♀♀, Panama City Beach, Bay County, May 6, 1949, McElvey; 5 ♀♀, Crystal River, Citrus County, July 17, 1950, Hudson; 3 ♀♀, Fort Myers, Lee County, Oct. 8, 1948, Brechtel; 3 ♀♀, Everglades City, May, Oct., 1948, 1950, Huntoon; 1 ♂, 1 ♀, Big Pine Key, Monroe County, Apr. 1, 1950, Sermon. Georgia: 2 ♂♂, 4 ♀♀, Thomasville, May 15–30, 1949, Palmer. Tennessee: 1 ♀, Nashville, June 18, 1937, Adams. Iowa: 1 ♀, Sioux City, July 15, 1950, Laffoon. Virginia: 3 ♂♂, 6 ♀♀, Falls Church, July 8, 29, 1950, Wirth. Maryland: 4 ♀♀, Leeds, Dorchester County, July 10, 1907, Barber. New Jersey: 1 ♀, Newport, July 1, 1937 (light trap). Costa Rica: 1 ♂, Higuito, San Mateo, no date, Schild. Panamá: 1 ♀, Fort Kobbe, Canal Zone, Aug. 21, 1950, Carpenter.

10. *Monohalea (Monohalea) multilineata* (Lutz), 1914

FIGURE 19, j

Palpomyia multilineata Lutz, Mem. Inst. Oswaldo Cruz, vol. 6, p. 93, 1914 (Brazil).
Monohalea multilineata, Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943.—
 Lane, Rev. Ent., vol. 16, p. 368, 1945.

Lane (1945) has very adequately redescribed this Brazilian species. It resembles *M. (M.) stonei*, new species, in general coloration and structure, the mesonotum yellowish with brown dots, the scutellum yellow with median brown spot and four marginal bristles, forelegs and midlegs yellowish, the hind femur and tibia black and scarcely swollen and hind tarsi unspined. The wings, however, in addition to the two anterior black spots, have smaller, rather strong spots at the wing margin in cells R_5 and M_1 , and across the apex of cell M_2 . The polished, brown, lateral spots on the abdomen, which are small in *stonei*, are larger and narrowly connected across the anterior margin of each tergite in *multilineata*.

The male genitalia of *multilineata* are of the same type as those of *stonei*, but there are four rather than two bristles at the base of the

lobe of the ninth sternite, the aedeagus is broader at the apex and only slightly notched rather than deeply cleft, and the parameres are slender and nearly straight with the apices abruptly bent and scimitar-shaped.

Material examined.—Brazil: Km. 47, Estrada Rio-São Paulo, Rio de Janeiro, Brazil, February 1945, Wygodzinsky, 2 ♂♂, 2 ♀♀.

Remarks.—*Monohalea nigeriae* Ingram and Macfie, 1922, known from the female from West Africa, is closely related to *M. (M.) stonei* and to *M. (M.) multilineata*, but according to the original description, the tarsi bear ventral spines, as in the *tessellata* group, and the spermathecae are unequal in size.

11. *Monohalea (Monohalea) guianae*, new species

FIGURE 19, k

Monohalea multilineata, Macfie, not Lutz (misidentification), Proc. Ent. Soc. London, Ser. B, vol. 9, p. 187, 1940 (♂, British Guiana).

Macfie (1940) has given as satisfactory a description of this insect as was possible from the single male specimen available. This specimen was borrowed from the British Museum for study and externally cannot be separated from either *M. (M.) multilineata* (Lutz) or *M. (M.) stonei*, new species. However the male genitalia are quite distinct and may be characterized as follows: Ninth sternite very short, with a low median lobe on caudal margin fitting against base of aedeagus, spiculose, with four long hairs arising from tubercles in a line at base of median lobe; ninth sternite very narrow, tapered to tip, with a pair of short, nipplelike apicolateral processes. Basistyles about twice as long as broad; dististyles nearly straight, with blunt, scarcely narrowed apices. Aedeagus very narrow, about 2.5 times as long as broad at base, the anterior arch very low, apex cleft about a third way to base, with a pair of very slender, submedian processes, from the bases of which a pair of slender, lateral arms curve around stems of parameres. Parameres broadly joined together at bases, each with a short anterior and lateral arm, stems slender, apex of each thickened and abruptly bent laterocephalad in a broadly rounded lobe about half as long as dististyle.

Types.—Holotype, ♂, British Museum (Natural History) collection, Mazaruni, British Guiana, Aug. 21, 1937, second growth (low forest), Richards and Smart.

tessellata—group

Wings with three large dark anterior spots and irregular posterior infuscated areas; scutellum often with middle yellow; hind legs swollen and black, with yellow knees, the tarsi short and with strong ventral

spines; claw of hind leg of male long and single as in the female; male aedeagus with slender, pointed, posterior sclerite borne in a notch in the quadrate basal sclerite, parameres short, curved, and pointed.

12. *Monohelea (Monohelea) nebulosa* (Coquillett), 1901

FIGURES 18, *f*; 19, *c*

Ceratopogon nebulosus Coquillett, Proc. U. S. Nat. Mus., vol. 23, p. 606, 1901 (♂, New Jersey).

Ceratolophus nebulosus, Kieffer, Genera insectorum, fasc. 42, p. 60, 1906.

Johannseniella nebulosa, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 226, 1914.

Hartomyia nebulosa, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, p. 340, 1915 (Indiana).

Monohelea nebulosa, Kieffer, Ann. Mus. Nat. Hungarici, vol. 15, p. 312, 1917.—Johannsen, Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943 (Massachusetts, Idaho).

Description.—FEMALE: Length 2.1 mm., wing 1.7 mm. by 0.6 mm. Head dull, dark brown, with a few pruinose gray spots on vertex; antennae light brown, distal segments not darker. Palpi light brown.

Mesonotum pruinose gray, with scattered, small, dark-brown dots, each mesonotal hair arising from a dot, these dots more or less confluent, especially on posterior portion of mesonotum. Scutellum brown, middle third yellow, with about eight marginal bristles. Postscutellum and pleura dark brown. Legs shining dark brown, knees and tarsi yellowish. Posterior femora and tibiae greatly thickened; hind basitarsus with basal and distal spine; second segment with two distal spines, third segment with one distal spine; claws minute and equal on forelegs and midlegs, outer claw very long, four times the length of inner, on hind legs. Proportions of segments of hind leg as in table 1.

Wing grayish hyaline, a quadrate black patch across first basal cell at half its length; two broad, irregular, more or less interconnected, transverse bands across wing, the first at first radial cell, the second at apex of second; cell R_5 thus with a dark, a light, a dark and a light band, all of subequal breadth. First radial cell 0.4 times as long as second. Halteres pale yellow.

Abdomen uniform, pruinose, dark brown; anal segment yellow.

MALE: Ninth sternite transverse, without caudal lobe, posterior portion spiculate; ninth tergite very narrow, with sides subparallel on distal half, apicolateral processes short and rounded. Basistyles very stout and convex; dististyles slender and curved, 0.6 as long as basistyles. Aedeagus with two sections, basal part about as broad as long, anterior margin contiguous with sternite, posterior margin deeply emarginate, the slender, rodlike, distal sclerite with notched apex fit-

ting into the emargination. Parameres connected by a transverse bridge near bases, with slender anterior and lateral apodemes; each paramere with posterior portion narrowed and curved ventrolaterad to a bladellike apex, a small sub-basal tooth on ventral side.

Material examined.—New York: Farmingdale, July 9, 1938, H. and M. Townes, 1 ♂; Millwood, June 21, 1936, H. Townes, 1 ♀.

New Jersey: Atsion, June 17, 1949, H. Townes, 1 ♀; Medford Lakes, June 17, 1939, H. Townes, 1 ♂; Riverside, June 18, 1939, H. Townes, 1 ♀; Riverton, June 19, Johnson, 1 ♂ (type).

Georgia: Thomasville, May 15–30, Palmer, 1 ♀.

Arkansas: Pike County, June 12, 1938, Turner, 1 ♀.

Remarks.—This species is very similar to the Palearctic species *M. (M.) tessellata* (Zetterstedt), 1850, which, however, has on the scutellum four marginal bristles, the ends of which are yellowish, as is the median area. The wing markings of *tessellata* are much more nearly as in *M. (M.) johannseni*, new species.

A male of *tessellata* from Norfolk, Hatfield, England, was examined through the kindness of Paul Freeman of the British Museum (Natural History). The specimen is unsatisfactory for a description of external characters, as it was glued to a card when wet. It is noted, however, that both the first and second segments of the hind tarsi bear a distal pair of spines. The aedeagus of the genitalia consists of a heavily sclerotized basal plate about three times as broad as long, bearing a small, crescentic, median sclerite on the ventroposterior margin and bearing dorsoposteriorly a large, triangular structure with sharp-pointed, median apex, and widely flaring, lateral arms articulating with inner margins of basistyles. Parameres with slender anterior arms connected by a broad, median bridge, the posterior portions simple, the basal halves stout, the distal halves very slender and curved ventrocephalad.

According to Tokunaga's (1940) description, his record of *tessellata* from Japan probably refers to an as yet unnamed species. This Japanese species has the scutellum yellow only in the middle, as in *nebulosa*, which it also closely resembles in wing markings; but the mesonotum has distinct yellow spots, the antennae have the distal segments and the apices of the basal segments brownish, the legs are yellowish brown with dark brown markings, and the dorsum of the abdomen is pale, yellowish brown.

The West African species *M. (M.) litoraurea* Ingram and Macfie, 1921, (female) and *M. (M.) mimas* de Meillon, 1939, (male) are very similar to *M. (M.) nebulosa* (Coquillett). The genitalia of *mimas* are the same as those of *nebulosa* except that the dististyles are abruptly bent near the base.

13. *Monohalea (Monohalea) johannseni*, new speciesFIGURES 18, *g, k, l*; 19, *a*

Monohalea tessellata, Johannsen, not Zetterstedt (misidentification), Ann. Ent. Soc. Amer., vol. 36, p. 781, 1943 (Alabama).

Diagnostic characters.—A dark brown species with large pruinose gray mesonotal markings, black scutellum and legs, and maculate wings.

Description.—FEMALE: Length 1.5 mm., wing 1.2 mm. by 0.5 mm. Closely resembling *M. (M.) nebulosa* (Coquillett) but smaller, the mesonotum dark brown with large, irregular, pruinose gray areas, the scutellum entirely blackish and with four long and several shorter marginal hairs. Proportions of hind leg of female as in table 1, hind tarsi with one basal and two distal spines on first segment, two spines at tip of second and occasionally two spines at apices of third and fourth segments; inner claw on hind leg of female about a third as long as outer. Wing as in *nebulosa*, but the markings behind vein M_1 much fainter than those on anterior part of wing. Spermathecae two, subequal, oval, each with very short, sclerotized duct.

Male genitalia as in *nebulosa*, but the parameres simple, without the sub-basal ventral tooth, and distinctly and abruptly bent mesad at distal fifth.

Types.—Holotype, ♀, USNM 61095, Falls Church, Virginia, July 8, 1950, Wirth. Allotype, Innerarity Point, Escambia County, Florida, Apr. 29, 1949, Rathert. Paratypes: Virginia: 2 ♀♀, Mountain Lake, July 15, 1938, July 21, 1940, L. and M. Milne. Florida: 4 ♂♂, 5 ♀♀, same data as allotype except date April and May 1949; 1 ♀, Santa Rosa, Walton County, May 5, 1950, Peterson. Alabama: 1 ♀, LaPlace, June 9, 1917, Bradley. Michigan: 1 ♀, Cheboygan County, July 17, 1942, Sabrosky. Iowa: 1 ♀, Pikes Peak State Park, Clayton County, July 4, 1949, Laffoon.

References

- FLOCH, H., and ABONNENC, E.
1942. Cératopogonidés divers de la Guyane Française III. Inst. Pasteur Guyane Terr. L'Inini Publ. 55, 6 pp., 2 figs.
- GOETGHEBUER, M.
1934. Heleidae (Ceratopogonidae), *In* Lindner, Die Fliegen der Palaearktischen Region, Lief. 78, pp. 49-94.
- JOHANNSEN, O. A.
1943. A generic synopsis of the Ceratopogonidae (Heleidae) of the Americas, a bibliography, and a list of the North American species. Ann. Ent. Soc. Amer., vol. 36; pp. 763-791.
- KIEFFER, J. J.
1917. Chironomides d'Amérique conservés au Musée National Hongrois de Budapest. Ann. Mus. Nat. Hungarici, vol. 15, pp. 292-364, 43 figs.
- LANE, J.
1945. Redescrição de Ceratopogonídeos Neotrópicos (Diptera: Ceratopogonidae). Rev. Ent., vol. 16, pp. 357-372, 19 figs.
- LEE, D. J.
1948. Australasian Ceratopogonidae (Diptera, Nematocera). Part 4. The *Stilobezzia* group of genera. Proc. Linn. Soc. New South Wales, vol. 72, pp. 345-356, 1 pl., 23 figs.
- MACFIE, J. W. S.
1937. Ceratopogonidae from Trinidad. Ann. Mag. Nat. Hist., ser. 10, vol. 20, pp. 1-18, 6 figs.
1940a. A report on a collection of Ceratopogonidae (Diptera) from British Guiana. Ent. Monthly Mag., vol. 76, pp. 23-32, 4 figs.
1940b. Ceratopogonidae (Diptera) from British Guiana and Trinidad. Proc. Ent. Soc. London, ser. B, vol. 9, pp. 179-195, 4 figs.
- TOKUNAGA, M.
1940. Chironomoidea from Japan (Diptera), XII. New or little-known Ceratopogonidae and Chironomidae. Philippine Journ. Sci., vol. 72, pp. 255-311, 4 pl.
- WIRTH, W. W.
1952. The Heleidae of California. Univ. California Publ. Ent., vol. 9, pp. 95-266, 33 figs.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1953

No. 3321

A REVIEW OF THE BEETLE FAMILY CEPHALOIDAE

By ROSS H. ARNETT, Jr.¹

The family Cephaloidae consists of only one genus, *Cephaloon* Newman, 1838, with eight known species that are locally rather common but are known only from the Eastern United States, Western United States, Western Canada, Japan, and Amur. All of the species are closely related and quite variable in color. Useful separation characters are to be found in the antennae and various male structures. As yet little is known concerning the habits and life histories of members of this group. All known species of this family are represented in the collections of the U. S. National Museum.

After study of some material from the Ussuri River Valley recently sent to me for determination, it seems desirable to reconsider the taxonomy, affinities, and distribution of this group. The ranking of this small assemblage of species as a family on equal ground with the rest of the families in the order is still somewhat doubtful in my mind. I believe the placing of the Cephaloidae as a satellite of the great family Tenebrionidae is firmly established, but my studies in the Tenebrionoidea have not as yet revealed, on the basis of our present ranking and evaluation of what defines a family, any group with which the genus *Cephaloon* can be incorporated; hence, I retain it as a family.

I wish to thank Mr. Hugh B. Leech and Dr. E. C. Van Dyke, both of the California Academy of Sciences, and Dr. Hans Klapperich of Bonn, Germany, for the loan of several specimens used in this study.

¹ Bureau of Entomology and Plant Quarantine: U. S. Department of Agriculture.

Family CEPHALOIDAE LeConte

Cephaloidae LeConte, Smithsonian Misc. Coll., vol. 3, art. 3, Classification of the Coleoptera of North America, pt. 1, p. 259, 1862.

LeConte originally proposed this family for the North American *Cephaloon lepturides* Newman, but also referred to two species, although not by name, which had been described by Motschulsky from the Amur River Valley. Several genera have since been erected for species in this group, and then synonymized, until in the present study the family contains only the original genus *Cephaloon* Newman.

Family diagnosis.—Size 8–20 mm.; head elongate, diamond-shaped, deflexed; antennae 11-segmented, filiform, with apical segments somewhat enlarged, inserted between the eyes and bases of the mandibles; mandibles elongate, acute at apex, never bifid or otherwise modified; eyes reniform, not prominent; maxillary palpus 4-segmented, first segment small, obscure, apical segment triangular. Pronotum without lateral margins, smooth, always abruptly narrowed anteriorly from the middle. Legs slender; front coxal cavities open behind; front and middle coxae prominent, conical; apical spurs of all tibiae large, two on each tibia; tarsi 5–5–4, the segments all simple, not lobed or tomentose beneath; claws pectinate, with a subequal membranous lobe beneath each claw. Elytra with vague costae, minutely punctate, never striate. Abdomen with 5 visible sternites in the female, 7 in the male (sternites 2 + 3 to 9 visible in the male). Body covered with very fine pubescence.

MALE GENITALIA: Apical abdominal segments (7–9) of the male considerably modified. Segment 7 with sternite and tergite laterally fused, forming a globular shaped segment. Segment 8 with sternite and tergite laterally fused, forming two laterally triangular pieces. Segment 9 closely fitted into segment 8, the tergite and sternite both triangular and filling the emarginations of segment 8. Genital organs themselves quite simple; paramere two short, freely articulate lobes fitted onto the apex of the large troughlike basal piece which more or less envelops a simple, small, somewhat curved, and tubelike median lobe; no evidence of a tegminite.

Affinities of the family.—The heteromerous tarsi place this family in the Tenebrionoidea; the open anterior coxal cavities place it in the group including the Oedemeridae, Pythidae, and Serropalpidae, as distinguished from the group including the Alleculidae, Lagriidae, and Tenebrionidae, all of which have closed coxal cavities. The serrate claws with fleshy pulvilli and the laterally fused eighth abdominal segment of the male separate it from the others of this group of Tenebrionoidea. The very small median lobe and the larger paramere with the small lateral lobes show affinities with the genus *Mycterus* of

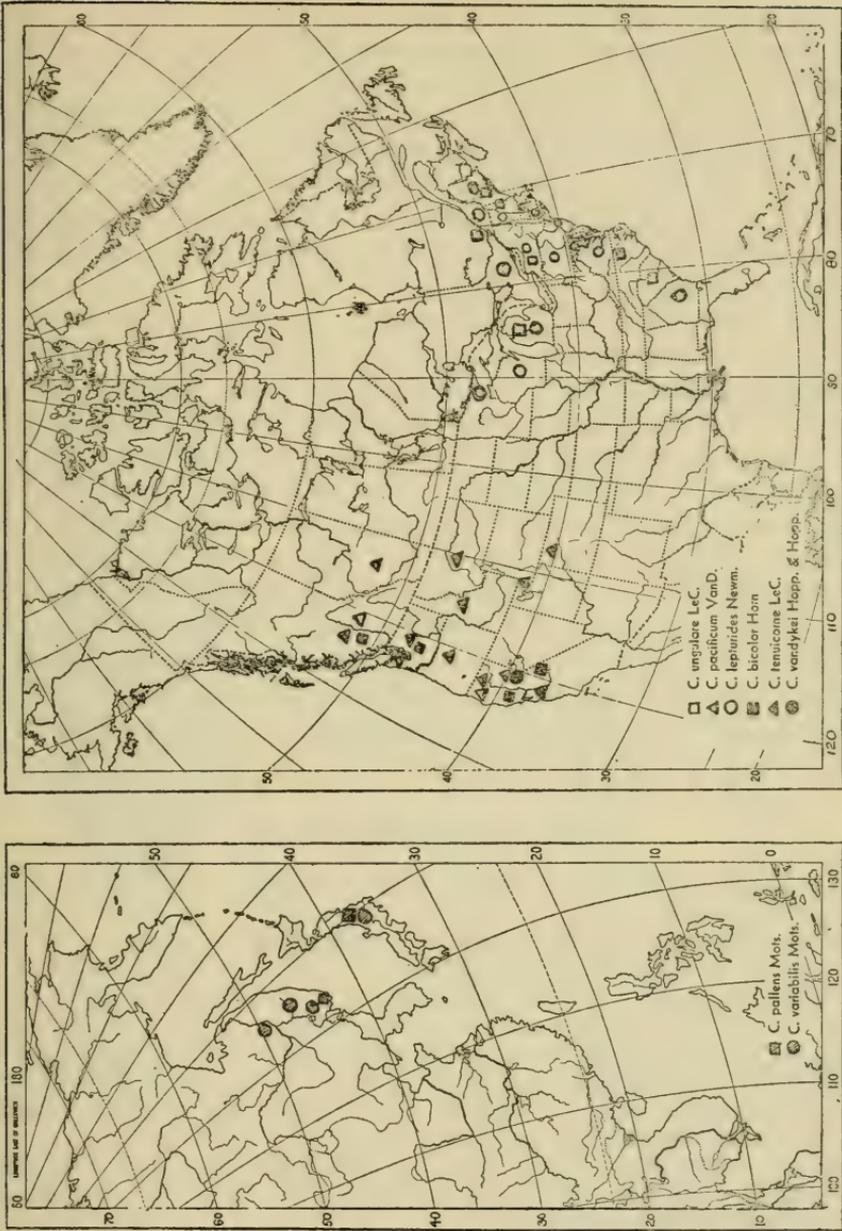


FIGURE 20.—Distribution of the family Cephaloidae.

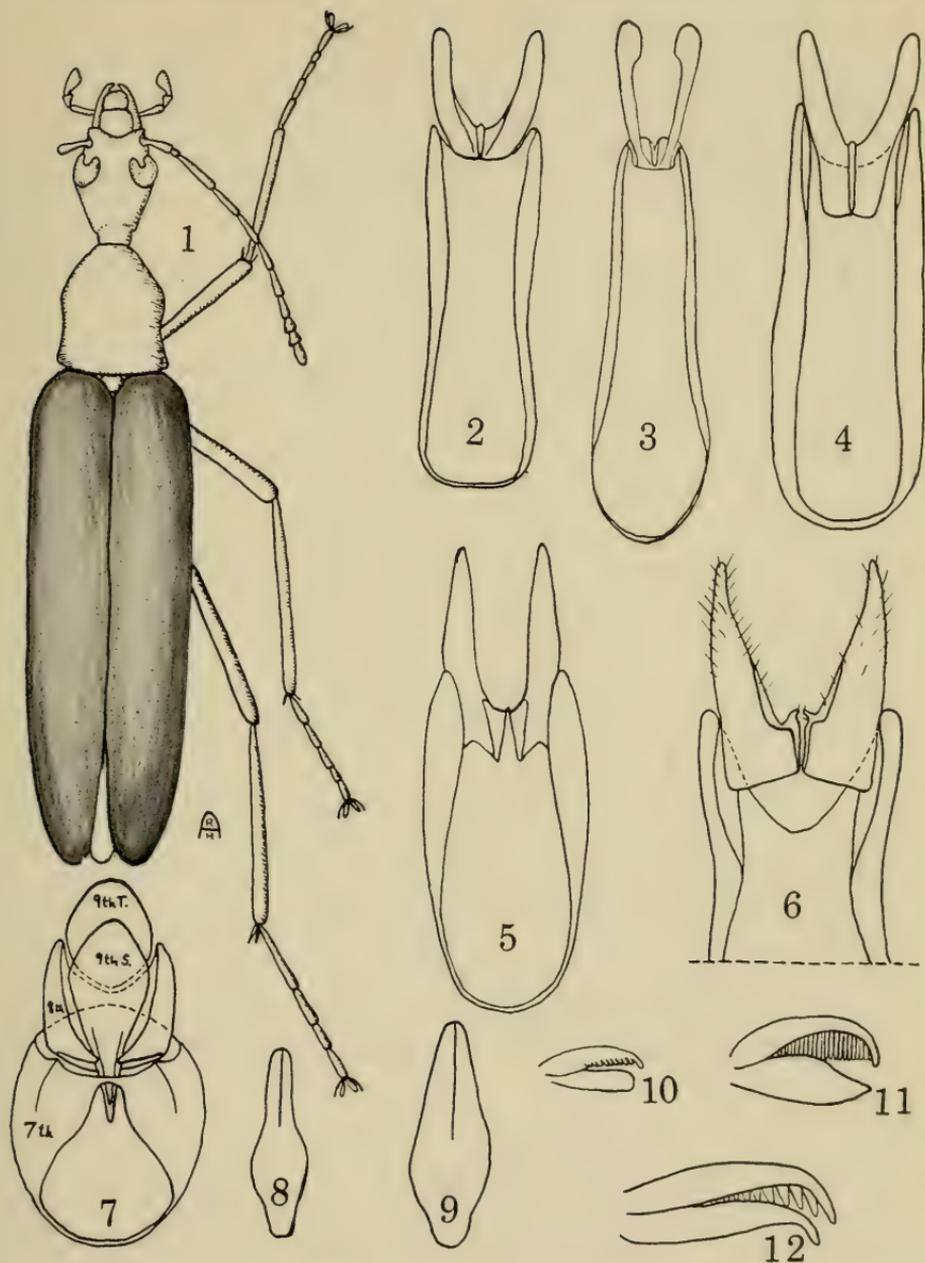
the family Pythidae. In addition, *Mycterus* and *Cephaloon* both have prominent procoxae and mesocoxae and the prothorax is without lateral margins. Most workers in the past have considered the Oedemeridae and Cephaloidae closely allied, but my incomplete studies of the male genitalia of the heteromerous beetles indicate that this is not so. The very different structure of the apical abdominal segments of the species of *Cephaloon* leads me to suppose that these species are far removed from the oedemerids, but their true affinities are not yet recognized.

Notes on the distribution of the species.—As can be seen from the accompanying map (fig. 20), the species of this family show the typical distribution pattern of a Holarctic group which was probably derived from some Asian stock and spread to North America via the Alaskan land bridge. It is interesting to note that, based on both external morphology and the morphology of the male genitalia (in the case of *C. pallens*) both of the Asian species are most similar to two of the Eastern North American species and not to the Western North American species. If these similarities of morphology reflect relationship, as we assume they do, then we again see the often-repeated pattern of a pre-glacial distribution across northern Canada from Alaska, down through Ontario and into Eastern United States. This I believe to be a further stock-piling of evidence against the theories of continental drift and the North Atlantic land bridge idea.

Genus *Cephaloon* Newman

- Ichnodes* Dejean, 1834, Cat. Col. ed. 3, p. 227. (*Nomen nudum*, one ms. trivial name listed.)
- Cephaloon* Newman, Ent. Mag., vol. 4, p. 376, 1838. (Genotype, *Cephaloon lepturides* Newman; 1838; monobasic.)
- Cephaloon* Motschulsky in Schrenck, Reisen und Forschungen in Amurlande, vol. 2, pt. 2, p. 140, 1860. (Error for *Cephaloon*.)
- Typitium* Casey, Ent. News, vol. 9, p. 193, 1898. (Genotype, *Cephaloon unguare* LeConte, Proc. Boston Soc. Nat. Hist., vol. 16, p. 275, 1873; original designation and monobasic. Placed in synonymy by Hopping and Hopping, Pan-Pacific Ent., vol. 10, p. 64, 1934.)
- Sponidium* Casey, Ent. News, vol. 8, p. 193, 1898. (Genotype, *Cephaloon tenuicorne* LeConte, 1873; present designation. Placed in synonymy by Hopping and Hopping, 1934.)
- Ephamillus* Semenow, Horae Soc. Ent. Ross., vol. 34, p. 495, 1900. (New synonymy. Genotype, *Cephaloon variabile* Semenow = *Cephaloon variabilis* Motschulsky in Schrenk, 1860; original designation and monobasic.)
- Drachylis* Casey, 1898, Ent. News, vol. 9, p. 195. (New synonymy. Genotype, *Drachylis simulans* Casey, 1898; monobasic.)

Discussion.—The type and only known specimen of *Drachylis simulans* Casey, the genotype of *Drachylis* Casey, has been examined. This is an unfortunate example of the description of a species on one



Adult, male genitalia, and claws of Cephaloidae: 1, *Cephaloon tenuicorne* LeConte, female, showing general habitus; 2, paramere of male, *C. tenuicorne*; 3, paramere of male, *C. bicolor* Horn; 4, paramere of male, *C. pacificum* Van Dyke; 5, paramere of male, *C. lepturides* Newman; 6, apical portion of paramere of male, *C. unguare* LeConte; 7 abdominal segments 7-9 of male, *C. unguare*; 8, median lobe of male, *C. pallens* Motschulsky; 9, median lobe of male, *C. lepturides* Newman; 10, hind claw of *C. tenuicorne*; 11, hind claw of *C. pallens*; 12, hind claw of *C. variabilis* Motschulsky.

poor specimen. Casey was certainly justified in wanting to describe this specimen for he believed that it lacked the comblike claws characteristic of the other species in the family, and therefore, its description, even though based on a single specimen, would alert collectors to hunt for such a strange cephaloid. A close examination, however, reveals it to have been patched, the legs being undoubtedly from some other beetle. It appears to be *Cephaloon bicolor* Horn, with which I synonymize it.

The genus *Ephamillus* Semenow is based on the same variable characters possessed by the other genera erected for species of this family. Kôno (Fauna Nipponica, vol. 10, fasc. 8, No. 10, pp. 76-82, 1937) illustrates three characters, which, if they were constant and as illustrated, would serve for recognition of a genus. However, none of them appears to be constant or as distinctive as thought by Kôno and others. The acute pulvilli, curved at the tips, are found in three species, *C. pacificum*, *C. unguare*, and *C. variabilis*. The shape of the pronotum, as illustrated by Kôno for *C. variabilis*, is subject to the same sort of variation in all the species. Finally, the sinuation of the hind tibia of *C. variabilis*, reported to be so pronounced that a portion of the tibia is thrown out of line at least a distance equal to the width of the tibia, is often barely perceptible even under a microscope, and on some specimens of the species it cannot be seen at all. For these reasons, I feel that this genus is invalid and I place it in synonymy with *Cephaloon*.

The marginate pronotum eliminates the genus *Stenocephaloon* Pic, 1932 (Mélanges Exotico-Entomologiques, fasc. 59, p. 2; genotype, *Stenocephaloon metallicum* Pic, monobasic) from this family. Until specimens can be studied, it is best placed in the family Serropalpidae near the genus *Stenotrachelus* Berthold.

The following key to the known species of this family is adapted from Hopping and Hopping (Pan-Pacific Ent., vol. 10, pp. 64-70, 1934). For identification purposes, the illustrations which accompany that paper are very useful.

Key to the species of Cephaloidae

1. Pulvilli of tarsal claws slender, acute, and curved at tips (pl. 5, fig. 12)----- 2
- Pulvilli of tarsal claws robust, obtuse, not curved at tips (pl. 5, figs. 10, 11)- 4
2. Three distal antennal segments together approximately 3 mm. long; hind femora at most simply curved; 10 to 15 mm. (United States)----- 3
- Three distal antennal segments together not over 1.5 mm. long; hind femora tending to be sinuate; size 17 to 20 mm. (Amur River, Eastern Siberia, and Japan)----- *C. variabilis* Motschulsky

3. Lateral margins of pronotum behind middle distinctly emarginate; Western United States.....**C. pacificum** VanDyke
Lateral margins of pronotum behind middle almost straight (Eastern United States).....**C. unguare** LeConte
4. Antennae with last three segments thickened..... 5
Antennae with last three segments not markedly thickened..... 6
5. Elytra without sutural and marginal black stripes (Eastern United States).
C. lepturides Newman
Elytra with sutural and marginal black stripes (Amur River, Eastern Siberia and Japan).....**C. pallens** Motschulsky
6. Three distal antennal segments together approximately 1.5 mm. long (West Coast of United States).....**C. bicolor** Horn
Three distal antennal segments together barely over 1 mm. long (Western United States and Canada)..... 7
7. Male with bifurcate process of third visible abdominal sternite long and finger-like; female with apical abdominal sternite shallowly and narrowly emarginate; color of female black to testaceous.....**C. tenuicorne** LeConte
Male with bifurcate process of third visible abdominal sternite shorter, more triangular; female with apical abdominal sternite deeply emarginate; color of female reddish testaceous with elytra and metasternum black.
C. vandykei Hopping and Hopping

Key to the species of *Cephaloon*, based upon the male genitalia

Male of *Cephaloon variabilis* Motschulsky unknown.

1. Ratio of length of paramere to length of basal piece not over 1:2..... 2
Ratio of length of paramere to length of basal piece not less than 1:3.5.... 3
2. Median lobe tapering abruptly at apical third, slender (pl. 5, fig. 8); paramere lobes long and slender.....**C. pallens** Motschulsky
Median lobe evenly tapering from base, more robust (pl. 5, fig. 9); paramere lobes shorter and heavier (pl. 5, fig. 5).....**C. lepturides** Newman
3. Paramere lobes acute at apex (pl. 5, fig. 6); median lobe long and slender, sides more parallel.....**C. unguare** LeConte
Paramere lobes enlarged at apex; median lobe shorter and more robust at apex..... 4
4. Apex of paramere lobes about twice width of base when viewed laterally (pl. 5, fig. 3).....**C. vandykei** Hopping and Hopping and **C. bicolor** Horn
Apex of paramere lobes about same width as at base..... 5
5. Apex of basal piece laterally extending beyond base of paramere to about one-half length of paramere lobes; paramere lobes stout, blunt at apex, uniform in width (pl. 5, fig. 4).....**C. pacificum** VanDyke
Apex of basal piece laterally extending only slightly beyond base of paramere; paramere lobes more slender, and slightly enlarged at apex (pl. 5, fig. 2).
C. tenuicorne LeConte

In view of the relatively recent and thorough discussion of the species by Hopping and Hopping (1934), I feel that it is superfluous to repeat it here except to mention that under *C. bicolor* the name *Drachylis simulans* Casey should be added as a synonym (see discussion under generic synonymy preceding).

There follows the bibliographic citations of the two exotic species not mentioned by Hopping and Hopping. The key and illustrations, I believe, sufficiently characterize them. A revised section of the Coleopterorum Catalogus (Junk) is being prepared which will give all of the literature references, therefore they will not be cited here.

***Cephaloon pallens* Motschulsky, 1860**

PLATE 5, FIGURES 8, 11

Cephaloon pallens Motschulsky, in Schrenck, Reisen und Forschungen in Amurlande, vol. 2, pt. 2, p. 140, pl. 9, fig. 15, 1860. (Type locality, Kisi, on the River Amur.)

Cephaloon pallens var. *cinctipennis* Heyden, Deutsche Ent. Zeitschr., p. 167, 1892. (Type locality unknown, except "Amur" as given in the title of the paper.)

Cephaloon pallens var. *koltzei* Heyden, Deutsche Ent. Zeitschr., p. 168, 1892. (Type locality, "Amur," as above.)

Cephaloon pallens var. *maculicolle* Heyden, Deutsche Ent. Zeitschr., p. 167, 1892. (Type locality, "Amur," as above.)

Cephaloon pallens var. *picticolle* Heyden, Deutsche Ent. Zeitschr., p. 167, 1892. (Type locality, "Amur," as above.)

?*Cephaloon pallens* Motschulsky, Solsky, Horae Soc. Ent. Rossicae, vol. 11, p. 295, 1875. (Djalinda River. Note: This is probably a misidentification of *Ephamillus variabilis* var. *tristiculus* Heyden, 1892, judging from the description and locality.)

Cephaloon sakurae Lewis, Ann. Mag. Nat. Hist., ser. 6, vol. 15, p. 444, fig. 10, 1895. (Placed as synonym by Kôno, 1937, Fauna Nipponica, vol. 10, fasc. 8, No. 10, p. 79.)

In a species with the extreme color variation exhibited in all of the species of this family, the naming of a few of the color variants serves no useful purpose and these are therefore here disregarded.

***Cephaloon variabilis* Motschulsky, 1860**

PLATE 5, FIGURE 12

Cephaloon variabilis Motschulsky, in Schrenck, Reisen und Forschungen in Amurlande, vol. 2, pt. 2, p. 141, 1860. (Type locality, Marûnsk on the River Amur.)

Cephaloon variabilis var. *tristiculus* Heyden, Deutsche Ent. Zeitschr., 1892, p. 169. (Type locality, unknown except "Amur.")

Here again, the naming of a single color form can serve no useful purpose.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1953

No. 3322

THE FRESH-WATER TRICLADS (TURBELLARIA) OF ALASKA

By ROMAN KENK

Introduction

In 1948, during an investigation of biting insects in Alaska conducted by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Dr. Reese I. Sailer collected and transmitted to me several samples of fresh-water triclads (planarians). An examination of the material revealed that the worms belonged to the genus *Polycelis*, a genus fairly common in Asia and Europe but only twice reported from North America. The finding suggested a closer relationship of the Alaskan fresh-water fauna with that of East Asia. A more thorough study of the triclads of Alaska promised to yield a more definite understanding of these zoogeographical relations.

My field trip ¹ to Alaska was made in the summer of 1950. Since the available time was rather limited, the collecting was done mainly along the highways of the territory and in the vicinities of Point Barrow and Umiat.

The following roads and fresh-water localities were visited on the trip: Steese Highway in the section between Fairbanks and Birch Creek (milepost 103); Elliot Highway, from Fairbanks to Livengood; tundra lakes and pools in the vicinity of Point Barrow; Colville River, several streams, and a lake near Umiat; Mount McKinley Park Road, a section of about 15 miles adjoining the railroad station; Glenn Highway, from Anchorage to Glenallen; road from Palmer to

¹ This study was supported by the Arctic Institute of North America under contractual arrangement with the Office of Naval Research.

Willow; road from Anchorage to Potter; and Richardson Highway, section between Valdez and Glenallen.

No fresh-water triclads were found by me either at Point Barrow or at Umiat. I received, however, from the U. S. National Museum, a sample of triclads collected by P. F. Scholander in a lake near Umiat. The relative scarcity of planarians in tundra lakes and pools may be due to the high acidity of the waters or to the extremely severe conditions prevailing in them during the long winter season.

Grateful acknowledgment is made of the very helpful cooperation which was extended to me by several agencies in Alaska: The Arctic Research Laboratory, Point Barrow; the U. S. Public Health Service, Anchorage; the Alaska Road Commission, Fairbanks, Anchorage, and Glenallen; and the Division of Forestry, Bureau of Land Management, Fairbanks and Anchorage. I also wish to express my indebtedness to Prof. Edward G. Reinhard of the Catholic University of America and to Dr. Fenner A. Chace, Jr., and Dr. Doris M. Cochran of the U. S. National Museum who kindly permitted me to use their laboratory and office facilities in Washington, D. C.

Four species of fresh-water triclads were collected in Alaska. Two are inhabitants of the White Mountains, a mountain range extending in an east-west direction north of Fairbanks. The other two are widely distributed in waters of the Alaska Range and of the southern section of Alaska and one of them reaches as far north as Umiat.

Family PLANARIIDAE

Genus *Phagocata* Leidy

Phagocata nivea, new species

FIGURE 21; PLATE 6, FIGURE 1

Description.—This is a slender, rather delicate species. Mature specimens measure up to 8 mm. in length and about 1.5 mm. in width. In the quietly gliding animal the anterior end is truncated, with a very slightly bulging frontal outline and with rounded lateral corners (auricles). There is no distinct narrowing or neck behind the auricles and the lateral margins of the head are approximately parallel. Behind the head, the body widens and soon reaches its greatest width. From there on, the lateral margins of the body run parallel up to the level of the mouth, to converge again in the postpharyngeal region and to meet in a bluntly pointed posterior end.

The species lacks pigment and usually appears white and somewhat transparent. The intestinal contents may shine through the body wall and give the animal a certain amount of color; the margins of the body, the head region, and the areas occupied by the pharynx and the copulatory apparatus, however, are always white.

There are two rather small eyes, situated close together (about one-fourth the body width apart at the level of the eyes) and far removed from the frontal end. This character, easily recognized in life, distinguishes the species from another white triclad with which it shares its habitat, *Dendrocoelopsis alaskensis*, described as new on p. 178.

The pharynx is inserted, in sexually mature specimens, somewhat behind the middle of the body and measures about one-sixth of the body length. The copulatory organs occupy the anterior half of the postpharyngeal region.

The animal moves by gliding only; crawling movements, such as are seen in other triclads, particularly in those equipped with anterior adhesive organs, have not been observed in this species.

From the description it may be seen that the species in life shows a close resemblance to other species of the same genus, particularly to the American *Phagocata morgani*, the European *P. albissima*, *P. vitta*, and related forms. A separation of these species can be made only on the basis of anatomical characters.

Only those characters of the digestive system that have a taxonomic significance are discussed here. The pharynx has a structure typical of the family Planariidae; i. e., the fibers of the internal muscle zone are arranged in two distinct layers, a thick inner circular layer and a narrower outer longitudinal one. The anterior intestinal trunk bears 10 or 11 branches on each side. Each posterior trunk has 21 to 27 lateral branches and numerous short medial branches in both the pharyngeal and postpharyngeal regions.

The testes are numerous and are arranged, on each side of the midline, in a longitudinal zone extending from a short distance behind the ovary almost to the posterior end of the body. Their position is predominantly ventral, below the intestinal branches. Only a few testes extend into the mesenchymatic "septa" between the branches toward the dorsal side.

The two ovaries are typical, each situated approximately below the second intestinal branch. An undifferentiated mass of cells, the parovarium, is attached to the dorsolateral side of each ovary.

The genital pore (*pg*), situated about halfway between the mouth and the posterior end of the body, leads into a small cavity (*ac*) which continues to the left and dorsally into the duct of the copulatory bursa (*bd*) and to the right and anteriorly into the male atrium (*am*). This cavity may be considered to represent a common genital atrium. In some specimens, however, there appears to be no differentiation of the atrium into male and common parts, and the bursa duct and an undivided atrium meet at or near the genital pore. These variations are obviously due to the different states of muscular contraction in which the animals were killed. The atrium, narrow at the genital aperture, widens as it extends forward, to the right side of the midline.

It is lined with a tall, glandular epithelium, the cells of which project into the cavity in a villuslike fashion. Below the epithelium there are two layers of muscle fibers, one circular and the other longitudinal.

The penis consists of a spherical, muscular bulb embedded in the mesenchyme, and a moderately large papilla projecting into the male atrium. The bulb is pierced by numerous gland ducts which open into the lumen of both the bulb and the papilla. The shape of the papilla is subject to great variation, due apparently to the state of contraction of the organ. It may be twisted to one side and even partly inverted into the lumen of the penis (similar to the pseudoflagellum of various dendrocoelids). The shape shown in figure 21 appears to be that of the organ at rest. The outer wall of the papilla is covered with a tall to cubical epithelium similar to that lining the atrium. Below the epithelium there is a layer of circular muscle fibers followed by another of longitudinal fibers. The shape of the penis lumen (*lp*) is as changeable as that of the papilla. Typically, it appears to be wider in the bulb than it is in the papilla, though there is no distinct ejaculatory duct differentiated. The lumen opens ventrally to the tip of the papilla. The two vasa deferentia (*vd*) penetrate the penis bulb from both sides and empty into the penis lumen separately, but not far apart.

The two oviducts converge at the level of the copulatory apparatus, the left one passing between the bursa duct and the male atrium, and unite at a point dorsally to the atrium. The rather long common oviduct (*ode*) curves ventrally and opens into the posterior part of the male atrium. The terminal sections of the paired oviducts and the greater part of the common oviduct receive the outlets of numerous eosinophilic glands, the cell bodies of which are scattered in the surrounding mesenchyme, particularly dorsally to the atrium.

The copulatory bursa (*b*) is of moderate to large size and is irregularly lobed. The bursa duct or stalk (*bd*) is wide, runs posteriorly to the left of the midline, and curves ventrally to reach the genital aperture. It is lined with a tall, glandular epithelium and surrounded with a strong muscular coat consisting of intermingled circular and longitudinal fibers.

Taxonomic position.—The genus *Phagocata* Leidy (*Fonticola* Komárek) in its present extent (cf. Hyman, 1937, pp. 300–302) has representatives in Europe, Asia, and North America. The genus is not quite homogeneous and will probably, in due time, be subdivided into several genera (cf. Beauchamp, 1939). For the purpose of comparison, we may consider here only those species of the genus that lack pigment. Though the presence, or the lack, of pigment is a character of subordinate taxonomic value, it may nevertheless serve well as a character of specific rank. The Alaskan form differs from

European species such as *P. vitta* (Dugès) and *P. albissima* (Vejdovský) and from the American white *P. morgani* (Stevens and Boring) mainly in the structure of the male copulatory organ. Asia has several species of *Phagocata*, the majority of them pigmented forms. Of the three unpigmented Asiatic species that may belong to the genus, two

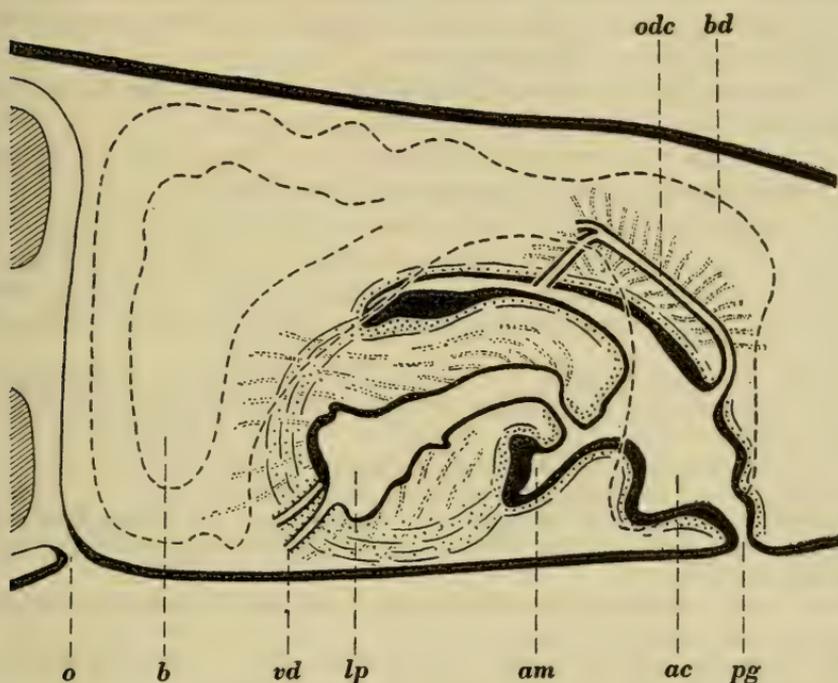


FIGURE 21.—*Phagocata nivea*, diagram of the copulatory organs in longitudinal section, $\times 92$. *ac*, common atrium; *am*, male atrium; *b*, copulatory bursa; *bd*, bursa stalk; *lp*, penis lumen; *o*, mouth; *odc*, common oviduct; *pg*, genital pore; *vd*, vas deferens.

have been described from immature specimens and the anatomy of their reproductive systems is not known: *Planaria pellucida* Ijima and Kaburaki (1916) from Sakhalin and a species from the Baikal region assigned tentatively to *Fonticola* by Bazikalova (1947). A third species, *Phagocata coarctata* (Arndt, 1922), from the vicinity of Vladivostok, is sufficiently well known, although no fully mature individuals of this species have been studied. *P. coarctata* differs from *P. nivea* externally in being smaller and broader, and in having a different contour of the anterior end, which bears protruding lateral lobes, and a greater distance between the two eyes. Anatomically, the two species are, undoubtedly, closely related.²

² Livanov and Zabusova (1940, p. 146) state that a reexamination of Arndt's slides of *Planaria coarctata* showed that the arrangement of the muscle fibers of the pharynx conformed with the dendrocoelid type (circular and longitudinal fibers of the internal muscle zone intermingled). Arndt (1922, p. 108) described the anatomy of the pharynx in minute detail and indicated, both in a figure (pl. 4, fig. 7) and in the text, a typical planariid pattern. I must assume that some confusion occurred somewhere, probably in the identification of the slides sent to Livanov.

In *Phagocata nivea* the penis lumen opens usually below the tip of the penis papilla. This character has been used by Livanov and Zabusova (1940, p. 96) to segregate a group of Asiatic species from *Phagocata* and to place them in a new genus, *Penecurva*. The same character is found, however, in a common North American species, *Phagocata morgani*, which shows no other close relations with the Asiatic group. This character is apparently inadequate as a basis for the establishment of a new genus.

Holotype.—On one slide, USNM 22332, creek crossing Elliot Highway at milepost ³ 31.0, July 24, 1950.

Distribution and ecology.—*Phagocata nivea* was collected in cool, fast mountain streams on the slopes of the White Mountains, a range north of Fairbanks. The temperature of the water ranged from 3.2 to 7.2° C. (July). The animals are cold-stenothermic and do not tolerate sudden increases in temperature. They were often found in the company of another white triclad, *Dendrocoelopsis alaskensis*.

Stream on Steese Highway (pl. 8), at milepost 84.0, altitude 2,700 feet, July 19 and 21, 1950, water temperature 6.9° C.; one immature and one mature specimen, from under stones.

Willow Creek, on Steese Highway, at milepost 96.6, altitude 2,100 feet, July 19, 1950, 7.2° C.; two immature specimens, from under stones.

Spring and stream on Steese Highway, milepost 82.5, near Alaska Road Commission camp, July 21, 1950; two mature and six immature specimens, on the undersides of stones.

Fox Gulch, on Elliot Highway, milepost 1.2, July 24, 1950, 5.0° C., one small specimen near bait (beef liver).

Creek crossing Elliot Highway at milepost 31.0, July 24, 1950; 39 specimens, about half of them mature, collected under stones (holotype).

Genus *Polycelis* Ehrenberg

Polycelis borealis, new species

FIGURE 22; PLATE 6, FIGURE 2

Description.—Mature animals are usually 12 to 15 mm. long and 1.5 to 2 mm. wide (larger specimens, measuring up to 20 mm. in length, have been seen). The frontal margin is slightly convex. At the lateral corners of the head there is a pair of elongated, bluntly pointed auricles which are held raised when the animal is gliding quietly. Behind the auricles, the body first narrows slightly, then gradually widens, reaching its greatest width at the level of the pharynx. Behind the pharynx the body tapers to a moderately pointed posterior end.

The color of the dorsal side is usually a uniform light or dark brown, that of the ventral side a light grayish brown. In animals

³ The large highways of Alaska are marked with wooden mileposts indicating only full miles. Many posts were missing at the time when the collections were made. Fractional milages were usually estimated from the nearest milepost or from the speedometer readings of the car used.

from some localities, an indistinct lighter median line occurred dorsally in the prepharyngeal region, with lighter areas above the pharynx and the copulatory organs.

The species has many small eyes (a generic character) arranged in a band along the frontal margin of the head, the base of the auricles, and the lateral margins of the body a short distance behind the head. Anteriorly the eyes are placed in more than one row, somewhat irregularly scattered; behind the head they are in a single row reaching backward about one-third to one-half the length of the prepharyngeal region. There is no narrowing of the band of eyes at the base of the auricles.

The pharynx is inserted at about the middle of the body and measures in length almost one-fourth the length of the body. The copulatory organs occupy more than half the post-pharyngeal region.

The animal moves by gliding only.

The pharynx of *Polycelis borealis* is structurally typical of the genus *Polycelis* and of the family Planariidae, the muscle zone being formed by two distinct layers, a thick circular layer adjoining the epithelium of the pharyngeal lumen and a thinner layer of longitudinal fibers. The anterior trunk of the intestine bears 5 to 6 lateral branches.

The numerous, fairly large testes are arranged in two zones, to the right and left of the anterior intestinal trunk, extending from the level of the ovaries posteriorly to the base of the pharynx. The testes are essentially ventral, though individual vesticles may extend dorsally in the mesenchymatic spaces between the intestinal branches and occupy almost the entire dorsoventral diameter of the body. Where intestinal branches are present, however, the testes develop only below them. Each zone of testes reaches laterally only little beyond the ventral nerve cord.

The ovaries are situated behind the first pair of lateral branches of the anterior trunk of the intestine.

The genital pore (*pg*), situated in the midline behind the middle of the postpharyngeal region, connects with a narrow posterior extension of the genital atrium (*a*). This extension leads dorsally and somewhat to the left into the duct of the copulatory bursa and anteriorly into the widened portion of the atrium containing the penis. There is no marked division of the atrium into a posterior common atrium and an anterior male atrium. The wall of the atrium is lined with a cubical epithelium and equipped with two muscle layers, one circular and the other longitudinal.

The penis consists of a bulb embedded in the mesenchyme and a papilla projecting into the atrium. Neither of the two parts is very muscular. The shape of the penis, particularly of the papilla, is very

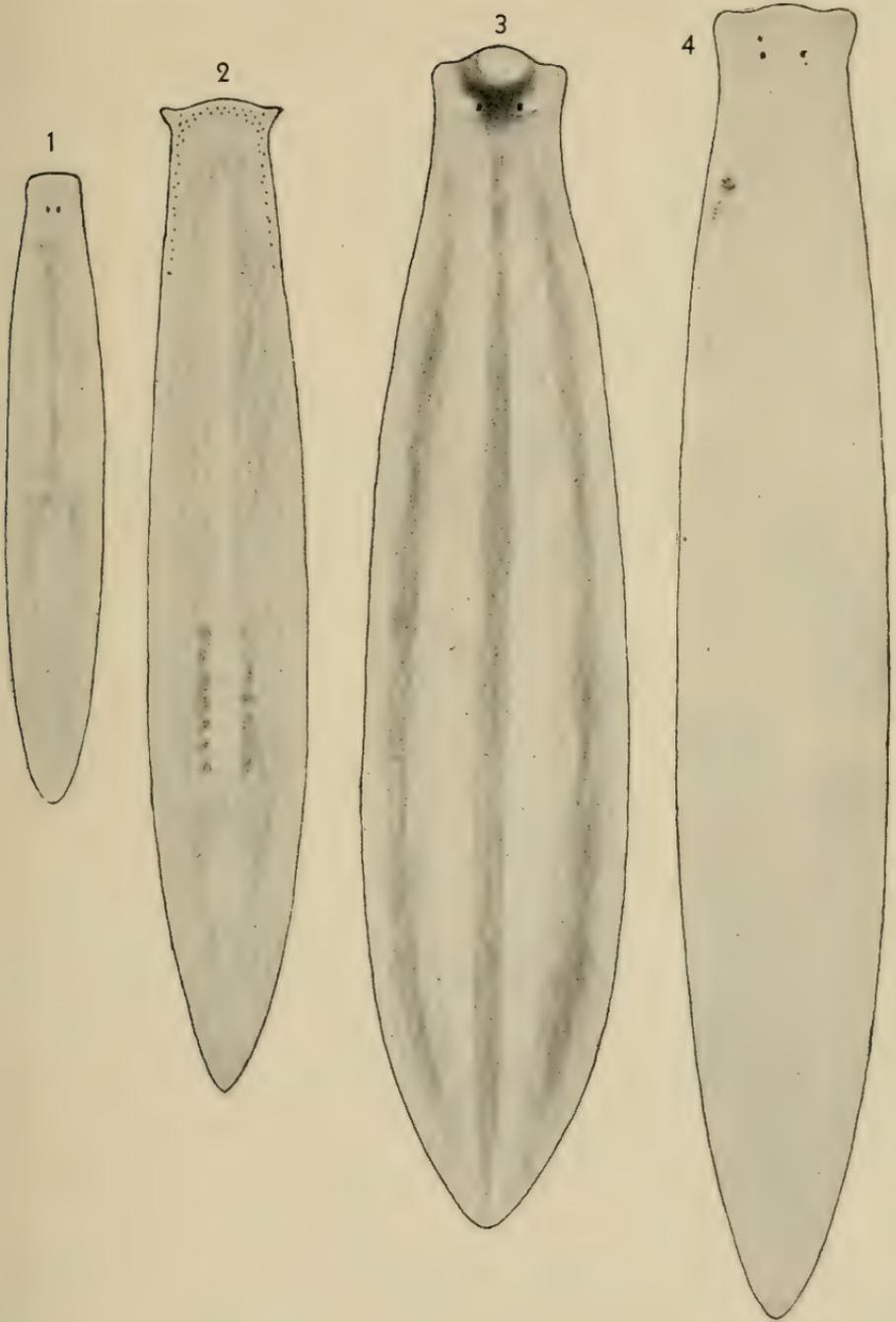
changeable. In specimens that were fixed in a well-extended condition, the bulb appears spherical and the papilla has a conical shape. The bulb contains a spacious, irregularly lobed cavity, the seminal vesicle (*vs*). Numerous gland ducts empty into the lumen of the bulb after entering the bulb, particularly from its anterior surface, and penetrating between its muscle fibers. The ducts are filled with a granular, slightly eosinophilic secretion. The two vasa deferentia (*vd*) open into the seminal vesicle separately from the anterolateral sides.

The penis papilla is conical or finger-shaped when well extended. It is covered with a cubical epithelium below which there are two rather feebly developed muscle layers, tapering in thickness toward the tip of the papilla: a layer of circular fibers adjoining the epithelium and a thinner layer of longitudinal fibers. The absence of a strong muscular wall probably accounts for the great variation in the shape of the penis papilla observed in the material. The lumen of the seminal vesicle continues into the papilla as a wide canal (*de*), opening at or near (ventrally to) the tip of the papilla. The canal is lined with an epithelium of cubical cells and lacks the gland openings characteristic of the seminal vesicle. It corresponds to an ejaculatory duct but it apparently has no distinct muscle coat.

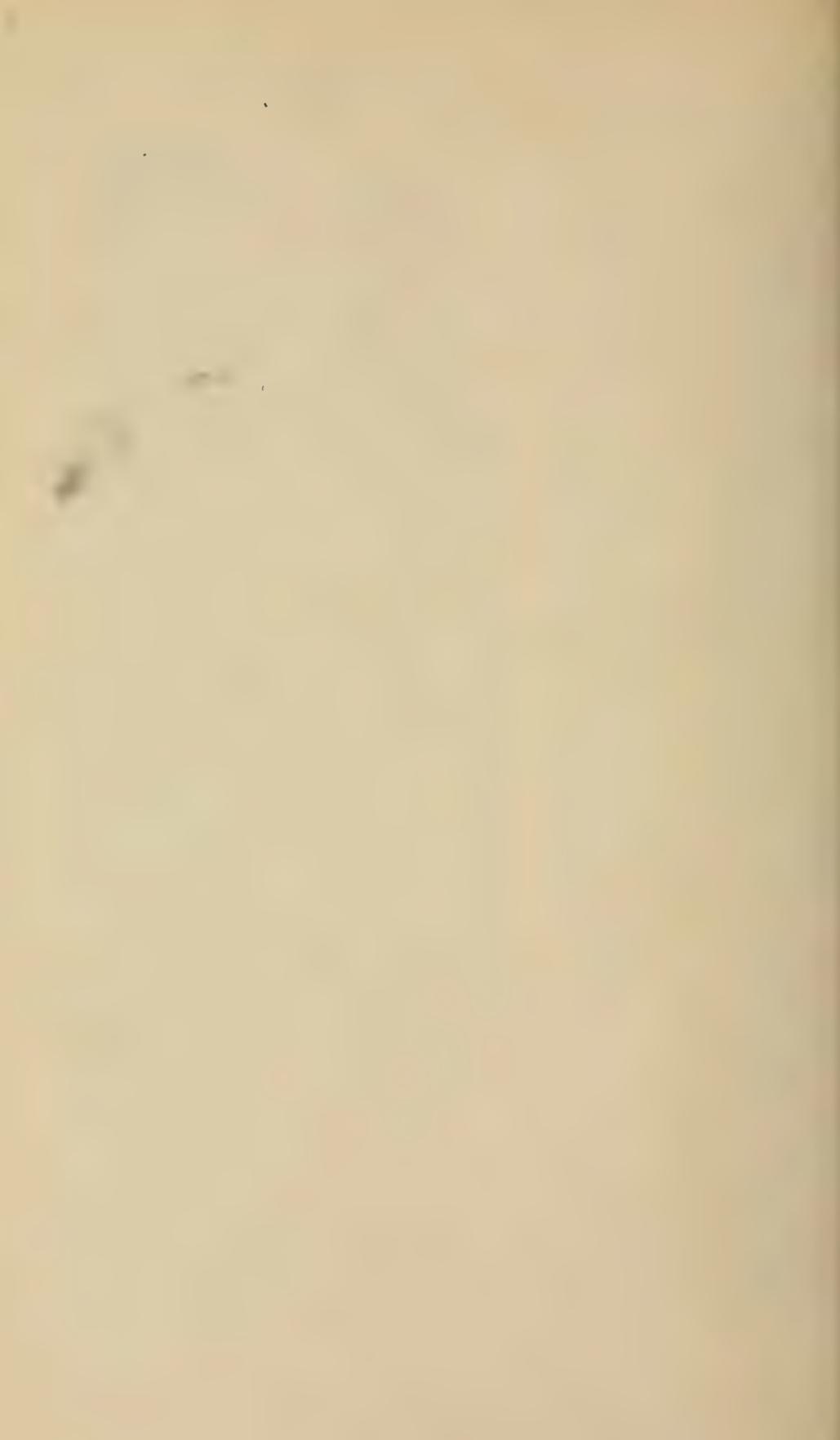
The two oviducts, running posteriorly along the ventral nerve cords, bend dorsally and medially at the level of the copulatory organs. The left one passes through the space between the atrium and the bursa duct and unites with the oviduct of the right side dorsally to the atrium. The common oviduct (*odc*) runs ventrally and opens into the posterior part of the atrial cavity. The terminal sections of the paired oviducts and a section of the common oviduct are equipped with strongly eosinophilic shell glands.

The copulatory bursa (*b*) is a large sac with a lobed outline. It connects posteriorly with a duct of almost uniformly wide diameter, the bursa stalk (*bd*). The duct runs first posteriorly, to the left of the penis bulb, then curves ventrally and opens, from the dorsal side, into the narrow terminal portion of the atrium, close to the genital pore. The bursa stalk has a strong coat of intermingled circular and longitudinal muscle fibers. There is no histological differentiation into anterior and posterior sections of the bursa stalk.

Taxonomic position.—*Polycelis borealis* is the second species of the genus *Polycelis* to be found on the North American continent. The other species, *P. coronata* (Girard), reported from Wyoming and South Dakota (Hyman, 1931), resembles it closely in external appearance and probably cannot be distinguished from it in life. In both species, the shape of the anterior end is very similar. The auricles of *P. borealis* are perhaps a trifle longer and more pointed than those of *P.*



Sketches of living specimens of the four Alaskan triclad species, all $\times 10$: 1. *Phagocata nivea*; 2. *Polycelis borealis*; 3. *Dendrocoelopsis piriformis*, striped form; 4. *Dendrocoelopsis alaskensis*.



coronata. Hyman (1931, p. 126) states that in *P. coronata* the curved band of eyes narrows as it crosses the base of the auricles; no such narrowing has been seen in *P. borealis*. These differences are, however, insignificant and do not permit a clear separation of the two forms. The same may be said of other species of the genus, which likewise could be confused with the American forms in life: the Japanese species, *P. auriculata* and *P. karafto*; and *P. schmidti* occurring both in Kamchatka and in Japan. These forms differ from each other more clearly in their anatomical characters.

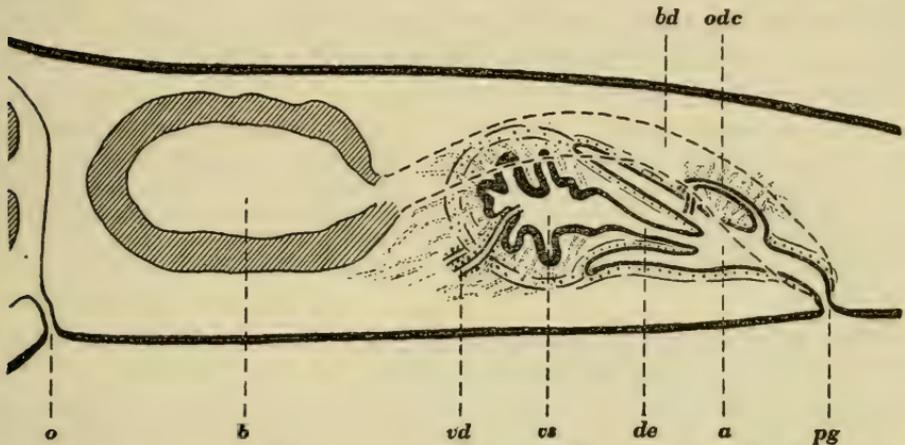


FIGURE 22.—*Polycelis borealis*, diagram of the copulatory organs in longitudinal section, $\times 70$. a, atrium; b, bursa; bd, bursa stalk; de, ejaculatory duct; o, mouth; odc, common oviduct; pg, genital pore; vd, vas deferens; vs, seminal vesicle.

To gain a better insight into the systematic relations of *Polycelis borealis* to other species of the same genus, it is necessary to review the present state of the systematics of the genus. The genus *Polycelis* has a muscular pattern of the pharynx typical of the family Planariidae; the oviducts unite, without embracing the bursa stalk, to form an unpaired terminal oviduct; the testes are situated in the anterior part of the body only; the male atrium is not surrounded by radial muscle plates; and the eyes are numerous. The genus thus defined (Kenk, 1930) has today about twenty species. It may be subdivided into subgenera on the basis of structural characters of the copulatory apparatus.

Subgenus *Polycelis*, lacking adenodactyls and lacking an excessive development of the muscle coat of the male atrium. This subgenus includes *Sorocelides* Sabussowa (1929, p. 521) and *Polycelidia* Zabusova (1936, p. 152), both described as distinct genera. The subgenus comprises the following species:

- Polycelis nigra* (O. F. Müller), Europe
P. receptaculosa (Livanov and Zabusova, 1940), Teletskoe Lake in the Altai Mountains
P. eburnea (Muth, 1912), Aral Sea region
P. tibetica Hyman (1934), Tibet
P. koslowi (Zabusov, 1911), Tibet
P. elongata (Sabussowa, 1929), Kamchatka
- P. polyopis* Zabusova (1936), Kamchatka
P. karafto Ijima and Kaburaki (1916), Sakhalin
P. sapporo (Ijima and Kaburaki, 1916), Japan
P. coronata (Girard, 1894), Wyoming and South Dakota

Subgenus *Seidlia* Zabusov (1911, suppl., p. 7), distinguished by an extraordinarily thick muscle zone surrounding the male atrium. Zabusov's (1916, p. 273) genus *Rjabuschinskya* likewise belongs here. Species of the subgenus:

- Polycelis sabussowi* (Seidl, 1911), including Seidl's species *Sorocelis sabussowi*, *S. lactea*, *S. stummeri* (cf. Kenk, 1936), Turkestan
P. relicta (Sabussowa, 1929), Kamchatka
P. eurantron (Zabusova, 1936), Kamchatka
- P. schmidti* (Zabusov, 1916), including *P. ijimai* Kaburaki (1922), Kamchatka, Kurile Islands, and Japan
P. auriculata Ijima and Kaburaki (1916), Japan

The third subgenus, *Ijimia* Bergendal (1890, p. 326), is characterized by possessing solid adenodactyls:

- Polycelis felina* (Dalyell), including *P. cornuta* Johnson, Europe and North Africa
P. tenuis Ijima, Europe and western Asia
- P. linkoi* Zabusov (1901), Onega Lake in European Russia
P. oculi-marginata (Palombi, 1931), New Guinea (see Beauchamp, 1947)

Two species of the genus *Polycelis* are too incompletely known to permit their assignment to either the subgenus *Polycelis* or *Seidlia*: *P. eudendrocoeloides* (Sabussowa, 1929) from the Kamchatka Peninsula and *P. tibetica* (Zabusov, 1911, p. 349) from Tibet (*P. tibetica* Hyman, 1934, will have to be renamed if it should prove to be different from Zabusov's species).

Polycelis borealis is clearly a member of the subgenus *Polycelis*. It differs from *P. nigra* in having well-developed auricles; from *P. elongata*, *P. polyopis*, and *P. sapporo*, in the arrangement of the eyes; and from *P. coronata* and *P. receptaculosa* in the structure of the male copulatory organ. The reproductive system of *P. karafto* has not been described adequately and thus does not permit a comparison with that of the Alaskan species. The remaining species of the subgenus, *P. eburnea*, *P. koslowi*, and *P. tibetica* Hyman, two of which are known only from the study of preserved specimens, agree with *P. borealis* in being pigmented forms with prominent auricles and in having a similar anatomy of the copulatory organs. The four species are

undoubtedly very closely related; whether some of them are identical or are the same as the Alaskan form cannot be established on the basis of present knowledge. The Alaskan *Polycelis*, therefore, is described as a new species.

Holotype.—On three slides, USNM 22333, clear spring on the road from Palmer to Willow, 20.1 miles from Palmer, altitude 3,800 feet, Aug. 9, 1950.

Distribution and ecology.—*Polycelis borealis* is a very common species occurring in mountain streams in the southern part of Alaska (Alaska Range, Talkeetna Mountains, Chugach Range). Typically it inhabits clear, cold, fast-running waters. It has also been found, however, in several small mountain lakes which connect with streams in which the species lives. It has not been observed in silt-bearing glacier streams.

The typical temperature range of the habitats was between 3.0° and about 15° C. (August 1950). Temperatures above 15° C. (up to 22.4° C.) were encountered only rarely and only in habitats which presumably have great diurnal temperature amplitudes (shallow lakes, small exposed streams).

The great majority of the specimens collected was asexual. Sexually mature animals were seen in only 6 of the 31 localities in which the species was found. In some localities, a large percentage of the specimens exhibited freshly regenerated heads or posterior ends, indicating that vivid asexual reproduction was taking place.

Clear springs on the road from Palmer to Willow, 20.1 miles from Palmer, altitude 3,800 feet, Aug. 9, 1950, water temperature 3.0° C., numerous specimens, five mature (holotype).

Clear, fast mountain stream crossing Mount McKinley Park road, 5.5 miles from the railroad station; Aug. 5, 1950.

Streams on road from Palmer to Willow 11.9, 18.0, 19.2, 20.2, 21.6, 22.1, 22.8, and 34.0 miles from Palmer, and Ice Lake, 20.4 miles from Palmer, Aug. 9, 1950.

Streams on Glenn Highway (Anchorage to junction with Richardson Highway near Glenallen) at mileposts 33.1, 33.9, 43.5, 64.8, 89.4, 98.8, and 117.1; Aug. 11 and 13, 1950.

Streams on road from Anchorage to Potter 2.9 (Campbell Creek), 10.3, and 10.6 miles from the city limits of Anchorage, Aug. 12, 1950.

Streams on Richardson Highway (section between Valdez and Glenallen) at mileposts 20.5, 25.5 (22.4° C.), 26.3 (see pl. 7), 29.0, 37.3, 54.7, 62.6 (see pl. 7), 81.0 (Squirrel Creek), and 87.5 (Rock Creek), and lake at milepost 27.3 (22.1° C.), Aug. 15, 1950.

Polycelis borealis was also identified in samples of triclads collected by Dr. Reece I. Sailer in July and September 1948. The following localities were represented: Richardson Highway, mileposts 8.3, 187.5, 192.9, 209.7, 223.6 and 239.9, and Glenn Highway, milepost 117.1.

Family DENDROCOELIDAE

Genus *Dendrocoelopsis* Kenk*Dendrocoelopsis piriformis*, new species

FIGURE 23; PLATE 6, FIGURE 3

Description.—Sexually mature specimens of this rather broad and plump species measure up to 15 mm. in length and 3 mm. in width. In quietly gliding animals, the head is truncated, with a convex frontal margin (grasping organ). There is a visible subterminal depression corresponding to the adhesive surface of the grasping organ or sucker. The rounded lateral corners of the head are formed by the auricles, which protrude only little laterally, thus causing an insignificant narrowing (neck) to appear behind them. Behind the head, the body margins widen gradually. The greatest width is reached at the level of the mouth. Behind that level, the body tapers again to a bluntly pointed posterior end. When the animal is at rest, the body appears short and wide, about pear-shaped, the body margins often forming a wavy or irregular contour. Young specimens are more slender and their lateral margins are more nearly parallel when they are in gliding motion. At rest, however, they assume the same pyriform shape as the adults. In short, the habit of the species may be described as resembling that of European and Asiatic representatives of the genus *Bdellocephala* Man, with which it has in common the broad shape and the anterior grasping organ.

The two eyes are situated on the dorsal side of the head. Their distance from each other amounts to somewhat more than one-third the width of the head at the level of the eyes. The distance of each eye from the lateral margin is smaller than the distance from the frontal margin.

The color of the dorsal side is usually a cloudy brown or dark brownish gray. In some specimens, the pigment is arranged in definite longitudinal stripes: one sharply marked median stripe flanked on each side by a light (usually yellow) band; laterad to this band the body darkens, losing its pigment again near the lateral margin. In other specimens, lacking the two light dorsal bands, the back may be either uniformly pigmented or may show a more or less distinct darker band along the midline. Young specimens and striped adults clearly show the finer disposition of the pigment in small rounded dots, each dot apparently corresponding to an individual pigment cell.

The pigment pattern of the dorsal side of the head is quite characteristic. A very dark field between the eyes extends anteriorly to both sides of the grasping organ. The area above the organ is unpigmented and white, and so are the two elongated ocular areas antero-

laterad to the eyes. A pair of indistinct, converging streaks of lighter coloration may run posteriorly from the lateral angles of the head.

The ventral side is light gray.

The pharynx is situated, in mature animals, behind the middle of the body; the mouth, at the beginning of the last third of the body; and the genital aperture, midway between the mouth and the hind end.

The normal locomotion of the animal is quiet gliding. When disturbed, it may attach itself to the substratum (apparently with the marginal adhesive zones) or move by "crawling." Young specimens do not crawl as readily as do adult ones.

The grasping organ, or sucker, in living animals, appears as a well-marked bulge on the frontal margin of the head, showing a concave ventral depression. In preserved specimens, the frontal margin is generally curved ventrally and the site of the organ forms a thick, grooved rim. Anatomically, the organ consists of glandular and muscular elements. The subterminal adhesive surface is covered with an epithelium devoid of rhabdites and pierced by numerous gland ducts filled with a granular, eosinophilic secretion. The cell bodies of the glands are scattered through the mesenchyme of the anterior half of the prepharyngeal region, particularly above the intestine. The gland ducts run anteriorly in dense bundles and, in their terminal sections, are thickly swollen with secretion. The muscular system of the organ, which could not be analyzed in detail on account of the density of the glandular structures, has fibers attached to the adhesive surface, serving presumably as retractors.

The rather short and thick pharynx is structurally typical of the family Dendrocoelidae; its internal muscular zone consists of intermingled circular and longitudinal fibers.

Auricular sense organs are represented by two bands of sensory epithelium extending posteriorly from the sides of the frontal margin. The cells of this epithelium are less tall than are those of the surrounding body epithelium; they lack rhabdites and are approached by nerve fibers from the underlying mesenchyme. The location of these organs corresponds to the two light, longitudinal streaks on the sides of the head seen in the living animal.

The testes are of moderate size, numerous, densely packed, and occupy the dorsal half of the mesenchyme, generally above the intestinal branches. They are arranged in two wide areas on both sides of the midline, extending from the level of the ovaries close to the posterior end.

The ovaries, situated at the level of the second pair of branches of the anterior intestinal trunk, show no structural peculiarities.

The genital pore (*pg*) leads immediately into two cavities, the male atrium (*am*) and, to the right and somewhat posteriorly, the duct of

the copulatory bursa (*bd*). No common atrium is present, and both the papilla of the penis and the opening of the oviduct are situated in the "male" atrium. The atrium is a conical cavity, wide anteriorly and tapering toward the genital pore. It is lined with a cubical epithelium, below which occurs a thin layer of fine circular muscle fibers and a thicker layer of coarser longitudinal fibers.

The penis consists of a spherical, muscular bulb and an elongated papilla. The penis bulb is differentiated into a wide peripheral muscular zone and a more central parenchymatic zone which contains a cavity, the seminal vesicle (*vs*). The vesicle is lined with a glandular epithelium and its wall forms villuslike projections. The two vasa deferentia (*vd*) penetrate the penis bulb from the anterolateral sides and open into the seminal vesicle on two prominent conical papillae projecting from the anterior wall of the vesicle a short distance from each other.

The papilla of the penis is finger-shaped, tapering toward the tip, and is highly muscular. It is covered with a thin cubical epithelium. Below the epithelium there is, in the basal portion of the papilla, a thin layer of longitudinal muscles, below which lie a stronger circular layer and a second longitudinal layer. In the distal part of the papilla, the external longitudinal layer is lacking. The axis of the papilla is pierced by the ejaculatory duct (*de*) which leads from the seminal vesicle to the tip of the papilla. The duct has a cubical epithelium and a strong coat of longitudinal muscle fibers.

The two oviducts approach the midline in the region of the copulatory apparatus, the right one passing between the atrium and the bursa stalk, and unite behind and above the atrium. The common oviduct (*ode*) proceeds ventrally, then curves anteriorly, and empties into the terminal part of the atrium close to the genital pore.

The copulatory bursa (*b*) is a lobed sac lined with a tall glandular epithelium. The distal parts of the epithelial cells are filled with fine eosinophilic granules. The duct or stalk of the bursa (*bd*) is differentiated into a narrow anterior section with a weak muscular coat, which connects with the bursa, and a posterior wider section which bends ventrally and opens at the genital pore. The cells of the anterior section resemble those of the bursa in having similar granular inclusions. Those of the posterior section lack the inclusions and are ciliated. The muscle coat of the duct consists of intermingled longitudinal and circular fibers.

Taxonomic position.—I have placed the species in the genus *Dendrocoelopsis* established originally for a European species, *D. spinosipenis* (Kenk). The original definition of the genus was based on the following characters: fibers of the inner muscle zone of the

pharynx intermingled; no adenodactyl; penis papilla developed, penis bulb of simple structure; oviducts unite without embracing bursa stalk; zone of testes extending behind the level of the copulatory organs; anterior end with subterminal true sucker; eyes not numerous (Kenk, 1930). Subsequently Beauchamp (1932, p. 254) founded a new genus, *Amyadenium*, with two species, *A. vandeli* Beauchamp and *A. brementi* (Beauchamp), both from the Pyrenees. Two more species were reported by the same author in later papers, *A. chattoni* Beauchamp (1949, p. 60), again from the Pyrenees, and *A. garmieri* Beauchamp (1950, p. 65), from central France. Beauchamp recognized the close relation of the new genus to *Dendrocoelopsis*, but

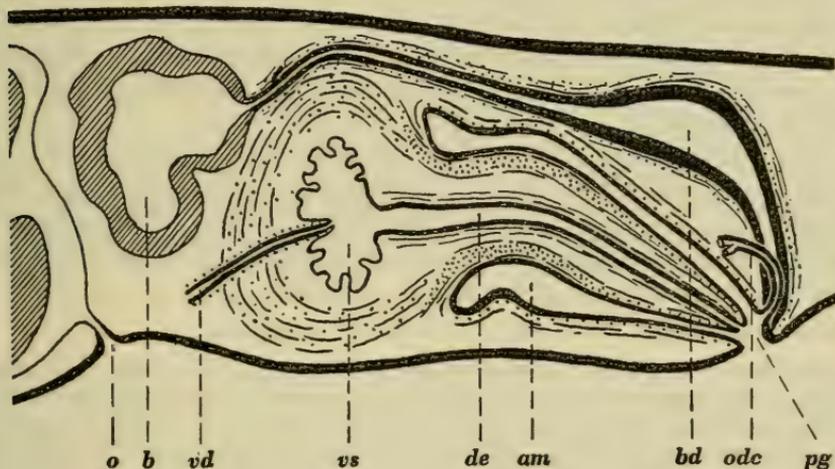


FIGURE 23.—*Dendrocoelopsis piriformis*, diagram of the copulatory organs in longitudinal section, $\times 60$. *am*, male atrium; *b*, bursa; *bd*, bursa stalk; *de*, ejaculatory duct; *o*, mouth; *odc*, common oviduct; *pg*, genital pore; *vd*, vas deferens; *vs*, seminal vesicle.

separated it from the latter on account of the absence of a highly complex grasping organ, or true sucker (i. e., an adhesive organ separated from the surrounding mesenchyme by a muscle layer). Hyman (1935) described a dendrocoelid species from Montana under the name of *D. vaginatus*. Again the main characters of the species coincide with those of *D. spinosipennis* with the exception of the grasping organ, which is of a simpler type. The new Alaskan species, *D. piriformis*, also falls clearly in the vicinity of the species enumerated, as does another species, *D. alaskensis*, the description of which follows on p. 178. Within this group of species there is a gradual differentiation of the grasping organ, which is absent in *D. alaskensis*, present as a moderately developed adhesive organ in *D. vaginata*, *D. piriformis*, *A. brementi*, *A. vandeli*, *A. chattoni*, and *A. garmieri*, and as a more highly developed and muscular sucker in *D. spinosipennis*. A similar wide variation of the structure of the anterior grasping organ

is seen in the genus *Dendrocoelum* Örsted where, however, true suckers are not known. In general, the taxonomic value of adhesive organs in triclads appears to be subordinated to that of other anatomical structures. I therefore tentatively modify the definition of the genus *Dendrocoelopsis* by omitting the presence of a sucker as a generic character, to include the species described as *Dendrocoelopsis* and *Amyadenium*.

Dendrocoelopsis piriformis differs from the other members of the genus (in its wider extent) in several characters: It is pigmented, whereas the others lack pigment and appear white; the presence of two eyes differentiates it from the three blind species, *D. vandeli*, *D. brementi*, and *D. garmieri* and from the many-eyed *D. chattoni*; and the dorsal position of the testes separates it from *D. spinosipenis*, *D. vaginata*, *D. garmieri*, and *D. alaskensis*. Apart from these most conspicuous characters, the structure of the male copulatory organ of *D. piriformis* is distinctive.

Holotype.—On five slides, USNM 22334, Moose Creek, on Glenn Highway, milepost 186, near Alaska Road Commission camp, Aug. 14, 1950.

Distribution and Ecology.—*Dendrocoelopsis piriformis* is a eurythermic species and inhabits lakes and their outlets in the southern part of Alaska and also occurs in a lake near Umiat.

Long Lake, on Glenn Highway, milepost 85.9, Aug. 11, 1950, clear water, 17.8° C. (near bank); under stones, several specimens, two of them mature.

Lake on Glenn Highway, milepost 88.1, Aug. 11, 1950, water temperature varying with depth (near bank, 19° C.); under stones, several specimens, one mature.

Lake on Glenn Highway, milepost 23.5 (see pl. 8), Aug. 13, 1950, clear water, 23.6° C. (near bank); several immature specimens.

Stream crossing Glenn Highway at milepost 147.2, outlet of Snowshoe Lake, Aug. 14, 1950, moderate current, water somewhat colored, 17.0° C.; one young specimen, under a stone.

Moose Creek, on Glenn Highway, milepost 186, near Alaska Road Commission camp, Aug. 14, 1950, fast, clear stream, 16.2° C.; under stones, two mature specimens (holotype).

Pippin Lake, on Richardson Highway, milepost 84.4, Aug. 15, 1950, shallow water near bank, 20° C.; under stones, many specimens, two of them mature.

Fresh-water lake near Umiat, collected by P. F. Scholander, Aug. 15, 1948; 18 specimens, majority belonging to the plain form, 1 with distinct stripes, 5 sexually mature (USNM 23678).

Dendrocoelopsis alaskensis, new species

FIGURE 24; PLATE 6, FIGURE 4

Description.—I had only limited material of this species and none of the animals was fully mature. The largest specimen measured 20 mm. in length and 4 mm. in width.

The anterior end is slightly lobed, with a convex frontal margin



Top: Beaver pond at milepost 62.6 of Richardson Highway, Alaska. Below the beaver dam, *Polycelis borealis* under stones. Bottom: Stream flowing along Richardson Highway, Alaska, at milepost 26.3. On the undersides of stones, *Polycelis borealis*.



Top: Stream crossing Steese Highway, Alaska, at milepost 84.0. Habitat of *Phagocata nivea* and *Dendrocoelopsis alaskensis*. Bottom: Lake at milepost 23.5 of Glenn Highway, Alaska. Under stones near bank, *Dendrocoelopsis piriformis*.

and a pair of rounded auricles protruding both anteriorly and laterally. No distinct adhesive or grasping organ is developed. There is a gentle narrowing of the head (neck) behind the auricles. Behind the head, the width of the body gradually increases until the greatest width is reached. The posterior end is bluntly pointed.

The body lacks pigment, being white except for the contents of the intestine, which may show through the body wall.

There are two principal eyes. The distance between them amounts to about one-third the width of the head at the level of the eyes. The distance of each eye from the frontal margin is equal to, or slightly larger than, the distance from the lateral margin. Additional, supernumerary, eyes were seen in a few individuals at short distances either anterior or posterior to the principal eyes.

The species bears a striking resemblance to a European species, *Dendrocoelum nausicaae* Schmidt of the Balkan Peninsula. It is generally associated with another triclad inhabiting the same streams in Alaska, *Phagocata nivea*, from which it may be distinguished by its larger size and by the position of the eyes.

A distinct adhesive organ is not seen in living animals. In histological sections, a transverse band, pierced by numerous openings of eosinophilic glands, is found below the frontal margin of the head. The nature of the glands and the local differentiation of the epithelium correspond entirely to the structure of the submarginal adhesive zone which is seen in this species, as well as in other triclads, bordering the lateral margins of the body. The frontal adhesive area may, therefore, be interpreted as an extension of the lateral adhesive zone. It is somewhat wider than the lateral one and has no muscular differentiations such as are typical of true grasping organs. The continuity of the two zones is interrupted by a short gap on each side of the head below the auricle.

The internal muscle zone of the pharynx consists of a layer of intermingled circular and longitudinal fibers. This character places the species in the family Dendrocoelidae. The anterior intestinal trunk bears a fairly large number, 21 to 24 pairs, of lateral branches, or diverticula.

Of a total of eight individuals of this species at my disposal, five were young, two showed primordia of genital structures, and only one had the principal parts of the reproductive system developed, though not fully differentiated histologically. The description of the genital organs, therefore, must be given with certain reservations.

The testes are predominantly ventral, situated mainly below the level of the intestinal diverticula, occasionally extending farther dorsally between the diverticula. No clearly recognizable testes were seen behind the level of the mouth; they may, however, appear there

when the animal matures completely. The ovaries are situated behind the third or fourth lateral branch of the anterior intestinal trunk.

The genital pore (*pg*) leads into an undivided cavity, the genital atrium (*a*), which is narrow at the pore and expands anteriorly. The narrow posterior part receives the outlet of the copulatory bursa and, anteriorly to it, the opening of the common oviduct.

The penis has a fairly large, spherical bulb and a plump and short papilla. The bulb contains a cavity with irregular outline, the seminal vesicle (*vs*), into which the two vasa deferentia (*vd*) open separately. The cavity of the bulb continues into the broad papilla and opens at its tip. The bulb has the usual coat of muscle fibers arranged in concentric layers. The papilla, which projects only little into the genital atrium, has two muscle layers underlying the outer epithelium, a circular layer and a longitudinal one. No glandular structures are differentiated in my specimen.

The two oviducts unite, without embracing the bursa duct, dorsally to the genital atrium. The common oviduct (*ode*) opens into the posterior, narrow part of the atrium from the dorsal side.

The bursa (*b*) is, in my specimen, a rather small sac with a narrow lumen. The bursa duct (*bd*) runs posteriorly, above the penis, to a level behind the genital pore. There it turns abruptly toward the ventral side. Its terminal portion is considerably wider than the anterior part of the duct and opens from the posterodorsal side into the genital atrium close to the genital aperture. In full maturity, the widened section of the bursa duct probably represents a histologically distinct vagina.

Taxonomic position.—The systematic relations of *Dendrocoelopsis alaskensis* are discussed together with those of the preceding species, *D. piriformis*. *D. alaskensis* is distinguished from all other species of the genus by the lack of a grasping organ.

Holotype. On seven slides, USNM 22335, creek crossing Elliot Highway at milepost 31.0, July 24, 1950.

Distribution and ecology.—*Dendrocoelopsis alaskensis* is an inhabitant of cool, fast streams of the White Mountains and usually shares its habitat with *Phagocata nivea*. It is a stenothermic and rheophilic species.

Clear spring and creek on Steese Highway, milepost 82.5, at the Alaska Road Commission camp, July 21, 1950; one immature specimen, under a stone.

Stream crossing Steese Highway at milepost 84.0 (see pl. 8), altitude 2,700 feet, July 21, 1950; two immature specimens, under stones, near liver bait.

Creek crossing Elliot Highway at milepost 31.0, July 24, 1950, water temperature 3.2° C.; under stones, five specimens, two of them with sexual structures (holotype).

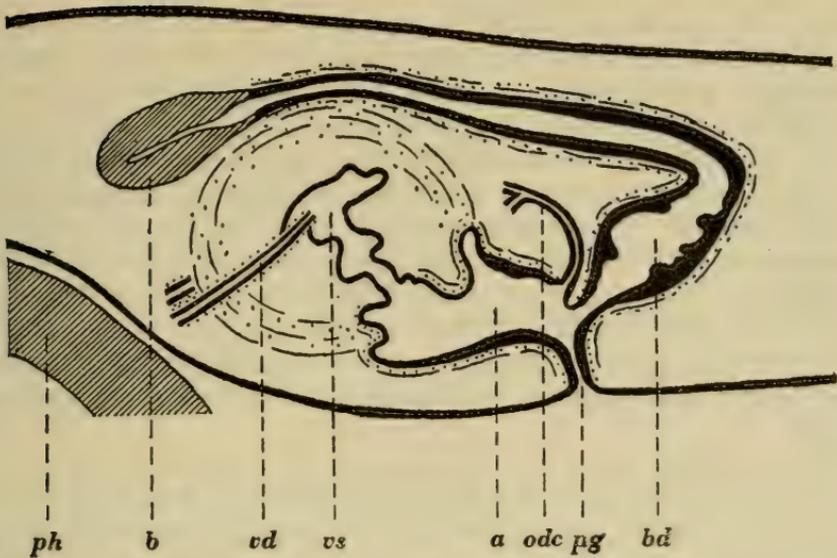


FIGURE 24.—*Dendrocoelopsis alaskensis*, diagram of the copulatory organs in longitudinal section, $\times 70$. *a*, genital atrium; *b*, bursa; *bd*, bursa stalk; *odc*, common oviduct; *pg*, genital pore; *ph*, pharynx (extended through the mouth); *vd*, vas deferens; *vs*, seminal vesicle.

Zoogeographic conclusions

The occurrence in Alaska of four endemic species of triclads poses several interesting questions. It is known that fresh-water triclads are most abundantly represented in the northern Temperate Zone and that the number of species declines toward both the Arctic and the Tropical Zones. The paucity of the triclad fauna at high latitudes has frequently been attributed to the effects of glaciation in rather recent geologic time. During the glacial period, when huge ice masses covered great parts of the northern hemisphere, all fresh-water life over wide areas must have vanished. After the glaciers had receded, the areas were gradually repopulated by species entering them from adjacent territories. The pattern of distribution of freshwater triclads in Europe shows evidence of a definite succession of species which migrated into the previously glaciated areas in the postglacial period (cf. Thienemann's 1950 summary of the pertinent literature).

It is well known, however, that the greater part of Alaska was not covered with ice in the glacial period. Geologic evidence of glaciation has been found only in the Brooks Range, the Alaska Range (and areas south of it), and in small isolated spots in the Yukon and Kuskokwim River Valleys while the remaining surface of Alaska remained free of ice (cf. Geological Society of America,

1945). We are thus justified in assuming that the fresh-water life of Alaska was not completely destroyed even at the peaks of glaciation when practically all Canada and a considerable part of the United States were covered with ice caps.

The Alaskan fresh-water triclads show no close relationships with the present North American triclad fauna inhabiting the midwestern plains and the eastern and southern areas of the continent. A comparison with the fauna of the Rocky Mountains is not possible at present, since the West of the United States and of Canada is almost unexplored with regard to triclads and to lower aquatic invertebrates in general. In any event it appears highly improbable that Alaska was populated by species migrating to it from the south or east.

On the other hand, the relations of the Alaska triclads to the fauna of Eurasia are unmistakable. Though, according to our present knowledge, none of the Alaskan triclads is specifically identical with any Asiatic form, two species, *Phagocata nivea* and *Polycelis borealis*, are very closely related to Asiatic species of the same genera.

Figure 25 shows the geographic range of the genus *Polycelis* as it is known at present. The individual dots on the map represent either single records or groups of neighboring localities where species of the genus have been found. In interpreting the map it is to be kept in mind that not all geographical areas are equally well investigated with regard to the occurrence of lower invertebrates. Europe, Japan, and the eastern parts of the United States are comparatively well known while our knowledge of the Asiatic, Western American, and African triclads is still rather deficient. A study of the map suggests that *Polycelis* is primarily a Eurasian genus. It appears to have extended its range, in some earlier geological period, to the northern rim of Africa.⁴ In a similar way it may have migrated into Alaska at the time of the cenozoic land bridges and may have penetrated south along the Rocky Mountains. It is highly probable that *Polycelis* will be found, in the future, more widely distributed in the Rockies than present collection records indicate.

The repeated emergence of a land bridge between Alaska and the eastern tip of Siberia is generally accepted by geologists and paleontologists. There is ample evidence of an exchange of faunal elements between the two continents (cf. Simpson, 1940 and 1947). The most recent corridor must have existed during the glacial stages of the Pleistocene. The volume of ice masses accumulated over vast areas of the northern hemisphere has been estimated conservatively at 34 to 42 million cubic kilometers. The corresponding depletion of

⁴ The presence of *Polycelis oculi-marginata* (Palombi) in New Guinea is a zoogeographic enigma (cf. Beauchamp, 1947).

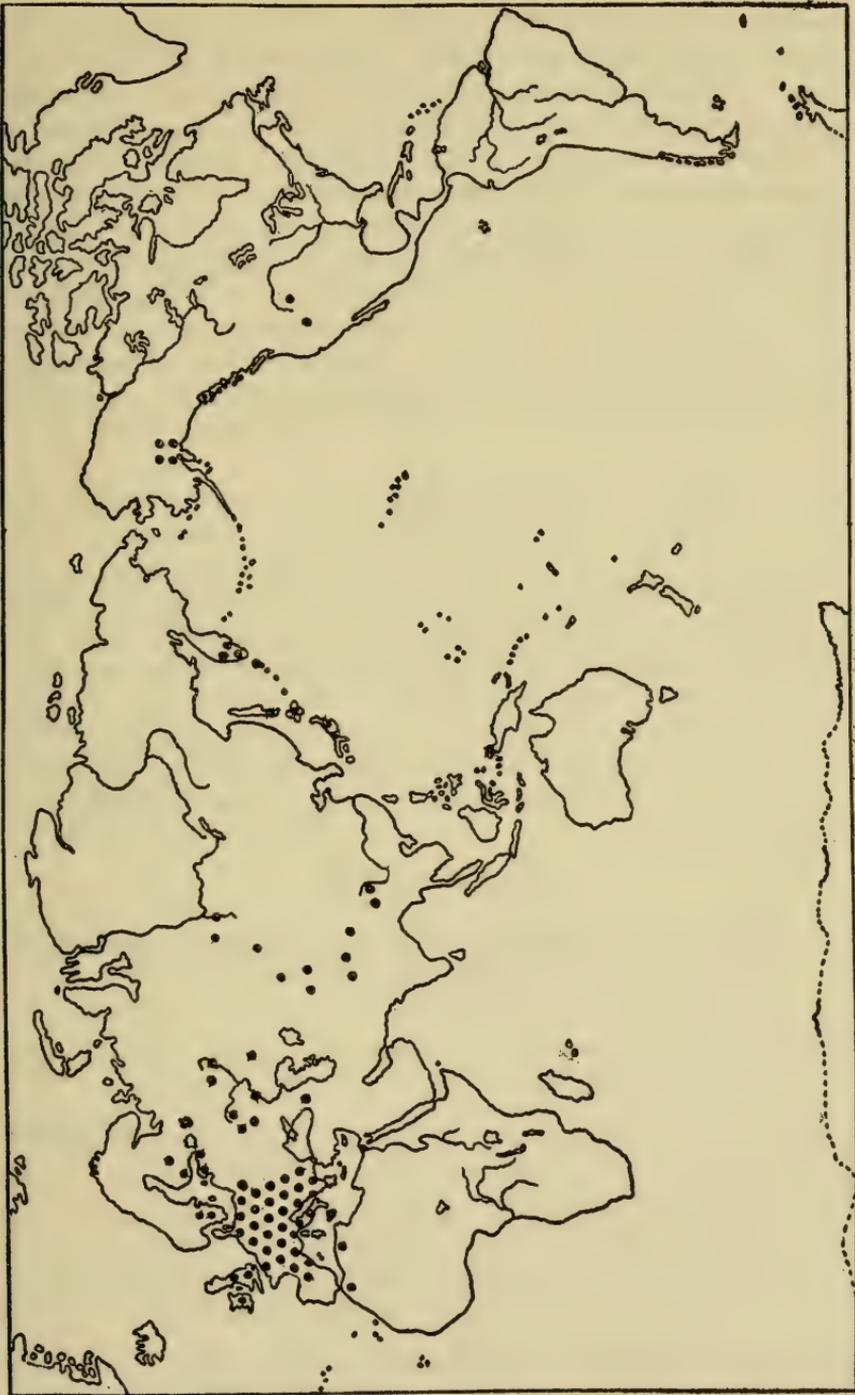


FIGURE 25.—Worldwide distribution of the genus *Polycelis*.

the ocean must have lowered the sea level 50 to 90 meters below the present level (Daly, 1934, pp. 41-50). The depth of the eastern part of the Bering Sea (within the perimeter passing through the eastern projection of Siberia, the Seward Peninsula of Alaska, and Nunivak and St. Lawrence Islands) averages less than 40 meters. Thus the ocean bottom between Alaska and Asia must have emerged with each glacial stage, forming a wide connection between the two continents. This process may have been enhanced by the uplifting of the area along the margin of the ice cap, brought about by plastic or elastic deformation of the earth crust under the weight of the ice masses.

A land bridge between Alaska and Asia must have persisted for prolonged periods of time. Simultaneously, Alaska was disconnected from other inhabitable areas of North America by broad ice fields.

In view of the geological history of Alaska we may conclude that the present Alaskan fresh-water triclads are the remnants or successors of triclads that lived in Alaska in the glacial times and perhaps even in preglacial periods, and that they are, in all probability, of Asiatic origin. It may further be assumed that some Alaskan triclads have extended their range during the postglacial period and proceeded southeast along the Rocky Mountains.⁵ The occurrence of a species of *Polycelis* in Wyoming and South Dakota may have resulted from this migration. More light would be thrown on this question by a more thorough study of the triclad fauna of the Canadian and American Rockies.

Literature cited

ARNDT, WALTHER

1922. Untersuchungen an Bachtricliden. Ein Beitrag zur Kenntnis der Paludicolen Korsikas, Rumäniens und Sibiriens. *Zeitschr. für wiss. Zool.*, vol. 120, pp. 98-146, pl. 4.

BAZIKALOVA, A. Ā.

1947. Turbellaria-Triclada vostočnoj Sibiri i Pribaľkal'fā. *Doklady Akad. Nauk SSSR*, new ser., vol. 55, pp. 671-672.

BEAUCHAMP, PAUL DE

1932. *Biospeologica*. LVI. Turbellariés, Hirudinées, Branchiobdellidés. Deuxième série. *Arch. Zool. Expér. et Gén.*, vol. 73, pp. 113-380, pls. 6-8.

1939. La systématique et l'éthologie des *Fonticola* (Turb. Triclades). *Věstník Českoslov. Zool. Společnosti v Praze*, vol. 6-7, pp. 91-96.

1947. Observations sur quelques Turbellariés du Musée royal d'Histoire naturelle de Belgique. *Bull. Mus. Roy. Hist. Nat. Belgique*, vol. 23, No. 33, 11 pp.

1949. *Biospeologica*. LXIX. Turbellariés (troisième série). *Arch. Zool. Expér. et Gén.*, vol. 86, Notes et Revue, pp. 50-65.

1950. Nouvelles diagnoses de triclades obscuricoles. *Bull. Soc. Zool. France*, vol. 75, pp. 65-70.

⁵ I wish here to correct my assumption in a previous paper (Kenk, 1943, p. 6) that all Canadian triclads had entered Canada from the south.

BERGENDAL, D.

1890. Studien über nordische Turbellarien und Nemertinen. Öfv. Vet.-Akad. Förh., 1890, pp. 323-328.

DALY, REGINALD ALDWORTH

1934. The changing world of the ice age. xxi+271 pp., 6 pls. New Haven.

GEOLOGICAL SOCIETY OF AMERICA

1945. Glacial map of North America. Special Papers, No. 60.

GIRARD, CHARLES

1894. Recherches sur les Planariés et les Némertines de l'Amérique du Nord. Ann. Sci. Nat., sér. 7 (Zool.), vol. 15, pp. 145-310, pls. 3-6.

HYMAN, LIBBIE H.

1931. Studies on the morphology, taxonomy, and distribution of North American triclad Turbellaria. III. On *Polycelis coronata* (Girard). Trans. Amer. Micr. Soc., vol. 50, pp. 124-135.

1934. Report on triclad Turbellaria from Indian Tibet. Mem. Connecticut Acad. Arts Sci., vol. 10, No. 2, pp. 5-12, pls. 1-2.

1935. Studies on the morphology, taxonomy, and distribution of North American triclad Turbellaria. VI. A new dendrocoelid from Montana, *Dendrocoelopsis vaginatus* n. sp. Trans. Amer. Micr. Soc., vol. 54, pp. 338-345.

1937. Studies on the morphology, taxonomy, and distribution of North American triclad Turbellaria. VII. The two species confused under the name *Phagocata gracilis*, the validity of the generic name *Phagocata* Leidy 1847, and its priority over *Fonticola* Komárek 1926. Trans. Amer. Micr. Soc., vol. 56, pp. 298-310.

IJIMA, I., and KABURAKI, T.

1916. Preliminary descriptions of some Japanese triclads. Annot. Zool. Japon., vol. 9, pp. 153-171.

KABURAKI, TOKIO

1922. On some Japanese freshwater triclads; with a note on the parallelism in their distribution in Europe and Japan. Journ. Coll. Sci., Imp. Univ. Tokyo, vol. 44, No. 2, 71 pp., 1 pl.

KENK, ROMAN

1930. Beiträge zum System der Probursalier (Tricladida paludicola), III. Zool. Anz., vol. 89, pp. 289-302.

1936. Bemerkung zur Trikladenfauna Turkestans. Zool. Anz., vol. 115, pp. 76-80.

1943. Notes on the planarian fauna of Canada. Canadian Field-Nat., vol. 57, pp. 5-6.

LIVANOV, N. A., and ZABUSOVA, Z. I.

1940. Planarii basseina Telet'skogo ozera i novye dannye o nekotorykh drugikh sibirskikh vidakh (Paludicoles du Lac Teletzkoë et nouvelles données sur quelques formes sibériennes). Trudy Obshch. Estestvoisp. pri Kazan. Univ., vol. 56, pp. 83-159.

MUTH, ANTON

1912. Beiträge zur Kenntnis der Gattung *Sorocelis* Grube. Mitt. Naturw. Ver. Steiermark, vol. 48, pp. 381-410.

PALOMBI, A.

1931. Turbellari della Nuova Guinea. In: Résultats scientifiques du voyage aux Indes Orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique, vol. 2, No. 8, 14 pp., 1 pl. (Mém. Mus. Roy. Hist. Nat. Belgique, hors série).

SABUSSOWA, Z. (see also ZABUSOVA, Z. I.)

1929. Die Turbellarien der Kamtschatka-Halbinsel nach den Sammlungen der Rjabuschinsky-Expedition 1908-1909. Zool. Jahrb., Abt. Syst., vol. 57, pp. 497-536, pl. 4.

SEIDL, HEINRICH H.

1911. Beiträge zur Kenntnis centralasiatischer Tricladen. Zeitschr. für wiss. Zool., vol. 98, pp. 31-67, pls. 5-7.

SIMPSON, GEORGE GAYLORD

1940. Mammals and land bridges. Journ. Washington Acad. Sci., vol. 30, pp. 137-163.
1947. Holarctic mammalian faunas and continental relationships during the Cenozoic. Bull. Geol. Soc. Amer., vol. 58, pp. 613-687.

THIENEMANN, AUGUST

1950. Verbreitungsgeschichte der Süßwassertierwelt Europas; Versuch einer historischen Tiergeographie der europäischen Binnengewässer. XVI+809 pp. Stuttgart.

ZABUSOV", I. P. (SABUSSOW, H.; ZABOUSOFF, H.)

1901. Zamîetki po morfologii i sistematikî Triclada. II. O planariâkh" Onezhskago ozera (Tricladenstudien. II. Zur Kenntniss der Tricladen des Onegasees). Protok. Zashêd. Obshch. Estestvoisp. Imp. Kazan. Univ., Prilozheniê No. 191, 18 pp.
1911. Izshêdovaniâ po morfologii i sistematikî planariî ozera Balkala. I. Rod" *Sorocelis* Grube (Untersuchungen über die Morphologie und Systematik der Planarien aus dem Baikalsee. I. Die Gattung *Sorocelis* Grube). Trudy Obshch. Estestvoisp. Imp. Kazan. Univ., vol. 43, No. 4, 422+8+2 pp., 11 pls.
1916. *Rjabuschinskya schmidti* n. g. n. sp., novyî vid" i rod" Tricladida paludicola iz" Kamchatki (*Rjabuschinskya schmidti* n. g. n. sp., espèce et genre nouveau des Tricladida paludicola du Kamtchatka). Russ. Zool. Zhur., vol. 1916, pp. 273-286.

ZABUSOVA, Z. I. (SABOUSOFF, Z.; see also SABUSSOWA, Z.)

1936. Planarii Kamchatki (Les planaires paludicoles du Kamtchatka). Kazan. Gosud. Univ., Uchenye Zapiski, Zool., vol. 96, No. 7, pp. 141-174.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1953

No. 3323

REVIEW OF THE INDO-PACIFIC ANEMONE FISHES, GENUS
AMPHIPRION, WITH DESCRIPTIONS OF TWO NEW
SPECIES.

By LEONARD P. SCHULTZ

During the summer of 1950 Dr. Arthur D. Welander, School of Fisheries, University of Washington, and I were engaged in studying reef fishes brought back from the Marshall Islands by the staff of the Applied Fisheries Laboratory of the University of Washington. Among this material was a specimen of anemone fish that we could not identify with any known species. After I returned to the U. S. National Museum, I reviewed the descriptions of all known species, compared that specimen with the numerous lots of *Amphiprion* in the National Museum, and found that it represented a new species. During March 1951, I studied the anemone fishes in the Museum of Comparative Zoology, Harvard University, and found another undescribed species from Mauritius.

Descriptions and analyses of species referable to the genus *Amphiprion* have been based on so few specimens, usually only one or two, that the problem of variability or constancy of the color pattern has been neglected. For most of the few hundred species among more than fifty fish families that I have studied in detail the basic color pattern has been observed to be fairly constant. It is of great value for the recognition of species, especially in the genus *Amphiprion*. Weber and de Beaufort (The fishes of the Indo-Australian Archipelago, vol. 8, pp. 330-348, 1940) recognized eight species, whereas we have distinguished fourteen and there may be others recognizable when larger series are compared and additional characters studied. Fin ray counts were made on various species and these data are recorded in table 1.

Except for original descriptions, no attempt was made to include all references to species referable to the genus *Amphiprion*. Whenever

figures of species were found these have been included in the synonymy. Most descriptions and records are not in sufficient detail to assign them to the correct species without examining the material on which the records were based.

Genus *Amphiprion* Bloch and Schneider

Amphiprion Bloch and Schneider, *Systema ichthyologiae* . . . , p. 200, 1801 (genotype, *Lutjanus ephippium* Bloch).

Prochilus (on Klein, 1775) Bleeker, *Nat. Verh. Hollandsche Maatsch. Wet. Haarlem*, ser. 3, vol. 2, No. 6, p. 20, 1877 (genotype, *Lutjanus ephippium* Bloch).

Actinicola Fowler, *Journ. Acad. Nat. Sci. Philadelphia*, ser. 2, vol. 12, p. 533, 1904 (genotype, *Lutjanus percula* Lacepède).

Phalerebus Whitley, *Mem. Queensland Mus.*, vol. 9, pt. 3, p. 216, 1929 (genotype, *Prochilus akalopisos* Bleeker).

Key to the species of *Amphiprion*

- 1a. A white band (sometimes indistinct) along middorsal line from snout to dorsal origin or beyond along base of dorsal fin; total pectoral rays 17 to 19; next to last dorsal spine about 1.3 to 1.5 in longest dorsal spine; no notable emargination in dorsal fin; scales on dorsal surface of head extend forward to a line between front of orbits.
 - 2a. No vertical pale bars; dorsal rays about X,18 or 19; anal about II,12 or 13; pectoral 17 to 19.....**A. akalopisos** Bleeker
 - 2b. A single vertical pale bar about 2 scales wide from nape to subopercle; dorsal rays about X,16; anal about II,12 or 13; pectoral 17. **A. perideraion** Bleeker
- 1b. No white band along middorsal line.
 - 3a. Caudal fin with pale or dusky roundish center posteriorly edged with black; outer edges of caudal fin white; second pale or white bar from rear of spiny dorsal fin to anus with a triangular anterior projection under depressed pectoral fin; tips of pelvics black; a broad white color bar on head and on caudal peduncle always present. Dorsal fin deeply indented at rear of spiny part, next to last dorsal spine contained three times in longest dorsal spine; scales on dorsal surface of head do not extend forward of nape.....**A. percula** (Lacepède)
 - 3b. Color not as in *A. percula*.
 - 4a. Central part of caudal fin black; outer edges of caudal fin broadly or narrowly edged with white; second pale bar, if present, without any projection anteriorly; pale bar on head present; next to last dorsal spine contained 1.2 to 2.0 times in longest dorsal spine; no notable emargination in dorsal fin.
 - 5a. Second pale bar represented dorsally on body by an ovate white area that continues anterodistally on soft dorsal fin; this white area does not extend below midlengthwise axis of body and never to anus; first pale bar 10 to 12 scales wide; anal fin black, except distally edged with white; spiny dorsal black; pelvics black; pectoral pale, except basally blackish; next to last dorsal spine contained about 1.2 to 1.5 in longest dorsal spine; no notable emargination in dorsal fin; scales on dorsal surface of head extend forward to a line between rear of orbits. **A. latilavivus** Cuvier and Valenciennes

5b. Second pale bar continuous from dorsal part of body to region of anus.

6a. Second pale bar broad, about 7 to 14 scales wide at level of lateral line (its width there contained 2 or less times in width of third black bar at level of lateral line) from whence it continues posterodorsally on soft dorsal fin; pelvics dusky to blackish; spiny dorsal blackish; anal blackish, at least basally; scales on dorsal surface of head extend forward to a line between rear of orbits.

7a. Caudal peduncle with broad white bar; pectoral fin pale distally, basally dusky.

A. chrysogaster Cuvier and Valenciennes

7b. Caudal peduncle black; no white bar; black coloration of posterior part of body continues on central part of caudal fin; pectoral fin dusky in basal third.—*A. polymnus* (Linnaeus)

6b. Second pale bar narrow, about 2 to 6 scales wide at level of lateral line, its width there contained 3.5 or more times in width of third black bar at level of lateral line; caudal fin black, narrowly edged with white; anal fin pale to blackish; scales on dorsal surface of head extend forward to over rear half of pupil; pelvics and pectorals pale; soft dorsal black, edged with white.

8a. Second and third (peduncular) pale bars about 2 or 3 scales wide, their width at level of lateral line contained 7 to 10 times in width of third black bar at level of lateral line; second pale bar not extending to distal edge of dorsal fin, ending on basal half of last dorsal spine; posterodorsal part of body blackish; anterior and ventral parts of body pale; spiny dorsal light dusky.

A. tricinctus Schultz and Welander, new species

8b. Second and third (peduncular) pale bars 4 to 6 scales wide, their widths at level of lateral line contained from 4 to 6.5 times in width of third black bar at level of lateral line; second pale bar extends into distal half of dorsal but not quite to the edge of that fin; dorsal and posterior half of body blackish; anteroventral part of body pale; spiny dorsal dusky to blackish.

A. mauritiensis Schultz, new species

4a. Caudal fin plain pale or plain dusky, no black central blotch edged with white posteriorly; first pale bar on head present.

9a. Second pale bar broad, about 7 to 10 scales wide at level of lateral line, and continuing to distal edge of spiny dorsal fin, thence posteriorly along distal edge of soft dorsal; caudal fin pale; caudal peduncle black, without the third pale bar, at least on adults; spiny dorsal, anal, and pelvic fins black; pectoral fin pale; next to last dorsal spine contained about 1.5 in longest dorsal spine; scales on dorsal surface of head extend forward to a line between rear of orbits.....*A. sebae* Bleeker

9b. Second pale bar, if present, not continuing to distal edge of dorsal fin; next to last dorsal spine contained 0.8 to 1.2 in longest dorsal spine; scales on dorsal surface of head extend forward to lines between rear edge of orbits to center of pupil.

10a. First two pale bars typically present on adults.

- 11a. First two pale bars broad, each about 5 to 7 scales wide at level of lateral line; third (peduncular) pale bar represented by a white bar, posteriorly edged with darkish, or the dark body color on anterior part of caudal peduncle may end abruptly, the white continuing on caudal fin; spiny dorsal black, dusky, or pale; soft dorsal and anal fins pale to black; pelvics pale to black, sometimes edged with black anteriorly; pectoral pale; next to last dorsal spine about 1.2 in longest dorsal spine.-----**A. xanthurus** Cuvier and Valenciennes
- 11b. First two pale bars narrow, second usually narrower than first, the latter 3 to 4.5 scales wide and the first 3 to 6 scales wide, at level of lateral line; caudal peduncle blackish, without third pale bar on adults, sometimes pale bar is present on young; dark color of caudal peduncle gradually fading into pale color of caudal fin; spiny dorsal pale to dusky, soft dorsal pale; anal fin pale; pectoral pale; pelvics pale, except anterior edge black; second from last dorsal spine contained from 1.0 to 1.2 times in longest dorsal spine.
- A. bicinctus** Rüppell
- 10b. First pale bar usually present on head, about 4 to 6 scales wide at level of lateral line; second pale bar lacking, except sometimes on small young specimens.
- 12a. Anal fin pale or partly pale; pelvics with some pale area.
- 13a. Anal fin pale, except distally edged with fine black line; pelvics pale, except anterior edge black; breast pale; dorsal spines X, soft dorsal rays usually 17.
- A. ephippium** (Bloch)
- 13b. Anal fin pale or distally pale with basal half (or less) dusky to blackish; pelvics pale distally and blackish ventrally, or inner rays pale and outer rays broadly blackish, except distal tips, which are pale; dorsal spines IX or X (more often IX than X), soft dorsal rays usually 17 or 18.-----**A. frenatus** Brevoort
- 12b. Anal and pelvic fins black, no pale areas anywhere; dorsal spines X, soft dorsal rays usually 17.
- A. melanopus** Bleeker

***Amphiprion akallopisos* Bleeker**

PLATE 9, FIGURE A

Amphiprion akallopisos Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 281, 1853.

Prochilus akallopisos Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 3, 1878.

Phalerebus Whitley (new genus), Mem. Queensland Mus., vol. 9, pt. 3, p. 216, 1929 (genotype, *Prochilus akallopisos* Bleeker = *A. akallopisos* Bleeker).

This species is best recognized by the presence of a wide white band from snout along middorsal line of head, thence posteriorly along each side of base of dorsal fin, and ending on dorsal side of caudal peduncle; no white bars are present. Three specimens were studied: USNM 147130, from the Philippine Islands; USNM 82781, from the Fiji Islands; and MCZ 3308, from Sabang Bay.

Amphiprion perideraion Bleeker

PLATE 9, FIGURE B

Amphiprion perideraion Bleeker, Nat. Tijdschr. Nederl-Indië, vol. 9, p. 437, 1855.—Montalban, Bur. Sci. Manila Monogr. 24, p. 16, pl. 4, fig. 1, 1928 (Philippine Islands).

Prochilus perideraion Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 1, 1878.

?*Amphiprion rosenbergi* Bleeker, Acta Soc. Sci. Indo-Neerl., vol. 6, p. 16, 1859; Atlas ichthyologique . . . , vol. 9, pl. 402, fig. 2, 1878.

This species is best recognized by the narrow white band on the middorsal line of head, beginning between front of eyes and extending to dorsal origin, and a narrow white vertical bar on rear of head behind eye. Four specimens were studied: USNM 141032, 141033, and 147129, from the Marshall Islands and Borneo; and MCZ 33409, from Amboina.

Amphiprion percula (Lacepède)

PLATE 9, FIGURE C

Lutjanus percula Lacepède, Histoire naturelle des poissons, vol. 4, pp. 194, 239, 240, 1802 (New Britain).

Amphiprion tunicatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 399, pl. 132, fig. 2, 1830 (Vanicolo).—Lesson, Voyage . . . La Coquille . . . , Zoologie, vol. 2, pt. 1, p. 192, pl. 25, fig. 3, 1830 (Port Praslin, New Ireland; Doreh, New Guinea).

Prochilus percula Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 2, 1878.

Anthias polymnus var. (non Linnaeus) Bloch, Naturgeschichte der ausländischen Fische, vol. 6, p. 103, pl. 316, fig. 3, 1792.

Amphiprion percula Günther, Journ. Mus. Godeffroy, vol. 15, Andrew Garrett's Fische der Südsee, pt. 7, pl. 124, fig. A, 1881 (Samoan Islands).—Day, The fishes of India . . . , vol. 2, p. 379, pl. 80, fig. 4, 1878 (Andamans).—Montalban, Bur. Sci. Manila Monogr. 24, p. 14, pl. 2, fig. 2, 1928 (Philippine Islands).

Actinicola percula Aoyagi, Coral Fishes, Tokyo, pl. 37, fig. 2, 1943 (Kakure-Kumanomi); Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 4, No. 1, p. 175, pl. 9, fig. 2, 1941 (Japan).

Amphiprion bicolor Castelnau, Proc. Zool. Acclim. Soc. Victoria, p. 92, 1873 (Port Darwin).

Actinicola bicolor (Castelnau) Whitley, Mem. Queensland Mus., vol. 9, pt. 3, p. 215, pl. 27, fig. 2, 1929 (Port Darwin).

This is the most characteristically colored species in the genus *Amphiprion*, and is one of the commonest seen associated with the sea anemone *Discosoma*. The second white bar has a forward projection under the depressed pectoral fin. No other species of *Amphiprion* observed by me has the forward edge of the second dark bar with a deep concavity. The centers of the dark bars on the sides may be pale brown to blackish; all dark bars are black edged. I have studied 20 lots, totaling 35 specimens, from the Philippine, Solomon, Palawan, Schouten, and Morotai Islands.

TABLE 1.—Fin-ray counts recorded for certain species of Amphiprion

	Dorsal										Anal						Pectoral					
	IX	X	XI	14	15	16	17	18	19	19	II	12	13	14	15	16	17	18	19	20	21	
<i>eplippium</i>																						
north Australia, near Darwin						2	9	1										3	8	1		
<i>metanopus</i>					1	2	8						1	8	3				6	5		
Marshall Islands		10	1								6		1	5					6			
Samoan and Paumotu Islands		4					4				3			3				3	1			
<i>frenatus</i>						2	19	12			16			16					23	2		
Philippine Islands	23	10					1	1			9			2					3			
Okinawa and Japan	2							2	1		3			1					1			
<i>akallopisos</i>		3					4				3			1					3			
<i>periderion</i>		4									3			1					1			
<i>chrysopaster</i>		6	2	71	1	2	5				8			1					3	8		2
<i>dicinctus</i>		5	1		1	2	3				6			2	3	1			1	3	1	
<i>mauridenis</i>		9	1			1	8	1			10			1	9				1	12	8	
<i>trichinus</i>		1					1				1			1								
<i>zanthurus</i>		11	1			8	1				11			4	5	1			7	5		
<i>percula</i>		7			4	3					7			6	1							
<i>sebae</i>		2				1	1				2			1	1							2

Amphiprion laticlavus Cuvier and Valenciennes

PLATE 9, FIGURE D

- Amphiprion laticlavus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 394, pl. 132, fig. 1, 1830 (New Guinea).
- Amphiprion bifasciatus* (non Bloch) Montalban, Bur. Sci. Manila Monogr. 24, p. 15, pl. 3, fig. 1, 1928 (Philippine Islands).
- Amphiprion bifasciatus annamensis* Chevy, Travaux l'Inst. Océanogr. Indochine, Mem. 4, pt. 1, poissons, p. 99, pl. 39, 1932 (Sud-Annam).
- Prochilus bifasciatus* (non Bloch) Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 4, 1878.
- Amphiprion polymnus* (non Linnaeus) Aoyagi, Coral Fishes, Tokyo, pl. 36, fig. 2, 1943 (Toaki-Kumanomi); Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 4, No. 1, p. 173, pl. 12, fig. 4, 1941 (Japan).
- Amphiprion unimaculatus* (non Meuschen) Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, p. 202, fig. 28, 1939 (Itoman, Okinawa).

This species differs from all others in regard to the second white bar, which is represented by an ovate white area on upper half of body and on soft dorsal fin, but without any extension on ventral part of body. Third white bar on caudal peduncle is lacking. Caudal fin is basally and centrally blackish, with posterolateral edges white. Anal is submarginally blackish, with distal edge white. One specimen, USNM 147128, from the Philippines, was studied.

Amphiprion chrysogaster Cuvier and Valenciennes

PLATE 9, FIGURE E

- Amphiprion chrysogaster* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 400, 1830 (Île de France)—Lesson, Voyage . . . La Coquille, . . . , Zoologie, vol. 2, pt. 1, p. 191, pl. 28, fig. 3, 1830 (Île de France).
- Amphiprion percula* (non Lacepède) Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, p. 200, pl. 6, fig. 1, 1939 (Riu Kiu Islands).
- Amphiprion trifasciatus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 595, 1830 (Moluccas).
- Amphiprion fusciventer* Bennett, Proc. Comm. Zool. Soc. London, vol 1, p. 165, 1831 (Mauritius).
- Prochilus bifasciatus* (non Bloch) Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 6, 1878.

This species, with three broad white bars, has the central part of caudal fin black and outer edges white; second white bar is continuous on distal part of soft dorsal fin. Seven specimens were studied: One each in USNM 61690 from Mauritius, 141034 from the Marshall Islands, 147127 from the Philippines; and four MCZ specimens, three from Zanzibar, Africa, and one, collected by Andrew Garrett, from Apiang, Kingsmill Islands.

Amphiprion polymnus (Linnaeus)

PLATE 9, FIGURE J

Perca polymna Linnaeus, Systema naturae, ed. 10, p. 291, 1758.

Anthias bifasciatus Bloch, Naturgeschichte der ausländischen Fische, vol. 6, p. 103, pl. 316, fig. 2, 1792.

Prochilus bifasciatus Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 5, 1878.

?*Amphiprion ocellaris* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 399, 1830 (Sumatra).

?*Amphiprion melanurus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 400, 1830 (Sumatra).

Lutjanus jourdin Lacepède, Histoire naturelle des poissons, vol. 4, pp. 191, 235, 1802 (Amboina).

Coracinus seu *Sciaena unimaculata* Meuschen, Zoophylacium Gronovianum . . . , Pisces, No. 227, 1781 (based on Gronow, 1763).

Coracinus vittatus Gray, Catalogue of fish collected and described by L. T. Gronow . . . , British Museum, p. 57, 1854 (based on Gronow's No. 227).

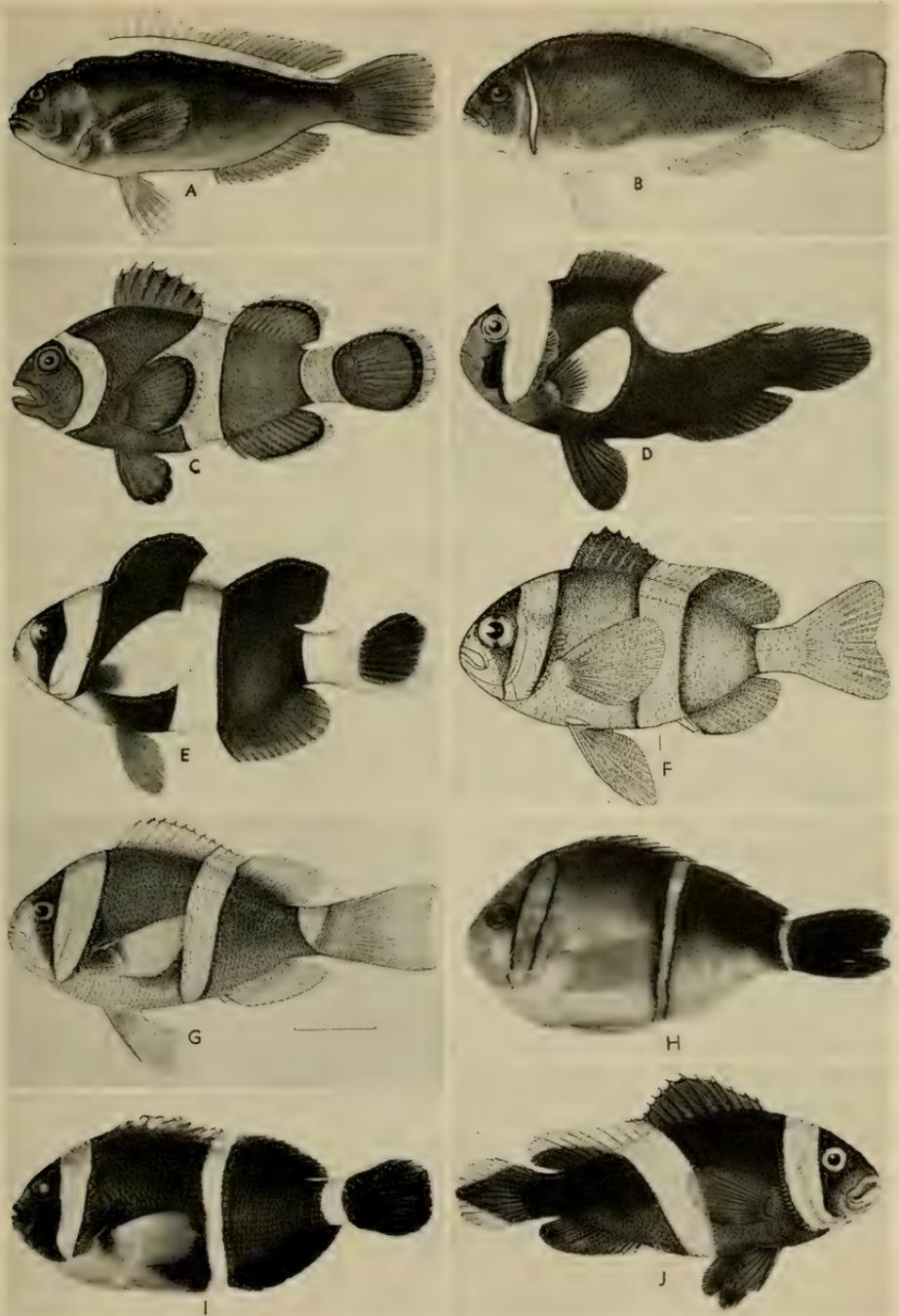
Amphiprion intermedius Schlegel and Müller, Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen . . . , Zoologie, p. 18, 1839-1841 (reference copied).

Amphiprion polymnus (Linnaeus) has been confused almost since the day it was named. Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 8, p. 344, 1940) discuss the confusion between *polymnus* and *bicinctus*, the former name having been used for the species currently called *bicinctus*.

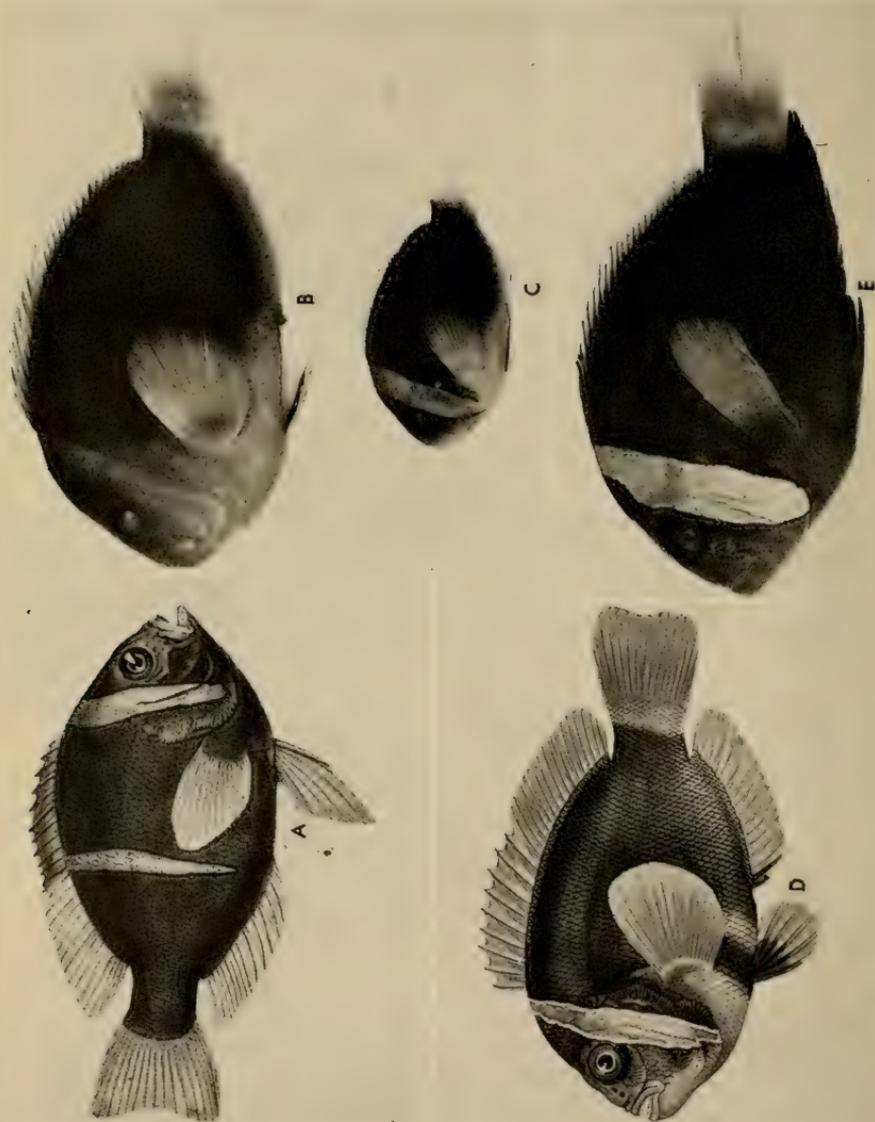
In *A. polymnus* the second white bar continues on to the distal part of the soft dorsal, but it lacks the third white bar on the caudal peduncle; also, the black coloration of the caudal peduncle continues on to the central part of the caudal fin, whereas in *A. sebae* the caudal fin is pale. The anal fin is black basally, with the distal third white.

EXPLANATION FOR PLATE 9

A, *Amphiprion akallopisos* Bleeker, photograph of a color drawing in the Philippine *Albatross* collection; B, *A. perideraion* Bleeker, photograph of a color drawing in the Philippine *Albatross* collection; C, *A. percula* (Lacepède), photograph of a color drawing in the Philippine *Albatross* collection; D, *A. latilavium* Cuvier and Valenciennes, photograph of plate 36, figure 2, in Aoyagi, Coral Fishes, 1943 (= *A. polymnus*, non Linnaeus, Aoyagi); E, *A. chrysogaster* Cuvier and Valenciennes, photograph of plate 6, figure 1, in Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, 1939 (= *A. percula*, non Lacepède, Okada and Ikeda); F, *Amphiprion sebae* Bleeker, photograph of figure 27 in Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, 1939; G, *A. xanthurus* Cuvier and Valenciennes, copy of figure 4 in Jordan and Dickerson, Proc. U. S. Nat. Mus., vol. 34, p. 611, 1908, of a specimen from Suva, Fiji; H, *A. tricinctus*, new species, holotype, USNM 152929, from Bikini Atoll, Amen Island, standard length 75 mm.; I, *A. mauritiensis*, new species, holotype, MCZ 6093, from Mauritius, standard length 111.5 mm.; J, *A. polymnus* (Linnaeus), photograph of plate 316, figure 2, Bloch, Naturgeschichte der ausländischen Fische, vol. 6, 1792 (= *Anthias bifasciatus* Bloch).



Certain species of *Amphiprion*
(For explanation, see facing page)



A, *Amphiprion bicinctus* Rüppell, copy of plate 35, figure 1, in Atlas, Fische des Rothen Meeres, 1828; B and C, *A. ephippium* (Bloch), large and small specimen, USNM 152777, collected by Dr. R. R. Miller in Woods Inlet, west of Darwin, Australia; D, *A. frenatus* Brevoort, photograph of a color drawing in the Philippine Albatross collection; E, *A. melanopus* Bleeker, specimen from Bikini, USNM 141026.

I have examined one specimen collected June 16, 1948, by Dr. Robert R. Miller in "a submerged canoe on a sand bar in Little Lagoon, northeast end of Groote Eylandt, Gulf of Carpentaria, Australia." The color when alive was as follows: "The pale bars were coral pink, with narrow emerald borders; the dark bars were velvet-black."

Amphiprion tricinctus Schultz and Welander, new species

PLATE 9, FIGURE H

Amphiprion ephippium (non Bloch) var. *chrysopterus* (non Cuvier and Valenciennes) Günther, Journ. Mus. Godeffroy, vol. 15, Andrew Garrett's Fische der Südsee, pt. 7, pp. 224-225, pl. 122, fig. C, 1881 (Kingsmill Islands).

Holotype.—USNM 152929, Bikini Atoll, Amen Island, lagoon, August 21, 1947, University of Washington, Staff of Applied Fisheries Laboratory, standard length 75 mm.

Description.—Dorsal fin rays X,17; anal II,14; pectoral ii,17,i to ii,16,ii; pelvics I,5; branched caudal fin rays 8+7; vertical scale rows from upper edge of gill opening to base of caudal fin 54, scales between lateral line and base of first soft dorsal ray 5, and between lateral line and anal origin 20; pores in lateral line 36; predorsal scales 19 or 20; gill rakers 5+1+13.

Detailed measurements were made on the holotype and these data are expressed in thousandths of the standard length, 75 mm.: Greatest depth 560; length of head 272; snout 99; eye 95; least preorbital 35; length from snout tip to rear edge of maxillary 101; postorbital length of head 147; least width of interorbital space 100; least depth of caudal peduncle 160; length of caudal peduncle from base of last anal ray to midbase of caudal fin 192; length of longest ray of pectoral 287, pelvic 313, upper caudal fin 307, lower lobe of caudal fin 300, spiny dorsal 160; length of next to last dorsal spine 160; width of white part of first pale bar at level of lateral line 73, second 40, last (peduncular) 20.

Depth of body 1.7, head 3.4, both in standard length. Snout 3.2; eye 3.1; least preorbital distance 8.0; upper jaw 2.8; postorbital part of head 2.0; least interorbital space 3.0; least depth of caudal peduncle 1.8; length of pectoral fin 1.0, pelvic 0.9, second dorsal spine 23, upper caudal rays 0.9 to 1.0; all in length of the head. Least depth of caudal peduncle in its length 1.2. Angle of upper profile of head with lengthwise axis of body about 50°; profile of head convex.

Teeth in both jaws in a single row, nearly conical, a little compressed forward, pointed; interorbital space scaled forward to a line between middle of pupils; 4 or 5 rows of scales on cheeks; gill cover with a few scales; scales occur part way out on all median fins; preorbital with 3 spines; suborbital with 10 to 12 smaller spines.

Color in alcohol.—Background coloration of body from about fifth dorsal spine posteriorly and dorsally to midlengthwise axis of body blackish, the anteroventral part of body pale light brown becoming paler ventrally; spiny dorsal dark brown; soft dorsal black; caudal fin black, except edged with white posteriorly; pectoral and pelvic fins pale or very light tan; anal pale or light tan, distally edged with a black line; first white bar begins a little in front of dorsal origin and just behind eye, ending on lower edge of subopercle; second white bar begins on last dorsal spine and base of first soft ray in lower third of fin, extends ventrally, meeting its fellow in narrow space between anal origin and anus; third white bar, about half width of second, or narrower than width of pupil, crosses caudal peduncle just in front of caudal fin base.

Remarks.—This new species may be recognized by the narrowness of the three white bars, especially the second and third, and by the black caudal fin narrowly edged with white posteriorly. It is separated from all other species of *Amphrion* by the key.

Named *tricinctus* in reference to the three white bars.

Amphrion mauritiensis Schultz, new species

PLATE 9, FIGURE I

Holotype.—MCZ 6093, Mauritius, collected by Nicolas Pike, standard length 111.5 mm.

Paratypes.—Bearing same data as holotype: Out of MCZ 6093, 4 specimens, 67 to 96 mm.; MCZ 5801, 2 specimens, 98 and 104.5 mm.; MCZ 5800, 1 specimen, 101.5 mm.; MCZ 5802, 2 specimens, 83.5 and 114 mm.

Description.—Dorsal rays X,17 or 18, one with XI,16, usually X,17; anal III,14, one with III,13; pectoral rays 20 or 21; pelvics I,5; branched caudal fin rays 8+7; vertical scale rows from upper edge of gill opening to base of caudal fin about 55 to 58; scales between lateral line and base of first soft dorsal ray 5; between lateral line and anal origin 17 to 19; pores in lateral line 35 to 42; predorsal scales about 10 or 11; gill rakers 5+1+13.

Detailed measurements were made on the holotype and two paratypes, and these data are expressed in thousandths of the standard length, first for the holotype then, in parentheses, for the paratypes: Standard length in mm. 111.5 (87.5; 104.5). Greatest depth 485 (490; 535); length of head 297 (286; 310); snout 90 (97; 96); eye 89 (86; 86); least preorbital width 31 (38; 28); distance from snout tip to rear edge of maxillary 91 (114; 112); least width of interorbital space 74 (91; 81); least depth of caudal peduncle 144 (157; 151); length of caudal peduncle 166 (153; 148). Length of longest ray of

pectoral 279 (269; 280); pelvic 291 (257; 296); upper caudal lobe 270 (280; 296); lower caudal lobe 265 (263; 277); spiny dorsal 135 (132; 124). Length of next to last dorsal spine 99 (86; 86). Width of first white bar at level of lateral line 81 (80; 67); second 71 (74; 57); third (peduncular) 48 (63; 48). Width of second black bar at level of lateral line 323 (331; 344); third 300 (292; 344).

Depth of body 1.8 to 2.1, head 3.2 to 3.5, both in standard length. Snout 2.9 to 3.2; eye 3.3 to 3.6; least preorbital 7.5 to 10.1; upper jaw 2.5 to 3.2; least interorbital 3.1 to 3.9; least depth of caudal peduncle 1.9 to 2.0, length of pectoral 1.1, pelvic 1.0 to 1.1, third dorsal spine 2.1 to 2.5; all in length of head. Least depth of caudal peduncle in its length 0.95 to 1.2. Width of second white bar at level of lateral line in width of third black bar at level of lateral line 3.5, third white bar 4.0 to 7.0.

Profile of head convex. Teeth uniserial, nearly conical, a little compressed forward, pointed; interorbital space scaled forward to a line between rear of eyes; 4 to 6 rows of scales on cheek; gill cover with a few scales; scales occur part way out on all median fins; preorbital with 1 to 3 spines; suborbital with about a dozen spines.

Color in alcohol.—Background coloration dark brownish or blackish, except that underside of head and ventrally below a line from pectorals to anus is white or pale; three white bars, one behind eye, second from origin of soft dorsal to anus, third on caudal peduncle; dorsal fin black, with distal edge of soft dorsal white; anal fin black or pale, if black, distal edge is white; pelvics pale; pectoral pale, except dusky basally on some specimens; central area of caudal fin blackish, edges white, with edge widest distally; gill membranes appear to be white.

Remarks.—This new species is most closely related to *A. tricinctus* but differs in having wider white bars, as compared in the key. Named *mauritiensis* in reference to the locality where it was collected.

Amphiprion sebae Bleeker

PLATE 9, FIGURE F

Amphiprion sebae Bleeker, Nat. Tijdschr. Nederl.-Indië, vol. 4, p. 478, 1853; Atlas ichthyologique . . . , vol. 9, pl. 400, fig. 9, 1878.—Day, Fishes of India . . . , vol. 2, p. 378, pl. 80, fig. 3, 1878 (Andamans).—Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, p. 200, fig. 27, 1939 (Isigaki and Irimote Islands).

This species, in which the second white color bar continues distally on the soft dorsal fin, is very much like *A. polymnus*, but differs in having a white bar on the caudal peduncle and a white caudal fin. Three specimens were studied: USNM 45169, from the Seychelles, and 133830, from the Paumotu Islands; and MCZ 33410, from Sumatra.

Amphiprion xanthurus Cuvier and Valenciennes

PLATE 9, FIGURE G

- Amphiprion xanthurus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 402, 1830 (Île de France).
- Amphiprion clarkii* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 9, p. 504, 1833 (emended spelling on Bennett).
- Anthias clarkii* Bennett, A selection from . . . fishes found on the coast of Ceylon, London, ed. 2, p. 29, pl. 29, 1834 (Ceylon).
- Sparus milli* Bory de Saint-Vincent, Dictionnaire classique d'histoire naturelle, vol. 17, p. 130, pl. 113, fig. 2, 1831 (China Sea).
- Prochilus polymnus* (non Linnaeus) Bleeker, Atlas ichthyologique, vol. 9, pl. 400, figs. 7, 8, 1878.
- Anthias polymna* (non Linnaeus) Bloch, Naturgeschichte der ausländischen Fische, vol. 9, p. 89, pl. 316, fig. 1, 1792.
- Amphiprion bicinctus* (non Rüppell) Aoyagi, Coral Fishes, Tokyo, pl. 37, fig. 1, 1943 (Kumanomi).—Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 4, No. 1, p. 169, pl. 9, fig. 1, 1941 (Japan).
- Amphiprion polymnus* (non Linnaeus) Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, p. 204, fig. 30, 1939 (Riu Kiu Islands).—Montalban, Bur. Sci. Manila Monogr. 24, p. 10, pl. 1, fig. 1, 1928 (Philippine Islands).
- Amphiprion chrysopterus* Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 5, p. 401, 1830 (no locality given).—Jordan and Dickerson, Proc. U. S. Nat. Mus., vol. 34, p. 612, fig. 4, 1908 (Suva, Fiji).
- Amphiprion japonicus* Temminck and Schlegel, Fauna Japonica . . . , Pisces, p. 66, 1843 (Japan).
- Amphiprion chrysargyrus* Richardson, Rep. Meetings British Assoc. Adv. Sci., vol. 15 (1845), p. 254, 1846 (Seas of China and Japan).
- Amphiprion boholensis* Cartier, Verh. phys. med. Würzburg, new ser., vol. 5, p. 96, 1874 (Bohol).
- Amphiprion melanostolus* Richardson, Ann. Mag. Nat. Hist., vol. 9, p. 390, 1842 (Depuch Island).
- ?*Amphiprion de bojer* Lienard, Treizième Rapp. Ann. Soc. Hist. Nat. Maurice, p. 68, 1843 (reference copied).
- Amphiprion snyderi* Ishikawa, Proc. Nat. Hist. Tokyo Mus., vol. 1, No. 1, p. 11, pl. 5, 1904 (Bonin Island).

I have examined 70 specimens (in 45 lots) of *xanthurus*, 22 of which are in the Museum of Comparative Zoology, Harvard University, and the others in the U. S. National Museum, and I find some variation in color pattern. Among these specimens 12 had black dorsal, anal, and pelvic fins; 3 had these three fins dusky; 10 had the dorsal and the anal black or dusky, with pelvics pale; 36 had the dorsal black and both anal and pelvics pale; 9 had dorsal, anal, and pelvics pale, except in some specimens the pelvic fins were dark edged. Of these 70 specimens 42 were from the Philippines, 4 were from Japan, 2 from the China coast, 18 from Zanzibar, 1 from the Gilbert Islands, and 3 from Kingsmill Islands.

Amphiprion bicinctus Rüppell

PLATE 10, FIGURE A

Amphiprion bicinctus Rüppell, Atlas zu der Reise im nördlichen Afrika, p. 139, pl. 35, fig. 1, 1828 (Red Sea).

Amphiprion papuensis Macleay, Proc. Linn. Soc. New South Wales, vol. 8, No. 2, p. 271, 1883 (New Guinea).—Whitley, Mem. Queensland Mus., vol. 9, pt. 3, p. 210, pl. 27, fig. 1, 1929 (D'Entrecasteaux Group, New Guinea, on holotype).

Amphiprion arion De Vis, Proc. Linnean Soc. New South Wales, vol. 8, p. 450, 1884 (South Seas).

This species has the first two white bars but lacks the peduncular bar; the anterior edges of the pelvics are black and the caudal fin is pale. Six lots containing seven specimens were studied: USNM 61679, from Suva, Fiji; USNM 141030 and 141031, from the Marshall Islands; uncataloged specimens, one from the Paumotu and two without data; also one from Bikini in the University of Washington collection.

Among these specimens, four adults, 82 to 99 mm. in standard length, have a pale anal fin, whereas two, 26 and 27 mm. long, have a black anal, and one, 25 mm. long, has a dusky anal fin. The caudal peduncle varies from pale dusky to black or brownish. The key gives the essential color pattern of this species.

Amphiprion ephippium (Bloch)

PLATE 10, FIGURES B, C

Lutjanus ephippium Bloch, Naturgeschichte der ausländischen Fische, vol. 4, p. 121, 1790 (reference not seen); Ichthyologie, ou histoire naturelle, générale et particulière des poissons . . . , vol. 7, p. 98, pl. 250, fig. 2, 1797 (East Indies).

Amphiprion ephippium Day, Fishes of India . . . , vol. 2, p. 378, pl. 80, fig. 1, 1878.

Amphiprion monofasciatus Thiollière in Montrouzier, Suite de la faune de l'Île de Woodlark ou Moïou, Ichthyologie, Ann. Sci., Physic. Nat. Agr. Indust., Lyon, vol. 8, p. 476, 1856 (Woodlark Island).

Amphiprion tricolor Günther, Catalogue of the fishes in the British Museum, vol. 4, p. 8, 1862 (Port Essington; South Australia).

Amphiprion rüppelli Castelnau, Proc. Zool. Acclim. Soc. Victoria, vol. 2, p. 91, 1873 (Port Darwin).

Amphiprion frenatus (non Brevoort) Day, Fishes of India . . . , vol. 2, p. 378, pl. 80, fig. 2, 1878.

Prochilos ephippium Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 401, figs. 1, 9, 1878.

Amphiprion rubrocinctus Richardson, Ann. Mag. Nat. Hist., vol. 9, p. 391, 1842 (Depuch Island; probably young).

The adults of this species usually have a plain blackish body and head, with a single white color bar on the head, but on a few specimens, the largest in the series, this first white bar is lacking or nearly

so. The smallest specimens among 57 collected by Dr. Robert R. Miller from Woods Inlet west of Darwin, Australia, have a variable color pattern of two or three white bars. One specimen, 20 mm. in standard length, has only one white bar on the head; 9, from 20 to 31 mm., have two white color bars, the first and second; 7, from 19.5 to 28 mm., have the first and second white bars distinct and the third indistinct, sometimes represented by a white spot on dorsal edge of caudal peduncle; 10, from 17 to 25 mm., have all three white color bars distinct. I presume that the second and third white bars disappear with increase in size, since a 35-mm. specimen in this lot looks like all the larger specimens with only one white bar on the head.

***Amphiprion frenatus* Brevoort**

PLATE 10, FIGURE D

Amphiprion frenatus Brevoort, U. S. Japan Exped. Nat. Hist., Washington, vol. 2, p. 263, pl. 6, fig. 4, 1856 (Lew Chew [Okinawa]).—Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 24, p. 597, 1902.—Montalban, Bur. Sci. Manila Monogr. 24, p. 12, pl. 2, fig. 1, 1928 (Philippine Islands).—Aoyagi, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 4, No. 1, p. 167, 1941 (Japan).—Okada and Ikeda, Biogeographica, Trans. Biogeogr. Soc. Japan, vol. 3, No. 2, p. 203, fig. 29, 1939 (Riu Kiu Islands).

Prochilus polylepis Bleeker, Versl. Akad. Wet. Amsterdam, ser. 2, vol. 11, p. 135, 1877; Atlas ichthyologique . . . , vol. 9, pl. 401, fig. 6, 1878.

Amphiprion polymnus (non Linnaeus) Montalban, Bur. Sci. Manila Monogr. 24, p. 10, pl. 1, fig. 1, 1928 (Philippines).

I have studied 72 specimens from the Philippines, Okinawa, and Japan referable to this species. In alcohol two color phases are evident, the usual one (53 specimens, ranging from 37 to 100 mm. in standard length) has a plain blackish body behind head, whereas 15, ranging from 39 to 60 mm., have 3 lengthwise pale bands on side of body, and 4 others are intermediate in regard to coloration. These pale bands at best are not very distinct. This species is characterized by having about twice as many of the specimens with IX dorsal spines as with X; this latter figure is the usual number of dorsal spines in the other species of *Amphiprion*.

Of 78 specimens in 54 lots studied, 76 were from the Philippine Islands and one each from Japan and Okinawa. The specimen from Okinawa (the type locality of *frenatus*), USNM 71702, Naha, Okinawa, *Albatross*, 69 mm. in standard length, is herewith designated as neotype of *Amphiprion frenatus* Brevoort since the type is not in existence.

Amphiprion melanopus Bleeker

PLATE 10, FIGURE E

Amphiprion melanopus Bleeker, Nat. Tijdschr. Nederl. Indië, vol. 3, p. 561, 1852.
Prochilus melanopus Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 401, fig. 7,
 1878.

Prochilus macrostomus Bleeker, Atlas ichthyologique . . . , vol. 9, pl. 401, fig. 5,
 1878.

Amphiprion ephippium (non Bloch) Günther, Journ. Mus. Godeffroy, vol. 15,
 pt. 7, pl. 122, fig. D (var. *melanopus* on p. 225), 1881.

Amphiprion mccullochi Whitley, Mem. Queensland Mus., vol. 9, pt. 3, p. 213,
 1929 (Lord Howe Island).

Amphiprion macrostoma (non Bleeker) Chevy, Travaux Inst. Oceanogr. Indo-
 Chine, Mem. 4, pt. 1, Poissons, p. 102, pl. 40, 1932 (Annam).

This species is characterized by the single white bar on the head, plain black body, pale soft dorsal, caudal, and pectoral, and black pelvics and anal fins.

Of 18 specimens in 7 lots studied, 14 were from the Marshall Islands, 3 from Apia, Samoa, and 1 from Paumotu Island.



SMITHSONIAN INSTITUTION

U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1954

No. 3324

MARINE POLYCHAETE WORMS FROM POINT BARROW,
ALASKA, WITH ADDITIONAL RECORDS FROM THE
NORTH ATLANTIC AND NORTH PACIFIC

By MARIAN H. PETTIBONE

This report of the Arctic polychaetes found in the region of Point Barrow, Alaska, is based on material collected during 1948, 1949, and 1950 by G. E. MacGinitie, of the Arctic Research Laboratory. Specimens were obtained from Eluitkak Pass, Elson Lagoon, near Point Barrow, were washed ashore at the Point Barrow base, and were dredged within 16 miles offshore at Point Barrow base in depths of 1.7 to 123.5 fathoms on bottoms of mud, stones, gravel, rocks, in masses of worm tubes, and various combinations of these. Additional specimens were collected from fish traps, from screen traps lowered through holes made in the ice, and from plankton hauls, some of which were made through holes in the ice. The latter collections are of particular interest in that they include specimens showing sexual epitokous stages of some of the syllids. Considerable care was taken in going over the miscellaneous material and separating polychaetes, as evidenced by the large collection and the presence in it of many small specimens of the young of larger species as well as small species which are often overlooked. There are a great number of small syllids, phyllocoids, hesionids, and terebellids. Great care also was taken in the preservation of the specimens. Some color notes were included and some color photographs were taken, and these added considerably to the value of the collection.

The material was worked on by the writer at the U. S. National Museum, where the collection is deposited. The facilities of the Museum, including laboratory accommodations, the library, and the vast

polychaete collections, which include much type material, were placed at the writer's disposal. Some previously unworked material was examined for comparative purposes, and the results of some of these related studies are included here. This material is chiefly from collections made by the following: R. A. Bartlett in the Canadian Arctic, Greenland, and Labrador from 1927 to 1942; W. H. Dall in Arctic Alaska, the Bering Sea, and southeastern Alaska from 1871 to 1880; the *Blue Dolphin* expeditions to Labrador and Newfoundland from 1949 to 1951 under the command of D. C. Nutt; the U. S. Fish Commission in dredgings off the east coast of North America, from which many specimens had been identified and recorded by A. E. Verrill; and by the writer in the Straits of Juan de Fuca, in Washington and Puget Sounds, Washington, chiefly during the summers from 1936 to 1940, and from the region of Woods Hole, Massachusetts, in the summers of 1950 and 1951. For the last three collections mentioned, only summaries of the data are given for species common to the Point Barrow region. More complete data are to be published separately and the summaries are included here only to make the distributional data of the Point Barrow species more complete.

The number of polychaetes previously recorded from Arctic Alaska is small indeed. The collection obtained by the International Polar Expedition to Point Barrow from 1881 to 1883 included only 17 polychaetes (Murdoch, 1885, p. 152). This collection, which was deposited in the U. S. National Museum, was examined by the writer and is referred to in this report. A few additional records in scattered papers have added to the list of polychaetes of Arctic Alaska.

For each of the species, a rather full but by no means complete synonymy is given, chiefly bringing together references to the original and additional descriptions and scattered distributional records. To facilitate identification, keys to the families, genera, and species are given, as well as synopses of the families and brief descriptions of the species with size ranges and color notes. An explanatory key to the lettering of the diagnostic features in the figures is given on page 210.

This study was aided by a contract between the Office of Naval Research, Department of the Navy, and Johns Hopkins University (Project No. NR 162 911, Contract and Task Order No. N6onr 243-16).

The writer acknowledges her appreciation to Prof. and Mrs. G. E. MacGinitie for their cooperation and help on this project; to the authorities of the U. S. National Museum for allowing her to make use of the facilities of the Institution, especially to Dr. Waldo L. Schmitt and Dr. Fenner A. Chace, Jr., for their valuable aid, suggestions, and patience; and to Mr. and Mrs. Cyril Berkeley, of Nanaimo, British Columbia, for their loan of specimens and their valuable suggestions.

The distribution of the Point Barrow polychaetes is summarized in table 1.

The collections include 3,270 specimens representing 88 species and 26 families of Polychaeta. Some of the species were exceedingly common; others were represented only by single or few specimens. The Polynoidae, Syllidae, and Terebellidae are the most abundant both as to numbers of species (11 each, or 37 percent) and specimens (66 percent). The Phyllodocidae and Sabellidae have 7 species each. Eleven families are represented by a single species each.

During 1948, because of the ice floes all summer, there was no heavy surf and practically nothing was washed up on the beach. During 1949, specimens were washed ashore on 17 different days. In 1950, specimens were collected from the beach on only one day. Altogether, 287 specimens of polychaetes were washed ashore, representing 20 species and 11 families. Two species, *Eunoë clarki* (2 specimens) and *Travisia carnea* (12 specimens), were obtained in this manner only. Four species were dredged occasionally but were washed ashore in much larger numbers, namely: *Antinoë sarsi* (58 specimens), *Melaenis lovéni* (65 specimens), *Arenicola glacialis* (54 specimens), and *Brada villosa* (24 specimens). Additional species were commonly obtained in the dredge but were washed ashore in small numbers.

On three occasions in 1950 when 80-foot vertical plankton hauls were taken through holes in the ice, the sexual stages of three of the syllids were found—*Autolytus fallax*, *Syllis cornuta*, and *Syllis fasciata*.

A station 12.1 miles from shore, 123.5 fathoms, August 17, 1949, produced literally bushels of worm tubes. The tubes of the terebellid *Pista maculata* made up the greater part of the mass.

Of the 88 Point Barrow species, 75 (85.2%) are common to the Arctic, Atlantic, and Pacific; 5 (5.7%) are common only to the Arctic and Pacific (*Gattyana ciliata*, *Eusyllis magnifica*, *Pionosyllis compacta*, *Glycinde wiréni*, and *Idanthyrus armatus*); 3 (3.4%) are common to the Arctic and Atlantic (*Autolytus fallax*, *Eumida minuta*, *Travisia carnea*); 4 (4.5%) are confined to the Arctic (*Eunoë clarki*, *Nerinides* sp., *Arenicola glacialis*, *Ampharete vega*); and 1 (1.1%) is bipolar, known only from the Arctic and Antarctic (*Ammotrypane breviata*).

The Point Barrow records help to complete the circumpolarity records for 58 circumpolar or almost circumpolar species, some of which previously had been known only from the Siberian and Canadian Arctic, Greenland, and Spitsbergen. The range has been extended for 28 species, 6 of which have been extended by combining Atlantic and Pacific specific names.

TABLE 1.—*Distribution of species*

Families and species	Page reference	Number of specimens	Ecological distribution				Geographic distribution				
			Washed ashore	Dredged on mud bottom (31 species)	Dredged on bottom of stones, gravel, pebbles, with mud (51 species)	Dredged on bottom of rocks, gravel, stones, tubes (74 species)	Dredged in masses of worm tubes (35 species)	Mainly Arctic (18 species, 20%)	Arctic-boreal (30 species, 34%)	Arctic-boreal-lustr-tamian (18 species, 20%)	Cosmopolitan (21 species, 24%)	Bipolar (1 species, 1%)
POLYNOIDAE (922 specimens)											
Melaenlis loyévni Malmgren	214	67	X								
Antioé sarsi Malmgren	215	63	X			X				X	
Eunoé clarki Potibone	217	2	X								
Eunoé nodosa (Sars)	217	33		X							
Eunoé oerstedt Malmgren	219	20		X							
Harmothoé imbricata (Linné)	220	215	X	X						X	
Harmothoé extenuata (Grube)	222	375		X						X	
Enlipo gracilis Verrill	225	3		X							
Arctobia anticostensis (McIntosh)	225	14	X	X						X	
Gattyana cirrosa (Pallas)	226	126	X	X						X	
Gattyana ciliata Moore	228	4		X						X	
SIGALIONIDAE (30 specimens)											
Pholoé minuta (Fabricius)	230	30				X					X
PHYLLODIDAE (192 specimens)											
Mystides borealis Théel	232	2				X					
Eteone barbata (Malmgren)	233	4		X							X
Eteone longa (Fabricius)	234	40		X						X	
Eteone flava (Fabricius)	235	22		X						X	
Eteone spetsbergensis Malmgren	235	4		X						X	
Phyllodoe groenlandica Oersted	236	74	X	X							X
Eumida minuta (Ditlevsen)	238	46								X	
HESIONIDAE (28 specimens)											
Castalia aphroditoides (Fabricius)	239	28		X							X

Explanation of symbols on figures

Roman numerals indicate body segments.

a, anus	frH, frontal horn
aBr, anal branchia	j, jaw
aC, anal cirrus	lAn, lateral antenna
aCo, anal cone	lGr, lateral groove
aCy, anal cylinder	lLo, lateral lobe
aK, anal knob	lN, lateral notch
aLi, anal ligule	lOr, lateral sensory organ
abd, abdominal region	liPl, limbate plate
ac, aciculum (heavy spine buried in parapodial ramus)	loL, lower lip
acH, acicular genital hook	mAn, median antenna
acL, acicular lobe	mLo, median lobe
ach, achaetous lobe	maxR, maxillary or distal ring
ai, aileron of jaw	mo, mouth
an, antenna	nPa, nephridial papilla
antLa, anterior or presetal lamella	ne, neuropodium or ventral ramus
anta, antanal achaetous segment	neC, neuropodial cirrus
ba, barbule	neLi, neuropodial ligule
bl, blade of seta (terminal or end piece of composite or jointed seta)	neS, neuroseta (seta of neuropodium)
br, branchia	neTo, neuropodial torus
brF, branchial filament	no, notopodium or dorsal ramus
brLo, branchial lobe	noLi, notopodial ligule
brP, brood pouch	noS, notoseta (seta of notopodium)
buS, buccal segment	noPi, notopodial pinnule
cP, cephalic peak	noTo, notopodial torus
cCre, cephalic crest	nuEp, nuchal epaulette
cPl, cephalic plate	nuF, nuchal fold, lobe or collar
cR, cephalic ridge	nuG, nuchal groove
caPl, calcareous plate	nuH, nuchal hook
co, collarette	nuO, nuchal organ
cph, cirrophore (base of a tentacular cirrus or a dorsal cirrus)	nuPa, nuchal papilla
cr, crotchet	oR, oral or basal ring
cre, crest	oT, oral tentacles
dC, dorsal cirrus	ocT, occipital tubercle
dL, dorsal lobe	op, operculum
dN, dorsal notch	opPe, opercular peduncle
dTu, dorsal tubercle (lobe corresponding to elytriphore on non-elytra-bearing segment)	p, palp
deR, denticled rim	pM, palmar membrane
Dor, dorsal	pa, papilla
el, elytron or scale	pal, paleae
elph, elytriphore (lobe bearing elytron)	parF, parapodial flange
ey, eye-spot	para, paragnaths or horny denticles
fTu, facial tubercle	parath, parathoracic segment
frAn, frontal antenna	poL, postsetal or posterior lobe
	poLa, postsetal or posterior lamella
	pr, prostomium
	preL, presetal or anterior lobe
	pro, proboscis
	pyF, pygidial or anal funnel
	pyPl, pygidial plate

s, seta	uL, upper lip
scH, scaphal hook	un, uncinus (very small and short, flattened setal hooks)
set, setigerous segment or setiger	unPi, uncinigerous pinnule (flattened parapodial ramus bearing numerous uncini or small setal hooks)
setLo, setigerous lobe	unTo, uncinigerous torus (low, inflated parapodial ramus bearing numerous uncini or small setal hooks)
sh, shaft of seta (basal part of composite or jointed seta)	vC, ventral cirrus
spH, special hook	vF, ventral faecal groove
tC, tentacular cirrus	vL, ventral lobe
tF, tentacular filament	vPa, ventral papilla
tM, tentacular membrane	vSh, ventral shield
tS, tentacular segment or peristomium (anterior modified segments around mouth)	Ven, ventral
th, thoracic region	w, basal crenulate wing
thM, thoracic membrane	
to, tooth	
tor, torus (low, inflated parapodial lobe)	

Order POLYCHAETA

Key to the families of Polychaeta from Point Barrow

1. Dorsal surface more or less completely covered by paired overlapping scales or elytra (fig. 26, *a*)..... 5
Dorsal surface not covered by elytra..... 2
2. Anterior end more or less concealed by feathery tentacles (fig. 38, *a*), chitinous golden setae forming an operculum (figs. 34, *n*; 35, *d*), long setae directed forward forming a cephalic cage, or long filamentous outgrowths (fig. 36, *f*). With more or less permanent tubes..... 6
Anterior end otherwise..... 3
3. Body thickly papillated, grub-shaped..... 21
Body smooth or finely granulated..... 4
4. Prostomium with conspicuous antennae, with or without fleshy palps (figs. 26–30), or prostomium or an anterior segment with pair of long, prehensile, tentacular palps (fig. 32, *i*)..... 13
Prostomium without palps and without conspicuous antennae (fig. 32, *a*) or with 2 pairs minute antennae (figs. 30, *j*; 31, *a*, *e*)..... 18
5. Elytra on all segments of posterior region (at least from segment 29 on).
Dorsal cirri lacking..... **Sigalionidae** (p. 228)
Elytra not on all segments of posterior region. With paired dorsal cirri on segments without elytra (fig. 26, *a*)..... **Polynoidae** (p. 213)
6. Anterior end with branchial plume (fig. 38, *a*)..... 7
Anterior end without branchial plume..... 8
7. Branchial filaments without operculum. Without thoracic membrane.
Tube gelatinous, membranous, or horny, covered or not with mud, sand, gravel, and debris..... **Sabellidae** (p. 332)
Usually 1 or 2 opercula on modified branchial filaments (fig. 39, *u*). Usually with thoracic membrane (fig. 39, *u*). Tube calcareous..... **Serpulidae** (p. 342)
8. Anterior end with chitinous, golden setae forming an operculum (figs. 34, *n*; 35, *d*). In free, conical, sandy tubes or concreted sandy tubes attached to rocks, shells, etc..... 12
Anterior end without opercular setae. Tube otherwise..... 9

9. Setae of anterior segments directed anteriorly, forming a cephalic cage.
 Body covered with papillae and often with adherent sand grains; may be encased in thick mucoid sheath..... **Flabelligeridae** (p. 288)
- Anterior end without cephalic cage but with long, filamentous outgrowths (may have 2 groups of paleal setae directed forward; fig. 36, *a, e, f*). Body without papillae..... 10
10. Anterior end with long, filamentous outgrowths and with similar outgrowths continued along sides of body on few to many segments (fig., 33, *a*). Segments similar, body not divided into 2 distinct regions.
Cirratulidae (p. 285)
- Long, filamentous outgrowths concentrated on anterior region only (figs. 36, 37). Body with 2 distinct regions..... 11
11. With numerous filiform oral tentacles retractile in mouth (fig. 36, *e*). Anterior region with or without 2 groups of paleal setae directed forward (fig. 36, *a, b*)..... **Ampharetidae** (p. 314)
- With numerous, grooved, oral tentacles not retractile in mouth (fig. 36, *f, g, i*). Anterior region without paleal setae..... **Terebellidae** (p. 318)
12. Opercular setae forming 1-3 concentric rows (fig. 34, *n-q*). Tube of concreted sand or fine gravel, attached..... **Sabellariidae** (p. 307)
- Opercular setae forming 2 bundles in horizontal rows, directed obliquely anteriorly (fig. 35, *c, d*). Tube free, conical, rigid, open at both ends, formed of single layer of sand grains..... **Pectinariidae** (p. 310)
13. Prostomium with 2-5 conspicuous antennae. With 1-8 pairs tentacular cirri (figs. 27-29)..... 14
- Prostomium without conspicuous antennae. Without tentacular cirri. With pair of tentaculiform, longitudinally-grooved palps (deciduous, may be missing; figs. 32, *i*; 33, *d*)..... 17
14. Dorsal cirri flattened, foliaceous, sometimes overlapping, or more or less globular (fig. 27). Prostomium with 2 eyes, 4-5 antennae, without palps..... **Phyllodoceidae** (p. 231)
- Dorsal cirri otherwise. Prostomium with 4-6 eyes, 2-3 antennae, 2 palps (may be reduced and fused in Syllidae)..... 15
15. With parapodial ligules, rounded, conical or straplike lobes (fig. 30, *b, c*). Dorsal cirri short, cirriform..... **Nereidae** (p. 263)
- Without parapodial ligules. Dorsal cirri filiform, may be more or less articulated (or small and subulate in some Syllidae)..... 16
16. Palps biarticulate (fig. 28, *a*)..... **Hesionidae** (p. 239)
- Palps not biarticulate (may be reduced and fused; figs. 28, *c*; 29, *a*).
Syllidae (p. 240)
17. Parapodia with postsetal lamellae more or less developed (fig. 32, *g*). Branchiae usually paired, dorsal, ligulate or cirriform (rarely pinnate, rarely lacking)..... **Spionidae** (p. 280)
- Parapodia with lobes scarcely projecting, without postsetal lamellae. Branchiae simple, filamentous, contractile, inserted above notopodia on few to many segments (fig. 33, *d*)..... **Cirratulidae** (p. 285)
18. Prostomium with 2 pairs minute antennae (figs. 30, *j*; 31, *a*)..... 19
- Prostomium without antennae..... 22
19. Prostomium subquadrate, with small antennae on anterior part (fig. 30, *j*). With anterior and posterior parapodial lamellae more or less developed (fig. 30, *k-n*)..... **Nephtyidae** (p. 266)
- Prostomium conical, pointed, annulated, with tiny terminal antennae (fig. 31, *a, e*). Without parapodial lamellae..... 20

20. Segments bi- or triannulate. Parapodia of single form throughout length of body, either only uniramous or only biramous..... **Glyceridae** (p. 272)
 Segments uniannulate. Body divided into 2 regions—anterior uniramous, posterior biramous (fig. 31, *f, g*)..... **Goniadidae** (p. 274)
21. Posterior part of body with 2 horny ventral plates with radiating bundles of setae (fig. 35, *b*)..... **Sternaspidae** (p. 309)
 Posterior part of body without horny plates..... **Flabelligeridae** (p. 288)
22. Some of segments considerably elongated, much longer than wide. Anal segment with limbate plate, spatulate, or funnellike (fig. 34, *d, h, m*).
 Prostomium hoodlike (fig. 34, *i, l*) or with limbate plate (fig. 34, *b-c, g*).
Maldanidae (p. 302)
 Segments not much longer than wide..... 23
23. Proboscis provided with dark, chitinous jaw pieces (fig. 31, *i*). Body smooth, elongate, cylindrical, resembling an earthworm. Parapodia weakly developed simple lobes..... **Lumbrineridae** (p. 275)
 Proboscis without chitinous jaws. Form variable..... 24
24. Body divided into 2 weakly to sharply separable regions, short anterior region, more or less flattened, with cushionlike neuropodia with several rows of setae, and long cylindrical posterior region with parapodial lobes projecting dorsally (fig. 32, *c*)..... **Orbiniidae** (p. 278)
 Parapodial lobes of median and posterior regions not projecting dorsally... 25
25. Prostomium conical..... 26
 Prostomium otherwise..... 27
26. Body short, grub-shaped or lancet-shaped. Parapodia with simple capillary setae only..... **Opheliidae** (p. 295)
 Body elongate, slender, fragile. Parapodia with capillary setae and, in long posterior region, with rows of hooded hooks on somewhat inflated tori (fig. 33, *t*)..... **Capitellidae** (p. 298)
27. Arborescent branchiae limited to anterior few segments. With capillary and forked parapodial setae..... **Scalibregmidae** (p. 293)
 Arborescent branchiae on long middle region of body. With capillary setae and sigmoid hooks embedded in elongated tori..... **Arenicolidae** (p. 300)

Family POLYNOIDAE

Prostomium bilobed, with two pairs of eyes in trapezoidal arrangement, three dorsal antennae, a pair of subulate ventral palps. First or tentacular segment with setae reduced in number (0-3), with two pairs of tentacular cirri (fig. 26, *a*). Parapodia biramous, with setae simple (not compound), paired dorsal scales or elytra on certain segments and paired dorsal cirri on non-elytra-bearing segments, paired subulate ventral cirri (fig. 26, *a, d*). Pygidium or anal segment with pair of anal cirri. Paired segmental or nephridial papillae near ventral bases of parapodia. Muscular proboscis eversible, with circle of soft marginal papillae and two pairs of interlocking, chitinous jaws.

Represented by 7 genera and 11 species. All the genera considered here have 15 pairs of elytra on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 26, 29, 32; lateral antennae inserted ventral to median antenna on prostomium (fig. 26, *a*).

Key to the genera of Polynoidae from Point Barrow

1. Notosetae stouter than or at least as stout as neurosetae, with tips blunt to pointed, not capillary----- 2
 Notosetae not as stout as neurosetae----- 5
2. Notosetae large, smooth or with only faint transverse striations, few in number (5-9)----- **Melaenis** (p. 214)
 Notosetae with transverse spinous rows, more numerous (more than 10)--- 3
3. Neurosetae long, slender, at least some end in capillary tips. **Antinoë** (p. 215)
 Neurosetae stouter, with tips straight or slightly hooked, not capillary----- 4
4. All neurosetae with entire bare tips----- **Eunoë** (p. 216)
 Some of neurosetae bidentate, with secondary tooth well developed or rudimentary (fig. 26, e)----- **Harmothoë** (p. 220)
5. Some notosetae with capillary tips. Segments less than 40 (35-38), thus, posterior end of body covered with elytra----- 6
 None of notosetae with capillary tips. Segments more than 40 (45-65), thus, a rather long posterior end without elytra. Elytra smooth, without tubercles----- **Enipo** (p. 225)
6. Neurosetae of 2 kinds, upper few end in slender tips, rest end in bifid tips. Elytra smooth except for few microtubercles on anterior curved part. **Arcteobia** (p. 225)
 Neurosetae all similar, with entire tips. Elytra with microtubercles and sometimes also with macrotubercles----- **Gattyana** (p. 622)

Genus *Melaenis* Malmgren, 1865*Melaenis lovëni* Malmgren, 1865

Melaenis lovëni Malmgren, 1865, p. 78, pl. 10, fig. 10.—Théel, 1879, p. 22.—Wirén, 1883, p. 391, pl. 28, fig. 4; pl. 29, fig. 3.—Murdoch, 1885, p. 152.—Moore, 1908, p. 337.—Fauvel, 1914, p. 49.—Augener, 1928, p. 695.—Ditlevsen, 1937, p. 16.—Gorbunov, 1946, p. 38.—Wesenberg-Lund, 1950a, p. 9; 1950b, p. 29.

Melaenis lovëni var. *gigantea* Wirén, 1883, p. 391, pl. 28, fig. 3; pl. 29, fig. 4.—Murdoch, 1885, p. 153.

Description.—Length 25-76 mm., width including setae 9-22 mm. (up to 110 mm. long—Ditlevsen, 1937). Segments 39-41. Body elongated, thick, tapering both anteriorly and posteriorly. Prostomium without cephalic peaks, antennae smooth. Dorsal cirri with fine, scattered, clavate papillae. Elytra smooth, soft, translucent to opaque, not covering middorsum and posterior few segments. Notosetae much stouter than neurosetae, few in number (5-9), light to dark amber-colored, smooth or with only very faint transverse striations. Neurosetae of two kinds: Numerous, long, slender, finely denticled, with capillary tips; few, shorter, with subequal, diverging, forked, blunt tips (one part of fork may be longer than the other). COLOR: In life and in alcohol: Wide greenish brown to bluish gray transverse stripes middorsally, green and white striped on dorsal tubercles, cirrophores and elytraphores; without color ventrally; elytra light to dark greenish in a wide, circular band, a circular area

and lateral border without color; one specimen (collected October 4, 1949) was noted as peach-colored from segment 10 posteriorly, the color showing mainly on the ventral side and extending into the parapodia (probably developing eggs).

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore, 1949 (July 30; August 21; September 22, 28, 30; October 4, 5, 16, 17; 65 specimens); off Point Barrow base, along shore, 1.7 fms., on bottom of gravel with mud (2 specimens). EAST COAST NORTH AMERICA: Off Labrador, 45 fms., *Blue Dolphin Expedition*, 1949.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Davis Strait, Greenland, Spitsbergen, Franz Josef Land, Kara Sea. Also Bering Sea; off Labrador. In 1.7–111 fathoms.

Genus *Antinoë* Kinberg, 1855 (sensu Malmgren, 1865)

Antinoë sarsi Malmgren, 1865

Antinoë sarsi Kinberg, 1862 (MS.), p. 468 (*vide* Malmgren, 1865).—Malmgren, 1865, p. 75, pl. 9, fig. 6 (part).—McIntosh, 1900, p. 365, figs.—Chamberlin, 1920, p. 8.—Hartman, 1944a, p. 334.

Polynoë sarsi Théel, 1879, p. 16, pl. 1, fig. 8.—Wirén, 1883, p. 390.—Murdoch, 1885, p. 152.

Harmoë sarsi Eliason, 1920, p. 20.—Annenkova, 1931, p. 203.—Friedrich, 1939, p. 122.—Thorson, 1946, p. 48.—Wesenberg-Lund, 1950a, p. 7; 1950b, p. 23; 1951, p. 17.

Harmoë (Antinoëlla) sarsi Augener, 1928, p. 687.

Antinoëlla sarsi Annenkova, 1937, p. 153; 1938, p. 137.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 107, pl. 28, fig. 8.

Description.—Length 21–68 mm., width including setae 11–27 mm. Segments 37 or 38. Fragments easily, posterior segments frequently regenerating. Body elongate, flattened, tapering slightly anteriorly and posteriorly. Prostomium with cephalic peaks distinct or poorly developed; anterior pair of eyes larger than posterior, slightly anterior to greatest width of prostomium. Antennae with short, clavate papillae. Dorsal cirri extending beyond setae, long, slender, tapering gradually, with short, clavate papillae. May be a single anal cirrus, extremely long, thick at base, tapering gradually; may be one long and one short anal cirrus. Elytra large, thin, soft, smooth, with scattered microtubercles and short, delicate, clavate papillae. Lose elytra readily; often show regenerating elytra, thus appearing variable in size. Notopodia and neuropodia extending into conspicuous, digitiform, acicular lobes. Setae yellowish or golden. Notosetae much thicker than neurosetae, large, clear basally; more distally, finely spinous, pointed. Neurosetae of two kinds, with capillary tips and with slender, relatively obtuse, slightly curved tips. COLOR: In life and preserved: Grayish green or light brown middorsally,

including elythrofores and dorsal tubercles; ventral surface without color or dusky midventrally; elytra gray, translucent to opaque, with a darker brownish-gray medial crescent-shaped area, with a colorless circular area medial to and a darker area posterior to the place of attachment.

Remarks.—*A. sarsi* differs from *A. badia* (Théel), with which it has sometimes been confused, by having the neurosetae of two kinds, with capillary tips and with slender, relatively obtuse tips. In *A. badia*, all the neurosetae have capillary tips.

Parasites.—One of the 63 specimens had the parasitic copepod *Herpyllobius arcticus* Steenstrup and Lütken attached to the prostomium (identified by P. L. Illg).

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore 1949 (August 21, 24; September 1, 12, 20, 22, 24, 26; October 5, 16; 58 specimens); off Point Barrow base, up to 5 miles from shore, 5 to 30.7 fms., on bottoms of mud or stones, and in screen trap through hole in ice, 6 fms., April 11, 1949 (3 stations, 5 specimens); near Point Belcher, Icy Cape, off Point Barrow, Dall. BERING SEA: 62°15' N., 167°48' W., 20 fms., G. M. Stoney, 1884. EAST COAST NORTH AMERICA: Off Labrador, 6–30 fms., *Blue Dolphin* Expeditions, 1950, 1951.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Jan Mayen, Spitsbergen, Norway, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes to Great Britain, the Baltic; Labrador to Maine; Bering Sea; north Japan Sea. In 3–1,215 fathoms.

Genus *Eunoë* Malmgren, 1865

Key to the species of *Eunoë* from Point Barrow

1. Elytra with scattered, bluntly conical microtubercles only, lacking fringe of papillae. Eyes small, anterior pair anterolateral on prostomium (scarcely visible dorsally)----- ***E. clarki***
Elytra with macrotubercles in addition to microtubercles, with lateral fringe of papillae. Eyes larger, anterior pair anterodorsal (visible dorsally)---- 2
2. Body broad, oval, flattened. Extra rounded lobes on inner sides of elythrofores and dorsal tubercles (lobes corresponding to elythrofores on non-elytra-bearing segments, fig. 26, c). Nuchal fold posterior to prostomium not prominent. Setae yellow. Elytra with microtubercles rather low, flattened, semiglobose, some bifid; macrotubercles confined essentially to single row near external border, nodular, with roughened tips. Antennae with short papillae----- ***E. nodosa***
Body more elongate, not so flattened. Without extra rounded lobes on inner sides of elythrofores and dorsal tubercles. Nuchal fold prominent. Setae dark amber-colored. Elytra with microtubercles one- to many-pronged; macrotubercles variable in number, size, and position, branched. Antennae with longer papillae----- ***E. oerstedii***

Eunoë clarki Pettibone, 1951

Eunoë clarki Pettibone, 1951, p. 44, fig. 1.

Description.—Length 36–38 mm., width including setae 12 mm. Segments 40 or 41. Body linear-oblong, tapered slightly anteriorly and posteriorly. Prostomium without cephalic peaks; anterior pair of eyes anterolateral. Antennae and dorsal cirri with short, clavate papillae. Elytra nearly cover dorsum, with conical microtubercles, without fringe of papillae. COLOR: In alcohol: Middorsum transversely banded grayish green; elytra greenish gray, with a darker mottled pattern on most of the exposed parts, with a darker spot medial to a lighter area over the elytophore; dorsal cirri with pigmented bands basally and subterminally.

New record.—ARCTIC ALASKA: Point Barrow base, washed ashore, October 17, 1949 (2 specimens).

Distribution.—Arctic Alaska.

Eunoë nodosa (Sars, 1860)

FIGURE 26, c

Polynoë nodosa Sars, 1860, p. 58.

Eunoë nodosa Malmgren, 1865, p. 64, pl. 8, fig. 4.—Fauvel, 1923, p. 51, fig. 18, a–e (part).—Annenkova, 1937, p. 149; 1938, p. 134.—Treadwell, 1937, p. 27.—Friedrich, 1939, p. 122.—Berkeley and Berkeley, 1942, p. 187; 1943, p. 129.—Hartman, 1944a, pp. 334, 337.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 107, pl. 28, fig. 7.

