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EDWARD J. NOLAN, M.D.,
Recording Secretary.

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1905.

January 3.

The President, Samuel G. Dixon, M.D., in the Chair.

Thirteen persons present.

The Council reported that the following Standing Committees had been appointed to serve during the ensuing year:

Library.—Dr. C. N. Peirce, Thos. A. Robinson, Thos. Biddle, Jr., M.D., Benjamin Sharp, M.D., and George Vaux, Jr.

Publications.—Henry Skinner, M.D., Philip P. Calvert, Ph.D., Witmer Stone, Henry A. Pilsbry, Sc.D., and Edward J. Nolan, M.D.

Instruction and Lectures.—Benjamin Smith Lyman, Henry A. Pilsbry, Sc.D., Charles Morris, Philip P. Calvert, Ph.D., and Dr. C. Newlin Peirce.

Finance.—Isaac J. Wistar, William Sellers, John Cadwalader, Edwin S. Dixon and the Treasurer (George Vaux, Jr.).

Committee of Council on By-Laws.—Isaac J. Wistar, Arthur E. Brown, Thomas H. Fenton, M.D., and John Cadwalader.

The President is, *ex-officio*, a member of all Standing Committees.

Original Centers Concerned in North American Plant Dispersal.—John W. Harshberger, Ph.D., remarked that the northern part of North America was covered during Miocene times with a dense forest of trees, the living representatives of which include the sequoias, magnolias, oaks, eucalyptus and species of the genus *Cinnamomum* and certain palms, and that these extended as far north as Greenland. As early as the close of the Cretaceous period we find an indication of the separation of the American flora into an eastern and a western division. In the eastern division, the deciduous trees perhaps predominated; in the western, the coniferous vegetation formed a large percentage of the floral elements. The great continental glacier destroyed this forest in the north, but remnants of it remained in the south.

At the close of the glacial period, the following centers of distribution of plants might have been recognized: first, the deciduous forest in the east; second, the prairie flora at the center of the continent; third, the great coniferous forest of the Pacific northwest; fourth, the desert or xerophytic flora of the Mexican tableland; fifth, the great American tropic flora which occupied at one time an Antillean continent that later broke up into several physiographic units, viz., the islands of the Greater Antilles, Central America and northern South America. While this Antillean landmass existed, Mexico was separated from it.

With the disappearance of the glacial ice sheet, the equilibrium between these separate floras was disturbed. The tundra vegetation and other Arctic species occupied during the glacial period the margin of the great ice sheet. These plants migrated north to the Arctic regions, but many remained behind to form the vegetation of sphagnum bogs and alpine summits of the higher mountains. The deciduous floras spread northward and northwestward, such plants as *Populus tremuloides* and *Betula papyrifera* reaching to Cook Inlet, Alaska. The prairie flora spread northward, reaching Saskatchewan, and southward to Texas. The Pacific coast conifers spread northward to Cook Inlet, Alaska, eastward to the Rocky Mountains and then southward, supplying one of the elements of the Rocky Mountain flora. The Mexican xerophytes—yuccas, agaves, cacti and the like—spread northward into a territory which was before the glacial period characterized by a more humid climate (hence the presence of many eastern deciduous trees), and which later assumed an arid climate with the consequent destruction of the deciduous element and the spread of the coniferous associations. The tropic center of northern South America, the West Indies, and Central America supplied part of Florida and much of lowland Mexico with tropic plants. The differences, now found, being emphasized by the separation of the islands from each other and the isolation of the floras by physiographic changes.

A study of the several regions above mentioned emphasizes the fact, that centers of distribution are determined by the following criteria: location of the greatest differentiation of type; of dominance or great abundance of individuals; of the presence of peculiar endemic forms; of the continuity and convergence of lines of dispersal.

JANUARY 17.

MR. ARTHUR ERWIN BROWN, Vice-President, in the Chair.

Twenty-three persons present.

The Publication Committee reported that papers under the following titles had been presented for publication:

"Cœlosperidium blattellæ sp. n., a Sperozoon Parasite of Blatella germanica" (Preliminary Notice), by Howard Crawley (January 6, 1905).

"The Spermatogenesis of Syrbula and Lycosa, with General Considerations upon Chromosome Reduction and Heterochromosomes," by T. H. Montgomery, Jr. (January 14, 1905).

"Some Fishes from Borneo," by Henry W. Fowler (January 16, 1905).

"The Movements of Gregarines," by Howard Crawley (January 16, 1905).

The following were elected members: Howard De Honey, M.D., A. Sidney Carpenter, Courtland Y. White, M.D.

The following were ordered to be printed:

ANNOTATED LIST OF THE TYPES OF INVERTEBRATE CRETACEOUS FOSSILS IN THE COLLECTION OF THE ACADEMY OF NATURAL SCIENCES, PHILADELPHIA.

BY CHARLES W. JOHNSON.

The following list of types and figured specimens was made during 1902. Leaving Philadelphia early the following year, I have been unable until the present time to verify some of the notes on synonymy, etc. No attempt has been made to fully work out the synonymy, so that only the published synonyms bearing on the types are given, usually where recent generic changes have been adopted. The generic position of many of the species is doubtful, as they are based on casts often lacking essential characters; the grouping of some of the species in families is therefore only provisional. Although a very thorough study was made of all the cretaceous material, a few types which should be in the collection are missing. I have not recorded these, as they may be found upon further search.

CŒLENTERATA.

ANTHOZOA.

Trochosmilia atlantica (Morton).

Anthophyllum atlanticum Morton, Am. Jour. Sci., XVII, 288, 1830; *l. c.*, XVIII, pl. 1, figs. 9, 10.

Turbinolia inauris Morton, Syn. Org. Rem., 81, pl. 15, f. 11, 1834.

Flabellum striatum Gabb and Horn, Jour. Acad. Nat. Sci., IV, 399, pl. 68, figs. 10, 11, 1860.

Trochocyathus conoides (Gabb and Horn).

Trochosmilia conoides G. and H., Jour. Acad. Nat. Sci., IV, 2 ser., 399, pl. 69, f. 12.

Trochocyathus woolmani Vaughan, Proc. Acad. Nat. Sci., 1900, p. 436. figs. 1–3.

ANNELIDA.

SERPULIDÆ.

Serpula barbata Morton, Syn. Org. Rem., 73, pl. 15, f. 12, 1834.

Serpula habrogramma Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 398, pl. 68, f. 16, 1860.

Spirorbis? rotula (Morton).

Vermetus rotula Morton, Syn. Org. Rem., 81, pl. 1, f. 14, 1834.

Hamulus onyx Morton, Syn. Org. Rem., 73, pl. 2, f. 8, and pl. 16, f. 5, 1834.

The type of the genus.

Hamulus falcatus (Conrad).

Dentalium falcatum Conrad, Am. Jour. Conch., V, 44, pl. 1, figs. 12, 16, 1869.

The type of Conrad's genus *Falcula, Am. Jour. Conch.*, VI, 77, where he refers to it as *Dentalium? hamatus* is truly an error, for in Vol. V he refers to a similar species, *D. hamatum* Forbes, found in India. The genus is based entirely upon internal casts of a *Hamulus*, probably *H. onyx* Mort. Also specimens figured by Whitfield, pl. 20, figs. 16, 17.

Hamulus squamosus Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 398, pl. 68, f. 45, 1860.

Hamulus major Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 399, pl. 68, f. 46, 1860.

Paliurus triangularis Gabb, Proc. Acad. Nat. Sci., 1876, 324, pl. 17, figs. 11–13.

POLYZOA.

Alecto regularis Gabb and Horn, Jour. Acad. Nat. Sci., V, 2 ser., 172, pl. 21, f. 63, 1862.

Biorisina abbotii G. and H., Jour. Acad. Nat. Sci., V, 174, pl. 21, f. 65, 1862.

Biflustra torta G. and H., Jour. Acad. Nat. Sci., V, 152, pl. 20, f. 36, 1862.

Cavea prisca G. and H., Jour. Acad. Nat. Sci., V, 175, pl. 21, f. 67, 1862.

Cellepora bilabiata G. and H., Proc. Acad. Nat. Sci., 1860, p. 366; Jour. Acad. Nat. Sci., IV, 400, pl. 69, figs. 21–23, 1860 (not Busk, 1854) = *C. prolifica* G. and H., Jour. Acad. Nat. Sci., V, 124, 1862.

Cellepora carinata G. and H., Proc. Acad. Nat. Sci., 1860, p. 366; Jour. Acad. Nat. Sci., IV, 400, pl. 69, figs 24–26, 1860.

On specimen with type of *Pyripora irregularis* G. and H.

Cellepora exserta G. and H., Jour. Acad. Nat. Sci., V, 125, pl. 19, f. 6, 1862.

Cellepora pumila G. and H., Jour. Acad. Nat. Sci., V, 126, pl. 19, f. 8, 1862.

Cellepora typica G. and H., Proc. Acad. Nat. Sci., 1860, p. 366; Jour. Acad. Nat. Sci., IV, p. 400, pl. 69, figs. 27–29, 1860 = *Escharifora typica* G. and H.

Crescis labiata G. and H., Jour. Acad. Nat. Sci., V, 177, pl. 21, f. 69, 1862.

Diastopora lineata G. and H., Jour. Acad. Nat. Sci., V, 172, pl. 21, f. 62, 1862.

Escharifora typica G. and H., Jour. Acad. Nat. Sci., V, pp. 134, 155, pl. 19, f. 16, 1862.

The type is encrusting a specimen of *Terebratula harlani.*

Escharinella muralis G. and H., Jour. Acad. Nat. Sci., V, 140, pl. 19, f. 23, 1862.

Escharipora abbottii G. and H., Jour. Acad. Nat. Sci., V, 149, pl. 20, f. 33, 1862.

Escharipora immersa G. and H., Jour. Acad. Nat. Sci., V, 149, 1862.

Eudea dichotoma Gabb, Proc. Acad. Nat. Sci., 1861, p. 330.

Fascipora americana G. and H., Jour. Acad. Nat. Sci., V, 165, pl. 21, f. 54, 1862.

Hippothoa irregularis G. and H., Proc. Acad. Nat. Sci., 1860, p. 366 = *Pyripora irregularis* G. and H.

Membranipora abortiva G. and H., Jour. Acad. Nat. Sci , V, 157, pl. 20, f. 41, 1862.

Membranipora perampla G. and H., Jour. Acad. Nat. Sci., V, 158, pl. 20, f. 42, 1862.

Multicresis parvicella G. and H., Jour. Acad. Nat. Sci., V, 178, pl. 21, f. 70, 1862.

Plioplœa sagena G. and H., Jour. Acad. Nat. Sci., V, 150, pl. 20, f. 34, 1862.

Pyripora irregularis G. and H., Jour. Acad. Nat. Sci., V, 157, pl. 20, f. 40, 1862.

Repteschareliina prolifera G. and H., Jour. Acad. Nat. Sci., V, 146, pl. 20, f. 28, 1862.

Reptocelleporaria aspera G. and H., Jour. Acad. Nat. Sci., V, 131, pl. 19, f. 14, 1862.

Reptoflustrella heteropora G. and H., Jour. Acad. Nat. Sci., V, 162, pl. 20, f. 50, 1862.

Reptomulticara cepularis G. and H., Proc. Acad. Nat Sci., 1860, p. 367; Jour. Acad. Nat. Sci., IV, 401, pl. 68, figs. 33–35, 1860.

Retelea ovalis G. and H., Jour. Acad. Nat. Sci., V, 164, pl. 21, f. 52, 1860.

Reticulipora dichotoma G. and H., Jour. Acad. Nat. Sci., V, 173, pl. 21, f. 64, 1860.

Reticulipora sagena G. and H., Proc. Acad. Nat. Sci., 1860, p. 366; Jour. Acad. Nat. Sci., IV, 400, pl. 69, figs. 30–32, 1860.

Desmatocium trilobatum Gabb.

The type of the genus and species is only a peculiar shaped sand concretion.

BRACHIOPODA.

Terebratula harlani Morton, Amer. Jour. Sci., XVII, 283, 1829; XVIII, pl. 3, f. 16, 1830.

Terebratula fragilis Morton, Amer. Jour. Sci., XVII, 283, 1829, XVIII, pl. 3, f. 17.

Terebratula perovalis Morton (not Sowerby) = *camella* Morton, Syn. Org. Rem., 70, var. "B," pl. IX, f. 8, 1834.

Terebratulina atlantica (Morton).

Terebratula atlantica Morton, Jour. Acad. Nat. Sci., VIII, 214, 1842.
Terebratulina halliana Gabb, Proc. Acad. Nat. Sci., V., 19, 1861.

The type of Gabb's species, but not of Morton's.

Terebratulina floridana (Morton).

Terebratula floridana Morton, Syn. Org. Rem., 72, pl. 16, f. 7, 1834.

Terebratella plicata (Say).

Terebratula plicata Say, Amer. Jour. Sci., II, 43, 1820; Jour. Acad. Nat. Sci., VI, 73, pl. 3, figs. 5, 6.
Terebratula sayi Morton, Syn. Org. Rem., 71, pl. 3, figs. 3, 4, 1834.

The specimen figured by Morton, but not Say's type.

ECHINODERMATA.

Pentacrinus bryani Gabb, Proc. Acad. Nat. Sci., 1876, 178, pl. 5, figs. 1, 1a, 1b.

Goniaster mammillata Gabb, Proc. Acad. Nat. Sci., 1876, 178, pl. 5, figs. 2, 2a, 2b.

Cidaris splendens (Morton).

Cidarites splendens Morton, Proc. Acad. Nat. Sci., 1841, 132.
Cidarites armiger Morton, Jour. Acad. Nat. Sci., VIII, 215, pl. II, f. 1.

Cidaris walcotti Clark, Johns Hopkins Univ. Cir., No. 87, p. 75, 1891; U. S. Geol. Sur. Bull., 97, p. 37, pl. VI, figs. 4a–d, 1893.

Salenia tumidula Clark, Johns Hopk. Univ. Cir., No. 87, p. 75, 1891; U. S. Geol. Sur. Bull., 97, p. 41, pl. XI, figs. 1a–j, 1893.

Salenia bellula Clark, Johns Hopk. Univ. Cir., No. 87, p. 75, 1891; U. S. Geol. Sur. Bull., 97, p. 43, pl XI, figs. 2a–g, 1893.

Pseudodiadema diatretum (Morton).

Cidaris diatretum Mort., Amer. Jour. Sci., XXIII, 294, 1833.
Cidarites diatretum Mort., Syn. Org. Rem., 75, pl. 10, f. 10, 1834.
Pseudodiadema diatretum Clark, U. S. Geol. Sur. Bulletin, 97, pl. 13, f. 1.

Coptosoma speciosum Clark, Johns Hopk. Univ. Cir., No. 87, p. 76, 1891; U. S. Geol. Sur. Bull., 97, p. 52, pl. 18, figs. 1a–h.

Psammechinus cingulatus Clark, Johns Hopk. Univ. Cir., No. 87, p. 76; U. S. Geol. Sur. Bull., 97, p. 55, pl. 20, figs. 1a–i.

Echinobrissus expansus Clark, Johns Hopk. Univ. Cir., 87, p. 76; U. S. Geol. Sur. Bull., 97, p. 61, pl. 26, figs. 1a–g.

Trematopygus crucifer (Morton).

Ananchytes cruciferus Mort., Am. Jour. Sci., XVIII, 245, pl. 3, f. 8, 1830.
Trematopygus crucifer Clark, U. S. Geol. Sur. Bull, 97, p. 63, pl. 27, figs. 1a–i.

Catopygus oviformis Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 39, pl. 1, f. 9.

Cassidulus florealis (Morton).

Clypeaster florealis Mort., Am. Jour. Sci., XXIII, 294, 1833; Synop. Org. Rem., 76, pl. 3, f. 12, and pl. 10, f. 12.
Cassidulus florealis Clark, U. S. Geol. Sur. Bull., 97, p. 66, pl. 28, figs. 1a–b.

Type from the Delaware and Chesapeake Canal. The specimens figured by Clark are probably from Alabama, and not from New Jersey. They agree with specimens in the "Gabb collection" from Uniontown, Alabama.

Cassidulus æquoreus Morton, Syn. Org. Rem., 76, pl. 3, f. 14, 1834.

Cassidulus micrococcus Gabb, Proc. Acad. Nat. Sci., 1860, p. 519; Clark, U. S. Geol. Sur. Bull., 97, p. 69, pl. XXX, figs. 1a–i.

Cassidulus subquadratus Conrad, Jour. Acad. Nat. Sci., 2 ser., IV, 291, pl. 47, f. 19, 1860.

Cardiaster cinctus (Morton).

Ananchytes cinctus Mort., Jour. Acad. Nat. Sci., VI, 200, 1830; Am. Jour. Sci., XVIII, 246, pl. 3, f. 7, 1830.

Cardiaster fimbriatus (Morton) = *C. cinctus*, Mort.

Ananchytes fimbriatus Mort., Jour. Acad. Nat. Sci., VI, 200, 1830; Am. Jour. Sci., XVIII, 245, pl. 3, f. 9, 1830.

Hemiaster parastatus (Morton).

Spatangus cor-marinum(?) Morton, Am. Jour. Sci., XVIII, 250, pl. 3, f. 10, 1830.
Spatangus parastatus Mort., Am. Jour. Sci., XXIII, 294, 1833; Syn. Org. Rem., 77, pl. 3, f. 21, 1834.

Hemiaster stella (Morton).

Spatangus stella Morton, Am. Jour. Sci., XVIII, 245, pl. 3, f. 11, 1830.

Hemiaster ungula (Morton).

Spatangus ungula Morton, Am. Jour. Sci., XXIII, 131, pl. 10, f. 6, 1833.

Pygurus(?) geometricus (Morton).

Clypeaster geometricus Morton, Am. Jour. Sci., XXIII, 131, pl. 10, f. 9, 1833.
Pygurus(?) *geometricus* Clark, U. S. Geol. Sur. Bull., 97, p. 92.

Discoidea occidentale Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 398, pl. 68, figs. 42–44, 1860.

MOLLUSCA.

PELECYPODA.

NUCULIDÆ.

Nucula eufalensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 397, pl. 68, f. 35.

Nucula percrassa Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 327, pl. 35, f. 4.

Also specimen figured by Whitfield (*Mon. U. S. Geol. Sur.*, IX, 102, pl. XI, figs. 4–6).

Nucula slackiana (Gabb).

Leda slackiana Gabb., Jour. Acad. Nat. Sci., IV, 2 ser., 397, pl. 68, f. 37.

Also specimen figured by Whitfield (*Mon. U. S. Geol. Sur.*, IX, 103, pl. XI, f. 3).

LEDIDÆ.

Leda pinnaforme Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 303, pl. 48, f. 23.

Also specimen figured by Whitfield (*Mon.*, IX).

Leda protexta Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 303, pl. 48, f. 23 (not 24).

Perrisonota protexta Conr., Amer. Jour. Conch., V, 98, pl. 9, f. 24.

Represented by three specimens; the smaller one, and not the specimen figured by Whitfield (pl. XI, figs. 14, 15), is probably the type, or one figured by Conrad.

Yoldia longifrons Conrad.

Leda longifrons Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 281, pl. 46, f. 18.

Nucularia papyria Conrad, Amer. Jour. Conch., V, 44, pl. 1, f. 7, and p. 98, pl. 9, f. 25.

ARCIDÆ.

Cucullæa vulgaris Morton, Amer. Jour. Sci., XVII, 1 ser., 285, and XVIII, pl. 3, f. 21, 1830; Syn. Org. Rem., 64, pl. 3, f. 8; pl. 13, f. 5, 1834.

Represented by 16 specimens accompanied by Morton's original label (No. 393), but the specimen is not numbered and the figure is too poor to positively identify.

Cucullæa antrosa Morton, Syn. Org. Rem., 65, pl. 13, f. 6, 1834.

A specimen marked "type" in Gabb's handwriting.

Cucullæa tippana Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 328, pl. 35, f. 1, 1858.

Cucullæa capax Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 328, pl. 35, f. 2, 1858.

Both *C. tippana* and *C. capax* will probably prove to be synonyms of *C. vulgaris* Morton.

Cucullæa maconensis Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 281, pl. 47, f. 20, 1860.

Type of the genus *Trigonarca* Conr. (*Am. Jour. Conch.*, III, 9, 1867).

Cucullæa neglecta Gabb, Proc. Acad. Nat. Sci., 1861, p. 326.

The species is based on a number of specimens; the actual type cannot be defined. Whitfield considers it the same as *C. antrosa* Morton. If so it is the young.

Cucullæa transversa Gabb, Proc. Acad. Nat. Sci., 1861, p. 326.

The specimen figured by Whitfield as *Trigonarca transversa* (pl. XII, figs. 14, 15) is not the type. I found the true type in a drawer containing material marked "Gabb collection." This is not the *C. transversa* Rogers, 1839, and being preoccupied, I propose the name of *C. gabbi* for this species.

Cucullæa alabamensis Gabb.

Idonearca alabamensis Gabb, Proc. Acad. Nat. Sci., 1876, p. 315.

The type, a characteristic specimen of Prairie Bluff, Alabama, is so altered by the work of the boring sponge (*Clione*) that all shell characters are obliterated. It is probably a synonym of *C. vulgaris* or *tippana*.

Cucullæa littlei Gabb.

Idonearca littlei Gabb, Proc. Acad. Nat. Sci., 1876, p. 316.

Trigonarca cuneata Gabb, Proc. Acad. Nat. Sci., 1876, p. 316.

Trigonarca cuneiformis Conrad, Amer. Jour. Conch., V, 98, pl. IX, f. 1, 1867.

Cibota obesa Whitfield, Mon. U. S. Geol., IX, 93, pl. XI, figs. 30, 31, 1885.

Cibota multiradiata Gabb, Proc. Acad. Nat. Sci., 1860, p. 95, pl. II, f. 1.

Nemoarca cretacea Conrad, Amer. Jour. Conch., III, 97, pl. IX, f. 21, 1869.

Arca rostellata Morton, Syn. Org. Rem., 64, pl. III, f. 11, 1834.

Arca uniopsis Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 17, 1853.

Arca altirostris Gabb, Proc. Acad. Nat. Sci., 1861, p. 325.

Arca quindecemradiata Gabb, Proc. Acad. Nat. Sci., 1860, p. 95, pl. 2, f. 1.

Arca saffordii Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 397, pl. 68, f. 37, 1860.

Represented only by the New Jersey specimens referred to this species.

Arca lintea (Conrad).

Barbatia (*Polynema*) *lintea* Conr., Kerr's Geol. Sur. N. Car., II, pp. 4, pl. I, f. 12, 1875.

Arca carolinensis Conrad.

Barbatia (*Plagiarca*) *carolinensis* Conr., Kerr's Geol. Surv. N. Car., I, App., p. 4, pl. I, f. 11, 1875.

Nemodon eufalensis (Gabb).

Arca (*Macrodon*) *eufalensis* Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 398, pl. 68, f. 39, 1860.

Whitfield's so-called type (pl. 12, fig. 5) may represent another species or the same as Conrad's, but the exterior is so eroded that specific characters are obliterated.

Nemodon eufalensis Conrad, 1869 (not of Gabb).

Conrad's type of the genus *Nemodon* (*Am. Jour. Conch.*, III, 9, and V, 97, pl. IX, f. 16). This is a very different species from *Nemodon eufalensis* Gabb. I therefore propose the name of *N. conradi* for this species.

Nemodon angulatum Gabb.

Leda angulata Gabb, Proc. Acad. Nat. Sci., 1860, p. 94, pl. II, f. 12.

Nemodon brevifrons Conr., Kerr's Geol. Sur. N. C., App., p. 4, pl. I, f. 15, 1875. Type?

The specimen figured by Whitfield (pl. XII, figs. 1, 2) as probably from Haddonfield, New Jersey, is more likely to be from Snow Hill, North Carolina. The micaceous "marl" from Haddonfield is harder, more dense and cuts smooth, while that from Snow Hill is more sandy and crumbles easily.

Pectunculus hamula Morton, Syn. Org. Rem., 64, pl. 15, f. 7, 1834.

Pectunculus australis Morton, Syn. Org. Rem., 64, 1834 = *P. subaustralis* d'Orb., Prod. de Pal., p. 243.

Pectunculus rotundatus Gabb.

Axinæa rotundata Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 396, pl. 68, f. 33, 1860.

PINNIDÆ.

Pinna rostriformis Morton, Proc. Acad. Nat. Sci., I, 132, 1841; Jour. Acad. Nat. Sci., VIII, 1 ser., 214, pl. 10, f. 5, 1842.

Pinna laqueata Conrad.

Specimen figured by Whitfield (pl. 16, f. 1).

MELINIDÆ.

Gervilliopsis ensiformis (Conrad).

Specimen figured by Whitfield (pl. 15, f. 11).

Inoceramus barabini Morton, Syn. Org. Rem., 62, pl. III, f. 11, pl. XVII, f. 3, 1834.

Inoceramus alveatus Morton, Syn. Org. Rem., 63, pl. XVII, f. 4, 1834.

Inoceramus perovalis Conrad, Proc. Acad. Nat. Sci., VI, 200, 1852; Jour. Acad. Nat. Sci., II, 2 ser., 299, pl. 27, f. 7, 1854.

Inoceramus sagensis Owen, var. **quadrans** Whitf., Mon. U. S. Geol. Sur., IX, 79, pl. 14, f. 16, 1885.

HAPLOSCAPHIDÆ Conrad.

Haploscapha capax Conrad, Ann. Rep. U. S. Geol. and Geogr. Sur. Ter. (Hayden), 456, 1873 (1874).

Haploscapha grandis Conrad, U. S. Geol. Sur. Ter. (Hayden), II, 23, pl. 56, 1875.

Haploscapha (Cucullifera) eccentrica Conrad, U. S. Geol. Sur. Ter. (Hayden), II, 24, pl. 57, 1875.

PTERIIDÆ.

Pteria laripes (Morton).

Avicula laripes Mort., Syn. Org. Rem., 63, pl. XVII, f. 5. 1834.

Pteria navicula Whitfield, Mon. U. S. Geol. Sur., IX, 70, pl. XIV, f. 8, 1885.

Meleagrinella abrupta (Conrad).

Avicula abrupta Conr., Jour. Acad. Nat. Sci., II, 2 ser., 274, pl. 24, figs. 5, 6, 1853.

OSTREIDÆ.

Ostrea cretacea Morton, Syn. Org. Rem., 52, pl. XIX, p. 3, 1834.

Ostrea plumosa Morton, Syn. Org. Rem., 51, pl. III, f. 9, 1834.

Specimen figured by Whitfield (pl. III, f. 13), also the specimen figured on pl. IV, f. 9, as *Anomia argentaria*.

Ostrea denticulifera Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 30, pl. 35, figs. 1, 8, 1858.

Ostrea littlei Gabb, Proc. Acad. Nat. Sci., 1876, 321.

Ostrea tecticosta Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 403, pl. 68, figs. 47, 48, 1860.

The New Jersey type is figured by Whitfield (pl. III, figs. 1, 2).

Ostrea falcata Morton, Jour. Acad. Nat. Sci., VI, 1 ser., 50, pl. I, f. 2, 1827.

Ostrea torosa Morton, Syn. Org. Rem., 52, pl. X, f. 1, 1834.

This is an eroded fragment of a large *Exogyra costata* Say.

Ostrea (Gryphæostrea) vomer (Morton).

Gryphæa vomer Morton, Syn. Org. Rem., 54, pl. IX, f. 5, 1834.

Gryphæa pitcheri Morton, Syn. Org. Rem., 55, pl. 15, f. 9, 1834.

This is now considered a synonym of *G. corrugata* Say.

Gryphæa mutabilis Morton, Jour. Acad. Nat. Sci., VI, 81, pl. IV, f. 3, 1828.

Dr. Dall is wrong in considering this a synonym of *Ostrea compressirostra.* The specimen he refers to might be that species, but the type is not; it is a broad, flattened form of *G. convexa* Say, which is considered by most authors to be the same as Lamarck's *G. vesicularis.*

Gryphæa convexa (Say).

The specimen figured by Morton (*Jour. Acad. Nat. Sci.*, VI, 79, pl. 4, figs. 1, 2, 1828).

Gryphæa bryanii Gabb, Proc. Acad. Nat. Sci., 1876, 321.

The specimens figured by Whitfield (pl. 27, figs. 6–9) are not the types, but probably a suite of co-types presented to the Academy by Gabb. Specimens marked "type" in Gabb's handwriting I found in the drawer marked "Gabb collection" above referred to.

TRIGONIDÆ.

Trigonia thoracica Morton, Syn. Org. Rem., 65, pl. 15, f. 13, 1834.

Trigonia eufalensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 396, pl. 68, f. 32, 1860.

Also the specimen figured by Whitfield (pl. 14, figs. 1, 2). This is only the young of *T. thoracica.*

Trigonia angulicostata Gabb, Proc. Acad. Nat. Sci., 1876, p. 312.

PECTINIDÆ.

Pecten craticula Morton, Amer. Jour. Sci., 1 ser., XXIII, 293, 1833; Syn. Org. Rem., 57.

Figured by Whitfield (*Mon. U. S. Geol. Sur.*, IX, 49, pl. VII, figs. 17, 18).

Pecten venustus Morton, Amer. Jour. Sci., 1 ser., XXIII, 293, pl. 5, f. 7, 1833.

Pecten quinquenaria Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 10, 1854.

Pecten mississippiensis Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 283, 1860.

Pecten tenuitesta Gabb, Proc. Acad. Nat Sci., 1861, 327; Whitfield, Mon. U. S. Geol. Sur., IX, 47, pl. VII, figs. 5, 6.

Pecten burlingtonensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 304, pl. 48, f. 26, 1860.

Pecten bellisculptus (Conrad).

Camptonectes bellisculptus Conr., Amer. Jour. Conch., V, 99, pl. 9, f. 11, 1869.

Dr. Whitfield is right in uniting this with *P. burlingtonensis;* further study may prove that both are synonyms of *P. argillensis* Conr.

Pecten perlamellosus Whitfield, Mon. U. S. Geol. Sur., IX, 50, pl. VII, f. 7, 1885.

Pecten conradi Whitfield, Mon. U. S. Geol. Sur., IX, 52, pl. VII, figs. 8–10, 1885.

This is the *P. simplicus* Conrad in part.

Neithea complexicosta Gabb, Proc. Acad. Nat. Sci., 1876, 319.

Probably only a form of *N. quinquecostata* Sowb.

SPONDYLIDÆ.

Spondylus gregale (Morton).

Plagiostoma gregale Mort., Syn. Org. Rem., 60, pl. V, f. 6, 1834.

Dianchora echinata (Morton).

Plagiostoma echinatum Mort., Syn. Org. Rem., Add. Obs., IV, 1835.
Spondylus capax Conr., Jour. Acad. Nat. Sci., II, 2 ser., 274, pl. 24, f. 8.
Dianchora echinata Whitf., Mon. U. S. Geol. Sur., IX, 59, pl. X, figs. 3–5.

Morton's and Conrad's species are based on the same shell, a very convex free valve.

Plicatula urticosa Morton, Syn. Org. Rem., 62, pl. X, f. 2, 1834.

Plicatula tetrica Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 283, pl. 46, f. 26, 1860.

LIMIDÆ.

Lima pelagica (Morton).

Plagiostoma pelagicum Mort., Syn. Org. Rem., 61, pl. V, f. 2, 1834.

Lima squarrosa (Gabb).

Ctenoides squarrosa Gabb, Proc. Acad. Nat. Sci., 1861, 366.

Lima acutilineata (Conrad).

Specimens figured by Whitfield (*Mon. U. S. Geol. Sur.*, IX, 62, pl. 9, figs. 6, 7).

ANOMIIDÆ.

Anomia argentaria Morton, Amer. Jour. Sci., XXIII, 293, pl. 5, f. 10, 1833.

Anomia argentaria Morton, var. **ornata** Gabb.

Anomia tellinoides Morton, Amer. Jour. Sci., XXIII, 294, p. 5, f. 11, 1833.

Paranomia scabra (Morton).

Placuna scabra Mort., Syn. Org. Rem., 62, 1834.

Figured by Whitfield (*Mon. U. S. Geol. Sur.*, IX, 44, pl. X, fig. 10).

Paranomia lineata (Conrad).

Placunanomia lineata Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 291, pl. 46, f. 20.

Paranomia saffordi Conrad, Am. Jour. Conch., III, 8.

Liroscapha squamosa Conrad, Am. Jour. Conch., V, 100, pl. 9, f. 23, 1869.

MYTILIDÆ.

Modiolus julia Lea, Proc. Acad. Nat. Sci., 1861, 149.

Specimen figured by Whitfield (pl. 17, f. 6). Probably the type.

Modiolus burlingtonensis Whitfield, Mon. U. S. Geol. Sur., IX, 65, pl. 17, figs. 8, 9, 1885.

Modiolus ovatus Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 396, pl. 68, f. 31, 1860.

Lithophaga affinis Gabb, Proc. Acad. Nat. Sci., 1861, 326.

Type figured by Whitfield (*Mon.*, pl. 17, figs. 2, 3).

Lithophaga ripleyana Gabb, Proc. Acad. Nat. Sci., 1876, 311.

The types are not very clearly defined; they include the specimen figured by Whitfield (pl. 17, figs. 4, 5).

PHOLADOMYIDÆ.

Pholadomya occidentalis Morton, Syn. Org. Rem., 68, pl. VIII, f. 3, 1834.

Pholadomya littlei Gabb, Proc. Acad. Nat. Sci., 1876, 306.

Pholadomya postsulcata Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 276, 1860.

Pholadomya (Anatimya) anteradiata Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 276, pl. 46, f. 3, 1860.

ANATINIDÆ.

Periplomya elliptica (Gabb).

Anatina elliptica Gabb, Proc. Acad. Nat. Sci., 1861, 324.

Ceroomya peculiaris (Conrad).

Inoceramus peculiaris Conr., Am. Jour. Conch., V, 43, pl. I, f. 13.

PERIPLOMIDÆ.

Periploma applicata Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 324, 1858.

POROMYIDÆ.

Leiopistha protexta (Conrad).

Cardium protextum Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 12.

PLEUROPHORIDÆ.

Veniella conradi (Morton).

Venilia conradi Mort., Amer. Jour. Sci., XXIII, 294, pl. 8, figs. 1, 2, 1833.

The specimen marked "type" is badly broken.

Veniella elevata Conrad, Amer. Jour. Conch., VI, 74, pl. 1 [= 3], figs. 7, 7a, 1870.

This is only the young of *V. conradi.*

Veniella inflata Conrad.

Goniosoma inflata Conr., Amer. Jour. Conch., V, 44, pl. 1, f. 10.

An internal cast, the type of Conrad's genus *Goniosoma.* This is undoubtedly the same as *V. conradi*, as Dr. Whitfield suggests.

Veniella trigona Gabb, Proc. Acad. Nat. Sci., 1861, p. 324.

The types are figured by Whitfield (pl. 19, figs. 11–14).

Veniella subovalis "Conrad."

As figured and described by Whitfield (*Mon. U. S. Geol. Sur.,* IX, 150, pl. 19, figs. 1, 2, 1885).

Veniella trapezoides Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 282, pl. 47, f. 7, 1860.

Veniella rhomboidea Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 275, pl. 24, f. 7, 1853.
Sphæriola umbonata Whitfield, Mon. U. S. Geol. Sur., IX, 152, pl. 19, figs. 17, 18, 1885.
Eta carolinensis Conrad, Kerr's Rept. Geol. N. Car., App., 6, pl. 1, f. 4, 1875.

A specimen agreeing in all respects with the figure, but I am not sure that it is the type. The species is the type of the genus.

CRASSATELLITIDÆ.

Crassatellites vadosus (Morton).

Crassatella vadosa Mort., Syn. Org. Rem., 66, pl. 13, f. 12, 1834.

Crassatellites ripleyanus (Conrad) = *C. vadosus* Mort.

Crassatella ripleyana Conr., Jour. Acad. Nat. Sci., III, 2 ser., 327, pl. 35, f. 3, 1858.

Crassatellites linteus (Conrad) = *C. vadosus*, Mort. juv.

Crassatella lintea Conr., Jour. Acad. Nat. Sci., IV, 279, pl. 46, f. 5, 1860.

Crassatellites prorus (Conrad).

Crassatella prora Conr., Amer. Jour. Conch., V, 43, pl. I, f. 8, 1869.

Crassatellites monmouthensis (Gabb).

Crassatella monmouthensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 302, pl. 48, f. 19, 1860.

Crassatellites delawarensis (Gabb).

Crassatella delawarensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 303, pl. 48, f. 20, 1860.

The type is from "Crosswicks, N. J.," in Gabb's handwriting, not "deep cut Delaware and Chesapeake Canal" as stated in text.

Crassatellites transversus (Gabb).

Crassatella transversa Gabb, Proc. Acad. Nat. Sci., 1861, p. 364.

Crassatellites subplanus (Conrad).

Crassatella subplana Conr., Jour. Acad. Nat. Sci., II, 2 ser., 274, pl. 24, f. 9, 1853.

Crassatellites (Scambula) perplanus (Conrad).

Scambula perplana Conr., Amer. Jour. Conch., V, 48, pl. 9, figs. 7, 8.

Eriphyla decemnaria (Conrad).

Gouldia decemnaria Conr., Amer. Jour. Conch., V, 48, pl. 9, f. 4.

Eriphyla conradi (Whitfield).

Gouldia conradi Whitf., Mon. U. S. Geol. Sur., IX, 125, pl. 18, figs. 1–3, 1885.

The type is badly broken.

Eriphyla parilis (Conrad).

Astarte parilis Conr., Jour. Acad. Nat. Sci., II, 2 ser., 276, pl. 24, f. 16, 1853.

The type is very badly broken, in fact worthless.

DICERATIDÆ.

Requienia senseni Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 299, pl. 27, f. 8, 1854.

LUCINIDÆ.

Lucina cretacea (Conrad), Whitfield.

Lucina cretacea Whitfield, Mon. U. S. Geol. Surv., IX, 129, pl. 18, figs. 23–25, 1885.

Lucina smockana Whitf., Mon. U. S. Geol. Sur., IX, 130, pl. 18, figs. 21, 22, 1885.

DIPLODONTIDÆ

Tenea pinguis (Conrad).

Lucina pinguis Conr., Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 18, 1853.

Mysia gibbosa Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 302, pl. 48, f. 17 (not 18), 1860.

Both the types of Conrad and Gabb.

Tenea parilis (Conrad).

Mysia parilis Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 278, pl. 46, f. 8, 1860.

Type as figured in the *Am. Jour. Conch.*, pl. 3, f. 12, and type of the genus *Tenea.*

CARDIIDÆ.

Cardium dumosum Conrad, Amer. Jour. Conch., VI, 75, 1870.

The type and specimen figured by Whitfield (pl. 20, figs. 9 and 13).

Cardium ripleyanum Conrad, Am. Jour. Conch., V, 96, pl. 9, f. 6, 1869.

Cardium (Lævicardium) spillmani Conrad.

Cardium spillmani Conr., Jour Acad. Nat. Sci., III, 2 ser., 326, pl. 34, f. 3 1858.

Type of the genus *Pachycardium* Conrad (*Am. Jour. Conch.*, V, 96, 1807).

Cardium (Lævicardium) perelongatum (Whitfield).

Protocardium perelongatum Whitf., Mon. U. S. Geol. Sur., IX, 136, pl. XXI, figs. 4, 5, 1885.

There is little doubt but that this is only the internal cast of *C. spillmani.*

Cardium (Lævicardium) burlingtonense (Whitfield).

Pachycardium Burlingtonense Whitfield, Mon. U. S. Geol. Sur., IX, 138, pl. XXI, figs. 6, 7, 1885.

This may also prove to be only a form of *C. spillmani.*

Protocardia arkansense (Conrad).

Cardium arkansense Conr., Proc. Acad. Nat. Sci., 1855, 266.

ISOCARDIIDÆ.

Isocardia conradi Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 393, pl. 68, f. 21, 1860.

VENERIDÆ.

Cyprimeria excavata (Morton).

Cytherea excavata Mort., Syn. Org. Rem., 67, pl. V, f. 1, 1834.

Cyprimeria depressa (Conrad).

Dosinia depressa Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 278, pl. 46, f. 6, 1860.
Dosinia haddonfieldensis Lea, Proc. Acad. Nat. Sci., 1861, 149.

Cyprimeria densata (Conrad).

Tellina densata Conr., Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 17, 1853.

Cyprimeria heilprini Whitfield, Mon. U. S. Geol. Sur., IX, 160, pl. 22, figs. 14 and 15.

Probably only the cast of a young *C. densata.*

Cyprimeria torta Gabb, Proc. Acad. Nat. Sci., 1876, 308.

May prove to be only a form of *C. densata.*

Æora cretacea Conrad, Amer. Jour. Conch., VI, 72, pl. 3, f. 8, 1871.

Type of the genus.

Aphrodina tippana (Conrad).

Meretrix tippana Conr., Jour. Acad. Nat. Sci., III, 2 ser., 326, pl. 34, f. 18, 1858.

Also specimen figured by Whitfield (pl. XX, f. 7).

Dione delawarensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 302, pl. 48, f. 18, 1860.

TELLINIDÆ.

Tellina georgiana Gabb.

Tellina (Tellinella) georgiana Gabb, Proc. Acad. Nat. Sci., 1876, 307.

Tellinimera eborea Conrad.

Tellina (Tellinimera) eborea Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 278, pl. 46, f. 14, 1860.

Also specimen figured by Whitfield (pl. 23, figs. 12, 13). The description says type from "Ala."; original label "Miss." The specimens used by Dr. Whitfield are from Haddonfield, New Jersey. In the *Am. Jour. Conch.*, VI, 73, Conrad shortens the name *Tellinimera* to *Tellimera*, *T. eborea* being the type of the genus.

Peronæoderma georgiana Gabb, Proc. Acad. Nat. Sci., 1876, 308.

Gari elliptica Gabb, Proc. Acad. Nat. Sci., 1876.

Ænona eufaulensis (Conrad).

Tellina eufaulensis Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 277, pl. 46, f. 15.

Specimen figured by Whitfield (pl. 23, figs. 2, 3). Type of the genus, *Ænona* Conr. (*Am. Jour. Conch.*, VI, 74).

Ænona papyria Conrad, Am. Jour. Conch., VI, 74, 1871.

Specimen figured by Whitfield (pl. 23, f. 4).

Linearia metastriata Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 279, pl. 46, f. 7, 1860.

Specimen from Haddonfield, New Jersey, figured by Whitfield (pl. 23, f. 6).

Linearia carolinensis Conrad, Kerr's Geol. Sur. N. Car., App., 9, pl. 1, f. 20, 1875.

DONACIDÆ.

Donax fordii Conrad, Amer. Jour. Conch., V, 102, pl. 9. f. 27, 1869; Whitfield, Mon. U. S. Geol. Sur., 171, pl. 23, f. 1.

Dr. Whitfield doubts whether the specimen he figures is the same as Conrad's.

SOLENIDÆ.

Leptosolen biplicata (Conrad).

Siliquaria biplicata Conr., Jour. Acad. Nat. Sci., III, 2 ser., 324, pl. 34, f. 17, 1858.

Type of the genus *Leptosolen* Conr. (*Am. Jour. Conch.*), III, 15, 188, 1867).

Solyma lineolata Conrad, Am. Jour. Conch., VI, 75, pl. 3, f. 9, 1871.

Type of the genus.

Siliqua cretacea (Gabb).

Cultellus cretacea Gabb, Jour. Acad. Nat. Sci., 2 ser., IV, 303, pl. 48, f. 24, 1860.

Legumen planulatum (Conrad).

Solemya planulata Conr., Jour. Acad. Nat. Sci., II, 2 ser., 274, pl. 24, f. 11 1853.

Legumen appressum Conrad, Jour. Acad. Nat. Sci., III, 325, 1858.

Specimens figured by Whitfield (pl. XXV, figs. 6–8).

Legumen elliptioum Conrad, Jour. Acad. Nat. Sci., III, 325, pl. 34, f. 19, 1858.

Also figured by Whitfield (pl. 25, f. 5); probably the same as *L. planulatum.*

MACTRIDÆ.

Cymbophora lintea (Conrad).

Cardium (*Protocardia*) *lintea* Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 278, pl. 46, f. 7, 1860.
Veleda lintea Conr., Amer. Jour. Conch., VI, 74, 1870.

Specimen figured by Whitfield (pl. 23, figs. 20, 21). The type of Conrad's genus *Veleda.*

Schizodesma appressa Gabb, Proc. Acad. Nat. Sci.. 1876, 306.

CORBULIDÆ.

Corbula crassiplica Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 394, pl. 68, f. 25, 1860.

Specimen figured by Whitfield (pl. 23, f. 30).

Corbula foulkei Lea, Proc. Acad. Nat. Sci., 1861, 149.

Specimens figured by Whitfield (pl. 23, figs. 27–29) are undoubtedly the same as Conrad's *C. bisulcata* from Snow Hill, North Carolina.

Corbula subcompressa Gabb, Jour. Acad. Nat. Sci., 2 ser., IV, 394, pl. 48, f. 24.

The specimen figured by Whitfield (pl. 23, fig. 26) is not the type or one figured by Gabb.

SAXICAVIDÆ.

Panopea decisa Conrad.

Panopea decisa Conr., Jour. Acad. Nat. Sci., II, 2 ser., 275, pl. 24, f. 19, 1853.

GASTROCHÆNIDÆ.

Gastrochæna americana Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 393, pl. 68, f. 20, 1860.

The specimen figured by Whitfield (pl. 25, f. 19).

PHOLADIDÆ.

Pholas pectorosa Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 299, pl. 27, f. 9.

Pholas cretacea Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 392, pl. 68, f. 18.

Casts of the excavations replaced by pyrite, with no indications of shell characters, so that it is doubtful whether it is the same as the following.

Martesia cretacea Gabb, Proc. Acad. Nat. Sci., 1876, 304.

TEREDINIDÆ.

Teredo tibialis Morton, Amer. Jour. Sci., XXIII, 292, Vol. XXIV, pl. 9, f. 2, 1833.

Teredo irregularis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 393, pl. 68, f. 19, 1860.

Teredo contorta Gabb, Proc. Acad. Nat. Sci., 1861, 323.

Bivonia cretacea Gabb, Proc. Acad. Nat. Sci., 1876, 302.

SCAPHOPODA.

Dentalium subarcuatum Conrad, Jour. Acad. Nat. Sci., II, 2 ser., 276, pl. 24, f. 13, 1853.

Also specimen figured by Whitfield (pl. XX, f. 19).

Dentalium ripleyanum Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 393, pl. 69, f. 48, 1860.

This name can only be applied to the smaller specimen; the other is *D. subarcuatum* Conrad.

Dentalium falcatum Conrad, Am. Jour. Conch., V, 44, pl. 1, figs. 12–16, 1869.

Internal casts of *Hamulus* (see under *Serpulidæ*).

Cadulus obrutus (Conrad).

Gadus obrutus Conrad, Am. Jour. Conch., V, 101, pl. 9, f. 18, 1869.

GASTEROPODA.

Actæon cretacea Gabb, Proc. Acad. Nat. Sci., 1861, p. 318.

In the drawer containing the "Gabb collection" above referred to, I found the types of this species, which were not studied by Prof. Whitfield when writing his monograph. These show, as Gabb says, a resemblance to *Tornatella bullata* Morton, but is a smaller species, "the spire higher," etc. The "two folds on the columella" are very distinct. The specimen figured by Whitfield (pl. XX, figs. 5, 6) as the type of "*Cinulia ovoidea*" Gabb, is a specimen of *A. cretacea*. Not having the types of this species probably led Prof. Whitfield to describe the type of *A. ovoidea* Gabb, as a new species, "*Actæon subovoides*," although the original label was present. Both of Gabb's species are well described, and in the true types all the characters in the original descriptions are clearly shown. There are also in the Academy's collection the specimens figured by Whitfield on pl. 19, figs. 9–12.

Actæon ovoidea Gabb, Proc. Acad. Nat. Sci., 1861, p. 319.

Figured by Whitfield (p. 155, pl. 19, figs. 14–16) as the type of a new species, "*A. subovoides*."

Actæon gabbana Whitfield, Mon. U. S. Geol. Sur., XVIII, 156, pl. 19, figs. 23–25, 1892 = *Actæonina biplicata* Gabb, Proc. Acad. Nat. Sci., 1860, p. 93, pl. 2, f. 13 (not d'Orbigny).

Actæon forbesiana Whitfield, Mon. U. S. Geol. Sur., XVIII, 157, pl. 19, figs. 17–22, 1892.

Avellana bullata (Morton).

Tornatella? *bullata* Morton, Syn. Org. Rem., 48, pl. V, f. 3, 1834.
Avellana bullata Whitfield, Mon. U. S. Geol. Sur., XVIII, 163, pl. 20, figs. 1–4.

Globiconcha curta Gabb, Proc. Acad. Nat. Sci., 1861, p. 319.

Cinulia naticoides (Gabb).

Actæonina naticoides Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 299, pl. 48, f. 2, 1860.

Cinulia costata Johnson, Proc. Acad. Nat. Sci., 1898, p. 462, f. 1.

Cylichna recta (Gabb).

Bulla recta Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 302, pl. 48, f. 17, 1860.

Bulla mortoni Lyell and Forbes, Quar. Jour. Geol. Soc., London, I, 63.

Specimen figured by Whitfield (pl. 20, f. 9).

Bulla macrostoma Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 301, pl. 48, figs. 15, 16, 1860.

Bulliopsis cretacea Conrad, Jour. Acad. Nat. Sci., III, 334.

PATELLIDÆ.

Patella tentorium Morton, Syn. Org. Rem., 50, pl. 1, f. 11, 1834.

PLEUROTOMARIIDÆ.

Pleurotomaria crotaloides (Morton).

Cirrus crotaloides Morton, Syn. Org. Rem., 49, pl. 19, f. 5, 1834.

Also the specimen figured by H. A. Pilsbry (*Proc. Acad. Nat. Sci.*, 1896, p. 10, pl. I).

Pleurotrema solariformis Whitfield, Mon. U. S. Geol. Sur., XVIII, 180, pl. 22, figs. 12, 13.

It is the *Architectonica abbottii* Gabb, in part (*Proc. Acad. Nat. Sci.*, 1861, p. 321).

DELPHINULIDÆ.

Straparolus lapidosus (Morton).

Delphinula lapidosa Morton, Syn. Org. Rem., 46, pl. 19, f. 7, 1834.

Straparolus subplanus Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 299, pl. 48, figs. 4a, b, 1860.

This will probably prove to be a synonym of *S. lapidosus* Mort.

Straparolus deplanatus Gabb, ms.

The type of this species is what Gabb figured by mistake for the type of *Delphinula lapidosa* Mort. (*Jour. Acad. Nat. Sci.* IV, 2 ser., 300, pl. 48, figs. 5a, b. With the specimen there is an original label in Gabb's handwriting, "*Straparolus deplanatus* Gabb, Cretaceous, Ala." On the specimen is written the word "type." This seems to be a good species, the characters of which are well shown in the figure referred to. It is more depressed than *S. lapidosus*, the body whorl being almost uniformly rounded above and below. While practically an internal cast, the spire still has some of the shell (altered to calcite) remaining, which shows a slight crenulation below the suture. The specimen evidently came from Prairie Bluff, Alabama. I have been unable to find a description.

TROCHIDÆ.

Trochus mortoni Gabb, Proc. Acad. Nat. Sci., 1861, p. 321.

Margarita abyssina (Gabb).

Solarium abyssina Gabb, Proc. Acad. Nat. Sci., 1860, p. 94, pl. 2, f. 9.

Margaritella abbotti (Gabb).

Architectonica abbotti Gabb, Proc. Acad. Nat. Sci., 1861, p. 321.
Margaritella abbotti Whitfield, Mon. U. S. Geol. Sur., XVIII, 134, pl. 17, figs. 12–15.

Ataphrus kerri Gabb, Proc. Acad. Nat. Sci., 1876, 303, pl. 17, f. 10, 1875.

Allied to the genus *Monodonta*.

EULIMIDÆ.

Eulima cretacea Conrad, Am. Jour. Conch., V, 100, pl. 9, f. 15.

PYRAMIDELLIDÆ.

Pyramidella conellus (Whitfield).

Obeliscus conellus Whitfield, Mon. U. S. Geol. Sur., XVIII, 151, pl. 19, f. 1.

SCALARIIDÆ.

Scala annulata (Morton).

Scalaria annulata Morton, Syn. Org. Rem., 47, Pl. 3, f. 10, 1834.
Cavoscala annulata Whitfield, Mon. U. S. Geol. Sur., XVIII, 177, pl. 22, figs. 1–5.

Type of the genus *Cavoscala* Whitfield.

Scala sillimani (Morton).

Scalaria sillimani Morton, Syn. Org. Rem., 47, pl. 13, f. 9, 1834.

Scala thomasi Gabb, Proc. Acad. Nat. Sci., 1876, p. 296.

Also specimen figured by Whitfield (pl. XVIII, f. 1).

Scala cyclostoma Gabb, Proc. Acad. Nat. Sci., 1876, p. 297.

NATICIDÆ.

Natioa abyssina Morton, Syn. Org. Rem., 49, pl. 13, f. 13, 1834.

Gyrodes petrosus (Morton).

Natica petrosus Morton, Syn. Org. Rem., 48, pl. 19, f. 6, 1834.

Gyrodes spillmanii Gabb, Proc. Acad. Nat. Sci., 1861, p. 320.

This is probably the same as *G. alveata* Conrad.

Gyrodes crenata (Conrad).

Natica (*Gyrodes*) *crenata* Conrad, Jour. Acad. Nat. Sci., IV, 289, 1860.

Specimens figured by Whitfield (pl. 16, figs. 5, 6), and co-types.

Gyrodes infracarinata (Gabb).

Natica infracarinata Gabb, Proc. Acad. Nat. Sci., 1861, p. 319.

Gyrodes abbottii Gabb, Proc. Acad. Nat. Sci., 1861, p. 320.

Type figured by Whitfield (pl. XV, f. 17).

Gyrodes obtusivolva Gabb, Proc. Acad. Nat. Sci., 1861, p. 320.

Gyrodes altispira (Gabb).

Lunatia altispira Gabb, Proc. Acad. Nat. Sci., 1861, p. 320.

An original label in Gabb's handwriting is marked "Dupl. types."

Lunatia halli Gabb, Jour. Acad. Nat. Sci., IV (2 ser.), 391, pl. 68, f. 11, 1860.

Also specimen figured by Whitfield (pl. 16, figs. 13, 14).

Amauropsis meekana Whitfield, Mon. U. S. Geol. Sur., XVIII, 131, pl. 16, figs. 22–25, 1892.

Amauropsis punctata (Gabb).

Phasianella punctata Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 299, pl. 48, f. 3, 1860.

Also specimens figured by Whitfield (pl. 16, figs. 19–21).

XENOPHORIDÆ.

Xenophora leprosa (Morton).

Trochus leprosus Morton, Syn. Org. Rem., 46, pl. 15, f. 6, 1834.

Also specimen figured by Whitfield (pl. 17, figs. 16, 17).

TURRITELLIDÆ.

Turritella vertebroides Morton, Syn. Org. Rem., 47, pl. 3, f. 13, 1834.

Turritella encrinoides Morton, Syn. Org. Rem., 47, pl. 3, f. 7, 1834.

Turritella granulicosta Gabb, Proc. Acad. Nat. Sci., 1861, p. 363.

Type figured by Whitfield (pl. 18, figs. 10, 11).

Turritella pumila Gabb.

Specimen figured by Whitfield (pl. 23, figs. 5, 6).

Turritella compacta Whitfield, Mon. U. S. Geol. Sur., XVIII, 142, pl. 18, figs. 8, 9.

Turritella quadrilirata Johnson, Proc. Acad. Nat. Sci., 1898, p. 463.

VERMETIDÆ.

Siliquaria pauperata Whitfield, Mon. U. S. Geol. Sur., XVIII, 149, pl. 18, figs. 26, 27, 28, 1892.

Included by Gabb under *Laxispira lumbricalis*.

Laxispira lumbricalis Gabb, Proc. Acad. Nat. Sci., 1876, p. 301, pl. 17, f. 7.

The original label (to which the specimen was gummed?) and a pencil drawing is in the Academy's collection, but the little shell is either lost or broken. The large specimen figured by Gabb (*l. c.*, pl. 17, f. 6) as *L. lumbricalis* is only part of an internal cast of *Turritella vertebroides.*

MATHILDIIDÆ.

Tuba reticulata Johnson, Proc. Acad. Nat. Sci., 1898, p. 461.

CERITHIDÆ.

Cerithium pilsbryi Whitfield, The Nautilus, VII, pp. 38 and 51, pl. II, f. 3, 1893.

"Chemnitzia" occidentalis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 391, pl. 68, f. 10, 1860.

"Chemnitzia" spillmani Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 287, pl. 46, f. 48, 1860.

"Chemnitzia" corona Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 287, pl. 46, f. 50, 1860.

"Chemnitzia" meekiana Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 299, pl. 48, f. 1, 1860.

APORRHAIDÆ.

Anchura arenaria (Morton).

Rostellaria arenarum Morton, Syn. Org. Rem., 48, pl. 5, f. 8, 1834.
Anchura arenaria Whitfield, Mon. U. S. Geol. Sur., XVIII, 112, pl. 14, f. 10.

Anchura pennata (Morton).

I have been unable to positively determine the type of *Rostellaria pennata* Morton (*Syn. Org. Rem.*, 48, pl. 19, f. 9). A specimen numbered (219) in Morton's handwriting (as most of his types are) agrees well with the description but not with the figure. It is a cast, and characteristic of the material from Prairie Bluff, Alabama. Three specimens (one nearly perfect) from Snow Hill, North Carolina, which Conrad has doubtfully referred to this species, on an original label, but which he has described and figured erroneously as "*Anchura rostrata* Morton" (*Kerr's Geol. N. C.*, App., 12, pl. 2, f. 28), with a reference to Gabb's description and figure of *Alaria rostrata.* It is an entirely different species from the one described by Gabb, having an expanded lip like that figured by me (*Proc. Acad. Nat. Sci.*, 1898, p. 463, f. 3), the entire lip showing one or two small projections below. Whether the form figured by Conrad or the one figured by Whitfield (pl. 14, figs. 7, 8) is the *R. pennata* of Morton I am unable to say.

Anchura abrupta Conr., var. **acutispira** Whitfield, Mon. U. S. Geol. Sur., XVIII, 114, pl. 14, f. 4

The two other specimens figured by Whitfield as *abrupta*? (pl. XIV, figs. 1–3) I should not consider the same species.

Anchura solitaria Whitfield, Mon. U. S. Geol. Sur., XVIII, 117, pl. 14, f. 9, 1892.

Anchura pergracilis Johnson, Proc. Acad. Nat. Sci., 1898, p. 463, f. 2.

Alaria rostrata (Gabb).

Rostellaria rostrata Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 390, pl. 68, f. 7, 1860.

The specimen figured by Whitfield (pl. 14, f. 6) from Haddonfield, New Jersey, has been somewhat broken.

Aporrhais ? bicarinata Gabb, Proc. Acad. Nat. Sci., 1876, 299.

STROMBIDÆ.

Pugnellus densatus Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 284, 1860.

Specimen figured on pl. 46, f. 31, *Jour. Acad. Nat. Sci.*, IV, but not the type.

Rostellaria spirata Whitfield, Mon. U. S. Geol. Sur., XVIII, 109, pl. 13, figs. 16, 17, 1892.

Rostellaria compacta Whitfield, Mon. U. S. Geol. Sur., XVIII, 108, pl. 13, figs. 18-21, 1892.

CYPRÆIDÆ.

Cypræa mortoni Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 391, pl. 68, f. 9, 1860.

Also the New Jersey specimen figured by Whitfield (120, pl. 15, figs. 1–3).

Cypræa squyeri Campbell, The Nautilus, VII, 52, pl. 2, figs. 1, 2, 1893.

CASSIDIDÆ.

Sconsia alabamensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 301, pl. 48, f. 13, 1860.

BUCCINIDÆ.

Nassa ? globosa Gabb, Proc. Acad. Nat. Sci., 1876, p. 282.

Both the specimens from North Carolina and from Pataula Creek, Georgia.

Euthria ? fragilis Whitfield, Mon. U. S. Geol. Sur., XVIII, 78, pl. 9, figs. 11, 12, 1892.

Pyropsis elevata (Gabb).

Rapa elevata Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 301, pl. 48, f. 12, 1860,

This and the following species will undoubtedly prove to be the same as *P. richardsonii* Tuomey (*Proc. Acad. Nat. Sci.*, 1854, p. 169).

Pyropsis perlata (Conrad).

Tudicla (*Pyropsis*) *perlata* Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 288, pl. 46, f. 39, 1860.

Pyropsis trochiformis (Tuomey)?

Pyrula trochiformis Tuomey, Proc. Acad. Nat. Sci., 1854, p. 169.

The specimens figured by Whitfield (not of Tuomey) (pl. I, figs. 4–6).

Pyropsis octolirata (Conrad).

Ficus octoliratus Conr., Jour. Acad. Nat. Sci., III, 2 ser., 332, pl. 35, f. 6. 1858.

Specimen from Haddonfield, New Jersey, figured by Whitfield (pl. II, f. 10).

Pyropsis septemlirata (Gabb).

Cancellaria septemlirata Gabb, Proc. Acad. Nat. Sci., 1860, 94, p. 2, f. 10.

Also the specimen figured by Whitfield (pl. 3, figs. 7, 8).

Pyropsis retifer (Gabb).

Fusus retifer Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 301, pl. 48, f. 11, 1860.

Pyropsis naticoides Whitfield, Mon. U. S. Geol. Sur., XVIII, 43, pl. 2, figs. 5–7, 1892.

Pyropsis alabamensis (Gabb).

Cancellaria alabamensis Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 301, pl. 48, f. 14, 1860.

Perissolax dubia (Gabb).

Purpuroidea dubia Gabb, Proc. Acad. Nat. Sci., 1860, 94, pl. 2, f. 11.

Perissolax trivolva (Gabb).

Fusus trivolvus Gabb, Proc. Acad. Nat. Sci., 1860, 94.

Type figured by Whitfield (pl. 21, f. 1).

Pyrifusus pyruloidea (Gabb).

Rapa pyruloidea Gabb, Proc. Acad. Nat. Sci., 1860, 94, pl. 2, f. 4.

Pyrifusus turritus Whitfield, Mon. U. S. Geol. Sur., XVIII, 54, pl. 5, figs. 3–5, 1892.

Pyrifusus cuneus Whitfield, Mon. U. S. Geol. Sur., XVIII, 51, pl. 4, f. 9, 1892.

Pyrifusus mullicaensis (Gabb).

Pleurotoma mullicaensis Gabb, Proc. Acad. Nat. Sci., 1860, 95, pl. 2, f. 8.
Neptunella mullicaensis Whitfield, Mon. U. S. Geol. Sur., XVIII, 56, p. 4, figs. 20, 21, 1892.

There is no character to separate the two types except that the specimen described by Whitfield is a little larger.

Fusus holmesianus Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 389, pl. 68, f. 4, 1860.

Fusus kerri Gabb, Proc. Acad. Nat. Sci., 1876, p. 279, pl. 17, f. 1.

Hercorhynchus tippanus (Conrad).

Fusus tippana Conrad, Jour. Acad. Nat. Sci., IV, 2 ser., 286, pl. 46, f. 4, 1860.

Type of the genus *Hercorhynchus* Conrad (*Amer. Jour. Conch.*, IV, p. 247, 1868).

FASCIOLARIIDÆ.

Odontofusus slackii Gabb.

Fasciolaria slackii Gabb, Proc. Acad. Nat. Sci., 1861, 322.

The type is figured by Whitfield (pl. VI, figs. 8, 9), and is the type of his genus *Odontofusus.*

Fasciolaria crassicosta Gabb, Proc. Acad. Nat. Sci., 1876, 282.

Fasciolaria obliquicostata Gabb, Proc. Acad. Nat. Sci., 1876, 283.

Fasciolaria kerri Gabb, Proc. Acad. Nat. Sci., 1876, 283.

Lagena ? edentata Gabb.

Tritonium (*Lagena*?) *edentatum* Gabb, Proc. Acad. Nat. Sci., 1876, p 281.

TURBINELLIDÆ.

Turbinella parva Gabb, Proc. Acad. Nat. Sci., 1860, p. 94, pl. 2, f. 3.

Turbinella subconica Gabb, Proc. Acad. Nat. Sci., 1860, p. 94, pl. 2, f. 6.

VOLUTIDÆ.

Volutoderma delawarensis (Gabb).

Voluta delawarensis Gabb, Proc. Acad. Nat. Sci., 1861, p. 322.

Type and specimen figured by Whitfield (pl. 10, figs. 5–7).

Volutoderma biplicata (Gabb).

Volutilithes biplicata Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 300, pl. 48, f. 6, 1860.

Type of the genus *Volutoderma* Gabb (*Proc. Acad. Nat. Sci.*, 1876, p. 289).

Volutoderma abbottii (Gabb).

Volutilithes abbottii Gabb, Proc. Acad. Nat. Sci., 1860, 94, pl. 2, f. 7.

Also the specimen figured by Whitfield (pl. 21, figs. 8, 9).

Volutoderma intermedia Whitfield, Mon. U. S. Geol. Sur., XVIII, 184, p. 23, figs. 14, 15, 1892.

Volutoderma woolmani Whitfield, The Nautilus, VII, pp. 37, 51, pl. 2, figs. 4, 5, 1893.

Ptychosyca inornata Gabb, Proc. Acad. Nat. Sci., 1876, p. 295, pl. 17, figs. 2–4.

Volutomorpha conradi (Gabb).

Volutilithes conradi Gabb, Jour. Acad. Nat. Sci., IV, 2 ser., 300, pl. 48, f. 10, 1860.

Also specimen figured by Whitfield (pl. VII, figs. 4, 5). Type of the genus *Volutomorpha* Gabb (*Proc. Acad. Nat. Sci*, 1876, p. 290).

Volutomorpha bella (Gabb).

Volutilithes bella Gabb, Jour. Acad. Nat. Sci., IV, 300, pl. 48, f. 7, 1860.

Described from the "Delaware and Chesapeake Canal"; original label says "N. J." Also the specimen figured by Whitfield (pl. VI, figs. 17, 18).

Volutomorpha mucronata (Gabb).

Voluta mucronata Gabb, Proc. Acad. Nat. Sci., 1861, p. 323.

Volutomorpha kanei (Gabb).

Voluta kanei Gabb, Proc. Acad. Nat. Sci., 1861, p. 323.

Volutomorpha gabbi Whitfield, Mon. U. S. Geol. Sur., XVIII, 73, pl. 8, figs. 2, 3, 1892.

Rostellites nasutus (Gabb).

Volutilithes nasuta Gabb, Jour. Acad. Nat. Sci., IV, 300, pl. 48, f. 9, 1860.

Also the specimen figured by Whitfield (pl. 11, f. 2).

Rostellites angulatus Whitfield, Mon. U. S. Geol. Sur., XVIII, 88, pl. 11, figs. 3, 4, 1892.

This may prove to be only the adult form of *R. nasutus*.

Liopeplum leioderma (Conrad).

Volutilithes (*Athleta*) *leioderma* Conrad, Jour. Acad. Nat. Sci., IV, 292, pl. 46, f. 32, 1860.

Lioderma lioderma Conrad, Proc. Acad. Nat. Sci., 1865, p. 184.
Liopeplum lioderma Dall, Trans. Wagner Free Inst. Sci., III, 73, 1890.

The type of both *Lioderma* Conrad and *Liopeplum* Dall.

Cancellaria eufaulensis Gabb, Jour. Acad. Nat. Sci., IV, 390, pl. 68, f. 8, 1860.

Cancellaria subalta Conrad, Am. Jour. Conch., V, 100. pl. 9, f. 22, 1869.

Morea naticella (Gabb).

Purpura (*Morea*) *naticella* Gabb, Jour. Acad. Nat. Sci., IV, 301, pl. 48, f. 15, 1860.

This is probably the same as *Morea cancellaria* Conrad.

Turbinopsis hilgardi Conrad, Jour. Acad. Nat. Sci., IV, 289, pl. 46, f. 29, 1860.

Turbinopsis depressa Gabb, Proc. Acad. Nat. Sci., 1861, p. 321.

This is doubtfully considered by Whitfield to be a synonym of *T. hilgardi*. The specimens figured by him (pl. 12, figs. 7–9) represents neither *T. hilgardi* Conr. nor *T. depressa* Gabb.

Turbinopsis angulata Whitfield, Mon. U. S. Geol. Sur., XVIII, 101, pl. 12, figs. 17, 18, 1892.

Type in the Academy's collection, not Rutgers College, as stated by Whitfield.

Turbinopsis curta Whitfield, Mon. U. S. Geol. Sur., XVIII, 102, pl. 12, figs. 5, 6, 1892.

Turbinopsis elevata Whitfield, Mon. U. S. Geol. Sur., XVIII, 102, pl. 12, figs. 10–14, 1892.

Four specimens are referred to this species, three of which are figured. I can find no character to separate three of these from *T. curta*. The type should, therefore, be restricted to the specimen represented by figs. 13 and 14.

Turbinopsis plicata Whitfield, Mon. U. S. Geol. Sur., XVIII, 104, pl. 12, figs. 1, 2, 1892.

Turbinopsis lapidosa (Whitfield).

Modulus lapidosa Whitfield, Mon. U. S. Geol. Sur., XVIII, 152, pl. 17, figs. 6–8, 1892.

This species is identical or close to *Turbinopsis depressa* Gabb.

Gyrotropis squamosus Gabb, Proc. Acad. Nat. Sci., 1876, 300, pl. 17, f. 5.

Probably a *Turbinopsis*.

Cithara crosswickensis Whitfield, Mon. U. S. Geol. Sur., XVIII, 107, pl. 13, figs. 7, 8, 1892.

Drillia georgiana Gabb, Proc. Acad. Nat. Sci., 1876, p. 280.

CEPHALOPODA.

Baculites ovatus Say, Am. Jour. Sci., II, 41, 1820; Morton, Jour. Acad. Nat. Sci., VI, 89, pl. 5, f. 6, 1828.

The specimen described by Say and figured by Morton.

Baculites compressus Say, Am. Jour. Sci., II, 41, 1820; Morton, Am. Jour. Sci., XXIII, 291, pl. 9, f. 1, 1833.

The specimen figured by Morton.

Baculites asper Morton, Am. Jour. Sci., XXIII, 291, 1830; Syn. Org. Rem., 43, pl. 1, figs. 12, 13, pl. 13, f. 2, 1834.

Baculites carinatus Morton, Syn. Org. Rem., 44, pl. 13, f. 1, 1834.

Baculites labyrinthicus Morton, Syn. Org. Rem., 44, pl. 13, f. 10, 1834.

Baculites columna Morton, Syn. Org. Rem., 44, pl. 19, f. 8, 1834.

The specimen, although marked type, does not agree with the figure. Morton's original label, which accompanied all the others, was wanting in this case.

Solenoceras annulifer (Morton).

Hamites annulifer Morton, Jour. Acad. Nat. Sci., VIII, 213, pl. 11, f. 4.
Solenoceras annulifer Conr., Jour. Acad. Nat. Sci., IV, 2 ser., 284.

The type of Conrad's genus *Solonoceras*. Whitfield refers it to the genus *Ptychoceras*, and also figures the type.

Hamites arculus Morton, Syn. Org. Rem., 44, pl. 15, figs. 1, 2, 1834.

Hamites torquatus Morton, Syn. Org. Rem., 45, pl. 15, f. 4, 1834.

Hamites trabeatus Morton, Syn. Org. Rem., 45, pl. 15, f. 4, 1834.

Heteroceras conradi (Morton).

Ammonceratites conradi Morton, Jour. Acad. Nat. Sci., VIII, 212, pl. 10, f. 1, 1841.
Heteroceras conradi Whitfield, Mon. U. S. Geol. Sur., XVIII, 269, pl. 45, figs. 9, 10, 11, and 14.

Scaphites hippocrepis (DeKay).

Scaphites cuvieri Morton, Jour. Acad. Nat. Sci., VI, 109, pl. 7, f. 1, 1828.

Morton's type.

Scaphites reniformis Morton, Syn. Org. Rem., 42, pl. 2, f. 6, 1843.

The type reported missing by Dr. Whitfield was found in working over the material.

Scaphites iris Conrad, Jour. Acad. Nat. Sci., III, 2 ser., 335, pl. 35, f. 23.

Scaphites similis Whitfield, Mon. U. S. Geol. Sur., XVIII, pl. 44, figs. 1, 2, 1892.

Scaphites conradi (Morton).

Ammonites conradi Morton, Syn. Org. Rem., 39, pl. 16, f. 3, 1834.
Ammonites conradi Morton, var. *A. gulosus*, *l. c.*, pl. 16, f. 2.
Ammonites conradi Morton, var. *B. petechialis*, *l. c.*, 40, pl. 16, f. 1.
Ammonites conradi Morton, var. *C. navicularis*, *l. c.*, 40, pl. 19, f. 4.

Types of the species and all the varieties.

Ammonites delawarensis Morton, Am. Jour. Sci., XVIII, 244, pl. 2, f. 4, 1830.

Specimens figured by Whitfield (pl. 42, figs. 6, 7, 8, and pl. 43, figs. 1, 2).

Ammonites vanuxemi Morton, Am. Jour. Sci., XVIII, 244, pl. 3, figs. 3, 4, 1830.

Ammonites dentatocarinatus Roemer.

Specimen figured by Whitfield (pl. 41, figs. 3, 4).

Placenticeras spillmani Hyatt, Mon. U. S. Geol. Sur., XLIV, 233, pl. 47, figs. 6–8, 1903.

Placenticeras placenta (DeKay).

Specimen figured by Whitfield (pl. 40). Also specimens figured by Hyatt (*Mon. U. S. Geol. Sur.*, XLIV, pl. 39, figs. 3–6).

Placenticeras telifer (Morton).

Ammonites telifer Morton, Am. Jour. Sci., XXIII, p. 290, 1833; Syn. Org. Rem., 38, pl. 2, f. 7.

Placenticeras syrtale (Morton).

Ammonites syrtalis Morton, Syn. Org. Rem., pl. 16, figs. 1, 2.
Placenticeras syrtalis Hyatt, Mon. U. S. Geol. Sur., XLIV, 205, pl. 28, figs. 1, 2, and pl. 27, f. 15.

Protengonoceras gabbi (Böhm).

Ammonites pedernalis Gabb, Pal. Calf. II, 258, pl. 35, figs. 1, 1a, 1869 (not v. Buch).
Engonoceras gabbi Böhm, Zeitschr. Deutsch. geol. Gesell., L, p. 197, 1898.
Protengonoceras gabbi Hyatt, Mon. U. S. Geol. Sur., XLIV, 153, pl. 17, f. 20.

The specimen figured by Hyatt, Pl. 17, f. 20.

Sphenodiscus lenticularis var. **mississippiensis** Hyatt, Mon. U. S. Geol. Sur., XLIV, 77, pl. 9, f. 9, 1903.

Eutrephoceras dekayi (Morton).

Nautilus dekayi Morton, Am. Jour. Sci., XXIII, 291, pl. 8, f. 4, 1833.

Specimen figured by Whitfield (pl. 37, f. 4). Type of Hyatt's genus *Eutrephoceras* (*Proc. Am. Phil. Soc.*, XXXII, 555).

Nautilus perlatus Morton, Syn. Org. Rem., 33, pl. 13, f. 4, 1834.

This may prove to be a synonym of *E. dekayi*.

Nautilus bryani Gabb, Proc. Acad. Nat. Sci., 1876, p. 277.

Hercoglossa paucifex (Cope).

Aturia paucifex Cope, Proc. Acad. Nat. Sci., 1866, p. 34.

Type figured by Whitfield (pl. 39, f. 1).

Belemnitella americana (Morton).

Belemnites americanus Morton, Am. Jour. Sci., XVII, 281, 1830; XVIII, pl. 1, figs. 1–3, 1830; Jour. Acad. Nat. Sci., VI, 190, pl. 8, figs. 1–3, 1830.

Variety A, Morton (*Syn. Org. Rem.*, 34, pl. 1, fig. 3), is the type of the var. *subfusiformis* Whitfield (pl. 47, figs. 1, 2). There is also the type of var. "B," Morton (*Syn. Org. Rem.*, 34, pl. 1, f. 3b).

Belemnites (?) **ambiguus** Morton, Am. Jour. Sci., XVII, 281, 1830; XVIII, pl. 1, figs. 4, 5, 1830; Jour. Acad. Nat. Sci., VI, 192, pl. 8, figs. 4, 5, 1830.

CRUSTACEA.

Callianassa mortoni Pilsbry, Proc. Acad. Nat. Sci., 1901, 112, pl. 1, figs. 1–6.

Hoploparia gabbi Pilsbry, Proc. Acad. Nat. Sci., 1901, 115, pl. 1, figs. 11–14.

Cancer whitfieldi Pilsbry, Proc. Acad. Nat. Sci., 1901, 118, pl. 1, f. 18.

Scalpellum conradi Gabb, Proc. Acad. Nat. Sci., 1876, 179, pl. V, figs. 3a, b, 4.

A CONTRIBUTION TO THE KNOWLEDGE OF THE ORTHOPTERA OF SOUTH AND CENTRAL FLORIDA.

BY JAMES A. G. REHN AND MORGAN HEBARD.

The material on which the following study is based is almost entirely the property of the junior author, the greater portion having been collected by him on trips taken in the months of January and February, 1903 and 1904. The localities represented are Tampa, Hillsboro county; Chokoloskee and Key West, Monroe county; and Miami, Dade county.

The specimens examined number 783, the species seventy-eight, of which seven are new, and several Cuban types are here recorded from the United States for the first time. A very representative series of the material has been presented to the Academy.

The field notes given after the species are entirely the work of the junior author, and are followed by the initial of his name. The brief descriptions of the localities visited, with other facts of interest from the standpoint of this paper, are also by him.

Tampa, Hillsboro County, Florida.

During my brief stay in Tampa (January 16 and 17, 1904) I had time for only a few expeditions, and found that from the Tampa Bay Hotel good collecting grounds were not easy to reach. Chilly weather also hampered me decidedly, as in South Florida the weather had been so cool that Orthoptera was scarce, except in the most sheltered places. There are many marshy spots along the shore of Tampa Bay, and in these few specimens of Orthoptera were to be found. In the driftwood along the shore I also captured a few Forficulids and Blattids, and noticed a small cricket of a pale straw color which I was unable to capture. Back from the bay the country is flat, and for the greater part open with frequent shallow ponds, around the edges of which the grasses grow rank, and in these I took numerous specimens. The occasional woods of scattering pines proved unproductive at this time of year, but along their borders the dead pine stumps yielded a number of *Eurycotis floridana*. A vacant lot near the hotel yielded in addition a few specimens of *Nemobius*.

Key West, Monroe County, Florida.

I arrived at Key West on January 18, at 4 P.M., and left on the 20th, but during this time I collected every spare moment, and although the Key was dry and a high wind kept the white coquina dust flying in clouds, collecting proved quite productive. During the fall months the collecting must be of the best.

Key West is one of the numerous small islands off the Florida coast, and is situated on the edge of the Gulf Stream, ninety miles northeast of Havana, Cuba. The surface of the Key is composed almost wholly of coquina and is perfectly flat. The greater part is covered with a dense scrub growing to a height of from fifteen to twenty feet, in which very few Orthoptera could be found. The lagoons extending along parts of the shore were also unproductive, but there are a few portions of the island near the city where the country is more open and the scrub is interspersed with occasional gumbo-limbo trees, and in such location the collecting was excellent. Here not only was Acrididæ abundant in the grass, but I also found the Blattidæ and Forficulidæ abundantly represented under the loose chunks of coquina.

I noticed many immature *Gonatista grisea* scurrying about on the gumbo-limbo trees, and at their roots captured several *Anisomorpha buprestoides*. Here and there are small shallow ponds, around the edges of which peculiar weeds flourish on the bare coquina.

Miami, Dade County, Florida.

I spent several weeks in Miami in the winter of 1903, but did no collecting of any importance in Orthoptera until February, 1904, when I was there from February 5 to February 9, and found Orthoptera plentiful. Near the town there are four different localities in which to collect: the thick jungle or "hammock," the open pine woods, the salt marshes, and the Everglades. In the "hammock" most insects are abundant, but Orthoptera are scarce. I took several species here on the weeds, under the bark of the oaks, and in the small open spaces. The open pine woods are filled with Orthoptera, and many species were to be found among the low vegetation and pine needles.

The dead pine logs, upon their bark being peeled off, also disclosed several interesting species. These pine woods extend along Biscayne Bay between the Everglades and the "hammocks" along the shore. The salt marshes are to be found here and there along the shore of the bay, but are quite distant from the hotel, and owing to the shortness of my stay I was unable to visit them. The Everglades are so difficult to penetrate that I found it impossible to collect there. Along their edge no Orthoptera could be found. Many species of Orthoptera were to be heard in the grounds of the Hotel Royal Palm after dark, and I made a number of interesting captures there.

During the summer of 1903, Mr. W. S. Dickinson collected for me in this locality and reported Orthoptera to be scarce in most places.

The material from Chokoloskee, Monroe county, was purchased, and therefore I can give no notes for it.

Family FORFICULIDÆ.

Labidura bidens (Olivier).

A single small male of this species is contained in the Miami collection, taken July 11, 1903. It is considerably smaller and lighter than males from Thomasville, Georgia, and has the anal segment almost unarmed.

Anisolabis maritima (Bon.).

A female of this species from Key West, taken January 19, 1904, and another from Miami, taken February 9, 1904, have been examined.

Key West.—This specimen was taken from under a coquina boulder, which also disclosed a number of *Anisolabis annulipes*. (H.)

Miami.—Taken from a stone wall. (H.)

Anisolabis annulipes (H. Lucas).

A series of fifty-three specimens from Miami taken during the summer of 1903, and a Key West series of nineteen taken January 19, 1904, represent this species. Considerable variation exists in the width and intensity of the femoral annuli, and in some specimens they are almost wholly lacking.

Key West.—All of these specimens were taken from under coquina boulders along a new road being built on the outskirts of the town. They were found several at a time, often in company with one or two large scorpions. (H.)

Labia burgessii Scudder.

Nine specimens from Tampa, taken January 17, 1904, and fourteen from Miami, taken February 6, 1904, are identical with specimens from Thomasville, Georgia.

Specimens from both localities were taken from under the bark of dead pine logs, those from Miami all being taken from the same log. (H.)

Labia guttata Scudder.

A single female of this species was taken at Tampa, January 17, 1904.

Taken from under a sign on an oak in company with a number of *Periplaneta australasiæ*. (H.)

Family BLATTIDÆ.

Blattella germanica (Linnæus).

Four specimens of this species from Miami have been examined.

Blattella adspersicollis (Stål).

Four specimens of this West Indian and tropical American species have been examined from Miami, taken February 6, 1903, and February 7, 1904. This is the first record of the species within the United States.

The specimen captured on February 6, 1903, I took on the porch of the Hotel Royal Palm in the early morning. All the others were found under signs on the pine trees in the town. (H.)

Ceratinoptera lutea Saussure and Zehntner.

An adult was taken at Tampa, in the driftwood along the shore of Tampa Bay, on January 17, 1904, and one in Key West on January 20, 1904. The specimen taken at Tampa was so recently emerged from the larval state that it had not then become hardened. (H.)

Temnopteryx deropeltiformis Brunner.

An adult female of this species was taken at Miami on the 5th of August, 1903. This record considerably extends the range of the species, Indiana being the only State from which it has previously been recorded. Brunner's original description merely credited the species to North America.

Eurycotis floridana (Walker).

This ill-smelling species is represented by a series of twenty-eight individuals in all stages of development, thirteen being adult. Tampa specimens were taken January 16, 1904; Key West individuals on January 18 and 19, 1904; and Miami representatives on February 6, 1904, and July 1 and August 11, 1903.

The greater portion of the immature individuals are of the *sabaliana* type, with the lateral margins light-colored. In some specimens this is quite marked, in others very obscure, and in a number absent; two adults are noteworthy as retaining indistinct traces of this early color pattern.

I found this species moderately common under the bark of dead pine stumps and logs both at Tampa and Miami. In Key West it fairly swarmed under the coquina boulders in the woods, one rock often disclosing a dozen, the greater part immature but ranging from tiny young to huge females bearing large oöthecæ. All would immediately scuttle away, making a rustling sound in the loose pebbles. When seized these insects emit a vile-smelling oily fluid. The females always produced far more of this than the males. (H.)

Periplaneta americana (Linnæus).

This species is represented by an adult female and four immature individuals taken at Tampa, January 17, 1904.

Periplaneta australasiæ (Fabricius).

Three adults from Miami, taken July 11 and 21 and August 23, 1903, and three adults and seven nymphs taken at Tampa, January 17, 1904, represent this species.

All the specimens from Tampa were taken from under a tin sign on an oak tree. (H.)

Pycnoscelus surinamensis (Linnæus).

This tropical species is represented by a series of sixty-four adult and immature specimens. But one specimen was taken at Tampa, a nymph, on January 17, 1904, and it would appear from this that the species is not so common that far north. Miami is represented by specimens taken in January, February and during the summer, while Key West individuals were all (fourteen in number) taken January 19 and 20, 1904.

I have always found this species plentiful at Miami under stones and rubbish. In Key West it was very abundant under coquina boulders in the woods. I have noticed that they usually attempt to escape by burrowing. (H.)

Plectoptera poeyi (Saussure).

This Cuban type is represented by a series of eight specimens taken at Key West on January 19, 1904. These specimens are the first of the species with exact data recorded from the United States.

Family MANTIDÆ.

Stagmomantis carolina (Johannson).

One immature female, beaten from scrub at Key West on January 20, 1904, belongs to this species. Several males were taken at Miami on February 4, 1903, attracted to light.

Gonatista grisea (Fabricius).

Six immature individuals from Key West, January 19, 1904, and one from Miami, February 6, 1904, are referable to this species.

Key West.—The immature specimens of this species were abundant upon the trunks of the gumbo-limbo trees. They ran about with great swiftness, but when resting pressed themselves close to the bark, which they exactly resembled.

Miami.—I found a few immature specimens on the trunk of a tree in a swampy spot near the Miami river. (H.)

Thesprotia graminis (Scudder).

This species is represented by an immature specimen from Tampa, taken January 17, 1904, another from Key West, taken January 18, 1904, and six mature or nearly mature individuals from Miami, taken in February, March, July and August.

I have usually found this species in the pine straw of the pine woods, which it so closely resembles as to be invisible when stationary. (H.)

Family **PHASMIDÆ.**

Anisomorpha buprestoides (Stoll).

Three specimens of this species were taken at Key West on January 19, 1904, and one adult has been examined from Miami, taken August 5, 1903.

Specimens from Key West were taken from among the roots of gumbo-limbo trees. A pair taken on January 19 were in coitu. (H.)

Family **ACRIDIDÆ.**

Apotettix minutus n. sp. (Pl. I, figs. 3 and 4).

Type: ♂; Miami, Dade county, Florida. February 6, 1904. Collected by Morgan Hebard.

Allied to *A. rugosus* (Scudder), but very considerably smaller, with the median carina of the pronotum very slightly depressed between the humeral angles, the margins of the median femora scarcely undulate and the pulvilli of the caudal metatarsi of subequal length.

Size small; form robust; surface finely tuberculate. Head small; occiput ascending; vertex not elevated above the level of the eyes; fastigium subtruncate, very slightly wider than one of the eyes, distinctly excavated laterad, cephalic margin distinctly carinate and rounded in toward the median carina; median carina of fastigium distinct, extending back to the middle of the eyes and projecting cephalad beyond the margin of the fastigium; frontal costa slightly and regularly divergent to the median ocellus, ventrad of which it is absent; eyes moderately prominent, slightly ovate in outline. Pronotum produced, surpassing the tips of the caudal femora; median carina distinct, slightly elevated and arcuate, very slightly depressed between the humeral angles; anterior margin subtruncate; caudal process very slightly subulate; humeral angle not strongly marked, scapular area very narrow; cephalic angle of the lateral lobes distinct, obtuse-angulate; caudal angle of the lateral lobes somewhat recurved, elytral and ventral sinus deep and angulate. Tegmina elliptical, the apex acute. Wings extending beyond the caudal process of the pronotum a distance equal to the length of the cephalic femora. Cephalic femora with the dorsal carina quite distinct but not very high, the lower margin slightly arcuate, but not undulate. Median femora with the margins very slightly undulate, the dorsal more so than the ventral. Caudal femora quite robust, inflated, femoral lobe rectangulate and not elevated, external pagina and dorso-lateral face with strong diagonal folds; tibiæ slightly shorter than the femora; metatarsi with the pulvilli of equal length.

General color clove brown becoming somewhat lighter laterad, the dorsal aspect of the caudal femora obscurely russet; eyes black.

Measurements.

Length of body,	6.75	mm.
Length of pronotum,	8.2	"
Greatest width of pronotum,	2.2	"
Length of caudal femora,	4.2	"

The type is the only specimen of the species which has been examined.

This specimen was taken near the south bank of the Miami river, in a damp spot in the "hammock." The exact locality is about one hundred yards downstream from the first bridge. (H.)

Tettigidea lateralis (Say).

This species was taken at Miami, February 6, 1903.

Radinotatum brevipenne (Thomas).

This species apparently does not occur on Key West, as no specimens were taken. Tampa is represented by sixteen specimens taken on January 17, 1904, while thirteen specimens from Miami were taken on January 29 and 31 and February 3, 1903, February 6 and 9, 1904, and July 28, 1904. Several of the adult females are of very large size. The usual color forms are represented in the series.

Specimens from Tampa were all taken in the grasses bordering the shallow ponds. Those from Miami were taken in the wire-grass and undergrowth of the pine woods. (H.)

Truxalis brevicornis (Johannson).

A single male from Chokoloskee represents this species.

Syrbula admirabilis (Uhler).

A single female of this species was taken at Miami on September 1, 1903. It is very much larger than specimens from the Northern States, measuring forty-five millimeters in length of body.

Macneillia obscura (Scudder).

A series of eighteen specimens—six adult males, six adult females, six nymphs—from Miami were taken February 6 and 9, 1904. They represent both color phases, the green and the brown, the latter predominating, and including all except one adult female and one nymph. The green female has the dorsal half of the latter lobes of the pronotum, the face except the costal region and the dorsal face of the caudal femora grass green, the remainder of the surface being colored much as in the brown phase.

Five nymphs from Tampa, taken on January 17, 1904, were also examined.

I found these specimens in the wire-grass of the pine woods, over a mile from town on the Everglades road. All the specimens were taken within a few yards of each other, and diligent search failed to reveal others in the surrounding woods. The females were easily captured, but the males sprang about with alacrity. (H.)

Amblytropidia occidentalis (Saussure).

Thirteen specimens of this species have been examined: three taken at Miami, February 7 and 9, 1904; eight at Cape Florida, Biscayne Key, February 8, 1904; one at Tampa, January 17, 1904, and one at Chokoloskee.

Orphulella pratorum Scudder.

A series of twenty-two specimens from Key West, taken January 18, 19 and 20, 1904, and seven individuals from Miami, taken in July and August, 1903, represents this species.

Dichromorpha viridis (Scudder).

Eight Tampa specimens, taken January 16 and 17, 1904, and one Chokoloskee individual represent this species. Both color phases are present.

Taken in a vacant field at Tampa. (H.)

Clinocephalus pulcher n. sp. (Pl. I, figs. 1 and 2).

Types: ♂ and ♀; Miami, Dade county, Florida. July 20 (♂) and 16 (♀), 1903. Collected by Dickinson. Hebard collection.

Allied to *C. elegans* Morse, but readily distinguished by the larger size, longer tegmina and more brilliant coloration in the green phase.

Size large (for the genus); form moderately slender. Head with the occiput with a hardly perceptible elevation; vertex sloping very slightly toward the fastigium, interocular space almost twice as wide as the frontal costa in the male and about once and a half the width in the female; fastigium moderately produced, rectangulate, with a distinct semicircular excavation, margins distinctly elevated, no median carina present; face distinctly retreating; frontal costa slightly and gradually expanding, reaching to the clypeus, sulcate through the entire length; eyes ovoid, in the male very decidedly longer than in infra-ocular portion of the genæ, in the female slightly longer than the same; antennæ distinctly longer (♂) or considerably shorter (♀) than the head and pronotum. Pronotum subequal in the male, slightly expanding caudad in the female, lateral carinæ very slightly constricted mesad; medium carina as distinct as the lateral; cephalic margin rotundato-truncate, caudal margin very broadly obtuse-angulate, more rounded in the male than in the female; transverse sulcus severing the median carina distinctly behind the middle; lateral lobes of the pronotum with the ventral margin very broadly obtuse-angulate. Tegmina falling slightly short of the apex of the abdomen, apex slightly narrowed and rotundato-truncate; costal area with the proximal lobe very prominent, ulnar area of the male with about eight distinct transverse veins. Abdomen with the subgenital plate of the male produced into a distinct tubercle; cerci straight, simple, tapering. Cephalic and median femora of the male somewhat inflated. Caudal femora exceeding the apex of the abdomen by nearly the length of the head, moderately robust, distal portion slender with the genicular region enlarged; tibiæ with thirteen or fourteen spines on the lateral margin in the male and sixteen in the female.

Male above apple green; sides and limbs cinnamon, shading to wood brown on the lower surface, eyes and a distinct brownish-black postocular streak which also suffuses the base of the tegmina; tegmina (except for the green anal area) pale drab; antennæ cinnamon, slightly infuscate apically; dorsal carina of the lateral face of the caudal femora olive; lateral carinæ of the pronotum narrowly lined with cinnamon.

Female with the sides, face and limbs apple green; postocular streak as in the male; head above centrally apple green, flanked by bars of vinaceous-rufous; pronotum above vinaceous-rufous; tegmina with the costal area apple green, the continuations of the postocular streak (reaching to the apex of the tegmina and including the whole discoidal field) brownish-black, angle of the anal vein and adjoining portion of the anal field salmon buff, margin of the anal field obscurely blackish-brown. Antennæ and limbs marked as in the male.

Measurements.

	♂	♀
Length of body,	20.5 mm.	28 mm.
Length of pronotum,	4.5 "	5.5 "
Caudal width of pronotum,	2.5 "	3.5 "
Length of tegmina,	12.5 "	17.8 "
Length of caudal femora,	12.5 "	17.5 "

A series of five males and three females of this beautiful species have been examined, all taken at Miami on July 20, 1903, except the female type. The males are all uniformly colored except for the presence of a median broad blackish longitudinal bar on the head, a character not noticeable in the type, very distinct in two and faintly indicated in two others. The females, however, exhibit a great color diversity, the type representing one form; another is dull brown with little or no contrasts, in fact resembling the coloration of *Amblytropidia occidentalis;* the third is cinnamon-rufous on the head and pronotum, with the usual postocular streak, while the tegmina are a very delicate pinkish without any longitudinal bar.

Arphia granulata Saussure.

This quite distinct species is represented by a series of four from Chokoloskee, two from Miami, taken February 6, 1903, and February 7, 1904, and four from Key West, taken January 20, 1904. Three of this series are females, and two of them from Chokoloskee are of a decided blackish hue.

Key West.—I found this species in a few sunny openings in the scrub at the eastern end of the Key.

Miami.—Specimens were taken in pine woods near the town. (H.)

Chortophaga viridifasciata (DeGeer).

A series of thirty-seven specimens represents this common and widely distributed species. Miami specimens were taken in January, February and July; Key West individuals on the 18th and 19th of January, 1904; Tampa is represented by three specimens taken January 16 and 17, 1904. Four specimens are from Chokoloskee.

Dissosteira carolina (Linnæus).

One female from Chokoloskee.

Scirtetica picta (Scudder).

This beautiful species is apparently rather common at Miami in July, sixteen specimens taken on the 20th having been examined.

Two specimens taken there on February 6, 1904, were also studied. The hoary suffusion so noticeable in the species of this genus is limited in some individuals, and more general in others, very much as in the closely related *S. marmorata*.

In a few places in the pine woods this species was plentiful, but specimens were hard to capture on account of their extreme shyness. (H.)

Psinidia fenestralis (Serville).

This sand-loving species is represented by a series of sixteen specimens, taken at Chokoloskee, and Miami on February 6, 1904, and July 20, 1903. As a rule they are darker than northern specimens, and have the transverse bars on the lateral aspects of the caudal femora more pronounced.

Dictyophorus guttatus (Stoll).

This striking species is represented by four specimens taken at Miami on July 11, 1903, and June 2, 1899, the latter collected by Dr. H. A. Pilsbry, and in the collection of the Academy. A number of specimens have also been examined from Chokoloskee, Tarpon Springs, Hillsboro county (November, 1903), and Goodall, Volusia county (August).

Pseudopomala brachyptera (Scudder).

A single adult female of this species from Chokoloskee has been examined. This is the first record of this species from the Southern States.

Stenacris chlorizans Walker.

This water-loving species is represented by a single individual from Miami, taken January 30, 1903. A specimen from St. Augustine, in the collection of the Academy, has also been examined.

Leptysma marginicollis (Serville).

This elusive species is no doubt of regular occurrence in suitable localities, ten specimens having been examined from Chokoloskee, Tampa (January 17, 1904), Miami (January 16, 23, and February 2, 1899; S. N. Rhoads), and De Funiak Springs, Walton county (February 20; C. W. Johnson). All the specimens have the lateral lines distinct.

Specimens from Tampa were taken in the marshy places along the bay. (H.)

Schistocerca americana (Drury).

This powerful species is represented by a series of thirteen Key West specimens taken on January 18 and 19, 1904, two females from Cape Florida, February 8, 1904, a single Chokoloskee individual and a series of ten from Miami taken in July, 1903, and February, 1904. January specimens from Miami are also in the Academy collection.

Schistocerca damnifica (Saussure).

A male from Miami taken February 6, 1904, and a female from Chokoloskee represent this species.

Schistocerca alutacea (Harris).

Three males, two from Key West, January 20, 1904, and one from Chokoloskee, represent this species. The Key West individuals are rather uniformly colored, while the Chokoloskee specimen is striped.

Key West.—These specimens were taken in the open bush near the city. (H.)

Schistocerca obscura (Fabricius).

One male from Miami taken August 12, 1903, is referred to this species.

Melanoplus puer (Scudder).

Twenty-nine specimens represent this peculiar species, several being immature and the adults all larger than Scudder's measurements. One individual is from Tampa, while the remainder are from Miami, taken February 6, 7 and 9, 1904. The species was previously known only from Fort Reed, Orange county, and Jacksonville, Duval county.

Tampa.—The specimen from Tampa was taken in a grassy spot near the railroad.

Miami.—These specimens were taken in the undergrowth of the pine woods both to the north and the west of the town. (H.)

Melanoplus keeleri (Thomas).

A series of twenty-six individuals, evenly divided between the sexes, represent this species. All are from Miami, taken in July and August, 1903.

Some of the male specimens have the cerci typical of *keeleri*, while others might with justice be referred to *deletor*, and it appears very possible that the two species are identical. The series examined cannot be separated by the cerci into two forms, one extreme running into the other, while in all other characters no difference exists. The series exhibits a considerable amount of color variation, and in size both sexes are larger than Scudder's measurements.

Paroxya floridiana (Thomas).

A male and a female from Miami, taken July 17, 1903, and January 23, 1899, and three females from Chokoloskee represent this species.

Paroxya atlantica Scudder.

A series of fifty-five males and twenty-six females represents this species. Miami individuals were taken in February, July and August; Cape Florida specimens (two) on February 8, 1904; Tampa individuals (two) on January 17, 1904, and the Key West series on January 19, 1904. Chokoloskee is represented by a number of specimens without data. Many of the males are extremely small, and the Key West series (twenty-six in number) is remarkable on account of the distinct bars on the posterior femora, a feature not very marked on specimens from other localities. The same series appears somewhat smaller than the mainland representatives, especially the females, and possibly may be an insular race worthy of separation.

Those taken in Tampa and Miami were found in marshy spots, while those from Cape Florida and Key West were found on dry ground among weeds. (H.)

Aptenopedes clara Rehn.

This beautiful species is represented by a series of forty-one specimens exhibiting a great amount of variation in size, and considerable in color. A topotypic series from Miami were taken on February 6 and 7, 1904, and in July, 1903, while Key West is represented by twelve specimens indistinguishable from the types, and taken on January 19 and 20, 1904. Several individuals from Cape Florida, Key Biscayne, taken February 8, 1904, are of enormous size, but cannot be separated otherwise from the types. Eight specimens from Tampa, taken January 16 and 17, 1904, have the cerci slightly shorter and less falcate than in Miami specimens, but the furcula are as in true *clara*, and the tendency toward *sphenarioides* is extremely slight. The range in total length of adult males is from 19 millimeters in Miami specimens to 26.5 in the Cape Florida type, in adult females from 24 in small Miami specimens to 34 in the largest Cape Florida representatives.

The brown phase of coloration has been noticed in the female only, the male presenting little else than variation in the intensity of the green phase of coloration.

The specimens from Tampa were taken in marshy spots along the bay. In Key West I found the species among the low, dry herbage near the city, and on Cape Florida in a dense tangle of vines and grasses. Those from Miami were captured in the undergrowth of the pine woods. (H.)

Aptenopedes aptera Scudder.

Four males of this species taken at Miami, February 7, 1904, have been examined. The caudal femora of this species appear heavier than in any of the other species of the genus.

These specimens were taken in the wire-grass of the pine woods to the north of Miami. Specimens were very hard to find here, and none were taken to the west of the town where, otherwise, the best collecting was secured. (H.)

Family TETTIGONIDÆ.

Stilpnochlora marginella (Serville).

A single female specimen of this neotropical species from Chokoloskee has been examined. It is slightly smaller than a Nicaraguan female in the Academy collection, but can without hesitancy be referred to this species. Scudder has recorded it from the Florida Keys.

Scudderia curvicauda (DeGeer).

A single female of this species was taken at Miami on July 20, 1903.

Scudderia cuneata Morse.

A pair of this southern species was taken at Miami on August 21 (♂) and 23 (♀), 1903.

Amblycorypha floridana n. sp. (Pl. I, fig. 5).

Types: ♂, Chokoloskee, Monroe county, Florida [A. N. S. Phila.]; ♀, Miami, Dade county, Florida, July 20, 1903 [Hebard collection].

Allied to *A. oblongifolia*, but differing in the straighter ovipositor and less angulate lateral angles of the disk of the pronotum. From *A. huasteca*, which it resembles in the latter respect, it can be separated by the very much shorter ovipositor.

Size medium; form slender, elongate. Head short, rather broad; vertex very strongly declivent; fastigium of the vertex very broad. about equal to the length of one of the eyes, truncate, broadly touching the frontal fastigium; eyes elliptical; antennæ reaching to the tips of the wings. Pronotum depressed above, distinctly expanding posteriorly; lateral margins of the disk rounded rectangulate, ratner obsolete cephalad; cephalic margin with a broad slight median emargination, caudal margin broadly rotundate; lateral lobes slightly deeper than long. Tegmina not quite four times as long as broad, costal margin evenly arcuate, apex rounded; radial rami bifurcate, the branches reaching the anal margin cephalad of the apex; costal region irregularly reticulate. Wings extending beyond the tegmina a distance slightly less than the length of the pronotum. Mesosternal lobes somewhat produced, rounded mesad, an angle developed latero-caudad; metasternal lobes each subcircular. Subgenital plate of the male carinate mesad, distad with a narrow V-shaped median emargination; styles very short, tapering. Ovipositor considerably longer than the pronotum, moderately curved, distal two-thirds of the dorsad and distal one-third of the ventral margins serrato-dentate, apex moderately acute. Cephalic tibiæ with the auricle elongate-elliptical. Caudal femora elongate, considerably inflated proximad, external margin unarmed, internal margin with nine spines; tibiæ very slightly longer than the femora.

General color (specimens discolored) straw yellow, traces of the original apple green visible on the tegmina; tympanum of male heavily marked with black.

Measurements.

	♂	♀
Length of body,	24.5 mm.	21 mm.
Length of pronotum,	7 "	7 "
Caudal width of pronotum,	4.5 "	4.5 "
Length of tegmina,	*c.* 33 "	32.5 "
Greatest width of tegmina,	9 "	9 "
Length of caudal femora,		28.5 "
Length of ovipositor,		11 "

This interesting species is represented by a series of five specimens, three females, two males, all of which are in bad condition, three having lost the caudal limbs. The specimens other than the types are all from Chokoloskee, Florida.

Microcentrum laurifolium (Linnæus).

Two specimens, male and female, from Miami represent this species in the Hebard collection. They were taken on February 5 and September 12. A single female, in the collection of the Academy, was taken at Miami on February 1, 1899, by S. N. and M. C. Rhoads, and another male at Braidentown, Manatee county.

Many specimens of this species could be heard stridulating in the trees after dark, but were difficult to capture. (H.)

Microcentrum rostratum n. sp. (Pl. I, figs. 6 and 7).

Type: ♀; Miami, Dade county, Florida. March 16, 1903. [Hebard collection.]

Allied to *M. lucidum* Brunner, from Brazil, from which it differs in the triangularly produced meso- and metasternal lobes, and the less rotundate character of the tegmina. The new form can readily be distinguished from the other North American species by its much smaller size and the peculiar fastigium.

Size small; form as usual in the genus. Head but slightly punctate dorsad; occiput and vertex deplanate, moderately declivent; fastigium of the vertex narrow, produced, distinctly sulcate, apically rounded and not as wide as the proximal joint of the antennæ; frontal fastigium much narrower than the fastigium of the vertex and touching the same; eyes subspherical, moderately prominent, slightly depressed, separated from one another by a space equal to the length of one of them; antennæ with the proximal joint subquadrate in section, rather small. Pronotum strongly punctate, depressed above, the lateral angles distinct, rectangulate, more apparent cephalad than caudad; cephalic margin very broadly and shallowly emarginate, caudal margin strongly arcuate; lateral lobes distinctly deeper than long, the ventral margin with an oblique cephalic sinuosity, a distinct humeral sinus present. Tegmina of the type usual in the genus, strongly punctate and coriaceous, the veins not pronounced; anterior ulnar vein becoming obsolete distad, the median vein reaching the sutural margin proximad of the apex, mediastine vein very short; apex narrowly rounded. Wings extending beyond the tegmina a distance slightly less than the length of the pronotum. Mesosternal and metasternal lobes produced caudad, the angles sharp. Cephalic femora with the ventral cephalic margin distinctly spined; tibiæ unspined above. Median femora armed as with the cephalic pair. Caudal femora short, hardly exceeding the tip of the ovipositor, ventral margins spined; tibiæ slightly exceeding the femora in length, slightly bent; tarsi rather small and weak. Ovipositor strongly bent dorsad at the base, the apex broad and bluntly rounded, apical margins serrato-dentate; subgenital plate triangular, produced, compressed.

General color apple green, suffused with yellowish on the abdomen; eyes ecru drab, tarsi and tip of ovipositor burnt umber.

Measurements.

Length of body,	26	mm.
Length of pronotum,	5	"
Caudal width of pronotum,	3.7	"
Length of tegmina,	31	"
Greatest width of tegmina,	8	"
Length of caudal femora,	16.1	"
Length of caudal tibiæ.	17.2	"
Length of ovipositor,	5.5	"

A single specimen of this species, the type, has been examined.

Belocephalus subapterus Scudder.

Two females, one from Miami, August 19, 1903, and the other from Chokoloskee, represent this species. The Chokoloskee specimen is smaller than the Miami individual, but has the ovipositor longer. Both are of a brownish color, which apparently is the natural coloration. The tegmina and wings are present as very small pads.

Pyrgocorypha uncinata (Harris).

This striking species is represented by four specimens, two from Miami, one taken July 11, 1903 (immature), the other without date, and two from Chokoloskee. They agree very well with Mexican specimens.

Conocephalus mexicanus Saussure.

Three specimens represent this species, one from Tampa, taken January 15, 1904, the others from Miami, taken February 5, 1903, and February 6, 1904.

Tampa.—I took this specimen in a marshy spot on the shore of Tampa Bay.

Miami.—One specimen was captured in a bush about 9 P.M. It was making a deafening noise. I saw and heard several other specimens, but all these when approached flew swiftly away.

Conocephalus lyristes n. sp. (Pl. I, figs. 8 and 9).

Type: ♂, Chokoloskee, Monroe county, Florida. [Hebard collection.]

Apparently allied to *Conocephalus truncatirostris* Redtenbacher from Brazil, *C. exiliscanorus* Davis from Staten Island, and *C. bruneri* Blatchley from Indiana. From the former it can readily be distinguished by the slenderer head and smaller size, while the shape of the fastigium will separate it from the latter species.

Size medium; form rather slender and moderately compressed. Head with the occiput and vertex horizontal, the rostrum elongate and produced into a rather slender, bluntly rounded process which is distinctly longer than the interspace between the eyes, ventral surface with a blunt basal tooth; frontal fastigium produced, but not quite touching the process of the rostrum; eyes rounded ovate in outline, not very prominent. Pronotum deplanate dorsad; lateral angles not distinct cephalad, distinct but rounded caudad; cephalic margin subtruncate, caudal margin broadly arcuate; lateral lobes equally long and broad, the ventral margin obtuse-angulate, humeral sinus rather broad and shallow. Tegmina long and narrow, very considerably surpassing the caudal femora. Cerci thick, heavy and parallel, apically with a strong, recurved, aculeate spine on the internal margin, dorsad of which is placed another of similar character but smaller size; subgenital plate with a broad apical V-shaped emargination and with short but distinct styles. Cephalic femora unarmed, tibiæ with the perforation a mere slit on each face. Median limbs slightly larger than the cephalic pair. Caudal femora no longer than the body, slender, genicular lobes spiniform, the internal more distinctly produced than the external, distal portion of the ventral margins spined; tibiæ heavy, straight and rather strongly spined.

General color tawny olive; head with a lateral line on the rostrum, the ocelli and a narrow postocular line ochre yellow, eye drab, ventral surface of the rostrum black; pronotum with the lateral angles marked with ochre yellow, another bar of the same color and a continuation of the postocular line crosses the lateral lobes; tegmina with the radial veins and the sides of the tympanum marked with blackish, a number of rather faint maculations of the same color being distributed over the tegmina, lateral margins of the tympanum external to the blackish bar striped with ochre yellow; limb with the ventral surfaces blackish, rather weak on the cephalic pair, very distinct and extending on to the lateral aspects of the tibiæ on the caudal pair.

Measurements.

Length of body,	30.5	mm.
Length of head (dorsal),	6	"
Length of rostrum from eyes,	3.1	"
Length of pronotum,	7.6	"
Greatest width of pronotum,	4.9	"
Length of tegmina,	39.2	"
Greatest width of tegmina,	5	"
Length of caudal femora,	21	"

The type is the only adult specimen examined. An immature female from Chokoloskee appears to belong to this species. The ovipositor is very considerably longer than the body, slightly decurved with an acute apex.

Conocephalus hoplomachus n. sp. (Pl. I, figs. 10 and 11).

Type: ♀; Chokoloskee, Monroe county, Florida. May. [Hebard collection.]

Apparently allied to *C. ensifer* Bolivar from Peru, but differing in the short and acuminate tegmina and wings. The blunt, broad fastigium short, sublanceolate tegmina, and straight elongate ovipositor will at once distinguish this species.

Size large; form robust, limbs short. Head somewhat depressed, subdeplanate dorsad, occiput and vertex horizontal; rostrum moderately produced, extending beyond the cephalic margin of the eyes a distance slightly less than the interocular space, apex rotundato-truncate, rounded and with no distinct angles; frontal fastigium broadly touching the blunt ventral process of the rostrum; eyes subovate, small, not prominent. Pronotum broad, rather deplanate dorsad, no distinct lateral angles, a slightly marked shoulder developed over the humeral sinus; cephalic margin truncate with a very faint median emargination; caudal margin truncate; lateral lobes distinctly longer than deep, ventral margin rounded with a faint median obtuse angle, humeral sinus distinct but not deep. Tegmina not reaching the apex of the abdomen, sublanceolate, the apex very narrowly rounded; longitudinal veins indistinct and almost lost in the irregular, reticulate character of the cross veins, mediastine veins extending almost half the length of the tegmen, median vein closely pressed to the posterior radial vein and extending to the extreme apex, anterior ulnar vein distinctly longitudinal in disposition and distad parallel and placed close to the median vein. Wings considerably shorter than the tegmina. Ovipositor very long, broad and with a hardly perceptible curve, the length being almost equal to that of the body and nearly twice that of the caudal femora, apex very acute; subgenital plate narrowed toward the apical margin, apex triangularly emarginate. Cephalic femora short, with two spines on the distal portion of the interno-ventral margin, tibiæ with the aperture slit-like. Median limbs about equal to the cephalic in size. Caudal femora slightly exceeding the apex of the abdomen, apical portion not very slender, both ventral margins spined distad, genicular lobes distinctly spined.

General color cinnamon, two faint longitudinal lines of umber present on the sides of the disk of the pronotum.

Measurements.

Length of body,	43	mm.
Length of rostrum from eyes,	2.7	"
Length of pronotum,	10	"
Caudal width of pronotum,	6.2	"
Length of tegmina,	23	"
Length of ovipositor,	38.5	"
Length of caudal femora,	24	"

The type only has been examined.

Conocephalus retusus Scudder.

A single female from Chokoloskee is referred to this species. This species has never before been recorded south of Georgia.

Orchelimum vulgare Harris.

A pair of this species from Chokoloskee has been examined.

Orchelimum concinnum Scudder.

A female from Chokoloskee is the most southern record for this species, whose general range is more western.

Orchelimum nitidum Redtenbacher.

A male individual from Chokoloskee probably belongs to this species, differing from the description in several details, which, however, appear to be unimportant.

Xiphidion gracillimum Morse.

A series of fourteen specimens, nine males and five females, represents this beautiful species. Miami adult specimens were taken on January 30, July 17–20 and September 12, 1903, immature specimens on February 6 and 8, 1904. A single immature male from Tampa was taken January 16, 1904. Considerable variation is exhibited in the intensity of the dorsal stripe. The type series of the species was taken at Capron and Biscayne Bay.

All specimens of this species which I captured were found among dense weeds. (H.)

Xiphidion brevipenne Scudder.

This widely distributed species is represented by one female taken at Chokoloskee.

Atlanticus sp.

Fourteen immature specimens belonging to a species of this genus were taken at Miami on February 6 and 9, 1904, and at Tampa on January 17, 1904. They apparently are not *gibbosus*, but are quite different from the other species of the genus.

Ceuthophilus latibuli Scudder.

A series of eleven specimens of both sexes represents this richly colored species. They were taken at Enterprise, Volusia county, April 18, 1903, by Mr. Philip Laurent. The species was described from Crescent City, Florida, and Georgia.

Mr. Laurent informs me that this species is found abundantly in gopher holes. In one hole which he dug out the whole of the bottom of the burrow was covered with them. (H.)

Family GRYLLIDÆ.

Mogoplistes slossoni Scudder.

A female specimen of this species, which is considerably smaller than the type measurements and apparently immature, was taken at Miami, February 6, 1904. The antennæ have four distinct blackish annuli on a chestnut ground.

I took this specimen under a sign on an oak tree in the "hammock" just across the river from Miami. One other specimen was noticed, but escaped by springing from the tree. Great difficulty was experienced in capturing the specimen without rubbing off its silver scales. (H.)

Liphoplus krugii Saussure.

This species was originally described from Cuba, and has never since been recorded outside of that island. Seven specimens, one male, six females, taken at Key West, January 19, 1904, appear to be referable to this form.

These specimens were taken from *Ilex cassine* by beating, in company with *Plectoptera poeyi* and *Cyrtoxipha delicatula*. The specimens were all secured with little difficulty. (H.)

Liphoplus zebra n. sp. (Pl. I, fig. 12).

Type: ♂; Miami, Dade county, Florida. February 6, 1904. (Morgan Hebard.) [Hebard collection.]

Distinguished from *L. krugii* by the apparent tegmina, the smaller size and peculiar coloration.

Size very small; form depressed; surface partially, and probably wholly in the perfect unabraded insect, covered with minute scales of a silvery-white color. Head depressed, the front with a distinct longitudinal median incision, narrow but distinct; eyes reniform in outline, subvertical; antennæ considerably exceeding the body in length. Pronotum scutellate, equal to half the length of the body, moderately arched, the lateral portions deflected toward the median line; cephalic portion considerably narrower than the caudal portion, the margin truncate; caudal margin very distinctly rotundate; lateral margins straight. Tegmina visible only as a projecting fringe around the caudal portion of the pronotum, the structure apparently being a fan-like set of radiating veins, margined apically by a narrow deflected subcoriaceous area. Abdomen short, thickly covered with scales. Limbs heavily scaled; cephalic and median pair very short; caudal femora strongly inflated, supplied with a number of long hairs, tibiæ shorter than the femora and narrowed somewhat proximad, metatarsi serrato-dentate dorsad.

General colors vandyke brown and silvery-white, the tibiæ and tarsi alternately ringed with these shades; caudal femora silvery-white obscurely mottled with the darker color; antennæ wood brown, becoming darker apically and narrowly and rather sparsely ringed with a deeper shade: head probably uniform silvery-white when unrubbed;

pronotum cinnamon darker on the lateral portions of the cephalic half, the lateral lobe lined above with pale ochre-yellow and below with a broad line of silvery-white scales. Tegmina bone white, the margins blotched with the two predominating colors. Abdomen finely mottled with the two contrasting tints.

Measurements.

Length of body,	5	mm.
Length of pronotum,	2.9	"
Caudal width of pronotum,	1.9	"
Length of caudal femora,	3.1	"

Of this beautiful and peculiar species the type is the only specimen which has been seen. The striking coloration is quite distinctive and will immediately separate it from *L. krugii.*

This specimen I captured in the pine woods to the west of Miami. It was first noticed perched on the top of a tuft of wire-grass. After having swept it into the net I very nearly lost it, for it jumped around with great agility. (H.)

Nemobius socius Scudder.

An adult female and an immature individual from Tampa, taken January 16 and 17, 1904, represent this species. The adult has the tegmina but slightly longer than the head and pronotum, while the wings are not visible. In all other respects, however, the Tampa female is inseparable from macropterous individuals from Thomasville, Georgia.

Nemobius ambitiosus Scudder.

This beautiful species is represented by three specimens, two males and a nymph, from Miami, taken February 6, 1904, and a pair from Tampa, taken January 16 and 17, 1904.

This species is almost invariably found in dead leaves. (H.)

Nemobius aterrimus Scudder.

This species, originally described from Jacksonville, Florida, is represented by a pair taken at Tampa on January 17, 1904.

Gryllus firmus Scudder.

A single male from Miami represents this species.

Gryllus rubens Scudder.

This species is represented by a series of ten males and sixteen females.

Miami specimens were taken on February 6, 1904, and August 19 and 21, 1903; Tampa specimens on January 16, 1904, and Chokoloskee individuals in April and May, 1903. Several of the specimens are smaller than the usual type and are referred here with a little uncertainty.

The specimens taken on February 6 were all found under boards and stones along the main street of Miami. They were captured after dusk while stridulating at a great rate. (H.)

Gryllodes poeyi (Saussure).

This Antillean species is represented by nine specimens, three adult males, two adult females and four nymphs, from Miami, taken February 6, 7, and 9, 1904. They are inseparable from a series of Cuban and Bahaman individuals, and constitute the first record of the species from the United States.

The first evening in Miami I heard this cricket stridulating in cracks between the bricks of the drive leading to the Hotel Royal Palm. Marking the places, as it was then too dark to investigate, I left them till the next morning. I then was able to raise the bricks and collected several specimens. One specimen was taken stridulating in a crack six feet from the ground between the stones which form the front of the Miami Bank. This insect emits a shrill sound easily distinguished from *Gryllus rubens* by its higher pitch and the longer duration of the stridulations. When exposed it waves its long slender antennæ about continually. (H.)

Cyrtoxipha delicatula Scudder.

A series of eight adult males, seven adult females and a nymph from Key West, taken January 19, 1904, are referred to this species. An adult male and a nymph were also taken at Miami, February 6, 1904. This series does not wholly agree with Scudder's description, taken from two males from Fort Reed and Sand Point, Florida, but as a great amount of variation in the presence of pronotal hairs and considerable in the length of the wings is exhibited by the specimens studied, it is impossible to attempt to separate them. Saussure's *C. gundlachi* is of a quite different appearance.

Key West.—These specimens I beat from *Ilex cassine* with little difficulty. I found no others on any other bushes, and would probably have missed the species in this locality had I not happened to beat this bush. I found it to be the same in the case of *Plectoptera poeyi* and *Liphoplus krugii.*

Miami.—The nymph was beaten from a bush in the "hammock," and the mature specimen was taken at night when beating for *Microcentrum.* (H.)

Hapithus quadratus Scudder.

This species, which has been synonymized with *H. agitator* by both Saussure and Scudder, appears to be quite distinct and really separable from the northern *H. agitator*. The tegmina of the female are somewhat longer and with a more complex venation, while the posterior limbs are longer and distinctly colored, and as far as available material goes the general size appears greater. Two adult females from Miami were taken August 11 and 21, 1903, while two nymphs from the same place were collected on February 6, 1904. One nymph was taken at Key West, January 19, 1904.

Key West.—This specimen was taken, together with *Plectoptera poeyi* and *Liphoplus krugii,* while beating *Ilex cassine.* (H.)

Orocharis saulcyi (Guérin).

This Antillean species, here recorded from the United States for the first time, is represented by two males taken at Miami, one on February 3, the other on August 19, 1903. The very slender form and structure of the tegmina will readily separate this from the other North American species.

The specimen captured on February 3, 1903, was beaten from the high weeds in a waste field. (H.)

Tafalisca[1] **lurida** Walker.

A single female from Chokoloskee represents this species.

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[1] This name was denied recognition by Saussure for lack of significance, but it should replace *Metrypa* Brunner, having five years priority.

SUMMARY OF SPECIES AND LOCALITIES.

	Tampa.	Choko-loskee.	Miami.	Key West.
FORFICULIDÆ.				
Labidura bidens			*	
Anisolabis maritima			*	*
Anisolabis annulipes			*	*
Labia burgessii	*		*	
Labia guttata	*			
BLATTIDÆ.				
Blattella germanica			*	
Blattella adspersicollis			*	
Ceratinoptera lutea				*
Temnopteryx deropeltiformis			*	
Eurycotis floridana	*		*	*
Periplaneta americana	*			
Periplaneta australasiæ	*		*	
Pycnoscelus surinamensis	*		*	*
Plectoptera poeyi				*
MANTIDÆ.				
Stagmomantis carolina			*	*
Gonatista grisea			*	*
Thesprotia graminis	*		*	*
PHASMIDÆ.				
Anisomorpha buprestoides			*	*
ACRIDIDÆ.				
Apotettix minutus			*	
Tettigidea lateralis			*	
Radinotatum brevipenne			*	*
Truxalis brevicornis		*		
Syrbula admirabilis			*	
Macneillia obscura	*		*	
Amblytropidia occidentalis	*	*	*	
Orphulella pratorum			*	*
Dichromorpha viridis	*	*		
Clinocephalus pulcher			*	
Arphia granulata		*	*	*
Chortophaga viridifasciata	*	*	*	*
Dissosteira carolina		*		
Scirtetica picta			*	
Psinidia fenestralis		*	*	
Dictyophorus guttatus		*	*	
Pseudopomala brachyptera		*		
Stenacris chlorizans			*	
Leptysma marginicollis	*	*	*	
Schistocerca americana		*	*	*
Schistocerca damnifica		*	*	
Schistocerca alutacea		*		*
Schistocerca obscura			*	
Melanoplus puer	*		*	
Melanoplus keeleri			*	
Paroxya floridiana		*	*	
Paroxya atlantica	*	*	*	*
Aptenopedes clara	*		*	*
Aptenopedes aptera			*	

	Tampa.	*Choko-loskee.*	*Miami.*	*Key West.*
TETTIGONIDÆ.				
Stilpnochlora marginella		*		
Scudderia cuneata			*	
Scudderia curvicauda			*	
Amblycorypha floridana		*	*	
Microcentrum laurifolium			*	
Microcentrum rostratum			*	
Belocephalus subapterus		*	*	
Pyrgocorypha uncinata		*	*	
Conocephalus mexicanus	*		*	
Conocephalus lyristes		*		
Conocephalus hoplomachus		*		
Conocephalus retusus		*		
Orchelimum vulgare		*		
Orchelimum concinnum		*		
Orchelimum nitidum		*		
Xiphidion gracillimum	*		*	
Xiphidion brevipenne		*		
Atlanticus sp	*		*	
GRYLLIDÆ.				
Mogoplistes slossoni			*	
Liphoplus krugii				*
Liphoplus zebra			*	
Nemobius socius	*			
Nemobius ambitiosus	*		*	
Nemobius aterrimus	*			
Gryllus firmus			*	
Gryllus rubens	*	*	*	
Gryllodes poeyi			*	
Cyrtoxipha delicatula			*	*
Hapithus quadratus			*	*
Orocharis saulcyi			*	
Tafalisca lurida		*		

Explanation of Plate I.

Fig. 1.—*Clinocephalus pulcher* n. sp. Miami, Florida. Male type, lateral view. Twice natural size.

Fig. 2.—*Clinocephalus pulcher* n. sp. Miami, Florida. Male type, dorsal view of head and pronotum. Twice natural size.

Fig. 3.—*Apotettix minutus* n. sp. Miami, Florida. Type, lateral view, twice natural size.

Fig. 4.—*Apotettix minutus* n. sp. Miami, Florida. Type, dorsal view of head and pronotum. Twice natural size.

Fig. 5.—*Amblycorypha floridana* n. sp. Chokoloskee, Florida. Type, lateral view. Natural size.

Fig. 6.—*Microcentrum rostratum* n. sp. Miami, Florida. Type, lateral view. Natural size.

Fig. 7.—*Microcentrum rostratum* n. sp. Miami, Florida. Type, dorsal view of head and pronotum. Natural size.

Fig. 8.—*Conocephalus lyristes* n. sp. Chokoloskee, Florida. Type, dorsal view of head and pronotum. Natural size.

Fig. 9.—*Conocephalus lyristes* n. sp. Chokoloskee, Florida. Type, lateral view. Natural size.

Fig. 10.—*Conocephalus hoplomachus* n. sp. Chokoloskee, Florida. Type, lateral view. Natural size.

Fig. 11.—*Conocephalus hoplomachus* n. sp. Chokoloskee, Florida. Type, dorsal view of head and pronotum. Natural size.

Fig. 12.—*Liphoplus zebra* n. sp. Miami, Florida. Type, dorsal view. Twice natural size.

NEW, RARE OR LITTLE-KNOWN SCOMBROIDS. No. II.

BY HENRY W. FOWLER.

CARANGIDÆ.

SCOMBEROIDINÆ.

SCOMBEROIDES Lacépède.

Hist. Nat. Poiss., III, 1802, p. 50 (*noelii*).

Dorsal spines I, VII. Pterygoid teeth present.

Subgenus SCOMBEROIDES Lacépède.

Scales shorter, not very elongate, or more normally developed.

Scomberoides toloo (Cuvier).

Chorinemus toloo Cuvier, Hist. Nat. Poiss., VIII, 1831, p. 277. Malabar. (M. Bélenger.) (Based on *Toloo parah* Russell, Fishes of Coromandel, II, 1803, p. 29, Pl. 137. Vizagapatam.)

Head $4\frac{3}{4}$; depth $3\frac{1}{6}$; D. I, VII–I, 20; A. II–I, 18; P. II, 15; V. I. 5; width of head $2\frac{2}{5}$ in its length; depth of head $1\frac{1}{5}$; mandible $1\frac{3}{5}$; fifth dorsal spine $5\frac{1}{5}$; first dorsal ray $1\frac{3}{7}$; first anal spine $4\frac{1}{4}$; least depth of caudal peduncle $4\frac{1}{6}$; pectoral $1\frac{1}{2}$; ventral 2; snout $3\frac{4}{5}$, from tip of upper jaw; eye 4; maxillary $1\frac{2}{3}$. Gill-rakers 3+9, compressed, pointed, and with fine bristles on inner edges. Longest about $\frac{2}{3}$ of longest filaments. Longest filaments about $\frac{3}{4}$ of orbit. Color when fresh in arrack slaty-gray above, sides and lower surface silvery-white. Top of head, snout, and upper marginal portion of back grayish. On sides a little above, about six daubs or blotches of grayish. Soft dorsal dull or pale yellowish-white on basal portion, upper part grayish. Ventral and anal similar. Axil of pectoral dusky. Iris pale yellowish. Peritoneum whitish. Length 13 inches. Four examples, one now in Stanford University. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

Scomberoides moluccensis (Gray).

Thynnus moluccensis Gray, Cat. Fish Gronow Brit. Mus., 1854, p. 121. Insulas Moluccenses. (British Museum.)

Chorinemus sancti petri Bleeker, Verh. Bat. Genoot. (Bijd. Makreel. Vissch. Soend. Moluk. Arch.), XXIV, 1852, p. 45.——Günther, Cat. Fish. Brit. Mus., II, 1860, p. 473.——Günther, Journ. Mus. Godef. (Fische der Südsee), V, 1876, p. 138. (Part. Not of Cuvier.)

Head $4\frac{1}{3}$; depth $3\frac{1}{2}$; D. I, VII–I, 20; A. II–I, 18; P. II, 16; V. I, 5;

width of head $2\frac{1}{2}$ in its length; depth of head $1\frac{1}{3}$; mandible $1\frac{1}{2}$; first dorsal ray about 2; first anal ray about $2\frac{1}{5}$; upper caudal lobe $1\frac{1}{4}$; pectoral $1\frac{2}{3}$; ventral $1\frac{5}{6}$; snout $3\frac{3}{4}$ in head, measured from its tip; eye 4; maxillary $1\frac{4}{5}$; interorbital space $3\frac{1}{2}$; least depth of caudal peduncle $4\frac{3}{5}$; sixth dorsal spine 4.

Body rather elongate, somewhat oblong-ovate, strongly compressed, and greatest depth about opposite origin of soft dorsal. Profiles nearly straight after origins of soft dorsal and anal. Caudal peduncle slender, compressed, and its least depth about half of its length.

Head rather small, compressed, upper profile but little inclined, and nearly straight till a little before spinous dorsal. Lower profile rather convex from tip of mandible. Snout rather short, a trifle longer than eye, rather narrow, convex, and tip of upper jaw rather pointed.

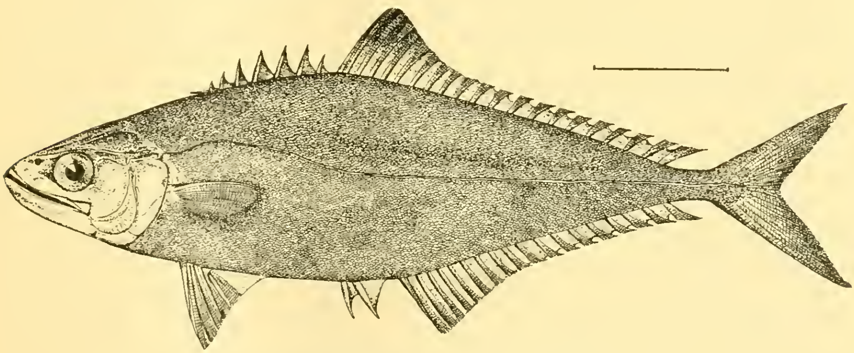

Fig. 1.—*Scomberoides moluccensis* (Gray).

Eye circular, lower rim well below in greatest depth, and posterior rim a little posterior in length of head. Mouth large, gape reaching about opposite front rim of pupil, and tip of mandible produced a little in front beyond tip of upper jaw. Preorbital narrow. Maxillary long, narrow, its distal expanded extremity equal to about $\frac{2}{3}$ of pupil, and reaching about opposite first $\frac{3}{5}$ of orbit. Mandible curved up a little in front. Teeth small, strong, and a single series of rather enlarged ones in upper jaw, especially in front. Front of upper jaw with patch of fine teeth inside and along edges, but narrowing posteriorly. Teeth biserial in mandible, those of outer series very small, close together, and directed outwards. Teeth of outer series of upper jaw fitting in between the two mandibular series when mouth is closed. Four slightly enlarged canine-like teeth in front of lower jaw in inner series. Patches of small teeth on vomer, palatines and pterygoids, that of former without backward elongation. Tongue small, a little elongate, rounded, and free in front. Tongue and basibranchials with fine asperous patches. Nostrils adjoining, level with upper part of iris, posterior a little larger, and without flap in front. Interorbital space elevated and a median trenchant keel extending from internasal space to spinous dorsal.

Gill-opening extending forward a trifle before front rim of orbit. Rakers 9+16, slender, compressed, pointed, and longest equal to filaments which are about $\frac{2}{5}$ of orbit. Pseudobranchiæ small. Isthmus strongly compressed but its edge rounded.

Scales small, elongate, not narrowly so, and not on head and fins, except base of caudal. Lateral line a little wavy at first, becoming straight after origin of soft anal. Axillary cavities at bases of pectoral and ventral. Each dorsal and anal spine depressible in a groove.

First dorsal spine directed forward, and its tip about opposite first third of pectoral. Of depressible spines fifth and sixth longest, and seventh a little shorter than fourth. When depressed spines overlap. Soft dorsal inserted a little nearer snout than base of caudal, first few rays longest, and about last eleven finlet-like though joined by a membrane. Soft anal inserted behind origin of soft dorsal and fin similar. Caudal forked, lobes pointed, and rather slender. Spinous anal inserted well beyond tip of pectoral, second spine longest and reaching origin of rayed fin. Pectoral broad, short, and origin of fin a little below middle of depth. Ventral large, inserted opposite origin of pectoral. First ray reaching about $\frac{2}{3}$ of space to spinous anal, and innermost joined to abdomen by a membrane. Spine slender and a little over half of length of fin.

Color in alcohol pale brownish-drab-gray above, side and lower surface silvery-white. Side of head silvery. Fins pale straw-brownish, ends of caudal lobes a little darker, and upper portions of soft dorsal rays deep brownish-black. Ventral and anal whitish. No blotches apparent on side of trunk. Iris pale brassy. Peritoneum whitish.

Length $6\frac{1}{4}$ inches.

No. 11,328, A. N. S. P. One example from Christmas Island, lat. 1° 59′ N., long. 157° 32′ W., Polynesia. Dr. William H. Jones.

One from Manila, Philippine Islands, from Dr. M. Burrough, differs a little as follows: Head $4\frac{1}{2}$; depth $3\frac{3}{7}$; width of head $2\frac{2}{5}$ in its length; depth of head $1\frac{2}{3}$; mandible $1\frac{3}{5}$; pectoral $1\frac{1}{2}$; ventral about 2; snout $3\frac{1}{2}$ in head, measured from tip of upper jaw. Maxillary reaching a little nearer posterior rim of orbit. Length $6\frac{1}{8}$ inches.

Also two examples, probably from Polynesia. They agree in most all details. One is very young, measuring $2\frac{1}{2}$ inches. It has: Head $3\frac{1}{2}$; depth $3\frac{2}{5}$. Body strongly compressed, and of more fusiform profile. Spines large, fifth longest. Second anal spine reaching past origin of soft anal fin which is inserted a little behind that of soft dorsal. Ventral equally as long as pectoral, and reaching a little beyond anus, but not quite to origin of spinous anal. Pectoral broad.

Scomberoides toloo-parah (Rüppell)[1] from the Red Sea needs comparison. The synonomies of the species of *Scomberoides* appear to have been greatly confused. Gray's *moluccensis* seems to be the oldest name available for the East Indian form, with which I also identify that from Polynesia.

RHAPHIOLEPIS subgen. nov.

Type *Chorinemus tol* Cuvier.

Scales elongate and slender. Approaching *Oligoplites*.

(Ῥάφιον, a small needle; λεπίς, a scale.)

Scomberoides tol (Cuvier).

Chorinemus tol Cuvier, Hist. Nat. Poiss., VIII, 1831, p. 283. Pondichéry. (M. Leschenault.) La côte de Malabar. (MM. Dussumier et Bélenger.) Amboine. Ile de Bourou. (MM. Quoy and Gaimard.) (Probably not *Tol parah* Russell.)

Head $4\frac{3}{4}$; depth 4; D. I, VII–I, 20; A. II–I, 19; P. II, 15; V. I, 5; width of head $2\frac{1}{3}$ in its length; depth of head $1\frac{2}{5}$; least depth of caudal peduncle 5; pectoral $1\frac{14}{15}$; ventral 2; snout $3\frac{1}{2}$, from its tip; eye $4\frac{2}{3}$; maxillary 2; interorbital space $3\frac{2}{3}$. Gill-rakers 8+18, compressed, slender, pointed, with minute bristles on their inner surfaces and longest nearly equal to longest filaments. Color when fresh in arrack rich slaty-gray above, deep or blackish along profile of back, and a deep blackish streak above eye along side of head above till over base of pectoral. Sides of body and lower surface silvery-white with about five distinct pale gray blotches anteriorly. Spinous dorsal gray-black. Soft dorsal dull or pale yellowish-white, except upper or outer portions of anterior rays which are black. Caudal grayish. Anal, pectoral and ventral whitish. Axil of pectoral blackish. Iris pale yellowish. Peritoneum pale or whitish. Length 9 inches. One example from Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

Russell's poor figure[2] cannot be certainly identified with this species.

Oligoplites saurus (Schneider).

Scomber saurus Schneider, Syst. Ichth. Bloch, 1801, p. 32. Jamaica. (Based on Browne.)

Fort Macon (North Carolina), Key West (Florida). Young exam-

[1] *Lichia toloo-parah* Cuvier, in Rüppell, *Atlas zu der Reise im nördlichen Afrika*, Zool., 1828, p. 91. Massaua.

[2] *Tol parah* Russell, *Fishes of Coromandel*, II, 1803, Pl. 138.

ples from Porto Rico (Coll. U. S. Fish Com.) about $4\frac{1}{2}$ inches long are more slender, the depth usually about $3\frac{7}{8}$, and the maxillary falling a little short of posterior margin of eye. At present, in alcohol, the iris is dilute silvery-white. The colored figure given by Messrs. Evermann and Marsh[3] unfortunately lacks the spinous dorsal and anal fins.

Oligoplites saliens (Bloch).

Scomber saliens Bloch, Naturg. Ausl. Fisch., VII (X), 1793, p. 49, Pl. 335. Bey den antillischen Inseln.

Head $4\frac{4}{5}$; depth $3\frac{2}{5}$; D. I, IV–I, 20; A. II–I, 20; P. III, 14; V. I, 5; width of head about $2\frac{1}{10}$ in its length; depth of head over posterior margin of eye $1\frac{1}{5}$; mandible $1\frac{4}{7}$; second articulated dorsal ray $1\frac{1}{2}$; first articulated anal ray $1\frac{3}{4}$; pectoral $1\frac{1}{3}$; ventral $2\frac{3}{7}$; snout $3\frac{4}{5}$ in head, measured from its own tip; eye 4; maxillary $1\frac{1}{7}$; interorbital space 4;

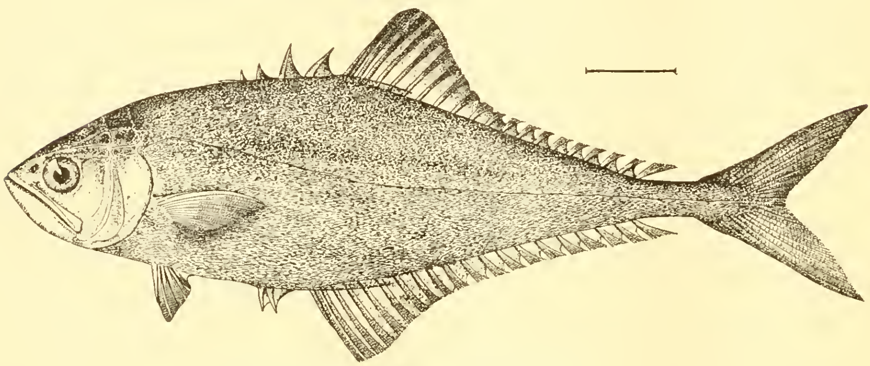

Fig. 2.—*Oligoplites saliens* (Bloch).

last dorsal spine 4; second anal spine $4\frac{3}{4}$; least depth of caudal peduncle $4\frac{2}{5}$.

Body deep, compressed, oblong-ovoid, and greatest depth at origin of rayed anal. Profiles similar, more or less straight to caudal peduncle after origins of soft dorsal and anal. Caudal peduncle rather slender, compressed, and its least depth about $2\frac{1}{6}$ in length.

Head deep, compressed, upper profile nearly straight, and lower about evenly convex from tip of mandible to gill-opening. Snout short, convex, a little broad, and upper jaw a little pointed in front. Eye circular, lower rim a little below greatest depth and posterior rim about midway in head. Mouth large, gape reaching about opposite middle of orbit, and tip of mandible produced a little beyond tip of upper jaw. Preorbital narrow. Maxillary long, narrow, its distal expanded ex-

[3] *Bull. U. S. Fish Comm.* (Fish. Porto Rico), 1899 (1900), Pl. 7.

tremity equal to about $\frac{2}{3}$ of pupil, much inclined and reaching well beyond posterior margin of orbit. Teeth small, strong, somewhat slender, pointed, uniserial in upper jaw and biserial in lower. Outer series of mandible directed somewhat outward so that those of upper fit in between. Patches of minute teeth on vomer and palatines, none on pterygoids. Patch on vomer more or less rounded in shape and without backward prolongation like that in *O. saurus*. Palatine teeth in form of broader patches anteriorly, becoming very narrow posteriorly. Tongue small, broad, rounded, and free in front, its upper surface asperous. Surfaces of basibranchials also asperous. Nostrils adjoining, nearly opposite middle of eye, and also a little nearer same than tip of snout. Posterior a little larger and partly concealed in front by a small flap along edge of anterior. Interorbital space elevated convexly, and with a median trenchant keel extending from internasal space to occiput. Region before spinous dorsal also trenchant.

Gill-opening extending forward about opposite nostrils. Rakers about 7+16, slender, and longest a trifle shorter than filaments which are nearly equal to $\frac{3}{4}$ of orbit. Pseudobranchiæ small. Isthmus strongly compressed but edge rounded.

Scales elongate, slender, pointed, and irregularly directed backward. Lateral line curved or wavy at first, becoming somewhat straight along side of trunk opposite rayed dorsal and anal. An axillary cavity at base of pectoral covered over above by a membrane. A similar one at base of ventral. Each spine of dorsal and anal depressible in a deep groove. Head entirely naked.

First dorsal spine directed forward, its tip about opposite middle of pectoral. Dorsal spines separate, each one posteriorly united with back by a membrane, and all graduated to last which is longest. Soft dorsal inserted well behind origin of soft anal, nearly midway between front margin of orbit and base of last dorsal ray. Anterior rays elongate, forming a small lobe, and about last ten finlet-like though united by a membrane. Soft anal similar, inserted about midway between tip of mandible and base of last anal ray. Spinous anal inserted about opposite tip of pectoral, spines nearly equal, united posteriorly with abdomen by a low membrane, also depressible in a groove, and not quite reaching origin of anal when depressed. Caudal moderate, deeply forked, and lobes somewhat slender. Pectoral short, broad, and its insertion nearly level above with lower rim of orbit. Ventral inserted a trifle in advance, inner ray joined to abdomen by a membrane, and depressed fin reaching a little over half way to origin of spinous anal. Ventral spine about half length of fin. Anus a little nearer tip of depressed ventral than origin of spinous anal.

Color in alcohol dull brown above, pale or whitish below. Body over most all of lower region washed with silvery-white. This also includes mandible and side of head. Fins pale straw-brown, ventral and anal paler or whiter. Iris pale brassy. Peritoneum pale.

Length $9\frac{3}{4}$ inches.

No. 11,334, A. N. S. P. One example from Rio Janeiro, Brazil. Drs. Ruschenberger and Turner.

This little-known form is well marked and easily distinguished from *O. saurus* by the longer maxillary and shape of the patch of vomerine teeth. The form called *palometa* is said to have the posterior margin of the infraorbital ring deeply concave. This is not true of my example, as it has the posterior rim of the infraorbital nearly vertical.

SERIOLINÆ.

Naucrates ductor (Linnæus).

Gasterosteus ductor Linnæus, Syst. Nat., Ed. X, 1758, p. 295. In Pelago, Satelles Squali.

Naucrates ductor Bonaparte, Cat. Met. Pesc. Europ., Napoli, 1846, p. 72.

Two examples $11\frac{5}{8}$ and $11\frac{3}{8}$ inches in length from the Mediterranean show the following: Head about 4; depth $4\frac{1}{8}$ to $4\frac{1}{6}$; D. III–I, 25 and 26; A. II–I, 16; eye $5\frac{5}{6}$ in head; maxillary 3; interorbital space $2\frac{3}{4}$ and $2\frac{4}{5}$; pectoral about $1\frac{2}{3}$; ventral $1\frac{2}{5}$ and $1\frac{2}{3}$. Bonaparte Coll. Also seven examples from the West Indies, ranging up to $4\frac{3}{8}$ inches in length. The latter has: Head $3\frac{3}{5}$; depth $4\frac{1}{3}$; D. IV–I, 26; A. II–I, 15; eye 5 in head; maxillary 3; interorbital space $2\frac{9}{10}$; pectoral $1\frac{7}{8}$; ventral $1\frac{4}{5}$. The others all more or less agree except that they become shorter and the ventrals of the smaller examples reach the anus. It is $2\frac{3}{16}$ inches in length and bears evidence of the *Xystophorus* stage in the presence of preopercular spines. The largest example noted above agrees perfectly with the large Mediterranean examples in the posterior position of the vent and the slender form of the body. The scales are decidedly small, and approximate about 175 in a lateral series below the lateral line to the base of the caudal.

Naucrates polysarcus sp. nov.

Head $3\frac{3}{4}$; depth $3\frac{1}{4}$; D. V–I, 25; A. II–I, 16; P. III, 16; V. I, 5; scales about 120 in a series directly below lateral line to base of caudal; 17? scales between origin of spinous dorsal and lateral line, and about 27? in a vertical series between latter and origin of soft anal; width of head $1\frac{3}{4}$ in its length; depth of head $1\frac{1}{3}$; snout $3\frac{1}{2}$; eye 5; maxillary 3; interorbital space $2\frac{7}{8}$; mandible $2\frac{4}{7}$; second dorsal ray about $2\frac{1}{6}$; least depth of caudal peduncle about 5; first anal ray about $2\frac{1}{2}$; pectoral (damaged) $1\frac{3}{4}$; ventral $1\frac{2}{3}$.

Body plump, robust, compressed, and greatest depth about origin of soft dorsal. Back about latter a trifle elevated. Caudal peduncle rather thick, depressed above and below, and its least depth about $\frac{2}{5}$ its length.

Head robust, plump, compressed, upper profile obtuse in front and convex. Snout broad, convex, and obtuse. Eye circular, not high, and its posterior margin well anterior to middle of length of head. Adipose eyelid not broad. Mouth rather small, and small mandible not produced beyond tip of upper jaw. Maxillary small, reaching front margin of pupil, slipping below preorbital most of its length, and distal expanded extremity equal to diameter of pupil. Teeth fine, small, and in narrow bands in jaws. Vomer and palatines with similar teeth, those on former forming a backward elongation. Tongue rather

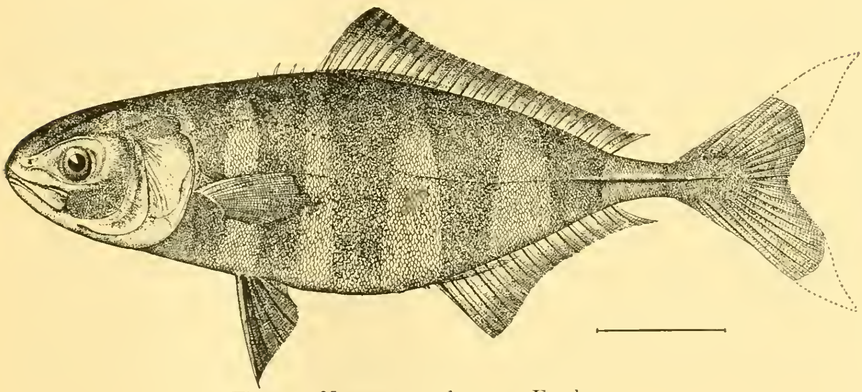

Fig. 3.—*Naucrates polysarcus* Fowler.

small, spatulate, free, and with a small asperous patch. Nostrils adjoining, level with upper part of pupil, but a little nearer tip of snout. Posterior with a cutaneous valve in front. Interorbital space broadly convex.

Gill-opening extending forward about opposite front rim of orbit. Rakers 6 + 16, compressed, pointed, longest about $\frac{3}{5}$ of orbit or about $\frac{2}{3}$ of longest filaments. Pseudobranchiæ well developed. Isthmus broad and with a median groove.

Scales small, cycloid, and of more or less even size. Cheeks, postocular, supraocular, mastoid, and occipital regions covered with small scales, head otherwise naked. Postocular scales elongate. Opercles striate. A patch of small scales extending along bases of soft dorsal and anal in front. Base and basal region of caudal lobes also covered with small scales. Base of inner ventral ray scaled anteriorly. Lateral line well curved convexly below origin of spinous dorsal, then descending rather steeply till about opposite first third in base of dorsal fin and continuing thence straight to base of caudal. Cutaneous keel along side of caudal peduncle not conspicuous. Tubes of lateral line simple.

Dorsal spines low, third longest and others graduated down. Origin of this fin nearly midway between middle of orbit and origin of soft anal in vertical. Soft dorsal inserted a little nearer tip of snout than base of last dorsal ray, and first ray longest, others graduated down though no lobe is formed. Soft anal similar, inserted far behind anal or about midway between origin of ventral and base of last anal ray. Caudal rather small, forked, and lobes apparently pointed. Pectoral broad, short, origin about level with lower margin of eye. Ventral long, pointed, inserted below bases of lowest or last pectoral rays, and reaching $\frac{2}{3}$ of space to origin of spinous anal. Ventral spine small and thin, and last ray united to abdomen by a membrane. Anus midway between tip of depressed ventral and origin of spinous anal.

Color in alcohol deep brown, back and upper surface darker. Lower surface pale brownish. Fins brownish. Pectoral deep brown. Ventrals with front margins of spine and rays light or pale, rest of fin more or less dusky or dull blackish-brown. Side with five broad deep brown transverse bands, rather regular, and spaces between much narrower. First band extends from space just before spinous dorsal down to side of chest including base of pectoral in its course. Second extends from spinous dorsal. Third extends from bases of anterior long dorsal rays toward vent and tip of ventrals. Fourth extends down on bases of long anterior anal rays. Fifth includes last rays of both dorsal and anal. Base of caudal also of same color. Transverse bands also become paler or more or less fade out below. Iris dull yellowish. Peritoneum pale.

Length (caudal damaged) $6\frac{3}{8}$ inches.

Type No. 11,379, A. N. S. P. West coast of Mexico. Dr. William H. Jones. One example.

This species is provisionally separated from *Naucrates ductor* by the more robust or deeper form of the body, the ventrals reaching back till the front margin of the vent is midway between in the space to the origin of the spinous anal, and the much larger scales.

Dr. Gill first pointed out the differences between this form and *N. ductor,* basing the examination apparently on one of the examples in the Bonaparte collection, now before me, and an example from Honolulu, Hawaiian Islands, sent to the Smithsonian Institution by the Rev. W. H. Pease.[4] From his account the latter example appears identical with my type.

(*Πολύσαρκος*, plump.)

Elagatis bipinnulatus (Quoy and Gaimard).

Seriola bipinnulata Quoy and Gaimard, Voyage de l'Uranie, Zool., 1825, p. 363, Pl. 61, fig. 3. Îsles des Papous. (M. Taunay.)

Head 4; depth $5\frac{1}{6}$; D. VI–I, 24, 2; A. I, 16, 2; P. III, 16; V. I, 5; scales about 105 in a lateral series to base of caudal; about 12 between origin of dorsal and lateral line; width of head 2 in its length; depth of head $1\frac{3}{5}$; mandible $2\frac{1}{4}$; third dorsal spine $5\frac{1}{2}$; base of spinous dorsal $2\frac{3}{4}$; spine of soft dorsal $4\frac{3}{5}$; first undeveloped dorsal ray $2\frac{3}{5}$; anal spine $7\frac{1}{4}$; first anal ray $3\frac{2}{3}$; least depth of caudal peduncle 5; pectoral $1\frac{7}{8}$; ventral 2; snout $2\frac{3}{5}$, from its tip; eye 6; maxillary 3; interorbital space $2\frac{9}{10}$.

Body elongate, fusiform, slender, and compressed, greatest depth near origin of soft dorsal. Caudal peduncle small, compressed, and its width $1\frac{2}{5}$ in its depth. Tail sloping down gradually. A small pit at origin of each caudal lobe.

Head elongate, subconic, compressed, pointed, and upper profile almost straight from end of snout to occiput. Snout long, pointed, rather broad, and with upper jaw projecting. Eye small, with narrow eyelid, and midway in length of head. Mouth small, slightly curved, and with mandible projecting beyond upper jaw. Maxillary broad posteriorly till equal to $\frac{2}{3}$ of eye, its entire edge slipping under preorbital, and reaching posteriorly half way between nostrils and front of orbit. Lips thick and fleshy, especially lower. Teeth in fine rasp-like bands in jaws, broader anteriorly, but not connected at symphysis or front of upper jaw. Vomer and palatines with patches of fine teeth. Tongue long, free, rather thin, upper surface with numerous small velvety patches, and tip broadly rounded. Nostrils small, lateral, together, and near last third of space between tip of snout and front of eye. Interorbital space broad, and elevated. A broad median ridge from snout to occiput, and also a broad ridge over each eye. Margin of preopercle entire.

Gill-opening extending forward till opposite nostrils. Rakers 9+26, compressed, long, with fine bristles on inner edges, and longest but little shorter than longest filaments. Filaments a little shorter than eye, and pseudobranchiæ about half as long as latter. Branchiostegals 7, large. Isthmus broad, with a shallow groove.

[4] *Proc. Acad. Nat. Sci. Phila.*, 1862 (1863), p. 441.

Scales small, numerous, irregularly rounded, generally elongate, with imperfect striæ, and not imbricated. Head more or less naked, except on cheeks, occiput, and space back of eyes. Bases of anterior long dorsal and anal rays scaly. Base of caudal scaly. Base of pectoral with minute scales. Lateral line superior at first, extending down to middle of side of tail opposite origin of anal, and then straight to base of caudal.

Dorsal spines small, pungent, third longest and others graduated in front and behind, all depressible in a groove. Insertion of spinous dorsal about over last fifth of pectoral, or nearly midway between front margin of eye and origin of anal. Origin of soft dorsal nearer tip of mandible than base of caudal, first ray highest, and others graduated. Last two rays detached. Anal similar, but smaller, and its origin nearer gill-opening than base of caudal. Caudal deeply forked, lobes long pointed and lower about $3\frac{1}{2}$ in body. Pectoral small, a little larger than ventral, and not reaching as far posteriorly. Origin of ventral a little nearer posterior margin of eye than origin of soft dorsal, rays strong, and reaching half way to anus. Anus about an eye-diameter before origin of anal.

Color when fresh in arrack deep leaden-gray or brownish above, lower parts pale or dirty white. Dorsals and caudal dark like back. Anals pale or whitish, last rays with a grayish margin. Pectoral and ventral grayish, latter with white rays. Lateral line forms a median dark streak along side of caudal peduncle. Iris pale brown. Peritoneum white.

Length $23\frac{5}{8}$ inches.

No. 25,130, A. N. S. P. Padang, Sumatra. One example. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

The American form[5] needs comparison. It has been considered identical by Lütken,[6] Meek[7] and Bollman.

CARANGINÆ.

Megalaspis cordyla (Linnæus).

Scomber cordyla Linnæus, Syst. Nat., Ed. X, 1758, p. 298. "America."
Megalaspis rottleri Fowler, Journ. Acad. Nat. Sci. Phila., XII (2), 1904, p. 506.

Head 4; depth $4\frac{1}{5}$; D. VIII–I, 11, 8; A. II–I, 9, 7; scales 28 in lateral line, and scutes about 60 to base of caudal; snout $3\frac{3}{4}$ in head,

[5] *Seriola pinnulata* Poey, *Mem. Hist. Nat. Cuba*, II, 1858, p. 233. Cuba.
[6] *Seriolichthys bipinnulatus* Lütken, *Kon. Dansk. Vid. Selsk. Skrift.* (*Spolia Atlantica*), XII, 1880, p. 603.
[7] *Proc. Acad. Nat. Sci. Phila.*, 1889, p. 42.

from its tip; eye 5; maxillary $2\frac{1}{2}$; interorbital space $3\frac{1}{3}$. Gill-rakers 11+21, long, compressed, and with fine bristles on inner margin. Color when fresh in arrack deep steel-gray on back, side and lower surface of body white. Latter, and especially sides of head and large scutes of lateral line, burnished with bright silvery. Top of head blackish. Upper margin of opercle with a blackish blotch a little smaller than eye. Dorsal, caudal and pectoral grayish, or dusky-black. Anal and ventral chalky-white, outer portions more or less dusky or blackish. After being in alcohol upper surface shows a dark purplish-metallic luster. Length $12\frac{1}{2}$ inches. Four examples in Acad. Nat. Sci. Phila. and Stanford University. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

Decapterus punctatus (Agassiz).

Caranx punctatus Agassiz, Sel. Gen. Spec. Pisc. Brasil., 1829, p. 108, Pl. 56*a*, fig. 2. Oceano Atlantico [Brazil]. (Museo Monacensi.)
Decapterus sanctæ-helenæ Fowler, Proc. Acad. Nat. Sci. Phila., 1899 (1900), p. 118. (Not of Cuvier.)

The three examples that I recorded from Jamaica appear to belong to this species. The largest, $4\frac{1}{8}$ inches in length, agrees with the others. It has: Head $3\frac{3}{5}$; depth 5; D. VIII–I, 31, 1; A. II–I, 27, 1; P. II, 18; V. I, 5; scales 55 in lateral line to first keeled scute; keeled scutes 37 in lateral line. Also three examples from the stomach of a horse mackerel (*Pelamys*?) taken at Newport, Rhode Island, by Samuel Powel. The largest of these only measures $4\frac{1}{4}$ inches. It has: Head $3\frac{3}{4}$; D. VIII–I, 31, 1; A. II–I, 26, 1; and keeled scutes 38 in lateral line. So far as I am able to judge they agree with the Jamaican examples.

Trachurus symmetricus (Ayres).

Caranx symmetricus Ayres, Proc. Cal. Acad. Nat. Sci., I, 1855, p. 62. Bay of San Francisco.

A single example from San Pedro, California.

Seriola picturata Bowdich[8] is represented by a miserable figure and does not appear certainly identifiable with the form on the Pacific coast of the United States. *Caranx cuvieri* Lowe[9] is also an Atlantic form.

Trachurus mediterraneus (Steindachner).

Caranx trachurus var. *mediterranea* Steindachner, Sitz. Ak. Wiss. Wien, LVII, 1868, p. 383. Das Mittelmeer. (Wiener Museum.)
Caranx trachurus Bonaparte, Cat. Met. Pesc. Europ., Napoli, 1846, p. 75. (Part.)

Head $3\frac{3}{4}$; depth 5; D. I, VIII–I, 32; A. II–I, 28; P. II, 20; V. I, 5; scutes in lateral line 41+41 (82) to base of caudal; width of head $2\frac{1}{3}$ in

[8] *Excursions in Madeira and Porto Santo*, 1825, p. 123, fig. 27.
[9] *Trans. Zool. Soc. Lond.*, II, 1837, p. 183.

its length; depth of head $1\frac{3}{7}$; mandible 2; fourth erect dorsal spine 2; snout 3 in head, measured from its own tip; maxillary $2\frac{1}{2}$; orbit $3\frac{1}{2}$; interorbital space $4\frac{1}{4}$; ventral 2; least depth of caudal peduncle 7; depth of largest keeled scute in lateral line 5.

Body elongate, slender, fusiform, greatest depth apparently near origin of soft dorsal, and profiles similar. Least depth of caudal peduncle nearly $\frac{1}{3}$ its length.

Head compressed, lower profile more full and steeper than upper. Snout long, compressed, and with a slight convex protrusion in front. Eye large, orbicular, with a well-developed adipose eyelid covering at least its posterior $\frac{2}{5}$, circular, high, and a little anterior in head. Mouth a little inclined, and mandible well protruded in front of upper jaw. Upper edge of maxillary entirely slipping under edge of preorbital,

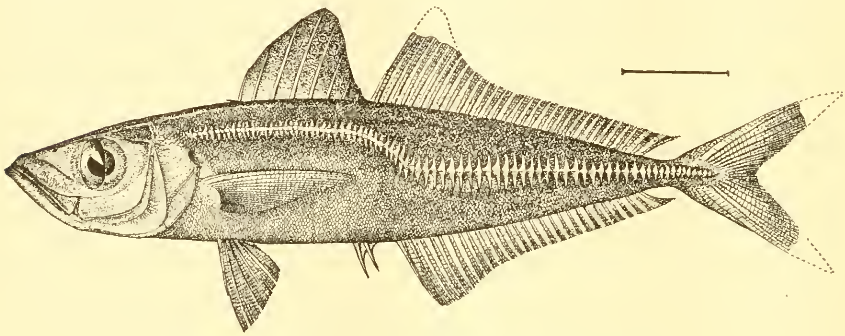

Fig. 4.—*Trachurus mediterraneus* (Steindachner).

reaching about opposite front margin of eye, and its distal expanded extremity about equal to pupil. Small teeth uniserial in jaws. A small series of teeth across vomer and also a single series on each palatine. Tongue elongate, slender, free, rounded at tip and with a single asperous median patch posteriorly. Nostrils adjoining, and much nearer upper front rim of orbit than tip of snout. Interorbital space a little elevated and with a median keel from internasal space to occiput.

Gill-opening extending forward not quite to nostril. Rakers 16 + 38? slender, equal to $\frac{2}{3}$ of orbit. Filaments only about $\frac{3}{5}$ length of longest rakers. Pseudobranchiæ a little smaller. Isthmus compressed, its lower surface with a median groove.

Scales small, extending well on head posteriorly, cheek, and opercle at least above. No scales now on anterior bases of rayed dorsal and anal. A large scaly flap behind axil of pectoral. Scutes in lateral line broadest along middle of keeled straight portion, those along side of caudal peduncle become more strongly keeled and dentate. Spinous dorsal and anal depressible in grooves.

Spinous dorsal inserted nearly midway between front margin of orbit and origin of soft anal in vertical. Third erect spine longest, others graduated down. Soft dorsal inserted about midway in length of trunk, and first rays longest. Spinous anal inserted a trifle before origin of soft dorsal, spines nearly equal. Soft anal similar to soft dorsal, only inserted more posteriorly. Caudal rather small, forked, and lobes apparently pointed. Pectoral rather long. Ventral inserted well behind pectoral and reaching a trifle over $\frac{2}{3}$ of space to origin of spinous anal.

Color in alcohol faded pale dull slaty-gray above, below pale brownish-white. Fins dull brown. Iris pale yellowish.

Length (end of caudal damaged) $7\frac{1}{2}$ inches.

No. 11,293, A. N. S. P. Beirut, Syria. One example.

It also agrees with twenty-one examples from Italy, of all ages. Bonaparte Coll. (No. 377). Dr. T. B. Wilson. One also from Malaga.

Dr. Steindachner first pointed out this form, basing it on Mediterranean examples with an increased number of scutes in the lateral line, 79–86. *T. trachurus* is said to have 70–75.

Trachurops crumenophthalmus (Bloch).

Scomber crumenophthalmus Bloch, Naturg. Ausl. Fisch., VII (X), 1793, p. 77, Pl. 343. An den afrikanischen Küsten, in der Gegend von Acara. (Dr. Isert.)

St. Thomas (West Indies), San Domingo (West Indies), New Providence (Bahamas), Santa Cruz (West Indies), and Newport (Rhode Island). Examples from the Pacific do not appear different. An example from Panama (Coll. J. A. McNeil) has: Head 3; depth $3\frac{2}{5}$; D. I, VIII–I, 26; A. II–I, 23; scales in lateral line 48, and remaining keeled scutes 33 (81); pectoral $1\frac{1}{6}$ in head; snout $3\frac{3}{4}$ in head, measured from tip of upper jaw; eye 3; maxillary $2\frac{1}{6}$; length $9\frac{3}{8}$ inches. Another example from Samoa differs in: Head $3\frac{1}{4}$; depth $3\frac{7}{8}$; A. II–I, 22; 54 scales in lateral line, and remaining keeled scutes 35 (89); eye $3\frac{1}{2}$ in head, measured from tip of upper jaw; snout $3\frac{1}{2}$; maxillary $2\frac{2}{7}$; length $7\frac{7}{8}$ inches. Smaller Hawaiian examples[10] differ in minor details.

I provisionally follow Dr. Günther in identifying all these examples with Bloch's *crumenophthalmus*, though possibly exhaustive material may prove different.

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[10] Recorded previously from Samoan and Hawaiian Islands (*Proc. Acad. Nat. Sci. Phila.*, 1900, p. 501).

Subgenus ALEPES Swainson.

Scales small. No vomerine or palatine teeth.

Alepes melanoptera Swainson.

Lardner's Cab. Cyclop. Nat. Hist., II, 1839, p. 248. (Based on *Wori parah* Russell, Fishes of Coromandel, II, 1803, p. 40, Pl. 155. Vizagapatam.)

Head $3\frac{1}{4}$; depth $2\frac{1}{2}$; D. I, VIII–I, 24; A. II, I, 20; P. II, 18; V. I, 5; scales 38 in lateral line, remaining portion composed of 55 scutes; about 15 scales between spinous dorsal and uppermost part of lateral line; width of head $2\frac{2}{5}$ in its length; depth of head $1\frac{1}{6}$; mandible $2\frac{1}{3}$; fourth dorsal spine 3; second dorsal ray 2; second anal ray $2\frac{1}{3}$; pectoral $1\frac{1}{9}$; least depth of caudal peduncle $5\frac{1}{2}$; snout $3\frac{1}{2}$ in head, from its tip; eye $3\frac{2}{3}$; interorbital space 3; maxillary $2\frac{2}{3}$.

Body moderately long, compressed, anterior profiles about evenly convex, and greatest depth at origin of soft dorsal. Caudal peduncle slender, compressed above and below, its least depth $1\frac{3}{4}$ in its length, and width a trifle less than its depth.

Head compressed, deep, and anterior profile obtuse. Snout convex, blunt, with upper jaw projecting. Eye small, anterior, and with a rather narrow adipose eyelid. Mouth small, oblique, upper jaw projecting beyond snout, and small maxillary reaching a little beyond front rim of orbit. Posterior distal expanded extremity of maxillary nearly equal to $\frac{1}{3}$ of orbit. Preorbital thin, and upper edge of maxillary slipping below all but a small portion posteriorly. Teeth minute, uniserial, and close together along edges of jaws. Vomer and palatines edentulous. Tongue with minute weak asperities, its own shape elongate, free and rounded in front. Lips thin. Nostrils close together, lateral, much nearer eye than tip of upper jaw, and anterior with a slightly elevated fleshy rim. Interorbital space broad, elevated, and giving place to median trenchant ridge which extends from above nostrils to occiput. Preopercular ridge and margin slightly inclined forward.

Gill-opening extending forward till below nostrils. Rakers 6+19, compressed, rather broad, and much shorter than filaments. Filaments about $\frac{2}{3}$ of orbit, and pseudobranchiæ much shorter. Isthmus narrow, not trenchant, and its lower surface very triangularly elongate.

Scales small, numerous, cycloid, and narrowly imbricated. Spinous dorsal with a narrow basal sheath. Soft dorsal and anal with anterior basal portion enclosed in rather broad basal scaly sheaths. Cheeks just below eye, and upper side of head posteriorly, also upper portion of opercle, with small scales. Base of caudal covered with small scales, but without any keels at bases of lobes. Lateral line strongly arched at first till opposite origin of soft dorsal, then straight to base of caudal. Shields small, deepest about 10 in greatest depth of body.

Spinous dorsal beginning well behind origin of pectoral, spines low, fourth highest, fin rounded above, and depressible in a groove. Origin of soft dorsal about midway between tip of mandible and base of caudal, first ray highest, and anterior higher rays graduated down from it, not forming a lobe. Last dorsal and anal rays hardly longer than those preceding. Soft anal similar to soft dorsal, its origin a little nearer base of caudal than front rim of orbit. Anal spines strong, short, depressible in a slight groove, and first inserted about opposite origin of soft dorsal. Belly in front of spinous anal with a short bony trenchant keel. Caudal small, forked, lobes pointed. Pectoral rather broad and pointed. Ventral small, reaching nearly half way to soft anal, and inserted a trifle in advance of origin of pectoral. Anus well anterior, near tips of ventrals.

Color when fresh in arrack with upper parts of body deep slaty-gray. Sides and lower surface whitish, and more or less silvery. Spinous dorsal black. Soft dorsal, caudal and anal dusky, other fins paler or whitish. Opercle with a large blue-black blotch above, nearly as large as eye. Iris yellowish. Peritoneum silvery.

Length 5 inches.

No. 27,501, A. N. S. P. Padang, Sumatra. One example.

Caranx nigripinnis Day[11] is identical. Russell's figure and description appear to represent this fish and not *Caranx præustus* Bennett,[12] which Bleeker claimed to have discovered.

Alepes amblyrhynchus (Cuvier).

Caranx amblyrhynchus Cuvier, Hist. Nat. Poiss., IX, 1833, p. 76, Pl. 248. Brésil. (M. Delalande.)

Head $3\frac{3}{4}$; depth $2\frac{1}{3}$; D. I, VII–I, 28; A. II–I, 24; P. II, 19; V. I, 5; scales 41 in lateral line, remaining portion composed of about 50 scutes; about 16 scales between uppermost part of lateral line and spinous dorsal; width of head about 2 in its length; depth of head at posterior margin of eye about $1\frac{1}{10}$; mandible $2\frac{1}{4}$; fourth erect dorsal spine $3\frac{1}{3}$; first dorsal ray $1\frac{3}{4}$; first anal ray $1\frac{9}{10}$; least depth of caudal peduncle 5; snout $3\frac{7}{8}$ in head, measured from tip of upper jaw; eye $3\frac{2}{5}$; maxillary 3; interorbital space $2\frac{7}{8}$; pectoral $2\frac{1}{3}$ in head and trunk.

Other characters unless otherwise stated similar to *melanoptera*. Least depth of caudal peduncle about $2\frac{1}{2}$ in its length. Mandible only protruded a trifle. Distal expanded extremity of maxillary $\frac{1}{2}$ of pupil.

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[11] *Fishes of India*, II, 1876, p. 225, Pl. 51, fig. 5. Madras and Andamans.

[12] *In Mem. Life and Serv. Raffles*, 1830, p. 689. Sumatra.

Gill-opening extending forward opposite front margin of orbit. Rakers 9+21. Filaments about half of orbit. Pseudobranchiæ shorter than filaments. Entire bases of rayed dorsal and anal scaly. Straight portion of lateral line beginning a little behind origin of soft dorsal. Soft dorsal inserted much nearer tip of mandible than base of caudal, and soft anal similarly inserted. No trenchant bony keel in front of spinous anal. Caudal rather large. Anus just before tip of ventrals. In alcohol spinous dorsal brown above. Anal whitish like ventrals. An indistinct diffuse grayish-dusky blotch on opercle above. Iris dull brassy.

One example from Rio Janeiro, Brazil, 8 inches long.

Subgenus SELAR Bleeker.

Nat. Tijds. Ned. Ind., I, 1850 (1851), pp. 343, 352 (*boöps*).

Caranx megalaspis (Bleeker).

Selar megalaspis Bleeker, l. c., V, 1853, p. 502. Priaman, in mari. (M. Godin.)

Caranx megalaspis Fowler, Journ. Acad. Nat. Sci. Phila., XII (2), 1904, p. 510, Pl. 13, upper figure.

Head $3\frac{7}{8}$; depth $2\frac{2}{3}$; D. VIII–I, 25; A. II–I, 20; P. II, 19; V. I, 5; scales in lateral line about 30, its remaining portion composed of about 40 large scutes; about 10 scales between origin of dorsal and upper part of lateral line, and nearly 30 between latter and origin of anal in an oblique series; width of head $2\frac{1}{8}$ in its length; depth of head $1\frac{1}{10}$; mandible $2\frac{1}{10}$; third dorsal spine $2\frac{1}{2}$; second dorsal ray $1\frac{3}{4}$; first anal ray $2\frac{2}{5}$; least depth of caudal peduncle 5; snout $3\frac{2}{3}$ from its tip; eye $3\frac{1}{3}$; maxillary $2\frac{2}{5}$; interorbital space 4; upper lobe of caudal $3\frac{1}{2}$ in head and trunk; pectoral $3\frac{1}{2}$.

Body greatly compressed, ovoid, and anteriorly upper and lower profiles evenly convex. Greatest depth at origin of soft dorsal. Caudal peduncle small, its depth $2\frac{1}{3}$ its length, and its width about $\frac{2}{3}$ its depth.

Head rhomboid, compressed, and blunt anteriorly. Snout short, blunt, and compressed. Eye large, anterior, and with a broad posterior adipose eyelid. Mouth oblique and upper jaw projecting slightly beyond snout. Lips fleshy and lower rather broad. Teeth minute, uniserial, in jaws. Small teeth in patches on vomer and palatines. Tongue free, rounded in front, and rather long. Mandible projecting beyond upper jaw. Maxillary reaching posteriorly a little beyond front rim of orbit, and its distal expanded extremity half of orbit. Also with a distinct oblique ridge. Nostrils lateral, close together, and a little nearer eye than tip of snout. Interorbital space convexly elevated, with a median trenchant keel which begins anteriorly and runs to spinous dorsal. Margin of preopercle convex.

Gill-opening carried forward till opposite front margin of orbit. Rakers 7 + 25, a little longer than longest filaments, or a trifle over half of eye, compressed, rather thin, and pointed. Pseudobranchiæ small. Isthmus narrow, but not trenchant.

Scales small, cycloid, discoid and imbricated. Head naked, except a patch of scales on cheek adjoining eye, opercle, and upper posterior side. Anterior portions of soft dorsal and anal with scaly sheaths. Spinous dorsal with a low basal sheath. Bases of caudal and pectoral scaled. Straight portion of lateral line beginning below origin of soft dorsal, curved portion about $2\frac{3}{4}$ in straight portion, and broadest scutes about $4\frac{1}{6}$ or less in depth of body.

Spinous dorsal small, spines slender, depressible in groove, third longest, and origin of fin well behind that of pectoral, or much nearer origin of soft dorsal than posterior rim of orbit. Soft dorsal inserted much nearer tip of snout than base of caudal, and anterior rays elevated, first developed ray longest. Soft anal similar, but its insertion posterior and nearly median in body. Anal spines inserted in advance of soft dorsal, depressible in a groove, and second longer. Caudal deeply forked, lobes long and pointed, and upper much longer. Pectoral a little longer than head, falcate, and reaching opposite base of fourth ray. Ventral small, pointed, inserted below origin of pectoral, and length about equal to eye.

Color when fresh in arrack with bright silvery prevailing, back and upper surface of head pale slaty-gray. A large blackish blotch nearly equal to eye on upper part of opercle and shoulder-girdle. This is also reflected inside gill-opening. Snout dusky above. Fins pale brownish, upper portions of dorsals and caudal dusky. Iris yellowish. Peritoneum pale and whitish.

Length $5\frac{1}{8}$ inches.

No. 27,504, A. N. S. P. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. In all 8 examples in Acad. Nat. Sci. Phila. and Stanford University.

This species is related to *Caranx kalla* Cuvier,[13] from which it is distinguished, however, by the broad armature of the lateral line. Upon comparison with Swatow examples[14] of *kalla* the scutes were found constantly much narrower than in *megalaspis*. In the latter they are always equal to a little over orbit. *Scomber kleinii*[15] is also

[13] Cuvier, *Hist. Nat. Poiss.*, IX, 1833, p. 37. Pondichéry. Malabar. La mer Rouge. (M. Geoffroy.) Mahé. (M. Bélenger et M. Dussumier.)

[14] Rutter, *Proc. Acad. Nat. Sci. Phila.*, 1897 (1898), p. 72.

[15] Bloch, *Naturg. Ausl. Fisch.*, VII (X), 1793, p. 86, Pl. 347, fig. 2. Der malabarischen Küste.

related, but differs in having shorter scutes. The figure shows them a little over 5 in greatest depth of body. Bloch remarks "les opercules sont unis; et l'on discerne une tache blue sur le postérieur," though it is not indicated on his figure. Cuvier considered *Caranx peronii*[16] very close, if not identical. *C. megalaspis* is also related to *C. boops* Cuvier, but the scutes of that species range from 45 to 50. while in the former they are seldom over 40.[17] No trace of a yellow longitudinal band observed.

Caranx mate Cuvier.

> Hist. Nat. Poiss., IX, 1833, p. 40. Pondichéry. Des Séchelles. (M. Dussumier.) Nouvelle-Guinée. (MM. Quoy and Gaimard.) D'étroit d'Antjer. (M. Raynaud.)——Fowler, Journ. Acad. Nat. Sci. Phila., XII (2), 1904, p. 510, Pl. 13, lower figure.

Head $3\frac{1}{2}$; depth $3\frac{2}{7}$; D. VIII–I, 23; A. II–I, 19; P. II, 19; V. I, 5; scales 50 in lateral line, remaining scutes about 42; 10 scales between origin of spinous dorsal and lateral line in a vertical series; about 30? scales between latter and anus (squamation injured); width of head $1\frac{9}{10}$ in its length; depth of head $1\frac{1}{4}$; mandible $2\frac{1}{4}$; third dorsal spine $2\frac{1}{10}$; first dorsal ray $2\frac{1}{8}$; first anal ray $2\frac{1}{3}$; least depth of caudal peduncle $7\frac{1}{3}$; snout $3\frac{1}{6}$, in head, measured from its tip; eye 4; maxillary $2\frac{3}{4}$; interorbital space $3\frac{1}{6}$; pectoral 3 in head and trunk.

Body compressed, deep, anterior profiles evenly convex, and lower becoming more so posteriorly so that greatest depth is at spinous anal. Caudal peduncle slender, broadly depressed, so that its least depth is 3 and its least width 2 in its length.

Head compressed, deep, and pointed in front. Snout conic, pointed, but with upper jaw projecting. Eye small, anterior, and with broad adipose eyelids, only a vertical slit equal in width to half its diameter exposed. Mouth inclined and slightly curved, and mandible projecting beyond upper jaw. Lips fleshy, and on each ramus of mandible broad and thick. Maxillary reaching a little beyond front rim of eye, its upper edge entirely slipping below broad preorbital, and its distal expanded extremity half of orbit. A short oblique groove continued down from lower angle of maxillary when mouth is closed. Teeth in jaws small, sharp pointed, and uniserial. Vomer and palatines with patches of minute teeth. Tongue elongate, free, and rounded in front, its upper surface with minute asperities. Nostrils small, high on snout, but nearer eye than tip of former. Interorbital space elevated, giving place to median keel which begins over nostrils and extends to occiput.

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[16] *Hist. Nat. Poiss.*, IX, 1833, p. 84. Vanicolo. (MM. Quoy and Gaimard.) Amboine. Java. Malabar.

[17] *L. c.*, p. 35. Amboine. (MM. Quoy and Gaimard.) Vanicolo.

Preorbital and preopercle with small flutings, edge of latter strongly convex.

Gill-opening carried forward below nostrils. Rakers 11+27, compressed, slender, and longest about $\frac{4}{5}$ length of longest filaments which are about $\frac{2}{3}$ of orbit. Pseudobranchiæ about half of eye. Isthmus narrow, not trenchant.

Scales small, narrowly imbricated, and cycloid. Head naked, except cheek and upper posterior side above opercles. Spinous dorsal with a low basal scaly sheath, but those of soft dorsal and anal well developed. Base of caudal scaled, and that of pectoral naked. Straight portion of lateral line beginning after elevated dorsal rays or at tip of depressed pectoral. Scutes small, deepest $6\frac{1}{2}$ in greatest depth of body.

Spinous dorsal small, spines slender, pungent, depressible in a groove, and third and fourth nearly equal. Origin of fin over first fifth of length of pectoral, or nearly equal in space between tip of latter and front rim of orbit. Soft dorsal beginning about over last third of pectoral, or nearly midway between tip of mandible and base of caudal. First few anterior rays elevated, and graduated down from first and second developed rays which are longest. Last dorsal and anal ray finlet-like and longer than preceding. Anal similar to soft dorsal, its origin a little before tip of pectoral, or a little nearer base of caudal than front rim of eye. Anal spines short, depressible in a groove, posterior longer, and origin of fin almost opposite that of soft dorsal. Caudal forked, lobes small and pointed, and no keels at their bases. Pectoral long, falcate, and its origin nearly level with lower rim of orbit. Ventral small, depressible in a groove, and about equal to postocular region. Anus nearly midway between root of ventral and origin of anal, or at tips of ventrals.

Color when fresh in arrack grayish-silvery, somewhat slaty above, and sides, together with lower surface, white. A large deep blue-black blotch on opercle, and upper portion of shoulder-girdle same color. Dorsals, caudal and pectoral grayish tinged with dull yellow, and other fins whitish. Iris yellowish. Peritoneum gray.

Length $7\frac{5}{8}$ inches.

No. 27,508, A. N. S. P. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Seven examples. Acad. Nat. Sci. Phila. and Stanford University.

Dr. Günther claims[18] *Selar hasseltii* Bleeker[19] is furnished with a nar-

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[18] *Cat. Fish. Brit. Mus.*, II, 1860, p. 430. Amboyna. (Mr. Frank.)
[19] Bleeker, *Nat. Tijds. Ned. Ind.*, I, 1850 (1851), p. 359. Batavia, Cheribon, Surabaja, in mari.

row band of teeth in the upper jaw. In Bleeker's account the maxillary teeth are said to be small, equal and conspicuous. This also agrees with my examples, though the transverse diffuse vertical bands were not observed when they were first received. Dr. Steindachner has united this form[20] with *Caranx affinis* Rüppell,[21] basing it on Hawaiian material, though Rüppell's fish never seems to have been satisfactorily compared. *Caranx xanthurus*[22] appears to be identical but is of later pagination.

ELAPHROTOXON subgen. nov.

Type *Scomber ruber* Bloch.

Subgenus *Caranx* Jordan and Evermann[23] is identical. Their subgenus *Tricropterus* becomes identical with subgenus *Caranx* as here understood.

(*Ἐλαφρὸς*, shallow; *τόξον*, bow; with reference to the slightly convex anterior portion of lateral line.)

Caranx ruber (Bloch).

Scomber ruber Bloch, Naturg. Ausl. Fisch., VII (X), 1793, p. 75, Pl. 342. Bey der Insel St. Croix. (Dr. Isert.)

One from New Providence (Bahamas), Coll. Dr. H. C. Wood.

Subgenus CARANX Lacépède.

Caranx hippos (Linnæus).

Scomber hippos Linnæus, Syst. Nat., Ed. XII, Reformata, 1766, p. 494. Carolina. (D. Garden.)

Newport (Rhode Island), Beasley's Point (New Jersey), San Domingo (West Indies), Pernambuco (Brazil).

VEXILLICARANX subgen. nov.

Type *Caranx africanus* Steindachner.

Inner teeth in each jaw minute, pointed, equal, and forming a narrow band, at least in front. Outer teeth a little enlarged and forming a single series at least, in each jaw. Breast naked. No opercular spot. Anterior rays of soft dorsal and anal produced into long slender falcate lobes. Pectoral long, falcate. Anterior curved portion of lateral line a little less than half of remaining straight portion. Adipose eyelid rather narrow.

(*Vexillum*, streamer; *Caranx*, from *Carangue*, French vernacular.)

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[20] *Sitz. Ak. Wiss. Wien*, LXXXIII, 1881, p. 211.

[21] *Neue Wirbelthiere*, Fisch., 1835, p. 49, Pl. 14, fig. 1. Massaua.

[22] Kuhl and Van Hasselt, in Cuvier, *Hist. Nat. Poiss.*, IX, 1833, p. 41. Java. (MM. Kuhl and Van Hasselt.)

[23] *Bull. U. S. Nat. Mus.* (Fish. N. Mid. Am.), No. 47, I, 1896, p. 916.

Caranx africanus Steindachner.

Sitz. Ak. Wiss. Wien, LXXXVIII, 1883 (1884), p. 1108, Pl. 7, fig. 1. Gorée. (Herr W. Höfler.) Küste Liberia's. (Herr Büttikofer.) Lagos und der Loango-Küste. [All Coll. Vienna Mus.]

Head $3\frac{2}{3}$; depth $2\frac{4}{7}$; D. I, VIII–I, 21; A. II–I, 18; keeled scutes 44 in straight portion of lateral line; fourth erect dorsal spine $2\frac{1}{2}$ in head; first developed anal ray $1\frac{1}{3}$; ventral (damaged) about $2\frac{1}{5}$; mandible 2; snout $3\frac{2}{7}$ in head, from tip of upper jaw; eye $3\frac{2}{3}$; maxillary $2\frac{2}{5}$; interorbital space $3\frac{1}{3}$; least depth of caudal peduncle 5. Maxillary reaching about opposite first $\frac{2}{5}$ of orbit, and its expanded extremity 2 in latter. Rakers 13+28, slender, compressed, much longer than filaments or about $\frac{2}{3}$ of orbit. Anus a little before tips of ventrals. Deepest scute about $8\frac{1}{2}$ in greatest depth of body. Long falcate dorsal lobe reaching when depressed at least opposite base of last dorsal ray. Pectoral $2\frac{1}{3}$ in head and trunk. Length $9\frac{3}{4}$ inches. West Africa. Dr. H. E. Savage.

Subgenus PARATRACTUS Gill.

Caranx crysos (Mitchill).

Scomber crysos Mitchill, Trans. Lit. Philos. Soc. New York, I, 1815, p. 424, Pl. 4, fig. 2. Bay of New York.

Nantucket (Massachusetts) and Newport (Rhode Island).

Caranx pisquetus Cuvier.

Hist. Nat. Poiss., IX, 1833. p. 73. Saint-Domingue. Cuba. Brésil.

Head $3\frac{3}{7}$; depth $3\frac{1}{8}$; D. VIII–I, 23; A. II–I, 20; P. II, 20; V. I, 5; scales about 46 in lateral line, and remaining keeled scutes about 45; about 16 scales between spinous dorsal and lateral line in a vertical series, and about 24 between latter and origin of rayed anal similarly; width of head $1\frac{9}{10}$ in its length; depth of head $1\frac{2}{7}$; mandible 2; third dorsal spine $2\frac{3}{7}$; first dorsal ray $1\frac{1}{12}$; first anal ray $2\frac{1}{6}$; length of ventral $2\frac{1}{2}$; snout $3\frac{1}{3}$ in head, measured from tip of upper jaw; eye $5\frac{1}{4}$; maxillary $2\frac{2}{5}$; interorbital space 3; least depth of caudal peduncle $7\frac{3}{5}$; pectoral $2\frac{4}{5}$ in head and trunk; upper caudal lobe $3\frac{3}{5}$.

Body elongate fusiform, compressed, and greatest depth at origin of anal. Lower profile a little more convex than upper. Caudal peduncle slender, its least depth about $3\frac{1}{3}$ in its length.

Head moderately large, robust, compressed, and upper profile evenly and a little more convex than lower. Snout a little long, convex, and upper jaw well protruding in front. Eye orbicular, its lower rim about level with middle of greatest depth, and its posterior rim a little posterior in length of head. Mouth little inclined, and mandible produced a little beyond tip of upper jaw. Lips rather thick and fleshy. Maxillary reaching at least opposite middle of orbit, its distal expanded extremity equal to about $\frac{5}{6}$ of orbit, and its entire upper edge slipping below preorbital edge. Teeth of upper jaw biserial, those forming outer series enlarged conic and forming a single series, and those inside forming a band of small pointed teeth broadest and mostly developed anteriorly. Mandibular teeth like outer series in upper jaw, and also uniserial. A finely asperous small triangle on vomer. Surfaces of palatines and tongue with broad spaces finely asperous. Tongue rather elongate, thick, rounded, and free in front. Nostrils adjoining, small slits, above middle of orbit in its vertical diameter, and also nearer front of same than tip of snout. Supraocular ridge a litt e pronounced. Top of head strongly convex and a somewhat obsolete median keel from internasal space to occiput.

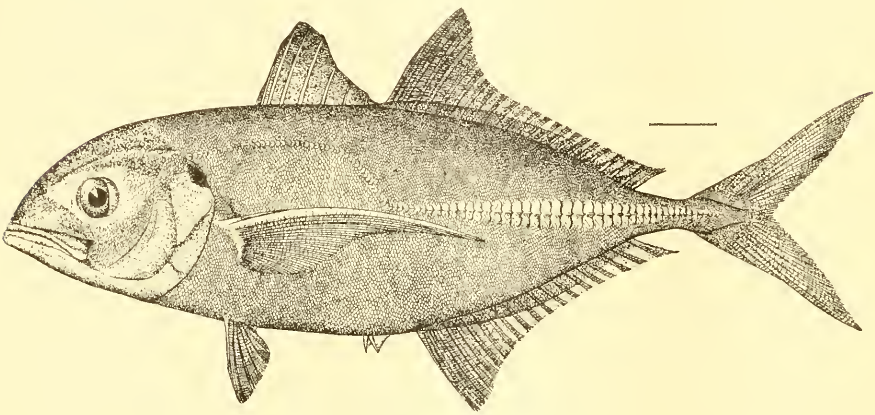

Fig. 5.—*Caranx pisquetus* Cuvier.

Gill-opening carried forward about midway between front of eye and posterior nostril. Rakers I, 15+25, I, slender, compressed, and longest equal to longest filament or about $\frac{2}{3}$ of orbit. Pseudobranchiæ about equal to diameter of pupil. Isthmus with a rather broad groove on lower surface.

Scales small, cycloid, extending over chest entirely and good portion of all rayed fins basally. On occipital region small, larger on postocular region, and again smaller on cheek. With exception of these regions together with upper side of head and opercle, head is naked. Adipose eyelid narrow, not covering much of iris posteriorly. No scales on spinous dorsal and anal, these fins each depressible in a groove along each side of which a sheath of fine scales is formed. Anterior rays forming lobes of soft dorsal and anal covered with minute crowded scales. Bases of anterior and elongated dorsal and anal rays also with scaly sheaths into which fins are more or less depressible, and on posterior rays scales gradually disappear. Base of caudal covered with small scales, and a cutaneous keel at base of each lobe laterally. Arch of lateral line about $1\frac{2}{3}$ in straight portion. Greatest depth of keels or scutes about 8 in greatest depth of body. Tubes in lateral line simple. An axillary pit at base of ventral.

Spinous dorsal inserted opposite first $\frac{2}{5}$ of depressed ventral, third spine highest, and others graduated down. Soft dorsal lobe higher than spinous fin, first ray highest, and origin of fin nearer front rim of orbit than base of caudal. Last dorsal and anal rays longer than those preceding. Soft anal similar to soft dorsal, though inserted nearly midway between base of caudal and posterior rim of orbit. Anal spine small, short, second longest, and first inserted nearly opposite origin of soft dorsal. Caudal large, forked, lobes slender, sharply pointed, and about equal. Pectoral long, falcate, upper ray much longest, and reaching well beyond beginning of straight portion of lateral line or dorsal and anal lobes. Ventral inserted a trifle behind origin of pectoral, and reaching over half way to origin of spinous anal. Spine small, slender, weak, and over half length of first or longest ray. Anus a little nearer tips of ventrals than origin of spinous anal.

Color in alcohol dull olivaceous-brown above, lower surface whitish or pale. Evident silvery reflections over most of lower regions. Fins brownish, lower ones paler, and dorsals and caudal a trifle more brownish. Iris dull brassy. Peritoneum pale silvery.

Length $13\frac{3}{4}$ inches.

No. 11,240, A. N. S. P. San Domingo, West Indies. Prof. W. M. Gabb. One example.

This species appears to differ from *Caranx crysos* chiefly in its more elongate fusiform body, higher dorsal and anal rayed lobes, and especially the longer pectoral. I have not had the opportunity of comparing small examples of *C. pisquetus*.

Subgenus CARANGICHTHYS Bleeker.

Nat. Tijds. Ned. Ind., III, 1852, p. 760 (*typus*).

Caranx sem Cuvier.

Hist. Nat. Poiss., IX, 1833, p. 79. Pondichéry. (M. Leschenault.)——Fowler, Journ. Acad. Nat. Sci. Phila., XII (2), 1904, p. 512, Pl. 14, upper figure.

Head $3\frac{2}{5}$; depth $2\frac{4}{7}$; D. VIII–I, 20; A. II–I, 16; P. II, 18; V. I, 5; scales 57 in curved portion of lateral line, and about 37 scutes in remaining straight portion; about 24 scales between origin of spinous dorsal and upper curved portion of lateral line; width of head $2\frac{1}{10}$ in its length; depth of head 1; mandible 2; third dorsal spine $2\frac{1}{2}$; second dorsal ray $1\frac{7}{8}$; second anal ray 2; least depth of caudal peduncle 7; ventral $2\frac{1}{3}$; snout $3\frac{1}{2}$ from tip of upper jaw; eye $3\frac{2}{3}$; maxillary $2\frac{1}{4}$; interorbital space $3\frac{9}{10}$; pectoral 3 in body; upper caudal lobe $3\frac{1}{3}$.

Body oblong, compressed, upper profile a little more convex than lower, and greatest depth at origin of soft dorsal. Caudal peduncle rather long, its least depth $2\frac{1}{2}$, and in its width $2\frac{1}{8}$ in its length.

Head deep, compressed and upper profile obliquely convex. Snout oblique, blunt, and with upper jaw projecting. Eye small, anterior, and with a rather narrow posterior adipose eyelid. Mouth oblique, gape reaching below nostrils, and mandible projecting beyond upper jaw. Maxillary reaching opposite anterior margin of pupil, with its distal expanded extremity free from preorbital above and about equal in width to $\frac{2}{3}$ of eye. Lips thick and fleshy. An outer series of enlarged teeth in upper jaw becoming a little larger anteriorly, and a double or irregular series of small inner teeth. Teeth in mandibles subequal, rather large, and with 6 or more forming a small outer series in front. Vomer, palatines and tongue with patches of minute teeth. Tongue elongate, rounded and free in front. Nostrils small slits close together, lateral, high, and near front rim of orbit. Interorbital space rather narrow, elevated, and with a median trenchant ridge originating above nostrils and continued to occiput. A low supraocular ridge. Preorbital broad, fluted above, and about equal to $\frac{2}{3}$ of orbit. Margin and ridge of preopercle oblique.

Gill-opening deep, extending forward opposite nostrils. Rakers 7 + 16, slender, compressed, a little shorter than filaments or about half of orbit. Pseudobranchiæ rather small. Isthmus rather narrow, with a slight groove.

Scales small, cycloid, and narrowly imbricated. Head, with exception of cheek, upper side and opercle, naked. Base of spinous dorsal with a low scaly sheath, and anterior basal portions of soft dorsal and anal with scaly sheaths. Base of caudal covered with small scales and base of each lobe with a low obsolete ridge. Base of pectoral naked. Anterior rays of soft dorsal and anal with small scales. Lateral line straight after fifth dorsal ray, and deepest shields about $8\frac{1}{2}$ in greatest depth of body.

Origin of spinous dorsal well behind that of pectoral, spines rather rigid, third longest, and all depressible in a groove. Soft dorsal inserted midway between front of orbit and base of caudal, anterior rays elevated in a lobe, and last ray a little longer than those immediately preceding. Soft anal similar, inserted a little nearer posterior rim of orbit than base of caudal, and its base like that of soft dorsal, a little convex. Anal spines small, first inserted opposite origin of soft dorsal, second longer, and both depressible in a groove. A short keel on abdomen in front reaching to anus. Caudal small, triangular, forked, and lobes pointed. Pectoral long, falcate, and reaching beyond beginning of straight part of lateral line. Ventral small, inserted a little in advance of origin of pectorals, and not reaching half way to origin of soft anal. Anus near tips of ventrals.

Color when fresh in arrack with upper part of body slaty-gray, shot with pale metallic blue and purple, lower surface white and washed everywhere with bright silvery. Upper part of spinous dorsal and upper part of anterior dorsal lobe dusky, latter deeper. Caudal more or less dusky on upper lobe. Base of pectoral dusky inside. Fins with these exceptions pale yellowish. No opercular spot. Peritoneum silvery.

Length $5\frac{5}{8}$ inches.

No. 27,514, A. N. S. P. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Two examples. Acad. Nat. Sci. Phila. and Stanford University.

Close to *Caranx latus* Agassiz,[24] but differing in the more convex profile, upper lobe of soft dorsal dusky, and tip of upper caudal lobe same color. *Scomber heberi*[25] may prove identical.

Caranx marginatus (Gill).

Carangus marginatus Gill, Proc. Acad. Nat. Sci. Phila., 1863 (1864), p. 166 Western Coast of Central America. (Capt. John M. Dow.)
Caranx latus Fowler, Proc. Acad. Nat. Sci. Phila., 1900 (1901), p. 501. (Not of Agassiz.)

Head $3\frac{1}{5}$; depth $2\frac{3}{4}$; D. VIII–I, 20; A. II–I, 16; scutes in straight part of lateral line 28; width of head $2\frac{1}{5}$ in its length; third dorsal spine $2\frac{1}{2}$; first dorsal ray about $1\frac{3}{5}$; first anal ray about 2; ventral $2\frac{1}{6}$; snout $3\frac{2}{5}$ in head, measured from its tip; eye 4; maxillary 2; interorbital space $3\frac{1}{6}$; pectoral 3 in head and trunk. Depth of deepest scute in lateral line about 7 in greatest depth of body. Maxillary reaching about opposite posterior margin of pupil. Gill-rakers 7 + 14, compressed, and longest a little longer than filaments or about $\frac{4}{7}$ of orbit. Adipose eyelid well developed, nearly covering posterior third of head. A very pale opercular spot at upper corner of gill-opening. Fins all pale except upper portions of anterior dorsal rays which are dusted

[24] *Sel. Gen. Spec. Pisc. Brasil.*, 1829, p. 105, Pl. 56*b*, fig. 1. Oceano Atlantico. (Museo Monacensi.)

[25] Bennett, *Fishes of Ceylon*, Ed. II, 1834, p. 26, Pl. 26. Ceylon.

with brownish. Length $7\frac{1}{4}$ inches. Two examples from Honolulu, Hawaiian Islands, collected by Dr. Benjamin Sharp. These were wrongly called *Caranx latus* by me, and are evidently identical with the examples identified as *C. marginatus* by Dr. Jenkins.[26]

Caranx latus Agassiz.

Sel. Gen. Spec. Pisc. Brasil., 1829, p. 105, Pl. 56*b*, fig. 1. In Oceano Atlantico. [Brazil.] (Museo Monacensi.)
Caranx hippus Cope, Trans. Amer. Philos. Soc., XIV, 1871, p. 472. (Not of Linnæus.)

Head $3\frac{1}{12}$; depth $2\frac{3}{5}$; D. I, VIII–I, 21; A. II–I, 16; scutes 34 in straight part of lateral line; width of head 2 in its length; mandible $1\frac{1}{12}$; fourth dorsal spine $2\frac{9}{10}$ (third longest but damaged); ventral $2\frac{1}{3}$; snout $3\frac{3}{5}$ in head, measured from its own tip; eye $3\frac{2}{3}$; maxillary $2\frac{1}{20}$; interorbital space $3\frac{1}{3}$; least depth of caudal peduncle $6\frac{3}{4}$; pectoral $2\frac{4}{5}$ in head and trunk. Maxillary not quite reaching posterior margin of orbit. Adipose eyelid covering posterior half of iris only. Gill-rakers 6+16, compressed, longest much longer than filaments or about $\frac{3}{5}$ of orbit. A pale brownish spot at upper corner of gill-opening. No opercular spot. Length $8\frac{1}{8}$ inches. Rio Janeiro, Brazil. Drs. Ruschenberger and Turner. Other examples also from San Domingo (West Indies) and Surinam.

Young examples from Culebra, Porto Rico, received from the U. S. Fish Commission, show spinous dorsal blackish. Side of trunk with five pale plumbeous-gray transverse bands extending down below lateral line and fading out on abdomen. First a little narrow and beginning from origin of spinous dorsal. Second extending from posterior base of spinous dorsal and crossing curved part of lateral line. Third much broader and crossing straight part of lateral line anteriorly. Fourth extending from middle of base of rayed dorsal, and fifth from bases of posterior rays. Some examples show a rather indistinct or diffuse grayish-brown streak sloping down anteriorly through eye to end of maxillary.

CARANGOIDES Bleeker.

Nat. Tijds. Ned. Ind., I, 1850 (1851), pp. 343, 352 (*præustus*).

Originally *Scyris*, *Alectis* and *Citula* were included. No type is indicated, though the first species mentioned, *præustus*, was probably intended. *Carangoides plagiotænia* cannot be used as it was not discovered till later.[27]

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[26] *Bull. U. S. Fish Comm.*, XXII, 1902 (1904), p. 444.
[27] *Act. Soc. Sci. Ind. Neerl.* (Acht. Bijd. Visch. Amboina), II, 1857, p. 59.

Carangoides malabaricus (Schneider).

Scomber malabaricus Schneider, Syst. Ichth. Bloch, 1801, p. 31. Habitat cum antecedente [which is "ad Tranquebariam"].

Head $3\frac{1}{10}$; depth 2; D. VIII–I, 22; A. II–I, 18; scales 65 in lateral line, and scutes about 30; pectoral 1 in head; ventral about 4; snout $3\frac{1}{3}$ from tip of upper jaw; eye $2\frac{4}{5}$; maxillary $2\frac{1}{4}$; interorbital space $3\frac{1}{2}$. Gill-rakers 11+22, and a little longer than filaments. Scutes small and weak. Color when fresh in arrack slaty-brown above, top of head grayish or leaden, greater portion of sides and all of lower surface whitish washed everywhere with silvery. Upper edge of opercle with a small blackish spot. Axil of pectoral brownish. Fins plain or dilute brownish. Length $4\frac{1}{16}$ inches. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Two examples. Acad. Nat. Sci. Phila. and Stanford University.

Carangoides oblongus (Cuvier).

Caranx oblongus Cuvier, Hist. Nat. Poiss., IX, 1833, p. 96. Vanicolo. (MM. Quoy and Gaimard.) Oualan. (M. de Mertens.)

Head $3\frac{1}{2}$; depth $2\frac{1}{2}$; D. VIII–I, 21; A. II–I, 18; scales 59 in lateral line, and scutes 39; snout 3 in head; eye $3\frac{4}{5}$; maxillary $2\frac{4}{7}$; interorbital space $4\frac{1}{5}$; ventral about 2; pectoral $2\frac{3}{7}$ in body, without caudal. Gill-rakers 7+16, II, long, compressed, and about equal to filaments of half of eye. Color when fresh in arrack leaden-gray above, silvery-white below, and everywhere more or less silvery. On back between bases of each fin ray a bluish-gray blotch. Basal portion of anterior soft dorsal and anal rays tinged with pale yellowish. Length 11 inches. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Two examples. Acad. Nat. Sci. Phila. and Stanford University.

CITULA Cuvier.

Règne Animal, Ed. I, II, 1817, p. 315 (*armata*).——Cuvier, l.c., Ed. II, II, 1829, p. 209

Subgenus CITULA Cuvier.

Ventrals short and pale. Straight portion of lateral line beginning well beyond origin of soft dorsal.

Citula armata (Forskål).

Sciæna armata Forskål, Descript. Animal., 1775, p. 53. [Red Sea.]
Citula atropos Fowler, Journ. Acad. Nat. Sci. Phila., XII (2), 1904, p. 513, Pl. 14, lower figure to left. (Not of Schneider.)

Head $3\frac{1}{10}$; depth 2; D. VIII–I, 22; A. II–I, 18; P. II, 19; V. I, 5; scales 95 in curved portion of lateral line, and about 32 in remaining short straight portion; about 25 scales between soft dorsal and upper curved portion of lateral line; width of head $2\frac{2}{3}$ in its length; depth of head greater than length; mandible $2\frac{1}{8}$; third dorsal spine $2\frac{3}{4}$; first dorsal ray $1\frac{1}{4}$; first anal ray $1\frac{1}{4}$; upper caudal lobe 1; least depth of caudal peduncle $6\frac{1}{2}$; ventral $2\frac{1}{2}$; snout $2\frac{4}{5}$ from tip of upper jaw; eye $3\frac{4}{7}$; maxillary $2\frac{2}{3}$; interorbital space $3\frac{1}{3}$; pectoral $2\frac{3}{5}$ in head and trunk.

Body rather oblong, deep, compressed, and greatest depth at origin of soft dorsal. Caudal peduncle small, its depth $2\frac{1}{8}$, and its width 2 in its length.

Head deep, compressed, and upper profile oblique, slightly convex at first and then more so at occiput. Lower profile less convex than upper. Snout broad, oblique, compressed, slightly prominent, and with upper jaw a little protruded. Eye large, a trifle anterior, and without adipose eyelid. Mouth oblique, small, curved, and gape reaching about $\frac{3}{4}$ in vertical to anterior nostril. Mandible projecting well beyond upper jaw. Maxillary free distally, its expanded portion 2 in eye, and reaching below posterior nostril, but not to orbit. Lips rather broad and thick. Teeth minute and in bands in jaws. Patches of minute asperities on vomer, palatines and tongue. Tongue broad, rather long, obtusely rounded and free in front. Nostrils close together, high lateral, and much nearer upper rim of orbit than tip of snout. Interorbital space broad, well elevated, and giving place to a high median trenchant keel extending to spinous dorsal. Preorbital broad, with several radiating flutings above, and its width about $\frac{4}{5}$ of orbit.

Gill-opening deep, extending forward opposite nostrils. Rakers 7+16, II, long, slender, compressed, asperous on inner surfaces, and longest half of eye. Filaments $\frac{5}{6}$ of longest raker, and pseudobranchiæ a little shorter. Isthmus compressed, edge not sharp.

Scales minute, narrowly imbricated, and crowded on back in front. Chest and base of pectoral naked. Cheeks and upper posterior side of head scaly, otherwise naked. A low scaly sheath along base of spinous dorsal. Soft dorsal and anal, except last few rays with rather high or broad basal scaly sheaths. Caudal with small scales on its base, and a low ridge at base of each lobe. Ventral with a deep basal fissure and a row of scales running back from its upper basal portion. Lateral line concurrent with back till opposite middle of base of soft dorsal and then straight to base of caudal. Scutes small, weak, deepest about $\frac{1}{3}$ least depth of caudal peduncle.

Origin of spinous dorsal but little behind that of pectoral, third ray longest. and all depressible in a low groove. Soft dorsal with first ray elongate, and those anteriorly also elevated, though much shorter. Last dorsal and anal rays much longer than those immediately preceding. Origin of soft dorsal nearly midway between front rim of orbit and base of caudal. Soft anal similar to soft dorsal, but its origin a short distance posterior. Anal spines short, small, second largest, and first inserted about opposite origin of soft dorsal. Short bony keel extending forward to tips of ventrals from origin of spinous anal. Caudal triangular, rather large and lobes pointed. Pectoral long, falcate, and nearly reaching beginning of straight portion of lateral line. Ventral inserted below origin of pectoral and reaching a little over half way to origin of soft anal. Anus midway between bases of ventrals and origin of spinous anal.

Color when fresh in arrack leaden or grayish-brown above, shot with bluish and purple, and silvery-white extending over lower surface. Basal portions of anterior rays of soft dorsal and anal tinged with pale yellowish. Spinous dorsal and upper portions of soft dorsal dusky. Upper front edge of caudal lobe dusky. Fins otherwise dilute yellowish. A small brown opercular spot. Peritoneum pale. Iris pale yellowish.

Length 11 inches.

No. 27,519, A. N. S. P. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Four examples. Acad. Nat. Sci. Phila. and Stanford University.

Two are young which I wrongly identified as *Citula atropos* (Schneider). The larger of the latter shows: Head $3\frac{1}{5}$; depth $1\frac{9}{10}$; D. VIII–I, 21; A. II–I, 17; P. II, 19; V. I, 5; scales 82 in lateral line, and scutes 28; pectoral $1\frac{1}{6}$ in head; ventral $1\frac{1}{3}$; snout $3\frac{1}{4}$, from tip; eye $3\frac{1}{8}$; maxillary $2\frac{1}{6}$; interorbital space $3\frac{1}{3}$. Gill-rakers 7 + 16, slender and compressed. Color when fresh in arrack pale leaden or slaty-gray on back and upper surface, lower side and under surface white. Body everywhere more or less silvery, especially below. Side with five broad pale gray vertical bars. Spinous dorsal blackish. Dorsal dusky above, other fins except ventral dilute yellowish. Ventral black, deepest distally and basal portions pale.

This species, originally from the Red Sea, has not been compared with Sumatran examples. The latter agree with Cuvier's figure,[28] except that only the first dorsal ray is elongate and the others are not prolonged into filaments. *Caranx cirrhosus* Cuvier[29] also lacks dorsal and anal filaments and an opercular spot. It is also supposed to be identical. Russell's figure of *Tchawil parah*[30] is apparently based on

[28] *Olistus malabaricus* Cuvier, Règne Animal, Ed. Pl. Grav., Poiss., 18—, Pl. 58. La mer Rouge.

[29] Ehrenberg, in Cuvier, *Hist. Nat. Poiss.*, IX, 1833, p. 94, Pl. 250.

[30] *Fishes of Coromandel*, II, 1803, p. 38, Pl. 151. Vizagapatam.

young examples of this species, though much older than my younger ones, as the ventral is represented as short.

SCYRIS Cuvier.

Règne Animal, Ed. II, II, 1829, p. 209 (*alexandrina*).

Scyris alexandrina (St. Hilaire).

Gallus alexandrinus Geoffroy St. Hilaire, Faune de Egypt, Zool., 1809, Pl. 22, fig. 2. Egypt. [Text not consulted.]

Head 3; depth $1\frac{1}{2}$; D. I, IV–I, 21; A. I, 18; P. II, 17; V. I, 5; scales about 134 in lateral line, several on base of caudal; mandible $2\frac{9}{10}$ in head; snout $2\frac{1}{2}$, measured from its own tip (not tip of upper jaw); eye $3\frac{3}{5}$; maxillary 3; interorbital space $4\frac{1}{2}$; least depth of caudal peduncle $5\frac{1}{2}$; ventral (damaged) $2\frac{2}{3}$. Gill-rakers 10+25, compressed, longest much longer than longest filaments or a trifle over half of orbit. Pseudobranchiæ equal to filaments. Rather narrow bands of nearly even small teeth in jaws. A small patch of similar ones also on vomer. Orbit $\frac{2}{3}$ depth of preorbital. Length $8\frac{5}{8}$ inches. Two examples from Beirut, Syria.

The original figure is good. *Gallichtys ægyptiacus* Cuvier[31] is probably the young. It is also possible that *Hynnis goreensis* Cuvier,[32] may be different, though suggested as identical by Lütken.[33] The adult of *Hynnis* would differ at all ages in not having the anterior soft dorsal and anal rays produced into filaments.

Scyris indica Rüppell.

Scyris indicus Rüppell, Atlas zu der Reise im nördlichen Afrika, Zool., 1828, p. 128, Pl. 33, fig. 1. Djetta. (Mus. Francos.)

Head $3\frac{1}{3}$; depth 2; D. I, 19; A. I, 16; P. II, 16; V. I, 5; width of head about 3 in its length; least depth of caudal peduncle $7\frac{1}{2}$; ventral $2\frac{1}{3}$; snout $2\frac{1}{4}$ in head, measured obliquely from tip of upper jaw to upper angle of opercle; eye 4; maxillary 3; interorbital space $4\frac{1}{6}$; pectoral $2\frac{2}{5}$ in body; upper caudal lobe about $3\frac{3}{7}$. Tongue long, narrow, rounded, and free in front, its upper surface finely asperous. Gill-rakers 8+23, short, compressed, broad, and longest about $1\frac{3}{5}$ in longest filament. Filaments 2 in orbit. Pseudobranchiæ about 5 in orbit. Scales developed about shoulder, behind eye, and on base of caudal. A few small scales along bases of soft dorsal and anal in front. First dorsal ray reaching back opposite base of last. Color when fresh in arrack more or less silvery-white, glaucous or slaty-gray on upper surface. Outer edge of membrane between rays of dorsal

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[31] Ehrenberg, in Cuvier, *Hist. Nat. Poiss.*, IX, 1833, p. 131.
[32] *L. c.*, p. 145. Gorée. (M. Rang.)
[33] *Kon. Dansk. Vid. Selsk. Skrift.* (*Spolia Atlantica*), XII, 1880, p.(538–42) 605.

blackish, and long dorsal lobe dark like outer portions of caudal lobe. A small blackish spot on edge of opercle, and a brown blotch over eye. Length 17 inches. Padang, Sumatra. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Three examples. Acad. Nat. Sci. Phila. and Stanford University.

Two are young, much deeper, and also have much longer anterior dorsal and anal rays. Ventral filamentous, reaching base of caudal. When fresh in arrack color was silvery, glaucous or slaty-gray above. Side with six broad bands of darker glaucous fading out below. Outer portions of all prolonged rays of dorsal and anal blackish. Ventral entirely black, other fins pale. They agree perfectly with examples from Cavite, Philippine Islands, in Stanford University, and also with the examples recorded from Formosa as *Alectis ciliaris* by Drs. Jordan and Evermann,[34] as I found when compared.

Alectis crinitus (Mitchill).

Zeus crinitus Mitchill, Amer. Journ. Sci. Art., XI, 1826, p. 144. Block Island.

Newport (Rhode Island), Key West (Florida), and San Domingo (West Indies).

Alectis ciliaris (Bloch),[35] the Indian form, may be different.

Vomer setapinnis (Mitchill).

Zeus setapinnis Mitchill, Trans. Lit. Philos. Soc. New York, I, 1815, p. 384, Pl. 1, fig. 9. Bay of New York.

Vomer curtus Cope, Proc. Acad. Nat. Sci. Phila., 1870, p. 119. North American Atlantic coast, the precise locality not recorded. (Bonaparte Coll., A. N. S. P.)

Head 3; depth $1\frac{1}{12}$; D. II,IV–I, 23; A. I. 19. Gill-rakers 8+23, compressed, longest about $\frac{4}{5}$ of orbit, and longest filament about $\frac{3}{5}$ of longest raker. Length $9\frac{3}{8}$ inches. West coast of Africa, probably at Gabun river. Dr. J. L. Leconte. Also another with same data, but smaller. It has 25 soft dorsal rays, and would appear to differ from *Vomer dorsalis* only in its greater depth. Dr. Steindachner, who has examined the types of *Vomer goreensis* Guichenot and *Vomer senegalensis* Guichenot, long ago concluded that they were identical with *Vomer setapinnis* (Mitchill).[36] He also pointed out the fact that *Vomer gabonensis* Guichenot represents a distinct species. Panama examples of about $8\frac{1}{2}$ inches in length have

[34] *Proc. U. S. Nat. Mus.*, XXV, 1903, p. 338.

[35] *Zeus ciliaris* Bloch, Naturg. Ausl. Fisch., III (VI), 1787, p. 36, Pl. 191. Suratte. [India.] (Doctor König.) [I have not been able to consult Rafinesque's account of *Alectis* in "*Analyse de la Nature ou Tableau de L'Univers et des Corps Organises*, 1815."]

[36] *Sitz. Ak. Wiss. Wien*, LX, 1869 (1870), p. 706.

the depth about 2, 22 and 23 dorsal and 18 anal rays. Coll. Dr. W. S. W. Ruschenberger. An example from Rio Janeiro, Brazil, about 8⅝ inches long, has depth $1\frac{9}{10}$, 21 dorsal and 17 anal rays. Drs. Ruschenberger and Turner. Examples from Newport, Rhode Island, of same size and smaller, have depth ranging from 1¾ to 2, dorsal with 22 or 23 and anal with 17 or 18 rays. Coll. Samuel Powel. Other examples from Maryland and South Carolina.

Type of *Vomer curtus* Cope from the Atlantic coast of eastern North America is the same. Bonaparte Coll. Dr. T. B. Wilson.

The specific denomination of this fish, though not correctly spelled, had best be adopted.

Vomer spixii (Swainson).

Platysomus spixii Swainson, Lardner's Cab. Cyclop. Nat. Hist., II, 1839, p. 406. (Based on *Vomer brownii* Agassiz, Sel. Gen. Spec. Pisc. Brasil, 1829, p. 110, Pl. 57. Oceano Atlantico. [Brazil.] (Museo Monacensi.)

Head 2⅗; depth 1½; D. VIII–I, 22; A. I, 18. Gill-rakers 7+27, compressed, longest much longer than filaments or about ⅗ of orbit. Length 7¾ inches. Many from San Domingo (West Indies). Prof. W. M. Gabb. St. Thomas (West Indies), from Henry Warrington.

Selene vomer (Linnæus).

Zeus vomer Linnæus, Syst. Nat., Ed. X, 1758, p. 266. America.

Surinam, Tobago (British West Indies), San Domingo (West Indies), Fort Macon (North Carolina), Beasley's Point and Squan river (New Jersey). A young example agrees with Lütken's figure.[37] Lat. 20° N., long. 105° W. (southern part of Gulf of Mexico). Dr. William H. Jones.

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[37] *Kon. Dansk. Vid. Selsk. Skrift.* (*Spolia Atlantica*), XII, 1880, Pl. 5, fig. 1.

THE MOVEMENTS OF GREGARINES.

BY HOWARD CRAWLEY.

For the proper comprehension of the movements displayed by gregarines, it is advisable first to consider the form and anatomy of the animals. In a species like *Porospora gigantea* Van Beneden the ratio of length to breadth is 50–1, whereas *Lophocephalus insignis* Aimé Schn. is nearly spherical. It is obvious that the first of these two species can display movements of contortion which the second cannot. These are extreme cases, but gregarines may roughly be divided into long, slender and short, stout species, and in a discussion of their movements it is well to keep in mind the limitations to flexibility imposed on the latter merely on account of their shape.

Further limitations are imposed by the anatomical structure. From without inward, a polycystid gregarine displays epicyte, sarcocyte, myocyte and entocyte. The epicyte is a cuticular layer, the function of which is protective. It is always present, and varies considerably in thickness in the different species. The sarcocyte is a layer of clear protoplasm which, in a typical case, is continuous over the entire animal. This condition exists in such genera as *Gregarina, Stenophora* and *Amphoroides.* Frequently, however, the sarcocyte is lacking, except for the septum, which it constitutes, and in the immediately adjacent parts. These two layers may collectively be termed the ectosarc.

The myocyte is described by some authors as a part of the ectosarc; by others as a part of the endosarc (entocyte). It is made up of a layer of fibrils. Of these, the more conspicuous encircle the animal in a slightly spiral direction. The circular fibres are joined together by longitudinal and diagonal connectives, the whole system forming a net.

The entocyte of gregarines is probably much like that of other protozoa. It is composed of soft, distinctly alveolar protoplasm, liberally provided with the so-called granules of reserve.

It will be seen from the above that the ectosarc of gregarines may vary greatly in thickness. We may have a species in which both the component layers are thick. On the other hand, the epicyte may be thin and the sarcocyte absent. We probably have here an explanation for the difference in the rigidity of gregarines. Some species, such as

Stenophora julipusilli Leidy, tend to maintain a certain definite shape. Changes of this shape may be extensive, but are usually of short duration. Further, the contortions are of such a character that the true form is by no means disguised, and the resumption of this true form is always a very sudden process. We may conclude from this that the ectosarc is stiff and elastic. Under the force of the contractile elements it may suffer contortion, but as soon as the force is released the proper form is resumed with a sudden jerk. The comparison may be made with a hollow india-rubber ball, or, perhaps better, it may be said that these gregarines behave as if their ectosarc were composed of india-rubber. They may further be compared with such ciliates as *Paramœcium,* at least in so far as regards the sudden resumption of the normal contour after a deformation.

On the other hand, gregarines like *Trichorhynchus pulcher* Aimé Schn. are highly polymorphic. Different individuals present quite different outlines, and these outlines are subject to continual and extensive changes. Their movements may not inaptly be termed amœboid. All polycystid gregarines possess what may be designated as a typical outline, but it is often difficult, in these polymorphic species, to determine what this typical outline may be. Their ectosarc, while extremely flexible and extensible, does not appear to possess any elasticity. In consequence, deformation may be carried to such an extent as to render the typical form wholly unrecognizable, nor is there ever seen that sudden resumption of the typical form so often displayed by such species as *Stenophora julipusilli.*

This difference appears to be due mainly to the sarcocyte. Usually, in these polymorphic animals, the ectosarc consists of epicyte alone. Further, the epicyte may be thin. The facts, then, are in accord with what we should expect on mechanical principles. The elastic species possess a sarcocyte; the polymorphic do not. It may therefore be inferred that the elasticity is due to the sarcocyte, and confirmatory evidence is furnished by the Monocystidea. These animals, which are frequently highly polymorphic, appear generally to lack a sarcocyte. The rule, however, is not absolute, since *Stenophora* (*Cnemidospora*) *spiroboli* Crawley, the protomerite of which is very flexible, possesses a thick sarcocyte.

Obviously, the ability of a gregarine to display changes of form depends upon two factors.[1] These are the flexibility of its ectosarc and the power of the contractile elements. It has been shown that

[1] There is possibly a third factor, as will be pointed out below.

great differences exist in the first of these in different gregarines. I shall now consider the contractile element.

This is evidently the myocyte. The evidence that the myocyte is contractile is purely inferential, but none the less satisfactory. The fibre is the form always taken by differentiated contractile substance. Other protozoa, ciliates and flagellates, show like elements, and most of the movements displayed by polycystid gregarines are comprehensible only by assuming the myocyte to be a contractile system. On the other hand, certain movements exhibited by the polymorphic species cannot so readily be explained in this way, as I shall presently show.

Confining our attention for the moment to these movements for which the myocyte seems an adequate cause, they are found to be displayed by all gregarines. They are, however, as we should expect, far more definite in the elastic than in the polymorphic species. The most usual are mere bendings of the longitudinal axis, the character and extent of which appear to depend largely upon the shape of the gregarine and the nature of its ectosarc. The least extensive are bendings of the protomerite, which may take place in any plane. These may be so slight as to be difficult to detect, or so extensive that the axis of the protomerite comes to form a right angle with that of the deutomerite. They readily lead to a distortion wherein the angle in the longitudinal axis is formed in the deutomerite instead of at the septum. This may be a right angle even in such relatively thick species as *Stenophora julipusilli* Leidy. In *Gregarina dicœli* Crawley, which is a vermiform gregarine with a thin epicyte and no sarcocyte, this distortion becomes more evident. The protomerite and anterior part of the deutomerite bend round to form a hook, the anterior surface of the protomerite being directed backward. As the point in the longitudinal axis where the original bending takes place moves further and further backward, the hook becomes larger and larger until the gregarine forms a U. This U may pass into a circle and the circle into a coil or a spiral. *Gregarina polydesmivirginiensis* Leidy[2] displays contortions of exactly the same character. Animals such as *S. julipusilli* Leidy frequently bend double, but the circular or coiled condition cannot well be assumed by any but the long slender gregarines.

When only the protomerite is involved, the movement is frequently first to one side and then to the other. This may also happen when the anterior part of the deutomerite participates along with the proto-

[2] According to Léger et Duboscq (1903), this species belongs to the genus *Stenophora*, since it stands very close to the *Stenophora nematoides* of these authors.

merite. Occasionally, also, it is the posterior part of the deutomerite which is bent, the balance of the animal maintaining its original position. Yet however varied these bendings may be, they are all of them only contortions whereby the longitudinal axis loses its original straightness.

Their cause is contractions of the myocyte. It is easy to see how such contortions could be produced by a shortening of the longitudinal fibres of one side, possibly aided by a contraction of the transverse fibres at the place where the bendings originate. This pull on the part of the myocyte is resisted by the ectosarc to a greater or less extent, contingent upon its rigidity and elasticity. This is shown by the suddenness with which the ectosarc springs back to its original position, which presumably takes place when the pull exerted by the myocyte ceases to act. The behavior of the ectosarc in such a case is, as previously stated, precisely what it would be were it composed of india-rubber.

The following point is also worthy of note. When a gregarine begins to curve, one side is lengthened and the other shortened. The ectosarc is evidently capable of a certain amount of contraction, since a crescentic form may be assumed with the shortened side still presenting a smooth contour. But if the bending be carried to any considerable extent, the inner surface folds, the number and depth of these folds depending upon the shape of the gregarine and the extent of the curvature. This shows that the power of the ectosarc to contract is limited.

A movement of the same general character as the bending is one whereby the longitudinal axis is shortened. It consists in the pulling of the protomerite into the deutomerite, as one may withdraw the hand into the sleeve. I have noticed this in a number of species, although it is by no means so frequently seen as the bending. It is displayed indifferently by animals which are progressing and those which are not. As in the case of the bending, the return to the typical shape, in the elastic species, is by a sudden jerk. This movement is explainable by a shortening of the longitudinal fibres around a given zone of the animal's body.

There is finally the so-called peristalsis. This, as defined by Delage et Hérouard (1896), consists of "Contractions péristaltiques, produites par un étranglement transversal qui se propage le long du corps." It does not, however, admit of quite so simple a definition. It may be a swelling instead of a constriction. Further, it frequently happens that instead of a series of such constrictions or swellings there will be but one, which passes from the region of the septum to the posterior end of the animal. In the typical associations, as in *Gregarina*, this movement is described as passing from the anterior end of the primite to the posterior end of the satellite without the slightest pause. We have here a demonstration that it is not due to endoplasmic movements.

In general, the conspicuousness of the peristaltic movement depends on the character of the ectosarc. In the stiff, elastic forms this movement is by no means common, and when it does occur it generally consists of a single contraction. On the other hand, it is well displayed by the polymorphic species with thin ectosarcs. In one species, *Actinocephalus harpali* Crawley, I have frequently observed a disposition to rumple the edges of the body, so that they present a series of scallops. These scallops were seen to undergo slow changes in size and sometimes they moved slowly backward. I take this to be a peristaltic movement, although much slower than is usual.

The cause throughout is probably contractions of the circular fibres. Further, following the division which I have made, the peristaltic movement comes under the head of shortenings of the longitudinal axis.

The above are all the movements involving change of shape which can with absolute certainty be credited to contractions of the myocyte. They result in varied and frequently considerable alterations of the contour of the animal, but they can all be placed in two categories:

(1) Bendings and curvings of the longitudinal axis.

(2) Shortenings of the longitudinal axis.

The two may, and doubtless frequently do, take place at once, but apparently the first is by far the more frequent expression of the contractility of the myocyte.

There now remain for consideration a series of phenomena displayed by the polymorphic forms wherein the Polycystidea approximate the conditions normal to the Monocystidea. Of the several species which I have observed, they are best illustrated by *Trichorhynchus pulcher* Aimé Schn. This animal changes shape as readily as *Euglena* or even *Amœba*. The anterior margin of the protomerite may present a straight edge, a curve or a long tongue-shaped protrusion. The posterior end of the deutomerite may be bluntly rounded, sharply pointed or even bifurcated. The animal may also be so contorted as to lose all semblance to a polycystid gregarine and to present the kind of outline we associate with *Amœba*. These changes take place constantly, and by no means slowly, but always gradually. *Stenophora spiroboli* Crawley, another polymorphic species, has to be watched very patiently before the true form can be made out. It constantly displays contortions which are most conspicuous at the anterior end, and these contortions are of such a character that it is wholly impossible to say whether a given point of the surface is protomerite or deutomerite. From this end, moreover, little lobopodia were seen to arise and disappear.

In the case of a small gregarine from *Lithobius*, a very noteworthy movement was seen. This expressed itself as a slight peristalsis, the wave being evident at times on only one side. It was accompanied by a flow, *en masse*, of the granules of the entocyte. This flow, starting at the posterior part of the deutomerite, would pass forward until it struck the septum. Here the granular mass was deflected backward, the peristalsis being reversed at the same instant. In one case the nucleus was carried forward and backward along with the granules. This movement was seen both in animals that were progressing and those which were not. It was displayed constantly, but was generally very much faster when the animal was progressing. In one observation made, however, the gregarine showing this movement had its progression suddenly checked by striking an obstruction, and here the flow and peristalsis continued with unabated vigor. Frequently when gregarines are pinched by passing through narrow places, or when they bend, the entocyte is seen to flow. But in no other case amongst the Polycystidea which has ever come under my notice was the flowing anything like so free and extensive. These gregarines were very favorable for a study of the movements of the entocyte, since the number of granules was remarkably few and their flowing easy to observe.

A somewhat similar peristaltic movement was once seen in *Trichorhynchus pulcher* Aimé Schn. Here, the gregarine lying in one place, the wave arose at the posterior end and passed forward. The movements on both sides were not synchronous. It differed from the case just described in that there was no reversal, the movement being continuously forward.

The protrusion of the long tongue-shaped process by *T. pulcher* and of the lobopodia by *S. spiroboli* are not satisfactorily credited to activity of the myocyte. Such an action would appear to involve the spontaneous lengthening of relaxed fibres, which is scarcely possible. But even if it did not, the form of the myocyte, which is that of a fine-meshed net, would not seem to lend itself to such movements. They would necessitate an enormous elongation of a very small part of the system, and would thus predicate a complexity of action which we could hardly expect in so simple an apparatus. Without, however, desiring to prejudice the decision, it is advisable to see if an explanation may not be had along different lines.

The formation of pseudopodia in rhizopods is due to movements of the endosarc, and in gregarines the endosarc is evidently mobile. It may therefore be suggested that the polymorphism of certain of the Polycystidea is caused in the same way as it is in Rhizopoda. An endoplasmic flow, if by chance it were directed radially, would evidently result in such protrusions as are actually seen in *Trichorhynchus*. For it is to be remembered that such forms have a thin, extensible ectosarc, which would offer little resistance to such a flow. The difficulty in arriving at a decision is that the endosarc of most polycystids is so opaque that flowing movements might take place without it being possible to detect them. As I have already stated, the little gregarine of Lithobius is the only species at all favorable for a study of this element which has yet come under my notice.

In the Monocystidea, however, the conditions are more favorable. Flowing of the endosarc is a matter of common observation, and it has generally been taken to be the cause of their polymorphism. While this may be so, my own observations on monocystids lead me to question it. These were made on a species of *Diplocystis*, a parasite of *Allolobophora longa*. This gregarine has the form of a serpent. In the cases observed movements were constant. There would appear at any point of the body a swelling which passed rapidly either forward or backward. The endoplasm fills this swollen part, flowing into it in front and out of it behind. Two such swellings may arise simultaneously and, advancing toward each other, amalgamate. The large swelling thus produced would maintain a fixed size for a moment, and then from its central part two streams would start in opposite directions, and the swelling would rapidly disappear. In one case the peripheral granules in a swelling moved along with it, while those in the centre moved in the opposite direction.

An individual of this species was observed to burst, permitting the escape of a portion of the granular contents. The ectosarc thereupon contracted, and showed very plainly a series of striæ, parallel and spirally disposed. Evidently these striæ were the expression of a powerful myocyte.

Contractions of the myocyte would produce a flowing of the endoplasm; flowing of the endoplasm would result in extensions of the limiting layer. Hence, on purely *à priori* grounds, the one explanation has as much claim to consideration as the other. In the case of the phenomena just described, however, it seems far more reasonable to credit them to muscular action. They were movements evidently to be compared with the peristalsis of the Polycystidea, which, as I have pointed out, cannot be credited to endoplasmic currents. Moreover, they were so rapid and so evidently powerful that a comparison with what we see in *Amœba* fails. Further, if they were caused by endoplasmic movements, the myocyte is left without a function, which is a most improbable supposition.

It therefore seems more probable that the polymorphism of the Monocystidea is due to muscular action. Hence, by analogy, the polymorphism of the Polycystidea should be accounted for in the same way. Nevertheless, as I have indicated, this view has certain objections and the decision is better postponed until additional data are obtained.

In an article on the progression of gregarines (Crawley, 1902), I endeavored to show that when the protomerite of a gregarine is bent to one side or the other, the surface of the deutomerite shows a wave which passes backward and transversely at the same time. My observations also indicated that the extent of the bending of the protomerite conditioned the extent of this wave. Further, when the bending of the protomerite was first to one side and then to the other, that is, when it oscillated, the transverse component of the wave on the surface of the deutomerite was also first to one side and then to the other. I therefore regard these two manifestations of activity as due to the same contraction of the myocyte. That is, a contraction which causes the protomerite to bend causes also this wave to pass over the surface of the deutomerite.

Certain criticisms which have been made upon this paper lead me to suppose that I did not bring out this point as clearly as desirable. I shall therefore make use of a comparison. If we bare the forearm and then slowly close the fingers tightly, a muscular wave passes upward and outward along the dorsal surface of the arm. By alternately contracting and relaxing the fingers, this wave exhibits an alternate transverse movement. In this case, the conspicuous result of muscular contraction is the closing or opening of the hand, but it is necessarily correlated with the disturbance on the surface of the forearm. In the gregarine, the oscillation of the protomerite is the conspicuous manifestation of muscular activity, and, under ordinary conditions of observation, the only one which is seen. But it is always accompanied by the wave on the surface of the deutomerite. The result is that a given point on the gregarine's surface pushes backward and transversely upon whatever may be in contact with it. This brings about a movement of the entire animal in an opposite direction. The movement will be rectilinear or zigzag, dependent on the less or greater extent of the transverse movement. This last, in its turn, depends on the extent of the oscillation of the protomerite. Hence, when the gregarine is advancing in a straight line, the evidence for muscular action is very slight.

My observations also indicated that gregarines are sticky, and that they do not seem able to progress unless in contact with a surface. I was therefore led to postulate the stickiness as more or less of a necessity in progression, its *rôle* being to prevent slipping of the particular part in contact with either the slide or cover-glass. Later observations, however, have led me to modify this opinion. Contact appears necessary, but not necessarily contact with a continuous surface. The observations were as follows:

The host intestine was teazed on a cover-glass, under a limited quantity of salt solution. The cover-glass was then inverted, and supported on a ring. In this way a mount having considerable depth was obtained. The results were to show that gregarines are able to progress away from a surface provided they can get into contact with some solid matter. One, originally moving on the surface film on the bottom of the drop, pushed its way upward through the particles of host intestine. In such cases, however, progression is slow and apparently difficult, and accompanied by constant and violent contortions. It may, moreover, be stated that in proportion as the environment renders progression more difficult, the evidences for muscular activity become more obvious. Thus, when an advancing gregarine encounters a mass of loose host tissue, it frequently endeavors to bore or wriggle its way through, and muscular contractions at once become very extensive.

The ability of gregarines to make their way amidst particles of solid in a hanging drop suggests that, in some cases at least, progression is effected in somewhat the same way as that of a snail. The presence of an adhesive substance on the surface may assist, but the primary factor is the alterations of the contour of the surface. These are doubtless by no means so regular as those of the foot of a snail, nor is gregarine progression usually so smooth. Yet, without going into tedious details, it is easy enough to see how such movements could produce progression. When, however, progression is being effected on a smooth surface, the adhesive substance probably plays a part.

A curious phenomenon was once exhibited by a little gregarine of *Scolopocryptops sexspinosus*. This is a very active species, progressing continually in straight lines and curves of long radius. It would occasionally give a sudden jerk, and advance by perhaps its own length by a leap. This ability to leap was never seen in any other species.

There finally remains for consideration what is probably a form of the progressive movement. Prior to encystment gregarines pair, the association in a genus like *Gregarina* being apparently only precocious pairing. It may be "head to tail" as in *Gregarina*, or "head to head" as in *Pterocephalus*. In either case the pair bends double at its middle point, thus bringing the gregarines side by side. Before or during this last process the system begins to rotate. During the course of this rotation the two individuals become more and more closely apposed until a spherical form is assumed. Meanwhile a common covering is secreted, the cyst formed and eventually the rotatory movement ceases.

This movement is generally mentioned by those authors who have made observations on the encystment of gregarines, but no attempt appears to have been made to account for it. Bütschli (1881), however, states that muscular contractions are to be observed at the time when the two animals begin to fuse. The explanation advanced by Schewiakoff, that gregarines progress by means of the extension of a stalk of gelatinous fibres, is here manifestly inapplicable. Further, since according to the accounts the rotation continues until after a certain amount of a gelatinous investment is secreted, changes of surface contour would not seem to be of effect. One point, however, is worthy of attention. The rotation, both in nature and when the gregarines are on the slide, doubtless takes place when the animals are suspended in a liquid. The only opposition which the rotation encounters is then the friction of this liquid, and this would be almost infinitesimal. That is, it does not seem necessary to assume that the impulse lasts as long as the rotation itself. The latter, once started, would continue of its own momentum for probably a considerable period of time.

Accurate observations are, nevertheless, a desideratum, and, as I have stated, these are yet to be made. I have, however, at times observed a rotation on the part of solitary gregarines. One case was particularly striking. The gregarines, specimens of *Trichorhynchus pulcher* Aimé Schn., holding the body bent, moved around the circumference of a circle. The curved longitudinal axis of the animals formed an arc of this circumference, the radius of which was perhaps one-half the animal's length. That part of the circumference not occupied by the gregarine was filled with a mass of sundry small particles, the movements of which followed that of the gregarine. That is, there was evidently present a ring-shaped mass of invisible jelly which was continuous from the anterior to the posterior end of the gregarine. In this case, although the conditions for observation were favorable, no cause for the motion could be detected. I have also seen individuals of *Stenophora julipusilli* exhibit this rotation.

These phenomena, while not in any way explaining the cause of the rotatory motion, show that it is not necessarily correlated with encystment. It is merely one of the several phases of the mobility of gregarines, ordinarily most conspicuously in evidence at the time of encystment. It has been the custom to separate these several phases and to treat them as wholly distinct phenomena. This custom I believe to be unfortunate. It appears to me that all the motor phenomena which the Polycystidea display may be directly credited to contractions of the myocyte, with the possible exception of the amœboid movements of certain species, and the rotation. For these observational evidence is required before pronouncing a final decision.

Bibliography.

Bütschli, O. 1881. Kleine Beiträge zur Kenntniss der Gregarinen. *Zeit. f. wiss. Zool.*, Bd. 35, pp. 384–409, Taf. 20 u. 21.

Crawley, Howard. 1902. The Progressive Movements of Gregarines. *Proc. Acad. Nat. Sci. of Philadelphia*, January, 1902, pp. 4–20, Pl. 1, 2.

Delage et Hérouard. 1896. Traité de Zoologie Concrète. Tom. I, *La Cellule et Les Protozoaires*, Paris.

Léger et Duboscq. 1903. Recherches sur les Myriapodes de Corse et leurs Parasites. *Archiv. de Zool. expér. et gén.* [4], Vol. I, pp. 307–358.

Schewiakoff, V. 1894. Ueber die Ursache der fortschreitenden Bewegung der Gregarinen. *Zeit. f. wiss. Zool.*, Bd. 58, pp. 340–354, Taf. 20 u. 21.

February 7.

Mr. Arthur Erwin Brown, Vice-President, in the Chair.

Twenty-two persons present.

The deaths of the following members were announced: George M. Stiles, M.D., June 9, 1904; William Sellers, January 24, 1905; and Albrecht Jahn, February 6, 1905.

The Publication Committee reported that papers under the following titles had been presented for publication:

"New Japanese Marine Mollusca," by Henry A. Pilsbry.

"Mollusca of the Southern States, I," by Henry A. Pilsbry.

"Mollusks of Flint and Caroline Islands, in the Central Pacific," by Henry A. Pilsbry and Edward G. Vanatta.

"A Contribution to the Knowledge of the Centrarchidæ," by Henry W. Fowler.

February 21.

The President, Samuel G. Dixon, M.D., in the Chair.

Twenty-three persons present.

The deaths of Jay Cooke, a member, February 17, 1905, and of Dr. Alpheus S. Packard, a correspondent, February 14, 1905, were announced.

The Publication Committee reported that papers under the following titles had been presented for publication:

"A New Species of Sea-Mouse (*Aphrodita hastata*) from Eastern Massachusetts," by J. Percy Moore.

"A Contribution to the Knowledge of the Orthoptera of Cuba, the Isle of Pines and the Bahamas," by James A. G. Rehn.

"A Contribution to the Knowledge of the Acrididæ (Orthoptera) of Costa Rica," by James A. G. Rehn.

Mr. Samuel S. Van Pelt was elected a member.

The following were ordered to be printed:

NEW JAPANESE MARINE MOLLUSCA.

BY HENRY A. PILSBRY.

The new species described herein are further evidences of the energy and industry with which Mr. Hirase is investigating the molluscan fauna of his country. For the illustrations I am indebted to Mr. Vanatta.

A name used by me last year, *Terebra hedleyi*, proves to have been applied before to a different species.[1] I propose, therefore, to change the name of the Japanese species to *Terebra hedleyana*. The description may be found in these *Proceedings* for 1904, p. 3.

Conus voluminalis avus n. subsp. Pl. II, fig. 4.

General form of *C. voluminalis* Hinds, but the later whorls are almost flat instead of concave above, and are smooth except for weak oblique growth-wrinkles. The conic earlier whorls are weakly marked with about three spiral lines, and the angular periphery is very slightly nodulous and projects a little above the suture. The last whorl is smooth except for about twelve grooves at the base.

Length 38, diam. 19 mm.

Kikai, Ōsumi, in a deposit probably of Pliocene age. Types No. 88,296, A. N. S. P., from No. 1,578 of Mr. Hirase's collection.

Conus aratispira n. sp. Pl. II, fig. 1.

Shell slender and long, with high, turreted spire, biconic, the cone of the spire about one-third the total length, somewhat terraced, the whorls angular in the middle, smooth below the angle, steeply sloping and marked with 4 or 5 spiral grooves above it, the shoulder of the intermediate whorls very weakly tuberculate in well-preserved specimens. Last whorl obliquely striate toward the base, the grooves and convex intervals of equal size below, but upwards they become more widely spaced, with wide flat intervals. The aperture is narrow, its length about three-fourths that of the shell.

Length 42, diam. 13.5 mm.

Length about 48, diam. 16 mm.

Kikai, Ōsumi, in a deposit of probably Pliocene age. Types No. 88,297, A. N. S. P., from No. 1,579 of Mr. Hirase's collection.

This belongs to a small group of cones with the spire much elevated.

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[1] See *Proc. Linn. Soc. N. S. W.*, 1904, pp. 187, 211.

Columbella pardalina subcribraria n. subsp. Pl. IV, fig. 23.

Shell obesely fusiform, swollen in the middle; dark brown closely spotted with white, without a darker or otherwise differentiated subsutural band. There are some spiral striæ at the base, but the surface is otherwise smooth. The aperture is narrow, sinuous, more than half the length of the shell, the outer lip decidedly thickened within in the middle, armed with about five tubercular or elongated teeth; apex entire or nearly so. Whorls 7 to 7½. Length 11.5, diam. 5.5 mm.

Hahajima, Ogasawara. Types No. 88,924, A. N. S. P., from No. 1,606 of Mr. Hirase's collection.

This form has a superficial resemblance to *C. cribraria*, but the shape of the aperture shows it to be related to *C. pardalina japonica* Rve. (+*C. sagena* Rve.). *C. p. subcribraria* is only about half the size of its larger cousin, its aperture is slightly less contracted and the spots are smaller, but otherwise the two forms do not differ materially.

Buccinum unicum n. sp.

Shell solid but rather thin, ovate-conic, fleshy-whitish under a very thin, smooth, dehiscent light olive cuticle. The last whorl has a strong keel at the shoulder, above which the surface slopes up to the suture, with a second obtuse keel a little nearer to the suture than to the first keel. Below the shoulder keel the surface is at first slightly concave, then evenly convex and rather swollen, contracting as usual below. The whorls of the spire are terrace-like, and the last 4 at least are carinated like the last whorl, those above being deeply eroded. Whorls 6. The base is sculptured with strong spiral cords, gradually diminishing toward the periphery. Over the whole there is a minute sculpture of fine spiral striæ, beautifully crenulated by minute growth-striæ. The aperture is white within, outer lip simple and unexpanded. The columellar margin is concave in the middle, straight below. The anterior notch is moderately wide and deep. The inner lip is covered with a white enamel, preceded by an eroded groove.

Length 58.5, diam. 32, length of aperture 31 mm.

Kisennuma, Rikuzen. Type No. 88,820, A. N. S. P., from No. 1,761 of Mr. Hirase's collection.

This peculiar whelk has much resemblance in general figure to *Buccinum taphrium* Dall, type of the section *Sulcosinus*. It is more elongated than that, and differs further in the less spreading columellar callous, the much less sinuous columella, the additional keel above the shoulder, and in not having a channelled suture, though the upper keel, in a more depressed shell, would define a channel. It seems to connect *Sulcosinus* with the more normal forms of *Buccinum*.

Buccinum chishimanum Pilsbry. Pl. III, fig. 20.

Nautilus, XVIII, p. 87, December, 1904.

Etorō, Chishima (Kuril Is.).

Siphonalia vanattai n. sp. Pl. III, fig. 12.

The shell is obesely-fusiform, the greatest width about median, solid and strong; white, irregularly marked with dull purplish-brown spots of irregular shape, and with narrow reddish-brown spiral lines, most distinct behind the lip, six and equidistant or fewer by the omission of some of them. Whorls 6 (the protoconch being lost in the specimens seen), longitudinally costate, 13 to 15 rounded ribs on the last whorl, where they are most prominent at the shoulder, rapidly diminishing below it, and not extending upon the base; sculptured throughout with spiral rounded cords with threads occasionally interposed. The last two whorls are subangular at the shoulder, the preceding whorls being very convex. Last whorl is strongly contracted below. The aperture is oblique, its length (including the anterior canal) about two-thirds that of the shell, pale, dull, reddish-brown inside becoming ochre-fleshy between the liræ, pure white on the bevelled edge. It is rather sharply sulcate within. The outer lip is symmetrically arched. Anterior canal deep and moderately recurved.

Length 28, diam. 15 mm.; aperture to end of canal 19 mm.

Length 26, diam. 13.7 mm.; aperture to end of canal 17 mm.

Yakushima, Ōsumi. Types No. 87,746, A. N. S. P., from No. 1,602 of Mr. Hirase's collection.

This small species resembles *S. hinnulus* in general contour and coloration; but it is much smaller, decidedly plicate, and lirate within the aperture. It does not seem to agree with any of the numerous unfigured and insufficiently described forms introduced by A. Adams. *S. spadicea* is more slender than *S. vanattai.*

Twenty-seven species of *Siphonalia* are now recorded from Japan. Of these, *S. hyperodon* Pils. is a synonym of *S. mikado* Melvill.[2] *S. stearnsii* Pils. is closely related to *S. pseudobuccinum* Melv., but seems to differ by its shorter anterior canal. *S. semiplicata* Pils. is a synonym of *S. fusoides* Rve., while *S. longirostris* Dkr. seems to be merely a variety of the same species. Eleven species have been described without figures by A. Adams. Omitting these, there remain about fourteen recognizable Japanese Siphonaliæ.

Maculotriton bracteatus longus Pils. and Van. Pl. III, fig. 13.

Proc. A. N. S. Phila. for 1904, p. 595.

Tanabe, Kii.

Length 11.5, diam. 4.7 mm.

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[2] *Journ. of Conchology,* V, p. 348.

Usilla gouldii (Smith). Pl. III, fig. 14,

Planaxis cingulata Gld., Otia Conch., p. 140, not of A. Adams.
Planaxis gouldii E. A. Smith, Ann. and Mag. N. H., 1872, IX, p. 42.

Shell ovate-oblong, thick and solid. On the last whorl there is a subsutural welt followed by a depression, then seven slightly convex girdles separated by narrower spaces, each occupied by a single low cord at and above the periphery, but on the base the spaces are wider, with two or three cords; on the spire a microscopic, dense subvertical striation may be seen in unworn specimens. The girdles are very low, almost flat on the latter part of the last whorl, but more and more raised earlier, two strong ones appearing on the penultimate whorl, where they are somewhat nodose. On the earlier whorls these two girdles and the subsutural welt are set with transversely oblong tubercles along weak vertical folds. Siphonal fasciole short and convex. Whorls about 6½, the tip minutely eroded, the first whorl smooth. Last whorl tapering and a little concave below the slightly swollen peripheral region. Aperture oblique, about three-fifths the total length of the shell, blackish within, with a single peripheral pale line. Anterior channel short and deep, posterior sinus narrow and gutter-like, defined by a curved ascending callous cord on the lip and a small callous pad on the body. Outer lip regularly arcuate, thickened within and armed with six teeth in adult shells. Columellar margin dilated, rather wide. Color blackish-brown, with blue spots on some of the spiral girdles, the tubercles on the spire and a few bands in intervals on the last whorl being yellowish. Behind the lip all of the intervals between the raised girdles become yellowish, terminating in subtriangular yellow spots on the bevelled lip, seven in number.

Length 13.2, diam. 7 mm.

Length 11.7, diam. 6 mm.

Hahajima, Ogasawara. The specimens described are No. 87,754, A. N. S. P., from No. 1,628 of Mr. Hirase's collection. Gould's types were from Ōshima, Ōsumi.

This peculiar little whelk has been unfortunate in its biographers. Dr. Gould placed it in a wrong genus and family, and used a preoccupied specific name; and Mr. Smith, who renamed it, had not seen a specimen, and left it in the genus *Planaxis*. Pease, in a note on *Usilla fusconigra*, alludes to Gould's species as a member of *Usilla*.[3] The species has not been figured hitherto.

The group *Usilla* has been considered a subgenus of *Vexilla*, and located in the *Purpurinæ*. The rather flat columella, and yellowish

[3] *Amer. Journ. of Conch.*, IV, 115.

bands of the shell, and the microscopic vertical lineolation discernible in places on *U. gouldii* are in favor of this classification, while the form of the shell and the other characters of the aperture remind one more of *Pisania* or *Tritonidea* in the *Buccinidæ*. Until the dentition can be examined, the position of *Usilla* must be left in doubt.

U. gouldii is a larger and rougher species than *U. fusconigra*, with the spire much more strongly sculptured. No other species are known to belong to the group.

Columbella liocyma Pils.

Described in these *Proceedings*, 1894, p. 14. The locality, Hachijo, Izu, was omitted.

Planaxis abbreviata ogasawarana n. subsp. Pl. III, figs. 18, 19.

The shell is larger and longer than *P. abbreviata* Pease, ovate-conic, thick and solid, chocolate-brown, the last whorl covered with a dull fibrous cuticle. Sculpture of spiral grooves, often weak in the middle of the last whorl, strong below the suture and at the base. Whorls about 6, convex. Aperture oblique, the outer lip thickened within, and bearing 11 to 14 liræ, which *extend into the throat;* basal and posterior notches small, deep and rounded.

Length 13, diam. 7.7 mm.

Length 12, diam. 7 mm.

Hahajima, Ogasawara. Types No. 87,769, A. N. S. P., from No. 1,629 of Mr. Hirase's collection.

This is a more robust form than *P. nigra*, with liræ in the throat like the Polynesian *P. abbreviata*.

Natica (Haloconcha) hirasei n. sp. Pl. II, figs. 5, 6.

Shell *wholly imperforate*, similar in shape to *N. clausa* B. and S. Brown-tinged white, with two chocolate-brown bands, which are more or less interrupted into spots or oblique streaks, one in the middle of the upper surface and ascending upon the penultimate whorl, the other immediately below the periphery. The surface is rather dull, marked with growth-lines, and showing faint, fine, subobsolete spiral striæ. Whorls 4½, convex, the spire very small. The aperture is oblique, half-round and chestnut colored inside, with a pale entering basal band and wide white lip-margin. The umbilical pad is small, semicircular, bounded by a furrow, and *separated from the parietal callous by a rather large notch.*

Length 17, diam. 15 mm., operculum 10 x 6.7 mm.

Length 15.5, diam. 14.5 mm.

The operculum (fig. 5) is ovate, slightly concave and white externally, with a short, low, curved rib over the spiral part, and a very faint impressed line parallel to the outer margin. The edge is rather thick.

Akkeshi, Kushiro, Hokkaido. Types No. 87,768, A. N. S. P., from No. 1,618 of Mr. Hirase's collection.

This species differs from *N. clausa* by the color-belts of the shell, the notch between the umbilical pad and the parietal callous, and the faint line parallel with the outer margin of the operculum. It differs from *N. janthostoma* Desh. and *N. adamsiana* Dkr. by the closure of the umbilicus, and in wanting strong grooves on the operculum.

Torinia densegranosa n. sp. Pl. III, figs. 15, 16, 17.

The shell is rather openly umbilicate, depressed-conic, dull light reddish-brown, with some indistinct darker and yellowish spots along the periphery. The spire is low-conic, apex obtuse; whorls 5½, but slightly convex, the last rounded peripherally. The sculpture consists of unequal flattened spiral cords and threads, cut by *very fine, close and regular radial grooves.* The cords are rather wide and flat except near the periphery, where two or three of them are convex and slightly prominent. Four spiral cords are visible on the upper surface, with a thread between the third and fourth. On the periphery there are two with a thread between them. On the base there are five; the outer one smaller, with a thread on each side of it, the umbilical cord coarsely crenate, the next outer one with only about half as many radial incisions as the following cords. There is a fine, not very distinct, spiral striation over the coarser sculpture described. The aperture is notched at the termination of the umbilical cord. The operculum is a conic stack of thin yellow lamellæ.

Alt. 5, diam. 8.5 mm.

Fukura, Awaji. Types No. 88,306, A. N. S. P., from No. 1,568 of Mr. Hirase's collection.

Chiefly notable for the close radial sculpture. The sculpture of the base, omitted in fig. 16, is shown enlarged in fig. 17.

Cingula kurilensis n. sp. Pl. IV, fig. 31.

Shell minutely perforate, ovate-conic, dark brown with more or less extensive, eroded, ashen patches, sometimes the whole surface eroded. Marked with fine, inconspicuous growth-lines where unworn. Whorls 5, convex, the last ventricose. Aperture roundly-ovate, slightly subangular. Peristome thin and simple, continued in an adherent callous across the parietal wall. Columella arcuate.

Length 3.3, diam. 2, longest axis of aperture 1.7 mm.

Kunashiri, Chishima [Kuril Is.]. Types No. 88,303, A. N. S. P., from No. 1,599 of Mr. Hirase's collection.

This little *Amnicola*-like snail is smaller than *Cingula robusta* 'Dall' Krause, and has no spiral sculpture. It is a wider shell than *Onoba aleutica* Dall, which seems to be its nearest relative.

EULIMIDÆ.

In my *Catalogue of the Marine Mollusks of Japan*, p. 77, some 23 species of *Eulima* are recorded, exclusive of *Leiostraca*, etc. Of this number "*E. cumingi* Sowb." may have been an erroneous identification, but as the specimen upon which it was based is not now accessible to me, I am unable to revise it. The original *E. cumingi* A. Ad.[4] was described from "Lord Hood's Island, South Pacific," but, as in numerous other cases, the island intended by the label may have been one of the Galapagos group, for the species does not seem to differ materially from *Eulima splendidula* Sowb.,[5] described from St. Elena, west coast of Colombia.

The name *Eulima stenostoma* A. Ad. is preoccupied for a species described by Jeffreys, and may therefore be ignored. There remain 18 species "described" by Arthur Adams in his absurdly inadequate manner, *without dimensions* or mention of the varices. While nobody would presume to identify specimens by these diagnoses, it is frequently possible to ascertain that no one of them corresponds wholly with a particular specimen in hand. To facilitate such use of the descriptions, I have recast the whole of them in the accompanying table. The most prominent characters of any specimen may now be compared with the entire series by glancing down the appropriate column, without the waste of time and diversion of attention ensuing from reading over the whole descriptions.

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[4] *Proc. Zool. Soc. Lond.*, 1851, p. 277.
[5] *Conchol. Illustrations*, fig. 7.

	Form.	*Curvature.*	*Whorls.*	*Suture.*	*Varices.*	*Last Whorl.*	*Aperture.*	*Peristome.*	*Color and Dimensions.*
E. robusta.	Pyramidal-subulate.	Flexuous, apex recurved.	Slightly convex.	Margined.		Large, oblique, rounded basally.	Ovate, produced.	Inner lip thickened above, outer lip arcuate.	Milk-white, semiopaque.
E. clavula.	Acutely pyramidal.	Apex inclined backward.	8, planulate.	Margined.		Wide, slightly angulate at periphery, oblique at base.	Small, ovate, effuse.	Inner lip thickened.	Milk-white, opaque, rather solid.
E. pinguicula.	Acutely pyramidal.	Arcuate, apex inclined forward.	8, planulate.			Large, oblique, obtusely angulate at periphery, oblique at base.	Small, porrect, ovate.	Inner lip thin, arcuate.	Milk-white, opaque, solid.
E. curvata.	Subulate, slender.	Arcuate, inclined forward.	7, planulate.			Elongate, produced forward.	Long oval.	Inner lip thin, curved.	White, opaque, rather solid.
E. mundula.	Subulate.	Tortuose, the spire laterally curved.	9, a little convex.			Ample, oblique at base.	Ovate, produced.	Inner lip thickened, outer arcuate, slightly inflexed.	Milk-white, subopaque.
E. stylata.	Subulate.	Slightly flexuose, spire laterally curved.	8, planate.	Obsoletely impressed.		Elongate.	Oblong, produced forward.	Lip arcuate.	White, opaque.
E. acicularis.	Subulate-pyramidal.	Posteriorly somewhat recurved, apex obtuse.	7, planate.			Angulate at the periphery.	Subrhombic.	Lip angulate in the middle.	White, semi-opaque.

E. flexa.	Subulate.	Flexuous, spire laterally and then posteriorly inclined.	About 12, planate.	Obsolete.		Long, rounded.	Ovate, acuminate posteriorly.	Inner lip thin.	Milk-white, semiopaque.
E. pandata.	Subulate, slender.	Flexuous, spire laterally inclined.	8, planate.			Long, produced forward.	Oblong, dilated anteriorly.	Inner lip thin, outer arcuate.	Milk-white, subopaque.
E. reclinata.	Subulate-pyramidal.	Spire acute, inclined backward.	6, planate.			Large, long, slightly angulate at periphery.	Oblong, anteriorly produced.	Lip subangulate in the middle.	Milk-white, opaque.
E. semitorta.	Subulate.	Subflexuose.	10, planate.			Long, rounded at periphery.	Ovate, posteriorly acute, anteriorly produced and dilated.	Inner lip thin, arcuate.	White, rufous tinted, thin, semipellucid.
E. eburnea.	Subulate.	Flexuous, spire recurved.	8, planate.			Large, wide, rounded.	Ovate, acute.	Inner lip rather straight, outer arcuate.	Ivory-white, solid.
E. dentaliopsis.	Subulate-pyramidal.	Straight, apex subobtuse.	9, planate.	Distinct.		Angulate at periphery.	Ovate.	Inner lip thin, outer arcuate in the middle.	White, glossy, subpellucid.
E. angulata.	Pyramidate-subulate.	Flexuous, apex recurved.	11, planate.			Angulate.	Short, ovate.	Inner lip thickened, short, straight, outer angulate in the middle.	White, opaque, solid.
E. valida.	Subulate.	Straight.	10, planate.		Last and penult. whorls varicose.	Rounded.	Oblong, produced in front.	Inner lip short, thickened, the outer lip arcuate.	White, opaque, solid.

	Form.	Curvature.	Whorls.	Suture.	Varices.	Last Whorl.	Aperture.	Peristome.	Color and Dimensions.
E. odontoidea.	Subulate.	Subflexuous, spire attenuate.	10, planate.			Ample, rounded.	Ovate, produced in front and narrowed.	Inner lip short, thin, curved, outer produced and arcuate.	Milk-white, semiopaque.
E. chrysallida.	Subrimate, ovate-subulate.	In the middle thickened, straight, apex slightly inclined.	11, slightly convex.	Margined.		Rounded.	Ovate.	Inner lip thin, rather straight, outer margin produced in the middle.	White, solid, semiopaque.
E. debilis.	Short, subulate.	Straight.	7, planate.			Long, dilated at the base.	Ovate.	Inner lip thin, slightly curved, outer margin produced and arcuate.	White, thin, semipellucid.
E. indeflexa.	Pyramidal-subulate.	Straight.	10, planate.	Margined.		Large, rounded.	Ovate, anteriorly dilated.	Inner lip regularly curved, the outer margin dilated and arcuate in the middle.	White, opaque, solid.
E. scitula.	Subulate, at base dilated.	Slightly flexuous, spire laterally inclined.	9, planate.			Rounded, dilated in the middle, oblique at base.	Ovate.	Inner lip arcuate.	White, thin, semipellucid.
E. carneola Gld.	Elongate-conic.	Apical 3 whorls pillar-like, the first globose, then 2 conic and 5 planate whorls.		Scarcely marked.		Base rounded.		Outer lip hardly sinuate, thickened.	Subdiaphanous, fleshy, very glossy, 4+x 1.5mm.

It will of course be understood, in studying descriptions of *Eulimidæ*, that the terms "spire inclined posteriorly," "apex recurved," etc., are not in themselves significant, except in species with the varices all on one side. In forms with alternately right and left varices, the spire will be inclined first toward one, then toward the other side, or the apex either forward or backward; and in species with irregular varices, the curvature may be in any direction. Moreover, the count of whorls is not especially significant except in combination witn the length of the shell. As in any shell having varices, there is no certain criterion of adult growth except where a number of specimens are in hand.

Eulima bovicornu n. sp. Pl. II, figs. 9, 10.

Shell moderately solid but not thick, white and glossy, the spire regularly tapering, attenuate near the apex, *strongly bent to the right* and backward. Whorls about 13, slightly convex, the sutures but lightly impressed. *Varices distinctly impressed, one on each whorl, all on the right side,* where they form a slowly receding ascending line, each succeeding one being very slightly in advance of the preceding. The aperture is ovate, the outer lip obtuse, arching well forward in the middle, receding above. Columella short, concave, slightly calloused but without a reflexed edge.

Length 15, diam. 4.7 mm.

Length 13, diam. 4.3 mm.

Hahajima, Ogasawara. Types No. 88,309, A. N. S. P., from No. 1,603 of Mr. Hirase's collection.

This species is apparently a near relative of *E. tortuosa* Adams and Reeve[6] from the China Sea, but that species is, from the figure, a little more slender, more attenuated near the apex, and it has a longer, vertical and straightened columella. With a length of about 12 mm., *E. tortuosa* is said to have 12 to 14 whorls.

Another specimen was sent from Kikaiga-shima, Ōsumi.

Eulima ogasawarana n. sp. Pl. II, figs. 2, 3.

Shell *thick* and solid, white and polished, the spire somewhat attenuated above and noticeably bent, acute. Whorls 12 or 13, nearly flat, the suture impressed and *distinct*. *Varices very few*, only 3 or 4 on the whole shell, irregularly placed and *deeply impressed*. Aperture small and ovate, vertical, the *outer lip very thick, but little arched for-*

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[6] *Zool. 'Samarang,'* p. 53, Pl. 11, fig. 26. The figure in the *Conch. Iconica* does not look like the same species. It has been copied by Tryon in the *Manual of Conchology*.

ward in the middle. Columella heavily calloused, with *broadly reflexed appressed edge.*

Length 11.3, diam. 3.5 mm.

Length 10.3, diam. 3.3 mm.

Hahajima, Ogasawara. Types No. 88,311, A. N. S. P., from No. 1,604 of Mr. Hirase's collection.

This species is much thicker than *E. valida,* with deeper variceal furrows and calloused columella. It is also more bent.

Eulima luchuana Pils. Pl. II, figs. 7, 8.

Proc. A. N. S. P., 1901, p. 396.

Shell rather thin, white and glossy, regularly tapering, almost straight, though there is a quite perceptible curvature near the apex. Whorls 10 or 11, slightly convex, the suture but slightly marked. Varices slightly impressed, not very distinct, mostly separated by the space of somewhat more than a whorl, and therefore quite irregularly placed. The aperture is acuminate-ovate, the outer lip obtuse, arched forward in the middle, retracted above and below; the columella slightly concave, slightly calloused, the edge not reflexed.

Length 11, diam. 3.7 mm.

The specimens originally described from Loochoo (Okinawa) Island had lost the apices. The description above is from perfect shells from Kikaiga-shima. The varices are all on the face and right side in the two type specimens, as stated in the original description, but this is merely accidental; in the larger series now received there are sometimes a few on the left side, though most of them are on the face, right side or back, usually scattered through an arc of a third of the circle, but sometimes several are in a line on successive whorls.

This species corresponds fairly well with A. Adams' description of *E. valida,* but that shell is said to be *straight,* and no dimensions are given. The curvature of *E. luchuana,* while slight, is readily appreciable.

Eulima articulata Sowerby. Pl. II, fig. 11.

P. Z. S., 1834, p. 8; Conch. Illustr., fig. 12; Conch Icon., XV, Pl. 1, fig. 1.

The shell is straight, slender and regularly tapering, solid but not thick, glossy and nearly smooth, but fine, forwardly-oblique growth-scratches are visible under a lens. The varices are situated at intervals of three-fourths of a whorl, each marked by a white stripe followed by a brown one, an impressed line between them. Color pinkish-brown, with a white band below the suture and another at the periphery, both with articulated brown and white borders. Whorls 14, the upper ones nearly flat, the last two or three more convex. The aperture is ovate, the outer lip, arched forward in the middle, retracted above. Columella arcuate, moderately calloused.

Length 24.5, diam. 6.3, length of aperture with peristome 5.2 mm.

Length 23.3, diam. 6.5, length of aperture with peristome 5.7 mm.

Hahajima, Ogasawara. No. 88,310, A. N. S. P., from No. 1,605 of Mr. Hirase's collection.

So far as I know, this species has been recorded hitherto only from Australia. I have not been able to compare Australian specimens, and various important details, such as the number of whorls, are not mentioned in the published descriptions. No critical comparison with them of the specimens from the Bonin Islands can therefore be made at this time.

Phorcus borealis n. sp. Pl. IV, figs. 29, 30.

Shell narrowly but deeply umbilicate, depressed, moderately solid, whitish ashen; the surface rather dull, smooth except for faint growth-striæ, and on the base excessively fine, close, subobsolete spiral striæ. Spire low, convex-conic, the periphery obtusely subangular, the base flattened. Whorls 4, convex, the last very wide. Aperture oblique, rounded-ovate, pearly with brilliant green reflections within, the lip with a wide, dull, whitish margin. Columella arcuate, rather thin; parietal callous thin. Umbilicus bounded by an angle. Operculum corneous, multispiral, the edges of the whorls slightly free.

Alt. 4, diam. 5.5 mm.

Kushiro, Kushiro, Hokkaido. Types No. 87,776, A. N. S. P., from No. 1,583 of Mr. Hirase's collection.

This little Gibbuloid snail is shaped like *Norrissia norrisi* of California. It does not resemble any Japanese species known to me.

Monilea nucleolus Pils.

See these *Proceedings* for 1904, Pl. 6, figs. 58, 58*a*. The locality, Yakujima, Ōsumi, was omitted in the original description.

Ethalia guamensis Quoy.

This species was described from a single specimen procured at Guam by the naturalists of the *Astrolabe*.[7] The figure represents the shell as having the umbilicus partly closed by a callous, but neither figure nor description show whether this partial closure is effected by (1) a callous pillar partly filling the umbilicus, or (2) by a mere reflection of the columellar margin, vaulting over a free umbilical cavity. A. Adams and subsequent authors have taken the first alternative and

[7] *Rotella guamensis* Q. and G., *Zool. Astrolabe*, III, p. 267, atlas Pl. 61, figs. 32, 33

identified *guamensis* with a shell of which *Trochus callosus* Koch and *Rotella montrouzieri* Souv. are varietal forms. No form of this type which I have encountered agrees fully with Quoy's figures and description; and it is not impossible that the real *guamensis* yet remains unidentified, in which case *Ethalia montrouzieri* will become the senior name for the *guamensis* of most authors.

Ethalia guamensis sanguinea n. subsp. Pl. IV, figs. 21, 22.

Trochus callosus Koch, in Philippi, *Abhld.*, I, Pl. 4, fig. 2. Philippi in *Conch. Cabinet, Trochus*, Pl. 35, fig. 7 (copied in *Man. Conch.*, XI, Pl. 57, figs. 41, 42). Not *T. callosus* Gmel.

Shell imperforate, low-conoidal above, convex beneath; glossy and smooth except for fine growth-lines and almost obsolete spirals. White, copiously marbled with purple-brown and pinkish above, with some opaque white spots, and a few indistinct articulated spiral lines; the base white, with a pink central area. Whorls 5½, convex, the last wide, narrowly rounded at the periphery. Aperture oblique, ovate, the lip thin and simple, calloused near the columellar insertion, the umbilicus wholly filled by a red callous pad, roughened by several irregular vein-like grooves.