Eunoa nodosa Malmgren, 1867, p. 6.—Webster and Benedict, 1884, p. 700; 1887, p. 708.—McIntosh, 1900, p. 291, figs.

Polynoë scabra Théel, 1879, p. 7.—Wirén, 1883, p. 387, pl. 28, fig. 2; pl. 29, fig. 1 (part; not pl. 28, fig. 1; not *Aphrodita scabra* Fabricius, 1780).

Polynoë islandica Hansen, 1882, pp. 17, 24, pl. 1, figs. 15–21.—Murdoch, 1884, p. 152.

Polynoë arctica Hansen, 1882, pp. 21, 27, pl. 3, figs. 1–5.

Polynoë spinulosa Hansen, 1882, p. 28, pl. 1, figs. 6–10.

Polynoë foraminifera Hansen, 1882, pp. 21, 23, 29, pl. 1, figs. 11–14.

Harmothoë nodosa Moore, 1902, p. 271.—Ditlevsen, 1917, p. 6, pl. 3, fig. 10 (part; not pl. 2, fig. 1).—Augener, 1928, p. 684 (part).—Wesenberg-Lund, 1950a, p. 6 (part); 1950b, p. 17 (part); 1951, p. 10 (part).

Eunoë depressa Hartman, 1948, p. 14 (part; not *E. depressa* Moore, 1905).

Description.—Length 13–75 mm., width including setae 7–35 mm. Segments 36 or 37. Prostomium with cephalic peaks short and blunt or lacking; anterior pair of eyes anterolateral, visible dorsally. Antennae with short papillae. Dorsal cirri with long papillae. Body flattened ventrally, strongly arched dorsally, especially in anterior part. With characteristic bulbous structures on inner sides of bases of elytophores and dorsal tubercles. Segmental papillae quite elongate, cylindrical, directed dorsally between the parapodia. Elytra with fringe of long papillae on external border. Elytral microtubercles numerous, close-set, rather low, flattened, semiglobose, some bifid;

macrotubercles confined mostly to a single row near external border, dark colored to pale yellow, nodular, with roughened tips or a fascicle of short spikes. Elytra often covered with a good deal of debris and foreign material. COLOR: In life and in alcohol: Mediodorsal surface colorless or banded with olive-brown between elytophores and dorsal tubercles; ventral surface without color or olive-brown; setae yellow or light amber-colored; elytra yellow or tannish mottled with reddish brown.

Remarks.—*Eunoë nodosa* has been confused with *E. oerstedii*. The two species have been separated by Sars (1860), Malmgren (1865), Verrill (1881), Murdoch and Benedict (1885, as *Polynoë islandica* and *P. scabra*), and Treadwell (1937). They have been considered to be synonymous and a highly variable species by Théel (1879), Wirén (1883), Fauvel (1923), Ditlevsen (1917), Augener (1928), and Wesenberg-Lund (1950a, b). Based on a study of the material from Point Barrow as well as numerous other specimens in the U. S. National Museum from Greenland and off New England, the two species appear to be separable on the basis of a number of characters as indicated in the key. They agree in having the prostomium with cephalic peaks short and blunt or lacking, the position of the eyes, the dorsal cirri with long papillae, and the palps each with six longitudinal rows of papillae.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, stony-mud; off Point Barrow base, up to 12.1 miles from shore, 18.3–87 fathoms, on various combinations of mud, stones, pebbles, gravel, rocks (14 stations, 33 specimens). BERING SEA: 57° N., 163° 48' W., 38 fms., Alaska King Crab Expedition (Hartman (1948), as *E. depressa*); Albatross Sta. 3252, 57°22' N., 164°24' W., 29.5 fms., black mud, 1890, and Sta. 3512, 57°49' N., 169°27' W., 38 fms., 1893. SOUTHWESTERN ALASKA: Belkofsky Bay, 15–25 fms., Dall, 1880. FRANZ JOSEF LAND: Aberdore Channel, east Alger Island, 10 fms., Baldwin-Ziegler Expedition, 1901. EAST COAST NORTH AMERICA: Off Labrador, 10–95 fms., *Blue Dolphin* Expeditions, 1949, 1950; Albatross Sta. 2432, off Newfoundland, 43°04' N., 50°45' W., 64 fms., 1885; Bay of Fundy, Grand Manan, Nova Scotia, Maine, Massachusetts, 16–120 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Norway, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea. Also Bering Sea; north Japan Sea; Iceland, Faroes, Shetlands to English Channel; Hudson Bay to Massachusetts. In 10–690 fathoms.

Eunoë oerstedii Malmgren, 1865

FIGURE 26, d

- Lepidonote scabra* Oersted, 1843, p. 164, pl. 1, figs. 2, 7, 10, 12-13, 17-18 (not *Aphrodita scabra* Fabricius, 1780).
- Polynoë scabra* Sars, 1860, p. 58.—Hansen, 1882, p. 11.—Wirén, 1883, p. 387, pl. 28, fig. 1 (part).—Murdoch, 1885, p. 152 (not *A. scabra* Fabricius, 1780).
- Eunoë oerstedii* Malmgren, 1865, p. 61, pl. 8, fig. 3.—Moore, 1909b, p. 135.—Sumner, 1913, p. 618.—Treadwell, 1937, p. 27.—Hartman, 1944a, pp. 334, 337.—Gorbunov, 1946, p. 38.—Pettibone, 1953, p. 46, pl. 23.
- Eunoë barbata* Moore, 1910, p. 334, pl. 28, figs. 1-6.—Treadwell, 1925, p. 1.—Hartman, 1939, p. 53.—Berkeley and Berkeley, 1945, p. 321; 1948, p. 14, fig. 16.—Pettibone, 1949, p. 2.
- Eunoë nodosa* Fauvel, 1923, p. 51, fig. 18, a-e (part).—Hartman and Reish, 1950, p. 7 (not *Polynoë nodosa* Sars, 1860).
- Harmothoë nodosa* Ditlevsen, 1917, p. 6, pl. 2, fig. 1 (part; not pl. 3, fig. 10).—Augener, 1928, p. 684 (part).—Wesenberg-Lund, 1950a, p. 6 (part); 1950b, p. 17 (part); 1951, p. 10 (part; not *P. nodosa* Sars, 1860).

Description.—Length 18-73 mm., width including setae 6-29 mm. Segments 37-39 (39-42 in specimens from Washington). Prostomium with cephalic peaks poorly developed or lacking; anterior pair of eyes anterolateral, visible dorsally. Antennae and dorsal cirri with long papillae. Body elongate, oval in cross section. Segmental papillae short and bulbous. Tips of notosetae may be worn down and blunt, especially in larger specimens. Elytra with lateral fringe of papillae. Elytral surface exceedingly scabrous, with microtubercles one- to many-pronged; macro-tubercles branched, extremely variable in size, number, arrangement and shape; some brownish, some translucent. COLOR: In alcohol: Dusky, dark or greenish black between elytophores and dorsal tubercles, with some color on cirrophores of dorsal cirri and tips of parapodia; setae dark amber-colored.

Remarks.—This species is closely related to and has been confused with *E. nodosa* as discussed above. Examination of the type of *E. barbata* Moore from central California revealed no essential differences from *E. oerstedii*.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, up to 8 miles from shore, 18.3 to 75.5 fms., on bottoms of mud, sand, shells, pebbles, gravel, rocks, stones (10 stations, 20 specimens). CANADIAN ARCTIC: Baffin Island, 66°43' N., 80°07' W., 1927; center, south, and southeast corner Foxe Basin, 25-37 fms., 1927; Kneeland Bay in Frobisher Bay, Baffin Island, 7-12 fms., 1942; all collected by Bartlett. WEST GREENLAND: Murchison Sound, 45-60 fms., Bartlett, 1938. EAST GREENLAND: Clavering Fiord, 1939; off Cape Hold with Hope, 23-40 fms., Bartlett, 1939. SOUTH GREENLAND: Off Cape Farewell, 70 fms., Bartlett, 1939. EAST COAST NORTH AMERICA: Off Labrador,

25–40 fms., *Blue Dolphin* Expeditions, 1949, 1950; Nova Scotia, Grand Manan, Maine, Massachusetts, low water to 110 fms., U. S. Fish Commission. JAPAN: *Albatross* Sta. 3656, Hakodate Bay, 11.5 fms., 1896.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan and Canadian Arctic, Baffin Bay, Davis Strait, Greenland, Spitsbergen. Also from Norway to English Channel; Labrador to Massachusetts; Bering Sea to central California; and Japan. In low water to 516 fathoms.

Genus *Harmothoë* Kinberg, 1857

As used herein, *Harmothoë* includes *Lagisca* Malmgren, 1865; *Evarne* Malmgren, 1865; and *Evarnella* Chamberlin, 1919.

Both species represented have the body short, attenuated posteriorly, segments about 40 (36–50), covered by elytra except for posterior few segments; elytra with numerous conical microtubercles. Prostomium with cephalic peaks prominent (fig. 26, *a*). Antennae and dorsal cirri with short papillae. Notosetae stouter than neurosetae, with long distal spinous regions and short, pointed, bare tips.

Key to the species of *Harmothoë* from Point Barrow

1. Anterior pair of eyes anteroventral on prostomium (slightly posterior and lateral to cephalic peaks), not visible dorsally (fig. 26, *a*). Elytra with or without large, globular macrotubercles near posterior border.

H. imbricata

Anterior pair of eyes anterolateral on prostomium, visible dorsally. Elytra with macrotubercles globular, sausage-shaped or elongate, rodlike.

H. extenuata

Harmothoë imbricata (Linné, 1767)

FIGURE 26, *a, e*

Aphrodita imbricata Linné, 1767, p. 1804.

Lepidonote cirrata Oersted, 1843, p. 166, pl. 1, figs. 1, 5–6, 11, 14–15.

Polynoë cirrata Sars, 1860, p. 60.

Harmothoë imbricata Malmgren, 1865, p. 66, pl. 9, fig. 8.—Webster and Benedict, 1884, p. 701; 1887, p. 709.—Johnson, 1897, p. 181; 1901, p. 390.—McIntosh, 1900, p. 314, figs.—Moore, 1902, p. 270; 1903, p. 402; 1908, p. 334.—Ditlevsen, 1909, p. 7, pl. 2, fig. 5.—Sumner, 1913, p. 617.—Southern, 1914, p. 52.—Chamberlin, 1920, p. 4.—Eliason, 1920, p. 19.—Fauvel, 1923, p. 55, fig. 18, f–e; 1933, p. 10; 1936, p. 50.—Treadwell, 1925, p. 1; 1937, p. 26.—Augener, 1928, p. 677; 1939, p. 133.—Annenkova, 1934, p. 322; 1937, p. 151; 1938, p. 136.—Okuda, 1938b, p. 83; 1939, p. 224.—Friedrich, 1939, p. 122.—Monro, 1939a, p. 345.—Hartman, 1944a, pp. 335, 337; 1948, p. 13.—Thorson, 1946, p. 46, figs. 17–18.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 108, pl. 28, fig. 10.—Berkeley and Berkeley, 1948, p. 11, fig. 9.—Pettibone, 1949, p. 2; 1953, p. 32, pls. 13–16.—Hartman and Reish, 1950, p. 6.—Wesenberg-Lund, 1950a, p. 6; 1950b, p. 18; 1951, p. 12.

Polynoë imbricata Marenzeller, 1879, p. 9, pl. 2, fig. 1.—Théel, 1879, p. 9.—Hansen, 1882, pp. 11, 13, 15, 23.—Wirèn, 1883, p. 389.

Harmothoë levis Treadwell, 1937, p. 26, figs. 1-5.

Description.—Length 24-53 mm., width including setae 8-19 mm. (length up to 65 mm.—Théel, 1879). Segments 37-39. Prostomium with anterior pair eyes ventral, slightly posterior and lateral to cephalic peaks. Elytra with scattered conical microtubercles, with or without few to numerous, small, brownish to reddish, globular to elongate cylindrical macro-tubercles in one, two, or several irregular rows near posterior border; may be a few additional globular papillae in middle of elytra; with or without short elytral fringe of papillae. Neurosetae with long spinous regions, with long, bare, hooked tips, and usually with a subterminal tooth (may be broken off). COLOR: In life and in alcohol: Irregularly pigmented middorsally, on cirrophores, dorsal tubercles, and parapodial lobes; usually without color ventrally; elytra show remarkable color variations of mottled tan and brown, blackish to grayish, or reddish; inner halves of elytra red or grayish brown resulting in a middorsal, longitudinal, pigmented band; uniformly tan; tan with bilateral darker spots near places of attachment (the color variety of *H. levis* Treadwell).

Remarks.—Examination of the types of *H. levis* Treadwell from Greenland waters revealed it to be but a color variation of *H. imbricata*.

Parasites.—Of the 215 specimens, 13 had parasitic copepods, *Herpyllobius arcticus* Steenstrup and Lütken, attached on the prostomium (identified by Paul L. Illg).

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms., gravel, stones, mud; Point Barrow base, washed ashore; off Point Barrow base, up to 16 miles from shore, 11.7-123.5 fms., on bottoms of stones, mud, masses of worm tubes, and various combinations of mud, pebbles, gravel, stones, large perforated rocks, with barnacles, bryozoans, hydroids, tunicates, shells, worm tubes (34 stations, 215 specimens). CANADIAN ARTIC: Southeast corner Foxe Basin, 66°46' N., 79°15' W., 34-37 fms., 1927; shoal in Kneeland Bay, Frobisher Bay, Baffin Island, 7-12 fms., 1942; west shore Frobisher Bay, 1942; off Daniels Island, northwest side in Newell Sound, Frobisher Bay, 10-30 fms., 1942; all collected by Bartlett. WEST GREENLAND: Oelricks Bay, mud, 1937; Vaigat, Disko Island, mud, 1937; between Capes Alexander and Chalon, 25-40 fms., rocks, 1937; Walrus grounds, Murchison Sound, 45-60 fms., 1938; off Conical Rock, 76° N., 67°30' W., 20-40 fms., rocks, shell, 1938; all collected by Bartlett. Upernivik Harbor, 13 fms., U.S.S. *Alert*, 1884. EAST GREENLAND: Clavering Fiord, 1939; Angmogssalik, 10-15 fms., 1939; off Cape Hold with Hope, 23-40 fms., 1939; all collected by Bartlett. SPITSBERGEN: Spitsbergen Sea,

U.S.S. *Alliance*, 1881; South Gatt, northwest Spitsbergen, 79°40' N., 7 fms., E. Wilkinson. EAST COAST NORTH AMERICA: Off Labrador and Newfoundland, intertidal to 60 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; off Nova Scotia, Grand Manan, Maine, Massachusetts, Rhode Island, Long Island Sound, intertidal to 110 fms., U. S. Fish Commission. BERING SEA: Bering Strait, 13 fms., Dall, 1880; 62°54' N., 166°38' W., 22 fms., and 66°12' N., 168°54' W., Stoney, 1884; St. George Island, Pribilofs, G. D. Hanna, 1914; *Albatross* Sta. 3252, 57°22' N., 164°24' W., 29.5 fms., 1890, and Sta. 3522, 57°58' N., 170°09' W., 41 fms., 1893. SOUTHWESTERN ALASKA: Bay of Islands, Adak Island, 9-16 fms., 1873, and Coal Harbor, Unga Island, 1872, Dall. SOUTHEASTERN ALASKA: Wrangel, W. H. Jones. Sitka, "worm-eaten" wood, L. A. Beardslee. JAPAN: *Albatross* Sta. 3656, Hakodate Bay, 1896.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya. Also Iceland and Norway to Mediterranean and Adriatic; Labrador to New Jersey; Bering Sea to southern California; and Japan. In low water to 2,030 fathoms.

***Harmothoë extenuata* (Grube, 1840)**

- Polynoë extenuata* Grube, 1840, p. 86 (*vide* Claparède, 1868).—Claparède, 1868, p. 380, pl. 2, fig. 2.
- Polynoë rarispina* Sars, 1860, p. 60.—Théel, 1879, p. 8.—Hansen, 1882, p. 7.—Wirén, 1883, p. 389.
- Lagisca rarispina* Malmgren, 1865, p. 65, pl. 8, fig. 2.—Verrill, 1881, pp. 311, 314.—Webster and Benedict, 1884, p. 700; 1887, p. 709.—Moore, 1902, p. 269; 1908, p. 335.—Fauvel, 1911, p. 9; 1914, p. 65.—Chamberlin, 1920, p. 5.—Berkeley and Berkeley, 1943, p. 129; 1948, p. 16, figs. 18, 19.
- Lagisca propinqua* Malmgren, 1867, p. 9, pl. 1, fig. 3, a-e.
- Lagisca extenuata* Marenzeller, 1876, p. 133, pl. 1, fig. 1; 1904, p. 318.—McIntosh, 1900, p. 307, figs.—Fauvel, 1923, p. 76, fig. 28, a-m; 1934a, p. 14.—Monro, 1939a, p. 345.—Wesenberg-Lund, 1939a, p. 6, fig. 2; 1950a, p. 8; 1950b, p. 27; 1951, p. 18.
- Lagisca impatiens* Webster, 1879b, p. 102; 1886, p. 129, pl. 4, figs. 1-7.
- Polynoë semisculpta* Hansen, 1882, p. 26, pl. 3, figs. 16-20 (?*P. semisculptus* Johnston, 1865).
- Lagisca floccosa* McIntosh, 1900, p. 298, figs.—Southern, 1914, p. 51 (not *Polynoë floccosa* Savigny, 1820).
- Harmothoë extenuata* Alaejos y Sanz, 1905, p. 55, pl. 9, fig. 8; pl. 10, figs. 1-12; pl. 11, fig. 1.—Ehlers, 1913, p. 446.—Pettibone, 1953, p. 31.
- Harmothoë rarispina* Ditlevsen, 1909, p. 5, pl. 1, figs. 2-4; 1937, p. 11.—Augener, 1928, p. 685.—Annenkova, 1937, p. 153; 1938, p. 136.—Friedrich, 1939, p. 122.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 108, pl. 28, fig. 15.
- Harmothoë triannulata* Moore, 1910, p. 346, pl. 29, figs. 18-22.—Hartman, 1938a, p. 118.—Berkeley and Berkeley, 1948, p. 12, fig. 10.
- Lagisca extenuata* var. *spinulosa* Fauvel, 1914, p. 64, pl. 4, figs. 27-29.
- Harmothoë propinqua* Ditlevsen, 1917, p. 14, pl. 3, figs. 1, 3.
- Harmothoë rarispina* forma *propinqua* Annenkova, 1937, p. 153; 1938, p. 137.

Evannella triannulata Berkeley and Berkeley, 1942, p. 188; 1943, p. 130.—Hartman, 1948, p. 13 (part; includes *H. multisetosa* Moore and *H. extenuata*).—Pettibone, 1949, p. 1.

Description.—Length 13–68 mm., width including setae 4–20 mm. (length up to 74 mm.—Ditlevsen, 1937). Segments 37–47. Prostomium with eyes large, anterior pair anterolateral, slightly anterior to widest part of prostomium, visible dorsally. Neurosetae with enlarged, long spinous regions, with tips slightly hooked, with small, secondary tooth present or absent; at least some of the setae show a remnant of a secondary tooth. The upper and lower neurosetae tend to be unidentate (not always) while the middle ones are bidentate, with a secondary tooth or remnant of it (in specimens from Woods Hole region only a few neurosetae have a secondary tooth or remnant of one). Elytra with numerous microtubercles, more or less uniform in size, conical, with tips blunt, pointed, or bifid; usually with few to fairly numerous macro-tubercles distinctly set off from elytral surface, usually narrower at the base, brown, smooth, globular, sausage-shaped, or elongate fusiform, variable in number, 0–9 near posterior border, 0–13 scattered near center of elytron. Elytra with short fringe of papillae on external border. COLOR: In alcohol: Without color anteriorly; on posterior half, with brownish transverse bands and two brown spots basally on cirrophores (in specimens from Woods Hole region, found intertidally, the body is darkly pigmented grayish-green middorsally); antennae and dorsal cirri ringed with brown; elytra mottled with brown, sometimes with a darker spot posterior and medial to the place of attachment; the microtubercles may be covered with a brown extraneous material, giving a streaked appearance.

Remarks.—*H. extenuata* is an extremely variable species as indicated by the number of names that have been applied to it. It reaches its greatest size in arctic waters; it is small when found intertidally, as in the Puget Sound region (up to 23 mm.—*H. triannulata* of Moore). When found intertidally off New England, it also is small (about 26 mm.), and the secondary tooth of the neurosetae is suppressed, usually with only a remnant showing on a few neurosetae, the rest being entire (*L. impatiens* of Webster). In the collection from Point Barrow, where it was the most abundant polychaete, it is represented by specimens of all sizes from very small to large (up to 68 mm.).

Parasites.—Of the 375 specimens, 3 had the parasitic copepod *Herpyllobius arcticus* Steenstrup and Lutken attached to the prostomium (identified by Illg).

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, up to 15 miles from shore, 13.3–123.5 fms., on bottoms of mud, stones, masses of worm tubes, and various combinations of mud, pebbles, rocks, gravel, stones, large perforated rocks, with shells, bryozoans, hydroids,

worm tubes, from starfish and crab, *Hyas coarctatus* (37 stations, 375 specimens). CANADIAN ARCTIC: Foxe Basin, 66°30' N., 80° W., 1927; center Foxe Basin, 25–31 fms., 1927; 7 miles east Cape Dorchester, Foxe Channel, 25 fms., 1927; Baffin Island, 66°43' N., 80°07' W., 1927; Hurd Channel between Bushman Island and Melville Peninsula, 11 fms., rocky, 1933; south end Cape Martineau, Melville Peninsula, 7–15 fms., 1933; 3 miles south Salisbury Island, Hudson Strait, 27 fms., 1933; south end Cobourg Island, Baffin Bay, 75°40' N., 78°58' W., 11.3–20 fms., 1935; east end Cobourg Island, 75°40' N., 78°50' W., 23–36 fms., 1935; southeast corner Foxe Basin, 66°46' N., 79°15' W., 34–37 fms., 1937; Kneeland Bay, Frobisher Bay, Baffin Island, 7–12 fms., 1942; all collected by Bartlett. WEST GREENLAND: Vaigat, Disko Island, mud, 1937; between Capes Alexander and Chalon, 25–40 fms., rocky, 1937; Walrus grounds, Murchison Sound, 45 fms., 1938; all collected by Bartlett. NORTH GREENLAND: North Omenolu near North Star Bay, 17 fms., and Cape Alexander, entrance to Smith Sound, rocky, 1932, Bartlett. EAST GREENLAND: Off Cape Hold with Hope, 23–40 fms., Bartlett, 1939. SOUTH GREENLAND: Cape Farewell, 70 fms., Bartlett, 1939. FRANZ JOSEF LAND: Aberdore Channel east Alger Island, 10 fms., Baldwin-Ziegler Polar Expedition, 1901. BERING SEA: Alaska King Crab Investigation, 1941, Sta. D8–41, 58°34' N., 165°17' W., 42 fms.; Sta. D7–41, 57° N., 163°48' W., 38 fms.; Sta. D11–41, 12 miles east Walrus Island, Pribilofs, 31–33 fms.; St. George Island, Pribilofs, village beach, 1914, and St. Paul Island, Pribilofs, 1915, Hanna; 62°54' N., 166°38' W., 22 fms., and 62°15' N., 167°48' W., 20 fms., Stoney, 1884. SOUTHWESTERN ALASKA: Alaska King Crab Investigation, 1940, 1941, Sta.: 89–40, Unga Strait, 37–47 fms.; 93–40, Spitz Island, 55–68 fms.; Sand Point; 128–40, Shelikof Strait off Hallo Bay, 35–48 fms.; 60–40, Lenard Harbor, 20–25 fms.; L18–41, Kupreanof Strait, south side, 2 miles northwest Bare Island, 13–15 fms.; 72–40, Cold Bay, 15–50 fms.; 52–40, Canoe Bay, 35–40 fms., on *Paralithodes camtschatica*; 100–40, Alitak Bay, 30 fms.; 59–40, between inner Iliasik and Goloï Island, 20–30 fms. SOUTHEASTERN ALASKA: Lituya Bay, 6–9 fms., Dall, 1874. EAST COAST NORTH AMERICA: Off Labrador, 6–100 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; Bay of Fundy, Gulf of Maine, Massachusetts, Long Island Sound, 4–134 fms., U. S. Fish Commission; Woods Hole region, intertidal and dredged, Pettibone, 1950, 1951; *Fish Hawk* Sta. 8826, 8898, Chesapeake Bay, 1920.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Davis Strait, Greenland, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Mediterranean and Adriatic; Hudson Bay to Chesapeake Bay; Bering Sea to southern California; north Japan Sea; South Africa. In low water to 1,000 fathoms.

Genus *Enipo* Malmgren, 1865, sensu Levinsen, 1883***Enipo gracilis* Verrill, 1874**

Enipo gracilis Verrill, 1874a, pp. 407, 411, pl. 6, fig. 4; 1874b, pp. 347, 361, 378, pl. 5, fig. 3.—Pettibone, 1953, p. 22, pl. 7.

Enipo cirrata Treadwell, 1925, p. 1, figs. 1-4.—Hartman, 1938a, p. 120, fig. 39, d, e.—Berkeley and Berkeley, 1942, p. 188; 1945, p. 322; 1948, p. 16, fig. 20.

Polynoë gracilis Hartman, 1942a, p. 26, figs. 23-26.

Description.—Length 25-76 mm., width including setae 3-4 mm. Segments variable in number (45, with regenerating posterior end, to 74). Body elongate, slender, with sides nearly parallel. Prostomium without cephalic peaks. In some specimens from New England there are slight prostomial peaks (prostomial peaks present—Hartman, 1942). Antennae and dorsal cirri with short, clavate papillae. Dorsal cirri short, barely reaching tips of setae in anterior part, longer in posterior region without elytra. Elytra oval, translucent, small, usually leaving middorsum uncovered, smooth, without papillae or tubercles. Notosetae form a short, bushy bundle, rather numerous (more than 30 in specimens from Point Barrow) to few (2-20 or rarely 0—Treadwell, 1925), slender to moderately stout, tapering gradually to short, bare, blunt tips, with spinous rows distally. Neurosetae stouter than notosetae, upper ones with longer spinous regions (17-23 or so rows), middle ones with shorter spinous regions (10 or so rows), with long, bare, slightly hooked tips (neurosetae may be all similar, with 5-10 transverse spinous rows). COLOR: In alcohol: Without color or brownish middorsally; elytra pigmented smoky brown on the medial halves.

Remarks.—Known to be commensal with the maldanid *Nicomache lumbricalis* (Fabricius) in Alaska (as *E. cirrata*—Berkeley and Berkeley, 1942) and off Halifax, Nova Scotia, and Cape Cod (specimens in the U. S. National Museum, identified by Verrill).

New Records.—ARCTIC ALASKA: Off Point Barrow, up to 12.1 miles from shore, 21-123.5 fms., from breaking rock, masses of worm tubes, with stones, large perforated rocks (3 stations, 3 specimens). EAST COAST NORTH AMERICA: Off Nova Scotia, Maine, Massachusetts, 2-198 fms., U. S. Fish Commission.

Distribution.—Alaskan Arctic; southwestern Alaska to Washington; Nova Scotia to Massachusetts. In 2-123.5 fathoms.

Genus *Arcteobia* Annenkova, 1934***Arcteobia anticostiensis* (McIntosh, 1874)**

Eupolynoë anticostiensis McIntosh, 1874, p. 265, pl. 10, figs. 1-4.—Wirén, 1883, p. 390, pl. 29, fig. 2.—Marenzeller, 1890, pl. 1.

Harmothoë anticostiensis Augener, 1928, p. 691, pl. 11, fig. 13.

Arctobia anticostiensis Annenkova, 1934, p. 322; 1937, p. 149, pl. 3, figs. 26, 27; 1938, p. 133.

Eucranta anticostiensis Hartman, 1944a, p. 337.

Description.—Length 11–26 mm., width including setae 4–8 mm. Segments 35 or 36. Prostomium with distinct cephalic peaks; anterior pair of eyes anteroventral, not visible dorsally. Antennae and dorsal cirri with short, clavate papillae. Elytral pairs get larger posteriorly, the last pair usually extending beyond end of body. Elytra without fringe of papillae, smooth except for scattered microtubercles on anterior curved part. Upper notosetae shorter, stouter, with short, blunt to sharp-pointed tips; most of notosetae more slender, with capillary tips. Few upper neurosetae longer, ending in sharp, slender tips; most of neurosetae with bifid tips. COLOR: In life and in alcohol: Irregularly banded middorsally, greenish to greenish black, with a transverse stripe and often a pair of small spots; elytra with reddish brown pigmented area, usually C-shaped on inner and posterior parts and often a darker spot over place of attachment; may form a complete, circular, colored area.

Remarks.—Probably commensal in habit; off Labrador, found commensal in the sinuous tubes of the terebellid *Pista flexuosa* (Grube), one worm per tube.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore; off Point Barrow base, up to 12.1 miles from shore, 24.7–123.5 fms., on bottoms of mud, masses of worm tubes, and various combinations of mud, gravel, stones, rocks, and large perforated rocks (7 stations, 14 specimens). EAST COAST NORTH AMERICA: Off Labrador, 40–95 fms., *Blue Dolphin Expedition*, 1949; off Nova Scotia, Maine, Massachusetts, 10–86 fms., U. S. Fish Commission.

Distribution.—Alaskan Arctic; Labrador to Massachusetts; Bering Sea; north Japan Sea. In low water to 123.5 fathoms.

Genus *Gattyana* McIntosh, 1897

Key to the species of *Gattyana* from Point Barrow

1. Notosetae with tips blunt to capillary. Anterior pair of eyes anteroventral, not visible dorsally; cephalic peaks distinct. Elytra with microtubercles only..... *G. cirrosa*
- All notosetae with capillary tips. Anterior pair of eyes anterolateral; cephalic peaks short and blunt. Elytra with conical and bifid microtubercles, with a few larger, knoblike macro-tubercles..... *G. ciliata*

Gattyana cirrosa (Pallas, 1766)

FIGURE 26, b

Aphrodita cirrhosa Pallas, 1766, p. 95, pl. 8, figs. 3–6.

Nychia cirrosa Malmgren, 1865, p. 58, pl. 8, fig. 1.—Théel, 1879, p. 7.—Verrill, 1881, pp. 306, 311.—Wirén, 1883, p. 387.—Webster and Benedict, 1884, p. 700; 1887, p. 708.—? Andrews, 1891, p. 279.

Gattyana cirrosa McIntosh, 1900, p. 285, figs.—Moore, 1902, p. 259; 1908, p. 337.—Southern, 1914, p. 51.—Eliason, 1920, p. 21.—Fauvel, 1923, p. 49, fig. 17, a-g.—Augener, 1928, p. 692; 1939, p. 136.—Gustafson, 1936, p. 5.—Treadwell, 1937, p. 25.—Annenkova, 1937, p. 148; 1938, pp. 83, 96, 133, 222.—Monro, 1939a, p. 345.—Berkeley and Berkeley, 1943, p. 129; 1948, p. 13, fig. 13.—Thorson, 1946, p. 45.—Gorbunov, 1946, p. 38.—Hartman, 1948, p. 14.—Zatsepin, 1948, p. 106, pl. 28, fig. 5.—Pettibone, 1949, p. 2; 1953, p. 41, pl. 20.—Wesenberg-Lund, 1950a, p. 5, pl. 1, figs. 1, 2; 1950b, p. 12; 1951, p. 9.

Gattyana cirrhosa Chamberlin, 1920, p. 8.

Description.—Length 11–35 mm., width including setae 4–12 mm. Segments 35–38. Elytra with long papillae on posterior and external borders as well as scattered over the exposed part of elytral surface, usually covered with debris, giving a straggly appearance. Elytral tubercles amber-colored, exceedingly variable in shape, conical or cylindrical, simple, bifid or quadrifid, showing various degrees of being worn down; tubercles on the anterior few pairs of elytra tend to be less worn down, showing their more characteristic shapes. COLOR: In alcohol: Elytra tan mottled with brown or uniformly tan; often with blackish foreign material on elytral tubercles and papillae. Specimens washed ashore were essentially free from debris, the elytra whitish, iridescent, with amber-colored tubercles and inconspicuous, delicate papillae.

Parasites.—Three of the 126 specimens had the parasitic copepod *Herpyllobius arcticus* Steenstrup and Lütken attached to the prostomia (identified by Illg).

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; Point Barrow base, washed ashore; off Point Barrow base, up to 15 miles from shore, 18.3–123.5 fms., on bottoms of mud, stones, masses of worm tubes, and various combinations of mud, pebbles, small and large rocks, stones, gravel, and worm tubes; from breaking rock (30 stations, 126 specimens). Cape Smyth, 2.5–3 fms., Point Barrow Expedition, 1883. CANADIAN ARCTIC: South end Cape Martineau, Melville Peninsula, 7–15 fms., 1933; Foxe Basin, 1933; east end Cobourg Island, Baffin Bay, 75°40' N., 78°50' W., 23–40 fms., 1935; Kneeland Bay, Frobisher Bay, Baffin Island, 14 fms., 1942; all collected by Bartlett. WEST GREENLAND: Vaigat, Disko Island, 1937; between Capes Alexander and Chalon, 25–40 fms., rocky, 1937; Walrus grounds, Murchison Sound, 60 fms., 1938; northwest Conical Rock, 1938; all collected by Bartlett. Upernivik Harbor, 13 fms., and Godhavn, U. S. S. *Alert*, 1884. EAST GREENLAND: Off Cape Hold with Hope, 4–6 fms., Bartlett, 1939. NORTH GREENLAND: North Omenolu near North Star Bay, 17 fms., Bartlett, 1932. SPITSBERGEN: Spitsbergen Sea, U. S. S. *Alliance*, 1881. BERING SEA: Bering Strait, 13 fms., Dall, 1880. *Albatross* Sta. 3326, 53°40'

N., 167°41' W., 1890. SOUTHWESTERN ALASKA: Iluliuk Harbor, Unalaska, Dall, 1871. SOUTHEASTERN ALASKA: Sitka, Dall. EAST COAST NORTH AMERICA: Off Labrador, 13–125 fms., *Blue Dolphin Expeditions*, 1949, 1950, 1951.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Spitsbergen, Novaya Zemlya. Also Iceland, Faroes, Norway to France; Hudson Bay to Massachusetts; Bering Sea to Washington; north Japan Sea. In low water to 630 fathoms.

Gattyana ciliata Moore, 1902

Gattyana ciliata Moore, 1902, p. 263, pl. 13, figs. 14–19; pl. 14, fig. 20; 1905a, p. 525; 1908, p. 337.—Annenkova, 1937, p. 148, pl. 2, figs. 9, 11; pl. 4, fig. 33; 1938, pp. 83, 100, 132, 224.—Berkeley and Berkeley, 1948, p. 12, fig. 11.—Pettibone, 1953, p. 40, pl. 19.

Description.—Length 63–65 mm., width including setae 25–29 mm. (length up to 80 mm.—Annenkova, 1937). Segments 36 or 37. Cephalic peaks lacking or short and blunt. Elytral tubercles of several kinds: Microtubercles numerous, conical, pointed, hooked, some bifid; usually intermediate-sized tubercles elongated, conical, some bifid, in several rows arranged diagonally from center of elytron laterally; conical macrotubercles with blunt, roughened tips, usually near posterior border of elytra, variable in number, size, and shape. COLOR: In alcohol: Elytra tannish mottled with brown.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 20–87 fms., on bottoms of rocks, stones, small amount of gravel (4 stations, 4 specimens). BERING SEA: *Albatross Sta.* 3606, 55°27' N., 167°47' W., 87 fms., green mud, fine sand, 1895.

Distribution.—Alaskan Arctic (originally recorded from Greenland waters, corrected to Icy Cape, Alaska—Moore, 1902, 1905); Bering Sea to Washington; north Japan Sea. In 4.4–303 fathoms.

Family SIGALIONIDAE

Prostomium subglobular, with two pairs of eyes, dorsal antennae 1–3, a pair of subulate, ventral palps (fig. 26, *f*). First or tentacular segment with or without numerous setae (lacking in *Pholoë*), with two pairs of tentacular cirri. Parapodia biramous, with notosetae simple, neurosetae simple or composite or both; with paired dorsal elytra on certain segments; without dorsal cirri; with paired subulate ventral cirri. Pygidium with pair of anal cirri. With or without cirriform branchiae and ciliated cushions or ctenidia on parapodia (both lacking in *Pholoë*). Muscular proboscis eversible, with circle of soft marginal papillae and two pairs of interlocking, chitinous jaws.

Represented by a single species from Point Barrow.

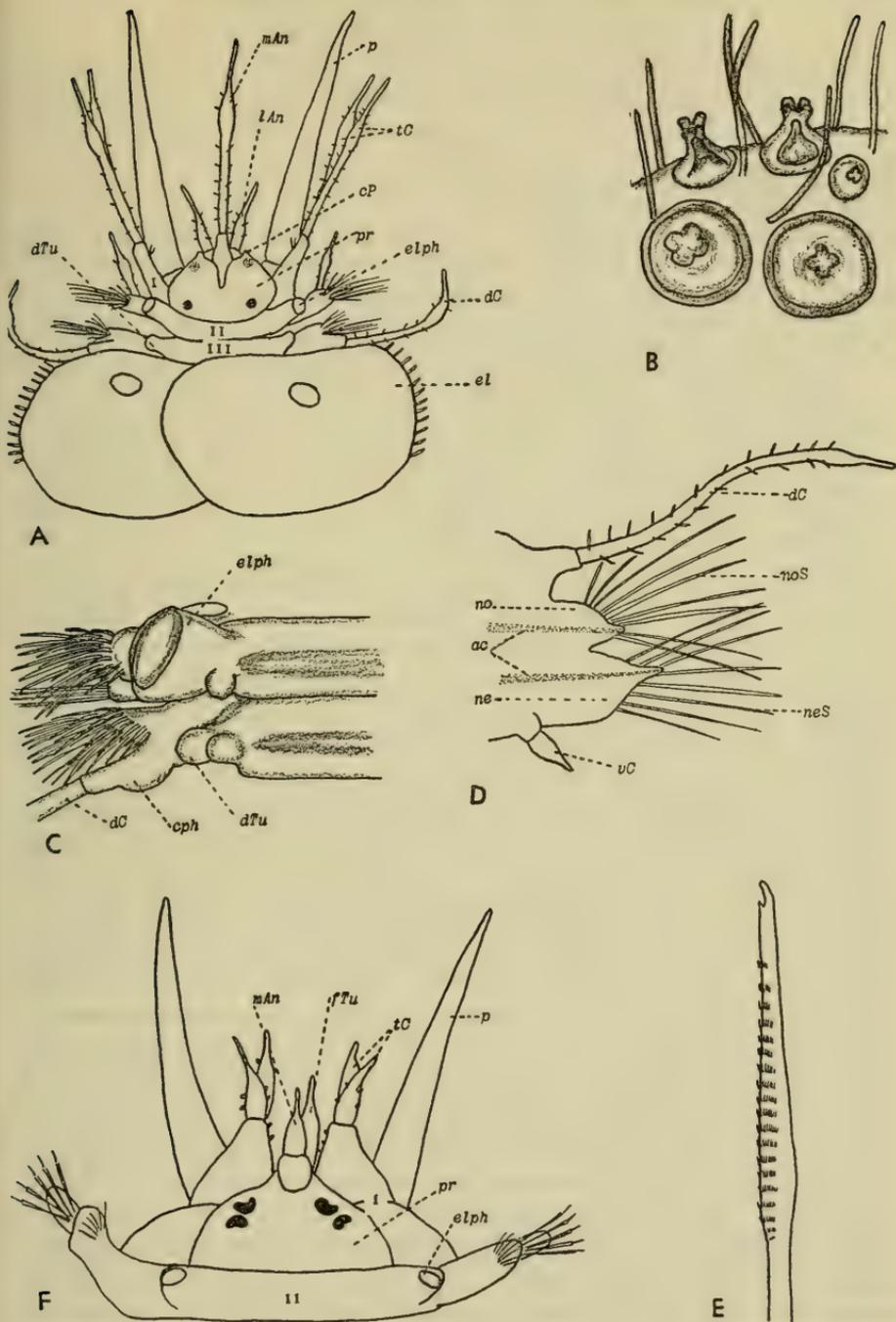


FIGURE 26.—Polynoidae: *a*, *Harmothoe imbricata*, dorsal view anterior end, first pair elytra removed; *b*, *Gattyana cirrosa*, part of elytron enlarged, showing elytral tubercles and papillae; *c*, *Eunoë nodosa*, dorsal view part of two segments showing extra rounded lobes on inner sides of elythrofore and dorsal tubercle; *d*, *Eunoë oerstedii*, biramous parapodium; *e*, *Harmothoe imbricata*, bidentate neuroseta. Sigalionidae: *f*, *Pholoë minuta*, dorsal view anterior end, first pair elytra removed. (For explanation of symbols, see p. 210.)

Genus *Pholoë* Johnston, 1839*Pholoë minuta* (Fabricius, 1780)

FIGURE 26, f

Aphrodita minuta Fabricius, 1780, p. 314.*Aphrodita longa* Fabricius, 1780, p. 313.

Pholoë minuta Oersted, 1843, p. 169, pl. 1, figs. 3, 4, 8, 9, 16.—Malmgren, 1865, p. 89, pl. 11, fig. 13.—Théel, 1879, p. 24.—Webster and Benedict, 1884, p. 701; 1887, p. 709.—McIntosh, 1900, p. 437, figs.—Moore, 1902, p. 274; 1908, p. 338.—Ehlers, 1913, p. 450.—Southern, 1914, p. 57.—Chamberlin, 1920, p. 5.—Eliason, 1920, p. 22.—Fauvel, 1923, p. 120, fig. 44, a-h.—Augener, 1928, p. 673.—Annenkova, 1934, p. 322; 1937, p. 155; 1938, p. 138.—Berkeley and Berkeley, 1942, p. 189.—Hartman, 1944a, pp. 335, 337; 1948, p. 15.—Thorson, 1946, p. 49, fig. 19; Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 109, pl. 28, fig. 17.—Hartman and Reish, 1950, p. 8.—Wesenberg-Lund, 1950a, p. 9; 1950b, p. 31; 1951, p. 22.—Pettibone, 1953, p. 77, pl. 39.

Pholoë tuberculata Southern, 1914, p. 57, pl. 6, fig. 14, A-L.—Berkeley and Berkeley, 1945, p. 323; 1948, p. 22, fig. 26.

Description.—Length 5–25 mm., width including setae 1–4 mm. Segments 36–84. Body small, elongate, nearly linear, flattened dorsoventrally; fragments easily. Lateral ventral surface and ventral sides of parapodial lobes thickly set with small, globular to elongate papillae, usually covered with debris. Prostomium small, oval; anterior and posterior pairs of eyes closely approximated. Single median antenna short, subulate (lateral antennae lacking). Tentacular segment achaetous; tentacular cirri similar to median antenna. A digitiform facial tubercle on a rounded lobe dorsal to the mouth and ventral to the prostomium. (On this character, Southern (1914) differentiated *P. tuberculata*; the lobe, on which the facial tubercle is located, appears to be retractile; surrounded by the bases of the palps, tentacular cirri and median antenna, the facial tubercle is easily overlooked unless the region is quite relaxed.) Elytra numerous, on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 24, continuing on all segments to end of body; elytra nearly cover the dorsum except for a narrow middorsal part, usually pressed close to body; elytral surface smooth, with few microtubercles, somewhat areolate as seen under magnification, posterior border with few scattered papillae, somewhat moniliform. Notosetae simple, slender, finely spinous, tapering to capillary tips, upper ones shorter, with pronounced angles, the rest longer, with more gradual curves. Neurosetae stouter than notosetae, compound, with short, falcate terminal pieces. COLOR: In alcohol: Without color or irregularly pigmented greenish gray; elytra translucent, colorless, or greenish gray with a light spot over the place of attachment, or brownish; often with much debris.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, up to 12.1 miles from shore, 16.7–123.5 fms., on bottoms of stones, masses of worm tubes, and various combinations of mud, gravel, stones, rocks, large perforated rocks, with bryozoans, hydroids; from screen trap through hole in ice, mud (16 stations, 30 specimens). WEST GREENLAND: Vaigat, Disko Island, mud, 1937, and Walrus grounds, Murchison Sound, 45 fms., 1938, Bartlett. EAST COAST NORTH AMERICA: Off Labrador, 6 fms., *Blue Dolphin* Expedition, 1949; off Nova Scotia, St. Georges Bank, Maine, Massachusetts, Rhode Island, intertidal to 110 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Jan Mayen, Norwegian Sea, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Shetlands, Norway to northern France; Labrador to Rhode Island; Bering Sea to southern Oregon; north Japan Sea; off South Africa. In low water to 1,254 fathoms.

Family PHYLLODOCIDAE

Prostomium subconical, suboval or cordiform, with two eyes, four or five antennae, without palps (fig. 27, *a-d*). Anterior segments 1–3 modified, with two to four pairs tentacular cirri. Parapodia uniramous (exceptionally biramous); setae compound (some may be simple). Dorsal and ventral cirri foliaceous or more or less globular (fig. 27, *e-i*). Two anal cirri. Proboscis eversible, with papillae, unarmed. Active; mucus secreted in quantities.

Represented by four genera and seven species. All genera represented have uniramous parapodia, with compound setae.

Key to the genera of Phyllodocidae from Point Barrow

1. Tentacular cirri 4 pairs; first tentacular segment rudimentary, not visible dorsally, with 1 pair tentacular cirri lateral to prostomium; second segment distinct, with 2 pairs tentacular cirri; third segment distinct, with 1 pair tentacular cirri, 1 pair normal ventral cirri (fig. 27, *c, d*) ----- 2
- Tentacular cirri 3 pairs; first tentacular segment distinct dorsally, with 1 pair tentacular cirri; second segment distinct, with 2 pairs tentacular cirri (fig. 27, *b*). Prostomium oval, without occipital tubercle ---- **Mystides** (p. 232)
- Tentacular cirri 2 pairs on first achaetous segment (fig. 27, *a*). Without dorsal cirri on second segment which has a setigerous lobe (may be very small or lacking) and a foliaceous ventral cirrus. Prostomium somewhat triangular, widest basally, with anterior part rounded, with 2 pairs short, subulate, frontal antennae, usually with 2 deep-set eyes (may not be visible when preserved), usually with a median occipital depression containing a small occipital tubercle (not always conspicuous), with a pair of lateral nuchal grooves ----- **Eteone** (p. 232)

2. Antennae 4 (2 pairs frontal antennae). Prosthomium cordiform, with an occipital tubercle in the posterior notch (fig. 27, *d*). Proboscis with papillae proximally arranged in longitudinal rows-----**Phyllodoce** (p. 236)
- Antennae 5 (2 pairs frontal antennae and unpaired median antenna). Prosthomium oval or bluntly conical, without occipital tubercle (fig. 27, *c*). Proboscis with surface smooth, wrinkled, or with few scattered papillae
Eumida (p. 238)

Genus *Mystides* Théel, 1879

Mystides borealis Théel, 1879

FIGURE 27, *b*

Mystides borealis Théel, 1879, p. 35, pl. 2, figs. 29–32.—Southern, 1914, p. 72, pl. 8, fig. 19, A–D.—Bergström, 1914, p. 176, fig. 64.—Fauvel, 1923, p. 181, fig. 65, a–d.—Augener, 1928, p. 711.—Zatsepin, 1948, p. 113, pl. 29, fig. 15.—Wesenberg-Lund, 1950b, p. 37.

Mystides viridis Webster and Benedict, 1887, p. 712, pl. 1, figs. 10, 11, 13; pl. 2, fig. 12. (Type in USNM.)

Mystides notialis Ehlers, 1913, p. 457, pl. 29, figs. 1–4.

Description.—Length 5–9 mm., width 0.5 mm. Segments 33–64 (up to 16 mm. long and 73 segments—Ehlers, 1913). Body small, linear, tapering anteriorly and posteriorly, flattened dorsoventrally. Prosthomium oval, wider than long, with two deeply-set eyes in middle of prosthomium, with four long, filiform antennae about one-third way back from anterior tip. Tentacular cirri 3 pairs, enlarged basally, with long, filiform tips. Dorsal, ventral, and anal cirri oval, thick, flattened. COLOR: In alcohol: Without color or irregularly pigmented with brown; cirri deep reddish brown.

Remarks.—The description of *M. notialis* from the Antarctic by Ehlers (1913) follows closely that of *M. borealis* and is herein considered to be synonymous.

New records.—ARCTIC ALASKA: Off Point Barrow, 7.5 miles from shore, 36 fms., on bottom of stones, perforated rocks (1 station, 2 specimens). WEST COAST NORTH AMERICA: Off Flat Point, Lopez Island, Washington Sound, Pettibone (1 specimen).

Distribution.—Scattered records in the Arctic: Arctic Alaska, West Greenland, Spitsbergen, Novaya Zemlya. Also Ireland, Madeira, Mediterranean; east coast North America (Maine); west coast North America (Washington Sound); Antarctic (Kerguelen). In 4–214 fathoms.

Genus *Eteone* Savigny, 1817

The four species represented have the body elongate, somewhat flattened dorsoventrally, tapering anteriorly and posteriorly, with segments numerous (100–300). Proboscis with a circle of soft papillae around opening.

Key to the species of *Eteone* from Point Barrow

1. Proboscis with 2 lateral, longitudinal rows of numerous soft papillae. Dorsal pair tentacular cirri slightly longer or up to 2-3 times longer than ventral pair. Dorsal cirri wider than long, nearly symmetrical, subcircular or slightly lanceolate (fig. 27, *e*). Color in alcohol: Darkly pigmented with bluish-violet iridescence, with longitudinal, lighter colored bands on each side of median dorsal line (or 3 dorsal longitudinal dark bands—1 median and 2 lateral). Anal cirri subcylindrical, 3-4 times longer than wide. Second segment with setigerous lobe and setae well developed... ***E. barbata***
Surface of proboscis smooth, rugose or irregularly papillate. Two pairs tentacular cirri subequal or ventral pair somewhat longer than dorsal pair... 2
2. Dorsal cirri small, not much larger than parapodial lobes, longer than or as long as wide, almost symmetrical, thick, flattened, bluntly conical (fig. 27, *h*). Anal cirri short, thick, almost spherical. Second segment with setigerous lobe and setae well developed..... ***E. longa***
Dorsal cirri much larger than parapodial lobes, wider than long..... 3
3. Dorsal cirri slightly asymmetrical, oval (fig. 27, *g*). Color in alcohol: Dorsum brownish with bluish-violet iridescence. Anal cirri short, thick, almost spherical. Second segment with setigerous lobe and setae well developed.
E. flava
Dorsal cirri much wider than long (about 2.5 times), asymmetrical, obliquely oval, with lower part larger than upper part (fig. 27, *f*). Color in alcohol: Middle third of dorsum light brownish, lateral third deep reddish brown. Anal cirri elongate, cylindrical, 3-4 times longer than wide. Second segment with setigerous lobe and setae poorly developed or lacking.

E. spetsbergensisSubgenus *Mysta* Malmgren, 1865***Eteone (Mysta) barbata* (Malmgren, 1865)**FIGURE 27, *e*

Mysta barbata Malmgren, 1865, p. 101, pl. 15, fig. 34; 1867, p. 26, pl. 3, fig. 20.—Bergström, 1914, p. 207, fig. 79.—Southern, 1914, p. 75.—Eliason, 1920, p. 28.—Augener, 1928, p. 711; 1939, p. 136.—Zatsepin, 1948, p. 113, pl. 29, fig. 14.—Wesenberg-Lund, 1951, p. 31.

Eteone striata Ditlevsen, 1917, p. 66, pl. 5, figs. 11, 17, 19.

Eteone (Mysta) barbata Fauvel, 1923, p. 176.—Annenkova, 1937, p. 159; 1938, p. 146.—Berkeley and Berkeley, 1942, p. 190.—Thorson, 1946, p. 62, fig. 27, A-B.

Description.—Length 42-180 mm.; width without setae 2.5-7 mm. See key. COLOR: In life: Three iridescent, brownish-purple dorsal longitudinal bands, median and lateral.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, stony-mud; off Point Barrow base, 6.1-27 fms., up to 3.2 miles from shore, on bottoms of mud, gravel, stones, rocks; also caught in trap on bottom (3 stations, 4 specimens).

Distribution.—Scattered records in the Arctic: Siberian and Alaskan Arctic, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Norway to Ireland, North Sea, Baltic; Bering Sea; north Japan Sea. In 5.5–60 fathoms.

***Eteone longa* (Fabricius, 1780)**

FIGURE 27, *h*

Nereis longa Fabricius, 1780, p. 300.

Eteone longa Oersted, 1843, p. 185, pl. 2, figs. 20, 28.—Bergström, 1914, p. 192, fig. 72.—Chamberlin, 1920, p. 11.—Eliason, 1920, p. 26.—Fauvel, 1923, p. 172, fig. 62, a–d; 1933, p. 16.—Augener, 1928, p. 710; 1939, p. 136.—Annenkova, 1934, p. 322; 1937, p. 158; 1938, p. 145.—Thorson, 1946, p. 59, fig. 26, A–E.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 113, pl. 29, fig. 13.—Berkeley and Berkeley, 1948, p. 41, figs. 57, 58.—Wesenberg-Lund, 1950a, p. 11, pl. 2, figs. 6, 7; 1950b, p. 38; 1951, p. 29.

Eteone arctica Malmgren, 1867, p. 27, pl. 2, fig. 12.

Eteone cinerea Webster and Benedict, 1884, p. 705, pl. 1, figs. 1–5.

Eteone tuberculata Treadwell, 1922, p. 174, figs. 7–10.

Eteone californica Hartman, 1936a, p. 131, figs. 43–46; 1948, p. 20, fig. 4, a–d.—Rioja, 1941, p. 687.

Description.—Length 10–65 mm., width without setae 0.5–3 mm. (length up to 160 mm.—Berkeley and Berkeley, 1948). See key. COLOR: In life: White.

Remarks.—*E. tuberculata* Treadwell (1922) from Friday Harbor, Washington, *E. californica* Hartman (1936) from central California (type examined as well as specimens from southeastern Alaska—Hartman, 1948), and *E. cinerea* Webster and Benedict (1884) from Provincetown, Massachusetts (type in USNM), appear to be synonymous with *E. longa*.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, 1.7–75.5 fms., up to 8 miles from shore, on bottoms of sandy-mud, stones, and various combinations of mud, pebbles, stones, gravel, rocks (12 stations, 40 specimens). WEST COAST NORTH AMERICA: San Juan Archipelago, Washington, Pettibone. WEST GREENLAND: Vaigat, Disko Island, mud, Bartlett, 1937.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Novaya Zemlya. Also Iceland, Norway to English Channel; Hudson Bay to Massachusetts; Bering Sea to México; north Japan Sea; China. In low water to 518 fathoms.

Eteone flava (Fabricius, 1780)FIGURE 27, *g**Nereis flava* Fabricius, 1780, p. 299.*Eteone flava* Malmgren, 1865, p. 102, pl. 15, fig. 35.—Bergström, 1914, p. 196, fig. 74.—Eliason, 1920, p. 27.—Fauvel, 1923, p. 173, fig. 62, e, f.—Augener, 1928, p. 709.—Annenkova, 1937, p. 158; 1938, p. 145.—Zatsepin, 1948, p. 113, pl. 29, fig. 12.—Wesenberg-Lund, 1950a, p. 11, pl. 2, fig. 7, c; 1950b, p. 39; 1951, p. 30.*Eteone depressa* Malmgren, 1865, p. 103, pl. 15, fig. 36.—Southern, 1914, p. 79.*Eteone sarsi* Malmgren, 1867, p. 28, pl. 2, fig. 14.—Webster and Benedict, 1887, p. 711.*Eteone lentigera* Malmgren, 1867, p. 29, pl. 2, fig. 13.

Description.—Length 24–68 mm.; width without setae 1–4 mm. (length up to 120 mm.—Fauvel, 1923). See key. COLOR: In life: Pinkish flesh and grayish white.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, 8.3–54.6 fms., up to 7.5 miles from shore, on bottoms of mud, and various combinations of mud, stones, gravel, rock, large perforated rocks, shells (10 stations, 22 specimens).

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen, Novaya Zemlya. Also Iceland, Faroes, Norway to English Channel; east coast North America (Maine); Bering Sea; north Japan Sea. In low water to 471 fathoms.

Eteone spetsbergensis Malmgren, 1865FIGURE 27, *f**Eteone spetsbergensis* Malmgren, 1865, p. 102, pl. 15, fig. 38.—Théel, 1879, p. 31, pl. 2, figs. 21, 22.—Bergström, 1914, p. 202, fig. 77.—Ditlevsen, 1917, p. 66, pl. 5, figs. 12, 14, 18.—Eliason, 1920, p. 27.—Augener, 1928, p. 708.—Annenkova, 1937, p. 159; 1938, p. 145.—Hartman, 1948, p. 20, fig. 5, b.—Berkeley and Berkeley, 1948, p. 42.—Zatsepin, 1948, p. 113, pl. 29, fig. 11.—Wesenberg-Lund, 1951, p. 31.

Description.—Length 17–75 mm., width without setae 0.7–4 mm. (length up to 100 mm.—Augener, 1928). See key. COLOR: In life: Pale green ventrally, reddish brown dorsolateral bands, with dark dorsal cirri; orange colored eggs.

New records.—ARCTIC ALASKA: Off Browerville near Point Barrow; off Point Barrow base, 1.7–36 fms., up to 4½ miles from shore, on bottoms of sandy-mud and various combinations of mud, gravel, rocks, stones, shell (4 stations, 4 specimens).

Distribution.—Scattered records in the Arctic: Arctic Alaska, Spitsbergen, Franz Josef Land, Novaya Zemlya. Also Iceland, Norway to Scotland; Bering Sea; western Canada; north Japan Sea. In 1.7–40 fathoms.

Eteone sp. larvae

Larvae of a species of *Eteone* found in a mass of jelly (off Point Barrow base, 1.7 fms., 300 ft. out, on sandy-mud, July 20, 1948); 11 segments, of which 8 were setigerous; triangular prostomium with short antennae and eyes; tentacular segment with short tentacular cirri; anal cirri short, spherical.

Genus *Phyllodoce* Savigny, 1817Subgenus *Anaitides* Czerniavsky, 1882*Phyllodoce* (*Anaitides*) *groenlandica* Oersted, 1842

FIGURE 27, d, i

- Phyllodoce groenlandica* Oersted, 1842, p. 121 (*vide* Bergström, 1914); 1843, p. 192, pl. 2, figs. 19, 21, 22, 29–32.—Malmgren, 1865, p. 96; 1867, p. 21, pl. 2, fig. 9.—Webster and Benedict, 1884, p. 703; 1887, p. 710.—Murdoch, 1885, p. 153.—Moore, 1903, p. 428.—McIntosh, 1908, p. 86, figs.—Ditlevsen, 1917, p. 56.—Fauvel, 1923, p. 153, fig. 54, f–i.—Augener, 1928, p. 703.—not Treadwell, 1937, p. 28 (= *Paranaitis wahlbergi* (Malmgren), in USNM).—Annenkova, 1937, p. 156.—Friedrich, 1939, p. 122.—Thorson, 1946, p. 52, fig. 21.—Gorbunov, 1946, p. 38.—Berkeley and Berkeley, 1948, p. 46, fig. 66.—Wesenberg-Lund, 1950a, p. 10; 1950b, p. 32; 1951, p. 26.
- Phyllodoce citrina* Moore, 1908, p. 328.—Hartman, 1948, p. 19 (part; includes *P. groenlandica* and *P. mucosa*, in USNM; not *P. citrina* Malmgren, 1865).
- Anaitides groenlandica* Bergström, 1914, p. 141, fig. 42.—Southern, 1914, p. 68.—Eliason, 1920, p. 24 (part).—Chamberlin, 1920, p. 11.—Hartman, 1944a, pp. 335, 338; 1948, p. 19.—Zatsepin, 1948, p. 111, pl. 29, fig. 2.

Description.—Length 16–285 mm., width without setae 1–9 mm. (length up to 450 mm.—Ditlevsen, 1917). Segments very numerous. Body elongate, large, robust, linear, flattened, attenuate posteriorly. Prostomium cordiform, notched posteriorly with an occipital tubercle in the notch, with four short subulate frontal antennae, with small, paired, lateral, retractile, nuchal knobs just anterior to the first pair of tentacular cirri. Tentacular cirri unequal; two pairs short, two pairs longer, extending to segments 9–11. Dorsal cirri of median region up to two times longer than wide, subquadrangular, with distal ends truncate; ventral cirri oval, with asymmetrical acuminate tip. Anterior part of extended proboscis transversely rugose, crowned with 17 papillae; basal part with 12 longitudinal rows of small, oval papillae (6 rows on each side), with 10–20 papillae per row. COLOR: In life and in alcohol: Body with bluish iridescence, usually heavily pigmented dark greenish brown or deep reddish blue, with dorsal and ventral cirri tan to dark brown; on some, body not so darkly pigmented, with cirri only partly pigmented.

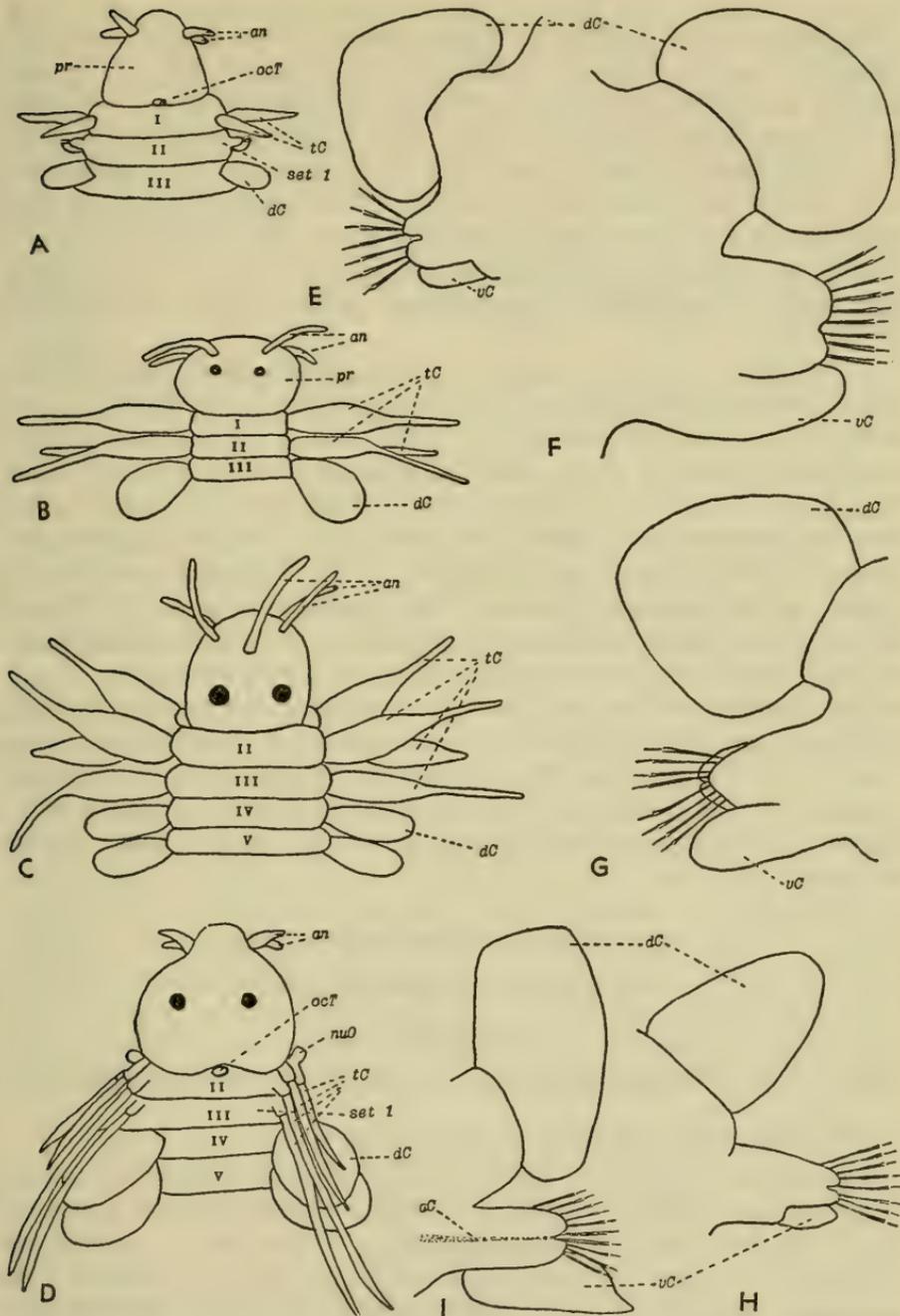


FIGURE 27.—Phyllodoceidae: a, *Eteone*, dorsal view anterior end; b, *Mystides borealis*, dorsal view anterior end; c, *Eumida minuta*, dorsal view anterior end; d, *Phyllodoce groenlandica*, dorsal view anterior end; e, *Eteone barbata*, parapodium; f, *Eteone spetsbergensis*, parapodium; g, *Eteone flava*, parapodium; h, *Eteone longa*, parapodium; i, *Phyllodoce groenlandica*, parapodium. (For explanation of symbols, see p. 210.)

Remarks.—Some smaller specimens were at first placed under *P. citrina* Malmgren, since the papillae on the proboscis were fewer than normal, four rows on each side, with 3–5 papillae per row. An intermediate-sized specimen from Canoe Bay, Alaska (Hartman, 1948, as *P. citrina*) has five rows on each side, with as many as 6 papillae per row. It appears that the papillae are added on gradually and that only in the fully developed individual is the full complement of 6 rows of papillae on each side developed; the number per row is variable, ranging from 10 (with some spaces as if some had dropped off) to 20.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow; Point Barrow base, washed ashore; off Point Barrow base, up to 12.1 miles from shore, 1.7–123.5 fms., on bottoms of mud, sandy-mud, mass of worm tubes, and various combinations of mud, gravel, stones, pebbles, rocks, large perforated rocks, shells; in screen trap on bottom (23 stations, 74 specimens). WEST GREENLAND: Vaigat, Disko Island, mud, Bartlett, 1937. EAST COAST NORTH AMERICA: Off Labrador, 70 fms., *Blue Dolphin* Expedition, 1950; off Maine, Massachusetts, intertidal to 42 fms., U. S. Fish Commission. WEST COAST NORTH AMERICA: Washington Sound, Pettibone.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea; Also Iceland, Faroes, Norway to English Channel; Hudson Bay to Massachusetts; Bering Sea to Washington; north Japan Sea. In low water to 800 fathoms.

Genus *Eumida* Malmgren, 1865

Eumida minuta (Ditlevsen, 1917)

FIGURE 27, c

Eulalia minuta Ditlevsen, 1917, p. 56, pl. 4, figs. 10, 12, 14.—? Gorbunov, 1946, p. 38.

Eulalia arctica Annenkova, 1946, pp. 185, 187, fig. 1, a-c.

Description.—Length 1–8 mm.; width without setae 0.3–0.8 mm. Segments few (12–36). Body very small, slightly tapered anteriorly and posteriorly, flattened dorsoventrally. Prostomium semiglobular to bluntly conical, with two large eyes near posterior border, with antennae rather long, slender, filamentous, almost as long as prostomium. First tentacular achaetous segment not distinct dorsally, with first pair tentacular cirri lateral to prostomium at same level as the eyes (thus placed under *Eumida* and not *Eulalia* Savigny); two pairs tentacular cirri on second segment (first setigerous); fourth tentacular cirri on third segment; tentacular cirri enlarged basally,

with slender filamentous tips, the latter about as long as the enlarged basal part except for the ventral tentacular cirri on the second segment which are much shorter. Dorsal cirri oval or bluntly conical. Ventral cirri elongate oval. Anal cirri short, oval, 1.5 to 2 times longer than wide. COLOR: In alcohol: Greenish tan to brown. In life: Flesh ventrally, green and flesh dorsally, with salmon-colored eggs showing through.

New records.—ARCTIC ALASKA: Off Point Barrow base, 16.7–75.5 fms., up to 8 miles from shore, on various combinations of gravel, small stones, rocks, bryozoans, hydroids, *Saxicava* shells (6 stations, 46 specimens).

Distribution.—Few scattered records in the Arctic: Siberian and Alaskan Arctic, Davis Strait. In 16.7–75.5 fathoms.

Family HESIONIDAE

Prostomium usually with four eyes, two or three antennae, two biarticulate palps (fig. 28, *a*). Two to eight pairs tentacular cirri on one to four more or less distinct achaetous tentacular segments. Parapodia biramous or subbiramous; notopodia may be greatly reduced, with notosetae simple or lacking; neurosetae compound (fig. 28, *b*). Dorsal cirri long, more or less distinctly articulated; ventral cirri shorter; two long anal cirri. Proboscis cylindrical, eversible, with marginal papillae, with or without horny jaws.

Represented by a single species from Point Barrow. (The specimens from Point Barrow, referred to *Castalia multipapillata* Théel by Murdoch (1885), do not agree with this species nor with any other species of hesionid; the parapodia are biramous, both lobes being pointed, the notopodia are well developed, with capillary setae; neurosetae compound, with delicate tips; the proboscis has numerous small papillae; tentacular cirri four pairs; prostomium with two pairs eyes, pair biarticulate palps, antennae ? (missing or absent); the specimens are very small and in poor condition.)

Genus *Castalia* Savigny, 1820; emend. Fauvel, 1923

Castalia aphroditoides (Fabricius, 1780)

FIGURE 28, *a, b*

Nereis aphroditoides Fabricius, 1780, p. 296.

Castalia arctica Malmgren, 1867, p. 32.—Annenkova, 1931, p. 203.

Castalia fabricii Malmgren, 1867, p. 32.—Théel, 1879, p. 37, pl. 3, figs. 36, 37.—Berkeley and Berkeley, 1943, p. 130.

Castalia aphroditoides Wirén, 1883, p. 401.—Augener, 1913, p. 260; 1928, p. 715.—Zatsepin, 1948, p. 114.—Wesenberg-Lund, 1950a, p. 13, pl. 3, fig. 14; 1950b, p. 44.

Psammate aphroditoides Chamberlin, 1920, p. 13.

Description.—Length 2.5–18 mm., width without setae 0.7–2.5 mm. Segments 25–43. Body cylindrical. Prostomium rectangular, wider than long, widest anteriorly, notched posteriorly, with two pairs eyes in trapezoidal arrangement, anterior pair larger; palps on anterolateral borders of prostomium; two filiform antennae medial to palps (without unpaired antenna); antennae subequal, about same length as prostomium. Six pairs tentacular cirri on three more or less distinct achaetous segments; tentacular cirri long, filiform, articulated, with prominent cirrophores. Without distinct notopodia (acicula in cirrophores of dorsal cirri only); without notosetae. Neuropodia well developed, with three diverging conical distal lobes: Lip anterior to setae with median and dorsal conical lobes; lip posterior to setae with rounded median and conical ventral lobes; neurosetae compound. Dorsal and anal cirri long, articulated. Proboscis barrel-shaped with 10 soft papillae around opening (four dorsal to lateral grooves, three each on two ventrolateral folds), with a median ventral notch, with two thickened ventrolateral ridges (the so-called jaws) lateral to the ventral notch. COLOR: In alcohol: Without color, or slightly greenish dorsally (especially in anterior part), or brownish. In life: Orange-flesh, with greenish eggs inside, with red eyes.

Remarks.—Two young specimens found in plankton tow beneath ice February 28, 1950.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms., stony-mud; off Point Barrow base, 21–75.5 fms., up to 8 miles from shore, on bottoms of mud, stones, and various combinations of mud, stones, gravel, rocks, and from breaking apart foliaceous bryozoans (10 stations, 28 specimens). NORTHWEST GREENLAND: Walrus grounds, Murchison Sound, Bartlett, 1938. EAST COAST NORTH AMERICA: Off Labrador, 45 fms., *Blue Dolphin Expedition*, 1949.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Bering Sea; Denmark; Hudson Bay, Labrador. In 2–75.5 fathoms.

Family SYLLIDAE

Body of small size. Prostomium with four eyes (sometimes six), two palps (may be reduced and fused), three antennae (figs. 28, 29). Tentacular segment achaetous, with one or two pairs tentacular cirri. Parapodia uniramous, with dorsal and ventral cirri (latter may be absent). Two anal cirri. Setae mostly compound, sometimes with additional simple setae. Proboscis eversible, armed or not with one

to several chitinous teeth. Reproduction direct (epigamy) or by stolons, sometimes having sexual dimorphism; with swimming capillary setae at maturity.

Represented by 6 genera and 11 species.

Key to the genera of Syllidae from Point Barrow

1. Without ventral cirri. Palps reduced, united, turned under on ventral side of prostomium (except for forked palps of male stolon; fig. 29, *a*). Antennae and dorsal cirri smooth or faintly annulated. Reproduction by stolons; stem forms produce by transverse fission, singly or in chains, sexually dimorphic male and female forms with swimming setae..... **Autolytus**—2
 With ventral cirri (fig. 28, *d*). Palps better developed, free or fused..... 4
2. Prostomium normal, with 4 dorsal eyes in trapezoidal arrangement, with 3 antennae, short fused palps; 2 pairs tentacular cirri (fig. 29, *a*). Without swimming setae. Pharynx long, more or less sinuous, usually with a crown of teeth..... Stem form or stock of **Autolytus** (p. 242)
 Prostomium abnormal, with 4 large eyes (usually 2 dorsolateral and 2 ventrolateral); 2–3 pairs tentacular cirri (fig. 29, *c–f*). Body divided into an anterior unmodified region, a middle region with long swimming setae and well-developed, paddlelike parapodia, and with or without a posterior unmodified region. Without pharynx..... Sexual stolons of **Autolytus**—3
3. Prostomium with 3 antennae (very long median one and pair of small frontal ones) and pair of anterior bifurcate palps; 1 pair tentacular cirri very long, similar to median antennae (these may be the dorsal cirri of the first setiger or of a small, knoblike achaetous lobe; fig. 29, *e, f*). Testes and sperm confined to anterior unmodified region.
 Male form of **Autolytus** (*Polybostrichus*) (p. 242)
 Prostomium with 3 subequal antennae, without palps; none of tentacular cirri especially elongate (fig. 29, *c, d*). Most of body filled with eggs; eggs carried in large sac on ventral surface (gestation).
 Female form of **Autolytus** (*Sacconereis*) (p. 242)
4. Dorsal cirri distinctly moniliform throughout body (fig. 28, *c*). Palps separate for their entire length or fused basally. Reproduction direct or by single stolons. Sexual stolons (*Chaetosyllis*): Small prostomium, with 2 pairs eyes, pair short moniliform antennae; without tentacular cirri; 1 anterior unmodified segment, a middle region with long swimming setae, and few unmodified posterior segments..... **Syllis** (p. 252)
 Dorsal cirri smooth or indistinctly articulate (may be more or less articulate anteriorly). Palps fused at base only or throughout..... 5
5. Palps fused for nearly their entire length (fig. 28, *k–m*). Body very small. Antennae and dorsal cirri short, not moniliform. One pair tentacular cirri (may be rudimentary). Reproduction generally direct, with swimming setae at maturity; eggs and larvae fixed to dorsal or ventral surface of female..... 6
 Palps fused at base only (fig. 28, *g*). Body larger. Antennae and dorsal cirri longer, smooth (antennae and anterior dorsal cirri may be indistinctly articulate, especially distally). Two pairs tentacular cirri. Reproduction direct, with swimming setae at maturity..... 7

6. Antennae and dorsal cirri swollen at base, tapering to narrow tip (fig. 28, *m*).
 Body and parapodia usually covered with adhesive papillae and fine, granular material.....**Sphaerosyllis** (p. 255)
 Antennae and dorsal cirri clavate or conical (fig. 28, *k, l*). Body and parapodia not covered with papillae.....**Exogone** (p. 257)
7. Compound neurosetae with distal blades all rather short (fig. 28, *i*). Proboscis with a distal and proximal row of soft papillae, with distal circular chitinous margin denticled (fig. 28, *g, h*).....**Eusyllis** (p. 259)
 Compound neurosetae with some distal blades elongate (fig. 28, *j*). Proboscis with distal row of soft papillae only, with distal circular chitinous margin smooth.....**Pionosyllis** (p. 262)

Genus *Autolytus* Grube, 1850

In working over the rather numerous specimens of *Autolytus* in the collections from Point Barrow, several things were revealed which throw light on the confusion in this group caused by the formation of sexually dimorphic stolons. For correct description of any species, one should have the stem form, the sexual buds in the process of formation including the mature sexual buds attached to the stem form, and the mature male and female stolons separated from the stem. Very often, however, stem forms and the male and female stolons of one species have been described and given different names, while sexual stolons and stem forms of different species have been given the same name. *A. fallax* Malmgren, described originally from specimens from Spitsbergen, is of particular interest. Malmgren described and figured the stem form with the head of a male stolon forming between setigers 13 and 14 and indicated that the sexual stolons were not known. *A. prismaticus* (Fabricius), described originally from specimens from Greenland, has a characteristic color pattern of three dark longitudinal bands (median and lateral at the level of the bases of the dorsal cirri). The sexual stolons have six unmodified setigers anterior to the setigers with swimming setae; the stolons show the characteristic color pattern of the stem form. In the absence of color, it would be difficult to distinguish *A. prismaticus* from certain other species of *Autolytus*. It apparently has been the usual practice to identify any sexual stolon of unknown connections that has six anterior unmodified setigers as *A. prismaticus*, and sometimes to identify the male stolons as *Polybostrichus longosetosus* Oersted or *A. longisetosus* (Oersted). However, as found in the Point Barrow material, *A. fallax* is the most common species of *Autolytus* and it was found along with *A. prismaticus* and *A. alexandri*. The majority of the specimens of *A. fallax* were in the process of stolon formation, the head of the stolon being formed between setigers 13

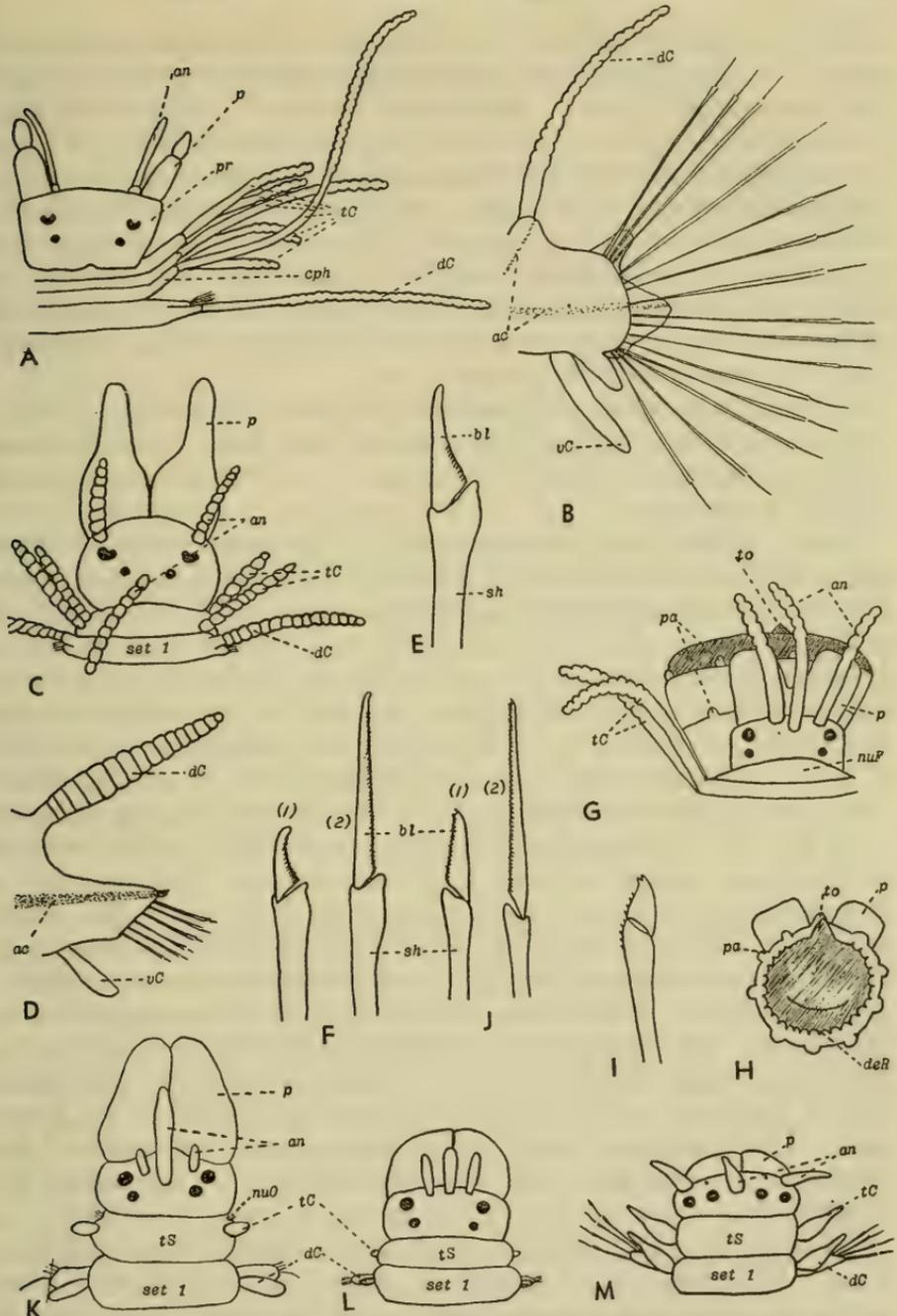


FIGURE 28.—Hesionidae: *a*, *Castalia aphroditoides*, dorsal view anterior end; *b*, same, parapodium, posterior view. Syllidae: *c*, *Syllis fasciata*, dorsal view anterior end; *d*, same, parapodium; *e*, same, neuroseta; *f*, *Syllis cornuta*, neurosetae, with short (1) and long (2) blades; *g*, *Eusyllis blomstrandii*, dorsal view anterior end, proboscis partially extended; *h*, same, frontal view extended proboscis showing distal row of papillae and denticled margin; *i*, same, neuroseta; *j*, *Pionosyllis compacta*, neurosetae, lower one (1) with shorter blade, upper one (2) with longer blade; *k*, *Exogone dispar*, dorsal view anterior end; *l*, *Exogone naidina*, dorsal view anterior end; *m*, *Sphaerosyllis erinaceus*, dorsal view anterior end. (For explanation of symbols, see p. 210.)

and 14. Although no mature sexual buds were found attached to the stem form, the rudiments of the notopodia with the developing swimming setae could be seen, beginning on setiger 7. Male and female stolons with six anterior unmodified segments were found. Of these, two female stolons showed the characteristic banding of *A. prismaticus* (this banding was noted on all the developing sexual buds still attached to the stem forms of this species). The others did not show this banding and are considered to be the sexual stolons of *A. fallax*. *A. fallax*, then, along with *A. prismaticus*, has six anterior, unmodified setigers and many of the records of *A. prismaticus* in the literature will no doubt prove to be *A. fallax*.

The stem form of *A. fallax* has been referred to *A. prolifer* (Müller) by Augener (1913, 1928) and Wesenberg-Lund (1947), thus the stem form of *A. fallax* has been confused with *A. prolifer* and sexual forms with *A. prismaticus*.

There appears to be a correlation in the place of formation of the sexual stolons in the stem form with the number of anterior, unmodified setigers and the number of tentacular cirri in the sexual stolons. At least for a group of species, including *A. prismaticus*, *A. fallax*, *A. cornutus* A. Agassiz, and *A. ornatus* (Verrill, 1873), the stem forms produce sexual stolons singly, with the head of the stolon forming between setigers 13 and 14. The stolon, then, consists of the segments of the stem posterior to setiger 13 (differing from *A. prolifer* where the sexual stolons are proliferated more posteriorly, often in chains of 2 to 8). The posterior part develops gradually into the male or female sexual stolon and breaks off when mature. The anterior 13 setigers of the stem regenerates another posterior end. The sexual stolons of these four species have six unmodified setigers anterior to the swimming setae and usually a more or less developed unmodified posterior region. The stolons have three pairs of tentacular cirri on the first two achaetous tentacular segments; the first two pairs on the first segment and the third pair on the second segment. The upper pair of tentacular cirri on the first segment are similar to the dorsal cirri. The lower pair may be very short, about the length of the prostomium. The third pair of tentacular cirri in the female are similar to the dorsal cirri; in the male they are very long, similar to the median antenna. In addition, there are a pair of small achaetous lobes. In contrast, in *A. prolifer* the sexual stolons have three anterior unmodified setigers (sometimes two or four) and a poorly developed posterior region; there is a single tentacular achaetous segment with two pairs of tentacular cirri (in the female both the upper and lower pairs are short; in the male the lower one is similar to the dorsal cirri and the upper one is very long, similar to the median antenna). In *A. alexandri* the sexual stolons have 14 (sometimes 13) anterior

unmodified setigers and a well-developed posterior region; there is a single achaetous tentacular segment with two pairs of tentacular cirri; the first setigerous segment in the female is similar to the following segment, but in the male it has a very long pair of dorsal cirri similar to the median antenna. Thus the male stolons of the different species of *Autolytus* agree in having a very long pair of anterior cirri similar to the median antenna, but they may be developed as the upper pair of tentacular cirri of a single tentacular segment as in *A. prolifer*, as the dorsal cirri of the first setigerous segment as in *A. alexandri*, or as the third pair of tentacular cirri on the second tentacular segment just dorsal to a pair of achaetous lobes as in *A. prismaticus*.

The number of setigers in the anterior, unmodified region of the sexual stolons appears to be a good taxonomic character for most species. That the number is somewhat variable in *A. prolifer* (usually three, sometimes two and four) does not mean that it is of no significance in other forms. Thus the specimens of *Autolytus* with six anterior unmodified setigers, which Dales (1951) referred to *A. prolifer*, are no doubt another species. The description agrees well with that of *A. cornutus*.

All three species of *Autolytus* from Point Barrow have the body linear elongate, attenuated posteriorly, flattened ventrally, arched dorsally. Prostomium with four eyes in trapezoidal arrangement, with palps fused, turned ventrally, exceeding the prostomium only slightly. Neuropodia with composite setae with blades short, bidentate, and usually with a simple bayonette seta.

Key to the species of *Autolytus* from Point Barrow

1. STEM FORM: Dorsal cirri irregular in length, at least some longer than body width, pigmented with reddish globules; body whitish, brownish, or transversely banded with reddish globules, 2 narrow bands per segment; with nuchal epaulettes on first 2 (to 4) setigers; sexual buds formed singly (?), the heads forming posterior to setiger 14. SEXUAL STOLONS: 14 setigers anterior to swimming setae; nuchal epaulettes on first 3 setigers; 2 pairs tentacular cirri, the upper one longer; in male, first pair dorsal cirri on first setiger very long, similar to median antenna; female stolons with 2-lobed egg sac----- **A. alexandri**
- STEM FORM: Dorsal cirri, except anterior 2 pairs, shorter than body width, not extending beyond or only slightly beyond the setae, subequal; sexual buds formed singly, the heads forming between setigers 13 and 14. SEXUAL STOLONS: 6 setigers anterior to swimming setae; 3 pairs tentacular cirri; in male, first pair similar to dorsal cirri, with second short pair at its ventral base, third pair very long and stout (similar to median antenna) with small achaetous lobe at its ventral base (fig. 29, *e, f*); in the female, similar except both the first and third pairs are similar to the following dorsal cirri (fig. 29, *c, d*); female stolons with 1-lobed egg sac----- 2

2. **STEM FORM:** Usually with 2 dorsolateral longitudinal black to brown bands just dorsal to bases of dorsal cirri (may be faint or absent); with short semicircular epaulettes on tentacular segment only. **SEXUAL STOLONS:** Colorless or female stolon dusky, especially posteriorly; male stolon rusty brown, darkest on anterior region, especially laterally; epaulettes on tentacular segment only (fig. 29, c-f)-----**A. fallax**

STEM FORM: With 3 longitudinal black bands, 1 medium and 2 lateral at same level as bases of dorsal cirri; medium band continuous throughout length of body, lateral ones may fade out in anterior fourth or be lacking; with semicircular epaulettes on tentacular segment and part of first setiger (fig. 29, a). **SEXUAL STOLONS:** With 3 longitudinal pigmented bands, median one continuous throughout most of body, lateral ones along bases of dorsal cirri in anterior unmodified region; with epaulettes on tentacular segment and part of first setiger-----**A. prismaticus**

Autolytus alexandri Malmgren, 1867

Autolytus alexandri Malmgren, 1867, p. 37, pl. 7, fig. 39.—Verrill, 1881, p. 292, pl. 12, fig. 8.—Chamberlin, 1920, p. 12.—Friedrich, 1939, p. 123.—Hartman, 1942a, p. 13; 1944a, p. 338, pl. 13, fig. 11 (not pl. 13, fig. 2); 1945, p. 17, pl. 2, fig. 11.

Stephanosyllis picta Verrill, 1874a, pp. 43, 132, pl. 4, fig. 6; 1874b, pp. 361, 362, pl. 4, fig. 1 (not *Proceraea picta* Ehlers, 1864).

Stephanosyllis ornata Verrill, 1874a, p. 132 (not *Proceraea ornata* Verrill, 1873).

Proceraea (*Stephanosyllis*) *ornata* Webster and Benedict, 1887, p. 724 (not *Proceraea ornata* Verrill, 1873).

Autolytus verrilli Marenzeller, 1892, p. 416, pl. 19, fig. 4.—Augener, 1928, p. 726.—Wesenberg-Lund, 1947, p. 33, figs. 14, 15; 1950a, p. 18; 1950b, p. 52; 1951, p. 52.

Description.—Stem form: Length 4–12 mm., width without setae 0.6–0.8 mm., up to 35–64 segments. Antennae rather short, thick, subequal or median one up to twice the length of the lateral; tentacular cirri equal to or shorter than antennae, upper pair longer; first pair dorsal cirri as long as or longer than median antenna; rest of dorsal cirri rather irregular, unequal, at least some longer than body width, with cirrophores prominent. Distinct epaulettes on first two setigerous segments (or to end of setiger 4—Hartman, 1945). None showed sexual bud formation (sexual bud is formed between segments 25 and 26—Hartman, 1945). **COLOR:** In alcohol: Colorless or transversely banded with reddish to brownish granules, may be two bands per segment.

Female stolon (*Sacconereis*): A single specimen of 72 setigers, 16 mm. long, 1.2 mm. wide without setae, 3.5 mm. wide with swimming setae, consisting of 14 anterior, 26 middle, and 32 posterior setigers. Prostomium rounded, with four large dorsal eyes, three antennae rather short, subequal; two pairs tentacular cirri of nearly same length as antennae; dorsal cirri of anterior part of unequal length but all much longer than body width. Thick epaulettes extending on first three setigers. The stolon, with swimming setae and filled with

eggs, was dredged in 27 fathoms February 18, 1950. (A 2-lobed egg mass is carried ventrally—Wesenberg-Lund, 1947.)

Male stolon (*Polybostrichus*): No specimens taken from Point Barrow. A specimen taken in plankton at Portage Bay, Alaska, was 12 mm. long, 1.5 mm. wide without setae, 4 mm. wide including swimming setae, with 61 setigers consisting of 14 anterior, 36 median, and 11 posterior segments. Prostomium similar to *A. fallax*; two pairs tentacular cirri, upper pair longer. First pair dorsal cirri on first setiger very long, similar to median antenna (achaetous—Wesenberg-Lund, 1947); dorsal cirri in anterior region long, unequal; in middle region short, about one-third length of elongated parapodial lobes. Large epaulettes on first three setigers.

New records.—ARCTIC ALASKA: Off Point Barrow base, 16.7–123.5 fms., up to 15 miles from shore, on bottoms of stones, worm tubes, and various combinations of mud, pebbles, gravel, stones, rocks, large perforated rocks, with bryozoans, hydroids, shells, and worm tubes (17 stations, 53 specimens). WEST COAST NORTH AMERICA: *Albatross* surface station, Portage Bay, Alaska; San Juan Channel, Washington Sound, 25 fms., Pettibone, 1940. EAST COAST NORTH AMERICA: Off Labrador, 30–40 fms., *Blue Dolphin* Expedition, 1949; Woods Hole region, Massachusetts, Pettibone, 1950.

Distribution.—Scattered records in the Arctic: Arctic Alaska, Greenland, Spitsbergen, Franz Josef Land, Barents Sea. Also Iceland; Labrador to North Carolina; Bering Sea to Washington. In low water to 123.5 fathoms; sexual forms at surface.

Autolytus fallax Malmgren, 1867

FIGURE 29, c-f

? *Polybostrichus longosetosus* Oersted, 1843, p. 183, pl. 5, figs. 62, 67, 71.—Treadwell, 1937, p. 28.

Autolytus fallax Malmgren, 1867, p. 33, pl. 6, fig. 41.—Ditlevsen, 1929, p. 17.

? *Autolytus longosetosus* Malmgren, 1867, p. 34, pl. 7, fig. 38.

Autolytus prolifer Augener, 1913, p. 258; 1928, p. 724.—Wesenberg-Lund, 1947, p. 19, figs. 8, 9 (part; not *Nereis prolifera* Müller, 1788).

Autolytus prismaticus Wesenberg-Lund, 1947, p. 24 (part; not *Nereis prismatica* Fabricius, 1780).

Description.—Stem form: Length 3–18 mm., width without setae 0.3–0.7 mm., up to 45–78 segments. Median antenna and first pair dorsal cirri very long; lateral antennae and upper tentacular cirri about half as long; lower pair tentacular cirri and second pair dorsal cirri shorter, about twice the length of the following cirri; rest of dorsal cirri short, less than half the body width and extending only slightly beyond the setae, subequal. Short epaulettes (a pair of shallow, semi-circular raised areas) on tentacular segment only. Of 68 specimens of the stem form, 45 showed bud formation of the sexual stolons, the

head of the bud forming between setigers 13 and 14; 6 were broken after setiger 13, 5 consisted of 13 setigers plus a definite posterior growing zone, and 12 consisted of 36 setigers or less and showed no sign of bud formation. Of the 45 specimens showing bud formation, 18 were young buds (sex?) showing four eyes and rudiments of head appendages; 17 were developing male stolons as indicated especially by the developing forked palps (at first, one part of fork about one-half the length of the other), large median antenna, and large dorsal tentacular cirri; the male buds consisted of a variable number of setigers (14-26 plus a definite growing zone, or 32-42 and tapered gradually to an attenuated posterior end); 10 were developing female buds as indicated by the developing three subequal antennae and the absence of forked palps; the female buds consisted of 40-65 setigers. COLOR: In alcohol: Two dorsolateral, longitudinal dark bands just dorsal to bases of dorsal cirri (almost all specimens showed at least faint bands). In life: Anterior part pale yellowish with dark dorsolateral bands, posterior part orange. TUBES: Thin, tough, transparent, on hydroids as *Lafoeina maxima* Levinsen; either on the surface or surrounded by the sessile hydrothecae of the hydroid colony.

Female stolon (*Sacconereis*): Length 5-15 mm., width without setae 0.5-1 mm., width including swimming setae 3.5-4 mm., up to 26-51 segments. Body widest in median region, tapering slightly anteriorly and more so posteriorly, forming an attenuated tail region; divided into three regions composed of 6 anterior unmodified setigers, 13-18 modified setigers with long, iridescent swimming setae, and 3-27 posterior unmodified setigers. Prostomium short, broad, one pair eyes dorsolateral, one pair larger ones ventrolateral, both with lenses; antennae long, stout, subequal or median one slightly longer than lateral pair. Upper two pairs tentacular cirri similar to dorsal cirri of following segments, with a third pair of short, ventral, tentacular cirri (about length of prostomium) and a pair of small, ventral, achaetous lobes. Dorsal cirri about as long as body width. Pair of shallow semicircular epaulettes on tentacular segment only. Pyriform-shaped egg sac carried on ventral surface in region of setigers 10-18, the egg mass flattened or slightly concave on side toward body, the narrower end of lobe anterior, the eggs orange-colored (in life). COLOR: In alcohol: Colorless, transparent, may be dusky posteriorly or somewhat dusky throughout. Two female stolons with eggs inside body dredged in 75 fms. October 11, 1949; females with egg sacs taken from vertical plankton hauls in 13 fathoms March 29, April 15, May 17, 1950; female with egg sac containing developing embryos dredged in 5 fathoms January 25, 1950.

Male stolons (*Polybostrichus*): Length 7-9 mm., width without setae 0.8-1 mm., width including swimming setae 2 mm., 43-66 seg-

ments, with body regions of 6 anterior, 27–30 middle, 9–10 posterior setigers, tapering gradually posteriorly. Prostomium short, wide, with a pair of eyes dorsolateral, a larger pair ventrolateral, all with lenses; palps bifurcated about basal third, the two branches subequal; very long, stout median antenna and very small lateral antennae anterior and medial to dorsal pair of eyes. Three pairs tentacular cirri with anterior dorsal pair similar to dorsal cirri, anterior ventral pair shorter than prostomial length, posterior dorsal pair very large, similar to median antenna, with a pair of achaetous knobs at their ventral bases. Dorsal cirri of anterior setigers about as long as body width, those of modified region about as long as the elongated, paddle-like parapodial lobes, those of posterior, taillike region short, digitiform. Shallow semicircular epaulettes on tentacular segment only. COLOR: In alcohol: Rusty brown, darkest on anterior part or colorless except anterior part. In life: Yellowish green. Taken in plankton, near shore, September 10, 1949; dredged in 27 fathoms February 18, 1950.

Remarks.—As referred to under the systematic discussion of *Autolytus*, the stem form of *A. fallax* has been incorrectly referred to *A. prolifer* by Augener (1913, 1928) and Wesenberg-Lund (1947, 1950). The two may be distinguished by the different positions of the sexual buds, the greater length of the dorsal cirri in *A. prolifer*, and the color markings. The sexual stolons of *A. fallax* have been confused with *A. prismaticus* (see discussion above).

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 5–6.6 fms., mud, in tubes associated with hydroid *Lafoëina maxima* Levinsen; Point Barrow base, washed ashore, on same hydroid; off Point Barrow base, 5–75.5 fms., up to 8 miles from shore, on bottoms of mud, stones, and various combinations of mud, gravel, stones, rocks, large perforated rocks, with bryozoans, hydroids including *Lafoëina maxima*, and shells (16 stations, 85 specimens); sexual stages from plankton near shore to 75.5 fms. (7 stations, 22 specimens). Cape Smyth, Point Barrow Expedition, winter, 1883 (1 male, 2 females with egg sacs). EAST COAST NORTH AMERICA: Off Labrador, 25–60 fms., *Blue Dolphin* Expeditions, 1949, 1951.

Distribution.—Widely distributed in the Arctic: Alaskan and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Novaya Zemlya. Also Faroes; Labrador. In low water to 75.5 fathoms; sexual stolons in plankton.

Autolytus prismaticus (Fabricius, 1780)

FIGURE 29, a, b

Nereis prismatica ? Müller, 1776, p. 218.—Fabricius, 1780, p. 302; 1799, p. 177, pl. 4, figs. 17–20.

? *Polybostrichus longosetosus* Oersted, 1843, p. 183, pl. 5, figs. 62, 67, 71.

- ? *Autolytus longisetosus* Malmgren, 1867, p. 34, pl. 7, fig. 38.—Verrill, 1881, p. 292, pl. 12, fig. 10.—Moore, 1902, p. 274; 1909b, p. 134.
- Autolytus incertus* Malmgren, 1867, p. 35, pl. 6, fig. 40.
- Proceraea gracilis* Verrill, 1874a, pp. 43, 132, pl. 5, fig. 1; 1874b, pp. 361, 362, 370, 379, pl. 3, fig. 2.—Webster and Benedict, 1887, p. 723.
- Autolytus prismaticus* Marenzeller, 1892, p. 420.—Chamberlin, 1920, p. 12.—Augener, 1928, p. 725.—Annenkova, 1934, p. 322; 1938, p. 156.—Not Berkeley and Berkeley, 1938, p. 48; 1948, p. 68.—Gorbunov, 1946, p. 38.—Wesenberg-Lund, 1947, p. 24, figs. 10–12 (part).—? Hartman and Reish, 1950, p. 13.
- Autolytus trilineatus* Berkeley and Berkeley, 1945, p. 318, fig. 1, a–b; 1948, p. 69, fig. 100.

Description.—Stem form: Length 5–24 mm., width without setae 0.7–1 mm., up to 52–92 segments. Proportion of anterior appendages and dorsal cirri similar to *A. fallax*. Distinct epaulettes on tentacular segment and usually extending also on at least part of first setigerous segment. Of 7 specimens, 2 were without signs of bud formation, although the body was constricted more than normally between setigers 13 and 14; 4 showed sexual bud formation with the head developing between setigers 13 and 14; and 1 had 13 setigers with a newly regenerating posterior end. COLOR: In alcohol: Creamy white with three conspicuous, longitudinal, black or dark bands, the median one broader, less dense, continuous throughout body, the dorsolateral ones narrower, darker, at level of bases of dorsal cirri, often confined to anterior fourth or half of body.

Female stolon (*Sacconereis*): A specimen of 58 setigers, 9 mm. long, 1 mm. wide without setae, 3 mm. wide with swimming setae, with body regions of 6 anterior, 18 middle, and 34 posterior setigers. Epaulettes somewhat triangular, extending on tentacular and first setigerous segments. Otherwise as in *A. fallax*. COLOR: In alcohol: Shows the same characteristic pigmentation as the stem form, three longitudinal, black pigmented bands. Two female stolons with swimming setae and eggs massed inside body dredged in 5 and 6 fathoms August 6, 30, 1948. Male stolons (*Polybostrichus*): no specimens taken.

Remarks.—*Polybostrichus longosetosus* Oersted, the male stolon (this might well be the male stolon of *A. fallax*, see systematic discussion above), *Autolytus incertus* Malmgren, the female stolon, and *Proceraea gracilis* Verrill, the stem form, have been referred previously by Marenzeller (1892) to *A. prismaticus*. *A. trilineatus* Berkeley and Berkeley is herein referred to *A. prismaticus*; the description, including the characteristic three longitudinal bands, is in agreement. The record of *A. prismaticus* by the Berkeleys (1938, 1948) is doubted since the stem form agrees with *A. cornutus* or *A. prolifer* but not *A. prismaticus*; the sexual forms agree with *A. cornutus* or *A. prismaticus* in the number of six anterior unmodified setigers; they agree with *A.*

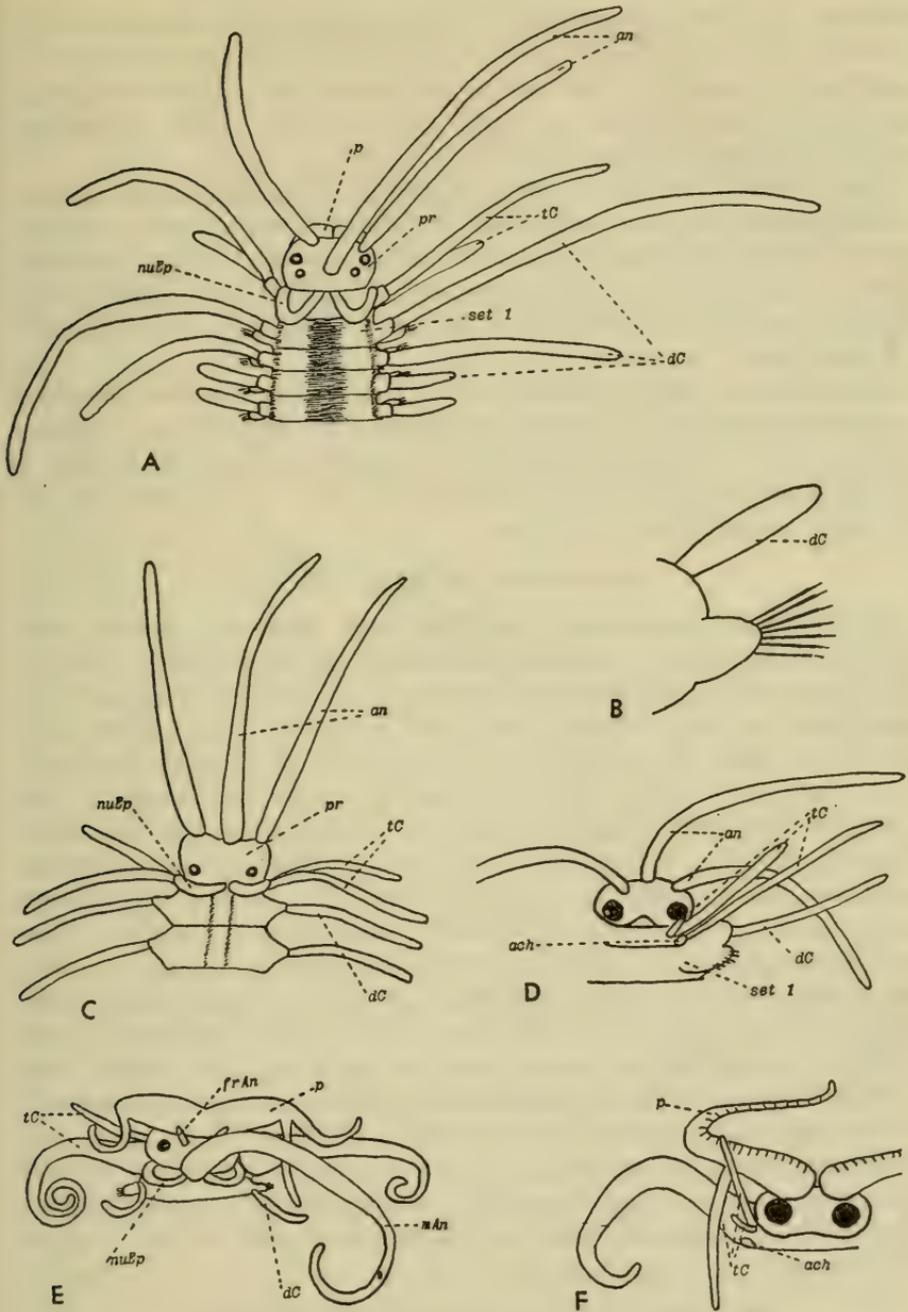


FIGURE 29.—Syllidae: *a*, *Autolytus prismaticus*, stem form, dorsal view anterior end; *b* same, parapodium; *c*, *Autolytus fallax*, female (*Saconereis*) form, dorsal view anterior end; *d*, same, ventral view anterior end; *e*, *Autolytus fallax*, male (*Polybostrichus*) form, dorsal view anterior end; *f*, same, ventral view anterior end. (For explanation of symbols, see p. 210.)

cornutus as to size, about one-third the size of the sexual stage of *A. prismaticus*, and in the absence of semicircular epaulettes (specimens examined through the kindness of the Berkeleys). The record of *A. prismaticus* from Oregon by Hartman and Reish (1950) is doubted since it is based on male stolons only.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms., stony-mud; off Point Barrow base, 5–70 fms., up to 7 miles from shore, on bottoms of stones, and various combinations of mud, gravel, stones (7 stations, 11 specimens). EAST COAST NORTH AMERICA: Lagoon Pond, Martha's Vineyard, Massachusetts, pile scrapings, Pettibone, 1951.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Barents Sea, Novaya Zemlya. Also Iceland; Labrador to Massachusetts; Bering Sea to British Columbia (? Oregon); north Japan Sea. In low water to 267 fathoms; sexual forms at surface.

Genus *Syllis* Savigny, 1818

Both species represented have the body elongate, slender, with numerous segments, flattened ventrally, arched dorsally, tapering slightly anteriorly and gradually posteriorly. Prostomium oval, wider than long; two palps wider basally, well separated except where their inner basal sides are fused (fig. 28, *c*). Dorsal cirri distinctly moniliform throughout body, alternately slightly longer and shorter. Ventral cirri digitiform, slightly shorter or longer than the parapodial lobes (fig. 28, *d*). Anterior end of extended proboscis with a smooth, chitinous rim, a single large, grayish dorsal tooth, with a ring of short, thick papillae, with a ring of 10 shorter papillae more basally. Male and female stolons or epitokous forms (*Chaetosyllis* Malmgren, 1867) developed from the posterior segments of the body; when fully developed consisting of small bilobed (or tetralobed) bulbous "head" with two pairs of eyes, a dorsal pair and a larger ventral pair, with a pair of short moniliform antennae; the first setigerous segment with neurosetae only, followed by a variable number of segments with additional long capillary swimming setae and usually a few unmodified posterior segments; stolons greatly distended with developing sex products; neurosetae, dorsal, ventral and anal cirri similar to those of stem form.

Key to the species of *Syllis* from Point Barrow

- Compound neurosetae with short and long distal blades (fig. 28, *f*). Acicula of parapodia not particularly enlarged or protruding. Body segments very short..... ***S. cornuta***
Compound neurosetae with terminal blades differing very slightly in length (fig. 28, *e*). From 1 to 4 very large acicula usually protrude somewhat from parapodial tip (fig. 28, *d*). Body segments longer..... ***S. fasciata***

Syllis (Ehlersia) cornuta Rathke, 1843

FIGURE 28, f

Syllis (Ehlersia) cornuta Rathke, 1843, p. 164, pl. 7, fig. 12.—Malmgren, 1867, p. 43, pl. 7, fig. 45.—Southern, 1914, p. 37.—Fauvel, 1923, p. 267, fig. 100, g-i.—Augener, 1928, p. 718.—Monro, 1933, p. 34; 1937, p. 273; 1939b, p. 387.—Wesenberg-Lund, 1947, p. 6; 1950a, p. 15; 1950b, p. 46; 1951, p. 36.—Zatsepin, 1948, p. 115, pl. 31, fig. 4.

Chaetosyllis oerstedii Malmgren, 1867, p. 45, pl. 8, fig. 51 (epitokous form).

Syllis oerstedii Théel, 1879, p. 40, pl. 2, fig. 33; pl. 3, figs. 34, 35.—Annenkova, 1938, p. 150.—Gorbunov, 1946, p. 38.

Syllis quaternaria Moore, 1906a, p. 352, fig. (epitokous form).

Syllis alternata Moore, 1908, p. 321, fig. (p. 324); 1909a, p. 321.—Annenkova, 1938, p. 148.—Rioja, 1941, p. 691, pl. 3, figs. 1-9.—Berkeley and Berkeley, 1948, p. 77, fig. 115.

Syllis (Ehlersia) heterochaeta Moore, 1909a, p. 322, pl. 15, figs. 1-4.—Annenkova, 1938, p. 148.—Rioja, 1941, p. 694, pl. 4, figs. 7-10; Berkeley and Berkeley, 1948, p. 76, fig. 113.

Ehlersia cornuta Hartman, 1945, p. 15.

Typosyllis alternata Hartman, 1948, p. 21.

Description.—Stem form: Length 9-45 mm., width without setae 1-1.2 mm. Segments very short. Prostomium with two pairs of eyes, anterior pair larger, crescentic, with or without pair of small ocular spots anterior to lateral antennae. Moniliform dorsal cirri with about 14-22 articles (11-40). Neurosetae all compound, with longer and shorter blades, the longer ones 2-4 times longer than the shorter ones, with fine marginal fringe extending to near the tips (may give appearance of having a bidentate tip with a subterminal tooth); tips of short blades slightly hooked; tips of long, thin blades slightly hooked or with a slight knob (worn down?). In posterior segments, terminal blades of neurosetae not as long as in anterior segments. One specimen with developing stolon of 41 segments beginning on segment 75 of stem form. COLOR: In alcohol: (1) anterior segments dusky, then two narrow, reddish brown, transverse bands per segment on anterior and middle part of each segment; (2) rusty brown, with two darker bands per segment on part of body; (3) colorless.

Male and female stolons (*Chaetosyllis*): Length 8-19 mm., width without setae 1-1.2 mm., width including setae 4-5 mm., segments 30-70 (1 unmodified anterior segment, 24-62 modified segments with swimming setae, 0-7 unmodified posterior segments); dorsal cirri alternately longer and shorter, with 11-18 articles (14-25—Moore, 1906); capillary setae much longer than the dorsal cirri; neurosetae as in posterior segments of stem form (distal blades not as long as in anterior region of stem form); some segments showed the characteristic banding of two narrow bands per segment.

Remarks.—The types of *Syllis alternata* Moore from Alaska and *S. heterochaeta* Moore from California were examined and are herein referred to *S. cornuta* (suggested previously by Monro (1933) for *S. heterochaeta*). The description of *S. quaternaria* Moore (1906), the epitokous form taken at the surface, Point Barrow, Alaska, agrees with that of the stolons of *S. cornuta* collected by Dr. MacGinitie in a plankton haul.

New records.—ARCTIC ALASKA: Stem form: Off Point Barrow base, 18.3–123.5 fms., up to 15 miles from shore, on bottoms of stones, mass of worm tubes, and various combinations of mud, pebbles, stones, gravel, rocks, large perforated rocks, and worm tubes (17 stations, 97 specimens). Sexual stolons: Off Point Barrow base, 1.6 miles from shore, vertical plankton haul of 13 fathoms through hole in ice, March 29, April 15, 1950 (12 specimens). WEST COAST NORTH AMERICA: Strait of Juan de Fuca and Puget Sound, Washington, 30–107 fms., Pettibone. EAST COAST NORTH AMERICA: Off Martha's Vineyard, 86, 134, and 146 fms.; off Salem, Massachusetts, 35 fms., U. S. Fish Commission.

Distribution.—Cosmopolitan. Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen, Novaya Zemlya. Also Iceland, Norway to Madeira, Mediterranean; Red Sea, South Arabian coast, Persian Gulf; Indian Ocean (Zanzibar); off South Africa; Maine to North Carolina; north Japan Sea, Alaska to Panamá; South Pacific (Marquesas, Tahiti). In low water to 1,400 fathoms; sexual stolons in plankton.

Syllis (Typosyllis) fasciata Malmgren, 1867

FIGURE 28, c-e

Syllis (Typosyllis) fasciata Malmgren, 1867, p. 43, pl. 7, fig. 47; pl. 8, fig. 52.—Augener, 1928, p. 719.—Fauvel, 1934b, p. 304.—Annenkova, 1934, p. 322; 1938, p. 150.—Gorbunov, 1946, p. 38.—Wesenberg-Lund, 1947, p. 10, fig. 2,a; 1950a, p. 16; 1950b, p. 47; 1951, p. 37.—Berkeley and Berkeley, 1948, p. 74, figs. 109, 110.—Zatsepin, 1948, p. 115, pl. 31, fig. 2.

Syllis armillaris Treadwell, 1937, p. 28 (not *Nereis armillaris* Müller, 1776; in USNM).

Description.—Stem form: Length 8–75 mm., width without setae 0.7–3 mm. Many small ones present; many broken ones and a number with regenerating posterior ends. Segments not as short as in *S. cornuta*. Prostomium with two pairs of eyes, anterior pair larger, crescentic. Moniliform dorsal cirri with about 24 articles (20–40; 12–17 in young specimens). Parapodia each with one to four large, pointed acicula usually protruding beyond distal tips of setal lobes. Neurosetae all compound, with terminal blades rather short, hooked, with tips entire; some setae may have blades broken

off (not to be confused with simple setae). COLOR: In alcohol: (1) pigmented with reddish-brown, one wide band per segment (darker on posterior part of band); more posteriorly two bands per segment, lighter anterior and darker posterior ones; then one band per segment; then without color (when mature, banded color pattern on the segments of the developing sexual stolon); (2) colorless, particularly in small specimens; (3) uniform brown mottling on anterior third of body (specimens from Washington). In life: Reddish rusty brown bands, one wide band or two narrower bands per segment, especially on the anterior fourth and posterior fourth (latter a developing stolon, with wide, orange-red bands). One specimen with developing stolon beginning on segment 71.

Sexual stolons (*Chaetosyllis*): Two male stolons, 34–37 segments (one unmodified anterior segment, 31–33 modified segments with swimming setae, 2 or 3 small, unmodified posterior segments); long swimming notosetae subequal to dorsal cirri; dorsal cirri of first unmodified segment broken off at cirrophores; darkly pigmented reddish brown dorsally and ventrally.

New Records.—ARCTIC ALASKA: Stem form: Off Point Barrow base, 18.3–123.5 fms., up to 15 miles from shore, on bottoms of mud, stones, worm tubes, from breaking rocks and bryozoans, from interstices between pebbles and gravel covering tunicate, *Molgula* sp., from various combinations of mud, pebbles, stones, gravel, rocks, large perforated rocks, worm tubes, and shells (21 stations, 206 specimens). Male stolons: Off Point Barrow base, 1.6 miles from shore, vertical plankton haul of 13 fms. through hole in ice (March 29, 1950, 2 specimens). WEST COAST NORTH AMERICA: Washington Sound, 17–21 fms., Pettibone. CANADIAN ARCTIC: Center Foxe Basin, 25–31 fms., Bartlett, 1927.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes; Bering Sea to southern California; north Japan Sea, China. In low water to 378 fathoms; sexual stolons in plankton.

Genus *Sphaerosyllis* Claparède, 1863

Represented by a single species from Point Barrow.

Sphaerosyllis erinaceus Claparède, 1863

FIGURE 28, *m*

Sphaerosyllis erinaceus Claparède, 1863, p. 45, pl. 13, fig. 38 (fide Fauvel).—Southern, 1914, p. 20.—Fauvel, 1923, p. 302, fig. 115, q-r.—Annenkova, 1934, p. 322; 1938, p. 153.—? Rioja, 1943, p. 211, figs. 1–6.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 116, pl. 31, fig. 7.

- Sphaerosyllis latipalpis* Levinsen, 1882, p. 244.—Augener, 1928, p. 722, pl. 11, fig. 3; 1939, p. 140.—Wesenberg-Lund, 1947, p. 13, fig. 4; 1951, p. 38.
- Sphaerosyllis longicauda* Webster and Benedict, 1887, p. 720, pl. 3, figs. 35–39.—Eliason, 1920, p. 11, fig. 3.
- Oophylax minuta* Treadwell, 1937, p. 29, figs. 6, 7.
- Brania* sp. Hartman, 1944a, pl. 24, figs. 1, 2.

Description.—Length 2–4.5 mm., width without setae 0.3–0.5 mm., segments 22–37. Body linear, tapering slightly anteriorly and posteriorly, oval in cross section. Body, including parapodia, covered with small papillae and incrustated with fine, granular material. Prostomium subrectangular, wider than long, with six black eyes, four larger ones (each with a lens, arranged in transverse line or slightly concave arc near middle of prostomium) and two small anterior ones. Antennae subequal, bulbous basally, narrower distally. Paired antennae lateral to anterior eye spots; median antenna more posterior, nearly in line with the four larger eyes. Palps short, wide, rounded anteriorly; they may project more anteriorly, extending about the same length as the prostomium, with basal halves fused and distal halves separated by a narrow groove, or they may project more ventrally, extending only about half the length of the prostomium, and fused except for a small anterior indentation; ventrally the palps are not fused although they may be closely approximated, extending back to the level of the four large eyes. Tentacular segment not distinctly set off from the prostomium, with a single pair of tentacular cirri which are similar to the antennae. Dorsal cirri short, slightly longer than parapodial lobes and shorter than the setae, inflated basally, tapering to narrow tips; they may be similar in shape throughout body or they may be only slightly inflated basally in middle and posterior regions. Dorsal cirri lacking on setiger 2. Ventral cirri digitiform, slightly shorter than parapodial lobes. Anal cirri larger than dorsal cirri; anal segment with several larger papillae. Parapodial tip usually with a larger papilla. Neurosetae consisting of a single long, simple, tapering, curved upper seta, the rest compound with distal blades long, subequal, entire, hooked, and finely pectinate. Colorless in alcohol. Female (21 fathoms, September 9, 1948) with large, rounded eggs (larger in diameter than parapodial length) fastened to dorsal surface rather irregularly between setigers 8–24, one to four per segment, attached between neuropodia and dorsal cirri and just medial to the dorsal cirri; another female (36 fathoms, October 6, 1949) with large, oval-shaped developing larvae (developing setae visible) attached to the dorsal surface; swimming setae lacking (with swimming setae in male—Fauvel, 1923; swimming setae in both male and female beginning on setiger 8—Webster and Benedict, 1887; eggs on ventral base of feet—Wesenberg-Lund, 1947).

Remarks.—The type of *Oophylax minuta* Treadwell from Foxe Channel was examined and is herein referred to *Sphaerosyllis erinaceus*; although not mentioned in the original description, the specimen has a median antenna (seen with difficulty on the prepared slide); neurosetae include a simple seta in addition to the compound ones, setiger 2 lacks dorsal cirri. The type specimens of *S. longicauda* Webster and Benedict from Eastport, Maine, were examined also but they are unsatisfactory, being hardened, shrunken, and covered with crystals; the description is fairly complete and agrees with *S. erinaceus* as does the description by Augener of *S. latipalpis* Levinsen. The record by Rioja of *S. erinaceus* from México is questioned chiefly because of the position of the eyes.

New records.—ARCTIC ALASKA: Off Point Barrow base, 16.7–75.5 fms., up to 8 miles from shore, on bottoms of stones and various combinations of gravel, stones, rocks, large perforated rocks, with bryozoans and hydroids (8 stations, 37 specimens). EAST COAST NORTH AMERICA: Off Labrador, 25 fms., *Blue Dolphin* Expedition, 1949. Vineyard Sound, Massachusetts, surface, U. S. Fish Commission, August 3, 1881.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, West Greenland, Spitsbergen. Also Iceland, Denmark, Ireland, English Channel, Baltic; Labrador to Massachusetts; Bering Sea; north Japan Sea; ? Mexico. In low water to 75.5 fathoms; sexual forms at surface.

Genus *Exogone* Oersted, 1845

Both species represented are very small, slender, linear-elongate, tapered slightly anteriorly and more so posteriorly, flattened ventrally, arched dorsally. Body colorless, translucent (in alcohol). Prostomium oval to subrectangular, arched somewhat anteriorly, much wider than long; four eyes, with lenses, in trapezoidal arrangement; palps fused dorsally into a rounded or triangular mass, with or without a slight anterior notch; palps separated ventrally by wide depression. Tentacular segment short, more or less distinct, the anterior part of which may form a fold covering the posterior part of the prostomium. Dorsal cirri shorter than parapodial lobes, ovoid to somewhat conical. Ventral cirri digitiform, shorter than parapodial lobes. Neurosetae of three kinds: (1) upper one simple, slightly curved; (2) composite, with longer, slender, pointed blades; (3) composite, with short, hooked blades. Everted pharynx crowned with circle of papillae and single conical tooth. With swimming setae at maturity. Large eggs, embryos or young (up to five setigers, resembling the adult) attached to ventral surface of female.

Key to the species of *Exogone* from Point Barrow

1. Antennae subequal. Tentacular cirri rudimentary, reduced to small knobs (fig. 28, *l*). Dorsal cirri lacking on setiger 2. Upper compound setae with rather short pointed blades.....*E. naidina*
 Median antenna more than 4 times length of lateral antennae (fig. 28, *k*). Tentacular cirri only slightly smaller than the lateral antennae or dorsal cirri. Dorsal cirri present on all setigerous segments. Upper compound setae with long pointed blades.....*E. dispar*

Exogone naidina Oersted, 1845FIGURE 28, *l*

Exogone naidina Oersted, 1845, p. 20, pl. 2.—Augener, 1939, p. 140.—Zatsepin, 1948, p. 116, pl. 31, fig. 8.

Exogone gemmifera Pagenstecher, 1862, p. 267, pl. 25; pl. 26, figs. 1, 2, 6–8.—McIntosh, 1908, p. 151, pl. 59, figs. 5, 6.—Southern, 1914, p. 17.—Eliason, 1920, p. 11.—Fauvel, 1923, p. 305, fig. 117, a–d.—Annenkova, 1934, p. 322; 1938, p. 154.—Rioja, 1943, p. 223, figs. 38–46.—Gorbunov, 1946, p. 38.—Thorson, 1946, p. 35, fig. 8.—Berkeley and Berkeley, 1948, p. 79, fig. 118.—Hartman and Reish, 1950, p. 13.

Description.—Length 3.5–5 mm., width without setae 0.3 mm., segments 32–36. Palps form rounded mass, 1.4–2 times length of prostomium. Antennae shorter than palps, subequal or median one slightly longer, clavate, inserted anterior to eyes in almost a straight line. Tentacular cirri very small, reduced to small knobs. Dorsal cirri lacking on setiger 2. Neurosetae of each parapodium consisting of one simple, curved upper seta, one upper composite seta with longer pointed blade, and four or five composite setae with short, hooked blades. Female (21 fathoms, September 15, 1948) without special swimming setae, with large eggs attached to ventral surface (between segments 11–25, one to three per segment) medial to ventral cirri and between parapodia. Another female (57 fathoms, October 11, 1949) with eggs on ventral surface of segments 13–21 (mostly four per segment); eggs large, nearly touching. (Swimming setae on females with internal ova, absent in females with ova attached to ventral surface, two eggs per segment—Thorson, 1946.)

New records.—ARCTIC ALASKA: Off Point Barrow base, 16.7–123.5 fms., up to 16 miles from shore, on bottoms of rocks, stones, worm tubes, and various combinations of mud, gravel, stones, rocks, large perforated rocks, with worm tubes, bryozoans, hydroids; on female *Hyas coarctatus alutaceus* (14 stations, 82 specimens).

Distribution.—Alaskan and Siberian Arctic; Denmark, Ireland, Great Britain to Madeira, Mediterranean; Bering Sea to Mexico; north Japan Sea. In low water to 123.5 fathoms; sexual stages at surface.

Exogone dispar (Webster, 1879)

FIGURE 28, k

Paedophylax dispar Webster, 1879a, p. 223, pl. 4, fig. 49; pl. 5, figs. 50-55; 1879b, p. 110; 1886, p. 138.—Sumner, 1913, p. 615.

Paedophylax longiceps Verrill, 1879, p. 170; 1881, p. 320, pl. 12, fig. 2; 1882, p. 370.—Andrews, 1891, p. 281.

Paedophylax longicirris Webster and Benedict, 1887, p. 722, pl. 3, figs. 46-50.

Exogone lourei Berkeley and Berkeley, 1938, p. 44, figs. 6-12; 1948, p. 79, fig. 117.—Rioja, 1941, p. 703, pl. 3, figs. 14-21; 1943, p. 224.

Exogone dispar Hartman, 1942a, p. 11; 1944a, p. 338, pl. 24, fig. 9; pl. 25, fig. 5; 1945, p. 16, pl. 2, figs. 7, 9, 10; 1951, p. 40.

Description.—Anterior ends of 3 specimens only (up to 8 mm. long, 45 setigers—Berkeley and Berkeley, 1938). Palps form a conical mass, about twice length of prostomium. Antennae inserted between and slightly in front of eyes; median antenna longer, usually reaching nearly to end of palps (may be not much longer than prostomium), lateral antennae short, ovoid. Tentacular cirri slightly smaller than lateral antennae and dorsal cirri. Dorsal cirri present on all setigerous segments, including setiger 2. Neurosetae on each parapodium consisting of one simple curved upper seta (may have a delicate thread coming off subterminally in some specimens), one to four composite setae with long terminal capillary blades, and three to nine composite setae with short, hooked blades.

Remarks.—The specimens were compared with the cotypes of *Paedophylax dispar* from New Jersey. The types of *P. longicirris* Webster and Benedict from Eastport, Maine, were examined also and the peculiar hairlike process on some of the simple setae was noted. This also occurs on some of the simple setae of the specimens from Point Barrow. *P. longiceps* Verrill has previously been referred to *P. dispar* by Sumner (1913). The description of *E. lourei* Berkeley and Berkeley from British Columbia agrees with that of *E. dispar*.

New records.—ARCTIC ALASKA: Off Point Barrow base, 36-70 fms., up to 7.5 miles from shore, on bottoms of stones, gravel, large perforated rocks (2 stations, 3 specimens). WEST COAST NORTH AMERICA: Strait of Juan de Fuca, Washington, shore, Pettibone, 1940. EAST COAST NORTH AMERICA: Woods Hole region, Massachusetts, Pettibone, 1950, 1951. Maine, Massachusetts, New Jersey, low water to 14 fms., U. S. Fish Commission.

Distribution.—Arctic Alaska to Mexico; Maine to southwestern Florida. In low water to 70 fathoms; sexual stages at surface.

Genus *Eusyllis* Malmgren, 1867

Both species represented are flattened ventrally, arched dorsally, tapering both anteriorly and posteriorly, very fragile, breaking up

easily and losing their antennae and dorsal cirri readily. Prostomium subrectangular to suboval, wider than long; four eyes fairly large, in trapezoidal arrangement, the anterior pair larger; palps broad, thick, oval to squarish, fused at their bases only and well separated distally, and may be curled ventrally or longitudinally like flopping ears; lateral antennae about 1.5 times the prostomial length; median antenna about twice the length of the lateral antennae (fig. 28, *g*). Upper tentacular cirri as long as median antenna, ventral pair much shorter. Ventral cirri thick, oval, about same size and length as parapodial lobes or may be slightly shorter (first pair not enlarged, similar to the following). Neuropodia short and plump, with neurosetae all composite except on the last setigers where there may be a simple, entire, upper seta and a simple, bidentate, lower seta; blades of composite setae rather short, hooked, distinctly bidentate, finely spinous on the cutting edge; shaft distally spinous (fig. 28, *i*). At maturity, with long capillary swimming setae. Proboscis with two rows of soft papillae, a proximal and a distal row of 10 papillae per row; inside the distal row, a chitinous lining provided with a large, triangular, dorsal tooth and a denticled, circular margin (fig. 28, *g, h*).

Key to the species of *Eusyllis* from Point Barrow

1. Cirrophores of dorsal cirri not prominent. Tentacular segment with a wide crescent-shaped nuchal lobe covering the posterior part of the prostomium (fig. 28, *g*)-----***E. blomstrandii***
- Cirrophores of dorsal cirri prominent, as long as the neuropodia. Tentacular segment short, without nuchal lobe-----***E. magnifica***

Eusyllis blomstrandii Malmgren, 1867

FIGURE 28, *g-i*

Eusyllis blomstrandii Malmgren, 1867, p. 40, pl. 6, fig. 43.—Fauvel, 1923, p. 293, fig. 112,h-m.—Augener, 1928, p. 721.—Annenkova, 1938, p. 153, fig. 6.—Wesenberg-Lund, 1947, p. 11, fig. 3; 1950a, p. 16; 1950b, p. 48; 1951, p. 37.—Berkeley and Berkeley, 1948, p. 84, fig. 126.

Eusyllis monilicornis Malmgren, 1867, p. 41, pl. 6, fig. 44.—Verrill, 1881, p. 319.—Zatsepin, 1948, p. 116, pl. 31, fig. 6,b.

? *Eusyllis phosphorea* Hartman, 1942a, p. 7; 1944a, pp. 334, 338, pl. 25, fig. 4.

Syllis monilicornis Théel, 1879, p. 41, pl. 3, fig. 39.

Eusyllis tubifex McIntosh, 1908, p. 173, figs.—Southern, 1914, p. 32 (not *Syllis tubifex* Gosse, 1855).

Eusyllis blomstrandii Friedrich, 1939, p. 122.

Typosyllis collaris Hartman, 1948, p. 23, fig. 6,a-c.

Description.—Length 7–32 mm., width without setae 0.8–1.2 mm., segments 50–124. Antennae, tentacular cirri, anterior dorsal cirri, and long anal cirri irregularly annulated, especially distally, more or less smooth basally; the more posterior dorsal cirri only indistinctly annulated or smooth. First few dorsal cirri may be longer than body width, especially the first pair which may be the longest appendage;

rest of dorsal cirri shorter than body width, tapering gradually. Tentacular segment with wide, short, crescent-shaped collar or nuchal fold covering posterior part of prostomium, may be inconspicuous and protruding or rather low, somewhat contracted. Composite setae similar throughout, with distal blades short, differing only slightly in length. Chitinous lining of proboscis light or dark gray or light amber-colored; dorsal tooth dark bluish gray; circular margin finely denticled. Epitokous female (Elson Lagoon, August 6, 1948) with large eggs massed in most of body segments, consisting of 16 anterior unmodified setigers, 25 setigers with long swimming setae, and 5 unmodified setigers (swimming setae begin on setiger 13—Wesenberg-Lund, 1947). COLOR: In alcohol: Colorless or tannish, slightly greenish anteriorly. In life: Orange or yellowish. May form definite hardened mucous tubes. Luminescent.

Remarks.—The type of *Typosyllis collaris* Hartman (1948) was examined and is herein referred to *E. blomstrandii*; the dorsal cirri are not distinctly annulated throughout the body as they would be in a *Typosyllis*. There is nothing in Verrill's description of *E. phosphorea*, dredged from St. George's Bank, to distinguish it from *E. blomstrandii*; according to Hartman (1942, p. 7) the type is unsatisfactory.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; Point Barrow base, washed ashore; off Point Barrow base, 13.3–123.5 fms., up to 15 miles from shore, on bottoms of stones, masses of worm tubes, and various combinations of mud, pebbles, gravel, stones, rocks, large perforated rocks, with worm tubes, bryozoans, hydroids, shells, and on female crab *Hyas coarctatus alutaceus* (24 stations, 175 specimens). BERING SEA: Robert White, 1879. WEST COAST NORTH AMERICA: Washington and Puget Sounds, 20–46 fms., Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 15–30 fms., *Blue Dolphin* Expeditions, 1949, 1951.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, West Greenland, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Ireland to Madeira, Mediterranean; Labrador to Maine; Bering Sea to Washington; north Japan Sea. In low water to 444 fathoms; epitokes at surface.

Eusyllis magnifica (Moore, 1906)

Pionosyllis magnifica Moore, 1906b, p. 223, pl. 10, figs. 9–11; 1908, p. 325.—Annenkova, 1938, p. 152.

Description.—Atokous specimen 52 mm. long, 2.5 mm. in greatest width without setae, 152 segments (in pieces, complete?). Epitokous specimen (18 fathoms, September 16, 1948) broken up and not quite complete, with larger eyes, consisting of 161 segments, 99 mm. long,

4 mm. wide without setae, 9 mm. wide including long swimming setae. Two atokous specimens from Washington 43–48 mm. long, 1.5–2 mm. wide without setae. Median antenna, tentacular cirri and some of anterior dorsal cirri somewhat annulated, especially distally; rest of dorsal cirri smooth. Some of anterior dorsal cirri longer than body width; rest shorter than body width, subulate, thick basally, tapering distally, on prominent cirrophores which may be as long as parapodial lobes. Tentacular segment very short, without nuchal collar. Blades of neurosetae all rather short. In anterior parapodia, blades of upper neurosetae somewhat longer than the lower ones; on rest of parapodia, blades of neurosetae only slightly different in length. Chitinous lining of proboscis and dorsal tooth light to darker amber-colored or transparent; circular anterior border with coarse, triangular denticles (when transparent, difficult to see denticled border). Swimming setae begin on setiger 24 (on setiger 19 in specimen from Portage Bay, Alaska). COLOR: In alcohol: Flesh.

Remarks.—The specimens were compared with the type of *Pionosyllis magnifica* Moore (1906) from Port Townsend, Washington. It is herein referred to *Eusyllis* since the composite neurosetae have rather short blades which differ only slightly in length, the proboscis has a proximal and a distal row of papillae, and the anterior circular border is denticled (difficult to see when the chitinous lining is transparent).

New records.—ARCTIC ALASKA: Off Point Barrow base, 18.3 fms., pebbles-mud (1 station, 2 specimens). WEST COAST NORTH AMERICA: *Albatross* surface station, Portage Bay, Alaska; Washington Sound, Pettibone.

Distribution.—Arctic Alaska to Washington; north Japan Sea. In 16 to 302.8 fathoms; epitokes at surface.

Genus *Pionosyllis* Malmgren, 1867

Pionosyllis compacta Malmgren, 1867

FIGURE 28, j

Pionosyllis compacta Malmgren, 1867, p. 40, fig. 48.—Augener, 1928, p. 722.—Annenkova, 1934, p. 322.

Description.—Anterior ends only of two small specimens, up to 1.5 mm. wide without setae (8–10 mm. long, 1 mm. wide—Malmgren, 1867). Body flattened ventrally, arched dorsally, fragile, with segments crowded. Prostomium subrectangular, wider than long; four eyes rather large, in trapezoidal arrangement; palps squarish, fused basally, widely separated distally. Tentacular segment without nuchal collar. Antennae, tentacular, and dorsal cirri smooth, without articulations, filiform to rather thick, breaking off readily; most of

dorsal cirri shorter than the body width. Ventral cirri thick, pointed, almost as long as parapodial lobes. Neurosetae all composite, distal blades distinctly bidentate, finely spinous along cutting edge; blades of upper setae longer, becoming gradually shorter in lower part of bundle with upper ones about twice the length of lower ones. Proboscis with a distal row of 10 papillae; transparent chitinous lining with a translucent bluish-gray dorsal tooth, with distal rim smooth. COLOR: In alcohol: Irregularly dotted with black pigment both dorsally and ventrally. (Epitokous forms have capillary setae beginning on segments 12-15—Malmgren, 1867.)

New records.—ARCTIC ALASKA: Off Point Barrow, 36-78 fms., up to 15 miles from shore, on bottoms of rocks, stones, and worm tubes (2 stations, 2 specimens).

Distribution.—Arctic Alaska; Spitsbergen; Bering Sea. In low water to 78 fathoms.

Family NEREIDAE

Prostomium distinct, with four eyes, two frontal antennae, two bi-articulated palps (fig. 30, *a*). Four pairs tentacular cirri; buccal or tentacular segment usually apodous and achaetous. Parapodia usually biramous (except first two pairs), with dorsal and ventral cylindrical cirri, two or three notopodial ligules and one neuropodial ligule (fig. 30, *b, c*). Setae usually compound spinigers and falcigers (fig. 30, *d-g*). Pair of anal cirri. Proboscis eversible, with pair of terminal, horny, falcate jaws and usually with horny denticles or paragnaths arranged in eight groups on two rings, a basal or oral ring and a distal or maxillary ring (fig. 30, *h, i*). At maturity usually with a pelagic epitokous or heteronereis stage.

Represented by a single genus and two species.

Genus *Nereis* Cuvier, 1817

Subgenus *Nereis* Linné, 1758

Both species have the body smooth, elongate, cylindrical, attenuated posteriorly, with numerous segments. Prostomium of the typical nereid form. Tentacular segment achaetous, over twice the length of the following segments; tentacular cirri short, fairly uniform in length, the upper one only slightly longer than the others (may reach setiger 2). Parapodia biramous, with two subequal notopodial ligules (remaining so throughout the body, the upper one not getting larger or longer than the lower one), a single neuropodial ligule ventral to the conical setigerous neuropodial lobe (fig. 30, *b, c*). Notosetae homogomph spinigers (fig. 30, *g*); in more posterior segments with some homogomph falcigers with blunt asymmetrical reduced appendages (fig. 30, *e*). Neurosetae homogomph and

heterogomph spinigers (fig. 30, *f*) and heterogomph falcigers with hooked end-pieces (fig. 30, *d*). Proboscis with paragnaths all chitinous, conical, separated in groups, occurring on both rings (fig. 30, *h, i*). Distal ring of paragnaths: Area II (dorsolateral)—oblique group of two or three rows; area III (medioventral)—small transverse group; area IV (ventrolateral)—arched mass. Basal ring of paragnaths: Area V (mediodorsal)—0. At maturity, with epitokeous stage, eyes enlarged; 14–19 anterior prenatatory setigers; modified natatory setigers with parapodial lobes compressed, flattened anteroposteriorly, developing foliaceous lamellar plates, with numerous paddlelike swimming setae; in males, first seven dorsal cirri enlarged and club-shaped, first five or six ventral cirri modified, and dorsal cirri of natatory setigers crenulate on lower margin; in females, dorsal and ventral cirri not modified or crenulate.

Key to the species of *Nereis* (*Nereis*) from Point Barrow

1. Parapodial ligules short, thick, evenly rounded (fig. 30, *b*). Body uniformly purplish or reddish brown, not banded. Paragnaths of distal ring: Area I (mediodorsal)—2 in tandem (rarely 1 or 3); paragnaths of basal ring: Area VI (dorsolateral)—4 in square or cross (rarely 3 or 5); areas VII–VIII (ventral)—1–2 irregular rows of larger paragnaths, with several rows of small ones, diminishing in size posteriorly (2–3 irregular rows of subequal paragnaths in subspecies *occidentalis*). Male epitokes with 16 and females with 17–19 prenatatory setigers.....N. (N.) **pelagica**
- Parapodial ligules triangular to conical, gradually tapering to a broad tip (fig. 30, *c*). Body transversely banded reddish brown or violet. Paragnaths of distal ring: Area I—0 or 1; paragnaths of basal ring: Area VI—6–10 or more in oval mass; VII–VIII—continuous row of larger paragnaths followed by a wide band of small subequal ones (fig. 30, *h, i*). Male epitokes with 14 and females with 16 prenatatory setigers....N. (N.) **zonata**

Nereis (*Nereis*) *pelagica* Linné 1758

FIGURE 30, *a, b*

Nereis pelagica Linné, 1758, p. 654.—Malmgren, 1867, p. 47, pl. 5, fig. 35.—Webster and Benedict, 1884, p. 718; 1887, p. 724.—Moore, 1903, p. 431.—McIntosh, 1908, p. 268, figs.—Sumner, 1913, p. 619.—Southern, 1914, p. 80.—Eliason, 1920, p. 29.—Chamberlin, 1920, p. 14.—Fauvel, 1923, p. 336, fig. 130, a–f.—Augener, 1928, p. 712.—Monro, 1930, p. 106.—Annenkova, 1934, p. 322; 1937, p. 162; 1938, p. 158.—Treadwell, 1937, p. 29.—Okuda, 1939, p. 230.—Friedrich, 1939, p. 123.—Hartman, 1940, p. 225, pl. 35, fig. 52; 1944a, p. 335; 1948, p. 26.—Berkeley and Berkeley, 1943, p. 130; 1948, p. 66, fig. 96, a–b.—Thorson, 1946, p. 64, fig. 29.—Zatsepin, 1948, p. 119, pl. 30, fig. 2.—Wesenberg-Lund, 1950a, p. 19, pl. 6, figs. 26a, 27a; 1950b, p. 53; 1951, p. 39.

Heteronereis grandifolia Rathke, 1843, p. 155, pl. 7, figs. 13, 14.—Malmgren, 1865, p. 108, pl. 11, fig. 15 (part—female heteronereid, not male).

Nereis neonigripes Hartman, 1936b, p. 471, fig. 48.

Nereis arctica Treadwell, 1937, p. 30.

Nereis pelagica var. *occidentalis* Hartman, 1945, p. 20, pl. 4, figs. 1–6; 1951, p. 46.

Nereis pelagica neonigripes Hartman and Reish, 1950, p. 17.

Description.—Length 60–155 mm., width 5–14 mm. See key. COLOR: In alcohol: Iridescent, uniformly purplish or reddish brown (narrow white intersegmental lines); ligules of parapodial lobes may be darkly pigmented (var. *neonigrripes*); tips of dorsal cirri may be black.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 18–87 fms., on various combinations of stones, gravel, rocks, large perforated rocks (8 stations, 10 specimens). SPITSBERGEN: Spitsbergen Sea, U. S. S. *Alliance*, August, 1881, surface (heteronereid). BERING SEA: *Albatross* Sta. at Nikolski, Bering Island, 1892, and Sta. 3496, 56°32' N., 169°45' W., 41 fms., 1893; St. George Island, Pribilofs, 1913, 1914, low tide and 30 fms., and St. Paul Island, Pribilofs, lagoon reef, 1915, Hanna; St. Paul Island, Wm. Palmer, 1890. SOUTHWESTERN ALASKA: *Albatross* Sta., Unalaska, Aleutians, 1888; Akutan Pass, Chica Islands, 1872; Kiska Harbor, sandy-mud, 9–12 fms., 1873; Anchorage, Big Koniuji Islands, Shumagin, 6–20 fms., sand and rocks; Port Moller, Alaska Peninsula, beach to 17 fms., sand, 1874; Killisnoo, 1897; Chiniak Bay, Kodiak Island, 1880; all collected by Dall. GULF OF ALASKA: *Albatross* Sta., at Observation Island, Cordova, Alaska, 1914. SOUTHEASTERN ALASKA: Sitka, 1932. WEST COAST NORTH AMERICA: *Albatross* Sta. 89a, Denman, British Columbia, 1914, and Sta. 3466, off Washington, 48°18'30'' N., 123°22' W., 56 fms., 1891. Washington and Puget Sounds, low tide to 166 fms. (very common), Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 7–60 fms., *Blue Dolphin* Expeditions, 1949, 1951; Woods Hole region, intertidal and dredged, Pettibone, 1950, 1951; Gulf of St. Lawrence, New Brunswick, Nova Scotia, Bay of Fundy, Maine, Massachusetts, Rhode Island, Connecticut, Long Island Sound, shore to 250 fathoms and surface, U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Spitsbergen, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Mediterranean; Hudson Bay to Long Island Sound; Bering Sea to Panamá; north Japan Sea, Japan; South Atlantic (Tristan da Cunha, Kerguelen, Magellan Straits). In low water to 609 fathoms; epitokes at surface. Variety *occidentalis* Hartman: North Carolina, Florida, Louisiana, Texas, Puerto Rico; intertidal.

Nereis (Nereis) zonata Malmgren, 1867

FIGURE 30, c, h, i

Heteronereis grandifolia Malmgren, 1865, p. 108, pl. 11, fig. 16 (part—male heteronereid, not female; not *H. grandifolia* Rathke, 1843).

Nereis zonata Malmgren, 1867, p. 46, pl. 5, fig. 34.—Théel, 1879, p. 42.—Wirén, 1883, p. 402.—Ditlevsen, 1911, p. 419, pl. 28, fig. 6; pl. 30, figs. 18, 22.—

Fauvel, 1914, p. 177, pl. 14, figs. 1-17; 1923, p. 338, fig. 130, g-n (part).—Augener, 1928, p. 713.—Annenkova, 1931, p. 203; 1932, p. 134; 1934, p. 322; 1937, p. 162; 1938, p. 158.—Friedrich, 1939, p. 123.—Berkeley and Berkeley, 1943, p. 130.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 119, pl. 30, fig. 3.—Hartman, 1948, p. 25.—Hartman and Reish, 1950, p. 17.—Wesenberg-Lund, 1950a, p. 20, pl. 6, figs. 26b, 27b; 1950b, p. 55; 1951, p. 41.

Description.—Length 30-125 mm., width 7 mm. See key. COLOR: In alcohol: Reddish or rusty brown or violet wide transverse bands; anterior fourth of segment without color.

Remarks.—*Nereis procera* Ehlers, 1868, originally described from the Gulf of Georgia, British Columbia, has been referred to *N. zonata* by Fauvel, 1914. In *N. procera* the body is long, slender, extremely attenuated posteriorly; the notopodial ligules of the anterior setigers are triangular, subequal; those of the median and posterior regions have the upper notopodial ligules larger than the lower one (may be nearly twice the size); the paragnaths of areas VII and VIII are in a wide, continuous area with no especially enlarged anterior row; male epitokes with 51 and females with 59 prenatory setigers. It may be that the variety *procera* of Fauvel refers to a different species from that of *N. procera* Ehlers.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 13 fms., gravel; off Point Barrow base, 21-78 fms., on bottoms of gravel, stones, small rocks, with shells and worm tubes (8 stations, 12 specimens). CANADIAN ARCTIC: Ellesmere Island, U.S.S. *Alert*, 1950, J. Peter Johnson (epitoke). EAST GREENLAND: 74°04' N., 17°58' W., 120 fms., Norcross-Bartlett Expedition, 1931. EAST COAST NORTH AMERICA: Off Labrador, 9-100 fms., mud, *Blue Dolphin* Expeditions, 1950, 1951.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Davis Strait, Greenland, Norway, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes; Hudson Bay to Labrador; Bering Sea to Oregon; north Japan Sea. In low water to 439 fathoms; epitokes at surface. Variety ? *procera* Fauvel (1914, 1923; not Ehlers, 1868): English Channel to Mediterranean. Variety *persica* Fauvel: Red Sea, South Arabian Coast, Persian Gulf, Indian Ocean.

Family NEPTYIDAE

Body elongated, subtetragonal in cross section. Prostomium small, somewhat flattened, angulate, with four small antennae (fig. 30, *j*). First segment rudimentary, with setae and usually with short dorsal and ventral tentacular cirri. Parapodia biramous, with rami well separated, with small dorsal cirri on lower sides of notopodia; with branchiae (interramal cirri) between the two rami, cirriform, sickle-shaped or foliaceous; with simple setae arranged in fan-shaped bundles;

ventral cirri short, conical, or foliaceous; with anterior and posterior lamellae more or less developed (fig. 30, *k-n*). A single anal cirrus. Proboscis eversible, strong, muscular, a pair of horny jaws within the pharynx, with rows of soft papillae and a crown of terminal, bifid papillae. Move rapidly with undulating motion; usually in sand or mud.

Represented by a single genus and four species.

Genus *Nephtys* Cuvier, 1817

The four species represented have numerous segments (65–150), tapered posteriorly and slightly anteriorly. Prostomium pentagonal to quadrate, with antennae conical, subequal, or more ventral pair slightly larger, without eyes, with pair of nuchal papillae at postectal margins (may be inverted or everted; fig. 30, *j*). Tentacular or first segment with both dorsal and ventral tentacular cirri. Parapodial rami with anterior lamellae rudimentary or lacking, with posterior lamellae developed in varying degrees, with branchiae recurved (convex side toward lateral side of body, fig. 30, *k-n*). Ventral cirri short, conical. Proboscis with 22 long terminal papillae (10 pairs bifid, and a single dorsal and ventral one), with 22 longitudinal rows of sub-terminal papillae, four to eight per row, decreasing in size basally.

Key to the species of *Nephtys* from Point Barrow

1. Branchiae cirriform, sickle-shaped, with dorsal cirri digitiform (fig. 30, *l, n*). Proboscis with a long median dorsal papilla.....2
 Branchiae foliaceous or cirriform and inflated basally, rudimentary or absent on last 15–30 segments, with dorsal cirri flattened, triangular, pointed (fig. 30, *k, m*). Proboscis without a long median dorsal papilla; proximal surface of proboscis ridged (may be low tubercles in *N. discors*).....3
2. Branchiae begin on setigers 3 or 4, continuing to almost posterior end; acicular lobes rounded or slightly bilobed, especially anteriorly (fig. 30, *l*). Neuropodial postsetal lamellae extend well beyond the acicular lobes, bilobed or irregularly sinuous. Setae very long, flowing. Proximal surface of proboscis smooth or furrowed.....*N. longosetosa*
 Branchiae begin on setigers 5–8, rudimentary on last 20–30 segments. Acicular lobes deeply bilobed in anterior and median regions (fig. 30, *n*). Neuropodial postsetal lamellae about same length as or only slightly surpassing the acicular lobes. Setae shorter. Proximal surface of proboscis tubercled.
N. ciliata
3. Branchiae begin on setiger 6, inflated basally, digitiform, recurved distally (fig. 30, *m*). Acicular lobes unequally bilobed, rounded in posterior region. Postsetal lamellae of anterior and median regions large, foliaceous, extending well beyond the acicular lobes; in posterior region, extend only slightly beyond.....*N. discors*
 Branchiae begin on setigers 8–14, thick, wide, foliaceous (fig. 30, *k*). Acicular lobes rounded to conical. Postsetal lamellae shorter than, as long as, or only slightly longer than the acicular lobes.....*N. paradoxa*

Nephtys longosetosa Oersted, 1843

FIGURE 30, l

Nephtys longosetosa Oersted, 1843, p. 195, pl. 6, figs. 75, 76.—Hartman, 1944a, p. 339, pl. 15, fig. 7.

Nephtys longisetosa not Malmgren, 1865, p. 106, pl. 12, fig. 20.—Eliason, 1920, p. 32.

Nephtys coeca Murdoch, 1885, p. 153 (part; includes var. *longisetosa*; not *Nereis caeca* Fabricius, 1780).

Nephtys longosetosa Fauvel, 1923, p. 367, fig. 143, f-h.—Monro, 1928, p. 82.—Annenkova, 1937, p. 163; 1938, p. 162.—Friedrich, 1939, p. 123.—Berkeley and Berkeley, 1943, p. 130; 1948, p. 52, fig. 76.—Gorbunov, 1946, p. 38.—Wesenberg-Lund, 1950a, p. 21; 1950b, p. 60; 1951, p. 44.

Nephtys ciliata forma *longosetosa* Augener, 1928, p. 698.

Nephtys ciliata Treadwell, 1937, p. 28 (part; not *Nereis ciliata* Müller, 1789).

Description.—Length up to 170 mm., width without setae 6 mm. Tentacular cirri subequal to antennae. Notopodial postsetal lamellae unequally bilobed (a rather large upper lobe and small lobe just above the dorsal cirri), extending slightly or not beyond the acicular lobes. Neuropodial postsetal lamellae of anterior region rounded, entire, extending beyond the acicular lobes; those of the median and posterior regions large, bilobed or irregularly sinuous on ventral side, extending well beyond the acicular lobes. COLOR: In alcohol: Without color, or dusky, especially anteriorly.

New records.—ARCTIC ALASKA: Eluitkak, Elson Lagoon near Point Barrow; Point Barrow base, washed ashore; off Point Barrow base, 1.7–25 fms., on bottoms of gravel, stones, and mud (7 stations, 16 specimens); Cape Lisburne, 5–7 fms., Dall. BERING SEA: 60°16' N., 167°41' W., Stoney, 1884; 66°45' N., 166°35' W., 10 fms., Dall, 1880. CANADIAN ARCTIC: Duckett Cove, Hurd Channel, Melville Peninsula, Foxe Channel, Bartlett, 1933. EAST COAST NORTH AMERICA: Off Labrador, 8 fms., *Blue Dolphin* Expedition, 1949.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Barents Sea, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes to France; to Maine; to Lower California and Panamá; north Japan Sea; Strait of Magellan. In low water to 528 fathoms.

FIGURE 30.—Nereidae: *a*, *Nereis pelagica*, dorsal view anterior end; *b*, same, middle parapodium; *c*, *Nereis zonata*, middle parapodium; *d*, compound heterogomph falciger; *e*, compound homogomph falciger; *f*, compound heterogomph spiniger; *g*, compound homogomph spiniger; *h*, *Nereis zonata*, dorsal view extended proboscis showing areas of paragnaths; *i*, same, ventral view. Nephtyidae: *j*, *Nephtys paradoxa*, dorsal view anterior end; *k*, same, middle parapodium, anterior view; *l*, *Nephtys longosetosa*, middle parapodium, anterior view; *m*, *Nephtys discors*, middle parapodium, anterior view; *n*, *Nephtys ciliata*, middle parapodium, anterior view. (For explanation of symbols, see p. 210.)

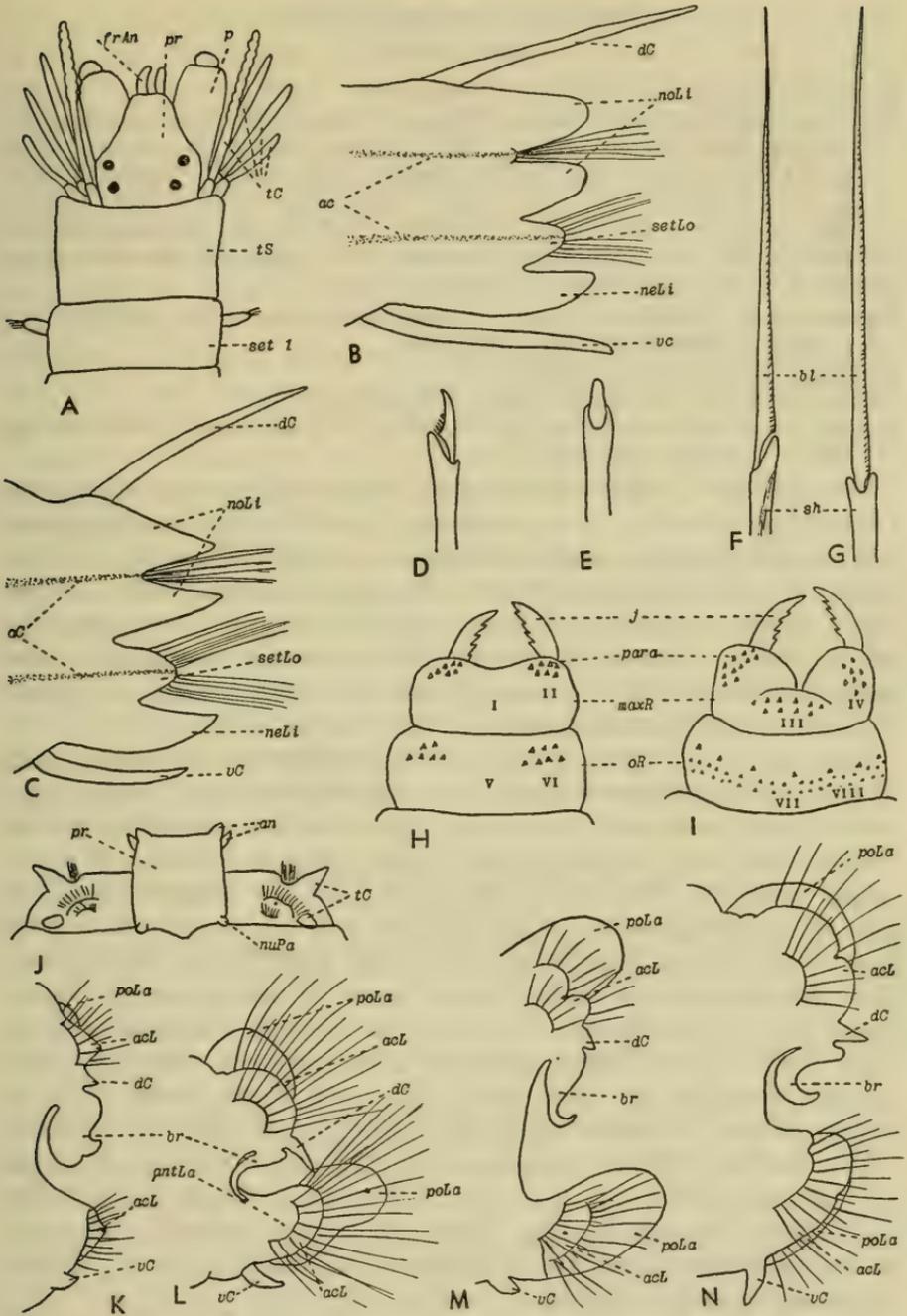


FIGURE 30.—For explanation see facing page.

Nephtys ciliata (Müller, 1789)

FIGURE 30, n

Nereis ciliata Müller, 1789, p. 14, pl. 89, figs. 1-4.*Nephtys ciliata* Malmgren, 1865, p. 104, pl. 12, fig. 17.—Webster and Benedict, 1887, p. 709.—Moore, 1903, p. 433.—Eliason, 1920, p. 31.—Fauvel, 1923, p. 371, fig. 145, a-b; 1933, p. 39.—Augener, 1928, p. 699.—Gustafson, 1936, p. 7.—Treadwell, 1937, p. 28 (part).—Annenkova, 1937, p. 164; 1938, p. 162.—Friedrich, 1939, p. 123.—Gorbunov, 1946, p. 38.—Thorson, 1946, p. 69, figs. 32, 33.—Berkeley and Berkeley, 1948, p. 55, fig. 82.—Wesenberg-Lund, 1950a, p. 21; 1950b, p. 59; 1951, p. 45.*Nephtys caeca* Murdoch, 1885, p. 153 (part; includes var. *ciliata*).—Moore, 1911, p. 243 (not *Nereis caeca* Fabricius, 1780).*Nephtys ciliata* Chamberlin, 1920, p. 9.*Nephtys hudsonica* Chamberlin, 1920, p. 10, pl. 2, figs. 4-6.*Nephtys ciliata* Hartman, 1944a, pp. 335, 339, pl. 15, fig. 9 (as *N. incisa*, not fig. 10 (= *N. caeca*)); 1950, p. 95.

Description.—Length 100-300 mm., width without setae 9-11 mm. Tentacular cirri subequal to antennae. Acicular lobes deeply bilobed in anterior and median regions; rounded or slightly bilobed in posterior region. Postsetal lamellae of both notopodia and neuropodia rounded, entire, short, about same length as or only slightly surpassing the acicular lobes. COLOR: In alcohol: White, tannish, or anterior third reddish brown or buff. (According to G. E. MacGinitie, the pellets of this worm indicate that it is a detritus feeder.)

New records.—ARCTIC ALASKA: Off Point Barrow aero radio mast, 10 fms.; off Point Barrow base, up to 8 miles from shore, 6-75.5 fms., on bottoms of mud and various combinations of mud, pebbles, gravel, stones, rocks, large perforated rocks, and shells (18 stations, 37 specimens). SIBERIA: Plover Bay, Dall, 1880. ALASKA: Chiachi Island, 20 fms., mud; Round Island, Coal Harbor, 6-8 fms., mud, 1872; Port Mulgrove, Yakutat Bay, 6-40 fms., 1874; Port Etches, 12-18 fms., 1874; all collected by Dall. WEST COAST NORTH AMERICA: Washington and Puget Sounds, low water to 83 fms. (common), Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 6-95 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; off Nova Scotia, Bay of Fundy, Maine, Massachusetts, 14-110 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Norway, Barents Sea, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes to France; to Massachusetts; to Southern California; to Japan, China. In low water to 500 fathoms.

Nephtys discors Ehlers, 1868

FIGURE 30, m

Nephtys discors Ehlers, 1868, p. 626, pl. 23, figs. 39, 40.—Verrill, 1873, p. 103.—Webster and Benedict, 1887, p. 709.*Nephtys discors* Hartman, 1938c, p. 9, pl. 1, figs. 2, 3; 1950, p. 96.*Nephtys rickettsi* Hartman, 1938b, p. 153; 1950, p. 97.

Description.—Length 115–300 mm., width without setae 9–12 mm. Dorsal pair tentacular cirri about half as large as ventral pair. Branchiae begin on setiger 6, at first a small swelling on the lower side of the base of the flattened, triangular dorsal cirrus, gradually becoming larger; where best developed, they are inflated on the basal half, with the distal half more slender, digitiform and slightly recurved or hooked; they are smaller and rudimentary only on posterior half of body. Notopodial acicular lobes of anterior and middle region unequally bilobed, the upper one wider and shorter and the ventral one narrower and longer; rounded in posterior region. Neuropodial acicular lobes slightly bilobed in anterior region; very low and rounded in middle and posterior regions (not very distinct from posterior lamellae). COLOR: In alcohol: Brownish.

Remarks.—The type of *N. rickettsi* Hartman from Alaska was compared with a specimen of *N. discors* from Bay of Fundy and is herein referred to the latter species.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore; off Point Barrow base, up to 12.1 miles from shore, 24.7–123.5 fms., on bottoms of mud, gravel-mud, stones and large perforated rocks, and mass of worm tubes (5 stations, 5 specimens). WEST COAST NORTH AMERICA: Puget and Washington Sounds, 70–83 fms., mud (3 specimens), Pettibone, 1938, 1939. EAST COAST NORTH AMERICA: Bay of Fundy, U. S. Fish Commission.

Distribution.—Alaskan Arctic to southern California; Bay of Fundy to Maine. In 24–268 fathoms.

Nephtys paradoxa Malm, 1874

FIGURE 30, j, k

Nephtys paradoxa Malm, 1874, p. 78, pl. 1, fig. 2.—Fauvel, 1923, p. 375, fig. 146, f-i.—Augener, 1928, p. 701.—Gustafson, 1936, p. 7.—Annenkova, 1938, p. 163.—Friedrich, 1939, p. 123.—Berkeley and Berkeley, 1943, p. 130.—Wesenberg-Lund, 1950a, p. 22; 1950b, p. 61; 1951, p. 47.

Nephtys phyllobranchia McIntosh, 1885, p. 164, pl. 26, fig. 10; pl. 27, fig. 3; pl. 14, A, figs. 12, 13.

? *Nephtys brachycephala* Moore, 1903, p. 431.—Annenkova, 1937, p. 164; 1938, p. 162.—Zatsepin, 1948, p. 121, pl. 30, fig. 9.

Nephtys paradoxa Hartman, 1944a, pp. 335, 339, pl. 15, fig. 6; 1950, p. 111.

Nephtys phyllobranchia Hartman, 1950, p. 111.

Description.—Length 150–200 mm., width without setae 8–13 mm. Dorsal pair tentacular cirri reduced to a tubercle, smaller than ventral pair. Branchiae begin on setigers 11–13 (8–14), very short, triangular at first, gradually becoming larger; where best developed, they are flat, wide foliaceous, weakly to distinctly concave; they are small, nearly absent on the last 15–30 segments. The anterior acicular lobes are rounded; those of the middle and posterior regions are conical, pointed. The postsetal lamellae in the anterior region are

slightly longer than the acicular lobes; they are shorter than the conical acicular lobes in the middle and posterior regions. COLOR: In alcohol: Dusky, especially anteriorly.

Remarks.—Augener (1928) indicated that he was of the opinion that *N. phyllobranchia* McIntosh should be referred to *N. paradoxa*; Hartman (1950) stated that they are separable by only slight differences. The type of *N. brachycephala* Moore from Japan is unsatisfactory (dried, when received); the description is in agreement with *N. paradoxa*.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 23.5–123.5 fms., on bottoms of mud and mass of worm tubes (2 stations, 3 specimens).

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Norway, Barents Sea, Kara Sea. Also Iceland, Faroes to France; off Delaware; Japan. In 3.3–4,001 fathoms.

Family GLYCERIDAE

Body rounded, elongated, attenuated at both ends, not divided into two regions, either only uniramous or only biramous. Segments bi- or tri-annulate. Prostomium sharply conical, wide basally, with a pair of nuchal organs, transversely annulated, ending in four minute antennae distally (fig. 31, *a*). Small, globular dorsal cirri; larger ventral cirri (fig. 31, *b*, *c*); two anal cirri. Branchiae present or absent. Notosetae simple capillaries; neurosetae compound spinigers. Proboscis eversible, long, clavate, with numerous, small papillae (proboscidual organs) and four dark, falcate, horny jaws each with an attached, embedded, rodlike aileron (fig. 31, *d*). Epitoky affects entire individual (parapodial lobes become more elongate, setae longer and more numerous).

Represented by a single species from Point Barrow.

Genus *Glycera* Savigny, 1818

Glycera capitata Oersted, 1843

FIGURE 31, *a-d*

Glycera capitata Oersted, 1843, p. 196, pl. 7, figs. 87, 88, 90–94, 96, 99.—Ehlers, 1913, p. 503.—Fauvel, 1923, p. 385, fig. 151, *a-e*.—Augener, 1928, p. 734.—Monro, 1930, p. 115; 1936, p. 114.—Annenkova, 1937, p. 165; 1938, p. 164.—Støp-Bowitz, 1941, p. 186, fig. 1; 1948b, p. 4.—Hartman, 1944a, pp. 336, 339; 1948, p. 28; 1950, p. 76, pl. 11, figs. 1–4.—Gorbunov, 1946, p. 38.—Zatsepin, 1948, p. 117, pl. 31, fig. 9.—Berkeley and Berkeley, 1948, p. 38, fig. 52.—Hartman and Reish, 1950, p. 20.—Wesenberg-Lund, 1950a, p. 23; 1950b, p. 64; 1951, p. 49.

Glycera setosa Oersted, 1843, p. 198, pl. 7, figs. 89, 95, 97 (epitokous form).

Glycera nana Johnson, 1901, p. 411, pl. 10, fig. 103.—Berkeley and Berkeley, 1948, p. 37, figs. 50, 51.

Glycera lapidum Fauvel, 1914, p. 205; 1923, p. 386, fig. 151, *f-m*; 1934a, p. 41.—Eliason, 1920, p. 36, fig. 6.—Treadwell, 1937, p. 32.—Støp-Bowitz, 1941, p. 191, fig. 2; 1948b, p. 7.

Description.—Length 80 mm., width without setae 6 mm. (length up to 150 mm.—Hartman, 1950). Segments usually triannulate (may be biannulate, a slightly longer anterior ring at the level of the parapodia and a shorter posterior ring; the former may be subdivided, thus triannulate; the latter may also be somewhat divided, thus tetra-annulate). Conical prostomium with 8–16 annuli (often difficult to count accurately). Dorsal cirri small, globular, inserted well above the parapodia. Ventral cirri wide, conical. Parapodia biramous throughout; notopodia represented by a short, conical presetal lobe and a small bundle of simple capillary setae; neuropodia with a longer, conical presetal lobe and a fan-shaped group of compound spinigerous setae; a single short, wide, rounded postsetal lobe common to both notopodia and neuropodia (thus two conical anterior lobes and a single postsetal lobe). The relative length of the parapodial lobes may be variable, associated with the epitokous condition, as indicated by Hartman (1950). Proboscis with two kinds of papillae, numerous, long, cylindrical, slender ones, and fewer, larger, short, subspherical ones; aileron of jaws with a long lateral prolongation. COLOR: In alcohol: Brownish.

Remarks.—Monro (1930) referred *Glycera lapidum* Quatrefages to *G. capitata*; they have been separated on minor and apparently variable characters; Fauvel (1914, 1923) regarded them as mere varieties. Hartman (1950) referred *G. nana* Johnson to *G. capitata*.

New records.—ARCTIC ALASKA: Off Point Barrow base, 15 miles from shore, 78.2 fms., on bottom of small rocks with worm tubes (1 station, 1 specimen). NORTHWEST GREENLAND: Off Conical Rock, 20–40 fms., 1938; 1 mile northwest Conical Rock, 1940; west side Wolstemholm Island, 1940; all collected by Bartlett. EAST COAST NORTH AMERICA: Off Nova Scotia, Maine, Massachusetts. Rhode Island, low water to 410 fms., U. S. Fish Commission. ALASKA: Eastern Harbor, Sitka, gravelly-mud, 15 fms., 1874; between Pinnacle and Ulakhta, Unalaska, 16 fms., 1874; Captain's Harbor, Unalaska, 25–75 fms., coarse sand, 1874; all collected by Dall. Albatross Sta. Herendeen Bay, 1890. WASHINGTON: Albatross Sta. 2876, 48°33' N., 124°53' W., 59 fms., and Sta. 2879, 48°53' N., 125°53' W., 34 fms., 1888; Strait of Juan de Fuca, Washington and Puget Sounds, low water to 165 fms., Pettibone.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Davis Strait, Greenland, Spitsbergen, Norway, Barents Sea, White Sea, Novaya Zemlya, Kara

Sea. Also Iceland, Faroes to Portugal, Azores, Madeira, Mediterranean, Adriatic; to Rhode Island; to Gulf of California and Mexico; Japan; South Atlantic and Antarctic. In low water to 1,889 fathoms; epitokous phase in surface layers.

Family GONIADIDAE

Body elongated, more or less attenuated at both ends, divided into two regions, anterior region with uniramous parapodia (fig. 31, *f*) and long, wider posterior region with biramous parapodia (fig. 31, *g*). Segments uniannulate. Prostomium sharply conical, transversely annulated, ending distally in four small antennae (fig. 31, *e*). Elongated conical dorsal and ventral cirri (fig. 31, *f*, *g*). Two anal cirri. Notosetae simple; neurosetae compound. Branchiae absent. Proboscis eversible, long, cylindrical, with terminal papillae and proboscoidal organs, a pair of larger, dentate, dark horny macrognaths, and a circlet of many smaller H- or Y-shaped micrognaths. Epitoky involves only biramous portion.

Represented by a single species from Point Barrow.

Genus *Glycinde* F. Müller, 1858

Glycinde wiréni Arwidsson, 1898

FIGURE 31, *e-g*

Goniada nordmanni Wirén, 1883, p. 403, pl. 30, figs. 4, 5, pl. 32, figs. 1, 2; (not *Eone nordmanni* Malmgren, 1867).

Glycinde wiréni Arwidsson, 1898, p. 53, pl. 3, figs. 48, 49.—not Moore, 1908, p. 348 (= *G. armigera* Moore; in USNM).

Description.—Length up to 45 mm., width without setae 2.5 mm., width including setae 5 mm., 120 segments. Anterior region rounded, tapering sharply to pointed anterior end; posterior two-thirds wider, more flattened, tapering gradually posteriorly. Prostomium with 10 annuli; two pairs of small deeply-set eyes, one pair in basal ring, one pair in distal ring (may be obscure). Anterior uniramous region consisting of 30–32 (31 in Arwidsson) setigers, with presetal lobe wide basally, narrowed abruptly to a lanceolate tip; postsetal lobe wide, conical; pre- and postsetal lobes as well as dorsal and ventral cirri subequal in length; a fan-shaped bundle of compound, spinigerous neurosetae. Posterior biramous region with shorter notopodia distinctly separated from neuropodia. Notopodium a short, rounded lobe with a short dorsal cirrus and a short, protruding presetal lobe; notosetae few in number, acicular, hooked at tip, with long pointed hood. Neuropodia with short conical, postsetal lobe, subequal to ventral cirrus; presetal lobe wide basally with a lanceolate narrower tip, longer than postsetal lobe; neurosetae as in anterior region,

except they may be longer and more numerous. Proboscis without chevrons; proboscoidal organs (horny, yellow, spinous processes) of several kinds arranged in longitudinal series. COLOR: In alcohol: Uniformly greenish brown or somewhat banded with one wide, dark-greenish-brown band per segment; iridescent.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 4 miles from shore, 23 to 29.1 fms., on various combinations of mud, sand, gravel, stones, rocks, shells (3 stations, 5 specimens).

Distribution.—Arctic Alaska to Bering Sea. In 23 to 29 fathoms.

Family LUMBRINERIDAE

Body elongate, cylindrical, tapered slightly anteriorly and more strongly posteriorly, superficially resembling oligochaetes. Prostomium conical to rounded, with a pair of nuchal organs on posterior margin, without antennae or palps (fig. 31, *h*). First two segments apodous and achaetous, without tentacular cirri. Without dorsal and ventral cirri. Two to four anal cirri. Parapodia uniramous. Proboscis eversible, with dark, chitinous, well-developed masticatory apparatus consisting of a pair of ventral mandibles and four pairs of maxillary plates (fig. 31, *i, j*).

Represented by a single species from Point Barrow.

Genus *Lumbrineris* Blainville, 1828

Lumbrineris fragilis (O. F. Müller, 1776)

FIGURE 31, *h-n*

Lumbricus fragilis Müller, 1776, p. 216; 1788, p. 22, pl. 22, figs. 1-3.

Lumbrineris fragilis Malmgren, 1867, pl. 14, fig. 83.—Chamberlin, 1920, p. 15.—Eliason, 1920, p. 33.—Berkeley and Berkeley, 1943, p. 130.

Lumbriconereis minuta Théel, 1879, p. 42, pl. 4, figs. 57-59.—Fauvel, 1911, p. 22.—Augener, 1928, p. 732.—Wesenberg-Lund, 1950a, p. 28; 1950b, p. 71.

Lumbriconereis fragilis Fauvel, 1923, p. 430, fig. 171, *k, l*.—Augener, 1928, p. 730, pl. 11, fig. 5.—Annenkova, 1937, p. 167; 1938, p. 167.—Gorbunov, 1946, p. 39.—Thorson, 1946, p. 74.—Zatsepin, 1948, p. 124, pl. 31, fig. 14.—Wesenberg-Lund, 1950a, p. 27; 1950b, p. 69; 1951, p. 55.

Lumbrineris fragilis Hartman, 1944a, pp. 335, 340.

Description.—Length 150-250 mm., width without setae up to 7 mm., width with setae 12 mm. Prostomium conical, pointed. First two achaetous segments about equal to the following segments or the first one slightly longer. Parapodia without branchiae, with presetal lobe short, rounded; postsetal lobe in anterior region of body slightly longer, rounded, diagonally truncate; in middle and posterior regions of body, postsetal lobe extended somewhat dorsally, somewhat digitiform; with arched limbate setae with fine capillary tips, dark amber-colored on basal half, on first 60-100 setigers; with simple (not compound), hooded, hooked setae, dark amber-colored basally, beginning

on setigers 15-24 (22-35 or more); on young specimens, the hooded, hooked setae may begin on more anterior segments; acicula black. With two anal cirri on ventral side of short, dislike pygidium. Jaw formula of proboscis (numbers refer to number of teeth): M II, 4+4 (sometimes 5?); M III, 1+1 (or 2+1); M IV, 1+1. COLOR: In life: Reddish orange, iridescent. In alcohol: Colorless to gray, iridescent; young specimens uniformly reddish brown or somewhat banded with one wide dark brown band per segment.

Remarks.—Three small specimens (0.8 mm. wide without setae) have the hooded, hooked setae beginning on the first one to three setigers as in *L. minuta* Thél. They are considered to be the young of *L. fragilis* as has been suggested earlier by Levinsen (1882) and Eliason (1920).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 20-123.5 fms., on bottoms of mud, stones, worm tubes and various combinations of mud, sand, gravel, stones, rocks, shells (16 stations, 29 specimens). EAST GREENLAND: Off Cape Hold with Hope, 23-40 fms., Bartlett, 1939. EASTERN NORTH AMERICA: Off Labrador, 5-13 fms., *Blue Dolphin* Expeditions, 1949, 1950; off Nova Scotia, Bay of Fundy, Maine, Massachusetts, Rhode Island, 7-452 fms., U. S. Fish Commission; Woods Hole region, low water and dredged, Pettibone, 1950, 1951. ALASKA: Chiachi Islands, 20 fms., mud, Dall, 1874.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Azores, Madeira, Mediterranean; Hudson Bay to Rhode Island; Bering Sea; north Japan Sea. In low water to 1,883 fathoms.

? Larval *Lumbrineris fragilis* (O. F. Müller)

On two occasions nonpelagic larval polychaetes were found in a mucous mass off Point Barrow base: September 9, 1948, 21 fathoms, from breaking rock (the larvae described as rose-red); September 6, 1949, 36 fathoms, attached to tunicate *Boltenia echinata*. Prostomium

FIGURE 31.—Glyceridae: *a*, *Glycera capitata*, dorsal view prostomium; *b*, same, parapodium from anterior region, posterior view; *c*, same, parapodium from middle region, anterior view; *d*, same, one of jaws. Goniadidae: *e*, *Glycinde wiréni*, dorsal view anterior end; *f*, same, uniramous parapodium from anterior region, anterior view; *g*, same, biramous parapodium from posterior region, anterior view. Lumbrineridae: *h*, *Lumbrineris fragilis*, dorsal view anterior end; *i*, same, maxillary plates of jaw apparatus (one of each pair shown); *j*, same, mandibles of jaw apparatus; *k*, same, parapodium from anterior region, posterior view; *l*, same, parapodium from posterior region, posterior view; *m*, same, limbate seta with capillary tips; *n*, same, simple hooded hooked seta (crotchet). (For explanation of symbols see p. 210.)