Alt. 10, diam. 15 mm.

Yakujima, Ōsumi. Types No. 88,312, A. N. S. P., from No. 1,458 of Mr. Hirase's collection.

This form differs from *E. g. selenomphala* by having the umbilicus wholly filled, both in half-grown and adult shells, by the roseate callous pad, as in *Helicina* or *Umbonium*. The general shape is not unlike, except that the spire is more regularly low-conic in *E. g. sanguinea*. Moreover, the upper surface is more coarsely maculate, and the base is white except near the central pad.

Probably "*Trochus callosus* Koch" of Fischer (*Iconogr. Coq. Viv.*, Pl. 115, fig. 3) should stand as another subspecies of *E. guamensis*. *Rotella montrouzieri* Souv. will be still another subspecies.

Ethalia guamensis selenomphala n. subsp. Pl. IV, figs. 27, 28.

Shell depressed, biconvex, glossy and smooth except for fine growth-lines and almost obsolete spiral lines on the last whorl. It is white, the upper surface sparsely marbled with purplish and pink, suffused with pink on the spire, and encircled with numerous fine lines articulated white and pink or brown. Base white, with a few pink spots. The upper surface is convex, the inner whorls only projecting in an acute little cone. Whorls 6½, convex, parted by a well-impressed suture, the last whorl very wide, narrowly rounded, almost subangular peripherally. The base is convex. The aperture is very oblique, ovate, the lip thin and simple. The umbilicus is nearly filled by a callous mass ending in a flattened, pink lobe, reducing the umbilicus to a narrow semicircular cavity, which is bounded by a rounded, overhanging cord ending in a flattened callous at the lip.

Alt. 11, diam. 17 mm.

Hirado, Hizen. Type No. 88.313, A. N. S. P., from No. 1,526 of Mr. Hirase's collection.

Distinguished by its narrowly crescentic umbilical cavity, in which a very large spiral pillar stands, terminating in the callous pad, and nearly filling the umbilicus. In *sanguinea* the callous is red and completely fills the umbilicus in both half-grown and adult shells—or at least this is the case with the type lot.

The whole shell is more depressed than the specimens of *E. g. montrouzieri* before me, in which, moreover, the callous is white.

Fischer's figure of *E. callosa* (*Trochus callosus*) differs by its semicircular callous nearly surrounding a subcircular umbilicus.

Ethalia striolata A. Ad. and *E. trilobata* Sowb. have much the structure of *selenomphala*, but differ in the shape of the callous.

ETHALIELLA n. gen.

Depressed, openly umbilicated, smoothish *Trochidæ*, with the peristome obtuse, the columellar margin dilated, partly vaulting over the umbilicus, which is radially sulcate within and has a very low, wide and rounded marginal cord. Type *E. floccata*. Distribution, Indo-Pacific.

This group is to comprise species related to *Monilea*, *Ethalia* and *Isanda*, but with features of the columellar lip and umbilicus unlike either. *Minolia* and its boreal ally *Solariella* differ by the almost or quite unexpanded columellar margin.

The group will include, besides the type, *Ethalia rhodomphala* Smith, *Isanda pulchella* A. Ad., and *Trochus rhodomphalus* Souv.

Ethaliella floccata Sowb. Pl. IV, figs. 24, 25, 26.

Ann. Mag. Nat. Hist., XII, 1903, p. 500.

Shell much depressed, biconvex, obtusely carinate peripherally, openly umbilicate. Flesh-tinted, with a band below the suture composed of fine obliquely radial dark red lines alternating with white ones. This is followed in the middle of the upper surface by a spiral series of oblique, oblong red blotches alternating with opaque white ones. Below these there is a minutely white-speckled belt, and then at the periphery a series of red spots. On the base, the umbilicus is fleshy-whitish; outside of this there is a red area closely mottled with opaque white; and between this tract and the periphery there is a pale zone, sometimes marked with distant radial series of two red dots each. The surface is smooth except at and above the periphery, where there are several spiral striæ. Whorls 5½, slightly convex, parted by an impressed suture. Umbilicus circular and deep, expanding funnel-like at the opening, where the sloping sides are excavated in the middle and finely sulcate radially. Aperture oblique, subcircular, the peristome obtuse, the columellar margin broadly dilated, covering a small part of the umbilicus.

Alt. 5, diam. 9 mm.

Alt. 4, diam. 7.7 mm.

Yakushima, Ōsumi. Topotypes No. 88.314, A. N. S. P., from No. 1,428 of Mr. Hirase's collection.

This species is evidently related to *Ethalia rhodomphala* E. A. Smith,[8] and *Isanda pulchella* A. Ad.[9] From the latter it differs by the much wider last whorl as viewed from above, and by the less extensively covered umbilicus and white callous. It differs from *E. rhodomphala* Smith chiefly by the color of the columellar callous. This is not a feature of much importance, and I would rank the Yakushima form under *rhodomphala* as a variety were it not that the name of that species is preoccupied for a new Caledonian form apparently referable to the same genus, *E. rhodomphala* Souv.[10]

Dentalium rhabdotum n. sp. Pl. V, figs. 45, 46, 47.

Shell curved posteriorly, the larger half nearly straight, slender, the diameter contained about 11 times in the length, moderately solid, lusterless; white, with more or less blackish incrustation. Sculpture of 12 acute, even ribs at the small end, parted by wider concave intervals; these ribs gradually become lower and wider, but usually retain their predominance over subsequently acquired sculpture to the end, though becoming low and obtuse. Secondary threads soon appear in the intervals, and on the last third of the shell tertiary threads, with some additional minor threads in some intervals, or riding on the slopes of the larger threads. In full-grown individuals all longitudinal sculpture becomes subobsolete close to the aperture. Growth-lines fine and obliquely circular throughout. The aperture is circular with rather thin peristome. Apical orifice ovate, the inner

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[8] The Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, Pt. 2, *Marine Mollusca*, p. 618, Pl. 36, figs. 1, 2 (1903).

[9] E. von Martens, List of the Shells of Mergui and Its Archipelago, in *Journal of the Linnean Society*, XXI, p. 197, Pl. 16, fig. 3*a*–3*e* (1887).

[10] *Trochus* (*Monilea*) *rhodomphalus* Souverbie, *Journal de Conchyliologie*, 1875, p. 36, Pl. 4, fig. 3. This species seems, as Fischer has suggested, close to *Trochus rotellæformis* Philippi, *Conchylien Cabinet*, *Trochus*, p. 302, Pl. 44, fig. 2.

layer usually projecting slightly, the margin shallowly notched at the narrow end of the orifice, the notch slightly excentric on the convex side of the shell (fig. 46).

Length 41, diam. at aperture 3.6, at apex 1 mm.

Length 29, diam. at aperture 3.1, at apex 1.2 mm. (immature shell).

Heda, Izu, with *D. coruscum*. Type No. 88,319, A. N. S. P.

This is probably nearer *D. weinkauffi* than to any other Japanese species now known. It apparently belongs to the group comprising *D. entalis, occidentale,* etc., and referred to the subgenus *Antalis,* but it is also about equally as much related to *D. agassizi,* a form from the Panamic region in 322 to 1,020 fms.

Dentalium (Lævidentalium) coruscum n. sp Pl. V, figs. 42, 43.

Shell well curved, thin-walled at the oral end, somewhat thickened at the apex, circular in section throughout; the greatest diameter contained 11 times in the length. White. The surface is polished, very faintly marked with growth-lines on the larger half. The apical orifice is shortly ovate, the narrow end toward the convex side of the shell, where there is a slight wave of the margin.

Length 33, diam. at apex 1, at aperture 3 mm.

Heda, Izu, at entrance to port, in 167 fms. Type No. 88,320, A. N. S. P.

This form is related to *D. leptosceles* Watson, and *lubricatum* Sowb. from Australia. My key to the species of *Lævidentalium* brings it to the latter species except in the matter of size, *lubricatum* being about double the dimensions of *coruscum*. This discrepancy, together with the widely separated habitats of the two forms, indicates specific diversity.

The curvature, measured from a chord connecting the ends, to the greatest convexity of the outer curve, is 4 mm., about one-eighth the length of the shell.

Dentalium (Rhabdus) cerinum n. sp. Pl. V, figs. 40, 41.

The shell is thin, almost straight, circular in section at the anal end, barely perceptibly compressed from side to side at the oral end; slender, the greatest diameter contained about 17 times in the length; translucent whitish. The surface is glossy, sculptured with very fine rather close and regular circular impressed lines and some coarser more widely spaced impressions indicating periods of growth-arrest.

Both apertures are simple, without slit or notch.

Length 33, diam. at apex .9, at aperture 1.9 mm.

Shimidzu, Suruga, off the spit. Type No. 88,305, A. N. S. P.

This species is allied to *D. rectius* Cpr. and *æquatorium* Pils. and Shp., but differs from both in its distinct though extremely minute annular sculpture. It is a typical *Rhabdus*, and the first to be found in Japanese waters.

Siliqua intuspurpurea n. sp. Pl. V, figs. 32, 33.

Shell regularly oblong, compressed, entirely covered with a glossy cuticle, green-yellow with darker olive concentric streaks, becoming purple toward the beaks, which, however, are white or whitish. The surface is lightly marked with growth-lines, and has a group of indistinct rays, composed of short, minute wrinkles in the direction of growth-lines, in the middle; and the dorsal surface posterior to the beaks is densely sculptured with minute raised radial lines. Upper and lower margins about equally convex; posterior end slightly truncate obliquely; anterior end rounded. Beaks at the anterior three-tenths of the length. Ligament short, black-brown, and prominent. Interior purple, the rib strong, straight and nearly vertical, whitish-purple. Pallial sinus extending anteriorly two-fifths the total length, its lower margin coalescent with the pallial line. Two cardinal teeth in each valve.

Length 41, alt. 21, diam. 9 mm.

Akkeshi, Kushiro (Hokkaido). Types No. 88,295, A. N. S. P., from No. 1,617 of Mr. Hirase's collection.

Related to the Californian *S. lucida* Conr., but that is a narrower species. The internal rib shows as an indistinct whitish ray outside.

Macrocallista chishimana n. sp.

The shell is oval, rather solid, white under a glossy cuticle. Drab with lighter concentric streaks, becoming pale yellow near the base and ends, and rather indistinctly marked with drab rays. Surface everywhere closely but irregularly concentrically plicate-striate. Under a strong lens a dense microscopic sculpture of papillæ and lines parallel to growth-lines is seen to cover the riblets and intervals. The dorsal and basal margins are about equally convex, the dorsal margin anterior to the beaks is nearly straight, the anterior end being rather narrowly rounded. The lunule is rather narrow, flat, bounded by a slightly impressed line. The interior is pure white, dull; the pallial sinus rather short and rounded. Teeth are rather slender. Margins of the valves are smooth and partly covered by the inflexed cuticle.

Length 64.5, alt. 48, diam. 28.5 mm.

Shikotan, Chishima (Kuril Is.). Type No. 88,301, A. N. S. P., from No. 1,615 of Mr. Hirase's collection.

This delicately colored clam is remarkably handsome for so northern a species. It has some resemblance to *Macrocallista pacifica* (Dillw.), a species better known as *Meretrix* (or *Callista*) *chinensis* Chemn., but that species is smaller, more oblong and smoother, and it is more or less marked with purple.

A somewhat larger specimen of *M. chishimana*, measuring length 78, alt. 57, diam. 32.5 mm., was contained in a collection of shells of unknown locality, but all species of Yesso and northward, which has been in the Academy many years.

Dr. William H. Dall has shown that the well-known and appropriate name *Callista* cannot be used for this Venerid group, but I believe no one has noticed that it was originally based upon the single species *Mactra neapolitana* Poli (*Test. utr. Sicil.*, I, pp. 67 and xi, 1791). In a later volume Poli added several species of *Veneridæ;* but subsequent additions do not affect a name based upon a single species. *Callista* Poli is therefore a synonym of *Mactra* s. str.

Lithophaga lithura n. sp. Pl. V, figs. 37, 38, 39.

The shell is thin, cylindrical, brown, and sculptured with growth-lines only under a smooth, thin, gray-white calcareous layer, which almost completely envelopes it. The low beaks are very near the anterior end. The hinge-margin is but little raised, hardly modifying the cylindric contour, but the height of the shell diminishes slightly toward both ends. The anterior end is narrowly rounded, the *posterior end abruptly and squarely truncate.* The calcareous layer thickened at the posterior end, where it projects, is abruptly narrowed, and is *excavated on the inner faces, and continued in narrow posterior projections.* The valves are flesh-tinted within, becoming blackish-purple at the posterior end.

Length 37, alt. 12, diam. 9.5 mm.

Length 32.5, alt. 10, diam. 8.5 mm.

Kikaigashima, Ōsumi. Types No. 88,294, A. N. S. P., from No. 1,577 of Mr. Hirase's collection.

This species is remarkable for the posterior truncation of the valves, and their mucronate, internally excavated, stony tails.

Trapezium japonicum n. sp. Pl. V, figs. 34, 35, 36.

The shell is rather solid, oblong, the altitude nearly half the length, the beaks at the anterior sixth or seventh of the length. Surface dull and earthy, whitish with some red or livid stains, and roughened by growth-wrinkles which are most strongly marked posteriorly. Only small remnants of a thin cuticle remain near the ventral margin. Dorsal margin convex, basal margin straight or a little concave (as in *Margaritana margaritifera*). Beaks low. No lunule. Escutcheon flat or slightly concave, lanceolate, very long, extending to the posterior end of the dorsal margin, bounded by acute elevated ridges. Interior white, often stained with violet in the cavity, or with some faint rays of the same color, or in some specimens it is delicately flesh-tinted, ochraceous toward the lower margin posteriorly. There is always a broad dark dorsal and posterior tract, dull violet in the cavity, but glossy blackish-purple between the posterior adductor scar and the posterior margin. There are three cardinal teeth, parallel to the long axis of the shell, in the right valve, the anterior one much the larger; the posterior tooth separated from the others, long and slender, lamellar. In the left valve there are also three, the anterior one very small. There is a short, strong lateral tooth in the right valve, a socket above it receiving a small process of the other valve.

Length 44, alt. 21, diam. 15 mm.

Length 36, alt. 17, diam. 12.7 mm.

Tsuda, Awa (Shikoku Is.). Types No. 88,293, A. N. S. P., from No. 1,622 of Mr. Hirase's collection.

This does not seem closely related to any *Trapezium* I have found described. There is a *Cypricardia formosensis* Dsh. enumerated in Paetel's *Catalog* (III Abth., 94, 1890), without reference, which I have been unable to trace. The name *Trapezium* is prior to the equivalent terms *Cypricardia* Lam. and *Libitina* Schum.

Trapezium japonicum delicatum n. subsp. Pl. V, fig. 44.

Similar in contour to *T. japonicum*, but thinner and smaller. The shell is partially covered with a very delicate corneous cuticle, deciduous toward the beaks; dull ashen, in large part stained with violet. Posterior half sculptured with delicate, subobsolete radial striæ, scarcely visible toward the margins except by being set with delicate, very minute and short cuticular spines. Interior dark livid purplish throughout, but darker at the posterior end. Lateral teeth very small.

Length 26.2, alt. 12.3, diam. 8 mm.

Length 24.3, alt. 12, diam. 8 mm.

Yokohama. Types No. 69,420, A. N. S. P.

Besides the differences given above, the escutcheon in this species is usually very asymmetrical, being much narrower in the left valve, where its limiting keel is nearly straight, while in *T. japonicum* it is nearly symmetrical.

Pecten awajiensis n. sp.

Shell solid, equilateral, both valves moderately convex, the right valve less so; lower half semicircular, the upper half straightly tapering. Convex valve dull purplish-white with purple-brown clouding and a few small white spots in the furrows. The other valve is light brown with some darker zones, and more white in the grooves.

Ears large, the posterior slightly longer. Ribs 17, high and rounded, and slightly wider than the intervals in the left valve, decidedly so in the right, where their margins slightly overhang the intervals. Growth-striæ fine, close and inconspicuous. Ears finely costellate. Anterior and posterior dorsal surfaces of the main disk flattened and smoothish. Interior white and strongly grooved, calloused above the muscle scar. Ctenolium short, of five teeth.

Length 48.6, height 47, diam. 14.5 mm.; length of the hinge-line 33 mm.

Fukura, Awaji. Type No. 88,300, A. N. S. P., from No. 1,636 of Mr. Hirase's collection.

This species is related to *P. singaporinus* Sowb. (*Thes. Conch.*, I, Pl. 14, fig. 71), from which it differs chiefly by the much coarser and less numerous ribs, 17 instead of 23 or 24. The dorsal half of the shell is also more wedge-shaped than in the Singapore scallop, of which a topotype is before me.

Reference to Plates II, III, IV and V.

Plate II, Fig. 1.—*Conus aratispira* n. sp.
Figs. 2, 3.—*Eulima ogasawarana* n. sp.
Fig. 4.—*Conus voluminalis avus* n. subsp.
Fig. 5.—*Natica hirasei* n. sp., exterior of operculum.
Fig. 6.—*Natica hirasei* n. sp., shell.
Figs. 7, 8.—*Eulima luchuana* Pils. Kikai-ga-shima, Ōsumi.
Figs. 9, 10.—*Eulima bovicornu* n. sp.
Fig. 11.—*Eulima articulata* Sowb. Hahajima, Ogasawara.

Plate III, Fig. 12.—*Siphonalia vanattai* n. sp.
Fig. 13.—*Maculotriton bracteatus longus* Pils. and Van.
Fig. 14.—*Usilla gouldii* Smith. Hahajima, Ogasawara.
Figs. 15, 16, 17. *Torinia densegranosa* n. sp.
Figs. 18, 19.—*Planaxis abbreviata ogasawarana* n. subsp.
Fig. 20.—*Buccinum chishimanum* Pils.

Plate IV, Figs. 21, 22.—*Ethalia guamensis sanguinea* n. subsp.
Fig. 23.—*Columbella pardalina subcribraria* n. subsp.
Figs. 24, 25, 26.—*Ethaliella floccata* Sowb. Topotype.
Fig. 27, 28.—*Ethalia guamensis selenomphala* n. subsp.
Figs. 29, 30.—*Phorcus borealis* n. sp.
Fig. 31.—*Cingula kurilensis* n. sp.

Plate V, Figs. 32, 33.—*Siliqua intuspurpurea* n. sp.
Figs. 34, 35, 36.—*Trapezium japonicum* n. sp.
Figs. 37, 38, 39.—*Lithophaga lithura* n. sp.
Fig. 40, 41.—*Dentalium cerinum* n. sp. Lateral views.
Fig. 42.—*Dentalium coruscum* n. sp. Ventral aspect of apical end.
Fig. 43.—*Dentalium coruscum* n. sp. Lateral view.
Fig. 44.—*Trapezium japonicum delicatum* n. subsp.
Fig. 45.—*Dentalium rhabdotum* n. sp. Lateral view, natural size.
Fig. 46.—*Dentalium rhabdotum.* Ventral view of apical end.
Fig. 47.—*Dentalium rhabdotum.* Lateral view of oral end.

STRUCTURE AND DEVELOPMENT OF THE COMPOUND EYE OF THE HONEY BEE.

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I.—INTRODUCTION.

The morphology of the compound eye has puzzled zoologists for years, and much work has been done on the subject, but so diverse are the views held by the various investigators in the field that we are far from a final solution of the problem. With a view to adding some evidence from the embryological point of view this work was begun, in the belief that a detailed examination of this one insect eye would throw some light on the adult morphology.

The eye of the common honey bee, *Apis mellifera*, is particularly favorable for embryological work, since its growth is gradual and the steps of development well marked out. The material is also easily obtained, and the various stages of growth can be distinguished by the external appearance of the larvæ and pupæ. It is also favorable for a comparison with the development of the eye of *Vespa*, which was described by Patten, since it is desirable to find how far his results can be verified on a closely related form. The large number of ommatidia in each eye make the preparation of sections an easier matter, since it was not necessary to cut so many eyes.

The adult ommatidium of the bee was briefly described and figured by Grenacher in his celebrated work, *Sehorgan der Arthropoden* (1879), and has been figured in works on apiculture, but has never been fully worked out in the adult condition, and no work has been done on the development of the eye. Bütschli (1860) in his work on the embryology of the bee discusses the formation of the eye, but does not go into the subject of the development of the ommatidium.

This work was taken up with a view to getting, first of all, a complete description of the development and structure, and in addition to get some light on certain problems which are of especial interest from a theoretical standpoint. The innervation of the ommatidium, the method of formation and fundamental plan of the ommatidium, the method of modification of numerical plan and structure in the evolution, the arrangement of ommatidia, the homology of various cells in different ommatidia, and the comparison of ommatidia with other sense-organs are questions which have been much discussed, and in this work an effort has been made to apply the observations made to the solution of these problems. This is done not without the realization that some of these things can be settled only from wide comparisons, but with the thought that a piece of work which takes in the whole course of development is of more value than superficial observations of a large number of forms. Some of the theories are merely matters of interpretation rather than of direct observation, and must remain so until decisive observations are made, but in matters of this kind the accumulation of evidence is of decided value.

The formation of the optic lobes and the course of the nervous elements through them are problems which have not been taken up for investigation in this work. Kenyon has worked out the structure of the optic lobes for *Apis* in detail with nerve methods. The technique used in the present work not being suitable for the tracing of nerves, only on matters concerning the nerve endings of the retinula has any investigation been made in this work, and that was not done by Kenyon.

In the matter of nomenclature an effort has been made to avoid the use of new names or of some of the names which have been proposed by some workers who have special theories to uphold, such as calyx, lentigen, corneagen, etc. In the case of the cells which surround the cone I have used the name corneal pigment cells, since they have a double function. In other cases I have used generally accepted names.

The plan followed in this paper is to give, first, a brief description of the adult eye, so that further discussion will be more intelligible, and then to take up the development of the entire eye and ommatidium, followed by a detailed description of the adult conditions, since that was the plan followed during investigation, and is, perhaps, the order which will be most clear to the reader.

This work was taken up at the suggestion of Dr. Thos. H. Montgomery, Jr., now Professor of Zoology in the University of Texas, and was completed under the supervision of Professor E. G. Conklin. To both I am indebted for many valuable suggestions and for help throughout the work.

II.—Methods.

Larvæ and pupæ were fixed in Flemming's fluid, Hermann's fluid, picro-sulphuric, picro-acetic and picric acid saturated in 50 per cent. alcohol, but of these the Flemming and Hermann preparations yielded the best results. For the smaller larvæ it was not necessary to dissect before fixation, but for older larvæ and pupæ the head was removed to make penetration easier. For adult material, where penetration is difficult, the best fixative was acetic acid, generally a 10 per cent. or 20 per cent. acetic solution in 80 per cent. to 100 per cent. alcohol. Kleinenberg's picro-sulphuric and picric acid in 50 per cent. alcohol were also used with fair results when the head was cut in two.

The material was all cut in paraffine, and it was found that for adult material long embedding was necessary, four to eight hours, to get the paraffine all through the tissues. Some material was embedded for a shorter time to see whether the heat had produced any artifacts in the other material which was embedded for the longer period, but in such cases the lens invariably separated from the retinular layer; no difference was observed in the internal tissues due to long heating.

In staining, the best results were obtained in the use of Heidenhain's iron hæmatoxylin, with the use of a strong mordant for a long time. For material of this kind there seems to be no better stain. It was found that by destaining to different degrees the various parts of the eye would show differences in color, the rhabdome, for example, staining an intense black in rather deeply stained material. The nerve fibrils of the retinula cells also stained black with this stain. Other stains, such as Delafield's hæmatoxylin and eosine or Bordeaux red, were employed with very good results.

For depigmenting Grenacher's solution with a somewhat greater per cent. of acid was used. Parker's solution was also used, though the former gave the better results.

III.—Adult Form of Eye and Ommatidium.

Before taking up the embryonic development of the eye, it may be well to give a short description of the adult form so that what follows concerning the embryology may be more clear.

The compound eye is made up of great numbers of similar ommatidia surrounded by pigment cells. Among the pigment cells lying between the ommatidia are large numbers of hair cells which secrete the long unbranched hairs which cover the surface of the eye. The entire eye is covered by a layer of chitin, continuous with the chitin of the body wall.

Each ommatidium is composed of an external lens, a crystalline cone and a rhabdome surrounded by eight or occasionally nine long retinular cells which extend from the cone to the basement membrane. Besides these are two pigment cells, the corneal pigment cells, which surround the crystalline cone and about twelve which run the entire length of the ommatidium from the lens to the basement membrane, making in all about twenty-eight cells to each ommatidium. It might be well to include in this enumeration a retinular ganglion cell, since there is probably one to each ommatidium. The lens is chitinous and quite thick and complicated in structure, as will be shown later. The crystalline cone is composed of four highly modified cells, whose nuclei have almost entirely disappeared, and the cells are modified internally by the accumulation of an intercellular secretion which is more dense than the original cytoplasm, but not so dense as the lens. The retinular cells begin at the apex of the cone, and from their proximal ends at the basement membrane send in neural fibres to the retinular ganglion. Each of the retinular cells has decome differentiated on its inner face to form a part of the rhabdome which extends from the apex of the cone to the distal side of the basement membrane. This rhabdome is not chitinous, but is perfectly transparent and slightly more dense than the surrounding cytoplasm. The corneal pigment cells and the outer pigment cells which surround the entire ommatidium serve to prevent the reflection of light in the ommatidium and the passage of rays of light from one ommatidium to another.

IV.—Embryology and Structure in Detail.

1. *The Entire Eye.*

The eye arises as a thickening of the hypodermis on the side of the head just posterior to the place where the antennæ arise and just over the optic ganglia. This thickening takes place before the larva is hatched from the egg and the newly hatched larva shows it clearly; the boundaries of the eye are not as well marked as they become by the time the larva is one day old. The optic ganglia are formed at this time, as they arise very early in the development, but the retinular ganglia are not formed until a later larval period.

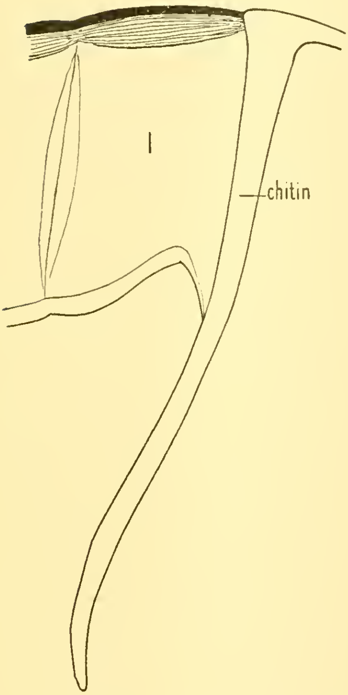


Fig. 1.—Edge of entire eye, showing the relation of lens to the chitin of the body and the strip of chitin running down into the head around the eye.

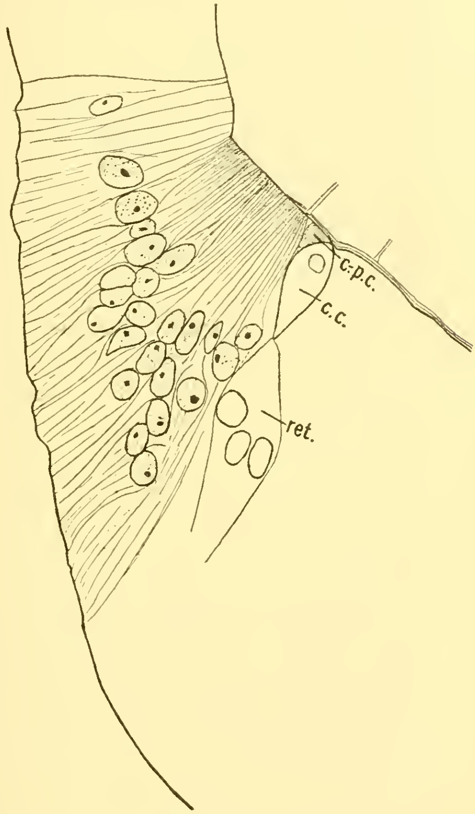


Fig. 2.—Section through edge of pupal eye before infolding occurs, showing transition from hypodermis to eye structures.

This thickened layer of the hypodermis of the newly hatched larva consists of columnar cells with their nuclei arranged at different levels, giving the eye a pseudo-striated appearance. The cells at this time all extend the same distance, so that the eye arises from a strictly one-layered condition. At this time there is no connection with the optic ganglia. During the larval growth the eye increases greatly in size and mitotic figures are abundant, the mitosis always d viding the cells lengthwise, so that the one-layered condition is retained until the close of the larval period.

During the semipupa stage, after the larva is sealed up by the workers of the hive but before it assumes the true pupa form, the one-layered epithelium gives place to a condition in which all the cells do not extend all the way from the outer surface to the basement membrane. This is brought about by the lengthening of some cells, the shortening of others and by the rearrangement of the cells in a manner to be described later. By the time the head has attained the size and shape of the adult, the cells have arranged themselves so that the ommatidia are completely formed and no more mitoses occur. The development of the ommatidia from now on consists of the differentiation of the cell elements until they assume their adult form. The development of the eye as a whole consists of a thickening of the organ and the laying down of a chitinous lens over the surface.

At the sides of the eye of the young pupa the appearance is as shown in text fig. 2, and the cells which correspond to the corneal pigment cells around the ommatidia are quite numerous and shade off gradually into the cells of the hypodermis over the rest of the head. As the eye increases in thickness by the lengthening of the ommatidia there appears a dipping in of the cells of the border, so that there is an invagination all around the eye where the secreting surface of the hypodermis is pulled down. This is shown by a thin sheet of chitin which runs around the eye (seen in section, text fig. 1) in the late pupa and adult eye. This chitin is similar to the chitin of the body proper, but not like that over the eye. This invagination must not be confused with such an invagination as is described by Patten for the formation of the lens layer, for the ommatidia are here completely formed and the corneal pigment cells have moved to their place at the proximal end of the cone before the dipping of the cells here described takes place.

In the formation of the optic ganglia, which takes place by the invagination of cells of the hypodermis, there is formed a brain sheath —a sheath of cells covering the ganglia and still continuous with the hypodermis at the edge of the eye. This layer of cells runs along proximal to the basement membrane and very close to it in the pupa stage. As the retinular ganglia take on their final shape these cells are pushed away from the basement membrane, and are seen in the adult eye as strands of cytoplasm woven in among the nerve fibres between the basement membrane and the retinular ganglion. The nuclei of these cells are smaller and are easily distinguishable from the retinular ganglion nuclei which lie near them (see text fig. 3). On the edge of the nerve bundle this layer is continuous with the brain sheath in the adult. The strands of protoplasm of which this layer of cells is composed after it is perforated by the nerve fibres often run up close to the basement membrane and might easily be mistaken for nerve fibres to the outer pigment cells, but their origin indicates that they are not nerves and there is no indication of any nervous connection for the pigment cells.

Kenyon recognized this layer of cells, which he describes as follows:[1] "The outer mass (first fibrillar mass) presents a lunar appearance in frontal sections (see fig. 1 of this paper), and lies close inside the basement membrane of the retina, being separated from it by sufficient space for the entrance of large tracheal sacs and a thin layer of cells commingled with the fibres from the retina." It will be seen that working with nerve methods this author did not recognize them as nerve fibres, nor did he describe any nervous connection with the pigment cells. Frequently these strands of protoplasm run close to the basement membrane and there spread out as a pyramidal protoplasmic mass lying between the nerve fibrils. This is particularly noticeable in pupa stages before this layer of cells is so greatly distorted.

The basement membrane is made up of a fusion of the proximal ends of the outer pigment cells with the pigmented portion of the retinular cells. This makes a sheet of cytoplasm, perforated where the nerve fibres pass from the retinular cells, which can easily be macerated away from the other elements of the eye and is easily distinguishable on account of its deeply pigmented condition. The nerve fibres from the retina pass through this and are seen as more or less separated on a section through that region (fig. 18). This basement membrane is continuous with the basement membrane of the hypodermal cells. Fig. 10 shows diagrammatically the structure of the base of an ommatidium and the elements which compose the basement membrane, but does not show the separation of nerve fibrils, since that is seen clearly only in cross sections through that region.

There are no tracheæ distal to the basement membrane in the compound eye of the bee such as have been described in other eyes, especially among the Diptera. Exception must be taken to the statement of Hickson[2] that "no spirally-marked tracheæ penetrate the optic tract at any part of its course in Hymenoptera." Between the basement

[1] P. 369.
[2] P. 223.

membrane and the retinular ganglion tracheæ with spiral markings occur in all specimens examined (see text fig. 3), but the statement of Hickson holds good for all other parts of the optic tract as far as has been observed. Kenyon also mentions the presence of tracheæ in this region.

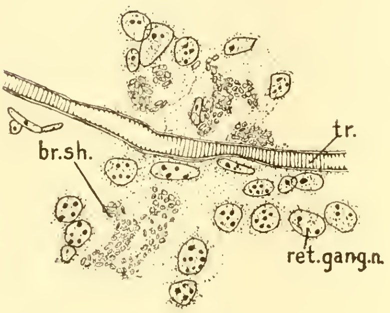


Fig. 3.—Section below basement membrane, showing retinular ganglion cells and nerve fibrils from ommatidia.

2. *Arrangement of Ommatidia.*

The facets of the lens are arranged in hexagons, as is true for so many insect eyes, but this is probably not a primitive condition. Hexagonal arrangement is what is produced whenever any circular objects are closely pressed together, just as the cells of the honeycomb are hexagonal, and this undoubtedly explains the shape and arrangement of the facets. Parker (for Crustacea) looks upon unfaceted eyes as primitive, and probably this is true for insects also. We have, however, in the proximal portion of the eye a different arrangement which is perhaps more primitive than the hexagonal method. At any level proximal to the cone cells the ommatidia are arranged in parallel rows, and the nearer we come to the base of the ommatidia the clearer is this arrangement, until on a section at the level of the basement membrane (fig. 18) we see this parallel arrangement very marked. Since here we get a condition in which the ommatidia are not pressed together and therefore are not modified mechanically, it probably represents a more primitive condition than that found in the lens region. In the pupa, even the facets do not have as marked a hexagonal arrangement as they have later, and in the larva we get an arrangement identical with that of the bases of the adult ommatidia.

The numerical plan and shape of the parts of the ommatidium may have something to do with the arrangement. The retinular cells are eight in number, but four of these are wider than those which alternate with them, and as a result a cross-section of the retina is roughly a square. The outer pigment cells are twelve in number when their arrangement is unmodified by hair cells, and this number readily arranges itself into a square with three on a side, or into a hexagon with two on a side. Since the outer pigment cells are simply strands of cytoplasm they readily accommodate themselves to any change of arrangement and are not, as a rule, without some bend, so these cells could scarcely modify an ommatidial plan of arrangement. The basement membrane is considerably smaller in area than the lens chitin, and as a result the room provided for each ommatidium is considerably decreased, so that in contrast with what has been stated, that the ommatidia are not so crowded proximal to the cone, it might be supposed that the converse would be true. However, the fact is that in cross-section a larger proportion of space is occupied by outer pigment cells, the interommatidial spaces, near the base of the ommatidia than near the lens; and since, as above stated, these cells are flexible and not crowded, it scarcely seems to follow that this parallel arrangement is due to crowding.

The hexagonal arrangement is undoubtedly the common plan, at least as far as the lens is concerned, and the tetragonal arrangement may be derived from it as held by Parker, and his arguments for such an origin seem good; but, on the other hand, the hexagonal arrangement could scarcely give rise to the tetragonal unless preceding the hexagonal facets the ommatidia were in squares, so that the secondary crowding would bring about the primitive arrangement again. Taking again the case of the honeycomb, no additional crowding could possibly make the cells square, for the more the circular walls (the primitive cells) are crowded the more truly they become hexagonal. However, if the walls were made of four parts, as is the cone, and if they were fastened at their bases in parallel rows, then additional crowding might cause the lens to lose its circular outline and become square, in which case the hexagonal arrangement of the lens would be lost. It seems probable that the cone determines the arrangement rather than the lens-secreting cells, and Parker's figures of *Gonodactylus* (Parker, 1890, Pl. VIII, fig. 93), in which the tetragonal arrangement is found in the large ommatidia and not in the small ones, lend support to this view.

To sum up, it seems probable that the arrangement of ommatidia, where they are sufficient in number to be said to have any plan at all, is normally the tetragonal plan. If the cones are somewhat compressed, as they generally are on account of the way in which a compound eye is made up, a hexagonal arrangement of the distal parts of the ommatidia results; but if the pressure is sufficient to cause the cone to lose its circular form then it becomes a square, and the facet plan again becomes tetragonal.

3. *Hair Cells.*

The entire lens of the eye of the bee, especially in the younger individuals, is covered with large hairs, unlike those of the rest of the body in being unbranched. These hairs are secreted by large hair-mother cells which lie among the outer pigment cells between the ommatidia, and their development is of interest on account

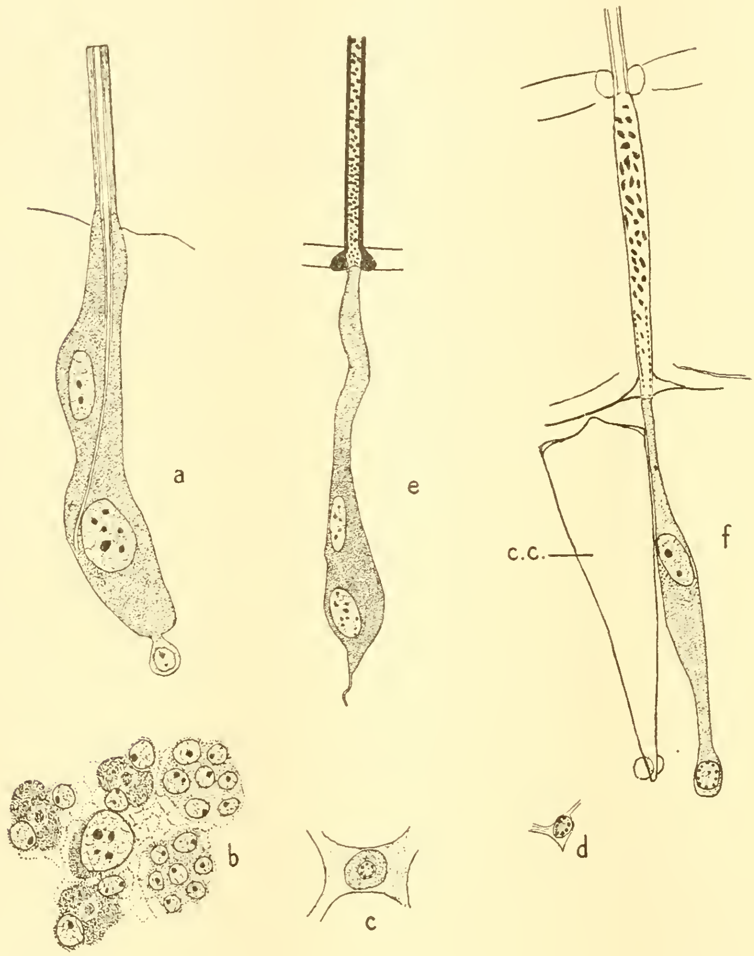


Fig. 4.—*a*. Hair cell of young pupa, showing three nuclei and intracellular duct. *b*. Cross-section through pupal retinulæ, showing one hair cell. *c*. Cross-section through hair just at level of cones, showing structure of intracellular duct. *d*. Cross-section distal to *c* and beyond surface of eye. *e*. Older pupa hair cell. *f*. Hair cell of adult, showing relation to cone and lens.

of the presence in them of an intracellular duct and because of their binucleated condition. In the larval eye these hair cells cannot be definitely located, but there are certain large cells with peculiar nuclei which are probably hair cells. In the early pupa these cells are large and have two, or sometimes three, nuclei, but when a third nucleus is present it is considerably smaller than the two more distally placed ones. In the early stages this polynucleated cell contains an intracellular duct which opens into the tubular hair, and through this duct passes the secretion products of the cell for the formation of the hair. The hair proper is tubular and in material stained in iron hæmatoxylin darker lines appear in the walls, and these structures extend for a short distance down into the cell proper around the duct. The duct has well-marked boundaries, does not branch, and generally coils around the second nucleus (text fig. 4).

As the lens increases in thickness the hairs elongate by the secretion of the hair cells, and as this goes on the cytoplasm of the cell is used up, until finally, in the adult eye, the cell has about one-sixth the volume it had in the early pupal eye. In the intracellular duct and in the hair duct the products of secretion may be observed in fixed material as darker bodies of irregular shape.

These hairs and hair cells have no nerve connection, as far as I can observe, and are therefore not sensory hairs. Just why the entire eye should be covered by hairs is hard to explain, for they must undoubtedly obscure vision, and since such a hindrance is present we should expect to find it compensated for by some sensory function on the part of the hair. I can find no indication that such is the case. It is worthy of note that the older bees have lost most of the hairs both on the eyes and on the body by the time they need the eyes for prolonged flight. The younger bees, up to nearly three weeks of age, leave the hive but rarely, and then for short distances only, but the older bees which take long journeys have the eyes much more bare. It is also noticeable that all the bees, but especially the drones, brush the hairs so that they all point down toward the mouth just before leaving the hive entrance. No doubt, in the hive, the head, which is so frequently put into the cells, becomes soiled with honey and pollen, and this action of brushing may be merely to remove dirt; but, on the other hand, the arranging of the partly transparent hairs in one direction may produce certain results of refraction which are favorable.

In *Vanessa*, Johansen describes hair cells as running the length of the ommatidia without an intracellular duct and with but one nucleus. He is able to locate these cells at an earlier stage than has been possible for the bee on account of the proximal position of the nucleus. From the figure of a cross-section of the cornea it would appear that these cells are not so abundant as in *Apis*. Patten figures hair cells for

Vespa very similar to those here described, but I am unable to find the nerve connections which he describes. Semper and Breitenbach also describe such hair cells for Lepidoptera.

The number of facets in the different kinds of individuals of the colony differs considerably. The drones (males) have an extremely large number of ommatidia, the eyes meeting on the top of the head, and as a result the three ocelli are crowded down to the front of the head. The workers and queens have a considerably smaller number, about one-third as many, and the ocelli are located at the top of the head. It is not clear why the drones should have a larger number of ommatidia than the females of the colony, since they do not seem to need so much larger range of vision. The only reason which might be suggested from a knowledge of the habits of the two sexes is that at the time when the queen takes her "mating flight" she flies almost directly upward, after a preliminary circle or two near the hive, and then often flies to some distance from the hive; this manner of flying making more probable a mating with a drone from some other colony than her own. Drones do not, as a rule, fly as high as does the queen, and it would be advantageous to have the eyes extending to the top of the head in order to follow the queen's flight. As soon as a queen starts upward any drones which are flying near at hand start upward after her, the eyes on the top of the head making it possible for them to see her.

To say that this difference has arisen on this account scarcely seems justifiable, for it would seem easier for natural selection, sexual selection, or whatever other factor is potent here, to modify the habits of flight rather than to enlarge an organ so much as in this case. This much may, however, be said with a good deal of surety: two things which would be likely to be acted on by selection in the bee are acuteness and range of vision and the power of flight.

V.—Retinular Ganglion.

In the early larval stages the optic ganglia are clearly marked out, but the retinular ganglia are not. The only indication of the retinular ganglia is a number of cells which lie near the basement membrane of the eye, principally at the posterior margin. During the larval growth the nerve fibres from the ommatidia grow in from the retinular cells, and as this growth goes on the cells of what are to be the retinular ganglia are pushed farther away from the basement membrane and assume their more definite position. Finally, in the adult animal the nerve fibres from the ommatidia form a relatively compact mass and the retinular ganglion cells are scattered through the fibres in such a way as to have the appearance of a definite ganglion. The nuclei of the retinular ganglion are no longer nearly in one plane, but are scattered for a considerable distance between the basement membrane and the outer fibrillar mass due to the crowding of the nerve fibres.

The question naturally arises as to the number of cells of the retinular ganglion as compared with the number of ommatidia. A count is, of course, impossible, but careful examination reveals that there cannot be many more than one to an ommatidium, certainly not one to each retinular cell. The eight nerve fibres from each group of retinular cells are entirely separate, but lie close together, so that probably one and only one retinular ganglion cell receives the impulse carried from the retina on eight nerve processes, and consecutive cross-sections indicate that the eight nerve fibrils surround the thick part of the retinular ganglion cell where the nucleus is located and transmit the impulse by contact.

In his description of this region Kenyon says:[3] "The elements from the retina terminate each in a small tuft of fine branches in the outer fibrillar body, and come in contact with the fine lateral branchlets given off in the same region by fibres originating from the cells of Berger's granular layer (retinular ganglion)." The tuft of fine branches here mentioned are the separate nerve fibres from the retinulæ. I have been unable to see the fine branches of the retinular ganglion cells.

The retinular ganglion cell in turn sends in its fibre through the first fibrillar mass, and then through the outer chiasma to the opposite side of the group of ganglia, where the impulse is given over to a cell of the first optic ganglion. From here on the tracing of the fibres requires special nerve methods which were not employed in this work. However, this much is evident: the cells of the first optic ganglion send their fibres through the second fibrillar mass and through the inner chiasma to the second optic ganglion, where the impulse is probably again transferred to another cell which, in turn, carries it to the brain. The course of these fibres has been worked out in detail by Kenyon (1897), and in my work I find nothing to contradict his results, although the methods used in my work were not such as to warrant either a positive denial or confirmation of his work.

[3] P. 374.

VI.—The Ommatidium.

1. *The Larva.*

In the larva, just after being hatched from the egg, I have been unable to find any indication of the grouping of cells which are later to go together to form a single ommatidium. The eye at this time is a simple layer of the thickened hypodermis with the nuclei arranged one above the other. At this time, and throughout the entire larval period, mitotic figures are abundant, the spindles always having their axes at right angles to the length of the cell and dividing the cells lengthwise.

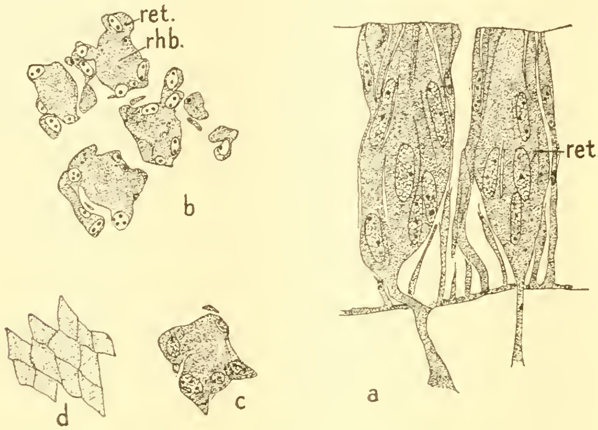


Fig. 5.—*a*. Longitudinal section of larval ommatidia. *b*. Cross-section near surface of eye, showing first differentiation of rhabdome (rhb.) as a clear space in the retinula (ret.). *c*. Cross-section at a lower level. *d*. Cross-section of a very young larva, each division line representing a complete ommatidium.

The division figures seem to be more abundant near the outer surface of the epithelium.

About one day after leaving the egg, when the larva has about doubled in size, a tangental section of the eye at right angles to the long axes of the cells at the outer surface reveals a grouping of cells as represented in text fig. 5*d*. The lines in this figure do not represent cell boundaries but are the boundaries of groups of cells; each group contains four or five cells at this time, the nuclei of these cells being directly one above the other. The cell groups are tetragonal and are arranged roughly in parallel rows. In longitudinal section these groups appear as made up of long strands with superimposed nuclei about the diameter of the entire width of the group of cells. That these are the beginnings of the ommatidia is evident since they can be traced through all the larval stages to the pupa, where the ommatidia are definitely marked. This is further indicated by the fact that they are arranged in the same way as are the proximal ends of the ommitidia, even in the adult eye. It should be borne in mind that this epithelium is strictly one-layered, and this is true all through the larval period.

During the larval period, as above stated, mitotic figures are abundant, and as a result of these divisions the groups come to be composed of more and more cells, but it is not until a late larval period (about four and a half days from the hatching of the egg for worker larvæ) that any further differentiation is observable, except possibly that the nuclei of some of the cells are larger than others in the same group. At this late larval period the cells arrange themselves as a spindle-shaped mass surrounded by smaller cells whose smaller nuclei lie in the space left at the outer end of the spindle. Mitotic figures are now absent except an occasional one in the smaller cells, but so far none have been observed in the larger centrally placed cells of the group. The number of cells in the spindle is hard to determine, since the nuclei are at different levels and the cell boundaries are not visible. All the nuclei of the central bundle of cells are some distance below the surface. There are certainly, however, not more than eight or nine, the number of retinular cells of the adult ommatidium. At the distal end of this spindle a differentiation of cytoplasm takes place, and a clear space is formed in the centre of the cells in the very granular protoplasm, and this I believe to be the beginning of the rhabdome. A cross-section near the outer surface of the cell mass shows this clear space surrounded by granular cytoplasm of the spindle cells, and this in turn surrounded by nuclei arranged around the central bundle. These outer nuclei are not as yet differentiated, so that their future fate cannot be determined. The cells of the spindle by this time have sent out protoplasmic processes toward the optic lobes which become the nerve fibres of the ommatidium, so that at any rate some of the spindle becomes the retinula.

Several facts seem to indicate that the spindle-shaped centre of the ommatidium goes to form only the retinula: (1) There are no nuclei near the outer surface, as one would expect were crystalline cone cells to be formed from any of the cells; (2) there are not enough cells to form both retinula and crystalline cone cells, and since no mitotic figures have been observed they have undoubtedly ceased division; (3) a clear space is formed at the distal end of the spindle by a differentiation of the cytoplasm, possibly the beginning of the rhabdome, since it is in this portion of the retinula that the rhabdome is seen in the youngest pupal eye observed (just after the semipupa stage). The number of nuclei around the spindle throws no light on this, since they are still dividing occasionally and their number in the adult is not fixed.

Considerable stress has been laid on the fate of this spindle-shaped mass of cells, since the determination of this fact alone is of such great importance in the consideration of the morphology of the ommatidium. That the outer pigment cells are morphologically peripheral to the crystalline cone and retinula no one would deny. The position of the corneal pigment cells might be a doubtful point if they were derived from a separate layer of cells formed by invagination of the entire eye, but as no such invagination occurs in the bee, and as at an early pupa stage they are clearly outside the cone, I think there can be no doubt as to their morphological position. The question as to the relative morphological position of the crystalline cone cells and the retinular cells is, however, not so clear.

According to Grenacher the ommatidium is two-layered, and the lens and cone are morphologically distinct from the retina. If this view is held, then the question stated above does not exist; but such an interpretation can no longer be held on comparative anatomical or embryological grounds, as has been shown so well by numerous investigators, the evidence for which it is not necessary to give here. Suffice it to say that, as has been shown previously, the ommatidium of *Apis* arises from a one-layered epithelium, and all the cells are morphologically equivalent. Taking into consideration, then, only such views as are based on such interpretations, we find two opposing theories.

According to Patten, Kingsley and others, the crystalline cone is sometimes continuous with the rhabdome; these two would therefore be the morphological centre of the ommatidium, while the retinula must arise from cells outside this. When the crystalline cone is not continuous with the rhabdome, Patten still considers the cone as the centre, since he describes processes running from each cone cell around the rhabdome but inside the retinula (as in *Vespa*). To this interpretation those investigators who consider the crystalline cone as the terminus of the nerve fibres would probably agree. On the other hand, Watase holds that the ommatidium is a morphological invagination of which the retinula is the centre, and the cone cells, lens cells (homologous with the corneal pigment cells of *Apis*) and pigment cells follow in the order named. By this interpretation the rhabdome, cone substance and lens are homodynamous. These two views seem in no way reconcilable, and more investigation is necessary to decide between them, since it scarcely seems probable that both plans exist, since all ommatidia are probably the result of one kind of development.

Patten bases his view on the fact that the cone cells are continuous with and part of the rhabdome, but surely in *Apis* there is no such continuity, since all through the development they are separate, and in the adult eye there is a sharp line of demarcation between them, and they also react very differently to stains. In *Vespa*, Patten admits that the rhabdome is not continuous with the crystalline cone cells, but in this case he describes processes between the rhabdome and retinula which correspond to the processes which form the rhabdome in other forms. Since, as will be discussed later, the rhabdome is really part of the retinula, being formed as an intracellular secretion, any such process from the cone cells would have to pierce the retinula cells to occupy such a position. No such processes occur in *Apis*. If such a view be held because it is necessary in some way for the nerve fibres to reach the crystalline cone, on the assumption that the nerves end there, such a necessity disappears, for, as will be shown under a discussion of the innervation of the ommatidium, the cone is in no way a nerve terminus. Such a theory of innervation does not seem justified for any ommatidium, and therefore the necessity for this conception of the morphology disappears.

On the other hand Watase based his view largely on the eye of *Limulus*. This view commends itself on account of its extreme simplicity, since all ommatidia readily lend themselves to the plan of diagrammatic representation used by Watase with this interpretation. Watase seems to have advanced this theory rather for the purpose of giving some explanation for the existence of the rhabdome than for the morphology of the entire ommatidium. There is, I think, no reason to believe that the rhabdome was ever a chitinous substance, and in that sense it is not homologous with the lens. In the ommatidium, as we now know it, the rhabdome is an intracellular secretion full of nerve fibrils, and is far from being a hard chitinous growth. To that extent, then, Watase's conception seems an error. If, however, we look on the lens, cone substance and rhabdome as secretions (non-living protoplasmic differentiations), of which the lens only is an extra-cellular secretion, then the homology may hold. Acording to this view, then, the ommatidium did not arise as a pit filled with chitin, but rather the sinking in of certain cells, with a corresponding retention of the secretion inside the cell, has taken place with the assumption of new functions. Parker has argued that the retinular cells cannot be considered as homologous with the lens secreting cells, since the lens cells secrete on their distal surface while the retinular cells secrete on their lateral surfaces. My observations show that both cone cells and retinular cells form their secretions intracellularly and from their very positions they could not secrete on their distal surfaces, but this does not seem to me to be any objection to the theory of Watase, since in the invagination of the cells and the taking on of new functions new forms of metabolic activity might easily be acquired.

Since, however, in the embryonic development of the ommatidium of the bee we find a stage in which the retinula is formed without cone cells on the distal end and with the rhabdome partly formed, the only inference, it seems to me, is that the cone arises from lateral cells, and the corneal and outer pigment cells are, of course, still more peripheral. From this, then, it seems to follow that the conception of Watase concerning the morphology of the ommatidium is the correct one. There is, so far as has been observed, no real invagination, but such a thing would scarcely be expected in so compact an organ; neither have I observed the actual overgrowing of the cone cells, but the conclusion seems inevitable that the retinula is the centre of the ommatidium.

Some compound eyes have been described in which, in the adult eye, the retinular cells extend outside the cone to the lens. Such cases are found when the number of pigment cells is reduced or when they are entirely wanting, and it is safe to assume that the distal lengthening has taken place secondarily, late in development. From the migration of the corneal pigment cells of the ommatidium of the bee, to be described later, we see that a late rearrangement is possible, and it seems more plausible to assume that such cases are a secondary modification rather than that there are two ground plans of ommatidia, one of which has its retinula centrally placed, the other has the cone cells inside the retinula as the axis.

The retinular spindle of the larva resembles in appearance various sense buds throughout the animal kingdom, such as taste buds and lateral line organs of vertebrates, the æsthetes of Chitons, etc. These sense buds often have some marked differentiation of the cytoplasm internally to enable the peripheral organ to perform its function. This similarity is more than superficial, however, for the method of innervation which will be described in detail later is from the sense cell toward the central nervous system, and this is the method for many of these sense buds, although the opposite direction of fibres is described for some (*e.g.*, taste buds).

It is safe to assume that these sense buds are accumulations of single sensory cells, such as are widely known (*e.g.*, sensory epithelial cells of *Lumbricus*, epithelial sensory cells [Flemming's cells] of Molluscs), giving greater efficiency at a certain spot, and that the internal differentiations are but secretions or cytoplasmic differentiations due to the specialized condition of the cell. Granting these facts, then, sense buds are homologous of necessity only in their origin from an epidermal tissue, although the homology may be greater. Since sense buds are known which are sensitive to touch, taste, smell, sight and vibration waves, it seems entirely unnecessary to assume that a light-perceiving organ, such as an ommatidium, has arisen as a modification of some other kind of sense bud, rather than that it arose as an accumulation of epithelial cells already sensitive to light.

Since we know that single cells are acted upon by light waves (*e.g.*, Protozoa), and that epidermal cells often give rise to nervous impulses when acted upon by light (*e.g.*, skin of the earth worm), there seems no reason for assuming that the ommatidium has arisen other than by an accumulation of such sensitive cells and then by invagination a light-refracting organ has been formed over it. Such a view is directly opposed to the view of Patten that the ommatidium is a hair-bearing sense organ. As will be shown later, his theory is untenable on account of the absence of the essential structure for such a homology—the hair. There is not only no indication of such an organ for the eye, but no need for such a complicated theory of the origin of these organs, since easy transition steps from a single cell sensitive to light to the ommatidium are obtainable and such an origin seems far more probable.

Johansen (1893), in his description of the development of the eye of *Vanessa urticæ* L., figures and describes a spindle-shaped mass of cells which is the ommatidium of the pupa when two days and one hour old. He has also observed the same spindle mass in the young pupa of *Sphinx euphorbiæ*. This differs from what I have described for *Apis* in that the corneal pigment cells and cone cells lie distal to the retinula, and I am led to conclude that he has observed a stage just after the sinking in of the retinula, a stage which I am unable to describe for *Apis*. At any rate his conception of the morphology agrees with mine, since the retinula is in the centre of the ommatidium and the cone cells and corneal pigment cells are lateral to it.

2. *Pupa*.

During the so-called semi-pupa stage, just after the larva is sealed up by the workers of the hive, and before the bee is a complete pupa, very rapid growth takes place, and the eye increases still more in size and becomes more and more differentiated until at the beginning of the pupa stage proper the ommatidia are completely formed. The exact method by which this differentiation takes place is difficult to learn, since the growth at this time is so very rapid that it is practically impossible to get all the stages. The head of the insect grows very rapidly and the eyes keep pace with it. The retinular cells become longer and broader, and the retinulæ lie closer together. The cone and corneal pigment cells come to lie at the distal end of the retinula by the method previously described. When the pupa stage proper is entered upon, the area of the eye is practically that of the adult eye.

The various stages of the pupa period are easily distinguishable externally, and this fact is of great value in the selection of material. The eye is first white, like the rest of the body, then pink, then brown, and finally, as the other parts of the body take on their adult colors, black. These changes of color are due to the deposition of pigment in the various cells of the ommatidium, pigment in the corneal pigment cells being red in color, giving the first color externally, and the darker pigments of the other cells obscuring this color at a later period. These changes enable one to choose the desired material by simply uncapping the cells containing pupæ without removing the bee from its cell, since the head is always toward the outside.

From this stage on it becomes necessary to discuss the various parts of the ommatidium separately. Such a method tends to give the impression of a lack of continuity in mode and time of development, but the drawings which accompany the description are made of the entire ommatidium, and these will show the relative size and degree of development at various stages. The order followed is from the retinula to the more lateral cells.

a. The Retinula.—The retinula cells are eight in number normally, but numerous ommatidia are observed in which nine cells are present. In the earliest pupa stage (fig. 3) these cells extend from the proximal end (apex) of the cone cells to the basement membrane, and each cell has a protoplasmic process extending through the openings in the basement membrane toward the optic lobes, which later functions as the nervous connection of these cells with the cells of the retinular ganglion. At this time the only indication of the rhabdome is the clear space at the distal end which was described for the larval ommatidium; its differentiation has gone on little, if any, during the rearrangement of cells. The cytoplasm at the distal end of the cells is more granular than elsewhere, and by the time the eye has reached the stage figured pigment is laid down around the forming rhabdome. This is the first pigment laid down in the ommatidium, but at almost the same time the corneal pigment cells acquire pigment. The spindle shape of the retinula so marked in the larval condition is still retained, the retinula being widest at about one-third of the distance from the cone cells to the basement membrane. The relatively large nuclei of the retinula at this time are near together, and in no definite arrangement in the thickest portion of the cell group. The cytoplasm of the cells is uniform except as described for the distal end, and the cell membranes between the various cells are not visible. The outside boundaries of the retinula group at this time and all through development mark off the retinula from its surrounding pigment cells very sharply, and the difference in the appearance of the protoplasm makes it impossible to confuse the various cells.

The portion of the retinula which lies between its thickest part and the basement membrane is a strand of protoplasm circular in cross-section and without any signs of differentiation. As the basement membrane changes its position, by a process to be described later, coming to lie near the optic ganglion, this portion of the retinula becomes longer, and the changes which take place in the retina consist of the making over of this strand of protoplasm into the retinula cells proper. This change progresses proximally and consists in the widening out of the cells with its accompanying rhabdome formation. The nuclei shift as the retinula enlarges and elongates until we reach a condition (fig. 2) in which two of them are at one level and the other six (or seven) are at a lower level and arranged in a rosette.

At the time when the nuclei are arranged in this manner, the most distal portion of the retinula becomes arranged in a definite rosette, caused by each of the cells forming a projection which shows its distinctness from the others in the group in cross-section. This arrangement also progresses proximally until in the adult condition it is found throughout the length of the retinula. At the same time the inner portion of the mass becomes still more differentiated, and in the stage just mentioned the axis of the distal end is occupied by a strand of protoplasm which takes the iron hæmatoxylin stain (the future rhabdome) surrounded by a clearer protoplasm. Outside of this clear area the protoplasm is granular and pigment deposition takes place here, keeping pace with the inner differentiations, and these changes also progress toward the basement membrane. The rhabdome formation precedes slightly the formation of the clear protoplasm around it, and the proximal end of the forming rhabdome shades off gradually into the surrounding undifferentiated cytoplasm.

The nuclei gradually move inward as the cells assume their adult form until they come to rest at about one-third of the distance from the cone to the basement membrane, which on account of the tapering of the retinula is at about the centre of the cell, as far as mass of cytoplasm is concerned. One of the nuclei, however, moves proximally until it lies about half-way between the other nuclei and the basement membrane. Where a nucleus is present, the retinula cell is slightly pressed out, encroaching on the outer pigment cells, and the upper nuclei are not all at the same level. The one nucleus which occupies a more proximal level is separated by some distance from any of the others, however, and, owing to the regularity with which it is found, cannot be considered as due merely to a mechanical shifting. In the older stages of development it becomes difficult to count the nuclei of the retinula since they are at different levels, but I have been unable to see anything which would lead me to suspect that this proximal nucleus was other than one of the retinular nuclei. Neither is there any indication that the presence of this nucleus is accountable for the presence of nine retinular cells in some ommatidia, for it is found in all ommatidia and the nine-celled condition is comparatively rare.

The rhabdome differentiation proceeds until it reaches the distal surface of the basement membrane where it ends abruptly. In the pupa stages I am unable to find the nerve fibres which in the adult eye run parallel with the rhabdome and send fine fibrillæ into it. It will be noticed, however, that in the pupa the rhabdome is wider and not so definite in outline as it is in the adult eye, and the nerve fibrils are no doubt included in this darker central body which I have identified as the rhabdome. Both rhabdome and nerve fibrillæ are but differentiations of the cytoplasm of the retinula cells and their development takes place together. The rhabdome is probably not a uniform structure, but no doubt contains a mass of fibrillæ, the endings of the nerve fibres. I am unable to see any such structures, however.

The development of the retinula consists, then, in the changing of the sense-bud-like spindle of the larval eye into a long column of cells with a clear shaft through the centre, through which light can pass to reach the nerve endings in it. From the previous description it will be evident that the rhabdome is not formed by processes from the cone cells, which are present from the beginning of ommatidial development, but is an intracellular differentiation of the retinula, there being a sharp line of demarcation between the cone cells and rhabdome throughout their development.

b. The Cone Cells.—The cone cells are four in number, and in the early pupa stage (fig. 3) the cone is spindle-shaped and lies directly distal to the retinular spindle. The nuclei are large and spherical, and lie slightly distal to the centre of the cell. The cytoplasm is granular, especially in the distal portion of the spindle, and the cell membranes are well marked.

Very soon the cytoplasm begins to be differentiated, and by the time the pupa has reached the stage figured (fig. 2) vacuoles begin to appear in the proximal end of the spindle, which marks the beginning of the formation of the clear cone substance. The cells now increase in size considerably, and at the same time the number of small vacuoles increases. Later these vacuoles unite, and finally a condition is reached in which the proximal end of each cell is occupied by one large clear vacuole. The cell boundaries remain distinct and a thin layer of granular protoplasm remains surrounding the vacuole, so that it is strictly an internal secretion and not to be interpreted as a secretion poured out on the inner face of each of the cells. This process of differentiation or intracellular secretion goes on until the nuclei, which decrease in size and become long and narrow, are pushed to the distal and lateral portion of the cell, where they remain in the adult eye. These nuclei are filled with fine chromatin granules. The cone in the meantime becomes wide at the distal end, and elongates very much to assume its true cone shape, and all that remains of the original cytoplasm is an extremely thin sheet all around the cone. I am inclined to attribute the descriptions by some authors of nerve fibrils on the cone to the shrinking of this thin film under certain fixatives. There is no nervous connection with the cone, nor does it appear to have any function save transmitting light rays to the sensitive retina.

There is no indication of any prolongation of the cone proximally, either to form the rhabdome, as previously described, or to form protoplasmic processes surrounding the rhabdome inside the retinula cells, such as Patten describes for *Vespa*. Such fibres could not exist unless they were to pierce the retinula cells, since the rhabdome is really a part of the latter; and since the cell boundaries of the cone and retinula are so well marked I feel sure that no such ingrowth occurs.

Equally unsuccessful has been a search for any additions to the cone at the distal end. In his work on the embryology of the eye of *Vespa*, Patten describes a layer of cells distal to the cone which arose by an overfolding of the sides of the entire eye, and which gave rise to the lens. In a later paper (1890) he disposes of his invagination theory, but describes a pouring out of chitin from the distal end of the cone, which secretion he mistook for the layer of nuclei at an earlier time. From my examination of *Apis* material I am unable to find anything which could be mistaken for nuclei in that position (unless it be the corneal pigment cells which are lateral to the distal end of the cone) or for chitinous secretion of the cone; and for this insect eye, at any rate, I am led to doubt the validity of his homology of such a structure with the pseudocone of ommatidia of the "pseudocone type," since the distal end of the cone is perfectly well defined at every stage observed.

The differentiation of the cone consists in a transformation of a cone without any refractive secretion into one in which this secretion fills all the cells proximal to the nuclei, or, in other words, a modification of an acone condition into an eucone condition, to use terms introduced by Grenacher for adult conditions of some eyes. There can be no doubt that this was the course taken during the evolution of the eucone ommatidium. Similarly, Hickson has shown that the so-called pseudocones described for many insect eyes are but instances in which the secretion has accumulated in the distal end of the cone rather than in the proximal end. While the distinction drawn between these three kinds of cones is justifiable, yet there seems nothing to oppose the view that they are but modifications of one primitive type. The acone ommatidia have no clear refractive substance differentiated in the cone cells, and are considered as the primitive type of eye. The pseudocone cones with the differentiation of clear cone substance distal to the nuclei and the eucone cones with a proximal secretion are but modifications of the primitive type.

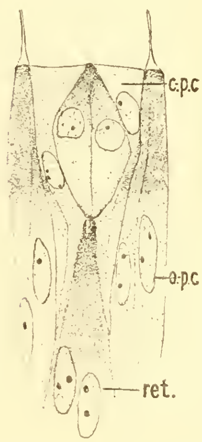


Fig. 6.—Young pupal ommatidium at time of migration of corneal pigment nuclei.

c. The Corneal Pigment Cells and the Lens.—The lens is secreted by the two cells which have been designated corneal pigment cells. In the very earliest pupa stage these cells lie distal and lateral to the cone cells, and since they are thus placed at this time, and since their secretion product is distal to the cone, they are next in order in going out from the axis of the typical ommatidium.

Before these cells begin their secretion, however, the nuclei migrate down the sides of the spindle-shaped cone and come to lie around the apex of the cone. The cause of this migration is probably purely mechanical, viz., the enlargement laterally and distally of the cone; at the same time the nuclei are thus brought nearer to the source of nutriment. As this shifting takes place the nuclei, originally ovoid, become crescent-shaped, and finally almost encircle the apex of the cone. Strands of cytoplasm connect the nucleated portion of the cell with the distal portion, which remains at the point where secretion is to take place. As the cone enlarges and the cell substance of the corneal pigment cells is used up in the secretion of the lens, the portion distal to the cone becomes reduced until in the adult eye it is almost entirely absent.

Almost immediately after pigment is first formed in the retinula cells, it begins to be deposited in these corneal pigment cells. Owing to the fact that the retinula pigment is at first small in quantity, and since there is none in the outer pigment cells at this time, the pigment of these distal pigmented cells, which is red, gives a pink color to the entire eye in the early stages, rather than the brown or black color possessed by the other pigment, as is true in late stages.

The granules of pigment are large and red in color, and when treated with depigmenting mixtures do not disappear, but become somewhat lighter in color.

The lens is secreted by these cells in much the same way as is ordinary chitin over the entire body of the bee. This chitinous covering is deposited in layers which are easily visible in the adult lens. In addition to these cells the outer pigment cells also seem to enter into this. In the pupal eyes before any chitin is deposited by the corneal pigment cells thin sheets of chitin extend out from the outer pigment cells, and since these cells are arranged at their distal ends in a nearly hexagonal manner a cross-section of these plates shows the future boundaries of the facets. In the adult eye the portion of the cornea which directly overlies the outer pigment cells differs slightly from the part directly over the cone in refractive index and in general appearance, so that I think it probable that the space between these sheets of chitin in the larva is filled by a secretion of the outer pigment cells. If this be true, then every cell which enters into the formation of the compound eye has to do with some sort of secretion, either intra- or extracellular.

The structure of the chitin laid down by the corneal pigment cells is not uniform, the outermost layer being more dense than the rest, with a decided tendency to take up an iron hæmatoxylin stain, the middle or main portion being arranged in alternating layers of different density, and the inner portion taking a protoplasmic stain, such as eosine or Bordeaux red.

From this description it will be seen that the corneal pigment cells (Hauptpigmentzellen, pigment cells of the first order) are homologous with the corneal hypodermal cells of the crustacean and apterygote insect eyes. In all crustacean compound eyes small nuclei are described as lying distal to the cone cell nuclei (or Semper's nuclei), and these are the nuclei of the cells which secrete the lens. When the ommatidia are arranged in facets, two such cells are present. In the Apterygota, *e.g.*, *Lepisma saccharinum*, *Orchesella*, etc. (Hesse, 1901), these two cells are present and occupy a similar position or may be placed slightly more laterally. These two cells are characteristic of these two types of compound eyes. On the other hand, the compound eyes of most pterygote insects have the two pigment cells of the first order (corneal pigment cells), and do not have the corneal hypodermal cells. Hesse (1901) concluded that these two kinds of cells are homologous from an examination of adult eyes, and considered his point strengthened by the fact that Johansen had described these pigment cells as being distal to the cone cells at an early stage. Johansen did not describe them as homologous, however, and derived the lens from another source. From an examination of *Apis* I am convinced that Hesse was correct in his deductions, for in this case the cells are not only homologous, but the pigment cells here have identically the same function as have the corneal hypodermal cells of the other eyes.

As mentioned above, Johansen failed to see this homology and describes and figures the lens as being secreted by the cone cells. It has been pointed out with sufficient detail that no such interpretation is tenable for *Apis* at least, and we may well doubt its occurrence in *Vanessa*. In Pl. 23, fig. 11, he figures the secretion of the lens by the cone cells and shows the corneal pigment cells extending to the distal margin, and I am led to conclude that he has overlooked the position of the pigment cell which remains distal to the cone.

d. The Outer Pigment Cells.—These cells from the earliest larva to adult stages extend the entire length of the ommatidium, and are what are known as accessory cells in many eyes. They, like all the other cells of the eye, are of ectodermic origin, there being no cells from the mesoderm in the eye of *Apis*, such as are described in some eyes. These cells are, normally, twelve in number, but when hair cells are present between the ommatidia, which is very frequently the case, this number is increased so that any definite enumeration is impossible; and since these cells serve merely to fill the interommatidial spaces and to prevent reflection inside the lens, no more definite arrangement is required. The nuclei of these cells lie proximal to the cone in pupal stages, but in the lengthening of the cone they come to lie at about its middle.

Pigment is deposited in these cells quite early, but not until after it has appeared in both the retinular and corneal pigment cells, and is most abundant at the two ends of the cell. It will be noticed that of all the cells of the eye which contain pigment none acquire this until they have begun to form the secretion to which they give rise. The rhabdome is the first secretion formed, and pigment first appears in the retinula; later the lens secretion appears, and then pigment appears in the secreting cells, indicating, it seems to me, that this pigment is of the nature of a by-product, although it is of itself of value. From one point of view, pigment itself is a secretion, but the accumulation of pigments often accompanies other secreting activities. Concerning any possible movements of the pigment under different light conditions, no observations have been made.

In the region where the basement membrane is formed these cells are deeply pigmented, and the line of demarcation from the cell below is very marked. At this point, also, and only here, the cells are fused with the retinular elements. This intimate union can exist only when the retinular elements have filled out to that point, since in the pupal stages that portion of the retinula is a thin strand. The retinular cells here are also deeply pigmented.

3. *The Adult Ommatidium.*

In the discussion of the changes which take place during the pupal period many of the details of the adult ommatidia are given, and to avoid unnecessary repetition only such things as have been omitted will be discussed here.

a. The Retinula.—The adult retinular cells are extremely complicated structures, due to the fact that each cell has so many differentiations internally. The central part of each cell is differentiated into a sector of the rhabdome, which is possibly a dead secretion, but of this there is room for some doubt. Outside the rhabdome is an area of clear protoplasm in which the nervous elements of the cell are found, and still outside of this is the granular portion of the cell in which pigment granules are found. Each of these cells then secretes part of the rhabdome, acts as a pigment cell by the accumulation of pigment on its outer surface, and is, in addition, a nerve-ending cell.

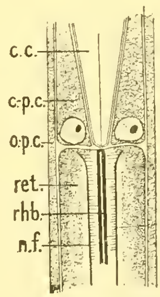


Fig. 7.—Diagram of part of ommatidium, showing apex of cone and distal end of retinula.

The innervation of the ommatidium is a question over which there has been much discussion, and various views have been put forth. The views can, however, be classed into two groups: those which make the cone cells the nerve-ending, and those which find the terminations in the retinula. It has been shown conclusively by numerous investigators that the cone has nothing whatever to do with receiving light stimuli, and it would be useless to take up the arguments against this view, any more than has been done in showing that in the development the cone and rhabdome are separate.

Those who hold that the retinula is the nerve-ending of the ommatidium have not always been able to show in a satisfactory manner just how this innervation takes place. On this point two views have been held: (1) that the retinula is innervated by nerve fibrils from the retinular ganglion which run into the retinular cells or rhabdome, or (2) that the retinular cells are themselves ganglionic epidermal cells which send in nerve fibres to the retinular ganglion. From the description which has preceded it is evident that the second of these views is the one here held for the eye of the bee. Before going into a detailed descripton of the nervous elements in the cells concerned, let us first examine the problem.

In the first place, it seems reasonable to assume that during the course of the evolution of light-perceiving organs the first condition was that in which certain cells of the hypodermis became sensitive to light, or possibly heat, through the accumulation of pigment or some other change in the cytoplasm. Such cells would arise before there were any cells in the central nervous system to receive their nerve stimuli, and it may be assumed without danger that such cells would send in processes to the centrally placed nerve cells, when the time for nerve connections arrived, rather than that the nerves arose from the central nervous system. In other words, the peripheral nervous system is older than the central nervous system which elaborates the impulses, and on hypothetical grounds, a basis which is rather unsafe in zoology unless backed up by observations, we may assume that the innervation is centrad.

From the standpoint of embryology, we find that the eye epidermis is formed and even the ommatidia are differentiated before the retinal ganglion cells have assumed their adult position or are connected with the optic ganglia. Not only that, but the strands of cytoplasm which become the nerves of the ommatidia arise from the retinula cells and grow centrad.

In the adult condition we find that the nerve fibres are continuous with the cytoplasm of the retinula and run to the retinular ganglion, where they surround the nuclei of the ganglionic cells. There is no indication of long nerve processes from the ganglion cells toward the eye.

The nervous elements of the retinular cell proper consist of a differentiated portion of the cytoplasm inside the clear area which lies outside the rhabdome. This nerve fibre can be seen best in sections stained in iron hæmatoxylin, where it stains black. From this fibre, which starts at the distal end of the cell and runs parallel to the rhabdome, smaller fibrils are given off which run into the rhabdome where they all end. More properly speaking, these fibrils are further differentiations of cytoplasm which lies between the main fibril and the centre of the retinula. These fibrils extend from the fibre to the rhabdome along the whole length of the retinula proper, so that the nerve-endings are very numerous. Below the basement membrane these main fibres can be traced as dark lines in the centre of the protoplasmic processes to the retinular ganglion. All of these fibres are best seen on cross-sections where they stand out as black dots, but they can also be seen on longitudinal sections. It is probable that the cause of the black color of the rhabdome in sections stained with iron hæmatoxylin is the presence of these numerous nerve fibrils. Concerning the distribution of these fibrils inside the rhabdome, I am unable to say anything definite, but they probably extend almost straight to the centre. In material fixed in Kleinenberg's picro-sulphuric fixing fluid the rhabdome sometimes appears as a tube, and this may indicate that these fibrils do not run all the way to the centre. While the innervation of the ommatidium is under discussion, it might be stated that there is no indication of nervous connection with any of the other cells peripheral to the retinula.

The significance of the single retinular nucleus which lies at a lower level than the others of each ommatidium, is somewhat hard to explain. Hickson held that some of the retinular cells of *Musca* had more than one nucleus. In this form there are three layers of nuclei in place of two, as in *Apis*. Hesse, on the contrary, homologizes these lower nuclei, only one of which is present in *Apis*, with the proximal retinular cells of the apterygote insect eyes. In these forms the retinula is divided into two parts, one distal to the other, each of which acts alone in the formation of rhabdome structure, and both have nerve fibre connections with the optic ganglia. A similar condition is found in some pterygote insect ommatidia. Of these two views the one of

Hesse seems more probable. As Hickson says, there is nothing morphologically wrong with the supposition that certain cells are multinucleate; but since the explanation of Hesse helps us to complete the homologies of the cells of the ommatidia of the various groups, it seems to have more weight.

The question as to the method of modification in number of retinular cells during the course of evolution is an interesting one, but it must be admitted that as yet very little is known concerning it. It seems not unlikely that the ommatidium of the bee is changing either from eight to nine retinular cells, or from nine to eight, since it is rather rare for the number of these elements to be variable. The thought has suggested itself that possibly this one proximal nucleus was one which was in the process of delamination from the ommatidial epidermis, and was therefore tending toward a reduction of retinal elements, but this does not seem to be as probable an explanation as that of Hesse. It may be said, however, that Johansen describes the ommatidium of *Vanessa* as having seven retinular cells and two retinal ganglion cells, while in *Apis* there is probably but one retinal ganglion cell to each ommatidium and at least one more cell in each retinula.

VII.—Homologies of Component Parts.

The question of homologies of the various eyes of the invertebrates has excited much discussion, but since only compound eyes have been investigated in this paper, this problem will not be taken up here. The question of the homology of the different kinds of compound eyes is worthy of consideration. Such eyes occur in crustacea and insects,[4] and a comparison of the groups indicates that there is here either uniformity of origin and plan or one of the most remarkable cases of convergence known in the animal kingdom. The essential part of the ommatidium is the retinula, and this may be considered as a sense bud, formed by the accumulation of cells sensitive to light, which has been modified internally to aid in light perception. Since such groups of cells occur throughout the whole animal kingdom and associated with all the senses, there is nothing remarkable about the similarity so far. In addition to the retinula, an ommatidium consists of a cone and a

[4] No account of the so-called compound eyes of myriapods and arachnids is taken here, since their plan is so different that they cannot readily be homologized with those of crustaceans or insects. Until we know more of the comparative embryology of these forms it may be as well to suspend judgment. I do not feel qualified to include these in the present discussion, but evidently from the researches of numerous investigators we may conclude that the homology is not as close as in the forms under discussion.

chitinous covering which may be faceted, and possibly accessory cells occur between ommatidia which act as pigment cells. In order that the light rays may be centred on the retinular nerve fibres, some refractive organ must be present above it (the cone) and the whole organ must be covered by chitin, as is the rest of the body. This chitin in turn may assist in the refraction, as it does in many cases, or may even secondarily assume the functions of the cone entirely if no cone substance is differentiated (acone eyes). For the occurrence of these parts there are but two explanations: either they are differentiations of cells which formerly lay outside the retinula group, and have been placed distal to it to assist in collecting light rays to form a more perfect image, or they have been placed distal to the retinula by the differentiation of some other cell layer which has been superimposed.

The various cells of the ommatidium seem to lend themselves to homologies very readily. The retinulæ of the various ommatidia are groups of cells which are the nerve endings of the eye, and all ommatidia agree in this respect. Retinulæ of apterygote insects, some crustacea and a few pterygote insects have two layers of retinular cells, while others have but one, but, as was pointed out for *Apis*, the position of nuclei at different levels in the higher insects may indicate a remnant of a former two-layered condition for these retinulæ also. In other words, the morphological invagination by which the insect eye has arisen may be carried farther in some cases than in others. Hickson has shown that acone, pseudocone and eucone cones are probably homologous, and the fact that some cones are composed of but two cells while others have four seems a matter of small moment. The probable homology of the corneal hypodermal cells of apterygote insects and crustacea with the corneal pigment cells of most pterygote insects has been dwelt on sufficiently and is held on comparative anatomical grounds by Hesse. The accessory pigment cells are undoubtedly but undifferentiated cells of the layer of epidermis from which the retinulæ arise, and their presence or absence is of small importance in homologizing the different ommatidia. The fact also that mesodermal cells may migrate to a position between ommatidia, as is held for some eyes, is also of small consequence. As far, then, as the component parts of the ommatidia are concerned there is no difficulty about establishing a very close homology, and this similarity is considerably strengthened by showing that the corneal pigment cells are not only similar in function to the corneal hypodermal cells, but that at an early stage they actually occupy the same position.

The whole question seems, then, to be one which must be settled from embryological evidence. The problem is, which of the two methods of formation previously mentioned is the method which actually exists in ontogony, and are all compound eyes formed by the same method? From this work on *Apis* and that of Johansen on *Vanessa* it is evident that the differentiation of cells outside the retinula to form cone and lens layers is what occurs in insects, and the whole question hinges on the development of the crustacean eye. Reichenbach and Kingsley describe the eye as arising by an invagination; and if either of these investigators is right, although they differ as to the fate of the three layers formed, then the compound eyes of these crustaceans are not homologous with the compound eyes of insects. On the other hand, Herrick insists that the compound eye of *Alpheus* arises from a single layer of epidermis, and according to this view the homology holds. Herrick's view, that even if an invagination does occur it is of no importance, does not seem tenable, for if an invagination occurs then cone and retinula do not come from contiguous cells, and that I believe to be a matter of great importance.

From the striking similarity in position and function of the parts of the ommatidium, and from the observations of Herrick, we are safe in concluding that the eyes of the various groups under consideration are distinctly homologous, and there must be some other explanation for the invaginations observed by the other writers mentioned.

The interpretation of the formation of the ommatidium which is held from an examination of the eye of *Apis* makes possible a very close homology of the elements of the compound eye with the ocelli of insects, such as was held by Grenacher; and this homology seems materially strengthened since an homology can be shown between the corneal pigment cells of insect ommatidia with the chitin-secreting cells of the ocelli. An objection that might be raised is that the vitreous body of the ocellus arises from cells which are all to one side of the retina rather than from all sides, but since they are adjoining cells this might be a secondary change. From sections of ocelli of the pupæ of the bee which have been examined, it is evident that the middle ocellus arises from a double invagination, indicating a fusion of two organs, while the lateral ocelli arise from single invaginations.

VIII.—Summary.

The primitive arrangement of ommatidia is tetragonal (p. 130).

The hairs over the lens are secreted by bi-nucleated hair cells with intracellular ducts which lie between the ommatidia (p. 131).

The ommatidium arises as a group of cells with superimposed nuclei, which later become arranged as a spindle surrounded by smaller cells (p. 136).

This spindle is the retinula, and the cone cells and pigment cells assume a distal position by a morphological invagination (p. 137).

The retinula is the centre of the ommatidium, and the cone cells, corneal pigment cells and outer pigment cells follow in the order named (p. 141).

The ommatidium is composed of eight or nine retinula cells around the rhabdome, four cone cells, two corneal pigment cells and about twelve outer pigment cells (p. 126).

The rhabdome and cone are intracellular secretions, while the lens is an extracellular secretion of the pigment cells (p. 144).

The corneal pigment cells are homologous with the corneal hypodermal cells of crustacean and apterygote insect ommatidia (p. 147).

The innervation of the ommatidium is by a differentiation of part of the retinular cells into nerve fibrils, and these extend to the retinular ganglia (p. 149).

The lens is secreted by the corneal pigment cells which early in the pupa stage lie distal to the cone, and possibly also by the outer pigment cells (p. 148).

Pigment is formed inside all the cells of the ommatidium, except the cone cells, by a cytoplasmic differentiation (p. 149).

The ommatidium arises from a strictly one-layered epidermis, which passes directly from the larva to the pupa without the loss of any cells or additions from other tissues (p. 136).

Literature.

Balfour, F. M. 1881. *A Treatise on Comparative Embryology*, II, London.

Bütschli, O. 1870. Zur Entwicklungsgeschichte der Biene. *Zeit. f. Wiss. Zool. XX*, pp. 519–564.

Carrière, J. 1884. On the Eyes of Some Invertebrates. *Qt. Jr. Micr. Sc.*, XXIV, New Series, pp. 673–81.

—— 1885. Die Sehorgane der Thiere vergleichend anatomisch dargestellt. München und Leipzig, R. Oldenbourg, 6+205 pp.

—— 1885. Einiges über die Sehorgane von Arthropoden. *Biol. Centralbl.*, V, No. 19, pp. 589–97.

—— 1886. Kurze Mittheilungen aus fortgesetzten Untersuchungen über die Sehorgane. *Zool. Anz.*, IX, Nos. 217 and 230.

Fernald, H. T. 1890. The Relationships of Arthropods. *Studies Biol. Lab. Johns Hopkins Univ.*, IV, pp. 431–513.

Grenacher, H. 1874. Zur Morphologie und Physiologie des facettirten Arthropodenauges. *Göttingen Nachrichten*, pp. 645–56.

—— 1877. Untersuchungen über das Arthropoden-Auge. *Beilageheft zu den klinischen Monatsblättern für Augenheilkunde*, XV.

—— 1889. Untersuchungen über das Sehorgan der Arthropoden, insbesonder des Spinnen, Insecten und Crustaceen. Göttingen, Vanderhoeck und Ruprecht, 8+188 pp., 11 Taf.

Herrick, F. H. 1889. The Development of the Compound Eye of Alpheus. *Zool. Anz.*, XII, pp. 164–9.

Hesse, Rich. 1901. Untersuchungen über die Organe den Lichtempfindung bei niederen Thieren. VII, Von den Arthropoden-Augen. *Zeit. f. wiss. Zool.*, LXX, pp. 348–473.

Hickson, S. J. 1884. The Eye and Optic Tract of Insects. *Qt. Jr. Mic. Soc.*, No. 98.

—— 1885. The Retina of Insects. *Nature*, XXXI, pp. 441–2.

Johansen, H. 1893. Die Entwicklung des Imagoauges von Vanessa urticæ L. *Zool. Jahrbüch*, VI, pp. 445–80.

Kenyon, F. 1896. The Brain of the Bee. *Jr. Comp. Neurology*, VI, pp. 133–210.

—— 1897. The Optic Lobes of the Bee's Brain in the Light of Recent Neurological Methods. *Am. Nat.*, XXXI, pp. 369–76.

Kingsley, J. S. 1886. The Arthropod Eye. *Am. Nat.*, XX, pp. 862–7.

—— 1886. The Development of the Compound Eye of Crangon. *Zool. Anz.*, IX, No. 234, pp. 597–600.

—— 1887. The Development of the Compound Eye of Crangon. *Jr. Morph.*, I, No. 1, pp. 49–66.

Leydig, F. 1855. Zum feineren Bau der Arthropoden. *Arch. f. Anat., Physiol. u. wiss. Med.*, pp. 376–480.

—— 1864. Das Auge der Gliederthiere. Tübingen, Laupp und Siebeck, 50 pp.

Lowne, Thompson B. 1878. On the Modifications of the Simple and Compound Eyes of Insects.

—— 1884. On the Compound Vision and the Morphology of the Eye of Insects. *Trans. Linn. Soc.*, London.

Parker, G. H. 1891. The Compound Eyes in Crustaceans. *Bull. Mus. Comp. Zool. Harvard Univ.*, XXI, No. 2, pp. 45–140, 10 plates.

Patten, William. 1886. Eyes of Molluscs and Arthropods. *Mitth. Zool. Stat. Neapel*, VI, pp. 542–756.

—— 1887. Studies on the Eyes of Arthropods. I. Development of the Eyes of Vespa. *Jr. Morph.*, I, pp. 193–226.

—— 1890. Is the Ommatidium a Hair-bearing Sense-bud? *Anat. Anz.*, V, Nos. 13, 14, pp. 353–9.

Reichenbach, H. 1886. Studien zur Entwickelungsgeschichte des Flusskrebses. Frankfurt.

Watasé, S. 1889. On the Structure and Development of the Eyes of the Limulus. *Johns Hopkins Univ. Circ.*, VIII, No. 79, pp. 34–7.

—— 1890. On the Morphology of the Compound Eyes of Arthropods. *Studies Biol. Lab. Johns Hopkins Univ.*, IV, No. 6, pp. 287–334.

Willem, V. 1897. Les yeux et les organes post-antennaires des Collemboles. *Ann. Soc. entomol. de Belgique*, XLI, p. 225.

Abbreviations.

l., lens.
c. p. c., corneal pigment cell.
o. p. c., outer pigment cell.
b. m., basement membrane.
l. ret. n., lower retinular nucleus.
ch., chitin.
f. b., facet boundary.
ret. gang. n., nucleus of retinular ganglion.
br. sh., brain sheath.
int. d., intracellular duct.
c. c., crystalline cone.
rhb., rhabdome.
ret., retinula.
pgm., pigment.
n., nucleus.
h. c., hair cell.
tr., trachea.
n. f., nerve fibre.

Explanation of Plates VI, VII, VIII.

Plate VI, Fig. 1.—Section of entire eye and optic lobes. The heavy lines show the course of the nerve fibres as worked out by Kenyon (diagrammatic).

Plate VII, Fig. 2.—Ommatidium of young pupa before rhabdome is differentiated and at time of first pigmentation of retinula cells.

Fig. 3.—Ommatidium of older pupa, showing differentiation of rhabdome and lens formation.

Fig. 4.—Cross-section through distal end of cone of pupa of same age as fig. 2, showing corneal pigment cells.

Fig. 5.—Cross-section through cone of older pupa.

Fig. 6.—Cross-section through proximal end of cone of pupa (same stage as figs. 3 and 5).

Fig. 7.—Cross-section through cone of young pupa.

Fig. 8.—Cross-section through retinula of young pupa before rhabdome formation.

Fig. 9.—Cross-section through distal end of retinula of young pupa, showing first traces of pigment.

Plate VIII, Fig. 10.—Entire ommatidium (somewhat diagrammatic). Adult.

Fig. 11.—Entire ommatidium, as if dissected out, without outer pigment cells (diagrammatic). Adult.

Fig. 12.—Section of entire ommatidium, showing distribution of pigment. Adult.

Fig. 13.—Cross-section just proximal to lens, slightly oblique.

Fig. 14.—Cross-section through extreme distal ends of retinulæ and proximal ends of cones, slightly oblique.

Fig. 15.—Cross-section through retinulæ, showing relation of outer pigment cells in this region.

Fig. 16.—Cross-section through retinulæ in region of nuclei.

Fig. 17.—Cross-section through retinulæ in region of proximal nucleus.

Fig. 18.—Cross-section of eye, cutting basement membrane parallel. The distinctness of nerve fibres of each ommatidium is shown.

CŒLOSPORIDIUM BLATTELLÆ, A NEW SPOROZOAN PARASITE OF BLATTELLA GERMANICA.

(Preliminary Note.)

BY HOWARD CRAWLEY.

The Malpighian tubules of the so-called Croton bug, *Blattella germanica* L., are the habitat of a Sporozoan parasite which apparently belongs to the Haplosporidia. This group, which has the value of an order, is divided into several rather poorly defined genera. The animal herewith described does not fit very well into the present scheme of classification, but for the sake of avoiding a needless multiplication of names, I shall accredit it to the genus *Cœlosporidium* Mesnil and Marchoux. The creation of a new species is warranted, whereupon, for the time being, the animal may be known as *Cœlosporidium blattellæ* sp. n.

The life cycle, so far as I have yet been able to trace it, originates as a minute cell of strongly acidophil cytoplasm, containing several granules of chromatin. These granules, which range around one micron in diameter, appear to have the value of nuclei, and they will be so termed in the description which follows.

At first the cell, or, to follow the terminology suggested by Minchin, the trophozoite, is generally somewhat longer than broad, and lies with its longer axis across the lumen of the tubule. The shape may be as shown in either fig. 1 or 2. One end lies against, and is apparently attached to, the lumen of the tubule. I have not been able, however, to determine the exact nature of this attachment. Neither in fixed nor fresh preparations were there ever seen any processes such as those of the epimerites of polycystid gregarines or the inert pseudopodia of Ophryocystis. The attachment seems merely to be a close apposition, and there is no objection to so regarding it. For in consideration of the narrow lumina of the tubules and the lack of fluid currents passing through them, the parasite is in little danger of being carried away. Certain appearances, however, suggest that the maintainance of the usual position is aided by the presence of an amorphous substance which lies

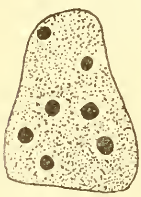


Fig. 1.

between the parasite and the host cell. It is often impossible, in the case of those small closely applied forms, to get a sharp line of demarkation between the sporozoan and the epithelium, the one blending with the other by imperceptible degrees.

However this may be, the juxtaposition of the parasite and the cell is evidently of no great importance to the former. Ordinarily the smaller, undeveloped stages are attached and the later stages free. The reverse may, however, be observed and the matter is evidently one largely of chance.

By a uniform growth in all directions the trophozoite becomes an egg or potato-shaped organism, reaching a length of around 20 microns. This, however, is to be noticed only in the free individuals and where the spatial relations are favorable. More usually the lumina of the tubules are so small and so closely crowded with the parasites that the latter are constrained to assume a vermiform or plate-like shape. Thus fig. 2, which is the longitudinal section of an indivdiual with a circular cross-section, would answer equally well for the cross-section of an individual extending for some distance along the tubule cells.

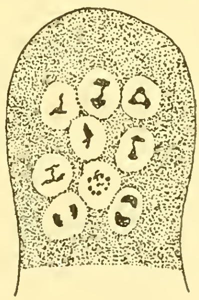


Fig. 2.

Both these elongated or flattened individuals, as well as the egg-shaped forms mentioned above, may still retain the primitive character of being naked masses of uniform cytoplasm with a various number of solid nuclei. Generally, however, the reproductive cycle is inaugurated while the organism is still very small. The first indications of this are furnished by the nuclei. These lose their spherical form and their solidity. They may become either somewhat irregular masses or else rings. The elements are so minute that the determination is difficult, but from what takes place later these early phenomena are apparently the expression of the breaking up of the nucleus into extremely small chromosomes.

Simultaneously there arises around each nucleus a vacuole, which, in its turn, can often be seen to be surrounded by a condensed belt of cytoplasm. These are the first steps in the breaking up of the trophozoite into separate elements, and from this point on development may progress along either one of two lines. In the one case the result is the production of what I shall call the "round bodies." In the other the process is clearly spore-formation. I have not yet succeeded in satisfactorily differentiating these two developmental courses in their earlier stages, and the detailed account will be reserved for my final communication. I shall here merely consider the latest stages in each case.

Fig. 2 shows an acidophil cell still attached to the epithelium. Within it are several clear areas. Each of these is occupied by a quantity of chromatin. In several cases the manner in which this chromatin is arranged is strongly indicative of mitotic division. In fig. 3 is shown what may be called a cyst of the round bodies. The original trophozoite consists of a shell, divided into irregularly shaped compartments. Each compartment contains a completed round body. The round body is normally spherical; occasionally ellipsoidal. It usually consists of a solid mass of strongly acidophil cytoplasm containing an irregular nucleus. That the element shown in fig. 3 is derived from that of fig. 2 is indicated by the striking resemblance between the nuclei, and by their size. In the stage of fig. 2 the nuclei are in division, and are thus, as is usual, lying within clear regions. To obtain the conditions shown in fig. 3 it is only necessary to conceive the collection of the cytoplasm around the nuclei, with the consequent disappearance of the vacuoles.

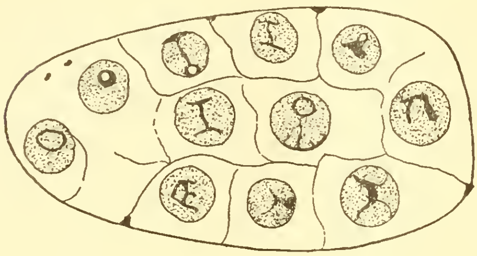


Fig. 3.

A little later, by the complete disintegration of the cyst, the round bodies come to lie free in the lumina of the tubules. They are minute elements, ranging in diameter from 1½–2 microns. There is probably a very delicate ectosarc or membrane, since at times the cytoplasm is wanting, the chromatin lying within an otherwise empty shell. The ultimate destiny of these bodies has not yet been discovered.

The formation of the spores follows much the same general lines, but differs considerably in detail. The nuclei, after passing through the stage of individual chromosomes, concentrate into rings, ovals, or the so-called dumbbell shape (figs. 4 and 5). Frequently they may become wholly solid masses of chromatin, but more usually they show a central cavity, or, in the case of those having the dumbbell shape, two such cavities. Around this chromatin mass there is nearly always a clear space, while the bulk of the spore consists of a thick shell of acidophil cytoplasm (fig. 5). Occasionally the clear space encroaches upon the cytoplasmic mass, which may thus become a thin shell, or even wholly wanting at the two ends of the spore. There is an evident

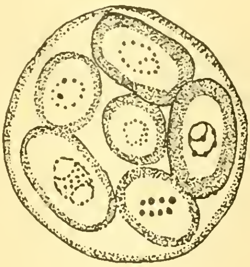


Fig. 4.

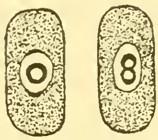


Fig. 5.

membrane or shell in the mature spore, the average length of which is 5 microns.

The reason for regarding these bodies as spores is the fact that they occur in the alimentary canal of the host, both before and behind the openings of the Malpighian tubules. In the former position they were seen to lie close against the epithelial cells, but none of my material showed any of them *en route* to entrance.

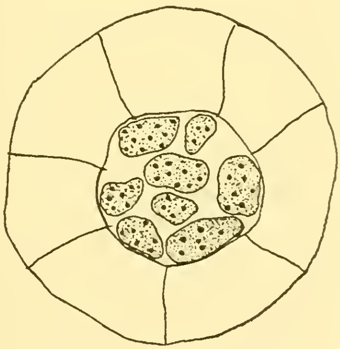


Fig. 6.

Perhaps the most striking phenomenon exhibited by this parasite is the abundance with which it occurs. Fig. 6 shows the cross-section of a tubule, wherein the parasites come near to occluding the entire lumen. This is a quite characteristic condition. It would seem that so complete a blocking up of the tubule should produce disturbances in the economy of the host. Yet the tubule epithelium was throughout, to all appearances, wholly normal.

THE SPERMATOGENESIS OF SYRBULA AND LYCOSA, WITH GENERAL CONSIDERATIONS UPON CHROMOSOME REDUCTION AND THE HETEROCHROMOSOMES.

BY THOMAS H. MONTGOMERY, JR.

The present paper presents observations on the spermatogenesis of *Syrbula* (a grasshopper) and of *Lycosa* (a spider), together with some broader conclusions in regard to questions of the behavior of the chromosomes during the maturation mitoses, and of the nature of those modified nuclear elements which have been termed by me heterochromosomes.

The subject of heredity, which in its broadest sense includes most of the problems of the phenomena of life, is being pursued from two main lines: from that of the study of the germ cells, and from that of an analysis of the results of cross breeding. The actual steps of the process of heredity, if we shall ever understand them, will be learned by the first method, by the investigation of the energies of those cells which transmit ancestral traits. The second method is of less importance than the first, for while it may permit an analysis of the proportional transmission of different ancestral traits, it can in no way elucidate the steps of this process, for the very reason that its material basis is the terminal stage alone, and the somatic condition at that.

And of all cellular investigations, those that concern themselves with the nuclear chromosomes seem to penetrate deepest into the mysteries of the problem, for these cellular components more than all others seem proven to be the centres of hereditary energies; can we unlock their secrets we will have opened the door to the light, for there seems to be no other portal.

The study of the chromosomes has ceased to be regarded as an academic question, or as a mere side issue of problems of cell division, and is slowly but surely coming into the centre of the field of biological thought—of that thought which embraces the broader community of natural phenomena and does not lose sight of the forest for the trees. All things are in the nature of processes, to the biologist of genetic processes, and of the vital changes heredity is the one that is the most comprehensive; broadly speaking, biology is the study of heredity. There are two methods used in the search for the solution, the morphological and the experimental. The former reasons out the process as it is to be understood from the sequence in structural change; the latter aims directly at an analysis of the process by a study of result where the cause is measurable. Yet just here it must be held in mind that the true morphologist has in ultimate consideration the explanation of process, so that he is fully as much a physiologist as the other. And his method is correct, because structure only is visible while process is an intangible change, and therefore he is reasoning from the perceptible to the imperceptible. Many morphologists do not conceive this mental attitude rightly, and most physiologists are inclined to hold that all morphologists see no further than the structure. Yet the morphological basis must precede the physiological experiment, and it is quite questionable whether both will not always be necessary as complemental methods; we cannot say which will ultimately prove the more important, but all will admit that the greater interpretations of biology have had a morphological basis, and that the morphologist has done his full half in reasoning out the processes.

That is not scientific morphology which goes no further than the structural fact; but with minor exceptions all morphologists try to go much further than this, and throughout their analyses have in mind the process. And the morphologist is an analyst of natural phenomena, an explainer of those normal experiments not performed within the laboratory. Therefore a present tendency to maintain that only experiment can furnish explanations, and that structural study can present only observational results, has no foundation whatsoever. The true method is to remember always that in the living as in the nonliving world the process must be interpreted; so long as this is not forgotten it matters little what mould the investigation is cast in.

Some years of rather intensive study of the structure of the germ cells, particularly of the behavior of their chromosomes, has led me to the conclusion that there is simplicity and essential uniformity among the bewildering maze of the observable. When we strive to explain the more complex from the more simple we discover this uniformity, but not when we stubbornly persist in regarding the more complex as the condition that can be immediately explained. Complete agreement of opinion there may never be, but this is because of mental differences and not of lack of uniformity in the natural processes. A main reason for the failure to interpret the uniformity has come from one of three preconceptions: of persistent study of an object which has shown itself incapable of furnishing a clear solution; consequently of the neglect of seeking comparative evidence; and of loyalty to the views of the first workers in the field, or fear of conflict with them. In common law a man is held innocent until he is proven guilty, but in scientific thought we should consider a view erroneous until it is proven to be correct to fact. That view which presents phenomena from the simplest interpretation, which is based upon the broadest comparative series of facts, and, above all, which admits of no exceptions in natural sequence, is the one which in the end has the greatest probability of maintaining itself, because the one most likely to be congruous with the facts.

1.—Spermatogenesis of Syrbula acuticornis Bruner.

Testes of adults of this Acridid were collected at Austin, Texas, in the middle of October, fixed in Flemming's stronger fluid, and stained with iron hæmatoxyline. For the identification of the species I am indebted to Mr. James A. G. Rehn, of the Academy of Natural Sciences, Philadelphia. A considerable number of testes were sectioned and studied, whence it resulted that some of them contained ten bivalent chromosomes in the first spermatocytes, others twelve. I cannot determine whether this is due to *Syrbula acuticornis* being a form including more than one species, or whether it is a single species with individual variation in the number of the chromosomes; the latter alternative would be in contradiction to the condition maintaining in most species. Because this point could not be explained, and because good proof is necessary to establish the occurrence of individual variation in the number of chromosomes, the following description is limited to cells contained in the testes of one individual.

Work has been done previously upon the spermatogenesis of Acrididæ by Wilcox (1895), McClung (1900) and Sutton (1900, 1902). My results are in essential agreement with those of McClung, except with regard to the time of the reduction division. Carnoy (1885) was the first to describe cell divisions of male germ cells in Acrididæ, and figured in detail spermatogonial mitoses.

As in the Hemiptera each testis is composed of long tubular follicles, but they are more numerous in number, the earlier stages of the sperm cells placed at the proximal end of the follicle, and the later stages at successively following regions of the follicle. As far as I have noticed there is no difference between the cells of different follicles, beyond a dimensional one.

Two generations of spermatogonia are found in the mature testis, the smaller of which is the last generation, and by division forms the first spermatocytes. The intermediate body or cell-plate (*Zwischen-*

körper of the German writers) persists for a long while after the division of the penultimate generation of spermatogonia, even up to the prophases of the last spermatogonic mitosis. Accordingly the rest stage of the last generation of spermatogonia (Plate IX, fig. 1) shows a distinct polarity of the cell-body, with a distal pole at which is the persisting cell-plate, and a dark mass of idiozome substance, which appears to be in part, at least, derived from the connective fibrils of the preceding mitosis; and an opposite or central pole containing the nucleus. The nucleus shows minute chromatin globules distributed in bead-like chains along the linin fibrils, and also accumulated in larger masses. With great regularity there is found also in each nucleus two or three larger, somewhat irregular, deep-staining bodies; whether they are nucleoli or heterochromosomes could not be decided by the use of the iron hæmatoxyline stain.

The prophases of the last and penultimate spermatogonic mitoses appear similar in character. The chromatin seems to arrange itself into a continuous spirem, or, if not into one thread, certainly into but a small number of very long threads. Plate IX, figs. 2–6 illustrate a succession of the later prophases, and all show stages of segmentation of the spirem. Fig. 2 shows a pair of minute centrosomes just external to the idiozome body, and figs. 3 and 5 successive stages of the central spindle; the nuclear membrane commences to dissolve first in the vicinity of the central spindle. The only point deserving particular comment in the stages is a chromatin element, marked *N. 2* in the figures, that is found in every cell; it is a portion of the chromatin spirem of smaller diameter than the other segments, much more convoluted and in such a manner as to represent a small corkscrew, and frequently appearing to be enclosed within its peculiar membrane. It resembles in this respect the accessory chromosome described by Sutton (1900) for the spermatogonia of *Brachystola*. It is an element that appears to be retarded in its stages on comparison with the others—not condensing nor segmenting as rapidly as they do. When the nuclear membrane has completely dissolved away this single loop segments into two, which are still to be distinguished from other chromosomes of the same length by narrower diameter and more spiral form. These two chromosomes resulting from the division of the single convoluted element are probably the heterochromosomes which become much better demonstrable in the spermatocytes; for the heterochromosomes of the spermatocytes differ from the other chromosomes in their behavior, as will be shown, and this pair in the spermatogonia behave at first differently from the others. Because these heterochromosomes are demonstrable in such early spermatogonic prophases, we can conclude that they must be present in the rest stage of the nucleus, though merely in the form of constituents of the chromatin reticulum. And their juxtaposition in the chromatin spirem is a point in evidence of an earlier contention of mine (1900, 1904*a*), that in the chromatin spirem of spermatogonia homologous chromosomes, *i.e.*, such as unite into pairs during the consequent synapsis stage, lie next each other. All the chromosomes become longitudinally split during the prophases.

Two clear pole views were found of the spermatogonic monaster stage (metaphase), Plate IX, figs. 7 and 8. Each showed exactly twenty chromosomes. These occur in pairs, and we can distinguish three largest pairs (*A, a; B, b; C, c*) and three smallest (in succession from the largest to the smallest, *F, f; D. d; E, e*). The exact similarity in form and size of the members of a pair does not evince itself so clearly in a camera drawing as in the study of the chromosomes themselves, because the members of a pair usually do not lie exactly in the same plane. So twelve of the twenty chromosomes can be demonstrated to form six pairs; the remaining eight chromosomes are so nearly of the same size and form that their arrangement into pairs cannot be shown, but by analogy with the others it is probable they constitute a series of four pairs. One pair of the latter four probably corresponds to the pair of heterochromosomes found in the prophases, but their earlier peculiarity of convoluted shape no longer persists, so they offer no means for recognition. The spermatogonia, accordingly, contain each two heterochromosomes and eighteen ordinary chromosomes.

All these chromatin elements were longitudinally split, and became so placed upon the spindle (Plate IX, fig. 9) that the daughter chromosomes separate along the line of this split; fig. 10 shows an early anaphase. Fig. 11 is a pole view of one of the two first spermatocytes resulting from this division, and shows exactly twenty chromosomes. Therefore the first spermatocyte receives a half of each of the two heterochromosomes and of each of the eighteen ordinary chromosomes. In each first spermatocyte, daughter cell of the last spermatogonic division, the nucleus commences to reconstitute itself (fig. 12). The nuclear membrane reasserts itself, the chromosomes commence to elongate and take on more irregular contours; but an interesting phenomenon is that two of the chromosomes (*n. 2*, fig. 13) do not undergo these changes, but remain smooth and dense; these are heterochromosomes, and in all probability identical with those in the spermatogonia. At a later stage (fig. 14) these unite to form a single bivalent heterochromosome (*n. 2*), and they retain this condition up to the time of the first maturation mitosis. The other chromosomes have become long and thread-like, and an irregular nucleolus (*N.*) has appeared. Following the stages of figs. 14 and 15 is reached a complete rest stage (fig. 16), with the chromatin globules finely distributed along the linin threads—the nucleus very similar in appearance to that of spermatogonia in the rest stage, except for the presence of the large heterochromosome. A rest stage preceding the synapsis I have never before found in any object, but it has been described for *Ascaris* and certain other forms. The heterochromosome is still nearly straight, and when viewed from the proper angle shows not only a transverse constriction, marking the point of junction of the two univalent ones, but also a longitudinal split in each of the latter (figs. 15, 16). In later stages of the spermatocyte these characteristics of the heterochromosome cannot be distinguished, and from a study of the later stages alone one might easily be misled to the conclusion that the heterochromosome of the spermatocyte were a univalent element.

Next the chromatin reticulum segregates into short loops, very much convoluted and occasionally simulating longitudinal splittings (Plate IX, figs. 17, 18). But a long study of cells in this period shows that the space between two mutually wound loops is not a longitudinal split, and that the latter, *i.e.*, a splitting into two of each chromatin globule along the length of a loop, rarely ever commences so early. On the contrary the double loops represent pairs of univalent and correspondent (homologous) chromosomes, so that this stage is the commencement of the conjugation into pairs of the eighteen ordinary chromosomes; this becomes the more obvious on comparison with subsequent conditions. Now, also, the heterochromosome commences to bend at an angle at its middle point, on its path from the earlier straight form to its later one of a nearly closed V.

This leads, the chromosomes becoming much longer (Plate IX, fig. 19), to the synapsis stage (figs. 20–22); throughout this stage the nuclear membrane is almost or quite imperceptible, and the chromatin loops in the form of irregular U's and V's, crowded most densely at that nuclear pole (the distal) next the greatest amount of cytoplasm. In all the drawings only a few of these loops are shown, mainly those seen distinctly for their entire length. Their relative lengths differ greatly in size, as is to be seen particularly in fig. 21. Each such loop is a bivalent chromosome, for they are nine in number, corresponding to the nine pairs of ordinary chromosomes of the spermatogonia, and therefore each arm of one is a univalent chromosome. Two univalent chromosomes are usually united only by one end, that marked x in fig. 21; but sometimes the opposite ends also are joined. elongated rings resulting instead of other forms. The space between the two arms of such a bivalent chromosome does not represent a longitudinal split, but the area between two entire bivalent chromosomes. The true longitudinal split becomes apparent as a cleavage of the small chromatin masses forming each univalent chromosome. and is a line of chromatin separation within each univalent chromosome; sometimes it cannot be seen, which is due to the chromosome being viewed from the edge. This is the first and only longitudinal split of the chromosomes from the time of first formation of the spermatocytes up to the stage of the spermatid. No trace of a longitudinal split can longer be seen in the heterochromosome, which now has in most cases the form of two nearly parallel rods, produced by the bending at the middle of the original straight one. This synapsis stage corresponds to the similarly named stage of the Hemiptera in the close massing of the chromosomes near one pole of the nucleus, but we have seen that the conjugation of the chromosomes becomes affected at an earlier period, that of the figs. 17 and 18. There is evidence that in *Syrbula*, as I have shown to be the case in *Peripatus*, there is a continuous linin spirem during the synapsis stage; but at no period of the first spermatocyte is there a continuous chromatin spirem. The splitting of the chromatin globules does not occur simultaneously for all composing a chromosome, but rather successively; and each globule or granule is a mass of demonstrable smaller microsomes. Hence there is no proof that each smallest visible microsome divides into two during the longitudinal splitting of a chromosome.

Then comes a post-synapsis stage in which the chromosomes are no longer densely grouped, and when the longitudinal split is very clear. In figs. 23 and 24, illustrating this stage, only three and four respectively of the nine bivalent chromosomes are drawn; and the point x on each marks the linin band connecting every two univalent chromosomes. Very rarely does the longitudinal split become wider than shown in these figures, but sometimes it widens as much as is shown in the largest chromosome of fig. 25. This was the maximum extent of separation seen of the halves of a split univalent chromosome, and from this stage through the following this split narrows gradually.

Unlike most of the Hemiptera no rest stage follows, but the spermatocytes enter immediately upon the prophases of the first maturation mitosis; successive steps of this process are shown in figs. 27–31. The nucleus enlarges, the chromosomes lie close to its wall, the delicate linin fibres change their character and break each into a row of minute globules, as roughly indicated in fig. 29; this last phenomenon I have found to be of general occurrence in spermatocytes, but it has been investigated most in ovocytes. The chromosomes through these stages shorten and condense, some into bent or straight rods, others into more or less closed rings; the surface of the chromosomes remains rough and somewhat filamentous until the nuclear membrane disappears (compare fig. 30 with fig. 31). The longitudinal split of the chromosomes gradually narrows, as one sees in the series of figures 23–25 and 27–30; it does not widen out, so that the relations of the univalent components of a bivalent chromosome remain approximately the same as in preceding stages. The early bivalent U or V of the synapsis period may become a straight dumbbell, or its univalent arms may become apposed along their length, or it may become a ring; but in all cases the position of the longitudinal split is along the length of each univalent chromosome, whether that be straight or bent (figs. 27, 28, 30). Very rarely have the chromosomes an X-shape (fig. 31). Therefore each bivalent chromosome is composed of two univalent chromosomes joined by one end or by both ends (in the case of rings), and the space enclosed by a ring is not a longitudinal split but the area separating two entire univalent chromosomes. Where the two univalent chromosomes of a pair are connected is in most cases marked by a constriction (x, figs. 27, 29), and in the rings there may be two such constrictions (the larger ring of fig. 29) in accordance with the conjunction in these cases of both ends. These chromosomes are thus essentially, in formation and shape, like those of the Hemiptera and *Peripatus:* each represents two longitudinally split univalent chromosomes joined by one or both ends. And the gradual narrowing or closure of the longitudinal split is as evident and undeniable as in any other object studied by me.

Through these prophases the heterochromosome is recognizable by its smooth contour and compact structure (Plate IX, *n. 2*, figs. 27–30). It is now almost always in the form of a rod so bent that both arms lie contiguous and parallel, as shown in fig. 26 where the arm seen on high focus is stippled and that seen on deeper focus drawn in outline only. Each of its arms, as we have seen, represents a univalent heterochromosome.

With the disappearance of the nuclear membrane, which commences to dissolve away first at the poles near the centrosomes (Plate IX, fig. 31), the chromosomes have attained their completed dense structure and smooth outline and take their position within the equatorial plate (figs. 32–34). There are exactly ten bivalent chromosomes present, one-half the number of univalent chromosomes present in the spermatogonia, namely, one bivalent heterochromosome and nine bivalent ordinary chromosomes. But at this stage there seems not to be possible a positive recognition of which is the heterochromosome. In a number of cases after nine of the chromosomes were arranged in the equator and some of them were beginning to divide (fig. 33), one (*y*) had not yet taken up that position but lay nearer one spindle pole than the other. This was the case, *e.g.*, with four cells in exactly the same stage lying in the same section of one testicular follicle, and in all of these the isolated chromosome was of the same size and form, straight, and appearing to consist of two closely apposed arms. It may be that this chromosome is the heterochromosome with which it agrees in general form and size, but this could not be definitely determined; ultimately it takes a position in the equator and divides with the others. In fig. 32 is an element, *y*, closely corresponding in size with it and with the heterochromosome during the prophases; but I cannot say positively that *y* of fig. 32 is the heterochromosome, though the probability of it is evident. All these chromosomes become so placed in the spindle that mantle fibres from one spindle pole are attached to one univalent element, and mantle fibres from the other spindle pole to the other univalent component of each bivalent chromosome. The longitudinal split can no longer be seen, but previously it lay in the axis of each univalent chromosome. These definitive chromosomes may be dumb-bell-shaped, or as frequently irregularly V-shaped, ring-shaped, or in the form of two parallel rods (Plate IX, figs. 31–33; Plate X, fig. 34). But whatever the form, they become arranged so in the spindle that the point or points of junction of the univalent components of each lies in the equatorial plane. The early formation of these chromosomes, their arrangement in the spindle, then their division (Plate X, figs. 34–36) show that the first maturation mitosis is a reduction division and separates from each other the univalent chromosomes of each pair. There is no evidence that this is an equation division taking place along the line of the longitudinal split—no evidence at any period that a chromosome had become elongated in a line at right angles to its original long axis. Each arm of a bivalent chromosome is a whole univalent chromosome and not a split half of one; and the long axis of each arm is in the same line as its long axis at earlier stages. I have tested the morphological evidence of this process very honestly and fairly, for at the commencement of my study I was quite prepared to find the first maturation mitosis an equation division. But it is a reduction division. The division of certain of the chromosomes may call for some further explanation. Next to the straight or slightly bent dumbbell-shaped bivalent chromosomes the most frequent form is that of an irregular V, such as those lettered *K* in Plate IX, figs. 32 and 33; in each of these figures one univalent half of each such chromosome is shown black and the other white; *p* of fig. 32 is such a chromosome seen at right angles to the other views. *K* of Plate X, fig. 34 shows the separation of the components of such a chromosome. The division of one of the forms of *y* of Plate IX, fig. 32 is shown by *y* in Plate X, fig. 34. The division of the dumbbell-shaped chromosomes is clear from the figures. Whereas ring-shaped chromosomes are frequent in the preceding late prophases, they are only very exceptionally found in the equatorial plate, so that probably by the pull of the mantle fibres upon them these rings change into the form of the chromosomes lettered *K*.

In the anaphase of this reduction division as homologous univalent chromosomes move apart from each other, each opens up in the form of a V (Plate X, figs. 35–37). This opening is the reappearance of the longitudinal split, since it is a cleft along the long axis of each univalent chromosome. In no way can it be considered a transverse split, a space between two whole univalent chromosomes. This split is widest and appears first at the end of the chromosome turned toward the equatorial plane, and rarely extends quite through the opposite end. Vertical (fig. 38) and obliquely lateral (fig. 37) views of a daughter plate of chromosomes, *i.e.*, of the chromosome plate of a second spermatocyte, show without exception ten elements, the same as the number in the first spermatocytes; accordingly all the chromosomes divide in the reduction mitosis. But each of the ten elements of the second spermatocyte is univalent instead of bivalent, and its cleft or constriction marks the longitudinal split. Without any indication of a rest stage the centrosomes of each second spermatocyte wander apart from each other, and each through an angle of 90°, so that the axis of the second maturation spindle comes to lie at right angles to that of the first (fig. 39). In the equator of this spindle each of the ten chromosomes becomes so placed that the line of its longitudinal split coincides with the equatorial plane. In the ensuing anaphase occurs, then, an equatorial division, separation from each other of longitudinal halves of univalent chromosomes. All ten chromosomes divide, and a pole view of one of the resulting daughter cells (spermatids) shows also ten chromosomes (fig. 40), exactly half the number found in the spermatogonium; no exceptions were observed to this numerical relation.

Exactly how the bivalent heterochromosome comports itself in the maturation mitoses could not be definitely settled, since it could not be satisfactorily distinguished from other chromosomes of about the same size. But there is some probability, as was pointed out, that it may be the chromosome marked *y* in Plate IX, figs. 32 and 33; and in very early stages of the spermatocytes (figs. 15, 16) it showed a longitudinal splitting which soon after seemed to disappear. For these reasons of its proved bivalence and its longitudinal splitting, in conjunction with the fact that each chromosome divides in each maturation mitosis, it becomes most probable that it undergoes a reduction division in the first mitosis, and an equation division in the second. For since it is formed and has essentially the same constitution as the other chromosomes, there would be all reason to expect it to divide like them; and a more trenchant reason is this, that of the ten chromosomes of a second spermatocyte there is no particular one which from any peculiarity of structure could be regarded as bivalent. This is, of course, only circumstantial evidence of its undergoing first a reductional and then an equation division, but the probability of this contention is obvious; there is no doubt that it undergoes two divisions.

In the monaster stage of the spermatogonia (Plate IX, figs. 7, 8) certain chromosome pairs could be recognized by peculiarities in form and size, namely, those lettered in these figures. It is corroborative evidence of the persistence of the individuality of the chromosomes, if, indeed, any further proof of this idea is needed to-day, that the same differences are observable in later stages. So among the ten univalent chromosomes of a second spermatocyte (Plate X, figs. 37, 38) are found three notably larger than the rest and three markedly smaller. So in the figures one marked *F* (*f*) would correspond either to *F* or *f* in Plate IX, figs. 7, 8; *A* (*a*) to either *A* or *a* of figs. 7 and 8; and so on for the others. And even in the spermatid (Plate X, fig. 40) there are the same size relations; the ten pairs of chromosomes of a spermatogonium could be obtained by putting together the ten chromosomes from each of two second spermatocytes derived from the same first spermatocyte; but the ten single chromosomes of a second spermatocyte could be reëstablished only by bringing together the ten semivalent chromosomes from each of the two spermatids resulting from such a spermatocyte. The first maturation mitosis separates from each other the two univalent chromosomes that compose a pair of dissociated ones in the spermatogonium, and a conjugated pair in the first spermatocyte.

Finally, a word as to the behavior of certain cellular structures other than chromosomes—only a brief statement, for the present results are corroborative of my (1900) earlier ones upon *Peripatus*. In the achromatic spindle a central spindle, fibres continued from pole to pole, but not attached to chromosomes, is found in the spermatogonia, but not in the spermatocytic mitoses; its fibres and the pole fibres are formed from the cytoplasm. The mantle fibres, on the other hand, those connecting the chromosomes with the centrosomes, are derived from linin fibres previously connected with the chromosomes—the mantle fibres are at least in great part nuclear in origin. Whatever be our views upon the nature of the pole and central fibres, whether we regard them as lines of currents or as actual fibrils, I think we must consider the mantle fibres as contractile fibrils, not simply paths of movements of fluids. This follows clearly from the results of my *Peripatus* paper, where the mantle fibres of mitosis were shown to be derivable from linin fibrils stretched out through the nucleus in the rest stage, and there constituting a continuous linin thread (spirem) with many fine collateral branches. Such fibrils crossing one another in all directions in the resting nucleus cannot be considered current-paths; how, then, change into current-paths during mitosis, except in so far as we regard a contracting gum-elastic cord to be a path of movement? What holds for the mantle fibres need not, however, obtain for the pole and central spindle fibres. The other achromatic spindle constituents of nuclear origin are the connective fibres, fibres pulled out between two separating daughter chromosomes; these are clearly derived from the linin forming the matrix within which the chromatin of a chromosome is imbedded or the sheath by which it is surrounded. When two daughter chromosomes separate in metakinesis it has the appearance as though two connective fibres pass between them; but it is more likely that such two lines represent in actuality the boundaries (visible because of their higher refraction) of a solid or hollow linin cylinder.

Already in the monaster stage of the spermatogonia (Plate IX, fig. 9) as of the first spermatocytes (fig. 32) there is a pair of centrosomes at each spindle pole. After each spermatogonic division these centrosomes wander through an arc of 180° to take up a position on the opposite side of the nucleus; the same process seems to take place in the spermatid; but before the second maturation mitosis each wanders through an arc of only 90°. In the first maturation mitosis there are two mantle fibres from each spindle pole to each chromosome (Plate IX, figs. 32–33; Plate X, figs. 34–36); in the second only one (fig. 39). This is understandable on the basis that the first mitosis is reductional, since, as is most clearly shown in a straight dumbbell-shaped bivalent chromosome, one univalent chromosome is turned toward one spindle pole and the other toward the opposite one, and each univalent chromosome being longitudinally split the linin thread attaching it to the spindle pole must be split into two; for any longitudinal splitting of the chromatin globules is always associated with, if indeed not induced by, a splitting of the linin matrix, as is shown in the details of chromosome formation, especially in the post-synapsis stage. If the first maturation division were equational there would be no adequate explanation for the double mantle fibres. As the centrosomes of the second spermatocyte move apart preparatory to the second maturation mitosis, each carries along with it one of the two mantle fibres attached to each chromosome.

2.—Spermatogenesis of Lycosa insopita Montg.

The only published work upon Araneæ is that of Carnoy (1885), Wagner (1896) and Wallace (1900). Miss Wallace's paper was done partly under my direction, and is a short preliminary note dealing with the accessory chromosomes, which she correctly found to be double in the spermatocytes, but did not determine positively its behavior in the maturation mitoses. Wagner's short paper I have not at hand, and cannot now recall his conclusions. Carnoy described quite minutely the process of cell division in male germ cells of a number of spiders, of *Phalangium* and *Scorpio,* illustrating both spermatogonic and spermatocytic divisions (his whole plate V with its numerous beautiful figures); such work has no direct bearing upon modern spermatogenetic study, in that it does not consider the sequence of changes through the several cell generations. But it is but just to say of this study of this priest of Louvaine, that it was in many respects the best work of its day upon cell division. Most writers, following a certain antiquated German school, have neglected to refer to him. But he pointed out that cell division is not all of one kind, but that two main types of it occur, and this we now know to be the case and term them respectively *reduction* and *equation* divisions; yet this was the main ground on which that particular German cult fought him. And he undoubtedly saw much more than many a later investigator, and lacked only a general standpoint of interpretation.

Testes were studied of an adult male caught in October; they were fixed and stained by the methods used for *Syrbula.* The testes are slender, cylindrical tubes, and on account of the difficulty of removing them entire from the fresh animal, one proceeds best by cutting off the abdomen from the living animal, removing the hypodermis, fixing the whole abdominal visceral mass, then dissecting out the testes in distilled water.

The spermatogonia form the inner epithelium of the organ, and by their last divisions the spermatocytes formed lose their connection with this cell layer and come to lie free within the lumen of the testis; in this cavity are found all stages of the growth period, the maturation mitoses, the spermatids and spermatozoa. In any transverse plane of a testis one finds the same series of stages. Not only in the arrangement of the cells within the testis, but also in the process of spermatogenesis this spider shows close resemblance to *Peripatus;* in both, *e.g.*, the longitudinal split of the bivalent chromosomes is very clear, and during the synapsis stage the chromatin loops are not so densely massed but that each may be distinguished.

Only two clear cases of pole views of the equatorial plate of spermatogonia were found. On one of these (Plate X, fig. 41) exactly twenty-eight chromatin elements could be distinctly counted. In the other case the chromosomes were more densely grouped, and I could not be certain whether there were twenty-eight or thirty of them; it was possible that two of them were already dividing in metakinesis. Two of these spermatogonic chromosomes are very small (*S.*); the subsequent history of these could not be ascertained with any degree of certainty. There are accordingly twenty-six larger chromosomes, all of which can be recognized in the thirteen bivalent chromosomes of the first spermatocyte. All of these appear to be longitudinally halved during the anaphase, so that each first spermatocyte receives twenty-six daughter chromosomes.

There is no rest stage at any period of the spermatocytic history. Shortly after the last spermatogonic mitosis commences the synapsis stage (figs. 42–44). At its beginning (fig. 42) the daughter chromosomes are elongated threads, already commencing to join into pairs (at the points lettered x). But two of them (*N. 2*) differ in maintaining the dense contour and smooth outline characteristic of mitosis; these are the heterochromosomes, and there is clearly one pair of them. Accordingly, of the twenty-six large chromosomes of the spermatogonia two are heterochromosomes, though they cannot be recognized in the spermatogonic monaster stage nor yet in the preceding rest stage. In following synaptic stages (figs. 43, 44) the twenty-six chromosomes unite to form thirteen bivalent pairs. This takes place, as in *Peripatus,* by an approximation or even close fusion of every two chromosomes of similar length at their ends directed toward the central pole of the nucleus (that one farthest removed from the greatest mass of cytoplasm). During this process there appears to be a continuous linin spirem, but no continuous chromatin spirem; the bivalent chromosomes in the form of V's or U's are arranged upon the linin thread so that their free ends are toward the distal nuclear pole. The distal ends of each V are rarely contiguous with those of a neighboring one, though that is sometimes the case, but, as the figures show, they are usually slightly separated. Between the distal end of one univalent component of a V and the corresponding end of a similar component of another V can be seen, whenever these structures lie in the same plane, a connecting linin thread. These phenomena are so similar to those in *Peripatus* that I think it unnecessary to describe them all in detail again, and refer to the very detailed account of the *Peripatus* paper. A pole view of a nucleus in the synapsis stage shows the optical cross-section of twenty-six chromatin loops, and lateral views demonstrate the presence of thirteen V's. Each V, therefore, corresponds to two univalent chromosomes of the spermatogonia; it is a bivalent structure in which each arm represents one chromosome, and has been formed by the conjugation of two end to end and not by transverse scission of a continuous chromatin spirem. Where the ends of two conjugated univalent chromosomes come together (the points marked x in these and the subsequent figures) is frequently found a slight notch or break, which is a connecting band of linin—corresponding to the *central* linin band in *Peripatus*. That the space between the two arms of a V is not a longitudinal split is indubitable, for stages like that of fig. 42 show previously separated chromosomes coming together. The longitudinal split appears in the long axis of each univalent chromosome (figs. 42–44), and proceeds latest to their distal ends (those directed toward the distal pole of the nucleus). No earlier longitudinal split occurs, and no later one. A nuclear membrane appears first at the close of the synapsis.

The behavior of the heterochromosomes can be followed with equal facility and certainty. All through the growth period they preserve their smooth contours, compact structure and strong affinity for chromatin stains. The two univalent heterochromosomes (*N. 2*, fig. 42) come together and conjugate side to side (figs. 43, 44), though their ends directed toward the distal nuclear pole are in closer touch than their opposite ends, in contrast to the behavior of the other chromosomes. So is produced a bivalent heterochromosome, throughout the growth period placed against the distal pole of the nucleus, consisting of two univalent chromosomes lying parallel or more usually in the form of a much narrowed V. It does not increase in size in the following stages, and its only perceptible change is a longitudinal split of each univalent component. This is shown in fig. 44*bis*, *A*. and *B*, which show merely the bivalent heterochromosome and an arc of the contiguous nuclear membrane. In most cases the space of this split is widest at the inner ends of the univalent components of this bivalent heterochromosome, as shown in fig. A. This longitudinal split cannot be seen from every point of vision, but only when the heterochromosome lies in particular directions, as is quite understandable.

Following the synapsis is a post-synapsis stage, with the bivalent chromosomes more evenly distributed through the nucleus (figs. 45, 46). The longitudinal split is wide and very evident, but does not extend through the distal ends of the still generally V-shaped loops. In each bivalent chromosome the angle of the V (x of the figures) is the point of junction of two univalent parts. Here also the longitudinal split of the bivalent heterochromosome (*N. 2*) can sometimes be seen. No nucleolus is formed in any part of the growth period.

Immediately succeeding are the prophases of the maturation mitoses (figs. 47–52). There occurs in them a gradual shortening and condensation of the chromosomes, leading to narrowing or even complete temporary obliteration of the longitudinal split. This split in the early prophases (figs. 47–49) in the case of some of the chromosomes becomes a little wider than during the post-synapsis (figs. 45, 46); so with the chromosomes marked *H* in these figures. But this happens with only a minority of the chromosomes in any nucleus. And it is not a definite stage in the structural change of every chromosome, for the reason of its relative infrequency. Most of the chromosomes, on the contrary, are straight or bent rods, and the angle or middle point of these marks the point of conjunction of two univalent chromosomes (x of the figs. 47–52). Such chromosomes as those marked *H* in figs. 47 and 49 are ones where the longitudinal split has become very wide at the point of union of the two univalent chromosomes; but even in such chromosomes one axis always remains longer than the other, so that there is no evidence of a bivalent chromosome becoming extended out in a line at right angles to its previous long axis. And even for these chromosomes, as is clearly the case with the others where there is no extensive widening of the longitudinal split, the successive prophases lead toward a narrowing or closure of this split. Regular rings appear not to be formed. But chromosomes in the form of an X are not infrequent. There is no difficulty in the interpretation of the form of these. For in the one shown in fig. 51, marked *D*., the X is seen to be two univalent chromosomes, each longitudinally split, joined by their middle points;

an X is then obviously formed from a V, not by any extension of the longitudinal split, but simply by the point of contact of the two univalent chromosomes shifting its position. The decisive phenomenon through these prophases is that most of the chromosomes preserve their original forms of bent rods, or modify them into straight rods, leading toward the forms most frequent at the end of the prophase (fig. 52), where the earlier point of union of two univalent chromosomes is recognizable (x), and the longitudinal split sometimes still discernible. For the greater number of the chromosomes the changes of the prophases lead to the retention of approximately their original form, but with a gradual partial or complete closure of the longitudinal split; and there is no reason to hold that the longitudinal split ever widens and remains open in such a manner as to change the position of the long axis of a bivalent chromosome. The heterochromosome undergoes no marked modification during the prophases; at first each of its univalent portions shows still the longitudinal split, shown in end view on fig. 49 (*N. 2*), but toward the close of this period this split appears to close up.

In the equatorial plate of the first spermatocyte (figs. 53, 54) are found thirteen larger bivalent chromosomes, and sometimes a minute chromatin body (*S.*) which does not appear to be bivalent, at least it is not bipartite. The latter may represent one of the two minute chromosomes of the spermatogonia (fig. 41); one of these small bodies is occasionally found in the monaster stage of the second spermatocytes (figs. 62, 63). Their behavior in the growth period could not be determined, so we must disregard them in our analysis of the chromosomal relations. The first maturation figure has then thirteen bivalent chromosomes, corresponding to the twenty-six larger univalent ones of the spermatogonia. Lateral views of the first maturation spindle are shown in figs. 55–58. While on most of the chromosomes at this stage the longitudinal split is not evident, in some cases it is still persistent, as notably in those lettered *K* in figs. 55, 56, 58. Particularly the one in the last figure is valuable in demonstrating how the chromosomes become placed in the spindle: the point of junction (x) of the two univalent components lies in the equator, therefore the one univalent chromosome just above and the other just below this plane. From this arrangement and from the mode of insertion of the mantle fibres it is evident that in this mitosis the two univalent chromosomes of each pair become separated from each other into opposite cells, and that this is a reduction division. Generally the long axis of each bivalent chromosome is parallel to the axis of the spindle, which is always the case when its univalent parts are placed in one line. Sometimes, as with the extreme right and left ones of fig. 57, the long axis of the chromosome appears to lie in the equatorial plane; this results also in a reduction division, however, because here there is a bent instead of a straight bivalent chromosome, with consequent convergent disposition of the two univalent chromosomes. *Lycosa* is particularly demonstrative of this first mitosis being a reduction mitosis, on account of the simple form of the chromosomes and of the occasional perceptible persistence of the longitudinal split at this stage. No chromosomal rings occur at this stage; the nearest approach to them are oval forms like the two largest in fig. 55, with very exceptional width of the longitudinal split; such forms are individual variations, not found in every cell, as one sees on comparison with pole views (figs. 53, 54) showing all the chromosomes, yet even in them the original long axis of the chromosome is recognizable.

In metakinesis (fig. 59) all the bivalent chromosomes undergo a reductional halving. Figs. 60–63 show pole views of the chromosomal plates of the daughter cells, second spermatocytes. Disregarding the two minute bodies (*S.*) of 62 and 63, we find in 60 fifteen chromosomes, in 63 fourteen, in 61 thirteen, in 62 twelve. There would then seem to be a range in number from twelve to fifteen. This I believe is due rather to some unexplained individual variation than to the possibliity of a normal unequal distribution of the chromosomes. For in the nine cases where they could be easily counted the numbers fifteen, fourteen and twelve were each represented by only one case, whereas thirteen appeared in six cases; and in the only two cases where the chromosomes of the second spermatocyte could be counted on lateral view (one of these shown in fig. 65) there were in both cases thirteen chromosomes. There were thirteen bivalent chromosomes in the first spermatocyte, and the counts show that in the majority of cases, so probably as the normal phenomenon, there are thirteen univalent ones in the second spermatocyte. As the chromosomes of the first spermatocyte separate in the anaphase (fig. 59) each daughter chromosome shows a divergent split widest at the equatorial end; this can be nothing else than the reopening of the original longitudinal split, if one compares the appearances in fig. 59 with the chromosome most to the left in fig. 55. So each bent chromosome of the second spermatocytes (figs. 60–65) is a univalent chromosome so split longitudinally that the cleft is narrow at one end and widens out toward the other. There is no proof of any kind that this is either a transverse break or a line of separation between whole univalent chromosomes.

The second maturation mitosis (figs. 64, 65) is accordingly an equational division. I have been unable to count the chromosomes in the resultant daughter cells, spermatids, because of their massed arrangement there, and therefore have not demonstrated that all the elements become halved in this second mitosis. But all these thirteen chromosomes are constricted or cleft, showing that each is therefore probably longitudinally split; for this reason it is probable that each spermatid receives thirteen chromosomes.

As was the case in *Syrbula* so also in *Lycosa* the mode of division of the bivalent heterochromosomes was not positively determined. In the spermatocytes it can always be distinguished by its smooth outline and compact structure only up to the time when the other chromosomes acquire their final shape. Yet among the chromosomes of the first mitosis there seems to be no particular one markedly different from the others. But on lateral view of the spindle (fig. 56) there is sometimes one (*t*) quite different from the others, in the form of two elongated rods; and its division is shown in fig. 58 (*t*). This may be the heterochromosome, but there is no satisfactory evidence for this conjecture. We found that in the synapsis this was formed, like the ordinary chromosome, by a conjugation of two univalent ones, and that each univalent one underwent a longitudinal splitting. This similarity in formation is some evidence that the heterochromosome may behave like the others during the maturation mitoses, namely, that it may undergo a reductional division in the first and an equational in the second mitosis. And we can say positively that the whole bivalent heterochromosome does not pass undivided into one of the second spermatocytes.

In both maturation divisions the centrosomes of both spindle poles touch the cell membrane (figs. 55–59, 64). As in the other objects studied by me there is no intermediate cell plate formed after the reduction division, but after all other divisions.

3.—Occurrence and Time of the Reduction Mitosis.

Korschelt (1903), in his excellent review upon the maturation phenomena, distinguishes two types of maturation: the "eumitotic," where both mitoses are equational, and the "pseudomitotic," where one of them is reductional. But these should be considered collective terms for groups of divergent opinions, rather than a classification of actually occurring natural phenomena. The general consensus of opinion at the present time, the greater part of all the more recent work on most diverse animals, is conclusive for the decision that a reductional mitosis, a separation of whole univalent chromosomes, occurs in many objects. In all the works where two successive equational divisions have been described, it is significant that no positive explanation has been given of the earliest mode of origin of the bivalent chromosomes, not even in the detailed study of Brauer (1893), and the same may be said of the recent elaborate analysis of de Sinéty (1901). All the "eumitotic" investigators seem to have interpreted as a first longitudinal splitting of the chromosomes a space which they have not proved to be such, and which the observations of others show to be in all probability the space between two conjugated univalent chromosomes. They likewise fail to account for the fact that the chromosomes in the reduction divisions so frequently differ in form from all other chromosomes, and leave undecided the question of the origin of the bivalent chromosomes. It is not necessary to go further into detail here upon this point, on which I have expressed myself many times previously. But we can say positively that there has not yet been proved any case of eumitotic maturation in the sense of Korschelt: that even in *Ascaris*, the foundation-stone of this doctrine, Sabaschnikoff (1897) has shown that Boveri (1888), Hertwig (1890) and Brauer (1893) may have given a wrong analysis, while recently Boveri (1904) himself and I (1904*a*) have argued for the probable occurrence of a reduction division here; and for the vertebrates also King (1901), Schreiner (1904), Maréchal (1904) and I (1903, 1904*a*) have proved the same contention. While this dispute will not be settled for some time, for the reason that scarcely a beginning has yet been made in the study of the germ cells, I do not hesitate to declare that in none of the Metazoa does maturation of the eumitotic type occur. And I make this prophecy after starting from the point of view (1898) that there may well be different modes of maturation, and consequently I can surely not be accused of starting out on my studies with bias in any particular direction.

Further, all evidence of any strength is to the effect that probably in no case are both maturation divisions reductional. This standpoint has been held by Wilcox (1895) and a few others, and by myself in my first paper (1898), but I quickly discovered and corrected this initial error (1899). To this "Correction" another correction must be made: in the note of 1899 I wrote that the second maturation may be occasionally reductional, occasionally equational; this was a mistake, for now I can say there is in *Pentatoma* (*Euchistus*) no evidence at all of reductional division in the second mitosis.

All maturation modes are then of the pseudomitotic type, and of these Korschelt distinguishes a "Prereduction," where the first mitosis is the reductional one, from a "Postreduction," where the second one is reductional. Until quite recently I held that it was not of great physiological importance which of these mitoses was reductional, provided that in all cases one of them was. But my own studies, extended over a diversity of objects, have convinced me that very probably there maintains a uniformity here also, even though the understanding of it may not be immediately forthcoming. For surely out of the endless diversity in small details a larger uniformity is gradually showing itself, and as scientific thinkers it is our object to discover the uniformity. The minutiæ of phenomena are but stepping-stones, and too often slippery ones, toward simple and broad concepts. By analogy with other natural phenomena we should *à priori* expect uniformity rather than diversity. From this standpoint I enter upon the discussion again, with the conviction that all maturation plans must be either prereductional or all postreductional, and that there can be no compromise. In our decision we must argue from the facts presented in the early growth period of the ovocytes and spermatocytes, from their first mode of formation and axial relations to each other, and not from analyses of their definitive forms. Other things being equal, such evidence must have the most weight which considers in the greatest detail the full sequence of stages, and most particularly such as treats minutely the early growth period. Too often follows upon a short and incomplete series of observations a long discussion in print of possibilities and probabilities, like shuffling with an incomplete pack of cards, instead of an attempt to settle the matter with the microscope.

The foundation of the argument for postreduction is in the work of Häcker and Rückert upon the Copepoda, and with but few exceptions this has been allowed to go unchallenged. On that account the facts of these workers call for careful examination.

Rückert (1894) studied the ovogenesis in three genera from the stage of the young ovocyte up to the monaster stage of the first maturation mitosis. From the number of chromosomes present in young blastomeres of one of these, he concluded that each chromosome of the ovocyte is bivalent, equal to two. He described most fully *Cyclops strenuus*, so that we will examine his work upon this species. His figs. 4–8 present stages of the earlier growth period, by no means a complete series. The first ovocyte in these stages has eleven chromosomes, each in the form of two more or less closely apposed rods. Rückert assumes that each of these is a longitudinally split chromosome; but while he correctly assumes that each is bivalent, he does not determine the boundaries of each univalent component at this stage, but from conditions in later stages (his figs. 9–22) concludes that the middle point of each double rod is such a boundary. This is the weak point in his whole analysis. For why may not each of the single rods be a whole univalent chromosome, the bivalent one being formed then by a conjugation side to side of two univalent ones? None of his figures in the least exclude this possibility. And here may be recalled Lerat's (1902) somewhat inclusive observations also upon *Cyclops*, to the effect that each such double rod may be so constituted. Then there is a great break in Rückert's observations between the stages of his figs. 8 and 9, the one apparently a post-synapsis or equivalent early stage, the latter an advanced prophase; yet within just this undescribed period we would expect great changes in the form of the chromosomes, such, for instance, as the appearance of an indubitable longitudinal split. He states that each double rod in the prophase bends at the middle, and later breaks transversely into two at this point; this he conceives to be a separation of the univalent chromosomes at the point at which they had hitherto been united. But he presents no positive evidence, certainly not in his drawings, that this is not the appearance of a longitudinal split of each univalent element, a split whereby the halves would remain attached at one end and gradually separate at the other (just as has been described for other objects), opening up from a narrow V to a condition in which the separated halves of one univalent chromosome come to lie together in one straight line. The uppermost chromosome of his fig. 11*b* is evidence of such a possibility. Accordingly, though the bivalent chromosomes lie so in the equator of the first pole spindle that their long axes coincide with this plane, and their "transverse" splits are at right angles to it, this does not prove the first mitosis to be equational. For all the proof he brings to the contrary, the opening along the length of each bivalent chromosome may be a line separating its two univalent components, and the first division therefore reductional. Rückert does not convince, though his is in many respects the most careful work yet done upon these forms, because of the hiatus in his stages, and because, and this is the cardinal issue, he failed to decide the mode of origin of the bivalent chromosomes.

I have not at hand Häcker's earlier papers (1891, 1892, 1893), and so quote from Rückert (*l.c.*) his opinions: "Zuerst hat er die Reduktion in die erste, dann in beide und zuletzt in die zweite Teilung verlegt." In later papers (1895, 1899) he confirms Rückert's view that the reduction is effected in the second maturation mitosis; though I cannot see that in so doing he brings any stronger proof than did

Rückert. Change of view is no dishonor but a sign of courage, and I respect any man for it, for it is not easy to discard an idea for which one has fought; but in scientific thought we expect change of view to be an accompaniment only of the discovery of more urgent facts. Such facts we do not find in Häcker's latest work (1902, 1904). He had previously observed that in *Cyclops brevicornis* the normal number of chromosomes is twelve, and that in the ovocytes before the maturation divisions there are six bivalent ones; that these divide equationally in the first and reductionally in the second spindle, so that the ovotid receives six univalent ones. But now he maintains this is wrong, that the chromosomes at all periods of the first ovocyte while bivalent are in the normal number, and that there is no union of them into pairs during the growth period. I have already criticised (1904*b*) this view, and in his retort (1904*b*) Häcker has failed to take up the cardinal issue and give further proof. He describes (1902) that in the ovocyte these twelve bivalent chromosomes are arranged in two planes of six each. This is not borne out by his figs. 30–34. He came to this strange conclusion in a roundabout way from observations upon the gonomerity of the nucleus, holding that even at the time of the first maturation division the chromosomes are arranged in two planes, corresponding to the earlier gonomeres of the nucleus, one layer of them being maternal and the other paternal. The only evidence for this are certain lines or septa said to divide the "provisory division figure" transversely and longitudinally. No one has corroborated the existence of such septa, and I have looked in vain for them upon a number of objects; he gives only lateral views of these structures, does not show their origin, and does not make it plain whence their substance is derived. Yet, fairly speaking, this may be said to be the whole observational basis for his new involved analysis! Each ovocyte of the second order is said to receive twelve bivalent chromosomes; and then follows a union of tetrads into pairs. "Bei der ersten Richtungsteilung gelangen, wie bei jeder anderen Kernteilung, je 6 väterliche und 6 mütterliche Elemente in die Tochterkerne, jedoch erfolgt die dicentrische Wanderung nicht in zwei gesonderten, den elterlichen Anteilen entsprechenden Gruppen, sondern die väterlichen und mütterlichen Elemente müssen, ihrer Aufstellung in den zwei Fronten entsprechend, zwischen einander durchtreten und sind also vollkommen durcheinander gemischt, während sie an die Pole wandern (Textfig. *Cb*). Diese Mischung ist jedoch, wie wir gesehen haben, keine unregelmässige. Denn es liesst sich mit grösster Wahrscheinlichkeit zeigen, dass bei der unmittelbar folgenden Paarung der Spalthälften die Paarlinge jeweils zwei im sekundären Keimbläschen einander opponierten Vierergruppen angehören. Es muss sich also schon die dicentrische Wanderung in einer ganz gesetzmässigen, Quadrillenähnlichen Ordnung vollziehen, mögen dabei regulierende, von den Chromatinelementen selbst ausgehende Reize oder irgend welche als Leitbahnen dienenden Kernstrukturen eine Rolle spielen. Bei der Paarung der Spalthälften erfolgt die Vereinigung je einer väterlichen und einer mütterlichen Spalthälfte. Von den beiden einander opponierten Vierergruppen $\frac{\mathrm{ab}}{\mathrm{ab}}$ und $\frac{\mathrm{no}}{\mathrm{no}}$ werden sich z. B. jeweils zwei Spalthälften ab und no miteinander verbinden und das Gesamtresultat des sersten Teilungschrittes ist demnach eine gleichmässige Durchmischung der väterlichen und mütterlichen Anteile (Textfig. *Cb* unten)." This recalls Fol's (1891) quadrille of the centrosomes! The result of it all amounts to this: spermatid and ovotid have each six bivalent chromosomes, the fertilized egg has twelve bivalent chromosomes, and the same number is found in the first polar spindle where they are arranged in two planes; each second ovocyte receives twelve bivalent chromosomes, and there unite into six quadrivalent chromosomes; and these undergo a reduction division in the second mitosis, so that the ovocyte receives six that are bivalent. This analysis is so intricate and complex, so little borne out by the fragmentary and somewhat doubtful evidence—only certain lines traversing a nucleus—that we can charitably say the paper is its own strongest critic. It is to be much regretted that Häcker has used these results in a general review (1904) of bastardization, because they are irreconcilable with all other work, and tend to make the supposed diversity and contradictoriness of the germ cell phenomena even more marked than ever before. We are not in any need of "Referate," but very pressing need of more observations.

The work of Linville (1900) on *Limnæa* is not conclusive, for the chromosomes are very minute and the prophases were not studied at all; the same may be said of Francotte's (1898) study of Polyclades, where the only figures are indistinct microphotographs. The investigations of Van der Stricht (1898) and von Klinckowström (1897) upon Polyclades have been strongly contradicted by Schockaert (1902), who has given a much more detailed examination than either of these writers. The papers of Prowazek (1901, 1902) I have not seen. Miss Wallace's paper (1900) is admittedly indecisive, and Griffin's (1899) studies on *Thalassema* and *Zirphæa* concern chromosomes of very intricate forms and small size, and their behavior was elucidated (or should we say nigrified?) by an analysis of their final shapes. So none of these investigations are decisive in any manner that requires rigid proof from a study of the whole series of changes.

There remain certain studies upon the spermatogenesis of insects, the most deserving of attention of which are those of McClung and Gross. Vom Rath's studies of *Gryllotalpa* (1892, 1895) omit all the earliest stages of the growth period; and while he takes the stand that the maturation is postreductional, he grants the possibility of its being prereductional. McClung (1900, 1902) holds the postreductional viewpoint, reasoning particularly from the forms of the definitive chromosomes; in the late prophases of the first spermatocyte the bivalent chromosomes vary much in shape, rods, rings, crosses, and apparently intermediate conditions. There is more uniformity in the first maturation spindle. These differences in form McClung interprets as successive stages and, to put it concisely, he argues that the axial relations of a chromosome change, so that if the long axis were originally from right to left, it subsequently changes into a line at right angles to this. X-shaped chromosomes are thereby interpreted as intermediate stages in this transformation. His figures of Acridid spermatocytes are very similar to those I give in the present paper of *Syrbula* of the same family of the Orthoptera; but McClung holds that an elongate bivalent chromosome placed with its long axis parallel to the first mitotic spindle undergoes an equational division, therefore that the line of separation of its univalent components lies along its length. From the assumption that the diverse forms of chromosomes of the late prophase are successive morphological stages he argues this change of axial relations; and that might be justified if this premise were proven. But that it is not is shown by the evidence given by me (1901*a*, 1904) that certain chromosome pairs are characterized by certain forms in the spermatogonia as well as in the spermatocytes; a point which Baumgartner (1904) has recently corroborated and amplified.[1] Against this evidence McClung does not bring satisfactory proof that the differences in form express steps in axial changes. McClung's work appears to be very accurate, but I cannot follow him in this interpretation, and would ask the critical reader to compare his descriptions and figures with those on the related object given in the present paper. To prove his point he has to assume a complex axial metamorphosis, which is wholly unnecessary on the basis of a prereduction. The same criticism applies to the study of Gross (1904) on *Syromastes*, which is

[1] In the paper just mentioned Baumgartner claims that Sutton discovered a difference in size of the chromosomes, and states that he himself has "been fortunate enough to find a difference in form." I think I was the discoverer of both of these differences and expressed them distinctly for various forms, as Baumgartner will find stated in my papers of 1901 and 1904. But he deserves credit for distinguishing constant forms among chromosomes of the first spermatocytes.

the strongest argument yet given for postreduction; he is the solitary worker on the spermatogenesis of Hemiptera who has taken the post-reductional view, and does it from a supposed secondary change in chromosomal form. Yet, strangely enough, he describes a prereductional division of the bivalent chromatin nucleolus, the only chromosome which is not said to pass through the stage of a cross! Its two whole univalent components become separated from each other in the first maturation mitosis. In his object the bivalent chromosomes are in some stages usually little longer than broad; they approach in some conditions more nearly the form of a cross than in any Hemipteron which I have studied. Had Gross taken up my old object, *Euchistus*, he would have found that X-shaped chromosomes do not occur at all, or only very rarely, that the phenomena there are accordingly simpler and more explicable than in *Syromastes*, and that intermediate forms between a chromosome elongated in one direction and one stretched out in another do not occur. Finally Gross admits that these forms admit of another interpretation: "Man könnte mir entgegenhalten, dass der von mir aus den Thatsachen erschlosene Modus der Tetradenbildung auf einer willkürlichen, durch nichts bewiesenen Annahme berühre. . . . . Sichere Anhaltspunkte dafür, nach welcher Richtung die Hälften der Kreuze aus einander weichen, lassen sich aus den beo. bachteten Figuren nicht entnehmen." I fully agree with him in this. But when he states, "Dasselbe gilt aber auch von der bis jetzt allgemein angenommenen Bildungsweise," he makes an error, for in some cases of spermatogenesis cross-shaped chromosomes do not occur, and that is so in *Euchistus*, and for such forms no voluntary assumptions are necessary. Gross' work appears very accurate, and I criticise only his interpretation of the crosses as intermediate forms. Evidently he is considerably influenced by Häcker's latest views. The same general criticism may be made of the work of Sutton (1902).

When we review all this work supposed to prove a postreduction, we find it based upon an incomplete series of stages, or upon forms with minute chromosomes of very diverse form, or upon such as have chromosomes in the form of rings and crosses. Every one will admit that chromosomes of such shapes are the most difficult to interpret: a tetrad with four parts of approximately equal size—where in it can we say lies the plane of the longitudinal split and where the line separating two univalent chromosomes? Just upon such chromosome forms is much of the postreduction argument based. The correct, because only decisive, method is not to reason from such forms, not to argue unnecessarily for a change in axis, but to explain such chromosome formation from objects where the phenomena are simpler, where the chromosomes show a definite long axis in early stages, where the mode of formation of the bivalent chromosomes has been worked out, and where forms like rings and crosses do not occur. We must seek to explain the more complex from the more simple, not force an interpretation from the more complicated upon the more simple. The strongest argument for postreduction is that of McClung and Gross, and yet they are reasoning from the basis of perplexing rings and crosses. That such forms can be explained in quite a different manner, and their first division be regarded reductional instead of the second, I have shown for *Peripatus*, where the series of changes of the linin elements as well as of the chromatic are clearer than in any object yet seen by me.

To the idea of postreduction we can apply the criticism "not proven." No one can say that it does not occur, yet I do not hesitate to state as my opinion, coming from observations of some years upon a number of different animal forms, that it will be proved not to occur. And this is said with no intention of any disparity of the work of those who take the contrary stand, for they have accumulated very important and hard-won facts; it is only one of their interpretations that is being criticised. Prereduction is based upon a simpler reasoning and to some extent upon more patent phenomena.

So we reach the conclusion that maturation phenomena are all of the pseudomitotic type of Korschelt, and only of the prereductional kind. There is a mass of evidence for the view that in all cases the first maturation is the reductional one. Korschelt (1895) has described this for *Ophryotrocha*, Henking (1890) for *Pyrrhocoris*, Paulmier (1899) for *Anasa*, King (1901) for *Bufo*, Nichols (1902) for *Oniscus*, Lerat (1902) for copepods, Schockaert (1902) for *Thysanozoon*, Schreiner (1904) and Maréchal (1904) for fishes, McGill (1904) for *Anax*, Bouin and Collin (1901) for myriapods, and I for Hemiptera of different families (1898, 1899, 1901*a* and *b*), for *Peripatus* (1900), for salamanders (1903, 1904), and in the present paper for a grasshopper and a spider. And it will be noted that it is the most recent work which supports this view. Quite as conclusive evidence comes from an examination of the heterochromosomes, as we shall see later. Most of the recent work upon the botanical side corroborates this point of view, as that of Gregoire (1904), Rosenberg (1904), Strasburger (1904), Berghs (1904) and Farmer and Moore (1903).

From what I consider to be the strongest evidence available at the present time we find the following series of phenomena during the spermatogenesis of animals. There are a number of successive generations of spermatogonia, each with the normal number of univalent chromosomes (the heterochromosomes will not be considered in this place); all of their mitoses are equational. The last generation of them produces the spermatocytes of the first order. At an early period in these there takes place a pairing of the univalent chromosomes to form bivalent ones, which may be a junction end to end or side to side.[2] This is in each case a pairing of a paternal chromosome (one derived from the spermatid) with a maternal one (one from the ovotid). At an early stage of the growth period the bivalent chromosomes become more or less densely grouped, the synapsis stage, but the pairing of the chromosomes may commence shortly before this time. After this conjugation each univalent chromosome becomes longitudinally split, and no second splitting follows the first. There may or may not be a rest stage during the growth period, and when it occurs it may come before or after the synapsis stage. In the first maturation mitosis each bivalent chromosome undergoes a division in such a way that one whole univalent element passes into one daughter cell, the other one into the other cell; this is a true reduction division in the sense of Weismann, and accomplishes the reduction in number of the chromosomes; their conjugation in the rest stage had not effected reduction, but only the formation of pairs. The second maturation division is equational, along the line of the longitudinal split, so that the spermatid receives half the normal number, and each of them on comparison with those of the first spermatocytes is semivalent, but on account of their increase in size during the growth period virtually univalent. All the facts speak for a strict preservation through the whole germinal cycle of the individuality of the chromosomes.

From the correspondence determined by Henking (1890) and Hertwig (1890) between spermatogenesis and ovogenesis, by the one for insects and by the other for *Ascaris*, we might conclude that in all cases of ovogenesis also prereduction occurs, as indeed has been described for some animals. I think there is no sufficient evidence at present for doubting this conclusion, and much in favor of it. Yet it must be acknowledged that the ovogenetic processes are less easily analyzed,

[2] Maréchal is incorrect in stating that von Winiwarter (1900) first described this process; he simply reasoned that of three possible explanations of the origin of the bivalent chromosomes this was the most probable. Henking (1890), before von Winiwarter, had more conclusively argued for this, but did not see the first steps in the process. I was the first (1900) to describe all the steps in this series, and (1901*a*) to prove that each bivalent chromosome is formed by the conjugation of a paternal and a maternal one—this corroborated in the next year by Sutton (1902). Gross (1904) is of course in error when he calls this the "Häcker'sche Theorie." This important phenomenon is at last receiving rapid confirmation from many sides.

because of the larger growth period with its much greater degree of metabolism, which is responsible for a certain inclination, curiously enough still surviving in some minds, to doubt the individuality of the chromosomes. The cases of peculiar interest to the student of the germ cells are parthenogenetically developing eggs. All the investigators of parthenogenesis hold that both pole bodies represent equational divisions, or that the second is the reductional one; and very general is the opinion that the second maturation mitosis being reductional, and the lack of formation, or secondary retraction, of the second polar body being generally associated with normal parthenogenesis, it is effected that by parthenogenesis the number of chromosomes does not become halved. But there is no good ground for this view, and parthenogenesis with fertilization following in a subsequent generation is really better explained on the idea of a prereduction. For if the first maturation is reductional and the second (equational) one is eliminated, the parthenogenetic egg would have one-half the normal number of chromosomes; whether this number persists through all cell generations of the succeeding individual remains to be determined; there is some evidence that it may do so. If the half number does persist, then when an egg of the following individual becomes fertilized by a spermatozoon the normal number would be restored, instead of being multiplied one and a half times. This could not be effected if the second maturation mitosis were reductional, and the second polar body not produced. And of one point we can be reasonably certain: as Sutton (1903) has reasoned, there is no probability that in a reduction mitosis all the paternal chromosomes pass to one daughter cell and all the maternal chromosomes to another; in other words, there is no evidence that half the spermatids or ovotids contain only paternal elements and half only maternal. Indeed, the chance of this would decrease inversely in geometrical ratio with number of chromosomes. And therefore it is a wholly unfounded assumption to conclude, as some have done with greater ability in the construction of hypotheses than in reasoning from phenomena, that either or both pole bodies eliminate all the "male chromatin" (paternal chromosomes). The great weight of evidence is in favor of the view that the first maturation mitosis reduces the number of chromosomes, breaks apart the univalent components of the bivalent chromosomes, but does not do it in such a way as to separate all the paternal from all the maternal; and those who have founded hypotheses on contrary premises have been weaving ropes of sand.

4.—The Heterochromosomes.

These were discovered but not correctly interpreted by Henking (1890) and Wilcox (1895); first recognized as modified chromosomes by Paulmier (1899) and myself (1898); then described for a variety of Arthropoda by McClung (1899–1904), Sutton (1900, 1902), de Sinéty (1901), Wallace (1900), Gross (1904), McGill (1904), Baumgartner (1904), myself (1901*a* and *b*, 1904*a*), Voinov (1903) and Prowazek (1901); the last two papers I have not seen. In all these objects there occur in the spermatogenesis peculiarly modified chromosomes, which I have proposed (1904*a*) to include under the term "heterochromosomes." I had named them previously "chromatin nucleoli," though with full appreciation of their chromosomal nature, Paulmier "small chromosomes," McClung "accessory chromosomes," and de Sinéty "special chromosomes." Their essential characteristic is their difference in behavior from the other chromosomes in the growth period of the spermatocytes and ovocytes, as sometimes during the rest stages of the spermatogonia, a difference which appears usually to consist in the maintenance of their compact structure and deep-staining intensity, so that while the other chromosomes become long loops or even compose a reticulum, these do not undergo any such changes or only to slight extent. There is really not much known as yet of these modified chromosomes despite extended studies upon them, and at this place I wish mainly to draw attention to and try to explain differences in their behavior during the maturation mitoses, and so endeavor to explain certain phenomena that up to this time have been regarded as contradictory. They appear to be of very general occurrence in insects, have been found in spiders by Miss Wallace and by me (in the present paper), but so far seem not to be demonstrated for other objects. To be sure Blackman (1900) described an "accessory chromosome" in spermatocytes of *Scolopendra*, but did not describe its action in the spermatogonia nor even in the maturation mitoses, and has not proved in any manner that this body is not a true nucleolus; true nucleoli containing chromatin or even chromosomes are relatively rare in metazoan cells, but they sometimes occur (as, *e.g.*, I have shown for the ovocyte of *Paragordius* in a paper recently published), and what Blackman has described appears to be such a structure.

As I recently pointed out (1904*a*) there are two main kinds of heterochromosomes: such as occur in pairs in the spermatogonia and unite to form bivalent ones in the spermatocytes, which are the most frequent kind in the Hemiptera and were named "chromatin nucleoli" by me;

and such as are unpaired or single in the spermatogonia and so do not conjugate in the spermatocyte, which McClung calls "accessory chromosomes." Both these kinds agree essentially in their behavior during the growth period of the spermatocyte, and are clearly distinguishable from the other ("ordinary") chromosomes by their compact form and smooth outline; they differ with regard to the point of being single or double in the spermatogonia. Both kinds may occur in the same animal, as I have shown (1901*b*) for *Protenor*. In *Anasa* I found a pair of heterochromosomes in the ovogonia exactly like those in the spermatogonia, which suggests that the paired heterochromosomes will be found to occur in both maternal and paternal germ cells of the same species; but whether unpaired heterochromosomes occur in maternal germ cells is not known.

Heterochromosomes that are paired in the spermatogonia and unite to form bivalent ones in the spermatocytes I have described (1898, 1901*a*, 1901*b*, 1904*a*) for some forty species of Hemiptera, and in the present paper for *Lycosa* (a spider) and *Syrbula* (an Orthopteron); Henking (1890), Paulmier (1899) and Gross (1904) likewise for Hemiptera; and McGill (1904) for *Anax* (an Odonate). Heterochromosomes that are single in both spermatogonia and spermatocytes for *Orphania* and *Gryllus* by de Sinéty (1901), for *Protenor* by me (1901*a*), for *Xiphidium* by McClung (1902), *Brachystola* by Sutton (1900, 1902), and *Gryllus* by Baumgartner (1904).

Not to be confused with heterochromosomes are the "odd" chromosomes I described (1901*a*, *b*) for *Alydus*, *Harmostes* and *Œdancola*, chromosomes that seem to behave exactly like any ordinary chromosome during the growth period of the spermatocytes, and cannot be distinguished from them by any compactness of structure or intensity of stain, except that they do not form bivalent chromosomes by conjugation with others. I called them *odd* because in cases where they are present the spermatogonium has an *odd* or *uneven* number of ordinary chromosomes, and the odd one is that which does not have a homologous mate with which to pair during the synapsis stage. These resemble in certain respects the unpaired heterochromosomes, but differ in not maintaining a compact form during the growth period. These three genera of Hemiptera are the only known cases where there is an uneven number of chromosomes in the spermatogonia, without the odd chromosome being a heterochromosome.

And now we come to the point of the behavior of the heterochromosomes and the odd chromosomes during the maturation mitoses. With regard to the heterochromosomes (chromatin nucleoli) that occur in pairs in the spermatogonia, I was able to determine the following relations (1901). In all the species of Hemiptera these unite to form one bivalent chromosome in the first spermatocytes, which appears clearly double at the time of the first maturation mitosis. In *Euchistus variolarius, Harmostes, Protenor* and *Œdancola* the heterochromosomes of this type divide reductionally in the first mitosis, so that their univalent components become separated; in the second mitosis each divides again, by comparison with the other chromosomes probably equationally, though I could not determine this in any decisive manner. The same process Gross (1904) has described for the chromatin nucleoli of *Syromastes,* and I have recently found it to hold for *Euchistus tristigmus.*[3] For *Anasa tristis, Alydus eurinus, Corizus, Oncopeltus, Calocoris, Acholla* and *Zaitha* I found (1901*a*) the bivalent heterochromosome to divide reductionally in the first mitosis, but did not determine its behavior in the second; this is also the case in *Lygus, Nobis, Corizus,* as I showed in the supplementary paper (1901*b*). Paulmier (1899) found the bivalent heterochromosome of *Anasa* to divide reductionally in the first mitosis, but not to divide in the second, in agreement with Henking's (1890) observations on *Pyrrhocoris,* and with those of McGill (1904) on *Anax.* That the bivalent heterochromosomes of *Syrbula* and *Lycosa* probably, but not certainly, divide first reductionally, then equationally, in the two maturation mitoses is shown in the present paper. Finally McClung (1900) describes for *Hippiscus* an accessory chromosome of the spermatocyte, said to divide in both maturation mitoses; he does not describe the relations for the spermatogonia, but it is quite probable to my mind that the phenomena in *Hippiscus* will be found essentially similar to those determined by me for *Syrbula,* namely, a bivalent heterochromosome in the first spermatocyte, formed by the conjugation of two univalent heterochromosomes of the spermatogonium.

We can summarize the facts of the preceding paragraph, noting parenthetically that for the details in the various species the reader must refer to the original descriptions, in the following statement: when heterochromosomes occur in pairs in the spermatogonia, *i.e.,* are of the type of "chromatin nucleoli," they always unite by conjuga-

[3] On a renewed study of my old preparations of the last species I find this to be certainly the case, and my earlier statement (1901*a*) was erroneous, to the effect that the bivalent heterochromosome divides first equationally, then reductionally. Also in my account of *E. variolarius* (1901*b*) I stated the heterochromosome in the second mitosis "is not always divided"; that must be amended to read "seems not always to be divided," in that in some of the spermatids it escapes detection by its small size or by being covered by another chromosome.

tion to form bivalent ones in the first spermatocytes, and all the describers except McClung agree that in the first maturation mitosis they always divide reductionally. No set of chromosomal structures is better adapted than such heterochromosomes to prove prereduction: there are two in the spermatogonium, which unite to form a bivalent one in the spermatocyte, and the separation of the univalent halves of the latter in the first mitosis is settled beyond any question of doubt for almost all the cases—for all the cases in which they can be recognized by peculiarities of form or size during this mitosis. Never in the spermatocytes do they take on the puzzling forms of rings and crosses which have misled so many good observers in the argument for postreduction. And it is significant that Gross (1904) shows the bivalent heterochromosome of *Syromastes* is prereductional in its division, and only by very indirect evidence attempts to show that the ordinary chromosomes divide postreductionally. As to the behavior of this kind of heterochromosome in the second maturation, for most of the species nothing positive could be decided; for other cases it has been shown that in some cases it divides in the second mitosis (probably equationally), as in *Euchistus, Harmostes, Protenor, Œdancola, Syromastes, Syrbula, Lycosa* and *Hippiscus*, while it does not divide in this second mitosis in *Anasa, Pyrrhocoris* and *Anax*.

Secondly, as to the division of the heterochromosomes that occur singly in the spermatogonia, and so undergo no conjugation in the spermatocytes. Those of *Orphania* (de Sinéty), *Gryllus* (de Sinéty and Baumgartner), *Brachystola* (Sutton), and *Xiphidium* (McClung do not divide in the first maturation mitosis, but do so in the second. Hence here again is prereduction: a whole chromosome passing undivided into one of the second spermatocytes, in the very mitosis which all these observers consider to be equational! The exceptional case is the unpaired heterochromosome of *Protenor* ("chromosome x"), which I described (1901*b*) as dividing transversely in the first mitosis, but not dividing in the second. I have recently gone over these old preparations with great care, and find nothing incorrect in my original description.

Thirdly, in regard to the divisions of the odd chromosomes of *Œdancola, Harmostes* and *Alydus*, which occur singly in the spermatogonia but are not heterochromosomes. In my original description (1901*b*) I did not determine their behavior positively in *Alydus* and *Harmostes*, beyond showing that they do not divide in one of the mitoses. I have recently studied them again, and find that in all these forms they divide in the first maturation mitosis but not in the second, just as is the case with the unpaired heterochromosome of *Protenor* and what Gross (1904) has called the "accessory chromosome" in *Syromastes* (to which we shall recur). They do not *appear* bivalent in the first spermatocytes; and whether their division in the first maturation mitosis is transverse or parallel to their long axis was not determined on account of their nearly spherical form.

Now to him who has had the patience to follow this account, which gives only a brief statement of some of the results of previously detailed observations, the occurrence and behavior of the two kinds of heterochromosomes and of the odd ordinary chromosomes may well seem difficult to reconcile. But there is nevertheless a general conformity of process here, which has not been elucidated heretofore. Whenever the heterochromosomes occur in pairs in the spermatogonia they always conjugate to form bivalent ones in the first spermatocytes, and their univalent components become separated in the first maturation mitosis, *i.e.*, divide prereductionally. This is strictly in confirmation with the doctrine we have tried to lay down in this paper, that the separation of entire univalent chromosomes, *i.e.*, their reduction in number, is always accomplished in the first mitosis. At the same time we have to bear in mind that there is no evidence that chromosomes divide in different ways in the first maturation mitosis, some equationally and some reductionally; it is very probable that does not happen, and indeed until proof is brought to the contrary we are justified in maintaining that it does not occur. This is an important premise in interpreting the divisions of the heterochromosomes and ordinary chromosomes that occur singly in the spermatogonia. Now in the Orthoptera (*Orphania, Gryllus, Xiphidium, Brachystola*) the heterochromosome is single in the spermatogonia; single, therefore, in the spermatocytes, it does not divide in the first maturation mitosis, but does in the second. Because it does not divide in the first mitosis it must be either univalent or else already in the spermatogonia be composed of two so firmly united that they cannot be divided in the reduction mitosis; its division in the second mitosis must be equational, and all the descriptions show this to be so. Now in *Protenor* the case is reversed; the single heterochromosome divides in the first mitosis, but not in the second, exactly like the odd ordinary chromosomes of the Hemiptera, but apparently the reverse of the single heterochromosomes of Orthoptera. Since this heterochromosome of *Protenor* and the odd ordinary chromosomes of three other Hemipteran species divide during the reduction mitosis, these chromosomes must be already bivalent within the spermatogonium—the single one there be two in close union, but not so close as to prevent their separation in the reduction mitosis. There is some observational proof for this, in that the odd chromosome or unpaired heterochromosome in the spermatogonium sometimes exhibits a transverse constriction, as if marking the point where two had joined, in *Harmostes* and *Protenor;* and in *Protenor* the division of the heterochromosome in the reduction mitosis is at right angles to its long axis. The failure to divide in the second mitosis can only be ascribed to an incomplete process of longitudinal splitting during the growth period. We can thus express the likeness and difference between the single heterochromosomes and odd ordinary chromosomes of the Hemiptera and the single heterochromosomes of the Orthoptera; they all agree in dividing reductionally in the first maturation mitosis, whether by a separation of two univalent components or by a transport of the whole chromosome into one of the daughter cells; they differ merely in not undergoing or in undergoing an equational splitting in the second mitosis. We can sum this up in the statement: all chromosomes and heterochromosomes, be they paired or single in the spermatogonia, divide reductionally in the first maturation mitosis, whether this division consist in two univalent components separating from each other or a single component passing undivided into one of the second spermatocytes.

And now we come to another point with regard to a general uniformity of heterochromosomes. I first showed (1901*a*, *b*) that the ordinary chromosomes in the spermatogonia are arranged in pairs, so that, *e.g.*, fourteen chromosomes form seven pairs, the two of a pair being alike in size; and I showed for several species that whenever spermatogonial chromosomes show marked differences in size they can be recognized again in the bivalent chromosomes of the spermatocytes. Sutton (1902) corroborated this for *Brachystola*.[4] And later I showed (1904*a*) corresponding chromosomes in the spermatogonia are alike not only in size but also in form. We have just seen, also, that one kind of heterochromosomes, the chromatin nucleoli, occur in pairs in the spermatogonia—where there is one bivalent one of these in the spermatocytes it corresponds to two in the spermatogonia. Further than this, we have shown that the odd ordinary chromosomes of Hemiptera and the unpaired heterochromosomes of *Protenor* must be regarded as already

[4] Boveri (1904), in his recent review, ascribes the main credit of this discovery to Sutton (1902), as others have done; but the point was very clearly stated in my papers, illustrated on a number of species, and, furthermore, I demonstrated that chromosomes of corresponding size conjugate to form the bivalent ones. Quite a number of papers have come out recently with "new discoveries" which had already been made in my papers on *Peripatus* and Hemiptera.

bivalent in the spermatogonium—there as a chromosome pair with the components closely united instead of being, as with most of the chromosomes, separated. Can we go further than this, and consider the unpaired heterochromosomes of the Orthoptera to be also already bivalent in the spermatogonium, but with the univalent parts so closely united that they do not become separated even in the reduction mitosis? The heterochromosomes of the Orthoptera appear to be usually larger than the ordinary chromosomes, which is the only observational evidence for the idea that they may have the value of more than one chromosome, and sometimes they are much larger. Such evidence is, of course, not at all sufficient. But should they be ultimately proven to be bivalent in the spermatogonia, a further uniformity would evince itself: all heterochromosomes and all ordinary chromosomes would be paired in the spermatogonia, whether the two members of a pair be separated there (univalent) or be united (bivalent); in the former case they would become bivalent by conjugation for the first time in the spermatocytes, in the second case they would pass over already bivalent to the spermatocytes. In any event an even number of univalent chromosomes in the spermatogonia and half that number of bivalent ones in the spermatocytes would be the primitive (unmodified) condition, as it is the one most usually found. In the preceding paragraph it was shown to be probable that the odd ordinary chromosomes of the Hemiptera and the unpaired heterochromosome of *Protenor* are already bivalent in the spermatogonia; this may or may not be the case with the unpaired heterochromosomes of the Orthoptera, but if it is the case, as I think is somewhat probable, then the following conclusion is reached—a conclusion well based at least for the odd ordinary chromosomes and the unpaired heterochromosome of *Protenor:* heterochromosomes that are paired in the spermatogonia and become bivalent in the spermatocytes would be an earlier condition, and would lead to the later condition of heterochromosomes unpaired in the spermatogonia by conjugation of their univalent components in spermatogonic cell generations. In this way unpaired heterochromosomes would be later modifications of the paired; and in the same manner, unpaired ordinary chromosomes later modifications of paired ordinary chromosomes. Two univalent chromosomes of a spermatogonium might conjugate to form one bivalent one before the spermatocyte stage, this would then be an odd ordinary chromosome, which later might or might not become an unpaired heterochromosome; or two ordinary chromosomes of a spermatogonium might become heterochromosomes (chromatin nucleoli) but still remain univalent in this cell (conjugating not before the spermatocyte stage), and two such univalent heterochromosomes might or might not later conjugate in a spermatogonium to form an unpaired heterochromosome. On such a premise paired heterochromosomes and chromosomes within the spermatogonia would be an earlier condition than unpaired ones, and unpaired heterochromosomes could be formed in two ways.

The conclusions of the preceding paragraph are put forward merely as tentative suggestions, and in no sense as final conclusions; the phenomena are too complex as yet for any thorough analysis and interpretation. But amongst all this complexity a certain agreement in the phenomena becomes evident, and this it is our business to discover. I still see no reason, despite the criticisms of McClung, to modify my original standpoint (1901*b*), that there is a transmutation in chromosomal numbers just as in any other parts of the organization, and that the heterochromosomes are chromosomes on the way to disappearance; following Paulmier's (1899) earlier contention that they are degenerated chromosomes. McClung (1900, 1902) urges that they are frequently larger than other chromosomes and show just as many signs of active metabolism. But neither Paulmier nor I regarded them as dead structures; and I pointed out that they seem to have a different metabolic energy from the ordinary chromosomes, because in some species of Hemiptera they are regularly attached to the true nucleolus, which condition the other chromosomes do not share, and have a different position within the nucleus (almost always against its membrane). There can well be no question that they are metabolically different, else they would not behave so differently, with a peculiar autonomy. McClung has described them only for Orthoptera, where they are frequently the largest chromosomes. But the paired heterochromosomes of the Hemiptera are usually the smallest of all, sometimes very minute granules (as in *Peribalus, Cœnus, Trichopepla, Corizus, Coriscus, Prionidus*); and when there are several pairs within a cell, as, *e.g., Acholla*, all of them are smaller than the other chromosomes. So I considered them degenerate in the sense that they no longer carry on exactly the same activities as the ordinary chromosomes, from which they must be derived, but have taken on other energies and have in most of the described cases become smaller. The excessively minute heterochromosomes would then be the last perceptible stage in their history; for surely there is no reason to consider this the first stage—to consider them as orginating as buds from larger ordinary chromosomes. Unpaired heterochromosomes do not conjugate during the growth period, for the reason of the absence of a mate with which to unite; and in cases of bastardization between different species, as described by Guyer (1902) and Moenkhaus (1904), the maternal and paternal chromosomes fail to conjugate. Or, if the parents have different numbers of chromosomes, some of those of the parent with the larger species are forced to remain univalent during the growth period, as shown by Rosenberg (1903) for *Drosera*. Facts like these might suggest that the presence of heterochromosomes has been produced by bastardization of species with different number of chromosomes. But that could be the case only of unpaired heterochromosomes; it would not explain the paired ones, and we have found that the unpaired kind are probably derivable from the paired. Again, they have been found in all insects in which they have been sought for, or in nearly all, but it would be rash to conclude that all these species of insects have arisen as bastards between parental forms with different chromosomal numbers. Therefore there is no good reason to refer the heterochromosomes to any hybridization process; and every reason to consider them as modified conditions of the ordinary chromosomes, formed in some cases concomitantly with a change in chromosomal number, probably from a higher number to a lower, chromosomes with a different metabolic activity and on the way to disappearance. A remarkable fact, for which I see no explanation whatsoever, is their very general occurrence among insects, and their absence elsewhere except in spiders; but they may be found in other groups when the attention is given them that they deserve. McClung (1902*a*) has put out the hypothesis that they are sex-determinants, reasoning from the condition of the unpaired heterochromosome of *Xiphidium;* here only half of the spermatids receive the division products, and he argues that its presence in them may determine the male sex. This is only a hypothesis, and as yet we do not even know whether in the ovocytes of such species similar heterochromosomes may not occur. Indeed, whether spermatozoa with and those without heterochromosomes are equally capable of fertilization is not known, and would be exceedingly difficult to determine. Further, in some species of Hemiptera all the spermatozoa receive division products of the heterochromosomes, and on McClung's hypothesis all spermatozoa in such species would produce males.

On the question of the perpetuation from generation to generation of an odd number of heterochromosomes or ordinary chromosomes I have touched at another place (1901*b*); but now I am convinced it is inutile to discuss this problem until we have facts of their behavior in the maternal germ cells.

In conclusion, attention should be drawn to the recent divergent ideas of Gross (1904). He describes for *Syromastes*, a Hemipteron, two pairs of modified chromosomes: one pair of these, which he calls *chromatin nucleoli*, differ from the other chromosomes in acting like heterochromosomes during the growth period of the spermatocytes, but agree with them in dividing in both maturation mitoses; the other pair, which he calls *accessory chromosomes*, differ from the ordinary chromosomes in not dividing during the second maturation mitosis, but behave exactly like them during the growth period. His chromatin nucleoli, which are not recognizable until the stage of the spermatocytes, are said not to differ in volume from the ordinary chromosomes in the spermatogonia; while his accessory chromosomes are described as the smallest of all the chromatin elements. Both kinds of these bodies are paired and univalent in the spermatogonia, and by conjugation become bivalent in the spermatocytes. Now Gross reasons these are separate genealogical conditions of one and the same structure. He argues that a pair of unmodified ordinary chromosomes of the spermatogonium become in the spermatocytes chromatin nucleoli, which there act like heterochromosomes, preserve their compact structure and undergo no longitudinal split, and divide in both maturation mitoses, so that each spermatid receives a half of each univalent component. A spermatozoon formed from such a spermatid unites with an ovotid with a corresponding semivalent chromatin nucleolus. But instead of these two semivalent heterochromosomes (chromatin nucleoli) of the fertilized egg appearing in the next following generation of spermatogonia as chromatin nucleoli, he conceives them to appear in the form of the pair of small accessory chromosomes, which form a bivalent one in the following spermatocyte, divide in the first maturation mitosis but not in the second, so that half of the spermatids receive a half of each of them. So he interprets them both as chromosomal elements whose maturation divisions are continued over two generations of individuals; although he really describes three divisions of them, two for the chromatin nucleoli and one for the accessory chromosomes. We need not enter here upon his further deductions from this interpretation, but shall consider simply its probability. A strong objection that suggests itself is this: all the individuals studied by him showed in the spermatocytes two chromatin nucleoli and two accessory chromosomes; but this would be impossible if in every other generation the chromatin nucleoli changed into accessory chromosomes, for then one should find in the cells of some individuals no chromatin nucleoli but four accessory chromosomes. And if, and Gross suggests this possibility, from time to time successive pairs of ordinary chromosomes become chromatin nucleoli.

then in the course of time all the chromosomes would become chromatin nucleoli; yet in no individuals were found more than one pair. So from whatever standpoint we regard his explanation its improbability becomes manifest. On the other hand his chromatin nucleoli behave exactly like the chromatin nucleoli (paired heterochromosomes) of *Euchistus*, except that they are not distinguishable in the spermatogonia (in some other Hemiptera they are also not recognizable in these cells); so there is every reason to consider them as persisting from individual to individual as chromatin nucleoli. What he calls in *Syromastes* the accessory chromosomes are not heterochromosomes at all, so certainly not later stages at all of chromatin nucleoli, for he describes them as conducting themselves exactly like the ordinary chromosomes during the growth period; the bivalent accessory chromosome of the spermatocytes differs only from the other bivalent chromosomes in failing to divide in the second mitosis. I think this "accessory chromosome" of *Syromastes* is to be considered a stage leading to that of the unpaired heterochromosome of *Protenor;* they resemble each other in failing to divide in the second maturation mitosis, and though the one in *Protenor* is virtually single in the spermatogonia we have given reasons to show that it is probably bivalent there. The failure to divide in the second mitosis can for both be ascribed to incompleteness of the longitudinal split. And this is surely a far simpler interpretation of the phenomena in *Syromastes*, one much more in accordance with what has been described in other objects, than that elaborated by Gross. It is hardly necessary to adjoin that such a process as the two maturation divisions of one pair of chromosomes being continued over two germinal cycles has no known counterpart in other animals, and so needs the most rigid observational demonstration.

Gérard (1901) has described for *Prosthecerœus* and Schockaert (1901) for *Thysanozoon* a peculiar deep-staining thread within the ovocytes which divides into two, and is said to give rise to the egg centrosomes; it is for future research to determine whether this structure may have any relation to the heterochromosomes.

Literature.

Baumgartner, W. J. 1904. Some New Evidences for the Individuality of the Chromosomes. *Biol. Bull.*, 8.

Berghs, J. 1904*a*. La formation des Chromosomes hétérotypiques dans la sporogénèse végétale. 2. *La Cellule*, 21.

—— 1904*b*. *Idem*. 3. *Ibid.*

Blackman, M. W. 1901. Spermatogenesis of the Myriapods. *Bull. Univ. Kansas*, 10.

Bouin, P., and Collin, R. 1901. Contribution à l'étude de la division cellulaire chez les Myriapodes. *Anat. Anz.*, 20.

Boveri, T. 1887. Zellen-Studien. 1. Die Bildung der Richtungskörper bei Ascaris megalocephala and Ascaris lumbricoides. Jena.

—— 1904. Ergebnisse über die Konstitution der chromatischen Sustanz des Zellkerns. Jena.

Brauer, A. Zur Kenntniss der Spermatogenese von Ascaris megalocephala. *Arch. mikr. Anat.*, 42.

Carnoy, J. B. 1885. La Cytodiérèse chez les Arthropodes. *La Cellule.*

Farmer, J. B., and Moore, J. E. S. 1903. New Investigations into the Reduction Phenomena of Animals and Plants. *Proc. Roy. Soc. London*, 72.

Francotte, P. 1898. Recherches sur la maturation, la fécondation et la segmentation chez les Polyclades. *Arch. Zool. expér. gén.*

Fol, H. 1891. Le Quadrille des centres. Un épisode nouveau dans l'histoire de la fécondation. *Arch. sci. phys. math.*

Gérard, O. 1901. L'ovocyte du premier ordre du Prostheceræus vittatus. *La Cellule*, 18.

Grégoire, V. 1904. La réduction numérique de chromosomes et les cinèses de maturation. *La Cellule*, 21.

Griffin, B. B. 1899. Studies on the Maturation, Fertilization and Cleavage of Thalassema and Zirphæa. *Journ. Morph.*, 15.

Gross, J. 1904. Die Spermatogenese von Syromastes marginatus L. *Zool. Jahrb.*, 20.

Guyer, M. F. 1900 (really published two or three years later). Spermatogenesis of Normal and of Hybrid Pigeons. Chicago.

Häcker, V. 1891. Die Richtungskörperbildung bei Cyclops und Canthocamptus. *Ber. naturf. Ges. Freiburg*, 6.

—— 1892. Die Eibildung bei Cyclops und Canthocamptus. *Zool. Jahrb.*, 5.

—— 1893. Das Keimbläschen, seine Elemente und Lageveränderungen. *Arch. mikr. Anat.*, 41.

—— 1895. Ueber die Selbständigkeit der väterlichen und mütterlichen Kernsubstanz während der Embryonalentwickelung von Cyclops. *Ibid.*, 46.

—— 1899. Praxis und Theorie der Zellen- und Befruchtungslehre. Jena.

—— 1902. Ueber das Schicksal der elterlichen und grosselterlichen Kernanteile, Jena. *Jenaische Zeitschr. Naturw.*, 37.

—— 1904*a*. Bastardirung und Geschlechtszellenbildung. Ein kritisches Referat. *Zool. Jahrb.*, Suppl., 7.

—— 1904*b*. Heterotypische Teilung, Reduktion und andere zelltheoretische Begriffe. *Zool. Anz.*, 28.

Henking, H. 1890. Ueber Spermatogenese und deren Beziehung zur Eientwicklung bei Pyrrhocoris apterus M. *Zeit. wiss. Zool.*, 51.

Hertwig, O. 1890. Vergleich der Ei- und Samenbildung bei Nematoden. *Arch. mikr. Anat.*, 36.

King, H. D. 1901. The Maturation and Fertilization of the Egg of Bufo lentiginosus. *Journ. Morph*, 17.

Klinckowström, A. v. 1897. Beiträge zur Kenntniss der Eireifung und Befruchtung bei Prostheceræus. *Arch. mikr. Anat.*, 48.

Korschelt, E. 1895. Ueber Kerntheilung und Befruchtung bei Ophryotrocha puerilis. *Zeit. wiss. Zool.*, 60.

Korschelt, E., and Heider, K. 1903. Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. Allgemeiner Theil, Zweite Lieferung, Jena.

Lerat, P. 1902. La première cinèse de maturation dans l'ovogénèse et la spermatogénèse du Cyclops strenuus. *Anat. Anz.*, 21.

Linville, H. R. 1900. Maturation and Fertilization in Pulmonate Gasteropods. *Bull. Mus. Comp. Zool. Harvard Univ.*, 35.

McClung, C. E. 1899. A Peculiar Nuclear Element in the Male Reproductive Cells of Insects. *Zool. Bull.*, 2.

—— 1900. The Spermatocyte Divisions of the Acrididæ. *Bull. Univ. Kansas*, 9.

—— 1901. Notes on the Accessory Chromosome. *Anat. Anz.*, 20.

—— 1902*a*. The Accessory Chromosome—Sex Determinant? *Biol. Bull.*, 3.

—— 1902*b*. The Spermatocyte Divisions of the Locustidæ. *Kansas Univ. Sci. Bull.*, 1.

McGill, C. 1904. The Spermatogenesis of Anax junius. *Univ. Missouri Studies*, 2.

Maréchal, J. 1904. Ueber die morphologische Entwickelung der Chromosomen im Keimbläschen des Selachiereies. *Anat. Anz.*, 25.

Moenkhaus, W. J. 1904. The Development of the Hybrids between Fundulus heteroclitus and Menidia notata, with especial Reference to the Behavior of the Maternal and Paternal Chromatin. *Amer. Journ. Anat.*, 3.

Montgomery, T. H., Jr., 1898. The Spermatogenesis in Pentatoma up to the Formation of the Spermatid. *Zool. Jahrb.*, 12.

—— 1899. Chromatin Reduction in the Hemiptera: a Correction. *Zool. Anz.*, 22.

—— 1900. The Spermatogenesis of Peripatus (Peripatopsis) balfouri up to the Formation of the Spermatid. *Zool. Jahrb.*, 14.

—— 1901*a*. A Study of the Chromosomes of the Germ Cells of the Metazoa. *Trans. Amer. Phil. Soc.*, 20.

—— 1901*b*. Further Studies on the Chromosomes of the Hemiptera heteroptera. *Proc. Acad. Nat. Sci. Philadelphia.*

—— 1903. The Heterotypic Maturation Mitosis in Amphibia and its General Significance. *Biol. Bull.*, 4.

—— 1904*a*. Some Observations and Considerations upon the Maturation Phenomena of the Germ Cells. *Ibid.*, 6.

—— 1904*b*. Prof. Valentin Häcker's Critical Review on Bastardization and Formation of the Sex Cells. *Zool. Anz.*, 27.

Nichols, M. L. 1902. The Spermatogenesis of Oniscus asellus Linn., with especial Reference to the History of the Chromatin. *Proc. Amer. Phil. Soc.*, 41.

Paulmier, F. C. 1899. The Spermatogenesis of Anasa tristis. *Journ. Morph.*, 15, Supplement.

Prowazek, S. 1901. Spermatogenese der Weinbergschnecke. *Arb. zool. Inst. Wien*, 13.

—— 1902. Ein Beitrag zur Krebsspermatogenese. *Zeit. wiss. Zool.*, 71.

Rath, O. Vom. 1892. Zur Kenntniss der Spermatogenese von Gryllotalpa vulgaris Latr. *Arch. mikr. Anat.*, 40.

—— 1895. Neue Beiträge zur Frage der Chromatinreduction in der Samen- und Eireife. *Ibid.*, 46.

Rosenberg, O. 1903. Das Verhalten der Chromosomen in einer hybriden Pflanze. *Ber. Deutsch. Bot. Ges.*, 21.

—— 1904*a*. Ueber die Tetradenteilung eines Drosera-Bastardes. *Ibid.*, 22.

—— 1904*b*. Ueber die Reduktionsteilung in Drosera. *Meddel. Stockholms Hogsk. Bot. Inst.*

Rückert, J. 1894. Zur Eireifung bei Copepoden. *Anat. Hefte.*

Sabaschnikoff, M. 1897. Beiträge zur Kenntniss der Chromatinreduktion in der Ovogenese von Ascaris megalocephala bivalens. *Bull. Soc. imp. Natur. Moscou.*

Schockaert, R. 1901. L'ovogénèse chez le Thysanozoon brocchi. Première Partie. *La Cellule*, 18.

—— 1902. L'ovogénèse chez le Thysanozoon brocchi. Deuxième Partie. *La Cellule*, 20.

SCHREINER, A. and K. E. 1904. Die Reifungsteilungen bei den Wirbeltieren. Ein Beiträg zur Frage nach der Chromatinreduktion. *Anat. Anz.*, 24.

SINÉTY, R. DE. 1901. Recherches sur la Biologie et l'Anatomie des Phasmes. *La Cellule.*

STRASBURGER, E. 1904. Ueber Reduktionsteilung. *Sitzb. preuss. Akad. Wiss. Berlin.*

STRICHT, O. VAN DER. 1898. La formation des deux globules polaires et l'apparition des spermocentres dans l'oeuf de Thysanozoon Brocchi. *Arch. de Biol.*, 15.

SUTTON, W. S. 1900. The Spermatogonial Divisions in Brachystola magna. *Bull. Univ. Kansas*, 9.

—— 1902. On the Morphology of the Chromosome Group in Brachystola magna. *Biol. Bull.*, 4.

—— 1903. The Chromosomes in Heredity. *Ibid.*, 4.

VOINOV, D. N. 1903. La spermatogénèse d'été chez le Cybistes roeselii. *Arch. zool. expér. gén.* (4), 5.

WAGNER, J. 1896. Einige Beobachtungen über die Spermatogenese bei den Spinnen (Vorläufige Mittheilung). *Zool. Anz.*, 19.

WALLACE, L. B. 1900. The Accessory Chromosome in the Spider. *Anat. Anz.*, 18.

WILCOX, E. V. 1895. Spermatogenesis of Caloptenus femur-rubrum and Cicada tibicen. *Bull. Mus. Com. Zool. Harvard Univ.*, 27.

WINIWARTER, H. VON. 1900. Recherches sur l'Ovogénèse et l'Organogénèse de l'Ovaire des Mammifères (Lapin et Homme). *Arch. de Biol.*, 17.

EXPLANATION OF PLATES IX AND X.

All the figures were drawn by the author with the aid of the camera lucida, at a magnification of about 1800 diameters. In all N. 2 denotes the heterochromosome.

PLATE IX. *Syrbula acuticornis* Bruner.

Fig. 1.—Spermatogonium, rest stage.

Figs. 2–6.—Spermatogonia, successive prophases.

Figs. 7, 8.—Spermatogonia, pole views of the monaster stage.

Fig. 9.—Lateral view of preceding stage.

Fig. 10.—Lateral view of spermatogonic anaphase.

Fig. 11.—Pole view of first spermatocyte, showing all the chromosomes, shortly after preceding stage.

Figs. 13–15.—First spermatocytes, successive early stages; in 15 only the nucleus shown.

Fig. 16.—Rest stage of first spermatocyte.

Figs. 17, 18.—Successive stages immediately following the preceding.

Figs. 19–22.—Successive stages of the synapsis, all lateral views, 19 showing only the nucleus.

Figs. 23–25.—Nuclei in post-synapsis stage.

Fig. 26.—Bivalent heterochromosome of this stage, consisting of two closely apposed univalent members, of which the upper one is stippled.

Figs. 27–31.—Successive prophases of first maturation mitosis; in the first three only the nucleus shown.

Figs. 32, 33.—Lateral views of the first maturation spindle; fig. 33 seen obliquely so that only one spindle pole shows.

PLATE X, Figs. 34–40.—*Syrbula acuticornis* (continuation).

Figs. 34–36.—Successive anaphases of first maturation mitosis; in 36 the largest chromosome of the upper plate is longitudinally split, but so that one split half covers the other.

Fig. 37.—Oblique lateral view of one daughter chromosome plate, anaphase of the same mitosis.

Fig. 38.—Pole view of chromosome plate of the second spermatocyte.

Fig. 39.—Lateral view of second maturation spindle.

Fig. 40.—Pole view of chromosome plate of the spermatid.
Figs. 41–65.—*Lycosa insopita* Montg.
Fig. 41.—Pole view of spermatogonium, monaster stage.
Figs. 42–44.—Lateral views of synapsis stages.
Fig. 44*bis*.—*A* and *B* each represent a bivalent and longitudinally split heterochromosome of the synapsis stage, and the curved line near each an arc of the nuclear membrane.
Figs. 45, 46.—Lateral views of nuclei, postsynapsis.
Figs. 47–49.—Nuclei in early prophases of first maturation mitosis.
Figs. 50–52.—Nuclei in later prophases.
Figs. 53, 54.—Pole views of monaster, first maturation mitosis.
Figs. 55–58.—Lateral views of the same stage.
Fig. 59.—Anaphase of first maturation mitosis.
Figs. 60–63.—Pole views of the chromosome plates of second spermatocytes.
Figs. 64, 65.—Lateral views of second maturation spindle; 65 oblique so as to show only one spindle pole.

Postscript.

Some time after the preceding was sent to press the following papers were received, all confirmatory of my views upon chromosomal conjugation and reduction: L. B. Wallace, "The Spermatogenesis of the Spider," *Biol. Bull*, 8, 1905; L. T. Dublin, "The History of the Germ Cells in Pedicellina americana," *Ann. New York Acad. Sci.*, 16, 1905; and J. B. Farmer and J. E. S. Moore, "On the Maiotic Phase (Reduction Divisions) in Animals and Plants," *Quart. Jour. Micr. Sci.*, 48, 1905. Dublin's paper is of particular importance, because he finds perfect agreement in both ovogenesis and spermatogenesis. Miss Wallace finds that the accessory chromosomes do not divide in either maturation mitosis; and believes that only that fourth of the spermatids which receives them become functional spermatozoa, so that the remaining three-fourths "are regarded as homologous to the polar bodies thrown off by the ovum."

March 7.

The President, Samuel G. Dixon, M.D., in the Chair.

Fifteen persons present.

The deaths of the following members were announced: Edward Longstreth, February 24, 1905, and J. Dundas Lippincott, March 6, 1905.

The Publication Committee reported that papers under the following titles had been presented for publication:

"Senility among Gasteropods," by Burnett Smith.

"Notes on some Arctic Fishes, with Description of a New Oncocottus," by Henry W. Fowler.

The Utility Principle in Relation to Specific Characters. — Mr. Arthur Erwin Brown made a communication of which the following is an abstract:

By way of introduction to an argument supporting a broad view of the factors of evolution, such as that taken by Darwin, against the exclusive valuation of Natural Selection urged by Neo-Darwinians, the speaker mentioned that Charles Darwin was elected a correspondent of the Academy on March 27, 1860, the *Origin of Species* having been first published in London on November 24, 1859, and the following extract was read from a letter written by Darwin on May 8, 1860, to Sir Charles Lyell: "This morning I got a letter from the Academy of Natural Sciences of Philadelphia announcing that I am elected a correspondent. It shows that some naturalists there do not think I am such a scientific profligate as many think me here."

The Academy appears to have been the first among scientific societies to confer its honors upon Darwin after the publication of his immortal work.

The opinion of Alfred Russell Wallace as a leading advocate of Neo-Darwinism, that utility has necessarily been the sole factor in the production of specific characters, was contrasted with Darwin's view, and the difficulty of bringing facts to bear against a logical proposition constructed in the form of a closed circle was pointed out. Many biologists have been led by this difficulty to the hasty conclusion that it is useless to cite cases of apparent inutility in face of it; but this view is unfortunate, for thereby the field is abandoned to the advocates of exclusive utility. Furthermore, the accumulation of probabilities by means of such cases is not only legitimate as a method, but at the present time is about the only one by which the argument can be met.

An examination of the evidence for utility in generic and specific characters in serpents was undertaken, chiefly for the reason that the relative simplicity of their organization and the nature of the characters which meet with general acceptance as of taxonomic value seemed likely to afford exceptions to Mr. Wallace's law. The result appears to be that if the validity of specific characters depends solely upon utility, species are few, many genera now including a number of accepted species which Mr. Wallace would be logically bound to reduce to one. Profound structural differences below family rank are not known among snakes. Generic determination is made upon associations of characters, such as the presence or absence of hypapophyses on the posterior trunk vertebræ with endlessly varying details in the form, number and serial proportion of teeth, the arrangement or absence of certain head plates, and differences in the scutellation upon the body. Utility is evident in the presence of ventral hypapophyses, for they supply attachment for bundles of muscular fibres running to the diapophyses of several succeeding vertebræ, which play an important part in throwing the body into curves. They are found in most aquatic species except in *Hydrophinæ,* where they are largely developed upon the tail. But they are present in groups as widely separated otherwise as the so-called *Natricinæ* among colubrine snakes, the *Elapinæ* among proteroglyphs, and in *Viperidæ.* They are, therefore, of no value, taken separately, as measures of affinity. The elapine and viperine snakes are not usually aquatic, and in them utility has doubtless had relation to the rapidity and force required in striking and the need of firm support for the hinder part of the body during the act. In fact, the distribution of these structures seems to afford a true case of convergent evolution.

While utility was primarily concerned in the development of teeth generally, it does not follow that the endless trifling differences in the teeth of *Colubridæ* and *Boidæ* are due to the same cause, for they do not present distinctive types, as in mammals and many lizards, having a mechanical relation to kind of food, but seem, on the whole, to be promiscuously distributed. That such minute differences are due to internal laws of growth and are reached by Natural Selection only when they become hurtful, is much more intelligible than that utility has required such endless variety of minute adaptations. It is admitted that by referring a structure to "laws of growth" no more is accomplished than to express a belief in the action of organic causes whose exact nature is not yet known.

In head plates the differences commonly met with are in the absence or fusion of certain ones upon the snout. That the presence or absence of a minute fissure between any of these plates, which are underlaid by the bony skull and incapable of flexure, can have selective value is inconceivable, and the frequency of their occurrence in degraded, burrowing species points clearly to the probability that they result from the direct action of external stimuli and are of too little importance to be acted upon by Natural Selection. In fact, the almost invariable occurrence of these anomalies in burrowing species is a powerful argument for the agency of external irritations as a cause of change in structure, and the further fact that they have become permanent in such genera as *Stilosoma*, *Helicops*, *Haldea*, *Abastor*, *Carphophis* and others, certainly indicates that these degradational characters have been inherited. They cannot be "ontogenetic" modifications, for they are exhibited by the newly born young; furthermore, it is of the very nature of ontogenetic modifications that they must be adaptive, while the whole burden of the present argument is to show that those here in question are not of that character. That the complete absence of internasals or loreal is sometimes correlated with a shortened snout and reduced dentition is true, but this condition is not adaptive but degradational. The result of adaptation in burrowing species is seen in *Heterodon*, where the bony snout has been lengthened and made stronger instead of being reduced. In response to external irritations this genus of exceptional burrowers has developed an irregular number of supernumerary plates on the snout, instead of suffering any loss.

The elongation of the rostral, or turning up of it like a plough, is usually regarded as an adaptation related to subterranean habits, and in some cases, as *Heterodon* and *Lystrophis*, it is doubtless true, but the elongation reaches a maximum in *Dryophis*, which is more arboreal than most snakes, and is wholly absent in many others which burrow freely.

In body scales the range of individual variation in the number of rows follows a general law of proportion to the normal mean. In *Colubridæ*, with a minimum of ten and maximum of thirty-five, they rarely vary more than two to six rows, while in *Boidæ*, with extremes of twenty-one and ninety-five, they frequently vary as much as fifteen. Mr. Bateson's law of "meristic" variation seems to be followed. The power of heredity is shown in this relative adherence to a mean, but with the normal range of variation in mind, it cannot be supposed that a slight difference in the number of rows can ever have had selective value to the ancestral form of any species. The fact that the normal number in a species bears a quite definite relation to girth of body, indicates that they are determined by laws of growth. This might be regarded as a correlation, under Mr. Wallace's comprehensive definition, but it may be doubted if size, as a general fact in nature, is conditioned by Natural Selection. It is more likely to be determined by laws of growth reacting to nutritive supply.

The function of keels and scale pits is not known. The last are probably vestigial. Keels may serve a purpose in the swimming habit of aquatic species. In *Hydrophinæ*, where they are not much developed on the dorsal scales, ventral keels are common. With both structures probable utility may be conceded.

The use pertaining to an entire or divided anal plate is not evident. It might appear that a divided anal would be of service in increasing extensibility of the parts involved, but in that case it would be a progressive character, and we have, on the contrary, genera with an entire anal, such as *Eutænia* and *Pityophis*, descended from *Tropidonotus* and *Coluber*, which have the divided form. It is the case, however, that an entire anal is present in all but two genera of *Boidæ*, which are near the base of the series in phylogeny.

Specific determination is made chiefly upon color. Some few cases of color in serpents are protective or warning, but very many species in most large genera are marked by differences in pattern or tint so inconspicuous, that in view of the want of keen eyesight in snakes, it does not seem credible that they can serve the ends usually regarded as useful. The range of color variation in many species is extraordinarily great, and some brilliantly colored species are mainly subterranean, both of which facts are inconsistent with the theory of recognition markings. Recognition in snakes is probably much more served by the olfactory than by the optic sense. Sexual selection cannot be a cause, for few species are known to present differences characteristic of sex.

Pigments in reptiles probably result from waste products of metabolism, which doubtless is influenced by external conditions and food. It is not, however, the existence of color, but its precise distribution in species which is here in question, and the minuteness of the differences in many cases between species of a genus, or between species belonging to distinct genera but occupying the same range, renders it doubtful if the utility principle can be held to explain them adequately. At the same time the subject is very obscure.

The opinion held by the extreme Neo-Darwinians is a deduction from the denial of the inheritance of acquired characters urged by the Weissman school. It is true that the experimental evidence for such inheritance is far from establishing it, but, on the other hand, none but that of negative kind can ever be brought against it, and as a philosophical proposition it has a right to consideration. The further assumption that Natural Selection *necessarily* requires the disappearance of "indifferent" characters which are outside of the law of utility, is unwarranted. As far as is now known, inheritance and variation are ultimate facts of organic life. Congenital variation occurs within relatively narrow limits about a mean, and if it be held that the characters we have been considering have come to be of this kind, so long as they are not injurious but merely "indifferent," no reason can be assigned, aside from the necessity of completing a logical system, why they may not be continued in succeeding generations.

Natural Selection is too often spoken of as if it were a positive force in evolution. It is not so. The struggle for existence is no more than the trial which conditions success, and Natural Selection does no more than determine the failures by means of their detrimental structures. It cannot directly affect those merely neutral.

The fact that characters such as the presence of brilliant colors in subterranean species, and the fusions among head plates which there is especially good reason to regard as "indifferent," have become fixed to the point of specific or generic value, directly contradicts Mr. Wallace's law of exclusive utility. Their continuance, furthermore, would seem to require explanation under a doctrine of absolute non-inheritance of acquired characters.

March 21.

The President, Samuel G. Dixon, M.D., in the Chair.

Forty-six persons present.

The death of A. Preudhomme de Borre, February 27, a correspondent, was announced.

The Publication Committee reported that papers under the following titles had been presented for publication:

"Notes on a Small Collection of Orthoptera from the Lesser Antilles, with the Description of a New Species of Orphulella," by James A. G. Rehn.

"Certain Aboriginal Mounds of the Tombigbee River," by Clarence B. Moore.

"Certain Aboriginal Mounds of the Black Warrior River," by Clarence B. Moore.

"Certain Aboriginal Mounds of Mobile Bay and of Mississippi Sound," by Clarence B. Moore.

"Miscellaneous Investigations," by Clarence B. Moore.

"Description of a New Commensal Crab," by Mary J. Rathbun.

Mr. Arthur H. Fisher was elected a member.

The following were ordered to be printed:

MOLLUSCA OF THE SOUTHWESTERN STATES, I: Urocoptidæ; Helicidæ of Arizona and New Mexico.

BY HENRY A. PILSBRY.

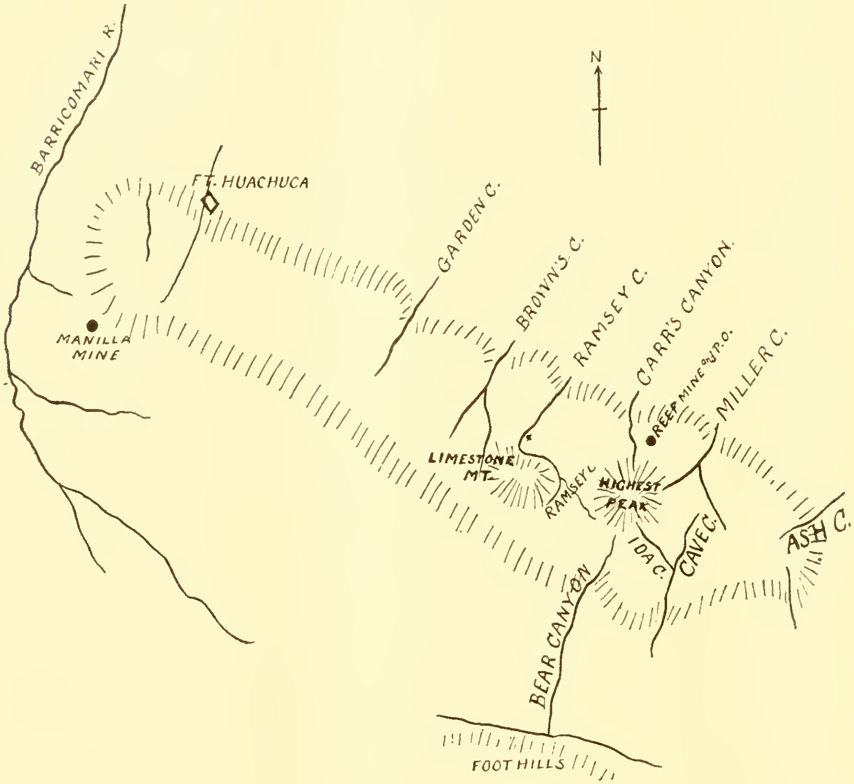
In these papers the mollusks collected by Mr. James H. Ferriss and the writer in the expedition made in 1903 and by Mr. Ferriss in two visits to Arizona in 1902 and 1904 will be discussed. The present contribution deals chiefly with Mr. Ferriss' researches in Arizona, where an extraordinarily rich and varied snail fauna was found in the canyons of the Chiricahua and Huachuca Mountains. In the study of these materials I have worked over many specimens received from the late E. H. Ashmun, who first made known to us the richness of the Arizona snail fauna, and from Prof. T. D. A. Cockerell, whose unceasing labors on the fauna and flora of New Mexico are familiar to all naturalists. The treatment of the genus *Ashmunella* has been made practically monographic.

It is unfortunate that no good topographic survey of southern Arizona has been published. It is extremely difficult at present to determine some localities given by previous naturalists, or to clearly indicate the positions of those explored by Mr. Ferriss. The accompanying sketch of the canyons explored in the Huachucas makes no pretensions to cartographic accuracy beyond showing the relative positions of the localities mentioned in the text. From Fort Huachuca to Ramsey Canyon is 10 miles; to Carr Canyon 14, and to Miller Canyon 20 miles. Manilla mine is 6 miles from Fort Huachuca. The range is about 30 miles long and 6 wide.

Of the Chiricahuas, it may suffice to say that Bar or Bearfoot Park is on the summit, and is believed to lie at 8,500 feet elevation. There was a sawmill there in 1904. From it toward the southwest Sawmill Canyon leads, and Cave creek flows down from the opposite side. This must not be confused with Cave Creek Canyon in the Huachucas. Fly Park, the type locality of *Ashmunella chiricahuana*, is on the same mountain, farther south about two(?) miles. Cave creek is 30 miles from Nine-Mile Canyon, and 20 miles from Fort Bowie. Mr. Ferriss has given notes on the general conditions of collecting and on the country in the *Nautilus* for September, 1904.

Some considerations of general interest to evolutionists are touched upon in the discussion of the composite nature of snail colonies (p. 226), since the conclusions reached from molluscan studies apply equally to communities of other comparatively sedentary animals.

Throughout the preparation of this paper I have had the coöpera-



Sketch of Huachuca range, by J. H. Ferriss.

tion of Mr. J. H. Ferriss. I would also gratefully acknowledge assistance lent by Dr. Wm. H. Dall, in the comparison of various species of *Holospira*, etc., with those described by him.

The figures of shells were photographed and those of soft anatomy drawn by the author.

Family **UROCOPTIDÆ** Pils.

This family is represented in the Southwest by members of two very distinct subfamilies: Eucalodiinæ with the genus *Holospira*, and Microceraminæ with the genus *Microceramus*.

Holospira is an old genus, containing several highly specialized phyla. Our species fall into five groups as indicated below. The subgenera were formerly defined by the internal lamellæ alone; but these are in some cases of less significance than the general form and sculpture.

A.—Last whorl distorted, its last half turning sinistrally.

I.—Internal column rather large, smooth throughout; last whorl sinuous, turning sinistrally. Aperture oblong, with a strong fold within the right margin and a vertical columellar callous in the throat. Metastoma Strebel. One species, *H. roemeri*.

B.—Last half of the last whorl straightened, normal.

II.—Internal column small, smooth and simple throughout, or with a small axial lamella in the last whorl; very slender below, slightly wider above. Shell rather large, 19 to 29 mm. long, the individual whorls comparatively high; the last one or two more coarsely sculptured than the intermediate ones. Number of whorls much less than the number of millimeters in the length of the shell. *Haplocion* Pils. Species, *H. pasonis* Dall, *H. hamiltoni* Dall.

III.—Penultimate whorl with a short, stout lamella on the axis, and a weaker one on the basal wall. Number of whorls decidedly less than the number of millimeters in the shell's length. *Distomospira* Dall. Species, *H. bilamellata* Dall.

IV.—Internal column moderate, one-fourth to one-sixth the diameter of shell. Shell 9 to 18 mm. long in known species, *compactly coiled*, ribbed or striated, the whorls short, their number about equal to the number of millimeters in the length of the shell, or exceeding that number. A short axial lamella is present within the penult. whorl, and sometimes short basal or parietal lamellæ. *Bostrichocentrum* Strebel. Type *H. tryoni*.

V.—Cavity of the penultimate whorl obstructed by four strong lamellæ, axial, basal, parietal and palatal. Holospira *s. str.* Species, *H. goldfussi* Mke.

In addition to the species noticed below, the following species of *Holospira* are known from north of the Mexican boundary:

H. (*Bostrichocentrum*) *pilsbryi* Dall, rather doubtfully recorded from New Mexico or Arizona, without definite locality, and known to inhabit the Mexican state Puebla.

H. (*Distomospira*) *bilamellata* Dall, from the top of Hacheta Grande Mountain, Grant county, New Mexico.

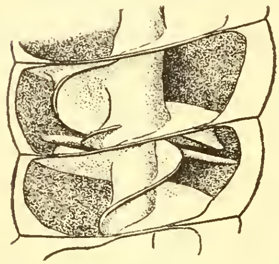
H. (*Haplocion*) *pasonis* Dall, from Mule Canyon, El Paso county, Texas.

H. (*Haplocion*) *hamiltoni* Dall, from Rio Grande Mountains, Brewster county, Texas, at an elevation of 3,500 feet, living on *Selaginella lepidophylla*, a common and conspicuous moss of western Texas.

Subgenus HOLOSPIRA (typical group).

Holospira goldfussi (Menke). Pl. XXVI, figs. 1-5.

Like *H. roemeri*, this species belongs to the hill country bordering the Lower Cretaceous area in Texas. Mr. Ferriss and the writer found it above San Marcos, Hays county, Texas, in the flood-débris of Sinking Spring, and on ledges of its bordering limestone cliff. This is farther northeast than the species has hitherto been found, for I have no doubt that the locality "Dallas," cited by Strebel, is an error. It is abundant under stones at the foot of the cliffs along the Guadalupe river, about six miles above New Braunfels, Comal county. Also nearer the town, in the hills above the head of Comal creek.



Internal structure of *H. goldfussi.*

It varies a good deal in size:

Length 14,	diam. 4	mm.;	whorls $14\frac{3}{4}$.
" 10,	" 3.9	"	" $10\frac{1}{2}$.
" 11.5,	" 3.1	"	" $12\frac{1}{2}$.

The specimens figured are from the Guadalupe. New Braunfels is probably the type locality.

At the Hondo river, two miles north of Hondo, Medina county, in the drift-débris, we also found *H. goldfussi*. This is the extreme western range of the species as far as we know. It did not occur in the Devil's river region, on the Pecos or westward.

Subgenus BOSTRICHOCENTRUM Strebel.

All of the species have a small, short lamella on the axis in the last part of the penultimate whorl, sometimes almost obsolete, and some of them have a very weak basal or parietal lamella, or both. These lamellæ are always very much smaller and lower down than those of typical *Holospira* (*goldfussi*, etc.). The variations are as follows:

Species.	*Lamellæ present.*		
H. ferrissi:	axial,	parietal,	basal.
H. arizonensis:	axial,	parietal,	....
H. bilamellata:	axial,	....	basal.
H. mearnsi:	axial,	....	....

In *H. crossei* the axial lamella is so weak as to be readily overlooked.

Part of the species of this group have the terminal cone short, others having it very long; *H. crossei* being somewhat intermediate. Otherwise they are very similar externally. They may be grouped thus:

Cone of the spire short, rapidly tapering.

Three internal lamellæ	*ferrissi*	Ribbed throughout.
Two internal lamellæ	*arizonensis*	Median whorls smoothish.
One internal lamella	*crossei*	Median whorls smoothish.
	cionella	Ribbed throughout.
	Spire slowly tapering.	
	mearnsi	Ribbed throughout.
	regis	Ribbed throughout.
	chiricahuana	Ribbed throughout.
	cockerelli	Median whorls smoothish.

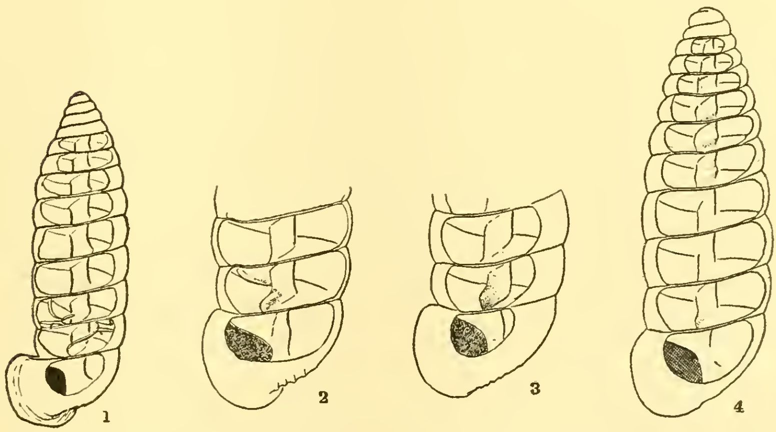


Fig. 1.—*Holospira goldfussi.* 2.—*H. ferrissi.* 3.—*H. cionella.* 4.—*H. chiricahuana.*

Holospira ferrissi n. sp. Pl. XXVII, figs. 22–25.

The shell is rimate but imperforate, short and cylindric, rather thin, and very pale brownish-corneous. Whorls 9½ to 11, the first whorl wider than the second, both of them smooth; all the rest of the whorls are regularly, evenly and closely rib-striate, the riblets as wide as their intervals or a little narrower, except on the last whorl, where the sculpture is a little coarser and irregular. The whorls are all convex, the last 4 or 5 forming the cylindric portion, the preceding whorls forming the terminal cone, which is about one-third the total length of the shell. The last whorl is pinched or compressed laterally, but the very short straight "neck" is full again, and carries the aperture very shortly free. The aperture is rounded, but a little irregular, the upper margin being somewhat straightened. The thin peristome is narrowly expanded.

The internal pillar is rather large and of equal calibre in the cylindric portion of the shell. At the end of the penultimate and beginning of the last whorl there is a short strong and blunt lamella on the pillar below the middle, a low, short lamella on the parietal wall and another on the basal wall. There is no palatal lamella.

Length 7.5 to 9, diam. 3 mm.

Manilla mine, Huachuca Mountains.

This is a very short, thick-set species, unlike all others known in its internal armature. The even ribbing and short terminal cone are also characteristic. It is closely related to *H. arizonensis* Stearns, from Dos Cabezas, a place west of the Chiricahua range and not far from one of the localities of *H. ferrissi;* but besides the slight difference in internal structure, *H. arizonensis* differs in being slightly larger with more whorls, and the riblets are subobsolete on the cylindric portion of the shell, while in *H. ferrissi* they are even stronger there than on the terminal cone.

This species occurred also at Fort Bowie, Arizona, where the shells average a trifle larger:

Length 7.5, diam. 3 mm., whorls 9½.

Length 10, diam. 3 mm., whorls 11½.

This species seems to partially connect typical *Holospira* with the sections *Eudistemma* and *Distomospira.* The lamellæ are far shorter and weaker than in the typical section, in fact, might easily be overlooked.

Holospira arizonensis Stearns.

This shell is cylindric with a *short, ribbed, terminal cone.* The *median whorls are smoother,* only obscurely sculptured, and the last whorl is ribbed. Whorls 12 or 13.

The internal axis is moderately large, and there is a short lamella on the axis and one on the parietal wall or roof in the penultimate whorl.

Length 12.5 to 13, diam. 4 mm.

Southeast Arizona, at Dos Cabezas, Cochise county.

This species resembles *H. ferrissi* and *H. cionella* in shape, but differs by its larger size and the obsolete sculpture of the median whorls, as well as by the slightly different internal lamellæ. It is known by the original specimens only.

Holospira cionella n. sp. Pl. XXVII, figs. 30–33.

The shell is very shortly rimate but imperforate, cylindric with a short terminal cone, corneous-white. Whorls $11\frac{3}{4}$ to $12\frac{1}{2}$, convex, the first $2\frac{1}{2}$ smooth, second whorl narrow, the first wider and bulging. Subsequent whorls are sharply and closely ribbed throughout. The last whorl is compressed laterally, tapering downward, the base white, rounded and prominent; it is contracted, descends a little, and is shortly free in front. The aperture is very shortly ovate, the peristome thin and narrowly expanded. The axis is moderately large and cylindric, with a low, blunt lamella at the end of the penultimate and beginning of the last whorl.

Length 10 to 12, diam. 3 mm.

Fort Bowie, Cochise county, Arizona.

The uniform ribbing throughout, the cylindric shape and short terminal cone are the prominent features of this species, which groups with *H. mearnsi*, *cockerelli* and *chiricahuana*.

Holospira crossei Dall. Pl. XXVI, fig. 8.

This species is closely related to *H. cockerelli*, but differs by its wider shorter form and much shorter terminal cone of the spire. At the end of the penultimate whorl there is a very weak prominence upon the axis near the basal wall, hardly to be called a lamella. The tapering portion of the spire is ribbed, the cylindric portion smoothish.

Length 11, diam. 3.7 mm.

New Mexico; top of Hacheta Grande Mountain, Grant county, with *H. mearnsi* and *H. bilamellata*.

Figured from one of the original lot for comparison with the related species. It has not again been found.

Holospira mearnsi Dall.

The spire tapers gradually and is ribbed, the ribs somewhat weaker on the intermediate whorls, stronger again at the base. Whorls 14. The axis is small, with a short, strong lamella near the base in the penultimate whorl, as in *H. cockerelli* and *H. regis*. Length 14.5 mm.

Southwestern New Mexico, on the top of Hacheta Grande Mountain, Grant county, with *H. crossei*, a smaller species with less projecting aperture.

Holospira regis Pils. and Ckll., n. sp. Pl. XXVI, fig. 7.

Shell small, the lower half cylindric, upper half slowly tapering in a long cone to the obtuse apex. Whorls $12\frac{2}{3}$, all convex, the first two smooth, the following whorls of the tapering portion of the spire rather strongly, obliquely rib-striate, the riblets slightly narrower than their interstices; the penultimate and next earlier whorls are more closely and a little more finely sculptured, but on the last whorl the riblets become stronger again. The last half of the last whorl is compressed laterally, sloping to an almost subangulate but very obtuse base. Near the end the whorl becomes free, descends a little, and is flattened and excavated above. The aperture is obliquely piriform, its contour being compressed near the upper outer angle. The peristome is free throughout, expanded, the columellar and upper margins a little reflexed. The upper margin is a little dilated inwardly. The axis is small and slender. Near the end of the penultimate whorl there is a short, stout lamella on the axis near the basal wall.

Length 10.8, diam. of cylindric portion 3.3 mm.

Near Kingston, Sierra county, New Mexico. Type No. 87,208, A. N. S. P., collected by Mr. O. B. Metcalfe.

This species is about the size of *H. chiricahuana*, which, however, differs in the less projecting last whorl, contracted behind the lip, and in the smaller, differently shaped mouth. The more closely related *H. mearnsi* is larger with more whorls, but it is not unlikely that specimens intermediate in these respects will be found. Several broken shells of *H. regis* indicate dimensions smaller than those of the type.

Holospira cockerelli Dall. Pl. XXVI, fig. 6.

Holospira (*Haplostemma*) *cockerelli* Dall, Nautilus, XI, p. 61, October, 1897.

Shell cylindric below, the upper half tapering in a long, very slowly tapering cone to the obtuse apex. Whorls $13\frac{2}{3}$, convex, the upper ones more so. The first $2\frac{1}{2}$ form the smooth embryonic shell, the second of them being wider and more swollen than the following one. Post-embryonic whorls of the tapering spire rather strongly rib-striate, the riblets oblique, narrower than the rather wide intervals. On the cylindric portion the riblets weaken to irregular growth wrinkles, but the base and the last half of the last whorl are strongly ribbed again. The last whorl is well rounded below, projects forward but very shortly, and descends to the mouth. The aperture is obliquely rounded-piriform, produced at the upper outer angle. Lip well expanded, the columellar and upper margins narrowly reflexed. The axis is slender. There is a low weak lamella on the axis in the last part of the penultimate whorl, close to the basal wall.

Length 12.1, diam. 3.5 mm.

The type was found in the débris of the Rio Grande at Mesilla, New Mexico. The specimen described above is from near Kingston, Sierra county, New Mexico, collected by O. B. Metcalfe, sent by Prof. T. D. A. Cockerell.

H. cockerelli differs from the related *H. regis* and *H. mearnsi* chiefly by the smoothness of the intermediate whorls. It is not improbable that the original specimen found in the flood-débris of the Rio Grande was washed down from the region around Kingston, as Prof. Cockerell suggests to me.

Holospira chiricahuana n. sp. Pl. XXVI, fig. 9; Pl. XXVII, figs. 26–29.

Shell imperforate, shortly rimate, cylindric, the upper half tapering, thin, pale brownish-corneous. Whorls 11 to 12, all convex, the first slightly bulging and wider than the second, both smooth, the following whorls sharply sculptured with close riblets a little narrower than their intervals. The last whorl is compressed laterally, tapering downward, the base prominent and white. It is very shortly straightened and a little contracted in front, not carrying the aperture in front of the ventral plane of the shell, though the peristome is very shortly free. The aperture is shortly ovate, nearly round, the peristome very narrowly expanded.

The axis is moderately large and of nearly equal calibre throughout, and at the end of the penultimate and beginning of the last whorl there is a low, short obtuse lamella below the middle on the axis.

Length 10, diam. 3 mm.; whorls 12.
" 8.5, " 2.9 " " 11.
" 8, " 2.7 " " 11.

Cave Creek Canyon, Chiricahua Mountains, southeast Arizona. Also Fort Bowie, at the southeastern termination of the same range.

H. mearnsi Dall is a larger and smoother species. In *H. cockerelli* the sculpture is coarse on the early and last whorls only, the middle ones having a polished or at least smoothish surface with quite faint striation only. The spire in *H. chiricahuana* tapers more gradually than in most other species.

Some of the specimens from Fort Bowie are larger, length 13, diam. 3.25 mm.; whorls 14; and one from Cave Creek Canyon, the type locality, measures length 13.5, diam. 3.2 mm.; whorls 14. The riblets are strong and uniform throughout in all the specimens.

Subgenus METASTOMA Strebel.

Holospira roemeri (Pfr.). Pl. XXVI, figs. 10–18.

This peculiar snail inhabits the hilly border of the 1,000 foot elevation which roughly defines the southeastern limit of the Lower Cretaceous area in Texas. It has not been observed northeast of New Braunfels. Thence it has been traced westward in Medina county, and near the Rio Grande, at Devil's river and the Pecos. We know nothing of its distribution northward upon the "Edwards Plateau," since only its lower scarps have been explored. Westward we have it from El Paso, where Ferriss got specimens on Franklin Mountain in 1902; and in New Mexico Rehn and Viereck found it in Alamo Canyon, near Alamogorda, Otero county, in the eastern range of the Cordillera.

The specimens from El Paso are large, like those of the Pecos. An average one measures, length 15.5, diam. 4.5 mm.; whorls 14. Those from Alamo Canyon are smaller, 12 to 13 mm. long, 4 wide. They vary but little in size.

In the canyon of the Pecos river, in Valverde county, Texas, above and below the High Bridge (figs. 16, 17, 18), the specimens are larger than at any other locality, and have more whorls for their length. The base is narrowly and deeply excavated, and the last whorl is very strongly sigmoid and projects in a longer neck than in the shells of central Texas. Most of the shells measure 15 to 16 mm. long, 4 wide, few being larger or smaller.

Length	17,	diam.	4.7	mm.;	whorls	15½.
"	16,	"	4	"	"	15⅓.
"	15.5,	"	4	"	"	14¾.
"	15,	"	4	"	"	15.
"	14.9,	"	4.5	"	"	14⅓.

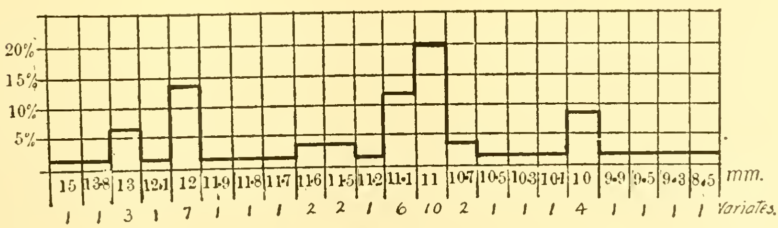
In the drift-débris of Devil's river, Valverde county, Texas, about four miles from its mouth, a large majority of the shells are 14 to 15 mm. long, with 14½ to 15½ whorls. The base and neck are like the larger shells of the Pecos.

Length	15.2,	diam.	4	mm.;	whorls	16.
"	15,	"	4	"	"	15½.
"	14.9,	"	3.9	"	"	15⅓.
"	14.9,	"	3.8	"	"	15¾.
"	14.3,	"	4.2	"	"	15.
"	13.8,	"	4	"	"	14½.
"	14,	"	4.1	"	"	14½.
"	12.9,	"	4	"	"	13¾.

Hondo river, two miles north of Hondo, Medina county, Texas (figs. 10–15). The shells are much smaller than in western Texas, usually 11 to 12 mm. long, and the diameter is generally less than 4 mm. A large proportion of the shells have "overhanging" upper whorls. They were picked out of river-débris, and probably came from the hill country some miles farther north. The measurements of fifty adult shells, all the perfect ones I found, follow:

Length	15	13.8	13	13	12	12	12	11.7	13
Diam.	3.8	4	3.8	3.7	3.9	3.6	4	3.3	4
Whorls	15	14½	13⅓	13⅓	12	13	12¾	12.5	13
Length	11.8	12	11.9	11.5	12.1	12	11.5	11.1	12
Diam.	3.8	4	3.9	4	4	4	3.5	4	4
Whorls	12½	12¾	12¾	12½	13	12½	12¾	12	12¾
Length	12	11.2	11.6	11	11	11.1	11.1	11.1	11
Diam.	4	4	3.9	3.9	3.8	3.8	3.9	4	3.8
Whorls	12½	12⅓	12½	12½	12½	12½	12	12	12⅓
Length	11.6	11	11	11	11.1	11	11	11.1	10.1
Diam.	3.6	3.8	3.5	4	4	3.9	3.6	3.9	3.8
Whorls	12½	12	12½	11½	12½	12	12	12⅓	12
Length	11	10.5	11	10.3	10.7	10.7	10	10	10
Diam.	3.9	3.6	3.5	3.8	4	3.8	3.5	3.8	3.5
Whorls	12	11½	13	11¾	11½	11½	11½	11½	11¾
Length	10	9.9	9.5	9.3	8.5 mm.				
Diam.	3.6	3.8	3.3	4.8	3.9 "				
Whorls	11¼	11	11¼	10½	10				

The lengths give the following curve, which, although of no great value on account of the small number of variates, is given for what it is worth.



Genus **MICROCERAMUS** Pils. and Van.

Nautilus, XI, p. 107; Proc. Acad. Nat. Sci. Phila., 1898, p. 281; Manual of Conchology, XVI, p. 151.

Microceramus comprises the species formerly referred to *Macroceramus* in works on snails of the United States. These, with their Antillean relatives, prove to have no near relationship to true *Macroceramus*, which belongs to a different subfamily, the *Urocoptinæ*, very unlike the *Microceraminæ* in dentition.

Microceramus texanus (Pils.). Pl. XXVI, figs. 19–21.

A species of the hill country inhabited by *Holospira goldfussi*, with which it is found. It was originally described from New Braunfels, Comal county, but the range has been extended both north and south by Mr. Ferriss and myself. Specimens were taken in the drift of the Hondo river, two miles north of Hondo, Medina county; in Comal county, on the rocky, wooded hillside above the head fountains of Comal creek, near New Braunfels, and along the Guadalupe river, some miles above (figs. 19–21). These last are the largest and best developed shells, but vary in size:

Length 10.5, diam. 3.5 mm.
" 8.3, " 3.5 "
" 8.3, " 3 "

The average is about 9 x 3.5 mm.

In the débris of Sinking creek, near San Marcos, Hays county, they are smaller:

Length 8, diam. 3.1 mm.
" 7.3, " 3 "

M. texanus is closely related to *M. mexicanus* (v. Mart.), a species extending from the State of Vera Cruz to Nuevo Leon and Tamaulipas, and to *M. floridanus* of Florida. The areas of the three are now widely separated.

Family HELICIDÆ

The following genera of *Helicidæ* are represented in Arizona and New Mexico:

Ashmunella Pils. and Ckll.
Sonorella Pilsbry.
Oreohelix Pilsbry.
Thysanophora Strebel.
Polygyra Say.

The first three of these, though degenerate in their reproductive organs, are believed to belong to the *Belogona euadenia* of my classification of Helices, and are therefore more nearly related to the Californian and Mexican Helices than to those of eastern North America.

Thysanophora is represented by two species, noticed below.

The only *Polygyra* yet reported from New Mexico or Arizona is *Polygyra triodontoides* Bld., which has been reported from South Spring creek, near Roswell, in the Pecos Valley, New Mexico (*Nautilus*, XIII, p. 84), but the specimens, now in my possession, proved to be a form of *P. texasiana*, near *P. t. texasensis*. This is farther west than any previous record of *P. texasiana*.

ASHMUNELLA Pils. and Ckll.

Pilsbry and Cockerell, Proc. Acad. Nat. Sci. Phila., 1899, p. 188; Nautilus, XII, p. 107; Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 107; Ancey and Murdoch, Journal of Malacology, VIII, 1901, p. 73.

Helicidæ with a *Polygyra*-like or *Triodopsis*-like shell, always umbilicate and with a reflexed or recurved lip; aperture with 0 to 4 teeth. Genitalia with, on the ♂ side, a short or moderate penis, an extremely long epiphallus, and an excessively short flagellum; ♀ side with a moderately long or very long spermatheca duct, but slightly or not dilated at the distal end; other organs as usual; no dart-sack, mucous glands or other accessory organs. Right eye-stalk retracted between the branches of the genitalia. Penis retractor muscle with a very long or double insertion near the base of the epiphallus, inserted distally on the lung-floor. Jaw ribbed. Teeth of the ordinary Helicid type, about 10 on each side being laterals.

Type *A. rhyssa miorhyssa*. All known species are from the mountains of New Mexico and southeastern Arizona.

Only two of the 15 species and 10 subspecies now known had been recognized prior to 1895, and but one of these was published at the time the last treatise on American land snails was issued, Binney's *Manual of American Land Shells*, 1885. The literature of the group is scattered through many volumes of several periodicals, and a large majority of the species have not been figured. In making substantial additions to the group, it seems timely to review and systematize the data accumulated.

The soft anatomy has proved to conform closely to the generic characters originally set forth. Ten species and varieties have now been dissected by myself and one additional by Mr. Murdoch, none of them diverging in any important respect. The proportions of the organs vary in the several forms, showing specific variation and affording valuable clues to the affinities of the species. To utilize these data it is necessary to give the measurements of the organs, readily obtained by pulling them out straight.[1] The measurements of the genitalia of ten species of *Ashmunella* follow:

[1] The comparative lengths of the organs are not materially altered by different degrees of contraction owing to different methods of preservation; and even the absolute dimensions are less affected than might be supposed. All but one of the dissections noticed herein were made from drowned specimens preserved in alcohol, with but little contraction.

Measurements of the Genitalia in Millimeters.

Species or subspecies	*mio-rhyssa*	*hypo-rhyssa*	*thom-soniana*	*porteræ*	*dupli-cidens*	*prox-ima*	*angi-gyra*	*angu-lata*	*esuritor*	*chirica-huana*
Total length of penis, epiphallus and flagellum	41	40	about 28	34	31	37	31	42	35	73
Length of penis (swollen portion)					4.5	2.5(?)	6	1	2.2	4.5
From atrium to upper insertion of penial retractor	15	11		11	9	8		7.5	11.5	
Length of flagellum	1.5	1	—1	.5—.75	1	1.5	1.3	1.2	1	1.7
Length of vagina (measured from atrium to base of spermatheca duct)					5.5	5	3	4.5	5.3	9
Length of the spermatheca and its duct	20.5	16	16.5	22	19.5	27	22	23	31	56
Length of spermatheca and duct as compared with the penis, epiphallus and flagellum	50%	40%	60%	65%	63%	73%	70%	55%	90%	77%
No. of specimen supplying data	73,557	77,869	77,870	76,789	87,024	86,498	83,269	87,015	87,023	87,021
Diameter of shell	16	18	13	15	12 to 13	12–13	13–14	13	15	18

The jaw and teeth of *Ashmunella* do not differ from those organs in *Sonorella*. The jaw is ribbed, the ribs variable and irregular, as is often the case in the Californian Helices. It is less strong and the ribs are less convex than usual in the jaw of *Polygyra*. The radula has from 24.1.24 to about 30.1.30 teeth. There are 9 to 12 lateral teeth. In nine of the ten species examined, both mesocone and ectocone are bifid on part of the marginal teeth. In *A. duplicidens* and *A. chiricahuana* the ectocone is usually simple, but on occasional outer marginals of the latter they are bifid, as in the other species. The number of teeth reckoned as laterals varies somewhat on different parts of the same radula, as I have observed in several species; so that the importance of variations from the counts of teeth given in the text must not be overestimated. Except in the case of *A. chiricahuana*, all of my preparations of genitalia, jaws and radulæ are from specimens of the type lots.

From the data now in hand, it seems in a high degree likely that the ancestral stock of all known Ashmunellas had a tridentate aperture. There was a tendency to split the basal tooth, perhaps not expressed in the original stock, but subsequently developed orthogenetically in most of the subgroups. This tendency culminates in the *levettei* group, where the original basal tooth has been divided into two distinct and often widely separated teeth. There has also been degeneration of the aperture-teeth, parallel in various stocks, and culminating in several toothless forms, astonishingly alike, though of undoubtedly diverse parentage. *A. hyporhyssa* Ckll., *robusta* Pils., *chiricahuana* Dall, *esuritor* Pils., etc., are convergent forms of this character. The true relationships of such simplified species must be demonstrated by their internal anatomy. The idea that the toothless forms are primitive can hardly be entertained in view of their anatomical diversity and their demonstrable relation to several groups of toothed species, the evidently homologous teeth of which, on this hypothesis, would have been independently evolved. This would be homoplasy on too extensive a scale to be readily believed.

The aperture-teeth in *Ashmunella* curiously imitate those of *Polygyra*, a genus not in the least related. In Europe, *Isognomostoma* and *Helicodonta* have evolved similar forms in still other phyla.

There has been a tendency to overload *Ashmunella* with subspecific names, which would logically end in naming every colony in existence. I do not minimize the importance of noting and recording local differentiation. My appreciation of its omnipresence convinces me that it cannot all be stereotyped in nomenclature, and if it were, the result would be too unwieldy for any human intellect to make use of.

The range of individual variation in *Ashmunella* among specimens from one place is (with the exception of *A. l. heterodonta*) not greater than in *Polygyra*. Among specimens I have measured or examined, I have seen no lot which would yield a markedly bimodal curve were the variations plotted. The variations between different colonies or *gens* are often appreciable, sometimes conspicuous; but here also the case may readily be paralleled in *Polygyra*, although usually not in such restricted areas, for the reason that in the *Polygyra* country the topographic and climatic features are less emphatic, and the life-zones are not crowded upon one another as in the land of the Ashmunellas, but are spread over larger areas.

The conception of *species* in such sedentary animals as snails is far from simple. A "species" comprises a multitude of colonies or communities which at any one time are isolated one from the other by the existing topographic and other surface features of the country. This is and always has been the case, even with the common, widespread forms of the more level parts of the country; but the colonies there have always been subject to frequent mixture with their neighboring colonies, by the ever slightly fluctuating conditions of woodland and local moisture, so that their network over the country has been here and there made practically complete within comparatively short periods. As a consequence, we have in many cases no tangible difference between individuals from colonies hundreds of miles apart.

In regions where the local physical features are more accentuated, the colonies or communities are often less subject to mixture. Moreover, the range of conditions within a limited area is far greater. Thus snails of the same original stock living in the rocky talus on opposite sides of a canyon are often subject to very diverse conditions of heat, moisture and consequently cryptogamic food. They are often wholly unable to cross from one side to the other by reason of a wide, freshet-swept or arid space. Moreover, subsequent changes, such as the formation of lateral canyons and the localization of suitable stations in the talus, tend to further isolate the several colonies, and to preserve their individuality for long periods.

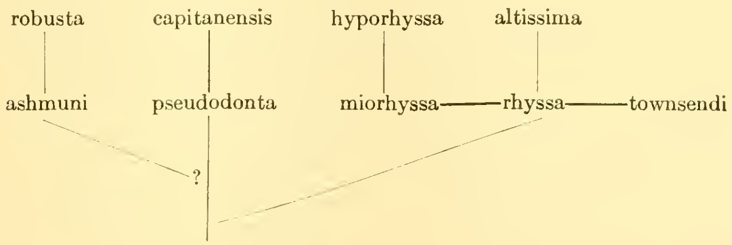
Thus each colony follows its own bent; and differentiation ensues, either by the cumulation of organic changes induced by varying conditions of growth and nutrition, determined by the local environment as mentioned above, or by the occurrence of diverse "mutations" in the several colonies, or by both causes. My idea of the practical isolation of snail colonies is based upon the experience of many years. Similar views have been expressed by Hemphill, in the account of his collecting in Utah, and by Ferriss, who in speaking of the Huachucas says, "Every colony in the canyon was liable to have some distinctive mark in size, color or form. . . . . No two colonies seemed exactly alike, and they did not visit back and forth, nor travel far from the best part of their own rock pile" (*Nautilus*, XVIII, p. 51).

When through some means two slightly differentiated colonies intermingle, as they occasionally must, hybridism follows, and a complex progeny issues, such as I have found in the Floridian *Liguus*. Who can unravel the tangled threads of affinity when the modified forms of two or more canyons reach each other across a divide! It is as complex as a modern human community, where subraces are mingling blood after centuries of pure breeding.

Group of A. rhyssa.

In species of this group, small basal and parietal teeth are often present, but there is no outer lip tooth. *The spermatheca and its duct are about half the length of the penis, epiphallus and flagellum, or even less.* The combined length of the penis, epiphallus and flagellum is decidedly less than three times the diameter of the shell. The penis is comparatively well developed.

This group is especially characteristic of the Capitan, White and Sacramento ranges of southern-central New Mexico, east of the Rio Grande. The forms now known arrange themselves in three series, thus:



The central and right-hand groups are known to be related by the genitalia. The group on the left is separated from these geographically, and its relationships must remain wholly uncertain until the soft parts can be examined.

Ashmunella rhyssa (Dall). Pl. XII, figs. 1–4.

Polygyra rhyssa Dall, Nautilus, XI, May, 1897, p. 2.
Ashmunella rhyssa Dall, Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192; Dall, Proc. U. S. N. Mus., XXIV, p. 500, Pl. 27, figs. 11, 14.

This is the senior name for a member of the group of closely related forms inhabiting the Sierra Blanca and adjoining Sacramento Mountains, in middle-southern New Mexico.

The shell is more globose than any other known *Ashmunella*, having about the proportions of the large Eastern Mesodons. It is dull and roughly sculptured on the last whorl with *coarse, curved irregular wrinkles*, between and over which fine incised spirals may be traced. The rather small aperture is contracted by a wide, heavy lip, the outer margin of which is indistinctly thickened within. There is a low, indistinct basal tooth or callous, and a very small, deeply placed, oblique parietal tooth, sometimes absent. The umbilicus is narrow and deep, but slightly enlarging at the last whorl. Whorls 5½.

Alt.	10,	diam.	17	mm.	
"	9,	"	17	"	(Dall's type).
"	10.2,	"	16	"	
"	10.2,	"	16	"	
"	9.9,	"	15.5	"	
"	9.3,	"	15	"	
"	8,	"	14.9	"	

Sierra Blanca, New Mexico, collected by Rev. E. H. Ashmun.

Ashmunella rhyssa miorhyssa (Dall). Pl. XII, figs. 5, 6.

Polygyra miorhyssa Dall, Nautilus, XII, p. 75, November, 1898.
Ashmunella rhyssa miorhyssa (Dall), Pils and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 193, figs. 1–3 on p. 189 (genitalia, jaw and teeth); Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 108 (anatomy).

This form differs from *A. rhyssa* chiefly in being smoother, the coarse wrinkles of that being reduced to striæ. The umbilicus is a little more open at the last whorl. In other respects there are no constant or even prevalent differences.

Alt. 9, diam. 16 mm. Sierra Blanca (Ashmun).

Alt. 9, diam. 15.5 mm. Sierra Blanca (Ashmun).

Alt. 10.6, diam. 16.8 mm., whorls 6
Alt. 9.9, diam. 16 mm., whorls 5½.
Alt. 10.3, diam. 16 mm., whorls 5¾.
} Near Eagle creek, Sierra Blanca (Townsend).

Sierra Blanca, Lincoln county, New Mexico (E. H. Ashmun). Near Eagle creek (C. H. T. Townsend).

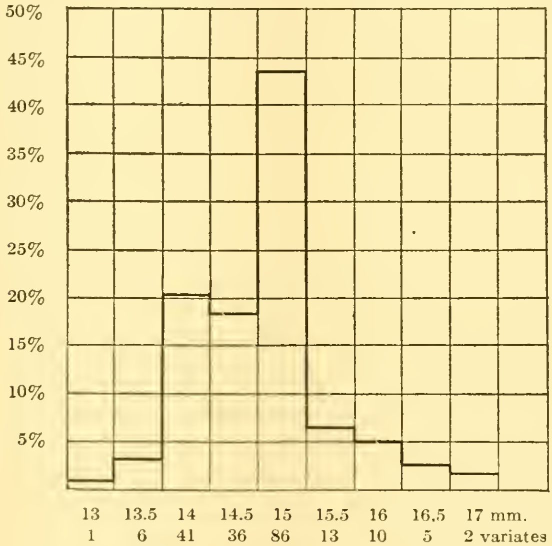
Ashmunella rhyssa hyporhyssa (Ckll.). Pl. XII, figs. 7–13.

Polygyra r. hyporhyssa Ckll., Nautilus, XII, November, 1898, p. 77.
Ashmunella hyporhyssa (Ckll.) var. *edentata*, with mut. *rufescens* and *alba*, Ckll., Nautilus, XIV, p. 72, October, 1900 (Cloudcroft).
A. r. hyporhyssa Ckll., Vanatta, Nautilus, XVI, p. 58, September, 1902 (Highrolls and Cloudcroft); Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 108, fig. 1 (genitalia of Cloudcroft specimen).

"Like *rhyssa* in size and form, but umbilicus wider, exposing the penultimate whorl; sculpture finer, consisting of striæ rather than riblets. One specimen, diam. max. 15, min. 12⅝, alt. 9 mm."

Lower slopes of Sierra Blanca, New Mexico, above head of Ruidoso creek, in aspen belt, about 9,500 feet altitude. (Prof. C. H. T. Townsend, August 14, 1898.)

The original description is given above. The unique type specimen was lost. Prof. Cockerell subsequently described what seems to be the same race, or one excessively similar, as *A. hyporhyssa edentata,* with mutations *rufescens* and *alba,* from Cloudcroft, Sacramento Mountains. In the absence of any differential feature in the description or measurements, I assume that the Cloudcroft shells are identical with *hyporhyssa.*



A somewhat large series was collected by Mr. H. L. Viereck in James Canyon, at Cloudcroft, Sacramento Mountains, at an elevation of 9,500 feet. Two lots were taken, one of a few large specimens (Pl. XII, figs. 7, 8), the other of many smaller ones. Compared with *A. rhyssa* the shells differ in the constantly *more depressed last whorl,* though the spire may be equally high; the umbilicus is wider at its opening, exposing more of the penultimate whorl; the basal tooth is obsolete or very weak, and the parietal tooth is present only as an extremely small vestige in less than 5 per cent. of the specimens. Finally, the sculpture is less strong except just behind the lip, where the wrinkles generally are emphatic.

The lot of smaller specimens (Pl. XII, figs. 9–13) consisted of about 300 shells. 200 fully adult specimens were measured. The diameter varies between 13 and 17 mm., and gives the curve plotted on p. 229. The major mode is at 15 mm., 43 per cent. of the lot being within .2 mm. of that dimension. There is a minor mode at 14 mm.; but the lot is remarkably homogeneous, since over 80 per cent. are between 13.8 and 15.2 mm. diameter.

The altitude bears no constant ratio to the diameter. It is individually variable within wide limits. In the first *50 individuals of 15 mm. diameter* (from my schedule of measurements of 200 specimens of all sizes) the following dimensions were found:

Alt. in mm.,	8	8.5	8.6	8.7	8.8	8.9	9	9.2
No. of variates,	3	2	3	3	5	3	15	2
Alt. in mm.,	9.3	9.4	9.5	9.6	9.7	9.8	10	10.2
No. of variates,	3	1	2	1	2	2	1	1
Alt. in mm.,	10.6							
No. of variates,	1							

It will be noticed that the mode is at 9 mm., 30% of the whole number having that altitude, while the number of more depressed individuals is as nearly as possible equal to the number more elevated. Specimens of the same lot, of other diameters, give altitude curves of the same symmetrical form, and need not here be detailed.

There are 5 albinos in the 200 shells measured, though an uninterrupted series from albinos to the darkest brown specimens makes a selection difficult.

Nine shells in 200 show a very small parietal tooth, one being shown in fig. 12.

The other lot, of larger shells (Pl. 12, figs. 7, 8), contains 2 albinos out of 14 shells. None has a parietal tooth. The measurements follow:

Alt.,	12	11	10	10.3	10.7	10	10	10	10
Diam.,	19.3	19	19	18.5	18.3	18.3	18.2	18	17.5
Alt.,	10	10	9.2	9.2 mm.					
Diam.,	17.5	17	17	16.8 "					

A small series from Cloudcroft, 8,750 feet, collected by E. O. Wooton, received from Prof. Cockerell, contains also large and small examples, the diameters being, large, 18.5, 18, 17.3, 17, 16.2, and small, 15, 15 mm. These are part of Prof. Cockerell's original lot of *A. h. edentata*.

At Highrolls, in the Sacramento Mountains, at 6,500 feet elevation, Mr. Viereck obtained three specimens, 17.2, 17 and 16.8 mm. diam. They have the umbilicus a trifle narrower than in the larger Cloudcroft shells.

In Alamo Canyon, 14 miles from Alamogorda, Mr. Ferriss picked up a few dead specimens. The umbilicus is decidedly narrower than in the Cloudcroft shells. One of five examined has a vestigial parietal tooth. The proportions of alt. to diam. are as in Cloudcroft shells. Diam. 16.2, 16, 15.8, 13.7 mm.

Ashmunella rhyssa townsendi (Bartsch).

Ashmunella townsendi Bartsch, Smiths. Misc. Coll., XXXXVII, p. 13, August 6, 1904.

Described from two specimens. "Most nearly related to *A. rhyssa* Dall, but is much smaller than that form, and is uniformly more strongly sculptured."

Alt. 8.2, diam. 15 mm.

Sierra Blanca, on the slopes of the ridge on the south fork of Ruidoso river, about 5 miles above the town of Ruidoso, Lincoln county, New Mexico, at an altitude of 8,500 feet. C. H. T. Townsend.

A. rhyssa commonly varies from less than 15 to 17 mm. in diameter, and from 8 to over 10 mm. alt., so that the present form falls within its range of size. The coarser sculpture of "many strong sublamellar axial ribs" seems to be its chief or only distinguishing character. It stands, apparently, between *rhyssa* and *altissima*.

Ashmunella altissima (Ckll.). Pl. XII, fig. 14.

Polygyra altissima Ckll., Nautilus, XII, p. 76, November, 1898.
Ashmunella altissima (Ckll.), Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192.

The shell is small and depressed, of $5\frac{1}{4}$ moderately convex whorls, the inner ones enlarging slowly, the last much wider, with the periphery above the middle, very obtusely subangular in front, elsewhere well rounded. The only specimens yet found are dead, bleached and somewhat worn, having lost all of the cuticle. The embryonic $1\frac{1}{2}$ whorls are smooth; the first neanic whorl almost equally so. Then oblique striæ set in which gradually become coarser. On the last whorl they become strong, *rounded sigmoid ribs, very strong on the last half whorl.* There are traces of fine spiral lines between the ribs. Behind the lip the whorl is moderately contracted, and it descends a trifle to the aperture. The aperture is very oblique, lunate. The peristome is thickened within and on its convex face, narrowly reflexed throughout.

There is a faint, hardly noticeable basal prominence, but nothing to be called a tooth. There is no parietal tooth, and the callous between the lip-ends is very thin.

Alt. 5.5, diam. 11 mm.

Sierra Blanca, on the highest summit, three found under a rock, elevation 11,092 feet (C. H. T. Townsend).

One of the co-types of this very distinct form is figured, No. 73,558, A. N. S. P.

Ashmunella pseudodonta (Dall). Pl. XII, figs. 15, 16, 17, 18.

Polygyra pseudodonta Dall, Proc. U. S. Nat. Mus., XIX, 1896, p. 343 (White Oaks, New Mexico).
Ashmunella pseudodonta Dall, Proc. U. S. Nat. Mus., XXIV, 1902, p. 500, Pl. 27, figs. 13, 15; Pl. 28, figs. 7.
Ashmunella pseudodonta Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192; Murdoch, Jour. of Malac., VIII, p. 79, Pl. 7, figs. 1–7 (anatomy).

This species differs from those of the Sierra Blanca chiefly by its more depressed shape and the bifid basal callous, which is split into two low denticles like some of the subspecies of *A. thomsoniana.* The comparatively short duct of the spermatheca shows *A. pseudodonta* to be much more closely related to *A. rhyssa* than to *A. thomsoniana.* Five specimens of the original lot collected by Mr. Ashmun at White Oaks, New Mexico, measure:

Alt.,	7	7	6.5	6.4	6.4 mm.
Diam.,	13	12.7	12.7	12.2	12 "

Two specimens found with *A. p. capitanensis* measure:

Alt.	7	6.7 mm.
Diam.,	13.9	13.5 "

The internal anatomy has been well described and figured by Murdoch.

Ashmunella pseudodonta capitanensis Ashm. and Ckll. Pl. XII, figs. 21–23.

A. p. capitanensis Ashmun and Cockerell, Nautilus, XII, p. 131, March, 1899.

The shell is depressed, glossy, brown, with weak irregular growth-wrinkles and fine, close incised spirals. The spire is very low conic. Whorls $5\frac{1}{2}$, quite convex, the last wide, rounded peripherally, swollen above behind the deep constriction behind the lip. The aperture is quite oblique, the lip either brown-tinted throughout or white. Within the basal margin there is a *low, very weakly bifid callous, often hardly noticeable.* There is a very small parietal tooth in four out of six specimens examined. The umbilicus is small and deep within, enlarging at the last whorl, *rather broadly exposing the penultimate whorl.*

Alt.,	9	9.5	9.2	9	9	9 mm.
Diam.,	18.5	18	17.8	17	17	17 "

Near Baldonado Springs, Capitan Mountains, Lincoln county, New Mexico, elevation 8,200 feet, collected by E. H. Ashmun.

This form is at present well separated from *pseudodonta* by the uniformly much larger size. The basal teeth are also less developed, and the lip comparatively narrower. It is to *pseudodonta* as *robusta* is to *ashmuni*. It has reached about the same stage of evolution as *A. hyporhyssa*, *A. a. robusta* and *A. chiricahuana*. In the lot of 100 specimens taken by Mr. Ashmun there is one pale greenish-corneous albino.

Ashmunella ashmuni (Dall). Pl. XII, figs. 19, 20.

Polygyra ashmuni Dall, Proc. U. S. Nat. Mus., XIX, p. 342, 1896.
Ashmunella ashmuni (Dall) Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192; Ancey, Jour. of Malac., VIII, p. 76; Dall, Proc. U. S. Nat. Mus., XXIV, p. 501, Pl. 28, figs. 4, 6, 9.

This species is small, much like *A. pseudodonta*, but there is scarcely the trace of a basal tooth. The outer lip is well thickened within, and there is no parietal tooth.' The usual wrinkle-like growth-lines are present, but spiral lines are very faint, not discernible in some specimens. Five of the original lot measure:

Alt.,	7.4	7	7	6.9	6.7 mm.
Diam.,	14.2	14	14	13.1	12.7 "

Bland, New Mexico. E. H. Ashmun.

Ashmunella ashmuni robusta n. subsp. Pl. XII, figs. 24–26.

Polygyra chiricahuana and *Ashmunella chiricahuana*, in part, of various authors, specimens from Jemez Mountains and at Jemez Sulphur Springs, New Mexico.

The shell is similar in size and general contour to *A. p. capitanensis;* chestnut or greenish-chestnut colored, glossy, sculptured with low, irregular growth-wrinkles which are strongest below the suture, and weaker on the base, and very fine incised spirals, close and numerous but very lightly impressed. The spire is very low conoid. Whorls $5\frac{1}{2}$, convex, the last about double the width of the preceding, its last third decidedly swollen, inflated behind the deep constriction back of the lip. The aperture is roundly lunate, without teeth. The lip is coffee-tinted, rather narrowly reflexed, convex on the face, and a little thickened inwardly within the outer margin. There is no parietal tooth. The umbilicus is cylindric within and deep, rather broadly expanding at the last whorl, exposing the penultimate whorl.

Alt.,	9.2	8.6	8.7	9 mm.
Diam.,	19	17.2	17.6	16.5 "

Jemez Mountains, near Bland, New Mexico, at higher elevations than *A. ashmuni*. E. H. Ashmun.

This form has hitherto been referred to *A. chiricahuana*, from which it differs chiefly in the greater *inflation of the latter part of the last whorl*. This is noticeable in a side view, and is seen prominently above the aperture in a front view. It differs from *A. pseudodonta capitanensis* chiefly by wanting basal teeth.

In such simplified forms as this, it is not easy to determine the true relationships by the shell alone. When the genitalia can be examined the affinities of *A. ashmuni* and *A. a. robusta* will doubtless become clear. There is an albino in Mr. Ashmun's collection.

Group of A. thomsoniana.

Aperture of the shell with parietal, outer and basal teeth, the latter often bifid, divided into two contiguous tubercles. Length of the spermatheca and its duct 60 to 65 per cent. that of the penis, epiphallus and flagellum in known forms.

These forms are from northern central New Mexico. They have been investigated chiefly by Prof. T. D. A. Cockerell and his pupils.

By their genitalia and shells they are related to the southeastern Arizona group. Three forms are perhaps sufficiently differentiated to require names: *A. t. porteræ*, *A. thomsoniana* and *A. t. pecosensis*.

Ashmunella thomsoniana (Ancey). Pl. XIII, figs. 27–30.

Helix levettei Bland var. *thomsoniana* and var. *orobæna* Ancey, Conchologist's Exchange, II, p. 64 (November, 1887).
Ashmunella thomsoniana (Anc.) Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192; Ancey, Jour. of Malac., VIII, p. 75, 1901; Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p 108, fig. 2 (genitalia of specimen from Santa Fé canyon); Ckll. and Cooper, Nautilus, XV, p. 109, February, 1902, with mut. *alba* C. and C., *l. c.*, p. 110 (Canyon Diablo); Ckll., Nautilus, XVI, January, 1903, p. 105 (Pecos Pueblo).
Ashmunella thomsoniana cooperæ Cockerell, Nautilus, XV, p. 35, July, 1901.
A. t. antiqua Ckll. and Coop., Science, December 27, 1901, p. 1,009; Nautilus, XV, p. 110 (Pleistocene, Las Vegas).

Specimens from J. H. Thomson, part of the original lot from Santa Fé Canyon, are before me, and two are illustrated (Pl. XIII, figs 27, 28).

It is narrowly umbilicate, brown and glossy, finely striate, with very faint traces of incised spirals on the last whorl. There are 5 whorls. The characters of the aperture are sufficiently shown by the figures, the only ones published to this time. The basal tooth is simple in all specimens I have seen from the type canyon.

Alt. 6.9,	diam. 13	mm.;	whorls 5.
" 6.9,	" 12.2	"	" $5\frac{1}{3}$.
" 6.9,	" 13.1	"	" $5\frac{1}{3}$.

The specimen I dissected in 1900, collected by Prof. Cockerell at

Monument Rock, Santa Fé Canyon, at 8,000 feet above the sea (Pl. 13, fig. 29), is slightly larger with *the umbilicus wider* at the opening. Alt. 7.2, diam. 14 mm.; whorls $5\frac{3}{4}$. The basal tooth is simple. Another like it, taken by Ashmun in the same canyon, is figured (Pl. 13, fig. 30).

In all the forms referred to *A. thomsoniana* and its subspecies no distinct internal lip-rib is formed when a resting-stage occurred in the neanic period. Such growth-arrests are often indicated by a darker streak on the penultimate or beginning of the last whorl, but the shell is very rarely thickened within by a white callous, and when present, the callous is very thin.

Distribution: Santa Fé Canyon (Thomson, Ashmun, Ckll.); Las Vegas and Las Vegas Hot Springs (Miss Cooper, Prof. Ckll.); Canyon Diablo, near Rowe (Mary Cooper); Old Pecos Pueblo, near Vallé ranch, Pecos (W. C. Ckll.).

The form from Las Vegas Hot Springs, at about 7,000 feet elevation, called *A. t. cooperæ*, offers no tangible difference from Santa Fé *thomsoniana*. It is not yet evolved enough to be distinguishable from *thomsoniana* if the specimens were mixed. I do not think it desirable or practicable to name forms so very slightly differentiated. The umbilicus is a trifle more open than typical *A. thomsoniana*, like the Monument Rock shells or a little less open, being thus intermediate in size. The teeth are in the average *slightly smaller*. The basal tooth is quite feebly doubled in a minority of the shells seen, simple, small and tubercular in the others. The spire is, in the average, a trifle higher than in Santa Fé *thomsoniana* (Pl. XIII, figs. 31–34, the last a co-type of *A. t. cooperæ*).

	Co-types of cooperæ.									
Alt.	8	7.9	7.3	7.9	7	7	7.3	7.1	6.8	mm.
Diam.	13	13	13.8	13.8	13.5	13.5	13.3	13	12.2	"
Whorls	5+	5+	5+	$5\frac{1}{2}$	$5\frac{1}{3}$	5	$5\frac{1}{3}$	5	$4\frac{3}{4}$	

A. antiqua Ckll. and Coop., from the Pleistocene at Las Vegas, New Mexico, is like the shells from Las Vegas Hot Springs noted above in size, but the basal tooth is a low, wide callous, slightly emarginate but not distinctly bifid. The rather heavy teeth and small umbilicus are like typical *thomsoniana*. A co-type measures 13.2 mm. diam. The parietal callous has scaled off, carrying the tooth with it. I see no valid reason for believing that it represents a divergent branch of *thomsoniana*. Such characters as this are merely individual.

Specimens from Canyon Diablo, near Rowe, New Mexico (Pl. XIII, figs. 35, 36, 37), are exactly like those from Las Vegas Hot Springs.

Alt.	8	6.8	6.6	6.4	6.3 mm.
Diam.	14	12.8	12.3	12.3	12 "
Whorls	$5\frac{1}{2}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{3}$	5 "

Ashmunella thomsoniana porteræ Pils. and Ckll. Pl. XIII, figs. 39–46.

Ashmunella thomsoniana porteræ Pils. and Ckll., Nautilus, XIII, p. 49, September, 1899; Cockerell and Cooper, Nautilus, XV, p. 109, February, 1902, with mut. *alba*, p. 110; Murdoch, Jour. of Malac., VIII, p. 82, Pl. 7, fig. 8 (genitalia); Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 559, footnote 4, Pl. 21, fig. 6 (pallial complex).
A. t. cooperæ Ckll., Nautilus, XVII, p. 36, July, 1903 (Pecos).

Shell larger than *thomsoniana*, light brown, glossy, a little translucent, with distinct growth-wrinkles and fine incised spiral lines. Whorls $5\frac{1}{3}$ to 6, convex, the last deeply constricted behind the lip, swollen behind the constriction. Lip brown-tinted above. Parietal lamina moderately developed. Outer lip-tooth long and concave. *Basal tooth bifid,* the inner denticle smaller, sometimes reduced to a low callous. Umbilicus rather broadly open, exposing the penultimate whorl more than in *thomsoniana.*

Type locality, Upper Sapello Canyon, Beulah, New Mexico (Pl. XIII, figs. 39–42, 46, Miss Wilmatte Porter, Dr. H. Skinner and others).

Twenty-two specimens collected by Dr. Skinner measure as follows:

Alt.	8	8.5	8	8.5	8	8	8	8	8.2
Diam.	17	15.3	15.8	15.3	15.3	15	15.6	14.8	15
Whorls	6	$5\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$
Alt.	8.2	8	8.5	8.8	7.8	8	7.7	8	7.8
Diam.	15.5	15	15	15.5	13.8	14	14.8	14	14
Whorls	$5\frac{1}{2}$	$5\frac{1}{3}$	$5\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{2}$	$5\frac{1}{3}$
Alt.	7.8	8	8	7.6 mm.					
Diam.	14.1	14	14.1	13.9 "					
Whorls	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{3}$					

Prof. Cockerell and Miss Cooper measured 40 specimens of *porteræ* from Beulah:

2	specimens are	14	mm.	diam.
12	" "	14+	"	"
17	" "	15	"	"
6	" "	15+	"	"
3	" "	16	"	"

There is no appreciable difference in the comparative altitude among the specimens I have seen.

Miss Mary Cooper collected specimens in Manzanares Valley, near Rowe, New Mexico, which have been reported on by Prof. Cockerell and Miss Cooper (*Nautilus*, XV, p. 109). They are in all respects like those of the type locality except that the inner basal denticle is more obsolete, as in fig. 39. The curve of diameters is the same as in the Beulah lot. The specimens I have seen are from 15 to 16 mm. diam.

A single specimen I have seen from Cooper's Mill, near Rowe, New Mexico, measures 8.7 x 16 mm., with $5\frac{3}{4}$ whorls. The inner basal denticle is low, as in Manzanares shells.

The shells from Pecos, New Mexico (Pl. XIII, figs. 43–45, collected by Cockerell), are intermediate between *thomsoniana* and *porteræ;* the size being that of the former, while in 14 out of 17 specimens before me the basal tooth is double, as in *porteræ*. In the others it is simple, as in *thomsoniana*. The umbilicus is rather wide, as in *porteræ*. Prof. Cockerell refers the form to *A. t. cooperæ*. Its location depends upon whether size is more important than the teeth as an index of affinity; but the question of name is of minor importance in view of the intergradation of the whole series. Specimens measure:

Alt.	8.2	8.2	8	8.2	8	8	7.7	7.9
Diam.	15	14.7	14.6	14.5	14.3	14.3	14.3	14
Whorls	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{3}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{3}$	$5\frac{1}{2}$
Alt.	7.8	7.8	7.6	7.5	7.6	7.3	7.2	7
Diam.	14	14	14	13.8	13.5	13.5	13.2	13.2
Whorls	$5\frac{1}{2}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{3}$	$5\frac{1}{4}$	$5\frac{1}{3}$	$5\frac{1}{4}$	$5\frac{1}{3}$

There is practically no variation in number of whorls, or in the proportion of altitude to diameter. The variation in diameter is not great, but serves to connect *thomsoniana* and *porteræ,* but the skew of the curve is toward the larger size of *porteræ*.

Ashmunella thomsoniana pecosensis Ckll. Pl. XIII, fig. 38.

Cockerell, *Nautilus*, XVI, p. 105, January, 1903.

Shell like *thomsoniana* in shape, size, the small umbilicus and the simple basal tooth; but differing in sculpture, a *coarse, low costation* being superposed upon minute growth-lines and microscopic spirals similar to those of *A. thomsoniana*. Aperture as in *thomsoniana,* the "lip and teeth strongly developed, the basal tooth single."

Alt. about 6.3, diam. 11.8 mm.

Vallé ranch, Pecos, New Mexico. A Pleistocene fossil. Type No. 84,209, A. N. S. P., collected by T. D. A. Cockerell.

Some specimens of *A. thomsoniana* from Las Vegas Hot Springs are almost as strongly wrinkled or costulate. The subspecies cannot, therefore, be considered to be strongly differentiated.

Group of A. levettei.

The aperture has four teeth, but sometimes the two basal teeth are contiguous, partially united. The length of the spermatheca and its duct is from 55 to 73 per cent. of that of the penis, epiphallus and flagellum in known forms.

This somewhat heterogeneous group is characteristic of southwestern New Mexico and southeastern Arizona. Here are grouped about ten species and subspecies, some of them exceedingly specialized.

Ashmunella levettei (Bld.). Pl. XV, figs. 72–78.

Triodopsis levettei Bland, Annals of the New York Academy of Sciences, II, 1882, p. 115 (cuts); Binney, Manual of American Land Shells, p. 385; Supplement to Terrestrial Mollusks, Vol. V, p. 154, Pl. 1, fig. E, copy from Bland; Second Supplement, in Bull. Mus. Comp. Zool., XIII, No. 2, p. 36, Pl. 1, fig. 15, December, 1886.
Polygyra levettei Bld., Dall, Proc. U. S. Nat. Mus., XIX, p. 341, 1896.
Ashmunella levettei Bld., Ancey, Journ. of Malac., VIII, p. 74, September, 1901.

This is a form of ample proportions, rich dark chestnut color and glossy surface. The periphery is rounded, or has a mere trace of angulation in front. The cylindric umbilicus enlarges rapidly at the last whorl. The spire, while compactly convoluted, has more rapidly widening whorls than *A. l. angigyra.* The spaces between the three lip-teeth are about equal. The parietal lamella has a "kink" or inward bend at the axial end in the type specimen, but this kink is often wanting, being a variable character in *levettei* and allied species. There are about 6½ whorls, all convex. The first 1⅓ are smooth and glossy except for short striæ radiating from the suture; on the second whorl these striæ extend across the whorl. The following whorls are very finely, irregularly marked with faint growth-lines. On the penultimate and last whorls there is a faint, excessively fine and close spiral striation, too minute to be visible except with a compound microscope; and a fine malleation in spiral direction, or spiral impressed lines, readily seen with the hand lens or even the naked eye. The periphery is rounded. Bland's type measured, alt. 6.5, diam. 16 mm.; aperture, including peristome, 7 x 8 mm., according to the original description. Bland evidently measured the altitude of the axis, not of the whole shell to the base of the lip. His type, which I have examined, agrees with the shells Mr. Ferriss found in Bear and Miller Canyons, in the Huachucas. Figs. 72–75 represent shells from Bear Canyon, agreeing with type specimen in all respects.

Huachuca Mountains, Cochise county, Arizona, in Bear, Miller and Carr Canyons (James H. Ferriss). It has been reported also from near Tucson, Arizona (Cox). I have seen no specimens from that place.

Bland originally described *levettei* as from Santa Fé Canyon, New Mexico, but the researches there of Ashmun, Cockerell and others have failed to bring it to light. Indeed, no closely related species is known to occur within hundreds of miles of that place, whereas some of the Huachuca shells agree perfectly with the type specimen of *levettei* which I have examined. There can be little doubt that Dr. Levette was mistaken in the locality. It is not known that he collected the shells himself. They may have been given him by some army officer who had served in the Southwest. There is, according to Mr. C. R. Biedermann, a Santa Fé Canyon in the San José mountains, just south of the Huachuca range, in Mexico.

A series from Bear Canyon measures:

Alt.	9,	diam.	17.8	mm.;	width	aperture	outside	8	mm.
"	9,	"	17.2	"	"	"	"	8	"
"	8.2,	"	17	"	"	"	"	8	"
"	7.8,	"	16.7	"	"	"	"	8	"
"	7.2,	"	16	"	"	"	"	7.2	"
"	7.8,	"	16.2	"	"	"	"	8	"

The lip is either brown or nearly white. Mr. Ferriss' largest specimen from Bear Canyon measures 8 x 18 mm.

Fig. 76 represents a beautiful albino found at the head of Bear Canyon, on the southwest side of the Huachuca range, at about 7,000 feet elevation. It is bluish white under a very thin caducious pale yellowish cuticle.

A pathologic specimen from the same place (fig. 77) has suffered extensive breakage at the aperture. A new peristome has been formed and three of the teeth regenerated, typical in shape and position. The inner basal tooth, however, is only feebly represented by a low callous.

The shells from Miller Canyon, on the north side of the Huachucas (Pl. XIII, fig. 78), are intermediate between the Bear Canyon *levettei* and the slightly different race from Carr Canyon, perhaps nearer the latter. They measure from alt. 8.5, diam. 16.3, aperture 7.8 mm. to alt. 7.5, diam. 14, aperture 6.3 mm.

In Carr Canyon, about four miles farther eastward, at about 5,000 feet elevation, a form was found resembling *angigyra* in its close-coiled whorls and small aperture, but differing in being usually larger, hardly angular, with a larger umbilicus and deeper constriction back of the lip. It differs from *levettei* in the smaller mouth, larger umbilicus and deeper constriction. Specimens measure:

Alt. 7,	diam. 15.2 mm.;	width	of	mouth,	outside,	7.3 mm.
" 7.2,	" 15.2 "	"	"	"		7 "
" 7.2,	" 15.2 "	"	"	"		7 "
" 7,	" 15 "	"	"	"		7 "
" 6.3,	" 14 "	"	"	"		6.1 "
" 6.8,	" 13.8 "	"	"	"		6 "
" 6.8,	" 14 "	"	"	"		6.7 "
" 6.3,	" 12.5 "	"	"	"		5.8 "

This form is about intermediate between *levettei* and *angigyra*, but it has some slight special characters of its own. They seem hardly sufficient to require that it be named. See Pl. XV, figs. 92, 93.

Ashmunella levettei angigyra n. subsp. Pl. XIV, figs. 47–51.

The shell is brown, smaller and more depressed than *levettei* obtusely but distinctly *angular* at the periphery. The surface of the post-embryonic whorls is smoothish, under the lens seen to be very closely, irregularly marked with minute growth-lines, giving it a silky luster, and the last whorl is often finely malleate spirally, as in *A. levettei*. Whorls 6¼ to 7, very closely coiled and slowly widening, *all of them convex* above. The suture descends rather abruptly to the aperture. Behind the outer and basal lips the whorl is rather deeply, angularly guttered. The back of the lip is creamy. Aperture very oblique, smaller than in *A. levettei*. The teeth are arranged as in *levettei*. The notch between the two basal teeth is wider than that between the outer basal and the tooth of the outer lip. The inner basal tooth is smaller than the outer. The cylindric umbilicus rapidly enlarges at the last whorl.

Alt. 6.5, diam. 13.6 mm.
" 6.3, " 13.2 "
" 6, " 13 "

Huachuca Mountains, in Ramsey or "Conservatory" Canyon, near Fort Huachuca. Types No. 83,269, A. N. S. P., collected by J. H. Ferriss, 1902 (figs. 47–49).

This form was also found in the drift-débris of Barbakomari creek, near Huachuca station. The same form was collected by Mr. Mearns some years ago, and then referred to *levettei*.

It differs from typical *A. levettei* in being smaller, with more closely coiled whorls, the last one angular at the periphery. The aperture is smaller and therefore more filled by the teeth. It resembles *A. angu-*

lata, but the whorls are not flattened above as in that species, and are not punctate.

With a single exception mentioned below, no *angigyra* have been found on the south side of the range. On the north side it occurs in Brown's Canyon (figs. 50, 54), varying much in size and degree of angulation, the smaller specimens being like the type lot, the larger ones less angular and approaching *levettei*. Five measure:

Alt. 7.3, diam. 14.8 mm.
" 7, " 14.8 "
" 6.7, " 14.5 "
" 7, " 13.8 "
" 6, " 12 "

At Ramsey Canyon, two miles east of Brown's Canyon, similar forms were found at about 6,000 feet elevation.

On the opposite side of the range, at the base of Bear Canyon, in the foothills, at about 5,000 feet, Mr. Ferriss collected a few small specimens which do not seem to differ much from typical *angigyra*. Two before me measure 5 x 11 and 4.8 x 10 mm., with only $5\frac{3}{4}$ whorls (figs. 51, 52, 53).

The genital system (Pl. XXI, fig. 28) is somewhat peculiar. The penis is quite long, but the vagina is unusually short. This is unlike *A. angulata* of the Chiricahuas, some forms of which imitate *angigyra* in the form of the shell.

The jaw (Pl. XXIII, fig. 14) has 8 very unequal ribs.

The radula (Pl. XXII, fig. 12) has 19.10.1.10.19 teeth. The ectocones of central and inner lateral teeth are very short. The mesocone is bifid from about the 15th tooth out, but the ectocone only on the outer marginals. This approximates to the condition found in *A. chiricahuana*. There are more teeth and more laterals than in *A. angulata*.

Ashmunella levettei heterodonta n. v. Pl. XV, figs. 80–91.

In Cave Creek Canyon and the tributary Ida Canyon on the southern slope of the east end of the Huachuca range, Mr. Ferriss found an extraordinary series of Ashmunellas, in which the teeth vary from about as well developed as in *A. levettei* to completely obsolete as in *A. chiricahuana*. No other member of the genus was found in these canyons. The several stages *occur together*,[2] and the chain of mutations is uninterrupted.

[2] See also Mr. Ferriss' notes on this race, *Nautilus*, XVIII, p. 51, below middle of page.

So far as I know, such variability in a land snail among individuals living under the same conditions in one spot is elsewhere absolutely unknown.

Most of the specimens measure from 15 to 18 mm. diam., but there is one pygmy of 12 mm. (fig. 88). In the general shape, etc., the race does not differ from *A. levettei*. There is no trace whatever of pathologic or abnormal growth. The forms with well developed teeth and those with none were found much less numerous than the intermediate stages. The most abundant forms (figs. 84, 85) may be considered the types of the variety.

The toothless examples have the lip slightly wider than that of *A. chiricahuana*. They constitute a race parallel to that, rather than identical with it.

The colonies of Cave and Ida Canyons are evidently undergoing rapid degeneration of the teeth, the parent form having been typical *A. levettei* such as occurs in the adjacent canyon westward, and that over the ridge. Examples of such degeneration are common enough at any stage of progress; but the unique feature about it in this particular colony is that the individuals have been so unequally affected that all stages of the process are present at one time and place. It does not seem to be a case of hybridism between *A. levettei* and *A. chiricahuana*, as I at one time suspected. The results are unlike hybrid colonies in the predominance of intermediate individuals.

Figs. 80 to 87 of Pl. XV are a series from Ida Canyon, showing stages of tooth development. Figs. 89, 90, 91 are from the Cave Creek Canyon series. All of these figures are photographed from fully mature shells.

Two specimens before me from Miller Canyon, or extreme head of Cave Creek Canyon, Huachucas, figured on Pl. XV, figs. 94, 95, may be toothless *heterodonta*, as Mr. Ferriss suggests to me; though from the narrower lip I had provisionally called them *A. chiricahuana*, to which they seem absolutely similar. If the latter be correct, these are the only specimens of that species I have seen from the Huachuca range. They measure 18.3 and 16 mm. in diameter. The smaller shell is an albino.

Ashmunella levettei proxima n. subsp. Pl. XIV, figs. 65, 66, 70. 71.

The shell is depressed, biconvex, strongly angular at the periphery, *pale corneous-brown*. Whorls $6\frac{1}{2}$, none with punctate sculpture. Aperture like that of *A. angulata*, except that *the two basal teeth are nearer together, the space between them being smaller than that between the outer basal and the upper lip-tooth;* though the two basal teeth are not united basally as in *A. fissidens*.

Alt. 5.3, diam. 12 mm.
" 5.3, " 12.9 "
" 5.8, " 12.9 "

Chiricahua Mountains, Sawmill Canyon. Types No. 86,498, A. N. S. P., collected by James H. Ferriss.

Less carinated than the closely related *A. fissidens* which is apparently a member of the same series. It is difficult to decide on the rank to be given to the members of these chains of modifications of a single type. *A. proxima* will probably be considered a species eventually.

There are 14.10.1.10.14 teeth. The side cusps are very short, almost subobsolete on the central teeth. The tenth to twelfth teeth are transitional. Both cusps are split on the marginal teeth.

The genitalia (Pl. XXI, fig. 24) of one of the type specimens figured has the atrium protruded. There seems to be an extremely short basal enlargement or penis in another individual opened. The retractor muscle of the penis is very weak. The proportions of the organs are given in the table on p. 224. The very short penis contrasts with *A. l. angigyra*, which also has more marginal teeth.

The jaw (Pl. XXIII, fig. 17) is thin, with about 5 ribs, of which only two are well developed.

Ashmunella fissidens n. sp. Pl. XIV, figs. 67-69.

Shell depressed, lens-shaped, biconvex, with *acutely angular periphery;* rather thin, brown. Sculptured with fine, irregular growth-lines, the penultimate and next earlier whorls more or less roughened with minute elevated points, as in *A. angulata.* Spire very low conoid. Whorls fully 6, closely coiled, moderately convex, the last usually a little impressed above the periphery, which is angular throughout. It is convex below, and deeply guttered behind the reflexed outer and basal margins of the lip. The suture descends a little to the aperture. The aperture is very oblique, much obstructed by four teeth; an oblique parietal lamella, curved in at its axial end, with, in old specimens, a very low converging ridge outside of it, the two arranged V-like; a long, square-topped or concave-topped tooth within the outer lip; and *two contiguous teeth on the basal lip, slightly united basally* the outer one thick and higher, the inner low and more spreading. Parietal callous distinct.

Alt. 5.3, diam. 12.3 mm.
" 5, " 11.5 "
" 4.9, " 11.7 "

Chiricahua Mountains, in Cave Creek Canyon. Types No. 87,022, A. N. S. P., collected by James H. Ferriss, February, 1904.

This species differs from *A. angulata* by its contiguous basal teeth, but is related to it by the punctate surface. It resembles *A. duplicidens* in some respects, but the basal teeth are not nearly so closely united as in that snail, the periphery is carinate, not merely angular, and the whole shell is much more depressed.

Ashmunella duplicidens n. sp. Pl. XVI, figs. 103–107.

Shell depressed, umbilicate, brown or corneous-brown, glossy and sculptured with minute growth-lines only. The spire and base are convex, the periphery obtusely subangular in front, and situated above the middle of the last whorl. There are $5\frac{3}{4}$ to $6\frac{1}{2}$ closely coiled, narrow and moderately convex whorls, the last one very slightly descending in front. The aperture is ear-shaped, very oblique, the lip white, well reflexed, and convex on the face. Within the outer margin there is a somewhat retracted broad tooth, *prominent at its two ends, concave between them.* Upon the basal lip there is a less widened, more emerging *double* tooth, the outer cusp larger than the inner. The parietal wall bears an oblique, straight lamella.

Alt. 6.5, diam. 13 mm.
" 5.9, " 12 "

Bearfoot or "Bar" Park, Chiricahua Mountains, Arizona, at an elevation of 8,500 feet.

This species is an important link in the *A. levettei* chain, showing the origin of the two basal teeth by splitting of an original median one. It is less differentiated from the group of *A. thomsoniana* than the other known Arizona species.

The genitalia (Pl. XXI, fig. 23) also resemble those of *thomsoniana.* The general proportions are shown in the figure and table of measurements. The penis is comparatively long. The duct of the spermatheca is large, weakly varicose, and contracted where it joins the vagina. I did not make out any lower attachment of the penis retractor muscle.

There are about 18.10.1.10.18 teeth, nine or ten being laterals, the next three or four transitional. The ectocone is not split on the marginals, at least not on most of them.

Ashmunella angulata n. sp. Pl. XI, fig. 11; Pl. XIV, figs. 55–61, 63, 64.

The shell is lens-shaped, angular peripherally, rather narrowly umbilicate, glossy, reddish-chestnut when unworn, paler and more corneous around the umbilicus and in the middle portion of the upper surface, but frequently dull throughout by slight wear of the surface. Sculpture of very fine and irregular growth-lines, and for a short space behind the lip there are fine, sharp striæ. The embryonic whorl is glossy, with fine radial striæ on the outer side of the suture; *some part or parts of the third or fourth whorls are sculptured with very minute raised points* in quincuncial order. The spire is low conic-convex, very obtuse above, the first two whorls being almost in a plane. Whorls 6½ to 6¾, *very narrow, and very slowly increasing;* the first three are convex, *those following being decidedly flattened,* only slightly convex. *The last whorl is acutely angular at the periphery,* the angle more obtuse on its last third. The base is convex. The suture descends a little to the aperture. The lip is preceded by a creamy stripe, and the base is deeply guttered behind the expansion. The aperture is very oblique, narrow and lunate, obstructed by four teeth: a more or less sinuous, oblique parietal lamella, two compressed, entering teeth on the basal lip, of which the outer one is higher and more compressed, and an oblique, square-topped tooth within the outer lip. *The sinus or notch between the two basal teeth is slightly wider* than that between the outer basal and the outer lip tooth. The umbilicus is about one-sixth the diameter of the shell.

Alt.	14.3, diam.	6.5 mm.
"	13.3, "	6.3 "
"	13.3, "	6.4 "
"	13, "	6 "
"	13, "	6 "

Two other specimens of the type lot measure 14 and 14.3 mm. diameter respectively.

Chiricahua Mountains, Arizona, in the South Fork of Cave Creek, at the base of the mountain. Types No. 87,019, A. N. S. P., collected by Mr. Ferriss, February, 1904.

The young shells show the characteristic punctation better than adults. At resting periods in the neanic stage of growth a callous rib is formed within the lip. When this occurs early (as in the specimen figured, Pl. XI, fig. 11, 8 mm. diameter) the rib is much thicker in the middle. When it occurs in the last whorl it is more equally thickened.

This species is closely related by shell characters, but not by its soft anatomy, to *A. levettei angigyra* of the Huachuca range, agreeing with that form in the close convolution of the whorls, the angular periphery and the general arrangement of the teeth. But all fresh specimens of *A. angulata* show a quincuncial punctation of some part of the neanic whorls, not present in the Huachuca form, and the two especially differ in the shape of the whorls, the upper surface of which is flattened in *angulata*, convex in *angigyra*. Moreover, the genitalia of *angigyra* and *angulata* differ in important respects.

As usual in *Ashmunella* and many other snails, the "species" is composed of a group of varying colonies, all living in Cave Creek Canyon and its branches. The largest and best developed of these has been taken as the type lot, Pl. XIV, figs. 55–57.

Another lot (87,015) from the South Fork of Cave Creek, "under cliffs" (fig. 58), has smaller shells of a paler dull brown tint. The whorls after the first $1\frac{1}{2}$ are flattened; and there is sometimes a low ridge making the parietal tooth V-shaped.

Alt. 12.8, diam. 6.5 mm.; whorls $6\frac{1}{2}$.
" 11.8, " 5.6 " " 6.
" 12, " 5.6 " " $6\frac{1}{8}$.

Another lot, from a different spot from the above, also consists of small shells:

Alt. 5, diam. 11 mm.; whorls 6 (2 specimens).
" 5.3, " 11 " " $6\frac{1}{2}$.
" 5.3, " 10.7 " " 6.
" 4.8, " 9.9 " " $5\frac{3}{4}$.

The following lots are from Cave Creek Canyon (the preceding being from its south fork):

No. 87,111 (fig. 61) is almost exactly like 87,015 (above).

No. 87,020 (figs. 59, 60) varies more in size and shape, as follows:

Alt. 6.3, diam. 11.2 mm.; whorls $6\frac{1}{2}$.
" 5, " 11.3 " " $6\frac{1}{2}$.
" 5, " 11 " " $6\frac{1}{2}$.
" 4.8, " 9.9 " " 6.

The punctation of the spire is well developed.

At the Falls in Cave Creek (figs. 63, 64) the shells are like the preceding lot, except that the punctation is less developed and the umbilicus frequently smaller:

Alt. 5, diam. 11 mm.; width of umbilicus 2 mm.
" 4.4, " 9.8 " " " 1.5 "
" 5.5, " 11 " " " 2.5 "

The genitalia of *A. angulata* (Pl. XXI, fig. 26) are figured from a specimen from the south fork of Cave Creek, No. 87,015, A. N. S. P. The penis is very short (long in *angigyra*, see fig. 28); the epiphallus, on the other hand, is very much longer than in *angigyra;* while the spermatheca and its duct are of about equal length in the two species. The vagina in *A. angulata* is rather long, as usual in *Ashmunella*, while in *A. l. angigyra* it is much shorter than in any other *Ashmunella* I have dissected.

The jaw (Pl. XXIII, fig. 15) of the same specimen is thin, with perhaps as many as eight very weak, narrow, delicate unequal ribs.

The teeth (Pl. XXII, fig. 9, a group of lateral, transitional and marginal teeth) number 16.8.1.8.16 to 18.9.1.9.18 on different parts of the same radula. There are 8 or 9 laterals and two or three transition teeth. Some of the outer marginals have the ectocone bifid.

Ashmunella ferrissi n. sp. Pl. XVI, figs. 108–110, 113.

The shell is biconvex and *acutely carinate*, narrowly umbilicate, brown, but slightly glossy, and sculptured with fine growth-wrinkles only. The spire is convex, of 6½ very *closely coiled* and slowly widening whorls, the earliest two convex, the rest flat, with *a narrow keel projecting upward and outward above the suture.* The last whorl is concave above and below the keel, and descends very shortly to the aperture. The aperture is very oblique and obstructed by four white teeth: a wide one slightly notched at the summit, just below the peripheral angle; two compressed teeth on the basal margin, connected by a low flange on the face of the peristome; these three teeth stand about equidistant. There is also a low prominence on the lip at the position of the keel. On the parietal wall there is a straight lamella, very obliquely placed and shortly, abruptly curved inward at the axial end.

Alt. 5.5, diam. 11.3 mm.
" 5.2, " 11 "

Cave Creek Canyon, Chiricahua Mountains. Types No. 89,232, A. N. S. P.

This extraordinary member of the group of *A. levettei* is at once distinguished from all others known up to this time by the projecting keel above the sutures of the spire, somewhat like the Chinese *Eulota tectumsinense* (v. Mts.), or like *Helicodonta maroccana* (Morel.).

Ashmunella walkeri Ferriss. Pl. XVI, figs. 111, 112, 117.

Ferriss, Nautilus, XVIII, p. 53, September, 1904.

The shell is *much depressed, lens-shaped, acutely carinate peripherally,* rather thin, and pale corneous-brown. The umbilicus, narrow within, *enlarges rapidly at the last whorl.* Surface lightly marked with growth-lines, but showing no trace of spiral striæ or lines. The upper surface is but slightly convex. The apex is sculptured like that of *A. levettei.* Whorls 4½, slightly convex, the last very shortly descending in front. Base more convex than the upper surface. The aperture is small and very oblique, the lip well reflexed, white, with an obtuse, squarish tooth in the outer margin and two compressed teeth in the basal margin, the inner one smaller; these three being nearly equally spaced, or the outer two may be nearer together. There is a rather short, straight, obliquely set parietal tooth, and in old shells a very low diverging ridge between it and the outer insertion of the lip.

Alt. 4½, diam. 13½ mm.

Florida Mountains, Luna county, New Mexico, in a rock talus near the top of the mountain, at an elevation of probably about 6,500 feet. Co-types in collections of J. H. Ferriss and A. N. S. P., No. 87,101.

Only a few specimens were found, and none living. While related to the carinate forms of the *A. levettei* group, and to *A. mearnsi* by the structure of the aperture, this species is flatter than any of them, and differs especially in the small number of whorls—less than in any other *Ashmunella*. It was named in honor of Mr. Bryant Walker, of Detroit.

Ashmunella mearnsi (Dall). Pl. XIV, fig. 62; Pl. XVI, fig. 116.

Polygyra mearnsi Dall, Proc. U. S. Nat. Mus., XVIII, 1895, p. 2 ("Hachita Grande and Huachuca Mountains, New Mexico"); Proc. U. S. Nat. Mus., XIX, 1896, p. 343, Pl. 32, figs. 7, 8, 11; Cockerell, Nautilus, XI, October, 1897, p. 69 (Filmore Canyon, Organ Mountains, New Mexico).
Ashmunella mearnsi Dall, Ancey, Jour. of Malac., VIII, September, 1901, p. 74.

In this species an accessory parietal lamella, incipient or rudimentary in *A. walkeri* and some forms of the *levettei* series, is well developed. The lip-teeth are arranged as in the *A. levettei* group. It is nearer *A. walkeri* than any other known species, but some specimens of *A. angulata* (fig. 58) have a weak upper arm of the parietal V.

The geographic range is wide for a species of this group: the Huachuca Mountains, in southeastern Cochise county, Arizona, the Hacheta Grande Mountains, Grant county, southwestern New Mexico, and the Organ Mountains, Donna Ana county, New Mexico, east of the Rio Grande. All of these localities are near the Mexican boundary.

The specimen figured is one of those collected in the Huachuca Mountains by the well-known ornithologist Edgar A. Mearns, for whom the species was named.

The remarkable parietal armature is weakly foreshadowed in *A. walkeri*, some forms of *A. l. angigyra*, etc. The soft anatomy remains unknown.

Group of A. esuritor.

Aperture of the shell without teeth. Length of the spermatheca and its duct about 90 per cent. that of the penis, epiphallus and flagellum, which do not much exceed twice the diameter of the shell.

A single species from the Chiricahua Mountains differs strikingly from the *levettei* and *chiricahuana* groups in the proportions of the genitalia, the epiphallus being as short as in the *thomsoniana* group, while the spermatheceal duct is much longer.

Ashmunella esuritor n. sp. Pl. XIII, figs. 23–26.

The shell is rather solid, light brown, biconvex, *angular at the periphery.* The cylindric umbilicus is suddenly dilated in the last whorl. The surface is irregularly marked with slight growth-wrinkles, and on the last whorl there are impressed spiral lines, more or less irregularly developed and sometimes almost obsolete. Some intermediate whorls are indistinctly punctulate. Spire low-conic. Whorls $6\frac{1}{3}$ to $6\frac{1}{2}$, slowly increasing. The first three whorls are convex, the rest more or less *flattened.* The last whorl is distinctly but not acutely angular in front, but becomes rounded in its later half. The suture descends a little to the aperture, and the whorl is rather deeply guttered behind the lip. The aperture is very oblique, roundly lunate. The peristome is white, thickened within, and equably reflexed. In the *middle of the basal margin there is a low, indistinct prominence, but there are no other traces of teeth.* The parietal callous is thin except in old specimens, when it is thickened at the edge, forming a cord across the whorl.

Alt.	7.7,	diam.	15.5	mm.
"	7.7,	"	15	"
"	7.5,	"	15	"
"	7,	"	14.5	"
"	7.7,	"	14	"

Chiricahua Mountains, in Bar (or Bearfoot) Park. Types No. 87,023, A. N. S. P., collected by James H. Ferriss, February, 1904.

At first glance this form seems to be a small angular race of *A. chiricahuana;* but upon closer study it seems far more likely that it is a terminal member of the *A. angulata* group, in which the teeth have degenerated. The slight flattening of the whorls, the shape of the mouth, and a faint punctation observable near the end of the third whorl in the freshest specimens, all indicate this relationship. Most of the fully adult and old individuals seen have lost much or all of the cuticle, and are dull flesh-tinted.

The spiral engraved lines vary a good deal in different specimens, and when slightly corroded neither spirals nor granulation are visible, even in living shells.

The smaller size, angular periphery and comparatively wider lip readily distinguish *A. esuritor* from *A. chiricahuana.*

The genital system (Pl. XXI, figs. 30, 25) resembles that of *A. chiricahuana* except that the ducts are very much shorter, both absolutely and in comparison with the size of the shell; and the spermatheca and its duct are nearly as long as the penis, epiphallus and flagellum. The extruded penis and atrium in another specimen are shown in fig. 25.

The penis has low, slowly spiral ridges. The entire length of the organs exserted is about 3.2 mm.

The jaw has about 7 unequal ribs.

The teeth number about 16.12.1.12.16, the tenth to thirteenth being transitional. Both cusps of the marginal teeth are bifid.

Five shells taken in Sawmill Canyon, running from Bear Park, Chiricahuas, are like the types. The periphery in some is not quite so angular. The punctulation is identical. Two measure:

Alt.	7.5	7 mm.
Diam.	16.3	14 "
Whorls	6⅓	6¼

Group of A. chiricahuana.

Aperture toothless. Epiphallus and duct of the spermatheca very much longer than in species of any of the other groups, the diameter of the shell contained four times in the length of the penis, epiphallus and flagellum.

Ashmunella chiricahuana (Dall). Pl. XVI, figs. 96-100.

Polygyra chiricahuana Dall, Proc. U. S. Nat. Mus., XVIII, p. 2, 1895 (Fly Park, Chiricahua Mountains); Proc. U. S. Nat. Mus., XIX, p. 341, Pl. 32, figs. 9, 10, 12, 1896.

Ashmunella chiricahuana (Dall), Pils. and Ckll., Proc. Acad. Nat. Sci. Phila., 1899, p. 192; Ancey, Jour. of Malacol., VIII, September, 1901, p. 76, with var. *varicifera*, p. 77.

This species has the general shape and rounded periphery of *A. levettei*. It varies from chestnut to rather light greenish-brown, and shells which have lost their cuticle are dull flesh-colored. It is very glossy and smooth, marked with weak growth-wrinkles and engraved spirals, which are distinct in some, almost obsolete in other specimens. Under the compound microscope fine spiral striæ are seen to cover the surface between the spiral lines. Whorls about 5½, slightly convex. The last descends a trifle in front, and is somewhat constricted behind the lip. The aperture is without teeth. *The lip is narrow*, reflexed, brownish above and at the edge, *without trace of lip-teeth*. The umbilicus opens rather widely at the last whorl.

There is almost always an opaque yellow stripe on the last whorl, marked inside by a strong white rib, and indicating a place of growth-arrest. Some shells have several such variceal streaks on earlier whorls also. The feature is a variable one in shells of the same lot, for reasons I have elsewhere discussed in full. In one lot of 16 specimens from Cave Creek Canyon, Chiricahuas, there are 3 specimens with a single streak on last whorl, 8 with 2 streaks on last 2 whorls, 4 with 3 streaks on last 3 whorls, and 1 with 4 streaks on last 3 whorls.

Type locality, Chiricahua Mountains, southeastern Arizona, in Fly Park, 10,000 feet altitude (Fischer); also in Cave Creek Canyon (Ferriss, 1904). The locality "near Tucson" is also given for specimens collected by a Mr. Cox, many years ago. ? Huachuca Mountains, in Miller Canyon (see below).

Dall's type measured, alt. 7.7, diam. 18 mm.[3] Three topotypes of the original lot collected by Fischer measure:

Alt. 9, diam. 18 mm.; whorls $5\frac{3}{4}$.
" 8.5, " 16 " " $5\frac{1}{2}$.

Sixteen of the specimens collected by Mr. Ferriss in Cave Creek Canyon (Pl. 16, figs. 96–100) measure:

Alt.	10	9.5	10	9	10	8.8	8.5	9.5
Diam.	20.5	20	19	19	18.5	18.5	18.5	18
Alt.	9	9	9	8.5	8.3	8.2	9	8.5
Diam.	18	18	18	18	18	18	17.7	17.5

The diameter curve from this small series has a strongly marked mode at 18 mm. (44% of the whole), with a skew toward the smaller diameter.

There is a considerable variation in the height of the spire, shown in the measurements above and in the figures, of which figs. 99 and 100 represent about the extremes of variation in this respect.

Two specimens from the head of Miller Canyon, in the Huachucas, measure 8.5 x 18.2 mm. and 8 x 16 mm. The smaller one is an albino, greenish-white. These may be referable to *A. levettei heterodonta, q. v.*

I have seen no Ashmunellas from Tucson, but no differential characters have been indicated for the variety *varicifera* Ancey, from that place. Nearly all the specimens from the Chiricahua range have varices.

The genital system (Pl. XXI, fig. 29) is remarkable for the great length of the epiphallus, vagina and spermatheca duct. The penis is large and well developed. The specimens examined are from Cave Creek Canyon, in the Chiricahuas.

The jaw (Pl. XXIII, fig. 13) is stronger than in most of the species, with 8 strong ribs and several weaker ones.

The radula (Pl. XXII, figs. 10, central and lateral, and 11, groups of transitional and marginal teeth) has 16.13.1.13.16 or 16.14.1.14.16 teeth. The thirteenth to fourteenth or fifteenth teeth are transitional.

[3] This measurement was not to the base of the lip, and hence is less than in the shells from the same lot measured by me.

The fifteenth tooth has the mesocone bifid. As a rule, the marginal teeth have the ectocone simple, but I found a few teeth in some rows having a bifid ectocone.

Ashmunella chiricahuana mogollonensis n. subsp. Pl. XVI, figs. 101, 102.

Similar to *chiricahuana* but slightly more tumid, dull greenish-brown, not glossy. Surface sculptured with low, irregular, coarse wrinkles of growth, and *distinct, clear-cut incised spirals* all over the last whorl. Spire very low, the early whorls depressed.

Alt. 9, diam. 17.5 mm.; whorls $5\frac{1}{2}$.

West fork of the Gila river, near Mogollon Peak, in the southwestern part of Socorro county, New Mexico, in a pine region, collected by Prof. E. O. Wooton, August 7, 1900, sent by Prof. T. D. A. Cockerell. Type No. 79,530, A. N. S. P. (fig. 102). A specimen has also been taken by Mr. O. B. Metcalfe near Kingston, Sierra county, New Mexico (fig. 101).

In *A. chiricahuana* the spirals are very much weaker or obsolete, and the cuticle, when in unworn condition, is conspicuously glossy.

Group of A. metamorphosa.

Shell edentulous, similar to *A. chiricahuana*. Genitalia peculiar, see below.

Ashmunella metamorphosa n. sp. Pl. XVI, figs. 114, 115.

Shell similar in form and color to *A. chiricahuana* and *A. esuritor.* Surface slightly marked with growth-lines and very minutely engraved spirally when unworn, but the spirals cannot be seen on slightly corroded living shells. Whorls $5\frac{3}{4}$ to $6\frac{1}{2}$, convex, slowly widening, the last rounded peripherally, slightly descending in front, contracted behind the reflexed and slightly recurved lip. Umbilicus a trifle less open than that of *A. chiricahuana.* Aperture like that of *A. chiricahuana* in shape, but in some specimens there is a low callous within the outer lip, and one or two indistinct callouses within the basal margin, while in others these are hardly noticeable.

Alt. 9, diam. 17 mm., or slightly smaller alt. 8.9, diam. 16.5 mm.

Bear (Bearfoot or Barfoot) Park, Chiricahua Mountains, Cochise county, Arizona. Types No. 88,885–6, A. N. S. P., collected by Mr. J. H. Ferriss, 1904.

Genitalia (Pl. XXI, fig. 27) with a very short atrium. There is no differentiated penis, the ♂ organ being of *equal calibre throughout, and evidently an epiphallus.* It terminates in the usual very short flagellum. I can find *no trace of a penial retractor muscle.* The very long vagina consists of a *very slender lower portion and an excessively thick, muscular* *upper part.* The spermatheca is long and narrow, its duct rather short. The epiphallus and flagellum measure 22 mm.; flagellum 2 mm.; spermatheca and duct 20 mm. The specimens had been placed in alcohol without drowning.

The jaw (Pl. XXIII, fig. 16) has seven ribs, grouped in the median half, the ends smooth.

The radula (Pl. XXII, fig. 8) has about 38.1.38 teeth. The ectocones are developed on central and lateral teeth. From the twenty-fourth or twenty-fifth teeth outward from the middle the inner cusp is bifid. The ectocones are unsplit. A central and two lateral teeth are shown.

This snail, so far as the shell is concerned, would be referred without hesitation to *A. chiricahuana;* the differences being less than the ordinary range of individual variation in *Ashmunella* or *Polygyra;* but the genitalia are so utterly unlike in the two forms that it is obvious that they are not even nearly related. From the granulation and the weak traces of teeth it seems that *A. metamorphosa* is probably a toothless derivative of the *A. levettei* stock; I regret that I have no alcoholic specimens of *A. levettei* or *A. l. heterodonta* for comparison. *A. esuritor* differs from *metamorphosa* by its angular or distinctly subangular periphery, rougher surface when perfectly fresh, and perhaps somewhat wider umbilicus; but it must be admitted that the two forms are so similar that their distinction may be difficult without an examination of the soft parts. The genitalia, however, are so very different that the two species cannot even be closely related. They must be independent derivatives from toothed ancestral forms.

I dissected two of the three specimens received. They could be extracted only by breaking into the shell. Having been preserved in alcohol without drowning the specimens were much more contracted than the *A. chiricahuana* and *A. esuritor* I examined. A somewhat extensive experience with snails in all conditions of preservation has shown that beyond a moderate diminution of the absolute size, the characters of the genitalia are not altered by preservation of the animal in strong alcohol.

Genus **SONORELLA** Pilsbry.

Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 556 (definition, anatomy); Bartsch, Smiths. Misc. Coll., Vol. 47, p. 187, 1904 (monograph).

The soft anatomy of this genus has hitherto been known in a single species. The study of numerous specimens of several species enables me to extend the generic characterization.

The shells in these Helices, while interminably modified locally in size and minor details of shape and sculpture, show with few exceptions no prominent specific differentiation. On the other hand, in the internal anatomy there has been a good deal of divergence. A few forms, such as *S. lohrii* Gabb and *S. wolcottiana* Bartsch, seem to be quite distinct conchologically, but in many cases the determination of specimens of the shells other than the type localities is so uncertain as to be little better than guesswork, even when types are available for comparison. In dealing with these ambiguous forms I have thought the interests of science best furthered by applying specific names only to those I am able to characterize anatomically, and thus put upon a secure basis.

An illustrated monograph of *Sonorella*, dealing with the shells only, has been published by Mr. Paul Bartsch, who has devoted great industry to the elucidation of the numerous species and races. The work is of permanent value for its exact descriptions and excellent figures, both of which I have had occasion to test; but it deals with selected or "type" specimens only, ignoring the fact of variation, and hence fails to give a just idea of the complex of varying forms which exist, or even of the variations of size, etc., occurring in the type lots. I would here express my indebtedness to Mr. Bartsch for his invariable kindness in comparing for me various forms of *S. hachitana* with specimens in the U. S. National Museum.

Mr. Bartsch has made the valuable observation that the embryonic shells of *Sonorella* are sculptured, usually with oblique forwardly descending threads, or with two sets of intersecting threads, sometimes interrupted to form papillæ at their intersections. This sculpture may, I think, be the accelerated vestige of a somewhat similar sculpture characteristic of the Californian Helices in their adult stage, and which may thus have been common to the ancestral Sonorellas.

The relationships of *Sonorella* are primarily with *Oreohelix* and *Ashmunella*. It differs from *Oreohelix* chiefly in the different proportions of the kidney and pericardium, but also in the structure of the shell, the oviparous reproduction, the unkeeled young shell, and in the distinctly ribbed jaw.

Sonorella stands nearer *Ashmunella* in internal anatomy, but there is a constant difference in the male organs, the penis being well developed in *Sonorella*, while in *Ashmunella* it is more or less completely degenerate, the epiphallus being hypertrophic. The divergence between the shells of the two genera is conspicuous. So far as the shell is concerned, *Sonorella* stands nearer to the generally prevalent type of Belogonous Helices than do either of the other genera.

Generic Characters of Sonorella.

The genitalia (Pl. XX) show no accessory organs on the female side. The vagina is long; the spermatheca is globular or ovate on a very long slender branchless duct. The atrium is always extremely short. The penis is a well-developed, thin-walled tube, containing a large papilla, and terminating in a well-developed epiphallus. There is always a loose sheath or wide collar enveloping the base of the penis, and attached by muscular threads to the end of the epiphallus, which is thus held loosely in a reflexed position. This sheath has been removed in most of my figures, as it obscures the parts enveloped.

The retractor muscle is attached to the epiphallus close to the penis, and is adnate to or envelops it to the apex of the latter. The flagellum is extremely short, or even absent. The details of structure are much varied in the several species as described below under each specific caption, and in the table of measurements.

The free muscles, pallial complex and digestive tract have been described in these *Proceedings* for 1900, p. 558. No material differences have been observed in additional species examined.

The jaw has four to eight ribs grouped in the median part, and either strong or weak, as in the Californian Helices (Pl. XXIII, figs. 18–23).

The radula has unicuspid middle and lateral teeth, bicuspid transitional and inner marginal teeth and low, wide marginals with both cusps bifid. Exactly the same type of teeth occurs in the Californian Epiphragmophoras, in *Ashmunella, Polygyra,* etc.

The upper surface of the foot is densely pebble-granose, with rather indistinct dorsal grooves; the genital furrow is undeveloped except near the mantle. The tail is depressed, rather long, and sometimes has a weak median impressed line along the top.

In my original diagnosis of *Sonorella* I stated that the shell was "neither malleate nor spirally striate." Mr. Bartsch has also asserted that "incised spiral lines are never present in this genus." This statement must now be withdrawn, since several forms discovered by Mr. Ferriss show impressed spiral lines; but they are inconspicuous, and visible only under the lens.[4] To the eye, the shells of all known Sonorellas appear nearly smooth, the sculpture, aside from slight growth-wrinkles, being microscopic. This is somewhat remarkable because they often live in the same rock-piles with rudely sculptured Oreohelices.

[4] Mr. Bartsch has excluded *Helix carpenteri* Newc. from *Sonorella* on account of its spiral sculpture; but since I have found that this is not a diagnostic character of the genus, I am disposed, pending an examination of the soft anatomy, to adhere to my former opinion that *carpenteri* belongs to *Sonorella*.

Up to this time, no carinate or even strongly angular species have been found. Such uniformity in the shell is unusual in a Helicid genus.

The characters of the soft anatomy originally attributed to the genus have proved to prevail in the more extensive material now examined, except that in one species the flagellum is obsolete. The penis was incorrectly described in my original diagnosis, through my failure to open it, and thus ascertain the exact limits of penis and epiphallus.

Measurements of the Genitalia in Millimeters.

Species	*Penis*	*Penis-papilla*	*Free epiphallus and flagellum*	*Flagellum*	*Vagina*	*Spermatheca and duct*	*Museum number*
S. hachitana, Florida Mountains	9	4	7	0.5	10.5	29	86,496
S. h. ashmuni, Purtyman's ranch	11	6	7	0.7	9	29	79,409
S. h. ashmuni, Purtyman's ranch	11	....	6.7	0.7	8	35	79,409
S. h. bowiensis, Bowie	10	3	8.5	0.6	10	....	86,497
S. rowelli, Sanford's	5	2	5.5	vestigial	5.3	20	83,273
S. rowelli var. Patagonia Mountains	4	....	....	wanting	4.5	....	83,268
S. granulatissima, Huachuca Mountains	7.3	4.8	6	0.7	21	24–25	83,257
S. virilis, Chiricahua Mountains	34	29	23	1	16	24	79,622
S. v. circumstriatus	24	....	21	0.8	20	....	87,026

Helix remondi Tryon belongs to another genus, still uncharacterized anatomically, of the Belogona Euadenia. A living specimen sent me by mail some years ago was crushed *en route*, partially decayed and dried hard when it reached me. I soaked up the remains, and found that the tail has a strong serrate keel above; there is a slender, cylindric-fusiform penis, but the rest of the genitalia were impossible to make out. The radula does not differ materially from the *Epiphragmophora* type. In Mexico, the genus *Lysinoe* and at least one species of *Leptarionta* have the same extremely unusual structure of the tail.

Neither is much like *H. remondi* conchologically; but further information on both *H. remondi* and *Leptarionta* is needed.

Sonorella hachitana (Dall). Pl. XVII, figs. 1–8.

Epiphragmophora hachitana Dall, Proc. U. S. Nat. Mus., XVIII, p. 2, 1895; XIX, p. 338.
Sonorella hachitana Dall, Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 557 (as type of *Sonorella*).
S. hachitana Dall, Bartsch, Smiths. Misc. Coll., XXXXVII, p. 190, Pl. 31, fig. 2 (shell), and Pl. 29 (apex), 1904.
Probably includes as subspecies *S. ashmuni* Bartsch, *l. c.*, p. 190, Pl. 31, fig. 5; *S. nelsoni* Bartsch, *l. c.*, p. 191, Pl. 31, fig. 3, and *S. goldmani* Bartsch, *l. c.*, p. 192, Pl. 32, fig. 6.

This is a widely distributed species in central and southeastern Arizona and southwestern New Mexico. It varies in size, degree of depression, width of umbilicus, size of aperture, and in color-tone; also in some measure in the sculpture; but so multifarious are the connecting links that I do not now see my way to support the dismemberment proposed by Mr. Bartsch. It will doubtless be found useful to recognize by name a half-dozen or more local races.

The internal anatomy of the types, from Hacheta Grande Mountains, Grant county, New Mexico, is not known, nor have topotypes been dissected. I have been able, however, to examine several specimens from other localities, which conchologically differ very little from the original lot of *hachitana*, some of which are before me.

The name "hachitana" seems to be a perverted form of that of the locality, "Big Hatchet." The Spanish name, locally in use, and appearing on most maps, is "Hacheta Grande."

1. Filmore Canyon, Organ Mountains, New Mexico (Pl. XVII, figs. 7, 8). A single specimen sent by Prof. Cockerell measures alt. 13.8, diam. 23.5 mm., umbilicus 3.2 mm. The aperture is ample, 11.8 x 13.3 mm., as in the large shells from Florida Mountains. This specimen has been referred by Mr. Bartsch to his *S. nelsoni*, which measured 25.5 x 13.4, umbilicus about 4 mm., aperture 11.1 x 12.8 mm., and is said to differ from *hachitana* in being "more depressed and has a larger aperture."

The genitalia show that the specimen, while full grown, is not quite mature, the male organs especially being thread-like. The spermatheca is globular, on a very slender duct. The specimen is No. 71,413, A. N. S. P. It has been referred by Mr. Bartsch to *S. nelsoni*.

The jaw (Pl. XXIII, fig. 19) has eight narrow equal ribs.

2. Florida Mountains, near Deming, Luna county, New Mexico. Mr. Ferriss states that these specimens were collected in a very barren, arid locality. Very large specimens were taken measuring 28.3 x 15.9

mm., width of umbilicus 4.7 mm., or even larger 29.5 x 15.5 mm. They exceed *S. ashmuni* Bartsch in size, and are larger than any *Sonorella* on record (Pl. XVII, figs. 1, 2). The aperture is ample, 12.9 x 14.5 mm.

Another lot (86,496, A. N. S. P.), figured on Pl. XVII, figs. 3–6, from the same locality, consists of smaller specimens. Some are typical *hachitana* in form and size except that the last whorl descends more deeply in front, making the aperture subhorizontal in some specimens (figs. 5, 6). In a few specimens the supraperipheral band is almost obsolete, very narrow and interrupted (figs. 3, 4), but most of them are pale reddish-brown, fading to white in the middle region of the base, and with a white or whitish band on each side of the dark supra-peripheral belt.

Alt. 14.5,	diam. 25.4,	width of	umbilicus	4	mm.
" 14.3,	" 27.7,	"	"	4	"
" 13,	" 26.7,	"	"	3.9	"
" 13.9,	" 26,	"	"	4	"
" 13.7,	" 26,	"	"	3.9	"
" 13.3,	" 23.5,	"	"	3	"
" 13.3,	" 23.4,	"	"	2.9	"
" 12.6,	" 22	"	"	3.9	"
" 10.7,	" 22,	"	"	3.8	"

Specimens of this lot were sent alive.

The pale sole is indistinctly tripartite, extremely weak impressed lines dividing it in some specimens, not traceable in others. The back is slate or blue-blackish, the tail brown above, paler toward the foot-edges. The surface is finely pebble-granulate. There is a pair of indistinct dorsal grooves, and the genital furrow is traceable only near the mantle. The tail is depressed, with a very faint median groove.

The genitalia (Pl. XX, fig. 12) show no differences of any moment from the form of *hachitana* from Purtyman's ranch, Arizona, figured by me in 1900, except in the shape of the spermatheca, which, however, is not constant in the Purtyman's lot. The individuals examined were partly not fully developed, and possibly older specimens will show a somewhat stouter vagina and penis than that figured. The penis papilla is long and slender, not convoluted in the specimen opened.

The jaw (Pl. XXIII, fig. 20) has eight ribs.

The radula is somewhat unlike other Sonorellas examined in the central tooth, which is narrower than the adjacent laterals. There are 55.1.55 teeth, an ectocone appearing on the fifteenth. Both cusps are bifid on most of the marginal teeth, the mesocone + entocone being very oblique and unusually long in the inner marginals. This radula differs a good deal from that of the Purtyman's ranch form, in both count of the teeth and in some details of their shape; but these features are admitted by all who have examined many radulæ to vary so widely among individuals that their value is largely discounted. The discrepancy between the forms should be controlled by the examination of several of each form.

Sonorella hachitana ashmuni Bartsch. Pl. XVII, figs. 9–14.

Sonorella hachitana, specimens from Oak creek, Purtyman's, Arizona, Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 557, Pl. 21, figs. 1–5 (anatomy).
Sonorella ashmuni Bartsch, Smiths. Misc. Coll., Vol. 47, p. 190, Pl. 31, fig. 5 (1904).

Purtyman's ranch, on Oak creek, 40 miles from Jerome, in the eastern edge of Yavapai county, Arizona. Collected by Rev. E. H. Ashmun, 1900 (No. 79,409, A. N. S. P.).

These specimens furnished the anatomical preparations described by me (*Proc. Acad. Nat. Sci. Phila.*, 1900, p. 557, Pl. XXI, figs. 1–5). Specimens of this lot have been examined by Mr. Bartsch and pronounced by him to be "a small race of *S. ashmuni.* They bear the same relation to *ashmuni* that *S. mearnsi* bears to *S. dalli.*" I would prefer to make an immaterial change in this statement. I would say that *S. ashmuni* represents a large race or colony of *S. hachitana,* and the Oak creek lot is nearly typical *hachitana.*

The specimens are well-developed shells, often larger than typical *hachitana* from Hacheta Grande Mountains. Nearly all are banded, whitish above and below the band; but 3 out of 350 collected by Mr. Ashmun at this place lack the dark band (figs. 13, 14). Specimens measure:

Specimens:	*a*	*b*	*c*	(*hachitana*)		*d*	*e*	*f*	
Alt.	13	13.4	13.5	(13.5	12)	13.3	13	13	mm.
Diam.	23	22.8	22.5	(22.7	22.2)	22.5	23.3	22	"
Alt. apert.	10.7	10	10.1	(9.6	9.9)	9.9	10.3	10	"
Diam. apert.	12.3	10.5	11.7	(11.9	10.7)	11.7	12	11.3	"

Compare with the measurements in parentheses of topotypes of *hachitana,* part of the original lot, received from Dall.

In general the aperture in the Purtyman ranch shells averages larger than in typical *hachitana,* but no hard and fast line can be drawn, and selected individual specimens of each are simply indistinguishable, either by measurements, color or any other character. The most we can claim for *S. ashmuni* is the rank of a weakly differentiated local race of *S. hachitana,* chiefly separable in actual practice by its geographic distribution. The radula has fewer teeth in a transverse row than in the *hachitana* from the Florida Mountains near Deming, New Mexico; but only one radula from each locality has been examined.

The color and other external features of the foot are as described for *S. virilis*. The internal anatomy was described and figured in my paper of 1900, Pl. XXI. The spermatheca in another specimen of the same lot was globular, as in other Sonorellas, not ovate with thickened duct as in the individual figured, which was stuffed with spermatophores. The penis was wrongly described in my former article. I did not then open it, and considered its upper portion to be epiphallic. When opened (Pl. XX, fig. 15) it is found to be a long, thin-walled sack, the upper half containing a long, slender, more or less convoluted papilla (*p.p.*). This is a little longer than in the *hachitana* examined from the Florida Mountains. Otherwise the genitalia are practically the same in the Florida Mountains and Purtyman's ranch snails.

Sonorella hachitana bowiensis n. subsp. Pl. XVIII, figs. 29–32.

The shell is similar to *hachitana* but is much smaller, with 4⅓ to 4½ whorls. The supraperipheral band shows on about 2½ whorls, above the suture on the spire; on the last whorl it has very faint, inconspicuous pale borders or none. No spiral lines are present in most specimens, but in two they may be seen very faintly, near the periphery. Seven fully adult shells measure:

Alt.	9.9	9.9	9.8	10	9.2	9.7	8.7	mm.
Diam.	17.8	17	17.5	17	17.2	16.6	15	"
Alt. apert.	8.2	7.8	8	8	7.7	7.7	6.9	"
Diam. apert.	9.5	9	9.2	9	9	8.4	8	"

Bowie, Cochise county. Types No. 86,497, A. N. S. P., collected by James H. Ferriss, 1904. Specimens were also taken by Mr. Ashmun at the same place. Mr. Ferriss writes that they were taken "in a situation exceedingly favorable for snails."

The genitalia (Pl. XX, figs. 10, 11) show externally only slight differences from *hachitana*. The penis and epiphallus are comparatively a little longer. Internally, however, the penis differs in having a *short, obtuse papilla*, only about 3 mm. long (Pl. XX, fig. 10), while in the forms referable to *hachitana* the papilla is twice as long, slender and tapering. These features, which I have confirmed in a number of individuals, indicate a certain amount of racial differentiation which may properly be recognized in nomenclature.

The jaw (Pl. XXIII, fig. 22) has four low, wide, unequal ribs and some minor riblets.

The radula is like that of Purtyman's ranch *hachitana* in general features. The twelfth lateral shows a small ectocone, larger on succeeding teeth.

Sonorella rowelli (Newcomb). Pl. XVIII, figs. 33-35.

Helix rowelli Newc., Proc. Cal. Acad. Sci., III, p. 181 (January, 1865).
S. rowelli (Newc.), Pilsbry, Proc. Acad. Nat. Sci. Phila., 1902, p. 511.

Shell like *S. hachitana*, but small, with large mouth and small umbilicus. Corneous-brown, with a dark band above the periphery, indistinct pale borders above and below it; somewhat translucent, thin. Whorls nearly $4\frac{1}{2}$, convex, the first (embryonic) $1\frac{1}{3}$ whorls nearly smooth, sculptured with some slight radial wrinkles only; following whorl or whorl and a half showing some indistinct granulation in places; last whorl with growth-lines only, rounded peripherally, descending a little in front. The aperture is large, subcircular, oblique, the thin whitish peristome being very narrowly expanded, columellar margin dilated. Umbilicus comparatively narrow, partially covered by the columellar lip.

Alt.	9.9	9.6 mm.
Diam.	17.1	16.6 "
Umbilicus	2.5	2.1 "
Alt. apert.	8.5	8.7 "
Diam. apert.	9.5	9.5 "

Sanfords, near the eastern border of Pima county, southeastern Arizona. No. 83,273, A. N. S. P., collected by James H. Ferriss, 1902 (figs. 33, 34).

Genitalia (Pl. XX, figs. 13, 14). The penis is short, containing a short, cylindric, obtuse papilla. The free portion of the epiphallus is about equal to the penis in length. The *flagellum is reduced to a mere tubercle,* being much shorter than in any other *Sonorella* yet dissected. The vagina is about as long as the penis, and the spermatheca and its duct are about four times as long.

The jaw has 6 or 7 narrow, unevenly spaced ribs.

The radula has 44.1.44 teeth, like those of *S. granulatissima.* The eleventh and twelfth are transitional.

The last whorl is less deflexed than in *S. h. bowiensis,* the aperture is larger and the umbilicus smaller. Both penis and vagina are decidedly shorter, though their proportionate lengths do not differ materially, and both have the penis-papilla short and obtuse; but in *S. rowelli* the flagellum is reduced to a minute vestige, unlike any of the other species. The remarkable constancy of this organ in the large number of individuals of *Sonorella* and *Ashmunella* which have been under my scalpel, gives reason for considering its modification in this species of importance.

I have identified these shells with *S. rowelli* (Newc.), a species said to have been collected in Arizona by Frick, many years ago. *S. arizonensis* (Dall), from Tucson, is more elevated, but is probably related to *rowelli*.

A form collected by Dr. G. H. Horn, the coleopterist, at Fort Grant, Arizona, is closely related to the shells described above.

In the Patagonia Mountains, a short distance eastward from the locality of *S. rowelli*, a smaller form of the species was collected by Mr. Ferriss (Pl. XVIII, fig. 35), and also by Mr. Ashmun. The umbilicus is narrower and more covered by the dilated lip than in Sanford's *rowelli*, and the last whorl descends more deeply in front. The shells measure:

	83,268, Ferriss coll.		*73,604, Ashmun coll.*			
Alt.	9	8	8	8	8	mm.
Diam.	15.4	14	14	14	13.5	"
Alt. apert.	7.8	6.9	6.8	6.8	....	"
Diam. apert.	8.5	7.8	7.7	7.5	....	"

One of Mr. Ferriss' specimens (fig. 35) was sent alive, and proves to be like the Sanford's *rowelli* anatomically, differing merely in the smaller size of all the organs, except that there is no perceptible flagellum (Pl. XX, fig. 20, the terminal ducts only are drawn). The jaw (Pl. XXIII, fig. 18) has about 6 narrow equal ribs.

The type measurements of *H. rowelli* given by Newcomb are alt. .4, diam. maj. .6, min. .5 inch., about equal to 10, 15, 12.5 mm. The type is in the collection of Cornell University.

Sonorella granulatissima Pils. Pl. XVII, figs. 21–23.

Nautilus, XVI, p. 32, 1902.
Bartsch, Smiths. Misc. Coll., Vol. 47, p. 193, Pl. 32, fig. 4.

The shell in the co-types of this species is thin, pale, with a rather wide dark chestnut band without white borders, and visible above the suture on the last 2½ or 3 whorls. The surface is very minutely and very densely granulated over the usual low growth-wrinkles. Near the periphery some faint traces of spiral lines may be deciphered in places, but they are so slight that they would have been overlooked if not especially looked for. The umbilicus is small. The two co-types measure:[5]

[5] These measurements differ slightly from those given in the original description, due to the fact that at that time I used only a flat millimeter rule, upon which it is, I find, impossible to read correctly the dimensions of globose shells.

Alt.	10.4	10 mm.
Diam.	19	18.5 "
Alt. apert.	9.5	8.7 "
Diam. apert.	10.4	9.7 "
Umbilicus	2.5	2.7 "

They are from "Spring Canyon," near Fort Huachuca, No. 83,257, A. N. S. P.

The sole is indistinctly tripartite, the middle field ochraceous, the sides dusky; the colors separated by very faint lines. The upper surface is blackish-gray, evenly pebble-granose. A subobsolete dorsal line is discernible, and a very weak line on the tail, not quite median.

The two co-types were dissected. The genitalia (Pl. XX, figs. 16, 17, 18) are characteristic by the proportions of the penis and vagina. The penis is short, cylindric, composed of a thin-walled sack containing a large, fleshy, cylindric papilla (fig. 18). Epiphallus and flagellum (fig. 16) as usual. The vagina is large, *very long* and muscular, *about three times the length of the penis*. Its upper portion is swollen and sometimes fusiform. Other organs as usual (see table of measurements).

The jaw (Pl. XXIII, fig. 23) has four very wide, low, flat ribs.

The radula has 36.1.36 teeth, the central and inner laterals unicuspid, the eleventh showing a minute ectocone. Most of the marginal teeth have both cusps bifid.

2. Brown's Canyon. One specimen similar to those from Cave Creek, Ida and Bear Canyons, 11.8 x 19 mm.

3. Ramsey Canyon. The shells are darker than the types, beautifully granulated, and show distinct spiral lines on the top of the last whorl. Umbilicus typical.

4. Carr Canyon (Pl. XVIII, figs. 51–54). These shells show the spiral lines more or less distinctly. They are otherwise typical, but vary a good deal in size.

5. Miller Canyon (Pl. XVIII, figs. 41, 42, 43). Of a rich dark reddish color with a wide darker band, well granulated and showing weak or excessively faint spirals. More depressed than any other *granulatissima* seen; and in some specimens the umbilicus is decidedly wider, 3 mm. in a shell 18.5 mm. diameter.

There were also some much lighter, greenish-yellow shells taken in Miller Canyon (Pl. XVIII, figs. 39, 40, 44). They are much depressed, with a wide umbilicus and very distinct spiral striation (Pl. XI, fig. 10). They photograph abnormally dark.

	(*Ramsey Canyon*)			(*Carr Canyon*)			
Alt.	10.7	11	11.1	11.8	10.8	10.2	11.3
Diam.	19.9	19.5	19.2	20.5	18.8	17.5	17.7

	(*Miller Canyon*)			
Alt.	11.5	10.7	9	mm.
Diam.	20	19.6	18.5	"

6. On the south side of the range, specimens were taken in Cave Creek Canyon, typical in form and sculpture, but larger, 12.6 x 20.8 mm.

7. Ida Canyon (Pl. XVIII, figs. 36, 37, 38). Typical in shape and color, but with slightly effaced granulation, very weak spirals, and variable size.

Alt.	11.9	10.4	9.3	mm.
Diam.	21.3	19.8	17.8	"

8. Bear Canyon. Similar to the Cave creek form, 11 x 19.3 mm., or more depressed, like Miller Canyon shells, 10.7 x 20.8 mm.; umbilicus 2.9 mm.

Sonorella granulatissima parva n. subsp. Pl. XVIII, figs. 45–47.

Shell with the sculpture of *S. granulatissima*, but much smaller, and *subangular at the periphery.* Whorls 4½, convex, parted by well-impressed sutures, the last moderately descending in front. The band is wide, without pale borders, and is visible on two or two and a half whorls.

Alt.	9.3	10	9	mm.
Diam.	16	16	15.2	"
Alt. apert.	7.4			"
Diam. apert.	8.3			"
Umbilicus	2.4			"

West end of the Huachuca Mountains, between Fort Huachuca and Manilla Mine. Types No. 87,114, A. N. S. P., collected by James H. Ferriss, 1904.

Eleven specimens of this small form were obtained at the place mentioned. It is chiefly notable for the subangular periphery, very unusual in *Sonorella.* It is very similar to *S. mearnsi* Bartsch, differing in the wider umbilicus and more oblique aperture. *S. mearnsi* may prove to be a subspecies of *S. granulatissima*, but its internal anatomy is unknown.

Sonorella granulatissima latior n. subsp. Pl. XVIII, figs. 24–28.

This form is very similar to *S. granulatissima*, from which it differs in the usually larger size and the *more depressed last whorl.* The granulation is finer and less distinct than in typical *granulatissima*, and the umbilicus is slightly wider. The supraperipheral band is wide, and has no paler borders. There are 4¾ whorls, the last rather deeply deflexed. The embryonic shell is sculptured as in *S. hachitana*.

Alt.	12.	12	12.4	12	12
Diam.	23.6	23	22.6	22	22
Alt. apert.	11	10.5	10.8	9.8	10
Width apert.	11.7	12.2	12	11.4	12
Width umbilicus	3.2	....	2.6	3.3	3

Alt.	11.7	11.2	11.7	12.2 mm.
Diam.	22	21.9	21.3	20.5 "
Alt. apert.	10.7	10	9.8	9.4 "
Width apert.	11.9	11.5	11.2	10.9 "

Huachuca Mountains, in Brown's Canyon. Types No. 87,083, A. N. S. P., collected by James H. Ferriss.

The soft anatomy is unknown, but the form, while not conspicuously differentiated, is yet readily distinguishable from *S. granulatissima*. Specimens sent to Mr. Bartsch were pronounced by him to "stand half way between *S. dalli* and *S. granulatissima*."

Sonorella dalli Bartsch.

Smiths. Misc. Coll., Vol. 47, p. 193, Pl. 21, fig. 1 (October 10, 1904).

This form is somewhat larger and more depressed than *S. g. latior*. It is described as with "numerous microscopic granulations," but in one of the type lot kindly presented by Dr. Dall these are hardly appreciable. The type measurements are alt. 12, diam. 26.5, aperture 10.5 x 11.8 mm.; and Mr. Bartsch has kindly supplied the diameters of the rest of the series in the U. S. National Museum, as follows: Type lot, Tanner's Canyon, Huachuca Mountains, 26.5, 26.1, 25.9, 24.1, 24, the last two not quite mature. Huachuca Mountains, 25.3 mm. Fort Huachuca, 24.6 mm.

The smallest mature specimen of *S. dalli* slightly exceeds the largest *latior* by 1 mm., and the smallest adult *latior* measures the same as the largest *granulatissima*. *S. mearnsi* Bartsch, from the San José Mountains, 4 miles south of the Arizona boundary, measures 16 mm. diam., being 1.5 mm. smaller than the smallest adult *granulatissima*. It is quite conceivable that *S. dalli* and *S. mearnsi* are merely the extremes of dimensions in a continuous series of variations in size. Since *S. granulatissima* is the only form of the series known anatomically, the ultimate status of the others remains in abeyance. Some or all of them may prove to have valid anatomical specific characters.

Mr. Ferriss did not find *S. dalli*. He thinks that Tanner's is another name for Garden Canyon of the sketch map on p. 212.

Sonorella virilis n. sp. Pl. XVII, figs. 15, 16.

The shell is openly umbilicate; pale brown, lighter around the umbilicus, with a dark band above the periphery, and visible on about 2½ whorls above the suture, with borders a trifle paler than the ground color. Whorls 4½, the earlier 1½ forming a slightly rugose embryonic shell. The next 1 or 1½ whorls are striate, the striæ appearing slightly broken into granules. The last whorl has the usual slight growth-lines, and near the end some spiral lines are visible, in the vicinity of the suture. The whorl descends rather deeply, and is well rounded peripherally. The aperture is rather large, oblique and rounded, the upper, outer and basal margins about equally arcuate. The outer and basal margins of the thin lip are slightly expanded. Alt. 11, diam. 19.5, umbilicus 3.1 mm.; aperture 9.3 mm. high, 10 wide.

Chiricahua Mountains, at 7,500 feet elevation, collected by V. Owen. Type 79,622, A. N. S. P.

There are no longitudinal lines on the sole. The pebbly-granose back and the eye-stalks are blackish-gray, becoming much paler dirty brownish-white on the sides and tail. Dorsal grooves are but weakly indicated, and there is no longitudinal median line on the tail.

The kidney is wedge-shaped, 15 mm. long. Pericardium 5.5 mm. long.

Genitalia (Pl. XX, figs. 21, 22). *The penis is relatively enormous*, more than double the length of the vagina, and much longer than the spermatheca and its duct. It has the usual thin wall, enclosing a fleshy "papilla" about 29 mm. long (fig. 21). The epiphallus is also very long, slender and convoluted. The vagina is much convoluted. The spermatheca has the usual globular shape; and its slender duct, while long, is shorter than in other species of equal or greater size.

The jaw (Pl. XXIII, fig. 21) has four broad ribs grouped near the middle.

S. virilis is slightly smaller than *S. hachitana*, with more rounded aperture and weak spiral lines near the suture. From the shell alone I would not separate this form more than varietally from *S. hachitana*; but the enormously developed ♂ reproductive organs indicate one of the most distinct species of the genus. The jaw has few ribs, as in *S. h. bowiensis*. It is not closely related to any other species I have dissected.

The faint spiral lines of the shell are perhaps its most important differential feature.

Several lots collected by Mr. Ferriss in the Chiricahua Mountains resemble *S. virilis* in size, color and sculpture, but differ in having about one-fourth of a whorl more ($4\frac{3}{4}$), and a noticeably smaller aperture. The spiral lines, while visible in some places on all of them, in a favorable light, are often excessively weak. None of them, unfortunately, were sent in the flesh.

In Bar (or Bearfoot) Park, at the summit of the Chiricahuas, the specimens taken show some very weak spiral lines below the last suture.

Alt.	10.7	10.7 mm.
Diam.	18.9	18.7 "

In Sawmill Canyon, Chiricahuas, adjacent to Bearfoot Park, similar shells, diam. 18.7 to 19.9 mm., were taken (Pl. XVII, figs. 17, 18, 19, 20).

Sonorella virilis circumstriata n. subsp. Pl. XVIII, figs. 48–50.

In Cave Creek Canyon, Chiricahuas, the shells are darker throughout, reddish-brown, with a broad very dark chestnut band with wide pale borders, sometimes not very conspicuous. The last whorl shows weak but *distinct spiral engraved lines above the periphery*, in addition to the usual fine growth-striæ. The umbilicus varies from about 3.3 to 3.8 mm. in width. A. N. S. P., No. 87,026.

Alt.	11.6	11.3	11	10.8 mm.
Diam.	21	20.3	20	19.5 "
Alt. apert.	9.7	9.2	9	8.9 "
Diam. apert.	10.7	10.4	10	9.5 "

The genitalia (Pl. XX, fig. 19) in two specimens dissected agree in having several minor differences from typical *S. virilis*. The penis, while still extraordinarily large, is only about two-thirds as long as in *virilis*. The vagina is a fourth longer. The epiphallus is the same as in *virilis*.

This form may prove to be connected with typical *virilis* by intermediate stages, in which case the subspecies may prove superfluous; but at present the dark color, more distinct spiral striæ, and small aperture of the shell, and the somewhat differently proportioned genitalia, seem worth recording.

Sonorella virilis huachucana n. subsp. Pl. XVII, fig. 24.

Shell slightly more elevated than *S. hachitana*, with *much smaller umbilicus;* more elevated than *S. virilis*, which also is more widely umbilicate; glossy, thin, striate but without granulation. The top of the last whorl, near the aperture, shows *numerous weak spiral incised* *lines.* The supraperipheral band is rather wide and dark, with distinct *white or whitish bands both above and below* it. Above the upper white band the surface is pale reddish to the white sutural line. Below the lower white border the same reddish color prevails, but gradually fades on the base to whitish around the umbilical region. The dark band runs about 2½ whorls up the spire. Apex with sculpture like *S. hachitana.* Whorls 4¾, the last rather deeply descending in front. Aperture rounded-oval, the peristome thin, expanded, the dilated columellar end partially covering the umbilicus. Alt. 12.4, diam. 20.6, alt. aperture 10, width 11.5 mm.; width of umbilicus 2.4 mm.

Brown's Canyon, Huachuca Mountains. Type No. 89,225, A. N. S. P., collected by James H. Ferriss, 1904.

This beautiful snail is the only Huachuca form I have seen which seems closely related to *S. virilis.* Unfortunately, the soft parts were not preserved, and its exact relationships are thus uncertain. It is not very unlike *S. hachitana*, but I can see no spiral lines on some of the original lot of *hachitana* before me. The white bordering bands are particularly conspicuous. Only a few were taken by Mr. Ferriss.

In Bear Canyon, Huachuca Mountains, Mr. Ferriss found a few specimens similar to those from Brown's Canyon, but noticeably more depressed, with a smaller mouth and obtuse lip. One measures, alt. 11.5, diam. 20, aperture 9.8 x 11 mm., umbilicus 3 mm. wide. The shell is also somewhat more solid, and the spiral lines are more distinct. In both forms they are readily seen with a hand lens.

Genus **OREOHELIX** Pilsbry.

Helix, Patula and *Pyramidula* of authors.
A new genus of *Helicidæ,* Pilsbry, Proc. Acad. Nat. Sci. Phila., 1902, p. 511.
Oreohelix Pils., Nautilus, XVII, p. 131, March, 1904.

The shell is umbilicate, varying from discoidal to pyramidal, with 4 to 6 tubular or carinate whorls; earthy, with thin cuticle or none. Embryonic whorls with radial and usually spiral sculpture and carinate periphery. Aperture rounded, oval or angular, oblique, the columellar lip dilated, the outer lip blunt or acute, unexpanded. The sole is undivided. Foot granulose and blackish above or smoothish tessellated with gray. A pair of dorsal grooves is present and usually a distinct genital groove. The tail is depressed above. No parapodial furrows.

The lung has thin-walled venation, chiefly on the cardiac side. *The kidney is short,* but little longer than the pericardium; has a large lumen with coarsely plicate walls, and the usual reflexed ureter. The secondary ureter is closed throughout in the species examined (Pl. XIX, fig. 1, *O. strigosa* var., Pecos, New Mexico).

The penis is well developed, its lower part being muscular, and plicate within, the upper part thinner and densely, finely papillose inside. The epiphallus is well developed, with terminal vas deferens or with a terminal tubercle (representing the flagellum) and a sublaterally inserted vas deferens. The vagina is rather long. The globular or ovate spermatheca terminates a slender duct nearly as long as the uterus. *Reproduction is viviparous.*

The retractor muscle of the penis arises from the apex of the penis and base of the epiphallus, or from the epiphallus near its base, and is inserted on the lung floor. The right ocular retractor passes between the ♂ and ♀ branches of the genitalia.

The jaw is strong, arcuate, its anterior face more or less distinctly striated vertically; and there are sometimes very weak traces of ribs. The radula is of the ordinary Helicid type. In some species the median area has unicuspid teeth, the cutting-edges usually overhanging the sides of the mesocone; while in others distinct ectocones are developed in all the teeth. The marginal teeth are bicuspid, the cusps unsplit as a rule, though there are exceptions where the inner of the two cusps is bifid.

Type *Helix strigosa* Gld. Distribution, Rocky Mountain region from the Canadian to the Mexican boundary.

This dominant type of *Helicidæ* in the area indicated above formerly extended farther east, one species occurring in the loess of Iowa, and there is one outlying species westward, *O. avalonensis* Hemph., on Catalina Island, California. In its present area the type has been interminably modified into local races of all grades of differentiation, *more than fifty of these having received names.*[6] It is true that in some ranges every canyon—I might almost say every rock-heap—has its own race; but in a broader view it is seen that a single strain usually extends over an entire range with numerous minor modifications, and with increasing elevation a general diminution of size, loss of sculpture and often intensification of color. These reduced forms are probably due to the diminished food supply and especially the shorter growing season in the heights—factors subject to great local variation, even at equal

[6] The number of species of *Oreohelix* is uncertain. About fifty forms of all degrees of differentiation have been described and named. My treatment of the group in former publications (*Manual of Conchology*, VIII, p. 115, IX, p. 50; *Catalogue of the Land Shells of America*, etc., pp. 31, 32 (1898), was unduly influenced by the views of Binney and Hemphill, both of whom advocated the inclusion of the entire series as varieties of *P. strigosa*. The characters of the shells, penes and teeth indicate, in my opinion, that the species are somewhat numerous; but their notorious variability cautions us to beware of multiplying them without ample materials.

altitudes. To attain a true idea of the relationships of any given alticolous dwarf it is essential to know the forms of the lower canyons of the same region.

The first step toward a fundamental knowledge of the races and species of *Oreohelix* must be the study and definition of races in the broad sense above indicated. In my opinion, the minor modifications can be so overnamed that the wider distinctions become altogether lost, as in the Utah series. The field is vast, and for many years to come there will be plenty of room for work. Anybody who secures a good series of the forms of any district can materially help the cause by working them up.

The sculpture of the embryonic shells and the genitalia seem to afford the most important characters for specific classification. It would take us too far afield to discuss the entire mass of data at hand. This must be reserved for another occasion. Only forms from central and southern Arizona and New Mexico are dealt with below.[7] The measurements of the genitalia in millimeters follow:

Species	*Penis*	*Epiphallus*	*Vagina*	*Spermatheca and duct*	*Diam. of shell*	*Mus. No.*
O. strigosa, Pecos	16.3	6.3	5	21	18.5	85,100
O. elrodi	17	6	8	19	22.5	79,475
O. s. huachucana	14	6.5	5	22	21	83,370
O. barbata	6	4	....	13	13.5	87,011
O. yavapai	5	3	....	....	15–16	79,415
O. y. neomexicana	4	2.1	....	....	15	80,700

The species thus far dissected show considerable differences in the genitalia, chiefly in the proportions and shape of the penis, the forms falling into three groups, as follows:

[7] For comparison with the southern forms I have, however, figured the anatomy of *O. elrodi* (Pils.), from Montana, Pl. XIX, fig. 2. The penis is like that of *O. strigosa*, from Pecos, the lower third having thick walls, densely plicate within; above that the walls are thinner, densely lined with long papillæ, and in the upper third there are several low fleshy ridges, also papillose. There is an extremely short, conic penis-papilla in the apex. The vas deferens enters the epiphallus centrally. The vagina is much dilated and muscular above. The uterus is provided with muscular strands forming an incoherent protractor muscle (fig. 2, *r.u.*). The embryos were packed in like coins except the two lower ones. The dimensions are given in the table.

1. Penis long, the distal half strongly twisted, there being two distinct kinks, resulting in convolutions variously disposed, and of course not always falling the same in the same species or variety. *O. strigosa*, from Pecos, and *O. elrodi* (Pl. XIX, figs. 3 and 2) belong here.

2. Basal half of the penis swollen and muscular, the distal half smaller, without distinct kinks. *O. s. huachucana* and *O. barbata* (Pl. XIX, figs. 6 and 5) are of this type.

3. Penis small, short, the basal half not much larger than the distal portion, the latter not kinked. *O. neomexicana* and *O. yavapai* (Pl. XIX, figs. 7 and 9) have penes of this kind.

All the above have the penis longer than the epiphallus. In the subgenus *Radiocentrum* the epiphallus is as long as the penis or longer.

As yet my observations have covered only about a dozen of the numerous species and subspecies; and until more of the forms of the central and northern States are examined, characters of the soft anatomy cannot be fully utilized in classification.

There are two types of dentition in *Oreohelix*. The ordinary forms have unicuspid central and inner lateral teeth. Here stand *O. strigosa, cooperi, newcombiana, huachucana, yavapai, neomexicana* and *haydeni*. In the second type of teeth ectocones are developed on all of the teeth, the centrals being thus tricuspid, the lateral and marginal teeth all bicuspid. Of this kind are *O. idahoensis, O. hemphilli, O. barbata, O. chiricahuana* and *O. clappi*, but in the last species the ectocones are not well developed.

The series of Huachuca Oreohelices shows that colonies of the same original stock vary greatly and often show parallel variations in different canyons.

Those from the greatest altitudes are smallest (Pl. XXIV, figs. 25–27, 29–32, Limestone Mountain, 8,000 feet; Pl. XXIV, fig. 28, Carr Canyon, 7,000 feet, etc.), though some large shells occur elsewhere at equal elevations.

Conspicuously banded shells were taken only at high elevations (Pl. XXIV, figs. 17, 18, Brown Canyon, 7,000 feet), plainer ones occurring lower down in the same canyon; but not all the high altitude shells are so marked.

Gerontic or senile individuals or colonies are common, manifested by deep descent of the last whorl in front, with a tendency to form a free or solute peristome (Pl. XXV, figs. 33–35, Ida Canyon).

The carinate periphery is an ancestral character of *O. strigosa* and its allies, present invariably in the neanic stage. It will be noted that in most colonies there is great individual variation in the extent to which it has been replaced in the adult stage by a rounded periphery.

Oreohelix strigosa (Gld.).

Various forms referable to *strigosa* occur in New Mexico, such as those sent from the Red river (Ashmun), Pecos (Cockerell), Canyon Diablo, near Rowe (Miss Cooper), and Big Spring, 5 miles east of Zuñi (H. S. Conard). They are two-banded, with the periphery of the last whorl rounded, not differing from the forms commonly found farther north, but slightly unlike the typical Northwestern *strigosa*. The exact affinities of these forms await further investigations now in progress.

I have examined the internal anatomy of specimens from Pecos, New Mexico. The shells are either rounded or subangular at the periphery in adults. Sculpture of sharp, irregular growth-wrinkles or striæ, decussated by slightly impressed spiral lines both above and below. The color varies from yellowish Isabelline to light reddish, with paler striæ, always with two narrow bands, and in one specimen a third band around the umbilicus. The embryonic shell is strongly carinate. The first whorl is convex and almost smooth; then fine, regular, obliquely radial striæ appear, and continue to the end of the embryonic shell of 2 to $2\frac{1}{3}$ whorls; over them there is an extremely minute regular spiral striation, and on the last half whorl coarser, spaced spirals (Pl. XXV, figs. 45, 46, 47).

The specimens examined were taken August 9, 1903. The penis is very long and strongly twisted. The basal third of its length is cylindric, the rest more or less lank, partially collapsed. Internally the basal third (5 mm.) is rather finely plicate longitudinally, thick-walled; the rest has larger lumen and thinner walls, which are densely papillose within, the distal half having three low fleshy internal ridges. The penial retractor is inserted upon the end of the penis and the base of the epiphallus, which is decidedly less than one-half the length of the penis. The vagina is subcylindric. The uterus is distended with embryos, of which there are 9, with shells 3 to 4 mm. in diameter (Pl. XI, figs. 14, 15). Each is enclosed in a membranous capsule, apparently the podocyst. Some of them seem to have a small cephalic vesicle. The other ♀ organs call for no especial notice (Pl. XIX, fig. 3).

The pallial organs have been described above. The kidney is 6.7, the pericardium 4.6 mm. long.

The foot is slate-blackish and finely granular above, the dorsal furrows distinct. The distinct genital furrow is duplicated on the left side.

The jaw (Pl. XXIII, fig. 25) has fine vertical striæ.

The radula (Pl. XXII, figs. 1, 2, 3) has 29.1.29 teeth. Central and inner lateral teeth are unicuspid. An ectocone appears on the eighth or ninth teeth. The marginal teeth are all bicuspid (fig. 2).

Mr. Binney has figured the genitalia of a specimen of *strigosa* from Salmon river. Just what race it belongs to is not positively known. It differs from the Pecos form of *strigosa* by the shorter, apparently untwisted penis. The epiphallus and vagina are also shorter. He figures the teeth of *strigosa* with the ectocone split on an extreme marginal, and the radula had 50.1.50 teeth—a far greater number than I have encountered in this genus. The teeth of *O. haydeni* as figured by Binney are like those of Pecos *strigosa*, and 33.1.33 in number. *O. elrodi* has 28.1.28 similar teeth, the tenth with an ectocone, marginals bicuspid.

Forms referable to *Oreohelix cooperi* have been found by Prof. Cockerell in central New Mexico. None were turned up in the regions explored by Mr. Ferriss.

Oreohelix strigosa concentrata (Dall).

Patula strigosa var. *concentrata* Dall, Proc. U. S. Nat. Mus., XVIII, 1895, p. 1; XIX, p. 336.

This was described from a dwarf form of the mountain tops, the types from the summit of the Huachuca Mountains, Cochise county, Arizona. Through the courtesy of Dr. William H. Dall, I have one of the typical lot (No. 89,237, A. N. S. P., from No. 129,999, U. S. Nat. Mus.), and a series from the top of Hacheta Grande, 9,000 feet elevation (No. 65,742, A. N. S. P.).

1. Typical *concentrata* is white with two dark red-brown bands, the lower one wider, and some livid clouding on the upper surface. The 5 whorls are convex, the last rounded peripherally, with a slight and inconspicuous trace of angulation at its origin. *The umbilicus is widely open, very ample within.* Sculpture of low, rude, nearly effaced wrinkles, with no trace of spiral lines anywhere. The type measures alt. 8, diam. 16 mm., the specimen before me 7.8 x 14.8 mm. with the umbilicus 4 mm. wide.

O. s. concentrata is a relatively evolved form, having lost the keel on the last whorl. The embryonic whorl seems to be similar to that of *huachucana*. There are no spirals on the last whorl. Diam. 14 to 16 mm.

The following lots from the Huachucas seem referable to *concentrata*.

2. Carr Canyon, 7,000 feet (Pl. XXIV, fig. 28). Similar to typical *concentrata*, with the same depressed shape, very ample umbilicus and nearly effaced sculpture, but fine radial ripples are visible on the em-

bryonic whorls in the least worn shells; broadly two-banded with chestnut, blackish in places, the upper band sometimes extending to the suture.

Alt.	9	8.7	10 mm.
Diam.	15.2	15	15 "

3. Limestone Mountain, Huachucas, south side at 8,000 feet elevation (Pl. XXIV, figs. 29–31). The shells are whitish with some fleshy or livid streaks or dots, and with two bands, or clouded and suffused with purple-brown. Similar to typical *concentrata* except that the umbilicus is decidedly smaller within. The last whorl descends to the aperture. They are like *O. s. huachucana*, No. 3, from Brown Canyon, in miniature. They are rounded or slightly angular in front. *The sculpture is subobsolete,* without a trace of spirals.

Alt.	8.9	8.4	9.5 mm.
Diam.	15.2	15.3	15 "
Whorls	5	$4\frac{3}{4}$	5

Scalariform monsters are not rare, but the inception of that abnormal condition seems to be invariably traceable to an injury of the shell. One such is figured (Pl. XXIV, fig. 31).

4. Limestone Mountain, south side, 8,000 feet. Like the preceding, but more elevated and fleshy white with pinkish apex. The last whorl descends rather deeply (Pl. XXIV, fig. 32).

Alt.	10	9.7	8.7 mm.
Diam.	15.3	15.5	13.7 "

5. Limestone Mountain, north side, 8,000 feet. Similar to the two preceding lots in size and sculpture, but broadly two-banded with purple-black, or entirely of this color (Pl. XXIV, figs. 25, 26, 27). This lot resembles *O. s. huachucana*, Nos. 11, 12, from Carr Canyon, which are also from a high altitude. No. 5 from 7,000 feet, Brown Canyon, has also similar coloring, but is much larger.

This lot, like all seen from Limestone Mountain, does not have the umbilicus so wide within as in typical *concentrata*.

Alt.	9	8.8	9.3 mm.
Diam.	16.3	15.5	15.2 "

6. The series of five specimens sent by Dall as *O. s. concentrata* from Hacheta Grande Mountain, Grant county, New Mexico, one of which is figured on Pl. XXV, fig. 60, shows no appreciable divergence from the

co-type before me, having the same ample umbilicus and blunted sculpture. Whether these shells are to be regarded as really identical with the Huachuca *concentrata*, or as a parallel dwarf race independently evolved, is a question remaining to be determined by a study of the forms from the lower canyons of the Hacheta Grande Mountains.

Oreohelix strigosa huachucana (Pils.). Pl. XXIV, figs. 5–7 (types).

> *"Pyramidula" strigosa huachucana* Pils., Proc. Acad. Nat. Sci. Phila., 1902, p. 511.[8]

1. The types are from "Conservatory Canyon," otherwise known as Ramsey Canyon, on the northeastern slope of the Huachucas between Brown and Carr Canyons.

They are depressed with a broad umbilicus, exposing more of the penultimate whorl than *strigosa*,[9] and it is also more ample within. There are 5 whorls, of which 2½ are embryonic. The tip is a little depressed; the first whorl is delicately striate or wrinkled in an obliquely radial direction. On the second whorl weak raised spiral lines usually set in; and the last embryonic whorl is rather coarsely, irregularly wrinkled radially, and finely striate spirally, with (in some shells) several raised threads on the last half whorl. These cease abruptly at the end of the embryonic stage. The following whorls are irregularly, obliquely wrinkled and have at most obsolete spiral lines or traces of them in places, often almost imperceptible. *The base has no spiral striation as a rule*, but in some specimens from Carr Canyon there are faint spirals there. Up to the end of the fourth whorl the periphery is strongly carinate, but in adult shells it is nearly angular in front, the last half or more becoming rounded. The suture follows the crest of the keel, and usually descends a trifle to the aperture.

The shell is flesh-colored above, with irregular whitish streaks or maculæ; beneath, the opaque white predominates more, and there is a purplish-brown band close to the periphery (but 4 or 5 of 25 examined are equally flesh-tinted beneath, and lack the band, Pl. XXIV, fig. 8). The aperture is small, very oblique, with the ends of the lip approaching. The peristome is not expanded.

Alt. 10.5, diam. 21.8, width of umbilicus 6 mm.; aperture 8.8 mm. wide. Types No. 83,370, A. N. S. P., collected by James H. Ferriss.

The reproductive system of one of the types is figured (Pl. XIX,

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[8] It was evidently this race which Dr. R. E. C. Stearns reported from Fort Huachuca as *Helix* (*Patula*) *hemphilli* Newc. (*Proc. U. S. Nat. Mus.*, XVI, 1893, p. 745), and Dall from the Huachuca Mountains, as *P. strigosa* (*Proc. U. S. Nat. Mus.*, XIX, 1896, p. 335).

[9] The comparisons are with typical *O. strigosa* from the extreme Northwest, which is identical with Hemphill's var. *parma*.

fig. 6). It was taken in February, during the inactive season, and the uterus is quite small. The dimensions of the organs are given in the table (p. 270). The lower half of the penis is much swollen, the upper half smaller and lank. When opened the basal narrower portion is found to have strong acute folds; these become weak in the swollen part, which contains a large fleshy process adnate to the upper side. The contracted upper portion of the penis is papillose inside, with three low ridges.

The retractor muscle and epiphallus are as in Pecos *strigosa*. The ♀ organs show nothing noteworthy.

The radula (Pl. XXII, fig. 5, group of transitional teeth) has 30.1.30 teeth. Those of the median area are much as in Pecos *strigosa*, with overhanging mesocones only. The ectocone begins weakly on the sixth or seventh, and is well developed on the eleventh tooth. The marginal teeth are all bicuspid, the cusps unsplit.

O. s. huachucana is widely distributed in the canyons of the Huachuca Mountains, and nearly every colony has some individual features. "Sometimes only one form was found in a colony, but usually they vary in color and form. They are slow travelers and hence the distinctive characteristics of the colonies. They had not encroached at all upon the ground burned over two years ago. Colonies on different sides of the divides between canyons were entirely different, even when but a hundred or two hundred feet apart" (Ferriss).

Brown Canyon, Huachuca Mountains. Numerous colonies in this canyon vary in color, but in all the periphery of the last whorl may either be rounded, as in the type lot, or the acute keel of the young may extend upon the first third or half. The color-forms of the individual colonies are as follows:

2. Solid, *opaque pinkish-white*, with a few fleshy streaks and scattered dots. Sculpture weak (Pl. XXIV, figs. 9, 10).

3. Similar, but with a narrow band on the upper surface and on the base a band below the periphery, as in the typical form. Frequently the upper surface is largely fleshy-brown. This is an abundant form, differing from the Conservatory Canyon race only in the frequent retention of the keel in adults (Pl. XXIV, figs. 11, 12, 16).

4. Dull brown predominates throughout. Usually there are no bands (Pl. XXIV, figs. 13, 14). This and all the preceding from Brown Canyon are from about 7,000 feet. Some specimens are like the following form. In one gerontic colony at 6,000 feet the peristome is contracted and continuous in old shells (Pl. XXIV, fig. 15).

5. A broad, blackish-chestnut band below the periphery, the rest

of the base whitish, often dotted. Upper surface also dark brown, usually with a light line below the periphery (Pl. XXIV, figs. 17, 18). 7,000 feet elevation.

6. Ramsey Canyon, Huachuca Mountains, collected in 1904, and evidently from a different colony from the types collected in 1902. Two specimens received are dirty whitish. The whorl descends very deeply to the aperture. They are markedly gerontic.

Alt. 9.5, diam. 17.3 mm.
" 10, " 16 "

Carr Canyon, Huachuca Mountains. In this canyon most or all colonies have the form with rounded periphery, and that with it acutely carinate on the first half of the last whorl. The spire is usually sharply striate obliquely, and the last whorl is frequently striate spirally. The special tendencies of this canyon are most strongly expressed in No. 12.

7. Carr Canyon, 5,500 feet. Similar to No. 4, Brown Canyon, except that the sutures are less impressed, nearly level, and margined very distinctly above by the keel. In some shells the last whorl is rather distinctly decussate by spirals above. In one specimen the suture is deeply deflexed above, as in the Ramsey Canyon shells. A basal band is sometimes present.

Alt.	12	10.5	9.8	10.8 mm.
Diam.	21	19.5	18	18 "

8. Carr Canyon, 5,500 feet. One specimen is similar to No. 7; the other three, measured below, are more calcareous, resembling No. 2, but the whorl is deflexed anteriorly (Pl. XXIV, figs. 21, 22, 23). In one the keel extends to the aperture, though rather weakly.

Alt.	10	9.8	8.6 mm.
Diam.	20	18.8	18.8 "

9. Carr Canyon, 6,000 feet (figs. 19, 20). Shells like No. 3, Brown Canyon, but not so white, the ground color being light brown, and the oblique striation sharper. Two specimens show a second band on the base.

Alt.	11	12	11	10 mm.
Diam.	19.8	19	18.7	17.4 "

10. Carr Canyon, 6,000 feet (fig. 24). Similar to the preceding, but the ground is much darker, like No. 4. Diam. 18.6 to 19.5 mm.

11. Carr Canyon, 7,000 feet. *Blackish-chestnut,* the inner whorls

paler; striation sharp; *spirals well developed on the last whorl;* not carinate. Alt. 8.8, diam. 14.7 mm. (Pl. XXV, fig. 36).

This lot is dwarfed, about the size of *O. s. concentrata*.

12. Another lot from Carr Canyon, altitude not stated, contains whitish bandless shells and brownish ones, uniform or banded like No. 7. One is carinated to the aperture and all are keeled in front. The sculpture consists of fine, sharp rib-striæ on the spire, and when fresh, young shells show cuticular laminæ on the costulæ, larger at intervals and at the periphery. The base has a similar sculpture. The last whorl is spirally striate above and below. Diam. 21 mm. (Pl. XXV, figs. 37, 38, 39, 40).

It may be noted that Dall has reported "a sharply carinated variety" from Tanner's Canyon, Huachuca Mountains (*Proc. U. S. Nat. Mus.*, XIX, p. 335).

Mr. Ferriss notes that the young are hirsute. This form diverges quite markedly from *huachucana* and to some extent parallels *O. barbata* of the Chiricahuas. It was found in one small colony only (No. 79 of Mr. Ferriss' coll., 87,132, A. N. S. P.).

13. Miller Canyon, 5,000 feet. Very large, depressed shells with 0, 1 or 2 bands, ground color fleshy-white or brown. Periphery rounded, or in one specimen angular in front (Pl. XXIV, figs. 1, 2, 3, 4, the last immature).

Alt.	14	13.6	13	12 mm.
Diam.	24.5	23	23	21 "

14. Miller Canyon, 5,500 feet. Similar to the preceding.

On the opposite side of the range specimens were taken in Cave Creek and Ida Canyons.

15. Cave Creek Canyon, 5,500 feet. Whitish or brown-banded specimens like Nos. 3 and 4 (Pl. XXV, figs. 41, 42, 43).

16. Ida Canyon. Whitish specimens, angular or rounded in front, and with or without a band. The whorl descends more or less in front, and some gerontic forms occur. Diam. 19.8 to 22 mm. (Pl. XXV, figs. 33, 34, 35).

Oreohelix strigosa metcalfei Ckll. Pl. XXV, figs. 44, 48, 52.

Nautilus, XVIII, p. 113 February, 1905.

The shell is calcareous, whitish with corneous and brownish streaks and dots, and a dark brown band below the periphery. The upper surface is rather rudely wrinkled obliquely, but scarcely shows spirals; but *the base is closely and in most specimens rather distinctly spirally striate.* Embryonic shell like that of *O. s. huachucana.* The whorls have an *acute, projecting carina which continues to the aperture,* and are flat above it, forming a straightly conic spire. Suture not impressed. The last whorl descends in front. Aperture rather small, as in *O. s. huachucana*. Umbilicus ample within, as in *huachucana*.

Alt.	12	10.2	10.6 mm.
Diam.	21	19.5	20 "
Whorls	$4\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{1}{2}$

Mountains near Kingston, Sierra county, New Mexico, collected by O. B. Metcalfe.

This form stands close to the *huachucana* series, from which it differs only in the spiral striation of the base, which is usually quite distinct though very minute,[10] and in the persistence of the peripheral keel to the aperture. In the last feature it is less evolved than *huachucana*. In some specimens of the latter the keel also persists, though less strongly.

Oreohelix strigosa socorroensis n. subsp. Pl. XXV, figs. 49–51.

The shell is thin, with $2\frac{1}{2}$ embryonic whorls closely and *sharply obliquely striate*, with a few low, coarse, indistinct spirals on the last embryonic whorl. Whorls $4\frac{1}{2}$ to $4\frac{3}{4}$, convex, the later ones rudely but not coarsely wrinkled, without noticeable spirals above, but *the base is very densely and distinctly striate spirally*. The last whorl is quite convex above and below a cord-like peripheral keel, which extends nearly or quite to the aperture. The last whorl descends a little and slowly in front. The umbilicus is rather small, but enlarges at the opening. Aperture as usual.

Alt.	8	9.2	8	8.8 mm.
Diam.	15	14.8	13.5	13.3 "

Negra Mountains, Socorro county, New Mexico. Types No. 58,128, A. N. S. P., presented by Dr. W. D. Hartman, collector unknown.

Related to *O. s. metcalfei*, its neighbor on the south, but that is a more strongly carinate shell with flat whorls and straightly conic spire. They agree in the beautiful circular striation of the base.

Oreohelix barbata n. sp. Pl. XXV, figs. 57, 58.

The shell is broadly and openly umbilicate, depressed, biconvex, carinate, pale brown, lusterless; obliquely closely lamellose costulate, the lamellæ lengthened into a cuticular fringe at the periphery, and at several places on the base, forming circular fringes there. A similar

[10] In some specimens of *huachucana* from Carr Canyon, such as Pl. XXV, fig. 36 and figs. 37–40, the base is spirally striate, but it is not so in *huachucana* from other places.

but less developed one runs in the middle of the upper surface of the last whorl. The embryonic shell of nearly two whorls is not distinctly defined from the subsequent growth; the first whorl is smoothish with some radial wrinkles only; the second is densely obliquely costulate, with cuticular lamellæ on the fine riblets in perfectly preserved examples. There are weak traces of a few coarse, low spirals. Whorls 4, rather rapidly increasing, the last slowly descending in front, very convex beneath. The aperture is very oblique, shortly pear-shaped, the peristome simple, upper and lower margins much converging and straightened, connected by a short and thin parietal callous.

Alt. 7, diam. 13.5 mm., not including the cuticular processes.

Cave Creek Canyon, Chiricahua Mountains, Arizona, collected by J. H. Ferriss. Co-types No. 87,011 and 87,146, Coll. A. N. S. P. It lives in a moist situation, in stone talus near the falls of the stream.

Cuticular processes or "hairs" are generally present on the shells of very young Oreohelices, but in this one alone their development culminates in the adult snail. Their projection at the angle of the whorls of the spire makes the lamellæ look continuous over the sutures. When denuded the shell is sharply striate, with some ill-defined spirals marking the positions of the more prominent cuticular wreaths. Besides those described above, there are some minor and variable spirals on the most perfect specimens.

The processes are very efficient as gatherers of soil, which is probably glued on by the mucous of the animal, as usual. In the general plan of ornamentation, this bearded *Oreohelix* is not unlike *Polygyra* (*Stenotrema*) *pilsbryi* Ferriss.

By its tricuspid central and bicuspid lateral teeth, as well as by the general form of the shell, *O. barbata* recalls *O. hemphilli*, especially when denuded of the "beard." The embryonic sculpture is not very unlike some forms of *hemphilli*, but it most resembles that of *O. s. socorroensis*, though a little coarser. The insertion of the penis retractor solely on the epiphallus is like *Radiocentrum*, and unlike any of the typical Oreohelices.

The foot of *O. barbata* is small, slate-blackish above, and finely granulated. No genital furrow is discernible, but there is a pair of dorsal grooves. The tail is flattened and pale above. The mantle edge is very thick and fleshy.

The genitalia of one of the types are figured (Pl. XIX, fig. 5). The penis resembles that of *S. strigosa huachucana*, the lower half being much swollen, the upper half smaller and cylindric. Internally the larger portion has 4 or 5 large and some smaller longitudinal folds, the upper part is densely papillose inside. The epiphallus bears the penis-retractor muscle, some distance from its base, and the vas deferens enters centrally at the end. The duct of the spermatheca is somewhat swollen basally. The uterus contained neither eggs nor embryos, the specimens having been collected in February.

The radula (Pl. XXII, fig. 6) has 23.1.23 teeth. The mesocones are long, and *all the teeth have well-developed ectocones.* The marginal teeth are bicuspid as usual, the cusps unsplit.

Oreohelix yavapai n. sp. Pl. XXV, fig. 53.

Shell thin, whitish more or less stained with brown, with a faint brown band above and another close below the periphery. The small peripheral keel extends to the aperture, but is pinched up less than in *neomexicana;* the last whorl elsewhere is well rounded, the earlier whorls flattened. Embryo of 2½ whorls, the first nearly smooth, convex, the next more flattened, finely, densely striate obliquely, and *very strongly striate and ribbed spirally.* At the end of the embryonic stage this *spiral sculpture abruptly stops,* and is succeeded by sharp oblique striation which becomes cut by a few spiral lines. On the last whorl there are more spirals, usually emphasized as series of granules or pits upon the oblique striæ (indicating cuticular processes in perfectly fresh shells). Whorls about 5⅓, the last hardly descending in front. The umbilicus is ample, as in *O. y. neomexicana.* Aperture oblique, rounded, with thin lip.

Alt.	8.7	9.5 mm.
Diam.	15.2	16.6 "

Purtyman's ranch, on Oak creek, Yavapai county, about 40 miles from Jerome, Arizona (northwest of the center of the Territory), types No. 79,415, A. N. S. P., collected by E. H. Ashmun. Also found on the summit of Mt. Mingus, near Jerome, and fossil in a road cutting in Walnut Gulch, near Jerome (Ashmun).

Dr. R. E. C. Stearns reported a form probably identical with *O. yavapai* from Coon Mountain, a curious crater about 10 miles south of Canyon Diablo, and about 3 days' travel from Flagstaff, Arizona (*Patula strigosa* Gld., *Nautilus,* VI, May, 1892, p. 1; *Proc. U. S. Nat. Mus.,* XVI, p. 745).

The embryonic young shells, 2 mm. diameter with 2½ whorls, are acutely carinate (Pl. XI, fig. 13).

This species differs from *O. strigosa* in the form of the shell, which is more like *O. hemphilli,* and by the diminutive penis, while the epiphallus is longer in proportion than in forms of *strigosa* I have examined ; it differs from *O. y. neomexicana* chiefly by the stronger spiral sculpture of the embryonic shell and the abrupt change in sculpture at the inception of the neanic growth. The same differences and the wider umbilicus separate it from the northern *O. hemphilli*, which, moreover, differs by its dentition, as indicated below under *O. y. neomexicana.*

The penis (Pl. XIX, fig. 7) resembles that of *O. y. neomexicana* except that it is larger, and the vas deferens enters the epiphallus centrally at the apex. There were 10 embryos in the uterus, each half enveloped in its podocyst.

The jaw has longitudinal and vertical striæ. The radula (Pl. XXII, figs. 7) has 26.1.26 teeth, those in the middle unicuspid; the ectocone distinctly appearing on the sixth. Marginal teeth bicuspid, the cusps unsplit.

Oreohelix yavapai neomexicana n. subsp. Pl. XI, figs. 8, 9 ; Pl. XXV, fig. 59.

The shell is thin, brown, acutely keeled, pinched in above and below the peripheral keel, which extends to the aperture, the whorls elsewhere convex above and below. Embryo of 2 to 2⅓ whorls, convex except near the periphery where they are impressed; they are densely striate obliquely and rather obsoletely striate spirally. The junction with the subsequent neanic growth is often indistinct. Whorls 4¾ to 5¼, the later ones rudely, very obliquely wrinkled, and showing raised spiral striæ, usually rather indistinct. The umbilicus is ample within and rather widely open, exposing the penultimate whorl. Aperture small with simple lip, the whorl descending slowly to it.

Alt.	8.5	7.8 mm.
Diam.	15.6	14.5 "

Canyon Diablo, near Rowe, San Miguel county, New Mexico. Types No. 84,297, A. N. S. P., collected by Miss Mary Cooper.

This form differs from *O. hemphilli* (Newc.) by its less convex embryonic whorls, which are more impressed near the periphery, and by the more ample umbilicus; but it differs chiefly by the unicuspid teeth of the median part of the radula, those teeth in *O. hemphilli* having well-developed ectocones, as in *O. barbata.* It seems to be rather widely separated geographically from the range of *O. hemphilli.*

It is also before me from Beulah, in the Sapello Canyon, San Miguel county, at 8,000 feet (Prof. Cockerell), small specimens only 10 mm. diameter, with 4½ whorls, perhaps not quite adult. Similar small specimens come from Las Huartes Canyon, Bernalillo county, New Mexico (Miss Cooper).

I have partially examined the internal anatomy of one of the specimens from Beulah. The penis (Pl. XIX, fig. 9) is bent in the middle, the lower half a little swollen, with muscular walls, the upper half slightly smaller, softer. There is a very small apical papilla, and the retractor muscle is inserted at the apex of the penis and root of the epiphallus. The epiphallus is large, shorter than the penis, and the vas deferens enters at the side, not the center of the apex.

The radula has 19.1.19 teeth, similar to those of *O. yavapai*. On the fifth or sixth teeth the ectocone is developed. Marginals bicuspid, as usual.

Subgenus RADIOCENTRUM nov.

Oreohelices with an embryonic shell of 1½ radially ribbed whorls, spiral striæ in the intervals between ribs excessively weak or wanting. Penis rather short, with a hollow dilation at the distal end. Epiphallus club-shaped, as long as the penis, the retractor inserted near its base. Type *O. chiricahuana* Pils.

This group differs from *Oreohelix* by the smaller number of embryonic whorls and their different sculpture, and in the somewhat different structure of the penis. It includes at present three species: *O. chiricahuana*, *O. clappi* and *O. avalonensis*.

The genitalia are similar in the two species examined, the only difference being in the shape of the distal end of the penis, and in the absolute dimensions. The pallial organs of *O. clappi* do not differ from those described above for *Oreohelix strigosa*.

Key to Species of Radiocentrum.

a.—Shell bluntly subangular or almost rounded at the periphery; covered with a green or olive cuticle, largely worn from old shells. Alt. 8.5 to 9.7, diam. 15 mm., ... *O. clappi* Ferriss.

a′.—Shell carinated; earthy, without perceptible cuticle.

b.—"Whorls 4½, granulated above and below, the last one wide; aperture large. Alt. 6, diam. 11 mm." (*Hemphill*). *O. avalonensis* Hemphill.

b′.—Whorls 5, striated but not granulated, slowly widening; aperture small. Alt. 6.5, diam. 11 mm., *O. chiricahuana* Pils.

Oreohelix chiricahuana n. sp. Pl. XI, figs. 1, 2, 3.

The shell is depressed, the altitude about .6 of the diameter, about equally convex above and below the peripheral keel. Umbilicus rather well-like, slowly contracting, and contained five or six times in the diameter of the shell. Whitish, with an indistinct gray band near the middle of the upper surface and another immediately below the white keel, the early whorls dull brown; without perceptible cuticle. Sculpture of close but irregular and rather sharp growth-wrinkles, very indistinctly decussated with spiral striæ. The embryonic shell consists of *only* 1½ whorls. The first half whorl is nearly smooth, the next whorl is *sharply and finely but very regularly ribbed radially.* With the compound microscope some very weak spiral striation may be seen indistinctly in the intervals. At the end of the embryonic period the rib sculpture abruptly gives place to a lower, less regular oblique striation. The spire is convexly conic. Whorls 5, convex, impressed above the suture, where the keel projects a trifle. At the periphery the keel projects somewhat, the surface being a little concave above and below it. Base convex. Aperture small, oblique, a little angular at the outer part. Lip simple, the ends approaching.

Alt. 6.5, diam. 11 mm.
" 7, " 10.5 "

Cave Creek Canyon, Chiricahua Mountains. Types No. 87,012, A. N. S. P., collected by James H. Ferriss. "Occurred on a dry, clay hillside, under dead vegetation and stones, and was found nowhere else on the mountain."

This is a very distinct little species, closely related to *O. avalonensis* Hemphill of Santa Catalina Island, California, which has an apex of the same type. *O. avalonensis* differs, however, by its conspicuously decussate surface, wider last whorl and larger aperture, and it has a half whorl less. It is figured for comparison, Pl. XI, figs. 4, 5, 6, 7. The umbilicus is about equal in the two species.

O. chiricahuana differs conspicuously from *O. yavapai* and *O. y. neomexicana* by its peculiar apical sculpture, etc.

The genitalia are figured (Pl. XIX, fig. 4). The penis is cylindric, a little flattened and protruding on one side at the distal end. The epiphallus is longer than the penis, club-shaped, the retractor inserted upon it not far from its base. The lower part of the spermatheca duct is enlarged and muscular. The lengths of the organs are as follows: penis 4, epiphallus 4.7, vagina 3.5, spermatheca and duct 7.5 mm. The foot is scarcely granulose, the integument smoothish, tessellated in rather coarse pattern with blackish or gray spots. No genital furrow is visible. The mantle edge is thin.

The jaw (Pl. XXIII, fig. 24) is striate, somewhat less arcuate than that of *O. clappi.*

The radula (Pl. XXII, figs. 10, 11) has 26.1.26 teeth. They are rather shorter than usual in *Oreohelix.* The central and lateral teeth have well-developed ectocones. The marginal teeth are bicuspid, as usual in *Oreohelix*, but the inner cusp is split.

Oreohelix clappi Ferriss. Pl. XI, fig. 12; Pl. XXV, figs. 51–56.

Nautilus, XVIII, p. 53 (September, 1904).

This is a remarkable snail, slightly resembling *Pyramidula solitaria* on a small scale, but very different from any other *Oreohelix* by its rapidly narrowing umbilicus and green or olivaceous cuticle.

The smoothish integument is blackish on the head and tail, and darker toward the foot margins, elsewhere tessellated with large polygonal gray pigment spots. Sole cream colored. There are two irregular dorsal grooves.

The kidney, 6.3 mm. long, is a thin-walled sack, its lumen large, with strongly corrugated walls. The pericardium is fully 4 mm. long.

The reproductive system (Pl. XIX, fig. 8) resembles that of *O. chiricahuana*. The rather slender cylindric penis is enlarged at the summit, the protuberance on the upper side (in the figure) hollow. The epiphallus enters through a very small acorn-shaped papilla. The walls of the penis are thin, with a minute oblique corrugation meeting V-like on one side. The penis measures 7, epiphallus 7, vagina 6, spermatheca and duct 13 mm. long. The penis retractor is inserted about 1.5 mm. from the base of the epiphallus.

The jaw (Pl. XXIII, fig. 26) is arcuate and striate vertically.

The radula (Pl. XXII, fig. 4) has about 29.1.29 teeth, of the general form usual in *Oreohelix*. There are rudimentary ectocones on the central teeth, at least where they are unworn. The laterals have similar outer cutting points. The marginal teeth are bicuspid. In general, the teeth are between the unicuspid type and that with developed ectocones.

Explanation of Plates XI–XXVII.

Plate XI.—Fig 11 was drawn by the author; the others are reproduced from photographs.

Figs. 1–3—*Oreohelix chiricahuana* Pils. × 3½. Co-types.

Figs. 4–6.—*Oreohelix avalonensis* Hemph. × 3½. Santa Catalina Island, California.

Fig. 7.—*O. avalonensis*. Early whorls. × 6.

Fig. 8.—*Oreohelix yavapai neomexicana* Pils. Young specimen. × 3. Showing embryonic whorls and two neanic whorls.

Fig. 9.—*O. y. neomexicana*. Segment of base. Only the coarser spirals are visible in the half-tone cut.

Fig. 10.—*Sonorella granulatissima* Pils. No. 87,087. Miller Canyon. Portion of last whorl above the periphery. × 7.

Fig. 11.—*Ashmunella angulata* Pils. No. 87,113. Immature shell of 8 mm. diameter showing temporary lip-rib.

Fig. 12.—*Oreohelix clappi* Ferriss. Early whorls. × 6. Sculpture is very imperfectly shown.

Fig. 13.—*Oreohelix yavapai* Pils. Young shell, showing embryonic whorls and about one-third of the first neanic whorl. × 6.

Figs. 14, 15.—*Oreohelix strigosa* Gld. Pecos, N. M. Uterine young. × 6. The very fine, even spiral striation is not sufficiently enlarged to be visible in the reproduction, though shown in the photograph ; the radial ripples are also largely lost.

Plate XII, Figs. 1–4.—*Ashmunella rhyssa* Dall. Sierra Blanca. Nos. 73,561 and 73,575.

Figs. 5, 6.—*Ashmunella rhyssa miorhyssa* Dall. Sierra Blanca, New Mexico. No. 73,577.

Figs. 7, 8.—*Ashmunella rhyssa hyporhyssa* Ckll., larger form. James Canyon, Cloudcroft, New Mexico. No. 89,201.

Figs. 9–13.—*A. r. hyporhyssa* Ckll. James Canyon, Cloudcroft. No. 83,345.

Fig. 14.—*Ashmunella altissima* Ckll. Co-type. Summit of Sierra Blanca. No. 73,558.

Figs. 15, 16.—*Ashmunella pseudodonta* Dall. White Oaks, New Mexico. No. 73,589.

Figs. 17, 18.—*A. pseudodonta* Dall. Capitan Mountains, New Mexico. No. 79,529.

Figs. 19, 20.—*Ashmunella ashmuni* Dall. Bland, New Mexico. No. 73,599.

Figs. 21–23.—*A. pseudodonta capitanensis* A. and C. Capitan Mountains, New Mexico. No. 74,556.

Figs. 24–26.—*A. ashmuni robusta* Pils. Bland, New Mexico. No. 73,576.

Plate XIII, Figs. 23–26.—*Ashmunella esuritor* Pils. Types.

Figs. 27, 28.—*Ashmunella thomsoniana* (Ancey). Part of the original lot, from J. H. Thomson. Santa Fé Canyon, New Mexico. Nos. 58,113 and 58,114.

Fig. 29.—*A. thomsoniana*. Specimen from Monument Rock, Santa Fé Canyon. Prof. Cockerell and Miss Porter. No. 77,870.

Fig. 30.—*A. thomsoniana*. Santa Fé Canyon. E. H. Ashmun. No. 76,709.

Figs. 31–34.—*A. thomsoniana* (Anc.). Las Vegas Hot Springs, New Mexico. Nos. 84,293, 80,750 and 83,946. Fig. 34 is a co-type of *A. t. cooperæ* Ckll.

Figs. 35–37.—*A thomsoniana* (Anc.). Canyon Diablo, near Rowe, New Mexico. No. 84,295.

Fig. 38.—*A. t. pecosensis* Ckll. Type. Vallé ranch, Pecos, New Mexico. No. 84,209.

Figs. 39–41.—*A. t. porteræ* Pils. and Ckll. Sapello Canyon, San Miguel county, New Mexico, 8,000 feet altitude. No. 81,983.

Figs. 42, 46.—*A. t. porteræ* P. and C. Co-types. Beulah, Upper Sapello Canyon. No. 76,789.

Figs. 43–45.—*A. t. porteræ* P. and C. Pecos, New Mexico. No. 85,099.

Plate XIV, Figs. 47–49.—*Ashmunella levettei angigyra* Pils. Types. Conservatory Canyon, Huachuca Mountains. No. 83,269.

Figs. 50, 54.—*A. l. angigyra*. Brown's Canyon. No. 87,093.

Figs. 51–53.—*A. l. angigyra*. Foothills, Bear Canyon. No. 89,202.

Figs. 55–57.—*Ashmunella angulata* Pils. Types. South fork of Cave creek, at base of mountain, Chiricahua Mountains. No. 87,019.

Fig. 58.—*A. angulata*. South fork of Cave creek, under cliffs; showing weak upper branch of the parietal tooth. No. 87,015.

Figs. 59, 60.—*A. angulata*. Cave Creek Canyon. No. 87,020.

Fig. 61.—*A. angulata*. Cave Creek Canyon. No. 87,111.

Fig. 62.—*Ashmunella mearnsi* Dall. Huachuca Mountains. No. 65,736.

Figs. 63, 64.—*Ashmunella angulata* Pils. Falls of Cave Creek. No. 87,112.

Figs. 65, 66.—*Ashmunella proxima* Pils. Types. Sawmill Canyon, Chiricahua Mountains. No. 86,498.

Figs. 67–69.—*Ashmunella fissidens* Pils. Cave Creek Canyon, Chiricahua Mountains. Types. No. 87,022.

Figs. 70, 71.—*A. proxima*. Topotypes. No. 87,102.

PLATE XV, Figs. 72–75, 79.—*Ashmunella levettei* (Bld.). Typical. Bear Canyon, Huachuca Mountains, 6,500 feet. No. 87,089.

Figs. 76.—*A. levettei.* Albino. Head of Bear Canyon, 7,000 feet. No. 87,098.

Fig. 77.—*A. levettei.* Pathologic monster, same locality.

Fig. 78.—*A. levettei.* Miller Canyon, Huachuca Mountains, 6,000 feet. No. 87,099.

Figs. 80–88.—*A. l. heterodon* Pils. Ida Canyon, Huachuca Mountains. No. 89,203.

Figs. 89–91.—*A. l. heterodon.* Cave Creek Canyon, Huachuca Mountains. No. 87,152.

Figs. 92, 93.—*A. levettei*, var. approaching *angigyra.* Carr Canyon, Huachuca Mountains, 5,000 feet. Nos. 87,092 and 89,204.

Figs. 94, 95.—*A. l. heterodon* Pils. or *chiricahuana* Dall(?), Miller Canyon, Huachuca Mountains. No. 87,097.

PLATE XVI, Figs. 96–99.—*Ashmunella chiricahuana* (Dall). Cave Creek Canyon, Chiricahua Mountains. No. 87,096, A. N. S. P.

Fig. 100.—*A. chiricahuana.* An elevated specimen from the same locality. No. 87,021.

Fig. 101.—*A. c. mogollonensis.* Base of a larger specimen from Kingston, Sierra county, New Mexico.

Fig. 102.—*Ashmunella chiricahuana mogollonensis* Pils. West fork Gila river, near Mogollon Peak, New Mexico. No. 79,530.

Figs. 103–107.—*Ashmunella duplicidens* Pils. Bearfoot Park, Chiricahua Mountains. No. 87,024.

Figs. 108–110, 113.—*Ashmunella ferrissi* Pils. Cave Creek Canyon, Chiricahua Mountains. No. 89,232.

Figs. 111, 112, 117.—*Ashmunella walkeri* Ferriss. Co-types. Florida Mountains, near Deming, New Mexico.

Figs. 114, 115.—*Ashmunella metamorphosa* Pils. Types.

Fig. 116.—*Ashmunella mearnsi* (Dall). No. 65,736.

PLATE XVII, Figs. 1, 2.—*Sonorella hachitana*, var. Florida Mountains, No. 87,078.

Figs. 3–6.—*Sonorella hachitana*, var. Florida Mountains. No. 86,496.

Figs. 7, 8.—*Sonorella hachitana*, var. Organ Mountains. No. 71,413.

Figs. 9–14.—*Sonorella hachitana ashmuni* Bartsch. Purtyman's. Nos. 79,409 and 80,707.

Figs. 15, 16.—*Sonorella virilis* Pils. Type. Chiricahua Mountains. No. 79,622.

Figs. 17–20.—*Sonorella virilis* Pils., var. Sawmill Canyon, Chiricahua Mountains. No. 87,081.

Figs. 21–23.—*Sonorella granulatissima* Pils. Types. No. 83,257.

Fig. 24.—*Sonorella virilis huachucana* Pils. Brown Canyon, Huachuca Mountains.

PLATE XVIII, Figs. 24–28.—*Sonorella granulatissima latior* Pils. Brown's Canyon, Huachuca Mountains. No. 87,083.

Figs. 29–32.—*Sonorella hachitana bowiensis* Pils. Fort Bowie. No. 86,497.

Figs. 33, 34.—*Sonorella rowelli* (Newc.). Sanfords. No. 83,273.

Fig. 35.—*Sonorella rowelli* (Newc.). Patagonia Mountains. No. 83,268.

Figs. 36–38.—*Sonorella granulatissima* Pils. Ida Canyon. No. 87,088.

Figs. 39, 40, 44.—*Sonorella granulatissima* Pils. Miller Canyon. No. 87,087.

Figs. 41–43.—*Sonorella granulatissima* Pils. Miller Canyon. No. 89,227.

Figs. 45–47.—*Sonorella granulatissima parva* Pils. West end of Huachuca Mountains. No. 87,114.

Figs. 48–50.—*Sonorella virilis circumstriatus* Pils. Types. Cave Creek Canyon, Chiricahua Mountains. No. 87,026.

Figs. 51–54.—*Sonorella granulatissima* Pils. Carr Canyon, Huachuca Mountains. No. 89,226.

PLATE XIX.—Anatomy of *Oreohelix.*

Fig. 1.—*Oreohelix strigosa*, from Pecos, New Mexico. Pallial complex.
Fig. 2.—*O. elrodi* (Pils.).
Fig. 3.—*O. strigosa* (Gld.), from Pecos, New Mexico.
Fig. 4.—*O. chiricahuana* Pils.
Fig. 5.—*O. barbata* Pils.
Fig. 6.—*O. s. huachucana* Pils.
Fig. 7.—*O. yavapai* Pils. Penis.
Fig. 8.—*O. clappi* Ferriss.
Fig. 9.—*O. y. neomexicana* Pils. Penis.

PLATE XX [all figures × 2], Fig. 10.—*Sonorella hachitana bowiensis* Pils. Penis opened to show papilla. Bowie, Arizona. No. 86,497.

Fig. 11.—*S. h. bowiensis* Pils. Genitalia of same specimen.
Fig. 12.—*Sonorella hachitana* (Dall). Genitalia of individual from Florida Mountains, New Mexico. No. 86,496. The penis-papilla shows faintly through.
Fig. 13.—*Sonorella rowelli* (Newc.). Penis opened to show papilla. Sanford's, Arizona. No. 83,273.
Fig. 14.—*S. rowelli* (Newc.). Genitalia of same individual.
Fig. 15.—*Sonorella hachitana ashmuni* (Bartsch). Opened penis of a specimen from Purtyman's ranch, Oak creek, New Mexico. No. 79,409.
Fig. 16.—*Sonorella granulatissima* Pils. ♂ organs, showing epiphallus and flagellum of one of the type specimens. Spring Canyon, Huachuca Mountains.
Fig. 17.—*S. granulatissima* Pils. Genitalia of same individual.
Fig. 18.—*S. granulatissima* Pils. Opened penis of same individual.
Fig. 19.—*Sonorella virilis circumstriata* Pils. Genitalia of No. 87,026. Cave Creek Canyon.
Fig. 20.—*Sonorella rowelli* (Newc.). Terminal ducts of genitalia of a small form from the Patagonia Mountains, Arizona. No. 83,268.
Fig. 21.—*Sonorella virilis* Pils. Opened penis of type specimen. Chiricahua Mountains. No. 79,622.
Fig. 22.—*S. virilis* Pils. Genitalia of same specimen.

PLATE XXI.—Genitalia of *Ashmunella.*

Fig. 23.—*Ashmunella duplicidens* Pils. $\times 2\frac{2}{3}$. No. 87,024.
Fig. 24.—*Ashmunella proxima* Pils. $\times 2\frac{2}{3}$. No. 86,498.
Fig. 25.—*Ashmunella esuritor* Pils. Exserted penis.
Fig. 26.—*Ashmunella angulata* Pils. $\times 2\frac{2}{3}$. No. 87,015.
Fig. 27.—*Ashmunella metamorphosa* Pils. $\times 2$. No. 88,885.
Fig. 28.—*Ashmunella l. angigyra* Pils. $\times 2\frac{2}{3}$. No. 83,269.
Fig. 29.—*Ashmunella chiricahuana* Pils. $\times 2$. No. 87,021.
Fig. 30.—*Ashmunella esuritor* Pils. $\times 2\frac{2}{3}$. No. 87,023.

PLATE XXII, Figs. 1, 2, 3.—*Oreohelix strigosa*, variety from Pecos, New Mexico. 1. Central tooth *r*, with three laterals; 2. Group of marginal teeth at the edge of radula; 3. Lateral and transitional teeth.

Fig. 4.—*Oreohelix clappi* Ferriss. Central and two lateral teeth of a co-type.
Fig. 5. *Oreohelix strigosa huachucana* Pils. Group of lateral and transitional teeth of a type specimen.
Fig. 6.—*Oreohelix barbata* Pils. Central tooth with laterals i–iii, vi and vii of a co-type.
Fig. 7.—*Oreohelix yavapai* Pils. Co-type. Group of lateral and transitional teeth, with a central tooth on the extreme right.
Fig. 8.—*Ashmunella metamorphosa* Pils. Central with two adjacent lateral teeth of a type specimen.
Fig. 9.—*Ashmunella angulata* Pils. No. 87,015. Group of transitional and marginal teeth.
Figs. 10, 11.—*Ashmunella chiricahuana* (Dall). Group of central and lateral teeth and two groups of marginal teeth of a typical specimen.
Fig. 12.—*Ashmunella levettei angigyra* Pils. Conservatory Canyon, Huachuca Mountains. Half row of teeth, some of the marginals omitted.

PLATE XXIII.—Jaws of *Ashmunella, Sonorella* and *Oreohelix.*

Fig. 13.—*Ashmunella chiricahuana* Dall. Cave Creek Canyon, Chiricahuas. No. 87,021.

Fig. 14.—*Ashmunella levettei angigyra* Pils. Type. No. 83,269.

Fig. 15.—*Ashmunella angulata* Pils. No. 87,015.

Fig. 16.—*Ashmunella metamorphosa* Pils. Co-type.

Fig. 17.—*Ashmunella levettei proxima* Pils. Co-type. No. 86,498.

Fig. 18.—*Sonorella rowelli* (Newc.). Patagonia Mountains, Santa Cruz county, Arizona. No. 83,268.

Fig. 19.—*Sonorella hachitana* var. Organ Mountains, New Mexico. No. 71,413.

Fig. 20.—*Sonorella hachitana* (Dall). Florida Mountains, New Mexico. No. 86,496.

Fig. 21.—*Sonorella virilis* Pils. Type. No. 79,602.

Fig. 22.—*Sonorella h. bowiensis* Pils. Type. No. 86,497.

Fig. 23.—*Sonorella granulatissima* Pils. Co-type.

Fig. 24.—*Oreohelix chiricahuana* Pils. Co-type.

Fig. 25.—*Oreohelix strigosa* Gld. var. Pecos, New Mexico.

Fig. 26.—*Oreohelix clappi* Ferriss. Co-type.

PLATE XXIV, Figs. 1–4.—*Oreohelix strigosa huachucana.* Miller Canyon, 5,000 feet. No. 87,144.

Figs. 5–7.—Conservatory Canyon. No. 83,370. Type specimens.

Fig. 8.—Uniform brown specimen. Same locality. No. 83,371.

Figs. 9, 10.—Brown's Canyon, at 7,000 feet. No. 87,125.

Figs. 11, 12, 16.—Brown's Canyon, at 7,000 feet. No. 87,124.

Figs. 13, 14.—Brown's Canyon, at 7,000 feet. No. 87,126.

Fig. 15.—Brown's Canyon, at 6,000 feet. No. 87,122.

Figs. 17, 18.—Brown's Canyon, at 7,000 feet. No. 87,127.

Figs. 19, 20.—Carr Canyon, at 6,000 feet. No. 87,135.

Figs. 21–23.—Carr Canyon, at 5,500 feet. No. 87,134.

Fig. 24.—Carr Canyon, at 6,000 feet. No. 87,136.

Figs. 25–27.—*O. s. concentrata* (Dall). Limestone Mountain, north side, at 8,000 feet. No. 87,128.

Fig. 28.—*O. s. concentrata* (Dall). Carr Canyon, 7,000 feet. No. 87,138.

Figs. 29–31.—*O. s. concentrata* (Dall). Limestone Mountain, south side, at 8,000 feet. No. 87,131.

Figs. 32.—*O. s. concentrata* (Dall). Limestone Mountain, south side, at 8,000 feet. No. 87,131.

PLATE XXV, Figs. 33, 34.—*Oreohelix s. huachucana* Pils. Ida Canyon, Huachuca Mountains, 7,000 feet elevation. No. 87,143.

Fig. 35.—*O. s. huachucana* Ida Canyon, 7,000 feet. No. 87,142.

Fig. 36.—*O. s. huachucana.* Carr Canyon, 7,000 feet. No. 87,137.

Figs. 37–40.—*O. s. huachucana,* keeled and hirsute form. Carr Canyon. No. 87,132.

Figs. 41–43.—*O. s. huachucana.* Cave Creek Canyon, 5,500 feet. No. 87,140, 87,141.

Figs. 44, 48, 52.—*O. s. metcalfei* Ckll. Co-types, 44 and 48 from bleached specimens, 52 from one collected alive.

Figs. 45–47.—*O. strigosa* (Gld.). Pecos, New Mexico. No. 85,100.

Figs. 49–51.—*O. strigosa socorroensis* Pils. Co-types. No. 58,128.

Fig. 52.—*O. s. metcalfei* Ckll.

Fig. 53.—*O. yavapai* Pils. Co-type. No. 79,415.

Figs. 54–56.—*O. clappi* Ferriss. Co-types. No. 87,013.

Figs. 57, 58.—*O. barbata* Pils. Co-types. No. 87,011.

Fig. 59.—*O. y. neomexicana* Pils. Co-type. No. 84,297.

Fig. 60.—*O. s. concentrata* (Dall). Hacheta Grande Mountain, at 9,000 feet. No. 65,742.

PLATE XXVI, Figs. 1–5.—*Holospira goldfussi* (Mke.). Guadalupe river, about six miles above New Braunfels, Texas. Nos. 89,209, 89,210.

Fig. 6.—*Holospira cockerelli* Dall. Near Kingston, New Mexico. No. 89,211.

Fig. 7.—*Holospira regis* Pils. and Ckll. Near Kingston, New Mexico. No. 89,208.

Fig. 8.—*Holospira crossei* Dall. Hacheta Grande Mountain, Grant county, New Mexico, No. 65,738.

Fig. 9.—*Holospira chiricahuana* Pils. Fort Bowie, Cochise county, Arizona. No. 87,118.

Figs. 10–15.—*Holospira roemeri* (Pfr.). Hondo river, about two miles north of Hondo, Medina county, Texas. No. 89,207.

Figs. 16–18.—*H. roemeri*. High Bridge of the Pecos river, Valverde county, Texas. No. 89,206.

Figs. 19–21.—*Microceramus texanus* (Pils.). Guadalupe river, above New Braunfels, Texas. No. 89,205.

PLATE XXVII, Figs. 22–25.—*Holospira ferrissi* Pils. Manilla Mine, Huachuca Mountains. No. 87,115.

Figs. 26–29.—*Holospira chiricahuana* Pils. Cave Creek Canyon, Chiricahua Mountains. No. 87,119.

Figs. 30–33.—*Holospira cionella* Pils. Fort Bowie. No. 87,117.

MOLLUSCA OF FLINT AND CAROLINE ISLANDS, IN THE CENTRAL PACIFIC.

BY HENRY A. PILSBRY AND EDWARD G. VANATTA.

The species recorded below were collected by Mr. C. D. Voy, a Californian naturalist, in the year 1875, in the course of a voyage from Honolulu through Polynesia to Sydney, New South Wales, Australia. Somewhat extensive series of mollusks, crustacea and echinoderms were also taken in the Marquesas, Society Islands, Rurutu Island of the Austral group, etc. These collections were acquired by the late Prof. E. D. Cope, and remained unopened in the original parcels until presented to the Academy of Natural Sciences in 1901 by Mrs. Annie P. Cope.

Most of the island groups represented in Voy's collection have been more or less exploited by other naturalists, particularly Garrett, Pease and the Godeffroy brothers; but so far as we know, no mollusks have been reported from Caroline and Flint Islands. Although the collection from these places is not extensive, we have thought it worth while on this account to put the facts on record. The only land animals taken on the two islands were the widely distributed *Birgus latro* and *Truncatella valida*.

Flint Island lies 11° 25′ 43″ S., 151° 48′ W., and Caroline Island is 10° S., 150° 14′ 30″ W. They are small, isolated, uninhabited islets, lying north of the Society group, in the central Pacific.

List of Species.

(*F., Flint Island; C., Caroline Island.*)

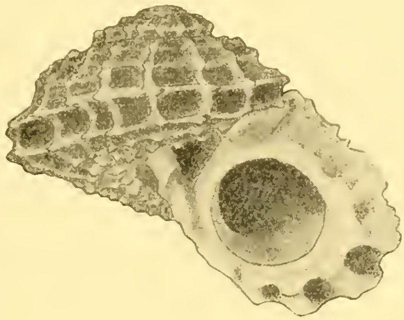
Conus catus Brug. F.
" *eburneus* Hwass. F.
" *ebræus* L. (*hebræus* auct.). F., C.
" *miles* L. F.
" *retifer* Mke. F.
" *vexillum* Gm. F.
" *vitulinus* Hwass. F.
" *violaceus* Rve. C.
Glyphostoma sp. F.
Murex rubesceus Brod. F.
Murex laqueatus Sowb. F.
Maculotriton bracteatus Hinds. F., C.
" *digitalis* Rve. F.,C.
Purpura armigera Dillw. C.
" *bituberculdaris* Lam. F., C.
Ricinula horrida Lam. F., C.
" *ricinus* L. F., C.
" " *elegans* Brod. F., C.

Ricinula digitata Lam. F., C.
" *marginatra* Blv. C.
" *morus* L. C.
Sistrum undatum Chem. C.
" *cancellatum* Q. C.
Iopas sertum Brug.
Vexilla tæniata Powis. F.
Mitra limbifera Lam. F., C.
" *pontificalis* L. C.
" *littrata* Lam. F., C.
Harpa minor Lam. F., C.
Cypræa arabica L. F.
" *araneosa* Gray. F.
" *caput-serpentis* L. F., C.
" *carneola* L. F.
" *cicercula* L. F.
" *cumingi* Gray. F.
" *fuscomaculata* Pse. F.
" *helvola* L. F., C.
" *intermedia* Gray. F., C.
" *irrorata* Sol. F., C.
" *isabella* L. F., C.
" *madagascariensis* Gm. F.
" *moneta* L. F., C.
" *nucleus* L. F.
" *obvelata* Lam. F., C.
" *poraria* L. F., C.
" *reticulata* Mart. F., C.
" *scurra* Gm. F.
" *tabescens* Sol. F.
" *ventriculus* Lam. F.
" *vitellus* L. F.
Ovula lactea Lam. C.
Pterocera scorpio L. F.
Strombus maculatus Nutt. F.
" *urceus* L. F.
Aquillus chlorostoma Lam. C.
" *pilearis* L. C.
" *rubeculus* L. F.
" *tuberosus* L. C.
Ranella affinis Brod. F., C.
" *bufonia* Gm. C.
Cassis rufa L. C.
Dolium perdix L. F., C.
Cerithium nesioticum P. and V. F.
" *patiens* Bayle. C.
" *rubus* Martyn (*echinatum* Lam.). F., C.
" *voyi* P. and V. C.
Clava obeliscus Brug. F.
" *pharos* Hinds. F.
Mitrularia equestris cicatricosa Rve. F.
Natica marochiensis Gm. C.
Polynices melanostoma Gm. C.
Littorina obesa Sowb. C., F.
Risella conoidalis Pse. F.[1]
Modulus tectum Gm. C.
Ianthina ianthina L. F.
Fasciolaria filamentosa Lam. C.
Latirus aplustre Gm. C.
Peristernia nassatula Lam. F.
Nerita undata L. C.
" *polita* L. var. C.
" *plicata* L., and transitions to *N. ringens* Rve. F., C.
Liotia voyi Pils. and Van. F.
Turbo argyrostomus L. F., C.
Astralium petrosum Martyn. C.
Truncatella valida Pfr. F.
Melampus luteus Q. and G. C.
Pinna semicostata Rve. C.
Tellina dispar Conv. C.
" *scobinata* L. F.
Crista pectinata L. F.
Trapezium oblongum L. (*guiniacum* Chem.). F., C.
Tridacna gigas L. C.
Pecten pallium L. F.
" *sulphureus* Dkr. F.

[1] One specimen wants undulations along the carina, having quite a distinct appearance.

Liotia voyi n. sp.

Shell obliquely trochiform, convexly conic above, flattened below. White. Nucleus lost, 3½ whorls remaining, separated by a deep suture which is regularly bridged across by thin lamellæ dividing it into a series of pits; which at the last whorl penetrate through to the umbilicus. The last whorl is convex above, with two low, obscurely double spiral cords, which are somewhat nodose at their intersections with rounded radial ribs. At the periphery two thin equal keels project, the space between bridged across by thin lamellæ (which are continuations of the radial ribs), the keels rising into spines at the lamellæ. The base is slightly convex, roughened by two circles of tubercles, lamellose-tuberculate at the edge of the umbilicus. A large spiral cord revolves within the umbilicus; near its lower termination it has a tooth, beyond which it is continuous with the basal lip. The aperture is oblique, circular, the outer lip being expanded in a scalloped varix with five shallow pits on its face.



Alt. 10, diam. 12.5 mm.

Flint Island, Polynesia. Types No. 80,916, A. N. S. P., collected by C. D. Voy.

This large and beautifully sculptured *Liotia* is related to *L. crenata* Kiener.[2] Compared with specimens of that species in the collection of the Academy, *L. voyi* is larger and more roughly sculptured, and it wholly lacks the minute sculpture of fine, even striæ in the intervals and pits of the coarser sculpture, which is characteristic of Kiener's species. The septa between the peripheral keels are straight in *L. voyi*, but strongly curved in *L. crenata*.

L. crenata was very imperfectly described by Kiener, and his dimensions are entirely wrong. It is doubtful whether Reeve's figure, copied by Tryon, represents the true *crenata*, which is, we think, rather rare.

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[2] *Delphinula crenata* Kiener, *Iconogr. Coq. Viv.*, p. 11, Pl. 4, f. 8.

A NEW SPECIES OF SEA-MOUSE (APHRODITA HASTATA) FROM EASTERN MASSACHUSETTS.

BY J. PERCY MOORE.

The common European sea-mouse (*Aphrodita aculeata*) has been so frequently and so widely reported from the American Atlantic coast, while none of the writers on our annelids have reported any other species, that the identity of the species occurring on the two sides of the Atlantic has been taken as established. It was, therefore, with genuine surprise that I found, while preparing a description from Wood's Hole specimens for a report on the annelids of that region, certain obvious points of difference between these and *A. aculeata* as described by European writers. Since returning to Philadelphia a more thorough examination of the literature and a detailed comparison of specimens in the collection of this Academy with those belonging to the U. S. F. C. laboratory at Wood's Hole, kindly sent to me by Mr. Vinal Edwards, and two specimens of *A. aculeata* from the neighborhood of Helgoland, for the opportunity of studying which I am indebted to Dr. W. McM. Woodworth, of the Museum of Comparative Zoology, have doubly convinced me of the wide distinction between the species common in the deeper waters of the open sea off the Wood's Hole region and the European species. This does not, of course, exclude the possibility of the occurrence of the true *A. aculeata* also on our coast, yet the few notes furnished by Prof. Verrill in his *Report on the Invertebrates of Vineyard Sound* lead to the belief that the species therein recorded as *A. aculeata* is the one herein described, which it seems probable is the only one occurring south of Cape Cod.[1]

A. hastata is really less closely related to *A. aculeata* than to other species of the genus and probably finds its nearest ally in *A. japonica* Maren., which is widely distributed in the northern Pacific. From that species it differs in having the notopodial setæ free from the felt and in the decidedly smaller number of neuropodial setæ, which also lack the terminal pilosity in all of those examined.

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[1] Mr. James E. Benedict writes me that Prof. Verrill has informed him that two species of *Aphrodita* are found on our coasts. Owing to the illness of Miss Bush, to whom their discrimination is said to be due, I have been unable to secure further information.

From *A. aculeata* it departs in many and striking characters. Perhaps the most important is the altogether different form of the large notopodial spines. In the former they are acute, rigid needles whose points project stiffly a short distance above the felt, and are capable of inflicting quite painful wounds. In the latter they curve over the back to or beyond the middle line and are soft, flexible but friable, and terminate in acute and hooked tips. It is interesting to note that McIntosh states that the young of *A. aculeata* possess setæ of this sort, which are later replaced by the acute spines. But *A. hastata* and several other species retain the more primitive form throughout life, unless, of course, as frequently happens, they are accidentally injured. In *A. aculeata* the number of neuropodial setæ is constantly greater in the middle and ventral rows and sometimes greater in the dorsal row, and they are stouter, less acute and differ otherwise in form. The lateral fringe of hairs is brilliant green in *A. aculeata,* pearl color or reddish in *A. hastata,* and there are other minor differences. A dissection of a single example of *A. hastata* indicates identity in the internal anatomy of the two species. The complete description follows:

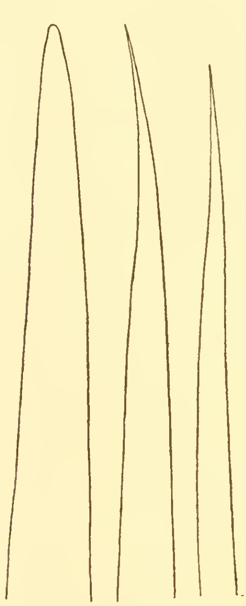
Aphrodita hastata sp. nov.

The size is large, examples of 125 mm. long and 40 mm. in maximum breadth at somite XII, exclusive of the setæ, being common, though none equalling the maximum size of *A. aculeata* has been seen. Examples of 70 to 125 mm. have 40 or 41 somites, the last 15 or so being very small and comprising not more than one-eighth of the total length.

As in *A. aculeata,* the form is robust and strongly arched in the anterior half, the last fourth becoming slender and tapering rapidly in both planes. The ventral surface is relatively smooth and pale, the brownish spherical papillæ being few in number but increasing toward the sides and becoming numerous on the dorsal, anterior and posterior surfaces of the parapodia. Hidden, of course, beneath the dorsal felt are 15 pairs of elytra and the dorsal fimbriated organs, both arranged as in *A. aculeata.*

The prostomium is orbicular obovate; the greatest width, which lies near the anterior border, is about equal to the length and the posterior half tapers rapidly to a width of about one-third the maximum. The two minute, closely approximated eyes on each side are placed just anterior to the greatest breadth of the prostomium and separated by a wide median interspace. Although apparently quite variable the facial tubercle is nearly always considerably shorter than the prostomium, strongly compressed below, broad and usually with a median groove above. While the usual spherical papillæ stud its surface it is otherwise smooth and exhibits little of the nodular character seen in some species. The median tentacle has a total length slightly exceeding the prostomium, of which about one-fourth or more constitutes the strongly clavate basal piece. The style is slender and regularly tapering, and in no case exhibits any trace of the club-shaped extremity figured by McIntosh for *A. aculeata*. The palpi are from six to eight times as long as the prostomium and nearly twice as long as the first parapodium and tentacular cirri; in form they are slender and regularly tapering.

Nothing peculiar appears in the form or modifications of the parapodia, which resemble those of *A. aculeata*, though the first pair appear to be rather longer, their tips reaching about $1\frac{1}{2}$ times the length of the prostomium beyond the latter. The ventral cirri reach to the middle row of neuropodial setæ, while the dorsal cirri extend fully one-third of their length beyond the tips of the longest of the latter, being therefore relatively somewhat longer than in *A. aculeata*.



Figs. 1, 2 and 3.—Neuropodial setæ from somite X. Anterior of dorsal, posterior of middle, and middle of ventral series, respectively. All × 56.

The general arrangement of the several forms of setæ is that usual in the genus. Of the three series of neuropodials the dorsal invariably contains two, the middle usually 4, and the ventral 8, though 5 may occasionally occur in the middle and 7 to 8 in the ventral series. All of these setæ are brown and decidedly iridescent, and the slender ones quite pale. In the dorsal row both spines (fig. 1) are very stout, and both terminate in blunt points which probably result from wear, though not a single one of these spines in any of my specimens presented a really acute tip. The middle setæ (fig. 2) are moderately and the ventral (fig. 3) decidedly slender, and both are similarly formed, with acute attenuated tips not preceded by any enlargement and not concealed in a pilose coat, though those newly extruded are sheathed. In the dorsal series the anterior seta is frequently stouter, while those in the other two increase in size from before backward. Toward the caudal end, coincidentally with the reduction in size of the parapodia, these setæ become more slender, smaller and fewer, and on the last 7 or 8 parapodia are altogether wanting.

From the lower side of the notopodial tubercle arises a tuft of iridescent hairs which spring from a curved line reaching from the anterior margin of the tubercle upward and backward to the base of the notopodial cirrus, which occupies a posterior position. These capillary setæ spread in a flowing plume outward, backward and upward, covering the sides of the body and the neuropodia. Compared with the corresponding structures in *A. aculeata* they present numerous differences. In the first place they are fewer, about one-third longer and spread more widely, irregularly and in greater disorder from the sides. In our species they are much softer and less harsh and rigid—a difference which becomes especially evident if they are brushed forward and released, when those of *A. aculeata* spring quickly back to position, while those of *A. hastata* return slowy and gently. But the most striking difference is in color, ours being far less brilliant than the European species. When placed in corresponding positions with reference to the light and the observer's eye, namely, with the caudal end toward the light and the head toward and below the observer, the marginal hairs of *A. aculeata* appear of a beautiful burnished golden green color, rich golden predominating toward the base and a fine viridian green in the outer half, the intensity of the display being enhanced by the great number and relatively compact arrangement of the hairs, while the general effect of those of *A. hastata* varies from a pearl color to a richer bronzy red in different individuals. In the paler variety the hairs appear purplish-blue, toward the base changing to a delicate red, and toward the tip to a varied mixture of reddish-purple and bluish-green which differs as the glancing light strikes particular hairs at different angles. Owing to the more open, spreading arrangement of the hairs in our species this dispersal of the colors is more evident. When viewed at other angles or by transmitted light the distribution of colors differs.

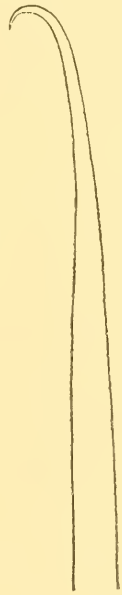
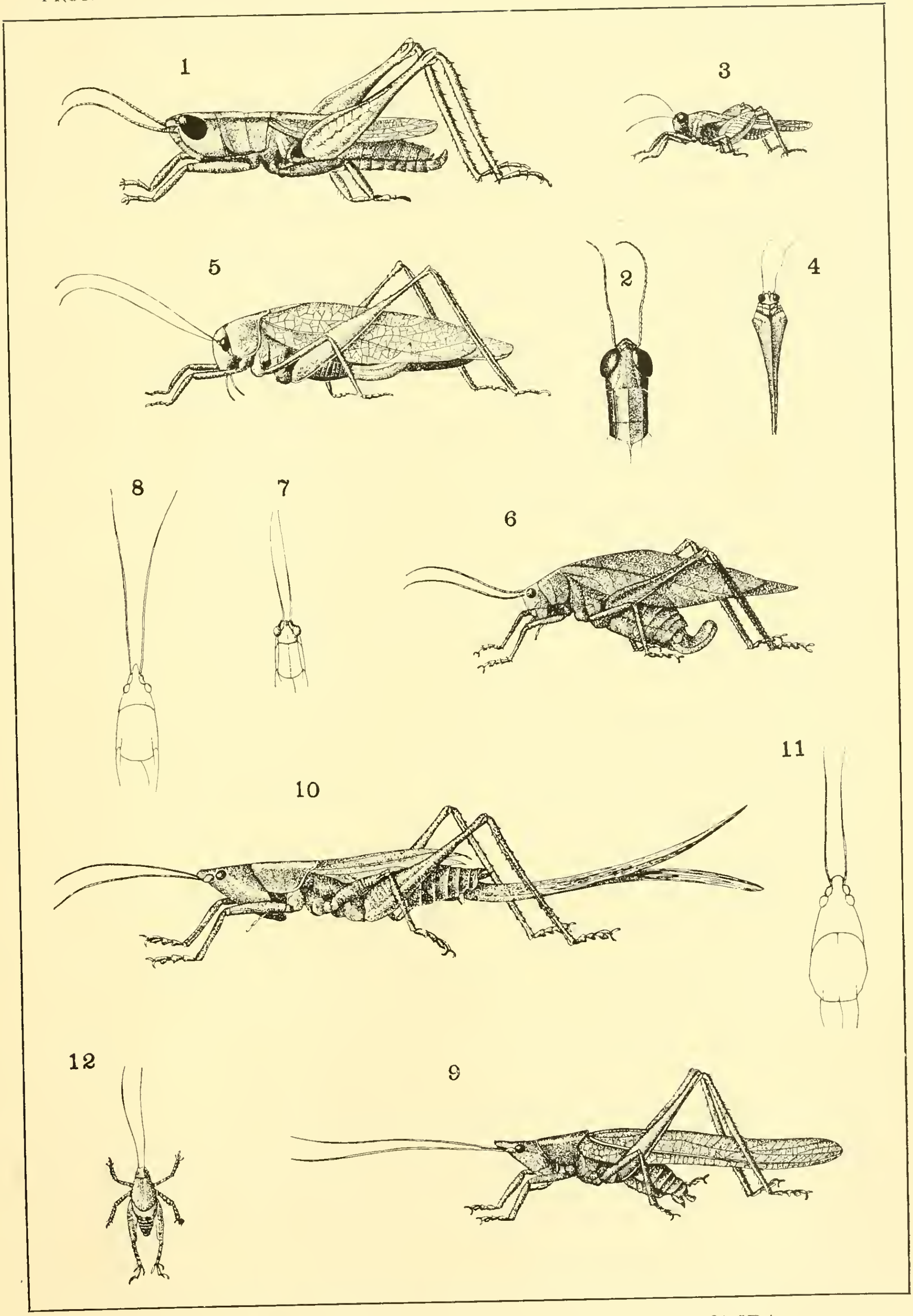


Fig. 4.—Tip of notopodial seta. × 250.

The two tufts of large notopodial spines arise, as in most species, one just anterior to the dorsal cirrus, the other, separated by a short interval, higher on the dorsum. The first consists of about 4 and the second of about 6 or 7 long, curved, soft, coarse and brownish setæ which, after perforating the dorsal felt, curve, most of them perfectly free from and above the latter, caudad and mediad, often crossing those of the opposite side and many of them attaining a length in excess of the greatest width of the body. At the base they are very coarse, but taper gradually to the tip, which is recurved as an acutely pointed hook (fig. 4). In section they are often flattened and seldom perfectly circular. The interior consists of a core of soft colorless fibres which are enclosed in a firmer and brittle sheath or shell of a more or less iridescent brown color. It is to this structure that these spines owe their softness and fragileness, the latter quality being so marked that large specimens almost invariably have all of them broken short off above the felt, leaving the latter exposed over the entire median expanse of the back, and giving to this species an aspect which has naturally led to its identification with *A. aculeata*.

The felt fibres arise in three tufts, one ventral, one between and one dorsal to the dorsal setæ bundles. In large specimens the felt forms a uniform continuous layer nearly $\frac{1}{8}$ in. thick and of a smooth, compact texture. The fibres appear to be finer than in the two specimens of *A. aculeata* available for comparison. They also have less color, many of them being altogether dull and colorless while others exhibit a slight greenish iridescence.

The type is No. 20, Collection Acad. Nat. Sci., and was taken by Dr. Benjamin Sharp on the beach at Nantucket after a storm. About a dozen other specimens have been examined, coming partly from the same place, partly from the collections of Mr. Vinal Edwards on Noman's Land and from dredgings of the U. S. F. C. steamer *Fish Hawk* in the deeper waters off the same region. The species has not been taken in the course of the recent extensive dredgings of the *Fish Hawk* and *Phalarope*, either in Vineyard Sound, Nantucket Sound, or Buzzard's Bay. Occasionally, it is brought up in lobster pots set in the deeper waters off Noman's Land, and it is probably this species which is said to be sometimes thrown up in great numbers during heavy storms on the shores of Block Island.

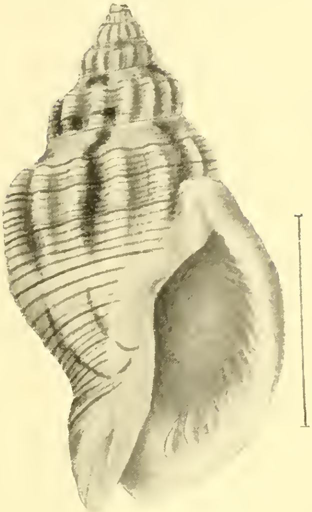


REHN AND HEBARD. ORTHOPTERA OF FLORIDA.

E. G. Vanatta, del.

PILSBRY. JAPANESE MARINE MOLLUSKS.

PLATE III.



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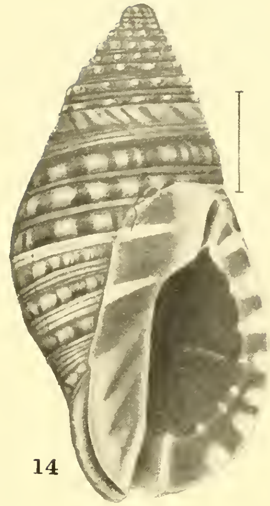

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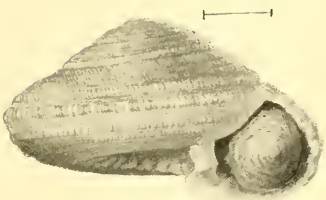

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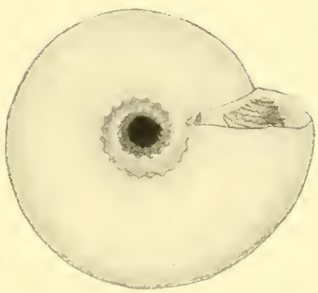

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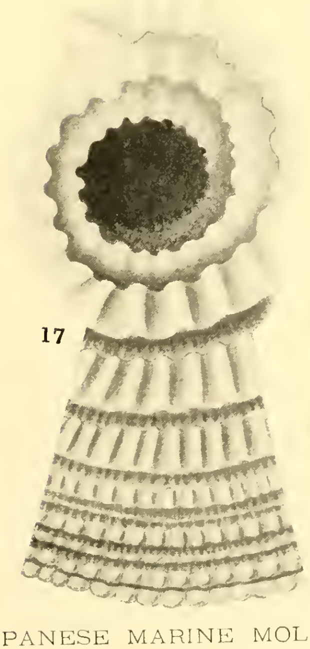

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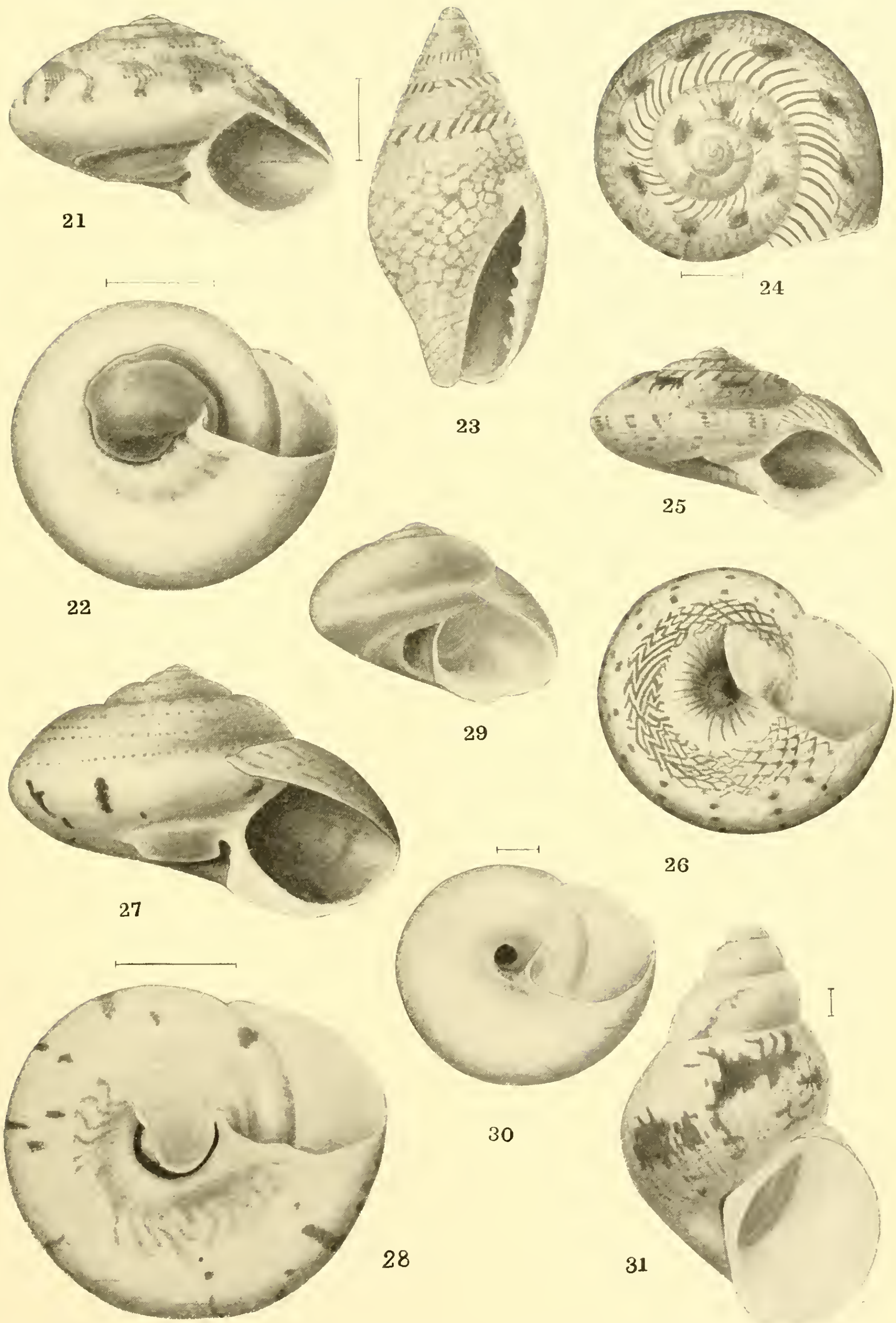
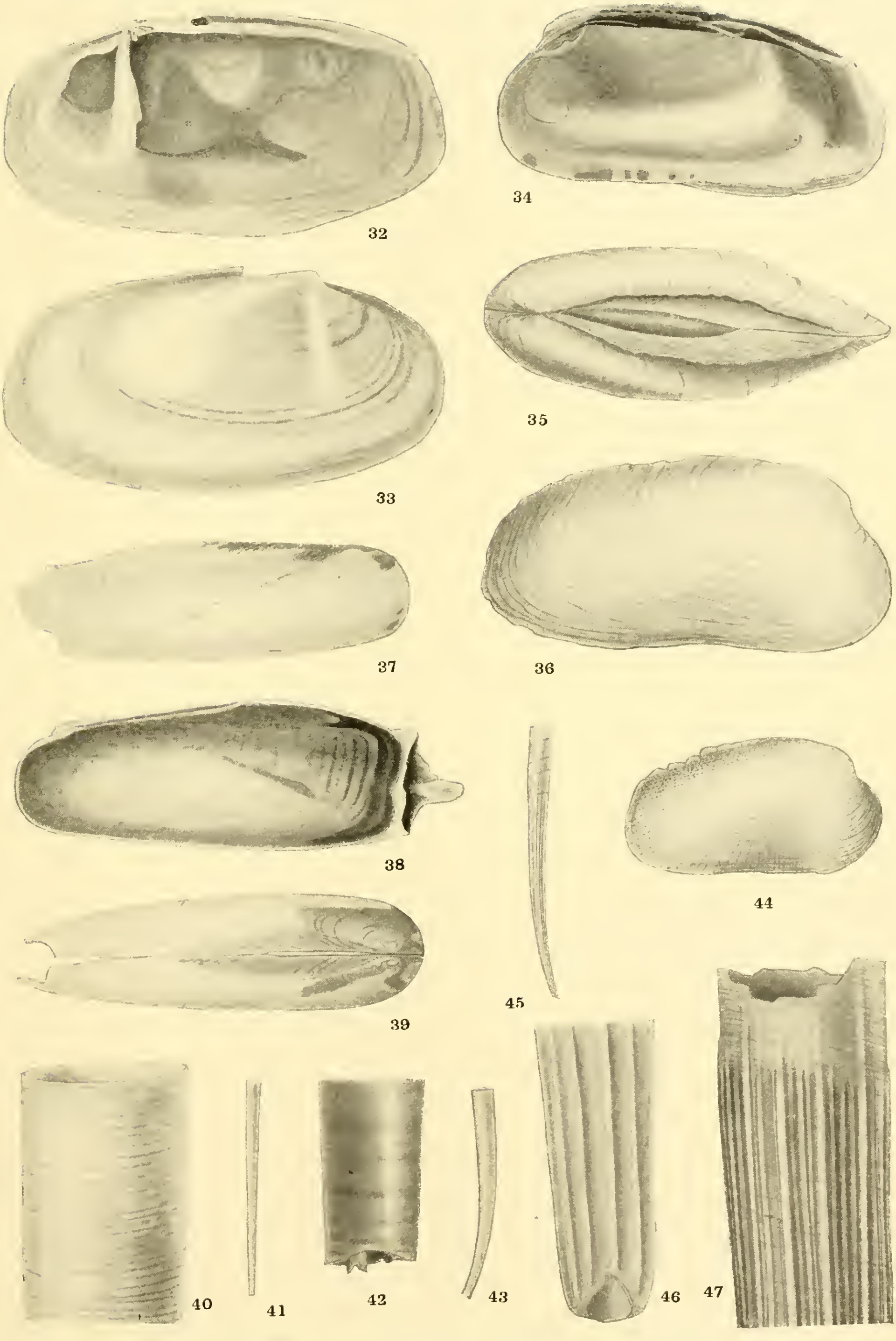
E. G. Vanatta, del.

PILSBRY. JAPANESE MARINE MOLLUSKS.



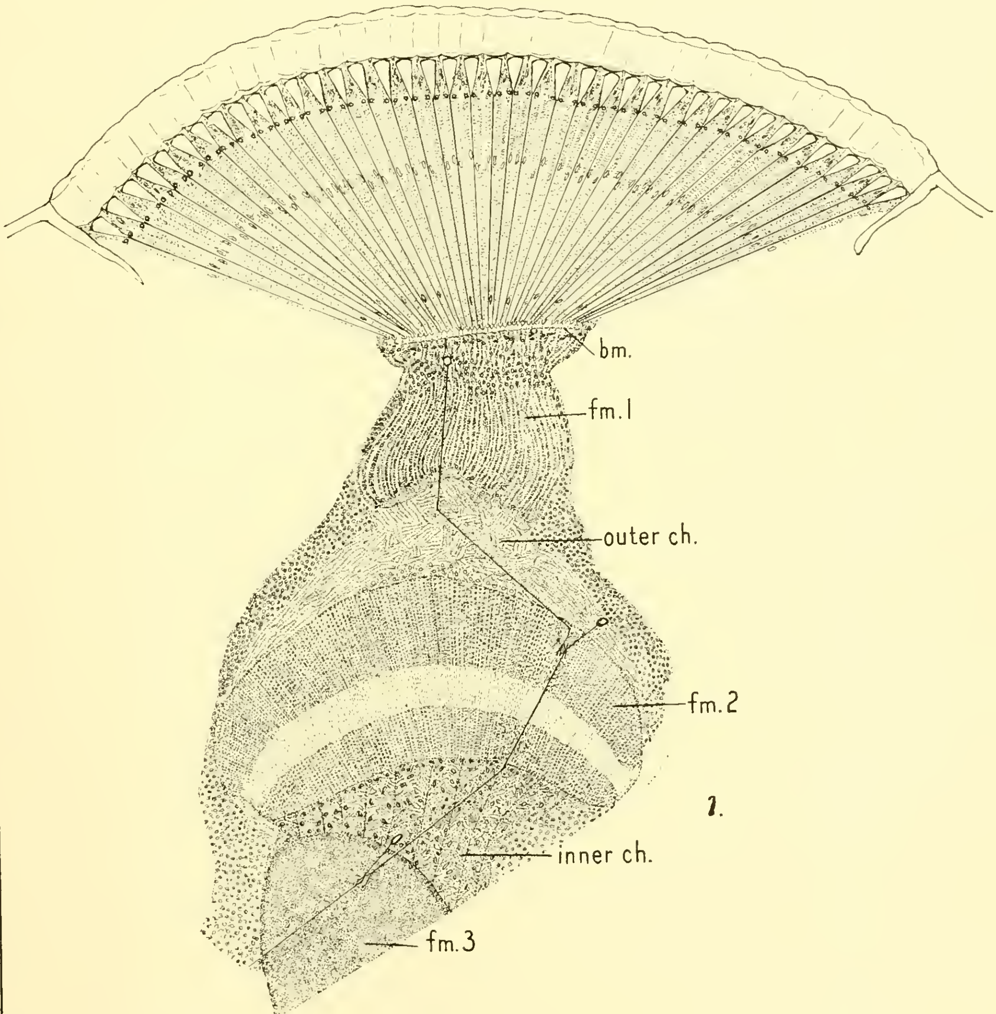
E. G. Vanatta, del.

PILSBRY. JAPANESE MARINE MOLLUSKS.

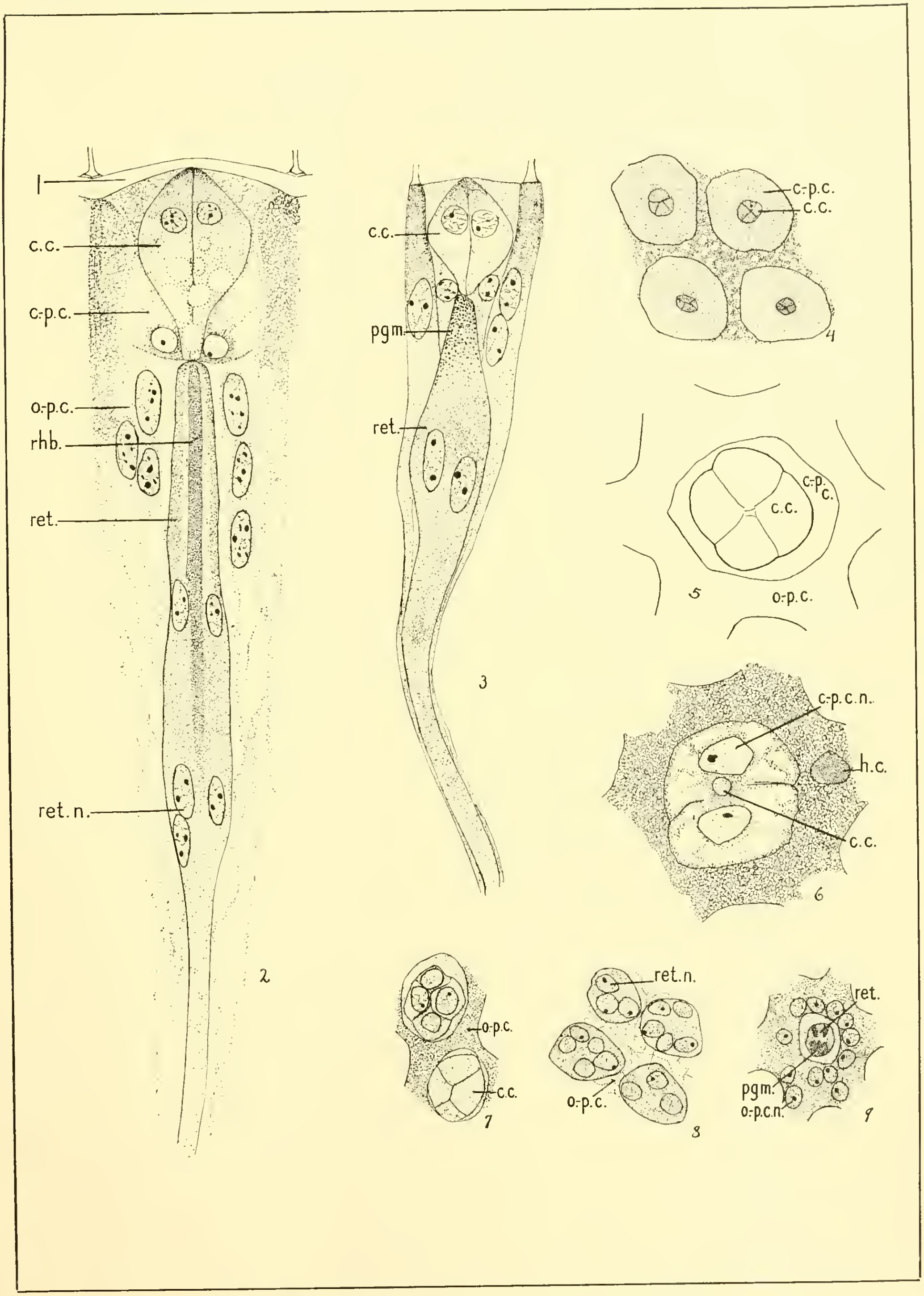


E. G. Vanatta, del.

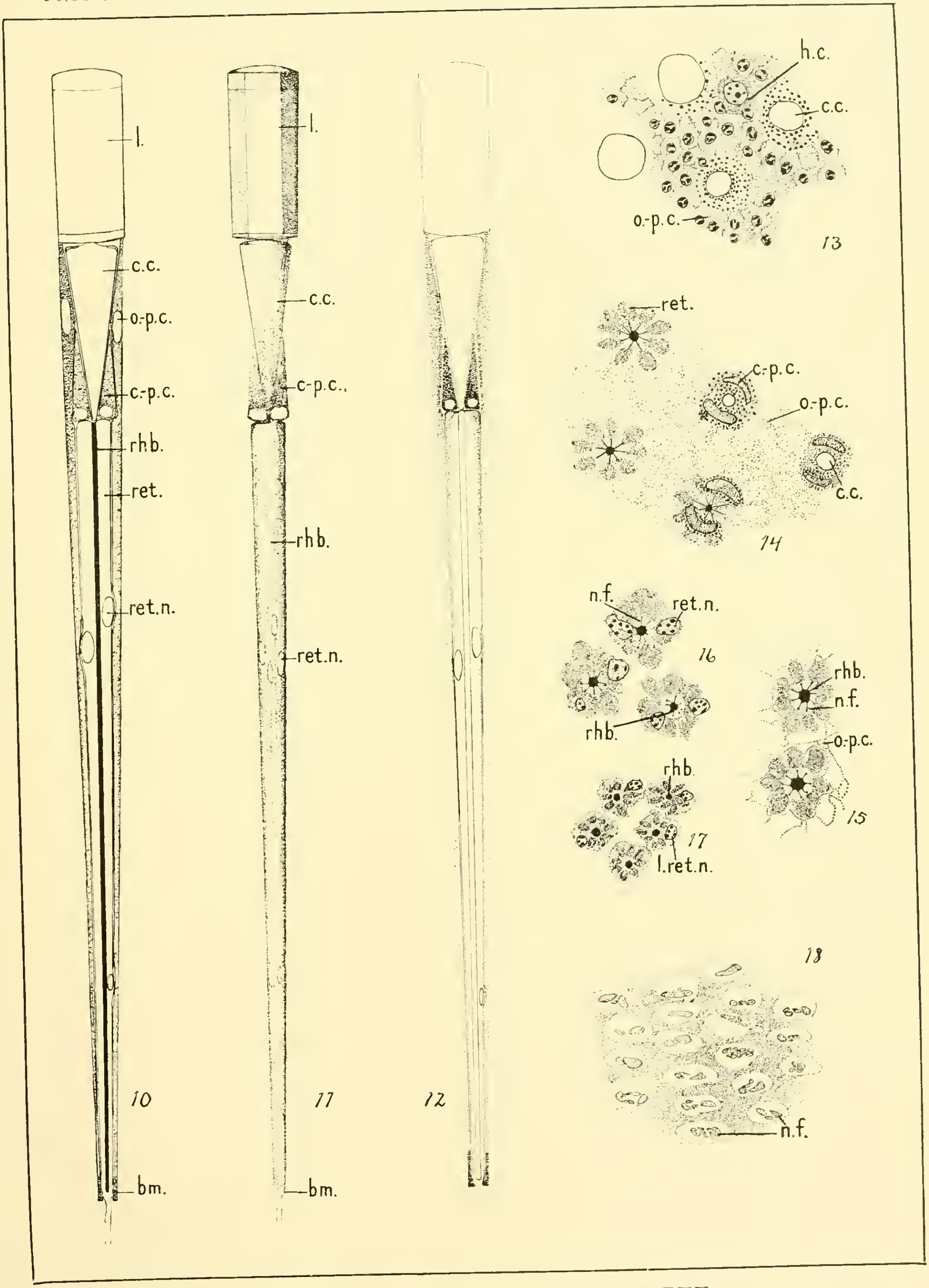
PILSBRY. JAPANESE MARINE MOLLUSKS.



PHILLIPS. EYE OF THE HONEY BEE.



PHILLIPS. EYE OF THE HONEY BEE.

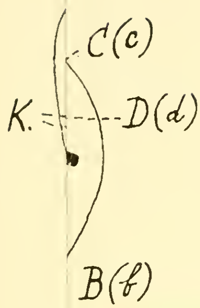


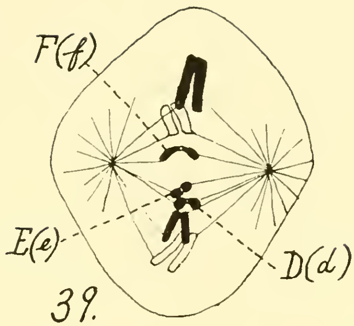
PHILLIPS. EYE OF THE HONEY BEE.

PLATE IX.

LYCOSA.

PLATE X.





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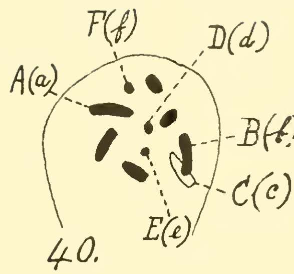

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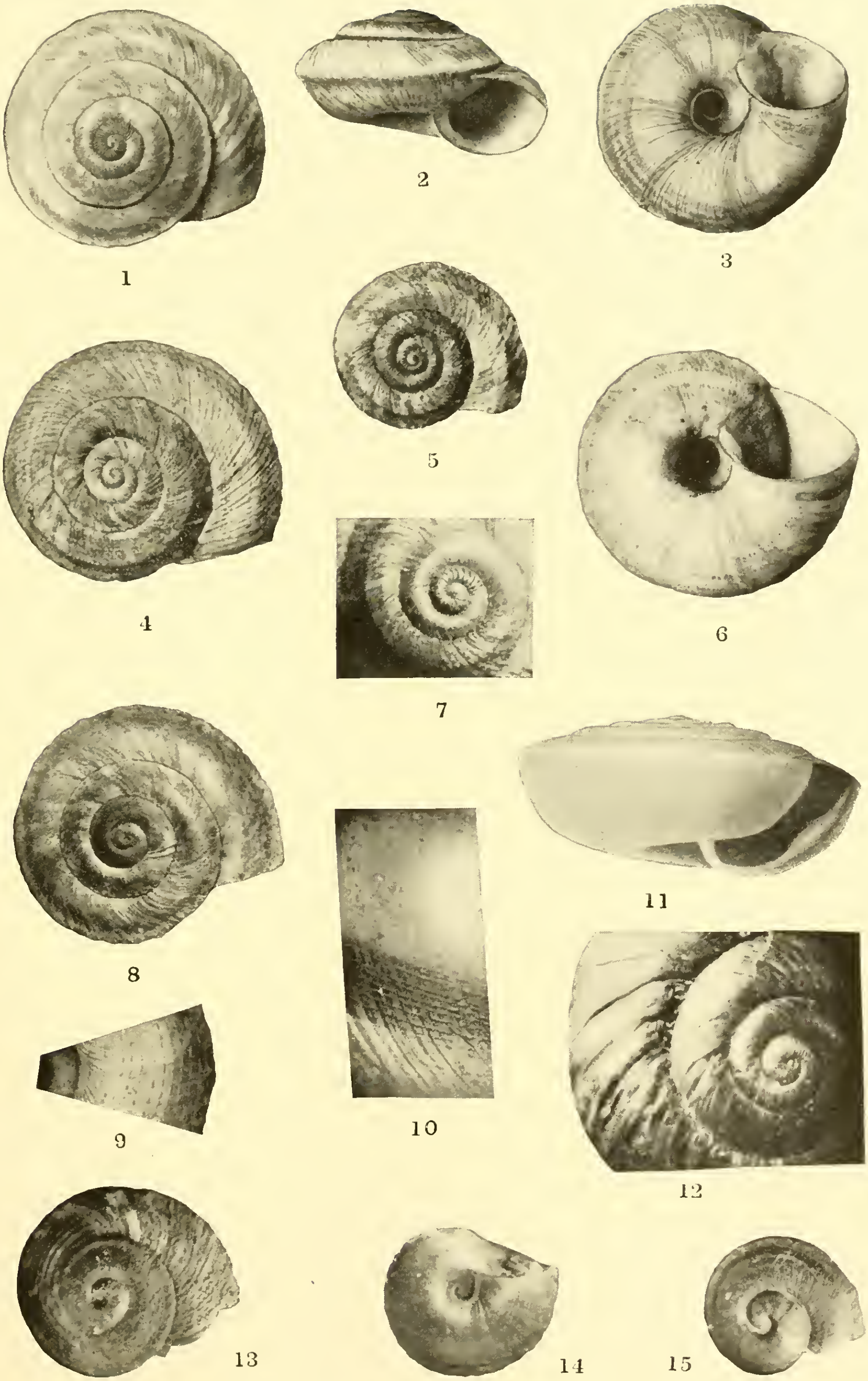
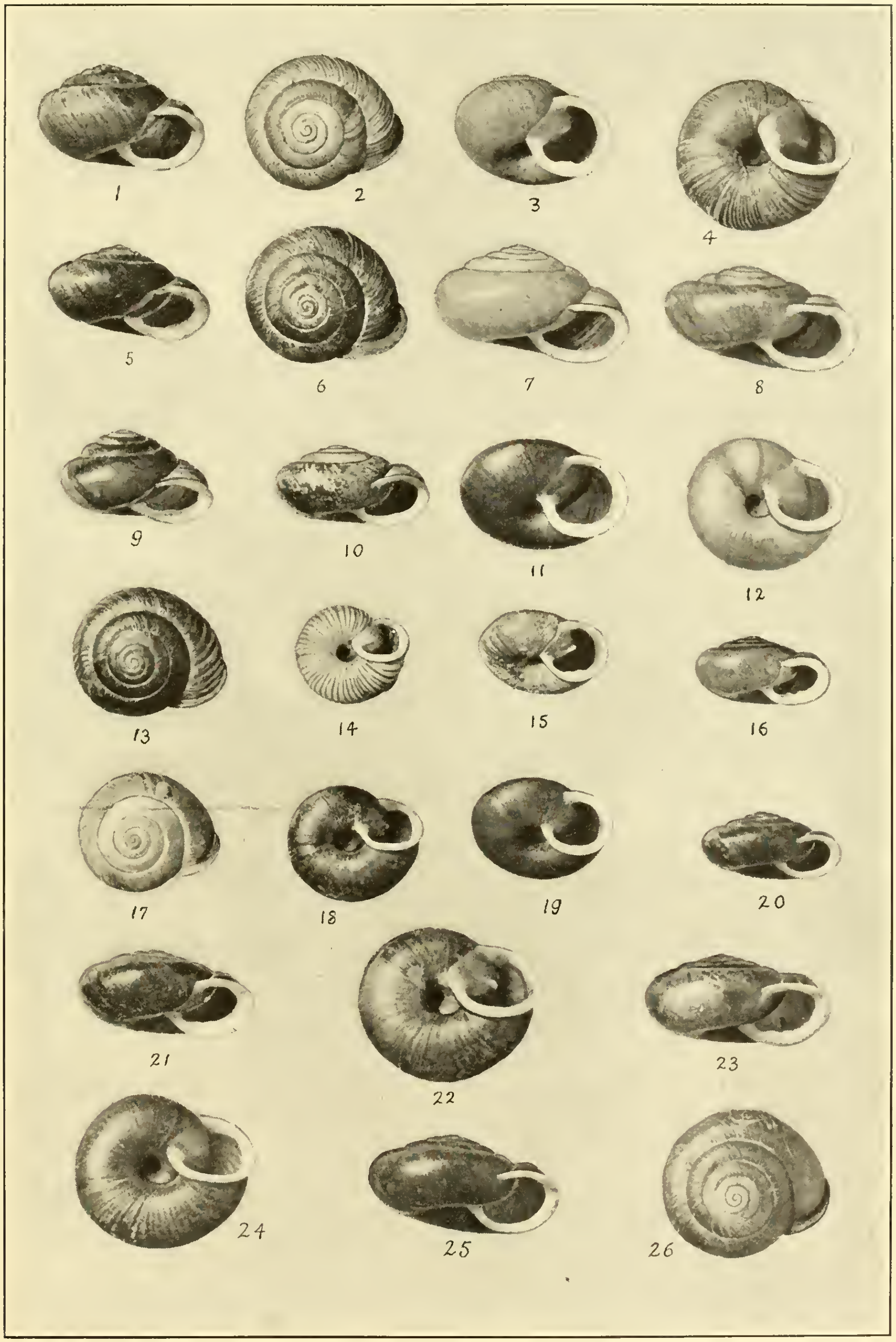


PILSBRY. MOLLUSCA OF THE SOUTHWESTERN STATES.



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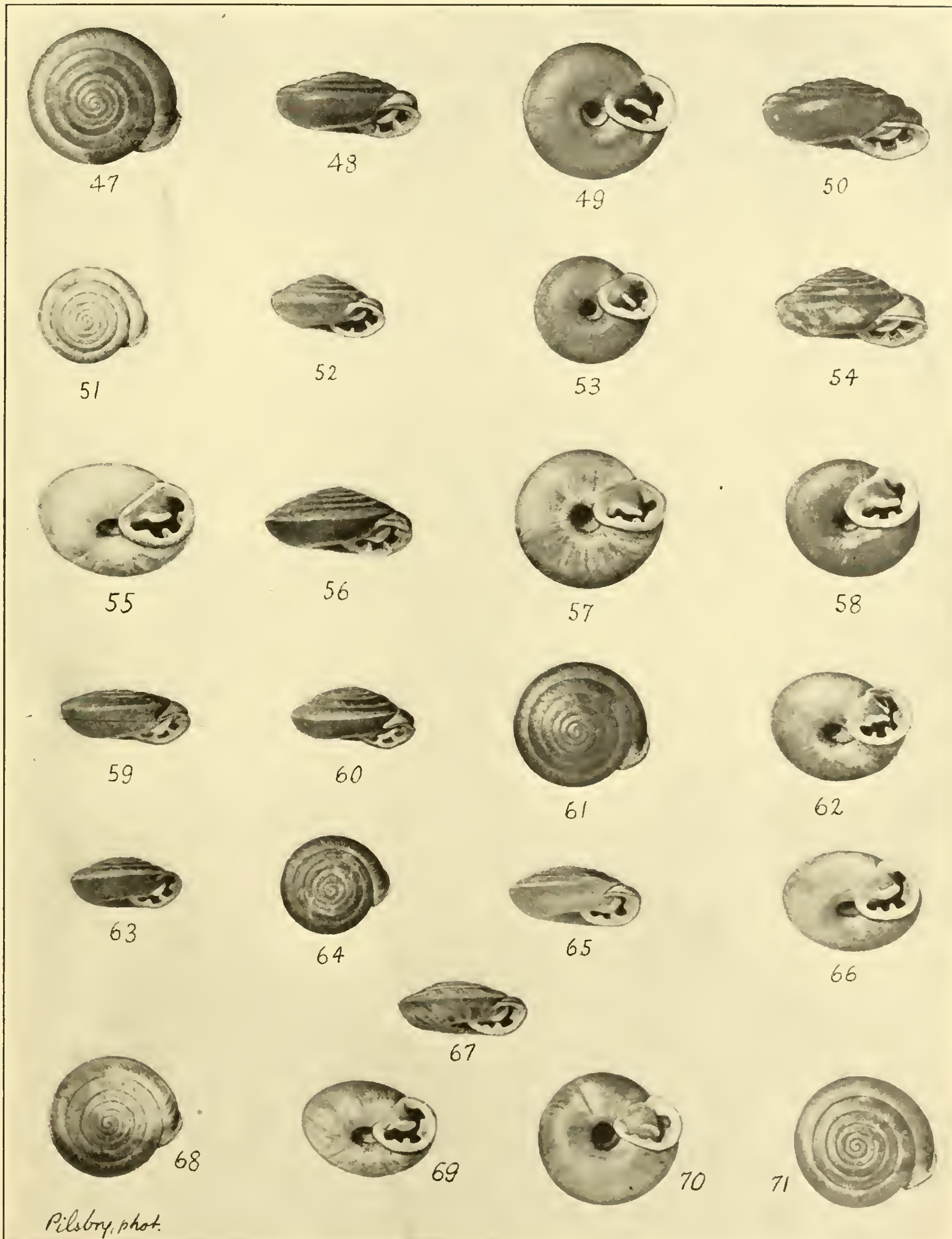
PILSBRY. MOLLUSCA OF THE SOUTHWESTERN STATES.



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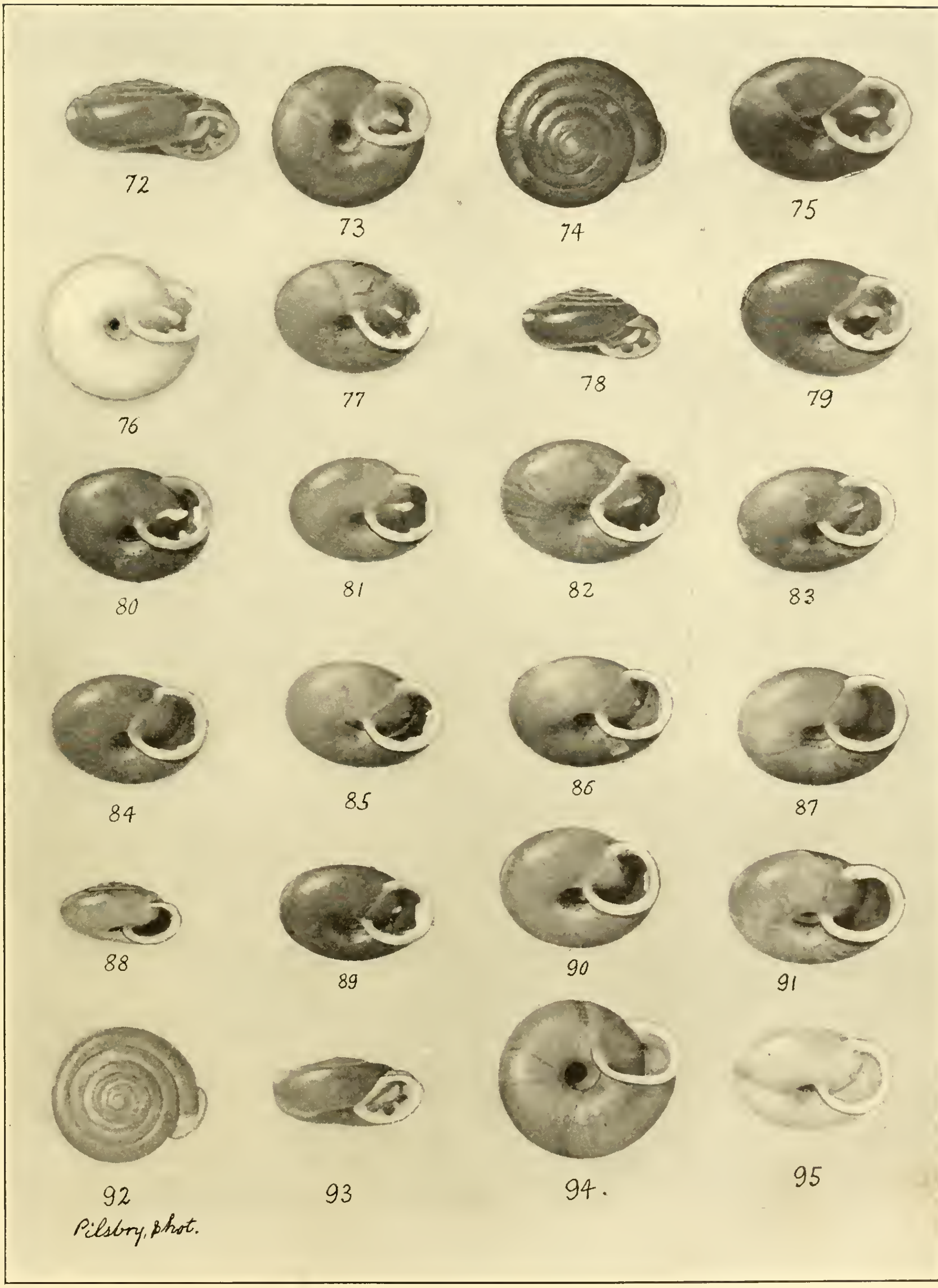

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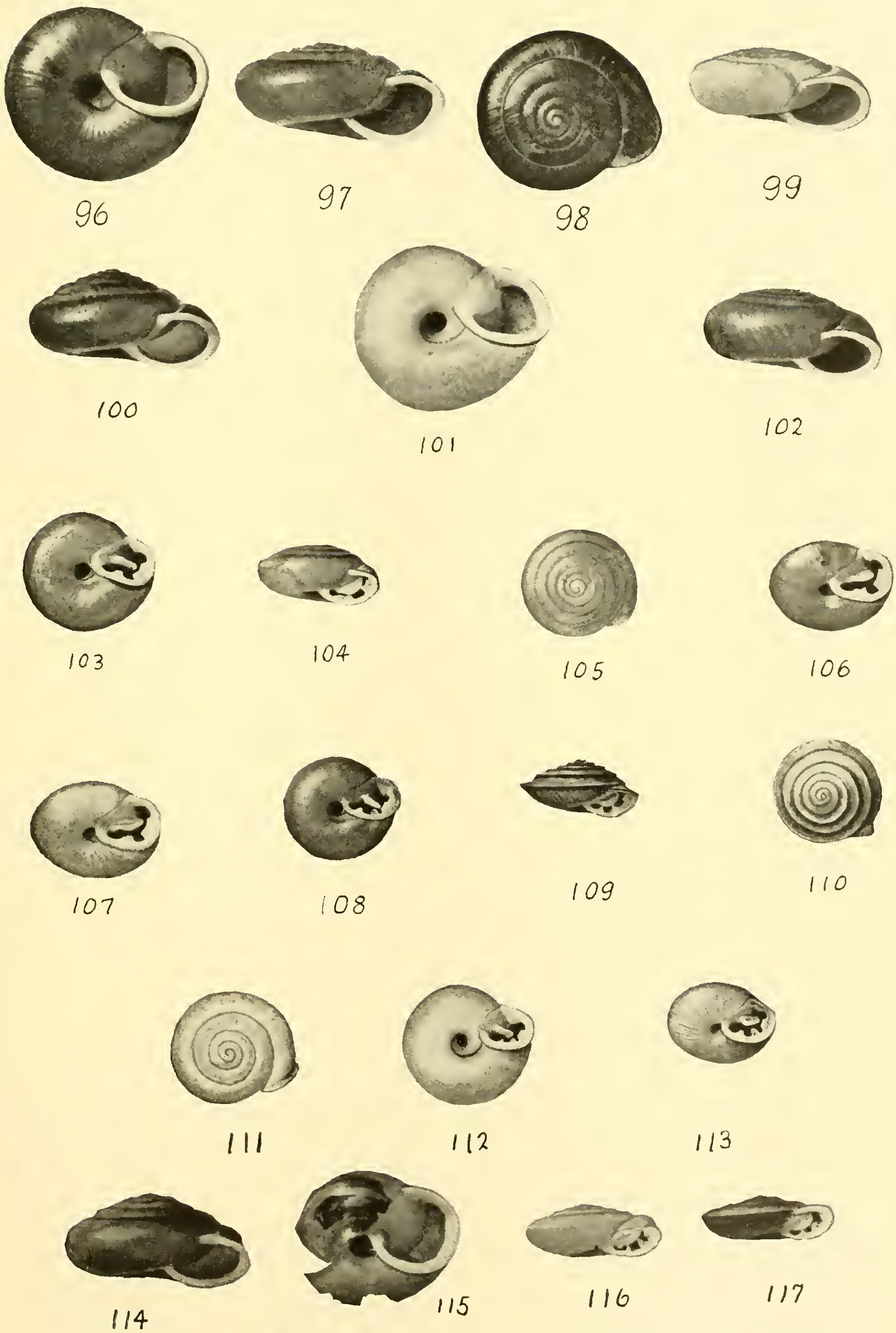

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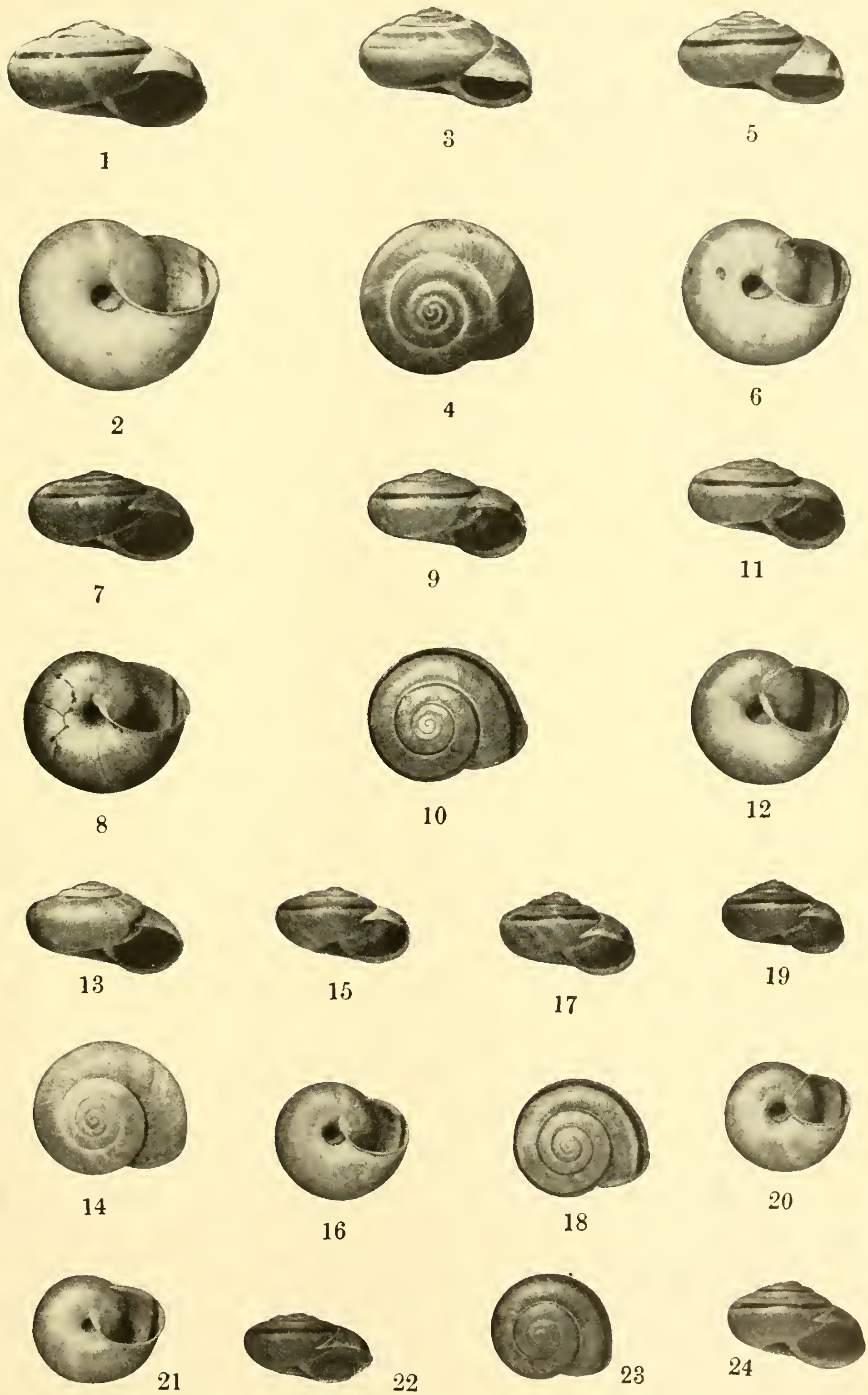

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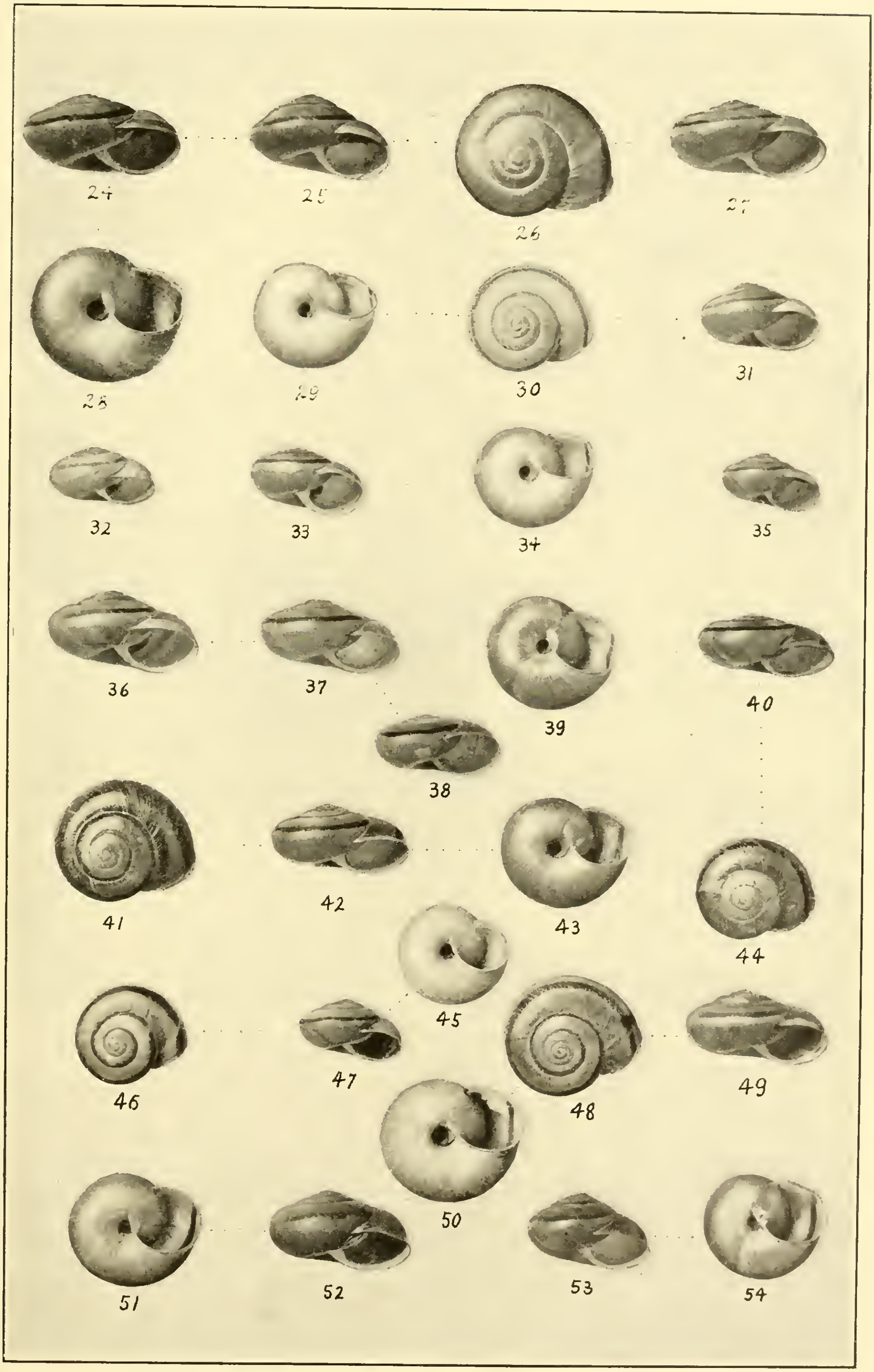

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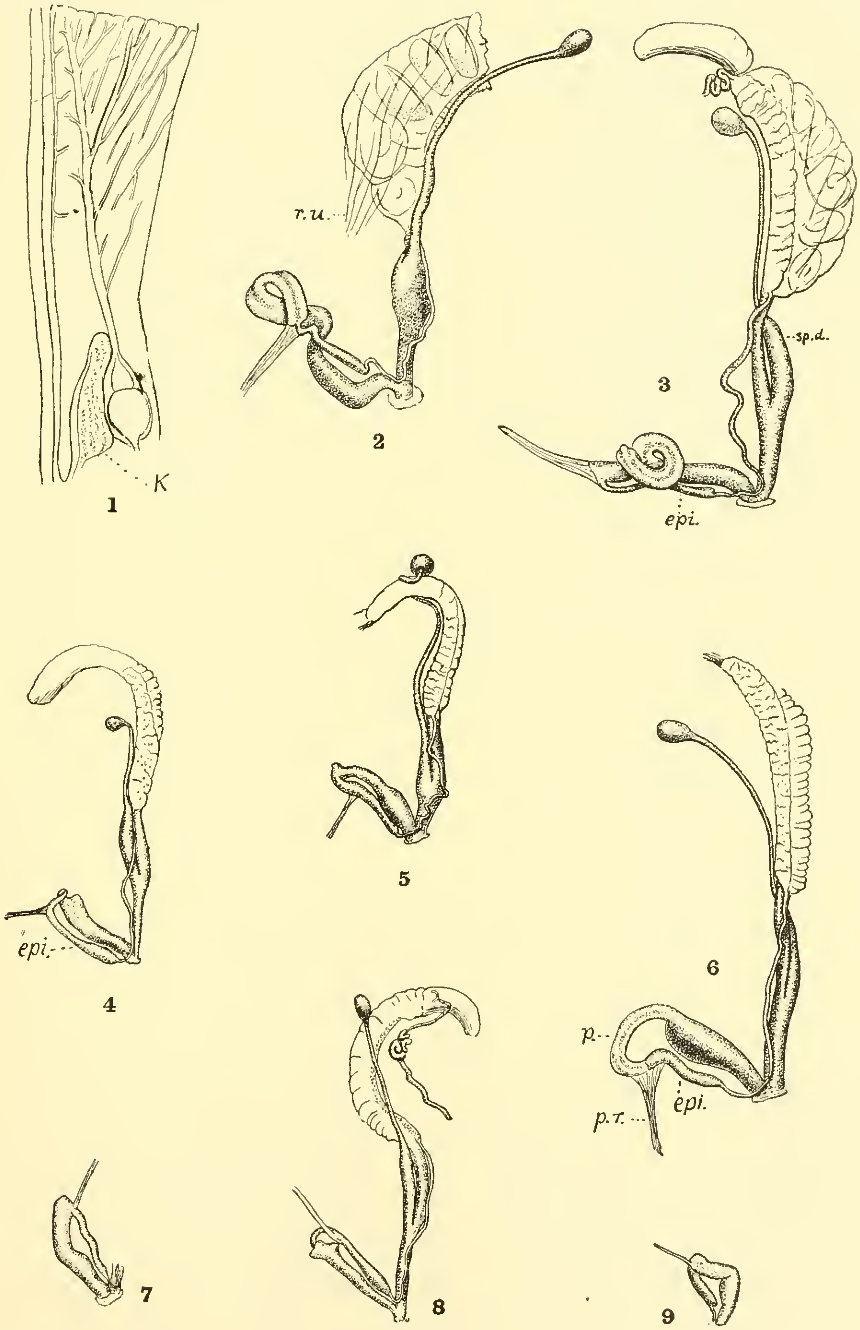

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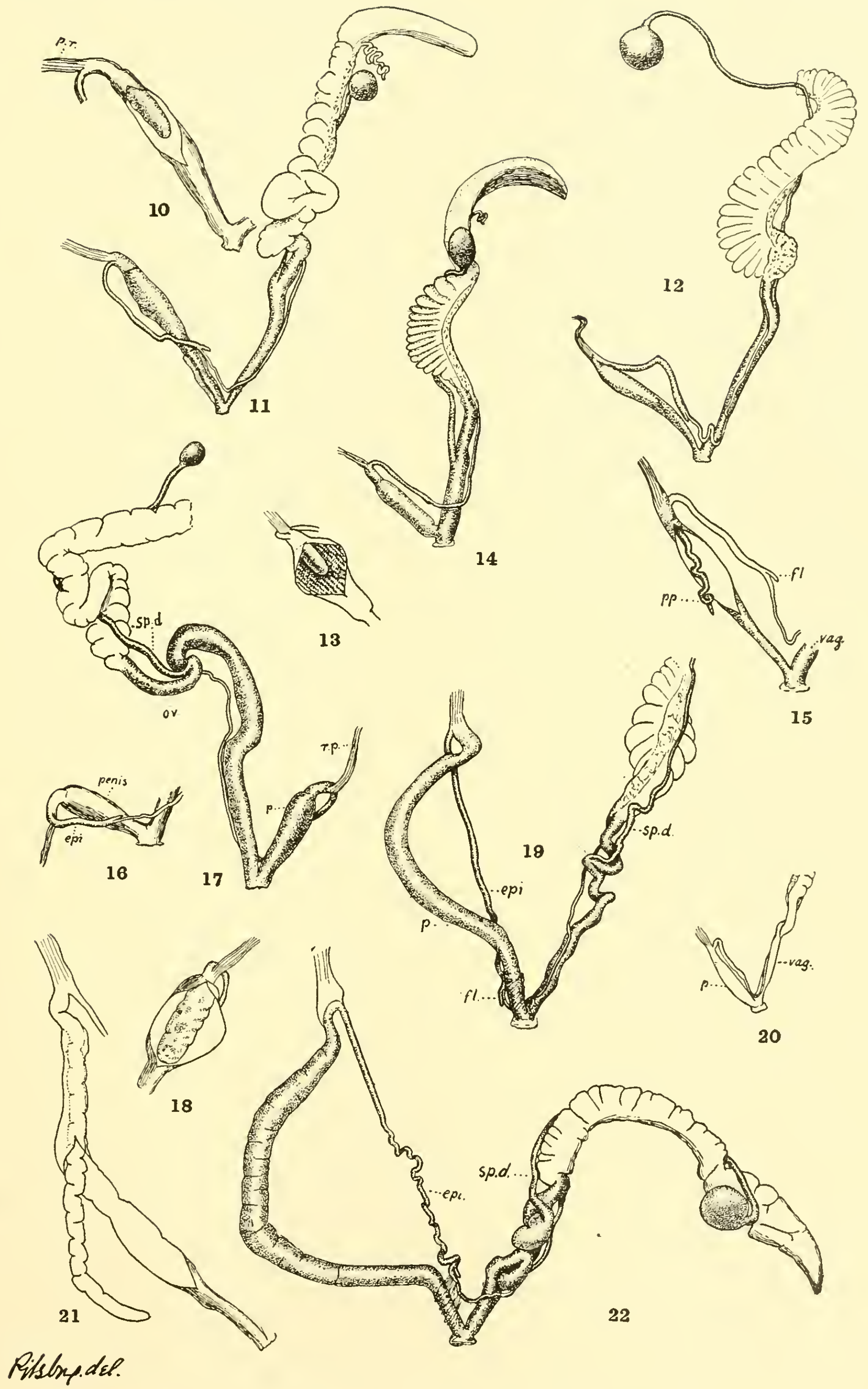

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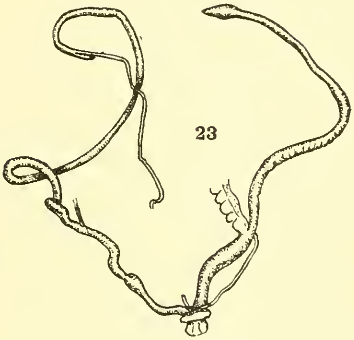

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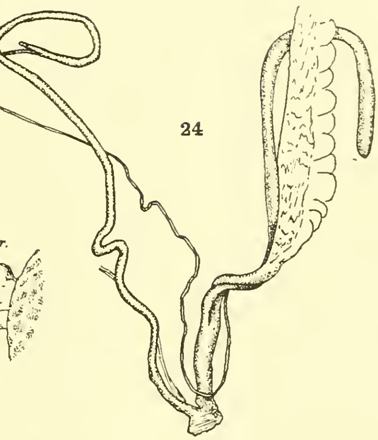

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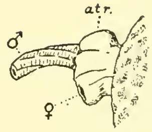

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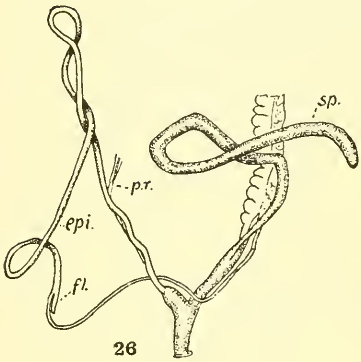

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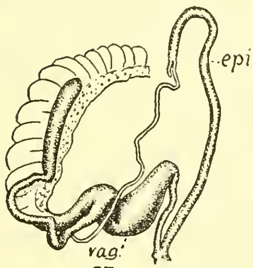

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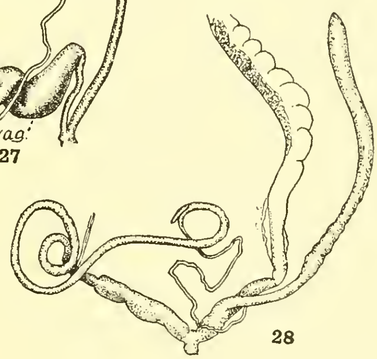

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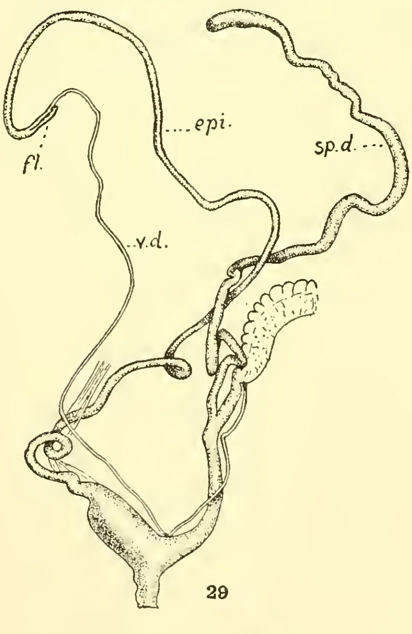

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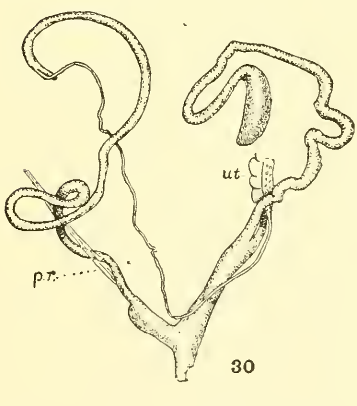

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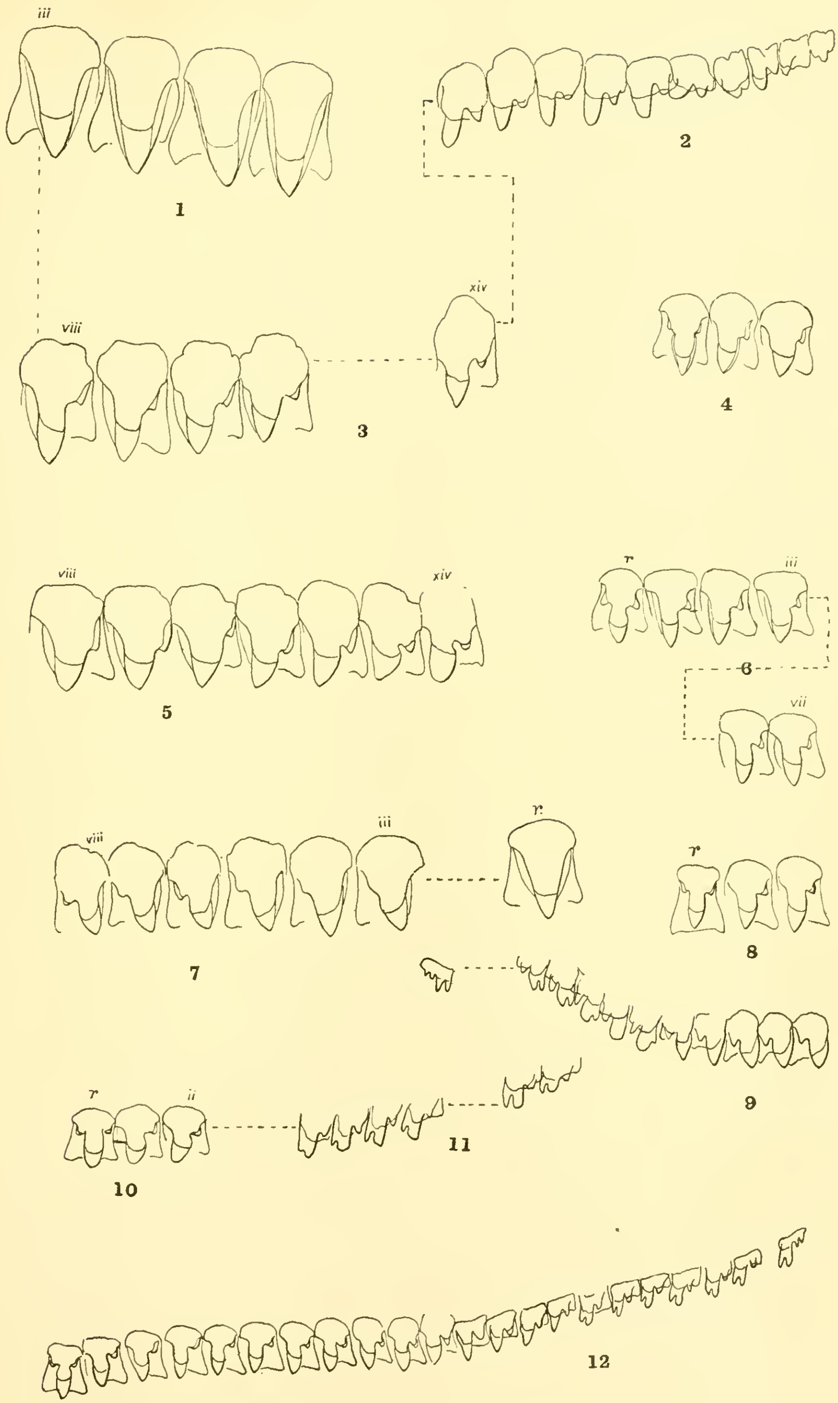

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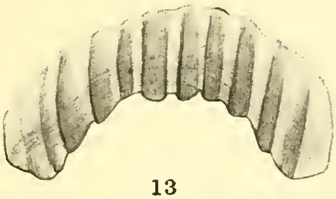

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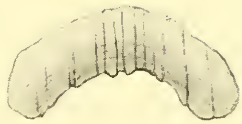

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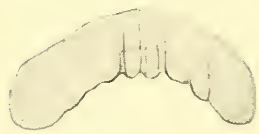

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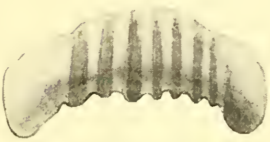

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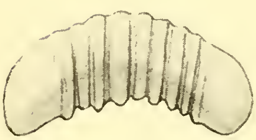

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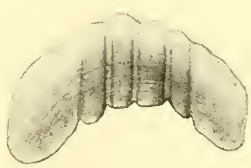

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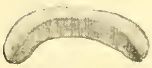

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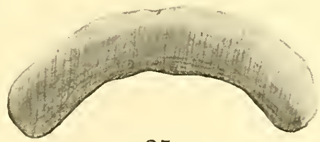

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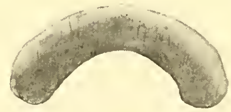

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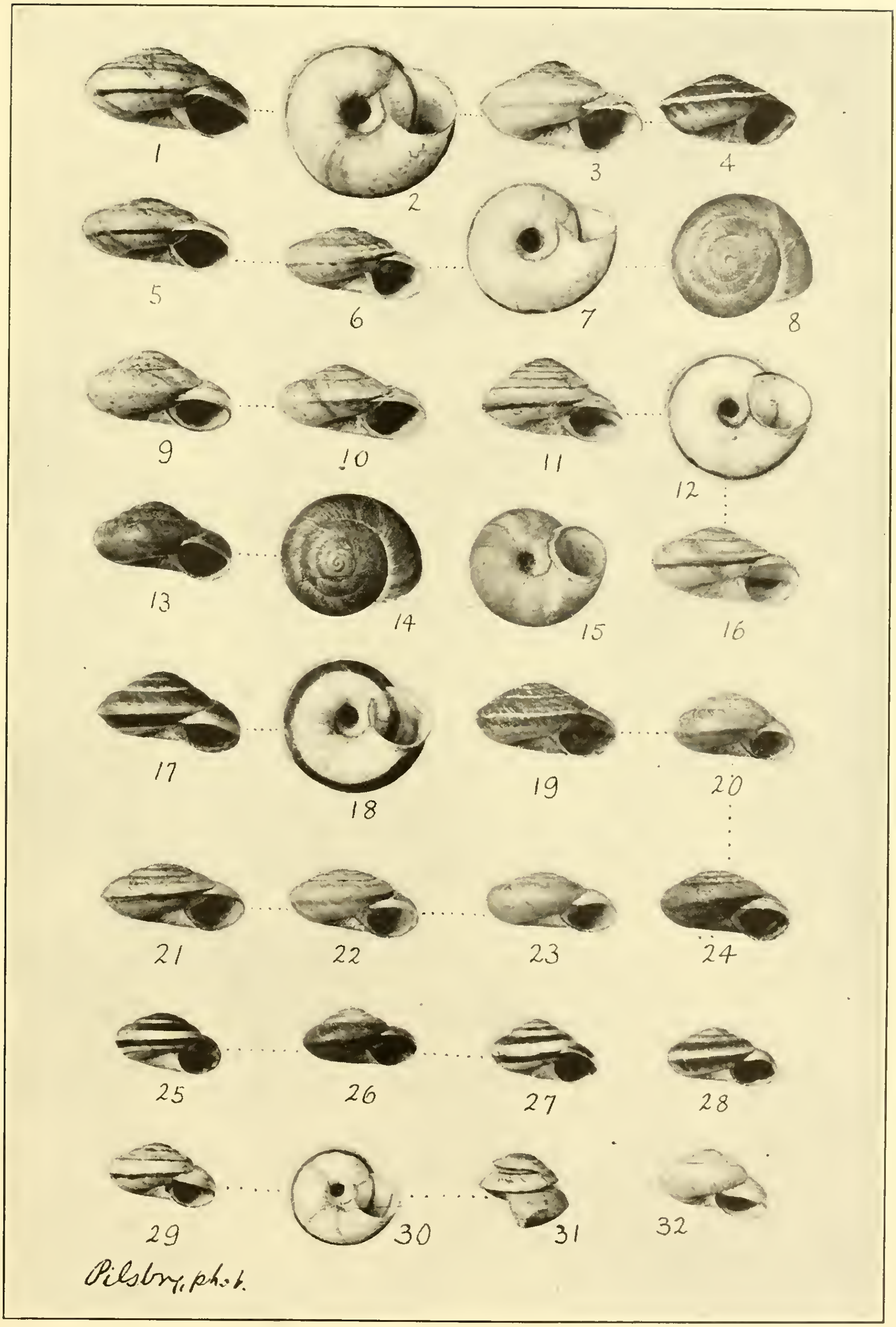

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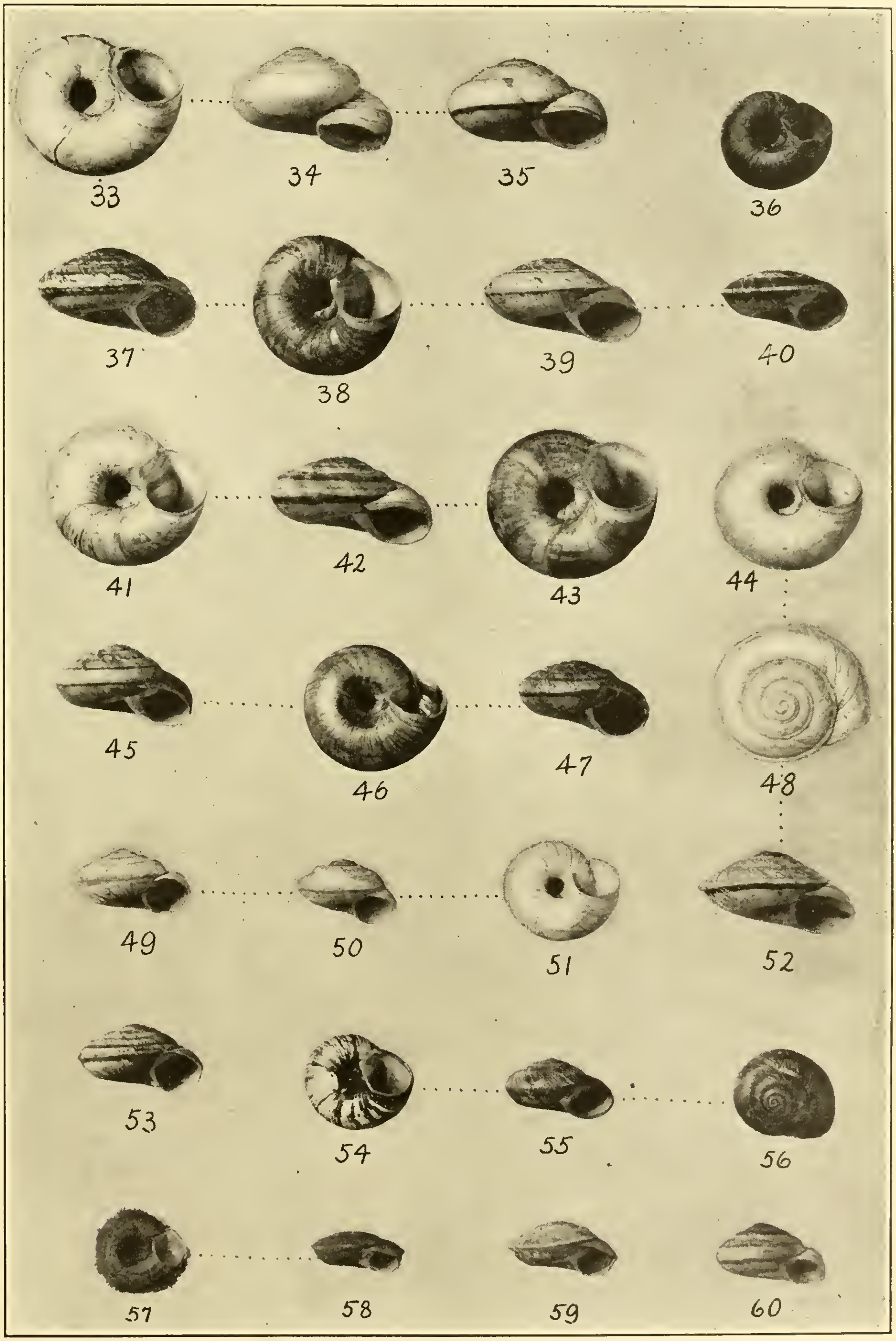

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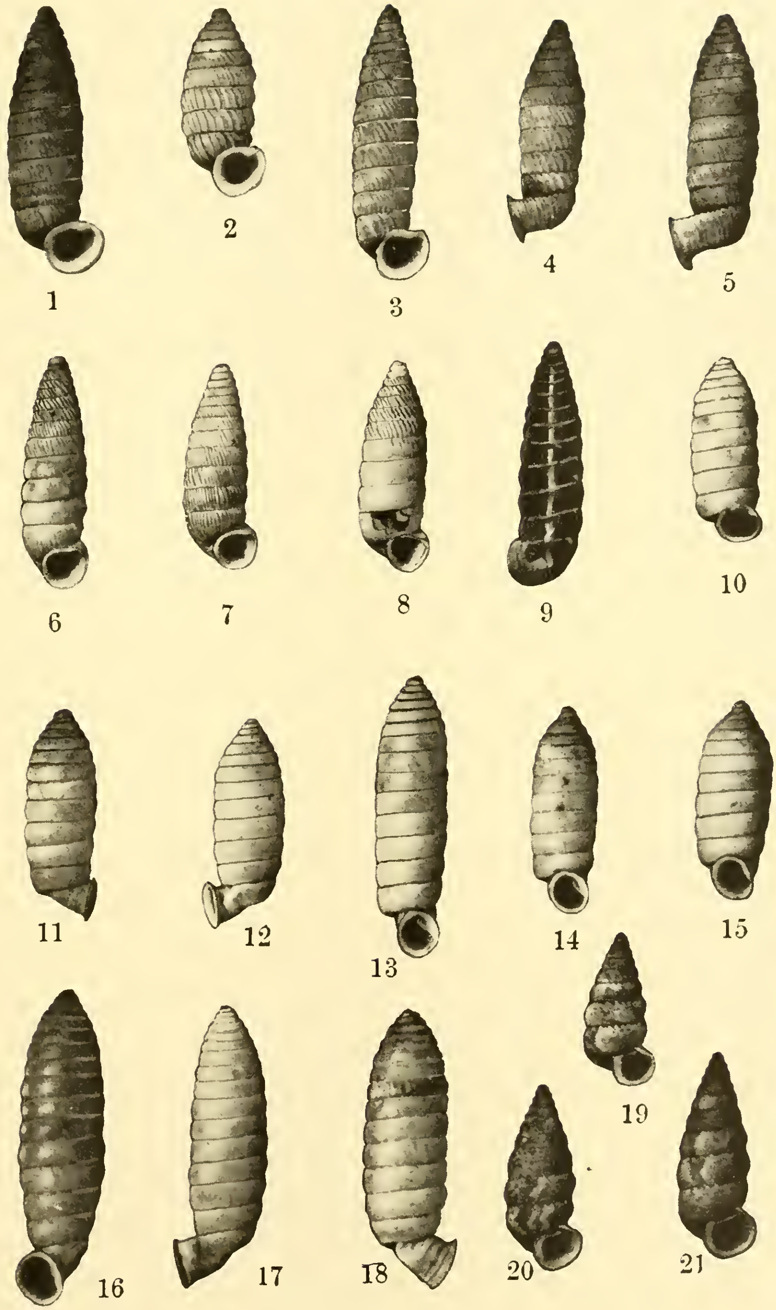

PILSBRY. MOLLUSCA OF THE SOUTHWESTERN STATES.


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PILSBRY. MOLLUSCA OF THE SOUTHWESTERN STATES.

April 4.

Mr. Arthur Erwin Brown, Vice-President, in the Chair.

Sixteen persons present.

The death of Henri de Saussure, a Correspondent, February 20, 1905, was announced.

Everett F. Phillips made a communication on variations and correlations in the honey bee and on queen rearing in agriculture. (No abstract.)

The following papers were received for publication:

"A Contribution to the Knowledge of some South American Hymenoptera chiefly from Paraguay," by C. Schrottky (March 28). Transferred to the Entomological Section.

"Some Marine Oligochæta of New England," by J. Percy Moore (April 3).

April 18.

Mr. Arthur Erwin Brown, Vice-President, in the Chair.

Thirty-four persons present.

The death of Victor Raulin, a Correspondent, March, 1905, was announced.

Mr. Stewardson Brown made a communication on the flora of the Lower Florida Keys. (No abstract.)

The following papers were withdrawn by the authors:

"A Contribution to the Knowledge of the Centrarchidæ," by Henry W. Fowler.

"A Contribution to the Knowledge of the Orthoptera of Cuba, the Isle of Pines and the Bahamas," by James A. G. Rehn.

A paper entitled "Notes on a Small Collection of Orthoptera from the Lesser Antilles, with the Description of a New Species of Orphulella," by James A. G. Rehn, was transferred to the Entomological Section.

Messrs. Robert D. Carson and Edward C. Knight were elected members.

Geo. T. Moore, Ph.D., of Washington, D. C.; John Stirling Kingsley, of Tufts College, Mass., and Charles D. Walcott, of Washington, D. C., were elected Correspondents.

The following were ordered to be printed.

A CATALOGUE OF THE ERIGONEÆ OF NORTH AMERICA, WITH NOTES AND DESCRIPTIONS OF NEW SPECIES.

BY CYRUS R. CROSBY.

The larger part of the material upon which the notes included in this paper are based is in the collection of Cornell University. This collection includes, in addition to the general collection of the University, the following special collections: Many of the specimens studied by Nathan Banks in the preparation of "The Spider Fauna of the Upper Cayuga Lake Basin" (*Proc. Acad. Nat. Sci. Phila.*, 1892); a collection purchased by the Entomological Department of Cornell University of Dr. William Fox; a collection made by Prof. J. H. Comstock in the Southern States, and a collection made by the writer chiefly near Ithaca, New York. The sequence of genera, with one exception, is that of Simon's *Histoire Naturelle des Araignées*. As many of the original descriptions are very brief, I have given in the notes such measurements and facts as may be of value in determining the generic position of the species. The types of the new species are in the Cornell University collection.

I wish to thank Prof. Comstock, under whose direction this paper was prepared, for the opportunity of using the University collection and for many favors and valuable suggestions. I am under obligations to Dr. A. D. MacGillivray and Dr. W. A. Riley for kindly encouragement and many specimens; to Mr. J. H. Emerton for the loan of specimens; to Dr. William Fox for the loan to the Department of Entomology of Cornell University of parts of types of his species of *Ceraticelus;* to Mr. P. B. Powell for specimens from California; and to many others for specimens of which no record was made.

I. A Catalogue of the Erigoneæ of North America.

CERATINELLA Em., Trans. Conn. Ac., VI, p. 32. *1882.*

C. brunnea Em., *l. c.*, p. 36, Pl. VIII, fig. 3. *1882.*

Ceraticelus brunneus E. Sim., Ar. Fr., V, p. 596. *1884.*

LOPHOCARENUM Menge, Preuss. Spinn., p. 198. *1868.*

L. frontalis Banks, Jour. N. Y. Ent. Soc., XII, p. 111, Pl. V, figs. 1–3. *1904.*

L. mæstum Banks (*Ceratinella*), Proc. Acad. Nat. Sci. Phila., p. 32, Pl. II, fig. 58; Pl. V, fig. 58. *1892.*

—— —— Banks, Jour. N. Y. Ent. Soc., I, p. 130. *1893.*

CERATICELUS E. Sim., Ar. Fr., V, p. 595. *1884.*

C. albus Fox (*Erigone* [*Ceratinella*]), Proc. Ent. Soc. Wash., II, p. 44. *1891.*

C. alticeps Fox (*Erigone* [*Ceratinella*]), *l. c.*, p. 45. *1891.*

C. atriceps Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 436, Pl. LV, fig. 7. *1874.*

Ceratinella atriceps Em., Trans. Conn. Ac., VI, p. 34, Pl. VII, figs. 5–5*d*. *1882.*

Ceraticelus atriceps E. Sim., Ar. Fr., V, p. 596. *1884.*

C. bulbosus Em. (*Ceratinella*), Trans. Conn. Ac., VI, p. 33, Pl. VII, fig. 3. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 596. *1884.*

Ceratinella bulbosa Banks, Proc. Acad. Nat. Sci. Phila., p. 32, Pl. V, figs. 59, 59*a*. *1892.*

C. emertoni Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 435, Pl. LV, fig. 6. *1874.*

Ceratinella emertoni Em., Trans. Conn. Ac., VI, p. 32, Pl. VII, fig. 1. *1882.*

Ceraticelus emertoni E. Sim., Ar. Fr., V, p. 596. *1884.*

Ceratinella similis Banks, Proc. Acad. Nat. Sci. Phila., p. 31, Pl. V, figs. 61–61*b*. *1892.*

C. fissiceps Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 438, Pl. LV, fig. 8. *1874.*

Erigone fissiceps Keys., Spinn. Am., Therid., II, p. 155, Pl. XVI, fig. 221. *1886.*

Ceratinella fissiceps Em., Trans. Conn. Ac., VI, p. 33, Pl. VII. fig. 2. *1882.*

Ceraticelus fissiceps E. Sim., Ar. Fr., V, p. 596. *1884.*

Ceratinella fissiceps Em., Com. Spid., p. 152, figs. 371–373. *1902.*

C. formosus Banks (*Ceratinella*), Proc. Acad. Nat. Sci. Phila., p. 33, Pl. II, figs. 55, 55*a*. *1892.*

Idionella formosa Banks, Jour. N. Y. Ent. Soc., I, p. 130. *1893.*

C. innominabilis n. n.

Ceratinella sp. Banks, Proc. Wash. Ac. Sci., II, p. 478, Pl. XXIX, fig. 5. *1900.*

C. lætabilis Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 435, Pl. LV, fig. 5. *1874.*

Ceratinella lætabilis Em., Trans. Conn. Ac., VI, p. 35, Pl. VIII, fig. 2. *1882.*

Ceraticelus lætabilis E. Sim., Ar. Fr., V, p. 596. *1884.*
Ceratinella lætabilis Em., Com. Spid., p. 151, figs. 368–370. *1902.*

C. lætus Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 433, Pl. LV, fig. 4. *1874.*
Ceratinella læta Em., Trans. Conn. Ac., VI, p. 35, Pl. VIII, fig. 1. *1882.*
Ceraticelus lætus E. Sim., Ar. Fr., V, p. 596. *1884.*
Erigone læta Keys., Spinn. Am., Therid., II, p. 176, Pl. XVII, fig. 236. *1886.*

C. melanocnemis Fox (*Erigone* [*Ceratinella*]), Proc. Ent. Soc. Wash., II, p. 45. *1891.*

C. minutus Em. (*Ceratinella*), Trans. Conn. Ac., VI, p. 36, Pl. VIII, fig. 4. *1882.*
Ceratinella minuta Banks, Proc. Acad. Nat. Sci. Phila., p. 31, Pl. II, fig. 60; Pl. IV, fig. 60. *1892.*

C. micropalpis Em. (*Ceratinella*), Trans. Conn. Ac., VI, p. 36, Pl. VIII, fig. 5. *1882.*
Ceraticelus micripalpis E. Sim., Ar. Fr., V, p. 596. *1884.*

C. occidentalis Banks (*Ceratinella*), Proc. Acad. Nat. Sci. Phila., p. 579. *1901.*

C. parvulus Fox (*Erigone* [*Ceratinella*]), Proc. Ent. Soc., Wash., II, p. 45. *1891.*

C. placidus Banks (*Ceratinella*), Proc. Acad. Nat. Sci. Phila., p. 32, Pl. II, figs. 54, 54*a*. *1892.*

C. pygmæus Em. (*Ceratinella*), Trans. Conn. Ac., VI, p. 34, Pl. VII, fig. 4. *1882.*
—— —— E. Sim., Ar. Fr., V, p. 576. *1884.*
Ceratinella pygmæa Banks, Proc. Acad. Nat. Sci. Phila., p. 32, Pl. II, fig. 57. *1892.*

C. rugosus n. sp.

C. tibialis Fox (*Erigone* [*Ceratinella*]), Proc. Ent. Soc. Wash., II, p. 45. *1891.*

THYREOBÆUS E. Sim., Ann. Soc. Ent. Fr., p. 228. *1888.*

T. laticeps Em. (*Ceratinella*), Trans. Conn. Ac., IX, p. 408, Pl. II, fig. 2. *1896.*

EXECHOPHYSIS E. Sim., Ar. Fr., V, p. 690. *1884.*

E. plumalis n. sp.

TROXOCHRUS E. Sim., Ar. Fr., V, p. 645. *1884.*

One undescribed species from Florida.

MINYRIOLUS E. Sim., Ar. Fr., V, p. 787. *1884.*

M. scopuliferus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 49, Pl. XIV, fig. 2. *1882.*

—— —— E. Sim., Ar. Fr., V, pp. 787, 792. *1884.*

PANAMOMOPS E. Sim., Ar. Fr., V, p. 792. *1884.*

P. quadricristatus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 48, Pl. XIII, fig. 3. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 792. *1884.*

DIPLOCEPHALUS Bertk., Beitr. z. Kennt. Sp. Reinp. *1883.*

D. castaneus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 45, Pl. XII, fig. 1. *1882.*

Erigone castanea Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Lophocarenum castaneum Banks, Proc. Acad. Nat. Sci. Phila., p. 35, Pl. IV, fig. 3. *1892.*

Diplocephalus castaneus E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. castigatorius n. sp.

D. crenatoideus Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 37, Pl. IV, figs. 8, *8a*, *8b*. *1892.*

D. crenatus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 51, Pl. XIV, fig. 7. *1882.*

Erigone crenatum Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Diplocephalus crenatus E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. cristatus Blackw. (*Walckenaëria*), Lond. Edinb. Phil. Mag., ser. 3, III, p. 107. *1833.*

Theridium bicorne Reuss, Zool. Misc., Ar., p. 214, Pl. XIV, fig. 12. *1834.*

Micryphantes cæspitum Koch, Uebers d. Ar.-Syst., I, p. 12. *1837.* Die Arachn., VIII, p. 104, Pl. CCLXXXI, figs. 673, 674. *1841.*

Argus bicornis Walck., Ins. Apt., II, p. 365. *1841.*

Erigone bicornis Westr., Göth. Kongl. Vet. Vit.-Samh. Handl., p. 41. *1851.*

Walckenaëria cristata Blackw., Spid. Gr. Brit., II, p. 309, Pl. XXI, fig. 224. *1864.*

Micryphantes cæspitum Ohl., Ar. Prov. Preuss., pp. 54, 60. *1867.*

Lophomma bicorne Menge, Preuss. Spinn., II, p. 212, Pl. XLII, tab. 111. *1868.*

Erigone cristata Thor., Syn. Europ. Spid., p. 108. *1871.*

—— —— Cambr., Proc. Zool. Soc. Lond., p. 438. *1874.*

Lophomma cristata Em., Trans. Conn. Ac., VI, p. 44, Pl. X, fig. 1. *1882.*

Prosoponcus cristatus E. Sim., Ar. Fr., V, p. 570. *1884.*

Erigone cristata Marx, Proc. Nat. Mus., XII, p. 533. *1889.*

Diplocephalus cristatus E. Sim., Hist. Nat. Ar., I, p. 656. *1894.*

—— —— Chyz. and Kulcz., Ar. Hung., II, p. 109, Pl. IV, fig. 22. *1894.*

—— —— Beck., Ar. Belg., III, p. 116, Pl. XI, figs. 5, 5*b*. *1896.*

D. depressus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 50, Pl. XIV, fig. 6. *1882.*

Erigone depressa Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890.*

Diplocephalus depressus E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. erigonoides Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 50, Pl. XIV, fig. 3. *1882.*

Erigone erigonoides Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890.*

Lophocarenum erigonoides Banks, Proc. Acad. Nat. Sci. Phila., p. 37, Pl. IV, fig. 9. *1892.*

Diplocephalus erigonoides E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. exiguus Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 36, Pl. V, figs. 7–7*b*. *1892.*

D. formosus Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 37, Pl. IV, fig. 10; Pl. V, fig. 10. *1892.*

D. latus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 50, Pl. XIV, fig. 4. *1882.*

Erigone lata Marx, Proc. Nat. Mus., XII, pp. 534, 538. *1890.*

Diplocephalus latus E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. lobiceps Banks (*Plæsiocrærius*), Can. Ent., XXIX, p. 196. *1897.*

D. longior Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 38, Pl. IV, figs. 12, 12*a*. *1892.*

D. montanus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 45, Pl. XII, fig. 2. *1882.*

Erigone montana Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*

Diplocephalus montanus E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. parvus Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 36, Pl. IV, figs. 6–6*b*. *1892.*

D. percisus Keys. (*Erigone*), Spinn. Am., Therid., II, p. 153, Pl. XVI, fig. 219. *1886.*

D. simplex Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 50, Pl. XIV, fig. 5. *1882.*

Erigone simplex Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Diplocephalus simplex E. Sim., Hist. Nat. Ar., I, p. 615. *1894.*

D. unimaculatus Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 35, Pl. IV, figs. 2, 2*a*. *1892.*

TAPINOCYBA E. Sim., Ar. Fr., V, p. 778. *1884.*

T. distincta Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 40. Pl. IV, fig. 32. *1892.*

POCADICNEMIS E. Sim., Ar. Fr., V, p. 713. *1884.*

P. longitubus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 49, Pl. XIII, fig. 6. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 718. *1884.*

Erigone longituba Marx, Proc. Nat. Mus., XII, pp. 534, 538. *1890.*

Pocadicnemis longitubus E. Sim., Hist. Nat. Ar., I, p. 617. *1894.*

CARACLADUS E. Sim., Ar. Fr., V, p. 589. *1884.*

C. gigas Banks (*Erigonoplus*), Can. Ent., XXVIII, p. 65. *1896.*

DELORRHIPIS E. Sim., Ar. Fr., V, p. 696. *1884.*

D. monocerus E. Sim., Ar. Fr., V, p. 697, fig. 554. *1884.*

Erigone monocerus Keys., Spinn. Am., Therid., II, p. 156, Pl. XVI, fig. 222. *1886.*

D. unicorn[*is*] Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 38, Pl. IV, figs. 13, 13*a*. *1892.*

Delorrhipis monocerus E. Sim., Hist. Nat. Ar., pp. 620, 659, n. 1. *1894.*

LOPHOMMA Menge, Preuss. Spinn., p. 209. *1868.*

L. longitarsus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 49, Pl. XIII, fig. 6. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 538. *1884.*

Erigone longitarsis Marx, Proc. Nat. Mus., XII, pp. 534, 538. *1890.*

Lophomma longitarsus E. Sim., Hist. Nat. Ar., I, pp. 621, 659. *1894.*

ACARTAUCHENIUS E. Sim., Ar. Fr., V, p. 750. *1884.*

A. columbiensis n. sp.

A. texana Banks, Proc. Ent. Soc. Wash., IV, p. 192. *1899.*

PROSOPOTHECA E. Sim., Ar. Fr., V, p. 829. *1884.*

P. brevicornis Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 42, Pl. XI, fig. 5. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone brevicornis Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Prosopotheca brevicornis E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

P. communis Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 41, Pl. XI, fig. 3. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone communis Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Lophocarenum arvensis Banks, Proc. Acad. Nat. Sci. Phila., p. 37, Pl. IV, fig. 11. *1892.*

Prosopotheca communis E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

P. directa Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 439, Pl. LV, fig. 9. *1874.*

Erigone provida Cambr., Proc. Zool. Soc. Lond., p. 398, Pl. XLVI, fig. 5. *1875.*

Cornicularia directa Em., Trans. Conn. Ac., VI, p. 40, Pl. XI, fig. 1. *1882.*

Prosopotheca directa E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone directa Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Prosopotheca directa E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

Cornicularia directa Em., Com. Spid., p. 152, figs. 374–376. *1902.*

P. formosa Banks (*Cornicularia*), Proc. Acad. Nat. Sci. Phila., p. 34, Pl. V, fig. 35. *1892.*

Lophocarenum venustum Banks, *l. c.*, p. 36, Pl. IV, fig. 5. *1892.*

Tmeticus luxuosus Banks, *l. c.*, p. 39, Pl. IV, fig. 16. *1892.*

P. humiliceps Keys. (*Erigone*), Spinn. Am., Therid., II, p. 148, Pl. XVI, fig. 214. *1886.*

P. indirecta Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 440, Pl. LV, fig. 10. *1874.*

Cornicularia indirecta Em., Trans. Conn. Ac., VI, p. 41, Pl. XI, fig. 4. *1882.*

Prosopotheca indirecta E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone indirecta Keys., Spinn. Am., Therid., II, p. 146, Pl. XVI, fig. 213. *1886.*

—— —— Marx, Proc. Nat. Mus., XII, pp. 534, 537. *1890.*

Prosopotheca indirecta E. Sim., Hist. Nat. Ar., p. 626. *1894.*

P. miniata Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila. p. 36, Pl. IV, fig. 4. *1892.*

?*P. minuta* Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 42, Pl. XI, fig. 6. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone paullula Marx, Proc. Nat. Mus., XII, pp. 535, 537, 593, n. 14. *1890.*

Prosopotheca minuta E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

P. pallida Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 42, Pl. XI, fig. 7. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 837. *1884.*

Erigone pallida Marx, Proc. Nat. Mus., XII, pp. 535, 537. *1890.*

Prosopotheca pallida E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

P. spiralis Em. (*Spiropalpus*), Trans. Conn. Ac., VI, p. 39, Pl. X, fig. 6. *1882.*

Cornicularia vigilax E. Sim., Hist. Nat. Ar., I, p. 627. *1894.*

—— —— E. Sim., Ar. Fr., V, p. 837. *1884.*

P. tibialis Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 41, Pl. XI, fig. 2. *1882.*

Erigone tibialis Marx, Proc. Nat. Mus., XII, pp. 536, 537. *1890.*

Prosopotheca tibialis E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

P. transversa n. sp.

CORNICULARIA Menge, Preuss. Spinn., p. 226. *1869.*

C. auranticeps Em., Trans. Conn. Ac., VI, p. 43, Pl. VIII, fig. 6. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 850. *1884.*

Erigone auranticeps Marx, Proc. Nat. Mus., XII, pp. 532, 537. *1890.*

Cornicularia auranticeps E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

C. clavicornis Em., Trans. Conn. Ac., VI, p. 43, Pl. VIII, fig. 7. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 850. *1884.*

Erigone clavicornis Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Cornicularia clavicornis E. Sim., Hist. Nat. Ar., I, p. 626. *1894.*

C. placida Banks, Proc. Acad. Nat. Sci. Phila., p. 35, Pl. V, fig. 36. *1892.*

C. recurvata Banks, Proc. Wash. Acad. Sci., II, p. 479, Pl. XXIX, fig. 9. *1900.*

C. varipes Banks, *l. c.*, p. 479, Pl. XXIX, fig. 4. *1900.*

TIGELLINUS E. Sim., Ar. Fr., V, p. 838. *1884.*

T. tricornis Em. (*Cornicularia*), Trans. Conn. Ac., VI, p. 43, Pl. XI, fig. 8. *1882.*

—— —— E. Sim., Ar. Fr., V., pp. 838, 842. *1884.*

Erigone tricornis Marx, Proc. Nat. Mus., XII, pp. 536, 537. *1890.*

Tigellinus tricornis E. Sim., Hist. Nat. Ar., I, pp. 626, 627, 663. *1894.*

TRACHELOCAMPTUS E. Sim., Ar. Fr., V, p. 577. *1884.*

?*T. rostrata* Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 49, Pl. XIV, fig. 1. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 580. *1884.*

Erigone rostrata Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Trachelocamptus rostratus E. Sim., Hist. Nat. Ar., I, p. 629. *1894.*

TYPHOCHRÆSTUS E. Sim., Ar. Fr., V, p. 583. *1884.*

T. pallidus Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 48, Pl. XIII, fig. 5. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 589. *1884.*

Erigone pallens Marx, Proc. Nat. Mus., XII, pp. 535, 538, 593, n. 14. *1890.*

Typhochræstus pallidus E. Sim., Hist. Nat. Ar., I, p. 629. *1894.*

GONATIUM Menge, Preuss. Spinn., p. 180. *1868.*

G. ma[*r*]*xi* Keys. (*Erigone*), Spinn. Am., Therid., II, p. 152, Pl. XVI, fig. 218. *1886.*

Erigone marxii Marx, Proc. Nat. Mus., XII, p. 534. *1890.*

Gonatium marxi E. Sim., Hist. Nat. Ar., I, p. 630. *1894.*

G. rubens Blackw. (*Neriene*), Lond. Edinb. Phil. Mag., ser. 3, III, p. 189. *1833.*

Theridion cheliferum Reus, Zool. Misc., Ar., p. 231, Pl. XVI, fig. 4. *1834.*

Micryphantes isabellinus Menge, Verzeichn. Danz. Spinn., p. 71. *1850.*

Erigone chelifera Westr., Göth. Kong. Vet. Vit.-Samh. Handl., p. 44. *1851.*

—— —— Westr., Ar. Svec., p. 264. *1861.*

Neriene rubens Blackw., Spid. Gr. Brit., II, p. 270, Pl. XVIII, fig. 184. *1864.*

Micryphantes isabellinus Ohl., Ar. Prov. Preuss., p. 57. *1867.*

Gonatium cheliferum Menge, Preuss. Spinn., p. 180, Pl. XXXIV, fig. 82. *1868.*

Erigone rubens Thor., Syn. Europ. Spid., p. 129. *1871.*

Gonatium rubens Em., Trans. Conn. Ac., VI, p. 60, Pl. XXIII, fig. 6. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 554. *1884.*

Erigone rubens Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Gonatium rubens Beck., Ann. Mus. Roy. Hist. Nat. Belg., XII, p. 106, Pl. X, figs. 9–9*d*. *1896*.

DISMODICUS E. Sim., Ar. Fr., V, p. 563. *1884*.

D. alpinus Banks, Can. Ent., XXVIII, p. 63. *1896*.

HYPOMMA Dahl, Sch. Nat. Ver. Schleswig, p. 87. 1886.

H. bilobata Banks (*Dicyphus*), Can. Ent., XXVIII, p. 64. *1896*.

H. trilobata Banks (*Dicyphus*), *l. c.*, XXVIII, p. 64. *1896*.

GRAMMONOTA Em., Trans. Conn. Ac., VI, p. 38. *1882*.

G. inornata Em., *l. c.*, VI, p. 39, Pl. X, fig. 5. *1882*.

Erigone inornata Marx, Proc. Nat. Mus., XII, pp. 534, 538. *1890*.

G. maculata Banks, Trans. Am. Ent. Soc., XXIII, p. 68. *1896*.

G. ornata Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 395, Pl. XLVI, fig. 3. *1875*.

—— —— Em., Trans. Conn. Ac., VI, p. 39, Pl. X, fig. 3. *1882*.

Erigone ornata Marx, Proc. Nat. Mus., XII, pp. 535, 537. *1890*.

G. pallipes Banks, Jour. N. Y. Ent. Soc., III, p. 86. *1895*.

G. pictilis Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 396. Pl. XLVI, fig. 4. *1875*.

—— —— Em., Trans. Conn. Ac., VI, p. 38, Pl. X, fig. 4. *1882*.

Erigone pictilis Keys., Spinn. Am., Therid., II, p. 194, Pl. XVIII, fig. 252. *1886*.

G. trivittata Banks, Jour. N. Y. Ent. Soc., III, p. 86. *1895*.

G. venusta Banks, Proc. Acad. Nat. Sci. Phila., p. 34, Pl. V, fig. 6. *1892*.

ŒDOTHORAX Bertk., Beitr. z. Kennt. Spinn. Fn. Reinp. *1883*.

?*Œ. alascensis* Banks (*Gonglydium*), Proc. Wash. Ac. Sci., II, p. 479, Pl. XXIX, fig. 3. *1900*.

Œ. bidentatus Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 56, Pl. XVII, fig. 1. *1882*.

Gongylidium bidentatum E. Sim., Ar. Fr., V, p. 500. *1884*.

Erigone bidentata Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890*.

Œ. bostoniensis Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 56, Pl. XVII, fig. 1. *1882*.

Gongylidium bostonense E. Sim., Ar. Fr., V, p. 500. *1884*.

Erigone bostoniensis Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890*.

Œ. brunneus Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 58, Pl. XVII, fig. 7. *1882*.

Gongylidium brunneum E. Sim., Ar. Fr., V, p. 500. *1884*.

Erigone fusca Marx, Proc. Nat. Mus., XII, pp. 533, 538, 593, n. 14. *1890.*

Œ. *concavus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 57, Pl. XVII, fig. 3. *1882.*

Gongylidium concavum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone concava Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890.*

Œ. *contortus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 54, Pl. XV, fig. 5. *1882.*

Gongylidium contortum E. Sim., Ar. Fr., V. p. 500. *1884.*

Erigone contortus Marx, Proc. Nat. Mus., XII, pp. 533, 538. *1890.*

Œ. *debelis* Banks (*Tmeticus*), ♂, Proc. Acad. Nat. Sci. Phila., p. 40, Pl. IV, fig. 20. *1892.*

Œ. *decemoculatus* Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 46, Pl. XII, fig. 4. *1882.*

Erigone decemoculata Marx, Proc. Nat. Mus., XII, pp. 533, 537. *1890.*

Neriene decemoculata E. Sim., Hist. Nat. Ar., I, p. 633. *1894.*

Œ. *falsificus* Keys. (*Erigone*), Spinn. Am., Therid., II, p. 199, Pl. XVIII, fig. 259. *1886.*

Gonglydium falsificum Banks, Proc. Wash. Ac. Sci., II, p. 480. *1900.*

Œ. *flaveolus* Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 39, Pl. IV, fig. 15. *1892.*

Œ. *gnavus* Banks (*Tmeticus*), *l. c.*, p. 41, Pl. V, fig. 44. *1892.*

Œ. *humilis* Banks (*Tmeticus*), *l. c.*, p. 39, Pl. IV, fig. 18. *1892.*

Œ. *limatus* n. sp.

Œ. *longisetosus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 54, Pl. XVI, fig. 1. *1882.*

Gongylidium longisetosum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone longisetosa Marx, Proc. Nat. Mus, XII, pp. 534, 538. *1890.*

Œ. *maculatus* Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 41, Pl. IV, fig. 23. *1892.*

Œ. *maximus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 55, Pl. XVI, fig. 5. *1882.*

Gongylidium maximum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone maxima Marx, Proc. Nat. Mus., XII, pp. 534, 538. *1890.*

Œ. *microtarsus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 57, Pl. XVII, fig. 4. *1882.*

Gongylidium microtarsus E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone microtarsis Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*

Œ. *montanus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 55, Pl. XVI, fig. 3. *1882.*
Gongylidium montanum E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone collina Marx, Proc. Nat. Mus., XII, pp. 533, 538, 593, n. 14. *1890.*

Œ. *montiferus* Em. (*Lophocarenum*), Trans. Conn. Ac., VI, p. 47, Pl. XIII, fig. 2. *1882.*
Gongylidium montiferum E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone montifera Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*
Neriene montifera E. Sim., Hist. Nat. Ar., I, p. 633. *1894.*

Œ. *obscurus* Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 38, Pl. II, figs. 14, 14*a*. *1892.*

Œ. *oxypæderotipus* n. sp.

Œ. *palustris* Banks (*Tmeticus*), ♂, Proc. Acad. Nat. Sci. Phila., p. 40, Pl. IV, fig. 21. *1892.*

Œ. *parvus* Banks (*Tmeticus*), Proc. Ent. Soc. Wash., IV, p. 192. *1899.*

Œ. *pectinatus* Em. (*Tmeticus*), Trans. Conn. Ac., IX, p. 409, Pl. II, fig. 4. *1894.*

Œ. *pertinens* Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 399, Pl. XLVI, fig. 6. *1875.*
Tmeticus pertinens Em., Trans. Conn. Ac., VI, p. 54, Pl. XVI, fig. 2. *1882.*
Gongylidium pertinens E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone pertinens Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*

Œ. *plumosus* Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 53, Pl. XV, fig. 3. *1882.*
Gongylidium plumosum E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone plumosa Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*

Œ. *probatus* Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 431, Pl. LV, fig. 2. *1874.*
Tmeticus probatus Em., Trans. Conn. Ac., VI, p. 52, Pl. XV, fig. 1. *1882.*
Gongylidium probatum E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone probata Keys., Spinn. Am., Therid., II, p. 166, Pl. XVII, fig. 228. *1886.*

—— —— Marx, Proc. Nat. Mus., XII, pp. 535, 538. *1890.*

Œ. rusticus Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 39, Pl. II, fig. 17. *1892.*

Œ. spiniferus Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 432, Pl. LV, fig. 3. *1874.*

Lophocarenum spiniferum Em., Trans. Conn. Ac., VI, p. 47, Pl. XIII, fig. 1. *1882.*

Gongylidium spiniferum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone spinifera Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Nericne spinifera E. Sim., Hist. Nat. Ar., I, p. 633. *1894.*

Œ. terrestris Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 57, Pl. XVII, fig. 6. *1882.*

Gongylidium terrestre E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone terrestris Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Œ. tibialis Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 56, Pl. XVI, fig. 6. *1882.*

Gongylidium tibiale E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone monticola Marx, Proc. Nat. Mus., XII, pp. 535, 538, 593, n. 14. *1890.*

Œ. trilobatus Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 53, Pl. XV, fig. 4. *1882.*

Gongylidium trilobatum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone trilobatus Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

Tmeticus mœstus Banks, Proc. Acad. Nat. Sci. Phila., p. 40, Pl. IV, fig. 19. *1892.*

Tmeticus debilis Banks, ♀, *l. c.*, p. 40, Pl. IV, fig. 20. *1892.*

Tmeticus palustris Banks, ♀, *l. c.*, p. 40, Pl. IV, fig. 21. *1892.*

Œ. truncatus Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 57, Pl. XVII, fig. 5. *1882.*

Gongylidium truncatum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone truncatus Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

GONGYLIDIELLUM E. Sim., Ar. Fr., V, p. 600. *1884.*

G. minutum Banks (*Tmeticus*), Proc. Acad. Nat. Sci. Phila., p. 41, Pl. II, fig. 24. 1892.

Tmeticus distinctus Banks, Jour. N. Y. Ent. Soc., I, p. 125. *1893.* (See TAPINOCYBA.)

G. pallidum Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 55, Pl. XVI, fig. 4. *1882.*

Gongylidium pallidum E. Sim., Ar. Fr., V, p. 500. *1884.*
Erigone pallescens Marx, Proc. Nat. Mus., XII, pp. 535, 538, 593, n. 14. *1890.*
G. rostratulum Keys. (*Erigone*), Spinn. Am., Therid., II, p. 186, Pl. XVII, fig. 247. *1886.*

ERIGONE Aud. in Sav., Descript. Egypt. Hist. Nat., I, Pt. IV, p. 115. *1825–27.*

E. albescens Banks, Can. Ent., XXX, p. 187. *1898.*
E. autumnalis Em., Trans. Conn. Ac., VI, p. 38, Pl. XVII, fig. 8. *1882.*
—— —— Keys., Spinn. Am., Therid., II, p. 171, Pl. XVII, fig. 232. *1886.*
—— —— Em., Com. Spid., p. 151, figs. 366, 367. *1902.*
E. coloradensis Keys., Spinn. Am., Therid., II, p. 168, Pl. XVII, fig. 230. *1886.*
—— —— Banks, Proc. Wash. Ac. Sci., II, p. 480. *1900.*
E. dentigera Cambr., Proc. Zool. Soc. Lond., p. 429. *1874;* p. 394, Pl. XLVI, fig. 2. *1875.*
—— —— Em., Trans. Conn. Ac., VI, p. 59, Pl. XVII, fig. 9. *1882.*
—— —— Em., Com. Spid., p. 149, figs. 361–365. *1902.*
E. dentipalpis Reus (*Theridium*), Zool. Misc., Ar., p. 242, Pl. XVII, fig. 1. *1834.*
Linyphia longipalpis Sund., Vet.-Akad. Handl., p. 212, var. *B*, 1829. *1830.*
Erigone dentipalpis C. Koch, Die Arach., VIII, p. 90, Pl. CCXXVIII, figs. 659, 660. *1841.*
Argus vagans Walck., Ins. Apt., II, p. 345. *1841.*
Erigone dentipalpis Westr., Göteb. Vet. -o. Vitt. Samh. Handl. Ny. Tidsf., II, p. 40. *1851.*
—— —— Westr., Ar. Svec., p. 199. *1861.*
Neriene dentipalpis Cambr., Zoologist, p. 8598. *1863.*
—— —— Blackw., Ann. Mag. Nat. Hist., ser. 3, XII, p. 266. *1863.*
Neriene longipalpis Blackw., Spid. Gr. Brit., II, p. 274, Pl. XIX, fig. 188. *1864.*
Erigone dentipalpa Ohl., Ar. Prov. Preuss., p. 50. *1867.*
Erigone dentipalpis L. Koch, Beitr. z. Kenntn. Ar. fauna Tirols, p. 200. *1869.*
—— —— E. Sim., Ar. Fr., V, p. 523, figs. 315–317. *1884.*
—— —— Chyz. and Kulcz., Ar. Hung., II, p. 89, Pl. III, fig. 39.
—— —— Beck., Ar. Belg., III, p. 95, Pl. X, figs. 3–3*e*. *1896.*

E. famelica Keys., Spinn. Am., Therid., II, p. 186, Pl. XVII, fig. 246. *1886.*

—— —— Banks, Proc. Wash. Ac. Sci., II, p. 480, Pl. XXIX, figs. 7, 8. *1900.*

E. longipalpis Sund. (*Linyphia*), Vet.-Akad. Handl., p. 212, 1829. *1830.*

Argus longimanus Walck., Ins. Apt., II, p. 346. *1841.*

Neriene longipalpus Blackw., Ann. Mag. Nat. Hist., ser. 2, IX, p. 270. *1852.*

Erigone longipalpis Westr., Ar. Svec., p. 197. *1861.*

Neriene longipalpis Blackw., Spid. Gr. Brit., II, p. 274. *1864.*

Erigone dentipalpa Ohl., Ar. Prov. Preuss., p. 50. *1867.*

Erigone longipalpis Menge, Preuss. Spinn., p. 196, Pl. XXXVII, tab. 93. *1868.*

—— —— L. Koch, Beitr. z. Kenntn. Ar. f. Tirols, II, Abt., p. 281. *1872.*

Neriene longipalpis Cambr., Spid. Dorset, I, p. 107. *1879.*

?*Erigone longipalpis* Em., Trans. Conn. Ac., VI, p. 59, Pl. XVII, figs. 9, 10. *1882.*

—— —— E. Sim., Ar. Fr., V, p. 515, figs. 301–303. *1884.*

—— —— Beck., Ar. Belg., III, p. 93, Pl. X, figs. 2–2*d*. *1896.*

E. persimilis Cambr., Proc. Zool. Soc. Lond., p. 394, Pl. XLVI, fig. 1. *1875.*

E. plicita n. sp.

E. præpulchra Keys., Spinn. Am., Therid., II, p. 172, Pl. XVII, fig. 233. *1886.*

E. simillima Keys., Spinn. Am., Therid., II, p. 170, Pl. XVII, fig. 231. *1886.*

—— —— Banks, Proc. Wash. Ac. Sci., II, p. 480. *1900.*

E. tridentata Em. (*Tmeticus*), Trans. Conn. Ac., VI, p. 53, Pl. XV, fig. 2. *1882.*

Gongylidium tridentatum E. Sim., Ar. Fr., V, p. 500. *1884.*

Erigone tridentata Marx, Proc. Nat. Mus., XII, pp. 536, 538. *1890.*

?—— —— E. Sim., Hist. Nat. Ar., I, p. 638. *1894.*

E. tristis Banks (*Lophocarenum*), Proc. Acad. Nat. Sci. Phila., p. 35, Pl. IV, fig. 1. *1892.*

E. usurpabilis Keys., Spinn. Am., Therid., II, p. 193, Pl. XVIII, fig. 252. *1886.*

Maso E. Sim., Ar. Fr., V, p. 861. *1884.*

M. frontatus Banks (*Ceratinopsis*), Proc. Acad. Nat. Sci. Phila., p. 33, Pl. V, fig. 63. *1892.*

—— —— Banks, Trans. Am. Ent. Soc., XXIII, p. 67. *1896.*

M. marxi Keys. (*Satilatlas*), Spinn. Am., Therid., II, p. 128, Pl. XV, fig. 207. *1886.*

—— —— E. Sim., Hist. Nat. Ar., I, p. 641. *1894.*

M. polita Banks, Trans. Am. Ent. Soc., XXIII, p. 67. *1896.*

HYPSELISTES E. Sim., Hist. Nat. Ar., I, p. 671. *1894.*

H. florens Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 403, Pl. XLVI, fig. 10. *1875.*

Lophocarenum florens Em., Trans. Conn. Ac., VI, p. 46, Pl. XII, fig. 3. *1882.*

Nematogmus florens E. Sim., Ar. Fr., V, p. 617. *1884.*

Erigone florens Keys., Spinn. Am., Therid., II, p. 158, Pl. XVI, fig. 223. *1886.*

Hypselistes florens E. Sim., Hist. Nat. Ar., I, pp. 641, 671. *1894.*

CERATINOPSIS Em., Trans. Conn. Ac., VI, p. 36. *1882.*

C. anglicanum Hentz (*Theridion*), Proc. Bost. Soc. Nat. Hist., VI, p. 275, Pl. IX, fig. 6. *1850.* Oc. papers Bost. Soc. Nat. Hist., II, p. 146, Pl. XVI, fig. 6. *1875.*

Erigone purpurescens Keys., Spinn. Am., Therid., II, p. 187, Pl. XVII, fig. 248. *1886.*

Ceratinopsis purpurascens E. Sim., Hist. Nat. Ar., I, pp. 644, 673. *1894.*

Bathyphantes anglicanum Banks, Proc. Ent. Soc. Wash., IV, p. 189. *1899.*

C. bicolor Banks, Trans. Am. Ent. Soc., XXIII, p. 67. *1896.*

C. interpres Cambr. (*Erigone*), Proc. Zool. Soc. Lond., p. 430. Pl. LV, fig. 1. *1874.*

—— —— Em., Trans. Conn. Ac., VI, p. 37, Pl. IX, fig. 1. *1882.*

Erigone interpres Keys., Spinn. Am., Therid., II, p. 144, Pl. XVI, fig. 212. *1886.*

Ceratinopsis interpres Em., Com. Spid., p. 153, figs. 377, 378. *1902.*

Notionella interpres, Banks, Am. Nat., XXXIX, p. 312. *1905.*

C. laticeps Em., Trans. Conn. Ac., VI, p. 37, Pl. IX, fig. 3. *1882.*

Erigone laticeps Marx, Proc. Nat. Mus., XII, pp. 535, 537. *1890.*

C. nigriceps Em., Trans. Conn. Ac., VI, p. 37, Pl. IX, fig. 2. *1882.*

Erigone nigriceps Marx, Proc. Nat. Mus., XII, pp. 535, 537. *1890.*

C. nigripalpis Em., Trans. Conn. Ac., VI, p. 38, Pl. IX, fig. 4. *1882.*
Erigone nigripalpis Marx, Proc. Nat. Mus., XII, pp. 535, 537. *1890.*
C. similis Banks, Trans. Am. Ent. Soc., XXIII, p. 67. *1896.*
C. unicolor n. sp.
C. xanthippe Keys. (*Erigone*), Spinn. Am., Therid., II, p. 192, Pl. XVIII, fig. 251. *1886.*
Clitolyna E. Sim., Hist. Nat. Ar., I, p. 673. *1894.*
C. electa n. sp.