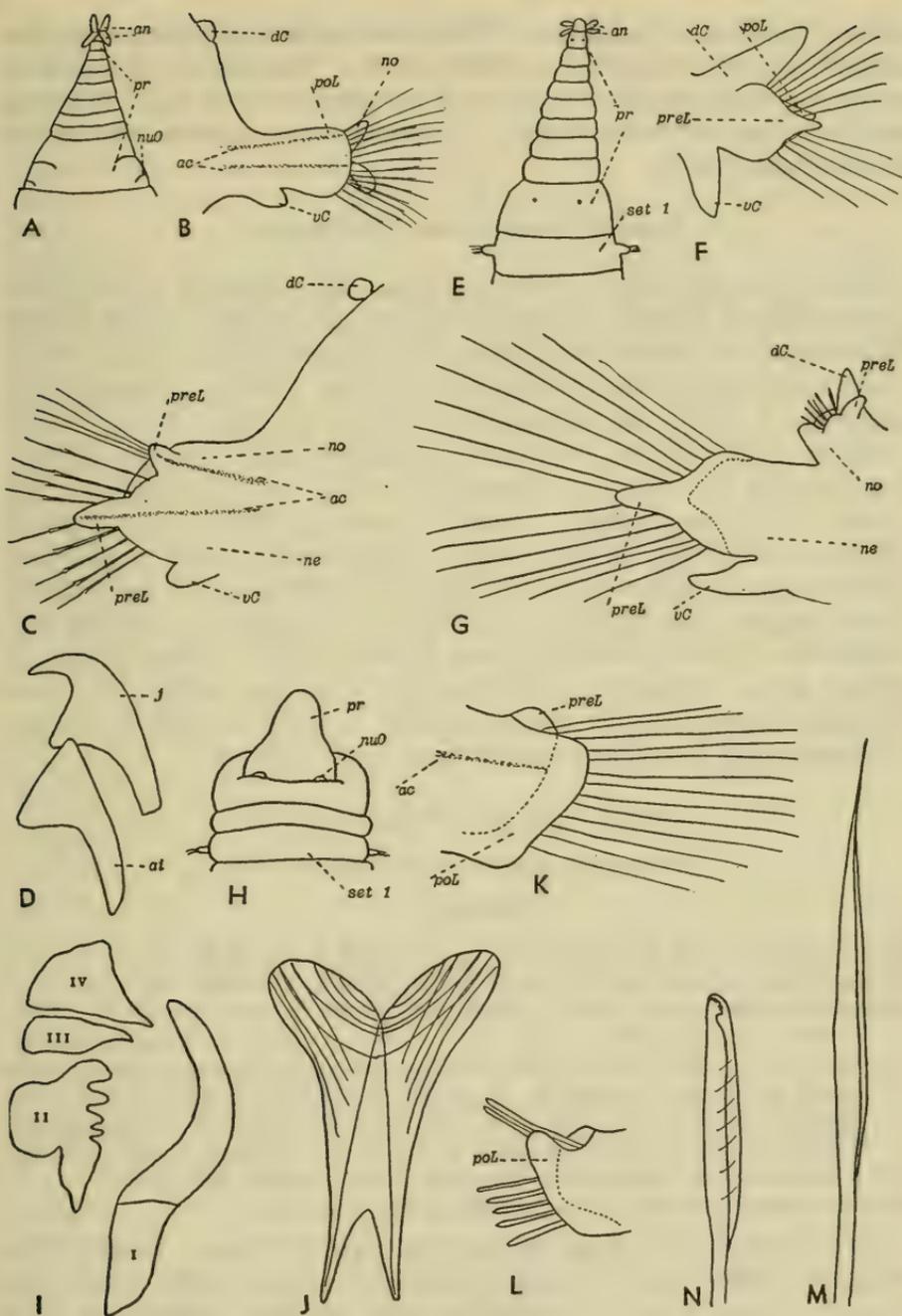


FIGURE 31.—For explanation see facing page.

conical, without appendages. Two wide peristomial segments, the second with wide transverse ciliated band. Setigerous segments 8, gradually tapering posteriorly, each parapodium with single limbate capillary seta and hooded seta. Pygidium bulbous, with wide transverse ciliated band.

Family ORBINIIDAE (ARICIIDAE)

Body long, vermiform, with very numerous segments, divided into two weakly to sharply separable regions: (1) thoracic: More or less flattened dorsoventrally and enlarged; attenuated anteriorly; neuropodia cushionlike, with several rows of setae; notopodia more or less cirriform, a bundle of crenulate capillary setae (fig. 32, *b*); (2) abdominal: Much longer, semicylindrical; neuropodia bilobed, projecting dorsally (fig. 32, *c*). Branchiae medial to notopodia, simple, dorsal, erect, lanceolate or straplike, strongly ciliated, a pair on all segments except the anterior ones. Prostomium conical or globular, without appendages, with or without two small eyes, with two ciliated nuchal organs (fig. 32, *a*). First one or two segments apodous and achaetous. Usually without dorsal or ventral cirri. Setae simple, of varied form. Pygidium with two to four anal cirri. Proboscis eversible, unarmed, a voluminous, weakly- to much-branched, soft sac.

Represented by a single species from Point Barrow.

Genus *Scoloplos* Blainville, 1828

Scoloplos armiger (O. F. Müller, 1776)

FIGURE 32, *a-e*

- Lumbricus armiger* O. F. Müller, 1776, p. 215; 1788, p. 22, pl. 22, figs. 4, 5.
Aricia arctica Hansen, 1882, p. 34, pl. 5, figs. 20-26.—Murdoch, 1885, p. 154.
Scoloplos armiger Fauvel, 1914, p. 224; 1927, p. 20, fig. 6, *k-q*.—Eliason, 1920, p. 39.—Augener, 1928, p. 742.—Monro, 1930, p. 145.—Annenkova, 1931, p. 203; 1937, p. 169; 1938, p. 170.—Okuda, 1937a, p. 102, fig. 4.—Wesenberg-Lund, 1939b, p. 12; 1950a, p. 29; 1950b, p. 73; 1951, p. 58.—Berkeley and Berkeley, 1942, p. 195; 1952, p. 97, figs. 197-199.—Hartman, 1944a, pp. 336, 340, pl. 18, fig. 5 (not pl. 19, fig. 6 (= *Orbinia*)).—Thorson, 1946, p. 78, fig. 37.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 128, pl. 32, fig. 1.
Haploscoloplos alaskensis Hartman, 1948, p. 30, fig. 8, *a-c*.

Description.—Length up to 120 mm., width 2 mm. Prostomium conical, pointed, with two deeply buried eyes (not visible when preserved). First segment achaetous and apodous. Branchiae first appear on setigers 12 or 13 (9-17), very small at first, then triangular, then ligulate. Thoracic region consisting of about 17 setigers (12-20); notopodia with conical postsetal lobes and numerous, finely crenulate setae with capillary tips; neuropodia elongate, cushionlike, with a median postsetal conical lobe, with numerous rows of crenulate

setae with capillary tips; some of these setae in the lower part of the neuropodial bundle may be worn down, with blunt tips resembling crotchets. These so-called crotchets may be more or less numerous on all thoracic segments or on some only, or may be lacking. Abdominal region having an exceedingly straggly appearance with the dorsally directed branchiae and parapodial lobes; notopodia with erect, digitiform postsetal lobes and capillary crenulate setae and sometimes also with forked setae; neuropodia with two conical, unequal lips, with capillary crenulate setae and an elongate thickened parapodial flange below the neuropodial lobe. On the last few thoracic and first few abdominal segments there may be one or two extra conical podal lobes, one at the level of the lower part of the neuropodial setae and one subpodal; they are in the transitional region of thoracic and abdominal regions and become part of the parapodial flanges of the abdominal segments. Without intermediate interramal cirri, but with lateral, ciliated organs between the rami. Pygidium with two filiform anal cirri. Proboscis soft, more or less lobed. COLOR: In alcohol: Without color or yellowish brown, with darker areas on the elongate neuropodial flanges of the abdominal region and on the branchiae.

Remarks.—*Haploscoloplos alaskensis* Hartman from southwestern Alaska is herein referred to *S. armiger*. It differs from the typical *S. armiger* in lacking crotchets in the thoracic neuropodia. As indicated previously by Fauvel (1914) and others, this seems to be a variable character, perhaps associated with the substratum and age. The crotchets were not present on small specimens from Point Barrow, and they may be more numerous in some parapodia than in others and more abundant in the lower part of the neuropodia; they appear to be worn crenulate capillary setae. On certain substrata, presumably, the setae may not be worn and thus the so-called crotchets are absent.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow; west side Elson Lagoon near entrance to small lagoon to the west, 1.2 fms.; off Point Barrow base, up to 12.1 miles from shore, 1.7–75.5 fms., on bottoms of mud, stones, and various combinations of mud, gravel, stones, rocks, large perforated rocks (12 stations, 19 specimens). Between Icy Cape and Cape Lisburne, 15–20 fms., mud, sand, Dall, 1874. EAST COAST NORTH AMERICA: Bay of Fundy, Maine, Massachusetts, 13–48 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Shetlands to France, Mediterranean; Labrador to

Massachusetts; southern Alaska to British Columbia; Japan; South Pacific (Chile); Antarctic; off South Africa. In low water to 1,100 fathoms.

Family SPIONIDAE

Body vermiform, without distinct regions. Prostomium small, elongated, scarcely separated from an enlarged peristomium lateral to prostomium, with or without eyes (usually four), antennae usually lacking (may be a small occipital antenna), two very long, extensile, tentaculiform, longitudinally grooved, easily deciduous palps (fig. 32, *f, i, l, r*). Parapodia biramous, with dorsal and ventral postsetal lamellae more or less developed; dorsal and ventral cirri lacking (fig. 32, *g, s*). With ligulate or cirriform dorsal branchiae on upper part of parapodial bases on a certain number of segments (rarely pinnate, rarely lacking). Setae simple capillaries and hooded crotchets (fig. 32, *h, k, q*). Pygidium terminated in an anal cup (fig. 32, *p*) or anal cirri. Proboscis short, scarcely or somewhat protrusible, may be somewhat lobulated.

Represented by four genera and four species from Point Barrow. All genera have branchiae present on certain segments and prostomia without frontal horns.

Key to the genera of Spionidae from Point Barrow

1. Setigerous segment 5 strongly modified with special large amber-colored setae and without dorsal and ventral lamellae (fig. 32, *m, n*). Branchiae numerous, paired, dorsal, simple, straplike. Notopodia with capillary setae only; neuropodia with capillary setae and hooded bidentate crotchets beginning on setigers 7 or 8 (fig. 32, *q*). Pygidium ending in anal cup (fig. 32, *p*)-----**Polydora** (p. 280)
- Setigerous segment 5 not modified----- 2
2. Branchiae on only few anterior segments, 3-11 pairs, often pinnate (fig. 32, *j*), beginning on setiger 2. Capillary setae and hooded crotchets in both noto- and neuropodia. Pygidium with anal cirri-----**Prionospio** (p. 282)
- Branchiae more numerous, simple, straplike. Notopodia with capillary setae only; neuropodia with capillary setae and hooded crotchets----- 3
3. Branchiae begin on setiger 1, continuing up to last setigers. Pygidium with anal cirri-----**Spio** (p. 284)
- Branchiae begin on setiger 2, continuing on large number of segments. Pygidium with anal cup, may be somewhat lobulated----- **Nerinides** (p. 285)

Genus *Polydora* Bosc, 1801

Polydora caulleryi Mesnil, 1897

FIGURE 32, *l-q*

Polydora caulleryi Mesnil, 1897, p. 88, pl. 3, figs. 12-16.—Fauvel, 1927, p. 54, fig. 19, *f-h*.

Polydora brachycephala Hartman, 1936c, p. 48, figs. 3-5; 1944b, p. 258.

Description.—Up to 50 mm. long, 2.2 mm. wide. Prostomium feebly notched anteriorly or distinctly bifid, prolonged posteriorly in a crest extending to setiger 4 (to 6), without distinct occipital antenna, with four eyes in trapezoidal arrangement (or six in young specimens) or eyes lacking. Palps usually missing in alcohol. A protrusible, somewhat lobulated, brownish proboscis region. Branchiae begin on setigers 7 or 8, continuing on numerous segments, absent from more posterior segments; branchiae short (about length of capillary notosetae), straplike, continuous with dorsal lamellae. Modified setiger 5 with group of capillary notosetae, usually 5–7 (3–12) special amber-colored hooks, and group of capillary neurosetae; special hooks all similar, falcate, with pectinate top. With conspicuous, somewhat conical dorsal and ventral postsetal lamellae on setigers 1–4, lacking on modified setiger 5, becoming rather low and wide on more posterior segments. With capillary setae in both notopodia and neuropodia; beginning on setiger 7, neuropodial capillary setae mostly replaced by hooded bidentate crotchets. In more posterior setigers (last 20 or so), notopodia conical, lacking branchiae or lamellae, with conical bundle of awl-shaped setae scarcely surpassing notopodial tip and small bundle of capillary setae; neuropodia with two or three crotchets and few capillary setae. Anal disc with complete middorsal notch, shorter midventral and midlateral notches, thus 4-lobed. COLOR: In alcohol: Without color or grayish.

Remarks.—The type of *P. brachycephala* Hartman from central California was examined and is herein referred to *P. caulleryi*.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 8 miles from shore, 16.7–75.5 fms., on bottoms of stones and various combinations of mud, gravel, stones, rocks, large perforated rocks, with bryozoans and hydroids (8 stations, 16 specimens). WEST COAST NORTH AMERICA: Washington and Puget Sounds, low water to 50 fms., Pettibone.

Distribution.—Arctic Alaska to central California; Ireland, Great Britain to France. In low water to 75.5 fathoms.

Polydora larva

A larva of a *Polydora* was taken in plankton August 2, 1948. This was perhaps the larva of *P. caulleryi* Mesnil since it was the only species of *Polydora* found in the Point Barrow region. Prostomium rounded, with two palps, and with black chromatophores. Fifth setigerous segment modified, with short, thick, slightly curved acicular setae; rest of 21 setigerous segments with long larval capillary setae. Pygidium a rounded disc, notched middorsally, with black chromatophores. Black chromatophores arranged transversely on setigers 2–5, then in two longitudinal lines on each side of middorsal line, extending to anal cup.

Genus *Prionospio* Malmgren, 1867*Prionospio malmgreni* Claparède, 1868FIGURE 32, *i-k*

Prionospio malmgreni Claparède, 1868, p. 333, pl. 22, fig. 3 (fide Fauvel, 1927).—Ehlers, 1913, p. 511.—Fauvel, 1927, p. 61, fig. 21, a-e.—Annenkova, 1937, p. 171; 1938, p. 174.—Hartman, 1948, p. 36.—Wesenberg-Lund, 1951, p. 70.—Berkeley and Berkeley, 1952, p. 29, figs. 54, 55.

Spiophanes tenuis Verrill, 1879b, p. 176.

Prionospio tenuis Verrill, 1882, p. 370.—Hartman, 1944a, pp. 336, 340, ? pl. 19, fig. 7; not 1945, p. 32 (= *P. treadwelli* Hartman, 1951).

Description.—Length up to 25 mm., width 1 mm. Prostomium dilated anteriorly, with anterior border rounded, narrowing posteriorly, extending in obtuse crest to setiger 2 (to 4). Four eyes, two smaller, two much larger (may be lacking). Two long palps, usually missing (in alcohol). A short, eversible, somewhat lobulated proboscicial region. Branchiae four pairs, on setigers 2–5, completely separated from dorsal lamellae, pairs 1 and 4 longer, pinnate, somewhat deciduous, pairs 2 and 3 shorter, smooth, triangular. Dorsal postsetal lamellae of first setiger small, much larger and triangular on next four setigers, then diminishing in size, becoming reduced beginning on setigers 8 or 9; ventral postsetal lamellae oval, rounded. Hooded, multidentate crotchets beginning about setigers 12–16 in neuropodia and about setiger 40 in notopodia. Beginning on setiger 7, slightly elevated transverse folds between dorsal lamellae, continuing on next 6–14 segments. Pygidium with longer, unpaired dorsal cirrus and two smaller lateral ones. Without color in alcohol.

Remarks.—The types of *Prionospio tenuis* Verrill from Cape Cod Bay were examined and are herein referred to *P. malmgreni*. There are four pairs of branchiae, the first and fourth pairs pinnate, the second and third pairs shorter, smooth.

New records.—ARCTIC ALASKA: Off Point Barrow base, 4 miles from shore, 29 fms., on bottom of gravel, small stones (1 station, 2 speci-

FIGURE 32.—Orbiniidae: *a*, *Scoloplos armiger*, dorsal view anterior end; *b*, same, parapodium from thoracic region, posterior view; *c*, same, parapodium from abdominal region, anterior view; *d*, *e*, same, crenulate neurosetae from thoracic region. Spionidae: *f*, *Spio filicornis*, dorsal view anterior end (palps missing); *g*, same, parapodium from anterior region, anterior view; *h*, same, hooded bidentate crotchet; *i*, *Prionospio malmgreni*, dorsal view anterior end; *j*, same, branchiae on setigers 2–5 (one of each pair shown); *k*, same, hooded multidentate crotchet; *l*, *Polydora caulleryi*, dorsal view anterior end (palps missing); *m*, same, parapodium of modified fifth setigerous segment; *n*, same, special hooks from setiger 5; *o*, same, notopodium of posterior setiger, with conical bundle awl-shaped setae; *p*, same, anal disc of pygidium, lateral view; *q*, same, hooded bidentate crotchet, *r*, *Nerinides* sp., dorsal view anterior end; *s*, same, parapodium from anterior region. (For explanation of symbols, see p. 210.)

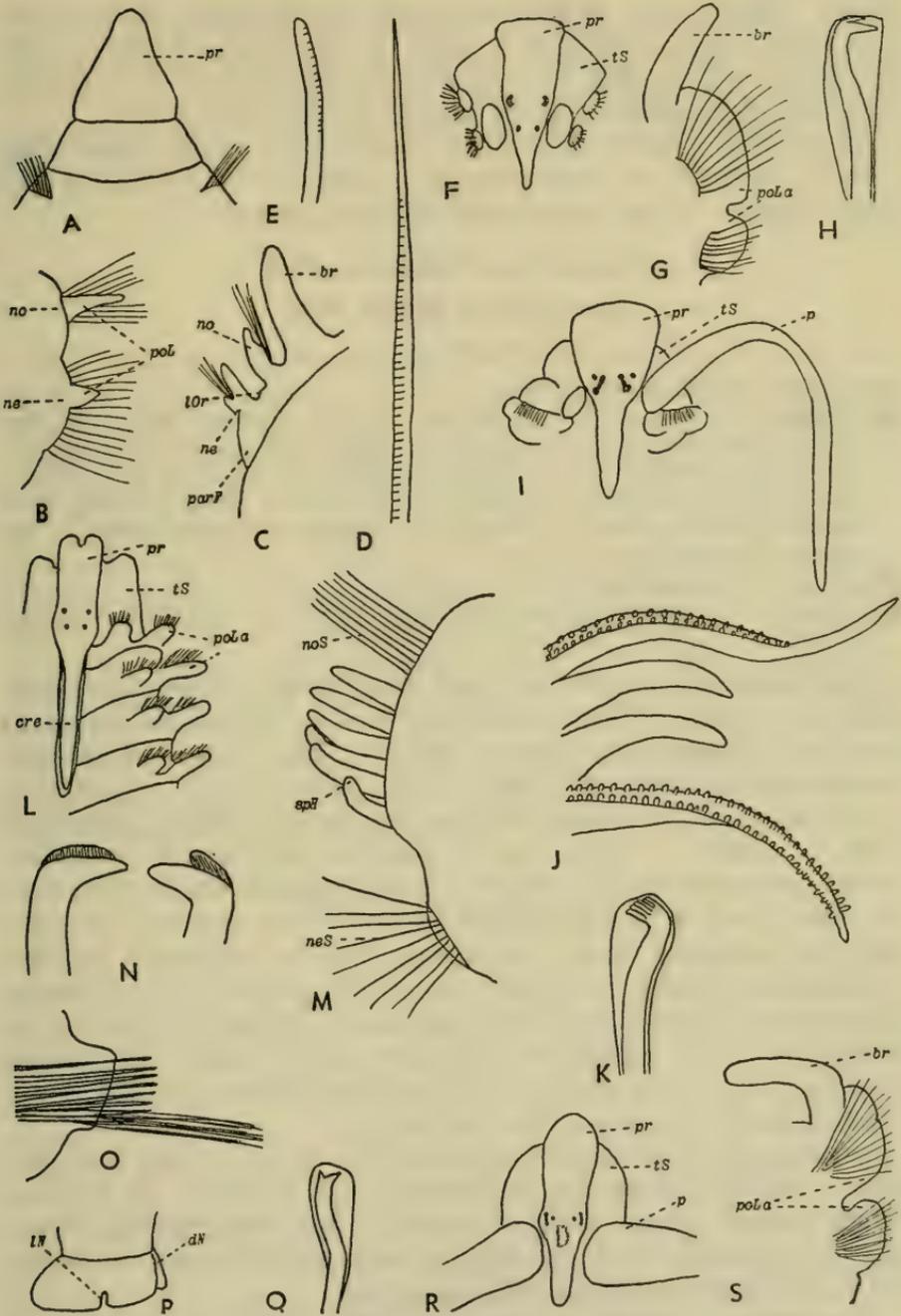


FIGURE 32.—For explanation see facing page.

mens). WEST COAST NORTH AMERICA: Puget Sound, Washington, low water, mud, Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 40 fms., *Blue Dolphin* Expedition, 1949; off New Hampshire and Massachusetts, 25-48 fms., U. S. Fish Commission.

Distribution.—Arctic Alaska to Washington; north Japan Sea; Iceland, Norway to Mediterranean; Labrador to Massachusetts; South Africa. In low water to 250 fathoms; surface.

Genus *Spio* Fabricius, 1785

Spio filicornis (Müller, 1776)

FIGURE 32, f-h

Nereis filicornis Müller, 1776, p. 218.

Spio filicornis Malmgren, 1867, p. 91, pl. 1, fig. 1.—Eliason, 1920, p. 40, figs. 7-9.—Fauvel, 1927, p. 43, fig. 15, a-g.—Augener, 1928, p. 738, pl. 11, fig. 7.—Annenkova, 1937, p. 169; 1938, p. 173.—Hartman, 1941a, p. 293; 1948, p. 36.—Berkeley and Berkeley, 1943, p. 130.—Thorson, 1946, p. 93, fig. 46.—Zatsepin, 1948, p. 132, pl. 32, fig. 11.—Wesenberg-Lund, 1950a, p. 30; 1950b, p. 76; 1951, p. 71.

Spio limicola Verrill, 1879, p. 176.

Spio filicornis var. *pacifica* Berkeley and Berkeley, 1936, p. 475; 1952, p. 25, figs. 47, 48.

Description.—Up to 30 mm. long, 2 mm. wide. Prostomium bell-shaped to conical, widest anteriorly, rounded, tapered posteriorly to short crest extending on first two setigers. Four eyes in trapezoidal arrangement, anterior pair larger. Two palps missing (in alcohol). A short, eversible, somewhat lobulated proboscoidal region. Branchiae begin on setiger 1, continuing to posterior end, simple, straplike. Dorsal postsetal lamellae of more anterior segments short, wide, with branchiae fused to upper sides; in more posterior segments, lamellae cirriform, separate from branchiae. Ventral postsetal lamellae rounded, not notched. Capillary setae only in notopodia. Neuropodia with hooded, bidentate crotchets beginning on setigers 9-18, about six in number (5-10). Pygidium with four cirri? COLOR: In alcohol: Yellowish white with dark brown pigment on peristomial region and along each side of anterior fourth of body.

Remarks.—The types of *Spio limicola* Verrill from Cape Cod Bay were examined and are herein referred to *S. filicornis*. *S. limicola* differs from *S. setosa* Verrill, to which it has been referred (Hartman, 1942, p. 63), in the number of neuropodial hooded crotchets, 6-9 in *S. limicola* and about 16 in *S. setosa*.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 8 miles from shore, 36-75.5 fms., on various combinations of gravel, rocks, stones, large perforated rocks (2 stations, 2 specimens). WEST COAST NORTH AMERICA: Washington Sound, low water, Pettibone. EAST COAST NORTH AMERICA: Off Massachusetts, 15-31 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Davis Strait, Greenland, Spitsbergen, Novaya Zemlya. Also Iceland, Faroes, Norway to France; Hudson Bay to Massachusetts; Bering Sea to central California; Japan. In low water to 211 fathoms; surface.

Genus *Nerinides* Mesnil, 1896

Nerinides sp.

FIGURE 32, *r*, *s*

Two small specimens obtained from plankton 10 feet from shore, agreeing in some respects with the description of *N. cantabra* Rioja (Fauvel, 1927, p. 31). Length 16 mm., width 1 mm., segments 57. Prostomium rounded anteriorly, tapering posteriorly, with middorsal crest extending on first setiger, with four eyes, one pair larger, a raised area just posterior to eyes (median antenna?), with two large, thick palps (fig. 32, *r*). Dorsal and ventral postsetal lamellae distinct, dorsal ones may be slightly undulate, ventral ones entire, not notched (fig. 32, *s*). Branchiae begin on setiger 2, continuing to near posterior end, fused to upper part of dorsal lamellae. Body with low transverse dorsal ridges between bases of branchiae. First setiger with both dorsal and ventral setae. Notopodia with only capillary setae, being extra long in posterior region. Neuropodia with capillary setae and hooded bidentate crotchets beginning around setiger 20. Pygidium with 4-lobed membranous appendage. Without color in alcohol.

Family CIRRATULIDAE

Body more or less cylindrical, attenuated at both ends, with numerous, short, compact, nearly similar segments. Prostomium small, usually without appendages, with or without eyes. Pair of large grooved spioniform palps (fig. 33, *d*) or with more or less numerous grooved tentacular filaments inserted on dorsal surface of an anterior segment (fig. 33, *a*). Branchiae simple, filamentous, long, contractile, inserted above notopodia on few to many segments (may be absent). Parapodia biramous, lobes scarcely projecting (fig. 33, *b*). Setae usually simple, some capillary, others acicular crotchets (fig. 33, *c*). Without dorsal, ventral, or anal cirri. Proboscis smooth, unarmed. May have epitokous pelagic form at time of reproduction. Usually in mud; some (*Dodecaceria*) in calcareous matrix.

Represented by two genera and two species from Point Barrow. Both genera have prostomium conical, buccal segment and two following segments achaetous, more or less fused to prostomium, with lateral filamentous branchiae beginning just anterior to first setigerous segment, continuing on large number of segments.

Key to the genera of Cirratulidae from Point Barrow

1. With few to numerous, grooved tentacular filaments just anterior to first setigerous segment, subequal to branchiae (without 2 palps; fig. 33, a).

Cirratulus (p. 286)

- With 2 large grooved, spioniform palps just anterior to first setigerous segment (without tentacular filaments; palps deciduous; may be missing in epitoke; fig. 33, d)-----*Chaetozone* (p. 287)

Genus *Cirratulus* Lamarck, 1801*Cirratulus cirratus* (Müller, 1776)

FIGURE 33, a-c

Lumbricus cirratus Müller, 1776, p. 215.

Cirratulus cirratus Malmgren, 1867, p. 95.—Chamberlin, 1920, p. 20.—Eliason, 1920, p. 57.—Fauvel, 1927, p. 94, fig. 33, a-g; 1933, p. 46; 1936, p. 72.—Augener, 1928, p. 750, pl. 11, fig. 9.—Monro, 1930, p. 154; 1936, p. 161.—Annenkova, 1931, p. 203; 1932, p. 136; 1934, p. 322; 1937, p. 173; 1938, p. 181.—Berkeley and Berkeley, 1942, p. 197; 1943, p. 130; 1952, p. 31, figs. 58, 59.—Hartman, 1944a, pp. 334, 341; 1944b, p. 263; 1948, p. 37.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 133, pl. 32, fig. 18.—Wesenberg-Lund, 1950a, p. 33; 1950b, p. 81; 1951, p. 74.—Hartman and Reish, 1950, p. 34.

Cirratulus robustus Johnson, 1901, p. 423, pl. 14, figs. 149, 150.—Rioja, 1941, p. 728.—Berkeley and Berkeley, 1942, p. 197.

Cirratulus cingulatus Johnson, 1901, p. 422, pl. 14, figs. 145-148.—Rioja, 1941, p. 729.

Cirratulus spectabilis Berkeley and Berkeley, 1952, p. 32.

Description.—Length up to 300 mm., width 5 mm. Prostomium variable in shape: Short, broad, bluntly conical; almost square-shaped; or tapered gradually, then abruptly. Prostomium with usually four or five (2-8) eyes on each side in obliquely transverse row or may be united in almost solid arc. Buccal segment more or less fused with prostomium, two following achaetous segments more or less distinct. Tentacular filaments anterior to first setigerous segment, in two groups of 2-24 in obliquely transverse rows, long, filamentous, grooved longitudinally. Branchiae begin just anterior to first setigerous segment, lateral to group of tentacular filaments, continuing through greater part of body, anteriorly inserted close to upper part of notopodia, then gradually shifting more dorsally and then slightly more ventrally. Parapodia consisting of slightly projecting tori common to both noto- and neuropodia, with capillary setae in both lobes, with additional acicular crotchets first appearing in neuropodia and more posteriorly in notopodia also. Anus subdorsal. COLOR: In life: Orange yellow with red branchiae; dark orange brown with orange-red branchiae. In alcohol: Yellowish brown or without color.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 5-6.6 fms.; off Point Barrow base, up to 8 miles from

shore, 13.3–75.5 fms., on bottoms of stones, and various combinations of mud, pebbles, rock, stones, gravel, large perforated rocks, with bryozoans, embedded in mud at bases of barnacles and bryozoans as *Eucratea loricata* (19 stations, 183 specimens). SIBERIA: Plover Bay, 10–35 fms., Dall, 1880. BERING SEA: *Albatross* station, Nikolski, Bering Island, 1892; St. George Island, Pribilofs, 2 miles off shore, 40 fms., Hanna, 1913; Atka Island, Aleutians, L. M. Turner, 1879. WEST COAST NORTH AMERICA: Strait of Juan de Fuca, Washington and Puget Sounds, low water, Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 95 fms., *Blue Dolphin* Expedition, 1949; off Maine, Massachusetts, low water to 67 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Barents Sea, Novaya Zemlya. Also Iceland, Faroes, Norway to France, Canary Islands; Hudson Bay to Massachusetts; Bering Sea to México; north Japan Sea to Japan, Manchuria. Southern latitudes: Falkland Islands, Magellan Straits, South Georgia, Kerguelen. In low water to 1,611 fathoms.

Genus *Chaetozone* Malmgren, 1867

Chaetozone setosa Malmgren, 1867

FIGURE 33, d

Chaetozone setosa Malmgren, 1867, p. 96, pl. 14, fig. 84.—Théel, 1879, p. 54, pl. 4, figs. 49–51.—Fauvel, 1914, p. 217, pl. 20, fig. 1; 1927, p. 101, fig. 35; 1934a, p. 47.—Eliason, 1920, p. 57.—Augener, 1928, p. 750.—Gustafson, 1936, p. 8.—Monro, 1937, p. 301.—Annenkova, 1937, p. 174; 1938, p. 182.—Berkeley and Berkeley, 1942, p. 197; 1952, p. 35, fig. 63.—Hartman, 1944a, pp. 334, 341.—Zatsepin, 1948, p. 133, pl. 32, fig. 16.—Wesenberg-Lund, 1950a, p. 34; 1950b, p. 81; 1951, p. 75.

Description.—Length up to 25 mm., width 2 mm. Prostomium conical, acutely pointed, without eyes. Buccal segment and two following achaetous segments more or less fused; in specimens from Point Barrow, buccal segment fused with prostomium, second and third segments fused dorsally. Paired palps large, long, grooved, inserted just anterior to first setigerous segment, deciduous, often missing on preserved specimens and missing when in epitokous phase. Branchial filaments begin just anterior to first setigerous segment, immediately posterior to palps, continuing on large number of anterior segments, lacking on posterior region, readily deciduous, inserted just posterior to upper part of parapodial tori. Parapodia are slightly projecting tori common to both noto- and neuropodia. In anterior region, both lobes with long, delicate capillary setae; more posteriorly, notopodia with still longer capillary setae, neuropodia with shorter, stouter capillary setae and short, unidentate acicular crotchets; more posteriorly, with acicular crotchets in both noto- and neuropodia.

In epitokous phase, dorsal setae in anterior region much longer; in posterior region, parapodial tori more projecting, dorsal and ventral acicular crotchets forming semicircular, fan-shaped group, almost encircling body. Pygidium with small, rounded to conical lobe, ventral and posterior to anus (like a cover for anal opening). COLOR: In alcohol: Light to dark gray, brownish, or iridescent bluish black.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 20–123.5 fms., on various combinations of mud, stones, gravel, rocks, large perforated rocks, mass of worm tubes, on surface of tunicates (12 stations, 29 specimens). EAST COAST NORTH AMERICA: Off Labrador, 95–125 fms., *Blue Dolphin Expedition*, 1949; off Maine, New Hampshire, Massachusetts, 11–58 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Davis Strait, Greenland, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya. Also Iceland, Faroes, Norway to Canary Islands, Mediterranean, Adriatic, Gulf of Aden; Labrador to Massachusetts; Bering Sea to British Columbia; north Japan Sea. Southern latitudes: Falkland Islands, Magellan Straits, Kerguelen. In low water to 1,333 fathoms; surface.

Family FLABELLIGERIDAE (CHLORAEMIDAE)

Body subcylindrical or subfusiform, with short similar segments covered with papillae, often with adherent sand grains, may be encased in thick mucous mantle. Prostomium and buccal segment fused, with two thick grooved palps, two groups of filiform cephalic branchiae, and more or less developed buccal tube around mouth, all of which may be partially or completely retracted within anterior setigers, with or without setae of anterior setigers directed anteriorly forming a cephalic cage. Parapodia biramous; notosetae simple, capillary, ringed; neurosetae simple or pseudocompound, capillary or hooked. Without dorsal, ventral, or anal cirri. Anus terminal. Usually in muddy sand.

Represented by two genera and three species from Point Barrow.

Key to the genera of Flabelligeridae from Point Barrow

1. Body covered with long pedunculate papillae (fig. 33, *g*), usually encased in thick mucous mantle. Fused prostomium and buccal segment partially retractile within first setigers and more or less hidden by cephalic cage formed by setae of first setiger, the setae long, directed anteriorly, almost completely encircling segment.----- **Flabelligera** (p. 289)
 Body covered with short papillae, usually encrusted with sand, not encased in mucous mantle. Fused prostomium and buccal segment completely retractile within anterior setigers, may be completely hidden; without cephalic cage formed by anterior setigers; when buccal segment, etc. are retracted, anterior end is trilobed (fig. 33, *h*)----- **Brada** (p. 290)

Genus *Flabelligera* Sars, 1829*Flabelligera affinis* Sars, 1829

FIGURE 33, e-g

- Flabelligera affinis* Sars, 1829, p. 31, pl. 3, fig. 16 (fide Malmgren, 1867).—Malmgren, 1867, p. 83.—Chamberlin, 1920, p. 21.—Eliason, 1920, p. 62.—Fauvel, 1927, p. 113, fig. 40, a-f.—Augener, 1928, p. 768.—Monro, 1930, p. 160, fig. 63; 1936, p. 164.—Annenkova, 1937, p. 174; 1938, p. 184.—Berkeley and Berkeley, 1943, p. 130.—Hartman, 1944a, pp. 335, 341, pl. 33, figs. 12, 13 (as ?*Brada setosa* Verrill).—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 134, pl. 33, fig. 1.—Støp-Bowitz, 1948a, p. 8, fig. 1; 1948b, p. 30.—Wesenberg-Lund, 1950a, p. 35; 1950b, p. 82; 1951, p. 76.
- Flabelligera infundibularis* Johnson, 1901, p. 417, pl. 12, figs. 124-127.—Hartman, 1938c, p. 14; 1948, p. 40.—Berkeley and Berkeley, 1952, p. 7, figs. 1-4.
- Flabelligera infundibularum* Moore, 1923, p. 223.
- Flabelligera infundibuliformis* Hartman and Reish, 1950, p. 35.

Description.—Length up to 130 mm., width including mantle 12-15 mm., segments up to 71. Body rounded, attenuated slightly anteriorly and more so posteriorly. Body covered with numerous papillae which are elongate, thin, flexible, usually somewhat coiled, with larger bulbous tips quite variable in shape. Body usually covered with thick, mucous, transparent mantle (may be missing in small specimens or specimens appearing in surface waters) which is penetrated by the pedunculate papillae. Fused prostomium and buccal segment retractile within anterior setiger, with pair of stout, grooved palps, two groups of numerous filiform branchiae, two pairs of eyes (almost coalesced), and somewhat protruding buccal siphon around ventral mouth opening. First setigerous segment with wide, funnellike depression into which buccal siphon, etc., can mostly be withdrawn; with cirlet of elongated, ringed setae around margin and directed forward or spread funnellike, forming cephalic cage; with numerous elongate papillae having slender straight peduncles and fusiform tips. Notopodia conical, diagonally truncate lobes, with capillary ringed setae, with elongate papillae on posterior side that may be up to three-fourths length of notosetae (similar in shape to those around cephalic cage; different from those on body). Neuropodia conical, each with usually one (sometimes two) large, hooked, amber-colored pseudo-compound seta, ringed basally, hooked tips dark to black. When mucous mantle is present, setae almost completely embedded and the hooked tips of neurosetae and capillary tips of notosetae only extending beyond mantle. Pygidium a fleshy, rounded rim; anus subdorsal. COLOR: In alcohol: Without color or slightly reddish brown.

New records.—ARCTIC ALASKA: West side Elson Lagoon near entrance to small lagoon to west, 1.2 fms.; Point Barrow base, washed ashore; off Point Barrow base, 18.3-123.5 fms., on various combina-

tions of mud, stones, gravel, rocks, with mass of worm tubes (12 stations, 15 specimens). **BERING SEA:** *Albatross* Sta. 3274, 55°34' N., 162°31' W., 19 fms., and station at Unalaska, Aleutians, 1890; Iluliuk Harbor, Unalaska, Dall, 1871. **WEST COAST NORTH AMERICA:** Washington and Puget Sounds, 10 fms. and surface, Pettibone. **CANADIAN ARCTIC:** Dobbin Bay, east Ellesmere Land, 79°36' N., 73°35' W., 16 fms., W. H. Littlewood, 1950. Foxe Basin, Baffin Island, 66°83' N., 80°07' W., Bartlett, 1927. **WEST GREENLAND:** Between Capes Alexander and Chalon, 25-40 fms., Bartlett, 1937. **EAST COAST NORTH AMERICA:** Off Labrador, 10-30 fms., *Blue Dolphin* Expeditions, 1949, 1950; Grand Manan, Maine, New Hampshire, Massachusetts, 3-90 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Barents Sea, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France, Mediterranean; Hudson Bay to Massachusetts; Bering Sea to southern California; north Japan Sea. Southern latitudes: Falkland Islands, Magellan Straits, South Georgia, South Africa, Australia. In low water to 889 fathoms; surface.

Genus *Brada* Stimpson, 1854

Key to the species of *Brada* from Point Barrow

1. Body covered with filiform papillae, often encrusted with sand grains, with tips of papillae bare. Notopodia distinct, with 2-5 capillary setae per lobe.

B. villosa

Body covered with low globular papillae, often encrusted with a thin layer of sand grains. Notopodia indistinct, with 0-2 very delicate capillary setae.

B. inhabilis

Brada villosa (Rathke, 1843)

Siphonostoma villosum Rathke, 1843, p. 215, pl. 11, figs. 11, 12.

Brada villosa Malmgren, 1867, p. 84.—Eliason, 1920, p. 62.—Chamberlin, 1920, p. 22.—Fauvel, 1927, p. 121, fig. 43, e-1; 1934a, p. 49.—Monro, 1930, p. 161; 1937, p. 303.—Annenkova, 1937, p. 175; 1938, p. 185.—Okuda, 1937b, p. 53, pl. 2, fig. D.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 7, fig. 5.—Zatsepin, 1948, p. 136, pl. 33, fig. 4.—Støp-Bowitz, 1948a, p. 33, fig. 9; 1948b, p. 39, fig. 15.—Hartman and Reish, 1950, p. 35.—Wesenberg-Lund, 1950a, p. 35; 1950b, p. 85; 1951, p. 78, fig. 7.

Brada setosa Verrill, 1873, pp. 431, 434, 508, 606; 1881, p. 302, pl. 9, fig. 4.—Sumner, Osburn and Cole, 1913, p. 630.

Trophonia rugosa Hansen, 1882, p. 38, pl. 7, figs. 9-12.

Trophonia arctica Hansen, 1882, p. 39, pl. 7, figs. 17-20.

Brada granulata Murdoch, 1885, p. 155 (not *B. granulata* Malmgren, 1867).

Brada pilosa Moore, 1906b, p. 231, pl. 10, figs. 14-17.

Stylaroides pluribranchiata Moore, 1923, p. 222.

Brada rugosa Støp-Bowitz, 1948a, p. 37, fig. 10; 1948b, p. 41.

Description.—Length 28–60 mm., width 5–9 mm., setigers 23–35. Body fusiform, slightly flattened ventrally, convex dorsally, attenuated and more or less elongated posteriorly, having a characteristic rough, hirsute aspect, covered with cylindrical, fusiform to claviform papillae, longer dorsally than ventrally, usually encrusted with sand grains more basally, with distal tips bare; there are all gradations: Without encrusting sand (looks “hairy”), with scattered sand grains, and with rather thick layer of sand grains, usually fewer on antero-ventral part. Underlying surface nodular and, in larger specimens, outer papillate layer may be worn off, the surface appearing rugose, with low mounds. Retractable prostomium and buccal region with two groups of numerous filiform branchiae borne on pair of dorsolateral bosses, pair of thick grooved palps, and ventral eversible buccal siphon around mouth. Setae of first setigerous segment 8–10 per bundle, slightly more elongate than following, directed anteriorly. Notopodia and neuropodia distinct, with long fusiform papillae grouped around setae. Notosetae long, capillary, ringed, 2–5 in number. Neurosetae beginning on setiger 2, large, 3–6 in number, amber-colored, ending in sharp, transparent, and fragile tips. Pair of nephridial papillae near anterior border of ventral side of setiger 5. COLOR: In life and in alcohol: Brownish, dull sandy-mud.

Remarks.—The types of *Brada setosa* Verrill from Massachusetts, *B. pilosa* Moore from Alaska, and *Stylaroides pluribranchiata* Moore from California were examined and are herein referred to *B. villosa*. The excessive “hairiness” of *B. pilosa* appears to be a variable character; there may be varying numbers of papillae as well as all gradations in the amount of encrusting sand grains. Two large specimens washed ashore at Point Barrow were at first identified as *B. rugosa*, following Støp-Bowitz (1948); they agree in the large size (23–24 setigers, 28–30 mm. long, 5–7 mm. wide), the almost complete absence of papillation, and the thick rugose surface; the outer surface, however, appears to be worn off. There are some remains of the papillated surface on the parapodial lobes. Thus *B. rugosa* (including *T. arctica*) is herein referred to *B. villosa*, where it has been referred earlier by Fauvel and others.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore September 22, 1949 (22 specimens), August 10, 1950 (2 specimens); off Point Barrow base, up to 4 miles from shore, 27–29 fms., on various combinations of mud, gravel, stones, rocks (2 stations, 2 specimens). BERING SEA: 62°15' N., 167°48' W., Stoney, 1884; *Albatross* Sta. 3337, 53°55' N., 163°26' W., 280 fms., 1890. WEST COAST NORTH AMERICA: Washington Sound, Pettibone; *Albatross* Sta., northwest West Point, Elliot Bay, Seattle, 1914. EAST COAST NORTH AMERICA: Off Nova

Scotia, Maine, Massachusetts, Rhode Island, 6-499 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Barents Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Spain, Mediterranean, Adriatic, south Arabian Coast; Hudson Bay to Rhode Island; Bering Sea to southern California; north Japan Sea to Japan; South Atlantic: South Orkney and South Shetland Islands. In low water to 853 fathoms.

***Brada inhabilis* (Rathke, 1843)**

FIGURE 33, h

Siphonostoma inhabile Rathke, 1843, p. 218, pl. 11, fig. 13.

Brada sublaevis Stimpson, 1854, p. 32.—Verrill, 1881, pp. 289, 304.—Webster and Benedict, 1887, p. 731.

Brada granulata Malmgren, 1867, p. 85, pl. 12, fig. 71.—Théel, 1879, p. 52.—not Murdoch, 1885, p. 155 (= *B. villosa*).—Annenkova, 1937, p. 176; 1938, p. 186.—Hartman, 1944a, pp. 334, 341; 1948, p. 41.—Zatsepin, 1948, p. 135, pl. 33, fig. 3.—Wesenberg-Lund, 1950a, p. 36; 1950b, p. 85.

Brada granosa Treadwell, 1937, p. 32 (not *B. granosa* Stimpson, 1854).

Brada inhabilis Støp-Bowitz, 1948a, p. 40, fig. 11; 1948b, p. 42, fig. 16.—Wesenberg-Lund, 1951, p. 80.

Description.—Length 30-60 mm., width 8-12 mm., segments 23-26. Body subfusiform, grub-shaped, flattened ventrally, strongly arched dorsally, usually curved ventrally (in alcohol). Body surface covered with low globular papillae (to naked eye surface appears almost smooth, granular), usually with thin layer of sand grains, often with an almost uniform layer of larger sand grains on dorsum. Prostomium and buccal segment with two groups of three to four filiform branchiae, pair of grooved palps, and buccal siphon around mouth. First segment achaetous (may be few very, delicate capillary setae), second segment with two small neurosetae, rest of segments with neuropodia as slightly elevated lobes and about four (2-9) amber-colored neurosetae with curved tips. Without distinct notopodia; notosetae poorly developed, one or two or absent, extremely capillary, easily overlooked. Nephridial papillae on ventral side between segments 4 and 5 (setigers 3 and 4, since the first segment is usually achaetous). COLOR: In life: Orange yellow. In alcohol: Light gray to ashy.

Remarks.—*B. granulata* Malmgren is herein referred to *B. inhabilis*, following Støp-Bowitz (1948a). *B. sublaevis* Stimpson should also be referred here and not to *B. rugosa* (Hansen) as indicated by Støp-Bowitz (1948a, p. 37).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 20-123.5 fms., on bottoms of rocks, stones, gravel, and mass of worm tubes (5 stations, 9 specimens). NORTHWEST

GREENLAND: 1 mile northwest Conical Rock, 25–60 fms., Bartlett, 1938. BERING SEA: *Albatross* Sta. 3223, 54°26' N., 165°32' W., 56 fms., 1890; Bering Strait, 13 fms., Dall, 1880. ALASKA: Iliuliuk Harbor, Unalaska, 1871, and New Harbor, Unga Island, under stones, 1872, Dall; Kodiak, W. J. Fisher. EAST COAST NORTH AMERICA: Off Labrador, 95 fms., *Blue Dolphin* Expedition, 1949; Bay of Fundy, Maine, 48–90 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Danish waters; Labrador to Maine; Bering Sea to Gulf of Alaska; north Japan Sea. In low water to 609 fathoms.

Family SCALIBREGMIDAE

Body inflated anteriorly or short, fusiform. Integument roughened or tessellated and divided into superficial rings. Prostomium small, bilobed, or entire and with frontal horns; two ciliated evaginable nuchal grooves on each side of prostomium (fig. 33, *i*). Buccal segment achaetous. Parapodia biramous, rami small, with or without dorsal and ventral cirri. Setae simple, capillary, some single, some forked. Branchiae limited to anterior few segments (may be absent). Pygidium with or without anal cirri. Proboscis eversible, unarmed, globular, smooth.

Represented by a single species from Point Barrow.

Genus *Scalibregma* Rathke, 1843

Scalibregma inflatum Rathke, 1843

FIGURE 33, *i-k*

Scalibregma inflatum Rathke, 1843, p. 184, pl. 9, figs. 15–21.—Moore, 1923, p. 217.—Fauvel, 1927, p. 123, fig. 44, a–f; 1932, p. 187; 1934a, p. 50.—Augener, 1928, p. 754.—Monro, 1930, p. 163.—Annenkova, 1934, p. 322; 1937, p. 176; 1938, p. 186.—Okuda, 1938b, p. 99.—Hartman, 1944a, pp. 336, 341; 1948, p. 40.—Støp-Bowitz, 1946, p. 67, fig. 2; 1948b, p. 24, fig. 8.—Zatsepin, 1948, p. 136, pl. 33, fig. 10.—Wesenberg-Lund, 1950a, p. 36; 1950b, p. 86; 1951, p. 81.—Berkeley and Berkeley, 1952, p. 58, figs. 119–121.

Scalibregma brevicauda Verrill, 1873, pp. 416, 422, 605; 1881, p. 302, pl. 9, fig. 5.

Scalibregma minutum Webster and Benedict, 1887, p. 727.

Description.—Length up to 100 mm., width 13 mm., 45–60 segments (two specimens washed ashore after a storm were longer than any previously recorded). Body divided into two more or less distinct regions, anterior inflated portion (anterior 15–17 setigers) tapered anteriorly, without dorsal and ventral cirri, and narrower attenuated posterior region with dorsal and ventral cirri. A more or less devel-

oped ventral groove along length of body, better developed in posterior region. Integument tessellated, with four annuli per segment. Prostomium subquadrangular, wider anteriorly, with frontal horns on anterolateral borders, with pair of evaginable nuchal organs lateral to prostomium (when inverted, appear as diagonal slits). Buccal segment achaetous, forming rugose ring around prostomium. Mouth ventral, at level of first setigerous lobes. Proboscis eversible, globular, smooth, unarmed. Branchiae four pairs, short, tufted, arborescent, inserted posterior to notopodia on setigers 2-5, increasing in size posteriorly. Noto- and neuropodial lobes of anterior segments small, projecting, subequal. Beginning on setigers 16-18, dorsal and ventral cirri develop gradually, becoming elongate-conical, flattened or inflated. Setae silky, iridescent, capillary (may be extra long in epitokous pelagic form). Lateral ciliated organs between rami. Pygidium with five to seven, short to long, deciduous, filiform anal cirri on ventral side. Epitokous sexual forms may appear in surface waters, massed with sexual products, with extra long setae and usually with highly pigmented dorsal and ventral cirri. COLOR: In life: Orange yellow. In alcohol: Without color, orange yellow, or sulfur yellow with darker pigmented masses in the outer portions of the dorsal and ventral cirri.

Remarks.—*Scalibregma brevicauda* Verrill is herein referred to *S. inflatum*. Although the types were not examined, specimens from the New England region identified by Verrill as *S. brevicauda* were observed. The types of *S. minutum* Webster and Benedict from Eastport, Maine, were examined and found to agree with *S. inflatum*.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore; off Point Barrow base, 22.5-78 fms., up to 15 miles from shore, on bottoms of mud and various combinations of mud, sand, gravel, stones, rocks, with shells and worm tubes (9 stations, 17 specimens). WEST COAST NORTH AMERICA: Washington and Puget Sounds, 25 fms., mud, Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 17-35 fms., *Blue Dolphin* Expeditions, 1950, 1951; off Nova Scotia, Maine, Massachusetts, Rhode Island, Connecticut, Long Island Sound, 5-95.5 fms., U. S. Fish Commission; Cuttyhunk, Massachusetts, low water, in sand, Pettibone, 1950.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France, Adriatic, Gulf of Oman; Labrador to Long Island Sound; Bering Sea to central California; north Japan Sea to Japan. Southern latitudes: New Zealand, Magellan Straits, South Georgia, Prince Edward Islands, Kerguelen. In low water to 1,333 fathoms; epitokes at surface.

Family OPHELIIDAE

Body relatively short, often grublike or lancet-shaped. Integument smooth or granulated; segmental grooves weak or obscured by superficial annuli. Prostomium small, conical, without appendages; pair of eversible nuchal organs (fig. 33, *l, o*). Proboscis eversible, saclike, unarmed. Parapodia biramous, lobes reduced or lacking; setae simple, capillary (fig. 33, *m, q*). Without dorsal cirri; rarely with ventral cirri. Branchiae paired, cirriform, inserted near parapodia, extending along most of body (may be lacking). Pygidium forming an anal cylinder, a flap, or knob, with or without cirri (fig. 33, *n, p*).

Represented by two genera and two species from Point Barrow. Both genera have paired cirriform branchiae along most of length of body; without lateral eyes along body.

Key to the genera of Opheliidae from Point Barrow

1. Body lancet-shaped; ventral surface thick, solelike, formed by 2 thick longitudinal muscular columns, with midventral and lateral grooves along length of body. Parapodial lobes small, along lateral grooves (fig. 33, *m*).

Ammotrypane (p. 295)

Body cylindrical, grub-shaped, without midventral or lateral grooves. Parapodial lobes absent, the simple, capillary noto- and neurosetae emerging directly from body wall (fig. 33, *q*)----- **Travisia** (p. 296)

Genus *Ammotrypane* Rathke, 1843

Ammotrypane breviata Ehlers, 1913

FIGURE 33, *l-n*

Ammotrypane breviata Ehlers, 1913, p. 523, pl. 39, figs. 1-7.—Monro, 1930, p. 165; 1936, p. 165.

Ophelina groenlandica Støp-Bowitz, 1948b, p. 20, fig. 6.

Description.—Length 6-7 mm., width 0.3 mm., setigerous segments 26 or 27 (up to 34 mm. long, 2 mm. wide, 26-28 segments—Monro, 1930, 1936). Body rigid, tapered at both ends, smooth, without superficial segmental divisions. Prostomium conical, the anterior tip constricted to form a small globular palpode; prostomial tip may be partly telescoped into rest of prostomium; pair of eversible nuchal organs at level of parapodia. Parapodia with two groups of fine capillary setae, the dorsal group slightly longer than the ventral. Branchiae begin on setiger 2, absent on last three to five setigers; branchiae slender, cirriform, subequal. Pygidium forming a short, somewhat contractile anal cylinder, closed on all sides, somewhat lobulate or papillate on open posterior end. Eversible proboscis saclike, smooth. COLOR: In alcohol: Without color or may be darkly pigmented laterally along posterior three setigerous segments and proximal part of anal tube.

Remarks.—The two small specimens from Point Barrow (6–7 mm. long) follow closely the description of Støp-Bowitz for *Ophelina groenlandica*, including size. They seem to agree with the description by Ehlers of *A. breviata* from the Antarctic, although the Antarctic specimens attain a much larger size (29 mm. long).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7.5 miles from shore, 29–36 fms., on bottoms of gravel, stones, large perforated rocks (2 stations, 2 specimens).

Distribution.—Arctic Alaska, East Greenland. Southern latitudes: South Orkney and Falkland Islands, Kaiser-Wilhelm II Land. In 10–214 fathoms.

Genus *Travisia* Johnston, 1840

Travisia carnea Verrill, 1873

FIGURE 33, o–q

Travisia carnea Verrill, 1873, pp. 431, 434, 508, 604; 1881, p. 302, pl. 8, fig. 1.—Sumner, Osburn, and Cole, 1913, p. 629.—Hartman, 1944a, pp. 336, 341, pl. 19, fig. 5 (as probably *Ophelia limacina*).

Travisia forbesi Murdoch, 1885, p. 154 (not *T. forbesii* Johnston, 1840).

Description.—Length up to 59 mm., width 8 mm., segments 25–29 (specimens washed ashore at Point Barrow much larger than any previously recorded). Body rounded, cylindrical, grub-shaped, tapered toward each end. Segments of posterior third may be somewhat imbricated or telescoped; triannulate in middle region. Integument with granulations or beading rather uniform (not larger on posterior part of segment as in *T. pupa* Moore). Prostomium small, conical, acutely to bluntly pointed, without eyes. Branchiae begin on setiger 2 (rarely on setiger 3), continuing posteriorly, absent on last four or five segments, cirriform, inserted posterior to notosetae. Without parapodial lobes, the small, slender, capillary noto- and neurosetae emerging directly from body wall. In posterior third of body, area in region of setae may be somewhat inflated but without enlarged lateral lobes extending posteriorly (as in *T. forbesii* Johnston and

FIGURE 33.—Cirratulidae: *a*, *Cirratulus cirratus*, dorsal view anterior end; *b*, same, parapodium from anterior region; *c*, same, acicular crotchet; *d*, *Chaetozone setosa*, dorsal view anterior end. Flabelligeridae: *e*, *Flabelligera affinis*, parapodium; *f*, same, hooked pseudocompound neuroseta; *g*, same, pedunculate papillae—(1) from tip of notopodium, (2) on body; *h*, *Brada inhabilis*, ventral view anterior end. Scalibregmidae: *i*, *Scalibregma inflatum*, dorsal view anterior end; *j*, same, parapodium from middle region; *k*, same, parapodium from posterior region. Opheliidae: *l*, *Ammotrypane breviata*, ventral view anterior end, proboscis extended; *m*, same, lateral view middle part of body; *n*, same, ventral view posterior end; *o*, *Travisia carnea*, dorsal view anterior end; *p*, same, dorsal view posterior end; *q*, same, parapodium. Capitellidae: *r*, *Capitella capitata*, dorsal view anterior end; *s*, same, dorsal view posterior part thoracic region; *t*, same, parapodium from abdominal region; *u*, same, hooded crotchet. (For explanation of symbols, see p. 210.)

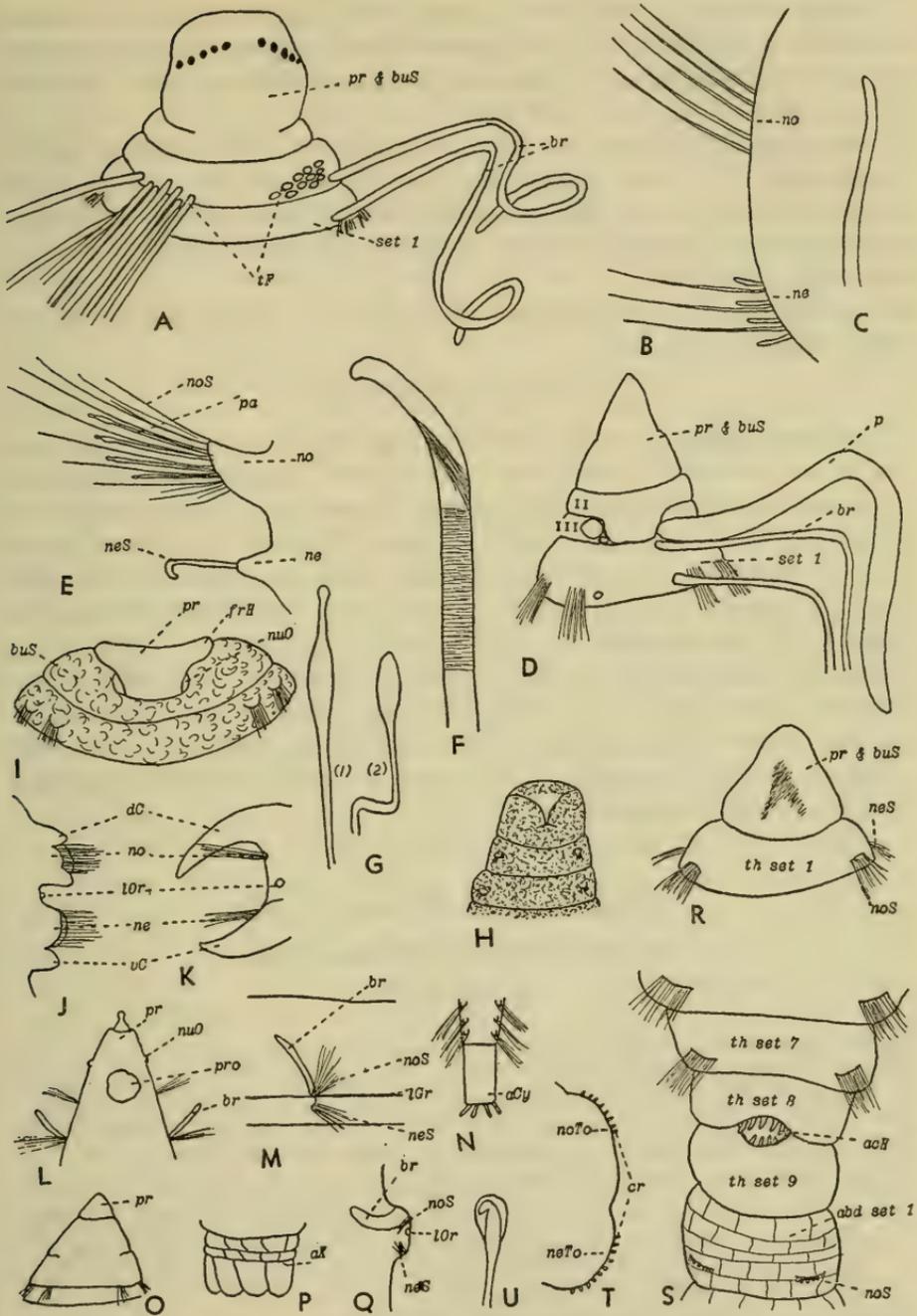


FIGURE 33.—For explanation see facing page.

T. brevis Moore). With lateral sensory pits between rami appearing as small oval slits. Nephridial pores ventral to neuropodia on setigers 3-14. Pygidium small, cylindrical, longitudinally furrowed. COLOR: In life: Flesh. In alcohol: Whitish.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore, October 16, 17, 1949; August 10, 1950 (12 specimens). EAST COAST NORTH AMERICA: Off Massachusetts, Long Island Sound, 3-19 fms., soft mud, U. S. Fish Commission; Woods Hole region, Massachusetts, Pettibone, 1950.

Distribution.—Arctic Alaska. Massachusetts to Long Island Sound. In 3-19 fathoms.

Family CAPITELLIDAE

Body cylindrical, weakly divided into 2 regions: Anterior thoracic region somewhat inflated, often reticulated, parapodial lobes rudimentary; posterior abdominal region longer and thinner, with rows of crotchets on somewhat inflated tori. Prostomium conical, more or less retractile, without appendages, with or without eyes, with pair of eversible nuchal organs. Buccal segment achaetous (may be fused with prostomium as in *Capitella*). Parapodia biramous, reduced to bundles of capillary setae or to dorsal and ventral tori bearing row of crotchets which have long manubrium and recurved hooded rostrum (fig. 33, *r-u*). Without dorsal, ventral, or anal cirri. With or without branchiae. Proboscis eversible, globular, unarmed, papillate. Constructs tubes.

Represented by a single species from Point Barrow.

Genus *Capitella* Blainville, 1828

Capitella capitata (Fabricius, 1780)

FIGURE 33, *r-u*

Lumbricus capitatus Fabricius, 1780, p. 279.

Capitella capitata Webster and Benedict, 1884, p. 730; 1887, p. 744.—Ehlers, 1913, p. 543.—Eliason, 1920, p. 63.—Fauvel, 1927, p. 154, fig. 55, a-h.—Augener, 1928, p. 749.—Monro, 1930, p. 163.—Annenkova, 1934, p. 322; 1937, p. 179; 1938, p. 189.—Hartman, 1942a, p. 69; 1944a, pp. 334, 341, pl. 34, fig. 3; 1945, p. 37; 1947, p. 404, pl. 43, figs. 1, 2; 1948, p. 41; 1951, p. 101.—Berkeley and Berkeley, 1943, p. 129; 1952, p. 100, figs. 206-208.—Gorbunov, 1946, p. 39.—Thorson, 1946, p. 110, fig. 60.—Zatsepin, 1948, p. 138, pl. 33, fig. 14.—Hartman and Reish, 1950, p. 40.—Wesenberg-Lund, 1950a, p. 39; 1950b, p. 91; 1951, p. 84.

Capitella capitata var. *antarctica* Monro, 1930, p. 164.

Description.—Length 23 mm., width 1 mm. (up to 120 mm.—Augener, 1928). Body attenuated slightly anteriorly, much more so posteriorly, fragile. Prostomium and achaetous buccal segment fused, forming wide obtuse cone, somewhat flattened dorsoventrally,

usually concave dorsally, with pair of small ventral eyes and pair of crescent-shaped nuchal slits behind eyes (best seen from lateral view). Thoracic region smooth, without reticulated integument, consisting of first 9 setigerous segments, each of first 7 with four bundles of capillary setae which on setiger 7 may be only capillaries, only crotchets, or both (in young specimens, crotchets may be present from setiger 4). Setigers 8 and 9 modified, having neuropodia with row of hooded crotchets, and with large, recurved, amber-colored acicular genital hooks located middorsally between these two segments. Abdominal segments with slightly raised dorsal and ventral parapodial tori each bearing a row of hooded crotchets. Without specialized branchiae or lateral organs. Pygidium a short ring, may be inflated. COLOR: In alcohol: Without color or reddish brown. Females with large yolky eggs (Point Barrow, August 9, 30, 1949; September 1, 6, 1949.)

Remarks.—According to Fauvel and others, in *C. capitata* the genital hooks on setigers 8 and 9 are present only in the males, the females having only crotchets. On all the specimens from Point Barrow, genital hooks are present, including some females containing large yolky eggs. They agree in all other respects with *C. capitata*. Having genital hooks in both males and females, they would fall under the very closely related *Capitellides* Mesnil. They differ from *C. giardi* Mesnil in the larger number of genital hooks. They are herein referred to the cosmopolitan *C. capitata* with the tentative idea that the relative development of genital hooks in the female may prove to be a variable character.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, up to 7.5 miles from shore, 23.3–70 fms., on bottoms of stones and various combinations of gravel, stones, rocks, large perforated rocks (8 stations, 26 specimens). BERING SEA: St. Paul Island, Pribilofs, in holdfasts with *Fabricia sabella* and lumbrinerids, W. L. Hahn, 1911. WEST COAST NORTH AMERICA: Corona del Mar, California, from branchial cavity of crab, *Loxorhynchus grandis*, MacGinitie, 1948. EAST COAST NORTH AMERICA: Off Labrador, 6 fms., mud-sand, *Blue Dolphin* Expedition, 1949; off Massachusetts, 15 fms., U. S. Fish Commission; Woods Hole region, Massachusetts, Pettibone, 1951.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France, Madeira, Mediterranean, Black Sea; Hudson Bay to North Carolina, Texas; Bering Sea to southern California; north Japan Sea. Southern latitudes: Magellan Straits, South Georgia, Bouvet Island, South Africa, Kerguelen. In low water to 500 fathoms.

Family ARENICOLIDAE

Body elongate, cylindrical, integument reticulated and divided into secondary annuli. Body divided into two or three distinct regions: (1) anterior, abranched; (2) abdominal, branched, each segment with pair of dorsally-borne branched gills; (3) caudal, achaetous and abranched; this region may be lacking. Prostomium small, simple or trilobed, without appendages; with nuchal groove (fig. 34, *a*). Parapodia biramous; notopodia conical, setigerous, with spiny, capillary setae; neuropodia with sigmoid crotchets in semicircular tori. Without dorsal, ventral, and anal cirri. Anus terminal. Proboscis eversible, globular, papillate, unarmed. Constructs tubes or burrows.

Represented by a single species from Point Barrow.

Genus *Arenicola* Lamark, 1801

Arenicola glacialis Murdoch, 1884

FIGURE 34, *a*

Arenicola glacialis Murdoch, 1884, p. 522; 1885, p. 155.—Ashworth, 1910, p. 24, figs. 10–14; 1912, p. 111, figs. 46, 47, pl. 6; 1924, p. 3, fig. 1.

Description.—Length up to 205 mm., width 11 mm., 17 setigerous segments. Body cylindrical, tapering slightly anteriorly and gradually posteriorly. Prostomium small, may be pretty well retracted in nuchal groove; median lobe small, lateral lobes larger, curved (fig. 34, *a*). Body divided into three regions: (1) anterior region of six abranched setigers, notopodia conical with spiny capillary setae, neuropodia low tori with few sigmoid crotchets; (2) branchial region of 11 setigers each divided into five superficial annuli, with short, bushy, arborescent branchiae at base of conical notopodia, with gill axes short, branching one or two times or simple; neuropodia raised tori with long row of crotchets; on more posterior segments, tori approach midventral line; (3) caudal achaetous and abranched region with papillae feebly developed, without processes (as in *A. cristata*). Nephridial pores six pairs, on setigers 4–9, posterior to upper part of neuropodial tori. Pair of statocysts on peristomium, open to exterior,

FIGURE 34.—Arenicolidae: *a*, *Arenicola glacialis*, prostomium. Maldanidae: *b*, *Praxillella praetermissa*, ventral view anterior end; *c*, same, frontal view cephalic plate; *d*, same, pygidial funnel; *e*, same, posterior end; *f*, same, crotchet from neuropodium; *g*, *Maldane sarsi*, lateral view anterior end; *h*, same, lateral view posterior end; *i*, *Nicomache lumbricalis*, lateral view anterior end; *j*, same, lateral view posterior end; *k*, *Nicomache personata*, lateral view posterior end; *l*, *Petaloproctus tenuis*, lateral view anterior end; *m*, same, lateral view posterior end. Sabellariidae: *n*, *Idanthyrus armatus*, dorsal view anterior end; *o*, same, lateral view anterior end; *p*, same, palea from inner row; *q*, same, palea from outer row. (For explanation of symbols, see p. 210.)

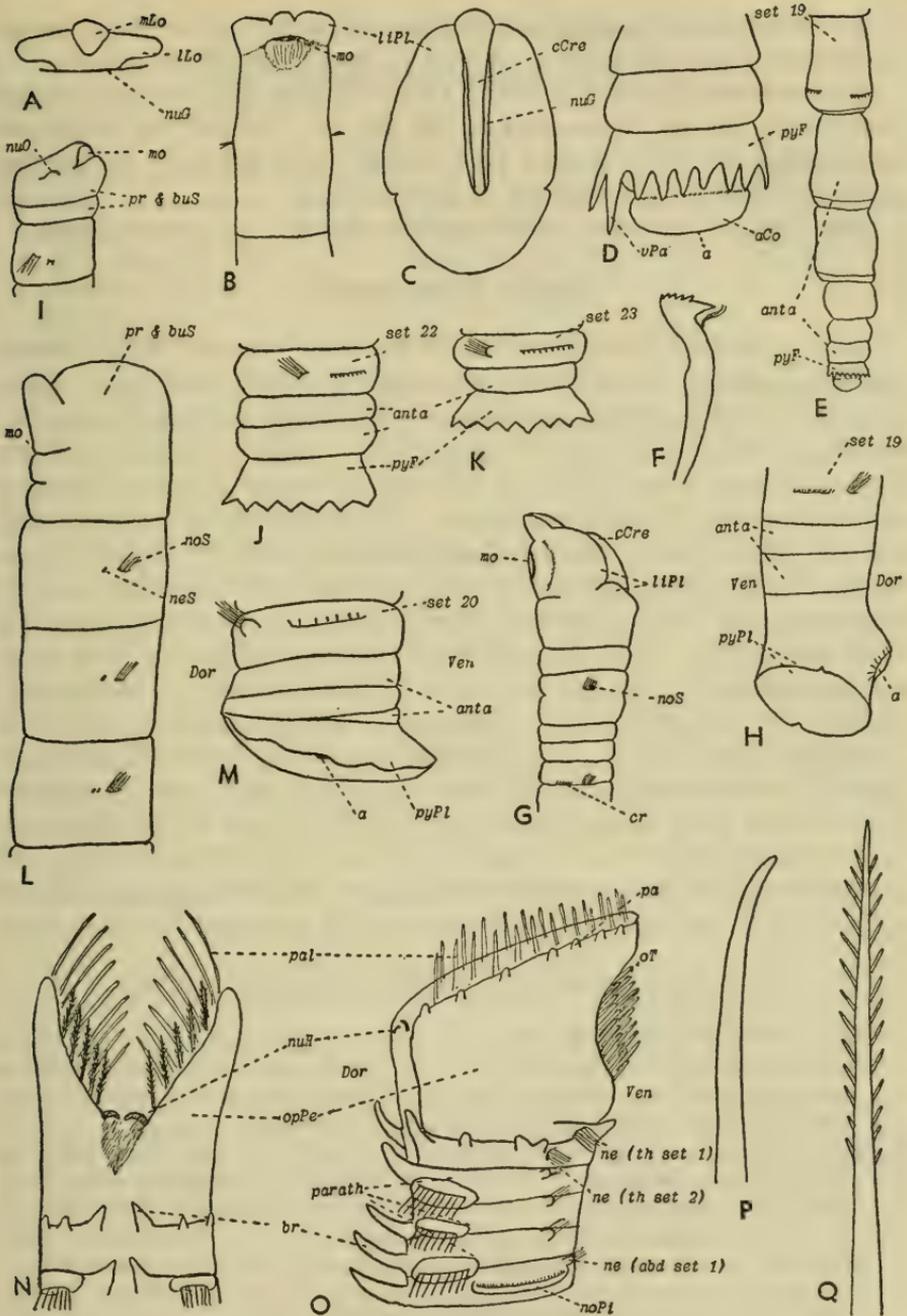


FIGURE 34.—For explanation see facing page.

with numerous sand grains as statoliths. COLOR: In life: Deep orange to brownish red. In alcohol: Bluish to grayish black or brown.

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore August 21, 24, 28, September 6, 12, 19, 22, October 16, 1949 (54 specimens); off Point Barrow base, along shore, 1.7 fms., on bottom of gravel with mud (2 stations, 3 specimens).

Distribution.—Alaskan and Canadian Arctic. In 1.7–3 fathoms.

Family MALDANIDAE

Body cylindrical, truncated at both ends, without differentiated regions, segments usually few, some much longer than wide. Pro-stomium a small cephalic crest fused with achaetous buccal segment, forming ovoid head, without appendages, with or without oblique limbate brim or plate (fig. 34, *b, i, l*); pair of nuchal slits on either side cephalic crest. In anterior region with numerous glandular cells, diffused or grouped in clear bands alternating with pigmented rings. Parapodia biramous; notopodia with capillary setae; neuropodia with projecting tori bearing rows of crotchets (fig. 34, *f*) with dentate rostrum and rostral hairs; the crotchets may be replaced by few stout acicular spines on first few setigers. Without dorsal or ventral cirri; usually without branchiae. Pygidium a limbate plate, spatulate or funnellike (fig. 34, *h, j, m*). Proboscis eversible, unarmed, globular. Live in tubes in sand or mud; tube cylindrical, membranous, covered with thin to thick layer of mud, sand, gravel, more or less resistant.

Represented by four genera and five species from Point Barrow. All the genera are without specialized collarettes, without special glandular ventral shield on setiger 8, with neuropodial crotchets in single rows.

Key to the genera of Maldanidae from Point Barrow

1. Head with limbate plate (fig. 34, *b, g*) ----- 2
 Head without limbate plate (fig. 34, *i, l*). With 1–2 stout acicular setae in neuropodia of first 3 setigers. Pygidium funnel-shaped or forming concave plate, with or without cirri; anus opening on surface of plate ----- 3
2. Head with low cephalic crest, bordered by oblique limbate plate, entire or notched laterally (fig. 34, *b, c*). With ventral crotchets beginning on setiger 1. Pygidium funnel-shaped, bordered with cirri, with anus in center of somewhat protruding anal cone within the funnel (fig. 34, *d*) ----- **Praxillella** (p. 303)
- Head with middorsal convex cephalic crest or keel, bordered by limbate plate, divided into 3 parts by 2 deep lateral grooves (fig. 34, *g*). Without neurosetae on setiger 1; crotchets begin on setiger 2. Pygidium a slightly oblique oval plate, bordered by rim which is incised laterally, smooth or denticled; anus dorsal to pygidial disc (fig. 34, *h*) ----- **Maldane** (p. 303)
3. Pygidium slightly oblique, funnel-shaped, bordered with cirri (fig. 34, *j, k*).
 ----- **Nicomache** (p. 304)
- Pygidium an asymmetrical, foliaceous, concave plate, reduced dorsally, wider ventrally, with border smooth or crenulate (fig. 34, *m*) ----- **Petaloproctus** (p. 306)

Genus *Praxillella* Verrill, 1881***Praxillella praetermissa* (Malmgren, 1865)**

FIGURE 34, b-f

Praxilla praetermissa Malmgren, 1865, p. 191; 1867, p. 100, pl. 11, fig. 62.*Praxillella praetermissa* Verrill, 1881, pp. 298, 305, 309, 312.—Webster and Benedict, 1887, p. 746.—Arwidsson, 1907, p. 192, figs.—Eliason, 1920, p. 66.—Augener, 1928, p. 762.—Annenkova, 1937, p. 182; 1938, p. 194.—Zatsepin, 1948, p. 142, pl. 35, fig. 1.—Wesenberg-Lund, 1948, p. 41, figs. 20, 21; 1950a, p. 43; 1950b, p. 98; 1951, p. 93.*Clymene (Praxillella) praetermissa* Fauvel, 1927, p. 179, fig. 62, a-e.

Description.—Length 45 mm., width 1 mm. (up to 120 mm. long, 2.5 mm. wide—Malmgren, 1865), 19 setigerous segments, 4–5 achaetous segments with rudimentary parapodia. Head with oblique limbate plate, with border entire, slightly or deeply incised laterally, slightly incised posteriorly, terminating anteroventrally in obtuse cone (not produced into digitiform process); median cephalic crest long; nuchal grooves one-half to two-thirds its length. Neuropodia of anterior three setigers with 2–10 slightly modified crotchets. Pygidial funnel with flat floor, with projecting anal cone with larger valvule on ventral side of cone; border of funnel with 20–38 subequal papillae except for a longer ventral one. Proboscis papillate basally. COLOR: In life: Yellow with wide, red and white bands on some anterior segments. In alcohol: Brownish to gray, with whitish bands anterior to setae on setigers 4–8. TUBE: Of clay, sand, small bits of rock; may be quite resistant.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7.5 miles from shore, 20–36 fms., on various combinations of mud, sand, gravel, stones, rocks, large perforated rocks, shells (7 stations, 10 specimens). EAST COAST NORTH AMERICA: Off Labrador, 5–8 fms., *Blue Dolphin* Expedition, 1949; off Cape Cod, Massachusetts, 14–19 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Alaskan Arctic, Davis Strait, Greenland, Spitsbergen, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes to English Channel, Mediterranean; Labrador to Massachusetts; north Japan Sea. In 7–1,111 fathoms.

Genus *Maldane* Grube, 1860***Maldane sarsi* Malmgren, 1865**

FIGURE 34, g, h

Maldane sarsi Malmgren, 1865, p. 188; 1867, p. 99, pl. 10, fig. 57.—Arwidsson, 1907, p. 251, figs.—Eliason, 1920, p. 66.—Fauvel, 1927, p. 197, fig. 69, a-i; 1932, p. 202.—Augener, 1928, p. 759.—Annenkova, 1937, p. 179; 1938, p. 192.—Okuda, 1939, p. 239.—Berkeley and Berkeley, 1942, p. 199.—Hartman,

1944a, pp. 335, 342, pl. 33, figs. 3, 4; 1951, p. 106.—Zatsepin, 1948, p. 142, pl. 33, fig. 3.—Wesenberg-Lund, 1948, p. 48, figs. 24, 25; 1950a, p. 44; 1950b, p. 100; 1951, p. 94.—Hartman and Reish, 1950, p. 37.

Maldane sarsi var. *antarctica* Arwidsson, 1911a, p. 32, figs.—Munro, 1930, p. 169; 1936, p. 168.

Maldane sarsi var. Moore, 1923, p. 237.

Maldane sarsi var. *tropica* Monro, 1937, p. 307, fig. 24.

Description.—Length up to 110 mm., width 3.9 mm., setigerous segments 19, two antanal achaetous segments. Head with long, convex keel, ending in blunt process above mouth, bordered by limbate plate, with border smooth, usually incised laterally, rather high posteriorly; nuchal organs short, divergent; without ocelli. Anterior segments biannulate. With notosetae only on first setiger; neuropodial crotchets begin on setiger 2. Two antanal segments short, with achaetous tori slightly marked. Pygidium an oblique flat, oval plate, with border usually slightly incised laterally, smooth or slightly crenulate ventrally. Anus a folded cushion dorsal to and close to pygidial rim. TUBE: Free, circular, thin to thick walled, of fine agglomerated mud and sand grains.

New Records.—ARCTIC ALASKA: Off Point Barrow base, 3 miles from shore, 20.3 fms., on bottom of mud, gravel, stones, shells (1 station, 1 specimen). BERING SEA: *Albatross* Sta. 3603, 55°23' N., 170°31' W., 1,771 fms., 1895. CANADIAN ARCTIC: Northwest shore Daniels Island, mouth Newell Sound, Frobisher Bay, Baffin Land, 10–30 fms., Bartlett. EAST COAST NORTH AMERICA: Off Labrador, 30 fms., *Blue Dolphin* Expedition, 1950; off Nova Scotia, Maine, Massachusetts, Rhode Island, 14–487 fms., U. S. Fish Commission.,

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan and Canadian Arctic, Davis Strait, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Norway to France; Labrador to Rhode Island, Louisiana, Mississippi, eastern Texas; Bering Sea to southern California; north Japan Sea to Japan; South Arabian coast (var. *tropica*); Bay of Bengal. Southern latitudes: South Georgia, South Shetlands, Palmer Archipelago (var. *antarctica*); south Australia. In low water to 1,771 fathoms.

Genus *Nicomache* Malmgren, 1865

Both species have buccal segment fused with prostomium forming hood-shaped head, irregularly rounded, with thickened anteroventral border, forming projecting upper lip (fig. 34, *i*). First three setigerous segments each with one or two stout, acicular, spinelike neurosetae. Some of notopodia with long, hairlike sinuous dorsal setae. Pygidium with anus terminal in center of short, slightly oblique funnel, with papillae on border of funnel (fig. 34, *j, k*).

Key to the species of *Nicomache* from Point Barrow

1. Single achaetous antanal segment (fig. 34, *k*)-----*N. personata*
 Two achaetous antanal segments (fig. 34, *j*)-----*N. lumbricalis*

Nicomache lumbricalis (Fabricius, 1780)FIGURE 34, *i, j*

Sabella lumbricalis Fabricius, 1780, p. 374.

Nicomache lumbricalis Malmgren, 1867, p. 99, pl. 10, fig. 60.—Webster and Benedict, 1884, p. 731; 1887, p. 745.—Arwidsson, 1907, p. 86, pl. 8, figs. 244, 245.—Fauvel, 1927, p. 190, fig. 66, a-i.—Augener, 1928, p. 764.—Monro, 1930, p. 173.—Annenkova, 1934, p. 322; 1937, p. 181; 1938, p. 193.—Hartman, 1944a, pp. 335, 342; 1948, p. 42.—Zatsepin, 1948, p. 144, pl. 26, fig. 1.—Wesenberg-Lund, 1948, p. 23, figs. 10, 11; 1950a, p. 41; 1950b, p. 95; 1951, p. 90.—Berkeley and Berkeley, 1952, p. 54, figs. 111, 112.

Nicomache carinata Moore, 1906b, p. 242, pl. 11, figs. 36-39, pl. 12, figs. 43, 44; 1923, p. 227.

Nicomache lumbricalis var. *borealis* Arwidsson, 1907, p. 94, figs.; 1922, p. 6.—Eliason, 1920, p. 65.

Description.—Length 40-60 mm., width 2.5-3 mm., setigerous segments 21-22, two short achaetous antanal segments (Point Barrow and Labrador specimens with 22 setigers; type of *N. carinata* with 21; up to 160 mm. long, 5 mm. wide—Fauvel, 1927). Prostomium without ocelli; nuchal organs S-shaped. Pygidial funnel with 14-30 subequal, pointed, triangular papillae. COLOR: In alcohol: Reddish brown on sides and dorsal surface of head and first three setigers. TUBE: Sandy, with small pieces of rock, with smooth membranous lining (Point Barrow), or thick, sandy, and coiled (Labrador; small ones on terebellid tubes).

Remarks.—They may share their tubes with the commensal polynoid *Enipo gracilis* Verrill (= *E. cirrata* Treadwell) reported by Berkeley and Berkeley from Alaska; also from off Nova Scotia and Massachusetts (in USNM).

New records.—ARCTIC ALASKA: Off Point Barrow, up to 12.1 miles from shore, 24.7-123.5 fms., on bottoms of mud, worm tubes, stones, and various combinations of rocks, stones, gravel (6 stations, 18 specimens). BERING SEA: Cape Prince of Wales, 23 fms., Dall, 1874. Albatross Sta. 3311, 53° 59' N., 166° 29' W., 85 fms., and Sta. 3313, 54° 01' N., 166° 27' W., 68 fms., 1890. ALASKA: Albatross Sta. 2848, Unalaska to Cook Island, 1888; Eastern Harbor, Sitka, 15 fms., Dall, 1874. KAMCHATKA: Albatross Sta. 3644, 51° 09' N., 157° 48' W., 96 fms., 1896. EAST COAST NORTH AMERICA: Off Labrador, 30-125 fms., Blue Dolphin Expeditions, 1949, 1950, 1951; off Nova Scotia, Bay of Fundy, Maine, New Hampshire, Massachusetts, 26-150 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and

Alaskan Arctic, Greenland, Jan Mayen, Spitsbergen, White Sea, Novaya Zemlya, Kara Sea. Also Bering Sea to Lower California; north Japan Sea; Iceland, Norway to English Channel, Santander; Labrador to Massachusetts; South Africa. In low water to 1,400 fathoms.

Nicomache personata Johnson, 1901

FIGURE 34, *k*

Nicomache personata Johnson, 1901, p. 419, pl. 13, figs. 134-139.—Arwidsson, 1922, p. 7, pl. 1, figs. 5, 6.—Hartman, 1948, p. 41, fig. 11, d-g.—Berkeley and Berkeley, 1952, p. 54, figs. 109, 110.

Nicomache minor Arwidsson, 1907, p. 100, pl. 2, figs. 68-73; pl. 8, figs. 252-256.—Augener, 1928, p. 765.—Annenkova, 1937, p. 181; 1938, p. 193.

Nicomache maculata Arwidsson, 1911b, p. 209, pl. 18, figs. 13-19; pl. 19, figs. 27-30.—Fauvel, 1927, p. 191, fig. 66, k-r.

Description.—Up to 110 mm. long, 2 mm. wide, 22 or 23 setigerous segments, single achaetous antanal segment (Point Barrow specimen with 23 setigers, Puget Sound specimen with 22). Prostomium with numerous ocelli (may be absent); nuchal clefts short, arched. Pygidial funnel with 16-26 papillae which are short, subequal, triangular, or very unequal, some being longer, some very short, few may be bifid or trifid. COLOR: In alcohol: Without color, or brownish, especially on anterior end. TUBE: Thick walls of coarse sand particles cemented together.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 8 miles from shore, 21.7-75.5 fms., on various combinations of pebbles, rocks, gravel, stones (3 stations, 5 specimens). BERING SEA: *Albatross* Sta. 3289, 56° 44' N., 159° 16' W., 16 fms., 1890. WEST COAST NORTH AMERICA: Security Bay, Alaska, Jones; Washington and Puget Sounds, low water to 61 fms., Pettibone.

Distribution.—Arctic Alaska, Spitsbergen; Bering Sea to Washington; north Japan Sea; Scandinavia, Ireland, North Sea to English Channel. In low water to 75.5 fathoms.

Genus *Petaloproctus* Quatrefages, 1865

Petaloproctus tenuis (Théel, 1879)

FIGURE 34, *l, m*

Maldane tenuis Théel, 1879, p. 57, pl. 4, figs. 52-54.

Maldane filifera Verrill, 1879, p. 179.

Petaloproctus tenuis Arwidsson, 1907, p. 114, pl. 6, fig. 190a.—Annenkova, 1937, p. 181; 1938, p. 193.—Zatsepin, 1948, p. 145, pl. 34, fig. 5.—Wesenberg-Lund, 1948, p. 31.—Berkeley and Berkeley, 1952, p. 55, fig. 113.

Petaloproctus tenuis var. *borealis* Arwidsson, 1907, p. 118, pl. 3, figs. 85-90; pl. 8, figs. 268-272.—Eliason, 1920, p. 66.—Hartman, 1948, p. 42.—Berkeley and Berkeley, 1952, p. 56, figs. 114-116.

Petaloproctus filifer Hartman, 1942b, p. 131, fig. 11, a-b.

Description.—Length 18 mm., width 0.5 mm., 20–21 setigerous segments, single achaetous antanal segment (may appear as two or three on longer ventral side). Prostomium rounded, with convex median ridge and anteroventrally extended brim. First three setigers with one or two acicular neurosetae; with some long, threadlike, sinuous notosetae covered with spinules. Pygidium with oblique, slightly concave, disclike, asymmetrical plate (absent dorsally), wide on ventral side, with rim smooth or slightly crenulate; anal opening terminal.

Remarks.—The Point Barrow specimen agrees with the stem form of *P. tenuis*, with 20 setigerous segments and the rim of the pygidial disc slightly crenulate (in var. *borealis* and *filifer* there are 21 setigers and the rim of the pygidial disc is smooth).

New records.—ARCTIC ALASKA: Off Point Barrow base, 16 miles from shore, 78.2 fms., on bottom of worm tubes, few rocks (1 station, 1 specimen). CANADIAN ARCTIC: Ducketts Cove, Hurd Channel, Melville Peninsula, 1–14 fms., in sandy tubes on empty tubes of *Pectinaria*, Bartlett, 1933. GREENLAND: Small bay, Camp No. 2, Nugsuak Peninsula, 74°7' N., on empty tubes of *Pectinaria*, J. C. Martin, 1897.

Distribution.—Scattered records in the Arctic: Alaskan and Canadian Arctic, East Greenland, Spitsbergen, Novaya Zemlya. Also off Cape Cod, Massachusetts; southeastern Alaska to British Columbia; north Japan Sea. In 1–833 fathoms.

Family SABELLARIIDAE

Body divided into three regions: (1) anterior thoracic region including two anterior thoracic segments with parapodia reduced to neuropodia with capillary setae and two large, more or less fused, heavy columns, the opercular peduncles, directed anteriorly, bearing very modified setae arranged in one to three concentric rows and forming an operculum for closing opening of tube; three or four parathoracic biramous segments with capillary neurosetae and paddlelike or styliform notosetae and dorsal falciform branchiae (fig. 34, n–q); (2) abdominal region with notopodia in form of broadly flattened pinnules bearing pectinate uncini, and neuropodia with capillary setae; with dorsal, simple, ligulate or falciform branchiae; (3) caudal region, achaetous, apodous, cylindrical, without appearance of segmentation. Prostomium indistinct, between opercular peduncles, with pair of palps and usually a median tentacle. Mouth unarmed, usually surrounded with numerous filiform tentacles. Tube of sand or fine gravel, concreted, resistant, may be solitary or colonial, constructing sandy reefs.

Represented by a single species from Point Barrow.

Genus *Idanthysrus* Kinberg, 1867***Idanthysrus armatus* Kinberg, 1867**FIGURE 34, *n-q*

- Idanthysrus armatus* Kinberg, 1867, p. 350.—Johansson, 1926, p. 9; 1927, p. 90.—Monro, 1930, p. 117, fig. 73; 1936, p. 172.—Annenkova, 1937, p. 184; 1938, p. 196.—Okuda, 1938a, p. 242, figs. 4, 5.—Hartman, 1944c, p. 336, pl. 31, fig. 36.—Berkeley and Berkeley, 1952, p. 107, figs. 220–222.
- Idanthysrus ornamentatus* Chamberlin, 1919, p. 262, pl. 3, figs. 2–5.—Hartman, 1944c, p. 337, pl. 31, fig. 34; 1948, p. 43.—Hartman and Reish, 1950, p. 41.

Description.—Length up to 60 mm., width 5 mm., caudal lobe 11 mm. Body widest anteriorly, tapering gradually posteriorly, with achaetous caudal region sharply set off from body. Opercular peduncles elongated, semicylindrical, completely separated and divergent anteriorly, obliquely truncated distally, with two rows modified golden setae or paleae; inner row paleae rather stout, smooth, gently curved, tapering gradually to acute tips, 7–16 per column; outer row paleae more slender, straight or slightly curved, with coarse lateral spines, 16–36 per column; row of 9–15 distal papillae per column, at base of outer paleae. One or two pairs heavy, deep amber-colored, strongly-bent nuchal hooks on dorsal side opercular peduncles. Numerous filiform oral tentacles on ventral side opercular peduncles. Pair of grooved slender palps and median tentacle between bases of peduncles. First thoracic segment short, with ventral group capillary setae lateral to conical papilla. Second segment with lateral group capillary setae, three papillae and dorsal branchiae. Three parathoracic segments with rectangular palletlike pinnules with flattened, paddlelike notosetae; neurosetae bipinnate capillary setae. Abdominal segments with wide, flattened dorsal pinnules bearing pectinate uncini; capillary barbed neurosetae. Caudal lobe smooth, achaetous. Paired dorsal branchiae cirriform, with transverse ridges on medial side, begin on setiger 2, absent on last few abdominal segments. COLOR: In life: Reddish brown to dark violet anteriorly, branchiae red, paleae golden yellow. In alcohol: Colorless, with purple patches anteriorly. TUBE: Thick, of coarse sand grains neatly cemented together, very resistant, one side flattened, attached to rocks, shells, crustaceans; upper surface convex.

Remarks.—*I. ornamentatus* Chamberlin is herein referred to *I. armatus*, following Okuda (1938). According to observations by G. E. MacGinitie it is a hardy species, a specimen living in a pail in the laboratory for three days, on a rock covered with a mass of barnacles, etc. Male specimen, collected from 70 fathoms, spawned in the laboratory August 9, 1949.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7 miles from shore, 4.3–70 fms., on bottoms of mud, and gravel, stones (3 stations, 6 specimens). BERING SEA: Bering Island, N. Grebintzky, 1884. WEST COAST NORTH AMERICA: *Albatross* Sta. 2842, 54°15' N., 166°3' W., 72 fms.; Washington and Puget Sounds, 10–110 fms., Pettibone.

Distribution.—Arctic Alaska, Bering Sea to Panamá; north Japan Sea to Japan; west coast South America (Chile), Straits of Magellan, Falkland Islands. In low water to 110 fathoms.

Family STERNASPIDAE

Body very short, grublike, aberrant; segments few, uniramous or achaetous, without parapodial lobes (fig. 35, *a*). Prostomium reduced to small rounded tubercle, without appendages. Mouth rounded, subterminal, ventral to prostomium. Body divided into three regions: (1) anterior, with complete rings, with lateral concentric rows of strong acicular yellow setae on anterior three segments (anterior region may be retracted into more posterior segments); (2) middle, with segmental divisions absent on midventral part, without setae visible externally; (3) posterior, with ventral horny shield formed by two trapezoidal plates provided on their external sides with radiating bundles of stiff, barbed and smooth capillary setae (fig. 35, *b*). Numerous, long, filiform anal branchiae, inserted on posterior end. Anus terminal. Lives in mud.

Represented by a single species from Point Barrow (the family is usually considered to have a single cosmopolitan species).

Genus *Sternaspis* Otto, 1821

Sternaspis scutata (Ranzani, 1817)

FIGURE 35, *a*, *b*

Thalassema scutata Ranzani, 1817, p. 1457, pl. 11, figs. 10–13.

Sternaspis fossor Stimpson, 1854, p. 29, pl. 2, fig. 19.—Webster and Benedict, 1884, p. 725.—Moore, 1909b, p. 144; 1923, p. 218.—Hartman, 1944a, pp. 336, 342, pl. 33, fig. 15.—Berkeley and Berkeley, 1952, p. 59, fig. 123.

Sternaspis islandica Malmgren, 1867, p. 87, pl. 14, fig. 85.

Sternaspis scutata Moore, 1903, p. 487; 1908, p. 357; 1923, p. 218.—Fauvel, 1927, p. 216, fig. 76, *a*–*g*; 1932, p. 213; 1933, p. 52; 1934a, p. 60.—Monro, 1930, p. 178.—Annenkova, 1937, p. 185; 1938, p. 196.—Hartman, 1942c, p. 102.—Gorbunov, 1946, p. 39.—Wesenberg-Lund, 1949, p. 345; 1950a, p. 46; 1950b, p. 104; 1951, p. 98.—Hartman and Reish, 1950, p. 38.

Sternaspis scutata var. *africana* Monro, 1930, p. 179.

Description.—Up to 31 mm. long, 14 mm. wide. Body variable in shape; may be inflated at both ends, anterior region may be retracted into more posterior segments. Integument densely pilose, covered with fine filiform papillae. Anterior region of seven segments; segments 1 and 5-7 achaetous; segments 2-4 each with lateral semi-circular row of strong, short, yellow setae which are arched, pointed to blunt (worn down), diminishing in size toward ventral side; pair of long genital papillae on segment 7. Middle region of six segments, well defined except for narrow midventral strip, with bundles of capillary setae embedded in body wall. Posterior region with five or more segments, with ventral horny trapezoidal plates showing concentric and radiating striae, each plate with 16 radiating bundles of stiff setae, 9 on lateral and 7 on posterior borders. Anal filaments or branchiae very numerous, long, filiform, sometimes spiralled. COLOR: In alcohol: Without color or brownish, with rusty-red ventral shield.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 5 miles from shore, 1.7-24.7 fms., on bottoms of mud and gravel with mud (3 stations, 5 specimens). BERING SEA: 63°37' N., 165°19' W., 12 fms., Stoney, 1884; off mouth Yukon River, 3 fms., E. W. Nelson, 1877. ALASKA: Iluiliuk Harbor, Unalaska, Dall, 1871; *Albatross* Sta. 3340, 55°26' N., 155°26' W., 695 fms., and Sta. 3330, 54° N., 166°53' W., 351 fms., 1890. Chiachi Islands, 20 fms., 1874; off Round Island, Coal Harbor, Unga Island, 6-8 fms., 1872; Eastern Harbor, Sitka, 15 fms., gravelly-mud, 1874; all collected by Dall. WEST COAST NORTH AMERICA: Washington and Puget Sounds, 10-111 fms., mud, Pettibone. EAST COAST NORTH AMERICA: Nova Scotia, Maine, Massachusetts, 5-102 fms., U. S. Fish Commission.

Distribution.—Scattered records in the Arctic: Siberian and Alaskan Arctic, Greenland. Also Iceland to English Channel, Mediterranean, Adriatic, Gulf of Oman, Persian Gulf; Nova Scotia to Massachusetts; Bering Sea to Panamá; north Japan Sea to Japan, China. Southern latitudes: South Shetlands, Palmer Archipelago, South Orkneys, South Georgia, west Africa, Indian Ocean, Australia, New Zealand. In 1.7-766 fathoms.

Family PECTINARIIDAE (AMPHICTENIDAE)

Body short, conical, with segments few in number. Prostomium indistinct, fused with buccal segment forming a truncate anterior end provided with two bundles of paleae (large, flattened, golden setae) in a horizontal row directed obliquely anteriorly, forming an operculum for the tube or as a fork for digging in sand or mud; ventral to paleae, an antennular or tentacular membrane bordered or not with short to long filiform papillae, surrounding numerous prehensile oral tentacles

not retractile in mouth; dorsal and posterior to paleae a semilunar flat or concave cephalic plate limited posteriorly by an entire or crenulate rim; two pairs tentacular cirri with first pair lateral to base of paleae, second pair lateral to rim of cephalic plate (fig. 35, *c, d*). Body divided into three regions: (1) anterior thoracic, including two achaetous segments each with a pair of lateral pectinate branchiae, three notopodial uniramous setigers lacking neuropodia; ventral side anterior region with thick glandular cushions; (2) median abdominal, with biramous segments (except last few may have notosetae only), notopodia with setae capillary, limbate, smooth or finely denticled; neuropodia in form of wide pinnules bearing single row of pectiniform uncini; (3) posterior anal plaque or scapha, small, foliaceous, concave dorsally, folded under abdomen, with rudimentary achaetous segments except for the first segment which has a series of acicular, more or less recurved setae (the scaphal hooks); an oval or filiform ligule above the anus (fig. 35, *g, h*). Tube free, conical, rigid, fragile, open at both ends, straight or arcuate, formed of a single layer of cemented sand grains or shells, and lined by a membrane. Live in sand or mud, with anterior and larger end of tube directed below. May secrete mucus in abundance.

Represented by a single genus (and subgenus) and two species from Point Barrow.

Genus *Pectinaria* Lamark, 1818

Subgenus *Cistenides* Malmgren, 1865

Both species have the tube slightly arched, lined with rusty-colored membrane. Tentacular membrane free, the lateral portions not fused to paleal segment, with 30–45 filiform to clavate marginal papillae. Oral tentacles short, thick, grooved. Dorsal rim of flat paleal segment entire, not denticled (fig. 35, *d*). Usually 17 segments with capillary notosetae (15–17, the last two segments may have the notosetae few in number or lacking), of which 12 (beginning on setiger 4) have elongate flattened pinnules bearing single rows of neuropodial uncini; pectiniform uncini thin, flat, with 3–4 major teeth and 4–5 small ones above basal process (fig. 35, *f*). Anal plaque distinctly separated from abdomen by constriction, suboval, festooned laterally (rudimentary parapodia); basally with 7–11 pairs short, heavy scaphal hooks (fig. 35, *g*).

Key to the species of *Pectinaria* (*Cistenides*) from Point Barrow

1. Cephalic paleae usually 7–9 pairs (7–13), heavy, with blunt tips (or very short sharp tips; fig. 35, *i, j*) ----- **P. (C.) granulata**
 Cephalic paleae usually 11–14 pairs (9–15), long, tapered to slender pointed tips (fig. 35, *e*) ----- **P. (C.) hyperborea**

Pectinaria (Cistenides) granulata (Linné, 1767)FIGURE 35, *i-k**Sabella granulata* Linné, 1767, p. 1268.*Cistenides granulata* Malmgren, 1865, p. 359.—Webster and Benedict, 1887, p. 747.—Chamberlin, 1920, p. 25.—Berkeley and Berkeley, 1942, p. 200.—Hartman, 1944a, pp. 335, 342.—Wesenberg-Lund, 1950b, p. 105; 1951, p. 99.*Pectinaria brevicoma* Johnson, 1901, p. 423, pl. 15, figs. 151-156.—Not Moore, 1923, p. 216 (= *P. californiensis* Hartman; in USNM).*Pectinaria (Cistenides) granulata* Hessle, 1917, p. 77.—Nilsson, 1928, p. 28, fig. 8.—Annenkova, 1937, p. 186; 1938, p. 198.—Treadwell, 1937, p. 32.*Cistenides brevicoma* Hartman, 1941b, p. 331, pl. 50, figs. 13, 14, 16; pl. 52, fig. 23; 1944b, p. 268.*Pectinaria (Cistenides) brevicoma* Berkeley and Berkeley, 1952, p. 106, figs. 218, 219.

Description.—Body 20-52 mm. long, 6-8 mm. wide. Tube 38-52 mm. long, 7-8 mm. in greatest diameter, of rather coarse sand grains, nearly uniform in size. Paleae usually 8 or 9 pairs (7-13), short, heavy, with tips blunt (may have short, sharp tips). Scaphal hooks strongly hooked, with a distinct shoulder. COLOR: In life: Colorless, transparent, with reddish-orange internal organs, red branchiae, golden paleae.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, stony; Point Barrow base, washed ashore; off Point Barrow base, up to 12.1 miles from shore, 3.7-123.5 fms., on bottoms of mud, stones, mass of worm tubes, and various combinations of mud, sand, gravel, rocks, stones, large perforated rocks, shells (17 stations, 53 specimens); 10 miles west Point Franklin, 13.5 fms., sand, Point Barrow Expedition, 1883. KAMCHATKA: Petropavlovsk, Grebintzky, 1883. BERING SEA: Atka Island, Aleutians, Turner, 1879; Bering Straits, 13 fms., Dall, 1880. ALASKA: Chichagof Harbor, Attu Island, 5-7 fms., 1873; Coal Harbor, Unga Island, 1872; and Port Etches, 12-18 fms., 1874; all collected by Dall. Kodiak, Fisher; Wrangel, Jones. WASHINGTON: Puget Sound, 39-83 fms., mud, rocks, shells, Pettibone. CANADIAN ARCTIC: Kneeland Bay, Frobisher Bay, Baffin Island, and off Daniels Island, Newell Sound, Frobisher Bay, 10-30 fms., Bartlett, 1942. NORTHWEST GREENLAND: Off Conical Rock, 76° N., 67°30' W., 20-40 fms., 1938; between Parker Snow Bay and Conical Rock, 25-45 fms., 1940; west side Wolstemholm Island, 12 fms., 1940; all collected by Bartlett. EAST COAST NORTH AMERICA: Off Labrador, 6-12 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; off New Brunswick, Nova Scotia, Maine, New Hampshire, Massachusetts, Long Island Sound, 5-190 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Novaya Zemlya. Also

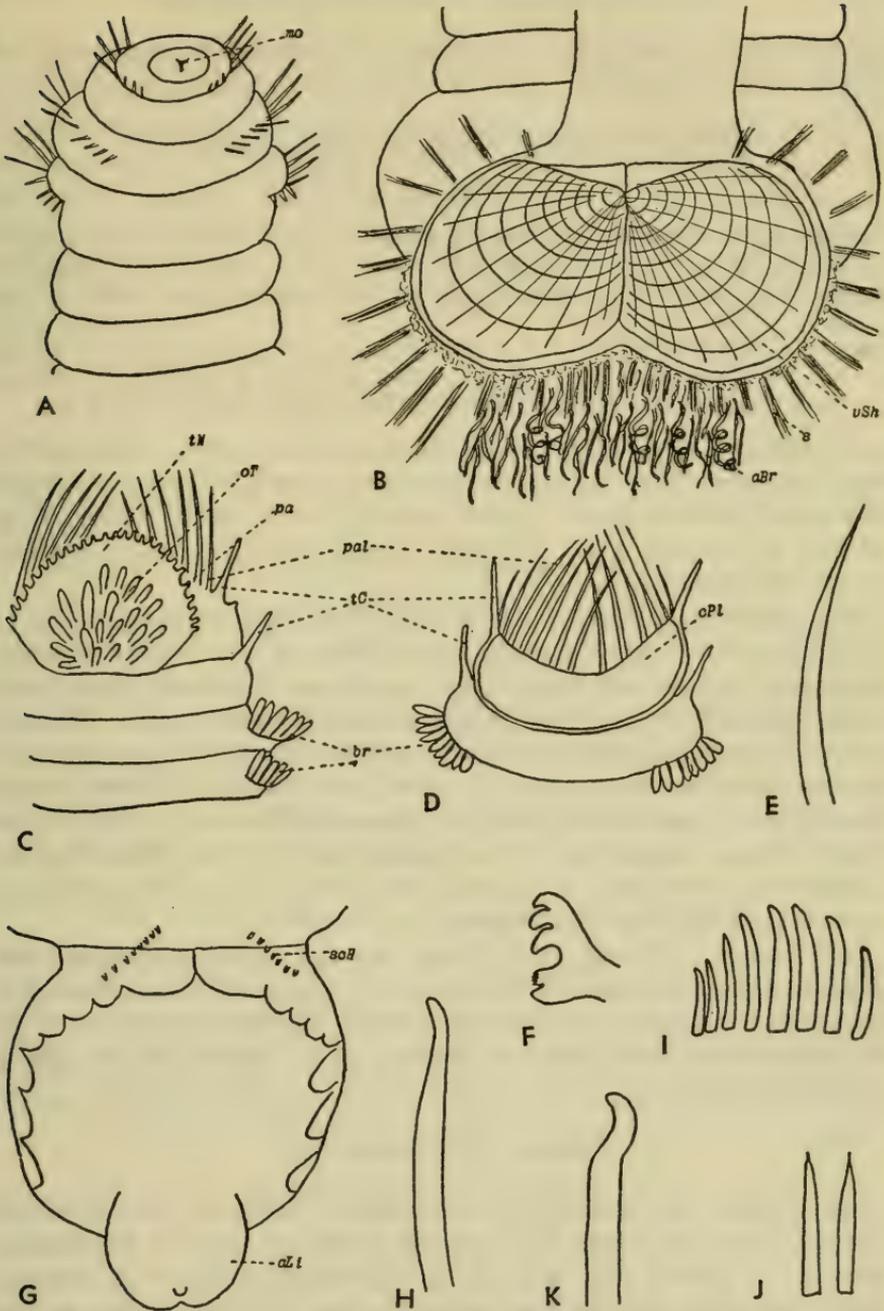


FIGURE 35.—Sternaspidae: *a*, *Sternaspis scutata*, ventral view anterior end; *b*, same, ventral view posterior end. Pectinariidae: *c*, *Pectinaria hyperborea*, ventral view anterior end; *d*, same, dorsal view anterior end; *e*, same, palea; *f*, same, pectiniform uncinus; *g*, same, dorsal view posterior anal plaque or scapha; *h*, same, scaphal seta; *i*, *Pectinaria granulata*, cephalic paleae; *j*, same, cephalic paleae, with short mucronate tips; *k*, same, scaphal hook. (For explanation of symbols, see p. 210.)

Iceland, Faroes; Labrador to Long Island Sound; Bering Sea to western México; north Japan Sea. In low water to 190 fathoms.

Pectinaria (Cistenides) hyperborea (Malmgren, 1865)

FIGURE 35, c-h

Cistenides hyperborea Malmgren, 1865, p. 360, pl. 18, fig. 40.—Moore, 1903, p. 479.—Fauvel, 1914, p. 277, pl. 26, figs. 27, 28.—Augener, 1928, p. 775.—Berkeley and Berkeley, 1942, p. 201.—Wesenberg-Lund, 1950a, p. 46; 1950b, p. 106; 1951, p. 100.

Pectinaria (Cistenides) hyperborea Hessle, 1917, p. 76.—Nilsson, 1928, p. 31, fig. 9.—Gustafson, 1936, p. 8.—Okuda, 1937b, p. 56, fig. 5; pl. 2, fig. F.—Annenkova, 1937, p. 186; 1938, p. 197.—Zatsepin, 1948, p. 147, pl. 37, fig. 4.

Description.—Body 28–55 mm. long, 6–12 mm. wide. Tube 45–72 mm. long, 7–10 mm. in greatest diameter, formed of fine sand grains plus some coarser ones. Paleae usually 11–14 pairs (9–15), long, tapered to slender tips. Scaphal hooks taper gradually, without distinct shoulder.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 6–123.5 fms., on bottoms of mud, mass of worm tubes, and various combinations of mud, gravel, stones, rocks, with shells, worm tubes; from fish trap (8 stations, 19 specimens). BERING SEA: *Albatross* Sta. 3610, 55°58' N., 167°16' W., 75 fms., mud, 1895. ALASKA: *Albatross* Sta. 4244, Kasaan Bay, Prince of Wales Island, 50–54 fms. WEST GREENLAND: Godhavn, U.S.S. *Alert*, 1884. EAST COAST NORTH AMERICA: Off Labrador, 8–125 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; off Nova Scotia, Maine, Massachusetts, 16–65 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Norway to Danish waters, North Sea; Labrador to Massachusetts; Bering Sea to Alaska; north Japan Sea to Japan. In 1.5–379 fathoms.

Family AMPHARETIDAE

Prostomium (or tentacular membrane) more or less distinctly trilobed, with numerous filiform oral tentacles, smooth or pinnate, retractile in mouth (fig. 36, *a*, *b*, *e*). Branchiae filiform or subulate (rarely pinnate), two to four pairs, inserted on dorsal part of first setigerous segments. First few segments achaetous, with or without special group of setae or paleae anterior to branchiae. Body divided into two distinct regions: (1) thoracic; conical notopodia with smooth, limbate capillary setae and, beginning on setigers 3 or 4, with neuropodial flattened pinnules bearing a row of pectiniform uncini; (2) abdominal; uncinigerous pinnules only. With or without dorsal,

ventral or anal cirri. Tube membranous, covered with mud or agglutinated foreign bodies.

Represented by two genera and four species at Point Barrow. Both genera have prostomia trilobed, without projecting glandular crests; oral tentacles numerous, pinnate; without large dorsal hooks posterior to branchiae; branchiae four pairs, filiform or subulate, arising on or near a distinct transverse dorsal ridge; thoracic setigers 14; uncinigerous pinnules begin on setiger 3; notopodia without claviform cirri.

Key to the genera of Ampharetidae from Point Barrow

1. With paleae, lateral group of golden setae anterior to branchiae (fig. 36, *a, b*)-----**Ampharete** (p. 315)
- Without paleae-----**Asabellides** (p. 318)

Genus *Ampharete* Malmgren, 1865

All three species have prostomium distinctly trilobed; median lobe with pair of basal eyes, lateral lobes encircling median lobe posteriorly (fig. 36, *a*). First two segments achaetous; first or buccal segment extended anteroventrally forming large lower lip. Segment 3 or paleal segment with group of paleae arranged in semicircle just anterior and lateral to branchiae. Abdominal segments with neuropodial cirri dorsally on uncinigerous pinnules poorly developed (short, rounded to conical) to well developed (cirriform, longer than pinnule).

Key to the species of *Ampharete* from Point Barrow

1. First 2 abdominal segments with enlarged, padlike, achaetous notopodial lobes----- **A. vega**
- Without enlarged notopodial lobes on first few abdominal segments----- 2
2. Paleae slender, taper gradually. Abdominal setigers 12, usually with prominent neuropodial cirri. Anal cirri numerous (fig. 36, *c*)-----**A. acutifrons**
- Paleae taper rather abruptly, with short mucronate tips. Abdominal setigers 16-17, with neuropodial cirri inconspicuous. Anal cirri 2----- **A. goësi**

Ampharete vega (Wirén, 1883)

FIGURE 36, *a*

Amphicteis vega Wirén, 1883, p. 415, pl. 32, figs. 3, 4.

Ampharete vega Hessler, 1917, p. 99.—Augener, 1928, p. 778.—Annenkova, 1929, p. 493.—Zatsepin, 1948, p. 150.

Description.—Length 16 mm., width 1.5 mm. (up to 50 mm. long, 4 mm. wide—Wirén, 1883). Paleae slender, tapering gradually to fine tips, 10-13 in each group. Eight branchiae form continuous transverse group, arising from low fold. Abdominal segments up to 27-28 (16 in Point Barrow specimen; complete?). First two abdom-

inal segments with enlarged, rounded, padlike, achaetous notopodial lobes. Neuropodial cirri poorly developed or lacking. Pygidium with several small papillae? Colorless in alcohol. Tube thin, membranous, with sand and debris, rather straggly.

New records.—ARCTIC ALASKA: West side Elson Lagoon near entrance to small lagoon to west, near Point Barrow (rather brackish water), 1.2 fms. (1 station, 1 specimen).

Distribution.—Scattered records in the Arctic: Siberian and Alaskan Arctic, Spitsbergen, Barents Sea, Kara Sea, Laptev Sea. In 1.2–11 fathoms.

Ampharete acutifrons (Grube, 1860)

FIGURE 36, b-d

Amphicteis acutifrons Grube, 1860, p. 109, pl. 5, fig. 6.

Ampharete grubei Malmgren, 1865, p. 363, pl. 19, fig. 44.—Eliason, 1920, p. 70.—Fauvel, 1927, p. 227, fig. 79, a-p.—Augener, 1928, p. 776.—Thorson, 1946, p. 121, fig. 66.—Hartman, 1948, p. 43.

Ampharete cirrata Webster and Benedict, 1887, p. 747, pl. 8, figs. 110–112.

Ampharete trilobata Webster and Benedict, 1887, p. 747.

Ampharete acutifrons Hessele, 1917, p. 96.—Annenkova, 1937, p. 188; 1938, p. 200.—Zatsepin, 1948, p. 150, pl. 37, fig. 8.—Wesenberg-Lund, 1950a, p. 47; 1950b, p. 109; 1951, p. 102.

Description.—Length 45 mm., width 6 mm. (up to 56 mm. long, 8 mm. wide—Wirén, 1883). Paleae slender, taper gradually to long, delicate tips, may be somewhat curved, 10–30 in each group. Branchiae in two groups separated middorsally, each group with three branchiae in transverse line and one slightly more posterior. Abdominal segments 12. With neuropodial cirri small, conical to quite long, longer than pinnule (well developed on Point Barrow specimens). Pygidium a short ring bearing a circle of numerous subequal anal cirri (2 lateral ones may be longer). Colorless in alcohol. Tube membranous, covered with soft, gray debris (or agglutinated mud).

Remarks.—The types of *Ampharete cirrata* Webster and Benedict from Eastport, Maine, were examined. This species was separated on the basis of the relative development of the neuropodial cirri, which appears to be somewhat variable. The types of *A. trilobata* Webster and Benedict, also from Eastport, were not available, but this species also, according to the original description, was differentiated by the relative development of the cirri.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow; Point Barrow base, washed ashore; off Point Barrow base, up to 6 miles from shore, 3.7–49 fms., on bottoms of mud, and various combinations of mud, pebbles, gravel, stones, rocks, and

shells (10 stations, 17 specimens). WEST COAST NORTH AMERICA: Washington and Puget Sounds, 80 fms., Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 8 fms., *Blue Dolphin Expedition*, 1949.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Jan Mayen, Spitsbergen, Novaya Zemlya. Also Iceland, Swedish west coast to France, Mediterranean; Labrador to Maine; Bering Sea to southern California; north Japan Sea. In 1–1,333 fathoms.

***Ampharete goësi* Malmgren, 1865**

Ampharete goësi Malmgren, 1865, p. 364, pl. 19, fig. 45.—Hessle, 1917, p. 91.—Augener, 1928, p. 778.—Annenkova, 1929, p. 492, pl. 38, fig. 37; 1937, p. 188; 1938, p. 200.—Zatsepin, 1948, p. 150, pl. 38, fig. 10.—Wesenberg-Lund, 1950a, p. 47; 1950b, p. 110; 1951, p. 102.—Berkeley and Berkeley, 1952, p. 66, fig. 136.

Ampharete goësi subsp. *braznikovi* Annenkova, 1929, p. 492, pl. 38, fig. 44.

Description.—Length 35 mm., width 6 mm. (up to 50 mm. long, 7 mm. wide—Malmgren, 1865). Paleae rather stout, taper abruptly, ending in short acuminate tips, 14–21 in each group. Branchiae in two groups separated middorsally, each group with three branchiae in transverse line. Abdominal segments 17 (stem form and Point Barrow specimens) or 16 (subsp. *braznikovi* and Washington Sound specimens). Neuropodial cirri inconspicuous, low, rounded. Pygidium with two long anal cirri. COLOR: In life: Body reddish orange, branchiae green. In alcohol: Colorless. TUBE: Membranous, rather thick, with debris including bits of shells, sea urchins tests, and foraminiferans, very straggly.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 20.3–123.5 fms., on bottoms of mass of worm tubes and various combinations of mud, pebbles, gravel, stones, rocks, shells, and worm tubes (11 stations, 20 specimens). WEST COAST NORTH AMERICA: Washington Sound, Pettibone.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen, Barents Sea, White Sea, Novaya Zemlya. Also Iceland; British Columbia to Washington; Okhotsk Sea to north Japan Sea. In 10.5–353 fathoms.

***Ampharete* sp. (Young)**

Two very small specimens, 12 mm. long, were found on bottom of rocks with bryozoans and hydroids in 17 fathoms September 9, 1948. Prostomium 3-lobed, with four eye spots, bases of four pairs branchiae, 14 thoracic segments, 10 abdominal segments plus a growing zone.

Genus *Asabellides* Annenkova, 1929

Includes *Pseudosabellides* Berkeley and Berkeley, 1943.

Asabellides sibirica (Wirén, 1883)

FIGURE 36, e

Sabellides sibirica Wirén, 1883, p. 418.

Asabellides orientalis Annenkova, 1929, p. 494, pl. 38, figs. 50, 51, pl. 39, figs. 60-65; 1937, p. 188.

Asabellides sibirica Annenkova, 1938, p. 201.

Pseudosabellides lineata Berkeley and Berkeley, 1943, p. 131; 1944, p. 3; 1952, p. 71, fig. 147.

Description.—Body long, slender, 38 mm. long, 1.5 mm. wide. Prostomium trilobed with median lobe wider and flared anteriorly, lateral lobes diagonal. Segments 1 and 2 fused laterally and ventrally, forming large lower lip; dorsally, appear as two short segments more or less hidden by dorsal branchial fold. Segments 3 and 4 more or less fused ventrally and laterally; dorsally, segment 3 without paleae but with branchiae; segment 4 with first notopodial lobes and, middorsally, a fused nephridial area with pair of papillae posterior to branchial bases. Branchiae slender, filiform, emerge from prominent ridge, six in transverse row, two slightly posterior. Abdominal segments 23 (14-23). Neuropodial cirri small, short, rounded (Point Barrow specimens) to long, slender, cirriform. Pygidium with few small cirri and pair of long lateral ones. COLOR: In life: Salmon below, darker above, branchiae green, oral tentacles pink. In alcohol: Colorless.

New records.—ARCTIC ALASKA: Off Point Barrow base, 5 miles from shore, 11.7 fms., on bottom of mud (1 station, 3 specimens).

Distribution.—Scattered records in the Arctic: Siberian, Alaskan, and Canadian Arctic. Also Hudson Bay; Bering Sea to British Columbia; Okhotsk Sea to north Japan Sea. In 4-106 fathoms.

Family TEREBELLIDAE

Body divided into two regions: (1) thoracic; more or less inflated, with dorsal bundles of capillary setae and ventral uncinigerous tori (sometimes acicular crotchets, sometimes absent), often with ventral glandular shields; (2) abdominal; elongated, more or less tapering, most often lacking dorsal setae and bearing only uncinigerous pinnules. Prostomium of variable form and dimensions, fused with buccal segment, forming a lower lip, a transverse dorsal cephalic ridge with or without numerous eye-spots, a tentacular membrane with numerous filiform grooved tentacles not retractile in mouth, a semicircular or folded upper lip (fig. 36, f). Branchiae 1-3 pairs, filiform or arborescent, or single, quadrilobed, pectinate, on anterior segments, or

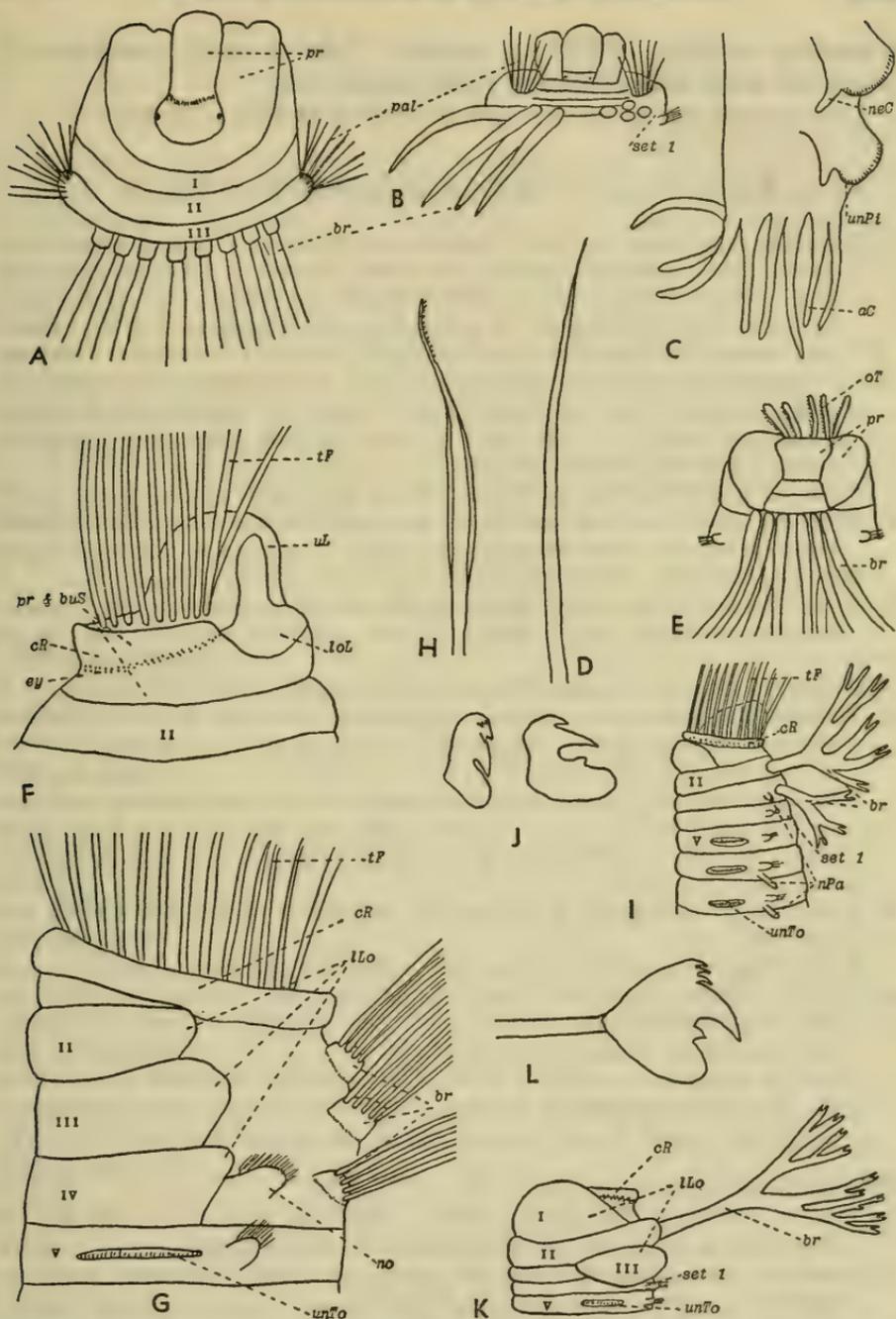


FIGURE 36.—Ampharetidae: *a*, *Ampharete vega*, dorsal view anterior end; *b*, *Ampharete acutifrons*, dorsal view anterior end; *c*, same, lateral view posterior end; *d*, same, palea; *e*, *Asabellides sibirica*, dorsal view anterior end. Terebellidae: *f*, lateral view anterior end of terebellid; *g*, *Amphitrite cirrata*, lateral view anterior end; *h*, same, notoseta; *i*, *Nicolea venustula*, lateral view anterior end of male; *j*, same, thoracic uncini; *k*, *Pista maculata*, lateral view anterior end, tentacles missing; *l*, same, uncinus with long manubrium. (For explanation of symbols, see p. 210.)

branchiae lacking. Without paleae. Tube usually membranous, encrusted with sand, debris of shells, algae, etc.

Represented by 10 genera and 11 species at Point Barrow.

Key to the genera of Terebellidae from Point Barrow

1. Uncini in single rows on first 6 uncinigerous segments, then in 2 rows (alternating, interlocking or opposite) on certain number of following segments. With distinct thoracic ventral shields (single, not paired). Notosetae begin on segment 4; uncini begin on segments 5 or 6 (setigers 2 or 3). Fused prostomium and buccal segment forming a prominent rectangular lower lip, a transverse semicircular cephalic ridge (with or without numerous eye-spots along basal groove), flared semicircular upper lip, semicircular depressed tentacular region between upper lip and cephalic ridge with numerous, filiform, grooved tentacles (fig. 36, *f*) ----- 2
 Uncini in single rows only (or with crotchets on thoracic segments) ----- 7
2. With 1-3 pairs branchiae dorsally on segments 2-4 (fig. 36, *g, i, k*). Uncini begin on segment 5 (setiger 2) ----- 3
 Without branchiae. With lateral lobes on anterior segments (fig. 37, *a*) ----- 5
3. Notosetae with tips finely denticled (fig. 36, *h*). Cephalic ridge usually without eye-spots. With lateral lobes on anterior segments (fig. 36, *g*).
Amphitrite (p. 321)
 Notosetae with tips smooth. Cephalic ridge usually with eye-spots ----- 4
4. Without lateral lobes on anterior segments. Uncini of anterior segments without long manubrium (fig. 36, *j*). Branchiae 2 pairs, branched dichotomously (fig. 36, *i*) ----- **Nicolea** (p. 322)
 With large lateral lobes on buccal segment, enclosing prostomium and connected ventrally (fig. 36, *k*). Uncini of first few segments with long manubrium (fig. 36, *l*). Branchiae 1-3 pairs, arborescent, with main trunk well marked ----- **Pista** (p. 323)
5. Uncini begin on segment 6 (setiger 3). Notosetae of 2 kinds, smooth and denticled ----- **Proclea** (p. 325)
 Uncini begin on segment 5 (setiger 2). Notosetae with tips smooth ----- 6
6. Uncini in single rows on first 6 uncinigerous segments, in double rows on next 10. Nephridial papillae of segment 3 not elongated. Notosetae broadly bilimbate below whiplike tip (fig. 37, *b*) ----- **Leaena** (p. 325)
 Uncini in single rows on first 6 uncinigerous segments, in double rows on next 8. Nephridial papillae of segment 3 (anterior to first setiger) elongated. Notosetae weakly limbate on one side along most of its length (fig. 37, *c*).
Lanassa (p. 326)
7. Uncini all short, avicular (fig. 37, *d*) ----- 8
 Uncini of 2 types; thoracic aciculiform, with long manubrium (fig. 37, *h*); abdominal avicular (fig. 37, *i*). Without ventral shields ----- 9
8. Branchiae 2-3 pairs, cirriform, in transverse rows. Notosetae begin on segment 3, continuing on large number of segments; uncini begin on segment 5 (setiger 3). Ventral shields usually slightly distinct. Tentacular lobe not especially enlarged ----- **Thelepus** (p. 327)
 Without branchiae. Notosetae begin on segments 2 or 3; uncini begin on variable number of segments, may be absent from thoracic region. With ventral shields, first unpaired, rest paired, more or less separated in median line (fig. 37, *f*). Tentacular membrane large, trilobed or undulating, bearing very numerous tentacles (fig. 37, *e-f*) ----- **Polycirrus** (p. 328)

9. Branchiae 2-3 pairs, single, filiform (fig. 37, *g*). Notosetae and uncini (crotchets) both begin on segment 6. Tentacular lobe folded, with very numerous thin, cylindrical, and short, grooved tentacles.

Trichobranchus (p. 329)

Branchiae single, consisting of large cylindrical trunk and 4 pectinate lobes (fig. 37, *j*). Notosetae begin on segment 3, uncini begin on segment 8 (setiger 6). Tentacular lobe large, folded, with numerous tentacles of a single kind.-----**Terebellides** (p. 330)

Genus *Amphitrite* O. F. Müller, 1771

Both species have the body inflated anteriorly, decidedly attenuated posteriorly. Cephalic ridge without eye-spots. Branchiae three pairs, on segments 2-4. Notosetae begin on segment 4; uncini begin on segment 5, in single rows on first six, in double rows on rest of thoracic setigers, in single rows on abdominal segments on projecting pinnules. Pygidium a crenulate ring.

Key to the species of *Amphitrite* from Point Barrow

1. Branchiae cirriform, a tuft of simple filaments from short, slightly swollen common base (fig. 36, *g*). Thoracic setigers 17-----**A. cirrata**
Branchiae branched. Thoracic setigers 19-----**A. groenlandica**

Amphitrite cirrata Müller, 1776

FIGURE 36, *g, h*

Amphitrite cirrata O. F. Müller, 1776, p. 216.—Malmgren, 1865, p. 375, pl. 21, fig. 53.—Webster and Benedict, 1887, p. 748.—Hessle, 1917, p. 185.—Chamberlin, 1920, p. 22.—Eliason, 1920, p. 74.—Fauvel, 1927, p. 251, fig. 86, *i-o*.—Augener, 1928, p. 785.—Okuda, 1938b, p. 102.—Hartman, 1944a, pp. 334, 342; 1948, p. 43.—Thorson, 1946, p. 127, figs. 71, 72.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 156, pl. 38, fig. 12.—Wesenberg-Lund, 1950a, p. 50; 1950b, p. 116; 1951, p. 106.—Berkeley and Berkeley, 1952, p. 86, fig. 175.

Amphitrite radiata Moore, 1908, p. 350; 1923, p. 193.

Description.—Length up to 200 mm., width 10 mm. About 12 ventral shields. Branchiae 3 pairs, cirriform, a tuft of simple filaments from a short common base. Each of three branchial segments (segments 2-4) with pair of lateral lobes. Nephridial papillae 7 pairs; on segment 3, prominent papillae ventral to second branchial pair; on segments 6-11, rather inconspicuous papillae between notopodia and neuropodia. Thoracic setigers 17. COLOR: In alcohol: Reddish brown. Tube: Mostly of mud, with scattered small pebbles and debris, soft, breaking easily.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon; off Point Barrow base, up to 7 miles from shore, 18.3-70 fms., on various combinations of mud, sand, gravel, stones, rocks, large perforated rocks, shells (8 stations, 14 specimens). WEST COAST NORTH

AMERICA: Wrangel, Alaska,⁵ Jones; Puget Sound, low tide, Pettibone. WEST GREENLAND: Vaigat, Disko Island, Bartlett, 1937. EAST COAST NORTH AMERICA: Bay of Fundy, Maine, Massachusetts, 14–110⁵fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitzbergen, Franz Josef Land, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to British Isles, Azores, Mediterranean, Adriatic; Bay of Fundy to Massachusetts; Bering Sea to southern California; Japan. In low water to 1,528 fathoms.

Amphitrite groenlandica Malmgren, 1865

Amphitrite groenlandica Malmgren, 1865, p. 376, pl. 21, fig. 52.—Verrill, 1881, pp. 305, 310.—Hessle, 1917, p. 181.—Fauvel, 1927, p. 250, fig. 86, a-c.—Augener, 1928, p. 787.—Annenkova, 1937, p. 192; 1938, p. 206.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 157, pl. 38, fig. 14.—Wesenberg-Lund, 1950a, p. 51; 1950b, p. 117; 1951, p. 107.

Neoamphitrite robusta Hartman, 1948, p. 44 (not *Amphitrite robusta* Johnson, 1901).

Description.—Length up to 190 mm., width 9 mm. (a single, much smaller specimen from Point Barrow). About 14 ventral shields. Branchiae 3 pairs, branched dichotomously 3–4 times, with main trunk short, thick. Lateral lobes of first two branchial segments well developed, continuing ventrally; small lateral lobes on third branchial segment. Nephridial papillae 12 pairs on segments 3–14, the first four with more prominent papillae. Thoracic setigers 19. Colorless in alcohol. Tube of mud.

Remarks.—*A. robusta* Johnson is very close to *A. groenlandica*; it differs in having 17 thoracic setigers instead of 19.

New records.—ARCTIC ALASKA: Off Point Barrow base, 5 miles from shore, 49 fms., on bottom of rocks, stones, gravel (1 station, 1 specimen). SOUTHWESTERN ALASKA: Round Island, Coal Harbor, Unga Island, 8–9 fms., Dall, 1872.

Distribution.—Scattered records in the Arctic: Siberian and Alaskan Arctic, West Greenland, Spitsbergen, Novaya Zemlya. Also Iceland, Scandinavian coast to North Sea, Ireland; Maine; southwestern Alaska; Okhotsk Sea to north Japan Sea. In 7 to 440 fathoms.

Genus *Nicolea* Malmgren, 1865

Nicolea venustula (Montagu, 1818)

FIGURE 36, *i, j*

Terebella venustula Montagu, 1818, p. 344, pl. 13, fig. 2.

Nicolea arctica Malmgren, 1865, p. 381, pl. 24, figs. 66, 67.

Nicolea zostericola Malmgren, 1865, p. 381, pl. 26, fig. 76.—Webster and Benedict, 1887, p. 749.—Moore, 1909b, p. 141.—Fauvel, 1927, p. 261, fig. 90, g-n.—Annenkova, 1934, p. 322; 1937, p. 191; 1938, p. 205.—Gustafson, 1936, p.

9.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 87, figs. 177, 178.—Gorbunov, 1946, p. 39.—Hartman, 1948, p. 44.

Nicolea simplex Verrill, 1873, p. 613; 1881, p. 302, pl. 10, fig. 1.—Sumner, Osburn, and Cole, 1913, p. 627.

Nicolea venustula Ehlers, 1913, p. 559.—Hessle, 1917, p. 171.—Chamberlin, 1920, p. 22.—Eliason, 1920, p. 73.—Fauvel, 1927, p. 260, fig. 90, a-f; 1934a, p. 68.—Augener, 1928, p. 788.—Thorson, 1946, p. 126.—Zatsepin, 1948, p. 156, pl. 38, fig. 11.—Wesenberg-Lund, 1950a, p. 51; 1950b, p. 118; 1951, p. 109.

Description.—Length 15–48 mm., width 2–5 mm., segments 30–46 (up to 70 mm. long—Wirén, 1883). Ventral shields about 14. Cephalic ridge with numerous dark eye-spots. Branchiae two pairs, on segments 2–3, branched dichotomously 3–6 times, with very short main stem, first pair much larger than second. Without lateral lobes on branchial segments. Nephridial papillae on segments 3 (slightly posterior to pair of second branchiae), 6, and 7; small in female; in male, papillae on segments 6 and 7 long, cylindrical. Thoracic setigers 15 (14–18, according to Hessle). Uncini begin on segment 5 (setigerous segment 2), in single rows on first six, in two alternating rows on rest of thoracic segments, in single rows on prominent projecting abdominal pinnules. Pygidium crenulate. Colorless or slightly brownish in alcohol. Females with large yolky eggs inside body (Point Barrow, August 21, and September 15, 1948; August 8, 1949). Tube with tough, translucent membranous lining, with small pebbles of various sizes, shell debris, foraminiferans, etc.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 13.3–123.5 fms., on bottoms of mud, stones, mass of worm tubes, and various combinations of mud, sand, gravel, pebbles, stones, rocks, large perforated rocks, with bryozoans, hydroids, shells (24 stations, 79 specimens). ALASKA: Security Bay, Jones. CANADIAN ARCTIC: Dobbin Bay, E. Ellesmere Island, 79°36' N., 73°35' W., 17 fms., Littlewood, 1950. EAST COAST NORTH AMERICA: Off Maine, Massachusetts, Rhode Island, Connecticut, shore to 63 fathoms and surface (young), U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France, Mediterranean, Adriatic, Red Sea; Hudson Bay to Connecticut; Bering Sea to western Canada; north Japan Sea; South Africa. In low water to 472 fathoms.

Genus *Pista* Malmgren, 1865

Pista maculata (Dalyell, 1853)

FIGURE 36, *k, l*

Terebella maculata Dalyell, 1853, p. 203, pl. 28, figs. 10–14, 19.

Sciöne lobata Malmgren, 1865, p. 383, pl. 23, fig. 62.—Verrill, 1881, pp. 305, 310.—Webster and Benedict, 1887, p. 749.—Augener, 1928, p. 789.—Friedrich, 1939, p. 127.

Pista maculata Hessle, 1917, p. 161, pl. 3, fig. 4.—Fauvel, 1927, p. 263, fig. 91, a-h.—Berkeley and Berkeley, 1943, p. 130.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 155, pl. 38, fig. 9.—Wesenberg-Lund, 1950a, p. 52; 1950b, p. 119; 1951, p. 110.

Pista groenlandica Treadwell, 1937, p. 33, figs. 14–16.

Description.—Length up to 150 mm., width 6 mm. Ventral shields about 14. Cephalic ridge with numerous eye-spots. Single pair large branchiae on segment 2, with large, cylindrical main trunk, branched. Buccal segment with two large, rounded lateral lobes embracing prostomium, connected ventrally by a crest; segment 2 short, without lateral lobes; segment 3 with large, rounded, flattened lateral lobes. Nephridial papillae on segments 6–7. Thoracic setigers 16 (one had small lobe on one side only on 17). Uncini begin on segment 5 (setiger 2), in single rows on first 6, in two alternating interlocking rows on rest of thoracic segments, in single rows on rectangular pinnules in abdominal region. Pygidium with six or seven (6–12) conical papillae, arranged starlike. COLOR: In alcohol: Branchiae and tentacles dark brown or colorless. TUBES: Irregularly twisted, with thin transparent membranous lining covered mostly with fine sand grains plus few large pebbles, bits of shell, bryozoans, foraminiferans, algae, parts of other worm tubes.

Remarks.—The type of *P. groenlandica* Treadwell from Baffin Bay was examined and is herein referred to *P. maculata*. Contrary to the original description, eye-spots are present on the cephalic ridge (small, in transverse groove, easily overlooked).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 21–123.5 fms., on bottoms of mass of worm tubes and various combinations of mud, gravel, stones, rocks, large perforated rocks; from crab, *Hyas coarctatus* (13 stations, 168 plus specimens). NORTH GREENLAND: 5 miles south Cape Chalon; north Omenolu near North Star Bay, 17 fms., Bartlett, 1932. WEST GREENLAND: Oelrichs Bay, 1937; off Conical Rock, 76°3' N., 67°30' W., 20–40 fms., 1938; 1 mile northwest Conical Rock, 25–60 fms., 1940; between north shores Parkers Snow Bay and Conical Rock, 25–45 fms., 1940; all collected by Bartlett. EAST GREENLAND: Off Cape Hold with Hope, 23–40 fms., Bartlett, 1939. EAST COAST NORTH AMERICA: Off Labrador, 8–125 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Baffin Bay, Greenland, Spitsbergen, Barent Sea, Novaya Zemlya. Also Iceland, Norway to English Channel: Hudson Bay to Maine; Bering Sea. In 3–1,528 fathoms.

Genus *Proclea* Saint-Joseph, 1894***Proclea graffii* (Langerhans, 1884)**

Leaena graffii Langerhans, 1884, p. 262, pl. 15, fig. 21.

Proclea graffi Southern, 1914, p. 120.—Hessle, 1917, p. 199, fig. 53.—Fauvel, 1927, p. 268, fig. 94, a-g.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 157, pl. 38, fig. 19.—Wesenberg-Lund, 1951, p. 111.

Description.—Length up to 42 mm., width 3 mm., segments 49. Ventral shields about 10. Cephalic ridge without eye-spots. Without branchiae. With lateral lobes on segments 2-4, those on segments 2 and 3 elongate, extending to ventral shields. Nephridial papillae on segments 3, 6-8. Thoracic setigers 16. Uncini begin on segment 6 (setiger 3), in single rows on first six, in double rows on rest of thoracic segments, in single rows on projecting abdominal pinnules. Pygidium crenulate. Colorless in alcohol. Tube?

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7.5 miles from shore, 21-36 fms., on bottoms of rocks, stones, large perforated rocks, from breaking rocks apart (3 stations, 6 specimens).

Distribution.—Scattered records in the Arctic: Siberian and Alaskan Arctic, Franz Josef Land, White Sea. Also Bering Sea to Okhotsk Sea; Iceland, Swedish west coast, Finland, Ireland, Madeira. In 1-36 fathoms.

Genus *Leaena* Malmgren, 1865***Leaena abbranchiata* Malmgren, 1865**

FIGURE 37, a, b

Leaena abbranchiata Malmgren, 1865, p. 385, pl. 24, fig. 64.—not Moore, 1909b, p. 141 (= *Lanassa venusta*).—Ehlers, 1913, p. 563.—Hessle, 1917, p. 197.—Augener, 1928, p. 793.—Annenkova, 1937, p. 192; 1938, p. 208.—Berkeley and Berkeley, 1943, p. 130.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 157, pl. 38, fig. 17.—Hartman, 1948, p. 45.—Wesenberg-Lund, 1950a, p. 53; 1950b, p. 121; 1951, p. 112.

Leaena antarctica McIntosh, 1885, p. 462, pl. 48, figs. 9, 10; pl. 28A, figs. 10, 11. *Leaena abbranchiata* var. *antarctica* Hessle, 1917, p. 197.—Monro, 1930, p. 188; 1936, p. 178.

Description.—Length 43 mm., width 3 mm. (up to 75 mm. long, 6 mm. wide—Malmgren, 1865). About 10 ventral shields. Cephalic ridge without eye-spots. Without branchiae. Lateral lobes on segment 2 extend ventrally, those on segment 3 extend dorsally, forming a prominent ridge (segment preceding first setiger; ridge not so prominent in var. *antarctica*). Thoracic setigers 10. Uncini begin on segment 5 (setiger 2), in single rows on first 6, in double rows on next 10, then in single rows on prominent abdominal pinnules. Notosetae widely bilimbate below whiplike tips. Colorless in alcohol. TUBE: Of soft mud with a few bits of scattered rock (some small ones on tubes of *Pista maculata*).

New records.—ARCTIC ALASKA: Off Point Barrow base, 25 fms., on bottoms of gravel, stones, shells (1 station, 1 specimen). EAST COAST NORTH AMERICA: Off Labrador, 15–55 fms., mud and mud with rock, *Blue Dolphin Expeditions*, 1950, 1951.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Baffin Bay, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway, Sweden, Finland; Hudson Bay to Labrador; southwestern Alaska; Okhotsk Sea to north Japan Sea. In 6–833 fathoms. Var. *antarctica*: Antarctic, South Georgia; up to 1,975 fathoms.

Genus *Lanassa* Malmgren, 1865

Lanassa venusta (Malm, 1874)

FIGURE 37, c

Laphaniella venusta Malm, 1874, p. 98, pl. 1, fig. 8.

Leaena nuda Moore, 1905b, p. 855, pl. 44, figs. 14, 15.

Leaena abranchiata Moore, 1909b, p. 141 (not *L. abranchiata* Malmgren, 1865).

Lanassa venusta Hesse, 1917, p. 205.—Eliason, 1920, p. 75.—Gustafson, 1936, p. 9.—Annenkova, 1937, p. 194; 1938, p. 209.—Zatsepin, 1948, p. 157.

Lanassa venusta subsp. *pacifica* Annenkova, 1938, pp. 209, 230.

Description.—Length 37–55 mm., width 3 mm., segments 54–67. Ventral shields about 10. Cephalic ridge without eye-spots (present in subsp. *pacifica*). Oral tentacles numerous (more than 12 as indicated by Malm). Without branchiae. Lateral lobes on segments 2 and 3 extending ventrally; small lateral lobes on segment 4. Nephridial papillae on segments 3, 6–8; those of segment 3 prominent (anterior to first setiger). Thoracic setigers 11 (12 on subsp. *pacifica*). Uncini begin on segment 5 (setiger 2), single on first six, in double rows on next eight, in single rows on prominent abdominal pinnules. Notosetae weakly limbate (fig. 37, c). Pygidium crenulate. Females with large yolky eggs in body (Point Barrow, Sept. 9 and 15, 1948; Aug. 17, Oct. 11, 1949; Aug. 1, 1950). COLOR: In life: Orange, with white shields, tentacles tan. In alcohol: Colorless. TUBE: With thin, transparent membranous lining, with very loose mud, bits of sand, rock, foraminiferans (tube of specimen from Labrador with great deal of loosely assembled shell debris).

Remarks.—The type of *Leaena nuda* Moore from southwestern Alaska was examined and found in poor condition. It has been referred previously to *Lanassa venusta* by Annenkova (1937).

New records.—ARCTIC ALASKA: Point Barrow base, washed ashore; off Point Barrow base, up to 12.1 miles from shore, 18.3–75.5 fms., on bottoms of mud, stones, and various combinations of mud, sand, gravel, pebbles, stones, rocks, large perforated rocks, with bryozoans, shells (17 stations, 44 specimens). CANADIAN ARCTIC: Cove in

Kneeland Bay, Frobisher Bay, Baffin Island, 14 fms., Bartlett, 1942.

Distribution.—Scattered records in the Arctic: Siberian, Alaskan, and Canadian Arctic. Also Swedish west coast, Danish waters; Labrador; southwestern Alaska; north Japan Sea. In 7–140.5 fathoms.

Genus *Thelepus* Leuckart, 1849

Thelepus cincinnatus (Fabricius, 1780)

FIGURE 37, *d*

Amphitrite cincinnata Fabricius, 1780, p. 286.

Thelepus cincinnata Malmgren, 1865, p. 387, pl. 22, fig. 58.

Thelepus cincinnatus Webster and Benedict, 1887, p. 749.—Hessle, 1917, p. 212.—Chamberlin, 1920, p. 23.—Eliason, 1920, p. 76.—Fauvel, 1927, p. 271, fig. 95, i–m; 1932, p. 233, fig. 40; 1934a, p. 69.—Augener, 1928, p. 790.—Monro, 1930, p. 192; 1936, p. 182.—Treadwell, 1937, p. 33.—Friedrich, 1939, p. 127.—Hartman, 1944a, pp. 336, 343; 1952, p. 236.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 154, pl. 38, fig. 7.—Wesenberg-Lund, 1950a, p. 54; 1950b, p. 122; 1951, p. 112.

Thelepus hamatus Moore, 1905b, p. 856, pl. 44, figs. 16–18.—Hartman, 1948, p. 44.—Berkeley and Berkeley, 1952, p. 82, fig. 167.

Description.—Up to 200 mm. long, 10 mm. wide, segments numerous. Dorsal surface rugose, with small glandular warts irregularly distributed and especially abundant anteriorly. Ventral shields indistinct, wide, somewhat wrinkled. Buccal segment and prostomium forming a thick lower lip, a prominent horseshoe-shaped upper lip, a semicircular cephalic ridge with numerous small eye-spots; tentacular area between upper lip and cephalic ridge with numerous, rather thick tentacles. Branchiae 2 pairs on segments 2 and 3, each formed of numerous, simple filaments arranged in parallel transverse rows. Nephridial papillae on segments 4–7. Notosetae begin on segment 3, continuing on about 40 segments (or almost to posterior end). Uncini begin on segment 5 (setiger 3), in single rows throughout, the uncingerous tori gradually transformed into projecting rectangular pinnules. Pygidium with crenulate anal opening. COLOR: In life: Orange with red branchiae, tan tentacles, with whitish glandular areas ventrally and laterally. In alcohol: Colorless. TUBE: Cylindrical, twisted, with tough, transparent, membranous lining, covered with small pebbles of varying sizes, with fragments of shells, bryozoans, foraminiferans, old worm tubes, algae.

Remarks.—The type of *T. hamatus* Moore from Alaska was examined and is herein referred to *T. cincinnatus*; it is a small specimen, consisting of anterior end only.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 20–123.5 fms., on bottoms of mass of worm tubes, rocks, stones, gravel, attached to stems of *Tubularia* (6 stations, 7 specimens). WEST GREENLAND: Godhavn, off Hare Island, 70°20'

N., 56° W., 90 fms., Greely Relief Expedition, 1884. One mile northwest Conical Rock, 25–60 fms., and north shore Wolstenholm, 13–25 fms., Bartlett, 1940. EAST GREENLAND: Off Cape Hold with Hope, 23–40 fms., Bartlett, 1939. EAST COAST NORTH AMERICA: Off Labrador, 12–30 fms., *Blue Dolphin* Expedition, 1949; off New Brunswick, Nova Scotia, Maine, New Hampshire, Massachusetts, 16–640 fms., U. S. Fish Commission. WEST COAST NORTH AMERICA: Washington and Puget Sounds, low water to 46 fms., mud, shell, rock, Pettibone.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Barents Sea, Novaya Zemlya. Also Iceland, Faroes, Shetlands, Norway to Portugal, Azores, Madeira, Mediterranean, Adriatic; Labrador to Massachusetts; Bering Sea to Washington; Japan; Indian Ocean (Andamans). Southern latitudes: South Georgia, South Orkneys, South Shetlands, Graham Coast, Palmer Peninsula. In low water to 1,391 fathoms.

Genus *Polycirrus* Grube, 1851

Polycirrus medusa Grube, 1855

FIGURE 37, e, f

- Polycirrus medusa* Grube, 1855, p. 120.—Hessle, 1917, p. 220.—Fauvel, 1927, p. 279, fig. 97, a–d.—Augener, 1928, p. 795.—Annenkova, 1934, p. 322; 1937, p. 194; 1938, p. 210.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 154, pl. 38, fig. 5.—Wesenberg-Lund, 1950a, p. 54; 1950b, p. 123; 1951, p. 114.
- Ereutho smitti* Malmgren, 1865, p. 391, pl. 23, fig. 63.—Webster and Benedict, 1887, p. 749.
- Polycirrus* sp., Hartman, 1948, p. 45.

Description.—Length up to 70 mm., width 6 mm. Integument tessellated. Large unpaired ventral shield on first few segments, followed by about six pairs of ventral shields separated in midline. Prostomium and buccal segment forming lower lip, wide semicircular dorsal cephalic ridge (without eye-spots), large trilobed or undulating tentacular membrane with very numerous tentacles on its outer edge, the inner part forming folded upper lip; some tentacles long, slender, filiform, others thicker, distinctly grooved. Thoracic setigers usually 13 (10–13), beginning on segment 3 (or 2). Without thoracic uncini; uncini begin on segment 16 (or 15 or just posterior to last setiger), uniserial, few in number, very small and inconspicuous, on slightly raised abdominal pinnules. Six pairs nephridial papillae on segments 3–8. Females with large, yolky eggs (Point Barrow, September 15, 1948, and October 14, 1949). COLOR: In life: Red. In alcohol: Colorless. TUBE: Simple galleries in mud or sand.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 13.3–78.2 fms., on bottoms of mud and various com-

binations of mud, pebbles, gravel, stones, rocks, large perforated rocks, with bryozoans, worm tubes (13 stations, 35 specimens). SPITSBERGEN: Spitsbergen Sea, U. S. S. *Alliance*, 1881. NORTHWEST GREENLAND: One mile northwest Conical Rock, 25–60 fms., Bartlett, 1940. BERING SEA: St. Paul Island, Pribilofs, Palmer, 1890. EAST COAST NORTH AMERICA: Off Labrador, 45 fms., silt, *Blue Dolphin Expedition*, 1949. WEST COAST NORTH AMERICA: Pavlof Bay, Alaska, 150 fms., Alaska King Crab Investigation, 1940; Washington Sound, 12–46 fms., mud and mussels, Pettibone.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Swedish west coast to France, Mediterranean; Labrador to Maine; Bering Sea to Washington; Okhotsk Sea to north Japan Sea. In low water to 889 fathoms.

Genus *Trichobranthus* Malmgren, 1865

Trichobranthus glacialis Malmgren, 1865

FIGURE 37, *g-i*

Trichobranthus glacialis Malmgren, 1865, p. 395, pl. 24, fig. 65.—Webster and Benedict, 1887, p. 750.—Ehlers, 1913, p. 566.—Hessle, 1917, p. 131.—Fauvel, 1927, p. 288, fig. 100, a–h.—Augener, 1928, p. 792.—Annenkova, 1937, p. 190; 1938, p. 202.—Zatsepin, 1948, p. 153, pl. 38, fig. 1.—Wesenberg-Lund, 1950a, p. 55; 1950b, p. 125; 1951, p. 115.—Berkeley and Berkeley, 1952, p. 76, figs. 154, 155.

Trichobranthus glacialis var. *antarcticus* Hessle, 1917, p. 132.—Hartman, 1952, p. 233.

Description.—Length up to 30 mm., width 3 mm., segments 60–70. Buccal segment and prostomium form thick, tessellated, inflated lower lip connected laterally with pair of projecting, rounded, flattened lobes (ventral to mass of tentacles), cephalic ridge with numerous black eyespots (absent in var. *antarcticus*), undulating tentacular membrane with very numerous tentacles, and folded upper lip; some tentacles larger, distinctly grooved; others smaller, filiform. Three pairs branchiae on segments 2–4, each composed of single long filament. With slightly projecting lateral lobes on branchial segments. Thoracic setigers and uncinigers 15, beginning on segment 6; notosetae limbate, with smooth capillary tips; neuropodial uncini aciculiform (crotchets). Abdominal segments with avicular uncini in single rows on triangular projecting pinnules. Pygidium with anal opening crenulate. Colorless in alcohol. Tube membranous, encrusted with mud or fine sand.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 5 miles from shore, 27–49 fms., on various combinations of mud, gravel, stones, rocks, shells (5 stations, 15 specimens). EAST COAST NORTH AMERICA: Cape Cod Bay, Massachusetts, 27–118 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Alaskan Arctic, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Swedish west coast to Spain, Canary Islands, Mediterranean; Maine to Massachusetts; British Columbia; north Japan Sea. Var. *antarcticus*: Magellan Straits, South Georgia, Ross Island, Kaiser Wilhelm II Land. In 3–1,517 fathoms.

Genus *Terebellides* M. Sars, 1835

Terebellides stroemii M. Sars, 1835

FIGURE 37, *j–m*

Terebellides stroemii M. Sars, 1835, p. 48, pl. 13, fig. 31.—Malmgren, 1865, p. 396, pl. 20, fig. 48.—Webster and Benedict, 1887, p. 750.—Moore, 1903, p. 478; 1908, p. 352; 1923, p. 199.—Hessle, 1917, p. 137.—Chamberlin, 1920, p. 23.—Eliason, 1920, p. 72.—Fauvel, 1927, p. 291, fig. 100, i–q; 1932, p. 234; 1947, p. 79, fig. 76, f–i.—Augener, 1928, p. 797.—Gustafson, 1936, p. 9.—Annenkova, 1937, p. 190; 1938, p. 202.—Treadwell, 1937, p. 35.—Okuda, 1938b, p. 102.—Friedrich, 1939, p. 127.—Berkeley and Berkeley, 1943, p. 130; 1944, p. 5; 1952, p. 75, figs. 152, 153.—Hartman, 1944a, pp. 336, 343; 1944d, p. 24; 1951, p. 113.—Thorson, 1946, p. 124, fig. 69.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 153, pl. 38, fig. 3.—Støp-Bowitz, 1948c, p. 68.—Wesenberg-Lund, 1949, p. 355; 1950a, p. 55; 1950b, p. 126; 1951, p. 115, fig. 11.—Hartman and Reish, 1950, p. 44.

Terebellides stroemii var. *japonica* Moore, 1903, p. 478; 1908, p. 352; 1923, p. 200.

Description.—Length up to 75 mm., width 8 mm., segments 50–60. Prostomium and buccal segment forming large, transverse, crescent-shaped plate below mouth, large and undulating tentacular membrane with numerous, short, grooved tentacles, folded upper lip; dorsally without cephalic ridge or eye-spots. Segment 2 short, achaetous. Single branchia formed of large cylindrical trunk dorsally on segment 3 (first setiger) and four pectinate lobes, frequently interlocked giving appearance of more or less solid mass. With somewhat developed lateral lobes extending ventrally on segments 2–7 (larger on segments 3–6). Thoracic setigers 18, begin on segment 3. Uncini begin on segment 8 (setiger 6), those on first unciniger consisting of crotchets with long manubrium and bent, pointed tips, those on rest of thoracic segments long, aciculiform, with large fang and few denticles; may be crowded in more than one row in large specimens. Abdominal uncini short, avicular, pectiniform, in single rows on projecting triangular pinnules. Prominent paired nephridial papillae on segment 3, smaller ones on segments 6 and 7. Pygidium with terminal anus, with sides crenulate. Female with large yolky eggs (ripe eggs and sperm, September 26, 1949). COLOR: In life: Body orange, branchia orange-red, tentacles tan. In alcohol: Colorless, with smooth iridescent surface.

Parasites.—One of the 87 specimens had the parasitic copepod *Saccopsis terebellidis* Levinsen (identified by P. L. Illg) attached to

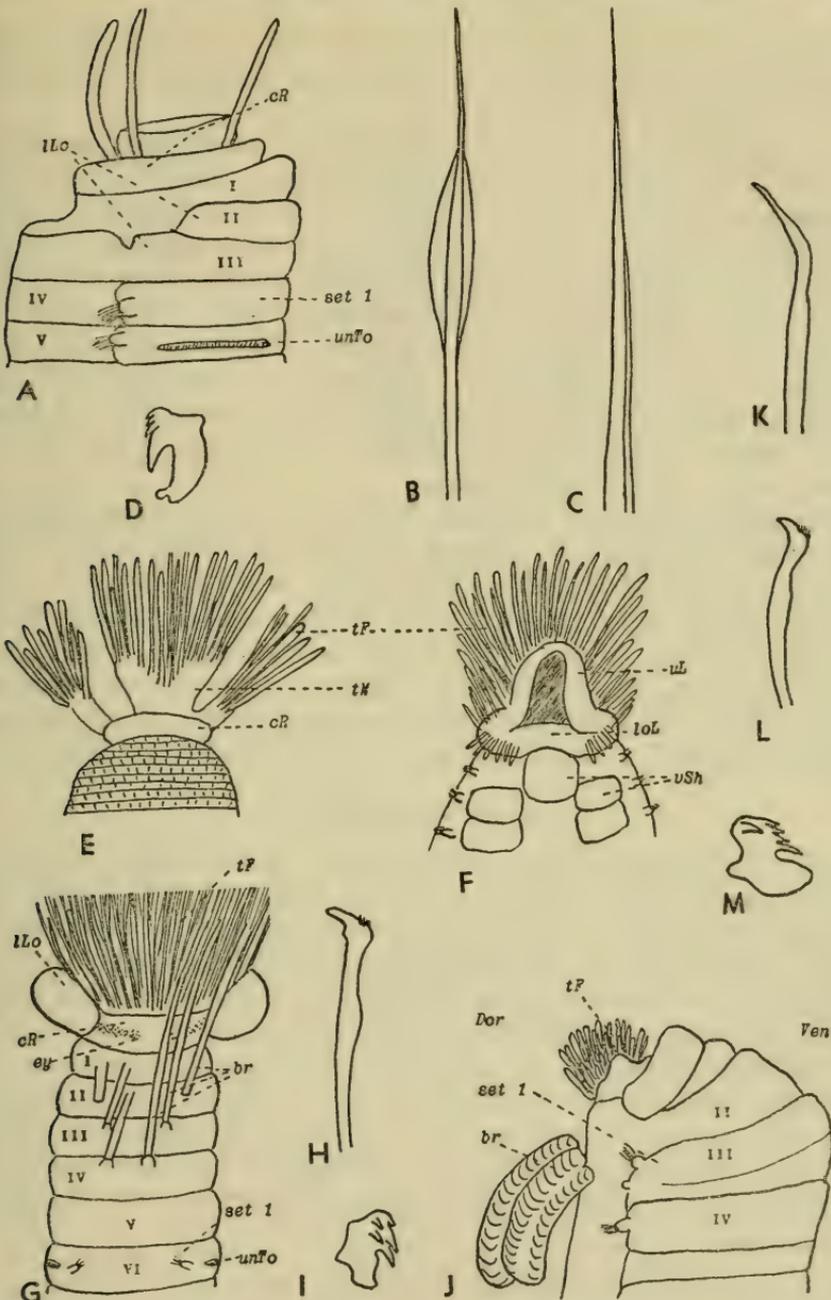


FIGURE 37.—Terebellidae: *a*, *Leana abranchiata*, lateral view anterior end; *b*, same, notoseta; *c*, *Lanassa venusta*, notoseta; *d*, *Thelepus cincinnatus*, avicular uncinus; *e*, *Polycirrus medusa*, dorsal view anterior end; *f*, same, ventral view anterior end; *g*, *Trichobranchus glacialis*, dorsal view anterior end; *h*, same, thoracic aciculiform uncinus; *i*, same, abdominal avicular uncinus; *j*, *Terebellides stroemii*, lateral view anterior end; *k*, same, crotchet from first unciniger; *l*, same, thoracic aciculiform uncinus; *m*, same, abdominal avicular uncinus. (For explanation of symbols, see p. 210.)

anterior part in the region of the branchia. The same polychaete and copepod species were found in Iceland waters and figured by Wesenberg-Lund (1951, p. 117, fig. 11).

New records.—ARCTIC ALASKA: West side Elson Lagoon near Point Barrow, 1.2 fms.; Eluitkak Pass, Elson Lagoon; Point Barrow base, washed ashore; off Point Barrow base, up to 15 miles from shore, 18.3–123.5 fms., on bottoms of mud, stones, mass of worm tubes, and various combinations of mud, sand, pebbles, gravel, stones, rocks, large perforated rocks, with shells, bryozoans, worm tubes (26 stations, 87 specimens). WEST COAST NORTH AMERICA: Washington and Puget Sounds, 10–165 fms., Pettibone. EAST COAST NORTH AMERICA: Off Labrador, 5–65 fms., *Blue Dolphin* Expeditions, 1949, 1950; off Nova Scotia, Maine, Massachusetts, Rhode Island, Long Island Sound, 6–368 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Barents Sea, White Sea, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to Portugal, Mediterranean, Adriatic, Black Sea; Hudson Bay to Long Island Sound, Gulf of Mexico, West Indies; Bering Sea to southern California, Panamá, Venezuela; north Japan Sea to Japan; Iranian Gulf; Indian Ocean; South Africa, Bouvet Island, Kerguelen, New Caledonia. In low water to 1,611 fathoms.

Family SABELLIDAE

Body cylindrical, tapered posteriorly. Prostomium indistinct. Buccal region with mouth terminal, with dorsal lip, two ventral lips or vesicular bulbs, two fleshy, membranous or filiform palps of variable length. Branchiae form conspicuous, often highly colored terminal funnellike plume surrounding mouth; plume formed of two semi-circular or spiral lobes bearing numerous filaments each with two rows of ciliated barbules (fig. 38, *a*). Branchiae without operculum. A collarette more or less developed on first segment. Body divided into two regions: (1) thoracic; few segments (4–12), with dorsal bundles of capillary setae and ventral uncinigerous tori (tori lacking in *Myxicola*); without thoracic membrane; (2) abdominal; with inversion

FIGURE 38.—Sabellidae: *a*, *Sabella crassicornis*, lateral view anterior end; *b*, same, tip of branchial filament; *c*, same, thoracic notosetae; *d*, same, dorsal view pygidium; *e*, same, thoracic hoe-like seta from ventral torus; *f*, same, thoracic avicular uncinus from ventral torus; *g*, same, ventral view collarette; *h*, same, lateral view; *i*, same, dorsal view; *j*, *Potamilla neglecta*, dorsal view collarette; *k*, same, lateral view; *l*, same, ventral view; *m*, same, dorsal thoracic limbate seta; *n*, same, dorsal thoracic spatulate setae; *o*, *Potamilla reniformis*, ventral view collarette; *p*, same, lateral view; *q*, same, dorsal view; *r*, same, portion of branchial filament; *s*, same, thoracic avicular uncinus from ventral torus; *t*, same, thoracic hoe-like seta from ventral torus; *u*, same, tip of tube, rolled at free end. (For explanation of symbols, see p. 210.)

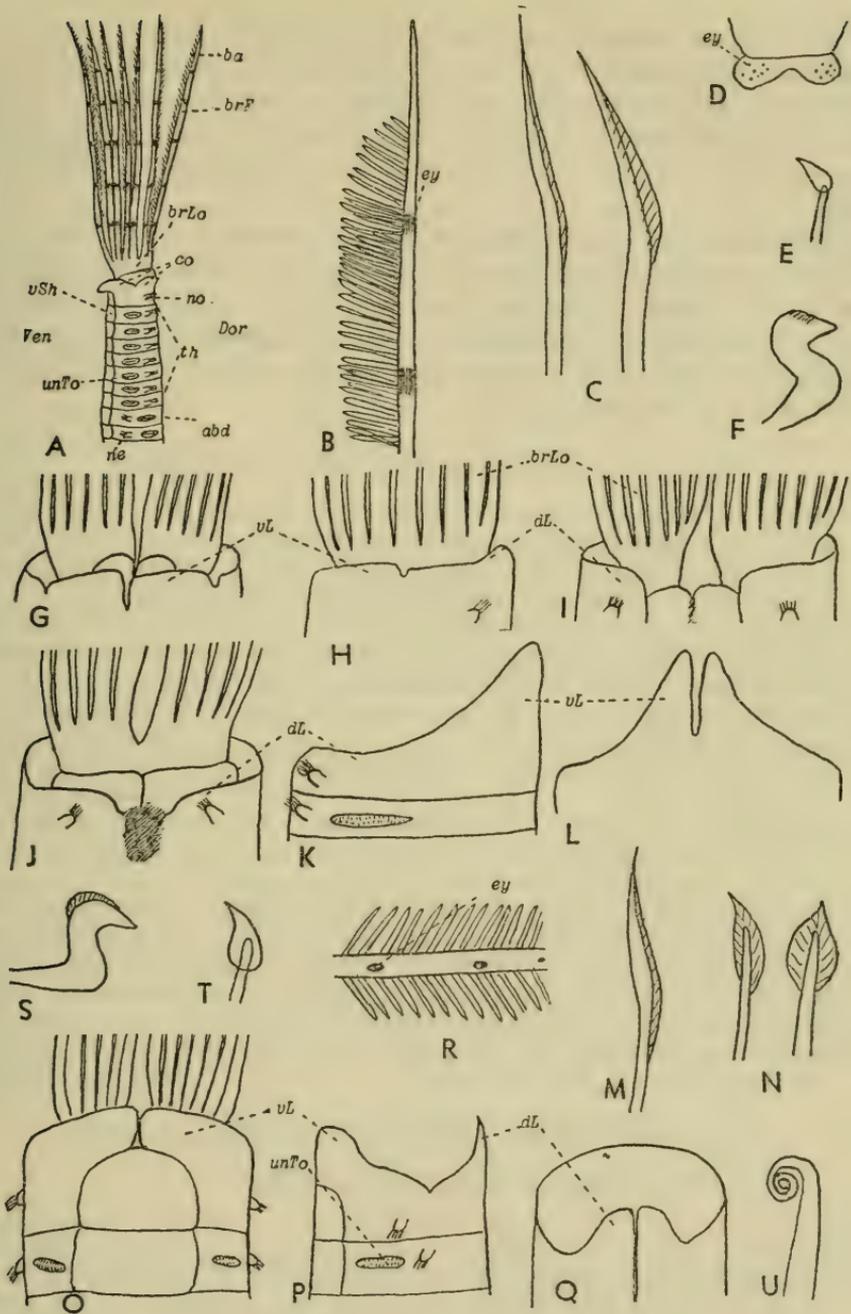


FIGURE 38.—For explanation see facing page.

of setae, dorsal uncinigerous tori and ventral capillary setae. A median ciliated faecal groove runs length of body, ventral in abdominal region and crossing to dorsal surface in thoracic region. Tube cylindrical, permanent or more or less transitory, gelatinous, membranous, or horny, covered or not with mud, sand, gravel, debris of shells.

Represented by five genera and seven species at Point Barrow. All the genera have large branchial plumes composed of two similar semicircular lobes; branchial filaments without large subterminal eyes, without dorsal appendages. First setigerous segments with limbate notosetae only; neurosetae begin on setiger 2. Abdominal region with numerous segments.

Key to the genera of Sabellidae from Point Barrow

1. Ventral tori of thorax with row of uncini of the avicular form (fig. 38, *f*); in *Sabella* and *Potamilla* with additional row of hoelike setae, fig. 38, *t*). Collarette well developed. Branchial filaments with or without eyes, united at base only, with palmar membrane poorly developed or lacking..... 2
- Ventral tori of thorax with crotchets with long manubrium (fig. 39, *i*); without tori in *Myxicola*). Branchial filaments without eyes, united along a large part of their length by a well-developed palmar membrane (fig. 39, *m*)... 3
2. Dorsal thoracic setae all limbate, some long with straight borders, others short with wide borders (fig. 38, *c*)..... **Sabella** (p. 334)
- Dorsal thoracic setae of two kinds, some limbate, others spatulate (fig. 38, *m*, *n*)..... **Potamilla** (p. 335)
3. Uncinigerous tori projecting, with short, lateral rows of uncini. Collarette well developed (fig. 39, *a-c*). Dorsal thoracic setae of two kinds, limbate and spatulate (fig. 39, *f*, *g*)..... 4
- Without projecting uncinigerous tori, abdominal uncini in almost complete transverse band (fig. 39, *p*). Collarette poorly developed, represented by a triangular ventral lobe (fig. 39, *o*). Dorsal thoracic setae all capillary, limbate..... **Myxicola** (p. 340)
4. Posterior segments without ventral depression..... **Chone** (p. 337)
- Posterior segments about 10, with ventral suckerlike disc, large ventral depression with flared sides (fig. 39, *n*)..... **Euchone** (p. 339)

Genus *Sabella* Linné, 1767 (sensu Malmgren, 1865)

Sabella crassicornis Sars, 1851

FIGURE 38, *a-i*

Sabella crassicornis Sars, 1851, p. 202.—Malmgren, 1865, p. 399, pl. 27, fig. 83.—Moore, 1909b, p. 144.—Johansson, 1927, p. 119.—Hartman, 1942a, p. 78; 1948, p. 46.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 114, figs. 236, 237.—Zatsepin, 1948, p. 161, pl. 39, fig. 4.

Sabella fabricii Kröyer, 1856, p. 20.—Fauvel, 1927, p. 300, fig. 103, *a-g*.—Augener, 1928, p. 800.—Annenkova, 1934, p. 322; 1937, p. 195; 1938, p. 211.—Wesenberg-Lund, 1950b, p. 128; 1951, p. 118.

Sabella spetsbergensis Malmgren, 1865, p. 399, pl. 29, fig. 93.

Sabella spitzbergensis Webster and Benedict, 1887, p. 750.

Description.—Length 20–80 mm., width 3–4 mm. Collarette widely separated middorsally, with midventral slit and lateral notches, resulting in 4-lobed structure; ventral lobes closely approximated, may be deflected. Two branchial lobes each with about 16 filaments (15–35), with short tapering tips. Branchial filaments with usually four to six (2–8) pairs of eyes (located in color bands of filaments and may easily be overlooked). Thoracic setigers usually 8 (7–9). Abdomen with one or two pairs of eye-spots between parapodial rami, well developed toward posterior end. Pygidium with pair of bulbous lobes with groups of eye-spots on dorsolateral sides. COLOR: In life: Body flesh color, with branchial filaments banded rusty red, 4–7 transverse bands per filament. In alcohol: Body colorless with reddish purple bands on branchial filaments. TUBE: Cylindrical, free end flexible, covered with thin, smooth layer of mud; embedded part transparent, horny, rigid, covered with sand grains and foreign material.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 15 miles from shore, 36–123.5 fms., on bottoms of stones, mass of worm tubes, and various combinations of gravel, stones, rocks, large perforated rocks, with worm tubes (8 stations, 15 specimens). KAMCHATKA: Petropavlovsk, Grevnitzky, 1888. ALASKA: New Harbor, Unga Island, under stones, Dall, 1872; *Albatross* Sta. 2847, 55°01' N., 160°18' W., 48 fms., and station at Kodiak, 1888. CANADIAN ARCTIC: Foxe Basin, 25–31 fms., Bartlett, 1927. EAST COAST NORTH AMERICA: Off Labrador, 5–6 fms., *Blue Dolphin* Expedition, 1949; Bay of Fundy, Maine, Massachusetts, 15 fms., U. S. Fish Commission. CENTRAL AMERICA: Golfo Dulce, west Costa Rica, M. Valerio.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France, Mediterranean; Hudson Bay to Massachusetts; Bering Sea to California, Central America (Costa Rica); north Japan Sea to Japan. In low water to 230 fathoms.

Genus *Potamilla* Malmgren, 1865

Key to the species of *Potamilla* from Point Barrow

1. Without branchial eyes.....***P. neglecta***
 With compound eyes in single rows on branchial filaments, 0–8 per filament
 (fig. 38, r).....***P. reniformis***

Potamilla neglecta (Sars, 1851)

FIGURE 38, *j-n*

Sabella neglecta Sars, 1851, p. 203.

Potamilla neglecta Malmgren, 1865, p. 401, pl. 27, fig. 84.—Webster and Benedict, 1884, p. 736.—Moore, 1909b, p. 145; 1923, p. 242.—Johansson, 1927, p. 143.—

Augener, 1928, p. 801.—Hartman, 1942a, p. 81; 1944a, pp. 336, 343; 1948, p. 46.—Zatsepin, 1948, p. 162, pl. 39, fig. 7.—Wesenberg-Lund, 1950a, p. 56; 1950b, p. 128; 1951, p. 119.—Berkeley and Berkeley, 1952, p. 116, fig. 238.

Potamilla torelli Malmgren, 1865, p. 402; 1867, p. 114, pl. 13, fig. 76.—Ehlers, 1913, p. 575.—Fauvel, 1927, p. 310, fig. 107, m-s; 1934a, p. 71.—Annenkova, 1934, p. 322; 1937, p. 195; 1938, p. 213.—Wesenberg-Lund, 1951, p. 121.

Potamilla acuminata Moore and Bush, 1904, p. 159, pl. 11, figs. 3-6; pl. 12, fig. 41.

Description.—Length 30-84 mm., 1-3 mm. wide. Collarsette widely separated dorsally, sloping ventrally, with midventral slit, entire laterally, resulting in a 2-lobed structure; ventral lobes triangular, may be deflected. Branchial lobes each with about 16 filaments (6-20), with short, naked distal tips, without eyes. Thoracic setigers usually 8 (5-8). Pygidium with pair of bulbous lobes with dark eyespots. COLOR: In alcohol: Body colorless, branchiae with two or three diffused reddish brown bands. TUBE: Horny, transparent, more or less covered with sand or mud; smaller tubes with rather uniform layer of small sand grains; larger tubes may be encrusted with living barnacles, bryozoans, hydroids, foraminiferans, amphipod tubes. Large yolky eggs in a single layer, pressed close to wall, about one-third way down in tube; a transparent, thin membrane laid down between eggs and worm (large developing yellow eggs found in tube, September 6, 1949, dredged in 36 fathoms, Point Barrow).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 21.7-123.5 fms., on bottoms of mass of worm tubes and pebbles, gravel, rocks, large stones (7 stations, 24 specimens). BERING SEA: Albatross Sta. 3496, 56°32' N., 169°45' W., 41 fms., 1893; St. Paul Island, Pribilofs, Hahn, 1911. ALASKA: Albatross Sta., Kodiak, 1888. WEST GREENLAND: Off Hare Island, 70°20' N., 56° W., 90 fms., U. S. S. *Alert*, 1884. EAST COAST NORTH AMERICA: Off Labrador, 125 fms., *Blue Dolphin* Expedition, 1949; off Maine, Massachusetts, 31-130 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Spitsbergen. Also Iceland, Faroes, Norway to France, Madeira, Mediterranean, Adriatic, Cape Verde Islands; Labrador to Massachusetts; Bering Sea to California; north Japan Sea to Japan; Antarctic. In low water to 1,044 fathoms.

***Potamilla reniformis* (Leuckart, 1849)**

FIGURE 38, o-u

Sabella reniformis Leuckart, 1849, p. 183, pl. 3, fig. 8.

Potamilla reniformis Malmgren, 1867, p. 114, pl. 13, fig. 77.—Webster and Benedict, 1884, p. 736; 1887, p. 750.—Johansson, 1927, p. 142.—Fauvel, 1927,

p. 309, fig. 107, a-l.—Okuda, 1937b, p. 61.—Annenkova, 1934, p. 322; 1937, p. 195; 1938, p. 212.—Zatsepin, 1948, p. 161, pl. 39, fig. 6.—Wesenberg-Lund, 1950a, p. 57; 1950b, p. 129; 1951, p. 120.

Pseudopotamilla intermedia Moore, 1905c, p. 562, pl. 37, figs. 15–22; 1908, p. 359.—Hartman, 1938c, p. 25, pl. 2, fig. 8; pl. 3, figs. 1–4; 1948, p. 46.—Rioja, 1941, p. 732.

Pseudopotamilla reniformis Hartman, 1944a, pp. 336, 343, pl. 21, figs. 3, 6; 1945, p. 47.—Berkeley and Berkeley, 1952, p. 116, fig. 239.

Description.—Length 80–100 mm., width 1–2 mm. Collarette with middorsal depression, deeply notched dorsolaterally (at level of notopodia), with midventral slit, resulting in a 4-lobed structure of pair of rounded or triangular dorsal lobes and pair of rounded ventral lobes which may be deflected. Branchial lobes each with about 10 filaments (5–15). At least some of branchial filaments with large compound eyes, usually 0–3 per filament (0–8), eyes may be variable in size or subequal, deep reddish in alcohol. Thoracic setigers usually 10 (7–14). Pygidium with pair of bulbous lobes with eye-spots. COLOR: In alcohol: Body colorless, branchiae with diffused reddish brown bands in region of eyes. TUBE: Somewhat twisted, horny, translucent or opaque, more or less covered with sand or mud, the free end usually flattened, rolled scroll-like when animal pulls inside.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7.4 miles from shore, 21.7–54.6 fms., on bottoms of pebbles, gravel, rocks, in holes of large stones (2 stations, 15 specimens). BERING SEA: Anchorage, Cape Etoliu, Nunivak Island, 8 fms., Dall, 1874. SOUTHEASTERN ALASKA: Lituya Bay, 6–9 fms., Dall, 1874. EAST COAST NORTH AMERICA: Off Nova Scotia, Maine, New Hampshire, Massachusetts, Rhode Island, Delaware, 10–317 fms., U. S. Fish Commission.

Distribution.—Scattered records in the Arctic: Arctic Alaska, Greenland. Also Iceland, Swedish west coast to France, Mediterranean; Nova Scotia to North Carolina; Bering Sea to British Columbia, México; north Japan Sea to Japan. In low water to 317 fathoms.

Genus *Chone* Kröyer, 1856

Both species have the segments biannulate. Collarette deeply incised middorsally, forming two longitudinal-folded brackets, with sides smooth; without midventral or lateral notches (fig. 39, a–c). Branchial filaments united on great part of their length by palmar membrane (fig. 39, m). Thoracic setigers 8. Thoracic dorsal setae of three kinds—limbate capillary setae, fine bayonette setae, and spatulate setae with asymmetrical mucronate tips or gently rounded (fig. 39, f–h). Pygidium with anus terminal, with rounded to conical bulbous dorsal valve (fig. 39, d).

Key to the species of *Chone* from Point Barrow

1. Collarette nearly straight (fig. 39, *b*). Free end of branchial filaments flattened, foliaceous, widely limbate (fig. 39, *e*)-----*C. infundibuliformis*
 Collarette oblique, longer on ventral side (fig. 39, *k*). Free end of branchial filaments with long filiform tips (fig. 39, *l*)-----*C. dunéri*

Chone infundibuliformis Kröyer, 1856FIGURE 39, *a-j*

Chone infundibuliformis Kröyer, 1856, p. 33.—Malmgren, 1865, p. 404, pl. 28, fig. 87.—Théel, 1879, p. 66.—Wirén, 1883, p. 422.—Fauvel, 1927, p. 334, fig. 116, *a-o*.—Augener, 1928, p. 806.—Annenkova, 1934, p. 322; 1937, p. 196; 1938, p. 215.—Hartman, 1942b, p. 136; 1944a, pp. 334, 336 (not pl. 20, fig. 5), pl. 21, fig. 7.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 123, figs. 252, 253.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 164, pl. 39, fig. 13.—Wesenberg-Lund, 1950a, p. 58; 1950b, p. 131; 1951, p. 123.