The following species, described under the genus *Erigone*, I have not attempted to place generically:

Keyserling, Spinn. Am., Therid., II. *1886.*
E. calcarata, p. 181, Pl. XVII, fig. 240.
E. famularis, p. 198, Pl. XVIII, fig. 258.
E. famulatoria, p. 182, Pl. XVII, fig. 242.
E. infernalis, p. 180, Pl. XVII, fig. 239.
E. minutissima, p. 219, Pl. XIX, fig. 276.
E. polaris, p. 148, Pl. XVI, fig. 215.
E. relaxata, p. 154, Pl. XVI, fig. 220.
E. schumaginensis, p. 182, Pl. XVII, fig. 241.
E. solitaris, p. 179, Pl. XVII, fig. 238.
E. ululabilis, p. 184, Pl. XVII, fig. 244.
E. umbratilis, p. 201, Pl. XVIII, fig. 261.
E. urusta, p. 193, Pl. XVIII, fig. 253.
E. vacerosa, p. 200, Pl. XVIII, fig. 260.
Thorell, Bull. U. S. Geol. Sur., III. *1877.*
E. cucuminum, p. 482.
E. strabo, p. 483.

II. Notes and Descriptions of New Species.

In the following notes all measurements are given in millimeters. In determining the curvature of the rows of eyes, the posterior row is viewed from above and the anterior from before.

CERATINELLA Em.

Emerton (*Trans. Conn. Ac.*, VI, p. 32) proposed the name *Ceratinella* for the genus *Ceratina* Menge, preoccupied. The species described by Emerton under this name, with the exception of *C. brunnea* Em., did not belong to Menge's genus *Ceratina*, type *C. brevis* Wid. For these species E. Simon (*Ar. Fr.*, V, p. 595) proposed the name *Ceraticelus*, and later (*Hist. Nat. Ar.*, I, p. 651) designated *C. fissiceps* Cambr. as its type. In 1893 Banks (*Jour. N. Y. Ent. Soc.*, I, p. 130), considering that Emerton did not propose *Ceratinella* to replace *Ceratina*, but rather to designate the species which he placed under it, proposed *Ceratinodes* for Menge's genus, and has since retained the name *Ceratinella* for the American species.

Ceratinella is easily distinguished from *Ceraticelus* by the double curve in the claw of the cheliceræ.

Ceratinella brunnea Em.

♀ Leg	I	Palpus
Tar	.26	.22
Met	.26	....
Tib	.34	.12
Pat	.17	.1
Fem	.46	....

Posterior eyes in a very slightly procurved line, the median eyes smaller than the lateral, separated from each other by a little less than their diameter, and from the lateral by their radius; anterior eyes in a straight line, the median eyes slightly smaller than the lateral, subcontiguous but separated from the lateral by two-thirds their diameter. Median ocular area a little wider than long. Clypeus narrower than ocular area. Claw of cheliceræ curved twice, first concave and then convex without.

CERATICELUS E. Sim.

Banks (*Jour. N. Y. Ent. Soc.*, I, p. 130) proposed the genus *Idionella* for *C. formosa* Banks, based on the position of the dorsal sclerite of the abdomen, a character of less than specific value in some species of the group. In certain species of the group this sclerite is wholly lacking in some individuals, while strongly developed in others of the same sex.

The figures and notes on the species described by Fox are from mounts of male palpi taken from the type specimens.

Ceraticelus albus Fox. (Pl. XXVIII, figs. 1, 2.)

♂ Palpus.		
Tar		.26
Tib	including the hook	.19
Pat		.29

Ceraticelus alticeps Fox. (Pl. XXVIII, fig. 3.)

♂ Palpus.		
Tar		.22
Tib	width including hook	.192
Pat		.204

Ceratioelus atriceps Cambr.

♀ Leg	I
Tar	.24
Met	.26
Tib	.31
Pat	.14
Fem	.41

Posterior eyes in a slightly recurved line, equal, the median eyes a little nearer the lateral than to each other, interocular spaces less than the diameter of the eyes; anterior eyes in a straight line, the median eyes smaller than the lateral, separated from the lateral by their diameter and from each other by a little smaller interval. Median ocular area wider than long.

Ceraticelus bulbosus Em.

This species is very closely allied to *C. fissiceps* Em. In the male the posterior lateral eyes are nearer the posterior median, and the anterior lateral eyes are considerably nearer the anterior median than in *fissiceps*. In the female the posterior median eyes are separated by their diameter, and the anterior lateral eyes are much nearer to the median than in *fissiceps*.

Ceraticelus emertoni Cambr.

♀ Legs	I	IV	Palpus
Tar	.29	.25	.19
Met	.36	.36	....
Tib	.38	.43	.12
Pat	.17	.16	.1
Fem	.5	.5	....

Posterior eyes in a very slightly recurved line, the median eyes slightly larger than the lateral, separated from each other by their diameter and from the lateral by a little smaller interval; anterior eyes in a very slightly procurved line, the median eyes smaller than the lateral, separated from each other by three-fifths their diameter and from the lateral by four-fifths. Median ocular area about as long as wide. Clypeus narrower than ocular area.

Ceraticelus fissiceps Cambr.

♂ Leg	I
Tar	.29
Met	.38
Tib	.41
Pat	.17
Fem	.53

Posterior eyes in a strongly recurved line, the median eyes a little larger than the lateral, all eyes separated by about twice the diameter of the lateral; anterior eyes in a straight line, the median eyes slightly smaller than the lateral, separated from each other by one-half their radius and from the lateral by three times their diameter. Median ocular area slightly longer than wide, clypeus narrower than ocular area.

♀ Legs	I	IV	Palpus
Tar	.26	.25	.18
Met	.31	.34	....
Tib	.34	.41	.12
Pat	.14	.17	.08
Fem	.46	.5	....

Posterior eyes in a slightly recurved row, the median eyes smaller than the lateral, separated from each other by their radius and from the lateral by three-fourths their diameter; anterior eyes in a slightly recurved line, the median much smaller than the lateral, separated from each other by their diameter and from the lateral by nearly twice as much. Median ocular area a little longer than wide, clypeus narrower than ocular area.

Ceraticelus formosa Banks.

♀.—Posterior eyes in a nearly straight line, equidistant, the median eyes a little larger than the interocular spaces; anterior eyes in a straight line, the median eyes smaller than the lateral and almost contiguous, while separated by more than their diameter from the lateral. The inframamillary and epigastric sclerites of the abdomen only slightly developed, while the dorsal sclerite is very thick, confined to the anterior part of the dorsum and squarely truncate behind.

Ceraticelus lætabilis Cambr.

♂ Legs	I	II	III	IV	Palpus
Tar	.24	.31	.26	.31	.31
Met	.35	.31	.29	.38	....
Tib	.43	.38	.31	.48	.11
Pat	.17	.19	.17	.17	.14
Fem	.55	.53	.43	.6	.34

Posterior eyes in a slightly recurved line, equal, the median eyes separated from each other by their diameter and from the lateral by three-fourths as much; anterior eyes in a straight line, the median eyes much smaller than the lateral, separated from each other by one-third their diameter and from the lateral by a little less than their diameter. Median ocular area wider than long, clypeus much wider than ocular area.

♀ Legs	I	II	III	IV	Palpus
Tar	.36	.31	.26	.31	.24
Met	.36	.34	.31	.41	....
Tib	.46	.41	.34	.53	.16
Pat	.18	.19	.17	.18	.1
Fem	.62	.55	.48	.65	.22

Posterior eyes in a slightly recurved line, the median eyes slightly smaller than the lateral, separated from each other by their diameter, and from the lateral by a little smaller interval; anterior eyes in a straight line, the median eyes much smaller than the lateral, separated from each other by their radius and from the lateral by a little wider interval. Median ocular area as wide as long. Clypeus as wide as ocular area.

Ceraticelus minutus Em.

♂ Legs	I	II	III	IV
Tar	.28	.26	.24	.26
Met	.25	.24	.22	.29
Tib	.34	.29	.22	.36
Pat	.14	.12	.1	.12
Fem	.41	.38	.34	.46

Posterior eyes in a slightly recurved line, about equal, the median eyes separated from each other by a little less than their diameter and from the lateral by one-half as much; anterior eyes in a straight line, narrowly equidistant, the median eyes much smaller than the lateral. Median ocular area wider than long. Clypeus as wide as ocular area.

♀ Leg	I	Palpus.
Tar	.25	.17
Met	.26	....
Tib	.31	.1
Pat	.14	.07
Fem	.41	....

Posterior eyes in a very slightly recurved line, the median eyes slightly smaller than the lateral, separated from each other by their diameter and from the lateral by their radius; anterior eyes in a straight line, the median eyes much smaller than the lateral, separated from each other by two-fifths their diameter and from the lateral by one-half as much. Median ocular area as wide as long. Clypeus narrower than ocular area.

Ceraticelus melanocnemis Fox. (Pl. XXVIII, figs. 4, 10.)

♂ Palpus.		
Tar		.29
Tib	length of hook	.19
Pat	.31, wide	.12
Fem		.38

Ceraticelus rugosus n. sp. (Pl. XXVIII, figs. 5, 7.)

♂ Length 1.5 mm. Cephalothorax, wide .5 mm., long .65 mm.

Legs	I	II	III	IV
Tar	.26	.26	.24	.26
Met	.29	.26	.25	.31
Tib	.35	.31	.26	.41
Pat	.19	.19	.19	.19
Fem.	.46	.43	.38	.5

Cephalothorax yellowish-brown, darker toward the eyes which are surrounded by black rings, anterior part strongly and abruptly elevated, head normal. Posterior eyes in a straight line, nearly equal, the median eyes being only slightly smaller, nearer each other than to the lateral; anterior eyes in a straight line, median eyes smaller than the lateral and much nearer to each other than to them. Clypeus plane, slightly protruding and about as wide as ocular area. Cheliceræ short, somewhat retreating. Sternum grayish-orange, black along edge inside a narrow band of yellow orange; posterior point narrower than length of fourth coxa. Endites and labium much lighter than sternum.

Abdomen has the dorsal sclerite almost contiguous with epigastric sclerite in front, thus covering the anterior end of the abdomen; hard parts orange, dorsal sclerite thickly armed with small tubercles, especially in front, soft parts grayish-yellow, darker below. Legs light yellow.

Apophysis of the tibia of palpus sharply bent near the apex, the outer margin armed with a series of three setæ; inner margin of tibia provided with an obtuse tooth; tarsal hook long, very strongly curved, dilated at the tip, armed on outer face with five setæ; style with a sharp bend near the middle.

Two males in Fox collection from Sea Cliff (N. Y.), labelled *C. rugosa*.

Ceraticelus tibialis Fox. (Pl. XXVIII, fig. 6.)

♂ Palpus.

Tar		.25
Tib	length including hook	.24
Pat		.12

THYREOBÆUS E. Sim.

Thyreobæus laticeps Em.

This genus was established for a single species from Madagascar. While it is very improbable that *T. laticeps* is congeneric with *T. scutiger* E. Sim., its type, yet it so closely agrees with it in all essential characters that it seems necessary to place it there.

♂ Leg.	I
Tar	.29
Met.	.29
Tib	.29

Cephalothorax broadly oval, squarely truncate before; head sloping gradually behind the eyes, obliquely descending and transversely depressed in the eye region; the lateral eyes occupying prominent angles on the sides of the head; color dull yellowish-brown; top of head armed with a median longitudinal series of four long curved hairs; one hair back of each posterior median eye; eye area thinly clothed with short hairs. Posterior eyes in a straight line, the median eyes a little smaller than the lateral, separated from each other by a little more than their diameter and from the lateral by three times their radius; anterior eyes in a strongly recurved line, the median eyes slightly smaller than the lateral, subcontiguous but separated from the lateral by two and two-thirds times their diameter. Median ocular area very much longer than wide. Clypeus narrow, plane and retreating; sternum broad, very wide behind between the posterior coxæ, light brown near the center and very dark near the edge, slightly rugose; endites yellow brown, labium darker. Abdomen completely covered above by a yellowish-brown sclerite; below the large epigastric sclerite surrounds the pedicle and is only narrowly separated from the dorsal sclerite except behind; no inframamillary sclerite present; soft parts gray. Legs and palpus very light yellow. Tibia of palpus armed above at tip with a short incurved tooth on the inside and with a broad blunt projection on the outside, armed below with a short rather blunt tooth. One specimen collected in pine leaves on the ground near Ithaca, New York, August, 1904.

EXECHOPHYSIS.

The following species is placed here with considerable doubt. There is great variation in the amount of chitinization of the dorsal sclerite of the abdomen, and also to a less degree in the form of the lobes of the head. It differs markedly from *Ceraticelus* in the form of the male palpus.

Exechophysis plumalis n. sp. (Pl. XXVIII, figs. 8, 13; Pl. XXIX, fig. 1.)

♂.—Length 1.3 mm. Cephalothorax, wide .55 mm., long .75 mm.

Legs.	I	IV
Tar.	.24	.20
Met	.36	.40
Tib.	.40	.48
Pat.	.19	.19
Fem.	.48	.53

Cephalothorax dark brown, black at edge, showing indistinct yellowish markings in alcohol; the cephalic part strongly elevated with an obtuse projection before the eyes densely clothed with light-colored hairs which are directed upward and backward. In one specimen the clypeal lobe is distinctly separated from the cephalic by a deep furrow, while in the others either the furrow is wanting or so obscured by hairs as to be invisible. All the eyes are borne on the cephalic lobe. Posterior eyes in a straight line; the median eyes slightly smaller than the lateral, separated from them by the diameter of the latter and from each other by a little greater interval; anterior eyes in a slightly procurved line; median eyes slightly smaller than the lateral, subcontiguous and separated from the lateral by their diameter. Median ocular area as long as wide and slightly narrower in front than behind. Clypeus much wider than ocular area. Sternum dark brown. Abdomen somewhat flattened, projecting over the cephalothorax and covered almost entirely by a dorsal sclerite which is dark brown, showing a reddish tinge in alcohol, punctulate and sparsely clothed with stiff hairs; sides and ventral surface of abdomen black and grayish-yellow in indistinct patches. In one specimen which is very light the dorsal sclerite is scarcely evident. Ventral sclerites indistinct, dull yellowish-gray. Sternum as long as wide, smooth, yellowish-brown, posterior point a little narrower than the length of fourth coxa.

Chelicerae dark brown, yellowish on the inside near the tip, upper margin of the furrow with five teeth, first four contiguous, fourth the largest and separated by nearly its length from the fifth; lower margin with four or five small teeth.

Legs brownish-yellow, lighter on the patellæ; spines on tibiæ short, on fourth leg situated near the middle of the joint. Lower side of femora armed with two series of spines. Femur of the palpus cylindrical, the patella short and thick; the tibia provided with a rectangular projection on the upper outer side which bears on its outer side a strong curved hook and along its edge a row of tubercles surmounted with black hairs.

♀.—Length 1.4 mm. Cephalothorax, wide .55 mm., long .67 mm.

Legs	I	II	III	IV	Palpus
Tar	.24	.22	.23	.24	.22
Met	.34	.31	.31	.38	....
Tib	.36	.34	.26	.46	.12
Pat	.19	.18	.19	.17	.1
Fem	.34	.48	.41	.53	.17

Cephalothorax dark yellowish-brown, lighter behind, black around eyes and along edge.

Posterior eyes in a straight line, median eyes a little smaller than the lateral, separated from each other by their diameter and from the lateral by their radius; anterior eyes in a procurved line, median eyes smaller than lateral, subcontiguous but distinctly separated from the lateral. Clypeus plane and slightly protruding. Cheliceræ stout and strongly retreating, dull yellowish-brown; margins of the furrow armed as in the male. Sternum and abdomen as in the male. Spines on lower side of femora longer than in male.

Palpus lighter than the legs, armed on last three segments with many strong spines. Epigynum consists of a broad slightly elevated plate, openings separated by a rather broad central lobe. Four males and several females taken in sifting. Ithaca, New York. Several females. Sylvan Beach, New York.

DIPLOCEPHALUS.

Diplocephalus castigatorius n. sp. (Pl. XXVIII, figs. 12, 14; Pl. XXIX, fig. 2.)

♂.—Length 1.1 mm. Cephalothorax, long .53 mm., wide .38 mm.

Leg	I
Tar	.23
Met	.23
Tib	.26
Pat	.14
Fem	.36

Cephalothorax oval, strongly elevated behind the eyes into a rounded hump bounded before and along the side by a crease in which there are holes just behind the lateral eyes, color light brownish-yellow, darker around the eyes and along the crease, marked with indistinct radiating gray lines.

Posterior eyes in a straight line, the median eyes slightly larger than the lateral, separated from each other by two-thirds their diameter and from the lateral by one-third their diameter; anterior eyes in a straight line, the median eyes smaller than the lateral and subcontiguous while distinctly separated from the lateral. Median ocular area longer than wide. Clypeus narrower than the ocular area and slightly projecting. Cheliceræ a little darker than the cephalothorax and somewhat retreating. Sternum light grayish-yellow, triangular heart-shaped. Endites yellow slightly tinged with red.

Abdomen greenish-black with five or six very distinct fawn-colored transverse bands. Beneath, all in front of the furrow fawn color except a small greenish-black spot near the base of the pedicle. Behind the furrow, all greenish-black except a fawn-colored area extending as an irregular band across the middle and narrowing to a rather broad point at the spinnerets. Spinnerets white. Legs and palpus uniform brownish-yellow. Femur and patella of the palpus robust, tibia provided with a long curved hook which has near its base a small broad projection. The tarsal hook short and flat. Style long and coiled four times around.

♀.—Length 1.4 mm. Cephalothorax, long .6 mm., wide .43 mm. Cephalothorax without the hump which is present in the male.

Posterior eyes in a straight line, median eyes smaller than the lateral, separated from each other by their diameter and from the lateral by their radius; anterior eyes in a straight line. median eyes much smaller than the lateral, subcontiguous but distinctly separated from the lateral. Median ocular area a little longer than wide. Color throughout is very nearly as in the male except that on the under side of the abdomen the light marking is narrower and continuous with one of the bands above. Patella of the palpus nearly cylindrical.

Two specimens, ♂ and ♀. Stanford. California. (Mr. P. B. Powell.)

Diplocephalus depressus Em.

♂.—Posterior eyes in a slightly procurved line, about equal, the median eyes only slightly larger than the lateral, separated from each other by their diameter and from the lateral eyes by a little greater distance; anterior eyes in a straight line, the median eyes much smaller than the lateral, subcontiguous but separated from the lateral eyes by more than the diameter of the median. Median ocular area a little longer than wide. Clypeus as wide as ocular area.

Diplocephalus erigonoides Em.

♂ Legs	I	II	III	IV
Tar	.31	.29	.26	.29
Met	.36	.34	.3	.38
Tib	.43	.38	.31	.48
Pat	.19	.19	.19	.19
Fem	.55	.5	.41	.55

Posterior eyes in a procurved line, equal, the median eyes separated from each other by more than their diameter, from the lateral eyes by more than twice as much; anterior eyes in a procurved line, equal, and very narrowly separated from each other. Median ocular area longer than wide. Clypeus wider than ocular area.

Diplocephalus formosus Banks.

♀ Legs	I	II	III	IV
Tar	.26	.29	.25	.29
Met	.31	.29	.26	.36
Tib	.38	.34	.29	.43
Pat	.19	.19	.17	.19
Fem	.5	.46	.39	.1

Posterior eyes in a strongly procurved line, equal and equidistant, separated by their diameter; anterior eyes in a procurved line, the median eyes a little smaller than the lateral, subcontiguous, separated from the lateral by less than their radius. Median ocular area as wide as long. Clypeus measured from the lateral eyes narrower than the ocular area. This species is closely allied to *D. percisus* Keys., if not identical with it. I have specimens from Columbia, Missouri, and Ithaca, New York.

TAPINOCYBA.

Tapinocyba distincta Banks.

In the absence of the male it is with great doubt that I refer this species to *Tapinocyba*. It is related to it by the curvature of the posterior row of eyes, by the form of the median ocular area and by the narrow clypeus as well as by the proportionally long tarsi of the legs (see under *Gongylidiellum minutum*).

♀ Legs	I	II	III	IV
Tar	.22	.22	.19	.22
Met	.19	.19	.19	.22
Tib	.26	.24	.19	.31
Pat	.14	.14	.14	.14
Fem	.38	.34	.29	.38

Posterior eyes in a slightly procurved line, equal, the median eyes a little farther from each other than from the lateral, interocular spaces less than the diameter of the eyes; anterior eyes in a straight line, the median eyes much smaller than the lateral, subcontiguous, but separated from the lateral by their diameter. Median ocular area longer than wide. Clypeus one-half as wide as ocular area.

POCADICNEMIS.

Pocadicnemis longitubus Em. (Pl. XXIX, fig. 3.)

This species has been doubtfully placed in this genus by Simon (*Ar. Fr.*, V, p. 718, and *Hist. Nat. Ar.*, I, p. 617). In the male the posterior median eyes are nearer each other than to the lateral and the tibial spines are rather short, otherwise it agrees with the European forms. The posterior eyes are in a strongly procurved line, the anterior eyes are in a straight line and the anterior tarsi are three-fifths the length of the metatarsi. The female is undescribed.

♀.—Length 1.9 mm. Cephalothorax, wide .62 mm., long .79 mm.

Legs	I	II	III	IV	Palpus
Tar	.26	.26	.24	.29	.26
Met	.46	.46	.46	.6	....
Tib	.55	.53	.43	.65	.16
Pat	.24	.23	.22	.22	.11
Fem	.6	.58	.5	.69	.24

Cephalothorax a rather broad oval, yellow brown with a distinct median line and fainter radiating lines darker. The head is only slightly elevated but is considerably compressed laterally.

Posterior eyes in a moderately procurved line, about equal in size, the median eyes slightly nearer the lateral than to each other; anterior eyes in a straight line, equidistant, the median eyes slightly smaller than the lateral. Median ocular area a little longer than wide. Clypeus seven-ninths the length of the ocular area, strongly projecting forward.

Cheliceræ dull greenish-yellow, lighter than the cephalothorax. Upper margin armed with five teeth, lower with four. Sternum dark brown, smooth, marked with minute yellow dots at the base of the hairs. Endites light grayish-yellow, labium darker. Abdomen yellowish-gray, lighter below, clothed with short fine hairs. Legs yellow, lighter toward the extremity, clothed with rather short hairs, the tibial spines longer than the diameter of the joint. Palpus lighter than the legs, thickly covered with strong hairs and spines.

These females and several males were taken in sifting leaves on a heavily wooded bank at Forest Home, near Ithaca, New York, May, 1904.

DELORRHIPIS.

Delorrhipis unicornis Banks. (Pl. XXIX, fig. 4.)

This species was considered by Simon (*Hist. Nat. Ar.*, I, p. 659, n. 1) as a synonym of *D. monoceros* E. Sim. It is, however, much smaller, and the proportion of the segments of the legs is very different from that given by Keyserling for *monoceros*, and the anterior median eyes are nearer the lateral eyes than they are to each other.

♂.—Length 1.4 mm. Cephalothorax, long .72 mm., including the horn, wide .45 mm.

Legs	I	II	III	IV
Tar	.26	.24	.22	.24
Met	.26	.26	.23	.31
Tib	.34	.3	.24	.41
Pat	.14	.14	.12	.14
Fem	.43	.41	.34	.46

Posterior eyes in a straight line, equal, the median eyes a little less than their diameter from each other and one-third their diameter from the lateral; anterior eyes in a distinctly procurved line, the median eyes smaller than the lateral from which they are narrowly separated, while they are separated from each other by their radius. Clypeus twice the width of the ocular area.

Femur of palpus cylindrical and straight, patella about half as long as femur and slightly enlarged distally, tibia short with a long curved apophysis. The side of the tarsus opposed to the apophysis raised into a ridge armed with a series of about ten short strong spines. The female is undescribed.

♀ Length 1.25 mm. Cephalothorax, long .53 mm., wide .41 mm.

Legs	I	II	III	IV	Palpus
Tar	.26	.24	.22	.24	.17
Met	.24	.24	.22	.29	...
Tib	.31	.26	.22	.38	.12
Pat	.16	.14	.14	.14	.07
Fem	.41	.38	.34	.43	.14

Cephalothorax not elevated as in the male. Posterior eyes in a straight line, median eyes smaller than the lateral, separated from each other by their diameter and from the lateral eyes by a narrower interval; anterior eyes in a procurved line, the median eyes two-thirds as large as the lateral, separated from each other by their radius and from the lateral by one-fourth their diameter. Epigynum consists of a smooth convex plate covering the openings when viewed from below. Several males and females were captured together on the under side of stones on an exposed hillside, on a sunny winter day, bank of Fall creek, one mile east of Forest Home, near Ithaca, New York.

ACARTAUCHEUIUS.

Acartaucheuius columbiensis n. sp. (Pl. XXVIII, fig. 11; Pl. XXIX, fig. 9.)

♂ Length about 1.7 mm. Cephalothorax, long .74 mm., wide .55 mm.

Legs	I	II	III	IV	Palpus
Tar	.34	.34	.29	.31	.22
Met	.46	.46	.38	.53	....
Tib	.5	.5	.38	.6	.26
Pat	.19	.19	.18	.17	.19
Fem	.6	.62	.48	.67	.31

Cephalothorax squarely and broadly truncate in front, gently inclined until just back of the eyes where it is abruptly elevated, brownish-yellow, clothed in the eye region with light colored hairs directed upward and backward. Posterior eyes in a slightly procurved line, equal, the median eyes separated from each other by a little less than their diameter, and from the lateral by a little less than twice as much; anterior eyes in a straight line, the median eyes much smaller than the lateral and very close to each other while separated from the lateral by about three times their diameter. Median ocular area much longer than wide. Clypeus very much wider than the ocular area, plane and strongly retreating.

Cheliceræ rather small. Sternum yellow brown, rounded with the posterior point rather broad and square.

Abdomen probably gray, somewhat faded in these specimens. Legs and palpus yellow. Tibia of palpus armed with two sharp projections above, of which the outer is the longer. Legs are clothed with short hairs and spines. Femora of first and second legs has below near the base three long slender hairs, on the third and fourth there is one each. No auditory hair on fourth metatarsus.

Five male specimens in the Fox collection from District of Columbia, labelled "*Erigone columbiensis.* Type."

PROSOPOTHECA.

Prosopotheca communis Em.

I have examined one of the types of *Lophocarenum arvenis* Banks, a female, and am convinced that it is a synonym of this species.

Prosopotheca directa Cambr.

♂ Legs	I	II	III	IV
Tar.	.43	.41	.36	.43
Met.	.58	.58	.51	.72
Tib.	.72	.67	.53	.82
Pat.	.27	.26	.24	.24
Fem.	.82	.79	.67	.86

Posterior eyes in a slightly procurved line, equal, the median eye separated by about one-half their diameter and from the lateral by a little greater distance; anterior eyes in a straight line, median eyes much smaller than the lateral, very narrowly separated from the lateral twice as far from each other. Median ocular area longer than wide. Clypeus a little narrower than ocular area.

♀ Legs	I	II	III	IV	Palpus
Tar.	.43	.41	.36	.46	.31
Met.	.6	.6	.55	.77	....
Tib.	.74	.72	.58	.89	.22
Pat.	.29	.29	.26	.29	.13
Fem.	.88	.84	.7	.86	.29

Posterior eyes in a slightly recurved line, the median eyes a little smaller than the lateral, separated from each other by less than their diameter and from the lateral by one-half the diameter of the latter; anterior eyes in a straight line, the median eyes much smaller than the lateral, separated from each other by about half their radius and from the lateral by about half as much. Median ocular area about as wide as long. Clypeus a little wider than the ocular area.

Prosopotheca formosa Banks.

Banks (*Jour. N. Y. Ent. Soc.*, I, p. 125) has stated that *Tmeticus luxuosus* Banks is the male of *Lophocarenum venustum* Banks. I have compared the types of *Lophocarenum venustum* and *Cornicularia formosa* Banks and feel sure they are the same species. This species is related to *Erigone* by the apophysis on the patella of the palpus. It lacks, however, the teeth on the margin of the cephalothorax and outer margin of the cheliceræ and its eyes are not arranged as in that genus. In the form of the sternum and cephalothorax it is related to *Prosopotheca*, but the auditory hair of the fourth metatarsus is on the distal fourth.

♂ Legs	I	II	III	IV
Tar	.48	.46	.38	.46
Met	.89	.89	.77	.98
Tib	.84	.86	.92	.91
Pat	.26	.26	.24	.26
Fem	.96	.96	.82	1.

Posterior eyes in a very slightly procurved line, median eyes slightly smaller than the lateral, separated from each other by a little less than their diameter, and from the lateral eyes by a little less than the diameter of the lateral; anterior eyes in a slightly procurved line, the median eyes much smaller than the lateral, separated from each other by one-half their radius and from the lateral by five-eighths their diameter. Median ocular area a little longer than broad. Clypeus narrower than the ocular area.

♀ Legs	I	II	III	IV	Palpus
Tar	.48	.48	.41	.48	.38
Met	.89	.91	.82	1.	....
Tib	.96	.91	.74	1.03	.24
Pat	.31	.31	.29	.29	.16
Fem	1.1	1.1	.95	1.2	.36

Posterior eyes in a straight line, equal, the median eyes separated from each other by a little less than their diameter and from the lateral by their diameter; anterior eyes in a straight line, about equal and equidistant, separated by less than their radius. Median ocular area a little longer than wide. Clypeus wider than ocular area.

Prosopotheca miniata Banks.

The following notes are taken from one of the types in the Cornell University collection. The form of the sternum and cephalothorax as well as the arrangement of the eyes leaves no doubt as to its generic position.

Posterior eyes in a straight line, about equal, the median eyes separated by their radius, slightly nearer to the lateral; anterior eyes in a straight line, the median eyes only slightly smaller than the lateral, very narrowly separated from them and from each other. Median ocular area about as wide as long. Clypeus about as wide as ocular area.

Prosopotheca pallida Em.

♂ Legs	I	II	III	IV
Tar	.41	.41	.34	.38
Met	.62	.6	.48	.67
Tib	.72	.65	.53	.74
Pat	.26	.26	.24	.24
Fem	.82	.77	.65	.79

Posterior eyes in a strongly procurved line, about equal, the median eyes separated from each other by two-thirds their diameter and from the lateral by a little greater interval; anterior eyes in a straight line, about equidistant, the median eyes much smaller than the lateral.

♀ Legs	I	II	III	IV
Tar	.48	.46	.38	.47
Met	.77	.74	.65	.79
Tib	.89	.84	.66	.89
Pat	.29	.29	.26	.26
Fem	.96	.96	.82	.96

Posterior eyes in a slightly procurved line, equal and equidistant, separated by two-thirds their diameter; anterior eyes in a straight line, equidistant, separated by one-half the radius of the median eyes which are considerably smaller than the lateral. Median ocular area a little longer than broad. Clypeus about as wide as ocular area.

Prosopotheca spiralis Em.

E. Simon has considered this species a synonym of *Cornicularia vigilax* Blackw. He has very kindly examined a specimen which I sent him and writes that he now considers them distinct.

♂ Legs	I	II	III	IV
Tar	.31	.31	.26	.34
Met	.46	.43	.38	.55
Tib	.55	.5	.38	.6
Pat	.24	.24	.22	.22
Fem	.7	.65	.53	.7

Posterior eyes in a straight line, equidistant, the median eyes a little smaller than the lateral and separated by less than their diameter; anterior eyes in a straight line, the median eyes much smaller than the lateral, a little nearer each other than to the lateral from which they are separated by a little more than half their diameter. Median ocular area about as wide as long. Clypeus narrower than ocular area.

Prosopotheca transversa n. sp. (Pl. XXIX, fig. 5.)

♀.—Length 1.9 mm. Cephalothorax, long .77 mm., wide .5 mm.

Legs	I	V	Palpus
Tar	.36	.34	.26
Met	.5	.58	....
Tib	.56	.69	.16
Pat	.22	.19	.1
Fem	.79	.74	.24

Cephalothorax oval, only slightly narrowed in front, not elevated, yellowish-brown, darker near edges and in front part of eye space, marked with darker radiating lines. Posterior eyes in a straight line, equal, the median eyes separated from the lateral by their radius and from each other by three-fourths their diameter; anterior eyes in a slightly procurved line, equidistant, and with the median eyes three-fifths as large as the lateral. Median ocular area as long as wide.

Clypeus vertical, much narrower than the ocular area. Cheliceræ not robust, straight, neither attenuate nor divergent. Upper margin of furrow with three teeth, the first two contiguous and the third smaller and placed at the inner angle. Lower margin of furrow with two teeth close together near the base. Sternum light brown, darker on the posterior point which is narrower than the length of the posterior coxæ.

Endites like the sternum, lighter near the tip. Abdomen dark gray with two oval coalescent lighter spots on the front part and a light area near the tip, under side dark gray with a reddish-yellow transverse quadrangular band midway between the spinnerets and the epigynum. Legs light yellow darkened at base; on the first pair the dark marking extends to near the end of the femur, on the second to the middle, on the third only a short distance and is much lighter. On the fourth pair there is a small dark spot on the under side of the base of the femur. Spines weak and rather short. No auditory hair on fourth metatarsus.

Palpus dark brown, short and thick; tip of tibia as thick as patella is long, tarsus robust, clothed with numerous weak spines.

I have a male of this species lacking one molt of adult, taken at Ithaca, New York, August, 1904, and another from Columbia, Missouri, October, 1904. The tibia of the palpus shows a dorsal apophysis and the yellow band on the ventral aspect of the abdomen is very distinct. The head is nearly normal. Clypeus narrow and retreating.

Three females, Otto, New York, August 10, 1903, and Interlaken, New York, July, 1904.

TRACHELOCAMPTUS.

Trachelocamptus rostrata Em.

♂ Legs	I	II	III	IV
Tar	.31	.29	.26	.34
Met	.36	.43	.38	.53
Tib	.48	.5	.38	.6
Pat	.2	.24	.22	.22
Fem	.58	.65	.53	.67

Posterior eyes in a recurved line, the median eyes oval, a little larger than the lateral, separated from each other by their diameter and from the lateral by nearly twice as much; anterior eyes in a recurved line, the median eyes much smaller than the lateral, subcontiguous and separated from the lateral by two-thirds their diameter. Median ocular area a little longer than wide. Clypeus a little wider than ocular area.

This species has been referred with doubt to this genus by Simon. It is related to *Typhochræstus* in having the posterior median eyes nearer each other than to the lateral. This arrangement, however, may be the result of the abnormal development of the head in the male. In the absence of female specimens, by which alone this point could be decided, I leave it doubtfully in *Trachelocamptus*.

HYPOMMA.

Dicyphus Menge, preoccupied.

I have been unable to examine specimens of the species included in this genus. *Dicyphus* was founded by Menge (*Preuss. Spinn.*, p. 221, 1869) for three species in the following order, *tumidus, cilunculus* and *bicuspidatus*, without indicating the type. In 1884 Simon (*Ar. Fr.*, V, p. 546) designated *tumidus* (=*bituberculatus*) as the type. Dahl (*Monographie der Erigone-Arten*, p. 87, 1886) proposed the genus *Hypomma* for *bifrons* Blackw. and *bituberculatus* Wid., without indicating the type. Chyzer and Kulczynski (*Ar. Hung.*, pp. 99, 100) seem to consider *bituberculatus* as the type of *Hypomma* and *cornutus* as the type of *Dicyphus*. As *Dicyphus* is preoccupied in the Hemiptera (Fieber, *Wien. Ent. Monats.*, II, p. 327, 1858) it is necessary to use the next oldest name applied to that group of species. This seems to be *Hypomma*. Simon has placed *bituberculatus* under *Gonatium*.

ŒDOTHORAX.

Œdothorax limatus n. sp. (Pl. XXIX, fig. 6.)

♀.—Length 1.3 mm. Cephalothorax, long .65 mm., wide .43 mm. Cephalothorax yellow brown, edge and radiating lines darker; eyes surrounded by narrow black rings.

Posterior eyes in a nearly straight line, equal, the median separated from each other by their diameter and from the lateral eyes by their radius; anterior eyes in a very slightly procurved line, nearly equidistant, median eyes a little smaller than the lateral. Median ocular area a little wider than long. Clypeus nearly vertical, narrower than ocular area.

Cheliceræ lighter than cephalothorax. Sternum gray; endites and labium the same only lighter. Abdomen greenish-gray in alcohol, a little lighter above, spinnerets nearly white. Legs and palpus light yellow; tibial spines a little longer than diameter of the segment; no auditory hair on fourth metatarsus. Tarsal claws almost unarmed.

♀ Legs	I	II	III	IV
Tar	.29	.26	.24	.26
Met	.31	.29	.25	.31
Tib	.34	.31	.24	.41
Pat	.17	....	.14	.17
Fem	.43	.43	.36	.48

Two females taken in sifting, Ithaca, New York, November, 1903.

Œdothorax maculatus Banks.

♀ Legs	I	II	III	IV
Tar	.36	.34	.29	.34
Met	.5	.46	.41	.53
Tib	.62	.48	.38	.6
Pat	.17	.22	.19	.22
Fem	.67	.52	.53	.72

Posterior eyes in a straight line, equidistant, and nearly equal; anterior eyes in a straight line, the median eyes smaller than the lateral eyes, separated from the lateral eyes by one-half and from each other by only one-fourth the radius. Median ocular area as wide as long. Clypeus narrower than ocular area. There is no auditory hair on metatarsus of fourth leg.

This is a very common species, of which the male is still unknown.

Œdothorax montiferus Em.

If this species really is an *Œdothorax* as Simon states, it must be rather abnormal.

♂ Legs	I	II	III	IV
Tar	.29	.31	.26	.31
Met	.43	.41	.41	.55
Tib	.48	.43	.38	.62
Pat	.19	.19	.18	.19
Fem.	.62	.55	.5	.7

Posterior row of eyes in a procurved line, the median eyes slightly larger than the lateral, separated from each other by five times their diameter and from the lateral by one-half their radius; anterior eyes in a procurved line, equal, the median eyes very narrowly separated from each other, separated from the lateral eyes by two and one-half times their diameter. Median ocular area over four times as wide as long. Clypeus narrower than ocular area. Femora of the legs provided on the under side with a row of long slender spine-like hairs.

♀.—Posterior eyes in a procurved line, equal, median eyes separated from the lateral by less than their diameter and from each other by twice their diameter; anterior eyes in a procurved line, median eyes a little smaller than the latter, separated from each other by their radius and from the lateral eyes by their diameter. Median ocular area wider than long. Clypeus much narrower than ocular area.

Œdothorax oxypæderotipus n. sp. (Pl. XXVIII, figs. 9, 15.)

♂.—Length 1.4 mm. Cephalothorax, long .65 mm., wide .55 mm.

Legs	I	II	III	IV
Tar	.3	.29	.26	.28
Met	.36	.34	.3	.41
Tib	.43	.38	.31	.48
Pat	....	.17	.14	.14
Fem	.5	.48	.41	.53

Cephalothorax rather broadly oval, obliquely narrowed in front, head not elevated, dull brownish and greenish-gray with a median line and indistinct radiating lines darker.

Posterior eyes in a straight line, nearly equal, median eyes slightly smaller than the lateral and slightly nearer them than to each other; anterior eyes in a straight line, median eyes much smaller than the lateral and subcontiguous, while separated from the laterals by one-third their diameter. Median ocular area a little wider than long. Clypeus narrower than ocular area, plane and vertical. Cheliceræ rather weak and retreating. Sternum gray. Labium and endites dull yellowish-gray. Abdomen gray with two light longitudinal lines beneath. Legs dull yellow to almost white, tibial spines about as long as diameter of segment, under side of femora provided with a row of slender spines most distinct on the fourth pair of legs. Tarsal hook broad and crossed by a transverse furrow near the tip.

♀ Length 1.2 mm. Cephalothorax, long .6 mm., wide .46 mm.

Legs	I	II	III	IV	Palpus
Tar	.24	.26	.24	.26	.19
Met	.29	.31	.29	.36	....
Tib	.48	.34	.29	.46	.11
Pat	.17	.17	.17	.17	.08
Fem	.48	.46	.38	.5	.19

Cephalothorax broadly oval, slightly narrowed in front and squarely truncate, dull grayish-yellow, darker along the edge, each eye surrounded by a black ring.

Posterior eyes in a straight line, median eyes a little smaller than the lateral and much nearer them than to each other; anterior eyes in a very slightly procurved line, median eyes much smaller than the lateral, subcontiguous but separated from the lateral by their diameter. Median ocular area a little wider than long. Clypeus narrower than ocular area, plane and vertical.

Cheliceræ dull yellowish, upper margin of the furrow with a row of six teeth, lower margin with five smaller ones. Sternum light gray, endites and labium dull yellow. Abdomen as in the male, parts near the epigynum nearly white. Legs and palpus nearly white with a tinge of yellow in some specimens; palpus armed with many strong setæ. Epigynum seen from below covered with a white translucent portion of the integument through which the inner parts show very distinctly.

Several specimens from Ithaca, New York, February, May, June, and July.

Œdothorax trilobatus Em.

♂ Legs	I	II	III	IV
Tar	.38	.34	.29	.34
Met	.5	.48	.41	.55
Tib	.58	.48	.38	.6
Pat	.22	.19	.17	.22
Fem	.62	.55	.48	.67

Posterior eyes in a straight line, about equal and equidistant, the intervals between them a little greater than their radius; anterior eyes in a straight line, equally and very narrowly separated, median eyes a little smaller than the lateral. Median ocular area wider than long. Clypeus narrower than ocular area. No auditory hair on fourth metatarsus.

I have examined one of the types of *Tmeticus mœstus* Banks, a male, and believe it is a synonym of this species.

♀ Legs	I	II	III	IV	Palpus
Tar	.38	.34	.29	.34	.24
Met	.48	.43	.37	.5	....
Tib	.5	.43	.35	.55	.17
Pat	.25	.22	.19	.22	.1
Fem	.62	.55	.48	.65	.26

Posterior eyes in a nearly straight line, equal, the median eyes separated from the lateral by their radius and from each other by five-eighths their diameter; anterior eyes in a straight line, equidistant, the median eyes smaller than the lateral and separated from them and each other by one-half their radius. Median ocular area a little longer than wide. Clypeus narrower than ocular area. Erect spines on anterior tibia distinct, longer than the diameter of the segment. No auditory hair on fourth metatarsus.

I have examined the female type specimens of *Tmeticus debilis* and *T. palustris* Banks and believe they are both synonyms of this species. Banks' figure of the epigynum of *T. debilis* seems to represent the caudal aspect, while that of *T. palustris* the ventral aspect.

GONGYLIDIELLUM.

Gongylidiellum minutum Banks.

♂ Legs	I	II	III	IV
Tar	.24	.22	.19	.2
Met	.24	.22	....	.24
Tib	.29	.26	....	.35
Pat	....	.....	....	.13
Fem	.36	.36	....	.38

Posterior eyes in a slightly recurved line, equal, equidistant, separated by a little less than their diameter; anterior eyes in a straight line, median eyes one-half as large as lateral, subcontiguous but separated from the lateral by their diameter. Median ocular area a little wider than long. Clypeus a little wider than ocular area. Tarsus of first legs thickened and armed below with two rows of spines.

Banks has considered this species as the ♂ of *Tmeticus distinctum* Banks, but they differ in the proportions of the segments of the first leg, in the curvature of the posterior row of eyes and in the relative length and width of the median ocular area. In *minutum* the tarsal claws are almost unarmed, while in *distinctum* they are provided with a series of long spreading teeth. The form of the sternum is also entirely distinct in the two species (see under *Tapinocyba distincta*).

Gongylidiellum pallidum Em.

♂	Legs	I	II	III	IV
	Tar	.22	.2	....	.22
	Met	.22	.2	....	.24
	Tib	.29	.26	.19	.34
	Pat	.14	.14	.14	.14
	Fem	.41	.34	.29	.38
♀	Tar	.19	.19	.17	.18
	Met	.19	.19	.17	.22
	Tib	.26	.24	.19	.31
	Pat	.17	.16	.14	.14
	Fem	.34	.31	.26	.36

The arrangement of the eyes is about the same in both sexes. Posterior eyes in a slightly procurved line, equal, the median eyes separated from each other by their radius and from the lateral by one-half as much; anterior eyes in a straight line, all subcontiguous, the median eyes much smaller than the lateral. Median ocular area about as wide as long. Clypeus narrower than ocular area.

ERIGONE.

Erigone persimilis Cambr.

♂.—Posterior eyes in a straight line, median eyes a little smaller than the lateral eyes and separated from them by their diameter and from each other by a little smaller interval; anterior eyes in a slightly procurved line, equidistant and nearly equal, the median eyes being only very little smaller than the lateral eyes. Median ocular area a little wider than long. Clypeus wider than ocular area.

♀.—Cephalothorax darker than in the male, margin armed with a series of very small teeth, head less elevated than in male. Posterior eyes in a straight line, equal, median eyes a little nearer to the lateral; eyes than to each other; anterior eyes in a very slightly procurved line, median eyes a little smaller than lateral eyes, one-half as far from each other as from the lateral eyes. Clypeus narrower than the ocular area. The row of small teeth on the outside of the cheliceræ extends only two-thirds the length of segment. The sternum, legs and endites are all darker than in the male. Epigynum consists of a broad plate, divided into two rounded lobes behind by a broad and shallow notch in front of which there is a crescentic pit.

These two specimens were taken together at Sheepshead Bay, New York, June or July, 1903.

Erigone plicita n. sp. (Pl. XXIX, fig. 7.)

♀.—Length about 1.45 mm. Cephalothorax, long .82 mm., wide .55 mm.

Cephalothorax yellowish-brown with a dark patch at the union of the head and thorax. From this patch three fine dark lines extend forward, the middle one passing between the posterior median eyes and the lateral ones extending to the posterior lateral eyes. Cephalothorax with narrow black border and obscure radiating lines, eye area darker.

Posterior eyes in a slightly recurved line, median eyes slightly larger than the lateral eyes and a little nearer each other than to the lateral; anterior eyes in a slightly procurved line, equidistant, median eyes much smaller than the lateral eyes. Median ocular area about as wide as long. Clypeus narrower than ocular area, slightly depressed. Cheliceræ moderately robust, brownish-yellow streaked with gray, outer margin armed with a row of small teeth, upper margin of furrow armed with five teeth, lower margin with four small ones.

Sternum very dark yellowish-brown marked with obscure radiating lines. Endites thickened, dark brown at base, tip light. Abdomen dark gray. Legs and palpus yellow brown, coxæ tipped below with dark gray. Egpiynum wrinkled transversely.

One specimen, Stanford, California. (Mr. P. B. Powell.)

Erigone tridentata Em.

This species was doubtfully placed by Simon in *Erigone*. In a male specimen which I have examined from District of Columbia, the apophysis at the end of the patella of the palpus is more distinct than represented in Emerton's figure.

The posterior eyes are in a straight line, equidistant and much larger than the intervals between them; anterior eyes in a straight line, equidistant, median eyes smaller than the lateral eyes. Median ocular area as wide as long. Clypeus narrower than ocular area.

Erigone tristis Banks.

♀.—The following measurements are taken from a specimen from Interlaken, New York, which was compared with one of the types in the Cornell University collection.

Legs	I	II	III	IV	Palpus
Tar	.48	.43	.34	.36	.34
Met	.62	.58	.5	.62	....
Tib	.67	.6	.46	.72	.24
Pat	.29	.26	.24	.25	.12
Fem	.84	.77	.65	.86	.34

Posterior eyes in a straight line, equidistant and about equal; eyes larger than intervals between them; anterior eyes in a slightly procurved line; median eyes smaller than lateral eyes from which they are separated by their diameter, separated from each other by a little more than their radius; median ocular area a little wider than long. Clypeus about as wide as ocular area.

Cheliceræ moderately robust, armed on the outside with a row of very small teeth. This is easily seen in the type.

MASO.

Maso frontatus Banks.

♀ Legs	I	II	III	IV	Palpus
Tar.	.18	.17	.19	.24	.22
Met.	.41	.41	.36	.48	....
Tib.	.46	.41	.34	.72	.13
Pat.	.13	.19	.19	.19	.08
Fem.	.48	.48	.41	.58	.19

Posterior eyes in a straight line, equal and nearly equidistant, anterior eyes in a slightly procurved line, the median eyes a little smaller than the lateral eyes, from which they are separated by their diameter, separated from each other by their radius.

Tibia and metatarsus of first and second legs armed below with two series of long spines. Fourth metatarsus has an auditory hair on distal half. Tarsal claws are armed with numerous teeth.

CERATINOPSIS.

Notionella Banks (*Am. Nat.*, XXXIX, p. 312, 1905) is a synonym of *Ceratinopsis*, its type, *C. interpres* Cambr., having already been designated as the type of *Ceratinopsis* by Simon (*Hist. Nat. Ar.*, I, p. 673, 1894).

Ceratinopsis anglicanum Hentz.

In the Cornell University collection is a specimen of this species from Louisiana, labelled by Mr. Banks *Bathyphantes anglicanum* Hentz.

Ceratinopsis unicolor n. sp.

♂.—Length 2.1 mm. Cephalothorax, long .94 mm., wide .6 mm.

Cephalothorax oval, gradually inclined toward the head, orange yellow, eyes surrounded by narrow black rings. Posterior eyes in a straight line, equidistant and nearly equal; median eyes only slightly larger than the lateral eyes; anterior eyes in a straight line, equal; median eyes a little less than their diameter apart, twice as far from the lateral.

Clypeus wider than eye space, convex below the eyes and raised into a short blunt prominence. Cheliceræ normal, upper margin of furrow armed with five nearly equal teeth, lower margin with four smaller ones. Sternum orange yellow, posterior point five-sevenths as wide as hind coxa is long. Endites yellow orange, slightly thickened. Legs lighter than cephalothorax. Abdomen much faded, probably light gray.

Femur of palpus cylindrical, patella short and curved, tibia short with an external apophysis bearing a wide tooth on its lower side. Tarsal hook broad and flat, bent to form a semicircle. Style has a sharp bend near the middle.

Legs.....	I	II	III	IV	Palpus
Tar.......	.5	.46	.38	.56	.36
Met.......	.74	.72	.55	.74	....
Tib.......	.74	.7	.5	.77	.24 { including apophysis
Pat.	.24	.24	.22	.22	.14
Fem......	.74	.84	.72	.89	.34

Five specimens in Fox collection, labelled "*Ceratinopsis unicolor*, D. C., May, Fox."

CLITOLYNA.

Clitolyna electa n. sp. (Pl. XXIX, fig. 8.)

♀.—Length 2.9 mm. Cephalothorax, long 1.27 mm., wide .91 mm.

Cephalothorax narrowly oval, slightly narrowed in front, yellow orange, tinged with red along the edge, eye space and a semicircular area below anterior median eyes black. Posterior median eyes borne on the sides of a broad tubercle.

Posterior eyes in a very slightly recurved line, median eyes a little larger than the lateral from which they are separated by a little less than their diameter, separated from each other by twice their diameter; anterior eyes in a straight line, about equal, median eyes separated from each other by less than their diameter, separated from the lateral eyes by nearly twice as much. Median ocular area much wider than long. Clypeus nearly as wide as ocular area. Cheliceræ yellow orange. Sternum orange red. Endites and labium lighter. Abdomen purple. Coxæ, trochanters and basal part of femora grayish-yellow, rest of the legs dark gray. Tarsus and tibia of palpus nearly black, other segments grayish-yellow.

Leg..........	I
Tar..........	.79
Met..........	1.45
Tib..........	1.27

One specimen taken by Prof. J. H. Comstock at Baton Rouge, Louisiana.

I place this species in *Clitolyna*, although it differs from Simon's diagnosis of the genus in having the anterior median eyes twice as far from the lateral eyes as from each other and in the form of the clypeus, which is only very slightly depressed below the eyes. Keyserling in his description of *C. fastibilis*, the type of the genus, says: "Die beiden vorderenen MA. sind kaum um ihren Radius von einander und reichlich um ihren Durchmesser von den SA. entfernt" (*Spinn. Am., Therid.*, II, p. 217). In *C. electa* they are more widely separated, but the same proportion is maintained.

Explanation of Plates XXVIII and XXIX.

Plate XXVIII, Fig. 1.—*Ceraticelus albus* Fox. Male palpus.
Fig. 2.—*Ceraticelus albus* Fox. Tibial apophysis.
Fig. 3.—*Ceraticelus alticeps* Fox. Male palpus.
Fig. 4.—*Ceraticelus melanocnemis* Fox. Male palpus.
Fig. 5.—*Ceraticelus rugosus* n. sp. Male palpus.
Fig. 6.—*Ceraticelus tibialis* Fox. Male palpus.
Fig. 7.—*Ceraticelus rugosus* n. sp. Male palpus.
Fig. 8.—*Exechophysis plumalis* n. sp. Male palpus.
Fig. 9.—*Œdothorax oxypæderotipus* n. sp. Male palpus.
Fig. 10.—*Ceraticelus melanocnemis* Fox. Tibial apophysis.
Fig. 11.—*Acartauchenius columbiensis* n. sp. Male palpus.
Fig. 12.—*Diplocephalus castigatorius* n. sp. Male palpus.
Fig. 13.—*Exechophysis plumalis* n. sp. Male palpus.
Fig. 14.—*Diplocephalus castigatorius* n. sp. Femur, patella and tibia of male palpus.
Fig. 15.—*Œdothorax oxypæderotipus* n. sp. Epigynum from behind.

Plate XXIX, Fig. 1.—*Exechophysis plumalis* n. sp. Epigynum.
Fig. 2.—*Diplocephalus castigatorius* n. sp. Epigynum.
Fig. 3.—*Pocadicnemis longitubus* Em. Epigynum.
Fig. 4.—*Delorrhypis unicornis* Banks. Epigynum.
Fig. 5.—*Prosopotheca transversa* n. sp. Epigynum.
Fig. 6.—*Œdothorax limatus* n. sp. Epigynum.
Fig. 7.—*Erigone plicita* n. sp. Epigynum.
Fig. 8.—*Clitolyna electa* n. sp. Epigynum.
Fig. 9.—*Acartauchenius columbiensis* n. sp. Patella and tibia of male palpus from above.

May 2.

The President, Samuel G. Dixon, M.D., in the Chair.

Twenty-seven persons present.

The death of Richard Rossmässler, a member, April 29, 1905, was announced.

Mr. Samuel N. Rhoads made a communication on a midwinter voyage in the Colorado Delta. (No abstract.)

Dr. H. E. Wetherill spoke of a telescope for expeditionary purposes and the uses to which a combination Galilean glass of his own invention could be put.

A paper entitled "Some Vertebrates of the Florida Keys," by Henry W. Fowler, was presented for publication.

May 16.

The President, Samuel G. Dixon, M.D., in the Chair.

Nineteen persons present.

The death of Alexander Mucklé, M.D., a member, April 28, 1905, was announced.

A paper entitled "New Species of Polychæta from the North Pacific, chiefly from Alaska Waters," by J. Percy Moore, was received for publication. (May 5.)

Dr. Harry Fielding Reid, of Baltimore, Maryland, was elected a correspondent.

The following were ordered to be printed:

SENILITY AMONG GASTROPODS

BY BURNETT SMITH.

Introduction.

The critical study of the development of Gastropod shell ornamentation has, until recent years, attracted the attention of few scientists in the United States. In Europe as early as 1889 Koken[1] made a careful study of Palæozoic Gastropods. This was followed in 1896 by the Countess von Linden's[2] study of the ornamentation and color patterns in *Voluta*, *Strombus* and *Conus*. In the United States, the first use of gastropod shell characters in the study of phylogeny occurs in the short notes of Heilprin[3] in 1888, dealing with the phylogeny of *Fulgur perversum* and *Strombus leidyi;* and of Leidy[4] and Wilcox on the ancestry of *Fulgur perversum.*

In 1900, A. W. Grabau presented a thesis at Harvard University dealing with the phylogeny of *Fusus* and allied forms. In June, 1902, the writer[5] applied the methods of the Countess von Linden to a study of the Fulgurs, and later in the same year A. W. Grabau[6] published a paper dealing with the general features of gastropod shell development. In 1903 Prof. Grabau[7] discussed the phylogenetic relations of the Fulgurs, and in the following year published an elaborate phylogenetic study of *Fusus*.[8]

In most of the above papers there is an attempt made to compare ontogeny with palæontogeny, dealing, therefore, with both recent and fossil forms. The individuals of species are studied from the earliest

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[1] Koken, E., "Ueber die Entwicklung der Gastropoden vom Cambrium bis zur Trias," *Jahrb. Mineral.*, 1889, Beilage, Band VI, pp. 305–484.

[2] Linden, Gräfen M. von, "Die Entwicklung der Skulptur und der Zeichnung bei den Gehäusschnecken des Meeres," *Zeit. Wiss. Zool.*, LXI, pp. 261–317.

[3] Heilprin, A., "The Geological Evidences of Evolution."

[4] Leidy, J., "Remarks on the Nature of Organic Species," *Tr. Wag.-Inst. Phila.*, pp. 55–53, 1889.

[5] Smith, Burnett, "Phylogeny of the Species of Fulgur, with remarks on an abnormal specimen of Fulgur canaliculatum and sexual dimorphism in Fulgur carica," *Proc. Acad. Nat. Sci. Phila.*, June, 1902.

[6] Grabau, A. W., "Studies of Gastropoda," *Am. Nat.*, Vol. 36, p. 925.

[7] Grabau, A. W., "Studies of Gastropoda, II—Fulgur and Sycotypus," *Am. Nat.*, Vol. 37, pp. 515–539.

[8] Grabau, A. W., "Phylogeny of Fusus and Its Allies," *Smithsonian Miscellaneous Collections,* Part of Vol. XLIV (No. 1,417), Washington, 1904.

whorls to the latest, and the changes in shell features and ornamentation noted in the individual have been correlated with characters observed in the species of past geologic time. Where phylogenetic trees have been constructed they have been based on the principle that the individual in its development repeats, in its early stages, shell features which are found in the adult individuals of its ancestors. The authors have, for the most part, followed the principles applied and the laws formulated by Hyatt in his classic studies of the Cephalopoda.

In any phylogenetic study of the gastropod shell, acceleration of the characters plays an important part. With the exception of *Fusus* and *Voluta*, most of the genera studied have been rather highly specialized and accelerated types like *Fulgur* and *Strombus*. In such forms many of the stages have been hurried back into the early whorls, slurred over or lost.

The writer feels that a detailed study of the shell features in some species of *Volutilithes*, as *Volutilithes petrosus* of the American Eocene, may add to our knowledge of the normal order in which such features are evolved. Several species of *Volutilithes* go through quite a number of stages of development in ornamentation, and there is little acceleration. Each stage, of course, does not necessarily represent an adult ancestor, for at present it is not known how much unequal acceleration of ancestral characters has come into play, yet nevertheless the writer feels that here we have a fairly normal and even succession of developmental features.

The occurrence of certain characteristics with considerable constancy in the later whorls of many individuals of *Volutilithes petrosus* has led the author to consider such features in other genera of gastropods. These features will be treated in the sections of this paper entitled *Senility* and *Senile Offshoots from Main Ancestral Stems.* The results of this later investigation are applied to *Fulgur carica*, in an endeavor to unravel its ancestry.

Normal Progressive Development.

In recording the characters which occur at different periods in the growth of any gastropod shell it is necessary to be exact; and this frequently results in the use of terms which appear arbitrary. The writer has, throughout this paper, endeavored as far as possible to apply the terms previously in use. Markings on the outside of the whorl which run parallel or nearly parallel to the suture are described as spiral; while those running across these spirals are described as transverse. The transverse markings which first appear are referred to as transverse ribs, or simply as ribs. When, in later stages, finer transverse markings appear between the ribs, they are described as riblets. Here the term is used principally for convenience, the actual difference between ribs and riblets being one of degree.

The angle which appears early on the rounded whorl is termed the shoulder angle. On the ribs, especially at the shoulder angle, may occur nodes or tubercles. These, in the early whorls, are mere rounded knobs; but in the later whorls they become larger, higher and sharper, and may therefore be referred to as spines. The writer considers that the difference between the small rounded tubercle of the early whorls and the large, sharp spine of the later whorl is one merely of degree. The word spine is therefore used, throughout this paper, simply in a descriptive sense, and implies no difference from the early tubercle, except that it is larger and sharper. Both are produced by the same fold of the mantle and every gradation between the two is observable.

As stated in the Introduction, *Volutilithes* has been chosen as an illustration on account of the normal and even course of its ontogeny. The stages are often very distinct, and frequently are all represented down to the senile condition in the later whorls. In addition, *Volutilithes petrosus* is of unusual interest on account of its individual variation and its division into more or less definite races, which exhibit different stages in the specialization of characters.

In the early stages of *Volutilithes petrosus* there is a varying number of smooth rounded whorls; but as a rule there are three or four. The first ornamental feature to appear on the rounded whorl is the transverse rib, which at first is simple (without tubercles) and usually decidedly curved. Soon the simple ribs are followed by uncurved ribs, bearing as a rule two tubercles, but sometimes more than two. One of these tubercles is situated at the suture, the other at the position of the shoulder angle. If more tubercles are present they are below the shoulder angle tubercle. Sometimes the suture tubercle and the shoulder angle tubercle are of the same size; but often they are of unequal size, and then it is usually the suture tubercle which is at first the larger. The suture tubercle, however, soon degenerates and becomes obsolete, while the shoulder angle tubercle increases in importance and by its increase in size and sharpness makes the spine of the later whorls.

Coincident with or shortly after the appearance of the tubercles on the ribs, a more or less well marked shoulder angle develops. As the shoulder angle tubercles become larger, sharper and more prominent the transverse ribs degenerate. This process begins first above the shoulder angle, where sometimes all trace of the rib has disappeared, when below the angle the rib is still well marked. As a rule, when the tubercles become very high and sharp (spines) the ribs practically disappear.

When fine spirals cover the early whorls below the shoulder angle, they are apt to disappear near the shoulder angle first in the later adult whorls. As the shell grows, these fine spirals are found in a more and more anterior position, until in old age only a few occur on the branchial siphon.

This briefly sums up the more important changes which are passed through in the development of most individuals of *Volutilithes petrosus*, and many other species of the genus. Many individuals and some races of *Volutilithes petrosus* pass through further stages of development; but these are all of a gerontic character, and may be now more fittingly discussed under the following section.

Senility.

In widely separated genera of gastropods the writer has observed that similar features are frequently found in the last whorl or in the last few whorls. These features are never followed, in any gastropod, by other and different ones, but are the last ornamental characters which the shell acquires. They are the marks of old age or senility. Many species and even genera and families never exhibit them, for in the Palæozoic they are rare and in the Mesozoic they are uncommon. In Tertiary and Recent time, however, few large families of gastropods are lacking in senile representatives. These representatives may be genera, species or individuals.

Individual Senility.—In many species, the vast majority of individuals die at the period of mature shell ornamentation. Senile characters are found only in an occasional specimen, which, as a rule, is either a very large old one or else a dwarfed or pathologic individual.[9] In individual senility, the senile features are seldom accelerated to any extent —that is, they are, as a rule, found in the last whorl, or in the latter part of the last whorl.

Specific Senility.—Often all the individuals of a species will show signs of senility in the last whorl, or in the last few whorls. This senile ornamentation of the species is more apt to be accelerated than the senile ornamentation of the individual; or, in other words, it occurs earlier in the growth of the shell.

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[9] A similar condition has been noted by Hyatt for the Cephalopoda: "Biological Relations of the Jurassic Ammonites," *Proc. Bost. Soc. Nat. Hist.*, Vol. XVII, 1874, p. 239.

Generic Senility.—Here all the species of a genus will exhibit signs of senility, and the generic senility is more accelerated than the specific.

Similarly, senility may extend to the genera of a family, and if, as is probably the case, the *Vermetidæ* are senile, we have the characters occurring early in the growth of shell, with the result that the forms comprising the family differ in appearance to a marked degree from the normal gastropod.

The marks of senility may be conveniently grouped under several heads. Two or three of them have been mentioned by Hyatt, Grabau and other authors, and these are merely noted in the present paper for the sake of completeness. The writer knows of no case in which all of the characters are found together. Frequently only one will indicate that the individual, species or genus has passed its prime, but more often two or more senile characters occur. As old age comes on the marks of senility appear, but not necessarily all at the same time. Usually one character will appear in the growth of the shell slightly ahead of another character. Sometimes one of the senile characters will be much accelerated and become prominent at a comparatively early stage, while the others will be found on the last whorl only.

The writer regards the following as marks of senility:

1. Passing of the shoulder tubercles or spines into a shoulder keel.
2. Swelling on the anterior siphon.
3. Protrusion of the mantle in the region of the anal siphon, producing a smoothing of the preceding whorl by a shelly overgrowth.
4. Encroachment of the anal siphon upward on the preceding whorl.
5. Stromboid form to the outer lip of the aperture.
6. Tendency toward loose coiling.
7. Irregularity of growth lines.
8. Thickening of the shell.
9. Tendency to form a smooth and rounded whorl.
10. Recurrent or discontinuous ornamentation.

1. *Passing of the shoulder tubercles or spines into a shoulder keel.*—This process is well shown in such forms as *Fulgur carica* and *Volutilithes petrosus,* where little acceleration has occurred. The change takes place by a shortening of the interval between spine formation, with the result that the spines are nearer each other. The growth lines, on which the spines are situated, are thus brought close together. The spines become lower in height, but longer in a spiral direction, until they fuse together into a continuous ridge, so that the final result of the process is a shoulder keel without definite spines.

In *Fulgur canaliculatum* acceleration has thrown the spines back into the early whorls, and they are mere tubercles. Their transformation into a shoulder keel is, however, essentially similar to the change in *F. carica.* The tubercles become longer in a spiral direction, but lower in height and soon merge into a shoulder keel.

2. *Swelling on the anterior siphon.*—In senile individuals and species the mantle, in the region of the anterior or branchial siphon, not infrequently bulges at a certain point. As the animal grows, this bulging of the mantle produces a swollen ridge in the shell. The long diameter of this swelling runs obliquely to the line of the shoulder angle, and in a more anterior direction. Numerous dissections of *Fulgur carica* have failed to show a cause for this mantle swelling.

The two above marks of senility—that is, the passing of the spines into a shoulder keel, and the swelling on the anterior siphon—are both well shown in old individuals of the *Fulgur carica* of our New Jersey coast. These two characters, together with a third (the tendency for the anal siphon to encroach upward on the preceding whorl), are the last ornamental features which occur on the oldest individuals. A well-marked sexual dimorphism occurs in this species. The full-grown males are considerably smaller than the full-grown females. The old males and old females show the senile characters above mentioned; and the difference in the size of the senile individuals of the different sexes furnishes a ready method of determ'ning sex without reference to the soft parts. These observations were made on a large series of *Fulgur carica.*[10]

3. *Protrusion of the mantle in the region of the anal siphon, producing a smoothing of the preceding whorl by a shelly overgrowth.*—This is beautifully illustrated by several races of *Volutilithes petrosus.* In the later whorls the mantle in the region of the anal siphon protrudes and tends to wrap itself around the preceding whorl. In the early stages of the process we have little more than a smoothing of the preceding whorl. The mantle soon passes up over the spines of the preceding whorl, and the shelly deposit becomes thicker and thicker, completely obliterating ornamentation, and making it in many cases extremely difficult to count the whorls. Every stage of the process can be traced in individual development; while several races make a series from forms in which the mantle has been little protruded to forms in which it has covered in the preceding whorl, obliterating ornamental features. It does not necessarily follow that these races in question make a phylogenetic succession, but they unquestionably represent stages in the

[10] *Proc. Acad. Nat. Sci. Phila.*, June, 1902.

development of certain features. The protrusion of the mantle onto the preceding whorl is often accompanied by an encroachment of the anal siphon upward onto the preceding whorl.

There is evidently a close relation between the swelling on the anterior siphon and the protrusion of the mantle on the preceding whorl in the region of the anal siphon; for as the latter feature becomes stronger the former declines. The races of *Volutilithes petrosus* above mentioned illustrate this fact perfectly. They range from forms with a well-marked swelling to others with no swelling; and in one race with an extreme mantle protrusion there is a depression in place of a swelling. As the swelling has been diminishing, there has been a corresponding increase in the amount of protrusion of the mantle on the preceding whorl in the region of the anal siphon.

4. *Encroachment of the anal siphon upward on the preceding whorl.*—This often accompanies the preceding mark of senility and is evidently produced by the same causes. It is well shown in *Volutilithes petrosus* and in *Fulgur carica,* also in *Strombus* and *Aporrhais,* where it is accompanied by the wing-like flaring of the outer lip of the aperture.

5. *Stromboid form to the outer lip of the aperture.*—This is a flaring, wing-like extension of the outer lip of the aperture and is found in *Strombus, Aporrhais* and a few other forms. In *Strombus* it is often accompanied by a thickening of the shell, by a bending of the branchial siphon upward or backward, by the encroachment of the anal siphon upward onto the preceding whorl, and by recurrent ornamentation (*Strombus leidyi*).

6. *Tendency toward loose coiling.*—In many gastropods the later whorls are not closely applied against the preceding whorls. In other words, the coiling becomes loose. *Ecphora, Rapana* and some species of *Murex* do not show signs of uncoiling until well along in life. In such forms as *Vermetus,* however, the process is further advanced, and all trace of the original spiral condition is lost at an early date; the shell becoming a mere irregular tube.

7. *Irregularity of growth lines.*—In many gastropods (*Volutilithes petrosus* is a good example) the final senile stages are characterized by a thickening and irregularity of the fine lines of growth. This character goes hand in hand with the thickening of the shell, the passing of the spines into a shoulder keel, recurrent ornamentation, and other senile features.

8. *Thickening of the shell.*—This is a character which occurs in the senile stages of many diverse groups of gastropods. It is usually accompanied by other senile features, and is probably more widely distributed than any other mark of senility.

9. *Tendency to form a smooth and rounded whorl.*—In many gastropods the later whorls tend to become rounded and more or less smooth, losing all ornamental features except growth lines and perhaps also fine spirals. In many individuals and varieties of *Fulgur pyrum* and related forms the shoulder keel stage is followed by a condition in which the whorl is rounded, the shoulder keel becoming fainter and fainter until it is not discernible. In many gastropods this rounded stage is accompanied by a thickening of the shell, but in others the shell actually becomes thinner. As the early whorls of most gastropods are rounded, it is possible that this mark of senility may be regarded as a recurrence of features of the same nature as the mark of senility next to be considered.

Fig. 1.—*Fulgur maximum* Con. Miocene. Cape Fear River, N. C. Diameter of shell across last whorl = 61 mm. Apical view exhibiting recurrent or discontinuous ornamentation.

Fig. 2.—*Fulgur maximum* Con. Miocene. Cape Fear River, N. C. Diameter of shell across last whorl = 52 mm. Apical view exhibiting recurrent or discontinuous ornamentation.

10. *Recurrent or discontinuous ornamentation.*—This is a term which may be applied to the discontinuity produced by the repetition, at a later stage, of a style of ornamentation characterizing an earlier stage. Thus spines or tubercles which are found on the early whorls disappear for a few whorls, but are repeated as a secondary series in old age. The development of secondary spines is well shown in *Fulgur maximum.*

In most examples of this very variable species and its near relatives the shoulder angle tubercles are soon lost, and only reappear again in the later whorls, where they are spine-like and accompanied by features of extreme senility. Sometimes the arrangement of the shoulder angle spines may be considered as discontinuous, that is, where an occasional spine is met with on a rounded whorl. Here, as above, the condition is accompanied by other senile features.

Recurrent or discontinuous ornamentation is also met with in the sinistral *Fulgurs* of the Miocene, in not a few *Strombs*, and in some individuals of *Volutilithes dalli*. In the last mentioned, the breaks in a particular style of ornamentation may occur early in life, but the shell always shows senile characters in its last whorls.

Senile Offshoots from Main Ancestral Stems.

In no group of gastropods are senile offshoots from main lines of descent so well marked as in the *Fulgurs*. The modern *Fulgur carica* of our New Jersey coast is a simple, little accelerated type which, however, shows well-defined senile characters in its last whorl.

In the Yorktown Miocene of North Carolina occur certain forms which were described by Conrad as *Fulgur striatum*. Some of these small forms are undoubtedly the young of *Fulgur maximum*, as can be seen in the early degeneration of the tubercles, but others whose tubercles increase in size can hardly be distinguished from the young of *Fulgur carica*. It is from these latter, or from very closely allied forms, that the modern New Jersey *Fulgur carica* is descended. The main line of the ancestry of *Fulgur carica* may be represented as follows:

Miocene.		Pliocene.	Recent.
F. fusiformis or a nearly allied form.	Ancestral *F. carica;* probably included in Conrad's *F. striatum.*	*F. carica.*	N. J. *F. carica.*

This has been a slow and even evolution, marked by increase in size, stronger and continuous spine development, and finally in the old individuals of *Fulgur carica* by the appearance of the senile characters in the last whorl, which have already been referred to.

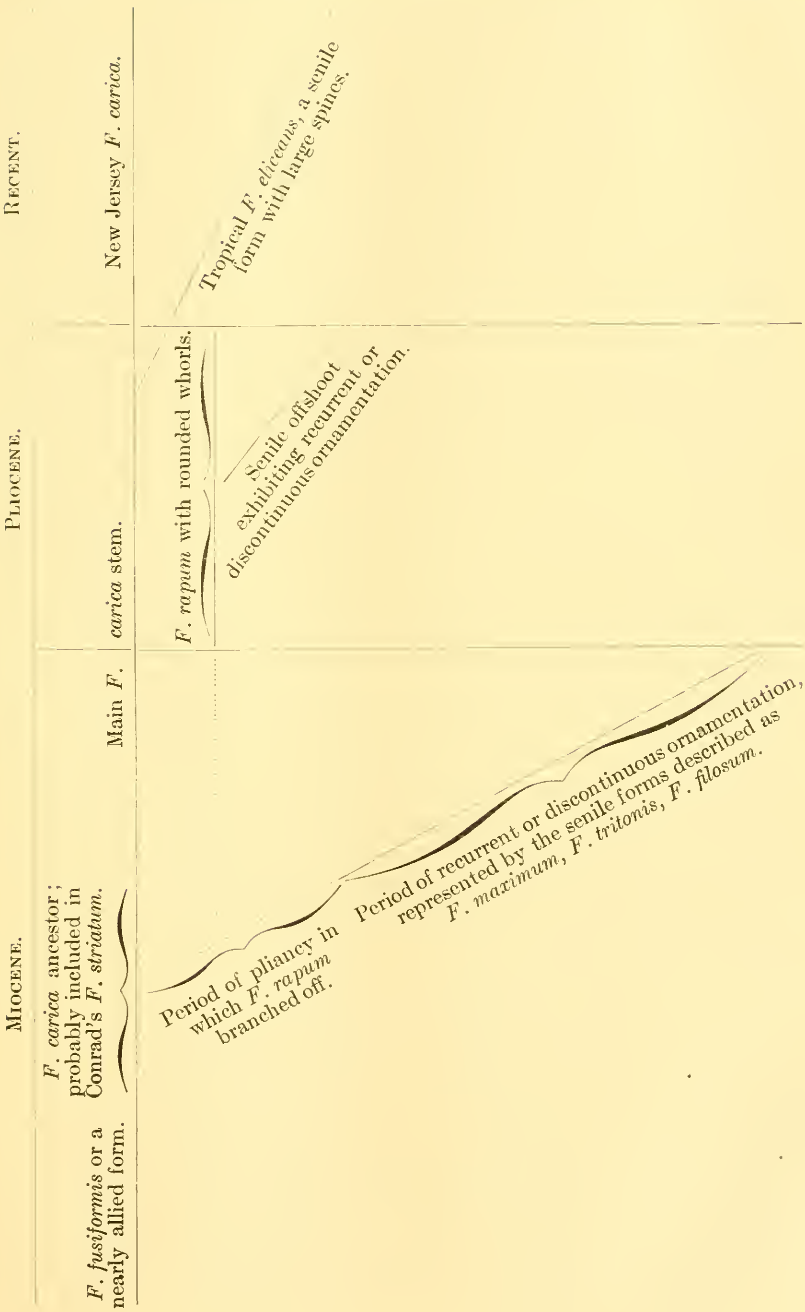
In the Yorktown Miocene the *Fulgur maximum* branch was evolved. As can be seen by examining the young *Fulgur maximum*, it owes its ancestry to the ancestral *Fulgur carica*. It differs from this form, however, in the early degeneration of the shoulder angle tubercles—a tendency which soon results in a rounded, lirate and relatively thin whorl. This spineless condition continues for some time, but in the later whorls secondary spines appear. This recurrent ornamentation is accompanied by shell thickening, encroachment upward of the anal siphon on the preceding whorl, and the swelling on the anterior siphon —all senile features. This is the method by which most of the individuals recognized as *Fulgur maximum* have been evolved. Sometimes, however, recurrent ornamentation is only slightly marked, the spines occurring at long intervals on the rounded whorls.

The whole assemblage shows every indication of being a senile offshoot. Every large individual shows senile characters. The main *Fulgur maximum* branch (including the forms described as *F. maximum, F. tritonis, F. filosum*) becomes extinct at the end of the Miocene.

Shortly after the divergence of the *Fulgur maximum* branch from the main *Fulgur carica* stem, a series of forms with rounded whorls diverged from the maximum stock. Their young are much like the young of *Fulgur maximum*, but the tubercles degenerate at a more early period. This short tubercled stage is followed by thin, rounded, spineless whorls in the vast majority of individuals, resulting in the form known as *Fulgur rapum*. A few senile individuals of *Fulgur rapum* exhibit a thickening of the last whorl, and recurrent or discontinuous ornamentation, in the shape of secondary spines. *Fulgur rapum* becomes extinct with the end of the Pliocene.

In Pliocene or Recent times a branch has been evolved from the *Fulgur carica* main stem which has resulted in such forms as *Fulgur eliceans*. These are senile and exhibit an acceleration of characters accompanied by very high spines. These spines are not as numerous as in *Fulgur carica*. They sometimes tend to pass into a shoulder keel, though less often than in *Fulgur carica*. In other respects, however, these forms show extreme senility—the swelling on the anterior siphon is very large, the shell is very heavy and the anal siphon encroaches upward.

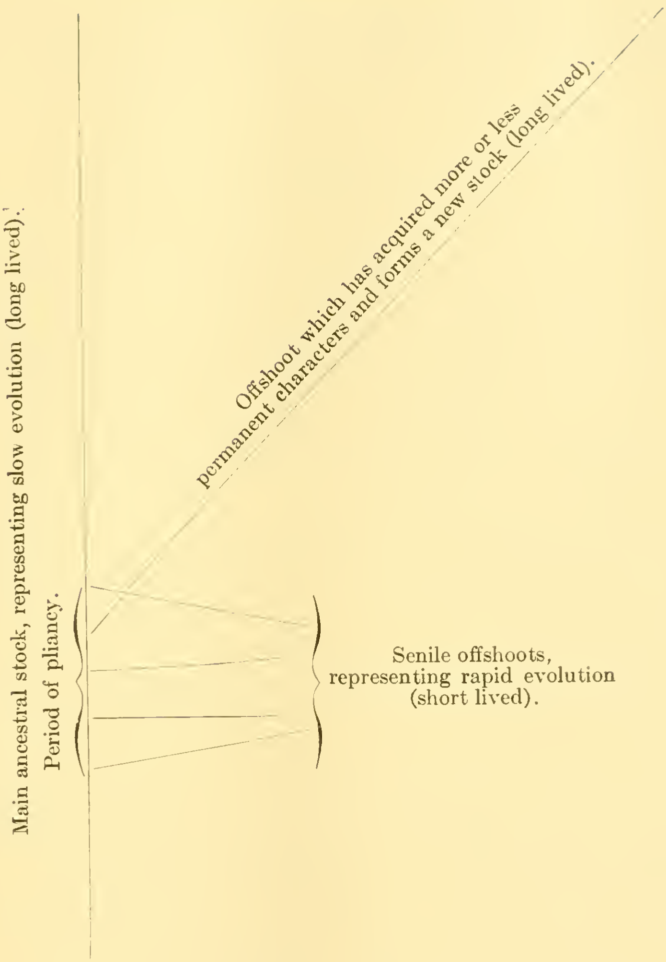
The phylogeny of *Fulgur carica* and allied forms may be represented as follows:


Miocene.
Pliocene.
Recent.
F. fusiformis or a nearly allied form.
F. carica ancestor; probably included in Conrad's *F. striatum*.
Main *F. carica* stem.
New Jersey *F. carica*.
F. rapum with rounded whorls.
Senile offshoot exhibiting recurrent or discontinuous ornamentation.
Tropical *F. eliceans*, a senile form with large spines.
Period of pliancy in which *F. rapum* branched off.
Period of recurrent or discontinuous ornamentation, represented by the senile forms described as *F. maximum*, *F. tritonis*, *F. filosum*.

From the above study the writer is led to believe that there are two modes in which evolutional features may develop. First, they may develop slowly and evenly in the growth of the individual (ontogeny), and in the evolution of the race in geologic time (palæontogeny). Such forms are stable and persist for long periods of time. Second, the same evolutional features may develop in the same order, but more rapidly; one feature following another in quick succession in the ontogeny and palæontogeny. Such forms are apt to be short lived, soon becoming senile and dying out. Where the rate of development of evolutional features is rapid, we find that some features are slurred over; while other features may be more exaggerated than the corresponding features in the forms whose rate of development of characters is slow. Of course acceleration, or the throwing back of characters into the ontogeny, is a natural result of an increased evolutional rate.

Further, we cannot escape the conclusion that there are times in the evolution of a group of organisms (palæontogeny) which might be termed periods of pliancy. In these the simple, generalized members of the main ancestral stem can be easily moulded. At such periods of pliancy we may expect to find, first, forms which follow out the succession of developmental features, as in the main stock, but at a more rapid rate, becoming senile and extinct; and second, forms which acquire characters of a more or less permanent nature, and which do not go through the same succession of developmental features which is found in the main ancestral stock. These latter forms make new stocks, or, in other words, they go to form new species, genera, etc.

Therefore, at every period of pliancy in a stock we have, on the one hand, new species and, on the other, senile offshoots. In the forms above considered, that is, the *Fulgurs*, the numerous senile offshoots far outnumber the few but persistent stable forms. The following diagram may be used:



ADVENTITIOUS SENILITY.

An acceleration of shell characters, produced by accident or by pathologic conditions, occurs in species of widely separated groups of gastropods. Hyatt[11] observed that "a wound and its results, whatever they may be, ... is primarily a severe shock to the system which lays additional burdens upon the powers of growth, and is usually followed, if severe, by retrogressive metamorphoses, or premature old age."

Individuals of *Volutilithes petrosus* whose shells in the later whorls

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[11] "The Genesis of the Tertiary Species of Planorbis at Steinheim," p. 15, *Anniversary Memoirs of the Boston Society of Natural History*, 1880.

have been subjected to breakage, often exhibit a sudden and sharp development of senile features. The shell gets heavy, the growth lines become irregular, and the spines tend to pass into a shoulder keel.

An individual of *Ecphora quadricostata*, collected by the writer from the Maryland Miocene, exhibits acceleration produced by accident very clearly. The accident occurred to the shell during the development of the third whorl. From this point on the rate of the development of later shell features increases, and is much more rapid than in normal individuals. The individual in question never became mature, only attaining five whorls. A normal specimen with this number of whorls has practically no indication of loose coiling in the region of the columella, and the spiral folds are simple. The abnormal individual in question shows plainly a loose coiling in the columella region, and the spiral folds approximate those of more mature individuals. Loose coiling is, as a rule, not marked in normal individuals of this species until the seventh or eighth whorl.

A specimen of *Fulgur canaliculatum* collected at Longport, New Jersey, exhibits well the acceleration of characters produced by breakage in the shell.[12] In the canaliculate *Fulgurs* the transversely ribbed condition occurs very early, and is followed by a few angular whorls, bearing tubercles on the shoulder angle. These tubercles soon pass into a shoulder keel, and this in turn disappears, and leaves the whorl rounded, in the more accelerated forms, such as *Fulgur pyrum*.

Fulgur canaliculatum, however, never entirely loses the shoulder keel, which marks its last stage of development. In the specimen under consideration the accident occurred when the shell was young, on an angular whorl having the tubercles so characteristic of the early stages of *Fulgur canaliculatum*. After the break the shoulder angle is not reproduced, but the whorls continue to the aperture of a shape much as in *Fulgur pyrum*. Just after the break there is, apparently, an attempt to reproduce the tubercles on the rounded surface of the whorl. This attempt was, however, unsuccessful, and the whorl continued smooth. An examination of the soft parts showed the specimen to be identical with normal male individuals of the species, except that the shoulder angle is not present on the mantle. No peculiarity in the mantle edge or other soft parts could be detected which would account for the change in shell ornamentation.

The acceleration in this case has caused the dropping out of that marked character of the later whorls of the species, namely, the un-

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[12] Smith, Burnett, *Proc. Acad. Nat. Sci. Phila.*, June, 1902.

tubercled shoulder keel. On the other hand, it has introduced a senile character which occurs normally in a near relative (if not an actual descendant) of *Fulgur canaliculatum*, namely, *Fulgur pyrum*.[13]

Summary.

In most Mesozoic and Cenozoic gastropods, changes in ornamentation occur in going from the earlier to the later whorls. A normal succession of developmental changes may be observed, which varies little in widely separated groups; but most families show certain peculiarities in the succession which distinguish them from other families. Infancy, youth and maturity are represented by their peculiar styles of ornamentation in the ontogeny of an individual; but these stages, with their characteristic styles of sculpture, cannot always be correlated with the adults of a previous geologic time. This latter discrepancy may be due, in part, to the imperfection of the geologic record; but the writer inclines to the belief that the unequal acceleration of characters plays an important part, and that features which occurred at the same time in an ancestor are apt to be widely separated in the ontogeny of a descendant.[14]

In the last whorl, or in the last few whorls, of many gastropods of different groups we find the characters of senility. These characters or marks of senility do not necessarily appear together in the ontogeny at exactly the same time. Some occur far in advance of others; that is to say, there is frequently an unequal acceleration of the senile characters.

These senile features, several of which are, as a rule, found together, are the last characters which occur on the shell, for their appearance is the forerunner of the death of the individual. As might be expected, senile species or genera of fossil gastropods never transmit descendants to later geologic formations, but represent the end members of short branches on the phylogenetic tree.

The writer believes from his researches that the forces of evolution sometimes work rapidly and sometimes work slowly, and that the forms in which the evolutional rate is rapid are bizarre, senile offshoots. On the other hand, forms which have a long time range go through a slow evolution, though the developmental features and even the order

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[13] There is good reason for believing that *F. pyrum* and its numerous varieties are descended from a Miocene form which is either identical with or closely allied to *F. canaliculatum*. See Smith, Burnett, *Proc. Acad. Nat. Sci. Phila.*, June, 1902, and Grabau, A. W., *Am. Nat.*, August, 1903, p. 521, and table, p. 539.

[14] Smith, James Perrin, "The Development and Phylogeny of Placenticeras," *Proc. California Academy of Sciences*, Third Series, Vol. I, No. 7, p. 185.

of succession may be the same as in forms whose evolutional rate is a fast one.

Lastly, an acceleration of characters may result from some accident which occurs to an individual; and in this case we may find a sudden appearance of senile characters, which may occur in the normal ontogeny of the species, at a later period, or they may be extra-specific; that is to say, never occurring in the ontogeny of the species, but found in some senile offshoot from the same stock.

The writer wishes to express his indebtedness to Prof. Amos P. Brown of the University of Pennsylvania, to Prof. Henry A. Pilsbry, Mr. Edward G. Vanatta and Mr. Witmer Stone of the Academy of Natural Sciences of Philadelphia, and to Mr. C. W. Johnson of the Boston Society of Natural History, for many courtesies and kindly suggestions and to Miss Helen Winchester for the care exercised in making the drawings.

Explanation of Plates XXX and XXXI.

Plate XXX, fig. 1.—*Volutilithes petrosus* Con. Eocene. Mt. Lebanon, La. Length = 16 mm. Young individual, showing the change from simple curved ribs to straight tubercled ribs. In the last whorl the ribs are well marked below the shoulder angle, but very faint above it.

Fig. 2.—Apex of the above specimen. Length = 2 mm. Shows the change from simple curved ribs to straight ribs with suture and shoulder angle tubercles.

Fig. 3.—*Volutilithes petrosus* Con. Eocene. Jackson, Miss. Diameter of shell at last whorl measured on the largest spine = 24 mm. Apical view of old individual with long spines. Here the tendency for the spines to pass into a shoulder keel is only slightly marked, but they decrease in size rapidly toward the aperture. The last whorl is slightly smoothed by the protrusion of the mantle in the region of the anal siphon.

Fig. 4.—*Volutilithes petrosus* Con. Eocene. Bell's Landing, Ala. Diameter of shell at last whorl = 33 mm. Apical view of old individual exhibiting extreme senile characters, such as the passage of the shoulder angle spines into a shoulder keel, encroachment of the anal siphon upward, and the shelly overgrowth produced by the protrusion of the mantle in the region of the anal siphon.

Fig. 5.—A different view of the above individual. Length = 56 mm. Here the senile characters mentioned under Fig. 4 show up still more plainly, especially the passage of the shoulder angle spines into a shoulder keel.

Fig. 6.—*Ecphora quadricostata* Say. Miocene. St. Mary's River, Md. Length = 24 mm. Normal young individual.

Fig. 7.—*Ecphora quadricostata* Say. Miocene. St. Mary's River, Md. Length = 23 mm. Example of adventitious senility. Young individual which has been injured early in life and senile characters appear early. Tendency toward loose coiling is well marked.

Fig. 8.—*Ecphora quadricostata* Say. Miocene. St. Mary's River, Md. Length = 76 mm. Normal adult individual exhibiting tendency toward loose coiling.

PLATE XXXI, fig. 9.—*Fulgur canaliculatum* Say. Recent. Atlantic City, N. J. Length = 170 mm. Normal adult individual.

Fig. 10.—*Fulgur canaliculatum* Say. Recent. Longport, N. J. Length = 168 mm. Adult individual which has been injured early in life and exhibits extra-specific adventitious senility.

Fig. 11.—*Fulgur pyrum* Dillw. Recent. Cards Sound, Dade County, Fla. Length = 81 mm. Normal adult individual. Introduced for comparison with fig. 10.

Fig. 12.—*Fulgur maximum* Con. Miocene. Yorktown, Va. Length = 165 mm. Adult individual exhibiting extreme senility—very heavy thick shell, irregular growth lines, discontinuous ornamentation and a large swelling on the anterior or branchial siphon.

NOTES ON SOME ARCTIC FISHES, WITH A DESCRIPTION OF A NEW ONCOCOTTUS.

BY HENRY W. FOWLER.

Dr. Milton J. Greenman, of the Wistar Institute of Anatomy, in Philadelphia, has submitted a small collection of Arctic fishes for my examination. The specimens were all obtained in northern Alaska by Mr. E. A. MacIlhenny while at Point Barrow.

SALMONIDÆ.

Coregonus kennicotti Jordan and Gilbert.

Milner, in Jordan and Gilbert, Bull. U. S. Nat. Mus., No. 16, 1882, p. 298. Fort Good Hope, British America, and Yucon River, Alaska. (J. Kennicott. Types Nos. 8,971 and 9,600, U. S. N. M.)——Fowler, Science, XXI, 1905, p. 315.

Coregonus nelsonii Fowler, Proc. Amer. Philos. Soc. Phila., XLIII, 1904, p. 451, Pls. 8 and 9. Meade River and Point Barrow, Alaska. (Not of Bean.)

Four large examples from Meade river and Point Barrow, Alaska. These I had previously recorded wrongly under the name *Coregonus nelsonii,* as now appears from an examination of more material. Dr. Smith has figured *C. kennicotti,*[1] which will be found to agree largely with this account. At Point Barrow Mr. MacIlhenny's notes indicate that *C. kennicotti* is known as 'Anocta.'

Coregonus nelsonii Bean. Fig. 1.[2]

Proc. U. S. Nat. Mus., VII, 1884 (1885), p. 48. Naulato, Alaska. (Mr. E. W. Nelson. Type No. 29,903, U. S. N. M.)

Head 5; depth $3\frac{4}{5}$; D. IV, 10, I; A. IV, 11, I; P. I, 14; V. I, 10; scales 74 in lateral line to base of caudal, and 4 more on latter; 10 scales obliquely back from origin of dorsal to lateral line; 9 scales between origin of ventral and lateral line in a vertical series; 8 scales obliquely forward to lateral line from origin of anal; about 40 scales before dorsal; width of head $1\frac{2}{3}$ in its length; depth of head $1\frac{1}{2}$; snout 4; eye $5\frac{1}{5}$; maxillary $3\frac{1}{3}$; interorbital space $3\frac{1}{6}$; least depth of caudal peduncle $2\frac{2}{5}$; length of base of dorsal $1\frac{5}{7}$; of anal $1\frac{3}{5}$; length of upper caudal lobe (damaged) about 1; pectoral $1\frac{2}{5}$; ventral $1\frac{2}{7}$.

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[1] *Rep. U. S. Fish Comm.*, XX, 1894 (1896), p. 294, Pl. 15.

[2] The accompanying figure represents a male without the characteristic hump.

Body elongate, well compressed, and greatest depth a little before first third in total length of fish, profiles sloping gradually and evenly back from this point to caudal peduncle. Upper profile before dorsal very convex or gibbous so that back is well elevated in this region. Caudal peduncle compressed, and its least depth about $1\frac{1}{3}$ in its length.

Head small, rather broad, compressed, upper profile strongly concave to occiput and lower nearly straight and but little inclined. Snout rather long, convex above, obtuse, rounded, and produced beyond upper jaw. Eye circular, supraorbital infringing a little on its upper anterior margin, and center of pupil only slightly behind first third in length of head. Adipose eyelids well developed.

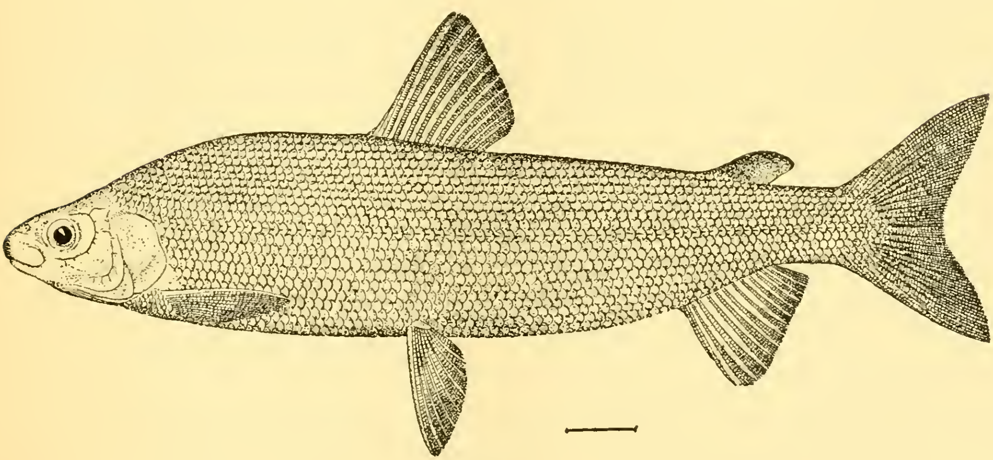

Fig. 1.

Mouth small, inferior, and transverse. Maxillary broad, reaching a trifle beyond front margin of orbit, and its greatest expansion about half of orbit. Jaws rather obtuse, mandible a little posterior. No teeth. Tongue thick, rounded, obtuse, and hardly free. Nostrils lateral on snout about midway in its length, adjoining, and anterior with an elevated cutaneous rim. Interorbital space broad and a little convex with a distinct median longitudinal ridge. Margin of preopercle entire. A number of mucous tubes on cheek and preopercle. Opercle with rather indistinct striæ. Gill-flap rather narrow.

Gill-opening extending forward about opposite posterior margin of orbit. Rakers 9 + 13, pointed, rather strong, and longest a trifle less than length of longest filaments. Filaments long, equal to orbit. Pseudobranchiæ about equal to gill-rakers. Isthmus broadly triangular. Branchiostegals 8.

Scales cycloid, mostly of even size, and in parallel longitudinal series. Head and fins scaleless, except base of caudal, where scales are small and crowded. Small scales on base of adipose fin, outer or free portion scaleless. Lateral line median, continuous and nearly straight to base of caudal. Tubes simple.

Dorsal inserted well forward, its origin much nearer tip of snout than base of caudal, first branched rays longest and others graduated down. Adipose dorsal over anal, its origin nearly midway between that of dorsal and tip of upper caudal lobe (damaged), and height of fin about $\frac{1}{3}$ in length of its base. Anal similar to dorsal, its origin a little nearer base of caudal than origin of ventral, first branched ray highest and others graduated down. Caudal deeply emarginate, lobes distinct and evidently pointed. Rudimentary caudal rays well developed. Pectoral low, small, lobate, and reaching about half way to ventral. Ventral inserted about opposite base of second dorsal ray, first branched ray longest and when depressed fin reaches half way to anal. Vent close before origin of anal.

Color in alcohol plain brown, back with a rather olivaceous cast and each scale at its junction with one below a little darker than general body color so that many longitudinal bands are formed, most pronounced or distinct on back and upper sides. Fins plain brownish, dorsal and caudal dusky. Iris slaty.

Length 16 inches.

In all, three examples from Point Barrow. The one described above is the only one with a well-developed hump. The hump cannot always be considered a character of the adult male, as the example described is but two inches longer than another example without the hump, which is also a male. This I have figured. Both have the milt little developed. The small male also shows the depth about $4\frac{1}{5}$. A female, but little smaller than the male, agrees with the hump-back male in depth, but this is due to the deeper abdomen as the predorsal region is not especially gibbous. The comparisons, etc., of these three examples will now be seen as follows: Head $4\frac{3}{4}$ to $5\frac{1}{4}$; depth $3\frac{3}{4}$ to $4\frac{1}{5}$; D. IV, 10, I to IV, 11, I; A. IV, 11, I to IV, 12, I; scales 73 to 79 in lateral line to base of caudal and usually 4 more on latter; rakers 8+13 to 8+15, usually 14 on lower part of first arch; total length of body (caudal damaged) 14 to 16 inches.

This species attains some size. The type, figured by Mr. Nelson, is 18 inches in length. The examples examined by Dr. Scofield, and those before me, are all smaller, and thus the number of gill-rakers in the original account (26) may be due to age. Dr. Scofield's range from 18 to 22,[3] while my specimens show 21 to 23. The scales on the type of *Coregonus nelsonii* are given as 88. This may be verified as a lateral count by consulting Mr. Nelson's figure,[4] though it is evident that the last 3 or 4 are on the base of the caudal.

As suggested by Dr. Boulenger, *Coregonus richardsonii* Günther[5] would appear to agree best with *C. nelsonii*, and in view of our present knowledge, the discrepancies in the lateral line and gill-rakers may now be accounted for. I hesitate, however, to unite these species until Dr. Günther's examples are more carefully studied, aside from the absence of locality.

Argyrosomus pusillus (Bean).

Head $4\frac{3}{4}$; depth $4\frac{2}{5}$; D. III, 9, I; A. II, 11, I; scales 84 in lateral line to base of caudal and 3 more on latter; snout $4\frac{1}{2}$ in head; eye $4\frac{1}{4}$; maxillary 3; interorbital space $3\frac{7}{8}$; least depth of caudal peduncle $2\frac{1}{2}$. Gill-rakers 16+28. Length of head from occiput to tip of snout a little less than half of distance from occiput to origin of dorsal. Length $12\frac{3}{4}$ inches. Meade river. November, 1897.

Only one example which agrees with Dr. Smith's figure,[6] especially in the dark or brownish spots. These are also distinct on the dorsal.

THYMALLIDÆ.

Thymallus signifer (Richardson).

Dr. Horace Jayne kindly forwarded the following of Mr. MacIlhenny's notes concerning this species. These refer to a large example taken in the Meade river, October 9, 1897. "Entire dorsum dark bronze-purplish, gradually fading on sides to lighter bronze toward ventral side and chest to plumbeous-white on abdomen. Two rusty stripes beginning just below bases of pectorals extending to bases of ventrals sharply separate the white area of abdomen from bronze of sides. Tail, anal and pectorals bluish. Ventrals with six or seven nearly perfect longitudinal reddish-brown streaks. An irregular patch of dark spots extends from angle of opercles and pectorals back till about opposite base of ventrals, sometimes nearly absent. Membranes of dorsal bluish, rays light brown. Mem-

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[3] *Fur Seals N. Pac.* (Fish. Arct. Alask.), III, 1899, p. 494.
[4] *Rep. Nat. Hist. Coll. Alaska*, III, 1887, p. 314, Pl. 20.
[5] *Cat. Fish Brit. Mus.*, VI, 1866, p. 185.
[6] *Rep. U. S. Fish Comm.*, XX, 1894 (1896), p. 312, Pl. 23.

branes of dorsal between seventh to twelfth rays spotted with reddish-brown and spots increasing in size, number, brightness and irregularity of outline from front to rear."

Five examples.

COTTIDÆ.

Oncocottus hexacornis (Richardson).

In all six examples, largest 9 inches long. They all appear to differ in the aggregate of characters from the form which I shall indicate as *Oncocottus hexacornis gilberti*. They are apparently all much broader than in the latter, the preopercular spines are all comparatively shorter, the coloration darker, the cranial osseus excrescences usually not so highly developed, and certain sexual characters are apparently well marked. A small male about 6 inches in length shows the membranes between the dorsal rays deeply scalloped, thus resembling Dr. Scofield's figure.[7] This fin, however, is more spotted or blotched with white. There are also two very distinct white transverse bands on the caudal, though a little further out from the base than his figure shows. In other respects, such as the small cranial protuberances and more pronounced markings on the pectoral, at least five transverse blackish bands. The more distinct color markings seem to be a character of small or young examples. The larger examples are females and agree better with most figures. They have the second dorsal entire. All from Point Barrow, one was found chilled on the beach August 29, 1897.

Oncocottus hexacornis gilberti subsp. nov. Figs. 2[8], 3[9], 4[8] and 5[8].

Head 3; depth $6\frac{2}{3}$; D. VIII–14; A. 15; P. 16; V. I, 3; 29 distinct and well-developed pores in lateral line; width of head a little less than $1\frac{1}{2}$ in its length; depth of head $2\frac{1}{2}$; snout $4\frac{1}{6}$; eye $4\frac{2}{3}$; maxillary $2\frac{1}{5}$; interorbital space 7; width of mouth $2\frac{1}{3}$; length of depressed spinous dorsal $1\frac{2}{3}$; third dorsal spine 3; length of base of second dorsal $1\frac{2}{5}$; fourth dorsal ray $1\frac{1}{2}$; sixth anal ray $2\frac{2}{5}$; length of caudal $1\frac{2}{3}$; least depth of caudal peduncle $9\frac{3}{4}$; length of pectoral, from base of uppermost ray, $1\frac{1}{10}$; length of ventral $1\frac{3}{4}$.

Body depressed, elongate, but more slender when viewed from above than that of *Oncocottus hexacornis*. Greatest depth apparently at middle of belly, and greatest width apparently at lower posterior angle of preopercle. Caudal peduncle slender, its least

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[7] *Fur Seals N. Pac.* (Fish. Arct. Alask.), III, 1899, p. 501, Pl. 68.
[8] Female.
[9] Male.

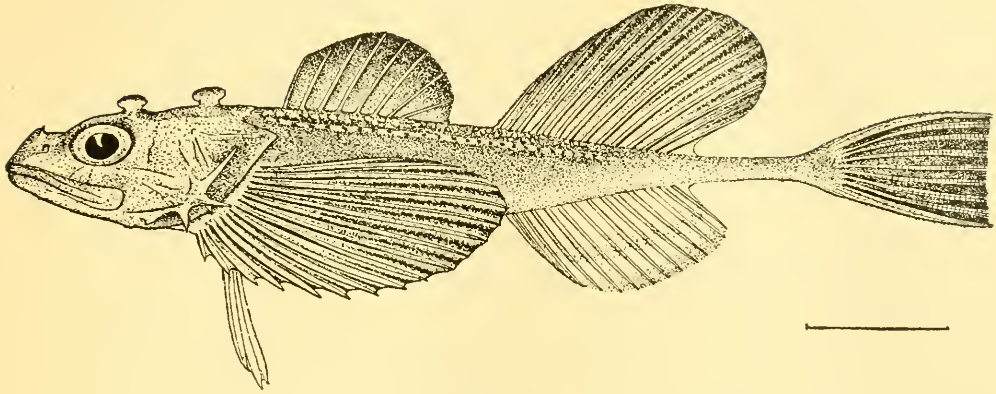


Fig. 2.

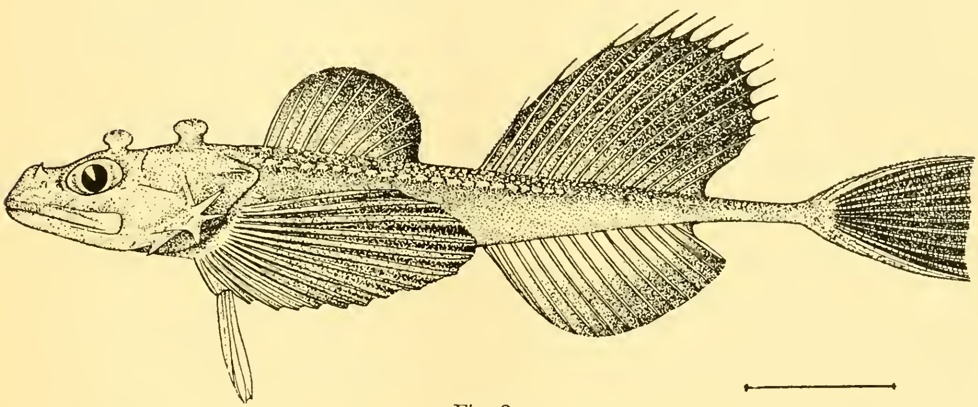


Fig. 3.

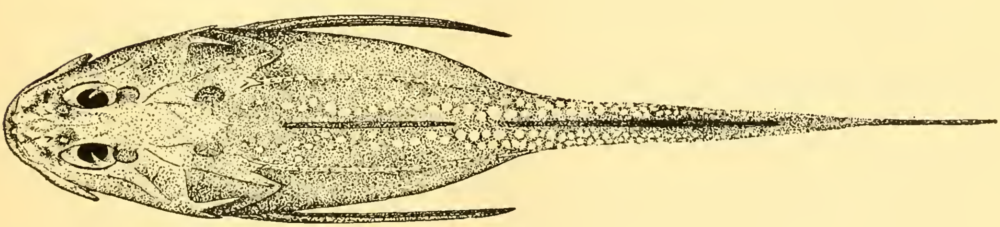


Fig. 4.

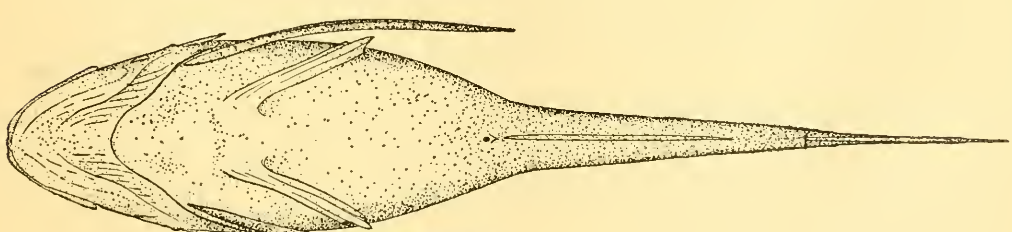


Fig. 5.

width about $\frac{2}{3}$ of least depth and least depth about $4\frac{1}{5}$ in its length.

Head rather deep, more elevated in proportion than that of *O. hexacornis.* It is also decidedly more narrow or angular when seen from above. Snout rather short, blunt, rounded above, or more rounded than in *O. hexacornis.* Upper jaw protruding a little and also produced a little beyond mandible. Eye large, impinging on upper profile, a little longer than deep, and its posterior margin a little before center in length of head. Mouth large, corner or gape extending till about opposite anterior margin of pupil. Lips a little fleshy. Maxillary long, reaching about opposite posterior margin of pupil, and its distal expanded extremity equal to about $\frac{3}{7}$ of horizontal orbital diameter. Teeth rather large, conic, coarse, and in bands in jaws. A patch also on vomer, though none on palatines or on tongue. Tongue broad, thick, triangular and rounded tip free. Buccal flaps rather narrow. Head cavernous, and with rather prominent ridges. Nostrils with rather broad cutaneous rims, anterior on side of snout and in about last third of its length. Posterior nostril large, in interorbital space just before anterior margin of orbit, and its margin large. Interorbital space narrow and concave, $1\frac{1}{2}$ in orbit. Nasal spines 2, well developed, close together and curving a little back. An osseous scabrous postorbital process of large size on each side and another similar one on each side, only larger, in occipital region. Opercular spines 3, upper two close together and both directed back. Lower opercular spine just below second preopercular spine and directed down. Preopercular spines 4, large, uppermost longest or about $\frac{7}{8}$ of horizontal orbital diameter and directed obliquely up and back, also perfectly straight. Third preopercular spine inclined a little down and second vertical. First opercular spine broad and directed forward. Two humeral spines behind upper opercular spine, and 1 axillary spine just above base of uppermost pectoral ray. Mandible cavernous. Ridges on head all more or less rounded. Gill-flap not broad.

Gill-opening rather large, extending forward till about opposite middle of orbit. Rakers rather broad asperous tubercles, 1+6 on first arch. Filaments well developed, about equal to $\frac{3}{5}$ of horizontal orbital diameter. Isthmus broad and flattened. Branchiostegal rays 6.

Body covered with smooth skin. Head with exception of spines and processes covered with smooth skin. On back on each side of median line an irregular double series of scabrous tubercles extending from neck to upper part of caudal basally. Upper edge of pectoral, of second dorsal, both upper and lower edges of caudal and also outer portions of rays of last two fins more or less scabrous. Lateral line distinct till below last dorsal rays, of elevated continuous tubes with pronounced pores at regular intervals and most developed anteriorly.

Origin of spinous dorsal midway between tip of snout and base of sixth dorsal ray, fourth spine longest and others graduated more or less down, edge of fin rounded. Origin of second dorsal about midway between tip of snout and tip of caudal. Fifth dorsal ray longest, several others immediately following subequal and others graduated down with edge of fin rounded. Anal inserted a little in advance of second dorsal, median rays longest, and margin of fin rounded. Caudal truncate, with 6 branched rays, and corners posteriorly a little pointed. Pectoral large, reaching vent, fourth ray longest, and base of first ray about opposite second spine on preopercle. Ventral rather long, second ray longest, and reaching $\frac{4}{5}$ of distance to vent. Vent large, close in front of anal.

Color in alcohol mostly more or less uniform brown above, lower surface paler. Head a little paler brown than trunk. Flanks or upper side of back tinged with dusky. Fins all brownish and ventrals paler or like belly. Dorsals paler basally, outer portions of membranes dusky. Caudal similar. Anal pale brownish, marked on membranes medianly and marginly with brownish so that two rather ill-defined longitudinal bands are formed. Pectoral pale basally, especially lower rays, and distally between each ray on membrane usually a longitudinal dusky streak. Ventral plain. Iris slaty.

Length 7 inches.

Type No. 7,203, W. I. A. P. ♀. Point Barrow, northern Alaska. November 21, 1897. E. A. MacIlhenny. Also another smaller example, paratype, with same data. It is a ♂. It differs a little in the armature of the opercle as the spines are a little shorter. The upper margin of the second dorsal is also not deeply scalloped, like that of male examples of *O. hexacornis*, the free ends of each ray being only a short slender filament. The anterior margins of the first dorsal rays are a little more scabrous. In most every other respect it agrees more or less, the color markings varying a little perhaps. The differences are best appreciated by a comparison of the figures.

Upon comparison with examples of *O. hexacornis* of similar size, the characters indicated by Dr. Scofield for the "*Oncocottus sp. incog.*" which he mentions from Point Barrow are found to disagree.

There is little to separate these two examples from *O. hexacornis*, save perhaps in the more compressed body, slightly notched second dorsal of the male, more narrow interorbital space, and longer or slender caudal peduncle. The coloration of *O. h. gilberti* is perhaps also paler in life as the examples are decidedly so at present, having been in the same preservative. At any rate, I provisionally retain them as distinct.

(Named for Dr. Charles H. Gilbert, of the Chair in Zoölogy in the Leland Stanford Junior University, whose valuable contributions to ichthyology may easily be identified by their thorough excellence and accuracy of detail.)

GADIDÆ.

Boreogadus saida (Lepechin).

Three examples from Point Barrow. Largest $7\frac{1}{4}$ inches.

Lota maculosa (Le Sueur).

Two examples from the Meade river. October 9, 1897. Larger about $20\frac{1}{2}$ inches. Pectoral not reaching front of dorsal, $1\frac{4}{5}$ in head.

DESCRIPTION OF A NEW SPECIES OF COMMENSAL CRAB.

BY MARY J. RATHBUN.

The crab here described as new was submitted to me for determination by Dr. H. A. Pilsbry. It differs from other American species in its great breadth, and in the form of the maxillipeds, the carpal and propodal segments of which are unusually short.

P. strombi. Dorsal and ventral views of type, ♀, × 2.

Pinnotheres strombi sp. nov.

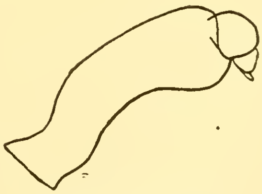
Description of adult ♀.—Carapace nearly one and a half times as broad as long, oblong, sides parallel, corners rounded; dorsal surface curving down toward the margins, smooth and naked; integument very thin and easily wrinkled.

Front less than one-fourth width of carapace, strongly bent down, margin forming an oblique angle at middle.

Orbits suborbicular, eyes partly visible in dorsal view.

Antennules nearly horizontal.

Outer maxillipeds oblique, the penult and antepenult joints short and stout, the last joint small and almost terminal.



Outer maxilliped, much enlarged

Chelipeds small, rounded; upper margin of propodus convex, lower margin sinuous; fingers deflexed, about half as long as palm, stout, fitting close together, tips sharp and crossing.

Second pair of ambulatory legs a little the longest, first pair stoutest, fourth pair much shorter and narrower than the other three. Dactyli short, strongly curved, stout at base, tapering to slender horny tips.

Abdomen as wide as carapace, and about as long as wide.

Edge of front, anterior margin of merus of first three ambulatories, and lower margin of carpus of first ambulatory, fringed with short dense pubescence, as are also the lower surface of the carapace and the edge of maxillipeds and abdomen.

Dimensions.—Width of carapace, 9.6 mm.; length, 6.6 mm.

Type locality.—Taken from a living *Strombus pugilis* Linnæus, at Clearwater Harbor, Florida, by Mr. H. S. Colton, 1905; one female. Type in Museum of the Academy, No. 1,629 of the collection of Crustacea.

SOME MARINE OLIGOCHÆTA OF NEW ENGLAND.

BY J. PERCY MOORE.

That the study of the littoral Oligochæta of the eastern United States has been much neglected becomes evident when it is mentioned that but four original references to the subject occur in the literature, and three of these are very brief diagnoses of species. The first is found in Prof. Leidy's *Contributions to the Marine Invertebrate Fauna of Rhode Island and New Jersey,* published in 1855, where *Lumbriculus tenuis* is described from specimens taken at Point Judith, Rhode Island. In 1863, Minor gave a quite recognizable description in the *American Journal of Arts and Sciences* of his *Enchytræus triventralopectinatus,* taken near high-water mark at New Haven, Connecticut. In 1873, in the *Report upon the Invertebrate Animals of Vineyard Sound,* Prof. Verrill describes as new *Clitellio irrorata* and *Halodrillus* (gen. nov.) *littoralis.* The first three of these have not since been reported by any other observers, but the last was carefully studied and its anatomy described in a *Bulletin of the Illinois State Laboratory of Natural History* for 1895 by Smith, who establishes its identity with a widely distributed species of *Enchytræus.* Michaelsen, in his *Monograph of the Oligochæta,* recognizes the close resemblance between Minor's species and the well-known *Paranais littoralis* of Europe. The remaining two species have been noticed repeatedly by monographers and systematic writers who have been unable to arrive at any satisfactory conclusions as to their status.

While engaged in studying *Polychæta,* chiefly in the region about Wood's Hole, Massachusetts, but also at other points on the New England coast, for several years past, the writer has collected a number of species of littoral *Oligochæta* which, besides permitting the identification of the previously recorded species with certainty, except in the case of *Lumbriculus tenuis,* embrace several interesting additions to our known fauna. Minor's *Enchytræus triventralopectinatus* proves to be *Paranais littoralis,* as supposed by Michaelsen; *Lumbriculus tenuis* Leidy is almost certainly *Clitellio arenarius* (Müller); *Halodrillus littoralis* Verrill is *Enchytræus albidus* Henle; and *Critellio irrorata* Verrill is a composite of *Tubifex irroratus* (Verrill), *Tubifex benedeni* Udekem and

Clitellio arenarius Müller. To the latter conclusion I have been much assisted by Prof. Verrill's great kindness in sending to me for study his entire collection of marine oligochætes, including many bottles labelled by him as *Clitellio irrorata*. Although this material was collected from 25 to 30 years ago, and had since been subjected to all of the vicissitudes of preservation in small vials of alcohol, it was possible to determine most of the specimens, and as a result to considerably extend the known range along our coasts of several species. For this privilege I am much indebted to Prof. Verrill.

In the present paper are noticed ten species representing three families, as follows: Naiidæ, *Paranais littoralis;* Tubificidæ, *Clitellio arenarius*, *Monopylephorus glaber*, *M. parvus*, *Tubifex irroratus*, *T. benedeni*, *T. hamatus* and *Limnodrilus subsalsus;* Enchytræidæ, *Enchytræus albidus* and *Lumbricillus agilis*. Of these *P. littoralis*, *C. arenarius*, *M. parvus*, *T. benedeni* and *E. albidus* are European species, but only the first and last have hitherto been recognized on our shores. *Tubifex irroratus* is the residuum of Verrill's *C. irrorata* and the remaining four are new, but have more or less closely related representatives in other parts of the world. It needs to be remarked that very few of these worms are really marine; they are more or less recent migrants from a rich limicoline or terrestrial oligochæte fauna. The naids and tubificids are derivatives of the former which have been carried down the streams into bays and estuaries and have spread through the brackish waters and along the littoral zone. In their new habitat they have undergone modifications that are sometimes considered to have generic value. A case of especial interest is that of the brackish water *Limnodrilrus subsalsus*, which is the only species of this large genus that has been recorded as occurring out of fresh water. As pointed out in the systematic part of the paper, especially under *Monopylephorus glaber*, some of the tubificids burrow in soil saturated with fresh water from springs, and are experimentally shown to take more kindly to pure fresh water than to salt water of sea density. The enchytræids are more particularly strand forms which inhabit the marine vegetation thrown by the waves upon the beach. They enter the littoral zone, but are often found in large numbers quite above the reach of the waves at high tide, particularly during rain storms. They are undoubtedly derived from terrestrial or amphibious forms that have found a favorable environment on the seashore. *Enchytræus albidus*, at least, is found in garden and wood soil also, but may have been introduced through the use of eel grass for fertilizer.

The species of Tubificidæ described in this paper, as well as some of those described recently by other authors, tend to traverse some of the generic boundaries usually set up and to obscure their limits. *Tubifex* is here employed in a broad sense, and it will be noticed that *T. irroratus* approaches *Monopylephorus* in many respects and removes that genus from the isolated position that it has been considered to occupy. This species resembles *Monopylephorus* in its valvular and moniliform blood-vessels, the form of its nephridia and the short sperm ducts with diffuse prostate glands. On the other hand, the paired genital orifices, the well-developed penes and the capillary setæ in the dorsal bundles are characters of *Tubifex*. Ditlevsen has referred to *Monopylephorus* a species (*M. trichochætus*) having all of these characters except the penes. The supposed great gap between these genera is thus bridged by two species. On the other hand, *Tubifex hamatus*, which is in most respects a typical *Tubifex* of the *Psammoryctes* group, appears to lack capillary setæ altogether. Some of our forms here referred to European species exhibit slight departures from the published descriptions, and it is possible may prove to be distinct when actual comparison of specimens from both places comes to be made. Besides the species described in this paper my collections include several others represented only by immature specimens, from which the characters of the reproductive organs cannot be ascertained.

The following key will facilitate the determination of species noticed in this paper:

A.—Asexual reproduction by serial budding and fission.
- B.—Spermathecæ in V; setæ all hooked and bifid, the dorsal bundles beginning on V; size very small, *Paranais littoralis.*

AA.—Reproduction normally by the sexual method only.
- BB.—Spermathecæ in V; setæ all with simple (not bifid) tips and dorsal bundles beginning with the ventral on II; male pores on XII.
  - C.—Setæ ∫-shaped; blood yellowish; testes deeply lobulated, *Lumbricillus agilis.*
  - CC.—Setæ straight, with hooked internal ends; blood colorless; testes not subdivided, . *Enchytræus albidus.*
- BBB.—Spermathecæ in X; setæ more or less distinctly bifid at the tips and of various forms, often associated in the dorsal bundles with capillary setæ; male genital pores on XI.
  - D.—Male genital pores and spermathecal pores paired; penes present.
    - E.—Atrium simple; no special prostate gland; spermathecæ reaching into XI when fully developed, ... *Clitellio arenarius.*

EE.—Atrium divided into penis sac and sperm reservoir, the latter with a special prostate gland; spermathecæ confined to X.

F.—Sperm ducts long and slender; prostate glands massive.

G.—Cuticle more or less completely covered with flattened papillæ; capillary setæ present or absent; no copulatory setæ, *Tubifex benedeni.*

GG.—Cuticle without papillæ; capillary setæ always(?) absent; posterior dorsal setæ enlarged and strongly hooked; copulatory setæ present on X, ... *Tubifex hamatus.*

GGG.—Neither cuticular papillæ, capillary setæ, nor copulatory setæ present; vas deferens very long and penis sac very complex, with spirally wound muscular coats and a trumpet-shaped chitinoid penis sheath, *Limnodrilus subsalsus.*

FF.—Sperm ducts short and wide; prostate glands diffuse.

H.—Penes present; genital pores paired; capillary setæ present. *Tubifex irroratus.*

DD.—No penes nor capillary setæ; spermiductal and spermathecal pores median or nearly so; sperm ducts short and wide; prostate glands diffuse.

I.—Spermathecæ paired; setæ all distinctly bifid at tips, *Monopylephorus glaber.*

II.—Spermatheca single; bifurcation of setæ often obsolete, *Monopylephorus parvus.*

Paranais littoralis (Oersted) Czerniavsky.

Nais littoralis Oersted, 1843.
Enchytræus triventralopectinatus Minor, 1863.
Paranais littoralis Czerniavsky, 1880.

This species was described under the name of *Enchytræus triventralopectinatus* as long ago as 1863, from New Haven, Connecticut, by Minor, but appears to have escaped subsequent notice in America. Michaelsen places Minor's species doubtfully among the synonyms of *P. littoralis.* Hitherto budding individuals only have been found, and until the characters of the mature reproductive organs of American examples are known the identity of the latter with the European species cannot be considered as established. Nevertheless, so far as budding worms are concerned, no distinctions can be detected, unless the number of setæ averages somewhat less in American specimens. The prostomium is often slightly pigmented, but there are no eyes. The blood is pale greenish-yellow, and the chlorogogue cells pale brown. The first budding zone usually occurs at XX or between XIX and XX. A second may occur at XXXV, but usually only the first is conspicuously developed. Still attached zooids may possess as many as 28 or 30 segments before the appearance of a second budding zone. In buds nearly ready to become detached both dorsal and ventral setæ occur on all segments. All through July and August active budding continues under natural conditions, but worms kept throughout the autumn at Philadelphia failed to develop genital organs.

Nothing but its small size and mode of occurrence has caused this species to be overlooked for so many years as it is extremely abundant and widely distributed. More than any other species it withstands a wide range of density in the water, being almost equally at home in the rain-soaked eel-grass above high tide, on the shores of brackish ponds and under stones near low-water mark on the exposed shores of Vineyard Sound. Its movements are characterized by frequent quick, nervous turnings and contractions.

Clitellio arenarius (Müller) Savigny.

Lumbricus arenarius Müller, 1776.
Clitellio arenarius Savigny, 1820.
?*Lumbriculus tenuis* Leidy, 1855.
Clitellio irrorata Verrill (in part), 1873.

Of the ten species noticed in this paper the present one is the largest, full-grown examples exceeding two inches in length and a millimeter in diameter at the clitellum. Preserved specimens usually have the mouths of the spermathecæ and the penes protruding in the form of prominent papillæ, as Prof. Verrill has noted in his description. Sexually mature worms are abundant, enabling one to secure cocoons in numbers and to study the anatomy of the genital organs with ease. There is little doubt of the identity of the American and European worms, the only noticeable differences being a slightly greater average number of setæ in ours and an apparently somewhat shorter spermathecal duct than is figured by European authors. No entirely satisfactory figures of the setæ of the European worm have been found, and it is possible that there may be a difference in their form also. The spermathecæ are often filled with large vermiform spermatophores.

The distribution of this form is equally extensive on the European and American sides of the Atlantic. It is excessively abundant in

Casco Bay and northward in Maine, where it occurs under stones and among grass roots up to high-water mark on muddy and gravelly shores. While apparently less plentiful south of Cape Cod, it is common at many suitable points on the shores of Vineyard Sound, Buzzard's Bay, Narragansett Bay and Long Island Sound.

Without being able to decide the matter definitely, it seems extremely probable that this is the species described by Leidy. Although the characters given in the brief description of *L. tenuis* are not diagnostic, they are sufficient to eliminate every other species described in this paper except the brackish water *Limnodrilus subsalsus*, while they all and the character of the habitat, as well, apply to *C. arenarius*. Vaillant, indeed, has already referred *Lumbriculus tenuis* doubtfully to *Clitellio*. Later writers have been more cautious.

In Prof. Verrill's collections this species occurs far more frequently than any other and usually under the name of *Clitellio irrorata*, thus giving the best of authority for the inclusion of the latter in the synonymy. It is this species that is figured under the name of *C. irrorata* in *Trans. Conn. Acad.*, 1881, Pl. VIII, figs. 3 and 3*a*. The localities represented cover a wide extent of coast and, named from north southward, are as follows: Nova Scotia, Bay of Fundy, Casco Bay, Cape Ann, Gloucester, Massachusetts; Salem, Massachusetts; Cape Cod, Vineyard Sound, Wood's Hole and New Haven.

Monopylephorus glaber sp. nov. Plate XXXII, figs. 1–6.

This species is relatively short and stout for a tubificid, the largest examples not exceeding 40 mm., and the usual length of living mature worms being about 25–30 mm., with a diameter of .8 mm. Young examples are relatively much more slender. In mature worms there are from 67–74 segments, and generally they are 4-ringed, bearing the setæ on the third and consequently well behind the middle. The greatest diameter is at the clitellum and genital region, from which the body tapers rapidly to the small pointed prostomium and very gently to the anal somite. The clitellum occupies part of X, all of XI and XII, and sometimes extends on to XIII. Except for the sensory hairs belonging to a zone of cutaneous organs encircling the middle of each somite, the skin is devoid of cuticular pilosities and perfectly smooth. Owing in part to the presence of grayish-brown pigment granules, and in part to the remarkably high peritoneal layer of cells, the body walls are decidedly opaque. The external opening of the genital bursa is a conspicuous median, transversely elongated aperture in the setæ zone on the venter of XI. The female pores are paired in the furrow

$\frac{XI}{XII}$, and the spermathecæ open close together in a common depression just behind furrow $\frac{IX}{X}$.

The general color varies from pinkish in young worms to brown or purple in fully grown ones, in which the color is due to a combination of the rose of the blood with the brown of the chlorogogue cells, the opaque white of the cœlomic corpuscles, the dark contents of the intestine and the pigment of the skin. Anteriorly the color remains pink or, through the accumulation of cœlomic corpuscles, becomes opaque white. When, as in certain individuals, the latter are very numerous, they impart a characteristic whiteness and opacity to the entire worm.

The setæ are all of the usual short, bifid, hooked form (fig. 4), with a deeply cleft tip and the terminal process somewhat longer and more slender than the widely divergent basal one. The portion of the seta external to the body wall is peculiarly thickened, but otherwise presents no characteristic features. In each bundle the inner setæ are somewhat the longer and those of ventral bundles slightly exceed the dorsal, but no marked differences are anywhere noticeable. As usual, the ventral bundles of XI are wanting. From II to XI 4 or 5 is the prevalent number in each bundle, the last being most usual in the ventral bundles, though they occasionally contain 6. Behind the clitellum 3 is usual in the ventral, 2 in dorsal bundles, and both may become reduced to one toward the posterior end.

Owing to the opacity of the body walls and the profusion of cœlomic corpuscles in mature worms the internal anatomy is difficult to work out upon living subjects, though practically all of the results of the study of sections have been confirmed upon living material and dissections. The spherical cœlomic corpuscles (fig. 5) are from .009 mm. to .0125 mm. in diameter, and filled with a comparatively small number of spherical granules measuring .0025 in diameter, and whose opacity and whiteness gives to the corpuscles their characteristic aspect. Among these corpuscles are seen a few filled with very much smaller granules which appear to be budded from the high peritoneal cells.

No unusual features are presented by the alimentary canal. The pharyngeal region is very small, though its glands extend diffusely to V or VI; the simple intestine is regularly and prominently sacculated, especially behind the intestine, and except in the genital region, where they are slightly developed, and in somites IV and V, in which they make their appearance, is thickly enveloped in chlorogogue cells, which largely conceal the dorsal vessel also.

As in all members of the genus hitherto described, the vascular system presents a well-developed integumental plexus on the lateral arches and a remarkable system of unicellular valves. The ventral vessel is free from the intestine, without sacculations and without valves. It bifurcates in III, but is usually reunited in II by an asymmetrical commissural vessel, from which a small azygous vessel arises. The dorsal vessel is contractile, sacculated and provided with a set of valves at each constriction throughout its entire length as far forward as somite III. Although its anterior end is largely free from the intestine, it retains a covering of chlorogogue cells as far as somite IV and bifurcates only on reaching II. A pair of small lateral arches without valves arises in I, and after dividing each joins the here double ventral vessel. Beginning with III, the arches spring from the dorsal trunk at the posterior ends of the somites just anterior to the valvular constrictions. They reach to the body walls, which they enter and then divide into a complex integumental network emptying into the ventral vessel by two trunks in each somite, while the plexuses of contiguous somites are united by a longitudinal connecting vessel. The network is similar to that of *M. pilosus*, but appears to be somewhat more open. The lateral contractile trunks increase in size to X, one of which loops into the sperm sac, while one in XI forms a rich plexus within the ovisac. Behind XI they become much smaller, but continue to form integumental plexuses which join the ventral vessel by two trunks. The arches from III to XI are moniliform and provided with valves at each constriction. That in III contains one set of valves, IV 2 sets, V 2 or 3 sets, VI and VII 3 or 4 sets, and in VIII to XI 5 or 6 sets—numbers which, while occasionally varying, are remarkably constant. In the larger arches the two primary branches also may each contain a set of valves.

The brain (fig. 3) has a peculiarly lobulated surface and is broad and very deeply incised anteriorly, somewhat narrower and scarcely emarginated posteriorly, where the muscular sheath is produced into a pair of contractile strands, between which the dorsal vessel passes. Ordinarily the brain is about $\frac{1}{4}$ longer than broad, but the proportions vary greatly with the state of contraction and extension of the worm.

Nephridia (fig. 2) begin in VII with their nephrostomes opening into VI; none is present in X and XI, though a pair communicating with the latter is frequently developed in XII. In young worms, in which the transparent body wall permits the nephridia to be readily studied, they are absent from many somites and developed on one side only of others, but in full-grown worms few segments, except at the posterior region, lack them. The funnel is small, with the prolonged lip or tongue more slender and elongated than in *M. pilosus*. It passes into a short neck, which penetrates the septum and joins an irregular massive region in which the canal is much folded, with granular coalesced walls and irregular lumen in the anterior part, while in the posterior part the lumen becomes more regular and provided at intervals with ciliated ampullæ. From this portion an elongated lobe passes caudally and medially along the ventral blood-vessel. In this lobe are four canals arranged in two loops, the proximal one of which contains ciliated ampullæ, while the distal one lacks cilia and, after returning to the massive region, passes into a large thick-walled efferent canal, the lumen of which exhibits a few irregular lateral diverticula, and which finally opens to the exterior by a pore situated a short distance anterior to the ventral setæ bundles.

The reproductive organs agree closely with what is known of other members of the genus. A pair of testes suspended from the posterior surface of the septum $\frac{IX}{X}$ fill not only the cœlome of X, but large anterior and posterior sperm sacs. The former is a short, wide, nearly spherical diverticulum from the septum $\frac{IX}{X}$ which arises dorsal to the intestine and projects forward when fully developed to the septum $\frac{VIII}{XI}$. The posterior sac is much longer and, arising from the septum $\frac{X}{XI}$ above the intestine, accompanies, but usually does not enter, the ovisac to about somite XIII or XIV. In young worms there are two, but later one disappears. Before maturity the cavity of the functional one is closed by a transverse diaphragm which prevents the vascular arch from entering more than a short distance.

The large sperm funnels rest on the floor of X against the posterior septum, which is perforated on each side of the nerve cord by the short vasa deferentia, which then bend laterally and each expands into a slightly enlarged region covered completely by a continuous layer of rather small prostate gland cells. This region—the sperm reservoir—bends upward around the intestine, and at the highest point passes into a short ductus ejaculatorius free from glands and opening into the summit of the fusiform penis sac. The latter is provided with a very deep epithelium thrown into rugous folds and relatively thin muscular layers; but there is no trace of a penis. The atria of the two sides open into the lateral portions of the summit of an eversible median bursa, which probably acts to some extent as a substitute for the penis (fig. 1).

Ovaries occupy a position in XI relatively similar to that of the testes in X, and are provided with a median dorsal ovisac which, arising from the septum $\frac{XI}{XII}$ above the intestine, reaches to XVI or beyond. In addition to the ova it receives a vascular network, usually from the left arch of the pair in XI, and sometimes the posterior sperm sac in addition.

Spermathecæ (fig. 6) are nearly always conspicuous even in young worms. They open either very close together or by a common median pore just behind the furrow $\frac{IX}{X}$, and consequently are well forward in the latter somite. They have short, thick, muscular ducts without glands, and ovoid or sometimes nearly spherical ampullæ which when fully distended may reach nearly the length of the somite. When fully distended the lining epithelium is thin and flat and the muscular layer thin, but when nearly empty the former becomes thick and folded, often in a spiral or annular fashion, a condition which usually prevails near the entrance to the duct, where the circular muscular layer is much thickened. The spermatozoa are never fashioned into spermatophores, but fill the ampulla in compact masses and bundles.

This species is closely related to *Monopylephorus rubronivens* Levinsen, to which Ditlevsen has recently referred *Vermiculus pilosus* Goodrich. From this species, as elaborately described by Goodrich, *M. glaber* differs in the entire absence of villous processes on the cuticle, the greater number of setæ, the form of the nephridia and some minor characters of the vascular system, brain, etc.

Another closely related species is *M. fluviatilis* (Ferronnière), but if the sperm ducts are correctly figured for the latter the position of the prostate glands is quite different.

Both Goodrich and Ditlevsen have attached much importance to the form of the nephridia, which they consider to approach the enchytræid type. In *M. glaber* this resemblance is entirely superficial and the arrangement of the tubules is nearly typically tubiciform, their analysis into glandular region, large and small tubule loops being easy.

In suitable localities this species is very abundant about the shores of Vineyard Sound and Buzzard's Bay. It prefers regions overlaid by a layer of fine organic mud in places where there is an accumulation of decaying eel grass or other vegetable matter, and especially where the salt water is diluted by springs or streams of fresh water. In such places it occurs in enormous numbers beneath stones or a short distance below the surface, while in nearby spots, where the water is of much greater density but the conditions otherwise similar, few or none will be found. Nowhere in this region have these worms been found in greater numbers or of such large size (mostly exceeding 40 mm. in length and 1 mm. in diameter) as along the gravelly and muddy banks of the Wareham river, a small stream emptying into the head of Buzzard's Bay. Here under stones near high water-mark, at a point where saltness of the water is just barely discernible to the taste, enormous numbers occur quite unmixed with other species. If placed in pure salt water of the density found in Vineyard Sound these worms die much sooner than if placed in fresh water, but may be acclimatized to either by gradual changes. In brackish water they have lived and bred in confinement in Philadelphia for seven months, and are now, after this lapse of time, as vigorous as ever. That they are partial to low rather than high densities is shown by the observation that those living on the shores of the Eel Pond at Wood's Hole, at a point where fresh water oozes from the ground below high-water mark, burrow deeper toward the source of the spring when the tide rises and covers their habitation, and come to the surface when it falls. Other favored localities are certain shallow and nearly closed coves where great quantities of eel grass and algæ accumulate and decay in water diluted by rains. Here under small stones below half-tide mark the species associates with *Tubifex irroratus* and *Lumbricillus agilis*, though the latter is far more plentiful in the decaying eel grass at a higher station on the shore, and the former prefers the roots of salt grasses growing on more gravelly shores. Though not active in their movements, they are less sluggish than the *T. irroratus* and far more hardy than that species. From the latter part of July, at least, onward this species breeds, and some specimens brought to Philadelphia continued sexually active throughout the fall and into winter. When breeding they are especially active and congregate in such numbers beneath stones that they impart a quite red color to the surface of the soil when exposed by turning over the stones.

Monopylephorus parvus Ditlevsen. Pl. XXXIII, figs. 29–34.

A second small species of *Monopylephorus* is referred to the above species, with which it agrees closely in nearly all of the characters recorded in the original brief diagnosis. Further information may necessitate a separation.

In size and form this species closely resembles *Lumbricillus agilis*, but its distinctly pink color and the opacity due to cœlomic corpuscles, as well as its more sluggish movements, are a ready means of separation. Fixed specimens can be distinguished in many cases only after a careful study, especially as sexually mature individuals are infrequent.

The length is from 8 to 15 mm., the diameter about .4 mm. and the number of segments from 38 to 43. The prostomium is much more slender and pointed than in *M. glaber*, but the somites are similarly quadri-annulate. The number of setæ in each ventral bundle is 3 or 4 anterior to the genital region and 2 posteriorly; in the dorsal bundles usually 5 anteriorly and 2 to 4 posteriorly. The setæ are all small and of the usual form, except that their tips are curiously variable (fig. 29). As the setæ were studied only under the rather unfavorable conditions presented by alcoholic material, it is uncertain how far this may be due to wear. Many of the setæ are undoubtedly broken, but those figured appear to be intact. In some the tips are deeply bifid and the points long and acute; others, especially in the posterior dorsal bundles, have the upper or distal point more or less reduced, and still others have a mere apical notch or are apparently entire.

The cœlomic corpuscles are very numerous and about .012 mm. in diameter, with opaque white granules smaller and more numerous than those of *M. glaber*.

In internal anatomy this species closely resembles *M. glaber*, from which, however, it is easily distinguished by the single spermatheca (fig. 34) which opens in the median line of the furrow $\frac{IX}{X}$, and is usually folded on itself transversely. The atria (figs. 32, 33) also differ in that they join in the middle line before opening into the bursa by a single small pore raised on the summit of a papilla. It will thus be noticed that the primitively strictly paired character of the reproductive organs has been departed from more widely in this than the other species. The prostate and other regions of the male ducts are otherwise as usual. An anterior sperm sac extends through IX, a posterior through XII and XIII, and an ovisac to XVI. The vascular system presents the characteristic valvular and chambered vessels and integumental plexus. The brain (fig. 31) is slender and the anterior lobes much elongated. Nephridia are of the character belonging to the genus, but are slender and elongated and the nephrostomial lip especially narrow and prolonged.

This species has not been found abundantly anywhere. Occasional examples occur with the larger tubificids and with *Lumbricillus*, but it appears to prefer more gravelly shores and the neighborhood of beach grass, among the roots of which it may be found. In a few cases larger numbers were found living gregariously beneath stones at half-tide on the south shore of Naushon. It is quite probable that it has often been mistaken for the young of *M. glaber* or even of *Lumbricillus*.

Tubifex irroratus (Verrill). Pl. XXXII, figs. 7–11.

Clitellio irrorata Verrill (in part), 1873.

The length of this slender species seldom exceeds 30 mm., but the number of somites may equal 90. Most of the examples found in the vicinity of Wood's Hole are not fully mature, and are from 15 to 17 mm. long, with about 70 somites. The prostomium is more acute than in *Monopylephorus*, and the somites are more elongated but similarly ringed. In mature examples the clitellum is developed on X, XI, XII and for a short distance on XIII. A pair of spermathecal pores occurs far forward on X just behind the furrow $\frac{IX}{X}$, and in line with the ventral setæ, the male pores occupy the place of the ventral setæ or a little behind on XI, and the ovipores are minute slits in the furrow $\frac{XI}{XII}$.

In young worms the color is pinkish, but in larger ones becomes deep brownish or purplish-red, often very dark, and in mature worms always very much darker than in *Monopylephorus glaber*, a difference which is probably due chiefly to the fact that the deep color of the chlorogogue cells is untempered by the whiteness imparted by great numbers of peritoneal corpuscles.

The setæ are of two forms, one kind being hooked and bifid and the other capillary and of very characteristic form. Both occur in the dorsal bundles. In preclitellar somites there are usually 2 or 3 or rarely even 4 of the former, with 1 or 2 or occasionally 3 of the latter alternating with, or 1 on the ventral side of each of, the hooked ones. Bundles of the middle region contain 2 hooked and 1 capillary seta, and those of the posterior region 1 of each. Normally every dorsal bundle except a few at the posterior end contains capillary setæ, but they are easily detached, and in some specimens fully formed ones are absent from as many as one-half or more of the bundles. When more than one is present they are usually of unequal lengths, the longest much exceeding the diameter of the body. They are very slender and taper regularly to the end, toward which they exhibit 2 or 3 very slight but distinct spiral turns (fig. 11). Possibly this region may be slightly flattened, though this appearance may be due to the lights and shadows caused by the spiral turns. The short hooked setæ (fig. 9) are always bifid, with the distal process decidedly longer unless worn or broken, which is seldom the case. Ventral bundles contain hooked setæ only which are quite similar in form to those of the dorsal bundles but somewhat larger; those of anterior bundles of both rows are larger than the posterior. Anteriorly the ventral bundles usually contain 3, in the middle region 2, and posteriorly 1. As usual the ventral bundles are wanting on XI, but those of X are not modified as copulatory setæ.

The vascular system of this species is remarkably like that of *Monopylephorus glaber*, presenting a similar valvular dorsal vessel, chambered and valvular lateral trunks, complex integumental plexus, and similar mode of branching. As distinctive characters it presents a finer and more numerously branched integumental plexus, with a more conspicuous longitudinal intersegmented trunk, and a greater number of sets of valves in the lateral arches. Usually the arches in III and IV have 1 set, V 1 or 2 sets ,VI 3 or 4, VII 4, VIII 4 or 5, IX and X 6 or 7, and XI 6. The right arch in X sends a loop into the sperm sac as far as the diaphragm present in the immature worm, while that of XI enters the ovisac and breaks up into a rich plexus. The intestinal plexus reaches as far forward as VII.

Owing chiefly to the height of the cœlomic endothelium the body walls are thick and opaque. Peritoneal corpuscles (fig. 10) are of two forms, about 90 per cent. of them being spherical and filled with rounded opaque granules having nearly the color of the vertebrate red blood corpuscle. The corpuscles measure .01 to .015 mm., and the granules .0012 mm. in diameter. The corpuscles are much less abundant than those of *Monopylephorus glaber*, and are easily distinguished by their smaller and more numerous granules. With the spherical corpuscles are associated a number of nearly homogeneous, colorless, flattened, fusiform corpuscles and a few leucocytes.

The brain is about as broad as long, very massive and with a slight median emargination posteriorly, and prolonged anteriorly into a pair of relatively slender lobes separated by a deep cleft.

Like so many other organs the nephridia have much in common with those of *Monopylephorus glaber*. The funnels are provided with a tongue which, however, is short and broad, and the remainder of the funnel is much lobulated. Nearly sessile on the septum, it passes into a short and narrow postseptal neck which, in turn, enters a large tubule with a very wide irregular lumen and highly granular walls which is doubled on itself and forms, with the first section of the tubule loops, the so-called glandular portion of the nephridium. The tubule loops have ciliated ampullæ and are in general arranged as in *M. glaber*, but their folds are much more open and in the posterior nephridia reach through two somites. The efferent canal springs from the glandular mass and opens to the exterior in front of the ventral setæ. Altogether the nephridium is of the true tubificid type. They are frequently developed on one side only or altogether absent from many somites.

The spermathecæ (fig. 8) are large, with prominent simple ellipsoidal ampullæ, varying much in size and shape with the degree of distension, but usually filling a large part of the cœlome of X, and reaching to the dorsal level of the intestine and the septum $\frac{X}{XI}$. There is always a well differentiated muscular duct without glands, short in distended spermathecæ, but relatively long in empty ones. There are no spermatophores, the spermatozoa being free and loose.

The male organs (fig. 7) are remarkable as combining the short sperm duct and diffuse prostate gland of *Monopylephorus* with the soft penis having a thin cuticular sheath of a typical *Tubifex.* Large funnels open into X on each side near the body floor and, after perforating the septum in line with the ventral setæ, pass into short wide vasa deferentia which bend laterally and gradually expand into the long sperm reservoirs constituting at least one-half of the entire duct. Near the posterior end of the somite they bend abruptly upward to a point above the intestine, and, by a short constricted region, pass into the summit of the penis sac, which is nearly vertical but curves forward to the external pores. The penis sac is cylindrical and has a thick muscular coat; the free penis begins at about its middle, but is usually considerably folded within the lower part of its cavity. There is a distinct but thin cuticular lining reflected on to the penis. The prostate gland is a thick layer of cells, especially enlarged on the dorsal side, uniformly covering the entire sperm reservoir.

The sperm sacs and ova sacs are quite similar to those of *Monopylephorus glaber.* When fully developed the anterior sperm sac reaches through IX, the posterior to XV and the ova sac to XXII. The posterior sperm sacs are originally paired and in immature worms may be seen to be swept back and forth, alternately reversing and righting themselves, with the movements of the cœlomic fluid.

It is certain that this is one of the species included by Prof. Verrill in his *Clitellio irrorata,* and a few specimens are included among those so labelled. As no type is indicated, it seems perfectly proper to preserve the name by applying it to this, rather than to permit it to lapse as a synonym of one of the species already named, even though the latter chiefly influenced the original description.

Like *M. glaber* this is a brackish water species, and the two are frequently found associated about the outlets of littoral springs where an accumulation of organic mud makes the conditions otherwise favorable. The remarks under *M. glaber* concerning acclimatization to fresh and salt water apply equally to this species, which is, however, much less resistant to unfavorable circumstances than that species. Perhaps this fact accounts for its much less abundance, though its habit of burrowing more deeply into the soil among the roots of beach grass, in the smaller rootlets of which its peculiar capillary setæ become twisted, make it much more difficult to find. Sexually mature individuals constitute a much smaller per cent. of those found than in *M. glaber.* So far as now known this species occurs only south of Cape Cod.

Tubifex benedeni Udekem.

Tubifex benedii Udekem, 1855.
Clitellio ater Claparède, 1862.
Clitellio irrorata Verrill (in part), 1873.
Hemitubifex benedii Beddard, 1889.
Psammoryctes benedeni Michaelsen, 1900.

In its usual form this interesting species is at once distinguished from any others of our marine oligochætes by the nearly black or deep gray color, resulting from the remarkable flattened papillæ filled with greenish-gray granules with which the cuticle is thickly studded. These papillæ are arranged in irregular transverse rows in all regions except the prostomium, peristomium and clitellum, but they differ greatly in size and consequently in conspicuousness in different regions, being largest on the segments following the clitellum, and thence gradually decreasing in size toward the posterior end, where they are small and widely separated. There is also much individual variation in respect to the number and size of these papillæ, and it seems probable that they may be shed and developed periodically, though my opportunities for observing this species over a period of time have been very limited. Certain it is that small individuals with nearly or quite smooth cuticle are frequently found living with fully papillated mature ones, from which they appear to be otherwise indistinguishable. Fully grown worms with the papillæ scarcely developed also occur, and some of these are among the material collected by Prof. Verrill at Savin Rock, near New Haven, Connecticut, which is one of the type localities for *Clitellio irrorata*. It is quite evident, from a careful study of Prof. Verrill's description, that his account of the setæ is derived largely from specimens of this species in which, as is frequently the case, some of these organs were broken or abraded, and the others exhibited the normally great variability in the length of the distal process. When as slightly developed as in the specimens mentioned, the papillæ might be readily overlooked as unimportant. In my experience the capillary setæ are more often absent than present. That the European worm also is variable in these respects is shown by discrepancies in the several descriptions, and by the numerous names that have been applied to the species and listed by Michaelsen. So far as studied the internal anatomy of American examples agrees fully with the accounts given by Claparède, Beddard, etc. The spermatophores are very large, but less slender than in *Clitellio arenarius*.

This black worm is widely distributed on the seashores of Europe down to a depth of 7 fathoms. On our coasts it has not hitherto been identified. It is common between tides on muddy shores strewn with stones in Casco Bay, Maine. Here it occurs nearly up to high-water mark in association with *Clitellio arenarius*, though the latter is far more abundant. In similar situations in Narragansett Bay also both species occur, and Prof. Verrill has taken them near New Haven. The writer has found *T. benedeni* only sparingly in the neighborhood of Wood's Hole, and in water both fully salt and brackish. My brother, Dr. H. F. Moore, has collected it along with *Clitellio arenarius* at Campobello, New Brunswick.

Tubifex hamatus sp. nov. Pl. XXXII, figs. 12–18.

Length up to 35 or 40 mm.; greatest diameter about .8 mm. at the genital region; number of somites 85–110. In preserved specimens the prostomium is short and bluntly rounded, the peristomium about as long as the prostomium and divided into two rings, the first of which is papillated and evidently retractile. Succeeding somites increase in size, and the next five or six are biannulate, with the smaller annulus anterior. No further annulation is evident. The greatest diameter is at XI, behind which the segments become much narrower, but undergo no diminution in length for half the length of the body. Many of the specimens have somite VIII and often part of IX or even X strongly wrinkled or furrowed transversely. None has the clitellum distinctly developed. The cuticle is thick and everywhere perfectly smooth.

Setæ are absent from the peristomium, the ventral bundle of XI and the anal somite. Elsewhere from one to four occur in each bundle. Anterior to the clitellum four is the normal number both dorsally and ventrally on somites V to VIII, and usually two or three on the remaining somites. Postclitellar somites bear almost invariably two in the ventral and a single large one in the dorsal bundles. In no case have capillary setæ been detected in the dorsal bundles, the setæ being, therefore, exclusively of the hooked and bifid type. It is, of course, possible that further acquaintance with the species, now known from but one locality, may disclose the occasional or periodical presence of capillary setæ in the dorsal bundle. The anterior setæ (fig. 14) exhibit no noteworthy peculiarities, and are but little larger in the dorsal than in the ventral bundles. They are slightly sigmoid, with a small nodulus at the junction of the inner and outer limbs, the distal process of the slightly hooked tip longer and more slender and the proximal one shorter and stouter. Behind the clitellum they undergo little change for several segments, but at about the 20th to 28th somite in different individuals the dorsal and ventral setæ become strongly differentiated. The latter (fig. 13) gradually diminish in size and the two divisions of the tip become equal in length, the proximal one, however, remaining the stouter. Probably as a result merely of their being less worn, the points are usually longer and sharper than on more anterior setæ. At the point indicated the dorsal bundles become abruptly reduced to a single seta of very characteristic form (fig. 15). These are very large and stout, especially in the outer limb, which joins the inner one in an abrupt elbow marked by a prominent enlargement. The tip remains bifid, but is formed almost entirely by the stout, strongly hooked proximal division, which bears the small, slender distal division as an accessory process on its convexity. In intact individuals such large setæ continue nearly or quite to the caudal extremity, but in those which are regenerating the dorsal as well as the ventral bundles contain unmodified setæ, which are consequently here probably provisional.

The ventral setæ of X, which lie just anterior to the orifice of the spermathecæ, are much modified as copulatory setæ (fig. 17). Usually each fasciculus is reduced to one functional and one developing seta. The former is about one-third longer than the ordinary setæ, with a very long slender outer limb curved in the same direction as the inner limb and deeply cleft into two delicate, very slightly diverging prongs, which are, however, united by a thin curved plate to form a groove. The setæ sacs are also enlarged and their outer thirds form eversible sheaths or pockets for the setæ, and their closed ends receive the secretion of two or three small groups of gland cells.

The preservation of the specimens is unsatisfactory, so that histological details are avoided in the following description of the internal anatomy. The digestive tract consists of a short eversible buccal chamber in I and II, a pharynx with a conspicuous spheroidal and glandular dorsal diverticulum in III, a short œsophagus extending through IV and V, and an intestine with its chlorogogue covering from VI onward. The septa $\frac{III}{IV}$, $\frac{IV}{V}$, $\frac{V}{VI}$ and $\frac{VI}{VII}$ are thickened, muscular, and carried back to the alimentary canal in the form of funnels. The last is especially muscular.

While a true integumental plexus appears to be absent, the vascular system is conspicuous from the great development of the anterior lateral vessels, which are very long and arranged in a series of loops and folds beside the alimentary canal as far back as the genital somites (X and XI), those in the latter especially being enlarged, somewhat moniliform and extending into the sperm sac and ovisacs respectively. The lateral vessels of VIII are also of large size, but whether they form contractile hearts is uncertain. A highly developed gridiron plexus of blood-vessels exists in the walls of the intestine, especially in the somites VIII to XII, where it resembles the condition figured by Stolc for *Bothrioneuron*.

None of the specimens is mature, so that the reproductive organs are not fully developed, and further study may require some modification of the following account, especially in what relates to the penis sheath, prostate glands and extent of the sperm sac and ovisacs. The testes have the usual location in X, but remain small in all of the specimens sectioned. A single sperm sac (which may be double anteriorly) reaches from the septum $\frac{X}{XI}$ as far as XIII or XIV, but probably much farther in fully mature worms. It includes long loops of the lateral blood-vessels of X, and is itself enclosed in the ovisac which arises from the succeeding septum.

The male efferent apparatus is shown semi-diagrammatically in fig. 16. The large, few-celled sperm funnel is so distorted by pressure from the intestines, blood-vessels, sperm sac and the septum $\frac{X}{XI}$ that no accurate drawing could be made. After penetrating the septum $\frac{X}{XI}$ the vas deferens forms several close loops between the sperm sac and the intestine, and then, after curving round the former, takes a more open course in the posterior part of the segment before opening into the atrium. The entire atrium is about one-fourth the length of the vas, consists of a small fusiform sperm reservoir receiving the vas at one end and the rather small prostate gland on one side. At the other end it passes into a scarcely distinct ductus ejaculatorius of about equal length, which in turn passes into the summit of the simple erect penis sac. The latter is about as long as the preceding two parts of the atrium combined, is of nearly cylindrical form, has no special nor well-developed muscle sheath and contains the soft filiform penis, which in these specimens lacks any chitinous sheath. The free end of the retracted penis is received into a small bursa which is provided with a circle of small glands and opens at the position of the missing ventral setæ of XI. The ovaries are in XI, but the oviducts have not been detected. As mentioned above, an ovisac arises from $\frac{XI}{XII}$ and, receiving the sperm sac and a pair of vascular loops, extends to about XV or XVI.

The spermathecæ (fig. 18) open just behind the ventral or copulatory setæ of X. They are probably not fully developed in any of the specimens. In those of largest size they have a length about equal to one-half the diameter of the body, are more or less club-shaped with a simple duct forming about one-half the length, and a more or less distinct pouch, which may be elongated or spherical and pass gradually into the duct or be sharply defined. No distinct spermatophores are present, though several of the spermathecæ contained small elongated aggregations of spermatozoa.

Nephridia are present on the left side only of most, if not of all, segments. In sections they are very conspicuous owing to the large size especially of the middle tubule loop, but they are not sufficiently well preserved to permit a detailed description of their structure. The terminal vesicles are likewise large and the external pores, which are situated well mediad and a little cephalad of the ventral setæ, are very conspicuous in entire mounts, in which their asymmetry is very striking.

The brain (fig. 12) is somewhat broader than long, slightly cleft anteriorly and deeply cleft posteriorly.

This species has been found only under stones between tides on the shores of the Acushnet river, above New Bedford, Massachusetts. At this point the water is brackish.

Limnodrilus subsalsus sp. nov. Pl. XXXIII, figs. 19-22.

Length up to 40 mm., but most examples are less than this; greatest diameter (at XII) .6 mm.; number of segments up to 120.

The prostomium is conical with the apex rounded, one and one-half times to twice as long as broad. The first two or three segments are very short, not exceeding the prostomium; succeeding somites rapidly increase in length to X, which, with those following, is five or six times that length. The greatest diameter is at XI and XII, from which point it decreases to the very slender posterior third. Usually the peristomium is simple, but occasionally is faintly biannulate; II, III and IV are very distinctly biannulate, with a small, sharply defined annulus split off anterior to the setæ, which are borne on the prominent middle portion of the larger annulus; V is triannulate with the setæ posterior to the middle of the largest, middle annulus; VI has a second narrow annulus splitting off anterior to the setigerous one and a single one behind; VII is more distinctly quadriannulate, and VIII has four narrow annuli before and two behind the large setigerous one. The next few annuli present an irregular multiannulate condition, there being in most cases 5 presetal and 2 postsetal rings, which are nearly or quite equal to the setigerous one. Postclitellar somites are only very obscurely or not at all annulated.

Setæ are absent from the prostomium, the ventral bundles of XI and 2 or 3 caudal somites. Preclitellar bundles contain 4 to 6, usually 5 setæ; behind the clitellum are found at first 4, then 3, and toward the posterior end 2. Smaller numbers are very likely to occur in the dorsal bundles, though there is no constancy in this respect. There are no copulatory setæ and none in any way much modified or enlarged. Throughout the entire length they have essentially the form shown in figs. 19 and 20, the ventral ones averaging somewhat longer and stouter. The two divisions of the tip are nearly equal in length, especially in posterior setæ, but the distal is usually longer and the proximal stouter.

The simple digestive tract has the pharyngeal diverticulum divided into two lobes by a median fissure in II and III; the chlorogogue investment begins in V or even IV, and the posterior region of the intestine is very strongly beaded. The anterior margin of the brain, near which the connectives arise, is nearly truncate, but has two pairs of small ganglionic projections; the posterior is about one-half as wide and produced into a pair of prominent lobes separated by a narrow sinus, through which the dorsal vessel passes. Nephridia are of the usual type, symmetrical, and open immediately in front of the ventral setæ.

The chief characteristic of the species is found in the reproductive organs, especially in the abruptly bent atrium. The testes are in X, the ovaries in XI, the latter filling a large part of the cavity of that somite, but apparently unprovided with an ovisac. The former produce spermatogonia very copiously and fill not only the cavity of X, but a prominent median sperm sac which reaches to about XXI. The male genital ducts (fig. 21) present the structure and complexity of Eisen's genus *Camptodrilus*. The large discoid sperm funnel is in contact with anterior face of the septum $\frac{\text{X}}{\text{XI}}$, on the posterior side of which the vas deferens has contracted to a diameter of one-eighth to one-tenth its diameter. From this point the vas deferens forms many and varied coils and loops (not accurately represented in the figure) and has a total length to the point of entrance into the sperm reservoir of about three and one-half times the entire atrium. The sperm reservoir (*ss.*) is stoutly fusiform, constitutes nearly one-fourth of the entire length of the atrium and receives the massive prostate gland (*p.*) near the middle of the ventral side. A ductus ejaculatorius about as long as and one-fourth to one-fifth the diameter of the reservoir unites the latter with the penis sac. Sometimes this ductus is folded as in the figure, and has a posterior connection with the sperm reservoir; in other examples it stretches forward beside the penis sac, and the ends of the reservoir are reversed. The penial apparatus is bent sharply at the summit of the bursa at nearly a right angle and extends thence caudad, sometimes horizontally, sometimes obliquely upward, carrying with it the septum $\frac{\text{XI}}{\text{XII}}$ to a point opposite the setæ zone of XII. The penis is the direct continuation of the vas deferens, and is slightly bulbous at the distal and gently enlarged toward the proximal end. Surrounding it is the cuticular penis sheath, which is 12 or 13 times as long as its proximal diameter and closely envelopes the penis except at the distal end, where it expands broadly like the mouth of a trumpet. The epithelial penis sheath (*cs.*) expands distally into a bursa divided by a horizontal, diaphragm-like partition into a larger dorsal chamber (*dc.*) which receives the free end of the penis and its cuticular sheath and a very shallow ventral chamber (*vc.*) lined by enlarged cells. From this lower chamber a narrow passage leads to the exterior. The entire penial apparatus is ensheathed in muscle, for the most part arranged in two layers, wound spirally in opposite directions and united at the proximal end in a loose coil around the lower end of the vas deferens. Distally these muscles partly unwind and form a sheet enveloping the bursa and binding the entire organ to the body floor.

Spermathecæ (fig. 22) open as usual in line with the ventral setæ of X. They are usually bent into a coil and have a large spherical pouch and a duct about twice as long, the proximal half of which is narrow and the distal half expanded into a somewhat fusiform enlargement with thick walls.

This species occurs in considerable numbers along with *Tubifex hamatus* under stones at half-tide on the Acushnet river, above New Bedford, Massachusetts. At flood-tide the water is here strongly brackish, and this species is of interest as the first of its genus to be recorded as occurring under such conditions, all other species being inhabitants of fresh water strictly.

Enchytræus albidus Henle.

Enchytræus albidus Henle, 1837.
Halodrillus littoralis Verrill, 1873.
Enchytræus humicultor Vejdovsky, 1879.
Enchytræus littoralis (Verrill) Smith, 1895.

This, the best known and most generally distributed of our littoral Oligochæta, was redescribed and identified with *E. humicultor* Vejd. by Smith. Michaelsen, to whose monograph reference is made for the complete synonymy, considers the latter to be part of *E. albidus* Henle. It is an abundant species from Casco Bay, Maine, to Sea Isle City, New Jersey, at least, and, while found more or less everywhere in the upper littoral zone, is especially abundant in the windrow of eel grass which traces the line of high-water along the beach. Wherever the eel grass is kept moist by brackish water and retains a thick coating of diatoms to serve as food, these worms become large and stout, attaining an inch in length and a millimeter in diameter. Elsewhere they are smaller. The same species, but of smaller size, is found in moist spots on farm lands on Martha's Vineyard, where it could readily be introduced in the large quantities of eel grass that are annually spread for fertilizer. About Wood's Hole it also lives in damp, sandy woods and on the shores of fresh-water ponds, especially of one that formerly was connected with the Sound. Whether this particular species originated on the strand and migrated landwards or *vice versa* is not apparent. Its wide distribution along the shore, however, may be accounted for by the ease with which it could be transported in masses of eel grass attached to floating logs, or by clinging to the feet of migrating shore birds. The same influences would affect *Lumbricillus,* but not the various species of tubificids, which burrow in the mud or conceal themselves beneath stones. As a consequence many of the latter appear to occur quite locally.

Enchytræus albidus may be easily recognized among our littoral species by its milk-white color and nearly straight, internally hooked setæ.

Lumbricillus agilis sp. nov. Pl. XXXIII, figs. 23–28.

The length of fully extended mature worms is about 16 mm. or less, the greatest diameter is .4 mm., and, owing to the relatively stout anterior and slender, tapering posterior parts, the general form is distinctly clavate, particularly in fixed examples. Considerable variation in the number of segments has been observed, ranging from 30 to 48, 47 being a very frequent number in breeding examples. The prostomium is short, blunt and verrucose, and possesses a distinct cephalic pore a little behind the apex on the dorsal side. The spermathecal pores are inconspicuous slits facing laterally in the furrow $\frac{\text{IV}}{\text{V}}$, and the spermaducal pores are rather conspicuous simple or usually trifid slits in the position of the absent ventral setæ of XII. In preserved worms they are usually on the apex of the everted male bursa. The female genital pores are visible only in sections. When fully developed the clitellum is thick and conspicuous and extends completely around somites XI and XII. Anteriorly the somites increase in diameter and length to the genital region, but are always short; posteriorly they taper rapidly, and are slender and divided into 3 annuli, of which the middle one bears the setæ, and each of which may be further divided into 2 or 3.

As usual in the genus, the setæ are of a gently sigmoid form with rather acute, slightly hooked tips and a slight thickening at the junction of inner and outer limbs. Those of the ventral fascicles (fig. 23*a*) are decidedly larger than the dorsal ones (fig. 23). Ventral bundles contain from 5 to 8, usually 6, anterior to the clitellum, and from 4 to 6, usually 5, posteriorly; dorsal bundles usually 5 anteriorly and 3 or 4 posteriorly. On somite XII there are no ventral and only 1 to 3 dorsal setæ.

Anteriorly the color is a delicate pink which resides in the ovaries, testes and œsophagus; this is purest as far back as the setæ of somite VI and again in XI and XII, but is elsewhere obscured by the brown color of the chlorogogue cells. In the youngest worms the blood is colorless, in larger ones sulphur yellow, and in still larger ones reddish-yellow. At all ages these worms are transparent and especially so when young, rendering the anatomical study of living ones an easy matter.

The septa $\frac{IV}{V}$, $\frac{V}{VI}$ and $\frac{VI}{VII}$ are thickened and $\frac{III}{IV}$ only less so. The three most anterior bear large, clear septal or pharyngeal glands, the third being more granular than the others. The brain (fig. 24) is slightly longer than broad, straight or slightly truncate anteriorly, with the prostomial nerves and circumœsophageal connectives arising from the antero-lateral angles; just behind these is the narrowest part, from which the width gradually increases to the two quadrate posterior lobes, which are separated by a moderate cleft and give rise to a pair of muscle strands. Copulatory supra-neural glands are well developed, especially in somites III, IV and V. They are slender and elongated, not closely united with the ventral nerve, and open on each side nearly at the ventral setæ bundles.

The blood vascular system presents the usual simple structure found in species of this genus. There is a well-developed periintestinal sinus terminating anteriorly at VII. The dorsal vessel is conspicuous and contractile for most of its length, becomes free from the intestine in XIII, and terminates without bifurcating at the anterior margin of the brain, where it joins the pair of vessels arising from the two loops into which the ventral trunk splits in III. Cœlomic corpuscles (fig. 25) are of two kinds, much the most numerous being elongated, irregular, flattened, colorless and finely granular ones measuring about .025 mm. long and .008 mm. wide. The other and less numerous being flattened, irregularly circular disks, with large granules and a pale grayish-green color, which are .015 mm. in diameter.

Nephridia of the form shown in fig. 26 occur regularly in pairs in every somite, except XI, XII and XIII, from VII caudally. They have very small funnels and massive tapering postseptal regions, from the postero-ventral angle of which the large efferent duct, which is shorter than the massive portion, arises and passes to the external pore.

When fully developed the testes, which occupy the usual position in

XI, are divided into from 10 to 20 slender, pyriform lobes which fill a large part of the somite. Sperm sacs are either altogether absent or very small. The sperm funnels occupy a great part of XI, are slender, about 6 to 8 times as long as thick, nearly cylindrical, more or less folded when *in situ*, and slightly contracted near the mouth, the margins of which are provided with a ciliated roll or lip. The vas deferens is about three times as long as the funnel, closely but very variously folded in XII, and has the terminal part somewhat enlarged and ciliated. It opens into the small, depressed, spheroidal, glandular and opaque atrium, which itself opens on the medial side of a small bursa in the position of the ventral setæ. The bursa can be everted as a conical penis (fig. 27).

Somewhat like the testes, the ovaries are subdivided into about 20 ellipsoidal bodies, each with a cross division, on one side of which is one or several large ova, and on the other a number of small ones. A small ovisac pushes back from septum $\frac{XII}{XIII}$, but is never extensively developed. The spermathecæ (fig. 28) are small, pinkish, pyriform tubes without diverticula or distinct ducts, which communicate with the lumen of the œsophagus in V and with the exterior in the furrow $\frac{IV}{V}$, near which they bear a circle of glands chiefly aggregated into an anterior and a posterior group.

This is an exceedingly pretty and active little worm which crawls rapidly and clings closely to surfaces. It is extremely abundant among the eel grass thrown on shore near high-water mark, and which accumulates in great quantities in sheltered coves. Its special habitat is a certain stratum in the bedded masses where the plant is neither soaked in water and much decayed, nor dried by the sun and air as in the uppermost layer, but where it remains moist and coated with a layer of diatoms on which the worm feeds. If sexually active worms be removed from such conditions and placed in clean salt water without diatoms the genital organs quickly shrink, but if kept in even a small quantity of moist eel grass exposed to moderate light they continue to reproduce. These worms are much parasitized by a monocystid gregarine. The species is known from Casco Bay, Maine, to Vineyard Sound, Massachusetts.

Bibliography.

Beddard, F. E. On Certain Points in the Structure of *Clitellio*. *Proc. Zool. Soc. London*, 1888, 485–495, Pl. XXIII.

Bourne, A. G. Notes on the Naidiform Oligochæta. *Quar. Jour. Micr. Sci.*, XXXII (1891), pp. 349–356, Pls. XXVI and XXVII.

Claparède, E. Études Anatomiques sur les Annélides, etc. *Mém. Soc. Phys. Genève*, XVI (1861), pp. 101–110, Pls. III and IV.

Claparède, E. Recherches Anatomiques sur les Oligochètes. *Id.*, XVI (1862), pp. 217–291, Pls. I–IV.

Ditlevsen, A. Studien an Oligochäten. *Zeit. f. Wiss. Zool.*, LXXVII (1904), pp. 398–480, Pls. XVI–XVIII.

Ferrionnière, G. Contribution à l'étude de la faune de la Loire-Inferieure. Annélides oligochètes. *Bull. Soc. Sci. nat. Ouest*, IX (1899), pp. 242–4, 246–9, 294, Pl. XIX.

Goodrich, E. S. On the Structure of *Vermiculus limosus*. *Quar. Jour. Micr. Sci.*, XXXVII (1895), 253–267, Pls. XXVI–XXVIII.

Leidy, J. Marine Invertebrate Fauna of Rhode Island and New Jersey. *Jour. Acad. Nat. Sci. Phila.*, III (1855), p. 148, Pl. XI, fig. 64.

Michaelsen, W. Oligochæta. Berlin, 1900.

Minor, W. C. Natural and Artificial Section in Some Chætopod Annelids. *American Journal of Science and Arts*, XXXV (1863), p. 36.

Smith, F. Notes on Species of North American Oligochæta. *Bull. Ill. State Lab. Nat. Hist.*, IV (1895), pp. 289–292.

Vaillant, L. Histoire des Annelés. Paris, 1890, III, 2, pp. 421, 422.

Verrill, A. E. Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters. *Rep. U. S. Fish Comm.*, 1873, pp. 622–624, 324.

Verrill, A. E. New England Annelida. *Trans. Conn. Acad.*, IV (1881), Pl. VIII, fig. 3.

Explanation of Plates XXXII and XXXIII.

Plate XXXII.—*Monopylephorus glaber*, figs. 1 to 6.

Fig. 1.—Male genital duct entire, dissected. ×180. The histology is semi-diagrammatic.

Fig. 2.—Outline of a living nephridium *in situ*, seen from below. ×180. *v*, ventral blood vessel.

Fig. 3.—Outline of brain, from above. ×180.

Fig. 4.—A ventral seta from VIII. ×335.

Fig. 5.—Three cœlomic corpuscles of different sizes. ×280.

Fig. 6.—A pair of spermathecæ. ×55.

Tubifex irroratus, figs. 7 to 11.

Fig. 7.—Side view of entire male genital duct, the penis sac partly concealed behind the sperm reservoir; from a dissection and sections. ×180.

Fig. 8.—Two spermathecæ from different worms; *a*, much and *b*, little distended with sperm. ×55.

Fig. 9.—Ventral setæ, *a*, from somite IV; *b*, from somite XL, and *c*, from the posterior end. ×335.

Fig. 10.—Cœlomic corpuscles, *a*, of the ordinary form; *b*, the homogeneous, colorless form. ×280.

Fig. 11.—Terminal portion of a dorsal capillary seta. ×560.

Tubifex hamatus, figs. 12 to 18.

Fig. 12.—Outline of brain, from above. ×180.

Fig. 13.—A posterior dorsal seta. ×280.

Fig. 14.—A dorsal seta from VIII, and *a*, tip of a ventral seta from the same. ×280.

Fig. 15.—Two of the hooked dorsal setæ from the middle region. ×280.

Fig. 16.—Outline of the male genital duct, with a portion only of the vas deferens represented. ×180. Funnel diagrammatic.

Fig. 17.—A copulatory seta retracted within its sac. ×280.

Fig. 18.—Outline of a nearly empty spermatheca. The line *a–a* shows the form of the same partly distended. ×180.

Plate XXXIII.—*Limnodrilus subsalsus*, figs. 19 to 22.

Figs. 19 and 20.—Ventral and dorsal setæ, respectively, from somite VI. ×280.

Fig. 21.—Side view of the entire male genital duct, combined from several dissections. × about 100.

Fig. 22.—A spermatheca shown in outline. × about 100.

Lumbricillus agilis, figs. 23 to 28.

Fig. 23.—Three dorsal and *a*, one ventral setæ. × 335.

Fig. 24.—Outline of brain, from above. × 150.

Fig. 25.—The two forms of cœlomic corpuscles. × 335.

Fig. 26.—A nephridium from life. × 225.

Fig. 27.—Dorsal view of one of the male genital ducts. Drawn from a living worm. × 55.

Fig. 28.—A spermatheca showing communication with œsophagus above and external opening below. × 110.

Monopylephorus parvus, figs. 29 to 34.

Fig. 29.—A strongly bifid seta from the ventral bundle of VI; *a*, a slightly forked one from a dorsal bundle; *b*, tips of three from the posterior region. × 280.

Fig. 30.—Two cœlomic corpuscles. × 280.

Fig. 31.—Outline of the brain, from above. × 180.

Fig. 32.—Outline of both male genital ducts *in situ*, as seen from the ventral surface of the body. × 180.

Fig. 33.—A transverse section passing through the male pore. × 180. *at*, atria; *b*, genital bursa; *dv*, dorsal blood-vessel; *in*, intestine; *n*, nerve cord; *p*, prostate gland; *ss*, sperm sac; ♂, common orifice of male ducts.

Fig. 34.—Outline of spermatheca. × 280.

A CONTRIBUTION TO THE KNOWLEDGE OF THE ACRIDIDÆ (ORTHOPTERA) OF COSTA RICA.

BY JAMES A. G. REHN.

The following study was based on a series of two hundred and ninety-one specimens from various localities in Costa Rica, and in the collections of the Academy, Mr. Morgan Hebard of Chestnut Hill, Philadelphia, and the United States National Museum. These collections were represented respectively by one hundred and fifty-nine, one hundred and twelve, and twenty specimens.

The author wishes to thank Mr. Hebard and Dr. Ashmead of the National Museum for permission to study portions of the material, and for other favors rendered during the preparation of this and other papers.

It is proposed to follow this contribution at a later date with others on the Tettigonidæ and Gryllidæ of Costa Rica, interesting collections of which are now in hand.

Subfamily ACRIDINÆ (*Truxalinæ* Auct.).

TRUXALIS Fabricius.

1775. *Truxalis* Fabricius, Syst. Entom., p. 279.

Included *nasutus* and *brevicornis*, of which the latter is the type *nasutus* being one of the two congeneric species on which Linnæus based the genus *Acrida*.

Truxalis brevicornis (Johansson).

1763. *Gryllus brevicornis* Johansson, Amœn. Acad., VI, p. 398. [America septentrionali.]

San Carlos, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One female.

Carrillo, Costa Rica. [Hebard collection.] Ten males, ten females.

Both color phases are represented, some of the females having distinct though small maculations on the axillary field of the tegmina.

SILVITETTIX Bruner.

1904. *Silvitettix* Bruner, Biol. Cent.-Amer., Orth., II, p. 55. Type.—*S. communis* Bruner.

Silvitettix communis Bruner.

1904. *Silvitettix communis* Bruner, Biol. Cent.-Amer., II, p. 56. [Monte Redondo Juan Veñas and Pozo Azul, Costa Rica.]

Carrillo, Costa Rica. [Hebard collection.] Three males, four females.

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two males, four females.

Escazu, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One male.

The variation in color noticed in the original description is apparent in the series studied.

AMBLYTROPIDIA Stål.

1873. *Amblytropidia* Stål, Recensio Orthopterorum, I, p. 107. Type.—*A. ferruginosa* Stål.

Amblytropidia costaricensis Bruner.

1904. *Amblytropidia costaricensis* Bruner, Biol. Cent.-Amer., Orth., II, p. 66. [Greytown, Nicaragua; San José, Costa Rica.]

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One immature female.

ORPHULELLA Giglio-Tos.

1894. *Orphulella* Giglio-Tos, Boll. Mus. Zool. Anat. Comp. Torino, IX, No. 184, p. 10.

Included *punctata* (De Geer), *intricata* Stål, *gracilis* and *elegans* Giglio-Tos, of which the first may be taken as the type.

Orphulella punctata (De Geer).

1773. *Acrydium punctatum* De Geer, Mém. Hist. Ins., III, p. 503, t. 42, fig. 12. [Surinam.]

Tarbaca, Costa Rica. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Guatel, Costa Rica. April, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

These specimens are referred here with some little doubt, but no material difference is detected on comparison with a female of *O. punctata* from St. Vincent, West Indies.

Orphulella costaricensis Bruner.

1904. *Orphulella costaricensis* Bruner, Biol. Cent.-Amer., Orth., II, p. 82. [San José, Costa Rica.]

Tarbaca, Costa Rica. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Guatel, Costa Rica. April, 1902. (C. F. Underwood.) [A. N. S. Phila.] Three males, eighteen females.

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Eight males, five females.

This species is extremely variable in color as noticed by Bruner, a great range of types being exhibited by the material studied. None of the specimens exhibit the median carina of the fastigium described by Bruner.

Subfamily ŒDIPODINÆ.

LACTISTA Saussure.

Lactista punctata (Stål).

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One male, one female.

These specimens have the median carina of the pronotum lower than in specimens from the States of Tamaulipas and Vera Cruz, Mexico, and the bluish tint of the caudal tibiæ is weaker and more fuscous in character.

A specimen from San Marcos, Nicaragua (C. F. Baker), agrees with the Costa Rican individuals in the points of difference from the Mexican type. The differences are, however, so slight that they appear unworthy of specific recognition.

HELIASTUS Saussure.

Heliastus costaricensis n. sp.

Type; ♀; Turrialba, Costa Rica. (Schild and Burgdorf.) [U. S. Nat. Mus., No. 8,173.]

Closely allied to *H. aztecus* Saussure from northern Mexico, but differing in the narrower and deeper fastigium, the deeper sulcation of the frontal costa, the more prominent eyes and the less sellate pronotum.

Size medium (about equal to that of *H. sumichrasti*); form moderately robust. Head very slightly elevated above the level of the pronotum, occiput moderately ascending; fastigium distinctly declivent and passing without any angle into the frontal costa; interocular region about twice as wide as the frontal costa; vertex and fastigium slightly excavated with a very slight median and distinct lateral carinæ; fastigium gradually narrowing to the frontal costa, which is broadly and distinctly sulcate with prominent carinæ, becoming obsolete a short distance ventrad of the median ocellus; antennæ distinctly exceeding the head and pronotum in length. Pronotum very slightly sellate, the dorsal outline but slightly depressed at the transverse sulci, all three of which are distinct and well marked; cephalic margin slightly arcuate, caudal margin obtuse-angulate with the angle somewhat rounded; median carina very slight cephalad, obsolete between the sulci, slight but distinct on the metazona, humeral angle very distinct on the metazona but rounded; surface of the metazona rugoso-punctate; lateral lobes deeper than long, sulci very distinct, the ventro-caudal angle subrotundate and not produced. Tegmina exceeding the tips of the abdomen and the caudal femora by the length (cephalo-caudal) of the head, subequal in width, the costal dilation apparent but not very large; apex obliquely truncato-rotundate; intercalary vein indistinct, irregular and of an indefinite character. Wings equal to the tegmina in length when closed; costal margin a very faint reverse curve in outline; apex rather bluntly rounded. Interspace between the mesosternal lobes twice as broad as long; interval between the metasternal lobes about three times as broad as long. Caudal femora robust, the genicular region not strongly enlarged, tibiæ slightly but distinctly shorter than the femora.

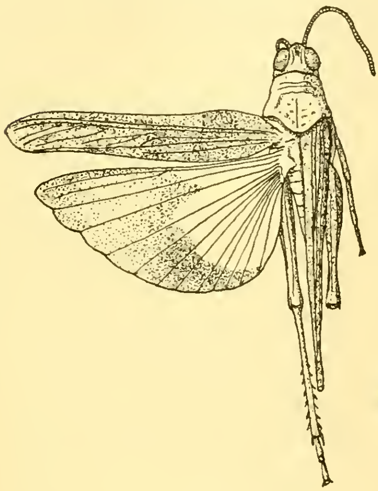


Fig. 1.

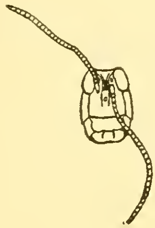


Fig 2.

Fig. 3.

Heliastus costaricensis n. sp. Type. Fig. 1, dorsal view; fig. 2, cephalic view of head; fig. 3, lateral view.

General color, above raw umber, becoming fawn color on the sides of the head and pronotum. Head distinctly punctate with blackish-brown; antennæ fawn annulate with blackish-brown, the annuli of each color increasing in size distad; eyes dark ferruginous. Pronotum with the metazona finely and closely punctulate with blackish-brown. Tegmina with two irregular transverse bands made up of burnt-umber annuli, one band median, the other premedian; the principal longitudinal veins are accompanied by rows of annuli of the same color and size, but more sparsely distributed and absent from the apical fourth, which is almost entirely hyaline; the median section of the tegmen bears over all a faint but noticeable "bloom" of ecru-drab, such as is found in some other species of the genus. Wings with the disk scarlet-vermilion; fuscous band rather faint, prout's brown in color, and absent toward the costal margin, ulnar tænia very slight, apex slightly suffused and the apical half of the costal margin strongly and narrowly marked with vandyke brown. Abdomen fawn color. Caudal femora dorsad and ventrad cinnamon clouded with mars brown, lateral face dull hoary with a median streak of blue-black, varying in length on the two femora, extending nearly the entire length in one, and not passing the middle in the other; genicular region blackish; internal face gallstone yellow with two bars of black, one of which suffuses the ventral sulcus. Caudal tibiæ greenish-white at the base (immediate base blackish), distal half scarlet, separated by an annulus of blackish; spine tipped with blackish.

Measurements.

Length of body,	28	mm.
Length of pronotum,	5.5	"
Caudal width of pronotum,	5	"
Length of tegmen,	25	"
Greatest width of tegmen,	4.5	"
Greatest width of wing,	12.5	"
Length of caudal femur,	13.5	"

The type is the only specimen seen.

Subfamily PYRGOMORPHINÆ.

PROSPHENA Bolivar.

1884. *Prosphena* Bolivar, Anal. Soc. Españ. Hist. Nat., XIII, p. 447.

Type.—*P. scudderi* Bolivar.

Prosphena scudderi Bolivar.

1884. *Prosphena Scudderi* Bolivar, Anal. Soc. Españ. Hist. Nat., XIII, p. 447. [Guatemala.]

Tarbaca, Costa Rica. November and December, 1902. (C. F. Underwood.) [A. N. S. Phila.] Three males.

Previously known only from the type locality. The specimens range in color from greenish-yellow to dull green, the tegmina solid dull brownish, the caudal tibiæ and tarsi suffused with crimson to a variable extent, the spines yellow with the tips black.

Subfamily LOCUSTINÆ.

MUNATIA Stål.

1875. *Munatia* Stål, Bihang till K. Svenska Vet.-Akad. Handl., III, No. 14, p. 28.

Type.—*M. punctata* Stål.

Munatia punctata Stål.

1875. *M[unatia] punctata* Stål, Bihang till K. Svenska Vet.-Akad. Handl., III, No. 14, p. 28. [Chiriqui.]

Tucurrique, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One male.

Turrialba, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One female.

Carrillo, Costa Rica. [Hebard collection.] One immature male, one immature female.

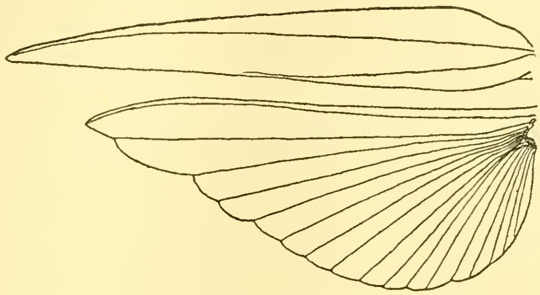


Fig. 4

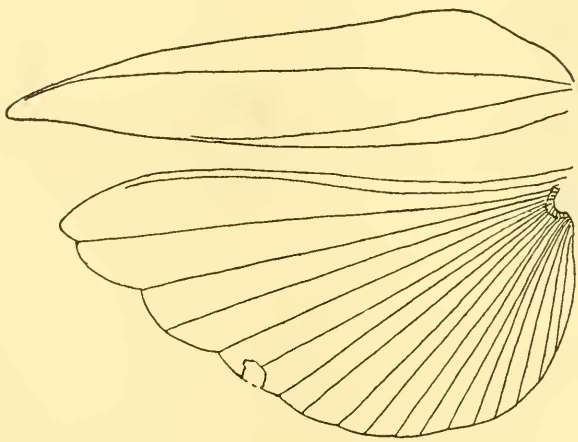


Fig. 5.

Munatia punctata Stål.—Fig. 4, tegmen and wing of male; fig. 5, tegmen and wing of female.

As far as can be determined from Stål's very brief diagnosis these specimens represent this species. The male does not present four blackish spots on the sides of the thorax, but has the median elytral stripe faintly indicated, as well as possessing a very distinct longitudinal stripe of yellowish on the anal area. The female is more uniformly colored than the male, and has the yellowish-green disk more suffused with fuscous.

COLPOLOPHA Stål.

1873. *Colpolopha* Stål, Öfversigt af K. Vetensk.-Akad. Förhandlingar, 1873, No. 4, pp. 52, 53.

Type.—*C. sinuata* Stål.

Colpolopha bruneri n. sp.

Types: ♂ and ♀; Monte Redondo, Costa Rica. January, 1903 (♂). Tarbaca, Costa Rica. December, 1902 (♀). (C. F. Underwood.) [A. N. S. Phila.]

Apparently allied to *C. sinuata* from Peru and New Granada, but differing in the color of the wings and the smaller size. Little else can be made from Stål's very insufficient description, but the later remarks made by Pictet and Saussure show that the new form is close to *sinuata*. From *obsoleta*[1] it can readily be distinguished by the smaller size, more robust form, shorter and more acute tegmina, more elevated median carina of the pronotum and the heavier fastigium.

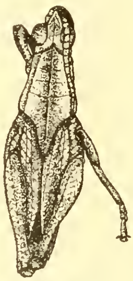


Fig. 6.

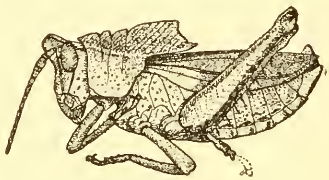


Fig. 7.

Colpolopha bruneri n. sp. Type male. Fig. 6, dorsal view; fig. 7, lateral view.

Size small for the genus; body distinctly compressed and semiscabrous. Head with the occiput slightly elevated and rounded in the female, plane in the male; fastigium strongly produced, but slightly shorter than the greatest length of the eye, subequal in the basal half, and but slightly narrower than the interocular space, apex rectangulate in the male, rounded in the female, broadly and shallowly excavated with a slight but distinct median carina continued back over the occiput, margins distinct and continued over the rostrum forming the

[1] Comparison made with a male from Demerara and a female from Cayenne.

lateral carinæ of the frontal costa; lateral foveolæ subtrigonal, subobsolete; frontal costa sulcate, parallel above the ocellus, expanding below and reaching the clypeal margin; accessory facial carinæ distinct; eyes ovate in the male, subelliptical in the female, slightly longer than the infraocular portion of the genæ in the male, slightly shorter in the female; antennæ depressed, slightly ensiform, slightly longer than the pronotum in the male, distinctly shorter in the female. Pronotum with the median crest rising evenly from the cephalic margin to within a very short distance of the apex of the caudal process where it is roundly and raggedly excised into a semicrescentic outline; transverse sulci distinctly and narrowly but not deeply cutting the crest; cephalic margin produced over the base of the occiput in a very acute harpoon-shaped process, caudal margin produced into a structure of similar character but of much greater size; lateral carinæ distinct, bluntly tuberculate; lateral lobes of the pronotum distinctly longer than deep. Prosternal spine erect, short, thick and rather blunt. Tegmina short, not reaching the apex of the abdomen and falling far short of the tips of the caudal femora, subsagittate, the apex acute, costal expansion distinct but short; surface subcoriaceous, irregularly reticulate. Wings two-thirds the length of the tegmina, the apex acute-angulate. Cephalic and median limbs short, the femora slightly but distinctly expanded distad. Caudal femora slightly compressed, considerably enlarged proximad and distinctly constricted in the pregenicular region, carinæ denticulate, the dorsal carina serrato-dentate; tibiæ slightly shorter than the femora, spines nine in number on each margin, those of the internal considerably longer and more curved than those of the external; caudal tarsi slender, the third joint distinctly shorter than the metatarsus.

General color, vandyke brown in the female, raw umber in the male, the whole surface sprinkled with small blackish-brown points, which, on account of the base color, are less conspicuous in the female than in the male. Eyes burnt umber. Pronotum with the lateral carinæ lined with blackish-brown on the prozona. Tegmina of the male vandyke brown, with a semicircular pale spot at the base of the costal expansion, a marking which is very faintly indicated in the female. Wings vermilion, apex and a rather dull tænia which extends to the base of the wing vandyke brown, the costal vermilion dull. Abdomen with the overlying maculations clear black. Caudal femora with a distinct "pepper and salt" appearance; caudal tibiæ very dull glaucous, spines suffused with blackish.

Measurements.

	♂	♀
Length of body,	22 mm.	39.5 mm.
Length of pronotum,	10 "	15.5 "
Greatest width of pronotum,	4.2 "	7 "
Length of tegmen,	13 "	22.5 "
Width of tegmen,	3.5 "	6.5 "
Length of caudal femur,	14.2 "	21 "

Two paratypic males have been examined in addition to the types.

I take pleasure in dedicating this species to Prof. Lawrence Bruner of the University of Nebraska, who has made, and is making, valuable contributions to our knowledge of American Acrididæ.

CIBOTOPTERYX[7] n. gen.

Type.—*C. variegata* n. sp.

Allied to *Elæochlora* Stål, but differing in the elevated and lobate median crest of the pronotum, the strongly tuberculo-dentate lateral carinæ of the same, and the short, peculiarly shaped tegmina.

Occiput rounded, rostrum projecting and separated from the interocular region by a distinct transverse depression; frontal costa not sinuate when viewed laterad; antennæ very slightly depressed. Pronotum with a distinct median crest, deeply cut by the transverse sulci

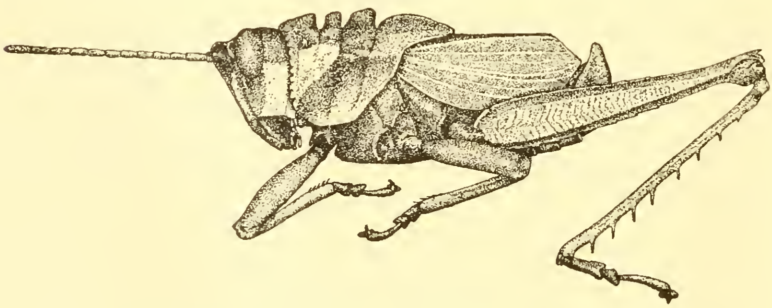


Fig. 8.—*Cibotopteryx variegata* n. gen. and sp. Lateral view of type.

and distinctly trilobate on the prozona; lateral carinæ tuberculate, parallel and descending ventrad on the prozonal lobes. Prosternal spine short, erect and acute. Tegmina short, not reaching the apex of the abdomen, rectangulate distad. Cephalic and median femora moderately inflated; caudal femora rather slender and weak.

Cibotopteryx variegata n. sp.

Type; ♂; Guatel, Costa Rica. August, 1902. (C. F. Underwood.) [A. N. S. Phila.]

[7] Κιβωτος, *chest;* πτερυξ, *wing.*

Size medium; surface of pronotum rugoso-tuberculate, of remainder of body subglabrous. Head with the occiput evenly rounded both longitudinally and transversely, dipping rather sharply down to the base of the fastigium; fastigium extending a distance cephalad of the eyes equal to the interspace, moderately elevated, acute, margins rather low but distinctly and roundly raised above the slightly excavated center, apex when viewed laterad rounding into the frontal costa; lateral foveolæ very slight and indistinct, trigonal; frontal costa narrow, rather strongly sulcate, equal in width above the ocellus except for the dorsal constriction, slightly inflated at the ocellus, distinctly constricted then regularly but slightly expanding below, reaching the clypeal margin; accessory facial carinæ quite prominent; eyes subovate, slightly shorter than the infraocular portion of the genæ, prominent when viewed dorsad; antennæ slightly exceeding the pronotum in length. Pronotum with the prozona moderately inflated, deeply cut by the transverse sulci; median crest rather high and developed into three quadrate lobes on the prozona, lower and evenly arched on the metazona; lateral carinæ tuberculate, bent ventrad at an angle of 45° cephalad of the second transverse sulcus, and joining the cephalic margin at the ventro-cephalic angle; margins tuberculate, cephalic very broadly obtuse-angulate with the angle truncate, caudal produced with concave sides and acute apex, caudal margin of the lateral lobes distinctly oblique, ventral margin subrotundate with the ventro-cephalic margin moderately distinct. Tegmina with the costal margin rather strongly arcuate, the apex rectangulate, anal area very slightly arcuate. Wings slightly shorter than the tegmina and completely covered by the same. Abdomen with the apex elevated; subgenital plate covered by the large lamellate cerci which meet on the median line; supraanal plate with the apex rectangulate. Cephalic and median femora slender proximad, moderately but distinctly inflated mesad and distad. Caudal femora slender, very slightly bowed, with the proximal inflation very slight, the genicular margin with a slight median spine; tibiæ about equal to the femora in length, spines nine in number on each margin, those of the internal margin much longer and more curved than those of the external margin, internal spurs much longer than the external; tarsi of moderate length, the metatarsus and third joint subequal in length.

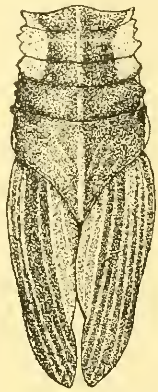


Fig. 9.—*Cibotopteryx variegata.* Dorsal view of pronotum and tegmina of type.

General color, above olive-green, slightly paler on the tegmina than on the dorsum of the head and pronotum; face, genæ, a diagonal line immediately dorsad of the lateral carinæ on the cephalic half of the prozona, and a diagonal bar on the caudal half of the lateral lobes chrome yellow, the last-mentioned streak being darker and more ochraceous. Frontal costa and mouth parts of the dorsal color; eyes chestnut; antennæ dragon's blood red, infuscate apically; dorsal median oblique streak on the lateral lobes of the pronotum suffused with blackish; transverse sulci marked slightly with blackish. Tegmina with the longitudinal veins distinctly and the cross veins slightly marked with wax yellow on a ground of the general color. Cephalic and median femora olive green; caudal femora between apple green and oil green, the ventral face glaucous blue, genicular margin with a narrow edging of rufous; cephalic and median tibiæ and tarsi dull ferruginous, caudal tibiæ and tarsi poppy red, the spines and spurs narrowly tipped with black.

Measurements.

Length of body,	23	mm.
Length of pronotum,	10	"
Greatest width of pronotum,	5.8	"
Length of tegmen,	11	"
Width of tegmen,	6	"
Length of caudal femur,	17	"

The type is the only specimen known to the author.

TÆNIOPODA Stål.

Tæniopoda centurio (Drury).

1773. *Gryll*[*us*] (*Loc*[*usta*]) *Centurio* Drury, Illust. Nat. Hist. Exot. Ins., p. 78, Pl. XLI, fig. 3 and Index. ["Bay of Honduras in America."]

San Carlos, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] Two males, one female.

This species has never before been recorded south of Honduras. One male has the general color decidedly purplish-black, the usual blotches on the tegmina absent and the veins pale against the solid dark ground.

Tæniopoda varipennis n. sp.

Types: ♂; Central America. [Hebard collection.] ♀; San José, Costa Rica. (Schild and Burgdorf.) [U. S. N. M., No. 8,174.]

Allied to *T. auricornis* (Walker) and *T. pulchella* Bolivar. From the former it differs in the slenderer form and more produced caudal process of the pronotum, and the longer and narrower tegmina. From

T. pulchella it can be separated immediately by the slenderer form and the shape of the caudal process of the pronotum.

Size medium (for the genus); male moderately slender, female short and heavy built. Head with the occiput and vertex rounded, subglobose; interspace between the eyes equal to the length of the eye in the female, equal to the width of the eye in the male; fastigium broad, subrectangulate, very distinctly declivent, slightly excavated, the lateral carinæ more marked than the rather faint median one; frontal costa very narrow, deeply sulcate, evanescent immediately below the median ocellus; lateral carinæ of the face distinct but not very sharp; eyes quite prominent and elliptical oval in the male, moderately prominent and subovate in the female; antennæ slightly depressed proximad, in an imperfect state slightly shorter than the head and pronotum. Pronotum compressed, metazona slightly longer than the prozona; median keel strongly elevated, compressed, roughly arcuate on the prozona, deeply slit but not distinctly divided by two transverse sulci, the caudal section being slightly higher than the cephalic; caudal

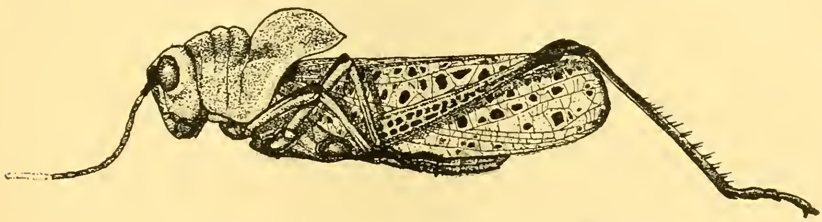


Fig. 10.—*Tæniopoda varipennis* n. sp. Male type.

transverse sulcus deeply dividing the median keel; metazona with the keel strongly arcuate, lateral portions of the disk flattened; humeral angles very distinct, not extending much cephalad of the last sulcus; cephalic margin produced over the head in a small subrectangulate (♂) or obtuse-angulate (♀) process, caudal margin produced into a long and distinctly hastate process in the male and an acute-angulate one in the female; lateral lobes considerably longer than deep. Tegmina rather broad, costal border distinctly arcuate, apex rounded with a faint oblique truncation; in the male exceeding the apex of the abdomen by two-thirds the length of the pronotum, in the female not exceeding the apex of the abdomen. Wings with the expanded portion of the axillary field broader distad than proximad and with the cross veins oblique; second lobe strongly developed, particularly so in the female. Prosternal spine long, erect, acute. Interspace between the mesosternal lobes strongly transverse, the lateral angles rounded.

Interspace between the metasternal lobes about twice as wide as deep in the male, three times as wide as deep in the female. Limbs of the slender type usual in the genus, the caudal femora distinctly exceeding

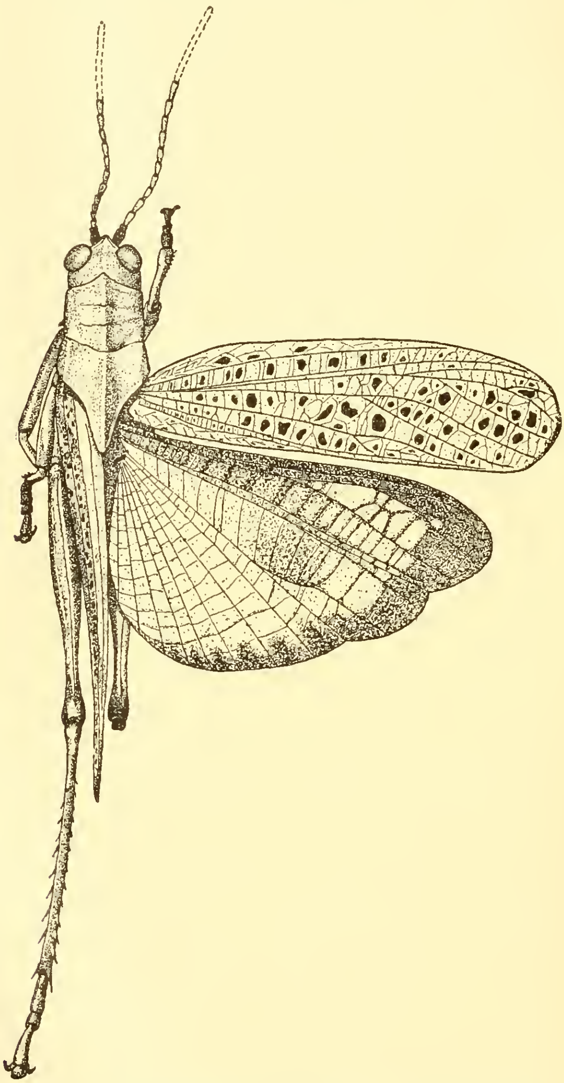


Fig. 11.—*Tæniopoda varipennis* n. sp. Male type.

the apex of the abdomen in the male, falling slightly short of the same in the female.

General color, above gallstone yellow with a strong greenish tinge on the tegmina, becoming more ochraceous on the pronotum and head. Head with the mandibles and a transverse line on the clypeus shining black in the female, the base of the mandibles suffused with ochraceous in the male; antennæ orpiment yellow, the two basal joints shining black; eyes hazel. Tegmina with an irregularly distributed series of seal brown spots of varying size; apex narrowly and rather obscurely margined with the same color. Wings geranium red, the margins, except the proximal portion of the radial margin, broadly suffused with black, the dilated ulnar and axillary regions also colored as usual in the genus. Abdomen blackish-brown. Limbs dull ochraceous and black, the two distributed as in other species of genus.

Measurements.

	♂	♀
Length of body,	35.5 mm.	53 mm.
Length of pronotum,	14.5 "	19 "
Greatest width of pronotum,	7 "	10 "
Length of tegmen,	33 "	36 "
Greatest width of tegmen,	10 "	11 "
Greatest width of wing,	18.2 "	17.5 "
Length of caudal femur,	23.5 "	25.5 "

Two specimens have been examined in addition to the types, both of which are males, one topotypic of the same sex and in the Hebard collection, the other topotypic with the female and in the United States National Museum. These specimens are identical with the male type in all essential respects, some slight variation in the distribution of spots on the tegmina being all that is noticed. The San José male has the antennæ but very slightly damaged, and from this we see that the terminal joints are blackish.

The genus *Tæniopoda* as represented by the material in hand falls into two groups. All the known species are at hand except *T. superba* (Stål) and *gutterosa* Bolivar, which appear to be quite distinct from the forms studied. The eighty-nine specimens examined can be divided usually into two groups, as separated by Bolivar in his key of the genus.[3] One type represented by *picticornis* (Walker) and *burmeisteri* Bolivar is characterized by the rather low and rather indistinctly biarcuate median crest of the pronotum. The other type represented by *centurio* (Drury), *auricornis* (Walker), *pulchella* Bolivar and *varipennis* Rehn is characterized by the elevated, strongly biarcuate median crest of the pronotum, while *T. tamaulipensis* Rehn is about intermediate between the two types.

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[3] *Bol. Soc. Españ. Hist. Nat.*, I, p. 265, 1901.

The type represented by *centurio* is especially interesting as all the species are in hand and their differential characters easily seen. Drury's *centurio* is quite distinct from the others and need not be considered as its size is diagnostic. The three others—*auricornis, pulchella*[4] and *varipennis*—can be easily separated by the outline of the dorsal aspect of the pronotum, *pulchella* representing an extreme broad, inflated type with an almost rectangulate caudal angle (fig. 14), *varipennis* (fig. 12) representing the other extreme with the pronotum compressed and the caudal angle strongly and acutely produced. Between these two extremes is *auricornis*, presenting a rather broad pronotum with the angle acute but not long produced (fig. 13).

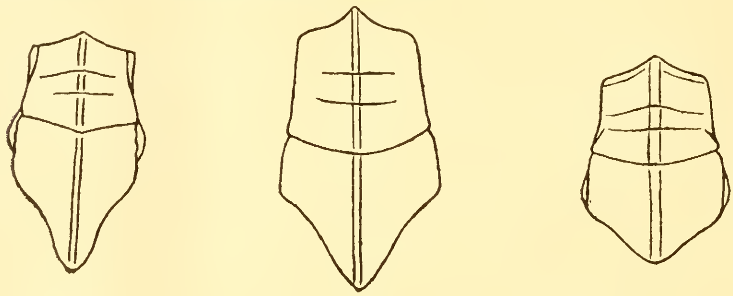

Fig. 12. Fig. 13. Fig. 14.

Fig. 12.—*Tæniopoda varipennis*, dorsal view of female type. Fig. 13.—*T. auricornis*, ditto of female from Alta Mira, Tamaulipas. Fig. 14.—*T. pulchella*, ditto of female from Jalapa, Vera Cruz.

CHROMACRIS Walker.

Chromacris trogon Gerstaecker.

1873. *Romalea trogon* Gerstaecker, Stett. Entom. Zeit., XXIII, p. 186. [Costa Rica.]

San Carlos, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] Five males, three females.

Pozo Azul de Pirris, Costa Rica. May–June, 1903. (C. F. Underwood.) [A. N. S. Phila.] One male.

Carrillo, Costa Rica. [Hebard collection.] Seven males, two females.

This series is remarkably uniform in coloration.

RHICNODERMA Gerstaecker.

1889. *Rhicnoderma* Gerstaecker, Mittheil. Naturwiss. Ver. Neu-Vorpomm. Rügen, XX, p. 28

Type.—*R. olivaceum* Gerstaecker.

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[4] This is the species previously recorded by myself as *T. centurio;* see *Trans. Amer. Ent. Soc.*, XXVII, p. 228; XXIX, p. 12.

Rhicnoderma humile n. sp.

Type; ♀; Tarbaca, Costa Rica. December, 1902. (C. F. Underwood.) [A. N. S. Phila.]

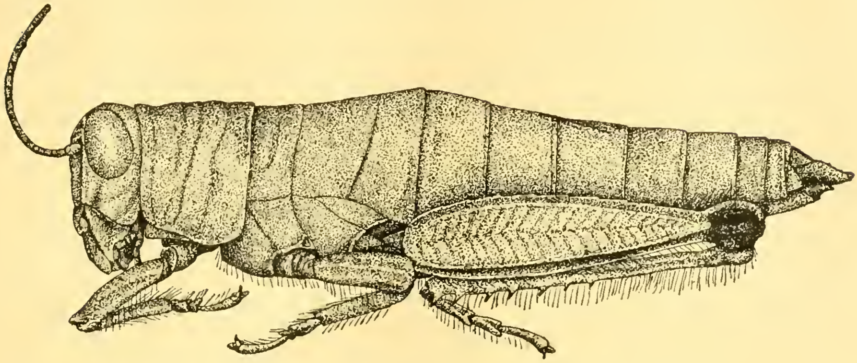

Fig. 15.—*Rhicnoderma humile* n. sp. Lateral view of type.

Allied to *R. olivaceum* from Chiriqui, but differing in the very low and weak median carina of the pronotum, the partially sulcate frontal costa and some color details.

Form subcylindrical, flattened ventrad; surface of the head, thoracic and basal abdominal segments regularly rugulose, smoother on the abdomen and ventral surface; limbs and ventral surface supplied with rather long, soft hairs, which are most numerous on the caudal tibiæ. Head flattened transversely, but little deeper than broad; occiput and vertex gently rounded; fastigium depressed, declivent, longitudinally excavated mesad, separated from the face by a low carina; interocular space considerably wider than the width of the eye; frontal costa considerably excavated, intersected by a transverse carina between the bases of the antennæ, about which is an oblong enclosed space, below constricted from the width of the dorsal section to half the same width, ventrad failing to reach the clypeal suture; supplementary facial carinæ distinct; clypeus considerably inflated; eyes elliptically ovate, distinctly longer than the infra-ocular portion of the genæ; antennæ about equal to the head and pronotum in length, filiform. Pronotum short; cephalic margin slightly rounded with a distinct median emargination, which forms two blunt points on each side of the median line; caudal margin subtruncate; median carina very slightly marked and more noticeable, by the absence of rugosities than any distinct eleva-

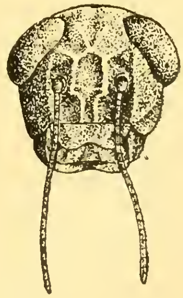

Fig. 16.—*Rhicnoderma humile* n. sp. Cephalic view of head.

tion; complete transverse sulci three in number, the caudal one placed close to the caudal margin, the cephalic sulcus distant from the cephalic margin a distance equal to the space from the second sulcus to the caudal margin, interspaces between the first, second and third sulci subequal dorsad; lateral lobes much deeper than long, cephalic and caudal margins subparallel, ventral margin rotundate, emarginate cephalad. No tegmina or wings present. Exposed portion of the mesonotum less than half as long as the metanotum; median carina on both segments marked as on pronotum. Abdomen very slightly compressed, distinctly but slightly carinate. Ovipositor jaws rather blunt. Prosternum with a low quadrate process with blunt slightly produced angles. Mesosternum and metasternum distinctly concave. Cephalic femora slightly bowed, inflated, with several depressed areas on the caudal face, and a distinct carina on the superior portion of the cephalic face, cephalic genicular lobe more produced and rotundate than the caudal one; tibiæ equal in length and but slightly slenderer than the femora, straight; terminal tarsal joint very distinctly exceeding the basal two in length. Median femora about equal in the length to the cephalic femora, compressed, several slight or irregular carinæ present, cephalic genicular lobe large and rotundate, caudal genicular lobe very slight and little more than a cingulum; tibiæ and tarsi as in the cephalic limbs. Caudal femora not reaching to the apex of the abdomen, about four and one-half times as long as the greatest width, compressed, margins regularly but slightly arcuate, pregenicular constriction slight, carina distinct, the median dorsal slightly serrato-dentate, pattern of the pagina distinct but flattened and with little relief, genicular arch rather low, genicular lobes rectangulate apically with the ventral margin rotundato-sinuate; tibiæ slightly shorter than the femora, lateral margins with seven rather blunt spines, including the apical one, internal margins with ten spines including the apical one; metatarsus and terminal tarsal joint subequal in length, second joint distinctly shorter than the others, the whole tarsus about half the length of the tibia.

General color cinnamon, eyes russet. Margins of the pronotum, and caudal margins of the metanotum and basal abdominal segments narrowly washed with a more or less distinct blackish-brown suffusion. Median limbs dull brownish caudad. Caudal femora marked along the lateral and median carinæ and on the whole genicular faces with blackish-brown; dorsal portion of the genicular region ochre yellow distad, caudal face of the caudal femora blackish except for a narrow ochre yellow edging to the genicular region. Caudal tibiæ and tarsi cephalad vinaceous-cinnamon, caudad dragon's blood red, spines with a small apical touch of black. Hairs of the limbs and ventral surface silvery white.

Measurements.

Length of body, ...	32 mm.
Length of pronotum, ...	4.5 "
Greatest width of pronotum, ...	6.7 "
Length of exposed portion of meso- and metanotum, . . .	7.2 "
Length of caudal femur, ...	14.5 "

The type is the only specimen seen.

COPIOCERA Burmeister.

1838. *Copiocera* Burmeister, Handb. d. Entom., Bd. II, Abth. II, I, p. 611.

Included *Gryllus euceros* Marschall and *Xiphicera erythrogastra* Perty, of which the former may be considered the type.

Copiocera specularis Gerstaecker.

1889. *Copiocera specularis* Gerstaecker, Mittheil. Naturwissen. Ver. Neu-Vorpomm. Rügen, XX, p. 35. [Chiriqui.]

San Carlos, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] Four males, two females.

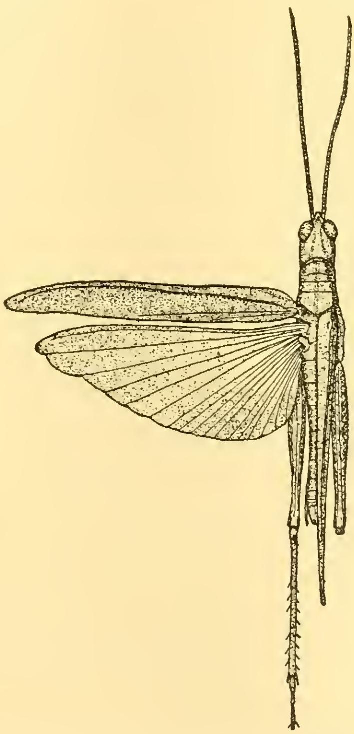

Fig. 17.—*Copiocera specularis* Gerstaecker. Male. Dorsal view.

Turrialba, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One male.

This beautiful species can readily be recognized by the coloration, the blood-red abdomen, dull yellow genicular areas and the bluish-

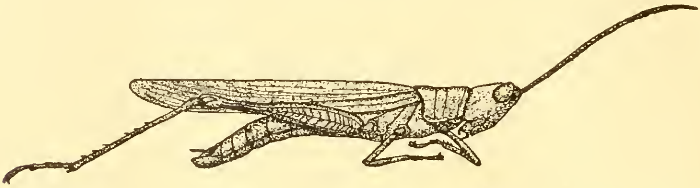

Fig. 18.—*Copiocera specularis* Gerstaecker. Male. Lateral view.

hyaline base of the wing. Some variation exists in the intensity of the color of the abdomen, several individuals being very dull gray brown with hardly any reddish tint, while others are fully colored. The colored base of the wing is more greenish than bluish in one female individual.

ŒDALOMETOPON[5] n. gen.

Type.—*O. petasatum* n. sp.

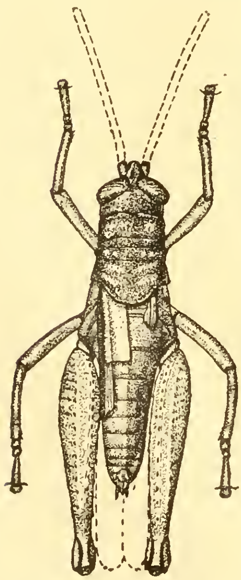

Fig. 19.—*Œdalometopon petasatum* n. gen. and sp. Type.

Apparently allied to *Bucephalacris* Giglio-Tos, but the whole structure has a different aspect, the form heavier, more inflated and quite different when taken in detail.

Head with the fastigium considerably produced; face subconcave when viewed laterad. Pronotum subselliform with the transverse carinæ strongly impressed, caudal portion produced and rounded. Tegmina and wings present. Prosternal spine very blunt and low. Interspaces between the mesosternal and metasternal lobes subequal cephalad, the metasternal interspace strongly narrowed caudad. Caudal femora inflated, strongly carinate and all carinæ serrato-dentate, genicular region inflated; caudal tibiæ with apical spines on both sides; caudal tarsi elongate, more than two-thirds the length of the tibiæ, arolia present.

Œdalometopon petasatum n. sp.

Type: ♀; Carrillo, Costa Rica. [Hebard collection.]

[5] Οιδαλεον, *swelling;* μετωπον, *forehead.*

Form subfusiform; entire surface, except the abdomen and ventral aspect, rugose. Head with the occiput and vertex gently rounded, descending to the extremely narrow interocular space; fastigium horizontal, produced from the interocular region at a level well below that of the vertex into a peg-like process about as long as the width of one of the eyes, compressed, faintly sulcate dorsad, expanding proximad, apex when viewed laterad rotundato-truncate; face retreating, subconcave when viewed laterad, frontal costa present as a slight short sulcation on the ventral aspect of the fastigial process; lateral ocelli placed on the dorsal aspect of the proximal part of the fastigium, median ocellus placed in the middle of the sulcation of the frontal costa; eyes ovate, the greatest length diagonal, greatest length slightly greater than the infraocular portion of the genæ; antennæ broken in the type. Pronotum rounded, subselliform, no median or lateral carinæ present; cephalic margin slightly rotundate with a broad shallow median emargination; caudal margin rounded rectangulate, no distinct angle present; transverse sulci strongly im-

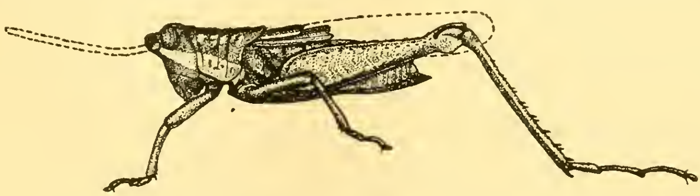

Fig. 2C.—*Œdalometopon petasatum* n. gen. and sp. Type.

pressed, three in number, prozona slightly longer than the metazona; lateral lobes slightly longer than deep, cephalic margin slightly arcuate, ventral margin emarginate cephalad, broadly subrotundate caudad, caudal margin with the dorsal half with a distinct but very shallow emargination, the ventral half with a blunt angle which rounds into the ventral margin; a longitudinal group of irregular callosities presented in the usual position of the lateral carinæ. Tegmina broken, surface coriaceous, rugose. Wings broken. Abdomen somewhat compressed, carinate above; ovipositor jaws weak, slender, unarmed. Prosternal spine a blunt cone, quadrate in basal outline. Interspace between the mesosternal lobes slightly wider than deep, as wide as the lobes themselves, angles slightly rounded; interspace between the metasternal lobes equal to the mesosternal interspace cephalad, constricted caudad to slightly less than half that width. Cephalic femora moderately robust, about two-thirds the length of the pronotum.

Median femora similar to the cephalic but larger, only slightly shorter than the pronotum. Cephalic and median tarsi with the two proximal joints short, the terminal only moderately long, the whole rather robust. Caudal femora robust, two-thirds the length of the body, slightly more than four times as long as broad, median and lateral carinæ distinct, serrato-dentate, pattern of the pagina dentato-tuberculate, genicular region large, slightly less than one-fourth the total length, strongly arched, genicular lobes apically acute, rotundato-emarginate below, pregenicular constriction very distinct; caudal tibiæ distinctly shorter tnan the femora, supplied with eight spines on each margin, including the apical, spurs of the internal margin longer than the external spurs; caudal tarsi slender, elongate, two-thirds the length of the tibiæ, the segments increasing in length distad, surface rather evenly clothed with long hairs.

General color, above brownish-olive green, the head and pronotum with spots of naples yellow, a line of the same on the angle of the tegmina, and a broad bar, widening caudad, extending from the antennal fossæ to the insertion of the median limbs, across the whole ventral portion of the lateral lobes of the pronotum. Eyes tawny-olive, lined diagonally with regular bars of olive-brown, the well-marked bars being six in number; apex of the fastigial process suffused with dull lake red. Cephalic and median limbs oil green, the proximal portions of the tibiæ darkening to parrot green. Caudal femora apple green, the serrations and tubercles of the pagina black, genicular regions ochraceous-buff, the arches blackish; tibiæ proximad dull ochraceous-buff, blending to oil green then to ochraceous-buff distad, spines black practically to the bases, spurs tipped with black; tarsi ochraceous-buff, the claws oil green with black tips, hair white.

Measurements.

Length of body, ...	27.5 mm.
Length of pronotum, ...	7.5 "
Caudal dorsal width of pronotum, ...	5.7 "
Length of caudal femur, ...	18.2 "

The type is unique.

ANNICERIS Stål.

1878. *Anniceris* Stål, Bihang till K. Svenska Vet.-Akad. Handlingar, V, No. 4, pp. 37, 82.

Included *A. geniculatus* and *nigrinervis* Stål, of which the former may be considered the type.

Anniceris truncatus n. sp.

Type: ♀; Tarbaca, Costa Rica. November, 1902. (C. F. Underwood.) [A. N. S. Phila.]

Allied to *A. geniculatus* Stål from Peru and *A. olivaceus* Giglio-Tos from Darien; differing from the former in the horizontal fastigium, the uncarinate vertex and the rather different coloration; differing from the latter in the moderately distinct lateral carinæ of the face and the more subdued color pattern.

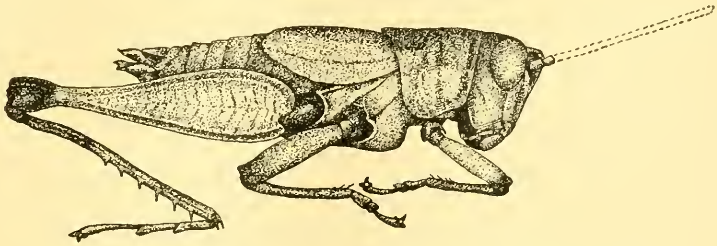

Fig. 21.—*Anniceris truncatus* n. sp. Lateral view of type.

Size small; form slightly compressed; surface rugulose. Head with the occiput and vertex gently rounded, descending easily to the base of the fastigium; interocular region narrow, slightly more than half the apical width of the fastigium; fastigium broad at the base, tapering evenly with a truncate apex, apical width about twice the length, dorsal surface slightly excavate near the cingulate margin; frontal costa not distinct below the insertion of the antennæ, very slightly sulcate; face slightly retreating when viewed laterad; lateral ocelli inserted in the supraantennal margin of the base of the fastigium, median below the insertion of the antennæ and slightly above the base of the fastigial process; eyes subreniform, moderately prominent, slightly longer than the infraocular portion of the genæ; antennæ missing. Pronotum rotundato-deplanate dorsad; median carinæ very weak, more apparent caudad than cephalad; lateral carinæ not present, but distinct shoulders on the metazona represent them; cephalic margin faintly arcuate; caudal margin subtruncate; transverse sulci three in number, the cephalic and caudal more apparent than the median, prozona àlmost half again as long as the metazona; lateral lobes of the pronotum distinctly deeper than long,. cephalic margin slightly sinuate, ventral margin emarginate cephalad, rotundate caudad, caudal margin very slightly and broadly emarginate for its whole length, a slight ventro-caudal angle developed above the level of the ventral margin. Tegmina ovate-lanceolate, slightly longer than the pronotum, breadth contained twice in the length, apex narrowly rounded; principal longitudinal veins distant, remainder irregularly reticulate. Abdomen compressed, carinate above; ovipositor jaws hooked apically. Prosternal protuberance very low and blunt, no spine present. Interspace between the mesosternal lobes wedge-shaped, slightly narrower than one of the lobes, but much wider than deep; interspace between the metasternal lobes about half the width of that between the mesosternal lobes, constricted caudad. Cephalic femora about four-fifths the length of the pronotum; tibiæ very slightly longer than the femora; tarsi about three-fourths the length of the tibiæ. Median limbs similar to the cephalic but slightly larger and more compressed. Caudal femora moderately robust, length equal to that of the head, pronotum and tegmina, greatest width at the basal fourth and contained about four times in the length, pattern of the external pagina regular, genicular region of medium size, the lobes moderately acute with the ventral margin sinuato-rotundate; tibiæ very slightly shorter than the femora, slightly sinuate, six spines present on the external margin, no apical spine, eight spines present on the internal margin including the apical spine; tarsi elongate, the joints slender.

General color olive-green, lighter on the tegmina than on the head and pronotum; eyes tawny-olive. An obscure postocular streak on the head and on the dorsal half of the prozona of the lateral lobes of the pronotum blackish, ventral half of the lateral lobes and all of the pleura except a narrow blackish dorsal section very dull gamboge-yellow. Abdomen above vandyke brown except the apex, which is ferruginous. Ventral surface cinnamon. Cephalic and median limbs oil green. Caudal femora oil green, the genicular region blackish; tibiæ and tarsi verdigris green, the spines narrowly tipped with blackish.

Measurements.

Length of body,	17	mm.
Length of pronotum,	4.1	"
Greatest dorsal width of pronotum	3.2	"
Length of tegmen,	6	"
Greatest width of tegmen,	3	"
Length of caudal femur,	11.6	"

The type is unique.

DELLIA Stål.

1878. *Dellia* Stål, Bihang till K. Svenska Vet. Akad. Handl., V, No. 4, pp. 37, 83.

Type.—*D. insulana* Stål.

Dellia miniatula n. sp.

Types: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Differing from *D. insulana* in the heavy cerci, the smaller general size, the recurved apex of the male abdomen, and the general coloration.

Size small; form elongate, slightly compressed; surface polished, clothed with numerous hairs. Head with the occiput considerably inflated, descending to the extremely narrow interocular space; fastigium short, wedge-shaped, the apex truncate, with a very slight longitudinal sulcus, when viewed laterad the dorsal outline descends and

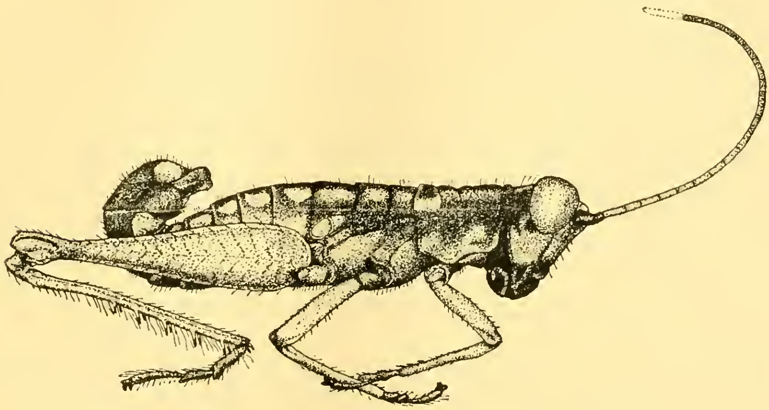

Fig. 22.—*Dellia miniatula* n. sp. Lateral view of male type.

rounds without any distinct angle in the regularly retreating face; no distinct frontal costa; lateral ocelli placed on the supra-antennal margin of the fastigium, the median placed near the point at which the fastigium blends into the face; eyes subovoid, very prominent and subglobose in the male, considerably elevated above the occiput, about twice as long as the infra-ocular portion of the genæ, moderately prominent and considerably inflated in the female, slightly less than twice as long as the infra-ocular portion of the genæ; antennæ very slender, filiform, about equal to the length of the body in the male, about equal to the length of the abdomen in the female. Pronotum rounded, without median or lateral carinæ, metazona of male slightly and of female distinctly punctate; cephalic margin subarcuate, the median portion slightly truncate; caudal margin with a broad, shallow angular emargination; transverse sulci four in number, very strongly impressed in the male, weaker but distinct in the female, metazona about one-third the length of the prozona; lateral lobes slightly deeper than long, the cephalic margin slightly sinuate, ventral margin rotundate-emarginate cephalad, subrotundate caudad, the ventro-cephalic angle rectangulate, caudal margin slightly sinuate with the ventro-caudal angle rounded obtuse-angulate. Exposed portion of the mesonotum slightly longer than the metazona in the males, distinctly shorter in the female. Tegmina minute pads, not reaching caudad of the caudal margin of the mesonotum in either sex. Abdomen compressed, carinate above; apex of the male abdomen strongly recurved; cerci broad flattened subequal plates, directed mesad, the tips flattened and acute when viewed caudad, caudal margin of the cerci thickened and forming a sort of ridge, which projects laterad of the body of the cerci; supra-anal

Fig. 23.

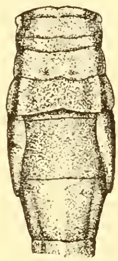

Fig. 24.

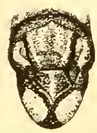

Fig. 25.

Fig. 23.—*Dellia miniatula*, dorsal view of apex of male abdomen. Fig. 24.—*Dellia ovatipennis*, dorsal view of pronotum and tegmina of type. Fig. 25.—*Dellia bimaeulata*, dorsal view of apex of male abdomen.

plate vertical in position; subgenital plate on the dorsal aspect, bullate, apically produced into a triangular process. Prosternum inflated mesad, forming a transverse rounded ridge, no spine developed. Interspace between the mesosternal lobes slightly broader than deep, equal to one of the lobes in width, the angles rounded; interspace between the metasternal lobes very narrow, trigonal, nearly closed caudad. Cephalic femora slightly longer than the pronotum in the male, subequal in the female, cephalic genicular lobe larger and more rotundate than the caudal; tibiæ equal to the femora; terminal tarsal joint much exceeding the proximal two in length, the whole tarsus about three-fourths the length of the tibia. Median limbs similar to the cephalic but perceptibly more robust. Caudal femora slender in the male and considerably exceeding the abdomen in its normal position, in the female more robust but exceeding the abdomen by nearly the length of the pronotum, in the female the greatest width is contained over four times in the length and in the male the width is almost five times in the length, carinæ not serrate, pattern of the pagina distinct and rather widely spaced, genicular lobes slightly acute apically; tibiæ slightly shorter than the femora, slightly sinuate in the male, external margin with six spines, internal margin with seven or eight spines in the male and eight in the female including the apical spine; tarsi about half the length of the tibiæ, slender, the terminal joint elongate, arolia present.

Male.—General colors greenish-black on an oil green ground. Head with a dark occipital line and blackish postocular blotches, dorsal aspect of the fastigium pale apple green, ventral aspect and a median facial line blackish; eyes tawny olive; basal joints of the antennæ blackish, remainder umber; mouth parts blackish except palpi which are greenish-white. Pronotum with two faint parallel greenish longitudinal bars on the prozona and a distinct patch of clear oil green on the "shoulders" of the metazona; lateral lobes oil green ventrad. Mesonotum and metanotum each with a pair of parallel blotches of oil green; lower section of the pleura yellowish-green. Abdomen with each segment decorated dorsad with a pair of subreniform blotches of oil green; laterad dull apple green; ventrad the black of the segments is relieved by narrow pea green margins; subgenital plate with a large transverse subreniform spot of pea green; supra-anal plate pea green; cerci black. Cephalic limbs apple green blending to gamboge yellow on the proximal portion of the femora. Median limbs with extreme distal portion of the femora, the tibiæ and tarsi apple green; median and proximal portions of the femora carmine. Caudal femora oil green, the genicular arch faintly marked with blackish; tibiæ oil green proximad blending to verdigris green on the median and distal sections, spines brownish with black tips; tarsi very pale apple green. Hairs ashy brown.

Female.—Colors and color pattern similar to the male, but duller and with the following exceptions. Sulcation of the fastigium with a narrow line of blackish and the bars on the pronotum are much less distinct. Dorsal maculations of the mesonotum, metanotum and abdomen are solid, forming a broad, wedge-shaped maculation, narrowing caudad, on each segment; apex of the abdomen and contiguous segments blackish.

Measurements.

	♂	♀
Length of body, ...	13.5 mm.	16 mm.
Length of pronotum, ...	2.5 "	3.2 "
Greatest width of pronotum, ...	2.2 "	3.1 "
Length of caudal femur, ...	9 "	11 "

A paratypic series of three males and sixteen females of this species have been examined. There is a slight difference in the size of some female individuals, several being slightly larger than the type. A tendency to the elimination of blackish marks on the abdomen is noticed in some female individuals, and in one the abdomen is about unicolorous.

Dellia bimaculata

Types: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Differing from *D. miniatula* in the form of the male cerci, the less recurved apex of the male abdomen and the striking coloration.

Size about equal to that of *D. miniatula* in the female sex, slightly larger in the male; form similar to that of *D. miniatula;* surface slightly rugulose, rather uniformly clothed with moderately long hairs, especially on the limbs. Head with the occiput rounded and sloping toward

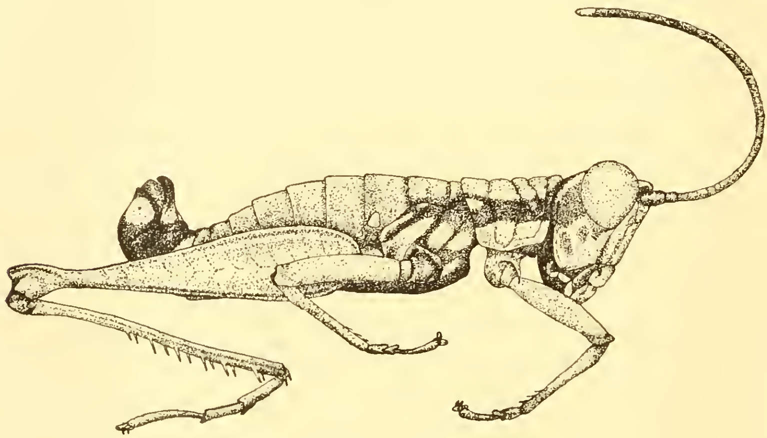

Fig. 26.—*Dellia bimaculata.* Lateral view of male type.

the fastigium; interocular space very narrow, in the male the eyes are subcontiguous; fastigium short, about as broad as long, distinctly but narrowly sulcate in both sexes, forming a distinct but narrowly rounded angle with the front, ventral aspect of fastigium slightly concave and passing insensibly into the face a very slight distance ventrad of the antennal insertions; eyes ovate and very prominent in the male, considerably elevated above the vertex and almost twice as long as the infra-ocular portion of the genæ, subreniform in the female, very slightly elevated above the vertex and slightly more than half again the infra-ocular length of the genæ; antennæ filiform, slightly shorter than the body in the male, considerably shorter in the female.

Pronotum slightly sellate; cephalic margin arcuate with a slight median truncation; caudal margin with a broad shallow angular emargination; transverse sulci four in number, more impressed in the male than in the female; prozona about twice the length of the metazona in the male, about three times in the female; lateral lobes slightly longer than deep, cephalic margin slightly sinuate, ventral margin strongly emarginate cephalad and rotundate caudad, ventro-cephalic angle rectangulate, ventro-caudal angle strongly rounded; metazona distinctly punctate. Exposed portion of the mesonotum not more than half the length of the metazona. Tegmina very small pads, not exceeding the mesonotum in length. Abdomen slightly compressed and weakly carinate dorsad; apex of the male abdomen erect and partially recurved, supra-anal plate subvertical, cerci narrower in the middle and apically than at the base, the tip curved mesad and subtruncate with a slight caudal blunt process, subgenital plate somewhat bullate with a distinct cingulate marginal ridge. Prosternum with a blunt swollen protuberance, more apparent than that found in *D. miniatula*, no spine present. Interspace between the mesosternal lobes considerably broader than deep, as broad as one of the lobes in the male, slightly broader in the female; interspace between the metasternal lobes very narrow, subcontiguous in the male. Cephalic femora as long as the pronotum in the female, slightly longer in the male; tibiæ equal to the tarsi in length; terminal joint of the tarsi considerably longer than the two proximal joints, the whole tarsus three-fourths the length of the tibia. Median limbs as the cephalic but slightly larger. Caudal femora rather slender, more robust in the female than in the male, considerably exceeding the apex of the abdomen in both sexes, greatest width contained four and one-half times in the length in the male, and four times in the female, genicular lobes acute, carinæ not serrate, pagina marked as in *D. miniatula;* tibiæ distinctly shorter than the femora, slightly sinuate, very slightly in the female, spines on the external margin four to five in the female, six in the male, on internal margin seven in each sex; tarsi elongate, slender, over half the length of the tibiæ, terminal joint very slightly shorter than the proximal two.

General color above dark oil green. Head with the vertex and fastigium pale apple green, the median sulcus slightly marked with a darker tint; face and sides of head dull french green; distinct post-ocular bar blackish; eyes raw umber; palpi oil green; antennæ blackish with the segments tipped with cinnamon. Pronotum with a continuation of the postocular streak blackish, covering the dorsal half of the lateral lobes and extending over the humeral angle to the dorsum, particularly on the metazona; humeral angle of the metazona and ventral half of the lateral lobes apple green. Mesonotum, mesopleura, metanotum and metapleura of the general tint dorsad with a distinct continuation of the postocular bar at their suture and the ventral portion of the pleura apple green, variegated with blotches of blackish chiefly along the sutures. Abdomen of the general color; recurved apex of the male abdomen blackish, the subgenital plate with two subcircular spots of olive yellow separated by a narrow line of black, cerci greenish-yellow proximad, blackish distad, supra-anal plate olive yellow. Cephalic and median limbs oil green. Caudal femora oil green with the genicular arches ochraceous-rufous; tibiæ oil green becoming blackish-brown distad, spines brownish with black tips.

Measurements.

	♂	♀
Length of body,	15.2 mm.	17.5 mm.
Length of pronotum,	2.6 "	3.2 "
Greatest width of pronotum,	2.5 "	3.1 "
Length of caudal femur,	10.2 "	10.5 "

A paratypic series of two males and three females, including the types, have been examined. They are quite constant in size and coloration.

Dellia ovatipennis n. sp.

Type: ♀; Carrillo, Costa Rica. [Hebard collection.]

Distinguished by the ovate tegmina, which are quite different from the linear type found in the other species, and also in the coloration; the blackish genicular region of the caudal femora resembling *D. insulana.*

Size rather small (when compared with females of *D. miniatula* and *bimaculata*); form as usual in the genus; surface polished, the metazona rather irregularly and feebly punctate. Head with the occiput considerably elevated, evenly descending to the vertex; interocular space narrow but equal to half the terminal width of the fastigium; fastigium very slightly shorter than the basal width, tapering, apically truncate, a very slight median longitudinal depression present; apex of the fastigium, when viewed laterad, rounded into the retreating face, the fastigial process losing its identity a short distance ventrad of the insertion of the antennæ; lateral ocelli situated at the base of the fastigium on the supra-antennal ridge, median ocellus placed at the ventral base of the fastigium; eyes ovate reniform, slightly but distinctly elevated above the vertex, greatest length distinctly greater than the length of the infra-ocular portion of the genæ; antennæ equal to the head, pronotum and tegmina in length, filiform. Pronotum rounded; cephalic margin subtruncate, caudal margin truncate with a narrow triangular median emargination; transverse sulci four in number, distinctly but not deeply impressed, metazona less than half the length of the prozona; lateral lobes slightly longer than deep, a slight sinuosity dorsad on the cephalic margin, ventral margin with the usual cephalic emargination, the caudal portion subrotundate, caudal margin faintly arcuate. Tegmina about twice as long as the metazona, elliptical, the dorsal margin with a very slight emargination toward the apex. Abdomen very distinctly compressed, strongly carinate dorsad. Prosternum with a swollen tubercle which is bluntly conic, little elevated. Interspace between the

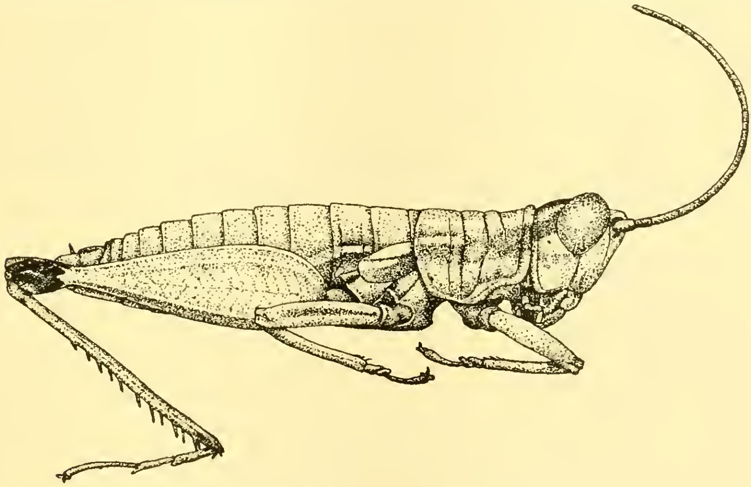

Fig. 27.—*Dellia ovatipennis* n. sp. Lateral view of type.

mesosternal lobes broader than deep, slightly broader than one of the lobes, the angles obtuse; interspace between the metasternal lobes narrow, constricted caudad by the converging lobes. Cephalic femora slightly shorter than the pronotum; tibiæ equal to the femora in length; terminal tarsal joint about twice as long as the two basal joints together, the tarsus about three-fourths the tibial length. Median limbs similar to the cephalic but slightly slenderer and longer. Caudal femora rather short, very slightly exceeding the apex of the abdomen, greatest width slightly more than one-fourth of the length, pattern of the pagina distinct and regular, genicular region slightly inflated, lobes acute; tibiæ slightly shorter than the femora, slightly sinuate in the proximal half, external margin with six spines, internal margin with eight spines including the apical; tarsi over half the tibial length, the terminal joint slightly shorter than the proximal two, the second shorter than the first; arolia present.

General color olive green, the pronotum oil green. Head with distinct postocular bars and a triangular occipital patch blackish, face and genæ oil green; fastigium narrowly margined with yellowish-green; eyes raw umber; antennæ blackish-brown. Pronotum with a continuation of the postocular bar olive green in color, a distinct humeral line of citron yellow on the metazona, a pair of indistinct parallel lines on the prozona and the ventral half of the lateral lobes citron yellow. Tegmina dull citron yellow along the dorsal edge, the ventral section blackish. Abdomen with the proximal joint with a pair of straw yellow bars placed laterad and surrounded by a blackish patch, this pattern being more or less distinctly indicated on the other abdominal segments. Cephalic and median limbs oil green, the median femora with a longitudinal blackish line; tarsi washed with ferruginous. Caudal femora oil green, the genicular region blackish; tibiæ dull verdigris green blending into umber distad, spines umber with blackish tips; tarsi ferruginous.

Measurements.

Length of body, ...	15.5 mm.
Length of pronotum, ...	3.1 "
Greatest width of pronotum, ...	2.9 "
Length of tegmen, ...	2 "
Greatest width of tegmen, ...	1.3 "
Length of caudal femur, ...	9.2 "

The type only has been examined.

JODACRIS Giglio-Tos.

1897. *Jodacris* Giglio-Tos, Boll. Mus. Zool. Anat. Comp., Torino, XII, No. 302, p. 32.

Type.—*Anniceris ferrugineus* Giglio-Tos.

Jodacris(?) costaricensis n. sp.

Types: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Differing from the previously known species of the genus in the shorter tegmina, the large and subcontiguous eyes, and the peculiar coloration. It is quite possible the species does not belong to the genus *Jodacris*, and in such case it represents a new genus.

Size small; form subfusiform; surface sparsely punctulate. Head with the occiput very slightly elevated, the vertex descending to the fastigium, slightly sulcate in the female, distinctly in the male; interocular region very narrow, the eyes subcontiguous in the male; fastigium much broader proximad than long, slightly tapering, the apex truncate and itself equal to the length, with a slight median excavation dorsad; lateral view of the fastigium with the apex broadly truncate and with a distinct dorsal angle in the male, slightly arcuate and with the angle reduced in the female; frontal costa extending but little below the ventral base of the fastigium and distinctly sulcate in the male, about limited to the ventral face of the fastigium and very slightly sulcate in the female; lateral ocelli placed at the base of the supra-ocular margin of the fastigium, median ocellus placed slightly below the insertion of the antennæ; face very strongly retreating in the male, distinctly declivent in the female, slightly concave in both sexes; eyes subreniform, quite

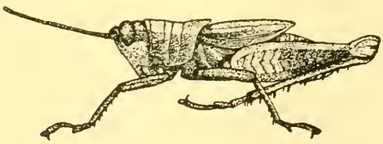

Fig. 28.

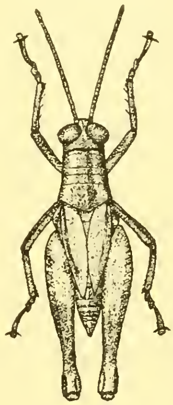

Fig. 29.

Jodacris(?) *costaricensis* n. sp. Female type. Fig. 28.—Lateral view. Fig. 29. —Dorsal view.

prominent in both sexes but very prominent in the male, considerably elevated above the interocular region, length of the eye distinctly (male) or slightly greater than the infra-ocular length of the genæ; antennæ of male slightly longer than the head and pronotum, filiform, slightly depressed distad. Pronotum very slightly tectate, median carina weakly indicated, no lateral carinæ present but humeral angle apparent; cephalic margin produced rotundate with a distinct but shallow median emargination, caudal margin very obtuse-angulate; transverse sulci three in number, all more deeply indicated in the male and of which the caudal alone intersects the median carina in the male, cephalic margin bordered caudad by a distinct depression which has the appearance of a sulcus in the female; metazona strongly punctulate, about half the length of the prozona; lateral lobes distinctly longer than deep, cephalic margin oblique, slightly sinuate, ventral margin very strongly emarginate cephalad, the ventro-cephalic angle rectangulate, caudal section obliquely (ventro-cephalad) truncate, slightly sinuate, ventro-caudal angle obtuse, caudal margin about straight from the humeral angle. Tegmina very slightly shorter than the head and pronotum, lanceolate; the tips very acute in the female, narrowly rounded in the male; surface reticulate, the principal longitudinal veins distinct. Abdomen slightly compressed, carinate dorsad; apex of the male abdomen very slightly recurved, cerci erect, slender, tapering, slightly recurved distad, subgenital plate moderately produced, subspatulate, apically rounded. Prosternal spine small, very short, rather blunt, submammiform. Interspace between the mesosternal lobes slightly broader than long, slightly broader caudad than one of the lobes, the angle obtuse in the male, in the female the interspace is decidedly broader than one of the lobes and the angles are rounded; interspace between the metasternal lobes very narrow and with the lobes subcontiguous caudad in the male, slightly longer than broad with the angles well rounded in the female. Cephalic femora comparatively much heavier in the male than in the female, slightly shorter than the pronotum; tibiæ equal to the femora in length, terminal tarsal joint about twice the length of the two small proximal joints, arolia broad. Median limbs similar to the cephalic but larger. Caudal femora robust, especially in the female, length exceeding that of the whole abdomen, greatest width contained three and a half (female) to three and three-fourths (male) in the length of the femur, genicular region moderately inflated, the lobes subrectangulate, carinæ with very minute serrulations, pregenicular constriction marked, pattern of the pagina distinct and regular but not deeply impressed; tibiæ slightly shorter than the femora, external margin with seven spines, internal with nine including the apical; tarsi about half the length of the tibiæ, the distal joint distinctly exceeding the proximal in length, the median about half the length of the proximal, arolia rather broad.

General color, oil green marked with olive yellow on the head and pronotum. Head with the face and genæ olive yellow, the postocular streak olive green; eyes walnut brown; antennæ apple green rather obscurely annulate with prout's brown. Pronotum mesad olive green bordered laterad by bars of olive yellow, the postocular bar french green, rather obscure on the metazona, the ventral portion of the lateral lobes olive yellow. Tegmina olive green in the female, that tint shading distad to apple green in the male, a group of the principal longitudinal veins marked with blackish. Abdomen dull brown, the segments margined caudad with a darker shade. Cephalic and median limbs oil green, marked at the articulations with blackish-brown. Caudal femora with the extreme proximal section and a section between the middle of the genicular region oil green, the intermediate portion and the genicular region chinese orange; tibiæ verdigris green, the extreme proximal section tinted with chinese orange, spines blackish apically; tarsi dull greenish.

Measurements.

	♂	♀
Length of body,	12.5 mm.	15 mm.
Length of pronotum,	3 "	4.7 "
Greatest width of pronotum,	2.2 "	3.2 "
Length of tegmen,	4 "	6 "
Greatest width of tegmen,	1.7 "	2.5 "
Length of caudal femur,	8 "	11 "

The types are unique.

SYLETRIA[6] **n. gen.**

A member of the *Xiphiolæ*, and probably allied to the genus *Saparus* Giglio-Tos, from which it differs in a number of characters. A decided superficial resemblance to the genus *Machærocera* is noticeable.

Type.—*S. angulata* n. sp.

Form compressed. Head very deep; occiput separated from the vertex and fastigium by an elevated interocular region; fastigium slightly produced, slightly broader than long; frontal costa narrow, facial carinæ distinct; eyes elongate elliptical. Pronotum depressed above; median carina distinct but not highly elevated; no lateral carinæ but distinct humeral angles on the metazona. Tegmina elongate, apex obliquely truncate. Abdomen strongly compressed. Prosternal spine erect, conic. Interspace between the mesosternal lobes quadrate, between the metasternal lobes longitudinal. Caudal femora slender, dorsal carinæ serrate. Caudal tibiæ with nine spines on the external margin, no apical spine; internal margin with eleven spines including the apical.

Syletria angulata n. sp.

Type: ♀; Carrillo, Costa Rica. [Hebard collection.]

Size rather large; form distinctly compressed; surface uniformly rugulose. Head when viewed cephalad twice as deep as wide; occiput ascending to the vertex which is less than half the width of the fasti-

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[6] Συλητρια, *a female plunderer.*

gium and subangulate when viewed laterad; cephalad descending slightly, bearing two distinct lateral and a weak median carinæ; fastigium horizontal, the proximal width considerably greater than the length, the lateral carinæ of the vertex continued on the fastigium,

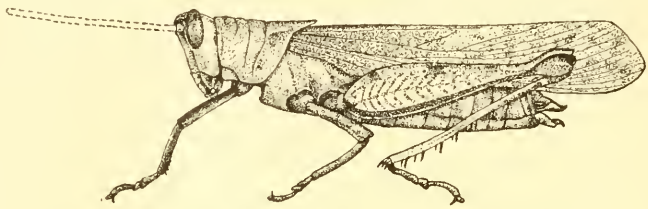

Fig. 30.—*Syletria angulata* n. gen. and sp. Lateral view of type.

distal portion angulate, the immediate angle blending into the frontal costa, broadly and shallowly excavated, the margins elevated, frontal costa narrow at its junction with the fastigium, expanding slightly between the antennæ, the margins below rather weak, constricted sharply below the ocellus, but ventrad to this of the normal width and reaching the clypeal margin, strongly punctate dorsad, sulcate at and below the ocellus; lateral facial carinæ distinct; lateral ocelli placed at the base of the fastigium, median ocellus placed ventrad of the slight dorsal expansion of the frontal costa; eyes elongate elliptical; antennæ missing. Pronotum with the median carina slight but distinct, slightly more elevated at the intersection of the caudal sulcus; cephalic margin subtruncate with a very small median emargination; caudal margin rectangulate, the angle very marked and the margin laterad very slightly emarginate; transverse sulci three in number, the metazona slightly longer than the prozona; lateral lobes longer than deep, the cephalic margin very slightly sinuate, ventral margin distinctly and sharply rotundate-emarginate cephalad, the ventro-cephalic angle obtuse, caudal portion of the ventral margin and the ventro-caudal angle rounded into the caudal margin, which is arcuate with a very slight humeral concavity. Tegmina considerably exceeding the abdomen and caudal femora in

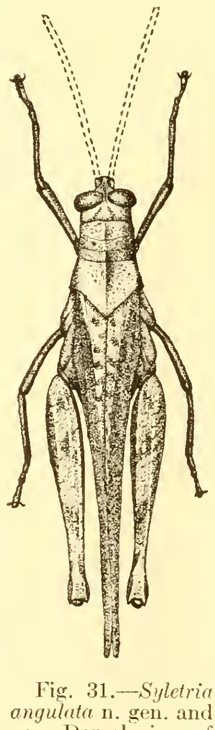

Fig. 31.—*Syletria angulata* n. gen. and sp. Dorsal view of type.

length, over twice the length of the head and pronotum together; greatest width in the apical fourth; costal expansion distinct, one-fourth the distance from the base, remainder of costal margin straight except near the apex where it is rounded; apex obliquely truncate, subrectangulate ventrad, obtuse-angulate dorsad; anal margin straight. Wings equal to the tegmina in length. Prosternal spine erect, acute, distinctly compressed. Interspace between the mesosternal lobes quadrate, slightly less than the width of one of the lobes, the lobes rounded. Interspace between the metasternal lobes longitudinal, about one and a half times as long as the caudal interspace, cephalic width slightly greater, lobes rounded. Abdomen strongly compressed, carinate dorsad. Cephalic femora straight, the greatest width in the distal third, length nearly three-fourths that of the pronotum, genicular lobes rounded, the cephalic much larger than the caudal; tibiæ as long as the femora, the spines on distal portion strong; tarsi but little shorter than the tibiæ, the median joint little more than a third the length of the proximal, the distal joint slightly exceeding the proximal and median in length, arolia present. Median femora about equal in length to the cephalic but more compressed, genicular lobes, tibiæ and tarsi as in the cephalic limbs. Caudal femora elongate, slender, two-thirds the length of the tegmina, proximal portion considerably inflated, the greatest width contained four and a half times in the length of the femur, dorsal carinæ serrate, pattern of the pagina elevated, distinct and regular, areas on the dorsal face finely tuberculate, ventral areas glabrous, pregenicular region distinctly constricted and extending a considerable distance proximad, genicular region little arched and produced into a pair of subacute processes dorsad, genicular lobes short, narrowly rounded at the apex; tibiæ slightly shorter than the femora, slightly sinuate, external margin with nine spines, internal margin with eleven including the apical; tarsi about one-third the length of the tibiæ, the proximal and distal joints subequal in length, median joint about half the length of the proximal, arolia present.

General color, broccoli brown minutely speckled with bistre. Head inclined toward tawny olive, two diverging subobsolete semilunate blotches of umber on the occiput; eyes prout's brown. Pronotum with the prozona very slightly lighter than the metazona, the whole uniformly dotted with bistre. Tegmina with numerous regularly disposed quadrate blotches of dilute bistre, those of the costal and anal areas smaller than the blotches of the discoidal area. Wings of the same tint as the tegmina. Segments of the abdomen margined with blackish. Cephalic and median limbs speckled with bistre on the cephalic aspect, shiny black on the caudal aspect. Caudal femora isabella color on the dorsal and lateral faces, with three distinct bars of bistre on the dorsal face, one basal, one median, one caudo-median, and one genicular, the median and caudo-median slightly suffusing the lateral face, carinæ and dorsal tubercles bistre, externo-ventral area blackish, internal face and interno-ventral area scarlet vermilion, genicular region suffused with bistre; tibiæ scarlet vermilion, the proximal portion, a touch on the external face of the proximal section, the entire external spines and the tips of the internal spines blackish; tarsi scarlet vermilion.

Measurements.

Length of body,	33	mm.
Length of pronotum,	8	"
Greatest width of pronotum,	5	"
Length of tegmen,	30	"
Greatest width of tegmen,	5.5	"
Length of caudal femur,	19	"

This interesting new genus is represented only by the unique type. It bears a great superficial resemblance to the Truxalid genus *Machærocera.*

LEPTOMERINTHOPRORA[7] n. gen.

A member of the *Xiphiolæ*, and probably related to *Xiphiola* Bolivar. The general structure is, however, very different, and suggests a relationship to the *Vilernæ.*

Type.—*L. brevipennis* n. sp.

Head with the fastigium trigonal, slightly projecting beyond the face; frontal costa precurrent. Pronotum with a distinct median carina, humeral angles marked; transverse sulci three in number; lateral lobes with the ventral margin emarginate cephalad and caudad. Tegmina little exceeding the pronotum in length, apex rectangulate, costal expansion marked. Prosternal spine erect, rather slender, blunt. Interspace between the mesosternal lobes slightly transverse, interspace between the metasternal lobes subquadrate. Caudal tibiæ with seven spines on the external margin, no apical spine; nine spines on the internal margin including the apical spine.

[7] Λεπτος, *thin;* μηρινθος, *cord;* πρωρα, *face.*

Leptomerinthoprora brevipennis n. sp.

Type: ♀; Pozo Azul de Pirris, Costa Rica. May–June, 1902. (C. F. Underwood.) [A. N. S. Phila.]

Size rather small; form elongate fusiform; surface of the pronotum and pleura rugoso-punctate. Head with the occiput and vertex rounded, not markedly elevated; interocular region slightly more than half the proximal width of the fastigium; fastigium produced trigonal, the apex rounded, shallowly excavated, margins distinct, lateral view of fastigium rounded, slightly projecting beyond and rounding into the slightly retreating face; frontal costa strongly constricted at the ocellus, subequal elsewhere, strongly sulcate except dorsad and ventrad; lateral ocelli placed close to the eye ventrad of the margin of the fastigium, median ocellus placed a short distance below the insertion of the antennæ; eyes reniform, slightly narrower dorsad than ventrad, slightly

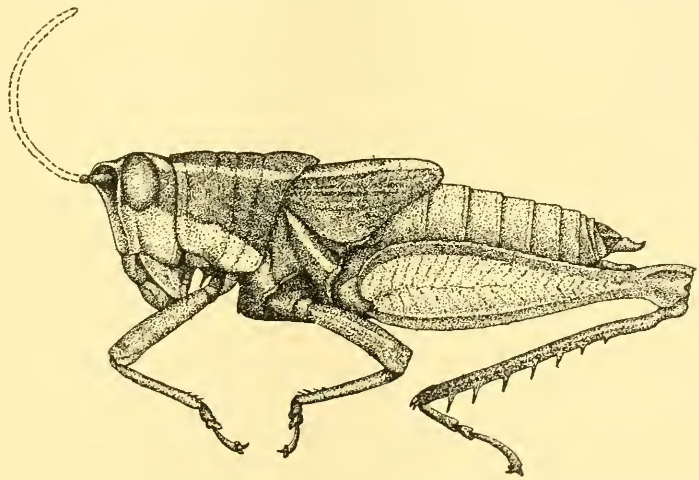

Fig. 32.—*Leptomerinthoprora brevipennis* n. gen. and sp. Lateral view of type.

longer than the infra-ocular portion of the genæ; antennæ missing. Pronotum moderately tectate, median carina slightly elevated; cephalic margin slightly produced and with a very slight median emargination; caudal margin rounded obtuse-angulate, the angle with a very slight emargination; transverse sulci three in number, a slight transverse depression extending parallel with the cephalic margin, metazona little more than half the length of the prozona; lateral lobes slightly longer than deep, cephalic margin regularly sinuate, ventral margin emarginate cephalad and caudad with a rounded median projection, ventro-cephalic angle obtuse, ventro-caudal angle rounded rectangulate, caudal margin slightly oblique. Tegmina slightly longer than the pronotum; costal area strongly and roundly dilated mesad; distal half acuminate, the apex narrowly rounded, anal area distinctly arcuate; principal longitudinal veins distinct, interspaces irregularly reticulate. Abdomen compressed, carinate dorsad; margins of the ovipositor jaws indistinctly serrulate. Prosternal spine erect, slightly tapering, the apex blunt. Interspace between the mesosternal lobes with the length contained nearly once and a half in the width, which latter is slightly greater than the width of one of the lobes, angles rounded; interspace between the metasternal lobes subquadrate, slightly broader cephalad than caudad. Cephalic femora distinctly shorter than the pronotum, cephalic genicular lobe slightly larger than the caudal; tibiæ equal to the femora in length; tarsi two-thirds the length of the tibiæ, the distal joint slightly longer than the proximal and median together. Median limbs similar to the cephalic but slightly more robust, cephalic genicular lobe decidedly larger than the caudal, lamellate. Caudal femora robust, length about equal to the head, pronotum and tegmina together, greatest width contained three and a half times in the length, dorsal margins slightly serrulate, pattern of the pagina distinct, well impressed, flattened, genicular lobes narrowly rounded, pregenicular constriction marked; tibiæ slightly shorter than the femur, external margin with seven spines, internal with nine, including the apical; tarsi slightly less than half the length of the tibia, distal joint about equal to the proximal and median joints together in length, arolia present.

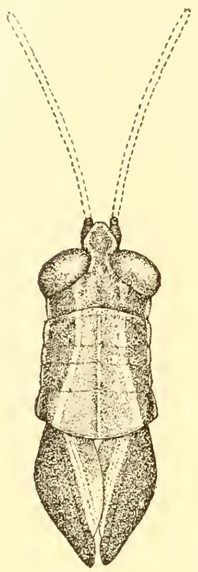

Fig. 33.—*Leptomerinthoprora brevipennis* n. gen. and sp. Dorsal view of head, pronotum and tegmina of type.

General colors vandyke brown on clay color. Head with an irregularly triangular occipital patch and a distinct postocular bar, ventral portion of the antennal fossæ blotched with the darker tint; eyes walnut brown. Pronotum with the humeral angles and the ventral third of the lateral lobes of the lighter shade, remainder vandyke brown. Tegmina dark with the angles marked with clay color, which spreads over the distal portion of the anal area. Pleura with two bars of clay color, one on the mesothoracic episternum and in continuation of the clay-colored ventral portion of the lateral lobe of the pronotum, the other on the ridge of the metathoracic episternum. Abdomen tawny olive. Limbs dull clay color with a slight greenish tinge, the caudal femora washed with cinnamon on the dorsal face, genicular arch raw umber; distal portion of the caudal tibiæ and caudal tarsi washed with bistre, spines tipped with blackish.

Measurements.

Length of body,	22.2 mm.
Length of pronotum,	5.9 "
Greatest width of pronotum,	4 "
Length of tegmen,	6.9 "
Greatest width of tegmen,	4 "
Length of caudal femur,	13.5 "

The type is unique.

SCHISTOCERCA Stål.

Schistocerca pyramidata Scudder.

Guatel, Costa Rica. August, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female, one nymph.

Tarbaca, Costa Rica. December, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female, one nymph.

Pozo Azul de Pirris, Costa Rica. August, 1902. (C. F. Underwood.) [A. N. S. Phila.] Four females.

Monte Redondo, Costa Rica. December, 1902, and January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two males, two females, eight nymphs.

San José, Costa Rica. September and December, 1902. (C. F. Underwood.) [A. N. S. Phila.] Five males, three females, one nymph.

This series is inseparable from Cuernavaca (topotypic) specimens.

Schistocerca malachitica n. sp.

Type: ♀; Turrialba, Costa Rica. (Schild and Burgdorf.) [U. S. N. M., No. 8,175.]

Allied to *S. alutacea* and *venusta*, but distinguished by the more flattened disk of the pronotum and the striking and peculiar coloration.

Size rather large; form as usual in the genus. Head with the occiput and vertex very slightly rounded longitudinally, rather flattened transversely; interocular space very distinctly greater than the width of the frontal costa; fastigium broad, obtuse-angulate, subhorizontal, margins very slightly elevated, rounding into the frontal costa without angle; frontal costa subequal in width, continued to the clypeus, slightly expanded ventrad, sulcate at and ventrad of the ocellus, strongly punctate dorsad; eyes elongate subreniform, slightly longer than the infra-ocular portion of the genæ; antennæ about as long as the head and pronotum together. Pronotum subdeplanate above, surface strongly rugoso-punctate; transverse sulci deeply impressed and all intersecting the median carina; median carina distinct and uniform in height throughout its length; metazona slightly longer than the prozona, very slightly bullate; cephalic margin obtuse-angulate, caudal

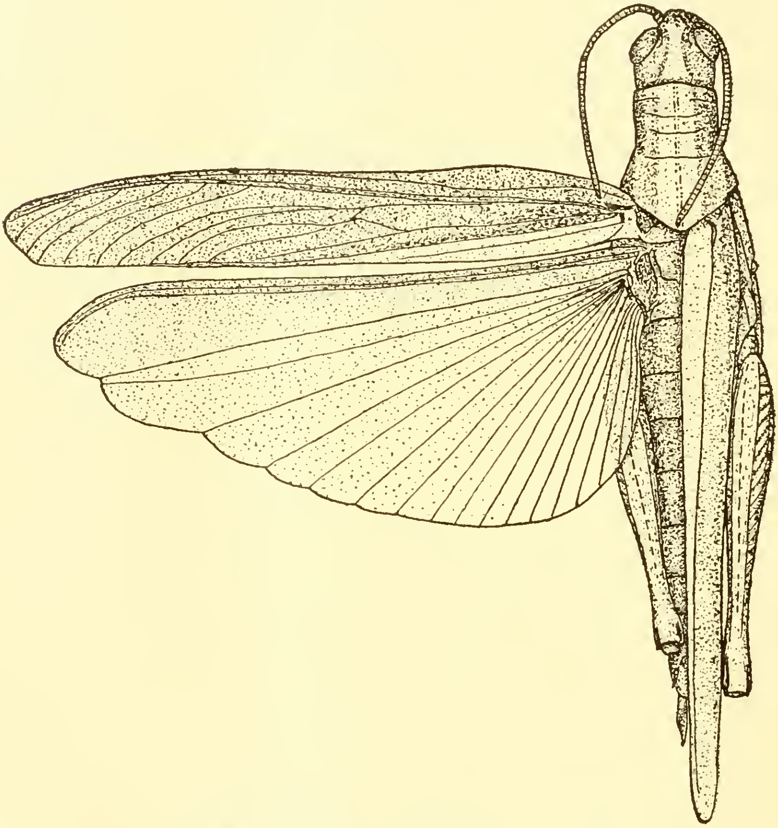

Fig. 34.—*Schistocerca malachitica* n. sp. Type.

margin rectangulate with the angle rounded; humeral angle distinct but rounded on the metazona, obsolete on the prozona; lateral lobes slightly longer than deep. Prosternal spine rather heavy, erect, apically rounded and blunt. Tegmina long, exceeding the tips of the posterior femora by the length of the pronotum. Interval between the mesosternal lobes distinctly longer than cephalic width, subcuneiform in shape. Interval between the metasternal lobes similar in outline to that between the mesosternal lobes. Caudal femora elongate, reaching the base of the ovipositor jaws, dorsal carina distinctly serrate; tibiæ slightly but distinctly shorter than the femora, spines of the internal borders longer than those of the lateral borders.

General color very dull olive green on the head and thorax, abdomen raw umber. Pronotum with a broad subequal median stripe of oil green which is continued on to and involves the whole anal area of the tegmina. Head with a broad streak of dull tawny-ochraceous on the fastigium, vertex and occiput, bordered laterad by faint blackish lines; eyes ferruginous; antennæ olivaceous. Pronotum with the lateral portions of the dorsum bistre. Tegmina (exclusive of the anal areas) chestnut. Wings with the costal portion and the apical two-thirds suffused with chestnut fading into a pale apple green on the basal third. Ceph-

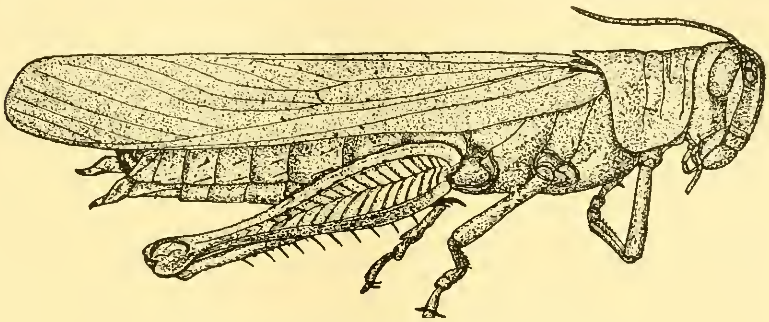

Fig. 35.—*Schistocerca malachitica* n. sp. Type.

alic and median limbs dull oil green, the genicular regions marked with gamboge yellow. Caudal femora oil green, basally suffused with hoary white, genicular arch black, the region immediately ventrad being ochraceous; tibiæ saffron yellow, the spines lemon yellow with the tips black.

Measurements.

Length of body,	54.5 mm.
Length of pronotum,	11 "
Greatest width of pronotum,	7.5 "
Length of tegmen,	50 "
Greatest width of tegmen,	8 "
Greatest width of wing,	20.5 "
Length of caudal femur,	27.5 "

The type is unique in the material studied.

AIDEMONA Brunner.[8]

Aidemona azteca (Saussure).

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) One male, one nymph. [A. N. S. Phila.]

Guatel, Costa Rica. April and September, 1902. (C. F. Underwood.) Three males, eighteen females. [A. N. S. Phila.]

This series appears to be rather uniform in size and of quite uniform coloration. The males differ somewhat from central Mexican (Jalisco, San Luis Potosi and Michoacan) specimens in the slenderer cerci, and both sexes in the shorter tegmina and wings, which but slightly exceed the caudal femora in the male, and are of proportionate length in the female. Specimens from the State of Vera Cruz are closer related to the Costa Rican type than to the more northern form. As the material of the male sex from Costa Rica is rather limited, I have refrained from describing the form, but a more extensive series will in all probability verify the observation made regarding the cerci.