Chone gracilis Moore, 1906b, p. 257, pl. 12, figs. 62-66.—Berkeley and Berkeley, 1952, p. 123, fig. 254.

Description.—Length 30 mm., width 2.5 mm. (up to 120 mm. long, 6 mm. wide—Fauvel, 1927). Collarette nearly straight laterally. Branchial filaments about 15 (10-36), with tips more or less foliaceous, edged by transparent border (prolongations of palmar membrane). COLOR: In life: Variable—flesh color, branchiae orange spotted with white; olive green with distal half of branchiae brick red, basal half red and olive, chalk white on outer sides of bases of branchiae. In alcohol: Colorless, grayish, or tannish. TUBE: Membranous, encrusted with sand, mud, or pebbles of variable sizes, foraminiferans.

New records.—ARCTIC ALASKA: Eluitkak Pass, Elson Lagoon near Point Barrow, 6.6 fms.; off Point Barrow base, up to 7.5 miles from shore, 20-49 fms., on bottoms of mud, stones, and various combinations of mud, sand, gravel, stones, rocks, large perforated rocks, shells (12 stations, 32 specimens). CANADIAN ARCTIC: East side Cobourg Island, Baffin Bay, 75° 40' N., 78° 40' W., Bartlett, 1935. NORTH-WEST GREENLAND: 1 mile northwest Conical Rock, Bartlett, 1940. EAST GREENLAND: Off Cape Hold with Hope, 23-40 fms., Bartlett, 1939. SPITSBERGEN: Spitsbergen Sea, U.S.S. *Alliance*, 1881. BERING SEA: St. Paul Island, Pribilofs, Palmer, 1890; St. George Island, Pribilofs, Hanna, 1913; *Albatross* Sta. 3232, 58° 30' N., 157° 34' W., 10.5 fms., 1890, Sta. 3233, 58° 23' N., 157° 42' W., 7 fms., 1890, and Sta. 3289, 56° 44' N., 159° 16' W., 16 fms., 1890; Kiska, Aleutians, Dall. WEST COAST NORTH AMERICA: Strait of Juan de Fuca, Washington, 40 fms., mud, Pettibone. EAST COAST NORTH AMERICA: Off Nova Scotia, Maine, Massachusetts, Rhode Island, 10-206 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Novaya Zemlya, Kara

Sea. Also Iceland, Faroes, Shetlands, Scandinavian coast to Danish waters; Hudson Bay to Rhode Island; Bering Sea to California; north Japan Sea. In low water to 1,955 fathoms.

***Chone dunéri* Malmgren, 1867**

FIGURE 39, *k, l*

Chone dunéri Malmgren, 1867, p. 116, pl. 13, fig. 75.—Wirén, 1883, p. 422.—Fauvel, 1927, p. 336, fig. 117, l-r; 1934a, p. 74.—Augener, 1928, p. 807.—Monro, 1936, p. 189.—Treadwell, 1937, p. 35.—Berkeley and Berkeley, 1944, p. 5.—Zatsepin, 1948, p. 164, pl. 39, fig. 15.—Wesenberg-Lund, 1950a, p. 58; 1950b, p. 130; 1951, p. 123.—Hartman, 1951, p. 117.

Description.—Length 20–35 mm., width 1.5–2.5 mm. Collarlette oblique, longer on ventral side. Branchial filaments about 10 (5–11), with long, tapered tips. COLOR: In life: Branchiae yellow. In alcohol: Colorless or tannish. TUBE: Thin, membranous, encrusted with sand.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 7.5 miles from shore, 13.3–49 fms., on bottoms of mud and various combinations of mud, sand, gravel, stones, rocks, large perforated rocks, shells (9 stations, 21 specimens). CANADIAN ARCTIC: Baffin Island, 66° 43' N., 80° 07' W., Bartlett, 1927. EAST COAST NORTH AMERICA: Off Labrador, 8 fms., mud, *Blue Dolphin* Expedition, 1949.

Distribution.—Widely distributed in the Arctic: Alaskan and Canadian Arctic, Greenland, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to North Sea, Madeira, Mediterranean, Adriatic; Labrador; Florida; west coast South America (Perú). In 8–889 fathoms.

Genus *Euchone* Malmgren, 1865

***Euchone analis* (Kröyer, 1856)**

FIGURE 39, *m, n*

Sabella analis Kröyer, 1856, p. 17.

Euchone analis Malmgren, 1865, p. 406, pl. 28, fig. 88.—Théel, 1879, p. 65.—Wirén, 1883, p. 423.—Chamberlin, 1920, p. 27.—Augener, 1928, p. 804.—Annenkova, 1937, p. 196; 1938, p. 216.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 121, figs. 250, 251.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 163, pl. 39, fig. 12.—Wesenberg-Lund, 1950a, p. 59; 1950b, p. 132; 1951, p. 124.

Description.—Length 19–28 mm., width 1.8 mm. (up to 60 mm. long—Augener, 1928). Segments biannulate and, with the ventral faecal groove, forming four large areas per segment. Collarlette with opening dorsally, nearly straight and entire laterally, with shallow midventral incision. Branchial filaments about 10 per lobe (up to 14), united through a great part of their length by a well-developed palmar membrane. Thoracic setigers 8. Ventral anal

depression extending over 10–12 most posterior segments, bordered by high sinuous membrane. Pygidium with terminal anus, with conical bulbous dorsal valve. Colorless or tannish in alcohol. Tube membranous, encrusted with sand grains and certain amount of debris.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 36–123.5 fms., on bottoms of mass of worm tubes and stones, rocks, large perforated rocks (3 stations, 3 specimens). EAST COAST NORTH AMERICA: Off Labrador, 30 fms., mud with rock, *Blue Dolphin* Expedition, 1950.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Davis Strait, Greenland, Jan Mayen, Spitsbergen, Novaya Zemlya, Kara Sea. Also Iceland, Norway to Danish waters; Hudson Bay to Labrador; Bering Sea to British Columbia; north Japan Sea. In 2–389 fathoms.

Genus *Myxicola* (Koch in MS.) Rénier, 1848

Myxicola infundibulum (Montagu, 1808)

FIGURE 39, o–q

Amphitrite infundibulum Montagu, 1808, p. 109, pl. 8.

Myxicola steenstrupii Krøyer, 1856, p. 35.—Malmgren, 1865, p. 408, pl. 29, fig. 90.—Théel, 1879, p. 66.—Webster and Benedict, 1884, p. 737; 1887, p. 750.—Moore, 1909b, p. 144.—Eliason, 1920, p. 79.—Zatsepin, 1948, p. 164, pl. 39, fig. 16.

Myxicola infundibulum Fauvel, 1927, p. 342, fig. 119, a–i; 1934a, p. 74; 1936, p. 86.—Annenkova, 1934, p. 322.—Okuda, 1939, p. 243.—Hartman, 1944a, pp. 335, 343, pl. 21, fig. 1; 1948, p. 47.—Wesenberg-Lund, 1950b, p. 134; 1951, p. 125.—Berkeley and Berkeley, 1952, p. 119, fig. 244.

Description.—Length 23 mm., width 5 mm. (up to 200 mm. long, 15 mm. wide—Fauvel, 1927). Collarsette represented by a triangular ventral lobe extending anteriorly between the branchial lobes, absent laterally and dorsally. A middorsal groove on first 8–10 segments. Branchial filaments 20–40, united for greater part of their length by

FIGURE 39.—Sabellidae: *a*, *Chone infundibuliformis*, ventral view collarsette; *b*, same, lateral view; *c*, same, dorsal view; *d*, same, dorsal view pygidium; *e*, same, tip of foliaceous branchial filament; *f*, same, thoracic dorsal limbate capillary seta; *g*, same, thoracic dorsal spatulate seta; *h*, same, thoracic dorsal bayonette seta; *i*, same, thoracic crotchet from ventral torus; *j*, same, abdominal uncinus; *k*, *Chone dunéri*, lateral view collarsette; *l*, same, tip of branchial filament; *m*, *Euchone analis*, lateral view anterior end; *n*, same, ventral view posterior end; *o*, *Myxicola infundibulum*, lateral view anterior end; *p*, same, lateral view segment from abdominal region; *q*, same, dorsal view pygidium. Serpulidae: *r*, *Spirorbis granulatus*, dorsal view tube; *s*, same, operculum (after Fauvel); *t*, same, collar seta (seta of first setiger); *u*, *Spirorbis spirillum*, dorsal view anterior end extended from tube (var. *ascendens*, after Emerton); *v*, same, discoidal form of tube; *w*, same, operculum; *x*, same, collar seta (seta of first setiger, after Fauvel). (For explanation of symbols, see p. 210.)

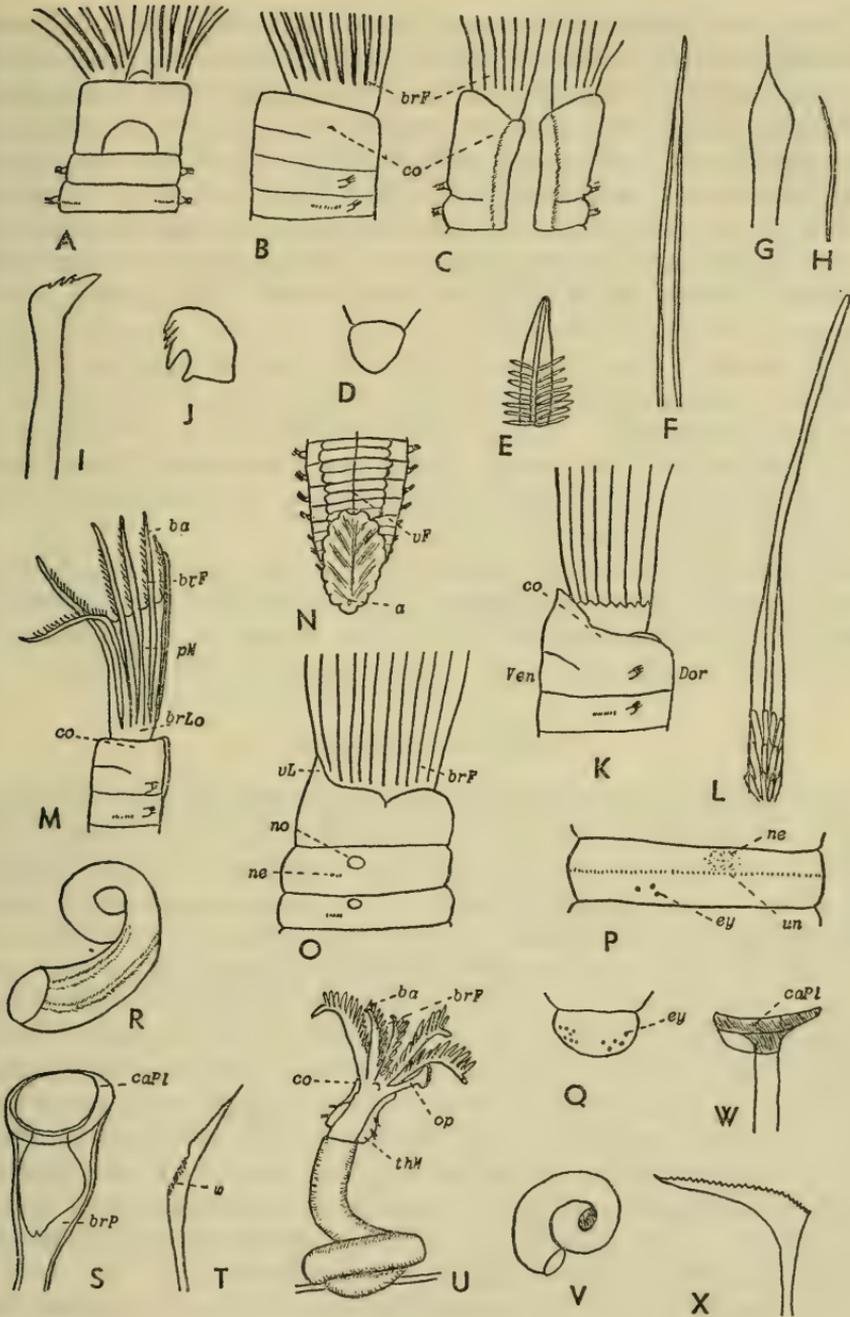


FIGURE 39.—For explanation see facing page.

well-developed palmar membrane; tips of filaments limbate. Thoracic setigers 8 (7-9). Thoracic notopodia with limbate capillary setae; neuropodia with crotchets with long manubrium (may disappear). Abdomen without projecting tori; avicular uncini in an almost complete circle; with capillary neurosetae. With one to several lateral eye-spots behind each parapodia. Pygidium with anus terminal, with rounded, bulbous dorsal valve with lateral groups of eye-spots. COLOR: In alcohol: Body irregularly speckled reddish brown, with branchiae violet distally. TUBE: Gelatinous, transparent, very firm and elastic, may be quite thick.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 4.25 miles from shore, 25-35.5 fms., on bottoms of mud with gravel (2 stations, 2 specimens). WEST COAST NORTH AMERICA: Washington and Puget Sounds, low water to 165 fms., Pettibone. EAST COAST NORTH AMERICA: Off Nova Scotia, Maine, Massachusetts, 9-90 fms., U. S. Fish Commission.

Distribution.—Scattered records in the Arctic: Arctic Alaska, West Greenland, Novaya Zemlya. Also Iceland, Finland, to English Channel, Mediterranean, Adriatic; Nova Scotia to Massachusetts; Bering Sea to California; Japan. In low water to 287 fathoms.

Family SERPULIDAE

Body cylindrical or fusiform, slightly flattened. Prostomium indistinct. Buccal region with mouth terminal, with two transverse lips, palps absent or slightly developed. Branchiae form a terminal funnel-like plume around mouth, formed of two semicircular or spiralled lobes bearing few to numerous filaments, each with two rows of ciliated barbules (fig. 39, *u*). Usually with one or two opercula (calcareous, horny, or membranous) formed on the first dorsal filaments of the branchial lobes. Usually with a collarette on first segment. Body divided into two regions: (1) thoracic; with few segments (3-7), with dorsal bundles of capillary setae and ventral uncinigerous tori; usually with a thoracic membrane; (2) abdominal; with inversion of setae, dorsal uncinigerous tori and ventral capillary setae. A wide, shallow, longitudinal ciliated faecal groove, ventral in abdominal region, dorsal in thoracic. Tube cylindrical or polygonal, calcareous, opaque or rarely transparent, fixed to substratum (rarely free).

Represented by a single genus and two species (two subgenera) at Point Barrow.

Genus *Spirorbis* Daudin, 1800

Both species are of small size, asymmetrical and coiled. Branchial lobes each with 3-5 filaments. A single, partly calcareous operculum

on smooth peduncle. Collarette large, widely separated dorsally, entire laterally and ventrally. Three thoracic setigers, the first setiger with only dorsal setae (collar setae) and the next two with ventral tori in addition to dorsal setae. With well-developed thoracic membrane. A long achaetous region between thorax and abdomen (may be crowded with ova; spermatozoa develop in more posterior segments; hermaphroditic). About 20 abdominal setigers. Pygidium with two rounded lobes. Colorless in alcohol. Tube small (1-3 mm. in diameter), closely coiled, white, opaque, fixed to hydroids, bryozoa, algae, carapaces of crustaceans, spines of tunicates, stones, etc.

Key to the species of *Spirorbis* from Point Barrow

1. Tube with sinistral (counterclockwise) spiral coiling (with mouth of tube facing observer, the opening is on the left; fig. 39, *r*). Eggs incubated in operculum. Collar setae with well-developed basal crenulate wings (fig. 39, *t*).....**S. (*Laeospira*) *granulatus***
- Tube with dextral (clockwise) spiral coiling (fig. 39, *v*). Eggs incubated in tube. Collar setae without crenulate wings (fig. 39, *x*).
S. (*Dexiospira*) *spirillum*

Spirorbis (*Laeospira*) *granulatus* (Linné, 1767)

FIGURE 39, *r-t*

Serpula granulata Linné, 1767, p. 1266.

Spirorbis quadrangularis Stimpson, 1854, p. 29.—Moore, 1908, p. 362.—Hartman, 1944a, pp. 336, 343.

Spirorbis (*Laeospira*) *granulatus* Borg, 1917, p. 28, figs. 14-16.—Fauvel, 1927, p. 403, fig. 137, q-u.—Augener, 1928, p. 815.—Annenkova, 1937, p. 198; 1938, p. 219.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 137, figs. 286, 287.—Gorbunov, 1946, p. 39.—? Thorson, 1946, p. 139, fig. 80.—Zatsepin, 1948, p. 166.—Wesenberg-Lund, 1950a, p. 63; 1950b, p. 141; 1951, p. 135.

Description.—Tube 1-2 mm. in diameter, dull chalky white, opaque, somewhat rugose and variable with two longitudinal ridges, one on each side (the opening almost quadrangular), or with three more or less distinct longitudinal keels, or without crests; the tube is coiled sinistrally, up to two coils, flatly on smooth surfaces or somewhat open when on rough surfaces; it may encircle a strand of hydroid and the free end may extend upward. Operculum with terminal plate strongly convex, calcareous, with long, cylindrical projection (short on one side, longer on opposite side), with large brood pouch for incubating eggs (eggs in operculum, Point Barrow, August 17, 1949, and February 18, 1950). Collar setae with blades finely serrated, with well-developed crenulate wing at base.

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 12.1 miles from shore, 27-123.5 fms., on bottoms of mass of worm tubes,

and various combinations of mud, gravel, rocks, stones (3 stations, 7 specimens). SOUTHWESTERN ALASKA: Kiska Harbor, Aleutians, 10 fms., Dall, 1873; Canoe Bay, 25 fms., on old clam shell, Alaska King Crab Investigation, 1940. EAST COAST NORTH AMERICA: Off Labrador, 30-35 fms., mud, rocks, *Blue Dolphin* Expedition, 1950; off Nova Scotia, Maine, Massachusetts, North Carolina (Cape Hatteras), 17-34 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian and Alaskan Arctic, Greenland, Jan Mayen, Spitsbergen, Franz Josef Land, Novaya Zemlya, Kara Sea. Also Iceland, Faroes, Norway to France; Hudson Bay to North Carolina; Alaska to British Columbia; north Japan Sea. In low water to 239 fathoms.

Spirorbis (Dexiospira) spirillum (Linné, 1758)

FIGURE 39, *u-x*

Serpula spirillum Linné, 1758, p. 785.

Spirorbis (Dexiospira) spirillum Borg, 1917, p. 20, figs. 3, 4.—Fauvel, 1927, p. 392, fig. 132, f-p.—Augener, 1928, p. 814.—Annenkova, 1934, p. 322; 1937, p. 197; 1938, p. 218.—Treadwell, 1937, p. 35.—Hartman, 1942a, p. 91; 1944a, pp. 336, 343, pl. 22, fig. 2.—Berkeley and Berkeley, 1943, p. 130; 1952, p. 133, figs. 272-274.—Thorson, 1946, p. 138.—Gorbunov, 1946, p. 39.—Zatsepin, 1948, p. 166.—Wesenberg-Lund, 1950a, p. 62; 1950b, p. 138; 1951, p. 132.

Circeis spirillum Chamberlin, 1920, p. 28.

Dexiospira spirillum Hartman, 1944b, p. 287; 1948, p. 51; 1951, p. 121.—Hartman and Reish, 1950, p. 47.

Description.—Tube 1-3 mm. in diameter, white, opaque (may be somewhat translucent), shiny, smooth, porcellaneous, coiled dextrally, up to 3½ coils; tube may be coiled flatly (discoidal form) when attached to smooth surfaces, or partly unrolled, the last coil or part of last coil raised from substratum (var. *ascendens* Levinsen, var. *lucidus* Mörch) when attached to rough surfaces, as branching bryozoan colonies. Operculum with shallow, calcareous, concave, terminal plate, with slight projection (talon) on under side. Collar setae with serrate blades, without basal crenulate wings. Embryos incubated in tube (eggs in tube, Point Barrow, September 9, 1948, and August 30, 1949).

New records.—ARCTIC ALASKA: Off Point Barrow base, up to 8 miles from shore, 21-75.5 fms., on bottoms of stones and various combinations of gravel, rocks, on bryozoa, on *Hyas coarctatus*, on spines of *Boltenia echinata* (8 stations, 39 specimens). GULF OF ALASKA: *Albatross* Sta., Observation Island, Cordova, 1914. WEST GREENLAND: Godhavn, Greely Relief Expedition, 1884. EAST COAST NORTH AMERICA: Off Labrador, 10-40 fms., *Blue Dolphin* Expeditions, 1949, 1950, 1951; off Nova Scotia, Maine, Massachusetts, Long Island Sound, 16-83 fms., U. S. Fish Commission.

Distribution.—Widely distributed in the Arctic: Siberian, Alaskan, and Canadian Arctic, Greenland, Spitsbergen, Franz Josef Land, Kara Sea. Also Iceland, Faroes, Norway to France; Hudson Bay to Long Island Sound, southern Texas; Bering Sea to México; north Japan Sea to Japan. In low water to 183 fathoms.

References

ALAEJOS Y SANZ, LUÍS.

1905. Estudio descriptivo de algunas especies de polinoinos de las costas de Santander. Mem. Soc. Española Hist. Nat., vol. 3, pp. 1-76
12 pls.

ANDREWS, E. A.

1891. Report upon the Annelida Polychaeta of Beaufort, North Carolina. Proc. U. S. Nat. Mus., vol. 14, pp. 277-302, pls. 12-18.

ANNENKOVA, N. P.

1929. Beiträge zur Kenntnis der Polychaeten-Fauna der U.S.S.R. 1. Fam. Pectinariidae Quatrefages und Ampharetidae Malmgren. Ann. Mus. Zool. Acad. Leningrad, vol. 30, pp. 477-502, pls. 37-39.
1931. Die Polychaeten in den Sammlungen der Jakutischen Expedition der Akademie der Wissenschaften der U.S.S.R. Zool. Anz., vol. 95, pp. 203-205, 4 figs.
1932. Zur Fauna der Polychaeten des Leptev-Meeress. Issled. Moreĭ USSR, Gosud. Gidrol. Inst., Leningrad, fasc. 15, pp. 133-139, figs. 1-7.
1934. Kurze übersicht der Polychaeten der Litoralzone der Bering-Insel (Kommandor-Inseln), nebst Beschreibung neuer Arten. Zool. Anz., vol. 106, pp. 322-331, 11 figs.
1937. The polychaete fauna of the northern part of the Japan Sea. Issled. Moreĭ USSR, Gosud. Gidrol. Inst., Leningrad, fasc. 23, pp. 139-216, 12 figs., 5 pls.
1938. Polychaeta of the North Japan Sea and their horizontal and vertical distribution. In Reports of the Japan Sea Hydrobiological Expedition of the Academy of Sciences of the USSR in 1934, pt. 1, pp. 81-230, 16 figs.
1946. New species of Polychaeta from the Arctic Ocean. Trudy Dreifušhchei ekspeditsii Glavsevmorputi na ledokolnom parokhode G. sedov 1937-1940, vol. 3, pp. 185-188, 3 figs. (Leningrad Vsesofuznyĭ arkticheskii institut).

ARWIDSSON, IVAR

1898. Studien über die Familien Glyceridae und Goniadidae. Bergens Mus. Åarb., No. 11, pp. 1-69, 4 pls.
1907. Studien über die skandinavischen und arktischen Maldaniden nebst Zusammenstellung der übrigen bisher bekannten Arten dieser Familie. Zool. Jahrb., suppl. 9, pt. 1, pp. 1-308, 12 pls.
- 1911a. Die Maldaniden. Wissenschaftlichen Ergebnisse der Schwedischen Südpolar-Expedition 1901-1903. Vol. 6, pt. 6, pp. 1-44, 2 pls.
- 1911b. On some Irish Maldanidae. Proc. Roy. Irish Acad. Dublin, vol. 29B, No. 6, pp. 209-228, pls. 17-19.
1922. Systematic notes on some Maldanids. Kongl. Svenska Vetensk. Akad. Handl., vol. 63, No. 7, pp. 1-46, 2 pls.

ASHWORTH, JAMES HARTLEY

1910. The annelids of the family Arenicolidae of North and South America, including an account of *Arenicola glacialis* Murdoch. Proc. U. S. Nat. Mus., vol. 39, No. 1772, pp. 1-32, figs. 1-14.
1912. Catalogue of the Chaetopoda in the British Museum (Natural History). A. Polychaeta: Pt. I. Arenicolidae. Pp. 1-175, 68 figs., 15 pls.

1924. The rediscovery of *Arenicola glacialis* Murdoch, with observations on its characters and on its status. Rep. Canadian Arctic Exped. 1913-18. Pt. J: Polychaeta, suppl. 1, vol. 9, pp. 3j-7j, 1 fig.

AUGENER, HERMANN

1913. Polychaeten von Franz-Joseph-Land. I, II. Zool. Anz., vol. 41, pp. 202-220, 253-273.
1928. Die Polychäten von Spitzbergen. In Fauna Arctica. Römer und Schaudinn, vol. 5, pt. 3, pp. 649-834, pl. 11.
1939. Beitrag zur Polychaetenfauna der Ostsee. Kieler Meersf., vol. 3, pt. 1, pp. 133-147, 3 figs.

BERGSTRÖM, ERIK

1914. Zur Systematik der Polychaetenfamilie der Phyllodociden. Zool. Bidr. Uppsala, vol. 3, pp. 37-224, 81 figs., pls. 1-5.

BERKELEY, EDITH

1930. Polychaetous annelids from the Nanaimo District. 5. Ammocharidae to Myzostomidae. Contr. Canadian Biol. Fish., new ser., vol. 6, No. 5, pp. 67-77, fig. 1.

BERKELEY, EDITH, and BERKELEY, CYRIL

1936. Notes on Polychaeta from the coast of western Canada. I. Spionidae. Ann. Mag. Nat. Hist., ser. 10, vol. 18, pp. 468-477, 1 fig.
1938. Notes on Polychaeta from the coast of western Canada. II. Syllidae. Ann. Mag. Nat. Hist., ser. 11, vol. 1, pp. 33-49, 12 figs.
1942. North Pacific Polychaeta, chiefly from the west coast of Vancouver Island, Alaska, and Bering Sea. Canadian Journ. Res., vol. 20, pp. 183-208, 6 figs.
1943. Biological and oceanographical conditions in Hudson Bay. II. Polychaeta from Hudson Bay. Journ. Fish. Res. Board Canada, vol. 6, No. 2, pp. 129-132.
1944. Polychaeta from the western Canadian Arctic region. Canadian Journ. Res., vol. 22, pp. 1-5, 6 figs.
1945. Notes on Polychaeta from the coast of western Canada. III. Ann. Mag. Nat. Hist., ser. 11, vol. 12, pp. 316-335, 6 figs.
1948. Annelida, Polychaeta errantia. In Canadian Pacific Fauna. Fish. Res. Board Canada, No. 9b (1), pp. 1-100, 160 figs.
1950. Notes on Polychaeta from the coast of western Canada. IV. Polychaeta sedentaria. Ann. Mag. Nat. Hist., ser. 12, vol. 3, No. 25, pp. 50-69, 8 figs.
1952. Annelida, Polychaeta sedentaria. In Canadian Pacific Fauna. Fish. Res. Board Canada, No. 9b (2), pp. 1-139, 292 figs.

BORG, FOLKE

1917. Über die Spirorbisarten Schwedens nebst einem Versuch zu einer neuen Einteilung der Gattung *Spirorbis*. Zool. Bidr. Uppsala, vol. 5, pp. 14-48, 16 figs.

CHAMBERLIN, RALPH V.

1919. Pacific coast Polychaeta collected by Alexander Agassiz. Bull. Mus. Comp. Zool., vol. 63, No. 6, pp. 251-276, pls. 1-3.
1920. The polychaetes collected by the Canadian Arctic Expedition, 1913-18. Rep. Canadian Arctic Exped. 1913-18, pt. B, vol. 9, pp. 1-41, 6 pls.

CLAPARÈDE, ÉDOUARD

1868. Les annélides chétopodes du Golfe de Naples. Mém. Soc. Phys. Genève, vol. 19, pt. 2, pp. 313-584, 16 pls.

DALYELL, JOHN GRAHAM

1853. The powers of the Creator displayed in the Creation. Vol. 2, pp. 1-359, 46 pls.

DITLEVSEN, HJALMAR

1909. Annulata Polychaeta. *In* Report of the second Norwegian Arctic expedition in the *Fram*, 1898-1902, vol. 3, No. 15, pp. 1-23, 3 pls.
1911. Annelids from the Danmark Expedition. *In* Danmark-Ekspeditionen til Grønlands Nordøstkyst 1906-1908, vol. 5, No. 9, pp. 411-432, pls. 27-31.
1917. Annelids. I. *In* The Danish *Ingolf*-Expedition, vol. 4, pt. 4, pp. 1-71, 24 figs., 6 pls.
1929. Polychaeta. *In* Zoology of the Faroes. No. 16, pp. 1-83.
1937. Polychaeta. The Godthaab Expedition, 1928, vol. 80, No. 4, pp. 1-64, 6 figs.

EHLERS, ERNST

1868. Die Borstenwürmer (Annelida Chaetopoda) nach systematischen und anatomischen untersuchungen dargestellt, vol. 2, pp. 269-748, pls. 12-24.
1913. Die Polychaeten-Sammlungen. *In* Deutschen Südpolar-Expedition, 1901-1903, Zool., vol. 5, pt. 4, pp. 399-602, pls. 26-46.

ELIASON, ANDERS

1920. Biologisch-Faunistische Untersuchungen aus dem Öresund. V. Polychaeta. *Acta Univ. Lundensis*, new ser., vol. 16, pt. 6, pp. 1-103, 18 figs.

FABRICIUS, OTTO

1780. Fauna groenlandica. . . . Pp. 1-452, 12 figs.
1799. Betragtninger over Nereide-slaegten. *Skrivter af Naturh. Selsk.*, vol. 5, pp. 154-190, pl. 4.

FAUVEL, PIERRE

1911. Annélides polychètes. *In* Campagne Arctique de 1907, Duc d'Orléans, pt. 9, pp. 1-44, 1 pl.
1914. Annélides polychètes non pélagiques provenant des campagnes de l'*Hirondelle* et de la *Princesse-Alice* (1885-1910), fasc. 46, pp. 1-432, 31 pls.
1923. Polychètes errantes. *Faune de France*, vol. 5, pp. 1-488, 181 figs.
1927. Polychètes sédentaires. *Faune de France*, vol. 16, pp. 1-494, 152 figs.
1932. Annelida polychaeta of the Indian Museum, Calcutta. *Mem. Indian Mus.*, vol. 12, No. 1, pp. 1-262, 40 figs., 9 pls.
1933. Annélides polychètes du Golfe du Pei Tcheu Ly. *Publ. Mus. Hoang ho Pai ho de Tien Tsin*, No. 15, pp. 1-67, 6 figs.
- 1934a. Annélides polychètes de Rovigno d'Istria. *Thalassia*, vol. 1, No. 7, pp. 1-78, 4 figs.
- 1934b. Sur quelques syllidiens du Japon. *Annot. Zool. Japon.*, vol. 14, No. 3, pp. 301-315, 2 figs.
1936. Annélides polychètes du Japon. *Mem. Coll. Sci. Kyoto Univ.*, ser. B, vol. 12, No. 1, pp. 41-92, 1 fig.
1947. Annélides polychètes de Nouvelle-Calédonie et des Îles Gambier. *In* *Faune de l'Empire Français*, vol. 8, pp. 1-107, 90 figs.

FRIEDRICH, HERMANN

1939. Polychaeten-Studien. IV. Zur Polychaeten fauna der Barents-See. *Kieler Meeresf.*, vol. 3, pt. 1, pp. 122-132, 6 figs.

GORBUNOV, G. P.

1946. Bottom life of the Novosiberian shoalwaters and the central part of the Arctic ocean. *Trudy Dreifufishchei ekspeditsii Glavsevmorputi na ledokolnom parokhode G. Sedov 1937-1940*, vol. 3, pp. 30-138, 1 pl. (Leningrad Vsesofuznyi arkticheskii institut).

GRUBE, ADOLPH EDUARD

1840. Actinien, Echinodermen und Würmen des Adriatischen und Mittelmeers. . . . Pp. 61-88, 1 pl.
1855. Beschreibungen neuer oder wenig bekannter Anneliden. *Arch. Naturg.*, vol. 21, pt. 1, pp. 81-136, pls. 3-5.
1860. Beschreibung neuer oder wenig bekannter Anneliden. *Arch. Naturg.*, vol. 26, pt. 1, pp. 71-118, pls. 3-5.

GUSTAFSON, GUNNAR

1936. Polychaeta and Sipunculoidea from the Siberian Arctic ocean. In *The Norwegian North Polar expedition with the Maud, 1918-1925*, Scientific Results, vol. 5, No. 17, pp. 1-12.

HANSEN, G. ARMAUER

1882. Anneliden fra den Norske Nordhavs-Expedition, 1876-1878. *Den Norske Nordhavs-Exped.*, pt. 7, pp. 1-53, 7 pls.

HARTMAN, OLGA

- 1936a. A review of the Phyllodoceidae (Annelida Polychaeta) of the coast of California, with descriptions of nine new species. *Univ. Calif. Publ. Zool.*, vol. 41, No. 10, pp. 117-132, 51 figs.
- 1936b. New species of polychaetous annelids of the family Nereidae from California. *Proc. U. S. Nat. Mus.*, vol. 83, No. 2994, pp. 467-480, figs. 46-53.
- 1936c. New species of Spionidae (Annelida Polychaeta) from the coast of California. *Univ. Calif. Publ. Zool.*, vol. 41, No. 6, pp. 45-52, 22 figs.
- 1938a. The types of the polychaete worms of the families Polynoidae and Polyodontidae in the United States Museum and the description of a new genus. *Proc. U. S. Nat. Mus.*, vol. 86, pp. 107-134, 41 figs.
- 1938b. Review of the annelid worms of the family Nephtyidae from the northeast Pacific, with descriptions of five new species. *Proc. U. S. Nat. Mus.*, vol. 85, No. 3034, pp. 143-158, figs. 62-67.
- 1938c. Annotated list of the types of polychaetous annelids in the Museum of Comparative Zoology. *Bull. Mus. Comp. Zool.*, vol. 85, No. 1, pp. 1-31, 3 pls.
1939. Polychaetous annelids. Pt. I. Aphroditidae to Pisionidae. *Allan Hancock Pacific Exped.*, vol. 7, No. 1, pp. 1-156, 28 pls.
1940. Polychaetous annelids. Pt. II. Chrysopetalidae to Goniadidae. *Allan Hancock Pacific Exped.*, vol. 7, No. 3, pp. 173-286, pls. 31-44.
- 1941a. Some contributions to the biology and life history of Spionidae from California. *Allan Hancock Pacific Exped.*, vol. 7, No. 4, pp. 289-322, pls. 45-48.
- 1941b. Polychaetous annelids. Pt. IV. Pectinariidae. *Allan Hancock Pacific Exped.*, vol. 7, No. 5, pp. 325-344, pls. 49-52.
- 1942a. A review of the types of polychaetous annelids at the Peabody Museum of Natural History, Yale University. *Bull. Bingham Oceanogr. Coll.*, vol. 8, pt. 1, pp. 1-98, 161 figs.

- 1942b. The identity of some marine annelid worms in the United States National Museum. Proc. U. S. Nat. Mus., vol. 92, No. 3142, pp. 101-140, figs. 8-15.
- 1942c. Report on the scientific results of the *Atlantis* expeditions to the West Indies under the joint auspices of the University of Havana and Harvard University. Mem. Soc. Cubana Hist. Nat., vol. 16, No. 2, pp. 89-104, pls. 8-9.
- 1944a. New England Annelida. Pt. 2, including the unpublished plates by Verrill with reconstructed captions. Bull. Amer. Mus. Nat. Hist., vol. 82, No. 7, pp. 327-344, pls. 13-35 [45-60].
- 1944b. Polychaetous annelids from California including the descriptions of two new genera and nine new species. Allan Hancock Pacific Exped., vol. 10, No. 2, pp. 239-307, pls. 19-26.
- 1944c. Polychaetous annelids. Pt. VI. Paraonidae, Magelonidae, Longosomidae, Ctenodrilidae, and Sabellariidae. Allan Hancock Pacific Exped., vol. 10, No. 3, pp. 311-388, pls. 27-42.
- 1944d. Polychaetous annelids. Allan Hancock Atlantic Exped., Rep. No. 3, pp. 1-32, 2 pls.
1945. The marine annelids of North Carolina. Bull. Duke Univ. Marine Sta., No. 2, pp. 1-51, 10 pls.
1947. Polychaetous annelids. Pt. VII. Capitellidae. Allan Hancock Pacific Exped., vol. 10, No. 4, pp. 391-480, pls. 43-58.
1948. The polychaetous annelids of Alaska. Pacific Sci., Univ. Hawaii, vol. 2, No. 1, pp. 3-58, 12 figs.
1950. Goniadidae, Glyceridae and Nephtyidae. Allan Hancock Pacific Exped., vol. 15, No. 1, pp. 1-180, 19 pls., 3 figs.
1951. The littoral marine annelids of the Gulf of Mexico. Publ. Inst. Marine Sci., vol. 2, No. 1, pp. 7-124, 27 pls.
1952. The marine annelids of the United States Navy Antarctic Expedition, 1947-1948. Journ. Washington Acad. Sci., vol. 42, No. 7, pp. 231-237, 12 figs.
- HARTMAN, OLGA, and REISH, DONALD J.**
1950. The marine annelids of Oregon. Oregon State Monogr. Studies in Zool., No. 6, pp. 1-64, 5 pls.
- HESSLE, CHRISTIAN**
1917. Zur Kenntnis der Terebellomorphen Polychaeten. Zool. Bidr. Uppsala, vol. 5, pp. 39-258, 66 figs., pls. 1-5.
- JOHANSSON, KARL ERIK**
1926. Berkmurkungen über die Kinberg'schen Arten der Familien Hermellidae und Sabellidae. Ark. Zool. Stockholm, vol. 18A, No. 7, pp. 1-28, 9 figs.
1927. Beiträge zur Kenntnis der Polychaeten Familien Hermellidae, Sabellidae und Serpulidae. Zool. Bidr. Uppsala, vol. 11, pp. 1-184, 15 figs., 5 pls.
- JOHNSON, HERBERT PARLIN**
1897. A preliminary account of the marine annelids of the Pacific coast with descriptions of new species. . . . Proc. Calif. Acad. Sci. Zool., ser. 3, vol. 1, No. 5, pp. 153-198, pls. 5-10.
1901. The Polychaeta of the Puget Sound region. Proc. Boston Soc. Nat. Hist., vol. 29, No. 18, pp. 381-437, 19 pls.
- KINBERG, J. G. H.**
1867. Annulata nova. Ofv. Vet. Akad. Forh. Stockholm, vol. 23, No. 9, pp. 337-357.

KRÖYER, HENRIK

1856. Meddelelser om ormeslaegten *Sabella* Linn., isaer dans nordiske Arter. Overs. Danske Videnskab. Selsk. Forh. (1856), pp. 1-36.

LANGERHANS, PAUL

1884. Die Wurmfauna von Madeira. IV. Zeits. wiss. Zool., vol. 40, pp. 247-285, pls. 15-17.

LEUCKART, RUDOLPH

1849. Zur Kenntniss der Fauna von Island. Erster Beitrag (Würmer). Arch. Naturg., vol. 15.1, pp. 149-208, pl. 3.

LEVINSEN, G. M. R.

1882. Systematisk-geografisk Oversigt over de nordiske Annulata, Gephyrea, Chaetognathi og Balanoglossi. Vidensk. Medd. Naturh. Foren. Kjøbenhavn, pt. 1, pp. 160-251, pl. 7.

LINNÉ, CARL

1758. Systema Naturae. Ed. 10.
1767. Systema Naturae. Ed. 12.

McINTOSH, WILLIAM C.

1874. On the Annelida of the Gulf of St. Lawrence. Ann. Mag. Nat. Hist., ser. 4, vol. 13, pp. 261-270, pls. 9-10.
1885. Annelida Polychaeta. In Report on the scientific results of the voyage of H.M.S. *Challenger* . . . 1873-76 . . . Zoology, vol. 12, pt. 34, pp. 1-554, 84 pls.
1900. A monograph of the British annelids. II. Polychaeta. Amphino- midae to Sigalionidae. Vol. 1, pp. 215-442, pls. 24-42.
1908. A monograph of the British annelids. I-II. Polychaeta. Neph- thydidae to Ariciidae. Vol. 2, pp. 1-524, pls. 43-87.

MALM, AUGUST W.

1874. Annulater i hafvet utmed Sverges vestkust och omkring Göteborg. Göteborgs Vetensk. Samh. Handl., vol. 14, pp. 71-105, 1 pl.

MALMGREN, ANDERS J.

1865. Nordiska Hafs-Annulater. Förh. Öfv. Kongl. Vet. Akad. Stockholm, Nos. 1, 2, 5, pp. 51-110, 181-192, 355-410, pls. 8-15, 18-29.
1867. Annulata Polychaeta Spetsbergiae, Groenlandiae, Islandiae et Scan- dinaviae hactenus cognita. Pp. 1-127, 14 pls.

MARENZELLER, EMIL VON

1876. Zur Kenntniss der adriatischen Anneliden. Sitzb. Akad. Wiss. Wien, vol. 72, pp. 129-171, 4 pls.
1879. Südjapanische Anneliden. Denkschr. Akad. Wiss. Wien, vol. 41, pp. 1-46, 6 pls.
1890. Annulaten des Beringmeeres. Ann. Naturh. Hofmus. Wien, vol. 5, pp. 1-8, 1 pl.
1892. Zoologische Ergebnisse der im Jahre 1889 auf Kosten der Bremer Geographischen Gesellschaft von Dr. Willy Kükenthal und Dr. Alfred Walter ausgeführten Expedition nach Ostspitzbergen. Polychäten. Zool. Jahrb., vol. 6, pp. 397-434, pl. 19.
1904. Zoologische Ergebnisse. XIII. Polychäten des Grundes, Gesam- melt 1893, 1894. Denkschr. Akad. Wiss. Wien, vol. 74, pp. 295-321.

MESNIL, FÉLIX

1897. Études de morphologie externe chez les annélides. II. Remarques complémentaires sur les spionidiens. Bull. Sci. France et Belgique, vol. 30, pp. 83-100, pl. 3.

MONRO, C. C. A.

1928. On the Polychaeta collected by Dr. Th. Mortensen off the coast of Panama. Vidensk. Medd. Naturh. Foren. Kjøbenhavn, vol. 85, pp. 75-103, 19 figs.
1930. Polychaete worms. *Discovery Reports*, vol. 2, pp. 1-222, 91 figs.
1933. The Polychaeta Errantia collected by Dr. C. Crossland at Colón in the Panama region and Galápagos Islands during the expedition of the S.Y. *St. George*. Proc. Zool. Soc. London (1933), pt. 1, pp. 1-96, 36 figs.
1936. Polychaete worms. II. *Discovery Reports*, vol. 12, pp. 59-198, 34 figs.
1937. Polychaeta. Scientific reports of the John Murray Expedition, 1933-34, vol. 4, No. 8, pp. 243-321, 28 figs.
- 1939a. Polychaeta of the *Rosaura* Expedition. Nov. Zool. London, vol. 41, pp. 345-354, 4 figs.
- 1939b. On some tropical Polychaeta in the British Museum, mostly collected by Dr. C. Crossland at Zanzibar, Tahiti and the Marquesas. II. Families Syllidae and Hesionidae. Nov. Zool. London, vol. 41, pp. 383-393, 4 figs.

MONTAGU, GEORGE

1808. Description of several marine animals found on the south coast of Devonshire. Trans. Linn. Soc. London, Zool., vol. 9, pp. 81-114, pls. 2-8.
1818. Description of five British species of the genus *Terebella* of Linné. Trans. Linn. Soc. London, Zool., vol. 12, pp. 340-344, pls. 11-13.

MOORE, J. PERCY

1902. Descriptions of some new Polynoidae with a list of other Polychaeta from North Greenland waters (and Alaska). Proc. Acad. Nat. Sci. Philadelphia, vol. 54, pp. 258-278, pls. 13-14.
1903. Polychaeta from the coastal slope of Japan, and from Kamchatka and Bering Sea. Proc. Acad. Nat. Sci. Philadelphia, vol. 55, pp. 401-490, pls. 23-27.
- 1905a. New species of Polychaeta from the North Pacific, chiefly from Alaskan waters. Proc. Acad. Nat. Sci. Philadelphia, vol. 57, pp. 525-554, pls. 34-37.
- 1905b. New species of Ampharetidae and Terebellidae from the North Pacific. Proc. Acad. Nat. Sci. Philadelphia, vol. 57, pp. 846-860, pl. 44.
- 1905c. Five new species of *Pseudopotamilla* from the Pacific coast of North America. Proc. Acad. Nat. Sci. Philadelphia, vol. 57, pp. 555-569, pl. 37.
- 1906a. Descriptions of two new Polychaeta from Alaska. Proc. Acad. Nat. Sci. Philadelphia, vol. 58, pp. 352-355, 2 figs.
- 1906b. Additional new species of Polychaeta from the North Pacific. Proc. Acad. Nat. Sci. Philadelphia, vol. 58, pp. 217-260, pls. 10-12.
1908. Some polychaetous annelids of the northern Pacific coast of North America. Proc. Acad. Nat. Sci. Philadelphia, vol. 60, pp. 321-364, 4 figs.
- 1909a. The polychaetous annelids dredged by the U.S.S. *Albatross* off the coast of southern California in 1904. I. Syllidae, Sphaerodoridae, Hesionidae and Phyllodocidae. Proc. Acad. Nat. Sci. Philadelphia, vol. 61, pp. 321-351, pls. 15-16.

- 1909b. The polychaetous annelids dredged in 1908 by Mr. Owen Bryant off the coasts of Labrador, Newfoundland, and Nova Scotia. Proc. U. S. Nat. Mus., vol. 37, No. 1703, pp. 133-146.
1910. The polychaetous annelids dredged by the U.S.S. *Albatross* off the coast of southern California in 1904. II. Polynoidae, Aphroditidae and Segaleonidae. Proc. Acad. Nat. Sci. Philadelphia, vol. 62, pp. 328-402, pls. 28-33.
1911. The polychaetous annelids dredged by the U.S.S. *Albatross* off the coast of southern California in 1904. III. Euphrosynidae to Goniadidae. Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 234-318, pls. 15-21.
1923. The polychaetous annelids dredged by the U.S.S. *Albatross* off the coast of Southern California in 1904. IV. Spionidae to Sabelariidae. Proc. Acad. Nat. Sci. Philadelphia, vol. 75 (Append.), pp. 179-259.
- MOORE, J. P., and BUSH, K. J.
1904. Sabellidae and Serpulidae from Japan, with descriptions of new species of *Spirorbis*. Proc. Acad. Nat. Sci. Philadelphia, vol. 56, pp. 157-179, pls. 11, 12.
- MÜLLER, OTTO FREDERICH
1776. Zoologiae Danicae prodromus, seu animalium Daniae et Norvegiae . . ., pp. 1-274.
1788. Zoologica Danica, seu animalium Daniae et Norvegiae . . ., vol. 1, ed. 3, pp. 1-52; vol. 3, ed. 3, pp. 1-71, 1789.
1806. Atlas to above volumes.
- MURDOCH, JOHN
1884. Description of seven new species of Crustacea and one worm from Arctic Alaska. Proc. U. S. Nat. Mus., vol. 7, pp. 518-522.
1885. Natural history of Alaska. Vermes. In Report of the International Polar Expedition to Point Barrow, Alaska, pt. 4, pp. 152-156.
- NILSSON, DAVID
1928. Neue und alte Amphieteniden. Goteborgs Vetensk. Samh. Handl., vol. 33, No. 4, pp. 1-96, 30 figs.
- OERSTED, ANDERS S.
1843. Groenlands Annulata Dorsibranchiata. K. Danske Vidensk. Selsk. Naturv. Math., vol. 10, pp. 155-216, 8 pls.
1845. Über die Entwicklung der Jungen bei einer Annelide und über die äusseren Unterschiede zwischen beiden Geschlechtern. Arch. Naturg., vol. 11.1, pp. 20-23, pl. 2.
- OKUDA, SHIRO
- 1937a. Some ariid worms from Japan. Annot. Zool. Japon., vol. 16, No. 2, pp. 99-105, 6 figs.
- 1937b. Annelida Polychaeta in Onagawa Bay and its vicinity. I. Polychaeta Sedentaria. Sci. Rep. Tôhoku Univ., ser. 4, vol. 12, No. 1, pp. 45-69, 12 figs., pl. 2.
- 1938a. The Sabellariidae of Japan. Journ. Fac. Sci. Hokkaido Univ. Zool., ser. 6, vol. 6, No. 3, pp. 235-253, 11 figs.
- 1938b. Polychaetous annelids from the vicinity of the Mitsui Institute of Marine Biology. Japan. Journ. Zool., vol. 8, No. 1, pp. 75-105, 15 figs.
1939. Annelida Polychaeta in Onagawa Bay and its vicinity. II. Polychaeta Errantia. Sci. Rep. Tôhoku Univ., ser. 4, vol. 14, No. 2-3, pp. 219-244, 14 figs.

PAGENSTECHEK, H. A.

1862. Untersuchungen über niedere Seethiere aus Cette. I. *Exogone gemifera* und einige verwandte Syllidien. Zeits. Wiss. Zool., vol. 12, pp. 265-283, pls. 25-26.

PALLAS, PETER SIMON

1766. Miscellanea zoologica quibus novae imprimis atque obscurae animalium species describuntur et observationibus inconibusque illustrantur. Pp. 1-244, 14 pls.

PETTIBONE, MARIAN H.

1949. Polychaetous annelids of the Polynoidae from the northeastern Pacific, with a description of a new species. Amer. Mus. Nov., No. 1414, pp. 1-5, 9 figs.
 1951. A new species of polychaete worm of the family Polynoidae from Point Barrow, Alaska. Journ. Washington Acad. Sci., vol. 41, No. 1, pp. 44-45, 1 fig.
 1953. Some scale-bearing polychaetes of Puget Sound and adjacent waters Pp. 1-89, 40 pls.

RANZANI, CAMILLO

1817. Neue Würmer. Isis von Oken, vol. 1, pp. 1449-1480, pl. 11.

RATHKE, HEINRICH

1843. Beiträge zur Fauna Norwegens. Nova Acta Acad. Leop. Carol., vol. 20, No. 1, pp. 1-264, 12 pls.

RIOJA, ENRIQUE

1941. Estudios annelidológicos. III. Datos para el conocimiento de las fauna de poliquetos de las costas del Pacífico de México. Anal. Inst. Biol. México, vol. 12, No. 2, pp. 669-746, 9 pls.
 1943. Estudios annelidológicos. VIII. Aportaciones al conocimiento de los exogoninos (anel. poliquetos) de las costas Mexicanas del Pacífico. Anal. Inst. Biol. México, vol. 14, No. 1, pp. 207-227, 47 figs.

SARS, MICHAEL

1835. Beskrivelser og iagttagelser over nogle moekelige eller nye i havet ved den Bergenske kyst levende dyr. . . . Pp. 1-81, 15 pls.
 1851. Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken. 5. Annelider. Nyt. Mag. Naturv., vol. 6, pp. 196-211.
 1860. Om de ved Norges Kyster forekommende Arter af Annelides lægten *Polynoë*. Vidensk. Selsk. Kristiania, pp. 54-62.

SMITH, S. I., and HARGER, O. (and VERRILL, A. E.)

1874. Report on the dredgings in the region of St. George's Banks in 1872. Trans. Connecticut Acad. Arts Sci., vol. 3, pp. 1-57, 8 pls.

SOUTHERN, ROWLAND

1914. Archiannelida and Polychaeta. In Clare Island survey, Pt. 47. Proc. Roy. Irish Acad. Dublin, vol. 31, pp. 1-160, 15 pls.

STIMPSON, WILLIAM

1854. Synopsis of the marine Invertebrata of Grand Manan. Smithsonian Contr. Knowl., vol. 6, pp. 1-66, 3 pls.

STØP-BOWITZ, C.

1941. Les glycériens de Norvège. Nyt. Mag. Naturv., vol. 82, pp. 181-250 4 pls., 14 figs.
 1946. Les scalibregmiens de Norvège. Nyt. Mag. Naturv., vol. 85, pp. 63-87, 2 pls., 6 figs.

- 1948a. Les flabelligériens Norvégiens. *Bergens Mus. Åarb.* 1946/47, *Naturv.*, No. 2, pp. 1-59, 13 figs., 12 pls.
- 1948b. Sur les polychètes arctiques des familles des glycériens, des ophéliens, des scalibregmiens et des flabelligériens. *Tromsø Mus. Aarsh.*, vol. 66, No. 2, pp. 1-58, 18 figs.
- 1948c. Polychaeta from the *Michael Sars* North Atlantic deep-sea expedition 1910. *In Rep. Sci. Results Michael Sars North Atlantic Deep-sea Exped.* 1910, vol. 5, No. 8, pp. 1-91, 51 figs., 5 tables.

SUMNER, F. B., OSBURN, R. C., and COLE, L. J.

1913. Annulata. *In A biological survey of the waters of the Woods Hole and vicinity.* *Bull. U. S. Bur. Fish.*, vol. 31, pt. 2, pp. 615-636.

THÉEL, JOHAN H.

1879. Les annélides polychètes des mers de la Nouvelle-Zemble. *Svenska Vetensk. Akad. Handl.*, vol. 16, pt. 3, pp. 1-75, 4 pls.

THORSON, GUNNAR

1946. Reproduction and larval development of Danish marine bottom invertebrates. *Medd. Komm. Havundersøg. Kjøbenhavn*, vol. 4, No. 1, pp. 1-523, 198 figs.

TREADWELL, A. L.

1922. Polychaetous annelids collected at Friday Harbor, State of Washington, in February and March, 1920. *Publ. Carnegie Inst.*, No. 312, pp. 171-181, 37 figs.
1925. A list of the annelids collected by Captain R. A. Bartlett in Alaska, 1924, with a description of a new species. *Proc. U. S. Nat. Mus.*, vol. 67, art. 29, No. 2601, pp. 1-3, 4 figs.
1937. Polychaetous annelids collected by Captain Robert A. Bartlett in Greenland, Fox Basin, and Labrador. *Journ. Washington Acad. Sci.*, vol. 27, No. 1, pp. 23-36, 16 figs.

VERRILL, ADDISON EMORY

1873. Report upon the invertebrate animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region. *Rep. U. S. Fish Comm. for 1871-72*, pp. 295-778.
- 1874a. Brief contributions to zoology from the Museum of Yale College. Results of recent dredging expeditions on the coast of New England. *Amer. Jour. Sci. Arts*, vol. 7, No. 4-8, pp. 38-46, 131-138, 405-414, 498-505, pls. 4-8.
- 1874b. Explorations of Casco Bay by the U. S. Fish Commission in 1873. *Proc. Amer. Assoc. Adv. Sci.*, vol. 22, pp. 340-395, 6 pls.
1879. Notice of recent additions to the marine invertebrata of the north-eastern coast of America, with descriptions of new genera and species and critical remarks on others. *Proc. U. S. Nat. Mus.*, vol. 2, pp. 165-206.
1881. New England Annelida. Pt. I. Historical sketch, with annotated lists of the species hitherto recorded. *Trans. Connecticut Acad. Arts Sci.*, vol. 4, pt. 2, pp. 285-324, pls. 3-12.
1882. Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England, and of some additions to the fauna of Vineyard Sound. *Amer. Journ. Sci.*, ser. 3, vol. 24, pp. 360-371 (plates referred to published in Hartman, 1944a).

WEBSTER, H. E.

- 1879a. Annelida Chaetopoda of the Virginia coast. *Trans. Albany Inst.*, vol. 9, pp. 201-272, 11 pls.

- 1879b. The Annelida Chaetopoda of New Jersey. Rep. New York State Mus., vol. 32, pp. 101-128.
1886. The Annelida Chaetopoda of New Jersey. Rep. New York State Mus., vol. 39, pp. 128-159, pls. 4-10.
- WEBSTER, H. E., and BENEDICT, J. E.
1884. The Annelida Chaetopoda from Provincetown and Wellfleet, Massachusetts. Rep. U. S. Fish Comm. for 1881, pp. 699-747, 8 pls.
1887. The Annelida Chaetopoda from Eastport, Maine. Rep. U. S. Fish Comm. for 1885, pp. 707-755, 8 pls.
- WESENBERG-LUND, ELISE
1934. Gephyreans and annelids. In The Scoresby Sound Committee's second East Greenland expedition in 1932 to King Christian IX's Land. Medd. Grønland, vol. 104, No. 14, pp. 1-38.
- 1939a. Pelagic polychaetes of the families Aphroditidae, Phyllodocidae, Typhlocoelidae and Alciopidae. II. Biology. In Report on the Danish oceanographical expeditions 1908-10 to the Mediterranean and adjacent seas, pp. 1-46, 29 figs.
- 1939b. Polychètes et géphyriens de Tunisie. Bull. Stat. Océanogr. Salambo, No. 39, pp. 1-20.
1947. Syllidae (Polychaeta) from Greenland waters. Medd. Grønland, vol. 134, No. 6, pp. 1-38, 15 figs.
1948. Maldanidae (Polychaeta) from west Greenland waters. Medd. Grønland, vol. 134, No. 9, pp. 1-58, 29 figs.
1949. Polychaetes of the Iranian Gulf. Danish Sci. Invest. Iran, pt. 4, pp. 247-400, 47 figs.
- 1950a. Polychaeta. In The Danish *Ingolf*-Expedition, vol. 4, No. 14, pp. 1-92, 10 pls., 67 charts, 2 figs.
- 1950b. The Polychaeta of west Greenland. . . . Medd. Grønland, vol. 151, No. 2, pp. 1-171, 37 charts, 4 tables.
1951. Polychaeta. In The Zoology of Iceland, vol. 2, pt. 19, pp. 1-182, 12 figs., 62 charts.
- WIRÉN, AXEL
1883. Chaetopoder från Sibiriska Ishafvet och Berings Haf insamlade under *Vega*-Expeditionen 1878-1879. In *Vega*-Exped. vetenskapliga Iakttagelser. . . . af A. E. Nordenskiöld, vol. 2, pp. 383-428, pls. 27-32.
1901. Über die während der schwedischen arktischen Expedition von 1898 und 1900 eingesammelten Anneliden. Zool. Anz., vol. 24, p. 253.
- ZACHS, I.
1933. Polychaeten vom Nordjapanischen Meer (Bucht *Peter der Grosse*). Issled. Morei USSR, Gosud. Hidrol. Inst., Leningrad, fasc. 19, pp. 125-137.
- ZATSEPIN, V.
1948. Klass Polychaeta. In *Opredelitel fauny i flory severnykh morei USSR*, N. S. Gaevskaia-Sokolova, pp. 94-167, figs. 18-22, pls. 28-39.

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1954

No. 3325

THE RELATIONSHIPS OF OLD AND NEW WORLD
MELANIANS

By J. P. E. MORRISON

Recent anatomical observations on the reproductive systems of certain so-called "melanian" fresh-water snails and their marine relatives have clarified to a remarkable degree the supergeneric relationships of these fresh-water forms.

The family of Melanians, in the broad sense, is a biological absurdity. We have the anomaly of one fresh-water "family" of snails derived from or at least structurally identical in peculiar animal characters to and ancestrally related to three separate and distinct marine families. On the other hand, the biological picture has been previously misunderstood largely because of the concurrent and convergent evolution of the three fresh-water groups, Pleuroceridae, Melanopsidae, and Thiaridae, from ancestors common to the marine families Cerithiidae, Modulidae, and Planaxidae, respectively.

The family Melanopsidae is definitely known living only in Europe. At present, the exact placement of the genus *Zemelanopsis* living in fresh waters of New Zealand is uncertain, since its reproductive characters are as yet unknown. In spite of obvious differences in shape, the shells of the marine genus *Modulus* possess at least a well-indicated columellar notch of the aperture, to corroborate the biological relationship indicated by the almost identical female egg-laying structure in the right side of the foot of *Modulus* and *Melanopsis*.

According to studies by Ankel (1928), *Fagotia esperi* (Ferussac) has the same reproductive anatomy of the female as does *Melanopsis*. The few large eggs (1 mm. in size) are laid singly in an irregular capsule.

Melanopsis dufourii (Ferussac) from Elche, Alicante Province, Spain, has been examined by me. Unlike the animals of the North American Pleuroceridae, in this species at least, the smooth mantle edge is continuous beneath the back of the foot, forming a circle around the aperture. In the female the end of the oviduct is quite far behind the mantle edge and simple, as is typical for the group. The egg-laying groove is not long, and does not even reach the mantle edge. The pit is enormously developed and has a large, whitish, tongue-shaped, basally-attached "ovipositor," with a groove on its posterior dorsal face, toward the rest of the pit. According to Ankel (1928), a few proportionately large eggs are laid by *Melanopsis*.

Family PLEUROCERIDAE (in the Americas)

Subfamily PLEUROCERINAE

All known American members of Pleuroceridae are oviparous, including those from North, Central, and South America and the West Indies. In other words, every American genus and species for which the characters of reproduction are known is egg-laying, with an egg-laying sinus or pit in the right side of the foot of the females. The presence of this pit is the single morphological character that proves them to belong to the typical subfamily. There is every indication that all the American genera and species of Pleuroceridae belong here, although some of the North American genera are still unrecorded as to critical animal characters.

Subfamily PLEUROCERINAE (in North America)

Genus *Oxytrema* Rafinesque, 1819

Oxytrema Rafinesque is the earliest and correct name for one of the most widespread "Melanian" genera in the world. This genus includes numerous North American species whose ranges extend from the Atlantic to the Pacific coasts and from southern Canada to Florida and Texas. It also includes North American fossils, as well as a number of Recent species from southeast Asia (Korea, China, and Thailand). All the species called "*Pleurocera*" by Bryant Walker, and other authors who followed him blindly, and all the species called "*Goniobasis*" (with very few exceptions) belong to this genus. Their eggs are laid in a single row in a close, irregularly spiral group, in apparent flat clusters of 3 to 10 egg capsules in each small egg mass, the whole covered with sand grains as recorded by Van Cleave (1932), Winsor (1933), and Woodward (1934).

Rafinesque originally described *Oxytrema* (1819, p. 423), including young specimens of both his genus *Pleurocera* and this one. There were no specific names included. Blainville, in 1824 and again in 1825 (p. 442), placed one species of Rafinesque under this generic name. He gave as the sole example of the subgenus *Pleurocerus* (*Oxytrema*) *acutus* (Rafinesque), validating the specific name in 1824. Rafinesque (1831, p. 3) again described his *Pleurocera acuta*, and at the same time declared he had given the name in 1818. From 1824 on, *Oxytrema* has been the earliest available name for the group because the genotype was fixed at that time as *Pleurocera* (*Oxytrema*) *acuta* Blainville by monotypy. With no serious question ever raised about the identity of *acuta*, the genotype, doubts about the identity of the genus *Oxytrema* vanish.

The eastern American (Appalachian) species of *Oxytrema* include some whose shells are almost completely smooth as adults, such as *O. symmetrica* (Haldeman); some with spiral sculpture predominant, such as *O. virginica multilineata* (Say); others with axial sculpture strong, such as *O. laqueata* (Say); and still others with both axial and spiral lirae to produce reticulate or nodose sculpture, such as *O. catenaria* (Say).

In exactly parallel fashion, as should be expected of congeneric stocks, the western American species now known to belong to *Oxytrema* show the same rather complete range of sculpture from smooth to axially and spirally sculptured adult shells. The easternmost living representative of the Rocky Mountain group of species is *O. comalensis* (Pilsbry). This species from Texas belongs to this minor group within the genus, possessing the same minutae of female reproductive characters as does *O. plicifera* (Lea) from Oregon and Washington. Most if not all the western America Tertiary fossil species described as "*Melania*," "*Goniobasis*," and "*Pachychilus*," from Texas to Washington, were members of this genus *Oxytrema* Rafinesque. For example, "*Ambloxus*" *olequaensis* Arnold and Hannibal (Hannibal, 1912, p. 178, pl. 8, fig. 27) closely resembles the smoother phase of the living *Oxytrema silicula* (Gould) from the same region, while "*Pachychilus*" *drakei* Arnold and Hannibal (Hannibal, 1912, p. 183, pl. 8, fig. 26) is close to the living species *Oxytrema plicifera* (Lea). Certain other fossil species from the Rocky Mountain region parallel eastern forms in the possession of cancellate or reticulate sculpture. Species known from the fossil record indicate the previous continuity of geographic distribution from Washington to Texas, now noncontinuous since much of the intervening area (progressively desiccated since the Miocene) is now unsuited to survival of pleurocerine freshwater snails.

Female animals of *Oxytrema canaliculatum undulatum* (Say) from

the Kentucky River, of *Oxytrema deshayesiana* (Lea) from the Tennessee River, of *Oxytrema bulbosa* (Gould) from eastern Oregon, and of *Oxytrema nodifila* (Martens) from the Han River, Korea, have been examined by me and sketched to show the egg-laying groove and the "ovipositor" pit on the right side of the foot (see pl. 11).

Section *Strephobasis* Lea, 1861

The group named *Strephobasis* by Lea (1861, p. 96), with the genotype *Oxytrema (Strephobasis) plena* Anthony, as stated by Pilsbry (1896a, p. 496), is only an extreme section of the genus, according to shell characters. This small group, which is confined to the larger rivers of the upper Tennessee drainage, is exactly parallel to *Goniobasis*, sensu stricto, from the Coosa River drainage. The animal characters must be examined to determine whether this group is identical to or biologically distinct from *Oxytrema*, sensu stricto, and *Goniobasis*, sensu stricto.

Genus *Gyrotoma* Shuttleworth, 1845

Gyrotoma Shuttleworth (1845, p. 88), based on the genotype (*Gyrotoma ovoideum* Shuttleworth=) *Gyrotoma excisum* (Lea), is confined to the Coosa River drainage. As Goodrich (1924, p. 6) has hinted, the group named *Goniobasis* by Lea in 1862 (genotype by subsequent designation by Hannibal 1912: *G. osculata* Lea) may eventually prove to be most closely related to *Gyrotoma*. It is possible that *Goniobasis*, sensu stricto, may be a subgenus of *Gyrotoma* different only by lack of or development of the fissure in the lip. Study of the animal characters (as yet unknown) of the genotype must prove the true biological position of *Goniobasis*.

Genus *Mudalia* Haldeman, 1840

Mudalia of Haldeman, whose genotype is *Mudalia carinata* (Bruguière) from the Atlantic coastal region, includes *trilineata* (Say) of the Ohio River and the more widespread "*Goniobasis*" *livescens* (Menke) from the upper St. Lawrence River and upper Mississippi River areas. The single carina typical of adolescent shells and the egg-laying habits are identical in *carinata* (Winsor, 1933) and in *livescens* (Jewell, 1931). Figures 10 and 14 of Goodrich (1945, pl. 1) show how closely the shape of adult shells of *livescens* may vary toward the usual shape of adult shells of *carinata*. The eggs of *Mudalia* are laid singly; that is, there is only one egg capsule in each egg mass.

Genus *Leptoxis* Rafinesque, 1819

Leptoxis of Rafinesque is the earliest name available for the American species related to the genotype *L. praerosa* (Say), and must be so used. Pilsbry (1917, p. 113) has stated the case for priority of *Lep-*

toxis Rafinesque 1819 over *Anculosa* Say 1821 so clearly that Walker's 1918 refusal to follow this needed correction of nomenclature appears at present to be only a prejudiced personal objection to the change. As in other similar cases, most American authors, especially those concerned with biology rather than nomenclature, from 1918 to date have followed Walker not because they had critically checked the generic names used by him, but simply because it was the most recent comprehensive classification outline for North American fresh-water shells. As stated elsewhere, this incorrect usage following Walker dates only from Walker, and has only 33 years standing, which is not enough to even raise any questions of usage over priority of names.

For the record Chenu states (Haldeman, 1847-1848, p. 1, footnote) that he and not Haldeman put the name *Leptoxis* of Rafinesque on Haldeman's pictorial monograph of the genus. Thus Chenu, and Pilsbry by formally designating *praerosa* as genotype in 1917, completely cleared up all doubts, concerning Rafinesque's genus, which had existed prior to 1848.

Genus *Eurycaelon* Lea, 1864

Eurycaelon of Lea (1864, p. 3) has as genotype *Eurycaelon anthonyi* (Redfield) by subsequent designation by Walker (1918, p. 36). The two known species, *Eurycaelon crassa* (Haldeman) 1841 and *E. anthonyi* (Redfield) 1854 are confined to the larger rivers of the upper Tennessee drainage as reported by Goodrich (1931). In this connection must be mentioned the fact that the two names *cristata* Anthony (young specimens) and *anthonyi* Redfield (adult specimens) were published simultaneously in April 1854, according to the printed signature dates of volume 6 of the Annals of the Lyceum of Natural History of New York. Goodrich, acting as first reviser, selected *anthonyi* Redfield, on page 130 of volume 6 of the above Annals, over the name *cristata* of Anthony, on page 108, which he placed in synonymy. In this way Goodrich avoided a confusing change of name of the genotype.

Genus *Pleurocera* Rafinesque, 1818

Pleurocera of Rafinesque became monotypic in 1820 with the valid publication by Rafinesque of *Pleurocera verucosa*. Tryon in 1864 and 1873 did not include the genotype in his usage, so his usage was biologically and nomenclatorially wrong. Pilsbry in 1896 questioned the genotype. Hannibal (1912, p. 169) formally designated the monotype species *verrucosa* Rafinesque as the genotype, being followed correctly by Pilsbry in 1917.

Bryant Walker, in his 1918 classification, continued to use Tryon's incorrect name for the genus when he used only the second available

name, *Lithasia* Haldeman (1840), which has the species *geniculata* of Haldeman for genotype.

The smooth species from the Kentucky River named *Ellipstoma zonalis* by Rafinesque in 1818 can only be the species commonly known as *Lithasia obovata* Say 1829. With over 10 years priority, the specific name of Rafinesque must be used. Animals of *Pleurocera zonalis* Rafinesque personally collected from the Kentucky River have been examined and sketched. The female egg-laying characters are illustrated in figure 4 of plate 11.

Subgenus *Ellipstoma* Rafinesque, 1818

In spite of the extreme brevity of Rafinesque's original description (1818b, p. 42), critical reading indicates that this name applies only to the group afterward named *Angitrema* by Haldeman (1841a). Hannibal (1912, p. 168) formally designated Rafinesque's first species, *Ellipstoma gibbosa*, as the genotype, although he misidentified that species. When one approaches the identification of *gibbosa* from every angle it is evident that there is only one kind of snail in the Ohio and Wabash Rivers with "a large knob behind the outward lip." This is the same species named almost three years later as *Melania armigera* Say (1821, p. 178).

Critical examination of the animal characters of the genotype *Pleurocera (Ellipstoma) gibbosa* Rafinesque is needed to check the biological distinction of *Ellipstoma* as a subgenus, a separate genus, or a synonym of *Pleurocera*, *sensu stricto*.

Genus *Anaplocamus* Dall, 1895

Anaplocamus of Dall (1895, p. 8), mistakenly described as an Alaskan marine shell because of accidentally transposed locality labels, is a monotypic genus based on the species "*Anculosa*" *dilatata* Conrad (Rehder, 1942, p. 49). This species of the Kanawha River drainage and the upper Cheat River of the Allegheny drainage is the northern representative of the *Io* group. It has the columellar shell structure of *Io*, not that of *Leptoxis*. From a broad biological viewpoint it may be considered a subgenus of *Io*, or, more conveniently, a separate genus closely related thereto.

Genus *Io* Lea, 1831

The genus *Io* of Lea is well known; it includes the largest living United States Pleuroceridae known. How many species other than the nominal genotype *fluvialis* (Say) there are or were in existence must await studies of the animals to check the magnificent analyses of shells by Adams (1915). Haldeman, in the American edition of

Heck's Iconographic Encyclopaedia (1851, p. 84), has given a general description of the animal of *Io*:

Its characters and habits are not those of *Fusus*, but of [*Oxytrema*] proper, as distinguished from *Leptozeis*; for although it inhabits the rapids as well as quiet water, in both cases it avoids the current by seeking shelter beneath shelving rocks, or in hollows or crevices in them. The head is large, and with the tentacles much exposed; the foot is ^{as large} as in [*Oxytrema*]; the coloration is the same (black lines upon an orange ground); the operculum is subspiral as in [*Oxytrema*], the mantle extends into the canal of the shell, but does not form a closed siphon; the vent is upon the right side; the mouth is a longitudinal slit; the eyes (which are sensitive to the light) are upon a short enlargement of the outer base of the tentacles, which may be a little longer than in [*Oxytrema*], and they are not visibly annulated. It differs from *Fusus*, and resembles [*Oxytrema*] in living upon vegetable food; and it moves along in a sluggish manner, moving the head from side to side upon the bottom. *Io spinosa* and *I. tenebrosa* are merely varieties of *I. fluviatilis*. The spinose individuals are much the most abundant, although the species is rare when compared with various species of [*Oxytrema*].

We have taken the liberty of replacing the name "*Melania*" in the foregoing quotation with that of *Oxytrema*, since Haldeman had studied and published as typical of "*Melania*" the animal of *Oxytrema virginica* (Gmelin) (Haldeman, 1841b, p. 21).

In this connection, it must be mentioned that the shells of the group of "*Pleurocera*" *alveare* Conrad (1834, p. 54, pl. 4, fig. 7) look suspiciously like normal sized representatives west of and downstream from the megasomatic *Io*, sensu stricto, species. The generic name *Megara* H. and A. Adams (1854, p. 306) has not hitherto been genotyped. Walker (in litt.), quoted by Goodrich (1928, p. 2, footnote 5), incorrectly reported that Hannibal (1912, pp. 169, 179) had designated the type of *Megara*. Reference to these pages shows that Hannibal listed parts of the original *Megara* twice, with two different species as examples (not as types) in the two synonymy lists 10 pages apart. The genotype here designated is the first species, *Megara alveare* (Conrad) 1834. Animal characters of this group remain a desideratum. If the group is most closely related to *Oxytrema*, as it has usually been regarded, *Megara* will remain as a synonym of *Oxytrema*. If, however, these species should prove upon examination to be closest to *Io* in relationship of animal characters, their group name *Megara* will be available.

Subfamily PLEUROCERINAE (in Central and South America)

Genus *Pachychilus* Lea, 1851

This genus seems to be the ecological replacement of *Oxytrema*, to the southward of the United States. In my opinion, all the known species of this family and subfamily from Central America and the West Indies belong to *Pachychilus*. In this connection, the ichthyol-

ogist S. E. Meek should be given credit as the first known discoverer of the eggs of any member of the family Pleuroceridae. Reporting on collections made in 1906 (Meek, 1908, pp. 205-206), he says:

Sphaeromelania largiliierti Phil. This is the largest and by far the most abundant species of shell found in the lake. It is found everywhere along the shore on plants and rocks. This species deposits its eggs in January and February. The eggs are very large and are usually attached to the under side of rocks. This species is so abundant that its large gelatin-like eggs would furnish a considerable amount of food for small fishes. It is a very abundant species in Guatemala and San Salvador to Central Nicaragua.

Goodrich and Van der Schalie (1937, pp. 39, 41, 42) have recorded and described the eggs of three additional species of *Pachychilus* as follows:

Pachychilus glaphyrus (Morelet) 1849. The eggs were found attached to dead leaves, which were abundant in the bottom of the arroyo. The leaves were in only a few inches of water on a mud-silt bottom near shore. The eggs occur in groups of 3 to 5, are round and glassy in appearance, and are irregularly and linearly arranged as a single loosely attached layer. As might be expected in a species as large as *glaphyrus*, the eggs are also large, having a diameter of 3.9 mm. (Arroyo Yalchactilla of the Rio de la Pasion, about 4 mi. S. W. of La Ceiba, Alta Vera Paz, Guatemala)

Pachychilus corvinus (Morelet) 1849. Egg masses of this species were found from which the infant shells were emerging. These were smooth, pinkish carnelian, translucent, and bluntly rounded at the periphery. The whorls varied from 3 to 3½. With growth the shell generally becomes black, even though the adults may be of a mahogany or yellowish color on the body whorls

Pachychilus pilsbryi Martens 1897. Eggs of this species were found on the lower surfaces of stones in a current near shore. The egg masses occur as flat layers spread out over flat objects. The size of the egg mass varies, the number of eggs in some of them observed running from 8 to 20. The eggs themselves are round, shotlike, and transparent. The whole mass is held together by a gelatinous coating. The average size of the individual eggs is 2.8 mm.

We are indeed fortunate in having on record, in the first four species so known, the egg-laying characters of three subgenera of the genus *Pachychilus*.

Subgenus *Oxymelania* Crosse and Fischer, 1892

Oxymelania Crosse and Fischer (1892, p. 328) possesses the species *schiedianus* Philippi as genotype by original designation. This group of small to medium-sized species has been most completely studied in the San Luis Potosí region by Pilsbry, following the collections made by A. A. Hinkley. In this subgenus, some species of which are widely different in height of spire, and thus of shell outline, the single general identifying character is the possession or prominence of macroscopic spiral lirations on the adult shell. The egg-laying habits for the species *pilsbryi* Martens are quoted above. The synonyms of *Oxymelania* include *Potamanax* Pilsbry (1893, p. 340), named only a few months later, and *Lithasiopsis* Pilsbry (1910, p. 47). In spite of

the great similarity of shells, *Cubaedomus* does not belong here. Animal characters prove it to belong in the family Thiaridae, as recorded below. *Oxymelania* is known to range geographically from the Panuco River system of México to the headwaters of the Usumasinta River in Guatemala.

Subgenus *Pachychilus* Lea, sensu stricto, 1851

Pachychilus Lea (Lea and Lea, 1851, p. 179) originally included only two specific names, *cumingii* Lea and *laevissima* Sowerby. In January 1860, Reeve (1859-1861, pl. 18, fig. 126) designated *laevissima* as the genotype. On the other hand, Reeve's "*laevissima*" was a mixture of the species from Chiapas, México, which has since been mistakenly called "*laevissima*" by many authors, and the true *laevissima* of Sowerby and Lea from La Guayra, Venezuela. Since the mixture of Reeve contained in synonymy the originally included *laevissima* of Sowerby, this designation was valid. Thus the genotype, correctly figured on plate 19, figure 133c, of Reeve (1859-1861) is the only known South American species of the genus. The typical group in Central America is the *corvinus* or *largillierti* group of species, characterized by medium- to large-sized shells with a generally elongate-ovate or elongate-conic outline, rather flat-sided whorls, and almost completely smooth macroscopic sculpture. The egg-laying habits are quoted above. The Cuban species *nigrata* Poey 1858, *fuentesii* Aguayo 1936, and *violaceus* Preston 1911 apparently belong here. Synonyms of *Pachychilus*, sensu stricto, include *Cercimelania* Crosse and Fischer (1892, p. 327) with *P. liebmanni* (Philippi) as genotype, and *Sphaeromelania* Rovereto (1899, p. 109) with the same genotype as *Pachychilus*, since it was proposed as a substitute name. Apparently both Crosse and Fischer and Hannibal did not know of Reeve's type designation and incorrectly listed *P. graphium* (Morelet) as the genotype.

Subgenus *Glyptomelania* Crosse and Fischer, 1892

Glyptomelania Crosse and Fischer (1892, p. 328) is confined to Central America. This group of large shells with variable to nodose or subspinose sculpture includes *glaphyrus* (Morelet), the subgenotype by original designation. The eggs of this species have been recorded by Goodrich and Van der Schalie as quoted above.

Subgenus *Pilsbrychilus* Morrison, 1952

Pilsbrychilus Morrison (1952, p. 7) is distinguished from other known members of the genus by the markedly sinuous lip-margin developed in mature adult shells. It seems probable that examination of the animal will serve to corroborate the distinction of this group now based

solely on shell characters. The genotype by original designation is *Pachychilus* (*Pilsbrychilus*) *dalli* Pilsbry, which was first validly published April 17, 1896, in *Science* (vol. 3, p. 608) ahead of the complete description by Pilsbry in *Proceedings of the Academy of Natural Sciences of Philadelphia*, June 16, 1896 (p. 269). Fortunately, this earliest validation preceded the typographical error "*walli*," which appeared in *Zoologischer Anzeiger* in May 1896.

Genus *Doryssa* H. and A. Adams, 1854

Doryssa H. and A. Adams (1854, p. 304), whose genotype is *D. atra* (Bruguière) from Suriname, ecologically and geographically replaces *Pachychilus* in northern South America from Venezuela to the Guianas and Brazil. In both these genera the females have a well-developed genital groove ending in the characteristic pleurocerine glandular egg-laying sinus near the right edge of the foot. The males lack this groove. *Doryssa consolidata* (Bruguière) was personally collected by the hundreds from rocks in the Mazaruni and Cuyuni Rivers of the Essiquibo system, British Guiana, in the summer of 1925. At that time the shells were cleaned and the radulae (see Baker, 1930, p. 30) extracted from the animals for future study of variation. Although at that time I did not know what characters were critical for subfamily classification, no difference of gross anatomy was observed between this British Guiana *Doryssa* and the North American species *Oxytrema semicarinata* (Say), already critically and completely personally studied near Lexington, Ky., in 1924. The egg-laying season of *Doryssa* is apparently still unrecorded. It was not observed during June, July, or August in the Kartabo region. *Sheppardiconcha* Marshall and Bowles (1932, p. 3), described as a new genus from the (Miocene?) fossil deposits of the Upper Amazon region of Ecuador, is not a subgenus of *Aylacostoma*. Reference of the group by later authors to *Aylacostoma* (= *Hemisinus*) is primarily due to the difficulty of complete separation of the genus *Doryssa* of the Pleuroceridae from *Aylacostoma* of the Thiaridae by shell characters alone. According to the shell characters of the original material, *Sheppardiconcha* is a synonym of *Doryssa*.

Family PLEUROCERIDAE (in Asia)

Subfamily PLEUROCERINAE

Genus *Oxytrema* Rafinesque, 1819

In the present state of our knowledge it is no longer possible to maintain the generic distinction of certain eastern Asiatic species from the genus *Oxytrema*, which has previously been considered

wholly North American. The generic name *Hua*, proposed by S. F. Chen (1943, p. 21) for the group of "*Melania*" *telonaria* Heude 1888, is a synonym of *Oxytrema* Rafinesque 1819. As is the case in both the Appalachian and Rocky Mountain regions of North America, the genus *Oxytrema* is represented in eastern Asia (Korea, China, and Thailand) by some species that are generally smooth (*Hua*) and some with strongly nodose or reticulate sculpture. Heude figured the female pleurocerine external anatomy of *Oxytrema* in 1890 in his excellent work on the Chinese fresh-water mollusks. Unfortunately, he misunderstood the structures of the females of such species as "*Melania*" *jacquetiana* Heude and called them male individuals. At present, Heude's mistake is easy to explain. The (female) egg-laying apparatus of these species (Heude 1890, pl. 43, fig. 5) is superficially identical in appearance to the (male) intromittent organ of certain operculate land snails of the subfamily Cyclophorinae (family Cyclophoridae) (see Heude 1890, pl. 42, fig. 12c), as a comparison of Heude's own figures will demonstrate. It is this extreme similarity in appearance that led Heude to an understandable misinterpretation and has effectively hidden the complete understanding of his critical discoveries for many years.

The present studies have corroborated those of Heude. The animals of *Oxytrema telonaria* (Heude) 1888 are dioecious; the sexes may be distinguished by the presence or absence of the female genital groove on the right side of the foot. There is a glandular, egg-laying pit at the terminal end of the groove a little above the right edge of the foot. The epithelium lining this groove is markedly different from that of the adjacent area and is easily distinguished in preserved material. The posterior edge of the groove is projected into the pit as a sort of papilla at its termination. The oviduct is not enlarged into a uterus; there are no embryos in the body behind the head. Animals of the following Asiatic species have been personally examined and found to exhibit the same pleurocerine reproductive anatomy with but little difference in minor details: *O. nodifila* (Martens) 1886, Han River, Korea (see pl. 11, fig. 3); *O. toucheana* (Heude) 1888, Min River, Fukien, China; *O. jacquetiana* (Heude) 1890, Shaohsing, Chekiang, China; *O. peregrinorum* (Heude) 1890, Fukien, China; *O. moutoniana* (Heude) 1890, Sa-Hsien, Fukien, China; *O. joretiana* (Heude) 1890, Chekiang, China; and *O. bailleti* (Bavay and Dautzenberg) 1910, Szechwan, China. How many of the other Asiatic species listed by S. F. Chen in these groups will prove to belong to *Oxytrema* can be determined only when their reproductive anatomy is examined. The presence of *Oxytrema* species in the recent fauna on both sides of the North Pacific Ocean demonstrates a geographic distribution similar to that of the genera *Viviparus* and *Anodonta*, *sensu stricto*. It is

evident also that the western American (Alaskan) region constituted the pathway of migration of these fresh-water mollusks between Asia and North America.

Genus *Paludomus* Swainson, 1840

With a short, ovate shell-shape corresponding to that of the American genus *Leptoxis*, the Asiatic genus *Paludomus* (Swainson, 1840, pp. 198, 340) also belongs to the subfamily Pleurocerinae. The anatomy of the animals of *Paludomus tanschaurica* (Gmelin) has been completely studied by Seshaiya (1934). The finding by Seshaiya of a tubular structure which he called a "penis" along the terminal portion of the primary gonoduct of the male must be discounted as a glandular discovery until it is proven to be an intromittent organ. As Seshaiya himself pointed out, it is not muscular as is the case of the similarly located and functional male organ of the Tiphobiinae. Seshaiya believed these animals oviparous, as he found no evidence of ovoviviparity in their anatomy. He did not, however, mention either the egg-laying groove or the pit. *Paludomus labiosus* (Benson) (?) from Thailand and *Paludomus maculatus* Lea from India (also members of the subgenus *Paludomus*, sensu stricto, with its concentric operculum) have been personally examined. The female animals are pleurocerine, with an egg-laying groove and pit in the side of the foot and without any brood pouch (see pl. 11, fig. 6). The true biological relations of the other subgenera such as *Hemimitra*, which differ markedly in shell and opercular characters, are still unknown or unrecorded.

Subfamily LAVIGERIINAE Thiele, 1929

Members of the subfamily Lavigeriinae Thiele (1929, p. 79) show the full dioecious mode of reproduction of the family. That is, there is a normal 1:1 sex ratio of males to females as in all other known members of the Pleuroceridae. The most important distinguishing character is the possession of a uterine brood pouch similar to that in the Viviparidae. As in the typical subfamily (Pleurocerinae), the males possess no intromittent structures whatsoever. Coincident to the development of ovoviviparity, the females have lost (at least do not possess) the egg-laying sinus and papilla characteristic of the Pleurocerinae. The name Semisulcospirinae Morrison (1952, p. 8) is a synonym of the earlier subfamily name Lavigeriinae.

Genus *Semisulcospira* Boettger, 1886

The genotype of *Semisulcospira* Boettger (1886, p. 4) is the well-known Japanese species *Semisulcospira libertina* (Gould) 1862. Examination of many specimens from the Hayakawa River, Honshu,

Japan, sent to the U. S. National Museum a few years ago by Captain Honess, U. S. Army Sanitary Corps, conclusively demonstrated that this species is ovoviviparous, as previously suspected. The head and snout of these snails are uncomplicated in either sex by external reproductive structures of any kind. Coitus is probably accomplished by apposition of the mantle edges, with perhaps some prolapsis of the genital duct openings. The lower part of the female reproductive duct (oviduct) is enlarged to form a functional uterus. It is thin-walled when fully distended with young and apparently is not glandular. The hundreds of embryonic young of uniformly small size developed at one time appear to be packed in axial rows, visible externally when the animal is removed from the shell and resembling the conglutinates of glochidia of the North American fresh-water mussel genus *Strophitus*. In some cases the young nearest the oviduct are not fully developed, showing that development of the ova is at least partly progressive as the young approach the uterine mouth. On the other hand, the great uniformity of size of all the fully developed young, with shells of about 2 whorls, would indicate a definite seasonal, mass release of the young. At any rate, there is no indication of any continued growth to large size of a few embryos at a time or continued parturition over a long season or throughout the year as in certain genera of the family Thiaridae.

Recently, Corp. W. E. Old of the U. S. Army Signal Corps sent four species of "*Melania*" from Korea to the U. S. National Museum. Examination of the animals by both R. T. Abbott and the author has proven that "*Melania*" *nodifila* Martens is an *Oxytrema* as noted above, while the species *gottschei* Martens, *nodiperda* Martens, and *graniperda* Martens (1905) are members of the genus *Semisulcospira*. The geographic range of *Semisulcospira* across continental Asia is imperfectly known and in need of continued research.

Family PLEUROCERIDAE (in Africa)

Subfamily PLEUROCERINAE

Genus *Potadoma* Swainson, 1840

The genotype of *Potadoma* Swainson (1840, pp. 200, 341), *P. freethii* (Gray), must be examined to completely clear up the position of this genus. Pilsbry and Bequaert (1927) have reported that these snails are apparently oviparous, with the edge of the mantle smooth and even. They compare these species to some species of the American genus *Pachychilus*. If *Potadoma* is oviparous as reported, with the egg-laying groove, it belongs in the subfamily Pleurocerinae, and the subfamilies

Potadominae Pilsbry and Bequaert and the Paludominae are included synonyms. In addition to the species called *Potadoma* by Pilsbry and Bequaert, some of the species they called "*Melanoides*" also belong to *Potadoma* of Swainson. "*Melanoides*" species such as *ignobilis* (Thiele) (Pilsbry and Bequaert, 1927, p. 278, pl. 26, figs. 1, 2) are smooth; others such as *medjeorum* Pilsbry and Bequaert (1927, p. 283, fig. 47) and *tornata* (Martens) (Pilsbry and Bequaert, 1927, p. 283, fig. 48) possess strong spiral sculpture. Still others, such as *wagenia* Pilsbry and Bequaert (1927, p. 262, pl. 22, figs. 14-16), *crawshayi* (E. A. Smith) and *mweruensis* (E. A. Smith) (Pilsbry and Bequaert, 1927, pp. 264-265, pl. 22, figs. 19-22) show strong plicate to cancellate shell sculpture. The total picture of sculpture in this genus seems exactly parallel to that seen in Appalachia, western America, and eastern Asia in the genus *Oxytrema*.

Genus *Limnotrochus* E. A. Smith, 1880

1880. *Limnotrochus* E. A. Smith, 1880b, p. 425. (Genotype, *Limnotrochus thomsoni*, E. A. Smith, 1880.)

Genus *Paramelania* E. A. Smith, 1881

1881. *Paramelania* E. A. Smith, 1881b, p. 559. (Genotype, *Paramelania damoni* E. A. Smith, 1881, by subsequent designation by Pilsbry and Bequaert, 1927, p. 320.)

Genus *Spekia* Bourguignat, 1879

1879. *Spekia* Bourguignat, 1879, p. 27. (Genotype, *Spekia zonatus* (Woodward), 1859, by monotypy.)

Pilsbry and Bequaert have said that, as far as known, the three above-named genera are oviparous. If complete study of the animals confirms this and reveals the characteristic egg-laying pit in the side of the foot, these Lake Tanganyika forms are also Pleurocerinae. Moore (1899a, p. 171) found neither an external groove nor a brood pouch of any type in the females of *Spekia zonata* (Woodward) examined by him. This condition seems identical in appearance to that of those North American members of the pleurocerine genus *Oxytrema*, in which the female egg-laying groove is not demarcated structurally and can only be seen functionally as a linear depression in the skin during the breeding season.

Subfamily LAVIGERIINAE Thiele, 1929

The statement of Pilsbry and Bequaert (1927, p. 300) in regard to the ovoviviparity of the mixture of species they called "*Melanoides*" is in need of clarification. They left the problem unsolved when they said: "*Typhobia*, *Bathanalia*, and *Lavigeria* are viviparous, having the

last part of the oviduct enlarged to form a brood pouch in the mantle, as in *Melanoides* and *Viviparus*." The fact is that *Melanoides* does not have a uterine brood pouch as in the family Viviparidae. True *Melanoides* species have the subhaemocoelic brood pouch in the back of the neck, with the brood pouch pore on the right, as in all other members of the Thiariidae.

If Pilsbry and Bequaert actually saw uterine brood pouches in the animals of any African species of "*Melanoides*," they probably were dealing with members of the subfamily Lavigeriinae, of an unnamed genus. In this connection, the possibility should be stated frankly that the subfamilies Lavigeriinae and Tiphobiinae may in the future prove to be biologically confluent. Much more study of the animals of African fresh-water species both in and out of Lake Tanganyika is needed to prove or disprove this possibility. As defined above, the subfamily Lavigeriinae includes those genera of pleurocerid snails in which the males have no intromittent organ and the females possess uterine brood pouches.

Genus *Lavigeria* Bourguignat, 1888

The genus *Lavigeria* Bourguignat (1888, p. 33) is another of the peculiar pleurocerid forms found in Lake Tanganyika. In addition to the shell characters, this genus differs from others by its operculum, which is modified by partial uncoiling to a subspiral form. Moore 1899b, p. 192, pl. 20, fig. 6) has furnished anatomical studies of the species *Lavigeria coronata* Bourguignat. He called the animal "*Nassopsis nassa* Woodward," while Pilsbry and Bequaert have referred this anatomical study to the genotype which they designated, namely: *Lavigeria grandis* (E. A. Smith) 1881. Moore's figure of the shell proves he studied the species *coronata*. He found that this genus possesses a uterine brood pouch similar to that of *Viviparus* and of the Tiphobiinae. According to him, the males do not possess any secondarily developed intromittent organ such as is found in the mantle edge of the males of *Tiphobia*.

Genus *Bourguignatia* Giraud, 1885

1885. *Bourguignatia* Giraud, 1885, p. 193, pl. 7, figs. 5-7. (Genotype, *Bourguignatia imperialis* Giraud, 1885, by monotypy.)

Genus *Edgaria* Bourguignat, 1888

1888. *Edgaria* Bourguignat, 1888, p. 33. (Genotype, *Edgaria paucicostata* (E. A. Smith), 1881, by subsequent designation by Pilsbry and Bequaert, 1927, p. 328.)

The shells of the *Bourguignatia*, *Lavigeria*, *Edgaria*, and *Paramelania* complex of Lake Tanganyika are almost identical in general characters; however, there are two distinct types of opercula known in the group.

Our present lack of anatomical knowledge of all but *Lavigeria* makes it impossible to say whether two or more subfamilies are represented in this complex of shells inhabiting the rocky shorelines of Lake Tanganyika.

Genus *Bythoceras* Moore, 1898

1898. *Bythoceras* Moore, 1898c, p. 452. (Genotype, *Bythoceras iridescens* Moore, 1898, by monotypy.)

These shells from deeper waters of Lake Tanganyika are also very similar to those of the *Lavigeria* complex; their opercula differ from those of *Lavigeria* in being secondarily concentric around a paucispiral nucleus. The general statement by Moore (1898d) that *Bythoceras* is much more like *Tanganyicia* in anatomy than ("*Nassopsis*"=) *Lavigeria* is in need of corroboration or clarification. Neither is it clear from Moore's subsequent statements and figures (1899b) whether *Bythoceras* is ovoviviparous or not.

The final allocation of these names and also of *Paramelania* and the subfamily name Paramelaniinae must await the complete recording of shell, opercular, and reproductive characters of all members of the *Lavigeria* complex of Lake Tanganyika. If the reproductive anatomy proves identical, Paramelaniinae (Moore, 1898b, p. 315) will supersede the name Lavigeriinae (Thiele, 1929, pp. 79, 83) used at this time.

Subfamily TIPHOBIINAE Moore, 1898

These are pleurocerid snails modified in the males by the development of a secondary, eversible "penis" or vergic structure in the mantle edge near the end of the vas deferens. As far as known, these are the only "Melanian" snails of any kind that possess any intromittent structures whatsoever. The females are ovoviviparous, with the terminal portion of the oviduct modified into a uterine brood pouch for the young. At present, our knowledge—or lack of knowledge—indicates that the Tiphobiinae are solely African in geographic distribution, parallel to but not identical with the Asiatic and African subfamily Lavigeriinae.

Genus *Tiphobia* E. A. Smith, 1880

The genotype of *Tiphobia* E. A. Smith (1880a, p. 348, pl. 31, fig. 6), *T. horei* E. A. Smith, 1880, possesses the reproductive characters of the subfamily, as defined above, according to the studies of Moore (1898a). The statement of Pilsbry and Bequaert that the characters of the Tiphobiidae do not distinguish them from the Melaniidae is based on their misunderstanding of the true nature of the brood pouch of the Thiariidae ("*Melaniidae*"). *Tiphobia* is one of the endemic genera of Lake Tanganyika, with a spinose shell and a

secondarily concentric operculum. Its complete biological relationship with the other Tanganyika genera and with extra-Tanganyika forms must be clarified by future studies.

Genus *Bathanalia* Moore, 1898

The genotype, *Bathanalia howesi* Moore, 1898, is stated by Moore (1898a) to be "almost identical anatomically with *Tiphobia horei*." This genus differs from *Tiphobia* by shell characters such as height of spire and the perforate columella. In addition, *Bathanalia* possesses an unmodified (paucispiral) operculum.

Family THIARIDAE

The pattern of reproduction is the same for all known members of the family Thiaridae. A high degree of specialization in this one character is indicated by this observed pattern of ovoviviparous parthenogenicity. In other words, there is no male individual known in this entire family of snails. To my knowledge, the parthenogenesis of the Thiaridae has not been examined cytologically to determine whether it is haploid or diploid.

There is required only one individual (any individual) to start a new population or colony if it reaches a new fresh-water locality by stream capture or by adventitious transportation. The resultant ability of these snails theoretically to spread more rapidly may partly explain their wider distribution in suitable habitats on islands in both the Pacific and the West Indies and their wider expansion southward across South America than that exhibited at present by the family Pleuroceridae. Certain corollaries are assumed in this theoretical explanation of the differences and peculiarities of distribution of the two fresh-water families of Pleuroceridae and Thiaridae. Structurally, the animals of these families are relatively primitive, exceedingly so as regards their fundamental reproductive characters. Without any proof to the contrary, we may assume them to be of approximately equal antiquity, geologically speaking. Reasoning from the specialized pattern of reproduction of the Thiaridae, we may logically argue that they are the younger group evolved from the older ancestral type represented now in fresh water by the Pleuroceridae. If this be true, the younger has outstripped the more primitive older type in geographic expansion over geologic time from the era of their differentiation up to the present. If the Thiaridae were ever in North America we must assume that they are no longer represented there because the conditions of existence are not now or were not, during some previous geologic era, favorable to their continued existence in those northern areas. Their expansion across the North American continent may be

unrepresented in any fossil record, known or yet undiscovered, because successfully living fresh-water mollusk species seldom undergo fossilization. They usually enter the fossil record only when a habitat change brings about the extinction of populations or species. On the other hand, the present geographic distribution of the Thiaridae argues for their greater ability to spread across oceanic areas on island stepping stones without the necessity for any continuous "land bridges."

There is one important taxonomic problem present in the Thiaridae that has not often been acknowledged in the study of these or any other parthenogenetic animal species. We know by observation the great variability of individuals within the species of the dioecious type such as the Pleuroceridae. This variability is the greatest single factor contributing to confusion in past and present studies of these fresh-water shells. The variability of individuals of the related Thiaridae may be either increased or decreased because of their reduction to unilateral ancestry. What we actually have in the entire family of the Thiaridae is the possibility of clone formation in every existing population of these animals. There is no biparental or cross-inheritance control or check on individual variation in their present parthenogenetic state. Wise indeed is the scientist who can tell whether a clone is a species or not, and be right every time, in the case of the Thiaridae.

Family THIARIDAE (in the Americas)

The earliest generic name for any of the indigenous American species of this family is *Aylacostoma* Spix (1827, p. 15, pl. 8). This manuscript name of Spix was first published in the synonymy of both *Melania tuberculata* Wagner (= *Aylacostoma tuberculatum* Spix) and *Melania scalaris* Wagner (= *Aylacostoma glabrum* Spix) in connection with the species description, and also on plate 8 (Spix, 1827) without the indication of synonymy. This is in the first edition (Munich) of plates, not the second edition (Leipsic). As a manuscript name of Spix, published in direct connection with two validly described and figured species, *Aylacostoma* is valid and available. The genotype, by subsequent designation by Morrison (1952, p. 8), is *Melania scalaris* Wagner (= *Aylacostoma glabrum* Spix). This species, as comparison of the figures will demonstrate, is that form called *behni* by Reeve (1859-1861, pl. 2, fig. 8) in his 1860 monograph on *Hemisinus*.

Swainson (1840, pp. 200, 341) was next to furnish a name for American Thiaridae. *Hemisinus* is his generic name given to the species *lineolata* Gray from Jamaica. The later emendations, *Aulacostoma* Agassiz 1846 and *Semisinus* Crosse and Fischer 1885, are both

unnecessary and invalid under present international rules of nomenclature. *Basistoma* Lea (1852, p. 295) is exactly equivalent biologically to *Aylacostoma*, being based on the same type of shell from South America. *Verena* H. and A. Adams (1854, p. 308) differs from the typical *Aylacostoma* group in shorter shell outline and in sculpture.

Genus *Cubaedomus* Thiele, 1928

This genus (Thiele, 1928, p. 401), based on the species *brevis* Orbigny from Cuba, is the only American group clearly and generically distinct from *Aylacostoma* on shell characters. The shell is ovate-conic, with a trace of nodulous coronate sculpture on the upper slope or shoulder of the body whorl. There is no columellar notch or sinus in the aperture, which is evenly rounded below (anteriorly). The operculum is paucispiral. Animals of this species, dried in the shells, were recently boiled up in water (softened) and personally examined. These specimens (USNM 407991) were collected by Jaume from Río "Los Cayos", Bahía Hondo, Pinar del Río, Cuba. The mantle is fringed. The embryonic young are relatively large, and there were only two in the subhaemocoelic brood pouch in the neck region at one time in the material examined (pl. 11, fig. 19). Proof that this genus belongs to the family Thiaridae gives us another excellent example of concurrent and convergent evolution. Both Pilsbry (1893) and Aguayo (1944, p. 69) have previously considered the species *brevis* Orbigny of Cuba congeneric with ("Potamanax" =) *Pachychilus* (*Oxymelania*) *pilsbryi* (Martens) of the Guatemala region, a member of the Pleuroceridae, because of the almost identical shell characteristics of the two species.

Genus *Aylacostoma* Spix, 1827

Subgenus *Hemisinus* Swainson, 1840

Genotype: (*Melania lineolata* Gray =) *Aylacostoma* (*Hemisinus*) *lineolatum* (Gray) 1828.

This group of elongate-ovate or ovate-conic shells, almost completely lacking macroscopic spiral sculpture, includes one or two species from Cuba, the genotype from Jamaica, and a few other species of Central and South America from Panamá to Ecuador and Perú.

Subgenus *Aylacostoma* Spix, 1827, *sensu stricto*

Genotype: (*Aylacostoma glabrum* Spix =) *Aylacostoma* (*Aylacostoma*) *scalare* (Wagner) 1827.

This typical group includes one species from the Atlantic side of Central America, one species from the Pacific drainage in the Darién region of Panamá, and numerous species from the Magdalena, Orinoco, Amazon, and southern Brazil regions of South America.

These shells have spiral sculpture more or less prominent on most of of the whorls, and in some of the species there is a peculiar swelling or expansion of the body whorl of adults. The female reproductive anatomy and embryos (from the brood pouch) of the Central American species *Aylacostoma ruginosum* (Morelet) were figured by Crosse and Fischer (1892, pl. 49, fig. 10). In these figures the brood pouch relation is not clearly indicated; it was not fully understood to be a separate adjunct to the primary female reproductive system. Hinkley (1920, p. 47) also has recorded the reproduction and ecology of this species. He says:

Their trail was made by burrowing instead of crawling on the surface as with other forms. They burrowed somewhat like a mole, and often the little mole-like ridge could be followed quite a distance, and the mollusk found working under cover.

It is a viviparous genus. When cleaning these shells the embryos run from one to three to the individual. None were noticed with more than three.

Hinkley's observations on the embryos are corroborated by dried animals, received with the shells (USNM 218018) from Hinkley, which show two large young in situ in the brood pouch. These specimens are from Lake Ysabal, Jocolo, Guatemala.

Subgenus *Longiverena* Pilsbry and Olsson, 1935

Genotype: (*Aylacostoma tuberculatum* Spix, 1827=*Melania tuberculata* Wagner, 1827, not *Melania tuberculata* (Müller) 1776=) *Aylacostoma* (*Longiverena*) *tuberculatum* Spix, 1827, by subsequent designation by Morrison, 1952.

This subgeneric group of *Aylacostoma* species possesses prominent longitudinal sculpture in addition to the spiral lirae present on the shells of *Aylocostoma*, sensu stricto. In this way, the upper spire whorls may greatly resemble the corresponding portion of the shell of some species of *Doryssa* described from the same general region. More study is required for proof, but this general resemblance of *Doryssa* and *Longiverena* shells may be another outstanding example of concurrent and convergent evolution of the families Pleuroceridae and Thiariidae.

Pilsbry and Olsson (1935, p. 11) did not formally designate any of the originally included species, recent or fossil, as genotype, so we designated the living species *tuberculatum* in order that the animal characters of the group may be used to correctly place this unit in the total biological picture.

Subgenus *Verena* H. and A. Adams, 1854

Genotype: (*Melania crenocarina* Moricand=) *Aylacostoma* (*Verena*) *crenocarina* (Moricand).

This fourth South American group, *Verena*, has been considered distinct by most authors. Its principal known distinguishing character is the possession of strong, undulate or scalloped spiral ridges on the post-nuclear whorls. Dr. Olsson of the Academy of Natural Sciences of Philadelphia has recently found species in the fossil record from the upper Amazon region that prove the existence of *Verena* in that area for considerable time. These fossil species possess shells with sculpture identical in type to that of *crenocarina* (Moricand), but, unlike that living species, show shell outlines more or less completely transitional to the high-spined outline of *Aylacostoma*, *sensu stricto*.

Genus *Tarebia* H. and A. Adams, 1854

One Asiatic species, probably *Tarebia lateritia* (Lea) from the Hawaiian Islands, has recently been introduced to American waters with aquarium plants. This species was first discovered living feral in Lithia Sulphur Springs, near Tampa, Fla., in December 1947 by C. W. Cooke of the U. S. Geological Survey. It was not there in March 1940 on the occasion of an earlier complete collection of mollusk species by Dr. Cooke from that spring. This kind of introduction is highly dangerous to public health because this Asiatic type of snail is one of the primary intermediate host species of the human lung fluke (Paragonimiasis).

Family THIARIDAE (in Asia)

Genus *Thiara* Röding, 1798

This genus (Röding, 1798, p. 109) was not originally monotypic. It included two valid specific names, *amarula* (Linnaeus) 1758 (Chemnitz, 1786, pl. 134, figs. 1218, 1219) and *cancellata* Röding 1798 (Chemnitz, 1786, pl. 134, figs. 1220, 1221), as well as three nomina nuda. Hermannsen (1849, p. 576) did not explicitly state that *amarula* Linnaeus was the type. In Latin, he said it was a genus "of the type of." However, Brot (1874, p. 7) formally designated *amarula* the genotype. In the same monographic work he named two other groups which are synonyms of *Thiara*. *Tiaropsis* Brot (1874, p. 7), based on the genotype species *winteri* von dem Busch (1842, p. 1, pl. 1, figs. 1, 2), and *Plotiopsis* Brot (1874, p. 7), based on the genotype species *balonnensis* Conrad (1850, p. 11), both possess the same shell characters as *Thiara*, differing principally in height of spire and size of shell. At present these differences are only considered of specific value. Another recently created synonym is *Pseudoplotia* Forcart 1950, with the species *scabra* Müller 1776 as originally designated genotype.

Subgenus *Thiara* Röding, 1798, sensu stricto.

Genotype: Thiara (Thiara) amarula (Linnaeus), 1758.

The animals of *Thiara* spp. from Szechwan, China, Mindanao, Philippine Islands, and Okinawa, Ryukyu Islands, have been examined by me and found to possess the reproductive structures described above as distinguishing characteristics of the family (pl. 11, figs. 9, 11).

Subgenus *Setaeara* Morrison, 1952

Genotype: (Thiara cancellata Röding 1798=) *Thiara (Setaeara) cancellata* Röding 1798.

The genotype has been known for many years under the name of *setosa* Swainson because the far earlier name of Röding has not hitherto been critically examined. These shells possess stronger spiral sculpture than those of *Thiara*, sensu stricto, and the "crown" of spines on the shoulder of the whorls is continued upward as a set of cuticular setae, easily broken off, and almost always missing from imperfect shells. This group of only a few species was proposed as a subgenus (Morrison, 1952, p. 8) until animal characters are found that confirm its separation from *Thiara*, sensu stricto, by means of the shell.

Genus *Tarebia* H. and A. Adams, 1854

Genotype: (Melania semigranosa von dem Busch =) *Tarebia semigranosa* (von dem Busch) 1842, by subsequent designation by Morrison, 1952.

Reexamination of the type designation of this genus by Brot (1874, p. 7) shows it to be completely inoperative. His statement that "*granifera*" is the type refers to *Melania granifera* von dem Busch, the only such specific name originally included by H. and A. Adams. To the best of my knowledge, *T. granifera* H. and A. Adams is still a nomen nudum. This nomen nudum is proven not to be the same as *Melania granifera* of Lamarck by H. and A. Adams, who listed Lamarck's specific name separately and distinctly as a member of the genus *Plotia*. One of the valid, originally included species was designated as genotype (Morrison, 1952, p. 8) in order to correctly and legally fix *Tarebia* upon the group of thiarid snails to which it has been restricted and applied since the time of Brot (1874).

The animals of *T. lateritia* (Lea) from China, of *T. granifera* (Lamarck) from the Philippines, and, more recently, of the *Tarebia* colony accidentally introduced to Lithia Sulphur Springs, near Tampa, Fla., have been examined for the reproductive characters and proven thiarid.

Genus *Sermyla* H. and A. Adams, 1854

Genotype: (*Melania mitra* Dunker =) *Sermyla tornatella* (Lea) 1850.

Recent examination of the animals of *S. kouloonensis* S. F. Chen 1943 and of *S. mauriensis* (Lea), from China and the Hawaiian Islands respectively, proves this genus typically thiarid, as most authors have considered it. These shells possess arcuate, longitudinal sculpture on the upper (posterior) portion of the whorls, strongly contrasting with the spiral lirae below (anterior). They are relatively short-spired.

Genus *Stenomelania* Fischer, 1885

Genotype: (*Melania aspirans* Hinds=) *Stenomelania aspirans* (Hinds).

Stenomelania Fischer (1885, p. 701) is a thiarid genus of elongate shells with the spire sometimes exceedingly attenuate and sharp-pointed, when not eroded away. Members of this genus possess the brood pouch typical of the family, that holds the eggs until they develop into veligers. Seshaiya (1940, p. 331) has shown that these snails, living in estuarine habitats, release the embryonic young into the water in the veliger stage. There is thus a free-swimming larval stage in the life history. These observations recently have been corroborated in the case of certain Philippine species of the genus by R. T. Abbott. The species *M. aspirans* is the genotype by monotypy. Another species, *M. hastula* (Lea), is the genotype by original designation of the synonymous generic name *Radina* of Preston (1915, p. 10).

Genus *Melanoides* Olivier, 1804

Genotype: (*Melanoides fasciolata* Olivier=) *Melanoides tuberculata* (Müller) 1776.

The shells of *Melanoides* are elongate-conic, of a number of regularly increasing whorls. The spire is usually twice the length of the aperture, or more. The sculpture is smooth to finely or coarsely tuberculate, in different species, without any material difference between the younger and older portions of the shell. The operculum is clearly paucispiral, with the nucleus so near the base that in some cases it may approach the subspiral condition.

A personal check on available material in the U. S. National Museum collections has shown that the following species belong to *Melanoides*, agreeing exactly in the thiarid type of ovoviviparous, parthenogenetic reproduction: *M. chinensis* (Nevill), China; *M. suifuensis* S. F. Chen, Szechwan, China; *M. turriculus* (Lea), Leyte, Philippine Islands; *Melanoides* sp., Rota, Marianas Islands; *M. vainafa* (Gould), Ofu, Samoa; and *M. indefinata* (Lea), Oahu, Hawaiian Islands.

Genus *Sulcospira* Troschel, 1857

Genotype: (*Melania sulcospira* Mousson=) *Sulcospira sulcospira* (Mousson).

Recorded as "also viviparous," this group must be studied further before its true relationships to the other genera from the Malayan region can be proved. Troschel (1857, p. 114) has recorded the radular characters; the shell appears similar to certain species of *Brotia*, to *Tylomelania*, or to immature individuals of *Balanocochlis*. Until the animal characters are reexamined, *Sulcospira* may be left tentatively in the "*Melanoides* complex."

Genus *Balanocochlis* Fischer, 1835

Genotype: (*Melania glans* von dem Busch=) *Balanocochlis glans* (von dem Busch) 1842.

Philippine animals of this species, collected by R. T. Abbott at San Ramon, Mindanao (USNM 543951), have recently been examined. These animals prove the genus to be thiarid. There is a minute brood-pouch pore bordered with "flaps," similar to that figured for *Melanoides turriculus* (pl. 11, fig. 14), low on the right side and close to the fringed mantle edge. Apparently there are many hundreds of minute eggs in the brood pouch. Either they develop as numerous, small, equal-sized young shells as in certain *Melanoides* species, or they may be released in the veliger stage for a free-swimming larval period, as is known for the genus *Stenomelania*. The material examined, which contained only the eggs, is not conclusive on this point. In any case, the shell and opercular characters are distinct enough from any other thiarids known to maintain the full generic separation of *Balanocochlis*. The earlier name *Melania inermis* Lesson 1830 was preoccupied by Gray in 1825; the later name *M. siccata* von dem Busch 1843 probably represents young of the species *Balanocochlis glans*.

Genus *Tylomelania* P. and F. Sarasin, 1898

Genotype: *Tylomelania neritiformis* P. and F. Sarasin.

This subpaludomiform group of shells only appears as a separate development of shell outline and proportions; they have the same type of "paleomelanian" operculum and the same general radular characters as do *Antimelania* and *Brotia*. The animals of all the groups must be completely and carefully reexamined before the genera (and the distinctions of the genera) of the "*Melanoides* complex" of the Thiaridae can be properly organized or understood. Shell, radular, and opercular characters of this group were carefully recorded by the Sarasins (1898, p. 52, pl. 4, figs. 56, 57; pl. 8, figs. 110, 111; pl. 9, fig. 115), but they did not examine the details of the reproduction of *Tylomelania*.

Genus *Antimelania* Crosse and Fischer, 1892

Genotype: (*Melania variabilis* Benson 1836 (not *Melania variabilis* DeFrance 1823)=) *Antimelania costula* (Rafinesque) 1833.

As the well-known but preoccupied and preceded name for the genotype implies, the shell sculpture of members of this genus is variable. These shells are similar to *Melanoides* but usually larger in size, with the sculpture bolder when present. The operculum is paleomelanian, often with about 6 turns in contrast to that of *Melanoides* with about 2 turns. The apex or nuclear whorl of these shells is perfectly symmetrical in uneroded individuals. The aperture is more-or-less regularly rounded at the base, without a forward projecting rounded angle as in *Brotia*.

Specimens of *Antimelania soriniana* (Heude) collected in 1940 by Dr. H. T. Chen at Tai-Mo-Shan, Kwangtung, China, possess a paleomelanian operculum (with large nucleus) as in Heude's figures (1890, pl. 41, figs. 6, 6a). They were all ovoviviparous, parthenogenetic females containing hundreds of minute young in the brood pouch, which is enormously expanded into the body cavity behind the head. They possessed a narrow genital groove terminating abruptly on the right side of the foot, without any trace of the pleurocerine type of egg-laying sinus.

Apparently Pilsbry and Bequaert (1927, p. 300) did not know that the specific name *variabilis* was preoccupied when they designated it the genotype of *Antimelania* (Crosse and Fischer, 1892, p. 313). A search for the correct name to use in replacement led to the discovery that *costula* Rafinesque (1833, p. 166) is clearly recognizable as identical to Benson's *variabilis*.

Moore (1899a, p. 161) has recorded the brood-pouch ovoviviparity of "*Melania*" *episcopalis* (Lea). His figure (pl. 14, fig. 13) of the female *Antimelania episcopalis* (Lea) agrees with our observations on the genus *Antimelania*. The figure given by him of a "male" animal of this same species is either a nongravid or nonbreeding female of the same species, or a female of the pleurocerine genus *Oxytrema* with only the genital groove and egg-laying pit in the side of the foot. Moore (1899a, p. 163) mentions the presence of males in *Tanganyicia* and "*Melania*," but nowhere proves it. The presence of any males in this family is still not proved.

Genus *Brotia* H. Adams, 1866

Genotype: (*Melania pagodula* Gould 1847 (not *Melania pagodulus* Reeve 1860)=) *Brotia pagodula* (Gould) 1847.

Shells of this genus are elongate-conic, of variable sculpture, and with the columellar angle of the basal lip of the aperture produced

slightly forward. The operculum is of the paleomelanian type, of many (6 or 8) turns, and, in the species seen, is considerably smaller than the aperture. The perfect apex of the shell (nuclear whorl) is asymmetrical. Specimens of the animals of *Brotia baccata* (Gould) and the adult and embryonic shells of three other species of *Brotia* from the Salween River of Thailand and Burma have been personally examined. In the species *baccata* there is a well-developed, deep genital groove down the right side of the foot that abruptly turns inward to become the entrance (or "birth pore") of the brood pouch. This brood pouch is very large, crowded with a great many relatively small young of uniform size. The single character of the embryonic shell, or the apex (when perfect) of the adult shell, that characterizes *Brotia* is the asymmetry. It appears as if each shell in its development is interfered with by a yolk sac (?) in the position of the apex to keep that apex soft, while the rest of the embryonic whorls develop normally and symmetrically, and then the apex collapses to a line below the curve of spiral symmetry. This may very well be connected with a secondary development in the brood pouch to insure a "nurse" type of nutrition of the young.

Synonyms of *Brotia* include *Acrostoma* Brot 1874, *Brotella* Rovereto 1899, *Paracrostoma* Cossman 1900, with the genotype *hugeli* Philippi, and *Wanga* S. F. Chen (1943, p. 21), based on the species *Melania henriettae* Gray (1834, pl. 13, fig. 2). In this connection it should be mentioned that the original figure of *henriettae* is poorly drawn and does not show the generic character of the slightly produced columellar angle of the aperture. This fault is corrected in the figure of the holotype published by Yen (1942, p. 204, pl. 15, fig. 66). In fact it is possible that the originally published locality of *henriettae* ("China") is at fault, and this may be the same species as *baccata* (Gould) of the Salween River and some of its tributaries.

Genus *Fijidoma* Morrison, 1952

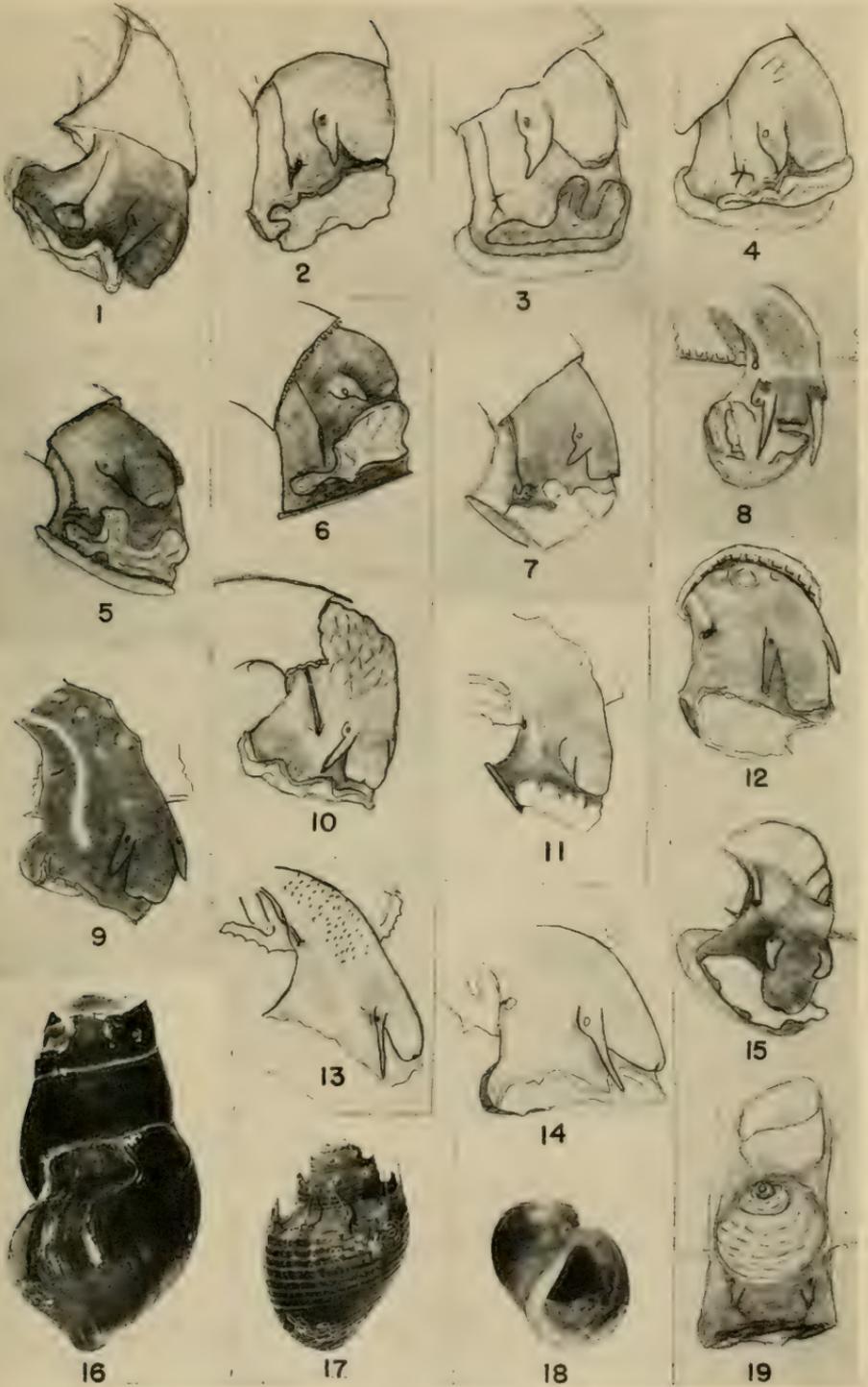
Genotype: (*Fijidoma laddi* Morrison 1952) = *Fijidoma maculata* (Mousson) 1865, by original designation.

Fijidoma Morrison (January 1952) antedates by only a few months the synonymous generic name *Veloplacenta* Hubendick (August 1952), which was based on the same species of thiarid snail. These fresh-water snails from Viti Levu in the Fiji Islands, superficially very similar in shell outline to those of the southeast Asiatic genus *Paludomus*, were named in allusion to that similarity. They have rather smooth, subglobose, neritiform shells with a few rather rapidly increasing, well-rounded whorls separated by a deep suture. The shell has fine spiral sculpture and regular flammules or rows of squarish dots (interrupted flammules) of red in the ground color. The aper-

EXPLANATION OF PLATE 11

- 1, *Melanopsis dufourii* (Ferussac), female, from the right side showing egg-laying groove and the "ovipositor" in pit on right side of foot, from Elche, Alicante Province, Spain (USNM 515845).
- 2, *Oxytrema canaliculatum undulatum* (Say), female, showing egg-laying groove and pit in right side of foot, from Kentucky River, Clifton, Ky. (USNM 597434).
- 3, *Oxytrema nodifila* (Martens), female, as in fig. 2, from Han River, Kwang-jang-in, Korea (USNM 597451).
- 4, *Pleurocera zonalis* (Rafinesque) (= *Melania obovata* Say), female, as in fig. 2, from Kentucky River, Clifton, Ky. (USNM 595969).
- 5, *Oxytrema bulbosa* (Gould), female, as in fig. 2, from tributary of John Day River, 10 miles east of Austin, Grant County, Oreg. (USNM 473801).
- 6, *Paludomus labiosus* (Benson) (?), female, as in fig. 2, from roadside run north of Lampang, Thailand (USNM 361267).
- 7, *Oxytrema deshayesiana* (Lea), female, as in fig. 2, from Tennessee River, near Florence, Ala. (USNM 601564).
- 8, *Planaxis sulcatus* (Born), ovoviviparous and parthenogenetic female showing egg-transfer groove and brood-pouch pore ("birth pore") on side of neck, and subhaemocoelic brood pouch in back of head and neck, from Romurrikku Island, Bikini Atoll, Marshall Islands (USNM 585106).
- 9, *Thiara* sp., female, showing brood-pouch pore and numerous young in the subhaemocoelic brood pouch, from Mindanao, Philippines (USNM 434144).
- 10, *Brotia baccata* (Gould), female, showing deep egg-transfer groove on right side and subhaemocoelic brood pouch with hundreds of relatively small young, from Salween River, Ban Mae Hick, Burma (USNM 420467).
- 11, *Thiara* sp., female, as in fig. 9, showing the anus, oviduct opening, and brood-pouch pore relations, from Naga, Okinawa, Ryukyu Islands (USNM 601311).
- 12, *Melanoides* sp., female, as in fig. 9, with unpigmented shallow "groove," and numerous, equal-sized, small young, from Palo, Leyte, Philippines (USNM 573572).
- 13, *Tarebia lateritia* (Lea), female, as in fig. 9, with numerous small young, from Caminiwit Point, Mindoro, Philippines (USNM 487583).
- 14, *Melanoides turriculus* (Lea), female, as in fig. 9, with numerous very small young in pouch, from Caminiwit Point, Mindoro, Philippines (USNM 487582).
- 15, *Melanoides* sp., female, as in fig. 9, with a very few proportionately enormous young developed in the subhaemocoelic brood pouch, from Manganyama, Rota, Marianas Islands (USNM 593472).
- 16, *Pachychilus (Pilsbrychilus) dalli* Pilsbry, old individual showing 3 consecutive peristomes to prove continuity of sinuous lip character of adults, from Tehuantepec, México (USNM 133197).
- 17, *Thiara (Setaeara) cancellata* Röding, fresh shell showing epidermal spines, from Siaton, Negros Oriental, Philippines (USNM 597436).
- 18, *Fijidoma maculata* (Mousson) (=holotype of *laddi* Morrison) from Viti Levu, Fiji Islands (USNM 597433).
- 19, *Cubaedomus brevis* (Orbigny), ovoviviparous and parthenogenetic female (sketched from dried material), showing only 2 embryonic young of relatively enormous size in subhaemocoelic brood pouch, from Río los Cayos, Bahía Honda, Pinar del Río, Cuba (USNM 407991).

(Animal sketches not drawn to scale; figs. 16, 17 slightly reduced; fig. 18 enlarged approximately 2 times.)



(FOR EXPLANATION SEE OPPOSITE PAGE)

ture is nearly semicircular with a broad, flattened, white columella. The operculum is similar to that of *Melanoides*; thin, corneous, and paucispiral, of less than two turns. A few small-to-medium, but not uniform-sized, young shells found dried inside some adult specimens indicated that this genus belongs to the Thiaridae, although the animals were not available for study.

Fijidoma maculata (Mousson) 1865.

Publication of the independent investigation by Hubendick of shells and animals in the collections of the Bernice P. Bishop Museum has brought to my attention the following synonymy:

Ampullacera maculata Mousson (1865, p. 203).

Ampullacera maculata Crosse (1865, p. 432, pl. 14, fig. 10).

Ampullarina maculata Nevill (1878, p. 249).

Salinator maculata Hubendick (1945, p. 108).

Fijidoma laddi Morrison (Jan. 1952, p. 8).

Veloplacenta maculata Hubendick (Aug. 1952, pp. 179-184, pl. 1).

In this species the body whorl is enormous, so that the height of the spire is less than one-fourth the height of the aperture. The aperture is roughly semicircular, with both upper and lower (anterior and posterior) angles well rounded. Nuclear whorls smooth; early postnuclear whorls sculptured by incised spiral lines between broad, flat rib-areas, crossed by microscopically fine (cuticular) growth lines. The spiral sculpture becomes obsolete or absent on the body whorl, persisting longest just below the suture and in the columellar region. The columella is rather straight, broad, heavily callused, and flattened or a little excavated, in contrast to the even curve of the thin outer lip. The shells are reddish horn with regular flammules or equivalent rows of minute squarish dots of red in the ground color. The broad columella is whitish. Embryonic shells of 3 whorls are globular, smooth except for growth lines, and even at this early stage possess a heavy, callused, but not flattened columella. (See pl. 11, fig. 18.)

The holotype of *F. laddi* (USNM 597433) and a number of paratypes (USNM 532559) were collected from rocks in a swift stream, the Lami River, on Viti Levu, Fiji Islands, May 30, 1926, by Dr. H. S. Ladd of the U. S. Geological Survey.

The holotype of *laddi* has 3 whorls remaining, and measures as follows: Height, 9.2 mm.; diameter, 8.2 mm.; aperture height, 8.0 mm.; aperture diameter, 5.8 mm. The flat, white columella is 1.5 mm. wide.

Comparison of all available figures and specimens has shown that there is only one described species of *Fijidoma*. It has been recorded to date from the upstream, swiftly flowing waters of the Rewa River and Lami River systems on Vit Levu.

Hubendick (1952) has rather completely described and figured the critical and diagnostic anatomy of animals of this genus. His slight misinterpretations of the reproductive anatomy are easily understood by anyone who has personally examined the gross reproductive anatomy of thousands of individual mollusks belonging to the "Melanian complex," including hundreds of individuals belonging to the family Thiaridae. Nearly all the biological peculiarities seen by Hubendick in the seven females of *Fijidoma maculata* available to him are the distinguishing biological characters possessed by every individual of the families Planaxidae and Thiaridae (Thorson, 1940, and Morrison, 1952). The assumption by Hubendick that these animals ever possess a testis must be histologically proven in order to refute the observed parthenogenicity of these females. Abbott (1952, p. 92) could not find sperm in living material or in histological sections of the gonads of six mature adults of the related *Tarebia granifera* (Lamarck). Hubendick did not recognize the completely separate, secondary or adventitious nature of the brood pouch of these animals. His "uterus" is not a part of the primary gonoduct as is the case in the Viviparidae and the Lavigeriinae, hence should not be called a uterus. Abbott (1952, p. 92) has pointed out that the brood pouch of the Thiaridae is not developed until the animal begins to reach maturity.

Hubendick's correction of the taxonomic placement of *Fijidoma* was incomplete; his references to its close relationship with the genus *Emmericia* of the family Hydrobiidae were erroneous. Elsewhere (Morrison 1949, p. 14) I have put on record the critical and diagnostic (male) reproductive characters of the subfamilies of the Hydrobiidae, including *Emmericia* of the Emmericiinae.

Family THIARIDAE (in Africa)

Genus *Thiara* Röding, 1798

This typical genus of the family occurs in the east Africa region as well as in Asiatic waters.

Genus *Melanoides* Olivier, 1804

The genotype of *Melanoides* (Olivier, 1804, p. 40), *M. tuberculata* (Müller) 1776, was probably the first member of the family to be proved ovoviviparous in the thiarid fashion. Raymond (1852) described the brood pouch very well. His tales of the young going back into the brood pouch at night, however, must be completely discounted. What he did not realize was that there is only a partial release of the young at any one time, so that every time he looked into the brood pouch of an adult he found young still there—not back there again.

As mentioned above in the discussion of the genus *Potadoma*, all species of *Melanoides* are ovoviviparous and parthenogenetic. They must also agree with the genotype in the paucispiral character of the operculum. The species that differ from this pattern and are incorrectly placed in the genus must be placed elsewhere when their anatomic characters become known.

Genus *Tanganyicia* Crosse, 1881

Genotype: (*Lithoglyphus rufofilosus* E. A. Smith=) *Tanganyicia rufofilosa* (E. A. Smith) 1880.

With a shell similar to that of the American genus *Cubaedomus*, *Tanganyicia* from the shores of Lake Tanganyika differs most notably in possessing an operculum that is secondarily concentric around a paucispiral center. This African genus *Tanganyicia* (Crosse, 1881, p. 123) has a brood pouch similar if not identical in origin to that of all other known genera of the family Thiaridae. The species *rufofilosa* (E. A. Smith 1880, p. 426) has been anatomically described by Moore (1898c, p. 457). The primary reproductive organs are identical in their simplicity. The genital groove from the oviduct opening to the opening of the brood pouch is of exactly the same type (structurally demarcated) as that observed by me in the genus *Brotia*. The brood-pouch pore is on the right side, as in all the other genera. Moore (1898c, fig. 3), in his "semidiagrammatic representation," depicts the brood pouch passing under the oesophageal canal. The extensively developed brood pouches of many genera of this family may effectively almost surround the pharyngeal or buccal mass, but I believe the brood pouch is ordinarily dorsal thereto. Even if the brood pouch proves upon complete reexamination only to be beneath and expanded to the left of the buccal mass, these differences in the subhaemocoelic extent of an identically originating invagination can only be further proof of the distinction of the genus *Tanganyicia* from the other members of the family.

Moore (1898b, p. 307) listed *Tanganyicia* as a member of the Planaxidae, and again (1898c, p. 456) stated that *rufofilosa*, in the characters of the radula and alimentary canal, approximates the Planaxidae. This statement constitutes unbiased corroboration of the present studies which show that the Thiaridae and the Planaxidae are relatives from the same stock, since Moore was completely unaware of the identical type of reproductive characters possessed by the Planaxidae (see Thorson, 1940).

The statement of Moore that the genital groove is present "in both sexes" may be easily explained by the assumption that he had before him nongravid females and gravid females at the beginning of a seasonal reproductive period. He mentions only eggs in

the brood pouch, so his material must have been collected at the beginning of the brood-pouch nursing period for the species.

Genus *Stanleya* Bourguignat, 1885

Genotype: Stanleya neritinoides (E. A. Smith) 1880.

The figures of this shell look suspiciously like a variant of the genus *Tanganycia*. The opercular and the animal characters must be discovered and compared in order to maintain the separation of *Stanleya*.

REFERENCES

ABBOTT, R. TUCKER

1952. A study of an intermediate snail host (*Thiara granifera*) of the Oriental lung fluke (*Paragonimus*). Proc. U. S. Nat. Mus., vol. 102, pp. 71-116, figs. 32-45, pls. 8, 9.

ADAMS, CHARLES C.

1915. The variations and ecological distribution of the snails of the genus *Io*. Mem. Nat. Acad. Sci. Washington, vol. 12, pt. 2.

ADAMS, HENRY

1866. Descriptions of a new genus and a new species of mollusks. Proc. Zool. Soc. London, 1866, p. 150.

ADAMS, HENRY, and ADAMS, ARTHUR

1854. The genera of Recent Mollusca, vol. 1, pp. 293-311.

AGUAYO, CARLOS G.

1944. El subgenero *Potamanax* Pilsbry. Revista de la Sociedad Malacol. "Carlos de la Torre," vol. 2, No. 2, p. 69.

ANKEL, WULF E.

1928. Beobachtungen über Eiablage und Entwicklung von *Fagotia esperi* (Ferussac). Arch. Mollusk., vol. 60, pp. 251-256, pls. 10, 11.

ANTHONY, JOHN G.

1854. Descriptions of new fluviatile shells of the genus *Melania* Lam., from the Western States of North America. Ann. Lyc. Nat. Hist. New York, vol. 6, pp. 80-130, pl. 3.

BAKER, H. BURRINGTON

1930. The Mollusca collected by the University of Michigan-Williamson Expedition in Venezeula. VI. Occ. Pap. Mus. Zool. Univ. Michigan No. 210, 94 pp., pls. 27-33.

BAVAY, ARTHUR, and DAUTZENBERG, PHILIPPE

1910. Contributions a la faune fluviatile de l'extrême Orient (Chine et Indo-Chine). Journ. Conchyliol., vol. 58, pp. 1-21, pls. 1, 1_{bis}.

BINNEY, WILLIAM G.

1858. The complete writings of Thomas Say on the conchology of the United States, 252 pp., 75 pls.

BINNEY, WILLIAM G., and TRYON, GEORGE W.

1864. The complete writings of Constantine Smaltz Rafinesque on Recent and fossil conchology.

BLAINVILLE, H. M. D. DE

1824. Mollusques, in Dictionnaire des sciences naturelles, ed. 2, vol. 32, pp. 1-392.

1825. Manuel de malacologie et conchologie . . . , 648 pp., 87 pls.

BOETTGER, OSKAR

1886. Zur Kenntniss der Melanien Chinas und Japans. Jahrb. Deutschen Malakozool. Ges., vol. 13, pp. 1-16.

BOURGUIGNAT, JULES R.

1879. Description de divers espèces terrestres et fluviatiles et de différents genres de mollusques de l'Égypte, de l'Abyssinie, de Zanzibar, du Sénégal et du centre de l'Afrique, 54 pp.
1885. Notice prodromique sur les Mollusques terrestres et fluviatiles recueillis par M. Victor Giraud, dans la région méridionale du Lac Tanganika, 110 pp.
1888. Iconographie malacologique des animaux Mollusques fluviatiles du Lac Tanganika, 82 pp., 35 pls.

BROT, AUGUSTE L.

1874. Die Melaniaceen (Melanidae), in Martini, Systematisches Conchylien-Cabinet . . . , vol. 1, pt. 24, 488 pp., 49 pls.
1880. Die Gattung *Paludomus* Auct. (Melaniaceen), in Martini, Systematisches Conchylien-Cabinet . . . , vol. 1, pt. 25, 52 pp., 8 pls.

BUSCH, GERHARD VON DEM

1842. In Philippi, Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien, vol. 1, p. 1, pl. 1, figs. 1, 2.

CHEMNITZ, JOHANN H.

1786. Land und Fluss-schnecken, in Martini, Neues Systematisches Conchylien-Cabinet, vol. 9, pt. 2, pp. xxvi+194, pls. 117-136.

CHEN, SUI FONG

1943. Two new genera, two new species, and two new names of Chinese Melaniidae. Nautilus, vol. 57, pp. 19-21, pl. 6, figs. 2, 3.

CONRAD, TIMOTHY A.

1834. New fresh water shells of the United States with coloured illustrations, and a monograph on the genus *Anculotus* of Say; also a synopsis of the American Naiades, 76 pp., 8 pls.
1850. Descriptions of new fresh water shells. Proc. Acad. Nat. Sci. Philadelphia, vol. 5, pp. 10-11.

COSSMANN, ALEXANDRE É. M.

1900. Rectifications de nomenclature, Rev. Crit. Paléozool., vol. 4, pp. 42-46.

CROSSE, J. C. HIPPOLYTE

1865. Addition a la note de M. le professeur A. Mousson sur la faune malacologique terrestre et fluviatile des archipels Viti et Samoa. Journ. Conchyliol. vol. 13, pp. 430-432, pl. 14.
1881. Faune malacologique du Lac Tanganyika. Journ. Conchyliol., vol. 29, pp. 105-139.

CROSSE, J. C. HIPPOLYTE, and FISCHER, PAUL HENRI

1892. Melaniidae, in Mission scientifique au Mexique et dans l'Amérique Centrale Recherches Zoologiques, pt. 7, vol. 2, pp. 305-371, pls. 49-53.

DALL, WILLIAM H.

1895. Diagnoses of new species of mollusks from the west coast of America. Proc. U. S. Nat. Mus., vol. 18, pp. 7-20.

FISCHER, PAUL HENRI

1885. Melaniidae, in Manuel de conchyliologie et de paléontologie conchyliologique . . . , pp. 699-707.

FORCART, LOTHAR

1950. Der Genotypus von *Plotia* Bolten und Röding 1798. Arch. Mollusk., vol. 79, pts. 1-3, pp. 77-78.

GIRAUD, J. C. Victor

1885. Description du nouveau genre *Bourguignatia* du Tanganika. Bull. Soc. Malacol. France, vol. 2, p. 193, pl. 7, figs. 5-7.

GOODRICH, CALVIN

1924. The genus *Gyrotoma*. Misc. Publ. Mus. Zool. Univ. Michigan No. 12, pp. 1-32, pls. 1, 2.
 1928. *Strephobasis*: A section of *Pleurocera*. Occ. Pap. Mus. Zool. Univ. Michigan No. 192, pp. 1-18, pl. 2.
 1931. The pleurocerid genus *Eurycaelon*. Occ. Pap. Mus. Zool. Univ. Michigan No. 223, pp. 1-10, pl. 1.
 1945. *Goniobasis livescens* of Michigan. Misc. Publ. Mus. Zool. Univ. Michigan No. 64, pp. 1-36, pl. 1.

GOODRICH, CALVIN, and VAN DER SCHALIE, HENRY

1937. Mollusca of Petén and North Alta Vera Paz, Guatemala. Misc. Publ. Mus. Zool. Univ. Michigan No. 34, pp. 7-50, pl. 1.

GRAY, JOHN E.

1834. In Cuvier, The animal kingdom, vol. 12, Mollusca and Radiata, with supplementary additions by E. Griffith and E. Pidgeon, p. 598, pl. 13, fig. 2.

HALDEMAN, SAMUEL S.

1840. A monograph of the Linniades and other fresh water univalve shells of North America, supplement to No. 1.
 1841a. A monograph of the Linniades and other fresh water univalve shells of North America, pt. 2., p. 3 of cover.
 1841b. Observations on the melanians of Lamarck. Amer. Journ. Sci., vol. 41, pp. 21-23.
 1847-1848. *Leptoxis*, in Chenu, Illustrations conchyliologiques, vol. 3, pts. 72-74, 77-78; pp. 1-6, pls. 1-5.
 1851. Mollusca, in Heck's iconographic encyclopaedia . . . , p. 84, Amer. ed. (F. S. Baird).

HANNIBAL, HAROLD

1912. A synopsis of the Recent and Tertiary fresh water Mollusca of the Californian Province, based upon an ontogenetic classification. Proc. Malacol. Soc. London, vol. 10, pp. 112-183, pls. 5-8.

HERRMANNSEN, A. N.

- 1847-1849. *Indicis generum malacozoorum primordia* vol. 2.

HEUDE, R. P. M.

1888. Diagnoses molluscorum novorum in Sinis collectorum. Journ. Conchyliol., vol. 36, pp. 305-309.
 1890. Memoires concernant l'histoire naturelle de l'Empire Chinois, vol. 1, pt. 4, pp. 125-188, pls. 33-43.

HINKLEY, ANSON A.

1920. Guatemala Mollusca. Nautilus, vol. 34, pp. 37-55.

HUBENDICK, BENGT

1945. On the family Amphibolidae. Proc. Malacol. Soc. London, vol. 26, pp. 103-110.
 1952. *Veloplacenta*, a new genus of prosobranchiate Mollusca. Arkiv Zool., Svensk. Vetensk. Akad., vol. 3, No. 15, pp. 179-184, pl. 1.

JEWELL, DOROTHEA D.

1931. Observations on reproduction in the snail *Goniobasis*. Nautilus, vol. 44, pp. 115-119.

LEA, ISAAC.

1831. Description of a new genus of the family Melaniana of Lamarck. Trans. Amer. Phil. Soc., new ser., vol. 4, pp. 122-123, pl. 15, figs. 37a, 37b.
1852. Description of a new genus (*Basistoma*) of the family Melaniana together with some new species of American melaniae. Trans. Amer. Phil. Soc., new ser., vol. 10, pp. 295-302.
1861. Description of a new genus (*Strepobasis*) of the family Melanidae, and three new species. Proc. Acad. Nat. Sci. Philadelphia, vol. 13, p. 96.
1862. Description of a new genus (*Goniobasis*) of the family Melanidae and eighty-two new species. Proc. Acad. Nat. Sci. Philadelphia, vol. 14, pp. 262-272.
1863. Observations on the genus *Unio*, etc., and descriptions of new genera and species of the Melanidae, vol. 9, 180 pp., pls. 24-39.
1864. Descriptions of eleven new species of indigenous Melanidae. Proc. Acad. Nat. Sci. Philadelphia, vol. 16, pp. 3-5.

LEA, ISAAC, and LEA, HENRY C.

1851. Description of a new genus of the family Melaniana, and of many new species of the genus *Melania*, chiefly collected by Hugh Cuming, esq., during his zoological voyage in the East. . . . Proc. Zool. Soc. London, 1850, pp. 179-197.

MARSHALL, WILLIAM B., and BOWLES, EDGAR O.

1932. New fossil fresh-water mollusks from Ecuador. Proc. U. S. Nat. Mus., vol. 82, art. 5, pp. 1-7, pl. 1.

MARTENS, EDUARD CARL VON

1886. Ueber einige von Dr. Gottsche in Japan und Korea gesammelten Land- und Susswasser Mollusken. Sitzber. Ges. Naturf. Freunde, Berlin, 1886, pp. 76-80.
1905. Koreanische Susswasser-Mollusken. Zool. Jahrb., suppl. 8, pp. 23-70, pls. 1-3.

MEEK, SETH EUGENE

1908. The zoology of Lakes Amatitlan and Atitlan, Guatemala, with special reference to ichthyology. Field Columb. Mus. Publ. No. 127, zool. ser., vol. 7, No. 6, pp. 159-206.

MOORE, JOHN EDWARD S.

- 1898a. The mollusks of the great African lakes. II. The anatomy of the typhobias, with a description of the new genus (*Batanalia*). Quart. Journ. Micr. Sci., new ser., vol. 41, pp. 181-204, pls. 11-14.
- 1898b. On the hypothesis that Lake Tanganyika represents an old Jurassic sea. Quart. Journ. Micr. Sci., new ser., vol. 41, pp. 303-321, pl. 23.
- 1898c. On the zoological evidence for the connection of Lake Tanganyika with the sea. Proc. Royal Soc. London, vol. 62, pp. 451-458.
- 1898d. Descriptions of the genera *Bathanalia* and *Bythoceras*, from Lake Tanganyika. Proc. Malacol. Soc. London, vol. 3, pp. 92-93, figs.
- 1899a. The mollusks of the great African lakes. III. *Tanganyikia rufifilosa*, and the genus *Spekia*. Quart. Journ. Micr. Sci., new ser., vol. 42, pp. 155-185, pls. 14-19.
- 1899b. The mollusks of the great African lakes. IV. *Nassopsis* and *Bythoceras*. Quart. Journ. Micr. Sci., new ser., vol. 42, pp. 187-201, pls. 20, 21.

MORRISON, JOSEPH P. E.

1949. The cave snails of eastern North America. Amer. Malacol. Union News Bull. and Ann. Rep. 1948, pp. 13-14.
 1952. World relations of the melanians (an abstract). Amer. Malacol. Union News Bull. and Ann. Rep. 1951, pp. 6-9.

MOUSSON, JOSEPH RUDOLF ALBERT

1865. Coquilles terrestres et fluviatiles de quelques Îles de l'Océan Pacifique, recueillies par M. le Dr. E. Graeffe. Journ. Conchyliol., vol. 13, pp. 164-209.

NEVILL, GEOFFREY

1878. Hand-list of Mollusca in the Indian Museum, pt. 1, xv+338 pp.
 1885. Hand-list of Mollusca in the Indian Museum, pt. 2, x+306 pp.

OLIVIER, GUILLAUME ANTOINE

1804. Voyage dans l'Empire Othoman . . . Vol. 3, p. 69.

PILSBRY, HENRY A.

1893. Notes on a collection of shells from the State of Tabasco, México. Proc. Acad. Nat. Sci. Philadelphia, vol. 44, pp. 338-341, pl. 14.
 1896a. Description of *Pachycheilus Dalli*. Science, new ser., vol. 3, p. 608.
 1896b. A remarkable Central American melanian. Proc. Acad. Nat. Sci. Philadelphia, vol. 48, pp. 269-270.
 1910. A new Mexican genus of Pleuroceratidae. Proc. Malacol. Soc. London, vol. 9, pp. 47-50, figs. 1-4.
 1917. Rafinesque's genera of freshwater snails. Nautilus, vol. 30, pp. 109-114.

PILSBRY, HENRY A., and BEQUAERT, JOSEPH

1927. The aquatic mollusks of the Belgian Congo, with a geographical and ecological account of Congo malacology. Bull. Amer. Mus. Nat. Hist., vol. 53, pp. 69-902.

PILSBRY, HENRY A., and OLSSON, AXEL A.

1935. Tertiary freshwater mollusks of the Magdalena Embayment, Colombia. Proc. Acad. Nat. Sci. Philadelphia, vol. 87, pp. 7-39, pls. 2-5.

PILSBRY, HENRY A., and RHOADS, SAMUEL N.

1896. Contributions to the zoology of Tennessee. No. 4. Mollusks. Proc. Acad. Nat. Sci. Philadelphia, vol. 48, pp. 495-497.

PRESTON, HUGH B.

1915. Mollusca, pt. 3 (Freshwater Gastropoda and Pelecypoda), in Blanford, The fauna of British India, including Ceylon and Burma, pp. xix+244.

RAFINESQUE, CONSTANTIN S.

- 1818a. Discoveries in natural history, made during a journey through the western region of the United States. Amer. Monthly Mag. Crit. Rev., vol. 3, pp. 354-355.
 1818b. Farther account of discoveries in natural history, in the Western States. Amer. Monthly Mag. Crit. Rev., vol. 4, pp. 39-42.
 1819. Prodrome de 70 nouveaux genres d'animaux découverts dans l'intérieur des Etats-Unis d'Amérique, durant l'année 1818. Journ. Phys. Chim., Hist. Nat., vol. 88, pp. 423-428.
 1820. Annals of nature, or annual synopsis of new genera and species of animals, plants, etc., discovered in North America, first annual number, pp. 10-11.
 1831. Enumeration and account of some remarkable natural objects in the cabinet of Prof. Rafinesque, in Philadelphia, pp. 1-4.
 1833. On five new fresh water shells of Bengal and Assam in Asia. Atlantic Journ., No. 5, pp. 165-166.

RAYMOND, LOUIS

1852. Recherches anatomo-physiologiques sur les mollusques de l'Algérie. Journ. Conchylol., vol. 3, pp. 325-329.

REDFIELD, JOHN HOWARD

1854. Descriptions of new species of shells. Ann. Lyc. Nat. Hist. New York, vol. 6, pp. 130-132, pl. 1, figs. 6, 7.

REEVE, LOVELL A.

- 1859-1861. Conchologica iconica; or, Illustrations of the shells of molluscous animals, vol. 12.

REHDER, HARALD A.

1942. A note on the genus *Anaplocamus* Dall. Nautilus, vol. 56, pp. 49-50.

RÖDING, PETER F.

1798. Museum Boltenianum. II, Conchylia, 199 pp.

ROVERETO, GAETANO

1899. Primi ricerche sinonimiche sui generi dei gasteropodi. Atti. Soc. Ligust. Sci. Nat. Geogr., vol. 10, pp. 101-110.

SARASIN, PAUL BENEDICT, and SARASIN, CARL FRIEDRICH

1898. Die Susswasser-Mollusken von Celebes, vi+104 pp., pls. 1-13.

SAY, THOMAS

1821. Descriptions of univalve shells of the United States. Journ. Acad. Nat. Sci. Philadelphia, vol. 2, pt. 1, pp. 149-179.

1829. Description of *Melania obovata*. New Harmony Disseminator, No. 18, p. 276, Sept. 9, 1829.

SESHAIYA, R. V.

1934. Anatomy of *Paludomus tanschaurica* (Gmelin). Rec. Indian Mus., vol. 36, pt. 2, pp. 185-212, 15 figs.

1940. A free larval stage in the life-history of a fluviatile gasteropod. Curr. Sci., Calcutta, vol. 9, No. 7, pp. 331-332.

SHUTTLEWORTH, ROBERT JAMES

1845. Über *Gyrotoma*, eine neue gattung der Melaniana, Gasteropoda Pectinibranchiata. Mitt. Naturf. Ges., Bern, No. 50, pp. 85-88.

SMITH, EDGAR A.

- 1880a. On the shells of Lake Tanganyika and of the neighbourhood of Ujiji, Central Africa. Proc. Zool. Soc. London, 1880, pp. 344-352, pl. 31.

- 1880b. Diagnoses of new shells from Lake Tanganyika and East Africa. Ann. Mag. Nat. Hist., ser. 5, vol. 6, pp. 425-430.

- 1881a. On a collection of shells from Lakes Tanganyika and Nyassa and other localities in East Africa. Proc. Zool. Soc. London, 1881, pp. 276-300, pls. 32-34.

- 1881b. Descriptions of two new species of shells from Lake Tanganyika. Proc. Zool. Soc. London, 1881, pp. 558-561, text figs.

SPIX, JOHANN BAPTIST VON

1827. *Aylacostoma*, in Wagner, Testacea fluviatilia . . . Brasiliam . . . , Munich ed., p. 15, pl. 8.

SWAINSON, WILLIAM

1840. A treatise on malacology, in Larner's cabinet cyclopedia of natural history, 419 pp.

THIELE, JOHANNES

1928. Revision des Systems der Hydrobiiden und Melaniiden. Zool. Jahrb., Abt. Syst. Ökol. Geogr., vol. 55, pp. 351-402.

1929. Handbuch der Systematischen Weichtierkunde . . . , vol. 1, 376 pp.

THORSON, GUNNAR

1940. Studies on the egg masses and larval development of Gastropoda from the Iranian Gulf. Danish scientific investigations in Iran, pt. 2, pp. 159-238, figs. 1-32.

TROSCHER, FRANCIS H.

- 1856-1863. Das Gebiss der Schnecken zur Begründung einer natürlichen Classification, vol. 1, 252 pp., pls. 1-20.

TRYON, GEORGE W.

1863. Synonymy of the species of Strepomatidae, a family of fluviatile Mollusca inhabiting North America. Proc. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 7, pp. 306-321.
1864. Synonymy of the species of Strepomatidae, a family of fluviatile Mollusca inhabiting North America. Proc. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, pp. 24-48, 92-104.
1873. Land and freshwater shells of North America. IV. Strepomatidae. Smithsonian Misc. Coll., vol. 16, art. 1, 435 pp.

VAN CLEAVE, HARLEY J.

1932. Studies on snails of the genus *Pleurocera*. I. The eggs and egg laying habits. Nautilus, vol. 46, pp. 29-34.

WAGNER, J. A.

1827. Testacea fluviatilia . . . Brasiliam . . ., Munich ed., p. 15, pl. 8.

WALKER, BRYANT

1918. A synopsis of the classification of the fresh-water Mollusca of North America, north of México, and a catalogue of the more recently described species, with notes. Misc. Publ. Mus. Zool. Univ. Michigan, No. 6, 213 pp., text figs.

WINSOR, CHARLES P.

1933. The eggs of *Goniobasis virginica* and *Anculosa carinata* Bruguière. Journ. Washington Acad. Sci., vol. 23, pp. 34-36.

WOODWARD, T. M.

1934. Anatomy of the reproductive system of *Goniobasis laqueata* (Say). Journ. Tennessee Acad. Sci., vol. 9, pp. 243-259, pls. 1, 2.

YEN, TENG-CHIEN

1942. A review of Chinese gastropods in the British Museum. Proc. Malacol. Soc. London, vol. 24, pp. 170-289, pls. 11-28.

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3326

PRELIMINARY ANALYSIS OF THE FOSSIL VERTEBRATES
OF THE CANYON FERRY RESERVOIR AREA

By THEODORE E. WHITE

The Canyon Ferry Reservoir will be located on the Missouri River below Townsend, the county seat of Broadwater County, Mont. The dam is being built about 1 mile downstream from the present Canyon Ferry Dam and Power Plant. The maximum pool will inundate an area approximately 25 miles long and 3 to 4 miles wide, and will include several known fossiliferous localities in Oligocene and Miocene sediments. The reservoir area includes one of the very few areas in the intermountain basins that have a complete succession of sediments from the Lower Oligocene well into the Middle Miocene. Fossil faunas are known from other intermountain basins in Montana but rarely do they embrace more than one of the time units represented here. These faunas are of special interest because they represent an environment totally different from that of the White River deposits of the plains and offer opportunities to study fossil faunas in the light of the principles of climatic zoning which have been worked out for recent faunas.

Most of our knowledge of the Tertiary deposits and their faunas of the intermountain basins of Montana is the result of the explorations and research of the late Dr. Earl Douglass around the turn of the century. His studies have been published principally in the *Annals of the Carnegie Museum*. His explorations have been greatly extended and enlarged by Dr. J. LeRoy Kay, of the same institution, whose assistance has greatly expedited the work of the River Basin Surveys. The studies by Douglass have been further augmented by those on the fossil rodents and lagomorphs by Dr. J. J. Burke, who

was the first to point out that certain genera were common to the Oligocene deposits of Eastern Asia and the intermountain basins. Also should be mentioned the work of the late Dr. W. D. Matthew on the fauna of Pipestone Springs, which is the only study on a single fauna which has been made on any of the intermountain basins.

As part of the salvage program being carried out by the River Basin Surveys of the Smithsonian Institution in the reservoir sites in the Missouri Valley, the fossiliferous localities in the Canyon Ferry Reservoir area have been prospected for fossils for three seasons. In 1947, the first season of work, largely reconnaissance, I was assisted by John C. Donohoe, now a student at the University of New Mexico; in 1948, by Mr. Donohoe and Ernest L. Lundelius, now a graduate student at the University of Chicago; and, in 1950, by William C. Harrup, Jr., a student at Columbia University, and Prentiss Shepherd, Jr., a student at Harvard University. With the aid of these sharp-eyed young men a collection of nearly 300 specimens was obtained from the several localities in the reservoir area, the basis of this study. These specimens are in the U. S. National Museum (USNM). In addition, Dr. Kay has given me free access to the material from the reservoir area in the Carnegie Museum (CM) which has materially supplemented the collection of the River Basin Surveys.

The graphic art of William D. Crockett has been invaluable in portraying the characters of the more interesting specimens.

In the discussion of the specimens, the localities from which they were obtained are indicated by code numbers according to the system used by the Missouri Valley Project of the Smithsonian River Basin Surveys. Following is a list of these localities.

Lower Oligocene (Chadronian) Localities

24LC16. NE $\frac{1}{4}$ SW $\frac{1}{4}$, sec. 3, T. 10 N., R. 1 W., of the Montana prime meridian, about 1 mile north of Canyon Ferry, Lewis and Clark County, Mont. This is a small area of badlands at the foot of the bluff on which the buildings of the permanent offices of the project are built (fig. 40). About 130 feet of light buff ashy clays are exposed at this locality with Chadronian fossils in the upper half. Only the remains of the smaller mammals were sufficiently well preserved for identification.

24BW18. NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 7, T. 9 N., R. 1 E., of the Montana prime meridian, about 1 $\frac{1}{4}$ miles southwest of the south end of Lake Sewell, Broadwater County, Mont. This locality (fig. 41) was originally discovered by Dr. Kay, who very generously directed the River Basin Surveys to it. Lithologically, the deposits in this area do not differ materially from those of the preceding locality, nor does the species

assemblage. About 300 yards east of this locality some Middle Oligocene fossils were collected but were so few that separate locality designation was not given.

Middle Oligocene (Orellan) Localities

24LC15. SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 10 N., R. 1 W., of the Montana prime meridian, about $\frac{1}{4}$ mile southeast of Canyon Ferry, Lewis and Clark County, Mont. This is a small butte, about 100 feet high, of light buff clayey ash showing indistinct bedding. The greatest concentration of fossils is on the south side. However, the fossiliferous area is so limited that it very strongly suggests that the fauna was brought together



FIGURE 40.—Locality No. 24LC16 from the south.

by an Oligocene owl. The photograph in the popular account by Douglass (1908) shows that this is the Canyon Ferry locality from which he obtained his Oligocene fossils.

24LC17. SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 10 N., R. 1 W., of the Montana prime meridian, about $1\frac{1}{4}$ miles north of Canyon Ferry, Lewis and Clark County, Mont. This locality offers a more complete Middle Oligocene section than the preceding one. About 140 feet of sediments are exposed at this locality. At the base they are light gray to buff clayey ash, grading to nearly pure ash, grayish green, at the top. The same faunal assemblage is found in the lower levels as at the preceding locality but no identifiable specimens were obtained from the upper levels.

Lower Miocene (Arikareean) Localities

24LC18. S $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 11, T. 10 N., R. 1 W., of the Montana prime meridian, about 1 mile east of Canyon Ferry, Lewis and Clark County, Mont. About 200 feet of fine-grained, dense, buff sandstone, which weathers into nearly vertical cliffs are exposed in this area (fig. 42). In texture and color these deposits very closely resemble the Harrison deposits of western Nebraska and eastern Wyoming. This locality is the one from which Douglass and others have obtained Miocene fossils at Canyon Ferry and it is still the most productive Miocene locality in the area; but, even so, fossils are not common.

24LC19. NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T. 10 N., R. 1 W., of the Montana prime meridian, about 1 $\frac{1}{2}$ miles northeast of Canyon Ferry, Lewis and Clark County, Mont. This locality is a small area of cliffs in the buff sandstone on the northeast side of the highway just southeast of the bridge over Cave Gulch. Very little material was obtained at this locality.

24LC20. SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T. 10 N., R. 1 W., of the Montana prime meridian, about 1 mile east of Canyon Ferry, Lewis and Clark County, Mont. This locality lies across Magpie Gulch, about $\frac{1}{4}$ mile north of locality No. 24LC18, and represents the lower levels of that locality. Only a very small fauna was obtained here.

Middle Miocene (Hemingfordian) Localities

24LC21. SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 10 N., R. 1 W., of the Montana prime meridian, about 2 miles east and little south of Canyon Ferry, Lewis and Clark County, Mont. A few isolated and imperfect *Merychippus* teeth were obtained from a buff sandstone resting on a lens of fresh-water limestone. These few teeth were the only material collected in this locality.

Earl Douglass location. W $\frac{1}{2}$ sec. 25, T. 9 N., R. 1 E., of the Montana prime meridian, about 8 miles east of Winston, Broadwater County, Mont. Douglass (1908b, p. 274) secured the greater portion of a skull, a lower jaw, and some skeletal element of an advanced species of *Merychippus* from the bluffs on the east side of the Missouri River. And, as far as I know, no other specimens have been collected from this locality.

Geology

The Canyon Ferry Reservoir area lies in the reentrant between the Big Belt Mountains on the east and the Spokane Hills on the west, at the north end of the deformational basin in which the Toston beds of Douglass (1901, pp. 242-243) were deposited. As near as could be determined in the limited time available, the beds are not lithologically

continuous with those of the Prickley Pear Valley or the Thompson Creek area until at least the Middle Miocene times. Also deposition was uninterrupted from Lower Oligocene (Pipestone Springs equivalent) into the Middle Miocene (possibly Marsland equivalent). In Late Miocene times orogenic movements tilted the earlier sediments to the northeast and coarse gravels, which were later cemented with calcium carbonate, were deposited on their truncated edges. As yet no identifiable fossils have been found in these gravels, but they are believed to be Pliocene in age. The Pleistocene is represented by local deposits of coarse, unconsolidated gravels which have not yet produced diagnostic fossils.

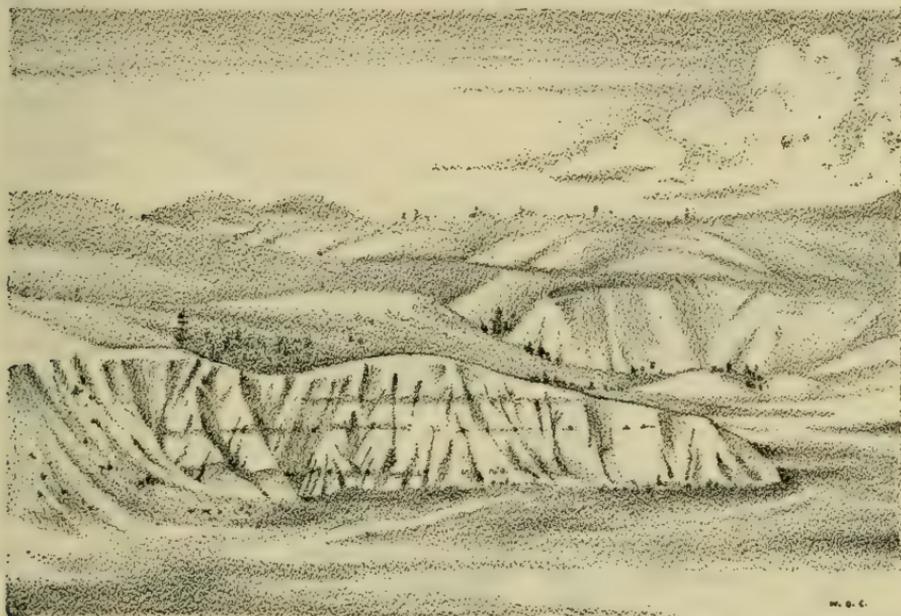


FIGURE 41.—Locality No. 24BW18 from the south.

The probable conditions under which these sediments were deposited are very well described by Douglass (1903, pp. 146–149). In summary, the sediments accumulated in a deformational basin which, in its lowest part, harbored a series of small, very shallow lakes or wet meadows or a combination of both. Evidence for the lakes lies in the several local areas of fresh-water limestones, some of which show very fine bedding planes. Evidence for the wet meadows lies in the areas of dark, gypsiferous clays, often with shale-like partings. However, in all probability the gypsum is of secondary development rather than primary.

As pointed out by Douglass (1903, p. 147) the fossils occur most abundantly near the margin of the depositional basin and are very

rare towards the central portion. One interpretation which could be placed on this fact is that only along the margins did sediments accumulate fast enough to bury the bone before weathering or other factors could destroy them. However, evidence of alluvial fans along the basin's margin have not been observed. The alternative, which seems the more probable, is that the accumulating soil of the central portion was more acid from decaying vegetation and the bones, reacting with the sulphides of vegetable decay, were a partial source of the gypsum in these deposits.

Throughout their observed exposures the Oligocene sediments are uniformly fine grained, ranging in color from light gray to light buff.



FIGURE 42.—Locality No. 24LC18 from the south.

No lithological distinction could be made between the Lower and Middle Oligocene sediments, but those which are believed to represent the Upper Oligocene contain considerably more ash, are less consolidated, and grayish green in color. The Oligocene sediments show rather even bedding planes which are indistinct except when the exposures are wet. Occasional stream gravels are found at nearly all levels but do not appear to have cut very deep into the Oligocene deposits. These gravels are made up almost entirely of angular fragments of the Proterozoic and Paleozoic sediments which form the Big Belt Mountains and the Spokane Hills.

The Miocene sediments, like the Oligocene, are uniformly fine grained but contain a higher percentage of sand and are better con-

solidated. In color and texture they very closely resemble the Harrison beds of western Nebraska and eastern Wyoming. Also like the Oligocene, the stream gravels occasionally encountered are composed largely of the angular fragments of the Proterozoic and Paleozoic sediments from the adjacent mountains. Also, basaltic, volcanic bombs from 8 inches to 1 foot in diameter are occasionally encountered, but they are not necessarily associated with the stream gravels. Although the Oligocene and Miocene sediments are quite different lithologically, at only one place, in a recent road cut, was the contact between the two observed. It was not possible to detect an angular unconformity either at this place or by measuring the angle of dip of the beds.

The following section was measured by Mr. Harrup at the north end of the reservoir area near the present construction camp; here, both the Oligocene and Miocene strata dip east 50° north at an angle of 6° from the horizontal:

Fine-grained, buff sandstone, often weathering into vertical cliffs; stream gravels common; occasional volcanic bombs. Arikareean fossils.—150 feet.

Light gray to buff clayey ash grading to nearly pure ash at top; lenses of stream gravels common. Orellan fossils at the bottom.—140 feet.

Dark gypsiferous clays, with iron nodules, alternating with lighter bands. No identifiable fossils.—110 feet.

Light buff clayey ash with Chadronian (Pipestone Springs) fossils at the top.—130 feet.

Class REPTILIA

Order SQUAMATA

Suborder SAURIA

Family ANGUIDAE

Glyptosaurus cf. montanus Douglass

USNM 19081, portion of right frontal with scutes and portion of left dentary with six teeth, from the Lower Oligocene of locality No. 24BW18.

The limited material of this form does not permit any additions to Gilmore's (1928, p. 115) discussion of the species.

Peltosaurus sp.

USNM 19085, a maxillary fragment; and USNM 19084, a dentary fragment; both from the Middle Oligocene at Canyon Ferry. These specimens appear to be referable to this genus but contribute nothing to our knowledge of the group.

Suborder SERPENTES

Family BOIDAE

Calamagras sp.

USNM 19082, a single thoracic vertebra from the Lower Oligocene of locality No. 24BW18, appears to be referable to this genus. As pointed out by Gilmore (1938, p. 36), this genus is difficult to distinguish from the following one, but in view of the very limited state of our knowledge it will be convenient to retain one genus for the small boids of the Oligocene and the other for the Miocene.

Ogmophis arenarum Douglass

USNM 19083, two thoracic vertebrae and the neural arch of a third in a connected series, from the Lower Miocene of Canyon Ferry, are referred to this species on the basis of the ovate central articulations, but the material is too limited to contribute anything to our knowledge of the genus.

It is interesting to note here that of the two other reptilian types commonly found in the Oligocene of the plains, one, the crocodylians, is unknown and the other, the turtles, is represented only by the terrestrial types. No fragments indicative of any of the aquatic types have yet been found. On the other hand, the aquatic types of turtles are rare in the White River deposits.

Class MAMMALIA

Order MARSUPIALIA

Suborder POLYPROTODONTIA

Family DIDELPHIDAE

Peratherium fugax Cope

USNM 18953, left mandible with P_2 - M_4 ; USNM 18954, left mandible with P_1 - M_4 . Both specimens are from locality No. 24LC15.

These specimens are nearly twice the size of *P. titanelix* Matthew from Pipestone Springs and only slightly larger than the measurements Scott (1941, p. 962) gives for this species. An examination of the material in the U. S. National Museum referable to this genus shows that the variation in the characters of the teeth and jaws is greater in this genus than in the higher mammals. It is probable, as Scott points out, that there are only two valid species, a large and a small, in the Middle Oligocene of North America. Measurements of teeth (in millimeters):

	USNM 18953	USNM 18954
P_1 - s -----	6.0	6.3
M_1 - 4 -----	7.5	7.1

Order INSECTIVORA

Family SOLENODONTIDAE

Apternodus mediaevus Matthew

USNM 18914, fragment of right maxilla with M^1 , from locality No. 24LC16; CM Field No. 30/48, skull and jaws somewhat crushed, from locality No. 24BW18.

The discovery of the skull and jaws was unusually fortunate in that they show the character of the enlarged upper and lower first (?) incisors.

Description.—Upper incisor is simple, placed nearly vertical in the premaxilla, tapering very slightly in width toward the tip and slanted medially so that the tips meet, stronger anteroposterior taper which extends from base to tip on the posterior side, anterior face slightly convex dorsoventrally and with uniform curvature, enamel covered except at tip where worn. Lower incisor is simple, making a very obtuse angle with the axis of the jaw, medial face flattened, lateral surface convex, very slight taper in width, anteroposterior taper from base to tip, tooth enamel covered.

Family LEPTICTIDAE

Ictops acutidens Douglass

USNM 18910, badly broken skull and jaws with skeletal fragments; USNM 18912, left maxillary fragment with P^4 – M^3 . Both specimens are from locality No. 24LC16.

This material does not permit any additions to be made to Matthew's (1903, p. 207) discussion of the species.

Family TALPIDAE

Genus and species undetermined

USNM 18915, right humerus lacking the distal epiphysis, from locality No. 24LC16; USNM 19024, right humerus lacking the distal epiphysis, from Pipestone Springs; CM 9184, right humerus lacking the distal epiphysis, from locality No. 24BW18.

Discussion.—A comparison of this material with the humeri of recent moles in the U. S. National Museum does not reveal any close affinities with any of the genera represented. On the other hand, the derivation of the humerus of the *Talpinae* and *Scalopinae* from this type of humerus would require only an exaggeration of its present characters. Consequently, the reference of this material to the *Talpidae* is reasonably certain, but generic designation will be withheld pending the acquisition of better material.

The discovery of this material confirms the suggestion (Simpson, 1947, p. 637) that this group probably migrated to North America from Eurasia during the Early Oligocene. Also of interest is that the group reached North America before the humerus acquired the extreme modification which it has today.

Family NYCTITHERIIDAE

Kentrogomphios strophensis, new genus, new species

Genoholotype.—USNM 18870 (fig. 43), facial portion of a skull anterior to the cribiform plate, lacking one canine, the crown of the other, and the incisors.

Referred material.—USNM 18871 (fig. 44), right mandibular fragment with M_{2-3} .

Horizon and locality.—Lower Oligocene, Chadronian; SW $\frac{1}{4}$ sec. 3, T. 10 N., R. 1 W., of the Montana prime meridian, about 1 mile north of Canyon Ferry, Lewis and Clark County, Mont.

Diagnosis.—Portion of skull preserved about the same size as the corresponding portion of *Scalopus aquaticus*; skull elements securely fused together, orbit small, infraorbital foramen large and opening into a deep elongate pit anterior to orbit, lacrymal duct large and situated within the orbit, no palatine vacuities, zygoma believed present but very slender, foramina of the alisphenoid region similar to those of the Soricidae; I?, C1, P3?, M3; root of canine elongate-triangular in cross section with the acute angle posterior, cusps of cheek teeth very high, posterior border of P^4 to M^2 deeply emarginate between hypocone and metastyle, no anterior or inner cingulum, strong cingulum on hypocone; P^2 (if present) minute, single rooted and simple; P^3 three rooted, a single outer cusp with a broad shearing blade extending posteriorly, deuterococone minute and placed nearer the anterior than the posterior edge; P^4 submolariform, parametacone twice as high as protocone, strong metaconal crest, parastyle and metastyle strong, external cingulum weak, protocone twice as high as hypocone, strong posterior cingulum on hypocone; M^1 with paracone and metacone close together and subequal in height, metastylar crest strong, parastyle and metastyle well developed, mesostyle obsolete, a small metastylule present, protocone strong and as high as paracone, a small protoconule present, hypocone half as high as protocone and with a strong posterior cingulum; M^2 similar to M^1 , paracone and metacone farther apart, a strong parastylar crest, parastyle and metastyle well developed, parastylule and metastylule present, a strong mesostyle present; M^3 triangular in outline, hypocone and metastyle absent, parastyle and parastylule present, a minute metaconule present, mesostyle well developed.

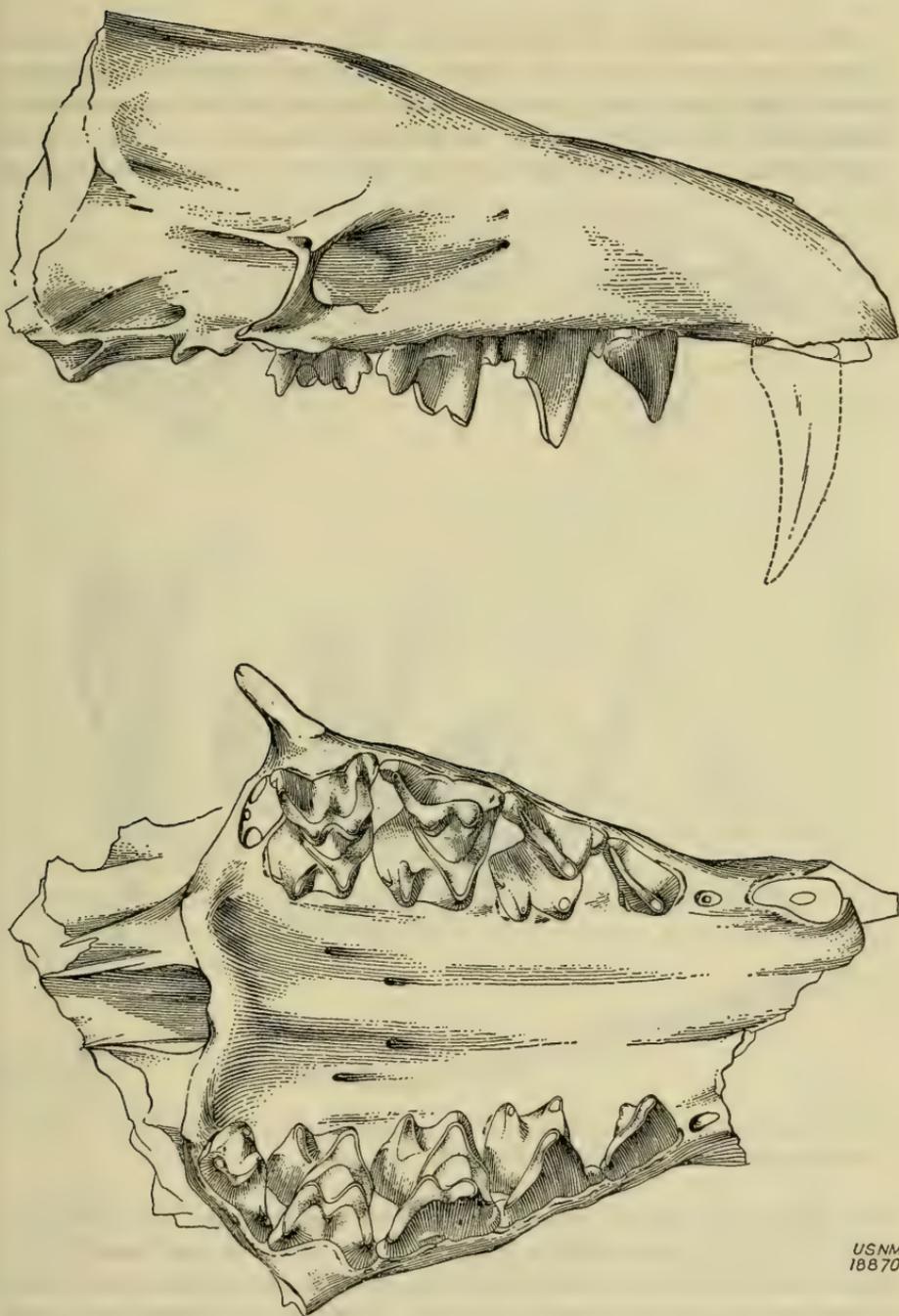


FIGURE 43.—Lateral and occlusal views of the type (USNM 18870) of *Kentrogomphios strophensis*, new genus and species. $\times 7$.

Referred specimen.—Trigonid on M_2 high, height twice that of the talonid and nearly twice the length of the tooth, recurved and compressed anteroposteriorly, protoconid slightly higher than paraconid and metaconid, which are equal, an anterior cingulum present which terminates in a small but distinct cusp about the middle of the base of

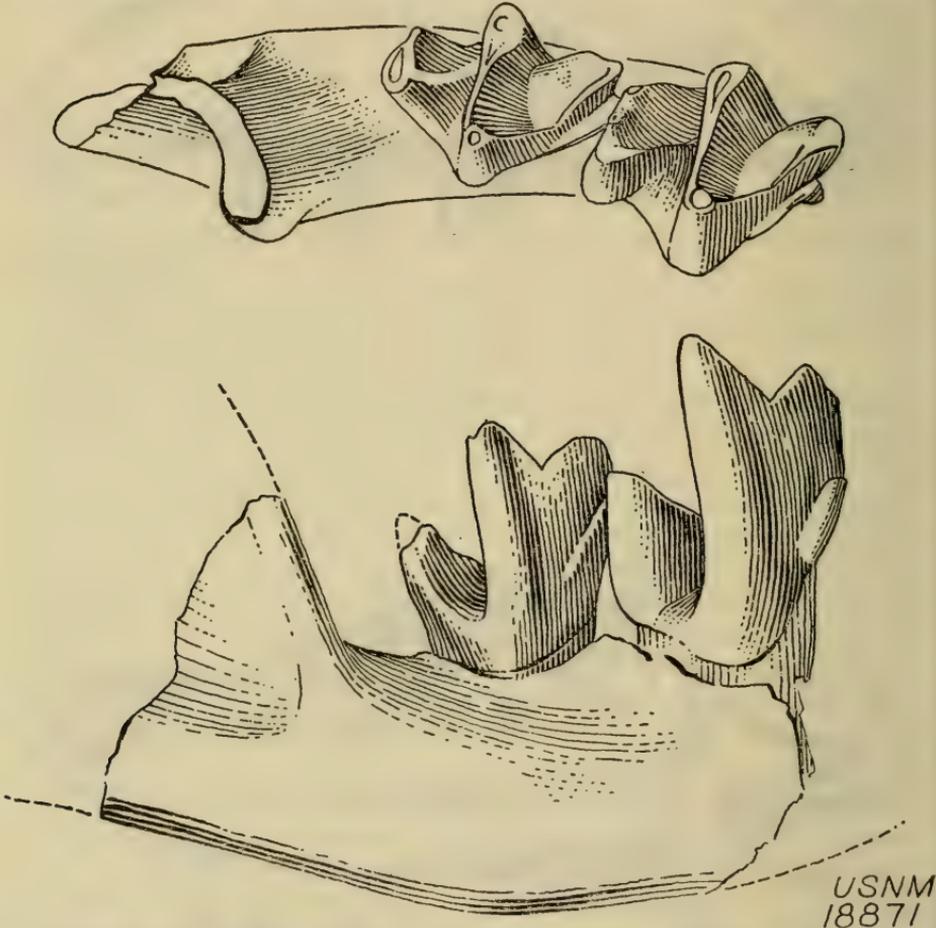


FIGURE 44.—Occlusal and lateral views of the referred specimen (USNM 18871) of *Kentrogomphios strophensis*, new genus and species. $\times 7$.

the paraconid; talonid nearly as long as the trigonid but narrower, hypoconid high and with a ridge sloping down to the base of the metaconid, height of hypoconid nearly equal to the length of the tooth, hypoconulid minute, entoconid nearly obsolete; M_3 similar to M_2 but smaller and with a narrower talonid.

The portion of the jaw preserved indicates a strong upward curvature back of the teeth. The masseteric fossa is deep and with a very prominent anterior rim.

This specimen is referred to this species on the basis of the occlusion with the type which is as good as occurs between different specimens of

the same species. The two specimens are from the same horizon and locality but the difference in amount of wear excludes them from belonging to the same individual.

Discussion.—Although this specimen adds many new data to our knowledge of this group of insectivores, the affinities of the family are still problematical. A number of the characters are shared by both the Soricoida and the Microchiroptera. Some characters are shared by some members of both groups but not by all members of either. Briefly, these characters are the fused skull elements and the character of the orbits. This is also true for the general characters of the cheek teeth. In some members of both groups the posterior border is deeply emarginate between the hypocone and metastyle. The parastylar and metastylar crests resemble both groups in their general features but in their details resemble the bats more than the shrews. The very high cusps of the cheek teeth, especially the hypocone, appear to be a unique feature of this specimen. The large canine excludes this specimen from the shrews but not from the moles (*Talpinae*) and bats. The elongate pit in front of the orbit is a characteristic of most shrews and many of the moles, but not of the bats. A slender zygoma is present in moles and most bats but is absent in the shrews. The rostrum is broken away and the anterior termination of the face cannot be determined.

In summary, the characters of this specimen exclude it from the Soricidae but do not definitely affiliate it with any other group. The molelike facial features certainly suggest that it could belong to the talpid humerus from the same locality. *Parascaptor* and *Scapatochirus* have a large canine and reduced premolars as does this specimen. However, the cheek teeth of this specimen are of a type unknown in any living moles and very suggestive of the bats. Measurements of teeth (in millimeters):

USNM 18870

C-M ³ -----	11.6
P ³ -P ⁴ -----	3.6
M ¹ -M ³ -----	5.5
	<i>Length</i> <i>Width</i>
P ⁴ -----	2.2 1.8
M ¹ -----	2.3 2.5
M ² -----	1.8 2.7
M ³ -----	1.1 2.2

USNM 18871

	<i>Width</i>			<i>Height</i>	
	<i>Length</i>	<i>Trigonid</i>	<i>Heel</i>	<i>Trigonid</i>	<i>Heel</i>
M ₂ -----	1.8	1.8	1.2	3.1	1.3
M ₃ -----	1.8	1.5	0.8	2.1	1.0
Depth of jaw between M ₂ and M ₃ -----			2.3		
Depth of jaw below masseteric fossa-----			1.2		

Order RODENTIA

Family SCIURAVIDAE

Prosciurus cf. relictus (Cope)

USNM 18857, left mandible with P_4 - M_3 ; USNM 18858, left mandible with P_4 - M_1 . Both specimens are from locality No. 24LC15.

The enamel patterns of the teeth and the measurements agree with the figures and description by A. E. Wood (1937, p. 168) but this material does not permit any additions to his discussion. Measurements of teeth (in millimeters):

<i>USNM 18857</i>		
	Length	Width
P_4 - M_3 -----	7.2	----
P_4 -----	1.5	1.6
M_1 -----	1.6	1.7
M_2 -----	1.7	1.9
M_3 -----	2.2	1.6

Family ISCHYROMYIDAE

Ischyromys cf. pliacus Troxell

USNM 18908, right mandible with P_4 - M_3 ; USNM 18909, left mandible with P_4 - M_2 ; USNM 18920, right mandible with M_1 - M_3 . Specimens are from locality No. 24LC16.

This material does not permit additions to our knowledge of the species.

Titanotheriomys veterior Matthew

USNM 18904, a palate with dP_3 - M_3 ; USNM 18905, a palate with dP_4 - M_2 ; USNM 18907, left mandible with P_4 - M_3 . Specimens are from locality No. 24LC16.

This material does not permit any additions to our knowledge of this species.

Family CASTORIDAE

Paleocastor cf. gradatus (Cope)

USNM 18963, palate with left P^4 - M^3 , from locality No. 24LC18; USNM 18962, left mandibular fragment with P_4 - M_2 , from locality No. 24LC20.

This material is referred to this species on the basis of size. As pointed out by Stirton (1935, p. 409), this species is very close to *P. peninsulatus* (Cope). Definite allocation of the Canyon Ferry material must await the acquisition of better specimens.

Family EOMYIDAE

Paradjidaumo cf. minor (Douglass)

USNM 18759, left mandible with P₄-M₃, from locality No. 24LC16; USNM 18758, right mandible with P₄-M₂, from locality No. 24LC17.

Discussion.—In size, this material agrees with both size groups which Wood (1937, p. 244) records from Pipestone Springs, but it differs in that M₁ and M₂ are broader than long in both specimens. One of the specimens measured by Wood (AMNH 9635) shows this condition, but with such a limited sample it is impossible to properly evaluate this character.

Although one of these specimens is from the Chadron equivalent and the other from the Lower Brule equivalent, I could find no morphological characters of the teeth which would separate them. Also, in the *Paradjidaumo* material from Pipestone Springs in the U. S. National Museum there is one specimen which agrees with *P. trilophus* in its dental morphology, including the flattened anterior face of the lower incisor. In view of the above facts and the variation in size and tooth proportions found in the material from Pipestone Springs and the Badlands, it is difficult to escape the inference that *P. minor* and *P. trilophus* represent species groups rather than single species. Measurements of teeth (in millimeters):

	USNM 18758		USNM 18759	
	Length	Width	Length	Width
P ₄ -M ₃ -----	6.2	----	----	----
P ₄ -----	1.4	1.4	----	----
M ₁ -----	1.5	1.6	1.3	1.4
M ₂ -----	1.5	1.6	1.3	1.4
M ₃ -----	1.6	1.4	----	----

Paradjidaumo spokanensis, new species

Holotype.—USNM 18760, a badly crushed skull with right mandible.

Horizon and locality.—Middle Oligocene, Orellan; SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 10 N., R. 1 W., of the Montana prime meridian, about $\frac{1}{4}$ mile southeast of Canyon Ferry, Lewis and Clark County, Mont.

Diagnosis.—Upper teeth broader than long with mesoloph extending to labial margin, posterior cingulum uniting with hypocone and extending nearly to labial margin, mure extending nearly to middle of tooth, shortest on P⁴ and longest on M². Lower teeth with mesolophid long, extending to lingual margin, free on P₄ and M₁ but uniting with entoconid on M₂ and M₃ with wear. P₄ longer than broad and M₃ nearly as broad as long. Measurements of teeth (in millimeters):

P ₄ -M ₃ -----	Upper		Lower	
	6.0		6.7	
	Length	Width	Length	Width
P ₄ -----	1.6	1.7	1.7	1.5
M ₁ -----	1.5	1.9	1.7	1.6
M ₂ -----	1.5	1.9	1.6	1.7
M ₃ -----	1.2	1.7	1.5	1.4

The characters which distinguish this species are the larger size, the elongate P₄, and the short, nearly quadrangular M₃.

Family CRICETIDAE

This family of rodents is represented in this area by a single genus, *Eumys*, and most of the specimens came from two localities, Nos. 24LC15 and 24LC17. The others, specimens in the Carnegie Museum, are from the upper levels of No. 24BW18, locally known as the Old Hadcock Ranch. This series of nearly 100 specimens, although showing considerable variation, is divisible into four groups, three of which exhibit characters of the teeth not readily referable to species described from the White River deposits of the plains. All of the specimens are 15 to 25 percent larger than those of the plains. Also, the teeth are higher crowned and the cusps are better developed.

By analogy with some of the wide-ranging species of the genus *Peromyscus*, one would normally expect only subspecific differences between the members of the genus *Eumys* from the Badlands of South Dakota and the Canyon Ferry Reservoir area since the former is on the plains and the latter is in the mountains. On the other hand, in the mountain areas two or three distinct species of *Peromyscus* usually occur in a single area in addition to the plains species. This appears to be correlated with the greater variety of ecological niches within a limited area, and the remains of a varied fauna from a variety of ecological niches could be concentrated in a very small area of deposition by the work of owls. In view of the geologic history of this region, the environment for small rodents during the Oligocene was probably as varied and as different from that of the plains as it is today. Although only one of the plains species has been positively identified in this material, A. E. Wood (1937, p. 250) reports *E. elegans* Leidy from Montana but gives no locality data.

The following artificial key gives the distinguishing characters of the species of this area:

Key to the species of *Eumys*

- a.¹ Anteroconid on M₁ large, anterior cingulum on M₂ extending the full width of tooth, a short but distinct mesolophid on M₂-----*cricketodontoides*
a.² Anteroconid on M₁ small, mesolophid on M₂ obsolete or absent.
b.¹ Cross lophs normal.

c.¹ Lingual portion of anterior cingulum on M₂ about half as long as labial..... *latidens*

c.² Lingual portion of anterior cingulum on M₂ obsolete or absent.

spokanensis

b.² Cross lophs weak, ectolophid strong..... *exiguus*

Eumys cricetodontoides, new species

Holotype.—USNM 18748 (fig. 45), right mandible with the incisor and M₁₋₃.

Horizon and locality.—Middle Oligocene, Orellan; SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 10 N., R. 1 W., of the Montana prime meridian, about $\frac{1}{4}$ mile southeast of Canyon Ferry, Lewis and Clark County, Mont.

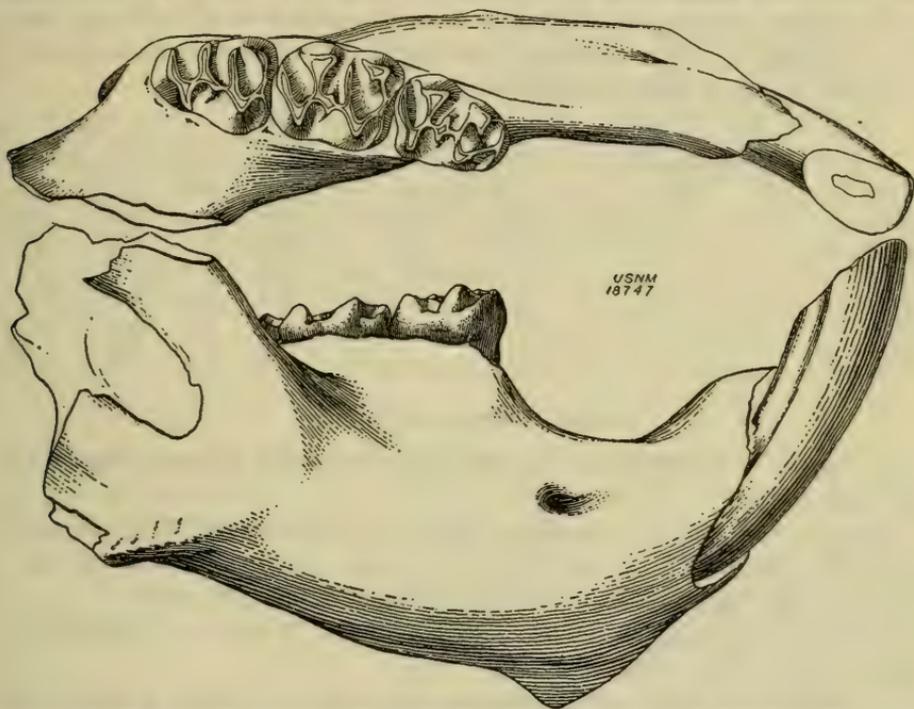


FIGURE 45.—Occlusal and lateral views of the type (USNM 18747) of *Eumys cricetodontoides* new species. $\times 7$.

Referred material.—USNM 18749–18754, six mandibles from the same locality.

Description of type.—M₁ elongate, anteroconid large, nearly as wide as tooth, anterior arm of protoconid united with anteroconid and posterior arm with the metaconid, mesolophid short but distinct, posterior cingulum not united with entoconid; M₂ quadrangular, longer than broad, anterior cingulum extending across anterior border of tooth, lingual and labial portions subequal, posterior arm of protoconid extending nearly to lingual margin of tooth, closely applied but not united with metaconid, mesolophid short but very

distinct, posterior cingulum not uniting with entoconid; M_3 subtriangular in outline, sharply constricted behind protoconid, lingual portion of anterior cingulum short but distinct, posterior arm of protoconid extending to lingual border of tooth and united with metaconid at base, no mesolophid.

Variation.—In one specimen the anterior arm of the metaconid is united to the anteroconid while the protoconid is not. In one, both are united to the anteroconid. The mesolophid of M_1 and M_2 is variable in length but is always distinct. In two specimens the posterior arm of the protoconid M_2 and M_3 is shorter than in the type, but the teeth agree in other particulars.

The short mesolophid on M_2 is very suggestive of *Cricetodon*, but the evidence does not warrant referring this material to that genus. Measurements of teeth (in millimeters):

USNM No.	M_{1-3}	M_1		M_2		M_3	
		Length	Width	Length	Width	Length	Width
18749.....	8.0	2.7	1.9	2.6	2.2	2.5	2.0
18751.....	8.2	2.9	2.2	2.6	2.4	2.5	2.2
18748 (Type).....	7.8	2.5	1.9	2.8	2.2	2.5	2.1
18753.....	---	2.8	1.8	2.5	2.2	---	2.0
18754.....	7.9	2.8	2.1	2.6	2.2	2.6	2.1
18750.....	7.7	2.6	1.8	2.3	2.0	2.6	2.0
18752.....	---	---	---	2.5	2.1	2.7	2.1

Eumys latidens, new species

Holotype.—USNM 18772 (fig. 46), right mandible of young individual with M_{1-3} .

Horizon and locality.—Middle Oligocene, Orellan; SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 10 N., R. 1 W., of the Montana prime meridian, about $\frac{1}{4}$ mile southeast of Canyon Ferry, Lewis and Clark County, Mont.

Referred material.—USNM 18764–71, 18773–80, 16 mandibles from the same locality.

Description of type.— M_1 elongate, anteroconid small, protoconid united to anteroconid and metaconid, mesolophid well developed and distinct, posterior cingulum not united with entoconid; M_2 quadrangular, longer than wide, anterior cingulum extending across front of the tooth, lingual portion shorter than the labial, both protoconid and mesoconid united to anterior cingulum, posterior arm of protoconid not united to metaconid and not extending to lingual border of tooth, mesolophid obsolete, posterior cingulum not uniting with entoconid; M_3 sharply constricted behind protoconid, lingual end of anterior cingulum obsolete, posterior arm of protoconid approaches but does not unite with metaconid, no mesolophid.

Variation.—The material assigned to this species is extremely variable in many of the dental characters but the designation of

another species does not seem warranted at this time. The anteroconid of M_1 is always small but the anterior cingulum is variable in extent. In one specimen, both the protoconid and metaconid are united to the anteroconid. This variation occurs in all three species but is not consistently associated with other characters. The mesolophid is variable in extent but is always distinct. On M_2 the lingual portion of the anterior cingulum is variable in extent but is always distinct. The posterior arm of the protoconid varies in length but never extends to the inner border of the tooth. The mesolophid is consistently obsolete or absent. On M_3 the lingual portion of the anterior cingulum may extend nearly to the border of

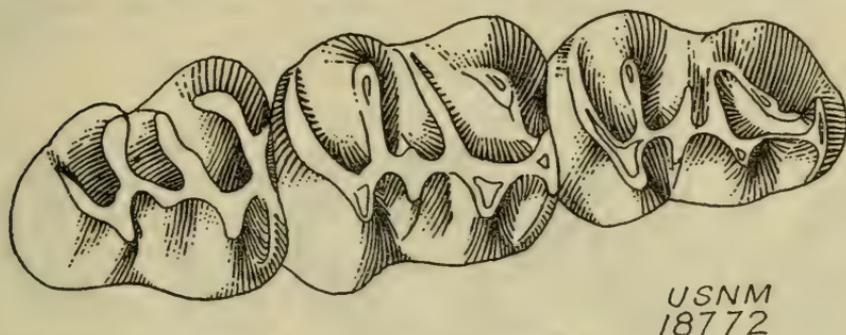


FIGURE 46.—Occlusal view of the type (USNM 18772) of *Eumys latidens*, new species, anterior end to the right. $\times 7$.

the tooth or may be nearly obsolete. The posterior arm of the protoconid may or may not unite with the metaconid. Measurements of teeth (in millimeters):

USNM No.	M_{1-3}	M_1		M_2		M_3	
		Length	Width	Length	Width	Length	Width
18772 (Type)-----	7.7	2.6	1.9	2.5	2.2	2.3	2.2
18771-----	8.0	2.8	1.9	2.4	2.3	2.7	2.2
18768-----	7.9	2.6	2.1	2.6	2.4	2.5	2.3
18770-----	7.4	2.4	1.9	2.5	2.2	2.3	2.1
18776-----	7.6	2.6	1.9	2.4	2.2	2.4	2.1
18769-----	7.5	2.7	2.0	2.5	2.2	2.4	2.1
18764-----	8.2	2.8	2.1	2.6	2.4	2.7	2.3
18776-----	7.5	2.7	1.9	2.4	2.3	2.3	2.1
18779-----	7.6	2.5	2.0	2.5	2.3	2.4	2.2
18773-----	7.5	2.5	1.9	2.4	2.1	2.4	2.1
18767-----	8.1	2.8	2.0	2.6	2.3	2.7	2.0

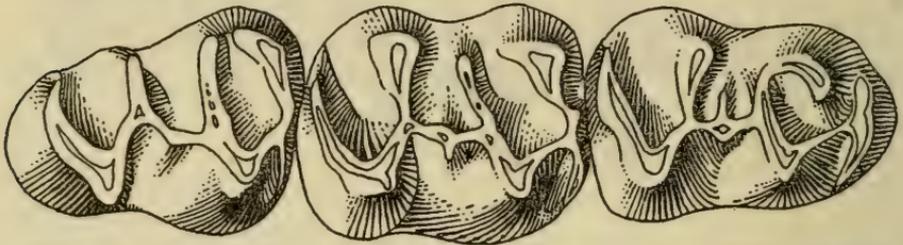
***Eumys spokanensis*, new species**

Holotype.—USNM 18833 (fig. 47), right mandible with M_{1-3} .

Horizon and locality.—Middle Oligocene, Orellan; SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 10, T. 10 N., R. 1 W., of the Montana prime meridian, about $\frac{1}{4}$ mile southeast of Canyon Ferry, Lewis and Clark County, Mont.

Referred material.—Eleven mandibles from the same locality and C. M. 9136 from the upper levels of locality No. 24BW18, locally known as the Old Hadcock Ranch.

Description.— M_1 elongate, anteroconid small, anterior cingulum well developed, anterior arm of protoconid connected to anteroconid and posterior arm to metaconid, mesolophid well developed and extending nearly halfway to inner margin of tooth, inner end of posterior cingulum close to but not united with entoconid; M_2 quadrangular, nearly as broad as long, lingual portion of anterior cingulum obsolete, posterior arm of protoconid closely applied to entoconid and extending nearly to inner margin of tooth, no mesolophid, posterior cingulum as in M_1 ; M_3 subtriangular in outline, sharply constricted posterior to protoconid, anterior cingulum as in M_2 , posterior arm of protoconid united to metaconid at base, no mesolophid or mesoconid.



USNM
18833

FIGURE 47.—Occlusal view of the type (USNM 18833) of *Eumys spokaneensis*, new species, anterior end to the right. $\times 7$.

Variation.—This species shows less variation than the other two. The teeth have the appearance of being shorter, for their breadth, and the cusps more crowded, but the measurements do not bear this out. On M_2 and M_3 the posterior arm of the protoconid often becomes united with the metaconid with wear. The lingual portion of the anterior cingulum of M_2 and M_3 is represented by a vertical fold near the midline of the tooth and soon becomes obliterated with wear. Measurements of teeth (in millimeters):

USNM No.	M_{1-3}	M_1		M_2		M_3	
		Length	Width	Length	Width	Length	Width
18833 (Type)-----	7.8	2.7	1.9	2.4	2.2	2.5	2.0
18831-----	7.4	2.5	1.8	2.5	2.1	2.3	2.0
18843-----	7.8	¹ 2.6	2.0	2.5	2.2	2.4	2.0
18840-----	7.6	2.6	1.9	2.4	2.1	2.5	2.0
18841-----	8.1	2.9	2.0	2.5	2.3	2.4	2.1
18847-----	7.7	2.7	2.0	2.3	2.2	2.3	2.1
18830-----	7.5	2.6	1.9	2.4	2.2	2.4	2.0
18846-----	7.8	2.6	1.9	2.3	2.2	2.6	2.3
18842-----	8.0	2.7	1.9	2.5	2.2	2.4	2.2
18845-----	7.6	2.7	1.8	2.2	2.0	2.5	2.0

¹ Estimated.

Eumys cf. exiguus Wood

USNM 18866 and 18867, 2 mandibular fragments with M_{1-3} ; USNM 18865, 1 maxillary fragment with M_{1-2} . All specimens are from locality No. 24LC17.

This material is provisionally referred to this species on the basis of the tooth cusp arrangement. While these specimens are larger than the type, the sample is too small to furnish grounds for separate designation. Measurements of teeth (in millimeters):

USNM No.	M_{1-3}	M_1		M_2		M_3	
		Length	Width	Length	Width	Length	Width
18867-----	7.1	2.7	1.6	2.2	1.7	2.3	1.7
18866-----	6.4	2.3	1.4	2.1	1.5	1.8	1.5
18865-----	---	2.7	1.9	2.0	1.6	---	---

Order LAGOMORPHA

Family LEPORIDAE

Paleolagus temnodon Douglass

USNM 18869, right maxilla with P^2-M^3 ; USNM 18875, right maxilla with P^3-M^2 ; USNM 18876, right maxilla with P^2-P^4 ; USNM 18877, right mandible with P_3-M_3 . Specimens are from locality Nos. 24LC16 and 24BW18.

This material does not permit any additions to Wood's (1940, p. 320) discussion of the species.

Paleolagus intermedius Matthew

USNM 18872, left mandible with P_3-M_3 ; USNM 18873, left mandible with P_4-M_2 ; USNM 18874, right maxilla with P^3-M^2 . Specimens are from locality Nos. 24LC15 and 24LC17.

This species appears to be relatively rare in these deposits and the limited material does not permit a satisfactory comparison with the specimens from the plains.

Paleolagus burkei Wood

USNM 18879-18894, 4 upper and 12 lower dentitions. All of the specimens are from locality Nos. 24LC15 and 24LC17.

The upper dentitions are slightly larger than the measurements given for the type (Wood, 1940, p. 327), but they agree quite closely in the details of the tooth form and do not agree with *P. haydeni* Leidy. I have not seen any material from the Middle Oligocene of this area referable to the latter species. It is possible that this species could have been restricted to the mountains and *P. haydeni* Leidy restricted to the plains during the Middle Oligocene and that *P. burkei* Wood did not spread to the plains until the Upper Oligocene.

Megalagus brachyodon (Matthew)

USNM 18903, right mandible with P₄-M₃; USNM 18902, right mandible with P₃-M₂. Both specimens are from locality No. 24LC16.

This limited material does not permit any additions to Burke's (1936, p. 150) discussion of this species.

Archaeolagus sp.

USNM 19096, right maxillary fragment with P⁴-M², from locality No. 24LC18.

This specimen is so incomplete that the generic reference is only provisional. The teeth are greatly flattened, the transverse diameter is twice the anteroposterior. The hypostria is deep, extending nearly to the middle of the tooth, a little closer to the posterior edge than the anterior, and extending to the base of the tooth. Groove on the lateral surface of the tooth shallow and broad. No crescentic valley (this may be a state of wear). No enamel on the lateral surface of the tooth. Cement present only in the hypostria (this may be an accident of preservation). The teeth appear to be rootless.

Order CARNIVORA

Family CANIDAE

Hesperocyon paterculus (Matthew)

USNM 18911, skull and jaws (fig. 48) with the greater portion of the skeleton; USNM 18897, right mandibular fragment with M₁₋₃; USNM 18896, left mandibular fragment with M_{1 & 2}; USNM 18895, left mandibular fragment with P_{2 & 3}, M₁₋₃. Specimens are from locality Nos. 24LC16 and 24BW18.

Description.—Dental formula: I₃³, C₁¹, P₄⁴, M₃³. Upper dentition: P¹ single rooted and closer to C than to P²; P² with anterior cingulum, incipient posterior cusp and minute cusp on heel; P³ with well developed anterior cingulum, posterior cusp and a cusp on heel; P⁴ with incipient anterior cusp; M¹ without incipient metaconule, paracone higher than metacone, protocone well developed, protoconule small but distinct, hypocone well developed, anterior cingulum terminates at base of protocone; M² similar to M¹ but smaller; M³ minute and probably of no systematic significance. Lower dentition: P_{1 & 2} missing, P₁ single rooted and closer to C than to P₂; P_{3 & 4} differ only in size, each with well-developed anterior basal and posterior cusp, heel well developed and with a small cusp; M₁ with well-developed hypoconid and incipient entoconid; M₂ with protoconid and metaconid subequal and elevated above the paraconid, hypoconid well developed, entoconid incipient; M₃ small, protoconid and metaconid subequal.

Discussion.—The general form of the skull of this species does not appear to be noticeably different from the other small dogs of the Oligocene of the plains, nor is it possible to detect differences in the skeletal material. The characters of the teeth of these specimens

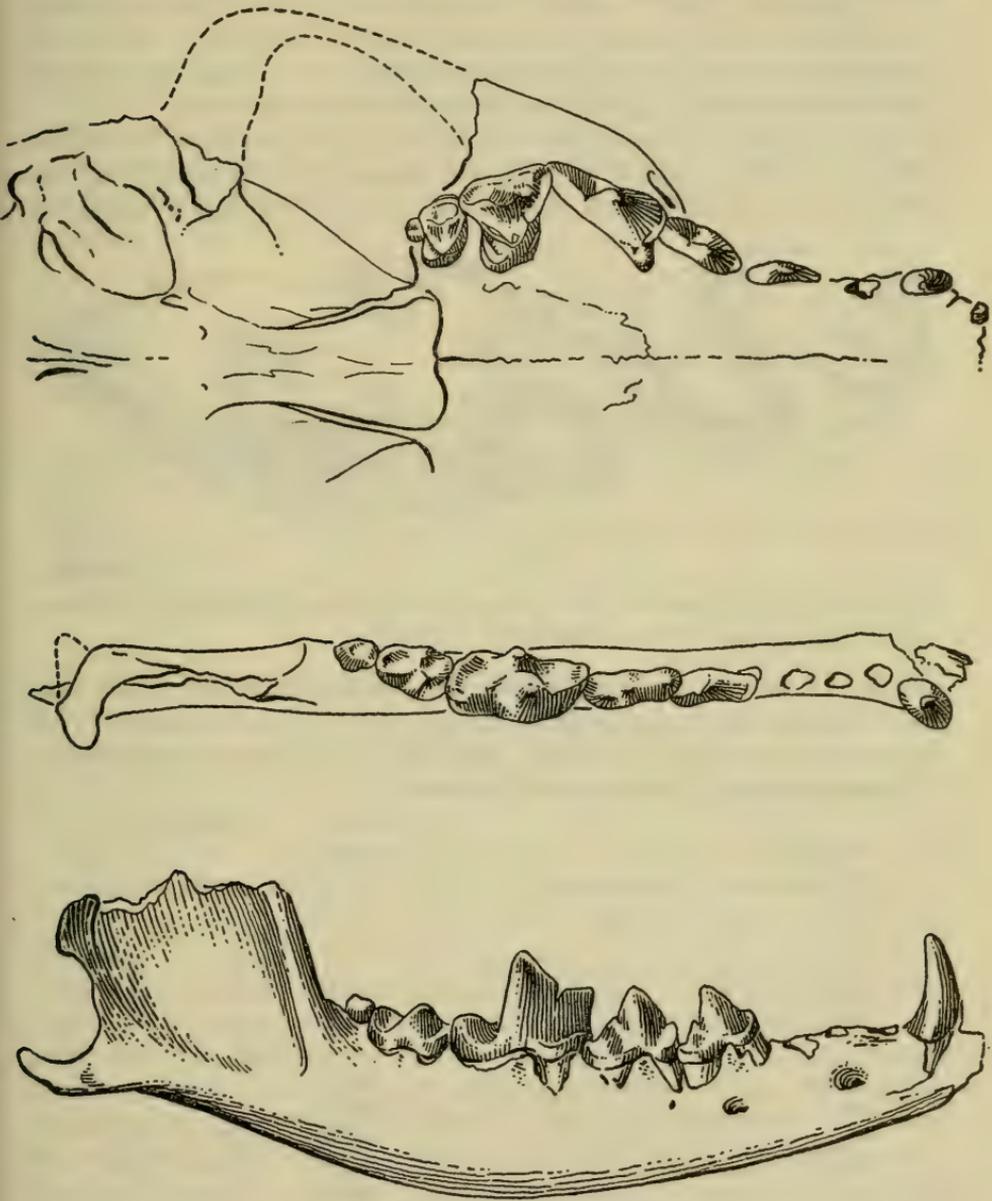
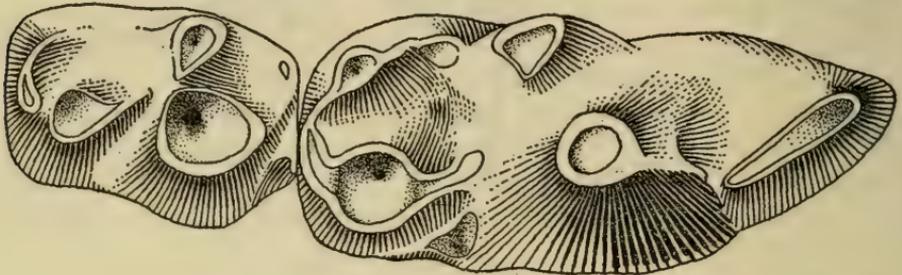
USNM
18911

FIGURE 48.—Upper and lower dentition of *Hesperocyon paterculus* Matthew (USNM 18911). $\times 1$.

appear to be quite constant and agree very well with the material from Pipestone Springs in the U. S. National Museum. The variety of tooth-cusp arrangement and height of crown exhibited by the small carnivores of the Middle Oligocene which have been referred to *H. gregarius* (Cope), both in the literature and in collections, make any attempt at comparison with that species entirely futile. However, these specimens are easily distinguished from the single specimen of *Hesperocyon* from the Lower Brule equivalent of this area.

The specimens of small carnivores of the Oligocene of the plains which I have examined in several museums convince me that the species represented by this tooth-cusp arrangement had a very close



USNM
18898

FIGURE 49.—Occlusal view of the first and second lower molars (USNM 18898) of *Hesperocyon gregarius* (Cope) showing dental caries. $\times 4$.

relative (if not the same species) in the Middle Oligocene. But until the material has been carefully studied and the indeterminate types have been relegated to *nomena nuda* we are helpless taxonomically.

Measurements of teeth (in millimeters):

	Length	Width	
		Anterior	Posterior
P ¹ -M ³ -----	33.0		
P ¹ -4-----	24.5		
M ¹ -3-----	16.0		
M ¹ -----	6.5	7.5	7.0
M ² -----	3.5	5.0	4.5
M ³ -----	1.0	1.25	-----
		Trigonid	Heel
P ₁ -M ₃ -----	34.0	-----	-----
P ₁ -4-----	20.0	-----	-----
M ₁ -----	9.0	4.0	3.5
M ₂ -----	5.0	3.5	3.0
M ₃ -----	2.0	2.0	-----

Hesperocyon gregarius (Cope)

USNM 18898 (fig. 49), right mandibular fragment with M₁₋₂, from locality No. 24LC15.

The specimen referred to this species differs from the preceding one in that on M₁ the entoconid is well developed and about half the size

of the hypoconid. A metaconulid and a protoconulid are present as in *Nothocyon* and *Tomarctos*. There is a small but distinct entoconid on M_2 .

An unusual feature of this specimen is that both teeth show evidence of dental caries. On M_1 there is a major lesion on the hypoconid (fig. 49) with a minor lesion on the entoconid, protoconid, metaconid and metaconulid. On M_2 there is a major lesion on the protoconid with a minor lesion on the metaconid and hypoconid. Among the recent carnivores the only evidence of dental caries I have seen was in the teeth of the grizzly bears (*Ursus horribilis* Ord) in the Museum of Comparative Zoology and in the U. S. National Museum. Measurements of teeth (in millimeters):

	Length	Width	
		Trigonid	Heel
M_1 -----	11.0	5.0	4.0
M_2 -----	5.0	4.0	3.5

Nothocyon cf. *geismarianus* (Cope)

USNM 19097, right mandible with P_2 - M_2 , from locality No. 24LC19.

This specimen is slightly smaller than the one described by Cope (1884, p. 920) but agrees in other details.

Family URSIDAE

Subfamily AMPHICYNODONTINAE

Daphoenocyon cf. *dodgei* (Scott)

USNM 19094, left mandibular fragment (fig. 50) with dP_{3-4} and M_{1-2} , from locality No. 24LC16.

This specimen is badly fractured but it is possible to make out the essential details of the teeth. The deciduous teeth are more canidlike in the cusp arrangement than are the permanent teeth, but are low crowned. In dP_3 the anterior and posterior cusps are well developed, the posterior accessory cusp present and distinct, heel broad with pronounced internal and external cinguli. In dP_4 the trigonid does not differ from that of the permanent tooth except in size, hypoconid and entoconid subequal with entoconid slightly larger, a distinct hypoconulid slightly smaller than the hypoconid present. The permanent teeth, being in an unworn condition, exhibit features on the heels of M_1 and M_2 which appear to be common to many members of this subfamily, namely, in the breaking up of the principal conids into smaller cusps. In this specimen, while the conids on the heel of M_1 are quite distinct, the hypoconid has two apices and the entoconid has three. The heel of M_2 is a further exaggeration of this phenome-

non. The hypoconid and entoconid are represented by two ridges which are beset with small tubercles and meet posteriorly.

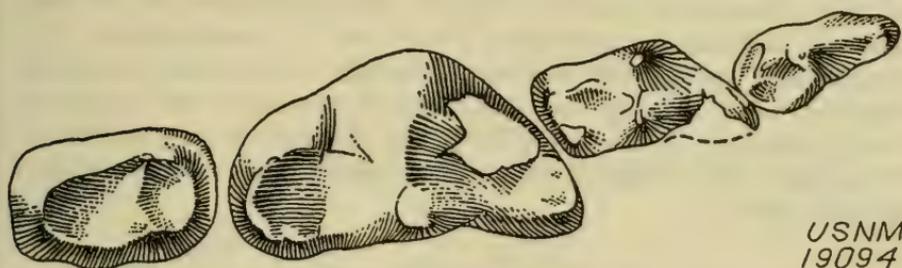
Hough (1948, p. 594), noting the striking difference between the type of this species and the other species of *Daphoenus*, proposed a new genus, *Daphoenocyon*, to receive it. At the same time she erected a new family, the Daphoenidae, to receive a number of North American genera which had been included in the Caninae but which, quite obviously, had little in common with the true dogs. On the other hand, there are three groups, the Amphicyonodontinae, the Amphicyoninae, and the Simocyoninae—all of holarctic distribution from the Lower Oligocene to the Pleistocene and well established in the literature—into one of which any member of the new family could be fitted without changing the definition of the group. Also, to include the Simocyoninae, as represented by *Protamnocyon*, in the same family with the other two subfamilies is an unnatural and nongenetic grouping.

Since the characters of the auditory region (Hough, 1948, p. 577) and the post cranial skeleton, insofar as it is known, of the Amphicyonodontinae and the Amphicyoninae are closer to the bears than the true dogs, it is my opinion, in view of the evolutionary fate of the former, that these two groups should be placed in the Ursidae rather than being placed in a separate family or included in the Canidae. That the early members of these two subfamilies should possess a generalized canoid dentition is to be expected if they are to be included in that superfamily, but it is a fallacy to use the superfamily characters of the teeth to determine the family and subfamily affinities when these determinations contradict the affinities shown by the fundamental structure of the limbs and basicranium.

A comparison of the figures of *D. dodgei* (Scott) and *Parictis dakotensis* Clark (Scott and Jepsen, 1936, pl. 12, fig. 3; pl. 14, fig. 1) shows that these two genera are indeed closely related and belong to the same subfamily. This relationship was confirmed by the comparison of a series of jaws in the Carnegie Museum from Pipestone Springs which are referable to these two genera. In fact, except for very minor details, the only difference between the two is size. In both forms the teeth are low crowned, rather broad, and distinctly less bladelike than in the more typical canids. Although, in the material available, size is the only character which distinguishes the two genera, it is probable that when the material is better known valid distinctions will be found.

Although specimens of this subfamily of carnivores seem to be relatively rare in North America, I suspect that the scarcity is more apparent than real and that quite a number have been referred to either *Hesperocyon* or *Daphoenus* in the collections of our various

museums. I have prepared table 1 (below), partly from the literature and partly from my knowledge of the collections in a few museums, to show the distribution of this group in North America. An examination of this table shows that the smaller form, *Parictis*, persisted from the Lower Oligocene into the Lower Miocene, while *Daphoenocyon* continued only into the Middle Oligocene (Hough, 1948, p. 595) and we have no record of it after that. In the Lower Miocene two new forms appeared, *Pachycynodon* and the form from Florida which I described as *Parictis bathygenus* White (1947, p. 500). Even though the available data are limited, they appear to substantiate the opinion (Simpson, 1947, p. 630) that this group is Eurasian in origin and immigrated to North America. Also it appears that there



USNM
19094

FIGURE 50.—Occlusal view of dP_{2-4} and M_{1-2} (USNM 19094) of *Daphoenocyon dodgei* (Scott). $\times 1\frac{1}{2}$.

was a migration in the Lower Oligocene and another in the Lower Miocene, since neither *Pachycynodon* nor *Parictis bathygenus* are at all closely related to the American Oligocene forms.

TABLE 1.—Distribution of the Amphicyodontinae in the Early Tertiary of North America

Locality	Chadronian	Orellan	Whitneyan	Arikareean
Pipestone Springs	<i>Parictis</i> <i>Daphoenocyon</i>			
Canyon Ferry	<i>Daphoenocyon</i>			
John Day				<i>Parictis</i>
Wyoming, Nebraska, and South Dakota	<i>Parictis</i> <i>Daphoenocyon</i>	<i>Parictis</i> <i>Daphoenocyon</i> (Hough, 1948)	<i>Parictis</i>	<i>Pachycynodon</i>
Florida				<i>Parictis bathygenus</i>

Order PERISSODACTYLA

Family EQUIDAE

Mesohippus hypostylus Osborn

CM 9184, left maxilla with M^{1-3} ; CM 8998, palate with right and left P^2-M^2 ; unnumbered, right maxilla with M^{1-3} ; USNM 18946, skull

with teeth badly worn; USNM 18949, right mandible with P_2 - M_3 ; CM 9171, right mandible with P_3 - M_2 ; CM 9365, right mandible with P_2 - M_2 ; CM 9363, right mandible with dP_{2-4} ; CM 9364, right mandible with dP_{2-4} . Specimens are from locality Nos. 24LC16 and 24BW18.

Discussion.—In size and tooth characters the material agrees better with this species than any of the many which have been described from the Lower Oligocene. Also, the small crochet, which characterizes *M. portentus* Douglass, is lacking.

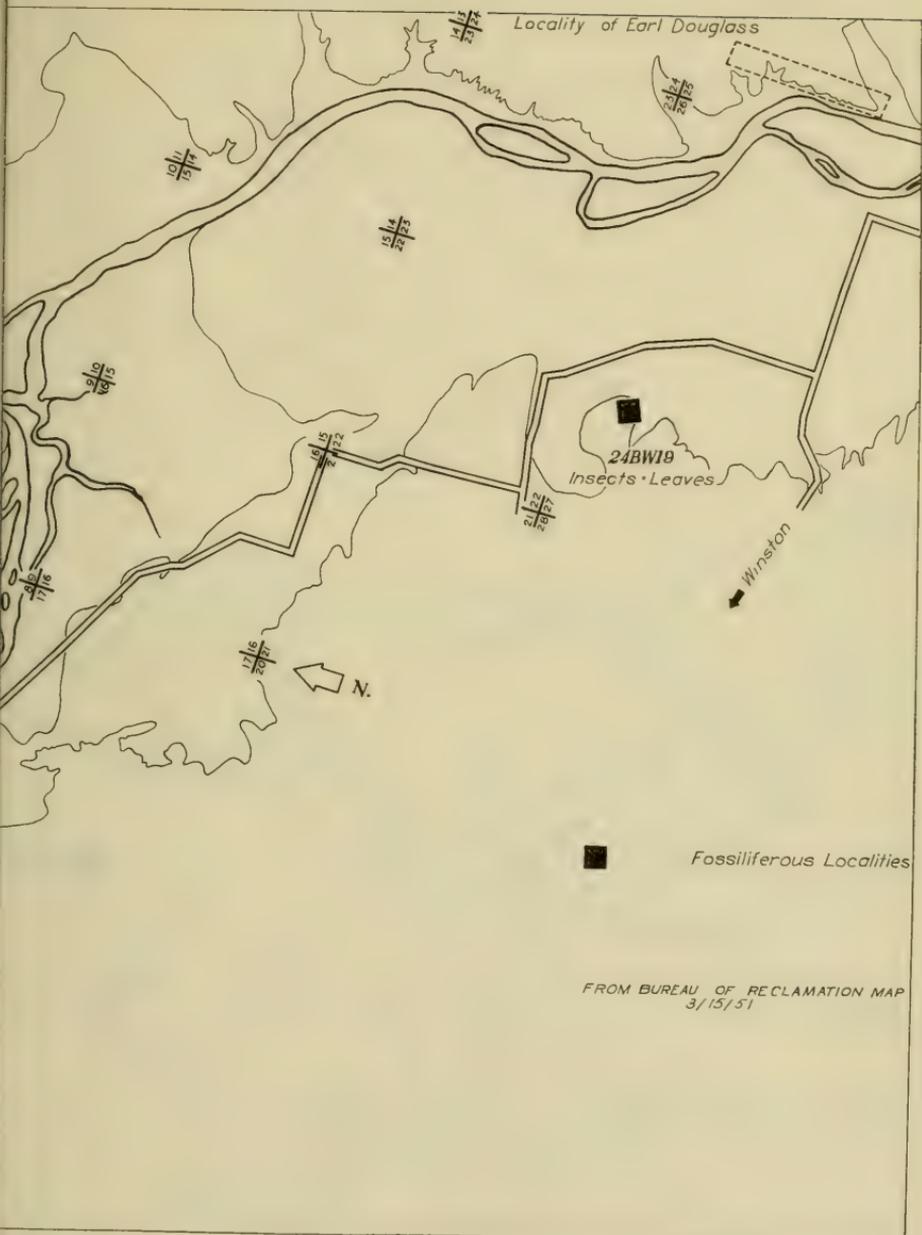
Since this material is more complete than any previously recorded from this area, it will be described briefly.

Description.—Upper dentition: P^2 with protocone well developed, protoloph weak, protoconule indistinct, metaloph well developed with distinct metaconule, hypostyle distinct, mesostyle weak but distinct, parastyle distinct, no metastyle; P^3 , P^4 , and M^1 quadrangular, protoconule and metaconule distinct, parastyle and hypostyle distinct, metastyle weak, internal cingulum between protocone and hypocone, mesostyle strong; M^2 similar to M^1 except metaconule very indistinct; M^3 similar to M^2 except much narrower posteriorly. Measurements (in millimeters):

	CM 8998			CM 9184		
P^2 - M^2 -----	60.0			-----		
P^2 - P^4 -----	35.0			-----		
M^1 - M^3 -----	-----			40.2		
	Length	Width	Height at metacone	Length	Width	Height at metacone
P^2 -----	11.8	12.3	-----	-----	-----	-----
P^3 -----	12.0	14.0	-----	-----	-----	-----
P^4 -----	12.0	15.0	-----	-----	-----	-----
M^1 -----	13.5	15.0	(worn) 8.0	13.7	15.8	10.0
M^2 -----	12.8	16.0	8.5	14.4	16.2	8.6
M^3 -----	-----	-----	-----	13.0	15.5	-----

Lower dentition: P_2 subtriangular in outline, protoconid reduced, metaconid not twinned, entostylid small but distinct, strong external cingulum; P_3 , P_4 , M_1 , and M_2 essentially similar, strong external, anterior, and posterior cinguli, small median external cusp, metaconid and entoconid distinctly twinned, parastylid indistinct; M_3 with metaconid indistinctly twinned and entoconid not twinned. Measurements (in millimeters):

	CM 9171		CM 9365	
P_2 - M_2 -----	-----		64	
P_3 - M_2 -----	52		52	
	Length	Width	Length	Width
P_2 -----	-----	-----	12.4	8.6
P_3 -----	13.0	10.0	-----	-----
P_4 -----	13.0	10.6	13.0	11.2
M_1 -----	12.6	9.0	12.4	10.0
M_2 -----	12.7	8.3	12.6	10.3



localities.

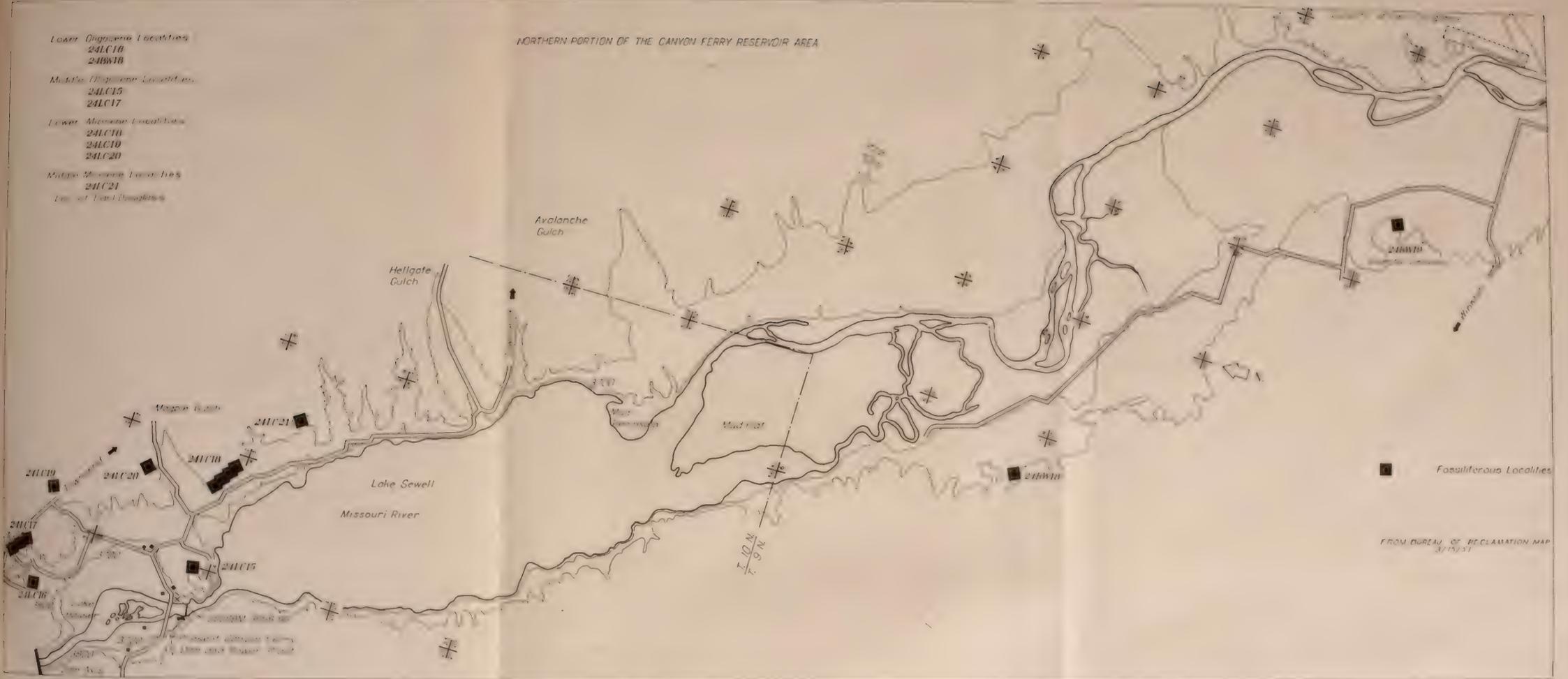


FIGURE 51.—Northern portion of Canyon Ferry Reservoir area showing location of the fossiliferous localities.

Merychippus sp.

USNM 19095, two fragmentary lower molars, from locality No. 24LC21. These teeth are too imperfect for specific identification but are sufficient to establish the presence of Middle Miocene deposits in this area.

Superfamily BRONTOTHERIOIDEA

At locality No. 24LC16 a few fragments of teeth referable to the large members of this group have been found but they are inadequate for even generic reference.

Family HYRACODONTIDAE

USNM 19025, right mandibular fragment with dP_3 - M_1 , from locality No. 24BW18.

Discussion.—This material is too fragmentary to permit allocation to any of the species described from the White River deposits. Sinclair (1922, pp. 65-79) recognized four species on the characters of the upper premolars and stated (p. 67) that no intermediate stages were recognized. Scott (1941, p. 841) expressed the opinion that there was only one valid species of this genus in the White River deposits on the grounds that four species of a single genus of large mammals could not occupy the same territory equivalent in size to that embraced by the White River deposits. On a previous page (p. 786) Scott quotes Matthew's (1930, pp. 271-272) views in connection with the species of *Trigonias*. In his introduction Matthew states that: "We do not, in fact, find two or more distinct species or subspecies of a genus occupying the same area and habitat at the same time." This statement appears to have been accepted by some workers as an axiom but, instead of inspiring caution and the use of recent faunas in interpreting fossil faunas, it has been used as a legitimate excuse for multiplying the number of genera. With the aid of Dr. Henry Setzer of the Division of Mammals, U. S. National Museum, I have prepared a short list of instances where two or more distinct species of the larger mammals occur in the same area and habitat:

CERVIDAE.—Within historic times the ranges of the Virginia deer (*Odocoileus virginianus*) and the mule deer (*O. hemionus*) overlapped by nearly a million square miles and they occupied the same habitat over the area. No natural crosses are known. These forms are morphologically distinct and the skulls and horns would be recognizable as fossils.

CANIDAE.—The above paragraph is true of the wolf (*Canis nubilus*) and the coyote (*C. latrans*).

EQUIDAE.—The horse (*Equus caballus*) and the ass (*E. asinus*) ran wild in western North America for about 300 years after escaping from the Spaniards

and no natural crosses are known. Also *E. prezevalskii* and *E. onager* occur together in Central Asia in the wild state and no undisputed cases of crossing are known.

BOVIDAE.—In the Malay region Lydekker (1898) records four species of *Bos* (*gaurus*, *indicus*, *depressicornis*, and *frontalis*) occurring in the same area.

ANTILOPIDAE.—Allen (1939) reports five species of *Gazella* (*dorcas*, *leptoceros*, *thomsonii*, *granti*, and *soemmerringii*) occurring together in the Anglo-Egyptian Sudan.

Even with this short list it is obvious that two or more species of a single genus of the larger mammals do occur together over large areas and in essentially the same habitat, and by analogy it is entirely possible that more than one species of a genus could be found in a "quarry fauna."

In his treatment of the fauna of a formation, Matthew (1930, p. 272) points out that there is a time factor involved and that shifts in ranges (possibly due to minor climatic fluctuations or seasonal movements of the herds) would make it possible for species with adjacent ranges to be found as fossils in a single time unit of a formation. This is illustrated by the ranges of the barren-ground caribou (*Rangifer arcticus*) and the woodland caribou (*R. caribou*), both of which range across Canada from east to west with a very narrow overlap in range. Even though the amount of overlap did not change, a minor climatic change would permit one to occupy a greater amount of the former territory of the other and the two might be found together as fossils, dependent, of course, on the accidents of preservation.

Another method by which species of adjacent areas may be introduced into an area of deposition is by floods. I think anyone who has ever seen the bloated carcasses of cattle floating in the streams of the west during a summer flood will admit that such a possibility cannot be overlooked in regard to the fluvial deposits of the plains. Even if this happened only once in each climatic microcycle (11 years) it would be sufficient to establish a species in a single time unit of a formation. It is obvious, of course, that the "visiting" species must have its range upstream from the area of deposition. A shift in the range of extraterritorial forms might be the explanation of the presence of *Caenopus* in only the Chadron and Upper Brule and its absence in the Lower Brule.

Another item which must be kept in mind in the consideration of fossil faunas is the territorial range of the individual. Some of the large predators, such as the mountain lion (*Felis concolor*) and the grizzly bear (*Ursus horribilis*), have a territorial range with a 200-mile radius, while with the large herbivores it seldom exceeds 50 or 60 miles. In the case of small mammals, such as *Microtus*, the radius of its territorial range seldom exceeds 20 or 25 feet. Even with this limited number of examples it is clear that with the same food habits

(carnivore or herbivore) the probability of dealing with a purely local fauna is in inverse ratio to the size.

This is not an attempt to justify the multitudinous species of *Mesohippus* or the subspecies of *Trigonias osborni* but to point out, as did Matthew, that we must utilize the principles of distribution and ecology, which have been worked out by the neozoologists, in interpreting the fossil faunas.

Family RHINOCERATIDAE

Caenopus cf. mitis (Cope)

USNM 19026, right mandibular fragment with P₄-M₃, from locality No. 24BW18.

This specimen is referred to this genus and species on the measurements of the teeth which agree with those of the type. The teeth of this specimen are well worn and it may not be identifiable.

Order ARTIODACTYLA

Family LEPTOCHOERIDAE

Leptochoerus sp.

USNM 18919, right mandibular fragment with P₄-M₃, from Lower Oligocene of locality No. 24LC16.

The teeth on this specimen are so badly worn that only provisional reference is possible. However, it is sufficient to record the presence of this group in these deposits.

Family MERYCOIDODONTIDAE

Merycoidodon? sp.

Only maxillary and mandibular fragments were obtained from the Oligocene deposits and these are inadequate for certain generic reference. The size of these specimens indicate an animal of about the size of *Merycoidodon culbertsoni* (Leidy). Nothing in the size range of the small and poorly known genera has yet been found.

Mesoreodon chelonyx Scott

USNM 19091, skull, jaws and greater part of the skeleton; USNM 19092, skull and jaws; both from the Lower Miocene of locality No. 24LC18.

These specimens are slightly larger than those recorded by Schultz and Falkenbach (1949, p. 154) from the same locality, but are still within the limits of individual variation.

Promerycochoerus montanus (Cope)

USNM 19089, skull and jaws with rostrum missing, from Lower Miocene of locality No. 24LC18.

This specimen is that of an old individual with the teeth well worn. However, the specimen is only slightly crushed and the size and configuration can be determined with reasonable certainty.

Cyclopidius simus Cope

USNM 19086, skull and jaws, from the Lower Miocene of locality No. 24LC18; USNM 19088, skull and jaws, from same locality; USNM 19087, right mandible with dP_3 - M_2 .

Discussion.—Thorpe (1937, p. 242) lists six species of *Cyclopidius* from the Miocene deposits of the Smith River area and concludes that only one species (*C. simus* Cope) is valid. Koerner (1940, pp. 856–858) describes two new species from this area, but he does not use the same set of characters to distinguish the two species from each other or from *C. simus*. Nor does he present a standard set of measurements for the three species. Consequently it is impossible to appraise the validity of his species from his treatise.

The best preserved specimen is somewhat larger than the measurements which Thorpe (1937, p. 291) gives for *C. simus* or its synonyms. It is nearly as large as *C. lullianus* Thorpe, but the details of the facial vacuities are very different from that species and agree with *C. simus*.

Family CAMELIDAE

Poëbrotherium cf. eximium Hay

USNM 18944, right mandibular fragment with P_3 - M_1 ; USNM 18945, left mandibular fragment with dP_{2-4} ; CM 9301, right mandibular fragment with P_4 - M_1 . All specimens are from locality No. 24BW18.

This material is too fragmentary for accurate specific determination but is adequate to establish the presence of this genus in these deposits.

Family HYPERTRAGULIDAE

Leptomeryx transmontanus Douglass

Leptomeryx? esulcatus Matthew, 1903. Bull. Amer. Mus. Nat. Hist., vol. 19, p. 222, fig. 15.

USNM 18931, 18932, 18934–18939, eight mandibular fragments, and USNM 18933, one maxillary fragment, all from locality No. 24LC16; USNM 18940–18943 and CM 9293, five mandibular fragments, and CM 9291, 9304, two maxillary fragments, all from locality No. 24BW18.

Frick (1937, p. 625) synonymized *L. ? esulcatus* Matthew (1903, p. 222, fig. 15) with *L. transmontanus* Douglass. On the following page he indicates that the specimens referred by Matthew (1903, p. 224) to *L. mammifer* Cope should be considered a large variant of this species, and on page 629 he refers the specimens figured by Matthew as *L. ? esulcatus* Cope to *L. evansi* Leidy. The upper dentitions of *Leptomeryx* in the U. S. National Museum and in the Carnegie Museum from Pipestone Springs and Lower Oligocene of Canyon Ferry agree with the figure and published measurements given by Douglass (1903, p. 167, fig. 11) for the type of *L. transmontanus*. Also, a comparison of this material with the type (USNM 157) and referred material of *L. evansi* Leidy from the Middle Oligocene reveal a number of differences which are fairly constant and are presented in table 2. As far as it was possible to do so the characters of *L. evansi* were taken from the type.

TABLE 2.—*Contrasting characters of Leptomeryx evansi Leidy and L. transmontanus Douglass.*

Character	<i>L. transmontanus</i>	<i>L. evansi</i>
Median internal cusp on M ₁	weak or absent	strong
Median internal cusp on M ₂	weak or absent	strong
Median internal cusp on M ₃	small	strong
Postero-internal cingulum on P ₂	strong	weak
Posterior ridges on P ₃	inner always connects with heel, outer rarely	outer connects with heel
"Paleomeryx fold" on lower molars	absent	present and uniting with posterior crescent with wear
Mesostyle on M ₁	strong	absent
Mesostyle on M ₂	weak	absent
Mesostyle on M ₃	weak	absent
Anterior cingulum on lower molars	weak or absent	strong but soon obliterated by wear

Matthew (1903, p. 223) stressed the differences in the length of the posterior ridges on the protoconid of the third lower premolar as the distinguishing characteristic of this species and it is valid for the majority of the specimens I have examined. Normally, there are an inner and an outer cusp on the heel of P₃, each with a short ridge extending antero-medially (axis of the tooth). These ridges usually meet and fuse near the middle of the heel. Normally, the inner ridge from the protoconid is united with this common meeting point. In the material at my disposal the outer ridge from the protoconid is variable in length, is usually bifid, and in one specimen it joins the heel at the common meeting point mentioned above. Occasionally the ridge from one of the cusps on the heel does not develop, or the ridge may extend directly anteriorly. In two specimens the ridges of both heel cusps have grown anteriorly and met the posterior ridges from the protoconid, giving P₃ the appearance of P₄.

Leptomeryx evansi Leidy

USNM 18924-18926, three maxillary fragments; USNM 18923, 18927-18930, five mandibular fragments; and seven unnumbered

mandibular fragments in Carnegie Museum; all from locality No. 24LC15; and CM 8995, two mandibular fragments, from the upper levels of locality No. 24BW18.

A comparison of this material with the type of *L. evansi* Leidy (USNM 157) and the abundant material from the Middle Oligocene of Wyoming fails to reveal any constant differences in the details of the upper and lower cheek teeth. This material averages about 3 percent smaller than the type, but the sample is too limited for this to be of any significance.

Climatic zoning of Lower Oligocene faunas

The possibility of climatic zoning of fossil faunas has received very little consideration in the literature. This is partially due to the lack of data (widely separated fossiliferous deposits of equivalent ages have become known only recently) and partially to the rather general belief that the Early Tertiary climates were uniformly mild. In regard to the latter, Berry (1922) pointed out that while the over-all climate of the Eocene may have been much milder than today the "arctic flora" of that time was not only distinct from that of temperate latitudes but was of circumpolar distribution. He also points out (1922, p. 13) that the southern limit of the Eocene "arctic flora" is about 15° north of the southern limit of the existing species of the same genera and that the present isotherm (p. 9) would have to swing 15° to 20° northward to permit the present existence of the same floras in the same areas from which we know the Eocene floras. Such a change would only eliminate the Arctic Zone of C. Hart Merriam as it is defined today and would by no means be sufficient change to produce a uniformly mild warm-temperate to subtropical climate. Simpson (1947, pp. 645-654) briefly cites evidence for climatic zoning in the Miocene in Asia and considers that climate was probably a relatively important selective factor in intercontinental migration. He also points out (p. 652) that while the evidence for climatic zoning is meager there is none against it.

The possibility of climatic zoning in the Tertiary was first brought to my attention by the relative abundance of the protoceratids in the Miocene of Texas and their extreme scarcity in equivalent deposits of Nebraska and Wyoming. These animals are large enough that they would not be easily overlooked. There are few areas in North America which have remained as consistently productive over a period of years as has the Miocene of Nebraska and Wyoming. Yet, from this area, *Syndyoceros* is known from only two specimens and *Prosynthetoceros* is entirely unknown. Even on such meager evidence it seemed highly probable that the factors which controlled the

present distribution of mammals in North America had been in operation throughout the Tertiary. The climatic zoning of mammalian distribution in North America by C. Hart Merriam (1892) is probably familiar to nearly everyone and will not be further discussed here. Many workers have greatly elaborated and refined the original statement (with some adverse criticism), but the basic concept is still valid.

It is the purpose of the present study to compare the Lower Oligocene faunas of the plains and the intermountain basins of Montana in the light of possible climatic zoning.

The statement often has been made that the nondiscovery of a particular form in a given deposit is not proof that the form did not live in that area while the sediments in question were being deposited. In general this is true, but to accept it as an axiom is to exclude from consideration all problems of distribution and intercontinental migration (see Simpson, 1947, p. 652). Probably the greatest value of the statement is that it is a very effective intellectual counterbalance against overenthusiastic speculation. For application to a specific problem it must be weighted against the answers to a number of questions:

1. Was the area accessible to the animal in question?
2. Is it known from older or younger deposits from this or closely adjacent areas?
3. Is it known from deposits of equivalent age from adjacent areas? Or, more remote areas?
4. If so, how frequently is it encountered?
5. Is it associated with other genera belonging to the same family?
6. How frequently are the related genera encountered?
7. Are the related genera found in the deposit in question?
8. Are the probable habits of the animal in question such that its remains would have a good chance of being buried and preserved?
9. How extensively and thoroughly have the deposits in question been explored?
10. Was the climate and environment of the area in question essentially the same as that of the adjacent area? Of the more remote area?
11. What was the size of the animal?
12. What was the probable territorial range of the individual estimated from the size and inferred habits?

If the faunas of Pipestone Springs and Canyon Ferry (see table 3) are compared in the light of these questions it will be seen that, since the two areas are so close both geographically and ecologically, any faunal differences must be attributed to the accidents of preservation and discovery.

On the other hand, Pipestone Springs and the Badlands of South Dakota are separated by a distance of 600 miles (air line), 3° of latitude, and 3,000 feet of altitude, and both have been collected extensively. Although the climate of Lower Oligocene times may have

been warmer as a whole, the environmental contrasts between the two areas must have been as great then as they are now, and it is permissible to expect these contrasts to find as much expression in faunal differences, particularly among the small, nonvolant mammals, as they do today. A comparison of the Lower Oligocene faunas of the two areas (table 3) shows that faunal differences did exist. By analogy with Recent faunas the differences appear to be correlated with environmental differences. It is expected that further explorations will modify the faunal differences somewhat; but, in view of the extensive explorations in both areas, radical changes are not anticipated.

TABLE 3.—*Distribution of Lower Oligocene fauna*

Species				Species			
	Plains	Pipe- stone Springs	Can- yon Ferry		Plains	Pipe- stone Springs	Can- yon Ferry
Peratherium titanelix	sp.	x	sp.	Hoplophoneus robustus	x		
Apternodus midiaevus		x	x	Mesohippus celer	x		
Apternodus altitalonidus	x			Mesohippus portentus	x	x	
Micropternodus borealis		x	sp.	Mesohippus latidens	x		
Talpa? sp.		x	x	Mesohippus montanus		x	
Clinopternodus gracilis	x			Mesohippus hypostylus	x		x
Metacodon magnus	x			Hyracodon cf. acridens	x		sp.
Kentrogomphios strophensis			x	Trigonias osborni	x		
Domnina thompsoni		x		Caenopus mitis	x		sp.
Ictops dakotensis	x			Colodon occidentalis	x		
Ictops acutidens		x		Colodon cingulatus			x
Ictops thompsoni, etc.		x	x	Titanotheres	many spp.	sp.	sp.
Prosciurus vetustus	x	x		Aepinacodon americanus	x		
Prosciurus jeffersoni		x		Archaeotherium cf. crassum	x		
Ischyromys pliacus		x	x	Archaeotherium marshi	x		
Titanotheriomys veterior	x	x	x	Archaeotherium scotti	x		
Cylindrodon fontis	x	x		Archaeotherium mortoni	x		
Pseudocylindrodon neglectus		x		Perchoerus cf. nanus	x		
Eutypomys cf. thompsoni	x			Perchoerus minor	x		
Adjidaumo minimus	x	x		Bothriodon americanus	x		
Paradjidaumo minor	x	x	x	Heptacodon sp.	x		
Paleolagus temnodon	x	x	x	Merycoidodonts	x	x	x
Megalagus brachyodon		x	x	Merycoidodon affinis	x		
Megalagus turgidus	x			Bathygenys alfa		x	
Desmatolagus dicei		x		Limnetes sp.		x	
Hyaenodon montanus		x		Hypertragulus chadronensis	x		
Hyaenodon cruentus	x			Hypertragulus crawfordensis	x		
Pseudopteronodon minutus		x		Leptomeryx transmontanus	x	x	x
Daphoenocyon dodgei	x	x	x	Leptomeryx annectens	x		
Parietis dakotensis	x	x		Hypisodus paululus	x		
Hesperocyon paterculus		x	x	Heteromeryx dispar	x		
Hesperocyon gregarius	x			Pseudoprotoceras longinarius	x		
Plesictis priscus	x			Ectylopus reedi	x		
Paleogale inflex		x		Poebrotherium eximium	x	x	x
Deinictis cf. fortis	x			Stibarus montanus	sp.	x	
Hoplophoneus o'harrai	x			Leptochoerus or Stibarus	sp.		x
Hoplophoneus mentalis	x						

For purposes of discussion, the fauna of the Mountain Province as here used is the combined faunas of Pipestone Springs and the Lower Oligocene of Canyon Ferry. These two areas were chosen deliberately because they are separated from the plains by more than one range of mountains and cannot possibly be interpreted as having been in the

Transition Zone as can the deposits in Weld County, Colo., and the less-well-known faunas of Bates Hole and Beaver Divide, Wyo. Thompson's Creek, McCarty's Mountain, and the Drummond Beds have been omitted because they have been incompletely reported upon, both faunistically and stratigraphically.

The fauna of the Plains Province has been compiled from Scott, et al. (1936-41), Clark (1937), Cook and Cook (1933), and Cook (1934). This compilation of the Plains Province fauna may be introducing error into the comparisons because, with a north-south extent of nearly 600 miles for the Oligocene deposits of the plains, latitudinal zoning may have existed. But, with so few detailed studies of limited areas, definite evidence either for or against latitudinal zoning is wholly lacking.

The comparison of these two faunas is limited by necessity to the smaller mammals because the remains of the larger forms, particularly the titanotheres and rhinoceri, are often too fragmentary for more than family identification. However, such fragmentary evidence is sufficient to establish the group in the area in question. Those cases where the generic identification is reasonably certain but no specific identification can be made are indicated in table 3 by the abbreviation "sp." In the following paragraphs an attempt is made to evaluate the differences found in the two faunas.

INSECTIVORA.—Although representatives of this group are not numerous in collections, one finds it difficult to escape the inference that it is due to their small size. There are two genera, *Apternodus* and *Ictops*, common to both areas but the species are distinct. Two genera, *Clinopternodus* and *Metacodon*, appear to be confined to the Plains Province and, as yet, are unknown from younger deposits outside of the plains. Two genera, *Micropternodus* and *Domnina*, appear to be confined to the Mountain Province. *Micropternodus* does not appear to have survived anywhere beyond the Lower Oligocene, and *Domnina* is well represented in the Plains Province in the Middle Oligocene. Consequently, one would expect to find it in the Lower Oligocene of the plains. On the other hand, the alternative that it did not spread to the plains until Middle Oligocene times (as appears to be the case with some other genera) is entirely within the limits of possibility. Since *Kentrogomphios* and *Talpa?* are known from single specimens they are useless for this study.

RODENTIA.—*Prosciurus* is common to both areas in both the Lower and Middle Oligocene. *Ischyromys*, a large active form, appears to be restricted to the Mountain Province in the Lower Oligocene but is well represented in the Middle Oligocene of the plains, where it underwent considerable radiation. *Titanotheriomys* and *Cylindrodon* are common to both areas but did not survive into the Middle Oligocene. *Pseudo-*

cylindrodon appears to be restricted to the mountains in the Lower Oligocene but did not survive into the Middle Oligocene. *Eutypomys*, a large active form, is common to both Provinces in the Lower Oligocene. Both genera of the Eomyidae are common to both Provinces in both the Lower and Middle Oligocene.

LAGOMORPHA.—*Megalagus* and *Paleolagus* are common to both areas. The species are distinct in *Megalagus* and probably also in *Paleolagus*. *Desmatolagus*, as with *Domnina* and *Ischyromys*, appears to be restricted to the mountains in the Lower Oligocene but is represented in the Middle Oligocene of the plains.

CARNIVORA.—The creodonts are rare in the Lower Oligocene of both Provinces and consequently are useless for this type of study. *Daphoenocyon* and *Parictis* are common to both areas and no specific separation appears possible. *Hesperocyon* is common to both Provinces but the species are distinct. *Plesictis* appears to be restricted to the Plains Province and *Paleogale* appears to be restricted to the mountains in the Lower Oligocene but is well represented on the plains in the Middle Oligocene. To the best of my knowledge, not even fragmentary evidence of the felids has been found in any of the Lower Oligocene deposits of the intermountain basins. With such complete negative evidence for an area as extensively collected as Pipestone Springs, it seems reasonable to infer that the mountains were climatically unsuited to the Lower Oligocene felids.

PERISSODACTYLA.—*Mesohippus* is common to both Provinces but the Lower Oligocene species have not been reviewed since the time it was considered an act of the greatest discourtesy to place someone else's species in synonymy. Consequently the data furnished by the species of this genus are not suitable for this study. The remains of the Rhinocerotidae from the Mountain Province are fragmentary but *Hyracodon* and *Caenopus* were common to both Provinces. The remains of the Brontotheroidea are too fragmentary for generic identification. *Colodon* is common to both areas but its scarcity makes it unsuited for this study.

ARTIODACTYLA.—Although the Leptochoeridae are common to both areas, their remains are too rare to be suitable for this study. The Entelodontidae appear to be restricted to the plains, and, like the felids, seem to have found the mountains climatically inhospitable. The Tayussuidae are unknown in the Mountain Province but are also rare in the plains and consequently unsuited for this study. Likewise, the Bothriodontidae are unknown in the mountains and are rare on the plains. The remains of the Merycoidodontidae in the Mountain Province are very fragmentary and useless for this type of study. Of the Hypertragulidae, only one genus, *Leptomeryx*, is common to the two areas but no specific separation between the two regions can be

made. *Hypertragulus* and *Hypisodus* appear to be restricted to the plains and, like the felids, may have found the mountains climatically unsuitable. *Heteromeryx* is known from a single specimen and therefore unsuited for this study. The same is true for *Pseudoprotoceras*. Of the Camelidae, *Eotylopus* is known from only three or four specimens and consequently is unsuitable for this study. *Poebrotherium* appears to be common to both Provinces but the remains in the mountain area are very fragmentary and consequently the genus is unsuitable for this study.

TABLE 4.—Distribution of genera in the Lower and Middle Oligocene

Genus	Lower Oligocene		Middle Oligocene		Genus	Lower Oligocene		Middle Oligocene	
	Mountain Prov.	Plains Prov.	Mountain Prov.	Plains Prov.		Mountain Prov.	Plains Prov.	Mountain Prov.	Plains Prov.
<i>Domnina</i> *	x			x	<i>Brontotheriidae</i>	x	x		
<i>Ischyromys</i>	x			x	<i>Apternodus</i>	x	x	x	x
<i>Desmatolagus</i> *	x			x	<i>Ictops</i>	x	x	x	x
<i>Paleogale</i> *	x			x	<i>Prosciurus</i>	x	x	x	x
<i>Metacodon</i>		x		x	<i>Eutypomys</i>	x	x	x	x
<i>Plesictis</i> *		x		x	<i>Adjidaumo</i>	x	x	x	x
<i>Deinictis</i> *		x		x	<i>Paradjidaumo</i>	x	x	x	x
<i>Hoplophonus</i>		x		x	<i>Megalagus</i>	x	x	x	x
<i>Archeotherium</i>		x		x	<i>Paleolagus</i>	x	x	x	x
<i>Perchoerus</i>		x		x	<i>Daphnoecyon</i> *	x	x	x	x
<i>Bothriodon</i> *		x		x	<i>Parietis</i> *	x	x	x	x
<i>Heptacodon</i> *		x		x	<i>Hesperocyon</i>	x	x	x	x
<i>Hypertragulus</i>		x		x	<i>Mesohippus</i>	x	x	x	x
<i>Hypisodus</i>		x		x	<i>Colodon</i>	x	x	x	x
<i>Micropternodus</i>	x				<i>Rhinocerotidae</i>	x	x	x	x
<i>Pseudocylindrodon</i>	x				<i>Leptochoeridae</i>	x	x	x	x
<i>Clinopternodus</i>		x			<i>Merycoidodontidae</i>	x	x	x	x
<i>Cylindrodon</i>	x	x			<i>Leptomeryx</i>	x	x	x	x
<i>Titanotheriomys</i>	x	x			<i>Poebrotherium</i>	x	x	x	x

*Subfamilies to which these genera belong are believed to be immigrants to North America from Eurasia in Early Oligocene times (Simpson, 1947).

Table 4 reveals some very striking contrasts between the faunas of the two Provinces, particularly in the number of genera in the Plains Province which are not yet known from the intermountain basins. Most of these forms are medium to large in size and the subfamily, at least, would be recognizable on very fragmentary evidence. Consequently their nondiscovery at Pipestone Springs indicates, if not complete absence, that only occasional stragglers entered the area during cycles of maximum abundance. Four of these genera, embracing three subfamilies, are believed to be immigrants from Eurasia. One of the subfamilies, the Anthracotherinae, with its hippopotamus-like habits, quite obviously would have found the smaller, swifter mountain streams entirely unsuited to its way of life. In the case of *Plesictis* and *Deinictis* (if this is the true situation), it would appear that a temperature factor was involved. Of the nonmigrant genera, one family, the Hypertragulidae, is of special interest as only one genus, *Leptomeryx*, appears to have been able to invade the mountains and

is present in fair abundance. In view of the relative scarcity of *Hypertragulus*, *Hypisodus*, and *Heteromeryx* in the Middle Oligocene compared to *Leptomeryx* and in view of the Late Tertiary development of this suborder, one finds very attractive the suggestion that the center of development and dispersal was more southern and central and that the first three genera were very near the northern limit of their range.

That none of the genera of the Plains Province invaded the Mountain Province between the Lower and Middle Oligocene and the rather long list of genera common to the two Provinces during both ages indicate that the indigenous genera had become adjusted to their environment, or ecologically stabilized, by the beginning of the Oligocene and that there were no major climatic changes before the close of the Middle Oligocene.

The Eurasian immigrants embrace six subfamilies. One, the Amphycynodontinae, quickly became adjusted to both Provinces; two, the Nimravinae and Anthracotherinae, were restricted to the plains; one, the Mustelinae, was divided between the two areas; and two, the Soricinae and Ochotoninae, appeared to require a period of readjustment before invading the plains. The apparent absence of *Domnina* in the Lower Oligocene of the plains is certainly open to question since its very small size greatly reduces its chances of discovery. On the other hand, the zonal distribution of mammals is more clearly reflected by the small species, which is possibly a result of the much smaller territorial range of the individual. However, *Desmatolagus* would have had as good a chance of being preserved as *Megalagus* or *Paleolagus* if it had been present on the plains during the Chadronian.

Ischyromys is the same size as *Titanotheriomys*, and had it been on the plains during the Chadronian it would have had as good a chance of being preserved as the latter. The occurrence of *Ischyromys* in the Cypress Hills does not necessarily indicate that the fauna was mixed (Wood, 1937, p. 193), as Lambe (1908, p. 8) supposed, but could indicate temperature zoning on the plains during Lower Oligocene time. The large ground squirrels of the genus *Citellus* (sensu lato) are, with very few exceptions, restricted to the mountains and the Boreal Zone of the plains. The Cypress Hills are far enough north to be climatically equal to Pipestone Springs regardless of what was the Lower Oligocene climate as a whole.

The following genera have been omitted from table 4 because our knowledge of them in the Lower Oligocene is inadequate for this type of study: *Talpa?*, *Kentrogomphios*, *Sinclairiella*, *Manitsha*, *Ardynomys*, *Macrotarsius*, *Hyaenodon*, *Pseudopteronodon*, *Aepinacodon*, *Bathygenys*, *Limnetes*, *Heteromeryx*, *Pseudoprotoceras*, *Eotylopus*.

In summary, the available data show that there was environmental (and, in a sense, climatic) zoning between the mountains and the plains in Lower Oligocene times. The faunal differences embrace larger systematic categories (Felidae and Entelodontidae) than the same areas do today (before civilization changed the picture). Both the immigrants and the indigenous faunas exhibit nearly the same degree of difference. The only change from Lower to Middle Oligocene was that the mountain forms were able to invade the plains and most of these were immigrants. None of the plains forms were successful in invading the mountains between Lower and Middle Oligocene times.

References

- ALLEN, GLOVER M.
1939. A check-list of African mammals. Bull. Mus. Comp. Zool., vol. 83, pp. 1-763.
- BERRY, E. W.
1922. A possible explanation of Upper Eocene climates. Proc. Amer. Philos. Soc., vol. 61, pp. 1-14.
- BURKE, J. J.
1934. New Duchesne River rodents and a preliminary survey of the Adjudumidae. Ann. Carnegie Mus., vol. 23, pp. 391-398.
1935. *Pseudocylindrodon*, a new rodent genus from the Pipestone Springs Oligocene of Montana. Ann. Carnegie Mus., vol. 25, pp. 1-4.
1936. *Ardynomys* and *Desmatolagus* in the American Oligocene. Ann. Carnegie Mus., vol. 25, pp. 135-154.
- CABRERA, ÁNGEL
1925. Genera Mammalium: Insectivora, Galeopithecina. Mus. Nac. Cienc. Nat. Madrid. 232 pp.
- CLARK, JOHN
1937. Stratigraphy and paleontology of the Chadron formation in the Big Bad Lands of South Dakota. Ann. Carnegie Mus., vol. 25, pp. 261-350.
- COLBERT, E. H.
1941. The ancestral Ursid, *Hemisyon*, in Nebraska. Bull. Univ. Nebraska State Mus., vol. 2, pp. 49-57.
- COOK, H. J.
1934. New Artiodactyls from the Oligocene and Lower Miocene of Nebraska. Amer. Midl. Nat., vol. 15, pp. 148-165.
- COOK, H. J., and COOK, M. C.
1933. Faunal lists of the Tertiary Vertebrata of Nebraska and adjacent areas. Nebraska Geol. Survey, Paper No. 5, pp. 1-58.
- COLYER, F.
1936. Variations and diseases of the teeth of animals.
- COPE, E. D.
1884. The Vertebrata of the Tertiary formations of the West. Rep. U. S. Geol. Surv. Terr. (Hayden), vol. 3, 1009 pp.
- DICE, L. R.
1917. Systematic position of several Tertiary lagomorphs. Univ. California Publ., Bull. Dep. Geol., vol. 10, pp. 179-183.

DOUGLASS, EARL

1901. Fossil Mammalia of the White River beds of Montana. *Trans. Amer. Philos. Soc.*, new ser., vol. 20, pp. 237-279.
1903. New vertebrates from the Montana Tertiary. *Ann. Carnegie Mus.*, vol. 2, pp. 145-199.
1905. The Tertiary of Montana. *Mem. Carnegie Mus.*, vol. 2, No. 5, pp. 203-224.
- 1907a. *Merycochoerus* and a new genus of merycoidodonts, with some notes on other Agriochoeridae. *Ann. Carnegie Mus.*, vol. 4, pp. 84-109.
- 1907b. New merycoidodonts from the Miocene of Montana. *Bull. Amer. Mus. Nat. Hist.*, vol. 23, pp. 809-822.
- 1908a. A hunt for extinct animals. *Guide to Nature*, vol. 1, No. 1.
- 1908b. Fossil horses from North Dakota and Montana. *Ann. Carnegie Mus.*, vol. 4, pp. 267-277.
- 1908c. Some Oligocene lizards. *Ann. Carnegie Mus.*, vol. 4, pp. 278-285.

FRICK, CHILDS

1937. Horned ruminants of North America. *Bull. Amer. Mus. Nat. Hist.*, vol. 69.

GAZIN, C. L.

1935. A marsupial from the Florissant beds (Tertiary) of Colorado. *Journ. Paleont.*, vol. 9, pp. 57-62.

GILMORE, C. W.

1928. Fossil lizards of North America. *Mem. Nat. Acad. Sci.*, vol. 22, 3d Mem., 169 pp.
1938. Fossil snakes of North America. *Geol. Soc. Amer.*, Special Paper No. 9.

HALL, E. R.

1945. Dental caries in wild bears. *Trans. Kansas Acad. Sci.*, vol. 48, pp. 79-84.

HOUGH, J. R.

1948. A systematic revision of *Daphoenus* and some allied genera. *Journ. Paleont.*, vol. 22, pp. 573-600.

JEPSEN, G. L.

1930. Stratigraphy and paleontology of the Paleocene of northeastern Park County, Wyoming. *Proc. Amer. Philos. Soc.*, vol. 69, pp. 463-528.
- 1936-1941. See Scott, Jepsen, and Wood.

KOERNER, H. E.

1940. The geology and vertebrate paleontology of the Fort Logan and Deep River formations of Montana. *Amer. Journ. Sci.*, vol. 238, pp. 837-862.

LAMBE, L. M.

1908. The Vertebrata of the Oligocene of the Cypress Hills, Saskatchewan. *Contr. Canadian Paleont.*, vol. 3, pt. 4.

LOOMIS, F. B.

1932. The small Carnivora of the Miocene. *Amer. Journ. Sci.*, vol. 24, pp. 316-329.
1936. Three new Miocene dogs and their phylogeny. *Journ. Paleont.*, vol. 10, pp. 44-52.

LYDEKKER, R.

1898. Wild oxen, sheep, and goats of all lands, living and extinct, pp. xiv+318

MCGREW, P. O.

1938. Dental morphology of the Procyonidae with a description of *Cynarctoides*, gen. nov. *Field Mus. Nat. Hist. Publ.*, geol. ser., vol. 6, pp. 323-339.

MATTHEW, W. D.

1903. The fauna of the Titanotherium beds at Pipestone Springs, Montana. Bull. Amer. Mus. Nat. Hist., vol. 19, pp. 197-226.
1909. The Carnivora and Insectivora of the Bridger Basin, Middle Eocene. Mem. Amer. Mus. Nat. Hist., vol. 9, pt. 6, pp. 291-567.
1930. Range and limitations of species as seen in fossil mammal faunas. Bull. Geol. Soc. Amer., vol. 41, pp. 271-274.

MERRIAM, C. HART

1892. The geographical distribution of life in North America with special reference to the Mammalia. Proc. Biol. Soc. Washington, vol. 7, pp. 1-64.

MILLER, GERRIT S., Jr.

1907. The families and genera of bats. U. S. Nat. Mus. Bull. 57, xvii+282 pp.
1924. List of North American Recent mammals. U. S. Nat. Mus. Bull. 128, xvi+673 pp.

PATTERSON, BRYAN, and MCGREW, PAUL

1937. A soricid and two erinaceids from the White River Oligocene. Field Mus. Nat. Hist. Publ., geol. ser., vol. 6, pp. 245-272.

PETERSON, O. A.

1906. The Miocene beds of western Nebraska and eastern Wyoming and their vertebrate fauna. Ann. Carnegie Mus., vol. 4, pp. 21-72.

SCHLAIKJER, E. M.

1933. A detailed study of the structure and relationships of a new zalambdodont insectivore from the Middle Oligocene. Bull. Mus. Comp. Zool., vol. 74, No. 1, pp. 1-27.
1935. A new basal Oligocene formation. Bull. Mus. Comp. Zool., vol. 74, No. 3, pp. 71-93.

SCHULTZ, C. B., and FALKENBACH, C. H.

1949. Promerycochoerinae, a new subfamily of oreodonts. Bull. Amer. Mus. Nat. Hist., vol. 93, pp. 73-198.
1950. Phenacocoelinae, a new subfamily of oreodonts. Bull. Amer. Mus. Nat. Hist., vol. 95, pp. 91-149.

SCOTT, W. B., JEPSEN, G. L., and WOOD, A. E.

- 1936-1941. The mammalian fauna of the White River Oligocene: Pt. 1, Insectivora and Carnivora, by Scott and Jepsen; Pt. 2, Rodentia, by Wood; Pt. 3, Lagomorpha, by Wood; Pt. 4, Artiodactyla, by Scott; Pt. 5, Perissodactyla, by Scott. Trans. Amer. Philos. Soc., new ser., vol. 28, pp. xiii+980.

SIMPSON, G. G.

1945. The principles of classification and a classification of mammals. Bull. Amer. Mus. Nat. Hist., vol. 85, pp. iii+350.
1946. *Paleogale* and early allied mustelids. Amer. Mus. Nov., No. 1320, pp. 1-14.
1947. Holarctic mammalian faunas and continental relationships during the Cenozoic. Bull. Geol. Soc. Amer., vol. 58, pp. 613-688.

SINCLAIR, W. J.

1922. Hyracodonts from the Big Bad Lands of South Dakota. Proc. Amer. Philos. Soc., vol. 61, pp. 65-79.

STIRTON, R. A.

1935. A review of the Tertiary beavers. Univ. California Publ., Bull. Dept. Geol., vol. 23, No. 13.

THORPE, M. R.

1921. *Leptauchenia* Leidy and *Cyclopidius* (*Pitheciestes*) Cope, with descriptions of new and little known forms in the Marsh collection. Amer. Journ. Sci., ser. 5, vol. 1, pp. 405-419.

1937. The Merycoidodontidae, an extinct group of ruminant mammals. Mem. Yale Peabody Mus. Nat. Hist., vol. 3, pt. 4.

Troxell, E. L.

1922. Oligocene rodents of the genus *Ischyromys*. Amer. Journ. Sci., ser. 5, vol. 3, pp. 123-130.

WHITE, T. E.

1947. Additions to the Miocene fauna of North Florida. Bull. Mus. Comp. Zool., vol. 99, No. 4, pp. 497-515.

WILSON, ROBERT W.

1949. On some White River fossil rodents. Carnegie Inst. Washington Publ. 584.

WOOD, A. E.

1936-1941. See Scott, Jepsen, and Wood.

WOOD, A. E., and WILSON, R. W.

1936. A suggested nomenclature for the cusps of the cheek teeth of rodents. Journ. Paleont., vol., 10, No. 5, pp. 388-391.

issued



by the

 SMITHSONIAN INSTITUTION
 U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3327

 A REVIEW OF THE LABRID FISH GENUS WETMORELLA
 WITH DESCRIPTIONS OF NEW FORMS FROM THE TROPICAL
 INDO-PACIFIC

 By LEONARD P. SCHULTZ and N. B. MARSHALL¹

Fowler (Fishes of Oceania, suppl. 1, p. 358, 1931) and Weber and de Beaufort (Fishes of the Indo-Australian Archipelago, vol. 8, p. 82, 1940) list *Wetmorella philippina* Fowler and Bean (U. S. Nat. Mus. Bull. 100, vol. 7, p. 211, pl. 17, 1928, type locality Philippine Islands) as a synonym of *Cheilinus fasciatus* (Bloch). We have studied the types of *Wetmorella philippina* (fig. 1) and conclude without any doubt that these specimens are generically distinct from *Cheilinus* and are remarkably distinct from *C. fasciatus* or any other species of labrid currently referred to that genus. The generic characters that distinguish *Wetmorella* from other genera in the Labridae are the large scales on the head, which form a pattern not occurring in any other genus of labrid fishes, and the acutely triangular head. Fowler and Bean (op. cit., pp. 211-212) had six specimens from the Philippines, but only four of them, in our opinion, are *philippina* (holotype: USNM 89968 from Little Santa Cruz, Zamboanga; paratypes: USNM 93503 from Port Langcan, Palawan, USNM 93505 from Atulayan Island, Philippines, and USNM 93528 from Cape Kait, Libani Bay, Celebes). The other two specimens represent undescribed species, and these, along with additional specimens from the Marshall Islands and the Red Sea, are described as new.

¹ Curator of Fishes, British Museum (Natural History).

Genus *Wetmorella* Fowler and Bean

Wetmorella Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 211, 1928.
(Genotype, *Wetmorella philippina* Fowler and Bean.)

The genus *Wetmorella* is characterized by dorsal rays IX or X, 9 or 10; anal III,8; pectoral ii,9 or 10; branched caudal rays 6+5; lateral line interrupted with 13 to 15+6 or 7 pores to base of caudal fin. Jaws equal or nearly so; premaxillary protractile; teeth short, conical, in a single row in both jaws, those near front of both jaws becoming gradually enlarged, the two pairs nearest tip of jaws largest; gill membranes broadly joined across isthmus, forming a free fold; head with a distinctive scale pattern composed of large, characteristically shaped scales, arranged in a pattern similar to that shown in figure 53. The chief variation in scales on the head is that there may be 2 median scales on the snout instead of 1; cheek with 1 or 2 rows below which on subopercle may occur another row and a single scale below the latter; 2 or 3 rows of scales behind eye, including the gill cover; a row of large scales occurs above dorsal lateral line, then a second row along spiny dorsal fin, mostly covering the spines except tips, becoming much smaller along soft dorsal rays, almost disappearing on base of last ray; anal fin with a similar sheath of scales; basal half of caudal fin enclosed in large scales; axillary pelvic scale present, short; interorbital space flattish and a little convex; dorsal profile of head nearly straight, forming an angle of 40° to 55° with ventral contour of head; maxillary covered by preorbital when mouth is closed. A blackish ocellate spot in pelvics and at rear of soft dorsal and anal fins; white bar behind eye and on caudal peduncle.

Key to the species of *Wetmorella*

- 1a. Greatest width of white bar between rear of bases of soft dorsal and of soft anal fins across caudal peduncle is contained about 2.0 to 4.7 times (3.8 to 4.7 in Red Sea specimens) in least depth of caudal peduncle; white bar on caudal peduncle completely encircles it; young only, with white bar from front of spiny dorsal through pectoral base, thence to pelvic base; white bar behind eye meets its fellow near occiput.
- 2a. Caudal fin plain dusky, except in smallest specimens there occur 2 narrow black cross bars, remainder of fin pale or white; some scales on middle of sides have black dots; greatest depth about 2.4 to 2.5 in standard length.----- ***Wetmorella ocellata*, new species**
- 2b. Caudal fin with a few black spots on middle rays, at about three-fourths their length distally; greatest depth 2.4 to 3.2.
- 3a. Greatest width of peduncular white bar 2.3 to 3.4 in least depth of caudal peduncle; no white bar in front of ocellate spot in soft dorsal and in front of soft anal fins (fig. 52).

***Wetmorella philippina philippina* Fowler**

- 3b. Greatest width of peduncular white bar 3.8 to 4.7 in least depth of caudal peduncle; white bar present in front of ocellate spot in soft dorsal and in soft anal fins (pl. 12, fig. A).

***Wetmorella philippina bifasciata*, new subspecies**

1b. Greatest width of white bar on caudal peduncle between rear of bases of soft dorsal and of soft anal fins contained about 6 to 10 times in least depth of caudal peduncle; greatest depth about 2.8 to 2.9.

4a. A white bar from behind ocellate spot in soft dorsal passes in front of ocellate spot in soft anal fin; a white bar from bases of third and fourth dorsal spines passes behind pectoral base, thence to just behind pelvic base; posterior third of caudal fin with a black band, but rear margin of caudal fin is edged with white; the white bar on caudal peduncle occurs as a saddle ventrally and does not extend on dorsal part of caudal peduncle.

Wetmorella albofasciata, new species

4b. No white bar passing between ocellate spot in soft dorsal and that in soft anal; a narrow, white bar extends from in front of ocellate spot in soft dorsal to in front of that in soft anal fin; caudal fin plain dusky, edged with white distally; a white bar between orbits in the interorbital space.-----*Wetmorella triocellata*, new species

Wetmorella philippina bifasciata, new subspecies

FIGURE 53; PLATE 12, FIGURES A, B

Holotype.—BM 1951.9.18.1, Red Sea, Suakin, Anglo-Egyptian Sudan, 'Manihine' Collection, January 13, 1951, taken by use of derris root (6 percent rotenone) from pieces of coral growing on sea wall surrounding Suakin, at depth of 3 feet, standard length 50 mm.

Paratype.—BM 1951.9.18.2, taken with holotype and bearing same locality data, standard length 41.5 mm.

Description.—Certain counts and measurements are recorded for the holotype and paratype in tables 1 and 2.

Body compressed, greatest depth opposite middle of spiny dorsal base; snout normal; dorsal profile of head straight or nearly so, forming an angle of 52 to 55° with ventral contour of head and body;

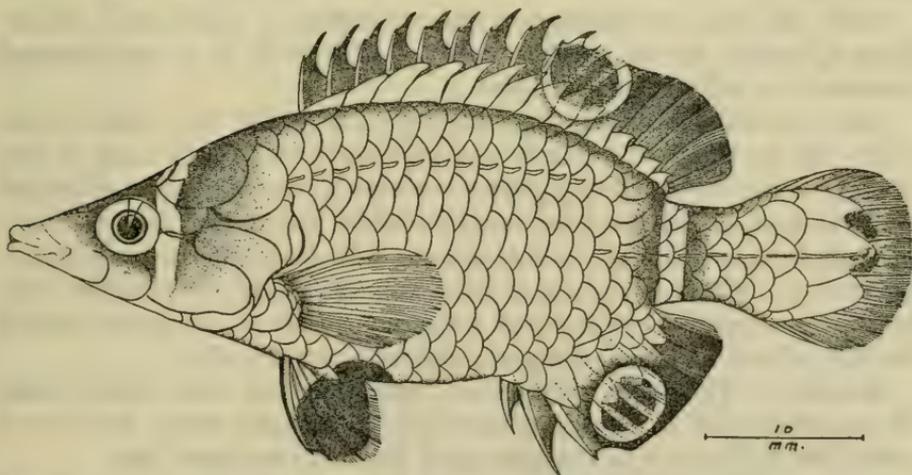
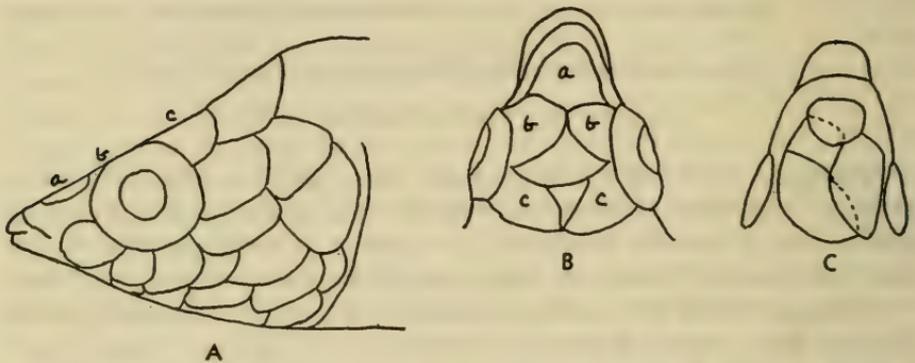


FIGURE 52. Holotype of *Wetmorella philippina philippina* Fowler and Bean (USNM 89968) from the Philippines.

TABLE 1.—Counts recorded for species of *Wetmorella*.

Species	Dorsal rays				Anal rays		Pectoral rays			Branched caudal rays		Lateral line pores				
										Dorsal lobe	Ventral lobe	Upper			Lower	
	IX	X	9	10	III	8	II	9	10	6	5	13	14	15	6	7
<i>W. philippina philippina</i>	3	1	1	3	4	4	7	1	6	4	4	2	1	1	2	2
<i>philippina bifasciata</i>	2	.....	.....	2	2	2	2	.....	2	2	2	.....	.....	.....	2	.....
<i>ocellata</i>	12	.....	.....	12	12	12	12	.....	12	3	3	.....	5	2	3	4
<i>albofasciata</i>	1	.....	.....	1	1	1	2	.....	2	1	1	.....	.....	1	.....	1
<i>triozellata</i>	1	.....	.....	1	1	1	2	.....	2	1	1	.....	.....	1	1	.....

FIGURE 53. Sketch of the arrangement of the scales on the head of holotype of *Wetmorella philippina bifasciata*, new species. A, B, holotype; C, paratype.

interorbital space slightly convex, nostrils small, the anterior one tubular; jaws equal or nearly so; scales on head as illustrated in figure 53.

Since the other morphological characteristics of *Wetmorella philippina bifasciata* are so similar to *W. p. philippina* it is not deemed necessary to redescribe them here.

Color in alcohol.—Background coloration brownish with a narrowish white bar just behind ocellate spot passing through rear base of soft dorsal, thence across caudal peduncle through rear of anal base behind ocellate spot in soft anal fin; another white bar, much less distinct, extends from in front of ocellate spot in soft dorsal fin across body to in front of ocellate spot in anal fin; a narrow, white bar extends from occiput past rear of eye to lower posterior corner of gill cover; caudal fin with about 7 or 8 black spots; pelvics black distally.

Remarks.—This new subspecies from the Red Sea differs from *W. p. philippina* in having a narrower peduncular white bar and a white bar in front of the ocellate spot in dorsal and anal fins.

Named *bifasciata* in reference to the two white bands, one in front and one behind the ocellate spots.

TABLE 2.—Measurements made on species of Wetmorella, expressed in thousands of the standard length

Characters	<i>philippina philippina</i> Fowler			<i>ocellata</i> , new species		<i>albo-fasciata</i> , new species	<i>tricolorata</i> , new species	<i>philippina bifasciata</i> , new subspecies, Red Sea	
	Holotype 89908	Paratypes		Holotype 112368	Paratypes			Holotype 1951.9.18.1	Paratype 1951.9.18.2
	93503	93505	93528	112371	112372	93504	93529	50	39.2
Standard length in mm.....	44	30.7	38.5	50	25	36.4	39.2	50	41.5
Length of head.....	407	394	402	400	415	406	408	380	397
Greatest depth.....	414	371	374	400	403	385	344	380	360
Least depth of body.....	148	153	156	136	142	140	148	140	136
Snout.....	109	111	112	122	115	115	110	120	120
Eye.....	105	124	125	100	138	115	110	110	108
Interorbital space.....	102	114	101	106	115	104	97	100	102
Greatest width of peduncular white bar.....	43	59	68	60	71	14	20	32	38
Postorbital length of head.....	189	192	187	186	190	201	204	170	180
Tip of snout to anus.....	682	619	688	688	682	646	638	670	710
Tip of snout to dorsal origin.....	448	440	436	424	434	456	446	450	433
Longest fin ray:									
Pectoral.....	200	195	205	206	205	192	181	200	180
Pelvic.....	177	186	219	182	205	170	191	190	192
Dorsal spine.....	157	199	169	184	178	206	191	240	205
Dorsal soft ray.....	132	163	161	158	158	145	140	180	169
Anal spine.....	134	218	184	176	182	225	191	220	205
Anal soft ray.....	118	114	138	154	146	135	140	180	180
Caudal.....	227	238	260	256	257	275	263	230	241

Wetmorella ocellata, new species

PLATE 12, FIGURES D, E

Holotype.—USNM 112368, Rongelap Atoll, Kieshiechi Island, north end, lagoon coral head, depth 20 feet, July 24, S-46-285,² Brock and Herald, standard length 38.6 mm.

Paratypes.—USNM 112372, Bikini Atoll, coral heads in eastern end of lagoon, depth 20 to 25 feet, March 26, S-46-42,² Brock and Schultz, 2 specimens, 25 mm. and 49 mm.; USNM 112371, Bikini Atoll, off Amen Island in lagoon, depth 30 feet, August 4, S-46-307,² Herald and Brock, 1 specimen, 50 mm.; USNM 112370, Bikini Lagoon, 100 yards off Airy Island, depth 20 to 40 feet, August 7, S-46-308,² Brock and Herald, 6 specimens, 23 mm. to 57 mm. Bikini Atoll, reef between Amen and Bikini Islands in lagoon, depth 30 feet, July 31, 1947, Donaldson and Welander, 1 specimen, 48 mm.; USNM 112369, taken with holotype and bearing same data, 1 specimen, 41 mm.; USNM 112373, Bikini Atoll, Amen Island, August 21, 1947, Univ. Washington, 1 specimen, 43 mm.

Description.—Dorsal rays IX,10; anal III,8; pectoral ii,10; pelvics I,5; branched caudal fin rays 6+5; pores in lateral lines 14 or 15+6 or 7; scales above lateral line 2, below lateral line to anal origin 6; vertical scale rows 20 or 21; gillrakers on first arch about 6+9. (Certain measurements made on the holotype and two paratypes, expressed in thousandths of the standard length, are recorded in table 2.)

Body compressed, the greatest depth opposite middle of spiny dorsal base; snout normal; dorsal profile of head straight or nearly so, forming an angle of 40° to 46° with ventral contour of head and body; interorbital space slightly convex; nostrils small, the anterior one tubular; a vertical line through rear nasal opening passes through front edge of eye; jaws approximately equal; maxillary reaches to a vertical line through front nostril; maxillary covered by preorbital when mouth is closed; dentary normal; premaxillary protractile; teeth short, conical in a single row in both jaws, those near front of both jaws becoming gradually enlarged, the 2 pairs nearest tip of jaws largest, and, when mouth is closed, those of lower jaw fitting

EXPLANATION OF PLATE 12.—*A*, holotype of *Wetmorella philippina bifasciata*, new subspecies (BM 1951.9.18.1) from Red Sea; *B*, paratype of same subspecies from same locality; *C*, holotype of *W. albofasciata*, new species (USNM 93504) from the Philippines; *D*, holotype of *W. ocellata*, new species (USNM 112368) from Rongelap Atoll, Marshall Islands; *E*, paratype of *W. ocellata*, new species (USNM 112372) from Bikini Atoll, 25 mm. standard length.

² Collecting station in Operation Crossroads, 1946 (see U. S. Nat. Mus. Bull. 202, 1953).



A



B



C



D



E

FOR EXPLANATION SEE FACING PAGE.

between the two opposite teeth in upper jaw; gill membranes broadly joined across isthmus and forming a free fold; head with a distinctive scale pattern composed of large and definite shaped scales as follows: Cheek with a single row of enlarged scales below which on subopercle is another row, and a single scale below the latter; 3 rows behind eye, including gill cover, dorsal surface of head scaled forward to snout just in front of orbits, the two anteriormost scales median in position, then 3 in middle of interorbital space, followed by a pair of larger ones between rear of orbits, then about 5 scales to dorsal fin origin; above dorsal lateral line is a row of large scales, then a second row along spiny dorsal fin, mostly covering the spines except tips, then the row of scales is much smaller along soft rays, almost disappearing on base of last ray; anal fin with a similar sheath of scales; basal half of caudal fin enclosed in large scales; axillary scale of pelvic short; pectoral fin reaches to opposite about seventh scale of lateral line; lateral line interrupted, beginning again 2 scale rows below on caudal peduncle; fourth pectoral ray usually longest; pelvics reaching or nearly reaching anus; caudal fin rounded.

Color in alcohol.—Background coloration light brownish to brownish, with a brown-edged white bar across caudal peduncle just behind rear of bases of soft dorsal and soft anal fins, and another brown-edged white bar just behind eye from side of head to nape; 3 prominent black ocellate spots, one at front of soft dorsal, another at front of soft anal, and the largest occupying each pelvic fin and the underlying part of the body opposite the pelvic fins; no white bar across interorbital space; middle of upper lip dark barred. The two smallest specimens, 23 mm. and 25 mm., probably represent a juvenile color pattern—in addition to the white bar behind the ocellate spots there is another white bar in front of them that extends from bases of last dorsal spines to bases of anal spines; another white band extends from first two dorsal spines just behind pectoral base to pelvics; caudal fin white with two narrow cross bars, the distal margin of fin white.

Ecology.—This interesting new labrid was taken only at depths of about 20 to 40 feet in the lagoon among coral heads. It was not seen in the intertidal zone of the reefs.

Remarks.—This new species may be distinguished from species in the genus *Wetmorella* by means of the key. Its closest relative is *philippina philippina* from which it differs in lacking black pigment spots in the caudal fin; *ocellata* has a plain dusky caudal fin in the adult, and none of the specimens of *ocellata* has even a trace of black spots in the caudal fin. After studying several hundred species of fishes of the tropical Indo-Pacific in numerous families we place a great deal of confidence in the color pattern differences such as occur in the Chaetodontidae, Labridae, Serranidae, and other families.

Thus we have decided to recognize two new species and one new subspecies. Larger series will make it possible to determine the exact status of these new forms. Among our 12 specimens of *ocellata* there is little variation in color pattern except that which occurs between small (young) specimens and the large adult specimens.

Named *ocellata* in reference to the ocellate spots which help to characterize all known species of the genus *Wetmorella*.

Wetmorella albofasciata, new species

PLATE 12, E

Wetmorella philippina (in part) Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 212, 1928 (specimen from Mabul Island, Philippines).

Holotype.—USNM 93504, Mabul Island, Philippines, *Albatross*, September 29, 1909, standard length 36.4 mm.

Description.—Dorsal rays IX,10; anal III,8; pectoral ii,10–ii,10; pelvics I,5–I,5; branched caudal 6+5; pores in lateral line 15+7 with 2 scales above and 6 below to anal origin; vertical scale rows 21.

Certain measurements made on the holotype and expressed in thousandths of the standard length are recorded in table 2.

Since the morphological characteristics of *albofasciata* are so similar to those of *ocellata* it is not deemed necessary to repeat them here except to point out that this species is more slender, its greatest depth about three times in the standard length.

Color in alcohol.—Background coloration brownish, with a narrow, white bar from just behind ocellate spot in soft dorsal, passing across body in front of ocellate spot in soft anal fin, ending on front of anal fin; peduncular white bar confined to lower half of caudal peduncle, not extending much above peduncular lateral line; a short, white bar occurs in front of ocellate spot in soft dorsal and ends near dorsal

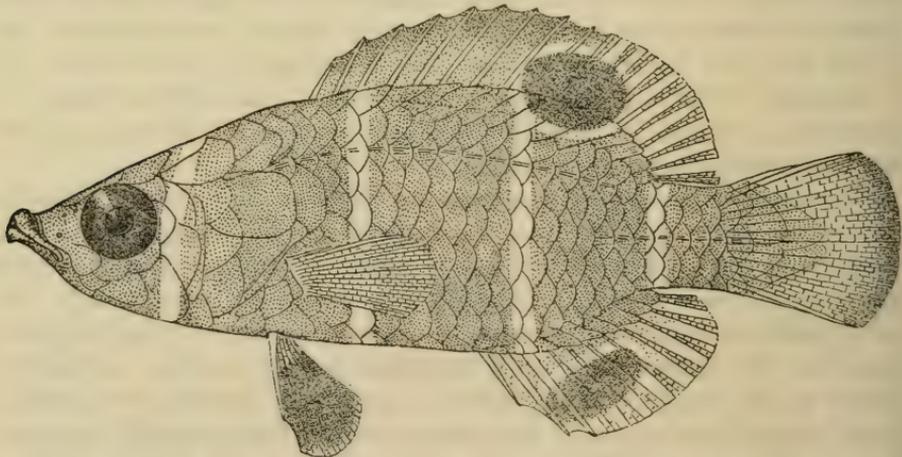


FIGURE 54. Holotype of *Wetmorella triocellata*, new species (USNM 93529) from the Philippines. Drawn by Mrs. Aime M. Awl.

lateral line; another white bar begins near base of third dorsal spine, curves ventrally, and passes about 2 scales behind pectoral base, thence to behind black area near base of pelvics; distal fourth of caudal fin blackish edged with white on rear margin and the black caudal spot edged with white anteriorly; pelvics blackish except edged with white and body next to pelvics blackish.

Remarks.—This species may be separated from all others referable to the genus *Wetmorella* by the white bar that passes across body between the ocellate spots in soft dorsal and soft anal fins. Named *albofasciata* in reference to the characteristic white bars.

Wetmorella triocellata, new species

FIGURE 54

Wetmorella philippina (in part) Fowler and Bean, U. S. Nat. Mus. Bull. 100, vol. 7, p. 212, 1928 (specimen from Rapurapu Island, June 24, 1909).

Holotype.—USNM 93529, Rapurapu Island, Philippines, *Albatross*, June 24, 1909, standard length 39.2 mm.

Description.—Dorsal rays IX,10; anal III,8; pectorals ii,10–ii,10; pelvics I,5–I,5; branched caudal rays 6+5; pores in lateral line 15+6, with 2 scales above and 6 below to anal origin; vertical scale rows 21.

Certain measurements made on the holotype, and expressed in thousandths of the standard length, are recorded in table 2.

Since the morphological characteristics of *triocellata* are so similar to those of *ocellata*, it is not deemed necessary to repeat them here, except in regard to greatest depth, which is contained about 3 times in the standard length; it is notably a more slender fish than *ocellata* and *philippina*.

Color in alcohol.—A narrow, white bar occurs behind the two ocellate spots in the median fins and another extends from in front of ocellate spot in dorsal to in front of that in anal, ending near base of third anal spine; background coloration light brown; a brown-edged pale bar from behind eyes meets its fellow dorsally on head; probably another brown-edged pale bar extends across interorbital space although this is faded as are all of the pale bars; caudal fin gradually a little darker distally, probably narrowly edged with white. We quote the following *Albatross* color note: "Pale band behind head extends across occiput and bounded by brown line in front and behind its entire extent."

Remarks.—This new species is recognizable from others referable to the genus *Wetmorella* by its slender form in connection with a distinctive color pattern. It is closest to *albofasciata* in regard to its slender form but differs in not having a white bar on the body passing between the two ocellate spots in the median fins.

Named *triocellata* in reference to the three ocellate spots that characterize this group of fishes.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3328

REVIEW OF THE ATLANTIC PERIWINKLES, NODILITTORINA, ECHININUS, AND TECTARIUS

By R. TUCKER ABBOTT

Since the 1942 publication in Johnsonia of "The Genera *Tectarius* and *Echininus* in the Western Atlantic" by Clench and Abbott, enough additional data have been assembled to warrant a review of this group of tropical, littoral snails. In addition to the anatomical, distributional, and biological information presented here, there is a short discussion of the phylogenetic position of the genus *Echininus*, and some changes in nomenclature.

It had been noted for some time that the operculum of *Echininus* was multispiral, a feature commonly found among members of such families as the Trochidae, Potamididae, and Modulidae but unusual for the Littorinidae, which are well known for their paucispiral opercula. In a paper that has generally been overlooked, Kesteven (1903) removed the genus *Echininus* (*Echinella* of Kesteven) from its customary position in the Littorinidae and placed it in the Modulidae. This has necessitated our making a study of the gross anatomy of *Echininus*, *Tectarius*, and *Modulus*. This study was made possible through the generosity of Mrs. Germaine L. Warmke, who collected and airmailed living specimens of *Echininus nodulosus* Pfeiffer and *Nodilittorina tuberculata* Menke from Puerto Rico. In the process of comparing the latter species with *Tectarius muricatus* Linné, we came to the conclusion that *Nodilittorina* should be considered as a full genus closely related to *Melarhaphe* or *Littoraria* rather than as a subgenus of *Tectarius*.

The nomenclatorial adjustments in this paper involve changing the name used in Johnsonia, *Tectarius tuberculatus* Wood, to *Nodilittorina tuberculata* Menke, and a new and presumably valid genotype designation for *Nodilittorina*.

Family LITTORINIDAE

Genus *Nodilittorina* von Martens, 1897

In Johnsonia, Clench and I had erroneously considered *Nodilittorina* as a subgenus of *Tectarius*. From a study of the shell and animal characters, the radula, and the type of egg capsules, it appears that this group is much more closely allied to the *Melarhappe* or *Littoraria* subgenera of *Littorina* than to *Tectarius*. An obvious relationship in shell characters is seen between the Indo-Pacific *Melarhappe mauritiana* Lamarck and such *Nodilittorina* as *miliaris* Quoy and Gaimard and *picta* Philippi, all of which have the peculiarly flattened, thin inner columella edge and the axial, zigzag color streaks on the whorls. The latter two, *miliaris* and *picta*, have strong sculpturing which tends towards the production of small nodules which are characteristic of *Nodilittorina*.

The floating egg capsule of *Nodilittorina tuberculata* Menke and *Littorina* (*Melarhappe*) *ziczac* Gmelin (copied in our fig. 55 from Marie Lebour, 1945) are similar in that they are drum-shaped and with 6 to 7 spiral lines or ridges on the top surface. These spiral ridges are absent in the capsules of *Tectarius muricatus* Linné and *Littorina* (*Melarhappe*) *neritoides* Linné. The latter species is from the eastern Atlantic and is the genotype of *Melarhappe*. Should it prove to have a simple, single-pronged penis, as does *Tectarius*, it is likely that such species as *L. ziczac* Gmelin and *L. mauritiana* Lamarck (which have complicated, *Nodilittorina*-like penes) do not belong to *Melarhappe*, *sensu stricto*.

Three recent papers have contributed to our knowledge of littorinid egg capsules (Ostergaard, 1950; Tokioka, 1950; and Tokioka and Habe, 1953.) There appear to be three groups of capsules: (1) Helmet-shaped—*Littorina littorea* Linné (Lebour, 1935, p. 375) and *Littorina pinctado* Wood (Ostergaard, 1950, p. 97); (2) simple drum-shaped—*Littorina neritoides* Linné (Lebour, 1935, p. 375) and *Tectarius muricatus* Linné (Lebour, 1945, p. 465); and (3) drum-shaped, with ridges on the top surface—*Littorina ziczac* Gmelin (Lebour, 1945, p. 465) and *Nodilittorina tuberculata* Menke (Lebour, 1945, p. 465).

To the latter group, Tokioka and Habe add the egg capsules of three possible littorinid snails. These capsules were given the non-binomial names of "*Littorina-capsula habei*, *multistriata*, and *hagruma*." The Japanese capsules differ from those in the Western Atlantic species in having concentric instead of spiral ridges on the top surface. The "*hagruma*" capsule is unique in bearing on its peripheral surface a series of 21 gearlike undulations.

The genus *Hamus* of Klein seems to have been first validated in 1886 by R. B. Watson (Scaphopoda and Gasteropoda, in Report on the Scientific Results of the Voyage of HMS *Challenger* . . . , vol. 15, pt. 42, p. 576). Although he intended it for the group we know as *Nodilittorina*, I prefer to relegate *Hamus* to the synonymy of the trochid *Turcica* A. Adams, 1854, by here designating *Tectaria montrouzieri* Fischer, 1878, as the genotype of *Hamus* Watson, 1886. For identity of that trochid species see Hedley (1901, p. 121).

Wenz's (1939, p. 523) genotype designation of *Nodilittorina* is invalid, since *Turbo nodulosus* Gmelin is not one of the species included by von Martens in 1897 either in name or substance and since *Turbo* (not *Trochus*) *nodulosus* Gmelin is a turbinid species. Von Marten's *Littorina nodulosa* Pfeiffer is an *Echininus*. I hereby designate *Littorina pyramidalis* Quoy and Gaimard as the genotype of *Nodilittorina* von Martens, 1897. This species is *Trochus nodulosus* Gmelin, non Solander, 1766.

Habe (1951, p. 90) followed the error of Clench and Abbott (1942) in considering *Turbo tuberculata* Wood the same as Gmelin's *nodulosus*. Actually it is the West Indian *Echininus*, as seen by our revised synonymy. *Littorina tuberculata* Wood is not included by name in von Martens' genus and cannot be designated as the genotype.

Below, I have included a revised synonymy of the Western Atlantic *Nodilittorina tuberculata* Menke which Clench and I had erroneously listed in Johnsonia as *Tectarius tuberculatus* Wood. Our error arose in not recognizing Wood's figure as representing the Atlantic *Echininus*. Although the columella region of the shell illustrated by Wood is very close to that found in some *Nodilittorina*, the nature and number of nodules clearly identifies it as *Echininus nodulosus* Pfeiffer.

Nodilittorina tuberculata Menke

Trochus nodulosus Gmelin (non Solander, 1766), Caroli a Linné Systema naturae . . . , ed. 13, p. 3582, No. 98, 1791 (in part as variety minor). (Mari, Americam meridonalem.)

Littorina tuberculatus Menke, Synopsis methodica Molluscorum . . . , p. 25 (Pyrmonti), 1828 (refers to Gmelin's minor).

Littorina thiarella Anton, Verzeichniss der Conchylien . . . , p. 53, 1839.

Littorina nodulosa d'Orbigny, Mollusques, vol. 1, p. 205 (exclusive of synonymy), pl. 14, figs. 11-14, in de la Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba, 1841. (Cuba, Martinique, and St. Lucia.)

Littorina dilatata d'Orbigny, Mollusques, vol. 1, p. 207, pl. 14, figs. 20-23, in de la Sagra, Histoire . . . naturelle . . . de Cuba, 1841. (Havana.)

Shell.—It is easy to confuse this species with *Echininus nodulosus* Pfeiffer, especially since their ranges overlap and their habitats are almost identical. *N. tuberculata* is usually 4 mm. to 5 mm. smaller than *E. nodulosus* from the same small area. The nodules in each

spiral row on the periphery of the whorl are always lined up under one another in *N. tuberculata*, while in *E. nodulosus* they are not, since the upper row bears fewer (and larger) nodules than the lower row.

Sexual dimorphism in the form of shell length was very slight in 103 specimens examined from Rincon Lighthouse, Puerto Rico. Of that number, 38 percent were males; their mean shell length was 7.7 mm. The mean length of the females was 9.1 mm. In *Echininus* the difference in the sizes of the shells of the two sexes was more pronounced, but this is a feature which is variable from colony to colony in the same species (see Abbott, 1949).

Animal.—Live specimens from Rincon Lighthouse, western Puerto Rico, were examined. The animal is typically littorinid. The tentacles are translucent yellowish with a small, circular band or ring of black around the region near the distal end. The underside of the foot is yellowish to yellowish gray with a distinct, longitudinal, indented line dividing the foot into two lateral areas. The furrow is more prominent near the center, and disappears towards the posterior and anterior ends of the sole. The waves of progression are retrograde and ditaxic (see Vlès, 1907, and remarks under *Tectarius muricatus*). The foot progresses somewhat in the manner of a person slowly shuffling forward in a potato sack.

The penis is large and located on the right side of the body under the base of the right tentacle. On the anterior edge of the penis there is a large, bean-shaped, snow-white gland, and just distal to it is a short, fairly large, clear accessory flagellum. The main prong of the penis is slender and tapering to a point, with a nearly closed seminal groove along the posterior edge. The penis of *N. tuberculata* is very similar to that of preserved specimens I have examined in *Littorina (Melarhappe) ziczac* Gmelin from the Bahamas.

Radula.—The ribbon is very long with the unused part coiled up like a watch spring in a pocket in the dorsal region behind the head. One specimen from Puerto Rico had about 1,125 transverse rows. The ribbon is delicate and half as wide as that found in *Echininus*. The central tooth is narrow, with the appearance of having been laterally compressed. It bears a large central cusp, and, crowded over this, are the two lateral cusps. The lateral and inner marginal teeth are massive, each with a large inner cusp and a much smaller outer cusp. The outer marginal tooth is smaller, fairly weak; it bears 5 denticles in Puerto Rico specimens and 8 denticles in Habana, Cuba, specimens.

Parasitology.—In living specimens examined from the rocky shore near Habana, Cuba, several specimens of *N. tuberculata* were found to be heavily infected with single-tailed, two-eye-spotted cercariae whose

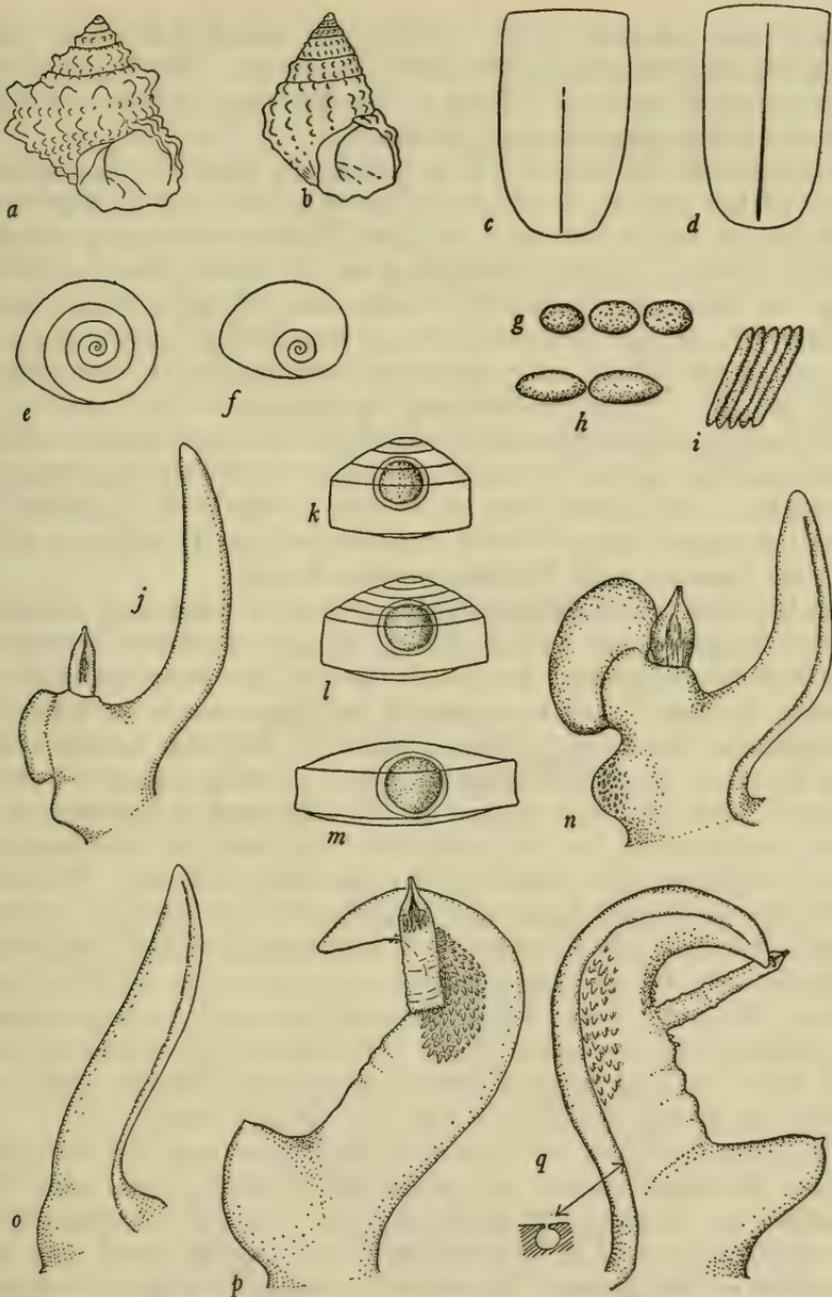


FIGURE 55.—a, Shell of *Echininus nodulosus* Pfeiffer ($\times 1\frac{1}{2}$). b, Shell of *Nodilittorina tuberculata* Menke ($\times 1\frac{1}{2}$). c, Underside of foot of *E. nodulosus* ($\times 2$). d, Underside of foot of *N. tuberculata* ($\times 2$). e, Operculum of *E. nodulosus* ($\times 2$). f, Operculum of *N. tuberculata* ($\times 2$). g, Fecal pellets of *E. nodulosus* ($\times 4$). h, Fecal pellets of *N. tuberculata* ($\times 4$). i, Fecal pellets of *Modulus modulus* Linné ($\times 4$). j, Penis of *Littorina ziczac* Gmelin ($\times 6$). k, Floating egg capsule of *L. ziczac* (diam. 0.20 mm.). l, Egg capsule of *N. tuberculata* (diam. 0.24 mm.). m, Egg capsule of *Tectarius muricatus* Linné (diam. 0.24 to 0.32. After Lebour, 1945). n, Penis of *N. tuberculata* ($\times 6$). o, Penis of *T. muricatus* ($\times 6$). p, q, Penis of *E. nodulosus* ($\times 6$).

identity was unknown to me. They were located in the upper part of the whorls in the region of the digestive glands. They may possibly be parasites of sea birds. None of the *Echininus nodulosus* Pfeiffer collected in the same area was infected.

Geographical distribution.—It is interesting that the geographical range of this species is identical with that of *Tectarius muricatus*. Both species are coastal rock dwellers, the former living in the immediate vicinity of tide and splash pools, the latter living anywhere from the spray zone, where the rocks are wet only during windy weather at high tide, to a point 70 feet from the sea, where the rocks are dry except during rainy or stormy periods (Clench and Abbott, 1942, pp. 2, 3). The *Nodilittorina* distribution in the Western Atlantic (see fig. 56, *a*) is Caribbean in its limits with two minor northern extensions, one along the southeast coast of Florida, the other in Bermuda. There have been no records in the Gulf of Mexico or along the eastern coast of South America south of Trinidad, as is the case, for instance, with *Modulus modulus* Linné.

On the other hand, the geographical range of *Echininus nodulosus* Pfeiffer is much more limited (fig. 56, *b*) and consists of a compact oval area which includes southeast Florida, the Bahamas, and the Greater Antilles. Despite numerous museum records for other littoral species, the locally common *Echininus* has not been recorded from Bermuda, the Lesser Antilles, or the Caribbean shores of Central or South America. The reasons for this difference in distribution is, as yet, unexplained, but the geological history and the life history of these two groups, when known, will likely offer a solution. The relatively dry habitat of *Echininus* and *Tectarius muricatus* in contrast to the lower and wetter station of *N. tuberculata* precludes any correlation between the immediate, ecological niche and the distributional range. However, food habits, dispersal factors by other animals, and enemies are unknown. Both *Nodilittorina* and *Tectarius* have been found to expel single, floating egg capsules (Lebour, 1945), but the manner of egg deposition is unknown for *Echininus*.

The facts published by Mattox (1949) concerning the ecological station (bio-stratification) and resistance to drying conditions (exsiccation) of *Nodilittorina tuberculata* (as *Tectarius tuberculatus*) in Puerto Rico are open to question since they may be based upon observations on two genera. *Echininus* is commonly found in company with *Nodilittorina* along the rocky shore of the western end of Puerto Rico. The two are easily confused and the author makes no mention of the common *Echininus* in his report on the eight littoral species of that area.

New records.—BAHAMAS: Andros Island; Aklin Island; New Providence Island; Great and Little Inagua Islands; Mariguana

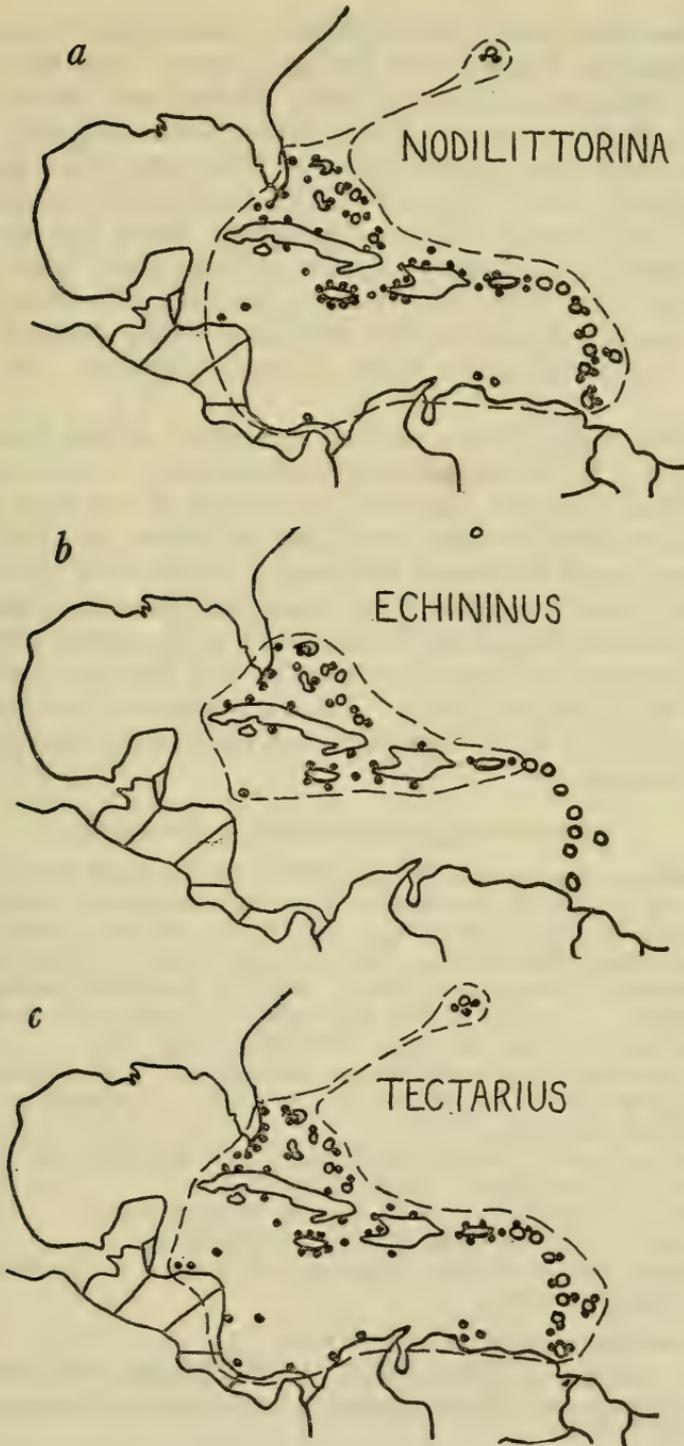


FIGURE 56.—Distribution in the West Indies of *Nodilittorina tuberculata* Menke, *Echininus nodulosus* Pfeiffer and *Tectarius muricatus* Linné (see locality records in text).

Island; East and Grand Caicos Islands; Cotton Cay, Turks Islands (all P. Bartsch). CUBA: Cape Cajon; Cabañas; Río Ojo de Toro, Oriente. HISPANIOLA: Torbeck, Dept. du Sud, and Saltrou, Dept. de l'Ouest, Haiti. JAMAICA: Little River, Trelawney; Dry Harbor Cave, St. Ann; Great Pedro Bay, St. Elizabeth; Ora Cabesa, St. Mary; Hector's River, Portland; Little Cayman Island (all C. R. Orcutt). PUERTO RICO: Rincon Lighthouse, Mona Passage (G. L. Warmke and N. T. Mattox); Aguadilla, Porto Real; Mona Island. LESSER ANTILLES: Villa, St. Vincent; Marigot, Dominica; Guadeloupe. CENTRAL AMERICA: Fort Sherman, Colón, Panamá (L. D. Sayers). SOUTH AMERICA: Santa Marta, Colombia. (All records USNM.)

I am also adding here a revised synonymy of the Indo-Pacific sibling species, *N. pyramidalis* Quoy and Gaimard. I have compared material from northern Australia (the region of the type locality) with specimens from the East Indies, the Philippines, and the Ryukyu Islands and do not believe, on the basis of the material at hand, that *N. vilis* or *N. malaccana* should be recognized even as subspecies. I have not included *subnodosa* Philippi, 1847, in the synonymy for lack of sufficient number of specimens from its Red Sea type locality. It may well be a good subspecies. The Formosan specimen figured by Habe (1951, pl. 14, fig. 1) is probably not the Red Sea species, despite its close resemblance.

Nodilittorina pyramidalis Quoy and Gaimard

- Trochus nodulosus* Gmelin (non Solander, 1766), Caroli a Linné Systema naturae . . . , ed. 13, p. 3582, No. 98, 1791 (refers to Martini and Chemnitz, Neues Systematisches conchylien-cabinet, vol. 5, pl. 168, figs. 1545, 1546 (of specimens from Cook's voyages "aus den Sudlandern.") ("Öceano australi."))
- Turbo trochiformis* Dillwyn (non Brocchi, 1814), A descriptive catalogue of recent shells . . . , vol. 2, p. 826, 1817 (refers to Gmelin, 1791, p. 3582, and Martini and Chemnitz (loc. cit.). ("Southern Ocean."))
- Littorina pyramidalis* Quoy and Gaimard, Zoologie, vol. 2, p. 482, pl. 33, figs. 12-15, in d'Urville, Voyage de . . . l'*Astrolabe* . . . pendant . . . , 1833. (Jervis Bay, Australia.)
- Litorina vilis* "Menke" Philippi, Abbildungen und Beschreibungen . . . Conchylien . . . , vol. 2, p. 145, pl. 2, fig. 21, 1846.
- Litorina malaccana* Philippi, Abbildungen und Beschreibungen . . . Conchylien . . . , vol. 3, p. 51, pl. 6, fig. 17, 1847. (Pulo Pinang.)
- Litorina cecillei* Philippi, Zeitschr. Malakoz., vol. 8, No. 2, p. 78, 1851. (Liewkiew=Ryukyu Islands.)

Type locality.—Jervis Bay, Australia.

Range.—India and Ceylon, Siam, the Philippines, and East Indies, south to New South Wales, Australia, and north to Honshu, Japan.

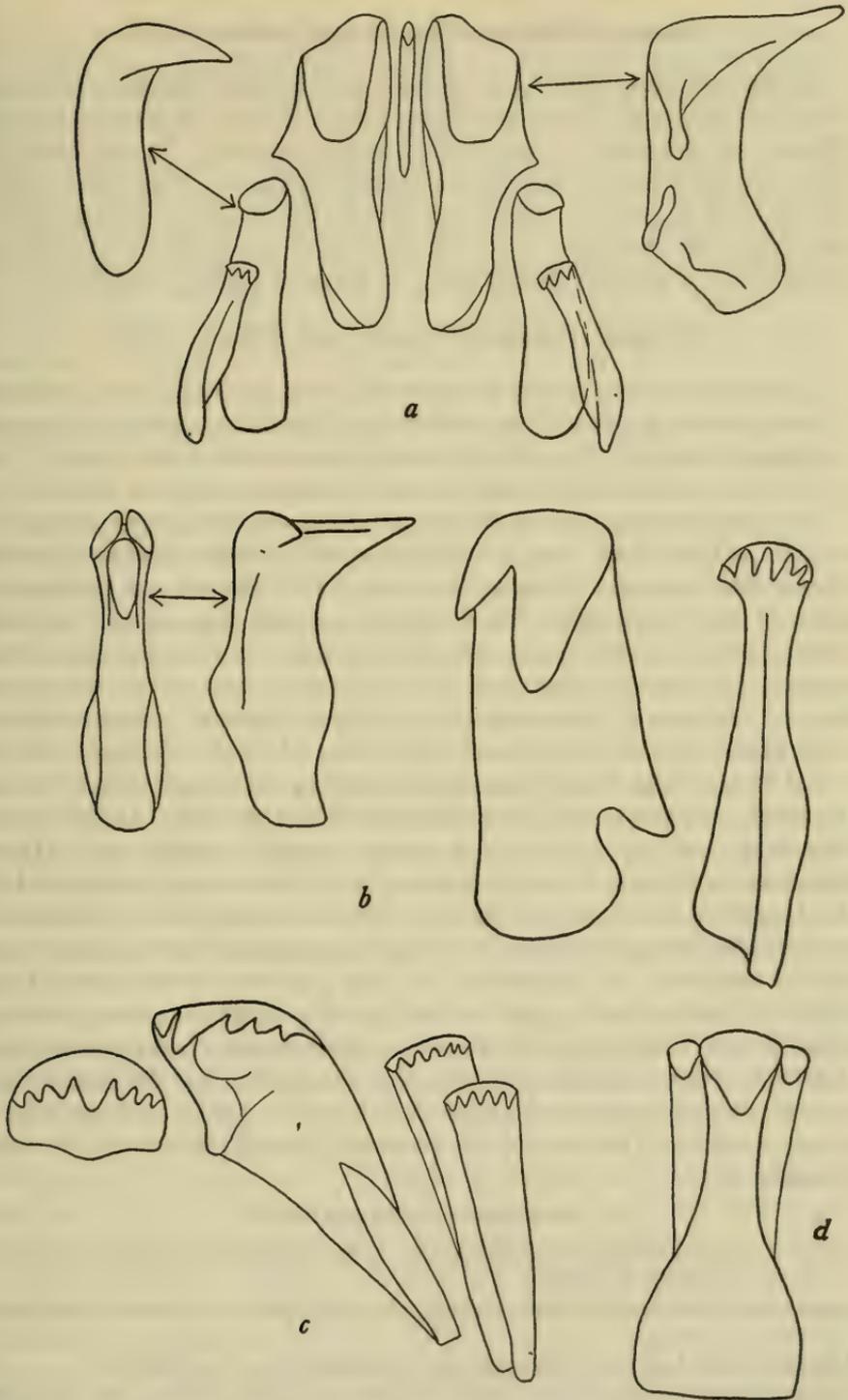


FIGURE 57.—Radulae of, a, *Echininus nodulosus* Pfeiffer, b, *Nodilittorina tuberculata* Menke, c, *Modulus modulus* Linné, and, d, the central tooth of *Tectarius muricatus* Linné. (Arrows point to side views of teeth.)

Genus *Echininus* Clench and Abbott, 1942

Echininus, sensu stricto, is limited to the Indo-Pacific. It differs from the subgenus *Tectininus* Clench and Abbott in having an umbilicus and in having a more spinulose sculpturing. It was formerly known as *Nina* Gray, 1850 (non Horsfield 1829, non *Nina* Gray 1855). *Echinella* of Kesteven, 1903, and some other authors is this genus, but *Echinella* Swainson is a synonym of *Tectarius* Valenciennes. Genotype, by original designation, is *Trochus cumingi* Philippi.

Subgenus *Tectininus* Clench and Abbott, 1942

Many of the subgeneric characters listed here may well be those of the genus as a whole, but we have not had an opportunity, as yet, to examine the genotype of *Echininus*, sensu stricto, in detail. The genotype, by original designation, is *Echininus nodulosus* Pfeiffer.

The general anatomy, both internal and external, is typically littorinid. Operculum loosely multispiral with about 6 whorls (trochid opercula of the same diameter, such as in *Calliostoma* and *Margarites*, have 11 to 13 whorls). Shell whorls roughly bicarinate, with the upper carina bearing about one-third fewer nodules than the lower carina. Columella short, and not shelved or protruding downward beyond the base of the outer lip as in *Nodilittorina*. Radula ribbon with about 800 to 1,250 transverse rows of teeth. Unused ribbon coiled in about 16 close turns and located in the dorsal region behind the head. Central tooth extremely small and slender. Lateral teeth very large, strong, and with a strong, hooked, single cusp. Inner marginal tooth with a single, large cusp. Outer marginal tooth half the length of the lateral one, and tri-denticulate. Foot weakly ditaxic, with retrograde waves. Penis large and located on the right side of the head just below and slightly posterior to the base of the right tentacle. Penis tri-lobed and with a seminal groove running along the posterior edge. In the area where the accessory prong arises there are numerous, small papillae on the penis. In the female, the ovaries are widespread through the digestive gland and are grass-green in color. The area of the prostate gland in the males is bright Prussian blue.

Echininus nodulosus Pfeiffer

Turbo tuberculatus Wood (non Pennant, 1777), Index testaceologicus, suppl., p. 19, pl. 6, fig. 30, 1828.

Littorina nodulosa Pfeiffer, Arch. Naturg., vol. 1, p. 357 (exclusive of synonymy), 1839. (Cuba.)

Littorina scabra Anton, Verzeichniss der Conchylien . . . , p. 53, 1839.

Littorina antoni Philippi (new name for *Littorina scabra* Anton, non *L. scabra* Linné, 1758, of authors), Abbildungen und Beschreibungen . . . Conchylien . . . , vol. 2, p. 145, pl. 2, fig. 18, 1847.

Littorina (Tectarius) pfeifferianus Weinkauff (new name for *Littorina nodulosa* Pfeiffer, non *Littorina nodulosa* Gmelin of authors), *Littorina*, in Martini and Chemnitz, Systematisches Conchylien-Cabinet, vol. 2, pt. 9, p. 46, pl. 5, figs. 15, 16, 1882.

Shell.—Perhaps the most distinctive feature of the shell of this species is the nature of the rows of nodules. As in *Nodilittorina tuberculata*, the periphery of the last whorl bears two prominent rows of large nodules, thus giving the shell a slightly bicarinate appearance. There are five or six minor rows of smaller beads. But especially notable in *Echininus* are the fewer and larger nodules in the upper major row. A count in 30 specimens revealed that, on the average, there are 3 or 4 fewer nodules in the upper row. No significant difference in this feature could be found between the males and the females. (In 15 males, the upper row, on the average, bore 11.3 nodules with a range of 9 to 14; the lower row had 14.9 nodules with a range of 11 to 17. In 15 females, the upper row bore 10.9 nodules with a range of 9 to 13; the lower row bore 13.0 nodules with a range of 10 to 15.)

Measurements of shell length were compared between 18 adult males and 21 females, and it was found that there is a slight sexual dimorphism in which the mean length of males is 13 mm. and that of the females 15 mm. The overlap in shell size, however, is too great to permit distinction of sex on this character alone.

I notice that the shells of some of the females are more eroded than those of the males, and in this connection there is need for further study on the wanderings of the females and their possible subjection to conditions slightly different from the males. M. Lebour (1945) believes that the amphibious Littorinids of Bermuda seasonally descend from their positions high in trees or from rock cliffs to the edge of the ocean to deposit their eggs. Whether the males also migrate is unknown.

Animal.—Our studies were made on living specimens from Rincon Lighthouse, western Puerto Rico. The animal is typically littorinid, as discussed under the remarks concerning the subgenus. The mantle edge is smooth, slightly swollen, and yellowish; the remainder is clear. The underside of the foot is yellowish gray, but not as yellow as in *Nodilittorina*. The longitudinal fissure on the sole of the foot is very weak and limited to the posterior half. The retrograde (front to back) waves at the anterior third of the sole are usually several and somewhat confused, but as they proceed posterior and reach the region of the weak, central fissure, they become stronger and take on a ditaxic, lateral division.

The penis is large, prominent, and located on the right side of the body of the males. The accessory flagellum is cylindrical, larger than that found in *Nodilittorina*, and located one-third from the distal end

of the penis. On both sides of the penis, in the region near the accessory flagellum, the surface bears numerous, small, fleshy, opaque-white papillae. These are absent in *Nodilittorina* and *Tectarius muricatus*. The posterior edge of the penis bears a narrow, nearly sealed seminal groove which ends near the distal end of the penis, and which has its origin on the side of the body some 2 mm. from the base of the penis. The region of the prostate gland on the right border of the mantle is cobalt blue in color. In mature females, this region bears the swollen, elongate, opaque-white accessory gland.

Radula.—The radula of *Echininus nodulosus* Pfeiffer (fig. 57, a) is very distinctive, although it conforms in general pattern to those found in the family Littorinidae. The reduction of the central tooth is most remarkable in that it has become a short, thin, sliverlike tooth. The main function of rasping has been taken over by the greatly enlarged, coarse lateral teeth. The inner and especially the outer marginal teeth are somewhat reduced. The tendency to reduce the central tooth appears to be a development arising perhaps through the *Nodilittorina* stock. The radula of *Echininus cumingi* from the Indo-Pacific has a reduced central tooth (fide Troschel, 1858, pl. 11, fig. 7) and enlarged lateral teeth. Among the *Nodilittorina*, our Atlantic *N. tuberculata* Menke has a strongly compressed, elongate central tooth (fig. 57, b). The Indo-Pacific *N. pyramidalis* has a much less reduced central tooth which closely resembles that in the members of the subgenus *Melarthaphe*. It may be noted that members of such species as *Littorina* (*Littorina*) *littorea* Linné and *irrorata* Say have a well-developed, almost square central tooth.

The radula ribbon of *Echininus nodulosus* measured 115 mm. in length in one specimen, 110 mm. in another. This is 7 to 8 times the length of the shell. The ribbon is twice the width of that found in a *Nodilittorina tuberculata* Menke of the same shell size. The number of transverse rows is about 1,250. In *N. tuberculata* there were about 1,225 rows, in *Tectarius muricatus* 1,500 rows in a ribbon 67 mm. in length. Pelseneer (Mollusca, Treatise in Zoology, 1906) reports 3,600 rows in *Littorina littorea*. I do not know if there is any phylogenetic or ecological significance to these various number of rows.

Geographical Distribution.—The range of this species is presented in figure 56, b, and its restricted distribution is discussed in the remarks under *Nodilittorina tuberculata*. The species is usually abundant where it occurs.

New records.—FLORIDA: Stock Island, Key West (C. I. Aslakson); Indian Key; Fortune Island (P. Bartsch). BAHAMAS: Nassau, New Providence Island (H. Dodge); South Bight, Andros Island (P. Bartsch); Pimlico Island, Racoon Cay, Ragged Islands (P. Bartsch). CUBA: Cape Cajon; Santa Cruz; Cienfuegos Harbor; Santiago de

Cuba. JAMAICA: Robins Bay, St. Marys; Montego Bay, St. James; Port Henderson; Annotta Bay (all C. R. Orcutt). HISPANIOLA: Morne Rouge, southwestern Haiti; Beata Island (A. Wetmore). PUERTO RICO: Rincon Lighthouse, Mona Passage (G. L. Warmke and N. T. Mattox). VIRGIN ISLANDS: St. Croix (H. F. Dunn). CARIBBEAN ISLANDS: Navassa Island. (All records USNM.)

Phylogenetic position of Echininus.—From the anatomical evidence presented here, it appears that there is little doubt that *Echininus* has many characters that are typically littorinid. This is especially true in the case of the long radula ribbon, the form of the teeth, the presence of an open seminal groove (instead of a closed, internal seminal canal) on the penis, and the simple tentacles with the eye set near the base. We reject Kesteven's (1903) placement of this genus in the family Modulidae. He did so on two characters—the tooth on the base of the columella, and the multispiral operculum. However, Kesteven was in error in stating that members of the genus *Echininus* (*Echinella*, as he called it) have a small tooth at the base of the columella. It is only in the *Tectarius*, sensu stricto, group (with paucispiral opercula) such as *T. coronarius* Lamarck, that we find a basal tooth. This leaves only the multispiral operculum as a character in common with *Modulus*, and although this character may be of convenient generic value in some cases, it certainly is not always a family character.

I believe that the following characters found in *Modulus*, and absent in *Echininus*, exclude the latter from the family Modulidae: Eyes located half way up the length of the tentacles, small digitations along the border of the mantle edge (Abbott, 1944, pl. 1); female with an "ovipositor" organ on the right side of the body; radula relatively short (100 to 150 transverse rows) with a thin, oval, 7-denticled central tooth; a lateral and two marginal teeth which are denticulated (the entire radula closely resembles that in the Rissoacea). Although not necessarily of phylogenetic importance, it may be pointed out that the feces of many, if not all, Littorinidae are relatively short (2 or 3 times as long as wide) and are lined up in the rectum, one directly behind the other, while in *Modulus modulus* Linné the feces are quite long (5 or 6 times as long as wide) and are closely packed side by side at an oblique angle in the rectum, as in the Thiariidae.

In summary of the position of *Echininus*, I am inclined to consider it a specialization of the ancestral stock of the *Melarhappe* group in the family Littorinidae which has shown a tendency towards the abortion of the central tooth in the radula, an enlargement and closer juxtaposition of the marginals, the reduction of the ditaxic fissure in the foot, a reduction in the size of the osphradium, and the increase

in the number of whorls in the operculum to a degree where it has become multispiral.

It should be pointed out that Kesteven included the genus *Peasiella* Neville in the family Modulidae. Although further anatomical study is needed on this genus, I would be inclined (with the radular and opercular characters presented by Kesteven, 1903, p. 633) to include *Peasiella* in the family Littorinidae and in a higher phylogenetic position than the genus *Echininus*. Kesteven also erected a new family, the Risellidae, for the inclusion of *Risella* Gray (now *Bembicium* Philippi) and *Risellopsis* Kesteven, 1902 (not Cossmann, 1908, which was renamed *Riselloidea* Cossmann, 1909). The new family name, Bembiciidae, was introduced by A. W. B. Powell (1937, p. 67). Before accepting this family, it would be best to have an anatomical study made, and, in the meanwhile, allow it to remain in the family Littorinidae as do J. Thiele and W. Wenz.

Genus *Tectarius* Valenciennes, 1833

Subgenus *Cenchrites* von Martens, 1900

Tectarius muricatus Linné

Tectarius muricatus Linné, Systema naturae, ed. 10, vol. 1, 1758.

Observations on living specimens from Vedado, Habana, Cuba, show that the animal is typically littorinid. The tentacles are one-third longer than the extended proboscis, are cylindrical and tapering, translucent gray in color with faint circular bars of brown. The proboscis is dark brown. The mantle edge is thickened, cream yellow in color, and slightly undulatory. The sides of the foot are light slate-gray with numerous, fine, clusters of chalk-white, embedded granules. Underside of foot is slate gray.

The mode of foot progression is ditaxic with a few simultaneous retrograde waves; that is, the sole of the foot is divided down its length from anterior to posterior by a faint fissure, and each side half acts independently of the other much in the manner of a person shuffling forward with his feet in a potato sack. On each half, a dark wave appears at the anterior end at the same time and moves towards the posterior end (retrograde wave). A bibliography concerning this subject is given by H. W. Lissmann (1945). This same type of progression was reported for *Littorina littorea* Linné (Vlès, 1907; Parker, 1911), *Littorina saxatilis* Olivi (as *L. rudis* Maton), and *Nodilittorina tuberculata* Menke (as *Tectarius nodulosus* from Bermuda) (Parker, 1911).

The penis of *Tectarius muricatus* is the simplest of the littorinids I have examined from the Western Atlantic, and, except for the absence of sawlike frills on one edge, it is not unlike that of *Littorina littorea*

Linné. It is located at the usual position on the right side of the body, and consists of a simple bent, tapering prong which bears a thin, seminal groove along its posterior edge.

The radula in one specimen was 67 mm. in length, with about 1,500 transverse rows of teeth. As in *Littorina*, the unused rows are coiled tightly like a watch spring in a pocket on the dorsal region behind the head. The central tooth is about half as wide as long, not unlike that in *Nodilittorina*, and bears a large central cusp with a smaller cusp on each side. (See fig. 57, *d*.)

The shell is adequately illustrated in *Johnsonia* by Clench and Abbott (1942).

Geographical distribution.—In addition to the records noted on the accompanying map (fig. 56, *c*) of the West Indian region, I am listing a few new ones which represent either extensions of the range, additional major islands, or the filling in of large gaps (for other records, see Clench and Abbott, 1942). Distribution in the Caribbean region, lower Florida, and Bermuda is almost identical with that of *Nodilittorina*.

New records.—BAHAMAS: South Bight, Andros Island; Little San Salvador Island. CUBA: Matanzas; Cardenas Bay; Port Gibara; Santiago de Cuba. HISPANIOLA: Fort Liberte, Dept. du Nord; Cap Haitien, Dept. du Nord; Torbeck and Aquin, Dept. du Sud; Santa Barbara de Samana. JAMAICA: Buff Bay, Portland; Stony Cave, St. Mary; Great Pedro Bay, St. Elizabeth; Runaway Bay, St. Ann; Montego Bay, St. James; Morant Bay, St. Thomas; Little Cayman Brac (C. R. Orcutt). PUERTO RICO: Mayagüez; Hamacoa. LESSER ANTILLES: Marigot, Dominica. CARIBBEAN ISLANDS: Curaçao; Aruba. CENTRAL AMERICA: Utilia Island and Roatan Island, Honduras; Colón, Panamá; Cartagena and Porto Colombia, Colombia; Tucacas, Falcon, Venezuela. (All records USNM.)

References

- ABBOTT, R. TUCKER.
 1944. The genus *Modulus* in the Western Atlantic. *Johnsonia* (Harvard Univ.), vol. 1, No. 14, 6 pp., 2 pls.
 1949. Sexual dimorphism in Indo-Pacific *Strombus*. *Nautilus*, vol. 63, No. 2, pp. 58-61, 1 fig.
- BEQUAERT, JOSEPH C.
 1943. The genus *Littorina* in the Western Atlantic. *Johnsonia* (Harvard Univ.), vol. 1, No. 7, 27 pp., 7 pls.
- CLENCH, WILLIAM J., and ABBOTT, R. TUCKER.
 1942. The genera *Tectarius* and *Echininus* in the Western Atlantic. *Johnsonia* (Harvard Univ.), vol. 1, No. 4, 4 pp., 3 pls.
- HABE, TADASHIGE.
 1951. Littorinidae in Japan. *Illus. Cat. Japanese Shells*, vol. 1, No. 4, pp. 87-93, 1 pl.
- HEDLEY, CHARLES.
 1901. A revision of the types of the marine shells of the Chevert Expedition. *Records Australian Mus.*, vol. 4, p. 121.
- KESTEVEN, H. LEIGHTON.
 1903. Notes on Prosobranchiata, No. 2—Littorinacea. *Proc. Linn. Soc. New South Wales*, 1902, pt. 4, pp. 620-636, 1 pl.
- LEBOUR, MARIE V.
 1945. The eggs and larvae of some prosobranchs from Bermuda. *Proc. Zool. Soc. London*, vol. 114, pt. 4, pp. 462-489, figs.
- LISSMANN, H. W.
 1945. The mechanism of locomotion in gastropod molluscs. *Journ. Exper. Biol.*, vol. 21, No. 1, pp. 58-69, 11 figs.
- MATTOX, NORMAN T.
 1949. Effects of drying on certain marine shells from Puerto Rico. *Ecology*, vol. 30, No. 2, pp. 242-244, 2 figs.
- OSTERGAARD, JENS MATHIAS
 1950. Spawning and development of some Hawaiian marine gastropods. *Pacific Sci. (Honolulu)*, vol. 4, No. 2, pp. 75-115, 42 figs.
- PARKER, GEORGE H.
 1911. The mechanism of locomotion in gastropods. *Journ. Morph.*, vol. 22, pp. 155-170.
- POWELL, A. W. B.
 1937. The shellfish of New Zealand. 100 pp., 18 pls.
- TOKIOKA, T.
 1950. Droplets from the plankton net: V, New names for egg capsules of littorinid gastropods. *Publ. Seto Marine Biol. Lab.*, vol. 1, No. 3, pp. 151-152, fig. 6.
- TOKIOKA, T., and HABE, TADASHIGE
 1953. Droplets from the plankton net: XI, A new type of *Littorina*-capsula. *Publ. Seto Marine Biol. Lab.*, vol. 3, No. 1, pp. 55-56, fig. 11.
- VLÈS, F.
 1907. Sur les ondes pédienses des mollusques reptateurs. *Compt. Rend. Acad. Sci. Paris*, vol. 145, pp. 276-278.
- WENZ, WILHELM.
 1939. Gastropoda. *Handb. Paläozool.*, vol. 6, pt. 4, pp. 481-720. [See p. 523.]

issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3329

MAMMALS OF NORTHERN COLOMBIA, PRELIMINARY
REPORT NO. 7: TAPIRS (GENUS *TAPIRUS*), WITH A
SYSTEMATIC REVIEW OF AMERICAN SPECIES¹

By PHILIP HERSHKOVITZ

All known New World species of tapirs occur in Colombia. Representatives of the Brazilian tapir (*Tapirus terrestris*) were secured in northern Colombia by the writer during his 1941–1943 tenure of the Walter Rathbone Bacon Travelling Scholarship. The mountain, or woolly, tapir (*Tapirus pinchaque*), originally described from the Bogotá region in Colombia, is found in parts of the temperate zones of Colombia and Ecuador and does not range into coastal provinces. Baird's tapir (*Tapirus bairdii*), the largest indigenous land mammal of the Neotropical region, is here recorded for the first time from South America. The author discovered the coexistence of this species with the Brazilian tapir in northwestern Colombia while conducting the Chicago Natural History Museum–Colombian Zoological Expedition (1949–1952). A woolly tapir was also taken, and it is described in this paper. A fourth species, *Tapirus indicus*, the only other living form of tapir, is Asiatic in distribution.

¹ Previous reports in this series have been published in the Proceedings of the U. S. National Museum as follows:

1. Squirrels, vol. 97, August 25, 1947
2. Spiny rats, vol. 97, January 6, 1948
3. Water rats, vol. 98, June 30, 1948
4. Monkeys, vol. 98, May 10, 1949
5. Bats, vol. 99, May 10, 1949
6. Rabbits, vol. 100, May 26, 1950

ERRATA: In No. 5: Bats, measurements given for *Glossophaga soricina soricina* on page 438 are misleading because of a transposition. On line 25, for "head and body" read "total length," for "tail" read "head and body," for "hind foot" read "tail," for "ear" read "hind foot," and add "ear, 15–15 mm."

Nomenclature

The generic name *Tapirus* employed here is from Brünnich, 1771. Scopoli's use of *Tapirus* in 1777 is next available. For rejection of Brisson's *Tapirus* and other Latin names in his "Regnum Animale," 1762, see Hopwood (Proc. Zool. Soc. London, vol. 117, pp. 534-536, 1947). *Tapirus* Brünnich is adopted here on the same authority, a copy of the "Zoologiae Fundamenta . . .," where the generic name appears, not being available in this country. Merriam (Science, new ser., vol. 1, p. 376, 1895) employed an ingenious device in his attempt to validate *Tapirus* Brisson. He combined his own with Brisson's (Regnum Animale, p. 81, 1762) monomial specific Latin designation for "Le Tapir" to produce the custom-made binomial *Tapirus tapirus*. This combination is valid, to be sure, but dates from its originator, Merriam, 1895, and not from Brisson. The question that has arisen over the basic date of publication of the "Regnum Animale" is entirely subordinate to the fact that the system of classification employed therein is incontrovertibly non-Linnaean. Hence, Brisson's Latin names, really classical rather than technical, are not available.

Bibliographic references and citations to generic synonyms are given under the subgeneric headings. Synonymies under specific headings include references to all original descriptions and to selected taxonomic works.

Classification

Cranial and external differences between living species of American tapirs are such as to warrant full generic rank for each of the recognized forms. Simpson (Bull. Amer. Mus. Nat. Hist., vol. 86, pp. 40-41, 1945) agreed with this in theory but found it impractical to recognize a multiplicity of closely related monotypic genera of Recent and Pleistocene tapirs. Accordingly, he grouped all species in the genus *Tapirus*. The simplified nomenclature can be justified in this special case because whatever hierarchic terminology is employed in classification interrelationships remain the same. However, the real separation between each of the species should be emphasized by adding to Simpson's system the available subgeneric names.

Living and fossil tapirs were first reviewed in a classical study by Hatcher (Amer. Journ. Sci., ser. 4, vol. 1, art. 17, 1896). Simpson (op. cit.) summarized much of the information since accumulated and described and analyzed the osteology of North American Recent and Pleistocene tapirs. Concerning modern American species, these authors agreed that *terrestris*, *bairdii*, and *pinchaque (roulinii)* are representative. Other named forms were regarded as either absolute synonyms or, at best, subspecies of one or another of the three species cited.

Material

A total of 122 specimens of Recent American tapirs were studied. Included in the 84 specimens examined in the U. S. National Museum were *Tapirus terrestris* (2 skins with complete skeletons, 4 skins with skulls, 5 complete skeletons only, 17 skulls only), *Tapirus bairdii* (4 skins with skulls, 7 complete skeletons only, 41 skulls only), and *Tapirus pinchaque* (1 skin only, 3 complete skeletons only, 1 skull only). Included in the 38 specimens examined in the Chicago Natural History Museum were *Tapirus terrestris* (2 skins with complete skeletons, 1 skin with skull, 4 skulls, skins mounted in habitat group; 21 skulls only), *Tapirus bairdii* (2 complete skeletons, 6 skulls only), and *Tapirus pinchaque* (1 skin with skeleton, 1 skull only). More than 20 skulls of the Indian tapir, *Tapirus (Acrocodia) indicus*, were compared with the American species.

Capitalized color terms in the text are from Ridgway (Color Standards and Color Nomenclature, 1912).

The following abbreviations of museums are used in the lists of types:

BM	British Museum (Natural History)
CNHM	Chicago Natural History Museum
MACN	Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"
MHNP	Muséum National d'Histoire Naturelle, Paris
USNM	U. S. National Museum

Genus *Tapirus* Brünnich

Distribution.—American forms are widely and nearly continuously distributed throughout most of the Neotropical region from about 30 degrees south latitude in eastern Brazil to about 20 degrees north latitude in southern México (see map, fig. 61); altitudinal range is from sea level to approximately 4,500 meters above. One species, *Tapirus (Acrocodia) indicus*, is represented in Burma, Siam, French Indochina, the Malay States, and Sumatra. Recent tapirs are survivors of a large family that originated in early Tertiary in the Palearctic region and which, at successive periods of time, occupied the land masses now intervening between Asiatic and American species.

Habitat and habits.—Within the geographic limits defined, tapirs may occur in practically any wooded or grassy habitat with good surface supplies of water. Forests and thickets are usual daytime retreats, while bordering exposed areas such as grass or scrublands, marshes, lakes and streams with herbaceous banks, and grassy islands are favored nocturnal feeding resorts. Streams, whether narrow, torrential watercourses of mountain gorges or wide, sluggish rivers of the interior and coastal plains are indispensable refuges of all tapirs attacked by enemies, be they of the itch-producing, external parasitic kind, or tigers, jaguars, and man.

Tapirs are omnivorous. They browse and graze. They feed on underwater organisms as readily as they pluck fruit, leaves, and twigs from shrubs and trees. They are facile of movement whether in open country or thick brushland, whether in water or under water. They are expert hill-climbers, runners, sliders, waders, and swimmers. Tapirs tame quickly and adjust themselves easily to artificial living conditions in captivity. They survive seasonal changes without apparent inconvenience when exhibited in American and European menageries. Ostensibly, there are no barriers in environment or limiting factors in tapir structure and physiology to preclude the coexistence of all three American species in a natural habitat suitable to any one of them. The Brazilian species does share a part of its range in northwestern South America with Baird's tapir. Here, both species frequent the same feeding and watering places. On the other hand, the high Andean woolly tapir (*Tapirus pinchaque*) is not recorded from lower slopes of the Andes and the other tapirs are not known to encroach upon the upper levels, or temperate zone, of the Cordilleras.

Characters.—External characters recorded in literature for distinguishing any one of the three living American species from the others are, for the most part, either common to all species or are juvenal and individually variable characters. In all American tapirs, entire margin or only upper borders and lower edges of ears either conspicuously trimmed or spotted with white or buff, or uniformly brown or black; lips edged white, gray or buff; cheeks paler than crown, the contrastingly paler color usually continuing onto throat, chest, and, to a varying degree, on belly; chin darker than cheeks and lips; upper parts of head and body, sides, and limbs light drab to brown in palest individuals, dark brown to black in darkest individuals. Juvenal pelage marked by a variable pattern of yellow and white spots and stripes covering entire body. Spotting persists past the first year of age and vestiges may remain (usually on limbs) in young adults. Apart from the urinogenital system, sexual dimorphism is not evident.

Size.—Simpson (Bull. Amer. Mus. Nat. Hist., vol. 86, p. 77, 1945) calculated the following proportional differences between Pleistocene *Tapirus excelsus* and Recent *T. terrestris* and *T. bairdii*: In linear measurements, *T. excelsus* about 1.37 times *T. terrestris* and about 1.19 times *T. bairdii*; in bulk and weight, *T. excelsus* over 2.5 times *T. terrestris* and about 1.7 times *T. bairdii*. On the basis of these figures, *T. bairdii* is about $1\frac{1}{2}$ the linear size and nearly $1\frac{1}{2}$ times bulkier and heavier than *T. terrestris*. The estimated difference in bulk and weight between the two species may be extreme. Length of skull and proportions of postcranial bones in present material confirm the greater average size of *T. bairdii*. *T. terrestris* averages slightly larger than *T. pinchaque*. Greatest length of skull, from gnathion to nuchal crest,

measured on a horizontal plane, may be taken as a fair index of total length and bulk of any one species. This measurement, in centimeters, is tabulated below according to the number of functional upper molars. In the tabulation, the first measurement of each tooth group is average length of skull, figures in parentheses are extremes, and the last figure shows number of specimens measured.

	M ¹ functional	M ² functional	M ³ functional
<i>bairdii</i> (36 specimens).....	39 (38-41) 10	41 (40-43) 9	42 (40-44) 17
<i>terrestris</i> (41 specimens).....	37 (35-41) 9	38 (36-41) 15	38 (36-41) 17
<i>pinchaque</i> (5 specimens).....	35	37, 40	37, 38

It is practically impossible to arrive at better than a rough estimate of differences in size between the three living species of American tapirs. There may be as marked size differences between two individuals or populations of a given species as between each of two "comparable" individuals or populations of different species. The above tabulation shows that in *T. terrestris* there is no significant relationship between age and size after the second upper molar becomes functional. The same appears to be true for *pinchaque*, but *bairdii* continues to grow for a time after eruption of its last upper molar. A specimen of *terrestris* from Rio Grande do Sul, Brazil, with the largest skull, length 415 mm.,² still has the second upper molar deep in the alveolus. Another skull of *terrestris* from Pozuzo, Perú, with complete and worn dentition is only 360 mm. long. Other specimens from the same regions indicate that difference in length between the two skulls is purely individual. Importance of individual variation in estimating size differences between species may also be demonstrated. A fully adult specimen of the larger *bairdii*, from Tiger Hill, C. Z., has a combined head and body length of 193 cm., while a "comparable" individual of the smaller *terrestris* from Mato Grosso, Brazil, measures 201 cm.

The few available measurements indicate that the Malay tapir, *Tapirus indicus*, averages slightly larger than *T. bairdii*.

Subgenus *Pinchacus*³ Gray

Cinchacus [sic] Gray, Hand-list of the edentate, thick-skinned, and ruminant mammals in the British Museum, p. 34, 1873 (typographical error for *Pinchacus*; genotype by monotypy, *Tapirus leucogenys* Gray = *Tapirus pinchaque* Roulin).

Included species.—*Tapirus pinchaque* Roulin.

² Actually, in *terrestris* the greatest skull length, 420 mm., is of a menagerie specimen. This individual died at the age of 32 years after living 27 years in the National Zoological Park, Washington.

³ The name "*Cinchacus*" originally proposed by Gray is so obviously a typographical error that it is quite permissible, according to article 19 of the International Code of Zoological Nomenclature, to emend the spelling to *Pinchacus* in conformity with both the etymology and the author's intent.

Distribution.—From upper subtropical and temperate zone forests into bordering "páramos," or grasslands, of the Andes in Colombia, Ecuador, and possibly in northern Perú and western Venezuela (Sierra de Mérida). (See map, fig. 61.)

Characters.—Head flattened dorsally, without mane; proboscis short and comparatively delicate; pelage long, coarse, thick, the skin well covered except usually on rump which may be marked by one or two patches of abraded pelage, or callouses in old adults; hoofs elongated, each longer than wide. Dorsal contour of skull flattened (fig. 58, *c*); median frontal line on about same horizontal plane as nasals and roughly parallel to horizontal plane of maxillary tooth row; superior parietal ridges approximating to form a low sagittal crest marked by a longitudinal groove (fig. 59, *c*) that tends to obsolescence in old individuals; ossification of mesethmoid cartilage not extending beyond tips of nasals; exposed dorsal surface of maxilla as in *Tapirus* but may be flattened mediolaterally, maxillae somewhat less divergent from each other than in *Tapirus*; postero-lateral maxillary process as in *Tapirus*, overlying frontal process and not entering into composition of inner lateral wall of narial meatus; posterolateral margin of premaxilla slightly, entirely, or not at all embraced laterally by outer anterior border of maxilla; nasals as in *Tapirus* but more elongate, descending process more delicate. First upper premolar with or without cinguloid shelf extending anteriorly from protocone (fig. 60, *a, b*); upper incisors distinctly opisthodont.

Remarks.—Cranial contours of the mountain tapir show least departure from primitive lines; cranial characters generally, and particularly those associated with the comparatively little-developed proboscis, are less specialized than in other Recent species; dentition, as manifested by the first upper premolar, is variable. Ecuadorian specimens show the simple condition, with cinguloid shelf absent, while the only authentic Colombian skull examined shows the premolar as in true *Tapirus*.

Distribution of *Pinchacus* points to its prior arrival into South America and at a period when a temperate climate prevailed at sea level in equatorial latitudes. It inhabits an area representing part of the original Colombian Central Land Mass, the South American side of the intercontinental land bridge where Tertiary mammals entering from North America established foothold. Present restriction of *Pinchacus* to the Colombian Central Land Mass, now the temperate zone of the bulk of the Venezuelan, Colombian, and Ecuadorian Andes, probably is the result of an inherited urge for sustenance in cooler climates pari passu with increasing rise in height of the Andes above sea level and rising temperatures at sea level. Newly established tropical zone habitats at the base of the Andes were invaded subsequently by other kinds of tapirs.

Tapirus pinchaque Roulin

(Woolly, Andean, or mountain tapir, "danta lanuda" or "danta cordillerana")

Le Pinchaque Cuvier, Ann. Sci. Nat., Paris, ser. 2 (Zool.), vol. 17, p. 110 (pp. 107-112), 1829 (advance notice with description and comparisons of the "pinchaque" of Roulin).

Tapir pinchaque Roulin, Ann. Sci. Nat., Paris, ser. 2 (Zool.), vol. 18, p. 46, pls. 1, 2, figs. 1-3, 1829.—Goudot, Compt. Rend. Acad. Sci., Paris, vol. 16, p. 331, 1843 (Las Juntas, Rio Combeima, southern foot of Mt. Tolima, Colombia, altitude, 1,918 meters; description, habits; tracks seen between 1,400 and 4,400 meters above sea level).—Blainville, Ostéographie, text, vol. 4, fasc. 19, p. 22, 1846 (osteology).

Tapirus pinchaque, Hunter, The natural history of the quadrupeds of Paraguay . . . (translated from the Spanish of Felix de Azara), vol. 1, p. 113, 1838, Edinburgh (ref.).

Tapirus pinchacus [sic], Gray, Proc. Zool. Soc. London (1867), p. 884, 1868; *ibid.*, (1872), p. 484, 1872 (original description quoted; bibliography; synonymy).—Blainville, Ostéographie, text, vol. 4, fasc. 19, p. 51, 1846 ("*T. roulini* Fischer," in synonymy), atlas, vol. 4, pl. 3, 1846 (skull of type; skull of specimen collected by Goudot in Colombia).—Döderlein, Ueber das Skelett des *Tapirus Pinchacus*, Inaugural-Dissertation, 1877 (osteology; distribution).

[Tapirus] Roulinii Fischer, Synopsis Mammalium, Addenda, p. 604 [sic=406], 1830 (new name for *Tapir pinchaque* Roulin).

Tapirus roulini [sic], Selater, Proc. Zool. Soc. London (1870), p. 51 and footnote, 1870 (report of specimen seen by Robert A. White on Volcán de Puracé, Cordillera Central, Colombia, altitudinal range reported as between 3,500 and 4,200 meters above sea level; "the first Latin name applied to this tapir appears to be *roulini* [sic] Fischer"); *ibid.*, (1872), p. 604, fig. 2 (nasals), 1872 (skull collected by Buckley, undoubtedly in Ecuador).—Hatcher, Amer. Journ. Sci., ser. 4, vol. 1, p. 173 and text, pl. 4, figs. 2, 2a, pl. 5, fig. 2, 1896 (cranial characters, comparisons, phylogeny, synonymy: *Pinchacus villosus*, *leucogenys*, *aenigmaticus* [=terrestris], *pinchaque*).—Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 44, 1916 (synonymy: *pinchaque*, *villosus*, *leucogenys*, *enigmaticus* [sic=terrestris]; specimens from Suñac and "Assuay," Ecuador).—Simpson, Bull. Amer. Mus. Nat. Hist., vol. 86, pp. 39-80, pl. 10, fig. 2, 1945 (cranial and dental characters, comparisons, phylogeny).—Crandall, Animal kingdom, Bull. New York Zool. Soc., vol. 44, No. 1, 1951 (description of live animal in captivity).

Tapirus roulinii, G. M. Allen, Extinct and vanishing mammals of the Western Hemisphere, p. 404, 1942 (part, not description; Department of Santander, Colombia, 8,000-10,000 feet altitude; Cordillera de Llanganates, Cordillera Oriental, Ecuador, 14,000 feet altitude).

Rhino [choerus] villosus Wagler, Natürliches System der Amphibien . . . , footnote 2, p. 17, 1830 (name proposed for "*le Pinchaque*" Cuvier=*Tapir pinchaque* Roulin).

Tapirus villosus Wagner, in Schreber, Die Säugthiere in Abbildungen nach der Natur, mit Beschreibungen, vol. 6, p. 392, pl. 319b, 1835 (new name for *Tapir pinchaque* Roulin).—Tschudi, Untersuchungen über die Fauna Peruana, Therologie, pp. 213, 215, 1844 (description, distribution in Perú).

Tapirus] *andicola* Gloger, *Gemeinnütziges Hand- und Hilfsbuch der Naturgeschichte* . . . , vol. 1, p. 124, 1842 (new name for *pinchaque* Roulin).

Tapirus leucogenys Gray, *Proc. Zool. Soc. London* (1872), p. 488, pl. 21, 1872 (type locality, "Ecuador, on the Cordilleras at Sunia and Assuay").—Lydekker, *Catalogue of the ungulate mammals in the British Museum (Natural History)*, vol. 5, p. 44, 1916 (type from "Assuay"; listed as synonym of *roulinii*).

Types.—Of *pinchaque* Roulin, adult male, skull only, MHNP, collected by Roulin; of *leucogenys* Gray, adult male lectotype (designated by Lydekker, *supra cit.*), skin and skull mounted, BM 72.1.24.3-4 (1577 b), collected by Clarence Buckley.

Type localities.—Of *pinchaque* Roulin, Páramo de Sumapaz, Cordillera Oriental, south of Bogotá, extreme southern part of Department of Cundinamarca, Colombia; of *leucogenys* Gray, Páramo del Azuay, Cordillera Oriental, southern Ecuador (restricted by Lydekker, *supra cit.*).

Distribution.—Generally as for the subgenus; actual specimens recorded in scientific literature were taken only in the Cordilleras Oriental and Central of Colombia and the Cordillera Oriental of Ecuador, from 5 degrees north latitude (Mt. Tolima) to about 4 degrees south latitude (Azuay) (see map, fig. 62); altitudinal range between 2,000 and 4,400 meters. Carriker (in G. M. Allen, *supra cit.*) reported tapirs common at altitudes from 8,000 to 10,000 feet in the Cordillera Oriental, Department of Santander, Colombia, at the Venezuelan border, about 7 degrees north latitude. No signs of *T. pinchaque* were seen by the writer in the comparatively low Sierra de Perijá, the extension of the Cordillera Oriental north of Santander, and the species is unknown in the Colombian Cordillera Occidental. Tschudi (*supra cit.*, p. 215) recorded the woolly tapir from the upper forest zone of the Peruvian Andes at elevations between 7,000 and 8,000 feet. This report, never since confirmed, was based on testimony of natives who killed the animal in "mittleren Peru in der Ceja von Comas, Huancavelica etc." Published records of tapir tracks noted in the Andes at elevations in the neighborhood of 1,500 meters above sea level may refer to any species, although no museum specimens of tapir have actually been collected anywhere within 300 meters of this altitude.

Characters.—Those given for the subgenus. Some general external characters are mentioned under the generic heading. Skin of adult female from Río Majuas, Colombia, collected by the writer in 1951, is blackish brown on back, sides of body, upper parts of limbs, and tail; pelage of rump on either side of middorsal line abraded; individual cover-hairs of dorsum 1 to 1½ centimeters long, with very fine, crinkly, brown tips, black basally; hairs on sides of body and chest become progressively longer to approximately 3 cms. with basal portions

brown; long, crinkly wool-hairs sparsely present on sides and underparts; guard-hairs scattered, slightly stiffer than cover-hairs and 1 to 2 cms. longer; hairs of lower parts of limbs short, harsh, black with fine brown tips. There is a thin sprinkling of white hairs over all dark parts of body. Head is blackish brown dorsally, with whorl on forehead; ear well haired on outer side, anterior and upper borders blackish brown, behind brown sprinkled with whitish; inner side of ear practically bare except for a thin concentration, not at all conspicuous, of whitish hairs along borders. Sides of head and neck are brownish, the hairs with gray bases; muzzle blackish brown with tip and sides strongly grizzled and sharply demarcated from narrow white band encircling mouth; underparts blackish brown, pelage of throat long, somewhat matted, that of belly shorter, and directed forward; anal region thinly haired, whitish. A pair of teats is present.

Another adult female exhibited in the New York Zoological Park is described by Crandall (Animal Kingdom, Bull. New York Zool. Soc., vol. 54, p. 3, figs., 1951) as "clothed [on body] with dense, matted hair, blackish brown in color . . . head paler. Individual hairs from the back are approximately an inch long, most of them with one or two kinks. The white fringe at the ear tips, present in all tapirs, is especially conspicuous in Panchita, because of the length and density of the hair . . . Also, the eyes are pale brown—not blue as often stated."

Skin of a third adult⁴ is blackish brown on back, hairs black terminally, dark brown basally, the brown portion increasing progressively toward posterior end of back; sides mixed blackish and auburn, becoming nearly uniformly Tawny on belly, chest, and posterior sides of thighs; limbs blackish brown with a scattering of buffy and ochraceous hairs; rump with a nearly bald area; top of head dark reddish brown, nearly black; muzzle brown, approximately auburn; sides of face mixed brown, ochraceous and buffy; upper lip and chin buffy, throat brown; ears auburn edged with buffy to ochraceous.