DICHROPLUS Stål.

1873. *Dichroplus* Stål, Recensio Orthopterorum, I, p. 78.

Included *arrogans, patruelis, cliens* and *lemniscatus* Stål, of which the first may be considered the type.

Dichroplus morosus n. sp.

Type: ♀; Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.]

Allied to *D. punctulatus* and *conspersus*, but differing in the more obtuse-angulate caudal margin of the pronotum, the more uniformly sulcate frontal costa, as well as the duller coloration.

Size small; form as usual in the genus. Head with the occiput very slightly rounded and ascending; interocular space slightly more than half the width of the eye; fastigium strongly declivent, not excavated, margins slightly elevated, hardly separated from the frontal costa; frontal costa subequal, slightly expanding ventrad, moderately sulcate to and for a short distance below the ocellus; lateral ocelli situated close to the eye at the dorsal margin of the antennal fossæ, median ocellus situated between the antennæ and slightly ventrad; eyes subreniform, slightly longer than the infra-ocular portion of the genæ, the greatest width contained about once and a half in the length; antennæ slightly depressed, apically damaged. Pronotum depressed dorsad, no median carina except a slight ridge on the meta-

[8] This generic name should be credited to Brunner (*Ann. Mus. Civ. Stor. Nat. Genova*, XXXIII, p. 145) instead of Scudder. It was based on Stål's "Divisio tertia" of the genus *Pezotettix*, of which the only species not eliminated —*azteca*—is the type.

zona, humeral angles distinct on the metazona; cephalic margin subtruncate; caudal margin obtuse-angulate; transverse sulci rather weak, three in number; lateral lobes as deep as long, the ventral angles obtuse. Tegmina slightly exceeding the tips of the abdomen and caudal femora, apex rounded, costal expansion slight but elongate. Abdomen considerably compressed. Prosternal spine erect, thick, conic, slightly retrorse, apex rather blunt. Interspace between the mesosternal lobes distinctly broader than long, equal to the one of the lobes in width, angles narrowly rounded; interspace between the metasternal lobes narrow, longer than broad, the lobes rounded. Caudal femora about twice the length of the head and pronotum together, the greatest width contained three and one-third times in the length, pattern of the pagina low but distinct, pregenicular constriction slight, genicular lobes rotundato-truncate; tibiæ slightly shorter than the femur, armed on the external margin with nine spines, on the internal margin with nine including the apical.

General color bistre sprinkled, lined and blotched on a ground of wood brown. Postocular bar indistinct and face suffused with the darker shade; antennæ wood brown irregularly marked with the overlying tint. Pronotum with the humeral angles and the ventral portions of the lateral lobes dull wood brown. Tegmina irregularly blotched and mottled, the intercalary area with regular alternating quadrate patches of shining black and wood brown. Abdomen wood brown marked with shining black. Limbs wood brown and vandyke brown blotched and imperfectly annulate; caudal femora with three irregular dorsal patches which extend over on the dorsal portion of the other unmarked wood brown lateral face, genicular region vandyke brown, tibial groove suffused with ochraceous-rufous; caudal tibiæ dull ochraceous-rufous, the spines tipped with black.

Measurements.

Length of body,	17.5 mm.
Length of pronotum,	4 "
Greatest width of pronotum,	3 "
Length of tegmen,	14 "
Length of caudal femur,	9.7 "

The type only has been examined.

OSMILIA Stål.

Osmilia tolteca (Saussure).

Carrillo, Costa Rica.‾ [U. S. Nat. Mus. and Hebard collection.] One male, five females.

Guatel, Costa Rica. April, 1902. (C. F. Underwood.) [A. N. S. Phila.] Eight males, nine females, one nymph.

Monte Redondo, Costa Rica. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two males, three females, eight nymphs.

San José, Costa Rica. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] Three nymphs.

Tarbaca, Costa Rica. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Pozo Azul de Pirris, Costa Rica. August, 1902, and January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Four males, seven females.

This Mexican and Central American form can be distinguished from the South American *O. flavo-lineata* by the shorter tegmina and wings in both sexes and the broader head and less prominent eyes. Demerara specimens of *O. flavo-lineata* and Vera Cruz and Tamaulipas specimens of *tolteca* have been used for comparison.

RHACHICREAGRA[9] n. gen.

Type.—*R. nothra* n. sp.

Allied to *Polysarcus* Saussure, but differing in the presence of minute tegmina, the greater number of joints in the antennæ, the slightly produced fastigium of the vertex, and the more distinctly forked cerci.

Form robust, obese in the female. Head with the vertex short, declivent, produced moderately beyond the face, frontal costa precurrent, sulcate; antennæ filiform, twenty-two to twenty-three joints. Median carina of the pronotum distinct, elevated, subcristate on the metazona. Metanotum and proximal segment of the abdomen with a median carina which is more elevated caudad. Tegmina minute, linear. Cerci of the male very distinctly forked. Prosternal spine erect, unguical, acute, slightly antrorse. Interspace between the mesosternal lobes subquadrate in both sexes; interspace between the metasternal lobes subquadrate in the male, strongly transverse in the female. Arolia present.

Rhachicreagra nothra[10] n. sp.

Types: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Size rather small in the male, medium in the female; form robust in the male, decidedly obese in the female; surface rugoso-punctate, the dorsum of the thorax heavily sculptured. Head with the occiput and vertex evenly rounded, the interocular space about half the width of the cephalic margin of the fastigium in the male, slightly narrower than

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[9] Ῥαχις, *back;* κρεαγρα, *hook.*

[10] Νωθρα, *inactive, sluggish.*

the cephalic width in the female; fastigium moderately declivent, slightly (male) or considerably (female) shorter than the proximal width, apex subtruncate, broadly and shallowly sulcate and rounding without demarkation into the frontal costa and sulcus, lateral view of the fastigium regularly rounded, blending imperceptibly into the face immediately ventrad of the median ocellus, the projection of the fastigium more pronounced comparatively in the male than in the female; lateral ocelli placed near the base of the fastigium on the supra-

Fig. 36.—*Rhachicreagra nothra* n. gen. and sp. Lateral view of male type.

antennal margin; frontal costa slightly expanded dorsad, extending to the clypeal margin, slightly constricted immediately below the ocellus, sulcus distinct, moderately deep, narrower dorsad than ventrad; eyes subovate, quite prominent in the male and elevated above the vertex, very much (male) and distinctly (female) longer than the infra-ocular portion of the genæ; antennæ as long as the caudal femora. Pronotum tectate, the median carina elevated, on the metazona developed

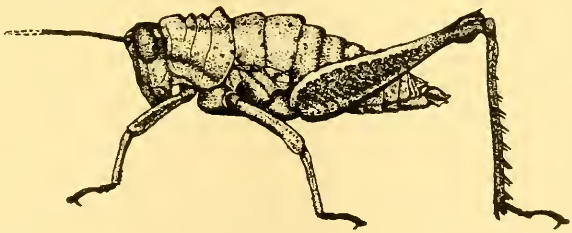

Fig. 37.—*Rhachicreagra nothra* n. gen. and sp. Female type, lateral view.

into a dentate crest, which is more apparent in the female than in the male; cephalic margin produced arcuate, the median section truncate; caudal margin emarginato-truncate; no lateral carinæ present, but humeral angles distinct in the male; lateral lobes of the pronotum distinctly longer than deep, particularly in the male, cephalic margin sinuate with a distinct postocular emargination, ventral margin with a distinct cephalic emargination, subarcuate caudad, caudal margin arcuate with a slight concavity dorsad of the rounded obtuse ventro-caudal angle; transverse sulci three in number, deeply impressed, the cephalic margin bordered caudad by an incomplete sulcus, prozona more than twice the length of the metazona. Exposed portion of the mesonotum very narrow; metanotum and proximal segment of the abdomen subequal in length, tectate, carinate, the caudal section elevated. Tegmina equal to the metanotum in length. Abdomen carinate dorsad, very distinctly compressed in the female; supra-anal plate of the male with the lateral margins parallel in the proximal half, distal half narrowed, apex broadly rounded, the lateral portions bent dorsad from the mesal section; cerci subequal to the fork, except at extreme base, cephalic arm short but distinctly separated from the longer caudal fork, tips narrowly rounded, the whole cercus evenly curved mesad; subgenital plate slightly shorter than proximal width, the margin arcuate with a very slight truncate apical process. Prosternal spine erect, acute, slightly antrorse distinctly flattened.

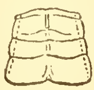

Fig. 38.

Fig. 39.

Rhachicreagra nothra n. gen. and sp. Types. Fig. 38.—Dorsal view of female pronotum. Fig. 39.—Dorsal view of apex of male abdomen.

transversely in the female. Interspace between the mesosternal lobes very slightly longer than broad in the male and with the angles rectangulate, in the female slightly broader than long and with the angles as in the male; interspace between the metasternal lobes very broadly cuneiform and narrower than the interspace between the mesosternal lobes in the male, in the female broader cephalad than the interspace between the mesosternal lobes, strongly narrowed caudad, the angles acute. Cephalic and median femora inflated in the male, the cephalic slightly longer than the pronotum, median slightly larger, tibiæ equal to the femora in length; tarsi two-thirds the length of the tibiæ, the distal joint almost twice the length of the proximal and median joints. Cephalic and median femora of the female not strongly inflated, the cephalic no longer than the pronotum, otherwise the cephalic and median limbs are as in the male. Caudal femora about three-fourths (male) to two-thirds (female) the length of the body, graceful, greatest width contained about four times in the length of the femur, dorsal margin sparsely serrate, pattern of the pagina distinct, pregenicular constriction more marked ventrad than dorsad, genicular arch very slight, genicular lobes obliquely rotundato-truncate at the apex; tibiæ very slightly shorter than the femora, slightly sinuate proximad, external margin with eight spines, no apical spine present, internal margin with nine spines including the apical; tarsi slightly less than half the length of the tibiæ, the distal joint slightly longer than the proximal and median joints, arolia large, transverse.

Male.—General dorsal color clay color, speckled with olive green, which latter is the color of a very distinct and broad postocular bar on the head, pronotum and dorsal portion of the pleura. Eyes mummy brown. Face, fastigium, mouth parts, genæ, ventral portion of the lateral lobes and a blotch on each episternum at the base of the limbs naples yellow, the face speckled with olive green. Lateral and ventrad aspects of the abdomen as well as the abdominal appendages, except the tips of the cercal forks (blackish), and limbs oil green. Genicular arches and tips of the tibial spines brownish-black. Antennæ olive yellow proximad, indian yellow distad, very obscurely blotched with dull brown.

Female.—Color pattern as in the male unless otherwise noted, the base colors replaced as follows: Dorsal clay color by ochraceous, olive green lateral stripes dull, naples yellow on head, pronotum and pleura replaced by dull ochre yellow. Antennæ dull ochre yellow. Cephalic and median limbs ochraceous, the femora marked ventrad with dull olive green. Caudal femora with the dorsal face ochraceous-cinnamon, the carina blotched and the distal half suffused with blackish, lateral, ventral and internal faces, tibiæ and tarsi more or less strongly suffused with blackish.

Measurements.

	♂	♀
Length of body, ...	16 mm.	24.5 mm.
Length of pronotum, ...	3.7 "	5.6 "
Greatest dorsal width of pronotum, ...	3.5 "	6.7 "
Greatest width across metapleura, ...	5 "	8 "
Length of caudal femur, ...	13.5 "	16.3 "

A series of paratypic specimens, nine males, seven females, have been examined in addition to the types, as well as a male from Monte Redondo (C. F. Underwood; January, 1903; A. N. S. Phila.).

Considerable variation is noticed in the size of both sexes, while the range of color variation is chiefly in the intensity of the pattern. The Monte Redondo male, however, has the olive green shades replaced by solid blue black, while the yellow markings of the head, pronotum and pleura are canary yellow, the contrast being very striking.

MICROTYLOPTERYX[11] n. gen.

Type.—*M. hebardi* n. sp.

Allied to *Rhachicreagra* Rehn, but differing in the slenderer, more compressed and less obese form, the broader vertex and fastigium, the comparatively larger head (very noticeable in the female), the single-toothed cerci, and uninflated cephalic femora in the male.

Body more or less elongate fusiform. Head with the vertex short, horizontal, forming a more or less distinct angle with the front, dorsal outline trigonal, the interocular space over half the proximal width of the fastigium; frontal costa weak ventrad, with the sulcation continued on the fastigium; antennæ filiform, fifteen or more joints. Pronotum subarcuate longitudinally, tectate, median carina elevated caudad into a distinct subcristate process. Metanotum, proximal segment of the abdomen and in a lesser degree the succeeding segments of the abdomen with a dorso-caudal elevation on the median carina. Tegmina pad-like, considerably longer than broad, not longer than the pronotum. Cerci of the male undivided; subgenital plate compressed. Prosternal spine erect, slender, acute. Interspace between the mesosternal lobes subquadrate in the male, slightly transverse in the female; interspace between the metasternal lobes distinctly longitudinal in the male, subquadrate in the female. Caudal tibiæ with six to seven spines in the external margin, no apical spine; eight to nine spines, including the apical on the internal margin. Arolia present.

Microtylopteryx hebardi n. sp.

Type: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Size rather large (compared with *M. fusiformis*); form elongate subfusiform; surface punctate. Head somewhat compressed, the depth considerably greater than the thoracic depth, width at mandibular margins very slightly less (male) or equal (female) to the greatest width across the eyes; occiput gently rounded, vertex gently declivent, the interspace between the eyes equal to one-half (male) or two-thirds (female) the greatest width of the eye; fastigium with the proximal width twice the length, trigonal, with a slight median depression, dorso-cephalic angle narrowly rounded; face slightly retreating in the female, distinctly retreating in the male, slightly concave; frontal costa weak on the ventral half of the face, distinctly and broadly sul-

[11] Μικρα, *small*; τυλη, *pad*; πτερυξ, *wing*.

cate above the ocellus, rounding into the fastigial groove without interruption, slightly and narrowly sulcate below; lateral ocelli placed on the fastigial margin close to the eye; eyes short-ovate, quite prominent in the male, equal to (male) or considerably less than (female) the infra-ocular length of the genæ; antennæ filiform, in the male very slightly shorter than the caudal femora. Pronotum distinctly tectate,

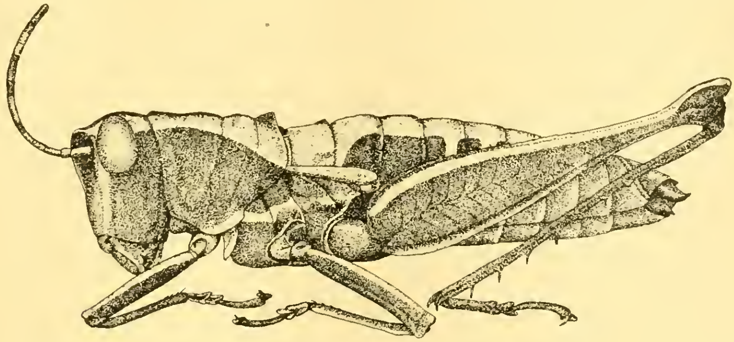

Fig. 40.—*Microtylopteryx hebardi* n. gen. and sp. Lateral view of female type.

elevated cephalad; median carina rather weak, a slight elevation present at the cephalic margin, a very distinct and slightly hooked ridge at the caudal margin, no lateral carinæ present but distinct lateral shoulders; cephalic margin arcuate in the male, subtruncate in the female; caudal margin very broadly, shallowly and triangularly emarginate; lateral lobes distinctly longer than deep, cephalic margin oblique, ventral margin obliquely emarginate cephalad, arcuate caudad,

Fig. 41.

Fig. 42.

Fig. 41.—*Microtylopteryx fusiformis*, lateral view of apex of male abdomen. Fig. 42.—*M. hebardi*, lateral view of apex of male abdomen.

ventro-caudal angle subrectangulate in the male and obtuse-angulate in the female, caudal margin with a distinct rotundate emargination above the angle; transverse sulci two in number, rather weak, particularly in the female, metazona about one-fourth the length of the prozona in the male, less than one-fourth in the female; lateral shoulders arcuate when viewed laterad. Metanotum and proximal segment of the abdomen subequal in length, a caudal projection developed as on the pronotum but to lesser degree. Tegmina slightly shorter than the prozona, linear, the greatest width in the apical third and contained about five times in the length. Abdomen somewhat compressed, carinate, and each segment with a very slight caudal lobule on the carina. Apex of the male abdomen not inflated, recurved; supra-anal plate narrow, almost twice as long as broad, the apex rounded; cerci short, rather thick, strongly falciform, apex rounded and compressed; subgenital plate compressed, narrowly rounded when viewed dorsad, moderately produced when viewed laterad. Prosternal spine slender, erect, acute, slightly antrorse. Interspace between the mesosternal lobes distinctly transverse in the male, almost as broad as one of the lobes, the angles narrowly rounded; in the female almost twice as broad as long, decidedly broader than one of the lobes, the angles rectangulate. Interspace between the metasternal lobes in the male narrow, longitudinal, constricted caudad; in the female quadrate wedge-shaped, the caudal width considerably less than the cephalic. Cephalic femora slightly longer than the pronotum in the male, subequal in the female, not inflated, cephalic genicular lobe larger than the caudal; tibiæ equal to the femora in length; tarsi slightly shorter than tibiæ, the distal joint considerably longer than the proximal and median joints united. Median limbs similar in structure and size to the cephalic. Caudal femora considerably inflated proximad, the length slightly less than that of the body in the male and equal to that of the metanotum and abdomen in the female, greatest width contained about four and a half times in the length, distal half evenly tapering to the narrowest pregenicular portion, dorsal carina serrate, pattern of the pagina distinct but shallow, genicular region hardly arched, genicular lobes acute apically and sinuato-rotundate ventrad; caudal tibiæ equal in length to the femora without the genicular dilation, slightly sinuate, external margin with seven spines, the proximal one of which is very short and subobsolete in the male, internal margin with nine spines including the apical, the proximal one short and subobsolete in the male; tarsi slightly less than half the tibial length, median segment about half the length of the proximal, distal segment about equal to the proximal and median together. Arolia quadrate.

General colors above mummy brown and ochraceous in the female, cinnamon and ochre yellow in the male, lateral aspects largely shining seal brown. Head with a broad stripe of dull sepia from the fastigium extending back over the occiput with a very narrow median line of cinnamon; ventral half of the genæ and face, except the dark frontal costa, ochre yellow in the male, distinct postocular bar shining seal brown; head of the female from the dorsal margin of the postocular bar and the margin of the fastigium ventrad seal brown, more or less shining; eyes in the male mars brown, in the female burnt umber; antennæ with about the proximal third of the pale general color, the distal two-thirds of the darker shade. Pronotum with the lateral angles ochre yellow, the protuberance of the median carina blackish; lateral lobes shining seal brown except for an oblique bar of dull ochre yellow which crosses the ventro-caudal lobe and is continued more or less distinctly across the seal brown pleura. Tegmina bicolor, dorsad buff yellow, ventrad seal brown. Abdomen with the seal brown lateral portions distinctly separated from the dorsum, on the third and fourth segments the lighter dorsal shade is continued ventrad and obliquely cephalad a short distance in a subelliptical patch, the median carina of the pronotum seal brown. Cephalic and median limbs seal brown, lined above with pale ochre yellow. Caudal limbs seal brown, the dorsal aspect between ochre yellow and buff yellow, the median carina seal brown.

Measurements.

	♂	♀
Length of body,	14.2 mm.	24 mm.
Length of pronotum,	4 "	5.2 "
Greatest dorsal width of the pronotum,	3 "	4.3 "
Length of tegmen,	2.5 "	3.5 "
Length of caudal femur,	12.5 "	15.5 "

A series of five paratypic specimens, three males and two females, have been examined in addition to the types. Little variation is noticed, except that two of the males have the lighter shades more greenish-yellow than the others.

The peculiar and striking appearance of this species should serve to readily distinguish it, the large head of the female and the lacquer-like character of the seal brown color being very striking.

I take pleasure in dedicating this species to Mr. Hebard, as a slight token of appreciation of much kindly interest and assistance.

Microtylopteryx fusiformis n. sp.

Type: ♂ and ♀; Carrillo, Costa Rica. [Hebard collection.]

Allied to *M. hebardi*, but differing in the shorter limbs, the more robust body, the broader tegmina, rather different color pattern and a number of minor characters.

Size medium (female) to small (male); form fusiform, very slightly compressed; surface strongly punctate dorsad. Head with the occiput and vertex little elevated, very slightly rounded, a slight median ridge present; interocular width about half the proximal width of the fastigium in the male, in the female about two-thirds; fastigium distinctly broader than long, trigonal, arched, very slight median sulcus present, fastigium when viewed laterad subrectangulate; frontal costa gradually constricted dorsad and rather sharply pinched ventrad of the ocellus, extending to the clypeal margin, sulcate throughout, more distinctly so dorsad and rounding into the fastigium; face retreating; eyes subelliptical, slightly longer than the infra-ocular portion of the genæ, moderately prominent in the male; antennæ in the male slightly longer than the head and pronotum, in the female distinctly shorter, slightly depressed, more so in the female than in the male, and with distal por-

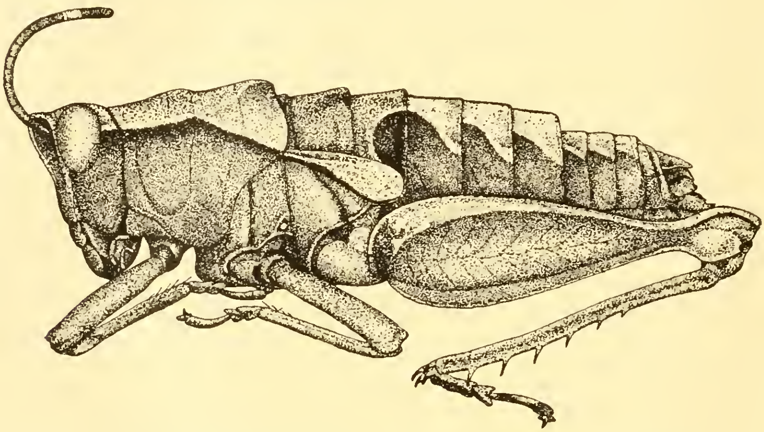

Fig. 43.—*Microtylopteryx fusiformis* n. sp. Lateral view of female type.

tion somewhat enlarged. Pronotum somewhat elevated caudad, tectate, the median carina distinct slightly sinuate caudad of the middle, the caudal elevation very distinct and compressed, lateral carinæ undeveloped but distinct sinuate angles as in *M. hebardi* are present, the disk of the pronotum when viewed dorsad being as narrow a third the distance caudad as at the cephalic margin, regularly expanding caudad; cephalic margin obtuse-angulate with the angle very slightly emarginate; caudal margin emarginato-truncate, the emargination covering the whole width and being very shallow; transverse sulci two in number, the cephalic being placed median and subobsolete in the female, metazona less than a third the length of the prozona; lateral lobes slightly deeper than long, cephalic margin oblique, slightly sinuato-emarginate, ventral margin emarginate cephalad, rounded caudad, ventro-cephalic angle obtuse, ventro-caudal angle obtuse, caudal margin rotundato-emarginate. Tegmina two-thirds (male) to three-fourths (female) the length of the pronotum, enlarged distad, the greatest width being in the distal third. Metanotum and proximal abdominal segment with a distinct median carina which is developed on the metanotum and proximal segment of the abdomen into a compressed caudal process, similar but smaller than on the pronotum. Abdomen slightly but distinctly compressed. Apex of the male abdomen not recurved, the appendages very small; supra-anal plate trigonal, the apex slightly produced and narrowly rounded; cerci very short, thick and blunt, hardly longer than broad; subgenital plate compressed, rather deep, blunt. Prosternal spine erect, slender, acute. Interspace between the mesosternal lobes subquadrate in the male, slightly transverse in the female, the angles very narrowly rounded; interspace between the metasternal lobes very narrow, strongly longitudinal in the male, very slightly longitudinal with the angles rectangulate in the female. Cephalic femora three-fourths (male) to four-fifths (female) the length of the pronotum, evenly enlarging distad, especially in the female, cephalic genicular lobe slightly larger than the caudal; tibiæ about equal to the femora in length; tarsi little shorter than the tarsi, distal joint about half again as long as the median and proximal joints together. Median limbs similar to the cephalic but slightly larger. Caudal femora robust, pregenicular constriction marked, length distinctly (male) or almost (female) equal to the length of the mesonotum and abdomen, greatest width in the proximal third and contained about three times in the length, dorsal carina irregularly and very weakly serrulate, pattern of the pagina regularly but not deeply impressed, genicular region distinctly arched, genicular lobes rectangulate; caudal tibiæ slightly shorter than the femoral length, rather heavy, slightly sinuate, the external margin with six spines, no apical spine present, internal margin with seven spines including the apical spine; tarsi less than half the length of the tibiæ, the distal joint only slightly longer than the proximal; arolia rather small.

General colors, above varying from prout's brown to raw umber, laterad shining seal brown. Head with all from the fastigium and dorsal margin of the usual portion of the postocular bar ventrad seal brown, a line on the clypeal margin, a line immediately caudad of dorsal section of the eye and the fastigial and dorsal frontal costa carinæ dull ochre yellow; eyes russet; antennæ varying from seal brown to ferruginous, a slight distance proximad of the apex annulate with buff. Pronotum with lateral angles slightly lighter than the dorsum and more of an ochre yellow, lateral lobes solid seal brown. Tegmina dull cream buff with a ventral line of seal brown, greatly narrowed distad. Abdomen with the lateral faces of the segments solid seal brown, the line of demarcation being oblique, dorso-cephalad, ventro-caudad, the proximal segment with a semicircular spot of seal brown, which is marked structurally by a ridge. Pleura and venter seal brown. Cephalic and median limbs solid vandyke brown. Caudal femora with the external face seal brown, varying somewhat in strength, dorsad ochraceous buff, rather obscure in the female, with two distinct and a third indistinct transverse bars in the male, internal face seal brown with indications of two lighter cross bars in the female, these bars quite apparent in the male; tibia and tarsi very dull ochraceous, a distinct annulus of rather dull citron yellow present on the proximal portion, spines tipped with seal brown.

Measurements.

	♂	♀
Length of body, ...	13.5 mm.	20.5 mm.
Length of pronotum, ...	3.5 "	5 "
Greatest dorsal width of pronotum, ...	3.2 "	5 "
Length of tegmen, ...	2.6 "	4.1 "
Length of caudal femur, ...	9 "	12 "

A paratypic series of fourteen individuals, four males and ten females, have been examined in addition to the types. They are quite uniform in character aside from a little variation in the intensity of the coloration, and may be readily separated from *M. hebardi* by the shape and length of the femora, as well as numerous other characters.

SOME FISHES FROM BORNEO.

BY HENRY W. FOWLER.

The Wistar Institute of Anatomy of Philadelphia has received valuable collections of fishes from Borneo, principally from the Baram region of Sarawak, or Brunei as given on some maps, in the British possessions. The larger collections were made by Dr. William H. Furness, 3rd, of Philadelphia, in 1898. They are all from the Baram basin. Previously Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller had also obtained material from the same region, together with some other from the Kapuas river in western Dutch Borneo.

The larger number of forms are either fluviatile or fresh-water and interesting on account of their apparent rarity. In order to facilitate satisfactory comparisons I have tried to give more or less complete accounts of these. Some others are represented by large series.

Drs. Horace Jayne and M. J. Greenman kindly submitted the collections to me for examination. I have also to thank them for their recommendation to the Institute of the services of the artist, Miss Helen Winchester, who made the accompanying figures. As usual the line with each represents an inch.

To the Academy of Natural Sciences of Philadelphia I am under obligations for many courtesies, such as the use of the library and collections. Among the latter are a number of Borneo fishes received from the Paris Museum by Prof. E. D. Cope, and presented by him to the Academy. As these form part of the collections of M. Chaper, reported by Prof. Léon Vaillant in 1893, they are of value as authoritative determinations. I beg to thank Prof. Vaillant for their verification. Dr. Samuel G. Dixon, President of the Academy, Dr. Henry A. Pilsbry, Mr. Witmer Stone and Mr. James A. G. Rehn have kindly given assistance and many suggestions.

For convenience it may be inferred that the material examined under each species was obtained by Dr. Furness, unless otherwise stated.

GALEIDÆ.

1. Carcharhinus tephrodes sp. nov.

Head about $4\frac{5}{6}$ to end of last caudal vertebra; depth about $7\frac{1}{2}$ to same; depth about $6\frac{1}{2}$ to origin of lower caudal lobe; upper caudal lobe about 3 in rest of body; snout $2\frac{1}{3}$ in head; space between tip of snout and anterior curve of mouth $2\frac{7}{8}$; width of mouth at corners $2\frac{4}{7}$; interorbital space 2; length of pectoral along upper or outer margin $1\frac{1}{3}$; margin of pectoral posteriorly $1\frac{1}{3}$; base of pectoral $2\frac{2}{3}$; anterior margin of first dorsal 2; base of first dorsal $2\frac{1}{3}$; anterior margin of second dorsal $2\frac{2}{3}$; base of second dorsal $3\frac{3}{5}$; least depth of caudal peduncle $5\frac{1}{4}$;

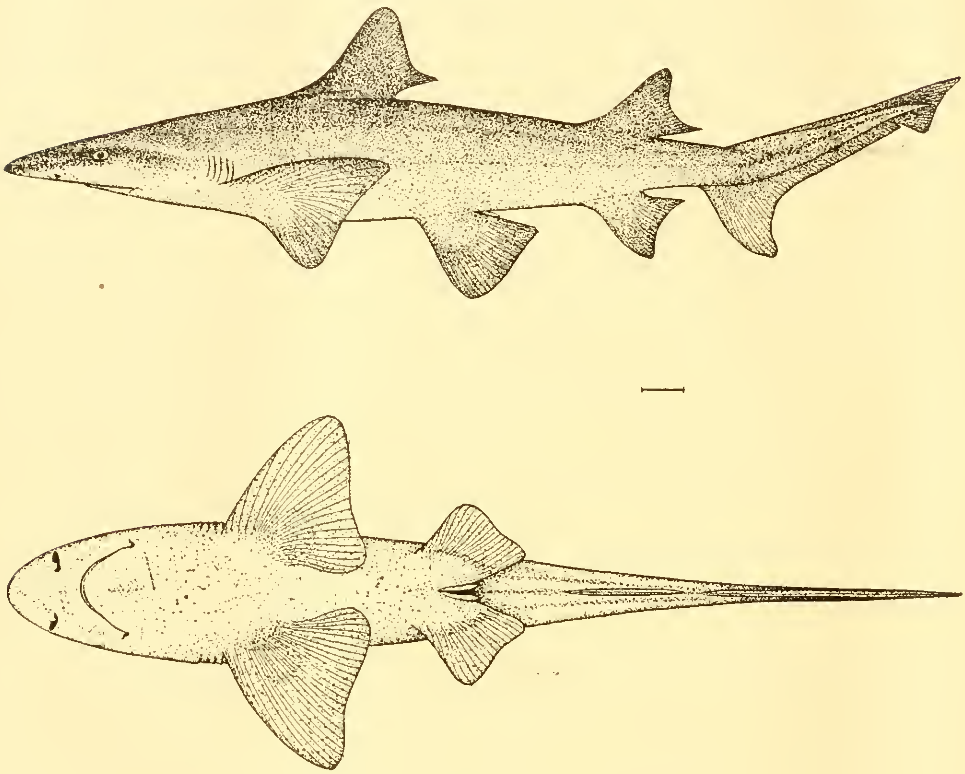

Fig. 1.—*Carcharhinus tephrodes* Fowler.

anterior margin of lower caudal lobe 2; anterior margin of anal 3; base of anal 3; anterior margin of ventral 3; base of ventral $3\frac{2}{3}$; eye $7\frac{2}{3}$ in interorbital space.

Body elongate, well compressed and greatest depth about origin of first dorsal fin. Caudal peduncle rather thick, compressed, flattened above and below, and a pit at origin of upper caudal lobe. A slight depression along middle of back above.

Head broad, its greatest width about $1\frac{3}{5}$ in its length, depressed, and rather slightly convex above. Snout broad, depressed or somewhat flattened, and margin obtuse when viewed from above. Eye small, circular, lateral, nictitating membrane well developed, and position a little anterior. Symphysis of mandible about opposite front rim of orbit, mandible itself very broadly convex. Teeth in mandible entire, long, slender, sharp pointed and radiating more or less as it were from margin of jaw. Teeth of upper jaw radiating inward or parallel with those of mandible when mouth is closed. Upper teeth broad, triangular, and finely serrated along both margins, each one may be said to have a slight notch on its outer or distal edge near base, margin at this region also finely serrated. Tongue broad and flat, only a little free around edges. Each corner of mouth with a short fold which extends obliquely outward. Nostrils nearer front of upper jaw or eye than tip of snout, oblique, rather large and each with a small pointed flap. Interorbital space broad and a little convex.

Gill-openings 5, last two over base of pectoral, and median three largest. No spiracle.

Body covered with fine shagreen denticles, largest on middle of back and anterior margins of fins basally. Head with numerous inconspicuous pores.

First dorsal inserted nearer origin of pectoral than that of ventral, its upper margin about $\frac{3}{4}$ base of fin slightly undulate, and posteriorly ends in a short point. Second dorsal similar, about equal to anal in size, and inserted a trifle behind origin of latter or much nearer origin of upper caudal lobe than posterior basal margin of first dorsal. Anal similar to second dorsal. Upper caudal lobe long, notched near its end. Origin of lower caudal lobe a little in advance of that of upper, but without a pit. Pectoral broad, reaching nearly $\frac{3}{4}$ of distance to origin of ventral, and posterior margin but little curved. Ventral broad, inserted nearer origin of anal than that of pectoral and corners rounded obtusely. Claspers small, on outer margin about $2\frac{3}{5}$ in length of anterior edge of ventral.

Color in alcohol, more or less uniform gray above and on fins, below white. Lower surfaces of pectorals and ventrals white. Side of head till eye is included gray like upper surface, otherwise lower surface white. Caudal gray, paler along lower portion of vertebral column. Iris slaty.

Length $24\frac{1}{2}$ inches.

Type No. 2,390, W. I. A. P. Baram, Borneo. 1897. Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

Also paratype No. 2,391, W. I. A. P. Same data. Length $14\frac{1}{2}$

inches. Eye about 5 in interorbital space. A pit at origin of lower caudal lobe and transverse fissure at origin of upper. Margins of dorsal and caudal brownish-gray. Pectoral $1\frac{2}{5}$ in head. In most other respects it agrees entirely.

This species differs from *Carcharhinus borneensis* (Bleeker) in the large broad pectoral. According to Bleeker's account it is $1\frac{2}{3}$ in the head.

(*Τεφρώδης*, ashy.)

2. Scoliodon acutus (Rüppell).

Head $5\frac{2}{3}$ to end of last vertebra; depth about $6\frac{1}{2}$ to same; depth about 5 to origin of lower caudal lobe; upper caudal lobe about $2\frac{9}{10}$ in rest of body; snout $2\frac{1}{3}$ in head; space between tip of snout and anterior curve of mouth $2\frac{1}{2}$; width of mouth at corners 3; interorbital space $2\frac{1}{10}$; length of pectoral along upper or outer margin $1\frac{3}{5}$; margin of pectoral posteriorly $2\frac{1}{6}$; base of pectoral $3\frac{1}{3}$; anterior margin of first dorsal $1\frac{3}{5}$; base of first dorsal about $1\frac{7}{8}$; posterior margin of second dorsal $3\frac{2}{3}$; base of second dorsal $5\frac{2}{3}$; least depth of caudal peduncle $4\frac{4}{5}$; anterior margin of lower caudal lobe $1\frac{2}{3}$; base of anal $3\frac{2}{3}$; anterior margin of ventral 4; base of ventral $4\frac{1}{3}$; eye $4\frac{1}{4}$ in interorbital space.

Body elongate, compressed, rather slender posteriorly, and greatest depth about origin of first dorsal fin. Caudal peduncle compressed, rather slender, also flattened above and below. Upper surface with a pronounced median groove and a transverse slit-like pit at origin of upper caudal lobe. Lower surface shallowly concave medianly, and also with a small pit at origin of lower lobe. Depression along middle of back between dorsals very slight.

Head rather slender, depressed, its greatest width about $1\frac{3}{4}$ in its length, and upper surface convex. Snout rather angular, depressed, and rising up more convexly posteriorly. Eye small, circular, and position a trifle anterior. Nictitating membrane well developed. Symphysis of mandible about opposite front rim of orbit. Mandible rather long, similar to shape of snout. Teeth oblique, slender, sharp pointed, entire, and those in upper jaw directed posteriorly, also with a notch on outer or posterior margin. Lower teeth a little more slender than upper. Tongue broad, flat, and little free except around edges. Each corner of mouth with a short groove running along outer margin of upper jaw. Nostrils nearer front of mouth or orbit than tip of snout, a little oblique, and each with a small pointed flap. Interorbital space broad and convex.

Gill-openings 5, last two above base of pectoral, and median three largest. No spiracle.

Body covered with fine shagreen denticles not especially enlarged on back or fins. Head with numerous small pores.

First dorsal inserted much nearer origin of pectoral than that of ventral, its upper margin about equal to base of fin and slightly undulate, and posteriorly ending in a slender point. Second dorsal inserted about opposite middle of base of anal, smaller than that fin, and ending in a small slender point posteriorly, and reaching about $\frac{3}{5}$ of space to origin of upper caudal lobe. Anal similar in shape, inserted about midway between posterior base of ventral and origin of lower caudal lobe, posterior slender point reaching about $\frac{4}{7}$ of space to latter. Pectoral rather small, posterior margin concave, and length of depressed fin about half way to origin of ventral. Ventral small, entirely behind base of first dorsal, or its origin a little nearer that of pectoral than origin of lower caudal lobe. Claspers long, on their outer margin about $2\frac{1}{4}$ in head.

Color in alcohol gray-brown above, belly and lower surface dirty creamy-white. Lower surface of pectoral and ventral same. Caudal paler along lower portion of vertebral column. Iris slaty.

Length $16\frac{1}{2}$ inches.

One example.

Rüppell suggests that *Pala sorra* Russell[1] may be this species, though later Day[2] considers it equally near *Scoliodon laticaudus* (Müller and Henle). Rüppell's figure is poor, as it shows a much thicker body, especially the caudal peduncle, and a longer snout than my example. The teeth also appear to be figured broader. Bleeker's account[3] agrees, and I follow him provisionally in the identity of the Red Sea form.

PRISTIDÆ.

3. Pristis zysron Bleeker.[4, 5, 6, 7]

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[1] *Fishes of Coromandel*, I, 1803, p. 9, Pl. 14. Vizagapatam. Madras.

[2] *Fishes of India*, IV, 1878, p. 712, Pl. 188, fig. 2. Madras.

[3] *Verh. Bat. Genoot.* (Bijd. Plag. Ind. Arch.), XXIV, 1852, p. 30. Batavia, in mari.

[4] This species agrees with *Pristis pectinatus* Latham in the absence of a lower caudal lobe. *Pristis semisagittatus* Shaw and *P. perrotteti* Müller and Henle have a pronounced lower caudal lobe. The groups may now stand as:

PRISTIS Linck.

Mag. P. Naturg. Gotha, VI, 1790, p. 31. Type *Squalus pristis* Linnæus.

PRISTIOPSIS subg. nov.

Type *Pristis perrotteti* Müller and Henle.

Lower caudal lobe developed.
(Πρίστις, the ancient name of the sawfish; ὄψις, appearance.)

The teeth in the saws range from 23 to 27 in the left side and 23 to 28 in the right side, the usual number being 26. Eye $2\frac{3}{4}$ to $3\frac{1}{4}$ in interorbital space. Shagreen denticles along median keels of back, anterior margins of dorsals and caudal above, pectorals, ventrals, and along lateral keel of side of tail after ventral, enlarged. Keel after first dorsal obsolete after $\frac{2}{3}$ of space to second dorsal. Origin of first dorsal a little behind that of ventral. Eight examples $23\frac{3}{4}$ to $30\frac{7}{8}$ inches in length.

RHINOBATIDÆ.

4. Rhinobatos thouinianus (Shaw).

Internasal space about $\frac{4}{7}$ in length of nasal cavity. Denticles along middle of back enlarged, those along median line thorn-like. One example $27\frac{1}{2}$ inches long.

DASYBATIDÆ.

5. Dasybatus brevicauda (Swainson).

A small example from the mouth of the Baram river is almost entirely smooth above except the caudal spines and four short spines which precede them on the median line of tail at base of caudal. Length $10\frac{7}{8}$ inches.

Another from the Baram, taken by Messrs. Harrison and Hiller, agrees with Day's figure of *Trygon walga*. It also has the tail a little thickened just beyond tips of caudal spines. Length (caudal broken) $11\frac{1}{2}$ inches.

A young example, possibly this species, is $4\frac{5}{16}$ inches. Dr. Furness.

Swainson's name, *Pastinaca brevicauda*, seems to be the oldest available with any certainty of identification. *Raia fluviatilis* Hamilton[8] is only to be referred to with doubt, as no attempt is made to particularly designate any species under that name. *Trygon immunis* Bennett[9] is described thus: "Tryg. corpore subquadrato, omnino lævi; caudâ longiore, spinis duabus serratis citra medium armatâ." It may possibly be identical, but the account is too brief. *Pastinaca dorsalis*

Subgenus PRISTIS Linck.

Type *Squalus pristis* Linnæus.

No lower caudal lobe.

Nat. Tijds. Ned. Ind., III, 1852, p. 441. Bandjermassing, in fluviis.

First is in *Verh. Bat. Genoot.* (Bijd. Plag. Ind. Arch.), XXIV, 1852, p. 55. Bandjermassing, Borneo austro-orientalis, in fluviis.

[6] *Cat. Fish. Brit. Mus.*, VIII, 1870, p. 438.

[7] *Fishes of India*, IV, 1878, p. 729, Pl. 191, fig. 2. Madras.

[8] *Acc. Fish. Ganges*, 1822, p. 1 (apparently called *Raia lymma*, p. 361).

[9] *Mem. Life of Raffles* (Cat. Zool. Spec.), 1830, p. 694. Sumatra.

Swainson,[10] also based on Russell,[11] is probably identical though following *P. brevicauda*, and therefore to be considered subsequent. All of these names are older than *Trygon walga* Müller and Henle,[12] which has had more general usage.

6. Hypolophus sephen (Forskål).

Tail with a single spine, its length a little greater along free lower edge than space between tip of snout and front of eye. Tail without asperities in front of caudal spine, and apparently not so asperous posteriorly as shown in Day's figure.[13] Only two tubercles in middle of back enlarged. Length 35 inches.

7. Pteroplatea micrura (Schneider).

Length of body from tip of snout to base of tail 2 in width. Greatest width of disk would fall a little nearer center of length than shown in Day's figure.[14] Eye $3\frac{3}{5}$ in interorbital space. Width of disk $8\frac{1}{2}$ inches. Baram river. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

PLOTOSIDÆ.

8. Plotosus canius Hamilton.

A young example has a more flattened interorbital space than the larger which is $16\frac{3}{4}$ inches. The former has depressed first dorsal also reaching well beyond origin of second fin.

CHLARIIDÆ.[15]

9. Chlarias batrachus (Linnæus).

Head, from tip of snout to gill-opening, 5; depth, about middle of base of dorsal, 7; D. about 67; A. about 54?; space between origin of dorsal and occipital crest $2\frac{1}{2}$ in head from latter point; pectoral reaching about opposite origin of dorsal. One example in bad condition agreeing with my Sumatran specimens.

10. Chlarias leiacanthus (Bleeker).

Head 5; depth at origin of dorsal $6\frac{3}{4}$; width of head $1\frac{3}{5}$ in its length to end of occiput; pectoral spine about $2\frac{1}{4}$; space between dorsal and occiput about $2\frac{3}{4}$. Traces of pale spots in same pattern as those on

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[10] *Lardner's Cabinet Cyclopædia Nat. Hist.*, II, 1839, p. 319.

[11] *Isacurrah tenkee* Russell, *Fishes of Coromandel*, I, 1803, p. 3, Pl. 4. Vizagapatam. Madras.

[12] *Syst. Besch. Plagiost.*, 1841, p. 159. Indien. Rothes Meer. (Britisches Museum. M. Hardwicke. Leyden, Paris. MM. Roux and Dussumier.)

[13] *Fishes of India*, IV, 1878, Pl. 195, fig. 2.

[14] *L. c.*, Pl. 194, fig. 2.

[15] *Phagorus* McClelland is a valid genus, differing in the confluent rayed dorsal, caudal and anal.

PHAGORUS NIEUHOFII (Valenciennes), examined.

former species. Length 7⅝ inches. Baram river. Messrs. Harrison and Hiller.

CHACIDÆ.

11. Chaca bankanensis Bleeker.

One from Kapuas river. Length 6¼ inches. Messrs. Harrison and Hiller.

SILURIDÆ.

TACHYSURINÆ.

12. Galeichthys sondaicus (Valenciennes).

A very interesting example has the mouth and pharynx nearly filled with ova in all stages of development. They are easily seen in the pharynx through the gill-arches. The largest eggs are about 15 mm. in diameter, the others varying down to rather large shot. Though not dissected the intestinal canal appears to be empty and the fish is a male. Length 12 inches. Two examples from Dr. Furness. Another was secured by Messrs. Harrison and Hiller in 1897.

A small example from the mouth of the Baram secured by Dr. Furness is 5⅞ inches long. Caudal more or less brownish, and no traces of the vertical pale lines shown in Bleeker's figure.[16] In this respect it agrees with the examples noted above, though the maxillary barbels are longer, reaching origins of ventrals.

13. Tachysurus argyropleuron (Valenciennes).

Head 3⅛ to 3⅝; depth 3⅞ to 4⅗; D. I, 7; A. v or vi, 15 or 16; total length of fish 4 to 9½ inches. Rakers short, shorter than filaments, and not numerous. Color in alcohol pale brown above, lower surface white and together with sides washed with silvery. Dorsal and caudal brownish. Pectoral and ventral brownish above, also outer portion of anal. From the largest one I extracted a small Siluroid, evidently the young, which measures a trifle over 2 inches (52 mm.).[17] It does not have the dark or dusky blotch seen on upper portion of adipose fin of the next example in size, and top of the head is nearly smooth or hardly rugose. Snout pale like the belly. The next example, or one second in size, has first dorsal ray prolonged considerably beyond dorsal spine. A third example has interorbital space and snout pale or whitish like belly. Lower fins also whiter and adipose fin a little paler. From the pharynx I extracted eggs, the largest about 10 mm. in diameter.

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[16] *Atlas Ichth.*, II, 1863, Pl. (14) 62.

[17] I have not included this specimen in the above measurements, etc.

They all appear to be about the same size or of similar development, no small ones like those seen in the preceding species were noted.

Four examples.

SILURINÆ.

APODOGLANIS gen. nov.

Type *Apodoglanis furnessi* sp. nov.

This genus is related to *Parasilurus* Bleeker, differing in the absence of ventral fins and the fewer anal rays.

(*A*, without; ποὺς, foot; γλάνις, an old name applied to *Silurus*.)

14. Apodoglanis furnessi sp. nov.

Head $4\frac{3}{5}$; depth $4\frac{3}{4}$; D. 4; A. III, 47; P. I, 10; width of head $1\frac{1}{6}$ in its length; depth of head, about middle of its length, $1\frac{5}{6}$; snout $2\frac{3}{4}$;

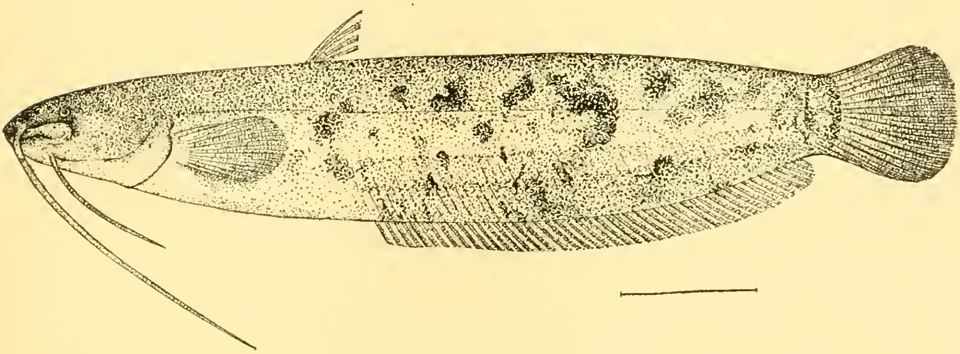

Fig. 2.—*Apodoglanis furnessi* Fowler.

width of mouth $1\frac{1}{2}$; interorbital space $2\frac{1}{10}$; length of dorsal $2\frac{2}{5}$; of caudal $1\frac{1}{3}$; of pectoral $1\frac{4}{7}$; base of anal about $1\frac{7}{8}$ in head and trunk.

Body rather elongate, robust anteriorly, and long anal region strongly compressed. Upper profile from nape to caudal nearly straight. Greatest depth of body about middle of length of body. Depth of base of caudal about $2\frac{1}{6}$ in head.

Head depressed, moderately broad, and triangular in profile. When viewed from above margin broadly convex. Snout broad, slightly convex, and projecting beyond mandible. Eye small, without eyelid, imbedded in skin of head and well anterior. Mouth broad, broadly convex, and with rather thick fleshy lips. A deep pit below front of eye, extended forward as a groove to below maxillary barbel. Teeth in rather broad bands in jaws without any projections, and mandibular series divided at symphysis posteriorly only. Teeth all small and pointed. On each side in front of roof of mouth a small patch of vomerine teeth. Tongue large, thick, fleshy and hardly free in front. Nostrils with small elevated cutaneous rims, those of anterior pair a trifle more developed. Anterior pair near tip of snout, well separated or with space between nearly double distance each one is anterior to posterior. Posterior internasal space a trifle greater than anterior. Maxillary barbel long, in profile originating just behind anterior nostril and well laterally, and when extended reaching beyond tip of depressed dorsal fin or beyond anterior anal rays a short distance. A single mental barbel well back on each ramus or in profile originating just behind posterior nostril.

Gill-opening extending forward till about opposite front margin of orbit, and left branchiostegal flap folded broadly over right. Rakers short, sparse, pointed, slender, and much shorter than filaments or about equal to diameter of pupil. Filaments a trifle longer than horizontal orbital diameter. A cutaneous keel along margin of shoulder-girdle inside gill-opening.

Body entirely naked. Lateral line a little high at first, but descending till about midway in depth of trunk at beginning of anal fin, and then continuous to base of caudal. All of bifurcations, which form tubes, given off below.

Dorsal without spine, first rays longest, inserted before anal or a little before first third of length of entire fish. Anal long, rays more or less equal, lower margin straight and edges rounded, and insertion of fin a little before tip of depressed dorsal. Caudal broad, margin truncate, and corners rounded. Pectoral broadly expanded, its origin about level with mouth, spine small, about $\frac{2}{5}$ in fin, and depressed fin reaching about $\frac{3}{5}$ of space to origin of anal or not quite opposite origin of dorsal. Ventral absent. Vent close in front of anal fin, with papilla.

Color in alcohol brown, paler below. Fins pale brown. Dorsal apparently unmarked. Basal $\frac{3}{5}$ of anal a slightly tawny-brown, margin pale like dorsal and caudal. Base of caudal dusky, sharply defined, and outer submarginal portion with a broad diffuse dusky shade, showing traces of indistinct darker though diffuse spots. Pectoral unmarked. Back and base of anal variegated with dusky blotches, irregular in size, shape or pattern and definition, though mostly large. Lower surface of head pale brownish. Maxillary barbels like upper surface of head, though under edges like lower surface of head. Mandibular barbels similar to latter. Iris slaty.

Length 7 inches.

Type No. 2,485, W. I. A. P. Baram river, Borneo. 1897. Dr. W. H. Furness.

(Named for Dr. W. H. Furness, 3rd, of Philadelphia, explorer of Borneo, who collected the type.)

15. Ompok nebulosus (Vaillant).

Head $3\frac{9}{10}$; depth 5; D. I, 4; A. 69; P. I, 13; V. I, 10; width of head $1\frac{3}{4}$ in its length, from tip of mandible; depth of head, at occiput, $1\frac{5}{6}$; length of dorsal 2; of lower caudal lobes $1\frac{9}{10}$; of pectoral $1\frac{3}{4}$; of ventral $3\frac{1}{6}$; depth of caudal peduncle $6\frac{1}{3}$; snout $2\frac{3}{5}$ in head, from tip of upper jaw; maxillary $2\frac{1}{2}$; width of mouth $1\frac{4}{5}$; interorbital space 2; eye $6\frac{7}{8}$ in interorbital space; base of anal 2 in total length of fish.

Body elongate, compressed, greatest depth about origin of anal, and upper profile of back nearly straight from occiput to caudal. Lower basal profile of anal gradually sloping up to narrow caudal peduncle.

Head broad, depressed in front and becoming conic posteriorly. Upper profile slightly concave. Anterior margin of head when viewed from above broadly convex. Snout broad, depressed, and with convex margin. Eye small, lateral, ellipsoid, a little anterior, and behind corner of mouth. A deep convex fissure before lower anterior margin of orbit, leaving a narrow preorbital rim. Lips thick and fleshy, with thick folds at corners of mouth. Mandible well protruded. Teeth numerous, sharp pointed, slender, and in rather broad uninterrupted bands with projections in jaws. Vomerine teeth smaller, similar, in two approximated patches anteriorly in roof of mouth, which is otherwise smooth and edentulous. Tongue smooth, broad, thick, fleshy, rounded and but little free on edges. Nostrils small, inconspicuous, and space between each about equal. Anterior nostrils in short cutaneous tubes near front edge of snout, their distance from posterior about $\frac{1}{3}$ of space between. Posterior would fall about midway in space between anterior and front rim of orbit. Maxillary barbel long, slender, filamentous, and reaching beyond tip of depressed dorsal or about first $\frac{3}{10}$ of anal base. Each ramus of mandible with a small thin barbel placed about midway in space between nostrils, and length a trifle greater than same.

Gill-opening extending forward about opposite space between mandibular barbels. Rakers 5 + 10, first eight just below bend also with an inner prong. Several of those above bend also bifid. In form conic, sharp pointed, firm, and length nearly $\frac{1}{2}$ that of longest filaments. Longest filaments a trifle more than horizontal orbital diameter, or not quite equal to space between anterior and posterior nostrils. Branchiostegal flaps broad, left forming a broad flap over right, and radii 19. Isthmus rather broad and fleshy.

Skin smooth, naked and without papillæ. A number of pores on head, small and inconspicuous. Lateral line a little high at first, and continuous, composed of short horizontally exposed tubes following one another and not arborescent.

Dorsal rather long, inserted about first third in total length of fish, first ray flexible, and not quite as long as second, which is longest, others graduated down. Anal long basally. Same region also overlaid by a cutaneous membrane extending out on half of depth of fin except posteriorly, where it gradually recedes till about ninth ray from end, where only a little less than a fourth is covered. First few graduated rays of anal enveloped in basal membrane. Caudal comparatively small, forked and lower lobe longer. Pectoral rather broadly expanded, reaching a little past base of dorsal, spine flexible distally, and second, and third rays longest. Ventral small, second and third developed rays longest, rounded, basally covered with membrane which is sharply defined like that of anal though not extending proportionately so far out, and inserted about opposite origin of dorsal. Pectoral with similar membrane to that of ventral basally. Anal begins a little before tip of depressed ventral, and vent in this space close behind ventral.

Color in alcohol deep brown. Abdomen and lower surface of head dull white. Fins brown, becoming dusky marginally on caudal and anal. Dorsal dusky-brown, and ventral more paler or whitish than pectoral. Upper edge of pectoral dusky. Margin of mandible brownish, composed of scattered brown dots of minute size gradually fading off to white of lower surface. Iris slaty brown.

Length $21\frac{3}{4}$ inches.

Three examples, largest described above. The others do not differ, showing about the same fin and branchiostegal radii, though the line of insertion of dorsal and anal is a trifle more anterior.

16. Ompok jaynei sp. nov.

Head $4\frac{2}{5}$; depth $4\frac{3}{5}$; D. I, 3; A. 56; P. I, 12; V. 7; width of head $1\frac{2}{5}$ in its length; depth of head, at posterior margin of eye, 2; length of dorsal $1\frac{4}{5}$; pectoral $1\frac{1}{12}$; ventral $2\frac{2}{3}$; base of caudal $4\frac{2}{5}$; snout 3, from tip of upper jaw; width of mouth $1\frac{7}{8}$; interorbital space $1\frac{5}{6}$; maxillary $3\frac{2}{5}$; pectoral spine $2\frac{1}{8}$; eye $4\frac{2}{3}$ in interorbital space; base of anal $1\frac{2}{3}$ in total length of fish.

Body long, compressed, upper profile rather evenly curved from tip of snout to dorsal and then more or less straight to caudal. Greatest depth at origin of ventral.

Head deep, flattened below, depressed in front, and somewhat constricted above posteriorly. Snout broad, depressed, and upper margin of head broadly convex when viewed above. Mouth broad, with rather thin lips, and mandible projecting. Eye small, circular, lateral, anterior, and distinctly behind corner of mouth. A deep fissure before and below eye leaving a narrow preorbital rim. Teeth fine, sharp pointed, and in rather broad bands in jaws without backward projections. Vomerine teeth similar, small, and in two approximated patches in front of mouth. Tongue large, rounded, fleshy, thick, its margin little free and with a small papilla medianly above. Nostrils like those of preceding species, with small cutaneous rims, those of anterior pair better developed. Maxillary barbel long, filamentous and reaching a little more than half of length of entire fish or well beyond tip of depressed dorsal. Mandibular barbel slender, inserted about opposite posterior nostril and reaching about opposite origin of pectoral fin.

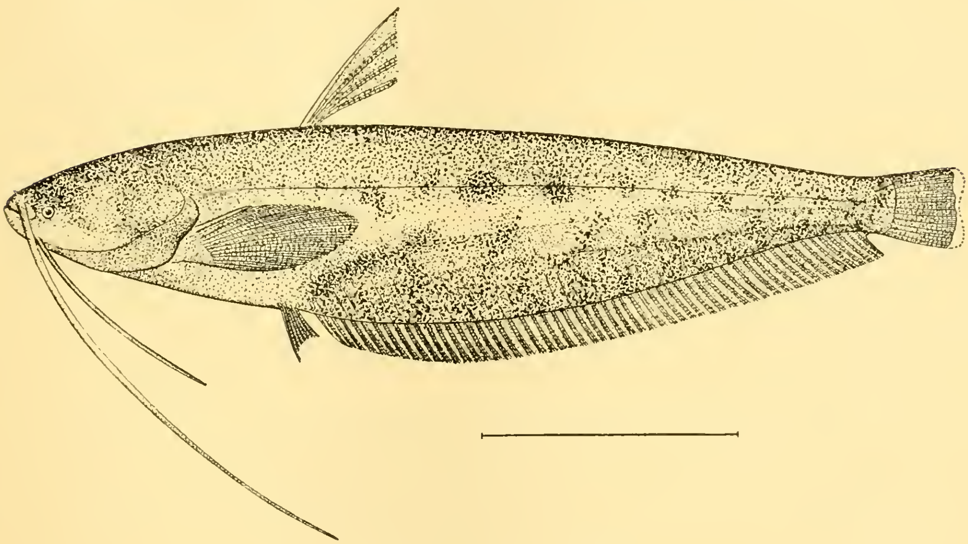

Fig. 3.—*Ompok jaynei* Fowler.

Gill-opening extending forward about opposite posterior nostril. Rakers 2+7, simple, rather firm, slender, pointed, and about $\frac{4}{5}$ of longest filaments. Longest filaments about equal to horizontal orbital diameter. Branchiostegal flaps broad, left one forming a broad flap over right, and radii about 8?. Isthmus broad.

Body naked, skin smooth. Head with a number of pores. Lateral line continued to base of caudal.

Dorsal small, slender, first ray flexible, and insertion of fin a little before first third in entire length of fish. Anal basis long, and basal enveloping membrane also continued along lower edge of caudal peduncle and out on base of caudal. Membrane on base of anal extending out as in preceding species, and last ray separate from caudal distally. Caudal small, damaged. Pectoral broad, expanded, rounded, median rays longest, and reaching beyond base of dorsal and first anal rays. Pectoral spine pungent, curved, outer margin entire, about $\frac{2}{3}$ length of fin or reaching opposite posterior basal margin of dorsal at least, and basally covered with a rather broad membrane. Ventral inserted about opposite origin of dorsal, small, rounded, reaching a little beyond tip of depressed pectoral, and also covered with a rather broad basal membrane. Vent close behind ventrals, with a papilla, and anal fin close behind it.

Color in alcohol brown, rather paler on trunk than on fins which are pale brownish. Several indistinct brown cloudings or blotches on trunk and base of anal. Barbels brownish. Iris slaty.

Length $3\frac{3}{4}$ inches.

Type No. 13,929, W. I. A. P. Borneo. 1898. Dr. W. H. Furness.

Only one example, the type described above. It is close to *Ompok leiacanthus* (Bleeker), but differs in coloration. That of *O. jaynei* is blotched and has dark ends to the pectoral fins. *Ompok borneensis* (Steindachner)[18] also differs in the uniform coloration, except the dark spot before the caudal.

(Named for Prof. Horace Jayne, formerly Director of the Wistar Institute of Anatomy, of Philadelphia, to whom I am principally indebted for this opportunity of studying the fishes of Borneo.)

17. Kryptopterus cryptopterus (Bleeker).

Head $5\frac{2}{5}$; depth $4\frac{2}{3}$; D. 2; A. 60; P. I, 14; V. I, 5; width of head $1\frac{3}{7}$ in its length; depth of head, at anterior margin of orbit, $2\frac{1}{6}$; width of mouth 2; snout 3; eye $3\frac{1}{4}$; interorbital space $1\frac{2}{3}$; ventral 5; pectoral 5 in head and trunk. Rakers rather long, slender and numerous.

18. Kryptopterus limpok (Bleeker).

Head 6 to $6\frac{1}{5}$; depth 5 to $5\frac{1}{3}$; D. 2; A. 69 to 77; P. I, 14 or 15; V. I, 7 or 8; pectoral 1 to $1\frac{1}{10}$ in head; ventral $2\frac{1}{6}$ to $2\frac{2}{3}$; pectoral spine $1\frac{3}{5}$ to $1\frac{5}{6}$; width of head $1\frac{1}{3}$ to $1\frac{3}{5}$; snout $2\frac{7}{8}$ to 3, from tip of upper jaw; eye $3\frac{1}{3}$ to $4\frac{1}{10}$; width of mouth $2\frac{1}{10}$ to $2\frac{2}{5}$; interorbital space $2\frac{1}{10}$ to $2\frac{2}{5}$. Inner edge of pectoral spine pectinate. About 12 inches long. Four examples from the Baram river, some from upper waters.

19. Kryptopterus palembangensis (Bleeker).

Head $5\frac{2}{3}$; depth $3\frac{7}{8}$; D. 2; A. 61; P. I, 11; V. I, 5; width of head $1\frac{1}{2}$ in its length; depth of head at posterior margin of orbit about $1\frac{2}{5}$ in

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[18] *Callichrous* (*Silurodes*) *borneensis* Steindachner, *Abhand. Senck. Nat. Ges.* Frankfurt, XXV (2), 1901, p. 445, Pl. 18, fig. 3. Aus dem Baram-Flusse, Borneo. (Herr Prof. Kükenthal.)

its length; snout 3; eye 3; width of mouth $2\frac{1}{4}$; interorbital space 2; depth at base of caudal $2\frac{1}{6}$; length of pectoral 4 in head and trunk; upper caudal lobe $4\frac{9}{10}$. Each ramus of mandible with a short inconspicuous barbel. Rakers rather slender, long and numerous. Pectoral and margin of caudal tinted with dusky. A dark or dusky postopercular blotch. One example $5\frac{3}{4}$ inches long.

20. Micronema phalacronotus (Bleeker).

Head $5\frac{1}{8}$ and $5\frac{1}{4}$; depth $5\frac{7}{8}$ and $5\frac{3}{8}$; A. 85 and 87; P. I, 15, and I, 14; V. I, 6, and I, 7; width of head $1\frac{7}{8}$ and $1\frac{4}{5}$; depth of head at posterior margin of eye $2\frac{1}{6}$ and $2\frac{1}{7}$; pectoral $1\frac{1}{5}$ and $1\frac{1}{3}$; base of caudal $4\frac{1}{6}$ and $3\frac{3}{5}$; length of ventral 3 and $3\frac{1}{10}$; width of mouth at corners 2 and $2\frac{1}{10}$; length of snout $2\frac{3}{8}$ and 3 in head, from tip of upper jaw; maxillary $2\frac{2}{3}$ and $2\frac{3}{4}$; interorbital space $2\frac{1}{4}$ and $2\frac{1}{8}$; orbit $5\frac{1}{2}$ and 5. Two examples, larger 12 inches long. Baram river.

Micronema micronema (Bleeker),[19] Java, is closely related, and probably differs in the dark spot at the base of the caudal. The small example described as *Cryptopterus micronema* by Prof. Vaillant[20] cannot belong to this species on account of the exceptionally small number of anal rays. Bleeker's figure of *Micronema typus*[21] is, however, identical with the example before me.

BAGRINÆ.[22]

21. Hemibagrus nemurus (Valenciennes).

Head $3\frac{1}{4}$; depth $4\frac{1}{3}$; D. I, 7; A. IV, 9; width of head $1\frac{1}{2}$ in its length; eye 2 in interorbital space; width of mouth $2\frac{2}{5}$ in head. Depressed dorsal reaching adipose fin, membranes between rays not deeply incised, and rays themselves expanded. Ventral inserted nearly as far forward as opposite middle of base of dorsal, and when depressed reaching origin of anal. No dark humeral blotch. Length 12 inches. Baram river. Male. Harrison and Hiller.

Another example $18\frac{3}{4}$ inches long, with same data, evidently a

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[19] *Silurus micronemus* Bleeker, *Verh. Bat. Genoot.* (Sil. Bat. Con.), XXI, 1846, p. —. [Not consulted.]

[20] *Notes Leyd. Mus.*, XXIV, November, 1902, p. 48.

[21] *Atlas Ichth.*, II, 1863, p. 91, Pl. 45 (93), fig. 1.

[22] BAGROIDES MELAPTERUS Bleeker.

Head 4; depth 4; D. I, 7; A. V, 11; width of head $1\frac{1}{3}$ in its length; snout 3; eye $5\frac{3}{5}$; interorbital space 4. Lateral line with a series of minute cutaneous filaments, most distinct anteriorly. Coloration not exactly agreeing with Bleeker's figure. More white on posterior portion of adipose dorsal, and distal portions of dorsal, anal, pectoral and ventral rays darker or deeper than body-color. A brown streak from upper edge of snout horizontally below eye back across cheek, also side of head with more brown. Upper lobe of caudal a little more forked than lower. Length $6\frac{5}{16}$ inches. One example from the Paris Museum in Acad. Nat. Sci. Phila.

female, has: Head $3\frac{1}{3}$; depth $4\frac{3}{5}$; D. I, 7; A. IV, 8; width of head $1\frac{2}{5}$ in its length; eye 3 in interorbital space; width of mouth $2\frac{1}{8}$ in head. Depressed dorsal with only prolonged tips of rays reaching adipose dorsal. The rays of this fin are similar to those found on examples by Prof. Vaillant.[23] In this case the dorsal spine is furnished with a long cutaneous point, while those of the three following branched rays are long, slender and pointed and graduated from the first which is longest. Ventral inserted about opposite the last dorsal rays and when depressed not reaching origin of anal.

22. Hypselobagrus nigrioeps (Valenciennes).

Head $4\frac{1}{6}$; depth $4\frac{1}{6}$; snout $2\frac{1}{3}$ in head; eye 4; width of mouth $3\frac{2}{7}$; interorbital space $3\frac{1}{6}$. One example $6\frac{11}{16}$ inches long.[24]

23. Glyptothorax platypogon (Valenciennes).

Head $3\frac{1}{2}$; depth 5; D. I, 6; A. IV, 10; P. I, 9; V. I, 5; width of head $1\frac{2}{5}$ in its length; depth of head over middle of eye $2\frac{1}{3}$; snout $2\frac{1}{10}$; width of mouth 2; dorsal spine $1\frac{3}{4}$, to end of its filament $1\frac{1}{3}$; pectoral spine $1\frac{3}{4}$; length of pectoral fin $1\frac{1}{6}$; ventral $1\frac{7}{8}$; least depth of caudal peduncle $2\frac{1}{2}$; base of anal $1\frac{9}{10}$; interorbital space 4; eye $2\frac{1}{2}$ in interorbital space.

Body rather robust, compressed, and greatest depth about origin of spinous dorsal. Caudal peduncle compressed, rather deep, its least depth about $1\frac{1}{5}$ in its length.

Head broad, convex above, and depressed or flattened below. Upper profile evenly though shallowly convex from tip of snout to origin of spinous dorsal. Snout long, broad, flattened medianly, protruding well beyond mandible, and profile slightly curved. When viewed from above margin of head is broadly convex. Eye small, superior, a little longer than deep, and a trifle posterior in length of head. Mouth broad, and lips rather fleshy and thin. Maxillary barbel broad basally, and reaching a trifle beyond origin of pectoral. Nasal barbel small, reaching a trifle over half way to front of eye. Outer mental barbel not quite extending to origin of pectoral. Inner mental barbel a little shorter than outer. Rather broad bands of fine slender numerous pointed teeth in jaws. No teeth on roof of mouth or on tongue. Tongue broad, thick, but little differentiated, and only its front edge slightly free. Nostrils close together, large, near front edge

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[23] *Macrones nemurus* Vaillant, *Notes Leyd. Mus.*, XXIV, November, 1902, p. 54.

[24] This agrees with an example from the Paris Museum in Acad. Nat. Sci. Phila., except as notes above will show. The Academy's example has: Head 4; depth $4\frac{1}{3}$; D. I, 7; A. IV, 7, I; P. I, 10; V. I, 5; width of head $1\frac{4}{7}$ in its length; snout $2\frac{1}{5}$; eye $3\frac{4}{7}$; width of mouth 3; interorbital space $3\frac{3}{4}$; dorsal spine $1\frac{4}{7}$; pectoral spine $1\frac{4}{7}$; base of adipose fin about $2\frac{1}{10}$ in head and trunk. Length $5\frac{1}{8}$ inches.

of snout, and nasal barbel situated between, posterior pair a little more remote from each other than space between anterior pair. Anterior internasal space about $1\frac{3}{5}$ in interorbital space. Top of head convex, and fontanel continued to interparietal region. Occipital process not joining dorsal process.

Gill-opening broad, membranes not free from isthmus, and extending anteriorly about first $\frac{4}{5}$ of snout. Rakers 3+8, slender, pungent, with flexible tips, and longest longer than filaments or about 2 in interorbital space. Knob on shoulder-girdle prominent. Isthmus broad.

Body covered with smooth skin. Traces of coriaceous-like longi tudinal papillæ on head above. Disk laminæ on chest obsolete owing perhaps to preservation. Humeral process with several rather coarse striæ. Lateral line continuous, sloping, and about midway on side of caudal peduncle.

Dorsal fin inserted about midway between tip of snout and origin of adipose fin, spine robust, margins entire, and with a prolonged cutaneous tip. Dorsal rays graduated down from first which is longest. Adipose dorsal small, inserted nearer base of caudal than base of last dorsal ray. Space between dorsal and adipose dorsal with about 9 rather small spinous knobs, rounded and covered with adipose-like tissue, though at least 5 or 6 still distinguishable in profile. Anal inserted a little before origin of adipose dorsal or a little nearer base of last dorsal ray than base of caudal, and radii graduated down from first branched ray which is longest. Pectoral inserted nearer origin of dorsal than tip of snout, spine reaching about opposite base of first dorsal ray, with a cutaneous point almost as long as first or longest ray, and inner margin of spine with about 9 long antrorse spines. Ventral inserted opposite posterior edge of base of dorsal, and reaching $\frac{3}{4}$ of space of anal. Genital aperture and vent well separated, near last third in space between origin of ventral and anal.

Color in alcohol brown, belly, breast and lower surface of head paler. Caudal and dorsal with pale brown or whitish, otherwise dusky, and other fins also marked with brownish. Maxillary barbel brown above, pale or whitish below, and lower mental barbels, like lower surface of head. Iris slaty.

Length $4\frac{1}{2}$ inches.

Twenty-four examples, most of which represent a large series of young. Two of the larger ones agree exactly with Dr. Steindachner's excellent figure,[25] though they have the laminæ on the thorax rather

[25] *Glyptosternum kükenthali* Steindachner, *Abhand. Senck. Nat. Ges.* Frankfurt, XXV (2), 1901, p. 448, Pl. 18, figs. 5, 5*a*. Aus dem Baram-Flusse, Borneo. (Herr Prof. Kükenthal.)

indistinct. I am unable on comparison with Sumatran examples to find any differences except such as may be due to individual variation. The Borneo examples, which may be considered topotypical of *kükenthali*, seem to leave little chance for doubt that Dr. Steindachner's example is simply the adult. All my Sumatran examples show at least traces of the interdorsal spinous knobs or processes, and their coloration evidently was somewhat purplish-tinted, according to my original notes, when first received in arrack.

24. Akysis baramensis sp. nov.

Head $3\frac{1}{2}$; depth $5\frac{1}{2}$; D. I, I, 5; A. II, 6, II; P. I, 5, II; V. I, 5; width

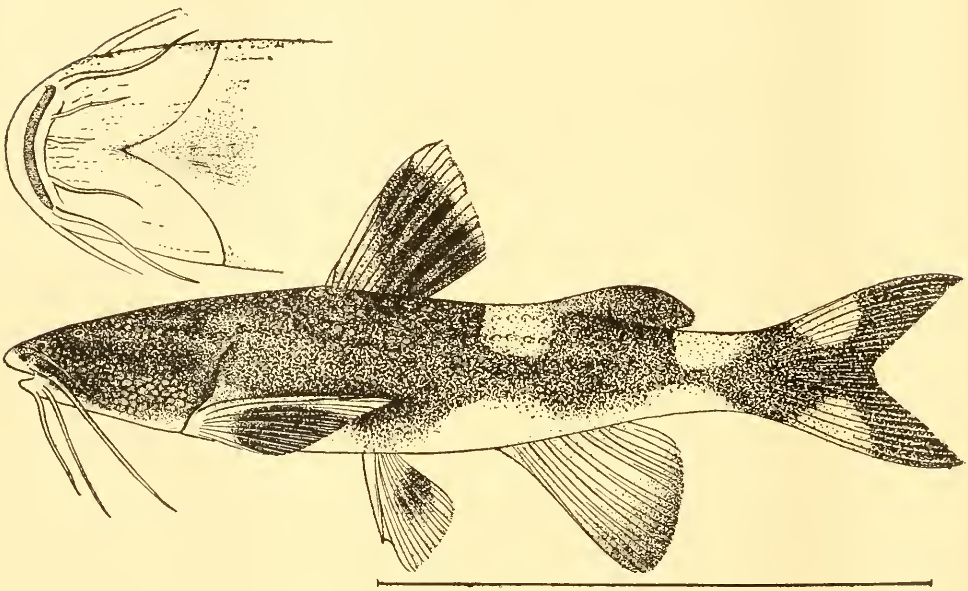

Fig. 4.—*Akysis baramensis* Fowler.

of head $1\frac{1}{4}$ in its length; depth of head $1\frac{2}{3}$; width of mouth 2; length of snout $2\frac{3}{4}$; interorbital space 3; length of depressed dorsal $1\frac{1}{6}$; of lower caudal lobe 1; of pectoral $1\frac{1}{10}$; ventral $1\frac{2}{3}$; least depth of caudal peduncle $2\frac{4}{5}$.

Body elongate, slender, depressed, and greatest depth about opposite middle of depressed pectoral. Caudal peduncle compressed, its least depth about $1\frac{2}{3}$ in its length from posterior base of adipose dorsal fin.

Head broad, depressed, evenly convex above, and lower portion more or less flattened. Breast flattened. Snout produced, broad and rounded convexly in profile when viewed from above. Eye small, superior, anterior, and eyelid not developed. Mouth broadly convex inferior, and in profile tip of mandible would fall in first $\frac{2}{5}$ of space between tip of snout and front of eye. A band of fine teeth in each jaw, none on roof of mouth or on tongue. Tongue broad, smooth and little free in mouth. Two large nasal cavities on side of snout in front of eye near together, and nasal barbel originating on frenum between. Nasal barbel about equal to ventral or reaching for about first $\frac{2}{3}$ of length of head. Maxillary barbel rather thick at first and reaching about first third of depressed pectoral. Outer mental barbel nearly as long. Inner mental barbel a little over half length of outer. Interorbital space flattened. Occipital process not forming a complete bony bridge to spinous process of dorsal.

Gill-openings inferior, well separated by a broad isthmus, and extending forward about opposite to eye. Rakers about $1+7$, slender, pointed, moderately long, and much shorter than filaments. Branchiostegals 7, upper clavate.

Skin smooth, on head and along lateral line more or less papillate, especially former anteriorly. Lateral line complete and median in depth of body along side.

First dorsal inserted about first third of total length of fish, spine robust and about $\frac{3}{5}$ of its own length when combined with adipose-like prolongation, and smooth. When depressed it reaches about $\frac{3}{4}$ of space to origin of adipose fin. Adipose fin large, rather high, and its base about $1\frac{3}{5}$ in head. Anal high, its origin a trifle in advance of that of adipose fin and when depressed its length a little more than that of dorsal. Pectoral a little longer than dorsal, and spine robust with posterior margin coarsely serrate, with an adipose-like prolongation. When depressed not quite reaching opposite posterior basal margin of dorsal, though beyond origin of ventral. Ventral not quite reaching origin of anal. Vent well forward or close behind roots of ventrals.

Color in arrack dusky-brown, forming about five blotches transversely on body, and mostly above. First included in head, second below dorsal, third below adipose fin, fourth on caudal peduncle at base of caudal and fifth on caudal distally. These all connected along middle of side of body by isthmi of same color. Dorsal dusky-brown. Adipose fin largely dusky-brown. Caudal except as noted whitish, and tip of each lobe same. Ventral and anal whitish, except a small dusky blotch on each medianly. Pectoral with spine whitish, fin otherwise dusky. Lower surface of body, including head and abdomen principally, whitish. Paler areas on upper surface of body brownish-white.

Iris slaty. Nasal and maxillary barbels whitish mostly, brownish above, and mental barbels entirely white.

Length 1⅞ inches.

Type No. 14,149, W. I. A. P. Baram river, Borneo. 1898. Dr. W. H. Furness. Also 25 paratypes with same data.

From *Akysis armatus* Vaillant[26] it differs in the coloration, that species having round pale spots.

This species shows great color variation in alcohol, some examples are almost black, the contrast between the coloration above and below being very pronounced, while in others this is rather obscure. Other examples have the blotches on the body distinct, and also those on the fins, while others are more or less unicolored. The amount of blackish or brownish on the ventrals also varies, in some examples these fins are noticeably dark, while those of others are pale. The largest example measures a little over 2 inches.

(Named for the Baram river in British Borneo.)

COBITIDIDÆ.

COBITIDINÆ.[27]

25. Botia macracantha (Bleeker).

The oblique dark brown band on head not so pronounced as in Bleeker's figure.[28] Anterior margins of pectoral, ventral and anal pale like belly. Color of smaller examples agrees best. Three from the Kapuas river. Harrison and Hiller.

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[26] *Notes Leyd. Mus.*, XXIV, November, 1902, p. 64, fig. 10.

[27] Prof. Vaillant has recently given an exposition of the differential characters of the fishes of this family. He divides them into two groups based on the presence and absence of the preorbital spine. This appears certainly to be of subfamily value. His *Enopla* will then correspond to the *Cobitidinæ* as proposed above which may be typified by *Cobitis* Linnæus [type *Cobitis tænia* Linnæus]. This group has the erectile spine on the side of the head. The other Loaches, or *Anopla*, may be known as subfamily:

MISGURNINÆ.

No erectile spine on side of head. Typified by *Misgurnus* Lacépède. A species belonging in this group has recently been described by Prof. Vaillant. It appears to differ from *Nemacheilus* Van Hasselt, and may be indicated as a new genus.

VAILLANTELLA gen. nov.

Type *Nemacheilus euepipterus* Vaillant.

It is closely related to *Nemacheilus*, differing at once in the long dorsal basis, the radii numbering about 64.

(Named for Prof. Léon Vaillant, the distinguished ichthyologist of the Museum of Natural History of Paris, and well known for his researches in East Indian ichthyology.)

[28] *Atlas Ichth.*, III, 1863, Pl. (1) 102, fig. 2.

HOMALOPTERIDÆ.

HOMALOPTERINÆ.[29]

Ventrals separate, not united to form a disk.

26. Homaloptera orthogoniata Vaillant.

Head 5; depth $4\frac{7}{8}$; D. III, 8; A. III, 6; P. V, 10, I; V. II, 8; scales 63 in lateral line to base of caudal; 20 scales before dorsal; 11 scales obliquely back from origin of dorsal to lateral line; 12 scales obliquely forward from origin of ventral to lateral line, and same of anal; width of head $1\frac{1}{4}$ in its length; depth of head over eye $2\frac{1}{6}$; snout $1\frac{5}{6}$; width of mouth 4; interorbital space $2\frac{4}{5}$; first developed dorsal ray 1; first developed anal ray $1\frac{2}{7}$; length of ventral 1; least depth of caudal peduncle $2\frac{1}{8}$.

Body elongate, somewhat compressed, rounded in middle, lower or ventral region of head and abdomen flattened, and trunk posteriorly well compressed. Upper profile anterior to dorsal more or less evenly convex. Greatest depth about origin of dorsal fin. Caudal peduncle compressed, and its least depth about half its length.

Head flattened below, more or less evenly convex above, and upper profile nearly straight or only very shallowly convex. Snout long, tip rounded and produced well beyond mouth. Eye small, high, directed rather laterally, near first $\frac{3}{5}$ in length of head, and with free eyelid. Mouth inferior, rather small, and lips thick and fleshy. Jaws rather soft, especially upper. Lower lip formed into three thick fleshy folds. A short thick conical cirrus at each corner of mouth, and 4 more along front edge of snout just above upper lip. Tongue not distinct. Nostrils adjoining, frenum between narrow, posterior much the larger and about in last third of length of snout. Interorbital space rather broad, a little convex and greater than internasal space.

Gill-opening lateral, not quite reaching forward till opposite posterior margin of eye. Rakers short points, much shorter than filaments, and not numerous. Isthmus broad, its width equal in length to gill-opening.

Scales rather small, especially those on lower costal region where they crowd out and completely cover abdomen. Breast, head and fins, except a few small scales on base of caudal, entirely naked. Scales on post-ventral region large like those on side of body. Inner basal regions of pectoral and ventral also naked. Lateral line of simple

[29] I have not consulted the original account of *Homaloptera* Van Hasselt. The earliest one I have seen is in *Bull. Sci. Nat. Geol.* Paris, II, 1824, p. 377. I accept the name in accordance with Bleeker's restriction of *Homaloptera javanica* Van Hasselt as the type.

tubes, nearly median in depth of body and continuous. A number of small pores on head.

Dorsal inserted a little nearer tip of snout than base of caudal or a little before origin of ventral, and first developed ray highest, though not reaching as far posteriorly as tip of last ray when fin is depressed. Anal well posterior, inserted about midway between origin of ventral and base of caudal, and first developed ray, which is longest, reaching well beyond last ray, when fin is depressed. Caudal damaged, evidently little if any emarginate. Pectoral with first simple rays robust, fin broad, rounded and reaching about $\frac{5}{6}$ of space to origin of dorsal. Ventral similar, only with first two rays simple and enlarged, and when depressed reaching posteriorly about as far as tip of last dorsal ray or almost to vent. Vent near tip of ventral well before origin of anal.

Color in alcohol brown, clouded with large distinct blotches or areas of deep brown, irregular though one distinct between dorsal and ventral. Ventral surface a little paler brown than upper surface. A brown streak from tip of snout to eye, and continued behind up to occiput, and another down across side of head. These streaks all with narrow pale brownish margins. Dorsal and anal brownish-white clouded with dull blackish or blackish-brown. Anal similar, also pectoral and ventral, though these fins all have more white and the dark colors more diffuse. Iris slaty.

Length 4$\frac{1}{4}$ inches.

Eight examples.

These beautiful fish all vary in the markings, some having the pale areas most pronounced, while in others the dark markings predominate. In the young they appear best defined, some having the ventrals with much black.

HOMALOPTEROIDES gen. nov.

Type *Homaloptera wassinkii* Bleeker.

Dorsal inserted well behind ventral, while in *Homaloptera* it begins in advance.

(*Ὁμᾰλὸς*, level; *πτερὸν*, wing or fin; *εἶδος*, appearance.)

27. Homalopteroides wassinkii (Bleeker).

Head 4; depth 7; D. III, 7, I; A. II, 5, I; P. V, 9; V. II, 7, I; scales in lateral line about 38 from gill-opening to base of caudal; 18 scales before dorsal; about 7 scales in an oblique series from origin of dorsal to lateral line; about 5 scales obliquely forward from origin of anal to lateral line; about 15 scales between dorsal and caudal on middle of back; width of head 1$\frac{1}{3}$ in its length; depth of head over posterior margin of orbit 2; length of snout 2$\frac{1}{10}$; eye 3$\frac{1}{2}$; width of mouth about 4; interorbital space 3$\frac{2}{5}$; length of depressed dorsal 1$\frac{1}{6}$; of caudal about same; of anal $1\frac{2}{3}$; of pectoral $3\frac{2}{5}$ in head and trunk; of ventral $4\frac{2}{5}$; least depth of caudal peduncle 3.

Body slender, depressed, elongate, convexly rounded above and flattened below, only caudal region of trunk compressed. Greatest depth about origin of dorsal. Least depth of caudal peduncle about $1\frac{2}{5}$ in its length.

Head triangular when viewed above, tip rounded, convex above and flattened below. Snout more or less depressed above. Eye large, superior, rounded, and a trifle posterior in head. Mouth convex, rather small, and jaws cartilaginous. Four superior barbels on upper lip, and one at each corner of mouth which is a little the longer. Tongue not free or distinct. Interorbital space slightly convex. Nostrils close together, posterior much larger, and close to front of eye.

Gill-opening lateral, a little less than width of broad isthmus.

Scales moderately small, those on anterior part of body smaller than elsewhere. Breast naked and scales on costal region not altogether extending over median ventral line. Head and fins naked. Lateral line of simple tubes, and continuous to base of caudal midway on side.

Origin of dorsal a little behind origin of ventral or a little nearer base of caudal than tip of snout. Origin of anal a little nearer base of caudal than origin of ventral, and reaching about $\frac{2}{3}$ of distance to former. Caudal emarginate. Pectoral large, reaching ventral. Ventral reaching for $\frac{2}{3}$ of distance to anal.

Color in arrack brown with about 5 diffuse brown blotches on back. Lower surface whitish. Fins whitish, dorsal and caudal slightly darker, and all with several brown blotches. Iris slaty.

Length $1\frac{7}{8}$ inches.

Fifteen examples.

GASTROMYZONINÆ.

Ventral fins united to form a disk.

28. Gastromyzon borneensis Günther.[30]

Head $4\frac{5}{6}$; depth at origin of dorsal 6; greatest width of body $3\frac{1}{2}$;

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[30] *Ann. Mag. Nat. Hist.* Lond., XIV (4), 1874, p. 454. Mountain torrents of the interior of Borneo. "These specimens come from the sources of the Mingalong river." (British Museum.)——Steindachner, *Abhand. Senck. Nat. Ges.* Frankfurt, XXV (2) 1901, p. 455. Aus dem Baram-Flusse auf Borneo. (Herr Prof. Kükenthal.)——Vaillant, *Notes Leyd. Mus.*, XXIV, November, 1902, pp. 18, 23. Haut Sibau. (Kapoeas supérieur—Bassin du Sibau.) Bloeoe. (Mahakan ou Koetei supérieur.)

Lepidoglanis monticola Vaillant, *Congr. Int. Zool. Paris*, Compt. Rend., 1889 (1890), p. 82. La montagne de Kina Balu. Borneo. (M. Whitehead.)

Gastromyzon monticola Vaillant, *Bull. Soc. Philomathique*, Paris, Compt. Rend., III (8), 1890–91 (1891), p. 6. [Remark.]——Vaillant, *Nouv. Arch. Mus. Hist. Nat.* Paris, V (3), 1893, p. 94, Pl. 1. figs. 3–3*e*. Kina-Balou. (M. Whitehead.)

D. III, 6, II; A. I, I, 4, I; P. 28; V. 16, IV; scales about 63 in lateral line to base of caudal, and tubes in about same number; about 36 small scales before dorsal; about 15 scales in a vertical series between origin of dorsal and lateral line; 8 scales obliquely back from origin of anal to lateral line; about 28 scales between last dorsal ray and first rudimentary caudal ray; head, to occiput, $1\frac{1}{5}$ in its greatest width; length of snout about $1\frac{1}{2}$ in length of head to gill-opening; width of mouth only a trifle less; interorbital space 2; internasal space $3\frac{1}{2}$; greatest width of breast between bases of pectorals ventrally equal to greatest width of head, and same of ventrals $1\frac{3}{5}$ in latter; length of depressed dorsal a little less than length of head; caudal 1; length of depressed anal $1\frac{1}{3}$; least depth of caudal peduncle $2\frac{1}{2}$.

Body depressed, broad, narrow in profile with greatest depth at origin of dorsal. Greatest width of body that of head opposite gill-openings. Ventral surface flattened, and with a small cutaneous or fleshy flap on costal region between pectoral and ventral. Caudal peduncle small, compressed, and its length about equal to its least depth.

Head large, convex above, flattened below and separated from breast by a thin cutaneous fold. When viewed from above profile is truncate in front. Snout pronounced, though not beyond margin of disk. Cheek not convex. Mouth very broad, without teeth, osseous jaws smooth, and lips thin, upper broader. Tongue not developed. A small, short, fleshy papilla at each corner of mouth, and four others along upper lip. Eye small, circular, superior, directed laterally, and near last fourth in length of head. Eyelid free. Nostrils conspicuous, adjoining or only separated by a thin frenum, and near last third in length of snout. Interorbital space broad, a trifle convex, or rather flattened.

Gill-opening small, its length a little more than orbit, and nearly midway in depth of head above base of pectoral.

Scales small, striate, and those on anterior part of body minute and crowded. Head naked and also entire lower surface within disk. Fins scaleless. Scales extending on post-ventral region. Head with a number of small pores above. Lateral line of simple tubes, continuous, and about midway in depth of body.

First branched dorsal ray highest, and origin of fin midway in body without caudal. Anal well posterior, first ray spine-like, first branched ray longest, origin of fin nearer base of caudal than base of last dorsal ray, and depressed fin reaching past latter. Caudal oblong, expanded and truncate with rounded corners. Pectoral and ventral arranged to form an abdominal disk, and both with long bases. Radii of both fins also graduated so that posterior are longest. Ventral fins united posteriorly by a membrane, though both bases are distinct.

Color in alcohol blackish-brown generally, disk pale brownish or whitish. Narrow vermiculating lines of pale brownish on head above. Upper surface of body with irregular, pale and somewhat vermiculating diffuse lines, leaving possibly eight or nine blotches medianly. Three laterally entire length of trunk. Dorsal and caudal brownish-white, with about three broad blackish-brown transverse bands. Pectoral and ventral dusky above, edges narrowly pale and upper surface mottled with dark brown more or less diffusely. Ventral paler. Both fins tinted with a little brownish below. Anal pale with a submarginal and basal tinge of brownish. Iris slaty.

Length 4 inches.

A large series of 193 examples of all ages. Individual variation in color is very noticeable. The larger or adult examples all have the pale vermiculating lines on the head pronounced, though in some they are more numerous. In a number of young examples $1\frac{3}{4}$ inches long they are fewer, like the specimen described. The markings on the fins and body also vary greatly, and sometimes the latter form vertical bands. Some small examples are nearly uniform brown above in alcohol. Others have the upper surface of the head marked with very numerous small brown spots, due to the equally numerous pale reticulating lines. Young examples also differ in their relatively shorter body and rounded profile of front of head when viewed from above.

CYPRINIDÆ.

LABEONINÆ.

29. Dangila cuvieri Valenciennes.

Head $4\frac{3}{5}$; depth $3\frac{3}{4}$; D. IV, 26; A. III, 6; scales 35 in lateral line to base of caudal and 2 more on latter; snout $2\frac{2}{3}$ in head; eye $3\frac{1}{6}$; interorbital space $2\frac{2}{5}$; pectoral $1\frac{1}{10}$; ventral $1\frac{1}{5}$; least depth of caudal peduncle $2\frac{1}{10}$. Length $5\frac{1}{16}$ inches.

30. Osteochilus melanopleurus (Bleeker).[31]

Four examples. One from the Kapuas river in western Borneo,

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[31] OSTEOCHILUS VITTATUS (Valenciennes).

Three small examples in the Academy from the Paris Museum. Bleeker's figure evidently represents the adult in which the lateral band is lost. The two small examples before me have this very distinct, and above and below with traces of indistinct series of pale spots longitudinally or parallel. Just before root of caudal appears a dark spot, another at latter, and both in dark lateral band. Traces of this are seen in the larger example, though its colors are paler. It measures about $2\frac{7}{8}$ inches (72 mm.) in length. Bleeker's figure occurs in *Atlas Ichth.*, III, 1863, Pl. (16) 117, fig. 2, not plate 17 or 118 as referred to in the text.

taken by Harrison and Hiller in 1897, has: Head $3\frac{2}{5}$; depth $2\frac{2}{3}$; D. II, 18; A. III, 6; scales 50 to base of caudal, 2 more on latter; length $7\frac{1}{4}$ inches. It agrees well with Bleeker's figure in the color pattern. Three other examples from the Baram river, one, taken by Dr. Furness in November, 1898, measures $20\frac{1}{2}$ inches, while the others, secured by Harrison and Hiller, measure 19 and 24 inches respectively. They show: Head $3\frac{2}{3}$; depth $2\frac{3}{5}$ to 3; D. IV, 16 to 18; A. III, 6; scales 41 to 44 in lateral line to base of caudal, and 5 or 6 more on latter; 10 scales between origin of dorsal and lateral line and 8 obliquely forward from origin of anal to latter; width of head $1\frac{4}{7}$ to $1\frac{3}{5}$ in its length; snout $2\frac{2}{3}$ to $2\frac{3}{5}$; eye $5\frac{1}{3}$ to $5\frac{7}{8}$; interorbital space about 2; least depth of caudal peduncle $1\frac{4}{5}$ to 2. Dr. Furness's example shows the bases of all the fins, at present in alcohol, pale buff with a slight pinkish tint. The silvery spots of the smaller example from the Kapuas are not evident. Also another example, $10\frac{1}{4}$ inches long, from Dr. Furness. It was taken in the Baram river in 1897.

31. Osteochilus kappenii (Bleeker).

Head $3\frac{7}{8}$; depth $2\frac{1}{2}$; D. IV, 17; A. III, 6; scales 29 in lateral line to base of caudal, 3 more on latter; $5\frac{1}{2}$ scales between origin of dorsal and lateral line, and $4\frac{1}{2}$ between latter and origin of ventral; width of head $1\frac{1}{2}$ in its length; snout 3; eye 4; interorbital space 2. Snout short and broad, obtuse, and its length in profile but little more than diameter of eye. Back well elevated, nape well convex, and upper anterior profile steep and straight. Pectoral long, nearly reaching origin of ventral. Along each series of scales longitudinally a well-defined brown band. On caudal peduncle at base of caudal traces of a brown spot. One example $3\frac{7}{8}$ inches (about 98 mm.) in length.

This example seems to agree somewhat with the notes under *Osteochilus kahajanensis* of Dr. Steindachner from the Baram river. In Bleeker's original account[32] the depth will be seen to be a little over 4 in what is presumably the total length, while the head is given as $5\frac{1}{2}$. Bleeker's figure,[33] published later, agrees except that the head is a little larger. Dr. Steindachner gives the depth[34] as $2\frac{3}{5}$ to $2\frac{2}{3}$, which is certainly not in agreement with *kahajanensis*.

32. Osteochilus harrisoni sp. nov.

Head $3\frac{3}{4}$; depth $2\frac{4}{5}$; D. II, 16; A. III, 5, I; P. I, 15; V. I, 8; scales 33 in lateral line to base of caudal, and 2 more on latter; 6 scales be-

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[32] *Rohita kahajanensis* Bleeker, *Act. Soc. Sci. Ind. Neerl.* (Tiend. Bijd. Ich. Born.), II, 1857, p. 18. In flumine Kahajan, Borneo meridionalis.
[33] *Atlas Ichth.*, III, 1863, Pl. (8) 109, fig. 1.
[34] *Abhand. Senck. Nat. Ges.* Frankfurt, XXV (2), 1901, p. 452.

tween origin of dorsal and lateral line obliquely back, uppermost scale very small; 5 scales between lateral line and origin of ventral, lowest scale very small; 10 scales before dorsal; width of head $1\frac{1}{2}$ in its length; depth of head $1\frac{1}{3}$; snout $2\frac{2}{5}$; eye $4\frac{1}{2}$; width of mouth $4\frac{1}{2}$; interorbital space 2; second simple dorsal ray $1\frac{1}{10}$; second simple anal ray $1\frac{1}{3}$; pectoral $1\frac{1}{5}$; ventral $1\frac{1}{6}$; least depth of caudal peduncle $1\frac{3}{4}$; lower caudal lobe $3\frac{1}{10}$ in head and trunk; base of dorsal $2\frac{7}{8}$.

Body elongate, compressed though robust, greatest depth at origin of dorsal, and profiles more or less similarly convex. Back but little elevated and its profile convex from occiput to dorsal. Caudal peduncle robust, compressed, and its least depth about equal to its length.

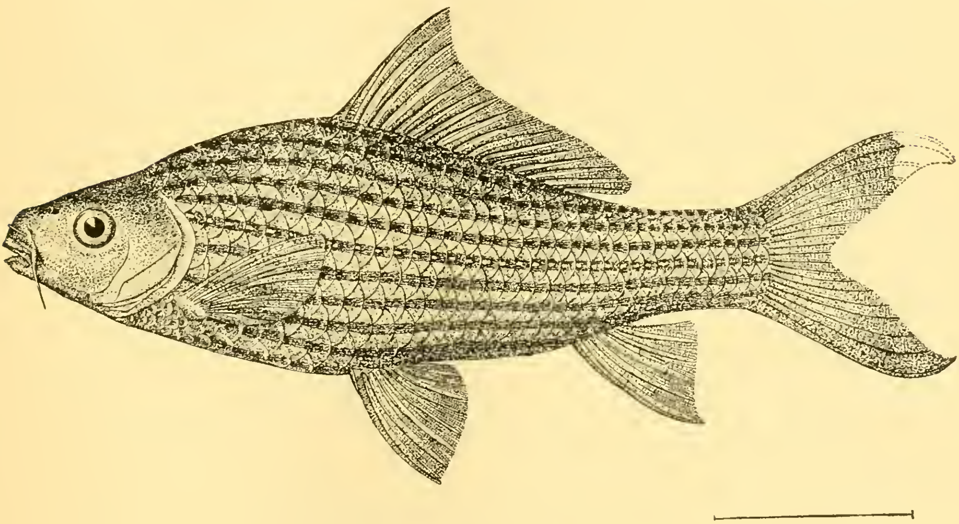

Fig. 5.—*Osteochilus harrisoni* Fowler.

Head rather small, compressed, broad, robust, and both upper and lower profiles inclined similarly, also nearly straight. Snout long, broad, convex, obtuse above, and somewhat declivous in front. Eye rather small, a little posterior to middle of length of head, circular, and not much above middle of depth of head. Pupil large and circular. Mouth inferiorly terminal, broad, the gape not extending far laterally. Lips rather thick, fleshy and plicate. Jaws horny and with a rather sharp edge. Premaxillaries protractile. Four upper mental barbels, upper lateral near edge of snout, and lower at corner of mouth, also much longer or about reaching opposite middle of orbit. Nostrils adjoining anterior in a short cutaneous tube, lateral, much nearer eye than tip of snout and level with upper margin of eye. Preorbital not distinct, and together with cheek covered with skin. Interorbital space elevated a little convexly and flattened medianly.

Gill-opening lateral, extending forward about opposite posterior margin of preopercle. Rakers in form of a low fringe of fine or minute filaments. Filaments long, about equal to orbit. No pseudobranchiæ. Width of isthmus where gill-membranes join about equal to orbit.

Scales large, cycloid, and well exposed, also of more or less even size. Scales on breast small, especially anteriorly. Small scales along bases of dorsal and anal. A pointed scaly ventral flap in axil of fin about $\frac{2}{5}$ its length. Head and fins naked, except base of caudal. Lateral line of short exposed single tubes, and continuous even on base of caudal.

Origin of dorsal about opposite tip of depressed pectoral or a little before origin of ventral, second simple ray highest, next three graduated down, after which they are all more or less of one size. Anal beginning a trifle before base of last dorsal ray, and second simple ray also longest. Caudal forked, lobes rather pointed. Pectoral small, and inserted low. Ventral not quite reaching vent or about $\frac{2}{3}$ of space to anal.

Color in alcohol dull olivaceous-brown, paler below and on sides of head. Fins pale brownish, dorsal and caudal scarcely darker. Each series of scales marked by a bar, making about ten longitudinal dark lines or bands less in width than pupil of eye, and dusky or most distinct above lateral line. Iris olivaceous, pupil slaty. Peritoneum silvery. Length 9 inches.

Type No. 2,392, W. I. A. P. Baram river, Borneo. 1897. Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Also No. 13,897, W. I. A. P. Paratype. Same data.

This species is close to *Osteochilus kahajanensis* (Bleeker), which has been reported from the Baram river by Dr. Steindachner, but differs apparently in the distinct longitudinal narrow brown stripes. My examples also have no blue spot on the shoulder-girdle, though in alcohol the other color markings are fairly distinct.

(Named for Mr. Alfred C. Harrison, Jr., of Philadelphia, explorer of Borneo and Sumatra, who collected the type.)

33. Garra borneensis (Vaillant).

Head $5\frac{1}{2}$; depth $5\frac{1}{2}$; D. III, 8, I; A. II, 5, I; scales 26 in lateral line to base of caudal, and 2 more on latter; width of head $1\frac{1}{4}$ in its length; snout 2; eye 4; width of mouth $2\frac{3}{5}$; interorbital space $2\frac{1}{4}$. Color in alcohol deep brown above, side paler, and lower surface pale brown. A broad deep slaty-dusky band enclosing lateral line from eye to base of caudal and running out on caudal in lower caudal lobe. A brownish streak at bases of upper rays of upper caudal lobe. Dorsal dusky, and with a median longitudinal pale line. Pectoral and ventral brownish, a little paler than caudal, and latter with a broad diffuse pale tint transversely and medianly. Anal pale brownish. Iris slaty with a narrow inner pale circle adjoining pupil. Length $3\frac{1}{8}$ inches.

Six examples. The five other examples show the following: Head $4\frac{1}{3}$ to 5; depth $4\frac{1}{2}$ to 5; scales 26 or 27 in lateral line to base of caudal, usually 2 more on latter; snout about 2, seldom a little more; eye $3\frac{3}{4}$ to 4; total length $2\frac{1}{2}$ to $2\frac{7}{8}$ inches (54 to 73 mm.).

34. Lobocheilos hispidus (Valenciennes).

Head $4\frac{4}{5}$; depth 4; D. IV, 8, I; A. IV, 5, I; scales 34 in lateral line to base of caudal, and 2 more on latter; width of head $1\frac{1}{2}$ in its length; depth of head, at anterior margin of orbit, 2; snout $2\frac{1}{6}$; eye $4\frac{3}{4}$; interorbital space 2; width of mouth $2\frac{1}{3}$; least depth of caudal peduncle $1\frac{4}{5}$; length of depressed dorsal $3\frac{1}{3}$ in head and trunk; length of lower caudal lobe $2\frac{2}{3}$; length of pectoral 4; length of ventral $3\frac{9}{10}$; length of anal, $3\frac{5}{6}$. Length $7\frac{3}{4}$ inches.

A single example which agrees with Bleeker's figure,[35] though there are more pores on the snout than he represents.

MYSTINÆ.[36]

35. Labeobarbus douronensis (Valenciennes).[37]

Head $3\frac{1}{2}$; depth 3; D. III, I, 8, I; A. III, 5, I; scales 19 in lateral line to base of caudal, and 2 more on latter; 8 scales before dorsal; width of head 2 in its length; snout 3; eye 4; interorbital space $3\frac{1}{10}$; mouth $3\frac{1}{4}$; least depth of caudal peduncle $2\frac{1}{3}$; pectoral $1\frac{1}{6}$; ventral $1\frac{1}{3}$. Length $6\frac{3}{4}$ inches.

A single example which agrees with Bleeker's figure.[38] It will be seen to differ in the deeper body and higher back. There are no dark dots on the upper surface of the body, which is darker brown than the lower, in my example.

36. Cyclocheilichthys megalops sp. nov.

Head 3; depth 3; D. III, I, 8; A. III, 6; P. I, 18; V. I, 9; scales 32 in lateral line to base of caudal, and 3 more on latter; 12 scales before

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[35] *Atlas Ichth.*, III, 1863, Pl. (7) 108, fig. 2.

[36] This name is proposed in place of *Barbinæ* for the Barbels, as *Mystus* Klein, in Walbaum, *Pet. Arted. Pisc.*, III, 1792, p. 586, is much older than *Barbus*. Walbaum's name is considered typified by *Cyprinus barbus* Linnæus.

[37] SIAJA MICROLEPIS (Bleeker).

One in the Academy from the Paris Museum. Bleeker's figure does not indicate the striæ on the head which are well displayed in this example. The upper margin of the dorsal is also dusky. Borneo.

[38] *Atlas Ichth.*, III, 1863, Pl. (21) 122, fig. 2.

dorsal; 7 scales obliquely back from origin of spinous dorsal to lateral line; 5 scales obliquely forward from origin of spinous anal to lateral line; width of head $2\frac{1}{8}$ in its length; depth of head, over middle of orbit, $1\frac{4}{7}$; snout $2\frac{3}{4}$; eye 3; maxillary $3\frac{1}{2}$; interorbital space $3\frac{1}{2}$; length of depressed spinous dorsal a trifle more than head; of anal $1\frac{1}{6}$; of pectoral $1\frac{1}{3}$; of ventral $1\frac{1}{4}$; least depth of caudal peduncle $2\frac{1}{2}$.

Body moderately elongate, well compressed, and greatest depth about origin of dorsal, so that back is a little elevated. Upper profile nearly straight from tip of snout to origin of dorsal. Caudal peduncle compressed, its least depth about $1\frac{1}{8}$ in its length.

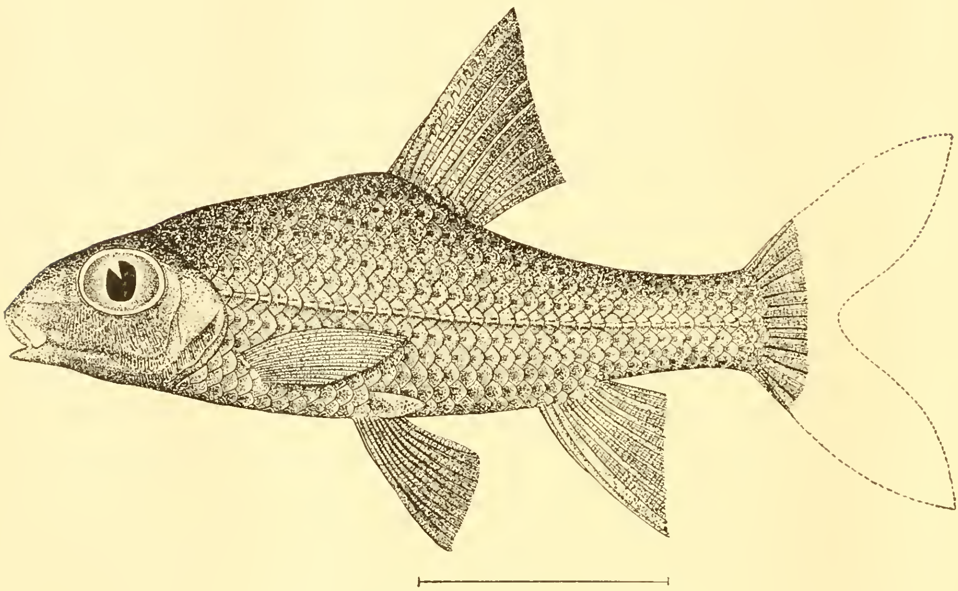

Fig. 6.—*Cyclocheilichthys megalops* Fowler.

Head compressed, moderately long, and upper profile horizontally oblique and straight. Snout rather long and obtuse. Eye large, longer than deep, a little anterior and high. Pupil large, vertical. Mouth inferior and terminal, upper jaw about even with tip of snout. Lips rather thin and transversely plicate. Tongue little free or distinct. Mandible inferior, not extending forward opposite tip of upper jaw. Upper jaw protractile. A small pointed maxillary barbel at corner of mouth. Nostrils adjoining, close in front of upper orbital rim. Preorbital long, about $\frac{7}{8}$ of length of horizontal orbital diameter. Interorbital space flattened, a trifle concave medianly.

Gill-opening lateral, not extending quite as far forward as posterior margin of orbit. Rakers 3+5, soft fleshy slender processes, much shorter than filaments, which are about equal to horizontal diameter of pupil. Isthmus broad.

Scales large, arranged in parallel horizontal series, and cycloid. A row of scales along base of dorsal and anal, each forming an adnate sheath. Base of caudal scaly. A scaly pointed flap at inner base of pectoral. Head and fins with these exceptions naked. Skin of head with numerous parallel striæ or plications, transverse above and vertical laterally. Lateral line of single tubes continuous, a little decurved at first till horizontal.

Origin of dorsal about opposite that of ventral, nearer base of caudal than tip of snout, fourth ray spine-like with posterior edge becoming coarsely serrated above, and when depressed first branched ray reaches well beyond others or about $\frac{2}{3}$ of distance to base of caudal. Anal inserted about midway between origin of dorsal and base of caudal, third ray enlarged but with flexible tip, and depressed fin reaching opposite base of caudal. Caudal damaged. Pectoral low, small, and reaching back for about first fifth of length of ventral. Ventral with first branched ray longest and reaching anal.

Color in alcohol brown, lower surface paler and with traces of silvery. Each scale on back with a dusky-brown spot, regular in disposition, so that longitudinal series are formed, and several persisting even below lateral line, but lowest much paler than those above. Lower surface of head pale like abdomen. Fins same color, dorsal more or less tinted with dusky, and caudal and anal with brownish. Iris pale brassy-brown.

Length $3\frac{3}{8}$ inches (caudal damaged).

Type No. 13,928, W. I. A. P. Borneo. 1898. Dr. W. H. Furness.

One example, the type. It agrees with Bleeker's description of *Capœta enoplos*, but his figure[39] agrees with Sumatran examples of *Cyclocheilichthys siaja*, which may be distinguished by the smaller eye, always less than a third of the length of the head. In *Cyclocheilichthys megalops* the eye is large, about 3 in the head, and the body is comparatively deeper.

(*Μέγας*, great; *ὤψ*, eye.)

37. Puntius schwanenfeldii (Bleeker).[40]

Head $3\frac{1}{2}$; depth 2; D. III, I, 8, I; A. II, I, 5, I; scales 33 in lateral

[39] *Atlas Ichth.*, III, 1863, p. 82, Pl. (27) 128, fig. 2.

[40] Species of this genus in the Academy from the Paris Museum are:

PUNTIUS BULU (Bleeker).

Fins all with brownish shades anteriorly.

One example.

line to base of caudal, and 3 more on latter; 8 scales between origin of dorsal and lateral line, and 6 between latter and origin of anal; width of head $1\frac{7}{8}$ in its length; snout $3\frac{1}{4}$; eye 3; mouth $3\frac{1}{2}$; interorbital space $2\frac{1}{4}$; least depth of caudal peduncle $1\frac{2}{3}$; pectoral $1\frac{1}{6}$; ventral $1\frac{1}{10}$. Dorsal with upper anterior lobe blackish, and this color extending along upper margin of fin nearly to end of last ray. One example $5\frac{1}{4}$ inches long. Kapuas river. Harrison and Hiller.

Bleeker's figure[41] agrees, though the Sumatran examples all show the caudal more forked and the lobes very long. Head 3 to $3\frac{1}{3}$ and depth $2\frac{1}{3}$ to $2\frac{1}{2}$.

38. Hampala macrolepidota (Valenciennes).

Two large examples 10 inches long do not show any blotches on the side. Baram. Harrison and Hiller.

A small example collected by Dr. Furness has a large diffuse dark blotch below dorsal and another on caudal peduncle before base of caudal.

39. Leptobarbus hoevenii (Bleeker).

One example.

40. Rasbora dusonensis (Bleeker).

Margin of caudal dusky or blackish. Two examples, larger $7\frac{1}{16}$ inches.

41. Rasbora leptosoma (Bleeker).[42]

Head 4; depth $4\frac{2}{3}$; D. II, 7, I; A. III, 5, I; scales (pockets) about 27 to base of caudal; snout $3\frac{1}{2}$ in head; eye 3; interorbital space $2\frac{7}{8}$. A lateral band tinted with silvery, rather faded, but still most distinct on caudal peduncle. Fins all plain colored, the dorsal and caudal without darker margins. Length $3\frac{1}{2}$ inches.

PUNTIUS BINOTATUS (Valenciennes).

A small example. Marked a little differently than the one figured by Prof. Vaillant in *Nouv. Arch. Mus. Hist. Nat.* Paris, V (3), 1893, p. 79, Pl. 1, figs. 1–1*b*.

PUNTIUS ANCHISPORUS (Vaillant).

Scales 21 in lateral line to base of caudal and 2 more on latter. Lateral line not continued on base of caudal. Second transverse dusky band across belly just in front of ventral fins. Third transverse band extends along bases of last dorsal rays and slopes obliquely backward at first. A small example originally identified as *Barbus sumatranus*.

[41] *Atlas Ichth.*, III, 1863, Pl. (35) 136, fig. 3. Wrongly identified as *Cyclocheilichthys* (*Siaja*) *macropus*, which is evidently fig. 2.

[42] RASBORICHTHYS HELFRICHII (Bleeker).

Head $3\frac{1}{2}$; depth 5; D. II, 8; A. III, 20, I; scales about 55? (squamation injured); snout $3\frac{1}{2}$ in head; orbit $3\frac{1}{4}$; maxillary about $3\frac{1}{2}$; interorbital space 4; pectoral $1\frac{2}{3}$; ventral $1\frac{1}{2}$. Length $2\frac{7}{16}$ inches. Two in the Academy from the Paris Museum. They show no trace of the adipose eyelids like those indicated in Bleeker's figure, *Atlas Ichth.*, III, 1863, Pl. (22) 123, fig. 3.

CHELINÆ.

42. Macrochirichthys snyderi sp. nov.

Head $4\frac{5}{6}$; depth, at lower base of pectoral, $5\frac{1}{5}$; at middle of trunk $5\frac{2}{3}$; D. III, 7; A. III, 25, I; P. II, 14; V. II, 7; scales about 96 in lateral line to base of caudal and several more on latter; about 18 scales in a vertical series between origin of dorsal and lateral line; 11 scales in a vertical series between lateral line and origin of anal; about 150? scales before dorsal; width of head $3\frac{1}{4}$ in its length; depth of head, opposite middle of orbit, $1\frac{2}{3}$; mandible $1\frac{2}{3}$; length of depressed dorsal $1\frac{9}{10}$; least depth of caudal peduncle $3\frac{1}{10}$; length of depressed ventral 2; snout $3\frac{2}{5}$ in head, from its own tip; eye $4\frac{1}{10}$; mouth $2\frac{1}{5}$; interorbital space $4\frac{1}{4}$; length of pectoral $3\frac{2}{7}$ in body without caudal; base of anal $5\frac{1}{5}$.

Body strongly compressed, upper profile evenly though slightly convex from neck to caudal, and lower not so much so though sharply

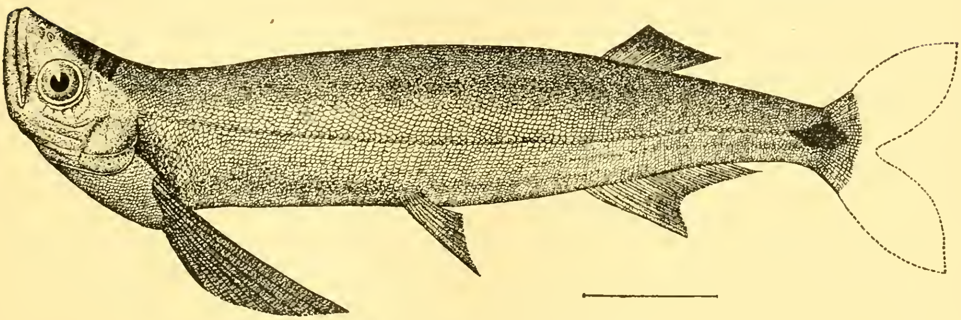

Fig. 7.—*Macrochirichthys snyderi* Fowler.

trenchant. Greatest depth of trunk near root of ventral Chest trenchant and produced below abdomen at lower root of ventral. Least depth of caudal peduncle about equal to its length.

Head well compressed, trenchant above and below, and directed upward. Upper profile nearly straight from tip of snout to nape, and sloping obliquely down posteriorly. Snout obliquely vertical. Upper jaw forms a slight protuberance above. Eye circular, anterior and rather high in head. Infraorbital (here preorbital in position) narrow, and about $\frac{1}{5}$ of pupil. Mouth vertical, gape reaching down till opposite lower margin of orbit. Lips thin. Mandible convex in profile, anterior to upper jaw. Jaws edentulous, trenchant, mandible with a large bluntish tooth-like process at symphysis, fitting in cavity of upper jaw. Tongue not free from floor of mouth. Nostrils above eye near its margin. Interorbital space elevated and trenchant, narrow.

Gill-opening extending forward nearly opposite front rim of preorbital, membrane forming a rather broad fold across isthmus. Rakers very short, about 25? hard denticles, much shorter than filaments. Filaments $\frac{1}{2}$ of orbit. Isthmus compressed narrowly and rounded. Three branchiostegal rays.

Scales small, cycloid, in series directed obliquely forward on middle of side above and below lateral line. Scales on back and on ventral region very much smaller and crowded. Ventral region of body strongly compressed and forming a cutaneous keel. Head naked except occiput, scaly region beginning over middle of orbit and much smaller than on rest of body. Fins naked, except base of caudal which is scaly. Lateral line of rather large simple tubes, continuous, sloping down till over ventral, then more or less straight to base of caudal.

Dorsal fin small, posterior, and its origin about last $\frac{15}{18}$ in space between front end of mandible and base of caudal or a trifle posterior to origin of anal. Anal with anterior rays elevated and base elongate, last ray reaching nearly half way to base of caudal. Caudal damaged. Pectoral inferior, upper rays enlarged, and first developed ray longest and reaching nearly to origin of ventral, other rays graduated down. Origin of ventral about opposite posterior margin of opercle. Ventral about midway in its insertion between anterior margin of eye and base of caudal, and reaching about half way to origin of anal.

Color in alcohol with more or less silvery everywhere, and back pale brownish. Snout dusky. Iris brassy. A dusky blotch at base of caudal. An interorbital band of deeper brown than body color, with two lines of deeper color. Also a similar postocular band extending down till close to posterior rim of orbit where it ends abruptly. Fins pale brownish-white, dorsal and caudal a shade darker than others. Pectoral axil dusky.

Length $6\frac{11}{16}$ inches.

Type No. 13,931, W. I. A. P. Borneo. 1898. Dr. W. H. Furness.

Only the type is known to me.

This species is closely related to *Macrochirichthys macrochir* (Valenciennes), but differs at once in the postocular transverse dark cranial bands. *Macrochirichthys uranoscopus* Bleeker has been united with *M. macrochir*, and it also lacks these bands.

(Named for my friend Prof. John O. Snyder, of the Leland Stanford Junior University, well known as a writer on Japanese fishes.)

MONOPTERIDÆ.

43. Monopterus albus (Zuiew).

("Lunong" of the Dyaks.)

Six examples from Marudi, a swamp at the mouth of the Baram, other localities in the Baram district, and the Kapuas river. Those from the latter place collected by Harrison and Hiller. Largest specimen 19 inches long.

CLUPEIDÆ.

44. Sardinella brachysoma Bleeker.[43]

Head $3\frac{1}{2}$; depth $2\frac{2}{3}$; D. IV, 13, I; A. III, 16, I; scales about 40 in a lateral series to base of caudal, and about 4 more on latter; mandible 2 in head; pectoral $1\frac{1}{3}$; ventral $2\frac{1}{5}$; least depth of caudal peduncle $2\frac{3}{5}$; snout $4\frac{1}{2}$ in head, from its own tip; eye $4\frac{1}{2}$; maxillary $2\frac{1}{5}$; interorbital space $4\frac{1}{2}$. Adipose eyelid well developed. Abdominal serratures 29. Each scale on back with a brown spot. Vertical striæ on cheek. One example 8 inches long.

NOTOPTERIDÆ.

45. Notopterus borneensis Bleeker.

Head $4\frac{1}{12}$; depth $3\frac{2}{3}$; D. II, 7; A. about 122. Length $17\frac{1}{4}$ inches. One example.

Bleeker gives a good figure[44] of this species, but my example differs in having the spots more numerous, smaller, extending the whole length of the anal and also above the lateral line on the end of the trunk. The spots on the trunk are also a little larger than those on the anal. The upper profile of the head is a little more concave and the end of the maxillary a little more posterior.

MASTACEMBELIDÆ.

46. Mastacembelus unicolor Valenciennes.

Head (without rostral appendage) $5\frac{2}{3}$; depth $7\frac{3}{4}$; D. XXXIII, 70?; A. III, 65?; P. 24; scales about 340 in a lateral series below lateral line to base of caudal; width of head $4\frac{1}{2}$ in its length (without rostral appendage); depth of head $2\frac{2}{5}$; snout 3; eye $9\frac{1}{2}$; mouth $4\frac{4}{5}$; maxillary $3\frac{3}{4}$; pectoral 3; caudal $2\frac{3}{5}$; interorbital space $1\frac{1}{2}$ in eye; eye 3 in snout.

Body elongate, deep, compressed, and tail rather broad posteriorly. Greatest depth at vent. Anterior part of body more tapering than posterior part.

Head long, triangular, rather slender, attenuated and greatly compressed. Snout long, attenuated, convex above, and its tip while projecting beyond tip of mandible extended into a long pointed fleshy rostral flap, perfectly smooth below, and equal to eye in length. Eye

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[43] *Sardinella brachysoma* Fowler, *Journ. Acad. Nat. Sci. Phila.*, XII (2), 1904, p. 501 = *Sardinella hypselosoma* (Bleeker).

[44] *Atlas Ichth.*, VI, 1869–72, Pl. (17) 275, fig. 1.

small, anterior or its anterior margin nearly at first third in total length of head, a little longer than deep, and high. A small sharp spine on preorbital below anterior rim of orbit and directed anteriorly. Maxillary reaching below nostril, but not front of orbit. Mouth small, narrow, inferior and mandible included. Lips rather thin. Teeth small, in rather broad bands which are distinct though approximated in front of each jaw, conic, and directed a little backward. Buccal folds broad. No teeth on roof of mouth or on tongue. Tongue slender or elongate and not evidently free. Nostrils lateral, directly in front of eye, and in form of a rather long horizontal slit. Interorbital space narrow and convex.

Gill-opening inferior, forming a narrow triangle on chest below and extending forward for about last $\frac{2}{5}$ of head. Rakers absent. Filaments about equal to vertical diameter of orbit. No pseudobranchiæ. Isthmus rather short and narrowly compressed.

Scales small, elongate, crowded in appearance or close together, adherent and in a regular oblique series. Lateral line continuous, extending at first superiorly and then median after anal spines to caudal. Tubes simple and rather pronounced. Smaller scales crowded along bases of vertical fins and pectorals. Head, except snout, branchiostegal region and mandible, covered with small scales.

Vertical fins continuous. Spinous dorsal longer than soft dorsal, though at first low where it originates over middle of pectoral, then each spine increasing gradually in height to last, which is highest. Soft dorsal and anal of about equal height, latter originating a little nearer tip of caudal than gill-opening. Caudal small, rounded, of about 16? rays, and last rays of soft dorsal and anal extending on it basally for at least half its length. Pectoral broad, short, rounded and a little low in its insertion. Second anal spine much largest, similar to last dorsal spine through placed a little anterior to its base. Vent close in front of spinous anal or a little nearer base of caudal than orbit.

Color in alcohol deep wood-brown, lower surface paler or inclining to very pale or dirty-brown, especially on abdomen, thorax and under surface of head. Dorsals and anals with more or less dark color medianly, and becoming more or less blackish submarginally, margins of these fins rather conspicuously creamy-whitish. Caudal and pectoral creamy or pale brownish, each with two rather variable cross blotches of deep or blackish-brown joined somewhat medianly by a bar of same color. Snout brownish and rostral appendage deep brown. Iris slaty.

Length $10\frac{1}{4}$ inches.

One example. This agrees somewhat with eight examples I recorded from Sumatra,[45] taken at Batu Sangkar in Padangsche Bovenland, and collected by Harrison and Hiller. The smallest of these differs in the color markings which are very pronounced. The vertical fins also have blackish bases with distinct margins and their edges with whitish blotches. The spots on the sides are distinct and the lower surface of the body is decidedly paler. The largest Sumatran example also shows the following: Head (without rostral appendage) $5\frac{9}{10}$; depth $8\frac{3}{4}$; D. XXXVI, 80?; A. II, 72?; P. 22; scales about 285 in a lateral series to base of caudal; width of head $3\frac{2}{3}$ in its length; depth of head $2\frac{2}{3}$; snout $3\frac{1}{10}$; eye 8; mouth $4\frac{2}{3}$; pectoral $2\frac{3}{5}$; caudal $3\frac{1}{8}$; interorbital space $1\frac{1}{2}$ in eye; eye $2\frac{7}{8}$ in snout. My figure also shows the caudal confluent almost entirely with the rayed dorsal and anal. This is in entire agreement with my largest Sumatran example which it was supposed to represent. However, the others, especially the smaller ones, have it distinct and with the ends of the caudal rays free. They also show the margins of these fins whitish. Surely Day's figure and account of *Mastacembelus unicolor*[46] represents a distinct species.

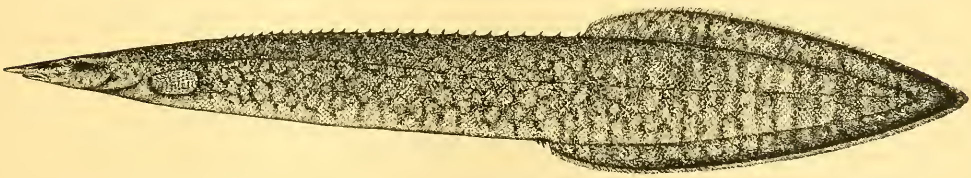

Fig. 8.—*Mastacembelus vaillanti* Fowler.

47. Mastacembelus vaillanti sp. nov.

Head (without rostral appendage) 7; depth 9; D. XXVIII, 58?; A. III, 65?; caudal 14?; P. 22; scales about 164 in a lateral series below lateral line to caudal; width of head 4 in its length (without rostral appendage); depth of head $2\frac{3}{4}$; snout $3\frac{1}{2}$; eye 8; mouth $5\frac{3}{4}$; maxillary 4; pectoral 3; caudal about 2; interorbital space about $1\frac{2}{3}$ in eye; eye 2 in snout.

Body long, strongly compressed, deep, especially posterior half or tail, and anterior half tapering more narrowly forward to tip of snout. Greatest depth at vent. Caudal peduncle not evident, its width would be about $6\frac{1}{8}$ in head without rostral appendage.

Head small, long, well attenuated and greatly compressed. Profiles

[45] *Journ. Acad. Nat. Sci. Phila.*, XII (2), 1904, p. 501, Pl. 8, upper figure.
[46] *Fishes of India*, II, 1876, p. 339, Pl. 72, fig. 3.

similar and nearly straight. Snout long, pointed, and its tip, while extended beyond tip of mandible, produced into a trifid fleshy rostral flap, which is perfectly smooth below and about equal to horizontal orbital diameter. Eye small, high, anterior or much nearer tip of rostral appendage than posterior edge of opercle, and a little longer than deep. A small sharp spine directed backward in front of eye below on preorbital region. Maxillary reaching till opposite anterior margin of posterior nostril. Mouth small, narrow, inferior and mandible narrow. Lips rather thin. Teeth rather large, conic, directed somewhat backward, and in rather broad approximated bands in jaws. No teeth on roof of mouth or on tongue. Buccal folds broad. Tongue little free and rather narrow. Anterior nostril in each short lateral tip or fleshy tube of rostral appendage. Posterior nostril an elongate slit directly in front of eye and about equal to diameter of pupil. Interorbital space narrow and convex.

Gill-opening inferior, forming a narrow triangle on chest below and extending forward for about last $\frac{2}{5}$ of entire length of head. Rakers absent. Filaments short, about equal to vertical diameter of pupil. No pseudobranchiæ. Isthmus short and narrowly compressed.

Scales close together, elongate, with more or less scalloped edges in places, in oblique crossing series, and adherent. Present on most all of body except pectoral, margins of other fins, snout, jaws, rostral appendage and branchiostegal region. Scales at base of pectoral and on other fins reduced in size. Lateral line rather high, continuous, only becoming median on posterior portion of tail or trunk and of simple tubes.

Vertical fins entirely continuous. Spinous dorsal a little longer than rayed dorsal, though at first low at its origin which is a little behind tip of pectoral, and then increasing gradually in height a short distance when spines become more or less subequal, and last spine highest. Soft dorsal inserted at a point about last $\frac{2}{5}$ in total length of body. Rayed anal similar in height, and both fins joined to pointed caudal so that it ends in a point with median rays longest. Origin of rayed anal well in advance of that of soft dorsal or at a point about midway between tip of pectoral and base of caudal. Anal spines strong, second much larger. Pectoral small, rounded, rather broad, low and median rays longest. Vent close in front of spinous anal.

Color in alcohol with ground-color more or less uniform brownish, a trifle paler or soiled brownish on lower surface of head and abdomen. Body most everywhere beautifully variegated with darker mottlings which form pale spots or blotches of variable size and pattern. On tail they form posteriorly into several broad indistinctly defined transverse bars. Rayed dorsal, anal and caudal with whitish margins, adjoining which is a blackish submarginal shade becoming diffuse toward middle of fins. Bases of these fins pale variegated with fine brownish mottlings on former and large whitish obliquely inclined forward blotches on anal. Caudal more or less finely barred, less distinctly so basally. Pectoral with many fine wavy transverse bars. A deep brown streak along side of snout to eye and continued behind latter to edge of preopercle. A number of variable brownish bars on side and under surface of head. Iris slaty.

Length 6 inches.

Type No. 14,150, W. I. A. P. Borneo. 1898. Dr. W. H. Furness. One example.

This species is evidently closely related to *Mastacembelus guentheri* Day[47] which has been recorded from Borneo by Prof. Vaillant.[48] The Indian fish appears to differ somewhat in coloration according to Day's account, especially as there is no black bar at the base of the caudal. His figure[49] fails to indicate this. Margins of the vertical fins of *Mastacembelus vaillanti* well edged with white, the color pattern different, presenting a beautiful blotched or spotted appearance, and the pectorals finely barred.

(Named for Prof. Léon Vaillant.)

MASTACCEMBELIDÆ.

48. Tylosurus leiuroides (Bleeker).

Depth in trunk, without head, about 11; D. III, 16; A. III, 22; eye $3\frac{3}{5}$ in postocular region of head; interorbital space $2\frac{1}{2}$; least depth of caudal peduncle $3\frac{1}{3}$. One example, $12\frac{1}{2}$ inches (jaws and caudal damaged).

HEMIRAMPHIDÆ.

HEMIRAMPHINÆ.

Mandible produced far beyond upper jaw in a long slender beak or point.

LABIDORHAMPHUS subgen. nov.

Type *Hemirhamphus amblyurus* Bleeker.

Upper jaw twice as long as broad.

(*Λαβίς*, pincers; *ῥάμφος*, beak.)

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[47] *Proc. Zool. Soc.* Lond., 1865, p. 37. In paddy-fields and the Trichoor backwater [Cochin, on the Malabar or western coast of India].
[48] *Nouv. Arch. Mus.* Paris, V (3), 1893, p. 106. Kina-Balou. (M. Whitehead.)
[49] *Fishes of India*, II, 1876, Pl. 73, fig. 2.

49. Zenarchopterus amblyurus (Bleeker).

One example.

Subgenus ZENARCHOPTERUS Gill.

Upper jaw about equal in length and in width.

50. Zenarchopterus buffonis (Valenciennes).

Head, with beak, $2\frac{1}{10}$; from tip of upper jaw 4; depth $6\frac{1}{3}$; D. I, 12; A. II, 8; about 37 scales in a lateral series to base of caudal; width of upper jaw about equal to its length. Length 6 inches.

EXOCŒTIDÆ.

51. Parexocœtus mento (Valenciennes).

Head $3\frac{5}{6}$; depth $4\frac{3}{5}$; D. I, 10; A. I, 10; scales 35 in a lateral series to base of caudal; snout $3\frac{4}{5}$ in head, from tip of upper jaw; eye $2\frac{3}{4}$; interorbital space 3. Length 5 inches.

A single example. It agrees with Bleeker's figure,[50] except that there is a brown band from along base of upper caudal lobe down across middle of lower lobe toward its distal portion which is also more or less brownish. The ventrals are almost all whitish, without the large dark blotch Bleeker shows, though the anal is dusky basally. The black on the pectoral and ventral is also more deep than Bleeker indicates.

MUGILIDÆ.

52. Mugil belanak Bleeker.

Head $3\frac{2}{3}$; depth $3\frac{3}{4}$; D. IV–I, 8; A. III, 9; P. II, 14; V. I, 5; scales 35 in a lateral series to base of caudal; about 10 scales in an oblique series from origin of spinous dorsal to middle of belly; 20? (pockets) scales before spinous dorsal; width of head $1\frac{1}{2}$ in its length; depth of head $1\frac{2}{5}$; snout $3\frac{3}{4}$; eye 4; maxillary 4; interorbital space $2\frac{1}{2}$; width of mouth 3; mandible 4; first dorsal spine $1\frac{1}{2}$; first dorsal ray $1\frac{1}{3}$; third anal spine $3\frac{1}{2}$; first anal ray $1\frac{3}{4}$; least depth of caudal peduncle 2; pectoral $1\frac{1}{2}$; ventral $1\frac{1}{2}$.

Body rather fusiform, well compressed, and greatest depth about middle of depressed spinous dorsal. Profiles rather evenly convex to greatest depth, and similar. Caudal peduncle compressed, and about as long as broad.

Head robust, a little constricted below, and profiles similarly convex. Snout broad, a little convex above, and upper jaw a little produced. Eye circular, its posterior margin a little anterior in middle of length of

[50] *Atlas Ichth.*, VI, 1869, Pl. (5) —, fig. 6.

head, and adipose eyelids well developed. Mouth a little inferior, and corner falling about opposite posterior nostril. Mandibular angle broad, and obtuse, symphysis forming a process fitting a depression in front of upper jaw. Teeth very minute, uniserial in upper jaw, and scarcely evident or absent on mandible. Lips rather fleshy. Roof of mouth and tongue edentulous. Tongue fleshy, not free, and forming a median longitudinal trenchant keel. Maxillary exposed, and reaching about opposite front rim of orbit. Lower edge of preorbital denticulate. Anterior nostril with a small cutaneous rim, near edge of snout, and space between it and posterior much greater than space between latter and front of eye. Posterior nostril vertical and slit-like. Interorbital space broad, flattened or but slightly convex.

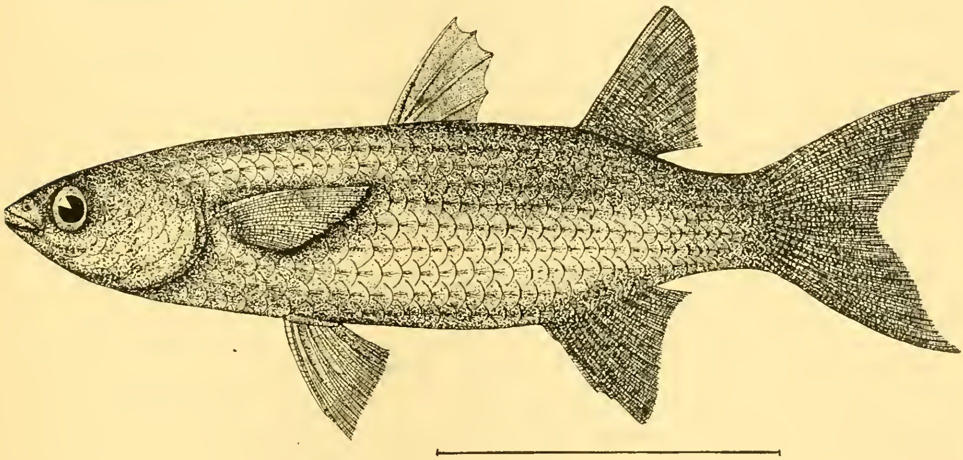

Fig. 9.—*Mugil belanak* Bleeker.

Gill-opening extending forward about opposite middle of orbit. Rakers about 62?, slender, fine, and equal to about $\frac{3}{5}$ of longest filaments. Filaments numerous, longest but little less than orbital diameter. Pseudobranchiæ about $\frac{3}{5}$ of orbital diameter. Isthmus narrow, with a depression.

Stomach gizzard-like, muscular, and rather large. Intestine rather long and convoluted. Peritoneum black. Vent close to origin of anal fin.

Scales rather large, and arranged in more or less even longitudinal series. Head scaly. Scales, according to pockets, extending down to edge of snout, small. A slender pointed scaly flap along base of spinous dorsal about equal in length to $\frac{2}{3}$ length of first spine. Scaly flap in axil of pectoral, possibly damaged, about $\frac{2}{7}$ length of fin. Ventral with a similar scaly flap which is about half length of fin, and a broad one between base of each which is a little over half of ventral, possibly damaged. Greater portions of rayed dorsal, anal and caudal densely scaled, those basally larger.

Spinous dorsal inserted a little nearer tip of snout than base of caudal, first spine longest and fourth shortest. Soft dorsal inserted nearer base of caudal than origin of spinous fin, and first ray longest. Anal similar to soft dorsal, spines slender, graduated to third which is longest, second but little shorter, and first hardly $\frac{1}{3}$ length of second. Origin of rayed anal well in advance of that of rayed dorsal. Caudal emarginate, lobes distinct and pointed. Pectoral small, not quite reaching opposite origin of spinous dorsal, and its origin a little above middle of vertical orbital diameter. Ventral inserted about opposite middle of pectoral and its spine about $\frac{2}{3}$ in length of fin.

Color in alcohol pale brownish with more or less silvery reflections. Back and upper surface darker brownish. Fins all pale brownish. Iris brassy.

Length $4\frac{1}{4}$ inches (caudal damaged).

One example.

Mugil belanak Bleeker[51] is the first name available for the present species. *Bontah* Russell[52] is not available, but it forms the basis of *Mugil bontah* Bleeker[53] which is its first introduction in a binomial sense. Later Bleeker identified other specimens[54] under the same name which appear to be different, and which have been referred to *M. belanak* by Dr. Günther. However, Russell's figure of *Bontah* had been named by Swainson as *Mugil gymnocephalus*.[55] This, according to Day, would lead to its identification with *Mugil our* Forskål. The discrepancies between my account and that by Day[56] are probably due to age.

53. Liza oligolepis (Bleeker).

Head $3\frac{1}{3}$; depth $2\frac{3}{4}$; D. IV–I, 8; A. III, 9, I; P. II, 13; V. I, 5; scales 24 in a lateral series to base of caudal; about 11 scales in an oblique series from origin of spinous dorsal to middle of belly; 20? (pockets

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[51] *Nat. Tijds. Ned. Ind.*, XIII, 1857, p. 337. Batavia, in mari.

[52] *Fishes of Coromandel*, II, 1803, p. 64, Pl. 180. Vizagapatam.

[53] *Verh. Bat. Genoot.* (Nalez. Ich. Beng. Hind.), XXV, 1853, p. 48. (Based on Russell.)

[54] *Nat. Tijds. Ned. Ind.*, XIII, 1857, p. 336. Batavia, in mari.——*L. c.*, XVI, 1858–59, p. 278.——*Act. Soc. Sci. Ind. Neerl.* (Diert. Bijd. Visch. Borneo), VIII, 1860, p. 49. [Not consulted.]

[55] *Lardner's Cabinet Cyclopædia Nat. Hist.*, II, 1839, p. 234.

[56] *Fishes of India*, II, 1876, p. 351, Pl. 74, fig. 5. Bombay.

mostly) scales before spinous dorsal; width of head $1\frac{3}{5}$ in its length; depth of head $1\frac{1}{4}$; mandible $2\frac{7}{8}$; first dorsal spine $1\frac{1}{4}$; first dorsal ray $1\frac{3}{4}$; third anal spine 2; first anal ray $1\frac{1}{2}$; lower caudal lobe 1; least depth of caudal peduncle 2; pectoral $1\frac{1}{4}$; ventral $1\frac{1}{3}$; snout $3\frac{3}{4}$ in head, measured from tip of upper jaw; eye $3\frac{3}{4}$; maxillary 4; width of mouth 3; interorbital space $2\frac{1}{4}$.

Body deep, compressed, and greatest depth about origin of spinous dorsal. Lower profile a little more convex than upper. Caudal peduncle compressed, deep, and its length about half its depth.

Head robust, a little large, well constricted below and convex above.

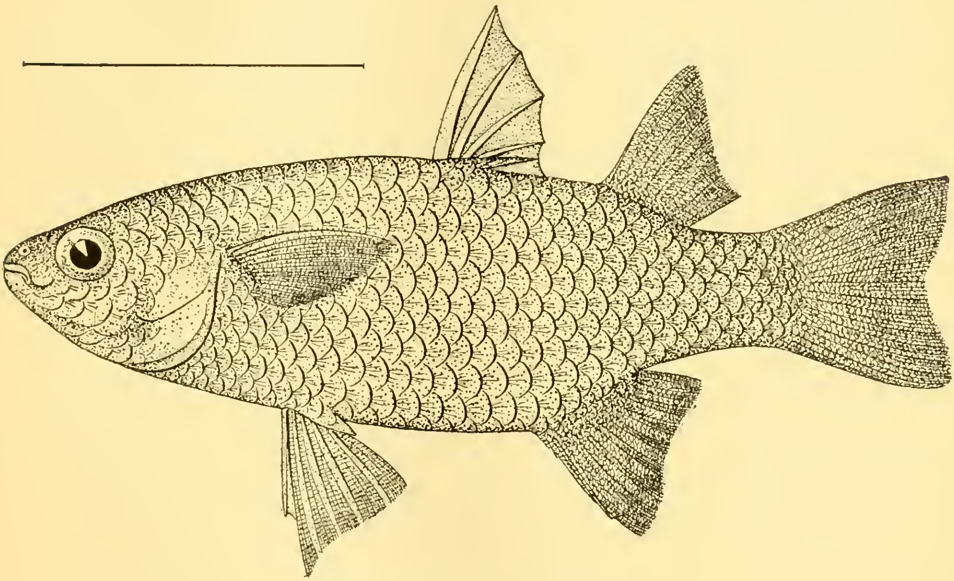

Fig. 10.—*Liza oligolepis* (Bleeker).

Lower profile a little more convex and inclined than upper which is a trifle concave just in front of eye above. Snout broad, convex above, and upper jaw not produced. Eye circular, close to upper profile, without adipose eyelids, and its posterior margin a trifle posterior in length of head. Mouth broad, gape small, reaching opposite anterior nostril. Mandibular angle broad and obtuse, symphysis forming a process fitting in a depression in front of upper jaw. Lips rather fleshy, though thin. Teeth very minute and apparently only evident in a series along margin of upper jaw. A small patch of minute teeth on each palatine. Tongue fleshy, not free from floor of mouth. Lower preorbital margin serrate. Anterior nostril with a slight cutaneous rim and placed about midway in snout in profile view. Posterior nostril larger, high, somewhat slit-like and about opposite upper anterior orbital margin. Interorbital space broad and flattened, or but slightly convex.

Gill-opening extending forward till nearly opposite first $\frac{2}{5}$ of orbit. Rakers 40??, slender, fine, rather short, or about half length of filaments. Filaments long, about $\frac{7}{8}$ of orbital diameter. Pseudobranchiæ about $\frac{4}{7}$ of orbit. Isthmus narrow, with a median groove.

Stomach gizzard-like, muscular, about equal to orbit in size. Intestine rather long and convoluted. Peritoneum black. Vent close in front of insertion of anal fin.

Scales large, with finely ciliated edges, and in more or less even longitudinal series. Head scaly. Opercles at present naked. Scales on snout small. A pointed scaly flap at base of spinous dorsal equals about $\frac{4}{7}$ length of first spine. A similar scaly flap in axil of pectoral equal to about $\frac{1}{4}$ length of fin. Ventral also with a similar flap equal to about $\frac{2}{5}$ length of fin, and a broad one between bases of fins which is damaged. Greater portions of soft dorsal, anal and caudal covered with minute scales, those about bases of fins larger.

Spinous dorsal inserted much nearer base of caudal than tip of snout, first spine enlarged and longest, and others graduated down. Soft dorsal inserted well behind origin of anal or much nearer base of caudal than origin of spinous dorsal, and first ray highest. Anal similar, first spine short, third longest and second but little shorter than third. First anal ray longest. Caudal small, broad, and a little emarginate. Pectoral small, and its insertion a little above middle in vertical orbital diameter. Ventral inserted a little before middle of depressed pectoral, and spine about equal to $\frac{2}{3}$ length of fin.

Color in alcohol brownish, and everywhere more or less silvery. Back and upper surface brownish. Fins all pale brownish, dorsals and caudal a trifle darker. Eye brassy-white.

Length about 3 inches.

Six examples, the one described above largest. Day's figure[57] shows a higher spine to second dorsal than that found on any of my examples.

SCOMBRIDÆ.

54. Scomberomorus guttatus (Schneider).

Differs but little from Sumatran examples. Teeth about 31 in upper jaw and about 34? in lower. Color faded so that spots are diffuse and indistinct. Caudal whitish. One example, $11\frac{3}{4}$ inches.

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[57] *Fishes of India*, II, 1876, p. 358, Pl. 76, fig. 2. Sunderbunds near Calcutta.

TRICHIURIDÆ.

55. Trichiurus savala Cuvier.

Head $8\frac{4}{5}$; depth $17\frac{3}{4}$; D. about 137; A. I, XCVI?; P. I, 10; snout a little less than 3 in head from its own tip; tip of snout to end of maxillary $2\frac{1}{6}$; orbit $8\frac{1}{3}$; interorbital space 7. Tip of mandible ending in a fleshy point and laterally compressed. Fangs 3, alternate and barbed in front of upper jaw. A single enlarged barbed fang in front of mandible. Tongue elongate, pointed and free. Rakers consist of several small pointed rudiments at angle of first branchial arch. Anal spine pointed. Color in arrack silvery, edge of back above brownish. Fins pale, margin of dorsal brownish and edge of pectoral dusky. Tail dusky-brown. Edge of preorbital brownish. Iris dull brassy. Length 26 inches.

CARANGIDÆ.

56. Scomberoides toloo (Cuvier).

One example, $6\frac{7}{8}$ inches long.

57. Megalaspis cordyla (Linnæus).

Three examples.

58. Alepes scitula Fowler.

Three examples, agreeing with the type except paler in color. Largest $4\frac{1}{8}$ inches long.

59. Citula atropos (Schneider).[58]

A single small example, about 2 inches long.

STROMATEIDÆ.

60. Pampus cinereus (Bloch).

Head $3\frac{3}{4}$; depth $1\frac{1}{3}$; D. I, VIII, 5, 34; A. VI, 5, 33; snout $3\frac{3}{5}$ in head; eye $3\frac{1}{10}$; width of mouth $3\frac{1}{2}$; least depth of caudal peduncle $2\frac{3}{4}$; pectoral $2\frac{2}{5}$ in head and trunk. Color in alcohol with silvery more or less everywhere. Back pale brown. Marginal portions of dorsals and caudal only slightly dusky. Pectoral whitish like caudal. Anal almost entirely silvery-white. Iris brassy. One example, $5\frac{1}{2}$ inches long.

Day's figure of *Stromateus cinereus*[59] shows the anal lobe much longer and the snout not so produced as in my example.

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[58] *Citula atropos* Fowler, *Journ. Acad. Nat. Sci. Phila.*, XII (2), 1904, p. 513, Pl. 14, lower figure to left is the young of *Citula armata* (Forskål).

[59] *Fishes of India*, II, 1876, Pl. 53, fig. 3.

LEIOGNATHIDÆ.

61. Leiognathus edentulus (Bloch).

One example.

CHANDIDÆ.[60]

62. Ambassis wolffii Bleeker.

One example. It agrees with Bleeker's figure,[61] except that the membranes of spinous dorsal and ventral fins are more dusky or blackish.

63. Ambassis ambassis (Lacépède).

Head $2\frac{1}{2}$; depth $2\frac{1}{2}$; D. I, VII, I, 10; A. III, 9, I; scales about 28 in lateral line to base of caudal; 4 scales obliquely back from origin of spinous dorsal to lateral line; about 8 scales obliquely up from origin of spinous anal to lateral line; about 12 scales before dorsal; snout $4\frac{1}{2}$ in head from tip of upper jaw; eye $3\frac{1}{2}$; maxillary $2\frac{1}{3}$; interorbital space $4\frac{1}{3}$. Rakers slender, a little longer than filaments or about equal to diameter of pupil, and 8+17 in number. Color faded a plain pale or nearly uniform brownish, all fins whitish. One example, 4 inches long.

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[60] *Chanda* is another of Hamilton's composite genera. Its elimination is as follows:

setifer = *Gerres* Cuvier, 1829.
ruconius = *Leiognathus* Lacépède, 1803.
nalua = *Ambassis* Cuvier, 1828.
nama = *Hamiltonia* Swainson, 1839.
phula = *Hamiltonia*, Swainson, 1839.
bogoda = *Hamiltonia* Swainson, 1839.
baculis = *Hamiltonia* Swainson, 1839.
ranga = *Hamiltonia* Swainson, 1839.
lala = *Pseudambassis* Bleeker, 1870.

The first species affected is *ruconius*, which cannot belong to my own genus *Deveximentum* if the original account and figure of Hamilton is correct. The latter certainly represents a *Leiognathus*, and the description is equally applicable. The second case is *nalua* which is an *Ambassis*. The third case is *setifer* which is a *Gerres*. *Hamiltonia* was next proposed for *ovata*, which is based on Hamilton's figure of *nama*, by Swainson, who follows with another name, *lata*, for the same figure! The remaining species appear to belong to this genus with the exception of *lala*, for which Bleeker proposed *Pseudambassis* in 1874. As this is the last name used generically *Chanda* must supersede it with *lala* as the type.

Provisionally the genera may be distinguished by the following key:

a.—Preorbital entire; D. long, 14 to 17 radii; A. long, 16 to 18 radii; scales small or minute, ... *Hamiltonia*.
aa —Preorbital denticulate.
  b.—Strong teeth in jaws, at least some of them enlarged and almost canine-like.
    c.—D. radii 12 to 14; A. radii 14 to 17; strong external series of premaxillary teeth, ... *Chanda*.
    cc.—D. radii 10 or 11; A. radii 9 to 11; outer series of teeth in part canine-like, ... *Parambassis*.
  bb.—Teeth small, equal or subequal; D. and A. radii 8 to 11; scales large, *Ambassis*.

PARAMBASSIS MACROLEPIS (Bleeker).

One example in the Academy from the Paris Museum. The black on the edge of the soft dorsal is very distinct.

[61] *Atlas Ichth.*, VIII, 1876–77, Pl. (47) 325, fig. 2.

64. Ambassis gymnocephalus (Lacépède).

Head $2\frac{3}{4}$; depth $2\frac{2}{3}$; D. I, VII, I, 9; A. III, 9; scales 27 in a lateral series to base of caudal; 14 tubes in first part of lateral line, and 14 in lower or caudal portion; 4 scales between origin of spinous dorsal and lateral line obliquely back; 8 scales obliquely forward from origin of spinous anal to lateral line; about 13 scales before spinous dorsal; snout $4\frac{1}{2}$ in head, from tip of upper jaw; eye 3; maxillary $2\frac{4}{5}$; interorbital space $3\frac{4}{5}$. Rakers small, thin, longer than filaments and numerous. Color faded plain or uniform brownish, fins whitish. Length $2\frac{1}{2}$ inches. Two examples.

SCIÆNIDÆ.[62]

65. Sciæna novæ-hollandiæ Steindachner.

Head $3\frac{1}{3}$; depth $3\frac{7}{8}$; D. X, 26, I; A. II, 6, I; scales 45 in lateral line to base of caudal; snout $3\frac{2}{5}$ in head; eye $5\frac{1}{8}$; end of maxillary to tip of snout 2; interorbital space $3\frac{2}{5}$; pectoral $1\frac{1}{4}$; ventral $1\frac{1}{4}$; least depth of caudal peduncle 4. One example, $4\frac{1}{4}$ inches, agreeing with Bleeker's figure.[63]

POLYNEMIDÆ.

TRICHIDIONTINÆ.[64]

Rayed dorsal and anal of equal size. Preopercle serrated.

66. Trichidion indicus (Shaw).

Head $3\frac{1}{4}$; depth $4\frac{2}{3}$; D. VIII–I, 13; A. III, 12; P. II, 11; pectoral filaments 5; V. I, 5; scales 70 in lateral line to base of caudal; about 36? scales (squamation damaged) before spinous dorsal; 7 scales between origin of spinous dorsal and lateral line; 8 scales between origin of soft dorsal and lateral line; 10 scales between origin of anal and lateral line; width of head $1\frac{7}{8}$ in its length; depth of head $1\frac{3}{5}$; snout $4\frac{2}{3}$; eye 8; maxillary $2\frac{1}{20}$; mandible $2\frac{1}{3}$; width of mouth $2\frac{2}{3}$; interorbital space 4; first dorsal spine $1\frac{4}{7}$; first dorsal ray $1\frac{2}{3}$; first anal ray 2; third anal spine $3\frac{4}{7}$; upper caudal lobe a little less than head; least depth of caudal peduncle $3\frac{1}{8}$; pectoral $1\frac{1}{2}$; ventral about $2\frac{1}{3}$. Uppermost pectoral filament reaching origin of anal. Length $21\frac{1}{2}$ inches. One example from the mouth of the Baram.

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[62] *Sciæna macroptera* Fowler, *Journ. Acad. Nat. Sci. Phila.*, XII (2), 1904, p. 530, is an *Umbrina*.

[63] *Atlas Ichth.*, IX, 1877, Pl. (4) 387, fig. 2.

[64] This is opposed to the POLYNEMINÆ or those species with the anal basis about twice the length of the second dorsal and an entire preopercle. Typified by *Polynemus* Linnæus. *Trichidion* Klein, in Walbaum, *Pet. Arted. Pisc.*, III, 1792, p. 585, is the earliest reference for that genus, thus having priority over *Polydactylus* Lacépède.

67. Trichidion hilleri sp. nov.

Head $3\frac{3}{4}$; depth $4\frac{1}{6}$; D. VII–IV, 16; A. III, 12; P. II, 15, with 6 filaments below; V. I, 5; scales about 68 in lateral line to base of caudal, and 11 more on caudal basally; 6 scales between middle of base of spinous dorsal and lateral line; 7 scales between middle of base of soft dorsal and lateral line; 9 scales obliquely up and back to lateral line; width of head $1\frac{4}{5}$ in its length; depth of head $1\frac{3}{7}$; snout 4; eye 9; maxillary 2; interorbital space 3; second dorsal spine $1\frac{1}{3}$; first developed dorsal ray about $1\frac{2}{3}$; first developed anal ray $1\frac{4}{5}$; ventral $1\frac{1}{2}$; least depth of caudal peduncle $2\frac{2}{5}$; second simple pectoral ray $2\frac{7}{8}$ in head and trunk; length of upper caudal lobe about $2\frac{3}{5}$.

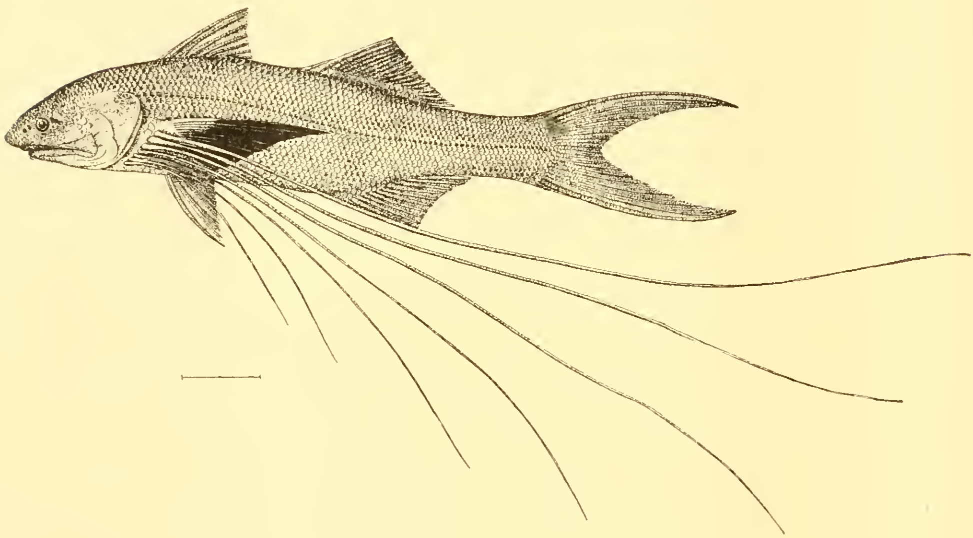

Fig. 11.—*Trichidion hilleri* Fowler.

Body long, compressed, greatest depth about middle of depressed ventral or spinous dorsal, and upper profile a little more convex than lower. Caudal peduncle a little long, and its least depth a trifle more than half its length.

Head obtuse, compressed, rather broad, and profiles similar with upper a little more convex, especially posteriorly. Snout broad, blunt, convex, and well protruded. Eye small, circular, a little low and lateral in position, and also placed a trifle behind first fourth of length of head. Adipose tissue well developed and extending over eye. Mouth inferior, large, gape curved in profile and upper jaw extending forward beyond symphysis of mandible. Maxillary expanded distally till about

$\frac{1}{4}$ more than diameter of orbit. Teeth in jaws minute asperities in rather broad band-like patches which are not confluent anteriorly. Similar patches on palatines. Vomer edentulous. Tongue large, thick, rounded and a little free in front but without asperities. Nostrils moderately large, rounded, similar, together, lateral and posterior on snout and directly in front of eye. Interorbital space broad, convex, and posteriorly to occipital region becoming more convex.

Gill-opening extending forward till below posterior portion of orbit. Gill-rakers small, slender, somewhat clavate, 13+18, and longest a little longer than longest filaments and a trifle more than distal expanded maxillary extremity. Pseudobranchiæ small. Isthmus broad and convex.

Scales rather small, mostly finely ctenoid and small ones extending over most of fins and head. On spinous dorsal, pectoral and ventral they are present only on basal regions, and other fins almost completely covered. Those on head small about and on snout. Head scaly with exception of lips and branchial flaps. Axil of pectoral with a fleshy flap and a thin pointed scale above. Axil of ventral with a grooved scaly flap. Lateral line continuous, of simple tubes, a little high at first and then running down along middle of side of caudal peduncle and well out on caudal.

Spinous dorsal inserted about midway between tip of snout and middle of base of soft dorsal or a trifle behind origin of ventral, spines slender, and second spine a little longest. Soft dorsal inserted a little nearer base of caudal than eye, and first branched ray highest. Anal similar to soft dorsal, inserted behind origin of same fin and a little nearer that of pectoral than base of caudal, and first branched ray highest. Caudal large, forked and lobes pointed. Pectoral long, second simple ray longest and reaching origin of anal. Pectoral filaments very long, first and third longest, and latter longer than entire length of fish. Lowest and shortest pectoral filament about equal to head without snout. Ventral with first ray longest and reaching about $\frac{3}{5}$ of space to anal. Insertion of ventral a little behind origin of pectoral. Vent close before tip of depressed ventral.

Color in alcohol mostly very pale brownish-white or pale brownish. Back darker brown with minute pale dusky dots on side of head and above pectoral. Dorsals and caudal sprinkled with similar pale dusky or gray dots and also slightly darker than other fins. Upper margins of dorsals slightly darker. Other fins like abdomen, except pectoral which is deep livid black on outer $\frac{2}{3}$. Pectoral filaments pale, like fin at base, soon becoming gradually browner till colored like back. Side and lower surface of head and snout whitish like abdomen. Iris pale slaty.

Length $8\frac{7}{8}$ inches.

Type No. 2,400, W. I. A. P. Baram river, Borneo. 1897. Alfred C. Harrison, Jr., and Dr. H. M. Hiller.

One example. This species may be distinguished principally by the black outer $\frac{2}{3}$ of the pectoral fin.

(Named for Dr. H. M. Hiller, explorer of Borneo and Sumatra with Mr. Alfred C. Harrison, Jr.)

COIIDÆ.

Body deep and elevated. Premaxillaries protractile and spines extending back to occiput. Teeth in jaws villiform and none on roof of mouth or on tongue. Maxillary slipping below lower edge of preorbital for most of its length. Preorbital narrow. Lower pharyngeal bones separate. Branchiostegals 6. Pseudobranchiæ present. Appendices pylorices few. Air-vessel simple. Dorsal fins continuous, spines XII and stout. Anal spines similar, III. Caudal rounded. Rivers and estuaries of India and the East Indies.

These fishes approach the *Gerridæ* in the spines of the premaxillary, but differ at once in the numerous stout dorsal spines. *Coius* Hamilton[65] (=*Datnioides* Bleeker) is the typical form.

68. Coius quadrifasciatus (Sevastianoff).

Four examples, largest $3\frac{7}{8}$ inches in length.

OSPHRONEMIDÆ.

69. Betta pugnax (Cantor).

One example from the Baram. Harrison and Hiller.

Bleeker's *Betta anabatoides*[66] appears to differ a little from *B. pugnax*, according to the accounts of Valenciennes and Cantor. *Panchax pic-*

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[65] This genus is also one of Hamilton's composite groups. Its elimination is as follows:

vacti = *Lates* Cuvier, 1828.
datnia = *Chrysophrys* Valenciennes, 1830.
catus = *Lutianus* Bloch, 1797.
trivittatus = *Therapon* Cuvier, 1829.
gudgutia = *Pomadasis* Lacépède, 1803.
polota = *Datnioides* Bleeker, 1857.
nandus = *Nandus* Valenciennes, 1831.
cobojius = *Anabas* Cuvier, 1829.
chatarcus = *Toxotes* Cuvier, 1817.

It is thus evident that *Datnioides* Bleeker is the last name proposed and therefore gives precedence to *Coius*. *Datnioides* first occurs in *Nat. Tijds. Ned. Ind.*, III, 1853, p. 440. Type *Datnioides quadrifasciatus* Bleeker = *Coius polota* Hamilton.

[66] *Nat. Tijds. Ned. Ind.*, I, 1850 (1851) p. 269. Bandjermassing, in fluviis. (Mr. J. Wolff.)

tum Valenciennes[67] is said to have 20 anal rays. Cantor's figure of *Macropodus pugnax* differs in showing a pale margined anal and uniform caudal, or without black undulating lines. Bleeker's figure[68] does not indicate any markings on the head or trunk and the rays are spotted.

70. Osphronemus goramy Lacépède.

One example from the Kapuas. Harrison and Hiller. It has depth of body $1\frac{2}{3}$ in its length. Total length of fish $7\frac{5}{8}$ inches.

ANABANTIDÆ.

71. Anabas scandens (Daldorff).

Three examples.

OPHICEPHALIDÆ.

72. Ophicephalus baramensis (Steindachner).

Head $3\frac{1}{4}$; depth $6\frac{2}{3}$; D. 36; A. 22; P. I, 13, I; V. I, 5; 53 scales in lateral line to base of caudal and 4 more on latter; about 15 osseous scales before dorsal; 5 scales between origin of dorsal and lateral line, and 8 between latter and origin of ventral; width of head $1\frac{2}{3}$ in its length; depth of head $2\frac{1}{4}$; mandible $2\frac{1}{10}$; thirtieth dorsal ray $2\frac{1}{6}$; seventeenth anal ray $2\frac{1}{2}$; pectoral $1\frac{2}{3}$; ventral $2\frac{9}{10}$; caudal $1\frac{3}{7}$; least depth of caudal peduncle $3\frac{3}{5}$; snout $4\frac{1}{5}$, from tip of upper jaw; eye 7; mouth $2\frac{1}{4}$; maxillary $2\frac{1}{6}$; interorbital space $3\frac{1}{4}$.

Body elongate, rather slender, and greatest depth about middle of depressed ventral. Tail long and well compressed.

Head rather large, elongate, broad, much depressed and sides rounded, presenting a somewhat swollen appearance. Snout short, broad and rather acutely rounded when viewed from above. Eye rather small, circular, superior, and placed a little before first third in length of head. Pupil circular and large. Mouth large, broad, oblique, and maxillary reaching well behind posterior margin of orbit. Posterior end of maxillary dilated till about equal to diameter of orbit and received in a deep infraorbital groove. Mandible large, flattened below, and well protruding beyond snout. Teeth in jaws minute, sharp pointed, numerous, and in broad bands which are continuous in front. Along sides of mandible a series of a few enlarged or erect canine-like teeth. Vomerine teeth minute, sharp pointed, uniserial and connecting with those on palatines. Palatine teeth large, depressible, irregular in size and position and rather numerous. Tongue a little long, rounded in front, and free. Lips rather broad and a little fleshy. Anterior

[67] *Hist. Nat. Poiss.*, XVIII, 1846, p. 285.
[68] *Atlas Ichth.*, IX, 1878, Pl. (1) 395, fig. 3.

nostrils far apart near edge of snout and each in a fleshy tube equal to about half of orbit. Posterior nostril small, lateral, close in front of eye and nearly level with upper margin of pupil. Interorbital space broad, flattened, and a trifle elevated. Opercle with a somewhat narrow fleshy gill-flap. Top of head broad and more or less flattened.

Gill-opening large, extending forward till about an eye-diameter posterior to posterior rim of orbit, and branchiostegal membrane forming a broad fold over isthmus. Gill-rakers small short broad asperous tubercles, and about 7 in number on first arch. Filaments small, nearly equal to pupil. Accessory branchial cavity large.

Scales rather small, cycloid, striate, and those on bases of caudal and pectoral fins small. On top of head scales more or less osseous and cemented together. Same on opercular region and on cheek. Scales on costal region a trifle larger than elsewhere. Lateral line a little high or superior at first, then dropping one or two scales till over vent, after which it continues medianly to caudal. Tubes simple.

Dorsal of nearly uniform height, long, and beginning about over first third of pectoral. Origin of anal about midway between tip of maxillary posteriorly and base of caudal, and similar to dorsal. Caudal rounded and middle rays longest. Pectoral long, rounded, reaching about $\frac{2}{3}$ of distance to anal, and middle rays longest. Ventral inserted just behind base of pectoral or a little before origin of dorsal, small or reaching about half way to vent. Vent close to origin of anal. Caudal peduncle compressed, and its least depth about $\frac{4}{5}$ its length.

Color in alcohol a livid plumbeous-brown, ventral but little paler or somewhat dirty white. Each scale on side marked with a slaty or dusky spot. Fins more or less slaty-brown, ventrals whitish. Tip of each dorsal and anal ray whitish. Indistinct oblique dusky bars or bands on dorsal and anal, and most distinct on last rays. Traces of many indistinct transverse narrow or wavy dusky cross-bars on caudal. Margin of pectoral narrowly pale. Lower surface of head pale livid slaty with round whitish blotches or spots. Iris slaty.

Length 8 inches.

Three examples. Baram, Borneo. Harrison and Hiller.

Dr. Steindachner's figure differs a little in the absence of the blackish oblique bars on the dorsal which are very distinct in one of my examples.

73. Ophicephalus pleurophthalmus Bleeker.

One example from Kapuas. Harrison and Hiller.

74. Ophicephalus lucius Cuvier.

Two examples from Baram. Harrison and Hiller.

TOXOTIDÆ.

75. Toxotes microlepis Günther.

One example. It differs a little in coloration from Bleeker's figure,[69] though purely individual.

EPHIPPIDÆ.

76. Ephippus argus (Linnæus).

Two examples, larger 3 inches long. The spots are not nearly so numerous as those shown in Day's figure.[70] Those on my smaller specimen are about 5 in number along the lateral line.

TRIACANTHIDÆ.

77. Triacanthus oxycephalus Bleeker.

Head $3\frac{1}{8}$; depth $2\frac{3}{5}$; D. V–23; A. 19; snout $1\frac{1}{2}$ in head; eye $3\frac{3}{4}$; dorsal spine $2\frac{1}{2}$ in head and trunk; anal spine $3\frac{3}{4}$; pelvic process $4\frac{1}{2}$; base of rayed dorsal $3\frac{4}{5}$; base of anal 6; length of caudal peduncle $4\frac{1}{6}$; length of pectoral equal to space between front margin of anterior nostril and posterior margin of orbit; interorbital space about equal to orbit. Upper edge of occipital crest nearly straight. Space between posterior margin of orbit and origin of spinous dorsal about equals $1\frac{3}{4}$ eye-diameters. Spinous dorsal pale brown, without markings. Length (caudal damaged) about 5 inches. A small example is much deeper, otherwise agreeing.

TETRAODONTIDÆ.

78. Tetraodon palembangensis Bleeker.

Two examples, largest 8 inches long from the Kapuas.

SCORPÆNIDÆ.

SYNANCEINÆ.

79. Leptosynanceia greenmani sp. nov.

Head $2\frac{7}{8}$; depth $3\frac{1}{4}$; D. XVI, 5; A. V, 5; P. 14; V. I, 4; width of head $2\frac{2}{3}$ in head and trunk; depth of head $1\frac{1}{4}$ in its length; seventh dorsal spine $3\frac{1}{2}$; last dorsal spine about 3; first dorsal ray about $2\frac{3}{5}$; fourth anal spine $3\frac{1}{2}$; third anal ray $2\frac{1}{3}$; caudal $1\frac{1}{2}$; length of pectoral $1\frac{3}{4}$; ventral $1\frac{3}{4}$; least depth of caudal peduncle $3\frac{7}{8}$; mandible 2; snout 4 in head, measured from tip of upper jaw medianly; eye 11; maxillary 2; distal expanded extremity of maxillary 5; interorbital space $3\frac{1}{4}$.

Body elongate, broadly depressed anteriorly, trunk compressed, so that when viewed from above tapering to caudal. Profiles more or

[69] *Atlas Ichth.*, IX, 1877, Pl. (1) 363.
[70] *Fishes of India*, I, 1875, Pl. 29, fig. 3.]

less similar. Caudal peduncle compressed, its least depth about equal to its length from base of anal membrane.

Head large, very broad, robust, broader posteriorly, and upper profile a trifle concave. Upper surface of head more or less flattened medianly, lower surface more or less convex. Snout short, very broad, flattened or only a trifle convex, when viewed from above both its margin and that of upper jaw, which is closely parallel, emarginate. Eyes small, a trifle longer than broad, rounded, superior though well separated and

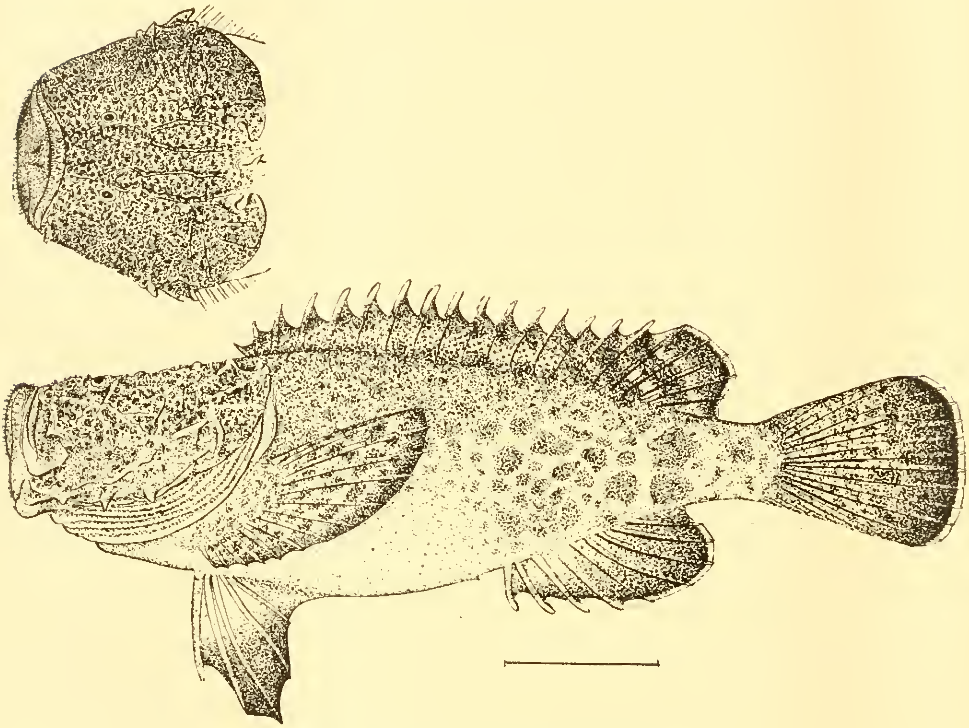

Fig. 12.—*Leptosynanceia greenmani* Fowler.

placed near first third of length in head. Maxillary nearly vertical, distally well expanded, so that its posterior margin is about level with anterior nostril. Mandible thick, heavy, nearly vertical, convex, and well protruded. Teeth minute, in rather broad bands which do not meet anteriorly though approaching close. No teeth on roof of mouth anteriorly or on tongue. Tongue very large, broad, thick, and only free around edges. Anterior nostrils each in a short tube about as far apart as interorbital space and close to edge of snout. Posterior nostrils same distance apart, each with a cutaneous margin and directly in front of eye. Interorbital space rather broad and flattened. Ridges on top of head distinct, especially parietal. Nuchal bony knob-like processes, one on each side of each parietal ridge large and distinct. Just anterior to nuchal knob a smaller parietal knob on each side. Tympanic knob small and inconspicuous. Two preorbital spines, lower much larger. Five spinous processes along margin of preopercle, upper 2, which are near its angle, enlarged and conspicuous. On ridge of preopercle 2 small blunt spinous processes and another on cheek just below eye. Opercular spines 2 and superior. Articular portion of mandible large.

Gill-opening lateral, large, and carried forward about an eye-diameter posterior to posterior margin of eye. Rakers about 10 small rounded knobs, low, and much less than eye, on first arch. Filaments about half of interorbital space. Pseudobranchiæ of several filaments. Width of isthmus a trifle more than interorbital space.

Body scaleless, and skin smooth, anteriorly and above, and together with most of head, covered with minute papillæ. In a lateral series close to and concurrent with upper profile a series of 10 short bony pricks following course of lateral line. Small papillæ also on spinous dorsal where they form oblique crossing series.

Spinous dorsal with long base, spines pungent, heteracanthous and, with exception of first two, of more or less equal height. Origin of spinous dorsal a little before base of uppermost pectoral ray. Each dorsal spine with a more or less cutaneous or adipose-like flexible tip. Anal spines similar, fourth longest. Origin of spinous anal about midway between base of lowest pectoral ray and base of caudal. Membranes of both spinous dorsal and anal emarginate. Rayed vertical fins with simple rays. Origin of soft dorsal about last fourth in length of head and trunk. Origin of rayed anal slightly before. Third dorsal ray longest and others graduated down, edge of fin rounded. Third anal ray longest, others more or less subequal. Caudal rounded and rather oblong. Pectoral large, broadly expanded, of simple rays, and base of lowest ray about last third in length of head. Ventral with broad base united by membrane with belly, and base of spine opposite to base of lowest pectoral ray. Spine robust and with fleshy end. Second ventral ray longest. Vent close in front of anal.

Color in alcohol pale brown, lower surface scarcely paler. Head finely mottled or marbled with darker brown, and back and sides with numerous large deep brownish blotches. Fins also similarly marked and colored. Soft dorsal, anal and caudal with conspicuous white and rather broad margins, color adjoining almost blackish but fading out to brownish ground-color soon, though on caudal distally more darker than on other fins. Pectoral mottled with brownish, becoming distally blackish, and without white margin. Ventral pale blotched with dusky distally. Iris slaty.

Length $6\frac{1}{4}$ inches.

Type No. 2,349, W. I. A. P. Baram, Borneo. 1897. Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Also paratypes No. 2,381, W. I. A. P., with same data, and No. 2,509, W. I. A. P., from the mouth of the Baram river, collected by Dr. W. H. Furness in 1898.

This species is closely related to *Leptosynanceia asteroblepa* (Richardson),[71] but differs at once in coloration, the edges of all the fins in that species being blackish, while in *Leptosynanceia greenmani* they are margined with whitish on the rayed dorsals and anal, and caudal. Bleeker's figure[72] shows a more marbled appearance, but the edges of these fins are also dark. Further, the dark and pale markings on the trunk are exactly negative to *L. greenmani*.

(Named for Dr. M. J. Greenman, Director of the Wistar Institute of Anatomy in Philadelphia.)

GOBIIDÆ.

ELEOTRIDINÆ.

80. Ophiocara porocephala (Valenciennes).

Head $2\frac{3}{4}$; depth $4\frac{1}{6}$; D. VI–I, 8; A. I, 6; scales 37 in a lateral series to base of caudal; about 15 series of scales from origin of spinous dorsal to middle of dorsal transversely; depth of head about $1\frac{5}{6}$ in its length; width of head $1\frac{1}{2}$; mandible 2; length of depressed spinous dorsal 2; base of second dorsal $2\frac{1}{4}$; sixth dorsal ray $2\frac{1}{10}$; base of anal $2\frac{1}{10}$; fifth anal ray $2\frac{1}{2}$; length of caudal about $1\frac{2}{3}$; pectoral $1\frac{9}{10}$; ventral $1\frac{15}{16}$; snout $3\frac{3}{5}$ in head measured from tip of upper jaw; eye $6\frac{3}{4}$; maxillary $2\frac{4}{7}$; width of mouth $3\frac{1}{6}$; interorbital space $2\frac{2}{3}$. Cleft of mouth extending but little beyond anterior margin of eye. Series of pearl-colored spots along lower part of sides more or less regular and persistent in alcohol. Traces of a whitish margin to soft dorsal and anal. Ventral dark like back with light margin. Length $6\frac{5}{8}$ inches. Three examples. Baram. Harrison and Hiller. All dark or blackish-brown with whitish spots on side, though the eye appears to be a little smaller than in Day's figure.[73]

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[71] *Synanceia asteroblepa* Richardson, *Voyage of the Sulphur*, Fish, I, 1844, p. 69, Pl. 39, figs. 1–3. Coast of New Guinea.
[72] *Atlas Ichth.*, IX, 1877, Pl. (6) 416, fig. 6.
[73] *Fishes of India*, II, 1876, Pl. 67, fig. 1.

GIGANTOGOBIUS gen. nov.

Type *Gigantogobius jordani* sp. nov.

Scales small, about 88. Body depressed, especially head. Snout broad and depressed. Dorsal spines not elevated. Ventrals separate. Eyes small and superior. Largest of the Gobies. Rivers of Borneo.

(*Γιγανταῖος*, gigantic; *κωβιὸς*, the ancient name of the Goby.)

81. Gigantogobius jordani sp. nov.

Head $2\frac{5}{6}$; depth 4; D. VI–I, 9, I; A. I, 8, I; P. 17; V. I, 5; scales 88 to base of caudal, and about 6 more on latter; scales about 32 in a transverse series at origin of anal; depth of head about 2 in its length; width of head $1\frac{2}{5}$; mandible 2; second dorsal spine $3\frac{2}{5}$; third branched dorsal ray $2\frac{2}{3}$; base of spinous dorsal $2\frac{3}{4}$; base of rayed dorsal 2; first branched anal ray $4\frac{1}{5}$; sixth anal ray $2\frac{1}{2}$; base of anal $2\frac{3}{5}$; length of caudal $1\frac{3}{5}$; least depth of caudal peduncle $2\frac{3}{7}$; pectoral 2; ventral $2\frac{1}{6}$;

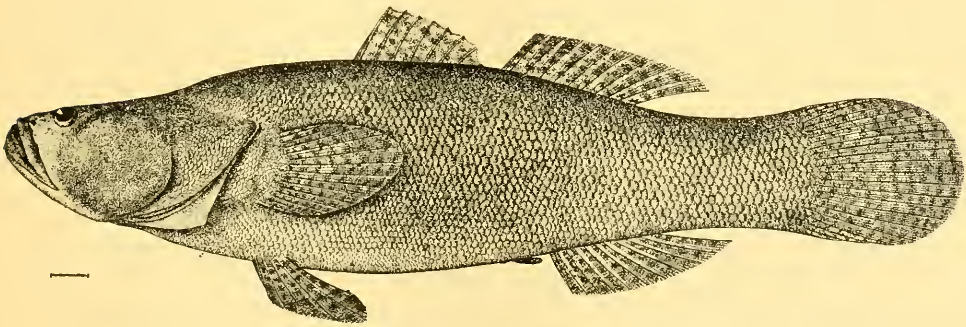

Fig. 13.—*Gigantogobius jordani* Fowler.

greatest width of trunk $1\frac{3}{7}$; snout $3\frac{3}{4}$ in head from tip of upper jaw; eye $11\frac{3}{5}$; maxillary $2\frac{1}{4}$; interorbital space $3\frac{2}{5}$; internasal space 4; width of mouth 2.

Body elongate, very robust and solid, depressed anteriorly, sides rather convex and tail well compressed. Greatest depth at origin of spinous dorsal. Profiles of trunk a little convex and similar. Caudal peduncle strongly compressed and its least depth about $1\frac{1}{6}$ in its length.

Head very large, depressed, more or less flattened above and more convex below. Upper profile concave from snout in front to occiput. Lower profile convex. Snout obtuse, broad, and a little convex above. Upper jaw broad and well produced in front. Eye small, circular, laterally superior, and placed about first third in total length of head. Mandible large, convex and well produced. Mouth large, superior, oblique, and gape curved in profile. Maxillary oblique and reaching about opposite posterior margin of pupil. Lips thick and fleshy, edges papillose. Teeth short, conic, powerful, erect, and irregular in at least outer series of each jaw. Only an inner adjoining broad band in upper jaw of minute ones. Roof of mouth and tongue edentulous. Tongue broad, rounded in front, and free. Nostrils superior, anterior ones each in a short tube near margin of snout, though well separated, distance between being equal to that of posterior pair, which are close in front of eye in form of simple pores. Interorbital space broad and flattened. Opercle ending in a triangular point above and with narrow cutaneous flap.

Gill-opening large, extending forward a little before middle in length of head, though falling a little behind posterior margin of orbit. Rakers about 10 knob-like bony processes on first arch, rounded, much shorter than filaments though large. Filaments about equal to orbit. Isthmus narrow.

Scales small, cycloid, striate, thin and rather narrowly imbricated. Head scaled except most of snout, jaws, mandible and branchiostegal regions which are naked. Both dorsals, pectoral, except base, and ventral also naked. Greater part of caudal scaly, also base of pectoral. Scales before spinous dorsal, and on head above, on base of caudal, and on breast, especially reduced or crowded. No lateral line.

Dorsal spines a little flexible, membranes emarginate, and second longest. Fin small, its origin about over middle of depressed pectoral or about midway between tip of snout and middle of last dorsal ray when depressed, and not reaching rayed dorsal. Rayed dorsal well developed, posteriorly higher or fifth ray about longest, and origin of fin a little nearer base of caudal than posterior margin of preopercle. Anal similar to rayed dorsal and inserted a little posterior to its origin. Caudal large, rounded, median rays a little longest. Pectoral rather small, lower rays more expanded and branched, base of fin a little fleshy, and when depressed tip of fin reaches about opposite middle of length of depressed spinous dorsal. Ventrals separate, anteriorly with base fleshy, inserted a little in advance of base of lowest pectoral ray, rays graduated to fourth which is longest and tip of depressed fin reaching a little more than half way to anal. Anal papilla large and fleshy. Vent at a point about last $\frac{2}{3}$ in space between tip of depressed ventral and origin of anal.

Color in alcohol deep blackish-brown, a slaty hue due doubtless to the precipitate, and more or less nebulous. Belly, lower surface of head and breast scarcely paler, or dirty-brownish. Lower surface of head with paler blotches, some of which are more or less confluent. Fins all dusky brownish variegated with darker or blackish-brown spots, giving them a somewhat barred appearance. Eyes slaty.

Length 26 inches.

Type No. 2,387, W. I. A. P. Baram, Borneo. 1897. Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. Also paratype No. 2,763, W. I. A. P. Same data. It is smaller.

(I take pleasure in dedicating this interesting species to Dr. David Starr Jordan, of the Leland Stanford Junior University, my most able preceptor in Ichthyology.)

82. Butis butis (Hamilton).

Head $2\frac{7}{8}$; depth $4\frac{3}{5}$; D. VI–I, 8; A. I, 8; scales 29 in lateral series to base of caudal, and 2 more on latter; 13 scales obliquely between origin of spinous dorsal and that of anal. Each scale of body with a smaller one, or more, usually at its base. This agrees fairly well with Day's figure of *Eleotris butis*,[74] though there are four or five brownish lines radiating from the eye. Sides of head marked sparsely with brownish specks. Four examples.

PERIOPHTHALMINÆ.[75]

83. Periophthalmodon schlosseri (Pallas).

Head $3\frac{1}{5}$; depth $4\frac{3}{5}$; D. VII–I, 12; A. I, 12; scales 51 in a lateral series to base of caudal, and 4 or 5 more on latter; about 14 scales in a transverse oblique series from origin of soft dorsal to anal; width of head $1\frac{3}{5}$ in its length; depth of head $1\frac{1}{2}$; snout 3; eye $6\frac{1}{4}$; maxillary $2\frac{3}{4}$; width of mouth $2\frac{3}{4}$; least depth of caudal peduncle $2\frac{3}{5}$; width of base of pectoral 3; length of pectoral $1\frac{1}{3}$; ventral 2; caudal $1\frac{1}{3}$; second dorsal spine $1\frac{2}{3}$; sixth dorsal ray $2\frac{7}{8}$; tenth anal ray $3\frac{2}{5}$. Lower surface of head and breast naked. In alcohol brownish, under surface of body paler or whitish, and ventrals and anal similar. Spinous dorsal blackish-brown with upper margin conspicuously white. Soft dorsal brownish with a broad median dusky or blackish-brown band. A dusky band from eye to shoulder. Iris slaty and outer lid white. Length $8\frac{1}{4}$ inches. Four examples.

84. Periophthalmus argentilineatus Valenciennes.

Head 4; depth $5\frac{1}{2}$; D. XIII–13; A. 11; P. I, 14; V. I, 5; scales about 80? in a lateral series from above gill-opening posteriorly to base of

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[74] *Fishes of India*, II, 1876, Pl. 67, fig. 3.

[75] *Boleophthalmus* Valenciennes may be distinguished from *Scartelaos* Swainson by the filamentous dorsal spines. As I have only examined examples of *Boleophthalmus chinensis* (Osbeck), *B. boddærti* Schlegel, the type of *Boleophthalmus* Valenciennes, may be different. Also I have only seen *Scartelaos aucupatorius* (Richardson) from China, which may be different from *S. viridis* (Swainson), the type of the latter's genus.

caudal, and about 4 more on latter; about 23 scales in a transverse series from origin of soft dorsal to base of anal; width of head $1\frac{4}{7}$ in its length; depth of head $1\frac{1}{2}$; snout $3\frac{1}{4}$; eye $3\frac{3}{5}$; width of mouth $2\frac{1}{5}$; first dorsal spine $1\frac{2}{5}$; first dorsal ray about $2\frac{1}{8}$; last anal ray about $3\frac{1}{2}$; caudal (damaged) $1\frac{1}{3}$; pectoral, to scaly base, about $1\frac{1}{2}$; length of ventral nearly 2; least depth of caudal peduncle 3.

Body elongate, somewhat compressed, tapering to caudal so that greatest depth exclusive of head is just behind it. Profiles even and similar. Caudal peduncle rather long, its least depth a trifle over half its length.

Head robust, a little oblong, widest below, upper surface little constricted, but little deeper posteriorly, and anterior profile steep. Snout broader than long, and with both anterior profile and surface convex.

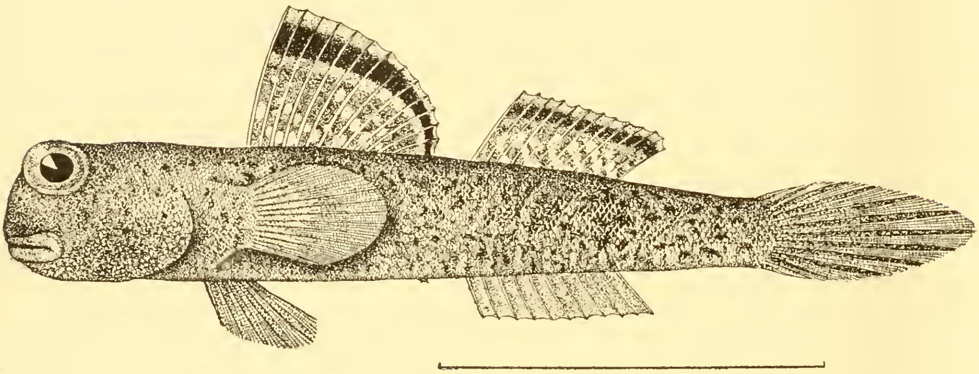

Fig. 14.—*Periophthalmus argentilineatus* Valenciennes.

Eye high, large, a little longer than deep and anterior. Mouth broad, with large jaws, and lower a little inferior. Lips fleshy, broad, and forming a broad fold at each corner of mouth. Teeth large, about 20? in each jaw, conic, pointed, and uniserial. Roof of mouth and tongue apparently smooth. Tongue large, thick, rounded and not free. Nostrils well separated, on each side of snout just below front margin of eye. Interorbital space hardly defined, eyes approximated.

Gill-opening lateral, its length about $3\frac{3}{4}$ in head. Gill-rakers a few small weak fleshy processes. First arch with lower anterior part more or less adnate to pharynx by membrane. Gill-filaments rather short. Isthmus broad.

Scales small, present on occiput or on top of head behind eyes, and on sides of head. In these regions and on back about spinous dorsal, and also on belly and chest they are small or crowded. On posterior side of body enlarged. Small scales only on bases of pectoral and caudal. No lateral line.

Spinous dorsal beginning behind base of pectoral, margin of fin entire, spines graduated down from first which are longest, and height of fin a little more than greatest depth of body. Soft dorsal inserted over that of anal, first ray highest and others graduated down. Origin of anal about opposite that of soft dorsal, and graduated to last rays which are longest. Margins of both rayed dorsal and anal entire. Caudal damaged, elongate, and median rays longest. Pectoral broad, with long scaled fleshy base and not quite reaching opposite vent. Ventrals separate, small, spine short and reaching about half way to anal. Vent well before anal and with an anal papilla.

Color in alcohol deep brown, back darker, and lower surface a more livid or soiled brownish, on abdomen and lower surface of head somewhat whitish. On lower side of head a number of small whitish round spots, and on lower side of trunk a number of short indistinctly defined vertical bars of same color. Trunk and head also more or less mottled with a darker shade of brown than general body-color, sprinkled with various irregular blackish spots. Dorsals brownish, margins whitish, below which is a broad blackish submarginal band, most distinct on spinous fin. Below dark bands another pale or whitish one, similar to margins. Basal portions of dorsals brownish marked with a number of rather large whitish spots of irregular distribution. Other fins brownish, pectoral and caudal darker and anal pale. Iris slaty.

Length $2\frac{1}{4}$ inches (caudal damaged).

Three examples.

GOBIINÆ.

85. Glossogobius giurus (Hamilton).

Head 3; depth $5\frac{1}{5}$; D. VI–I, 9; A. I, 8; scales 32 in lateral line to base of caudal, and 3 more on latter; 14 scales between origin of dorsal and that of anal; snout $3\frac{1}{3}$ in head from tip of upper jaw; eye $4\frac{1}{3}$. In alcohol body shows traces of about 8 pale longitudinal narrow lines which are continuous. Side with 5 nebulous or brownish blotches. Opercle with a dusky-brown blotch. Several short deep brown bars on base of pectoral. In several of these latter points it will thus be seen to differ a little from Day's figure of *Gobius giurus*.[76] Length $4\frac{3}{4}$ inches. Five examples.

[76] *Fishes of India*, II, 1876, Pl. 66, fig. 1.

86. Chænogobius megacephalus sp. nov.

Head 3; depth about 6?; D. VI–I, 11; A. I, 10; P. 16; V. I, 5 (I, 5); scales about 75? (squamation injured) to base of caudal; scales about 14? (squamation injured) in a transverse series at origin of anal; depth of head about $2\frac{1}{3}$ in its length; width of head $1\frac{7}{8}$; snout $3\frac{1}{2}$; eye 5; width of mouth $2\frac{2}{3}$; maxillary 2; pectoral $1\frac{3}{7}$; ventral $2\frac{1}{3}$; third dorsal spine $2\frac{1}{3}$; second developed dorsal ray $2\frac{1}{4}$; last 3; first developed anal ray 3; last 3; caudal about $1\frac{1}{2}$; least depth of caudal peduncle $3\frac{4}{7}$; interorbital space $2\frac{1}{3}$ in horizontal orbital diameter.

Body elongate, depressed anteriorly, and sides and tail well compressed. Greatest depth apparently about belly. Caudal peduncle rather long, its least depth about $1\frac{2}{3}$ in its length.

Head large, depressed, below more or less flattened, and upper sur-

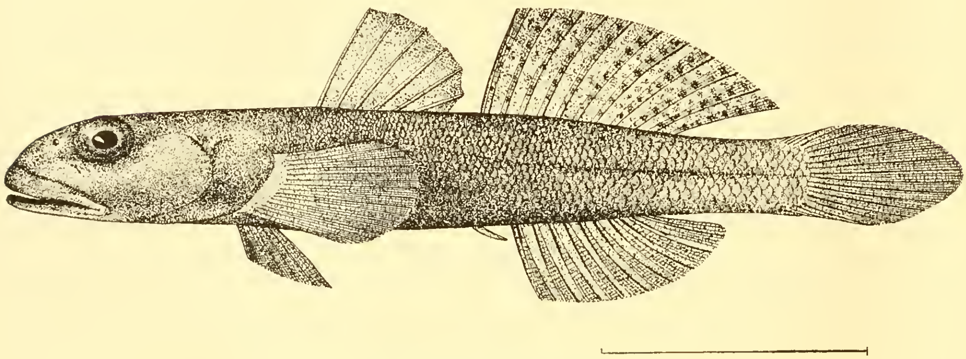

Fig. 15.—*Chænogobius megacephalus* Fowler.

face convex. Upper profile steep and convex, or obtuse to eye, then more or less shallowly convex. Snout large, broad, convexly rounded, and well developed upper jaw produced. Eye rather small, high, somewhat directed upward, a little longer than deep, and posterior margin a little in advance of middle of length of head. Jaws rather large and powerful and upper slightly protruding. Mouth large, broad, and maxillary reaching a trifle past posterior margin of orbit. Lips rather thin, fleshy, and with lateral margins papillose. Teeth in broad bands in jaws, not connected in front, and outer ones not forming a pronounced outer series, though a little larger than inner. No vomerine or palatine teeth. Upper buccal flap broad. Tongue broad, smooth, thick, truncated, with a median groove or emargination and little free in front. Nostrils lateral, in front of eye, anterior a little nearer front margin of eye than tip of upper jaw, and posterior close in front of eye. Interorbital space narrow and flattened.

Gill-opening lateral, slightly oblique, and its length about $2\frac{1}{2}$ in head. Rakers about 3+5 short rounded tubercles. Filaments short, about equal to horizontal diameter of pupil.

Scales small, finely ctenoid. Body mostly scaly, almost all fallen in this example. Scales on back before and below spinous dorsal greatly reduced and crowded. Posteriorly on trunk larger scales. Fins, except base of caudal and traces of minute scales at base of pectoral, scaleless. Breast and median line of belly scaleless and without traces of pockets. No lateral line.

Dorsal spines a little pungent, third a trifle longest, and others graduated. Origin of spinous dorsal about midway between tip of upper jaw and penultimate dorsal ray. Second dorsal inserted a trifle in advance of anal, a little nearer base of caudal than posterior margin of eye, and fin rays mostly uniform in height. Anal similar. Caudal elongate, median rays longest and edges above and below rounded. Pectoral long, broad, radii similar, none silky but all joined by membranes and those about and just below median longest. Ventrals united and with a rather broad frenum in front. Vent close in front of anal. Anal papilla but little shorter than eye.

Color in alcohol dull pale brown, lower surface not paler. Spinous dorsal pale brown. Soft dorsal and caudal similar with series of indistinct brownish blotches, those on former oblique and those on latter transverse. Anal, ventral and pectoral brown, latter darker. Iris brownish.

Length $3\frac{5}{8}$ inches.

Type No. 13,900, W. I. A. P. Borneo. 1898. Dr. W. H. Furness. One example.

This species is related to *Gobius melanocephalus* Bleeker,[77] *G. personatus* Bleeker[78] and *G. grammepomus* Bleeker.[79] From all of these it differs at once in the larger head which is equal to $3\frac{1}{2}$ in the entire length of the fish, inclusive of caudal.

(*Μέγας*, great or large; *κεφαλή*, head.)

SOLEIDÆ.

87. Brachirus panoides (Bleeker).

One example.

88. Paraplagusia marmorata (Bleeker).

Head 4; depth $3\frac{3}{7}$; D. 100; A. 80; scales 100 in a median lateral

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[77] *Verh. Bat. Genoot.* (Bijd. Blenn. Gob. Soend. Moluk. Arch.), XXII, 1849, p. 33. Purworedjo in flumine Bogowonto.

[78] *L. c.*, p. 34. Banjumas, in flumine Seraiju.

[79] *L. c.* Purworedjo in flumine Bogowonto

series from gill-opening below lateral line to base of caudal; in greatest width of body 26 series of scales between ventral profile of body and lateral line, and between latter and upper lateral line 16; snout $2\frac{1}{10}$ in head; eye equal to interorbital space. Length $7\frac{5}{8}$ inches. Two examples.

89. Cynoglossus borneensis (Bleeker).

Head $4\frac{1}{3}$; depth $3\frac{3}{4}$; D. 100; A. about 4, 82; caudal about 10; space between tip of snout and upper eye $2\frac{4}{7}$ in head; mouth cleft 5; upper eye $4\frac{1}{4}$ in space to tip of snout; interorbital space $4\frac{1}{4}$; about 81 scales in lateral line, beginning count above posterior edge of gill-opening, to base of caudal (squamation injured); below and in a median series nearly 85 scales within same limits; 40 scales in a transverse series in greatest width of body or 6 between upper profile and upper branch of lateral line, 14 between latter and median branch, and 20 below.

Body long, greatly compressed, sinistral and greatest depth falling about first $\frac{2}{5}$ in length. Tail tapering rather narrowly posteriorly.

Head moderate, upper profile a little more convex, though both evenly rounded. Snout a little long, well compressed and profile strongly convex. Eyes rather small, close together, and upper with only $\frac{1}{3}$ of its length in advance of anterior margin of lower. Posterior margin of lower eye much further from posterior edge of gill-opening than anterior margin of upper eye is from tip of snout. Mouth large, cleft nearly horizontal. Teeth fine, small, sharp pointed, and in bands only in dextral side of jaws. Sinistral side of jaws with a labial fringe of rather small ragged cutaneous flaps. Tongue thick and inconspicuous. Upper nostril just about opposite anterior margin of lower eye in interorbital space, but nearer upper eye than lower. Lower nostril just a trifle in advance of anterior edge of upper eye, close to gape of mouth and in a short fleshy tube. Interorbital space narrow, flattened medianly, otherwise slightly concave.

Gill-opening small, ascending about level with middle of lower eye, and membrane forming a broad fold over narrow compressed isthmus. Rakers none. Filaments about $\frac{3}{5}$ length of mouth cleft.

Scales ctenoid, small and crowded on anterior half of body and around its profiles, but becoming enlarged on posterior half, especially medianly. Lateral system of mucous pores double along trunk, median series begins near tip of snout and runs direct to base of caudal, while upper one is confluent at its origin with this, and again well behind eye, by means of a downward or nearly vertical series. Upper series then continues near and concurrent with upper profile-line till below fifth ray of caudal, counting from caudal where it ascends on dorsal. A system or series of mucous pores continues lateral system close to lower profile of snout to mouth, and giving off horizontally a series which extends toward upper nostril. A series of pores extends down irregularly from intersecting series between eyes and gill-opening, and also another small series on lower side of head anterior to former. A similar pattern of lateral system on dextral side of body.

Dorsal and caudal confluent with anal, margins of first and last more or less scalloped or incised, while caudal is pointed. First 4 rays of anal united by a broad membrane with rest of fin.

Color in alcohol uniform dull brown on sinistral side. Dextral side pale brownish-white. Fins brownish, darker than sinistral side. Traces of 3 median longitudinal darker lines on side of trunk, median one on median branch of lateral system. Inside gill-opening brownish. Iris pale slaty.

Length $7\frac{1}{4}$ inches.

One example.

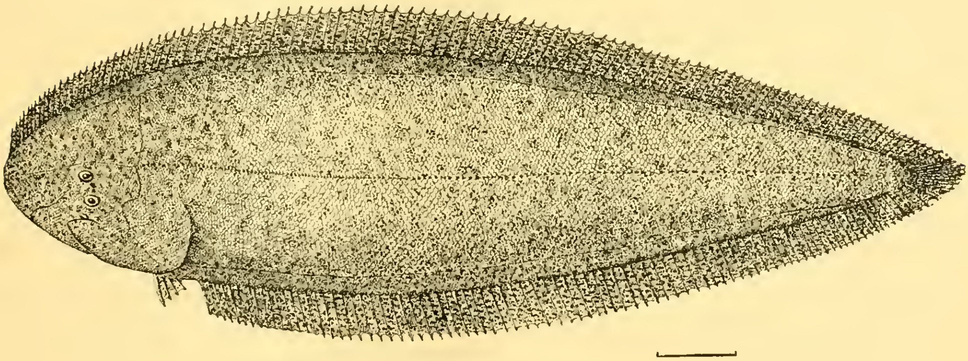

Fig. 16.—*Cynoglossus kapuasensis* Fowler.

90. Cynoglossus kapuasensis sp. nov.

Head 5; depth $3\frac{1}{5}$; D. 109; A. 4–87; caudal 10; space between tip of snout and upper eye $2\frac{1}{6}$ in head; mouth cleft $5\frac{2}{5}$; upper eye $5\frac{1}{2}$ in space to tip of snout; interorbital space 5; about 124 scales in lateral line, beginning count above posterior edge of gill-opening, to base of caudal; below and in a median series about same number within same limits; 67 scales in a transverse series in greatest width of body, or 9 between upper profile and upper branch of lateral line, 21 between latter and median branch, 29 between latter and lower branch and 8 between latter and lower profile-line.

Body elongate, greatly compressed, sinistral and greatest depth faling about first third in length. Tail tapering posteriorly and its profiles nearly straight. Head small, upper profile a little more convex than lower and both rounded. Snout rather long, compressed and profile strongly convex. Eyes small, close together, and upper with about ½ its diameter in advance of anterior margin of lower. Posterior margin of lower eye about same distance from gill-opening as anterior margin of upper eye is from tip of snout. Mouth cleft large, a little curved upward in middle and nearly horizontal in position. Teeth very minute, merely an asperous edge to each jaw on dextral side, those of sinistral side perfectly smooth. Dextral side with a broad fleshy labial fold finely or minutely fringed. Tongue thick and fleshy. Upper nostril midway in interorbital space and just below posterior margin of upper eye. Lower nostril a little behind anterior margin of upper eye, close to gape of mouth and in a short fleshy tube. Interorbital space narrow and a little concave.

Gill-opening small, ascending about level with lower margin of upper eye, and membrane forming a broad fold over rather narrow compressed isthmus which has rounded edge. Rakers minute fleshy or cutaneous points. Filaments rather long, longest about $\frac{7}{8}$ of length of gape of mouth.

Scales rather finely ctenoid, small, and crowded on anterior third of body and around its profiles, but becoming enlarged on median portion of trunk posteriorly and tail. Lateral system of mucous pores triple. Median series begins near tip of snout and extends to base of caudal direct. Upper series confluent at its origin with middle series, runs concurrent with dorsal profile but a short distance below till below base of fifth dorsal ray, counting from caudal, where it ascends dorsal fin. Lower series has its origin at front of mandible laterally, extending along lower edge of preopercle and down lower side of head, and finally concurrent and near lower profile of body till above base of fifth anal ray, also counting from caudal, where it descends on the anal fin. Intersecting series connect occipital region of upper series with median series and is then continued below to lower series. Along lower anterior margin of snout upper series is continued some distance, after which it ascends obliquely toward upper eye.

Dorsal, anal and caudal confluent, margins of former two fins scalloped or a little emarginate between each ray. Caudal rather rounded. Anal with first 4 rays apparently a little separate from rest of fin.

Color in alcohol rather dark brown on sinistral side, with traces of darker brown mottlings and blotches. Fins brownish, marginally whitish, and mottled more or less basally with darker brownish. Dextral side whitish or brownish-white, also same color extending on fins. Iris dull slaty. Inside gill-opening pale or whitish.

Length $11\frac{13}{16}$ inches.

Type No. 2,402, W. I. A. P. Kapuas river, western Borneo. 1898. Mr. Alfred C. Harrison, Jr., and Dr. H. M. Hiller. One example.

This species approaches *Cynoglossus microlepis* (Bleeker)[80] in the posterior position of the upper nostril which is below the posterior portion of the eye, but it differs from that species in the fewer fin rays and scales. It also resembles *Cynoglossus potous* (Cuvier)[81] in coloration, traces of blotches being evident, but differs in the nostrils and fin radii. From *Cynoglossus borneensis* (Bleeker) it differs in the absence of the three median longitudinal dark lines, etc.

(Named for the Kapuas river, in western Dutch Borneo.)

Faunal Works.

Bleeker, Pieter van.

1851. Bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van 16 nieuwe soorten van zoetwatervisschen. *Nat. Tijds. Ned. Ind.* Batavia, I, 1850 (1851), pp. 1–16. (March, 1850.)

Visschen van Borneo. *L. c.*, pp. 161–162.

Nieuwe bijdrage tot de kennis der ichthyologische fauna van Borneo met beschrijving van eenige nieuwe soorten van zoetwatervisschen. *L. c.*, pp. 259–275. (November, 1850.)

Derde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. *L. c.*, II, 1851, pp. 57–70. (February, 1851.)

Vierde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. *L. c.*, pp. 193–208. (May, 1851.)

Vijfde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. *L. c.*, pp. 415–442. (August, 1851.)

1852. Zesde bijdrage tot de kennis der ichthyologische fauna van Borneo. Visschen van Pamangkat, Bandjermassing, Praboekarta en Sampit. *L. c.*, III, 1852, pp. 407–442. (June, 1852.)

1853. Zevende bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervisschen van Sambas, Pontianak en Pangaron. *L. c.*, V (II), pp. 427–462. (January–August, 1853.)

1855. Achtste bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervisschen van Bandjermasin. *L. c.*, VIII (V), pp. 151–168. (November, 1854.)

Negende bijdrage tot de kennis der ichthijologische fauna van Borneo. Zoetwatervisschen van Pontianak en Bandjermasin. *L. c.*, IX (VI), pp. 415–430. (July, 1855.)

1857. Tiende bijdrage tot de kennis der ichthyologische fauna van Borneo (1). Visschen van de rivieren Barito, Kahajan en Kapoeas. *Act. Soc. Sci. Ind. Neerl.*, II, pp. 1–21. (September, 1856.)

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[80] *Plagusia microlepis* Bleeker, *Nat. Tijds. Ned. Ind.*, I, 1850 (1851), p. 413. Bandjermassing, Borneo austro-orientalis, in fluviis. (J. Wolff.)

[81] *Pleuronectes potous* Cuvier, *Règne Animal*, Ed. II, II, 1829, p. 344. (Based on *Jerree potoo* Russell, *Fishes of Coromandel*, I, 1803, p. 58, Pl. 74. Vizagapatam. Madras.)

Elfde bijdrage tot de kennis der ichthyologische fauna van Borneo. Visschen van Sinkawang. *L. c.*, III, pp. 1–4. (May, 1857.)
1858. Twaalfde bijdrage tot de kennis der vischfauna van Borneo. Visschen van Sinkawang. *L. c.*, V, pp. 1–10. (October, 1857–March, 1858.)
[82]Vischsoorten van Sinkawang, verzameld door J. H. A. B. Sonnemann Rebentisch. *Nat. Tijds. Ned. Ind.*, XVI (II), 1858–59, pp. 195, 196. (March, 1858.)
[82]Slangen en visschen uit de omstreken van Montrado, verzameld door G. J. Filet. *L. c.*, pp. 196, 197. (March, 1858.)
[82]Slangen en visschen van Koetei, verzameld door J. Wolff. *L. c.*, p. 206. (April, 1858.)
1859. Verslag van eene verzameling Reptiliën en Visschen van Westelijk Borneo, aangeboden door J. H. A. Sonnemann Rebentisch. *L. c.*, pp. 433–441. (January, 1859.)
Zoetwatervisschen van Sintang (verzameld door den heer A. Thepass). *L. c.*, XX (VI), 1858–59, pp. 199–200. (July, 1859.)
1860. Dertiende bijdrage tot de kennis der vischfauna van Borneo. *Act. Soc. Sci. Ind. Neerl.*, VIII, pp. 1–64. (September, 1859.) [Not consulted.]

MARTENS, EDUARD VON.
1864. Süsswasser Fische von Borneo. *Sitz. Gesell. Nat. Fr. Berlin*, 1863–64, p. 5. [Verbal communication.]

GÜNTHER, ALBERT.
1868. Description of two new Gobioid Fishes from Sarawak. *Ann. Mag. Nat. Hist.* London, I, (4) pp. 264–266, Pl. 12.

VINCIGUERRA, DOCIO.
1880. Appunti ittiologici sulle collezioni del Museo Civico di Genova. Prima contribuzione alla Fauna Ittiologica dell' Isola di Borneo. Siluroidei raccolti durante il viaggio dei Signori M. se G. Doria e Dr. O. Beccari. *Ann. Mus. Civ. Stor. Nat. Genova*, XVI, 1880–81, pp. 161–182, with 7 text figures.

JANOS, KÁROLI.
1882. Prodromus piscium Asiæ orientalis a domine Joanne Xantus annis 1868–70 collectorum. *Természetrajzi Füzetek Kiadja a Magyar Nemzeti Múzeum*, Budapest, 1881, pp. 147–187.

VAILLANT, LÉON.
1890. Sur les Poissons des eaux douces de Bornéo. *Congr. Int. Zool. Paris*, 1889, Compt. Rend., pp. 81–82.
1891. [Note on Lepidoglanis.] *Bull. Soc. Philomath.* Paris, III (8), 1890–91, Compt. Rend., No. 2, p. 6.
1893. Contribution a l'étude de la faune ichthyologique de Borneo. *Nouv. Arch. Mus.* Paris, V (3), pp. 23–114, Pls. 1–2.
1894. Sur la faune ichthyologique des eaux douces de Bornéo. *Compt. Rend. Acad. Sci.* Paris, CXVIII, pp. 209–211.
1902. Résultats zoologiques de l'expédition scientifique néerlandaise au Bornéo central. Poissons. *Notes from the Leyden Museum*, XXIV (I–III). January–July (November), 1902, pp. 1–166, figs. 1–47, Pls. 1, 2.

BOULENGER, GEORGE A.
1894. Descriptions of new Freshwater Fishes from Borneo. *Ann. Mag. Nat. Hist.* London, XIII (6), pp. 245–251.
1895. List of the Freshwater Fishes Collected by Mr. A. Everett on Palawan and Balabac. *L. c.*, XV (6), pp. 185–187.
Descriptions of Two New Fishes Obtained by Mr. C. Hose in Sarawak. *L. c.*, p. 247.

BARTLETT, ——.
1896. *Sarawak Gazette.* [An account of the fishes, both in this and the following. Neither consulted.]
Notebook of Sarawak, No. 2.

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[82]These titles are from "Lijst der geschriften van Dr. P. Bleeker over Ichthyologie in chronologische volgorde" in *Nat. Tijds. Ned. Ind.* Batavia, XL, 1881, pp. 49–89.

STEINDACHNER, FRANZ.

1901. Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo, im Auftrage der Senckenbergischen naturforschenden Gesellschaft ausgeführt von Dr. Willy Kükenthal, ordentl. Professor der Zoologie an der Universität Breslau. Zweiter Teil: Wissenschaftliche Reiseergebnisse. Band III, Heft II. Mit 8 Tafeln, einer Abbildung im Text und einer Kartenskizze. Fische. *Abhand. Senck. Nat. Ges.*, Frankfurt, XXV (2), 1901, pp. 408–464, Pls. 17, 18.

POPTA, MLLE. C. M. L.

1904. Descriptions préliminaires des nouvelles espèces de Poissons recueillies au Bornéo central par M. le Dr. A. W. Nieuwenhuis en 1898 et en 1900. *Notes from the Leyden Museum*, XXVI (IV), October, 1902 (July 15th, 1904), pp. 179–202.

DIACHÆA CYLINDRICA, A NEW SPECIES OF MYCETOZOA.

BY HUGO BILGRAM.

Sporangia: cylindrical with obtuse apex, sessile, gregareous, iridescent, steel gray or bronze, 1 to 1.7 mm. high, .5 to .65 mm. thick. Hypothallus: whitish, rugose. Sporangium wall: membranous, hyaline, not adhering to the capillitium. Columella: arising from the hypothallus and extending nearly to the apex, brown, very light and semitranslucent near the base, irregular, flexuous, limeless throughout. Capillitium: brown, radiating from the columella to the periphery, repeatedly branching and anastomosing. Spores: 10 to 12 microns diameter, warted, the warts connected by ridges forming a more or less perfect coarse reticulation.

If the published descriptions of the genera of the Mycetozoa are taken verbally, this species cannot be classed with any one of those heretofore described. Its proper location is between *Diachæa, Lamproderma* and *Comatricha.* It differs from the first by the total absence of lime in its columella; from the second by the cylindrical form of the sporangia and the fact that the capillitium does not radiate from the end of the columella as a centre; and from the third by the persistent, iridescent wall, the absence of a stipe and the irregular columella. In external appearance as well as in the character of its capillitium it agrees with *Diachæa,* from which it differs, as before stated, only by the absence of lime. It was found near Wissahickon creek, not far from Indian Rock, Philadelphia.

NEW SPECIES OF POLYCHÆTA FROM THE NORTH PACIFIC, CHIEFLY FROM ALASKAN WATERS.

BY J. PERCY MOORE.

In connection with the investigations of a special Alaskan Salmon Commission the U. S. Fish Commission steamer *Albatross* established, during the summer of 1903, a series of more than 100 dredging and trawling stations, extending from the vicinity of Vancouver Island along the coast of British America and into Alaskan waters as far north and west as Shelikof Strait. The zoölogical collections were in charge of Prof. Harold Heath of Leland Stanford Junior University, to whom and to Dr. B. W. Evermann, I owe the opportunity of studying the annelids.

Some of the more interesting novelties in the families already fully studied are described in this paper; those of the remaining families will be noticed in later papers, while a full report upon the collection, with a complete list of all stations at which each species was taken, will appear in the publications of the U. S. Bureau of Fisheries.

Not the least interesting result of these investigations is the discovery of a probable error of locality in my paper on Greenland Polychæta. In that paper are described four new species of Polynoidæ, viz., *Gattyana senta*, *Gattyana ciliata*, *Lagisca multisetosa* and *Eunoe truncata*. Some surprise was expressed at the occurrence of these new species at a single locality in McCormick Bay, while other bottles of specimens from the same bay yielded none of these, but only well-known Arctic species. There was then, however, no reason for questioning the authenticity of the label. The discovery that all of these are common species throughout most of the region covered by these investigations makes their occurrence in Greenland under the circumstances described exceedingly doubtful. Moreover, the collections of this Academy include several bottles of Polychæta taken by Dr. Benjamin Sharp at Icy Cape, Alaska. On seeing the Polynoidæ in question Dr. Sharp states his belief that they were collected by him. It seems almost certain, therefore, that the McCormick Bay label was misplaced in this bottle, and that the specimens really came from Alaska. Unless confirmed by subsequent discoveries the Greenland record should be ignored as valueless.

Eunoe truncata was described from a fragment of the anterior end and proves to have been incorrectly referred. Numerous perfect specimens in this collection show that this is an elongated worm and properly belongs to Kinberg's genus *Hermadion*, if this be recognized as a distinct genus.

Aphrodita negligens sp. nov. Pl. XXXIV, figs. 1, 2; Pl. XXXV, fig. 31.

This species presents a very characteristic shaggy and disordered appearance, owing to the manner in which the loose tufts of coarse dorsal setæ, instead of lying recumbent on or in the dorsal felt, as usual in species of this division of the genus, stand erect and arch high above the back. As a result also of this relation the back appears flat beneath these setæ and the sides are nearly vertical. The general outline is narrowly ovate, the caudal $\frac{1}{5}$ attenuated. The extreme lateral margins are formed by the neuropodia and their setæ below, by the convexities of the lateral dorsal bristles above, while the iridescent bristles fall in spreading vertical tufts in the space between but are too sparse to conceal the neuropodial setæ. The dorsal felted area between the bases of the most medial dorsal spines covers about $\frac{2}{3}$ of the width of the back, but the spines themselves arch over this area and, as the longest almost meet, form a sort of imperfect bower. As shown below, while there are really but two series of these spines the uppermost tufts are inserted alternately at different angles and consequently perforate the felt at different levels, thus giving an appearance of three series. The segments, of which there are 41 bearing setæ, are strongly defined ventrally, where the body is deeply marked by a median neural groove and a pair of lateral furrows just inside the bases of the parapodia. The anus is small, dorsal, subterminal and posterior to somite XXXVIII.

Numerous minute sharp-pointed cuticular papillæ stud the surface of the body above and spherical papillæ even more thickly below, and the neuropodium as well. Those on the latter vary much in size, being nearly twice as large on the ventral as the dorsal surface of the neuropodium, and especially large ones are clustered about the base of the ventral cirrus.

The prostomium is slightly broader than long, with the pedicle of attachment narrowed dorsally and is smoothly rounded on all sides. There are two pairs of small pigmented eyes, the two on each side being borne on a common slight prominence on the anterior face of the prostomium. On both of the two specimens in hand the median tentacle is missing. The palpi are rather stout for the basal $\frac{1}{3}$, then taper rapidly to the slender terminal half, the total length being $4\frac{1}{2}$ times the prostomium. The surface is covered with minute prickles. The frontal caruncle is a compressed, vertical plate as long as the prostomium and much deeper, with its upper border thickened and somewhat lobulated and its ventral margin forming an angle from which an unusually long finger-like process depends over the mouth. The mouth has the usual characters and is bounded posteriorly by III. The dorsal tentacular cirri are about $\frac{1}{2}$ and the ventral about $\frac{1}{3}$ the length of the palpi.

Elytra to the number of 15 pairs occur on the usual somites. They are all thin, delicate, smooth and membranous and, except for a slight brown incrustation on the middle ones, quite colorless. Being of large size they cover the back completely and overlap medially. In the middle region they are nearly orbicular and slightly emarginate, but scarcely auriculate as in some species The scar is anterior to the center and reaches to the lateral emargination. Those of the first pair are narrowly ovate, extending over and concealing the head. The next have the part anterior to the pedicle larger than that posterior. Toward the posterior end they become narrower and relatively much longer.

There are 15 pairs of "branchiæ" (fig. 31) also, supported on somites VI, VIII, X, XII, XIV, XV, XVI, XVIII, XX, XXII, XXIV, XXVI, XXVII, XXIX and XXX. They arise from the extreme postero-lateral region of the dorsum of their somites and are rather larger and more complex than in many species. The medial side is high and rises vertically to an angle from which the organ slopes laterally to the level of the back, bearing the often bifid or trifid pinnæ on its free sloping margin. The number of terminal branches varies from 4 on the last and 6 on the first to about 12 on the larger branchiæ of the middle region. The elytra and gills were studied on the type specimen only.

Parapodia are of the usual form. The ventral cirrus scarcely reaches the base of the second row of neuropodial setæ. After tapering for most of its length the cirrus is provided with a subterminal enlargement followed by a constriction and a terminal ball. Dorsal cirri spring from a large ceratophore and the long slender style is shaped distally like the ventral cirri. Like the ventral surface of the body the parapodia are thickly studded with spherical papillæ of various sizes, the larger ones increasing in number laterally and a group of especially large ones occurring on the base of the ventral cirri, while slightly smaller ones are closely crowded about the bases of the setæ.

On cirriferous somites the notopodial setæ are arranged as follows: A dense tuft of not very long capillary bristles springs from the ventral side of the tubercle and spreads ventrally and caudally over and between the neuropodia. The deeper concealed ones are colorless, those on the exposed surface of the tuft iridescent, but they show little brilliancy, being usually of a pale rose-red with dull green or occasionally bluish reflections. Compared with some species they are coarse and rather short, so that they do not conceal the neuropodial setæ. Posteriorly they become dull gray. Immediately anterior to the dorsal cirrus is a tuft of about 7 of the large curved setæ arranged in a transverse row and becoming larger dorsally. A second more median tuft, which springs from a line curving obliquely caudad and mediad, consists of 10 or 11, the ventral ones being very small and the dorsal much larger than any in the more lateral tuft, so that they nearly meet those of the opposite side in the median line. These setæ are of a peculiar clay brown color, of rather soft though brittle texture, finely striated, strongly curved, very coarse at the base and gradually tapered to near the end, which is abruptly contracted to a hard, strongly hooked, acute tip (fig. 2). The surface is devoid of asperities, perhaps through wear. Between these two tufts and anterior to the more lateral a second tuft of iridescent capillary setæ, more slender than those described above, arises and spreads caudally and dorsally of the bases of the large setæ. The dorsal felt fibres arise in a compact bundle dorsal to the dorsalmost tuft of large setæ. The neuropodial setæ are arranged in the customary 3 rows, the dorsal usually containing 2 stout, the middle 3 medium and the ventral 5 more slender ones (fig. 1). All are of similar form, slightly curved and somewhat hooked and tapered at the tip. All of these setæ are much worn, the points blunt and only slight traces of the hairy sheath remaining.

On elytra-bearing somites the arrangement is the same, except that the bundle of felt fibres is wanting and the dorsalmost tuft of large setæ is inclined more medially so that they penetrate the felt nearer to the middle line than on the cirri-bearing somites, leading to the appearance of three series of large setæ, as mentioned above.

At the ends of the body the parapodia are considerably modified. Posteriorly the notopodium becomes relatively more elevated, the whole parapodium more compressed and turned so that it overlaps its successor behind, the capillary setæ tufts more flattened, the neuropodial setæ more slender, the large notopodials more crowded, and the dorsal cirri relatively longer. At the anterior end the first has the usual 3 tufts of capillary bristles, and the dorsal barely longer than the ventral cirrus, the excess being due entirely to the length of the basal joint. The second bears 2 dorsal and 2 middle neuropodial setæ, and a tuft of short fine bristles in place of the ventral tuft of capillary setæ, which is not fully established till about somite VI.

The type of this species is No. 944 in the collection of this Academy, taken by the U. S. F. C. steamer *Albatross* at station 3,727, off Japan. This specimen measures 42 mm. long, 17 mm. wide exclusive of the setæ, and about 9 mm. deep. A larger example, measuring 60 mm. long and 40 mm. wide in a much contracted condition, was taken off Port Townsend at station 4,205. It agrees in all respects with the foregoing description, which is based upon the type, and has the body cavity filled with egg strings.

Aphrodita parva sp. nov. Pl. XXXIV, figs. 3–7.

This interesting species is founded upon two specimens of 6 mm. and 9 mm. long respectively, the latter having a maximum breadth of 6 mm. at XI, which is about the middle of the body. Owing to the deposit which completely covers the body above the general outline is broadly elliptical, but beneath this the form is that typical of the genus though less attenuated posteriorly. Twenty-seven segments bear parapodia

The prostomium (fig. 3) is broadly elliptical with the long diameter transverse and about 1⅓ times the length. The posterior margin is slightly concave; the anterior face bears a slight median elevation for the tentacle, and on each side and slightly above it a somewhat more prominent papilla bearing two minute pigmented eyes. A small compressed frontal tubercle having a smooth surface without lobulations lies between the bases of the palpi. The slender tentacle, which is about 2½ times as long as the prostomium, consists of a rather stout vase-shaped ceratophore bearing a slender tapering style with a terminal knob. The palpi arise close together from the ventral surface of the prostomium; they are about twice as long as the tentacle, relatively slender, and taper regularly from the base to a blunt point; their surface is devoid of cilia. Although the large mouth is situated unusually far forward, being bounded posteriorly by a broad, smooth, unfurrowed lip formed by II, the ventral nerve cord may be seen through the skin to bifurcate to form the circumœsophageal connectives at IV, the usual position of the lip.

Notwithstanding the great breadth when viewed from above, the body when seen from below is really more slender than usual in the genus, the widest part being only about ⅓ the apparent width and much less than this posteriorly. The cuticle is opalescent and thickly covered ventrally with spherical papillæ. Being thickly covered above with a grayish flocculent deposit the undisturbed animal looks much like a piece of sponge or organic débris. On each side is a broad ridge where the dorsal setæ rise above the felt, each one or tuft supporting a thick vestment of the deposit, which increases its thickness many fold and adheres with great tenacity. When this deposit, together with the superficial layer of felt supporting it, is cleared from the back a deeper clean layer of felt is exposed, through which the elytra are visible.

There are 14 pairs of the latter situated on somites II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI and XXIX. Owing to their very small size and the softness of the tissues the position of the last 2 or 3 pairs is somewhat doubtful, but as they seem to occupy the positions usual in other species these determinations are probably correct. This count was made on but one specimen and a fifteenth pair may be expected to occur on better preserved material. The elytra are smooth, thin, transparent and colorless, without markings or papillæ of any kind. The anterior and middle ones are orbicular, with large, narrow scars running from the lateral margin to the center; the posterior five are very thin, folded longitudinally, elongated, overlapping, with anterior attachment and free posterior ends.

The parapodia are well developed and prominent throughout, relatively more so than in most species of sea-mice. Typical parapodia (fig. 4) have a prominent, rather slender, elongated, slightly compressed neuropodium, its end fashioned into three inverted steps sloping upward and outward. Like the ventral surface of the body the neuropodium is studded, especially below, with spherical papillæ. The ventral cirrus arises from a short base somewhat on the posterior surface proximad of the middle of the ventral border. Its style is slender, tapering, balled at the tip, and reaches nearly to the end of the neuropodium. The notopodium is more elevated than usual in the genus and forms a broad tubercle which slopes on to the back and bears posteriorly a prominent ceratophore from which the long slender style of the dorsal cirrus arises. The latter is $2\frac{1}{4}$ to $2\frac{1}{2}$ times the length of the neuropodium, is slender and regularly tapered for $\frac{2}{3}$ of its length, then slightly enlarged and again tapered to a terminal ball with thickened cuticle perforated at the end for sensory hairs. These cirri rise above the felt and their ends often appear above the material deposited on the back. Toward the ends of the body the parapodia become both much smaller and more slender; posteriorly they are directed caudally and their dorsal cirri are much elongated; anteriorly the first is bent forward by the sides of the prostomium and bears a tuft of slender setæ and the tentacular cirri at its end. The ventral cirrus of the second parapodium approaches the dorsal in size and form.

Notopodium and neuropodium are each supported by a stout aciculum, both of which are nearly colorless and the former strongly curved and terminating just below the base of the dorsal cirrus, the latter straight and projecting rather prominently through the apex of the neuropodium.

The setæ are arranged as usual in the genus (fig. 4), but in certain respects resemble those of *Lætmatonice.* The neuropodial setæ are arranged in 3 horizontal rows arising from the three steps on the end of the neuropodium. The dorsal contains 1 or 2 of the stoutest, the middle 2 or 3, and the ventral 3 or 4 of the smallest. While retaining the same general characteristics they differ much in detail. The free portion of the largest (fig. 6) exceeds the neuropodium in length, is nearly straight and uniform in diameter to the distal $\frac{1}{3}$, which is very gently curved and tapered to a point encased in a densely hairy sheath terminating in a tuft of very coarse fibres with an often recurved axial prolongation. The smallest ventral setæ are nearly colorless, instead of deep yellow like the larger ones, and much less striated longitudinally. Their shafts are distinctly curved, with a short enlarged end (fig. 5*b*) tapering rather abruptly to somewhat hooked tips with less densely hairy sheaths, often worn away. The middle setæ (fig. 5*a*) are intermediate in character. Usually 1 or 2 setæ of the middle and ventral series are provided with a stout curved spur at the base of the terminal region. The location of such setæ is so irregular and their resemblance to the other setæ otherwise so complete that the possibility of this spur being caducous is suggested, yet this is opposed by the firmness with which it is fixed whenever present.

Coarse notopodial setæ are found in two tufts, one of 8 to 10 anterior to the dorsal cirrus and a more dorsal one of 10 to 12. In each bundle they diminish in both length and thickness from the dorsal to the ventral margin. They are brown, polished, flattened and though standing nearly erect are more or less curved toward the median line. The longest are 3 mm. long and, relatively to the size of the animal, very stout at the base, at first gently but in the outer part rather abruptly tapered to a slender end with minute superficial asperities and a hooked tip (fig. 7). The smaller ones are similar but frequently taper to a point lacking the hook. On the ventro-anterior aspect of the notopodium is a dense spreading tuft of setæ varying in size from the smallest of the dorsal groups to strictly capillary fibres; all taper to capillary ends which lack hooks but are provided with recurved asperities coarser than those on the dorsal setæ. This tuft corresponds to the lateral iridescent hairs of the sea-mouse but is dull and gray in the present species. A very large and dense bundle of felt fibres arises on the dorsum of the notopodium and smaller tufts between and anterior to the large setæ. They form a felt much thinner but otherwise similar to that of the large species.

This species is evidently closely related to *A. intermedia* McIntosh, dredged by the *Challenger* in the West Indies, which is, so far as known, somewhat larger. The latter species is very briefly described from a single specimen, but appears to differ from *A. parva* chiefly in the absence of ocular papillæ and eyes, the form of the neuropodial setæ and their longer spurs which, it is implied, occur on all setæ. Although these two stand apart from the remaining species of the genus they can scarcely constitute a group of greater than subgeneric value. In any case it is interesting to find such a comparatively minute representative of a genus that includes some of the bulkiest of polychætes.

The two known examples of *A. parva* were taken in the Gulf of Georgia at station 4,194, in 111 to 170 fathoms.

Euphrosyne bicirrata sp. nov. Pl. XXXIV, figs. 8–12.

In their contracted state the largest examples are 20 mm. long and 6.5 mm. in greatest width, with 25 setigerous segments, all well differentiated. The body has the usual robust, depressed form with the anterior end broadly rounded and the posterior decidedly narrower and more tapering. The smooth dorsal area is completely concealed by the notopodial setæ, but when the latter are removed proves to constitute about one-fifth of the width of the back. The dorsal caruncle is short, the basal plate reaching to the anterior margin only of V, while the posterior end of the prominent crest extends freely to the posterior end of that segment. A pair of prominent black dorsal eyes is situated at the anterior termination of the caruncle and between them arises the median tentacle, which is two-thirds as long as the caruncle with a very large stout base bearing a suddenly contracted terminal filament forming one-third of the total length. The ventral eyes are smaller than the dorsal, black and closely approximated and just external to them on each side is a minute tentacle having a length of about two-thirds the width of the prostomial area. The palpi are ovoid, the broader end largely free at III and are separated for their entire length by a very deep longitudinal cleft. Posteriorly they overlap the mouth, which is small and bounded behind by the wrinkled triangular lip incising III and IV. There is a well-marked and continuous neural groove and the subanal cirri are fleshy and of the usual form. The cuticle generally exhibits a pale blue iridescence and on each side of the dorsal area is a series of brown spots.

Parapodia are of the usual form and the two divisions are separated by a broad naked achætous space. All three cirri and the branches of the gills (fig. 12) are long, slender and regularly tapering, the latter shorter and more slender than the former. The cirri stand a little anterior to the branchiferous zone, the dorsal a little medial to the first dorsal gill, the ventral just behind the neuropodial setæ and the middle about halfway between. Usually the dorsal cirrus is somewhat longer than the others. On most of the somites the branchiæ number 7 or 6 pairs, 2 of which usually occur between the dorsal and middle cirri and 5 between the latter and the ventral margin of the notopodial setigerous area. As the latter distance is much the shorter the gills occupying it are much more crowded than those dorsal to the middle cirrus. When but 6 gills are present the missing one is almost invariably the second from the dorsal end. No gills occupy the smooth achætous interramal space as in some species. Individual branchiæ are usually biramous and cleft almost to the base; others have 3 branches, in which case one is usually very much shorter than the other two; or they may be simple and cirriform.

The setæ are all glistening white or colorless, giving to these worms a beautiful silvery aspect. They are also extremely long, and as the worms roll up they give the aspect of bristly balls like chestnut burrs or minute porcupines. Those on the dorsal surface are much the longer and conceal the cirri and branchiæ completely from view. In the notopodial palisade the setæ are disposed in about 4 transverse rows. In the second row, counting from the anterior, are found the deeply cleft serrate setæ (fig. 11), but these appear to rarely extend much dorsad of the middle cirrus. The prongs are slender and their inner margins extensively and prominently serrated. Like other setæ they are hollow, with granular contents impregnated with calcium carbonate. The first, third and fourth rows contain only the unequally pronged bifid setæ, those of the third row (fig. 9), while not much stouter, being nearly twice as long as the others (fig. 10), and having much longer prongs. As is the case with the serrate setæ, the longer prong is expanded slightly opposite the tip of the shorter, beyond which it tapers in a slightly curved point. Neuropodial setæ (fig. 8) have the form of the smooth notopodials, and the longest are about the length of the shorter of the latter. At the ventral margin of the bundles they become much shorter with more strongly curved tips. Dried preparations of the smooth setæ show that their cavities are camerated, with septa and telescoped siphuncle-like tubes much like a *Nautilus* shell, but much less regularly.

This species is most closely related to *E. borealis* Oersted and *E. longisetosa* Horst, but is distinguished from both by numerous characters. It was taken from the Gulf of Georgia to Behm canal, in depths ranging from 18 to 134 fathoms.

Euphrosyne hortensis sp. nov. Plate XXXIV, figs. 13 to 16.

Length about 22 mm., width 7 mm., number of segments 35 to 38. The general aspect of the dorsum of this species reminds one of a well-kept garden with a central avenue from which diverge parallel rows of plants with aisles between.

The body has the usual depressed form, flat below, slightly arched above; in contraction the two ends are rounded nearly equally. Below the segments are strongly marked; above they are more obscured by the gills and setæ except in the median space which equals about $\frac{1}{7}$ of the total width and in which each segment is divided into a posterior median and a pair of anterior lateral areas. The caruncle is long and narrow, reaching from II to the posterior margin of VI, with a pair of pronounced lateral longitudinal grooves and a narrow but distinct median ridge or crest, the posterior end of which is free. At the end of the caruncle are the conspicuous, black, dorsal eyes, sometimes two pairs, of which the anterior are the larger, sometimes a single pair of elongated form, or occasionally a single one on one side and two on the other. A median tentacle arises from between the eyes and has a length of barely $1\frac{1}{2}$ times the width of the caruncle; it is 2-jointed, the basal joint stout, the terminal filamentous and somewhat shorter. On the ventral aspect of the prostomial area between the first pair of forwardly directly parapodia is a pair of black ventral eyes, which are frequently coalesced into a single median one flanked by a pair of minute tentacles. The palpi are continuous anteriorly with somites I and II, and extend caudally as a pair of prominent rounded lobes which end freely at IV, covering the small mouth, which is bounded behind by IV and V. A faint neural groove follows the median ventral line to the pygidium, which bears a pair of short, thick, fleshy, grooved, subanal cirri.

The notopodia are completely coalesced with the dorsal surface and their setigerous areas cover most of the back except the median region. The neuropodia project from the sides of the somites, and between them and the notopodia are narrow oblique smooth areas without setæ, into which the lower end of the series of branchiæ bend forward. All three cirri are rather stout and conical. The dorsal is situated at the dorsal end of the branchiferous line, the middle anterior to the latter and about the middle of the notopodial area and the ventral just behind the neuropodial tuft of setæ.

The branchiæ are situated behind the palisade of notopodial setæ, beginning at the dorsal cirrus and extending forward around the ventral border of the setæ into the interramal area. Owing to the relatively short notopodial setæ the gills show distinctly and the body appears more depressed and has a dorsal aspect totally different from *E. bicirrata*. Like *E. heterobranchia* and some other species the form of the gills (fig. 16) varies greatly. A few near the ventral end of the series are often quite simple and cirriform, and from this unbranched form they vary to those with as many as 8 branches, the complexity of the branching increasing with approximate regularity from the ventral to the dorsal end of the series, except that the ventralmost gill is usually much more branched than those immediately above it. The following table shows the number of branches counted on segments of the middle of the body of four specimens, the position of the three cirri being indicated by their initial letters:

D.C. 6, 8, 7, 7, 6, M.C. 6, 6, 6, 6, 4, 2, 3, 3, V.C.
D.C. 7, 7, 6, 6, –, M.C. 5, 5, 4, 3, 1, 1, 5, –, V.C.
D.C. 6, 5, 6, 5, 5, M.C. 5, 5, 4, 4, 1, 1, 6, –, V.C.
D.C. 7, 6, 6, 5, –, M.C. 5, 5, 4, 3, 3, 2, 5, –, V.C.

The 2 or 3 ventralmost gills occupy the space between the neuropodial and notopodial setæ, and it will be noticed that 4 or 5 lie dorsal and 7 or 8 ventral to the middle cirrus. The larger numbers are found upon the larger and the smaller upon the smaller specimens, but it seems probable from a comparison of the number of branches that both divisions and coalescences of the ventral gills occur. Reduced numbers are found also on a few segments at each end of the body. The branches, which seldom arise upon a strictly dichotomous plan, spread widely from a short trunk into a low bush-like form and terminate without expansions in slender, tapering tips.

All setæ are white or colorless except at the extreme tips, which are stained with sulphur yellow. All are translucent, very brittle and hollow, with their cavities filled with the usual granular contents. The notopodials are slightly longer than the gills and of two forms. Deeply cleft, very strongly and extensively serrate setæ (fig. 15) occur in the middle rows of the palisade. The remaining rows have only stout spurred setæ (fig. 14) without serrations, and there are no deeply cleft or bifid setæ without serrations. The spur is always very short, though the internal cavity is deeply bifurcate. Many of these setæ have the middle part of the shaft encircled by many fine parallel canals situated just beneath the cortical layer and more or less completely annular. The neuropodials are somewhat longer and more slender. They have more slender, longer and more curved tips and longer lateral spurs than the notopodial setæ just described and in some cases at least the cavity is not bifurcate (fig. 13). The setæ of the middle region depart remarkably little from the exact forms figured for the three kinds.

This species appears to resemble *E. maculata* Horst rather closely, but is readily distinguished by the position of the middle cirrus, which is between the second and third gills in the latter. From *E. heterobranchia* Jonnson the absence of smooth cleft notopodial setæ especially distinguishes it, while *E. aurantiaca* Johnson and *E. superba* Marenzeller both have a smaller number of gills, longer spurs to the notopodial setæ and other distinguishing features.

This species is much less common than *E. bicirrata*, and was taken at stations 4,272 and 4,274 only, in Chilkoot Inlet, Alaska, in 45 to 73 fathoms.

Eunoe depressa sp. nov. Pl. XXXIV, figs. 17, 18, Pl. XXXV, figs. 19 and 20.

An interesting species of at least partially commensalistic habits. The type is 30 mm. long, 11 mm. between the tips of the parapodia, and 14 between the tips of the setæ at XVII, the broadest somite. The largest specimen is 40 mm. long.

The prostomium is about as long as broad, divided anteriorly by a deep median furrow which reaches half its length; its lobes produced into divergent, widely separated and prominent peaks. Of the two pairs of eyes the anterior are slightly the larger, strictly lateral and at the widest part of the prostomium near the middle; the smaller posterior pair dorsal, less widely separated and close to but distinctly anterior to the posterior margin of the prostomium. All of the cephalic appendages are short and stout. The median tentacle is barely $2\frac{1}{2}$ times the length of the prostomium, its base very short and stout; the proximal $\frac{2}{3}$ of the style thick and little tapered, ending in a slight enlargement beyond which it abruptly contracts into a delicate terminal filament; its surface is covered with numerous but short cilia. The lateral tentacles arise entirely ventral to the median, close to the median line and quite inside the line of the peaks; they are stout, taper gently for about the proximal $\frac{3}{5}$ and beyond that are contracted abruptly into a terminal filament; the ciliation is sparse. The palpi are stout, short, in all 4 specimens much shorter than the median tentacle, the terminal filament of which they barely reach; their own terminal filament is minute; their cilia are arranged along a few longitudinal lines. The tentacular cirri resemble the median tentacle, which the dorsal almost equals, while the ventral is $\frac{1}{4}$ shorter. In one specimen the protruded proboscis is short and broad, 7 mm. long and 3.5 wide. The jaws are deep brown, strong and with a prominent lateral ridge on the jaw plate. There are 9 soft papillæ above and 9 below.

Fifteen pairs of elytra are borne on the usual somites by stout elytrophores which are nearly equalled in size by the homologous dorsal tubercles of the cirriferous somites. The elytra (fig. 20) are thick, stiff and of tough, cartilaginoid texture; the margins bear only a few goblet-shaped sensory papillæ and traces of a few or no cilia; the dorsal surface is studded with small, distant, horny spines and much more numerous, smaller, horny prickles; the former are always in the center of round, slightly elevated brown spots and the latter, while themselves brown, are surrounded by a pale ring. The first elytron is circular, the next 11 subquadrate reniform, and the last 2 or 3 broadly ovate, the last with a straight inner margin.

Typical parapodia (fig. 19) are rather long, high and compressed. The neuropodium is prominent and slopes both dorsally and ventrally to the prominent acicular process which is produced into a short soft supraacicular papilla. The notopodium is also large and produced into a prominent acicular process. The ventral cirrus is subulate, with a slender end reaching to about the third row of subacicular setæ. The dorsal cirrus is remarkable for the great length of the ceratophore which is $\frac{2}{3}$ as long as the style and in close contact with the dorsal border of the notopodium. The style is short and stout, little tapered and has a subterminal enlargement tapering into a slender tip.

The body is very flat and much depressed, widest near the middle and tapering both ways. Nephridial tubercles exist on all but a few of the most anterior somites; they are of moderate length and are directed dorsally between the bases of the parapodia. The anal cirri are similar to the dorsal cirri and equal to the last 9 segments in length.

Neuropodial setæ are borne in 3 supraacicular and 8 subacicular series, those in the dorsal rows being, as usual, more slender and provided with a greater number of spines. They (fig. 17) are moderately slender with rather elongated ends provided with numerous rows of spines which become larger and more prominent distally; the smooth tip is rather long, slender and but little hooked. The parapodium of I, bearing the tentacular cirri, has a small neuropodium with an acicular process and 2 or 3 setæ. The notopodial setæ (fig. 18) are relatively few in number, much stouter than the neuropodials, the dorsal ones especially being short and stout and the longest ventral ones about $\frac{1}{2}$ the length of the longest neuropodial setæ; they are closely pectinated with $\frac{3}{4}$ rings of fine spines, leaving a smooth tip somewhat less in length than the greatest diameter of the seta.

The body throughout is colorless, the exposed parts of the elytra mottled with white and rich brown, the caudal cirri, dorsal cirri and cephalic appendages brown with a subterminal white ring and light filament, the palpi only lacking the ring but retaining the white tip.

This species is represented by four examples, the type from station 4,261, Dundas Bay, 8–10 fathoms, and one specimen each from Union Bay, Alaska, and from station 4,270, Afognak Bay, 14–19 fathoms. The latter is labelled "Hermit crab, messmate," and many of the papillæ on the elytra bear 2 or 3 spines.

Antinoe macrolepida sp. nov. Pl. XXXV, figs. 21–23.

This fine species has a length up to 45 mm. with a breadth of 12 mm. and including the setæ of 18 mm.

The short broad prostomium (fig. 21) is about $1\frac{1}{2}$ times as broad as long, smoothly rounded laterally, broadly cleft and bilobate anteriorly and slightly divided for its entire length by a shallow, dorsal, median furrow. The anterior lobes are broadly rounded and largely occupied by the anterior eyes and the cephalic peaks, usually prominent in the genus, are in this species nearly obsolete. In one small specimen of 14 mm., however, they present the ordinary appearance, and, as the eyes are small, it seems quite probable that in the species as here described we have to do with an epigamous phase in which the great development of the anterior eyes has mechanically or otherwise reduced the size of the peaks. The anterior eyes are very large, provided with well-developed lenses, and occupy the entire antero-lateral aspect of the prostomium, facing forward and outward. The posterior eyes appear by comparison minute, and are widely separated on the postero-lateral curvature of the prostomium; in the preserved specimens they are always partly hidden by the bases of the elytrophores of somite II.

The median tentacle is long and slender, 5 or 6 times the length of the prostomium; its ceratophore is more than $\frac{1}{2}$ as long as the latter, and the delicate style tapers regularly to the outer $\frac{1}{4}$ where a slight thickening occurs followed by a slender terminal filament. It bears a few scattered clavate cilia. The very small lateral tentacles spring from short, nearly spherical ceratophores situated on the ventral surface of the anterior prostomial lobes and partly beneath the median tentacle. Their total length is only $1\frac{1}{2}$ times the prostomium and their slender subulate styles have the terminal half almost filamentous. The palpi are likewise slender and from 6 to 9 times (usually the former) the length of the prostomium. They taper regularly to an acute tip and are marked with longitudinal ciliated lines. The tentacular cirri are similar in form to the median tentacle, but they are much more strongly ciliated and only $\frac{2}{3}$ as long. The mouth is bounded behind by a strongly furrowed lip which reaches to III. In a specimen 30 mm. long the proboscis is extended to a length of 9 mm. and a breadth of 3 mm. It is provided with acute jaws of the usual form and bears 9 soft papillæ above and 9 below.

The body is narrow and nearly linear; its ventral width scarcely equals the extreme length of the parapodia, and is practically uniform from somite V to the middle of the body, beyond which it tapers very gently to the pygidium. A strongly marked neural groove runs for its entire length. Nephridial tubercles are first evident on IX and are nowhere much elongated. Dorsally the greatest width is from VIII to XIX. There are 39 somites.

The 15 pairs of elytra are borne on somites II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI, XXIX and XXXII. They are remarkably large, overlap broadly both antero-posteriorly and medially, have a soft membranous texture and a weak attachment, so that they are easily detached. The first is subcircular, the next 3 are broadly reniform, and those following, except the last, broadly elliptical; the last is broadly subovoidal with a straight inner margin. To the naked eye the scales appear quite smooth, but a moderate magnification shows the greater part of the surface covered with scattered small, slightly curved, conical spines which become more numerous toward the posterior margin where they are associated with a few slender, clavate cilia. Cilia of various lengths occur also on the free margin of the scales. It appears that in nature the elytra are frequently lost and replaced, and that when detached asymmetrically the remaining one of the pair will increase in size and completely cover the back as far as the bases of the dorsal cirri of the opposite side. Even when both elytra of a pair are symmetrically developed they overlap so broadly in the median line that less than half of their extent is exposed when all are in place.

As indicated above the parapodia are elongated and fully equal the body width. The prominent and slender neuropodia are obliquely truncate distally and have the dorsal angle prolonged anterior to the setæ into a slender acicular process with a free filament equalling the ventral cirrus in length. The notopodium is a low cylindrical process arising rather anterior to the base of the neuropodium and bears the slender acicular process which is not prolonged into a filament beyond the place of emergence of the aciculum. The notopodial cirri have a form similar to the median tentacle, but the subterminal enlargement is rather more prominent and the entire style about $\frac{1}{4}$ longer so that they reach well beyond the tips of the longest setæ. They bear clavate cilia which decrease in size and number distally and are altogether absent from the distal filament. The ceratophores are small and slightly dorsal and posterior to the base of the notopodium. Ventral cirri arise well distad of the middle of the ventral surface of the parapodium; they have slender subulate styles that barely reach the base of the neuropodial acicular process. Toward the ends of the body the parapodia undergo the customary changes in form, the posterior dorsal cirri especially being very slender, elongated and nearly lacking the subterminal enlargement.

Each ramus of the parapodium is supported by a tapering aciculum, especially stout in the case of the neuropodium, and suddenly reduced in diameter at the end, which is free for only a short distance. All of the setæ are of a pale glistening straw color and to the naked eye or under a hand lens appear to be highly burnished. The notopodials (fig. 23) are relatively few in number and spread radially from a center. The dorsal ones are quite short; the ventrals about $\frac{2}{3}$ as long as the longest neuropodials. All are rather stout, nearly straight, with short, bluntly pointed, smooth tips and numerous rows of minute spines extending about half way round the seta and covering about $\frac{1}{2}$ of its exposed portion. All of the neuropodials and especially the supraacicular ones are very long and slender. They are arranged in a dense tuft spreading vertically. The shaft is very slightly curved and the distal thickening (fig. 22) remarkably elongated and at the tip (fig. 22*a*) abruptly contracted into a delicate terminal bristle. All of this region is furnished with numerous short transverse rows of long, very fine hairs which become longer and more spreading at the tip where a number of the longest overlap the base of the terminal awn. The peristomial parapodium bears small tufts of both notopodial and neuropodial setæ.

The general color of the body above is reddish-brown with narrow, light, transverse, intersegmental lines which become broader in some of the paler specimens, in which also a second narrow transverse line may appear across each segment. The dorsal cirri and all cephalic appendages except the palpi, which are pale, are dark brown with a pale subterminal ring. The elytra are pale marbled with brown, especially posteriorly, or with 2 large divided crescentic spots of brown. One particularly beautiful specimen has the body nearly without pigment, and the elytra with large irregular spots and a narrow posterior border of reddish-brown. The ventral surface generally and the parapodia, except their dorsal surface, are unicolor, sometimes clear pale brown, often dark brown or purplish or even nearly black, but always uniform and unspotted and highly characteristic. The neuropodial cirri are always pale and in strong contrast to their dark surroundings.

Many of these large-eyed examples are sexually mature and, as mentioned above, it is probable that they represent the epigamous phase, which the long setæ indicate may be pelagic. The single small-eyed individual is only 14 mm. long and immature, but the neuropodial setæ are elongated and exactly like those of the larger specimens.

A. macrolepida is quite plentiful at the more northerly stations, but occurs as far south as the Gulf of Georgia, at station 4,192, in 89 to 97 fathoms, but also in 293 fathoms in Chatham Strait, from which the type came at station 4,264.

HOLOLEPIDA gen. nov.

The body is much elongated; anteriorly elytra and dorsal cirri alternate in the usual manner, but in the middle and posterior regions all segments bear elytra only; a large free nuchal plate overlaps the prostomium dorsally

Hololepida magna sp. nov. Pl. XXXV, figs. 24–29.

Unfortunately but a single specimen represents this interesting species. This is in three pieces, apparently making up the entire worm, as they fit together accurately. If this be the case the total length from the anterior margin of the prostomium to the posterior margin of the pygidium is 250 mm., the number of somites 120 and the arrangement of the elytra as indicated below. The form is elongated and depressed, increasing in width to about XXV, then remaining uniform to about the last 20 segments.

The prostomium (fig. 24) is twice as wide as long, omitting the tentacular prolongations, deeply divided by an anterior cleft and a median dorsal furrow, its posterior border straight and concealed and the lateral angles very prominent. Anteriorly it is prolonged into a pair of prominent tentacular processes in the fashion of *Lepidonotus*, though they lie on a somewhat lower plane than in that genus, being slightly ventral to the median tentacle. The two pairs of eyes are very large, occupy the entire postero-lateral portion of the prostomium and their pigment cups are coalesced. Both are blue-black and possess distinct lenses. The anterior pair looks forward, upward and outward and the posterior upward and backward. The median tentacle arises from a large swollen base which fills the anterior cleft, but the style is lost. As noted above, the ceratophores of the lateral tentacles are the anterior prolongations of the prostomium, which nearly equal and lie somewhat ventral to the median tentacle; their styles are slender, about $2\frac{1}{2}$ times as long as the prostomial width, and taper to the tip without a subterminal enlargement. Comparatively very stout palpi crowd the peristomial parapodia; they are constricted at the base, then swollen and again tapered to acute tips; their length is about $1\frac{1}{2}$ times the lateral tentacles; each is marked longitudinally by a prominent broad ridge and lateral impressed lines.

The buccal parapodia are prominent and elongated, reaching directly forward far beyond the prostomium; they are swollen at the base, deeply cleft at the end and bear no setæ. The tentacular cirri have a distinct subterminal enlargement tapering into a filiform tip. They somewhat exceed the lateral tentacles in length. As usual in the family the proboscis is stout and muscular. When fully protruded it measures 21 mm. long, equalling the first 17 somites, and 7 mm. wide by 9 mm. deep. Its surface is strongly wrinkled and its end bears 16 soft papillæ above and 16 below, all nearly fan-shaped and folicaeous in this specimen, but probably collapsed. A pair of stout jaw-plates above and below are subtriangular, each bearing at the anterior angle a blunt claw-like tooth followed on the lateral border by a dentinal ridge. At the base of the proboscis, on the dorsal surface between the bases of the palpi, is a single prominent tubercle.

The peristomium is scarcely evident as a distinct ring, being completely united with the prostomium and succeeding somite. From the dorsum of the latter (II) arises a prominent nuchal fold similar to but larger than that of *Halosydna gelatinosa*. It is subtriangular, attached by its posterior border but otherwise free, and conceals the entire posterior and middle portions of the head. It can be drawn forward so as to cover much more than shown in the figure.

Generally the segments are well differentiated and about 4 times as wide as long. The nephridial tubercles are prominent, begin on somite XII and project outward and backward. Parapodia are much elongated, quite equalling $\frac{2}{3}$ of the width of the body. The neuropodia are strongly predominant, broad and truncate at the ends, with a pointed somewhat membranous presetal lobe which conceals the end of the aciculum. The notopodia are small and very slender; they arise from the middle of the dorsal surface of the neuropodia and enclose a slender aciculum. Dorsal cirri arise just above the notopodia, from large stout bases having a prominent glandular lobe. Their styles are long, about equalling the width of the body without the parapodia; they taper regularly, then suddenly to a terminal filament, and reach far beyond the end of the foot itself to the tips of the elongated setæ; no cilia or papillæ are borne on the surface. These cirri are confined to the segments lacking elytra at the anterior end and all are of equal length. Ventral cirri occur on all segments. They arise from about the middle of the ventral surface of the neuropodium and reach nearly to the tip of the presetal lobe. In form they are rather stout and conical with a short terminal filament. That borne on II has a large ceratophore and a style resembling the dorsal cirri in form and size. The next one has no ceratophore and the style is about half as long, while succeeding ones regularly diminish in length until the normal is attained. At the posterior end the parapodia diminish in size and the ventral cirri are relatively much longer. The caudal cirri are similar to the dorsal cirri and equal the last 9 segments.

Elytra are probably more numerous than in any other species of the family. They occur on II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI, XXIX, XXX, XXXII, XXXIII, XXXV, XXXVI, XXXVIII, and then on every somite for 79, leaving only 3 or 4 very small somites at the caudal end doubtful, though these certainly bear no dorsal cirri. It is true that a majority of the elytra are detached and lost, but in several cases they remain on 3 or 4 successive segments. There is, moreover, no mistaking the elytrophores, which are thick, prominent and wrinkled, with swollen margins surrounding the scars. The continuous presence of elytra is further indicated by the total absence of dorsal cirri from this region. Even on the cirriferous somites there is a broad dorsal tubercle with a slightly free margin. It is barely possible that this specimen may be abnormal, but the constancy and regular, paired arrangement of the elytrophores render this extremely improbable. A very few cases were noted in which the elytrophores and elytra were of smaller size than usual. The elytra are of a very soft gelatinous texture, of large size, with nearly central scar, and the margin is broadly lobed and so folded as to draw the elytron into a funnel form. Both those of the same pairs and on contiguous somites are curiously adherent over the back, forming a sort of irregular roof. The adhesion results from a gritty substance, perhaps an extraneous deposit, perhaps a secretion, but apparently not due solely to the method of preparation, as other species contained in the same bottle are free from it.

The dorsal surface of the body generally, the head and its appendages and the proboscis are raisin color; the elytra are more or less tinged with the same. Owing to their being distended with eggs the parapodia are dull yellowish. The entire ventral surface is dirty white.

The setæ seen in mass are of a pale yellow color. The notopodials (fig. 29) arise from the base of the prolonged acicular process and spread horizontally. They are very long and slender, capillary, nearly straight, tapered regularly from the base and smooth or with barely discernible marginal denticulations and oblique striations. Although the notopodium is well developed on II, III, and IV, it bears no setæ on these somites; the extreme posterior ones are very small. The neuropodial setæ form a large vertical tuft and are of two forms. Those dorsal to the aciculum have slightly enlarged ends more or less denticulate and pectinate and tapering to simple pointed tips. The dorsalmost are slender with long capillary tips and very fine pectination. The ventral ones are much coarser, with shorter and more conspicuously pectinated tips (fig. 28). The subacicular setæ have bifid tips (figs. 26, 27). They are rather abruptly enlarged at the end, rather stout, strongly curved and conspicuously pectinated. The bifid tip has the stout limb beak-like and the slender one bent toward it or even hooked.

The type and only known specimen comes from station 4,198, in 157 to 230 fathoms, on Halibut Bank, in the Gulf of Georgia.

Lepidonotus robustus sp. nov. Pl. XXXVI, figs. 32–35.

Founded upon a single example, which the label describes as taken from a hermit crab, this species bears a striking superficial resemblance to the similarly commensalistic *Eunoe depressa*. The type is of relatively large size and robust build, measuring 40 mm. long, 13 mm. wide between the tips of the parapodia of X and about 8 mm. deep.

Without including the tentacular prolongations the prostomium is about $\frac{2}{3}$ as long as wide, the posterior border straight and somewhat concealed by a fold of the succeeding somite, the lateral surfaces bulging into ocular prominences behind the middle and converging thence gradually into the lateral borders of the tentacular prolongations. The latter are of the usual form, slightly divergent, and as long as the body of the prostomium. There are two pairs of eyes, prominent, black, circular and lenseless. The anterior are much the larger, situated on the lateral swellings and look outward, forward and upward. The posterior pair are near the posterior border and directed upward.

All cephalic appendages are short and stout and lack cilia and papillæ. The middle tentacle has a short, very stout base somewhat ventral to the tentacular prolongations with which it is largely coalesced; its style is about $1\frac{1}{3}$ times the length of the prostomium with its tentacular processes, and tapers from a broad base to the abruptly contracted tip which is not longer than the basal diameter and scarcely filamentous. The tentacular processes are largely united along the medial face with the base of the median tentacle, their tips only being free for a short distance; the style is similar to the median one, but somewhat more slender, slightly shorter, and with a longer terminal filament having a length of fully twice the basal diameter. The palpi are very stout, bulge widely beyond the sides of the prostomium at the base, and taper abruptly at the end to a short, acute appendage, five longitudinal lines extend for their entire length. On the two sides the dorsal tentacular cirri are of very unequal length, one exceeding the median tentacle, the other being considerably shorter than the lateral tentacle, which is just equalled by the ventral tentacular cirri of both sides; in form they are similar to the median tentacle. The mouth is large with very rugous lips.

There are 26 segments, all of which are broad and stout, and the posterior ones relatively little reduced, though the body is clearly complete. Nephridial papillæ begin on VIII and continue to XXVI; they are elongated, the basal half adnate, the distal half free and curved outward and upward between the parapodia. The caudal cirri are similar to the dorsal cirri, but more tapered and longer, equalling the last 4 segments.

Typical parapodia (fig. 35) are very short and thick, those in the middle region about $\frac{2}{5}$ the width of the body. The neuropodium is obliquely truncate with a very short presetal acicular process near the dorsal angle. The notopodium is a small, rather slender lobe on the antero-dorsal face of the neuropodium and is divided into a prolonged acicular process and a setigerous papilla. The ventral cirrus arises from a rather stout ceratophore near the base of the neuropodium, and its style tapers to a slender tip which reaches slightly beyond the end of the ventral border of the neuropodium. The dorsal cirrus has a very large tapering ceratophore borne partly on the postero-dorsal portion of the parapodium and partly on the body wall and reaching beyond the end of the notopodium; the style has the form of the lateral tentacles and extends beyond the tips of the longest setæ. The last dorsal cirrus is borne on the posterior face of its parapodium and tapers more regularly from base to tip than the others. The ventral cirrus of II resembles in form and size the ventral tentacular cirrus.

There are 12 pairs of elytra (fig. 32) situated as usual in the genus. Notwithstanding their large size they fail to cover the broad back, which is largely exposed along the middle. All, including those apparently of the first pair which are detached, are somewhat irregularly quadrately-ovate, thick and of a soft, somewhat gelatinoid texture. Their margins are somewhat folded and irregular but without trace of cilia or sensory papillæ. The exposed surface is somewhat irregular, the white spots being somewhat raised, but there are no spines or papillæ of any kind. The narrow, transversely elongated area of attachment is situated nearest to the anterior and lateral borders.

Neuropodial setæ form a dense fascicle arranged in 3 supraacicular and 7 subacicular horizontal series. They vary but little, are rather stout but less thickened at the end than in many species; the pectinated region (fig. 33) is rather extensive and the smooth tip relatively short and strongly hooked. The notopodials (fig. 34) are a close tuft of rather stiff, acutely tapered setæ marked with close transverse rows of fine teeth. The peristomial parapodium bears a notopodial process with a small tuft of setæ on one side, but lacks it on the other.

Except for a median series of dull brown spots, one on the posterior margin of each segment, the body is colorless. The cephalic and caudal appendages are all deep brown with white tips, the dorsal cirri with but little brown and the ventral cirri white. The elytra are reddish-brown and white. No pigment is found along the anterior border or on an extensive area anterior to and laterad of this scar. A transverse area of clear reddish-brown passes from just in front of the scar to the median border and is concealed by the preceding scale; from this a mottled brown and white area spreads to and along the median and posterior borders, the brown predominating medially, where it is marked by small, round, discrete white spots, while laterally the white becomes predominant owing to the increase in size, number and confluence of the spots. On many elytra there is a narrow, scarcely broken posterior border of brown. The round white spots are slightly raised, and in the center of each is a small yellowish opaque pigment spot or excretophore.

The only known specimen was taken from a hermit crab at station 4,291, 48 to 65 fathoms, in Shelikof Strait.

Lepidonotus cæloris Moore. Pl. XXXVI, figs. 36, 37.

This species, originally described from specimens dredged off the coast of Japan, proves to be one of the most abundant and generally distributed species throughout the region covered by these explorations. It represents in the Pacific the widely spread *L. squamatus* of the Atlantic, and in the younger stages resembles that species more closely, but with increasing age and size the fringe of elytral hairs becomes more restricted and the posterior detached tuft is lost. At the same time the differences in the sculpturing and form of the papillæ and the character of the neuropodial cirri become more marked. Many of the specimens are of a nearly black color.

Ninoe simpla sp. nov. Pl. XXXV, fig. 30; XXXVI, figs. 39–44.

This species has much the form, general aspect and usual size of *Ninoe nigripes* Verrill, but none of the examples in this collection reaches the maximum size of the latter. The body is very fragile and no specimen is nearly complete and none represents the caudal end. The most perfect example, hence designated as the type, consists of 160 segments and is 24 mm. long and 1.3 mm. in diameter. Other larger ones, having a diameter up to 2.5 mm., are less complete.

The prostomium has a slightly depressed sugar-loaf shape, with a length about $\frac{1}{5}$ greater than the basal width. Posteriorly its median dorsal portion is inserted into an overarched recess of the peristomium and here bears a pair of minute brown eyespots, behind which one or two others are sometimes visible. Within this same recess, but sometimes projecting slightly beyond the peristomial fold, is a minute mammiliform process (median tentacle) with a thickened base embraced by a pair of slight lateral folds. Two symmetrical dorso-lateral longitudinal grooves join the sides of this recess posteriorly, and probably enter the deep slit-like nuchal organs seen on each side by raising or dissecting off the peristomial covering. A similar pair of more distinct ventro-lateral grooves join the ends of a deep transverse slit bounding the palpi anteriorly. The palpi are a pair of small rounded lobes facing each other on each side of a deep longitudinal groove and sunk into a depression on the ventral surface of the prostomium or between the latter and the mouth. A rather small mouth is bounded anteriorly and dorsally by these palpi and posteriorly and ventrally by the peristomium.

Except for the special features already indicated the peristomium is exactly like the following segment and, also like it, is apodous. Anteriorly the body is slightly flattened and increases in width to the end of the branchial region, behind which it again narrows and becomes perfectly terete.

Parapodia (figs. 39 and 40) are absent from the peristomium and following somite. Beginning on III they are at first small and placed at a low level, but gradually rise to a middle height and become more prominent in the branchial region, behind which they again decrease in size, but retain the more elevated position. Throughout they are uniramous, the notopodium being a mere tubercle bearing sensory hairs and entered by delicate aciculæ reduced to mere fibres. The prominent neuropodium divides distally into presetal and postsetal lobes, of which the former is short and broadly rounded and without any appendage to about XX, when a small papilla appears projecting freely from its anterior and distal margin directly outward or slightly ventrad. This increases in size for several somites, but becomes again greatly reduced by XLV. The postsetal lobe is always much more prominent; on the first few somites it is rather narrowly foliaceous and strongly curved dorsad, ending in a blunt apex; by somite IX it has become much broader, fully equals in length the base of the parapodium and bears a small but distinct branchial process on the dorsal border near the end. From this point the branchial process increases rapidly in length and becomes somewhat broad and flattened, while the postsetal lobe itself becomes gradually wider (deeper) and shorter, until by XXII it no longer reaches beyond the presetal lobe. At this point the branchial process fully equals the rest of the parapodium in length and projects prominently directly upward. Both the foliaceous margin of the postsetal lobe and its process have an open structure and are richly vascular and they undoubtedly serve as gills. Posterior to XLV the branchiæ are so reduced that the foot (fig. 40) consists only of a tapering base bearing small conical divergent presetal and postsetal lobes which become still further reduced toward the caudal end.

Anteriorly each parapodium is supported by three black aciculæ which are curved and tapered distally and terminate in an acute pale-colored tip projecting freely beyond the surface. Posterior parapodia have but two (fig. 41). The setæ are of two forms, one winged and with acute tips, the other hooded crochets. The former (fig. 42) have black bases and pale yellow exposed portions, are sigmoidly curved, provided with a delicate wing and taper to very acute tips. They vary somewhat in length, curvature and extent of the border. The crochets (fig. 43) are black or deep brown throughout, strongly striated, very slightly enlarged distally and then contracted to a scarcely hooked tip provided with five teeth, of which the lowermost greatly exceeds the others in size. The hood consists of the usual pair of delicate striated pieces which embrace the end of the crochet and conform to its shape. Most of the setæ are broken, but enough can be made out of a comparison of all the specimens to show that acute setæ alone, to the number of about 12 or 14 arranged in a fan-shaped fascicle, are found in the anterior parapodia. The number gradually diminishes and about the middle of the branchial region crochets appear and continue in association with the acute setæ throughout the middle region, while posteriorly 3 or 4 crochets alone remain.