⁴ Sex unknown, it was removed from exhibition in the halls of the U. S. National Museum in March, 1911, and preserved as skull and two flat pieces of hide. Somehow, the skin was given the same catalog number (USNM 61221) as one of two skins of *T. bairdii* formerly mounted and exhibited by the Guatemalan Commission in the Columbian Exhibition. The skull was likewise misnumbered but in September 1938 was renumbered 267894. Most likely, the specimen originated in Ecuador but it may have come from Colombia. According to records of the Smithsonian Institution, Gen. S. A. Hurlbut donated skins with complete skeletons of two mountain tapirs he secured in Tolima, Colombia. The skeletons were entered in the Mammal Division "bone" catalog on November 11, 1871, as numbers 11883 and 11884. There is no account of corresponding skins, if ever accessioned. In 1872, President García Moreno of Ecuador presented through the U. S. Minister to Ecuador, the Hon. E. Rumsey Wing, a complete skeleton of mountain tapir. The specimen is entered in the "bone" catalog as No. 12759. However, according to the Annual Report of the Smithsonian Institution for 1873 (p. 47), a mounted specimen was also donated by President García Moreno. A "skin" catalog entry in 1874, No. 11869, is of a mounted "*Tapirus Roulini*" without further data, but almost certainly the specimen now at hand.

Measurements.—Of the type specimen, fully adult male with worn dentition (ex Roulin, supra cit., p. 32): Total length, 5 ft., 6.5 in., in old French system, or approximately 1,800 mm.; height at withers, 2 ft., 9 in., or about 900 mm.; length of forefoot, 1 ft., 4 in., or about 433 mm.; hind foot slightly shorter; circumference of upper foreleg, over 16 in.; circumference of upper hind leg considerably less; weight, completely eviscerated, between 240–250 French pounds. Of the fully adult female, from Río Majuas, upper Río Magdalena Valley, Huila, Colombia, 2,700 meters altitude: Head and body, about 2,000 mm.; tail, 50 mm.; hind foot (approx., from skeleton) 310 mm.; ear, 170 mm.; height at withers (approx., from skeleton) 870 mm.; height at rump (approx., from skeleton) 910 mm.; weight, 583 pounds (including fetus of approximately 10 pounds). Of “Panchita,” adult female, on 21 November, 1951, age between 3½ and 4 years, measurements according to Lee S. Crandall, General Curator of the New York Zoological Park (in litt.): “Tip of nose to base of tail, 6 ft. [1,829 mm.]; tail, 2 in. [51 mm.]; height at shoulder, 2 ft., 7½ in. [80 mm.]; height at hips 2 ft., 9½ in. [851 mm.]; greatest circumference, 4 ft., 3 in. [1,295 mm.].” At reported age of 2½ years, Panchita weighed 223 pounds.

Remarks.—The abraded, bald, or calloused areas of the rump are evidently consequences of the tapir’s habit of sitting or reclining on either side of its rump and from scrubbing the affected areas against rocks, gravelly ground, and tree trunks to relieve itching. The large size and quantity of ticks attached to all species of tapirs is notorious. Similar abrasions of the rump in short and thinly haired species living in tropical lowlands where rocks are rare could easily escape detection. Goudot (Compt. Rend. Acad. Sci., Paris, vol. 16, p. 331, 1843) reports that native hunters attribute the peculiarities of the rump to the animal’s proclivities for sliding downhill in, presumably, a sitting posture. This explanation need not be given serious consideration. No bald spot or abrasion appeared on the rump of the young adult female tapir killed by Goudot in the Colombian Cordillera Central and none was present on the type of *T. leucogenys* Gray. On the other hand, abrasions mark the rumps of the specimens described in the preceding section, and were present in two live woolly tapirs that arrived at the New York Zoological Park (see below). Both individuals were hand raised from the very young, spotted-and-striped stage. Neither of them had been exposed to conditions of life conducive to downhill rump sliding.

Color of upper border of ear is variable. The female from Majuas, Colombia, described above and the two males observed by Roulin lack white on upper borders of the ears. Ears of the type of *leucogenys* Gray are described as “with scarcely any indication of white edges.”

All other specimens of woolly tapirs of which external characters are known and recorded or described herein have white ear tips.

In skinning the woolly tapir taken in Colombia, the writer was impressed by its comparatively thin hide. Hides of the Brazilian, Baird's, and Indian tapirs are notoriously thick and range in thickness in the order named, that of the last the heaviest. Characteristic extra thickness of hide of nape in these species is altogether absent in the maneless *T. pinchaque*. The Indian tapir with maximum thickness of hide offers a deep armor where most vulnerable to the tiger's fangs. Hide of nape combined with mane in Brazilian and Baird's tapirs are equally good fenders against the smaller-toothed and weaker-jawed jaguar. Mountain fastnesses of the woolly tapir are rarely, if ever, visited by jaguars. Mountain lions (*Felis concolor*) occur within the range of *T. pinchaque* but rarely attack any wild animal larger than a brocket (*Mazama*). Bears (*Tremarctos ornatus*) sometimes prey on woolly tapirs but their technique of attack, distinct from that of cats, gives no special advantage to quarry with a well-protected nape.

Tapirs eat anything edible and a surprisingly large amount of material such as woody twigs and mud, which is not generally regarded as edible. However, in any given habitat the bulk of the tapir's diet consists of green shoots of the commonest browsing plant. Stomachs of woolly tapirs examined by the writer, by Roulin, and by Goudot (supra cit.) contained mostly ferns and shoots of "chusque," a trailing bamboo of the genus *Chusquea*. These are the dominant plants in many situations of the steeper, more sterile wooded slopes of the Andean temperate zone. In "páramo" zone, according to Goudot (p. 334), woolly tapirs eat tender shoots of "frailejón" (*Espeletia*) as well as those of rough grasses.

The word "pinchaque" is, according to Roulin, the name of a large fabulous animal believed to live within the Colombian range of the woolly tapir. It may refer to the extinct Mastodon but few, if any, Colombians now use the term. "Danta" is the name applied indiscriminately by natives to all three species of tapirs. The terms woolly tapir, mountain tapir, and Andean tapir have been in use in the English language for over a century. Their Colombian equivalents are "danta lanuda" and "danta cordillerana." Ecuadorians of the eastern slope of the Cordillera Oriental distinguish the woolly from the Brazilian tapir by the names "danta negra" and "danta café," respectively. "Huagra" is the Quechua term for tapir. For lack of another word in their vocabulary, Quechua-speaking Indians of Ecuador use "huagra" also for domestic cattle.

The first specimen of *Tapirus pinchaque* to be exhibited alive outside its country of origin is "Panchita," received in the fall of 1950 by the New York Zoological Society's park in the Bronx, New York. The animal, a female, was approximately 2½ years of age at the time.

According to Crandall (Animal Kingdom, Bull. New York Zool. Soc., vol. 44, no. 1, pp. 3-8, 1951), the specimen, from the Cordillera Oriental of Ecuador, lived "as a village pet in a hamlet called Borja, sixty miles [kilometers is surely intended] to the east of Quito at an elevation of about 6,000 feet. . . . 'Panchita', as the villagers called the animal, had been captured higher up the Andean range while still in her striped-and-spotted coat of tapir infancy." The second captive tapir, a male from Papallacta, east of Quito, Ecuador, about 3,150 meters above sea level on the eastern slope of the Cordillera Oriental, was received June 19, 1952, by the same zoological park (cf. Animal Kingdom, Bull. New York Zool. Soc., vol. 45, Nos. 1, 2, 1952). It had been sent by Charles Cordier, the dealer who also secured the first live tapir.

Contrary to all ruling, previous authors have attempted to replace the first valid name, *pinchaque* Roulin, with Latin names of which the earliest and most commonly cited is *roulinii* Fischer. The specific name *pinchaque* was properly proposed in combination with the generic synonym *Tapir* as technical name for the woolly tapir. Roulin explicitly borrowed *pinchaque* from the vernacular term applied by some Colombians to a large legendary animal, possibly the extinct mastodon. In an advance notice of the discovery of the woolly tapir, Cuvier (supra cit.) discreetly used "pinchaque" strictly as the vernacular term for the new species, leaving the formal proposal of a technical name to Roulin.

Published descriptions and figures of misidentified species of American tapirs have led to some garbled accounts in current literature. External characters attributed to the woolly tapir by G. M. Allen (supra cit.) are derived from a figure and description by Sclater (Proc. Zool. Soc. London (1878), p. 631, pl. 39, 1878) of a living example of *T. terrestris* exhibited in the London Zoological Gardens. The individual was first misrepresented as "*Tapirus roulini*." Later, as the result of a post mortem, Sclater (ibid. (1885), p. 718, 1886) discovered his error and emended the name to *Tapirus americanus* (= *T. terrestris*). Tapirs secured by Buckley at Sarayacu, eastern Ecuador, and mentioned by G. M. Allen are also misidentified representatives of *T. terrestris* (cf. *antea*, in synonymy of *T. terrestris terrestris*).

An early revision of tapirs by Gray (Proc. Zool. Soc. London (1872), pp. 483-492, pls. 21, 22, 1 fig., 1872) has been a popular but confusing and misleading source of information. The work is characterized by numerous typographical errors, misquotations of authors, contradictions, and assumptions derived from specimens mislabeled as to sex and locality and mismatched as regards skins and corresponding osteological material. Gray's description of external characters of the adult *leucogenys* may be that of *terrestris*, but the skull, as analyzed,

certainly pertains to *pinchaque*. It may be necessary to restrict the type of *leucogenys* to the skull only. The young individual described by Gray as "*Tapirus leucogenys* jun., or *T. aenigmaticus*," if correctly figured (pl. 21, and skull, p. 491) must be regarded as *T. terrestris*. The skin of this specimen may be that of a mountain tapir but the skull as figured by Gray is unquestionably that of a lowland tapir. Indeed, Gray (pp. 484, 491, 492) questioned both locality data and the association of skin and skull as given by the collector, Clarence Buckley. Present determination of types and type localities of Gray's specimens follow Lydekker (Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 44, 1916).

In addition to specimens examined by the writer, there is a mounted skin and skeleton and a skull only from Ecuador in the Museum of Comparative Zoology and two specimens from the Cordillera de los Llanganates (Cordillera Oriental), Ecuador, in the Academy of Natural Sciences of Philadelphia. The species is also poorly represented in European museums.

Specimens examined.—Six. COLOMBIA: Huila, San Agustín, Río Majuas, upper Río Magdalena, 2,700 meters, 1 female, skin and skeleton (CNHM); no precise locality, 2 complete skeletons (USNM). ECUADOR: Cordillera de los Llanganates, upper Río Pastaza drainage, Cordillera Oriental, 1 skull (CNHM); no precise locality, 1 complete skeleton (USNM). No locality (probably Ecuador, possibly Colombia), 1 skin with skull (USNM).

Subgenus *Tapirus* Brünnich

Tapirus Brünnich, Zoologiae fundamenta . . . , pp. 44, 45, 1772.—Scopoli, J. A. Scopoli . . . Introductio ad historiam naturalem . . . , p. 492, 1777.—Merriam, Science, new ser., vol. 1, p. 376, 1895 (based on "Le Tapir" or *Tapirus* Brisson, Regnum Animale, 1762).

Tapir Blumenbach, Handbuch der Naturgeschichte, ed. 1, vol. 1, p. 129, 1779 (genotype, by monotypy, *Tapir suillus* Blumenbach=*Tapirus terrestris* Linnaeus).—Zimmermann, Geographische Geschichte . . . , vol. 2, p. 154, 1780 (genotype, by monotypy, *anta* Zimmermann=*terrestris* Linnaeus).—Gmelin, Caroli a Linné systema naturae . . . , ed. 13, vol. 1, p. 216, 1788 (genotype, by monotypy, *americanus* Gmelin=*tapir* Erxleben=*terrestris* Linnaeus).

Syspotamus Billberg, Synopsis faunae Scandinaviae, vol. 1, pt. 1, Mammalia, Conspectus A (before p. 1), 1827 (new name for *Tapir* Gmelin).

Rhinochoerus Wagler, Natürliches System der Amphibien . . . , p. 17, 1830 (proposed for *Tapirus* Brisson).

Tapyra Liais, Climats, géologie, faune et géographie botanique du Brésil, p. 397, 1872 (emendation of *Tapirus*).

Included species.—*Tapirus terrestris* Linnaeus.

Distribution.—Tropical zones of mainland South America, from Rio Grande do Sul, Brazil, and the Chaco of Argentina, Paraguay,

and Bolivia, north through the Amazonian regions of Brazil, Bolivia, Perú, Ecuador, and Colombia; in the Guianas and Venezuela west across the Sierra de Perijá of the Cordillera Oriental into northern Colombia at least as far as the Río Atrato (see map, fig. 61); unknown from the Pacific coastal plains of South America; altitudinal range from sea level to 1,200 meters above, not certainly recorded from higher altitudes.

Occurrence of the Central American *Tapirella* in northwestern South America presupposes the probable existence of typical *Tapirus* in Central America. However, bonafide records of *T. terrestris* from Central America do not exist. A specimen of *T. terrestris*, supposedly from Talamanca, Costa Rica, was recorded by Goldman (Smithsonian Misc. Coll., vol. 69, p. 83, 1920). Later authors have cited the same record. The specimen in question, a skull only, was entered into the catalog of the mammal collection of the U. S. National Museum in 1873 or 1874 along with other skulls of *terrestris* and *pinchaque* and 14 skulls of *bairdii* from Costa Rica. No doubt, the skull, without original locality data, was inadvertently included in the catalog with the Costa Rican material of Prof. Gabb.

Characters.—Crest of head rising abruptly from behind base of muzzle and surmounted by a low, narrow mane that continues back to withers, sometimes to behind middle of back; proboscis well developed, fairly bulky; pelage short, stiff, and usually not completely hiding skin; hoofs short, broad, the middle always wider than long. Dorsal contour of braincase (fig. 58, *a*) decidedly convex, the median frontal line rising steeply from horizontal plane of nasals and diverging even more sharply from horizontal plane of maxillary tooth row; superior ridges of parietals united to form a single arched sagittal crest (fig. 59, *a*); ossification of vertical mesethmoid cartilage usually not extending anteriorly beyond middle of nasals, rarely to tips of nasals; maxillae divergent, exposed dorsal surface of each rounded mediolaterally, without rising process in front of plane of infraorbital foramen; posterolateral maxillary process overlying anterior frontal process and not entering into composition of inner lateral wall of nasal meatus; posterolateral margin of premaxilla forming a nearly straight or a slightly curved line, not embraced laterally by anterior margin of maxilla; nasal with thick descending sigmoid process overlapping maxilla. First upper premolar with cinguloid shelf extending anteriorly from internal cusp (fig. 60, *a*); upper incisors slightly pro-odont.

Remarks.—A glance at the striking sagittal crest of the skull or the head of the living animal is sufficient for distinguishing *T. terrestris* from all other Recent tapirs. The crest appears to be an extreme development of a condition that is incipient in *T. pinchaque*

where the parietal ridges almost or barely unite to form a low, inconspicuous crest. Cranial characters associated with the proboscis are, in *T. terrestris*, hardly distinguishable from those of *T. pinchaque*. Nevertheless, the proboscis of the Brazilian tapir is more developed.

Tapirus terrestris terrestris Linnaeus

(“Tapir” of Brazilian Tupi; “danta,” “anta,” and “gran bestia” of Spanish and Portuguese; “huagra” of Quechua Indians of Peruvian and Ecuadorian Amazonas, “mborebi” of Paraguayan Guaraní; “maipuri” or “manipuri” of Guianan Gahibi and Macusi Indians; “bushcow” of British Guianan colonists)

Hippopotamus terrestris Linnaeus, *Systema naturae*, ed. 10, vol. 1, p. 74, 1758.

Hydrochaerus tapir Erxleben, . . . *Systema regni animalis*. . . Mammalia, p. 191, 1777 (range given: Isthmo de Darién to Rio Amazonas).

Tapir suillus Blumenbach, *Handbuch der Naturgeschichte*, ed. 1, vol. 1, p. 129, 1779 (based on Allamand suppl. in Buffon, *Histoire naturelle*, vol. 15, Holland ed., pls. 9, 10, of male and female *T. terrestris* exhibited in Amsterdam, origin unknown, possibly Surinam).

Tapir (Anta) Zimmermann, *Geographische Geschichte* . . . vol. 2, p. 154, 1780, part (based primarily on the tapir of Marggraf and Linnaeus=*terrestris* Linnaeus).

Tapir americanus Gmelin, *Caroli a Linné* . . . , *Systema naturae*, ed. 13, vol. 1, p. 216, 1788 (primary reference, Brisson, *Regnum animale*, p. 119, 1756, the tapir of Guiana and Brazil; range given: Isthmo de Panamá to Rio Amazonas).

T[apirus] americanus, Tschudi, *Untersuchungen über die Fauna Peruana, Therologie*, pp. 213–215, 1844 (Perú; description, habits and distribution).

Tapirus rufus, Fischer, *Zoognosia tabulis synopticis illustrata* . . . , vol. 3, p. 292, 1814 [ed. 3] (Guiana).

Tapir maypuri Roulin, *Ann. Sci. Nat. Zool. Paris*, vol. 18, p. 45, 1829 (name derived from the vernacular of Indians living between right bank of the Caroní and mouth of Amazon).

Tapirus laurillardi Gray, *Proc. Zool. Soc. London* (1867), p. 881, figs. A, B, 1–4, 1868.

Tapirus terrestris laurillardi, Lydekker, *Catalogue of the ungulate mammals in the British Museum (Natural History)*, vol. 5, p. 43, 1916 (Venezuela?).

Tapirus leucogenys, juv., Gray, *Proc. Zool. Soc. London* (1872), p. 490, pl. 22, fig. 1 (animal), fig. p. 491 (skull), 1872.

T[apirus] aenigmaticus Gray, *Proc. Zool. Soc. London* (1872), p. 490, pl. 22, fig. 1, 1872 (alternative name for “*leucogenys*, juv.” Gray).—Lydekker, *Catalogue of the ungulate mammals in the British Museum (Natural History)*, vol. 5, p. 44, 1916 (type from “Sunac,” synonym of “*roulini*”).

Tapirus ecuadorensis Gray, *Proc. Zool. Soc. London* (1872), p. 492, pl. 22, fig. 2, 1872.—Thomas, *Proc. Zool. Soc. London* (1880), p. 400, 1880 (synonym of *roulini*).

Tapirus (terrestris) peruvianus Gray, *Proc. Zool. Soc. London* (1872), p. 624, pl. 45, 1872.

Tapyra sabatyra Liais, *Climats, géologie, faune et géographie botanique du Brésil*, p. 397, 1872 (name suggested as more “appropriate” for the Brazilian tapir).

Tapirus pinchaque ou *roulinii* . . . variété *brasilensis*, Liais, *Climats, géologie, faune et géographie botanique du Brésil*, p. 398, 1872.

- Tapirus tapirus* Merriam, Science, new ser., vol. 1, p. 376, 1895 (new combination of *tapirus* Brisson plus *tapirus* Merriam ex Brisson=*terrestris* Linnaeus).
- Tapirus americanus* Brisson, var. *mexicanae* Hagman, Archiv Rass.-Ges. Biol., vol. 5, p. 22, fig. 1, 1908.
- Tapirus terrestris mexicana*, Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 43, 1916.
- Tapirus spegazzinii* Ameghino, Anales Mus. Nac. Buenos Aires, vol. 20, p. 31, pls. 5, 6, December 1909 (separate); *ibid.*, ser. 3, vol. 18, p. 31, pls. 5, 6, 1911 (bound volume).
- Tapirus terrestris spegazzinii*, Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 43, 1916.
- Tapirus terrestris guianae* Allen, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 566, 1916.
- Tapirus anulipes* Hermann, Mitt. Zool. Mus. Berlin, vol. 11, pt. 1, p. 167, 1924.
- Tapirus (Hippopotamus) terrestris*, Hatcher, Amer. Journ. Sci., vol. 1, p. 174, pl. 4, figs. 1, 1a, pl. 5, fig. 1, 1896 (cranial characters; comparisons; phylogeny; synonymy: *americanus*, *anta*, *suillus*, *laurillardi*, *equadorensis* [sic]).
- Tapirus terrestris*, Gray, Proc. Zool. Soc. London (1867), p. 879, 1868 (revision; skulls only from Brazil; Berbice and Demerara in British Guiana).—Selater, Proc. Zool. Soc. London (1873), p. 193, fig. p. 194, 1873 (Paraguay).—Osgood, Field Mus. Nat. Hist. Publ., Zool. Ser., vol. 10, p. 46, 1912 (Empalado Savanas, Zulia, Venezuela).—Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 41, 1916 (synonyms: *tapir*, *anta*, *americanus*, *suillus*, *ecuadorensis*, *tapirus* Palmer ex Brisson; type locality, Brazil or Paraguay).—Goldman, Smithsonian Misc. Coll., vol. 69, p. 83, 1920 (skull only in U. S. National Museum labeled "Talamanca, Costa Rica").—Tate, Bull. Amer. Mus. Nat. Hist., vol. 76, p. 222, 1939 (Duida and Auyán-tepuí, Venezuela; British Guiana).—Simpson, Bull. Amer. Mus. Nat. Hist., vol. 86, p. 42, tables 1-8, figs. 1-4, pl. 10, fig. 2, 1945 (osteological and dental characters; comparisons; phylogeny; Mato Grosso, Brazil; Colombia; eastern Perú; British Guiana; "South America").—Goodwin, *ibid.*, vol. 87, p. 451, 1946 ("Talamanca, Costa Rica").
- Tapirus terrestris terrestris*, Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 42, 1916 (Rio de Janeiro; Taquara, Rio Grande do Sul, Brazil; "Brazil"; Berbice and Demerara, British Guiana; Surinam).
- Tapirus roulini* [sic], Selater (nec Fischer), Proc. Zool. Soc. London (1878), p. 631, pl. 39, 1878.—Thomas, Proc. Zool. Soc. London (1880), p. 400, 1880 (Sarayuacu, Ecuador; striped juvenals without skulls; part of original series described by Gray as *ecuadorensis* placed in synonymy of *roulini*).—Lydekker, Catalogue of the ungulate mammals in the British Museum (Natural History), vol. 5, p. 44, 1916 (part; *enigmaticus* [sic] in synonymy only).
- Tapirus roulini* [sic, nec Fischer] x *Tapirus americanus*, Selater, Proc. Zool. Soc. London (1882), p. 311, 1882 (specimen of "*roulini*" same as the "*roulini*" of Selater, 1878, *supra cit.*).
- Tapirus dowii* (?), Selater (nec Gill), Proc. Zool. Soc. London (1882), p. 391, pl. 23, 1882 (Río Yuruari, Venezuela).
- Tapirus americanus*, Selater, Proc. Zool. Soc. London, 1885, p. 718, 1886 (correction of identification of "*roulini*" Selater, 1878, *supra cit.*, and "*dowii* (?)" Selater, 1882, *supra cit.*).—Döderlein, Ueber das Skelett des *Tapirus pinchacus*; Inaugural-Dissertation, p. 3, Bonn, 1877 (distribution).

Types.—Of *terrestris* Linnaeus, *tapir* Erxleben, *anta* Zimmermann, *americanus* Gmelin, *suillus* Blumenbach, none in existence, names based on bibliographic references; of *rufus* Fischer, skin and skull, MHNP; of *maypuri* Roulin, *sabatyra* Liais, none in existence, names proposed as substitutes for *terrestris* Linnaeus; of *brasiliensis* Liais, none in existence, name based on reported differences alleged to exist in a "variety" of Brazilian tapir; of *laurillardii* Gray, adult, skull only, BM 52.12.9.3. (709 g), purchased from Brandt of Hamburg in 1852; of *aenigmaticus* Gray, immature, skull only if skin mismatched, BM 72.1.24.9-10 (1577 f), collected by Clarence Buckley; of *ecuadorensis* Gray, striped juvenal, male, skin mounted, BM 72.1.24.13, collected by Buckley, original number, 13; of *peruvianus* Gray, striped juvenal, skin and skull, presumably the specimen later listed by Gray (Handlist of the Edentate, Thick-skinned and Ruminant Mammals in the British Museum, p. 33, 1873) as BM 69.3.31.9. (38 d), with skull, 72.4.11.4 (709 l), collected May 31, 1868, by E. Bartlett; of *mexicanae* Haggmann, young adult, skull only, "Zoological Collection, Strassburg"; of *spgazzinii* Ameghino, adult male, skull only, MACN, collected by Carlos Spegazzini; of *guianae* Allen, young adult, skull only, AMNH 36198, collected by Leo E. Miller; of *anulipes* Hermann, young adult with persistent juvenal streaks and spots, especially on limbs, observed in zoological garden in Corumbá, Mato Grosso, Brazil.

Type localities.—Of *terrestris* Linnaeus, Brazil, restricted to Pernambuco by Thomas (Proc. Zool. Soc. London (1911), p. 155, 1911); of *anta* Zimmermann, here restricted to Pernambuco; of *sabatyra* Liais, same as for *terrestris* Linnaeus; of *laurillardii* Gray, "South America," here restricted to Pernambuco; of *mexicanae* Haggmann, Ilha Mexiana, mouth of Rio Amazonas, Brazil; of *brasiliensis* Liais, Rio São Francisco, Minas Geraes, Brazil; of *anulipes* Hermann, neighborhood of Cuyabá, Mato Grosso, Brazil; of *spgazzinii* Ameghino, Río Pescado, Departamento de Orán, Salta, Argentina; of *peruvianus* Gray, "Peruvian Amazons," here restricted to Santa Cruz, Río Huallaga, Perú (this locality that of a specimen reported by Bartlett (*in* Gray, Proc. Zool. Soc. London (1872), p. 625, 1872) as mother of type; of *aenigmaticus* Gray, said to be "Sunia," Cordillera Oriental, Ecuador, but almost certainly from Macas, eastern Ecuador; of *ecuadorensis* Gray, Macas, eastern Ecuador; of *tapir* Erxleben, *suillus* Blumenbach, and *americanus* Gmelin, here restricted to Surinam; of *rufus* Fischer, Guiana, probably French Guiana; of *maypuri* Roulin, here restricted to the Guianas; of *guianae* Allen, Tumatumari, British Guiana.

Distribution.—As for the subgenus except in western Colombia where it is replaced by another race (see map, fig. 61). Tschudi (*supra cit.*) affirmed that in Perú the common tapir is confined to the

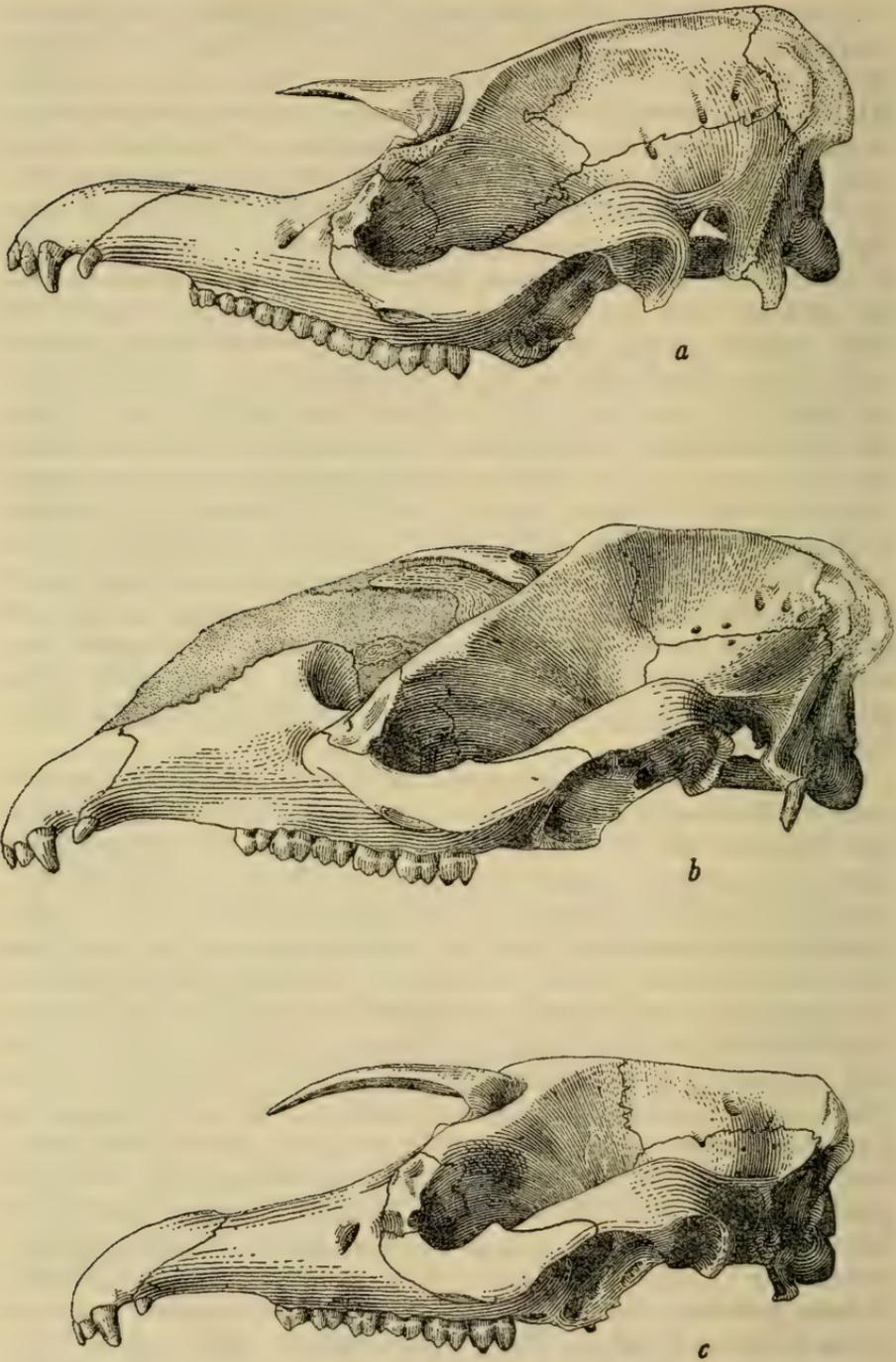
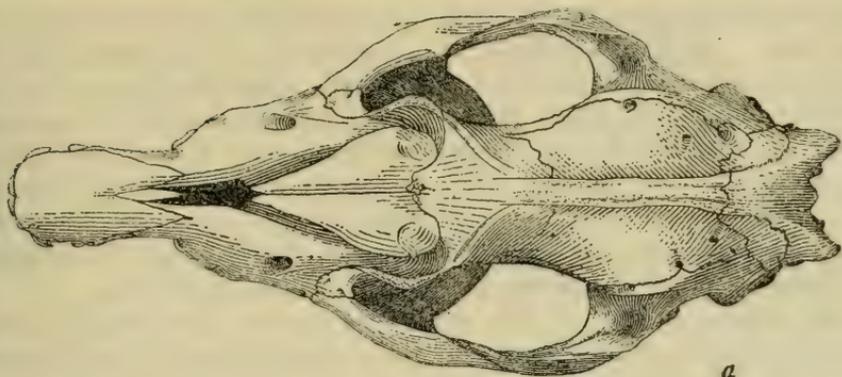
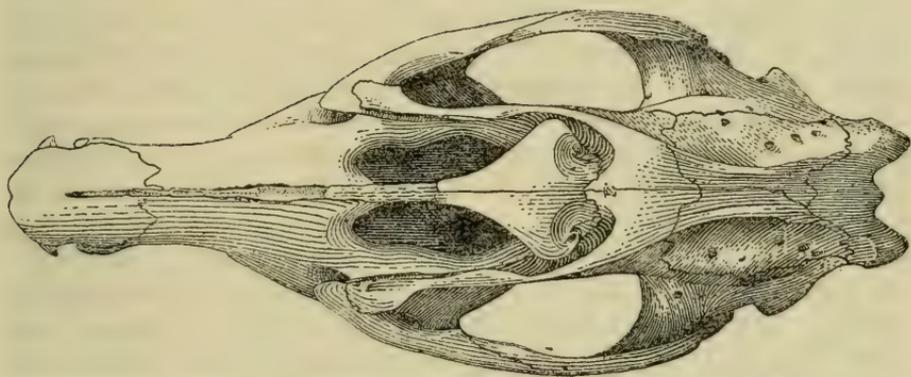


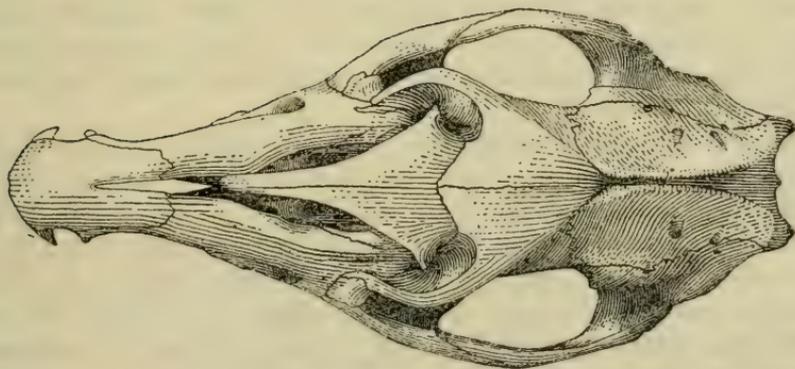
FIGURE 58.—Crania of American tapirs, lateral views $\times \frac{1}{4}$. *a*, *Tapirus terrestris*; *b*, *Tapirus bairdii*; *c*, *Tapirus pinchaque*.



a



b



c

FIGURE 59.—Crania of American tapirs, dorsal views $\times \frac{1}{4}$. a, *Tapirus terrestris*; b, *Tapirus bairdii*; c, *Tapirus pinchaque*.

tropical forest region and is never found at 3,000 feet or more above sea level. On the other hand, Tate (supra cit., p. 223) stated that on "Mt. Auyan-tepui [Venezuela] tapir tracks were abundant as high as 3,500 feet." Tate added that "on the eastern slopes of the Andes near the Pastaza River I found tracks of tapir above 7,000 feet." It is possible that the last refers to the mountain tapir of Ecuador, *T. pinchaque*. It has already been shown (p. 478) that the common tapir recorded from "Talamanca, Costa Rica," by authors, is probably South American, possibly Brazilian, in origin.

Characters.—Those of the subgenus; general external characters given under the generic heading. Skin of adult female from Surinam (USNM) blackish brown on back and sides, dark brown on chest, belly, and limbs; top of head blackish brown, ears blackish brown except for white edging; cheeks grizzled brown and gray, throat with more gray, neck brown, chin blackish brown; mane from front of ears to withers black. Specimen from Río Yuruari, Venezuela, figured by Sclater as "*Tapirus dowii* (?)", similarly colored but jaws strikingly white. Two skins of menagerie individuals (CNHM, received from Chicago Zoological Society) also like Surinam specimens, one practically indistinguishable, the other with less black on sides and limbs. Untanned skin from Buena Vista, Santa Cruz, Bolivia (CNHM, collected by José Steinbach), considerably paler, dorsal surface from Cinnamon-Brown to Tawny, sides paler, mixed with gray, mane blackish brown, limbs like back but becoming Prout's Brown on posterior surface. Skin of adult male (USNM) that died at 32 years of age after living 27 years in the National Zoological Park, Washington, is extremely pale; back Cinnamon-Brown mixed with gray, sides more grizzled, underparts dominantly gray to dirty white, mane Prout's Brown, hoofs unpigmented. A portion of hide from posteriormost end of body of another specimen (USNM) from same zoological park is nearly uniformly Ochraceous-Tawny on dorsal surface, sides grizzled, underparts tending to become dominantly gray; pelage of both menagerie specimens considerably thicker and longer than in any wild, living *T. terrestris*.

Measurements.—Of an adult male and a female, respectively, collected in Porto Campo, Rio Sepotuba, Mato Grosso, Brazil, by Leo E. Miller (ex Allen, Bull. Amer. Mus. Nat. Hist., vol. 35, p. 566, 1916): In millimeters, total length, 2,070, 2,000; tail, 60, 100; "hind foot" (digits only), 140, 140; ear, 120, 120. Of type of *spgazzinii*, collector's measurements cited by Ameghino (supra cit.): Height, 80 cm.; weight, approximately, 250 kilos. Of type of *anulipes*, living animal measured by Hermann (supra cit.): Total length, 210 cm.; height at shoulder, 77 cm.; height at rump, 83 cm. Of an adult from Perú, measurements from Tschudi (supra cit.): Head and body, 6 ft., 7 in.

(German system); tail, 3 in., 3 lines; height at withers, 3 ft., 6 in. Of an adult male from Paraguay (ex Azara, *Essais sur l'Histoire Naturelle des Quadrupèdes de la Province du Paraguay* . . . , French ed., vol. 1, p. 5, 1801): Head and body, 2,000 mm.; tail, 100 mm.; height at shoulder, 1,100 mm., at rump, 1,130 mm.; circumference of chest, 1,215 mm.; ear, from crown, 80 mm.

Remarks.—All evidence points to the existence of but one species of tapir east of the Andes in South America. That there is more than one subspecies within the range assigned to the typical form is likely but cannot be satisfactorily demonstrated without comparisons with the Linnaean *terrestris* from Pernambuco. Earlier characterizations based on single skulls only (*laurillardii*, *spgazzinii*, *guianae*, *mexianae*) define nothing more than individual variation. Descriptions of species based on skins of striped juvenals (*aenigmaticus*, *ecuadorensis*, *peruvianus*) and young adults with persistent juvenal striping (*anulipes*) are trivial. Except for the Guianan *rufus*, the remaining names included in the synonymy of *terrestris* are founded on bibliographic references or simply distaste for the original Linnaean designation.

Color and, possibly, size seem to be the only valid characters for distinguishing subspecies of tapirs. Unfortunately, external characters of typical representatives of *terrestris* are unknown. With their type localities now restricted, *anta* Zimmermann, *sabatyra* Liais, and *laurillardii* Gray become absolute synonyms of *terrestris*. The Rio São Francisco *brasiliensis* Liais is almost certainly identical with the Pernambuco form. Tapirs of the Guianas are extremely dark, blackish brown in general appearance, and probably distinctly darker than typical *terrestris*. The earliest available name for a Guianan tapir is *tapir* Erxleben (synonyms: *suillus* Blumenbach, *americanus* Gmelin, *rufus* Fischer, *maypuri* Roulin, *guianae* Allen). It is extremely doubtful if *mexianae* Hagmann, from the mouth of the Rio Amazonas, is recognizable. It may be referable to either the Guianan or typical form or it may represent an intergrading population not certainly separable from either of its nearest allies. In any case, the earlier named *aenigmaticus* Gray (*ecuadorensis* Gray) from Macas and *peruvianus* Gray from the Río Huallaga must be given prior consideration if an Amazonian race is recognized. The tapir of Mato Grosso, Brazil, is extremely pale grayish brown in general appearance. Three adults collected by Colin C. Sanborn and mounted in a habitat group in the Chicago Natural History Museum agree with the published description of the living type of *anulipes* from Cuyabá, Mato Grosso. The specimen from Buena Vista, Santa Cruz, Bolivia, described above, is similarly pale. This pale austral tapir is certainly distinguishable from the saturate Guianan form but comparison with

the typical Pernambuco tapir is required. The name *spgazzinii* Ameghino (*anulipes* Hermann, a synonym) is available, should recognition be indicated. Finally, the tapir of the Maracaibo basin, western Venezuela, may be referable to the northern Colombian race but it is known from skulls only and is here provisionally assigned to the "catch-all" *terrestris* Linnaeus.

Specimens examined.—Forty-nine. BRAZIL: Pará, 4 (CNHM); Rio Grande do Sul, 4 (USNM); Mato Grosso, 1 (USNM); Descalvados, Mato Grosso, 4 (CNHM); 50 miles northwest of Miranda, Mato Grosso, 1 (CNHM); Salto do Hua, Rio Maturaca, at Venezuelan boundary, Amazonas, 1 (USNM); Serra da Lua, Amazonas, 1 (CNHM); "Branch of Amazon," 1 (USNM); SURINAM: Moengo, 1 (USNM); Paramaribo, 1 (USNM); no precise locality, 2 (USNM). VENEZUELA: Empalado Savanas, Zulia, 1 (CNHM); Sierra de Perijá, Zulia, 1 (CNHM). BOLIVIA: near Brazilian boundary, west of São Luiz de Cáceres, 1 (USNM); Buena Vista, Santa Cruz, 1 (CNHM). PERÚ: Tingo María, Huanuco, 1 (CNHM); Pozuzo, Huanuco, 10 (CNHM); Yarinacocha, Loreto, 1 (CNHM). "COSTA RICA": 1 (USNM, a skull only, probably from Brazil). SOUTH AMERICA: 11 (USNM, 9; CNHM, 2).

Tapirus terrestris colombianus, new subspecies

("danta colombiana")

Tapir [sp.] Roulin, Ann. Sci. Nat., Paris, ser. 2 (Zool.), vol. 18, p. 35, 1829 (distribution of *T. terrestris* in Colombia: Lower Magdalena and Cauca valleys; common at Murindó, right bank of Río Atrato; in Colombian Darién but never seen on Panamanian side).

Tapirus terrestris, Bangs, Proc. New England Zool. Club, vol. 1, p. 90, 1900 (adult female, skin and skull from Dibulla, coastal plain north of the Sierra Nevada de Santa Marta).—Allen, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 430, 1904 (two adults with skeletons, one spotted immature, from Cacagualito, Sierra Nevada de Santa Marta, 20 miles east of Santa Marta, altitude, 1,500 ft.).—Goodwin, Bull. Amer. Mus. Nat. Hist., vol. 87, p. 451, 1946 (Naranjo, Santa Marta region, Colombia).

T[apirus] terrestris, G. M. Allen, Extinct and vanishing mammals of the Western Hemisphere, p. 405, 1942 (part; Dibulla, northern Colombia.).

Holotype.—Young adult male, skin and skull, USNM 281389; collected July 15, 1942, by Philip Hershkovitz; original number, 438.

Type locality.—El Salado, eastern slope of Sierra Nevada de Santa Marta, on road between Valencia and Pueblo Bello, Department of Magdalena, Colombia; altitude, 430 meters.

Distribution.—Tropical Zone of northern Colombia, in the Departments of Magdalena, Atlántico (?), Bolívar, Córdoba, and northwestern Antioquia; the species is not known to occur west of the

Río Atrato in the Department of Chocó and north of the Río Rancherfa, in La Guajira. The subspecies may range into the Lake Maracaibo basin in Venezuela but external characters of the tapir there are unknown. (See map, fig. 62). H. H. Smith (*in* Allen, *supra* cit.) stated that on the western slope of the Santa Marta region, Magdalena, "the tapir is common from sea-coast to 6,000 feet, and probably higher as I have seen tapir tracks at nearly 8,000 feet." I saw no signs of tapir above 700 meters on the southern and eastern slopes of the Sierra Nevada de Santa Marta. In the absence of reliable records proving otherwise, the altitudinal range of the species has been determined as sea level to not over 1,200 meters above. The tapir is certainly extinct now in the Department of Atlántico and is vanishing from Córdoba.

Characters.—Distinctly paler throughout than Guianan representatives of *terrestris*; slightly darker, less gray than the Mato Grosso-Chaco tapir at the opposite extreme of the range of the species.

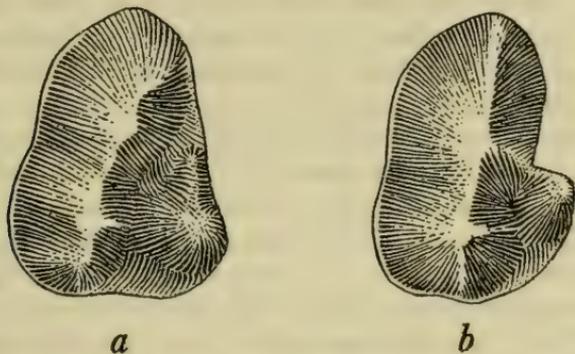


FIGURE 60.—Structural variation in first upper premolar of American tapirs, $\times 2$. *a*, first premolar of *Tapirus terrestris* with fully developed cinguloid shelf extending from protocone. *b*, first premolar of *Tapirus pinchaque*, specimen from Ecuador (CNHM 47051) with cinguloid shelf absent (in another specimen from Colombia, CNHM 70557, premolar is as shown in *a*).

Coloration of holotype.—Back thinly haired Prout's Brown, basal portions of hairs buffy to ochraceous; side paler, hairs gray basally, Prout's Brown to Cinnamon-Brown terminally; pelage of chest and belly thinner, more gray. Fore and hind limb Prout's Brown with persistent juvenal spots and patches of whitish to buffy. Snout and frontal region Prout's Brown, ear Prout's Brown rimmed with white; cheek and side of lower jaw gray lightly mixed with brown, throat and anterior part of chest less brown; chin brown, lips fringed with stiff gray and buffy hairs. Sharply defined blackish brown mane extends from forehead to well behind middle of back.

Measurements.—Those of the holotype followed by those of an adult male paratype (in millimeters): Total length, 1,760, 1,870;

tail, 46, 83; hind foot, 333, 350; ear, 137, 125; greatest length of skull (from gnathion to nuchal crest), 370 (m^2 functional), 385 (m^3 functional), zygomatic breadth, 175, 175.

Remarks.—Distinction of *colombianus* from trans-Andean *terrestris* is based on comparisons with the blackish-brown representatives of the species in the Guianas (= *Tapirus terrestris tapir* ?Erxleben). The skin of the adult male paratype of *colombianus* could not be preserved and was discarded. Its color was quite like that of the type. The specimen recorded by Bangs (supra cit.) was collected by W. W. Brown, Jr., in Dibulla, a humid tropical locality on the northern base of the Sierra Nevada de Santa Marta. It was examined by Miss Barbara Lawrence of the Museum of Comparative Zoology, Harvard, and found to agree with the above description of *colombianus* except for its slightly paler back, chest, and belly, more buffy cheeks, sides of lower jaws, and throat; greatest length of skull (M^2 functional), 385 mm.

Herbert H. Smith (in Allen, Bull. Amer. Mus. Nat. Hist., vol. 20, p. 431, 1904) reported that "all the hunters near Santa Marta aver that there is a tapir, found in the mountain forest, which, in general color, resembles *T. americanus*, but has a broad white mark over the shoulder." Smith concluded that it might represent an "undescribed tapir, which differs in color from all the known American species, and resembles that of the Malay Islands." The tapir in question, if not a myth, may be a pied individual of *colombianus*.

Specimens examined.—Seven. COLOMBIA: El Salado, Sierra Nevada de Santa Marta, Magdalena, 2 (USNM); El Orinoco, Río Cesar, Magdalena, 2 (USNM); Río Guaimaral, Río Cesar, Magdalena, 1 (USNM); "Río Magdalena," 1 (USNM); Socorré, upper Río Sinú, Córdoba, 1 (CNHM).

Subgenus *Tapirella* Palmer

Elasmognathus Gill, Proc. Acad. Nat. Sci. Philadelphia, vol. 17, p. 183, 1865 (genotype by monotypy, *Elasmognathus bairdii* Gill).

Tapirella Palmer, Science, new ser., vol. 17, p. 873, 1903 (new name for *Elasmognathus* Gill, preoccupied by *Elasmognathus* Fieber, 1844, a genus of Hemiptera).

Included species.—*Tapirus bairdii*.

Distribution.—From México, in Veracruz and the Istmo de Tehuantepec, east into Campeche and British Honduras, south through Guatemala into Panamá, Colombia west of the Río Cauca, and Ecuador west of the Andes (see map, fig. 61).

Characters.—Head flattened dorsally, a low mane, not always well defined, extending from front of ears to withers; proboscis longer and bulkier than in other American species; pelage of lowland populations thin and not completely hiding skin, in highland populations longer,

thicker, and completely hiding skin; hoofs broad, larger than in subgenus *Tapirus* with middle hoof always wider than long. Dorsal contour of skull (fig. 58, *b*) flattened or slightly rounded; median frontal line usually placed abruptly above level of nasals, roughly parallel to horizontal plane of nasals but strongly divergent from horizontal plane of maxillary tooth row; superior longitudinal parietal ridges separated by a broad flat table, not uniting to form a sagittal crest (fig. 59, *b*); ossification of vertical mesethmoid plate extending beyond tips of nasals to angle between premaxillae in old adults; outer anterodorsal surface of maxillae produced upward to form thin, parallel-sided plates embracing mesethmoid; posterolateral maxillary process projecting back to form inner lateral wall of narial meatus but not contacting nasal bone; posterolateral border of premaxilla rounded or angular and embraced by maxilla; nasal without descending process overlapping maxilla; two ossification centers of nasal sometimes persistent in fully ossified bone of adult. First upper premolar as in subgenus *Tapirus*; upper incisors orthodont.

Remarks.—*Tapirella* resembles the Indian *Tapirus* (*Acrocodia*) *indicus* more than it does either of its American relatives. The raised but flat crown of Baird's tapir has the same relationship to the equally broad but low crown of the Indian tapir as the crested crown of *T. terrestris* has to that of *T. pinchaque*. Cranial characters associated with the proboscis are diagnostic of *T. bairdii* when compared with other American species but, in many details, are like conditions found in *T. indicus*.

The name *Tapirella*, diminutive of *Tapirus*, is most inappropriate for the largest living species of American tapir.

Tapirus (*Tapirella*) *bairdii* Gill

(Baird's tapir; "danta centroamericana")

Tapir (*Anta*) Zimmermann, Geographische Geschichte . . . , vol. 2, p. 154, 1780 (part; Yucatán and Panamá).

Elasmognathus bairdii Gill, Proc. Acad. Nat. Sci. Philadelphia, vol. 17, p. 183, 1865.

Elasmognathus dowii Gill, Amer. Journ. Sci., ser. 2, vol. 50, p. 142, 1870.

Elasmognathus bairdii, Hatcher, Amer. Journ. Sci., ser. 4, vol. 1, p. 175, pl. 3 (nasals), pl. 4, fig. 4a, pl. 5, fig. 4, 1896 (osteological characters; phylogeny).

Elasmognathus bairdi [sic], Gray, Proc. Zool. Soc. London (1867), p. 885, pl. 42, 1868 (revision; description).

Elasmognathus dowi [sic], Hatcher, Amer. Journ. Sci., ser. 4, vol. 1, p. 175, pl. 3 (nasals), 1896 (osteological characters; phylogeny; "might better be considered as a subspecies [of *bairdii*]").

Tapirus (*Elasmognathus*) *bairdi* [sic], Sumichrast, Naturaleza (México), vol. 5, p. 332, 1882 (Sierra Madre, Istmo de Tehuantepec; Chiapas, México).

- Tapirus bairdi* [sic], Selater, Proc. Zool. Soc. London (1872), p. 635, pl. 51, 1872.—Gaumer, Monografía de los mamíferos de Yucatán, México, p. 43, 1917 (Yucatán, México; British Honduras).
- Tapirus dowi* [sic], Alston, Proc. Zool. Soc. London (1879), p. 666, 1880 (comments; range probably restricted to Pacific slope of Guatemala and Nicaragua).—Alston, Mammalia, in Godman and Salvin, Biologia Centrali-Americana: Zoology, p. 104, pl. 8, figs. 3–5, 1882 (part; description, characters, bibliographic references; figure pl. 9 = *T. terrestris*).
- Tapirus bairdii*, Alston, Mammalia, in Godman and Salvin, Biologia Centrali-Americana: Zoology, p. 101, pl. 8, figs. 1, 2, 1882 (description, characters, bibliographic references).—Simpson, Bull. Amer. Mus. Nat. Hist., vol. 86, pp. 37–80, pl. 8, fig. 2, 1945 (osteological characters; comparisons; phylogeny).
- [*Tapirella*] *dowi* [sic], Simpson, Bull. Amer. Mus. Nat. Hist., vol. 86, p. 41, footnote, 1945 (“specific status does not appear to be demonstrated”).
- Tapirella bairdii*, Goldman, Smithsonian Misc. Coll., vol. 69, p. 81, 1920 (Panamá).—Goodwin, Journ. Mamm., vol. 27, p. 91, 1946 (*dowii* a synonym); Bull. Amer. Mus. Nat. Hist., vol. 87, p. 450, 1946 (Costa Rica: Talamanca and Pacuare, Limón; Carillo, San José).—Hatt, Cranbrook Inst. Sci. Bull. 33, p. 72, 1953 (México: Actún Lara, Yucatán; extinct).

Lectotypes.—Of *bairdii* Gill, skull only, adult, USNM 6019, collected April 9, 1863, by W. T. White (one of two cotypes designated by Poole and Schantz, U. S. Nat. Mus. Bull. 178, p. 233, 1942); of *dowii* Gill, skull only, young adult, USNM 11278, collected by J. M. Dow, original number, 1 (one of five cotypes designated by Poole and Schantz, loc. cit.)

Type localities.—Of *bairdii* Gill, “Isthmus of Panama,” here restricted to Canal Zone, Panamá; of *dowii* Gill, “Guatemala,” believed by Alston (Proc. Zool. Soc. London, 1879, p. 666, 1880) to be “confined to the Pacific slope of Guatemala and Nicaragua.” Later, Alston (Mammalia, in Godman and Salvin, Biologia Centrali-Americana: Zoology, p. 105, 1882) quoted Godman and Salvin as follows: “On the Pacific coast [of Guatemala] Tapirs are no doubt abundant. In the forest of the hacienda of El Overo, a few leagues from the port of San José, the proprietor, Don Juan Viteri, assured us that they were to be found in plenty. He it was, we believe, who supplied Captain Dow with the original specimens of *T. dowi* [sic].” Accordingly, the type locality of *dowii* is here restricted to the Pacific slope of Guatemala.

Distribution.—As for the subgenus. According to Hatt (Cranbrook Inst. Sci. Bull. 33, p. 72, 1953), who recorded skull fragments from caves in southern Yucatán, “tapir has not been known in Recent time from this part of Yucatán.” In Panamá the species is known to range from sea level to the summits of the highest ridges of the eastern and western mountains. Oliver Pearson, who climbed to the top of the Volcán de Chiriquí in 1937, found well-worn tapir trails at 3,350 meters altitude, near the very summit of the peak. (See map, fig. 62.)

In northwestern Colombia, east of the Río Atrato, Baird's tapir lives side by side with *Tapirus terrestris colombianus*. The writer

preserved a skull only of the Colombian tapir killed in the upper Río Sinú valley 3 kilometers below the mouth of the tributary Río Verde, and a skull only of a Baird's tapir killed by a hunter about 4 kilometers lower down the Sinú, near the confluence of the Río Nain. Within the same area, but more than a year before, a hunter killed a Baird's tapir while it was feeding on fallen fruit of the cannon-ball tree (*Couroupita guianensis*) and two weeks later killed a Colombian tapir feeding on the same fruit. The hunter preserved the skulls and they were identified by the writer.

Earliest authentic record of the existence of Baird's tapir in South America and first knowledge of the occurrence of this species in western Ecuador is based on a photograph of the animal kindly loaned to the writer by Belle Benchley, Executive Secretary of the Zoological Society of San Diego. Mrs. Benchley added the information (in litt.) that the individual photographed was brought to the San Diego Zoological Park by Fred Lewis, who "had taken a small boat and gone up the river at Guayaquil, Ecuador, and brought it back." The animal died in captivity in 1945.

Characters.—Those given for the subgenus. See also general external characters mentioned under the generic heading. Skin of adult male topotype of *bairdii* from Tiger Hill, C. Z., collected by E. A. Goldman, is dark brown with pelage thin, stiff, sleek, the skin showing through. Two skins of young adults from Guatemala, probably topotypical of *dowii*, are darker, nearly black on dorsal surface, pelage thick, coarse, comparatively long, and completely hiding skin.

Measurements.—Of the topotype of *bairdii* from Tiger Hill: Total length, 2,000 mm.; tail, 70 mm.; hind foot, 372 mm. Of an adult from Vera Cruz, México (ex Goodwin, Bull. Amer. Mus. Nat. Hist., vol. 87, p. 450, 1946): Total length, 2,020 mm.; tail, 70 mm.; hind foot, 375 mm.; ear, 140 mm. Skull lengths given under the generic heading.

Remarks.—That *bairdii* and *dowii* are conspecific has already been indicated by Hatcher, Simpson, and, finally, by Goodwin, all cited above in the synonymy. It is possible, however, that there may be two geographic races, one the typical lowland thinly haired form, the other a comparatively thickly haired highland race. However, additional characters to support what are ostensibly individual somatic responses to cooler climate are required for validating the name *Tapirus bairdii* *dowii* for the highland tapir of western Guatemala and El Salvador.

The two Guatemalan skins described above were mounted specimens exhibited in the Columbian Exposition by the Guatemalan Commission. They are now preserved as study skins in the collection of the U. S. National Museum and numbered 61221 and 61222, the last with skull. A skull only of a young individual, numbered 61221-B, has the same history and may correspond to the first skin.

The head of "*Tapirus dowi*" figured by Alston (Mammalia, pl. 9, in Godman and Salvin, *Biologia Centrali-Americana: Zoology*, 1882) has the high, maned crest distinctive of *T. terrestris*, to which species it is now assigned.

Baird's tapir, the least known and the last living species of the genus to be given a Linnaean name, was the first recorded in European literature. A recognizable, though exaggerated, description was given by Peter Martyr D'Angher, the first chronicler of the discovery and conquest of America, in book 9 of the second (of eight) Ocean Decade of his "*De Orbe Novo*," published in 1516. Martyr's concept of the tapir, acquired from descriptions brought to him by the first explorers of the Isthmus of Panamá, is of an animal which "Nature created in prodigious form. It is as large as a bull, and has a trunk like an elephant; and yet it is not an elephant. Its hide is like a bull's and yet it is not a bull. Its hoof resembles that of a horse, but it is not a horse. It has ears like an elephant's though smaller and drooping, yet they are larger than those of any other animal." Prior to official date of publication, the manuscripts of the "Oceanic Decades" were made available to students and correspondents as they were being written, from 1494 onward. This led to a pirated published edition in 1504 and another in 1507, both Italian. The second record of a tapir refers to another Panamanian *T. bairdii* and dates from the "Summario" of Gonzalo Fernández de Oviedo y Valdes, published in 1526 (or 1525) at Madrid. The accurate description of this tapir is repeated, accompanied by a first-rate woodcut, in Oviedo's "*Historia General y Natural de las Indias*" (book 12, chap. 11, pl. 1, fig. 11), published in 1535 at Seville, Spain. Oviedo extolled the gastronomic virtues of tapir meat and slow-boiled tapir feet, and told of how the animal is hunted with dogs. During the remainder of the 16th century practically all travelers, missionaries, and students interested in New World natural history described or referred to Baird's tapir. Francisco Hernández (*Rerum Medicarum Novae Hispaniae Thesaurus, seu Plantarum, Animalium . . .*, tract. I, cap. 8, p. 3, 1651) described the *Tlacaxolotl*, which, in spite of the long tail attributed to it, is unmistakably a tapir. The animal was said to occur in Atzacán [Veracruz], Tepetzotlán [México] and Tlaquilapán [Hidalgo or Veracruz]. The Hernández account of the *Tlacaxolotl* is identical to that of Fray Bernardino de Sahagún in his "*Historia General de las Cosas de Nueva España*." This work was written during the latter half of the 16th century. The manuscript, examined and cited by 16th and early 17th century students of Mexican history, was not published until 1831. Publication dates are of no importance in comparing the works of Hernández and

Sahagún because they were written contemporaneously. It cannot be determined now which author, or editor, copied from the other.

The first Linnaean reference to Baird's tapir is by Zimmermann in 1780 (*supra cit.*), who considered it the same as the Brazilian species. Zimmermann's Panamá record for the tapir is based either on Oviedo or other pre-Linnaean authors who quoted Oviedo. His Yucatán record is almost certainly derived from the account of the tapir in "Dampier's Voyages," volume 2, part 2 entitled "Two Voyages to

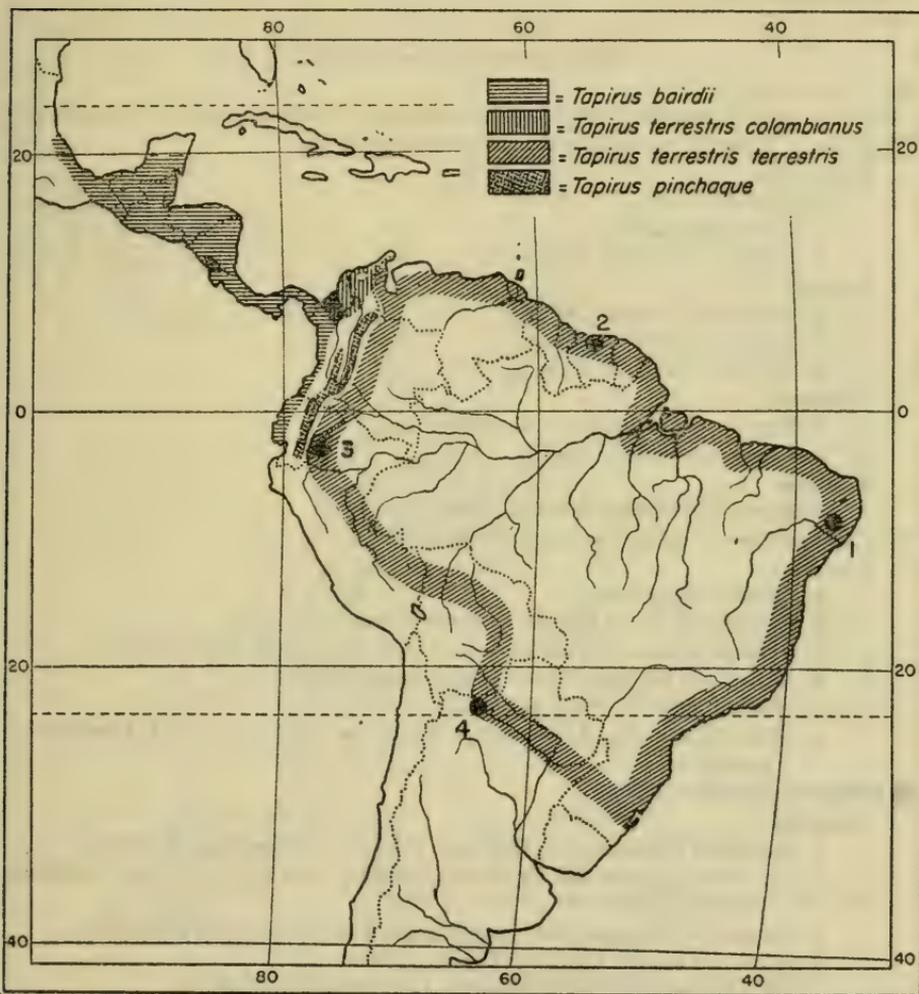


FIGURE 61.—Distribution map of American tapirs. Range of *Tapirus terrestris terrestris* as outlined includes those of other possibly recognizable subspecies. Type localities: (1) Pernambuco, Brazil, *Tapirus terrestris terrestris* Linnaeus; (2) Surinam, [*T. terrestris*] *tapir* Erxleben; (3) Macas, Ecuador, [*T. terrestris*] *aenigmaticus* Gray; (4) Río Pescado, Salta, Argentina, [*T. terrestris*] *spegazzinii*.

Campeachy; with a description of the Coasts, Product, Inhabitants, Logwood-Cutting, Trade, Etc. of Yucatan, Campeachy, New Spain, Etc.," page 102, which was first published in 1698.

The common name "danta" for the tapir is a corruption of the Spanish word for elk, "alce" or "anta." Early Spaniards in America gave peninsular names to all animals that resembled, whether in fact or fancy, those they had known in the Old World. The now universally accepted term "tapir" is from the same word in the Brazilian Tupi language.

EXPLANATION OF MAP, FIGURE 62

● = *Tapirus bairdii* Gill

Locality records of authentically identified specimens from South America, Panamá, and Costa Rica. Range of species extends northward into México.

COSTA RICA

1. Pacuare, Limón.
2. Talamanca, Limón.
3. Carillo (=Carrillo), San José.

PANAMÁ

4. Volcán de Chiriquí, Chiriquí.
5. Canal Zone (type locality).
6. Mt. Pirri and Caná, Panamá.

COLOMBIA

7. Unguía, Chocó (sight record, by author).
8. Upper Río Sinú, Córdoba.

ECUADOR

9. North of Guayaquil (exact locality unknown).

○ = *Tapirus terrestris colombianus*, new subspecies.

COLOMBIA

1. Dibulla, Magdalena.
2. Cacagualito, Sierra Nevada de Santa Marta, Magdalena.
3. El Salado, Sierra Nevada de Santa Marta, Magdalena (type locality).
4. El Orinoco, Río Cesar, and Río Guaimaral, Magdalena.
5. Socorré, upper Río Sinú, Córdoba.
6. Murindó, Chocó. Recorded by Roulin as *T. terrestris* but identification questionable.

■ = *Tapirus pinchaque* Roulin.

COLOMBIA

1. Santander (Department), Cordillera Oriental, at Venezuelan boundary.
2. Las Juntas, upper Río Combeima, southern foot of Mt. Tolima, Cordillera Central, Caldas.
3. Páramo de Sumapaz, Cordillera Oriental, Cundinamarca (type locality).
4. Volcán de Puracé, Cordillera Central, Cauca.
5. Río Majuas, upper Río Magdalena, Cordillera Central, Huila.

ECUADOR

6. Borja, about 60 kilometers east of Quito, Cordillera Oriental Napo-Pastaza.
7. Papallacta, Cordillera Oriental, Pichincha.
8. Cordillera de los Llanganates, Cordillera Oriental, Tungurahua.
9. Páramo de Azuay, Cordillera Oriental, Azuay.

Specimens examined.—Sixty. COLOMBIA: Unguía, Urabá, Chocó, 1 (CNHM). PANAMÁ: No precise locality, probably Canal Zone, 5, including type of *bairdii* (USNM); Tiger Hill, C. Z., 1 (USNM); Madden Dam, C. Z., 1 (USNM); Río Chagres, C. Z., 1 (USNM); Panamá Railroad, C. Z., 1 (USNM); Gatún, C. Z., 1 (USNM); Mt. Hope, C. Z., 1 (USNM); Mt. Pirri, Panamá, 1 (USNM); Caná, Panamá, 2 (USNM). COSTA RICA: Talamanca, 4 (USNM); Pacuare, 3 (USNM); San José, 1 (USNM); "Dota Mountains," 1 (USNM); no precise locality, 6 (USNM). NICARAGUA: Ebenezar, Río Prinza-

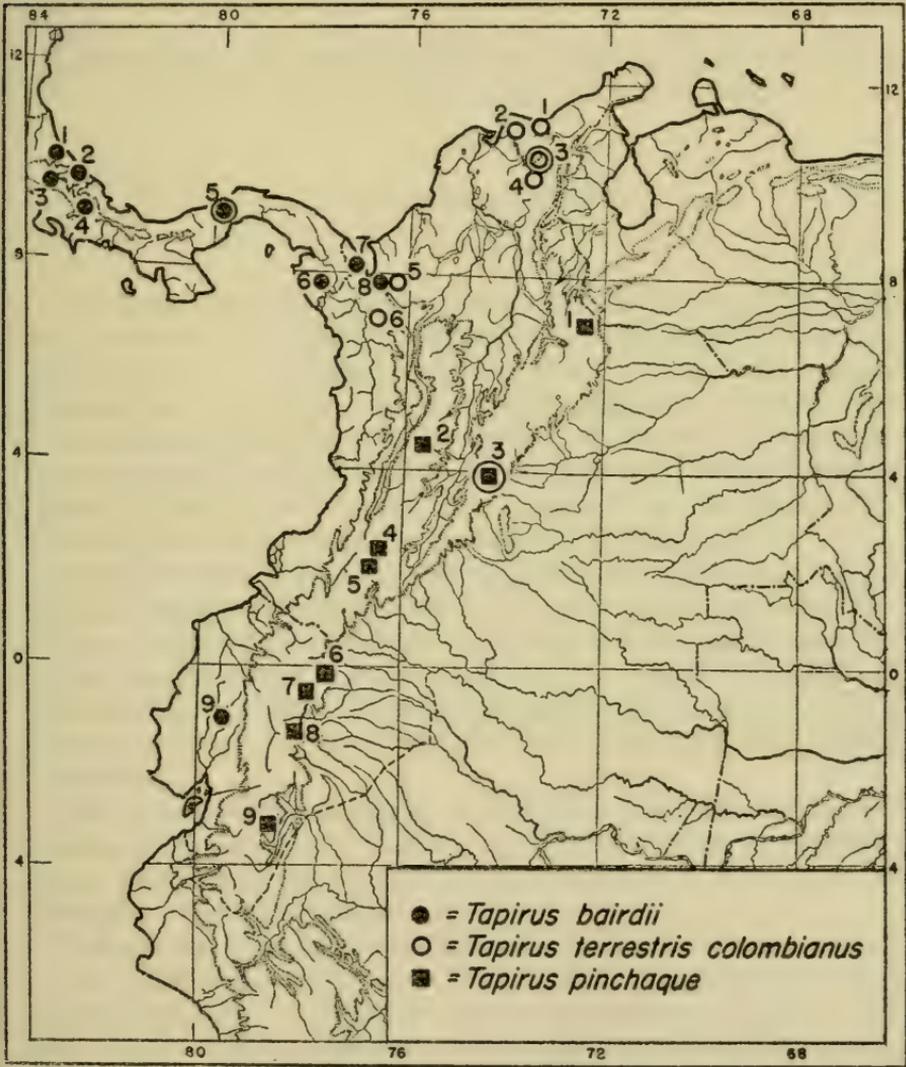


FIGURE 62.—Map of locality records for tapirs in Colombia and adjacent countries; type localities circled. See opposite page for key.

polka, 1 (USNM). HONDURAS: No precise locality, 2 (USNM). EL SALVADOR: No precise locality, 4 (USNM). GUATEMALA: Los Amates, Yzabal, 2 (CNHM); no precise locality, 8 (USNM). BRITISH HONDURAS: Belize, 1 (CNHM); Middlesex, 2 (CNHM). MÉXICO: Achotal, Vera Cruz, 2 (CNHM); Istmo de Tehuantepec, 1 (USNM); Chiapas, 1 (USNM); Buena Vista, 1 (USNM). CENTRAL AMERICA: No precise localities, 5 (USNM).



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3330

A REVISION OF THE GOATFISH GENUS *UPENEUS* WITH
DESCRIPTIONS OF TWO NEW SPECIES

By Ernest A. Lachner

The most recent and comprehensive studies of the genus *Upeneus* were included in the faunistic reports of Herre and Montalban, 1928, Weber and de Beaufort, 1931, and Fowler, 1933. Six species of *Upeneus* were recognized by Herre and Montalban as occurring in the Philippine Islands, and Weber and de Beaufort recognized the same species in the Indo-Australian Archipelago. Fowler listed eleven species in his Philippine report but included five extralimital species, four of which are not valid or are highly questionable.

In all, 24 nominal species have been referred to the genus and much nomenclatorial confusion exists. The characters presented by the various authors to distinguish the species did not prove satisfactory in the identification of specimens in the U. S. National Museum from the same faunal areas. Additional specimens from the Philippine Islands and the Persian Gulf did not conform to any published accounts.

The object of this study is to determine the valid species in the genus and characters for their accurate identification, to evaluate the extent of interspecific differentiation, and to evaluate the population divergence in the various subfaunal areas.

Ten species are herein recognized, two of which are described as new.

The collections in the U. S. National Museum formed the chief basis of this study on which counts, measurements, and color analyses were made. These collections are listed by subfaunal areas of the Indo-Pacific region in the descriptions of the respective species.

Specimens and types at the Museum of Comparative Zoology, Harvard University, were also examined. One specimen (*Upeneus subvittatus* Snyder, 1907, p. 101) was loaned from the Natural History Museum, Stanford University, through the courtesy of Dr. George S. Myers. The type of *Mullus dubius* Temminck and Schlegel (1843, p. 30) was reexamined for the author by Dr. M. Boeseman, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

I am also indebted to William C. Schroeder for making laboratory facilities available at the Museum of Comparative Zoology, Harvard University, and to Dr. Robert R. Harry, Academy of Natural Sciences, Philadelphia, for loan of the holotype of *Upeneus phillipsi* Fowler. The photographs were taken by personnel of the Smithsonian Institution's photographic laboratory.

The synonymy listed in the descriptive accounts of each species is incomplete. Many faunal studies were largely ignored except in cases where adequate descriptions or illustrations were presented, or where the collections involved were available for reexamination. The geographical distribution given for each species was constructed from the distributions of examined specimens and from the literature where the descriptions or illustrations were sufficiently thorough and accurate to enable me to identify the species with assurance.

All measurements of the length of a fish refer to the standard length, unless stated otherwise. The method of counting fin rays, gillrakers, and scales of the body is similar to that given by Lachner (1951, p. 581). In the first paragraph under "Description" of each species the count for each character is recorded as follows: the mean: range (number of specimens); for example, pectoral rays 16.1: 15 to 17 (68). This method of recording does not apply for the new species. For these, separate methods are given in the description of each species. Dark spots at the tips of the lobes of the caudal fin, distinct from black margins, were counted as bars in the tabulated data, but the small spots or blotches near the midbase of the caudal fin were omitted.

Diagnostic characters

Several of the important diagnostic characters useful in distinguishing the species have been misinterpreted by various authors or were entirely overlooked. It is necessary, therefore, to discuss the critical characters in the approximate sequence of their importance in the identification of the species. These characters are of taxonomic value because of their low variability and the accuracy by which they can be measured. The sequence in which they are discussed is not intended to portray phylogenetic relationships although this may partially exist.

The number of SPINES IN THE SPINOUS DORSAL FIN is either 7 or 8 in any particular species. Only one abnormally developed specimen of a species normally with seven had 6 spines. The difference of one spine among the species is associated with the presence or absence of the minute first spine. No variability was found in this character in any species in more than 300 specimens examined. This small spine is located near the first enlarged one, often partially embedded, and may be entirely overlooked without employing some probing and a microscope. The variability of this character as given by Fowler (1933, pp. 322, 341) is erroneous.

Counts of the PECTORAL FIN RAYS for 10 species from various localities in the Indo-Pacific are given in table 1. The range of this character in any species did not exceed four rays. An inspection of the data in the table shows that the species are divisible into two groups and that the modes of the frequency distributions fall on 13 or 14 in one group and on 16 in the other, except for *U. parvus*, where only 6 specimens were available for study. It is unfortunate that descriptive accounts of certain nominal species did not include this character; with it, a more reliable interpretation would have been possible.

The TOTAL NUMBER OF GILLRAKERS of 260 specimens are arranged from lowest to highest, respectively, for nine species from the Indo-Pacific region in table 1. The tenth species, *parvus*, represents the single form in American waters. These data represent specimens from various localities. The range of this character for each species is low.

The usual count of the gillrakers reported in the literature is that of the lower limb only. The rudiments were seldom included. Sometimes they were partly included but without explanation as to how they were distinguished from the developed rakers, making it impossible to interpret the count. To form a more reliable basis for the interpretation of data in the literature, the raker count of both limbs and the raker-rudiment relationship are recorded separately in tables 2, 4, and 5. It is apparent from these data that the number of rudiments and rakers differs for different species and that the addition of developed rakers and rudiments of the upper and lower limbs to form the total count displays the greatest differences among the species.

Species having a minute first dorsal spine can be divided into two subgroups on the basis of the total number of gillrakers (see key, p. 508). The number of gillrakers in these two divisions also has a positive relationship to the number of pectoral fin rays.

The species are divisible into two groups on the basis of color of peritoneum: Those in which it is light to silvery (first four species and the last species, table 1), and those in which it is light brown to blackish (all other species, table 1). A positive relationship occurs

between color of peritoneum and number of gillrakers (table 1) for the Indo-Pacific species but does not hold when the Atlantic species, *U. parvus*, is included. Indo-Pacific species with the peritoneum light colored have fewer gillrakers than those with dark peritoneal linings.

The COLOR OF THE PERITONEUM is a clear-cut character in most of the species and specimens. However, certain species show some variation and intermediacy and these may be difficult to evaluate, especially to one inexperienced with this character. Species with light or transparent to silvery peritoneal linings may have a few scattered, dark, pepperlike spots. Species with peritoneum colored light brown to blackish may in some cases have a silvery cast over a brownish background. This is especially so in *asymmetricus* and in some small specimens of *bensasi*.

A summary of the number of ROWS OF VERTICAL SCALES in 253 specimens and scales below the lateral line is given in table 2. The low intraspecific variability of the number of scale rows is evident in that the range does not exceed five for any species. The scales are somewhat deciduous and the count cannot always be made. Many large or poorly preserved specimens lack some or all of the scales. The number of scale rows has been widely used in the literature as a diagnostic character but interspecific differences have never been compared. The discrepancies between my data and that given in the literature may in part be associated with different methods of making this count. Others are not explainable.

Life colors are useful in the identification of the species but fade in preservation. However, certain brown to black stripes, bars, spots, and blotches on the body and fins persist in preservation in varying intensities. These COLOR MARKS are extremely valuable in distinguishing certain species, especially the number of oblique bars on the upper lobe, lower lobe, or both lobes of the caudal fin. In some species the number of bars increases with growth, whereas in others it remains constant. The variation and relationship of the number of bars in respect to size of body for three species is given in table 3. Failure to understand this character by various authors has caused considerable confusion in distinguishing the species (Fowler, 1918a, p. 37, fig. 15).

Average values of the LENGTH OF THE BARBEL show differences among the species, but great overlaps occur in the ranges (table 1). In at least one species (*sulphureus*) there may be an increase in the length of barbel with increase in length of body (see tables 6, 8, 9, 11).

Other characters such as depth of body, length of head, length of snout, and size of eye were investigated. Although small average differences were apparent among the species, they were too insignif-

TABLE 2.—Number of vertical scale rows and scale rows below the lateral line, and number of gillrakers on each limb of the first arch in 10 species of *Upeneus*

Species	Vertical scale rows												Scales below lateral line	
	28	29	30	31	32	33	34	35	36	37	38	6	7	
<i>luzonius</i>				6	2							5		
<i>arge</i>										6	4		6	
<i>oligospilus</i>		1	7	3								11		
<i>tragula</i>	2	14	16	12	4							37		
<i>bensasi</i>		15	7	3								13	2	
<i>asymmetricus</i>	1	2	1									3		
<i>moluccensis</i>						2	5	3	3				8	
<i>vittatus</i>						1	13	20	14	1		1	22	
<i>sulphureus</i>							5	21	13	5			27	
<i>parvus</i>									1	1	2	1	2	

Species	Gillrakers																					
	Upper limb ¹											Lower limb ¹										
	5	6	7	8	9	10	13	14	15	16	17	18	19	20	21	22						
<i>luzonius</i>	5	4					2	5	2													
<i>arge</i>	2	9					1	4	5	1												
<i>oligospilus</i>	1	10					2	6	3													
<i>tragula</i>	10	41	6				16	35	5	1												
<i>bensasi</i>		8	25	4				1	6	18	10											
<i>asymmetricus</i>			4								1	2	1									
<i>moluccensis</i>			1	16	3						1	8	8	1	2							
<i>vittatus</i>			4	53	11					1	14	34	17	1	1							
<i>sulphureus</i>			2	25	14	1					3	8	20	10	2							
<i>parvus</i>		1	1	3	1						2	4										

¹ Raker at angle of arch omitted from counts, all rudiments included.

TABLE 3.—Variation and relationship of the number of bars on the caudal fin with increase in body length in three species of *Upeneus*

Length in mm.	Number of caudal bars on upper lobe—on lower lobe: ¹										
	2-2	2-3	3-3	3-4	4-4	4-5	5-5	5-6	6-6	6-7	7-7
21-30	2[1]		[1]	[1]							
31-40		4	4		[2]		[1]				
41-50			5	3	[1]	[1]					
51-60			1	7	1						
61-70		(1)	2	9		3					
71-80			1(1)	5	2	4		[1]	[1]		
81-90			(2)	2	4	5					
91-100			(2)	3	1	6	3	1			
101-110			(1)	1	1	5		1	[1]		[1]
111-120					(1)	3		1			
121-130					(2)	3					
131-140					(1)	3					
141-150						3	1				
151-160					(1)						
161-170						3					
171-180						2		1	1		
181-190						1					
191-200							1				
201-210										1	1
211 and over											

¹ Numbers in parentheses refer to *U. oligospilus*; those without enclosures, *U. tragula*; and those in brackets, *U. luzonius*. Following data not recorded for *U. tragula*: 1 specimen, 97 mm., 4 bars on upper lobe, 6 on lower lobe; 1 specimen, 107 mm., 3 bars on upper lobe, 5 on lower lobe.

icant or variable to be of any practical taxonomic importance. The basal rigidity of the barbel, used as a key character by Weber and de Beaufort (1931, p. 363), was not found reliable. The different lengths of the barbel among the species probably led them to misinterpret this character. Herre and Montalban (1928, pp. 96-97) distinguished between groups of species by the presence or absence of pre-orbital scales. While this character may be of some value, great errors in the identification of the species can result since these scales as well as those on the head and body are somewhat deciduous in most species. The size and number of intestinal loops and the number of pyloric caeca were studied but poor preservation of these structures made it impossible to evaluate their taxonomic significance.

Group relationships

The species are divisible into two groups in three different ways by using a single character or combinations of characters. The first method, based chiefly on the absence of the minute first dorsal spine, separates *bensasi*, *asymmetricus*, and *parvus* from the remainder of the species, in which the spine is always present. These three species have little or no coloration on the dorsal fins (limited to light tan spots arranged in rows in *asymmetricus* and very faint bars in *parvus*), whereas the alternate group has the dorsal marked with bars or blotches, always very distinct except in *arge* and *luzonius*.

A second method includes the combination of the color of the peritoneum and the number of gillrakers. The Indo-Pacific species *luzonius*, *arge*, *oligospilus*, and *tragula* are related in having, almost always, light to silvery colored peritoneal linings, and fewer and shorter gillrakers. The remainder of the Indo-Pacific species have a light brown to blackish peritoneum, a higher number of gillrakers, and comparatively longer rakers. Of these species, *bensasi* is intermediate in respect to the number of gillrakers and *bensasi* and *asymmetricus* show the greatest variation in the color of the peritoneum. The Western Atlantic form, *parvus*, does not conform to this relationship in that the peritoneum is light but the gillrakers are numerous.

The third method, based on the number of pectoral fin rays (table 1), clearly indicates two groups of species.

Although the three methods are useful in identifying the species, the presence or absence of the minute first dorsal spine strongly suggests an ontogenetic change resulting in two phyletic lines on a sub-generic level of organization. I do not propose or advocate sub-generic terminology in a problem such as this where so few species are involved and where troublesome and complicated classification problems above the species level do not exist.

TABLE 4.—*Relationship of number of rudimentary and developed gillrakers on the upper limb in 10 species of Upeneus*

Species	Combinations of rudiments and rakers on upper limb ¹																									
	3,2	4,2	5,2	6,2	2,3	3,3	4,3	1,4	2,4	3,4	4,4	1,5	2,5	3,5	1,6	2,6	3,6	0,7	1,7	2,7	3,7	0,8	1,8	2,8	0,9	
<i>luzonius</i>	1				1			4	1																	
<i>arce</i>	1				1				1				3													
<i>atgospitus</i>	1	5				8																				
<i>trigata</i>	9	12			25	5		1	1	3		3	1													
<i>benasii</i>			1	1		2	4	3	3	17	1	3	3	2												
<i>asymmetricus</i>																1										
<i>moluccensis</i>																			3							
<i>vittatus</i>																			1	7			9	3		
<i>sulphureus</i>																			1	28	4		8	4		1
<i>pareus</i>																			2	10		1	15	10	1	4

¹ Numeral for the rudiment appears first in each column. Raker at the angle of the arch not included. When length of raker exceeded diameter of its base it was classified as developed raker, not rudimentary.

TABLE 5.—Relationship of number of rudimentary and developed ptilrakers on the lower limb in 10 species of *Upeneus*

Species	Combinations of rakers and rudiments on the lower limb ¹																					
	9, 5	10, 3	10, 4	10, 5	10, 6	11, 3	11, 4	11, 5	11, 6	11, 7	12, 2	12, 3	12, 4	12, 5	12, 6	13, 3	13, 4	13, 5	13, 6	14, 3	14, 4	
<i>luzonius</i>		2				3	2	3			2	2	1	1								
<i>arpe</i>				1	1	1	1	1														
<i>oligospius</i>	1			2	2	1	1	1														
<i>trigula</i>				6	4		8	19	1			2	10	4	1	2						
<i>bensasi</i>							1	2	3	2			3	7	1	1	4	3				1
<i>asymmetricus</i>																						
<i>moluccensis</i>																						
<i>ritikatus</i>																						
<i>sulphureus</i>																						7
<i>portus</i>																					1	1

Species	Combinations of rakers and rudiments on the lower limb 1—Continued																						
	14, 5	14, 6	15, 2	15, 3	15, 4	15, 5	16, 2	16, 3	16, 4	16, 5	16, 6	17, 1	17, 2	17, 3	17, 4	18, 1	18, 2	18, 3	19, 1	19, 2	19, 3	20, 2	
<i>luzonius</i>																							
<i>arpe</i>																							
<i>oligospius</i>																							
<i>trigula</i>																							
<i>bensasi</i>	2			3																			
<i>asymmetricus</i>					2		1	1	1			1	1	3	3						1	1	1
<i>moluccensis</i>					22	5	1	3	8	1		1	2	2	2						1	1	1
<i>ritikatus</i>	5	2	1	5			2	1	3				4	4	2	2	11	7	2	1		2	
<i>sulphureus</i>					1																		
<i>portus</i>					1			1					2	2									2

¹ Numeral for developed raker appears first in each column. Raker at the angle of the arch not included.

Populations

No notable differentiation of any species in the subfaunal areas of the Indo-Pacific was revealed by an analysis of various meristic counts (see descriptions of *bensasi*, *vittatus*, and *tragula*, and tables 6, 10, and 11), proportional measurements, color, and color pattern of specimens segregated by locality. Differentiation in this genus appears to have gone to the species level, after which considerable stability was attained. These conclusions are tentative owing to the limited number of specimens of several species.

Although little is known of the life histories of these inshore forms, populations of such widely distributed species as *vittatus*, *sulphureus*, and *tragula* occurring in the subfaunal areas of East Africa, the East Indies, the Philippines, and areas of Oceania are assumed to be considerably isolated, yet they are characteristically homogeneous.

Larval forms of some species are thought to be pelagic, and their drift or movement may account for some minor association of these populations.

The genus is restricted to the tropical and subtropical, littoral, marine waters of the Indo-Pacific and Western Atlantic regions. The East Indies and Philippine Islands, near the center of the Indo-Pacific region, contain at least seven of the species, four are known from East Africa, four from Oceania, but only one (*arge*) is known in the Hawaiian fauna. Five extend northward as far as southern Japan and at least three reach eastern Australia. Only one species, *U. parvus*, occurs in the Western Atlantic area of American waters.

Genus *Upeneus*

Upeneus Cuvier and Valenciennes, 1829, p. 448 (type species, *Mullus vittatus* Forskål, designated by Bleeker, 1876, p. 333).

Hypeneus Agassiz, 1846, p. 190 (type species *Mullus vittatus* Forskål) (corrected orthography).

Upeneoides Bleeker, 1849, p. 64 (type species, *Mullus vittatus* Forskål, designated by Jordan, 1919, p. 240).

The characters best defining the genus are: (1) dentition complete, consisting of small villiform teeth on the vomer in the form of an irregular or triangular patch, on the palatines in an elongate band, and on both jaws in bands of narrow to moderate widths, and (2) scales present on soft dorsal, anal, and caudal fins. The bodies are elongate and somewhat compressed; the caudal fin is marked with dark, oblique bars in most species. The species attain a small size compared with other members of the family.

The following characters, some of which apply to other genera in the family, were found to be common to all the species: Anal fin rays I, i, 6; pelvic fin rays I, 5; caudal fin rays i, 7+6, i; scale rows around

caudal peduncle 16; scales ctenoid with 4 to 7 radii; lateral line complete; first elongate spine of first dorsal fin flexible; a small portion of barbel, less than one-third its total length, rigid at base.

Questionable species

I place two nominal species in a doubtful status, *Upeneoides sundaicus* Bleeker (1855, p. 411; 1877, pl. (4) 394, fig. 2) and *Upeneus taeniopterus* Cuvier and Valenciennes (1829, p. 451, type locality Trinquemale, Ceylon).

It is highly possible that *U. sundaicus* Bleeker may be represented by either *U. tragula* or *luzonius*. Bleeker's specimens were taken in the East Indies where both *tragula* and *luzonius* occur. Weber and de Beaufort (1931, pp. 370-371) saw one of Bleeker's specimens but their account, at least in part, was extracted from Bleeker. The account of *sundaicus* by Herre and Montalban (1928, p. 98) was "compiled from Bleeker, and Evermann and Seale" (1907, p. 88). Fowler's account (1933, p. 323) was also compiled from Bleeker. Examination of the specimen reported by Evermann and Seale as *sundaicus* (orig. No. 3201, USNM 56138) revealed a large, very poorly preserved specimen of *luzonius*. *U. luzonius* usually has weakly developed bars on the upper caudal lobe while those on the lower lobe may be completely obscure. Three dark saddles on the body are often completely faded. Such specimens, as well as large faded specimens of *tragula*, could easily have been involved in Bleeker's illustration. Yet, there still is the possibility of the existence of a species unknown to us. There is no method of solving this problem at present. Intensive collecting in the East Indies Islands, as well as study, is necessary. The characters listed for *sundaicus* by Bleeker and Weber and de Beaufort (dorsal spines VIII, the first spine minute, "gillrakers 13+3," barbels reaching "hindborder of preoperculum") clearly relate it with *tragula* and *luzonius*. The number of vertical scale rows that they report, 33 to 35, is higher than in these species, but this may be due to the different methods of counting. Only the bars on the caudal fin illustrated by Bleeker are unique but these may be highly diagrammatic. Therefore, *sundaicus* may be a synonym of *tragula*, may replace *luzonius*, or may represent a distinct species.

The second questionable form, *Upeneus taeniopterus*, known only by the type specimen, is characterized by having seven dorsal spines, each dorsal fin with three bars, each lobe of the caudal fin with six oblique bars, and a large triangular reddish spot on the caudal fin. Day (1876, p. 122) reported on the faded type and Fowler (1928, p. 227; 1933, p. 327) repeated Day. Steindachner (1901, p. 487) reported two specimens from Honolulu, but he probably had *U. arge*, the only member of the genus found in the Hawaiian Islands to date.

Key to the species of *Upeneus*

(References to groups of species in the descriptions pertain to all the species in the following categories of the key: 2a, *bensasi* group; 4a, *vittatus* group; 4b, *tragula* group.)

- 1a. Dorsal spines VII, the first spine longest.
- 2a. Pectoral rays number 13 or 14; vertical scale rows range from 28 to 31; peritoneum brown to silvery brown.
- 3a. Lower lobe of caudal fin without oblique bars, upper lobe with 2 to 3 faint, oblique brownish or dusky bars; body nearly uniform light tan to brown, without lateral stripe or dark brown saddle posterior to soft dorsal fin; fewer gillrakers, modally 25, range from 23 to 27.
U. bensasi (Schlegel)
- 3b. Lower lobe of caudal fin with 6 or 7 narrow, brown, oblique bars, and the upper lobe with 3; body dark tan above, light tan below with a brown, horizontal stripe on midside and a dark brown saddle on caudal peduncle just posterior to soft dorsal fin; more gillrakers, modally 28, range 27 to 29.....**U. asymmetricus**, new species
- 2b. Pectoral rays number 15 or 16; vertical scale rows range from 36 to 38; peritoneum light to silvery; upper and lower lobes of caudal fin with 3 oblique, brownish black bars on the smaller specimens (68, 69 mm.) increasing to 5 bars on the larger specimens; bars more pronounced on lower lobe; body light tan, possibly with light colored median stripe; without dark saddle over caudal peduncle; gillrakers range from 26 to 29.
U. parvus Poey
- 1b. Dorsal spines VIII, the first spine minute.
- 4a. Total number of gillrakers range from 26 to 32; pectoral rays number 15 to 18; peritoneum brown to black.
- 5a. Caudal fin transparent to dusky, without dark bars; chin barbels long, 58 to 82 percent of head length in large specimens (over 85 mm.); barbel when extended posteriorly usually extends beyond vertical drawn through posteriormost point of preopercle.
U. sulphureus Cuvier and Valenciennes
- 5b. Caudal fin with oblique dark bars on upper lobe; chin barbels short, 46 to 66 percent of head length; barbel when extended posteriorly not reaching vertical drawn through posteriormost point of preopercle.
- 6a. Lower lobe of caudal fin transparent to dusky, without dark, oblique bars; a pale to yellow, median horizontal stripe on side of body, often faintly developed, or obscure.....**U. moluccensis** (Bleeker)
- 6b. Lower lobe of caudal fin with 2 to 3 dark oblique bars, the outer bar widest and more intensely colored; a light colored median and dorsolateral, horizontal stripe on body usually present.
U. vittatus (Forskål)
- 4b. Total number of gillrakers range from 19 to 25; pectoral rays number 12 to 15; peritoneum silvery to transparent, sometimes with scattered, fine, brownish spots.
- 7a. Scales small, 36 to 38 vertical rows on body, 7 rows below lateral line; a faint, tan colored median and dorsolateral, horizontal stripe on body, often completely faded.....**U. arge** Jordan and Evermann
- 7b. Scales large, 28 to 32 vertical rows on body, 6 rows below lateral line; a conspicuous dark brown median stripe on body always present.
- 8a. A dark brown saddle just posterior to base of soft dorsal fin almost always present; two additional saddles through spinous and soft dorsal fins sometimes evident; spotting or blotches absent on body;

upper lobe of caudal fin with 6 brown, oblique bars in adult specimens of about 80 mm. in length, 4 to 5 bars in juveniles of about 50 mm.; lower lobe of caudal with 6 to 7 such bars in adults, 4 to 6 in juveniles; second spine of spinous dorsal fin usually longest; dark spots or blotches on spinous dorsal fin almost always faded; barbels long, usually reach vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 62 to 72.....U. *luzonius* Jordan and Seale

- 8b. Dark brown saddle just posterior to base of soft dorsal fin faint, usually not visible; saddles through fins absent; numerous, distinct, small brown spots on cheeks and sides of body to belly; upper lobe of caudal fin almost always with 4 to 5 brown, oblique bars in adults over 80 mm. in length, 3 or 4 in juveniles less than 80 mm. (see table 3); lower lobe with 5 or 6 brown, oblique bars in adults, 4 or 5 in juveniles; fourth spine of spinous dorsal fin longest or about equal to third; dark spots or blotches on spinous dorsal fin almost always conspicuous; barbels short, not reaching vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 52 to 68..U. *tragula* Richardson
- 8c. Dark brown saddle just posterior to base of soft dorsal fin faint or completely obscure; saddles through fins absent; a few small dusky spots on sides of head, almost completely absent on sides of body to belly but with large, irregular, dusky to blackish blotches on body; upper and lower lobes of caudal fin with 3 or 4 dusky to black, oblique bars in adults over 80 mm. in length, 3 in juveniles; third spine of spinous dorsal fin longest or about equal to fourth spine; dark blotches on spinous dorsal fin almost always conspicuous; barbels short, not reaching vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 50 to 64.....U. *oligospilus*, new species

Upeneus bensasi (Temminck and Schlegel)

PLATE 13, FIGURE A

Mullus bensasi Temminck and Schlegel, 1843, pt. 2, p. 30, pl. 11, fig. 2 (type locality, Nagasaki).—Boeseman, 1947, p. 43.

Upeneoides guttatus Day, 1867, p. 938, (type locality, Madras?); 1876, p. 121.

Upeneoides japonicus Steindachner and Döderlein, 1884, p. 22 (type locality, Tokyo, Kochi, and Tango, Japan) (not *Mullus japonicus* Houttuyn, 1782, p. 334).

Upeneoides tokisensis Steindachner and Döderlein, 1884, p. 22 (name in synonymy, specimens from Tokyo).

Specimens studied.—One hundred fifteen specimens, ranging in length from 37 to 148 mm., from the following localities: Japanese area, 16 USNM collections, 42 specimens; Formosa, 3 USNM collections, 21 specimens; Philippine Islands, 8 USNM collections, 52 specimens.

Description.—Dorsal rays, VII-i,8(65), the first spine longest (two abnormal specimens with some irregularly developed spines, VIII-i,8 and VI-i,8, the first spine in both specimens also longest; pectoral rays 13.8: 13 to 14 (44); vertical scale rows 29.4: 29 to 31

(25); scale rows above lateral line 3 (7); scale rows below lateral line 6.1: 6 to 7 (15); total number of gillrakers 25.0: 23 to 27 (38); length of longest raker in longest filament about 1.1 to 1.3 (6).

Peritoneum brown to blackish; preorbital scales present; barbels long, extending beyond preopercular margin, barbel length in percent of head length 64 to 84 (35); first dorsal spine longest.

Color in alcohol.—Head and body uniform tan to brown above and light tan below; some dusky pigmentation on outer portion of soft dorsal fin in larger specimens and two faint, dusky, horizontal bars sometimes seen in smaller ones, 40 to 60 mm. in length; lower lobe of caudal fin dusky, the tip of the rays transparent to light tan, the smaller specimens have a lengthwise dusky streak through middle portion of lobe; 3 faint oblique brownish to dusky bars on upper lobe in larger specimens and 2 bars in smaller ones about 40 mm. in length; remainder of fins transparent to uniform light tan.

Geographical distribution.—This species has been reported from the East African coast eastward through the East Indies and Philippines, and northward to Formosa, east China, Ryukyu Islands, and southern Japan. It has not been reported from the islands of Oceania.

Remarks.—There is reason to suspect that more than one species was involved in certain literature references to this species. Day (1876, p. 121, pl. 30, fig. 5) gives a high pectoral fin ray (15) and lateral line scale count (32 to 34), shows 4 oblique bars on the lower lobe as well as the upper lobe of the caudal fin, and 2 rows of red spots on the body. These are not characteristic of *bensasi*. Day listed and illustrated 7 spines on the dorsal fin. His account may include or represent an undescribed species related to *bensasi* or to a species of the *vittatus* group (*vittatus*, *sulphureus*, *moluccensis*).

The account by Snyder (1907, p. 97, fig. 3) agrees with our specimens, especially in respect to the number of dorsal spines (7) and the absence of bars on the lower lobe of the caudal fin. His description of color in life is contradictory to that of Day (1876) and Smith (1949, p. 229, pl. 27, fig. 562). Fowler (1933, p. 321, fig. 27) and Smith (op. cit.) list the number of dorsal spines as variable, 5 to 8 and 6 to 8 respectively, but each figure a specimen with 7 spines, the first small spine, typical of the *vittatus* and *tragula* group, being absent.

In the Western Indo-Pacific (East Africa, India) this species may be represented by another form entirely distinct from that of the Philippine-Japan area. *U. bensasi* was not listed by Herre and Montalban (1928) nor by Weber and de Beaufort (1931).

The length of the barbel compared with body length in four size-groups is shown in table 6. The data are too meager to conclude that any appreciable differences exist. There is no population divergence indicated from an inspection of the gillraker and vertical scale counts separated by geographical localities.

TABLE 6.—Length of barbel in four size-groups, and the number of gillrakers and vertical scale rows, by locality, in *Upeneus bensasi*

Standard length in mm.	Barbel length in percent of head length										
	64	66	68	70	72	74	76	78	80	82	84
41-60			1	2			1				
61-80	1	1		2	2	1	2	1			
81-100			2	3		3	1				
Over 100				2	1	2	5			1	1

Locality	Gillrakers					Vertical scale rows		
	23	24	25	26	27	29	30	31
Philippines	2	2	4	2	2	4	1	
Japan	2	4	11	4	1	9	3	3
Formosa			1	2		2	3	

Upeneus asymmetricus, new species

PLATE 13, FIGURE B

Upeneus tragula Fowler, 1933, p. 339 (in part).

Holotype.—USNM 154659, a female specimen 76 mm. in standard length, collected March 24, 1909, at Pandanon Island, east of Cebu, Philippine Islands, by the *Albatross* Expedition.

Paratypes.—USNM 154660, 2 specimens, 73 and 81 mm., taken with holotype and having same data; USNM 154661, 1 specimen, 101 mm., collected April 15, 1908, at Catbalogan, Samar, Philippine Islands, by the *Albatross* Expedition.

Description.—This description is based on the holotype and three paratypes listed above. The counts are recorded for the holotype and followed in parentheses by the range of counts for the paratypes. Certain characters are compared with other species of the genus in tables 1 and 2.

Dorsal rays VII-i,8 (VII-i,8), the first spine longest; pectoral rays ii,11 (ii,11 to ii,12); vertical scale rows 28 (29-30); scale rows above lateral line 2 (2-3); scale rows below lateral line 6 (5-6); total number of gillrakers 27 (28-29); length of longest raker in longest filament 1.4 (1.3-1.5).

Measurements, expressed in thousandths of the standard length, are given for the holotype and paratypes in table 7.

Peritoneum silver brown; preorbital scales present; barbels of average length, extend beyond eye but not reaching preopercular margin, and barbel length in percent of head length 58 to 66; first dorsal spine longest.

Body slightly slab-sided; jaws nearly horizontal; snout rounded; pectoral fins pointed; anal slightly falcate; caudal fin deeply forked.

TABLE 7.—Measurements of *Upeneus asymmetricus* expressed in thousandths of the standard length

Characters	Holotype USNM 154659	Paratype USNM 154660	Paratype USNM 154660	Paratype USNM 154661
Standard length, mm.....	76	81	73	101
Body:				
depth (approximate).....	238	-----	232	232
width (approximate).....	145	143	136	144
Head:				
length.....	290	287	279	277
depth.....	192	189	184	178
Caudal peduncle:				
length.....	279	251	241	228
least depth.....	96	98	88	94
Interorbital, least bony width.....	82	79	69	84
Snout, length.....	99	103	104	112
Orbit, length.....	74	78	75	67
Upper jaw, length.....	105	101	98	105
Barbel, length.....	184	178	195	188
Spinous dorsal fin, depressed length.....	214	198	196	203
Pectoral fin, length.....	209	210	200	212
Pelvic fin, length.....	210	214	196	197
Anal fin, depressed length.....	165	178	169	192
Tip of snout to origin of spinous dorsal fin.....	370	356	368	364
Tip of snout to origin of anal fin.....	621	615	639	655

Color in alcohol.—Head and body light tan, darker tan above and lighter below; a brown, horizontal stripe, its width about one-half diameter of eye extends from junction of gill opening with body to area just above midbase of caudal fin; a dark brown saddle on caudal peduncle just posterior to soft dorsal fin, its width equals least depth of peduncle and extends ventrally to lateral line; traces of brown color pattern indicating that probably two more saddles existed through soft dorsal and spiny dorsal fins; a small, dark spot at origin of spiny dorsal and soft dorsal fins and one dorsally on peduncle, at first procurvent caudal ray; head and body dorsally above lateral line with a “salt and pepper” coloration.

Spiny dorsal fin with 4 rows of faint tan spots forming horizontal bars; soft dorsal with 3 narrow, brown, horizontal bars; pelvic fins with traces of 3 or 4 bars; caudal fin with 3 narrow, oblique brown bars on upper lobe, the clear interspaces more than twice width of bar; lower lobe with 6 or 7 brown oblique bars, more or less spotlike and not on the two outermost developed rays (lower lobe on USNM 154661 malformed and small); areas on caudal fin just above and below base with a fine, brownish spot; pectoral and anal fins transparent.

Named *asymmetricus* in reference to the unusually reduced number of oblique bars on the upper lobe of the caudal fin.

Geographical distribution.—At present, only known by the type specimens listed above from the Philippine Islands.

Remarks.—The number of oblique caudal bars, more than twice as many on the lower lobe as on the upper, and their narrow width coupled with the absence of the small first dorsal spine, low number of pectoral rays, low vertical scale row count, dark lateral stripe,

dark saddle posterior to soft dorsal, and moderate-to-short barbels best characterize this species.

Upeneus sulphureus Cuvier and Valenciennes

PLATE 13, FIGURE C

Upeneus sulphureus Cuvier and Valenciennes, 1829, p. 450 (type locality, Antjer Straits of Sundra).—Bleeker, 1877, pl. (3) 393, fig. 4.—Smith, 1949, p. 229, pl. 28, fig. 563.—Fowler, 1933, p. 330.

Upeneus bivittatus Cuvier and Valenciennes, 1831, p. 520 (type locality, Coromandel).

Mullus subvittatus Temminck and Schlégel, 1843, p. 30 (type locality, Japan).—Boeseman, 1947, p. 43.

Upeneoides sulphureus Bleeker, 1849, p. 63.—Day, 1876, pt. 1, p. 120, pl. 30, fig. 3.—Herre and Montalban, 1928, p. 103, pl. 3, fig. 1.

Mulloides pinnivittatus Steindachner, 1870, p. 624 (type locality, Nagasaki).

Upeneoides belaeque Fowler, 1918a, p. 40, fig. 16 (type locality, Philippines).

Specimens studied.—Two hundred seventeen specimens, ranging in length from 48 to 132 mm., from the following localities: Zanzibar, USNM 12614, 3 specimens, 72 to 79 mm., received from the British Museum; East Indies Islands, four USNM collections totalling 10 specimens; Philippine Islands, 36 USNM collections totalling 200 specimens; China, USNM 94814, one specimen, 132 mm.; Okinawa, USNM 71838, one specimen, 107 mm.; Fiji Islands, Suva, USNM 66069, one specimen, 91 mm.; Pacific, USNM 83115, one specimen, 89 mm., Wilkes Expedition.

Description.—Dorsal rays VIII-i,8(48), the first spine minute; pectoral rays 15.8: 15 to 17 (58); vertical scale rows 35.4: 34 to 37 (44); scale rows above lateral line 3 (10); scale rows below lateral line 7 (27); total number of gillrakers 29.4: 26 to 32 (43); rakers comparatively long and slender, length of longest raker in longest filament averages about 1.1 (6).

Peritoneum dark, uniform light brown to blackish brown; preorbital scales absent; barbels show considerable variation in length and are longer in larger specimens (table 8), usually extending beyond preopercular margin in specimens over 85 mm. in standard length, barbel length in these larger specimens in percent of head length 58 to 82 (73 specimens); range of barbel length in percent of head length, all specimens, 50 to 82 (84 specimens); third dorsal spine slightly longer than second or fourth.

Color in alcohol.—Head and body silvery tan to golden tan, darker brown dorsally and light silvery to golden tan below.

Spinous dorsal with three blackish horizontal bars located near base, middle and outer parts of fin, and separated from each other by whitish bars; the outer black bar is the most intensely developed

and is somewhat blotched; soft dorsal with three dusky to black bars, usually less intense than those of first dorsal and separated by three light or whitish bars often completely faded; caudal fin with some dusky near tips of rays, especially near fork; pectoral, pelvic, and anal fins clear.

Geographical distribution.—From East Africa eastward through the East Indies, Philippines, and certain island groups of western Oceania (Fiji, USNM 66069; New Hebrides, Herre, 1936, p. 210), and northward to Japan.

TABLE 8.—Length of barbel in *Upeneus sulphureus*

Standard length in mm.	Barbel length in percent of head length																
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
41-60.....	2		3	1		1	1	2	6	5	2	2					
61-80.....	2	1	2					2	3	4		1	2	1			
81-100.....		1					1	1	2	1	2	4	3	2	3	1	1
Over 100.....								1	1	1	2	2		3	3	2	2

Remarks.—Illustrations of this species in "life colors" show considerable differences in the development and intensity of the bars on the dorsal fins and general body coloration, even those completed by recent artists (Smith, 1949, pl. 28, fig. 563; Herre and Montalban, 1928, p. 103, pl. 3, fig. 1). These differences may be associated with state of preservation, size, or perhaps sexual dimorphism.

The recognition of *Upeneus subvittatus* Temminck and Schlegel by Snyder (1907, p. 101) is probably entirely erroneous in view of the recent account by Boeseman (1947, p. 43) on the reexamination of the type material and on my examination of a specimen collected by Jordan and Snyder at Wakanoura, Japan (see "Remarks" in description of *tragula*).

Upeneus moluccensis (Bleeker)

PLATE 13, FIGURE D

Upeneoides moluccensis Bleeker, 1855, p. 409 (type locality, Amboina).—Seale, 1914, p. 68, pl. 392, fig. 1.—Herre and Montalban, 1928, p. 101, pl. 6, fig. 1.

Upeneoides dubius Kner, 1865, p. 67.

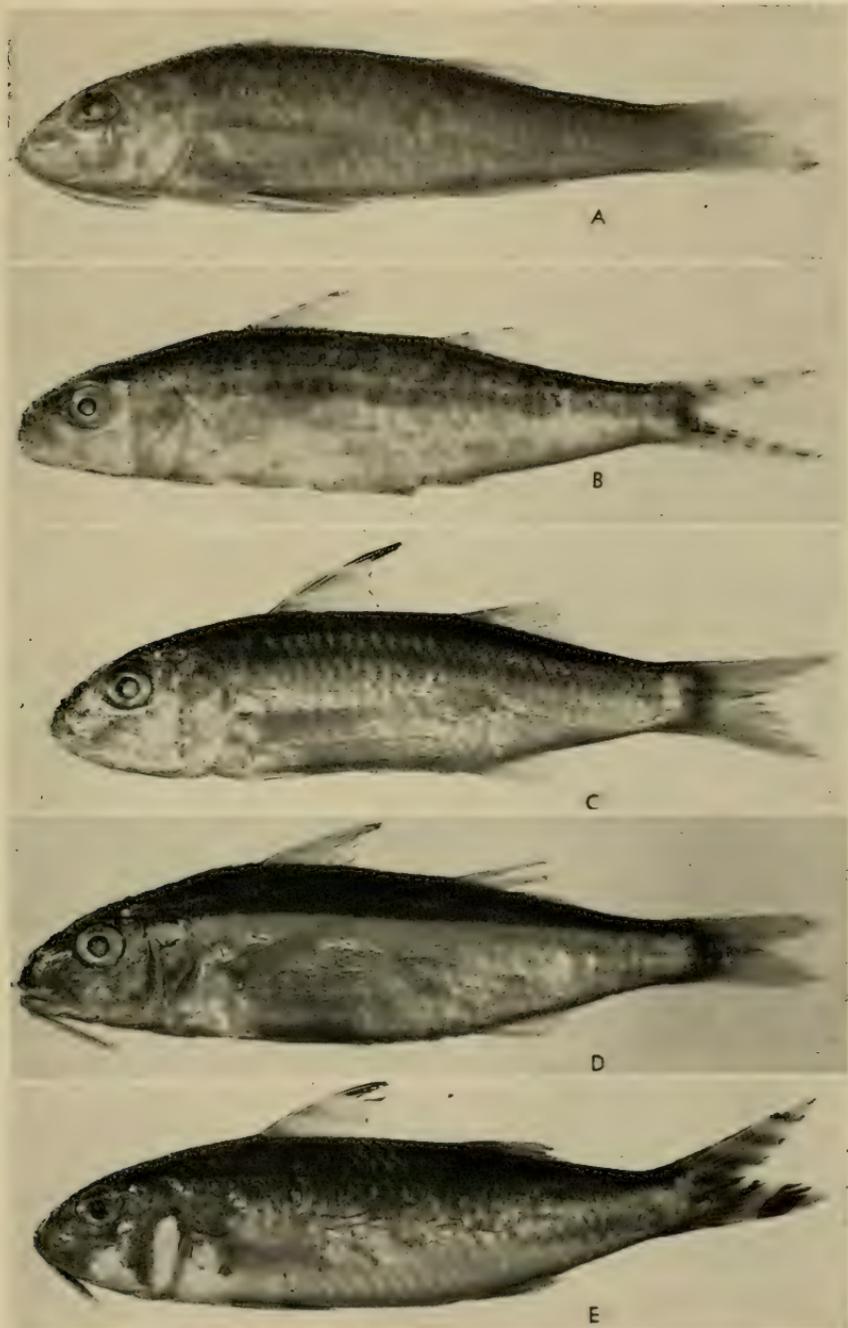
Upeneoides fasciolatus Day, 1868a, p. 151 (type locality, Madras).

Upeneoides sulphureus Day, 1876, p. 120 (in part).

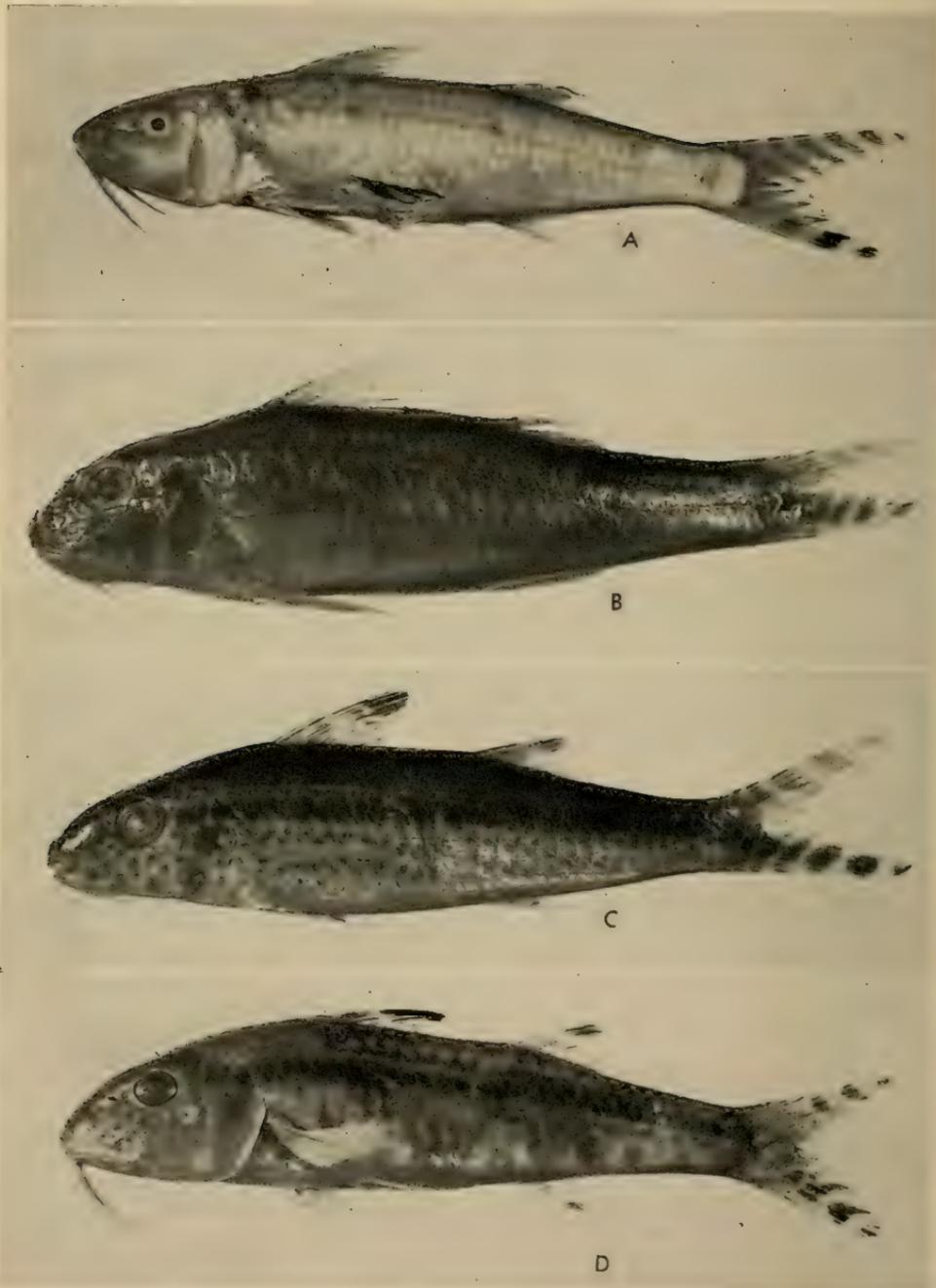
Upeneus moluccensis Bleeker, 1877, pl. (2) 392, fig. 1.—Fowler, 1933, p. 328.

Upenoides (error) *moluccensis* Herre and Montalban, 1928, p. 101.

Specimens studied.—Twenty-one specimens, ranging in length from 49 to 125 mm. from the following localities: East Indies Islands, Borneo, Sandakan Bay, USNM 138638, 6 specimens, 66 to 74 mm.; Java, USNM 72694, one specimen, 82 mm.; Philippine Islands, nine USNM collections totalling 10 specimens, taken chiefly by the *Alba-*



A, *Upeneus bensasi* (Temminck and Schlegel), USNM 71356, 85 mm., Shimizu, Suruga Bay, Japan; B, *U. asymmetricus*, new species, holotype, USNM 154659, 76 mm., Pandanon Island, Philippines; C, *U. sulphureus* Cuvier and Valenciennes, USNM 145207, 93 mm., Parang, Mindanao Island, Philippines; D, *U. moluccensis*, (Bleeker), USNM 138629, 94 mm., Balayan Bay, Luzon Island, Philippines; E, *U. vittatus* (Forskål), USNM 106850, 147 mm., Iloilo, Panay Island, Philippines.



A, *Upeneus arge* Jordan and Evermann, USNM 115685, 213 mm., Canton Island, Phoenix Islands; B, *U. luzonius* Jordan and Seale, USNM 106829, 81 mm., Iloilo, Panay Island, Philippines; C, *U. tragula* Richardson, USNM 145233, 105 mm., Luzon Island, Philippines; D, *U. oligospilus*, new species, paratype, USNM 147995, 124 mm., Tarut Bay, Persian Gulf.

tross Philippine Expedition; Japan, Kagoshima, Satsuma, USNM 71354, 2 specimens, 106 and 125 mm. (Samoan Islands, USNM 41559, 2 specimens, 78 and 79 mm., questionable identification).

Description.—Dorsal rays VIII-i,8(15), the first spine minute; pectoral rays 16.0: 15 to 18 (20); vertical scale rows 34.5: 33 to 36 (13); scale rows above lateral line 3: (7); scale rows below lateral line 7: (8); total number of gillrakers 28.9: 27 to 31 (20); length of longest raker in longest filament 1.0 to 1.4 (5).

Peritoneum uniform light brown to dark brown; preorbital scales absent; barbels extend to area between eye and preopercular margin, and barbel length in percent of head length 48 to 64 (21 specimens); second and third dorsal spines about equal in length and these only slightly greater than fourth spine.

Color in alcohol.—Head and body pale to brown above and silvery to light tan below; a sharp horizontal, lemon-yellow stripe persists on the body in some specimens after about 50 years of preservation and extends from eye to area just above midbase of caudal fin.

The spiny dorsal fin has three dark brown bars separated by three transparent to whitish bars, and the tips of the second to fourth spines are whitish; soft dorsal with brown bars separated by two transparent to whitish bars with the tips of the longest rays sometimes in white; caudal fin with three to four brownish to dusky oblique bars on the upper lobe, the lower lobe clear to dusky, especially near tips of rays; pectoral, pelvic, and anal fins clear.

Geographical distribution.—From India (Day, 1868 and 1876) eastward through the East Indies to the Philippines and possibly Oceania (Samoan Islands); from Japan (Kagoshima) southward to Australia (Kner, 1865).

Remarks.—Certain characters given in the account and shown on the illustration of *Mullus dubius* Temminck and Schlegel (1843, p. 30, pl. 11, fig. 3) can be associated, in part, to those of *U. moluccensis*. The narrow, yellow stripe on the body, the oblique bars only on the upper lobe of the caudal fin, and the bars on the dorsal fins as shown for *dubius* are characteristic of *moluccensis*. Seven spines in the spiny dorsal fin were listed for *dubius*, but a report on the type by Boeseman (1947, p. 44) revealed eight. Boeseman found the type specimen in a very bad state of preservation and the color and color pattern were faded. He recently examined the dentition of the type of *dubius* for me and found the teeth of the jaws to be rather stout and large and clearly separated from each other. No teeth were on the vomer or palatines. Thus *Mullus dubius* Temminck and Schlegel must definitely be referred to the genus *Parupeneus* Bleeker (1868, p. 344). We may never know if more than one species was involved in their description.

Upeneus vittatus (Forskål)

PLATE 13, FIGURE E

Mullus vittatus Forskål, 1775, p. 31; (type locality, Djedda, Red Sea).—Lacépède, 1802, p. 382, pl. 14, fig. 1.—Shaw 1803, p. 616, pl. 89.

Mullus bandi Shaw, 1803, p. 615 (type locality, Vizagapatam).

Upeneus vittatus Cuvier and Valenciennes, 1829, p. 448.—Bleeker, 1877, pl. (2) 392, fig. 3.—Fowler, 1933, p. 334, fig. 31; 1949, p. 95.—Smith, 1949, p. 228, pl. 27, fig. 561.

Upeneus bitaeniatus Bennett, 1831, p. 59 (type locality, Mauritius).

Hypeneus vittatus Cantor, 1850, p. 1017.

Upeneoides vittatus Gunther, 1859, p. 397.—Day, 1876, p. 120, pl. 30, fig. 2.—Sauvage, 1891, p. 219 (not pl. 27, fig. 2).—Herre and Montalban, 1928, p. 105, pl. 4, fig. 1.

Upeneoides caeruleus Day, 1868b, p. 194 (type locality, Madras); 1876, p. 121.

Upeneoides vittatus Klunzinger, 1870, p. 741 (error).

Upeneoides philippinus Fowler, 1918a, p. 37, fig. 15 (type locality, Philippines).

Specimens studied.—One hundred fifty specimens, ranging in length from 56 to 226 mm., from the following localities: Zanzibar, USNM 154172, 1 specimen, 67 mm., received from British Museum; Mauritius, USNM 19956 and 19985, 19 specimens collected by Col. N. Pike; East Indies, USNM 72693, 88032, 88033, 145288, and 145290, 6 specimens from Sumatra, Java, Borneo, and Bouro Islands; Philippines, 32 USNM collections, 93 specimens collected by the *Albatross* Philippine Expedition, The Philippine Commission, Mearns and McGregor; Japan, Okinawa, USNM 71679, 4 specimens, collected by the *Albatross*; Marianas, USNM 124088 and 139854, 7 specimens, collected by Frey, McElroy, and Markley; Fiji Island, USNM 66070, 1 specimen; Samoan Islands, 3 USNM collections, 10 specimens; Society Islands and Tuamotus Islands (Low Archipelago), USNM 89045 and 133844, 3 specimens; Marquesas Islands, USNM 89750, 6 specimens, collected by the Pinchot Expedition.

Description.—Dorsal rays VIII-i,8(48) the first spine minute (one specimen with 7 spines, the last abnormally small, the first minute and typical); pectoral rays 16.1: 15 to 17 (68); vertical scale rows 35.0: 33 to 37 (49); scale rows above lateral line 3 (13); scale rows below lateral line 6.9: 6 or 7 (23); total number of gillrakers 28.2: 26 to 31 (68); length of longest raker in longest filament averages about 1.2 (6).

Peritoneum dark brown to silvery brown (in many of the smaller specimens the peritoneum is brownish with a silvery cast); pre-orbital scales absent; barbels extend beyond eye but not beyond preopercular margin, barbel length in percent of head length 46 to 66 (74 specimens); third dorsal spine equal to or slightly greater than second.

Color in alcohol.—Head and body light tan to golden tan, darker above and lighter tan to silvery below; two to three faint, dark, horizontal stripes situated dorsolaterally above middle of body.

Spinous dorsal fin with two blackish horizontal bars, one on outer and one near middle of fin; the outer bar passes through outer third of 2nd to 5th spines, and is colored an intense black; a whitish bar between these bars; soft dorsal with three dusky to black bars or marks, a short mark near the posterior basal area, a long horizontal bar at middle of fin and a narrow dusky tip on the 1st to 3rd rays; caudal fin with oblique, dusky to black bars, 3 or 4 on the upper lobe and 2 or 3 on the lower; sometimes the tip of the longest (outer) rays of the upper lobe are slightly touched in black (these I have considered as a bar in my counts); outer bar on lower lobe with more intense black and twice as wide as other bars on caudal; this particular bar never at tip of lower lobe (only one specimen with tip of the lower lobe touched in blackish, see table 9); two nearly horizontal bars extend from near fork of caudal to areas just above and below midbase of fin and were not included in counts of the total number of oblique bars of the caudal fin; pectorals, pelvics, and anal fins transparent.

TABLE 9.—*Relationship of number of bars on caudal fin with increase in body length, and the length of chin barbel by four size-groups in Upeneus vittatus*

Total length in mm.	Number of bars on lobes of caudal fin		
	Upper 3 Lower 2	Upper 4 Lower 2	Upper 4 Lower 3
50-74.....	19		
75-99.....	23		
100-124.....	5	2	
125-149.....	2	5	1
150-174.....	5	3	
175-199.....	1		
200-224.....	1		

Standard length in mm.	Barbel length in percent of head length										
	46	48	50	52	54	56	58	60	62	64	66
41-60.....						1					
61-80.....			2		3	1	2	4	3	1	
81-100.....			1	1	5	4	7	3	2		
Over 100.....	2		3	6	6	3	8	3		2	1

Geographical distribution.—A widely ranging species, occurring from the Red Sea eastward through the East Indies and islands of Oceania to the Low Archipelago, and reported from Japan southward to Australia. Fowler (1933, pp. 334-335) has given an almost complete list of references, but many of these include only lists of species and such records cannot be accurately appraised. This species has not been reported from the Hawaiian and Johnston Islands.

Remarks.—There is no evidence of any change in barbel length with increase in body length from the statistics presented in table 9. The relationship of the number of bars on the caudal fin with increase in body length is also shown in table 9. At most, one more bar is sometimes formed on the upper lobe in the larger specimens and this bar is merely a touch of blackish at the tips of the outer rays. Only one specimen had such a mark on the lower lobe.

TABLE 10.—*Certain counts of Upeneus vittatus, by locality*

Locality	Gillrakers						Lateral line scales				
	26	27	28	29	30	31	33	34	35	36	37
Zanzibar.....	1						1				
Mauritius.....		3	4		1				3	2	
East Indies.....			2					1	1		
Philippines.....	1	7	13	7					11	3	
Japan.....		1	2	1				1		2	
Marianas.....		3	3	1				1	1	1	
Fiji.....				1				1			
Samoa.....				5	4			1	2	5	
Society, Tuamotus.....			1		1	1			5		
Marquesas.....		2	3		1				3	2	1

Very little intraspecific differentiation was found in the subfaunal areas from an analysis of color and color pattern, body proportions, and meristic counts. In table 10 the statistics of the number of gillrakers and vertical scale rows are segregated by locality, from the east African area eastward. Some of these localities represent subfaunal areas of the Indo-Pacific region, and although a maximum separation of about 12,000 miles exists between the extreme localities, the data does not suggest any significant population divergence.

Upeneus arge Jordan and Evermann

PLATE 14, FIGURE A

Upeneus arge Jordan and Evermann, 1903, p. 187 (type locality, Honolulu); 1905, p. 264, pl. 39.—Fowler, 1928, p. 227, pl. 19,c; 1931, p. 336; 1938, pp. 224, 285; 1940, p. 777; 1949, p. 96.—Jenkins, 1902, p. 456.—Schultz, 1943, p. 128.—Snyder, 1904, p. 527.

Upeneoides arge Fowler, 1922, p. 83.—Jordan, Evermann, and Tanaka, 1927, p. 674.—Jordan and Jordan, 1922, p. 52.

Specimens studied.—Eleven specimens, ranging in length from 164 to 250 mm.: Hawaiian Islands, USNM 50667 (holotype), 17999, 52817, 55100, 83358, 83449, 88194, and 151524, 9 specimens; Phoenix Islands, USNM 115685, 2 specimens.

Description.—Dorsal rays VIII-i,8(11), the first spine minute, pectoral rays 13.9: 13 to 14 (12); vertical scale rows 37.3:37 to 38 (10); scale rows above lateral line 3 (6); scale rows below lateral line

7 (6); total number of gillrakers 22.3:21 to 24(11); length of longest raker in longest filament 1.5 to 1.7 (4).

Peritoneum transparent; preorbital scales absent; barbels extend beyond eye to about the preopercular margin and barbel length in percent of head length 64 to 74 (10 specimens); second dorsal spine equal to or slightly longer than third.

Color in alcohol.—Head, body, and barbels light tan to pale above, lighter on chin and belly; two very faint horizontal stripes on body, dusky in color, and about as wide as pupil; one stripe is located dorso-laterally and the other medially.

Spinous dorsal with some dusky on outer membrane, remainder clear or faintly dusky, soft dorsal with three narrow, transverse bars colored diffuse brown; pectoral, pelvic, and anal fins clear; caudal fin with 6 oblique brown to black bars on upper lobe and 5 on lower lobe; lobes tipped in brownish black; the outer two bars on lower lobe about twice as wide as those on upper lobe; two nearly horizontal streaks near fork of caudal, just above and below median line.

Geographical distribution.—The Hawaiian Islands and various island groups of Oceania. Our specimens are from the Hawaiian and Phoenix Islands. Fowler (1928, p. 227) reports the species from the Palmyra, Caroline, and Gilbert Islands.

Remarks.—Fowler (1928, p. 227) conjectured that *U. arge* "may eventually be found inseparable" with *U. vittatus*. He pointed out that *vittatus* has slightly smaller scales than *arge* but he overlooked such trenchant characters as the differences in the color of the peritoneum, number of pectoral fin rays, and number of gillrakers.

Upeneus luzonius Jordan and Seale

PLATE 14, FIGURE B

Upeneus luzonius Jordan and Seale, 1907, p. 25, fig. 9 (type locality, Cavite).—

Weber and de Beaufort, 1931, p. 372.—Fowler, 1933, p. 325, fig. 28.

Upeneus sundaicus Evermann and Seale, 1907, p. 88.

Upeneoides luzonius Seale, 1910, p. 279.—Herre and Montalban, 1928, p. 97, pl. 1, fig. 1.

Specimens studied.—Sixteen specimens from the Philippines ranging in length from 25 to 119 mm., from the following Islands: Panay, USNM 106829, 102649, 106793, 106846, and 154201, 7 specimens; Luzon, USNM 53067 (cotypes) and 138658, 5 specimens; Linapacan, USNM 138659, 3 specimens, USNM 154200, 1 specimen.

Description.—Dorsal rays VIII-i,8(11), the first spine minute; pectoral rays 14.1:14 to 15 (10); vertical scale rows 31.3:31 to 32 (8); scale rows above lateral line 3 (5); scale rows below lateral line 6 (5); total number of gillrakers 20.4:19 to 22 (9); length of longest raker in longest filament averages about 1.5 (5).

Peritoneum transparent; preorbital scales present; barbels long, extend to preopercular margin, barbel length in percent of head length 62 to 72 (10 specimens); second dorsal spine longest.

Color in alcohol.—Head and body tan to dark brown on upper half of body, lighter below; smaller specimens lighter tan than larger specimens; a dark brown stripe extends from snout through eye to area just above midbase of caudal fin, being below the lateral line on anterior part of body and above lateral line on posterior portion; width of lateral stripe about three-fourths diameter of eye; lateral stripe most pronounced in adults and more conspicuous than illustrated by Fowler (1933) or Herre and Montalban (1928); body with three dark brown saddles, their width about 1 to 2 times greater than diameter of eye; first saddle passes through midbase of spinous dorsal fin, the second through midbase of soft dorsal, and the third passes over caudal peduncle just posterior to soft dorsal fin; saddles extend ventrally to the lateral line and are more conspicuous in smaller specimens; the two anteriormost saddles almost completely faded in the larger specimens.

Spinous dorsal dusky on upper half, three very faint, transverse, dusky bars in specimens about 50 mm. in length; soft dorsal with 2 faint, dusky, transverse bars in smaller specimens and 3 in the larger ones; pectoral fin with about 3 to 5 barely discernible vertical bars on one adult specimen, fins of other specimens completely clear; pelvic fin with a faint brownish blotch or bar in specimens about 50 mm. in length, fins of largest specimens clear; anal fin with a faint dusky bar in smaller specimens, completely clear in larger specimens; caudal fin with 2 to 7 oblique, dusky-to-brown bars on each lobe, the bars increasing in number with increase in length (table 3); the bars on the lower lobe broader, wider than the clear interspaces, and more intensely developed than those of the upper lobe; bars on upper lobe almost as wide as clear interspaces; bars on fins in varying degrees of intensity, the caudal bars being most evident.

Geographical distribution.—East Indies (Seale, 1910; Herre and Montalban, 1928) and Philippine Islands.

Remarks.—The differences in the color pattern between Fowler's illustration (1933, fig. 28) and that of Herre and Montalban (1928, pl. 1, fig. 1) are undoubtedly associated with the state of preservation and the sizes of specimens used for the illustrations. Fowler indicated his specimen was a "young" one. The low number of caudal bars, fairly conspicuous bars on the dorsal fins, and well-developed saddles, as he has illustrated, are characteristic of the smaller sizes. Herre and Montalban illustrate about 7 bars on each lobe of the caudal, which is characteristic of specimens about 100 mm. in length (table 3).

This species is closely related to *U. tragula*, and the smaller specimens of each species are easily confused with each other. The geographic range of *tragula* completely overlaps that of *luzonius* and both have been collected together. The young of *tragula* often have a moderately developed saddle on the caudal peduncle, generally lack the spotting characteristic of the adults, and the color pattern of the fins may be nearly obscure; consequently, these specimens superficially resemble *luzonius*. The characters listed in table 11 are most helpful in distinguishing between these species.

TABLE 11.—*Characters distinguishing Upeneus luzonius and U. tragula*

Character	<i>luzonius</i>	<i>tragula</i>
Pectoral fin rays.	92 percent with 13 or fewer, range 12 to 14.	All with 14 or 15.
Total number of gill-rakers.	20.4 (19 to 22). ¹	22.8 (21 to 25).
Barbel length in percent of head length.	66.6 (62 to 72).	59.2 (52 to 68).
Brown spots on head and body.	Always absent.	Usually well developed and numerous, sometimes faint to obscure.
Dark brown saddles on body. ²	3 in young, 2 or 1 (the posteriormost one) in adults; sometimes all are almost completely faded.	Faint to moderately developed saddle over caudal peduncle in young and juvenile specimens, often inconspicuous or entirely faded in adults.
Pigmentation of:		
(a) dorsal fins.	2-3 faint dusky bars on each but often completely faded.	Each almost always tipped in a large blackish irregular blotch, remainder of fin blotched with black, white, or clear.
(b) pelvics and anal fins.	Clear in adults; each with a faint transverse bar in small specimens.	Almost always with dark brown spots arranged in 2 to 3 rows.
(c) caudal fin.	Dark brown oblique bars nearly uniformly narrow and elongate; developed with almost equal intensity on each lobe; usually occurring in equal numbers on the lobes; 1 bar more per lobe at a given length (table 3).	Dark brown, oblique bars, elongate anteriorly becoming oval-shaped posteriorly, especially outer two bars on lower lobe; bars on lower lobe conspicuously more intensely developed; usually 1 more bar on the lower lobe; 1 bar less per lobe at a given length (table 3).

¹ The mean is followed by the range of variation in parentheses.

² All descriptions of color and color pattern refer to preserved specimens.

Upeneus tragula Richardson

PLATE 14, FIGURE C

Upeneus tragula Richardson, 1846, p. 220 (type locality, Canton).—Fowler, 1933, p. 339 (in part).

Upeneoides variegatus Bleeker, 1849, p. 64 (type locality, Batavia).

Upeneoides kiushiuana Döderlein, in Steindachner and Döderlein, 1884, p. 22 (name only; type locality, Kagoshima).

Upeneus subvittatus Snyder, 1907, p. 101.

Upeneoides tragulus Snyder, 1912, p. 503.

Specimens studied.—One hundred eighty-eight specimens, ranging in length from 29 to 227 mm., from the following localities: Zanzibar, USNM 12614, 1 specimen, 83 mm., received from the British Museum; East Indies Islands, USNM 72695, 145263, and 145624, 6 specimens, 79 to 188 mm.; Philippine Islands, 64 USNM collections, 115 specimens, most taken by the *Albatross* Philippine Expedition; China, USNM 9128, 145265, and 148413, 3 specimens; Japan and Okinawa, 9 USNM collections, 13 specimens; Palau Islands, USNM 154202, 47 specimens collected by Eugenie Clark, July 1949; Australia (New South Wales), USNM 59957 and 82984, 3 specimens.

Description.—Dorsal rays VIII-i,8(35), the first spine minute; pectoral rays 13.0: 12 to 14 (77); vertical scale rows 30.0: 28 to 32 (48); scale rows above lateral line 3 (9); scale rows below lateral line 6 (37); total number of gillrakers 22.8: 21 to 25 (57); length of longest raker in longest filament averages about 1.5 (5).

Peritoneum transparent to silvery; preorbital scales present; barbels extend to area between eye and preopercular margin, barbel length in percent of head length, 52 to 68 (58 specimens); third dorsal spine slightly longer or about equal to fourth.

Color in alcohol.—Dorsal portion of head and body pale or dusky to tan; chin and belly lighter; barbels pale; a tan to blackish brown horizontal stripe extends from tip of snout, through eye, along middle of body to base of caudal fin; width of stripe somewhat variable, about 0.5 to 1.0 in diameter of eye; chin, cheeks, operculum, and body below lateral line with numerous circular to irregularly shaped spots, colored tan to dark brown or dusky; these spots are more irregular, larger, blotchlike and less intense on some of our larger specimens over 160 mm.; spots sometimes faint or completely absent. (Specimens of the large collection recently taken in the Palau Islands lack well-developed spots almost entirely, whereas many specimens taken nearly a half century ago by the *Albatross* Expedition in the Philippines have well-defined spots. These island groups are contiguous, geographically, and such color variations may be associated with different methods employed in collecting and preserving rather than racial differences.) Dorsal portion of head and body usually

finely speckled with brown; lower sides of body with 8 to 10 faint, dusky blotches or bars, variable in size and often completely obscure; an inconspicuous dusky to brown saddle, sometimes obsolete, just posterior to soft dorsal fin, its width about two-thirds length of base of soft dorsal.

Spinous dorsal fin with large, brown-to-blackish, irregular spot on outer third, a clear or whitish spot anteriorly on basal third followed by a large, brownish-black, irregular spot midbasally, remainder of fin transparent; soft dorsal transparent with three brown to black marks, an outer spot, a horizontal stripe near middle, and a short stripe near base on anterior third; pectoral fin transparent with one circular, brown to dusky spot near base; pelvic fin transparent with 6 to 9 circular, brown to black spots arranged in 2 to 3 rows, often completely faded; anal fin transparent with 2 to 3 bars (or spots, depending on condition of fading), brown to blackish colored and almost parallel to base; caudal fin transparent with 2 to 6 oblique bars on the upper lobe and 2 to 7 on the lower lobe, colored brown to black, the number of bars increase with increase in length (table 3); lower lobe usually has one more bar than the upper lobe, and coloration of bars more intense; the caudal bars first appear as spots which become oval shaped (specimens under 50 mm.) and then elongate to form the definitive oblique bars.

Geographical distribution.—Represented in the U. S. National Museum collections from East Africa, eastward, in the East Indies and Philippines to the Palau Islands and from southern Japan to New South Wales, Australia. Although abundant in the Philippine Islands (note specimens studied above; Herre and Montalban, 1928, p. 99; Fowler, 1933, p. 339; and Weber and de Beaufort, 1931, p. 368), this species apparently becomes rare eastward, in certain islands of Oceania, and has not been reported for most of the island groups. In addition to the excellent collection made by Eugenie Clark from the Palau Islands, USNM 154202, Herre (1935, p. 165) also listed it. Seale (1935, p. 362) listed specimens from the Solomon and Samoan Islands, all of which were small. Herre (1936, p. 209) also reported on two small specimens from the Solomons, but his description was based on Philippine material. Jordan and Seale (1906, p. 273) reported it, too, from the Samoan Islands. Schultz (1943) did not collect it in either the Phoenix or Samoan Islands, nor was it taken by the recent intensive collecting by Schultz and others in collaboration with the U. S. Navy project in the Marshall Islands (1946–1947). Superficial examinations, particularly of the small specimens, could easily lead to misidentifications, especially with such forms as *U. luzonius* and *vittatus*. Specimens reported from the Solomons and

Samoan Islands should be reexamined. *U. tragula* has not been reported from the Hawaiian faunal area.

Remarks.—The change and variation in length of barbel with increase in body length was investigated (table 12) but no appreciable difference was found.

This species appears constant in body proportions, meristic counts, and coloration over its range. Counts of the number of gillrakers and vertical scale rows were segregated by locality (table 12) and these data do not even suggest any population divergence.

U. tragula is most closely related to *oligospilus* and *luzonius* and compared with them in their descriptive accounts. Table 3 shows the relationship of the number of oblique bars on the caudal fin with increase in body size in these three species.

TABLE 12.—Number of gillrakers and vertical scale rows, by locality, and length of chin barbel in four size-groups in *Upeneus tragula*

Locality	Number of gillrakers					Number of vertical scale rows				
	21	22	23	24	25	28	29	30	31	32
Zanzibar.....		1					1			
East Indies.....	1		5				2	2	1	1
Philippines.....	3	4	21	2		2	7	9	6	2
China.....		1							1	
Japan.....	3	4		1			1	2	1	
Palau.....			6	3	2		3	3	2	1

Standard length in mm.	Barbel length in percent of head length									
	52	54	56	58	60	62	64	66	68	
41-60.....						3				1
61-80.....	1					2	5	3		
81-100.....		1		6	3	3	1	1		
Greater than 100.....	3	3	3	8	5	2	2			

A specimen of *U. subvittatus* Snyder (1907, p. 101), Stanford University Natural History Museum No. 20156, collected by Jordan and Snyder at Wakanoura, Japan, is without question *U. tragula*. The following counts for this specimen almost all fall on the modes of the frequency distributions given above for *tragula*: pectoral fin rays 28, gillrakers 2, 4+1+11, 5 totaling 23, barbel length in head length 58 percent, vertical scale rows 29. Other important characters as the silvery peritoneum, dark lateral stripe on body, dark dorsal saddles, and oblique bars on caudal fin are also identical to those of *tragula*. Snyder gave a "length" of 175 mm. in contrast to my measure of 228 mm. (standard length) for the above specimen. This discrepancy is not explainable.

Upeneus oligospilus, new species

PLATE 14, FIGURE D

Upeneus tragula Blegvad and Løppenthin, 1944, p. 135, pl. 7, fig. 3.

Holotype.—USNM 153988, a female specimen 115 mm. in standard length, collected April to June, 1948, at Tarut Bay, Ras Tannura, Persian Gulf, by Donald S. Erdman.

Paratypes.—USNM 147995, 11 specimens, 70 to 160 mm., taken with the holotype and having the same data.

Description.—This description is based on the holotype and paratypes listed above. The counts are given for the holotype, followed in parentheses by the average and range of counts taken from the 11 paratypes. When counts for the paratypes are identical with those of the holotype, only one number is given. Certain characters are compared with other species of the genus in tables 1-3.

Dorsal rays VIII-i,8 (VIII-i,7.8: VIII-i,7 to i,8), the first spine minute; pectoral rays 14 (13.6: 13 to 14); vertical scale rows 30 (30.2: 29-31); scale rows above lateral line 3; scale rows below lateral line 6; total number of gillrakers 23 (22: 20-23), rakers short and blunt, length of longest raker in longest filament 1.5 to 2.3.

Measurements, expressed in thousandths of the standard length, are given for the holotype and paratypes in table 14.

Peritoneum transparent, slightly dusky in certain areas of some specimens; preorbital scales present; barbels of average length, extend beyond eye but not to margin of preopercle, barbel length in percent of head length 50 to 64; fourth dorsal spine equal to or slightly smaller than third.

Margins of pectoral fins round, spiny dorsal fin round, soft dorsal and anal slightly falcate, caudal fin deeply forked.

Color in alcohol.—Head and body pale with dusky to blackish blotches of irregular shape and size; body darker above, with scattered dusky pigmentation, and lighter below; a dark stripe from tip of snout through eye to area just above midbase of caudal fin; diffuse dusky spots on snout and cheeks and a few on sides of body in some specimens but absent on belly; light or silvery spots on scales of body, the diameter about one-third to one-half vertical length of scale; a weakly developed, dark saddle just posterior to soft dorsal fin, nearly obsolete in most of the specimens.

Outer third of spinous dorsal with dense black blotch, remainder of fin blotched in black, whitish or clear; soft dorsal with an irregular black spot near tip, a black spot or incomplete bar near base and some scattered, dusky spots; pectoral fin with a small, black spot near base, remainder transparent; pelvic fin with 2 to 3 rows of circular, black spots, about 6 in all; anal fin with 2 faint, elongate dusky marks,

remainder of fin clear; caudal fin with black, oblique bars on both lobes, varying from 2 on the upper and 3 on the lower in the smallest specimen and 4 bars on both lobes in the larger specimens (table 3); bars on the lower lobe more distinct and slightly wider than those of the upper; a diffuse, blackish, irregular, and broken spot near midbase of caudal fin.

Named *oligospilus* in reference to the faint, scattered, dusky spots on the sides of the body.

Geographical distribution.—Known from the Persian Gulf and probably the Gulf of Oman (Blegvad and Løppenthin, 1944, p. 136). It may occur more widely, especially along the Indian coast, than is now known.

Remarks.—This species is related to *luzonius* and *tragula*; considerably more to the latter species. It differs from *tragula* chiefly in the reduced number of oblique bars on the caudal fin (table 3) and in the reduced number of dark spots on the sides of the body, which are decidedly more diffuse and larger, and absent on the belly. It differs from *tragula* also in certain other characters, some of which are difficult to measure for statistical inspection. Of these it is worthy to mention the deeper, more robust body, shorter fins, especially the pectorals and pelvics (see table 13), slightly longer head, and higher modal count of the pectoral fin rays (table 1).

TABLE 13.—*Coloration in life of Upeneus oligospilus and of U. tragula*

Item	<i>U. oligospilus</i> ¹	<i>U. tragula</i> ²
	(Persian Gulf)	(Philippines)
Head and body.	Head brownish dorsally; side of body below lateral stripe with bluish green cast; abdomen silvery with red tinge.	Grayish yellow; body ventrally white flushed with roseate.
Horizontal stripe.	Orange.	Dusky to brown.
Spots on head and body.	Scattered, irregular, vivid, vermilion spots, quickly fading in alcohol.	Conspicuous uniform brown spots; sparingly to thickly spotted and persist in preservation.
Spiny dorsal fins.	Vermilion bars.	Upper third black with circular, yellow spots, and lower portion with two dusky bars.
Caudal fin.	Vermilion bars; narrower.	Dusky bars; wider.

¹ Blegvad and Løppenthin (1944)

² Herre and Montalban (1928)

Blegvad and Løppenthin (1944, p. 135) attributed the differences in color of their specimens, when compared with the descriptions of Weber and de Beaufort (1931, p. 368) and Day (1876, p. 121), as apparently due to the preserved state of the material. This may have been so in part, but it is now realized that two species were involved. A description and figure of the color in life of *oligospilus* is given by Blegvad and Løppenthin (op. cit., pl. 7, fig. 3) in their account of *U. tragula*, and when it is compared with the color in life of *tragula* given by Herre and Montalban (1928, p. 100, pl. 2, fig. 2) notable differences are found. There are some obvious errors in both illustrations, such as the diagrammatic arrangement of the bars on the fins of *tragula* by Herre and Montalban, as well as the excessively uniform distribution of the spots on the body and the omission of the dark brown saddle just posterior to the soft dorsal fin. The illustration of Blegvad and Løppenthin appears to have much of an artist's touch but lacks details. No pigmentation is shown on the outer portion of the spiny dorsal fin by them, but in preserved specimens this area has a most conspicuous black blotch. The salient differences of color in life between *oligospilus* and *tragula* as recorded by the above authors are summarized in table 13.

TABLE 14.—Measurements of *Upeneus oligospilus* expressed in thousandths of standard length

Characters	Holotype	11 Paratypes ¹
Standard length, mm.....	115	105 (70-160)
Body:		
depth.....	238	241 (213-261)
width.....	157	157 (136-173)
Head:		
length.....	320	306 (280-323)
depth.....	195	203 (184-241)
Caudal peduncle:		
length.....	230	260 (247-277)
least depth.....	102	101 (93-107)
Interorbital, least bony width.....	82	78 (74- 81)
Snout, length.....	130	117 (113-131)
Orbit, length.....	71	69 (59- 78)
Upper jaw, length.....	137	129 (119-139)
Barbel, length.....	207	179 (152-204)
Spinous dorsal fin, depressed length.....	210	214 (194-236)
Pectoral fin, length.....	195	202 (167-217)
Pelvic fin, length.....	197	197 (160-216)
Anal fin, depressed length.....	174	176 (166-196)
Tip of snout to origin of spinous dorsal fin.....	378	375 (366-390)
Tip of snout to origin of anal fin.....	662	648 (610-697)

¹ In paratypes the average values are followed by the range of variation in parentheses.

TABLE 15.—Length of pelvic fins in two species of *Upeneus*, expressed as a percentage of the head length

Species	Percent																	
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	
<i>oligospilus</i>	1				1	1	2	1	2	1	2	1						
<i>tragula</i>								1	1	9	7	13	8	8	7	3	1	

Upeneus parvus Poey

Upeneus parvus Poey, 1853, p. 226 (type locality, Cuba).—Poey, 1852, pl. 17, fig. 4.—Norman, 1922, p. 534.—Longley and Hildebrand, 1941, p. 142.
Upeneoides parvus Stahl, 1882, pp. 76, 162.

Specimens studied.—Six specimens from the Western Atlantic ranging in length from 68 to 119 mm., from the following localities: Cuba, USNM 37576, collected by F. Poey, 1885, 2 specimens; Puerto Rico, Anasco Bay, USNM 128263 and 144555, collected by V. Barnes, Jr., 1943–1944, 3 specimens; Tortugas, Fla., USNM 92051, collected by W. H. Longley, 1931, 1 specimen.

Description.—Dorsal rays VII–i,8, the first spine longest; pectoral rays 15.5: 15 to 16 (6); vertical scale rows 37.2: 36 to 38 (4); scale rows above lateral line 3: (4); scale rows below lateral line 6.6: 6 to 7 (3); total number of gillrakers 27.4: 26 to 29 (6); length of longest raker on longest filament about 1.2 (4).

Peritoneum light, transparent to slightly silvery; preorbital scales present; barbels extend to posterior margin of preopercle; barbel length in percent of head length 62 to 78 (6 specimens).

Color in alcohol.—Head and body light tan. One specimen shows evidence of a light colored median stripe on body and possibly a finer one below it. Caudal fin with dark, oblique bars, more pronounced on lower lobe; 3 bars on the upper and lower lobes in the smaller specimens and 4 or 5 on each lobe of the larger ones. Traces of bars or marks on the spinous and soft dorsal fins. Remainder of fins clear. No photograph was included because of the poor condition of the specimens.

Geographical distribution.—Known from the following localities in the Western Atlantic, where it is apparently rare: Cuba, Tobago (Norman, 1922), Puerto Rico, and Tortugas.

Remarks.—In Fowler's description of *Upeneus phillipsi* (1918b, p. 5, fig. 1, type locality, Corson's Inlet, Cape May County, New Jersey) he suggested that it may be "allied, if not identical" with *Upeneus parvus*. Examination of the holotype of *U. phillipsi* Fowler revealed this species to be a juvenile specimen, 52 mm. in standard length, of *Mullus auratus* Jordan and Gilbert.

Critical generic and specific characters were inaccurately recorded by Fowler. He lists and figures 8 spines in the first dorsal fin; states that the dentition of the upper jaw consists of at least a row of low, simple teeth, and that the vomer and palatines have fine teeth; lists 30 scales in the lateral line to base of caudal fin and 16 pectoral rays. I find 7 spines in the first dorsal fin, no teeth on the upper jaw and those of the vomer and palatines coalesced to form a palatal tooth patch which is characteristic of the genus *Mullus*, 34 or 35 vertical scale rows along the lateral line to hypural base, and 15 pectoral rays for each fin.

The following characters were also recorded from the type specimen: total number of gillrakers, 22; barbels extend slightly beyond margin of preopercle; peritoneum light colored to slightly dusky; 2 barlike marks on spinous dorsal fin and 3 on soft dorsal; caudal fin with 3 dark oblique bars on each lobe (tips of lobe now broken off); a salmon-colored stripe on body along lateral line and prolonged through eye with coarse flecks of salmon color on the lower portion of sides of body (observed in life by collector, R. J. Phillips).

The characters given above clearly place *U. phillipsi* in the synonymy of *Mullus auratus*.

References

AGASSIZ, J. L. R.

1846. Nomenclatoris zoologici. Index universalis . . . , 393 pp.

BENNETT, EDWARD TURNER.

1831. Observations on a collection of fishes from the Mauritius, with characters of new genera and species. Proc. Zool. Soc. London (1831), pt. 1, pp. 32, 59-61, 126-128, 165-169.

BLEEKER, PIETER.

1849. Bijdrage tot de kennis der Percoiden van den Malajo-Molukschen Archipel, met beschrijving van 22 nieuwe soorten. Verh. Batavia Gen., vol. 22, 64 pp.

1855. Zesde bijdrage tot de kennis der ichthyologische fauna van Amboina. Nat. Tijdschr. Nederlandsch-Indië, vol. 8, pp. 391-434.

1868. Notice sur le *Parupeneus bifasciatus* (*Mullus bifasciatus* Lacép.) de l'île de la Réunion. Versl. Gewone Vergad. Akad. Amsterdam, ser. 2, vol. 2, pp. 342-348.

1876. Systema Percarum revisum. Arch. Néerlandaises Sci. Exact. Nat., vol. 11, pt. 1, pp. 247-288; pt. 2, pp. 289-340.

1877. Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 9, pp. 1-80, pls. 355-360, 363-420.

BLEGGVAD, H., and LØPPENTHIN, B.

1944. Fishes of the Iranian Gulf, 247 pp., 135 figs., 12 pls.

BOESEMAN, MARINUS

1947. Revision of the fishes collected by Burger and von Siebold in Japan, 242 pp., 5 pls.

CANTOR, THEODORE

1850. Catalogue of Malayan fishes. Journ. Asiatic Soc. Bengal, vol. 18, pp. i-xii + 983-1443, pls. 1-14.

CUVIER, GEORGES, L. C. F. D., and VALENCIENNES, ACHILLE

1829. Histoire naturelle des poissons, vol. 3, 500 pp.

1831. Histoire naturelle des poissons, vol. 7, 531 pp.

DAY, FRANCIS

1867. On some new or imperfectly known fishes of India. Proc. Zool. Soc. London (1867), pp. 935-942.

1868a. On some new or imperfectly known fishes of India. Proc. Zool. Soc. London (1868), pp. 149-156.

1868b. On some new fishes from Madras. Proc. Zool. Soc. London (1868), pp. 192-199.

1876. The fishes of India, vol. 1, 320 pp., 68 pls.

EVERMANN, BARTON W., and SEALE, ALVIN

1907. Fishes of the Philippine Islands. Bull. U. S. Bur. Fish., vol. 26 (1906), pp. 49-110, 22 figs.

FORSKÅL, PETRUS

1775. Descriptiones animalium avium, amphibiorum, piscium . . . , 164 pp., 43 pls.

FOWLER, HENRY W.

- 1918a. New and little-known fishes from the Philippine Islands. Proc. Acad. Nat. Sci. Philadelphia, vol. 70, pp. 2-71, figs. 1-27.
- 1918b. Fishes from the Middle Atlantic States and Virginia. Occ. Pap. Mus. Zool. Univ. Michigan No. 56, pp. 1-19, pls. 1, 2.
1922. A list of Hawaiian fishes. Copeia, No. 112, pp. 82-84.
1928. The fishes of Oceania. Mem. Bishop Mus., vol. 10, iii+540 pp., figs. 1-82, pls. 1-49.
1931. The fishes of Oceania. Mem. Bishop Mus., vol. 11, suppl. 1, No. 5, pp. 313-381, figs. 1-7.
1933. *In* Contributions to the biology of the Philippine Archipelago and adjacent regions. U. S. Nat. Mus. Bull. 100, vol. 12 (The fishes of the families Banjosidae . . . Mullidae . . .), 465 pp., 32 figs.
1938. The fishes of the George Vanderbilt South Pacific Expedition, 1937. Acad. Nat. Sci. Philadelphia, Monogr. No. 2, v+349 pp., pls. 1-12.
1940. The fishes obtained by the Wilkes Expedition, 1838-1842. Proc. Amer. Philos. Soc., vol. 82, No. 5, pp. 733-800, figs. 1-76.
1949. The fishes of Oceania. Mem. Bishop Mus., vol. 12, suppl. 3, No. 2, pp. 37-186.

GUNTHER, ALBERT

1859. Catalogue of the fishes in the British Museum, vol. 1 (Acanthopterygii), 524 pp.

HERRE, ALBERT W. C. T.

1935. A check list of the fishes of the Pelew Islands. Journ. Pan-Pacific Res. Inst., vol. 10, No. 2, pp: 163-166.
1936. Fishes of the Crane Pacific Expedition. Field Mus. Nat. Hist. Publ. 353, Zool. Ser., vol. 21, 472 pp., 50 figs.

HERRE, ALBERT W., and MONTALBAN, HERACLIO R.

1928. The goatfishes, or Mullidae, of the Philippines. Philippine Journ. Sci., vol. 36, No. 1, pp. 95-136, pls. 1-6.

HOUTTUYN, MARTIN

1782. Beschrijving van eenige Japansche visschen en andere zeeschepselen. Verh. Hollandsche Maatsch. Wet., Haarlem, vol. 20, pt. 2, pp. 311-350.

JENKINS, OLIVER P.

1903. Report on collections of fishes made in the Hawaiian Islands, with descriptions of new species. Bull. U. S. Fish. Comm. (1902), vol. 22, pp. 417-511, figs. 1-50, pls. 1-4.

JORDAN, DAVID S.

1919. The genera of fishes. Leland Stanford Junior Univ. Ser., pt. 2, pp. ix, 163-284, xiii.

- JORDAN, DAVID S., and EVERMANN, BARTON W.
 1903. Descriptions of new genera and species of fishes from the Hawaiian Islands. Bull. U. S. Fish. Comm., vol. 22 (1902), pp. 161-208.
1905. The aquatic resources of the Hawaiian Islands. I. The shore fishes of the Hawaiian Islands, with a general account of the fish fauna. Bull. U. S. Fish. Comm., vol. 23 (1903), pt. 1, pp. 1-574, figs. 1-229, colored pls. 1-73; pls. 1-65.
- JORDAN, DAVID S., EVERMANN, BARTON W., and TANAKA, SHIGEHO.
 1927. Notes on new or rare fishes from Hawaii. Proc. California Acad. Sci., ser. 4, vol. 16, No. 20, pp. 649-680, pls. 22-24.
- JORDAN, DAVID S., and JORDAN, ERIC K.
 1922. A list of the fishes of Hawaii, with notes and descriptions of new species. Mem. Carnegie Mus., vol. 10, No. 1, 92 pp., 4 pls., 7 figs.
- JORDAN, DAVID S., and SEALE, ALVIN.
 1906. The fishes of Samoa . . . Bull. U. S. Bur. Fish., vol. 25 (1905), pp. 173-455, pls. 38-53, figs. 1-111.
1907. Fishes of the Islands of Luzon and Panay. Bull. U. S. Bur. Fish., vol. 26 (1906), pp. 1-48, figs. 1-20.
- KLUNZINGER, CARL B.
 1870. Synopsis der Fische des Rothen Meeres. Pt. 1. Percoiden-Mugiloiden. Verh. Zool.-Bot. Ges. Wien, vol. 20, pp. 669-834.
- KNER, RUDOLF.
 1865-1867. Reise der österreichischen Fregatte "Novara" um die Erde in den Jahren 1857-1859 . . . , Zoologischer Theil, Fische, 1-3 Abtheilung, 433 pp., 16 pls.
- LACÉPÈDE, BERNHARD G. DE LA
 1802. Histoire naturelle des poissons . . . , vol. 3, 558 pp., 34 pls.
- LACHNER, ERNEST A.
 1951. Studies of certain apogonid fishes from the Indo-Pacific, with descriptions of three new species. Proc. U. S. Nat. Mus., vol. 101, No. 3290, pp. 581-610, pls. 17-19, fig. 105.
- LONGLEY, WILLIAM H., and HILDEBRAND, SAMUEL F.
 1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits, and local distribution. Carnegie Inst. Washington Publ. 535 (Pap. Tortugas Lab., vol. 34), 331 pp., 34 pls.
- NORMAN, J. R.
 1922. Fishes from Tobago. Ann. Mag. Nat. Hist., vol. 9, pp. 533-536.
- POEY, FELIPE
 1852-1853. Memorias sobre la historia natural de la Isla de Cuba. Vol. 1, pp. 201-280 (1853); pls. 15-22 (1852).
- RICHARDSON, JOHN
 1846. Report on the ichthyology of the seas of China and Japan. Rep. Fifteenth Meeting British Assoc. Adv. Sci. (1845), pp. 187-320.
- SAUVAGE, HENRI E.
 1891. Poissons. In Grandidier, Histoire physique, naturelle et politique de Madagascar, vol. 16, text, 543 pp., Atlas, 50 pls.
- SCHULTZ, LEONARD P.
 1943. Fishes of the Phoenix and Samoan Islands collected in 1939 during the expedition of the U. S. S. *Bushnell*. U. S. Nat. Mus. Bull. 180, x+316 pp., 9 pls., 27 figs.

SEALE, ALVIN

1910. Fishes of Borneo, with descriptions of four new species. *Philippine Journ. Sci.* (1910), sec. D, vol. 5, No. 4, pp. 263-288, pls. 1-4.
 1914. Fishes of Hongkong, *Philippine Journ. Sci.*, vol. 9, No. 1, pp. 59-79.
 1935. The Templeton Crocker Expedition to western Polynesian and Melanesian Islands, 1933. *Proc. California Acad. Sci.*, ser. 4, vol. 21, No. 27, pp. 337-378, pls. 20-23.

SHAW, GEORGE.

1803. General zoology or systematic natural history . . . , vol. 4, pt. 2, 632 pp., 92 pls.

SMITH, J. L. B.

1949. The sea fishes of South Africa, 550 pp., 103 pls., 1245 figs.

SNYDER, JOHN O.

1904. A catalogue of the shore fishes collected by the steamer *Albatross* about the Hawaiian Islands in 1902. *Bull. U. S. Fish. Comm.*, vol. 22 (1902), pp. 513-1538, pls. 1-13, figs. 1-24.
 1907. A review of the Mullidae, surmulletts, or goatfishes of the shores of Japan. *Proc. U. S. Nat. Mus.*, vol. 32, No. 1513, pp. 87-102, figs. 1-3.
 1912. The fishes of Okinawa, one of the Riu Kiu Islands. *Proc. U. S. Nat. Mus.*, vol. 42, No. 1913, pp. 487-519, pls. 62-70.

STAHL, AUGUSTIN

1882. Fauna de Puerto-Rico. Catalogo del gabinete zoológico del Dr. A. Stahl, en Bayamon (Pto.-Rico) precedido de una classification sistematica de los animales que corresponden á esta fauna. San Juan. 249 pp.

STEINDACHNER, FRANZ

1870. Ichthyologische Notizen. X. *SitzBer. Akad. Wiss. Wien*, vol. 61, pp. 623-643, pls. 1-5.
 1901. Fische aus dem Stillen Ocean. *Ergebnisse einer Reise nach dem Pacific (Schauinsland 1896-97)*. *Denkschr. Akad. Wiss. Wien*, vol. 70, pp. 483-521, 6 pls.

STEINDACHNER, FRANZ, and DÖDERLEIN, LUDWIG

1884. Beiträge zur Kenntniss der Fische Japan's. II. *Denkschr. Akad. Wiss.*, vol. 48, pp. 1-40, pls. 1-7.

TEMMINCK, COENRAAD J., and SCHLEGEL, H.

1843. *Pisces, in Siebold, Fauna Japonica* . . . , pt. 2, pp. 21-72, 160 pls.

WEBER, MAX, and DE BEAUFORT, L. F.

1931. The fishes of the Indo-Australian archipelago, vol. 6, 448 pp., 81 figs.

WHITLEY, G. P.

1943. Poisonous and harmful fishes. *Australia Council Sci. Ind. Res.*, Bull. 159, 28 pp., 3 pls., 16 figs.

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3331

STUDIES IN NEOTROPICAL MALLOPHAGA, XI:
BIRD LICE OF THE SUBORDER AMBLYCERA, GENUS
DENNYUS NEUMANN

By M. A. CARRIKER, Jr.

Dennyus Neumann, a genus of Amblycera found only on the swifts (Apodidae), is a relatively small group, 13 valid species being listed by Hopkins and Clay in "A Checklist of the Genera and Species of Mallophaga," 1952. Very little concerning the genus has appeared in literature. Apparently few specimens have been collected, owing, I suspect, to the difficulty of securing their hosts.

Of the 13 recognized species, 3 are from North American hosts, 2 from Central America, 1 from South America, 1 from Jamaica, 1 from Europe, and 5 from Asia and the East Indies.

Harrison (*Genera and Species of Mallophaga*, 1916) listed six valid species, of which one, *latifrons* Carriker and Shull, is a *Myrsidea*.

Ewing reviewed the genus in 1930 (Proc. U. S. Nat. Mus., vol. 77, art. 20) and listed eight valid species, of which two are *Myrsidea* (*femuralis* Kistiakowsky and *piageti* Kistiakowsky). He placed *bruneri* Carriker under the synonymy of *dubius* Kellogg, stating that Ferris had examined a cotype of it and pronounced it to be the same as *dubius*, in which he agreed; but this statement is clearly an error, as will be shown later in this paper. He also described three new species (*richmondi*, *spiniger*, and *australis*). On page 2 he says, "*latifrons* Carriker and Shull . . . is a true *Dennyus*," but he does not include it in his list of species of the genus. He redescribed and figured *dubius* Kellogg and, on the whole, left a much clearer picture of the genus than we previously had.

In 1941 Thompson (Ann. Mag. Nat. Hist., ser. 11, vol. 7, p. 530, 1941) described a species (*francicus*) from the Solomon Islands and in 1948 (Bol. Ent. Venezolana, vol. 7, Nos. 1, 2, June 1948) he described a species from Ceylon and another from Jamaica (*cypsiurus* and *gossei*).

Because of the small number of specimens and species available for study to any single worker, it has been and still is impossible to prepare a thoroughly comprehensive review of the genus. I have been fortunate in securing a considerable number of species of this interesting group. In my collection are the types of *bruneri* (Carriker) and *meridionalis* (Carriker), several specimens of *australis* Ewing from the type host, and a male of *distinctus* Ferris.

In addition, there are specimens of seven forms which appear to be undescribed, all from various countries of South America. Some of these species are very distinct and may be easily recognized, but others form a closely related group, some of which may be conspecific but may be separated from each other by the shape of the head and thoracic segments, chaetotaxy, etc. I have examined males of seven species (four described species and three new ones) and found very little difference in the genitalia (see figures). Even the genitalia of *distinctus* Ferris, one of the most aberrant species of the genus, are very similar to the others. Apparently, the only very different genitalia are those of *major* (Uchida), for which Uchida erected a new genus not recognized by Hopkins and Clay. The males, insofar as I can determine, differ but little from the females except in size and in the terminal segments of the abdomen.

The best characters for the separation of the species are the gular plate and its chaetotaxy, the shape and proportions of the thoracic segments, the prosternal plate and its chaetotaxy, the mesosternal and metasternal plates, and a median sternal sclerite usually present in abdominal segments I and II (sometimes wanting).

The following key contains the new species described in this paper as well as all of the known species except *cypsiurus* Thompson, *francicus* Thompson, and *hirundinidis* (Linnaeus), the European species for which I lack sufficient data for their inclusion. I have followed Peters in the nomenclature of the hosts. All hosts whose identities were uncertain have been verified by Dr. A. Wetmore except that of *D. similis*, which was furnished by Mr. Phelps. To both of these my thanks are due. All measurements are in millimeters and all drawings were prepared by the author.

Key to the species of *Dennyus*

(Data are insufficient for the inclusion of *cypsiurus* Thompson, *francicus* Thompson, and *hirundinidis* (Linnaeus).)

- 1a. Head very short and wide; prothorax quadrilateral, without lateral lobes; mesothorax and metathorax very short and very wide (more than 3 times wider than long); abdomen oval.....**brevicapitis**, new species
- 1b. Head but little wider than long.
- 2a. Pre-antennary portion of head with sides almost parallel and front transverse (head, .49 by .51); temples more or less angular...**distinctus** Ferris
- 2b. Pre-antennary area circular; temples small, narrow and rounded, but little expanded (head, .47 by .59).....**minor** (Kellogg)
- 1c. Head, thorax, and abdomen of shape normally found in the genus.
- 3a. Fringe of setae along anterior edge of temples double, one pointing outward, the other backward; double rows of long hairs on posterior margins of temples, occiput, prothorax, and metathorax; patches of 4 to 6 exceedingly long hairs in median portion at each side of tergites II to VII (nearly as long as abdomen).....**intonsus**, new species
- 3b. Chaetotaxy normal, not as above.
- 4a. Posterolateral margins of temples clearly convex from lateral to posterior angle, not straight or concave.
- 5a. Abdominal segment VIII in both sexes deeply concave on posterior margin, with all (♂) or most (♀) of segment IX within this concavity; Male genitalia very different from all other species of the genus.....**major** (Uchida)
- 5b. Abdominal segments VIII and IX normal, not as in 5a.
- 6a. Numerous peglike spines on dorsal surface of head and prothorax.
spiniger Ewing
- 6b. No peglike spines on head or thorax.
- 7a. Prosternal plate with numerous short, thickened spines (10 to 12), with or without longer setae.
- 8a. Pre-antennary margin of head uniformly rounded and posterior margin of temples strongly convex; 10 short spines on prosternal plate, without any longer setae.
rotundocapitis, new species
- 8b. Pre-antennary margin of head not uniformly rounded, but with sides slightly concave.
- 9a. Twelve short, straight spines and 2 long setae on prosternal plate; plate with straight sides converging sharply posteriorly; temples strongly convex posteriorly.
brunneitorques, new species
- 9b. Twelve short, curving spines on central area of prosternal plate, and a long, curving seta at anterior angle of same area; plate with sides subparallel and concave...**richmondi** Ewing
- 7b. Prosternal plate with 3 to 6 longish setae on anterior portion.
- 10a. Prosternal plate long, and narrow posteriorly, with narrow lateral bands, and with 5 (or 6) longish setae; temples strongly rounded and pre-antennary margin uniformly circular.
- 11a. Setae along posterior margin of abdominal tergites consist of short, thickened hairs, alternating with hairs nearly length of segments; sides of thorax straight.
similis, new species

- 11b. Setae along posterior margin of abdominal tergites consist of slender hairs, sparsely set, and mostly longer than the succeeding segments-----**australis** Ewing
- 10b. Three longish setae on prosternal plate, one on each side on anterior border and one in anterior center of inner, clear area; temples very slightly convex and pre-antennary margin with slight concavity on each side---**gossei** Thompson
- 4b. Posterolateral margins of temples straight or concave (never convex).
- 12a. Posterolateral margin of temples straight; occiput transverse; prosternal plate large, with slightly concave, converging sides and wide marginal bands; 11 or 12 short spines set on inner portion of plate and a long hair at anterior, lateral angles of inner portion.
spininotus, new species
- 12b. Posterolateral margins of temples decidedly concave just forward of the posterior angle.
- 13a. Metathorax normal, with posterolateral angles simple and connected by a submarginal band to abdominal segment I (see fig. 68).
- 14a. Prosternal plate with 3 to 5 setae; when only 3, all are long; when 5, one is very small and 2 medium.
- 15a. Prosternal plate with 2 long and 2 rather short setae, all set in anterior marginal band of plate, with the 2 short ones set medially (often a very short spine at one side).
limbus, new species
- 15b. Prosternal plate with 3 long setae, set in anterior portion of medial clear area; temples small; head narrow.
dubius (Kellogg)
- 14b. Prosternal plate with about 8 longish setae, all set within the median clear space-----**bruneri** (Carriker)
- 13b. Metathorax with posterior margin much wider than abdominal segment I, with the posterolateral angle bifurcated; the spines along the posterior margin of segment beginning at the inner point of the bifurcation, also connecting band across to the abdomen-----**meridionalis** (Carriker)

***Dennysus australis* Ewing**

FIGURE 63,*i*

Dennysus australis Ewing, Proc. U. S. Nat. Mus., vol. 77, art. 20, p. 5, 1930.
(Host, *Apus a. andecolus* (d'Orbigny and La Fresnaye).)

I have in my collection one adult male and two immature females from *Apus andecolus parvulus* (Berlepsch and Stolzmann) collected at Huarmey, Perú, and one adult female from the type host collected at Oploca, Bolivia. The type of *australis* is a female, and my female from Oploca agrees closely with Ewing's description and figure of the species, although the measurements differ slightly, those given for the type being 2.75 by 1.30, while my female measures 2.86 by 1.19.

The male from *A. andecolus parvulus* has exactly the same shape, structure, and chaetotaxy of the head as the female, as well as the

shape and chaetotaxy of the prosternal plate as given by Ewing. It measures 2.36 by .90.

This species is close to *bruneri* (Carriker), having the same style of head bands and exactly the same gular plate and chaetotaxy. It differs, however, in the shape of the head, *australis* having the temples convex, while in *bruneri* they are concave. In *australis* the sides of the mesothorax and metathorax are straight, while in *bruneri* the sides of the mesothorax are convex and the sides of the metathorax are concave. *D. australis* is also much larger than *bruneri*, the male of the latter measuring only 2.13 by .80. The dorsal aspect of the paratergals is different, as well as the shape and chaetotaxy of the prosternal plate, that of *bruneri* being shorter, and broader anteriorly, and with the eight longish hairs all set inside the clear area, while in *australis* there are four setae in the clear area and two in the lateral band (male). Ewing shows three setae in the lateral band and three in the clear area (female), but in my female the setae are arranged in the same manner as in the male.

Measurements of adult male and female in collection of author:

	Male		Female	
	Length	Width	Length	Width
Body-----	2.39	-----	2.88	-----
Head-----	-----	-----	-----	-----
ant. fossae-----	-----	.49	-----	.51
temples-----	.49	.65	.542	.76
occiput-----	.434	-----	.51	-----
Prothorax-----	.288	.40	.314	.465
Meso-metathorax-----	.358	.655	.37	.803
Abdomen-----	1.44	.90	1.86	1.19
Basal plate-----	.41	.13	-----	-----
Parameres-----	.24	.14	-----	-----
Endomeral sac-----	.217	.14	-----	-----

Dennyus dubius (Kellogg)

Nitzschia dubius Kellogg, Proc. California Acad. Sci., ser. 2, vol. 6, p. 540, 1896.
(Host, *Chaetura pelagica* (Linnaeus).)

I have no specimens of this species and have used, with some misgivings, Ewing's description and figures as a basis for my conclusions regarding it. Ewing says his description is based "upon many adult specimens chiefly from the type host" (italics mine), and lists under *dubius* specimens not only from *Aeronautes melanoleucus* (*A. s. saxatilis*), type host for *D. bruneri* (Carriker), but from *Chaetura richmondi*, from Eden, Nicaragua; yet, in the same paper, he describes *Dennyus richmondi* whose host is *Chaetura richmondi*, also from Eden, Nicaragua.

I have in my collection two males (paratypes) of *D. bruneri*, from *Aeronautes s. saxatilis*, and they certainly are not what Ewing describes as *dubius* (see key). Although the two are undoubtedly closely related, and may possibly be conspecific along with the new species (*limbus*) described on page 542, until more is known about this group I prefer to leave them as separate species.

***Dennyus bruneri* (Carriker)**

FIGURE 63,c

Nitzschia pulicaris var. *tibialis* Carriker, Journ. New York Ent. Soc., vol. 10, p. 225, pl. 22, figs. 4, 5, 1902. (Host, *Aeronautes melanoleucus* (= *A. s. saxatilis* (Woodhouse).)

Nitzschia bruneri Carriker, Univ. Nebraska Stud., vol. 3, No. 2, p. 55, 1903 (new name for *N. tibialis*, preoccupied by *N. tibialis* Piaget, 1880).

I have in my collection two males (labeled as types) of this species. The original type series contained three males and one female. I imagine that one male and the female remained in the collection of the University of Nebraska, and if they still exist they should be considered as the male holotype and female allotype of the species.

This species may be distinguished from its closely related forms by the detailed characters as given in the key. From *dubius* it may easily be distinguished by the chaetotaxy of the prosternal plate, *dubius* having three longish setae set in a row along the edge of the clear area, while in *bruneri* there are eight longish setae irregularly placed within the clear area. Ewing's figure shows the posterior margin of the prothorax with sides angulated and median portion strongly concave, while in *bruneri* the posterolateral angles are rounded and the posterior margin is almost transverse. In *dubius* the metathorax has the sides straight and is "over twice as broad as long," while in *bruneri* the sides of metathorax are concave and its width is three times the length. Ewing's description of the abdominal chaetotaxy is very vague but I suspect that it is different from that of *bruneri*, which has one spine in lateral angle of segment I and one slender, submarginal hair; in segment II there are one spine and one slender hair in the angle and a longer, coarser, submarginal dorsal hair. In segments III to VII there are two short hairs in the angle and one long submarginal hair, with two very long hairs at angles of segments VIII and IX. These long dorsal hairs become progressively longer posteriorly.

In *dubius* the parameres are incurved apically, their tips touching, while in *bruneri* they are almost straight in one specimen and slightly incurved apically in the other.

Measurements of the male paratype:

	Length	Width
Body.....	2.13	-----
Head.....		-----
ant. fossae.....		.456
temples.....	.48	.63
occiput.....	.44	-----
Prothorax.....	.26	.38
Meso-metathorax.....	.326	.615
Abdomen.....	1.26	.80
Parameres.....	.23	.14

Dennyus meridionalis (Carriker)

FIGURE 63,b,h

Nitzschia bruneri var. *meridionalis* Carriker, Univ. Nebraska Stud., vol. 3, No. 2, p. 56, 1903. (Host, *Chaetura griseiventris* (= *C. spinicauda fumosa* Salvin).)¹

I have in my collection a slide containing a male and a female of this species, labeled as "types," and another slide, also containing a pair of adults and several nymphs, labeled merely "Pozo Azul, Costa Rica, June, 1902."

Eight skins of the host swift were collected by me at Pozo Azul, and all are in the Carnegie Museum. It is probable that the various specimens of *Dennyus* came from more than one of these birds. This fact is mentioned because of the presence of two apparently distinct species in this series, including specimens from *Chaetura spinicauda aetherodroma* Wetmore, from Colombia. The whole series seems to be practically the same in every way except in the structure of the metathorax, of which there are two very distinct types (see figs.). It does not seem possible that this can be a case of individual variation, since the difference is very great and clear-cut.

The male and female labeled as the types of *meridionalis* are of one class, while the male and female "paratypes" are of the other. A female from Cartagena, from *C. s. aetherodroma* Wetmore, has the metathorax as in the "paratype" of *meridionalis*, as have also a female taken at El Real, Colombia, from the same host and a female taken at Las Vegas, Colombia; but a male from El Real is like the types of *meridionalis*.

All the above specimens have the chaetotaxy of the prosternal plate the same except the female from Las Vegas, which has only three rather short, spinelike setae in a straight row across the anterior marginal band, while the plate itself is longer and narrower than in

¹ Hopkins and Clay (A Checklist of the Genera and Species of Mallophaga, 1952) have given the host of this species as *Chaetura griseiventris phaeopygus* Hellmayr, a bird found on the Caribbean side of Costa Rica. The birds from Pozo Azul (Pacific side) were identified by Todd as well as by Wetmore as *Chaetura spinicauda fumosa* Salvin.

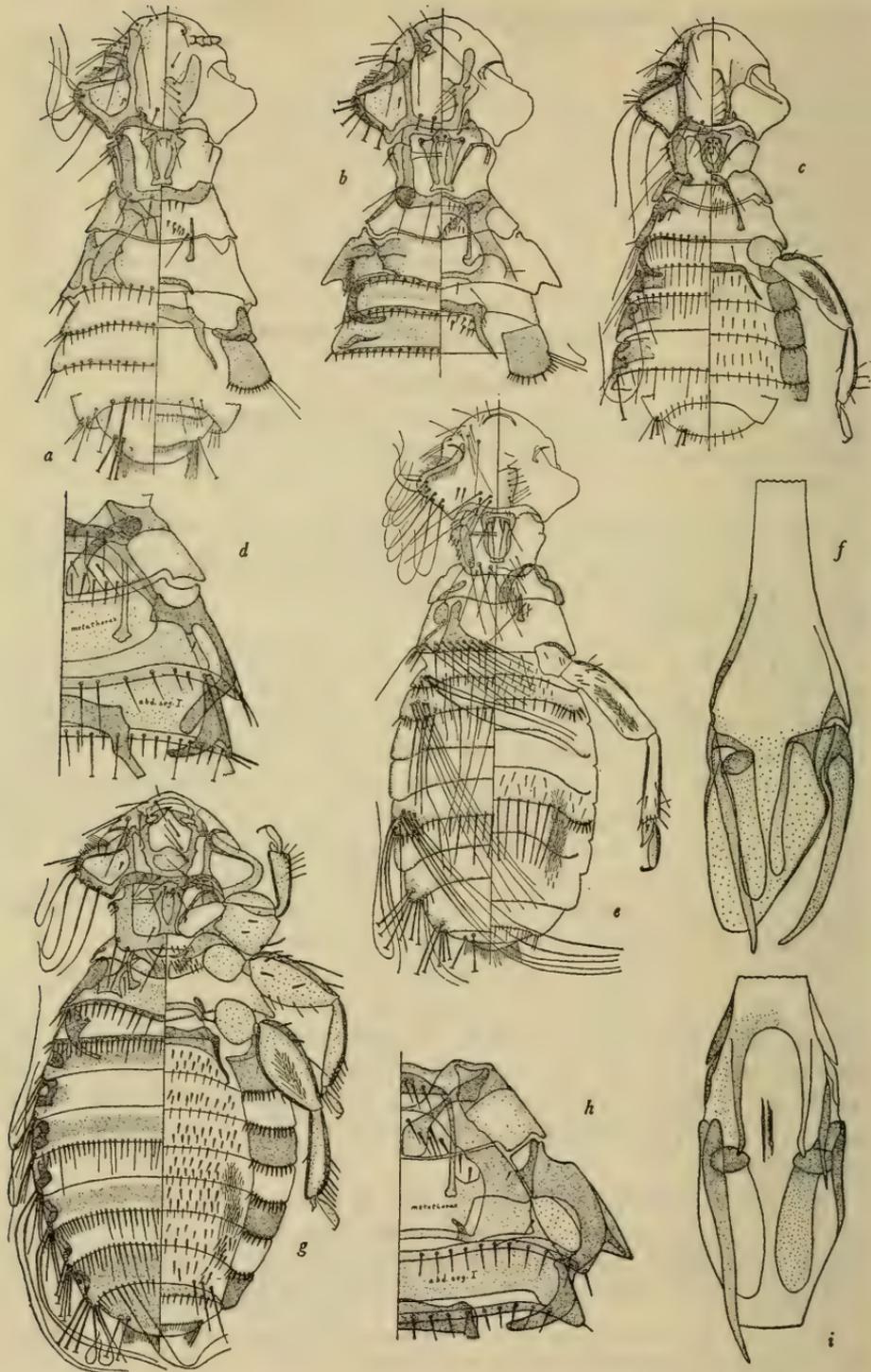


FIGURE 63.—For explanation see facing page.

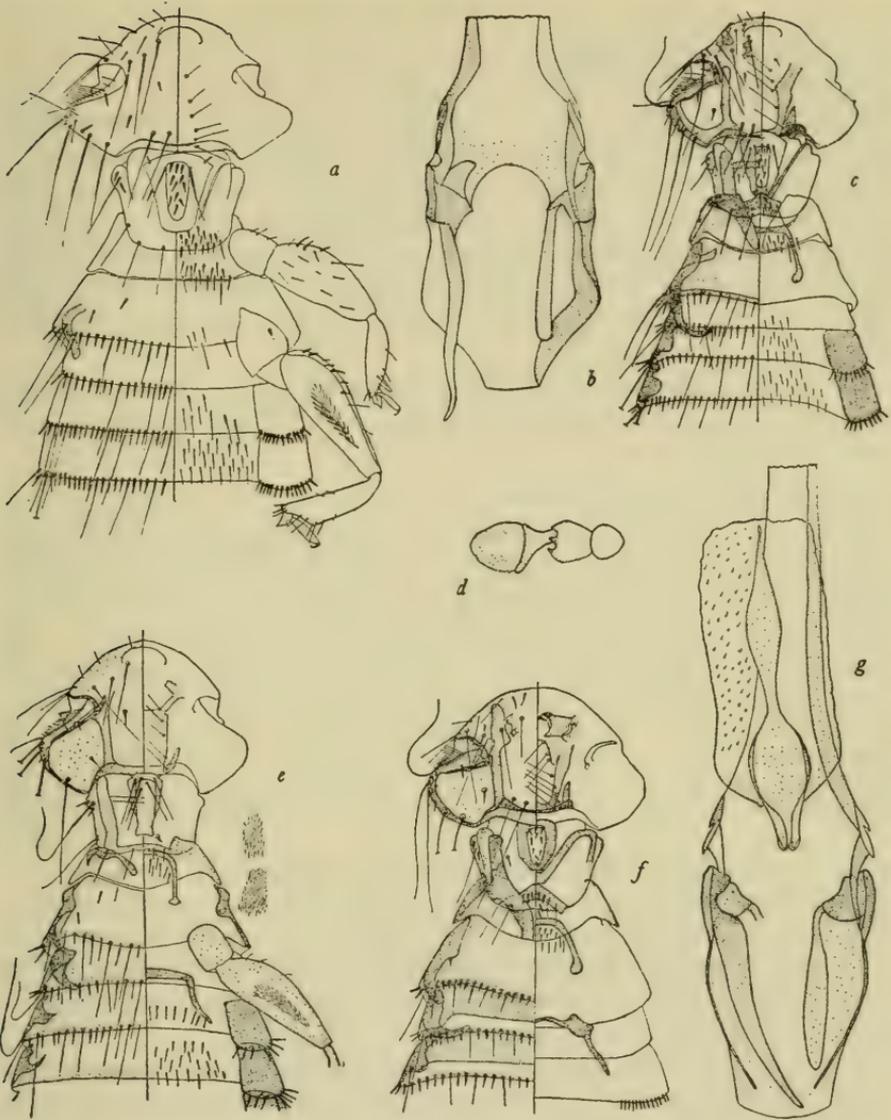


FIGURE 64.—*a*, *Dennyus spininotus*, new species, female; *b*, female genitalia of *D. rotundocapitis*, new species; *c*, *D. brunneitorques*, new species, female; *d*, antennae of *D. rotundocapitis*, male; *e*, *D. similis*, new species, female (patches of sternal setae to right of figure); *f*, *D. rotundocapitis*, female; *g*, male genitalia of *D. similis*.

FIGURE 63.—*a*, *Dennyus limbus*, new species, female; *b*, type, female, of *D. meridionalis* (Carriker); *c*, paratype, male, of *D. bruneri* (Carriker); *d*, thorax and abdominal segment I of female *D. limbus*; *e*, *D. intonsus*, new species, female; *f*, male genitalia of *D. limbus*; *g*, *D. brevicapitis*, new species, female; *h*, thorax and abdominal segment I of *D. meridionalis*; *i*, male genitalia of *D. australis* Ewing.

the other specimens. It is possible that the Las Vegas (in Sierra Nevada de Santa Marta) birds are not typical *C. s. aetherodroma*. Todd originally called them *C. s. spinicauda*, saying that they were like birds from Venezuela and Trinidad, although Dr. Wetmore lists the Las Vegas birds as that race in his description of *aetherodroma*.

The only solution to this problem seems to be the separation of the series into two species, the male and female types of *meridionalis* and the single male from El Real comprising one species (*meridionalis*), while the pair of "paratypes" of *meridionalis* and the three females from Colombia form the other, which I have described below as *D. limbus*, new species.

D. meridionalis may be recognized at a glance by the peculiar structure of the metathorax in conjunction with the prosternal plate and its chaetotaxy.

Measurements of the types:

	Male		Female	
	Length	Width	Length	Width
Body.....	2. 13	-----	2. 71	-----
Head:				
ant. fossae.....	-----	. 477	-----	. 50
temples.....	. 51	. 694	. 545	. 745
occiput.....	. 456	-----	. 475	-----
Prothorax.....	. 29	. 41	. 326	. 435
Meso-metathorax.....	. 38	. 814	. 435	. 976
Abdomen.....	1. 20	. 705	1. 62	1. 02
Parameres.....	. 206	. 13	-----	-----

Dennyus limbus, new species

FIGURE 63,a,d,f

Types.—Male and female adults from *Chaetura spinicauda fumosa* Salvin, collected by the author at Pozo Azul, Costa Rica, June 1902 (in collection of author).

Diagnosis.—Closely related to *dubius* (Kellogg) and *bruneri* (Carriger), having the same concave posterolateral margins of the temples and the same thoracic structure.

D. limbus differs from *bruneri* in the wider head (.49 by .684 against .48 by .63) and much wider thorax (.76 against .615); the abdomen (females) is smaller (1.20 by .716 against 1.26 by .80). It differs from both *dubius* and *bruneri* in the shape and chaetotaxy of the prosternal plate. The plate is much larger than that of *bruneri*, having four setae (two long and two short) set in the marginal band, while *bruneri* has eight shorter setae, all within the clear median area. *D. dubius* has but three long setae, set at head of median clear area. A discussion of the metathoracic characters is given under remarks on *meridionalis* and in the key.

Measurements of the types:

	Male		Female	
	Length	Width	Length	Width
Body.....	2.10	-----	2.84	-----
Head:				
ant. fossae.....	-----	.46	-----	.51
temples.....	.49	.684	.542	.755
occiput.....	.445	-----	.48	-----
Prothorax.....	.28	.40	.325	.467
Meso-metathorax.....	.355	.76	.42	.74
Abdomen.....	1.20	.716	1.73	1.04
Parameres.....	.225	.14	-----	-----

***Dennyus gossei* Thompson**

Dennyus gossei Thompson, Bol. Ent. Venezolana, vol. 3, Nos. 1, 2, p. 1, June 1948. (Host, *Tachornis p. phoenicobia* Gosse.)

This species is well described and figured by the author and needs little comment beyond the characters given in the key. The occipital margin is deeply reentering, with occiput strongly convex; the shape of the gular plate also seems to be characteristic; the temples are very flatly convex and the prosternal plate characteristic with its straight, converging sides, narrow borders, and three very long setae (almost as long as plate), two in marginal band and one in clear area.

***Dennyus distinctus* Ferris**

Dennyus distinctus Ferris, Canadian Ent., vol. 48, p. 310, 1916. (Host, *Callocalia* sp. from Java.)

A single male of this interesting species was collected by R. H. Baker from *Callocalia inexpectata bartschi* Mearns on the Island of Guam on July 29, 1945. This specimen was previously reported on and figured by the author (Proc. U. S. Nat. Mus., vol. 100, p. 16, 1949).

D. distinctus is probably the most abnormal species of the genus as regards the shape of the head, which is about as long as wide, with a wide, transverse frons and sides of pre-antennary area straight and slightly divergent. The meso-metathoracic suture is faintly visible, but the two segments are very closely united (this detail omitted in my figure in paper cited above).

***Dennyus major* (Uchida)**

Takamatsua major Uchida, Journ. Coll. Agric. Tokyo, vol. 9, p. 32, 1926. (Host, *Hirundapis c. caudacutus* (Latham).)

A new genus was erected by Uchida for this species on the strength of the shape of abdominal segments VIII and IX in both sexes and the male genitalia. Segment IX is very small (especially in the male) and enclosed within a deep emargination of the posterior margin of

Segment VIII. The male genitalia is also quite different from all others of the genus which I have seen, the remainder being unusually uniform. I have carefully examined Uchida's description and figures and am of the opinion that this species may be entitled to subgeneric rank, but without actual examination of specimens I hesitate to do this.

***Dennyus minor* (Kellogg and Paine)**

Nitzschia minor Kellogg and Paine, Rec. Indian Mus., vol. 10, p. 243, pl. 15, fig. 10, 1914. (Host, *Apis a. affinis* (J. E. Gray).)

Like most of Kellogg's descriptions, this one is very inadequate and the figure not particularly illuminating. The species seems to be characterized by its small size, circular frontal margin of head, and small, rounded temples. He gives the following measurements:

	Male		Female	
	Length	Width	Length	Width
Body-----	1. 75	-----	1. 92	-----
Head-----	. 39	. 52	. 47	. 59
Prothorax-----	. 22	. 32	. 23	. 36
Metathorax-----	. 27	. 48	. 32	. 58
Abdomen-----	. 87	. 71	. 90	. 71

***Dennyus brevicapitis*, new species**

FIGURE 63, g

Type.—Female adult from *Chaetura b. brachyura* (Jardine), collected by the author at Carenage, Trinidad, B. W. I., August 14, 1909 (in collection of author).

I have been undecided as to the generic position of this species, whether it belongs in *Eureum* or *Dennyus*. Certainly it presents characters common to both, resembling the former genus in its wide, short head, rectangular prothorax, and oval abdomen. It might be classed as the connecting link between *Dennyus* and *Eureum*, but on the whole it seems best to place it under *Dennyus*.

Diagnosis.—The species is so different from all other known species of the genus that, in addition to the figure given, very little description seems necessary.

The head is nearly twice as wide as long, with pre-antennary area flatly conical, and sides flatly convex; temples short and expanded laterally; prothorax quadrilateral in shape, encircled by a wide, deeply chitinized band, with three spines on anterior angles, two long hairs on the rounded posterior angles and two on posterior margin. The prosternum is of the usual type for the genus, with four short spines and two longer, thickened setae, all set in the marginal band.

The mesothorax is very short and wide, with acute lateral angles and strongly convex posterior margin. The metathorax is nearly four times as wide as long, with posterior margin flatly pointed medially. The greater portion of the paratergal plates lies on the ventral side; they are wide, heavily chitinized, and deeply colored, with 6 to 12 spines on posterior margin; the dorsal portion of pleurites II to VIII contains heavily chitinized incrassations of varying shapes, no two being exactly the same.

The legs are normal for the genus, but the third pair of femora are unusually short, scarcely longer than the second pair. The chaetotaxy of the head and mesosternum is typical of the genus. The long hairs at the lateral angles of tergites II to VIII are thick and long, there being one or two in each angle which are thicker and longer than the others. The dorsal chaetotaxy of tergites II, III, and V is not shown in the figure, but is approximately equal to that of IV and VI, the hairs becoming progressively longer posteriorly, with one or two shorter hairs between the longer ones which reach across the succeeding segment. The female holotype is the only specimen of the species.

Measurements of the type:

	Length	Width
Body.....	2. 21	-----
Head.....		
ant. fossae.....		. 52
temples.....	. 456	. 80
occiput.....	. 38	-----
Prothorax.....	. 303	. 467
Meso-metathorax.....	. 38	. 88
Abdomen.....	1. 36	1. 10

Dennyus intonsus, new species

FIGURE 63,e

Type.—Adult female from *Chaetura chapmani viridipennis* Cherrie, collected by the author at El Real, Río Cauca, Colombia, March 8, 1948 (in USNM).

Diagnosis.—*D. intonsus* is a very distinct species and may be recognized at a glance by the abnormal chaetotaxy of the whole body. There is a double fringe of setae along the anterior margin of the temples; one fringe is along the edge, pointing outward, and the other is submarginal, parallel to the first, and pointing inward and backward. There are two rows of very long hairs along the posterior margin of the temples, the usual four along the edge and an additional row of five submarginal; also four long, dorsal hairs on the occiput, two near the margin and two others, longer, inside the marginal pair:

There are three spines on the anterolateral angle of the prothorax, and two more posterior to them; the three long marginal hairs on posterior edge of prothorax are also duplicated by three longer ones just inside them. There are eight hairs (four long, four short) on each side of the posterior margin of the metathorax with an additional submarginal row of nine much longer ones.

The chaetotaxy of the abdomen is exceedingly complex, but may be understood from a careful study of the figure. However, it was not possible to put in the figure all of the hairs on all of the segments. The most striking feature of the abdominal chaetotaxy is the groups of six extremely long hairs set in the median portion of tergites II to VI, just within the lateral margins. These hairs are almost as long as the abdomen. In the same position on tergite I there are three long hairs and a spine, while on tergites VII to IX there are two long submarginal hairs in addition to the other long ones at the angle.

The first and second pairs of legs are normal, but the third femur is short and slender, scarcely longer than the tibia. The setae forming the patches on the third femora and abdominal sternites are very fine and closely set, those on the abdomen forming a continuous patch from middle of sternite V to near end of sternite VII.

The structure of abdominal pleurites and sternites is unusual and not clearly determined, the posterior margin of the sternites not reaching to the lateral edges of the abdomen. The head is unusually small and the thorax narrow. The type apparently is an adult female recently moulted so that all of the chitinized bands are not clearly outlined. The characteristic sternal plate on segments I and II is apparently absent. The prosternal plate is normal and contains four long and two short, slender setae.

In addition to the type there is a nymph which has a quite different chaetotaxy, having not yet acquired the duplicated temporal fringe and the patches of long hairs on the tergites (only one long hair and a spine on tergites II to V, and two long hairs on VI to IX). It is impossible to determine with certainty the sex of this nymph, but it seems, from the structure of abdominal segments VIII and IX, to be a female.

Measurements of the type:

	<i>Length</i>	<i>Width</i>
Body.....	2. 20	-----
Head.....		
ant. fossae.....		. 456
temples.....	. 47	. 655
occiput.....	. 434	-----
Prothorax.....	. 267	. 282
Meso-metathorax.....	. 355	. 654
Abdomen.....	1. 24	. 846

Dennys spininotus, new species

FIGURE 64,a

Type.—Female adult from *Cypseloides fumigatus* (Streubel) collected by the author on Río Esmeralda, Department of Córdoba, Colombia, May 19, 1949 (in USNM).

Diagnosis.—The general shape of the head resembles very much that of *D. gossei* Thompson, although the temples are perfectly straight on posterior margin, but the measurements of the body are very different, 2.80 by 1.02 against 2.30 by .81 for *gossei*.

Unfortunately the type, and only specimen, is in poor condition, having been cleared too much and having collected within the head and thorax a quantity of food particles which obscure the few visible details of internal structure.

The whole thorax and abdomen are of normal shape and structure, presenting no outstanding characters. The chaetotaxy of the head is also normal, except for the three dorsal spines which are present in but few species. The prosternal plate is unusually large, very broad anteriorly, and with wide marginal band. There is a long, slender seta at each anterior corner of the clear area and 11 heavy, short spines irregularly set within it. There are numerous heavy spines on the mesosternum, those beneath the posterior portion of the prothorax being thicker than the patch on the posterior margin of the mesosternum.

The spines along posterior margin of the tergites are thick and closely set, interspaced irregularly with long setae, usually 2 to 3 spines between the long hairs; there is but one longish hair at the posterolateral angle of tergites II to VII. Short, thick setae are scattered irregularly over the sternites, while the patches of setae on sternites V and VI are sparse and coarse, as well as those on the third femora; there are an unusual number of short, thick spines along the outer edge of the second and third femora, and the spines along posterior edge of ventral pleurites are unusually numerous and thickened. The peculiar median sternal plate usually present on segment I of abdomen seems to be absent, at least it is not visible.

Measurements of type:

	Length	Width
Body.....	2. 80	-----
Head.....		-----
ant. fossae.....		. 586
temples.....	. 521	. 836
occiput.....	. 456	-----
Prothorax.....	. 37	. 471
Meso-metathorax.....	. 51	. 91
Abdomen.....	1. 65	1. 02

Dennyus rotundocapitis, new species

FIGURE 64,b,d,f

Types.—Male holotype from *Streptoprocne zonaris albicincta* (Cabanis) collected by the author near Cali, Colombia, December 16, 1950 (in USNM), and female allotype from same host collected by the author at Huancano, Perú, March 9, 1931 (in collection of author).

Diagnosis.—This species may be recognized by the narrow, broadly rounded temples, without angles, the flatly rounded pre-antennary margin, the prosternal plate and setae, the sparse, coarse setae of femoral and abdominal patches, and by the shape of the sternal plate on segments I and II.

The bands of chitin which connect the prothorax with the mesothorax and the metathorax with the abdomen are unusually heavy, as are the dorsal incrassations of the paratergal plates. The prosternum contains 10 short, thick spines, all within the clear area. The species is represented only by the male holotype and the female allotype.

Measurements of the types:

	Male		Female	
	Length	Width	Length	Width
Body.....	2. 04	-----	2. 63	-----
Head.....	-----	-----	-----	-----
ant. fossae.....	-----	. 49	-----	. 564
temples.....	. 46	. 673	. 55	. 77
occiput.....	. 434	-----	. 488	-----
Prothorax.....	. 303	. 39	. 35	. 48
Meso-metathorax.....	. 325	. 62	. 445	. 835
Abdomen.....	1. 16	. 78	1. 67	1. 11
Parameres.....	. 228	. 13	-----	-----

Dennyus brunneitorques, new species

FIGURE 64,c

Type.—Female adult from *Chaetura rutila brunneitorques* La Fresnaye, collected by the author at San Juan, Chanchamayo, Perú, June 6, 1930 (in collection of author).

Diagnosis.—Somewhat similar to *rotundocapitis*, new species, but considerably smaller (head, .467 by .694 against .55 by .77), with temples less rounded and more angulated both front and rear; pre-antennary margin with pronounced concavities on each side; occipital bands and gular plate very similar to those of *rotundocapitis*, as well as entire thoracic structure. The prosternal plate is of decidedly different shape and chaetotaxy, having three spines and two long setae along the border of the anterior band, and with nine spines set within the clear area. The shape and chaetotaxy of the terminal abdominal segments are also somewhat different. The median sternal plate on

segments I and II is absent. The abdominal chaetotaxy and lateral tergal incassations are very similar to those of *rotundocapitis*.

Measurements of type:

	Length	Width
Body.....	2. 30	-----
Head.....	-----	-----
ant. fossae.....	-----	. 52
temples.....	. 467	. 694
occiput.....	. 435	-----
Prothorax.....	. 31	. 412
Meso-metathorax.....	. 39	. 716
Abdomen.....	1. 34	. 94

Dennyus similis, new species

FIGURE 64, e, g

Types.—Male and female adults from *Progne c. chalybea* (Gmelin)¹ collected by J. Pablo Anduze at Barinas, Venezuela, January 14, 1943 (in Department of Hygiene, Caracas, Venezuela).

Diagnosis.—Somewhat similar to *D. australis* Ewing, from which it differs as follows: Gular plate differently shaped; temples more convex posteriorly; lateral wings of prothorax less pronounced and posterior margin slightly concave instead of convex; the sides of both mesothorax and metathorax are quite straight (except for slight swelling near suture on metathorax), while these segments in *australis* are convex on sides.

The setae along posterior margin of abdominal tergites consist of short, thickened hairs, alternating with hairs nearly the length of succeeding segments, while in *australis* the chaetotaxy consists of slender hairs, sparsely set, and mostly longer than the succeeding segments; the patches of setae on femora and abdominal sternites are composed of finer hairs, set closer together. The male genitalia also differs slightly, the parameres being shorter and endomerical sac longer, while the shape of the basal portion of the basal plate is quite different.

Measurements of types:

	Male		Female	
	Length	Width	Length	Width
Body.....	2. 00	-----	2. 73	-----
Head.....	-----	-----	-----	-----
ant. fossae.....	-----	. 464	-----	. 52
temples.....	. 51	. 66	. 542	. 738
occiput.....	. 456	-----	. 467	-----
Prothorax.....	. 25	. 369	. 303	. 423
Meso-metathorax.....	. 303	. 586	. 367	. 73
Abdomen.....	1. 08	. 78	1. 75	1. 01
Parameres.....	. 217	. 152	-----	-----

¹ A note on the identity of this host is in press (1954) in the Boletín de Entomología Venezolana.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1954

No. 3332

NEARCTIC FLIES OF THE FAMILY PERISCELIDAE
(DIPTERA) AND CERTAIN ANTHOMYZIDAE
REFERRED TO THE FAMILY

By A. H. Sturtevant ¹

The family Periscelidae was not recognized by earlier authors, its species being assigned to varying ones of the other acalypterate families. Even when it is recognized as a distinct group there is no agreement as to what genera should be included. My own studies have convinced me that the family is best limited (as concerns the Nearctic region) to the single genus *Periscelis*. (Nearctic species have been assigned to the genera *Microperiscelis* and *Sphyroperiscelis*, not here recognized as distinct.)

There are included here a few notes on exotic Periscelidae, with a list (including references) of the known species of the world and a key to the known genera. I have included *Cyamops* since it has been included in recent accounts. I have also included *Stenomicro*, which has been referred here but neglected by some recent students. In order to place these two genera I have added a discussion of the Anthomyzidae, with a key to the Nearctic genera of that family.

The following abbreviations have been used in designating locations of type specimens: AMNH, for American Museum of Natural History; and USNM, for U. S. National Museum.

¹ California Institute of Technology, Pasadena, Calif.

Family PERISCELIDAE

Auxiliary vein rudimentary, ending free (not apically fused with costa or first vein); no costal breaks; anal cell present; first vein ending well distal to basal third of wing; costa ending at apex of third vein; second antennal segment with one or more dorsal apical bristles, rather long third segment arising from its ventral surface; arista plumose; face strongly receding below, extending laterally below the buccae, narrowed below the antennae by the anterior extension of the eyes (the longest diameter of the latter being oblique); bucca extending upward anteriorly, bearing a row of bristles, of which the anterior is placed well above the oral margin; hairs on lateral portions of face; one reclinate orbital bristle; no preapicals on tibiae; postverticals divergent; no presutural dorsocentral; scutellum with four marginal bristles, its disc bare.

Genus *Periscelis* Loew, 1858

I have suggested elsewhere that *Microperiscelis* Oldenberg (type, *Notiphila annulata* Fallén) is antedated by the isogenotypic *Myodris* Lioy and that the genus is scarcely valid. The properties of the new species described here have led me to conclude that *Sphyroperiscelis* Sturtevant is also best considered a synonym of *Periscelis*. There are 11 or 12 species of the family known from the world, and five genera are recognized here, even though *Myodris* and *Sphyroperiscelis* are not accepted (see list, p. 556). For convenience, the use of broad generic limits is desirable here. If both the names under consideration are retained it will not be easy to fit the new species into any of the available categories, and a new genus will be indicated, giving 8 genera for 12 species.

Key to the Nearctic species of *Periscelis*

1. Mesonotum dull gray, with a brown median stripe; posterior crossvein strong.....**P. annulata** (Fallén)
Mesonotum rather shining black; posterior crossvein faint or largely absent...2
2. Antennal bases about as far from each other as each is from eye; posterior crossvein represented by stumps at each end....**P. wheeleri** (Sturtevant)
Antennal bases much nearer each other than to eyes; posterior crossvein complete but faint.....**P. occidentalis**, new species

Female genitalia: I have described the internal reproductive systems of *Periscelis annulata* and *P. wheeleri* (Sturtevant, 1926, p. 7). These species are much alike, and are very different from any other known forms, especially in that they have three chitinized spermathecae that are attached directly to a singly common duct. They are also unusual in that the eggs are blackish brown in color.

The European species of *Periscelis* are known to be most often found about the sap of bleeding trees (see, for example, Oldenberg, 1914), and the South American *P. nebulosa* was also taken on a bleeding tree. All three of the Nearctic species are to be found in the same situations—most often on oak trees east of the Mississippi River, on cottonwoods west of it. I have reared *P. wheeleri* from larvae found in fermenting oak sap, and there can be little doubt that sap is the normal breeding place of all three Nearctic species.

P. annulata has been taken in eastern Massachusetts from June 13 until the end of August, in Missouri in June and July, in South Dakota in June, in Nebraska, New Mexico, and Washington in August, in Texas in October, and in Alabama on May 2. *P. wheeleri* has been taken in Massachusetts from June 18 to August 24; in New Jersey on July 3; and in California on October 24. *P. occidentalis* has been found in California from March 25 to July 30, in Arizona in June and July, and in Washington in August. Evidently all three species have numerous broods, probably overlapping, and may be found throughout the warmer months.

Periscelis annulata (Fallén), 1813

Described from Europe; recorded by Sturtevant (1923) from Alabama, South Dakota, and New Mexico, and by Malloch (1915) from Illinois. From the following locations 48 specimens were examined: Budapest, Hungary (Kertesz); Falmouth, East Falmouth, Woods Hole, and Naushon Island, Mass.; Webster Grove, Mo. (H. D. Stalker); Kushla (Mobile County), Ala.; Austin, Tex. (M. R. Wheeler); Chadron and Oakdale, Nebr. (M. R. Wheeler); Chamberlain, S. Dak.; Mogollon, N. Mex. (M. R. Wheeler). Dr. Wheeler informs me that he also has collected this species at Verlot, Wash. The specimen from Mogollon has the wings clouded on the anterior margin and it may represent a distinct form.

The species was described in the ephydrid genus *Notiphila* and often has been placed in the Drosophilidae; I formerly referred it to the Agromyzidae, and later to the Lonchaeidae; Malloch (1915) has listed it under the Sapromyzidae. This species is the genotype of *Myodris* Lioy, of *Microperiscelis* Oldenberg, and of *Meronychina* Enderlein (*Meronychia* Enderlein). It was described by Malloch (1915) as *Phorticoides flinti* (genus and species both to be included in the synonymy).

Periscelis wheeleri (Sturtevant), 1923

Type from Naushon Island, Mass. (AMNH), and a paratype from the same locality (USNM). From the following locations 24 specimens were examined: Woods Hole and Naushon Island, Mass.;

Mendham, N. J.; and Pasadena, Calif. (M. R. Wheeler). The California specimen is most unexpected, but it is certain that it was collected in Pasadena, and it closely resembles eastern specimens.

This species is the genotype of *Sphyroperiscelis* Sturtevant.

The puparium is rather flattened, tapering at both ends, and, not including posterior spiracular processes, is nearly three times as long as broad. Surface dark brown, granular. There is a conspicuous thornlike process on each lateral margin of each abdominal segment. The posterior spiracles are on tapering divergent processes, each of which is nearly half as long as the maximum breadth of the puparium. There are no stalks to the anterior spiracles.

Periscelis occidentalis, new species

Male. Antennae yellow, brownish dorsally. Frons dark brown, subshining. Face pale yellowish, brown below centrally; entire oral margin silvery white. Mesonotum, scutellum, and humeri subshining black. Pleurae brown. Legs pale yellow, two dark brown annular bands on each femur and each tibia. Wing with rather indistinct broad median darkened area (including anterior crossvein, most of first vein, basal section of third vein, and two basal sections of fourth), and a dark tip. Abdomen black, subshining.

Arista with about 5 rather short branches above, 3 below. No differentiated vibrissae. Face in profile concave above oral margin, with a hump below antennal insertions. Eyes oblique. Frons about three-fifths width of head, as seen from above. Postverticals strong, divergent. Two pairs of dorsocentrals, both postsutural. Acrostichal hairs rather sparse, not in distinct rows. Scutellum with four marginal bristles, anterior pair about half length of posterior ones. One humeral, two notopleurals. Mesopleura bare. No preapical tibial bristles.

First vein ends near middle of wing. Auxiliary vein rudimentary, does not bend anteriorly at apex. Posterior crossvein present but very faint. Second vein strongly curved posteriorly in distal section. Discal and second basal cells separated. Anal crossvein faint. Costal index about 6, fourth vein index about 3. Costa reaches only to apex of third vein.

Length, $2\frac{1}{4}$ mm., wing, 2 mm.

Type from Cottonwood Springs (near Mecca, Riverside County), Calif., May 1939 (USNM 61473). Sixteen paratypes from Cottonwood Springs, Pasadena (M. R. Wheeler), and Lancaster, Calif., Prescott, Ariz. (M. R. Wheeler), and Mogollon, N. Mex. (M. R. Wheeler). Dr. Wheeler states that he also has collected this species at Peshastin, Wash., Patagonia, Ariz., and Fort Davis, Tex.

Exotic Periscelidae

Two current keys to the genera of Periscelidae are confused; the key for the North American forms given by Curran (1934, p. 323), and the key for the genera of the world by Malloch (1932, p. 266). My own familiarity with exotic forms is limited to a single damaged specimen from Colombia in the collection of Cornell University. However, this specimen roused my suspicions of the validity of one of the major characters used in these keys. As a result, at my request C. W. Sabrosky has kindly examined the type specimens of *Marbenia peculiaris* Malloch, *Neoscutops rotundipennis* Malloch, *Scutops fascipennis* Coquillett, and *S. maculipennis* Malloch (all USNM) and reports that in all these the costa reaches only to the third vein.

This is the case also with *Periscelis* (contrary to Curran's key), which means that the first separation given by him is nonexistent if *Cyamops* is removed from the family. A further conclusion then becomes evident: *Panamenia* Curran is a synonym of *Scutops* Coquillett, and *P. chapmani* is doubtfully distinct from *S. fascipennis* Coquillett. The above-mentioned specimen from Colombia is also a *Scutops*, probably best referred to *S. fascipennis*, though the wing pattern is slightly different.

The account by Malloch (1932) is confused in that he says he had not seen the European *Microperiscelis* (*Myodris*), whereas the genotype is *annulata*, with which he was familiar. I think it was *Periscelis* that he had not seen. As indicated above, I do not think that *Myodris* is valid. The first separation in Malloch's key is based on the anterior curvature of the auxiliary vein, and he places *Scutops* in the section without such curvature, which is contrary to the notes of Melander (1913a, p. 167) on the type specimen of *S. fascipennis*, the genotype. It may also be noted that utilization of this character makes *Periscelis occidentalis*, on Malloch's key, run to the neighborhood of *Marbenia*, a genus that seems to me doubtfully distinct from *Periscelis*, though I am not prepared to insist on the point without seeing *Marbenia*.

In view of the above it seems desirable to present a revised key to the genera of the world, even though I have seen only two of the five.

Key to the genera of Periscelidae of the world

(Modified from Malloch, 1932)

- | | |
|--|---------------------------|
| 1. Face hairy over entire surface..... | 2 |
| Face bare in central area..... | 3 |
| 2. Eyes on conspicuous stalks..... | Diopsosoma Malloch |
| Eyes not on stalks..... | Neoscutops Malloch |
| 3. Face conspicuously flattened, more or less shield-shaped, and extending forward below the antennae..... | Scutops Coquillett |
| Face without a projecting shield-shaped area..... | 4 |

4. Face with two conspicuous transverse furrows..... **Marbenia** Malloch
 Face not with two conspicuous transverse furrows..... **Periscelis** Loew

List of the described Periscelidae of the world

(Valid genera are in boldface. Synonyms are in italic. The first species listed under each genus is the genotype)

- Cyamops* Melander, 1913b, p. 291. To Anthomyzidae.
Diopsosoma Malloch, 1932, p. 267.
D. prima Malloch, 1932, p. 267. Perú.
Marbenia Malloch, 1931, p. 31.
M. peculiaris Malloch, 1931, p. 32. Panamá.
Meronychina Enderlein, 1917. Lapsus for *Meronychina*.
Meronychina Enderlein, 1914, p. 327. Synonym of *Periscelis*.
Microperiscelis Oldenberg, 1914, p. 39. Synonym of *Periscelis*.
Myodris Lioy, 1864, p. 1103. Synonym of *Periscelis*.
Neoscutops Malloch, 1926, p. 25.
N. rotundipennis Malloch, 1926, p. 25. Costa Rica.
Panamenia Curran, 1934, p. 323. Synonym of *Scutops*.
Periscelis Loew, 1858, p. 113. Synonyms: *Meronychina*, *Microperiscelis*, *Phorticoides*, *Sphyroperiscelis*, *Myodris*.
P. annulipes Loew, 1858, p. 113. Europe.
P. annulata (Fallén), 1813. (Notiphila.) Europe, United States.
Myodris annulata Lioy, 1864, p. 1103.
Microperiscelis annulata Oldenberg, 1914, p. 39.
Meronychina annulata Enderlein, 1914, p. 327.
Phorticoides flinti Malloch, 1915, p. 87.
P. nebulosa Hendel, 1913, p. 389. Argentina.
P. occidentalis, new species. Western United States.
P. wheeleri (Sturtevant), 1923, p. 2. (*Sphyroperiscelis*.) United States.
P. winnertzi Egger, 1862. Europe.
Microperiscelis winnertzi Oldenberg, 1914, p. 39.
Phorticoides Malloch, 1915, p. 87. Synonym of *Periscelis*.
Podocera Czerny, 1929, p. 93. To Anthomyzidae.
Scutops Coquillett, 1904, p. 97. Synonym: *Panamenia*.
S. fascipennis Coquillett, 1904, p. 97. Central America.
S. chapmani (Curran), 1934, p. 323 (=fascipennis Coquillett?). (*Panamenia*.) Panamá.
S. maculipennis Malloch, 1926, p. 24. México.
Sphyroperiscelis Sturtevant, 1923, p. 1. Synonym of *Periscelis*.

Family ANTHOMYZIDAE

Since *Cyamops* Melander and *Podocera* Czerny, formerly referred to the Periscelidae, are being put in this family, an account of the Nearctic genera is presented.

The following definition of the family is based largely on that of Collin (1944).

Third antennal segment making nearly a right angle with the second; at least one reclinate orbital bristle; postverticals small and convergent, or absent; vibrissae present; no presutural dorsocentrals; mesopleura and disc of scutellum bare; first vein short, not over one-third length of wing; auxiliary faint apically, ending in costa just basal

to first vein; distal costal break represented at least by a definite weakening; tibiae without preapicals.

The antennal structure suggests that of the Periscelidae, but that family is easily distinguished from the Anthomyzidae by its long first vein; complete absence of distal costal break; divergent postverticals.

The members of this family are sometimes treated as belonging to the Opomyzidae, which differ in having presutural dorsocentrals, hairy mesopleura, divergent postverticals, and no true vibrissae. The only Nearctic genus of Opomyzidae known to me is *Geomyza*, which has a large oral bristle that might be considered a vibrissa were it not situated some distance behind the anterior end of the row of oral hairs. The remaining genera listed by Curran (1934) under this family and not included in the key below make up the family Tethiniidae. (See Melander, 1951, p. 187.)

Key to the Nearctic genera of Anthomyzidae

1. Upper occiput convex; posterior margin of wing usually absent, making wing very narrow..... *Mutilloptera* Coquillett
Upper occiput concave; wing complete except sometimes with reduced anal angle..... 2
2. Postverticals small; 2 or 3 reclinate orbitals..... 3
Postverticals absent; usually only one conspicuous reclinate orbital; proclinate orbitals present or absent..... 4
3. Second vein sinuate; marginal cell at level of posterior crossvein less than half width of submarginal..... *Ischnomyia* Loew
Second vein greatly curved; marginal cell at level of posterior crossvein more than half width of submarginal..... *Anthomyza* Fallén
4. Yellow species; anal angle of wing rudimentary..... *Stenomiera* Coquillett
Blackish; anal angle well developed..... 5
5. Arista pubescent or short-plumose (branches not longer than length of third antennal segment); no comb of short spines on first femur; no proclinate orbital..... *Mumetopia* Melander
Arista long plumose (branches longer than length of third antennal segment); a comb of short, close-set spines on distal inner flexor surface of first femur; a proclinate orbital..... *Cyamops* Melander

I have not seen *Mutilloptera*, which is perhaps an opomyzid. Of the other genera, the above key is based on examination of the indicated number of species (some Neotropical or Palearctic) of the following genera: *Ischnomyia*, 2; *Anthomyza*, 6; *Stenomiera*, 1; *Mumetopia*, 3; *Cyamops*, 2.

Genus *Cyamops* Melander, 1913

Brues and Melander (1932) and Curran (1934) included *Cyamops* in the Periscelidae. This genus was described as a "geomyzid," and seems to me best placed in the Anthomyzidae, close to *Mumetopia*.

In the keys in both the above works the Periscelidae are separated from the Anthomyzidae (treated as part of the Opomyzidae by

Curran) by the absence, in the former, of a break in the costa just before the apex of the first vein. In *Cyamops* there is no actual break here, but there is a definite weakening of the vein, differing, so far as I can see, in no way from that found in *Mumetopia*.

I have examined the internal female genitalia in *Cyamops nebulosa* Melander. There are three chitinized spherical spermathecae, of which two are attached to a common duct. The two spirally thickened ducts open into a large weakly chitinized pouch that arises from the dorsal surface of the uterus, thus somewhat suggesting the single common duct found in *Periscelis*. There are two parovaria; no sperm or ventral receptacle was found. The other known Anthomyzidae (*Anthomyza*, *Ischnomyia*, and *Mumetopia*) differ in having only two spermathecae and no dorsal uterine pouch. The eggs of *C. nebulosa* are also unusual in that they have two short, thick, anterodorsal filaments suggestive of those found in *Drosophila* or *Parallelomma*. The eggs are white rather than dark blackish brown as in *Periscelis*.

Since the genus may be looked for under the Periscelidae, and since I have available a new species and new data on the one previously described species, a synopsis is given here.

Key to the species of *Cyamops*

1. First tibiae and tarsi yellow, darkened only on terminal tarsal segment; second section of costa at least twice length of third section; two pairs of scutellar bristles..... **C. nebulosa** Melander
- First tibiae and tarsi largely black; second and third costal sections nearly equal in length; one pair of scutellar bristles..... **C. imitata**, new species

Cyamops nebulosa Melander, 1913

I have examined 43 specimens from Middleboro, Rochester, Mashpee, and Woods Hole, Mass., and Dismal Swamp (Cornell University collection) and Lake Drummond (H. S. Barber), Va. Specimens from Woods Hole (the type locality) are in the U. S. National Museum. The species is recorded by Johnson (1925) from Salisbury Cove, Maine, and Woburn, Mass. Mr. Sabrosky informs me that there are specimens in the U. S. National Museum from Beltsville and from near Lloyds (Dorchester County), Md., Alexandria, Va. (bred May 20, 1951, from pupae collected by W. W. Wirth in osmundine bog), La Fayette, Ind., and Jacksonville, Fla.

The original description was based on a male; the female differs in having a distinctly broader face.

In eastern Massachusetts I have found the species easy to collect from June to the end of August by sweeping around the edges of shady sphagnum bogs. Of the 40 specimens so collected in this region, 16 (of both sexes) have no dark pattern on the wings. I had supposed these represented a distinct species, since their body color

is not consistent with the hypothesis that they are teneral. However, through the kindness of Mr. Sabrosky I have seen a mated pair collected at Lake Drummond, Va. (H. S. Barber, June 8-11, 1905), in which the male has the typical pattern of wing clouds while the female has hyaline wings. It seems likely that we are concerned here with dimorphism of a single species, rather than with two species. Mr. Sabrosky reports that the other specimens listed above in the U. S. National Museum collection all have the typical wing pattern.

C. nebulosa is variable in color. In some specimens the legs are wholly yellow, except that the terminal segments of all tarsi are darkened. In others there is more or less darkening of the apical portions of the second and third femora, which in some cases are as dark as in the single specimen of *imitata*. The leg color is not correlated with the clouding of the wings, and is less easily used for a sharp classification into distinct groups of individuals, since intermediates occur.

Cyamops imitata, new species

Female. Subshining black. Orbits silvery; antennae brownish. Legs, including coxae, yellow except brown to black first tibiae and tarsi, apical halves of second and third femora, and apices of second and third tarsi. Palpi and proboscis yellow. Knob of haltere white. Wing clouded, with a hyaline anterior border that includes costal and marginal cells and anterior half of submarginal, except that the apical portion of the latter is wholly clouded distal to a point midway between the ends of second and third veins.

Arista with 8 or 9 long dorsal branches and 2 or 3 distal ventral ones; the 6 or 7 proximal dorsal branches are themselves bifid beyond their middle. One vibrissa; posterior to it are two downward-pointing, long bristles. Clypeus evident, small. A large proclinate orbital and a smaller reclinate one; no ocellars or postverticals; a single (divergent) vertical. Face narrowed by the eyes below the antennae. A single posterior dorsocentral; hairs on mesonotum sparse, not in regular rows; one supra-alar; one post-alar; no humerals; two notopleurals; mesopleura bare; one conspicuous sternopleural; a single (apical) pair of convergent scutellars; no preapicals on tibiae; a long apical on third tibia. Abdomen flattened.

Second and third costal sections nearly equal; last section fourth vein about 2.3 times penultimate section. Third and fourth veins distinctly divergent apically. A conspicuous, erect bristle arising from costa near its base.

Length, 2.5 mm.

Type (USNM 61474) collected at La Fayette, Ind., July 6, 1915 (J. M. Aldrich).

Genus *Stenomicro* Coquillett, 1900

This genus was described as a drosophilid, and is still sometimes referred to that family. Sturtevant (1923) referred it to the "Geomyzidae," and Hendel as well as Brues and Melander (1932) put it in the Asteidae, a reference not favored by Sabrosky (1943). Czerny (1929) described *Podocera ramifera*, from Ceylon, as a periscelid. Hendel and Malloch both point out that *Podocera* is a synonym of *Stenomicro* and that it should not be placed in the Periscelidae. Finally, the British and Fijian genus *Diadelops* Collin (1944, 1951) is evidently a synonym of *Stenomicro*. Collin places this genus in the Anthomyzidae, near *Anagnota*, a disposition that seems appropriate for *Stenomicro*.

Stenomicro was overlooked by Curran (1934). Malloch (1927) has presented a key to the species of the world, of which *Stenomicro angustata* Coquillett is the only known American one.

Stenomicro angustata Coquillett, 1900

Coquillett (1900) recorded this species from Puerto Rico, and Sturtevant (1923) added localities in Pennsylvania, Florida, Alabama, and Louisiana. I have since seen four specimens collected by Dr. H. D. Stalker at Creve Coeur, Mo., about the reedy shores of a fresh-water pond (July 15, 1951).

References

- BRUES, C. T., and MELANDER, A. L.
1932. Classification of insects. Bull. Mus. Comp. Zool., vol. 73, 672 pp.
- COLLIN, J. E.
1944. The British species of Anthomyzidae (Diptera). Ent. Monthly Mag., vol. 80, pp. 265-272.
1951. A new species of *Diadelops* Collin (Diptera: Anthomyzidae) from Fiji. Proc. Roy. Ent. Soc. London, Ser. B, vol. 20, pts. 3-4, pp. 47-48.
- COQUILLET, D. W.
1900. Report on a collection of dipterous insects from Puerto Rico. Proc. U. S. Nat. Mus., vol. 22, pp. 249-270.
1904. New Diptera from Central America. Proc. Ent. Soc. Washington, vol. 6, No. 2, pp. 90-98.
- CURRAN, C. H.
1934. The families and genera of North American Diptera, 512 pp.
- CZERNY, A. L.
1929. *Podocera ramifera*, eine neue Gattung und Art der Perisceliden von Ceylon. Konowia, vol. 8, pt. 1, pp. 93-94.
- EGGER, JOHANN
1862. Dipterologische Beiträge. Verh. Zool.-Bot. Ges. Wien, vol. 12, pt. 3, pp. 777-784.

ENDERLEIN, GÜNTHER

1914. Diptera, Fliegen, Zweiflügler, in Brohmer, Fauna von Deutschland, pp. 313-368.
 1917. Dipterologische Studien. XVI. Dipterologische Notizen. Zool. Anz., vol. 49, Nos. 3-4, pp. 65-72.

FALLÉN, CARL F.

1813. Berskrifning öfver några i Sverige fume vattenflugor. Svenska Vetensk. Akad. Handl., vol. 34, pp. 240-257.

HENDEL, F.

1913. Neue Drosophiliden aus Südamerika und Neuguinea (Dipt.). Ent. Mitt., vol. 2, pp. 386-390.

JOHNSON, CHARLES W.

1925. Fauna of New England. 15. List of the Diptera or two-winged flies. Occas. Papers Boston Soc. Nat. Hist., vol. 7, 326 pp.

LIOY, PAOLO

1864. I Ditteri . . . , Atti Ist. Veneto, vol. 9, ser. 3, pp. 1087-1126.

LOEW, H.

1858. Ueber einige neue Fliegengattungen. Berliner Ent. Zeitschr., vol. 2, pp. 101-122.

MALLOCH, J. R.

1915. An undescribed sapromyzid (Diptera). Bull. Brooklyn Ent. Soc., vol. 10, No. 4, pp. 86-88.
 1926. New genera and species of acalyptate flies in the United States National Museum. Proc. U. S. Nat. Mus., vol. 68, art. 21, 30 pp.
 1927. The species of the genus *Stenomicro* Coquillett (Diptera, Acalyptrata). Ann. Mag. Nat. Hist., ser. 9, vol. 20, pp. 23-26.
 1931. Notes on some acalyptate flies in the United States National Museum Proc. U. S. Nat. Mus., vol. 78, art. 15, 32 pp.
 1932. A new genus of diopsid-like Diptera (Periscelidae). Stylops, vol. 1, pt. 12, pp. 266-268.

MELANDER, A. L.

- 1913a. Some acalyptate Muscidae. Psyche, vol. 20, pp. 166-169.
 1913b. A synopsis of the dipterous groups Agromyzinae, Milichiinae, Ochthiphilinae and Geomyzinae. Journ. New York Ent. Soc., vol. 21, No. 4, pp. 283-300.
 1951. The North American species of Tethinidae (Diptera). Journ. New York Ent. Soc., vol. 59, No. 4, pp. 187-212.

OLDENBERG, LORENZ

1914. Beitrag zur Kenntnis der europäischen Drosophiliden (Dipt.). Arch. Naturg., vol. 80A, pt. 2, pp. 1-42.

SABROSKY, C. W.

1943. New genera and species of Asteiidae (Diptera), with a review of the family in the Americas. Ann. Ent. Soc. Amer., vol. 36, No. 3, pp. 501-514.

STURTEVANT, A. H.

1923. New species and notes on synonymy and distribution of Muscidae Acalypteratae. Amer. Mus. Nov., vol. 76, 12 pp.
 1926. The seminal receptacles and accessory glands of the Diptera with special reference to the Acalypterae. Journ. New York Ent. Soc., vol. 34, No. 1, pp. 1-21.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3333

NORTH AMERICAN TRICLAD TURBELLARIA, XIII:
THREE NEW CAVE PLANARIANS

By LIBBIE H. HYMAN

Previously (Hyman, 1937, 1939, 1945) I have described a total of 11 species of planarians from the waters of North American caves. Comment was made in these articles on the extensive speciation exhibited by the cave planarians of the United States. It was pointed out that every locality appears to have a different species of cave planarian and that the investigation of caves in new localities inevitably reveals new species of these animals. The present report is based on collections from caves in three new localities and each locality is again found to harbor a new and different species of cave planarian. As generic and familial definitions have been presented in my previous articles on cave planarians, it appears unnecessary to repeat them here.

Family PLANARIIDAE

Phagocata cavernicola, new species

FIGURE 65, a-c

Material.—Five specimens sent by the U. S. National Museum (USNM).

Form.—Small, slender, elongate (fig. 65, a), around 7 to 8 mm. long, probably up to 10 mm. in length; anterior end appears slightly rounded as in figure 65, a in some of the specimens, truncate or slightly indented in others (fig. 65, b).

Color.—White in life, according to the collector, but turns brown on preservation.

Eyes.—Typically two, but two of the five specimens show supernumerary eyes as in figure 65, *a, b*; possibly this indicates a breakdown of the eyes in relation to the cave habitat.

General structure.—The histological condition of the specimens is poor and it is impossible to furnish details of the structure. The pharynx appears somewhat long for the size of the animal (fig. 65, *a*). In the median line of the head anterior to the eyes a light streak was noticeable on the whole animals (fig. 65, *a*) but one of the heads was sectioned sagittally and, although its histological condition is bad, it appears certain that the midregion does not differ histologically from the rest of the head. The body margins do not present any enlarged rhabdites.

Reproductive system.—Testes evident in the worms when whole and extend in lateral regions from the level of about the fourth intestinal diverticulum to the level of the gonopore (fig. 65, *a*). Transverse and sagittal sections show that the testes are situated ventrally. A sagittal view of the copulatory apparatus, constructed from two sets of sagittal sections, is shown in figure 65, *c*. The sperm ducts, ascending from below into the slightly developed penis bulb, enter separately the bulbar cavity. This is an oval cavity that makes a right-angled bend and continues through the penis papilla as the ejaculatory duct. The penis papilla has a short truncate form, and is noticeably lacking in muscularity. It is also asymmetrical, very decidedly so in one of the sagittal series; its dorsal wall is longer than the ventral wall. The penis papilla lies in a well-developed male antrum that narrows towards the common gonopore. Juxst before joining the vagina, the male antrum receives the common ovovitelline duct into its dorsal wall. The female canal shows an unusual degree of separation from the male antrum. There is, in fact, no development of a female antrum or common antrum as the vagina joins the male antrum almost at the gonopore. The vagina or terminal part of the female canal is somewhat expanded and lined by a very tall epithelium. The vagina is continuous with the bursal canal of which it is really the terminal portion. The bursal canal as usual is a narrow

EXPLANATION OF FIGURES

- | | |
|-----------------------------------|--|
| 1, eyes | 15, cavity of adhesive organ |
| 2, intestinal diverticula | 16, eosinophilous lining of adhesive organ |
| 3, testes | 17, retractor muscle of adhesive organ |
| 4, pharynx | 18, adhesive organ |
| 5, sperm ducts | 19, ovaries |
| 6, penis bulb | 20, margin of large rhabdites |
| 7, penis papilla | 21, adhesive tail region |
| 8, ejaculatory duct | 22, eosinophilous gland cells |
| 9, male antrum | 23, protractor muscle |
| 10, vagina | 24, gland areas of male apparatus |
| 11, copulatory bursa | 25, female antrum |
| 12, bursal canal | 26, common antrum |
| 13, entrance of ovovitelline duct | 27, common gonopore |
| 14, bulbar cavity | |

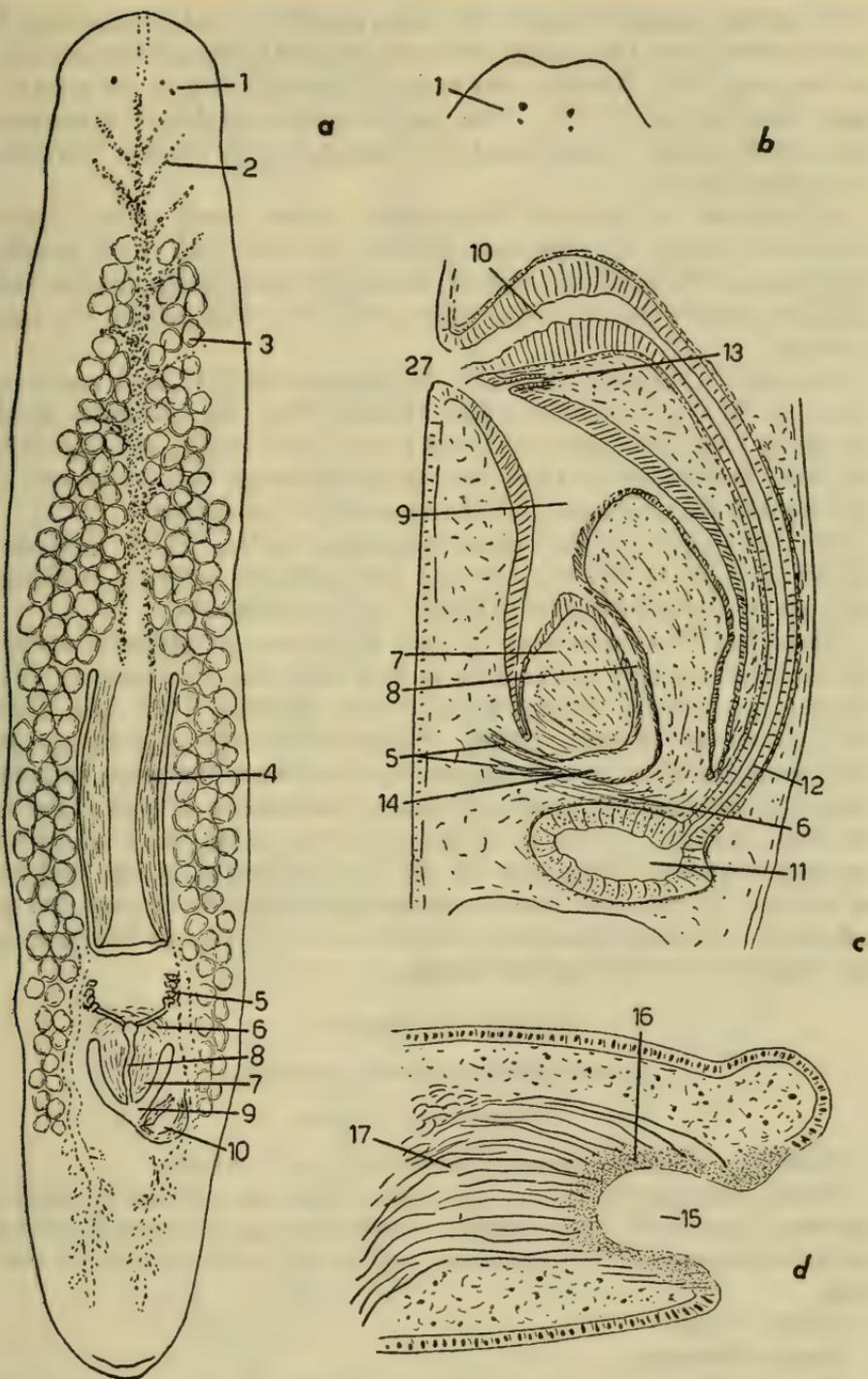


FIGURE 65.—*a*, General view of *Phagocata cavernicola*; *b*, anterior end of another specimen of *P. cavernicola*, showing supernumerary eyes; *c*, sagittal view of the copulatory apparatus of *P. cavernicola*, posterior end above; *d*, sagittal section of the adhesive organ of *Sphalloplana georgiana*. (For explanation see facing page.)

duct passing anteriorly above the male apparatus and terminating in a rather small sac, the copulatory bursa, situated immediately anterior to the penis bulb, between this and the posterior end of the pharyngeal chamber (fig. 65, *c*). The entire female copulatory apparatus (copulatory bursa, bursal canal, and vagina) is but slightly provided with musculature.

Differential diagnosis.—This species differs from other North American species of *Phagocata* in the asymmetrical penis papilla, expansion of the terminal part of the bursal canal into a vagina, lack of a female antrum, and sharp separation of the vagina from the male antrum.

Locality.—Collected by R. C. Hoffmaster in 1949 and again on Jan. 19, 1951, in Evac Cave near Hillside, Pa. An additional small specimen from Conodoguinet Cave in the same region, also collected in 1949, is presumably the same species although this could not be determined with certainty, as the specimen is immature.

Holotype.—One whole mount deposited in the U. S. National Museum (USNM 24610); also set of transverse sections (4 slides) and set of sagittal sections (3 slides) in this institution.

Remarks.—The occurrence of eyes in a cave planarian is always unexpected but eyes are present in two other North American cave planarians, namely, *Phagocata subterranea* Hyman, 1937, and *Sorocelis americana* Hyman, 1939b. Thus both of our cave planarians that belong to the genus *Phagocata* have retained their eyes and this may indicate only a moderate degree of adaptation of this genus to the cave habitat. It is to be noted, further, that there are white epigeal species of *Phagocata* in the United States, so the absence of pigment in the cave species of this genus cannot be regarded as adaptive. *Sorocelis americana* often occurs in epigeal habitats, so its retention of eyes is not surprising.

Family KENKIIDAE

Sphalloplana georgiana, new species

FIGURES 65,*d*; 66,*b*; 67,*a*

Material.—Four specimens presented by C. E. Mohr.

Form.—Elongated, slender but less so than the preceding species; narrowed anteriorly with truncate anterior margin bearing a central adhesive organ (fig. 66, *b*); posterior end bluntly pointed; about 8 mm. long.

Color.—White.

Eyes.—Wanting.

General structure.—The histological condition of the specimens, three of which were sectioned, is very bad. The pharynx appears relatively small compared to its size in the preceding species. The digestive diverticula are exceedingly numerous and narrow as indi-

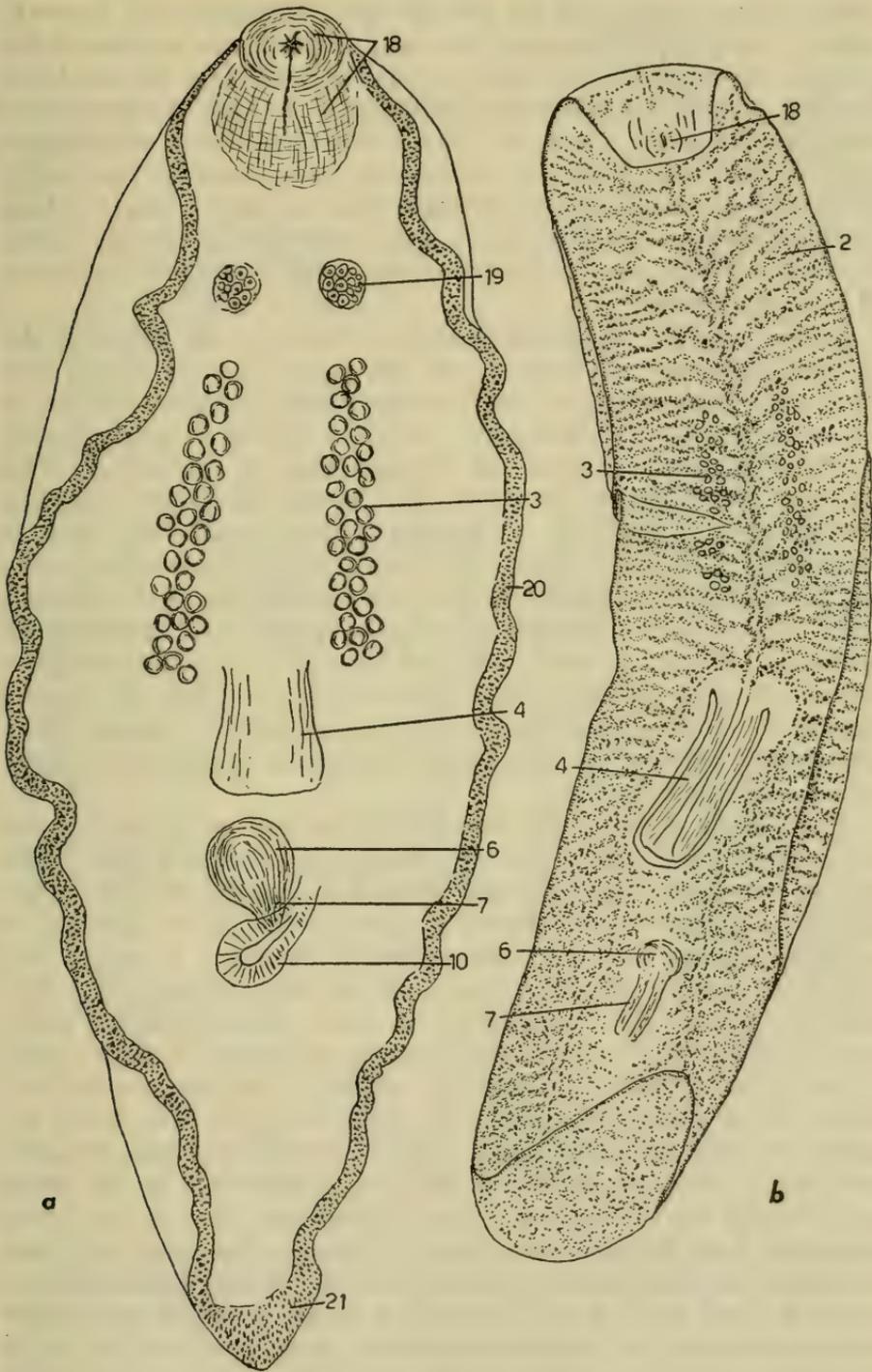


FIGURE 66.—a, General view of *Speophila hoffmasteri*; b, general view of *Sphalloplana georgiana*. (For explanation see page 564.)

cated in figure 66,*b*. In the case of white planarians with truncate anterior margin, it is necessary to examine transverse sections of the pharynx to determine the family. Such sections were prepared but because of their bad histological condition I was left in some uncertainty on this point. As far as I can make out, however, the arrangement of the inner pharynx musculature corresponds to the family Kenkiidae but the possibility remains that the animal might belong to the Dendrocoelidae, which it much resembles externally. The body margins are provided with enlarged rhabdites as characteristic of cave planarians.

Adhesive organ.—An adhesive organ is found in the center of the anterior margin in all members of the family Kenkiidae and also frequently in members of the Dendrocoelidae. Sagittal sections of the anterior end of *Sphalloplana georgiana* showed a rather simply constructed adhesive organ as characteristic of the genus. This region of the specimens proved to be in better histological condition than the rest of the body. A sagittal view of the adhesive organ is given in figure 65,*d*. There is a small cuplike depression at the margins of which the regular covering epidermis ceases rather abruptly, being replaced by a noncellular margin dotted with eosinophilous secretion. From the inner surface of the cup longitudinal retractor muscles proceed posteriorly and curve ventrally to join the regular ventral subepidermal musculature. The eosinophilous glands, which presumably provide the eosinophilous secretion, could not be found in the available material.

Reproductive system.—The testes could not be seen in any of the animals when whole but were discovered in sections in a poor condition in two rather short, lateral bands immediately anterior to the pharynx and have been inserted in figure 66,*b*. As far as could be ascertained, they do not extend anteriorly as far as is usually the case in planarians. The testes are small and situated ventrally. The ovaries were not discernible in the sections. The copulatory apparatus is situated well behind the pharynx as shown in figure 66,*b*. It was in bad condition in both of two sets of sagittal sections prepared, but a sagittal view, given in figure 67,*a*, has been pieced together by study of these sections. There is a well-developed, rounded, and highly muscular penis bulb that was conspicuous in the whole animals (fig. 66, *b*) but less evident in sections. The sperm ducts, ascending from below, pass separately through the penis bulb and open into the sides of the rounded bulbar cavity, occupying the center of the bulb (fig. 67, *a*). The bulbar cavity continues as a rather wide ejaculatory duct through the conical penis papilla to the tip of the latter. The penis papilla is somewhat muscular and clothed with a tall epithelium. It lies in a spacious male antrum, into the dorsal wall of which there opens the common ovovitelline duct surrounded

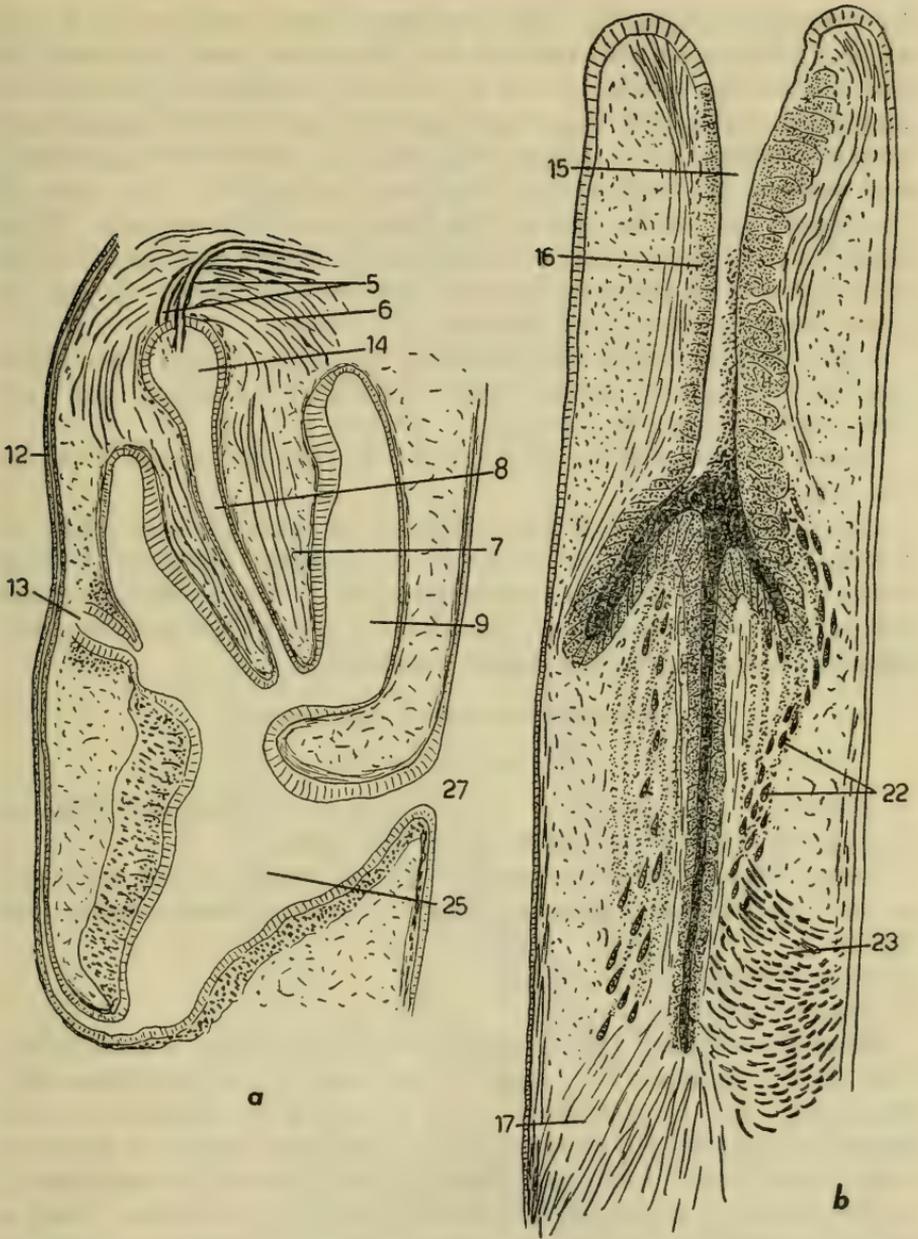


FIGURE 67.—*a*, Sagittal view of the copulatory apparatus of *Sphalloplana georgiana*, anterior end above; *b*, sagittal section of the adhesive organ of *Speophila hoffmasteri*. (For explanation see page 564.)

by eosinophilous glands. The copulatory bursa could not be found on any of the available sections but its slender canal was more or less in evidence, passing dorsal to the male apparatus. This curves downward and enters the dorsal posterior angle of the greatly expanded female antrum, which exits below by the common gonopore and receives the male antrum into its anterior wall. The walls of the female antrum are greatly thickened, especially dorsally. This thickening consists mainly of muscle fibers, chiefly circular, but the thick dorsal wall seems to contain, next to the lining epithelium, a glandular layer through which radial fibers pass.

Differential diagnosis.—*Sphalloplana georgiana* differs from other species of the genus in the greatly expanded female antrum with thick walls, presumably serving as a vagina.

Locality.—Collected by C. E. Mohr in Waterfall Cave, Trenton, Ga., Dec. 8, 1950.

Holotype.—The best of the specimens has been mounted whole as a holotype and deposited in the U. S. National Museum (USNM 24614). However, as the anterior margin of this specimen appears damaged, a whole mount of the anterior part of another specimen showing the adhesive organ is also deposited.

Speophila hoffmasteri, new species

FIGURES 66,*a*; 67,*b*; 68

Material.—Two specimens sent by the U. S. National Museum and one specimen presented by Leslie Hubricht.

Form.—Size moderate, around 11 mm. in length, plump, narrowed at the ends; anterior margin rounded with an adhesive organ (fig. 66, *a*).

Color.—White.

Eyes.—Wanting.

General structure.—The histological condition of the worms is fair. The pharynx appears very short for the length of the specimens (fig. 66,*a*) but may be contracted. The intestinal diverticula were not clearly evident on the whole mount. The body margin is provided with a thick zone of enlarged rhabdites and this widens considerably on the tail end, which therefore must be highly adhesive. Such a wide marginal zone of large rhabdites is characteristic of cave planarians of the family Kenkiidae and gives these worms unusual ability to cling to objects.

Adhesive organ.—At the anterior margin there is a conspicuous and well-developed adhesive organ of the type characteristic of the genus. It is shown in surface view in figure 66,*a*, and in sagittal section in figure 67,*b*. The surface epithelium stops as usual at the lips of the organ which is lined throughout with an indefinite layer filled with

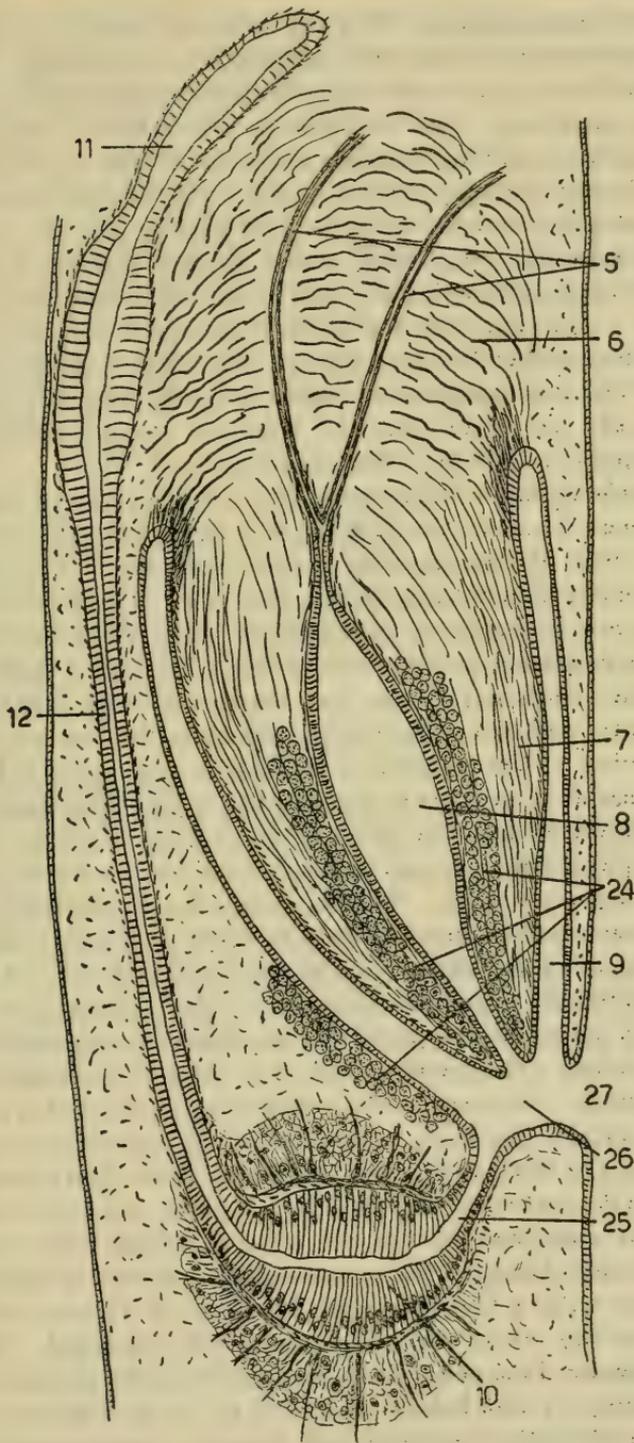


FIGURE 68.—Sagittal view of the copulatory apparatus of *Speophila hoffmasteri*, anterior end above. (For explanation see page 564.)

eosinophilous granulations. The organ has the form of a long tubular gland whose lumen is filled with eosinophilous secretion. At about the middle of the gland are found lateral outpocketings, and from this point posteriorly there are seen to either side of the gland the long-necked eosinophilous glands that furnish the secretion. They appear as darkly stained pyriform bodies. At the posterior end of the gland a retractor muscle extends posteriorly, joining the muscle layer of the ventral body wall, and a thicker and more prominent protractor muscle curves dorsally and anteriorly to insert on the dorsal body wall. The presence of a protractor muscle indicates that the gland can be everted to some extent, probably as far as the lateral pouches. The eosinophilous secretion is of an adhesive nature and it is generally supposed that the adhesive organ functions in the capture of prey as well as in leechlike crawling.

Reproductive system.—The gonads could not be seen in whole specimens but were found in the sections and have been entered on figure 66,*a*. The pair of ovaries occurs in the usual site. The testes form a tract on either side anterior to the pharynx. They are rather large and fill the middle region of the sections. The copulatory apparatus was in poor condition in both sets of sagittal sections that were prepared. The copulatory bursa was made out with great difficulty and the dorsal wall above the vagina was badly broken in both series. A sagittal view of the copulatory apparatus as constructed by study of the two series of sections is given in figure 68. The penis is a conspicuous object behind the pharynx in the whole worm (fig. 66,*a*) but as the penis bulb appears somewhat curved its full extent is not evident in any one section. There seems to be an unusually large and muscular penis bulb formed of muscle fibers paralleling its contours and penetrated by the two narrow sperm ducts (fig. 68). At the base of the penis papilla these join to a narrow ejaculatory duct that soon widens as it traverses the penis papilla, narrowing again towards the tip of the latter. The penis papilla is of elongated conical form and rather muscular. It presents the peculiarity of a layer of cyanophilous gland cells outside the lining epithelium of the ejaculatory duct along the distal part of the latter. The penis bulb lies within a male antrum that follows its contours. As already indicated, the female apparatus was in poor condition in the available material. The copulatory bursa was much damaged but appeared as indicated in figure 68 as a flattened sac with a low epithelial lining in its anterior half, a tall lining posteriorly where the bursa passes into its canal. The latter is a long, slender duct proceeding posteriorly above the male antrum. After reaching a point behind the level of the gonopore, the bursal canal turns abruptly ventrally and enters a conspicuous, rounded vagina that was very evident in the whole specimens (fig. 66,*a*).

The vagina is lined by a very tall epithelium and this is surrounded by a wide halo of what seems to be mesenchyme traversed by radial muscles. Distally the vagina narrows to a short tube that joins the male antrum, forming a very small common antrum that opens below by the common gonopore. The entrance of the ovovitelline duct into the copulatory apparatus could not be found but presumably this duct opens into the roof of the male antrum. In the posterior wall of the male antrum is found an area of cyanophilous glands similar to those surrounding the ejaculatory duct in the penis papilla.

Differential diagnosis.—*Speophila hoffmasteri* is distinguished from the other known species of the genus by the round, thick-walled vagina and the layer of gland tissue in the penis papilla and wall of the male antrum.

Locality.—Collected by R. E. Hoffmaster in Blowing Cave, Pendleton County, W. Va. (no date), and by Leslie Hubricht in Mystic Cave, Pendleton County, W. Va., May 30, 1952.

Holotype.—One whole mount of the better of the Hoffmaster specimens deposited in the U. S. National Museum (USNM 24616); also one set of sagittal sections to show the adhesive organ (5 slides) and one set of sagittal sections of the copulatory region (3 slides) in the same institution.

References

HYMAN, LIBBIE HENRIETTA

1937. Studies on the morphology, taxonomy, and distribution of North American triclad Turbellaria. VIII. Some cave planarians of the United States. *Trans. Amer. Micr. Soc.*, vol. 56, pp. 457-477, 21 figs.
- 1939a. New species of flatworms from North, Central, and South America. *Proc. U. S. Nat. Mus.*, vol. 86, pp. 419-439, 5 figs.
- 1939b. North American triclad Turbellaria. X. Additional species of cave planarians. *Trans. Amer. Micr. Soc.*, vol. 58, pp. 276-284, 9 figs.
1945. North American triclad Turbellaria. XI. New, chiefly cavernicolous, planarians. *Amer. Midl. Nat.*, vol. 34, pp. 475-484, 8 figs.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1954

No. 3334

A SUPPLEMENT TO W. M. TATTERSALL'S REVIEW OF THE
MYSIDACEA OF THE UNITED STATES NATIONAL MUSEUM¹

By ALBERT H. BANNER²

In 1942 Dr. Walter M. Tattersall completed the manuscript of his lengthy study of the crustaceans of the order Mysidacea of the U. S. National Museum. This study, more than a simple catalog of specimens stored at the museum, was a listing of all species of the order ever reported from the Americas, both North and South, and a review of all literature pertinent to them. Many species were described and depicted, taxonomic confusions were cleared, and 1 new genus and 19 new species were described.

This study, as it stands, is the most valuable contribution to the knowledge of the order yet made in America and will be invaluable to every worker, specialist or not, who will need to identify these crustaceans. However, Dr. Tattersall died on October 1, 1943, before even the initial preparations were made by the U. S. National Museum for the publication of the study. Because of the war-induced delay, the manuscript was not finally published until October 4, 1951. In the intervening eight years several papers on the group appeared, and others, published earlier in Europe during the war, became available for the first time. Some of these contain references to the species discussed by Tattersall, and a few changes in taxonomic status have been introduced. As references to these additional studies were not inserted in the manuscript in the course of editing, the actual date of publication is deceptive.

¹ Tattersall, Walter M., *A Review of the Mysidacea of the United States National Museum*. U. S. Nat. Mus. Bull. 201, x + 292 pp., 103 figs., Oct. 4, 1951.

² Department of Zoology and Entomology, University of Hawaii, Honolulu, T. H.

As author of one of the pertinent papers mentioned above, I was asked by Dr. Fenner A. Chace, Jr., of the U. S. National Museum, and by Mrs. Olive S. Tattersall to prepare this short paper to supply the information needed to bring Dr. Tattersall's study up to its actual date of publication. I wish to thank Dr. Chace and Mrs. Tattersall for asking me to make this emendation.

In preparing these addenda, I hope also to keep the seeming errors, resulting from the long delay in printing, from reflecting in any way on the excellent reputation of Dr. Tattersall in the eyes of those who may not know the true cause of the omissions, and to keep these omissions from confusing later workers, especially those nonspecialists who may not be in a position to investigate all the literature on the group.

No more will be done than to point out under the various species the additions to the literature pertinent to their taxonomic status or to the American records. Where there may be a question about the taxonomy of any species, it will merely be mentioned but not resolved; finally, any publications issued after the date of publication of Tattersall's work will not be reported.

Addenda

Page 3.

The list of American species should be changed as follows:

Subfamily Boreomysinae.....	8 species
Tribe Erythropini.....	28
Tribe Mysini.....	35
Subfamily Mysidellinae.....	1

Page 4.

To the fresh-water species of mysids should be added *Neomysis mercedis*, from the west coast of North America (Banner, 1948, pt. II, p. 75).

The total of littoral species for the Pacific coast should be raised to 32 and *Mysis oculata* should be added as a species common to both coasts of North America (see the discussion under that species below).

Page 5.

In table 1 the number of west coast species of *Acanthomysis* should be changed to 9.

Page 7.

To the list of deeper-water species found only off the continental shelf of the Pacific slope should be added *Katerythrops* sp. and *Mysidella americana*.

To the list of pelagic species common to both the Atlantic and Pacific coasts should be added *Boreomysis microps*.

Page 8.

To the list of pelagic species known only from the Pacific side should be added *Boreomysis kincaidi*, *Euchaetomeropsis pacifica*, and *Caesaromysis vanclavei*, while *Caesaromysis* sp. should be substituted for *Caesaromysides liguriae*.

In table 2, *Neomysis mercedis* should be listed as a species distributed from Alaska to California rather than from British Columbia to California. (The identification of the Alaskan specimens was somewhat uncertain.)

Page 14.—*Chalaraspidum alatum* (Willemoes-Suhm)

Fage (1941, p. 4) not only discussed the anatomy and relationships of this species but also recorded its capture from the Pacific Ocean near Panamá.

Pages 15–22.—*Lophogaster* M. Sars

Any worker dealing with the genus *Lophogaster* should also consult the work of Fage (1942, pp. 1–39) in which, like Tattersall, he reviewed the known species and described new species. Fage, moreover, established new criteria, not used by Tattersall and previous workers, which serve to distinguish the species.

Below is a listing of the species of *Lophogaster* recognized by Tattersall and Fage, those arranged in opposition being presumably the same. In Fage's list, the species prefaced by an asterisk are those for which he gave additional records, some of which are American.

TATTERSALL	PAGE
<i>L. rotundatus</i> Illig	* <i>L. rotundatus</i>
	* <i>L. typicus</i>
<i>L. typicus</i> M. Sars	* <i>L. subglaber</i> Hansen ³
	* <i>L. challengerii</i> Fage
<i>L. americanus</i> Tattersall	
<i>L. spinosus</i> Ortmann	* <i>L. spinosus</i>
<i>L. hawaiensis</i> Fage	* <i>L. hawaiensis</i>
<i>L. longirostris</i> Faxon	<i>L. longirostris</i>
	* <i>L. pacificus</i> Fage
<i>L. intermedius</i> Hansen	<i>L. intermedius</i>
	* <i>L. multispinosus</i> Fage
	* <i>L. schmitti</i> Fage
<i>L. japonicus</i> Tattersall	
<i>L. erythraeus</i> Colosi	<i>L. typica</i> var. <i>erythraeus</i>
<i>L. affinis</i> Colosi	<i>L. subglaber</i> var. <i>affinis</i>

On the basis of the published descriptions it would appear that the new species described by Tattersall (*L. americanus* and *L. japonicus*) are not synonyms of the six described or reestablished by Fage (*L. subglaber*, *L. challengerii*, *L. hawaiensis*, *L. pacificus*, *L. multispinosus*,

³ Nouvel (1943, p. 90) described *L. subglaber insulare* a new variety from the eastern Atlantic (referred to earlier in his paper as *L. challengerii* Fage).

and *L. schmitti*). However, final judgment on the validity of Tattersall's species will have to wait until the specimens are examined.

Pages 25-32.—*Gnathophausia* Willemoes-Suhm

Like the species of the genus *Lophogaster*, the species of this genus were reported on by Fage (1941) on the basis of the extensive Dana collections. In his work Fage discusses both the morphology of the species and their distributional patterns.

Page 25.—*Gnathophausia ingens* (Dohrn)

This species was discussed by Fage (1941, p. 15) and many new records were given for it, including some from the Caribbean and adjacent waters.

Page 26.—*Gnathophausia gigas* Willemoes-Suhm

Records of this species, including some from off Central America, were given by Fage (1941, p. 24). Nouvel (1943, p. 12) gave some records from off Newfoundland. In addition, new records from off the northwestern coast of North America were given in my paper (Banner, 1948, pt. II, p. 358).

Page 28.—*Gnathophausia gracilis* Willemoes-Suhm

Records of this species from off Central America were given by Fage (1941, p. 27).

Page 29.—*Gnathophausia zoea* Willemoes-Suhm

One record was given by Fage (1941, p. 34) from off the northeastern coast of South America; Nouvel (1943, p. 15) gave two records of capture from off Newfoundland.

Pages 32-34.—*Eucopeia* Dana

Three papers dealing with the names applied to the species and the separation of the species of this genus were published while Tattersall was finishing his manuscript. The studies were those of Nouvel (1942a, 1943) and Fage (1942).

Page 32.—*Eucopeia sculpticauda* Faxon

Fage (1942, p. 56) recorded many captures of this species, including one off the eastern coast of the United States, two in the Caribbean Sea, and several off the Pacific coast of Central America and northern South America.

Page 33.—*Eucopeia australis* Dana

Fage (1942, p. 41) recorded additional distributional records for this species, including two captures on the Pacific side of Panamá and one in the eastern Caribbean.

Page 33.—*Eucopia major* Hansen

Fage (1942, p. 41 ff.) has placed this species in the synonymy of *E. australis*; Nouvel (1943, pp. 95–97) rejected the proposal and retained *E. major* as a separate and distinct species. Nouvel (p. 28) gave one record from off Newfoundland in addition to non-American collections.

Page 34.—*Eucopia unguiculata* (Willemoes-Suhm)

This species was divided into *E. hansenii* and *E. grimaldii*, two new species, by Nouvel (1942a, pp. 3–6). This distinction was accepted by Fage (1942, p. 40) but he used the names only provisionally until an examination of the type should determine which form must retain the name *E. unguiculata*. Tattersall and Tattersall (1951, p. 99) established that the name *E. unguiculata* should be retained for *E. hansenii* Nouvel and that *E. grimaldii* Nouvel is to be accepted. Unless subsequent work makes it necessary to reject Nouvel's separation, the specimens recorded by Tattersall should be reexamined and separated into the new species.⁴

Additional records for the two species were given by Fage (1942, p. 47), including some records from near the coasts of the Americas, by Nouvel (1943, pp. 30–43), where there is one record from off Newfoundland, and by Banner (1948, pt. I, p. 359), including many records from off the northwestern coast of North America.

Page 45.—*Boreomysis* G. O. Sars

Instead of about 20 species belonging to this genus, as given by Tattersall, there are now about 25 or 26 species recognized; only one of these new species has been described from American waters.

Page 48.—*Boreomysis tridens* G. O. Sars

Nouvel (1942b, p. 1; 1943, p. 45) described a variety *lobata* as new from off Newfoundland.

Page 49.—*Boreomysis arctica* (Krøyer)

Add synonym: *B. tregonboffi* Băcesco (1941a, p. 168; 1941b, p. 12) [according to Nouvel, 1943, p. 52].

Page 52.—*Boreomysis californica* Ortmann

A description, figures, and additional records from off the northwestern coast of North America were given by Banner (1948, pt. I, p. 367).

Page 55.—*Boreomysis microps* G. O. Sars

Additional records for this species were given by Nouvel (1943, p. 48), including one record from off Newfoundland, and by Banner (1948, pt. I, p. 365) from off the northwestern coast of North America.

⁴ I plan to publish in the near future a review of the names and the specific distinctions applied within this genus.

Page 60.

To the American species of *Boreomysis* should be added the species *B. kincaidi* Banner (1948, pt. I, p. 362) with a range from Washington to Alaska.⁵

Page 60.—*Siriella thompsonii* (H. Milne-Edwards)

Perhaps reference here should be made to the records of Nouvel (1943, p. 62), some of which are from locations that lie between the Azores and Newfoundland.

Page 81.—*Archaeomysis grebnitzkii* (Czerniavsky)

This species also has been described and depicted by Banner (1948, pt. I, p. 369, pl. 5). The records are for the ocean coast and the inland waters of Washington, the middle of the range established by Tattersall.

Page 100.—*Anchialina typica* (Krøyer)

This species was recorded from American waters south of Newfoundland by Nouvel (1943, p. 70).

Page 106.—*Holmesiella anomala* Ortmann

This species has been redescribed and discussed with additional records (Banner, 1948, pt. I, p. 395). It should be noted that both Tattersall and Banner observed that there are two races of the species that reach different sizes at maturity.

Page 112.—*Euchaetomera tenuis* G. O. Sars

To the records of this species should be added those collections made off British Columbia (Banner, 1948, pt. I, p. 383), a considerable extension of the range as given by Tattersall.

Page 112.

After the genus *Euchaetomera* should be added the genus and species *Euchaetomeropsis pacifica* Banner (1948, pt. I, p. 285), a new species described from British Columbia and the first record of the genus from American waters of either coast.

Page 113.—*Meterythropros robusta* S. I. Smith

Additional records for this species have been given from Washington to Alaska (Banner, 1948, pt. I, p. 377). This paper also noted that there were small-eyed individuals similar to those described by Tattersall as the new species *M. microphthalmalma*, but that after the examination of over 85 specimens the conclusion was reached that differences between the two forms were bridged by intermediate forms. If *M. microphthalmalma* is considered to be a synonym of *M.*

⁵ I plan to discuss *B. californica* and *B. kincaidi* in a subsequent paper.

robusta, then the record given for the new species constitutes the furthest extension of the range for *M. robusta*.

Page 118.—*Katerythrops* Holt and Tattersall

To the species of the genus should be added *Katerythrops* sp. Banner (1948, pt. I, p. 379), which is the only record of the genus in the Pacific.

Page 120.—*Longithorax capensis* Zimmer

Tattersall states that his specimens from Bermuda are the only ones known save the type; however, Nouvel (1943, p. 75) has recorded from the Azores a damaged specimen probably of this species.

Page 128.—*Amblyops abbreviata* (G. O. Sars)

To Tattersall's record of this species from Alaska should be added the two records from Alaska and one record from British Columbia (Banner, 1948, pt. I, p. 382).

Page 134.—*Pseudomma truncatum* S. I. Smith

To the west coast records of this species should be added the records from Washington (Banner, 1948, pt. I, p. 381).

Pages 137, 244.—*Caesaromysides liguriae* Colosi

This genus should be cancelled as an immature stage of *Caesaromysis*; the worth of the species could not be determined because of the immaturity of the specimen described (Banner, 1948, pt. I, p. 389).

To Tattersall's account of American mysids, *Caesaromysis vanclavei* Banner (loc. cit.,) should be added here, with its records from off Oregon to off Alaska.

Page 160.—*Inusitatomysis serrata* Tattersall

To this species should be added the reference *Inusitatomysis* sp. Banner (1948, pt. II, p. 67), which is apparently the same species as Tattersall's *I. serrata*. One major difference between the two sets of specimens is in the depth of the terminal cleft of the telson, which is one-eighth the length of the telson in Tattersall's specimens and one-third the length in mine; however, this may well be a growth difference and the two groups of specimens are probably the same species.

If they are the same, then the records of *Inusitatomysis* sp. from off British Columbia should be added to Tattersall's record from the Bering Sea.

Page 165.—*Mysis oculata* (Fabricius)

To the list of synonyms of this species should be added *Pugetomysis litoralis* Banner (1948, pt. II, p. 104), and the range of the species in the Pacific should be extended to include the waters of Washington.⁶

⁶ I plan to discuss this change in a forthcoming publication.

Page 181.—*Neomysis rayii* (Murdoch)

Tattersall and Banner arrived independently at the same conclusion that *N. franciscorum* Holmes is a synonym of *N. rayii*. The records given by Banner (1948, pt. II, p. 78) augment those given by Tattersall.

Page 187.—*Neomysis mercedis* Holmes

Under this species should be added the observations that it penetrates and lives in fresh-water lakes, such as Lake Washington near Seattle (Banner, 1948, pt. II, p. 75).⁷

Page 192.—*Neomysis kadiakensis* Ortman

Additional records of this species from Washington and British Columbia have been given (Banner, 1948, pt. II, p. 82).

Pages 208, 248.—*Acanthomysis sculpta* (Tattersall)

Observations have shown that this species exhibits great variation on many points, especially in the sculpturing of the abdomen (Banner, 1948, pt. II, pp. 97-101). The records have extended the range of the species from Washington to southern California.

Page 215.—*Acanthomysis macropsis* (Tattersall)

The known range of this species has been extended to include the inland waters of Washington (Banner, 1948, pt. II, p. 91).

Page 217.—*Acanthomysis pseudomacropsis* (Tattersall)

Tattersall, in an earlier publication (1933, p. 94) and again in this publication, states that he believes the exopod of the fourth pleopods of the male to be of three articles; this appendage was found to be composed of a single article (Banner, 1948, pt. II, p. 89). In addition, the records cited have extended the range southward into Washington and also give another Alaskan record.

Page 218.

To the genus *Acanthomysis* should be added two new species described from the northwestern coast of America, *A. nephrophthalma* Banner and *A. davisii* Banner (1948, pt. II, pp. 93, 95), and an unnamed specimen from Alaska, *Acanthomysis* sp. Banner (1948, pt. II, p. 101).

Pages 220, 249.—*Proneomysis wailesi* Tattersall

In an additional record for this species from Washington a new location has been given (Banner, 1948, pt. II, p. 104).

Pages 242 or 250.

To Tattersall's list of genera and species occurring in the waters of the Americas should be added *Mysidella americana* Banner (1948, pt. II, p. 109), a member of the last subfamily of the Mysidae, the Mysidellinae, which was described from British Columbia and which is the only record of the subfamily from American waters.

⁷ I plan to discuss the validity of this species in a forthcoming publication.

References

BĂCESCO, MIHAI

- 1941a. Sur une petite collection de Mysidacés provenant de Villefranche-sur-Mer (Méditerranée). Arch. Zool. Exp. et Gén., vol. 81, pt. 4, pp. 164-172.
- 1941b. Les Mysidacés des eaux méditerranéennes de la France (spécialement de Banyuls) et des eaux de Monaco. Bull. Inst. Océanogr. Monaco, No. 795, pp. 1-46.

BANNER, ALBERT H.

1948. A taxonomic study of the Mysidacea and Euphausiacea (Crustacea) of the Northeastern Pacific. Part I, Mysidacea, from family Lophogastridae through tribe Erythropini; Trans. Roy. Canadian Inst., vol. 26, pp. 345-397, pls. 1-9. Part II, Mysidacea, from tribe Mysini through subfamily Mysidellinae; Trans. Roy. Canadian Inst., vol. 27, pp. 65-125, pls. 1-7.

PAGE, LOUIS

1941. Mysidacea. Lophogastrida—I. Dana Report, No. 19, 52 pp., 51 figs.
1942. Mysidacea. Lophogastrida—II. Dana Report, No. 23, 67 pp., 42 figs.

NOUVEL, HENRI

- 1942a. Sur la systématique des espèces du genre *Eucopia* Dana, 1852 (Crust. Mysidacea). Bull. Inst. Océanogr. Monaco, No. 818, 8 pp.
- 1942b. Diagnoses préliminaires de Mysidacés nouveaux provenant des Campagnes du Prince Albert I^{er} de Monaco. Bull. Inst. Océanogr. Monaco, No. 831, 12 pp.
1943. Mysidacés provenant des Campagnes du Prince Albert I^{er} de Monaco. In Résultats des Campagnes Scientifiques . . . par Albert I . . . de Monaco, vol. 105, pp. 1-128, pls. 1-5.

TATTERSALL, WALTER M.

1933. Euphausiacea and Mysidacea from western Canada. Contr. Canadian Biol. Fish., new. ser., vol. 8, No. 15, pp. 181-205.
1951. A review of the Mysidacea of the United States National Museum. U. S. Nat. Mus. Bull. 201, x + 292 pp., 103 figs.

TATTERSALL, WALTER M., and TATTERSALL, OLIVE S.

1951. The British Mysidacea. Ray Society Publ. No. 136, pp. viii + 460.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington : 1955

No. 3335

ON THE ANATOMY AND RELATIONSHIPS OF GLOSSY
CUCKOOS OF THE GENERA *CHRYSOCOCCYX*,
LAMPROMORPHA, AND *CHALCITES*

By ANDREW J. BERGER¹

The relationships of the glossy cuckoos have long been in question. Sharpe (1873, p. 579) commented that he could not "find any character in the genus *Chrysococcyx* to justify its separation from *Cuculus*, beyond the metallic plumage . . ." Shelley (1891, pp. 280, 288) recognized as distinct the genera *Chrysococcyx* and *Chalcococcyx* (= *Chalcites*), but placed *Lampromorpha* in synonymy with *Chrysococcyx*. Bannerman (1922, pp. 413-420; 1933, pp. 111-120), however, recognized both *Lampromorpha* and *Chrysococcyx*. Chapin (1939, pp. 197-201), Peters (1940, p. 29), and Friedmann (1948, p. 115) again placed *Lampromorpha* in synonymy with *Chrysococcyx*. Delacour (1951, p. 19) and Friedmann (in litt.) further suggest that the genus *Chalcites* should be united with *Chrysococcyx*, which would place all species of this complex in the genus *Chrysococcyx*.

Little has been written on the internal anatomy of *Chrysococcyx* and, so far as I know, there has been no published description of the internal anatomy of *Lampromorpha* or *Chalcites*.

I am indebted to the following for supplying alcoholic and skeletal material: Dr. Dean Amadon, American Museum of Natural History; Dr. Herbert Friedmann, United States National Museum; and Mr. John G. Williams, the Coryndon Museum, Nairobi, East Africa. I had the following spirit material for study: *Chrysococcyx cupreus* (3), *Lampromorpha caprius* (2), *L. klaas* (1), and *Chalcites*

¹ Department of Anatomy, University of Michigan Medical School, Ann Arbor, Michigan.

lucidus (2). Skeletal material was available as follows: *Chrysococcyx cupreus* (3), *Lampromorpha caprius* (2), and *L. klaas* (1). Certain information was also obtained from the skeletons of the alcoholic specimens. For reading the manuscript and for offering suggestions I am indebted to Dr. Amadon, Dr. Jean Delacour, Los Angeles County Museum, California, Dr. Friedmann, and Dr. Josselyn Van Tyne, University of Michigan Museum of Zoology.

Pterylosis

Beddard (1885, p. 187), basing his comments on manuscript notes of Garrod and Forbes, grouped *Chrysococcyx* with those cuckoos which have the "ventral tract [abdominal] of both sides single," but this arrangement is, in fact, not found in *Chrysococcyx*. Miller (1924, p. 330) reported that the nestling of *Chrysococcyx* lacks natal down. Nothing else seems to have been published on the pterylosis of the species discussed in this paper.

In general the pterylosis of the four species is similar. In each species there are 10 primaries and 10 secondaries, though secondaries 8, 9, and 10 (outermost counted as first) are progressively smaller. The fifth secondary is present, i. e., the wing is eutaxic, or quintocubital. There are four alula quills, the outermost being the longest. The carpal remex and its covert are present. There are 10 rectrices and 10 upper tail coverts. The oil gland is nude; a single, median feather at the base of the gland passes caudad, covering it. The eyelashes are featherlike rather than hairlike as in *Coua caerulea*. The tarsi are what Sharpe (1873, p. 579) spoke of as "accipitrine," i. e., feather tracts descend for a distance of about 6 mm. on the tarsometatarsus; the lateral tract shows the best development.

In the capital region, the median frontal apterium is wanting. A small supraorbital apterium is present, but it is separated from the eyelashes by a single row of feathers. The dorsal cervical feather tract is continuous with the interscapular tract. A wide lateral cervical apterium is present. A long, narrow, median dorsal apterium extends through the dorsal region and the anterior half of the pelvic region. There is a single, medium pelvic feather tract.

Bilateral submalar apteria are present; these are widest in *Chrysococcyx* and narrowest in *Lampromorpha caprius*.

The abdominal branches of the above-mentioned genera differ from those shown for *Cacomantis*, *Piaya* (Beddard, 1885), and *Cuculus canorus* (Lowe, 1943, p. 493) in that two separate tracts form at the posterior margin of the sternum. An inner abdominal tract extends to the anus; this tract is two feathers wide at the beginning, but is reduced to one row about two-thirds the distance to the anus. The outer abdominal tract turns inward to meet the inner abdominal tract about midway to the anus.

Osteology

All four species have 14 cervical vertebrae. There are two pairs of cervicodorsal ribs and, usually, only the last such rib possesses an uncinete process, though one specimen of *Chrysococcyx cupreus* has uncinete processes on both left cervicodorsal ribs, one specimen of *Lampromorpha caprius* possesses these processes on both right ribs, and an alcoholic specimen of *Chalcites lucidus* has uncinete processes on all four ribs. The atlas is perforated by the odontoid process, except in a strongly bleached skeleton of *Lampromorpha klaas*, where the atlas appears to be notched.

With one exception, each specimen has four dorsal vertebrae, four dorsal ribs, and one thoracic rib. In each case, the thoracic rib articulates with the synsacrum dorsally and fuses with the last dorsal rib ventrally. One alcoholic specimen of *Chrysococcyx cupreus*, however, has five dorsal vertebrae and five dorsal, or true, ribs. Of the latter, four articulate with the sternum, while the fifth fuses ventrally with the fourth rib; there is no thoracic rib. Of ten cuculine genera I have thus far investigated, this is the first example I have seen of intra-specific variation in the number of dorsal vertebrae. The number of ribs articulating directly with the sternum, on the other hand, is far more variable. Four, apparently, is the "normal" number of sternal ribs in these species. In one specimen of *Chrysococcyx cupreus* and two specimens of *Lampromorpha caprius*, however, only three of the four dorsal ribs articulate directly with the sternum; and in an alcoholic specimen of *L. klaas* three ribs articulate with the sternum on the left side, whereas four do so on the right.

Apparently in younger individuals the general pattern of the posterior emargination of the sternum is double-notched; it does not seem likely that the bone would be resorbed to form fenestrae in older individuals. In half of the specimens, the sternum is single-notched and bilateral fenestrae are present. In some cases, these fenestrae are bounded posteriorly by a bony bar only 1 mm. in width.

The external nares are oval to rounded and their borders are conspicuously swollen. On the floor of the narial cavity is a well-developed tubercle which has a small bony core; the latter is readily discernible in the skeleton.

A pectineal process is not developed.

Wing Myology

In all four species the following wing muscles are absent: proscapulohumeralis brevis, abductor indicis brevis, abductor digiti II, and the biceps slip to the tendon of *M. tensor patagii longus*. Gadow's pars propatagialis musculi cucullaris does not insert on the tendon of *M. tensor patagii longus*.

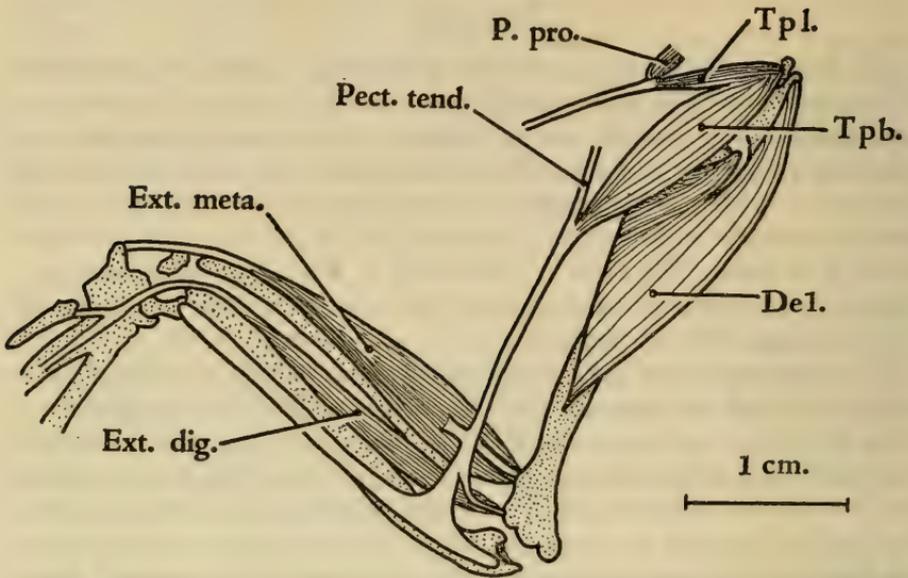


FIGURE 69.—*Chrysococcyx cupreus*. Anconal view of left arm and forearm to show the structure and relationships of *M. tensor patagii brevis*. Explanation of symbols: Del., deltoideus major; Ext. dig., extensor digitorum communis; Ext. meta., extensor metacarpi radialis; P. pro., pars propatagialis, pectoralis superficialis; Pect. tend., accessory tendon of pectoralis superficialis; Tpb., tensor patagii brevis; Tpl., tensor patagii longus.

The structure of *M. tensor patagii brevis* (fig. 69) is similar in the three genera and exhibits some differences from that found in other cuckoos studied. In *Lampromorpha caprius* the belly is 14 mm. long and 5 mm. in maximum width. The distal end of its fleshy belly has no relationship to the tendon of *M. tensor patagii longus*. A strong flat tendon (0.5 mm. wide) arises from the dense fascial envelope which surrounds the insertion of *M. pectoralis superficialis*, and fuses with the tendon of *M. tensor patagii brevis*. About 5 mm. distal to the ectepicondylar process of the humerus, part of the tendon of *M. tensor patagii brevis* fuses with the superficial surface of *M. extensor metacarpi radialis*. From this region of fusion, a strong tendon passes proximad to attach to the ectepicondylar process; distal to the area of fusion, the tendon expands and gives origin on both its superficial and deep surfaces to fleshy fibers of *M. extensor metacarpi radialis*. Posterior to the area of fusion, the tendon of *M. tensor patagii brevis* bifurcates: one branch fuses with the superficial surface of *M. extensor digitorum communis* and attaches to the humerus with that muscle; the second branch fans out, extends nearly the entire length of the ulna, attaches to the bases of the secondaries, and fuses with the antibrachial fascia. This muscle shows the same relationships in the other species, but measurements are slightly smaller in them. In its insertion, *M. tensor patagii brevis* is similar to that in *Coccyzus erythrophthalmus*.

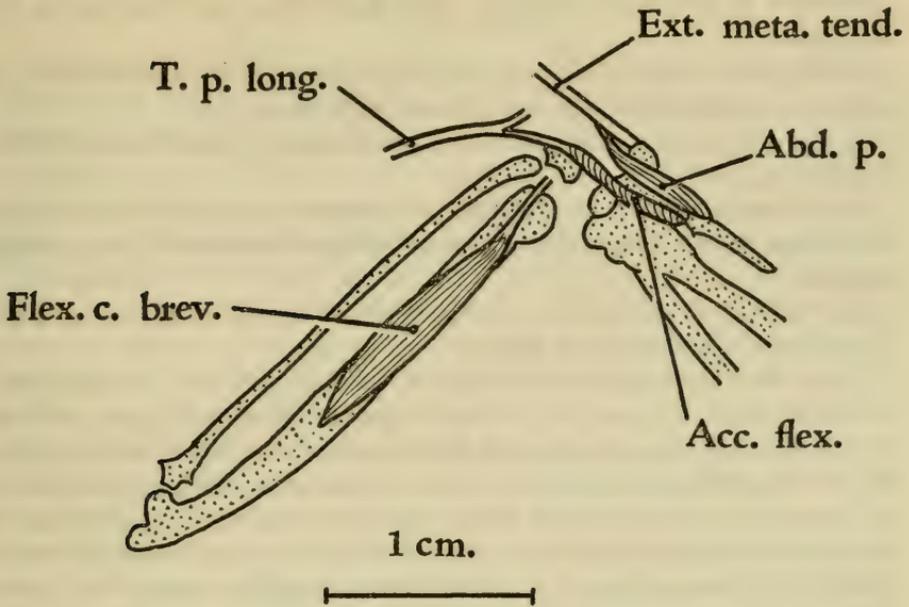


FIGURE 70.—*Chrysococcyx cupreus*. Palmar view of part of left wing to show relationships of the accessory flexor muscle of the pollex. Explanation of symbols: Abd. p., abductor pollicis; Acc. flex., accessory flexor muscle; Ext. meta. tend., tendon of extensor metacarpi radialis; Flex. c. brev., flexor carpi ulnaris brevis; T. p. long., tendon of tensor patagii longus.

Although *M. tensor patagii longus* (figs. 69, 70) has a common origin with *M. tensor patagii brevis* from the superomedial surface of the furculum, the two bellies are incompletely fused distally. In *Lampromorpha caprius*, *M. pectoralis, pars proptatagialis*, is a well-developed, fleshy fasciculus 14 mm. in length and 5 mm. wide at its base on the furculum. The belly tapers to a tendon whose direct continuation is the tendon of *M. tensor patagii longus*. The belly of the latter muscle (about 8 mm. long and 2 mm. wide) fuses with *M. pectoralis, pars proptatagialis*, just before the formation of the common tendon. The tendon runs distad in the leading edge of the propatagium and bifurcates near the distal end of the radius. The main tendon fuses with the fascia of the manus and has a minor attachment to the extensor process. The smaller tendon serves as the origin for a small (4 mm. long) fleshy belly (fig. 70) which inserts on the postero-basal corner of the pollex superficial to the insertion of *M. flexor pollicis*, which, although present, is poorly developed. *Chrysococcyx* and *Chalcites* exhibit this same structure, which I have found neither in other cuckoos nor in literature on other birds.

M. coracobrachialis anterior is similar in the four species and, as in *Coccyzus erythrophthalmus*, it is poorly developed. The belly is surrounded by a dense fascia and, in fact, the muscle almost seems to be

imbedded in the joint capsule. The belly does not fan out at its insertion.

M. expansor secundariorum is a single muscle with two tendons of origin: a scapular tendon and a humeral tendon.

M. scapulotriceps does not have an accessory attachment to the humerus.

M. subcoracoideus has two heads, one arises from the furculum and the other arises from the coracoclavicular membrane as in other cuckoos.

M. deltoideus minor is present and arises inside the triosseal canal from the inferior furcular process.

In all four species, the tendon of *M. latissimus dorsi*, pars posticus, inserts posterior to and in contact with the tendon of pars anticus. In *Chalcites*, *Chrysococcyx*, and *Lampromorpha klaas* the area of insertion of pars posticus begins about .5 mm. proximal to the insertion of pars anticus, whereas in *Lampromorpha caprius* the insertion of pars posticus begins about .5 mm. distal to the uppermost fibers of insertion of pars anticus. A dermal component is present, but is very small, and I was unable to demonstrate it in every specimen.

In each species, *M. pronator longus* is a relatively short muscle, extending distad the same distance as *M. pronator brevis*, i. e., about two-thirds the length of the radius.

M. flexor digitorum profundus arises on both sides of the area of insertion of *M. brachialis*.

M. flexor carpi ulnaris brevis (fig. 70) shows the best development yet seen in cuckoos. The fleshy belly is relatively and absolutely longer (14 mm. in *Chrysococcyx* and *Lampromorpha caprius*) than in *Coua*, *Geococcyx*, etc., and the belly is located more proximally on the ulna.

M. flexor metacarpi brevis is well developed in all four species. The belly is triangular in shape; it arises fleshy from the base of the carpometacarpus; it inserts on the tendon of *M. extensor indicis longus*.

M. extensor pollicis brevis exhibits minor variation. In *Chrysococcyx cupreus* none of its fibers appear to arise from the tendon of *M. extensor pollicis longus*. In *Lampromorpha caprius* there are two heads as in *Crotophaga sulcirostris*. In *Chalcites* the structure is intermediate between that found in *Crotophaga* and in *Coccyzus*, and a few fibers arise from the tendon of *M. extensor pollicis longus*.

M. abductor pollicis is a small muscle with a maximum length of 6 mm. I found two bellies to this muscle in *Chrysococcyx cupreus*, but I was unable to determine to my satisfaction in preserved material that there are two parts in *Lampromorpha* or *Chalcites*. The origin and insertion of this muscle are in each case, however, typical for cuckoos.

Leg Myology

The muscle formula in the three genera is AXYAm. The following muscles are absent: pars iliofemoralis of the piriformis, ilirotrochantericus medius, gluteus medius et minimus, iliacus, adductor digiti IV, extensor brevis digiti III, and, apparently, adductor digiti II. A vinculum is present between the tendons of Mm. flexor digitorum longus and flexor hallucis longus, but a vinculum is wanting between the tendons of Mm. flexor perforatus digiti III and flexor perforans et perforatus digiti III. The tendon of insertion of M. flexor perforatus digiti II forms a sheath for the tendon of M. flexor perforans et perforatus digiti II, but the latter tendon does not ensheath the tendon of M. flexor digitorum longus which supplies digit II. The tendon of M. flexor perforatus digiti IV does not ensheath the tendon of M. flexor digitorum longus which supplies digit IV.

In *Lampromorpha caprius*, M. iliotibialis (fig. 71) arises semitendinous from the entire anterior iliac crest, the anterior iliac process, and from approximately the anterior half of the posterior iliac crest. The muscle is composed of anterior and posterior fleshy portions separated by a central aponeurosis, which distally is intimately fused with the underlying M. femorotibialis externus. The central aponeurosis is best developed distally, where it is 13 mm. long and 3.5 mm. in maximum width; proximally, this band is only 1 mm. wide. In this central area, however, the muscle is completely aponeurotic from origin to insertion. Except for its smaller size, M. iliotibialis exhibits the same structure in *Chalcites lucidus*. In *Chrysococcyx cupreus* the distal aponeurotic portion is the same shape and size as in *Lampromorpha*, but it is separated from the aponeurosis of origin by a central fleshy portion 5 mm. long; for this short distance, therefore, the belly is entirely fleshy from anterior to posterior border. In each of the genera, the insertion of M. iliotibialis is typical and its belly conceals only the anterior and proximal half of M. biceps femoris.

M. semitendinosus (fig. 71) is similar in the three genera. It arises from the posterior third of the posterior iliac crest and from the transverse process of the first free caudal vertebra. Its insertion is typical.

M. gastrocnemius is composed of three main parts: pars externa, pars media, and pars interna. Pars externa arises by two heads, as in *Coccyzus*. Pars media is very small: 5, 7, and 8 mm. long, respectively, in *Chalcites*, *Lampromorpha*, and *Chrysococcyx*. The fleshy portions of pars externa and pars interna are nowhere in contact; the posterior aspect of the complex is a thin, tendinous sheet, which connects the fleshy bellies.

M. peroneus longus is poorly developed, resembling the structure of that muscle in *Coccyzus*. Fleshy fibers begin some distance (7 to 10 mm.) distal to the rotular crest, and the belly does not conceal any part of *M. tibialis anticus*.

M. plantaris is a long, thin muscle whose belly extends about two-thirds the distance down the tibiotarsus.

In *Chrysococcyx cupreus*, *M. extensor proprius digiti III* is a long thin muscle which begins just distal to the proximal articular surface of the tarsometatarsus and extends to the distal end of that bone. The belly does not increase much distad, as it does in *Coccyzus*. The muscle is similar in origin in *Chalcites lucidus*, but the fleshy fibers end 5.5 mm. proximal to the insertion. In *Lampromorpha caprius*, the muscle arises at the level of insertion of *M. tibialis anticus*.

M. lumbricalis exhibits its best development in *Lampromorpha* and its poorest development in *Chalcites*; in the latter genus it is limited to the distal half of the tarsometatarsus.

M. obturator internus, similar in the three genera, is triangular in shape and has only a small fasciculus arising from inside the pelvis.

Syrinx

The syrinx is tracheobronchial. There is one pair of intrinsic syringeal muscles. In *Chrysococcyx cupreus* and *Lampromorpha klaas* these muscles insert on the fourth bronchial semiring. This ring is not much wider than adjacent rings, but it has the largest diameter of any in the bronchial series. The structure is similar in *L. caprius* and *Chalcites lucidus* except that the muscles insert on the third semiring. However, not more than two syringes were suitable for study in any one species so I cannot say that the point of insertion is constant.

Viscera

In each specimen the right lobe of the liver is much larger than the left lobe. A gall bladder is not evident. The pancreas is bilobed. One can obtain only an approximate total-length measurement of the intestine. Its total length in millimeters in two specimens of *Lampromorpha caprius* is 220 and 240; in two specimens of *Chalcites lucidus*, 160 and 180; and in two specimens of *Chrysococcyx cupreus*, 170 and 260. Only insect remains were found in the stomachs. A peculiar feature is the presence of a single caecum, about 4 mm. long in *Chalcites* and 5 mm. long in *Lampromorpha* and *Chrysococcyx*.

Discussion

The genera *Chrysococcyx* and *Lampromorpha* are restricted to Africa. *Chalcites* is found in Asia, Australia, and New Zealand.

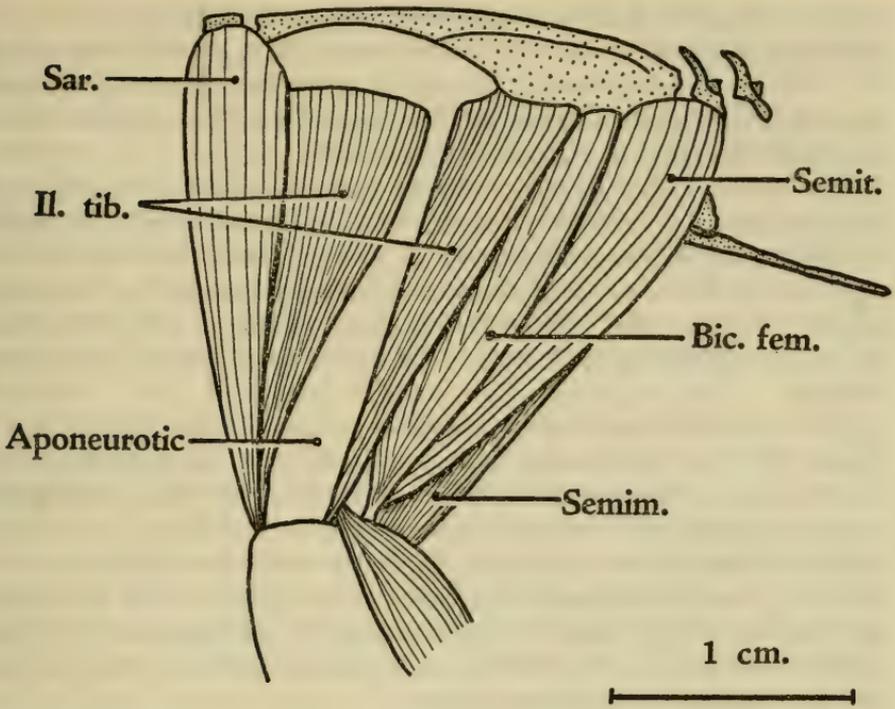


FIGURE 71.—*Lampropromorpha caprius*. Superficial muscles of the left thigh (lateral view). Explanation of symbols: Bic. fem., biceps femoris; Il. tib., iliotibialis; Sar., sartorius; Semim., semimembranosus; Semit., semitendinosus.

Except for the rare yellow-throated cuckoo (*Chrysococcyx flavigularis*), which has not been studied in the field, it is known that all of the glossy cuckoos are parasitic on other birds. A large number of hosts have been recorded, but for the African species the most important hosts seem to be members of the following families: Ploceidae, Nectariniidae, Sylviidae, Muscicapidae, and Motacillidae. Common hosts of the bronze cuckoos (*Chalcites*) in Australia are certain thornbills, wrens, and scrub-wrens of the family Sylviidae (Serventy and Whittell, 1948, p. 238). For other species of *Chalcites* in India, Baker (1934, pp. 353-354) reports the most common hosts to be sunbirds and spider-hunters (Nectariniidae).

Friedmann (1948, pp. 115-116) remarked that: "The eggs of the glossy cuckoos show far more variation in color and markings than do those of any of the other cuckoos of Africa." The eggs of Klaas's cuckoo (*Lampropromorpha klaas*), for example, have "the ground color . . . white, pale greenish blue, or pale blue, and either unspotted or quite abundantly flecked with brick red, brown, or purplish gray," (ibid., p. 136). According to Barrett (1945, p. 149), "five kinds of bronze cuckoos occur in Australia, and the eggs of four of them are bronzy-green in colour, while that of the fifth, the narrow-billed bronze

cuckoo (*Chalcites basalis*) is pinkish, with a uniform sprinkling of tiny reddish spots." Serventy and Whittell (1948, p. 238), in speaking of *Chalcites lucidus*, state: "The egg is pale olive in colour, without any markings, but this colour can be removed with water, after which the shell is found to be light bluish in colour."

Friedmann (1948, p. 115; 1949, p. 519) has called attention to a behavior pattern "unique" among parasitic birds in that the "habit of feeding of fledged young by adult parasitic cuckoos is known . . . only in some four species of the small glossy cuckoos of the *Chalcites-Chrysococcyx* group." However, Moreau (1949, p. 537) cited two references indicating that adults of *Cuculus* occasionally feed young cuckoos.

"The African glossy cuckoos also have a courtship feeding behavior," which "is otherwise known, in cuckoos, only in African forms of *Clamator* and *Cuculus*" (Friedmann, 1948, p. 115). Since this statement was published, however, Watson and Bull (1950, p. 226) have reported observations of *Chalcites lucidus* which gave them the "impression . . . that some form of communal display with courtship feeding was taking place." These authors do not agree with Friedmann (1949, p. 517) that feeding of young by adults has been proved for the New Zealand shining cuckoo.

That the species of glossy cuckoos here discussed are closely related, biologically and anatomically, is evident from an analysis of the data presented. The behavior patterns of courtship feeding and feeding of fledged young indicate close relationship. Too little is known about the detailed life history of these birds to justify further comparison. In morphological characters, also, these species exhibit a general uniformity of structure. For the most part, differences in muscles, for example, can be ascribed only to size differences of the species.

It seems certain that unsatisfactory characters have been used by some authors to separate *Chrysococcyx* and *Lampromorpha*. Jackson (1938, p. 500) used shape and length of tail to separate them: *Lampromorpha* "has the tail much shorter and slightly rounded, but not graduated." Priest (1934, p. 227) separated them on the basis of sexual dimorphism, but this surely was a misprint in his key. In establishing the genus "*Adamatornis*" for *klaas*, Roberts (1922, p. 219) stated only that *klaas* "is much smaller than *cupreus*."

Little has been written on the locomotor habits of these species. Yet, of seven differences in anatomical structure which might be useful for determining relationship, six seem definitely to be correlated to functional phenomena. These involve primarily the extent of origin or insertion and relative length of belly of the following muscles: latissimus dorsi, iliobtibialis, extensor proprius digiti III, abductor

pollicis, flexor hallucis longus, and extensor hallucis longus. It must be emphasized, however, that all differences in structure here discussed are minor in degree.

An analysis of *M. iliotibialis* will serve to illustrate the minor differences encountered and to cast doubt on the validity of them as a basis for establishing separate genera. The structure of this muscle has been discussed in some detail above (p. 591). The complete aponeurotic central portion of *M. iliotibialis* in *Lampromorpha caprius* is most like the structure of that muscle in *Coccyzus*. In each of eight other genera (*Crotophaga*, *Geococcyx*, *Coua*, etc.) the aponeurotic portion is limited to the distal half or two-thirds and there is a well-developed fleshy belly located proximal to this aponeurosis. Only in *Chrysococcyx cupreus* and *Lampromorpha klaas*, where the middle fleshy portion is very small, does the structure of the muscle represent an intermediate stage. The locomotor pattern seems to be similar in these species (Friedmann (1948, pp. 129, 150, 158) implies this as regards the manner of flight), so one might place some weight on this character as indicating degree of relationship. Also, the place of insertion of the syringeal muscles, if proven constant, would indicate relationship as follows: *caprius* with *lucidus* (insertion on the third bronchial ring); *cupreus* with *klaas* (insertion on the fourth ring). Minor differences in other muscles, however, indicate a closer relationship between *lucidus* and *cupreus* than between the former and *caprius*, so that it seems unlikely that the structure of *M. iliotibialis*, in this instance, is a valid character for judging relationship. In anatomical features *klaas* resembles *cupreus* more than it does *caprius*. Van Someren (1925, pp. 660-662) came to the same conclusion after a study of feather structure; he stated that *klaas* should either be placed with *cupreus* in the genus *Chrysococcyx* or else in an intermediate position, but that *klaas* could not be placed with *caprius* if only two genera were to be recognized. Both van Someren and Friedmann (1948, pp. 150, 151) felt that *cupreus*, *caprius*, and *klaas* are congeneric.

In reviewing the evidence presented here, I must conclude that all of the glossy cuckoos are congeneric. Following the law of priority, all the species of this complex must be placed in the genus *Chrysococcyx*. Anatomical similarities further suggest that *cupreus* and *klaas* are more closely related to each other than to either *caprius* or *lucidus*. Though *lucidus* possesses certain anatomical features exhibited by *caprius* (especially the structure of *M. iliotibialis* and the place of insertion of the syringeal muscles), in most respects *lucidus* is like *cupreus*. Therefore, *caprius* is most unlike the other species of this genus.

References

- BAKER, E. C. STUART
1934. The nidification of birds of the Indian Empire, vol. 3, 568 pp., 8 pls.
- BANNERMAN, DAVID A.
1922. On the emerald and golden cuckoos of Africa. *Nov. Zool.*, vol. 29, No. 2, pp. 413-420.
1933. The birds of tropical West Africa, vol. 3, 487 pp., 144 figs., 12 pls., map.
- BARRETT, CHARLES
1945. Australian bird life, 239 pp., 46 pls.
- BEDDARD, FRANK E.
1885. On the structural characters and classification of the cuckoos. *Proc. Zool. Soc. London* (1885), pp. 168-187.
- CHAPIN, JAMES P.
1939. The birds of the Belgian Congo. II. *Bull. Amer. Mus. Nat. Hist.*, vol. 75, 632 pp., 38 figs., 21 pls.
- DELACOUR, JEAN
1951. Commentaires, modifications et additions a la liste des oiseaux de l'Indochine Française. *L'Oiseau Rev. Française d'Ornith.*, vol. 21, pp. 1-32.
- FRIEDMANN, HERBERT
1948. The parasitic cuckoos of Africa. *Washington Acad. Sci. Monogr.* No. 1, 204 pp., 10 pls.
1949. Additional data on African parasitic cuckoos. *Ibis*, vol. 91, No. 3, pp. 514-519.
- JACKSON, FREDERICK J.
1938. The birds of Kenya Colony and the Uganda Protectorate, vol. 1, 542 pp., 115 figs., 10 pls.
- LOWE, PERCY R.
1943. Some notes on the anatomical differences obtaining between the Cuculidae and the Musophagidae, with special reference to the specialization of the oesophagus in *Cuculus canorus* Linnaeus. *Ibis*, vol. 85 (October 1943), pp. 490-515.
- MATHEWS, GREGORY M.
1918. The birds of Australia, vol. 7, pts. 1-4, pp. 1-384, pls. 325-362.
1919. The birds of Australia, vol. 7, pt. 5, pp. 385-499, pls. 363-479.
- MILLER, W. DEWITT
1924. Further notes on ptilosis. *Bull. Amer. Mus. Nat. Hist.*, vol. 50, art. 5, pp. 305-331.
- MOREAU, R. E.
1949. Friedmann on African cuckoos (special review). *Ibis*, vol. 91, pp. 529-537.
- PETERS, JAMES L.
1940. Check-list of birds of the world, vol. 4, 291 pp.
- PRIEST, CECIL D.
1934. The birds of Southern Rhodesia, vol. 2, 553 pp., 172 figs., 10 pls.
- ROBERTS, AUSTIN
1922. Review of the nomenclature of South African birds. *Ann. Transvaal Mus.*, vol. 8, pp. 187-272.
- SERVENTY, D. L., and WHITTELL, H. M.
1948. A handbook of the birds of western Australia, 365 pp., 32 figs., 2 pls.
- SHARPE, R. BOWDLER
1873. On the Cuculidae of the Ethiopian region. *Proc. Zool. Soc. London* (1873), pp. 578-624.

SHELLEY, G. E.

1891. *Picariae—Scansores and Coccyges*, in *British Museum catalogue of birds*, vol. 19, 484 pp., 13 pls.

VAN SOMEREN, V. G. L.

1925. What is the true relationship of Klaas's cuckoo to *Chrysococcyx cupreus* and *Lampromorpha caprius*? *Ibis*, ser. 12, vol. 1, pp. 660-662, pls. 22, 23.

WATSON, J. S., and BULL, P. C.

1950. Communal display of the shining cuckoo. *New Zealand Bird Notes*, vol. 3, p. 226.



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1955

No. 3336

SUPPLEMENT AND CORRECTIONS TO J. A. HYSLOP'S
GENOTYPES OF THE ELATERID BEETLES OF THE
WORLD¹

By ROSS H. ARNETT, Jr.²

The publication in 1921 of J. A. Hyslop's "Genotypes of the Elaterid Beetles of the World" (Proc. U. S. Nat. Mus., vol. 58, No. 2353, pp. 621-680) opened the road to a stabilized nomenclature in the family Elateridae. The impetus of this work resulted in a great many studies in the generic classification of this moderately large family. Although many of the generic names employed up to that time were shown to be incorrect, a great stride was made in providing a means for the stabilization of the names in this group, because, as I believe has been shown repeatedly, it is only after the genotypes have been correctly determined that generic assignments can be made.

However, during the 34 years since the publication of this work, a considerable number of new names have been proposed, and a fair number of inaccuracies have been discovered. Many of these errors have been pointed out by Méquignon and Lane in the following papers:

MÉQUIGNON, A.

1930. Notes synonymiques sur les Élatérides . . . Bull. Soc. Ent. France (1930), pp. 91-96.

LANE, M. C.

1948. Some generic corrections in the Elateridae—I. Proc. Ent. Soc. Washington, vol. 50, pp. 179-182.
1948. Some generic corrections in the Elateridae—II. Proc. Ent. Soc. Washington, vol. 50, pp. 221-223.
1949. Some generic corrections in the Elateridae—III. Proc. Ent. Soc. Washington, vol. 51, pp. 152-153.
1953. Some generic corrections in the Elateridae—IV. Proc. Ent. Soc. Washington, vol. 55, pp. 86-89.

¹Proc. U. S. Nat. Mus., vol. 58, No. 2353, pp. 621-680, 1921.

²Formerly of Entomology Research Branch, Agriculture Research Service, U. S. Department of Agriculture; now Head, Department of Biology, St. John Fisher College, Rochester, N. Y.

The following pages are intended as a supplement to Hyslop's paper to bring together these corrections and additions, as well as to add further corrections. There are a number of minor typographic mistakes in Hyslop's paper which I have not listed below, and in a few cases he gives incorrect dates which are obvious to anyone using the catalog (i. e., Linnaeus "1857," etc.) and which have not been corrected here. With these exceptions, it is thought that this list is correct to and including part of 1952.

New names

As a result of this study, three new names are necessary to replace others which are shown to be unavailable.

Malloea new subgenus.

TYPE: *Ctenicera* (*Malloea*) *sjaelandica* (Müller) (= *Elater sjaelandicus* Müller), Fauna Insectorum Fridrichsdalina, p. 21, 1764. (Here designated.)

NOTE: This subgenus of *Ctenicera* includes those species grouped under the subgeneric name *Actenicerus* Kiesenwetter in the Coleopterorum Catalogus (Schenkling, 1927, pt. 88, pp. 368-370, 1927) and the species described by Kiesenwetter under the name *Actenicerus*. The name *Actenicerus* Kiesenwetter, 1857 (Naturgeschichte der Insecten Deutschlands, vol. 4, p. 285), is not available because it is a junior synonym of *Prosternon*. *Corymbites tessellatus* Germar, (Zeitschr. Ent., vol. 4, p. 62, 1843), which Kiesenwetter gives as the only included species in his subgenus *Actenicerus*, is referred back to *Elater tessellatus* Linnaeus (Systema Naturae, ed. 10, p. 406, 1758), a species which is now included in the genus *Prosternon* Latreille, 1834. The *Elater tessellatus* of Fabricius (Systema Entomologiae, p. 211, 1775), which Kiesenwetter redescribed and misdetermined as *Corymbites tessellatus* Germar, is *Elater sjaelandicus* Müller, 1764, and not *E. tessellatus* Linnaeus, 1758. (*Malloea* is the name of a town in Thessaly and is feminine.)

Dido, new genus.

TYPE: *Dido macrocera* (Castelnau) (= *Tetralobus macrocerus* Castelnau, Revue Entomologique, vol. 4, p. 12, 1836). (Here designated.)

NOTE: This genus includes only the genotype, a species found in Madagascar, and belongs to the subtribe Dicrepidina. Both Candèze (Catalogue Méthodique des Élatérides, p. 49, 1891) and Schenkling (Coleopterorum Catalogus, pt. 88, p. 74, 1927) used the generic name *Coresus* for *T. macrocerus* Castelnau. However, Gemminger and Harold (Catalogus Coleopterorum, vol. 5, p. 1509, 1869) validated the Dejean name *Coresus* (MS) as a synonym of *Piezophyllus* Hope,

1842. The genotype of *Piezophyllus* is *P. spencei* Hope, designated by Hyslop (Proc. U. S. Nat. Mus., vol. 58, pp. 621-680, 1921), and it is, therefore, automatically the genotype of *Coresus*. *P. spencei* is not congeneric with *T. macrocerus*, making this new generic name necessary. The characters of this genus are as given in Schwarz (Genera Insectorum, fasc. 46, p. 61, 1906) under the name *Coresus*. (Dido is a classical Latin name from Greek and is feminine.)

Mesembria, new genus.

TYPE: *Mesembria subtilis* (Candèze) (= *Cosmesus subtilis* Candèze), Monographie des Élatérides, vol. 4, p. 355, 1863. (Here designated.)

NOTE: This genus is represented by 62 species, all found in South America and all placed in the genus *Cosmesus* by Schwarz (Genera Insectorum, fasc. 46, p. 265, 1907) and Schenkling (Coleopterorum Catalogus, pt. 88, pp. 438, 439, 1927). The genotype of *Cosmesus* Eschscholtz, 1829, is *C. bilineatus* Eschscholtz, 1829, and is not congeneric with the species included in *Mesembria*. *Cosmesus* Eschscholtz is the prior name for *Parapomachilius* Schwarz, 1900. (*Mesembria* is a classical Latin name and is feminine.)

Supplement and corrections

Abelater Fleutiaux

1947. Notes d'Ent. Chinoise, vol. 11, p. 379.

TYPE: *Melanoxanthus rubiginosus* Candèze, Élatérides Nouveaux, pt. 2, p. 29, 1878. (Present designation.)

Invalid genus, no genotype cited; here validated, assuming no previous designation.

Abiphis Fleutiaux

1926. Bull. Soc. Ent. France, p. 91.

TYPE: *Elater nobilis* Illiger, in Wiedemann, Arch. Zool., vol. 1, p. 116, 1800. (Original designation.)

Abseus Fleutiaux

1931. Bull. Mus. Hist. Nat., Paris, ser. 2, vol. 3, pp. 611, 613.

TYPE: *Anchastus maximus* Fleutiaux, *ibid.*, p. 613. (Original designation.)

Acanthus Van Dyke (not Block, 1795, Borkhausen, 1797, Dumont, 1816, Gistel, 1834, or Lockington, 1877)

1932. Proc. California Acad. Sci., ser. 4, vol. 20, p. 387.

In error for *Athous* Eschscholtz, 1829.

Adelocera Latreille

1829. Crustacés, Arachnides et Partie des Insectes. In Cuvier, Le Règne Animal . . . , ed. 2, vol. 4, p. 451, April 1829.

TYPE: *Elater ovalis* Germar, Insectorum Species . . . Vol. 1, Coleoptera, p. 49, 1824. (Designated by Hyslop, 1921.)

This genus is distinct from *Agrypnus* Eschscholtz, 1829 (Jan.).

Aeleoderma Fleutiaux

1932. Mem. Mus. Zool. Univ. Coimbra, ser. 1, No. 55, p. 15.

In error for *Aeoloderma* Fleutiaux, 1928.

Aelus Chagnon

1935. Nat. Canadien, vol. 62, p. 133.

In error for *Aeolus* Eschscholtz, 1829.

Aemidioides Fleutiaux

1922. Bull. Mus. Hist. Nat., Paris, vol. 28, p. 47.

TYPE: *Aemidioides rohan-chaboti* Fleutiaux, loc. cit. (Monobasic.)

Aeoloderma Fleutiaux

1928. Encyclopédie Entomologique, ser. B, pt. 1, vol. 3, p. 135.

TYPE: *Elater crucifer* Rossi, Fauna Etrusca, vol. 1, p. 183, 1790. (Original designation.)

Agriodratus Reitter

1911. Fauna Germanica, vol. 3, p. 222.

TYPE: *Elater pallidulus* Illiger, Mag. Insekt., vol. 6, p. 6, 1807. (Original designation.)

Agriotella Brown

1933. Canadian Ent., vol. 65, p. 179.

TYPE: *Elater bigeminatus* Randell, Boston Journ. Nat. Hist., vol. 2, p. 37, 1838. (Original designation.)

Agrypnus Eschscholtz

1829. In Thon, Ent. Archiv, vol. 2, No. 1, p. 32, January 1829.

TYPE: *Elater murinus* Linnaeus, Systema Naturae, ed. 10, p. 406, 1758. (Designated by Westwood, Introduction to the Modern Classification of Insects, vol. 2, synopsis, p. 26, 1838.)

Aiolus Wilson

1941. Florida Ent., vol. 24, p. 26.

In error for *Aeolus* Eschscholtz, 1829.

Alestrus Méquignon

1942. Bull. Soc. Ent. France, vol. 47, p. 10.

TYPE: *Elastrus dolosus* Crotch, Proc. Zool. Soc. London (1867), p. 386, 1867. (Monobasic and original designation.)

Anchastelater Fleutiaux

1928. Encyclopédie Entomologique, ser. B., pt. 1, vol. 3, p. 144.

TYPE: *Anchastelater ornatus* Fleutiaux, loc. cit. (Original designation and monobasic.)

Anischia Fleutiaux

1896. Mém. Soc. Zool. France, p. 300.

TYPE: *Anischia boliviana* Fleutiaux, loc. cit. (Designated by Fleutiaux, Ann. Soc. Ent. France, vol. 105, p. 292, 1936.)

Fleutiaux designated *Anischia languarioides* Fleutiaux, 1931, as genotype of *Anischia* (Bull. Ann. Soc. Ent. Belgique, vol. 71, p. 80, 1931) but the designation is invalid because *A. languarioides* was not an originally included species.

Antoligostethus Blackburn

1911. Trans. Roy. Soc. South Australia, vol. 35, p. 203.

TYPE: *Antoligostethus lucidus* Blackburn, loc. cit. (Monobasic.)

Aphanopenthes Fleutiaux

1932. Ann. Soc. Ent. France, vol. 101, p. 35.

TYPE: *Aphanopenthes acutipennis* (Germar) (= *Aphanobius acutipennis* Germar), Zeitschr. Ent., vol. 5, p. 187, 1844. (Present designation.)

Ascoliocerus Méquignon

1930. Bull. Soc. Ent. France, p. 94.

TYPE: *Hypnoidus basalis* Motschulsky, Mém. Biol. Acad. St. Petersbourg, vol. 3, p. 227, 1859. (Original designation.)

This is a new name for the subgenus *Scoliocerus* Motschulsky, 1859, not Wollaston, 1854.

Athoina Reitter

1906. In Heyden, Reitter, and Weise, Catalogus Coleopterorum Europae . . . , ed. 2, p. 399.

TYPE: *Athous revelieri* Mulsant, Ann. Soc. Linn. Lyon, p. 416, 1874. (Present designation.)

Athous Eschscholtz

1829. In Thon, Ent. Archiv, vol. 2, No. 1, p. 33.

TYPE: *Elater vittatus* Fabricius, Entomologia Systematica, vol. 1, pt. 2, p. 224, 1792. (Designated by Westwood, Introduction to the Modern Classification of Insects, vol. 2, synopsis, p. 26, 1838.)

Atoloderma Fleutiaux

1934. Bull. Soc. Ent. France, vol. 39, p. 182.

In error for *Aeoloderma* Fleutiaux, 1928.

Aulacon Arnett

1952. Wasmann Journ. Biol., vol. 10, p. 112.

TYPE: *Lepidotus (Aulacon) nobilis* (Fall) (= *Adelocera nobilis* Fall) Canadian Ent., vol. 64, p. 58, 1932. (Original designation.)

Betarmou Schenkling

1927. Coleopterorum Catalogus, pt. 88, p. 543.

In error for *Betarmon* Kiesenwetter, 1863.

Blaiseus Fleutiaux

1931. Bull. Soc. Zool. France, vol. 56, pp. 307, 308.

TYPE: *Blaiseus bedeli* Fleutiaux, *ibid.*, p. 308. (Monobasic.)

Brachygonus Buysson

1912. Bull. Soc. Roumaine Sci., vol. 21, p. 139.

TYPE: *Brachygonus megerlei* (Boisduval and Lacordaire) (= *Elater megerlei* Boisduval and Lacordaire), Faune Entomologique . . . Paris, p. 656, 1835. (Monobasic.)

Brevicerus Fleutiaux

1940. Bull. Ann. Soc. Ent. Belgique, vol. 80, p. 102.

TYPE: *Brevicerus cylindricus* Fleutiaux, *loc. cit.* (Original designation.)

Bruyantius Fleutiaux

1925. Bull. Soc. Ent. France, p. 101.

TYPE: *Bruyantius capensis* Fleutiaux, *ibid.*, p. 102. (Monobasic.)

Buffeventius Fleutiaux

1925. Bull. Soc. Ent. France, p. 102.

TYPE: *Buffeventius lividus* Fleutiaux, *ibid.*, p. 103. (Monobasic.)

Cardiohypnus Miwa

1930. Trans. Nat. Hist. Soc. Formosa, vol. 20, p. 11.

In error for *Cardiohypnus* Fleutiaux, 1928.

Calostirus Thomson

1864. Skandinaviens Coleoptera, vol. 6, p. 67.

In error for or isogenotypic with *Anostirus* Thomson, 1859, p. 103.

Campsodernus Fleutiaux

1927. Faune des Colonies Françaises, vol. 1, pt. 3, p. 116.

In error for *Campsosternus* Latreille, 1834.

Campsosternus Miwa

1929. Trans. Nat. Hist. Soc. Formosa, vol. 19, p. 241.

In error for *Campsosternus* Latreille, 1834.

Candezella Szombathy

1910. Ann. Mus. Nat. Hungarici, vol. 8, p. 354.

TYPE: *Candezella horvathi* Szombathy, *ibid.*, p. 356, fig. 1. (Present designation.)

Cardiohypnus Fleutiaux

1929. Bull. Soc. Ent. France, p. 23.

In error for *Cardiohypnus* Fleutiaux, 1928.

Cardiohypnus Fleutiaux

1928. Bull. Soc. Ent. France, p. 284.

TYPE: *Cardiophorus mirabilis* Candèze, Monographie des Élatérides, vol. 3, p. 142, 1860. (Original designation.)

Cardiophorus Eschscholtz

1829. *In* Thon, Ent. Archiv., vol. 2, No. 1, p. 34.

TYPE: *Elater thoracicus* Fabricius, Systema Entomologiae, p. 214, 1775. (Designated by Westwood, Introduction to the Modern Classification of Insects, vol. 2, synopsis, p. 26, 1838.)

Cardiotarsus Lacordaire

1857. Histoire Naturelle des Insectes. Genera des Coléoptères, vol. 4, pp. 168, 192.

TYPE: *Cardiotarsus capensis* Lacordaire, *ibid.*, p. 193. (Monobasic.)

Catelanus Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, p. 112.

TYPE: *Hemirhipus trilineatus* Castelnau, Revue Entomologique, vol. 4, p. 12, 1836. (Monobasic.)

Cavicoxum Pic

1928. Mél. Exot.-Ent., vol. 51, p. 21.

TYPE: *Cavicoxum monstrosum* Pic, *loc. cit.* (Monobasic.)

Ceroleptus Fleutiaux

1927. Faune des Colonies Françaises, vol. 1, pt. 3, pp. 121, 122.

TYPE: *Ceroleptus brevicollis* (Candèze), Élatérides Nouveaux, pt. 2, p. 10, 1878. (Present designation.)

Ceropectus Fleutiaux

1927. Faune des Colonies Françaises, vol. 1, pt. 3, pp. 110, 117, 118.

TYPE: *Pectocera messi* Candèze, Révision de la Monographie des Élatérides, fasc. 1, p. 207, 1874. (Monobasic.)

Chalcolepidinus Pjatakowa

1941. Deutsche Ent. Zeitschr., p. 104. (Publication not seen.)

In error for *Chalcolepidius* Eschscholtz, 1829?

Chatanayus Fleutiaux

1940. Ann. Soc. Ent. France, vol. 108, pp. 122, 124.

TYPE: *Agonischius ruficollis* Fleutiaux, Ann. Soc. Ent. France, vol. 87, p. 267, 1918. (Monobasic.)

Chesotraxus Fleutiaux

1940. Bull. Ann. Soc. Ent. Belgique, vol. 80, pp. 98, 99.

TYPE: *Chesotraxus celebensis* Fleutiaux, *ibid.*, pp. 99, 100. (Original designation.)

Chiagosnius Fleutiaux

1940. Ann. Soc. Ent. France, vol. 108, p. 136.

TYPE: *Elater obscuripes* Gyllenhal. *In* Schoenherr, Synonymia Insectorum . . . , vol. 3, append., p. 131, 1817. (Original designation.)

Cleniocerus Stephens

1829. The Nomenclature of British Insects, p. 10.

TYPE: *Elater pectinicornis* Linnaeus, Systema Naturae, ed. 10, p. 405, 1758. (Designated by Lane, Proc. Ent. Soc. Washington, vol. 50, p. 182, 1948.)

Colaulon Arnett

1952. Wasmann Journ. Biol., vol. 10, p. 116.

TYPE: *Colaulon rectangularis* (Say) (= *Elater rectangularis* (Say)), Ann. Lyc. Nat. Hist. New York, vol. 1, p. 263, 1825. (Original designation.)

Conobajulus Van Zwaluwenberg

1940. Occ. Pap. Bishop Mus., vol. 16, p. 95.

TYPE: *Conobajulus ugiensis* Van Zwaluwenberg, *ibid.*, p. 96. (Original designation and monobasic.)

Coresus Gemminger and Harold

1869. Coleopterorum Catalogus, vol. 5, p. 1509.

TYPE: *Piezophyllus spencei* Hope, Proc. Zool. Soc. London (1842), p. 76, 1842. (Validation in synonymy of *Piezophyllus*, takes same genotype as *Piezophyllus*.)

Coryleus Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, p. 94.

TYPE: *Coryleus desruisseauxi* Fleutiaux, *loc. cit.* (Monobasic.)

Cratonychus Dejean

1833. Catalogue de la Collection de Coléoptères . . . , ed. 3, p. 87.

TYPE: *Elater obscurus* Olivier, Entomologie, ou Histoire Naturelle des Insectes . . . , Coléoptères, vol. 2, No. 31, p. 29, pl. 8, fig. 6, 1790. (Designated by Blanchard, Histoire des Insectes, vol. 2, p. 76, 1845.)

Crypnoideus Fleutiaux

1928. Bull. Soc. Ent. France, p. 252.

TYPE: *Quasimus setosus* Buysson, Coléopt. Rundschau, vol. 3, p. 42, 1914. (Original designation.)

Cryptohypnus Eschscholtz

1830. Quatember, vol. 2, No. 3, p. 17.

TYPE: *Elater riparius* Fabricius, Entomologia Systematica, vol. 1, No. 2, p. 232, 1792. (Designated by Thomson, Skandinaviens Coleoptera, vol. 1, p. 106, 1859.)

Cryptypnus Munster

1935. Norsk Ent. Tidsskr., vol. 3, pp. 362-369. (Emendation for *Cryptohypnus* Eschscholtz, 1833.)

Csikia Szombathy

1910. Ann. Mus. Nat. Hungarici, vol. 8, p. 359.

TYPE: *Csikia dimatoides* Szombathy, *ibid.*, p. 360. (Monobasic.)

Ctenicera Latreille

1829. Crustacés, Arachnides et Partie des Insectes. *In* Cuvier, Le Règne Animal . . . , ed. 2, vol. 4, p. 454, April 1829.

TYPE: *Elater pectinicornis* Linnaeus, Systema Naturae, ed. 10, p. 406, 1758. (Designated by Lane, Proc. Ent. Soc. Washington, vol. 50, p. 182, 1948.)

Ctenicerus Stephens

1830. Illustrations of British Entomology . . . Mandibulata, vol. 3, p. 264.

TYPE: *Elater pectinicornis* Linnaeus, Systema Naturae, ed. 10, p. 405, 1758. (Designated by Westwood, Introduction to the Modern Classification of Insects, vol. 2, synopsis, p. 26, 1838.)

Cteniocerus Miwa

1934. Rep. Dep. Agric. Gov. Res. Inst. Formosa, No. 65, p. 167.

In error for *Ctenicera* Latreille, 1829?

Ctenocera Stepanov

1935. Ent. Nachrichten, vol. 9, pp. 187-189.

In error for *Ctenicera* Latreille, 1829.

Ctenonyphus Castelnau

1836. Revue Entomologique, vol. 4, p. 7.

In error for *Ctenonychus* Stephens, 1830 (*ibid.*, p. 6).

Curtisius Miwa

1934. Rep. Dep. Agric. Gov. Res. Inst. Formosa, No. 65, pp. 23, 24.

TYPE: *Aplotarsus maritimus* Curtis, Ann. Mag. Nat. Hist., vol. 5, p. 277, 1840. (Original designation.)

New name for *Aplotarsus* Curtis, 1854, not Stephens, 1830.

Dactylosimus Fleutiaux

1922. Trans. Ent. Soc. London, pp. 429, 430.

TYPE: *Dactylosimus dorsalis* Fleutiaux, *ibid.*, p. 431. (Monobasic.)

Dalopius Eschscholtz

1829. *In* Thon, Ent. Archiv, vol. 2, No. 1, p. 34.

TYPE: *Elater marginatus* Fabricius, Systema Eleutheratorum . . . , vol. 2, p. 236, 1801. (Designated by Westwood, 1838.)

Delox Quelle

1932. Coleopt. Centralblatt, vol. 5, p. 208.

TYPE: *Adelocera conspersa* (Gyllenhal) (= *Elater conspersa* Gyllenhal), Insecta Suecica, vol. 1, p. 377. (Present designation.)

Isogenotypic with *Danosoma* Thomson, 1864.

Diacanthus Latreille (not Rudolphi, 1819)

1834. Ann. Soc. Ent. France, ser. 1, vol. 3, p. 151.

TYPE: *Elater aeneus* Linnaeus, Systema Naturae, ed. 10, p. 406, 1758. (Designated by Thomson, Skandnaviens Coleoptera, vol. 1, p. 102, 1859.)

Isogenotypic with *Aphotistus* Kirby, 1837.

Dichonychus Méquignon

1931. Bull. Soc. Ent. France, p. 207.

In error for *Dicronychus* Castelnau, 1840.

Dicronychus Brullé (not Castelnau, 1840)

1832. Arachnides-Myriapodes-Insectes-Annélides, in Expédition Scientifique de Morée, vol. 3, pt. 1, sec. 2, p. 138.

TYPE: *Elater obesus* Brullé, loc. cit. (Present designation.)

This genus is distinct from *Dicronychus* Castelnau, 1840, which is a synonym of *Lanelater* Arnett, 1952.

Diocarphus Fleutiaux

1947. Notes d'Ent. Chinoise, vol. 11, p. 364.

TYPE: *Phorocardius solitarius* Fleutiaux, Bull. Soc. Zool. France, vol. 56, pp. 309, 310, 1931. (Monobasic.)

Diphyaulon Arnett

1952. Wasmann Journ. Biol., vol. 10, p. 111.

TYPE: *Lepidotus (Diphyaulon) pyrsolepis* (LeConte) (= *Adelocera pyrsolepis* LeConte) Proc. Acad. Nat. Sci. Philadelphia, vol. 18, p. 389, 1866. (Original designation.)

Diplocconus Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 208.

In error for *Diploconus* Candèze, 1860.

Discrepeidius Van Dyke

1932. Proc. California Acad. Sci., ser. 4, vol. 20, p. 325.

In error for *Dicrepeidius* Eschscholtz, 1829.

Dolopus Méquignon

1930. Bull. Soc. Ent. France, p. 94.

In error for *Dalopius* Eschscholtz, 1829.

Domeneplus Fleutiaux

1932. Bull. Mus. Hist. Nat., Paris, ser. 2, vol. 4, p. 277.

TYPE: *Phedomenus flavangulus* Candèze, Ann. Soc. Ent. Belgique, vol. 39, p. 1895. (Designated by Fleutiaux, Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, p. 104, 1935.)

Dresterius Brullé

1832. Arachnides-Myriapodes-Insectes-Annélides, in Expédition Scientifique de Morée, vol. 3, pt. 1, sec. 2, p. 141.

In error for *Drasterius* Eschscholtz, 1829.

Endicronychus Fleutiaux

1935. Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, p. 95.

In error for *Eudicronychus* Méquignon, 1931.

Eudicronychus Méquignon

1931. Bull. Soc. Ent. France, p. 207.

TYPE: *Dicronychus serraticornis* Castelnau, Histoire Naturelle des Insectes, vol. 1, Coléoptères, p. 251, 1840. (Original designation.)

Eupsephus Fleutiaux

1935. Coleoptera V. Elateridae, in Mission Scientifique de l'Omo, vol. 2. Mém. Mus. Hist. Nat., Paris, new ser., vol. 2, p. 204. Parts of Mission Scientifique de l'Omo were issued as a separate series.

TYPE: *Eupsephus dilaticollis* Fleutiaux, loc. cit. (Original designation.)

Exophthalmus Berthold (not Schoenherr, 1823)

1827. Latreille's Natürliche Familien des Thierreichs, p. 335.

TYPE: *Elater linearis* Linnaeus, Systema Naturae, ed. 10, p. 404, 1758. (Designated by Hyslop, Proc. U. S. Nat. Mus., vol. 58, p. 646, 1921, as *Exophthalmus* Latreille, 1829, which is a later reference to this same genus.)

Fleutiauxellus Méquignon

1930. Bull. Soc. Ent. France, p. 95.

TYPE: *Hypnoidus maritimus* Curtis, Ann. Nat. Hist., vol. 5, p. 277, 1840. (Original designation.)

Fusimorphus Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, p. 111.

TYPE: *Hemirhipus submetallicus* Fleutiaux, Bull. Soc. Ent. France, p. 184, 1924. (Monobasic.)

Gamepentes Fleutiaux

1928. Encyclopédie Entomologique, ser. B, pt. 1, vol. 3, p. 158.

TYPE: *Megapentes octomaculatus* Schwarz, Deutsche Ent. Zeitschr., p. 144, 1898. (Original designation.)

Ganoxanthus Fleutiaux

1928. Encyclopédie Entomologique, ser. B., pt. 1, vol. 3, p. 156.

TYPE: *Melanoxanthus virgatus* Candèze, Monographie des Élatérides, vol. 2, p. 516, 1859. (Original designation.)

Georgicus Gistel

1948. Naturgeschichte des Thierreichs . . . , p. 190.

TYPE: *Georgicus sanguinipennis* Gistel, loc. cit. (Monobasic.)

Geraniella Gourley

1950. Trans. Proc. Roy. Soc. New Zealand, vol. 78, p. 192.
(New name for *Geranus* Sharp, 1877, not Bonaparte, 1854.)

Gnathodictus Fleutiaux

1934. Bull. Soc. Ent. France, vol. 39, pp. 183, 184.

TYPE: *Gnathodictus francki* Fleutiaux, loc. cit. (Monobasic.)

Gonodyrus Fleutiaux

1923. Trans. Ent. Soc. London (1922), p. 429.

TYPE: *Gonodyrus tarsalis* Fleutiaux, ibid., p. 430. (Monobasic.)

Gyrus Jacobson

1913. Zhuiki Rossicae, fasc. 10, p. 740. (Publication not seen.)

TYPE: *Selatosomus guttatus* (Germar) (= *Diacanthus guttatus* Germar), Fauna Insectorum Europae, vol. 21, No. 5, 1817.
(Present designation.)

Haupathesus Miwa

1928. Insecta Matsumurana, vol. 2, p. 133.

In error for *Hapatesus* Candèze, 1863.

Hemirhaphes Fleutiaux

1930. Bull. Mus. Hist. Nat., Paris, ser. 2, vol. 2, p. 639.

In error for *Hemirrhaphes* Candèze, 1878.

Hemirhipus Berthold

1827. Latreille's Natürliche Familien des Thierreichs, p. 336.

TYPE: *Elater lineatus* Olivier, Entomologie, ou Histoire Naturelle des Insectes . . . , Coléoptères, vol. 2, No. 31, p. 10, pl. 6, fig. 63, 1790. (Monobasic.)

Hoabinh Fleutiaux

1940. Bull. Soc. Zool. France, vol. 65, p. 195.

TYPE: *Hoabinh coomani* Fleutiaux, loc. cit. (Monobasic.)

Horizoteichos Van Zwaluwenburg

1931. Proc. Hawaii Ent. Soc., vol. 7, p. 432, 433.

TYPE: *Horizoteichos papuensis* Van Zwaluwenburg, ibid., p. 432.
(Monobasic and original designation.)

Hypdonus Fleutiaux

1928. Bull. Soc. Ent. France, p. 149.

TYPE: *Hypnoidus bakeri* Fleutiaux, Philippine Journ. Sci., ser. D., vol. 9, p. 446, 1914. (Monobasic.)

Hypnoidus Dillwyn

1829. Memoranda Relating to Coleopterous Insects in the Neighborhood of Swansea, p. 32.

TYPE: *Elater riparius* Fabricius, Entomologia Systematica, p. 232, 1792. (Designated by Westwood, Introduction to the Modern Classification of Insects, vol. 2, synopsis, p. 26, 1838.)

Hypolittus Weber

1950. Trans. American Ent. Soc., vol. 76, p. 183.

In error for *Hypolithus* Eschscholtz, 1829.

Idiotarmon Binaghi

1940. Bull. Soc. Ent. Italiana, vol. 72, p. 101.

TYPE: *Betarmon quadrivittatus* Ragusa, Nat. Siciliano, vol. 12, p. 305, 1893. (Original designation and monobasic.)

Ipostirus Binaghi

1940. Mem. Soc. Ent. Italiana, vol. 19, p. 211.

TYPE: *Ipostirus parumcostatus* (Buysson) (= *Ludius parumcostatus* Buysson), Faune Gallo-rhénane . . . , vol. 5, p. 80, 1894. (Original designation.)

Jonthadocerus Buysson

1918. Bull. Soc. Hist. Nat. Afrique Nord, vol. 9, p. 109.

TYPE: *Jonthadocerus theryi* Buysson, *ibid.*, p. 110. (Monobasic.)

Kudius Miwa

1928. Insecta Matsumurana, vol. 2, p. 140.

In error for *Ludius* Berthold?

Lacais Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, p. 109.

TYPE: *Lacais glauca* (Castelnau) (= *Iphis glauca* Castelnau), Rev. Ent., vol. 4, p. 9, 1836. (Present designation.)

Possibly should be considered monobasic, but not clear.

Lamononia Van Zwaluwenburg

1928. Insects of Samoa, vol. 4, pt. 2, p. 118.

TYPE: *Lamononia monticola* Van Zwaluwenburg, *loc. cit.* (Monobasic.)

Lampropsephus Fleutiaux

1928. Encyclopédie Entomologique, ser. B., pt. 1, vol. 3, p. 104.

TYPE: *Psephus cyaneus* Candèze, Élatérides Nouveaux, vol. 2, p. 11, 1878. (Monobasic.)

Lanelater Arnett

1952. Wasmann Journ. Biol., vol. 10, p. 105.

TYPE: *Lanelater schotti* (LeConte) (= *Agryphus schotti* LeConte), Trans. American Philos. Soc., vol. 10, p. 492, 1853. (Original designation.)

Lasiocerus Buysson

1912. Bull. Soc. Ent. France, p. 129.

TYPE: *Cardiophorus schusteri* Buysson, *ibid.*, p. 128. (Present designation.)

Lepidotus Stephens (not Asso, 1801, Anales Cien. Nat. (Madrid))

1830. Illustrations of British Entomology . . . Mandibulata, vol. 3, p. 374.

Zalepia Arnett, 1953, replaces this homonym.

Lesnelater Fleutiaux

1935. Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, p. 116.

TYPE: *Pachyelater madagascariensis* Lesne, Bull. Soc. Ent. France, p. 173, 1906. (Original designation.)

New name for *Pachyelater* Lesne, 1906 (not Lesne, 1897) *ibid.*, p. 174.

Lincydrus Fleutiaux

1932. Bull. Soc. Ent. France, vol. 37, p. 148.

TYPE: *Lincydrus cylindricus* Fleutiaux, *ibid.*, p. 149. (Monobasic.)

Lobitarsus Fleutiaux

1935. Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, p. 93.

In error for *Lobotarsus* Schwarz, 1898.

Ludius Berthold

1827. Latreille's *Natürliche Familien des Thierreichs*, p. 336.

TYPE: *Elater ferrugineus* Linnaeus, *Systema Naturae*, ed. 10, p. 405, 1758. (Monobasic.)

Magacnemis Hyslop

1921. Proc. U. S. Nat. Mus., vol. 58, p. 655.

In error for *Megacnemis* Schwarz, 1906.

Malekula Van Zwaluwenburg

1940. Occ. Pap. Bishop Mus., vol. 16, p. 129.

TYPE: *Malekula piceus* Van Zwaluwenburg, *ibid.*, p. 130. (Original designation and monobasic.)

Mallerius Fleutiaux

1933. Bull. Soc. Ent. France, vol. 38, p. 280.

TYPE: *Mallerius brasiliensis* Fleutiaux, *loc. cit.* (Monobasic.)

Melanatractus Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, pp. 200, 201.

TYPE: *Melanatractus acutus* Fleutiaux, *loc. cit.* (Monobasic and original designation.)

Melanotus Eschscholtz

1829. *In* Thon, *Ent. Archiv.*, vol. 2, p. 32.

TYPE: *Elater fulvipes* Herbst, *Natursystem . . . Insekten, Käfer*, vol. 10, p. 46, pl. 162, fig. 2, 1806. (Designated by Westwood, *Introduction to the Modern Classification of Insects*, vol. 2, synopsis, p. 26, 1838.)

Melanoxanthus Miwa

1930. Wiener Ent. Zeit., vol. 47, p. 97.

In error for *Melanoxanthus* Eschscholtz, 1836.

Meristhus Candèze

1857. *Monographie des Élatérides*, vol. 1, p. 162.

TYPE: *Meristhus scobinula* Candèze, *ibid.*, p. 164. (Designated by Candèze, *Élatérides Nouveaux*, fasc. 6, p. 12, 1896.)

Metactenicerus Miwa

1934. Rep. Dep. Agric. Gov. Res. Inst. Formosa, No. 65, p. 37.

TYPE: *Corymbites gratus* Lewis, Ann. Mag. Nat. Hist. ser. 6, vol. 13, p. 262, 1894. (Original designation.)

Mopleonus Fleutiaux

1935. Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, pp. 114–115.

TYPE: *Mopleonus candezei* (Fleutiaux) (= *Nomopleus candezei* Fleutiaux), Insectes Coléoptères, in Alluaud and Jeannel, Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911–1912), vol. 13, p. 108, 1919. (Original designation.)

Neolacon Miwa

1929. Trans. Nat. Hist. Soc. Formosa, vol. 19, pp. 225, 234–236.

TYPE: *Neolacon formosanus* Miwa, *ibid.*, pp. 235–236. (Original designation.)

Neonomopleus Schenkling

1927. Coleopterorum Catalogus, pt. 88, pp. 308, 331.

TYPE: *Neonomopleus strictus* Candèze, Monographie des Élatérides, vol. 4, p. 498, 1863. (Present designation.)

New name for *Nomopleus* Reitter, 1891 (not Candèze, 1891.)

Nomopleus Candèze

1891. Catalogue Méthodique des Élatérides, p. 213.

TYPE: *Pleonomus argentatus* Candèze, Monographie des Élatérides, vol. 4, p. 499, 1863. (Present designation.)

Nullaborica Blackburn

1911. Trans. Roy. Soc. South Australia, vol. 35, p. 202.

TYPE: *Nullaborica concinna* Blackburn, *loc. cit.* (Monobasic.)

Nyctor Semenov-Tian-Shanskij and Pjatakova

1936. Československá Spol. Ent., vol. 33, pp. 101, 102.

TYPE: *Nyctor expallidus* Semenov-Tian-Shanskij and Pjatakova, *ibid.*, pp. 102, 103. (Monobasic and original designation.)

Odontocardus Fleutiaux

1931. Bull. Soc. Zool. France, vol. 56, pp. 307, 332.

TYPE: *Cardiophorus vitalisi* Fleutiaux, Ann. Soc. Ent. France, vol. 87, p. 231, 1918. (Original designation.)

Ovalpalpus Orellana

1939. Rev. Chilena Hist. Nat., vol. 42, p. 165.

In error for *Ovipalpus* Solier, 1851.

Pacificola Van Zwaluwenburg

1932. Bull. Bishop Mus., vol. 98, pp. 131–133.

TYPE: *Pacificola obscura* Van Zwaluwenburg, *ibid.*, pp. 133–135. (Original designation.)

Paracapiophonus Fleutiaux

1929. Bull. Soc. Ent. France, p. 23.

In error for *Paracardiophorus* Schwarz, 1895.**Paradaxon** Fleutiaux

1929. Ann. Soc. Ent. France, vol. 98, p. 224.

In error for *Paradoxon* Fleutiaux, 1903.**Paradima** Miwa

1929. Insecta Matsumurana, vol. 3, pp. 36-39.

TYPE: *Paradima tattakensis* Miwa, op. cit., p. 38. (Monobasic and original designation.)**Parastirus** Binaghi

1940. Mem. Soc. Ent. Italiana, vol. 19, pp. 197, 204.

TYPE: *Elater purpureus* Poda von Neuhaus, Insecta Musaei Graecensis, p. 41, 1761. (Original designation.)**Parathous** Fleutiaux

1918. Ann. Soc. Ent. France, vol. 87, p. 242.

TYPE: *Parathous sanguineus* Fleutiaux, ibid., p. 126. (Monobasic.)**Paroedostethus** Van Dyke

1932. Proc. California Acad. Sci., ser. 4, vol. 20, p. 327.

TYPE: *Paroedostethus relictus* Van Dyke, ibid., p. 328. (Monobasic and original designation.)**Parvistoma** Fleutiaux

1929. Ann. Soc. Ent. France, vol. 98, pp. 230, 233-235.

TYPE: *Corymbites tenuicornis* Fleutiaux, Bull. Soc. Ent. France, p. 138, 1902. (Original designation.)**Patricia** Van Zwaluwenburg

1947. Proc. Hawaii Ent. Soc., vol. 13, p. 113.

TYPE: *Patricia australica* Van Zwaluwenburg, ibid., p. 114. (Monobasic and original designation.)**Pectoerra** Miwa

1929. Trans. Nat. Hist. Soc. Formosa, vol. 19, p. 239.

In error for *Pectocera* Hope, 1842.**Pectora** Reymond

1939. Misc. Ent., ann. 47, vol. 40, p. 34.

In error for *Pectocera* Hope, 1842.**Pengamethes** Fleutiaux

1928. Encyclopédie Entomologique, ser. B., pt. 1, vol. 3, p. 173.

TYPE: *Pengamethes fulvicollis* Fleutiaux, ibid., p. 176. (Original designation.)**Pharotarsus** Motschulsky

1861. Bull. Soc. Nat. Moscou, vol. 34, pt. 1, p. 119.

In error for *Phorotarsus* Motschulsky, 1859.

Pherhimius Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, pp. 112, 114.

TYPE: *Elater fascicularis* Fabricius, Mantissa Insectorum . . . , p. 171, 1787. (Original designation.)

Phibisa Fleutiaux

1942. Ann. Soc. Ent. France, vol. 111, p. 105.

TYPE: *Ctenicera pupieri* Fleutiaux, Bull. Soc. Ent. France, p. 228, 1903. (Original designation.)

Phorocardius Fleutiaux

1931. Bull. Soc. Zool. France, vol. 56, pp. 308-312.

TYPE: *Cardiophorus florentini* Fleutiaux, Ann. Soc. Ent. France, vol. 62, p. 687, 1894. (Original designation.)

Placonides Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 235.

In error for *Ploconides* Fleutiaux, 1933.

Ploconides Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 208.

TYPE: *Diploconus spiloderus* Candèze, Élatérides Nouveaux, vol. 1, p. 45, 1857. (Original designation.)

Practapyrus Fleutiaux

1929. Ann. Soc. Ent. France, vol. 98, pp. 223, 224, 227, 228, 242.

TYPE: *Practapyrus descarpentriesi* Fleutiaux, *ibid.*, p. 228. (Monobasic and original designation.)

Pristolophus Van Dyke

1932. Proc. California Acad. Sci., ser. 4, vol. 20, p. 442.

In error for *Pristilophus* Latreille, 1834.

Prodrasterius Fleutiaux

1927. Bull. Soc. Ent. France, p. 91.

TYPE: *Drasterius brahminus* Candèze, Monographie des Élatérides, vol. 2, p. 426, 1859. (Original designation.)

Prolacon Fleutiaux

1934. Bull. Soc. Ent. France, vol. 39, pp. 179, 180.

TYPE: *Prolacon allaudi* Fleutiaux, *loc. cit.* (Monobasic.)

Proquasimus Fleutiaux

1932. Soc. Ent. France, Livre de Centenaire, pp. 189, 191.

TYPE: *Cryptohypnus micros* Fairmaire, Ann. Soc. Ent. France, p. 204, 1903. (Monobasic.)

Pseudathous Méquignon

1930. Bull. Soc. Ent. France, p. 95.

TYPE: *Athous hirtus* (Herbst) (= *Elater hirtus* Herbst, Archiv der Insectengeschichte, vol. 5, p. 114, 1784). (Original designation.)

Pseudoderomecus Fleutiaux

1907. Rev. Chiliana Hist. Nat., vol. 11, p. 186.

TYPE: *Medonia fairmairei* Candèze, Élatérides Nouveaux, vol. 2, p. 31, 1878. (Monobasic.)

Pseudo-Elater Heer

1847. Neue Denkschr. Allgemeine Schweiz. Ges., vol. 8, p. 143.
(No incl. sp., fossil.)

Pseudonomopelus Fleutiaux

1931. Bull. Soc. Ent. France, pp. 29, 30.

TYPE: *Pleonomus niger* Candèze, Élatérides Nouveaux, vol. 2, p. 54, 1878. (Original designation.)

Pseudopristilophus Méquignon

1930. Bull. Soc. Ent. France, p. 93.

TYPE: *Pristilophus sericans* Germar, Zeitschr. Ent., vol. 4, p. 87, 1843. (Monobasic and original designation.)

Pseudostirus Binaghi

1940. Mem. Soc. Ent. Italiana, vol. 19, pp. 198, 221.

TYPE: *Corymbites sulphuripennis* Germar, Zeitschr. Ent., vol. 4, p. 55, 1843. (Original designation.)

Pulchronotus Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 206.

TYPE: *Diploconus ornatus* Candèze, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 10, p. 782, 1894. (Original designation.)

Raphaea Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 202.

TYPE: *Raphaea vitida* Fleutiaux, loc. cit. (Monobasic and original designation.)

Rastrocephalus Fleutiaux

1924. Opusc. Ent. Indochine Française, vol. 2, p. 140.

In error for *Rostricephalus* Fleutiaux, 1918.

Rhaciaspis Arnett

1952. Wasmann Journ. Biol., vol. 10, p. 121.

TYPE: *Elater lepidotus* Beauvois, Insectes Recueillis en Afrique et en Amérique . . . , p. 11, pl. 7, fig. 7, 1805. (Original designation.)

Rismethus Fleutiaux

1947. Notes d'Ent. Chinoise, vol. 11, pp. 242, 257.

TYPE: *Meristhus scabinula* (= *scobinula*) Candèze, Monographie des Élatérides, vol. 1, p. 164, 1857. (Original designation.)

Isogenotypic with *Meristhus*.

Roggevenia Van Zwaluwenburg

1928. Insects of Samoa, vol. 4, pt. 2, p. 120.

TYPE: *Roggevenia buxtoni* Van Zwaluwenburg, loc. cit. (Monobasic and original designation.)

Rostricephalus Fleutiaux

1918. Ann. Soc. Ent. France, vol. 87, p. 252.

TYPE: *Rostricephalus vitalisi* Fleutiaux, *ibid.*, p. 253. (Monobasic.)**Rygodonus** Fleutiaux

1932. Bull. Mus. Hist. Nat., Paris, ser. 2, vol. 4, pp. 856, 857.

TYPE: *Dorygonus alluaudi* Fleutiaux, *ibid.*, p. 863. (Original designation.)**Rymcobites** Fleutiaux

1936. Ann. Soc. Ent. France, vol. 105, pp. 280, 282.

TYPE: *Rymcobites singularis* Fleutiaux, *ibid.*, p. 282. (Monobasic and original designation.)**Semiotinus** Pjatakova

1941. Deutsch. Ent. Zeitschr., p. 107. (Not seen.)

Sicardius Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, p. 201.

TYPE: *Sicardius longicornis* Fleutiaux, *loc. cit.* (Monobasic and original designation.)**Sphenicosomus** Buysson

1894. Faune Gallo-rhénane . . . , vol. 5, p. 129.

In error for *Spheniscosomus* Schwarz, 1892.**Sternocampus** Fleutiaux

1927. Bull. Soc. Ent. France, p. 104.

TYPE: *Sternocampus villosus* Fleutiaux, *loc. cit.* (Monobasic.)**Subathous** Fleutiaux

1918. Ann. Soc. Ent. France, vol. 86, p. 203.

TYPE: *Subathous tonkinensis* Fleutiaux, *loc. cit.* (Monobasic.)**Subathrus** Schenkling

1925. Coleopterorum Catalogus, pt. 80, p. 82.

In error for *Subathous* Fleutiaux, 1918.**Sulcilacon** Fleutiaux

1927. Faune des Colonies Françaises, pp. 56, 65.

TYPE: *Adelocera geographica* Candèze, *Élatérides Nouveaux*, vol. 1, p. 7, 1865. (Original designation.)**Sulcimerus** Fleutiaux

1947. Notes d'Ent. Chinoise, vol. 11, p. 255.

TYPE: *Meristhus quadripunctatus* Candèze, *Monographie des Élatérides*, vol. 1, p. 163, 1857. (Present designation.)

Invalid genus, no genotype cited; here validated, assuming no previous designation.

Taiwanathous Miwa

1930. Trans. Nat. Hist. Soc. Formosa, vol. 20, pp. 66, 68.

TYPE: *Taiwanathous arisanus* Miwa, *ibid.*, p. 68. (Monobasic and original designation.)

Tenalomus^r Fleutiaux

1933. Ann. Soc. Ent. France, vol. 102, pp. 215, 234.

TYPE: *Tenalomus fulvipennis* Fleutiaux, *ibid.*, p. 234. (Monobasic.)**Thacana** Fleutiaux

1936. Ann. Soc. Ent. France, vol. 105, p. 282.

TYPE: *Corymbites cambodiensis* Fleutiaux, Ann. Soc. Ent. France, vol. 87, p. 250, 1918. (Monobasic and original designation.)**Tinecus** Fleutiaux

1940. Ann. Soc. Ent. France, vol. 108, pp. 122, 124, 125.

TYPE: *Agriotes (Ectinus) gratiosus* Fleutiaux, Bull. Soc. Ent. France, p. 278, figs. 1, 2, 1925. (Original designation.)**Trelasus** Fleutiaux

1922. Trans. Ent. Soc. London (1922), p. 420.

TYPE: *Trelasus antennalis* Fleutiaux, *loc. cit.* (Monobasic.)**Tyloarsus** Fleutiaux

1934. Bull. Soc. Zool. France, vol. 59, pp. 56, 60.

In error for *Tylotarsus* Germar, 1840.**Tyleudacus** Fleutiaux

1923. Trans. Ent. Soc. London (1922), p. 429 (Note).

TYPE: *Eudactylus wapléri* Sallé, Ann. Soc. Ent. France, ser. 3, vol. 3, p. 267, 1855. (New name for *Eudactylus* Sallé (not Fitzinger, 1843). (Monobasic.)Isogenotypic with *Platycrepidius* Candèze, 1859.**Vuilletus** Fleutiaux

1940. Ann. Soc. Ent. France, vol. 108, pp. 122-124.

TYPE: *Agonischius altus* Candèze, *Élatérides Nouveaux*, pt. 4, p. 54, 1889. (Original designation.)**Xanthelater** Miwa

1931. Trans. Nat. Hist. Soc. Formosa, vol. 21, p. 259.

TYPE: *Elater granulipennis* Miwa, Trans. Nat. Hist. Soc. Formosa, vol. 19, p. 489, 1929. (Original designation.)**Xantherater** Miwa

1934. Rep. Dep. Agric. Gov. Res. Inst. Formosa, No. 65, pp. 48, 197, 198.

In error for *Xanthelater* Miwa, 1931.**Xantholamprus** Fleutiaux

1935. Bull. Ann. Soc. Ent. Belgique, vol. 75, p. 304, August 1935.

TYPE: *Pantolamprus sulcicollis* Schwarz, Deutsche Ent. Zeitschr., p. 93, 1896. (Original designation.)

This genus also proposed as new by Fleutiaux in Journ. East Africa Uganda Nat. Hist. Soc., vol. 12, p. 96, March 1936. No genotype designated, three included species of which the above is one.

Xanthopenthes Fleutiaux

1928. Encyclopédie Entomologique, ser. B, pt. 1, vol. 3, p. 166.

TYPE: *Megapenthes birmanicus* Candèze, Ann. Mus. Civ. Stor.
Nat. Genova, p. 617, 1888. (Original designation.)

Yezodima Miwa

1928. Insecta Matsumurana, vol. 3, pp. 36, 40.

TYPE: *Yezodima convexuni* Miwa, *ibid.*, pp. 39, 40. (Original designation.)

Zalepia Arnett

1953. Coleopt. Bull., vol. 7, p. 7.

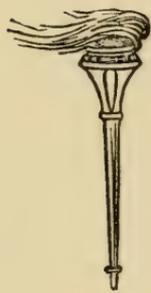
New name for *Lepidotus* Stephens, 1830 (not Asso, 1801).

Zorochros Thomson

1859. Skandinaviens Coleoptera, vol. 1, p. 106.

This is the original spelling, *Zorochrus* is the emendation.

×



PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

Issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103

Washington: 1955

No. 3337

NEOTROPICAL MIRIDAE, LXIV: NEW BUGS OF THE
SUBFAMILY CYLAPINAE (HEMIPTERA)

By JOSÉ C. M. CARVALHO¹

Through the courtesy of the U. S. National Museum I was able to study specimens of Cylapinae in that institution's collection, among which were found the new genera and species herein described.

Brachyfulvius, new genus

Cylapinae, Fulviini. Body rounded, strongly convex on hemielytra, distinctly shagreened and very short pubescent.

Head elongate, protruding between the antennae, somewhat horizontal, with a very short neck; eyes small, slightly removed from anterior margin of pronotum; vertex sulcate; seen from side, clypeus prominent, gula long; rostrum reaching about middle of abdomen, the first segment reaching level of base of head, remaining segments decreasing gradually in thickness.