The dissected jaws are shown in ventral view in fig. 44. With the exception of the mandibles they are dark brown. The maxillæ are slender, very strongly curved and acutely pointed; their expanded and excavated bases are borne on separate carriers which are deeply emarginated about the middle of the outer margin, but have the contiguous but distinct median margin straight. A narrow horny bow extends from the lateral and distal angle of each carrier to the corresponding second dorsal jaw. There are 3 pairs of dorsal jaws. The large posterior pair are broadly arcuate, connected posteriorly with the maxillæ carriers by a narrow bar and bear 5 or 6 acute, strongly curved teeth and a blunt tubercle. The second pair are triangular, with smooth sides and a single stout claw-like apical tooth. The anterior are similar, but with the base rather trapezoidal in shape. Unlike the other jaws the mandibles (fig. 30) are white with longitudinal streaks of pale brown, the distal margin wide and irregularly denticulate, with a prominent lateral angle and the base slender. They are very hard and brittle.

N. simpla differs widely from all described species of *Ninoe* known to me in the form of the gills and the presence of the mammiliform tubercle or rudimentary median tentacle on the prostomium. The branchial process corresponds to the dorsal limb of the gill of *N. nigripes*, *N. palmata*, etc., but the palmate gill of these species is wanting, though its base is represented by the expanded portion of the postsetal lobe.

This species was taken in Behm Canal, Alaska, only, at stations 4,235, 4,236 and 4,238, on muddy bottoms, in 130 to 229 fathoms.

Goniada annulata sp. nov. Pl. XXXVI, figs. 45 to 48.

The length of mature specimens considerably contracted in alcohol is from 70 to 90 mm., the greatest width to the tips of the parapodia (not including setæ) about 3 mm. The prostomium, which is broadly coalesced with the peristomium at the base, is depressed and about twice as long as its basal width or about equal to the first 6 or 7 somites; it is distinctly divided into 5 rings, of which the first equals the total of the others which successively diminish in both length and breadth, the last being minute and apparently sometimes absent. A wavy longitudinal groove on each side of the head is joined by the transverse furrows, which do not correspond above and below, and meets the nuchal organs behind; there is also a faint longitudinal ventral furrow. The apical tentacles diverge diagonally from the tip of the prostomium; the dorsal pair, which are slightly the longer, about equalling the transverse diameter of the last ring. Eyes appear to be absent. The palpi are small, low, rounded, immobile and widely separated on each side of the mouth.

The peristomium is fused with the prostomium above and the second somite below, where also it is produced forward as a rather prominent median lip. In complete sexually mature worms there are from 130 to 160 somites, of which all but 59 or 60 constitute the posterior or genital region. Especially in the anterior region the segments are well defined, smooth and terete, increasing in length to about XXX, and in width more gradually to XL, where they are about 3 times as wide as long; from that point to LIX or LX they remain nearly unchanged in proportions or even somewhat contracted, except when distended with ova or sperm, when they suddenly expand. In immature specimens this change does not take place. At this point there is internally a strong development of radiating muscles to which the constriction is due, and which form a bar to the movement of the genital products forward. On the other hand, the muscles of the body walls are somewhat weakened and one specimen is actually broken in two exactly at this point. This species, therefore, presents a condition similar to that described for *Goniada foliacea,* which it otherwise closely resembles in many respects. The posterior region is somewhat depressed, an appearance that is much exaggerated by the prominence of the parapodia, especially as the body decreases in width posteriorly. In only one specimen is the caudal cirrus preserved; it arises below the anus and is slender, tapering, and as long as the last 9 segments.

Anterior to XXXIII or XXXIV the parapodia are uniramous, behind that point biramous. The former (fig. 45) consist of an elongated neuropodium terminated by a presetal lobe divided by a deep cleft into slender, nearly conical dorsal and ventral lingulæ and an undivided presetal lobe of similarly slender form and nearly equal length. The ventral cirri are prominent, with swollen bases united to the ventral margin of the neuropodium and followed by a slight constriction, beyond which is a short conical style. Dorsal cirri arise a little above and behind the neuropodium. They have prominent but generally relatively slender bases and broadly ovate foliaceous distal portions bent abruptly dorsad. Beyond a gradual increase in size of all parts, especially the dorsal cirrus and postsetal lobe, relatively little change takes place from before backward. The base of the dorsal cirrus is relatively thickest from X to XX. On the first two parapodia the presetal lobe is undivided and the postsetal altogether absent; on the next 3 the latter increases to its normal proportions.

At XXXIII or XXXIV the notopodium appears somewhat suddenly and immediately bears setæ. It consists of an acutely conical presetal lobe and a minute rather ventral postsetal tubercle and is nearly half as long as the neuropodium. From the point of its appearance caudally the notopodium and all other parts of the foot gradually increase in size and become foliaceous, especially the neuropodial lobes and the notopodial cirrus. At LIX or LX the entire parapodium suddenly becomes larger and more folicaeous, without, however, any change in its fundamental characteristics. It is at this point that the posterior genital region with its swimming setæ begins. In a typical parapodium of this region (fig. 46) both notopodium and neuropodium are large and well separated. The former is the smaller and consists of a presetal lobe broad at the base and with a nearly conical terminal portion and a short, broad, presetal lobe situated somewhat ventrally. The cirrus arises from the dorsal base and a little posterior to the notopodium, has a relatively narrow but flattened base bent abruptly dorsad and bearing a broadly orbicular style, the whole slightly exceeding the notopodium in length. The neuropodium is comprised of the same parts as anteriorly, but the lobes are very much broader and more foliaceous in character; the two presetal ones are terminated by abruptly slender tips, while the postsetal lobe is both broader and blunt-pointed, as well as shorter. The neuropodial cirrus is closely united with the base of the neuropodium and tapers to an acute conical point reaching about half way to the end of the neuropodium. The characters of the foot become emphasized to at least LXXX, behind which the parts diminish gradually in size, the dorsal cirri alone remaining prominent to the end but becoming narrower. Numerous large ova or aggregations of spermatozoa are seen in parapodia of this region, but none anteriorly.

Both notopodium and neuropodium are each supported by a single large tapering acicula. Setæ are of two forms—compound in the neuropodium and simple in the notopodium. Both closely resemble those of *G. foliacea.* The former are arranged in a vertical fan-shaped fascicle and vary in number with the size of the neuropodium. They are colorless, with usually strongly curved shafts terminated by oblique sockets, and bear delicate, nearly straight or curved, acutely pointed and superficially granulated blades. They increase in length both ways to the middle of the fascicle and in the posterior region both shafts and blades are greatly elongated, the exposed parts equalling $\frac{1}{2}$ the width of the body, while the longest in the anterior region are not more than $\frac{1}{4}$ or $\frac{1}{5}$ the corresponding dimension. Simple setæ appear with the notopodia and, like the compound, are arranged in a vertically spreading fascicle composed of never more than about 10 setæ, of which 3 or 4 are ventral to the acicula. They are colorless, shorter than the compound setæ and about twice as thick, slightly curved and rather abruptly tapered to an acute point. Like the compound setæ they are superficially granulated and they are much elongated in the genital region.

A majority of the specimens have the proboscis protruded to various degrees, one to a length of 16 mm., but in no case as far as the jaws. It increases slightly in diameter from the base distally, where it may equal 1.5 mm. in diameter. In the best preserved examples it is fluted longitudinally by about 18 parallel muscular ridges. The entire surface is covered thickly with stiff cuticular papillæ arranged rather regularly in longitudinal rows, to correspond with the ridges. These papillæ are of various sizes, varying from .065 mm. to .02 mm. in height, but chiefly divided into a large and a small set, of which the former crown the ridges and the latter occupy the furrows. These papillæ (fig. 48) are colorless and stiffened by a thick striated cuticle, have broad trilobate bases with the paired lobe forward and the elevated portion a broad-based, pointed and slightly hooked cone, the cuticular covering of which has a deep cleft running up the anterior face and terminating in a pore near the apex.

In the retracted state of the proboscis the position of the jaws varies from somite XXXVII to XLII. The jaws are black and very hard, the principal pair nearer together ventrally than dorsally. The latter (fig. 47*a*) bear 3 or 4 large claw-like fangs which diminish in size medially and point caudal. The accessory jaws are of much smaller and variable size, the dorsal arch containing 14 to 16 besides a few very minute ones. They (fig. 47*b*) have bases which are deeply bilobate anteriorly and broadly unilobate behind, and usually bear a pair of equal divergent claws but sometimes 3 or 1. The ventral jaws are similar and 7 or 8 in number and with the others form an unbroken ring. Anterior to this ring is the jaw sheath consisting of a circle of about 18 soft papillæ. The chevron-shaped jaws form lateral longitudinal series of about 20 at the base of the extended proboscis. As the largest ones occur in the middle of each series and smaller ones at the ends, they form elongated elliptical areas tailing out behind where several quite rudimentary denticles occur.

Considerable individual variation is exhibited in the colors, which have resisted the solvent action of the alcohol quite well. Generally the ground is a yellowish-brown, showing a strong tendency to an annular arrangement in the anterior region where the furrows are pale. Posteriorly it is generally darker and more uniform. Most specimens are more or less blotched or even strongly annulated anteriorly with dark purplish-brown, and each segment in the genital region is marked by a, sometimes very conspicuous, pigment spot at the posterior margin in the median ventral line.

Most of the specimens are sexually mature and have the posterior region distended with eggs or sperm. A couple of immature examples 35 mm. long have parapodia of the usual form, but the distinction between genital and pregenital regions is slight and there are no swimming setæ.

Goniada annulata is a quite common species from Halibut Bank, in the Gulf of Georgia, northward to Chatham Strait. There it occurs in 282 to 293 fathoms at station 4,264. The type comes from station 4,235 in Behm Canal, where in 90 fathoms the species occurs at the least depth recorded.

Explanation of Plates XXXIV, XXXV, XXXVI.

(Unless otherwise expressly stated all setæ figured are from somite X.)

Plate XXXIV. *Aphrodita negligens.*

Fig. 1.—Half of the exposed portion of a ventral neuropodial seta. × 56.
Fig. 2.—Tip of an average hooked notopodial seta. × 82.

Aphrodita parva.

Fig. 3.—Head from above. × 24.
Fig. 4.—Posterior view of right parapodium of X. × 24.
Fig. 5.—Ends of three neuropodial setæ; *a*, spurred and bearded seta from middle series; *b*, bearded seta without spur from ventral series; and *c*, spurred seta without beard from the same. All × 250.
Fig. 6.—Bearded neuropodial seta. × 250.
Fig. 7.—End of a hooked notopodial seta. × 360.

Euphrosyne bicirrata.

Fig. 8.—End of a middle neuropodial seta. × 250.
Fig. 9.—Part of a long slender notopodial from a posterior row. × 82.
Fig. 10.—End of a short, smooth and bifid notopodial from the anterior row. × 250.
Fig. 11.—End of a serrate bifid notopodial seta. × 250.
Fig. 12.—Two gills and the middle cirrus (*mc*) from somite XII. × 24.

Euphrosyne hortensis.

Fig. 13.—End of an average neuropodial seta. × 250.
Fig. 14.—End of a smooth-spurred notopodial seta from the posterior row. × 250.
Fig. 15.—Serrate bifid notopodial seta. × 250.
Fig. 16.—Four gills from somite XII. × 24.

Eunoe depressa.

Fig. 17.—A neuropodial seta from the middle of the bundle of somite V. × 98.
Fig. 18.—End of a middle notopodial seta from X. × 98.

Plate XXXV. *Eunoe depressa.*

Fig. 19.—Posterior view of parapodia from X. × 15.
Fig. 20.—A middle elytron. The larger papillæ are shown as circles, the small horny ones are indicated on a part of the surface by dots and short lines. × 9.

Antinoe macrolepida.

Fig. 21.—The head from above. × 6.
Fig. 22.—An average neuropodial seta, × 56; *a*, tip of the same, × 250.
Fig. 23.—End of an average notopodial seta. × 56.

Hololepida magna.

Fig. 24.—Head from above, showing the much folded first right elytron in place. × 6.

Fig. 25.—Outline of a cirriferous parapodium from an anterior somite without setæ and as seen from behind. × 8.

Fig. 26.—End of a middle subacicular neuropodial seta from XXV. × 56.

Fig. 27.—Tip of the same. × 250.

Fig. 28.—End of a moderately slender supraacicular neuropodial seta from XXV. × 56.

Fig. 29.—An average notopodial seta from the dorsal part of the bundle. × 56.

Fig. 30.—Mandible of *Ninoe simpla* with the stem broken and ridges shown on the left side only. × 56.

Fig. 31.—Gill (dorsal organ) from somite VII of *Aphrodita negligens*. × 24.

PLATE XXXVI. *Lepidonotus robustus.*

Fig. 32.—An elytron from the middle region. The stippling indicates the distribution of brown pigment; the white circles are the raised uncolored areas with a central yellow excretophore(?). × 5.

Fig. 33.—End of a middle neuropodial seta. × 98.

Fig. 34.—An average notopodial seta. × 98; *a*, a portion of the same, × 440.

Fig. 35.—Outline of anterior aspect of parapodium X; the notopodial setæ only are represented. × 9.

Lepidonotus cœloris.

Fig. 36.—An elytron from the middle region of a medium-sized specimen. Only a portion of the sculpturing on each region is shown. × 9. *a*, one of the larger papillæ of the middle region; *b*, two of the lateral marginal papillæ; and *c*, three small rough papillæ from near the anterior end of the fringe. All × 56.

Fig. 37.—End of an average dorsal notopodial seta from XI. × 98.

Fig. 38.—A corresponding seta from somite XI of a specimen of *L. squamatus* from Wood's Hole, Mass. × 98.

Ninoe simpla.

Fig. 39.—Outline of parapodium XXV, showing the acicula and the position of the dorsalmost and ventralmost neuropodial setæ. × 82.

Fig. 40.—Outline of parapodium L, showing crochets *in situ*. × 82.

Fig. 41.—An aciculum. × 250.

Fig. 42.—A margined seta. × 250.

Fig. 43.—End of a hooded crochet from a posterior parapodium. × 250.

Fig. 44.—The jaws represented in their natural relations except that the halves of the basal plate are separated. From a dissection. × 56.

Goniada annulata.

Fig. 45.—Anterior view of a parapodium (XV) of the anterior region. × 32.

Fig. 46.—Similar view of one (C) of the posterior region. × 32.

Fig. 47.—One of the large (*a*) and an accessory (*b*) jaws. × 56.

Fig. 48.—A small and a large papilla from the proboscis, and *a*, one of the latter shown in optical section. × 250.

FIVE NEW SPECIES OF PSEUDOPOTAMILLA FROM THE PACIFIC COAST OF NORTH AMERICA.

BY J. PERCY MOORE.

A noteworthy portion of the Polychæta collections of the Alaskan Salmon Commission of 1903 is seven species, five of which are herein described as new, of the genus *Pseudopotamilla* recently established by Miss Bush. These new species are of interest in indicating the interrelations of *Pseudopotamilla* and other genera into which the former tends to grade. In most respects *P. intermedia* is most typical, and stands between the other species, which may be grouped in couples having quite distinct affinities. On the one hand *P. brevibranchiata* and *P. occelata* approach *Eudistylia* in the structure of the collar, and the former especially in the uncini and the latter in the numerous eyes and general habit. Neither of these, however, shows any indication of spiral coiling of the branchial bases, which are small and simple. On the other hand, *P. splendida* and *P. anoculata* have the angulated branchial stems without eyes and the more elongated spatulate thoracic setæ which characterize *Parasabella* and *Sabella*, but the dorsal collar lobes are exceptionally well developed and the branchial bases are very small and simple. The first three species have the avicular uncini of the posterior thoracic segments enlarged and otherwise peculiar, in this respect resembling *P. oculifera* Leidy.

Pseudopotamilla brevibranchiata sp. nov. Pl. XXXVII, figs. 1 to 7.

A species remarkable for the shortness of its branchiæ and the conspicuousness of its eyes. Two specimens containing nearly mature ova measure 55 and 58 mm. long and have 128 and 151 segments respectively. Of this length the palpi and branchial crown measure only 6 to 6.5 mm. and the thorax 8 mm. Owing to the contraction of the abdomen the form is rather short and stout, but the posterior $\frac{1}{3}$ tapers in the usual way to the small pygidium, which bears a close aggregation of small brown eye spots dorsal to the anus.

The palpi or branchial bases are very firm and rigid, not at all produced ventrally nor spirally twisted, though slightly inflected and winged; the distal margin is even and transverse and the height uniform (about 1.5 mm.) all round. The dorsal free margin bears a rather prominent, rigid, slightly incurved wing which overlaps its fellow medially and is separated by a deep, narrow incision from a similar but thinner wing borne upon the base of the dorsalmost branchial stem. Including a few rudimentary ventral ones and several in process of regeneration at other points, the number of branchiæ varies from 29 to 31. Owing to excessive crowding some of them are forced inward, producing an appearance of two series. The stems or radioles are remarkably short, stout, rigid and brittle and, without considering the rudimentary and regenerating ones, increase gradually in length from ventral to dorsal, the latter being about $\frac{1}{4}$ longer than fully developed ventral ones. Although the outer face is round, the basal $\frac{1}{3}$ or so, distally to the position of the first eye, bears a pair of very low lateral wings or margins which are united for a very short distance at the base. Beyond this point the stems are laterally compressed. The barbs are also thick and brittle, closely two-ranked, and all short, the longest proximal ones not exceeding 3 times the diameter of the stem and the distal ones being much shorter. When fully developed they continue nearly to the end, leaving free a short thick tip only. Eyes are exclusively in one series on the side of the stem nearest to the dorso-median line. They are deep purplish-brown and very conspicuous, and confined to a zone comprising the middle half of the branchiæ, but most irregularly arranged on individual branchiæ, on which they seldom occupy the entire width of the zone, though they may be variously scattered, or crowded into one or more groups. The usual number has 4 or 5, but varies from 2 to 9, and they may equal $\frac{1}{2}$ the diameter of the stem or be minute, scarcely visible specks, and all or any number may be large or small.

A high oral membrane with rumpled, sinuous margins begins ventrally at the sides of the mouth, is reflected on itself and passes around the internal bases of the branchiæ to become continuous dorsally with the large, much folded, foliaceous tentacles.

The peristomial collar differs considerably from the structure typical of the genus, as exemplified by *P. reniformis* and *P. oculifera*, and indicates the method of transition between forms with the collar lobes widely separated and those with them in contact dorsally. The dorsal portion consists of a pair of very low folds reflected into the dorsal fissure and there coming into contact. These are continuous with the remainder of the collar which rises abruptly into a pair of rounded lobes just above the collar setæ. From this point it is high and regular to near the median ventral region, where a wide open notch on each side partly separates the slender, pointed ventral lobes which are divided from each other by the deep ventral fissure.

Besides the peristomium there are 8 setigerous thoracic somites, all uniannulate and separated by deep segmental furrows. The region is nearly cylindrical, but slightly depressed and from 3 to 3.5 mm. wide. The 8 ventral glandular plates, including the first, are all transversely oblong and the second and third only are divided transversely into 2 equal halves. Abdominal somites are also uniannulate and the posterior ones much crowded. Thick ventral plates are developed throughout the region and are divided into halves by a deep fæcal groove extending from the anus to the first abdominal segment, cutting the latter obliquely to the right and entering the thoracico-abdominal furrow in front of the setæ, then appearing again faintly in the dorsal mid-line of the thorax and entering the dorsal fissure.

Thoracic parapodia are strictly lateral and the uncinigerous tori flush with the surface, while the setigerous tubercles may project slightly or be retracted within little pockets. The collar setæ form a very small tuft and the remaining 7 fascicles are somewhat elongated laterally and oblique. On all thoracic somites the uncinigerous tori are separated ventrally by about $\frac{1}{6}$ and dorsally by nearly or quite $\frac{1}{2}$ the body circumference. They increase in length gradually to the third which equals the ventral interspace, then decrease to the last which is $\frac{2}{3}$ of the longest, while the first equals the fifth or sixth. As the tori shorten the setæ tufts, closely approximated to their dorsal ends, assume a correspondingly lower position. Abdominal parapodia are more prominent and distinct lateral elevations, highest at the position of the setæ tufts near their ventral ends. The anterior tori are, like the thoracic ones, nearly flush with the surface and are consequently transitional, but, like all of the others, they are separated from the ventral plates by a deep longitudinal groove. Both setæ and uncini are in strictly vertical, linear series. On the first abdominal segment the former has a length of about $\frac{1}{2}$ that of the setæ tuft, and the latter equals the uncinigerous torus of the last thoracic somite. From this point both gradually diminish in length and number of setæ or uncini to the caudal end. At the dorsal end of each thoracic and the ventral end of each abdominal torus is a small, eye-like pigment spot.

In the collar tuft all setæ are capillary, winged, lanceolate, the ventral ones, however, shorter and with wider wings than the dorsal. On the remaining thoracic somites the setæ are of two sorts; a few in the dorsal and anterior part of the fascicle resemble the collar setæ (fig. 1), the number of which decreases from anterior segments backward. Those in the ventral and posterior portions of the bundle form a compact phalanx of several rows of obovate paddle-shaped or spatulate setæ with mucronate tips and the broad blades curved and often slightly asymmetrical (fig. 3). Abdominal setæ are all capillary with the shaft bent at the widest portion of the short double asymmetrical blades. They are arranged in two vertical rows, those in the anterior (fig. 2) having very long, attenuated, smooth tips, the posterior much shorter but otherwise similar. Their number varies from 24 in anterior to 4 or 5 in posterior fascicles. All setæ are distinctly striated.

Thoracic tori bear avicular uncini in the posterior and pick-shaped setæ in the anterior rank, the number of each on somite VI being 65 and on IX 40. The former (fig. 4) have a rather long slender base, narrow but prominent breast, thick erect neck, and little expanded head, with the prominent, finely divided crest pushed well forward and its frontal margin forming a perfectly straight profile with the acute beak, which is just perceptibly bent forward at the tip. On the posterior thoracic somites the uncini are somewhat larger, but the difference is not so great as in *P. occelata* and *P. intermedia;* the neck is also more craned forward and there are other slight peculiarities. The latter (figs. 6 and 7) have slender, finely striated stems slightly curved near the end, and expanded into a coarsely striated head enclosed in a sheath inflated at the base, and prolonged nearly at right angles to the stem into a moderately elongated slender process. Abdominal tori contain avicular uncini only (fig. 5), smaller than the thoracic uncini which they resemble in many respects, but have much the form of the wooden decoys used in duck shooting.

Except for the caudal eyes, the minute spots at the ends of the tori and a trace of brown on the median dorsal portion of the collar, no pigment exists on the body, which is of a pale yellowish color. On one specimen the basal half of the branchial wreath has no pigment, but in the distal half are four partly coalescent bands of brown, not extending on to the back of the stems, but deep-colored on the sides of the latter and the basal half of the barbs. When the branchiæ are opened up the barbs of the concealed branchiæ are found to be of a beautiful orange in those parts from which pigment is absent. The second specimen has very little pigment showing on the exterior except narrow longitudinal streaks of brown on the branchial base corresponding with the intervals between branchiæ. When opened up the distal half of the branchiæ shows traces of orange on the barbs, while the basal half is of a nearly solid orange brown.

The tubes are rather thick, tough and horn brown, and are thickly covered with fine sand; the free end is collapsible for a considerable distance.

This species presents an interesting combination of characters which weaken one's faith in the adequacy of some recent generic definitions. Indeed, it is doubtful whether this species should not go into the genus *Eudistyla*. The entire structure of the collar agrees closely with Miss Bush's description of the organ in that genus; the uncini and setæ are almost counterparts, and Johnson's figures of those of *Eudistyla* (*Bispira*) *polymorpha*, with which the preliminary determination associated these specimens, would answer almost equally well for the present species. The eyes and the dorsal wings of the palpi or branchial bases are also features of similarity. But the absence of any pronounced ventral prolongation of the branchial bases and the total absence of a spiral twist to the latter, in the writer's opinion, more than overbalance those more trivial characters. The shortness of the branchiæ may suggest the possibility of their having been injured and in process of regeneration, but a careful study has brought to light many reasons for rejecting this view.

The type and co-type were taken July 11, 1903, at station 4,247 in Kasaan Bay, Prince of Wales Island, in 95–114 fathoms, in a bottom of mixed mud, sand and broken shells.

Pseudopotamilla occelata sp. nov. Pl. XXXVII, figs. 8 to 14.

From the other species described in this paper the present is distinguished by its great length and numerous and conspicuous eyes. The type measures 130 mm., of which the branchiæ are 18 mm. and the thorax 11 mm. long. A still larger specimen from the same station is nearly 20 mm. longer.

The branchial bases are stiff, high and prominent, of uniform height, provided dorsally with notched wings, and ventrally with a slightly involute thin membrane. Full-grown specimens possess 21 to 24 pairs of branchiæ, small ones 60 mm. long from 17 to 20. They are moderately long, the dorsal somewhat exceeding the ventral, and entirely without a connecting membrane. The stems are rather stout, rounded externally and provided with a slightly raised line on each margin just external to the bases of the barbs. The latter are rather short and well separated toward the base of the stems, but near the distal end become very slender, about three times as long as the basal ones and much crowded, leaving a very short thick tip of the stem which also bears minute budding barbs of decreasing length almost to the extreme end.

Very conspicuous are the rich dark brown eyes, which are very uniform in size and large (about $\frac{1}{2}$ the diameter of the stem), elevated and bulging; all are on the margin of the external surface that lies nearest to the dorso-median line when the branchiæ are spread. They exhibit the usual irregularity in arrangement, but on the ventral branchiæ all are situated on the proximal $\frac{1}{3}$ and on the dorsal on the proximal half of the stem, except that on the two dorsalmost they are even more extensively distributed. The ventral stems commonly bear 5 or 6 eyes, occasionally as few as 3, usually distant or in couples. On the dorsal half of the circle of branchiæ each shaft bears from 7 to 12, even the latter number being exceeded on the dorsalmost pair. Except that they are usually much crowded proximally, they are arranged similarly to the ventral ones.

As in *P. brevibranchiata* the collar is intermediate in form between that of *Eudistyla* and typical *Pseudopotamilla*. The dorsal lobes are broadly rounded and slope caudally from their anterior median margin into the dorso-lateral incision; but they are so largely united with the dorsal surface of the thorax upon which they rest that only the outer portion is free, though to a greater depth than in *P. brevibranchiata*. The lateral portions rise abruptly as prominent lobes just dorsal to the collar setæ, and then continue of nearly even height until they rise directly into the elongated narrow and pointed ventral lobes.

Palpal and oral membranes of the usual form are present and the tentacles have a length about equal to the breadth of the thorax, their basal half being broad and foliaceous and the distal half slender and cirriform.

As a result of having been preserved in the tubes the body is slender, elongated and nearly cylindrical throughout, only a very short region at the posterior end being tapered to the pygidium, while the anterior thoracic region is slightly depressed. Probably as a result of pressure in the tubes, the segments are very faintly separated, except along the glandular ventral plates. Except posteriorly they are rather long, the anterior abdominal and the thoracic ones being from $\frac{1}{3}$ to $\frac{1}{2}$ as long as wide. The pygidium is oblique, with two pairs of minute lobes guarding the anus laterally and sometimes a group of numerous small brown specks on each side above. Normally there are 9 thoracic segments, of which 8 are setigerous, though one example has but 7. The abdominal segments vary from 125 on a specimen 60 mm. long to 187 on the largest example, measuring 148 mm.

All of the ventral plates are narrow, nowhere exceeding $\frac{1}{2}$ the body width and usually much less than this. Corresponding to the form of the segments the extreme posterior ones are 4 times as wide as long; throughout most of the length of the abdomen they are twice as wide as long; and those of the anterior abdominal and most of the thoracic segments are square, only the first 3 of the latter being again wider and irregular.

Except on the collar the thoracic setæ tufts are oblique and linear, nearly half as long as the corresponding tori, and each guarded by a conspicuous anterior and posterior fold. Tori are relatively short, little exceeding ½ the distance separating them ventrally, and of remarkably uniform length, the second being slightly the longest and those following decreasing in length to the last. On the abdomen the uncinigerous tori and the setæ tufts lie in nearly the same line, the latter very slightly in advance of the former and but little shorter.

The fæcal groove is well marked throughout both thorax and abdomen and passes obliquely across the right side of the first abdominal and last thoracic segments for their entire length.

Collar setæ are all of one form, capillary, acute, curved, narrowly double-winged, not very long. The remaining thoracic fascicles are composed of a small dorsal group of capillary setæ similar to those just described (fig. 8) and a large number of broad-bladed spatulate setæ (fig. 10), forming a close phalanx of several vertical rows. Abdominal setæ are arranged in two vertical rows (about 15 in each on XX), the one with short tips, the other with them more slender and about twice as long (fig. 9). Both have their shafts abruptly bent at the surface of the body, where they are provided with short striated wings of unequal width, beyond which projects the long, slender, acute tip.

Thoracic tori contain the usual two forms of avicular uncini and pennoned setæ, of which there are of each about 45 in each torus of V and 30 on IX. On anterior segments the former have the form shown in fig. 11, except that the beak is usually straighter. The body is long and straight, the breast moderate, the neck rather short, head large and crest prominent and well forward. On the last thoracic segment the uncini (fig. 12) are very much larger and of quite different form, the body being very long and slender, the breast very small, the neck rather long and sloping forward, the head and crest small and the beak less sharply bent downward. Anterior abdominal tori bear about 40 uncini (fig. 13) which are much smaller than the smallest of the thoracic and characterized by the small size of the posterior portion of the body, the large breast, and exceeding high and full crest. The pick-shaped or pennoned setæ (fig. 14) have short stems and slightly enlarged heads with the usual hood and prolonged tip.

Besides a slight tinge of brown about the parapodia, and, on some specimens, 4 to 6 pairs of brown spots, diminishing in size posteriorly, on the dorsum of II to V or VII, there is no pigment on the body. On the branchiæ there is usually a narrow band of dull purplish-brown on the branchial bases and 3 zones of rich purplish-brown on the basal half of the branchiæ, the lower two of which sometimes coalesce to form a very broad zone covering the entire occelated region. On the alcoholic specimens this color very little involves the outer surface of the stems, but is deep on their inner surfaces and the barbs. On one specimen the barbs of the basal half of the branchiæ are also largely orange and the pigment of each eye extends as a narrow oblique line in a proximal direction halfway across the outer surface of the stem.

The tubes of this species occur, sometimes singly attached to stones, sometimes in clumps of several wound among one another in an intricate fashion and firmly united. They are thick, of cartilage-like consistency after preservation and usually little encrusted with sand or other foreign substances. In one case the attached surface of the tubes is much infiltrated with calcareous matter.

Specimens occur off Fort Rupert, Vancouver Island (station 4,202), in 25–36 fathoms, on a bottom of gray sand; in Icy Strait (station 4,261), in 10 fathoms, on a bottom of mud and rock; and at Afognak Island (stations 4,269 and 4,270), in 14–19 fathoms, on a bottom of hard sand with rocks. The last station yielded the largest specimens, among them the type.

Pseudopotamilla intermedia sp. nov. Pl. XXXVII, figs. 15 to 22.

Of this well-marked species the type alone is known. This is a female filled with eggs and having a total length of 58 mm., of which the branchiæ are 3 mm. and the thorax 7 mm. The thorax is 2 mm. and the anterior part of the abdomen 2.5 mm. wide. There are 158 somites, 10 (9 setigerous) of which are thoracic.

Most noteworthy is the small size of the branchiæ, the extreme length of which is only 3 mm. The entire absence of pigment and the relatively pale color of the eyes suggests the possibility of their being in process of regeneration. The branchial bases are remarkably small, of soft texture, have the distal margin evenly transverse, the ventral margin truncate and not at all elongated or spirally coiled, and the dorsal margin provided with a notched lappet as in *P. brevibranchiata*, but smaller and soft and membranous instead of rigid. Each palpus bears 12 branchiæ, including 2 or 3 rudimentary ventral ones. The longest are only 3 times the height of the base, and only a little more than $\frac{1}{3}$ of the length of the thorax. In arrangement they are strictly one-ranked, and none is crowded into the interior. The stems are rather stout, rounded on the external face and lack altogether marginal wings and connecting membranes. The barbs are two-ranked, distributed rather sparsely, the largest about 4 times the diameter of the stem, diminishing in length toward the end, leaving a short thick tip of the stem naked. Never more than 2 eyes, and sometimes one or none, occur on each stem. They are rather small, pale brown, regular in arrangement and always on the proximal half and the dorso-median aspect of the stems of the spread branchiæ. The oral membrane and tentacle are slightly developed, the latter folded longitudinally.

In most respects the collar is typical of the genus. The median dorsal portion is better developed than in *P. brevibranchiata*, but less so than in *P. oculifera* (Leidy); the lateral portions are rather prominent, rising abruptly from just above the collar setæ, and expanding ventrally in broad, prominent lobes separated by the median ventral fissure; on one side a deep notch, on the other a slight one bounds the ventral lobe laterally.

The form is generally slender and cylindrical, the thorax slightly depressed anteriorly, narrower than the anterior region of the abdomen, the posterior half of which tapers very gently to the pygidium, and the anus nearly terminal but surmounted by a small lobe bearing two groups of minute brown eye-spots.

Thoracic setigerous tufts are prominent, the anterior especially elongated and oblique. The uncinigerous tori are very little elevated above the surface, the first and second longest, equalling about $\frac{1}{6}$ the circumference of the body and separated by an equal ventral distance. From the second they decrease in length, the last scarcely more than $\frac{1}{3}$ of the first and separated by a ventral distance of about $\frac{1}{5}$ of the circumference. Abdominal parapodia are rather prominent, especially the ventral setigerous ends, the first about equal to the eighth thoracic and succeeding ones decreasing slowly but steadily to the last.

The ventral glandular plates are narrow on the abdominal region, separated from the parapodia by wide grooves and completely divided into a pair of squares by the deep fæcal groove, which turns to the right obliquely across the first and appears again on the dorsum of the anterior part of the thorax, where it opens into the dorsal fissure. It is not visible on the posterior part of the thorax. The thoracic ventral plates are indistinct and poorly developed in the type.

No pigment is present on the greater part of the body, being confined to 4 pairs of discrete reddish-brown spots on the dorsum of somites II to V, which become successively smaller and the last mere specks. Owing to the presence of great numbers of eggs the abdomen is somewhat yellowish.

All setæ have a pale yellow color. Those in the collar tuft are, like the succeeding thoracic tufts, of two kinds. A few of the dorsalmost are capillary, more or less sigmoidly curved and narrowly winged. The ventral ones, more numerous and arranged in several parallel rows, are of the mucronate-spatulate type, but have a somewhat narrower and longer obovate blade than those on the following somites. On remaining thoracic somites the setæ are more numerous, the capillary (fig. 15) forming a projecting tuft, the spatulate (fig. 17) in more and longer rows and having somewhat shorter and broader blades than those on the collar; the mucronate tip is long and slender. Abdominal setæ are in two vertical rows, 9 or 10 in each row of the first few fascicles and 4 or 5 in the less distinctly 2-ranked fascicles of the caudal end. Both kinds have the shaft abruptly bent just beyond the surface of the body, the longer form with a very narrow accessory wing on the concave side and a wider but very short wing on the convex side, and the smooth acute tip often much longer than in the seta figured. The short setæ (fig. 16) are sigmoidly curved, have shorter, smooth tips and broader, strongly striated wings reflexed from the convex side.

Thoracic tori bear avicular uncini in the posterior and pick-shaped setæ in the anterior row. The former (fig. 18) have long straight bodies, moderate-sized breasts, rather short, erect necks, enlarged heads, prominent crests very low in front, and curved beaks. On the last, and possibly other posterior, thoracic somites the uncini (fig. 19) are very much larger, with very long bodies, minute breast, long neck well sloped forward, head not enlarged, very small crest and weak beak. Another less typical one with somewhat larger crest is shown in fig. 20; 43 occur in the 9th and 60 in the 4th torus, though the latter occupy twice as long a space. The pick-shaped setæ have the form shown in fig. 22, the heads being much reduced and the hoods much inflated and with slender tips about as long as the beaks of the uncini. Abdominal aviculæ (fig. 21) are much smaller than the thoracic, with relatively shorter bases, larger breast, short thick neck, and crest larger, farther forward and extending low down on the beak, which has a straight profile.

One specimen only known, from station 4,267, off Cape Edgecumbe, Sitka Sound, 922 fathoms, on a bottom of soft gray mud.

Pseudopotamilla splendida sp. nov. Pl. XXXVII, figs. 23 to 27.

This large handsome species is founded on two specimens lacking the posterior end; with the 37 anterior segments alone the type measures 65 mm. long, 27 mm. belonging to the branchiæ and 8 mm. to the thorax including the collar, while the greatest width of the thorax, exclusive of the setæ, is 5 mm.

The branchial lobes are very small, barely reaching the border of the collar, stiff, thick, very little free, lacking all trace of the dorsal appendage or lappet of some species; the ventral end lower, not at all produced nor involute, without a thin membrane, and partly united to its fellow of the opposite side. Twenty-two pairs of branchiæ are present in each specimen. Except that those of one side are in process of regeneration all are of approximately equal length and are entirely separate to the base. The external surface of the stems is wider than the internal, flattened and provided with lateral angles but no wings. There is no indication of eyes. The barbs are numerous and closely arranged in 2 ranks; they increase in size regularly from the base for $\frac{3}{4}$ the length of the stem, those at the distal end of this region being 3 times the length of the basal ones and $\frac{1}{2}$ the width of the thorax; in the distal $\frac{1}{4}$ they again decrease, leaving a filamentous tip equal to the basal barbs. Several of the basal barbs of the dorsalmost branchiæ are much enlarged.

The conspicuous, flaring collar has very large dorsal lobes, separated by the dorsal fissure and bounded laterally by large, deep incisions midway between the dorsal fissure and the collar setæ; these dorso-lateral incisions are partly filled by a small, thin lobe arising from the bottom. The lateral portion of the collar rises in an even curve to the same height as the dorsal lobe, its margin is slightly wavy but not at all notched nor produced into ventral lobes, but instead is broadly rounded below and overlaps the ventral fissure from both sides.

Oral membranes are prominent, but present no characteristic features. The tentacles slightly exceed the collar in length and have a thick midrib tapering to a free end, the basal half being provided on each side with broad margins folded together.

On a specimen preserved outside of the tube the thorax is broad and depressed and tapers regularly from the collar segment into the more slender terete abdomen. The second example, having been removed from a tube after preservation, is more nearly cylindrical throughout. All segments are very distinctly indicated and uniannulate. The type possesses 9 thoracic (8 setigerous) and 28 remaining abdominal segments; another specimen has 10 thoracic (9 setigerous) and 58 abdominal segments, both, of course, being incomplete.

Although the dorsal fissure is deep on the anterior 2 thoracic segments, the fæcal groove is not discernible on the thorax. On the abdomen it is deep and conspicuous, and can be traced around the right side of the first abdominal segment until it disappears in the furrow anterior to the setæ.

The thoracic setigerous tubercles have short bases but project prominently. The tori are very long, the first about twice and the last about $1\frac{1}{4}$ times the ventral interspace, the others intermediate. On the abdomen the same parts are little elevated and placed at nearly the same level as the dorsal end of the last thoracic. The setigerous line is shorter than the thoracic and the first torus about $\frac{1}{4}$ as long as the last thoracic. About 90 aviculæ and the same number of pick-shaped setæ occur on the torus of III and 60 of each on IX. On the thoracic segments the spatulate setæ are very numerous and arranged in 5 or 6 vertical rows, while the capillary setæ do not exceed about 15. The capillary abdominal setæ are in two regular rows of about 10 each on the anterior segments.

All of the collar setæ and the dorsalmost setæ on the other thoracic segments are rather short, stout, capillary, tapered to an acute tip, little curved and with small, nearly symmetrical wings with very fine oblique striæ on each side. The spatulate setæ (fig. 24) have stout stems and rather long, narrow curved blades about $2\frac{1}{2}$ times as long as wide with apical arms of moderate length. The abdominal setæ of both rows do not differ greatly in length. They are longer than the thoracic capillary setæ, especially posteriorly, and are gracefully curved and tapered, with fairly broad, oblique, strongly striated and nearly symmetrical wings (fig. 23). Avicular uncini are nearly uniform in size and form on all thoracic segments. They (fig. 25) have moderately long curved bodies, full breasts, slender upright necks, elevated crests and slender acute beaks. Abdominal avicular uncini (fig. 26) are smaller and have very small bodies and deeper breasts but are otherwise similar. The pick-shaped thoracic setæ have the form shown in fig. 27.

Pigment is totally absent from the body and on the branchiæ exists only as six regular, narrow zones of pale reddish-brown, chiefly confined to the basal halves of the barbs and scarcely apparent on the stems.

The tubes are nearly straight, thick, pale brown and very little incrusted with sand or other foreign matter.

Known only from two large specimens taken at station 4,245, Kasaan Bay, Prince of Wales Island, June 11, 1903, in 95–98 fathoms, on a bottom of dark green mud and sand mixed with shell and rock fragments.

Pseudopotamilla anoculata sp. nov. Pl. XXXVII, figs. 28 to 33.

This handsome species has the branchial bases exactly as in *P. splendida*, that is, they are very small and concealed by the collar, somewhat coalesced ventrally, and lack the dorsal lappet, ventral membrane and any indication whatever of a ventral involution. There are 15 pairs of plume-like branchiæ, each very long and graceful and without any trace of an interbranchial membrane. The stems are more convex externally than those of *P. splendida*, but still distinctly flattened, and there is no trace of eyes. The barbs are all very slender, 2-ranked, well separated and increase regularly in size from very short ones at the base to very long ones, much exceeding the diameter of the thorax toward the end; in the distal $\frac{1}{7}$ they again decrease, leaving a short tip entirely free from them.

The dorsal lobes of the collar are narrow and very long, considerably exceeding the second segment in length, with nearly parallel sides and rounded ends, the two separated by a wide dorsal fissure. The dorso-lateral notches are very deep but narrow and not occupied by a small lobe. Laterad of the notches the collar rises nearly to the height of the dorsal lobes, which it somewhat overlaps by means of low, broad extensions toward the median line. The remainder of the margin is even and scarcely crenulate, the ventral lobes arising regularly and gradually, without the formation of any notch, into prominent triangular lobes overlapping the bases of the branchiæ and separated by a deep median fissure.

The single example is fortunately complete. It measures 122 mm. long, the thorax being 15.5 mm. and the branchiæ 32 mm. long, and the former 3.5 mm. wide. It is consequently long and slender, tapering to the pygidium in the posterior $\frac{1}{3}$. There are 14 (13 setigerous) thoracic somites and 162 abdominal somites. The former region is scarcely depressed and the remainder of the body nearly cylindrical from pressure of the tube. Besides being unusually broad and deep anteriorly the dorsal fissure is prolonged into a fæcal groove extending for nearly the length of the thorax, but gradually fading out behind. The thoracic segments are $\frac{1}{2}$ as long as wide, the middle abdominal about $\frac{1}{6}$ as long as wide, and the posterior very much shorter. Ventral plates are developed much as in *P. splendida*, but the thoracic are relatively longer and the lateral notches divide them unequally, being nearer to the posterior border; the anterior abdominal plates are twice as wide as long and the posterior 4 times or more, all very thick and deeply divided; none of the abdominals are notched laterally, and they occupy about $\frac{1}{3}$ of the body width.

Thoracic setæ tufts are short and straight, the anterior ones placed at a very high level. The tori of III have a length of nearly $\frac{1}{4}$ the circumference of the body and are separated by ventrally $\frac{1}{2}$ this distance. From the first they decrease in size regularly, the last and shortest being but $\frac{1}{3}$ as long as the first. The first abdominal torus is not more than $\frac{1}{2}$ as long as the last thoracic, and is on the level of the thoracic setæ tufts. The first thoracic torus bears 65 uncini and an equal number of pick-shaped setæ, the fifth 43 and the last 33. Anterior abdominal tori have about 25 uncini and the setæ tufts about 15 setæ, less distinctly in 2 rows than in other species.

All of the collar setæ and the dorsalmost setæ of other thoracic fascicles are of the usual slightly curved, acute, tapering form with short, rather narrow, obliquely striated wings which arise at an angle with the stem. Not over about a dozen occur in each fascicle. Spatulate setæ (fig. 30) are much less numerous than in *P. splendida*, and arranged in only 2 or 3 vertical rows. The wings are decidedly long, the entire expanded region being 3 times as long as wide, with an apical arm exceeding in length its greatest diameter. The striation of the blade is unusually faint. Abdominal setæ (figs. 28, 29) are few (about 15 in anterior tori), not distinctly arranged in two rows, and the longer and shorter ones not greatly different. The stem is constricted but not sharply bent at the base of the blade.

Avicular uncini (fig. 31) of similar form occur throughout the thoracic region. The base is only moderately elongated and slightly curved, the breast rather prominent, the neck moderately long and sloped forward, the crest well forward and forming a straight profile with the slender acute beak. Abdominal uncini (fig. 32) are much smaller, with very short bodies slightly curved downward posteriorly, the breast deep and full, neck and crest similar to those of the thoracic uncini, but the beak much shorter and smaller. The pick-shaped or pennoned setæ (fig. 33) have slightly curved stems, elongated flattened heads, very difficult to see clearly, and high compressed hoods drawn out at a wide angle with the stem into delicate pennants.

No color remains except on the branchiæ, the ventral ones of which have 6 or 7 rich wine-color spots on the barbs and slightly on the stems. On some of the dorsal branchiæ these spots coalesce so that they are chiefly colored, with a few irregular white spots at the base and a more extensive white region toward the tip.

The tube is dark colored, rough, brittle and covered with sand.

This species is known from the type only, taken June 7, at station 4,230, in the vicinity of Naka Bay, Behm Canal, on a rocky bottom, in 108 to 240 fathoms.

Explanation of Plate XXXVII.

(All figures are magnified 250 diameters.)

Pseudopotamilla brevibranchiata, figs. 1 to 7.
Fig. 1.—Dorsal thoracic capillary seta from somite VI.
Fig. 2.—Long abdominal capillary seta from somite XX.
Fig. 3.—Spatulate thoracic seta from somite VI.
Fig. 4.—Thoracic avicular uncinus from somite VI.
Fig. 5.—Abdominal avicular uncinus from somite XX.
Fig. 6.—Pick-shaped seta from somite VI.
Fig. 7.—Another view of the end of the same.

Pseudopotamilla occelata, figs. 8 to 14.
Fig. 8.—Dorsal thoracic capillary seta from VI.
Fig. 9.—Long abdominal capillary seta from XX.
Fig. 10.—Spatulate thoracic seta from VI.
Fig. 11.—Thoracic avicular uncinus from VI.
Fig. 12.—Thoracic avicular uncinus from IX.
Fig. 13.—Abdominal avicular uncinus from XX.
Fig. 14.—Pick-shaped uncinus from VI.

Pseudopotamilla intermedia, figs. 15 to 22.
Fig. 15.—Dorsal thoracic capillary seta from VI.
Fig. 16.—Short abdominal capillary seta from XX.
Fig. 17.—Spatulate thoracic seta from VI.
Fig. 18.—Thoracic avicular uncinus from VI.
Fig. 19.—A typical avicular uncinus from the last thoracic somite (X).
Fig. 20.—Portion of another from the same torus showing a larger crest.
Fig. 21.—Abdominal avicular uncinus from XII.
Fig. 22.—Pick-shaped seta from somite VII.

Pseudopotamilla splendida, figs. 23 to 27.
Fig. 23.—Long abdominal capillary seta from XXI.
Fig. 24.—Spatulate thoracic seta from VI.
Fig. 25.—Thoracic avicular uncinus from VI.
Fig. 26.—Abdominal avicular uncinus from XX.
Fig. 27.—Pick-shaped seta from VI.

Pseudopotamilla anoculata, figs. 28 to 33.
Fig. 28.—A shorter abdominal capillary seta from XXVI.
Fig. 29.—Face view of the bladed portion of the same.
Fig. 30.—Spatulate thoracic seta from VI.
Fig. 31.—Thoracic avicular uncinus from VI.
Fig. 32.—Abdominal avicular uncinus from XXVI.
Fig. 33.—Pick-shaped seta from VI.

NOTES ON SOME HAWAIIAN ACHATINELLIDÆ AND ENDODONTIDÆ.

BY H. A. PILSBRY AND E. G. VANATTA.

In the course of identifying various snails received from Mr. D. Thaanum some new species were encountered, and the necessity of several rectifications in previous classifications became apparent.

ACHATINELLIDÆ.

In 1900, Mr. Sykes proposed the name *Kauaia* to replace the preoccupied term *Carinella* Pfr., based upon *Amastra kauaiensis*. With some doubt he included several umbilicated snails in the same group. In our view, the latter may better be segregated under another sectional name. The groups will stand thus:

Genus **AMASTRA** Ads.

(Forms with the whorls carinated.)

Section **Kauaia** Sykes.

Shell oblong-conic or biconic, carinated, solid, imperforate. Axis tubular though small, obliquely contracted near the base in each whorl, and in the last spirally plicate, making the columella obliquely truncated at the base. Both species are from Kauai.

A. kauaiensis Newc. *A. knudseni* Baldw.

This group stands very close to the section *Amastrella*.

Section **Cyclamastra** nov.

Shell turbinate, with the spire conically elevated, carinated peripherally, *thin, umbilicated;* the *axis a rather large tube, widening toward the base in each whorl*, and in the last encircled with a callous spiral cord extending upon the reflexed columellar lip. Type *A. cyclostoma* Baldw. Kauai.

The section *Amastrella* seems to us to be composite, comprising members of several parallel series of *Amastra*. The species from Maui and those from Oahu should be eliminated from the group, if this view is correct.

Section **Helicamastra** nov.

Shell discoidal or biconvex, carinated, the diameter greatly exceeding the height, spire flattened; thin; umbilicated, the axis a large tube, cylindric in each whorl, and in the last encircled by a callous cord or lamella, extending horizontally upon the reflexed columellar lip. Type *A. discus.*

A. discus P. and V. Oahu. *A. heliciformis* Anc. Oahu.
A. alata (Pfr.) P. and V. Lanai. *A. rex* Sykes. Oahu.

Amastra (Helicamastra) discus n. sp. Pl. XXXVIII, figs. 1, 2, 3.

Shell thin and fragile, openly umbilicate, flat above, convex below, the periphery carinate, the keel obtuse. Uniform dull brown. Whorls nearly 4, the first hardly convex, marked with faint growth-lines; second whorl flat, weakly marked with oblique growth-lines, its outer edge distinctly margined, cord-like. The next whorl is slightly convex, without a peripheral cord or margin, and has rather rude wrinkle striæ. The last whorl becomes more swollen above, in part rising above the level of the preceding whorls, and is rather rudely wrinkled. The angular periphery is on a level with the flat spire. The umbilicus is deep and subcylindric. The aperture is oblique, wider than high; outer and basal margins thin and simple, columellar margin dilated, bearing an acute, subhorizontal white lamella. Alt. 3.4, diam. 10 mm.

Waianae, Oahu. Types No. 58,158, A. N. S. P., received from D. D. Baldwin.

This curious snail differs from *A. alata* by its flat spire, irregular growth and larger umbilicus. It is much more depressed than *A. heliciformis* Anc., with fewer whorls.

Amastra rex Sykes (*Ann. and Mag. N. H.*, Ser. 7, Vol. XIV, p. 159, 1904) is a larger species with peripheral appendages as in *Pterodiscus wesleyi*. It seems to have a much smaller umbilicus than *A. discus*, but neither the description nor figure are clear on this point.

Amastra (Helicamastra) alata (Pfr.?) P. &. V. Pl. XXXVIII, figs. 4, 5, 6.

Amastra (*Kauaia*) *alata* Pfr., Sykes, Fauna Hawaiiensis, Mollusca, p. 355 (no description).
? *Helix alata* Pfr., P. Z. S., 1856, p. 33.

Shell thin, umbilicate, biconvex, the base more convex than the spire, periphery carinate. Brown, nearly lusterless. Whorls 4, the first nearly smooth, hardly convex, the second flat, obliquely striate, with a peripheral marginal cord, the next whorl densely marked with growth-striæ, convex near the periphery but without a margining cord. Last whorl barely convex, sloping above, densely marked with growth-striæ and on its later portion with some coarse oblique wrinkles, convex beneath. Umbilicus rather narrow and tubular. Aperture wider than high, the dilated columellar lip bearing an acute, subhorizontal lamella. Alt. 4.3, diam. 8.2 mm.

Lanai. Dr. W. Newcomb collection, Cornell University Museum.

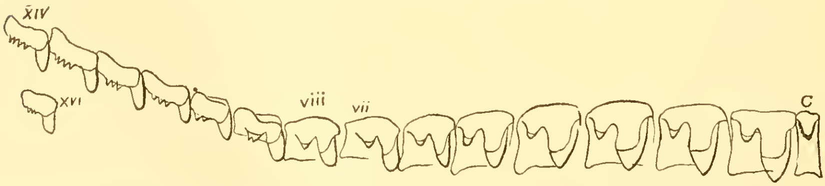
The specimens here described and figured are from Newcomb's collection, and since Pfeiffer's types were from Newcomb, it may be inferred that they were from the same lot. In view of Dr. Pfeiffer's well-known accuracy as a diagnostician, it is hard to believe that his description of *Helix alata* was based upon the same species, since it disagrees in the number of whorls and shape of the spire, and in omitting a reference to the columellar lamella. It is possible that two species were present in Newcomb's collection, and what Pfeiffer actually described was a *Pterodiscus* close to *P. wesleyi.* This could be decided by a reference to Pfeiffer's own collection. Mr. Sykes, who had occasion to correct the senior author's former identification of *H. alata,* did not take the trouble to place the species upon a recognizable basis.

Genus **PTERODISCUS** Pilsbry.

Manual of Conchology (Series 2), IX p. 36, November 16, 1893.

Shell openly umbilicate, discoidal or subdiscoidal, thin, uniform brown, and carinate at the periphery. Peristome simple or expanded, the columellar lip dilated. Axis and columella smooth, without a spiral lamella. Jaw and radula as in *Amastra.* Type *P. wesleyi* Sykes (=*Endodonta alata* Pils., not *Helix alata* Pfr.?). This group was originally established as a section of *Endodonta.* Mr. Sykes elevated it to a genus of the *Endodontidæ.* The examination of the jaw and radula of *P. digonophora* shows it to belong to the *Achatinellidæ;* and in that group it stands close to *Helicamastra,* from which it is differentiated solely by the total loss of the columellar lamella. In shape, texture, sculpture and the structure of the early whorls, *Pterodiscus* and *Helicamastra* agree very closely.

The jaw of *P. digonophora* is very thin, deeply arcuate, smooth except for a few wide plaits or flat ribs in the median part.



The radula of *P. digonophora* has 11, 7, 1, 7, 11 teeth. Those of the median field stand in nearly straight transverse rows, but at the sides the rows of marginal teeth bend rapidly forward. The centrals are narrow, less than half the width of the adjacent lateral teeth, and bear a single small cusp. The lateral teeth are square, bicuspid with a large mesocone and small ectocone as usual. The marginal teeth are short and broad, with the mesocone oblique, and the ectocone split into two, three or four minute, acute denticles.

The known species are from Oahu.

P. wesleyi Sykes. *P. petasus* Anc.

P. digonophora Anc.

Two other species were referred to this group by the senior author in 1893: *Helix prostrata* Pse. and *H. depressiformis* Pse.,[1] both described from the "Central Pacific Islands," and neither figured nor seen by any subsequent author. Mr. Sykes did not find them in the British Museum collection; they are not in the collections at Philadelphia or Washington, nor is any trace of them to be found in the Pease collection at Cambridge, Massachusetts.[2] We learn from labels in the Academy collection that Andrew Garrett knew them not. While there cannot be much doubt that *prostrata* and *depressiformis* were based upon species of *Pterodiscus* much like *wesleyi* and *digonophora*, it must be admitted that the diagnoses are insufficient for positive identification; and in the absence of types, the names must be regarded as defunct. The three species known are quite distinct, being characterized as follows:

1.—Spire low-conic, with projecting, mucro-like apex; aperture small, as high as wide, the peristome expanded, nearly continuous; umbilicus ample, ... *P. petasus*.

2.—Spire flat or nearly so, the apex not raised.

a.—Umbilicus very large, broadly conic, the base strongly angular around it, ... *P. digonophorus*.

b.—Umbilicus comparatively narrow, tubular, . . . *P. wesleyi*.

Pterodiscus wesleyi Sykes. Pl. XXXIX, figs. 7, 8, 9.

Endodonta (*Pterodiscus*) *alata* Pfr., Pilsbry, Manual of Conch., IX, p. 36, Pl. 4, fig. 44 (no specific description or measurements).

Endodonta (*Pterodiscus*) *wesleyi* Sykes, Proc. Mal. Soc. Lond., II, p. 127, 1896, based upon preceding reference. *Pterodiscus wesleyi* Sykes, Fauna Hawaiiensis, Moll., p. 292.

Shell umbilicate, thin, flat above, convex beneath, carinated peripherally, brown with some irregular yellowish streaks, nearly lusterless. Whorls $3\frac{1}{2}$, the first perceptibly convex, the rest somewhat flattened, sculptured with fine oblique growth-lines only. Last whorl carinated, the keel bearing an irregular flange or "wing" of adhering earth; base

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[1] Described in *Proc. Zool. Soc. Lond.*, 1860, p. 670. On p. 675 *H. depressiformis* is said to be *H. alata* Pfr., on Cuming's authority.

[2] We are indebted to Dr. William H. Dall, of the National Museum, and Dr. W. Faxon, of the Museum of Comparative Zoology at Cambridge, for examining the collections under their charge for these species.

convex, obtusely angular around the tubular umbilicus. Aperture oblique, much wider than high, the lip thin and simple, the columellar margin dilated. Alt. 3, diam. 8 mm.

Kalaikoa, Oahu. Type No. 58,159, A. N. S. P., from Mr. D. D. Baldwin.

Quite unlike the other known species in its larger aperture and smaller umbilicus. It has not been described before, Mr. Sykes's name being based solely upon the figure published in the *Manual of Conchology*. It seems rather an unequal division of labor that we should have to both figure and describe Mr. Sykes's species.

This shell agrees well with Pfeiffer's description of *Helix alata;* but as the British Museum specimens under the name *alata* and those in the Newcomb collection have the columella lamellate, it has been held by Mr. Sykes that Pfeiffer overlooked the lamella.

Pterodiscus petasus Ancey. Pl. XXXVIII, figs. 7, 8.

Mr. Ancey's figures were evidently drawn from a specimen not wholly mature. When full-grown, the peristome is distinctly expanded, and its margins approach much more than his figure shows.

Waianae, Oahu. (D. D. Baldwin.)

ENDODONTIDÆ.

Endodonta (Nesophila) thaanumi n. sp. Pl. XXXIX, figs. 1, 2, 3.

Shell discoidal, yellowish-white radially marked with dark brown lightning-shaped streaks. Spire composed of 5 rounded whorls, separated by a well-impressed suture. The first 4 whorls are about at the same level, but the last 2 gradually descend to the aperture. The last whorl is well rounded at the periphery and sculptured with 57 slightly curved regularly spaced sharp ribs, the interstices of which are covered with microscopical *straight* vertical striæ, about 8 or 10 between two larger ribs. The apex is smooth, but all the other whorls are costate. The umbilicus is perspective, circular and about $\frac{1}{4}$ the diameter of the shell. The aperture is lunate, parietal callus thin, bluish-white, and provided with two strong spirally entering lamellæ. Palatal teeth or plicæ are absent.

Alt. 2, diam. 5 mm.

Kaiwiki, near Hilo, Hawaii.

The types are in the collection of the Academy of Natural Sciences, No. 89,245. They were collected by Mr. D. Thaanum, in whose honor the species is named.

Specimens of *E. hystrix* ("Migh." Pfr.) received by the Academy from Dr. A. Gould have the vertical striæ undulating, which at once distinguishes them from *E. thaanumi;* otherwise they are very similar. *E. paucicostata* (Pse.) is smaller and of a different shape.

Melanistic and albino specimens occur with the types at Kaiwiki. Mr. Thaanum has collected this species also at Olaa, Hawaii, and Honokowai Gulch, West Maui. Under a lens in a good light some faint scratches may be seen in some places, but they do not amount to spiral lines.

Endodonta (Thaumatodon) luctifera n. sp. Pl. XXXIX, figs. 4, 5, 6.

Shell discoidal, light yellow marked with brown flames, whorls $5\frac{1}{2}$, suture moderate, spire rather flat, the entire last whorl a little descending. Apex smooth, the rest of the shell evenly costate. There are about 59 costæ on the last whorl with about 10 to 12 vertical interstitial striæ, but no spiral lines. The periphery is well rounded, umbilicus perspective and about $\frac{1}{3}$ the diameter of the shell. Aperture lunate, with 2 strong spirally entering parietal lamellæ and a very short basal plica or tooth. A smaller specimen has another very weak palatal plica at the periphery.

Alt. $2\frac{1}{2}$, diam. 6 mm.

Sandwich Islands. Types are in the collection of the Academy of Natural Sciences, No. 58,137.

This species differs from *E. elisæ* Ancey in having two parietal lamellæ, and it has fewer palatal folds than *E. hystricella paucilamellata* Ancey.

Explanation of Plates XXXVIII and XXXIX.

Plate XXXVIII, Figs. 1–3.—*Amastra discus* n. sp.
Figs. 4–6.—*Amastra alata* (Pfr.) P. and V.
Figs. 7, 8.—*Pterodiscus petasus* Anc.

Plate XXXIX, Figs. 1–3.—*Endodonta thaanumi* n. sp.
Figs. 4–6.—*Endodonta luctifera* n. sp.
Figs. 7–9.—*Pterodiscus wesleyi.* Type specimen.

ON TWO HAWAIIAN CERITHIIDÆ.

BY H. A. PILSBRY AND E. G. VANATTA.

Cerithium thaanumi n. sp.

Shell slender, turreted, with slightly convex outlines below, acuminate above. Brownish-white, very sparsely maculate with brown. Varices very low and inconspicuous, two on a whorl. The last whorl has a low wide varix opposite the lip, is excavated at the base, and produced in a short, straight anterior canal. Sculpture of rather coarse spiral cords with a smooth thread in each interval, three of the larger cords on the penultimate and earlier whorls granose. Whorls 12 (without the nucleus), convex. Aperture small, the outer lip very strongly arcuate, thin; basal notch deep, rounded and contracted. Length 14.2, diam. 4.5, longest axis of aperture without canal 3 mm.

Hilo, Hawaii. (Mr. D. Thaanum.) Types No. 85,855, Coll. A. N. S. Phila.

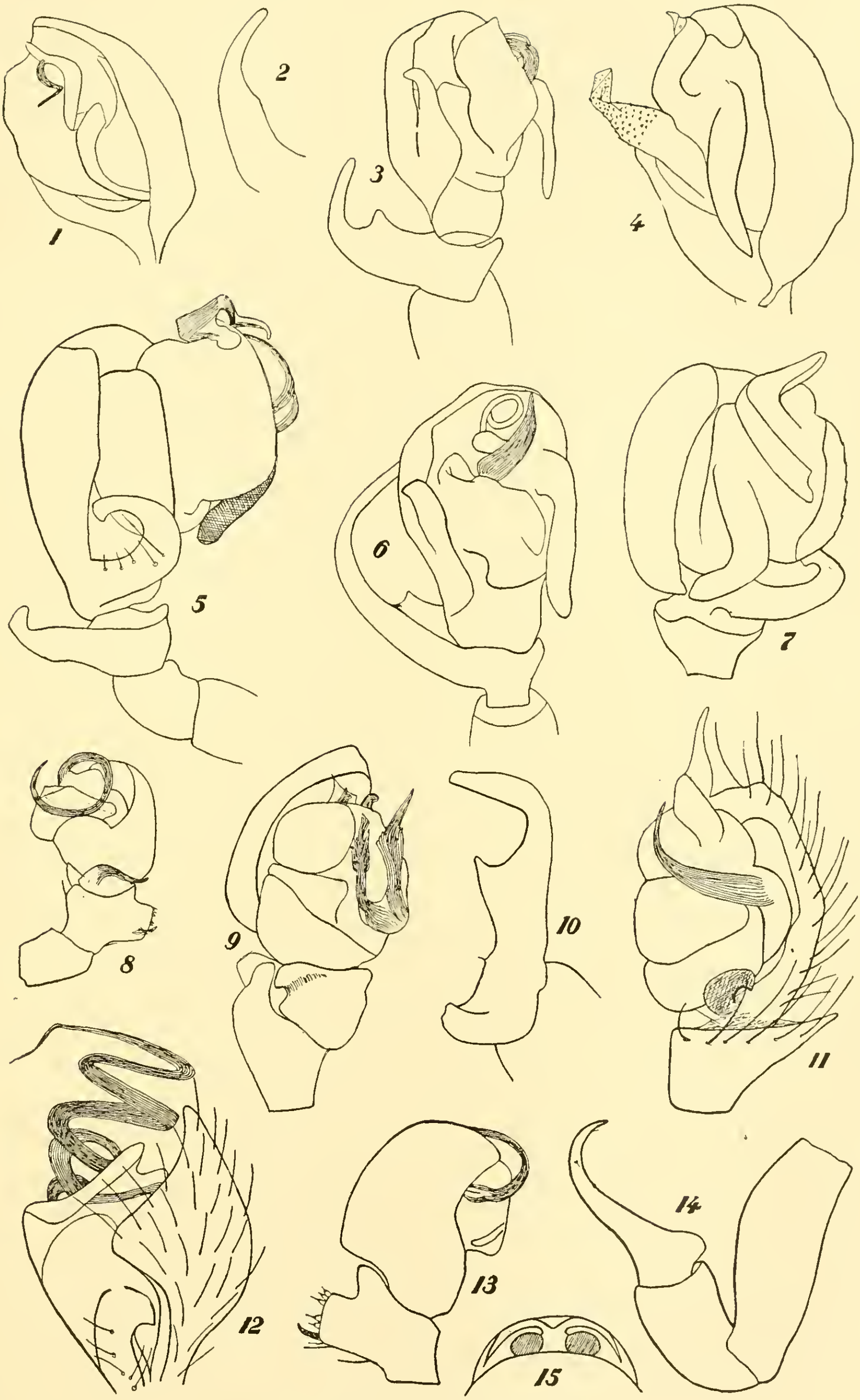
A more slender shell than *C. nesioticum*, more coarsely sculptured, with convex whorls and smaller, more laterally expanded aperture.

Cerithium hawaiense n. sp.

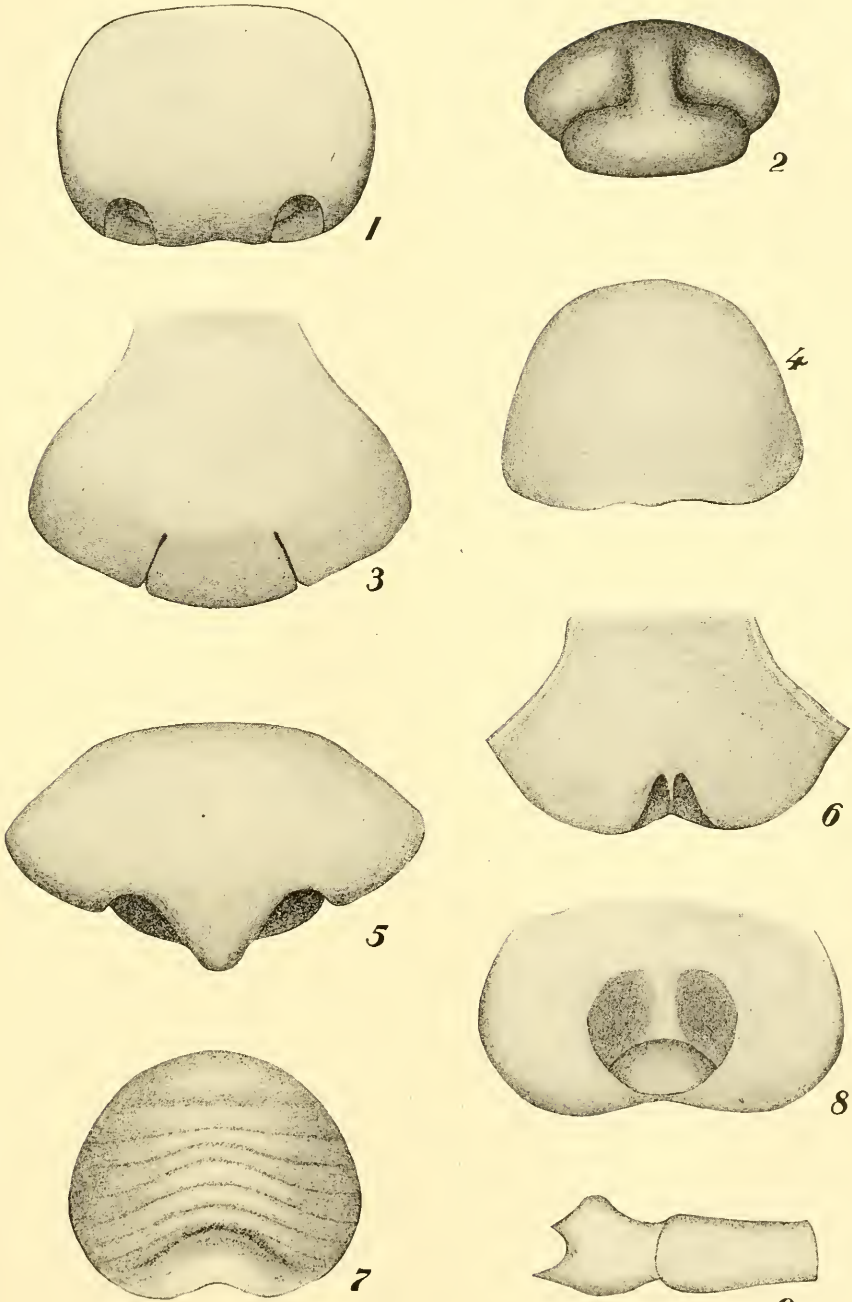
Shell minute, purplish-black, the whorls of the spire carinated a short distance above the suture, acutely so on the earlier whorls; strongly plicate above the carina, the folds rounded, about as wide as the intervals, obsolete or reduced to ripples on the latter half of the last whorl. There is one strong varix, usually white, on the back of the last whorl; the whole surface closely striate spirally throughout. Whorls 7 or 8, the last shortly produced below. Aperture ovate, the outer lip evenly arcuate; basal notch short, deep and open. Length 3.5, diam. 1.2 mm.

Hilo, Hawaii. (D. Thaanum.) Types No. 90,089, Coll. A. N. S. Phila. There are also specimens in the collections of D. Thaanum, S. Raymond Roberts, and the Australian Museum at Sydney.

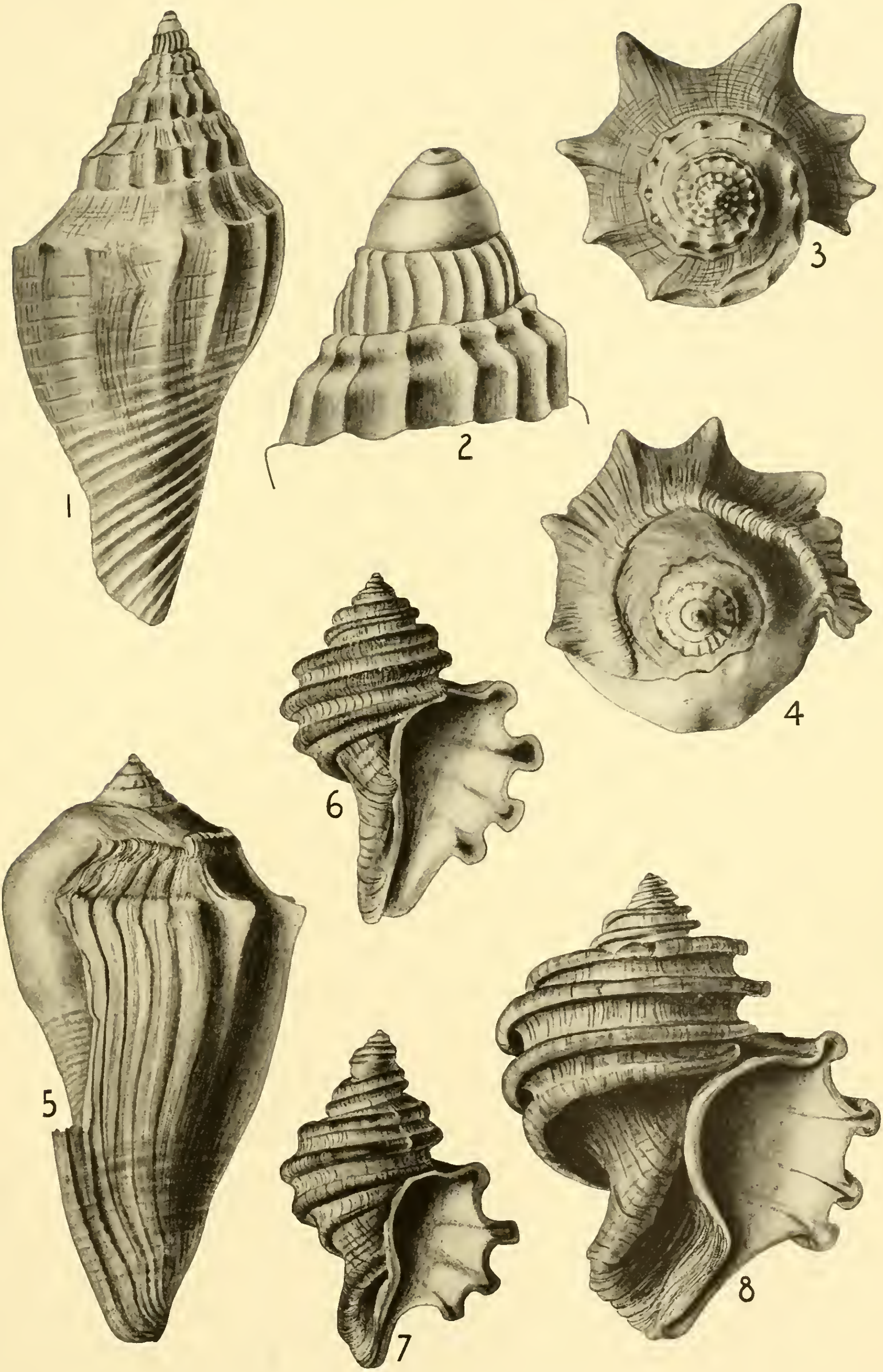
Its more striking characters are the acute keel on the earlier whorls and the regular wave-like folds above the keel.



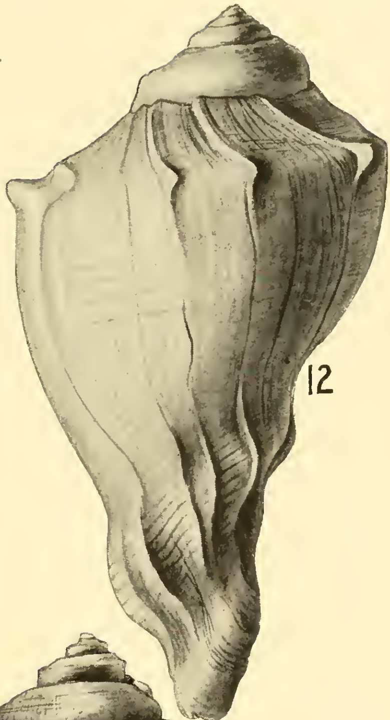
CROSBY. ERIGONEÆ.

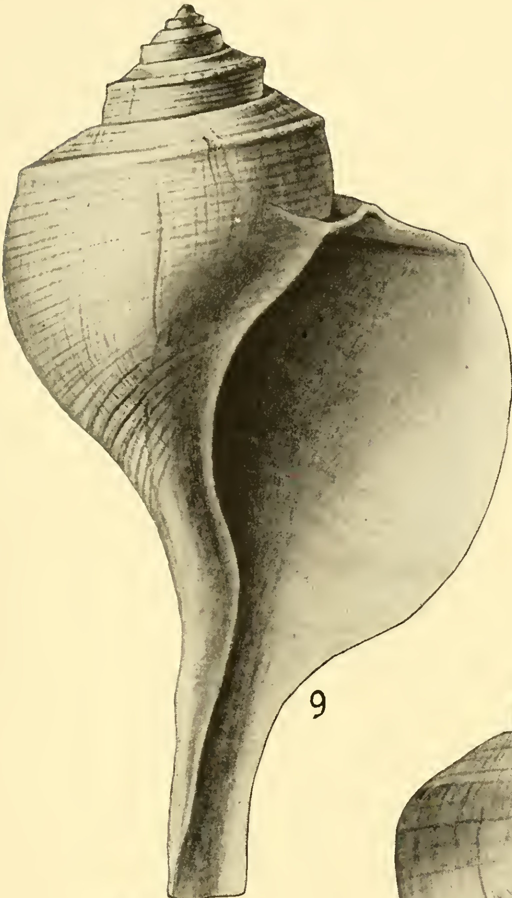


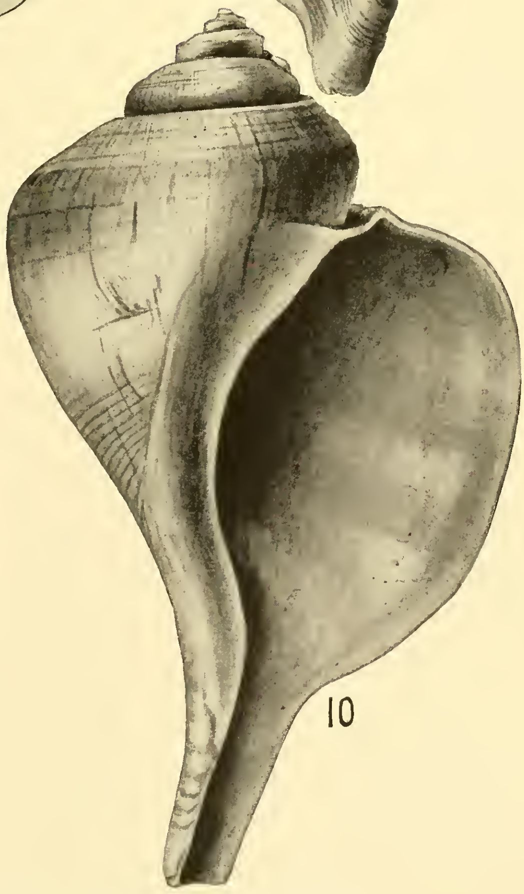
CROSBY. ERIGONEÆ

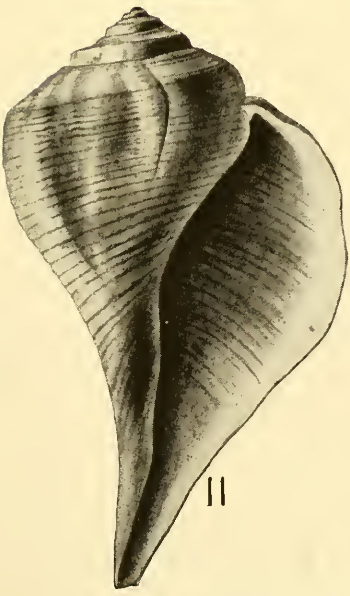


SMITH. SENILITY AMONG GASTROPODS.

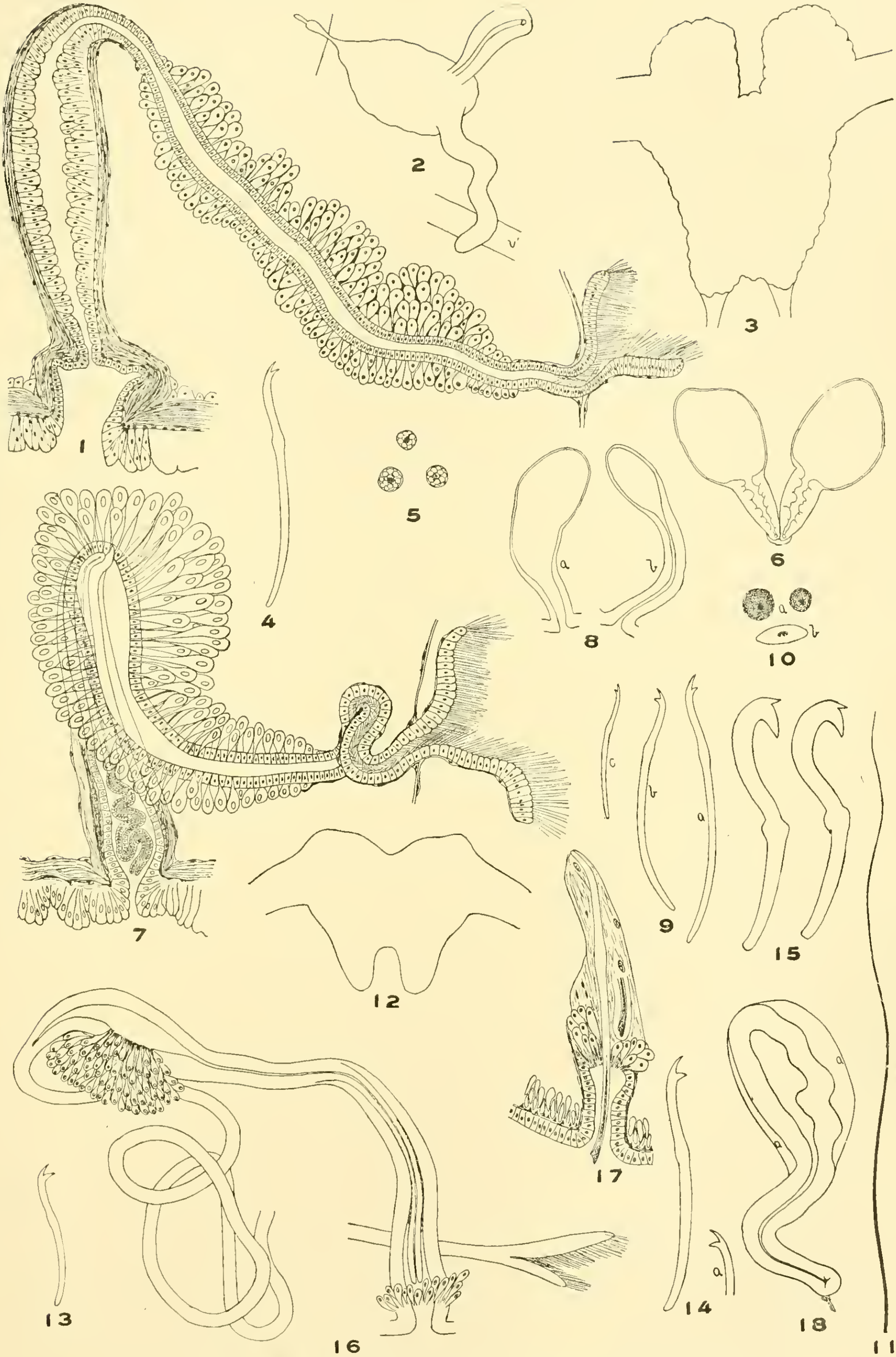




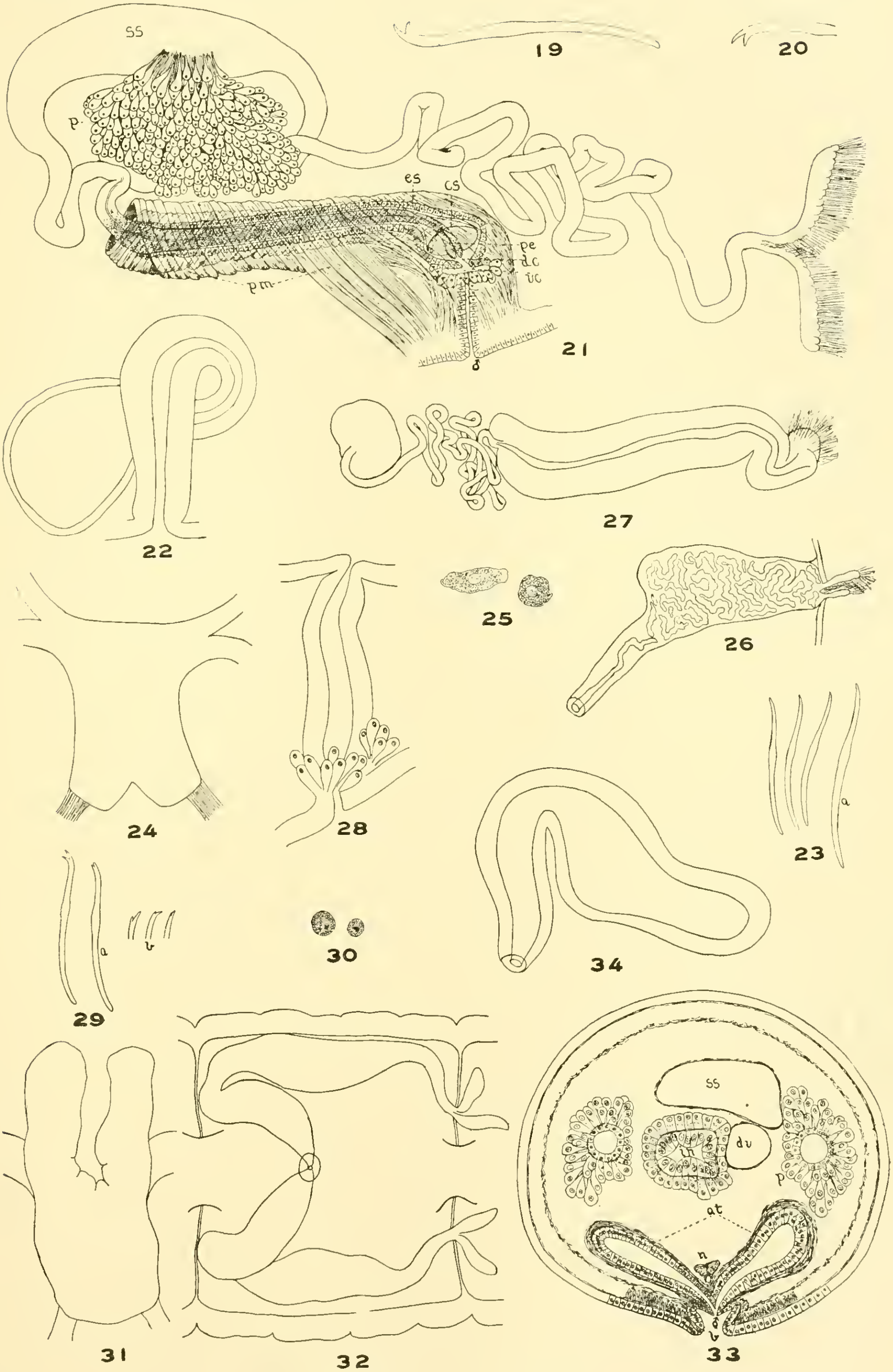




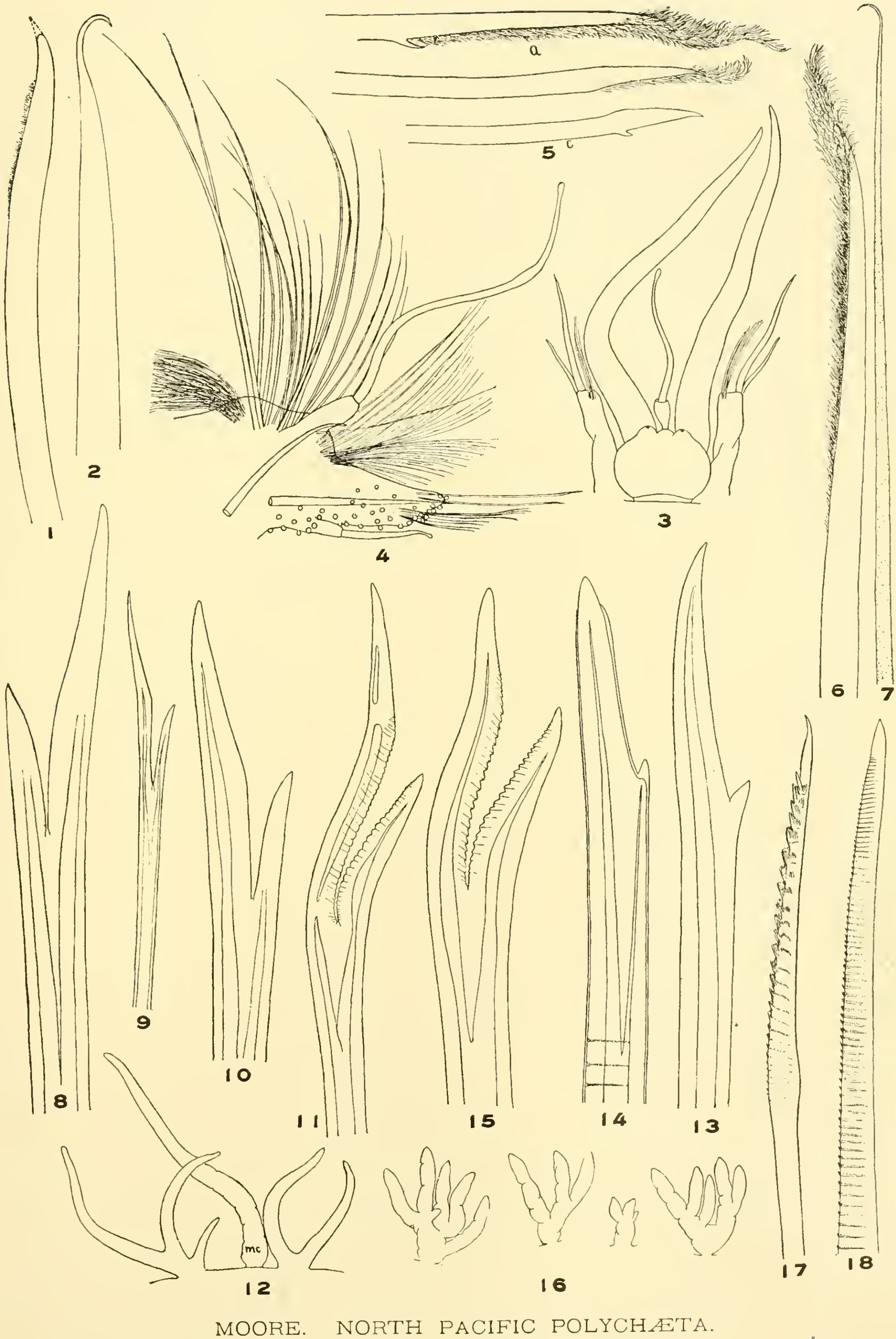
SMITH. SENILITY AMONG GASTROPODS.



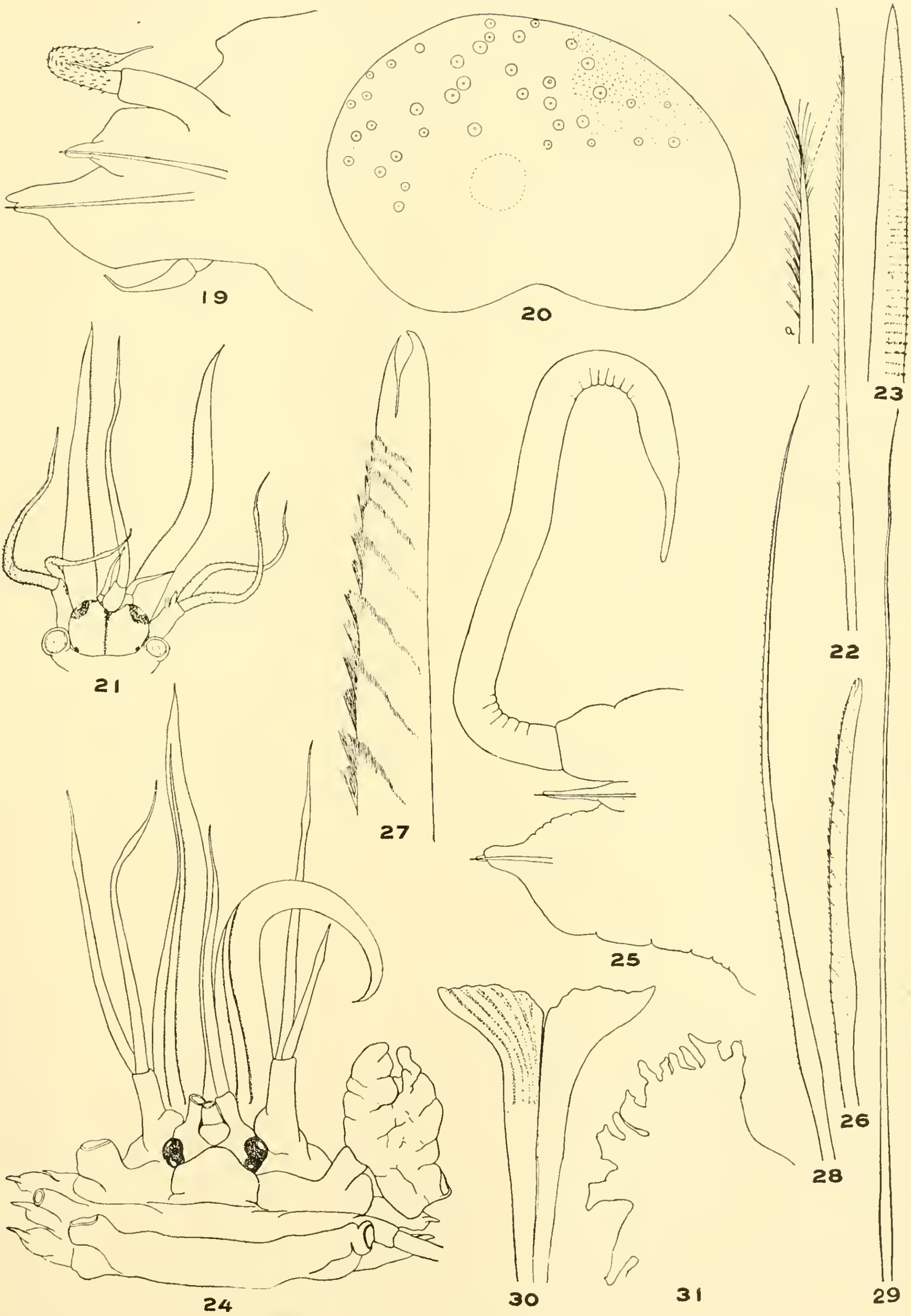
MOORE. OLIGOCHÆTA OF NEW ENGLAND.



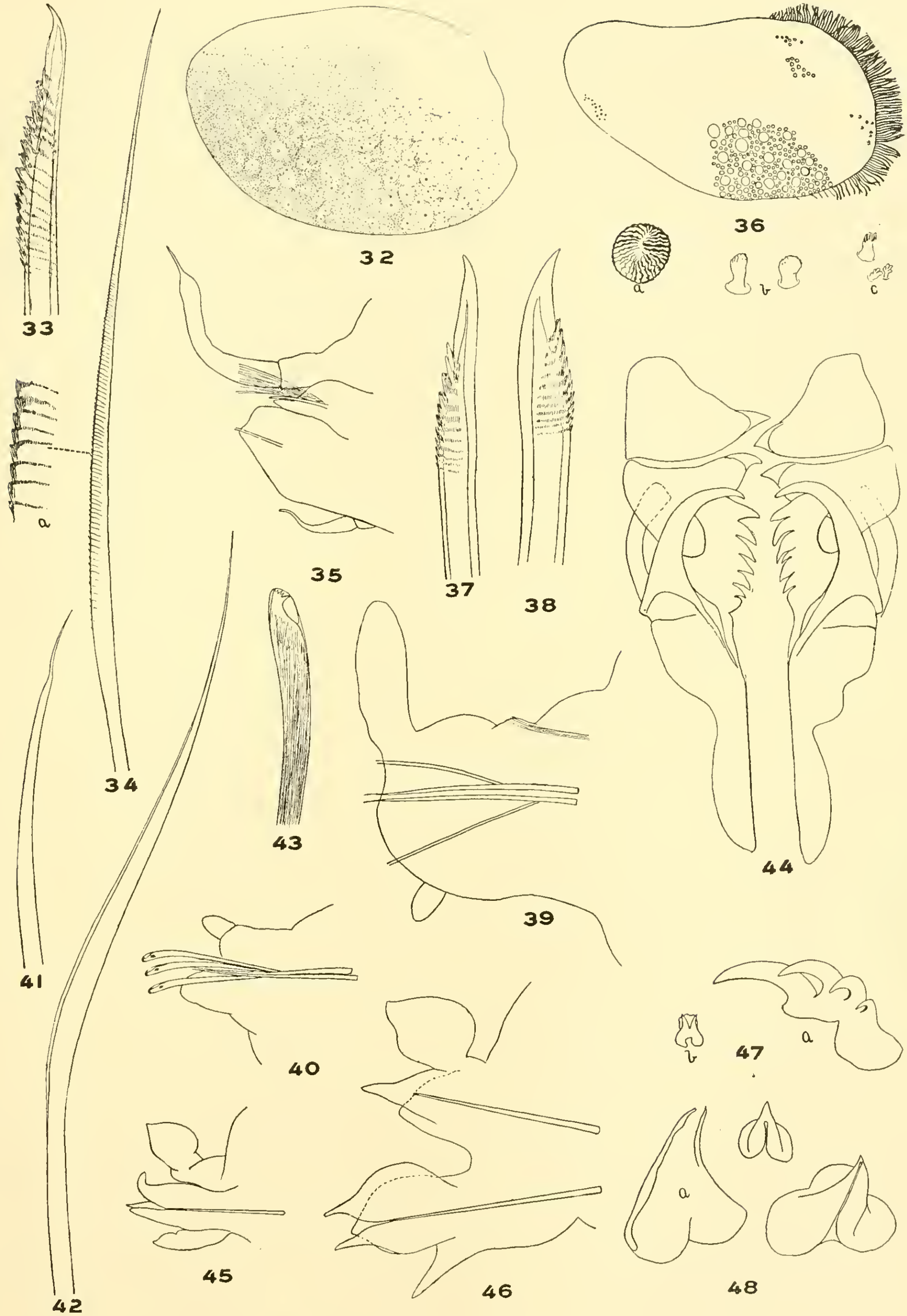
MOORE. OLIGOCHÆTA OF NEW ENGLAND.



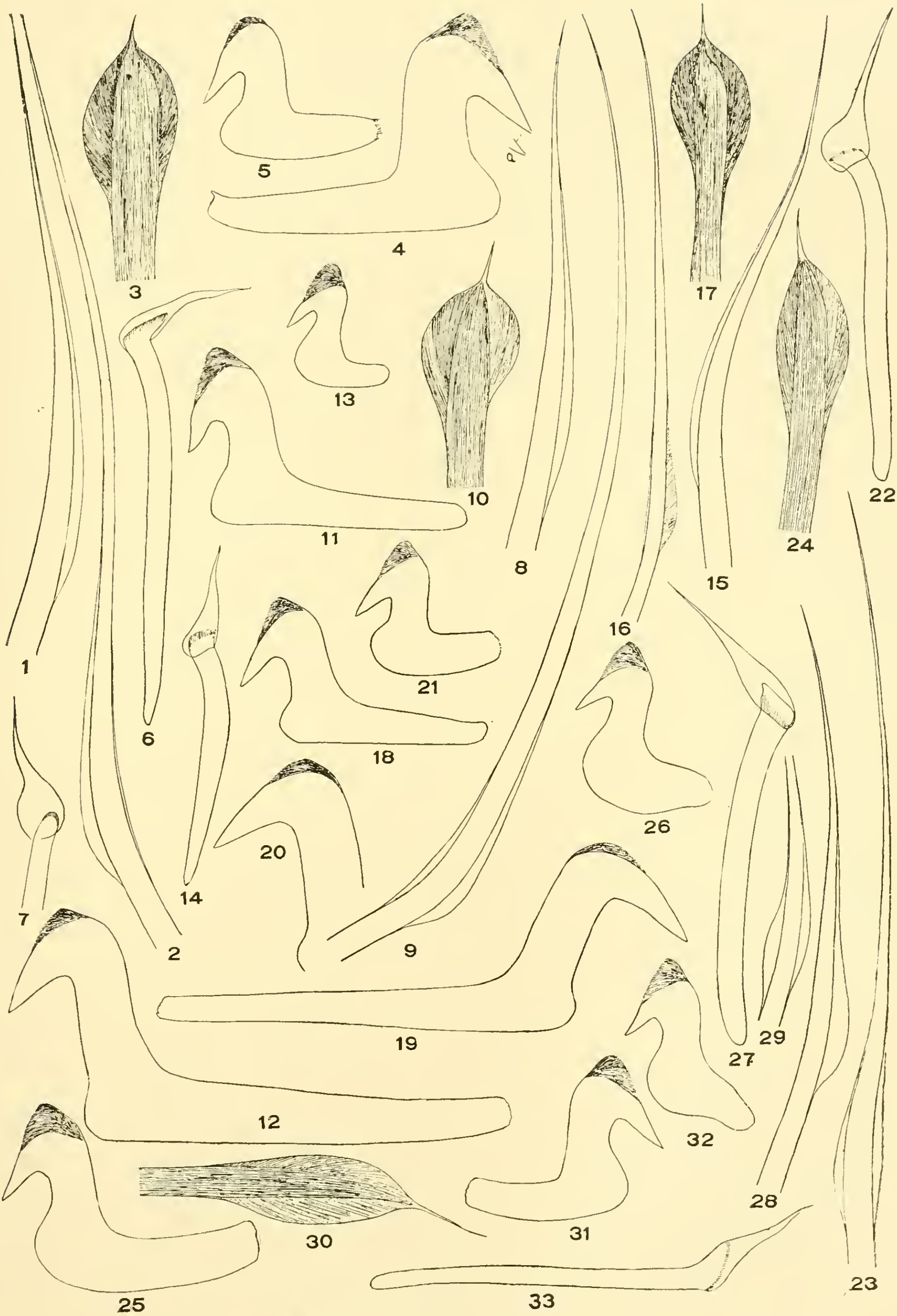
MOORE. NORTH PACIFIC POLYCHÆTA.



MOORE. NORTH PACIFIC POLYCHÆTA.



MOORE. NORTH PACIFIC POLYCHÆTA.



MOORE. PSEUDOPOTAMILLA.

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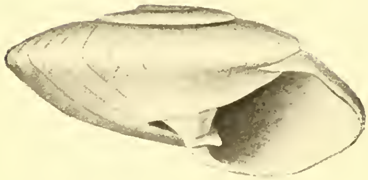

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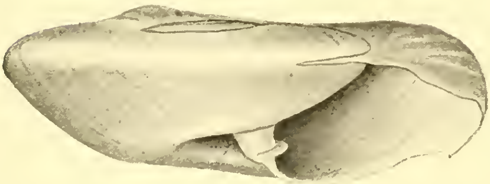

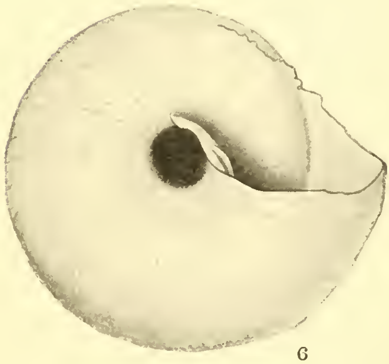

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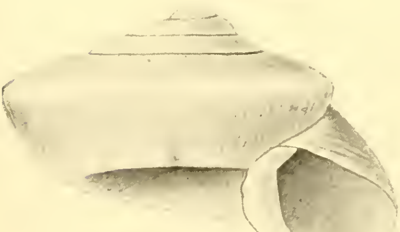
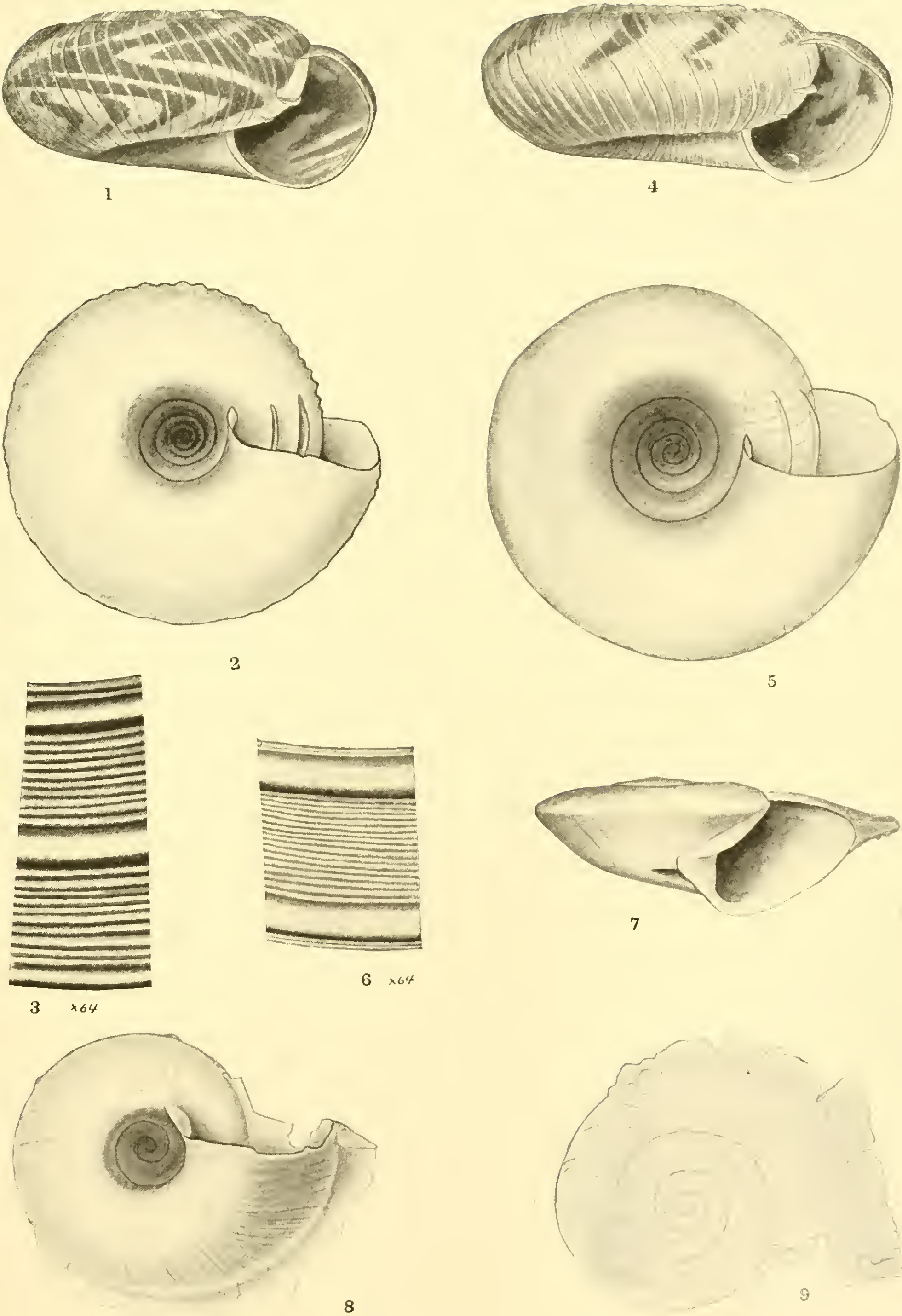


7

PILSBRY AND VANATTA.
HAWAIIAN ACHATINELLIDÆ AND ENDODONTIDÆ.



PILSBRY AND VANATTA.
HAWAIIAN ACHATINELLIDÆ AND ENDODONTIDÆ.

CRATÆGUS IN EASTERN PENNSYLVANIA.

BY C. S. SARGENT.

This preliminary sketch of the genus *Cratægus* in eastern Pennsylvania is based chiefly on the large collections and copious field notes made during the last five years by Mr. Benjamin H. Smith, of Philadelphia, in Delaware, Philadelphia and Chester counties, by Dr. C. D. Fretz, of Sellersville, in Bucks county principally in the neighborhood of Sellersville and at Durham, and by Mr. C. L. Gruber in Berks county, largely near Kutztown, and in North Heidelberg township. Their careful observations and assistance have made this publication possible. A few specimens collected by the late Prof. Porter in Easton, Northampton county, and by Mr. A. MacElwee, of the Philadelphia Museums, are also included. Previous to his death in 1904, Mr. W. M. Canby, of Wilmington, Delaware, had become interested in the thorns of eastern Pennsylvania, and together we had collected considerable material in Bucks, Delaware and Monroe counties during several journeys that we made for the purpose of studying the genus in this interesting region.

This paper is published at this time with no idea that it is exhaustive or final, but to show the richness of eastern Pennsylvania in forms of this genus, and with the hope that this unexpected revelation will lead other botanists living in that part of the State to carry on the work of investigation so ably begun by their associates.

The following arrangement of the natural groups in which the species of eastern Pennsylvania may be arranged will perhaps prove helpful in the study of the group.

CONSPECTUS OF THE NATURAL GROUPS OF THE SPECIES OF EASTERN PENNSYLVANIA.

1.—Nutlets without ventral cavities.

*Petioles short, glandless or with occasional minute glands; leaves obovate to oblong, oval or rarely ovate, cuneate at the base; corymbs many-flowered.

Leaves coriaceous, dark green and shining above, mostly quite glabrous, usually serrate only above the middle, their veins thin except on vigorous shoots and sometimes within the parenchyma; corymbs glabrous; fruit oblong to subglobose; nutlets 1–3, generally obtuse and rounded at the ends, prominently ridged on the back, . 1. CRUS-GALLI.

Leaves membranaceous to subcoriaceous, mostly acute or occasionally rounded at the apex, their veins prominent; corymbs villose; fruit usually short-oblong, often conspicuously punctate; flesh dry and mealy; nutlets 2–5, prominently ridged on the back, . . . 2. PUNCTATÆ.

**Petioles elongated, usually slender (short and stout in Unifloræ), glandular only toward the apex (in Intricatæ sparingly glandular throughout).

Leaves mostly broad at the base.

Corymbs many-flowered (few-flowered in some species of Pruinosæ).

Fruit subglobose to short-oblong, rarely pyriform, red or green, often slightly 5-angled, generally pruinose, especially during the summer; leaves blue-green, thin and firm to subcoriaceous, or rarely coriaceous, 3. PRUINOSÆ.

Fruit short-oblong to obovate, ovate or subglobose, red or scarlet, mostly lustrous, usually 1–1.5 cm. long; stamens 10 or less; anthers rose color, purple or red; leaves mostly membranaceous, hirsute on the upper surface while young, ... 4. TENUIFOLIÆ.

Fruit subglobose, obovate or short-oblong, scarlet, 1.5–2 cm. long; flesh thick; nutlets thick, pointed at the ends, usually slightly ridged; corymbs tomentose; leaves membranaceous, broad, cuneate to rounded or cordate at the base, more or less pubescent below; stamens 10 or less; anthers white or pink, 5. MOLLES.

Fruit short-oblong to subglobose, 1.5–2 cm. long, scarlet, lustrous; flesh succulent; nutlets 3–5, grooved and occasionally ridged on back; corymbs slightly villose; leaves large, membranaceous, oblong, more or less acutely lobed; stamens 10 or less; anthers rose color, 6. FLABELLATÆ.

Leaves cuneate at the base (rarely broad in Intricatæ), subcoriaceous or membranaceous.

Corymbs many- or few-flowered, glabrous or villose; fruit subglobose, 9–12 mm. in diameter; leaves dark green and lustrous on their upper surface, . . 7. COCCINEÆ.

Corymbs usually few-flowered; fruit subglobose to short-oblong or obovate, 1–1.5 cm. long, greenish-yellow, orange color or red; nutlets 3–5, rounded at the ends, generally conspicuously ridged on the back, 8. INTRICATÆ.

Flowers solitary, or in 2 or 3-flowered simple corymbs; calyx lobes large and foliaceous; stamens 20; anthers pale yellow; leaves obovate, nearly sessile; small shrubs, ... 9. UNIFLORÆ.

2.—Nutlets with longitudinal cavities on their ventral faces; fruit pyriform to subglobose or short-oblong, 1–1.5 cm. in diameter lustrous, orange or scarlet; nutlets 2 or 3, usually obtuse at the ends, prominently ridged on the back, 10. TOMENTOSÆ.

I.—CRUS-GALLI.

Anthers rose color.

Primary veins within the parenchyma; leaves obovate-cuneiform. mostly rounded at the apex; stamens 10; fruit short-oblong, often covered with a glaucous bloom, 8–12 mm. long; nutlets 2, 1. *C. crus-galli.*

Primary veins without the parenchyma, thin but conspicuous.

Leaves obovate to oval, acute at the apex; stamens 15, fruit short-oblong, dull red covered with a glaucous bloom, 1.8–1.2 cm. long; nutlets 2, ... 2. *C. rivalis.*

Leaves oblong, cuneate to ovate or rarely obovate, acute or rarely rounded at the apex; stamens 10–13; fruit short-oblong to subglobose, dark crimson, lustrous, 1.2–1.5 cm. long; nutlets 3–5, ... 3. *C. canbyi.*

Anthers pale yellow.

Leaves obovate, acute, acuminate or rarely rounded at the apex, their primary veins mostly within the parenchyma; stamens 5–10, rarely 12; fruit short-oblong, 1–1.2 cm. long, dark dull crimson; nutlets 1 or 2, ... 4. *C. arduennæ.*

Leaves obovate-cuneate, short-pointed or rarely rounded at the apex, their primary veins very slender, mostly without the parenchyma; stamens 8–10; fruit subglobose, dark crimson, rather lustrous, 8–9 mm. in diameter; nutlets 1 or 2, 5. *C. bartramiana.*

1. Cratægus crus-galli Linnæus.

Spec. 476 (1753).——Sargent, Silva N. Am., IV, 91, t. 178; Man. 368, f. 286.

Cratægus trahax Ashe, Jour. Elisha Mitchell Sci. Soc., XIX, part I, p. 27 (1903). Gruber, Proc. Berks County Nat. Sci. Club, I, 21 (Cratægus in Berks County, II).

Berks county: North Heidelberg, *C. L. Gruber* (No. 61), 1901, May and September, 1903; (No. 105), 1902, May and August, 1903; Kutztown, *C. L. Gruber* (No. 45), 1902, August, 1903. Philadelphia county: Gray's Ferry, Philadelphia, *A. MacElwee* (No. 2,267, Herb. Philadelphia Museums), June, 1901; Haddington, *A. MacElwee* (No. 2,233A, Herb. Philadelphia Museums), June, 1901.

Cratægus trahax (Gruber, No. 45) appears to differ from common forms of *Cratægus crus-galli* only in its usually unarmed branchlets and small fruit. Gruber's No. 105 is, perhaps, the same.

Cratægus crus-galli var. **oblongata** Sargent.

Bot. Gazette, XXXV, 99 (The Genus Cratægus in New Castle County, Delaware); Man. 369.

Leaves slightly hairy on the upper side of the midribs while young, becoming glabrous. *Fruit* oblong, often 2–5 centimeters in length, rather brighter-colored than those of the type; nutlets usually 1 or occasionally 2, acute at the ends, prominently or only slightly ridged on the dorsal side, 1–1.2 cm. long.

Bucks county: Durham, *C. D. Fretz* (No. 147A), September and October, 1901, September, 1902. Berks county: North Heidelberg, *C. L. Gruber* (No. 109), 1902, May and September, 1903. Also near Wilmington, Delaware.

Readily distinguished by the hairs on the upper side of the midribs of the young leaves, and by the larger oblong fruits usually with a single nutlet. Further investigation of this form may show that it should be considered a species.

Cratægus crus-galli var. **capellata** Sargent.

Bot. Gazette, XXXV, 100 (The Genus Cratægus in New Castle County, Delaware) (1903); Man. 369.

Leaves oblong-obovate, rounded or acute at the apex. *Flowers* 8–10 mm. in diameter, in many-flowered slightly villose corymbs; stamens 7–10; anthers pale rose color; styles usually 1, rarely 2. *Fruit* subglobose to short-oblong, green, slightly blotched with red, 8–9 mm. in length.

Philadelphia county: Meadow at the head of the Wissahickon Drive, Germantown, *W. M. Canby*, May 24, 1902.

What appears an unusual form of *Cratægus crus-galli* has been found by Mr. Smith below Gray's Ferry in West Philadelphia (No. 248). It is a tree about 5 m. high, nearly destitute of thorns, with wide-spreading branches forming a round-topped head, oblong-obovate leaves acute, acuminate or rarely rounded at the apex, their veins more prominent than those of the leaves of ordinary forms of *Cratægus crus-galli*. Flowers 8–10 mm. in diameter in many-flowered glabrous corymbs; stamens 6–10; anthers pink; styles 1 or 2. The fruit I have not seen. The absence of thorns is remarkable in plants of this group.

2. Cratægus rivalis n. sp.

Leaves obovate to oval, acute at the apex, gradually narrowed and concave-cuneate at the base, and sharply usually simply serrate above the middle, with glandular teeth; nearly fully grown when the flowers open from the 20th to the 25th of May, and then villose, with long pale hairs on the upper side of the midribs and of the petioles, and at maturity glabrous, dark green and very lustrous on the upper and dull and paler on the lower surface, 4–5 centimeters long, 2–2.5 centimeters wide, with prominent yellow midribs and slender conspicuous veins without the parenchyma; their petioles slender, grooved, more or less wing-margined toward the apex, becoming glabrous, occasionally furnished with minute glands; on vigorous shoots leaves oval, acute or abruptly acuminate, coarsely doubly serrate often nearly to the base, sometimes laterally divided into short acute lobes, 8–10 cm. long and 5–6 cm. wide, with stout petioles wing-margined nearly to the base, and foliaceous lunate coarsely serrate stalked petioles 1–1.5 cm. in length. *Flowers* 1.3–1.5 cm. in diameter, on slender pedicels, in compact glabrous corymbs, with caducous glandular bracts and bractlets; calyx-tube narrowly obconic, the lobes linear, acuminate, entire or occasionally glandular-serrate, sparingly villose on the inner surface below the middle; stamens 15; anthers rose color; styles 2 or 3, surrounded at the base by tufts of pale hairs. *Fruit* ripening toward the end of September in few-fruited drooping clusters, short-oblong, full and rounded at the ends, dull red covered with a glaucous bloom, 1–1.2 cm. long; calyx-cavity narrow, the lobes little enlarged, reflexed and closely appressed, villose above, often deciduous from the ripe fruit; nutlets narrowed at the apex, rounded at the base, very prominently ridged on the back, with a broad high grooved ridge, 8–10 mm. long and 5–6 mm. wide.

A bushy tree, with a short stout stem occasionally 30 cm. in diameter, covered with light red-brown scaly bark, stout ascending ashy-gray branches forming a broad open head, and stout branchlets glabrous, dull green and marked by numerous pale lenticels when they first appear, light orange or reddish-brown and very lustrous in their first winter, dull orange or dull gray-brown in their second year, and armed with numerous stout straight or slightly curved dark reddish-brown ultimately ashy-gray spines 2–3 cm. in length.

Bucks county: Meadows of Perkiomen creek, Sellersville, *C. D. Fretz* (Nos. 8, 24, 113), May, 1881, May, July, September and October, 1899.

Well distinguished from *Cratægus crus-galli* Linnæus, by the shape of the acute leaves, their prominent veins, the hairs on the upper surface of the midribs, and especially by the shape of the large leaves of vigorous shoots, by the larger number of stamens and the earlier ripening of the fruit.

3. Cratægus canbyi Sargent.

Bot. Gazette, XXXI, 3 (1901); Silva N. Am., XIII, 41, t. 638; Man. 369, f. 287.

Bucks county: Point Pleasant, *C. D. Fretz* (No. 116), September, 1899; Tohikon, *C. D. Fretz* (No. 25), July 1, 1899. Delaware county: Tinicum, *B. H. Smith*, October, 1899, May and October, 1900 (No. 191*b*), May, 1902. Bucks county: Near Quakertown, *C. D. Fretz* (No.

120), October, 1889; meadows of Tohikon creek, Quakertown, *W. M. Canby*, May, 1900. Also in the hedge of old thorn trees bordering the lane leading to Bartram's Garden in West Philadelphia, where, judging by the size of these trees, it may have been planted by John Bartram himself; also in Delaware and Maryland.

4. Cratægus arduennæ Sarg.

Bot. Gazette, XXXV, 377 (1903); Man. 373, f. 291.

Berks county: Near Kutztown, *C. L. Gruber* (No. 145), 1902, August and October, 1903, June, 1904; also from southern Michigan to northeastern Illinois.

5. Cratægus bartramiana n. sp.

Leaves obovate-cuneate, abruptly short-pointed or rarely rounded at the apex, gradually narrowed to the elongated slender base, coarsely and often doubly serrate above, with glandular teeth, nearly fully grown when the flowers open during the first week of June, and at maturity glabrous, dark green and lustrous on the upper, dull and paler on the lower surface, 2.5–4 cm. long and 1.5–2 cm. wide, with very slender primary veins mostly within the parenchyma; petioles slender, winged usually to below the middle, sometimes glandular, with occasional large dark glands, 6–7 cm. long; leaves of vigorous shoots obovate to oblong-obovate, usually short-pointed at the apex, coarsely serrate often to below the middle, 5–8 cm. long and 4–5 cm. wide, with linear lanceolate coarsely glandular-serrate deciduous stipules. *Flowers* about 8 mm. in diameter, on slender pedicels, in compound many-flowered corymbs, with linear slightly glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes elongated, linear, entire or rarely obscurely glandular-dentate; stamens 8–10; anthers pale yellow; styles 1 or 2, or rarely 3. *Fruit* ripening from the middle to the end of September, on stout pedicels, in drooping many-fruited clusters, subglobose but a little longer than broad, crimson, lustrous, marked by large dark dots, 8–10 mm. in diameter; calyx-cavity broad and shallow, the lobes enlarged, spreading, reflexed, entire or coarsely serrate and mostly persistent on the ripe fruit; nutlets 1 or 2, full and rounded at the ends, prominently ridged, with broad grooved ridges, about 7 mm. long and 5–6 mm. wide.

A tree 5–7 m. high, with a trunk 25–30 cm. in diameter, covered with dark red-brown scaly bark, stout spreading branches, and slender slightly zigzag dark dull red-brown branchlets armed with numerous stout straight purplish thorns 4–5 cm. long.

Hedgerow along the lane leading to Bartram's Garden, West Philadelphia, *A. MacElwee* (No. 2,270, Herb. Philadelphia Museums), June, 1901; *Canby* and *Sargent*, September, 1902; *Smith* and *Sargent*, October, 1904.

This species is named for John Bartram, the distinguished Pennsylvania botanist of the eighteenth century, by whom, perhaps, was planted the hedge of thorn trees in which it is growing.

II.—PUNCTATÆ.

Anthers rose color or yellow; stamens 20; leaves obovate, often acutely lobed above the middle, especially on vigorous shoots, more or less villose below; fruit on short pedicels, flattened at the ends, marked by large pale dots, dull red or bright yellow, . . 1. *C. punctata.*
Anthers rose color; stamens 10–20; leaves oblong-obovate to oval, glabrous at maturity; fruit on elongated slender pedicels, occasionally slightly obovate, dark brick-red marked by large pale dots, 2. *C. pausiaca.*

1. Cratægus punctata Jacquin.

Hort. Vind., I, 10, t. 28 (1770).——Sargent, Silva N. Am., IV, 103, t. 184; Man. 389, f. 308.
Cratægus crocata Ashe, Ann. Carnegie Mus., I, 389 (1902).——Gruber, Proc. Berks County Nat. Sci. Club, I, 21 (Cratægus in Berks County, II).

Common in eastern Pennsylvania; also from the Province of Quebec to Illinois and through the northeastern States, and along the Appalachian Mountains, to North Carolina and Tennessee.

Cratægus crocata is the common yellow-fruited form which appears to be most abundant in the region adjacent to Lakes Ontario and Erie.

Cratægus punctata var. **canescens** Britton.

Bull. Torrey Bot. Club, XXI, 231 (1894).——Sargent, Man. 389.

Bucks county: Durham, *C. D. Fretz* (No. 153), May and September, 1901. Monroe county: Near Stroudsburg, *W. M. Canby*, May, 1903.

This is a form densely hoary-tomentose on the under surface of the leaves and on the pedicels and corymbs.

2. Cratægus pausiaca Ashe.

Ann. Carnegie Mus., I, 390 (so far as relates to Bucks county) (1902).——Sargent, Trees and Shrubs, I, 105, t. 53; Man. 390, f. 309.

Bucks county: Without locality, *W. W. Ashe*, June and October, 1900; Durham, *C. D. Fretz* (No. 147), May and October, 1901. Delaware county: Newtown, near Crum creek above the West Chester road, *B. H. Smith* (No. 192), May, September and October, 1901, May, 1902, *Smith* and *Sargent*, September, 1902; Lownes' Run, Springfield, *B. H. Smith* (No. 235), May and September, 1903; meadows near Chadsford, *W. M. Canby*, September, 1903.

III.—PRUINOSÆ.

Stamens 20.
- Anthers rose color to pink or red.
  - Corymbs glabrous, fruit subglobose.
    - Corymbs many-flowered.
      - Leaves elliptical; fruit subglobose, green and pruinose when fully grown, becoming dark red and lustrous at maturity, 1.2–1.7 cm. in diameter; anthers large, light rose color, 1. *C. pruinosa.*
      - Leaves ovate, mostly rounded at the broad base; fruit hard and green, 1–1.2 cm. in diameter; anthers red, 2. *C. austera.*
    - Corymbs few-flowered.
      - Leaves ovate to elliptic; fruit depressed-globose, frequently swollen and mamillate at the middle, scarlet, often dark olive green toward the apex, 1.2–1.4 cm. in diameter; anthers light pink, ... 3. *C. bona.*
      - Leaves ovate.
        - Leaves cuneate at the base; fruit short-oblong to ovate, conspicuously 5-angled and mamillate below the middle, bright plum color, 1.3–1.4 cm. long, . 4. *C. arcana.*
        - Leaves rounded to subcordate at the base; fruit depressed-globose, not mamillate below the middle, 1.7–2 cm. in diameter, light red; anthers pale pink, 5. *C. philadelphica.*
        - Leaves ovate to deltoid, usually rounded or truncate at the base; fruit short-oblong to subglobose, bright scarlet; anthers light rose color, ... 6. *C. felix.*
  - Corymbs villose; leaves slightly scabrate above.
    - Leaves ovate, villose below toward the base of the midribs and on the petioles; fruit short-oblong to subglobose, olive green, rarely with a rose-tinted cheek, 9–10 mm. in diameter; anthers light pink, ... 7. *C. virella.*
    - Leaves broadly ovate; villose on the midribs while young; fruit subglobose, retuse at the base, bright green until late in the season, turning scarlet, 1.2–1.4 cm. in diameter; anthers light red, ... 8. *C. ruthiana.*
    - Leaves oblong to elliptic, villose on the upper surface and on the base of the midribs while young; fruit depressed-globose, broader than high, bright green and lustrous until late in the autumn, ultimately becoming bright cherry red, 1.5–1.7 cm. in diameter, . . 9. *C. comata.*
- Anthers pale yellow.
  - Leaves subcoriaceous.
    - Fruit short-oblong to ovate, dull green, 8–9 mm. long; leaves ovate, ... 10. *C. jejuna.*
    - Fruit globose to depressed-globose or round-ovate, deep dark red at maturity, 1–1.6 cm. in diameter.
      - Leaves broadly ovate to deltoid-ovate; arborescent, 5–6 m. high.

Calyx-tube long; fruit dry and mealy, . . 11. *C. uplandia.*
Calyx-tube short; fruit bitter and acid, . 12. *C. callosa.*
Leaves narrow-ovate to oblong-ovate; shrubby, usually 2–5 m. high.
Flowers about 1.2 cm. in diameter, in compact mostly 4–7-flowered corymbs; fruit often obovate, 13. *C. cestrica.*
Flowers often 2 cm. in diameter, in lax 5–10-flowered corymbs, ... 14. *C. augusta.*
Fruit obovate, dull green tinged with red, 1–2 cm. long; leaves oblong-ovate, ... 15. *C. insueta.*
Leaves coriaceous, oblong-ovate to oval, acuminate and long-pointed, glabrous; fruit pyriform, sometimes becoming oblong, dark crimson, 1–1.2 cm. long. . . . 16. *C. porteri.*
Stamens 10 or less. Anthers pink, dark rose color or purple.
Leaves smooth on the upper surface.
Leaves ovate to rhombic, cuneate at the base; fruit depressed-globose, crimson, slightly pruinose, 1–1.2 cm. in diameter; anthers pale pink, ... 17. *C. dissona.*
Leaves rhombic or occasionally oblong-ovate, deeply laciniately lobed; fruit oblong to short-oblong, crimson, covered with a thick glaucous bloom, about 1.2 cm. long; anthers purple, 18. *C. alacris.*
Leaves oval to ovate, cuneate at the base; fruit short-oblong to ovate, conspicuously mamillate at the base, dull red, covered with a glaucous bloom, 1–1.2 cm. in diameter; anthers purple, 19. *C. deducta.*
Leaves scabrate on the upper surface; anthers dark rose color.
Pedicels glabrous.
Leaves ovate, as broad as long, truncate or rounded at the broad base; fruit depressed-globose, bright red, 1–1.2 cm. in diameter, ... 20. *C. deltoides.*
Leaves ovate, usually rounded or cuneate at the base; fruit obovate, greenish-red, with a crimson cheek, 1.2–1.5 cm. long, 21. *C. fretzii.*
Leaves ovate to rhombic, rounded or cuneate at the base; fruit obovate, orange red, 8–10 mm. long, . 22. *C. scabriuscula.*
Pedicels villose; leaves ovate, usually rounded or truncate at the broad base, deeply lobed; fruit oblong to obovate, dull red, covered with a glaucous bloom, 1.4–1.5 cm. long, 23. *C. delicata.*

1. Cratægus pruinosa K. Koch.

Verhandl. Preuss. Gart. Verein, neue Reihe, I. 246 (Cratægus und Mespilus) (1854).——Sargent, Silva N. Am., XIII, 61, t. 648; Man. 411, f. 331.

Philadelphia county: Kingsessing, *B. H. Smith* (No. 208), May, 1902, May and October, 1903, May, 1904. Berks county: Near West Leesport, *C. L. Gruber* (No. 110), 1902, September, 1903, May and August 1904; Forge Hill, North Heidelberg township, *C. L. Gruber* (No. 104)

1902, May and August, 1904. Also from southern Vermont to Illinois and Missouri and southern Virginia.

In Mr. Smith's specimens the anthers are lighter colored than in the Berks county and New England plants. The pedicels of the fruit of all the Pennsylvania specimens are much shorter and stouter than those of the tree figured in *The Silva of North America* and growing in the Arnold Arboretum, and the fruit is smaller.

2. Cratægus austera n. sp.

Leaves ovate, acute or acuminate, full and rounded or broadly or narrowly concave-cuneate at the base, coarsely doubly serrate, with straight glandular teeth, and divided above the middle into three or four pairs of narrow acuminate lateral lobes; when they unfold deep vinous red and glabrous with the exception of a few scattered caducous hairs above, almost fully grown when the flowers open about the 20th of May, and at maturity thin but firm in texture, dark blue-green on the upper, paler and yellowish-green on the lower surface, 4–6 cm. long and 3–4.5 cm. wide, or on vigorous shoots sometimes nearly as broad as long; petioles very slender, grooved on the upper side, glandular toward the apex, with occasional minute glands and 2–3 cm. long; stipules linear, glandular, deep red, caducous. *Flowers* 1.8–2 cm. in diameter, on slender elongated pedicels, in compact glabrous mostly 6- or 7-flowered corymbs, with oblanceolate glandular deep red conspicuous caducous bracts and bractlets; calyx-tube broadly obconic, the lobes slender, entire or sparingly dentate above the middle; stamens 20; anthers large, red; styles 3 to 5, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening very late and remaining hard, on long slender pedicels, in few-fruited clusters, subglobose, dull green or ultimately reddish, 1–1.2 cm. in diameter; calyx enlarged and prominent, with a broad deep cavity and erect or spreading mostly persistent lobes; flesh very thin, hard and dry, closely adhering to the nutlets; nutlets dark reddish-brown, full and rounded at the base, gradually narrowed to the acute apex, broadly ridged on the back, with a grooved ridge, nearly as long as the fruit and about 6 mm. wide.

A shrub 2.5–3 m. high with ascending stems, and slender slightly zigzag branchlets marked by small scattered pale lenticels, dull green to purplish when they first appear, rather bright reddish-brown during their first summer, becoming purplish during the following winter and dull gray-brown in their second year, and armed with numerous very slender nearly straight purplish spines 4–6 cm. in length.

Bucks county: *C. D. Fretz,* near Sellersville (No. 102), May and September, 1899; Hilltown (No. 124), May and September, 1900; Deep

Run, near Sellersville (No. 127, type!), May and September, 1900; Perkasie (No. 137), May and October, 1901; near Sellersville (No. 138), May and September, 1901.

A specimen collected by the late Prof. Porter on College Hill, Easton, Northampton county, September 15, 1893, and labelled *Cratægus coccinea* L., is probably of this species.

3. Cratægus bona n. sp.

Leaves ovate-oblong or occasionally rhombic, acuminate, usually full and rounded or rarely acute or truncate, or on vigorous shoots sometimes subcordate, at the entire base, finely doubly serrate above, with straight glandular teeth, and often slightly divided into 2 or 3 pairs of small acute lateral lobes, pale reddish-bronze when they unfold, more than half-grown when the flowers open about the 20th of May, and then membranaceous and glabrous with the exception of a few scattered caducous hairs on the base of the upper side of the midribs, and at maturity thin, dark bluish-green on the upper, pale on the lower surface, 3.5–4.5 cm. long and 2.5–3 cm. wide, with thin midribs and slender veins extending obliquely to the points of the lobes; petioles very slender, obscurely grooved on the upper side, slightly wing-margined at the apex, glandular at first, with scattered stipitate caducous glands, 2–2.5 cm. in length; stipules narrow, acuminate, falcate, conspicuously glandular, caducous. *Flowers* 1.6–1.8 cm. in diameter, on short slender glabrous pedicels, in small very compact 2–6-flowered simple corymbs, with comparatively large oblong-obovate to linear glandular caducous bracts and bractlets; calyx-tube broadly obconic, the lobes separated by wide sinuses, gradually narrowed from a broad base, short, acute or acuminate, entire or rarely obscurely toothed, tinged with red at the apex; stamens 20; anthers pink; styles 3–5, usually 4, surrounded at the base by a narrow ring of short pale hairs. *Fruit* ripening early in October, on short erect pedicels, usually in 1–4-fruited clusters, depressed-globose, often angular, sometimes swollen and acutely mamillate round the middle, slightly concave or flattened at the apex, retuse at the base, scarlet, frequently dark olive-green or spotted with russet or orange toward the apex, covered with a glaucous bloom, 1.2–1.4 cm. in diameter and 1–1.1 cm. high; calyx enlarged, with a short tube, a broad deep cavity and spreading and closely appressed lobes red on the upper side below the middle and mostly persistent on the ripe fruit; flesh thin, firm, yellow or greenish-yellow, dry and mealy; nutlets usually 4.

A shrub, sometimes 3–4 m. high, with numerous ascending to semi-erect slender flexuose stems covered with dark gray or nearly black scaly bark, and slender nearly straight branchlets marked by occasional pale lenticels, dull red-brown and covered with a glaucous bloom when they first appear, becoming lustrous and dull gray-brown in their second year, and armed with few slender nearly straight purplish-brown spines usually 3–6 or occasionally only 1–2 cm. in length, often becoming compound on old stems.

Berks county: Gravelly limestone bluffs along Tulpehocken creek, North Heidelberg township, *C. L. Gruber* (No. 106, type!), 1902, May, August and September, 1904.

4. Cratægus arcana Beadle.

Bilt. Bot. Studies, I, 122 (1902); Small, Fl. S. E. States, 564.——Sargent, Bot. Gazette, XXXV, 101 (The Genus Cratægus in New Castle County, Delaware).

Berks county: Limestone bluffs, Tulpehocken creek, North Heidelberg township, *C. L. Gruber* (No. 151), 1902, May, August and September, 1903. Bucks county: Near Sellersville, *C. D. Fretz* (Nos. 126, 141), May, 1898, October, 1899, May and September, 1900, May, 1901. Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 229), May and October, 1903; near Chadsford, *B. H. Smith* (No. 196), May and September, 1902; *W. M. Canby*, October 8, 1902. Also northern Delaware to the elevated regions of western North Carolina.

A shrubby species common in eastern Pennsylvania, with thin cuneate leaves except on vigorous shoots, and fruits obconic at the base and conspicuously swollen or mamillate below the middle.

5. Cratægus philadelphica n. sp.

Leaves ovate, acute or acuminate, full and rounded or subcordate at the broad entire base, sharply doubly serrate above, with straight glandular teeth, and divided above the middle into 3 or 4 pairs of small acute spreading lobes, more than half-grown when the flowers open about the 10th of May and then membranaceous, light yellow-green and sparingly villose above, especially on the midribs and veins, pale and glabrous below, and at maturity subcoriaceous, dark dull blue-green on the upper, pale bluish-green on the lower surface, 4–4.5 cm. long and 3.5–4 cm. wide, with stout midribs and usually 4 pairs of thick primary veins arching obliquely to the points of the larger lobes; petioles stout, abruptly wing-margined at the apex, grooved on the upper side, glabrous, only occasionally glandular and 1.5–2 cm. in length; stipules linear, acuminate, coarsely glandular, fading red, caducous; leaves on vigorous shoots often broader than long and cordate or truncate at the base. *Flowers* 2 cm. in diameter, on slender glabrous pedicels, in compact few, usually 5–7-flowered corymbs; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, acuminate, entire with slightly undulate margins, or occasionally furnished with 1 or 2 teeth near the middle, reflexed after anthesis; stamens 16–20; anthers pale pink; styles usually 5, surrounded at the base by a conspicuous ring of long white hairs. *Fruit* ripening from the first to the middle of October, on short stout erect pedicels, in mostly 3–5-flowered clusters, depressed-globose, full and rounded at the base, more or less angled, green and lustrous until late in the season, marked by many large dark dots, becoming finally light red, 1.7–2 cm. in diameter and 1.5 cm. high; calyx much enlarged, without a tube and with a broad deep cavity, and spreading often incurved lobes slightly and irregularly serrate particularly toward the apex, red on the upper side below the middle, and mostly deciduous from the ripe fruit; flesh thick, pale yellow, dry and mealy; nutlets 3–5, usually 5, full and rounded at the ends, prominently ridged on the back, with a broad deeply grooved ridge, about 7 mm. long and 4 mm. wide.

A broad shrub, with numerous erect stems 3–4 m. high, and slender nearly straight branchlets marked by many pale lenticels, dark red-brown and covered with a glaucous bloom when they first appear, darker and very lustrous during their first winter, dark gray-brown the following year and armed with nearly straight slender red-brown lustrous spines 3.5–5 cm. in length.

Philadelphia county: Island road, Kingsessing, West Philadelphia, *B. H. Smith* (No. 194, type!), May and September, 1901; *Smith* and *Sargent*, September, 1902.

6. Cratægus felix n. sp.

Leaves ovate to deltoid, acuminate, rounded, truncate or rarely concave-cuneate at the entire or glandular base, sharply doubly serrate above, with straight gland-tipped teeth, and deeply divided into 3 or 4 pairs of narrow acuminate lobes, more than half-grown when the flowers open from the 10th to the 15th of May and then very thin, bright yellow-green, slightly hairy and scabrate above, soon becoming smooth and glabrous, and pale or glaucous and glabrous below, and at maturity thin and firm in texture, dark yellow-green on the upper and pale on the lower surface, 3–5 cm. long, 2–5 cm. wide, and often rather broader than long, with slender yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, grooved on the upper side, slightly wing-margined at the apex, glandular, with minute persistent glands, glabrous, 1–1.5 cm. in length; leaves on vigorous shoots broadly ovate, rounded to subcordate at the base, coarsely serrate, usually deeply divided into broad acuminate lateral lobes, sometimes 6–7 cm. long and wide, with stout broadly winged coarsely glandular petioles. *Flowers* 1.7–2 cm. in diameter, on slender glabrous pedicels, in 3–8-flowered simple corymbs, with small linear acuminate glandular bracts and bractlets, fading brown; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, entire or slightly toothed near the middle, reflexed after anthesis; stamens 18–20; anthers light rose color; styles 3–5. *Fruit* ripening about the 20th of September, on slender pedicels, in usually 4- or 5-flowered compact drooping clusters, short-oblong to subglobose, often slightly tapering at the base, bright scarlet, rarely blotched with russet, covered with a glaucous bloom, finally becoming very lustrous, 1.2–1.5 cm. in diameter; calyx little enlarged, closely appressed, with a broad shallow cavity and slender reflexed persistent lobes, dark red on the upper side toward the base; flesh firm, light orange color sometimes tinged with red; nutlets 3 or 4, gradually narrowed and rounded at the base, acute at the apex, slightly and irregularly ridged on the back, 7–8 mm. long and 5–6 mm. wide.

A broad compact bush 2–3 m. high, with numerous erect flexuose stems covered with dark gray bark and slender nearly straight glabrous branchlets marked by oblong pale lenticels, light orange color tinged with red and slightly glaucous when they first appear, becoming light reddish or chestnut-brown in their first winter, and ashy-gray the following year, and armed with numerous stout nearly straight or slightly reflexed bright chestnut-brown or purplish spines 2.5–3 cm. in length.

Berks county: Dry open stony fields east of Reading; common; *C. L. Gruber* (No. 112, type!), August and September, 1904, May, 1905.

7. Cratægus virella Ashe.

Annals Carnegie Mus., I, pt. 3, 396 (1902).——Gruber, Proc. Berks County Nat. Sci. Club, I, 15 (Cratægus in Berks County, II).

Leaves ovate, acuminate, cuneate or rounded at the entire base, sharply doubly serrate above, with slender spreading or incurved teeth, and divided into numerous small acuminate spreading lobes, more than half-grown when the flowers open from the 15th to the 20th of May and then membranaceous, bluish-green and villose above, with short pale deciduous hairs and below along the base of the midribs with long spreading hairs, and at maturity thin but firm, dark blue-green and slightly roughened on the upper and pale and still villose on the slender midribs below, 3.5–4.5 cm. long, 2–4 cm. wide, with 3 or 4 pairs of primary veins extending obliquely to the points of the largest lobes; petioles slender, abruptly and often broadly wing-margined at the apex, villose while young, with long matted hairs, becoming glabrous, glandular, with occasional minute caducous glands, and 1.5–2.5 cm. in length; stipules linear, acuminate, glandular, caducous; leaves on leading shoots broadly ovate, rounded or cuneate at the base and decurrent on the stout petioles, more coarsely serrate and more deeply lobed, villose on the under side of the midribs and veins and often 5.5–6 cm. long and 5 cm. wide. *Flowers* 1.5–1.7 cm. in diameter, on elongated slender slightly villose pedicels, in mostly 5- or 6-flowered compact villose corymbs, with linear acuminate glandular bracts and bractlets, fading brown and mostly persistent until after the petals have fallen; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from broad bases, acuminate, sharply glandular-serrate above the middle, reflexed after anthesis; stamens 17–20; anthers pink; styles 3–5, surrounded at the base by a broad ring of matted pale hairs. *Fruit* ripening about the first of October, on slender erect glabrous or occasionally slightly villose pedicels, depressed-globose, olive-green rarely with a rose-flushed cheek, 9–10 mm. in diameter; flesh thin, dry and hard; calyx enlarged and prominent, without a tube and with a wide deep cavity, and small reflexed and closely appressed lobes dark red on the upper side toward the base and mostly persistent on the ripe fruit; nutlets 3–5, thick, rounded at the ends, irregularly ridged on the back, often with a high grooved ridge, 6–7 mm. long and about 4 mm. wide.

A shrub 3–5 m. high, spreading into broad thickets, with many erect stems, and slender nearly straight branchlets marked by many small pale lenticels, reddish-brown and slightly villose when they first appear, soon glabrous, dull red-brown in their first season, and dark brown tinged with red the following year, and armed with numerous very slender straight or slightly curved red-brown or purple spines often 6–7 cm. in length.

Berks county: Common; near Kutztown, *C. L. Gruber* (Nos. 36 and 132), 1901, May and September, 1902, 1903, 1904.

8. Cratægus ruthiana n. sp.

Leaves ovate, acuminate, full and rounded or abruptly concave-cuneate at the base, finely often doubly serrate, with straight glandular teeth, and divided above the middle into several short acuminate lateral lobes, dark vinous red, and covered with long caducous hairs when they unfold, more than half-grown when the flowers open the middle of May and then scabrate and slightly hairy along the midribs above and sparingly villose below at the junction of the midribs and veins, and at maturity glabrous, subcoriaceous, blue-green and still rough on the upper, paler and yellow-green on the lower surface, 4–7 cm.

long and 3–5 cm. wide, their petioles grooved, at first very slender and villose, becoming stouter and glabrous, glandular, with minute scattered deciduous glands, 1.5–2 cm. long; leaves on vigorous shoots more broadly ovate, truncate, slightly cordate or sometimes cuneate at the base, more coarsely serrate and more deeply lobed, and often 7–9 cm. long and wide, with stout broadly winged petioles, and foliaceous lunate coarsely glandular-serrate persistent stipules. *Flowers* about 1.5 cm. in diameter, on slender villose pedicels, in compact mostly 5–7-flowered villose corymbs, with oblanceolate glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes narrow, acuminate, glabrous, entire or sparingly glandular-serrate; stamens 20; anthers small, pale rose color; styles 3 to 5. *Fruit* on stout glabrous pedicels, in erect clusters, bright apple-green, and lustrous until October, later turning red, 1 cm. in diameter and rather broader than high, and retuse at the insertion of the pedicels; calyx prominent with a deep narrow cavity, and spreading closely appressed lobes dark red on the upper side below the middle; nutlets 3 to 5, usually 4, rounded at the gradually narrowed ends, irregularly and often only slightly ridged on the rounded back, 6–7 mm. long, and 5 mm. wide.

An arborescent shrub sometimes 5 meters high, with dark gray stems, and stout nearly straight branchlets marked by numerous small pale lenticels, light olive-green when they first appear, becoming dark red-brown tinged with red the following year, and armed with numerous stout or slender nearly straight purple spines 4–5 cm. in length.

Bucks county: Limestone bluffs, Durham, *C. D. Fretz* (No. 150, type! and 149), May, September and October, 1901; *Fretz* and *Sargent*, September, 1902.

No. 149 differs from the type in the rather smaller fruit and narrower leaves.

This species is named for the late Harvey F. Ruth, of Durham, an excellent botanist familiar with the plants of Durham and its vicinity.

9. Cratægus comata n. sp.

Leaves oblong-ovate to rhombic or broadly ovate on leading shoots, acuminate, rounded or broadly or acutely concave-cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 3 or 4 pairs of short acuminate spreading lobes, when the flowers open about the first of May membranaceous, yellow-green, sparingly villose above and on the midribs below, 5–6 cm. long and 3–4 cm. wide; petioles slender, slightly wing-margined at the apex, villose, with long matted hairs, glandular, with occasional minute stipitate glands and 1.5–2.5 cm. in length; mature leaves not seen.

Flowers 1.6–1.7 cm. in diameter, on long densely villose pedicels, in compact 4–6-flowered hairy corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, glabrous, the lobes elongated, acuminate, entire or sparingly serrate above the middle; stamens 20; anthers pale pink; styles 3–5, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening the middle of October, on slender pedicels, in drooping few-fruited clusters, depressed globose, bright green and lustrous until late in the season, finally becoming light cherry red, about 1.6 cm. in diameter and 1.1 cm. in height; calyx little enlarged, without a tube and with a deep narrow cavity and spreading lobes mostly persistent on the ripe fruit; flesh firm, white or yellow; nutlets usually 3 or 4, full and rounded or acute at the apex, broadly ridged on the back, with a high usually grooved ridge, about 6 mm. long and 4 mm. wide.

A broad shrub 3–4 m. high, with numerous stems, and slender zigzag branchlets marked by small pale lenticels, light reddish-brown and pubescent when they first appear, soon glabrous, light reddish-brown and lustrous during their first winter and darker and purplish the following year, and armed with numerous slender straight slightly curved purple spines 4–5 cm. in length.

Philadelphia county: Below Gray's Ferry, and Angora, *B. H. Smith* (No. 241, type!), November 19, 1902, May, 1904.

10. Cratægus jejuna n. sp.

Leaves ovate to oval, acuminate, abruptly or acutely concave-cuneate or rounded at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided into numerous short acute lateral lobes, half-grown when the flowers open about the 25th of May and then membranaceous, yellow-green and glabrous with the exception of a few caducous hairs along the upper side of the midribs, and at maturity subcoriaceous to coriaceous, dark blue-green and smooth on the upper, paler on the lower surface, 4.5–5.5 cm. long and 3–4 cm. wide, with stout midribs deeply impressed on the upper side and 4 or 5 pairs of slender primary veins arching obliquely to the points of the larger lobes; petioles sparingly villose at first, soon glabrous, stout, grooved on the upper side, slightly wing-margined at the apex, and 2.5–3 cm. long; leaves on vigorous shoots mostly truncate at the broad base, more coarsely serrate and more deeply lobed, often 5 cm. long and broad, with stout conspicuously glandular petioles. *Flowers* about 1.6 cm. in diameter, on long slender pedicels, in compact usually 5–7-flowered corymbs, with linear glandular bracts and bractlets often deciduous before the flowers open; calyx-tube broadly obconic, the lobes wide, acuminate, entire or occasionally glandular-toothed, tipped with dark glands, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening at the end of October, on stout pedicels, in few-fruited clusters, short-oblong to ovate, angled, dull green, hard and dry, 8–9 mm. long; calyx very prominent, with a long tube, a deep narrow cavity, and lobes reflexed and deciduous from the ripe fruit; flesh thin, dry and yellow; nutlets usually 4 or 5; bright red-brown, narrowed and acute at the ends,' ridged on the back, with a high doubly grooved ridge, 6–7 mm. long and about 4 mm. wide.

An arborescent shrub 3–5 mm. high, with numerous erect stems sometimes forming thickets and slender only slightly zigzag branchlets marked by occasional large pale lenticels, dark orange-green when they first appear, soon becoming purplish, bright reddish-brown and lustrous in their first winter and dull dark red-brown the following year, and armed with stout straight purple spines 3–4 cm. in length.

Bucks county: Dry hillsides near Sellersville, *C. D. Fretz* (Nos. 145, type!, 127, 136 and 181), May and October, 1901.

In No. 181 the fruit is described by Dr. Fretz as "greenish or slightly red." The fruit of No. 136, which is 1.1–1.2 cm. in diameter, is described by him as "dark red with a bloom." This last number may prove distinct.

11. Cratægus uplandia n. sp.

Leaves broadly ovate, acute, full and rounded, truncate or abruptly cuneate at the wide entire base, slightly doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of short acute lateral lobes, when they unfold yellow-bronze color and sparingly villose on the midribs and veins below, more than half-grown when the flowers open about the 20th of May and then membranaceous and very smooth on the upper and paler on the lower surface, light yellow-green and glabrous with the exception of occasional tufts of short caducous pubescence in the axis of the primary veins below, and at maturity subcoriaceous, dull dark blue-green, 4–5 cm. long and 3.5–4.5 cm. wide, with stout yellow midribs and 4 or 5 pairs of slender primary veins arching obliquely to the points of the lobes; petioles slender, grooved on the upper side, slightly wing-margined at the apex, glandular, with occasional minute glands, and 2–2½ cm. in length; on vigorous shoots leaves ovate-deltoid, truncate to subcordate at the base, more deeply lobed, the sinuses of the lowest lobes often extending more than half way to the midribs, and 5–6 cm. long and broad, with stout conspicuously glandular petioles broadly wing-margined below the middle and

1.5–2 cm. long, and foliaceous lunate sharply serrate persistent stipules. *Flowers* 1.8–2 cm. in diameter, on stout elongated glabrous pedicels, in mostly 5–9-flowered compact corymbs with linear acute glandular bracts and bractlets generally caducous before the petals fall; calyx-tube narrowly obconic, the lobes slender, acuminate, nearly entire, or serrate sometimes to the base, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5, surrounded at the base by a few pale hairs. *Fruit* in few-fruited spreading clusters, subglobose to short-oblong or slightly obovate, dark deep red marked by large pale dots, about 1.4–1.5 cm. in diameter; calyx prominent, with a long tube, a narrow deep cavity, and reflexed lobes, their tips mostly deciduous from the ripe fruit; flesh yellow, thin, hard, dry and mealy; nutlets 4 or 5, bright red-brown, full and rounded at the ends or narrowed and acute at the apex, prominently but very irregularly ridged and grooved on the back, 6–7 cm. long and about 5 mm. wide.

A tree sometimes 6 m. high, with a trunk 2.5 cm. in diameter, covered with dark gray-brown bark separating into thin plate-like scales, small spreading branches forming a round-topped head, and slender nearly straight branchlets, dark yellow-green tinged with red and covered with a glaucous bloom when they first appear, bright red-brown and marked with small pale lenticels during their first season, darker brown and rather lustrous the following year, and armed with slender nearly straight bright red-brown shining spines 3–5 cm. in length, sometimes becoming on old stems 10–12 cm. long and furnished with numerous stout branches.

Delaware county: Upper Darby, near the State road, *B. H. Smith* (No. 195, type!), May and October, 1901, May, 1902, May, 1903, *Smith* and *Sargent*, September, 1902; *B. H. Smith*, Crum Creek, Newtown (No. 234), May, 1903.

12. Cratægus callosa n. sp.

Leaves broadly ovate to deltoid-ovate or rarely oval, acute or acuminate, rounded or occasionally truncate at the entire base, coarsely doubly serrate above, with straight glandular teeth and slightly divided into numerous small acuminate lateral lobes, red-bronze and slightly pubescent near the base of the upper side of the midribs when they unfold, about half-grown when the flowers open about the 20th of May and then membranaceous, yellow-green and nearly glabrous, and at maturity thin but firm in texture, dark bluish-green on the upper and paler on the lower surface, 4.5–8 cm. long and 4–7 cm. wide, or on vigorous shoots often rather larger, with thin orange-colored midribs and slender primary veins extending obliquely to the points of the lobes, turning yellow or greenish-yellow in the autumn and falling during the latter half of October; petioles slender, grooved on the upper side, abruptly wing-margined at the apex, glabrous, glandular, with minute stipitate dark caducous glands, 1.5–2.2 cm. in length; stipules linear to lanceolate, often falcate, usually lobed at the base, glandular-serrate, fading red or yellow, caducous. *Flowers* 1.7–2.5 cm. in diameter, on glabrous pedicels 1–2 cm. long, in 3–10 usually about 6-flowered compact corymbs, with oblong-obovate linear conspicuously glandular bracts and bractlets often persistent until after the flowers open; calyx-tube broadly obconic, the lobes separated by wide sinuses, narrow, acuminate, sometimes glandular, or rarely slightly serrate above the middle, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3–5, usually 4 or 5. *Fruit* ripening late in October or in November and often retaining its color on the ground until the following spring, in 1–6-flowered clusters, globose or depressed-globose, slightly retuse at the base, rounded or slightly concave at the apex, remaining green until October, when fully ripe dark red to cardinal and usually blotched with dark olive-green or russet, punctate with greenish or russet dots and covered with a slight glaucous bloom, 1.3–1.6 cm. in diameter and 1.2–1.5 cm. high; calyx enlarged and prominent, with a short tube, a broad deep cavity and erect or spreading lobes dark red on the upper side toward the base, mostly persistent on the ripe fruit; flesh greenish, firm, bitter, acid; nutlets usually 4 or 5, rounded at the ends, rounded and ridged on the back, with a low slightly grooved ridge, 6–8 mm. long and about 4 mm. wide.

A tree occasionally 5 m. high, with a stem sometimes 1 m. long and 10–15 cm. in diameter, covered with dark gray-brown scaly bark, stout horizontal or semierect flexuose olive-gray branches forming a round-topped head, and slender nearly straight branchlets marked by occasional large oblong pale lenticels, dark reddish-brown when they first appear and darker and purplish during their first winter, and armed with numerous stout straight or slightly curved orange-brown ultimately purplish or nearly black spines 2.5–6 cm. in length, and on old stems much branched and sometimes 10 cm. long.

Berks county: Border of woods in high rocky ground, North Heidelberg township, *C. L. Gruber* (Nos. 159, type! and 176), May, September and October, 1902, 1903 and 1904.

13. Cratægus cestrica n. sp.

Glabrous. *Leaves* ovate, acute, broadly concave-cuneate and mostly entire or glandular, with stipitate bright red glands at the base, sharply doubly serrate above, with straight glandular teeth, and slightly divided above the middle into three or four pairs of slender acute lobes, slightly tinged with red when they unfold, nearly fully grown when the flowers open about the middle of May, and at maturity thin but firm in texture, dark blue-green and lustrous on the upper, pale yellow-green on the lower surface, 3.5–4.5 cm. long and 3–3.5 cm. wide, with stout midribs and four or five pairs of prominent primary veins; petioles slender, slightly wing-margined toward the apex, glandular, with conspicuous usually persistent glands, and 1.5–2 cm. in length; stipules linear, acuminate, coarsely glandular, fading red, caducous; leaves on vigorous shoots full and rounded or nearly truncate at the broad base, more deeply lobed and more coarsely serrate, and often 5–6 cm. long and broad, with stout margined petioles 2–2½ cm. in length. *Flowers* about 1.2 cm. in diameter, on slender pedicels, in very compact 4–7-flowered corymbs, with conspicuous oblanceolate glandular pectinate bracts and bractlets; calyx-tube broadly obconic, the lobes gradually narrowed from broad bases, acuminate, entire or obscurely serrate above the middle; stamens 20; anthers small, pale yellow; styles 4 or 5, surrounded at the base by a narrow ring of short pale hairs. *Fruit* ripening about the middle of October on stout pedicels, in erect few-fruited clusters, subglobose to obovate, dark crimson, lustrous, marked by numerous small dark dots, 1.2–1.5 cm. long; calyx enlarged and prominent, without a tube and with a broad deep cavity, and short acute lobes coarsely and irregularly serrate above the middle, with occasional large teeth; flesh thick, dry and mealy, white slightly tinged with pink; nutlets 4 or 5, gradually narrowed and acute at the ends, prominently ridged on the back, with a wide deeply grooved ridge, about 6 mm. long and 4 mm. wide.

A pyramidal shrub 2.5–3 m. high, with numerous small erect stems, and slender slightly zigzag branchlets marked by occasional large pale lenticels, dark orange-green when they first appear, becoming light red-brown and very lustrous during their first summer and dull and darker red-brown the following year, and armed with many slender straight or slightly curved purple lustrous spines 4–6 cm. long.

Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 204, type!), May 15, 1902, May 9, 1903; *Smith* and *Sargent*, September, 1902; *B. H. Smith* (No. 217), September, 1902, May, 1903 and 1904; *Smith* and *Sargent*, September, 1902.

14. Cratægus augusta n. sp.

Glabrous. *Leaves* narrowly ovate to oblong-ovate, acuminate, broadly cuneate or rounded at the entire base, coarsely doubly serrate above, with straight glandular teeth, and divided into 3 or 4 pairs of short broad acute lateral lobes, when they unfold bronze-red and glandular with the exception of a few hairs in the axils of the veins below, nearly half-grown when the flowers open the middle of May and then membranaceous, dark yellow-green above and pale below, and at maturity subcoriaceous, dark blue-green and lustrous on the upper and paler or glaucous on the lower surface, 6–7 cm. long and 4–5 cm. wide, with thin yellow midribs and slender primary veins extending obliquely to the points of the lobes; turning dull yellowish-bronze or purplish-bronze before falling from the first to the middle of October; petioles slender, grooved on the upper side, slightly wing-margined at the apex, glandular at first, with minute stipitate dark red deciduous glands, 1.5–3 cm. in length; stipules ovate to lanceolate, often falcate, glandular, fading yellow or orange, caducous; leaves on vigorous shoots more broadly ovate, cordate, truncate or rounded at the broad base, 6–7 cm. long and wide, with stouter glandular petioles 1.5–2 cm. in length. *Flowers* 1.8–2.5 cm. in diameter, on slender glabrous pedicels 1.2–3.2 cm. long, in lax 5–10-flowered corymbs, with linear to lance-linear glandular bracts and bractlets conspicuous and persistent until after the petals fall; calyx-tube narrowly obconic, the lobes broad, acute or acuminate, entire or sparingly serrate above the middle, reflexed after anthesis; stamens 18–20; anthers pale yellow; styles 2–5, usually 3 or 4. *Fruit* ripening late in September or early in October, on stout erect pedicels, in 3–5-fruited clusters, pyriform until nearly fully grown, becoming depressed-globose or globose, angled, slightly concave at the ends, red or crimson, frequently blotched with dark olive-green and usually greenish at the apex, covered with a thick glaucous bloom, about 1–1.4 cm. in diameter and 9–10 mm. high; calyx prominent with a short tube, a wide shallow cavity, and much enlarged spreading or appressed lobes mostly persistent on the ripe fruit; flesh thin, dry and mealy; nutlets 3 or 4, pale green or yellowish-green, hard, usually rounded at the ends, irregularly ridged on the back, with a low usually broad grooved ridge, 6–7 mm. long and 4–5 mm. wide.

A slender treelike shrub 2.5–3 m. high, with few long slender flexuose ascending or semierect branches frequently forming an oblong head, and slender nearly straight branchlets marked by numerous large pale lenticels, purplish and covered when they first appear with a glaucous bloom, red-brown and lustrous in their second season and dark dull gray-brown the following year, and armed with slender nearly straight or slightly curved purplish or ultimately dark brown spines 4–6 cm. in length.

Berks county: Borders of woods and open thickets, near Kutztown, *C. L. Gruber* (No. 160, type!), 1902, May, August and October, 1903.

15. Cratægus insueta n. sp.

Glabrous. *Leaves* oblong-ovate, acuminate, full and rounded at the entire base, sharply doubly serrate above, with straight glandular teeth and slightly divided into 2 or 3 pairs of short acute lateral lobes, faintly tinged with red or bronze color when they unfold, nearly half-grown when the flowers open from the 12th to the 20th of May and then dark yellow-green and very lustrous above and paler and dull below, and at maturity subcoriaceous, very dark blue-green on the upper and paler and yellow-green on the lower surface, 4–5 cm. long, 2.5–3 cm. wide, with slender midribs and 4 or 5 pairs of inconspicuous primary veins; petioles slender, grooved on the upper side, glandular, with numerous scattered glands, 1.5–2 cm. in length; stipules linear, acuminate, glandular or furnished with occasional minute glands, bright pink like the conspicuous accrescent inner bud-scales; leaves on vigorous shoots often cordate at the base, sometimes deeply divided into broad lateral lobes, 5–6 cm. long and 4–5 cm. wide, with rather thicker petioles 1.5–2 cm. in length. *Flowers* 1.4–1.6 cm. in diameter, on long slender pedicels, in 5–8 usually 5-flowered corymbs, with linear caducous bracts and bractlets, the lower peduncles 1-flowered from the axils of upper leaves; calyx-tube narrowly obconic, the lobes narrow, elongated, acuminate, entire or sparingly glandular-serrate above the middle, strongly reflexed after anthesis; stamens 20; anthers white faintly tinged with yellow; styles 5. *Fruit* ripening late in October, pyriform, dull green tinged irregularly with red, becoming dull red in drying, 1–1.2 cm. long, 9–10 mm. broad above the middle, gradually narrowed to the base; calyx little enlarged, without a tube, with a broad shallow cavity, and small reflexed and closely appressed lobes gradually narrowed from broad bases; flesh thin, yellowish-green, dry and hard; nutlets 5, thin, tapering to the acute ends, irregularly ridged on the back, usually with a broadly grooved ridge, about 6 mm. long and 4–5 mm. wide.

A bushy tree, with a short stout trunk about 2 cm. in diameter, stout spreading ascending branches forming a broad shapely head, and slender only slightly zigzag branchlets marked by numerous small dark lenticels, orange-green and slightly tinged with red when they first appear, bright chestnut-brown and very lustrous during their first season and darker the following year, and armed with many stout nearly straight spines 3–4 cm. in length.

A single tree on the lawn near the lake in West Fairmount Park, Philadelphia, of unknown origin but probably planted, certainly an eastern American species, and possibly indigenous. *Alexander MacElwee* (No. 2,165A, Herb. Philadelphia Museums), May and June, 1901; *Canby* and *Sargent*, September, 1902; *Smith* and *Sargent*, October, 1904.

16. Cratægus porteri Britton.

Bull. N. Y. Bot. Gard., I, 448 (1900); Torreya, IV, 39 (1904).

Glabrous. *Leaves* oblong-ovate to oval, long-pointed and acuminate at the apex, concave-cuneate and often unsymmetrical or full and rounded at the entire base, finely doubly serrate above, with straight or slightly incurved teeth, and divided above the middle into 4 or 5 pairs of short acute lobes, tinged with red when they unfold, about half-grown when the flowers open the middle of May and then membranaceous, light yellow-green above, and rather paler below, and at maturity coriaceous, dark blue-green and very lustrous on the upper and dull or pale blue-green on the lower surface, 6–7 cm. long and 3.5–5 cm. wide, with stout yellow midribs and slender primary veins extending obliquely to the points of the lobes, turning dull vinous red in the autumn; petioles slender, grooved on the upper side, slightly wing-margined at the apex, sparingly glandular, with minute deciduous glands, and 2–3 cm. in length; stipules linear, glandular, fading brown, caducous. *Flowers* 1–1.2 cm. in diameter, on slender elongated pedicels, in mostly 5–7-flowered lax corymbs, with linear to oblong-obovate glandular bracts and bractlets persistent until after the petals fall; calyx narrowly obconic, the lobes narrow, elongated, acuminate, entire, tipped with minute dark glands, reflexed after anthesis; stamens 20; anthers small, pale yellow; styles 3 or 4. *Fruit* ripening early in October, on slender pedicels, solitary or in few-fruited clusters, pyriform, sometimes becoming short-oblong when fully mature, dark crimson marked by small dark dots, 1–1.2 cm. long and 9–10 cm. wide; calyx not greatly enlarged, with a short tube, a broad deep cavity, and closely appressed lobes mostly persistent on the ripe fruit; flesh yellow, dry and mealy; nutlets 3 or 4, narrowed and pointed at the ends, prominently ridged on the back, with a broad grooved ridge, red-brown, about 8 mm. long and 5 mm. wide.

A shrub 3–4 m. high, with numerous stout erect stems, and slender nearly straight branchlets marked by occasional large pale lenticels, pale yellow-green when they first appear, and dull reddish-brown during their first season, becoming very dark gray-brown the following year.

Monroe county: Borders of woods in low moist soil near Tannersville, *Britton* and *Porter*, July 4, 1896; *Canby* and *Sargent*, September, 1902; *W. M. Canby*, May, August and October, 1903.

17. Cratægus dissona Sargent.

Rhodora, V, 60 (1903); Bot. Gazette, XXXV, 379 (Cratægus in Northeastern Illinois).

Bucks county: Race-bank, Benjamin, near Sellersville, *C. D. Fretz* (No. 106), May and September, 1899; *Fretz* and *Sargent*, September, 1902. Also western New England to northeastern Illinois.

The anthers of the plants at Great Barrington, Berkshire county, Massachusetts, on which this species was established, are light purple, while those of the Sellersville plant are described by Dr. Fretz as light pink. I can detect no other difference. This shrub is evidently extremely rare in eastern Pennsylvania, while in western New England it is common and widely distributed.

18. Cratægus alacris n. sp.

Leaves rhombic or occasionally oblong-ovate, acuminate, mostly entire at the cuneate glandular base, sharply doubly serrate above, with straight glandular teeth, and deeply divided above the middle into numerous narrow acuminate lobes, dull vinous red as they unfold, nearly fully grown when the flowers open about the middle of May and then light yellow-green and glabrous with the exception of a few caducous hairs near the base of the upper side of the midribs, and at maturity thin but firm in texture, glabrous, dark blue-green on the upper and pale blue-green on the lower surface, 4–6 cm. long and 3.5–4.5 cm. wide, with thin yellow midribs, and slender primary veins arching very obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly glandular early in the season, with minute deciduous glands, and 2–3 cm. in length; stipules linear, acuminate, glandular, fading pink, caducous, or foliaceous and lunate on the upper leaves of leading shoots. *Flowers* 1.8–2 cm. in diameter, on slender elongated glabrous pedicels, in usually 5-flowered glabrous corymbs, with oblong-obovate to linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes broad and short, gradually narrowed to the acuminate apex, entire, occasionally slightly serrate above the middle; stamens 8–10; anthers pale rose color; styles 3 or 4, surrounded at the base by a broad ring of long white hairs. *Fruit* ripening at the end of September, on slender pedicels, in drooping clusters, short-oblong or slightly obovate, bright red and covered with a glabrous bloom, 1–1.2 cm. long, 8–10 mm. broad; calyx prominent, with a wide but very shallow cavity, and spreading lobes, their tips mostly deciduous from the ripe fruit; flesh thin, dry and mealy; nutlets 3 or 4, rounded at the narrowed base, acute at the apex, prominently ridged on the back, with a broad deeply grooved ridge, 6–7 mm. long and 4–5 mm. wide.

A shrub 3–4 m. high, with slender nearly straight branchlets marked by occasional small pale lenticels, dark orange-green when they first appear, becoming purplish in their first season and dark red-brown the following year, and armed with numerous slender nearly straight purple ultimately gray-brown spines 3.5–5.5 cm. in length.

Bucks county: Alluvial bottom lands, Deep Run, near Sellersville, *C. D. Fretz* (No. 125, type!), May and September, 1900, May and September, 1903. Rare.

19. **Cratægus deducta** n. sp.

Leaves oval to ovate, acuminate, concave-cuneate at the entire base, coarsely doubly serrate above with glandular teeth and sharply divided into 3 or 4 pairs of short acute lateral lobes, more than half-grown when the flowers open about the 20th of May and then membranaceous, light yellow-green, smooth and shining above, pale below, and glabrous with the exception of a few caducous hairs on the upper side of the midribs, and at maturity thin but firm in texture, light bluish-green, 6–7 cm. long and 4–4.5 cm. wide, with stout yellow midribs and remote primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, puberulous at first, soon glabrous, glandular with conspicuous stipitate dark caducous glands, and 2–2.5 cm. in length; leaves on vigorous shoots mostly ovate, full and rounded at the broad base, deeply lobed with acuminate lobes, and often 6 cm. long and wide. *Flowers* about 2 cm. in diameter, on slender glabrous pedicels, in compact 5–10-flowered corymbs, with conspicuously glandular oblong-obovate to lanceolate bracts and bractlets often persistent until after the flowers open; calyx-tube narrowly obconic, the lobes wide, coarsely glandular-serrate, reflexed after anthesis; stamens 7–9; styles 2–4, surrounded at the base by a few short pale hairs. *Fruit* ripening about the middle of October, on slender pedicels, in few-fruited clusters, short-oblong to ovate, angled and green when fully grown, becoming distinctly mamillate at the base and dull red when fully ripe, thickly covered with a glaucous bloom, 1–1.2 cm. long and broad; calyx prominent, without a tube, and with a wide shallow cavity, and spreading reflexed closely appressed lobes often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 3 or 4, gradually narrowed and acute at the ends, prominently ridged on the broad back with a low wide ridge, 8–9 mm. long and 5 mm. wide.

A shrub 2–3 m. high, with erect stems and slender nearly straight branchlets marked by oblong pale lenticels, light orange-green when they first appear, becoming dull reddish-brown during their first winter and gray tinged with red the following season, and armed with numerous very slender slightly curved lustrous purplish spines 4–6 cm. in length.

Bucks county: Near Sellersville, *C. D. Fretz* (No. 112, type!), May, 1898, May and October, 1899; *Fretz* and *Sargent*, September, 1899. Rare.

20. Cratægus deltoides Ashe.

Jour. Elisha Mitchell Sci. Soc., XVII, pt. 2, p. 19 (1901).

Leaves broadly ovate, acute and short-pointed at the apex, rounded truncate or occasionally abruptly cuneate at the wide base, sharply and often doubly serrate, with straight glandular teeth, and slightly divided into numerous small acuminate lobes; nearly fully grown when the flowers open about the end of May and then light yellow-green, roughened above by short pale hairs and sparingly villose along the base of the upper side of the midribs, and at maturity thin but firm in texture, dull blue-green and scabrate on the upper, and pale blue-green on the lower surface, 5–6 cm. long and 4–5 to nearly 6 cm. wide, with slender yellow midribs and 4 or 5 pairs of thin primary veins arching to the points of the larger lobes; petioles very slender, wing-margined at the apex, glandular, with minute sometimes persistent glands, 1.5–3 cm. in length; stipules linear, acuminate, glandular, fading red, caducous. *Flowers* 1.8–2 cm. in diameter, on elongated slender pedicels, in 5–8-flowered compact glabrous corymbs, with lanceolate conspicuously glandular bracts and bractlets mostly persistent until after the flowers fall; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, acuminate, entire, obscurely toothed, tipped with dark glands, reflexed after anthesis; stamens 10; anthers dark rose color; styles 3–5, surrounded at the base by a broad ring of matted pale hairs. *Fruit* ripening from the middle to the end of September, on long slender pedicels, in drooping few-fruited clusters, pyriform when first fully grown, becoming depressed-globose at maturity, slightly angled, without a bloom, bright red, 1.1–1.3 cm. in diameter and rather broader than long; calyx much enlarged, without a tube, and with a broad shallow cavity, and coarsely serrate erect and incurved lobes very conspicuous on the unripe fruit and persistent throughout the season; flesh thin, yellow, dry and mealy; nutlets thick, gradually narrowed and pointed at the ends, irregularly ridged and very deeply grooved on the back, about 7 mm. long and 5 mm. wide.

A shrub 2–3 m. high, with slender nearly straight branchlets marked by small pale lenticels, light orange-green when they first appear, orange-brown and lustrous during their first season, becoming dull gray or gray-brown the following year, and armed with occasional stout purple lustrous spines 5–5.5 cm. in length.

Bucks county: Near Ridge Road, Rockhill, *C. D. Fretz* (No. 104, type), September, 1899, May and September, 1901; near Bruckers, Rockhill, *C. D. Fretz* (No. 103), May and September, 1899. Rare.

21. Cratægus fretzii n. sp.

Leaves ovate, acute, rounded or occasionally concave-cuneate or rarely truncate at the broad entire base, coarsely doubly serrate above, with straight or incurved glandular teeth, and more or less deeply divided into two or three pairs of broad acute lateral lobes, nearly fully grown when the flowers open about the 20th of May and then membranaceous, light yellow-green, roughened by short rigid white hairs and sparingly villose along the midribs on the upper surface, and pale or glaucous and glabrous on the lower surface, and at maturity subcoriaceous, dark blue-green and scabrate or nearly smooth above, pale bluish-green below, 6–8 cm. long and 4–6 cm. wide, with stout yellow midribs and four or five pairs of thin primary veins; petioles slender, grooved on the upper side, narrowly wing-margined toward the apex, sparingly glandular, villose while young, soon becoming glabrous, 1.5–2.5 cm. in length; stipules on leading shoots foliaceous, lunate, coarsely glandular-serrate, about 5 mm. long, caducous. *Flowers* about 1 cm. in diameter, on long slender glabrous pedicels, in lax 4- or 5-flowered corymbs; calyx-tube narrowly obconic, the lobes narrow, elongated, acuminate, tipped with dark red glands, entire or occasionally furnished above the middle with a few small glandular teeth, erect after anthesis; stamens usually eight; anthers small, dark rose color; styles 2–4. *Fruit* ripening about October 1, on stout erect pedicels, obovate, full and rounded at the apex, gradually narrowed from above the middle to the slender base, greenish-yellow with a crimson cheek destitute of bloom, 1.2–1.5 cm. long, 1–1.2 cm. broad; calyx little enlarged, without a tube, and with a wide shallow cavity, and erect spreading lobes most deciduous before the fruit ripens; flesh thin, yellow, dry and mealy; nutlets usually 4, thick, full and rounded at the ends, rounded and conspicuously ridged on the back, with a high deeply grooved ridge, 8–9 mm. long and 5 mm. wide.

A broad arborescent shrub 7–8 m. high, with stout intricately branched stems spreading into broad thickets.

Bucks county: Durham, in low rich soil, *C. D. Fretz* (No. 151, type), May and September, 1901; *Fretz* and *Sargent*, September, 1902.

This interesting thorn resembles in foliage and in the number of the stamens and the color of the anthers *Cratægus compta* Sarg., from western New York, but differs from that species in its few-flowered corymbs, more slender and elongated mostly entire calyx-lobes, and in its more obovate greenish-yellow fruit without bloom, the fruit of *Cratægus compta* being bright cherry-red and coated with a thick glaucous bloom. It is named for its discoverer, Dr. Clayton Detweiler Fretz, the enthusiastic and industrious student of the flora of Bucks county.

22. Cratægus scabriuscula n. sp.

Leaves ovate to rhombic, acute or acuminate at the apex, full and rounded or concave-cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 3 or 4 pairs of short broad acute lateral lobes, slightly tinged with red when they unfold, nearly half-grown when the flowers open about the 10th of May and then yellow-green and roughened above by short rigid white hairs and paler and glabrous below, and at maturity thin but firm in texture, light blue-green and scabrate on the upper and pale or glaucous on the lower surface, 4–5 cm. long and 3.5–4 cm. wide, with thin yellow midribs and slender primary veins arching obliquely to the points of the lobes; petioles slender, grooved, slightly wing-margined at the apex, conspicuously glandular at first, the glands mostly deciduous, and 2–3 cm. in length; stipules linear, acuminate, glandular, fading pink caducous; leaves on vigorous shoots deltoid to broadly ovate, truncate or rounded at the base, more coarsely serrate and more deeply lobed, 5–6 cm. long and broad, with stout glandular petioles 1.2–1.6 cm. in length. *Flowers* about 1.5 cm. in diameter, on slender elongated pedicels, in compact 5–8-flowered corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes gradually narrowed from broad bases, acuminate, entire or slightly and irregularly serrate above the middle, their tips often bright red, reflexed after anthesis; stamens 6–8; anthers red; styles 3 or 4, surrounded at the base by a broad ring of hoary tomentum. *Fruit* ripening about the 1st of October on slender pedicels, in few-fruited drooping clusters, obovate, full and rounded at the apex, gradually narrowed from above the middle to the slender base, dull red, not pruinose, about 1 cm. long and 8 cm. wide; calyx enlarged and prominent, without a tube, and with a broad shallow cavity and spreading closly appressed mostly persistent sparingly serrate lobes red on the upper side below the middle; flesh thin, dry or mealy; nutlets 3 or 4.

An arborescent shrub 3–4 m. high, with slender nearly straight branchlets marked by numerous oblong pale lenticels, light yellow-green slightly tinged with red when they first appear, bright red-brown and very lustrous during their first season and dull gray-brown the following year, and armed with numerous stout slightly curved bright chestnut-brown ultimately gray spines 4–6 cm. in length.

Bucks county: Durham, *C. D. Fretz* (No. 170, type), May and September, 1903; *Fretz* and *Sargent* (No. 160), September, 1902.

23. Cratægus delicata n. sp.

Leaves ovate, acute or acuminate, rounded, truncate or occasionally cuneate at the broad entire glandular base, sharply doubly serrate above, with straight slender teeth tipped with large dark glands, and deeply divided into 3 or 4 pairs of narrow acuminate lateral lobes, when they unfold deeply tinged with red, glabrous below and covered above with short lustrous white hairs, nearly fully grown when the flowers open the middle of May and then membranaceous, pale yellow-green, and hairy on the upper surface, and at maturity thin but firm in texture, blue-green and scabrate above, pale blue-green below, 3.5–4 cm. long and 2.5–4 cm. wide, with slender midribs and thin remote primary veins; petioles very slender, slightly wing-margined at the apex, at first sparingly pilose, soon glabrous, 1.2–1.5 cm. in length; leaves on vigorous shoots mostly truncate or occasionally subcordate at the base, more deeply lobed, and 5–6 cm. long and broad. *Flowers* about 1.5 cm. in diameter, on long hairy pedicels, in 4–7-flowered compact corymbs; calyx-tube narrowly obconic, glabrous, the lobes broad, acuminate, coarsely glandular-serrate toward the bright red apex, reflexed after anthesis; stamens 5 or 6; anthers dark rose color; styles 3, surrounded at the base by a ring of long snow-white hairs. *Fruit* ripening the middle of September, ovate to oblong, dull red, covered with a thick glaucous bloom, 1.4–1.5 cm. long, 1–1.2 cm. wide; calyx little enlarged, without a tube, and with a wide shallow cavity, and spreading appressed lobes dark red on the upper side below the middle, their tips mostly deciduous from the ripe fruit; flesh thick and pulpy; nutlets 3, gradually narrowed to the obtuse rounded ends, very prominently ridged on the broad rounded back, with a high broad deeply grooved ridge, about 8 mm. long and 5 mm. wide.

A shrub with numerous erect stems 2–3 m. high and 5–8 cm. in diameter, covered with silvery-gray slightly fissured scaly bark, and slender slightly zigzag branchlets dark orange-green when they first appear, dark red-brown and very lustrous during their first winter, becoming ashy-gray or gray tinged with brown in their second or third year, and armed with numerous stout slightly curved red-brown shining spines 3–3½ cm. in length.

Bucks county: Hillsides near Sellersville, *C. D. Fretz* (No. 177, type), May and September, 1903.

IV.—TENUIFOLIÆ.

1.—Fruit longer than wide.
 Fruit oblong; anthers dark pink or purple.
  Petioles 1.5–2 cm. long.
   Leaf-lobes short, mostly pointing forward, 1. *C. tenella.*
   Leaf-lobes long, spreading, often recurved, 2. *C. rufipes.*
  Petioles 2–3 cm. long.
   Pedicels elongated, slender; corymbs broad and open; leaves broad-ovate to nearly orbicular, yellow-green, 3. *C. lata.*
   Pedicels short; corymbs compact; leaves ovate to ovate-oblong, blue-green.
    Corymbs 4–6-flowered; mature leaves scabrate, 4. *C. collinsiana.*
    Corymbs 8–12-flowered; mature leaves smooth, 5. *C. pumila.*
 Fruit obovate, ovate-oblong to subglobose.
  Leaves 5–9-lobed.
   Petioles slender, 2.5–3 cm. long; pedicels slender, elongated.
    Corymbs open, 7–12-flowered.
     Stamens 10; anthers rose color; mature leaves scabrate, 6. *C. firma.*
     Stamens 5–8; anthers rose-pink; fruit glaucous; mature leaves glabrous, ... 7. *C. gruberi.*
    Corymbs compact, 5–12-flowered; stamens 5–10; fruit scarlet.
     Anthers dark rose color or purple; pedicels elongated; leaves yellow-green, ... 8. *C. ampla.*
     Anthers light purple; pedicels short; leaves blue-green, ... 9. *C. populnea.*
   Petioles stout, 2–3 cm. long; pedicels stout; corymbs compact, 8–12-flowered.
    Stamens 6–8; anthers purple; fruit yellowish-red; leaves thin, ... 10. *C. condensa.*
    Stamens 10; anthers rose color; fruit cherry-red; leaves thick, ... 11. *C. moyeriana.*
  Leaves 9–11-lobed.
   Petioles 2–3 cm. long; anthers light pink or rose color; ripe fruit with a glaucous bloom.
    Stamens 5–7; fruit dark red, ... 12. *C. saturata.*
    Stamens 8–10; fruit scarlet, ... 13. *C. miniata.*
   Petioles 3–4 cm. long; anthers dark pink.
    Corymbs narrow, compact; fruit 9–12 mm. long; petioles very slender, . . . 14. *C. longipetiolata.*
    Corymbs broad; fruit bright cherry-red, 1.3–1.5 cm. long; petioles stout, ... 15. *C. insolita.*
2.—Fruit globose to depressed-globose; anthers dark pink or purple.
 Fruit scarlet or bright crimson; leaves 9–11-lobed; corymbs 5–10-flowered, compact.

Leaves ovate-oblong, 4.5–6 cm. in length; fruit 1.2–1.5 cm. in diameter, ... 16. *C. stolonifera.*
Leaves ovate, 3.5–4 cm. in length; fruit 8–10 mm. in diameter, 17. *C. modica.*
Fruit with a glaucous bloom, 1.2–1.5 cm. in diameter.
Leaves 7–9-lobed; petioles and pedicels stout; corymbs broad and open, 7–12-flowered, ... 18. *C. vittata.*
Leaf-lobes numerous; petioles and pedicels slender; corymbs compact, 5–9-flowered, . . 19. *C. sequax.*

1. Cratægus tenella Ashe.

Ann. Carnegie Mus., I, pt. 3, 388 (1902).——Sargent, Bot. Gazette, XXXV, 108 (The Genus Cratægus in New Castle County, Delaware).

Leaves ovate, acuminate, abruptly cuneate or rounded at the broad entire base, sharply doubly serrate above, with slender glandular teeth, and divided into 4 or 5 pairs of short acuminate lateral lobes mostly pointing forward, deeply tinged with red when they unfold and coated above with long pale hairs, nearly half-grown when the flowers open the middle of May and then light yellow-green, glabrous below and covered above by short white hairs, and at maturity membranaceous, glabrous, dark yellow-green on the upper and pale and glaucous on the lower surface, 4–6 cm. long and 3–4.5 cm. wide, with very slender midribs and primary veins; petioles slender, slightly grooved on the upper side, sparingly glandular, with minute scattered caducous glands, 1.5–2 cm. long; stipules linear, acuminate, glandular, mostly deciduous before the flowers open. *Flowers* 1.2–1.4 cm. in diameter, on slender glabrous pedicels, in broad many-flowered corymbs, with oblong-obovate to linear scarious caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes narrow, long-pointed and acuminate, usually irregularly serrate above the middle, reflexed after anthesis; stamens 5–10; anthers small, dark rose color; styles 2 or 3, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening early in September on long slender pedicels, in few-fruited drooping clusters, and often persistent on the branches until October, short-oblong or rarely obovate, bright scarlet, lustrous, 1–1.2 cm. long and 6–7 mm. wide, calyx little enlarged, with a narrow shallow cavity, and spreading closely appressed lobes often deciduous from the ripe fruit; flesh yellow, soft and pulpy; nutlets 2 or 3, rounded at the base, gradually narrowed and acute at the apex, prominently ridged on the back, with a broad high deeply grooved ridge, about 7 mm. long and 4 mm. wide.

A shrub 3–4 m. high, with numerous erect stems covered with pale gray bark, and slender nearly straight branchlets marked by small pale lenticels, orange-green when they first appear, and rather dull reddish-brown during their first winter, becoming ashy-gray in their second or third years, and armed with stout straight or slightly curved bright chestnut-brown shining spines 2–3½ cm. in length.

Delaware county: Common; *B. H. Smith* (No. 199, type, *teste* Smith, Nos. 200, 206, 207). Bucks county: Hills near Sellersville, *C. D. Fretz* (No. 13), August, 1899, May, 1901, (No. 100) September, 1899, (No. 101) May and September, 1901, (No. 130) May and September, 1900, (No. 142) May and September, 1901, (No. 143) May and September, 1901; *Fretz* and *Sargent* (No. 105), September, 1899. Berks county: Banks of Sacony creek, near Kutztown, *C. L. Gruber* (No. 17), 1901, May and August, 1903. Monroe county: Between Tannersville and Stroudsburg, *W. M. Canby*, May and August, 1903, without flowers, and doubtfully referred to this species.

2. Cratægus rufipes Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XX, p. 51, 1904.

Leaves oblong-ovate, long-pointed and acuminate at the apex, rounded, cuneate or truncate at the broad base, finely doubly serrate, with slender straight acuminate teeth, and deeply divided into 4–6 pairs of lateral spreading and often recurved acuminate lobes, nearly fully grown when the flowers open from the 15th to the 20th of May and then roughened above by short pale hairs and glabrous below, and at maturity membranaceous, yellow-green, lustrous and slightly scabrate on the upper and pale on the lower surface, 4.5–6.5 cm. long and 4–5 cm. wide, with thin midribs and slender veins arching obliquely to the points of the lobes; petioles slender, sparingly glandular, with minute scattered glands, 1.5–2 cm. in length; leaves on vigorous shoots mostly cuneate at the base, very coarsely serrate, more deeply lobed, occasionally 8–9 cm. long and 6–7 cm. wide, with broadly winged petioles and large foliaceous lunate stipules. *Flowers* 1.3–1.5 cm. in diameter, on elongated slender glabrous pedicels, in wide many-flowered corymbs, with linear glandular bracts and bractlets mostly deciduous before the flowers open; calyx narrowly obconic, the lobes gradually narrowed from broad bases into long slender acuminate tips, irregularly glandular-serrate, reflexed after anthesis; stamens 5–8; anthers dark rose color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening the middle of September on long slender drooping pedicels, in wide many-fruited clusters, narrow-pyriform until nearly ripe, becoming oblong to oval, gradually narrowed and rounded at the base, bright scarlet mottled with green or russet, 1–1.2 cm. long and 6–8 mm. wide; calyx much enlarged, with a broad shallow cavity, and elongated reflexed closely appressed usually persistent lobes;

flesh soft, orange or yellow-orange sometimes slightly tinged with red; nutlets 2 or 3.

A shrub 2–4 m. high, with numerous flexuous ascending branches forming a narrow oblong head, and slender nearly straight branchlets marked by many small pale lenticels, dull dark red-brown during their first season, becoming pale gray-brown the following year, and armed with slender slightly curved bright chestnut-brown shining ultimately gray-brown spines 2–3 cm. long, becoming elongated and forked on the large branches.

Berks county: Near Kutztown, *C. L. Gruber* (No. 128, type!), 1902, May and August, 1903, September 1904; North Heidelberg, *C. L. Gruber* (No. 173), 1903, May and August, 1904. Bucks county: Near Sellersville, *C. D. Fretz* (No. 174), May and September, 1903.

The anthers of the Bucks county plant are described by Dr. Fretz as light pink. The leaves are rather less deeply lobed and the fruit is persistent until after all the leaves have fallen.

3. Cratægus lata n. sp.

Leaves broadly ovate to nearly orbicular, short-pointed and acuminate at the apex, rounded, truncate, slightly cordate or rarely cuneate at the wide entire often glandular base, sharply doubly serrate above, with slender glandular teeth, and divided above the middle into numerous short acuminate lobes; when they unfold tinged with red, slightly hairy above and glabrous below, nearly fully grown when the flowers open about the 20th of May and then very thin, nearly glabrous, and scabrate above, and at maturity membranaceous, light yellow-green and slightly roughened on the upper and pale on the lower surface, 4.5–6 cm. long and wide, and often, especially on leading shoots, rather wider than long, with slender yellow midribs, and 6 or 7 pairs of thin primary veins extending obliquely to the points of the lobes; petioles very slender, glandular, with minute often persistent glands, 2–3 cm. in length. *Flowers* about 1.5 cm. in diameter, on slender elongated glabrous pedicels, in wide open 7–15-flowered corymbs; calyx-tube narrowly obconic, the lobes narrow, gradually contracted into long slender tips, entire or occasionally irregularly glandular-toothed, reflexed after anthesis; stamens 5–8; anthers dark purple; styles 2–4, usually 3, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening at the end of September, on slender drooping pedicels, in few-fruited clusters, oblong, gradually narrowed and rounded at the ends, bright scarlet, lustrous, 1–1.2 cm. long and about 7 mm. wide; calyx little enlarged, with a narrow shallow cavity and spreading lobes, often entirely deciduous from the ripe fruit; flesh yellow, rather juicy; nutlets 2–3, rounded at the base, gradually narrowed and acute at the apex, ridged on the back, with a low grooved ridge, 6–7 mm. long and 3–4 mm. wide.

An arborescent shrub 3–4 m. high, with stout ascending stems, and slender nearly straight branchlets marked by occasional small pale lenticels, light orange to reddish-brown and lustrous during their first winter and ashy-gray the following year, and armed with slender slightly curved bright chestnut-brown shining spines 2.5–3 cm. in length.

Bucks county: Hillside near Sellersville, *C. D. Fretz* (No. 140, type), May and September, 1901, September, 1903.

4. Cratægus collinsiana n. sp.

Leaves oblong-ovate, acuminate, gradually narrowed and cuneate or full and rounded at the entire base, finely often doubly serrate, with broad straight glandular teeth, and slightly lobed, with numerous short lobes, more than half-grown when the flowers open the middle of May and then membranaceous, light yellow-green and roughened above by short white hairs and pale below, and at maturity thick and firm in texture, dark blue-green and scabrate on the upper, and light bluish-green on the lower surface, 5–6 cm. long and 4–5 cm. wide, with slender midribs, and 5 or 6 pairs of thin primary veins extending very obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, usually without glands, 2–3 cm. long. *Flowers* 1–1.2 cm. in diameter, on slender pedicels, in very compact 4–6-flowered corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes gradually narrowed and acuminate, glandular-serrate especially above the middle, tipped with dark red glands, reflexed after anthesis; stamens 3–7; anthers red; styles 2 or 3. *Fruit* ripening and falling before the middle of September on short pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, dark crimson, lustrous, about 1 cm. long and 8 mm. wide; calyx little enlarged, with a deep narrow cavity, and spreading lobes, their tips deciduous from the ripe fruit; flesh thick, yellow, soft and pulpy; nutlets 2 or 3, gradually narrowed and acute at the ends, prominently ridged on the back, with a broad deeply grooved ridge, 6–7 mm. long and 4 mm. wide.

A tree 3–4 m. high, with a short erect trunk 7–8 cm. in diameter, and slender zigzag branchlets marked by numerous small pale lenticels, dark orange color when they first appear, dark dull red-brown during their first year, becoming dark gray-brown the following season, and armed with very stout straight or slightly curved bright red ultimately dark gray-brown spines 2.5–4 cm. in length.

Bucks county: Meadow at Hilltop, near Sellersville, *Fretz* and *Sargent* (No. 163, type!), September, 1902; *C. D. Fretz*, May and September, 1903.

This species is named in memory of Zacchaeus Collins (1764–1831), the distinguished Philadelphia botanist, who was one of the early collectors of plants in Bucks county.

5. Cratægus pumila n. sp.

Leaves ovate, acuminate, rounded or cuneate at the usually unsymmetrical base, finely serrate, with slender glandular teeth, and deeply divided into numerous narrow spreading lateral lobes, about half-grown when the flowers open the 20th of May and then light yellow-green and covered above with short white hairs and pale and glabrous below, and at maturity membranaceous, glabrous, bluish-green on the upper and glaucous on the lower surface, 4.5–6 cm. long and 3.5–5 cm. wide, with slender midribs, and thin primary veins arching obliquely to the points of the lobes; pedicels slender, grooved on the upper side, sparingly glandular, with mostly deciduous glands, 2.5–3 cm. in length. *Flowers* 1.2–1.4 cm. in diameter, on short glabrous pedicels, in very compact 8–12-flowered compound corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes slender, acuminate, tipped with dark red glands, entire or occasionally with one or two teeth near the middle, reflexed after anthesis; stamens 6–10; anthers deep red; styles 3–5, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening toward the end of September, in few-fruited clusters, oblong, rounded at the ends, dark red and lustrous, 1.2–1.8 cm. in length, 8–10 mm. in diameter; calyx little enlarged, with a broad shallow cavity, and spreading lobes mostly deciduous from the ripe fruit; flesh thick, yellow, very soft and pulpy; nutlets 3–5, narrowed at the ends, rounded at the base, acute at the apex, slightly ridged on the back, 1.6–1.7 cm. long and 4–5 cm. wide.

A shrub 1–2 m. high, with numerous erect stems, and slender slightly zigzag branchlets marked by small oblong pale lenticels, bright chestnut-brown and lustrous when they first appear, becoming dull reddish-brown the following year, and armed with numerous stout straight bright red-brown shining spines about 3 cm. in length.

Bucks county: Hillsides, in thickets near Sellersville, *C. D. Fretz* (No. 139, type!), May, 1901, May and September, 1903.

6. Cratægus firma n. sp.

Leaves oblong-ovate, acuminate, rounded or cuneate at the gradually narrowed entire base, coarsely doubly serrate above, with straight glandular teeth, and usually slightly divided above the middle into 2 or

3 pairs of short acute lobes, when they unfold deeply tinged with red, glabrous below and covered above with short shining white hairs, about half-grown when the flowers open from the 15th to the 20th of May and then membranaceous, pale bluish-green and nearly glabrous above with the exception of a few scattered hairs and a slight pubescence on the upper side of the midribs, and pale below, and at maturity thick and firm in texture, bluish-green, smooth and glabrous on the upper, light yellow-green on the lower surface, 5.5–6 cm. long and 4–4.5 cm. wide, with thick midribs, and usually 5 pairs of slender primary veins; petioles slender, grooved on the upper side, slightly wing-margined at the apex, sparingly glandular, with minute dark red glands, at first slightly pubescent, soon glabrous, 2.5–3 cm. in length; stipules linear to lanceolate, glandular, fading rose color, caducous. *Flowers* 2 cm. in diameter, on long slender glabrous pedicels, in usually 7–10-flowered corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or occasionally irregularly toothed above the middle, tipped with minute dark glands, reflexed after anthesis; stamens 10; anthers rose color; styles 2–4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening from the middle to the end of September on drooping pedicels, in few-fruited clusters, short-oblong to obovate, crimson, lustrous, 1.2–1.4 cm. long, 1–1.2 cm. wide; calyx only slightly enlarged, with a wide shallow cavity, and spreading or erect lobes, their tips usually deciduous from the ripe fruit, flesh thick, yellow, rather juicy; nutlets usually 3 or 4, full and rounded at the base, gradually narrowed to the acute or rounded apex, ridged on the back, with a broad high ridge 7–8 mm. long and 4–5 mm. wide.

A tree sometimes 7 m. high, with a short stem 3.5–3.8 cm. in diameter, dividing near the ground into several stout erect stems, covered with gray-brown scaly bark, and forming a narrow irregular head, and stout nearly straight branchlets marked by few oblong pale lenticels, dark orange color when they first appear, pale orange color to light reddish-brown and very lustrous during their first winter, pale gray-brown the following year, and armed with numerous very stout curved chestnut-brown shining spines 2–3 cm. in length.

Bucks county: Banks of a stream in the meadow near Pleasant Spring bridge, Hilltop near Sellersville, *C. D. Fretz* (No. 128, type!), May and September, 1900; *Fretz* and *Sargent*, September, 1902.

7. Cratægus gruberi Ashe.

Ann. Carnegie Mus., I, 3 (1902).——Gruber, Proc. Berks County Nat. Sci. Club, I, 11 (Cratægus in Berks County, II).

Leaves ovate to oval or rhombic, acuminate and often long-pointed at the apex, concave-cuneate or rounded at the entire base, sharply doubly serrate above, with straight glandular teeth, and slightly divided into 3 or 4 pairs of short acute or acuminate spreading lobes; when they unfold reddish-bronze color, pubescent above and glabrous below with the exception of small axillary tufts of pale pubescence sometimes persistent during the season, about half-grown when the flowers open during the second week in May and then slightly roughened above by short white hairs, and at maturity membranaceous, dark green, scabrate and lustrous on the upper and pale or glaucous on the lower surface; 3–5 cm. long and 2.5–4 cm. wide, with slender midribs, and thin primary veins extending obliquely to the points of the lobes, turning yellow or orange-yellow occasionally tinged with red before falling; petioles slender, nearly terete, slightly wing-margined at the apex, at first puberulous, soon glabrous, sparingly glandular, with minute often persistent glands, 1.5–3 cm. in length; stipules ligulate to falcate, glandular, fading rose color, caducous; leaves on vigorous leading shoots ovate, truncate to cordate at the broad base, more deeply lobed and often deeply cleft below the middle, sometimes 8–9 cm. long and 6–7.5 cm. wide, with stout winged conspicuously glandular petioles. *Flowers* 1.6–2 cm. in diameter on long slender glabrous pedicels, in 3–15, usually 8–10-flowered corymbs, with obovate to linear glandular bracts and bractlets, mostly persistent until after the flowers open; calyx-tube broadly obconic, the lobes slender, acuminate, entire, without glands, glabrous or minutely pubescent toward the reddish apex, reflexed after anthesis; stamens 5–8, usually 5; anthers pink or rose-pink; styles 2–4, usually 3, surrounded at the base by a broad ring of hoary tomentum. *Fruit* ripening late in September and falling with the leaves, on slender pedicels, in few-fruited drooping clusters, obovate to obovate-oblong or rarely subglobose, concave at the base, slightly concave or rounded at the apex, red or reddish-scarlet, marked by russet or greenish-orange blotches, dull or lustrous, covered with a glaucous bloom, rarely puberulous at the ends, 1.2–1.6 cm. long, 1.1–1.5 cm. wide; calyx somewhat enlarged, with a short tube, a wide shallow cavity, and spreading often erect and incurved lobes red on the upper side below the middle; flesh orange or orange-yellow frequently tinged with red, soft, juicy and acid; nutlets 2–4, acute at the ends, ridged on the back, with a deeply grooved ridge, 7–8.5 mm. in length.

A shrub or slender tree occasionally 3–4 m. high, with a short more or less flattened or angled trunk rarely 1.8 cm. in diameter, and covered with rough gray scaly bark, numerous ascending or semi-erect slender flexuose branches, and slender slightly zigzag branchlets marked by minute pale lenticels, light reddish-brown when they first appear, light red-brown and lustrous during their first year and grayish-brown the following season, and armed with numerous slender straight or slightly curved red-brown shining spines 3–5 cm. long, becoming branched on old stems and branches and sometimes 7 cm. long.

Berks county: Fields, fence-rows and borders of woods in rich gravelly soil, Kutztown and near West Lockport, *C. L. Gruber* (Nos. 6 and 190), May, 1901, May and September, 1904.

Mr. Gruber calls attention to the fact that on this species "a number of small leaves are found distinct in shape from the larger ones. These are 2–3.5 cm. long and wide; broadly ovate, rhombic, fan-shaped, or nearly ovate, sometimes ovate, rarely suborbicular; base widely obtuse to broadly cuneate; apex obtuse, abruptly acute, or rarely almost rounded; lower portion serrate often till near the petiole, the portion above the basal sides doubly serrate, cut-serrate, or slightly lobed."

Cratægus perlevis (Ashe, *Jour. Elisha Mitchell Sci. Soc.*, Vol. XX, p. 48, 1904), known only from a single plant near Sacony creek in the neighborhood of Kutztown (*C. L. Gruber*, No. 15), is probably only a form of *Cratægus gruberi*, with leaves which are nearly glabrous below while young and smooth and glabrous above at maturity, and with slightly brighter-colored fruit remaining later on the branches in the autumn.

8. Cratægus ampla n. sp.

Leaves ovate to oval, abruptly narrowed, acuminate and usually long-pointed at the apex, full and rounded or rarely cuneate at the broad mostly entire base, coarsely doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of short spreading acuminate lobes, more than half-grown when the flowers open from the 7th to the 10th of May and then slightly tinged with red and roughened above by short white caducous hairs and pale and glabrous below, and at maturity membranaceous, smooth, glabrous or puberulous, dark yellow-green on the upper and pale or glaucous on the lower surface, 6 to 8 cm. long and 5 to 7 cm. wide, with slender yellow midribs and primary veins, turning yellow sometimes tinged with red in the autumn and falling late in September; petioles slender, grooved on the upper side, slightly wing-margined toward the apex, sparingly glandular above the middle, with stipitate deciduous glands, 2.5–4 cm. in length. *Flowers* 1.3–1.8 cm. in diameter, on slender glabrous pedicels, in compact usually 5–12-flowered corymbs; calyx-tube narrowly obconic, the lobes gradually narrowed, slender, acuminate, entire or rarely sparingly serrate near the base, red toward the apex, reflexed after anthesis; stamens 5–10;

anthers rich purple; styles 2–4, usually 3, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening the end of August and falling as soon as ripe, on elongated slender pedicels, in wide drooping clusters, short-oblong or rarely depressed-globose, scarlet often blotched with russet, concave at the base, lustrous, marked by small pale dots, 1.2–1.4 cm. long, 1.1–1.2 cm. thick; calyx little enlarged with a wide shallow cavity, and spreading closely appressed lobes mostly persistent on the ripe fruit; flesh orange-yellow, soft; nutlets 3, gradually narrowed and rounded at the ends, only slightly ridged on the back, with a broad low ridge, about 7 mm. long and 4 mm. wide.

A shrubby tree 3–4 m. high, with a trunk 20–30 cm. in diameter, covered with ashy-gray scaly bark, and dividing near the ground into numerous ascending gray branches forming a narrow oval head, and slender nearly straight branchlets marked by small pale lenticels, light red-brown during their first season and light gray-brown to ashy-gray the following year, and sparingly armed with slender straight or recurved chestnut-brown spines, becoming ultimately dark gray and 3–7 cm. in length.

Berks county: Dry gravelly banks near Sacony creek, Kutztown, *C. L. Gruber* (No. 32, type), 1901, May, 1902, August, 1904.

9. Cratægus populnea Ashe.

Ann. Carnegie Mus., I, pt. 3, 395 (1902); Gruber, Proc. Berks County Nat. Sci. Club, I, 11 (Cratægus in Berks County).

Leaves ovate, acuminate, rounded, truncate or occasionally cuneate at the wide glandular base, sharply doubly serrate above, with straight glandular teeth and slightly divided into 2 or 3 pairs of broad acute lateral lobes, about one-third grown when the flowers open the middle of May and then membranaceous, yellow-green and slightly roughened above by short white hairs, pale and glabrous below, and at maturity thin but firm in texture, glabrous, dark bluish-green and lustrous on the upper and pale on the lower surface, 6–6.5 cm. long, 5.5–6 cm. wide, with slender midribs and usually 4 pairs of thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, glandular, with persistent glands, 2.5–3.5 cm. in length. *Flowers* 1.4–1.8 or occasionally 2 cm. in diameter, on stout pedicels, in compact usually 5–10-flowered corymbs; calyx-tube narrowly obconic, the lobes very slender, long-acuminate, usually entire or furnished above the middle with an occasional tooth, reflexed after anthesis; stamens 5–10; anthers light purple; styles 2–4, surrounded at the base by a ring of pale tomentum. *Fruit* ripening toward the end of September and mostly persistent until after the fall of the leaves, on slender pedicels, in spreading few-fruited clusters, globose to oblong-globose, often slightly tapering at the base, scarlet, sparingly blotched with orange or russet, 1.3–1.7 cm. long; calyx enlarged with a broad shallow cavity and spreading and incurved lobes; flesh thick, juicy, soft, yellow or orange, sweetish acid; nutlets usually 3 or 4, full and rounded at the base, gradually narrowed to the rounded apex, prominently ridged on the back, with a broad deeply grooved ridge, 7–8 cm. long and 3–4 cm. wide.

A tree sometimes 4 m. high, with a short trunk 25–30 cm. in diameter covered with rough ashy-gray to dark gray bark, spreading and ascending stout flexuose gray branches forming a broad round-topped head, and slender slightly zigzag branchlets marked by numerous pale lenticels, dark green tinged with red when they first appear, bright chestnut-brown and very lustrous during their first winter, becoming dull gray-brown the following year, and armed with numerous stout conical spines brown or purplish-brown during their first season, dark gray the following year and 1–3 cm. in length, becoming on old trunks elongated and much-branched.

Berks county: Banks of Sacony creek, near Kutztown, *C. L. Gruber* (No. 31, type!), 1901, May, 1902, and September, 1903.

10. Cratægus condensa n. sp.

Leaves oblong-ovate, acuminate, full and rounded at the entire base, coarsely serrate above, with broad glandular teeth, and slightly divided into 3 or 4 pairs of short acute spreading lobes, nearly half-grown when the flowers open about the 20th of May and then very thin, light yellow-green and slightly roughened above by short white hairs and pale and glabrous below, and at maturity thin but firm in texture, dark yellow-green, smooth and glabrous on the upper and light yellow-green on the lower surface, 5–7 cm. long and 4.5–5.5 cm. wide, with stout yellow midribs, and slender primary veins arching obliquely to the points of the lobes; petioles stout, usually without glands, 2–3 cm. in length. *Flowers* about 1.2 cm. in diameter, on short stout glabrous pedicels, in crowded compact usually 8–12-flowered corymbs, with linear glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, the lobes gradually narrowed from broad bases, slender, acuminate, entire or occasionally sparingly toothed, reflexed after anthesis; stamens 6–8; anthers purple; styles 2 or 3; surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening the middle of September, on short stout pedicels, in few-fruited drooping clusters, obovate, yellowish-red and lustrous, about 1 cm. long and 8–10 mm. wide; calyx little enlarged, with a narrow shallow cavity, and spreading lobes, their tips mostly deciduous from the ripe fruit; flesh yellow, thick and pulpy; nutlets 2 or 3, gradually narrowed and rounded at the base, acute at the apex, ridged on the back, with a high often grooved ridge, 5–6 mm. long and 3–4 mm. wide.

A shrub about 1 m. high, with stout contorted stems and branches, covered with light brown furrowed bark, and slender branchlets marked by many small pale lenticels, dark orange-green when they first appear, bright red-brown and lustrous during their first season, becoming dark brown the following year, and armed with very stout chestnut-colored spines 3–3.5 cm. in length.

Bucks county: Meadows at Pleasant Spring bridge, Hilltop near Sellersville, *C. D. Fretz* (No. 173, type!), May, July and September, 1903.

11. Cratægus moyeriana n. sp.

Leaves ovate to oblong-ovate, acute or acuminate, rounded or cuneate at the broad entire base, coarsely doubly serrate above, with straight gland-tipped teeth, and slightly divided into 2 or 3 pairs of short broad acute lateral lobes, deeply tinged with red and covered above with short white hairs and pale and glabrous below when they unfold, nearly fully grown when the flowers open about the 20th of May and then membranaceous, yellow-green and still slightly hairy above especially along the midribs, and at maturity thick to subcoriaceous, dark yellow-green and scabrate on the upper, pale on the lower surface, 7.5–8 cm. long and 6–6.5 cm. wide, with stout yellow midribs and 4 or 5 pairs of thin remote primary veins; petioles stout, grooved on the upper side, slightly wing-margined at the apex, 2.5–3 cm. long; stipules foliaceous, lunate, glandular-serrate, soon deciduous; leaves on vigorous shoots rounded or cordate at the wide base, more coarsely serrate, often deeply divided into broad acute or acuminate lateral lobes and often 6–7 cm. long and wide, with stout glandular winged petioles 1.5–2 cm. long. *Flowers* about 1.8 cm. in diameter, on short stout glabrous pedicels, in very compact 6–9-flowered corymbs, with usually oblong-obovate glandular bracts and bractlets mostly deciduous before the flowers open; calyx narrowly obconic, the lobes slender, acuminate, entire or occasionally toothed toward the apex, tipped with dark glands, reflexed after anthesis; stamens 10; anthers rose color; styles 2–4, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening the middle of September on short pedicels, in 2 or 3-fruited clusters, obovate to short-oblong, cherry-red, marked by occasional large dark dots, 1.3–1.5 cm. long and 1–1.1 cm. wide; calyx little enlarged, with a narrow cavity, and erect and incurved lobes often deciduous from the ripe fruit; flesh thin and yellow; nutlets usually 3, full and rounded at the base, rounded at the narrow apex, ridged on the back, with a high narrow ridge, about 7 mm. long and 4 mm. wide.

A tree-like shrub sometimes 3 m. high, with stout erect stems covered with ashy-gray bark, and stout slightly zigzag branchlets marked by small pale lenticels, dark red-brown when they first appear, light red-brown and very lustrous during their first season, becoming dark gray-brown the following year, and occasionally armed with short stout nearly straight bright red-brown shining spines.

Bucks county: Near Sellersville, *C. D. Fretz* (No. 111, type!), May, 1899, May and September, 1901; *Fretz* and *Sargent*, September, 1902. Rare.

This species is named for Isaac Shoemaker Moyer, A.M., M.D. (1838–1898), long a practicing physician at Quakertown in Bucks county, deeply interested in botany, ornithology and entomology, and the author of a flora of Bucks county published in 1876 in General W. W. H. Davis' *History of Bucks County*.

12. Cratægus saturata n. sp.

Leaves oblong-ovate, acuminate, cuneate or rounded at the base, finely doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of short acuminate lateral lobes, slightly tinged with red when they unfold, nearly half-grown when the flowers open about the 20th of May and then membranaceous, glabrous with the exception of a few short scattered hairs toward the base on the upper side of the midribs and glabrous below, and at maturity thin but rather rigid in texture, glabrous, very smooth and dark blue-green on the upper and pale on the lower surface, 4–6 cm. long and 3–3.5 cm. wide, with thin midribs, and very slender primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly glandular, with often persistent glands, 2–2.5 cm. in length; stipules linear, lanceolate to linear-lanceolate, glandular, with minute long-stalked glands, fading rose color, mostly deciduous before the flowers open; leaves on vigorous shoots thicker, much more deeply lobed, with broad acute lobes, and often 6 cm. long and nearly as wide. *Flowers* about 1.4 cm. in diameter, on short slender glabrous pedicels, in usually 4–6 very compact corymbs, with linear acute glandular bracts and bractlets; calyx-tube broadly obconic, the lobes wide, acuminate, usually entire, glandular, with stipitate glands, and reflexed after anthesis; stamens 5–7; anthers rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening at the end of September, on stout erect pedicels, in few-fruited clusters, short-oblong to subglobose, dark red, covered with a glaucous bloom, about 1 cm. in diameter; calyx enlarged, with a narrow deep cavity, and erect more or less incurved or spreading lobes often deciduous from the ripe fruit; flesh yellow, dry and mealy; nutlets 3 or 4, gradually narrowed and acute or rounded at the ends, ridged on the back with a low deeply grooved ridge, 6–7 mm. long and about 4 mm. wide.

An arborescent shrub spreading into broad clumps, 4–5 m. high, with numerous stout erect stems forming a broad head, and slender nearly straight branchlets marked by many small oblong pale lenticels, bright reddish-brown or green tinged with red when they first appear, bright reddish-brown and very lustrous during their first winter, becoming dull gray-brown the following year, and armed with slender straight or slightly curved purplish shining spines 3–6 cm. in length.

Bucks county: Near a stream in the meadow at Pleasant Spring bridge, Hilltop near Sellersville, *Fretz* and *Sargent* (No. 110, type!), September, 1899; *C. D. Fretz*, May, 1900.

13. Cratægus miniata Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XX, p. 51, 1904.

Leaves oblong-ovate, long-pointed and acuminate at the apex, concave-cuneate or rounded at the entire or glandular base, sharply doubly serrate above, with straight glandular teeth, and divided above the middle into 4 or 5 pairs of spreading acuminate lobes, more than half-grown when the flowers open from the 10th to the middle of May, and then covered above with short white hairs and glabrous below, and at maturity membranaceous, dark green and scabrate on the upper and pale on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with slender midribs, and thin veins arching obliquely to the points of the lobes, turning yellow or greenish-yellow before falling early in October; petioles slender, grooved on the upper side, slightly wing-margined at the apex, at first glandular, with minute dark red stipitate caducous glands, 2.5–3 cm. in length. *Flowers* 2 cm. in diameter, on slender glabrous pedicels, in compact 3–12- mostly 6–10-flowered corymbs; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or occasionally sparingly toothed, glabrous or puberulous near the apex, reflexed after anthesis; stamens 8–10; anthers light rose color; styles 2–4, surrounded at the base by a broad ring of hoary tomentum. *Fruit* ripening early in September and soon falling, or rarely persistent and shrivelling on the branches, on slender elongated pedicels, in drooping clusters, oblong to subglobose or ovate-oblong, mostly concave at the ends, scarlet more or less blotched with russet, slightly glaucous, 1.2–1.5 cm. long and 1.1–1.3 cm. wide; calyx little enlarged, with a deep cavity and closely appressed usually persistent lobes red above toward the base; flesh thin, yellow, occasionally slightly tinged with red, sweet, rather juicy; nutlets 3 or 4, gradually narrowed and rounded at the ends, 5–6 cm. long and 3–4 mm. wide.

A bushy tree occasionally 3 m. high, with a short trunk 12–14 cm. in diameter covered with light gray scaly bark, numerous ascending flexuose gray branches forming a round-topped head, and slender nearly straight branchlets marked by small pale lenticels, orange-brown when they first appear, dark reddish-brown during their first year and dull gray the following season, and armed with slender straight or slightly curved bright red-brown lustrous ultimately ashy-gray spines 2.5–5 cm. in length, becoming branched on large stems.

Berks county: Banks of streams, near Kutztown, *C. L. Gruber* (No. 9), 1901, May and September, 1903.

14. Cratægus longipetiolata n. sp.

Leaves broadly ovate to oval, full and rounded to truncate or concave-cuneate at the broad base, coarsely doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lobes, about half-grown when the flowers open the middle of May and then very thin, light yellow-green and slightly roughened above by short white hairs, pale and glabrous below, and at maturity thin, light yellow-green, and nearly smooth on the upper and pale on the lower surface, 5–6 cm. long and 4.5–5 cm. wide, with thin yellow midribs, and slender primary veins extending obliquely to the points of the lobes; petioles very slender, slightly grooved on the upper side, sparingly or not at all glandular, often 3.5–4 cm. in length. *Flowers* 1.6–1.8 cm. in diameter, on slender glabrous pedicels, in 5–10-flowered narrow compact corymbs, their bracts and bractlets deciduous before the flowers open; calyx-tube broadly obconic, the lobes slender, elongated, acuminate, entire or occasionally slightly serrate near the middle; stamens 6–9; anthers red; styles usually 3 or 4, surrounded at the base by a broad ring of long white hairs. *Fruit* ripening the middle of September, on slender drooping pedicels, in few-fruited clusters, oblong-obovate, dark red, lustrous, 9–12 mm. long; calyx little enlarged, with a narrow shallow cavity and spreading lobes, their tips deciduous from the ripe fruit; flesh thin and yellow; nutlets usually 3, rounded at the base, gradually narrowed to the rounded apex, slightly grooved on the back, about 7 mm. long and 4–5 mm. wide.

A branching shrub, with erect stems 3–4 m. high and 5–6 cm. in diameter, spreading into thickets, and slender nearly straight branchlets marked by numerous small dark lenticels, dark orange color and lustrous when they first appear, becoming dark orange-brown during their first winter and light gray-brown the following year, and armed with few slender slightly curved light red-brown spines 2–2.5 cm. in length.

Bucks county: Borders of rich woods, near Sellersville, *C. D. Fretz* (No. 178, type!), May and September, 1903.

15. Cratægus insolita n. sp.

Leaves oblong-ovate, rounded or occasionally cuneate at the broad entire base, coarsely doubly serrate above, with straight gland-tipped teeth, and divided into 4 or 5 pairs of short acuminate spreading lobes, less than half-grown when the flowers open about the middle of May and then membranaceous, light yellow-green and covered above with short white hairs, and pale and glabrous below, and at maturity thin but firm in texture, glabrous, dark yellow-green on the upper and pale on the lower surface, 6–8 cm. long and 5–6 cm. wide, with stout yellow midribs, and thin primary veins extending very obliquely to the points of the lobes; petioles stout, slightly grooved on the upper side, sparingly villose at first, soon glabrous, slightly glandular, with minute caducous glands, and 3–4 cm. long; stipules linear-lanceolate, acuminate, glandular, with minute stipitate glands, fading pink, caducous; leaves on vigorous shoots becoming subcoriaceous, full and rounded or occasionally slightly cuneate at the base, more coarsely serrate and often 8–9 cm. wide and long, with stout petioles wing-margined at the apex and 3–4 cm. in length. *Flowers* about 1–2 cm. in diameter, on slender glabrous pedicels, in broad mostly 10–12-flowered corymbs, with oblong-obovate acuminate coarsely glandular-serrate bracts and bractlets mostly persistent until after the flowers open; calyx-tube narrowly obconic, reddish, the lobes linear, long-acuminate, entire or occasionally sparingly serrate, reflexed after anthesis; stamens 10 or less, usually 5–8; anthers dark rose color; styles 2–4, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening at the end of September, on long stout pedicels, in drooping few-fruited clusters, broad ovate, bright cherry red, marked by many large dark dots, 1.3–1.5 cm. long and 1.2–1.3 cm. wide; calyx little enlarged, with a narrow deep cavity, and elongated mostly entire closely appressed lobes gradually narrowed from broad bases; flesh thick, pale yellow, and somewhat juicy; nutlets usually 3 or 4, broad and rounded at the base, gradually narrowed to the rounded apex, prominently ridged on the back, with a high narrow ridge, 7–8 cm. long and about 5 mm. wide.

A shrub 3–5 m. high, often forming thickets, with stout ascending stems covered with ashy-gray bark, and thick slightly zigzag branchlets marked by oblong pale lenticels, dark orange-green when they first appear, light orange or reddish-brown and lustrous during their first winter, light gray-brown the following year, and armed with numerous stout curved or rarely straight red-brown shining spines 3.5–5 cm. in length.

Delaware county: Collen Brook, Upper Darby, *Smith* and *Sargent* (No. 216, type!), September, 1902; *B. H. Smith*, May and September, 1903, May, 1904; Lownes' Run, Springfield, *B. H. Smith* (No. 203), May and June, 1902, May, 1904; Collen Brook, Upper Darby, *B. H. Smith* (No. 240), May, 1904.

16. Cratægus stolonifera Sargent.

Bot. Gazette, XXXV, 109 (The Genus Cratægus in New Castle County, Delaware) (1903).

Leaves ovate-oblong, acuminate, rounded, truncate or sometimes especially on leading shoots cordate at the broad base, more or less deeply divided into 4 or 5 pairs of acute or acuminate lobes, coarsely and often doubly serrate, with straight or incurved glandular teeth, as they unfold suffused with red and villose above, with long pale caducous hairs, and at maturity thin but firm in texture, glabrous, dark yellow-green on the upper, pale on the lower surface, 4.5–6 cm. long, 3–4 cm. wide, with slender midribs slightly impressed above, 4 or 5 pairs of remote primary veins extending to the points of the lobes, and very indistinct veinlets; petioles slender, slightly grooved, at first glandular, with numerous small dark deciduous glands, often red below the middle, 1.5–2 cm. long; stipules linear, acuminate, finely serrate, bright red, caducous. *Flowers* appearing from the 10th to the middle of May, 1.5 cm. in diameter, in compact mostly 5–10-flowered thin-branched glabrous corymbs, with oblong-obovate to linear, acuminate, finely glandular-serrate, bright red, caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes acuminate, entire or slightly serrate toward the apex, often red toward the base, reflexed after anthesis; stamens 5–7; anthers small, dark red tinged with purple; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening early in September and soon falling, in few-fruited drooping clusters, usually on short pedicels, subglobose to short-oblong, scarlet, lustrous, 1.2–1.3 cm. long; calyx-cavity broad and shallow, the lobes gradually narrowed from broad bases, acuminate, mostly entire or sparingly serrate, red on the upper side toward the base, closely appressed; flesh yellow, thick and succulent; nutlets 3 or 4, thick, narrow and acute at the ends, prominently ridged on the back, with a thin high ridge, 7–8 mm. long.

A shrub 2–3 m. tall, with numerous stems spreading into broad thickets, and slender slightly zigzag branchlets olive-green tinged with red when they first appear, dull red-brown during their first and olive-green during their second year, and armed with numerous stout slightly grooved bright chestnut-brown spines 3–5 cm. long.

Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 223), October, 1902, May and October, 1903; Lownes' Run, Springfield, *B. H. Smith* (No. 230), May and September, 1903. Bucks county: Meadow at Pleasant Spring bridge, Hilltop near Sellersville, *C. D. Fretz* (No. 107), September, 1899, May, 1900; *Fretz* and *Sargent*, September, 1902; near South Perkasie, *C. D. Fretz* (No. 175), May and September, 1903. Also in New Castle county, Delaware.

17. Cratægus modica n. sp.

Leaves ovate, acuminate, rounded, cuneate or occasionally nearly truncate at the entire often glandular base, finely doubly serrate above, with slender glandular teeth, and divided into 4–6 pairs of narrow acuminate spreading lateral lobes, nearly fully grown when the flowers open about the middle of May and then very thin, light yellow-green and hairy above, with short soft white hairs, and pale and glabrous below, and at maturity membranaceous, glabrous, yellow-green, smooth and lustrous on the upper and pale on the lower surface, 2.5–4 cm. long and 2–3.5 cm. wide, with thin yellow midribs, and slender primary veins arching obliquely to the points of the lobes; petioles very slender, at first reddish and puberulous, soon glabrous, sparingly glandular, 1.5–2.5 cm. in length. *Flowers* about 1.5 cm. in diameter, on slender glabrous pedicels, in compact 5–7-flowered corymbs, with linear bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, the lobes slender, acuminate, usually entire or slightly toothed above the middle, tipped with minute dark glands, reflexed after anthesis; stamens 7–8; anthers rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening early in September, on stout pedicels, in few-fruited clusters, globose, bright crimson, lustrous, 8–10 mm. in diameter; calyx little enlarged, with a wide shallow cavity and lobes usually deciduous from the ripe fruit; flesh orange color, sweet, soft and pulpy; nutlets 3 or 4, gradually narrowed and rounded at the ends, prominently ridged on the back, with a high grooved ridge 5–7 mm. long and 4–5 mm. wide.

A shrub 1–1.5 m. high and broad, with stout contorted grayish-brown stems, and slender nearly straight branchlets marked by small oblong pale lenticels, light red-brown and slightly puberulous when they first appear, soon glabrous, dark red-brown and rather lustrous during their first winter and light gray-brown the following season, and armed with slender slightly curved red-brown lustrous spines often 4 cm. long on young branches, and on old stems very stout, gray-brown and frequently not more than 3 cm. in length.

Bucks county: Meadows near the brook, in low moist soil, at Pleasant Spring, Hilltop near Sellersville, *Fretz* and *Sargent* (No. 109, type!) September, 1899; *C. D. Fretz*, May, 1900. Rare.

18. Cratægus vittata Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XX, p. 50, 1904.

Leaves ovate to oblong-ovate, acuminate and often long-pointed at the apex, rounded, truncate or rarely cuneate at the broad entire or crenate base, sharply double serrate above, with straight glandular teeth, and more or less divided into 3 or 4 pairs of broad acuminate lobes; nearly half-grown when the flowers open during the first week of May and then membranaceous, light yellow-green and glabrous or sparingly villose especially on the midribs above, pale and glabrous below, and at maturity thin, dark yellow-green and lustrous on the upper, pale on the lower surface, 7–8 cm. long and 5.5–6.5 cm. wide, with stout midribs, and conspicuous primary veins arching obliquely to the points of the lobes; petioles stout, furnished with occasional dark glands, glabrous, and 3–4 cm. in length; stipules lanceolate sometimes falcate, glandular, caducous. *Flowers* 1.5–2 cm. in diameter, on stout elongated glabrous pedicels, in broad lax, usually 7–12-flowered corymbs, with linear glandular caducous bracts and bractlets; calyx-tube broadly obconic, the lobes short, slender, entire or sinuate-toothed near the middle, reflexed after anthesis; stamens 5–10, generally 8–10; anthers reddish-purple; styles 3–5, mostly 3 or 4, surrounded at the base by a ring of long white hairs. *Fruit* ripening early in September and falling gradually before the leaves, on elongated pedicels, in drooping few-fruited clusters, depressed-globose to short-oblong, scarlet, usually blotched with green, covered with a slight glaucous bloom, 1.3–1.5 cm. in diameter; calyx enlarged, with a broad shallow cavity, and spreading lobes mostly deciduous from the ripe fruit; flesh thick and pulpy, acid, yellow-orange, sweetish; nutlets 3 or 4, narrowed and rounded at the base, acute at the apex, prominently ridged on the back, with a high grooved ridge, 6–7 mm. long and 4 mm. wide.

A tree-like shrub 2–3 m. high, with a short stem covered with dark gray scaly bark, small branches forming a broad round-topped head, and stout nearly straight branchlets marked by small pale lenticels, dark red-brown during their first season and ultimately dark brown or gray-brown, and armed with numerous stout straight or slightly curved bright red-brown shining spines 6–7 cm. in length.

Berks county: Borders of oak woods, in gravelly soil, near Robesoniana, North Heidelberg township, *C. L. Gruber* (No. 14), May and September, 1900.

19. Cratægus sequax Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XX, p. 40, 1904.

Leaves ovate, acuminate and often long-pointed at the apex, rounded, truncate or occasionally slightly cordate at the broad entire base, sharply doubly serrate above, with slender straight glandular teeth, and more or less divided into numerous narrow acuminate lateral lobes, more than half-grown when the flowers open about the 10th of May and then covered above with soft white hairs and pale and glabrous below, and at maturity membranaceous, dark yellow-green, glabrous and very smooth on the upper and pale and conspicuously reticulate-venulose on the lower surface, 3–4.5 cm. long, 2.5–4 cm. wide, with thin midribs and slender veins extending obliquely to the points of the lobes; petioles slender, grooved on the upper side, slightly wing-margined at the apex, tinged with red, glandless or sparingly glandular, 1.5–2.5 cm. in length; leaves on vigorous shoots cuneate or cordate at the base, more deeply lobed and often deeply cleft, with stout broadly winged conspicuously glandular petioles. *Flowers* 1.8–2.1 cm. in diameter, on slender glabrous pedicels, in 5–9-flowered compact corymbs with linear glandular bracts and bractlets, fading red, mostly deciduous before the flowers open; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, entire or sparingly minutely serrate, glabrous or slightly pubescent toward the apex, reflexed after anthesis; stamens 5–10, frequently 8; anthers purple; styles 3–5, usually 3 or 4, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening about the 20th of September and falling gradually during several weeks, on slender pedicels, in few-fruited drooping clusters, globose to depressed-globose or rarely to oblong-globose, occasionally slightly tapering toward the base, dark crimson to cardinal, usually mottled with russet or orange, covered with a glaucous bloom, 1.2–1.5 cm. in diameter; calyx much enlarged, with a broad shallow cavity, and spreading and reflexed or erect lobes dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh thick, soft and juicy, orange color often tinged with red; nutlets usually 3 or 4, rounded at the narrow ends, ridged on the back, with a broad deeply grooved ridge, 7–8 mm. long and about 4 mm. wide.

A tree sometimes 4 m. high, with a short trunk 25 to 30 cm. in diameter covered with dark red bark separating into large thin scales, numerous stout ascending gray branches forming a round-topped head, and slender nearly straight branchlets marked by many small circular pale lenticels, light reddish-brown when they first appear, reddish-brown or purplish and often covered with a glaucous bloom during their first year, and gray-brown the following season, and armed with numerous slender straight or slightly curved light chestnut-brown shining spines 3–5 cm. in length, becoming on the upper part of the trunk and on the base of the large branches compound and many-branched.

Berks county: Low moist soil, in the neighborhood of swamps, on Sacony creek, near Kutztown, *C. L. Gruber* (No. 25), 1901, September, 1902, May, 1903 (No. 108 with 5–8 stamens).

V.—MOLLES.

Stamens 10; anthers white, ... 1. *C. tatnalliana.*
Stamens 5 or 6; anthers pink, ... 2. *C. digna.*

1. Cratægus tatnalliana Sargent.

Bot. Gazette, XXXV, 106 (The Genus Cratægus in New Castle County, Delaware) (1903).

Leaves ovate to oval, acute, broadly cuneate, or on leading shoots rounded or rarely cordate at the entire base, divided above into short acute lobes, and coarsely and usually doubly glandular-serrate; as they unfold light green and covered above with short lustrous white hairs, rather paler below and villose along the midribs and primary veins, and at maturity membranaceous, dark yellow-green and scabrate on the upper and paler and glabrous on the lower surface with the exception of a few scattered hairs on the slender yellow midribs and 5 or 6 pairs of thin primary veins extending to the points of the lobes, 8–10 cm. long and 5.5–6 cm. wide; petioles slender, at first villose-pubescent, soon glabrous or rarely puberulous at maturity, 2.5–3 cm. long; stipules spatulate, acute, conspicuously glandular-serrate, caducous, or on vigorous shoots foliaceous, full and rounded below, and acuminate at the apex. *Flowers* opening during the first week in May, 2 cm. in diameter, in compact ultimately lax slender-branched many-flowered compound corymbs, with foliaceous, oblong-obovate bracts and bractlets, acute or short-pointed at the apex, and coarsely serrate, with glandular teeth; calyx-tube broadly obconic, thickly coated like the short slender pedicels with long white hairs, the lobes acuminate, serrate, with elongated teeth tipped with red glands, dark green, slightly puberulous particularly along the lower side of the prominent midvein; stamens 10; anthers large, white, styles 3 or 4, surrounded at the base by a broad ring of white tomentum. *Fruit* ripening from the middle to the end of August, in few-fruited drooping puberulous corymbs, globose, obovate or rarely oblong, full and rounded at the ends, bright orange-red, marked by large pale dots, puberulous toward the base, 1.5–2 cm. long, 1–2 cm. wide; calyx enlarged, with a broad deep cavity and lobes gradually narrowed from broad bases, acuminate, coarsely serrate usually only above the middle, puberulous, bright red on the upper side toward the base, closely appressed or rarely erect and incurved; flesh thick, yellow, dry and mealy; nutlets 3 or 4, thin, acute at the narrow ends, very irregularly ridged on the rounded back, 7–8 mm. long and 4–5 mm. wide.

A shrub 4–5 m. high, with numerous stout stems forming a broad head, and thick slightly zigzag branchlets at first villose, soon glabrous, dark red-brown, lustrous and marked by numerous large oblong white lenticels during their first season, ashy-gray and lustrous during their second year and ultimately darker, and armed with stout straight or slightly curved bright chestnut-brown shining spines 4–5 cm. long.

Chester county: Along Brandywine creek below Sager's Mill, *W. M. Canby* (No. 4), October, 1902, May and September, 1903. Philadelphia county: Bartram's Garden, *A. MacElwee* (Nos. 72A and 76, Herb. Philadelphia Museums), May, 1899, June, 1901; *B. H. Smith*, 1903. Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 222), May, 1903. Berks county: *C. L. Gruber* (No. 129), 1902, May and August, 1903. Also in New Castle county, Delaware.

It is interesting to find that this common Delaware species was probably known to John Bartram, as the old specimen in his garden, judging from its size and age, may have been planted there during his lifetime.

2. Cratægus digna n. sp.

Leaves broadly ovate, acute or acuminate, full and rounded or concave-cuneate at the wide entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of short acute lateral lobes, less than one-third grown when the flowers open during the first week of May and then coated above with soft white hairs and villose below along the midribs and veins, and at maturity thin, yellow-green and sparingly short-pubescent or glabrate on the upper, paler and still slightly hairy on the lower surface along the thin midribs and in the axils of the slender primary veins arching obliquely to the points of the lobes, 7–8 cm. long and 6–7 cm. wide; petioles slender, grooved on the upper side, at first villose, becoming glabrous or nearly glabrous, sparingly glandular, with minute often persistent glands, 1.5–4 cm. long. *Flowers* 1.5–2.2 cm. in diameter, on stout densely villose pedicels, in wide 6–12-flowered villose corymbs, with linear glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, coated toward the base with long matted white hairs, the lobes gradually narrowed, acuminate, coarsely glandular-serrate, puberulous on the outer and villose on the inner surface, red toward the apex, reflexed after anthesis; stamens 5 or 6; anthers pink or light rose color; styles 5, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening at the end of August and soon falling, on slender slightly hairy reddish pedicels, in drooping usually many-fruited clusters, globose to rarely pyriform-globose or oblong-globose, concave at the base, concave or flattened at the apex, pubescent or puberulous at the ends, scarlet, dotted with yellow or orange, 1.2–1.4 cm. in diameter; calyx little enlarged, with a wide shallow cavity, and spreading incurved coarsely serrate lobes covered above with short white hairs and dark red toward the base on the upper side; flesh thick, dark yellow, soft, sweetish acid; nutlets 5, gradually narrowed and acute at the ends, slightly grooved on the back, 7–8 mm. long and about 4 mm. wide.

A tree 4–6 m. high, with a short trunk sometimes 30 cm. in diameter, covered with dark gray bark separating into thin papery scales or often shrubby with two or three stems, long ascending flexuose branches forming a round-topped head, and stout nearly straight branchlets marked by small scattered pale lenticels, dark orange color and pubescent when they appear, soon becoming glabrous, dark reddish or purple-brown and lustrous during their first season, lighter-colored the following year and ultimately ashy-gray, and armed with numerous straight or slightly curved bright chestnut-brown shining spines 2.5–3 cm. in length, becoming elongated and much branched on old stems and branches.

Berks county: Borders of meadows, in low moist soil, near Kutztown, *C. L. Gruber* (Nos. 144, type!, and 19), 1902, May and September, 1903, (No. 207), August, 1904.

No. 184, *Fretz,* meadows near Sellersville, Bucks county, a tree now destroyed, with 8–10 stamens and rather smaller leaves more frequently cuneate at the base and often oblong-ovate, is doubtfully referred to this species.

VI.—FLABELLATÆ.

Flowers cup-shaped, less than 2 cm. in diameter, on puberulous or glabrous pedicels; anthers rose-purple; fruit narrow-oblong, 1. *C. holmesiana.*

Flowers not cup-shaped, 2 cm. or more in diameter, on villose pedicels; anthers light rose color or pink; fruit subglobose to short-oblong, 2. *C. arcuata.*

1. Cratægus holmesiana Ashe.

Jour. Elisha Mitchell Sci. Soc., XVI, pt. II, 78 (1900).——Sargent, Bot. Gazette, XXXI, 10; Silva N. Am., XIII, 111, t. 676; Man. 449, f. 366.

Bucks county: Banks of Perkiomen creek, Sellersville, *C. D. Fretz* (No. 2), May 12, 1896, (No. 18), May, 1899, (No. 32), July, 1899, (Nos. 34 and 35), August, 1899; *Fretz* and *Sargent*, September, 1899; *A. MacElwee* (Nos. 414 and 811, Herb. Philadelphia Museums), June, 1899, (No. 1,507), October, 1899, (No. 1,655), May, 1900. Berks county: Near Kutztown, *C. L. Gruber* (No. 4), 1901, May and September, 1903.

The Pennsylvania tree differs from *Cratægus holmesiana* as it usually occurs in New England and Canada in its puberulous or villose corymbs, pedicels and young branchlets, and in the hairs found on the under surface of the leaves particularly on the midribs and veins, and is the variety *villipes* Ashe (*Jour. Elisha Mitchell Sci. Soc.*, XVII, pt. II, 11, 1901) (*Cratægus villipes* Gruber, *Proc. Berks Co. Nat. Sci. Club*, I, 7) (*Cratægus in Berks County*, II) (1903).

2. Cratægus arcuata Ashe.

Ann. Carnegie Mus., I, pt. 3, 387 (1902).——Sargent, Bot. Gazette, XXXV, 108 (The Genus Cratægus in New Castle County, Delaware).——Gruber, Proc. Berks County Nat. Sci. Club, 7 (Cratægus in Berks County, II).

Leaves ovate to oval, acute, rounded or concave-cuneate at the entire base, coarsely doubly serrate above, with straight or recurved glandular teeth, and divided into short acute lateral lobes, about half-grown when the flowers open toward the first week of May and then light yellow-green and roughened above by short white hairs and sparingly villose below along the thin midribs and primary veins, and at maturity dark yellow and scabrate on the upper and paler and still slightly villose on the lower surface especially in the axils of the veins, 6–9 cm. long and 5–6 cm. wide; petioles slender, slightly grooved on the upper side, wing-margined toward the apex, at first villose-pubescent, becoming puberulous or nearly glabrous before autumn, sparingly glandular, 3–3.5 cm. in length; stipules linear, glandular, fading red, caducous; leaves on vigorous shoots sometimes subcordate at the base, more coarsely serrate, often deeply laciniately lobed, with slender acuminate lobes, 9–10 cm. long and 8–9 cm. wide, with stout winged petioles and foliaceous lunate coarsely serrate persistent stipules. *Flowers* 2–2.5 cm. in diameter, on slender villose pedicels, in wide many-flowered compound hairy corymbs, with linear acuminate glandular bracts and bractlets, fading red, and mostly deciduous before the flowers open; calyx narrowly obconic, glabrous, the lobes slender, elongated, coarsely glandular, with long-stalked glands, red toward the apex, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens

5–8, usually 5; anthers light rose color or pink; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening at the end of August and soon falling, on stout slightly villose pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the apex, concave and slightly hairy at the base, scarlet, lustrous, marked by large pale dots, 1.3–1.5 cm. long and 1.1–1.3 cm. wide; calyx slightly enlarged, with a narrow deep cavity, and laciniately serrate mostly incurved lobes generally persistent on the ripe fruit; flesh thick, yellow, rather juicy; nutlets usually 4, gradually narrowed and acute at the ends, slightly grooved or occasionally ridged on the back, with a low narrow ridge, about 8 mm. long and 4 mm. wide.

A tree 5–7 m. high, with a short trunk occasionally 10 cm. in diameter, or often a tall shrub, with small erect or ascending branches forming a narrow oblong head, and slender nearly straight branchlets marked by small pale lenticels, dark orange-green and slightly villose when they first appear, dull reddish-brown during their first year and finally ashy-gray, and armed with stout straight or slightly curved red-brown spines usually 3–4 cm. long and on old stems becoming elongated and much branched.

Borders of streams and meadows. Common. Berks county: *C. L. Gruber* (Nos. 5 and 168), 1901. Bucks county: *C. D. Fretz* (Nos. 135, 146 and 146A), May and September, 1901. Philadelphia county: *B. H. Smith*, Island road, Kingsessing (No. 209), May and September, 1902 and 1903. Delaware county: Lownes' Run, *B. H. Smith*, May, 1905. Also in New Castle county, Delaware.

VII.—COCCINEÆ.

Corymbs many-flowered; stamens 10 or less; anthers pale yellow; nutlets 2 or 3, obtuse at the ends, conspicuously rounded on the back.
  Leaves subcoriaceous; fruit 1.2–1.5 cm. in diameter, 1. *C. coccinea.*
  Leaves thin; fruit usually less than 1 cm. in diameter, 2. *C. dodgei.*
Corymbs few-flowered; stamens 20; anthers bright rose color; nutlets 5, acute at the ends, obscurely grooved on the back,
3. *C. evansiana.*

1. Cratægus coccinea Linnæus.

Spec., I, 476 (1753).——Sargent, Bot. Gazette, XXXI, 11; Silva N. Am., XIII, 133, t. 683; Man. 459, f. 375.

Berks county: Near Kutztown, *C. L. Gruber* (No. 197), 1903, May and September, 1904. Northampton county: *T. C. Porter*, May and August, 1894, June, 1896.

The specimens from Easton are quite glabrous and well represent the variety *rotundifolia* Sarg. (*Bot. Gazette*, XXXI, 14 [1900]; *Silva*

N. Am., XIII, 134; *Man.* 460), although those gathered by Mr. Gruber near Kutztown have slightly villose corymbs and thus approach the typical *Cratægus coccinea* L. with its extremely villose corymbs, calyx and young branchlets.

2. Cratægus dodgei Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XIX, p. 26, 1903.
Cratægus gravesii Sargent, Rhodora, V, 159 (June, 1903).
Cratægus fallens Gruber, Proc. Berks County Nat. Sci. Club, I, 19 (Cratægus in Berks County, II) (October, 1903).

Leaves ovate to obovate, acute or rounded at the apex, narrowed from below the middle to the concave-cuneate or rarely rounded entire base, and slightly divided above the middle into 3 or 4 pairs of broad acute lobes; when they unfold tinged with red and coated above with silky white hairs, nearly fully grown when the flowers open about the 20th of May and then membranaceous, light green and slightly hairy above, with scattered pale hairs, and at maturity thin but firm in texture, glabrous, dark green and lustrous on the upper surface, pale yellow-green on the lower surface, usually 3.5–4 cm. long and 2.5–3 cm. wide, with slender yellow midribs, and 3 or 4 pairs of slender primary veins extending obliquely to the points of the lobes, or occasionally 3-nerved; petioles slender, more or less wing-margined at the apex, slightly hairy and often glandular early in the season, 1–1.4 cm. in length; leaves on vigorous shoots often broadly ovate, rounded, slightly cordate or broadly cuneate at the base, coarsely serrate and divided into numerous short acute lateral lobes, 5–6 cm. long and nearly as wide, with thick rose-colored midribs and stout winged petioles. *Flowers* 1.5–1.6 cm. in diameter, on slender slightly hairy or glabrous pedicels, in compact 5–16- mostly 10–12-flowered compound corymbs, with linear and acuminate to lanceolate, glandular, pink bracts and bractlets; calyx-tube narrowly obconic, light green, the lobes gradually narrowed from broad bases, linear, acuminate, tipped with bright red glands, finely glandular-serrate usually only above the middle, reflexed after anthesis; stamens 4–10, usually 7 or 8; anthers small, pale yellow; styles 2 or 3, rarely 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* in erect few-fruited compact clusters, globose or depressed-globose, dark orange-red, marked by numerous large dark dots, 7–11 usually about 8 mm. in diameter; calyx small with a broad shallow cavity, the lobes usually deciduous from the ripe fruit; flesh pale yellow-green, dry and mealy; nutlets 2 or 3, full and rounded at the ends, prominently ridged on the broad rounded back, about 6 mm. long and 4–5 mm. wide.

A shrub with several stout stems and a broad round-topped or flattened head, 2–3 m. tall and broad, and slender, nearly straight or slightly zigzag branchlets marked by large pale lenticels, dark orange-green and slightly or densely villose or glabrous when they first appear, light red-brown and lustrous during their first season and dull gray-brown the following year, and armed with numerous slender nearly straight bright red-brown and shining ultimately ashy-gray spines 3–6 cm. in length.

Berks county: Near Kutztown, *C. L. Gruber* (No. 13), 1901, May and July, 1903, (No. 195), 1903, May and August, 1904. Bucks county: Meadows at California, *W. M. Canby*, May, 1900; *C. D. Fretz* (No. 123), May and September, 1900; *Fretz* and *Sargent*, September, 1902. Also from central and western New England to Ontario, eastern Michigan and western New York; rarely arborescent in southern New England.

3. Cratægus evansiana n. sp.

Leaves rhombic to ovate or rarely oval, acute or short-pointed and acuminate at the apex, gradually narrowed from near or above the middle to the concave-cuneate slender entire base, finely often doubly serrate above, with incurved teeth ending in minute dark glands, and irregularly divided toward the apex into short broad lobes, more than half-grown when the flowers open from the middle to the end of May and then membranaceous, dark yellow-green, very lustrous and slightly pubescent along the midribs above and dull, pale and glabrous below with the exception of large axillary tufts of white hairs, and at maturity coriaceous, glabrous, dark green, lustrous and very smooth on the upper and yellow-green on the lower surface, 4–5 cm. long and 3.5–4 cm. wide; petioles slender, grooved on the upper side, winged toward the apex, glandular, with small scattered dark red glands, villose, sometimes becoming nearly glabrous, and 2–3 cm. in length; stipules linear, glandular, bright scarlet, caducous; leaves on vigorous shoots broadly ovate to nearly orbicular, coarsely serrate, often three-lobed by deep narrow sinuses and 5–6 cm. wide, with stout conspicuously glandular petioles broadly winged nearly to the base and foliaceous lunate glandular-serrate persistent stipules. *Flowers* about 2 cm. in diameter, on slender elongated slightly villose pedicels, in compact 4–8- usually 5-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, minutely glandular-serrate, tipped with dark red glands, glabrous on the outer, puberulous on the inner surface above the middle, reflexed after anthesis; stamens 20; anthers bright rose color; styles 5. *Fruit* ripening early in October, on stout reddish pedicels, in drooping clusters, subglobose to short-oblong, full and rounded at the apex, narrowed at the base, scarlet, about 1 cm. long; calyx little enlarged, with a wide deep cavity and spreading closely appressed lobes mostly deciduous from the ripe fruit; flesh thin, greenish-yellow, dry and mealy; nutlets 5, gradually narrowed and acute at the ends, slightly grooved on the back, about 7 mm. long and 4 mm. wide.

A bushy tree about 5 m. high, with a short stem covered with furrowed dark brown scaly bark, stout ashy-gray branches wide-spreading on the ground and forming a round-topped head wider than high, and slender slightly zigzag branchlets orange color and deeply covered with matted pale hairs when they first appear and light red-brown and lustrous during their first winter, and armed with very slender, straight purplish spines, 2.5–4 cm. long.

A single tree near the tree of *Cratægus insueta* Sarg., on the lawn near the lake in West Fairmount Park, Philadelphia, of unknown origin, but probably planted, certainly North American and possibly indigenous. *W. Findlay* (No. 1,503A, Herb. Philadelphia Museums), October, 1899; *A. MacElwee* (No. 2,168A, Herb. Philadelphia Museums); *Canby* and *Sargent*, September, 1902; *Smith* and *Sargent*, September, 1904.

This handsome and very distinct species is named in memory of John Evans (1790–1862), a native of Radnor, Delaware county, where he established a garden long famous for its collections of rare trees and other plants (see Smith, *History of Delaware County, Pennsylvania*, 459; Harshberger, *Garden and Forest*, X, 182; also Meehan, *Garden and Forest*, X, 198, and Harshberger, *The Botanists of Philadelphia and Their Work*, 172).

VIII.—INTRICATÆ.

Anthers pale yellow.
  Stamens 10 or less.
    Fruit subglobose to short-oblong.
      Corymbs and pedicels villose; leaves scabrate.
        Leaves ovate-oblong; fruit yellow with a red cheek, hairy at the ends, ... 1. *C. modesta*.
        Leaves ovate to rhombic or oval; fruit greenish-orange, not hairy, ... 2. *C. abjecta*.
      Corymbs and pedicels glabrous; leaves ovate to oval.
        Leaves scabrate; fruit dark crimson blotched with green, 3. *C. bartoniana*.
        Leaves smooth.
          Fruit orange to reddish-orange, ... 4. *C. neo-canbyi*.
          Fruit green, becoming dark clear red when fully ripe, 5. *C. nemoralis*.
        Leaves oblong-ovate.
          Fruit dark orange or reddish-orange; leaves yellow-green, 6. *C. saxatilis*.

Fruit red or orange-red; leaves blue-green, 7. *C. fœtida.*
Fruit oblong-obovate, green, more or less blotched with red; leaves oblong to oval, smooth, yellow-green, 8. *C. apposita.*
Stamens 10–18; corymbs and pedicels glabrous; leaves oval to ovate; fruit globose to depressed-globose, dark red, . . 9. *C. reses.*
Anthers pale pink or rose color.
Stamens 10 or less (rarely 13 in No. 10).
Fruit subglobose to short-oblong.
Leaves yellow-green.
Leaves ovate to oval.
Leaves gradually narrowed into a long cuneate base; stamens 8–13, usually 10; fruit green-bronze to red-bronze color, 1.2–1.4 cm. in diameter, 10. *C. inducta.*
Leaves full and rounded at the broad base; stamens 6–8; fruit green or bronze-yellow, about 1 cm. in diameter, 11. *C. definita.*
Leaves oval to obovate or rhombic; stamens 8–10; fruit orange or orange-red, ... 12. *C. painteriana.*
Leaves blue-green, oval; fruit orange-red or red-bronze color, 13. *C. fulva.*
Fruit obovate.
Fruit dark crimson; leaves oval, usually lobed only on vigorous shoots; anthers cream color faintly tinged with pink, ... 14. *C. pygmæa.*
Fruit reddish-orange color; leaves oval to oblong-ovate, more or less lobed; anthers light purple, . . . 15. *C. infera.*
Anthers red; stamens 10; fruit oblong, dark red; leaves rhombic to obovate, yellow-green, ... 16. *C. schweinitziana.*
Flowers unknown; fruit short-oblong to depressed-globose, bright canary yellow; leaves oblong-ovate, . . 17. *C. darlingtoniana.*

1. Cratægus modesta Sargent.

Rhodora, III, No. 26, 28 (1901).
Cratægus premora Ashe, Ann. Carnegie Mus., I, pt. 3 (1902).——Gruber, Proc. Berks County Nat. Sci. Club, I, 3 (Cratægus in Berks County, II).

Leaves ovate-oblong, acute, cuneate, rounded or on leading shoots truncate or slightly cordate or abruptly narrowed at the base, sharply doubly serrate, with minute glandular spreading teeth, and divided into numerous short broad acute lobes or occasionally 3-lobed by the greater development of the lowest pair, in the early spring bronze color, hirsute above, with short white hairs and villose below, and at maturity thick and firm in texture, dark yellow-green and scabrous on the upper surface, pale and pubescent below along the slender often light-red midribs and 2 or 3 pairs of prominent veins, or scabrous over the lower surface of the leaves of vigorous shoots, 5–7 cm. long and 3.5–6 cm. wide; petioles more or less winged above, villose, glandular, often red, and 2–3 cm. in length. *Flowers* opening late in May, 1.8–2.5 cm. in diameter, on short stout hairy pedicels, in compact 3–6-flowered villose corymbs; the bracts and bractlets lanceolate, conspicuously glandular-serrate, with stipitate large dark glands; calyx-tube broadly obconic, villose, the lobes lanceolate, glandular-serrate, coated with matted pale hairs; stamens 10; anthers large, pale yellow; styles 3, surrounded at the base by tufts of matted white hairs. *Fruit* erect on short villose pedicels, subglobose and flattened at the ends to short-oblong or obovate, 1–1.2 cm. long and 8–9 mm. wide, bright yellow, or orange with a red cheek, marked by numerous large dark spots, hairy at the ends; calyx high and prominent with a broad deep cavity, the lobes small, linear-lanceolate, glandular-serrate, spreading, mostly deciduous; flesh thick, light yellow, sweet, dry and mealy; nutlets 3, broad, rounded and obtuse at the ends, conspicuously ridged on the back, with a broad thick grooved ridge, 6–7 mm. long and 4–5 mm. wide.

A shrub, with numerous much-branched slender stems 2–3 m. high, and slender branchlets bright chestnut-brown and lustrous during their first season, later becoming dull gray-brown, and armed with thin straight spines $\frac{3}{4}$–$1\frac{1}{2}$ inches long.

Berks county: Near Kutztown, *C. L. Gruber* (No. 49), 1902; *Gruber* and *Sargent*, October, 1904. Also western New England, from Vermont to Connecticut, and in eastern New York.

2. Cratægus abjecta n. sp.

Cratægus biltmoriana Small, Porter, Fl. Penn., 177 (not Beadle) (1903).

Leaves ovate to rhombic or oval, acute or acuminate at the apex, gradually or abruptly narrowed and cuneate at the glandular base, finely doubly serrate above, with straight gland-tipped teeth, and slightly divided above the middle into short broad acute lobes, more than half-grown when the flowers open during the first week of June and then thin, light yellow-green and roughened above by short white hairs and pale and slightly hairy below along the midribs and veins, and at maturity subcoriaceous, dark bluish-green and scabrate on the upper and pale and still slightly villose on the slender midribs and veins on the lower surface, 4–6 cm. long and 2.5–4.5 cm. wide; petioles stout, deeply grooved on the upper side, wing-margined sometimes nearly to the base, conspicuously glandular, slightly villose early in the season, becoming glabrous, 1–2 cm. in length; leaves on vigorous shoots broadly ovate to oblong-ovate, often rounded at the base, sometimes 3-lobed by deep narrow sinuses, and 5–6 cm. long and broad, with stouter broadly winged petioles 1.5–2 cm. long. *Flowers* about 2 cm. in diameter, on slender elongated pedicels, sparingly covered with long white hairs, in compact usually simple mostly 5–7-flowered corymbs, with large laciniate glandular-viscid reddish bracts and bractlets persistent until the flowers open; calyx-tube broadly obconic, slightly hairy toward the base, the lobes wide, acuminate, laciniately divided and glandular above the middle, glabrous on the outer and villose on the inner surface; stamens 10; anthers light yellow; styles 3 or 4, surrounded at the base by a narrow ring of long white hairs. *Fruit* ripening about the middle of September and remaining on the branches until after the leaves have fallen, on short stout slightly villose pedicels, in erect or spreading few-fruited clusters, subglobose, often slightly longer than wide, greenish-orange and about 1.5 cm. in diameter; calyx enlarged, with a broad shallow cavity, and foliaceous coarsely serrate lobes conspicuous on the half-grown fruit but mostly deciduous before its maturity; flesh thin, hard and green; nutlets usually 3, full and rounded at the ends, ridged on the back with a broad high deeply grooved ridge, reddish-brown, about 7 cm. long and 5 cm. wide.

A shrub 1–2 m. high, spreading into broad thickets, with slender slightly zigzag branchlets marked by occasional oblong pale lenticels light orange color and slightly villose when they first appear, bright chestnut-brown or purplish and very lustrous during their first winter and dark dull brown tinged with red the following year, and armed with numerous slender nearly straight purplish or red-brown shining spines 2.5–5 cm. long.

Bucks county: Roadside at Pleasant Spring bridge, Hilltop near Sellersville, *C. D. Fretz* (No. 108, type!), June and October, 1899, and 1901; near Perkasie, *C. D. Fretz* (No. 157), June and October, 1901.

3. Cratægus bartoniana n. sp.

Leaves ovate to oval, acute, concave-cuneate at the glandular base, coarsely doubly serrate above, with straight glandular teeth, and deeply divided above the middle into 3 or 4 pairs of broad acute or acuminate lobes, nearly fully grown when the flowers open during the last week in May and then membranaceous, light yellow-green and roughened above by minute short white hairs and pale and glabrous below, and at maturity thick and firm in texture, dark bluish-green and scabrate on the upper and pale on the lower surface, 5–6.5 cm. long and 3.5–5 cm. wide, with stout midribs and thin primary veins arching obliquely to the points of the lobes, turning dull orange-red in the autumn before falling; petioles slender, grooved on the upper side, more or less wing-margined toward the apex, glandular while young, with mostly deciduous glands, reddish in the autumn, and 1.5–2 cm. in length; stipules linear, acuminate, glandular, generally deciduous before the flowers open; leaves on vigorous shoots broadly ovate, sometimes rounded or almost truncate at the broad base, more deeply lobed and more coarsely serrate and often 6 cm. long and wide, with stout broad-winged petioles. *Flowers* 1.5–1.7 cm. in diameter, on stout elongated glabrous pedicels, in 4–7-flowered simple corymbs, with large oblong-obovate to lanceolate glandular bracts and bractlets persistent until after the petals have fallen; calyx-tube broadly obconic, the lobes slender, acuminate, separated by wide sinuses, minutely glandular-serrate and reflexed after anthesis; stamens 10; anthers yellow; styles 3 or 4. *Fruit* ripening early in October, on stout elongated erect pedicels, solitary or in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dark crimson often blotched with green, 1–1.2 cm. in diameter; calyx little enlarged, with a wide deep cavity, and spreading appressed lobes mostly persistent on the ripe fruit; flesh thin, green, dry and mealy; nutlets 3 or 4, full and rounded at the ends, ridged on the back, with a broad often doubly grooved ridge, about 7 mm. long and 4–5 mm. wide.

A shrub 1.5–2 m. high and rather broader than high, with stout intricately branched stems, and slender nearly straight branchlets dark orange color when they first appear, and dark reddish-brown or purplish and lustrous during their first winter, becoming dark red-brown the following year, and armed with stout straight purplish spines 3–4 cm. in length.

Philadelphia county: Gray's Ferry, on the Schuylkill river, *B. H. Smith* (No. 242, type!), May, 1904; *Smith* and *Sargent*, October 5, 1904; slope to the Schuylkill river, West Fairmount Park, *Smith* and *Sargent*, October, 1904.

This species is named in memory of Benjamin Smith Barton (1776–1815), and of his nephew, W. P. C. Barton (1786–1856), distinguished Philadelphia botanists.

4. Cratægus neo-canbyi n. sp.

Leaves oval to ovate, acute or acuminate, concave-cuneate at the entire or glandular base, finely often doubly serrate above, with incurved or straight gland-tipped teeth, and slightly divided above the middle into 2 or 3 pairs of short broad acute lobes, about half-grown when the flowers open during the last week of May and then membranaceous, glabrous with the exception of a few short hairs on the upper side of the midribs, light yellow-green and very smooth above and pale below, and at maturity thick to subcoriaceous, glabrous, dark yellow-green on the upper and pale or glaucous on the lower surface, 6–7 cm. long and 4–5 cm. wide, with stout orange-colored midribs and slender primary veins, turning deep orange color in the autumn before falling;

petioles stout, deeply grooved on the upper side, wing-margined sometimes nearly to the middle, glandular, 1.5–2 cm. in length; leaves on vigorous shoots broadly ovate, full and rounded at the wide base, coarsely serrate, more deeply lobed, 7–8 cm. long and 6–7 cm. wide, with stout broadly winged conspicuously glandular petioles. *Flowers* 1.5–1.7 cm. in diameter, on slender glabrous pedicels, in few rarely more than 5-flowered corymbs, with linear conspicuously glandular bracts and bractlets, fading brown and mostly persistent until after the petals have fallen; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, acuminate, coarsely glandular-serrate above the middle, glabrous on the outer and sparingly villose on the inner surface near the apex; stamens 10; anthers pale yellow; styles 5. *Fruit* ripening toward the middle of October and soon falling, on long stout erect pedicels, globose to short-oblong, flattened at the ends, somewhat angled, dull orange to reddish-orange color, marked by numerous large dark dots 1.2–1.5 cm. in diameter; calyx only slightly enlarged, with a narrow deep cavity and closely appressed lobes coarsely glandular-serrate above the middle and mostly persistent on the ripe fruit; flesh thick, green, dry and mealy; nutlets 5, full and rounded at the base, narrow and rounded at the apex, ridged on the back, with a broad high rounded ridge, about 7 mm. long and 5 mm. wide.

A shrub, with small spreading stems 1–3 m. high, and slender nearly straight branchlets marked by numerous large pale lenticels, dark orange color when they first appear and light reddish-brown during their first year, later becoming dark gray-brown, and armed with slender nearly straight bright purplish shining spines 2.5–4 cm. long.

Monroe county: Hillside between Stroudsburg and Tannersville, *W. M. Canby*, June 2, 1900; *Canby* and *Sargent*, October 12, 1900; *W. M. Canby*, May 30, 1902.

5. Cratægus nemoralis Sargent.

Bot. Gazette, XXXV, 104 (Cratægus in New Castle County, Delaware) (1903).

Leaves ovate to oval, acute, gradually or abruptly narrowed to the cuneate entire base, sharply mostly doubly serrate above, with incurved glandular teeth, and slightly divided above the middle into acute lobes, tinged with red when they unfold, and covered with long pale caducous hairs on the upper and pale blue-green and sparingly villose on the lower surface, glabrous when the flowers open about the middle of May, and at maturity thick and firm, dark yellow-green above, paler below, 4–5 cm. long and 3–4 cm. wide; petioles slender, slightly grooved, at first villose-pubescent, soon glabrous, glandular, with small scattered dark persistent glands, 1.5–2 cm. long; stipules linear, lobed at the base, villose, coarsely glandular-serrate, like the inner bud-scales, often becoming bright red before falling; leaves on vigorous shoots broader, full and rounded at the base, and often deeply lobed. *Flowers* 1.4 cm. in diameter, on slender pedicels, in compact few-flowered glabrous compound corymbs, with oblanceolate to linear, acuminate, finely glandular-serrate bracts and bractlets, fading bright red; calyx-tube broadly obconic, glabrous, the lobes broad, acute or acuminate, laciniately glandular-serrate, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* erect, in few-fruited clusters, globose to subglobose or slightly obovate, about 1 cm. in diameter, dark green until late in the season, becoming dark clear red when fully ripe; calyx prominent, with a broad deep cavity, a short tube, and spreading mostly persistent acuminate lobes often serrate above the middle; flesh thin, greenish, dry and mealy; nutlets 3 or 4, thick, acute at the ends, prominently ridged on the back, with a broad often deeply grooved ridge, 7–8 mm. long and 4–5 mm. wide.

A tree-like shrub, with stems sometimes 3–4 m. high and stout zigzag branchlets, light olive-green and glabrous when they first appear, dark purple or reddish-brown and marked by numerous small oblong pale lenticels during their first season and dark gray-brown in their second year, and armed with many slender chestnut-brown or purple spines usually pointed toward the base of the branch and 5–6 cm. long.

Bucks county: Near Sellersville, Rockhill and Durham, *C. D. Fretz* (Nos. 4, 15, 108, 118, 121, 131, 148, 155), 1898–1901.

6. Cratægus saxatilis n. sp.

Leaves oblong-ovate, acute or acuminate, abruptly or gradually concave-cuneate at the glandular base, finely doubly serrate above, with straight teeth tipped with dark red glands, and divided above the middle into 3 or 4 pairs of short acute lobes, about half-grown when the flowers open from the 15th to the 20th of May and then membranaceous, light yellow-green above, pale below, and glabrous with the exception of occasional pale hairs on the upper side of the midribs, and at maturity thin and firm to subcoriaceous, dark yellow-green and smooth on the upper and paler on the lower surface, 5–6 cm. long and 3–4 cm. wide, with slender yellow midribs and thin primary veins arching obliquely to the points of the lobes, turning orange color or crimson and falling by the middle of October; petioles slender, grooved on the upper side, slightly wing-margined toward the apex, glandular, with numerous small dark mostly persistent glands, 1.5–2 cm. in length;

leaves on vigorous shoots broadly ovate, often full and rounded at the base, coarsely serrate, more deeply lobed, coriaceous, 5–6 mm. long and wide, with stout conspicuously glandular winged petioles sometimes not more than 1 cm. long. *Flowers* about 1.4 cm. in diameter, on slender elongated glabrous pedicels, in usually 6–8-flowered compound corymbs, with large oblong-obovate viscid bracts and bractlets conspicuously glandular with large long-stalked dark glands, fading rose color, persistent until after the petals have fallen; calyx-tube broadly obconic, the lobes large, acuminate, coarsely glandular-serrate above the middle, glabrous, reflexed after anthesis; stamens 5–10; anthers cream color; styles 3, surrounded at the base by a narrow ring of hoary tomentum. *Fruit* ripening toward the end of September and falling before the middle of October, on slender erect or spreading pedicels, in usually 2- or 3-fruited clusters, short-oblong, full and rounded at the apex, gradually narrowed to the base, dark orange or reddish-orange color marked by numerous large dark dots, 1–1.2 cm. long, 9–10 mm. wide; calyx enlarged and prominent, with a short tube, a wide deep cavity, and spreading lobes mostly persistent on the ripe fruit; flesh thin, greenish, dry and mealy; nutlets 3, rounded at the ends, irregularly ridged or grooved on the back, about 7 mm. long and 4–5 mm. wide.

A shrub usually about 1 m. high, with small dark-colored straggling stems, and slender branchlets marked by occasional dark lenticels, bright red-brown when they first appear, red-brown and lustrous during their first year, becoming dull and dark brown tinged with red, and armed with many slender nearly straight red-brown or purplish shining spines 3–5 cm. long.

Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 218, type!), May and September, 1903; *Smith* and *Sargent*, September, 1902; *B. H. Smith* (No. 233), May, 1903.

7. Cratægus fœtida Ashe.

Ann. Carnegie Mus., I, pt. 3, 389 (1902).——Gruber, Proc. Berks County Nat. Sci. Club, i, 5 (Cratægus in Berks County, II).
C. baxteri Sargent, Proc. Rochester Acad. Sci., IV, 107 (1903).

Glabrous with the exception of a few caducous hairs on the upper surface of the unfolding leaves and young petioles. *Leaves* oblong-ovate to oval, acuminate, concave-cuneate, rounded or on leading shoots sometimes truncate at the entire or crenulate base, finely doubly serrate above, with straight gland-tipped teeth, and divided into short broad acute lateral lobes; when they unfold furnished on the upper surface with a few long white caducous hairs, nearly fully grown when the flowers open about the 20th of May and then membranaceous, nearly glabrous, dark yellow-green above, pale below, and at maturity smooth and coriaceous, dull dark bluish-green on the upper, and pale on the lower surface, slightly concave by the infolding of the margins, 4.5–6.5 cm. long, 4–6 cm. wide, with stout midribs deeply impressed on the upper side and usually rose-colored below late in the season, and 3–5 pairs of thin primary veins arching obliquely to the points of the lobes; petioles slender, more or less wing-margined at the apex, grooved, sparingly hairy early in the spring, glandular, with numerous small dark persistent glands, and 1.5–3 cm. in length. *Flowers* about 1.8 cm. in diameter, on short stout glabrous pedicels, in narrow compact 3–10- usually 5- or 6-flowered compound corymbs; with oblong-obovate, acuminate, very glandular, large and conspicuous bracts and bractlets, often deciduous before the flowers open; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, broad, acuminate, coarsely glandular-serrate, usually only above the middle, reflexed after anthesis; stamens 6–11, commonly 10; anthers large, pale yellow; styles 4 or 5; surrounded at the base by a broad ring of pale hairs. *Fruit* on short stout reddish pedicels, in few-fruited erect clusters, subglobose, flattened at the ends, concave at the base at the insertion of the stalk, cardinal or dark red sparingly blotched with russet to orange-bronze or reddish-bronze, about 1.5 cm. in diameter; calyx prominent, with a broad deep cavity, and wide lobes gradually narrowed into the long slender acuminate glandular-serrate reflexed and closely appressed tips often deciduous from the ripe fruit; flesh thin, hard and dry, greenish-yellow; nutlets 4 or 5, broad, obtuse at the narrowed ends, ridged and slightly grooved on the back, about 7 mm. long and 5 mm. wide.

An intricately branched shrub 3–4 m. high, with numerous stout stems covered with dark scaly bark, and erect and spreading branches forming a broad round-topped head, and slender only slightly zigzag branchlets, orange-green and marked by numerous large pale lenticels when they first appear, light red-brown and lustrous at the end of their first season, becoming light gray the following year, and armed with many slender or stout nearly straight bright red-brown shining spines 2.5–4 cm. in length.

Berks county: Near Kutztown, *C. L. Gruber* (No. 14), 1901, May and October, 1903; *C. L. Gruber* (No. 68), 1902, July, 1902, August and October, 1903; *Gruber* and *Sargent*, October, 1904.

The fruit of *Cratægus baxteri* from Rochester when fully ripe is bright orange-red, lustrous and marked by numerous large pale dots; that of *Cratægus fœtida* (No. 14) is described by Mr. Gruber as "dull mottled red-scarlet or bronze, ground color apparently a dark red-scarlet or orange-red usually much blotched with dark olive-green, often blotched, tinged or shaded with olive, light olive-green or dark red, sometimes with reddish-orange, rose or russet, punctate with greenish-orange or russet." In No. 68, which is evidently the same species, the fruit is described by him as "red-bronze to orange-bronze or light reddish-bronze, and not so much mottled or blotched, often very little blotched or not at all." Except in these slight variations in the color of the fruit I can find no differences between *Cratægus baxteri* and *Cratægus fœtida*, which is thus widely distributed from western Massachusetts to western New York and eastern Pennsylvania.

8. Cratægus apposita Sargent.

Bot. Gazette, XXXV, 103 (The Genus Cratægus in New Castle County, Delaware) (1903).

Leaves oblong to oval, acute, acuminate or rarely round at the apex, cuneate at the base, glandular-serrate, above the middle usually doubly with spreading teeth, below, with small incurved teeth, or often entire near the base, slightly and irregularly lobed toward the apex, with short acute lobes; as they unfold coated above with soft pale deciduous hairs, when the flowers open the middle of May more than half-grown and then membranaceous and nearly glabrous, and at maturity thin but firm in texture, dark yellow-green on the upper, paler on the lower surface, 3.5–4 cm. long and 2–3 cm. wide, with slender 2–4 thin remote primary veins extending obliquely to the points of the lobes; petioles slender, wing-margined above, at first villose, soon glabrous, glandular, with small scattered dark red glands, often red toward the base, 1.5–2 cm. long; stipules oblong-obovate to linear, conspicuously glandular-serrate, caducous; leaves on vigorous shoots often ovate, acute, broadly cuneate and abruptly narrowed at the base into the wide wing of the short stout petiole, coarsely serrate, deeply 3–5-lobed, 5–6 cm. long and 4–6 cm. wide, with foliaceous lunate coarsely glandular-serrate stipules 7–10 mm. long. *Flowers* 1.5 cm. in diameter, on slender pedicels, in few usually 4–7-flowered corymbs, with oblong-obovate to linear conspicuously glandular-serrate bracts and bractlets, turning red before falling, caducous; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from broad bases, acute glandular-serrate, slightly hairy on the inner face, reflexed after anthesis; stamens 10; anthers pale yellow; styles usually 3. *Fruit* ripening the middle of October, in few-fruited drooping clusters, oblong-obovate, full and rounded at the apex, gradually narrowed below into the stout pedicel, green until late in the season, then reddish or green more or less blotched with red, or occasionally when fully ripe light red or rarely yellowish-bronze color, 1–1.5 cm. long and 9–11 mm. wide; calyx-tube elongated, prominent, with a deep narrow cavity, and spreading and appressed lobes coarsely serrate toward the apex; flesh thin, yellow-green, dry and mealy; nutlets usually 3, broad, obtuse at the ends, rounded and prominently ridged on the back, with a wide rounded ridge, 8–9 mm. long.

A thin-stemmed shrub usually 1–2 m. high, rarely taller and almost arborescent in habit, with slender spreading branchlets yellow-green tinged with red when they first appear, bright red-brown or purple-brown and marked by few large pale lenticels during their first season, becoming dark gray-brown or reddish-brown the following year, and armed with numerous very slender bright chestnut-brown spines mostly 4–6 cm. long.

Berks county: West Leesport, *C. L. Gruber* (No. 89), 1902; near Kutztown, *C. L. Gruber* (Nos. 179, 180). Bucks county: Rockhill, near Sellersville, *C. D. Fretz* (No. 121), October, 1899, May and October, 1901, (No. 165), May and September, 1903; Durham, *Fretz* and *Sargent*, October, 1902. Delaware county: Upper Darby, near Collen Brook, *B. H. Smith* (No. 226), September, 1902, May and September, 1903. Also in New Castle County, Delaware.

9. Cratægus reses Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XX, p. 55, 1904.

Leaves oval, to broadly ovate on vigorous shoots, acute or acuminate, gradually narrowed and concave-cuneate at the base, finely often doubly serrate, with straight or incurved gland-tipped teeth, and divided above the middle into 3 or 4 pairs of short broad acute lobes, more than half-grown when the flowers open about the 20th of May and then membranaceous, more or less tinged with red and slightly hairy along the midribs and veins above and pale and glabrous below, and at maturity thick and firm to subcoriaceous, dark dull bluish-green and smooth on the upper and light yellow-green on the lower surface, 4–5.6 cm. long and 3–5 cm. wide, with thick yellow midribs, and slender primary veins extending obliquely to the points of the lobes, turning dark red-bronze or scarlet-bronze mottled with green in the autumn before falling; petioles stout, deeply grooved and while young slightly hairy on the upper side, broadly winged toward the apex or nearly to the middle, glabrous at maturity, glandular, with minute dark often persistent glands, tinged with red toward the base after midsummer, and 1.5–2.5 cm. in length; stipules lanceolate, acuminate, elongated, glandular, with minute glands, generally deciduous before the flowers open. *Flowers* 1.8–2.2 cm. in diameter, on long stout glabrous or rarely slightly hairy pedicels, in usually 6- or 7-flowered compact corymbs, with large and conspicuous oblong-obovate to linear glandular-viscid bracts and bractlets persistent until the flowers open; calyx-tube broadly obconic, glabrous, the lobes abruptly narrowed from wide bases, slender, acuminate, glandular above the middle, with small bright red stipitate glands, glabrous on the outer, sparingly villose on the inner surface toward the apex; stamens 10–18, usually 10–11; anthers cream color; styles 3–5, rarely 3. *Fruit* ripening toward the middle of October and often persistent until the middle of November, on stout reddish elongated erect pedicels, in few-fruited clusters, obovate when fully grown, becoming globose or depressed-globose and slightly tapering to the base or rarely pyriform-globose or oblong-globose at maturity, full and rounded at the apex, gradually narrowed to the base, dark red, sparingly blotched with russet or dark green, marked by many small pale green dots, 1.2–1.4 cm. long and 1.4–1.7 cm. thick; calyx little enlarged, with a long narrow prominent tube and reflexed lobes mostly deciduous from the ripe fruit; flesh thin, greenish-yellow and dry; nutlets 4 or 5, full and rounded at the base, gradually narrowed and rounded at the apex, ridged on the back, with a broad low slightly grooved ridge, about 8 mm. long and 4 mm. wide.

A narrow shrub about 2 m. high, with erect stems covered with dark brown bark, and slender nearly straight branchlets marked by occasional small oblong pale lenticels, orange or purplish when they first appear, bright chestnut-brown and lustrous during their first year and dark dull brown the following season, and armed with slender nearly straight chestnut-brown shining spines 2.5–3 cm. in length.

Berks county: Open oak woods, North Heidelberg, *C. L. Gruber* (No. 147), 1902, May and October, 1904; *Gruber* and *Sargent*, October, 1904.

10. Cratægus inducta Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XIX, pt. I, p. 24 (1903).——Gruber, Proc. Berks County Nat. Sci. Club, I, 15 (Cratægus in Berks County, II).

Leaves ovate to oval or rarely slightly obovate, acute or acuminate, gradually narrowed into a long concave-cuneate glandular base, sharply doubly serrate above, with gland-tipped teeth, and divided above the middle into 3 or 4 pairs of large acute spreading or reflexed lobes, when they unfold dark red and slightly hairy on the upper and faintly tinged with red and glabrous on the lower surface, nearly half-grown when the flowers open about the 20th of May and then membranaceous, dark yellow-green and slightly hairy above along the midribs and pale and glabrous below, and at maturity thin, dark yellow-green on the upper, pale on the lower surface, 6–7 cm. long and 4.5–5.5 cm. wide, with slender light yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, grooved on the upper side, narrowly wing-margined sometimes to the middle, glandular, with minute dark persistent glands and 2–3 cm. long; stipules oblong-obovate to linear, acuminate, glandular, often deciduous before the flowers open. *Flowers* 2–2.3 cm. in diameter, on long slender glabrous pedicels, in 4–8-flowered corymbs, with large obovate to linear glandular bracts and bractlets usually persistent until the flowers open; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, acuminate, coarsely glandular-serrate above the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 8–13, usually 10; anthers pink or light rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening early in October and persistent until after the fall of the leaves, on slender pedicels, in spreading few-fruited clusters, subglobose to short oblong, rounded at the ends, greenish-bronze to pale red-bronze color, marked by small pale dots, 1.2–1.4 cm. in diameter; calyx little enlarged, with a short tube, a deep narrow cavity, and spreading appressed lobes, their tips mostly deciduous from the ripe fruit; flesh thin, greenish-yellow, hard and dry; nutlets usually 3, rounded at the ends, ridged on the broad back, with a prominent deeply grooved ridge, 8–9 mm. long and 4–5 mm. wide.

A shrub 2–3 m. high, with slender ascending stems and branches covered with dark almost black bark, and slender nearly straight branchlets marked by large oblong pale lenticels, orange or reddish-brown when they first appear, dull reddish-brown during their first winter and darker the following year, and armed with slender nearly straight purplish spines 3–5 cm. long.

Berks county: Open woods, West Leesport, *C. L. Gruber* (No. 88, type, Nos. 86 and 112), 1902, May and October, 1904; North Heidelberg, *C. L. Gruber* (No. 150), with larger leaves and fruit; near Kutztown, *C. L. Gruber* (No. 147), 1902, September, 1903, April, 1904. Delaware county: Davis Hill, Chadsford, *B. H. Smith* (No. 244), May, 1904; *Smith* and *Sargent*, September, 1904.

No. 198 of B. H. Smith, from Preston Run Barrens (*Cratægus definita* Sarg.), was referred to *Cratægus inducta* by Mr. Ashe (in letter to B. H. Smith, November, 1901), and is probably his only authority for this species in Delaware county (see his description of the species), as *Cratægus inducta* was not found at Chadsford until the spring of 1904.

11. Cratægus definita n. sp.

Leaves ovate to oval, acute, full and rounded at the wide often unsymmetrical base, finely doubly serrate above, with straight glandular teeth, and irregularly divided into 2 or 3 pairs of short broad acute lobes, fully grown when the flowers open at the end of May and then membranaceous, glabrous with the exception of a few hairs on the upper side of the midribs, very smooth and light yellow-green above and pale below, and at maturity thin but firm in texture, yellow-green, 4–5 cm. long and wide, with slender yellow midribs and thin veins arching obliquely to the points of the lobes; petioles stout, wing-margined toward the apex, puberulous on the upper side while young, becoming glabrous, glandular, with minute glands, 1–2 cm. in length. *Flowers* about 2 cm. in diameter, on slender elongated glabrous pedicels, in 5- or 6-flowered compact corymbs, with large conspicuous lanceolate coarsely glandular-serrate viscid reddish bracts and bractlets persistent until after the flowers have opened; calyx-tube narrowly obconic, glabrous, the lobes broadly foliaceous, coarsely laciniately serrate at the acuminate apex, reflexed after anthesis; stamens 6–8; anthers pale pink; styles 3 or 4, surrounded at the base by a narrow margin of pale hairs. *Fruit* subglobose to short-oblong, somewhat narrowed at the base, full and rounded at the apex, green or greenish-yellow, about 1 cm. in diameter; flesh thick, green, dry and mealy; nutlets 3 or 4, rounded and obtuse at the ends, slightly ridged on the broad rounded back, with a narrow ridge, about 8 mm. long and 4 mm. wide.

A shrub about 2 m. high, with slender branchlets marked by oblong pale lenticels, dark orange color when they first appear, dark red-brown during their first year, becoming dark gray tinged with red, and armed with slender straight dark purplish spines 5–6 cm. in length.

Delaware county: Preston Run Barrens, Newtown, *B. H. Smith* (No. 198, type!), May and September, 1901. Rare.

This species, which is still imperfectly known, resembles in general appearance *Cratægus peckii* Sarg. of the Hudson River Valley, but differs from that species in the absence of hairs on the lower side of the shorter and comparatively broader leaves, by the more slender entirely glabrous pedicels, and in the smaller number of stamens.

12. Cratægus painteriana n. sp.

Leaves oval to obovate or rhombic, acute, gradually narrowed and concave-cuneate at the entire or glandular base, finely doubly serrate above, with straight glandular teeth and deeply divided above the middle into 3 or 4 pairs of narrow acuminate lobes, slightly tinged with red and glabrous with the exception of a few soft hairs on the upper side of the midribs and veins when they unfold, more than half-grown when the flowers open about the 20th of May and then membranaceous, light green and nearly glabrous above and pale below, and at maturity thin, smooth, dark yellow-green on the upper and paler on the lower surface, 4–5 cm. long and 2.5–3 cm. wide, with slender yellow midribs and thin primary veins arching to the points of the lobes; petioles slender, slightly grooved on the upper side, more or less wing-margined toward the apex, glandular, with minute persistent dark glands, 1–2 cm. in length; stipules lanceolate, glandular, fading brown, usually deciduous before the flowers open; leaves on vigorous shoots broadly ovate, abruptly cuneate at the wide base, often three-lobed by deep narrow sinuses, coarsely serrate, frequently 6 cm. long and wide, with stout broadly winged conspicuously glandular petioles. *Flowers* 1.6–1.8 cm. in diameter, on long slender glabrous pedicels, in usually 4–6-flowered corymbs, with oblong-obovate to linear glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or slightly serrate toward the apex, reflexed after anthesis; stamens 8–10; anthers pale pink; styles 3 or 4. *Fruit* ripening the middle of October and soon falling, on long slender red pedicels, in usually 2 or 3-fruited clusters, subglobose to short-oblong, sometimes rather broader than high, orange color or orange-red, about 1.2 cm. in diameter; calyx prominent, with a short tube, a broad deep cavity and slender lobes, their tips generally deciduous from the ripe fruit; flesh thick, light yellow-green, dry and mealy; nutlets usually 3, full and rounded at the base, narrow and rounded at the apex, ridged on the back, with a high narrow ridge, 8–9 mm. long and about 5 mm. wide.

A shrub 2–3 m. high, with numerous small erect dark stems forming an open irregular head and slender nearly straight branchlets marked by minute dark lenticels, light orange color when they first appear, light red-brown and lustrous during their first winter, becoming dull gray-brown, and armed with many slender nearly straight purple shining spines 3–6 cm. long.

Delaware county: Serpentine Barrens, common; Preston Run Barrens, Newtown, *B. H. Smith* (No. 205, type!), May and October, 1902, May, 1904, (No. 220), May, 1903; Lownes' Run, Springfield, *Smith* and *Sargent* (No. 214), September, 1902; *B. H. Smith,* May and October, 1903.

This species is named in memory of the botanists, Marshall Painter (1801–1873) and Jacob Painter (1814–1876), his brother, natives of Middletown, Delaware county, where they planted and maintained a collection of rare trees and shrubs (see Harshberger, *The Botanists of Philadelphia and Their Work*, pp. 184 and 210).

13. Cratægus fulva n. sp.

Leaves oval, acute or acuminate, cuneate or concave-cuneate at the entire or glandular base, finely doubly serrate above, with straight gland-tipped teeth, and slightly divided usually only above the middle into 3 or 4 pairs of short broad acute lobes, when they unfold deeply tinged with red, and hairy above, with soft white hairs, about half-grown when the flowers open from the 20th to the 25th of May, and then dark green and still slightly hairy above and pale below, and at maturity membranaceous, dark bluish-green, very smooth, and glabrous or nearly glabrous on the upper and pale or glaucous on the lower surface, 4.5–5 cm. long and 3–4 cm. wide, with thin orange-colored midribs and 3 or 4 pairs of slender primary veins; petioles slender, grooved on the upper side, slightly wing-margined at the apex, glandular, with minute dark scattered persistent glands, often orange color at maturity, 1.5–2.5 cm. in length; stipules linear-obovate, glandular, fading brown or red, mostly deciduous before the flowers open; leaves on vigorous shoots often ovate, full and rounded at the serrate base, sometimes deeply lobed, about 7 cm. long and 6 cm. wide. *Flowers* 2–2.5 cm. in diameter, on slender reddish-glabrous pedicels, in small 1–6-flowered simple corymbs, with obovate to linear dark red glandular-serrate viscid bracts and bractlets; calyx-tube broadly obconic, the lobes wide, acuminate, coarsely glandular-serrate usually only above the middle; stamens 5–9; anthers pale pink; styles 2–4, usually 3–4. *Fruit* ripening early in October and falling with or after the leaves, on slender erect pedicels, solitary or in 2- or 3-flowered clusters, obovate, or when fully ripe oblong-globose to globose, rounded at the apex, gradually narrowed at the base, orange color tinged with red or red-bronze, 1–1.3 cm. long and 8–12 mm. wide; calyx only slightly enlarged, with a short tube, a wide deep cavity, and spreading and reflexed lobes deciduous from the ripe fruit; nutlets 3 or 4, full and obtuse at the ends, very slightly ridged on the broad rounded back, about 6 mm. long and 3–4 mm. wide.

A shrub 1–2 m. high, with few thin wand-like stems, covered with green or yellow-gray bark, very slender nearly straight branchlets marked by occasional large pale lenticels, dark reddish-brown when they first appear, chestnut-brown and lustrous during their first winter and dull gray-brown the following year, and armed with few very slender nearly straight purplish shining spines 2–4 cm. long.

Berks county: Borders of woods, in gravelly soil, above Forge Hill, North Heidelberg township, *C. L. Gruber* (No. 178, type!), 1903, May, and October, 1904.

14. Cratægus pygmæa n. sp.

Leaves oval, acuminate, gradually narrowed and concave-cuneate at the entire base, coarsely doubly serrate above, with spreading teeth tipped with large dark glands, not lobed, more than half-grown when the flowers open about the 25th of May and then membranaceous, yellow-green and roughened above by short white hairs, and light yellow-green and glabrous below, and at maturity thin but firm in texture, dark yellow-green, smooth or scabrate on the upper and pale on the lower surface, 4–4.5 cm. long and 2–2.5 cm. wide, with slender midribs tinged with red below, and obscure primary veins; petioles slender, wing-margined at the apex, slightly grooved on the upper side, glabrous, glandular while young with numerous dark caducous glands, dark red early in the season, 1.5–1.8 cm. in length; stipules linear, obovate, finely glandular-serrate, mostly deciduous before the flowers open; leaves on vigorous shoots ovate, rounded or concave-cuneate at the broad base, coarsely serrate, divided above the middle by broad shallow sinuses into short acute lobes, subcoriaceous and sometimes 6 cm. long and 5 cm. wide, with stout broadly winged petioles furnished with persistent glands, and foliaceous lunate coarsely glandular-serrate stipules. *Flowers* about 1.5 cm. in diameter, on slender glabrous pedicels, in 5–7-flowered simple corymbs, with linear acute glandular bracts and bractlets, fading red and mostly persistent until the flowers open; calyx broadly obconic, the lobes narrow, acuminate, glabrous, entire or finely and irregularly glandular-serrate above the middle; stamens 5; anthers cream color, faintly tinged with pink; styles 2–4. *Fruit* ripening about the 20th of September, on slender erect pedicels, in 1–4-fruited clusters, oblong-obovate, rounded at the apex, gradually narrowed to the base, dark crimson, lustrous, marked by occasional small pale dots, 1.2–1.4 cm. long, 8–11 mm. wide; calyx prominent, with a short tube, a deep narrow cavity and much enlarged coarsely serrate reflexed and appressed lobes dark red on the upper side below the middle, and mostly persistent on the ripe fruit; flesh thin, dark yellow, dry and mealy; nutlets usually 3, obtuse and rounded at the ends, ridged on the back, with a broad often grooved ridge, dark colored, 6–7 mm. long and about 5 mm. wide.

A shrub, with slender stems 1–2 m. high covered with pale gray bark, and slender nearly straight branchlets marked by numerous small pale lenticels, green more or less tinged with red when they first appear, bright chestnut-brown and lustrous at the end of their first season and dull gray-brown tinged with red the following year, and armed with occasional slender straight purplish spines 2–3.5 cm. in length.

Bucks county: Roadsides near Sellersville, *Fretz* and *Sargent* (No. 161, type!), September, 1902; *C. D. Fretz*, May, 1905.

15. Cratægus infera n. sp.

Leaves ovate to oblong-ovate, acuminate, concave-cuneate at the entire or glandular base, coarsely doubly serrate above, with straight gland-tipped teeth, and slightly divided into 4 or 5 pairs of small acute lobes, when they unfold dark purple and coated above by long white hairs and slightly hairy below on the midribs and veins, nearly half-grown when the flowers open about the 20th of May and then membranaceous, light yellow-green and nearly glabrous on the upper and pale or glaucous and glabrous on the lower surface, and at maturity thin but firm in texture, dark yellow-green and scabrate or smooth above, pale below, 5–6 cm. long, 3.5–4 cm. wide, with slender yellow midribs, and obscure primary veins arching obliquely to the points of the lobes, turning dull orange color or scarlet in the autumn before falling; petioles slender, deeply grooved, narrowly wing-margined to below the middle, sparingly villose on the upper side while young, soon glabrous, glandular, with minute dark red stipitate glands, 1.5–2 cm. in length; stipules linear, acuminate, glandular-serrate, caducous; leaves on vigorous shoots ovate, cuneate or rounded at the broad base, more coarsely serrate, more deeply lobed, and 5–6 cm. long and broad. *Flowers* 1.5–1.7 cm. in diameter, on slender slightly hairy pedicels, in 3–6-flowered simple corymbs, with linear obovate glandular-hispid bracts and bractlets generally deciduous before the flowers open; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, coarsely and irregularly serrate above the middle, or nearly entire, glabrous on the outer, slightly villose on the inner surface toward the apiculate glandular apex, reflexed after anthesis; stamens 8–10; anthers large, light purple; styles 2 or 3, surrounded at the base by a ring of pale hairs. *Fruit* ripening from the 20th to the end of September, on short stout erect reddish pedicels, solitary or in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed below the middle to the rounded base, dark reddish-orange color, marked by occasional large dark dots, about 1.2 cm. long and 1–1.1 cm. wide; calyx little enlarged, with a small shallow cavity, and spreading and reflexed lobes often deciduous from the ripe fruit; flesh thin, orange color, dry and mealy; nutlets 2 or 3, full and rounded at the base, gradually narrowed and rounded at the apex, ridged on the back, with a wide deeply grooved ridge, light colored, 7–8 mm. long and about 4 mm. wide.

A shrub 1–2 m. high, with small erect stems and slender slightly zigzag branchlets marked by numerous small pale lenticels, orange-green more or less tinged with red when they first appear, bright chestnut-brown and very lustrous during their first winter, and dull dark gray or brown tinged with red the following year, and armed with slender slightly grooved red-brown or purplish spines often pointing toward the base of the branch, and 4–5 cm. in length.

Bucks county: Roadsides near Sellersville, *Fretz* and *Sargent* (No. 162, type!), September, 1902; *C. D. Fretz* (No. 162), May, 1905, (No. 199), May, 1905.

16. Cratægus schweinitziana n. sp.

Leaves rhombic or slightly obovate, acuminate, gradually narrowed and concave-cuneate at the entire or occasionally glandular base, finely doubly serrate above, with straight gland-tipped teeth, and divided into 3 or 4 pairs of short broad acuminate lobes, nearly one-third grown when the flowers open about the 20th of May and then membranaceous, light yellow-green and glabrous with the exception of a few short hairs on the upper side of the midribs, and at maturity subcoriaceous, glabrous, dark yellow-green on the upper and paler on the lower surface, 4–5 cm. long and 3–4 cm. wide, with thin prominent yellow midribs, and slender primary veins arching obliquely to the points of the lobes; petioles slender, grooved on the upper side, more or less wing-margined at the apex, glandular, with minute stipitate dark mostly deciduous glands, 1–1.5 cm. in length; leaves on vigorous shoots broadly ovate, full and rounded or abruptly cuneate at the wide base, coarsely serrate, more deeply lobed, 5–6 cm. long and 4.5–5 cm. wide, with thick midribs and stout conspicuously glandular petioles broadly winged below the middle. *Flowers* 1.7–1.8 cm. in diameter, on slender glabrous pedicels, in 4–6-flowered simple corymbs, with linear-obovate to linear-acuminate glandular bracts and bractlets, fading pink, and usually persistent until after the petals have fallen; calyx-tube narrowly obconic, the lobes broad, acuminate, finely glandular-serrate above the middle, glabrous, reflexed after anthesis; stamens 8–10, usually 10; anthers red; styles 3 or 4. *Fruit* ripening late in October, on slender pedicels, in spreading few-fruited clusters, oblong, full and rounded at the ends or often sometimes narrowed at the base, 1.2–1.4 cm. long, 8–9 mm. thick, dark red; calyx enlarged and prominent with a short tube, a wide shallow cavity, and spreading lobes mostly deciduous from the ripe fruit; flesh thin, yellowish-green, dry and mealy; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a high narrow ridge, 8–9 mm. long and about 5 mm. wide.

A shrub about 2 m. high, with numerous ascending stems covered with smooth greenish-gray bark, and slender zigzag branchlets marked by numerous small pale lenticels, light orange color when they first appear, bright chestnut-brown and very lustrous during their first winter, becoming light gray tinged with red, and armed with numerous stout or slender nearly straight dark purplish shining spines 4–6 cm. long.

Bucks county: Roadsides near Sellersville, *C. D. Fretz* (No. 119, type!), September, 1899, May and October, 1901.

This species is named in memory of Louis David de Schweinitz (1780–1834), the distinguished Pennsylvania botanist.

17. Cratægus darlingtoniana n. sp.

Leaves oblong-ovate, acuminate, gradually narrowed and concave-cuneate at the entire or serrate base, sharply doubly serrate above, with straight gland-tipped teeth, and divided above the middle into 3 or 4 pairs of narrow acute lobes, at maturity thin but firm in texture, glabrous, dark yellow-green on the upper and pale yellow-green on the lower surface, 3.5–4 cm. long and 2–2.5 cm. wide, with slender red or reddish midribs, and thin primary veins extending obliquely to the points of the lobes; petioles very slender, slightly grooved on the upper side, wing-margined at the apex, glandular, with minute dark glands, reddish toward the base, 1–1.2 cm. in diameter; leaves on vigorous shoots broadly ovate, sometimes rounded at the wide base, more coarsely serrate and more deeply divided into broad lateral lobes, and sometimes 5–6 cm. long and 3.5–4 cm. wide, with stout petioles broadly winged nearly to the base. *Flowers* unknown. *Fruit* ripening early in October, on short slender pedicels, in few-fruited clusters, short-oblong to depressed-globose, full and rounded at the ends, bright canary-yellow, 1.2–1.4 cm. in diameter; calyx with a short tube and a broad deep cavity, the lobes deciduous from the ripe fruit; flesh thin, sweet, light yellow; nutlets 3 or 4; rounded and obtuse at the ends, ridged on the back, with a high narrow or broad grooved ridge, about 7 mm. long and 5 mm. wide.

A shrub 1–2 m. high, with slender nearly straight bright chestnut-brown lustrous branches, becoming dull red-brown in their second year and marked by numerous small oblong pale lenticels.

Chester county: Serpentine Ridge, near West Chester, *Canby* and *Smith* (No. 228, type!), October 8, 1902.

The dry ridge where this plant and several other dwarf forms of *Cratægus* were found by Canby and Smith was burnt over after their visit. The plants were all killed to the ground, and, although the flowers are not yet known, I do not hesitate to describe this species, as the very distinct beautiful clear yellow fruit is different from that of any other of the recognized species. It is named for William Darlington (1782–1861), of West Chester, the distinguished Pennsylvania botanist and the author of the *Flora Cestrica*.

IX.—UNIFLORÆ.

Leaves crenately serrate, ... 1. *C. uniflora.*
Leaves with straight teeth, ... 2. *C. smithii.*

1. Cratægus uniflora Muench.

Hausv., V, 147 (1770).——Sargent, Silva N. Am., IV, 117, t. 191.——Porter, Fl. Penn., 177.
Cratægus parviflora Aiton, Hort. Kew., II, 169 (1789).——Watson and Coulter, Gray's Man., ed. 6, 166.

Berks county: Near Kutztown, *C. L. Gruber* (No. 74), 1902. Bucks county: Near Sellersville, *C. D. Fretz* (No. 22), May and July, 1899. Delaware county: Lownes' Run, Springfield, *B. H. Smith* (No. 202), May, 1902 and 1904.

2. Cratægus smithii Sarg.

Trees and Shrubs, I, 67, t. 34 (1903).
Cratægus vailiæ Small, Porter, Fl. Penn., 177 (not Britton) (1903).

Leaves obovate, rounded or acute at the apex, gradually narrowed from near the middle to the concave-cuneate entire glandular base, finely and doubly serrate above, with straight gland-tipped teeth, and occasionally divided into short terminal lobes; nearly fully grown when the flowers open about the 20th of May and then membranaceous, slightly viscid, bright yellow-green and roughened above by short white hairs, paler, and villose below along the slender midribs, and usually three pairs of thin primary veins extending to the apex of the leaf; at maturity subcoriaceous, very dark yellow-green, lustrous and scabrate on the upper, pale and still slightly hairy on the lower surface, 2.3–3 cm. long and 1.2–2.2 cm. wide; petioles short, wing-margined nearly to the base, villose early in the season, pubescent in the autumn, 4–5 mm. long; stipules oblong and acuminate to lanceolate, glandular, turning brown in fading, caducous. *Flowers* about 1.6 cm. in diameter, solitary or occasionally in 2- or 3-flowered clusters, on short stout villose pedicels; then bractlets linear to oblong, glandular, caducous; calyx-tube narrowly obconic, villose, the lobes foliaceous, broad-ovate, acuminate, conspicuously serrate, with slender teeth tipped with minute red glands, reflexed when the flowers open; stamens twenty; anthers pale yellow; styles 5, or rarely 6. *Fruit* ripening from the middle to the end of September, erect on short stout slightly hairy pedicels, short-oblong, full and rounded at the ends, orange or orange-green to bronze-green when ripe, lustrous, about 1.5 cm. long and 1.2 cm. wide; calyx enlarged, sessile, with a broad deep cavity, and reflexed and closely appressed lobes; flesh thin, green and hard; nutlets 5, rarely 6, thick, gradually narrowed to the acute ends, irregularly ridged and deeply grooved on the back, 7 mm. long.

A dichotomously branched straggling shrub, from 1 to 2 m. in height, with slender nearly straight branchlets, orange-brown and coated when they appear with long pale matted hairs, dull reddish-brown and pubescent at the end of their first season and dark gray-brown the following year, and armed with very slender straight dark purple spines, ashy-gray and long persistent on the old stems, from 1.5–3 cm. in length.

Delaware county: Open hillsides along Lownes' Run, Springfield, *Dr. George Smith,* May, 1867; *B. H. Smith* (No. 201, type!), May, 1902; *Smith* and *Sargent,* September, 1902. Bucks county: Near Sellersville, *C. D. Fretz* (No. 182), May and September, 1903.

X.—TOMENTOSÆ.

Leaves thin, with midribs and veins only slightly impressed on their upper surface; fruit obovate to oblong, orange or orange-red; stamens 20.
- Anthers rose color, ... 1. *C. tomentosa.*
- Anthers yellow, ... 2. *C. structilis.*

Leaves subcoriaceous to coriaceous, with midribs and veins deeply impressed on their upper surface; fruit subglobose to short-oval, usually scarlet.
- Stamens 20.
  - Anthers rose color or pink.
    - Leaves villose below at maturity.
      - Pedicels villose; fruit long-stalked, in drooping clusters, often 1.5 cm. in diameter; leaves elliptical, acute at the ends; anthers light or dark rose color, . . . 3. *C. succulenta.*
      - Pedicels glabrous; fruit on erect pedicels, in few-fruited clusters, about 1 cm. in diameter; leaves rhombic to obovate; anthers pale pink, ... 4. *C. radiosa.*
    - Leaves nearly glabrous below at maturity, ovate to oval or obovate; fruit on erect glabrous pedicels, in few-fruited clusters, 7–8 mm. in diameter; anthers dark rose color, 5. *C. micrantha.*
  - Anthers yellow; leaves rhombic to oval; fruit on drooping slightly villose pedicels, in many-fruited clusters, . . 6. *C. opica.*
- Stamens 10; anthers pale yellow; leaves ovate to rhombic; fruit on erect or spreading glabrous pedicels, in few-fruited clusters, 7. *C. chadsfordiana.*

1. Cratægus tomentosa Linnæus.

Spec., 476 (1753).——Sargent, Silva N. Am., IV, 101, t. 183; Man., 492, f. 406.

Cratægus cerea Gruber, Berks County Nat. Sci. Club, I, 3 (Cratægus in Berks County, II) (without description) (1903).

Bucks county: Near Sellersville, *C. D. Fretz* (Nos. 21 and 167), June and September, 1899, 1901, 1903; Durham, *Fretz* and *Sargent*, 1902. Berks county: Near Kutztown, *C. L. Gruber* (No. 37), 1901, June and October, 1903. Northampton county: Chestnut Hill, Easton, *T. C. Porter*, May, 1889.

Gruber's No. 127, a small tree near Kutztown, seems to differ from *Cratægus tomentosa* only in its short-oblong to subglobose (not pyriform) bright red-orange fruit, and requires further study.

2. Cratægus structilis Ashe.

Jour. Elisha Mitchell Sci. Soc., XIX, 12 (1903).——Gruber, Proc. Berks County Nat. Sci. Club, I, 3 (Cratægus in Berks County, II).

Leaves oblong-ovate to oval or obovate, acuminate, gradually narrowed to the slender concave-cuneate entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into numerous short acuminate lobes, nearly fully grown when the flowers open during the first week of June and then membranaceous, yellow-green and covered above by short soft white hairs most abundant on the midribs and veins, and pale and hoary-pubescent below, and at maturity thin but firm in texture, dark green and glabrous or nearly glabrous on the upper and pale and puberulous on the slender midribs and primary veins below, 7–8 cm. long and 4.5–5 cm. wide; petioles stout; deeply grooved on the upper side, broadly wing-margined to below the middle, hoary-tomentose while young, puberulous later in the season, 1–1.5 cm. in length. *Flowers* 1.4–1.8 cm. in diameter, on stout hoary-tomentose pedicels, in wide compact many-flowered tomentose corymbs, with linear acuminate glandular bracts and bractlets fading brown; calyx-tube broadly obconic, hoary-tomentose, the lobes narrow, acuminate, slightly serrate usually only near the middle, puberulous, reflexed after anthesis; stamens 20; anthers pale yellow; styles 2, surrounded at the base by a narrow ring of white tomentum. *Fruit* ripening about the 1st of October, and mostly persistent until after the leaves have fallen, on stout erect puberulous pedicels, in wide many-fruited erect or spreading clusters, oblong to obovate, narrowed at the ends, orange-scarlet, lustrous, 8–10 mm. long, 6–7 mm. wide; calyx prominent, with a long groove, a deep narrow cavity, and spreading appressed pubescent lobes mostly deciduous from the ripe fruit; flesh thick, orange color, sweet and succulent; nutlets 2, rounded and obtuse at the ends, obscurely ridged on the broad rounded back, penetrated on the inner face by wide grooves, 5–6 mm. long and about 4 mm. wide.

A tree 5–6 m. high, with a tall slender stem covered with dark gray scaly bark, spreading or ascending branches forming a broad round-topped head, and slender nearly straight branchlets marked by many large pale lenticels, dark orange color and hoary-tomentose when they first appear, bright chestnut-brown and puberulous during their first winter and dark gray-brown the following year, and sparingly armed with slender dark gray spines 2–5 cm. long, becoming elongated and much-branched on old stems and branches.

Berks county: Banks of Sacony Creek, near Kutztown, *C. L. Gruber* (No. 24), June and October, 1903. Bucks county: Near Sellersville, *C. D. Fretz* (No. 21), June and October, 1903.

3. Cratægus succulenta Link.

Handb., II, 78 (1831).——Sargent, Silva N. Am., XIII, 139, t. 131; Man. 497, f. 411.

Berks county: Near Kutztown, *C. L. Gruber* (No. 166), May and September, 1903. Bucks county: Near Sellersville, *C. D. Fretz* (Nos. 19 and 20), May, 1899, May and October, 1901. Delaware county: Crum Creek, below Castle Rock Park, *B. H. Smith* (No. 190), May and July, 1900, September, 1903; *Smith* and *Sargent*, September, 1902. Northampton county: Easton, *T. C. Porter*, June, 1893.

4. Cratægus radiosa n. sp.

Leaves rhombic to obovate, acute, acuminate or rarely rounded at the apex, gradually tapering and concave-cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and divided above the middle into several short broad lobes, nearly fully grown when the flowers open from the 15th to the 20th of May and then membranaceous, light yellow-green and sparingly villose along the midribs and veins above, and pale and slightly hairy on the midribs and in the axils of the primary veins below, and at maturity subcoriaceous to coriaceous, dark green and lustrous on the upper and pale and still hairy on the lower surface, 5–8 cm. long and 4–5 cm. wide; petioles stout, wing-margined toward the apex, puberulous while young along the deep groove on their upper side, without glands, 1–2.5 cm. in length; stipules linear, acuminate, fading brown, caducous. *Flowers* about 1.5 cm. in diameter, on slender elongated glabrous pedicels, in wide many-flowered glabrous corymbs, with oblong-obovate to linear serrate bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, the lobes foliaceous, acuminate, deeply laciniately serrate above the middle, with gland-tipped teeth, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale pink; styles 2 or 3. *Fruit* ripening early in September and mostly falling before October, on stout erect pedicels, in few-fruited clusters, subglobose, rounded at the apex, truncate and concave at base, bright cherry-red, lustrous, about 1 cm. in diameter; calyx little enlarged, with a narrow deep cavity, and spreading reflexed lobes often deciduous from the ripe fruit; flesh thick, succulent, dark orange-yellow; nutlets 2 or 3, full and rounded at the obtuse ends, prominently ridged on the back, with a broad deeply grooved ridge, penetrated on the inner face by short irregular deep cavities, 5–6 mm. long and about 4 mm. wide.

A tree 3–4 m. high, with a trunk 1–1.5 m. long and 1–1.3 dm. in diameter, covered with thin close gray bark, heavy spreading branches forming a handsome round-topped head, and stout zigzag glabrous branchlets marked by large oblong pale lenticels, light orange color when they first appear, becoming bright chestnut-red and very lustrous before autumn and gray tinged with red the following year, and armed with numerous slender or slightly curved purplish or red-brown shining spines 6–8 cm. long.

Delaware county: Banks of Collen Brook, Upper Darby, *Smith* and *Sargent* (No. 215, type!), September, 1902; *B. H. Smith,* May and September, 1903, May, 1904.

5. Cratægus micrantha n. sp.

Leaves ovate to oval or obovate, acute or obtuse and rounded at the apex, gradually or abruptly narrowed to the cuneate entire base, sharply doubly serrate above, with straight gland-tipped teeth, and slightly divided above the middle into short acuminate lobes, nearly fully grown when the flowers open about the 20th of May and then membranaceous, yellow-green and puberulous along the midribs above and pale and glabrous below, with the exception of a few sometimes persistent hairs in the axils of the primary veins, and at maturity subcoriaceous, dark green, lustrous and glabrous on the upper and pale and dull on the lower surface, 4–5.5 cm. long and 3–4 cm. wide, with stout yellow midribs, and prominent veins extending obliquely to the points of the lobes; petioles slender, grooved on the upper side, narrowly wing-margined below the middle, sparingly glandular, 8–14 mm. in diameter. *Flowers* 8–10 mm. in diameter, on slender elongated glabrous pedicels, in broad many-flowered compound corymbs, with linear acuminate finely glandular-serrate rose-colored caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes slender, elongated, acuminate, deeply glandular-serrate, with small bright red glands, glabrous on the outer, hairy on the inner surface, with pale matted hairs, reflexed after anthesis; stamens 20; anthers dark rose color; styles 2 or 3. *Fruit* ripening the end of September and soon falling, on slender erect reddish pedicels, in few-fruited clusters, subglobose, orange-red, lustrous, marked by occasional pale dots, 7–8 mm. in diameter; calyx little enlarged, with a short tube, a narrow deep cavity, and closely appressed lobes often deciduous from the ripe fruit; flesh very thin, yellow, dry and mealy; nutlets 2 or 3, obtuse at the ends, ridged on the back, with a high narrow ridge, penetrated on the inner face by broad shallow grooves, about 4 mm. long and 3 mm. wide.

A shrub with numerous small much-branched stems 2–3 m. high, with slender nearly straight branchlets marked by oblong pale lenticels, dark orange-colored and glabrous when they first appear, becoming light chestnut-brown and very lustrous during their first season and dull gray-brown the following year, and armed with numerous slender straight or slightly curved purplish ultimately gray-brown spines 3.5–4.5 cm. in length.

Bucks county: Dry banks of streams near Sellersville, *C. D. Fretz* (No. 183, type), May and September, 1903. Berks county: Rocky ridge near Kutztown, *C. L. Gruber* (No. 1), May and August, 1903.

6. Cratægus opica Ashe.

Jour. Elisha Mitchell Sci. Soc., Vol. XIX, p. 10 (1903).——Gruber, Proc. Berks County Nat. Sci. Club, I, 3 (Cratægus in Berks County, II).

Leaves rhombic to oval, acuminate, concave-cuneate at the entire base, finely often doubly serrate above, and sometimes slightly divided toward the apex into 3 or 4 pairs of broad acute lobes, nearly fully grown when the flowers open about the 20th of May and then membranaceous, dark yellow-green, very smooth and puberulous along the midribs above and pale or glaucous and glabrous with the exception of a few short hairs in the axils of the veins below, and at maturity coriaceous and glabrous, dark green and lustrous on the upper and pale and conspicuously reticulate-venulose on the lower surface, 6–7 cm. long and 4–5 cm. wide, with stout orange-colored midribs, and slender veins extending obliquely to the points of the lobes; petioles stout, broadly wing-margined from the apex sometimes to below the middle, deeply grooved, without glands, puberulous while young on the upper side, soon glabrous, 1.5–2 cm. in length; stipules linear-lanceolate, minutely glandular, fading brown, caducous. *Flowers* 1.4–1.6 cm. in diameter, on stout elongated villose pedicels, in broad many-flowered compact hairy corymbs, with oblong-obovate to linear acuminate glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube narrowly obconic, villose at the base only, the lobes gradually narrowed, acuminate, deeply laciniately serrate, with gland-tipped teeth, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening early in October, on long red slightly hairy spreading or drooping pedicels, in many-fruited clusters, depressed-globose to short-oblong, scarlet, lustrous, translucent when fully ripe, 1–1.2 cm. in diameter; calyx enlarged and prominent, with a deep narrow cavity, and spreading and reflexed coarsely serrate lobes villose above, often deciduous from the ripe fruit; flesh thick, dark yellow, and succulent; nutlets 2 or 3, full and rounded at the base, gradually narrowed to the acute apex, ridged on the back with a high narrow ridge, penetrated on the inner faces by deep wide cavities, dark colored, about 5 mm. long and 3–4 mm. wide.

A tree 4–7 m. high, with a slender stem covered with dark nearly black scaly bark, short spreading branches forming a narrow oblong or oval crown and slender nearly straight glabrous branchlets marked by oblong pale lenticels, light orange color when they first appear, light red-brown and lustrous during their first winter and gray tinged with red the following year, and armed with numerous slender nearly straight purplish spines 3–3.5 cm. long, becoming much elongated, branched and dark gray on old stems and branches, or often shrubby.

Berks county: Near Sacony Creek, in the neighborhood of Kutztown, *C. L. Gruber* (No. 23, type!), 1901, May and September, 1903. Bucks county: Durham, *C. D. Fretz* (No. 154), May, 1901; *Fretz* and *Sargent*, September, 1902; near Sellersville, *C. D. Fretz* (No. 158), June, 1901.

7. **Cratægus chadsfordiana** n. sp.

Leaves ovate to rhombic, acute or acuminate, cuneate or rarely rounded at the entire base, coarsely doubly serrate above, with straight gland-tipped teeth, and divided into 4 or 5 pairs of small acuminate lateral lobes, more than half-grown when the flowers open about the 20th of May and then membranaceous, light yellow-green, very smooth and glabrous with the exception of a few scattered white hairs above, and pale or glaucous and slightly villose in the axils of the primary veins below, and at maturity subcoriaceous, dark yellow-green, lustrous and glabrous on the upper, light yellow-green and glabrous with the exception of small tufts of axillary hairs on the lower surface, 6–7 cm. long and 5–6.5 cm. wide, with stout yellow midribs, and slender veins extending very obliquely to the points of the lobes; petioles stout, deeply grooved on the upper side, wing-margined toward the apex, slightly hairy while young, soon glabrous, occasionally glandular, with minute stipitate persistent glands and 2–2.5 cm. in length; leaves on vigorous shoots often full and rounded at the base, more deeply lobed and more coarsely serrate. *Flowers* 2–2.2 cm. in diameter, on long slender glabrous pedicels, in 5–9-flowered glabrous corymbs, with linear acuminate glandular bracts and bractlets, fading red; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, nearly entire or glandular-serrate, glabrous on the outer and sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2–4. *Fruit* ripening about the 20th of September, on long stout erect or spreading pedicels, in few-fruited clusters, subglobose, often somewhat narrowed at the base, scarlet, lustrous, marked by occasional large pale dots, 1–1.4 cm. in diameter; calyx little enlarged, with a wide shallow cavity and spreading lobes mostly deciduous from the ripe fruit; flesh thick, yellow, dry and mealy; nutlets usually 3 or 4, gradually narrowed to the rounded ends, prominently ridged on the back, with a high narrow ridge, dark colored, penetrated on the inner faces by narrow deep grooves, 7–8 mm. long and 4–5 mm. wide.

A shrub 2–3 m. high, with stout ascending stems and slender nearly straight branchlets marked by oblong pale lenticels, dark orange color and glabrous when they first appear, becoming bright red-brown and lustrous before winter, and dull and darker colored the following season, and armed with many stout or slender nearly straight purple shining spines often pointing toward the base of the branch and 5–7 cm. long.

Delaware county: Wooded slopes at Chadsford, *B. H. Smith* (No. 225, type!), September, 1902, May, 1903, May, 1904; *W. M. Canby*, October, 1902.

Cratægus chadsfordiana is closely related to *Cratægus dumicola* Sarg., of the Aroostook Valley, Maine, but differs from that species in its larger flowers, glabrous pedicels, usually larger fruit, darker colored nutlets and much thicker leaves.

Cratægus cordata Ait., from the south and west, and *Cratægus oxycantha* L., from Europe, have become naturalized in eastern Pennsylvania.

THE SPHAGNUM FROG OF NEW JERSEY—RANA VIRGATIPES Cope.

BY HENRY W. FOWLER.

On April 23, 1905, Mr. Thomas D. Keim and the writer, while investigating the fauna of the Great Egg Harbor river, obtained a number of specimens of the interesting frog *Rana virgatipes* Cope, and were fortunate enough to learn something of its habits. The species seems to have been obtained on but two other occasions since it was first found by Cope in October of 1891.[1] Mr. Witmer Stone secured one on Shoal Branch of Wading river, near Speedwell, N. J., June 20, 1901, and on May 31, 1905, Mr. Paul Lorrilliere obtained one on a branch of the Batsto river near White Horse, N. J. All the above specimens, as well as Cope's types, are now in the collection of the Academy, making a series of thirty-two examples.

Our specimens were obtained at the mouth of Mare Run, the type locality, and we noticed no other batrachia in the vicinity. The frogs seemed to occur exclusively in the almost submerged masses of sphagnum which line the shores in many places, and often extend well out in the stream. Here the water is still and the animals rest more or less below, so that their dull colors harmonize well with the surroundings. They were shy and sank quickly out of sight among the aquatic vegetation on the approach of danger. In attempting to escape they would not jump or leap, and when caught in the dip-net moved about in a rather slow stupefied manner. They swam for short distances, but were usually able to find suitable shelter close at hand.

The individuals obtained by Cope and Stone did not make any noise, but when we discovered ours the males were in full cry, which would seem to indicate that late April was the height of the nuptial season. The males are provided with distensible vocal vesicles, and when about to utter their call these sacs are inflated like little bladders till nearly spherical, and then by degrees the air is allowed to escape. This gives the sac the appearance of collapsing by a series of jerks. As it is done quickly, each jerk at an interval of a second, the result is a sort of rapping sound. These raps, or jerks, are about five or six in number. The sound produced is peculiar in that it is difficult at times to detect

[1] *Amer. Naturalist*, XXV, 1891, p. 1,017.

its source, and if the frog is close is quite startling. This is due not only to the suddenness, but also to the volume of sound. On one occasion an example which I captured had his vocal vesicles well inflated, and though they partly collapsed as I held him in my hand he did not utter any sound. The call bears considerable resemblance to the noise produced by woodchoppers cutting trees a short distance back in the forest, and is different from the cry of any other batrachian, so that when first heard I suspected it was produced by this species.

In life the general color of the body is muddy-brown above. The lower surface is whitish, with a very diluted tint of dull yellowish in some examples. This was especially noticeable on the lower surface of the head and the forefeet. Side of head brownish. A pale brownish line from behind each eye back toward hind leg, distinct at first, but fading out gradually behind. Edge of upper jaw of same color, though with bronzed reflections in some examples. This color is then continued back as a line from below tympanum to groin. Along the flank it is a little paler and sometimes a little broader than the streak above. It serves to separate similar tinted or blackish-brown blotches of the lower surface from the color of the back. Back variegated with obscure blackish blotches nearly as large as pupil, and the same on the upper surface of the legs. Lower surface of legs with blackish-brown variegations, which also extend on the belly, and flanks below, though they vary greatly. Feet dusky, membranes of hind toes with blackish blotches. Tympanum and iris beautiful bronzed brown, a narrow ring of bronze encircling pupil.

Considerable variation as to color is observed in the large series of examples before me. This is striking in the color markings of the lower surface and is to be found in both sexes. Some examples have the dusting of the throat more intense or dark, some nearly white, and in others it is variegated with diffuse blotches of blackish-brown like those on breast. The same is true of the markings of the other lower regions, though they do not have the dusted appearance. In the case of two large females the markings on the under surface of the hind legs are very pale. Though there is a great variation in the extent of the dark coloring of the lower surface the general character of the markings is always retained. No two individuals are alike and the hind legs sometimes differ from one another. Two of Cope's examples are a little smaller than any of mine, though both are more or less mottled or blotched on the belly. As this seems to be the case with all of my smaller or medium-sized examples I suspect it to be a character associated with youth. The style of the coloration of the upper parts is less variable. In some living examples I noticed here and there one a trifle pale, or with paler streaks, or the upper jaw more bronzed. The lower lateral streak from below the tympanum appears to vary also, as it is either ochraceous, dull reddish, brownish, olivaceous or whitish. Some variation may also be noticed in the skin. Some have the dermal papillæ rather more scattered than others. These are usually the smaller individuals, as the larger ones have a somewhat warty appearance.

Explanation of Plate XL.

Left figure, female.
Middle figures, dorsal and ventral views of males with distended vocal vesicles.
Right figure, more usual type of coloration of male with vocal vesicles collapsed

DELAWARE VALLEY FORMS OF TRACHELOMONAS.

BY T. CHALKLEY PALMER.

The uniflagellate protozoa belonging to the genus Trachelomonas are normally provided with intensely green chromatophores, a red pigment-spot, a contractile vacuole and a hard, brittle, brownish lorica. The lorica has a single aperture wherethrough issues the very long flagellum. With the aid of this flagellum the monad swims rapidly in an irregularly spiral course. Though habitually inhabiting the lorica, the monad is able to squeeze through the very small aperture and to swim naked; and almost any rich gathering of Trachelomonas will show numerous individuals in this condition, wherein they are scarcely to be distinguished, except by minute study, from species of the normally naked genus Euglena. Different species of Trachelomonas, when without their loricæ, are not at all recognizable. Specific distinctions, in short, are founded of necessity, in this genus, on lorica characters.

These loricæ, when heated nearly to redness on a cover-glass, still keep their shapes, and show only a certain loss of transparency and a considerable reddening of the originally brown color. The ability to withstand a high degree of heat was taken by early students of the genus as an indication of their silicious constitution. When, however, these loricæ are treated with acids, the hardness, brittleness and color gradually disappear, and soon nothing remains but a thin, gelatinous pellicle, which in turn is capable of gradual and complete solution in hot nitric acid or in sulphuric acid and bichromate of potash. The mineral matter they contain is, therefore, something other than silica; and Klebs,[1] among others, has stated that this mineral matter is, in some cases at least, ferric hydroxide. The test to determine this point is sufficiently simple. It is only necessary to burn the loricæ on a cover-glass, and to invert over a drop of a solution of potassium ferrocyanide containing a small addition of hydrochloric acid. In a very few minutes the acid begins to dissolve the oxide of iron, and simultaneously ferric ferrocyanide deposits as a blue cloud around each of the loricæ. The writer has put to this test most of the loricæ pertaining

[1] KLEBS, *Untersuch. Tubing. Inst.*, I, 1883.

to the Delaware Valley species, and in every case the result was as described.[2] During this investigation numerous loricæ were also dried upon the cover-glass without burning, and examined for carbon dioxide with hydrochloric acid. The result was negative in every case. The lorica of *T. piscatoris* was included in these tests. The supposition of Fisher,[3] that these loricæ are to a considerable extent composed of calcium carbonate, is therefore still without confirmation. The effervescence observed by Fisher, and attributed by him to carbon dioxide, may be capable of another explanation.

Reduplication in the genus Trachelomonas is usually, if not always, accomplished within the lorica, and the act is followed normally by the withdrawal of one of the newly formed monads through the minute aperture. This operation has been observed frequently by students, so that its apparent impossibility goes for nothing. The naked individuals already referred to are largely the product of this process. Subsequently, but after how great an interval of time is uncertain, the euglenoid form is lost, the body assumes the spherical or ovoid shape proper to the species, and a new shell is secreted. This process the writer has seen in part. The individual was of the species *T. hispida.* The shell was already outlined as a very tenuous layer of nearly invisible gelatin, to the outside of which clung a dim halo of inert minutæ. But this soft and adherent condition was only transitory. The animal, revolving tirelessly within the nascent, stationary shell, continued without ceasing to brush and pat and feel all over the surface with its wonderful flagellum. By degrees the débris was mostly dislodged. Within two hours the lorica was beginning to take on a slight tint; it had attained to a consistency, though the spines characteristic of the mature shell were still almost invisible. Very suddenly the lorica itself began to revolve with the revolving monad, and in a moment monad and lorica were gone.

It sometimes happens that after subdivision the withdrawal of one of the monads does not at once follow. Loricæ are to be seen, now and again, with two monads, much pressed for room, and with flagellæ mutually interfering and working at cross-purposes. The course of the

[2] These loricæ are, therefore, altogether different from the silicious shells described by the present writer in these PROCEEDINGS, 1902, and there placed tentatively in the genus Trachelomonas. Some of those described and figured, and a few among the large number of similar ones observed, were afterwards seen in living but quiescent condition, and the indications are that they represent the resting or encysted state of various Protozoa, some of which at least belong to the Chromomonadina. It was, therefore, a complete error to refer them to the genu Trachelomonas.

[3] FISHER, 1880, *Proc. Amer. Soc. Micros.*

combination through the water is then erratic beyond what is usual. Loricæ occur, also, with duplicate apertures, though whether such are due to a similar state of affairs, only more prolonged, may be matter of doubt. Sporulation, or the splitting up of the whole monad into a multitude of very small, monoflagellate spores, which has been observed in this as well as in other genera of the Protozoa, is evidently a less frequent phenomenon. The evidence of it, however, is often seen in the numerous very small loricæ of many shapes. These small loricæ cannot with any certainty be referred to species, since in them the specific features are to a large extent undeveloped. The different steps of the process that results at last in a fully developed monad, starting from these spores, would seem not to have been followed by students. It is evident, however, that the steps are few; since while very small loricæ are common, medium-sized ones are comparatively rare. Authors have endeavored, and generally with success, to confine their descriptions in this genus to mature forms. The specific characters being almost without exception founded on the shape, size and surface markings of the loricæ, it is at once evident that for specific diagnosis these loricæ should be fully formed. It would seem, however, that in a few cases this principle has not been in operation to the fullest extent possible, and a few species are in consequence not quite adequately characterized. In the descriptive part that follows, only the loricæ that are mature, as manifested by their full development in point of color, size and markings, are accepted as typical.

All the species of Trachelomonas known to the writer are found in fresh water. Roadside pools, ditches, ponds. all yield them in larger or smaller numbers. They congregate in particular around rusty patches where ferrous compounds oozing out of the soil are in process of oxidation and precipitation. They often abound, however, in still waters covered with *Lemna*, and in those filled with *Utricularia*, *Potamogeton* and other aquatics.

Klebs has described[4] two forms of Trachelomonas that are devoid of chlorophyll, one of which he has named *T. reticulata* and the other *T. volvocina* var. *hyalina*. Both occur in decaying organic solutions, and are no doubt of saprophytic habit. Neither of these appears to have been noted in the territory covered by this paper.

In the table of species all the well-known forms are given whether known in Delaware Valley or not. A single form, not considered of specific value, is distinguished by an asterisk.

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[4] KLEBS, *Untersuch. Tubing. Inst.*, I, 1883.

Analysis of Species.

I.—*Lorica nearly spherical.*

- Surface smooth or nearly so, ... *T. volvocina.*
- Surface marked with
  - Hemispherical elevations, ... *T. verrucosa.*
  - Obliquely transverse, irregular, crooked wrinkles, . . *T. rugulosa.*
  - Longitudinal, somewhat oblique, continuous ridges, . *T. Stokesiana.*

II.—*Lorica not spherical.*

- Surface nearly smooth.
  - Not caudate, aperture produced, outline somewhat quadrate,
    - Narrowly cylindrical, *T. cylindrica.*
    - Broader, flask-shaped, *T. euchlora.*
  - Caudate, aperture produced, outline not quadrate.
    - Vasiform, aperture denticulate, *T. urceolata.*
    - Pyriform, aperture smooth, oblique, *T. acuminata.*
  - Not caudate, outline ovate, aperture rim wide, crenulate, *T. eurystoma.*
- General surface not smooth.
  - Spirally ridged. Aperture in an oblique groove, . . . *T. torta.*
  - Punctate
    - Punctæ fine, uniform. Two rows of spines around aperture.
      - A posterior crown of large spines, *T. armata.*
      - No posterior spines, * *T. acanthostoma.*
    - Punctæ coarse, irregular, ... *T. crebea.*
  - Reticulate. Lorica ovoid. Cell-contents colorless, . *T. reticulata.*
  - Spiny.
    - Spines short, stout, thickly set.
      - Ovoid, ends equally rounded, *T. hispida.*
      - Tapering posteriorly, caudate, *T. caudata.*
    - Spines short, more slender, less thickly set.
      - Rounded in front, obtusely conical posteriorly, ... *T. obtusa.*
      - Both ends rounded.
        - Neck conically contracted, *T. bulla.*
        - Neck trumpet-form, spiny, *T. piscatoris.*
    - Spines long and large, numerous. Neck trumpet-form, wavy, ... *T. horrida*

Trachelomonas volvocina Ehr.

Trachelomonas volvocina Ehrenberg. 1833. Abh. Berlin. Akad.

Lorica spheroidal, brown, surface nearly smooth. Aperture plane or produced into a cylindrical tube, which may be normal to the surface or slightly oblique.

This is perhaps the most common of local species, and very variable. The lorica may be prolately—or oblately—spheroidal, and of any size from very minute to 29 μ in diameter. The oblately spheroidal forms seldom exhibit any tube-like prolongation, but often a wide saucer-shaped depression surrounds the aperture and the wall is at that point very heavy. The tube, when present, may be altogether without the lorica, or partly within it and attached to the apex of a funnel-shaped depression in the wall. The surface of the finished lorica is almost smooth, or at most slightly wavy, though the intimate granular nature of the wall may at times be made out.

Trachelomonas verrucosa Stokes. Pl. XLI, fig. 2.

Trachelomonas verrucosa Stokes. 1887. Proc. Amer. Philos. Soc., XXIV.

"Lorica subspherical, colorless, the entire surface covered with minute hemispherical elevations, the anterior extremity slightly emarginate."

This species is not uncommon in the Delaware Valley, and it is especially plentiful at times in tidal ditches. As observed, it agrees closely with the description as quoted from Dr. Stokes, except only that the lorica is very generally brown instead of colorless. The hemispherical elevations sometimes show a slight tendency to elongate. Observed maximum diameter 24 μ.

Trachelomonas rugulosa Stein. Pl. XLI, figs. 7 and 8.

Trachelomonas rugulosa Stein. 1878. Infusionsthiere, III.

Lorica subspherical, thick-walled, brown. Surface with short, irregular, transverse to oblique, crooked wrinkles. Aperture plane, generally surrounded by a flat, smooth area.

Observed maximum diameter 23 μ.

It is a present tendency to reduce this form to a variety of *T. volvocina*. Immature individuals of the spheroidal species show resemblances that are more or less puzzling. No doubt these species are closely related and of recent differentiation. But the well-developed, highly colored, mature loricæ seem to differ with a sufficient constancy.

Published figures of the present species, mostly copied from Stein, are naturally quite as nebulous and unsatisfactory as Stein's own. Since it is proposed to insist herein upon the apparent validity of this species, the mature lorica, as it occurs along the Delaware, is illustrated in Pl. XLI, figs. 7 and 8, with such fidelity as was attainable. The markings vary in development from faint, elongated dots to crooked, confluent ridges. These ridges are by no means uniformly arranged spirally in the manner indicated in Stein's figures; and the internal spiral vestiges, shown in one of these figures, can scarcely constitute a specific character, since the like may often be seen, under favorable conditions, in almost any species of the genus.

The form figured was collected in numbers in Tinicum, August, 1903. Others quite similar were observed at Penn Valley, September, 1904. The same species, collected at Hammonton, New Jersey, in 1902, showed confluent rugosities that could only be described as cerebroid convolutions. In none of these was observable any tendency toward production of the aperture into a tube like that of *T. volvocina*. In every way *T. rugulosa* seems much more closely related to *T. verrucosa* than to *T. volvocina*. Certain plainly immature conditions resemble figures of *T. rugulosa* hitherto published, but no valid conclusions as to specific relationships are to be drawn from such.

Trachelomonas Stokesiana sp. nov. Pl. XLI, figs. 4 and 5.

Lorica spheroidal, thin-walled, one-tenth longer than broad, at maturity dark brown. Surface with conspicuous, mostly distinct, occasionally anastomosing, continuous ridges, obliquely longitudinal on the sides, strongly spiral at the ends. Aperture a round, bluntly conical, short tube, seated in a shallow circular depression. Monad green, with red pigment-spot. Flagellum long.

Observed maximum length of lorica 18 μ. Ponds, Penn Valley, Bucks county, Pennsylvania.

This species differs from *T. rugulosa* in the thinner wall of the mature lorica, in its smaller size, in its shape, and in the character and disposition of the markings. It differs from *T. torta* in size, shape, aperture and markings.

It was collected in large numbers at Penn Valley during the summer and autumn of 1904. With it were smaller numbers of *T. armata, volvocina* and *hispida*. Later it was found, but sparsely, in Tinicum, where, however, the remarkable constancy of its characters was again in evidence. The monad moves rapidly in an irregular spiral. Many individuals were observed in the naked condition, and the pigment-spot was then seen without difficulty.

I am glad of the permission to name this species in honor of Dr. A. C. Stokes, of Trenton, New Jersey, whose work in this and other genera of the Protozoa is known to all students.

Trachelomonas cylindrica Ehr.

Trachelomonas cylindrica Ehrenberg. 1833. Abh. Berlin. Akad.

Lorica reddish-brown, narrowly cylindrical, ends slightly flattened, smooth. Aperture plane or produced into a short, straight or oblique tube with smooth limb. Length 25 μ.

Only a few specimens of this have been seen by the writer, all of them coming from Tinicum. They accompanied the following species, which they resembled in a general way, really differing therefrom in loricate characters only in being very much narrower, and mostly of a deeper color.

Trachelomonas euchlora (Ehr.) comb. nov.

Lagenella euchlora Ehrenberg. 1833. Abh. Berlin. Akad.
Trachelomonas lagenella Stein. 1878. Infusionsthiere, III.

Lorica light-brown, elliptical or somewhat quadrate, surface smooth, Aperture generally produced into a short oblique tube. Length about 33 μ.

This is not more plentiful than *T. cylindrica* locally, and has not been found by the writer in numbers sufficient for proper study. There is room for doubt whether this is the organism described and figured by Ehrenberg. Neither the lorica as observed nor Stein's figure resembles Ehrenberg's figure xxiv, Taf. II, *Infusionsthieren.* Assuming, however, for the present, an identity, *T. lagenella* Stein becomes *T. uchlora* in accordance with known rules.

Trachelomonas urceolata Stokes.

Trachelomonas urceolata Stokes. 1887. Proc. Amer. Philos. Soc.

"Lorica vasiform, smooth, about twice as long as broad, the lateral margins slightly flattened, produced anteriorly in a short, subcylindrical neck, the borders somewhat everted, truncate, not oblique; posterior extremity not inflated, produced in an acuminate, tail-like prolongation; endoplasm enclosing numerous, probably amylaceous, corpuscles."

Dr. Stokes gives the length of lorica in this remarkable species at the equivalent of about 44 μ, and the "habitat, pond-water." It has been observed by the writer in some abundance in living condition in a gathering from Riverton, New Jersey. It was accompanied by *T. volvocina, armata* and *piscatoris.* It differs remarkably from familiar species of the genus in the proportionately wide aperture, and in the thin, easily distorted, parchment-like lorica. The surface of the lorica in these specimens was not smooth, but profusely tuberculate, and the caudal process showed in some cases two or three appressed setæ. The material containing this form was made available through the kindness of Mr. Edward Potts.

Trachelomonas eurystoma Stein.

Trachelomonas eurystoma Stein. 1878. Infusionsthiere, III.

Lorica brown, broadly ovoid, obtusely pointed posteriorly, surface entirely smooth. Aperture surrounded by a short, wide rim with crenulated edge. Length 30 μ.

Apparently rare in Delaware Valley. It has been observed, in numbers too small for proper study, in gatherings made in Tinicum. The crenulation of the wide, shallow rim around the aperture is not always evident.

Trachelomonas torta Kellicott.

Trachelomonas torta Kellicott. 1885. Proc. Amer. Soc. Micros.

"Egg-shaped colorless, ornamented by oblique rugosities, giving the appearance of having been twisted; aperture situated in a short oblique groove; flagellum very long; animalcule green, with red eyespot."

Length of lorica, the equivalent of 50 μ.

This is one of the largest of the genus, and one of the rarest in Delaware Valley. The writer has seen at most three specimens, and in one of these the lorica was colored a deep brown.

Trachelomonas armata (Ehr.) Stein. Pl. XLI, figs. 9, 10 and 11.

Chætotyphla armata Ehrenberg. 1833. Abh. Berlin. Akad.
Chætotyphla aspera Ehrenberg. 1833. Abh. Berlin. Akad.
Trachelomonas armata Stein. 1878. Infusionsthiere, III.
Trachelomonas acanthostoma Stokes. 1887. Proc. Amer. Philos. Soc.

"*C. armata.* C. corpore ovato, utrinque rotundato, subgloboso, fusco, ubique setis brevibus hispido, corona apiculorum postica, nigra.

"*C. aspera.* C. corpore oblongo, fusco, utrinque rotundato, ubique setis brevibus hispido, apiculus posticis minoribus sine ordino sparsis."—Ehrenberg, *Abh. Berlin. Akad.*, 1833.

Lorica ellipsoidal, brown, the general surface densely and finely punctate. Two irregular rows of short, conical spines around aperture. Often a ring of six to twelve or more long, hollow, curving spines around posterior end. Aperture in a shallow, wide, rimmed depression, and infrequently produced into a short tube with stellate limb. Length of lorica 39 μ.

This species is common in Delaware Valley and it exhibits much variety of form. But among the thousands of specimens examined, not one has shown a lorica with the smooth surface attributed to the species by authors. Dr. A. C. Stokes has accurately described his form *acanthostoma* as having a punctate surface. This would unquestionably be a specific distinction were it not true that all forms of *T. armata*, as found in this region, have precisely the same punctation.

The posterior ring of large, curving spines seems to be a very late excrescence in the individual development, and these spines may be seen in all stages of sprouting.

Trachelomonas crebea Kellicott. Pl. XLI, fig. 1.

Trachelomonas crebea Kellicott. 1887. Proc. Amer. Soc. Micros.

"Lorica spheroidal, varying from decided brown to colorless, elliptical in side view, length to breadth as 5 to 4; surface not spined, but with minute raised points over entire surface. Anterior projection hyaline, minutely notched and slightly everted at outer extremity, $\frac{1}{5}$ length of shell."

The length of lorica is given by Kellicott at the equivalent of 25 μ. This species, as it occurs along the Delaware, where it is not uncommon, presents some variations. A prevalent form, figured herewith, is indefinitely and coarsely punctate, the punctæ being of various sizes and shapes. The aperture is produced into a curving tube, coarsely toothed and not everted at the extremity. It reaches a length of 30 μ. A curious circumstance is that individuals of this description habitually swim in a reverse direction, that is to say, with aperture in the rear.

Forms with straight aperture-tubes are not wanting, but they are not common in the territory.

Trachelomonas hispida (Perty) Stein.

Chætoglena volvocina Ehrenberg. 1833. Abh. Berlin Akad.
Chonemonas hispida Perty. 1852. Lebensformen.
Trachelomonas hispida Stein. 1878. Infusionsthiere, III.

Lorica brown, ovoid to long-elliptical, ends equally rounded. Surface mostly densely hispid throughout, occasionally nearly smooth. Aperture plane or produced into a short, cylindrical, hyaline tube.

A common and variable species, presenting all its well-known shapes in the Delaware Valley. A very small, tail-like, hyaline projection is sometimes present on the posterior end. The maximum size attributed to the species by Saville Kent is about the equivalent of 40 μ, but it is usually much smaller, and mostly about 30 μ. An occasional specimen has measured as high as 42 μ.

Trachelomonas caudata (Ehr.) Stein.

Chætoglena caudata Ehrenberg. 1840. Monatsberichte der Berliner Akad.
Trachelomonas caudata Stein. 1878. Infusionsthiere, III.

Lorica brown, elongate-ovoid, acuminate posteriorly and produced into a conspicuous, hyaline, tail-like process. Surface densely hispid. Aperture in a long, hyaline, trumpet-form tube with everted and deeply dentate limb.

A rare species, but occurring in typical form in Tinicum. It is said to reach a length of 52 μ. The local specimens measured at most 40 μ. The spiny ornamentation is precisely like that of *T. hispida*, but there is never any trouble in distinguishing the two. This species is figured by Perty (*Zur Kentniss Kleinster Lebensformen*, 1852, Tab. X, fig. 14) under the name of *Chonemonas acuminata*.

Trachelomonas obtusa sp. nov. Pl. XLI, fig. 3.

Lorica brown, with straight sides, rounded in front, abruptly conical posteriorly. Surface clothed with short, slender spines. Aperture not produced, bordered by a smooth area. Monad green with red pigment-spot. Flagellum long.

Lorica 33 μ long, 16 μ broad. Fresh-water ditches and ponds.

This species is not rare, but it has not yet been found in any large numbers in a single gathering. It occurs in tidal ditches in Tinicum, and in ponds among aquatic plants at Riverton, New Jersey. It presents no notable peculiarities beyond the characteristics of the lorica. The spines are like those of *T. bulla* and *T. piscatoris*, being more sparse and slender than in *T. hispida*. Its very considerable size, and oftentimes its well-developed color, would preclude the obvious suspicion that it represents an immature state of some other species. Moreover, intermediate forms have not been observed.

Trachelomonas piscatoris (Fisher) Stokes.

Lagunculа piscatoris Fisher. 1880. Proc. Amer. Soc. Micros.
Trachelomonas piscatoris Stokes. 1886. Jour. Trenton Nat. Hist. Soc.

"Lorica flask-shaped, cylindrical, less than twice as long as broad, the surface clothed by numerous short, conical spines; both extremities equally rounded, the anterior aperture produced into a smooth, cylindrical, neck-like prolongation, about one-seventh the entire length of the lorica, the frontal border denticulate and often bearing a row of short, conical spines similar to those on the general surface. . . . ."

The length of lorica is given by Dr. Stokes, from whom the above is quoted, at the equivalent of 25–39 μ. It is a beautiful and very distinct species, not at all rare in Delaware Valley. It is present in most gatherings from Tinicum, and it occurs abundantly in lily-ponds at Riverton, New Jersey. In shaded situations, or where the water is poor in salts of iron, the lorica is sometimes light in color and thin-walled. This is probably the form referred to, but not adequately described nor at all figured, by Archer (1880, *Annals and Magazine of Natural History*), who suggested in a tentative way the name *T. acanthophora*.

Trachelomonas horrida sp. nov. Pl. XLI, fig. 6.

Lorica ovoid, brown, the general surface tuberculate, beset with very long, nearly straight, prismatic, abruptly pointed spines, longer on the ends than on the sides. Aperture plane, or produced into a short trumpet-shaped tube with wavy limb. Monad green, pigment-spot obvious. Flagellum long.

Fresh-water ditches. Length of lorica 40 μ.

This species is at once separated from all others by the character of the spines, as well as by their distribution. These spines are nearly as long as those of *T. armata*, but are not confined to certain areas, and are straight instead of curved, angular instead of round in cross-section, and pointed like a dagger. Those on the ends are 6 μ to 7 μ long, those on the sides one-half as long. It is also distinguished from *T. armata* by the tuberculate surface and the character of the aperture. Collected in living condition in Tinicum ditches, June and July, 1905.

While not plentiful, it presented itself in a number of gatherings containing also *T. volvocina, hispida* and *piscatoris.*

This same species has also been collected in Iowa by Prof. C. H. Edmundson, who has kindly sent specimens for identification and comparison with Eastern forms.

Explanation of Plate XLI.

Fig. 1.—*Trachelomonas crebea,* a prevalent form, not typical
Fig. 2.—*Trachelomonas verrucosa.*
Fig. 3.—*Trachelomonas obtusa.*
Fig. 4.—*Trachelomonas Stokesiana,* front view.
Fig. 5.—*Trachelomonas Stokesiana,* side view.
Fig. 6.—*Trachelomonas horrida.*
Fig. 7.—*Trachelomonas rugulosa,* front view.
Fig. 8.—*Trachelomonas rugulosa,* side view.
Fig. 9.—*Trachelomonas armata,* posterior spines undeveloped
Fig. 10.—*Trachelomonas armata,* posterior spines partially developed.
Fig. 11.—*Trachelomonas armata,* posterior spines developed.

ON A COLLECTION OF BIRDS AND MAMMALS FROM THE COLORADO DELTA, LOWER CALIFORNIA.

BY WITMER STONE.

WITH FIELD NOTES BY SAMUEL N. RHOADS.

Early in 1905 Mr. Samuel N. Rhoads made a trip, in the interests of the Academy of Natural Sciences of Philadelphia, through the northwestern portion of Lower California. The birds and mammals, numbering respectively 258 and 117 specimens, have been submitted to me for identification, and are listed below with such comments as they demand. Mr. Rhoads has added his field notes on various of the species, which enhance greatly the value of the report.

The conditions that prevailed during the expedition were peculiarly unfavorable to collecting of any sort, the rain, cold and high water being almost unprecedented. The accounts of the botanical expeditions sent out later by the New York Botanic Garden over the same route taken by Mr. Rhoads give a good idea of the conditions that prevailed (see *Journ. N. Y. Bot. Garden*, May and June, 1905).

Mr. Rhoads "embarked at Yuma, Arizona, in an open rowboat, February 4, accompanied by Mr. H. E. Wilder, of Riverside, and a guide. They descended the Colorado river as far as the mouth of the Hardy river, which is a slackwater bayou emptying into the Colorado about ten miles above the head of the Gulf of California. The Hardy was reached February 8, after an exchange of guides at the Colony, where they were fortunate to secure the services of Frank Tejano, a Cocopah Indian.

"This stream was then ascended as far as the base of the Cocopah range, reaching Bruce's ranch February 15, Pescadoro Slough on the 18th and Cocopah Major Mountain on the 19th. Several days were spent at the last point and also just above the mouth of the Hardy.

"From camp at the base of the Cocopah Knob, after a stay of nine days, the trip was continued overland to Calexico, on the Californian border, which was reached after five days of the most fatiguing driving and marching through the fresh mud and sloughs of the overflowing Colorado.

"During the entire trip more than half of the whole number of days were rainy, and the total precipitation was stated to have been more than often aggregates in this desert region for a period of years. The temperature was correspondingly low, on the 13th reaching 34° with ice in the coffee-pot, something the guide had never seen before in his lifetime of forty-five years. On these accounts the animal life of the region was at a standstill and the results of field work most discouraging."

In the list which follows Mr. Rhoads' field notes are given in quotation marks.

Ovis canadensis cremnobates Elliot. Lower California Sheep.

Three females, one of which was adult, obtained in the Cocopah Mountains, near camp, February 24; also a weathered skull and other bones of an old male.

"Numerous in the Cocopah range. Said to abound on the arid slopes and valleys lying between this and the San Pedro Martir range."

Sigmodon hispidus eremicus Mearns. Western Desert Cotton Rat.

Nineteen specimens of various ages, from the mouth of the Hardy river, the type locality for this race.

"Abounding in the overflow lands where the tules and reeds were a permanent food supply. Not an upland species, but essentially littoral."

Reithrodontomys longicaudus pallidus Rhoads. Lower California Harvest Mouse.

Six specimens from the mouth of the Hardy river.

"Found only in fine grass on the higher banks—situations, however, which would be temporarily overflowed at highest periods of spring tides and freshets. The Sigmodon was abundant in the same locations."

Neotoma intermedia albigula (Hartley). White-throated Wood Rat.

Five specimens from the mouth of the Hardy seem to be referable to this race.

"The large bush nests of this animal were seen at two or three other points in the delta, including the last camp at Mount Major; here they frequented the rocks also, or possibly this was another species. The habits and homes of this animal on the banks of the Hardy resemble those of the mesquite rats in the vicinity of Corpus Christi, Texas. They subsist largely on the bark and twigs as well as the seeds and pods of the mesquite."

Peromyscus eremicus (Baird). Desert Mouse.

Two forms of white-footed mice were obtained by Mr. Rhoads, and typical examples of each were submitted to Mr. W. H. Osgood, of the U. S. Biological Survey, who has kindly identified them.

The present species was abundant in the Cocopah Mountains, where a series of nineteen specimens was secured. A single female was obtained at the mouth of the Hardy, doubtless carried down in the flood, and four were trapped in the hills near the Mexican boundary, on the Colorado river.

"A rock-loving mountain species, whose habitat touches upon but not invades that of *sonoriensis*."

Peromyscus sonoriensis (Le Conte). Sonora White-footed Mouse.

This was the prevalent form in the low ground, nineteen specimens being obtained at the mouth of the Hardy and five others on the Colorado thirty-five miles below Yuma. Four specimens were also trapped in the Cocopahs with the preceding species.

"Excessively abundant in the bottoms, preventing the capture of other small rodents, etc., by incessantly springing the traps. Without studying its anatomy, I should predict that this species was more nearly related to *gossypinus* of the East than to *leucopus*. I base this view solely on its habitat and manner of life."

Perognathus penicillatus angustirostris Osgood. Slender-nosed Pocket Mouse.

Three specimens from the Cocopahs and one from the Colorado river, near the Mexican boundary. In going over the large series of these mice in the Rhoads collection at the Academy, I find among them three examples of *P. fallax pallidus* Mearns, obtained at Mission Creek, California, by R. B. Herron. These, as their labels show, had been separated in 1895 as a distinct race of *fallax* by Mr. Rhoads, but his name has remained in manuscript and the specimens were afterward referred by him to this species.

Perognathus spinatus Merriam. Spiny Pocket Mouse.

Eleven examples, all from the Cocopah Mountains.

"This and the former named inhabit the desert mountain and plain to the edge of the delta bottoms. Their homes are made by tunnelling at the base of greasewood and other low thickset bushes, as well as among the rocky clefts of the hills where any vegetation has a foothold. The entrances to these burrows remain open. They do not plough underground as *Blarina*, *Scalops*, *Thomomys*, etc., but excavate and throw out the dirt largely at the mouth of the burrow, thus raising the vicinity of their bush colonies into slight mounds. Both species may be caught at the same entrance on successive nights. They are closely associated with the kangaroo rats in these colonies. Judging by the lack of specimens on coldest nights, I judge there is a short period of intermittent hibernation in February."

Dipodomys merriami arenivagus Elliot. San Felipe Kangaroo Rat.

Three specimens from the Cocopahs. These seem to be referable to Elliot's race, though whether it is really separable from *simiolus* I am in doubt.

"All three were taken at the mouth of the same sand burrow at the base of Mount Major, near camp. This and a large white species, probably *deserti* Stephens, are said by the guides to abound in the sand plains on the borders of the delta all the way to Calexico. If so, this would indicate a continuous distribution toward the habitat of *simiolus* in the Mojave Desert. I doubt the separability of *arenivagus*."

Lepus arizonæ Allen. Arizona Hare.

One example from the Colorado river, near the Mexican boundary line, and another from New river, twelve miles from Calexico.

"A bottom-land species, not abundant because of the overabundance of coyotes."

Pipistrellus hesperus (Allen). Western Bat.

One obtained in the Cocopah Mountains, February 21, identified by Mr. J. A. G. Rehn. The margins of the interfemoral membrane as well as the inner portion of the wing margin is whitish.

Procyon pallidus Merr. Pallid Raccoon.

A specimen from the mouth of the Hardy river and one from the Colony.

"Coons occur everywhere along the river."

Urocyon littoralis (Baird). Coast Fox.

A skull from nine miles west of Bruce's ranch; also a mummified skeleton from Mount Major which could not be preserved.

Canis estor Merriam? Coyote.

Five skulls and four skins, which seem to be referable to this form; but without topotypes for comparison, it is impossible to satisfactorily identify them. That three species of coyotes occur together in the San Pedro Martir Mountains, as stated by Mr. Elliot, seems to me very unlikely.

"Mr. Wilder, whose experience with coyotes extends over a wide territory in the far West, told me he never heard the like of those which nightly sang and yelled us to sleep in the Colorado delta. They were overabundant and easily trapped."

Tursiops gillii Dall. Gill's Dolphin.

One skull, found on the Hardy river at the base of the Cocopah Mountains, fifty miles above the Gulf.

Additional Species Observed.

Odocoileus hemionus eremicus (Mearns). Sonoran Mule Deer. Burro Deer.

"It was probably this race which we found inhabiting the delta on the Californian side. The floods had driven them to the uplands, so they were rarely seen, but their old tracks were abundant. Two specimens were shot by a comrade near the last camp, the horns of which were taken home by Mr. Wilder. On the delta this species ruts in February, the fawns being born in August."

Antilocapra americana mexicana Merr. Mexican Antelope.

"A trip was taken to the base of the mountains, nine miles from Bruce's ranch, for this species, but none were seen. Their old tracks were plentiful. About forty miles south of this point, on the mesas of the San Pedro Martir and Major Cocopahs, they are reported to be abundant."

Castor canadensis frondator Mearns. Arizona Beaver.

"Several are trapped in winter on the lower Colorado. I examined some fresh hides in a trapper's camp above the Colony, and a large number taken on Pescadoro Slough, where they are reported more abundant. They make no dams nor any homes in the banks, but raise large flat piles of brush and mud for their homes back in the densely grown sloughs and ponds of the bottoms."

Felis cougar browni (Merr.). Sonoran Puma?

"None seen. Our guide, Frank Tejano, denied having met with this species, but had seen their tracks. He seemed to be in awe of them and declined to give his experiences. They are rare."

Lynx ruffus peninsularis Thomas. Peninsular Wild Cat?

"One or two seen. Not rare."

Taxidea taxus infusca Thomas? Badger.

"Tracks of badgers were seen, as well as holes stated to belong to them."

Thomomys fulvus nigricans Rhoads? Lower Sonoran Mole Rat.

"A few places indicated the presence of some species of this genus even in the bottom lands. None were captured."

Birds.

Podilymbus podiceps (Linn.). Pied-billed Grebe.

One specimen from mouth of Hardy river, February 11.

"Only one seen."

Larus philadelphia (Ord.). Bonaparte's Gull.

One secured at the mouth of the Hardy and one thirty miles below Yuma.

"Very scarce and mostly in a half-starved condition, appearing to suffer greatly from the unusual cold.

Nycticorax n. nævius (Bodd.). Night Heron.

One at "Colony," February 7.

"Without exception the most abundant water bird on the river. Some individuals appeared to belong to the yellow-crowned species."

Symphemia semipalmata inornata Brewst. Western Willet.

One obtained at the mouth of the Hardy.

"The only one noted."

Lophortyx gambelii (Gambel). Gambel's Quail.

A number of specimens from the Cocopah Major Mountains, several from the mouth of the Hardy, and one fifty miles below Yuma.

"They were subsisting almost wholly on the mistletoe berries growing on the mesquites."

Accipiter velox (Wils.). Sharp-shinned Hawk.

One obtained on the Colorado thirty miles below Yuma.

"Rarely seen."

Falco sparverius phalæna (Lesson). Desert Sparrow Hawk.

Specimens obtained on the Hardy river and at Bruce's ranch.

"A scarce bird."

Bubo virginianus pallescens Stone.

One specimen from midway up the Hardy river, and another without locality.

"Found nesting at Bruce's ranch and everywhere abundant."

Centurus uropygialis (Baird). Gila Woodpecker.

Specimens from the Hardy river and Cocopah Major Mountains, as well as on the Colorado near the Mexican boundary. These birds are all typical.

"These also lived largely on the mistletoe berries."

Dryobates scalaris lucasanus (Xantus). Saint Lucas Woodpecker.

Two specimens from Colony and two from the Cocopah Major Mountains. The white on the tail feathers is variable, but less so in the females than in the males. The Colony specimens approach *bairdi*, but the others are *lucasanus*. A specimen in the Academy's collection obtained in June, 1852, by Col. McCall, in southern California, is a marked example of *lucasanus*. After examining a number of these birds, I can see no reason for elevating the Lower Californian race to specific rank, as has recently been done by Mr. William Brewster.

"These birds were extremely wild and difficult to secure."

Calypte costæ (Bourc.). Costa's Hummingbird.

Two specimens from Cocopah Major Mountains.

"These tiny birds were breeding, one of the specimens shot showing bodily marks of protracted incubation on the 21st of February."

Selasphorus rufus (Gmel.). Rufous Hummingbird.

One example from the Cocopahs.

"This bird was going through its aerial love antics in February with all the energy of a midsummer madness. This was the more remarkable as all other bird and animal life was in its deepest winter lethargy during my entire stay at this camp, and the temperature frequently fell to near 45°. This coincides with the actions of *rufus* in the vicinity of Puget Sound, as observed by me in early April, 1903, where I found it breeding though frost frequently formed at night."

Myiarchus cinereus (Lawr.). Ash-throated Flycatcher.

Specimens from Colony and Cocopahs.

"Of uniform but scanty distribution. They nested on the tops of the densely wooded cottonwood and willow bottoms, uttering frequent ejaculations as they darted upward for insects. Generally in quartettes, sometimes five or six within hearing."

Sayornis saya (Bonap.). Say's Phœbe.

One from Bruce's ranch and another from the California-Mexican boundary on the Colorado.

"Wherever we reached bluffs or other elevations not bottom land, this solitaire of the mountains and foothills is wont to appear. Its weird and plaintive cry is in impressive keeping with these barren solitudes."

Sayornis nigricans (Sw.). Black Phœbe.

Obtained at Bruce's ranch, and at the mouth of the Hardy river. The under-tail coverts appear perfectly white, although the longer ones are dusky centrally for more than half their length.

"One of the most lively bits of bird life, which relieved the tedium of our boat journey, was the frequent sight of these birds sitting on the floating drift and hawking flies and other insects from the steaming surface of Colorado of a chilly morning."

Pyrocephalus rubineus mexicanus (Scl.). Vermilion Flycatcher.

Several from the mouth of the Hardy, and also from Pescadoro Slough.

"We were sure to find one or more pairs of these in the mesquite groves. They seem to continue their conjugal attachments all winter, some pairs being inseparable. They furnished the only strong bit of color to be seen in the wintry landscape of the Colorado delta in February. The males on warm days were performing their whimsical little flight songs and tumbling feats, but there was no other sign or suggestion that this had anything to do with sexual excitement."

Corvus corax sinuatus (Wagl.). American Raven.

One obtained at the mouth of the Hardy.

"Numerous everywhere. Some of the ravens may have been the white-necked species. While at Cocopah Major I was entertained by the love antics and really wonderful medley of sounds which a love-sick raven is able to make. Some of these are truly melodious modulations of the so-called 'croak,' and run through quite a slice of the gamut. In addition to this they can tumble, twist, dive, soar and sport about the fleeting form of their mate with all the abandon and daring of less sedate and more elegant masters of the air."

Molothrus ater obscurus (Gmel.). Dwarf Cowbird.

One example taken on the lower Colorado, above Colony.

"They were associated with flocks of Redwings. Some were seen near Pescadoro Slough."

Agelaius phœniceus sonoriensis Ridgw. Sonoran Redwing.

Obtained along the Colorado above Colony, and at the mouth of the Hardy, as well as at Pescadoro Slough. I find it very difficult to separate this form from *neutralis,* and question whether the two will prove distinct when full series representing all seasonal variations are available for comparison. The specimens under consideration might be either form so far as measurements go, but the stripes on the breast of the females appear narrower than in San Diegan birds.

Sturnella magna neglecta (Aud.). Western Meadow Lark.

Several obtained about the mouth of the Hardy and one farther up the river, all of them typical *neglecta.*

"A rare bird except in open savannas along the Hardy river at two or three points."

Carpodacus mexicanus frontalis (Say). House Finch.

Three specimens taken on the Cocopah Major Mountains.

"Small flocks in the foothills; none seen down the river."

Astragalinus lawrencei (Cass.). Lawrence's Goldfinch.

Three examples from the Cocopahs.

"Two of this, or possibly another Goldfinch, were seen on a mesa above Colony."

Passerculus sandwichensis alaudinus (Bonap.). Western Savanna Sparrow.

A number from the mouth of the Hardy river and from Bruce's ranch. Several of them are in the spring molt.

"This species, with flocks of Brewer's and Chipping Sparrows and Abert's Towhee, were in great numbers in some favorable mesquite bottoms where grass weeds and mistletoe berries formed an abundant harvest."

Passerculus rostratus (Cass.). Large-billed Sparrow.

Five specimens from the mouth of the Hardy, all of them typical *rostratus*.

"These occupied a narrow strip or beach of marsh grass or sedge bordering the river and reaching far back over the mesquite bottom to higher open ground. They kept close to the river bank when flushed, while the Savannas flew across to the upland. About twenty *rostratus* were seen."

Zonotrichia leucophrys gambelii (Nutt.). Intermediate Sparrow.

Obtained at Bruce's ranch and Cocopah Mountains.

Spizella socialis arizonæ Coues. Western Chipping Sparrow.

Specimens from mouth of the Hardy and Bruce's ranch.

Spizella breweri Cass. Brewer's Sparrow.

Found at Bruce's ranch and on the Cocopahs.

Junco hyemalis (Linn.). Slate-colored Junco.

One typical male example from the Cocopah Major Mountains, February 24.

Junco oreganus thurberi Anthony. Thurber's Junco.

Three specimens from the Cocopahs, one of them not typical, but nearer to this than any other form.

Amphispiza bilineata deserticola Ridgw. Desert Sparrow.

One obtained on the Cocopah Mountains.

"Two or three were found in the chapparal, very wary indeed. The males occasionally uttered a sweet song. I saw no others."

Melospiza cinerea fallax (Baird). Desert Song Sparrow.

A number of specimens from the mouth of the Hardy, Bruce's ranch and the Colorado sixty miles below Yuma.

"The song of this form is precisely like that of our Eastern bird, and was a constant reminder of the winter minstrelsy of my home in the Delaware River Valley. They are very abundant in the whole delta."

Pipilo aberti Baird. Abert's Towhee.

Obtained on the Colorado and Hardy rivers at various points, and in the Cocopah Mountains.

"This peculiar or, rather, original bird character is abundant. In habits and appearance and in character also it reminds one of a female cardinal Grosbeak. Its voice or call note completes the illusion. Its song I never heard. That, together with its anatomy, may be sufficient proof that the systematists have not gone wrong in naming it *Pipilo*. No cardinals seem to inhabit its rendezvous in the Colorado delta, and that is another puzzling factor in the life history of Abert's Towhee."

Iridoprocne bicolor (Vieill.). Tree Swallow.

One example from Bruce's ranch.

"Several flocks seen."

Phainopepla nitens (Swains). Phainopepla.

Two examples on the Colorado fifty miles below Yuma and one from the Cocopahs.

"Wherever mesquites and their parasitic berries abounded plenty of these shining crested fellows plaintively flitted about from one high perch to another."

Lanius ludovicianus gambeli Ridgw. California Shrike.

Three specimens from the mouth of the Hardy river come nearer to *gambeli* than any other race, though they are not quite typical.

"Another was taken near Pescadoro Slough and several seen at the Mount Major camp."

Helminthophila celata lutescens (Ridgw.). Lutescent Warbler.

One obtained at Bruce's ranch, February 16.

"No others seen."

Dendroica auduboni (Towns.). Audubon's Warbler.

One from Colony and one from the Colorado river near the Mexican boundary.

"Exceedingly abundant everywhere along our route."

Anthus pensilvanicus (Lath.). American Pipit.

One specimen secured on the Hardy river, February 18.

"A very few seen on the Hardy only."

Toxostoma crissale Henry. Crissal Thrasher.

Two from the Cocopah Mountains.

"About five seen altogether. Occasionally one would sing a little, but they were only beginning. Only found in the foothill chapparal above high-water mark, and very shy and cunning in their terrestrial manœuvres to outwit the man with a gun."

Heleodytes brunneicapillus couesi (Sharpe).

Specimens from various points along the Hardy river from its mouth to the Cocopah Mountains.

"Frequenting both the arid foothills and the mesquite bottoms."

Salpinctes obsoletus (Say). Rock Wren.

Six specimens from the Cocopahs and one from the Colorado river near the Mexican boundary in southeastern California.

"A wonderful member of a wonderful family. Its life history, who can tell it? Sprite, sylph, orpheus of the barren mountains, what man could put thy likeness on paper or reveal to the reader thy inmost life? Now that the quest is over and I see seven skins lying side by side in the tray named and numbered, I trow they will be the last of that happy family to serve the demands of science."

Troglodytes aedon parkmanii (Aud.). Parkman's Wren.

One from Bruce's ranch. I follow Mr. Ridgway in uniting *parkmanii* and *aztecus*.

"A few, two or three, were seen at Mount Major."

Telmatodytes palustris paludicola (Baird). Tulé Wren.

Two specimens obtained at the mouth of the Hardy.

"They were numerous near our first camp on the Hardy, keeping close to the tules along the river bank. Very few seen farther up."

Telmatodytes palustris plesius (Oberholser). Western Marsh Wren.

One example of this race, associated with the above.

"No others noted."

Auriparus flaviceps (Sund.). Verdin.

Specimens from the mouth of the Hardy, Bruce's ranch and the Cocopahs.

"Uniformly distributed in the mesquite. One was caught in its gourd-like roosting nest. It sat with its tail projecting from the opening, so as to void all excrement on the ground during the night and keep its winter quarters cleanly."

Regulus calendula (Linn.). Ruby-crowned Kinglet.

One specimen.

"Many seen on both streams."

Polioptila cærulea obscura Ridgw. Western Gnatcatcher.

One from the Mexican boundary and one from Bruce's ranch.

"Abundant and always making a fuss out of proportion to its size."

Polioptila plumbea Baird. Plumbeous Gnatcatcher.

Specimens from Bruce's ranch, Pescadoro Slough and the Cocopah Mountains.

Mimus polyglottos leucopterus (Vigors). Western Mockingbird.

Three examples from the Cocopahs.

"I do not remember seeing any other specimens than those noted at our Mount Major camp. They were beginning to sing."

Additional Species Observed by Mr. Rhoads.

Larus occidentalis Aud. Western Gull.

Very abundant on the Colorado and its tributaries.

Larus argentatus Linn. Herring Gull.

A few seen on both the Colorado and the Hardy.

Larus californicus Lawr. California Gull.

A few seen.

Larus heermanni Cass. Heermann's Gull.

A few seen as far up as Yuma, Arizona.

Sterna elegans Gambel?

A few terns were seen in pairs on all the waters visited, either *S. elegans* or *S. dougalli* or both.

Sterna antillarum (Less.)? Least Tern.

Three or four very small terns were probably this species.

Phalacrocorax mexicanus (Brandt). Mexican Cormorant.

Exceedingly abundant, fishing in great shoals with the pelicans.

Pelecanus erythrorhynchos Gmel. American White Pelican.

"Increasingly abundant as Yuma disappeared in our wake, these splendid lordly birds were an ever-present source of delight and admiration during the remainder of our journey. At our camp on the upper Hardy at Mount Major, they came regularly every morning to fish in a lagoon formed by the recent floods directly in front of the camp. Sometimes there would be half a thousand of them, with hundreds of Cormorants plunging about at once. On the outskirts of the fray Great White Egrets gathered the fragments of this royal feast.

Merganser americanus (Cass.). American Merganser.

A few.

Merganser serrator (Linn.). Red-breasted Merganser.

Many.

Anas boschas Linn. Mallard.

Abundant.

Nettion carolinensis Gmel. Green-winged Teal.

Several flocks.

Spatula clypeata (Linn.). Shoveller.

Several.

Dafila acuta (Linn.). Pintail.

Several.

Erismatura jamaicensis (Gmel.). Ruddy Duck.

Chen hyperborea (Pall.). Lesser Snow Goose.

In great flocks going northward over the Cocopah Major, also near the mouth of the Hardy.

Branta canadensis subsp.?

A form of this species was continually going toward the coast from the delta, mostly at great elevations.

Tantalus loculator Linn.? Wood Ibis.

A few seen.

Ardea herodias Linn. Great Blue Heron.

Very abundant.

Egretta candidissima (Gmel.). Snowy Heron.

Several seen up the Hardy, especially at the Mount Major camp.

Grus mexicana (Müll.). Sandhill Crane.

Abundant.

Tringa minutilla Vieill. Least Sandpiper.

A few seen.

Actitis macularia (Linn.). Spotted Sandpiper.

Often seen.

Numenius hudsonicus Lath. Hudsonian Curlew.

Two flocks on the Hardy.

Oxyechus vociferus (Linn.). Killdeer.

Several.

Zenaidura macroura (Linn.). Mourning Dove.

Two or three seen near Colony and one or two up the Hardy. Very scarce.

Scardafella inca (Less.). Inca Dove.

A very few seen in the upper Hardy river region.

Pseudogryphus californianus Shaw. California Vulture

One seen at Mount Major camp.

Cathartes aura (Linn.). Turkey Vulture.

Abundant.

Elanus leucurus (Vieill.). White-tailed Kite.

Seen twice along the Hardy.

Circus hudsonius (Linn.). Marsh Hawk.

Frequent.

Accipiter cooperi (Bonap.). Cooper's Hawk.

Several noted

Parabuteo unicinctus harrissi (Aud.). Harris's Hawk.

Numerous.

Buteo borealis calurus (Cass.). Western Redtail.

Abundant.

Buteo lineatus elegans (Cass.) Red-bellied Hawk.

Several.

Buteo swainsoni Bonap. Swainson's Hawk.

Several.

Buteo platypterus (Vieill.). Broad-winged Hawk.

Two or three seen.

Aquila chrysaëtos (Linn.). Golden Eagle.

At Mount Major.

Haliæetus leucocephalus (Linn.). Bald Eagle.

One seen twice, or else two individuals, on the upper Hardy river. Stated to be very rare by our Indian guide.

Polyborus cheriway (Jacq.). Caracara.

Only two seen on the upper Hardy.

Pandion haliaëtus carolinensis (Gmel.). Osprey.

Seen only at Mount Major.

Strix pratincola Bonap. Barn Owl.

One seen above the Colony.

Asio accipitrinus (Pall.). Short-eared Owl.

A few seen near the mouth of the Hardy.

Megascops asio cineraceus Ridgw. Mexican Screech Owl.

Heard several times.

Geococcyx californianus (Less.). Road Runner.

Often seen on the banks of the river.

Ceryle alcyon (Linn.). Belted Kingfisher.

Often seen.

Chordeiles sp.

Two or three seen.

Contopus richardsonii (Swains.). Western Wood Pewee.

Otocoris alpestris pallida Dwight? Sonoran Horned Lark.

A few seen flying overhead.

Corvus sp.

Crows of some species were seen, but rarely.

Euphagus cyanocephalus (Wagl.). Brewer's Blackbird.

Always abundant near human habitations.

Tachycineta thalassina (Swains.). Violet-green Swallow.

Of large flocks seen some seemed to be this species.

Riparia riparia (Linn.). Bank Swallow.

Several seen along the Hardy river.

Ampelis cedrorum (Vieill.). Cedar Waxwing.

Not many seen.

Galeoscoptes carolinensis (Linn.). Catbird.

I feel sure that this bird was seen and heard two or three times along the Hardy river.

Troglodytes hiemalis pacificus Baird? Western Winter Wren.

Two or three Wrens seen in woods near Colony were presumably this form.

Merula migratoria propinqua Ridgw. Western Robin.

Seen here and there, sometimes numerously.

Sialia mexicana subsp.? Bluebird.

Numerous.

OCTOBER 3.

Mr. ARTHUR ERWIN BROWN, Vice-President, in the Chair.

Twenty-nine persons present.

The work of the Academy since the last meeting in May was reported on by the Curators, the Librarian and the Secretaries.

The Chair announced the death, September 18, 1905, of General Isaac J. Wistar, whereupon the following minute was unanimously adopted:

The Academy desires to record its profound regret at the death of General Isaac Jones Wistar.

His long service to the Academy as President, Councillor and Chairman of the Committee on Finance, was coincident from the beginning with the course of active development which has marked its later years, in the advancement of which no movement designed to promote its material welfare, or its usefulness in research, has ever failed to receive earnest support from his forceful energy. Courteous and impartial as the Chairman of its meetings, wise and suggestive as a member of its Council, expert and judicious in controlling its investments, the loss to the Academy of a faithful and efficient officer is felt by its members even less than their personal loss of a genial and welcome associate.

The Publication Committee reported that papers under the following titles had been offered for publication since the last meeting:

"The Sphagnum Frog of New Jersey, Rana virgatipes Cope," by Henry W. Fowler (June 1).

"Diachæa cylindrica, a New Species of Mycetozoa," by Hugo Bilgram (June 6).

"Five New Species of Pseudoptamilla from the Pacific Coast of North America," by J. Percy Moore (June 9).

"Cratægus in Eastern Pennsylvania," by C. S. Sargent (June 20).

"Notes on Some Hawaiian Achatinellidæ and Endodontidæ," by H. A. Pilsbry and E. G. Vanatta (July 31).

"On Two Hawaiian Cerithiidæ," by H. A. Pilsbry and E. G. Vanatta (August 31).

"The Plant Formations of the Bermuda Islands," by John W. Harshberger, Ph.D. (September 1).

"The Hour-glass Caudices of the Bermuda Palmetto," by John W. Harshberger, Ph.D. (September 1).

"Delaware Valley Forms of Trachelomonas," by T. Chalkley Palmer (September 2).

"On a Collection of Birds and Mammals from the Colorado Delta, Lower California," by Witmer Stone, with field notes by S. N. Rhoads (September 18).

"New Land Mollusks of the Japanese Empire," by H. A. Pilsbry and Y. Hirase.

A paper entitled "Some Vertebrates of the Florida Keys," by Henry W. Fowler, was withdrawn by the author.

The following papers, by Mr. Clarence B. Moore, were accepted for publication in the JOURNAL, and will constitute the second part of the thirteenth volume, quarto series:

"Certain Aboriginal Mounds of the Tombigbee River."

"Certain Aboriginal Mounds of the Black Warrior River."

"Certain Aboriginal Mounds of Mobile Bay and of Mississippi Sound."

"Miscellaneous Investigations."

The Identity of Eutænia atrata Kenn.—MR. ARTHUR ERWIN BROWN stated that in the *Report of the Pacific Railroad Survey* (1860) Kennicott described four garter snakes from California under the name of *Eutænia atrata*. Two of his specimens are still in the United States National Museum, and a third is in the Academy's collection. In 1892 Professor Cope established *Eutænia infernalis vidua* upon the two co-types of *E. atrata* in the National Museum, and subsequently marked the Academy's specimen with the same name. Cope's description was referred by Van Denburgh in 1897 to *E. elegans*, with the statement that this color-form seems to occur only on "the coast slope of the peninsula of San Francisco." In the same paper he cites *E. atrata* Kenn. as a probable synonym of *E. leptocephala* B. and G. In 1901 the speaker recognized the identity of Cope's types with those of Kennicott, and referred them to the highly variable *E. leptocephala*.

A collection of twenty or more living *E. elegans*, received by the Zoological Society from Santa Cruz county, just south of San Francisco, contains four examples of the *vidua* color-form. These correspond with the one type of *atrata* in the Academy's collection, and with the detailed description of the two in the National Museum with which Dr. Stejneger has kindly supplied me, the only difference of moment being that the four from Santa Cruz have nineteen rows of dorsal scales, while the types of *atrata* each have nineteen on the anterior third and seventeen on the middle of the body. It is significant that three red *elegans* from Santa Cruz show a parallel change from the normal number of twenty-one rows to nineteen, about the place where nineteen drops to seventeen in the *atrata* specimens. This scale variation is quite within the range of *elegans*, which sometimes has nineteen, and occasionally seventeen rows; and as in the remaining details of scutellation, as well as in other characters distinctive of *elegans*, such as the yellow chin and throat, the usually short hinder chin-shields, and the frequent presence of red markings on the ventrals, there is complete agreement, it seems that these snakes must be regarded as specimens of *E. elegans*, showing a more or less uniform dark olive color with a wide yellow dorsal stripe and little or no indication of laterals, correlated with a tendency to a reduced number of scale rows, and occurring, as far as is known, in a restricted area. Such a form requires recognition as a subspecies, for which the proper name obviously is *Eutænia elegans atrata* Kenn. Cope's name *E. infernalis vidua* being a pure synonym.

Anomalies such as these, occurring in some numbers and over a period of at least some generations, belong to the mutations of De Vries, but their proper assignment to any one of his special categories of the constituent parts of species is not so clear. It was pointed out on a previous occasion that *E. sirtalis*, with nineteen rows of scales, is probably the parent species of the genus, in which case the occasional appearance of that number in a species normally possessing twenty-one rows might be, in De Vries' view, an outbreak of a tendency to specific reversion to that number, and would fall under the definition of atavistic or degressive varieties; but, on the other hand, it is difficult to show, and would indeed be impossible when there is no knowledge of the line of descent, that the case may be no more than individual loss of two rows, a view to which color is lent by the further reduction in three specimens to seventeen rows. This mode of change would class them as retrogressive varieties. And again, the gain of a new color-pattern, occurring nowhere in a possibly ancestral form, brings them within the definition of elementary species. In fact, these specimens seem to demonstrate the lack of value of these theoretical definitions to the practical work of the systematist.

The evidence for the evolutionary value of mutations being so scanty among animals, it is not amiss to direct attention to the instability of nearly the whole genus *Eutænia*, and especially the species of the Pacific coast. This condition suggests that if the theory of alternating periods of stability and mutation be well founded, this group of species may at the present time be passing through a period of extreme mutability.

OCTOBER 17.

The President, SAMUEL G. DIXON M.D., in the Chair.

Forty-two persons present.

The death of Sutherland M. Prevost, a member, September 30, 1905, was announced.

The Publication Committee reported the reception of a paper entitled "Catalogue of the Land and Fresh-water Mollusca of Taiwan (Formosa) with descriptions of new species," by Henry A. Pilsbry and Y. Hirase. (October 9.)

Dr. Benjamin Sharp made a communication on oyster culture, native and foreign, illustrated by lantern slides. (No abstract.)

Alexander Wilson's Tombstone.—Mr. Nathaniel E. Janney remarked that on his first visit in 1862 to the grave of Alexander Wilson in the Old Swedes' Churchyard on Water street, north of Washington avenue in this city, the inscription was entirely legible, but from year to year by the action of the elements it had grown more and more indistinct, until, on the occasion of a visit last month, it was found to be almost obliterated.

Obtaining the consent of a warden of the church he employed a stonecutter who resurfaced the stone and renewed the original inscription which reads as follows:

This Monument
Covers the remains of
Alexander Wilson
Author of the
American Ornithology
He was born in Renfrewshire, Scotland
on the 6th of July, 1766.
Emigrated to the United States
in the year 1794.
and died in Philadelphia
of the dysentery
on the 23rd August, 1813
Aged 47.
Ingenio stat sine morte decus.

The Latin line is not given by Ord in his *Life of Wilson.*

Ezra T. Cresson, Jr., and Rev. J. A. Tomlinson were elected members.

The following were ordered to be printed:

THE PLANT FORMATIONS OF THE BERMUDA ISLANDS.

BY JOHN W. HARSHBERGER, PH.D.

No phytogeographic sketch has ever been published of this region, which comprehends the archipelago of larger and smaller islands lying south of the Gulf Stream in the western Atlantic between 32° 14′ and 32° 23′ N. Latitude and 64° 38′ and 64° 53′ W. Longitude, thus being about 600 miles from the nearest land, Cape Hatteras in North Carolina. It is evident from a study of the composition of the Bermuda flora that it is of comparatively recent introduction. Briefly, says Hemsley,[1] "it is not of purely West Indian origin, but was derived from the West Indies and that region of southeastern North America where the West Indian and North American types of vegetation overlap each other." There being no running streams, the original flora of Bermuda was essentially of a xerophytic type. The islands have been settled so long that the character of the original vegetation has been altered, and we must infer from the appearance of the flora at the present what its condition was when Bermuda was first discovered. The following formations, according to the observations of the writer in June, 1905. may be distinguished.

Marine Algal Formation.

The marine algæ of Bermuda are mainly those which have accustomed themselves to living on a shore composed of limestone rocks (reef rocks, or eolian rocks) exposed to the action of the surge, or which live in limestone, or coral sand in the comparatively placid water of salt water lakes, bays, or lagoons.

According to my observations the algæ of the rocks exposed to the surge are *Sargassum bacciferum, Dictyota Barteyresiana, Halimeda tridens, H. tuna, Zonaria lobata, Haliseris polypodioides, Anadyomene flabellata, Codium tomentosum, Neomeris dumetosus, Ulva lactuca, U. latissima, Rhodymenia palmata, Padina pavonia, Galaxaura rugosa, G. lapidescens* and others. Those of the tidal pools formed in the rock hollows are: *Padina pavonia, Digenia simplex, Acetabularia cren-*

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[1] HEMSLEY, W. BOTTING: Report on the Botany of the Bermudas. *Challenger Report. Botany*, I, p. 14.

ulata, Caulerpa mexicana, C. racemosa uvifera, Ulva lactuca, etc. The sandy bottoms beneath mangrove trees or in the channels leading from salt water sounds or ponds to the sea are characterized by *Halimeda tridens, Penicillus capitatus, Caulerpa taxifolia, C. cupressoides lycopodium, Padina pavonia.* The salt-water ponds, especially at Walsingham, are fed by underground channels, so that the water in them rises and falls with the tide. Here grow several interesting marine algæ, such as *Valonia utricularis, Caulerpa plumaris, C. racemosa,* and *Colpomenia sinuosa.*

Mangrove Swamp Formation.

The mangrove swamps occur at the heads of bays, especially along the south shore of the Bermudas and in the salt-water ponds which are here and there found distributed over the islands. The vegetation consists either of a pure growth of *Rhizophora mangle* with its prop roots extending in all directions, or a pure growth of *Avicennia nitida* (in flower in June) with its numerous pencil-like root knees projecting through the sticky mud at low tide. In some places, as in Castle Harbor, both *Avicennia nitida* and *Rhizophora mangle* are in association, and frequently one finds arising from the mud the green brush-like tops of *Penicillus capitatus.* Little else grows beneath the dense shade formed by the overarching crowns of these trees. Frequently a morass is formed by either *Rhizophora* or *Avicennia* taking possession of a shallow inland pond which thus becomes a swamp. Several such swamps are found near the coast on the north shore of Bermuda where *Avicennia nitida* has taken possession and has excluded everything else, except *Pluchea purpurascens, Sesuvium portulacastrum, Salicornia fruticosa, Heliotropium curassavicum* and a low sedge. In the salt-water pools in such swamps at Shelly Bay is found *Ulva lactuca,* and on the projecting roots of *Avicennia nitida* a moss-like growth of considerable bushiness.

Salt Marsh Formation.

This is found at the head of bays and elsewhere where the soil is influenced by the tides. In such a marsh along Harrington Sound the writer noted *Salicornia fruticosa, Heliotropium curassavicum, Sesuvium portulacastrum* and a number of sedges. The projecting roots from a single tree of *Avicennia* were also observed together with the long upright culms of a form of the crabgrass, *Stenotaphrum americanum.* The rare *Statice Lefroyi* also is a salt marsh plant.

Brackish Marsh Formation.

This exists in depressions some distance inland where marshes occur such as Smith's Parish Marsh, Devonshire Marsh, Pembroke Marsh all of which were investigated by me. Smith's Parish Marsh is devoid of trees. Here in the soil rendered brackish by underground channels grow *Typha angustifolia* in pure association, *Baccharis heterophylla* in thickets (Baccharis Association,) *Dichromena leucocephala*, *Scirpus lacustris*, while *Osmunda cinnamomea* is frequent. *Acrosticum aureum* forms pure associations at the edge of this marsh.

Devonshire Marsh is a large area with a few pools of water in the depressions. It gives evidence that it was once a pond. *Juniperus bermudiana*, *Sabal Blackburniana* and *Baccharis heterophylla* have encroached on this marsh so as to shade it. On the ground in the wettest places, according to Coulter,[2] are *Hydrocotyle asiatica*, *Herpestis monnieria*, *Mentha viridis* and a white bracted sedge, *Dichromena leucocephala*. On the drier ground, *Osmunda regalis* and *O. cinnamomea* become abundant, while in the still drier peaty soil, according to my observations, *Pteris* (*Pteridium*) *aquilina caudata* is growing vigorously. Here also occur two other plants, *Cladonia* and *Leucobryum*. *Typha angustifolia* is in some places in pure association. *Acrosticum aureum* also forms pure association here and there in this marsh. The pools are occupied by two species of Sphagnum, *Proserpinaca palustris* and *Lemna minor*. Pembroke Marsh is characterized by somewhat similar associations of plants; but in addition to the plants noticed above, Governor Lefroy[3] mentions several other plants peculiar to it, such as *Nasturtium officinale* (in water channels), *Ascyrum crux-andreæ*, *Kosteletzkya virginica*, *Walthcria americana* (=*indica*), *Eclipta erecta*, *Pluchea odorata*, *Ceratophyllum demersum*, *Kyllinga monocephala*, *Scirpus validus*, *Cladium occidentale* (=*germanicum*) and *Spiranthes brevilabrus*, the only orchid of Bermuda. The omnipresent cedar is found along the edge of this marsh together with *Sabal Blackburniana* which invades it. In a small pool grows *Lemna minor*.

Sand Dune Formation.

Sand dunes occur typically along the south shore of Bermuda at the head of reëntrant bays between stretches of rocky coast. Several low dunes are found on the north shore as at Shelly Bay. The middle

[2] Coulter, Samuel Monds: An ecological Comparison of some typical Swamp Areas, *Fifteenth Report Missouri Bot. Garden*, 1904, p. 62.

[3] Lefroy, General Sir John Henry: The Botany of Bermuda, *Bulletin U. S. National Museum*, No. 25. 1884.

beach is covered with masses of *Sargassum,* washed ashore at high tide. The upper beach at the foot of the dunes is characterized by the presence of *Cakile æqualis*, occasional clumps of *Tournefortia gnaphalodes, Scævola Plumieri* and *Croton maritimus. Ipomœa pes-capræ* sends its long runners down from the slopes of the dunes, associated with *Scævola Plumieri, Stenotaphrum americanum.* A little back of the crest of dunes are found *Tournefortia gnapholades, Ipomœa pes-capræ, Scævola Plumieri, Juniperus bermudiana* (wind-swept form), *Sisyrynchium bermudianum, Lepidium virginicum, Euphorbia buxifolia, Canavalia obtusifolia, Opuntia vulgaris.* On the dunes at Tuckertown, *Scævola Plumieri* forms extensive tracts in pure association (Scævola Association). *Solidago sempervirens,* as in the eastern United States, is also a dune plant, together with the glaucous and hairy forms of *Borrichia arborescens* and *Dodonæa viscosa. Conocarpus erectus* forms thickets which in some places protects the dune crest. Here we have a mangrove plant occurring on sand dunes under perhaps similar ecologic conditions as in salt water. *Stenotaphrum americanum* forms mats on the lee slopes and a tall fennel, *Fœniculum vulgare,* is also very abundant.

The dunes in Paget on the south shore are high, but since the settlement of the country they have been captured by the encroachment of various exotic plants such as *Nerium oleander, Lantana camara, L. crocea,* while *Croton maritimus, Canavalia obtusifolia, Dodonæa viscosa, Borrichia arborescens* and *Passiflora suberosa* are among the more important native plants. *Yucca aloifolia* forms clumps on low sandy hills at Shelly Bay in association with *Ipomœa pes-capræ, Tournefortia gnaphalodes* and *Opuntia* sp.

Cliff Rock Formation.

The coast line of Bermuda is generally rocky and the waves have honeycombed the rocks into jagged forms with sea caves hollowed out beneath. These rocks support a characteristic vegetation consisting of the hairy and smooth forms of *Borrichia arborescens,* prostrate trees of *Conocarpus erectus,* clumps of *Solidago sempervirens, Lantana involucrata, L. Camara, Euphorbia buxifolia,* the crabgrass, *Stenotaphrum americanum* (covering all the available soil on the rocks), while windswept trees of *Juniperus bermudiana, Yucca aloifolia* and dwarf palmettos *Sabal Blackburniana,* also abound in some places. *Coccoloba uvifera* in Bermuda seems to prefer the rocky shores to those of the sand. *Sesuvium portulacastrum* and *Lippia nodiflora* are also rock plants while in one place I collected the introduced *Linaria elatine* trailing over the ground on the limestone rocks.

Cedar Forest Formation.

This formation has been dignified by the name of forest, although no true forest exists on the islands, for the reason that the growth of the cedar trees *Juniperus bermudiana* is too open and the trees are not tall and dominant in the forest sense. All of the hillsides and hill summits not under cultivation are covered with the cedar *Juniperus bermudiana* with the admixture of *Sabal Blackburniana*. This species of juniper is a rapid growing one and reaches a merchantable size (two to three feet in diameter), but it differs from the eastern American species (*J. virginiana*) in branching more freely. It produces fruit in abundance. It is hard to determine the character of the original undergrowth. Now it consists of two species of *Lantana* (*L. involucrata, L. camara*), the prevailing *Nerium oleander, Lippia nodiflora, Solidago sempervirens* and *Sisyrynchium bermudianum*. The rock crevices are filled with a delicate endemic fern, *Adiantum bellum*. *Bryophyllum calycinum* (the floppers of the natives) is perhaps the most abundant plant in the undergrowth. It is found in all parts of the islands. The ground beneath the cedars is carpeted with the crabgrass *Stenotaphrum americanum* in the absence of other plants. Here and there the botanist meets with an introduced tree, such as *Citharexylum quadrangulare, Buddleia americana, Crescentia cujete, Hura crepitans, Duranta Plumieri,* which together with certain weeds enter into this formation and change its constitution. In abandoned cellars surrounded by cedars, one frequently sees *Ficus carica, Nicotiana glauca, Bryophyllum calycinum,* etc.

Limestone Sinks Forest Formation.

The so-called Walsingham Tract and several places near Harrington Sound on the south shore are characterized by the presence of numerous depressions, or sinks, as well as several caves. The Walsingham Tract, a narrow ridge of land about two miles long, and from a quarter to half a mile wide, which separates Castle Harbor from Harrington Sound, contains within its bounds nearly the whole of the indigenous flora of the islands. The following list of plants given by Lefroy includes plants of West Indian origin and their survival on the Bermudas is, I think, due to their growth in the limestone depressions many feet below the general surface, protected from the cutting blasts of the ocean breezes, and in situations where the soil moisture is greater than on the surface of the hills above.

Ampelopsis (*Parthenocissus*) *quinquefolia*
Asplenium myriophyllum
Chiococca racemosa
Elæodendron xylocarpum
Forestiera porulosa
Ipomœa purpurea
Jatropha curcas
Peperomia obtusifolia
Psychotria undata
Sicyos angulatus
Triumfetta semitriloba
Asplenium crenulatum
Callicarpa ferruginea
Dodonæa viscosa
Eugenia axillaris (=*monticola*)
Caesalpinia (*Guillandina*) *bonducella*
Jasminum gracile
Passiflora ciliata (=*fœtida*)
Psilotum triquetrum
Pteris heterophylla
Trema (*Sponia*) *Lamarckiana*
Xanthoxylum Clava-Herculis

According to my observations the following trees form a large part of the vegetation of one of the sinks: *Celtis mississippiensis*, *Citrus limonium*, *Ficus carica*, *Musa Cavendishii* (planted), *Melia azederach*, *Lantana camara*, *L. involucrata*, while *Stenotaphrum americanum* abounds and *Asplenium trichomanes* together with *Rhus toxicodendron* are found on the sloping sides of such depressions. Two vines are abundant and loop themselves across the trees, viz., *Cardiospermum halicacabum* and *Jasminum gracile*. *Commelina agraria* (=*nudiflora*) also occurs in such sinks.

At Walsingham, *Juniperus bermudiana* prevails mixed with *Sabal Blackburniana*, *Celtis mississippiensis*, *Citharexylum quadrangulare*, *Calophyllum calaba*, etc., while the trees are festooned with *Jasminum gracile*, *Rhus toxicodendron* and *Ipomœa purpurea*. *Peperomia obtusifolia* and several ferns are found on the rough rocks in the bottom of the sinks, together with *Bryophyllum calycinum* and one or two species of *Lantana*. *Citrus limonium* and *Musa Cavendishii* are also present in this jungle of plants.

Scrub Formation.

This formation is due to the hand of man. After the cedars are cut down, if the land is neglected and allowed to stand without cultivation it is covered by a growth of several species of *Lantana*, *L. camara* and *L. involucrata*. *Bryophyllum calycinum* also abounds together with many introduced weeds and thickets of *Nerium oleander*. Many of the hillsides in Bermuda are covered with this worthless scrub. Later perhaps under favorable conditions *Juniperus bermudiana* appears, but the flora is never restored to its original condition because the sage bush plants always form an important constituent of the undergrowth.

THE HOUR-GLASS STEMS OF THE BERMUDA PALMETTO.

BY JOHN W. HARSHBERGER, PH.D.

The only indigenous palm of the Bermuda islands is *Sabal Blackburniana* Glazebrook. It grows in all kinds of soil, on the barren hillsides, on the rocky shores in wind-swept situations and in the inland marshes, such as Pembroke and Devonshire marshes. Along the shores of these islands, in the eolian rocks and on the smaller islets of the Bermuda archipelago, the tree is usually dwarfed with a small crown of yellowish-green leaves. In rich soil, the crown is large and the tree usually reaches a considerable diameter (Plate XLII, fig. 18). When found in the inland brackish marshes, the caudex is tall and flexuous, resembling that of the coconut palm (fig. 22). The height of the Bermuda palmetto varies from fifteen to twenty feet in good soil; in the marshes, it grows from thirty-five to forty feet, while its circumference varies with edaphic conditions. In good soil, the circumference ranges from forty to fifty inches; in the marshes, sixteen to twenty inches. The breadth of the leaf is approximately six to eight feet and the length of the petiole three to seven feet.

The hour-glass constrictions of the trunk, or caudex, is a unique feature of this palm. Mr. Oswald A. Reade, in communication with Sir Joseph Hooker, says of them:[1] "In many individuals the stem is wanting; in others a small stem has apparently been the result of many years' growth, evidenced by the extreme roughness of the trunk, hour-glass contractions and decay. . . . . The hour-glass contractions mentioned above are very curious; in one which I measured, the circumference at one foot from the ground was thirty inches; at two feet eight inches, eight inches only; and at three feet, twenty-five inches. In other stunted individuals the stem appears conical, and sometimes as a bulbous expansion close to the ground." The significance of these waist-like constrictions has not been considered by any botanist, and in a study of the few papers dealing with the Bermuda flora, the writer can find no other reference to the hour-glass stems. The object of this paper, therefore, is to describe such caudices and to

[1] HEMSLEY, W. BOTTING: Challenger Report. Botany of the Bermudas. *Botany*, I, p. 71.

discover the cause which has produced this absolutely unique kind of palm-stem.

The explanation is found in the manner in which palm stems grow in general and the influence of the meteorologic and soil (edaphic) conditions on the cells of the growing crown. It is a well-known fact that the primary root of all palms soon perishes and is replaced by adventitious roots springing from the base of the stem. It is some years before the stem appears above the surface of the ground. In the meantime, the circumference of the growing point is continually increasing, producing successively larger leaves, so that the much-compressed axis forms an inverted cone, which is kept in position by the numerous adventitious roots. Finally, a rosette of normal-sized leaves is produced and the stem grows erect, forming a cylindric structure, the diameter of which varies widely in different species, but which, once formed, shows no secondary increase in thickness by the formation of new elements, so that the diameter of the stem remains almost uniformly the same from the base to the top of the tree. There is, however, an increase in diameter in the older stems of some palms which causes the gradual tapering upwards which is sometimes observed. This increase is due to the expansion of the parenchymatous fundamental tissue which separates the vascular bundles, accompanied by an increase in the cell-cavity and in the thickness of the walls of the sclerenchymatous fibers which support the bundles.

Evidently, we can explain the hour-glass caudices in the Bermuda palmetto by the general application of principles of palm-stem growth described above. If we remember that the diameter of the cylindric palm-stem is determined by the dividing cells of the rosette, or crown of green leaves, then any environmental condition which influences the growth and division of this terminal mass of meristematic cells influences in a direct way the diameter of the stem. We have already alluded to the fact that the leaves of the Bermuda palmetto in extremely rocky and dry situations are yellowish-green and smaller than those of a tree in correspondingly rich soil. Fig. 9 perhaps best represents a tree found in an extremely dry situation with a trunk that gradually tapers upward, showing that in youth the tree made a rapid and vigorous growth, but that in subsequent years the conditions which have influenced the crown growth of this particular tree have been unusually unfavorable. Now, if we apply this discovery to a study of other trees, many forms of which are figured on Plate XLII, we have the solution of the question concerning the apparent anomalous condition of the stem structure.

Given alternating periods of dry and wet weather, or given conditions which are at seasons prejudicial to the best growth of this palmetto, we would find alternate constrictions and enlargements of the stem in response to the environmental conditions. In seasons favorable to growth, the growing apex of the stem would expand itself with a correspondingly larger crown of leaves and increased diameter growth of the stem. During dry periods, the apex would become contracted, the crown of leaves smaller and the stem diameter correspondingly constricted, or contracted. The stem diameter is controlled by the size of the crown, and the size of the crown is in direct response to the meteorologic, edaphic and physiologic conditions which surround the tree. A comparison of figs. 18 and 12, representing trees growing in wet marshy ground, with figs. 9, 14 and 20, illustrating trees found in dry rocky situations, will show that the statements made above are almost axiomatic.

That climate influences the cell growth of palms is illustrated by a specimen in the botanical laboratory of the University of Pennsylvania, presented by S. L. Schumo. It is a section of stem of a *Sabal palmetto* which grew at Daytona, Florida. The cross section shows evidence of two rings of growth outside of the main, uniformly-constructed cylinder of bundles and parenchymatous tissue. The description accompanying the specimen states that the tree from which the section was made shed its leaves in a manner similar to the horse-chestnut, so that the petiole was left attached to the main stem. The statement also is made that the natives claim that the petioles, which they call bootjacks, all fall off and then the trunk becomes bare when this tree becomes mature. It is evident, therefore, that the recurrent fall of leaves from this tree, just as in typical dicotyledonous stems with concentric annual rings of wood, has produced the corresponding stem structure just described—that is the appearance of two well-marked rings, external to the central uniform stem cylinder.

The secondary growth in thickness which we have described for the Bermuda palmetto, where the stem is alternately enlarged and contracted producing the hour-glass forms, is different from the secondary growth in thickness displayed by *Sabal palmetto* in Florida. However, the fact that palms do show secondary growth in thickness renders these examples absolutely unique, as far as the information of the writer goes.

Another fact of somewhat similar import may be mentioned, namely, that the stems of the coconut palm, *Cocos nucifera*, as seen by the writer in Jamaica, and of the Bermuda palmetto, *Sabal Blackburniana*, as seen by him in Bermuda in June, 1905, contrary to the usual belief that old stems with permanent tissue cannot alter the position of such tissue, will make secondary growth curvatures and will grow again into upright position after they have been blown prostrate to the ground by hurricanes, as illustrated in fig. 17, a drawing of a tree found along the shores of Harrington Sound near Devil's Hole, Bermuda.

The figures sufficiently display the peculiarities of the stem of the Bermuda palmetto, so that a description of each figure is superfluous. It may be said, however, that figs. 1–8 inclusive represent trees growing along the north shore of the main island in front of a golf clubhouse. Fig. 9 pictures a tree found in extremely dry situations. Fig. 14 is that of a tree in a rocky abandoned quarry. Fig. 15 depicts a tree at the edge of a field along the north shore road; fig. 22, a tree in Pembroke Marsh, and fig. 18, a palmetto in rich soil along the edge of this marsh, while fig. 20 pictures the trunk of a tree on the dry cliffs along St. George Harbor. The other figures are drawings of trees, which grew in other parts of the Bermuda archipelago.

NEW LAND MOLLUSKS OF THE JAPANESE EMPIRE.

BY H. A. PILSBRY AND Y. HIRASE.

A number of new forms chiefly collected by Mr. Nakada in Kyushu and the Ryukyu chain last winter are herein described. In working up these islands many hardships and dangers were encountered, not the least being the abundance of venomous snakes locally called "*Habu.*" The malacological results have been most gratifying, as we now have a fair knowledge of the snails of all the larger islands and many of the smaller ones. Mr. Nakada has now been sent to China.

CYCLOPHORIDÆ.

Cyclophorus turgidus miyakoensis n. subsp.

This form differs from *C. turgidus* by its wider umbilicus, smaller aperture, slightly expanded and obtuse but not thickened lip, which is white. It differs from *C. kikaiensis* by the non-duplicate peristome and large size. It is related also to *C. elegans* Mlldff., from the Marble Rocks, Kuang-tung, China. The coloration varies from yellowish-white with numerous spiral lines and bands of brown spots, to dark chestnut brown with interrupted, irregular whitish bands on the base and whitish flames below the suture.

Alt. 17.5, diam. 22 mm.; aperture 11 x 11 mm., including peristome.

Miyako, in the Southwestern group of the Ryukyu Islands. Types No. 83,886, A. N. S. Phila., from No. 983 of Mr. Hirase's collection.

Pupinella oshimæ yorojimana n. subsp.

Shell similar to *P. oshimæ*, but smaller, with the lip reddish-orange.

Length 9.2 to 9.8, diam. 4.3 to 4.8 mm.

Yoro-jima, Ōsumi. Types No. 89,951, A. N. S. Phila., from No. 1,214*a* of Mr. Hirase's collection.

Cyclotus taivanus peraffinis n. subsp.

Shell similar to *C. taivanus*, but with the last whorl a more slender tube, the aperture in consequence being smaller. Surface glossy, finely striatulate vertically; yellow, closely marked with irregular, often interrupted or dislocated narrow red-brown streaks.

Alt. 8.5, diam. 14; alt. and diam. aperture with peristome 5.7 mm.; width of umbilicus 4.5 mm.

Yaeyama, Ryukyu Islands. Types No. 84,787, A. N. S. Phila., from No. 612*a* of Mr. Hirase's collection.

Diplommatina tokunoshimana errans n. subsp.

Shell similar to *D. tokunoshimana* except that the whorls of the conical portion of the spire, and the back of the penultimate whorl are sculptured with widely spaced threads. On the front of the penultimate and on the last whorl the thread-striæ are much closer, though neither so close or so fine as in *tokunoshimana*.

Tamina, Kunchan, Ryukyu. Types No. 89,955, A. N. S. Phila., from No. 1349 of Mr. Hirase's collection.

In *D. tokunoshimana* and *D. t. errans* the spout or sinus at the foot of the columella is developed more strongly than in *D. paxillus* Gredler, of China; the columella is straighter, and the mouth is more irregular in shape, not approaching circular as in *paxillus*, the columellar margin being vertical and straight. The Formosan *D. hungerfordiana* has a much shorter cone than *tokunoshimana*.

Diplommatina tosana kureana n. subsp.

Differs from *D. tosana* by the longer, straightly conic upper half of the shell, which tapers regularly from the penultimate whorl, while in *D. tosana* the next earlier whorl is larger, and the spire convexly conic. There is also nearly a whorl more, almost 7 in *kureana*, and the columellar margin of the aperture is more straightened. The constriction is above or barely behind the outer lip, as in *tosana;* the palatal plica is long, covered by the parietal callus, and the columellar lamella strong and horizontal.

Length 3, diam. 1.7 mm.

Kure, Tosa. Types No. 89,950, A. N. S. Phila., from No. 1,027*b* of Mr. Hirase's collection.

Diplommatina tosana nogawana n. subsp.

Shell smaller than *D. tosana*, composed of $6\frac{1}{2}$ very convex whorls, the penultimate swollen and predominating, very finely thread striate, those above regularly tapering, more distantly thread-striate, the last whorl smaller, with the striæ more oblique and more distant than on the penultimate, well rounded, the suture slowly ascending to the lip. *Constriction median* above the aperture; the palatal plica is long, lying chiefly *in front of the parietal callus.* Peristome well expanded, with a narrow "collar" close behind it. Parietal callus small, with distinctly raised edge. Columellar lamella strong.

Length 2.7, diam. 1.4 mm.

Nogawa, Tosa. Types No. 89,962, A. N. S. Phila., from No. 1,026*b* of Mr. Hirase's collection.

The special features of this form may entitle it to specific rank, but for the present its relationship to *D. tosana* may be kept in view by the use of a trinomial designation.

Palaina (Adelopoma) **paucicostata** n. sp.

Shell sinistral, perforate, cylindric-conic, white or pale yellow, thin, sculptured with delicate widely spaced thread-like riblets, about 20 on the last whorl. Whorls 5½, very convex, the earlier ones rapidly increasing, the last two about equal. Last whorl well rounded peripherally and basally, having a weak, inconspicuous constriction above the columella. Aperture nearly circular with continuous peristome, not dilated on the parietal wall. Peristome reflexed, with an inner rim; columellar tooth small and deeply situated.

Length 2.2, diam. 1.1 mm.

Nanae, Ojima, Yesso. Types No. 89,813, A. N. S. Phila., from No. 1,311, of Mr. Hirase's collection.

This species is larger than *P. pusilla* (*Diplommatina pusilla* Martens) or its variety *omiensis* Pils., with much more widely-spaced riblets.

TRUNCATELLIDÆ.

Truncatella japonica n. sp.

Shell of the usual cylindric, truncate shape, 3½ whorls remaining; of a light reddish color. Sculpture of nearly straight rounded ribs about as wide as their intervals, 28 or 30 on the last whorl. There is usually a small crest behind the lip, which is narrowly expanded. Aperture ovate.

Length 5.8., diam. 2.3 mm.

Length 5.6, diam. 2.1 mm.

Futami, Ise. Types No. 89,942, A. N. S. Phila., from No. 1,319 of Mr. Hirase's collection.

This species is related to *T. kiusiuensis*, from which it differs in the smaller size, smaller and more numerous ribs, there being about 30 on the last whorl, while *T. kiusiuensis* has about 20; and the rib behind the lip is not so large. *T. pfeifferi* Marts., described from Japan without more exact locality, is larger and more robust, 6 x 3 mm., and is sculptured "with nearly straight riblets equal to their intervals, and evanescent on the last whorl." It has not been figured, and was collected by Siebold. Mr. Hirase has found no *Truncatella* agreeing with the characters quoted. The province Ise is on the East coast of the main island. The locality is far north for a *Truncatella*.

HELICIDÆ.

Eulota mercatoria iejimana n. subsp.

Shell narrowly umbilicate, solid, compact, rich chestnut, paler near the suture and umbilicus, and with a chocolate-brown band at the periphery, with a whitish band above and below it. Surface somewhat shining, rib striate above, nearly smooth below. Spire convexly-conoid. Whorls about 6, convex, very slowly widening, the last rounded peripherally, very slightly descending in front; base convex. Aperture oblique, lunate. Peristome flesh-tinted or whitish, well reflexed, thickened within, arcuate throughout; in a basal view the basal margin is slightly arched forward.

Alt. 22, diam. 30 mm.

Alt. 20, diam. 29.5 mm.

Iejima, Ryukyu. Types No. 89,902, A. N. S. Phila., from No. 1,352 of Mr. Hirase's collection.

This peculiar little form differs from *Eulota mercatoria* by its more globose shape, more closely coiled whorls, wider peristome, etc. It resembles also *E. caliginosa*, but the base is more convex and the basal lip is arcuate. It might be considered a distinct species.

Eulota connivens iheyaensis n. subsp.

Shell differing from *E. c. phæogramma* by its strong thread-like ribstriæ both above and below.

Alt. 16, diam. 22 mm.

Alt. 15, diam. 21 mm.

Iheya-jima, Ryukyu. Types No. 89,873, A. N. S. Phila., from No. 1,353 of Mr. Hirase's collection.

Eulota (Plectotropis) **tokunovaga** n. sp.

Shell openly umbilicate, shaped much like *E. mackensii*, being low-conic above, convex beneath; *thin and light, almost fragile;* chestnut colored or sometimes pale dull green. Surface lusterless, irregularly marked with growth lines, and where unrubbed, bearing sparse linear adnate cuticular threads; peripheral fringe rather short and sparse in young shells, generally absent in adults. Under the dull outer coat the surface is *closely striate spirally*, both above and below. Whorls $6\frac{1}{2}$ to $6\frac{3}{4}$, slightly convex, the last not descending in front, strongly carinate peripherally, convex beneath. Aperture oblique, trapezoidal. Peristome thin, narrowly expanded, the basal and columellar margins narrowly reflexed. Parietal callus very thin.

Alt. 15, diam. 29 mm.

Alt. 14.7, diam. 28 mm.

Alt. 15, diam. 26.3 mm.

Alt. 12.7, diam. 25 mm.

Tokunoshima, Ōsumi. Types No. 87,501, A. N. S. Phila., from No. 1,211 of Mr. Hirase's collection.

This species, while related to *E. mackensii*. is smaller and much more delicate, almost to be called fragile. The cuticular processes are shorter; the surface when rubbed is seen to be closely and distinctly striate spirally, and the base is not so angular around the umbilicus. It is a much thinner, weaker shell than *E. vulgivaga*.

The *Ganesella largillierti* group consists of richly colored and beautiful snails, confined, so far as we know, to the Ōshima and Okinawa groups—the central islands of the Ryukyu chain. The following forms may be recognized:

I.—Surface with *extremely weak* spiral striæ or *none*,
G. largillierti ("Phil." Pfr.).

II.—Spiral striation minute but distinct.

a—Spire straightly pyramidal; altitude exceeding the diameter,
G. adelinæ Pils., Ōshima.

*a*¹—Spire obtuse; diam. exceeding the alt.,
G. sororcula Pils., and varieties.

b.—Spire conoidal; columella nearly vertical; diam. about 2 mm. greater than the alt.,
G. sororcula, typical; Kikai.

*b*².—Spire lower; columella more sloping; 21 x 26 to 17 x 21 mm., *G. s. tokunoshimana* P. and H., Tokunoshima and Ōshima.

*b*³.—Still more depressed, columella oblique; size about 21 x 28 mm., *G. s. okinoerabuensis* P. and H., Okinoerabushima.

*b*⁴.—Like typical *sororcula*, but with less conic spire and nearly closed umbilicus,
G. s. iheyaensis P. and H., Iheyajima.

Ganesella sororcula okinoerabuensis n. subsp.

Narrowly umbilicate, broad and low-conic, light yellow with a broad purplish-brown band immediately above and another a short distance below the periphery. Spire bicolored, the lower half of the penultimate whorl purple-brown, the upper half yellow; on the next earlier whorl purple replaces the yellow; and the upper two whorls are dark purple-brown. The surface is finely striate spirally.

Alt. 22, diam. 28 to 28.5 mm.; whorls 5½.

Okinoerabushima, Ōsumi. Types No. 89,996, A. N. S. Phila., from No. 1,337 of Mr. Hirase's collection.

Ganesella sororcula iheyaensis n. subsp.

Shell globose-trochiform, minutely obliquely perforate, pale yellowish (or white when denuded of the thin cuticle) with three red-brown bands, one at the periphery, one above and one below it, the latter sometimes concrescent with the peripheral; there is also a dark subsutural line, and a small umbilical dark area. Spire convex-conic with obtuse apex; whorls $5\frac{1}{2}$, the last angular peripherally. Basal lip thickened within.

Alt. 19.5, diam. 22 mm.

Alt. 18.5, diam. 21.3 mm.

Iheyajima, Ryukyu. Types No. 89,981, A. N. S. Phila., from No. 1,355 of Mr. Hirase's collection.

Moellendorffia eucharistus (Pils.).

Originally described as a *Chloritis*, but the cord across the parietal wall, the shape of the aperture, and the vestigial sulci behind the lip in some specimens, show that the species belongs to the subgenus *Trihelix* of the genus *Moellendorffia*.

Moellendorffia eucharistus tokunoensis n. subsp.

Shell larger than *eucharistus*, the spire and last whorl wider, whorls less convex above; color darker, chocolate brown. Whorls $4\frac{3}{4}$, the first very glossy and smooth.

Alt. 11, diam. 23.7 mm.

Alt. 10.5, diam. 22 mm.

Tokunoshina, Ōsumi. Types No. 90,048, A. N. S. Phila., from No. 1,207 of Mr. Hirase's collection.

Moellendorffia eucharistus diminuta n. subsp.

Shell smaller than *eucharistus*, with more deeply sunken and narrower spire; whorls $4\frac{1}{2}$, more convex above than in *eucharistus*. There is a slight indentation or flattening above the periphery behind the aperture, and an oblique excavation behind the columellar lip, in the positions of the pits in *Trihelix*, and evidently homologous with them.

Alt. 7.2, diam. 13.8 mm.

Alt. 6.3, diam. 12.8 mm.

Koniya, Ōshima, Ōsumi. Types No. 90,049, A. N. S. Phila., from No. 354*a* of Mr. Hirase's collection.

Pupisona japonicum depressum n. subsp.

Shell similar to *P. japonicum*, but decidedly more depressed.

Alt. 1.1, diam. 1.3 mm.

Mikage, Settsu. Types No. 89,993, A. N. S. Phila., from No. 1,321 of Mr. Hirase's collection.

ZONITIDÆ.

The *Zonitidæ* of the Ogasawara or Bonin Islands, exclusive of *Hirasea* and related forms, may be determined by the following key. The generic relations of part of the forms are uncertain, since we as yet know little of the extent to which convergent evolution has moulded shell-form in this family.

I.—Shell elevated, trochiform, as high as wide, 5 x 5 mm.; whorls $7\frac{1}{2}$, the last strongly angular,. . . . *Kaliella ogasawarana* Pils.
II.—Shell depressed, the spire convex or low-conic.
  a.—Columella thin, reflexed.
    b.—Very glossy and densely striate spirally above and below; periphery not carinate, obtusely subangular.
      c.—Shell narrowly, obliquely perforate; 3 x 4.5 mm., *Macrochlamys chaunax.*
      c^2.—Shell narrowly umbilicate; 2 x 3.2 mm., *Macrochlamys lineatus.*
    b^1.—Periphery strongly carinate.
      c.—Surface dull, minutely, irregularly granulate, *Otesia chichijimana.*
      c^1.—Surface glossy, obliquely wrinkled and spirally, striate,. . . . . *O. hahajimana.*
  a^1.—Columella calloused within, with a low tooth or nodule. Spiral striæ wanting or excessively faint, *Microcystina.*
    b.—Periphery rounded, or very weakly subangular in front; surface very glossy.
      c.—Outer lip thin; whorls 5; about 4 x 6.5 mm., *Microcystina hahajimana* Pils., 1902.
      c^1.—Outer lip thin; whorls about $4\frac{3}{4}$; smaller, about 2.9 x 5 mm.,. . . . . *M. hahajimana jejuna.*
      c^2.—Outer lip thickened within; whorls $4\frac{1}{2}$; 2.8 x 5 mm., *M. hahajimana pachychilus.*
      c^3.—Outer lip thin; spire quite convex; aperture a narrower crescent; whorls $4\frac{1}{2}$; about 2.7 x 4 mm., *M. hahajimana kitaiwojimana.*
    b^1.—Periphery with an inconspicuous but rather acute angle in front, elsewhere rounded; whorls $4\frac{1}{3}$; 2.2 x 4 mm., *M. anijimana.*

Microcystina hahajimana Pils.

This species was described in 1902 from specimens from Hahajima Ogasawara, the types being 82,606, A. N. S. Phila., No. 803 of Mr. Hirase's collection. It seems to be a typical *Microcystina*, having a calloused, obtusely nodular columella, and a glossy surface which is not spirally engraved. Numerous closely related forms have subsequently been received from various islands, as follows:

M. hahajimana jejuna n. subsp.

Smaller than *hahajimana* and typically with the spire distinctly lower, though still quite convex. There is a fraction of a whorl less.

Alt. 2.8, diam. 5 mm.

Imotojima. Types No. 84,955, A. N. S. Phila., from No. 803*e* of Mr. Hirase's collection.

Similar specimens, but with the spire a little higher, more like typical *M. hahajimana*, were taken on Nakanoshima (803*c* of Mr. Hirase's collection), the largest measuring alt. 3.3, diam. 5.2 mm. The spire is about as high as in typical *hahajimana*. Others came from Anijima (No. 803*a* of Mr. Hirase's collection), 3 x 5 mm.; and another lot, of the same size, from Anejima (803*d*).

M. hahajimana kitaiwojimana n. subsp.

Smaller than any of the preceding, with the spire elevated as in typical *M. hahajimana*. Aperture more narrowly crescentic. Whorls 4½.

Alt. 2.7, diam. 4 mm.

Kita-iwo-jima, Ogasawara. Types No. 89,867, A. N. S. Phila., from No. 803*f* of Mr. Hirase's collection.

M. hahajimana pachychilus n. subsp.

Similar to typical *M. h. jejuna* in shape, the spire being more depressed than in *M. hahajimana;* outer and basal margins of the peristome *distinctly thickened within.* Whorls 4½.

Alt. 2.8, diam. 5 mm.

Mukojima, an islet near Hahajima. Types No. 84,949, A. N. S. Phila., from No. 803*b* of Mr. Hirase's collection.

Microcystina anijimana n. sp.

Shell minutely perforate, depressed, convex above and below, thin pale brown, somewhat transparent. Surface smooth, with no trace of spiral striæ. Whorls nearly 4½, but slightly convex, the suture linear, with a narrow transparent margin below; last whorl rather acutely angular in front of the aperture, elsewhere rounded. Base convex, impressed around the perforation. Aperture slightly oblique, crescentic, the outer and basal margins thin, columellar margin slightly thickened within, with a very weak, low median nodule.

Alt. 2.2, diam. 4 mm.

Anijima, Ogasawara. Types No. 83,298, A. N. S. Phila., from No. 803*a* of Mr. Hirase's collection.

Readily distinguished from the smaller forms of *M. h. jejuna* by the angulation of the periphery in front. A single specimen of apparently the same form was sent from Nakanojima. It differs from *Macrochlamys lineata* by the smooth surface, without spiral striation.

Macrochlamys lineatus n. sp.

Shell narrowly umbilicate, depressed, convex above and below, thin, amber colored, glossy; closely and rather deeply striate spirally above and below. Whorls $4\frac{1}{3}$, hardly convex, the last weakly and obtusely subangular peripherally, convex below. Aperture but slightly convex, lunate, the lip thin and fragile; columellar margin thin, triangularly reflexed at the insertion.

Alt. 2, diam. 3.2 mm.

Nakanoshima, Ogasawara. Types No. 86,489 and 89,868, A. N. S. Phila., from No. 1,177 of Mr. Hirase's collection.

A very much smaller and more depressed shell than *M. chaunax*, and differing from other Ogasawaran *Zonitidæ* by its spiral sculpture.

Otesia chichijimana n. sp.

Shell obliquely perforate, low-conic above, convex below, acutely carinate at the periphery; thin, brown, not glossy, but with a dull silken luster. Sculpture of irregular growth-wrinkles and a very fine, close irregular granulation. Spire low-conic, with convex outlines and an obtuse apex. Whorls $4\frac{3}{4}$, but slightly convex, the last two with a shallow furrow above the keel. Base convex, impressed at the axis, paler in the middle. Aperture oblique, the lip thin, subangular at the termination of the keel, basal margin narrowly dilated and reflexed above.

Alt. 3.2, diam. 5.5 mm.

Chichijima, Ogasawara. Types No. 83,223, A. N. S. Phila., from No. 865*c* of Mr. Hirase's collection.

Otesia hahajimana n. sp.

Shell obliquely perforate, conoid-convex above, convex beneath, carinate at the periphery, thin, amber-brown, glossy. Sculpture of strong irregular growth-wrinkles and striæ, stronger and more conspicuous above, and comparatively coarse spiral striæ. Spire low conoid with convex outlines. Whorls 5, slightly convex, the last a little impressed above the keel, the base convex, impressed at the axis. Aperture oblique, the lips thin, basal margin deeply arcuate, columella dilated and reflexed at the insertion.

Alt. 4, diam. 5.3 mm.

Hahajima, Ogasawara. Types No. 83,234, A. N. S. Phila., from No. 865*b* of Mr. Hirase's collection.

This species resembles *O. chichijimana* in shape, but differs in the glossy and spirally striate surface, the sculpture of the two species being quite different.

Trochomorpha cultrata iheyaensis n. subsp.

Shell much larger than *cultrata,* of a very pale brownish-buff tint, granulation excessively minute; umbilical keel strong.

Alt. 8.7, diam. 24.3 mm.; diam. umbilicus (measured from its bounding keel) 9.7 mm. Whorls 7.

Iheyajima, Ryukyu. Types No. 89,932, A. N. S. Phila., from No. 631*c* of Mr. Hirase's collection.

Trochomorpha cultrata oshimana n. subsp.

Shell smaller than *cultrata,* chestnut brown, not perceptibly granulose; strongly angular around the umbilicus but not keeled. Whorls more numerous, 7 or 7¼, *slightly projecting above the sutures,* the last acutely carinate.

Alt. 5.2, diam. 15 mm.; diam. of umbilicus (measured from the bounding angle) 5.6 mm.

Ōshima, Ōsumi. Types No. 89,936, A. N. S. Phila., from No. 1,334 of Mr. Hirase's collection.

Ten specimens of this very distinct race were taken.

Macrochlamys kumeensis n. sp.

Shell perforate, depressed, thin, brown, somewhat glossy, weakly striatulate, without spiral striæ. Spire low conoidal. Whorls 5, convex, slowly increasing, the last much wider, rounded peripherally, convex beneath, impressed around the axis. Aperture slightly oblique, lunate; columella oblique, strengthened with a slight callus inside.

Alt. 3.8, diam. 6 mm.

Kumejima, Ryukyu. Types No. 90,250, A. N. S. Phila., from No. 1,357 of Mr. Hirase's collection.

Only six specimens of this species were taken. It is a compact little snail, with low growth-wrinkles but no spiral striæ.

Microcystina acuta n. sp.

Shell low-conic, resembling *M. ceratodes* in general shape; minutely perforate, thin, brownish-yellow, very glossy, sculptured with low growth-wrinkles only. Spire convexly conic with obtuse apex. Whorls 5½; convex, slowly increasing, parted by an impressed suture, very narrowly margined above. Last whorl acutely carinate, the keel narrow, becoming weaker on the latter part of the whorl. Base convex. Aperture lunate, the columella thickened with a white callus, abruptly dilated at the insertion, half covering the perforation.

Alt. 4.6, diam. 6 mm.

Ichikimura, Satsuma. Types No. 90,076, A. N. S. Phila., from No. 1,325 of Mr. Hirase's collection.

This species resembles *Microcystina ceratodes* (Gude) in shape. It is a much larger form, with the keel weak or subobsolete just behind the lip.

Microcystina hakonensis n. sp.

Shell minutely perforate, low-conic above, convex below, the periphery angular, becoming rounded near the aperture. Surface glossy, rather weakly, distantly striatulate above, smooth below. Whorls $5\frac{1}{2}$, convex, with well impressed suture, the last angular in front, becoming rounded on the last third. Base convex, impressed in the middle. Aperture lunate. Peristome thin, the columella reflexed above, internally a little irregular, but not distinctly thickened.

Alt. 4, diam. 6 mm.

Hakone, Sagami. Types No. 90,221, A. N. S. Phila., from No. 1,315 of Mr. Hirase's collection.

This form, of which but 8 specimens have been received, differs from *Kaliella gudei* by the angular, not acutely carinate periphery. It has no vertical striation or spiral lines.

Microcystina edgariana n. sp.

Shell minutely perforate, with convexly low-conic spire and convex base, the periphery obsoletely angular in front; yellowish, somewhat transparent, very glossy. Surface irregularly, weakly marked with growth-wrinkles, but without spiral striation. Whorls $5\frac{1}{2}$, convex, slowly increasing, parted by a well-impressed suture, the last indistinctly angular in front, its later half rounded peripherally. Aperture lunate. Columellar lip narrowly reflexed above, sloping, thickened within.

Alt. 3.6, diam. 5 mm.

Ikejijima, Ōsumi. Types No. 90,219, A. N. S. Phila., from No. 1,327 of Mr. Hirase's collection.

This species stands near *M. vaga* P. and H., but it is more depressed, larger, with a half whorl less. It resembles *Macrochlamys* (?) *gudei* in color, texture and form, but that is a very much larger species. Only seven specimens of *M. edgariana* were taken. Named in honor of Mr. Edgar A. Smith.

Microcystina kumejimana n. sp.

Shell minutely perforate, with low conoid spire, rounded periphery and convex base; thin, yellowish, somewhat translucent and brilliantly glossy. Surface showing rather coarse radial grooves, irregularly spaced above, the base delicately engraved with very minute spiral lines. Apex obtuse, whorls $4\frac{1}{2}$, slightly convex, a little impressed below the suture. Aperture lunate, the columellar margin dilated above, thickened within.

Alt. 2.25, diam. 3.8 mm.

Kumejima, Ryukyu. Types No. 90,222, A. N. S. Phila., from No. 1,358 of Mr. Hirase's collection.

Much larger than *M. sinapidium* or *M. radiata*, which seem to be the most closely related species.

Microcystina hokkaidonis n. sp.

Shell minutely perforate, depressed, with low, conically convex upper surface, convex base, and rounded periphery; yellowish, somewhat transparent, thin and glossy. Surface marked with very slight growth lines; under a strong magnification showing a weak very fine radial striation, in places, on the spire. Whorls $4\frac{1}{2}$, moderately convex; suture well impressed; aperture rather broadly lunate, oblique, the columellar margin reflexed close to its insertion scarcely thickened within.

Alt. 3.5, diam. 5 mm.

Kayabe, Ojima. Types No. 87,925, A. N. S. Phila., from No. 1,043 of Mr. Hirase's collection.

The second whorl, and sometimes several others, have a sculpture recalling *Kaliella*, but excessively minute.

Kaliella lioconus n. sp.

Shell minutely perforate, trochiform, the spire conic, base convex, periphery acutely angular, becoming rounded at the lip; base convex; thin, yellow, somewhat transparent and very glossy. Sculpture of irregular rather close but not very strong wrinkles of growth. Spire low-conic with straight lateral outlines and obtuse apex. Whorls $5\frac{1}{2}$, convex, separated by an impressed suture. The first half whorl is smooth, the next whorl finely striate vertically, the rest with growth-wrinkles as described above, the last whorl very acutely angular in front, the angle disappearing gradually on the last third, leaving it rounded near the outer lip in full-grown shells. Aperture lunate-truncate. Columella vertical, the margin triangularly dilated near the insertion.

Alt. 4, diam. 5 mm.

Yutagawa, Uzen. Types No. 90,226, A. N. S. Phila., from No. 1,313 of Mr. Hirase's collection.

This species is closely related to *K. okinoshimana*, but that is acutely *carinate* throughout. It differs from *K. ceratodes* in the sculpture of the early whorls as well as by the less developed peripheral keel.

K. lioconus goniozona n. subsp.

This form of the species is smaller, alt. 3.6, diam. 4.1 mm., a trifle higher in proportion, with 6 whorls.

Amagisan, Izu. Types No. 90,227, A. N. S. Phila., from No. 1,314 of Mr. Hirase's collection.

About a dozen specimens were taken.

Kaliella affinis n. sp.

Shell minutely perforate, low-trochiform, thin, yellowish-corneous, subtranslucent. Surface glossy, the base smooth, upper surface faintly striolate vertically, especially the earlier whorls. Spire conic, the apex obtuse, lateral outlines a trifle convex, nearly straight. Whorls $5\frac{1}{2}$, very convex, the last with a narrow, acute peripheral keel. Aperture truncate-lunate, the columellar margin dilated above, slightly thickened within.

Alt. 2, diam. 2.6 mm.

Harutori and Akkeshi, Kushiro. Cotypes No. 90,228 and 90,229, A. N. S. Phila., from No. 1,145 and 1,145*a* of Mr. Hirase's collection.

This specimen is more depressed than *K. harimensis*, and more carinate. *K. hachijoensis* has not the faint vertical striation of *affinis*. In shape it is much like the larger *K. humiliconus*. *Microcystina higashiyamana* differs by its glossy upper surface, without vertical striation.

Kaliella crenulata basistriata n. subsp.

Shell similar to *K. crenulata* but larger, with the base radially thread-striate like the upper surface.

Alt. 4.2, diam. 4 mm., whorls 7.

Alt. 3.7, diam. 3.3 mm., whorls $6\frac{1}{2}$.

Yakushima, Ōsumi. Types No. 87,934, A. N. S. Phila., from No. 1,283 of Mr. Hirase's collection.

In *K. crenulata* the base is smooth, and that species has not been found in Kyushu or southward up to this time.

ENDODONTIDÆ.

Punctum boreale n. sp.

Shell depressed, umbilicate, dark brown, thin, dull; whorls $3\frac{1}{2}$, the first $1\frac{1}{2}$ smooth, the rest with oblique, coarse, widely, irregularly spaced wrinkle-like ribs, the intervals and ribs finely striate spirally. Whorls convex, the last rounded peripherally and below. Umbilicus somewhat smaller than the aperture. Aperture oblique, rounded, about one-fourth of the circle excised at the parietal margin.

Alt. 1, diam. 2.1 mm.; width of umbilicus 0.6, of aperture 1 mm.

Akkeshi, Kushiro. Types No. 90,230 A. N. S. Phila. from No. 1,309 of Mr. Hirase's collection.

This species differs from *P. amblygona* Reinh. by its rounded periphery. It is also related to the southern *P. rota.*

PUPILLIDÆ.

Vertigo hirasei kushiroensis n. subsp.

Differs from *V. hirasei* Pils. by being larger, more solid, brown, with a strong pale ridge or crest a short distance behind the outer lip. It is not as wide and swollen as *V. h. hachijoensis*. The typical four teeth are developed.

Length 1.8, diam. 1 mm.

Akkeshi, Kushiro. Types No. 90,223, A. N. S. Phila., from No. 1,310 of Mr. Hirase's collection.

Vertigo hirasei in some of its varieties will probably be found throughout Japan, since the type came from Kyushu, while the form described above is from northern Yesso, and another subspecies occurs in the islands of Izu.

ACHATINELLIDÆ.

Tornatellina ruouana n. sp.

Shell imperforate, ovate-conic, thin, pale brown, lightly striatulate, glossy. Spire conic; whorls 4½, convex. Aperture oblique, ovate. Outer lip thin and simple. Columella convex and somewhat callous above; parietal lamella well developed, long.

Alt. 3.3, diam. 1.9 mm.

Kerama-jima, Ryukyu. Types No. 89,891, A. N. S. Phila., from No. 1,360 of Mr. Hirase's collection.

This is a wider shell than *T. triplicata*, and the young do not have internal varices or a triplicate columella. It is the first imperforate *Tornatellina* found in the Ryukyu Islands.

AURICULIDÆ.

Cassidula labrella japonica n. subsp.

Shell imperforate, oval with conic spire, solid, dark brown. The whorls of the spire have a groove defining a rather wide subsutural border, and rarely several weak spirals below it. The last whorl is very finely striate spirally, the most strongly sculptured specimens with some deeper, punctate striæ among the others; *all the striæ being very weak* or even obsolete. Whorls $7\frac{1}{2}$ to 8, nearly flat. Some inconspicuous, slightly paler variceal streaks are visible on the spire. The last whorl has a narrow and often very low crest close behind the outer lip, and the usual keel or cord at the base, defining a small umbilical area. Aperture including peristome seven-twelfths the length of the shell, regularly ovate, slightly oblique. Peristome nearly white; outer lip with a strong internal callus, excised above as usual, and either even-edged or weakly two-toothed near the upper end. Inner lip with three folds, the lower two entering, not emerging to the lip-edge, the upper parietal fold small and tubercular, not longitudinal, sometimes wanting.

Length 13, diam. 7.3 mm., length aperture 8 mm.

Length 12, diam. 6.9 mm., length aperture 7.4 mm.

Nishigo, Uzen. Types No. 78,767, A. N. S. Phila., from No. 407 of Mr. Hirase's marine shell collection.

C. labrella, described from the Isle of France, is a more strongly striate shell with larger aperture. The present form is almost smooth, the striæ scarcely being discernible in most specimens. *C. plecotrematoides* Mlldff. is more strongly striate, with the upper parietal tooth and the two on the lip-callus better developed.

I am disposed to consider both the Japanese form described above and the Chinese *C. plecotrematoides* as subspecies of *C. labrella*; but if the Chinese form be separated specifically, then *C. l. japonica* will be referred to it as a subspecies.

Cassidula paludosa nigrobrunnea n. subsp.

Similar to *C. paludosa* Garrett, but the parietal denticle is better developed than usual in that species; the color is deep chocolate brown, with a blackish line below the suture.

Length 10, diam. 6 mm.; length of aperture 6.3 mm.

Length 9, diam. 5.2 mm.

Length 7.2, diam. 5 mm.

Kunchan, Ryukyu. Types No. 89,973, A. N. S. Phila., from No. 1,345 of Mr. Hirase's collection.

This little *Cassidula* has the egg-like shape and high lip-crest of the Vitian *C. paludosa*, of which the types are before me; but that is, so far as known, invariably yellow or light brown in color.

CATALOGUE OF THE LAND AND FRESH-WATER MOLLUSCA OF TAIWAN (FORMOSA), WITH DESCRIPTIONS OF NEW SPECIES.

BY HENRY A. PILSBRY AND Y. HIRASE.

Early in the present year Mr. Okura, collecting for Mr. Hirase, proceeded to Taiwan (Formosa), with instructions to confine his attention chiefly to collecting land shells. He succeeded in getting a large number of species, but many of them only in small quantity, so that the expedition, while laborious and expensive, was hardly productive of so large a supply of specimens as anticipated. The number of species taken (71) was, however, greater than any previous naturalist has obtained, and adds largely to our knowledge of the distribution of known species, besides augmenting the total number of land snails known by the discovery of some 27 new species and 13 subspecies.

The number of species taken is so considerable that it has been thought useful to add the names of all previously known Formosan snails, making the list complete for the island.

Our first knowledge of Formosan land and fresh-water shells was from specimens collected by H. B. M. Vice-Consul Robert Swinhoe, who, though chiefly interested in the higher Vertebrates, accomplished a vast amount of work on invertebrate groups as well. His first sending of land shells to Hugh Cuming, in London, was worked up by Dr. Pfeiffer,[1] the marine and fresh-water forms being identified by H. Adams and Cuming himself, and the list published by Frazer.[2] Subsequent sendings were described by Henry Adams.[3]

Few if any additions were made to the list of land snails until the

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[1] Descriptions of thirteen new species of land-shells from Formosa, in the collection of the late Hugh Cuming, collected by Mr. Robert Swinhoe, Vice-Consul of that island. By Dr. Louis Pfeiffer. *P. Z. S.*, 1865, pp. 828–831, pl. 46.

No localities are given for the species described in this paper, but we know from a letter from Swinhoe published in *P. Z. S.*, for 1864 that these shells were chiefly from Tamsui in northern Formosa, a few from Takow in the south.

[2] List of species of mollusks recently collected by Mr. R. Swinhoe in Formosa, etc. *P. Z. S.*, 1865, pp. 196, 197.

List of species of mollusks recently collected by Robert Swinhoe, Esq., H. B. M. Vice-Consul, C. M. Z. S., in Formosa. *Proc. Zool. Soc. Lond.*, 1866, p. 146.

[3] Description of fifteen new species of land and fresh-water shells from Formosa, collected by Robert Swinhoe, Esq., Consul at Taiwan in that island. *Proc. Zool Soc.*, 1866, pp. 316–319, pl. 33.

Descriptions of ten new species of land and fresh-water shells collected by Robert Swinhoe, Esq., in China and Formosa. *P. Z. S.*, 1870, pp. 377–379, pl. 27.

end of the next decade, when Surgeon-General R. Hungerford, Ritter von Fries and a few other naturalists visited the island. Their collections were worked up chiefly by Dr. O. von Möllendorff, who published the results in his enlightening series of papers upon the Chinese snail fauna.[4] Meantime the *Melaniidæ* collected by Mr. Dickson had been described by Mr. E. A. Smith.[5] After von Möllendorff's departure for Manila the field was left to Mr. B. Schmacker, then of Hongkong, whose material was obtained in part from several German friends who travelled in Formosa, but largely by his Japanese collector who spent over three months there in the latter part of 1889. The materials gathered were ably worked up by Schmacker and Boettger.[6] From 1891 until this time, only a few inconsiderable additions have been made to the list of Formosan mollusks. The data for the principal papers may be tabulated thus:

Authors.	*Described as new* *Species.*	*Subspecies.*	*No. of species recorded, based on new material.*
Pfeiffer, 1865	13		13
H. Adams, 1866, '70	18		18
Moellendorff	6	2	23
Schmacker and Boettger, 1890–'91	13	7	57
Pilsbry and Hirase	29	13	80

The total number of land shells now known from Formosa is 127 species and 17 subspecies; of fresh-water shells 26 species. References to literature have in most cases been restricted to original descriptions and citations pertaining specially to Formosa. In the case of well-known species ranging also outside of the island, references not dealing with Formosa have been omitted.

[4] Materialien zur Fauna von China. *Jahrbücher der Deutschen Malakozoologischen Gesellschaft,* IX (1882), X (1883), XI (1884), etc.

[5] Descriptions of five new shells from the island of Formosa and the Persian Gulf, and notes upon a few known species. *P. Z. S.*, 1878, pp. 728–733, pl. 46.

[6] Neue Materialien zur Characteristik und geographischen Verbreitung chinesischer und japanischer Binnenmollusken. I. *Nachrichtsblatt der deutschen Malakozoologischen Gesellschaft,* Jahrg. XXII, 1890, pp. 113–137; II, Jahrg. XXIII, 1891, pp. 145–194, pls. 1, 2.

CYCLOPHORIDÆ.

Cyclophorus turgidus Pfr.

Hotawa (Hirase). Has also been reported by E. A. Smith from Formosa, without exact locality, *P. Z. S.*, 1887, p. 318. The specimens taken by Mr. Okura are quite typical. It is a common Ryukyuan species.

Cyclophorus formosaensis Nevill.

J. A. S. Bengal, 1881, p. 148, based upon *C. exaltatus* var. Pfr., Novit. Conch., II, pl. 68, figs. 14, 15.
C. formosensis Nev., Mlldff., Jahrb. d. m. Ges., IX, 1882, p. 277.

Keelung and Takohan (Hungerford). Suganiikei (Hirase). This is probably to be regarded as a variety of *C. turgidus*. The specimens taken by Mr. Okura are not quite elevated enough to be typical.

Mr. E. A. Smith incidentally reports *C. exaltatus* from Formosa (*P. Z. S.*, 1887, 318). It is a well-known Hongkong species, and in view of the excessively critical nature of the species of *Cyclophorus* of the Sino-insular group, the specimens referred by Smith to *exaltatus* may belong to *C. formosaensis*. Some forms given the rank of species in the *exaltatus* group by von Moellendorff and others are distinguished by only slight and elusive characters.

Cyclophorus indicus Desh. is reported from Formosa by H. Adams, *P. Z. S.*, 1866, p. 146.

Cyclophorus moellendorffi Schm. and Bttg.

Nachrbl. d. m. Ges., 1891, p. 191, pl. 2, fig. 9.

South Cape of Formosa, in the mountains (Schmacker). Carinate, with relatively small aperture.

C. m. humicola Schm. and Bttg.

Nachrbl., 1891, p. 193.

South Cape, at the foot of the mountains (Schmacker). There was a transposition of pages 192 and 193 in the *Nachrichtsblatt* which creates some confusion with this form until understood.

Cyclophorus friesianus Mlldff.

Jahrb. d. m. Ges., 1883, p. 286.——S. and B., Nachrbl. d. m. Ges., 1891, p. 191.

Lakuli (Fries); Bankimtsong and Bagsa. Distinguished by having numerous small carinæ above and below the peripheral keel.

Japonia zebra n. sp.

Shell umbilicate, conic-turbinate, pale yellowish-corneous with numerous red-brown longitudinal stripes, waved below the periphery, and about as wide as the light intervals. Surface glossy, with sculpture of numerous spiral threads separated by rather wide intervals, and most of them bearing rather long, delicate hairs. There are about ten of these hair-bearing threads on the last whorl. Spire straightly conic. Whorls 4½, very convex. Aperture slightly oblique, subcircular, the peristome simple, the ends connected by a short, very thin parietal callus.

Alt. 5, diam. 5 mm.; diam. aperture 2.3 mm.

Taihoku, Taiwan. Type No. 90,240 A. N. S. Phila., from No. 1,389 of Mr. Hirase's collection.

The handsome coloration and numerous spiral series of hairs are the more conspicous features of this pretty *Japonia,* of which but two specimens were taken.

Japonia formosana n. sp.

Shell umbilicate, turbinate-conic, with rather slender spire, the outlines concave. Dark red-brown or rather light olive colored. Surface but slightly shining, striatulate, with a number of low, irregularly spaced spiral cords or threads, often in part indistinct, and when fresh with irregularly spaced cuticular lamellæ along the lines of growth. There are two or three series of sparse hairs, readily deciduous, on the last whorl. Whorls 5, very convex. Aperture circular, subvertical, the peristome simple, ends connected by a very short parietal callus.

Alt. 5, diam. 5 mm.

Hotawa, Taiwan. Types No. 90,238 A. N. S. Phila., from No. 1,407 of Mr. Hirase's collection.

Only five specimens were taken. The cuticular lamellæ and hairs are sometimes entirely lost, perhaps always in old shells. Of the two specimens in the type lot, they are developed on the dark red-brown specimens which may be regarded as typical, and absent from the pale greenish one.

Leptopoma vitreum taivanum Mlldff.

Leptopoma taivanum Mlldff., Jahrb. d. m. Ges., X, p. 287, pl. 10, fig 4.—— S. and B., Nachrbl., 1890, p. 125.
L. vitreum var. *lactea* Kob., S. and B., Nachrbl. d. m. Ges., 1891, 190.

Lakuli, near Takao (Fries); South Cape (Lauts); Bankimtsong and Bagsa (Schmacker). Also taken in Formosa by Prof. Steere.

Cyclotus taivanus H. Ad.

P. Z. S., 1870, p. 378, pl. 27, fig. 11.——Mlldff., Jahrb. d. m. Ges., X, 1883, p. 283.——Schm. and Bttg., Nachrbl., 1891, 192.

Taiwan (Swinhoe); Lakuli, near Takao (von Fries); Inrin, Tapanii and Ensuikō (Hirase); Bankimtsong (Schmacker).

Cyclotus taivanus adamsi n. subsp.

Shell similar to *C. taivanus,* but uniform yellow or tawny-yellow, more elevated, with the umbilicus narrower. Taihoku.

Alt. 10, diam. 14, aperture 6.9 x 6.5 mm., umbilicus 3.1 mm. wide.

Alt. 9.9, diam. 14.2, aperture 6.9 x 6.5 mm., umbilicus 3.2 mm. wide.

Cyclotus swinhoei H. Ad.

P. Z. S., 1866, p. 318, pl. 33, fig. 9.

Takao (Swinhoe). Sculptured with raised spiral threads.

Alt. 7, diam. 11 mm.

Cyclotus swinhoei depressus n. subsp.

Shell similar to *C. swinhoei* but more depressed.

Alt. 6, diam. 11 mm., umbilicus 2.9 mm. wide; diam. and alt. aperture with peristome 4.9 mm.

Giiran. Type No. 89,915 A. N. S. Phila., from No. 1,372 of Mr. Hirase's collection.

Cyclotus minutus H. Ad.

P. Z. S., 1866, p. 318, pl. 33, fig. 9.——Schm. and Bttg., Nachrbl., 1891, p. 192 ??

Takao (Swinhoe); Takao and Bagsa (Schmacker).

The typical form was not found by Mr. Okura. Prof. Steere collected a large series some years ago, part of which are in our collections.

Cyclotus minutus concentratus n. subsp.

Shell reddish-brown or pale olive-green with a brown spire, closely sculptured with fine spiral threads (closer than in *C. minutus*) on a glossy ground, except for a band below the suture (both on the spire and within the umbilicus), which is covered with narrow whitish cuticular rays. Whorls $3\frac{3}{4}$, tubular, the last barely in contact at the mouth. Umbilicus much smaller than the aperture, and smaller than in *C. minutus*. Aperture but slightly oblique, circular, the peristome a little expanded, obtuse. Operculum concave, with dark gray central spot and obliquely striate whorls.

Alt. 5.3, diam. 7.9 mm.; width of umbilicus 2 mm.

Chikutozaki, Taiwan. Types No. 89,897 A. N. S. Phila., from No. 1,426 of Mr. Hirase's collection. Six specimens taken.

Cyathopoma taiwanicum n. sp.

Shell umbilicate, conic, corneous, somewhat translucent. Whorls $3\frac{1}{2}$, the first smooth, dark corneous, the rest spirally lirate, very convex, the penultimate with four or five thread-like spirals. Last whorl tubular, the threads weaker on its later part, much stronger around and in the umbilicus. Aperture circular, the peristome thin, simple, barely in contact with the preceding whorl. Operculum lodged at the aperture, white, concave externally, usually with a dark dot at the center.

Alt. 1.5, diam. 2 mm.

Giiran, Taiwan. Types No. 89,945 A. N. S. Phila., from No. 1,365*a* of Mr. Hirase's collection.

The genus *Cyathopoma* is not yet known from China. Its eastern limit has hitherto been the Khasi, Naga and South Garo Hills, where the species are like the Formosan in features of the operculum. It has not been found north of these places, nor eastward in the Dafla Hills, so that its known range heretofore has been sub-Himalayan and southward.

In this and other known Formosan and Japanese *Cyathopomas*, the shell has no fibrous vertically striated coating, such as is conspicuous in the Indian *C. filocinctum* and others. The whorls of the operculum have no projecting lamellæ. The species belong therefore to the subgenus *Jerdonia*, as defined by Kobelt (*Das Thierreich*, Cyclophoriden, p. 219). It is clear, however, that Kobelt ignores the character of the operculum in his distribution of the species of *Cyathopoma* and *Jerdonia*.

C. taiwanicum is not unlike *C. album* Bedd., but it has more spirals, and they are not so prominent in the umbilicus.

There is a form of *C. taiwanicum* from Chosokei which is a little more variable in sculpture than the type lot, sometimes having one or two more spiral threads.

Cyathopoma taiwanicum degeneratum n. subsp.

At Suganiikei, Taiwan, five specimens were taken which differ from *C. taiwanicum* by the degeneration of the spiral threads, which are very weak or even almost wanting on the last whorl. Types are No. 89,944 A. N. S. Phila., from No. 1,365*b* of Mr. Hirase's collection.

Cyathopoma micron (Pils.).

Cyclotus micron Pils., Nautilus, 1900, p. 12.

Taihoku (Hirase). Also found in the Ryukyu Islands and Japan.

Mr. Ancey has proposed a genus *Nakadiella* for *Cyclotus* (?) *micron;* but this species differs from typical forms of *Jerdonia* in nothing but the absence of spiral striation. There are a number of equally smooth species in Ceylon. *Nakadiella* may be retained as a sectional name for the smooth forms, if the distinction proves to be natural; otherwise it will become a synonym of *Jerdonia*.

Ptychopoma (?) wilsoni (Pfr.).

Pterocyclos wilsoni Pfr., P. Z. S., 1865, p. 831, pl. 46, fig. 12.
Ptychopoma w., Kobelt, Das Thierreich, Cyclophoriden, p. 85.

Formosa (Swinhoe). The operculum is still unknown, and the generic position therefore uncertain.

Pupinella swinhoei H. Ad.

P. Z. S., 1866, p. 318, pl. 32, fig. 12.——Schm. and Bttg., Nachrbl., 1891, p. 187, with var. *meridionalis*.
Pupina adamsi Sowb., Conch. Icon. XX, pl. 4, fig. 33.
Pupinopsis morrisonia H. Ad., P. Z. S., 1872, p. 13, pl. 3, fig. 21.

Tamsui (Swinhoe); Anshiryosan, Hotawa and Suganiikei (Hirase). This species varies a good deal in size and structure of the lip, but Schmacker and Boettger seem to be right in holding that all the described Formosan forms are but varying races of one species. The specimens from Hotawa are about typical, length 13 mm. Those from Anshiryosan seem referable to the race *morrisonia* H. Ad., described from Mt. Morrison. They are 10.5–11 mm. long, and have the upper funnel of the lip much smaller than in the type. At Suganiikei there is also a small form of about the same length.

The var. *meridionalis* S. and B. is distinguished by smaller size, length 9.5 to 11, width $4\frac{1}{4}$ to $4\frac{3}{4}$ mm. It is from Bankimtsong. The type of *P. morrisonia* is 12 x 5 mm., while the size of typical *P. swinhoei* is given as 14 x 5.5 mm.

Diplommatina hungerfordiana Nevill.

Jour. Asiat. Soc. Bengal, L, 1881, p. 150.——Mlldff., Jahrb., IX, 349.

Keelung (Hungerford) = Kiirun (Hirase). Dr. von Moellendorff considered this a variety of the Chinese *D. paxillus* Gredler; but its differential features seem constant.

Diplommatina taiwanica n. sp.

Shell imperforate, the lower half cylindric, upper half conic, light orange colored, darker toward the apex. Whorls $6\frac{1}{2}$, the first $4\frac{1}{2}$ regularly increasing, the next whorl larger, swollen, the last whorl much smaller, especially as seen in a dorsal view. First $1\frac{1}{2}$ whorls smooth, the next $3\frac{1}{2}$ sculptured with delicate thread-like riblets which become a little closer on the front of the swollen penultimate whorl, and then become more or less obsolete, so that the last whorl or whorl and a half are nearly or quite smooth. Constriction median above the aperture. Palatal plica short, partly under the parietal callus. Aperture vertical, irregularly rounded, the columellar margin straightened. Peristome well expanded and somewhat thickened, angular at the junction of the columellar and basal margins; parietal callus rather small, its border usually indistinct. Columellar tooth small.

Length 2.9, diam. 1.5 mm.

Giiran, Taiwan. Types No. 89,965 A. N. S. Phila., from No. 1,364*b* of Mr. Hirase's collection.

In *D. hungerfordiana* the cone of the spire is shorter. Another set of specimens from Giiran differs in having the last two whorls striate throughout, the striæ closer than on the conical upper portion of the spire. This may be only individual variation. Eleven of the entirely striate and fifteen of the typical specimens were taken.

Diplommatina taiwanica suganiikeiensis n. subsp.

Shell brownish corneous, more obese than *D. taiwanica;* last whorl more ascending to the aperture, and more deeply constricted; striation finer and nearly even throughout, very weak; palatal plica very short; basal angle more projecting.

Length 3, diam. 1.7 mm., whorls 5½.

Suganiikei, Taiwan. Types No. 89,966 A. N. S. Phila., from No. 1,364*c* of Mr. Hirase's collection.

This form seems rather unlike *D. taiwanica,* and unless intermediate specimens are found it will probably rank as a distinct species. Only nine individuals were taken.

Diplommatina camura n. sp.

Shell imperforate, cylindric below, conic above, pale orange or brownish-yellow. Whorls 6, the first 4 regularly increasing, the next whorl swollen, the last much smaller, especially as seen dorsally. First 1½ whorls smooth; following whorls of the cone sculptured with widely spaced thread-like riblets, penultimate whorl with the riblets much closer, last whorl smooth. Constriction rather deep, median above the mouth. Palatal plica very weak and short. Aperture vertical, irregularly rounded. Parietal callus moderate, with distinct edge. Peristome well expanded, thickened within, wide, projecting at the junction of the columellar and basal margins. Columellar lamella moderately prominent, very short inside.

Length 3, diam. 1.6 mm.

Hotawa, Taiwan. Types No. 90,243 A. N. S. Phila., from No. 1,424 of Mr. Hirase's collection.

This species differs from *D. taiwanica,* chiefly by its very small palatal plica and the very short columellar lamella, which in *taiwanica* ascends to the constriction. *D. tokunoshimana* differs from *camura* in sculpture and the well-developed palatal plica.

Diplommatina prava n. sp.

Shell cylindric below, conic above, imperforate, pale yellowish corneous, the upper whorls often orange tinted. Whorls 6½, regularly increasing to the penultimate, which is wider but not especially swollen; last whorl scarcely smaller, its last third making a long ascent to the aperture. Sculpture of weak rather close and very fine thread-like striæ. Constriction distinct, situated near or at the end of the penultimate whorl, behind the lip. Aperture irregularly rounded, the columellar side straight. Parietal callus small. Peristome expanded and thickened or duplicated, the outer lip, in profile, seen to be a little retracted or concave in the middle, projecting in a blunt point a short distance from the upper insertion; an angle outside at the junction of the columellar and basal margins.

Length 2.3, diam. 1.2 mm.

Giiran, Taiwan. Types No. 89,967 A. N. S. Phila., from No. 1,369 of Mr. Hirase's collection.

Smaller than any other known Formosan *Diplommatina,* and readily distinguished by the retrograde constriction, sinuous outer lip, etc. It resembles *D. luchuana* somewhat, but differs in the position of the constriction, stronger basal angle, less distinct parietal callus, etc. It occurred in some numbers (*pravus,* deformed).

Slightly smaller specimens were taken at Suganiikei. At Hotawa the sculpture is better developed.

Palaina formosana n. sp.

Shell sinistral, minute, pupiform, imperforate, yellow or pale brownish-yellow, sculptured with delicate, distant, thread-like very oblique riblets, about 7 in number on the last whorl, absent on the front of this whorl, and very weak on the penultimate whorl. Whorls 5, convex, the first three regularly and rapidly increasing, the penultimate very much swollen, predominating, the last whorl smaller, rapidly tapering to the base, slightly constricted immediately above the aperture. Suture well impressed, quite oblique. Aperture rounded, the peristome yellow, narrowly expanded, doubled in old shells; the margins continued in a callus with raised edge, spreading up above the aperture nearly to the preceding suture. Columellar tooth small, deeply placed.

Length 2, diam. 1.1 mm.

Hotawa, Taiwan. Types No. 89,969 A. N. S. Phila., from No. 1,413 of Mr. Hirase's collection.

This species belongs to the subgenus *Cylindropalaina.* It is the first of its kind known from Formosa. The Indian *Palaina gibberosa* Godwin-Austen (*Land and Fresh-water Mollusca of India,* II, p. 16, pl. 66, figs. 12*a–c*) is closely related, but differs in being much wider and more obese.

Pseudopomatias eos n. sp.

Shell perforate, turreted, regularly tapering to the obtuse apex, rather thin but strong, opaque greenish-corneous, with more or less brown on the last whorl and sometimes on the spire; glossy, sculptured throughout with strong, nearly straight ribs, except the first whorl, which appears to be smooth. Whorls 7, quite convex, the last rounded peripherally and below. Aperture circular, vertical, the peristome reflexed, thickened on the face, narrow where in contact with the preceding whorl. There is a small notch or groove at the junction of the outer and parietal margins of the peristome.

Length 8, diam. 3.1; length of aperture 2.1, width 2.1 mm., including peristome. Length 7.1, diam. 3 mm.

Hotawa, Taiwan. Types No. 89,917 A. N. S. Phila., from No. 1,416 of Mr. Hirase's collection.

This species stands close to *P. amœnus* Mlldff. of China. It is a little more slender than the Chinese species, the last whorl is quite regular in shape, and the umbilical slit is shorter. The genus is new to Formosa.

Alycæus (Dioryx) swinhoei H. Ad.

P. Z. S., 1866, p. 318, pl. 33, fig. 11.——Schm. and Bttg., Nachrbl., 1891, p. 189.

Takao (Swinhoe); Bagsa (Schmacker); Suganiikei and Sammaipo (Hirase).

Alycæus hungerfordianus G. Nevill.

Jour. Asiat. Soc. Beng., L, 1881, p. 149.——Mlldff., Jahrb., IX, p. 344, pl. 10, fig. 6.

Northern Formosa (Hungerford).

[*Alycæus mouhoti* Pfr. has been erroneously credited to Formosa by Sowerby, *Conch. Icon.*, XX, pl. 3, fig. 19.]

Alycæus varius n. sp.

Shell openly umbilicate, depressed, the spire very low, convex, apex projecting mucro-like; surface lusterless, ashen or dull reddish, rather obsoletely striate, the striæ stronger and crowded on the swollen part of the last whorl, thinner, more delicate and subobsolete on the neck. Whorls $3\frac{3}{4}$, the first corneous or reddish, the last swollen laterally, then strongly contracted, slightly enlarged and deeply deflexed beyond the contraction. Tube long. Aperture circular, oblique; peristome well expanded, thickened within, the columellar margin wider.

Alt. 2.5, diam. 4 mm.

Taihoku, Taiwan. Types No. 90,244 A. N. S. Phila., from No. 1,383 of Mr. Hirase's collection.

This species is related to *A. laevicervix*, but that has a smoother neck and a shorter sutural tube. The aperture is peculiarly turned inward.

Helicina hungerfordiana formosana Schm. and Bttg.

Nachrbl. d. m. Ges., 1891, p. 186.

Bankimtsong and Bagsa (Schmacker); Suganiikei (Okura).

We quite agree with Schmacker and Boettger as to the very close relationship of this to *H. hungerfordiana* of China. The Suganiikei specimens are a trifle less angular peripherally than Schmacker and Boettger's figure.

Helicina badia Schm. and Bttg.

Nachrbl., 1891, p. 185, pl. 2, fig. 8.

Takao and South Cape (Schmacker).

Helicina verecunda Gld.

Otia Conch., p. 105.

Sammaipo (Hirase). The specimens are typical. Also Ryukyu Islands.

Truncatella valida Pfr.

Schmacker and Boettger, Nachrbl., 1891, p. 194.

South Cape (Schmacker). Also in the Philippines, Malacca Peninsula and southward, and in the Ryukyu Islands.

HELICIDÆ.

[*Helix luhuana* Sowerby has been reported from Formosa, specimens identified by Cuming (*P. Z. S.*, 1865, p. 197, No. 84). We doubt its occurrence there. *Helix melanostoma* has been recorded from Formosa in a list of Swinhoe's shells, identified by Cuming. Mr. Gude has already remarked upon this anomalous record.]

Eulota (Aegista) subchinensis ('G. Nev.' Mlldff.).

Jahrb. d. m. Ges., XI, 1884, p. 355, pl. 7, fig. 8.

Tamsui (Hungerford); Taihoku (Hirase).

Eulota (Plectotropis) mackensii (A. and R.).

Zool. Samarang, Moll., p. 60, pl. 15, fig. 6.

Taihoku. Specimens practically typical though rather small, 27 to 30 mm. diam., and either rich chestnut or greenish-yellow in color. Also Ryukyu Islands.

Eulota (Plectotropis) mackensii formosa Pils.

Nautilus, XVI, 1902, p. 46.

Taihoku (Hirase); Tamsui (Schmacker).

Eulota (Plectotropis) impexa n. sp.

Shell very openly umbilicate, the umbilicus regularly conic; low conoid above, convex beneath; rather thin, pale clear brown. Sculpture of low oblique wrinkles along the lines of growth, and minute, very short cuticular adnate threads in places; the base densely but not very distinctly striate spirally. Peripheral filaments sparse and short. Whorls $6\frac{1}{2}$, slowly widening, the early ones convex, the later nearly flat; last whorl acutely carinate, the base angular around the umbilicus. Aperture very oblique, the lip narrowly expanded, basal margin narrowly reflexed, deeply arcuate; columellar margin dilated; parietal callus very thin.

Alt. 10, diam. 26.7 mm.

Anshiryozan, Taiwan. Types No. 89,984 A. N. S. Phila., from No. 1,433 of Mr. Hirase's collection.

A delicate and handsome *Plectotropis* of the *mackensii* group, with narrower spire and wider last whorl than *mackensii*, wide-spaced peripheral filaments, finer sculpture, and openly conic umbilicus.

Eulota fulvicans (H. Ad.).

P. Z. S., 1866, p. 316, pl. 33, fig. 2.

Tamsui (Swinhoe).

Eulota (Pleototropis) fulvicans browni n. subsp.

Shell low trochoidal, umbilicate, the umbilicus one-fifth the diameter of the shell; thin, pale brownish corneous. Surface dull, lusterless, densely beset with *very short, delicate, erect bristles*, in large part removed by wear from the upper surface. Spire conic, its lateral outlines a trifle convex. Whorls $6\frac{2}{3}$, slowly widening, the last very little descending in front, acutely carinate throughout, the base convex. Aperture very oblique, slightly angular outwardly. Peristome thin, expanded, the basal margin reflexed, columellar margin dilated, running forward.

Alt. 7.9, diam. 12.5 to 12.7 mm.

Formosa (Taiwan). Type No. 4,639 A. N. S. Phila., part of the A. D. Brown collection.

This form differs from *E. perplexa* in sculpture. It is not so high as *E. fulvicans* H. Ad., and the shape of the aperture differs. *E. fulvicans* is known to us by the description and figure only. *E. lautsi brachylasia* S. and B. is also related.

Eulota (Plectotropis) lautsi (Schm. and Bttg.).

Nachrbl. d. m. Ges., 1890, p. 4, pl. 1, fig. 1.

H. shermani var. *lautsi* S. and B., Nachrbl., 1891. p. 154.

South Cape (Lauts); Bankimtsong, Takao (Schmacker).

Eulota lautsi brachylasia (Schm. and Bttg.).

Nachrbl. d. m. Ges., 1891, p. 156.

Takao.

Eulota lautsi micra n. subsp.

General shape of *E. lautsi.* Pale brownish-corneous, unicolored or with a red-brown band on the acute peripheral keel. Smooth, showing faint striation under a lens, with nearly effaced scarcely visible spiral striæ on the dull upper surface, densely striate spirally on the base. Whorls fully six. Outer and basal margins of the peristome expanded, subreflexed; columellar margin very steeply ascending, dilated above.

Alt. 5.7, diam. 9.8 mm.; width of aperture 4.8, of umbilicus 1.8 mm.

Tapanii, Taiwan. Types No. 89,875 A. N. S. Phila., from No. 1,428 of Mr. Hirase's collection.

Compared with typical *lautsi,* this form differs in the small size, wider mouth as seen in front view, and narrower last whorl as seen from above, and it wants a white edge on the keel. A small form of *lautsi* has been recorded by Schmacker and Boettger from Takao.

The subordination of *lautsi* to *H. shermani* Pfr. in Schmacker and Boettger's second discussion of it was apparently an error, *H. shermani* being a *Trochomorpha.*

Eulota (Plectotropis) inrinensis n. sp.

The shell is depressed-trochiform, thin, umbilicate, the umbilicus narrow, less than one-fifth the diameter of the shell, rapidly contracting within; pale brownish-corneous, lusterless, lightly striatulate, and finely striate spirally, the spirals very delicate, scarcely visible above, more distinct below. Spire low-conic, with nearly straight outlines. Whorls $5\frac{1}{4}$ to $5\frac{1}{2}$, somewhat convex, the last acutely carinate at the periphery, convex below, slightly descending in front. Aperture quite oblique. Peristome thin, narrowly expanded, the basal margin deeply arcuate, reflexed, columellar margin dilated above.

Alt. 5, diam. 8.9 mm.; width of aperture 4 mm.

Alt. 5, diam. 8 mm.; width of aperture 3.8 mm.

Inrin, Taiwan. Types No. 89,872 A. N. S. Phila., from No.1, 393 of Mr. Hirase's collection.

Only four specimens of this little *Plectotropis* were taken. It is closely related to *E. lautsi micra,* yet differs by the more diminutive size, narrower umbilicus, less dilated columellar lip and paler color. It is decidedly more depressed than *E. hebes.*

Eulota (Plectotropis) hebes n. sp.

Shell trochiform, very thin, umbilicate, pale brown, but slightly shining, weakly striatulate, and showing very fine, weak spiral striæ beneath. Spire conic, the apex obtuse. Whorls $5\frac{1}{2}$, convex, the last strongly carinate at the periphery, the keel projecting but blunt at the edge, becoming weak near the aperture; slightly descending in front. Suture well impressed. Aperture oblique, broadly lunate, the peristome thin, narrowly expanded, the columellar margin dilated above; basal margin deeply arcuate.

Alt. 5.4, diam. 7 mm.; width of aperture 3.3 mm.

Suganiikei, Taiwan. Type No. 90,047 A. N. S. Phila., from No. 1,390 of Mr. Hirase's collection.

Very rare, as only two fully adult shells were found. With as many whorls as *E. inrinensis*, this species is smaller, more elevated, with a narrower umbilicus and a more deeply arcuate basal lip. It has much the shape of the far larger *E. fulvicans* (H. Ad.).

Eulota (Plectotropis) perplexa n. sp.

Shell trochoidal, thin, rather openly umbilicate, the umbilicus about one-fourth the diameter of the shell, rapidly contracting inward. Surface dull, covered with a brown cuticle, sculptured with minute closely placed, short, linear, raised processes above the periphery, with an under-sculpture of indistinct fine spiral lines; below the periphery it is very closely engraved with fine spiral lines. The spire is conic, with straight lateral outlines. Whorls $6\frac{1}{4}$, slowly increasing, but slightly convex, the last with a slightly projecting, acute keel at the periphery, descending slightly below the keel to the aperture. Suture well impressed, following the lower edge of the keel. Aperture oblique, peristome thin, the basal and outer margins narrowly reflexed, arcuate, the upper margin but slightly arcuate, hardly expanded, columellar margin nearly vertical, arcuate, dilated above; parietal callus very thin.

Alt. 8.2, diam. 12 mm.; diam. of aperture 5.3 mm.; of umbilicus nearly 3 mm.

Suganiikei, Taiwan. Types No. 89,874 A. N. S. Phila., from No. 1,377 of Mr. Hirase's collection.

This snail is related to *E. granti* Pfr., *E. fulvicans* H. Ad. and especially to *E. lautsi brachylasia* S. and B., a decidedly less elevated form.

Eulota (Plectotropis) granti (Pfr.).

P. Z. S., 1865, p. 828, pl. 46, fig. 10.

Formosa (Swinhoe).

Eulota (Acusta) assimilis (H. Ad.).

P. Z. S., 1866, p. 316, pl. 33, fig. 1.——S. and B., Nachrbl., 1891, p. 158.——Mlldff., Jahrb., XI, p. 370.

Takao (Swinhoe, Steere).

[*Eulota* (*Acusta*) *redfieldi* (Pfr.) has been reported from Formosa by Fraser, the specimens collected by Swinhoe and identified by Cuming. Later confirmation is lacking.]

Eulota (Acusta) sieboldiana (Pfr.).

Jyushikyaku (Hirase). I cannot distinguish these from Japanese examples. The species is not, we believe, found in the Ryukyu Islands. It has been identified from Formosa by H. Cuming (*P. Z. S.*, 1865, p. 197), from specimens sent by Swinhoe. It occurs also in Corea, but has not been found in China.

Eulota (Eulotella) similaris (Fér.).

Mlldff., Jahrb., XI, 1884, p. 325.

A Formosan specimen before me, received from Cuming, and probably collected by Swinhoe, belongs to the angular race *stimpsoni* Pfr.

Eulota (Acusta) tourannensis (Soul.).

Rev. Zool., 1842, p. 101.——Voy. Bonite, p. 507, pl. 29, figs. 1, 2.——Schm. and Bttg., Nachrbl. d. m. Ges., 1891, p. 158.

South Cape (Schmacker).

Eulota (Euhadra) swinhoei (Pfr.).

P. Z. S., 1865, p. 829, pl. 46, fig. 6.

Formosa (Swinhoe); Taihoku (Hirase). The shells taken at this place are small (diam. 45 mm.) and light yellowish-olive with some darker streaks, quite unlike the typical form in color. Mr. Okura took only three specimens.

Eulota (Euhadra) pancala (Schm. and Bttg.).

Helix bacca var. *sinistrorsa* Mlldff., Jahrb. XI, p. 387.
Helix (*Hadra*) *pancala* S. and B., Nachrbl., 1891, p. 161, pl. 1, fig. 6.

South Cape, in the mountains (Schmacker).

Eulota (Euhadra) pancala trifasciata (Schm. and Bttg.).

L. c., p. 162.

South Cape, at foot of the mountains (Schmacker).

Eulota (Euhadra?) formosensis (Pfr.).

P. Z. S., 1865, p. 829, pl. 46, fig. 7.

Formosa (Swinhoe). A sinistral species, not found by any later collector.

Eulota (Euhadra) bacca (Pfr.).

P. Z. S., 1865, p. 829, pl. 46, fig. 8.

Formosa (Swinhoe).

Eulota (Euhadra) succincta (H. Ad.).

P. Z. S., 1866, p 316, pl. 33, figs. 4, 4*a*.——S. and B., Nachrbl., 1891, 159.

Takao (Swinhoe); Ape Hill, Takao and Bagsa (Schmacker).

Eulota (Euhadra) succincta amblytropis Pils.

Proc. A. N. S. Phila., 1901, p. 193.

Formosa (Steere); Taiwan (Hirase).

Eulota (Euhadra) friesiana (Mlldff.).

Jahrb., XI, 1884, p. 385, pl. 9, figs. 3, 4.——S. and B., Nachrbl., 1891, pp. 159, 160.——Man. Conch., VI, p. 118.

Takao (Fries); Bankimtsong (Schmacker); Tapanii (Hirase).

Eulota (Euhadra ?) mellea (Pfr.).

P. Z. S., 1865, p. 829, pl. 46, fig. 4.

Formosa (Swinhoe); Suganiikei (Hirase).

A peculiar snail, of doubtful systematic position.

Eulota (Coniglobus) bairdi (H. Ad.).

P. Z. S., 1866, p. 316, pl. 33, fig. 3.

Tamsui (Swinhoe).

Eulota (Coniglobus) nux (Mlldff.).

Nachrbl. d. m. Ges., 1888, p. 43.
E. sargentiana Pils., Proc. A. N. S. Phila., 1901, p. 194.

Formosa (Mlldff.); Hotawa (Hirase). The specimens collected by Mr. Okura are a little lower than Moellendorff's type. *E. sargentiana* is a still more depressed form, perhaps varietally separable. The original specimens were anonymously sent to von Moellendorff, without exact locality.

Eulota (Coniglobus) sphæroconus (Pfr.).

Bulimus sphæroconus Pfr., P. Z. S., 1865, p. 830, pl. 46, fig. 3.
Helix sphæroconus Pfr., Pils., Man. Conch., VIII, p. 200, with var. *campochilus*, p. 201, pl. 53, fig. 76.

Formosa (Swinhoe); Suganiikei (Okura), the typical small form and var. *campochilus* Pils. This species is type of *Coniglobus* n. subg.

Buliminopsis incerta (Pfr.).

Bulimus incertus Pfr., P. Z. S., 1865, p. 830, pl. 46, fig. 1.
Pseudobuliminus incertus Pfr., S. and B., Nachrbl., 1891, p. 164.
Helix (Satsuma) taivanica Mlldff., Jahrb., 1886, p. 197.

Formosa (Swinhoe); Taihoku (Hirase); South Cape (Schmacker).

Dolioheulota swinhoei (Pfr.).

Bulimus swinhoei Pfr., P. Z. S., 1865, p. 830, pl. 46, figs. 2, 2*a*.

Formosa (Swinhoe).

Dolioheulota formosensis (H. Ad.).

Bulimus (Amphidromus) formosensis H. Ad., P. Z. S., 1866, p. 317, pl. 33, fig. 5.——Schm. and Bttg., Nachrbl., 1891, p. 195.
Dolicheulota formosensis Pils., Man. Conch., XIV, p. 19, pl. 2, figs. 26–28.

Tamsui Mountains (Swinhoe); Bankimtsong (Schmacker); Lakuli Mountains (Fries); Anshiryosan (Hirase).

Allowing *Buliminopsis* and *Dolicheulota* to stand as genera is a concession to the genus splitters. The former is known to be an *Eulota* anatomically, and the latter will probably prove to have the anatomy of *Euhadra*.

Ganesella albida (H. Ad.).

P. Z. S., 1870, p. 378, pl. 27, fig. 9.——Schm. and Bttg., Nachrbl., 1891, p. 159.——Mlldff., Jahrb., XI, p. 335.

Taiwan-fu (Swinhoe); Takao; Bankimtsong (Schmacker); Sammaipo (Hirase).

Ganesella albida insignis n. subsp.

Shell similar to *G. albida*, but having a purple-black area around the axis, the columella and basal lip of the same color; the apical whorl also sometimes black. Whorls 6.

Alt. 16.8, diam. 14.3 mm.

Alt. 15.8, diam. 12.5 mm.

Hotawa, Taiwan. Types No. 89,989 A. N. S. Phila., from No. 1,403 of Mr. Hirase's collection.

Five specimens of this charming snail were taken.

Chloritis hungerfordianus ('G. Nevill').

Jahrb., XI, 1884, p. 336, pl. 7, fig. 7.

Formosa (Hungerford); Suganiikei (Hirase), two examples. Von Moellendorff also reports the species from the island of Hongkong.

Moellendorffia (Trihelix) hiraseana Pilsbry.

Nautilus, XIX, Oct., 1905, p. 66, pl. 2, figs. 4, 5, 6.

Hotawa (Hirase).

STREPTAXIDÆ.

Streptaxis (Odontartemon) heudei Schm. and Bttg.

Nachrbl., 1891, p. 147, pl. 1, fig. 1.

South Cape (Schmacker); Sammaipo (Hirase).

Ennea (Huttonella) bicolor (Hutt.).

Schm. and Bttg., Nachrbl., 1891, p. 148.

Takao (Schmacker); Taiwan (Hirase).

Ennea (Elma) swinhoei H. Ad.

P. Z. S., 1866, p. 317, pl. 33, fig. 8.——S. and B., Nachrbl., 1891, 148.

Tamsui (Swinhoe); Bankimtsong (Schmacker); Taihoku (Hirase).

Ennea swinhoei hotawana n. subsp.

Shell decidedly smaller than *E. swinhoei*, composed of fewer whorls. Length 10, diam. 4.4 mm., whorls $7\frac{1}{2}$.

Length 9.3, diam. 3.7 mm., whorls 7½.

Hotawa. Types No. 89,940 A. N. S. Phila., from No. 1,408 of Mr. Hirase's collection.

ACHATINIDÆ.

Opeas gracile (Hutt.).

Schm. and Bttg., Nachrbl., 1891, p. 178.

South Cape and Takao (Schmacker).

Opeas clavulinum (P. and M.) ?

Schm. and Bttg., 1901, p. 179.

Takao (Schmacker).

Opeas pyrgula 'A. Ad.,' S. and B.

Schm. and Bttg., Nachrbl., 1891, p. 179.

South Cape (Schmacker). Also Japan and China.

ACHATINELLIDÆ.

Tornatellina boeningi Schm. and Bttg.

Nachrbl., 1891, p. 180, pl. 2, fig. 7.

Tamsui, in northern Formosa (G. Degener-Boening). *T. inexpectata* of the Ryukyu Islands is very similar to this, probably not specifically distinct.

PUPILLIDÆ.

Ena cantori taivanica (Mlldff.).

Buliminus c. t., Mlldff., Jahrb., 1884, 165.——Schm. and Bttg., Nachrbl., 1891, 166.

Takao, Banksa and Bankimtsong (Schmacker).

Ena luchuana (Pils.).

Buliminus luchuanus Pils., Nautilus, XIV, March, 1901, p. 129.

Hotawa (Hirase). Originally described from the Loochoo Islands. A smaller variety was taken at Giiran.

Ena leptostraca (Schm. and Bttg.).

Buliminus l., S. and B., Nachrbl., 1891, p. 166, pl. 1, fig. 7.

South Cape (Schmacker).

Ena warburgi (Schm. and Bttg.).

L. c., p. 167, pl. 2, fig. 1.

South Formosa (Dr. Otto Warburg).

CLAUSILIIDÆ.

Clausilia (Euphædusa) eumegetha Schm. and Bttg.

Nachrbl., 1891, p. 168, pl. 2, fig. 2.

Takao (Schmacker).

Clausilia (Euphædusa) aculus Bens.

Taihoku (Hirase). A well-known Chinese species.

Clausilia (Hemiphædusa) myersi Schm. and Bttg.

Nachrbl., 1891, p. 172, pl. 2, fig. 4.

Bagsa and Takao (Dr. Myers).

Clausilia (Hemiphædusa) bagsana Schm. and Bttg.

Nachrbl., 1891, p. 175, pl. 2, fig. 5.

Bagsa (Schmacker).

Clausilia (Hemiphædusa) sheridani Pfr.

P. Z. S., 1865, p. 830, Novit. Conch., p. 284, pl. 69, figs. 13–18.——Schm. and Bttg., Nachrbl., 1891, p. 173.

Formosa (Swinhoe); South Cape, Takao and Kankow (Schmacker); Arikwan, Sammaipo and Chikutozaki (Hirase).

Clausilia (Hemiphædusa) similaris H. Ad.

P. Z. S., 1866, p. 446, pl. 38, fig. 10.——S. and B., Nachrbl., 1891, p. 170, with var. *ventriosa*.

Formosa (Swinhoe); Takao and South Cape (Schm.). Var. *ventriosa* S. and B. from Kankow.

Clausilia (Hemiphædusa) odontochila Schm. and Bttg.

Nachrbl., 1891, p. 171, pl. 2, fig. 3.

Lakuli, in southern Formosa, type loc.; Hotawa (Hirase).

Clausilia odontochila nigra Pils.

Black, with the lip-tooth obsolete; densely striate, like *C. swinhoei;* spire entire. Ensuikō (Hirase).

Clausilia (Hemiphædusa) exilis H. Ad.

P. Z. S., 1866, p. 317, pl. 33, fig. 6.——Mlldff., Jahrb., X, 1883, p. 257 (*forma minor*).

Tamsui (Swinhoe, Hungerford); Chosokei (Hirase).

Clausilia (Formosana) swinhoei Pfr.

P. Z. S., 1865, p. 830, pl. 46, fig. 11.——Mlldff., Jahrb., X, 1883, p. 252.——Schm. and Bttg., Nachrbl., 1891, p. 170.

Formosa (Swinhoe); Tamsui (Hungerford). Hotawa, Taiwan, Kiirun and Suganiikei (Hirase.)

The shells from Hotawa, Taiwan, are obese, with the striæ irregularly crimped, the intervals finely wrinkled across as in *C. formosensis*, but the color is dark purplish-brown as in *swinhoei*. Those from Kiirun and Suganiikei taper more and have finer nearly straight striæ without interstitial sculpture, and are clearly the true *C. swinhoei*.

There is a variety *subformosensis* Nevill mentioned by Schmacker and Boettger, but I have been unable to trace the name to a description.

Clausilia (Formosana) formosensis H. Ad.

P. Z. S., 1866, p. 317, pl. 33, fig. 7.——Mlldff., Jahrb., X, 1883, p. 253.——S. and B., Nachrbl., 1891, p. 169 (new diagnosis).

Takao (Swinhoe. v. Fries); Bankimtsong (Schmacker); Arikwan, Hotawa and Sammaipo (Hirase).

Clausilia (Heterozaptyx[1]) uraniscoptyx Schm. and Bttg.

C. (Hemiphædusa) uraniscoptyx S. and B., Nachrbl., 1891, p. 177, pl. 2, fig. 6.

Bankimtsong (Schmacker).

Clausilia (Heterozaptyx) diacoptyx Pils.

Sammaipo (Hirase).

Clausilia (Thaumatoptyx) bivincta Pils.

Hotawa (Hirase).

ZONITIDÆ.

Ariophanta taiwanica Mlldff.

Jahrb. d. malak. Ges., XII, 1885, p. 387, pl. 10, fig. 16.

Takao (Fries). A sinistral acutely carinate form of large size, diam. 28, alt. 15.5 mm.

Trochomorpha shermani (Pfr.).

Helix shermani Pfr., P. Z. S., 1865, p. 828, pl. 46, fig. 5.

Formosa (Swinhoe). A rather solid, opaque, uniform dark brown shell with very minutely decussate surface. The exact locality in Formosa of several specimens in collection A. N. S. Phila. is not recorded.

Trochomorpha haenseli Schm. and Bttg.

Nachrbl., d. m. Ges., 1891, p. 152, pl. 1, fig. 5.

South Cape, Bankimtsong and Bagsa (Schmacker).

Trochomorpha pellucida n. sp.

Shell umbilicate, the diameter of umbilicus contained about four and one-half times in that of the shell, conic-depressed, acutely carinate, thin, pale brownish-corneous, quite translucent. Surface glossy, finely striatulate with some very indistinct traces of spiral lines. Spire low-conic with straight sides. Whorls 6¼, the earlier ones convex and slowly increasing, the last two more rapidly widening, convex below the suture, then concave. Last whorl concave above and below the acute peripheral keel, convex beneath, rather suddenly passing into the umbilicus, but not angular around it. The aperture is somewhat oblique, with thin, acute peristome; the basal margin is rather deeply arched, columellar margin steep and arcuate, upper margin short and nearly straight.

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[1]*Heterozaptyx* Pils., *sect. nov.*, type *Clausilia munus* Pils.

Alt. 5.3, diam. 10.8, width of the aperture 4.7, oblique alt. 3.4 mm.

Hotawa, Taiwan. Types No. 89,879 A. N. S. Phila., from No. 1,405 of Mr. Hirase's collection.

Only two specimens of this delicate little *Trochomorpha* were taken. It is closely related to *T. haenseli* S. and B., but is less depressed, the umbilicus smaller, the aperture larger, with basal lip much more deeply arcuate. The width of the aperture is contained in that of the shell 2.3 times in *T. pellucida*, about 2.7 times in *T. haenseli*.

Trochomorpha cultrata formosana n. subsp.

Similar to *T. cultrata* in general shape and color, but *very distinctly, finely and evenly granulose* above and below. Whorls $6\frac{1}{2}$, the first two convex, the rest almost flat above; base excavated below the very acute keel, then quite convex, with a strong angle, almost a keel, around the umbilicus, which is a trifle wider than in *T. cultrata*. Basal lip strongly sinuous, being well *retracted midway between the peripheral and basal keels*.

Alt. 7, diam. 19.3 mm.; diam. umbilicus, measured from the keel, 8 mm.

Hotawa, Taiwan. Types No. 89,939 A. N. S. Phila., from No. 1,399 of Mr. Hirase's collection.

Twenty specimens of this fine *Trochomorpha* were taken. While evidently related to *T. cultrata* of the Ryukyu Islands, it may eventually be given specific rank.

Otesia japonica (Mlldff.).

Nanina japonica Mlldff., Journ. Asiat. Soc. Beng., LIV, pt. 2, p. 59, 1885.

This species, originally described from Sengoku in Kyushu, and unknown in the Ryukyu chain, was taken by Mr. Okura at Kiirun (Keelung), five specimens.

Helicarion hiraseanus Pilsbry, n. sp.

Shell imperforate, depressed-globose, thin and fragile, pale amber-colored, transparent. Surface very glossy, smooth and polished. Spire convex, narrow. Whorls $3\frac{1}{2}$, rapidly increasing, the last rounded peripherally and beneath. Aperture oblique, broadly lunate, the peristome with a narrow reflexed cuticular edge. Columella simple, thin, concave.

Alt. 6, diam. 9.5 mm.

Sammaipo, Taiwan. Types No. 90,235 A. N. S. Phila., from No. 1,431 of Mr. Hirase's collection.

Six specimens of this charming species were taken. No snail of similar *Vitrina*-like shape is known from Formosa, the Ryukyu Islands or Japan.

Macrochlamys vesta (Pfr.).

P. Z. S., 1865, p. 828, pl. 46, fig. 9.

Formosa (Swinhoe).

Macrochlamys fulgens Gude.

Proc. Malac. Soc. Lond., IV, p. 75, pl. 8, figs. 24–26.

Hotawa and Kiirun (Hirase). Originally described from Ryukyu.

Macrochlamys formosana Schm. and Bttg.

Nachrbl., 1891, p. 149, pl. 1, fig. 2, with var. *atypa*, p. 150.

South Cape (Schmacker); Tapanii (Hirase).

M. f. atypa S. and B.

Bankimtsong (Schmacker).

Macrochlamys par Schm. and Bttg.

Nachrbl. d. m. Ges., 1891, p. 150, pl. 3, fig. 3.

Takao (Schmacker).

Macrochlamys nitidus n. sp.

Shell minutely perforate, depressed, pale yellow, subtransparent, glossy and smooth, under a strong lens showing excessively fine spiral striæ below the suture and around the umbilicus; the parietal callus very thin, minutely granulose. Spire very low-conic. Whorls $4\frac{3}{4}$, slightly convex, the last nearly twice the width of the preceding, rounded at the periphery. Aperture deeply lunate, slightly oblique, the peristome simple, minutely dilated at the axis.

Alt. 3.5, diam. 5.8 mm.

Hotawa, Taiwan. Types No. 90,236 A. N. S. Phila., from No. 1,422 of Mr. Hirase's collection.

This species has much the general appearance of *Zonitoides nitida*, but with a less impressed suture and rather narrowly lunate aperture. A few somewhat smaller, thinner specimens, apparently not fully mature, were taken at Giiran.

Microcystina spadix Schm. and Bttg.

Lamprocystis spadix S. and B., Nachrbl., 1891, p. 151, pl. 1, fig. 4.

Takao. Very distinct by its brown color. The nodule on the columella shows it to be a *Microcystina*.

M. s. cinctus Pils.

Lamprocystis spadix S. and B., var. *cinctus* Pils., Proc. A. N. S. Phila., 1901, p. 194.

Formosa (Steere), exact locality unrecorded.

Microcystina lamprobasis n. sp.

Shell minutely perforate, low-conic above, convex below the rounded periphery; thin, amber-tinted, somewhat transparent and brilliantly glossy below, opaque above, with the luster of a dull silk, the opaque appearance resulting from a sculpture of excessively fine and close vertical or radial striæ which extends over the periphery and forms a band at the circumference of the base around the glossy basal area, which under a strong lens shows fine, well-spaced spiral lines. Whorls 4, convex, the suture well impressed. Aperture lunate, the columellar margin not perceptibly thickened, triangularly reflexed at the insertion.

Alt. 1.9, diam. 2.7 mm.

Giiran, Taiwan. Types No. 89.869 A. N. S. Phila., from No. 1,368 of Mr. Hirase's collection.

The dull silky surface is like that of some species of *Euconulus, Guppya*, etc. Only four specimens were taken. The non-callous columella may cause the removal of this species from *Microcystina*, yet the number of whorls is so small that we would hardly consider it a *Kaliella*. There are traces of spiral sculpture on the first whorl.

Microcystina lissobasis n. sp.

Shell minutely perforate, depressed, with low-conoid spire and convex base; thin and fragile, pale yellow, subtransparent. Upper surface and a zone at and below the periphery having a silky luster, the rest of the base smooth and glossy. Whorls 4, convex, separated by an impressed suture, the periphery rounded. Aperture widely lunate, columella oblique, slightly thickened within, its edge a little dilated.

Alt. 1, diam. 2.1 mm.

Hotawa, Taiwan. Types No. 89.870 A. N. S. Phila., from No. 1,423 of Mr. Hirase's collection.

This species is related to *M. lamprobasis*, having the same silky upper surface and glossy base. It differs by its smaller size and much wider aperture. About 20 specimens were taken.

Microcystina radiata n. sp.

Shell minutely perforate, depressed, thin, yellowish-corneous, subtransparent, very glossy. Sculpture of fine, close and minute radial striæ and grooves above, the base smooth. Spire low-conoid, the apex obtuse. Whorls 4½, moderately convex, slowly increasing, the last much wider, rounded peripherally, convex below. Aperture lunate; columella dilated above, slightly thickened within.

Alt. 1.7, diam. 2.5 mm.

Giiran, Taiwan. Types No. 90,224 A. N. S. Phila., from No. 1,371 of Mr. Hirase's collection.

Related to *M. sinapidium*, but unlike it in sculpture. Only four specimens taken.

Microcystina sinapidium (Reinh.).

Hotawa (Hirase). A common Japanese snail.

Kaliella depressa Mlldff.

Mlldff., Jahrb. d. m. Ges., 1883, p. 368, pl. 12, fig. 7; 1887, p. 42 (Canton and Hongkong).——Schm. and Bttg., Nachrbl. d. m. Ges., 1891, p. 154.

Tamsui (Boening).

Kaliella yaeyamensis Pils.

Nautilus, XV, p. 21, June, 1901.

Shohokumon and Daitomon, Taiwan (Hirase). This strongly striate *Kaliella* was taken in some abundance; about 30 were found at Daitomon. It was described from the Ryukyu Islands.

Kaliella costata n. sp.

Shell minutely perforate, acutely carinate, the spire conic, base convex; thin, amber-colored, translucent: *upper surface sculptured with strong ribs,* nearly straight and slightly oblique, the glossy smooth intervals three or four times the width of the ribs; first two whorls smooth; *base convex, smooth* and glossy. Spire straightly conic; whorls 5¼, convex. Aperture truncate-lunate. Columella vertical, thickened, with reflexed margin.

Alt. 3, diam. 3.5 mm.

Hotawa, Taiwan. Types No. 89,977 A. N. S. Phila., from No. 1,410 of Mr. Hirase's collection.

This is the most strongly sculptured *Kaliella* known to us. It is related to *K. costulata* Godwin-Austen, from the North Cachar Hills, 8,000 feet elevation (*Land and Fresh-water Mollusca of India,* p. 7, pl. 2, fig. 5), but in *K. costata* the base is smooth, the whorls much more convex; and while slightly larger than its Indian relative (which measures alt. 2.8, diam. 3.3 mm.), the Formosan shell has fewer whorls, 5¼ instead of 6.

Kaliella crenulata hotawana n. subsp.

Shell larger and more elevated than *K. crenulata,* with less distinct sculpture, the vertical striation being weak; whorls 6½.

Alt. 3.4, diam. 3 mm.

Hotawa, Taiwan. Types No. 89,883 A. N. S. Phila., from No. 1,419 of Mr. Hirase's collection.

Kaliella venusta n. sp.

Shell very minutely perforate, conic with semiglobose base, thin, reddish-brown. *The surface has the luster of silk,* produced by excessively fine, close vertical striæ, which covers the upper surface and extend over the periphery nearly half way to the center of the base, *the* *middle region of the base being smooth and glossy.* Spire straightly conic, the apex obtuse. Whorls 5½, very convex, parted by a deep suture. *Last whorl almost rounded at the periphery,* there being the slightest indication of an obtuse angle; convex beneath, narrowly and rather deeply impressed around the perforation. Aperture semilunar, the columellar margin subvertical, suddenly dilated above.

Alt. 2.9, diam. 3.1 mm.

Hotawa, Taiwan. Types No. 89,882 A. N. S. Phila., from No. 1,418 of Mr. Hirase's collection.

The convex whorls, rounded periphery and silken surface with a smooth basal area, are the more prominent features of this little snail.

Kaliella longa n. sp.

The shell is imperforate, cupola-shaped, *much elevated,* the diameter only two-thirds the height, amber-colored, subtransparent and very thin. Surface glossy. The *very high spire has convex outlines* and a very obtuse apex. Whorls 7½, the earlier ones quite convex, the later whorls less so; last whorl with a delicate, acute, thread-like peripheral keel, the base convex, impressed around the axis. Aperture semicircular, small, the columellar margin reflexed above.

Alt. 3, diam. 2 mm.

Hotawa, Taiwan. Types No. 89,876 A. N. S. Phila., from No. 1,415 of Mr. Hirase's collection.

Compared with *K. prœalta* and its varieties *izushichitoensis* and *xenica,* this species has more convex sides and a more obtuse apex. It is nearer in shape to *K. elongata* Godwin-Austen (*Land and Fresh-water Mollusca of India,* p. 9, pl. 2, fig. 9), but that has more whorls, a more acute apex and is larger, being 5 mm. high, 3.3 wide.

Sitala trochulus formosana Schm. and Bttg.

Nachrbl. d. m. Ges., 1891, p. 153.

Tamsui (Boening). *S. trochulus* Mlldff. is a Chinese species, of which Schmacker and Boettger consider the Formosan snail a variety.

Sitala hirasei Pilsbry, n. sp.

Shell imperforate, acutely carinate, conic above, convex below the carina, excessively thin, fragile, amber-colored, somewhat transparent. Surface somewhat shining, roughened with rather coarse but low oblique ripples or wrinkles in places, and showing extremely fine spiral striæ; on the apical two whorls these striæ are delicate raised threads; on the later whorls and base they appear as lines of minute, close, regular punctures. Immediately around the axis the puncture lines give way to fine smooth spiral striæ. Spire straightly conic; whorls 4½, slightly convex, rapidly increasing. Aperture rather large, the thin lip acutely angular in the outer part, basal and columellar margins arcuate, the latter delicately reflexed above.

Alt. 3, diam. 4 mm.

Sammaipo, Taiwan. Types No. 89,881 A. N. S. Phila., from No. 1,417*a* of Mr. Hirase's collection.

This remarkable *Sitala* is similar in shape to *S. insignis* of Japan, but is very much larger. We know of no Chinese or Indian species of like appearance.

Sitala angulifera n. sp.

Shell imperforate, fragile, pale olive-green, subtransparent, acutely carinate in the middle, conic above, convex below the keel. Sculpture of rather coarse oblique wrinkles on the upper surface, the first whorl with numerous low or inconspicuous spiral threads; the other whorls showing some very weak cuticular spirals in a favorable light; base with more widely spaced radial wrinkles, and a few spiral lines below the keel. Spire straightly conic. Whorls $3\frac{1}{2}$, the first one convex, with subobsolete spiral lines, the last whorl nearly flat above the periphery. Aperture large, oblique, the thin peristome angular at the keel, arcuate below; columellar margin narrowly reflexed above.

Alt. 2, diam. 2.8 mm.

Alt. 2.3, diam. 2.7 mm.

Hotawa, Taiwan. Types No. 90,237 A. N. S. Phila., from No. 1,417 of Mr. Hirase's collection.

The shell is similar to *S. hirasei* in shape, but decidedly smaller with only $3\frac{1}{2}$ whorls. The rounded apical whorl is nearly smooth, usually without distinct spiral threads, and spirals are almost obsolete on the last whorl. The base is free from spiral striæ except for a few fine ones just below the periphery.

Sitala circumcincta taiwanica n. subsp.

Shell larger than *S. c. clata* Gude, with stronger spiral threads and more whorls, fully 6. There are 6 or 7 spirals on each whorl. The base is smooth.

Alt. 2.2, diam. 1.7 mm.

Hotawa, Taiwan. Types No. 89,903 A. N. S. Phila., from No. 1,411 of Mr. Hirase's collection.

This is the largest of the *circumcincta* series. The Indian *Sitala conulus* Blanf. is wider than the Japanese and Formosan forms, with more minute spirals. It is a trifle wider than high, alt 2.9, diam. 3.1 mm.; and while allied, it is doubtless distinct.

ENDODONTIDÆ.

Punctum taiwanicum n. sp.

Shell umbilicate, very minute, with low-conoid spire and tubular whorls; brownish-corneous, very finely, densely striate. Whorls 4, convex. Aperture rounded lunate, the peristome simple and thin, its insertions widely separated.

Alt. 0.8, diam. 1.35 mm.; width of umbilicus 0.4, of aperture 0.56 mm.

Hotawa, Taiwan. Types No. 90.220 A. N. S. Phila., from No. 1.414 of Mr. Hirase's collection.

Very closely related to *P. atomus*, but slightly larger with less sharp striation, four whorls, and an umbilicus nearly as wide as the aperture. *P. atomus* has 3½ whorls (not 3 as stated in the original description), and the aperture is much larger than the umbilicus.

PHILOMYCIDÆ.

Philomycus formosensis (Ckll.).

Limacella formosensis Ckll., Ann. and Mag. Nat. Hist. (6), VI, p. 384, 1893.
? *Philomycus bilineatus* Heynemann, Jahrb. d. m. Ges., 1885, p. 300.
Cf. Collinge, Journ. of Malac., VII, p. 82.

Formosa. This slug is not known to me by specimens. It requires comparison with the species of China, the Ryukyu Islands and Japan.

AURICULIDÆ.

Carychium pessimum Pils.

Proc. A. N. S. Phila., 1901, p. 562.

Hotawa (Hirase). Originally described from Tanega-shima in the N.E. Ryukyu group.

Fresh-water Mollusks.

LYMNÆIDÆ.

Lymnæa swinhoei H. Ad.

P. Z. S., 1866, p. 319, pl. 33, fig. 13.

Takao (Swinhoe). An allied form with shorter last whorl was taken at Toshen (Hirase, 1901).

Planorbis compressus japonicus Marts. (?).

Toshen (Hirase, 1901). A form not quite so compressed and a little less angular than that named by von Martens, yet nearer to that than to any other named form known to us.

Segmentina swinhoei H. Ad.

L. c., pl. 33, fig. 14.

Tungkang, 15 miles below Takao, and also at Takao in ponds and rice-fields (Swinhoe).

MELANIIDÆ.

Melania scabra (Müll.).

Schm. and Bttg., Nachrbl. d. m. Ges., 1891, p. 181.

South Cape (Schmacker).

M. s. lyriformis (Lea).

Bankimtsong (Schmacker).

M. s. pagoda (Lea).

Takao (Schmacker).

Melania turriculus Lea.

P. Z. S., 1850, p. 190.——Brot, Conchyl. Cab. Melaniaceen, 1874, p. 239, pl. 25, figs. 7, 7*a*.——Schm. and Bttg., Nachrbl., 1891, p. 183.

South Cape (Schmacker).

Melania tuberculata chinensis Nevill.

Nevill, Handlist Ind. Mus., II, p. 244 (China).——Schm. and Bttg., Nachrbl., 1891, p. 183.——Bttg., Jahrb. d. malak. Ges., 1886, p. 11; 1887, p. 114.

Lakuli, southern Formosa (Fries).

Mr. E. A. Smith reports *M. tuberculata* Müll., collected by Dickson, *P. Z. S.*, 1878, p. 729, pl. 46, fig. 9.

Melania juncea Lea.

Schm. and Bttg., Nachrbl., 1891, p. 184.

South Cape (Schmacker). Otherwise known only from Luzon.

Melania tennisulcata Dkr.

P. Z. S., 1865, p. 197, No. 79.

Formosa (Swinhoe). Identified by H. Cuming.

Melania fulgurans Hinds is reported from Takao by Brot, *Melaniidæ*, p. 183, as recorded by H. Adams. Brot evidently doubts the occurrence of this New Ireland species over so wide an area. In a list of Formosan mollusks collected by Swinhoe and identified by H. Adams (*P. Z. S.*, 1866, p. 146) the following Melanians are recorded: *M. pyramis* v. d. Busch, *M. lateritia* Lea, *M. fasciolata* Oliv., *M. crenulata* Chem. It is clear that the *Melaniidæ* of Formosa stand in need of a revision.

Melania formosensis E. A. Smith.

P. Z. S., 1878, p. 728, pl. 46, figs. 4, 5.——S. and B., Nachrbl., 1891, p. 183.——Bttg., Jahrb., 1886, p. 12; 1887, p. 115.
M. pyramis v. d. Busch, H. Adams, P. Z. S., 1866, p. 146.

Formosa (Dickson); Takao (Schmacker).

Melania dicksoni Smith.

P. Z. S., 1878, p. 728, pl. 46, fig. 6.

Formosa (Dickson).

Melania obliquegranosa Smith.

P. Z. S., 1878, p. 729, pl. 46, figs. 7, 8; with var. *monstrosa*.——Schm. and Bttg., Nachrbl., 1891, p. 185.——Bttg., Jahrb., 1886, p. 16; 1887, p. 116.

Formosa (Dickson); Takao and Bankimtsong (Schmacker); Kiirun (Hirase).

"*M. obliquexpansa* Sow." of Brot, Nachrbl. d. m. Ges., 1883, p. 80, is evidently an error for *obliquegranosa*.

This species is viviparous.

Melania subplicatula Smith.

P. Z. S., 1878, p. 729, pl. 46, fig. 10.——Brot, Nachrbl. d. m. Ges., 1883, p. 84.

Formosa (Dickson).

Melania niponica E. A. Smith.

Brot, Nachrbl. d. m. Ges., 1883, p. 85.

Formosa (Mlldff.). The specimens, identified by Brot, are said to belong to the var. *minor* Smith.

Melania libertina Gld.

Nevill, Handlist Ind. Mus., p. 266.

Tamsui (Hungerford). Identified by G. Nevill.

M. l. subplicosa Nevill.

Nevill, *l. c.*, p. 267.

Formosa (Hungerford); Kiirun (Hirase, 1901).

M. l. sublævigata Nevill.

Nevill, *l. c.*, page 266 (no description).

Tamsui (Hungerford).

M. l. plicosa Marts.

Nevill, *l. c.*, p. 267.

Mai Tionlek (Hungerford). Identified by G. Nevill.

M. l. microstoma Nevill.

Nevill, *l. c.*, p. 267 (no description).——Bttg., Jahrb., 1886, p. 5 (description).

Formosa (Hungerford).

VIVIPARIDÆ.

Viviparus chinensis (Gray).

Paludina chinensis Gray has been reported from Formosa collected by Swinhoe, the specimens identified by Cuming, *P. Z. S.*, 1865, p. 196. Whether they are different from the following species remains to be seen.

Viviparus malleatus (Reeve).

Specimens which seem referable to this Japanese species were taken at Kaisanko (Hirase, 1901).

Viviparus angularis (Müll.).

P. Z .S., 1866, p. 146.

Formosa (Swinhoe). Identified by H. Adams.

AMNICOLIDÆ.

Stenothyra glabra A. Ad.

G. Nevill, Handlist Moll. Indian Mus., p. 43.

Tokohan (Hungerford). Described from Peiho, China.

Stenothyra formosana Pils.

Nautilus, XVIII, p. 8, May, 1904.

Kironten (Hirase).

CYRENIDÆ.

Corbicula fluminea (Müll.).

Prime, Annals N. Y. Lyc. N. H., VIII, p. 60, fig. 4.

Taihoku and Kaisanko (Hirase, 1901).

Corbicula subsulcata Dkr.

Clessin, Conchyl. Cab. Cycladeen, p. 164, pl. 29, figs. 5, 6 (1879).

Formosa (Clessin). Clessin gives no reference to a description of this species by Dunker.

Corbicula insularis Prime.

Ann. Lyc. N. H. of N. Y., VIII, 1864, p. 414, fig. 67.

Formosa (Prime).

Cyrena (Cyrenodonax) formosana Dall.

Proc. Biol. Soc., Washington, XVI, p. 6, 1903.

Formosa.

UNIONIDÆ.

Anodonta swinhoei H. Adams.

Anodonta swinhoei H. Ad., P. Z. S., 1866, p. 446.
Anodon swinhoei H. Ad., Sowerby, Conch. Icon., XVII, pl. 27, fig. 108. Copied by Clessin, Conchyl. Cab. Anodonta, p. 225, pl. 75, fig. 6, and erroneously credited to Reeve.
Cristaria swinhoei H. Adams, Simpson, Synopsis of the Naiades, p. 586 (in part).

Formosa (Swinhoe). The localities "Tonkin" and "Cambodia," given by Simpson, had their inception in errors. While the species may prove to be a *Cristaria*, no evidence making for that view has been published.

Henry Adams gives the size as, length 90, alt. 50, diam. 28 mm. The figure in *Conch. Icon.* measures, length 76.5, alt. 47.7 mm.

Unio swinhoei 'Reeve,' Sowb.

Unio swinhoei Rve. MS., Sowerby, Conch. Icon., XVI, pl. 42, fig. 232, May, 1866 (false locality "Camboja").
Unio swinhoei H. Ad., P. Z. S., 1866, p. 319.

Formosa (Swinhoe). This species was published independently by Sowerby and Henry Adams. The later author presented his paper to the Zoological Society at the meeting of May 22, 1866; and since a colored plate had to be prepared, it could not well have been published for some months later. The descriptions, so far as they go, agree. Sowerby's figure measures, length 65, alt. 40 mm.; and Adams gives the size as, length 60, alt. 39, diam. 22 mm. Sowerby gives the false locality "Camboja"—a region where Swinhoe never collected; but then the monograph of *Unio* in the *Iconica* is famous for false localities.

Mr. Simpson, in his *Synopsis of the Naiades*, 1900, p. 586, has quoted this species in the synonymy of "*Cristaria swinhoei* H. Ad.," which is a totally different species. It may belong to Simpson's genus *Lamellidens*.

Nodularia douglasiæ taiwanica Pils., n. subsp.

Shell oblong, narrow, inflated, rather solid, the dorsal and ventral margins subparallel, the former slightly arcuate, anterior end rounded, basal margin straightened in the middle, posterior end long, somewhat pointed. Beaks full, swollen, worn but showing traces of oblique corrugation on the anterior and posterior slopes; situated at the anterior two-sevenths of the length. Exterior covered with a blackish cuticle, somewhat wrinkled along growth-lines. Interior white, iridescent posteriorly. Cardinal teeth compressed, strong, single in the right, double in the left valve. Laterals moderately strong, rather short.

Length 49, alt. 25, diam. 19.7 mm.

Formosa. Types No. 58,170, A. N. S. Phila., received from Andrew Garrett.

A mussel closely related to *N. douglasiæ* of China, but showing only very weak traces of corrugation.

Appendix.

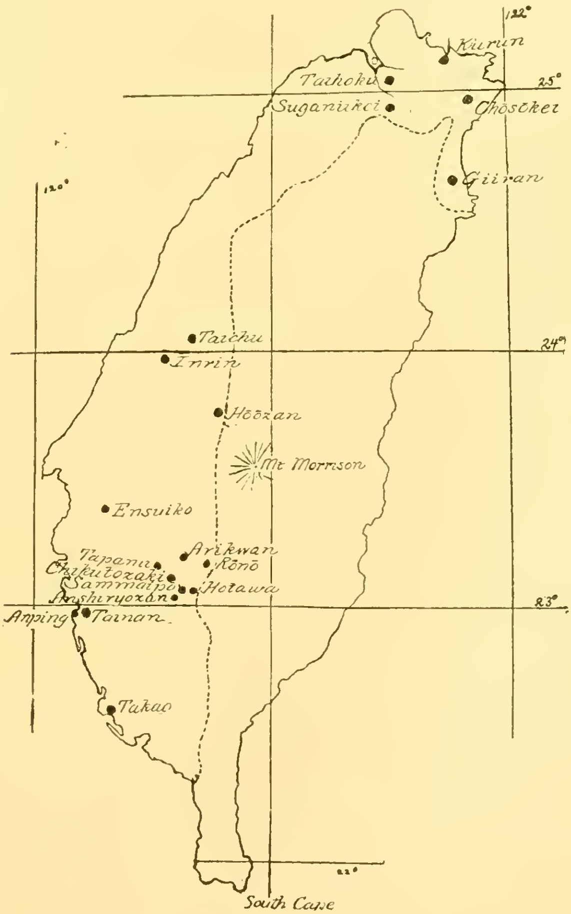
The following species, received since the preceding was in type, adds a genus new to the Formosan fauna.

Blanfordia formosana n. sp.

The shell is perforate, light brown, rather solid, turrite-conic, the outlines of the spire straight, apex rather acute. Whorls $6\frac{3}{4}$, quit convex and parted by well impressed sutures, smooth except for faint growth-lines. The last whorl has a rounded and rather strong crest or varix behind the outer lip. The aperture is ovate, brown within; peristome brown-edged, the columella concave and somewhat thickened, whitish. Length 7, diam. 3.25 mm., length of aperture with peristome 2.8 mm.

Rōnō. Types No. 90,726 A. N. S. P., from No. 1,453 of Mr. Hirase's collection.

This species is related to *B. japonica* (A. Ad.) of Sado Island, but is smaller and especially narrower, with a much lower varix behind the outer lip. The apex is perfect.



Some of the localities explored by Mr. Okura are not to be found on any Occidental map. The location of these places has been indicated on the outline map, p. 751. Mr. Schmacker says that Bagsa (or Baksa) where his Japanese collector worked, is half a degree W.N.W. from Tainan (Tainan-fu or Taiwan-fu), and Bankimtsong is directly east of Takao (Takow). The orthography of Formosan place-names is in a state of transition, owing to the change of ownership of the island and the diverse phonetics of Chinese and Japanese; the older mode being the Chinese, the newer Japanese. Thus, *Keelung* of ordinary maps is *Kiirun* in the Japanese mode.

The dotted line indicates the approximate border of the western mountainous area, most of which is still practically unknown except to adventurous camphor gatherers, and is inhabited by savage and in part head-hunting tribes.

NOVEMBER 7.

The President, SAMUEL G. DIXON, M.D., in the Chair.

Twenty-two persons present.

The death of Benjamin W. Frazier, a member, January 4, 1905, was announced.

The Publication Committee reported that papers under the following titles had been received for publication since the last meeting:

"Hawaiian Species of Endodonta and Opeas." By H. A. Pilsbry and E. G. Vanatta (October 18).

"Notes on the Orthoptera of Costa Rica with descriptions of new species." By James A. G. Rehn (October 24).

"On some Pacific Cerithiidæ." By H. A. Pilsbry and E. G. Vanatta (October 25).

"On a collection of Birds from British East Africa obtained by Mr. George L. Harrison, Jr." By Witmer Stone (November 6).

JOHN W. HARSHBERGER, Ph.D., made a communication on phytogeographic influence in North American civilization. (No abstract.)

In compliance with the recommendation of the Committee on the Hayden Memorial Geological Award, the medal for 1905 was conferred by unanimous vote on CHARLES DOOLITTLE WALCOTT, LL.D., Director of the United States Geological Survey.

CHARLES DOOLITTLE WALCOTT was born in New York Mills, New York, the thirty-first of March, 1850. He was educated in the schools of Utica, New York. On leaving school he entered a large hardware establishment, but after a year and a half decided to pursue geological investigations. He located north of Utica, and for five years studied by himself, and worked in the field. In 1876 he received an appointment under Professor James Hall, State Geologist of New York, remaining there until 1879, when he received an appointment as Field Assistant on the United States Geological Survey. He became successively Assistant Paleontologist, Chief Paleontologist, Geologist in Charge of Geology, and, July 1, 1894, Director of the Survey.

He began publishing paleontological papers in 1875, and in 1879 published his first geological and paleontological memoir, on the "Utica Slate and Related Formations." Since that time numerous papers on geological and paleontological topics have appeared, the most extended of which are "The Paleontology of the Eureka District," 1884; "Cambrian Faunas of North America," 1885 and 1886; "The Fauna of the Lower Cambrian, or Olenellus, Zone," 1890; "Correlation of Cambrian Formations," 1891; "Algonkian Rocks of the Grand Canyon of the Colorado," 1895.

Honorary Curator, Department of Paleontology of the U. S. National Museum, 1892–1897, and since 1898; from January, 1897, to July, 1898, at head of U. S. National Museum, with title of Acting Assistant Secretary of the Smithsonian Institution; Secretary of the Carnegie Institution of Washington, 1902, and since. Received the degree LL.D. from Hamilton College, 1897; University of Chicago, 1901; Johns Hopkins University, 1902; University of Pennsylvania, 1903.

November 21.

The President, Samuel G. Dixon, M.D., in the chair.

Thirty-eight persons present.

The deaths of the following persons were announced:

Albert von Richtofen, a Correspondent, October 29, 1905; Albert von Kölliker, a Correspondent, November 3, 1905; George R. Morehouse, M.D., a member, November 12, 1905; Allen Shryock, a member, November 12, 1905.

Behavior of Sea Anemones.—Dr. H. S. Jennings gave an account of studies on the behavior of sea anemones, made at the Tortugas Laboratory of the Carnegie Institution. Special attention was given to the modifiability of behavior. The speaker showed that these low organisms by no means always react in the same way to the same external conditions. On the contrary, their reactions are modifiable from a variety of causes. Changes in the internal physiological processes, former stimuli that have affected the animal, former reactions performed by the animal, and a number of other factors, all assist in determining the present action of the organism. There is a clearly marked tendency, in some cases, to repeat an action in the way it has been performed before. These various factors give a high degree of complexity and adaptiveness to the behavior of even these low animals.

C. H. Smyth, Jr., was elected a member.

The following were ordered to be printed:—

ON A COLLECTION OF BIRDS FROM BRITISH EAST AFRICA OBTAINED BY MR. GEORGE L. HARRISON, JR.

BY WITMER STONE.

The Academy of Natural Sciences of Philadelphia has recently received on deposit from Mr. George L. Harrison, Jr., a collection of birds obtained by him on his travels through Central East Africa in 1904. Through the courtesy of Mr. Harrison and the Academy I have had the privilege of studying this collection and of preparing a report upon it.

While only one of the species represented proves to be new to science, the collection illustrates many interesting points in connection with seasonal and sexual plumages. The specimens are beautifully prepared, and this fact, together with the fullness of the data which accompany them, renders the collection exceptionally valuable.

Mr. Harrison has favored me with the following outline of his route: "We left Nairobi on May 16, 1904, and arrived at Fort Hall on May 30, spending a few days there. From Fort Hall I took a trip down the Tana river, and should have made a much better collection but for the fact that both Camburn, my taxidermist, and myself suffered very severely with fever, and were laid up for some weeks. I got back to Fort Hall on July 9 and sent Camburn in from there to Nairobi. In the meantime I took a trip and met him at Naivasha on August 24. We then started along the Morandat river to El Bolossa swamp, thence to Pesi swamp and along the Guaso Nyiro, until well north of Mount Kenia. I then sent Camburn back over the Abedare range, which he crossed at an altitude of about 10,500 feet, while I got back to Nairobi on November 4."

On account of the lack of adequate material for comparison I have, as a rule, made no attempt to indicate subspecific relationship, although a number of forms here recognized certainly intergrade with others whose ranges they adjoin. In the sequence of families and genera I have followed Dr. Bowdler Sharpe's classification.

PHASIANIDÆ.

1. Francolinus schuetti Cab.

Francolinus (*Scleroptera*) *schuetti* Cab., J. F. O., 1880, p. 351. [Lunda, Kongo.]

A pair from the Thika river, May 25 and 26. "Irides hazel, orbits and ears ochraceous, bill and feet coral red."

2. **Francolinus hildebrandti** Cab.

Francolinus (Sclcroptera) hildebrandti Cab., J. F. O., 1878, p. 206, T. 4. [Teita Dist.].

Naivasha, August 12; Morandat river, August 26. "Irides hazel, orbits dull red, bill dusky, red at base, feet coral red."

3. **Francolinus coqui** (A. Smith).

Perdix Coqui Smith, Rep. Exped. Cent Africa, 1836, p. 55. [Kurrichaine.]

One specimen, Tana river, June 17. "Irides hazel; bill black, yellow at base of lower mandible and edges of upper; feet chrome yellow, ovaries large."

4. **Francolinus** sp.

One chick, Tana river, June 6, probably of the preceding or following species. "Irides hazel, bill and feet pale red."

5. **Francolinus granti** Hartl.

Francolinus grantii Hartl., P. Z. S., 1865, p. 655, Pl. 39, fig. 1. [Unyamuezi.]

Male and young from the Tana river, June 22 and 29. "Irides hazel, bill horn color, feet dull red."

6. **Pternistes infuscatus** Cab.

Pternistes infuscatus Cab., J. F. O., 1868, p. 413. [German E. Africa.]

A pair from Pesi swamp, October 3. "Irides hazel, orbits pale red, bare skin of throat lemon yellow, bill and feet black."

7. **Numida ptylorhyncha** "Licht" Less.

Numida ptylorhyncha "Licht" Less, Traité d'Orn., 1831, p. 498. [Africa.]

A pair from Pesi swamp, Laikipia plateau, October 8. "Irides hazel, throat black spotted with blue, cheeks and wattles pale blue, bill and horn horn-color, feet black."

TRERONIDÆ.

8. **Vinago nudirostris** Swains.

Vinago nudirostris Swains., Birds W. Afr., II, p. 205 (1837).

One from Tana river, June 18, and another on the Guaso Nyiro, October 19. "Irides pale ultramarine, bill ochraceous yellow at base, dull white at tip."

These specimens seem very close to *V. calva* and may be regarded as intermediates.

COLUMBIDÆ.

9. **Columba arquatrix** Temm.

Columba arquatrix Temm., Pigeons, 1, fam. seconde, p. 11, Pl. 5,[1] 1809. [W. Africa.]

[1] The copy of this work in the Academy's library contains not only the suppressed pages but the original covers of the Livraisons. The latter are dated as follows: 1 to 5, 1809; 6 to 8, 1810; 9 to 15, 1811, and it is stated that each Livraison consisted of six plates.

Five examples from El Bolossa swamp, August 31 to September 24. "Irides silver gray, orbits, bill and feet chrome yellow."

PERISTERIDÆ.

10. **Turtur senegalensis** (Linn.).

Columba senegalensis Linn., S. N., I, p. 283, No. 26, 1766. [Senegal.]

Three specimens from the Tana river, June 6 to 17. "Irides hazel, bill purplish black, feet vinaceous."

11. **Turtur damarensis** Finsch and Hartlaub.

Turtur damarensis Finsch and Hartl., Vög. Ost-Afr., p. 550, 1870.

Two from the Tana river, June 20 and 29. "Irides hazel, bill black, feet vinaceous."

12. **Turtur semitorquatus** (Rüpp.).

Columba semitorquata Rüpp., Neue Wirbelth. Vög., p. 66, t. 23, fig. 2, 1835. [Abyssinia.]

Thika river, May 22. "Irides chrome yellow, bill black, feet vinaceous."

13. **Tympanistria tympanistria** (Temm.).

Columba sympanistria [*sic*] Temm. and Knip., Pigeons, 1, fam. seconde, p. 80, Pl. 36, 1810. [S. Africa.]

One from the Thika, May 25, and another from the Guaso Nyiro, October 21. "Irides hazel, bill dusky purple, feet vinaceous."

14. **Chalcopelia afra** (Linn.).

Columba afra Linn., S. N., I, p. 284, 1766. [Senegal.]

Pesi swamp, October 6. "Irides hazel, bill dark purple, feet vinaceous."

RALLIDÆ.

15. **Limnocorax niger** (Gmel.).

Rallus niger Gmel., S. N., II, p. 717, 1788. [Cape of Good Hope.]

Guaso Nyiro, October 21. "Irides and orbit crimson, bill greenish yellow, feet pale coral red."

16. **Gallinula chloropus** (Linn.).

Fulica chloropus Linn., S. N., p. 152, 1758. [Europe.]

Naivasha, August 13. "Irides crimson, bill coral red tipped with yellow, feet grass green, garter crimson."

17. **Porphyrula alleni** (Thomps.).

Porphyrio Alleni Thomps., An. and Mag. Nat. Hist., X, p. 204, 1842. [Idda W. Africa.]

Naivasha, August 25, shot among reeds on the edge of the lake. "Irides light brown, bill pale green, dusky on ridge and at base of upper mandible, feet greenish gray."

Sharpe and most authors quote this genus in the emended form *Porphyriola* from Sundevall, 1872. The original reference, however, is Blyth, *Cat. Birds, Mus. Asiat. Soc. Bengal*, p. 283. While the genus is not described, a type species, *Porphyrio chloronotus* [=*alleni*] is mentioned, which is all that is necessary. The date of Blyth's Catalogue on the title-page is 1849, which is also the year in which the type species was described by him; and from the fact that he leaves the page reference to *Jour. Asiat. Soc.*, XVIII, where the description occurs, blank, we should infer that it had not appeared when he proposed the new generic name. Furthermore, the very paper in which *P. chloronotus* is described is entitled a *supplement* to the Catalogue! This would seem to make *Porphyrula* untenable, being based on a *nomen nudum*.

On the other hand, the appendix of the Catalogue, which has every appearance of being strictly a part of it, is dated 1852. If this is the real date of issue it will, of course, make the name *Porphyrula* available, but it will also raise the question of priority between it and *Ionornis*, which likewise dates from 1852.

Some additional light upon the actual date of publication of Blyth's Catalogue seems to be badly needed.

18. Porphyrio porphyrio (Linn.).

Fulica porphyrio Linn., S. N., I, p. 152, 1758.

Naivasha, August 21. "Irides red brown, shield and bill crimson, feet pink."

19. Fulica cristata Gm.

Fulica cristata Gm., S. N., II, p. 704, 1788. [Madagascar and Sina.]

Naivasha, August 16.

PODICIPEDIDÆ.

20. Colymbus cristatus Linn.

Colymbus cristatus Linn., S. N., I, p. 135, 1758.

Niavasha, August 13. "Irides crimson, bill dark slate, feet mottled black and greenish yellow."

LARIDÆ.

21. Hydrochelidon hybrida (Pallas).

Sterna hybrida Pallas, Zoogr. Russ. Asiat., II, p. 338, 1811. [S. Volga and Sarpa.]

Naivasha, August 12. "Irides hazel, bill and feet dark crimson."

22. Larus cirrhocephalus Vieill.

Larus cirrhocephalus Vieill., Nov. Dict. d'Hist. Nat., XXI, p. 502, 1818. [Brazil.]

Naivasha, August 12. "Irides hazel, bill and feet dull brick red, bill dusky at tip."

CHARADRIIDÆ.

23. **Hoplopterus speciosus** (Wagl.).

Charadrius speciosus Wagler, Isis, 1829, p. 649. [Kaffirland.]

A pair, Naivasha, August 16 and 21. "Irides crimson, bill and feet black."

24. **Stephanibex coronatus** (Bodd.).

Charadrius coronatus Bodd., Tabl. Pl. Enl., p. 49, 1783. [Cape of Good Hope.]

Naivasha, August 11. "Irides dark straw, bill rose pink at base, black at tip, feet rose pink."

25. **Ochthodromus asiaticus** (Pall.).

Charadrius asiaticus Pall., Reis. Russ. Reichs II, p. 715, 1773. [S. Tartary.]

A pair, Pesi swamp, Laikipia, October 5. "Irides hazel, bill dusky, feet ochraceous green."

26. **Ægialitis tricollaris** (Vieill.).

Charadrius tricollaris Vieill., Nov. Dict. d'Hist. Nat., XXVII, p. 147, 1818. [Africa.]

Tana river, June 16. "Irides golden brown, orbits chrome red, bill rose pink at base, tip dusky, feet flesh color."

SCOLOPACIDÆ.

27. **Totanus stagnalis** Bechst.

Totanus stagnalis Bechst., Orn. Taschenb., II, p. 292, 1803.

Naivasha, August 21. "Irides hazel, bill dark olivaceous, feet ochraceous green."

28. **Aotitis hypoleucus** (Linn.).

Tringa Hypoleuca Linn., S. N., p. 149, 1758. [Europe.]

Nairobi, July 21. "Irides hazel, bill dusky, feet pale ochraceous."

29. **Glottis nebularis** (Gunner.).

Scolopax nebularis Gunner., Leem. Lapp. Beschr., p. 251, 1767.

El Bolossa swamp, September 9. "Irides hazel, bill ash gray, dusky at tip, feet ashy green."

30. **Ryaoophilus glareola** (Linn.).

Tringa Glareola Linn., S. N., I, p. 149 1758. [Sweden.]

Naivasha, August 21. "Irides hazel, bill dusky greenish, feet ochraceous green."

31. **Aotodromas minuta** (Leisl.).

Tringa minuta Leisl., in Bechst Naturg. Deutsch. Nacht., I, p. 74, 1812. [Germany.]

A pair, El Bolossa swamp, September 14. "Irides hazel, bill black, feet very dark brown."

32. **Gallinago nigripennis** Bp.

Gallinago Nigripennis Bp., Icon. Faun. Ital., text to Pl. 43, p. 4, 1832. [Cape of Good Hope.]

El Bolossa swamp, September 1. "Irides hazel, bill ochraceous green, dusky at tip, feet olivaceous."

33. **Rostratula capensis** (Linn.).

Scolopax capensis Linn., S. N., I, p. 246, 1766. [Cape of Good Hope.]

Tana river, June 16. "Irides hazel, bill greenish gray at base, dull brick red at tip, feet ashy green."

ŒDICNEMIDÆ.

34. **Œdicnemis vermiculatus** Cab.

Œdicnemis vermiculatus Cab., J. f. O., 1868, p. 413. [Interior E. Africa.]

Tana river, June 29. "Irides golden yellow, nares and gape yellow, bill black, feet greenish yellow."

OTIDIDÆ.

35. **Eupodotis kori** (Burch.).

Otis Kori, Burch., Travels in S. Afr., I, p. 393, 1822. [Ky Gariep.]

Naivasha. October 29. "Irides gold flecked with black, bill yellowish white, dusky on ridge, feet yellowish white."

GRUIDÆ.

36. **Balearica gibbericeps** Reich.

Balearica gibbericeps Reich., J. f. O., 1892, p. 126. [E. Africa.]

Pesi swamp, October 3. "Irides white, bill black, bare skin purplish red with a creamy white patch on the cheeks, feet black."

IBIDIDÆ.

37. **Ibis æthiopica** Lath.

Ibis æthiopicus Lath., Ind. Orn., II, 1790, p. 706. [Æthiopia.]

Naivasha, August 12. "Irides red brown, bill black, feet dull purple."

38. **Hagedashia hagedash** (Lath.).

Tantalus Hagedash Lath., Ind. Orn., II, p. 1790, p. 709. [Cape of Good Hope.]

Guaso Nyiro, October 19.

39. **Plegadis autumnalis** (Hasselq.).

Tringa autumnalis Hasselq., Reise nach Paläst. Deutsche Ausg., 1762, p. 306.

Naivasha, August 12 and 13. "Irides hazel, bill dark olivaceous, bare skin olivaceous edged with gray, feet olivaceous."

CICONIDÆ.

40. Pseudotantalus ibis (Linn.).

Tantalus Ibis Linn., S. N., I, p. 241, 1766. [Egypt.]

Tana river, June 19. "Irides silver gray, bill ochraceous, duller and darker at the tip, bare skin bright red fading to yellow in front of the feathers, feet ashy green, thighs paler with a broad garter of magenta red."

41. Leptoptilus crumeniferus (Less.).

Ciconia crumenifera Less., Traité d'Orn., p. 585, 1831. [Senegal.]

El Bolossa swamp, September 2. "Irides hazel, bill dirty greenish white, bare skin on head dull red spotted and mottled with black, neck purplish flesh spotted with black, a patch of pale vermilion at base between shoulders, feet black."

ARDEIDÆ.

42. Ardea purpurea Linn.

Ardea purpurea Linn., S. N., I, p. 236, 1766. [Asia.]

Naivasha, July 18. "Irides pale straw, bill yellow deepening to orange at tip and brown along ridge of upper mandible, a brown patch below and in front of the eye, orbit greenish yellow, tarsus greenish yellow, metatarsus brown in front, greenish yellow at back, toes brown chrome yellow beneath."

ANATIDÆ.

43. Chenalopex ægyptiacus (Linn.).

Anas ægyptiacus Linn., S. N., I, p. 197, 1766. [Egypt.]

Naivasha, August 12 and 22; Pesi swamp, October 8. "Irides dark straw, bill flesh mottled with black, nail black, feet flesh color."

44. Sarkidiornis melanota (Penn.).

Anser melanota Penn., Ind. Zool., p. 12, Pl. XI, 1769.

Tana river, June 16. "Irides hazel, bill black, feet ash."

45. Anas undulata Dubois.

Anas undulata Dubois, Orn. Gall., p. 119, Pl. 77, 1839. [Cape of Good Hope.]

A pair from Naivasha, August 12 and 18. "Irides hazel, bill chrome, with triangular black spot at gape, black nail and patch on ridge, feet brown."

46. Nettion punctatum (Burch.).

Anas punctata Burch., Travels, I, p. 283 (note), 1822. [Zak river.]

Naivasha, August 12; El Bolossa swamp, September 17. "Irides blue gray, bill blue gray, black along the ridge, feet stone gray."

47. **Pœcilonetta erythrorhyncha** (Gmel.).

Anas erythrorhyncha Gmel., S. N., I, Pt. II, p. 517, 1788. [Cape of Good Hope.]

Naivasha, August 12; El Bolossa swamp, September 1. "Irides crimson, bill purplish red, feet dark gray."

48. **Nyroca brunnea** Eyt.

Nyroca brunnea Eyton, Mon. Anat., p. 161, Pl. 23, 1838. [S. Africa.]

Naivasha, August 16 and 18. "Irides crimson, bill stone gray, nail black, feet ochraceous gray."

49. **Thalassornis leuconota** "Smith" Eyt.

Thalassornis leuconota "Smith" Eyton, Mon. Anat., p. 168, 1838. [Cape of Good Hope.]

Naivasha, August 12. "Irides hazel, bill black spotted with yellow."

PHALACROCORACIDÆ.

50. **Phalacrocorax africanus** (Gmel.)

Pelecanus africanus Gmel., S. N., I, Pt. II, p. 577, 1788. [Africa.]

Naivasha, August 12. "Irides crimson, bill yellow, dusky at tip and along ridge, gape and orbits yellow, feet black."

PELECANIDÆ.

51. **Pelecanus onocrotalus** Linn.

Pelecanus onocrotalus Linn. S. N., I., p. 132, 1758. [Africa and Asia.]

Naivasha, August 13. "Bill blue, terminal portion of lower and margins and nail of upper mandible mottled red and yellow, pouch and bare skin round the eye yellow, feet flesh color."

52. **Pelecanus rufescens** Gmel.

Pelecanus rufescens Gmel., S. N., I, Pt. II, p. 571, 1788. [W. Africa.]

Naivasha, August 13. "Bill ochraceous gray, nail yellow ochre, pouch ochraceous gray marked with fine parallel lines of pale yellow, bare skin round eye ochraceous gray with darker spot before and behind the orbit, feet ochraceous flesh color."

VULTURIDÆ.

53. **Neophron pileatus** (Burchell).

Vultur pileatus Burch., Travels, II, p. 195, 1824. [S. Africa.]

Tana river, June 6. "Irides dark hazel, bill dusky, darker at tip, scale at base pink, feet bluish white, bare skin of head and neck bluish white flushed with pink in patches, wattles cream color."

FALCONIDÆ.

54. **Melierax gaber** (Daud.).

Falco gaber Daud., Traité, II, p. 87, 1800. [River Swart Kop, S. Africa.]

Pesi swamp, October 7. "Irides crimson, bill black, cere and feet pale coral red."

55. **Buteo augur** (Rüpp.).

Falco (*Buteo*) *augur* Rüpp., Neue Wirb. Fauna Abyss. Vögel, p. 38, Taf. 16, 1835. [Abyssinia.]

El Bolossa swamp, September 24; Guaso Nyiro, October 15. "Irides hazel, bill dark slate, feet yellow."

56. **Milvus ægyptius** (Gmel.).

Falco ægyptius Gmel., S. N., I, p. 261, 1788. [Egypt.]

Tana river, June 8; Naivasha, August 23. El Bolossa swamp, September 1; near the Guaso Nyiro, October 14. "Irides brown, bill dusky in young, yellow in adults, feet, cere and orbits yellow."

57. **Elanus cæruleus** (Desf.).

Falco cæruleus Desf., Mém. Acad. Sci., 1787, p. 503, Taf. 15.

"Irides bright crimson, bill black, feet, cere, etc., chrome yellow."

BUBONIDÆ.

58. **Glaucidium perlatum** (Vieill.).

Strix perlata Vieill., Nov. Dict. d'Hist. Nat., VII, 1817, p. 26. [Senegal.]

Tana river, June 19. "Irides bright yellow, bill ochraceous."

PSITTACIDÆ.

59. **Pœocephalus meyeri** Rüpp.

Pœocephalus meyeri Rüpp., [in Cretzschmar's Atlas, p. 18, Taf. 11, 1826. [Kordofan.]

Four from Pesi swamp, October 1 and 9. "Irides chrome red, bill and feet black." These are probably *P. matschiei* Neum., but the variability in the color of the under parts makes me doubtful as to the validity of this species.

60. **Pœocephalus massaicus** Fisch. and Reich.

Pœocephalus massaicus Fisch. and Reich., J. f. O., 1884, p. 179. [Cross Aruscha.]

El Bolossa swamp, August 31 and September 1. "Irides scarlet, orbits and cere ochraceous, upper mandible flesh lower dusky, feet ochraceous spotted with black."

CORACIIDÆ.

61. **Coracias caudata** Linn.

Coracias caudata Linn., S. N., I, p. 160, 1766. [Angola.]

Fort Hall, Maranga, May 29; Tana river, June 29; El Bolossa swamp, September 4. "Irides hazel, bill dusky, feet greenish ochre."

ALCEDINIDÆ.

62. **Ispidina picta** (Bodd.).

Todus pictus Bodd., Tabl. Pl. Enl., p. 49, 1783. [Juida.]

Tana river, July 5. "Irides hazel, feet and bill coral red."

63. **Halcyon chelicuti** (Stanley).

Alaudo [*sic*] *Chelicuti* Stanley, in Salt's Exped. Abyss. App., p. lvi, 1814. [Abyssinia.]

Tana river, June 9. "Irides hazel, bill dusky, lower mandible dull red, feet pinkish horn color, dull red beneath."

64. **Halcyon semicæruleus** (Forskål).

Alcedo semicœrulea Forskål, Descrip. Anim, 1775, p. 2. [Yemen.]

Tana river, June 24. "Irides hazel, bill and feet coral red."

BUCEROTIDÆ.

65. **Bycanistes cristatus** (Rüpp.).

Buceros cristatus Rüpp., Neue Wirb., Fauna Abyss. Vögel, p. 3, Pl. 1, 1835. [Zana See.]

Two from Guaso Nyiro, October 23 and 24. "Irides hazel, bill horn color, horn yellowish pink, feet black."

UPUPIDÆ.

66. **Upupa epops** Linn.

Upupa epops Linn., S. N., p. 183, 1766. [Europe and India.]

Guaso Nyiro, October 22. "Irides hazel, bill dusky, feet ochraceous."

IRRISORIDÆ.

67. **Irrisor jacksoni** Sharpe.

Irrisor Jacksoni Sharpe, Ann. and Mag. Nat. Hist., VI, p. 503, 1890. [Kikuyu.]

El Bolossa swamp, September 21. "Irides hazel, orbits, bill and feet coral red."

68. **Irrisor viridis** (Licht.).

Upupa viridis Licht., Cat. rer. Nat. Hamb., p. 22, 1793.

Tana river, June 22. "Irides hazel, bill and feet coral red."

69. **Rhinopomastus schalowi** Neumann.

Rhinopomastus schalowi Neumann, J. f. O., p. 221, 1900 [Usandawe, E. Africa.]

Pesi swamp, September 30. "Irides hazel, bill black, feet dusky."

70. **Rhinopomastus cabanisi** (De Filippi).

Irrisor cabanisi De Filippi, Rev. and Mag. de Zool., p. 289, 1853. [White Nile.]

Tana river, June 24. "Irides hazel, bill dusky, feet black."

MEROPIDÆ.

71. **Mellitophagus bullockoides** (Smith).

Merops bullockoides Smith, S. Africa Jour. (2), II, p. 320, 1834.

Five from Naivasha, July 21 and 29. "Irides hazel, bill black, feet dusky black."

72. **Mellitophagus oreobates** Sharpe.

Mellitophagus oreobates Sharpe, Ibis, p. 320, 1902. [Elgon.]

Two from Pesi swamp, Laikipia, October 3 and 10. "Irides crimson, bill black, feet horn color." One is immature with green under tail coverts and green down the middle of the breast.

73. **Mellitophagus cyanostictus** (Cab.).

Merops cyanostictus Cabanis, von der Decken's Reisen, III, p. 34, 1869. [Mombasa and Dschagga.]

Tana river, June 3 and 22. "Irides crimson, bill and feet black."

CAPRIMULGIDÆ.

74. **Caprimulgus frænatus** Salvad.

Caprimulgus frænatus Salvadori, Ann. Mus. Civ. Gen., p. 118, 1884. [Shoa.]

Two specimens from the Tana river, June 6, appear to belong here. "Irides hazel, bill dusky, feet pinkish brown."

75. **Caprimulgus poliocephalus** Rüpp.

Caprimulgus poliocephalus Rüpp, Neue Wirbelth. Vögel, p. 106, 1835. [Kulla, Abyssinia.]

El Bolossa swamp, September 6. "Irides dusky, bill hazel, feet pinkish horn."

COLIIDÆ.

76. **Colius leucotis affinis** (Shelley).

Colius affinis Shelley, Cat. Bds. Brit. Mus., XVII, p. 342, 1892. [White Nile to E. Africa.]

Three adults from Thika river, May 25, and three young in the juvenal plumage from the Tana, June 9. "Irides dark hazel, bill ash gray, upper mandible black except at the base of the ridge, feet red."

MUSOPHAGIDÆ.

77. **Turacus hartlaubi** (Fisch. and Reich.).

Corythaix Hartlaubi Fisch. and Reich., J. f. O., p. 52, 1884. [Meru Berg, Massai.]

Two from El Bolossa swamp, September 5, and two from Guaso Nyiro, October 19. "Irides hazel, orbits crimson, bill dull red, feet dark horn."

78. **Chizærhis leucogaster** (Rüpp.).

Chizærhis leucogaster Rüpp., P. Z. S., p. 9, 1842. [Abyssinia.]

Tana river, June 21. "Irides hazel, bill and feet black."

CUCULIDÆ.

79. **Chrysococcyx klaas** (Steph.).

Cuculus Klaas Steph., Gen. Zool., IX, p. 128, 1815. [Senegal.]

Morandat river, July 28; Pesi swamp, September 1 and 27. "Iris hazel, orbits pale green, bill green, dusky at tip, feet greenish ash."

80. **Centropus superoiliosus** Hempr. and Ehrh.

Centropus superciliosus Hempr. and Ehrh., Symb. Phys., fol. V, 1828. [Arabia and Ethiopia.]

Tana river, June 20 and 22; Naivasha, August 10; Pesi swamp, Laikipia, October 6. "Irides crimson, bill black, feet bluish ash."