Antennae inserted in front of eyes, removed from anterior margin of the latter by a space equal to thickness of base of first antennal segment, the latter thick, incrassate towards the apex, second segment linear, about 2.5 times longer than the first, both shortly pilose; third and fourth joints very slender and longly pilose.

Pronotum with a distinct collar, the calli strongly raised and forming two conical protuberances with a median furrow, both occupying an area of about three-fourths of disc, anterior margin of pronotum curved posteriorly, lateral margins rounded and depressed anteriorly, then

¹Museu Nacional, Rio de Janeiro, Brazil; John Simon Guggenheim Memorial fellow, 1953. Additional help granted by the Brazilian National Research Council.

strongly emarginate, humeral angles prominent, posterior margin widely emarginate; mesoscutum broadly exposed; scutellum small with a median conical protuberance.

Hemelytra brachypterous, shagreened, strongly convex at middle, without membrane, cuneus absent (in its place there is a calloused area over margin of corium), clavus, corium, and embolium fused but delineated at base, the embolial area flattened throughout.

Apex of abdomen, seen from above, showing a short anal tube. Legs shagreened, the anterior femora narrowed towards the apex, tibiae with short spines and hairs, tarsi long, claws of the Cylapinae type, very long and slender. Two last legs mutilated.

Type of genus, *Brachyfulvius chapini*, new genus, new species.

This genus is easily differentiated from others of the tribe Fulviini by its brachypterous condition and the strongly raised calli and scutellum. At first sight it resembles a small beetle.

Brachyfulvius chapini, new species

FIGURES 72, 74,a; PLATE 15,A

Characterized by its color, dimensions, and protuberances of pronotum.

Female: Length 2.8 mm., width 1.5 mm., head length 0.5 mm., width 0.6 mm., vertex 0.35 mm. Antennae segment I length 0.3 mm.; II, 0.8 mm.; III, 0.3 mm.; IV, 0.4 mm. Pronotum length 0.4 mm., width at base 0.9 mm. Rostrum length 1.7 mm.; segment I length 0.42 mm.; II, 0.45 mm.; III, 0.42 mm.; IV, 0.48 mm.

Color dark brownish; head, rostrum, antennae, legs, and embolial area lighter; apical callosity of corium and anal tube yellowish; second antennal segment whitish at apex; coxae light with a reddish tinge on the inner surface.

Morphological characters as given for genus. Male unknown.

Holotype: Female, USNM 61939, Cinchona, Jamaica, May 9, 1941, E. A. Chapin.

As in the genus *Corcovadocola* Carvalho, 1948, whose females are brachypterous, the males of *Brachyfulvius* are expected to be macrop-terous.

I take pleasure in naming this species for Dr. E. A. Chapin, who collected this interesting new genus and species of mirid.

Peritropoides, new genus

Cylapinae, Fulviini. Species of small size, body ovoid, smooth, beset with rigid semierect pubescence. Head inclined and pointed in front, vertex convex and inclined towards frons, posterior margin straight, frons strongly inclined in the same level of clypeus; eyes

divergent anteriorly, touching anterior angles of pronotum; seen from side, the eye is compressed and touches the gula below or nearly so. Rostrum reaching middle of abdomen or slightly beyond, the first segment thicker than the others, reaching slightly beyond the base of anterior coxae, remaining segments about subequal in length.

Antennae inserted a little above inferior line of orbita, touching anterior margin of eye, segment I very short, reaching about apex of clypeus, segment II subequal in thickness to the first and three times longer, linear, segments III and IV more slender, the fourth twice as long as third or so, the whole antenna covered by very short pubescence.

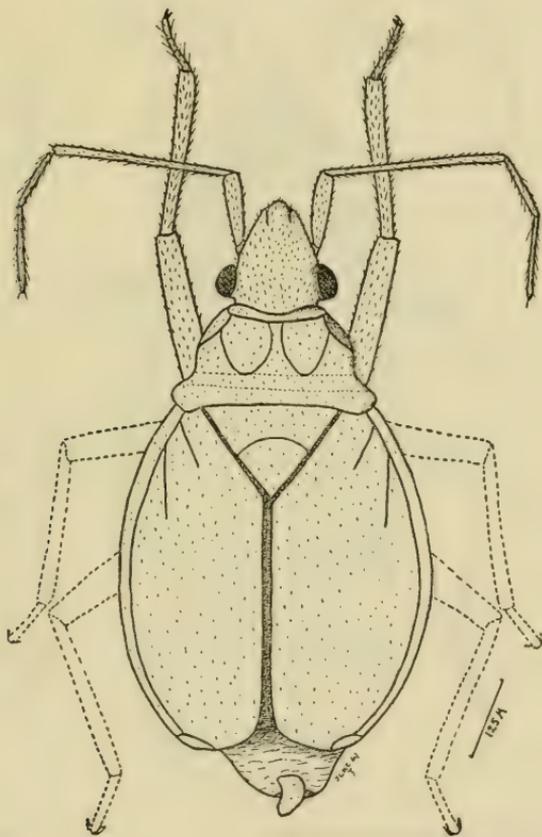


Figure 72.—*Brachyfulvius chapini*, new genus and new species, female, holotype; seen from above.

Pronotum slightly inclined towards the head, collar present, widest at middle and narrowed towards the sides, calli area somewhat raised on two anterior thirds of pronotum, lateral margins of disc rounded and declivous, posterior margin rounded at lateral angles, emarginate in front of mesoscutum; the latter prominent, carinate transversally at middle; scutellum relatively small, slightly convex.

Hemelytra smooth, densely pubescent, embolium more distinct towards the base, cuneus as long as wide at base, fracture distinct, incisure obsolete; membrane biareolate, very minutely pubescent (iridescent under reflected light).

Legs relatively short, the posterior femora incrassate, tibiae with slender spines and common pubescence, tarsi very long, claws of the Cylapinae type. Cleft of anterior coxae deeply incised.

Type of genus, *Peritropoides annulatus*, new species.

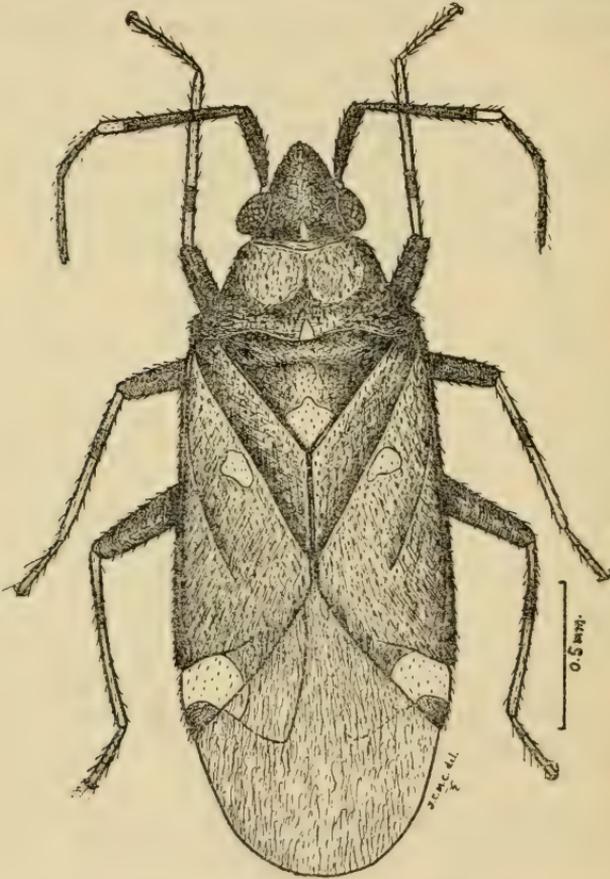


Figure 73.—*Fulvius albonotatus*, new species, male, holotype.

This genus is very near *Peritropis* Uhler, 1891, being easily distinguished, however, by the presence of a distinct collar, sides of pronotum not carinate, calli not raised, narrow embolium, vertex smooth, and body surface not shagreen.

Peritropoides annulatus, new species

PLATE 15,B

Characterized by its color, size, and structure of head.

Female: Length 2.2 mm., width 0.9 mm. Head: Length 0.2 mm., width 0.3 mm., vertex 0.22 mm. Antennae: Segment I length 0.1 mm.; II, 0.4 mm.; III, 0.2 mm.; IV, 0.3 mm. Pronotum: Length 0.3 mm., width at base 0.8 mm. Rostrum: Length 1.0 mm., segment I length 0.25 mm.; II, 0.28 mm.; III, 0.25 mm.; IV, 0.25 mm.

Color brownish with whitish spots or areas; head brown on vertex with two whitish spots bordering eye, clypeus and frons with brown and whitish areas, sides of head, clypeus, and first segment of rostrum reddish brown, remaining rostral segments yellowish; eyes dark brown; first antenna brown with whitish apex, second antenna with three whitish and two brown rings, third and fourth antennae brown with whitish apices; pronotum brown, especially at middle and lateral margins, with yellowish spots, the posterior margin with three distinct whitish spots, one adjacent to each lateral angle of mesoscutum and the third median; mesoscutum also with two whitish spots at base; scutellum brown with whitish apex; hemielytra with clavus and basal half of corium white with small brown dots, apical portion of corium and embolium brown to reddish brown (except a white spot on apex of embolium and external apical angle of corium reaching the middle of base of cuneus), cuneus reddish brown with extreme apex white; membrane infumate; underside darkish brown, apex of coxa reddish, trochanters and extreme apex of femora whitish, the posterior pair noticeably darker, tibiae yellow with a small black ring near base and a large one near middle, the anterior pair with a median and two basal rings; whitish apex of posterior femur with a reddish to brown ring.

Morphological characters as given for genus. Male unknown.

Holotype: Female, USNM 61940, Colombia (on orchid), intercepted at San Francisco, Calif., Dec. 16, 1940.

Peritropoides quadrinotatus, new species

FIGURES 74,b, 75,e,f, 76,b,f

Characterized by its color, dimensions, and structure of head.

Male: Length 3.0 mm., width 1.1 mm. Head: Length 0.3 mm., width 0.5 mm., vertex 0.24 mm. Antennae: Segment I length 0.2 mm.; II, 0.6 mm.; III, 0.3 mm.; IV, 0.5 mm. Pronotum: Length 0.4 mm., width at base 1.0 mm. Rostrum: Length 1.7 mm.; segment I length 0.42 mm.; II, 0.45 mm.; III, 0.42 mm.; IV, 0.45 mm.

Color yellowish mottled with brown, reddish marmorate on embolium, the hemielytra with four brown areas; head yellowish on vertex and frons (except for a small central brown spot at middle of vertex and two other bordering eye near base of frons), sides of head above antennae with a reddish brown fascia reaching from eye to clypeus, the latter variegated with red becoming solid reddish brown

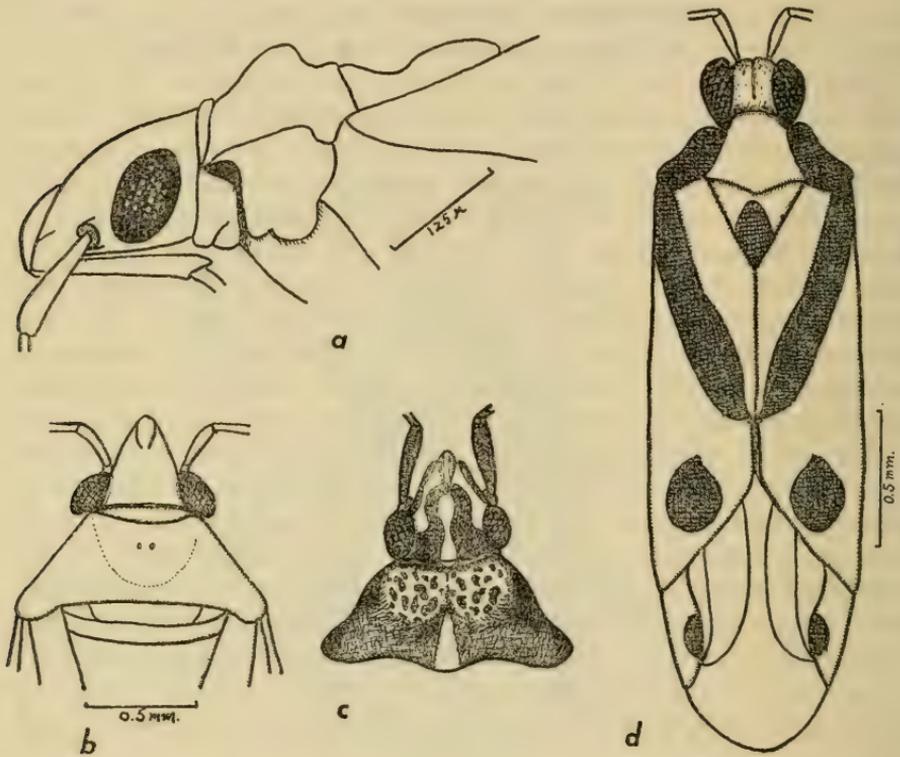


Figure 74.—*a*, *Brachyfulvius chapini*, new species, side view of head and pronotum; *b*, *Peritropoides quadrinotatus*, new species, head and pronotum from above; *c*, *Fulvius ornatifrons*, new species, head and pronotum of female, holotype; *d*, *Vannius oculus*, new species, showing color pattern.

towards the apex, genae and first rostral segment yellowish brown, gula brown, the remaining rostral segments yellowish; eyes brown; antennae yellowish, the apex of first joint with a reddish ring; pronotum variegated with brown, two roundish brown spots are to be seen over the collar and a brownish fascia behind each eye occupying also lateral margin of pronotum (on anterior margin, contiguous to eye there are two short whitish fasciae below and above the pronotal margin, which is also whitish), pleural region bark brown; mesoscutum with brown spots at basal angles and a more pronounced dark brown



A



B

A, *Brachyfulvius chapini*, new genus and new species, female, holotype. B, *Peritropoides annulatus*, new species, female, holotype.

median portion separated from angles by a whitish raised spot; scutellum brown with faint yellowish spots and whitish apex; hemelytra yellowish, variegated with brown externally and vice versa interiorly, clavus with two large median brown spots, embolium marmorated with red, corium with a faint brownish area beyond apex

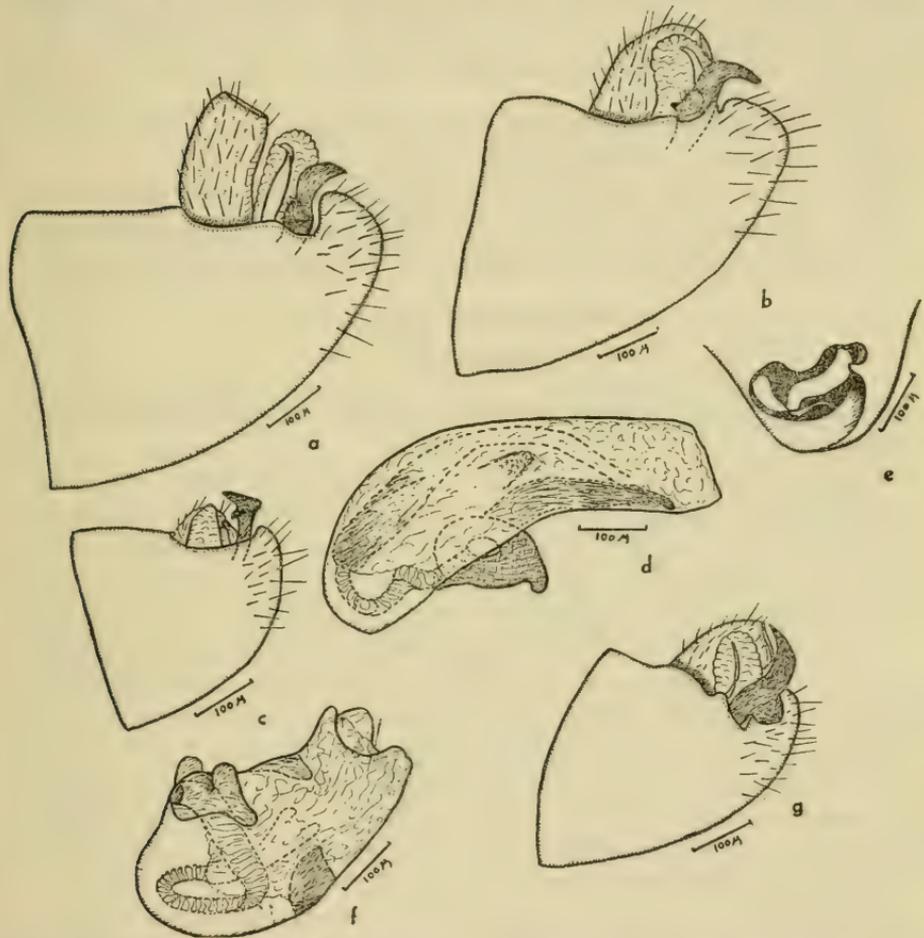


Figure 75.—Male genitalia: a, pygophore of *Fulvius castaneus*, new species, left side, lateral view; b, pygophore of *F. quadristillatus* (Stål), left side, lateral view; c, pygophore of *F. albonotatus*, new species, left side, lateral view; d, aedeagus of *F. castaneus*, new species; e, apex of pygophore of *Peritropoides quadrinotatus*, new species, seen from above; f, aedeagus of *P. quadrinotatus*; g, pygophore of *Fulvius bisbistillatus* (Stål), left side, lateral view.

of cubital vein, cuneus whitish with reddish apex and a well marked dark brown spot on inner basal angles; membrane infumate, the veins yellowish; underside of body yellowish at median line, the tergites becoming darker towards the upper surface, legs yellowish (coxae and trochanters), femora and tibiae mutilated.

Head more horizontal than in the preceding species, the eyes larger, straight posteriorly, coarsely granulose, second antennal segment slightly incrassate towards the apex, body pubescence long and semi-erect, eyes reaching the gula below.

Aedeagus (fig. 75, *f*) of the Cylapinae type, short and thick, without chitinized teeth internally. Left clasper (figs. 75, *e*, 76, *b, f*) curved, pointed apically, with a median short prong. Right clasper small, roundish apically, with a few setae.

Female unknown.

Holotype: Male, USNM 61941, Barro Colorado Island, Canal Zone, Panamá, July 1923, R. C. Shannon.

This species differs from *Peritropoides annulatus*, new species, by its color and structure of head. Its trivial name is derived from the four brown spots to be seen on clavus and internal angles of cuneus.

Vannius oculatus, new species

FIGURE 74,*d*

Characterized by its color, structure of eyes, and yellow first antennal segment.

Female: Length 2.7 mm., width 0.8 mm. Head: Length 0.3 mm., width 0.4 mm., vertex 0.14 mm. Antennae: Segment I length 0.2 mm.; II, 1.0 mm.; III, 1.3 mm.; IV, 0.4 mm. Pronotum: Length 0.2 mm., width at base 0.7 mm. Rostrum: Length 0.71 mm.; segment I length 0.17 mm.; II, 0.25 mm.; III, 0.14 mm.; IV, 0.14 mm.

Color yellowish with red areas; eyes, sides of pronotum, median portion of scutellum, corium bordering clavus and a small fascia on the latter joining the corial fascia, a round spot on apex of corium and a smaller one on internal margin of cuneus, frons and sides of head, pleural region, apex of abdomen, and base of same on upper surface, red; antennae (except red ring near apex and whitish apical portion), rostrum, coxae, and middle circular band of abdomen, yellow. The third antennal segment is fuscous at base.

Head small, sulcate on frons and vertex, eyes very large, elongate, narrowed posteriorly, longer than the head as seen from above; seen from side, eyes distant from gula by a space about equal to length of eye, lorum strongly enlarged, gula very short. Rostrum reaching very slightly beyond the hind coxae.

Pronotum with anterior margin raised and hooded over the vertex between the eyes, emarginate behind each eye, lateral margins rounded and slightly emarginate at middle, the posterior margin biconcave, humeral angles produced; mesoscutum exposed; scutellum elongate with acute apex.

Hemelytra elongate, the margins subparallel, cuneus very long, almost three times as long as wide at base, embolium very narrow, linear. Legs mutilated. Male unknown.

Holotype: Female, USNM 61942, Costa Rica (on bananas), intercepted at New York, May 11, 1936.

This species is similar to *Vannius rubrovittatus* Distant, 1893, but easily distinguished by the yellow first antennal segment, the eyes pointed posteriorly, and different color markings of apex of corium and cuneus.

Fulvius albonotatus, new species

FIGURES 73, 75,c, 76,d,f

Characterized by its small size, whitish spots of head and pronotum, and male genitalia.

Male: Length 2.4 mm., width 1.0 mm. Head: Length 0.3 mm., with 0.4 mm., vertex 0.21 mm. Antennae: Segment I length 0.2 mm.; II, 0.5 mm.; III, 0.2 mm.; IV, 0.4 mm. Pronotum: Length 0.2 mm., width at base 0.7 mm. Rostrum: Length 1.0 mm., segment I length 0.25 mm.; II, 0.28 mm.; III, 0.28 mm.; IV, 0.28 mm.

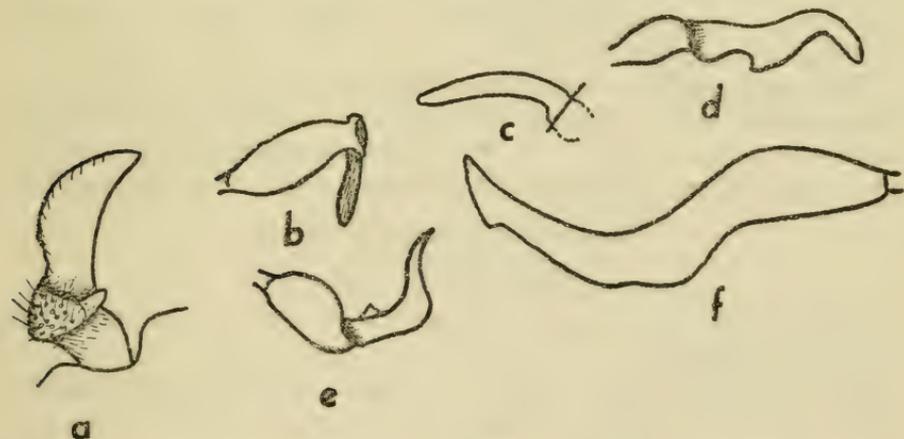


Figure 76.—Male claspers: a, *Fulvius castaneus*, new species, left clasper; b, *Peritropoides quadrinotatus*, new species, left clasper, dorsal view; c, *Fulvius castaneus*, new species, right clasper; d, *F. albonotatus*, new species, left clasper, dorsal view; e, *Peritropoides quadrinotatus*, new species, left clasper, ventral view; f, *Fulvius albonotatus*, new species, left clasper, side view.

Color brown, distinctly darker on head and pronotum; head dark brown with a whitish, short fascia on vertex between the eyes, pronotum also dark brown with a whitish spot touching posterior margin on median line; antenna with segment I reddish brown, lighter at apex (but not white), segment II yellowish sulphurescent, whitish at apex and lighter at base, third and fourth segments fuscous; mesoscutum dark brown at middle, lighter on basal angles; scutellum dark brown

with whitish apex; hemielytra chestnut brown with a roundish small white area near base of corium on level with middle portion of clavus, cuneus whitish on basal half, reddish brown apically; membrane infumate; underside with pleural portion dark brownish, abdomen reddish brown, coxae white (except extreme base), femora brown with reddish apices, tibiae pale, each with a brown to fuscous ring near base, tarsi yellow.

Head strongly pointed, first antennal segment incrassate, narrowed toward the base, second linear, about half as thick as the first, remaining joints very slender. Pronotum slightly biconcave posteriorly. Hemielytra with embolium enlarged towards the apex, cuneus about as long as wide. Rostrum reaching beyond posterior coxae.

Aedeagus similar to that of *Fulvius castaneus*, new species (fig. 75, *d*); left clasper as seen in figures 76, *d, f*. Pygophore seen from left lateral aspect as in figure 75, *c*.

Female slightly more robust than male but similar in color and general appearance.

Holotype: Male, USNM 61943, Barro Colorado Island, Canal Zone, Panamá (on *Heliconia mariae* flowers), June 1940, J. Zetek, No. 4667. Allotype: Female, same data. Paratypes: 9 ♂♂ and 3 ♀♀, same data. Also 1 ♂, Panamá (with *Hevea* and other seeds), intercepted at Hoboken, N. J., Sept. 8, 1950.

This species differs from all others in the genus by its small size, color markings, and male genitalia. It is easily distinguished from *Fulvius lunulatus* Uhler, 1891, by its color pattern of the head and pronotum. These structures are uniformly dark in the latter species.

***Fulvius castaneus*, new species**

FIGURE 75, *a, d*; 76, *a, c*.

Characterized by the very faint whitish area on corium, large size, and male genitalia.

Male: Length 3.9 mm., width 1.5 mm. Head: Length 0.4 mm., width 0.6 mm., vertex 0.21 mm. Antennae: Segment I length 0.4 mm.; II, 1.0 mm.; III, 0.4 mm.; IV, 0.7 mm. Pronotum: Length 0.5 mm., width at base 1.1 mm. Rostrum: Length 2.0 mm., segment I length 0.50 mm.; II, 0.57 mm.; III, 0.57 mm.; IV, 0.42 mm.

Color blackish brown; head, pronotum, and antennae (except whitish apical one-fourth of second segment) unicolorous; mesoscutum with two lighter areas; scutellum unicolorous, dark brown; hemielytra brown to cinnamon, with a faint whitish area on corium in level with middle of clavus, apex of the latter also lighter, cuneus reddish brown apically, white on basal third; membrane infumate; underside black-brown on anterior half and reddish brown on abdomen; posterior and

middle coxae white (except on extreme bases), anterior coxae black (except on extreme apex), femora and tibiae brownish, the tibiae lighter than femora. In some specimens the whitish mark on corium is almost absent, giving the insect the aspect of having a totally black corium.

Body fairly large, head strongly produced, antennae quite long, calli small and roundish.

Aedeagus (fig. 75,*d*) with a chitinized spiculiform projection internally and a small field of chitinized teeth. Left clasper (fig. 76,*a*) curved apically, with a median enlargement bearing setae. Pygophore seen from left lateral view as in figure 76,*c*.

Female identical to male in color and dimensions.

Holotype: Male, USNM 61944, Tigambato, Michoacán, México (on orchid), intercepted at Laredo, Tex., Oct. 16, 1948. Allotype: Female, México, Distrito Federal, México (on *Philodendron* sp.), intercepted at Laredo, Tex., July 29, 1952. Paratypes: 1 ♂ and 1 ♀, same data as allotype; 1 ♀, Tamazunchale, San Luis Potosí, México (on orchid), intercepted at Laredo, Tex., Dec. 30, 1948; 1 ♂, Huichacan, San Luis Potosí, México (on orchid), intercepted at Laredo, Tex., Jan. 29, 1938; 1 ♀, México (on chrysanthemum), intercepted at Brownsville, Tex., Sept. 5, 1942; 1 ♂, Guatemala (on bananas), intercepted at Philadelphia, Pa., Oct. 21, 1935; 1 ♀, San José, Costa Rica, altitude 1,135 meters, P. Biolley (*Fulvius quadristillatus* Stål, det. A. C. Montandon). Paratypes in collections of U. S. National Museum and the author.

This species runs to *F. bisbistillatus* (Stål) in Poppius' key (Acta Soc. Sci. Fennicae, vol. 37, pt. 4, p. 32, 1909), but differs from the latter by the much less marked light area on corium, larger size, and male genitalia (fig. 75,*g*). It also shows similarity with *Fulvius imbecilis* (Say), 1832, but can be distinguished by the color of hemielytra, antennae, and male genitalia. From *Fulvius quadristillatus* (Stål), 1860, it differs in the color and male genitalia (fig. 75,*b*).

***Fulvius ornatifrons*, new species**

FIGURE 75,*c*

Characterized by its color, size, and very long rostrum.

Female: Length 2.7 mm., width 1.1 mm. Head: Length 0.4 mm., width 0.5 mm., vertex 0.30 mm. Antennae: Segment I length 0.3 mm.; II, 0.8 mm.; III, 0.2 mm.; IV, 0.4 mm. Pronotum: Length 0.4 mm., width at base 1.0 mm. Rostrum: Length 1.7 mm., all segments subequal in length.

Color brown with a reddish tinge; head and calli variegated with red or fuscous as seen in figure 75,*c*, a small whitish fascia on middle of

posterior margin of pronotum touching mesoscutum; hemielytra with extreme base of corium, extreme apex of clavus, and a faint mark on corium in level with median portion of clavus, a semilunar white spot on base of cuneus; antennae brown tending to reddish brown, the second segment unicolorous; underside reddish brown, middle and posterior coxae white (except at extreme bases), anterior coxae reddish brown, whitish at base; legs reddish brown, extreme base and apices of femora whitish, tibiae lighter than femora tending to yellow; rostrum yellow.

Species of small size, the antennae fairly thick, calli of pronotum noticeably raised, rostrum reaching the genital segment (male).

Male slightly smaller and more reddish than the female and the calli not so distinctly marked. The genitalia of the male was lost when being manipulated.

Holotype: Female, USNM 61945, Caracas, Venezuela (on *Cattleya* sp.), intercepted at San Francisco, Calif., July 10, 1946. Paratypes: 1 ♂, Caracas, Venezuela (on *Cattleya speciosissima*), intercepted at San Francisco, Calif., May 23, 1946; 1 ♂, Venezuela (on orchid), intercepted at Washington, D. C., July 14, 1939. Paratypes in collections of U. S. National Museum and the author.

This species differs from all others in the genus by the variegated markings of head and pronotum as seen in figure 74,c.

INDEX

(New genera, species, etc., are printed in *italics*. Page numbers of principal entries also in *italics*)

- Abbott, R. Tucker; Review of the Atlantic periwinkles *Nodilittorina*, *Echininus*, and *Tectarius*, 449.
- abbreviata, Amblyops, 581
- Abelater, 601
- aberrans, Stilobezzia (Eukraiohelea), 61
- Abiphis, 601
- abranchiata, *Leaena*, 209, 325, 326, 331 (fig.)
- Abseus, 601
- Acanthomysis*, 576, 582
- davisi, 582
- macropsis, 582
- nephrophthalma, 582
- pseudomacropsis, 582
- sculpta, 582
- sp., 582
- Acanthus*, 601
- accidentalis, *Colodon*, 430
- acridens, *Hydracodon*, 430
- Acrostoma*, 383
- Actenicerus*, 600
- Actinicola*, 188
- bicolor, 191
- percula, 191
- acuminata*, *Strabala*, 125 (fig.), 127, 128
- acuminata*, *Potamilla*, 336
- acuta*, *Pleurocera*, 360
- Pleurocera* (*Oxytrema*), 360
- acutidens*, *Ictops*, 403, 430
- acutifrons*, *Ampharete*, 208, 316, 319 (fig.)
- Amphicteis*, 316
- acutipennis*, *Aphanobius*, 603
- Aphanopenthes*, 603
- acutus*, *Melanatractus*, 612
- Pleurocerus* (*Oxytrema*), 360
- Adamatornis*, 594
- Adelocera*, 601
- conspersa*, 607
- geographica*, 617
- pyrsolepis*, 608
- Adjidaumo*, 433
- minimus, 430
- Aeoloderma*, 602
- Aelus*, 602
- Aemidioides*, 602
- rohan-chaboti, 602
- aeneipennis*, *Vasaces*, 87, 88, 89, 91 (fig.), 94
- aeneus*, *Elater*, 608
- aenigmaticum*, *Rhopalosoma*, 19
- Pinchacus*, 471
- Tapirus*, 477, 479, 481, 485
- Aeoloderma*, 602, 603
- Aeolus*, 602
- Aepinacodon*, 434
- americanus, 430
- Aeronautes melanoleucus*, 537, 538
- saxatilis saxatilis, 537, 538
- aetherodroma*, *Chaetura spinicauda*, 539, 542
- affinis*, *Apis affinis*, 544
- Flabelligera*, 207, 289, 297 (fig.)
- Lophogaster*, 577
- Lophogaster subglaber*, 577
- Merycoidodon*, 430
- africana*, *Eukraiohelea*, 61
- Sternaspis scutata*, 309
- Stilobezzia* (*Eukraiohelea*) 63
- agitator*, *Hapithus*, 20, 21, 23, 24, 25, 31
- Hapithus agitator*, 23
- Agonischius altus*, 618
- ruficollis, 605
- Agriodratus*, 602
- Agriotella*, 602
- Agriotes* (*Ectinus*) *gratiosus*, 618
- Agryphus schotti*, 611
- Agrypnus*, 602
- Aiolus*, 602
- akallopisus*, *Amphiprion*, 188, 190, 192
- Prochilus*, 188, 190
- alaskensis*, *Dendrocoelopsis*, 165, 168, 177, 178, 181 (fig.)
- alaskensis*, *Haploscoloplos*, 278, 279
- alatum*, *Chalaraspidium*, 577
- albicincta*, *Streptoprocne zonaris*, 548
- albissima*, *Phagocata*, 165, 167
- albitarsis*, *Ceratopogon*, 138
- albofasciata*, *Wetmorella*, 441, 442, 443, 446, 447
- albonotatus*, *Fulvius*, 624 (fig.), 627 (fig.), 629 (fig.)
- Alestrus*, 602
- alexandri*, *Autolytus*, 207, 242, 244, 245, 246
- alfa*, *Bathygenys*, 430
- alluaudi*, *Dorygonus*, 617
- Prolacon*, 615
- Allohelea*, 137
- polita, 138
- alternata*, *Syllis*, 253, 254
- Typosyllis*, 253
- Altica*, 121, 122, 123, 124
- ferruginea, 121, 132
- scutellaris, 121
- testacea, 122
- altitalonidus*, *Apternodus*, 430
- altus*, *Agonischius*, 618
- alutaceus*, *Hyas coarctatus*, 261

- alveare, Megare, 364
 Pleurocera, 364
 amarula, Thiara, 378
 Thiara (Thiara), 379
 Ambloxyus olequaensis, 360
 Amblyops abbreviata, 581
 Ambrysus, 1
 bispinus, 3 (fig.), 4, 6
 buenoi, 4
 cosmius, 6
 dilatatus, 6
 funnebris, 1
 guttatipennis, 6
 hungerfordi, 6
 mormon, 3, 4
 parviceps, 6
 pudicus, 6
 puncticollis, 6
 signoreti, 6
 thermarum, 1, 3 (fig.)
 Two new naucorid bugs of the
 genus, 1
 woodburyi, 3
 ambulans, Haltica, 122, 123, 131
 Strabala, 125 (fig.), 127, 131
 Amechanus, 101
 ferrugineus, 102
 fossatus, 103
 serratus, 113
 americana, Mysidella, 576, 582
 Sorocelis, 566
 americanus, Aepinacodon, 430
 Bothriodon, 430
 Lophogaster, 577
 Tapir, 479
 Tapirus, 476, 477, 479, 480, 481,
 485, 488
 Amotrypane, 295
 breviata, 205, 208, 295, 297 (fig.)
 amnigena, Eukraiohelea, 61
 Ampharete, 315 (key)
 acutifrons, 208, 316, 319 (fig.)
 cirrata, 316
 goësi, 208, 317
 goësi braznikovi, 317
 grubei, 316
 sp. (young), 317
 trilobata, 316
 vega, 208, 315, 319 (fig.)
 Ampharetidae, 208 (table), 212, 314,
 315 (key), 319 (figs.)
 Amphicteis acutifrons, 316
 vega, 315
 Amphictenidae, 310
 Amphicynodontinae, 419, 421 (table),
 434
 Amphicyoninae, 420
 Amphiprion, 187, 188 (key), 192 (table),
 196, 200
 akallopisos, 188, 190, 192
 arion, 199
 bicinctus, 190, 192, 194, 198, 199
 bicolor, 191
 bifasciatus, 193
 bifasciatus annamensis, 193
 boholensis, 198
 chrysargyrus, 198
 chrysogaster, 189, 192, 193
 chrysopterus, 198
 clarckii, 198
 de bojer, 198
 ephippium, 190, 192, 199, 201
 ephippium chrysopterus, 195
 frenatus, 190, 192, 199, 200
 fusciventer, 193
 intermedius, 194
 japonicus, 198
 laticlavus, 188, 193
 macrostoma, 201
 mauritiensis, 189, 192, 196
 mccullochi, 201
 melanopus, 190, 192, 201
 melanostolus, 198
 melanurus, 194
 monofasciatus, 199
 ocellaris, 194
 papuensis, 199
 percula, 188, 191, 192, 193
 perideraion, 188, 191, 192
 polymnus, 189, 193, 194, 197, 198,
 200
 Review of the Indo-Pacific anemone
 fishes of the genus, with descrip-
 tions of two new species, 187
 rosenbergi, 191
 rubrocinctus, 199
 rüppeli, 199
 sebae, 189, 192, 197
 snyderi, 198
 tricinctus, 189, 192, 195, 197
 tricolor, 199
 trifasciatus, 193
 tunicatus, 191
 unimaculatus, 193
 xanthurus, 190, 192, 198
 Amphitrite, 320, 321 (key)
 cincinnata, 327
 cirrata, 209, 319 (fig.), 321
 groenlandica, 209, 321, 322
 infundibulum, 340
 radiata, 321
 robusta, 322
 Ampullacera maculata, 385
 Ampullarina maculata, 385
 Amyadenium, 177, 178
 bremonti, 177
 chattoni, 177
 garmieri, 177
 vandeli, 177
 Anagnota, 560
 Anaitides, 236
 groenlandica, 236
 analis, Euchone, 209, 339, 341 (fig.)
 Larra, 32
 Sabella, 339
 Anaplocamus, 363
 Anatomy and relationships of glossy
 cuckoos of the genera *Chryso-*
coccyx, *Lampromorpha*, and
Chalcites, 585-597
 Anchastelater, 602
 ornatus, 602

- Anchastus maximus, 601
 Anchialina typica, 580
 Anculosa, 362
 dilatata, 363
 andecolus, Apus andecolus, 536
 andicola, Tapirus, 472
 Angitrema, 363
 Angulidae, 401
 angulus, Bolboceras, 95, 117
 Bolborhombus, 99 (fig.), 115 (map),
 117, 119
 angustata, Stenomicroa, 560
 Anischia, 602, 603
 boliviana, 603
 languarioides, 603
 annamensis, Amphiprion bifasciatus,
 193
 annectens, Leptomeryx, 430
 annulata, Meronychina, 556
 Microperiscelis, 555, 556
 Myodris, 556
 Notiphila, 552
 Periscelis, 552, 553, 556
 annulatus, *Peritropoides*, 624, 625, 628
 annulipes, Periscelis, 556
 Anodonta, 368
 anomala, Holmesiella, 580
 Anostirus, 604
 anta, Tapir, 477, 479, 481
 Tapirus, 481, 485
 antartica, Capitella capitata, 298
 Leaena, 325
 Leaena abbranchiata, 325, 326
 Maldane sarsi, 304
 antarticus, Trichobranchus glacialis,
 329
 antea, Tapirus, 476
 antennalis, Ceratolophus, 68
 Ceratopogon, 68
 Hartomyia, 68
 Johannseniella, 68
 Stilobezzia, 59, 60, 61, 68
 Stilobezzia (Stilobezzia), 68, 73
 (fig.), 83
 Trelasus, 618
 Anthias bifasciatus, 194
 clarkii, 198
 polymna, 198
 polymnus, 191
 Anthomyza, 557
 Anthomyzidae, 551, 553, 556, 557
 (key)
 anthonyi, Eurycaelon, 362
 Anthracotherinae, 434
 anticostiensis, Arctobia, 206, 225
 Eucranta, 226
 Eupolynoë, 225
 Harmothoë, 225
 Antilopidae, 424
 Antimelania, 381, 382
 costula, 382
 episcopalis, 382
 soriniana, 382
 Antinoë, 214, 215
 badia, 216
 sarsi, 205, 206, 215
 Antinoëlla sarsi, 215
 Antoligostethus, 603
 lucidus, 603
 antoni, Litorina, 458
 anulipes, Tapirus, 480, 481, 484, 485,
 486
 Aphanobius acutipennis, 603
 Aphanopenthes, 603
 acutipennis, 603
 Aphrodita cirrhosa, 226
 imbricata, 220
 longa, 230
 minuta, 230
 scabra, 217
 aphroditoides, Castalia, 206, 239, 243
 (fig.)
 Nereis, 239
 Psammate, 239
 Apis affinis affinis, 544
 Aplotarsus, 607
 maritimus, 607
 Apternodus, 431, 433
 altitalonidus, 430
 mediaevus, 403, 430
 Apus andecolus andecolus, 536
 aquaticus, Scalopus, 404
 Archaeolagus sp., 416
 Archaeomysis grebnitzkii, 580
 Archaeotherium, 433
 crassum, 430
 marshi, 430
 mortoni, 430
 scotti, 430
 Arctobia, 214, 225
 anticostiensis, 206, 225
 arctica, Aricia, 278
 Boreomysis, 579
 Castalia, 239
 Eteone, 234
 Eulalia, 238
 Nereis, 264
 Nicolea, 322
 Polynoë, 217
 Trophonia, 290, 291
 arcticus, Herpyllobius, 221, 223, 227
 Rangifer, 424
 arcuatus, Bolbelasmus, 97, 98, 99 (fig.),
 100, 114 (map)
 Bolboceras, 97, 98
 Kolbeus, 97, 98
 Ardynomys, 434
 arenarum, Ogmophis, 402
 Arenicola, 300
 glacialis, 205, 208, 300, 301 (fig.)
 Arenicolidae, 208 (table), 213, 300, 301
 (figs.)
 arge, Upeneoides, 518
 Upeneus, 500 (table), 502 (tables),
 503, 504 (table), 505 (tables),
 506, 507, 508, 518
 argentatus, Pleonomus, 613
 Aricia arctica, 278
 Ariciidae, 278
 arion, Amphiprion, 199
 arisanus, Taiwanathous, 617

- armatus, *Idathyrus*, 205, 208, 301
(fig.), 308
- armiger, *Lumbricus*, 278
Scoloplos, 207, 278, 283 (fig.)
- armigera, *Melania*, 363
- armillaris, *Nereis*, 254
Syllis, 254
- Arnett, Ross H., Jr.; A review of the beetle family *Cephaloidea*, 155
Beetles of the oedemerid genus *Vasaces* Champion, 87
Supplement and corrections of J. A. Hyslop's Genotypes of the elaterid beetles of the world, 599-632
- Artiodactyla, 425, 432
- Asabellides, 315, 318
orientalis, 318
sibirica, 208, 318, 319 (fig.)
- Asclerini, 88
- Ascoliocerus, 603
- asinus, *Equus*, 423
- aspirans, *Melania*, 380
Stenomelania, 380
- Asteidae, 560
asymmetricus, *Upeneus*, 500 (table), 501, 502 (tables) 503, 504 (table), 505 (tables), 511, 512 (table)
- Athoia, 603
- Athous, 601, 603
hirtus, 615
revelieri, 603
- Athyreus ferrugineus*, 102
- Atoloderma, 603
- atra, *Doryssa*, 367
- Atrichopogon*, 66
- Athyreus* (*Bradycinetus*) *ferrugineus*, 102
serratus, 113
(*Bradycinetus*) *serratus*, 113
- Aulacon, 603
- Aulacostoma, 375
- auratus, *Mullus*, 528, 529
- auriculata, *Polycelis*, 171, 172
- australasiae, *Bolboceas*, 101
- australis, *Dennysus*, 533, 534, 536, 537, 540 (fig.), 549
Eucopia, 578, 579
Geckobia, 15
- austratica, *Patricia*, 614
- Autolytus, 241, 242, 245 (key), 249
alexandri, 207, 242, 244, 245, 246
cornutus, 244, 245, 250, 252
fallax, 205, 207, 242, 244, 246, 247, 250, 251 (fig.)
incertus, 250
longisetosus, 242, 247, 250
ornatus, 244
prismaticus, 207, 242, 244, 245, 246, 247, 249, 251 (fig.)
prolifer, 244, 245, 247, 249, 250
trilineatus, 250
verrilli, 246
- Aylacostoma, 367, 375, 376
(*Verena*) *crenocarina*, 377, 378
glabrum, 375, 376
(*Hemisinus*) *lineolatum*, 376
ruginosum, 377
- (*Aylacostoma*) *scalare*, 376
tuberculatum, 375, 377
(*Longiverena*) *tuberculatum*, 377
- baccata, *Brotia*, 383
- badia, *Antinoë*, 216
- bailleti, *Oxytrema*, 368
- bairdi, *Elasmognathus*, 489
Tapirus, 490
Tapirus (*Elasmognathus*), 489
- bairdii, *Elasmognathus*, 488, 489
Tapirella, 490
Tapirus, 465, 466, 467, 468, 469, 473, 478, 482 (fig.), 483 (fig.), 488, 489, 490, 493 (map), 495 (map)
Tapirus (*Tapirella*), 489
- bakeri, *Hypnoidus*, 610
- Balanocochlis, 381
glans, 381
- balonnensis, *Plotiopsis*, 378
- bandi, *Mullus*, 516
- Banner, Albert H.; A supplement to W. M. Tattersall's Review of the Mysidacea of the United States National Museum, 575
- barbata, *Eteone*, 206, 233
Eteone (*Mysta*), 233
Eunoë, 219
Mysta, 233
- bartschi, *Callocladia inexpectata*, 543
- basalis, *Chalcites*, 594
Hypnoidus, 603
- Basistoma, 376
- Bathanalia, 371, 374
howesi, 374
- bathygenus, *Parictis*, 421
- Bathygenys, 434
alfa, 430
- Bdellocephala, 174
- beckae, *Stilobezzia*, 59, 60, 61
Stilobezzia (*Stilobezzia*), 69, 72 (fig.), 82
- bedeli, *Blaiseus*, 604
- beetle family *Cephaloidea*, A review of the, 155
- beetles, *Chrysomelid*, of the genus *Strabala* Chevrolat, 121
Of the oedemerid genus *Vasaces* Champion, 87
Scarabaeid, of the genus *Bradycinetus*, and closely related genera in the United States, 95
- Beezia *stecki*, 138
- behni, *Hemisinus*, 375
- belaque, *Upeneoides*, 513
- Bembiciidae, 462
- Bembicium, 462
- bensasi, *Mullus*, 509
Upeneus, 500 (table), 501, 502 (tables), 503, 504 (table), 505 (tables), 506, 508, 509, 511 (table)
- Berger, Andrew J.; On the anatomy and relationships of glossy cuckoos of the genera *Chrysociccyx*, *Lampromorpha*, and *Chalcites*, 585-597

- Betarmon, 603
 quadrivittatus, 611
 Betarmou, 603
bethaniensis, Photuris, 36
Bezzia elegantulus, 62
bicinctus, Amphiprion, 190, 192, 194, 198, 199
bicolor, Actinicola, 191
 Amphiprion, 191
 Cephaloon, 157 (map), 159, 160
 Stilobezzia, 59, 60, 61, 71
 Stilobezzia (Stilobezzia), 71, 72 (fig.)
bifasciata, Wetmorella philippina, 440, 441, 442 (fig.), 443
bifasciatus, Amphiprion, 193
 Anthias, 194
 Prochilus, 193, 194
bigeminatus, Elater, 602
bilineatus, Cosmesus, 601
birmanicus, Megapenthes, 619
bisbistillatus, Fulvius, 627 (fig.), 631
bispinus, Ambrysus, 3 (fig.), 4, 6
bitaeniatus, Upeneus, 516
bivittatus, Upeneus, 513
Blaberus craniifer, 46
Blaiseus, 604
 bedeli, 604
 Blake, Doris Holmes; The chrysomelid beetles of the genus *Strabala* Chevrolat, 121
Blatta, 41
 livens, 40, 41
 livida, 40, 41
 maderae, 45
 surinamensis, 45
Blattella, 53
blomstrandii, Eusyllis, 207, 243 (fig.), 260
boholensis, Amphiprion, 198
 Boidae, 402
Bolbelasmus, 95, 97 (key)
 arcuatus, 97, 98, 99 (fig.), 100, 114 (map)
 galicus, 97, 99 (fig.)
 hornii, 97, 98, 99 (fig.), 100, 115 (map)
 minor, 97, 98, 99 (fig.), 100, 115 (map)
 unicorne, 97
Bolboceras, 95, 96, 101
 angulus, 95, 117
 arcuatus, 97, 98
 australasiae, 101
 coreanus, 97
 ferrugineus, 102
 (Amechamus) ferrugineus, 102
 fossatus, 103
 (Amechamus) fossatus, 103
 hornii, 100
 lecontei, 102
 minor, 100
 quadridens, 101
 schaefferi, 117, 119
 (Amechamus) serratus, 113
 serratus peninsularis, 116
Bolbocerastes, 95, 97, 99 (figs.), 105 (key), 113
 imperialis, 99 (fig.), 106, 109, 112, 113, 114 (map), 116
 imperialis kansanus, 106, 112, 115 (map)
 peninsularis, 98 (fig.), 105, 112, 114 (map), 116
 regalis, 99 (fig.), 105, 106, 109, 112, 115 (map)
 serratus, 99 (fig.), 106, 107, 108, 109, 112, 113, 115 (map)
 Bolboceratini, 96 (key)
 Bolbocerosoma, 95, 96
Bolborhombus, 95, 97, 99 (figs.), 116, 117 (key)
 angulus, 99 (fig.), 115 (map), 117, 119
 parvul, 99 (fig.), 115 (map), 117, 118, 119
 schaefferi, 99 (fig.), 114 (map), 117, 119
boliviana, Anischia, 603
Boltenia echinata, 276
borealis, Polycelis, 168, 171 (fig.), 172, 182
borealis, Micropternodus, 430
 Mystides, 206, 232, 237 (fig.)
 Nicomache lumbicalis, 305
 Petaloproctus tenuis, 306, 307
 Boreomysinae, 576
Boreomysis, 579, 580
 arctica, 579
 californica, 579
 kincaidi, 577, 580
 microps, 576, 579
 tregonboffi, 579
 tridens, 579
Bos depressicornis, 424
 frontalis, 424
 gaurus, 424
 indicus, 424
Bothriodon, 433
 americanus, 430
Bothriodontidae, 432
Bourguignatia, 372
 imperialis, 372
 Bovidae, 424
brachycephala, Nephthys, 271, 272
 Polydora, 280, 281
Brachyfulvius, 621
 chapini, 622, 623 (fig.), 626 (fig.)
Brachygonus, 604
 megerlei, 604
brachyodon, Megalagus, 416, 430
brachyura, Chaetura brachyura, 544
Brada, 288, 290 (key)
 granosa, 292
 granulata, 290, 292
 inhabilis, 207, 290, 292, 297 (fig.)
 pilosa, 290, 291
 rugosa, 290, 291, 292
 setosa, 290, 291
 sublaevis, 292
 villosa, 205, 207, 290
Bradycellus, 101

- Bradycinetulus*, 95, 96, 97, 99 (figs.),
 101, 102 (key)
ferrugineus, 96, 99 (fig.), 102, 103,
 104, 105, 115 (map)
fossator, 103
fossatus, 99 (fig.), 102, 103, 105,
 114 (map)
hornii, 100
rex, 99 (fig.), 102, 103, 114 (map)
 Scarabæid beetles of the genus, 95
serratus, 113
Bradycinetus, 95, 101
carinatus, 117, 119
ferrugineus, 102
fossatus, 103
hornii, 95, 97, 100
minor, 95, 97, 100
serratus, 113
serratus peninsularis, 116
brahminus, *Drasterius*, 615
Brania sp., 256
brasilensis, *Mallerius*, 612
Monohelea, 137, 145
Monohelea (*Monohelea*), 145
Tapirus, 481, 485
Tapirus pinchaque, 479
Tapirus roulinii, 479
braznikovi, *Ampharete goësi*, 317
brementi, *Amyadenium*, 177
Dendrocoelopsis, 178
brevisata, *Ammotrypane*, 205, 208, 295,
 297 (fig.)
brevicapitis, *Dennyus*, 535, 540 (fig.), 544
brevicauda, *Scalibregma*, 293, 294
Brevicerus, 604
cylindricus, 604
brevicollis, *Creoleptus*, 605
brevicoma, *Cistenides*, 312
Pectinaria, 312
Pectinaria (*Cistenaria*), 312
brevipennis, *Hapithus*, 24, 25
brevis, *Cubaedomus*, 376
Travisia, 298
Brontotherioidea, 423, 432, 433
Brotella, 383
Brotia, 381, 382, 387
baccata, 383
pagodula, 382
bruneri, *Dennyus*, 533, 534, 536, 537,
 538, 540 (fig.), 542
Nitzschia, 538
brunneitorques, *Dennyus*, 535, 541 (fig.),
 543
brunneitorques, *Chaetura rutila*, 548
Bryantius, 604
capensis, 604
buenoi, *Ambrysus*, 4
Bufveventius, 604
lividus, 604
bulbosa, *Oxytrema*, 361
bullata, *Stilobezzia*, 59, 61, 74, 83, 84
Stilobezzia (*Stilobezzia*), 73 (fig.)
 74, 84
burkei, *Paleolagus*, 415
buxroni, *Roggeveenia*, 616
Bythoceras, 373
iridescens, 373
caballus, *Equus*, 423
Cacomantis, 586
Cadiohypnus, 604
caeca, *Nephtys*, 270
Nereis, 270
Caenopus, 424, 432
mitis, 425, 430
caerulea, *Coua*, 586
caeruleus, *Upeneoides*, 516
Caesaromysides liguriae, 557, 581
Caesaromysis, 581
 sp., 577
vancleveii, 577, 581
Calamagras sp., 402
californica, *Boreomysis*, 579
Eteone, 234
Calliostoma, 458
Callocalia inexpectata bartschi, 543
 sp., 543
Calostirus, 604
cambodiensis, *Corymbites*, 618
Camelidae, 426, 433
Camposodernus, 604
Campososternus, 604
Campososternus, 604
camtschatica, *Paralithodes*, 224
cancellata, *Thiara*, 378, 379
Thiara (*Setaeara*), 379
candezei, *Mopleonus*, 613
Candezella, 604
horvathi, 604
Canidae, 416, 420, 423
Caninae, 420
Canis latrans, 423
nubilus, 423
canorus, *Cuculus*, 586
 Canyon Ferry Reservoir area, Pre-
 liminary analysis of the fossil
 vertebrates of, 395
capensis, *Bryantius*, 604
Cardiotarsus, 605
Longithorax, 581
capitata, *Capitella*, 208, 297 (fig.), 298
Glycera, 207, 272, 277 (fig.)
capitatus, *Lumbricus*, 298
Capitella, 298
capitata, 208, 297 (fig.), 298
capitata antarctica, 298
giardi, 299
Capitellidae, 208 (table), 213, 297
 (figs.), 298
Capitellides, 299
caprius, *Lampromorpha*, 585, 586, 587,
 588, 589, 590, 591, 592, 593 (fig.), 595
capsula habeii, *Littorina*, 450
Cardiohypnus, 604
Cardiohypnus, 604
mirabilis, 604
Cardiophorus, 605
florentini, 615
schusteri, 611
vitalisi, 613

- Cardiotarsus, 605
 capensis, 605
 Cariblatta sp., 43
 caribou, Rangifer, 424
 carinata, Mudalia, 361
 Nicomache, 305
 carinatus, Bradycinetus, 117, 119
 carnea, Traviaia, 205, 208, 296, 297
 (fig.)
 Carnivora, 416, 432
 Cartwright, O. L.; Scarabaeid beetles
 of the genus Bradycinetulus and
 closely related genera in the
 United States, 95
 Carriker, M. A., Jr.; Studies in Neo-
 tropical Mallophaga, XI; Bird
 lice of the suborder Amblycera,
 genus Dennyus Neumann, 533
 Carvalho, José C. M.; Neotropical
 Miridae, LXIV; New bugs of the
 subfamily Cylapinae (Hemip-
 tera), 621
 Castalia, 239
 aphroditoides, 206, 239, 243 (fig.)
 arctica, 239
 fabricii, 239
 multipapillata, 239
 castaneus, Fulvius, 627 (fig.), 629 (fig.),
 630
 Castoridae, 408
 Catelanus, 605
 catenaria, Oxytrema, 360
 Cattleya sp., 632
 speciosissima, 632
 caudacutus, Hirundapis caudacutus,
 543
 caulleryi, Polydora, 207, 280, 281, 283
 (fig.)
 cavernicola, Phagocata, 563, 565 (fig.)
 Cavicoxum, 605
 monstrosum, 605
 cecillei, Litorina, 456
 celebensis, Chesotraxus, 605
 celer, Mesohippus, 430
 Cenchrates, 462
 Cephaloon, 158
 Cephaloidea, 155, 156, 157 (map), 158,
 159 (key)
 A review of the beetle family, 155
 Cephaloon, 155, 156, 158, 160 (key)
 bicolor, 157 (map), 159, 160
 lepturides, 156, 157 (map), 158,
 160
 pacificum, 157 (map), 159, 160
 pallens, 157 (map), 158, 160, 161
 pallens cinctipennis, 161
 pallens koltzei, 161
 pallens maculicollis, 161
 pallens picticollis, 161
 sakurae, 161
 tenuicorne, 157 (map), 158, 160
 ungulare, 157 (map), 158, 159, 160
 vandykei, 157 (map), 160
 variabile, 158
 variabilis, 157 (map), 158, 159, 161
 variabilis tristiculus, 161
 cephus, Scarabaeus, 101
 Ceratolophus antennalis, 68
 diversus, 76
 copiosus, 138
 leucopeza, 138
 nebulosus, 151
 politus, 138
 viridis, 84
 Ceratopogon albitarsis, 138
 antennalis, 68
 copiosus, 137, 138
 diversus, 76
 leucopeza, 138
 maculipennis, 135, 140
 nebulosa, 135
 nebulosus, 151
 ochraceus, 63
 pictus, 75
 politus, 138
 sequax, 135
 viridis, 84
 Cercimelania, 366
 Cerithiidae, 357, 358
 Ceroleptus, 605
 brevicollis, 605
 Ceropectus, 605
 Cervidae, 423
 chadronensis, Hypertragulus, 430
 Chaetosyllis, 241, 252, 253, 255
 oerstedii, 253
 Chaetozone, 286, 287
 setosa, 207, 287, 297 (fig.)
 Chaetura brachyura brachyura, 544
 chapmani viridipennis, 545
 griseiventris, 539
 griseiventris phaseopygus, 539
 pelagica, 537
 richmondi, 537
 rutila brunneitorques, 548
 spiniacauda aetherodroma, 539, 542
 spiniacauda fumosa, 539, 542
 spiniacauda spiniacauda, 542
 Chalaraspidum alatum, 577
 Chalcites, 585, 589, 590, 591, 592, 593
 basalis, 594
 lucidus, 586, 587, 591, 592, 594, 595
 Chalcites-Chrysococyx group, 594
 Chalcococyx, 585, 586
 Chalcolepidinus, 605
 Chalcolepidius, 605
 challenger, Lophogaster, 577
 chalybea, Progne chalybea, 549
 chapini, Brachyfulvius, 622, 623 (fig.),
 626 (fig.)
 chapmani, Panamenia, 555
 Scutops, 556
 Chatanayus, 605
 chattoni, Amyadenium, 177
 Dendrocoelopsis, 178
 Cheilinus, 439
 fasciatus, 439
 chelonyx, Mesoreodon, 425
 Chesotraxus, 605
 celebensis, 605
 Chiagnosnius, 605
 chinensis, Melanoides, 380

- Chloraemidae, 288
 Chone, 334, 337, 338 (key)
 dunéri, 209, 338, 339, 341 (fig.)
 gracilis, 338
 infundibuliformis, 209, 338, 341 (fig.)
 chopardi, Ectobius livens, 44
 Chorisonera texensis, 42
 chrysargyrus, Amphiprion, 198
 Chrysis sp., 32
 Chrysocoecyx, 585, 589, 590, 591, 592, 594, 595
 cupreus, 585, 586, 587, 588 (fig.), 589 (fig.), 590, 591, 592, 594, 595
 flavicularis, 593
 chrysoaster, Amphiprion, 189, 192, 193
 chrysopterus, Amphiprion, 198
 Amphiprion ehippium, 195
 Chusquea, 475
 ciliata, Gattiana, 205, 206, 226, 228
 Nephtys, 268, 270
 Nephtys, 207, 267, 269 (fig.), 270
 Nephtys, 270
 Nereis, 268, 270
 Cinchacrus, 469
 cincinnata, Amphitrite, 327
 cincinnatus, Thelepus, 209, 327, 331 (fig.)
 cinctipennis, Cephaloon pallens, 161
 cinerea, Eteone, 234
 Nauphoeta, 40, 46, 51
 cingulatus, Cirratulus, 286
 Colodon, 430
 Circeis spirillum, 344
 circinnatus, Thelepus, 327
 cirrata, Ampharete, 316
 Amphitrite, 209, 319 (fig.), 321
 Enipo, 225, 305
 Lepidonote, 220
 Polynoë, 220
 Cirratulidae, 207 (table), 212, 285, 286 (key), 297 (figs.)
 Cirratulus, 286
 cingulatus, 286
 cirratus, 207, 286, 297 (fig.)
 robustus, 286
 spectabilis, 286
 cirratus, Cirratulus, 207, 286, 297 (fig.)
 Lumbrieus, 286
 cirrhosa, Aphrodita, 226
 Gattiana, 227
 cirrosa, Gattiana, 206, 226, 229 (fig.)
 Nychia, 226
 Cistenides, 311
 brevicoma, 312
 granulata, 312
 hyperborea, 314
 Citellus, 434
 citrina, Phyllodoce, 236
 Clamator, 594
 clarki, Eunoë, 205, 206, 216, 217
 clarekii, Amphiprion, 198
 Anthias, 198
 Cleniocerus, 606
 Clinopternodus, 431, 433
 gracilis, 430
 Clymene (Praxillella) praetermissa, 303
 coarctata, Phagocata, 167
 coarctatus, Hyas, 224, 324
 Coccyzus, 590, 591, 592
 erythrophthalmus, 588, 589
 cockroaches, Distribution, general bi-
 nomics, and recognition char-
 acters of, recently established in
 the United States, 39
 coeca, Nephtys, 268
 Colaulon, 606
 rectangularis, 606
 collaris, Typosyllis, 260, 261
 Colodon, 432, 433
 accidentalis, 430
 cingulatus, 430
 colombianus, Tapirus terrestris, 486, 490, 493 (map), 495 (map)
 columbiana, Strabala, 125 (fig.), 127, 133
 comalensis, Oxytrema, 360
 compacta, Pionosyllis, 205, 207, 243 (fig.), 262
 concinna, Nullarborica, 613
 concolor, Felis, 424, 475
 Conobajulus, 606
 ugiensis, 606
 consanguineus, Photinus, 36
 consolidata, Dorssa, 367
 conspersa, Adelocera, 607
 convexuni, Yezodina, 619
 coomani, Heabinh, 610
 copiosa, Schizohalea, 138
 copiosus, Ceratolophus, 138
 Ceratopogon, 137, 138
 coquilletti, Stilobezzia, 58, 60, 61, 75
 Stilobezzia (Stilobezzia), 72 (fig.), 75
 Coracinus, 194
 intermedius, 194
 vittatus, 194
 Corcovadocola, 622
 coreanus, Bolboceras, 97
 Coresus, 600, 601, 606
 cornuta, Ehlersia, 253
 Syllis, 205, 207, 243 (fig.), 252, 254
 Syllis (Ehlersia), 253
 cornutus, Autolytus, 244, 245, 250, 252
 coronarius, Tectarius, 461
 coronata, Lavigeria, 372
 Polycelis, 171, 172
 corvinus, Pachychilus, 365, 366
 Coryleus, 606
 desruisseauxi, 606
 Corymbites cambodiensis, 618
 gratus, 613
 sulphuripennis, 616
 tenuicornis, 614
 tessellatus, 600
 Cosmesus, 601
 bilineatus, 601
 subtilis, 601
 cosmius, Ambrysus, 6
 costaricensis, Strabala acuminata, 125 (fig.), 127, 129
 costatus, Vasaces, 87, 89, 90

- costula, Antimelania, 382
 Coua, 590, 595
 caerulea, 586
 Couroupita guianensis, 491
 craniifer, Blaberus, 46
 crassa, Eurycaelon, 362
 crassicornis, Sabella, 209, 333 (fig.), 334
 crassum, Archaeotherium, 430
 Cratonychus, 606
 crawfordensis, Hypertragulus, 430
 crawshayi, Melanoides, 371
 crenocarina, Aylacostoma (Verena), 377, 378
 Melania, 377
 Cricedon, 412
 Cricetidae, 410
 cricetodontoides, Eumys, 410, 411 (fig.)
 Cricket parasite of the genus Rhopal-
 osoma, Notes on the biology and
 immature stages of a, 19
 cristata, Eurycaelon, 362
 Crotophaga, 590, 595
 sulcirostris, 590
 crucifer, Elater, 602
 cruentus, Hyaenodon, 430
 Crypnoideus, 606
 Cryptohypnus, 606
 micros, 615
 Cryptypnus, 606
 Csikia, 607
 dimatoides, 607
 Ctenicera, 600, 607
 pupieri, 615
 (Malloeae) sjaelandica, 600
 Ctenicerus, 607
 Cteniocerus, 607
 Ctenocera, 607
 Ctenonychus, 607
 Ctenonyphus, 607
 Cubaedomus, 366, 376, 387
 brevis, 376
 Cuculus, 585, 594
 canorus, 586
 culbertsoni, Merycoidodon, 425
 cumingi, Echininus, 460
 Trochus, 458
 cumingii, Pachychilus, 366
 cupreus, Chrysococyx, 585, 586, 587,
 588 (fig.), 589 (fig.), 590, 591, 592,
 594, 595
 Curtisius, 607
 Cyamops, 551, 555, 556, 557, 558 (key)
 imitata, 558, 559
 nebulosa, 558
 cyaneus, Psephus, 611
 Cyclopidius, 426
 lullianus, 426
 simus, 426
 cyclops, Scarabaeus, 101
 Cylapinae, 621, 622
 cylindricus, Brevicecus, 604
 Lincydrus, 612
 Cylindrodon, 431, 433
 fontis, 430
 Cypseloides fumigatus, 547
 cypsiurus, Dennyus, 534, 535
- Dactylosimus, 607
 dorsalis, 607
 dakotensis, Ictops, 430
 Parictis, 420, 430
 dalli, Pachychilus (Pilsbrychilus), 367
 Dalopius, 607, 608
 damoni, Paramelania, 371
 Danosoma, 607
 Daphnoidea, 420
 Daphnoecyon, 420, 421, 432, 433
 dodgei, 419, 421 (fig.), 430
 Daphoenus, 420
 davisii, Acanthomyia, 582
 de bojer, Amphiprion, 198
 Deinictis, 433
 fortis, 430
 Delox, 607
 Dendrocelopsis spinosipenis, 176
 Dendrocoelidae, 174, 568
 Dendrocoelopsis, 174, 176, 177, 178
 alaskensis, 165, 168, 177, 178, 181
 (fig.)
 bremonti, 178
 chattoni, 178
 garmieri, 178
 piriformis, 174, 177 (fig.), 178, 180
 spinosipenis, 177, 178
 vaginata, 178
 vaginatus, 177
 vandeli, 178
 Dendrocoelum, 178
 nausicaeae, 179
 Dennyus, 533, 535 (key), 549, 534
 australis, 533, 534, 536, 537, 540
 (fig.), 549
 brevicapitis, 535, 540 (fig.), 544
 bruneri, 533, 534, 536, 537, 538,
 540 (figs.), 542
 brunneitorques, 535, 541 (fig.), 548
 cypsiurus, 534, 535
 distinctus, 534, 543
 dubius, 533, 536, 537, 538, 542
 femuralis, 533
 francicus, 534, 535
 gossei, 534, 536, 543, 547
 hirundinidis, 534, 535
 intonsus, 535, 540 (fig.), 545
 latifrons, 533
 limbus, 536, 538, 540 (fig.), 542
 major, 534, 535, 543
 meridionalis, 534, 536, 539, 540
 (fig.), 542
 minor, 535, 544
 piageti, 533
 richmondi, 533, 535, 537
 rotundocapitis, 535, 541 (fig.), 548,
 549
 similis, 534, 535, 541 (fig.), 549
 spiniger, 533, 535
 spininotus, 536, 541 (fig.), 547
 depressa, Eteone, 235
 Eunoë, 217, 218
 depressicornis, Bos, 424
 descarpentrii, Practapyrus, 615
 deshayesiana, Oxytrema, 361

- Desmatolagus, 432, 433, 434
 dicei, 430
 desruisseauxi, Coryleus, 606
 Dexiospira spirillum, 344
 Diacanthus, 608
 guttatus, 610
 Diadelops, 560
 dicei, Desmatolagus, 430
 Dichonychus, 608
 Dicrepidius, 608
 Diconychus, 608
 serraticornis, 609
 Didelphiade, 402
Dido, 600
 macrocera, 600
 dilatata, Anculosa, 363
 Littorina, 451
 dilaticollis, Eupsephus, 609
 dilatus, Ambryus, 6
 dimatoides, Csikia, 607
 Diocarphus, 608
 Diopsosoma, 555, 556
 prima, 556
 Diphyaulon, 608
 Diplocenus, 608
 Diploconus, 608
 ornatus, 616
 spiloderus, 615
 Diploptera, 51, 52
 discors, Nephthys, 270
 Nephthys, 207, 267, 269 (fig.), 270
 Discrepeidius, 608
 Disonycha, 122, 124, 126
 rufa, 122
 dispar, Exogone, 207, 243 (fig.), 258,
 259
 Heteromeryx, 430
 Paedophylax, 259
 distinctus, Dennyus, 534, 543
 diversa, Hortomyia, 76
 Johannseniella, 76
 Stelobezzia, 59, 60, 61, 76
 Stilobezzia (Stilobezzia), 73 (fig.),
 76, 79
 diversus, Ceratolophus, 76
 Ceratopogon, 76
 Dodecaceria, 285
 dodgei, Daphoenocyon, 419, 421 (fig.),
 430
 Dolopus, 608
 dolosus, Elastrus, 602
 Domenephus, 608
 dominicensis, Strabala, 121
 Domnina, 431, 432, 433, 434
 thompsoni, 430
 dorcas, Gazella, 424
 dorsalis, Dactylosimus, 607
 dorsofasciata, Palpomyia, 62
 Dorygonus alluaudi, 617
 Doryssa, 367, 377
 atra, 367
 consolidata, 367
 Drachylis, 158
 dowi, Elasmognathus, 489
 Tapirella, 490
 Tapirus, 490, 492
 dowii, Elasmognathus, 489
 Tapirus, 480, 484, 490, 491
 Tapirus bairdii, 491
 Drachylis simulans, 158, 160
 drakei, Pachychilus, 360
 Drasterius, 608
 brahminus, 615
 Dresterius, 608
 Drosophilidae, 553
 dubius, Dennyus, 533, 536, 537, 538, 542
 Mullus, 498, 515
 Nitzschia, 537
 Upeneoides, 514
 dufourii, Melanopsis, 359
 dunéri, Chone, 209, 339, 341 (fig.)

 eburnea, Polycelis, 172
 echinata, Boltenia, 276
 Echinella, 449, 458, 461
 Echininus, 449, 451, 452, 454, 455 (fig.),
 458, 459, 461
 cumingi, 460
 nodulosus, 449, 451, 452, 453 (fig.),
 454, 455 (fig.), 457 (fig.), 458
 Ectobius, 40
 finoti, 41
 lapponicus, 41, 45
 livens, 39, 40, 47 (fig.)
 livens chopardi, 44
 livens minor, 44
 lividus, 40, 41
 panzeri, 44
 perspicillaris, 41
 siculus, 41
 sp., 41
 ecuadorensis, Tapirus, 479, 481, 485
 Edgaria, 372
 paucicostata, 372
 Ehlersia cornuta, 253
 Elasmognathus, 488
 bairdi, 489
 bairdii, 488, 489
 dowi, 489
 dowii, 489
 Elastrus dolosus, 602
 Elater aeneus, 608
 bigeminatus, 602
 crucifer, 602
 fascicularis, 615
 ferrugineus, 612
 fulvipes, 612
 granulipennis, 618
 hirtus, 615
 lepidotus, 616
 linearis, 609
 lineatus, 610
 marginatus, 607
 megerlei, 604
 murinus, 602
 nobilis, 601
 obesus, 608
 obscuripes, 605
 obscurus, 606
 ovalis, 602
 pallidulus, 602
 pectinicornis, 606, 607

- purpureus, 614
 riparius, 606, 610
 sjaelandicus, 600
 tessellatus, 600
 thoracicus, 605
 vittatus, 603
 Elaterid beetles of the world, Supplement and corrections to J. A. Hyslop's genotypes of the, 599-619
 Elateridae, 599
 elegans, Eumys, 410
 elegantula, Eukraiohelea, 62
 Parabezzia, 62
 Probezzia, 62
 Stilobezzia, 58, 60, 61
 Stilobezzia (Eukraiohelea), 62, 72 (fig.)
 elegantulus, Bezzia, 62
 Ellipstoma, 363
 gibbosa, 363
 zonalis, 363
 elongata, Polycelis, 172
 elongatus, Vasaces, 89, 91 (fig.), 93
 Emmericia, 386
 Emmericiinae, 386
 Endieronychus, 609
 enigmaticus, Tapirus, 471, 493 (map)
 Enipo, 214, 225
 cirrata, 225, 305
 gracilis, 206, 225, 305
 Entelodontidae, 432, 435
 Eomyidae, 409, 432
 Eotylopus, 433, 434
 reedi, 430
 Ephamillus, 158, 159
 variabilis tristiculus, 161
 ephippium, Amphiprion, 190, 192, 199, 201
 Lutjanus, 188, 199
 Prochilos, 199
 episcopalis, Antimelania, 382
 Melania, 382
 Equidae, 421, 423
 Equus asinus, 423
 caballus, 423
 onager, 424
 prezevalskii, 424
 Ereutho smitti, 328
 erinaceus, Sphaerosyllis, 207, 243 (fig.), 255
 erythraeus, Lophogaster, 577
 Lophogaster typica, 577
 Erythropini, 576
 erythropthalmus, Coccyzus, 588, 589
 esakiana, Stilobezzia (Eukraiohelea), 61, 62
 Espeletia, 475
 esperi, Fagotia, 359
 esulcatus, Leptomeryx, 426, 427
 Eteone, 231, 232, 233 (key), 237 (fig.)
 arctica, 234
 barbata, 206, 233
 (Mysta) barbata, 233
 californica, 234
 cinerea, 234
 depressa, 235
 flava, 206, 233, 235, 237 (fig.)
 lentigera, 235
 longa, 206, 233, 234, 237 (fig.)
 sarsi, 235
 sp. (larvae), 236
 spetsbergensis, 206, 233, 235
 striata, 233
 tuberculata, 234
 Eucanthus, 95, 97
 Euchaetomera, 580
 tenuis, 580
 Euchaetomeropsis, 580
 pacificus, 577, 580
 Euchone, 334, 339
 nalis, 209, 339, 341 (fig.)
 Eucopia, 578
 australis, 578, 579
 grimaldii, 579
 hanseni, 479
 major, 579
 sculpticauda, 578
 unguiculata, 579
 Euranta anticostiensis, 226
 Eudactylus, 618
 wapleri, 618
 eudendrocoeloides, Polycelis, 172
 Eudicrenychus, 609
 Eukraiohelea, 61, 62, 83
 africana, 61
 amnigena, 61
 elegantula, 62
 foyi, 61
 inuitata, 61
 versicolor, 61, 62
 Eulalia, 238
 arctica, 238
 minuta, 238
 Eumecomera, 88
 Eumida, 238
 minuta, 205, 206, 237 (fig.), 238
 Eumys, 410 (key)
 cricketodontoides, 410, 411 (fig.)
 elegans, 410
 exiguus, 411, 415
 latidens, 411, 412, 413 (fig.)
 spokanensis, 411, 413, 414 (fig.)
 Eunoa nodosa, 217
 Eunoë, 214, 216 (key)
 barbata, 219
 clarki, 205, 206, 216, 217
 depressa, 217, 218
 nodosa, 206, 216, 217, 219, 229 (fig.)
 oerstedii, 206, 216, 218, 219, 229 (fig.)
 Eupolynoë anticostiensis, 225
 Eupsephus, 609
 dilaticollis, 609
 eurantron, Polycelis, 172
 Eureum, 544
 Eurycaelon, 362
 anthonyi, 362
 crassa, 362
 cristata, 362
 Eurycotis floridana, 46

- Eusyllis*, 242, 259, 260 (key), 262
blomstrandii, 207, 243 (fig.), 260
magnifica, 205, 207, 260, 261
monilicornis, 260
phosphorea, 260, 261
tubifex, 260
Eutypomys, 432, 433
thompsoni, 430
evansi, *Leptomeryx*, 427 (table)
Evarnella triannulata, 223
excelsus, *Tapirus*, 468
excisum, *Gyrotoma*, 361
exiguus, *Eumys*, 411, 415
eximium, *Poëbrotherium*, 426, 430
Exogone, 242, 257, 258 (key)
dispar, 207, 243 (fig.), 258, 259
gemmafer, 258
loureii, 259
naidina, 207, 243 (fig.), 258
Exophthalmus, 609
expallidus, *Nyctor*, 613
extenuata, *Harmothoë*, 206, 220, 222
Lagisca, 222
Polynoë, 222
Fabricia sabella, 299
fabricii, *Castalia*, 239
Sabella, 334
Fagotia esperi, 359
fairchildi, *Photuris*, 37
fairmairei, *Medonia*, 616
fallax, *Autolytus*, 205, 207, 242, 244,
 246, 247, 250, 251 (fig.)
farctus, *Scarabaeus*, 101
fasciata, *Syllis*, 205, 207, 243 (fig.)
Syllis (*Typosyllis*), 254
fasciatus, *Cheilinus*, 439
fascicularis, *Elater*, 615
fasciolata, *Melanooides*, 380
fasciolatus, *Upeneoides*, 514
fascipennis, *Scutops*, 555, 556
Felidae, 435
felina, *Polycelis*, 172
Felis concolor, 424, 475
femoralis, *Dennyus*, 533
ferruginea, *Altica*, 121, 132
Lactica, 123
Strabala, 122, 125 (fig.), 127, 132
ferrugineus, *Amechanus*, 102
Athyreus, 102
Athyreus (*Bradycinetus*), 102
Bolboceras, 102
Bolboceras (*Amechanus*), 102
Bradycinetulus, 96, 99 (fig.), 102,
 103, 104, 105, 115 (map)
Bradycinetus, 102
Elater, 612
Scarabaeus, 101, 102
fiebrigi, *Stilobezzia*, 76
Fijidoma, 383, 385, 386
laddi, 383, 385
maculata, 383, 385
filicornis, *Nereis*, 284
Spio, 207, 283 (fig.), 284
filifer, *Petaloproctus*, 306, 307
filifera, *Maldane*, 306
finoti, *Ectobius*, 41
firefly, *lampyrid*, *Photuris bethaniensis*,
 A new, 35
fish genus Wetmorella, Review of, with
 descriptions of new forms from
 the tropical Indo-Pacific, 439
fishes, Indo-Pacific anemone, Review
 of the, genus *Amphiprion*, with
 descriptions of two new species,
 187
Flabelligera, 288, 289
affinis, 207, 289, 297 (fig.)
infundibulariformis, 289
infundibularis, 289
infundibularum, 289
Flabelligeridae, 207 (table), 212, 213,
 288 (key), 297 (figs.)
flava, *Eteone*, 206, 233, 235, 237 (fig.)
Nereis, 235
flavangulus, *Phedomenus*, 608
flavigularis, *Chrysococyx*, 593
Fleutiauxellus, 609
flexuosa, *Pista*, 226
flies, Nearctic, of the family *Peris-*
celidae (*Diptera*) and certain
Anthomyzidae referred to the
 family, 551
finti, *Phorticoides*, 553, 556
floccosa, *Lagisca*, 222
Polynoë, 222
florentini, *Cardiophorus*, 615
floridana, *Strabala rufa*, 125 (fig.), 127,
 128
floridana, *Eurycotis*, 46
fluvialis, *Io*, 363, 364
Fonticola, 166, 167
fontis, *Cylindrodon*, 430
foraminifera, *Polynoë*, 217
forbesi, *Travisia*, 296
forbesii, *Travisia*, 296
Forficula livida, 41
formosanus, *Neolacon*, 613
fortis, *Deinictis*, 430
fossator, *Bradycinetulus*, 103
fossatus, *Amechanus*, 103
Bradycinetulus, 99 (fig.), 102, 103,
 105, 114 (map)
Bradycinetus, 103
Bolboceras, 103
Bolboceras (*Amechanus*), 103
fossor, *Sternaspis*, 309
foyi, *Eukraiohelea*, 61.
fragilis, *Lumbrineris*, 275
Lumbrineris, 207, 275, 277 (fig.)
Lumbriconereis, 275
Lumbricus, 275
francicus, *Dennyus*, 534, 535
franciscorum, *Neomysis*, 582
francki, *Gnathodierus*, 610
freethii, *Potadoma*, 370
frenatus, *Amphiprion*, 190, 192, 199, 200
Hemidactylus, 9, 11, 14
frontalis, *Bos*, 424
fuentesii, *Pachychilus*, 366
fugax, *Peratherium*, 402

- fulvicollis, Pengamethes, 614
 Fulviini, 621, 622
 fulvipennis, Tenalomus, 618
 fulvipes, Elater, 612
 Fulvius *albonotatus*, 624 (fig.), 627 (fig.),
 629 (fig.)
 bisbistillatus, 627 (fig.), 631
 castaneus, 627 (fig.), 629 (fig.), 630
 imbecilus, 631
 lunulatus, 630
 ornatifrons, 626 (fig.), 631
 quadrillatus, 627 (fig.), 631
 fumigatus, Cypseloides, 547
 fumosa, Chaetura spinicauda, 539, 542
 funebris, Ambrysus, 1
 fusciventer, Amphiprion, 193
 fuscula, Stilobezzia, 58, 59, 61, 64
 Stilobezzia (Neostilobezzia), 64, 72
 (fig.)
 Fusimorphus, 609
 Fusus, 364

 gallicus, Bolbelasmus, 97, 99 (fig.)
 Scarabaeus, 97
 Gamepentes, 609
 Ganoxanthus, 609
 garmieri, Amyadenium, 177
 Dendrocoelopsis, 178
 Gattiana, 214, 226 (key)
 ciliata, 205, 206, 226, 228
 cirrhosa, 227
 cirrosa, 206, 226, 229 (fig.)
 gaurus, Bos, 424
 Gazella *dorcas*, 424
 granti, 424
 leptoceros, 424
 soemmerringii, 424
 thomsonii, 424
 Geckobia, 9, 10, 15
 australis, 15
 hindustanica, 15
 keegani, 10 (fig.), 11 (fig.)
 philippinensis, 12, 13 (fig.), 14 (fig.)
 simplex, 12
 sp., 9, 10
 texana, 15
 Geckobiella, 15
 texana, 9, 15, 16 (fig.), 17 (fig.)
 geismarianus, Nothocyon, 419
 gemmifera, Exogone, 258
 geniculata, Lithasia, 363
 Geococcyx, 590, 595
 geographica, Adelocera, 617
georgiana, Sphaloplana, 565 (fig.), 566
 567 (fig.), 569 (fig.)
 Georgicus, 609
 sanguinipennis, 609
 Geraniella, 610
 Geranus, 610
 giardi, Capitella, 299
 gibbosa, Ellipstoma, 363
 Pleurocera (Ellipstoma), 363
 gigantea, Melaenis lovéni, 214
 gigas, Gnathophausia, 578
 gilva, Hartomyia, 65, 66
 glabrum, Aylacostoma, 375, 376
 glacialis, Arenicola, 205, 208, 300, 301
 (fig.)
 Trichobranchus, 209, 329, 331 (fig.)
 glans, Balanocochlis, 381
 Melania, 381
 glaphyrus, Glyptomelania, 366
 Pachychilus, 365
 glauca, Iphis, 611
 Lacais, 611
 Stilobezzia, 59, 60, 61, 77, 85
 Stilobezzia (Stilobezzia), 73 (fig.),
 77
 Glossophaga *soricina soricina*, 465
 Glycera, 272
 capitata, 207, 272, 277 (fig.)
 lapidum, 273
 nana, 273
 setosa, 272
 Glyceridae, 207 (table), 213, 272, 277
 (figs.)
 Glycinde, 274
 wiréni, 205, 207, 274, 277 (fig.)
 Glyptomelania, 366
 glaphyrus, 366
 Glyptosaurus *montanus*, 401
 Gnathedicus, 610
 franci, 610
 Gnathophausia, 578
 gigas, 578
 gracilis, 578
 ingens, 578
 zoca, 578
 goësi, Ampharete, 308, 317
 Goniada *nordmanni*, 274
 Goniadidae, 207 (table), 213, 274, 277
 (figs.)
 Goniobasis, 359, 360, 361
 livescens, 361
 osculata, 261
 Gonodyrus, 610
 tarsalis, 610
 gossei, Dennyus, 534, 536, 543, 547
 gottschei, Melania, 370
 gracilis, Chone, 338
 Clinopternodus, 430
 Enipo, 206, 225, 305
 Gnathophausia, 578
 Polynoë, 225
 Proceraea, 250
 gradatus, Paleocastor, 408
 graffi, Proclea, 325
 graffii, Leaena, 325
 Proclea, 209, 325
 grandifolia, Heteronereis, 264, 265
 grandis, Lavigeria, 372
 Leucophaea, 51
 Loxorhynchus, 299
 granifera, Melania, 379
 Tarebia, 379, 386
 graniperda, Melania, 370
 granosa, Brada, 292
 granti, Gazella, 424

- granulata*, Brada, 290, 292
 Cistenides, 312
 Pectinaria, 208, 313 (fig.)
 Pectinaria (Cistenides), 311, 312
 Sabella, 312
 Serpula, 343
granulatus, Spirorbis, 209, 341 (fig.)
 Spirorbis (Lacospira), 343
granulipennis, Elater, 618
graphium, Pachychilus, 366
gratiosus, Agriotes (Ectinus), 618
gratus, Corymbites, 613
grebnitzkii, Archaeomysis, 580
gregarius, Hesperocyon, 418 (fig.), 430
grimaldii, Eucopia, 579
griseiventris, Chaetura, 539
groenlandica, Amphitrite, 209, 321, 322
 Anaitides, 236
 Ophelina, 295, 296
 Phyllococe, 206, 236, 237 (fig.)
 Phyllococe (Anaitides), 236
 Pista, 324
Gromphadorhina, 51, 52
 laevigata, 52
grubei, Ampharete, 316
gryllodes, Orocharis, 24
guianae, Monohelea, 137, 147 (fig.)
 Monohelea (Monohelea), 150
guianae, Tapirus terrestris, 480, 481, 485
guianensis, Couroupita, 491
 Gurney, Ashley B.; Distribution, general
 bionomics, and recognition char-
 acters of two cockroaches re-
 cently established in the United
 States, 39
 Notes on the biology and immature
 stages of a cricket parasite of the
 genus *Rhepalosoma*, 19
guttatipennis, Ambrysus, 6
guttatus, Diacanthus, 610
 Selatosomus, 610
 Upeneoides, 509
Gyrotoma, 361
 excisum, 361
 ovoideum, 361
Gyrus, 610
haematina, Strabala, 134
hagruma, Littorina, 450
Haltica, 122
 ambulans, 122, 123, 131
 rufa, 121, 122, 123, 127
 scutellaris, 123
hamatus, Thelepus, 327
Hamus, 451
hanseni, Eucopia, 479
Hapatesus, 610
Hapithus agitator, 20, 21, 23, 24, 25, 31
 agitator agitator, 23
 agitator quadratus, 23, 24
 brevipennis, 24, 25
 sp., 21, 22, 23, 24, 25, 32
Haploscoloplos alaskensis, 278, 279
Harmothoe, 214, 220 (key)
 anticostiensis, 225
 extenuata, 206, 220, 222
 imbricata, 206, 220, 229 (fig.)
 levis, 221
 multisetosa, 223
 nodosa, 217, 219
 propinqua, 222
 rarispina, 222
 rarispina propinqua, 222
 sarsi, 215
 (Antinoëlla) sarsi, 215
 triannulata, 222, 223
Harpagocryptus, 33
Hartomyia antennalis, 68
 gilva, 65, 66
 lutea, 65, 66
 pallidiventris, 78
 picta, 75
 viridis, 84
Hartomyis nebulosa, 151
hastula, Melania, 380
Hauptathes, 610
hawaiensis, Lophogaster, 577
haydeni, Paleolagus, 415
hebes, Photuris, 36
Heleidae, 57, 136, 141
Heliconia mariae, 630
Heliocis, 88
Hemiblabera tenebricosa, 46
Hemidactylus frenatus, 9, 11, 14
 leschenaulti, 12, 15
Hemimitra, 369
hemionus, Odocoileus, 423
Hemiptera, 488
Hemirhaphes, 610
Hemirhipus, 610
 submetallicus, 609
 trilineatus, 605
Hemirrhaphes, 610
Hemisinus, 367, 375, 376
 behni, 375
 lineolata, 375
henriettae, Melania, 383
Heptacodon, 433
 sp., 430
Herpyllobius arcticus, 221, 223, 227
Herskovitz, Philip, Mammals of north-
 ern Colombia, preliminary report
 No. 7; (genus *Tapirus*), with a
 systematic review of American
 species, 465
Hesionidae, 206 (table), 212, 239, 243
 (figs.)
Hesperocyon, 420, 432, 433
 gregarius, 418 (fig.), 430
 paterculus, 416, 417 (fig.), 430
 sp., 418
heterochaeta, Syllis, 254
 Syllis (Ehlersia), 253
Heteromeryx, 433, 434
 dispar, 430
Heteronereis grandifolia, 264, 265
Hevea sp., 630
hieroglyphica, Monohelea, 135, 136, 137,
 139, 140, 141, 142, 143, 147 (fig.)
 Monohelea (Monohelea), 140, 144,
 145
hindustanica, Geckobia, 15

- Hippopotamus terrestris*, 479
hirtus, Athous, 615
 Elater, 615
Hirundapis caudacutus caudacutus, 543
hirundinidis, Dennyus, 534, 535
Hoabinh, 610
 coomani, 610
hoffmasteri, *Speophila*, 567 (fig.), 569 (fig.), 570, 571 (fig.)
Holmesiella anomala, 580
Hoplophoneus, 433
 mentalis, 430
 o'harrai, 430
 robustus, 430
horei, *Tiphobia*, 373, 374
Horizoteichos, 610
 papuensis, 610
hornii, *Bolbelasmus*, 97, 98, 99 (fig.), 100, 115 (map)
 Bolboceras, 100
 Bradycinetulus, 100
 Bradycinetus, 95, 97, 100
 Kolbeus, 100
horribilis, *Ursus*, 419, 424
Hortomyia diversa, 76
horvathi, *Candezella*, 604
howesi, *Bathanalia*, 374
Hua, 368
hudsonica, *Nephtys*, 270
hugeli, *Paracrostoma*, 383
hungerfordi, *Ambryus*, 6
Hyaenodon, 434
 cruentus, 430
 montanus, 430
Hyas coarctatus, 224, 324
 coarctatus alutaceus, 261
Hydrobiidae, 386
Hydrochaerus tapir, 479
hyeroglyphica, *Monohalea*, 140
Hyman, Libbie H.: North American triclad *Turbellaria*, XIII: three new cave planarians, 563
Hypdonus, 610
Hypeneus, 506
 vittatus, 516
hyperborea, *Cistenides*, 314
 Pectinaria, 208, 313 (fig.)
 Pectinaria (Cistenides), 311, 314
Hypertragulidae, 426, 432, 433
Hypertragulus, 433, 434
 chadronensis, 430
 crawfordensis, 430
Hypisodus, 433, 434
 paululus, 430
Hypnoidus, 610
 bakeri, 610
 basalis, 603
 maritimus, 609
Hypolithus, 610
Hypolittus, 610
hypostylus, *Mesohippus*, 421, 422 (table), 430
Hyracodon, 432
 acridens, 430
Hyracodontidae, 423
Ichnodes, 158
Ictops, 431, 433
 acutidens, 403, 430
 dakotensis, 430
 thompsoni, 430
Idanthyrus, 308
 armatus, 205, 208, 301 (fig.), 308
 ornamentatus, 308
Idiotarmon, 611
ignobilis, *Melanoides*, 371
Ijimia, 172
imbecilis, *Fulvius*, 631
imbricata, *Aphrodita*, 220
 Harmothoë, 206, 220, 229 (fig.)
imitata, *Cyamops*, 558, 559
impatiens, *Lagisca*, 222, 223
imperialis, *Bolbocerastes*, 99 (fig.), 106, 109, 112, 113, 114 (map), 116
imperialis, *Bourguignatia*, 372
incertus, *Autolytus*, 250
indefinata, *Melanoides*, 380
indicus, *Bos*, 424
 Tapirus, 465, 469
 Tapirus (Acrocodia), 467, 489
Indo-Pacific anemone fishes, genus *Amphiprion*, with descriptions of two new species, Review of, 187
inermis, *Melania*, 381
inflatum, *Scalibregma*, 208, 293, 297 (fig.)
inflex, *Paleogale*, 430
infundibulariformis, *Flabelligera*, 289
infundibularis, *Flabelligera*, 289
infundibularum, *Flabelligera*, 289
infundibuliformis, *Chone*, 209, 338, 341 (fig.)
infundibulum, *Amphitrite*, 340
 Myxicola, 209, 340, 341 (fig.)
ingens, *Gnathopausia*, 578
inhabile, *Siphonostoma*, 292
inhabilis, *Brada*, 207, 290, 292, 297 (fig.)
Insectivora, 403, 431
insulare, *Lophogaster subglaber*, 577
intermedia, *Lactica*, 123
 Pseudopotamilla, 337
 Strabala, 121, 122, 125 (fig.), 127, 131, 133
intermedius, *Amphiprion*, 194
 Coracinus, 194
 Lophogaster, 577
 Paleolagus, 415
intonsus, *Dennyus*, 535, 540 (fig.) 545
inuitata, *Eukraiohelea*, 61
Inusitatomysis serrata, 581
 sp., 581
Io, 363
 fluvialis, 363, 364
 spinosa, 364
 tenebrosa, 364
Iphis glauca, 611
Ipostirus, 611
 parumcostatus, 611
iridescens, *Bythoceras*, 373
irrorata, *Littorina*, 460

- Ischnomyia*, 557
Ischyromyidae, 408
Ischyromys, 431, 432, 433, 434
 pliacus, 408, 430
islandica, Polynœ, 217, 218
 Sternaspis, 309
jacquetiana, Melania, 368
 Oxytrema, 368
jamaicensis, *Strabala ambulans*, 125
 (fig.), 127, 131
japonica, *Terebellides stroemii*, 330
japonicus, *Amphiprion*, 198
 Lophogaster, 577
 Mullus, 509
 Upeneoides, 509
jeffersoni, *Prosciurus*, 430
johannseni, *Monohelea*, 137, 139, 146
 (fig.), 147 (fig.), 152, 153
Johannseniella antennalis, 68
 diversa, 76
 nebulosa, 151
 polita, 138
 viridis, 84
Johannsenomyia polita, 138
Jonthadocerus, 611
 theryi, 611
joretiana, *Oxytrema*, 368
jourdin, *Lutjanus*, 194
kadiakensis, *Neomysis*, 582
kansasus, *Bolbocerastes imperialis*, 106,
 112, 115 (map)
karafto, *Polycelis*, 171, 172
Katerythrospis, 581
 sp., 576, 581
keegani, *Geckobia*, 10 (fig.), 11 (fig.)
Kenk, Roman; The freshwater triclads
 (*Turbellaria*) of Alaska, 163
Kenkiidae, 566, 568
Kentrogomphios, 404, 431, 434
 strophensis, 404, 405 (fig.), 406
 (fig.), 430
kiefferi, *Stilobezzia* (*Stilobezzia*), 81
kincaidi, *Boreomysis*, 577, 580
kiushiuana, *Upeneoides*, 522
klaas, *Lampromorpha*, 585, 586, 587,
 590, 592, 593, 594, 595
knulli, *Vasaces*, 89, 90, 91 (fig.)
Kolbeus, 95, 97
 arcuatus, 97, 98
 hornii, 100
 minor, 100
koltzei, *Cephaloon pallens*, 161
koslowi, *Polycelis*, 172
kowloonensis, *Sermyla*, 380
Kudius, 611
La Rivers, Ira; Two new naucorid bugs
 of the genus *Ambrysus*, 1
labiosa, *Paludomus*, 369
Lacais, 611
 glauca, 611
Lachner, Ernest A.; A revision of the
 goatfish genus *Upeneus* with
 descriptions of two new species,
 497
Lactica, 122, 124, 126, 133, 134
 ferruginea, 123
 intermedia, 123
 scutellaris, 122, 123, 129, 130
laddi, *Fijidoma*, 383, 385
laevigata, *Gromphadorhina*, 52
laevissima, *Pachychilus*, 366
Lafoëina maxima, 248, 249
Lagisca extenuata, 222
 extenuata spinulosa, 222
 floccosa, 222
 impatiens, 222, 223
 propinqua, 222
 rarisipina, 222
Lagomorpha, 415, 432
Lamononia, 611
 monticola, 611
Lampromorpha, 585, 590, 591, 592, 594
 caprius, 585, 586, 587, 588, 589, 590,
 591, 592, 593 (fig.), 595
 klaas, 585, 586, 587, 590, 592, 593,
 594, 595
Lampropsephus, 611
Lanassa, 320, 326
 venusta, 209, 326
 venusta pacifica, 326
Lanchaeidae, 553
lanei, *Monohelea*, 137, 139, 146 (fig.),
 147 (fig.)
 Monohelea (*Monohelea*), 140, 142
Lanelater, 608, 611
 schotti, 611
languarioides, *Anischia*, 603
languida, *Strabala*, 122
Laphaniella venusta, 326
lapidum, *Glycera*, 273
laponicus, *Ectobius*, 41, 45
laqueata, *Oxytrema*, 360
largillierti, *Pachychilus*, 366
 Sphaeromelania, 365
Larra, 33
 analis, 32
Larridae, 32
Lasiocerus, 611
lateritia, *Tarebia*, 378, 379
laticlavus, *Amphiprion*, 188, 193
latidens, *Eumys*, 411, 412, 413 (fig.)
latidens, *Mesohippus*, 430
latifrons, *Dennyus*, 533
latipalpis, *Sphaerosyllis*, 256, 257
latrans, *Canis*, 423
laurillardi, *Tapirus*, 479, 481, 485
 Tapirus terrestris, 479
Lavigeria, 371, 372, 373
 coronata, 372
 grandis, 372
Lavigeriinae, 358, 369, 371, 373, 386
Lawrence, R. F.; Two new scale-mite
 parasites of lizards, 9
lazarus, *Scarabaeus*, 95, 101
Leaena, 320, 325
 abranchiata, 209, 325, 326, 331 (fig.)
 abranchiata antarctica, 325, 326
 antarctica, 325
 graffii, 325
 nuda, 326

- lecontei, *Bolboceras*, 102
 lentigera, *Eteone*, 235
Lepidonote cirrata, 220
 scabra, 219
lepidotus, *Elater*, 616
 611, 619
 (*Aulacon*) *nobilis*, 603
 (*Diphyaulon*) *pyrsolepis*, 608
 Le Pinchaque, 471
Leporidae, 415
Leptictidae, 403
leptoceros, *Gazella*, 424
Leptochoeridae, 425, 432, 433
Leptochoerus sp., 425, 430
Leptomeryx, 427, 432, 433, 434
 annectens, 430
 esulcatus, 426, 427
 evansi, 427 (table)
 mammifer, 427
 transmontanus, 426, 427 (table),
 430
Leptoxis, 361, 363, 364, 369
 praerosa, 361, 362
lepturides, *Cephaloon*, 156, 157 (map),
 158, 160
leschenaulti, *Hemidactylus*, 12, 15
Lesnelater, 612
leucogenys, *Pinchaucus*, 471
 Tapirus, 469, 471, 472, 474, 476,
 477, 479
leucopeza, *Ceratolophus*, 138
 Ceratopogon, 138
 Monohelea, 136, 139, 146 (fig.)
 Monohelea (*Schizohelea*), 138
 Schizohelea, 138
Leucophaea, 45, 50, 51
 grandis, 51
 maderae, 40, 45, 47 (figs.)
 puerilis, 53
levis, *Harmothoë*, 221
libertina, *Semisulcospira*, 369
liebmanni, *Pachychilus*, 366
liguriae, *Caesaromyzodes*, 577, 581
limacina, *Ophelia*, 296
limbus, *Dennyus*, 536, 538, 540 (fig.), 542
limicola, *Spio*, 284
Limnetes, 434
 sp., 430
limnophila, *Stilobezzia*, 83
Limnotrochus, 371
 thomsoni, 371
Lincydrus, 612
 cylindricus, 612
linearis, *Vasaces*, 89, 91 (fig.)
linearis, *Elater*, 609
lineata, *Pseudosabellides*, 318
lineatus, *Elater*, 610
lineolata, *Melania*, 376
 Hemisinus, 375
lineolatum, *Aylacostoma* (*Hemisinus*),
 376
linkoi, *Polycelis*, 172
literals, *Pugetomysis*, 581
Lithasia, 363
 geniculata, 363
 obovata, 363
Lithasiopsis, 365
Lithoglyphus rufifilosus, 387
litoraurea, *Monohelea* (*Monohelea*), 152
Littorina, 459
 antoni, 458
 cecillei, 456
 malaccana, 456
 nodulosa, 458
 (*Tectarius*) *pfeifferianus*, 459
 scabra, 563
 thiarella, 451
 tuberculatus, 451
 vilis, 456
Littoraria, 449, 450
littorea, *Littorina*, 450, 460, 462
 Littorina (*Littorina*), 460
Littorina, 450, 463
 -capsula habei, 450
 dilatata, 451
 hagruma, 450
 irrorata, 460
 littorea, 450, 460, 462
 (*Littorina*) *littorea*, 460
 mauritiana, 450
 multistriata, 450
 (*Melarhapse*) *neritoides*, 450
 nodulosa, 451, 459
 pinetado, 450
 pyramidalis, 451, 456
 rudis, 462
 saxatilis, 462
 scabra, 458
 tuberculata, 451
 ziczac, 450, 453 (fig.)
 (*Melarhapse*) *ziczac*, 450, 452
Littorinidae, 449, 450, 460, 461, 462
livens, *Blatta*, 40, 41
 Ecetobius, 39, 40, 47 (figs.)
livescens, *Goniobasis*, 361
livida, *Blatta*, 40, 41
 Forficula, 41
lividus, *Buffeventius*, 604
 Ecetobius, 40, 41
Lizards, Two new scale-mite parasites
 of, 9
lobata, *Scione*, 323
Lobitarsus, 612
Lobotarsus, 612
longa, *Aphrodita*, 230
 Eteone, 206, 233, 234, 237 (fig.)
 Nereis, 234
longicauda, *Sphaerosyllis*, 256, 257
longiceps, *Paedophylax*, 259
longicirris, *Paedophylax*, 259
longicornis, *Sicardius*, 617
longinaris, *Pseudoprotoceras*, 430
longirostris, *Lophogaster*, 577
longisetosa, *Nephtys*, 268
longisetosus, *Autolytus*, 242, 247, 250
Longithorax capensis, 581
Longiverena, 377
longosetosa, *Nephtys*, 268
 Nephtys ciliata, 268
 Nephtys, 207, 267, 268, 269 (fig.)
longosetosus, *Polybostrichus*, 242, 247,
 249, 250

- Lophogaster*, 577, 578
 affinis, 577
 americanus, 577
 challengeri, 577
 erythraeus, 577
 hawaiensis, 577
 intermedius, 577
 japonicus, 577
 longirostris, 577
 multispinosus, 577
 pacificus, 577
 rotundatus, 577
 schmitti, 577, 578
 spinosus, 577
 subglaber, 577
 subglaber affinis, 577
 subglaber insulare, 577
 typica erythraeus, 577
 typicus, 577
lourei, *Exogone*, 259
lovéni, *Melaenis*, 205, 206, 214
Loxorhynchus grandis, 299
lucidus, *Antoligostethus*, 603
 Chalcites, 586, 587, 591, 592, 594, 595
lucricrescens, *Photuris*, 36, 37
Ludius, 611, 612
 parumcostatus, 611
lullianus, *Cyclopidius*, 426
lumbricalis, *Nicomache*, 208, 225, 301
 (fig.), 305
 Sabella, 305
Lumbriconereis minuta, 275, 276
 fragilis, 275
Lumbrius armiger, 278
 capitatus, 298
 cirratu, 286
 fragilis, 275
Lumbrinereis fragilis, 275
Lumbrineris, 275
 fragilis, 207, 275, 277 (fig.)
Lumbrineridae, 207 (table), 213, 275
lunulatus, *Fulvius*, 630
lutea, *Hartomyia*, 65, 66
 Stilobezzia, 58, 60, 61, 65, 68
 Stilobezzia (*Neostilobezzia*), 65, 72
 (fig.)
Lutjanus ephippium, 188, 199
 jourdin, 194
 percula, 188, 191
luzonius, *Upeneoides*, 519
 Upeneus, 500 (table), 502 (tables), 503, 504 (table), 505 (tables), 507, 509, 519, 521 (table); 523, 526
macfiei, *Monohalea*, 137, 139, 140, 146
 (fig.), 147 (fig.)
 Monohalea (*Monohalea*), 143, 144
macfiei, *Stilobezzia*, 65
macrocera, *Dido*, 600
macrocerus, *Tetralobus*, 600, 601
macroopsis, *Acanthomyia*, 582
macrostoma, *Amphiprion*, 201
macrostomus, *Prochilus*, 201
Macrotarsius, 434
maculata, *Ampullacera*, 385
 Ampullarina, 385
 Fijidoma, 383, 385
 Nicomache, 306
 Pista, 205, 209, 319 (fig.) 323, 325
 Salinator, 385
 Terebella, 323
 Veloplacenta, 385
maculatus, *Vasaces*, 89, 91 (fig.), 92
maculatus, *Paludomus*, 369
maculicolle, *Cephaloon pallens*, 161
maculipennis, *Ceratopogon*, 135, 140
 Monohalea, 137, 139, 140
 Monohalea (*Monohalea*), 140, 142
 Scutops, 555, 556
madagascariensis, *Pachyelater*, 612
maderae, *Blatta*, 45
 Leucophaea, 40, 45, 47 (figs.)
 Rhyparobia, 45
Magacnemis, 612
magnifica, *Eusyllis*, 205, 207, 260, 261
 Pionosyllis, 261, 262
magnus, *Metacodon*, 430
major, *Dennyus*, 534, 535, 543
 Eucopia, 579
 Takamatsuia, 543
malaccana, *Litorina*, 456
 Nodilittorina, 456
Maldane, 302, 303
 filifera, 306
 sarsi, 208, 301 (fig.), 303
 sarsi antarctica, 304
 sarsi tropica, 304
 tenuis, 306
Maldanidae, 208 (table), 213, 301 (figs.), 302 (key)
Malekula, 612
 piceus, 612
Mallaphaga, *Studies in Neotropical*, bird lice of the suborder *Amblycera*, genus *Dennyus* Neumann, 533
Mallerius, 612
 brasiliensis, 612
mallochi, *Stilobezzia*, 65, 66
Malloea, 600
malgreni, *Prionospio*, 207, 282, 283
 (fig.)
Mammals of northern Colombia, genus *Tapirus*, 465
memmifer, *Leptomeryx*, 427
Manitsha, 434
Marbenia, 555, 556
 peculiaris, 555, 556
Margarites, 458
marginatus, *Elater*, 607
mariae, *Heliconia*, 630
Marine polychaete worms from Point Barrow, Alaska, with additional records from the North Atlantic and North Pacific, 203
maritimus, *Aplotarsus*, 607
 Hypnoidus, 609
Marshall, N. B., see under *Schultz*, Leonard P.

- marshi, *Archaeotherium*, 430
Marsupialia, 402
 mauiensis, *Sermyla*, 380
 mauritiana, *Littorina*, 450
 Melarhappe, 450
mauritiensis, *Amphiprion*, 189, 192, 196
 maxima, *Lafoëina*, 248, 249
 maximus, *Abchastus*, 601
 maypuri, *Tapir*, 479, 481, 485
 Mazama, 475
 mccullochi, *Amphiprion*, 201
 McDermott, Frank A.; *Photuris bethan-*
 iensis, a new lampyrid firefly, 35
mediaevus, *Apternodus*, 403, 430
medjeorum, *Melanoides*, 371
Medonia fairmairei, 616
medusa, *Polycirrus*, 209, 328, 331
 (fig.)
Megacnemis, 612
Megalagus, 432, 433, 434
 brachyodon, 416, 430
 turgidus, 430
Megapenthes birmanicus, 619
 octomaculatus, 609
Megara, 364
 alveare, 364
megerlei, *Brachygonus*, 604
 Elater, 604
Melaenis, 214
 lovéni, 205, 206, 214
 lovéni gigantea, 214
Melanatractus, 612
 acutus, 612
Melania, 360, 364, 370, 382
 armigera, 363
 aspirans, 380
 crenocarina, 377
 episcopalis, 382
 glans, 381
 gottschei, 370
 granifera, 379
 graniperda, 370
 hastula, 380
 henriettae, 383
 inermis, 381
 jacquetiana, 368
 lineolata, 376
 mitra, 380
 nodifila, 370
 nodiperda, 370
 pagodula, 382
 pagodulus, 382
 scalaris, 375
 semigranosa, 379
 siccata, 381
 sulcospira, 381
 telonaria, 368
 tuberculata, 375, 377
 variabilis, 382
Melanian complex, 358 (key)
Melanians, The relationships of Old
 and New World, 357
Melaniidae, 373
Melanoides, 371, 372, 380, 382, 385,
 386
 chinensis, 380
 crawshayi, 371
 fasciolata, 380
 ignobilis, 371
 indefinata, 380
 medjeorum, 371
 mweruensis, 371
 sp., 380, 381
 suifuensis, 380
 tornata, 371
 tuberculata, 380, 386
 turriculus, 380, 381
 vainafa, 380
 wagenia, 371
melanoleucus, *Aeronautes*, 537, 538
Melanopsidae, 357, 358
Melanopsis, 357, 359
 dufourii, 359
melanopus, *Amphiprion*, 190, 192, 201
 Prochilus, 201
melanostolus, *Amphiprion*, 198
Melanotus, 612
Melanoxanthus, 612
 rubiginosus, 601
 virgatus, 609
Melanoxocanthus, 612
melanurus, *Amphiprion*, 194
Melarhappe, 449, 450, 460, 461
 mauritiana, 450
mentalis, *Hoplophoneus*, 430
mercedis, *Neomysis*, 576, 577, 582
meridionalis, *Dennyus*, 534, 536, 539,
 540 (fig.), 542
 Nitzschia bruneri, 539
Meristhus, 612, 616
 quadripunctatus, 617
 scabinula, 616
 scobinula, 612, 616
Meronychia, 553, 556
Meronychina, 553, 556
 annulata, 556
Merychippus sp., 423
Merycoidodon affinis, 430
 culbertsoni, 425
 sp., 425
Merycoidodontidae, 425, 432, 433
Merycoidodonts sp., 430
Mesembria, 601
 subtilis, 601
Mesohippus, 425, 432, 433
 celer, 430
 hypostylus, 421, 422 (table), 430
 latidens, 430
 montanus, 430
 portentus, 430
Mesoreodon chelonyx, 425
messi, *Pectocera*, 605
Metacodon, 431, 433
 magnus, 430
Metactenicerus, 613
metallicum, *Stenocephaloon*, 159
Meterychrops microphthalma, 580
 robusta, 580
mexicanae, *Tapirus americanus*, 480, 481,
 485

- Microchiroptera, 407
 Microperiscelis, 551, 552, 553, 555, 556
 annulata, 555, 556
 winnertzi, 556
 microphthalmal, Meterythroptus, 580
 microps, Boreomysis, 576, 579
 Micropternodus, 431, 433
 borealis, 430
 micros, Cryptohypnus, 615
 Microtus, 424
 Midges, American biting, of the heleid
 genus *Monohalea*, 135
 biting, of the heleid genus *Stil-
 obezzia* in North America, 57
miliaris, *Nodilittorina*, 450
 milli, *Sparus*, 198
mimas, *Monohalea* (*Monohalea*), 152
minimus, *Adjidaumo*, 430
minor, *Bolbelasmus*, 97, 98, 99 (fig.),
 100, 115 (map)
 Bolboceras, 100
 Bradycinetus, 95, 97, 100
 Dennyus, 535, 544
 Ectobius livens, 44
 Kolbeus, 100
 Nicomache, 306
 Nitzschia, 544
 Paradjidaumo, 409, 430
 Perchoerus, 430
minuta, *Aphrodites*, 230
 Eulalia, 238
 Eumida, 205, 206, 237 (fig.), 238
 Lumbriconereis, 275, 276
 Oophylax, 256, 257
 Pholoë, 206, 229 (fig.), 230
minutum, *Scalibregma*, 293, 294
minutus, *Pseudopteron*, 430
mirabilis, *Cardiohypnus*, 604
mitis, *Caenopus*, 425, 430
mitra, *Melania*, 380
mobilicornis, *Scarabaeus*, 101
Moduliade, 357, 358, 449, 461, 462
modulus, *Modulus*, 453 (fig.), 454, 457
 (fig.), 461
Modulus, 357, 449, 461
 modulus, 453 (fig.), 454, 457 (fig.),
 461
Mogula sp., 255
moluccensis, *Upeneoides*, 514
 Upeneus, 500 (table), 502 (tables),
 504 (table), 505 (tables), 508,
 510, 514
 Upeneoides, 514
monilicornis, *Eusyllis*, 260
 Syllis, 260
monofasciatus, *Amphiprion*, 199
Monohalea, 135, 136, (key), 139 (table),
 146 (figs.), 147 (figs.)
 American biting midges of the
 heleid genus, 135
 brasiliensis, 137, 135
 (*Monohalea*) *brasiliensis*, 145
 guianae, 137, 147 (fig.)
 (*Monohalea*) *guianae*, 150
 hieroglyphica, 135, 136, 137, 139,
 140, 141, 142, 143, 147 (fig.)
 (*Monohalea*) *hieroglyphica*, 140,
 144, 145
 hyeroglyphica, 140
 johannseni, 137, 139, 146 (fig.), 147
 (fig.), 152, 153
 lanei, 137, 139, 146 (fig.), 147 (fig.)
 (*Monohalea*) *lanei*, 140, 142
 leucopeza, 136, 139, 146 (fig.)
 (*Schizohalea*) *leucopeza*, 138
 (*Monohalea*) *litoraurea*, 152
 macfiei, 137, 139, 140, 146 (fig.),
 147 (fig.)
 (*Monohalea*) *macfiei*, 143, 144
 maculipennis, 137, 139, 140, 146
 (fig.), 147 (fig.)
 (*Monohalea*) *maculipennis*, 140, 142
 (*Monohalea*) *mimas*, 152
 multilineata, 137, 139, 145, 147
 (fig.), 149, 150
 (*Monohalea*) *multilineata*, 149
 nebulosa, 137, 139, 146 (fig.), 147
 (fig.) 151
 (*Monohalea*) *nebulosa*, 151, 153
 nigeriae, 150
 ornata, 137, 139, 146 (fig.)
 (*Monohalea*) *ornata*, 144
 sp., 135
 stonei, 137, 139, 146 (fig.), 147 (fig.)
 (*Monohalea*) *stonei*, 148, 149, 150
 tessellata, 147 (fig.), 150, 152, 153
 (*Monohalea*) *tessellata*, 152
 texana, 136, 147 (fig.)
 (*Monohalea*) *texana*, 143
monstrosum, *Cavicoxum*, 605
montanus, *Glyptosaurus*, 401
 Hyanedon, 430
 Mesohippus, 430
 Promerycochoerus, 426
 Stibarus, 430
monticola, *Lamononia*, 611
montrouzieri, *Tectaria*, 451
Mopleonus, 613
 candezei, 613
morgani, *Phagocata*, 165, 167, 168
mormon, *Ambrysus*, 3, 4
Morrison, J. P. E.; The relationships
 of Old and New World melanians,
 357
mortoni, *Archaeotherium*, 430
moutoniana, *Oxytremia*, 368
mucosa, *Phyllodoce*, 236
Mudalia, 361
 carinata, 361
 trilineata, 361
Mulloides pinnivittatus, 513
Mullus, 528
 auratus, 528, 529
 bandi, 516
 bensasi, 509
 dubius, 498, 515
 japonicus, 509
 subvittatus, 513
 vittatus, 506, 516

- multilineata, *Monohalea*, 137, 139, 145,
 147 (fig.), 149, 150
 Monohalea (*Monohalea*), 149
 Oxytrema virginica, 360
 Palpomyia, 149
 multipapillata, *Castalia*, 239
 multisetosa, *Harmothoe*, 223
 multispinosus, *Lophogaster*, 577
 multistriata, *Littorina*, 450
 Mumetopia, 557, 558
 muricatus, *Tectarius*, 449, 450, 452, 453
 (fig.), 454, 455 (fig.), 457 (fig.),
 459, 460, 462
 murinus, *Elater*, 602
 Mustelinae, 434
 Mutilloptera, 557
 mweruensis, *Melanoides*, 371
 Mycterus, 156, 158
 Myodris, 552, 553, 555, 556
 annulata, 556
 Myrsidea, 533
 A supplement to W. M. Tattersall's
 review of, 575
 Mysidae, 582
 Mysidella americana, 576, 582
 Mysidellinae, 576, 582
 Mysini, 576
 Mysis oculata, 576, 581
 Mysta, 233
 barbata, 233
 Mystides, 231, 232
 borealis, 206, 232, 237 (fig.)
 notialis, 232
 viridis, 232
 Myxicola, 334, 340
 infundibulum, 209, 340, 341 (fig.)
 steenstrupii, 340

 naidina, *Exogone*, 207, 243 (fig.), 258
 nana, *Glycera*, 273
 nanus, *Perchoerus*, 430
 nassa, *Nassopsis*, 372
 Nassopsis, 373
 nassa, 372
 Naucorid bugs of the genus *Ambrysus*,
 Two new, 1
 Naucoridae, 1
 Nauphoeta, 48, 51
 cinerea, 40, 46, 51
 nausicaae, *Dendrocoelum*, 179
 nearcticum, *Rhopalosoma*, 19, 20, 24, 32
 nebulosa, *Ceratopogon*, 135
 Cyamops, 558
 Hartomyia, 151
 nebulosa, *Johannseniella*, 151
 Monohalea, 137, 139, 146 (fig.),
 147 (fig.), 151
 Monohalea (*Monohalea*), 151, 153
 Periscelis, 553, 556
 nebulosus, *Ceratolophus*, 151
 Ceratopogon, 151
 neglecta, *Potamilla*, 209, 333 (fig.), 335
 Sabella, 335
 neglectus, *Pseudocylindrodon*, 430
 Neoamphitrite robusta, 322

 Neolacon, 613
 formosanus, 613
 Neomysis franciscorum, 582
 kadiakensis, 582
 mercedis, 576, 577, 582
 rayii, 582
 neonigripes, *Nereis*, 264
 Nereis pelagica, 264, 265
 Neonomopleus, 613
 strictus, 613
 Neoscutops, 555, 556
 rotundipennis, 555, 556
 Neostilobezzia, 63
 Neotropical Miridae, LXIV, New bugs
 of the subfamily *Cylapinae*
 (*Hemiptera*), 621-632
 nephrophthalma, *Acanthomyia*, 582
 Nephthys brachycephala, 271, 272
 caeca, 270
 ciliata, 268, 270
 ciliata longosetosa, 268
 discors, 270
 coeca, 268
 longisetosa, 268
 longosetosa, 268
 paradoxa, 271
 phyllibranchia, 271
 Nephthyidae, 207 (table), 212, 266, 269
 (figs.)
 Nephthys, 267 (key)
 ciliata, 207, 267, 269 (fig.), 270
 discors, 207, 267, 269 (fig.), 270
 longosetosa, 207, 267, 268, 269
 (fig.)
 paradoxa, 207, 267, 269 (fig.), 271
 phyllibranchia, 271, 272
 rickettsi, 270, 271
 Nephthys ciliata, 270
 hudsonica, 270
 Nereidae, 207 (table), 212, 263, 269
 (figs.)
 Nereis, 263, 264 (key)
 aphroditoides, 239
 arctica, 264
 armillaris, 254
 caeca, 270
 ciliata, 268, 270
 filicornis, 284
 flava, 235
 longa, 234
 neonigripes, 264
 pelagica, 207, 264, 269 (fig.)
 (*Nereis*) pelagica, 264
 pelagica neonigripes, 264, 265
 pelagica occidentalis, 264, 265
 prismatica, 247, 249
 procera, 266
 zonata, 207, 265, 269 (fig.)
 (*Nereis*) zonata, 264, 265
 zonata persica, 266
 Nerinides, 280, 285
 sp., 205, 207, 283 (fig.), 285
 neritiformis, *Tylomelania*, 381
 neritoides, *Stanleya*, 388
 neritoides, *Littorina* (*Melarhaphe*), 450

- Nicolea*, 320, 322
 arctica, 322
 simplex, 323
 venustula, 209, 319 (fig.), 322
 zostericola, 322
Nicomache, 303, 304, 305 (key)
 carinata, 305
 lumbricalis, 208, 225, 301 (fig.), 305
 lumbricalis borealis, 305
 maculata, 306
 minor, 306
 personata, 208, 301 (fig.), 305, 306
niger, *Pleonomus*, 616
nigeriae, *Monohelea*, 150
nigra, *Polycelis*, 172
nigrata, *Pachychilus*, 366
nigriceps, *Strabala*, 122
Nimravinae, 434
Nina, 458
Nitzschia bruneri, 538
 bruneri meridionalis, 539
 dubius, 537
 minor, 544
 pulicaris tibialis, 538
 tibialis, 538
nivea, *Phagocata*, 164, 167 (fig.), 179, 180, 182
nobilis, *Elater*, 601
 Lepidotus (*Aulacon*), 603
nodifila, *Melania*, 370
 Oxytrema, 361, 368
Nodilittorina, 449, 450, 454, 455 (fig.), 458, 459, 460, 463
 malaccana, 456
 miliaris, 450
 picta, 450
 pyramidalis, 456, 460
 subnodosa, 456
 tuberculata, 449, 450, 451, 453 (fig.), 454, 455 (fig.), 457 (fig.), 459, 460, 462
 vilis, 456
nodiperda, *Melania*, 370
nodosa, *Eunoa*, 217
 Eunoë, 206, 216, 217, 219, 229 (fig.)
 Harmothoë, 217, 219
 Polynoë, 217, 219
nodulosa, *Littorina*, 458
 Littorina, 451, 459
nodulosus, *Echininus*, 449, 451, 452, 453 (fig.), 454, 455 (fig.), 457 (fig.), 458
 Tectarius, 462
 Trochus, 451, 456
 Turbo, 451
Nomopleus, 613
nordmanni, *Goniada*, 274
North American triclad Turbellaria, XIII; three new cave planarians, 563
Northern Colombia, Mammals of, genus Tapirus, 465
Nothocyon geismarianus, 419
notialis, *Mystides*, 232
Notiphila, 553, 556
 annulata, 552
 nubilus, *Canis*, 423
 nuda, *Leaena*, 326
 Nullarborica, 613
 concinna, 613
 Nychia cirrosa, 226
 Nyctitheriidae, 404
 Nyctor, 613
 expallidus, 613
obesus, *Elater*, 608
obovata, *Lithasia*, 363
obscura, *Pacificola*, 613
obscuripes, *Elater*, 605
obscurus, *Elater*, 606
occidentalis, *Periscelis*, 552, 553, 554, 555, 556
occidentalis, *Nereis pelagica*, 264, 265
ocellaris, *Amphiprion*, 194
ocellata, *Wetmorella*, 440, 442, 443, 444, 446, 447
Ochotoninae, 434
ochraceus, *Ceratopogon*, 63
octomaculatus, *Megapenthes*, 609
oculata, *Mysis*, 576, 581
oculatus, *Vannius*, 626 (fig.), 628
oculi-marginata, *Polycelis*, 172, 182
Odocoileus hemionus, 423
 virginianus, 423
Odontaeus, 96, 101
Odontocardus, 613
Oedemeridae, 158
oerstedii, *Chaetosyllis*, 253
 Eunoë, 206, 216, 218, 219, 229 (fig.)
 Syllis, 253
Ogmophis arenarum, 402
o'harrai, *Hoplophoneus*, 430
olequaensis, *Ambloxyus*, 360
oligospilus, *Upeneus*, 500 (table), 502 (tables), 503, 504 (table), 505 (tables), 509, 525, 526 (table), 527 (table)
onager, *Equus*, 424
Oophylax minuta, 256, 257
Ophelia limacina, 296
Opheliidae, 208 (table), 213, 295 (key), 297 (fig.)
Ophelina groenlandica, 295, 296
Opomyzidae, 557
Orbiniidae, 207 (table), 213, 278, 283 (figs.)
orientalis, *Asabellides*, 318
ornata, *Monohelea*, 137, 139, 146 (fig.)
 Monohelea (*Monohelea*), 144
ornamentatus, *Idanthyrus*, 308
ornata, *Proceraea* (*Stephanosyllis*), 246
 Stephanosyllis, 246
ornatifrons, *Fulvius*, 626 (fig.), 631
ornatus, *Anchastelater*, 602
 Autolytus, 244
 Diploconus, 616
 Tremarctos, 475
Orocharis grylloides, 24
 saltator, 22, 23, 24
 sp., 22, 23, 24, 25, 32
osborni, *Trigonia*, 425, 430

- osculata, *Goniobasis*, 361
 ovalis, *Elater*, 602
Ovalpalpus, 613
Ovipalpus, 613
 ovoideum, *Gyrotoma*, 361
Oxymelania, 365
 schiedianus, 365
Oxytremia, 359, 364, 367, 370, 371, 382
 bailleti, 368
 bulbosa, 361
 canaliculatum undulatum, 360
 catenaria, 360
 comalensis, 360
 deshayesiana, 361
 jacquetiana, 368
 joretiana, 368
 laqueata, 360
 moutoniana, 368
 nodifila, 361, 368
 peregrinorum, 368
 (*Strephobasis*) *plena*, 361
 plicifera, 360
 semicarinata, 367
 silicula, 360
 symmetrica, 360
 telonaria, 368
 toucheana, 368
 virginica, 364
 virginica multilineata, 360

Pachychilus, 360, 364, 366, 367, 370
 corvinus, 365, 366
 cumingii, 366
 (*Pilsbrychilus*) *dalli*, 367
 drakei, 360
 fuentesii, 366
 glaphyrus, 365
 graphium, 366
 laevisima, 366
 largillierti, 366
 liebmanni, 366
 nigrata, 366
 pilsbryi, 365
 (*Oxymelania*) *pilsbryi*, 376
 violaceus, 366
 walli, 367

Pachycynodon, 421
Pachyelater, 612
 madagascariensis, 612
pacifica, *Euchaetomeropsis*, 577, 580
 Lanassa venusta, 326
 Spio filicornis, 284
Pacificola, 613
 obscura, 613
pacificum, *Cephaloon*, 157 (map), 159, 160
pacificus, *Lophogaster*, 577
Paedophylax dispar, 259
 longiceps, 259
 longicirris, 259
pagodula, *Protia*, 382
 Melania, 382
pagodulus, *Melania*, 382
Paleocaster gradatus, 408
 peninsulatus, 408
Paleogale, 432, 433
 inflex, 430

Paleolagus, 432, 433, 434
 burkei, 415
 haydeni, 415
 intermedius, 415
 temnodon, 415, 430
pal lens, *Cephaloon*, 157 (map), 158, 160,
 161
pallidiventris, *Hartomyia*, 78
 Stilobezzia, 59, 61, 78
 Stilobezzia (*Stillobezzia*), 78
pallidulus, *Elater*, 602
Palpomyia dorsofasciata, 62
 multilineata, 149
Paludominae, 371
Paludomus, 369, 383
 labiosa, 369
 maculatus, 369
 tanschaurica, 369
Panamenia, 555, 556
 chapmani, 555
Panchlora, 45, 51
Pantolamprus sulcicollis, 618
panzeri, *Ectobius*, 44
papuensis, *Amphiprion*, 199
 Hortizoteichos, 610
Parabezzia, 61
 elegantula, 62
 petiolata, 61
 poikiloptera, 62, 83
Paracapiophonus, 614
Paracardiophorus, 614
Paracrostoma, 383
 hugeli, 383
Paradoxon, 614
Paradoxon, 614
Paradima, 614
 tattakensis, 614
Paradjidaumo, 433
 minor, 409, 430
 spokanensis, 409
 trilophus, 409
paradoxa, *Nephtys*, 271
 Nephtys, 207, 267, 269 (fig.), 271
Paragonimiasis, 378
Paralithodes camtschatica, 224
Paramelania, 371, 372, 373
 damoni, 371
Paramelaniinae, 373
Paranaitis wahlbergi, 236
Parapomachilius, 601
Parascaptor, 407
Parastirus, 614
Parathous, 614
 sanguineus, 614
Parcoblatta, 43, 45, 50
Parictis, 421, 432, 433
 bathygenus, 421
 dakotensis, 420, 430
Paroedostethus, 614
 relictus, 614
parumcostatus, *Ipostirus*, 611
 Ludius, 611
Parupeneus, 515
parviceps, *Ambrysus*, 6
Parvistoma, 614

- parvulus*, *Bolborhombus*, 99 (fig.), 115
 (map), 117, 118, 119
parvus, *Upeneoides*, 528
Upeneus, 499, 500 (table), 501, 502
 (tables), 503, 504 (table), 505
 (tables), 508, 528
paterculus, *Hesperocyon*, 416, 417 (fig.),
 430
Patricia, 614
austratica, 614
paucicostata, *Edgaria*, 372
paulistensis, *Stilobezzia*, 71
paululus, *Hypisodus*, 430
Peasiella, 462
Pectinaria, 311
 (*Cistenides*), 311 (key)
brevicoma, 312
 (*Cistenides*) *brevicoma*, 312
granulata, 208, 313 (fig.)
 (*Cistenides*) *granulata*, 311, 312
hyperborea, 208, 313 (fig.)
 (*Cistenides*) *hyperborea*, 311, 314
 sp., 307
Pectinariidae, 208 (table), 212, 310, 313
 (figs.)
pectinicornis, *Elater*, 606, 607
Pectocera, 614
messi, 605
Pectoerra, 614
Pectora, 614
peculiaris, *Marbenia*, 555, 556
pelagica, *Chaetura*, 537
Nereis, 207, 264, 269 (fig.)
Nereis (*Nereis*), 264
pellucida, *Planaria*, 167
Peltosaurus sp., 401
Penecurva, 168
Pengamethes, 614
fulvicollis, 614
peninsularis, *Bolbocerastes*, 99 (fig.),
 105, 112, 114 (map), 116
Bolboceras serratus, 116
Bradycinetus serratus, 116
peninsulatus, *Paleocastor*, 408
Peratherium fugax, 402
titanelix, 402, 430
Perca polymna, 194
Perchoerus, 433
minor, 430
nanus, 430
percula, *Actinicola*, 191
Amphiprion, 188, 191, 192, 193
Lutjanus, 188, 191
Prochilus, 191
peregrinorum, *Oxytrema*, 368
perideraion, *Amphiprion*, 188, 191, 192
Prochilus, 191
Periplaneta, 46, 50, 53
Periscelidae, 551, 552, 555 (key), 556
 (list), 557, 560
Periscelis, 551, 552 (key), 555, 556
annulata, 552, 553, 556
annulipes, 556
nebulosa, 553, 556
occidentalis, 552, 553, 554, 555, 556
wheeleri, 552, 553, 556
winnertzi, 556
Perissodactyla, 421, 432
Peritropis, 624
Peritropoides, 622
annulatus, 624, 625, 628
quadrinotatus, 625, 626 (fig.), 627
 (fig.), 629 (fig.)
Peromyscus, 410
persica, *Nereis zonata*, 266
personata, *Nicomache*, 208, 301 (fig.),
 305, 306
perspicillaris, *Ectobius*, 41
peruvianus, *Tapirus* (*terrestris*), 479,
 481, 485
Petaloproctus, 302, 306
filifer, 306, 307
tenuis, 208, 301 (fig.), 306
tenuis borealis, 306, 307
petiolata, *Parabezzia*, 61
Pettibone, Marian H.; Marine poly-
 chaete worms from Point Barrow,
 Alaska, with additional records
 from the North Atlantic and
 North Pacific, 203
pfeifferianus, *Litorina* (*Tectarius*), 459
Phagocata, 164, 166, 167, 168, 566
albissima, 165, 167
cavernicola, 563, 565 (fig.)
coarctata, 167
morgani, 165, 167, 168
nivea, 164, 167 (fig.), 179, 180, 182
subterranea, 566
vitta, 165, 167
Phalerebus, 188, 190
Pharotarsus, 614
phaseopygus, *Chaetura griseiventris*,
 539
Phedomenus flavangulus, 608
Pherhimius, 615
Phibisa, 615
philippina, *Wetmorella*, 439, 440, 446,
 447
Wetmorella philippina, 440, 441
 (fig.), 442, 443, 445
philippinensis, *Geckobia*, 12, 13 (fig.),
 14 (fig.)
philippinus, *Upeneoides*, 516
phillipsi, *Upeneus*, 498, 528, 529
Philodendron sp., 631
phoenicobia, *Tachnornis phoenicobia*,
 543
Pholoë, 228, 230
minuta, 206, 229 (fig.), 230
tuberculata, 230
Phorocardius, 615
solitarius, 608
Phorotarsus, 614
Phorticoides, 556
flinti, 553, 556
phosphorea, *Eusyllis*, 260, 261
Photinus consanguineus, 36
pyralis, 35, 36
Photuris, 35
bethaniensis, 36

- bethaniensis*, a new Lampyrid fire-fly, 25
 fairchildi, 37
 hebes, 36
 lucrescens, 36, 37
 versicolor, 35, 36
 phyllobranchia, Nephthys, 271
 Nephthys, 271, 272
 Phyllodoce, 236
 citrina, 236
 groenlandica, 206, 236, 237 (fig.)
 (Anatides) groenlandica, 236
 mucosa, 236
 Phyllococidae, 206 (table), 212, 231
 (key), 237 (figs.)
 Piaya, 586
 piceus, Malekula, 612
 picta, Hartomyia, 75
 Nodilittorina, 450
 Stephanosyllis, 246
 picticollis, Cephaloon pallens, 161
 pictus, Ceratopogon, 75
 piegeti, Dennyus, 533
 Piezophyllus, 600, 601, 606
 spencei, 601, 606
 pilosa, Brada, 290, 291
 Pilsbrychilus, 366
 pilsbryi, Pachychilus, 365
 Pachychilus (Oxymelania), 376
 pinchacus, Tapirus, 471, 480
 Pinchacus, 469, 471
 aenigmaticus, 471
 leucogenys, 471
 pinchaque, 471
 terrestris, 471
 villosus, 471
 pinchaque, Pinchacus, 471
 Tapir, 471
 Tapirus, 465, 466, 467, 468, 469,
 471, 478, 479, 482 (fig.), 483
 (fig.), 484, 487 (fig.), 489, 493
 (map), 495 (map)
 pinctado, Littorina, 450
 pinnivittatus, Mulloides, 513
 Pionosyllis, 242, 262
 compacta, 205, 207, 243 (fig.), 262
 magnifica, 261, 262
 piriformis, Dendrocoelopsis, 174, 177
 (fig.), 178, 180
 Pista, 320, 323
 flexuosa, 226
 groenlandica, 324
 maculata, 205, 209, 319 (fig.), 323,
 325
 Placonides, 615
 Planaria pellucida, 167
 Planariidae, 164, 563
 Planaxidae, 357, 358, 387
 Platycrepidius, 618
 plena, Oxytrema (Strephobasis), 361
 Pleonomus argentatus, 613
 niger, 616
 Plesictis, 432, 433
 priscus, 430
 Pleurocera, 359, 360, 362, 363
 acuta, 360
 (Oxytrema) acuta, 260
 alveare, 364
 (Ellipstoma) gibbosa, 363
 verucosa, 362
 zonalis, 363
 Pleuroceridae, 357, 358, 359, 363, 365,
 367, 369, 370, 374, 375, 376, 377
 Pleurocerinae, 358, 359, 364, 367, 369,
 370
 Pleurocerus (Oxytrema) acutus, 360
 pliacus, Ischyromys, 408, 430
 plicifera, Oxytrema, 360
 Ploconides, 615
 Plotia, 379
 Plotiopsis, 378
 balonnensis, 378
 pluribranchiata, Styelaroides, 290, 291
 Podocera, 556, 560
 ramifera, 560
 Poëbrotherium, 433
 eximum, 426, 430
 poeyi, Phopalosoma, 19
 poikiloptera, Parabezzia, 62, 83
 polita, Allohelea, 138
 Johannseniella, 138
 Johannsenomyia, 138
 Schizohelea, 138
 Sphaeromias, 138
 politus, Ceratolophus, 138
 Ceratopogon, 138
 Polybostrichus, 241, 247, 248, 251 (fig.)
 longosetosus, 242, 247, 249, 250
 Polycelidia, 171
 Polycelis, 163, 168, 169, 171, 172, 173,
 182, 183 (map), 184
 auriculata, 171, 172
 borealis, 168, 171 (fig.), 172, 182
 coronata, 171, 172
 eburnea, 172
 elongata, 172
 eudendrocoeloides, 172
 eurantron, 172
 felina, 172
 karafto, 171, 172
 koslowi, 172
 linkoi, 172
 nigra, 172
 oculi-marginata, 172, 182
 polyopsis, 172
 receptaculosa, 172
 relicta, 172
 sabussowi, 172
 sapporo, 172
 schmidti, 171, 172
 tenuis, 172
 tibetica, 172
 Polychaeta, 211 (key)
 Polycirrus, 320, 328
 medusa, 209, 328, 331 (fig.)
 sp., 328
 Polydora, 280, 281
 brachycephala, 280, 281
 caulleryi, 207, 280, 281, 283 (fig.)
 polylepis, Prochilus, 200
 polymna, Anthias, 198
 Perca, 194

- polymnus, Amphiprion, 189, 193, 194,
 197, 198, 200
 Anthias, 191
 Prochilus, 198
 Polynoë arctica, 217
 cirrata, 220
 extenuata, 222
 floccosa, 222
 foraminifera, 217
 gracilis, 225
 islandica, 217, 218
 nodosa, 217, 219
 rarispina, 222
 sarsi, 215
 scabra, 217, 218, 219
 semisculpta, 222
 semisculptus, 222
 spinulosa, 217
 Polynoidae, 206 (table), 212, 213, 214
 (key), 229 (figs.)
 polyopis, Polycelis, 172
 Polyprotodontia, 402
 portentus, Mesohippus, 430
 Potadoma, 370
 freethii, 370
 Potadominae, 371
 Potamanax, 365, 376
 Potamididae, 449
 Potamilla, 334, 335
 acuminata, 336
 neglecta, 209, 333 (fig.), 335
 reniformis, 209, 333 (fig.), 335, 336
 torelli, 336
 Practapyrus, 615
 descarpentriesi, 615
 praerosa, Leptoxis, 361, 362
 praetermissa, Clymene (Praxillella), 303
 Praxilla, 303
 Praxillella, 208, 301 (fig.), 303
 Praxilla praetermissa, 303
 Praxillella, 302, 303
 praetermissa, 208, 301 (fig.), 303
 prezevalskii, Equus, 424
 prima, Diopsosoma, 556
 Prionospio, 280, 282
 malmgreni, 207, 282, 283 (fig.)
 tenuis, 282
 priscus, Plesictis, 430
 prismatica, Nereis, 247, 249
 prismaticus, Autolytus, 207, 242, 244,
 245, 246, 247, 249, 251 (fig.)
 Pristilophus, 615
 sericans, 616
 Pristolophus, 615
 Probezzia elegantula, 62
 procera, Nereis, 266
 Proceraea gracilis, 250
 (Stephanosyllis) ornata, 246
 Prochilos ephippium, 199
 Prochilus, 188
 akallopisus, 188, 190
 bifasciatus, 193, 194
 macrostomus, 201
 melanopus, 201
 percula, 191
 perideraion, 191
 polymnus, 198
 polypepis, 200
 Proclea, 320, 325
 graffi, 325
 graffii, 209, 325
 Prodrasterius, 615
 Progne chalybea chalybea, 549
 Prolacon, 615
 allaudi, 615
 prolifer, Autolytus, 244, 245, 247, 249,
 250
 Promerycochoerus montanus, 426
 Proneomysis wailesi, 582
 propinqua, Harmothoë, 222
 Harmothoë rarispina, 222
 Lagisca, 222
 Proquasimus, 615
 Prosciurus, 431, 433
 jeffersoni, 430
 relictus, 408
 vetustus, 430
 Prosternon, 600
 Prosynthetoceros, 428
 Protemnocyon, 420
 pruinosa, Stilobezzia, 59, 60, 61, 79
 Stilobezzia (Stilobezzia), 73 (fig.),
 79
 Psammate aphroditoides, 239
 Psephus cyaneus, 611
 Pseudathous, 615
 Pseudocylindrodon, 432, 433
 neglectus, 430
 Pseudoderomecus, 616
 Pseudo-Elater, 616
 pseudomacropsis, Acanthomysis, 582
 Pseudomma truncatum, 581
 Pseudonomopleus, 616
 Pseudoplotia, 378
 scabra, 378
 Pseudopotamilla intermedia, 337
 reniformis, 337
 Pseudopristilophus, 616
 Pseudoprotoceros, 433, 434
 longinaris, 430
 Pseudopteroodon, 434
 minutus, 430
 Pseudosabellides, 318
 lineata, 318
 Pseudostirus, 616
 Pterygosomidae, 10
 pudicus, Ambrysus, 6
 puerilis, Leucophea, 53
 puertoricensis, Strabala ambulans, 125
 (fig.), 127, 132
 Pugetomysis literalis, 581
 pulchripennis, Sphaeromyas, 137
 Pulchronotus, 616
 puncticollis, Ambrysus, 6
 punctipes, Stilobezzia, 58, 60, 61
 Stilobezzia (Stilobezzia), 72 (fig.), 79
 punctulata, Stilobezzia (Stilobezzia), 81
 pupa, Travia, 296
 pupieri, Ctenicera, 615
 purpureua, Elater, 614
 Pycnoscelus, 45, 51
 surinamensis, 45, 51

- pyralis, *Photinus*, 35, 36
 pyramidalis, *Littorina*, 451, 456
 Nodilittorina, 456, 460
 pyrsolepis, *Adelocera*, 608
 Lepidotus (*Diphyaulon*), 608
 Pythidae, 158

 quadrangularis, *Spirorbis*, 343
 quadratus, *Hapithus agitator*, 23, 24
 quadridens, *Bolboceras*, 101
 Scarabaeus, 101
quadrinotatus, *Peritropoides*, 625, 626
 (fig.), 627 (fig.), 629 (fig.)
 quadripunctatus, *Meristhus*, 617
 quadristillatus, *Fulvius*, 627 (fig.), 631
 quadrivittatus, *Betarmon*, 611
 Quasimus setosus, 606
 quaternaria, *Syllis*, 253, 254

 rabelloi, *Stilobezzia*, 59, 60, 61, 81
 Stilobezzia (*Stilobezzia*), 72 (fig.), 81
 radiata, *Amphitrite*, 321
 Radina, 380
 ramifera, *Podocera*, 560
 Rangifer arcticus, 424
 caribou, 424
 Raphaea, 616
 vitida, 616
 rarispina, *Harmothoe*, 222
 Lagisca, 222
 Polynoë, 222
 Rastrocephalus, 616
 rayii, *Neomysis*, 582
 receptaculosa, *Polycelis*, 172
 rectangularis, *Colaulon*, 606
 reedi, *Eotylopus*, 430
 regalis, *Bolbocerastes*, 99 (fig.), 105,
 106, 109, 112, 115 (map)
 relictæ, *Polycelis*, 172
 relictus, *Paroedostethus*, 614
 Prosciurus, 408
 reniformis, *Potamilla*, 209, 333 (fig.),
 335, 336
 Pseudopotamilla, 337
 Samella, 336
 Reptilia, 401
 revelieri, *Athous*, 603
 Review of the Atlantic periwinkles,
 Nodilittorina, *Echininus*, and
 Tectarius, 449
 rex, *Bradycinetulus*, 99 (fig.), 102, 103
 114 (map)
 Rhaciaspis, 616
 Rhinoceretidae, 425, 432, 433
 Rhinochoerus, 477
 Rhino(choerus) villosus, 471
 Rhopalosoma, 19, 20, 21, 22, 23, 24, 25,
 27 (figs.), 29 (figs.), 31, 32, 33
 aenigmaticum, 19
 nearcticum, 19, 20, 24, 32
 Notes on the biology and immature
 stages of a cricket parasite of
 the genus, 19
 poeyi, 19
 Rhopalosomatidae, 19
 Rhopalosomidae, 19

 Rhyparobia, 45
 maderæ, 45
 richmondi, *Chaerura*, 537
 Dennyus, 533, 535, 537
 rickettsi, *Nephtys*, 270, 271
 riparius, *Elater*, 606, 610
 Risella, 462
 Risellidae, 462
 Riselloidea, 462
 Risellopsis, 462
 Rismethus, 616
 Rjabuschinskya, 172
 robusta, *Amphitrite*, 322
 Meterythrope, 580
 Neoamphitrite, 322
 robustus, *Cirratulus*, 286
 Hoplophoneus, 430
 Rodentia, 408, 431
 Roggeveenia, 616
 buxtoni, 616
 rohan-chaboti, *Ameidioides*, 602
 rosenbergi, *Amphiprion*, 191
 Rostricephalus, 616, 617
 vitalisi, 617
 rotunda, *Strabala*, 125 (fig.), 127, 130,
 133
 rotundatus, *Lophogaster*, 577
 rotundipennis, *Neoscutops*, 555, 556
 rotundocapitis, *Dennyus*, 535, 541 (fig.),
 548, 549
 roulini, *Tapirus*, 471, 473, 476, 480
 roulinii, *Tapirus*, 466, 471, 472, 476, 479
 rubiginosus, *Melanoxanthus*, 601
 rubrocinctus, *Amphiprion*, 199
 rubrovittatus, *Vannius*, 629
 rudis, *Littorina*, 462
 rufa, *Disonycha*, 122
 Haltica, 121, 122, 123, 127
 Strabala, 125 (fig.), 126, 127, 128,
 129
 ruficollis, *Agonischius*, 605
 rufifilosa, *Tanganyicia*, 387
 rufifilosus, *Lithoglyphus*, 387
 rufus, *Tapirus*, 479, 481, 485
 ruginosum, *Aylacostoma*, 377
 rugosa, *Brada*, 290, 291, 292
 Trophonia, 290
 rüppeli, *Amphiprion*, 199
 Rygodonus, 617
 Rymcobites, 617
 singularis, 617

 sabatyra, *Tapyra*, 479, 481, 485
 sabella, *Fabricia*, 299
 Sabella, 334
 analis, 339
 crassicornis, 209, 333 (fig.), 334
 fabricii, 334
 granulata, 312
 lumbricalis, 305
 neglecta, 335
 reniformis, 336
 spetsbergensis, 334
 spitzbergensis, 334
 Sabellariidae, 208 (table), 212, 301
 (figs.), 307

- Sabellidae, 209 (table), 211, 332, 333
 (figs.), 334 (key), 341 (fig.)
Sabellides sibirica, 318
sabussowi, *Polycelis*, 172
Sacconereis, 241, 246, 248, 250, 251 (fig.)
sakurae, *Cephaloon*, 161
Salinator maculata, 385
saltator, *Orocharis*, 22, 23, 24
sanguineus, *Parathous*, 614
sanguinipennis, *Georgicus*, 609
Saphromyzidae, 553
sapporo, *Polycelis*, 172
sarsi, *Antinoë*, 205, 206, 215
 Antinoëlla, 215
 Eteone, 235
 Harmothoë, 215
 Harmothoë (*Antinëlla*), 215
 Maldane, 208, 301 (fig.), 303
 Polynoë, 215
 Sauria, 401
saxatilis, *Aeronautes* s., 537, 538
 Littorina, 462
scabinula, *Meristhus*, 616
scabra, *Aphrodita*, 217
 Lepidonote, 219
 Litorina, 458
 Littorina, 458
 Polynoë, 217, 218, 219
 Pseudoplotia, 378
scalare, *Aylacostoma* (*Aylacostoma*),
 376
scalaris, *Melania*, 375
 Scale-mite parasites of lizards, Two
 new, 9
Scalibregma, 293
 brevicauda, 293, 294
 inflatum, 208, 293, 297 (fig.)
 mintum, 293, 294
Scalibregmidae, 208 (table), 213, 293,
 297 (figs.)
Scalopinae, 403
Scalopus aquaticus, 404
Scapatochirus, 407
Scarabaeus cephus, 101
 cyclops, 101
 fartus, 101
 ferrugineus, 101, 102
 gallicus, 97
 lazarus, 95, 101
 mobilicornis, 101
 mobilicornis testaceus, 101
 quadridens, 101
Sceloporus, 15
 undulatus, 9, 15
schaefferi, *Bolboceras*, 117, 119
 Bolborhombus, 99 (fig.), 114 (map),
 117, 119
schiedianus, *Oxymelania*, 365
Schizohalea, 137
 copiosa, 138
 leucopeza, 138
 polita, 138
schmidti, *Polycelis*, 171, 172
schmitti, *Lophogaster*, 577, 578
schotti, *Agryphus*, 611
 Lanelater, 611
schusteri, *Cardiophorus*, 611
scobinula, *Meristhus*, 612, 616
Scoliocerus, 603
scotti, *Archaeotherium*, 430
Schultz, Leonard P.; Review of the
 Indo-Pacific anemone fishes,
 genus *Amphiprion*, with descrip-
 tion of two new species, 187
 And Marshall, N. B.; A review of
 the labrid fish genus *Wet-*
 morella with descriptions of new
 forms from the tropical Indo-
 Pacific, 439
Sciaena unimaculata, 194
Scione lobata, 323
Sciaravidae, 408
Scoloplos, 278
 armiger, 207, 278, 283 (fig.)
sculpta, *Acanthomysis*, 582
sculpticauda, *Eucopia*, 578
scutata, *Sternaspis*, 208, 309, 313 (fig.)
 Thalassema, 309
scutellaris, *Altica*, 121
 Haltica, 123
 Lactica, 122, 123, 129, 130
 Strabala, 122, 123
scutellata, *Strabala*, 121
Scutops, 555, 556
 chapmani, 556
 fascipennis, 555, 556
 maculipennis, 555, 556
sebae, *Amphiprion*, 189, 192, 197
Seidlia, 172
Selatosomus guttatus, 610
semicarinata, *Oxytrema*, 367
semigranosa, *Melania*, 379
 Tarebia, 379
Semiotinus, 617
semisculpta, *Polynoë*, 222
semisculptus, *Polynoë*, 222
Semisinus, 375
Semisulcospira, 369
 libertina, 369
Semisulcospirinae, 369
sequax, *Ceratopogon*, 135
sericans, *Pristilophus*, 616
Sermyla, 380
 kowloonensis, 380
 mauiensis, 380
 tornatella, 380
Serpentes, 402
Serpula granulata, 343
 spirillum, 344
Serpulidae, 209 (table), 211, 341 (figs.),
 342
serrata, *Inusitatomysis*, 581
serraticornis, *Dicronychus*, 609
serratus, *Amechanus*, 113
 Athyreus, 113
 Athyreus (*Bradicinetus*), 113
 Bolboceras (*Amechanus*), 113
 Bolbocerastes, 99 (fig.), 106, 107,
 108, 109, 112, 113, 115 (map)
 Bradicinetulus, 113
 Bradicinetus, 113

- Serropalpidae, 159
 Setaera, 379
 setosa, Brada, 290, 291
 Chaetozone, 207, 287, 297 (fig.)
 Glycera, 272
 Spio, 284
 Thiara, 379
 setosus, Quasimus, 606
 Sheppardiconcha, 367
 sibirica, Asabellides, 208, 318, 319 (fig.)
 Sabellides, 318
 Sicardius, 617
 longicornis, 617
 siccata, Melania, 381
 siculus, Ectobius, 41
 Sigalionidae, 206 (table), 211, 228
 signoreti, Ambryus, 6
 silicula, Oxytrema, 360
similis, Dennyus, 534, 535, 541 (fig.),
 549
 Simocyoninae, 420
 simplex, Geckobia, 12
 Nicolea, 323
 simulans, Drachylis, 158, 160
 simus, Cyclopidius, 426
 Sinclairella, 434
 singularis, Rymcobites, 617
 Siphonostoma inhabile, 292
 villosum, 290
 Siriella thompsonii, 580
 Sisenes, 88
 sjalaendica, Ctenicera (*Malloca*), 600
 Elater, 600
 smitti, Ereutho, 328
 snyderi, Amphiprion, 198
 soemmerringii, Gazella, 424
 Solenodontidae, 403
 solitarius, Phorocardius, 608
 sordidus, Vasaces, 87, 89, 92
 Soricidae, 407
 soricina, Glassophaga soricina, 465
 Soricinae, 434
 Soricoidea, 407
 soriniana, Antimelania, 382
 Sorocelides, 171
 Sorocelis americana, 566
 Sparus milli, 198
 speciosissima, Cattleya, 632
 spectabilis, Cirratulus, 286
 spegazzinii, Tapirus, 480, 481, 484, 485,
 486
 Tapirus terrestris, 480, 493 (map)
 Spekia, 371
 zonatus, 371
 spencei, Piezophyllus, 601, 606
 Speophila *hoffmasteri*, 567 (fig.), 569
 (fig.), 570, 571 (fig.)
 spetsbergensis, Eteone, 206, 233, 235
 Sabella, 334
 Sphaeromelania, 366
 largillierti, 365
 Sphaeromias polita, 138
 Sphaeromyas pulchripennis, 137
 Sphaerosyllis, 242, 255
 erinaceus, 207, 243 (fig.), 255
 latipalpis, 256, 257
 longicauda, 256, 257
 Sphaloplana *georgiana*, 565 (fig.), 566,
 567 (fig.), 569 (fig.)
 Sphenicosomus, 617
 Sphyroperisceelis, 551, 552, 554, 556
 spiloderus, Diploconus, 615
 spinicauda, Chaetura spinicauda, 542
 spiniger, Dennyus, 533, 535
spininotus, Dennyus, 536, 541 (fig.),
 547
 spinosa, Io, 364
 spinosipenis, Dendrocelopsis, 176
 Dendrocelopsis, 177, 178
 spinosus, Lophogaster, 577
 spinulosa, Lagisca extenuosa, 222
 Polynoë, 217
 Spio, 280, 284
 filicornis, 207, 283 (fig.), 284
 filicornis pacifica, 284
 limicola, 284
 setosa, 284
 Spionidae, 207 (table), 212, 280 (key),
 283 (figs.)
 Spiophanes tenuis, 282
 spirillum, Circeis, 344
 Dexiospira, 344
 Serpula, 344
 Spirorbis, 209, 341 (fig.)
 Spirorbis (Dexiospira), 343, 344
 Spirorbis, 342, 343 (key)
 granulatus, 209, 341 (fig.)
 (Lacospira) granulatus, 343
 quadrangularis, 343
 spirillum 209, 341 (fig.)
 (Dexiospira) spirillum, 343, 344
 spitzbergensis, Sabella, 334
spokanensis, Eumys, 411, 413, 414
 (fig.)
 Paradjidaumo, 409
 Sponidium, 158
 Squamata, 401
 Stanleya, 338
 neritinoidea, 388
 stecki, Beezia, 138
 steenstrupii, Myxiolella, 340
 Stelobezzia diversa, 59, 60, 61, 76
 Stenocephaloon, 159
 metallicum, 159
 Stenomelania, 380, 381
 aspirans, 380
 Stenomiera, 551, 557, 560
 angustata, 560
 Stenotrachelus, 159
 Stephanosyllis ornata, 246
 picta, 246
 Sternaspidae, 208 (table), 213, 309,
 313 (figs.)
 Sternaspis, 309
 scutata, 208
 fossor, 209
 islandica, 309
 scutata, 208, 309, 313 (fig.)
 scutata africana, 309
 Sternocampus, 617
 villosus, 617

- Stibarus montanus*, 430
 sp., 430
Stilobezzia, 57, 58 (key), 61 (table), 63, 68, 72 (figs.), 73 (figs.), 135
 (Eukraiohelea) aberrans, 61
 (Eukraiohelea) africana, 63
 antennalis, 59, 60, 61, 68
 (Stilobezzia) antennalis, 68, 73 (fig.), 83
beckae, 59, 60, 61
 (Stilobezzia) *beckae*, 69, 72 (fig.), 82
 bicolor, 59, 60, 61, 71
 (Stilobezzia) bicolor, 71, 72 (fig.)
 Biting midges of the heleid genus, in North America, 57
 bulla, 59, 61, 74, 83, 84
 (Stilobezzia) bulla, 73 (fig.), 74, 84
 coquilletti, 58, 60, 61, 75
 (Stilobezzia) coquilletti, 72 (fig.), 75
 (Stilobezzia) diversa, 73 (fig.), 76, 79
 elegantula, 58, 60, 61
 (Eukraiohelea) elegantula, 62, 72 (fig.)
 (Eukraiohelea) esakiana, 61, 62
 fiebrigi, 76
 fuscua, 58, 59, 61, 64
 (Neostilobezzia) fuscua, 64, 72 (fig.)
 glauca, 59, 60, 61, 77, 85
 (Stilobezzia) glauca, 73 (fig.), 77
 (Stilobezzia) kiefferi, 81
 limnoplila, 83
 lutea, 58, 60, 61, 65, 68
 (Neostilobezzia) lutea, 65, 72 (fig.)
 macfiei, 65
 mallochi, 65, 66
 pallidiventris, 59, 61, 78
 (Stilobezzia) pallidiventris, 78
 paulistensis, 71
 pruinosa, 59, 60, 61, 79
 (Stilobezzia) pruinosa, 73 (figs.), 79
punctipes, 58, 60, 61
 (Stilobezzia) *punctipes*, 72 (fig.), 79
 (Stilobezzia) punctulata, 81
 rabelloi, 59, 60, 61, 81
 (Stilobezzia) rabelloi, 72 (fig.), 81
stonei, 58, 60, 61
 (Neostilobezzia) *stonei*, 66, 72 (fig.)
sybleae, 59, 60, 61
 (Stilobezzia) *sybleae*, 73 (fig.), 82
thomsenae, 59
 (Stilobezzia) *thomsenae*, 73 (fig.), 83
 ugandae, 62
 viridis, 59, 60, 61, 78, 84
 (Stilobezzia) viridis, 73 (fig.) 84
stonei, *Monohalea*, 137, 139, 146 (fig.), 147 (fig.)
Monohalea (*Monohalea*), 148, 149, 150
Stilobezzia, 58, 60, 61
Stilobezzia (*Neostilobezzia*), 66, 72 (fig.)
- Strabala*, 121, 122, 123, 124, 125 (figs.), 126, 127 (key)
acuminata, 125 (fig.), 127, 128
acuminata costaricensis, 125 (fig.), 127, 129
acuminata leapensis, 125 (fig.), 127, 129
 ambulans, 125 (fig.), 127, 131
 ambulans *jamaicensis*, 125 (fig.), 127, 131
 ambulans *puertoricensis*, 125 (fig.), 127, 132
 Chrysomelid beetles of the genus, 121
columbiana, 125 (fig.), 127, 133
dominicensis, 121
ferruginea, 122, 125 (fig.), 127, 132
haematina, 134
intermedia, 121, 122, 125 (fig.), 127, 131, 133
languida, 122
nigriceps, 122
rotunda, 125 (fig.), 127, 130, 133
rufa, 125 (fig.), 126, 127, 128, 129
rufa floridana, 125 (fig.), 127, 128
scutellaris, 122, 123
scutellata, 121
 sp., 134
trinitatis, 125 (fig.), 127, 134
Strephobasia, 361
Streptoprocne zonaris albicincta, 548
striata, *Eteone*, 233
strictus, *Neonomopleus*, 613
stroemii, *Terebellides*, 209, 330, 331 (fig.)
strophensis, *Kentrogomphos*, 404, 405 (fig.), 406 (fig.), 430
Strophitus, 370
 Sturtevant, A. H.; Nearctic flies of the family Perisclidae (Diptera) and certain Anthomyzidae referred to the family, 551
Stylaroides pluribranchiata, 290, 291
Subathous, 617
tonkinensis, 617
Subathrus, 617
 subglaber, *Lophogaster*, 577
 sublaevis, *Brada*, 292
 submetallicus, *Hemirhipus*, 609
 subnodosa, *Nodilittorina*, 456
 subterranea, *Phagocata*, 566
 subtilis, *Cosmesus*, 601
Mesembris, 601
 subvittatus, *Mullus*, 513
Upeneus, 498, 514, 522, 524
suifuensis, *Melanoides*, 380
suillus, *Tapir*, 477, 479, 481, 485
sulceicollis, *Pantolamprus*, 618
Sulcilacon, 617
Sulcimerus, 617
sulcirostris, *Crotophaga*, 590
sulcospira, *Melania*, 381
Sulcospira, 381
Sulcospira, 381
sulcospira, 381

- sulphureus, *Upeneoides*, 513, 514
 Upeneus, 500 (table), 501, 502
 (tables), 504 (table), 505 (tables),
 506, 508, 510, 513, 514 (table)
- sulphuripennis, *Corymbites*, 616
- sundaicus, *Upeneoides*, 507
 Upeneus, 507, 519
- Supella supellectilium, 40
- supellectilium, *Supella*, 40
- surinamensis, *Blatta*, 45
 Pycnoscelus, 45, 51
- Sybleae*, *Stilobezzia*, 59, 60, 61
 Stilobezza (*Stilobezza*), 73 (fig.),
 82
- Syllidae, 207 (table), 212, 240, 241
 (key), 243 (figs.), 251 (figs.)
- Syllis, 241, 252 (key)
- alternata*, 253, 254
 armillaris, 254
 cornuta, 205, 207, 243 (fig.), 252,
 254
 (*Ehlersia*) *cornuta*, 253
 fasciata, 205, 207, 243 (fig.)
 (*Typosyllis*) *fasciata*, 254
 heterochaeta, 254
 (*Ehlersia*) *heterochaeta*, 253
 monilicornis, 260
 oerstedii, 253
 quaternaria, 253, 254
- symmetrica*, *Oxytremia*, 360
- Syndoceros*, 428
- Syspotamus*, 477
- Tachornis phoenicobia phoenicobia*, 543
- taeniopterus*, *Upeneus*, 507
- Taiwanathous*, 617
 arisanus, 617
- Takamatsuia major*, 543
- Talpa*, 431, 434
 sp., 430
- Talpidae*, 403
- Talpinae*, 403
- Tanganyicia*, 373, 382, 387, 388
 rufifilosa, 387
- tanschaurica*, *Paludomus*, 369
- tapir*, *Hydrochaerus*, 479
 Tapirus, 481, 485, 493 (map)
 Tapirus terrestris, 488, 493 (map)
- Tapir*, 477
 (*Anta*), 489
 americanus, 479
 anta, 477, 479, 481
 maypuri, 479, 481, 485
 pinchaque, 471
 sp., 486
 suillus, 477, 479, 481, 485
- Tapirella*, 478, 488
 bairdii, 490
 dowi, 490
- tapirus*, *Tapirus*, 466, 480
- Tapirus*, 466, 467, 470, 477, 489
 aenigmaticus, 477, 479, 481, 485
 americanus, 476, 477, 479, 480, 481,
 485, 488
 americanus mexianae, 480, 481, 485
 andicola, 472
 anta, 481, 485
 antea, 476
 anulipes, 480, 481, 484, 485, 486
 bairdi, 490
 (*Elasmognathus*) *bairdi*, 489
 bairdii, 465, 466, 467, 468, 469, 473,
 478, 482 (fig.), 483 (fig.), 488, 489,
 490, 493 (map), 495 (map)
 (*Tapirella*) *bairdii*, 489
 bairdii dowii, 491
 brasiliensis, 481, 485
 dowi, 490, 492
 dowii, 480, 484, 490, 491
 enigmaticus, 471, 493 (map)
 ecuadorensis, 479, 481, 485
 excelsus, 468
 indicus, 465, 469
 (*Acrocodia*) *indicus*, 467, 489
 laurillardii, 479, 481, 485
 leucogenys, 469, 471, 472, 474, 476,
 477, 479
 Northern Colombia species, 465
 pinchacus, 471, 480
 pinchaque, 465, 466, 467, 468, 469,
 471, 478, 479, 482 (fig.), 483
 (fig.), 484, 487 (fig.), 489, 493
 (map), 495 (map)
 pinchaque brasiliensis, 479
 roulini, 471, 473, 476, 480
 roulinii, 466, 471, 472, 476
 roulinii brasiliensis, 479
 rufus, 479, 481, 485
 spegazzinii, 480, 481, 484, 485, 486
 tapir, 481, 485, 493 (map)
 tapirus, 466, 480
 terrestris, 465, 466, 467, 468, 469,
 471, 476, 477, 478, 479, 480, 481,
 482 (fig.), 483 (fig.), 484, 485,
 486, 487 (fig.), 488, 490, 492
 (*Hippopotamus*) *terrestris*, 480
 terrestris colombianus, 486, 490, 493
 (map), 495 (map)
 terrestris guianae, 480, 481, 485
 terrestris laurillardii, 479
 (*terrestris*) *peruvianus*, 479, 481,
 485
 terrestris spegazzinii, 480, 493
 (map)
 terrestris tapir, 488, 493 (map)
 terrestris terrestris, 476, 479, 493
 (map)
 villosus, 471
- Tapyra*, 477
 sabatyra, 479, 481, 485
- Tarebia*, 378, 379
 granifera, 379, 386
 lateritia, 378, 379
 semigranosa, 379
- tarsalis*, *Gonodyrus*, 610
- tattakensis*, *Paradima*, 614
- Tayussidae*, 432
- teapensis*, *Strabala acuminata*, 125 (fig.),
 127, 129

- Tectaria montrouzieri*, 451
Tectarius, 449, 450, 454, 455 (fig.), 458, 461, 462
 coronarius, 461
 muricatus, 449, 450, 452, 453 (fig.), 454, 455 (fig.), 457 (fig.), 459, 460, 462
 nodulosus, 462
 tuberculatus, 449, 451, 454
Tectininus, 458
telonaria, Melania, 368
 Oxytrema, 368
temnodon, Paleolagus, 415, 430
Tenalomus, 618
 fulvipennis, 618
tenebricosa, Hemiblamera, 46
tenebrosa, Io, 364
Tenebrionidae, 155
Tenebrionidea, 155
tenuicorne, Cephaloon, 157 (map), 158, 160
tenuicornis, Corymbites, 614
tenuis, Euchaetomera, 580
 Maldane, 306
 Petaloproctus, 208, 301 (fig.), 306
 Polycelis, 172
 Prionospio, 282
 Spiophanes, 282
Terebella maculata, 323
 venustula, 322
Terebellidae, 209 (table), 212, 318, 319, (fig.), 320 (key), 331 (figs.)
Terebellides, 321, 330
 stroemii, 209, 330, 331 (fig.)
 stroemii japonica, 330
terebellidis, Saccopsis, 330
terrestris, Hippopotamus, 479
 Pinchacus, 471
 Tapirus, 465, 466, 467, 468, 469, 471, 476, 477, 478, 479, 480, 481, 482 (fig.), 483, (fig.), 484, 485, 486, 487 (fig.), 488, 490, 492
 Tapirus (Hippopotamus), 480
 Tapirus terrestris, 476, 479, 493 (map)
tessellata, Monohelea, 147 (fig.), 150, 152, 153
 Monohelea (Monohelea), 152
tessellatus, Corymbites, 600
 Elater, 600
testacea, Altica, 122
testaceus, Scarabaeus mobilicornis, 101
Tetralobus macrocerus, 600, 601
texana, Monohelea., 136, 147 (fig.)
 Monohelea (Monohelea), 143
texana, Geckobia, 15
 Geckobiella, 9, 15, 16 (fig.), 17 (fig.)
texensis, Chorisonera, 42
Thacana, 618
Thalassema scutata, 309
Thelepus, 320, 327
 cincinnatus, 209, 327, 331 (fig.)
 circinnatus, 327
 hamatus, 327
thermarum, Ambrysus, 1, 3 (fig.)
- theryi*, Jonthadocerus, 611
Thiara, 378, 379, 386
 amarula, 378
 (Thiara) *amarula*, 379
 cancellata, 378, 379
 (Setacea) *cancellata*, 379
 setosa, 379
thiarella, Litorina, 451
Thiaridae, 357, 358, 366, 367, 372, 373, 374, 375, 377, 378, 386, 461
Thiaropsis, 378
 winteri, 378
thompsoni, Domnina, 430
 Eutypomys, 430
 Ictops, 430
 Limnotrochus, 371
thompsonii, Siriella, 580
thomsenae, Stilobezzia, 59
 Stilobezzia (*Stilobezzia*), 73 (fig.), 83
thomsonii, Gazella, 424
thoracicus, Elater, 605
tibetica, Polycelis, 172
tibialis, Nitzschia, 538
 Nitzschia pulicaris, 538
Tinecus, 618
Tiphobia, 372, 373, 374
 horei, 373, 374
Tiphobiidae, 373
Tiphobiinae, 358, 372, 373
titanelix, Peratherium, 402, 430
Titanotheres sp., 430
Titanotheriomys, 431, 433, 434
 veterior, 408, 430
tokisensis, Upeneoides, 509
tonkinensis, Subathous, 617
torelli, Potamilla, 336
tornata, Melanoides, 371
tornatella, Sermyla, 380
toucheana, Oxytrema, 368
tragula, Upeneus, 500 (table), 502 (tables), 503, 504 (table), 505 (tables), 506, 507, 509, 510, 511, 514, 521 (table), 522, 524 (table), 526 (table), 527
tragulus, Upeneoides, 522
transmontanus, Leptomeryx, 426, 427 (table), 430
Travisia, 295, 296
 brevis, 298
 carnea, 205, 208, 296, 297 (fig.)
 forbesi, 296
 forbesii, 296
 pupa, 296
tregonboffi, Boreomysis, 579
Trelasus, 618
 antennalis, 618
Tremarctos ornatus, 475
triannulata, Evarella, 223
 Harmothoë, 222, 223
Trichobranchus, 321, 329
 glacialis, 209, 329, 331 (fig.)
 glacialis antarcticus, 329
tricinctus, Amphiprion, 189, 182, 195, 197

- Triclad, Fresh-water (Turbellaria) of
 Alaska, 163
 tricolor, Amphiprion, 199
 tridens, Boreomysis, 579
 trifasciatus, Amphiprion, 193
 Trigonias, 423
 osborni, 425, 430
 Trigonidiidae, 33
 trilineata, Mudalia, 361
 trilineatus, Autolytus, 250
 Hemirhipus, 605
 trilobata, Ampharete, 316
 trilophus, Paradjidaumo, 409
 trinitatis, Strabala, 125 (fig.), 127, 134
 triocellata, Wetmorella, 441, 442, 443,
 446 (fig.), 447
 tristiculus, Cephaloon variabilis, 161
 Ephamillus variabilis, 161
 Trochidae, 449
 trochiformis, Turbo, 456
 Trochus cumingi, 458
 nodulosus, 451, 456
 Trophonia arctica, 290, 291
 rugosa, 290
 tropica, Maldane sarsi, 304
 truncate, Pseudomma, 581
 tuberculata, Eteone, 234
 Littorina, 451
 Melania, 375, 377
 Melanoides, 380, 386
 Nodilittorina, 449, 450, 451, 453
 (fig.), 454, 455, (fig.), 457 (fig.),
 459, 460, 462
 Pholoë, 230
 Turbo, 451
 tuberculatum, Aylacostoma, 375, 377
 Aylocostoma (Longiverena), 377
 tuberculatus, Litorina, 451
 Tectarius, 449, 451, 454
 Turbo, 458
 tubifex, Eusyllis, 260
 Tubularia sp., 327
 tunicatus, Amphiprion, 191
 Turbellaria, Fresh-water triclad of
 Alaska, 163
 North American triclad, XIII;
 three new cave planarians, 563
 Turbo nodulosus, 451
 Trochiformis, 456
 tuberculata, 451
 tuberculatus, 458
 Turcica, 451
 turgidus, Megalagus, 430
 turriculus, Melanoides, 380, 381
 Tyleudacus, 618
 Tyloarsus, 618
 Tylomelania, 381
 neritifformis, 381
 Tylotarsus, 618
 Typhobia, 371
 typica, Anchialina, 580
 typicus, Lophogaster, 577
 Typitium, 158
 Typosyllis, 261
 alternata, 253
 collaris, 260, 261
 ugandae, Stilobezzia, 62
 ugiensis, Conobajulus, 606
 undulatum, Oxytrema canaliculatum,
 360
 undulatus, Sceloporus, 9, 15
 unguiculata, Eucopia, 579
 ungulare, Cephaloon, 157 (map), 158,
 159, 160
 unicorne, Bolbelasmus, 97
 unimaculata, Sciaena, 194
 unimaculatus, Amphiprion, 193
 Upeneoides, 506
 arge, 518
 belaque, 513
 caeruleus, 516
 dubius, 514
 fasciolatus, 514
 guttatus, 509
 japonicus, 509
 kiushiuana, 522
 luzonius, 519
 moluccensis, 514
 parvus, 528
 philippinus, 516
 sulphureus, 513, 514
 sundaicus, 507
 tokisensis, 509
 tragulus, 522
 variegatus, 522
 vittatus, 516
 Upeneus, 497, 500 (table), 502 (tables),
 504 (table), 505 (tables), 506,
 508 (key), 527 (table)
 arge, 500 (table), 502 (tables), 503,
 504 (table), 505 (tables), 506,
 507, 508, 518
 asymmetricus, 500 (table), 501, 502
 (tables), 503, 504 (table), 505
 (tables), 511, 512 (table)
 bensasi, 500 (table), 502 (tables),
 503, 504 (table), 505 (tables),
 506, 508, 509, 511 (table)
 bitaeniatus, 516
 bivittatus, 513
 luzonius, 500 (table), 502 (tables),
 503, 504 (table), 505 (tables),
 507, 509, 519, 521 (table), 523,
 526
 moluccensis, 500 (table), 502
 (tables), 504 (table), 505 (tables),
 508, 510, 514
 oligospilus, 500 (table), 502 (tables),
 503, 504 (table), 505 (tables), 509,
 525, 526 (table), 527 (table)
 parvus, 499, 500 (table), 501, 502
 (tables), 503, 504 (table), 505
 (tables), 508, 528
 phillipsi, 498, 528, 529
 Revision of the goatfish genus,
 with descriptions of two new
 species, 497
 subvittatus, 498, 514, 522, 524
 sulphureus, 500 (table), 501, 502
 (tables), 504 (table), 505 (tables),
 506, 508, 510, 513, 514 (table),
 sundaicus, 507, 519

- taeniopterus, 507
 tragula, 500 (table), 502 (tables),
 503, 504 (table), 505 (tables),
 506, 507, 509, 510, 511, 514, 521
 (table), 522, 524 (table), 526
 (table), 527
 vittatus, 500 (table), 502 (tables),
 504 (table), 505 (tables), 506, 508,
 510, 516, 517 (table), 518
 (table), 519, 523
 Upenoides moluccensis, 514
 Ursidae, 419
 Ursus horribilis, 419, 424
 vaginata, Dendrocoelopsis, 178
 vaginatus, Dendrocoelopsis, 177
 vainafa, Melanoides, 380
 vancevei, Caesaromysis, 577, 581
 vandeli, Amyadenium, 177
 Dendrocoelopsis, 178
 vandykei, Cephaloon, 157 (map), 160
 Vannius oculatus, 626 (fig.), 628
 rubrovittatus, 629
 variabile, Cephaloon, 158
 variabilis, Cephaloon, 157 (map), 158,
 159, 161
 Melania, 382
 variegatus, Upeneoides, 522
 Vasaces, 87, 88, 89 (key), 91 (figs.)
 aeneipennis, 87, 88, 89, 91 (fig.), 94
 Beetles of the oedemerid genus, 87
 costatus, 87, 89, 90
 elongatus, 89, 91 (fig.), 93
 knilli, 89, 90, 91 (fig.)
 linearis, 89, 91 (fig.)
 maculatus, 89, 91 (fig.), 92
 sordidus, 87, 89, 92
 vega, Ampharete, 208, 315, 319 (fig.)
 Amphicteis, 315
 Veloplacenta, 383
 maculata, 385
 venusta, Lanassa, 209, 326
 Laphaniella, 326
 venustula, Nicolea, 209, 319 (fig.), 322
 Terebella, 322
 Verena, 376, 377
 verrilli, Autolytus, 246
 versicolor, Eukraiohelea, 61, 62
 Photuris, 35, 36
 verucosa, Pleurocera, 362
 veterior, Titanotheriomys, 408, 430
 vetustus, Prosciurus, 430
 vilis, Litorina, 456
 Nodilittorina, 456
 villosa, Brada, 205, 207, 290
 villosum, Siphonostoma, 290
 villosus, Pinchacus, 471
 Rhino (choerus), 471
 Sternocampsus, 617
 Tapirus, 471
 violaceus, Pachychilus, 366
 virgatus, Melanoxanthus, 609
 virginianus, Odocoileus, 423
 virginica, Oxytrema, 364
 viridipennis, Chaetura chapmani, 545
 viridis, Ceratolophus, 84
 Ceratopogon, 84
 Hartomyia, 84
 Johannseniella, 84
 Mystides, 232
 Stilobezzia, 59, 60, 61, 78, 84
 Stilobezzia (Stilobezzia), 73 (fig.),
 84
 vitalis, Rostricephalus, 617
 vitalisi, Cardiophorus, 613
 vitida, Raphaea, 616
 vitta, Phagocata, 165, 167
 vittatus, Coracinus, 194
 Elater, 603
 Hypeneus, 516
 Mullus, 506, 516
 Upeneoides, 516
 Upeneus, 500 (table), 502 (tables),
 504 (table), 505 (tables), 506,
 508, 510 516, 517 (table), 518
 (table), 519, 523
 Viviparidae, 372, 386
 Viviparus, 368, 372
 Vuilletus, 618
 wagenia, Melanoides, 371
 wahlbergi, Paranaitis, 236
 walesi, Proneomysis, 582
 walli, Pachychilus, 367
 Wanga, 383
 waplari, Eudactylus, 618
 Wetmorella, 439, 440, (key), 442 (table),
 443 (table), 445, 446, 447
 albofasciata, 441, 442, 443, 446,
 447
 ocellata, 440, 442, 443, 444, 446,
 447
 philippina, 439, 440, 446, 447
 philippina bifasciata, 440, 441, 442
 (fig.), 443
 philippina philippina, 440, 441
 (fig.), 442, 443, 445
 Review of the labrid fish genus,
 with descriptions of new forms
 from the tropical Indo-Pacific,
 439
 triocellata, 441, 442, 443, 446 (fig.),
 447
 wheeleri, Periscelis, 552, 553, 556
 White, Theodore E.; Preliminary analy-
 sis of the fossil vertebrates of
 the Canyon Ferry Reservoir
 area, 395
 winnertzi, Microperiscelis, 556
 Periscelis, 556
 winteri, Thiaropsis, 378
 wiréni, Glycinde, 205, 207, 274, 277
 (fig.)
 Wirth, Willis W.; American biting
 midges of the heleid genus
 Monohelea, 135
 Biting midges of the heleid genus
 Stilobezzia in North America,
 57

- woodburyi, *Ambrysus*, 3
worms, Polychaete, from Point Barrow,
Alaska, with additional records
from the North Atlantic and
North Pacific, 203
- Xantheater*, 618
Xantherater, 618
Xantholamprus, 618
Xanthopenthes, 619
xanthurus, *Amphiprion*, 190, 192, 198
- Yezodima*, 619
convexuni, 619
- Zalepia*, 611, 619
Zemelanopsis, 357
ziczac, *Littorina*, 450, 453 (fig.)
Littorina (*Melarhappe*), 450, 452
zoa, *Gnathophausia*, 578
zonalis, *Ellipstoma*, 363
Pleurocera, 363
zonata, *Nereis*, 207, 265, 269 (fig.)
Nereis (*Nereis*), 264, 265
zonatus, *Spekia*, 371
Zonurobia, 15
Zorochros, 619
Zorochrus, 619
zostericola, *Nicolea*, 322



SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01420 9852