81. **Centropus monachus** Rüpp.

Centropus monachus Rüpp., Neue Wirb. Vögel, p. 57, Pl. 21, fig. 2, 1835. [Kulla, Abyssinia.]

Guaso Nyiro, October 21. "Irides crimson, bill black, feet dark gray."

INDICATORIDÆ.

82. **Indicator variegatus** Less.

Indicator variegatus Less., Traité, p. 155, 1831. [Africa.]

El Bolossa swamp, August 31. "Irides hazel, bill dusky, feet ochraceous gray."

CAPITONIDÆ.

83. **Tricholæma masaicum** (Reich.)

Pogonorhynchus masaicus Reich., J. f. O., p. 59, 1887. [Massai Land.]

Four from Naivasha, July 29 to August 3. "Irides hazel, bill and feet black."

PICIDÆ.

84. **Dendromus neumanni** Reich.

Dendromus neumanni Reich., Orn. Monatsber., p. 132, 1896. [Naivasha.]

Pesi swamp, October 10. "Irides silvery gray, bill dark slate, feet pale grayish green."

85. **Dendromus nubicus** (Gmel.).

Picus nubicus Gmel., S. N., p. 439, 1788. [Nubia.]

Tana river, June 18 and July 3. "Irides crimson, bill dark slate, feet greenish." These specimens seem to be typical *nubicus*.

86. **Dendropicus lafresnayi** Malh.

Dendopicus Lafresnayi Malh., Rev de Zool., p. 533, 1849. [Africa.]

El Bolossa swamp, September 19. "Irides crimson, bill dark slate, feet greenish gray."

87. **Dendropious guinensis massaicus** Neum.

Dendropicus guinensis massaicus Neumann, J. f. O., p. 206, 1900. [Ndalalani.]

Pesi swamp, October 10. "Irides crimson, bill dark slate, feet greenish gray."

88. **Thripias namaquus** (Licht.).

Picus namaquus Licht., Cat rer. Nat. Hambr., p. 17, No. 179, 1793.

Tana river, June 17 and 21. "Irides crimson, bill black, feet greenish."

89. Mesopicus spodocephalus Bp.

Mesophicus spodocephalus Bp., Conap. Gen. Av., I, p 125, 1850. [W. Africa.]

Naivasha, August 10; Morandat river, August 26. "Irides hazel, bill dark slate, feet greenish gray."

90. Iynx ruficollis Wagl.

Iynx ruficollis Wagler, Hist. Nat. de Amph., p. 118, footnote, 1830. [Kaffirland.]

Morandat river, August 28; El Bolossa swamp, September 22. "Irides light brown, bill horn, feet ochraceous."

HIRUNDINIDÆ.

91. Riparia cincta (Bodd.).

Hirundo cincta Boddaert, Tabl. Pl. Enl., p. 45, 1783.

El Bolossa swamp, September 9. "Irides hazel, bill dusky, feet dark horn color." One is an old bird just beginning to molt the body plumage, but with no indications of molting the flight feathers. The other is a bird of the year.

92. Riparia minor (Cab.).

Clivicola minor Cab., Mus. Hein. Th., I, p. 49, 1850. [N. E. Africa.]

Naivasha, May 19 and August 21; Tana river, June 6. "Irides hazel, bill black, feet black." The May specimen has just completed the wing molt, and both it and one of the August specimens are obviously young of the year. The other August bird is in the midst of the molt of the flight feathers, while the body molt is nearly completed. It presents an entirely different appearance from the spring adult, being dark plumbeous instead of brown, with white tips to the tertials. The resemblance of the June specimen in the brown breeding plumage to the North American *Stelgidopteryx serripennis* is remarkable.

93. Hirundo smithii Leach.

Hirundo Smithii Leach, App. Tuckey's Voy. Congo, p. 407, 1818. [Off Chisall Island.]

Tana river, June 24; Naivasha, August 2. "Irides hazel, bill and feet black."

94. Hirundo senegalensis Linn.

Hirundo senegalensis Linn., S. N., I, p. 345, 1766. [Senegal.]

Nairobi, July 21. "Irides hazel, bill black, feet horn color." This specimen is molting; the new feathers are all glossy blue on the body, glossy green on the tail and wing, tertials narrowly tipped with pale buff, old flight feathers dull blackish. The tail shows the outline of the superimposed feathers still glossy, only the exposed terminal portion being worn and dull.

95. **Hirundo griseopyga** Sundev.

Hirundo griseopyga Sundevall, Oefv. K. Vet. Akad. Förh. Stockh., p. 107, 1850. [Natal.]

Nairobi, May 19; Naivasha, August 21. "Irides hazel, bill black, feet dusky."

96. **Hirundo puella abyssinica** Guerin.

Hirundo abyssiniea Guerin, Rev. Zool., p. 322, 1843. [Abyssinia.]

Tana river, June 8 and 29. "Irides hazel, bill and feet black."

97. **Hirundo emini** Reich.

Hirundo emini Reichenow, Berl. allg. deutsch. Orn. Ges., XI, p. 2, 1892. [Bussisi and Bukoba.]

Tana river, June 3 and 6. "Irides hazel, bill and feet black."

98. **Psalidoprocne orientalis** (Reich.).

P. petiti orientalis Reichenow, J. f. O., p. 277, 1889. [Usambara.]

El Bolossa swamp, September 22. "Irides hazel, bill black, feet horn color." Wing 4.40 inches, under wing coverts sooty, plumage with an oily green gloss.

MUSCICAPIDÆ.

99. **Melænornis ater** (Sund.).

Bradyornis ater Sundevall, Oefv. Vet. Ak. Förh. Stock., p. 105, 1850. [Kaffirland.]

Fort Hall, May 31; Tana river, June 3. "Irides dark hazel, bill and feet black."

100. **Bradyornis murinus** Hartl. and Finsch.

Bradyornis murinus Hartlaub and Finsch., Vög. Ost. Afr., p. 866.

Thika river, July 18; Naivasha, August 6; Pesi swamp, October 6. "Irides hazel, bill dusky, feet horn color."

101. **Dioptrornis fischeri** Reich.

Dioptrornis fischeri Reichenow, J. f. O., p. 53, 1884. [Maern Berg, Massai.]

Fort Hall, July 11; Naivasha, August 2; El Bolossa swamp, August 31 to September 8. "Irides hazel, bill ashy, black at tip, feet black." The July adult is in the molt, as are also two young birds obtained August 31 and September 3. The juvenal plumage is strikingly different from that of the adult, being mottled black and white both above and below; the breast feathers are white with black edges, while those of the upper surface are gray at the base with the terminal portion black surrounding a triangular white spot.

102. **Pogonocichla orientalis** (Fisch. and Reich.).

Tarsiger orientalis Fischer and Reichenow, J. f. O., p. 57, 1884. [Pangani, Küstengebeit.]

Kiangop Mts., 10,000 ft., October 26. "Irides hazel, bill black, eet ochraceous gray."

103. Parisoma jacksoni Sharpe.

Parisoma jacksoni Sharpe, Bull. B O. C., X, p. xxviii, 1899. [Mt. Elgon.]

104. Chloropeta massaica Fisch. and Reich.

Chloropeta massaica Fischer and Reichenow J. f. O., p. 54, 1884. [Tschaga, Fuss des Kilimanjaro.]

Tana river, June 3; Guaso Nyiro, October 21. "Irides hazel, bill dusky, feet dark slate."

105. Batis puella Reich.

Batis puella Reichenow, Jarb. Hamb., p. 19, 1893. [Mrabbo.]

Tana river, June 9. "Irides straw, bill and feet black."

106. Tchitrea perspicillata suahelica (Reich.).

Terpsiphone perspicillata suahelica Reichenow, Werth. Mittl. Hochl., p. 275, 1898.

Fort Hall, Maranga, May 30; Naivasha, August 2. "Irides dark brown, bill, orbits and feet cobalt blue."

107. Cryptolopha mackenziana Sharpe.

Cryptolopha mackenziana Sharpe, Ibis, p. 153, 1892. [Kikuyu and Mt. Elgon.]

Nyeri, October 24. "Irides light brown, bill dusky, feet ash gray."

CAMPOPHAGIDÆ.

108. Campophaga quiscalina "Finsch" Sharpe.

Campophaga quiscalina "Finsch" Sharpe, Ibis, p. 189, 1869. [Fantee country.]

Nyeri, October 13. "Irides hazel, bill black, feet very dark brown."

109. Campophaga nigra Vieill.

Campophaga nigra Vieill., Nov. Dict. d'Hist. Nat., X, p. 50, 1817. [Africa.]

Pesi swamp, October 1; Tana river, June 22 (?). "Irides hazel, bill and feet black."

PYCNONOTIDÆ.

110. Pycnonotus layardi Gurney.

Pycnonotus layardi Gurney, Ibis, p. 390, 1879. [Rustenburg, Transvaal.]

Thika, May 22; Fort Hall, May 31 and July 11; El Bolossa swamp, September 3. "Irides hazel, bill and feet black."

TIMALIIDÆ.

111. Argya rufula Hengl.

Argya rufula Henglin, N. O. Afr., II, p. cccxii (Index), note.

Tana river, June 20. "Irides straw, bill dusky, feet grayish flesh color.'

112. Crateropus sharpei Reich.

Crateropus sharpei Reichenow, J. f. O., p. 432, 1891. [Kakoma, Umamuesi.]

Pesi swamp, Laikipia, September 30. "Irides very pale straw, bill black, feet very dark brown."

113. Crateropus buxtoni Sharpe.

Crateropus buxtoni Sharpe, Ibis, p. 445, 1891. [Turquel, Suk country.]

Pesi swamp, October 6. "Irides dark straw, bill and feet black."

114. Crateropus.

One is juvenal plumage, Tana river, July 6, which I cannot identify with certainty.

TURDIDÆ.

115. Cossypha iolæma Reich.

Cossypha iolæma Reichenow, Ornith. Monats. Ber., VIII, p. 5, 1900. [German E. Africa.]

Naivasha, July 28. El Bolossa swamp, September 5 and 14. "Irides hazel, feet and bill black." *C. mawensis* Neum. does not seem separable.

116. Cossypha heuglini Hartl.

Cossypha Heuglini Hartlaub, J. f. O., p. 37, 1866. [Keren.]

Pesi swamp, September 26 and October 6. "Irides hazel, bill black, feet dark brown."

117. Merula elgonensis Sharpe.

Merula elgonensis Sharpe, Ibis, p. 445, 1891. [Mt. Elgon.]

El Bolossa swamp, August 31, September 3. "Irides hazel, orbits yellow, feet horn color." One of the August specimens is in full juvenal plumage.

118. Pratincola axillaris Shelley.

Pratincola axillaris Shelley, P. Z. S., p. 556, 1884. [Kilimanjaro.]

Naivasha, August 6; Markham Downs, August 29; El Bolossa swamp, September 5 and 10; Guaso Nyiro, October 23. "Irides hazel, bill and feet black." I fail to distinguish this from *P. emmæ* Hartl., J. f. O., 1890, p. 152, but Neumann and Sharpe recognize both.

119. Myrmecocichla cryptoleuca Sharpe.

Myrmecocichla cryptoleuca Sharpe, Ibis, p. 445, 1891. [Kikuyu.]

Nairobi, May 16; Thika river, July 18. "Irides brown, bill and feet black."

120. Saxicola isabellina Cretzschm.

Saxicola isabellina Cretzsch., Rüpp., Atlas Vög., p. 32, Pl. 34, fig. 1, 1826 [Nubia.]

El Bolossa swamp, September 14 and 20; Pesi swamp, October 6. "Irides hazel, bill and feet black."

121. Saxicola schalowi Fisch. and Reich.

Saxicola schalowi Fischer and Reichenow, J. f. O., p. 57, 1884. [Naiwascha.]

Naivasha, August 4 and 29. "Irides hazel, bill and feet black."

122. Campicola livingstonei Tristr.

Campicola livingstonei Tristram, P. Z. S., p. 888, 1867. [Zambesi.]

Naivasha, July 28 and 31; Markham Downs, August 29; El Bolossa swamp, September 23. "Irides hazel, bill and feet black." Much grayer on the back than the South African bird, *C. pileata*. These specimens are topotypes of Neumann's *C. albinotata* which I fail to separate from *livingstonei*.

SYLVIIDÆ.

123. Melocichla orientalis (Sharpe).

Cisticola orientalis Sharpe, Cat. Bds. B. M., VII, p. 245. [Pangani R.]

Tana river, June 3 and 6, July 3. "Irides pale straw, bill dusky, feet slate gray."

124. Cisticola tinniens (Licht.).[2]

Malurus tinniens Licht., Verz. Samuel Kaffernl, p. 13, No. 70 (1842).

El Bolossa swamp, September 9 and 10. "Irides brown, bill dusky, feet horn color."

125. Cisticola robusta nuchalis (Reich.).

Cisticola nuchalis Reichenow, Orn. Monats., I, p. 61, 1893. [Kagera.]

Nairobi, May 16 and 17; Thika river, May 21; Tana river, June 6; Guaso Nyiro, October 22. "Irides light brown, bill dusky, feet flesh color."

126. Cisticola chiniana (Smith).

Drymoica chiniana Smith, Ill. Zool., S. Afr. Aves, Pl. 79, 1843. [North of Kurrichane.]

Tana river, June 18. "Irides light brown, bill dusky, feet flesh color."

127. Cistioola hindii Sharpe.

Cisticola hindii Sharpe, Bull. B. O. C., VI, p. 7, 1896. [Machakos Sta.]

Fort Hall, June 2; Tana river, June 6; Pesi swamp, October 1. "Irides light brown, bill dusky, feet flesh color."

128. Cisticola rufopileata Reich.

Cisticola rufopileata Reichenow, J. f. O., p. 69, 1891.

Fort Hall, Maranga, July. "Irides light brown, bill dusky, feet flesh color."

129. Cisticola harrisoni sp. nov.

Two specimens of a Cisticola obtained in El Bolossa swamp, September 5 and 19, appear to belong to an undescribed form. In its slender bill and long tail it is evidently related to *C. prinioides* Neuman, but apparently differs in coloration.

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[2] I am under obligations to Mr. Harry C. Oberholser, of the U. S. Department of Agriculture, for aid in identifying the species of this difficult genus.

The type specimen (No. 381 Coll. G. L. Harrison, Jr., El Bolossa swamp, Brit. E. Africa, September 19, 1904, ad. ♂) is nearly uniform above, the dark shaft stripes being but faintly indicated. The prevailing color is sepia, with the edges of the feathers lighter, the head slightly more tawny than the back, being about raw umber of Ridgway's *Nomenclature of Colors*. The edges of the flight feathers are russet, the tail bistre with lighter edgings. Below grayish white, darker and inclining to buff on the sides and flanks, only approaching pure white on the throat, chin and middle of the abdomen, thighs russet. Length (skin) 155 mm., wing 61, tail 71.

The other specimen is in the juvenal plumage and is uniform russet brown above the under surface more suffused with buff than in the adult.

The species is named in honor of Mr. George Leib Harrison, Jr.

Through the courtesy of the U. S. National Museum I have received through Dr. Chas. W. Richmond a series of *C. prinoides*, collected by Dr. W. L. Abbott on Mt. Kilimanjaro, for comparison with this specimen. I find that *C. harrisoni* is at once distinguished by the more uniform, less striped back, by the brighter, more ochraceous tone of the upper parts and the lack of decided contrast between the color of the head and back. The bill is moreover distinctly more slender.

Another Kilimanjaro specimen, identified by Mr. Oberholser[3] as *C. hunteri*, is also before me, and appears to be more nearly allied to *C. prinoides* than to *C. harrisoni*, differing in its duller, more sooty coloration. While all three are closely related, *C. harrisoni* stands at one extreme of the series well removed from the other two.

130. Cisticola cisticola (Temm.).

Sylvia cisticola Temm., Man. d'Orn., I, p. 228, 1820. [Portugal and Spain.]

Nairobi, May 17; Naivasha, July 31; El Bolossa swamp, September 10. "Irides brown, bill dusky, feet flesh color."

131. Cisticola lugubris Rüpp.

Sylvia (Cisticola) lugubris Rüpp., N. W., p. 111, 1835. [Gondar, Abyssinia.]

Nairobi, May 17; Naivasha, June 8.

132. Schœnicola apicalis Cab.

Schœnicola apicalis Cabanis, Mus. Hein. Th., I, p. 43 note, 1850. [Kaffirland.]

Thika river, May 22; Tana river, June 3. "Irides light brown, bill dusky, feet flesh color."

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[3] Cf. *Proc. U. S. Nat. Mus.*, XXVIII, p. 902.

133. Bradypterus salvadorii Neum.

Bradypterus salvadorii Neumann, J. f. O., p. 304, 1900. [Gurui.]

El Bolossa swamp, September 10. "Irides hazel, bill dusky, feet horn." I have no specimens from Abyssinia for comparison, but I take the specimen to be this rather than *cinnamomeus*.

134. Apalis porphyrolæma Reich. and Neum.

Apalis porphyrolæma Riechenow and Neumann, Orn. Monats., p. 75, 1895. [Eldoma Sta. Mau.]

El Bolossa swamp, September 6. "Irides light brown, bill black, feet pale horn."

135. Apalis pulchra Sharpe.

Apalis pulchra Sharpe, Ibis, p. 119, 1891. [Mt. Elgon.]

Guaso Nyiro, October 22. "Irides light brown, bill black, feet silvery gray."

136. Eminia lepida Hartl.

Eminia lepida Hartl., P. Z. S., p. 625, 1880. [Magungo.]

Naivasha, August 10. "Irides red brown, bill black, feet flesh color."

137. Euprinodes golzi Fisch. and Reich.

Euprinodes Golzi Fischer and Reichenow, J. f. O., p. 182, 1884. [Gross Aruscha.]

Nairobi, August 6. "Irides pale golden brown, bill black edged with slate, feet flesh color."

138. Sylviella whytii Shelley.

Sylviella whytii Shelley, Ibis, p. 13, 1894. [Zomba.]

Naivasha, August 2 and 4. "Irides light brown, bill dusky, feet flesh." Clearly this species, according to Grant's Key, *Ibis*, p. 156, 1900. *S. jacksoni* Sharpe is a synonym according to Grant, but is recognized by Sharpe in his *Hand List*.

139. Camaroptera brevicaudata "Cretzschm." Rüpp.

Sylvia brevicaudata Cretzschmar, Rüpp., Atlas Vög., p. 53, Pl. 35b, 1826. [Kordofan.]

Tana river, July 5; Naivasha, August 2; Pesi swamp, September 30. "Irides light brown, bill black, feet flesh." I fail to distinguish this from specimens so identified by Dr. R. Bowdler Sharpe in Dr. Donaldson Smith's collection. Cassin's type of *C. tincta* is the same, but *C. griseigula* Sharpe, *Ibis*, p. 158, 1892, I do not know.

140. Prinia mystacea Rüpp.

Prinia mystacea Rüpp., Neue Wirbelth. Vögl., p. 110, 1835–40. [Gondar, Abyssinia.]

Fort Hall, Maranga, May 31. "Irides light brown, bill dusky, feet flesh color."

PRIONOPIDÆ.

141. **Eurocephalus rüppelli** Bon.

Eurocephalus rüppelli Bon., Rev. Mag. Zool., p. 440, 1853. [White Nile, Schoa.]

Tana river, June 24. "Irides hazel, bill and feet black."

LANIIDÆ.

142. **Lanius humeralis** Stanley.

Lanius humeralis Stanley, Salt's Travels App., p. li, 1814. [Abyssinia.]

Fort Hall, July 11; Naivasha, July 28 and August 21. "Irides hazel, bill and feet black."

143. **Lanius caudatus** Cab.

Lanius caudatus Cabanis, in V. d. Decken's Reis. Ost-Afr., III, p. 28, Pl. V, 1869. [Mombasa.]

Thika river, May 27; Fort Hall, May 29; Tana river, June 17. "Irides dark hazel, bill and feet black."

144. **Dryoscopus cubla hamatus** (Hartl.).

Dryoscopus hamatus Hartlaub, P. Z. S., p. 106, 1863. [Kazeh, E. Africa.]

Tana river, June 17, July 3 and 5. "Irides chrome red, bill black, feet blue gray." Reichenow regards this as a subspecies of *cubla*, while Sharpe places it in another section of the genus.

145. **Laniarius poliocephalus** Licht.

Laniarius poliocephalus Licht., Vertz Doubl., p. 45, 1823.

Tana river, July 3. "Irides yellowish gray, bill black, feet greenish gray."

146. **Laniarius æthiopicus** (Gmel.).

Turdus æthiopicus Gmelin, S. N., II, p. 824, 1788. [Abyssinia.]

Naivasha, August 10; El Bolossa swamp, September 20 and 22. "Irides hazel, bill black, feet ashy gray." One of these has only white scapulars and white at the nostril.

147. **Pomatorhynchus senegalus** (Linn.).

Lanius senegalus Linn., S. N., I, p. 137, 1766. [Senegal.]

Tana river, June 18 and 24, July 3. "Irides hazel, bill black, feet pale gray."

PARIDÆ.

148. **Parus albiventris** Shelley.

Parus albiventris Shelley, Ibis, p. 116, 1881. [Ogogo.]

El Bolossa swamp, September 3; Pesi swamp, September 30. "Irides hazel, bill black, feet ash."

ZOSTEROPIDÆ.

149. Zosterops jacksoni Neuman.

Zosterops jacksoni, Orn. Monatsb., p. 23, 1999. [Mau.

Naivasha, August 10; El Bolossa swamp, September 1. "Iris hazel, bill black, feet ash gray."

150. Zosterops kikuyensis Sharpe.

Zosterops kikuyensis Sharpe, Ibis, p. 444, 1891. [Kikuyu Forest.]

Kiangop Mountain, alt. 10,000 feet, October 26. "Irides brown, bill black, feet blue gray." This specimen differs from the preceding species in the greater extent of yellow on the forehead, the white eye ring, and the distinctly narrower bill. The two seem to be quite distinct.

NECTARINIIDÆ.

151. Drepanorhynchus reichenowi Fischer.

Drepanorhynchus reichenowi Fischer, J. f. O., p. 56, 1884. [Naiwascha-see.]

Naivasha, July 28; El Bolossa swamp, September 14. "Irides hazel, bill and feet black." One specimen shows green reflections on the back predominating over the copper; none are fully adult, the head and back being to a considerable extent dull black.

152. Nectarinia pulchella (Linn.).

Certhia pulchella Linn., S. N., I, p. 187, 1766. [Senegal.]

El Bolossa swamp, September 6. "Irides hazel, bill and feet black."

153. Nectarinia kilimensis Shelley.

Nectarinia kilimensis Shelley, P. Z. S., p. 555, 1884. [Kilimanjaro.]

Fort Hall, May 31 to July 11; Naivasha, August 6 and 21; Pesi swamp, October 5. "Irides dark hazel, bill and feet black." The females or young are much yellower above and below than *N. tacazze*. One of the July specimens is molting.

154. Nectarinia tacazze "Stanley" Shelley.

Nectarinia tacazze Stanley, Shelley, Mon. Nect., p. 19, Pl. 7, 1877.

El Bolossa swamp, September 5 and 6. "Irides hazel, bill and feet black." I fail to distinguish *N. jacksoni* Neumann. Molting individuals show that the juvenal plumage is mouse gray like the adult female, except that the center of the abodmen is yellowish. The adult plumage of the male is acquired in September.

155. Nectarinia famosa cupreoniteus (Shelley).

Nectarinia cupreoniteus Shelley, Mon. Nect., p. 17, Pl. 6, fig. 1, 1876. [Abyssinia.]

El Bolossa swamp, September 5. "Irides hazel, bill and feet black."

156. **Cinnyris falkensteini** Fisch. and Reich.

Cinnyris Falkensteini Fischer and Reichenow, J. f. O., p. 56, 1884. [Naiwasha.]

Naivasha, July 28 and 29, August 6. Guaso Nyiro, October 22. "Irides hazel, bill and feet black." The female is dull olive brown, lighter yellow in the middle of the belly.

157. **Chalcomitra aoik** Antin.

Nectarinia Acik Antinori, J. f. O., p. 205, 1866. [Djur Territory.]

Fort Hall, Maranga, July 11. "Irides hazel, bill and feet black." Specimen immature.

MOTACILLIDÆ.

158. **Motacilla vidua** Sund.

Motacilla vidua Sund., Oefv. Vet. Ak. Förh., p. 128, 1850. [Kaffirland.]

Tana river, July 3. "Irides hazel, bill and feet black."

159. **Budytes campestris** (Pall.).

Motacilla campestris Pallas, Reise Russ. Reichs, III, Anh., p. 696, 1776. [S. Tartary.]

El Bolossa, September 17 and 23. "Irides brown, bill dusky, lighter at base, feet very dark brown." Two of the four examples are adult, the others are in the juvenal (?) plumage, beginning to acquire a few yellow feathers.

160. **Anthus pyrrhonotus gouldi** (Fraser).

Anthus Gouldi Fraser, P. Z. S., p. 27, 1843. [Cape Palmas.]

Pesi swamp, October 9. "Irides hazel, bill dusky, feet ochre-flesh."

161. **Anthus rufulus cinnamomeus** (Rüpp.).

Anthus cinnamomeus Rüpp., Neue Wirb., p. 103, 1835. [Abyssinia.]

Naivasha, July 29 and 31, August 4; El Bolossa swamp, September 9. "Irides hazel, bill dusky, feet flesh." The Naivasha birds are just finishing a complete molt, while the September specimen is in worn plumage and is just beginning to molt. It is evidently an adult, while I take the others to be birds of the year.

162. **Macronyx croceus** (Vieill.).

Alauda crocea Vieill., Nov. Dict. d'Hist. Nat., I, p. 365, 1816.

Thika river, May 22; Tana river, June 3; Pesi swamp, October 3. "Irides hazel, bill dusky, feet ochraceous flesh." The June specimen in full juvenal plumage, while the others are all adults and all in the midst of a complete molt, showing that this species has two complete molts a year.

ALAUDIDÆ.

163. Mirafra albicauda Reich.

Mirafra albicauda Reichenow, J. f. O., p. 223, 1891. [Schluss der Sitzang.]

Near Nairobi, May 17. "Irides hazel, bill dusky, feet flesh."

164. Mirafra athi (Hartert).

Mirafra africana athi Hartert, Nov. Zool., p. 46, 1900. [Athi plain, Nairobi.]

Near Fort Hall, May 29; Naivasha, July 29, August 6 and 23; Pesi swamp, September 26. "Irides hazel, bill dusky, feet flesh."

165. Tephrocorys cinerea saturatior Reich.

Tephrocorys cinerea saturatior Reichenow, Vög. Afr., III, p. 378, 1904. [Angola.]

Naivasha, July 29 and 31. "Irides hazel, bill dusky, feet horn color." Three of the four specimens are in full molt and appear to be young of the year, which in this family have a complete molt when changing from the juvenal to the first winter plumage.

166. Alseonax murina Fischer and Reich.

Alseonax murina Fischer and Reichenow, J. f. O., p. 54, 1884. [Fusse, Maern-berg.]

El Bolossa swamp, September 1 and 22. "Irides hazel, bill and feet dark brown."

FRINGILLIDÆ.

167. Crithagra albifrons Sharpe.

Crithagra albifrons Sharpe, Ibis, p. 118, 1891. [Kikuyu.]

El Bolossa swamp, September 3. "Irides hazel, bill dusky, feet horn color."

168. Anomalospiza imberbis (Cab.).

Crithagra imberbis Cabanis, J. f. O., p. 412, 1868. [Inner E. Africa.]

Naivasha, July 29, August 4; Pesi swamp, September 30. "Irides hazel, bill greenish, feet dusky."

169. Petronia pyrgita (Heugl.).

Xanthodina pyrgita Heuglin, J. f. O., p. 30, 1862. [Abyssinia.]

Tana river, June 17. "Irides hazel, bill pale horn, feet grayish brown."

170. Passer rufocinotus Fischer and Reich.

Passer rufocinctus Fischer and Reichenow, J. f. O., p. 55, 1884. [Naivasha.]

Naivasha, August 2 and 6. "Irides pale straw, bill black, feet horn color."

171. Serinus reichenowi Salvad.

Serinus reichenowi Salvadori, Ann. Mus. Civ. Gen., p. 272, 1888. [Cialalaka.]

Naivasha, August 4. "Irides hazel, bill dusky, feet horn."

172. **Serinus flaviventris** (Blanf.).

Crithagra flaviventris Blanford, Geol. and Zool. Abyss., p. 414, Pl. VII, 1870. [Abyssinia.]

El Bolossa swamp, September 3 and 8. "Irides hazel, bill dusky, feet dark horn color."

173. **Chrysomitris melanops** (Heugl.).

Fringilla melanops Heuglin, J. f. O., p. 92, 1868. [Gondar (?), Abyssinia.]

Fort Hall, June 2, July 11. "Irides brown, bill dusky, feet horn."

174. *Sp. ?*

A young finch in juvenal plumage.

PLOCEIDÆ.

175. **Hypochæra ultramarina** (Gmel.).

Fringilla ultramarina Gmelin, S. N., I, p. 927, 1788. [Abyssinia.]

Guaso Nyiro, October 24. "Irides hazel, bill pearl white, feet salmon pink."

176. **Lagonosticta brunneiceps** Sharpe.

Lagonosticta brunneiceps Sharpe, Cat. Bds. Brit. Mus., XIII, p. 277, 1890. [Maragaz.]

Fort Hall, June 10. "Irides dull red, orbits yellow, bill dusky, edged with red, feet horn color."

177. **Coccopygia kilimensis** Sharpe(?).

Coccopygia kilimensis Sharpe, Cat. Bds. Brit. Mus., XIII, p. 307, 1890. [Kilimanjaro.]

El Bolossa swamp, September 22. "Irides brown, bill black, feet dark horn color." This is a female, and is referred to this form on the ground that Nairobi specimens were so identified by Shelley. Without a male it is impossible to be sure of its relationship.

178. **Estrilda rhodopyga** Sundev.

Estrilda rhodopyga Sundevall, Oefv. K. Vet. Akad. Förh. Stockh., p. 126, 1850. [E. Africa.]

Tana river, June 18, July 5. "Irides brown, bill dusky, feet horn color."

179. **Estrilda minor** (Cab.).

Habropyga minor Cabanis, J. f. O., p. 229, 1878. [Voi River.]

Near Nairobi, May 17; Fort Hall, May 29; Tana river, June 9 (?). "Irides light brown, bill bright red, feet dusky." The Tana river specimen is young, and I am not sure that it belongs here.

180. **Uræginthus bengalus** (Linn.).

Fringilla bengalus Linn., S. N., p. 323, 1766.

One specimen without data.

181. Uræginthus ianthinogaster Reich.

Uræginthus ianthinogaster Reichenow, Ornith. Centralbl., p. 114, 1879.

Naivasha, August 6. "Irides brick red, bill dull crimson, feet grayish black."

182. Spermestes cucullatus Sw.

Spermestes cucullatus Swainson, Bds. W. Afr., I, p. 201, 1837. [Senegambia.]

Fort Hall, July 11. "Iris hazel, upper mandible black, lower pearl gray."

183. Nigrita schistacea Sharpe.

Nigrita schistacea Sharpe, Ibis, p. 118, 1891 (251). [Sotik.]

El Bolossa swamp, September 1. "Irides pale straw, bill black, feet horn color."

184. Vidua serena (Linn.).

Emberiza serena Linnæus, S. N., p. 312, 1766.

Fort Hall, July 11; Guaso Nyiro, October 23 and 24. "Irides hazel, bill coral red, feet dusky gray."

185. Quelea æthiopica (Sundev.).

Ploceus sanguinirostris var. *æthiopica* Sundev., Oefv. K. Vet. Akad. Förh., p. 126, 1850; Pl. 10, fig. 5, 1890. [Senaar.]

Naivasha, July 31. "Irides brown, bill pale red, feet flesh color."

186. Philetairus arnandi (Bonap.).

Nigrita arnandi Bonaparte, Conspect., I, p. 444, 1850. [White Nile.]

Pesi swamp, October 3. "Irides hazel, bill black, feet flesh color."

187. Coliuspasser delamerei Shelley.

Coliuspasser delamerei Shelley, Bull. B. O. C., XIII, p. 73, 1903.

El Bolossa swamp, September 9; Pesi swamp, October 8 and 9. "Irides hazel, bill pearl white, feet horn color."

188. Coliuspasser jacksoni (Sharpe).

Drepanoplectis jacksoni Sharpe, Ibis, p. 246, Pl. 5, 1891. [Kikuyu.]

Nairobi, May 16; Markham Downs, August 30. "Irides hazel, bill black splashed at the tip with white feet, dark brown." These two specimens are adult males in the black plumage; four birds from Naivasha, August 21, and two from El Bolossa swamp, September 24, are in the striped plumage and appear to belong to this species.

189. Coliuspasser laticauda (Licht.).

Fringilla laticauda Lichtenstein, Verg. Doubl., p. 24 footnote, 1823. [Nubia.]

Nairobi, May 16; on the Daruku, May 20; Thika, May 21 to 25; Fort Hall, May 30; El Bolossa, September 5; Guaso Nyiro, October 23 and 24. "Irides hazel, bill black, feet black."

190. **Penthetria eques** (Hartl.).

Vidua eques Hartlaub, P. Z. S., p. 106, Pl. XV, 1863. [Kazeh.]

On the Daruku, May 20; Thika river, May 22; Fort Hall, July 11. "Irides dark hazel, bill pearl white, feet black."

191. **Orynx xanthomelas** (Rüpp.).

Euplectes xanthomelas Rüppell, Neue Wirb. Vög., p. 94, 1835–40. [Temben and Simen.]

Fort Hall, June 2; Tana river, June 3; Naivasha, July 29 to August 6. "Irides dark hazel, bill white splashed with black on upper mandible, feet horn color."

192. **Hyphantornis spekei** Heugl.

Hyphantornis spekei Heuglin, Peterm. Geogr. Mitt., p. 24, 1861.

Naivasha, August 6; Laikipia plateau northeast of Nairobi, October 19. "Irides pale straw, bill dusky tinged with red, feet horn color."

193. **Hyphantornis nigriceps** Layard.

Hyphantornis nigriceps Layard, S. Afr., p. 180, 1867. [Kuruman.]

Fort Hall, June 10; Guaso Nyiro, October 24. "Irides crimson, bill black, feet horn color."

194. **Hyphantornis ocularis crocatus** (Hartl.).

Hyphantornis crocata Hartlaub, Abb. Breman, p. 100, 1881.

Naivasha, August 2; Pesi swamp, October 10; Laikipia plateau northeast of Nairobi, October 22. "Irides pale straw, bill black, feet ash gray."

195. **Othyphantes reichenowi** (Fischer).

Sycobrotus Reichenowi Fischer, J. f. O., p. 180, 1884. [Gross Aruscha.]

Fort Hall, May 31, July 11; Naivasha, August 2; El Bolossa swamp, September 1; Pesi swamp, October 3. "Irides pale straw, bill black, feet horn color."

196. **Xanthophilus xanthops** (Hartl.).

Hyphantornis xanthops Hartlaub, Ibis, p. 342, 1862. [Angola.]

Fort Hall, July 11. "Irides pale straw, bill dusky, feet horn."

197. **Ploceipasser melanorhynchus** Rüpp.

Ploceipasser melanorhynchus Rüppel, Syst. Uebers., p. 78, 1845. [Schoa.]

Thika river, June 15; Tana river, July 6. "Irides hazel, bill black, feet dark gray."

198. **Amblyospiza unicolor** (Finsch and Reich.).

Pyrenestes unicolor Finsch and Reichenow, Orn. Centralb., p. 88, 1878. [Mombasa and Zanzibar.]

Tana river, June 3. "Irides hazel, bill dusky splashed with yellow, feet black."

199. Dinemellia dinemelli "Horsf." Rüpp.

Textor Dinemelli "Horsf." Rüppell, Syst. Uebers., pp. 72, 76, T. 30, 1845. [Schoa.]

Tana river, June 17. "Irides hazel, bill and feet black."

ORIOLIDÆ.

200. Oriolus larvatus Licht.

Oriolus larvatus Lichtenstein, Vertz. Doubl., p. 20. [Kaffirland.]

Tana river, June 21. "Irides crimson, bill dull brick red, feet dusky black."

DICRURIDÆ.

201. Dicrurus afer fugax (Peters).

Dicrurus fugax Peters, J. f. O., p. 132, 1868. [Inhambane, Mosambique.]

Naivasha, August 6. "Irides crimson, bill and feet black."

STURNIDÆ.

202. Pholidauges verreauxi Finsch and Hartl.

Pholidauges verreauxi Finsch and Hartlaub, Orn. Afr., p. 867, 1876.

El Bolossa swamp, September 3. "Irides pale straw, bill black, yellow at tip, feet dark horn."

203. Pholia sharpii (Jackson).

Pholidauges sharpii Jackson, Bull. B. O. C., LVIII, Dec., 1898. [Nandi, Equatorial Africa.]

El Bolossa swamp, August 31. "Irides dark straw, bill black, feet very dark horn."

204. Lamprotornis viridipectus Salvad.

Lamprotornis viridipectus Salvadori, Mem. R. Acad. Sci. Torin, p. 560, 1894. [Elgeyn.]

Tana river, June 17. "Irides hazel, bill and feet black."

205. Lamprocolius chalybeus (Ehr.).

Lamprotornis chalybeus Ehrenberg, Symb. Phys., fol. y, Pl. 10, 1828. [Donegala.]

Naivasha, July 28. "Irides dark straw, bill and feet black."

206. Malaconotus olivaceus hypopyrrhus (Hartl.).

Malaconotus hypopyrrhus Hartlaub, Verz. Ges. Mus. Brem., p. 61, 1844.

Tana river, July 3. "Irides yellow gray, bill black, feet greenish gray."

207. Spreo superbus (Rüpp.).

Lamprotornis superbus Rüppell, Syst. Uebers., pp. 65, 75, Taf. 26, 1845. [Schoa.]

Naivasha, July 29, August 6 and 21. "Irides pale straw, bill and feet black."

208. Perrisornis oarunculata (Gmel.).

Gracula carunculata Gmelin, S. N., I, p. 399, 1788. [Cape of Good Hope (?).]

Naivasha, August 6. "Irides hazel, bill white dusky at base, feet pale horn, bare skin on throat purplish flesh color, behind the eye lemon yellow."

209. Buphaga erythroryncha (Stanley).

Tanagra erythroryncha Stanley, Salt's Voy. Abyss., Append., p. lix, 1814. [Abyssinia.]

Naivasha, August 6; Morandat river, August 26. "Irides dark straw, orbits chrome yellow, bill coral red, feet black."

CORVIDÆ.

210. Corvultur albicollis (Lath.).

Corvus albicollis Latham, Ind. Orn., p. 151, 1790. [Africa.]

Fort Hall, May 29; Tana river, June 4; Markham Downs, August 29. "Irides dark hazel, bill black white at tip, feet black."

211. Corvus scapulatus Daud.

Corvus scapulatus Daudin, Traité, II, p. 232, 1800. [Asia and Africa.]

Tana river, June 4 and 9. "Irides hazel, bill and feet black."

212. Heterocorax minor (Heugl.).

Heterocorax minor Heuglin, Syst. Uebers., p. 35.

El Bolossa swamp, September 17. "Irides hazel, bill and feet black."

HAWAIIAN SPECIES OF ENDODONTA AND OPEAS.

BY H. A. PILSBRY AND E. G. VANATTA.

Some five species of the typical group of Endodonts have been described from these islands. One of these, *E. binaria* (Pfr.), is unlike the others in wanting palatal teeth. Two, *E. laminata* (Pse.) and *E. apiculata* Anc., are roughly sculptured, and two, *E. lamellosa* (Fér.) and *E. fricki* (Pfr.), are smoothish, marked with weak growth-lines only. The present paper deals with the smooth species. According to Mr. Thaanum, these snails are found among dead leaves on the ground, never on logs or stumps. The round-whorled, ribbed Endodonts, such as *E. luctifera* and *E. thaanumi*, live on dead stumps and logs, and under the bark of dead trees, but also among fallen leaves. *E. lanaiensis* was found at Mapulehu, Molokai, under bark and on stumps.

Endodonta lamellosa (Fér.). Pl. XLIII, figs. 7, 8.

Helix lamellosa Fér., Histoire, etc., I, p. 369, Pl. 51A, fig. 3.

The locality of the original specimens of this species is not known. Specimens labelled Kauai in the collection of the Academy agree best with the original figures, one of these being illustrated on our plate. This shell measures, alt. 3.5, diam. 9.5 mm., and has $6\frac{1}{2}$ whorls. The umbilicus is rounded at the bottom, being at first thimble-shaped with subvertical walls; then the suture diverges more, leaving a narrow, flat spiral terrace which descends about 1 to $1\frac{3}{4}$ turns, the side wall remaining vertical except on the last half whorl where it slopes outward a little, as shown in fig. 8. The keel does not project at the suture on the upper surface, though visible there. The upper parietal lamella is distinctly bifid.

Somewhat smaller shells have been examined from Waianae, Oahu (D. D. Baldwin), and a small race also occurs at Mt. Lihau, near Lahaina, West Maui (D. Thaanum).

Mr. Sykes has placed *E. fricki* (Pfr.) under *E. lamellosa* as a synonym, but without stating that he had seen the type. As originally described and figured, it differs from *lamellosa* by the absence of a columellar lamella. This is, next to the parietal, the most constant of the laminæ in *Endodonta*, and its absence, if confirmed by other specimens and not pathologic, would seem to be of some significance. We have not seen specimens.

Endodonta marsupialis n. sp. Pl. XLIII, figs. 1, 2.

Shell lenticular; nearly smooth; light horn colored profusely maculated with reddish brown; spire elevated, convexly conoid; whorls 6½ nearly flat, overhanging a little at the suture; periphery acutely keeled; base convex, with a shallow depression near the peripheral keel; the umbilicus is about one-fifth the diameter of the shell, angular at the edge; the whorls within the umbilicus concave, the side walls sloping inward, and hence the cavity is wider within than at the opening, where the whorl projects in a sort of cord.

Aperture oblique, trapezoidal, provided with two spirally entering parietal lamellæ, the outer one largest and bifid, one columellar lamella, four basal plicæ and one palatal plica.

Alt. 4, diam. 8 mm.

Oahu. Types in the collection of the Academy of Natural Sciences No. 58,190, presented by Mr. J. S. Phillips.

Some specimens have an extra smaller basal and palatal plica near the peripheral angle and some are albinos, corneous yellow, without dark markings.

This species may be distinguished from *E. lamellosa* (Fér.) by its smaller umbilicus and higher spire; from *E. kamehameha* by its greater size, larger teeth and elevated spire. It is distinguished from *E. concentrata* by the greater size and more numerous teeth. It differs from all the other forms by its cavern-like umbilicus, in which the eggs are deposited.

This snail represents a line of differentiation parallel to the section *Libera* Garrett, in the structure of the umbilicus.

Endodonta kamehameha n. sp. Pl. XLIII, figs. 3, 4.

Shell lenticular; nearly smooth; yellowish olive, often with the last whorl partly brown, with some traces of darker brown maculation on the spire. Spire moderately depressed, composed of 5½ flat whorls; suture linear; periphery acutely keeled; base conical, slightly impressed near the periphery. Umbilicus about one-third the diameter of the shell, wide and rounded at the bottom, thimble-like with subvertical walls at first, then becoming perspective, terraced, a narrow ledge running down about 1½ whorls, the side walls remaining vertical, only sloping outward a little at the last half whorl. Aperture oblique, trapezoidal, furnished with two spirally entering parietal lamellæ, one columellar lamella, three basal plicæ and one palatal plica, all of which are much weaker than in *E. lamellosa* (Fér.).

Alt. 2.75, diam. 6 mm.

Locality: Wailau Pali, Mapulehu, Molokai. The types are in the collection of the Academy of Natural Sciences, No. 90,140, presented by Mr. D. Thaanum.

This species has a proportionately larger umbilicus than *E. lamellosa* (Fér.) or *concentrata* P. and V., and the teeth are much smaller than in either. The umbilicus resembles that of *E. lamellosa.* It is utilized as a receptacle for the eggs.

Endodonta concentrata n. sp. Pl. XLIII, figs. 5, 6.

Shell lenticular; nearly smooth; marked with weak growth-lines only; oliveaceous yellow becoming brown near the lip where the epidermis is preserved, but usually in large part denuded of cuticle, grayish, with irregular angular brown spots on the upper surface of the last whorl, and often some marking on the base; spire convex, composed of 5½ nearly flat whorls, separated by a linear suture. The last half whorl a little descending, the preceding keel a little overhanging, periphery sharply keeled; base convex; umbilicus about one-fifth the diameter of the shell, well-shaped, a little contracted and rounded at the edge, being perceptibly more ample within. Aperture trapezoidal, obstructed by two parietal lamellæ, the outer being the larger and bifid; one columellar lamella; three basal plicæ and one palatal plica.

Alt. 2.75; diam. 5 mm.

Locality: Lanai. The types are in the collection of the Academy of Natural Sciences of Philadelphia, No. 89,241, presented by Mr. D. Thaanum. This *Endodonta* is smaller than *E. lamellosa* (Fér.) and *marsupialis* P. and V. It has the opening of the umbilicus contracted as in *marsupialis* but to a less degree, and neither sharp-edged nor provided with a spiral cord. As in *E. marsupialis*, the eggs are carried in the umbilicus. The apertural laminæ are well developed, much larger than in *E. kamehameha* P. and V.

Opeas opella n. sp. Fig. 1.

Shell cream colored, glossy, indistinctly irregularly striate, rather stout, apex obtuse, whorls six moderately convex, body whorl high, umbilicus very small, aperture ovate more than one-third the height of the shell, outer lip evenly arched, columella sinuous and reflexed over the umbilical perforation.

Alt. 6.8, diam. 2.9 mm.

Locality: Honolulu. This species is a little larger and more slender than *O. brevispira* Pils. and has the aperture more elongate. It is smaller and more openly umbilicate than *O. semperi* Hid. *O. hawaiense* Sykes is rougher and more slender. The types were presented to the Academy of Natural Sciences by Dr. W. H. Rush. Mr. R. C. McGregor also found two of these shells under guava leaves at Hilo, Hawaii, and donated them to the Academy.

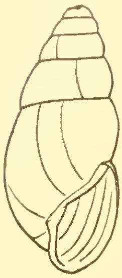

Fig. 1.

Opeas junceum, hawaiense and *upolense* are taken, Mr. Thaanum informs us, under stones and bits of board, etc., in gardens and open country. Their occurrence in such places affords no proof that they are native Hawaiians, but, so far as it goes, makes for the view that they are immigrants

Plate XLIII.

Figs. 1, 2.—*Endodonta marsupialis* n. sp.
Figs. 3, 4.—*Endodonta kamehameha* n. sp.
Figs. 5, 6.—*Endodonta concentrata,* n. sp.
Figs. 7, 8.—*Endodonta lamellosa* Fér. Kauai

ON SOME PACIFIC CERITHIIDÆ.

BY H. A. PILSBRY AND E. G. VANATTA.

Two species described in these *Proceedings*, p. 576, are now figured, *C. thaanumi* and *C. hawaiense,* and two others are described.

Cerithium thaanumi P. and V. Fig. 1.

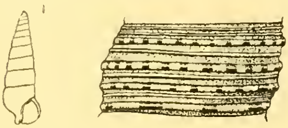

Fig. 1. *C. thaanumi.*

Besides the typical form of this species, which measures about 12 to 14 mm. long, there is a very small form, with nearly the same shape and sculpture. Specimens measure from length 7.8, diam. 2.5 mm., to length 6, diam. 2 mm.

This form is also from Hilo, Hawaii, found by Mr. D. Thaanum.

Cerithium hawaiense P. and V. Fig. 2.

Hilo, Hawaii. See p. 576.

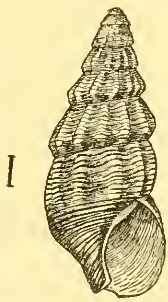

Fig. 2. *C hawaiiense.*

Cerithium voyi n. sp. Fig. 3.

Shell solid, turreted, acuminate above, the lateral outlines slightly convex below, straight above. White. Varices very low and inconspicuous, somewhat more than two on each of the whorls of the upper half of the spire; one low wide one on the last whorl opposite the lip. Surface nearly smooth to the eye, showing under the lens a dense sculpture of finer and coarser spiral threads, the coarser ones spaced, one or two near the periphery somewhat granose; the earlier whorls of the spire are coarsely plicate longitudinally, and crossed by three coarse cords; this sculpture gradually becoming weaker below. Whorls about 12 (the nucleus lost), but slightly convex, the later ones a little constricted below the suture, the last whorl swollen behind the lip, produced in a very short canal in front. Aperture oval, acuminate above; basal notch deep and open, inner lip calloused, having a callous ridge above.

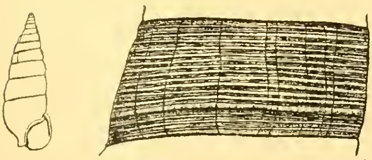

Fig. 3. *C. voyi.*

Length 17. diam. 6 mm.

Caroline Island (C. D. Voy); Hawaiian Islands (W. H. Pease). Type No. 58,192, coll. A. N. S., from the first locality mentioned.

This species is related to *C. nesioticum,* from which it differs chiefly in the finer sculpture of the later whorls, while the earlier ones have a somewhat different and coarse pattern. *C. egenum* Gld. is also allied, but differs in sculpture.

Cerithium nesioticum Pilsbry and Vanatta, n. n. Fig. 4.

Cerithium pusillum Nutt. in Jay's Catalogue of Shells. Not *C. pusillum* Pfr., 1840.

Cerithium lacteum Kiener, Coq. Viv., p. 58, Pl. 7, fig. 3. Not *C. lacteum* Philippi, 1836.

Shell solid, turreted, acuminate above, the lateral outlines more or less convex. White, usually having a series of reddish-brown spots below the suture and some inconspicuous, sparse maculation elsewhere. The varices are inconspicuous, low and convex, usually a little whiter than the rest of the surface, irregularly disposed, there being two or three on each of the whorls of the spire, a single rather prominent wide one on the last whorl opposite the lip, and a swelling behind the lip. The sculpture consists of inconspicuous longitudinal folds below the sutures, very variable in strength and length, and numerous spaced spiral cords which may be either smooth or weakly granose, three threads usually occupying each of the spaces between the cords, the middle thread often larger. There are generally five to seven of the larger cords on the penultimate whorl. The early whorls have four spiral cords and numerous narrow longitudinal folds, producing a cancellated pattern. Whorls 11 to 12, the first one smooth, following several whorls convex, the rest but slightly so. The last whorl is somewhat flattened above, rounded at and below the periphery, and terminates in a very short, slightly recurved anterior canal. The suture is very shallow below, becoming impressed above. Aperture oval, acuminate above, the outer lip strongly arcuate; basal notch deep and open, oblique. The inner lip is covered with a rather strong callus with raised outer edge, and calloused near the posterior angle of the aperture.

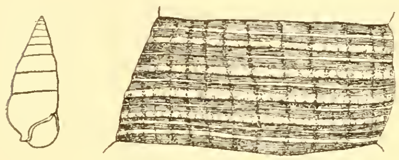

Fig. 4. *C. nesioticum.*

Length 16.5, diam. 6.7, longest axis of aperture 5 mm.

Length 15.7, diam. 5.7, longest axis of aperture 5 mm.

Hawaiian Islands (W. H. Pease); Oahu (W. Newcomb); northern end of Hawaii (Dr. B. Sharp); Fiji Islands (A. Garrett); Flint Island (Voy); Kikaigashima, Ōsumi, in the Riukiu chain (Hirase). Types No. 58,193, A. N. S. P., from Oahu.

This species varies widely in the degree of development of the longitudinal folds, and especially in the sculpture of the major spiral cords, which may be either smooth, slightly granose or rather strongly so. The contour of the shell is also subject to some variation. *C. papillosum* Sowb. (*Thes. Conch.*, II, p. 876, Pl. 184, fig. 215) is apparently related to *nesioticum*, but differs in sculpture and coloration.

It seems to be a common species over a large part of the Indo-Pacific life-area.

NOTES ON THE ORTHOPTERA OF COSTA RICA, WITH DESCRIPTIONS OF NEW SPECIES.

BY JAMES A. G. REHN.

The following notes and descriptions are based on a study of over three hundred and fifty specimens, representing one hundred species, of which eleven are here described as new. This material is distributed through the collections of the Academy of Natural Sciences of Philadelphia, the United States National Museum and the private collection of Mr. Morgan Hebard, of Chestnut Hill, Philadelphia.

The writer is much indebted to Prof. P. Biolley, of San José, Costa Rica, who courteously supplied some very valuable material accompanied by full notes and remarks, and also to Dr. William H. Ashmead, of the United States National Museum, and Mr. Hebard for permission to study the collections mentioned above.

The number of records here published which extend the range of species is rather remarkable, and clearly shows the lack of definite information regarding the Orthoptera of northern South America.

The Forficulidæ, Blattidæ, Mantidæ, Phasmidæ and Acrididæ of the greater portion of these collections have already been studied and reported by the author.[1]

Family BLATTIDÆ.

ANAPLECTA Burmeister.

Anaplecta fallax Saussure.

1862. *Anaplecta fallax* Saussure, Revue et Magasin de Zoologie, 2e ser., XIV, p. 163. [Guatemala.]

Surubres river at San Mateo, altitude 250 meters. Under stones on the borders of the river. February, 1905. [No. 7.] (P. Biolley.) Two specimens.

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[1] Studies in American Forficulidæ, *Proc. Acad. Nat. Sci. Phila.*, 1903, pp. 299-312.

Studies in American Blattidæ, *Trans. Amer. Ent. Soc.*, XXIX, pp. 259-290.

Studies in American Mantids or Soothsayers, *Proc. U. S. Nat. Mus.*, XXVII, pp. 561-574.

Studies in the Orthopterous Family Phasmidæ, *Proc. Acad. Nat. Sci. Phila.*, 1904, pp. 38-107.

Studies in the Orthopterous Subfamilies Acrydiinæ (Tettiginæ), Eumastacinæ and Proscopinæ, *Proc. Acad. Nat. Sci. Phila.*, 1904, pp. 658-683.

A Contribution to the Knowledge of the Acrididæ (Orthoptera) of Costa Rica, *Proc. Acad. Nat. Sci. Phila.*, 1905, pp. 400-454.

Anaplecta decipiens Saussure and Zehntner.

1893. *Anaplecta decipiens* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 27, tab. III, fig. 5, tab. IV, figs. 10 and 11. [States of Vera Cruz and Tabasco, Mexico.]

La Palma, altitude 1,600 meters. May, 1905. In decayed leaves. [No. 11.] (P. Biolley.) Two females.

These specimens are slightly larger than the original measurements and approach *A. lateralis* Burmeister from South America, but in the absence of material from that region and in the broader pronotum and thicker form of *decipiens,* characters shared by the material in hand, I prefer to use the name applied by Saussure and Zehntner.

BLATTELLA Caudell.

Blattella azteca (Saussure and Zehntner)?

Reventazon river, plains of Santa Clara, altitude 200 meters. December, 1904. [No. 4.] (P. Biolley.) One male.

Referred here with some doubt.

Blattella zapoteca (Saussure).

1862. *Bl[atta] zapoteca* Saussure, Revue et Magasin de Zoologie, 2e ser., XIV, p. 166. [Tropical Mexico.]

Surubres river at San Mateo, altitude 250 meters. Under stones on the border of the river. February, 1905. [No. 9.] (P. Biolley.) One female.

This is the most southern record for this beautiful species.

PSEUDOPHYLLODROMIA Brunner.

Pseudophyllodromia peruana (Saussure).

Reventazon river, plains of Santa Clara, altitude 200 meters. December, 1904. [No. 5.] (P. Biolley.) One female.

This specimen is similar in coloration to the one described by the author from San Carlos, Costa Rica.[2]

PSEUDOMOPS Serville.

Pseudomops grata Rehn.

1903. *Pseudomops grata* Rehn, Trans. Amer. Ent. Soc., XXIX, p. 260 [San Carlos, Costa Rica.]

Reventazon river, plains of Santa Clara, altitude 200 meters. December, 1904. [No. 6.] (P. Biolley.) One male.

This specimen differs from the type in the possession of a broad blackish bar on the caudal margin of the pronotum and a pair of circular blackish dots slightly cephalad of the middle of the same plate.

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[2] Trans. Amer. Ent. Soc., XXIX, pp. 261-262.

The other characters, both structure and color, are similar to the type.

PELMATOSILPHA Dohrn.

Pelmatosilpha rotundata Scudder.

1900. *Pelmatosilpha rotundata* Scudder, Proc. Davenport Acad. Nat. Sci., VIII, p. 93, Pl. II, fig. 5. [Texas; Panama.]

Reventazon river, plains of Santa Clara, altitude 200 meters. December, 1904. [No. 3.] (P. Biolley.) One femal .

CHORISONEURA Brunner.

Chorisoneura flavipennis Saussure and Zehntner.

Surubres river at San Mateo, altitude 250 meters. Under stones on the border of the river. February, 1905. [No. 8.] (P. Biolley.) One female.

La Palma, altitude 1,600 meters. May, 1905. In decayed leaves. [No. 11a.] (P. Biolley.) One male.

Slightly darker, but otherwise inseparable from a female from Turrialba, Costa Rica.

HOLOCOMPSA Burmeister.

1838. *Holocompsa* Burmeister, Handb. d. Entom., II, Abth. II, Pt. I, p. 491.

Included *Corydia cyanea, collaris* and *fulva* Burmeister, of which *collaris* (= *Blatta nitidula* Fabricius) has been selected as the type by Kirby.

Holocompsa cyanea (Burmeister).

1838. *C[orydia] cyanea* Burmeister, Handb. d. Entom., II, Abth. II, Pt. I, p. 169. [St. Thomas.]

Surubres river at San Mateo, altitude 250 meters. In house. February, 1905. [No. 10.] (P. Biolley.) One specimen.

This species has previously been recorded in America only from the West Indies.

BLABERUS Serville.

Blaberus thoracicus Saussure and Zehntner.

Reventazon river, plains of Santa Clara, altitude 200 meters. December, 1904. [No. 1.] (P. Biolley.) One female.

This individual is larger than the measurements given in the original description, and has the pattern of the disk of the pronotum slightly different.

Blaberus biolleyi n. sp.

Type: ♀; Reventazon river, plains of Santa Clara, Costa Rica. Altitude 200 meters. December, 1904. [No. 2.] (P. Biolley.) [A. N. S. Phila.]

Closely allied to *B. thoracicus*, but differing in the slightly smaller size, narrower and longer anal area of the tegmina as well as the less distinct and more numerous nervures of the same area, the subtruncate and narrowly incised supra-anal plate, the broader subgenital plate and rather different coloration.

Size medium; form elongate ovoid. Head with the narrowest portion of the interspace between the eyes about equal to the greatest dorso-ventral depth of the eyes; antennæ about a fourth again as long as the width of the pronotum. Pronotum subovate, transverse, half again as broad as long; cephalic margin subangulate, caudal margin arcuate, cephalo-lateral sections moderately deflected. Tegmina elongate, costal margin arcuate, more distinctly so proximad than distad; apex narrowly rounded; sutural margin arcuate in the distal third rounding to the apex; venation distinct, the costal area only irregular reticulate; anal area about two-fifths the length of the tegmen, the anal vein slightly but evenly arcuate. Supra-anal plate rather broad, bilobate, the median emargination V-shaped, rather shallow and broad. Cerci short, very slightly exceeding the supra-anal plate, tapering. Subgenital plate large, broad, slightly produced, the apex blunt and rather narrowly rounded. Femora without spines on the ventral margins. Cephalic tarsi with the distal joint slightly longer than the proximal; median tarsi with the proximal and distal joints subequal; caudal tarsi with the proximal joint slightly longer than the distal.

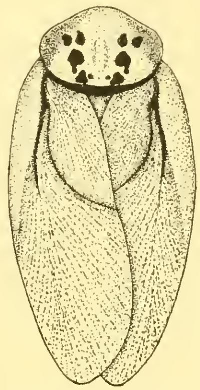

Fig. 1. *Blaberus biolleyi* n. sp. Type. Natural size.

General color pale clay-color, the pronotum with the ground color ochraceous. Head pale ochraceous, with the region between the eyes, between the paired ocelli, except a median spot of the base color, and a median line on the lower face burnt umber; eyes blackish; antennæ blackish-brown. Pronotum with a broad bar of blackish on the caudal margin, tapering laterad and disappearing before the angles of greatest width, two pairs of irregularly rounded spots of the same color situated before the middle and in pairs with the space between them slightly greater than their distance from the cephalic margin, caudad of these a pair of rather large comma-shaped spots of the same color and caudad of these a pair of roughly trigonal spots.

Limbs with the tarsi, tibiæ and distal sections of the femora suffused with burnt umber. Abdomen with the lateral marks of the dark brown color united at, and suffusing the greater portion of, the subgenital plate, as is usual in species of the genus.

Measurements.

Length of body,	42 mm.
Length of pronotum,	11.5 "
Breadth of pronotum,	16.6 "
Length of tegmen,	42 "
Width of tegmen,	15.7 "

The type is unique.

I take pleasure in dedicating this species to Prof. P. Biolley, of San José, Costa Rica, who collected the type and supplied a portion of the material on which this paper is based.

Family **MANTIDÆ**.

ACONTISTA Saussure.

Acontista mexicana Saussure and Zehntner.

Carrillo. (Hebard Collection.) One female.

STAGMOMANTIS Saussure.

Stagmomantis nahua Saussure.

Carrillo. (Hebard Collection.) One male, one female.

The facial scutellum of the female is not narrowly emarginate dorsomesad as in a female from Chinandega, Nicaragua, while all three specimens examined have the cephalic limbs unspotted.

Stagmomantis tolteca (Saussure).

Surubres river at San Mateo, altitude 250 meters. February, 1905. [No. 13.] (P. Biolley.) One male.

Stagmomantis venusta Saussure and Zehntner.

1894. *Stagmomantis venusta* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 145, Pl. VII, figs. 4 and 5. [Sinanja, Panima and Teleman, Vera Paz, Guatemala.]

Surubres river at San Mateo, altitude 250 meters. February, 1905. [No. 15.] (P. Biolley.) One male.

Stagmomantis androgyna Saussure and Zehntner.

1894. *Stagmomantis androgyna* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 147, Pl. VII, fig. 1. [Belize, British Honduras.]

Surubres river at San Mateo, altitude 250 meters. February, 1905. [No. 14.] (P. Biolley.) One male.

This specimen has the black stigma very small, and the pronotum shorter (19.5 mm.) than the original measurements (23.5 mm.). The maculations of the wings are practically absent, those organs being weakly suffused with reddish brown as is the case with the tegmina. The shape and proportions of the pronotum readily separate this species from *S. montana*.

PSEUDOMIOPTERYX Saussure.

Pseudomiopteryx infuscata Saussure and Zehntner.

Caché, altitude 1,000 meters. May, 1905. In forest. [No. 16.] (P. Biolley.) One male.

Family PHASMIDÆ.

BOSTRA Stål.

Bostra turgida (Westwood).

1859. *Bacteria turgida* Westwood, Catal. Orthopt. Ins. Coll. Brit. Mus., Phasm., p. 28, Pl. VIII, figs. 4 and 9. [Venezuela.]

Caché, altitude 1,000 meters. May, 1905. [No. 24.] (P. Biolley.) One male.

As far as can be determined from the broken male figured and described by Westwood, this appears to be the same species. It is, however, somewhat smaller, and has the antennæ longer than in Westwood's figure and equal to the body in length, instead of reaching "rather beyond the middle of the metathorax."

The species of the genus *Bostra* in hand for study are four: *incompta* Rehn,[3] *jaliscensis* Rehn,[4] *jugalis* Rehn[5] and *turgida* Westwood. The males of all these species are now before me and can be separated by the following key:

a.—Cerci not exceeding the subgenital opercule proper (*i.e.*, the eighth ventral segment) in length.

b.—Ninth dorsal abdominal segment somewhat bullate, the caudal margin bilobate, with the median emargination subtrigonal. Subgenital opercule without a distinct claw-like process.

c.—Median segment in length not exceeding one-half the remaining portion of the metanotum. Cerci slightly tapering, ... *B. turgida* (Westw.).

cc.—Median segment in length nearly equal to the remaining portion of the metanotum. Cerci not tapering. *B. incompta* Rehn.

bb.—Ninth dorsal abdominal segment longitudinal, subequal, not bullate, the caudal margin laterad acute-angulate and brace-shaped[6] between. Subgenital opercule with a distinct claw-like process ventrad of the caudal margin. *B. jaliscensis* Rehn.

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[3] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 57. [San Carlos, Costa Rica.]
[4] *Ibid.*, 1904, p. 514. [Tuxpan, Jalisco, Mexico.]
[5] *Invertebrata Pacifica*, I, p. 72. [Chinandega, Nicaragua.]
[6] Shaped thus .

aa.—Cerci exceeding the subgenital opercule in length, very distinctly bent arcuate proximad and compressed in the distal half, *B. jugalis* Rehn.

Stål's *B. dorsuaria*[7] and Scudder's *B. exigua*[8] are known from the males, while *B. remiformis* Rehn[9] is based on the female sex. The latter has the median segment two-thirds the length of the metanotum itself, which fact would associate it with *jaliscensis, incompta* and *jugalis*. As the female of *jugalis* is known it is certainly not that species, while the other two species are very much larger in the male sex than the female type of *remiformis*. Accordingly I think it a good species of which the male is unknown.

LIBETHRA Stål.

1875. *Libethra* Stål, Recensio Orthopterorum, III, pp. 20, 74.

Type.—*L. nisseri* Stål.

Libethra auritus n. sp.

Type: ♀; San José, Costa Rica. Altitude, 1,160 meters. August, 1904. [No. 22.] (P. Biolley.) [A. N. S. Phila.]

Allied to *L. ignavus* Westwood, but differing in the ear-like cephalic appendages, the reduction of the lobes on the median and caudal limbs, the absence of especially pronounced lobes on the second abdominal segment and the presence of such on the fifth segment, and the shorter caudal limbs.

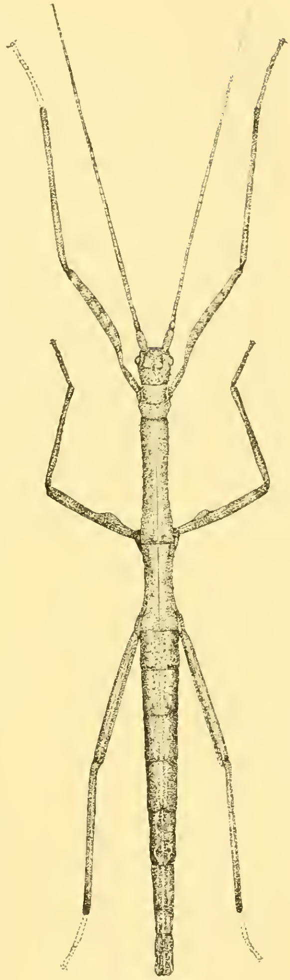
Size rather small; form moderately robust; surface closely supplied with tubercles of several sizes, the larger size arranged in parallel longitudinal rows. Head slightly longer than broad, supplied between and slightly caudad of the eyes with a pair of erect subrotundate foliaceous lobes, about twice as high as the eye is deep, margins of the lobes irregularly crenulate; eyes short ovate; antennæ about equal to the head and thorax in length, proximal joint large, considerably depressed. Pronotum slightly longer than broad. Mesonotum about twice as long as the head and pronotum together, a longitudinal median carina present but subobsolete cephalad, the large tubercles irregularly paired laterad of the median carina with a regularly placed pair caudad. Metanotum with the median segment about two-thirds the length of the mesonotum with the median carina distinct through the entire length; median segment subquadrate, slightly narrowed cephalad,

[7] *Recensio Orthopterorum*, III, p. 79. [Chiriqui.]

[8] *Proc. Boston Soc. Nat. Hist.*, XVII, p. 278. [Eastern slope of Peruvian Andes.]

[9] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 58. [Piedras Negras, Costa Rica.]

length about two-thirds of the remaining portion of the metanotum. Abdomen considerably longer than the remaining portion of the body, with a distinct longitudinal median carina and a pair of supplementary lateral carinæ, which latter on the caudal margins of the first and second proximal segments are developed with distinct boss-like tubercles, the general surface tubercles of the abdomen are mostly resolved into longitudinal series; fifth segment with the caudal section bearing two erect foliaceous lobes similar to those found on the head, but with the margins more regular and not crenulate; first, second and third segments increasing distad in length, fourth, fifth and sixth subequal in length, seventh slightly more than half the length of the sixth, eighth very short, ninth about equal to the seventh in length and with the caudal margin with a very broad shallow median emargination; subgenital opercule reaching to the caudal margin of the eighth dorsal segment, produced, the apex semicircularly emarginate, carinate ventrad. Cephalic femora slightly shorter than the pronotum and mesonotum, strongly depressed, proximal flexure distinct; cephalic tibiæ slightly longer than the femora, carinate, in section irregularly pentagonal; cephalic tarsi with the first proximal joint (metatarsus) slightly longer than the remaining tarsal joints. Median femora slightly shorter than the mesonotum, slightly arcuate, subquadrate in section, with the ventral carinæ supplied at about the proximal third with subtrigonal foliaceous lobes; median tibiæ very slightly longer than the femora; median tarsi with the proximal joint very slightly longer than the second, third and fourth united. Caudal femora reaching to about the middle of the



Figs. 2 and 3. *Libethra auritus* n. sp. Dorsal view and lateral view of head. (× 1½.)

fourth abdominal segment; caudal tibiæ slightly longer than the femora.

General color raw umber, washed and stained with vandyke brown, the cephalic femora and tibiæ and median femora irregularly annulate and sprinkled with ecru drab. Head bister, lighter around the mandibles and on the labrum and clypeus.

Measurements.

Length of body,	63	mm.
Length of pronotum,	4.5	"
Length of mesonotum,	12.5	"
Length of metanotum (including median segment),	9.5	"
Length of abdomen,	35.	"
Length of cephalic femur,	14.5	"
Length of cephalic tibia,	17.	"
Length of median femur,	11.	"
Length of caudal femur,	14.	"

The type is unique.

HETERONEMIA Gray.

Heteronemia ignava Rehn.

1904. *Heteronemia ignava* Rehn, Proc. Acad. Nat. Sci. Phila., 1904, p. 54. [Piedras Negras, Costa Rica.]

San José, altitude 1,160 meters. August, 1904. [No. 22.] (P. Biolley.) One male.

OLCYPHIDES Griffini.[10]

1875. *Phocylides* Stål, Recensio Orthopterorum, III, pp. 57, 96. [Not of Pascoe, 1872.]
1899. *Olcyphides* Griffini, Zoolog. Anz., XXII, p. 90.

Type.—*Olcyphides bicarinatus* (Stål).

Olcyphides viridipes n. sp.

Type: ♀; Caché, Costa Rica, altitude 1,000 meters. May, 1905. [No. 25.] (P. Biolley.) [A. N. S. Phila.]

Allied to *O. venilia* Westwood from Bogota, but differing in the shorter mesothorax and metathorax, the slenderer abdomen and limbs, the shorter subgenital opercule, the absence of distinct blackish spots on the sutural portions of the tegmina and other features of the coloration. The relationship to *O. venilia* is great, as such structures as the

[10] Kirby (*A Synon. Catal. Orth.*, I, p. 411) has placed *Pseudophasma cryptochlore* Rehn as a species of *Olcyphides*. After examining a typical specimen I find this is erroneous, as the species is a *Pseudophasma* as originally described.

sulcate mesonotum, weakly ridged tegmina, long metatarsi and elongate antennal joints show.

Size medium; form very slender; surface not polished. Head longitudinal, subequal; occiput with three impressed longitudinal lines caudad; ocelli present, the cephalic large, elliptical, placed between the insertions of the antennæ, caudal pair smaller, placed diagonally at about the cephalic third of the occiput; eyes slightly elliptical, projecting, slightly flattened; antennæ composed of about twenty-five joints, some very poorly defined, and, except the proximal two and the terminal joints, the segments are very slender and elongate, the whole antennæ laid back exceeding the tip of the abdomen, second joint somewhat inflated. Pronotum nearly twice as long as broad, narrow, transverse line slightly in advance of the middle. Mesonotum over twice the length of the pronotum, subequal in width, fine longitudinal median sulcus present, dorsolateral angles with distinct carinæ, accompanied dorsad by longitudinal sulci which are rounded contiguous caudad; mesosternum without longitudinal median carina. Metathorax very slightly longer than the mesothorax. Tegmina about equal to the mesonotum in length, apex rounded; tubercle longitudinal, low and weak. Wings in repose reaching to the caudal margin of the fifth abdominal segment. Abdomen with the six proximal segments longitudinal, the first to fourth subequal in length, the fifth and sixth decreasing, seventh about two-thirds the length of the sixth, eighth about two-thirds the length of the seventh, ninth subequal to the eighth in length, the caudal margin truncate; cerci compressed, tapering, acute, slightly longer than the ninth dorsal

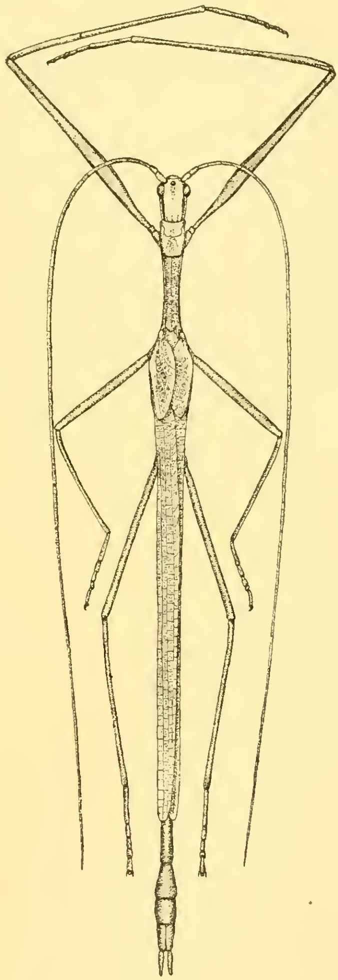


Fig. 4. *Olcyphides viridipes* n. sp. Dorsal view of type. (× 2.)

segment; subgenital opercule moderately produced, scoop-like, reaching to the caudal margin of the eighth dorsal segment. Cephalic femora equal to the mesothorax and metathorax together in length, compressed, basal flexure slight; cephalic tibiæ about equal to the femora in length; tarsi with the proximal joint very slightly shorter than the remaining joints. Median femora slightly longer than the metathorax; tibiæ slightly shorter than the femora; tarsi with the proximal joint equal to the second, third and fourth in length. Caudal femora about equal to the head, prothorax and mesothorax united in length, extending, when stretched parallel to the abdomen, to slightly caudad of the caudal margin of the second segment; tibiæ slightly longer than the femora; tarsi with the proximal joint about equal to the remaining tarsal joints in length.

General color wood brown becoming russet on the mesothorax and cephalic limbs. Head, prothorax and mesothorax with a pair of lateral lines of bister extending from the olive eyes to the base of the tegmina. Venter of the thorax pale mauve. Tegmina with a line through the "boss" greenish-yellow, the dorsal section with the areas between the longitudinal and transverse nervures finely sprinkled with blackish. Wings with the yellow of the tegmina extended on them for a considerable distance. Abdomen pale drab. Median and caudal limbs oil green.

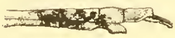


Fig. 5. *Olcyphides viridipes* n. sp. Lateral view of apex of abdomen of male type. (× 2.)

Measurements.

Length of body,	54	mm.
Length of head,	3.2	"
Length of pronotum,	2.2	"
Length of mesonotum,	5.2	"
Length of metathorax,	7.8	"
Length of tegmen,	5.7	"
Length of wing,	32	"
Length of cephalic femur,	14.3	"
Length of cephalic tibia,	14.2	"
Length of median femur,	8.3	"
Length of caudal femur,	11.2	"

The type is unique.

PSEUDOPHASMA Kirby.

Pseudophasma menius (Westwood).

Carrillo, altitude 400 meters. February, 1904. [No. 21.] (P. Biolley.) One male.

Family ACRIDIDÆ.

OCHETOTETTIX Morse.

1900. *Ochetotettix* Morse, Biol. Cent.-Amer., Orth., II, p. 9.

Included *O. barretti* (Hancock) and *O. volans* Morse, of which the former may be selected as the type.

Ochetotettix volans Morse.

1900. *Ochetotettix volans* Morse, Biol. Cent.-Amer., Orth., II, p. 9, fig. [Dos Arroyos, Chilpancingo, Venta de Zopilote, Xucumanatlan and Omilteme, Guerrero, Mexico, 1,000 to 8,000 feet.]

San José, altitude 1,160 meters. September, 1904. [Nos. 85 (part), 86 (part) and 87.] (P. Biolley.) One male, four females.

Ochetotettix barretti (Hancock).

1899. *Neotettix barretti* Hancock, Ent. News, X, p. 277. [Tizapan, D. F., Mexico.]

San José, altitude 1,160 meters. September, 1904. [No. 86 (part).] (P. Biolley.) One female.

In addition to the type locality this species has been recorded from Chilpancingo, Guerrero, and Atoyac, Vera Cruz, Mexico.

PARATETTIX Bolivar.

Paratettix toltecus (Saussure).

1861. *T*[*ettix*] *tolteca* Saussure, Revue et Magasin de Zoologie, 2e ser. XIII, p. 401. [Tropical Mexico.]

San José, altitude 1,160 meters. September, 1904. [No. 85 (part) and 87.] (P. Biolley.) One male, one female.

ALLOTETTIX Hancock.

Allotettix peruvianus (Bolivar).

La Palma, altitude 1,600 meters. May, 1905. [No. 90.] (P. Biolley.) One female.

This specimen has the pronotum abbreviate, not extending beyond the tips of the caudal femora.

TETTIGIDEA Scudder.

Tettigidea nicaraguæ Bruner.

1895. *Tettigidea nicaraguæ* Bruner, Bull. Labor. Nat. Hist. Univ. Iowa, III, Pt. 2, p. 62, Pl. III, figs. 3a and 3b. [Nicaragua.]

San José, altitude 1,160 meters. September, 1904. [No. 84.] (P. Biolley.) One female.

This species has also been recorded from Atoyac, Vera Cruz, and Teapa, Tabasco, Mexico. The specimen examined is short-winged.

EPISACTUS Burr.

1899. *Episactus* Burr, Anal. Soc. Esp. Hist. Nat., XXVIII, p. 254.

Type.—*E. brunneri* Burr.

Episactus brunneri Burr.

1899. *Episactus brunneri* Burr, Anal. Soc. Esp. Hist. Nat., XXVIII, p. 254. [Guatemala.]

Side of Tablazo, at 1,350 meters. October, 1904. [No. 69.] (P. Biolley.) Male and female taken in coitu.

These specimens constitute the first record of the species since the original description.

TRUXALIS Fabricius.

Truxalis brevicornis (Johansson).

La Palma, altitude 1,600 meters. May, 1905. [No. 89.] (P. Biolley.) One female.

ORPHULELLA Giglio-Tos.

Orphulella punctata (De Geer).

San José, altitude 1,160 meters. August, 1904. [No. 81.] (P. Biolley.) One male.

Santa Clara. (P. Biolley.) One male.

Orphulella costaricensis Bruner.

San José, altitude 1,160 meters. August, 1904. [Nos. 75 (part), 76, 77, 78, 79, 80 and 81.] (P. Biolley.) One male, ten females.

Surubres river at San Mateo, altitude 250 meters. February, 1905. [No. 74.] One female.

Side of Tablazo, at 1,350 meters. October, 1904. [No. 71.] (P. Biolley.) One male.

Orphulella meridionalis Bruner ?

1904. *Orphulella meridionalis* Bruner, Biol. Cent.-Amer., Orth., II, p. 81. [Costa Rica.]

San José, altitude 1,160 meters. August, 1904. [No. 76.] (P. Biolley.) One female.

Side of Tablazo, at 1,350 meters. October, 1904. [No. 70.] (P. Biolley.) One male.

These specimens are referred to the species with a query.

PLECTROTETTIX McNeill.

Plectrotettix calidus Bruner.

1904. *Plectrotettix calidus* Bruner, Biol. Cent.-Amer., Orth., II, p. 101. [Cuernavaca, Morelos and Guerrero, Mexico; Nicaragua; Costa Rica.]

Side of Tablazo, at 1,350 meters. October, 1904. [No. 60.] (P. Biolley.) One male, two females.

These specimens agree fairly well with Cuernavaca specimens, but have the caudal tibiæ with the colors much richer. One female without exact data, but presumably from Costa Rica as it was sent by Biolley, has the ventral face of the caudal femora and the caudal tibiæ red as in Walker's poorly described *nobilus* from Oaxaca, Mexico. This specimen also has the tegmina and wings shorter than in the Tablazo specimens and similar in this respect to individuals from Tacubaya, Mexico, which appear to be referable to *P. excelsus* Bruner.

CHORTOPHAGA Saussure.

Chortophaga meridionalis Bruner.

1905. *Chortophaga meridionalis* Bruner, Biol. Cent.-Amer., Orth., I, p. 136. [Slopes of the Volcan de Irazu, at an elevation of 7,500 to 9,000 feet, Costa Rica.]

Side of Tablazo, altitude 1,700 meters. October, 1904. [No. 65.] (P. Biolley.) One female.

On comparison with specimens of *Chortophaga viridifasciata* from the eastern United States, I find great difficulty in separating this specimen. The pronotal carina is slightly less arched, but the size is considerably greater than given in the original description. The sulcation of the frontal costa appears deeper than in *viridifasciata* instead of shallower, but as the specimen in hand appears to have been in alcohol, preparation may have caused this. Several races of *C. viridifasciata* of value equal to this exist in the United States.

LACTISTA Saussure.

Lactista punctatus (Stål).

Side of Tablazo, at 1,700 meters. October, 1904. [No. 68.] (P. Biolley.) One female.

HELIASTUS Saussure.

Heliastus venezuelæ Saussure.

1884. *H[eliastus] Venezuelæ* Saussure, Prodr. Œdipodiorum, p. 213. [Venezuela; Colombia; Panama.]

Mouth of the Jesus Maria river, Pacific side.[11] April, 1905. [No. 88.] (P. Biolley.) Two females.

These specimens are referred here with some little doubt. They are unquestionably closely allied to *H. sumichrasti*, but have the fastigium broader and shallower than in that species, while the frontal costa is broader and has a slight constriction ventrad of the ocellus. The two in hand are larger than Guadalajara and Jalapa individuals of *sumichrasti*, and about equal in size to a female from Alta Mira, Tamaulipas.

[11] This locality is between Punta Arenas and the mouth of the Rio Grande de Tarcoles.

LEPTYSMA Stål.

Leptysma obscura (Thunberg).

1827. *Tr[uxalis] obscurus* Thunberg, Nova Acta Reg. Soc. Scient. Ups., IX, p. 79. [Tropical America, Brazil.]

Surubres river at San Mateo, altitude 250 meters. February, 1905. [No. 82.] (P. Biolley.) One male.

This species has been recorded from Nicaragua.

CORNOPS Scudder.

1875. *Cornops* Scudder, Proc. Boston Soc. Nat. Hist., XVII, p. 276.

Type.—*Cornops bivittatum* Scudder.

Cornops longipenne (De Geer)?

1773. *Acrydium longipenne* De Geer, Mem. d. Hist. Ins., III, p. 501, Pl. 42, fig. 9. [Surinam.]

Surubres river at San Mateo, altitude 250 meters. Esparta, altitude 50 meters. February, 1905. [No. 83.] (P. Biolley.) Male and female.

As far as can be determined from the descriptions these specimens appear referable to this species, but probably will represent a closely allied form when compared with typical Surinam individuals. The lateral bars are not sharply separated from the wine-color of the dorsum, but present a strong contrast with the yellowish of the ventral portions.

The genus *Cornops* as defined by Stål[12] appear to agree better with these specimens than does Scudder's description. This may be due to the fact that Stål's description was based on *longipenne*.

SCHISTOCERCA Stål.

Schistocerca pyramidata Scudder.

San José, altitude 1,160 meters. November, 1904. [Nos. 72 and 73.] (P. Biolley.) Four males, four females.

Side of Tablazo, at 1,700 meters. October, 1904. [Nos. 61, 62, 63 and 64.] (P. Biolley.) Seven males, seven females.

Some of the above recorded individuals have the tegmina considerably longer than others, while the variation in the intensity of the coloration is quite striking.

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[12] Bihang K. Svenska Vetensk.-Akad. Handl., V, No. 4, p. 39, 1878.

DICHROPLUS Stål.

Dichroplus morosus Rehn.

1905. *Dichroplus morosus* Rehn, Proc. Acad. Nat. Sci. Phila., 1905, p. 442. [Monte Redondo, Costa Rica.]

Side of Tablazo, at 1,350 meters. October, 1904. [No. 67.] (P. Biolley.) Two males, two females.

As the male of this species has never been described its characters are given herewith.

♂. Size small. Head with the interspace between the eyes moderately narrow, shallowly sulcate; fastigium declivent, passing into the frontal costa without interruption of the shallow sulcus; costa narrowed dorsad, regularly but slightly expanding ventrad, more distinctly sulcate ventrad of the ocellus; eye about half again as long as the infra-ocular groove. Pronotum with the caudal margin subrectangulate. Interspace between the mesosternal lobes subquadrate; metasternal lobes subcontiguous. Tegmina exceeding the tips of the caudal femora by about half the length of pronotum. Furcula present as extremely minute knobs; supra-anal plate with a longitudinal median groove, outline slightly narrowed with the apex abruptly rounded except for a slight median angle; cerci with the proximal section broad, strongly tapering in the proximal half, the distad section very narrow, styliform and subequal, tip slightly incurved, decurved and acute; subgenital plate produced, longer than broad, the apex narrowly rounded.

Measurements.

Length of body,	16	mm.
Length of pronotum,	3.5	"
Length of tegmen,	12.5	"
Length of caudal femur,	8.5	"

The specimens examined exhibit considerable variation in the shade of the ground color and the intensity of the pattern.

AIDEMONA Brunner.

Aidemona azteca (Saussure).

Side of Tablazo, at 1,700 meters. October, 1904. [No. 66.] (P. Biolley.) One female.

TETTIGONIDÆ.

APHIDNA Stål.

1874. *Aphidna* Stål, Recensio Orthopterorum, II, pp. 13, 28.

Type.—*Phaneroptera alipes* Westwood ♂.

Aphidna simplicipes Brunner.

1878. *A[phidna] simplicipes* Brunner, Monogr. d. Phaneropt., p. 157. [Mexico.]

San José, altitude 1,160 meters. July, 1904. [No. 43.] (P. Biolley.) One male.

This is the first record of the species since the original description.

HORMILIA Stål.

1873. *Hormilia* Stål, Öfversigt Kongl. Vetens.-Akad. Förhandl., 1873, No. 4, p. 41.

Type.—*Phaneroptera toltcca* Saussure.

Hormilia intermedia Brunner.

1878. *H[ormilia] intermedia* Brunner, Monogr. d. Phaneropt., p. 232. [Cordova, Mexico; Guatemala.]

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Four males, one female, one nymph.

Guatel. (C. F. Underwood.) One nymph.

Piedras Negras. (Schild and Burgdorf.) [U. S. N. M.] One male, three females.

This series of specimens exhibits considerable variation in color, both in the ground color and the intensity of the pattern. Some individuals are without a trace of greenish, while others have the base color, very pale apple green; the pattern of the tegmina in some is a complicated subscalariform arrangement, in others only an irregular mottling. In all the specimens examined, including the nymphs, the dorsal abdominal markings are distinct.

The species has been recorded once before from Costa Rica, from Caché, by Saussure and Pictet.

CERAIA Brunner.

1891. *Ceraia* Brunner, Verhandl. k.-k. Zool.-botan. Gesellsch. Wien, XLI, p. 18, 127.

Included nine species,[13] of which the first, *tibialis* (which is the species figured), may be considered the type.

Ceraia cruenta (Burmeister).

1838. *Ph[aneroptera] cruenta* Burmeister Handb. d. Entom., II, Abth. II, Pt. I, p. 691. [Rio Janeiro, Brazil.]

San José, altitude 1,160 meters. July, 1904. (P. Biolley; No. 42.) [A. N. S. Phila.] One female.

This striking species is recorded for the first time north of Brazil. The only definite records previously published are from the type ocality.

[13] *Ceraia tibialis* Brunner, *maxima* Brunner, *punctulata* (Brunner), *surinamensis* Brunner, *dentata* (Brunner), *cornuta* Brunner, *atrosignata* Brunner, *zebrata* Brunner and *cruenta* (Burmeister.)

STILPNOCHLORA Stål.

Stilpnochlora marginella (Serville).

1839. *Phylloptera marginella* Serville, Orthoptères, p. 405. [Cape of Good Hope; erroneous.]

San José. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] One male.

Stilpnochlora tolteca (Saussure).

1859. *Phylloptera tolteca* Saussure, Revue et Magas. de Zool., 2e ser., XI, p. 203. [Mexico.]

Ateñas. (Schild and Burgdorf.) [U. S. N. M.] One female.

San José. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] Three males, five females.

Stilpnochlora azteca (Saussure).

San José. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Tarbaca. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

STEIRODON Serville.

1831. *Steirodon* Serville, Ann. Sci. Nat., XXII, p. 140.

Type.—*Phyllophora citrifolia* Thunberg = *Steirodon validum* Stål.[14]

Steirodon validum Stål.

1815. *Phyllophora citrifolia* Thunberg, Mém. l'Acad. Imp. Sci. St. Pétersb., V, p. 286. (Not *Gryllus* (*Tettigonia*) *citrifolius* Linnæus and authors.)
1874. *S*[*teirodon*] *validum* Stål, Recensio Orthopterorum, II, p. 44. (Based in part on Thunberg's material.) [Locality unknown.]

Costa Rica. (C. F. Underwood.) [A. N. S. Phila.] One female.

This Brazilian and Guianan species is here recorded for the first time from Central America.

OROPHUS Saussure.

1859. *Orophus* Saussure, Revue et Magas. de Zoolog., 2e ser., XI, p. 204.
1878. *Anepsia* Brunner, Monogr. der Phaneropt., p. 269.
1897. *Paragenes* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 338.

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[14] The genus *Steirodon* was based on three forms: *citrifolius*, *prasinus* and *thoracicus*. The second was removed to *Trigonocorypha* in 1874; the third to *Posidippus* the same year. The first, *citrifolius*, was based wholly on references as follows:

Locusta citrifolia Fab., Ent. Syst., No. 1.
De Geer, Mém., t. III, p. 437, Pl. 37, fig. 3.
Stoll, Sauter., Pl. 4, fig. 12.

Phyllophora citrifolia Thunb., Mém. de l'Acad. Imp. des Sc. de Saint-Pétersb., t. V, p. 286.

The references of Fabricius and De Geer were based on Linné's *Gryllus* (*Tettigonia*) *citrifolius*, which was placed in *Posidippus* in 1874. Stoll's figure was considered a *Peucestes* the same year, leaving Thunberg's misidentification, later named by Stål, who examined the Thunberg material, as the type.

Included *mexicana*, *otomia*, *salicifolia*, *rhombifolia*, *totonaca*, *salvifolia* and *huasteca*. Of these *otomia*, *salicifolia*, *rhombifolia*, *totonaca* and *salvifolia* belong to the genus *Microcentrum*, 1873; *huasteca* to *Amblycorypha*, 1873; and *mexicana* remains as the type.

Orophus mexicanus Saussure.

1859. *Ph[ylloptera (Orophus)] mexicana* Saussure, Revue et Magas. de Zoologie, 2e ser., XI, p. 204. [Mexico.]

1905 *Paragenes conspersa* Baker, Invert. Pacifica, I, p. 78. (Not of Brunner.) [San Marcos, Nicaragua.]

Escazu. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Guatel. (C. F. Underwood.) [A. N. S. Phila.] One male, one female.

Santa Ana. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Four females.

A San Marcos, Nicaragua, female individual, received from Baker and determined as *conspersus*, is larger than any Costa Rican specimen examined.

This species has previously been recorded from Caché, Rio Sucio, San Francisco, San José, Azahar de Cartago and Monte Redondo in Costa Rica.

Orophus ovatus (Brunner).

1878. *A[nepsia] ovata* Brunner, Monogr. der Phaneropt., p. 271. [Costa Rica.]

Zarzero. (Schild and Burgdorf.) [U. S. N. M.] Five males, one female.

Tarbaca. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] Two females.

Escazu. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two males.

Santa Ana. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] Two males.

This quite distinct species varies somewhat in size and from a greenish-brown to a distinct green in color, with the small fuscous annuli practically absent in some specimens.

This species is more austral than the others of the genus, having been recorded but once from outside of Costa Rica, then from San Gerónimo, Guatemala. The previous definite Costa Rican records are from Rio Sucio, Caché and Volcan de Irazu.

Orophus conspersus (Brunner).

1878. *A[nepsia] conspersa* Brunner, Monogr. der Phaneropt., p. 270. [Chiriqui.]

Guatel. (C. F. Underwood.) [A. S. N. Phila.] Two males.

Tucurrique. (Schild and Burgdorf.) [U. S. N. M.] One male.

Carrillo. (Schild and Burgdorf.) [U. S. N. M.] Two males.

Carrillo. [Hebard Collection.] Twenty-eight males, nine females.

This form is probably, as Brunner says, a small type of *tessellata*. The large series examined is rather uniform in size, but the coloration varies greatly, both in the general color and the presence or intensity of the fuscous annuli of the tegmina. Most of the males have the tambourine marked laterad more or less regularly with brownish, and the paler specimens which are little marked with fuscous have the femoral spines with the dark color restricted to a very slight apical touch.

The previous Costa Rican records of this species are from San José, La Uruca, El Coronal, Tucurrique, La Palma, Turrialba and Monte Redondo.

Orophus tessellatus Saussure.

1861. *Phylloptera (Orophus) tessellata* Saussure, Revue et Magas. de Zoolog., 2e ser., XIII, p. 129. [Mexico.]

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] Four males, four females.

Tucurrique. (Schild and Burgdorf.) [U. S. N. M.] One male.

Carrillo. [Hebard Collection.] Three females.

Guatel. (C. F. Underwood.) [A. N. S. Phila.] Two females.

Reventazon, plains of Santa Clara; altitude 200 meters. December, 1904. (P. Biolley; No. 40.) [A. N. S. Phila.] One female.

The material examined fully demonstrates the variability of this species in color, some being strongly dotted with fuscous and with the usual large annuli distinct, while others are almost uniform green. Considerable variation is also exhibited in size, and some individuals might be referred to either *tessellatus* or *conspersus*. This is particularly true of the individuals from Carrillo.

The previous Costa Rican records are from Volcan de Irazu, Caché and Santa Clara.

ANAULACOMERA Stål.

1873. *Anaulacomera* Stål, Öfv. Kongl. Vet.-Akad. Förhandl., XXX No. 4, pp. 41, 43.

Included *submaculata, nodulosa* and *opacifolia* Stål, of which the first may be considered the type.

Anaulacomera digitata n. sp.

Type: ♀; San José, Costa Rica, 1,160 meters. At electric light. July, 1904. (P. Biolley; No. 44.) [A. N. S. Phila.]

Allied to *A. furcata* Brunner, but differing in the sulcate fastigium, the undivided superior ramus of the radial vein, the absence of a distinct angle on the dorsal margin of the ovipositor and the broader tegmina.

Size rather small; form moderately elongate. Head with the fastigium narrow, the apex rounded and constricted proximad, moderately but distinctly sulcate, the expanded proximal section with the margins elevated, the lateral ridges being lost on the constriction; facial fastigium touching the fastigium of the vertex; eyes subglobose, quite prominent; antennæ reaching to the tips of the wings, proximal joint large, equal to the space between the basal joints, flattened. Prono-

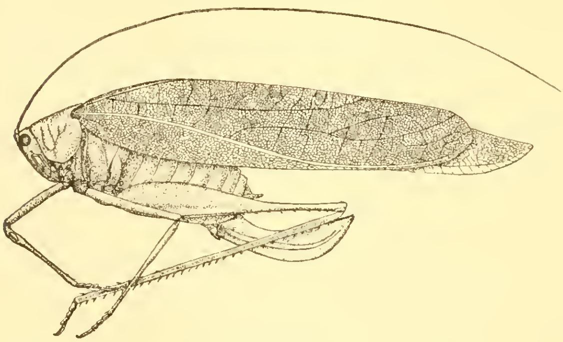

Fig. 6. *Anaulacomera digitata* n. sp. Lateral view of type. (× 2.)

Fig. 7. *Anaulacomera digitata* n. sp. Dorsal view of head. (× 3.)

tum deplanate dorsad; cephalic margin truncato-emarginate, caudal margin flattened arcuate, lateral angles narrowly rounded; lateral lobes about as long as deep, caudal margin with the sinus rather broad and deep, the margin arcuate from this to a point on the ventral section which is obtuse-angulate, the cephalic margin being arcuato-emarginate and the ventro-cephalic margin oblique. Mesosternum with the lobes subtrigonal, each longer than broad. Metasternum with the lobes rotundate, the medio-lateral section of their curve being flattened. Tegmina about half again as long as the caudal femora, extremely elongate-elliptical in outline, nearly four and a half times as long as broad, the width except proximad and distad being subequal, costal margin very gently arcuate, apex evenly rounded; radial vein with the two branches not distinctly subdivided, the division of the vein being near the distal third of the tegmen; anterior ulnar vein reaching the sutural margin a short distance distad of the furcation of the radial vein. Wings extending beyond the closed tegmina, a distance about equal to the length of the pronotum. Ovipositor about twice the length of the pronotum, saber-like in form, the greatest width slightly less than a third the length and in the distal half, apex acute, dorsal margin straight with a slight proximal curve, ventral margin almost straight in the proximal half, strongly arcuate in the distal half, margins of the distal half crenulato-dentate; subgenital plate very deeply and triangularly emarginate, the base of the emargination rounded, lateral processes of the plate produced slender and digitiform. Cephalic tibiæ moderately rounded and unarmed dorsad. Caudal femur reaching to the apex of the ovipositor, slender in the distal half.

General color apple green, the head and thorax soiled olive-yellow; abdomen pale orange-buff; sutural margins of the tegmina naples yellow; margins of the tip of the ovipositor vandyke brown; eyes mars brown.

Measurements.

Length of body,	16	mm.
Length of pronotum,	4.5	"
Length of tegmen,	27.5	"
Breadth of tegmen,	6.2	"
Length of caudal femur,	15.8	"
Length of ovipositor,	9	"

The specific name refers to the appendages of the subgenital plate.

In addition to the type, a badly damaged male individual from Esparta (altitude 50 meters; no. 45; P. Biolley) is referred with some doubt to this species. The tegmina are somewhat slenderer than in the type, but the venation is similar, while the head and pronotum, as well as the sternal lobes, are identical. Subgenital plate and supra-anal plate are as in *A. lanceolata* Brunner, the cerci however differ in being without a basal lobule and having a spiral twist instead of being straight and lanceolate.

Anaulacomera laticauda Brunner.

1878. *A[naulacomera] laticauda* Brunner, Monogr. der Phaneropt., p. 292. [Mexico; Orizaba; St. Jean, Colombia.]

Tucurrique, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One male.

San Carlos, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One female.

The male individual has the sutural margin of the tegmina narrowly areolate with blackish-brown. This is the first Costa Rican record for the species, which ranges from Orizaba to Colombia.

Anaulacomera denticauda Saussure and Pictet.

1898. *Anaulacomera denticauda* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 345, Pl. XVI, figs. 15 and 16. [Temax, North Yucatan, Mexico.]

Piedras Negras, Costa Rica. (Schild and Burgdorf.) [U. S. N. M.] One male.

This specimen agrees fully with the description of the species, which was hitherto known only from the type.

TURPILIA Stål.

Turpilia oblongooculata Brunner.

1878. *Turpilia oblongooculata* Brunner, Monogr. der Phaneropt., p. 326. [Oaxaca, Mexico; Guatemala.]

Esparta, 50 meters. February, 1905. (P. Biolley; No. 45.) [A. N. S. Phila.] One female.

This species has been recorded from Costa Rica, without definite locality, by Saussure and Pictet.

Turpilia linearis n. sp.

Type: ♂; Carrillo, Costa Rica. Hebard Collection.

Allied to *T. mexicana* Brunner, but differing in the deplanate dorsum of the pronotum, the narrower tegmina and the slightly longer caudal femora. As *mexicana* was based on the female sex, the comparisons are not as full as could be desired.

Size medium; form very elongate. Head with the occiput very slightly rounded; fastigium declivent, strongly compressed, proximal section narrowly sulcate, distal portion without sulcus; fastigium of the face touching the fastigium of the vertex; eyes subglobose, quite prominent; antennæ when laid back exceeding the tips of the closed wings by more than the length of the body, proximal joint not depressed. Pronotum decidedly deplanate dorsad, cephalic margin very slightly arcuato-emarginate, caudal margin arcuate, lateral angles moderately rounded cephalad, sharp caudad; lateral lobes deeper than long, sinus on the caudal margin shallow, remainder of the caudal margin and the ventral margin arcuate, cephalic margin very slightly emarginate. Mesosternal lobes transverse, angles rectangulate, not produced; metasternal lobes rounded and with a narrow median fissure. Tegmina very slender, about twice the length of the body, the greatest width contained five and a half times in the length; costal margin slightly arcuate proximad, straight distad, sutural margin straight with a slight arcuation proximad, apex rounded with the costal section more arcuate than the sutural; mediastine vein very short, median vein issuing slightly proximad of the middle of the tegmen, bifurcate. Wings extending beyond the tegmina a distance slightly greater than the length of the pronotum; sutural margin straight, costal margin arcuate. Supra-anal plate not exceeding the preceding abdominal segment in length, transverse, margin truncate; cerci rather thick, blunt, with a strong curve mesad; subgenital plate longitudinal with a U-shaped median emargination, styles as long as the processes of

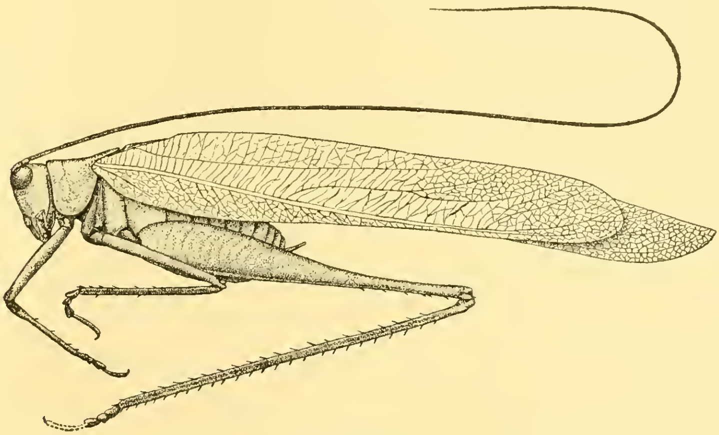

Fig. 8. *Turpilia linearis* n. sp. Lateral view of type. (× 2.)

the plate surrounding the median emargination and on which they are placed. Cephalic tibiæ with the dorsal face unarmed, the cephalic ventral margin with several spines. Median tibiæ with several spines on the dorsal face. Caudal femora slightly more than three times the length of the head and pronotum, inflated proximad and regularly decreasing to the slender distal two-fifths; caudal tibiæ slightly longer than the femora, the dorsal margins strongly and closely spined, ventral margins with the spines much fewer, smaller and adpressed.

Fig. 9. *Turpilia linearis* n. sp. Dorsal view of head. (× 3.)

General color oil green; eyes mars brown; antennæ suffused with blackish; sutural margins of the tegmina and weakly on the wings marked with brownish-black, the areas between nervures alone being colored.

Measurements.

Length of body,	16.5 mm.
Length of pronotum,	4.5 "
Length of tegmen,	33.5 "
Greatest breadth of tegmen,	6 "
Length of exposed portion of wing beyond tegmen,	6.5 "
Length of caudal femur,	22 "

The type is the only specimen of the species seen.

MICROCENTRUM Scudder.

Microcentrum syntechnoides Rehn.

1903. *Microcentrum syntechnoides* Rehn, Trans. Amer. Ent. Soc., XXIX, p. 23. [Cuernavaca, Morelos, Mexico.]

San José, altitude 1,160 meters. July, 1904. (At electric light.) (P. Biolley; No. 41.) [A. N. S. Phila.] One male.

This individual is inseparable from the type, and is separated from *M. lanceolatum* by the slenderer tegmina and caudal limbs.

SYNTECHNA Brunner.

1878. *Syntechna* Brunner, Monogr. d. Phaneropt., p. 30, 347.

Included *olivaceo-viridis* Brunner and *tarasca* (Saussure), of which the first may be considered the type.

Syntechna caudelli Rehn.

1901. *Syntechna caudelli* Rehn, Trans. Amer. Ent. Soc., XXVII, p. 224. [Orizaba, Vera Cruz, Mexico.]

San José. September and October, 1902. (C. F. Underwood.) [A. N. S. Phila.] Two females.

Tarbaca. October and December, 1902. (C. F. Underwood.) [A. N. S. Phila.] One male, one female.

Escazu. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Not separable from the type specimen. Apparently separated from *tarasca* by the form of the lateral lobes of the pronotum and the tegmina.

LICHENOCHRUS Karsch.

1890. *Lichenochrus* Karsch, Entom. Nachr., XVI, p. 268.

Type.—*L. crassipes* Karsch.

Lichenochrus marmoratus n. sp.

Type: ♀; Carrillo, Costa Rica. (Hebard Collection.)

Allied to *L. modestus* Brunner and *brevistylus* Saussure and Pictet, but differing from the former in the marmorate tegmina, the number of spines on the median femora and the larger size, and from *brevistylus* in the form of the lateral lobes of the pronotum, the number of femoral spines and the curved ovipositor.

Size medium; form robust. Head with the occiput arched; fastigium declivent, slightly produced, acuminate, the margins elevated and the apex an acute horizontally directed process; facial fastigium touching the fastigium of the vertex; eyes subovate, the greatest length dorso-ventral, very prominent when viewed from the dorsum; antennæ with the proximal joint large, cylindrical, margins of the insertion of the antennæ placed close together, the facial fastigium being narrow, joints of the antennæ slightly nodose distad. Pronotum saddle-shaped, depressed mesad, elevated cephalad and caudad; cephalic margin arcuato-truncate, elevated mesad at an angle of about 45°; caudal section slightly elevated into a rather flattened transverse structure with the surface lineato-rugose and the outline strongly constricted cephalad with the cephalic angles rounded, caudal margin subtruncate; dorsal section between the first and second transverse sulci with a pair of erect rather blunt diverging processes which form part of the rather broken lateral margins of the dorsal surface; lateral lobes nearly quadrate, the margins nearly straight, transverse sulci distinct and carried well down on the lobes. Mesosternal lobes with a pair of lateral erect trigonal processes. Tegmina about two and a half times the length of the head and pronotum, lanceolate, the greatest width contained four times in the length; costal margin straight except for a strong proximal arcuation, sutural margin evenly arcuate, apex rather blunt, rounded; costal field with the mediastine vein short and soon lost in the general caudo-ventral trend of the veins, median vein issuing slightly distad of the middle of the tegmen, bifurcate, the principal branch reaching the sutural margin near the apex, ulnar vein with one ramus, anal vein with a ramus on the dorsal field. Ovipositor equal to the length of the pronotum and twice the length of the head, acuminate, the proximal half straight and subequal, the distal pronotum moderately bent arcuate and tapering, with the dorsal margin nearly straight distad of the curve, apex acute, ventral margin of the apex serrulate; subgenital plate transverse, the margin with a deep brace-shaped emargination, the lateral processes acute. Cephalic femora slightly more than twice the length of the head, the distal portion with a very slight curve, genicular lobes acute, dorsal margins unarmed, cephalo-ventral margin with four dentate lobes; cephalic tibiæ slightly shorter than the femora, dorsal margins each with three trigonal lobes, ventral margins with five to six spines; terminal joint of the cephalic tarsi slightly shorter than the remaining joints together. Median limbs about equal to the cephalic in size; femora shaped in the cephalic limbs but with three instead of four lobes; tibiæ with three lobes on each of the dorsal margins and six to seven spines on the ventral margins. Caudal limbs missing.

General color tawny-olive. Head marked around the eyes, fastigium,

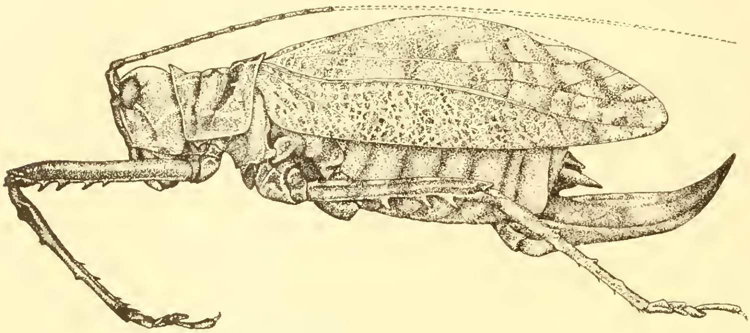

Fig. 10. *Lichenochrus marmoratus* n. sp. Lateral view of type. (× 2.)

lateral ridges and clypeus and irregular annulations of the antennæ, bister; lateral ridges and cephalic face of mandibles also indian yellow; eyes walnut brown. Pronotum washed on the lateral ridges with, and small scattered patches of color on the ventral portion of the lateral

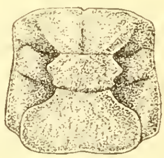

Fig. 11. *Lichenochrus marmoratus* n. sp. Dorsal view of pronotum. (× 3.)

lobes, indian yellow; the first transverse sulcus on the dorsal section of the lateral lobes are slightly washed with blackish-brown, the second sulcus is bordered caudad through two-thirds the depth of the lobes by a broad blotch of the same color; caudal section of the dorsal face faintly washed with apple green. Tegmina marbled and blotched with several colors: mummy brown, chrome yellow and apple green, the brown being solid in subquadrate blotches, the yellow faint and only suffusing some veins, the green weak and filling quadrate blotches as well as being irregularly distributed. Ovipositor with the distal half blackish-brown. Limbs irregularly mottled and annulate with vandyke brown and very weak greenish, the femoral lobes being touched with blackish-brown.

Measurements.

Length of body,	30.5 mm.
Length of pronotum,	6.2 "
Length of tegmen,	37 "
Greatest width of tegmen,	9 "
Length of ovipositor,	14.2 "

The type is unique.

GONGROCNEMIS Brunner.

1895. *Gongrocnemis* Brunner, Monogr. der Pseudophyll., p. 18, 163.

Included thirteen species, of which the only species figured, *pallidespinosa*, may be selected as the type.

Gongrocnemis nigrospinosa Brunner.

1895. *Gongrocnemis nigrospinosa* Brunner, Monogr. der Pseudophyll., p. 167. [Mexico.]

Surubres river, by San Mateo, altitude 250 meters. February, 1905. (P. Biolley; No. 49.) [A. N. S. Phila.] One female.

This specimen has the number of femoral spines slightly different from the formulæ given in the original description and the cephalic tibiæ have the fuscous annuli incomplete.

DREPANOXIPHUS Brunner.

1895. *Drepanoxiphus* Brunner, Monogr. der Pseudophyll., p. 18, 173.

Type.—*D. minutus* Brunner.

Drepanoxiphus minutus Brunner?

1895. *Drepanoxiphus minutus* Brunner, Monogr. der Pseudophyll., p. 174. [Chiriqui.]

Carrillo. [Hebard Collection.] One female.

San José. (Schild and Burgdorf.) [U. S. N. M.] One female.

These specimens are referred to this species with some doubt, as the cephalic femora of the San José specimen measure nearly eight millimeters in length, instead of five and a half as given in the original description. These parts are missing in the Carrillo individual. The latter has the tegmina and wings shorter than the San José representative, the limbs are distinctly annulate and the size is slightly less. The wings are infuscate in both specimens.

COCCONOTUS Stål.

1873. *Cocconotus* Stål, Öfver. Kongl. Vetensk.-Akad. Förhandl., XXX, No. 4, p. 46.

Type.—*Meroncidium degeeri* Stål.

Cocconotus degeeri (Stål).

1860. *Meroncidium De Geeri* Stål, Kongl. Svenska Fregat. Eugenies Resa, Zool. I, Ins., p. 322. [St. Joseph Island, Bay of Panama.]

Surubres river at San Mateo, altitude 250 meters. February, 1905. (P. Biolley; No. 50.) [A. N. S. Phila.] One male, one female.

Pirrus. (C. F. Underwood.) [A. N. S. Phila.] One male.

These specimens have the faces solid black without evident stripes, and the costal region of the tegmina is more or less strongly washed with pale greenish. The departure from the typical form in the coloring of the face has already been noticed by Griffini.[15]

Specimens of this species have been recorded from Matachin, Panama, Rio Cianati; lagoon of Pita and Punta de Sabana, Darien, and Volcan de Chiriqui.

Cocconotus ravus n. sp.

Types: ♂ and ♀; San José, Costa Rica. September, 1902. (C. F. Underwood.) [A. N. S. Phila.]

Allied to *C. castus* Brunner, from Mexico, but differing in the larger size, the shape of the emargination of the male anal segment, and the shape of the supra-anal and subgenital plates. It can be separated from *C. ignobilis* Brunner, a near ally, by the shape of the anal segment, the supra-anal plate and the undilated styles.

Size medium; form moderately robust. Head transversely rounded, strongly declivent toward the fastigium; fastigium short, acuminate, narrow, horizontal, sulcate proximad with the lateral margins elevated into rather low rounded processes, apex acute, compressed, about reaching to the margins of the antennal scrobes; facial fastigium contiguous with the fastigium of the vertex; eyes short ovoid, the point directed ventrad, prominent; antennæ contained two (♂) to two and a half times (♀) in the length of the body. Pronotum scabrose, slightly flattened dorsad; cephalic margin arcuate, caudal margin truncato-arcuate, no lateral angles marked except faintly on the "shoulders," two transverse sulci distinctly marked, the caudal more distinct than the cephalic; lateral lobes distinctly longer than deep, the ventral margin nearly straight, the angles subrectangulate, caudal transverse sulcus extending to the ventral margin in a ventro-cephalic direction, a supplementary sulcus being present caudad of this and extending ventro-caudad to the angle. Tegmina very slightly exceeding the body in length elongate lanceolate, the greatest width being contained about four and a half times in the length; costal and sutural margins very slightly arcuate, the apex rather narrowly rounded; mediastine vein

[15] *Bollett. Mus. Zool. ed Anat. Comp. Torino*, X, No. 232, p. 21.

very short and lost in the general vein structure of the costal field, the trend of the principal veins of which is ventro-caudal; median vein diverging before the distal third of the tegmen and reaching the apical margin; ulnar vein rather irregular and indirect in its course. Male with the last abdominal segment transverse, margin subtruncate

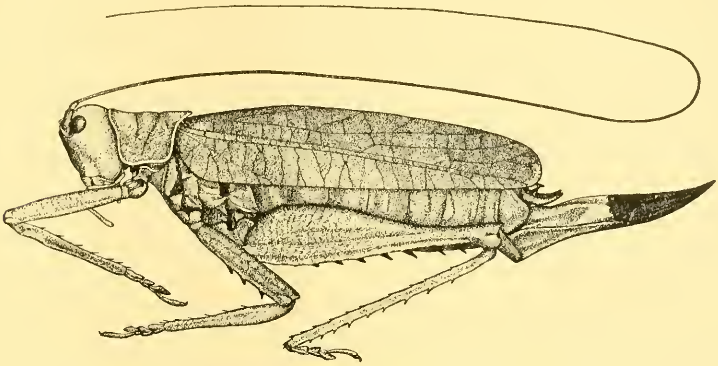

Fig. 12. *Cocconotus ravus* n. sp. Lateral view of female type. (× 2.)

with a strong incurved hook present on each side; supra-anal plate subquadrate excavated mesad, caudal margin with a broad median and two slender lateral acute processes; cerci short, thick, blunt, recurved, the internal margin of the apex with a strong claw-like tooth; subgenital plate longitudinal, produced, the apical margin with a V-shaped emargination, styles slightly longer than the plate, depressed, subequal, tips rather blunt. Ovipositor about two and a half times the length of the pronotum, slightly sinuate, the tip with a slight dorsal elevation, the proximal half subequal, the distal half tapering to the very acute apex, ventral margin slightly arcuate, dorsal margin except for the proximal third and a short space near the apex dentato-serrate, ventral margin feebly serrate near the apex; subgenital plate trigonal with a narrow V-shaped median emargination. Cephalic femora about equal to the head and pronotum in length, the ventro-cephalic margin with four heavy dentiform spines distad; cephalic tibiæ very slightly longer than the femora, unarmed dorsad; each ventral margin armed with seven spines; tarsi with the third joint very broad, the entire length nearly two-thirds that of the tarsi. Me-

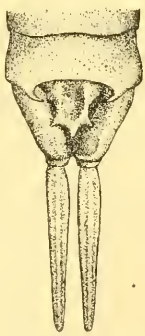

Fig. 13. *Cocconotus ravus* n. sp. Dorsal view of apex of male abdomen. Type. (× 3.)

dian femora slightly larger than the cephalic and similarly armed; tibiæ similar in armament to the cephalic. Caudal femora reaching nearly to the apex of the abdomen, the proximal portion (two-thirds) considerably inflated and tapering to the slender distal fourth, genicular lobes rounded, ventro-lateral margins with eight to ten spines ranging from a mere tubercle proximad to large dentiform structures distad; tibiæ about equal to the femora in length, all margins regularly spined, those of the dorsal margins closer together and more numerous than on the ventral face.

General color russet, the limbs and venter more wood brown and fawn color. Principal thoracic sutures, coxæ, all femoral spines, lateral and median areas of the subgenital plate of the male and the distal half of the ovipositor marked with blackish. Tegmina with a weak suffusion of apple green. Tympanum of the male blackish.

Measurements.

	♂	♀
Length of body,	34.5 mm.	40 mm.
Length of pronotum,	7 "	7.8 "
Length of tegmen,	26.3 "	31.2 "
Length of caudal femur,	18.5 "	21.5 "
Length of ovipositor,		19 "

A series of seventeen specimens, five males, twelve females, of this species have been examined. The localities represented are: San José, September, 1902, three males, six females; Monte Redondo, January, 1903, one male; Tarbaca, October and November, 1902, one male, three females; Cizahar de Cartago, October, 1902, one female; Tablazo, November, 1902, one female; Guatel, August, 1902, one female.

This series exhibits considerable variation in size and a slight amount in color, but in this regard chiefly in the strength of the greenish suffusion of the tegmina. In a few specimens the tegmina are somewhat tessellated by the infuscation of veins, but usually this is not pronounced. The pronotum is in several specimens rather dark, while the cingulate margin is light colored, producing a decided contrast. The most striking variation, however, is in size, one male and several females being considerably smaller than the types of their respective sexes.

CECENTROMENUS Brunner.

1895. *Cecentromenus* Brunner, Monogr. der Pseudophyll., pp. 20, 220.

Type.—*C. marmoratus* Brunner.

Cecentromenus marmoratus Brunner.

1895. *Cecentromenus marmoratus* Brunner, Monogr. der Pseudophyll., p. 221, taf. VIII, fig. 97. [Chiriqui.]

Carrillo. [Hebard Collection.] One female.

This individual agrees very well with the original description and figure except that the caudal femora are shorter, forty-two instead of fifty millimeters in length.

This species has definitely been recorded from the Volcan de Chiriqui by Saussure and Pictet.

EUACRIS Saussure and Pictet.

1898. *Euacris* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 440.

Type.—*E. pictipennis* Saussure and Zehntner.

Euacris richmondi Rehn.

1903. *Euacris richmondi* Rehn, Trans. Amer. Ent. Soc., XXIX, p. 30. [Escondido river, fifty miles from Bluefields, Nicaragua.]

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] One male.

This specimen appears to fully represent *richmondi*, the type of which is not available for examination, but is slightly larger than the original measurements.

The typical species, *pictipennis*, was described from Volcan de Irazu, Costa Rica, at an elevation of 7,000 feet.

SCOPIORUS Stål.

1873. *Scopiorus* Stål, Öfv. Kongl. Veten.-Akad. Förhandl., XXX, No. 4, pp. 45, 48.

Type.—*S. sutorius* Stål.

Scopiorus mucronatus Saussure and Pictet.

1898. *Scopiorus mucronatus* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 443, tab. XXI, fig. 15. [Azahar de Cartago, Costa Rica.]

Tarbaca. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] Male and female.

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] One female.

San José. (Schild and Burgdorf.) [U. S. N. M.] One male.

The annulations of the antennæ are more distinctly marked than one would infer from the original description, particularly in the San Carlos female.

MIMETICA Pictet.

1888. *Mimetica* Pictet, Mém. Soc. Phys. et d'Hist. Nat. Genève, XXX, No. 6, p. 30.

Type.—*M. mortuifolia* Pictet.

Mimetica brunneri Saussure and Pictet.

1898. *Mimetica brunneri* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 453, tab. XXII, fig. 8. [Las Mercedes, Guatemala; Rio Sucio, Costa Rica; Costa Rica; Bugaba, Volcan de Chiriqui and Tolé, Panama; Chiriqui.]

Tucurrique. (Schild and Burgdorf.) [U. S. N. M.] One male.

This specimen is referred to this species with some doubt as the tegmina are slightly more caudate and the costal emarginations are of a slightly different shape.

COPIPHORA Serville.

1831. *Copiphora* Serville, Ann. Sci. Nat., XXII, p. 147.

Type.—*C. longicauda* Serville.

Copiphora cultricornis Pictet.

1888. *C*[*opiophora*] *cultricornis* Pictet, Mém. Soc. Phys. et d'Hist. Nat. Genève, XXX, No. 6, p. 47, Pl. 2, fig. 23. [Central America.]

Guatel. August, 1902. (C. F. Underwood.) [A. N. S. Phila.] One immature female.

Carrillo. [Hebard Collection.] One male.

The male specimen has the rostrum shorter and deeper than the female. The size is also rather less than the measurements given by Saussure and Zehntner,[16] while the face is suffused with brownish-red.

This species has been definitely recorded from Bugaba and Volcan de Chiriqui, Panama.

Copiphora rhinoceros Pictet.

1888. *C*[*opiophora*] *rhinoceros* Pictet, Mém. Soc. Phys. et d'Hist. Nat. Genève, XXX, No. 6, p. 48, Pl. 2, fig. 25. [Central America.]

Turrialba. (Schild and Burgdorf.) [U. S. N. M.] One male.

This specimen is about the same size as the male measured by Redtenbacher[17] and agrees fully with his description, except for the presence of but one spine on the dorsal face of the right median tibiæ and absence of brownish-black coloring on the terminal tarsal joints. The left median tibiæ bears three spines dorsad as mentioned by Redtenbacher.

This species has been recorded from Nicaragua and Volcan de Chiriqui, Panama.

LIROMETOPUM Scudder.

1875. *Lirometopum* Scudder, Proc. Bost. Soc. Nat. Hist., XVII, p. 457.

Type.—*L. coronatum* Scudder.

Lirometopum coronatum Scudder.

1875. *Lirometopum coronatum* Scudder, Proc. Boston Soc. Nat. Hist., XVII, p. 458, figs. 1 and 2. [Greytown, New Grenada.[18]]

Tucurrique. (Schild and Burgdorf.) [U. S. N. M.] One male.

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] One male.

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[16] *Biol. Cent.-Amer.*, Orth., I, p. 377.

[17] *Verhandl. k.-k. Zool.-bot. Gesell. Wien*, XLI, p. 342, 1891.

[18] Greytown, Nicaragua.

Turrialba. (Schild and Burgdorf.) [U. S. N. M.] Two females.

This extraordinary species varies considerably in size, the specimens here tabulated measuring in the order given: breadth of face 10.5, 12, 11.2, 10; length of pronotum 12.9, 14, 12.1, 11.3; length of tegmina 31, 35.5, 31, 29.5; length of caudal femora 15.8, 18, 17, 14.6.

The previously known records for this species are Greytown, Caché, Costa Rica, and Colombia.

ERIOLUS Bolivar.

1888. *Eriolus* Bolivar, Mém. Soc. Zool. France, I, p. 150.

Type.—*E. caraibeus* Bolivar.

Eriolus spiniger Redtenbacher.

1891. *Eriolus spiniger* Redtenbacher, Verhandl. k.-k. Zool.-bot. Gesell. Wien, XLI, p. 349. [Cayenne.]

Tarbaca. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

This specimen presents some points of difference from the description of *spiniger*, and may represent the female of *E. longipennis* Redtenbacher from Costa Rica, known only from the male; but that species is said to have the "meso- et metasternum lobis rotundatis," while the specimen in hand has the lateral margins of the mesosternum elevated and developed into rather blunt flattened spines. On the other hand the fastigium is flattened above, while in *spiniger* this is "superne haud deplanatum," and in *longipennis* "superne *planum*." The ovipositor is typical of *spiniger*.

This species was previously known only from the type locality.

PYRGOCORYPHA Stål.

1873. *Pyrgocorypha* Stål, Öfver. K. Veten.-Akad. Förhandl., XXX, No. 4, p. 50.

Type.—*Conocephalus subulatus* Thunberg.

Pyrgocorypha rogersi Saussure and Pictet.

1898. *Pyrgocorypha rogersi* Saussure and Pictet, Biol. Cent.-Amer., Orth., I, p. 387, tab. XIX, figs. 13 and 14. [Caché, Costa Rica.]

Escazu. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One female.]

Tablazo. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] One nymph.

Pyrgocorypha hamata (Scudder).

1879. *Conocephalus hamatus* Scudder, Proc. Boston Soc. Nat. Hist., XX, p. 87. [Guatemala.[19]]

Guatel. (C. F. Underwood.) [A. N. S. Phila.] One male, one female.

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[19] Saussure and Pictet (*Biol. Cent.-Amer.*, Orth., I, p. 387) consider this locality probably an error for Costa Rica.

San José, altitude 1,160 meters. September, 1904. [Nos. 53 and 55.] (P. Biolley.) Two males, two females.

These specimens are somewhat larger than individuals from Cuernavaca, Morelos, Mexico.

This species has also been recorded from Cuernavaca, Morelos and Michoacan, Mexico, and Salvador.

CONOCEPHALUS Thunberg.

Conocephalus guttatus Serville.

1839. *Conocephalus guttatus* Serville, Orthoptères, p. 518. [Cuba.]

Guatel. (C. F. Underwood.) [A. N. S. Phila.] Three males, six females, one nymph.

Carrillo. [Hebard Collection.] One female.

Tucurrique. (Schild and Burgdorf.) [U. S. N. M.] One male.

Pozo Azul de Pirris. June, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Surubres river at San Mateo, altitude 250 meters. February, 1905. (P. Biolley; Nos. 51 and 52.) [A. N. S. Phila.] Two females.

Some of the specimens here listed differ considerably from others in the form of the fastigium, the subconic typical form with the rounded apex being connected with one with a more rounded, inflated type with parallel sides. Both color phases are represented in the series, which also exhibits considerable variation in size.

Conocephalus muticus Redtenbacher.

1891. *Conocephalus muticus* Redtenbacher, Verhandl. k.-k. Zool.-bot. Gesell. Wien, XLI, p. 393. [Cuba; St. Vincent, Lesser Antilles.]

Carrillo. [Hebard Collection.] One female.

This form appears rather questionably distinct from *guttatus*. It has been previously recorded from Punta de Sabana, Darien.

Conocephalus mexicanus Saussure.

1859. *Conocephalus mexicanus* Saussure, Revue et Magasin de Zoologie, 2e ser., XI, p. 208. [Mexico.]

Tarbaca. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] One female.

Escazu. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One female.

San José. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] Four females.

This species had previously been recorded from Caché, Costa Rica.

Conocephalus obscurellus Redtenbacher.

Tarbaca. October, 1902. (C. F. Underwood.) [A. N. S. Phila.] One male.

Conocephalus diversus n. sp.

Type: ♀; Guatel, Costa Rica. August, 1902. (C. F. Underwood.) [A. N. S. Phila.]

Allied to *C. laticeps* Redtenbacher, but differing in the very much shorter tegmina and ovipositor, the shorter caudal femora and the reduction of the number of femoral spines.

Size rather small; form aborted, thick-set, robust, limbs rather short;

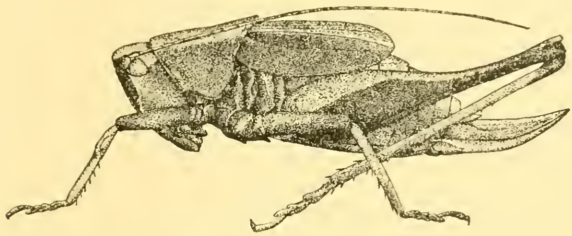

Fig. 14. *Conocephalus diversus* n. sp. Lateral view of type. (× 2.)

surface rugose. Head with the face distinctly but not strongly flattened; occiput transversely arched, slightly elevated to very broad fastigium, which is as broad as the exposed portion of the head, with the cephalic margin regularly arcuate, ventral point placed against the facial fastigium; eyes subtrigonal in basal outline, hardly prominent; antennæ nearly reaching to the tip of the ovipositor. Pronotum moderately flattened dorsad, cephalic and caudal margins arcuate, lateral angles only moderately distinct caudad, rounded cephalad, a subobsolete, broken median carina present on the caudal section of the dorsum; lateral lobes of the pronotum longer than deep, the caudal sinus very slight, ventro-cephalic and ventro-caudal angles obtuse, the former much broader than the latter. Tegmina equal to the head and pronotum in length, greatest breadth much more than half the length; costal and sutural margins broadly arcuate; apex rounded dorsad, obliquely truncate ventrad; dorsal field of the tegmen distinctly broader than the lateral; humeral, discoidal and anal veins apparent, others fused in an irregular network of nervures. Wings minute, not functional, hidden under the tegmina. Abdomen somewhat compressed, slightly carinate dorsad; ovipositor slightly shorter than the head and pronotum together, rather thick,

Fig. 15. *Conocephalus diversus* n. sp. Dorsal view of head, pronotum and tegmina. (× 3.)

the dorsal margin straight, ventral margin arcuate, apex acute, proximal half subequal, margins entire; subgenital plate subtrigonal, apex very shallowly emarginate. Cephalic and median limbs short, rather weak. Caudal femora slightly shorter than the length of the body, the proximal half strongly inflated tapering to the slender subequal distal third, ventral margins with three spines at the distal third; tibiæ somewhat shorter than the femora, dorsal margins with numerous spines, ventral margins with several on the distal section.

General color vandyke brown, washed and sprinkled with bister and black. Head with the face solid black margined laterad with a narrow ochre line, antennæ annulate with black. Pronotum with a pair of broken longitudinal blackish lines on the disk, the caudal margin alternately black and ochre, and the lateral lobes suffused with bister. Tegmina with the lateral fields blackish-brown. Abdomen with the dorsum ochre yellow sprinkled with brown, venter and lateral aspects dark brown. Ovipositor hazel. Cephalic and median femora bister, the tibiæ ranging from russet to ferruginous. Caudal femora with the sections ventrad of the medio-lateral line blackish, dorsad of this line mingled prout's brown and wood brown; caudal tibiæ and tarsi bister.

Measurements.

Length of body,	20	mm.
Length of pronotum,	8	"
Length of tegmen,	10	"
Length of caudal femur,	19.2	"
Length of ovipositor,	9.3	"

The type is the only specimen of this striking and distinct species seen.

XIPHIDION Serville.

1831. *Xiphidion* Serville, Ann. Sci. Nat., XXII, p. 159.

Included *X. fuscum* (Fabricius) and *fasciatum* (De Geer), of which the former, *fuscum*, can be considered the type.

Xiphidion fasciatum (De Geer).

1773. *Locusta fasciata* De Geer, Mém. d'Hist. Ins., III, p. 458, Pl. 40, fig. 4. [Pennsylvania.]

San José, altitude 1,160 meters. June, 1904. (P. Biolley; Nos. 47 and 48.) [A. N. S. Phila.] Two females.

Guatel. (C. F. Underwood.) [A. N. S. Phila.] One male.

This species has been recorded from Caché, Costa Rica, and Punta de Sabana, Darien, Panama.

PHLUGIS Stål.

1860. *Phlugis* Stål, Kongl. Svenska Fregat. Eugenies Resa, Zool. I, Ins., p. 324.

Type.—*Locusta teres* De Geer.

1874. *Thysdrus* Stål, Recens. Orth., II, pp. 102, 116.
1903. *Alogopteron* Rehn, Ent. News, XIV, p. 141.

Phlugis virens (Thunberg).

1815. *C*[*onocephalus*] *virens* Thunberg, Mém. l'Acad. Imp. Sci. St. Pétersb., V, p. 274.
1903. *Alogopteron carribbeum* Rehn, Ent. News, XIV, p. 141. [Turrialba, Costa Rica.]

San José, altitude 1,160 meters. June, 1904. (P. Biolley; No. 46.) Two females.

Guatel. (C. F. Underwood.) One female.

These specimens are inseparable from the type of *A. carribbeum.*

GRYLLACRIS Serville.

1831. *Gryllacris* Serville, Ann. Sci. Nat., XXII, p. 138.

Included *gryllacris maculicollis* (Stoll), *G. ruficeps* and *personata* Serville, of which *maculicollis* can be considered the type.

Gryllacris maculata Brunner.

1888. *Gryllacris maculata* Brunner, Verhandl. k.-k. Zool.-bot. Gesell. Wien, XXXVIII, p. 364. [Chiriqui, Panama; Costa Rica.]

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Male and female.

The femora of these individuals are suffused distad with carmine.

ANABROPSIS Rehn.

1859. *Schœnobates* Saussure, Revue et Magasin de Zoologie, 2e ser., XI, p 209. (Not of Blackwall, 1850.)

Type.—*S. mexicanus* Saussure.

1901. *Anabropsis* Rehn, Canad. Ent., XXXIII, p. 272.

Anabropsis marmorata n. sp.

Type: ♀; Carrillo, Costa Rica. [Hebard Collection.]

Allied to *A. mexicana* (Saussure), but differing in the fully developed tegmina and wings, the rotundate caudal margin of the pronotum, the more rotundate ventral margin of the lateral lobes and the different coloration. The new form appears to be closely related to *A. alata* (Brunner),[20] which was very poorly described and based on a mutilated specimen, but which appears to differ in the roundly inserted lateral lobes of the pronotum.

Size rather large; form moderately robust. Head with the occiput

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[20] *Verhandl. k.-k. Zool.-bot. Gesell. Wien*, XXXVIII, p. 274. [Ecuador.]

arched and bearing a narrow longitudinal median carina extending down to the base of the fastigium; fastigium compressed, depressed with the outline arcuate, constricted proximad, bearing a very shallow longitudinal median sulcus, and carrying the paired ocelli on its lateral faces; facial fastigium touching the fastigium of the vertex; eyes reniform in basal outline, the greatest diameter dorso-ventral and nearly twice the greatest width, quite prominent when viewed from the dorsum; mouth-parts produced ventrad, in depth equal to the remainder of the head, maxillar palpi with the distal joint elongate, slender, with the apex slightly expanded into a crudely trumpet-shaped structure, penultimate joint strongly compressed; antennæ apparently exceeding the tips of the tegmina when in perfect condition, insertion of the antennæ broad and occupying all the section between the facial fastigium and the eyes. Pronotum faintly saddle-shaped, dorsum arched except for a semicircular caudal section which is deplanate; cephalic margin sinuato-truncate, caudal margin gently arcuate, lateral angles obsolete cephalad, distinct, but not sharp, caudad, and diverted ventro-cephalic on the lobes caudad of the last transverse sulcus; distinct transverse sulci two in number, the cephalic situated immediately caudad of the cephalic margin, and the caudal situated in its usual place laterad, but on the dorsum extending caudad and crudely following the outline of the caudal margin; lateral lobes longer than deep, the ventral margin evenly arcuate, cephalic margin very slightly arcuate with the ventro-cephalic angle obtuse, caudal margin arcuato-emarginate, the ventro-caudal angle subrectangulate, surface depressed along the line of the sulci and on the ventro-caudal section, the deflected angle being roundly arched. Prosternum unarmed; mesosternum with a pair of erect blunt spines; metasternum with a pair of broad flat trigonal diverging spines. Tegmina long, nearly reaching to the tips of the caudal femora, greatest width contained about three times in the length (apexes damaged); costal margin arcuate proximad; mediastine vein straight, humeral vein with three rami, discoidal with two rami, median with two, the dorsal of which again divides, ulnar vein undivided. Wings equal to the tegmina in length. Ovipositor slightly longer than the pronotum, regularly arched and falciform, apex acute, margins unarmed; subgenital plate produced mesad into an elongate sagittate process with needle-like apex, and a deep median sulcus through the greater part of its length. Cephalic femora equal to the head and pronotum in length, ventro-cephalic margin with three small spines, ventro-caudal margin unarmed; cephalic tibiæ about equal to the femora in length, armed with long slender spines, four apical, one mesad on the dorso-cephalic margin, four on each ventral margin; cephalic tarsi with the distal joint very slightly shorter than the remaining joints. Median femora slightly longer than the cephalic, compressed as in them, with two slight spines on the ventro-cephalic margin; median tibiæ slightly longer than the cephalic tibiæ, armed

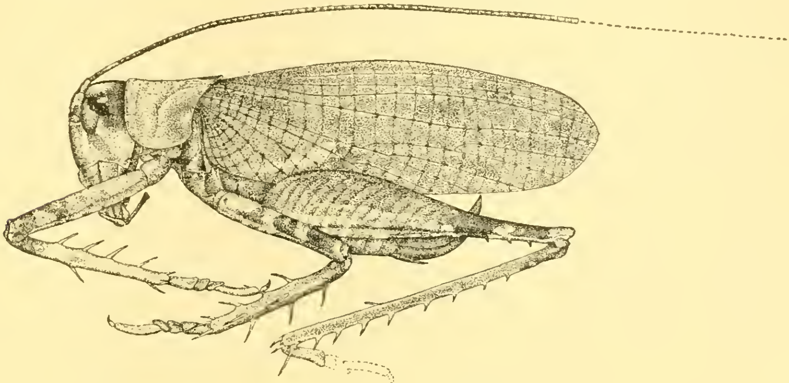

Fig. 16. *Anabropsis marmorata* n. sp. Lateral view of type. (× 2.)

distad and on the ventral margins the same, but bearing dorsad two spines on the cephalic and three spines on the caudal margin; median tarsi similar to the cephalic. Caudal femora elongate, about three-fourths the length of the body, moderately inflated proximad, external pagina strongly marked with an overlapping lamellate pattern, the ridges being ventro-cephalic in direction, genicular lobes rounded, ventral margins each with three to four short spines; caudal femora about equal to the femora in length, trigonal in section, armed with eight or nine spines on the dorsal margins, ventral margin armed with several distad.

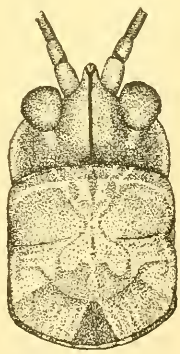

Fig. 17. *Anabropsis marmorata* n. sp. Dorsal view of head and pronotum. (× 3.)

General colors bister and cream-buff, the two colors mingled and marbled on the head, to a slight extent on the tegmina and the limbs annulate and dotted with the same. Head with the eyes walnut brown, a broad poorly defined postocular bar of seal brown present, extending toward mesad on the caudal section of the head, uniting and suffusing that portion; fastigium and median carina colored with the darker shade; antennæ obscurely annulate. Pronotum clear walnut brown with a very fine but irregular pattern of lines and blotches of vandyke brown covering the surface, a distinct median hour-glass shaped figure present on the cephalic portion of the dorsum, and a median caudal spot of velvety black. Tegmina with the darker color predominating, but usually broken up and confined to veins, except an indistinct proximal spot and several distinct but irregular spots on the apical half. Cephalic and median femora distinctly annulate thrice with dark; tibiæ light with only one dark annulus. Caudal femora clouded dorsad with vandyke brown, a clear light section along the ventral carina of the pagina, the carina itself proximad alternately light and dark, dark distad with the genicular region except the lobes light and one light pregenicular annulus; caudal tibiæ light, dark distad.

Measurements.

Length of body,	22	mm.
Length of pronotum,	6.5	"
Length of tegmen (approximately),	26.5	"
Length of caudal femur,	21.5	"
Length of ovipositor,	9	"

The type is unique.

Anabropsis costaricensis n. sp.

Type: ♂; Carrillo, Costa Rica. [Hebard Collection.]

Closely allied to *A. aptera* (Brunner) from Guatemala, but smaller and with distinct subtruncate tegmina half as long as the abdomen present.

Size medium; form rather slender; surface glabrous. Head with the occiput arched, median longitudinal carina extending to the fastigium present; fastigium similar to that of *A. marmorata* but not sulcate; eyes elongate reniform in basal outline, the elongation being ventrad, moderately prominent when viewed from the dorsum; palpi with the terminal joint as *A. marmorata*, but penultimate joint much less compressed and nearly cylindrical; antennæ four times the length of the body. Pronotum slightly less than three times the length of the head, dorsum arcuate; cephalic margin truncate, caudal margin regularly arcuate, lateral angles obsolete cephalad, distinct but not acute caudad, extending down along the caudal tranverse sulcus on the lateral lobes; median carina present but weak; transverse sulci two in number, cephalic immediately caudad of the cephalic margin, caudal rather poorly defined dorsad and more evident on the lobes where it has a ventro-cephalic trend; lateral lobes with the ventral and caudal margins from the dorso-caudal margin to the ventro-cephalic angle one continuous and regular arcuation, ventro-cephalic angle rounded rectangulate. Prosternum armed with a pair of erect slender spines; mesosternum with a pair of heavier spines but of the same general form; metasternum with the coxal lobes produced into blunt trigonal lobes. Tegmina slightly shorter than the pronotum, about half again as long as broad; distal margin

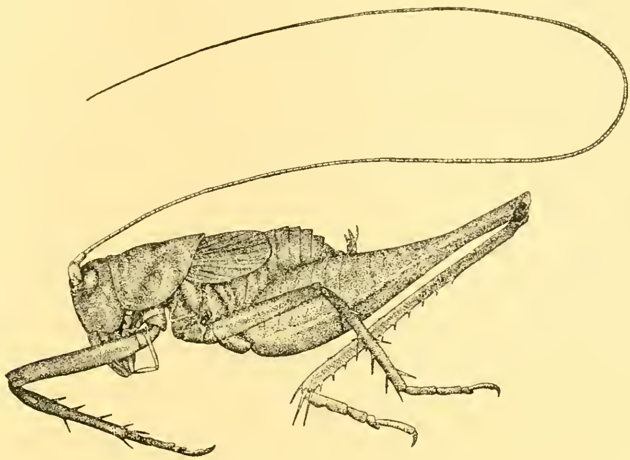

Fig. 18. *Anabropsis costaricensis* n. sp. Lateral view of type. (× 2.)

rotundato-truncate; veins moderately distinct. Wings extremely small, completely hidden under the tegmina. Abdomen compressed, carinate dorsad; supra-anal plate distorted and true form not ascertainable; cerci arcuate, moderately long, somewhat compressed, apex acute; anal filaments longer than cerci, tapering; subgenital plate produced, apical margin very shallow and broadly emarginate, styles short, thick, simple, blunt. Cephalic femora slightly longer than the pronotum, unarmed, cephalic tibiæ about equal to the femora in length, each dorsal margin armed with one spine mesad and four on each ventral margin; tarsi with the distal joint shorter than the remainder. Median femora of equal length and similar character as the cephalic; median tibiæ with two cephalic and three caudal spines on the dorsum and four on each ventral margin; median tarsi with the distal joint shorter than the remainder. Caudal femora slightly longer than the body, strongly inflated proximad and quite slender in the distal

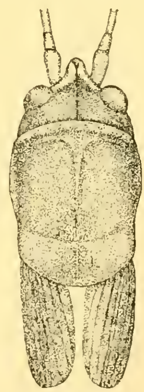

Fig. 19. *Anabropsis costaricensis* n. sp. Dorsal view of head, pronotum and tegmina. (× 3.)

third, genicular lobes rounded, the internal spined, internal ventral margin with a few weak spines distad, pagina sculptured as in *A. marmorata* but much weaker; caudal tibiæ very slightly longer than the femora, compressed, dorsum armed with eleven to twelve external and eight nternal spines, venter with several weak adpressed spines, spurs on the external face shorter than those of the internal; caudal tarsi with the distal and proximal joints subequal.

General color vandyke brown, becoming tawny-olive on the venter, the proximal portions of the femora, the distal section of the caudal tibiæ and the tarsi. Antennæ, ocelli and mouth-parts tawny-olive.

Measurements.

Length of body,	19.5 mm.
Length of pronotum,	7.1 "
Length of tegmen,	6.2 "
Length of caudal femur,	20.5 "

The type of this species is the only specimen examined.

GRYLLIDÆ.

GRYLLOTALPA Latreille.

Gryllotalpa hexadactyla Perty.

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] Two females.

This species has been recorded from Caché, Costa Rica.

SCAPTERISCUS Scudder.

Scapteriscus didactylus (Latreille).

1804. *Gryllotalpa didactyla* Latreille, Hist. Nat. Crust. et Ins., XII, p. 122. [Cayenne; Surinam.]

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] One male, one female.

RIPIPTERYX Newman.

1834. *Ripipteryx* Newman, Entom. Magazine, II, No. II, p. 204, Pl. VII.

Type.—*R. marginatus* Newman.

Ripipteryx carbonaria Saussure.

1896. *Rhipipteryx carbonaria* Saussure, Biol. Cent.-Amer., Orth., I, p. 211. [Volcan de Chiriqui, Panama, 2,000 to 3,000 feet.]

Escazu. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two females.

Side of Tablazo, altitude 1,500 meters. April, 1905. [No. 37.] (P. Biolley.) Thirteen specimens.

Ripipteryx limbata (Burmeister).

1838. *X[ya] limbata* Burmeister, Handb. d. Entom., II, Abth. II, Pt. 1, p. 742. [South America.]

San Carlos. (Schild and Burgdorf.) [U. S. N. M.] One female.

Santa Clara, Reventazon river, altitude 150 meters. December, 1904. [No. 39.] (P. Biolley.) One male.

Carrillo. [Hebard Collection.] Three females.

The terminal joints of the antennæ of these specimens are solid black.

This species has been recorded from Chontales, Nicaragua, the only other Central American record.

Ripipteryx biolleyi Saussure.

1896. *Rhipipteryx biolleyi* Saussure, Biol. Cent.-Amer., Orth., I, p. 215. [San José, Volcan de Irazu, 6,000 to 7,000 feet, Costa Rica.]

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Five males, four females, two imperfect individuals.

San José, altitude 1,160 meters. March, 1905. [No. 38.] (P. Biolley.) Twelve males, seven females.

Ripipteryx pulicaria Saussure.

1896. *Rhipipteryx pulicaria* Saussure, Biol. Cent.-Amer., Orth., I, p. 215, tab. XI, fig. 24. [Dos Caminos, Guerrero; Atoyac, Vera Cruz; Teapa, Tabasco, Mexico; var. Tarma, Peru.]

Santa Clara, Reventazon river, altitude 150 meters. December, 1904. [No. 140.] (P. Biolley.) One male.

Mouth of the Jesus Maria river, Pacific coast. April, 1905. [No. 141.] (P. Biolley.) One female.

These specimens differ somewhat in coloration from the original specimens described by Saussure, but they are unquestionably this species.

ANUROGRYLLUS Saussure.

1877. *Anurogryllus* Saussure, Mélanges Orthoptér., V fasc., p. 451.

Included *A. muticus* (De Geer), *clarazianus* (Sauss.), *australis* Sauss., *antillarum* (Sauss.), *abortivus* (Sauss.), and *brevicaudatus* Sauss., of which *muticus* may be considered the type.

Anurogryllus muticus (De Geer).

1773. *Gryllus muticus* De Geer, Mém. d'Hist. Ins., III, p. 520, tab. 43, fig. 2. [Surinam.]

Reventazon, plains of Santa Clara, altitude 200 meters. December, 1904. (P. Biolley; No. 32.) [A. N. S. Phila.] One male, one female.

ANAXIPHA Saussure.

1874. *Anaxipha* Saussure, Miss. Scient. Mex. et l'Amer. Cent., part 6, pp. 363, 370.

Included *A. pulicaria* (Burmeister), *pallens* (Stål) and (?) *pumila* (Burmeister), of which *pulicaria* may be considered the type.

Anaxipha exigua (Say).

1825. [*Acheta*] *exigua* Say, Journ. Acad. Nat. Sci. Phila., IV, p. 309. [Missouri.]

Reventazon, plains of Santa Clara, altitude 200 meters. December, 1904. (P. Biolley; No. 34.) [A. N. S. Phila.] One male.

This individual is inseparable from specimens from the eastern United States.

CYRTOXIPHA Brunner.

Cyrtoxipha championi Saussure.

1897. *Cyrtoxiphus championi* Saussure, Biol. Cent.-Amer., Orth., I, p. 236, tab. XI, fig. 41. [Bugaba, Panama]

Carrillo. [Hebard Collection.] One female.

Reventazon, plains of Santa Clara, altitude 200 meters. December, 1904. (P. Biolley; No. 33.) [A. N. S. Phila.] One male, one immature individual.

The caudal femora of these specimens are shorter than in the type specimen measured by Saussure, four and five millimeters instead of six. The female is blackish-brown in color, while the male is fulvous.

PHYLLOSCYRTUS Guérin-Méneville.

1844. *Phylloscyrtus* Guérin-Méneville, Iconogr. du Règne Anim., III, p. 333.

Type.—*P. elegans* Guérin-Méneville.

Phyllosoyrtus cæruleus Saussure.

1874. *Phylloscyrtus cœruleus* Saussure, Miss. Scient. Mex. et l'Amer. Cent., part 6, p. 366, Pl. VII, fig. 3. [Eastern Cordillera, Mexico.]

Turrialba. (Schild and Burgdorf.) [U. S. N. M.) One female.

This species is here recorded for the first time outside of Mexico.

HETEROGRYLLUS Saussure.

1874. *Heterogryllus* Saussure, Miss. Scient. Mexiq. et l'Amer. Cent., part 6, pp. 430, 439.

Type.—*H. ocellaris* Saussure.

Heterogryllus crassicornis Saussure.

1878. *H*[*eterogryllus*] *crassicornis* Saussure, Mélanges Orthoptérologiques, VI, p. 557. [Venezuela.]

Carrillo. [Hebard Collection.] One female.

Costa Rica (exact locality unknown). [U. S. N. M.] One female.

These specimens appear to represent this long unrecognized species. Superficially the coloration resembles species of the genus *Amphiacusta*, but the peculiar rostrum and slenderer limbs readily differentiate it. The anal filaments are very long, considerably exceeding the ovipositor. The coloration of the limbs is very rich, the caudal femora being wine-color with one complete and one broken distal annulus of ochre.

ŒCANTHUS Serville.

Œcanthus nigricornis Walker ?

1869. *Œcanthus nigricornis* Walker, Catal. Derm. Salt. Brit. Mus., p. 93. [Illinois.]

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One female.

This specimen is referred here with some doubt.

XABEA Walker.

1869. *Xabea* Walker, Catal. Derm. Salt. Brit. Mus., p. 109.

Type.—*X. decora* Walker.

Xabea bipunctata (De Geer).

1773. *Gryllus bipunctatus* De Geer, Mém. d'Hist. Ins., III, p. 523, tab 43, fig. 7. [Pennsylvania.]

Turrialba. (Schild and Burgdorf.) [U. S. N. M.] Two males.

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One female.

Previously recorded from Bugaba, Volcan de Chiriqui and Caldera, Panama.

ENEOPTERA Burmeister.

1838. *Eneoptera* Burmeister, Handb. d. Entom., II, Abth. II, part I, p. 736,

Included *E. brasiliensis* Fabricius (= *surinamensis* De Geer) and *E. livida* Burm., of which the former has been selected [21] as the type.

Eneoptera surinamensis (De Geer).

1773. *Gryllus surinamensis* De Geer, Mém. d'Hist. Ins , III, p. 519, tab. 43. fig. 1. [Surinam.]

Pozo Azul de Pirris. September, 1902. (C. F. Underwood.) [A. N. S. Phila.] Two females.

This widely distributed species has been previously recorded twice from Central America, from Chontales, Nicaragua, and Bugaba, Panama.

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[21] *Miss. Scientif. Mex. et l'Amer. Cent.*, part 6, p. 481.

PARŒCANTHUS Saussure.

Parœoanthus aztecus Saussure.

1874. *Parœcanthus Aztecus* Saussure, Miss. Scientif. Mex. et l'Amer. Cent., Rec. Zool., part 6, p. 471. [Mexico.]

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] Two males, four females.

These specimens are smaller than the measurements given by Saussure and probably belong to his small variety *b*.[22]

OROCHARIS Uhler.

Orocharis cayennensis Saussure?

1897. *Orocharis cayennensis* Saussure, Biol. Cent.-Amer., Orth., I, p. 275, tab. xiii, figs. 23, 24. [Cayenne].

Monte Redondo. January, 1903. (C. F. Underwood.) [A. N. S. Phila.] One male, one female.

These specimens are referred questionably to this species on account of the form of the terminal joints of the palpi which are exactly as in *O. tibialis*, and not the funnel-shaped type found in *cayennensis*. On the other hand the male tegmina are not as in *tibialis*, but are typical of *cayennensis*, and the proportions also agree with the latter species.

ECTOTRYPA Saussure.

1874. *Ectotrypa* Saussure, Miss. Scientif. Mex. et l'Amer. Cent., Rec. Zool., part 6, pp. 465, 466.

Type.—*E. olmeca* Saussure.

Eotrypa brevis n. sp.

Type: ♀; Carrillo, Costa Rica. [Hebard Collection.]

Closely allied to *E. olmeca* Saussure, but differing in the shorter pronotum, which also has the lateral lobes with the ventral margin arcuate, and the shorter tegmina and wings.

Size medium, form moderately slender. Head slightly depressed, occiput gently rounded transversely, not arched longitudinally; fastigium bluntly angulate, the space between the internal margins of the antennal scrobes about one-fourth that between the eyes; eyes irregularly pyriform in basal outline, the greatest diameter nearly horizontal, the narrowest portion cephalad, eyes when viewed from the dorsum little prominent; maxillary palpi with the distal segment short trumpet-shaped with the apex excavated; antennæ nearly twice the length of the body, proximal joint depressed. Pronotum ar-

[22] *Biol. Cent.-Amer.*, Orth., I, p. 262.

cuate transversely, the greatest length equal to the caudal width; cephalic margin subtruncate, caudal margin very broadly obtuse-angulate, lateral angles rounded; lateral lobes very considerably longer than deep, the ventral margin truncate-arcuate both angles rounded. Tegmina very slightly shorter than the apex of the abdomen; mediastine vein with about eleven branches, lateral field with the margin moderately arcuate distad. Ovipositor slightly more than half the length of the body, slender, with a hardly perceptible arcuation, valves finely serrate; styles slender, slightly exceeding the tip of the ovipositor; subgenital plate distad with a broad, shallow subtrigonal emargination. Cephalic femora distinctly longer than the pronotum, moderately inflated; cephalic tibiæ equal to the femora in length, very slightly and gradually tapering, the tympanum perforate caudad. Median limbs missing. Caudal femora very slightly shorter than the tegmina, considerably inflated, the genicular region small and with the lobes narrowly rounded; caudal tibiæ about four-fifths the length of the femora, dorsal margins spinulose proximad, spinulose and spinose distad, the spines five in number on each margin, the spurs on the internal margin much longer than those of the external margins; caudal tarsi with the proximal joint nearly equal to the remaining joints in length, the distal joint but slightly shorter than the proximal.

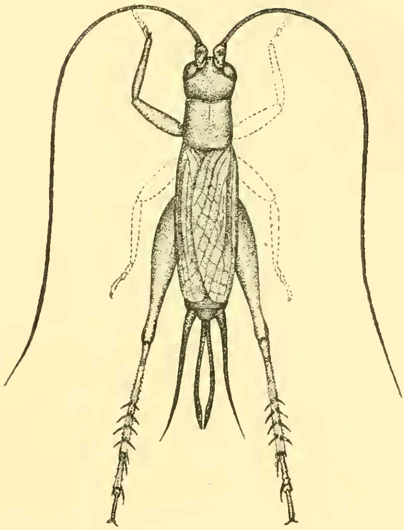

Fig. 20. *Ectotrypa brevis* n. sp. Dorsal view of type. (× 2.)

Fig. 21. *Ectotrypa brevis* n. sp. Lateral view of head and pronotum. (× 3.)

General color cinnamon, the pronotum somewhat inclined toward umber; eyes vandyke brown; mouth-parts and antennæ pale; abdomen mummy brown; styles and ovipositor vandyke brown.

Measurements.

Length of body,	16	mm.
Length of pronotum,	3.5	"

Length of tegmen,	10.2 mm.
Length of caudal femur,	9.2 "
Length of ovipositor,	8 "

But one specimen, the type, has been examined.

APHONOMORPHUS Rehn.

1874. *Aphonus* Saussure, Miss. Scientif. Mex. et l'Amer. Cent., Rec. Zool., part 6, pp. 466, 509. (Not of Leconte.)
1903. *Aphonomorphus* Rehn, Ent. News, XIV, p. 260.

Included *A. mutus, telskii, peruvianus, diversus* and (?) *lividus*, of which *mutus* may be considered the type.

Aphonomorphus silens (Saussure)?

1878. *A[phonus] silens* Saussure, Mélanges Orthoptérologiques, fasc. VI, p. 805. [Brazil?]

Santa Ana. November, 1902. (C. F. Underwood.) [A. N. S. Phila.] One male.

It is with some doubt that I place this specimen under this species, as it differs considerably in color and has the caudal femora slightly smaller than Saussure's measurements. The caudal metatarsi have very well developed spines, but Saussure says they are "énormes." The head (except the eyes, rostrum and antennal fossæ), pronotum and cephalic and median limbs are blackish-brown, while the tegmina are sienna.

The specimen apparently fits no other species, but may be quite distinct from the true *silens*.

Species of Orthoptera Recorded from Costa Rica by the Author.

The following list of one hundred and ninety-five species represents the species recorded in this and previous papers by the author (*vide* p. 790), bearing wholly or in part on the Orthoptera of Costa Rica.

FORFICULIDÆ.

Pyragra fuscata Serville.
Psalis americana (Palisot).
Psalis pulchra Rehn.
Labia annulata (Fabricius).
Labia auricoma Rehn.
Opisthocosmia (*Sarcinatrix*) *anomalia* Rehn.
Apterygida linearis (Eschscholtz).

BLATTIDÆ.

Anaplecta flabellata Saussure and Zehntner.
Anaplecta fulgida Saussure.

Anaplecta fallax Saussure.
Anaplecta decipiens Saussure and Zehntner.
Blattella germanica (Linnæus).
Blattella nahua (Saussure).
Blattella azteca (Saussure and Zehntner)?
Blattella zapoteca (Saussure).
Blattella pavida Rehn.
Blattella spectativa Rehn.
Blattella brunneriana (Saussure).
Pseudophyllodromia peruana (Saussure).
Pseudophyllodromia angustata (Latreille).
Pseudomops oblongata (Linnæus).
Pseudomops discoidalis (Burmeister).
Pseudomops crinicornis (Burmeister).
Pseudomops grata Rehn.
Ischnoptera inœqualis Saussure and Zehntner.
Paratropes biolleyi Saussure and Zehntner.
Calolampra cicatricosa Rehn.
Periplaneta australasiœ (Fabricius).
Pelmatosilpha rotundata Scudder.
Chorisoneura flavipennis Saussure and Zehntner.
Plectoptera pulicaria Saussure and Zehntner.
Plectoptera hastifera Rehn.
Plectoptera picta Saussure and Zehntner.
Pelloblatta lata Rehn.
Panchlora acolhua Saussure and Zehntner.
Panchlora peruana Saussure.
Panchlora punctum Saussure and Zehntner.
Achroblatta luteola (Blanchard).
Zetobora sublobata Saussure and Zehntner.
Capucina cucullata Saussure.
Holocompsa cyanea (Burmeister).
Archimandrita tessellata Rehn.
Blaberus trapezoideus Burmeister.
Blaberus thoracicus Saussure and Zehntner.
Blaberus biolleyi Rehn.

MANTIDÆ.

Acontista mexicana Saussure and Zehntner.
Acontista fraterna Saussure and Zehntner.
Acontista vitrea Saussure and Zehntner.

Stagmomantis nahua Saussure.
Stagmomantis heterogamia Saussure and Zehntner.
Stagmomantis theophila Rehn.
Stagmomantis tolteca (Saussure).
Stagmomantis dimidiata (Burmeister).
Stagmomantis venusta Saussure and Zehntner.
Stagmomantis androgyna Saussure and Zehntner.
Angela perpulchra Westwood.
Pseudomiopteryx infuscata Saussure and Zehntner.
Harpagonyx carlottæ Rehn.
Spanionyx bidens Saussure and Zehntner.
Acanthops tuberculata Saussure.
Stagmatoptera insatiabilis Rehn.

PHASMIDÆ.

Sermyle physconia Rehn.
Heteronemia ignava Rehn.
Calynda bicuspis Stål.
Bostra turgida (Westwood).
Bostra incompta Rehn.
Bostra remiformis Rehn.
Oncotophasma martini (Griffini).
Libethra auritus Rehn.
Stratocles multilineatus Rehn.
Stratocles costaricensis Rehn.
Olcyphides viridipes Rehn.
Pseudophasma phæton Rehn.
Pseudophasma phthisicum (Linnæus).
Pseudophasma menius (Westwood).
Pseudophasma cryptochlore Rehn.
Planudes crenulipes Rehn.
Xerosoma glyptomerion Rehn.
Metriotes agathocles Stål.
Prisopus berosus Westwood.

ACRIDIDÆ.

Chiriquia serrata Morse.
Ochetotettix volans Morse.
Ochetotettix barretti (Hancock).
Paratettix mexicanus (Saussure).

Paratettix toltecus (Saussure).
Allotettix peruvianus (Bolivar).
Tettigidea nicaraguæ Bruner.
Eumastax dentatus Saussure.
Episactus brunneri Burr.
Truxalis brevicornis (Johansson).
Silvitettix communis Bruner.
Amblytropidia costaricensis Bruner.
Orphulella punctata (De Geer).
Orphulella costaricensis Bruner.
Orphulella meridionalis Bruner?
Plectrotettix calidus Bruner.
Chortophaga meridionalis Bruner.
Lactista punctatus (Stål).
Heliastus costaricensis Rehn.
Heliastus venezuelæ Saussure.
Prosphena scudderi Bolivar.
Munatia punctata Stål.
Colpolopha bruneri Rehn.
Cibotopteryx variegata Rehn.
Tæniopoda centurio (Drury).
Tæniopoda varipennis Rehn.
Chromacris trogon Gerstaecker.
Rhicnoderma humile Rehn.
Leptysma obscura (Thunberg).
Copiocera specularis Gerstaecker.
Cornops longipenne (De Geer)?
Œdalometopon petasatum Rehn.
Anniceris truncatus Rehn.
Dellia miniatula Rehn.
Dellia bimaculata Rehn.
Dellia ovatipennis Rehn.
Jodacris (?) *costaricensis* Rehn.
Syletria angulata Rehn.
Leptomerinthoprora brevipennis Rehn.
Schistocerca pyramidata Scudder.
Schistocerca malachitica Rehn.
Aidemona azteca (Saussure).
Dichroplus morosus Rehn.
Osmilia tolteca (Saussure).
Rhachicreagra nothra Rehn.

Microtylopteryx hebardi Rehn.
Microtylopteryx fusiformis Rehn.

TETTIGONIDÆ.

Aphidna simplicipes Brunner.
Hormilia intermedia Brunner.
Ceraia cruenta (Burmeister).
Stilpnochlora marginella (Serville).
Stilpnochlora toltcca (Saussure).
Stilpnochlora azteca (Saussure).
Steirodon validum Stål.
Orophus mexicanus Saussure.
Orophus ovatus (Brunner).
Orophus conspersus (Brunner).
Orophus tessellatus Saussure.
Anaulacomera digitata Rehn.
Anaulacomera laticauda Brunner.
Anaulacomera denticauda Saussure and Pictet.
Turpilia oblongooculata Brunner.
Turpilia grandis Rehn.
Turpilia linearis Rehn.
Microcentrum syntechnoides Rehn.
Syntechna caudelli Rehn.
Lichenochrus marmoratus Rehn.
Gongrecnemis nigrospinosa Brunner.
Drepanoxiphus minutus Brunner?
Cocconotus degeeri (Stål).
Cocconotus ravus Rehn.
Ischnomela pulchripennis Rehn.
Cecentromenus marmoratus Brunner.
Euacris richmondi Rehn.
Scopiorus mucronatus Saussure and Pictet.
Mimetica brunneri Saussure and Pictet.
Mimetica crenulata Rehn.
Copiphora cultricornis Pictet.
Copiphora rhinoceros Pictet.
Lirometopum coronatum Scudder.
Eriolus spiniger Redtenbacher.
Pyrgocorypha rogersi Saussure and Pictet.
Pyrgocorypha hamata (Scudder).
Conocephalus guttatus Serville.

Conocephalus muticus Redtenbacher.
Conocephalus mexicanus Saussure.
Conocephalus obscurellus Redtenbacher.
Conocephalus diversus Rehn.
Xiphidion fasciatum (De Geer).
Phlugis virens (Thunberg).
Gryllacris maculata Brunner.
Anabropsis marmorata Rehn.
Anabropsis costaricensis Rehn.

GRYLLIDÆ.

Gryllotalpa hexadactyla Perty.
Scapteriscus didactylus (Latreille).
Ripipteryx carbonaria Saussure.
Ripipteryx limbata (Burmeister).
Ripipteryx biolleyi Saussure.
Ripipteryx pulicaria Saussure.
Anurogryllus muticus (De Geer).
Anaxipha exigua (Say).
Cyrtoxipha championi Saussure.
Symphaloxipha magnifica Rehn.
Phylloscyrtus cœruleus Saussure.
Heterogryllus crassicornis Saussure.
Œcanthus nigricornis Walker?
Xabea bipunctata (De Geer).
Eneoptera surinamensis (De Geer).
Paræcanthus aztecus Saussure.
Orocharis cayennensis Saussure?
Ectotrypa brevis Rehn.
Aphonomorphus silens (Saussure)?

December 5.

Mr. Arthur Erwin Brown, Vice-President, in the Chair.

Fifty-five persons present.

The deaths of the following correspondents were reported: Frederick W. Hutton, October 27, 1905; J. Burden-Sanderson, November 3, 1905; Gustave Dewalque, November 3, 1905.

The Publication Committee reported that papers under the following titles had been offered for publication since the last meeting:

"Coon Mountain and Its Crater." By Daniel Moreau Barringer. (December 5.)

"Coon Butte, Arizona." By Benjamin Chew Tilghman. (December 5.)

Coon Mountain and its Crater.—Dr. Dixon announced that Mr. Daniel Moreau Barringer and Mr. Benjamin Chew Tilghman, members of the Academy, had notified him of their discovery that the crater of Coon Mountain or Coon Butte, in northern Arizona, twelve miles southeast of Cañon Diablo Station on the Atchison, Topeka and Santa Fé Railway, is an impact crater and not a crater produced by a steam explosion, as has been supposed since the examination made of it by members of the United States Geological Survey. They have proved, by a large amount of development work, according to their statements, that the large crater and elevation known as Coon Mountain is the result of a collision with the earth of a very large meteorite, or possibly a small asteroid, fragments of which are well known to the scientific world by the name of the Cañon Diablo siderites. Their development work, consisting of cuts, shafts and boreholes, has established the following facts:

First. That the formation of the crater and the deposition of the meteoric material were simultaneous.

Second. That meteoric material has been found five hundred feet below the surface of the center of the crater; and,

Third. That sandstone supposed to be in place exists less than one thousand feet below the surface of the center of the crater.

Mr. Barringer and Mr. Tilghman have presented to the Academy for publication two comprehensive papers in which they set forth in full their reasons for the above statements.

Dr. Henry Skinner made a communication on his collecting trip of last summer to the Huachuca Mountains, Arizona. (No abstract.)

DECEMBER 19.

The President, SAMUEL G. DIXON, M.D., in the Chair.

Forty persons present.

The deaths of the following members were announced: William H. Walmsley, October 22, 1905; Philip C. Garrett, December 9, 1905; Israel Morris, December 13, 1905.

The Publication Committee reported that a paper under the following title had been offered for publication:

"New Species of Ampharetidæ and Terebellidæ." By J. Percy Moore. (December 8.)

The following were ordered to be printed:

NEW SPECIES OF AMPHARETIDÆ AND TEREBELLIDÆ FROM THE NORTH PACIFIC.

BY J. PERCY MOORE.

Among the Polychæta dredged by the steamer *Albatross* while in the service of the Alaskan Salmon Commission of 1903 occur the following new species. Two previous papers based upon the same collections have been published in these *Proceedings* for 1905.

Amphicteis alaskensis sp. nov. (Plate XLIV, figs. 1–4.)

The available examples of this species vary in length from 22 to 76 mm. One selected for the type is 33 mm. long, of which the thorax is 19 mm.; its greatest width is 4.3 mm., and the cephalic cone is 2.3 mm. in both length and breadth.

Counting the region of trunk anterior to the paleoli as formed of two somites, the worm consists of thirty-four segments and the pygidium. The setigerous segments are from III to XX inclusive, and the uncinigerous VII to XXXV inclusive.

The median prostomial plate (fig. 1) is shield-shaped, about twice as long as broad, the posterior end pointed, the anterior cleft in the middle and formed of two somewhat divergent lobes. On each side of the plate is a broad, low, lateral ridge broadly rounded anteriorly and reaching not quite so far forward as the median plate. Bounding both these ridges and the plate posteriorly is a pair of transverse folds curving slightly forward laterally and caudad medially to meet in the median line at a sharp angle. These ridges are pigmented with brown above and they form the angle at which the nearly vertical anterior portion of the prostomium meets the nearly horizontal posterior region. The latter is much broader than the former and at its convex posterior margin nearly twice as wide as long. All of these parts taken together constitute the dorsal face of the prostomium. Beneath, and usually retracted within the mouth, is the folded tentacular membrane bearing a few short slender tentacles which scarcely exceed the cephalic cone in length. The somewhat quadrate prostomium is bounded by the short peristomial ring which completes the base of the cephalic cone.

The large mouth is bounded below by the prominent thickened peristomial lip, while dorsally the peristomium is much shorter and overlapped by the branchial ridge medially and more extensively by the paleolar tubercles laterally. This region is biannulate. The third somite is somewhat enlarged and tumid ventrally, the dorso-lateral portions project as thickened prominences bearing the paleoli, while the dorsal half is merely a low welt, strongly concave along its anterior margin and partly covered by the branchial ridge.

Somites IV and V are much shorter, together barely equaling III, and coalesced dorsally to form the ridge upon which the branchiæ are supported. The branchiæ form a group of four on each side so arranged that three are attached in a transverse anterior row on the region corresponding to somite IV and only one more posteriorly on V. Between the branchial scars of the two sides is a smooth quadrate area nearly twice as long as broad which is slightly inserted posteriorly into a transversely elongated area which reaches across the entire distance between the posterior pair of scars. A single branchia remains. This is slightly flattened, especially toward the tip, 's regularly tapered to a slender end and its length about equals the greatest diameter of the thorax.

The next four or five somites increase slightly in both length and diameter, and then decrease in diameter but remian of constant length throughout the thoracic region. Each is divided into a dorsal and a ventral half-ring by the prominent setigerous tubercles. The latter have thick glandular walls and the intersegmental furrows are deep and well defined. The dorsal region is thin-walled and smooth, and the first five intersegmental furrows only are distinct.

Abdominal segments taper gradually to the pygidium and are nowhere distinctly defined by furrows. Dorsally the walls are high-arched, thin and smooth, ventrally they are thickened by a pair of prominent longitudinal muscle ridges with a neural groove between. Laterally between the parapodia of successive segments is a series of rugous areas, while across the ventral surface between each pair of parapodia a narrow glandular line frequently extends.

The pygidium is provided with a pair of thick lips bounding the vertical, slit-like anus and each bearing on the side an inconspicuous cirrus much shorter than the diameter of the pygidium.

Of the setigerous tubercles the pair bearing the paleoli are prominent and much larger than any others and they encroach much upon the lateral portions of the peristomium. The paleoli are about twenty (18-21) in number in each group and are inserted with their long diameters radial around an arc of nearly two-thirds of a circle. From this base they spread forwards and laterad in a broad, scoop-like figure.

The tubercles of IV and V are crowded closely together beneath the lateral margins of the branchial scars, that of the latter being slightly medial and caudal of the other. Both, and especially the latter, are minute. Succeeding tubercles up to the sixth increase in size, after which they remain of constant size and of a slightly flattened cylindrical form. Distinct, more or less club-shaped cirri are borne on the ventral side of the distal portion of all the tubercles, but they are larger and more abruptly clavate on the first four. The first and second tufts contain only six or eight setæ, the others twelve to fifteen, always arranged in two rows.

The uncinigerous tori are distinct, somewhat ear-shaped lappets arising from the posterior border of the segments below and separated by a short space from the setigerous tubercles. The anterior ones are the longest and their ends project most freely. Their size decreases regularly to the last thoracic. The uncini form a single irregularly curved line containing 160 to 170, which are largest dorsally and decrease regularly to the ventral end.

Abdominal somites are provided with shorter tori (fig. 2) which project more prominently than those of the thoracic segments. They bear about 75 uncini in a single series. No trace of ventral cirri can be detected, but the achætous notopodia are provided with prominent, curved, paddle-shaped cirri.

The paleoli form rather close spreading tufts, with the largest ones near the anterior margin but not reaching to the tip of the prostomium. They (fig. 3) are much flattened and moderately stout at the base and taper rather abruptly to acute tips. They are bright yellow and polished. The setæ are pale yellow, strongly striated, slightly curved, with narrow double wings and very acute tips. On the first three somites they are rather more slender than on the others.

The uncini (figs. 4*a* to *c*) are more or less triangular, with the upper rounded portion much elevated, the posterior ligament process very prominent, and the anterior one small and covered by the lowermost hook. The base is relatively short. The relative breadth to length varies. Usually there are six large, acute, closely appressed teeth or fangs, the clefts between which do not incise the base very deeply (less than one-half of the entire width of the uncinus). Frequently the upper tooth is much reduced in size.

The type of this species was taken with one other specimen at station 4,274, in Kadiak Bay, at a depth of 41 fathoms on a bottom of green mud with some fine sand. Another and larger one comes from Boca de Quadra, Southeast Alaska, in 48 fathoms and soft green mud.

Amphicteis alaskensis is easily distinguished from the species recorded in my paper of Japanese Polychæta, under the name of *A. japonica* McIntosh, by the character of the paleoli, which in the latter species are only ten or twelve, and when perfect have slender curved tips reaching far beyond the end of the prostomium.

Amphicteis glabra sp. nov. (Plate XLIV, figs. 5 to 8.)

The two known examples of this species are of moderate size, the type having a length of 23 mm., of which 15 mm. belong to the thorax, which is 3 mm. wide.

The form is rather slender, slightly clavate, and gently tapered. There are 20 thoracic segments, 17 of which are setigerous, and 15 abdominal segments, or possibly more as the extreme posterior end is macerated.

The entire prostomial region is relatively much broader than in *A. alaskensis* and its median plate (fig. 5) much wider than long, irregularly pentagonal, with the long anterior border cleft into a pair of short divergent lobes, from between which a broad median groove extends about halfway across the dorsal surface. On each side of this plate is a small triangular area, which is again bounded laterally by a narrow fold ending freely in front. The pigmented transverse ridges occur as in *A. alaskensis*, but are longer correspondingly to the width of the prostomium, which they cross nearly transversely; beginning at the posterior end of the lateral fold mentioned above they arch forward and meet at a wide angle in the median line immediately behind the apex of the cephalic plate. The entire dorsal surface of the prostomium lies in nearly the same plane, and its anterior portion is not bent downward at an angle with the rest as in *A. alaskensis*. The tentacular membrane is rather low and has a nearly regular elliptical outline, and the few tentacles remaining are scarcely longer than the entire prostomium.

The upper lip is slightly cleft medially and the peristomium in the region of the lower lip is enlarged and more or less tumid. Ventrally somite II is about one-third as long as the prostomium, and dorsally it exhibits a transversely elongated median area slightly elevated above and separated from the surrounding parts by a slight groove. Somite III is nearly as long as I ventrally; dorso-laterally it is prominently enlarged to bear the paleoli, and dorsally becomes very much reduced in length to form a narrow border that passes along the anterior margin of the branchiferous area and joins the median interbranchial area of IV. Succeeding somites are well differentiated and of nearly equal length throughout the thoracic region. The dorsal portion includes more than a semicircumference and is very smooth and iridescent. The ventral is much flatter, has deep bounding furrows and a transverse glandular line near the anterior margin. The ventral region slightly exceeds the dorsal in width and embraces it laterally so as to form a shelf or flange supporting the setigerous tubercles. The thoracic region tapers regularly into the abdominal, which differs from it little except in the form of the parapodia and the more prominent lateral muscles and deeper neural groove. The pygidium is much injured on both specimens.

Branchia have existed in the usual four pairs, but a single one only remains in place. It is nearly terete but somewhat compressed and tapers regularly from the base to the slender subulate tip. Its length is about equal to the width of the thorax or when appressed it reaches somite IX. The scars (fig. 5) show the branchiæ to have been more crowded than in *A. alaskensis* and to arise in a distinctly quadrate group, two pairs on each side. Apparently the two anterior belong to somite IV and the two posterior to V, and the two medial are somewhat larger than the two lateral. A shield-shaped area about twice as long as wide is present between the median branchiæ, reaching from the anterior margin of IV to the middle of V where it meets a transversely extended area limited laterally by the outer pair of branchiæ.

The paleoli arise from the dorso-lateral tubercles of III and form an open, spreading tuft, little concave and arising from a small arc. They number but eight or ten and all are slender and curved, with awn-like tips (fig. 7), and the longest reach beyond the tip of the snout.

The setæ tufts on the branchiferous segments are borne on small papillæ placed close together just laterad of the branchiæ. The setæ are few in number and much smaller than those on succeeding segments. Remaining setigerous tubercles are cylindrical and quite prominent with small truncate cirri, and bear compact tufts of about twelve setæ which are longer, more slender, and more curved than in *A. alaskensis.*

Uncinigerous tori are short inconspicuous lines near the posterior margins of the segments just below the setigerous tubercles. Posteriorly they become more prominent and on the abdominal segments project freely, but are usually so macerated in these specimens that the exact form is doubtful. The one represented in figure 6 shows the thickened dorsal cirrus.

The uncini (fig. 8) are narrow with very long base lines and five very slender acute teeth very deeply divided at the base. The anterior ligament process is rather conspicuous and lies beneath the lowermost tooth, while the posterior ligament process is only moderately developed. The number of teeth is very constant and the dorsalmost are not so greatly larger than the ventral as in *A. alaskensis*. On somite X there are 115. Abdominal uncini are precisely similar, but owing to maceration the number on a torus is uncertain.

This species was taken at station 4,227 only, in Behm Canal, the depth being 62 fathoms and the bottom of dark green mud with fine sand.

A small portion of tube present is rather elastic and springy and is coated externally with a layer of brownish flocculent sediment.

Melinna cristata sp. nov. (Plate XLIV, figs. 9 and 10.)

The single example representing this species closely resembles *M. cristata* (Sars) Malmg., from which it differs especially in the more finely denticulated post-branchial membrane as well as in the much larger size and greater number of segments.

Although the posterior extremity is missing and the last one-third of the body is strongly spirally coiled, the specimen measures approximately 73 mm. long, exclusive of the branchiæ. At its widest part the thorax measures 3 mm., while the abdomen has a maximum width of 2 mm. The 17 setigerous thoracic segments have a length of 12 mm. and the fifty-five remaining abdominal segments 61 mm.

The prostomium or cephalic plate is a broad, short plate with a slightly convex crenulated anterior margin projecting freely over the bases of the fourteen to sixteen tentacles. The latter have a uniform diameter from base to end. The anterior and median ones are the largest with a length of about one and one-half times the thoracic width and about twice that of the posterior tentacles, which are scarcely as long as the body width and about half the diameter of the anterior ones. On the dorsal surface of the prostomium are the sensory folds, which are directly transverse. Beginning close to the lateral margins of the head they meet at the middle line and bend slightly forward side by side. Their dorsal surface is pigmented with a rich orange brown. Just in front of them on each side is a small, slightly elevated pad. The much folded upper lip is large and projects far beyond the mouth, just anterior to which is a distinct glandular area.

The lower lip is formed by the prominently projecting smooth margin of the prostomium, which is indistinguishably united to the first setigerous segment. Dorso-laterally it forms a prominent wing anterior to the first tuft of setæ, whence it is continued caudally into a flange-like ridge on each side of the thorax. Somites III and IV are well defined and together equal in length the single ring formed by the union of the prostomium and first setigerous somite. The remaining thoracic segments are equal and well distinguished on the ventral side, but thin-walled and coalesced dorsally. The ventral body walls between the tori are well provided with glands forming indistinct ventral plates on each segment. On the first four thoracic segments the flange-like ridges above the setæ are very distinct and, together with the pectinated membrane on somite V, bound a quadrate area in which the branchiæ arise. Anterior to the gills this region is marked by several slight transverse furrows. The postbranchial membrane is thin and deep and closely appressed to the dorsum of the thorax. It springs from the anterior border of V, and reaches nearly to the anterior border of IV, the free border being provided with eighteen blunt but prominent teeth.

The four pairs of branchiæ are permanently bent forward over the prostomium, and each has a length slightly exceeding twice the width of the thorax. They are all rather thick and coarse and taper from above the base to the bluntly pointed tip. For the basal one-fourth or one-fifth they are constricted and those on each side coalesced and so arranged that three lie externally, apparently arising from II, III and IV, and one internally on somite III. Between the latter, and uniting them across the middle line, is a thin membrane.

Somites II, III and IV bear short oblique lines of small setæ on the highest part of the lateral ridge, on the medial side of which and just posterior and lateral to the branchiæ, there is on each side of III a single very large claw-like spine. On V and all succeeding thoracic somites the setæ are in small tufts borne on truncate papillæ having the usual position. Each tuft contains about eleven or twelve setæ in two rows. Thoracic tori are constricted at the base, broad, truncate and beveled at the end. The uncini are borne on the thickest portion of the bevel, so that the free, thin margin projects a considerable distance beyond them. On somite X there are 63 uncini. Abdominal tori are narrow but much longer and of uniform width throughout, and the uncini are borne on the extreme unbeveled end. Somite XXV bears 36 uncini. The notopodial cirri are small and not conspicuously enlarged distally.

The setæ are all arranged in two equal rows. Those in one are larger, stouter and more broadly winged. Otherwise they are similar in both rows, and all have the stems slightly curved and strongly striated with the ends very acute and tapering. The isolated postbranchial spine is large and stout and has exactly the form figured by McIntosh for *M. cristata*.

The uncini (figs. 9 and 10) also resemble those of that species. Usually they have three teeth above the ligament process, but occasionally there is a fourth small or even well-developed one at the apex. Abdominal uncini differ from the thoracic only in their small size.

The tube measures 5 mm. in diameter with a lumen of half that size. The lining is a tough mucous membrane and the exterior a thick brittle coat of dark gray mud.

The type and only specimen was taken at station 4,258, in Lynn Canal, on a muddy bottom at a depth of 300 fathoms.

Artacama coniferi sp. nov. (Plate XLIV, figs. 11 to 13.)

This species is established upon two specimens measuring 22 and 45 mm. long respectively and neither of which is complete. The small one consists of 20 thoracic and 17 abdominal segments, is 3.5 mm. wide in the anterior part of the thorax and 2.2 mm. wide in the abdomen and posterior half of the thorax, and has the proboscis protruded for 3 mm. The larger example has 20 thoracic and 35 abdominal segments, with the caudal end still lacking. The proboscis is 6 mm. long, the thorax 17 mm. long, and its anterior half 6 mm. wide, while its posterior half tapers into the abdomen, which has a diameter of 2.5 mm.

The form is club-shaped with the first ten or eleven thoracic segments much enlarged, the middle of the thorax more or less abruptly contracted and the posterior portion tapered to the abdomen which continues to diminish to the posterior end.

The proboscis, which protrudes ventral to the mouth, is a large sugar-loaf-shaped organ as long as the first nine or ten segments, and has a basal diameter nearly equaling these. At the apex is a slender conical process about three times as long as thick, with its end rounded. Into it the retractor muscle is inserted, and it stands out prominently when the proboscis is extended. At the base the proboscis is somewhat rugous like the peristomium, with which it is continuous. Except for the rugosities the basal one-third is smooth, but the remainder bears small, low, rounded papillæ arranged in irregular rows, at first distant, but converging distally to the apical process, where they are more crowded, being separated by at most their own diameter.

The prostomium is folded into a double horseshoe-shaped oral fold with a broad, thin, median plate or membrane above the mouth, and behind this a pair of thick reflexed pads which become wider dorsally and nearly meet in the median line, and which bear the very numerous and much crowded tentacles. From the ventral end of the group, where they are mere papillæ, the latter increase until they almost equal the branchial filaments. Usually they are very slender with the ends enlarged.

The peristomium is longer dorsally than ventrally and is marked with longitudinal creases which are continued on to the base of the proboscis. Somite II is as long as the prostomium and equals the combined length of III and IV. Succeeding segments are again slightly longer and are distinctly annulated. In the posterior thoracic region the segments are divided by the setigerous tubercles into dorsal and ventral halves, the latter being again divided into a posterior larger and two anterior smaller annuli. Abdominal segments are annulated both dorsally and ventrally.

Three pairs of branchiæ occur on somites II, III and IV. Each is composed of numerous slender filaments having a length about one-third of the diameter of the body and sessile in a close tuft. The first contains about thirty, the second twenty-five and the third fifteen, but the number in each is probably greater in perfect specimens.

Ten ventral plates occur on the somites IV to XIII; the anterior ones are obscure, the posterior distinct. All are very short, about one-fourth to one-sixth as long as wide.

Setigerous tubercles number seventeen, and occur on somites IV to XX inclusive; though connected with the side of the body by an integumental fold they are very mobile, and the flattened, oblique tufts of setæ project prominently in various directions from near the dorsal end of the uncinigerous tori. Posterior tufts are broader and more mobile.

Anterior uncinigerous tori are long and narrow, extending over about one-sixth of the circumference of the body and separated ventrally by twice their length. Without becoming shorter they gradually approach ventrally until the intervening space is less than one-third their length. On the abdominal segments the tori are much more prominent and have a free ventral angle and a thin membranous wing arising from the dorsal border. This wing is gradually reduced posteriorly coincidently with a decrease in the size of the parapodium, but remains fairly prominent to the last.

What appears to be a slit-like sense organ is present on somite III below the gill. Small papillæ occur ventral to the setæ tufts of VI, VII, VIII and IX.

The setæ are all slender, nearly colorless, longitudinally striated, slightly curved and winged, and taper to very acute tips. In each tuft they are arranged in two rows of twelve to fifteen each, those in one row having longer and narrower wings (fig. 12), the others having them shorter and broader (fig. 11).

The uncini are arranged in a single series on the tori of somites V to X, are partly doubled on XI and completely in two series on XII to

XX. They are small and their number rather large, about 140–150 on V, 116 to 120 on X, about 110 in each series on XX and about 50 to 60 on the middle abdominal tori. They have the general form described for other species of the genus (fig. 13). The base is small and oblique, strongly convex below and with a prominent anterior angle, above which is a deep narrow sinus from which a slender process bearing the delicate, scarcely visible guard arises. There is no distinct neck, but a large head with a slender, acute, strongly decurved and slightly reflected beak, above which is the high, full crest with four cross rows of teeth.

No color remains.

The type comes from station 4,194, in the Gulf of Georgia, the depth being 111 fathoms and the bottom of soft green mud. The station from which the second specimen was taken is unknown.

Læna nuda sp. nov. (Plate XLIV, figs. 14, 15.)

This is another imperfectly known species, the only specimen available being a fragment of the anterior end measuring 21 mm. long and 1.5 mm. across the thorax, and comprising 28 anterior segments.

Projecting prominently from the anterior end is a broad, unfolded, scoop-like prostomial membrane curving gently and regularly upward from beside and above the mouth. Apparently the tentacles formed a complete series around the margin of the posterior limb of the prostomial membrane, but in this specimen most of them are gone and the three or four remaining are short and thick, and scarcely reach beyond the free border of the anterior prostomial membrane. Behind the tentacles the posterior prostomial fold is low and thick and at the dorsum nearly obsolete. On its posterior face are traces of a few eyes.

The mouth is a large, wide, transverse slit slightly bent down at the margins, and is bounded below by a low thick lip, and a prominent, broad, truncate process with slightly fimbriated margin springing from the middle of the peristomium.

Anterior somites are irregularly developed, the second being much larger than the adjacent ones. The second to eleventh somites inclusive have ventral plates, the glandular areas extending upward to include the setæ tufts. The third to the seventh have dorsal glandular areas also, which are separated on each side from the setigerous tubercles by a narrow non-glandular space. On the eighth also is a trace of a glandular region with a median break.

Not the slightest trace of gills exists. At the dorsal margin of III, in line with the setæ bundles of the following somites, is a prominent, stiff, erect cirrus on each side.

Behind the glandular region the segments become much longer, equaling or exceeding their diameter. These walls are very smooth and thin, highly arched above and nearly flat below, with thick longitudinal muscle bands along the ventro-lateral angles.

There are eleven setigerous somites, IV to XIV inclusive, but on the left side the bundle of IV is missing. Owing to the flatness of the dorsum of the region back to X the setæ tufts rise up nearly erect from the dorso-lateral margins. Though few, the setæ are long and, except on XII to XIV, conspicuous. Uncinigerous tori begin on V and are short and inconspicuous anteriorly, but about XV begin to increase in prominence, and on the posterior segments, while remaining short, project freely from the ventro-lateral longitudinal muscle bands. On the tori of somites V to X the uncini are arranged in one series, on XI to XIV in two apposed series. Each series on the thoracic somites contains about 55 uncini, while on posterior somites (XXX) only 40 occur.

The setæ (fig. 14) are slightly curved, delicate, with narrow wings, almost obsolete on one side and on the other frayed out and then abruptly ceasing, leaving a very acute almost whiplash-like tip. The uncini (fig.15) have the base broadly rounded in front and provided with a prominent triangular process behind. The sinus is narrow, and from its bottom rises a slender process bearing a very indistinct guard. The beak is rather slender and strongly curved, and above it is a very high crest composed usually of five or sometimes of six transverse rows, of about six or seven each, of long curved spines. The abdominal uncini have six or seven transverse rows.

The single specimen is a female filled with large eggs, and is preserved with a fragment of a soft mucous tube with a slight coating of foreign material.

It was taken at station 4,279, at Kadiak Island, at a depth of 29 fathoms and on a bottom of dark gray mud.

Thelepus hamatus sp. nov. (Plate XLIV, figs. 16 to 18.)

An apparently small species known only from the type, an incomplete specimen consisting of 31 anterior segments, and measuring 21 mm. long and 2.5 mm. in diameter at III, thence gradually diminishing caudally.

The tentacles number very few, less than 15 on each side, but are so fragile that they could not be safely untangled and the exact number ascertained. In the specimen the longest are 13 mm. long, coarse, thick and deeply folded longitudinally. The prostomial membrane forms a prominent horseshoe-shaped fold or upper lip above the mouth, while its tentacular fold is narrower and bears the tentacles in a nearly continuous band around its entire margin. On its posterior face are right and left groups of numerous, rather large, conspicuous, nearly black eyes arranged for the most part in one row and separated by a narrow dorsal space.

The large mouth is coverd by the upper lip, the inner surface of which bears a prominent grooved longitudinal ridge on each side of the middle line, and is bounded below by a thick slightly bilobed pad within the membranous anterior margin of the peristomium.

As far as about XX the anterior somites are short, the length not exceeding one-fourth or one-fifth of the width; those following are about two-thirds as long as wide, none is distinctly annulated, but all are rough and furrowed both above and below. The first four segments are glandular all round; the others have the thick glandular layer confined to the ventral half, but covering their entire length and extending to and including the setæ tufts. At about XVIII the glands disappear from the anterior one-third of the ventral surface also. The dorsum is thin-walled but rugous and constitutes less than one-third of the circumference.

Two pairs of branchiæ are developed and are situated dorso-laterally on II and III. The first consists of six and the second of three detached and independent filaments about as long as the diameter of the body; the area of attachment of the former extending over the entire length of the second segment, while that of the latter is limited to the anterior margin of the same dorso-lateral level of the third segment.

Setæ tufts begin on III and continue on all succeeding segments throughout the length of the specimen. All are small but prominent, little flattened and oblique, and are retractile within pits in the glandular layer of the skin. Throughout they are situated at a high level. Uncinigerous tori begin at V. They are all short, never exceeding one-sixth of the ventral interspace, and are separated from the corresponding setæ tufts by nearly their length. Posteriorly they grow smaller but more prominent. Like the setigerous tubercles they are situated in thin-walled, sunken spots within the glandular area.

The first seta tuft includes about twelve rather short, acute, slightly curved setæ with very narrow wings. In others the setæ (fig. 16) are more numerous, longer and more strongly curved. Still farther back in the posterior region they again become fewer. The uncini are arranged in a single series on all somites and number from 40 to 60.

They bear a close resemblance to Marenzeller's figures of the uncini of *T. cincinnatus* (Fabricius), but the height is greater in proportion to the length and the body and beak are more nearly equal in length. Those on the anterior segments usually have two teeth on the vertex of the crest above the beak (fig. 17*b*), but frequently there are three (fig. 17*c*) or even a fourth small one. The exact arrangement of the teeth in the crest varies, two of the varieties being shown in fig. 17*a*. Posteriorly the uncini (fig. 18) are smaller and the number of teeth in a transverse row of the crest usually more numerous.

No color remains in the specimen and no ova or sperm to indicate the sex. The fragment of tube present is membranous with scattered fragments of stone and siliceous sponge spicules.

The single specimen comes from station 4,235, at Yes Bay, in Behm Canal, at a depth of 181 fathoms and on a bottom of green mud.

Amphitrite palmata sp. nov. (Plate XLIV, figs. 19 to 22.)

Several specimens of this species occur in the collection. They resemble *A. affinus* very closely in most respects, but differ decidedly from that species in the form of the branchiæ, which have no elevated and branched base and no indication of dichotomy among the branches.

Complete specimens measure from 40 mm. to 88 mm. long, the last being 5 mm. wide across the thorax. The segments number from 62 to 64, those from V to XX being setigerous.

The general form is almost exactly as figured for *A. affinus* by Malmgren. Somites II, III and IV present similar slight lateral wings in successively ascending positions. The tentacles are moderately numerous and have a length of about five times the diameter of the thorax. No eyes can be detected on any of the specimens. The lower lip is square and rather prominent. Swollen glandular areas occur intersegmentally at the level of the gills on somites V to XIII; and ventral plates extend from III to XIII inclusive, the first three being very short. All of the segments are rugous and biannulate and taper gradually to the pygidium. The anus is a vertical slit surrounded by papillæ.

Most characteristic are the gills (fig. 22) which occur in three pairs on somites II, III and IV. Their bases are exceedingly short, so that the filaments are nearly sessile. They are expanded and flattened and the filaments spread regularly in a palmate fashion. The filaments are slender and when contracted are thrown into tight spiral coils. Full-grown specimens have 13 to 18 on the first, 10 to 12 on the second and 7 to 9 on the third gill.

Small papillæ or cirri are found just beneath the setigerous tubercles of somites VI, VII and VIII.

Setæ (fig. 19) have very short wings and a prominent fringed terminal pennant with a distinct knee at the place of its origin from the body of the seta. Abdominal uncini (fig. 21) resemble those of *A. affinus* quite closely, but those of thoracic tori (fig. 20) differ decidedly in the shape and proportions of the base and the number and arrangement of the teeth on the crest.

Some of the specimens are colored a nearly uniform reddish-brown, absent, however, from the gills and tentacles; and two are accompanied by portions of rather fragile tubes of fine mud.

This species was taken at the following stations: 4,227, Naha Bay, Behm Canal, 62–65 fathoms and on a bottom of dark green mud and fine sand; type locality 4,245, Kasaan Bay, Prince of Wales Island, 95–98 fathoms, dark green mud with fragments of shell, rock and sand; 4,253, Stephens Passage, 131 fathoms, rock and broken shells.

Explanation of Plate XLVI.

Amphicteis alaskensis—figs. 1 to 4.

Fig. 1.—Anterior end of type seen from the dorsum. × 7.
Fig. 2.—Parapodium of XXV. × 32.
Fig. 3.—Middle-sized paleolus; *a*, tip of another. × 32.
Fig. 4.—Three uncini from X; *a*, dorsal, *b*, middle (somewhat foreshortened), and *c*, ventral. × 585.

Amphicteis glabra—figs. 5 to 8.

Fig. 5.—Dorsal view of anterior end of cotype. × 12.
Fig. 6.—Parapodium of XXV. × 32.
Fig. 7.—Middle-sized paleolus. × 45.
Fig. 8.—Uncinus from X. × 585.

Melinna denticulata—figs. 9 and 10.

Fig. 9.—Uncinus with 3 teeth above the ligament process from X. × 585.
Fig. 10.—Uncinus with 4 teeth from the same torus; the anterior end of the base is broken. × 585.

Artacama conifera—figs. 11 to 13.

Fig. 11.—A broad-bladed seta from X. × 585.
Fig. 12.—A narrow-bladed seta from X. × 585.
Fig. 13.—An uncinus from X. × 800.

Læna nuda—figs. 14 and 15.

Fig. 14.—Seta from X. × 585.
Fig. 15.—Uncinus from X. × 800.

Thelepus hamatus—figs. 16 to 18.

Fig. 16.—Seta from X. $\times$ 585.
Fig. 17.—Two forms of uncini from X; *a*, front views of two similar ones showing different arrangements of the teeth. $\times$ 585.
Fig. 18.—Uncinus from XXX; *a*, front view of another. $\times$ 585.

Amphitrite palmata—figs. 19 to 22.

Fig. 19.—Seta from VII. $\times$ 335.
Fig. 20.—Uncinus from XX. $\times$ 480.
Fig. 21.—Uncinus from L. $\times$ 480.
Fig. 22.—One of the second pair of gills. $\times$ 8.

COON MOUNTAIN AND ITS CRATER.

BY DANIEL MOREAU BARRINGER.

Foreword.

In October, 1902, I heard for the first time—in casual conversation with Mr. S. J. Holsinger—of Coon Mountain or Coon Butte and its crater, which is located in the northern part of Arizona. He stated to me at the time that he had never seen this remarkable crater, but had heard of it on several occasions, and had heard that quite a large amount of meteoric iron had been found in the immediate vicinity and that some had been found on the inside of the crater, which latter statement was subsequently proved to be incorrect.

I naturally was very incredulous of the theory which, Mr. Holsinger informed me, was held by some of the people living in the neighborhood of Cañon Diablo, namely, that this great hole in the earth's surface had been produced by the impact of an iron body falling out of space, if for no other reason than that I realized that the crater must have been examined by members of the United States Geological Survey while making the topographical maps of this region, and in their report they evidently did not accept this theory.

Nevertheless, the subject continued to interest me so much that upon my return to Philadelphia I determined to speak to my friend, Mr. B. C. Tilghman, in reference to it, because of his general scientific knowledge. This was in the latter part of January, 1903. We decided to write to Mr. Holsinger for further information, and upon receipt of this took the necessary steps to locate the mountain under the United States Mineral Land Laws. Since then, between us, Mr. Tilghman and I have collected an astounding array of evidence in favor of the correctness of the above theory of the causation of this great hole in the earth's surface, and in refutation of the theory adopted by Mr. Gilbert, of the United States Geological Survey, that it was produced by a steam explosion.[1]

[1] See Presidential Address by Grove Karl Gilbert, 1895, before the Geological Society of Washington, published by the Society in March, 1896. Also published in *Science*, N. S., Vol. III, page 1, 1896. Also 13th Ann. U. S. Geol. Sur. Rep., Part I, p. 98, and 14th Ann. U. S. Geol. Sur. Rep., Part I, p. 187. Also Chamberlin and Salisbury's *Geology* (1904), Vol. I, p. 569.

In fact we can now prove that this crater is due to the collision with the earth of an extra-terrestrial body, possibly a small asteroid, which was presumably metallic in nature.

We do not know, and indeed may never know, whether this great meteor was originally an irregularly shaped fragment or whether it was a spheroid, but we have strong reason to believe that the composition of the exterior was that of nickeliferous iron, containing in minute quantity platinum and iridium.

Since acquiring possession of the property, we have learned that this meteoric fall has been the subject of many papers and that the composition of the iron, and the fact that it contains microscopic diamonds, has been well known, upwards of ten tons of iron specimens having been shipped away from this locality; although, singularly enough, the presence of platinum and iridium has not been suspected. The presence of these metals was ascertained for us by Mr. H. H. Alexander, of the Globe Smelter, Denver, by subjecting the iron and the magnetite (the origin of which we shall attempt to explain hereafter) to the fire assay test, samples of each having been sent to him for the purpose. Their presence has been also confirmed by the very high chemical authority, Dr. J. W. Mallet, F.R.S., of the University of Virginia, whose letter on the subject is herewith submitted.[2]

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[2] UNIVERSITY OF VIRGINIA,
CHARLOTTESVILLE, VA.

August 17, 1905.

D. M. BARRINGER, ESQ., Philadelphia.

DEAR MR BARRINGER:

About a fortnight ago I was at last able to undertake the examination you desired of the residue sent me by Mr. Alexander from solution in dilute hydrochloric acid of 25 lbs. of the Cañon Diablo meteoric iron, and I now report results:

I first repeated twice the assay experiments made by Mr. Alexander, and obtained substantially the same results that he did.

It then seemed to me desirable to apply a method which should not involve any addition of foreign metals (though I have full confidence in the purity of Mr. Alexander's lead, gold and silver), and to avoid determination of platinum "by loss."

I therefore boiled the greater part of the residue sent me by him with a mixture of strong hydrochloric and nitric acids as long as there was any action. This was a very tedious affair, the Schreibersite (phosphide of iron and nickel), which formed a large proportion of the residue, being but slowly attacked, and there being a strong tendency to boiling over from sudden, irregular evolution of nitrogen dioxide. The solution obtained was evaporated two or three times with hydrochloric acid, diluted, filtered and treated with a current of sulphuretted hydrogen, first cold and then while heated. This gave a copious precipitate of sulphur (from reduction of ferric to ferrous chloride) colored brownish by the sulphides of the platinum metals.

This precipitate was filtered off, well washed with water, dried and burned. The small residue left was then reconverted into chlorides, and the platinum and iridium separated in the usual way, by partial reduction of the iridium salt and precipitation of that of platinum with ammonium chloride.

It has seemed to Mr. Tilghman and to me to be better for us each to discuss this matter from our separate points of view—he from the point of view of a physicist, chemist and mathematician, and I from the point of view of a geologist.

The number of arguments which between us we have worked out, in support of the theory that this gigantic hole is an impact crater, will be set forth in the two following papers. It must be remembered that while a great deal of the evidence collected by us is positively in favor of the theory, much of it is negatively so; that is to say it disproves the theory that this great hole is the crater of an ancient volcano, or was produced by an explosion of steam, which latter theory seems to have been adopted by Mr. G. K. Gilbert on what seems to be very insufficient evidence. Perhaps it would be more accurate and just to say that he has adopted this theory because of an inadequate examination of the phenomena at Coon Mountain, or, as it is frequently called, Coon Butte; for had he examined the surface carefully, it does not seem possible to me that any experienced geo'ogist could have arrived at such a conclusion.

Coon Mountain and Its Crater.

There is to be found in the almost level plain country, about five miles almost due south of Sunshine Station, on the Atchison, Topeka & Santa

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The result represented 3.63 grammes platinum and 14.96 grammes iridium per ton (of 2,000 lbs.) of the original meteoric iron, with probably a trace of rhodium. . . . .

I add the following remarks:

1. Mr. Alexander in using his method undoubtedly dissolved out with *aqua regia* from his cupelled button not only gold and platinum but some iridium, so that the loss of weight (after deduction of gold added) represented not merely platinum, as he assumed, but in part iridium also.

2. On the other hand, it is not certain that in my process *all* the iridium is dissolved out from the original material (residue sent me by Mr. Alexander) by *aqua regia* as used.

3. My results as to separation of the two platinoid metals are fairly trustworthy, but would be more so if there had been a larger absolute quantity of material to work on.

4. It is of course possible that these platinoid metals are not uniformly distributed in the original meteoric iron.

Believe me,
Sincerely yours,
(Signed) J. W. Mallet.

From the specimen of Cañon Diablo iron you left for me, with drill holes in it and a memorandum as to drills being blunted and spoiled, I have obtained five excellent microscopic diamonds—quite like those of South Africa in appearance and markings.

J. W. M.

Fé Ry., in Coconino county, Arizona, a very remarkable and almost perfectly round crater, differing in many respects, as will be hereafter seen, from any crater on the earth's surface with which I, at least, am familiar. The rocks exposed in this region, and for many miles around in every direction, belong to the Aubrey formation of the Upper Carboniferous series. These beds are perfectly horizontal, never having been disturbed since they were laid down except by volcanic tremors, which were probably the cause of several small but deep cracks in the vicinity of Cañon Diablo gorge and running parallel with it. Erosion has removed the upper strata which overlie these beds elsewhere in the region, so that now the uppermost stratum which is found is red sandstone, and this exists only as isolated and quite widely separated flat-topped buttes. It is not likely that this stratum was ever of great thickness. The portions of it which are left vary from a few feet to less than fifty feet in thickness. At the place now occupied by Coon Mountain and its crater (for it should be stated that this crater is within a rather low long mountain rising out of the level plain to a height of from 120 to 160 feet, the irregular top of the mountain forming the rim of the bowl-shaped crater) this sandstone stratum, at the time the crater was made, probably existed here as a flat-topped butte of considerable area, not over thirty feet in height above the surrounding limestone plain. The exact locality now occupied by the mountain and the crater was no doubt very similar to portions of the present surrounding plain before the event which produced them. These isolated buttes of red sandstone, which are dotted over the plain, probably average from fifteen to twenty feet in thickness. Underneath this sandstone there are from 200 to 350 feet of yellowish-gray calcareous sandstone, which when eroded and weathered has the appearance of limestone. In fact, this stratum, which is well shown in the neighboring gorge of Cañon Diablo, is referred to by the United States Geological Survey as the Aubrey limestone. For the sake of clearness it will hereafter be referred to as limestone. Underneath this limestone there is a stratum of apparently from 800 to 900 feet in thickness, but probably much less,[3] of very light gray, almost white, fine-grained sandstone; and underneath this stratum there is a thin stratum of yellow sandstone, the thickness of which is not definitely

[3] It is probable that these figures are very excessive and that the true thickness of this sandstone stratum at this point much more nearly approximates the thickness given to it in the record of the Winona well given below. The record of our bore holes and as obtained from the surrounding exposures must of necessity be unreliable, for reasons which will hereafter appear.

known. This seems to be the uppermost member of what are known as the "Red Beds," for underneath this yellow sandstone there is a reddish-brown sandstone, the thickness of which is given by the United States Geological Survey as more than 1,000 feet. The following record of a well driven by the Railroad Company at Winona, less than thirty miles distant in an air line from the crater first mentioned, shows the thickness of these various strata at that point. It is assumed that the Geological Survey obtained these figures from the Railroad Company, since the figures which they give as to the thickness of these strata, at the place where the A., T. & S. F. Ry. crosses the Cañon Diablo gorge, closely approximate the record of the well.[4] There are no eruptive rocks of any sort in this neighborhood, the nearest eruptive rocks to the so-called crater above referred to being a mountain known as Sunset Mountain about twelve miles in a southeast direction, the Black Mesa in a west and southwest direction about twenty miles distant, and the San Francisco Mountains and the flows therefrom about forty-five to fifty miles distant in a northwest direction. The latter, as is well known, are composed of many volcanic craters and the material ejected therefrom. Some of these craters are of comparatively recent origin, geologically considered, but presumably of much greater age than Coon Mountain and the crater it contains. The Black Mesa above referred to is supposed to be a flow from the San Francisco craters. In the San Francisco Mountains there are many volcanic cones containing more or less perfect craters. These are true volcanic craters. Such, for instance, is the well-known "Sunset" crater, a few miles north of the Santa Fé Railroad and easily accessible from Flagstaff. I have no hesitancy in saying that there is absolutely no connection between the first mentioned crater, which I shall hereafter attempt to describe, and these volcanic craters. And more than that, there is not a single point of similarity, excepting perhaps that of the round shape of the interior basin.

As above stated, the crater which is the subject of this paper is to be found in an area composed of level beds of stratified rocks (Carboniferous sandstones, limestones and shales), which extend uninterruptedly,

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[4] Record of Winona well: Aubrey limestone, 185 feet; Dakota sandstone, 456 feet; Red sandstone, 16 feet plus.

"Although no direct measurements have been made in that immediate vicinity, the thickness of the Aubrey limestone at Cañon Diablo is probably not far from 300 feet. At Winona, where its surface is considerably eroded, 185 feet remain. The gray sandstone next below is between 400 and 500 feet thick. The Red Beds are about 1,000 feet thick. Next below is the Redwall limestone which is 600 feet or more in thickness." From information furnished by U. S. Geological Survey.

with the exception of the above volcanic areas, for easily seventy miles in every direction. Generally speaking the same rocks are exposed in the Grand Cañon of the Colorado, the cañons of the Little Colorado and of the stream known as Cañon Diablo, which is distant to the southwest and west only two and one-half miles. The cliffs exposed in this cañon are composed entirely of the upper portion of the limestone bed above referred to, as the cañon does not cut down to the underlying light gray sandstone also referred to above, and the overlying thin red sandstone stratum has been eroded off in this locality. In this crater and around it are to be found nothing but stratified sedimentary rocks or the fragments thereof. Viewed from the railroad across the perfectly level plain, Coon Mountain presents a very peculiar appearance to anyone accustomed to study the sky line. Such an observer would see a small mountain or butte, about one and a half miles long, rising out of the level plain, the sky line of which (the rim of the crater) is very irregular, the mountain differing widely in this respect as well as in its light color from other mountains in the region, which show the usual rounded appearance and gentle lines produced by erosion, and the dark color produced by the eruptive rocks of which they are composed.

Coon Mountain or Coon Butte, as it is often called, does not suggest to one viewing it, especially at close range, from any direction, the existence within itself of a large crater, approximately 3,800 feet in diameter (its diameter along a north-and-south line passing through it being 3,654 feet, while its east-and-west diameter is 3,808 feet) and approximately 600 feet deep from the rim of the crater to the surface of the interior central plain. It is a fact worthy of mention, but after all just what one would expect when one realizes the cause of its origin, that this mountain presents very much the same view to an observer stationed several miles distant, whether he stands on the north, south, east or west side of the mountain. This so-called mountain has an extreme elevation of about 160 feet above the level of the plain, and an average elevation of about 130 feet. Upon closer examination it is found to be composed to a great extent on its outside slopes of an enormous quantity of fragmentary material, which is made up as follows: red sandstone fragments, limestone fragments, white sandstone fragments and a few small yellow and brown sandstone fragments; the largest masses probably weighing upwards of 5,000 tons (these are nearly always limestone) down to silica in powder of microscopic fineness (pulverized sand grains) which will be described hereafter. I have made no attempt to compute the amount of this fragmentary material, but roughly guess it to be in the neighborhood of 200,000,000 tons; perhaps rather less than more. An additional reason for the existence of the elevation known as Coon Butte or Coon Mountain is to be found in the fact that the uppermost strata exposed in the walls of the interior crater dip quaquaversally, or generally speaking in every direction from the exact center of the crater, at an angle usually varying from ten to forty degrees, and in one case from sixty to seventy degrees. It should be stated, however, that in this case it is evident that a great, presumably wedge-shaped, piece of the material of the cliffs which form the sides of the crater and the rim, has nearly been turned out bodily by the force which produced this enormous hole in the earth's surface. The effect of this would be, of course, to turn the strata nearly on edge at this place. Naturally, this wedge-shaped piece—an expression which is used for want of a better one—lies between two faults, on the other side of each of which the strata dip at a much lower angle, not to exceed perhaps twenty degrees in the one case, that is to the north, and not to exceed five or ten degrees in the other, that is to the southwest. On the west side of the crater the strata are upturned so that they dip at about forty-five degrees west. It is an interesting fact that many large fragments of limestone, which have been hurled out of the crater, are to be found at least a mile from it; and if I am not mistaken there are several large fragments, weighing perhaps fifty tons each, which are more than a mile distant from the center of the crater. These fragments, great and small, are distributed concentrically around the crater, being more abundant near the rim than distant from it. It is worthy of note, however, that the greater number of the larger fragments of the limestone stratum, some of them weighing probably over 5,000 tons, are to be found on the slopes of the mountain outside of the crater, on an east-and-west line passing through the center of the crater. That is to say, there are two places on the rim where these large fragments are most abundant; one almost directly east of the center and the other almost directly west of the center. It is also interesting to see how shattered and cracked many of the exposed limestone fragments are, showing probably that they have been subjected to the concussion from a great blow. These great and small angular blocks of limestone lie in every conceivable position on the slopes of the mountain, many of them standing on end so to speak, that is with the lines of stratification showing a vertical or nearly vertical dip.

I have made more than ten trips to this locality and have examined almost every foot of the ground around it most carefully, and have failed to find a single piece of eruptive or metamorphosed rock, or any rock indicative of solfateric activity, which has not in all probability been brought to the locality by Indians or the prehistoric inhabitants of this region.

The sharp edges of the angular fragments of rock, which have certainly been expelled out of this crater with great force, are indicative of the recent origin of the crater. In fact, I am ready to believe that it is not more than 2,000 or 3,000 years old, and perhaps much younger. Cedars have been found growing on the rim which are upwards of 700 years old. Were it not for this fact the evidence afforded by the fractured surfaces of the rocks would indicate even a more recent origin.[5]

The interior of the crater can best be likened to a great bowl, excepting that there is an almost vertical escarpment running around the upper portion of the basin, formed of cliffs composed of limestone and the overlying red sandstone. From the bottom of the limestone stratum, or where the more or less shattered and disintegrated white sandstone begins to be seen underneath the limestone cliffs, a great interior fringe of talus commences, which is composed of angular fragments of red sandstone, limestone and gray or white sandstone. This talus slopes at a very low and, for talus representing the effect of weathering, an unusual, or as I think an impossible, angle toward the interior of the plain; but before it reaches the center it disappears underneath stratified sedimentary material which was undoubtedly deposited while the interior of the crater was a lake bottom. There are about seventy feet, and perhaps somewhat more in places, of this material, as has been proved by the shafts and drill holes which have penetrated it. It is composed very largely of wind- and water-borne silica or pulverized sand grains, in which are found numerous fresh-water shells. There are some layers composed almost entirely of microscopic shells, and in some of these sediments there are to be found great numbers of miscroscopic organisms which have silicious skeletons. There has been no opportunity to submit these fresh-water shells and organisms for examination, but it is intended to have this done at an early date. Underneath this sedimentary material there is to be found a more or less compact and unknown quantity of pulverized sandstone (silica), containing here and there angular rock fragments or so-called boulders. The upper portion of this sedimentary material forms, with the over-

[5] It is possible that the cause of this crater may possess considerable historical interest, as explaining the hitherto unexplained fact that throughout this portion of Arizona there are indisputable evidences that the prehistoric civilization ceased abruptly several thousand years ago, according to the necessarily rough estimates of the time which has elapsed.

lying accumulations of soil and wind-blown material and a certain amount of talus which for the greater part has been distributed by torrential action, an almost level central plain in the present visible bottom of the crater. Just how far these lacustrine deposits extend toward the cliffs and underneath the talus, which has been brought to its present position by torrential action, has not yet been determined, but enough is known to state quite positively that they cover the greater portion of the surface of the ancient visible bottom of the crater. As above stated, underneath this sedimentary material there is to be found an incredibly large amount of what has been locally termed silica, and which certainly is due to the pulverization of the sandstone strata and the sand grains composing them. This so-called silica (this name will hereafter be used in referring to this material) is almost free from impurities; several analyses having shown it to contain upwards of 98 and even 99 per cent. SiO_2. To be properly understood this silica should be examined under a microscope. When so examined it is found to be composed of broken sand grains; some of the minute fragments being as large as the half of a sand grain, but the vast majority are very much smaller, and many of the fragments are so small as to be invisible under an ordinary lens. Under a strong glass or microscope they have the general appearance of broken pieces of ice, being of every conceivable shape and almost invariably having very sharp edges, and of course being translucent. Much of this so-called silica is so finely pulverized that no grit can be noticed when it is placed between the teeth, and in fact can be truthfully described as being an impalpable powder. At many places this silica is less finely subdivided than has been described above and is distinctly gritty when placed between the teeth; but at no place has there been found any particle of it which is larger than one of the small sand grains which go to make up the strata in which the crater is found. Without further explanation it can be stated definitely that this silica is nothing more or less than pulverized sandstone. How many million tons of this material there are it would be impossible to estimate. It composes a great part of the enormous rim, over three miles in length measured around the base of the mountain, in which the crater is situated. The amount of it within the crater is absolutely unknown; for it has been found by means of drill holes to a depth of more than 850 feet. At places both on the exterior of the rim and in the interior of the crater, underneath the sedimentary deposits, it is found admixed with a small percentage of lime carbonate, which admixture can of course be readily understood when it is remembered that there is shown in the walls of the crater a calcareous sandstone (herein referred to as limestone for the sake of convenience) which has a thickness of some 250 to 350 feet. If one digs down through the surface soil a foot or more, almost anywhere on the outside of the rim, among the angular fragments which have been thrown out of the hole he will come into this silica, and a great number of trenches and several shafts have shown it to continue downward certainly to the solid or rather more or less shattered rock upon which all of the fragmentary material forming the rim rests. One of these shafts, almost at the base of the mountain and near the surrounding plain, is forty-eight feet in depth. However there are, especially on the southern side of the mountain, several dry washes, where this almost snow-white silica has been exposed for hundreds of feet in length and in places to a depth of upwards of ten feet. It is difficult to understand how this exposure could escape the eye of any careful geologist making a circuit of the crater. If noticed by him it would certainly seem that he would have examined it and ascertained its nature. Having done this, it would seem that he would have been impelled to make a few shallow trenches at different places around the crater, in order to determine how much of this material there was. Having then proved it to exist on all sides of the crater in enormous quantities, it would seem to me that he could not have explained its presence in any other way than that which we have adopted; especially in view of the fact of there being so much corroborative evidence of even a more convincing character. Briefly, it seems to me impossible that this silica could be produced by volcanic action, or by a steam explosion, and I assume that it could be produced only by the pulverizing effect of an almost inconceivably great blow. It should be stated that the silica on the outside of the rim, and to a less extent underneath the sedimentary material in the bottom of the crater, is plentifully admixed with broken fragments of red sandstone, limestone and white sandstone of all sizes within the limits mentioned and sharply angular shapes. It also should be mentioned that the many cuts and shafts (over fifty in all) which we have caused to be made on the outside of the crater, have shown that the silica carrying with it these broken fragments, especially those of smaller size, has evidently welled out of the crater almost like liquid mud, or perhaps, more accurately, like flour when it is poured out of a barrel. It is an interesting fact that it often contains innumerable angular fragments of sandstone in which the grains of sand (some pulverized into silica, some whole and unbroken) are no longer coherent, an effect which we have assumed has been produced by tremendous concussion. It would seem that these fragments, before they disintegrated entirely, were caught in the flow of silica and carried gently outward and deposited where they are found at present, surrounded by the almost snow-white silica. As the sandstone is itself often very white, the outline of these fragments is not readily distinguished in the sides of the open cuts, until they have been exposed for some time to the weather. However, it is to be remembered that there are in the silica, as far as we have explored it with trenches and shafts, great numbers of perfectly solid coherent sharply angular pieces of sandstone and limestone, as well as of the incoherent fragments. So far as it can be observed the white sandstone stratum, where it is exposed beneath the limestone cliffs inside the crater, is in this same incoherent condition. It is as if it had received a tremendous blow, the concussion from which caused the solid sandstone to disintegrate and become almost like compacted sand, since it can in many instances be dug out and crumbled by the fingers. The effect of this has been of course to cause the sandstone stratum at this point to occupy more space than it previously occupied. The result of this has undoubtedly been the raising of the superimposed limestone and red sandstone strata, causing them to show, when viewed from the interior of the crater, several anticlinal and synclinal folds, and to dip outwardly from the center of the crater, and in this way assisting in forming the elevation locally known as Coon Mountain, which has already been described.

No order is to be observed in the distribution of the angular fragments either within or without the crater, excepting that which I have already referred to, that the greatest amount of large limestone fragments, which it should be remembered is the most coherent rock of the series and the one which has most successfully resisted disintegration, is to be found almost due east and due west of the center of the crater; and also excepting that at certain places there are to be seen spurts of one kind of solid fragments, for example white sandstone, aggregating in amount thousands of tons, and extending from the rim of the crater almost down to its base.

These tongues of fragmentary material, which seem to have been spurted out of the crater with such force as to displace everything which they met, are very interesting; especially those of the white sandstone, some of the fragments of which exhibit very beautiful examples of cross-bedding. The lowest members of the series which was ejected are the red sandstone and the overlying yellow sandstone, small pieces of which are to be found in relatively small quantities on the surface of the southern and southeastern portion of the rim. These are almost certainly from the upper portion of the Red Beds already referred to.

This brings me to describe more particularly the rim itself. On first examination it would seem that the fragmentary material and silica are almost equally distributed on all sides of the crater. Upon closer examination, however, it is found that there is vastly more of it to the southwest, south and southeast than to the northeast, north and northwest. It also will be observed that the fragmentary material is much more comminuted to the southwest, south and southeast than it is on the opposite sides of the crater. It will also be observed that the limestone cliffs on the interior of the crater are much more shattered to the southwest and south than anywhere else, and the limestone bed itself is raised higher, and to the southeast is to be found the great wedge-shaped piece of the material forming the cliffs and rim, which was turned over and seems to have been near to going out bodily. It will also be observed that the lowest point on the crater is on the north rim, somewhat to the west of a north-and-south line passing through it; and finally the ejected fragments, of ten tons or more in weight, are found distributed over the plain at a greater distance south and southeast of the crater than anywhere else. From all of these facts, the inference is unavoidable that the cause which produced the crater acted with somewhat more violence in a southwest, south and southeast direction than in the opposite direction.

It would be possible to extend this description of the crater to a much greater length; but I hope that in the above I have stated most of the salient facts which would impress the careful observer. Now, there are only three conceivable causes for such a tremendous disturbance of the horizontal strata at this point, and I will take them up separately.

I. *An extremely violently acting volcano.* This can be set aside as being impossible inasmuch—

First: No lava is to be found, or any other volcanic rock, for many miles in any direction. Nor is there to be seen any sulphur, which is found in most volcanic craters of recent origin.

Second: I assume that huge fragments of rock, weighing perhaps upwards of fifty tons, could not have been expelled from the crater and deposited a mile or more distant from its center by volcanic action, in the absence of other numerous and indisputable facts to show that a volcano existed at this place. Moreover, any stone which has been hurled from a volcanic crater through the agency of steam is usually of igneous origin.

Third: We know absolutely the series of rocks at this point, and this series has been described in the first part of this paper. We also know that only the uppermost strata have been hurled out of this hole by some terrific force. Briefly, it would seem to me to be impossible that any geologist carefully examining the region could reach the conclusion that this is a volcanic crater, or in any way produced by volcanic agencies.

II. *A steam explosion.* This is the theory which seems to have been adopted by the United States Geological Survey to account for this remarkable crater, on the report of one of its members, Mr. Grove Karl Gilbert, and his associates.[6] To me it seems incredible that they could have adopted this explanation of the crater and its surrounding phenomena, if they had carefully examined the surface as above described, for the following reasons:

First: Such a violent paroxysmal outburst of steam as they assume in order to account for Coon Mountain and its crater is, to the best of my knowledge, unrecorded, unless perhaps in connection with some great volcano, and even there its force, I assume, has been, with few exceptions, less than the force expended here; and in such volcanic manifestations there were a number of such explosions, not merely one.

Second: The vast amount of steam required to do the amount of work accomplished at this place could only be stored up in regions of present or recent volcanic activity. There is no evidence that this has ever been such a region.

Third: As suggested above, it is inconceivable to me that there could have been, even in such a region, much less in a region of undisturbed stratified rocks, such a *single* great steam explosion, before which and after which all was quiet.

Fourth: I assume that such an explosion would not have produced the beautifully round crater which we have here; and, moreover, it seems certain that the country round about would be seamed for miles with cracks and fissures, perhaps more or less radial, through which in all probability steam would have ascended for many centuries. Nothing of the sort has been found here. It is certain that the crater was made in an instant of time, after which all was as quiet as before. Any one visiting the locality is impressed by the many evidences of this fact. It is also certain that the crater is very recent, comparatively little or no erosion having taken place since it was made. The evidences of this are to be found on every side. If there had been

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[6] See Thirteenth Ann. Rep. U. S. Geol. Sur., Part I, p. 98, and Fourteenth Ann. Rep. U. S. Geol. Sur., Part I, p. 187. Also *Science*, N. S., Vol. III, p. 1, and Chamberlin and Salisbury's *Geology* (1904), Vol. I, p. 569.

much erosion, such as must have taken place in order to account for the great amount of talus which is to be observed on the inside of the crater, supposing it to have accumulated in the usual way, the crater would certainly not be as round as it is. If originally round, it would certainly have been greatly deformed by the process. It could not weather round. It is perfectly clear that this is contrary to any known mode of action of erosion. Therefore it is certain that the talus did not accumulate in the usual way, and that its presence and distribution must be explained on some other theory than that of weathering. This view receives further support from the fact that the very low angle (about twenty degrees from horizontal) which the upper portion of the talus on the interior of the crater makes in its descent from the base of the almost perpendicular cliffs, is a very unusual one.

Fifth: Granting that such a single violent steam explosion is not an absurb hypothesis, it would seem that on this hypothesis there would be abundant evidences of solfateric activity within and without the crater, especially in the immediate vicinity; such as redeposited or secondary silica, carbonate of lime and other minerals which are usually deposited by hot spring action. These minerals would certainly be found within the crater and in the cracks which, under this hypothesis, it would seem should be found traversing the horizontal stratified rocks forming the plain on the outside of the crater. Neither the cracks nor the minerals are to be found. In short, there is no evidence of any sort at or near this spot of solfateric action.

Sixth: If a steam explosion had formed this crater, it is inconceivable to me that it would not have thrown up rocks from a greater depth than that represented by the three uppermost strata, together with a very small portion of the upper part of the Red Beds which underlie them. Nothing would seem to be more certain than that the greater portion of these Red Beds and the great Carboniferous series of strata extending thousands of feet under them, as exposed by the Grand Cañon of the Colorado, only seventy miles distant, are undisturbed In other words, the series of strata at Coon Mountain have not been disturbed, at least to the extent of being thrown out, for a greater depth than the upper portion of the Red Beds, geologically speaking, or about 1,200 feet more or less—perhaps as much as 1,300 feet—below the present surface of the plain.

Seventh: A steam explosion I assume could not have pulverized the individual sand grains, as they have been pulverized here, and produced as a result the millions of tons of "silica" which exists on the inside of the crater and on the outside of the rim as already described. It is not conceivable to me, as I have already stated, that this material could have been produced in the quantities in which we find it in any other way than by a heavy blow.

Additional Argument against the Theory of a Steam Explosion.

Eighth: Even if a steam explosion could have produced the silica dust it would have blown, as Mr. Tilghman points out (see page 899), such finely divided material high into the atmosphere, after the manner of the great Krakatoa explosion in 1883, and a very large portion of this material would certainly have been carried away by air currents and finally deposited far from the crater, instead of in the crater or on the exterior slopes of the mountain immediately surrounding it, where finely pulverized material is distributed in enormous quantities in such a manner as to warrant the belief that it and the rock fragments contained in it behaved not unlike a liquid when they were expelled by some force out of the crater. Again, the dust or minute particles or filaments of volcanic glass expelled from the volcano of Krakatoa were not only certainly of igneous origin, but when examined under the microscope were in every case found to be more or less round in shape, instead of being sharply angular particles of crystalline quartz, due, as is safely assumed, to the disintegration or rather pulverization of sand grains.

Since we have come into possession of the property we have found several thousand pieces, in all something over a ton, of various sized fragments of meteoric iron, the largest weighing as I remember 225 pounds, down to pieces weighing much less than an ounce or only a few grains. These meteoric iron specimens (known to the scientific world as the Cañon Diablo siderites) are so well known that I shall not attempt to describe them. The following analysis by Messrs. Booth, Garrett and Blair, of Philadelphia, may be taken as representing the general composition of these irons: Si 0.047; S 0.004; P 0.179; C 0.417; Ni 7.940; Fe 91.396; total 99.983. In the present discussion it is far more interesting to state that they have been found more or less concentrically distributed around the crater and to an extreme distance, so far as we know, of two and one-half miles from it, a few small specimens having been found in Cañon Diablo gorge. It is a remarkable fact that these so-called "irons" (to distinguish them from the so-called "iron shale") are very angular in shape, indicating by their fracture that they may have been violently torn off or burned from similar ma-much erosion, such as must have taken place in order to account for the great amount of talus which is to be observed on the inside of the crater, supposing it to have accumulated in the usual way, the crater

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III. *The impact of an extra-terrestrial body.*

I shall attempt now to describe briefly such facts as are evident to any geologist making an examination of the region which furnish strong affirmative evidence that this crater could have been made *only* by an extra-terrestrial body falling out of space and moving at great speed. Something between ten and fifteen tons of meteoric iron have been shipped away from this locality, most of it going to the various museums of the world. It is a fact, so far as I know, that none of the "iron shale" or magnetic iron oxide, which will be described hereafter, is to be found in any of these museums; why I cannot understand, for the scientific interest which attaches to it is very great. It is probably not generally known that by far the greater portion of the meteoric iron which has been shipped from this locality has been found lying on the plain immediately surrounding the crater, and much of it has been found on the rim itself. At Cañon Diablo a merchant, Mr. F. W. Volz, tells me he has shipped nearly ten tons of this iron, and he also tells me that before he came to the country a merchant from Winslow shipped perhaps half as much. Both of these merchants hired Mexicans to look for iron specimens in the neighborhood of the crater. These men discovered several pieces weighing from 600 to over 1,000 pounds.

Since we have come into possession of the property we have found several thousand pieces, in all something over a ton, of various sized fragments of meteoric iron, the largest weighing as I remember 225 pounds, down to pieces weighing much less than an ounce or only a few grains. These meteoric iron specimens (known to the scientific world as the Cañon Diablo siderites) are so well known that I shall not attempt to describe them. The following analysis by Messrs. Booth, Garrett and Blair, of Philadelphia, may be taken as representing the general composition of these irons: Si 0.047; S 0.004; P 0.179; C 0.417; Ni 7.940; Fe 91.396; total 99.983. In the present discussion it is far more interesting to state that they have been found more or less concentrically distributed around the crater and to an extreme distance, so far as we know, of two and one-half miles from it, a few small specimens having been found in Cañon Diablo gorge. It is a remarkable fact that these so-called "irons" (to distinguish them from the so-called "iron shale") are very angular in shape, indicating by their fracture that they may have been violently torn off or burned from similar material. Some of them contain holes or cavities which were probably once occupied by nodules of troilite (sulphide of iron). Such nodules are beautifully shown by sawing through some of the larger specimens in the Ward and other collections. When exposed to the action of the atmosphere these have oxidized, leaving the cavities they had occupied. Occasionally some of the specimens have a noticeable amount of iron oxide or shale adhering to them, but as a rule they are very free from this. They are usually covered, however, with a very thin film of iron oxide, which may be easily rubbed off with a wire brush if the specimen has been previously heated. When this is done their appearance would indicate that they may have been torn or burned from presumably similar material.

It is a fact worthy of note that so far none of these specimens of meteoric iron have been found at any depth beneath the surface. They are usually lying on the surface or partially or wholly covered by the merely superficial soil, and are distributed, as already stated, more or less concentrically around the crater, most of the small specimens being found, however, to the north and northeast. That there are great numbers of them contained in the thin soil overlying the solid limestone composing the level plain on all sides of the mountain is proven by the fact that we have found several specimens, from seven pounds to twenty-seven pounds in weight, so imbedded in digging a trench for a pipe line from Cañon Diablo gorge to the crater. They have not been found in the numerous cuts or shafts which have been made in the silica. Four of them, weighing three or four pounds each, have been found on the interior of the crater, and, so far as I know, these are the only iron specimens which have been found inside of the crater. These were found above the cliffs already described. Considerable "iron shale" has also been found inside the crater, among the talus at the base of the cliffs. I shall propose hereafter a possible explanation of the fact why these irons are found only on the surface. It is also worthy of note, as already stated, that we have found more of the smaller irons, on or in the surface soil, on the north and northeastern portion of the rim than in other places.

Now there have been found abundantly distributed around the rim, and especially on and in its northern portion, and nearby on the plain, very large quantities, probably aggregating a ton or more in weight, of magnetic oxide of iron. This is so abundantly distributed over the northern surface of the rim and over the surrounding plain, and is so apparent to the casual observer, that it seems wonderful to me that Mr. Gilbert and his associates did not make any reference to it in their report. It is certainly different from any substance in nature with which I am familiar, and had they taken the trouble to have it analyzed they would have found that the large pieces almost invariably contain nickel (certainly in all the specimens examined) to the same extent, proportionately speaking, as it is found in the Cañon Diablo meteoric iron, from which this magnetic iron oxide was no doubt produced. However, if they had merely broken open some of the larger pieces of this magnetic iron oxide, which it seems to me they could not have failed to see, they would have observed in some of the specimens the characteristic green hydroxide of nickel. The iron oxide was produced, as I assume, by the heat generated from friction while the great iron meteor passed through the earth's atmosphere. As above stated, it has been determined for us that the larger pieces of this so-called ''iron shale'' contain invariably iron, nickel, iridium and platinum in the same relative proportion (remembering that two are in the form of oxide while the others are in the metallic state) as they are found in the iron from which this material was separated. In the very minute pieces of shale the nickel has been leached out to a greater or less extent. For the sake of clearness and because of the peculiar laminated structure, I shall hereafter refer to this magnetic oxide of iron as ''iron shale,'' adopting the local name by which it is known. This iron shale is very much more magnetic than the original metallic meteoric iron, which in some speci mens is only feebly so.

It should be stated in this connection that the surface of the surrounding country for perhaps several miles, concentrically around the crater, contains minute particles of this iron shale, either in the shape of fragments or as spherules. It is found everywhere in the vicinity of the crater, on the rim and on the outside plain. We have assumed that these small particles once constituted a portion of the great luminous tail of the meteoric body which, in our belief, by its collision with the earth made the crater.

Having observed all these things, containing as they do many arguments in favor of the theory that this great hole in the plain was produced by the impact of a body falling out of space, and against the theory that it was produced by either volcanic action or by a steam explosion, it naturally suggested itself to us to endeavor to prove *absolute* synchronism of the two events, namely, the falling of a very great meteor on this particular spot and the formation of this crater. The easiest method of doing this, which at once suggested itself to us, was to have a number of open cuts made through the silica and rock fragments on the outside of the rim, and to sink a number of shallow shafts through this material, in order to find if possible pieces of the meteor *overlaid by and thoroughly admixed with* the rock fragments and silica which certainly came from great depths in the adjacent hole. Numbers of these cuts were made before finding the objects of our search, but at last we began to find them and now we have found nearly one hundred pieces of meteoric material, some of them as much as fifty pounds in weight, a number of feet beneath the surface in the silica, overlaid and underlaid in no particular order by the various kinds of rock fragments described above, namely, white sandstone, limestone and red sandstone. In one case that I remember we found a large piece of meteoric oxidized material or ''iron shale'' about six feet beneath the surface in the silica, directly underneath an angular fragment, several feet in diameter, of red sandstone. On the top of this red sandstone was a piece of limestone, and on top of the limestone was a still larger piece of white sandstone. I merely mention this case as it is interesting to reflect that the white sandstone comes from a depth of at least about 400 feet below the surface, and yet it is found on top of the red sandstone fragment (the surface rock) and the limestone fragment which, when the geological order of the rocks is considered, lie above it. However, the most interesting piece of work in this connection which we have done is to be found in one of the shafts on the rim, which shaft is forty-eight feet deep. In this shaft we found vertically one above the other no less than seven quite large specimens of meteoric material or iron shale; the first one being found twelve feet beneath the surface, and the last one being found twenty-seven feet beneath the surface, underneath a large fragment of red sandstone. These pieces were from a pound to probably thirty pounds in weight. On top of the uppermost specimen, and at varying distances between it and the other specimens found in this shaft, there was the usual admixture of silica, white sandstone fragments, limestone and red sandstone fragments. On no conceivable theory other than the one which we have adopted can the facts above described be explained.[7]

I have used the words ''meteoric material'' because this material is somewhat unlike any which up to that time had been found on the surface. Such material has, however, since been found on the surface,

[7] Since the above was written Mr. Tilghman has informed me that he has by means of a small magnetic separator found distributed through samples of silica, taken from deposits on the slopes of the rim, an appreciable amount of metallic iron in the form of very minute particles and scales which are covered by magnetic oxide of iron. These of necessity are meteoric in nature. They have been found by him in silica which was taken from several feet beneath the surface.

several large specimens, one weighing over 200 pounds and others over 100 pounds, having been found nearly a mile west of the crater, and many small ones distributed around it, generally to the northeast, north and northwest. This material is usually roughly globular or oval in shape, the outside having been converted into hydrated oxide of iron, while the interior is usually magnetic oxide of iron, showing when broken open in nearly every instance the green hydroxide of nickel. In a number of instances, however, these so-called "shale balls" (I again adopt the local name) are found to contain *a solid iron center*. We have some specimens where these iron centers probably weigh as much as twenty to thirty pounds, the total weight of the shale ball being considerably more than this. The magnetic oxide which surrounds the iron center usually presents a more or less laminated appearance, and I assume therefore that much of the so-called iron shale found on the surface, as small flat or slightly curved pieces or thick scale, from an inch to six inches in length and from one-sixteenth inch to several inches in thickness, has resulted from the alteration of shale balls, the iron in the great majority of the cases where these were small or were detached from the meteor in the upper atmosphere having had time to be entirely converted into magnetic oxide. There is such a great similarity of appearance that this inference is to me unavoidable, and I have recently noticed that the pieces of laminated magnetic iron oxide are often grouped, especially where they have been found on the outside plain some distance away from the crater, as if a shale ball, or a piece of metallic iron which was once covered by magnetic oxide of iron, had fallen on this spot and the magnetic oxide of iron had been disintegrated, either by the force of the fall or afterwards by ordinary atmospheric agencies.[8] It is worthy of note that the flat or slightly curved pieces of iron shale are found, like the iron specimens, only on the surface or in the surface soil, and to date at least have not been found admixed with the silica and rock fragments on the outside of the rim, as the shale balls are frequently found.

This brings me to attempt an explanation of the fact that these so-called shale balls are to be found beneath the surface on the outside of the rim, and admixed with the fragmentary material which was certainly expelled from the crater, to a proven depth of twenty-seven feet, and that the angular pieces of meteoric iron have been found up to date *only* on the surface or in the shallow soil which overlies the rock

[8] It may easily be, however, that pieces of metallic iron were found at some of these spots and taken away by the merchants who made a business of collecting these specimens for sale to museums, etc. See footnote 9.

fragments and the silica, which forms part of the rim, or on the surrounding limestone plain.

On April 11, 1904, it was my good fortune to observe, while at Pearce, Arizona, between five and six o'clock in the afternoon, a very brilliant meteor. This same meteor was observed at Tucson, Arizona, by Mr. Holsinger, who had been in charge of our exploratory work for some time previous to this. He was at the time over seventy miles distant from Pearce in an air line. It is a source of much regret that the sun was shining at the time, for otherwise the spectacle would have been a most brilliant and instructive one. As it was, however, the meteor was so large and so brilliant that the following facts could be most clearly determined: The head of the meteor was blue-white in color; from this head there seemed to dart from time to time, and almost from the moment the meteor became visible, many jets of bluish-colored light. Behind the meteor was a glorious comet-like tail, the color of which was generally yellow. From behind the meteor and out of this tail there appeared from time to time, and after the meteor had been visible for an appreciable length of time, great flaming drops, not unlike drops of burning tar. These rapidly fell behind the meteor, being distanced by it. In shape they were, generally speaking, somewhat like a gourd, with the small ends, which as I remember seemed to bend slightly downward, pointing toward the rapidly receding meteor. I counted as many as five of these drops. Mr. Holsinger thought he saw more than five.

Bearing in mind what I have related above, I shall now offer an explanation of the difference in distribution of the pieces of metallic meteoric iron and the so-called shale balls, realizing fully, however, that in the first place not enough work has been done to state with positiveness that no large pieces of iron are to be found in the fragmentary material forming in great part the slopes of the mountain, and in the second place that the explanation which I offer may be proved to be an erroneous one. I am inclined to believe that many of the thousands of pieces of metallic meteoric iron which have been found distributed around Coon Mountain, and which are generally known by the name of the Cañon Diablo siderites, were pieces that were torn loose from the surface of the meteor when it entered the earth's atmosphere by the violent expansion strains set up because of the intense coldness of the main body of the meteor, which of course was cooled to the temperature of outer space, and the intense heat immediately generated upon the entrace of the meteor into the earth's atmosphere. This would explain the darts of light which Mr. Holsinger and I saw going out of the front of the meteor above referred to, from almost the instant the meteor became visible.[9] These fragments would naturally soon fall behind the meteor, and in the case which is the subject of this paper probably reached the earth after the collision had taken place and all of the material had been thrown out from the crater produced by the impact. The same would be true of the first "shale balls" to be detached, the origin of which, it seems to me, can be explained as follows. As the front surface became more heated it is possible that fewer of these irons would be thrown off, and almost certain that some of the iron would be melted and would naturally run back to the sides or to the rear surface of the meteor, from which from time to time it would be detached. This burning iron would then drop behind, as in the case of the meteor observed by Mr. Holsinger and myself, and form the shale balls above referred to. On this theory the laminated structure which I have spoken of is possibly due to the fact that the melted iron ran back over the meteor to its rear surface, or at least to its sides, and was detached therefrom in a pasty condition. This would seem to offer an explanation of the five flaming drops which I saw falling behind the meteor in April, 1904, and why they were not seen until the meteor had been visible for an appreciable length of time.

These shale balls probably continued to drop off from the great Cañon Diablo meteor, referred to in this paper, until the very moment

[9] Since writing the above it has occurred to the author that the pieces of metallic iron, and the pittings known as "thumb marks" which they show, are due to the very high temperature developed by friction against compressed air in passing through the earth's atmosphere. Dr. Mallet has confirmed this, and points out that in the case of iron meteorites this temperature would of course bé still further raised by burning. He has also told me that this is a commonly accepted theory of the cause of these characteristic pittings. The effect of this furious burning, produced by the friction against the compressed air ahead of the flying iron meteor, would probably be to make great irregular cavities or furrows on its surface, as in the case of the 14-ton Willamette meteorite described by Mr. Henry A. Ward in the *Proceedings of the Rochester Academy of Science*, Vol. 4, pp. 137-149, plates 13-18. Whether the spaces represented by such cavities or furrows were once partly filled with nodules of troilite is not of importance in this connection. Having this action in mind it can readily be seen how these furrows or cavities in meeting might cause unconsumed pieces of metallic iron to be liberated, which would then fall behind the main body of the meteor and still burning reach the earth after the collision. Not only "thumb marks" but so-called "ring" meteorites are perfectly explainable on this theory. It receives very strong support from certain iron specimens which have recently been found by us (and since this paper was written) in the trench for the pipe line between Cañon Diablo gorge and the crater. To these specimens when found a large amount of magnetic oxide of iron or iron shale was still firmly attached, and occupied the "thumb mark" pittings on the specimens as well as being adherent to the more or less flat surfaces. When it is found in the pittings, generally referred to by the term of "thumb marks," it is distinctly shaly in character and is seen to curve upward from the bottom of the cavity. There is much to recommend this theory, but may there not be truth in both this theory and in the one just mentioned?

of collision. It is very natural, therefore, to conclude that some of them must have been caught before they reached the surface of the earth by the outgoing rock fragments and silica which poured out of the hole at the moment of collision. They were doubtless all burning fiercely at this moment, and would have continued to burn, like those which were detached in the upper atmosphere, until all of the iron was converted into magnetic iron oxide, had enough oxygen been present to produce this result. However, some of them seem to have been smothered out when covered up by the silica and the rock fragments included in it. This would perfectly explain why some of them have iron centers and some of them do not possess this peculiar feature, and why the pieces of iron shale continued to rain down for some moments after the collision. An interesting fact which is perhaps worthy of note is, that these iron centers nearly always show a peculiar exudation of drops of moisture, often colored green, partly perhaps from the presence of nickel. This exudation, Dr. Mallet explains to me, is due to the presence of chloride of iron. It is singular, however, that only one of the pieces of meteoric iron which we have, one of those which was found in the trench for the pipe line and is referred to in foot-note 9, exhibits this peculiarity, it being confined to the so-called iron centers, which have only been found in the shale balls which were entirely covered and surrounded by silica and rock fragments.

During the many visits which I have paid to this remarkable spot, I have made a most thorough search for any other stone than the sandstone and limestone fragments above described. I have found a number of pieces of flint and some pieces of eruptive rock, but in every case there was every reason to believe they had been brought there by Indians who visited this locality, as many of them were pieces of "matates," in which the Indians and prehistoric inhabitants of this country ground their corn; and especially because most of them were found in the near neighborhood of the Indian "hogans" or camps. I had another object, however, than that of trying to find pieces of igneous or eruptive rock, which was to find if possible some pieces of meteoric stone, on the theory that perhaps the great meteor, which by this time I had become firmly convinced produced this crater, was partly metallic and partly stony in composition; in other words, a siderolite. A most careful search of the country for miles around failed to reveal the slightest evidence in favor of this theory. None of the pieces of iron, and by this time several thousands of such pieces have been found on all sides of the crater, have attached to them any particle of stone; except indeed where some pieces of iron shale have been found adhering to small fragments of limestone and sandstone, or in one small specimen which I found including them, showing conclusively that this iron oxide was in a liquid or fused state when it fell to the earth. In this specimen there are sealed together, as sealing wax would hold them, three small angular fragments of sandstone, and another piece of iron shale which I have is firmly adherent to a piece of limestone, upon which it evidently fell when in a melted condition. The latter specimen shows the green hydroxide of nickel. The result of my careful search has been the conclusion that there is not the slightest evidence in favor of the meteor having been part iron and part stone.

It is only fair to state, however, that upon one of my recent visits to the crater, or accurately on June 24, 1905, I found on the surface of the plain, about a mile and a half west of the mountain, a very remarkable aerolite or meteoric stone. This is as different from all the other meteoric specimens which we have examined, which have come from this locality, as one specimen can be from another. It is subangular in shape, having on one side a rather sharply pointed protuberance, with a generally round and smooth surface which is covered by quite a heavy film of oxide of iron. Two corners were broken off when I found it. The fracture exhibited was very fresh, in fact almost as fresh as the fracture produced by me when knocking off a piece of it for analysis, which was made by Mr. H. H. Alexander and is as follows: SiO_2 37.32%; Fe 22.30%; Ni 1.65%; Al_2O_3 2.53%; CaO 2.96%; MgO 23.02%; S 2.34%. See also description and analysis of the stone which will be hereafter published by Dr. Mallet.

It has some curious markings, looking as if it possibly had received a blow before it entered the earth's atmosphere, these markings being covered with the same film of oxide of iron which cover the rest of the aerolite. A comparison of this analysis with the analysis of the Cañon Diablo meteoric iron shows the wide difference between the two, and the fact that it does not contain a trace of platinum or iridium and relatively small percentages of iron and nickel, while every specimen which has been examined of the meteoric iron or iron shale found in this locality contains the first mentioned metals, is very significant and is in favor of the theory that the aerolite or meteoric stone specimen is not in any way connected with the others.

Now comes a story which is at least very interesting, for as a coincidence, if such it is, it is very remarkable. Two years ago, about January 15, 1904, while two of our employees at Coon Mountain were watching the camp—we had suspended operations during the winter—

they were awakened, so they told us, by a loud hissing noise, and looking northward saw that the heavens were brilliantly lighted, and while rushing out of their tent saw a meteor fall somewhere northwest of the mountain, between them and the railroad. We paid no especial attention to their story, and supposed that although they might have seen a meteor fall, it had come to the earth, if it came to the earth at all, many miles distant. However, if we have been able to fix the dates correctly, on the same evening, at the same moment, a few minutes before nine o'clock, the hour being fixed by the train schedule, Dr. A. Rounsville, of Williams, and Dr. G. F. Manning, of Flagstaff, Arizona, were travelling to Cañon Diablo station, where Dr. Manning had been called to visit a patient. Just before the train stopped Dr. Rounsville saw from one of the windows, on the south side of the train, a blazing meteor fall in the direction of Coon Mountain. According to Dr. Rounsville's statement Dr. Manning did not see the meteor fall, but only saw the very brilliant light produced by it. It is very probable that this was the same meteor that was seen by our employees at Coon Mountain. If so it would appear that our two employees saw it from one side, while Drs. Rounsville and Manning saw it from the other, the observers being about 12 miles apart. As accurately as I can determine, it was very near a spot at the intersection of the two lines of sight, a spot which of course they could not locate exactly, that I found the above described meteoric stone—the only one, so Mr. Volz, of Cañon Diablo, tells me, that has ever been found in this locality, and his intimate knowledge of the locality extends for a period of over fifteen years. That a small stony meteorite should have fallen on almost exactly the same spot on the earth's surface as the great Cañon Diablo iron meteorite fell many centuries ago, is certainly a most remarkable coincidence. I have stated the facts as accurately as possible, and I have no opinion to offer as to whether or not these involve anything more than a coincidence.

I have endeavored to describe in this paper as briefly as possible only such matters as would appeal to a geologist and which have come within my personal observation. Such as they are, after a very careful study of this locality, they do not leave in my mind a scintilla of doubt that this mountain and its crater were produced by the impact of a huge meteorite or small asteroid, and that this fell upon the earth almost vertically, with probably a slight inclination toward the north. As is explained above, the greatest effort seems to have been expended on the southern side of the crater, as evidenced by the walls of the crater itself and by the great amount of material thrown out on the southern rim, and by the fact that this material is much more comminuted than similar material elsewhere on the rim, and by the further fact that on this portion of the rim alone do we find fragments of the yellow and red sandstone, which we know to be from the deepest strata of which fragments have been expelled from the crater. This theory is still further borne out by the fact that most of the shale balls and smaller meteoric iron specimens have been found on the northern rim, which position they would occupy if they fell slightly behind the meteor itself, and yielded more than it did to the retarding effect of the earth's atmosphere and to the force of gravity.

In using the words "northern" and "southern" in the above connection, I mean by "northern" any direction between northwest and northeast; and by "southern" any direction between southeast and southwest. However, the direction from which the meteor came is a matter which is not as yet susceptible of positive proof and is of probably small importance at this time.

To summarize, we believe we have proved the following facts:

First. That a great meteor, the whole or at least the outside of which was metallic in nature, did fall to the earth at this locality, and that it was so large that portions of it became fused and were detached.

Second. That this great hole in the upper strata of the Aubrey formation was made at the instant of time when this meteor fell upon this exact spot. Having proved these facts, the conclusion is unavoidable that this hole, which as we have seen cannot have been produced by a volcano or by a steam explosion, was produced by the impact of the meteor, which, even admitting that it retained some large proportion of its planetary speed, must have been of great size.

Having proved these facts, and having been prevented by wet silica, a material very difficult to penetrate with a shaft, from sinking with a horse-whim to a depth of more than 200 feet, we put down a number of drill holes in the hope of finding evidence of the meteor beneath the central plain in the crater, using the ordinary type of rotary well-boring machinery. Several of these drill holes encountered obstructions, at least one (and probably more) of which would seem to be meteoric, inasmuch as a magnet put down at the time was strongly attracted to the obstructing object and brought up from it material which assayed four-tenths of one per cent. of nickel. We were unable to force the drill past this obstruction. In another hole the extreme depth of 1,020 feet was reached. In this, however, over 100 feet of red sandstone (the Red Beds above referred to) was penetrated. This seemed to be in place and to form the floor of what, judging by the results of artillery experiments, we have termed the inner or interior crater, somewhere in which we suppose the wreck of the meteoric body to lie. In *all* of the holes the material (silica, broken and whole sand grains and some pieces of dense layers of cemented material composed largely of carbonate of lime) brought up by the drill from underneath the lacustrine sedimentary formations shows when concentrated many minute fragments of iron shale or minute shale balls which contain an appreciable percentage of nickel, and are therefore doubtless meteoric in nature. It seems certain that much of the nickel has been leached from these fine particles of meteoric material, but notwithstanding this fact they invariably have been found to contain a small fraction of one per cent. of this element, and in other respects are generally similar to the fine particles of iron shale which we have found on the outside of the crater. This evidence, to say the least, is strongly corroborative of, if not absolute proof of, the above theory. To test it still further, however, we are now proceeding to sink with a steam hoist a double compartment shaft in the exact center of the crater. Unless we should be prevented by difficulties which we cannot overcome, this will be sunk to such depths as will demonstrate the existence, as we suppose in a fragmentary condition and several hundred feet below the central plain, or the non-existence of the extra-terrestrial body which, in my best judgment, produced when it collided with the earth the crater which I have endeavored to describe.[10]

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[10] It should be borne in mind that this paper treats only of such facts as are of interest to the scientific world, and has no reference whatever to the commercial value of the discovery.

COON BUTTE, ARIZONA.

BY BENJAMIN CHEW TILGHMAN.

In Central Arizona, situated at approximately longitude 111° 1′ west and latitude 36° 2′ north, about five miles almost due south of Sunshine Station on the line of the Atchison, Topeka & Santa Fé Railroad, is situated the very remarkable eminence known locally by the names of Coon Butte, Coon Mountain and Crater Mountain.

This so-called mountain consists of a circular ridge from 130 to 160 feet in height, surrounding an almost circular cup-shaped depression in the earth about 400 feet deep and varying from 3,600 to 3,800 feet in diameter. Viewed from the inside, the crest of the ridge is elevated from 530 to 560 feet above the level of the flat interior plain.

The strata penetrated by this hole are, first, from twenty to forty feet of red sandstone; second, about 250 to 350 feet of a yellowish silicious limestone, or possibly more correctly a very calcareous sandstone; third, an unknown depth of a whitish or light gray sandstone, consisting of rather small water-worn grains but weakly attached to each other; fourth, about 80 to 100 feet of brownish sandstone in which it terminates. The contact between these latter strata is some 880 feet below the floor of the crater, but there is some reason to think it may not be in place but below its original position. These strata are of late Carboniferous formation, and in the surrounding plain lie perfectly level and conformably with each other. The uppermost, the red sandstone, being almost removed by erosion and only showing in spots upon the plain in the form of more or less scattered flat-topped red buttes, although it seems to have been nearly or quite continuous over the area now occupied by the interior edge of the crater.

These same level strata cover the plain in all directions for many miles. They are cut through by Cañon Diablo to a depth of some sixty to seventy feet about two miles to the westward of the crater, and near this gorge are two large earth cracks penetrating the strata to an unknown depth.

Immediately around the crater the strata dip outward in all directions from the center of the crater at an angle of about thirty degrees, and are raised from 140 to 180 feet above the normal position. This is the locality in which the Cañon Diablo meteoric iron has been found to the amount of some ten to fifteen tons, and the question as to whether or not the hypothetical main body of the meteorite formed the crater in question in its impact with the earth has been the subject of numerous speculations and papers, notably by Professor Gilbert, of the United States Geological Survey, and others. The shape and general appearance of the crater, together with the absolute and entire absence of all evidence of volcanic action in or around it, manifestly inclined these early observers to decide this question, at least tentatively, in the affirmative, and they regarded the matter as worthy of further investigation. In pursuance of this object Professor Gilbert devised what he at the time, regarded as two crucial experiments to determine the presence or absence of a large amount of meteoric iron in the bottom of the crater. These were, first, a topographical survey of the hole and rim by which he made their contents approximately equal, and therefore gave no room for the presence of the bulk of the very considerable body required to produce such a hole by its impact; and secondly, a magnetic survey of the locality, which by its negative results was thought to preclude the possibility of the presence of any considerable mass of metallic iron in the vicinity. By these two experiments the question seemed to be authoritatively decided in the negative and the whole matter has remained in abeyance for many years.

The author of this present paper, having had his attention called to the matter by his friend Mr. D. M. Barringer, has examined the locality with great care, and with Mr. Barringer has done a considerable amount of development work there, and as a result of the facts disclosed thereby is very strongly of the opinion that the hole and its rim were produced in exactly the way at first supposed by the earlier investigators, and wishes here to bring to notice several points in support of the correctness of this theory which have escaped notice, or at least mention, in the papers of the earlier investigators of this most interesting locality.

It is first, however, necessary to criticise the so-called crucial experiments of Professor Gilbert, upon the results of which he definitely abandoned the theory of the meteoric formation of the crater in question, as, if these can be regarded as definitely settling the matter in the negative, there is no use in bringing forward facts looking towards its probability, no matter how plausible they may be. In regard to the first of these crucial experiments, that is, the alleged identical contents of the rim and the hole. In reply to this it can only be said that the author has also made surveys of this locality, and is very sure that the contents of the rim not only does not show the excess over that of the hole that would allow for a large buried meteorite in the latter, but that it is short by many, at least several million, cubic yards of the quantity necessary to fill the hole at all. This, of course, if correct, and of that the author has no doubt, entirely destroys the weight of Professor Gilbert's reasoning, which was based on the assumed fact that everything ejected from the hole still remained around it. The solution is, of course, that in the time since the impact the rim has been reduced to its present dimensions by erosion, and the reason why it is or was so particularly subject to erosion will be taken up later when the formations of the rim are discussed more in detail.

As to the absence of sufficient magnetic perturbation, this is on its face a much more serious objection, as it undoubtedly proves the absence of any *one* large mass of iron near the locality, whether magnetized itself or only magnetized by the induction of the earth's magnetism, and also the absence of a mass of fragments of a magnetically neutral but magnetically permeable character magnetized by the inductive action of the earth. But it would have no bearing whatever as to the presence or absence of a mass of magnetized fragments each having sufficient coercive force of its own to be independent of the earth's inductive action, to the extent at least of retaining its own proper polarity irrespective of the position in which it is placed in regard to the terrestrial magnetic field. Such a mass of polarized fragments would form a series of closed magnetic circuits with practically no external field whatever. In support of this the following experiment was made. Two little cubes of magnetite about half an inch on one side were taken, which, as nearly as could be observed, had about the same effect on the magnetic needle. The weaker of the two, if there was any difference, was preserved intact, and the stronger was carefully broken up without loss to about the size of coarse sand. These fragments were then packed in a paper case but little larger than the original piece had been. It was found that this had to be approached to within an eighth of an inch of the compass needle to produce the same deflection that the original piece did at eight inches. Not only this, but it was found that one single grain of the sand-like fragments of the pulverized magnetite had more effect upon the compass needle when taken alone than the whole mass of them had when taken together. If the attraction of the mass of fragments of the supposed iron meteorite could be reduced in this proportion to its normal attraction when in a single piece, it might, on Professor Gilbert's own figures, lie within a very short distance of the surface of the present bottom of the hole.

The only remaining questions in regard to this so-called crucial experiment are: First, could the meteorite be reduced to this condition of physical wreck? and second, do the fragments have the necessary inherent magnetism? As to the last requirement, the overwhelming majority of the fragments picked up on the surface, probably ninety-eight per cent., do have this much magnetism, and some much more, and there is no reason to believe that the fragments of the main mass, if there be such, differ much, if any, in this regard from pieces collected on the surface.

Now, as to the probability of the shock of the collision breaking up the body of a solid iron meteorite of considerable size to sufficiently small fragments, it can only be submitted that the velocity and shock were enormous, and that it has been shown that ordinary soft iron at the temperature of liquid air is of about the brittleness of glass under the shock of a blow. Now, as it is practically certain that the body of such a falling mass would be at the actual absolute zero of space beneath its incandescent exterior, it seems much more than probable that the result of such a collision would be to reduce the projectile to an extremely fine state of subdivision in comparison with its original size. If these conditions of subdivision and magnetism are present, and it seems much more than probable that they are, the crux of the second crucial experiment is also escaped and we may proceed to consider the question on its merits, as nothing forbids us from allowing the possibility that the wreck of a great iron meteorite may underlie the bottom of the crater of Coon Butte.

Distribution of Irons around the Hole.

The early accounts of the locations of the finds of irons about this locality the author regards as of very doubtful value, for the reason that the great majority of these finds have been made by persons who were engaged in the occupation of selling them to museums and collectors, and who naturally did not wish to disclose the source of their supply to others. Also, these previous finds have been principally of large size, big enough in fact to enable them to take quite a divergent trajectory from that of the main mass, and too few to enable any reliable generalization to be drawn from their locations, even if the latter could be regarded as thoroughly reliable.

In the last two years the author and men in his and Mr. Barringer's employ have picked up more than 2,000 such irons, ranging in weight from 200 pounds down to a small fraction of an ounce, and have plotted the position of these finds upon a chart which shows plainly that the principal locality for such finds is in the shape of a crescent surrounding the hole and strictly concentric therewith, and embracing its edges from the northwest to the east and having its line of greatest density about midway between these two points. These directions are taken from the center of the hole. The above distribution is by the number of finds regardless of their weight, as that of the scattering outlying finds is as a rule so much greater than that of the nearer finds as to entirely disturb the symmetry of the distribution. Moreover, the disposition of the smaller irons, which from their irregular forms and light weight could not have been propelled far from the mass from which they separated, is of more importance than that of the larger fragments, which would have more liberty of independent motion.

Distribution of Magnetic Oxide of Iron around the Hole.

In addition to the irons found around the hole there is a very considerable amount of magnetic oxide of iron similarly distributed, the disposition of which does not differ materially from that of the irons themselves. For although it is more generally distributed around the hole and the radius of the area upon which it is found is considerably greater, yet the fragments are arranged in the same general way with the axis of the group, which is also the line of greatest density of their deposition, extending away from the center of the hole in a direction between north and northeast.

Proof of the Meteoric Origin of the Magnetic Oxide of Iron.

The fact that this magnetite is of meteoric origin is proved from the following facts: First—It is found attached to and in some of the cavities of some of the larger irons. Second—Some of the larger pieces, although not the largest, are found to have centers of metallic meteoric iron. Third—The chemical analysis of the iron and the magnetite show a very close agreement between the proportion of metallic iron and the other metals present in the magnetite and in the meteoric iron. These other metals consist of nickel, cobalt, platinum and iridium, and another metal or metals of the platinum group. Fourth—The magnetite is fused and massive and at the same time stratified and laminated, and in general appearance different from any terrestrial magnetite known and closely resembles what would be thought, *à priori*, to be the appearance of such a product of iron melted and burned on the surface of a great meteorite in its passage through the air.

Identity in Position of the Point of Impact of the Meteorite with the Center of the Hole, and Identity in Time of the Formation of the Hole with the Impact of the Meteorite.

We thus have two different meteoric materials distributed over the rim of the hole and the surrounding plain on areas symmetrical about the same line, which is a line drawn in a north-northeasterly direction from the center of the hole. And also each of these areas closely embraces the hole and there terminates. For, with few exceptions, no iron nor magnetite has been found on the surface within the hole, and these exceptional pieces were found close to the wall, and may have fallen in by ordinary weathering action from the cliffs along with outside surface material. This brings these meteoric materials into close relation with the hole, which cannot be accidental, as if the shower of meteoric iron and magnetite fell after the formation of the hole, by other agencies, it is inconceivable that the densest portion of the shower of each material should coincide accurately with the north-easterly rim of the hole and yet none fall into it, although scattered individuals of each shower are found around the hole on all sides. Whereas, if the shower occurred before the formation of the hole, it is equally inconceivable that the fallen material could be found most thickly on the surface of the rim, composed of material ejected from the hole. To further assure the absolute identity in point of time of the fall of meteoric material and the formation of the hole, cuts and shafts were made in the débris composing the rim, and up to date over one hundred pieces of meteoric material have been taken from the ground, at distances varying from six inches to twenty-seven feet below the surface, mixed with the rim material and under large imbedded rocks. In many places it was absolutely impossible, from the slope of the ground and other circumstances, that they could have gotten where found except by simultaneous deposition with the broken material forming the rim. In one shaft seven pieces were found with fifteen feet of vertical depth between the highest and the lowest, which was twenty-seven feet below the surface of the ejected material.

The Rim.

This consists, as has been briefly stated before, of a circular ridge of from 130 to 160 feet high closely surrounding the hole. A generalized description of its profile would be somewhat as follows: Beginning at a point on the inside of the hole on a level with the surrounding plain, the surface of the rim consists of the edges of the strata which should normally be lying level some 150 feet below the surface. These strata themselves dip downward and outward from the center of the hole at an angle of, on the average, about thirty degrees, although this varies in places from more than vertical or inclining backward to about ten degrees. The strata themselves are crushed and shattered to an extraordinary degree, and the surface of the rim slopes upward and outward from the center of the hole at an angle of from fifty to eighty degrees; possibly sixty degrees would describe the general shape better than any other slope. Considering the shattered and disintegrated material of which these cliffs are composed, it is remarkable how little talus has fallen from them. This slope continues up almost to the top of the ridge, although here and there are flat benches in it both at the junction of the yellow limestone and the red sandstone and at partings in the red sandstone itself. From fifteen to forty feet from the top of the ridge on the inside is located the top of the red sandstone, which was the original surface of the plain; at the place of impact and from this point the ridge slopes outward at the ordinary sliding angle of loose materials, somewhat less than forty degrees, to its summit. The summit of the ridge is of necessity a closed ring and is sharply serrated into peaks, and the colls between these serrations do not exceed thirty to forty feet in depth but their slopes are steep, often ten to twenty degrees. There is a marked low place in the rim, extending over nearly one-sixth of its circumference on its northern side. On the outside no description will suffice for all sides. The greatest amount, by far, of the material thrown out of the hole is found in the southern quarter of its circumference, and here the rim is almost flat on top for a number of yards and then slopes outward at an angle of only seven degrees for some 900 feet, where it ends in a sharp slope of some twenty-five feet high at an angle of some twenty degrees. Beyond this is a thin cover of ejected material and detached and partly buried limestone fragments which extend for a considerable distance; some of the latter having been thrown nearly a mile from the edge of the hole. The actual surface of this southern side of the rim consists largely of blown sand, as the winds in the country are strong and storms frequent and their usual direction is from the southwest. On the eastern, northern and western sides the ridge is thin and sharp; in many places not over a yard or so in thickness at the very top and sloping outward very sharply, in places up to thirty degrees, for about half its height, and then more gradually at some five degrees until it joins the plain. The general surface of the outer slope is not at all a smooth cone of the angles above stated, but is cut up into hills and hollows and every imaginable subfeature to a very great degree. This is almost entirely due to the irregularity of its deposition, slightly modified later by the action of water. The surface material of the outside of the rim, where it is not covered with blown sand, as on the southern side, is composed of the broken débris of the three strata through which the hole penetrates, piled together in the utmost confusion and disorder, pieces from all the three strata being thrown together in the most intimate mixture with a slight tendency towards inversion in the order of their deposition. That is, there is rather more of the red sandstone in the deeper portions of the rim than on the surface, while on the surface the limestone and white sandstone predominate, with here and there large areas of unmixed white sandstone lying on the surface. In size these fragments vary from huge rocks forty to fifty feet in length and weighing thousands of tons down to impalpable powder and all intermediate sizes, and many of the rocks are so crushed and broken that they barely hold together. And imbedded in the deposits of impalpable powder are many pieces still retaining the form of rocks, still showing the stratification and bedding planes distinctly, but so crushed as to have lost all solidity. These crushed rocks in many cases have been subjected to such pressure that not only is their consistency as rocks destroyed, but even a certain proportion of the sand grains composing them have been utterly destroyed and they can be rubbed between the fingers to a fine powder, the grains of which will average much less than that of the sand grains originally composing the stone.

This powder forms a very considerable proportion of the substance of the rim. It is not merely a filling material occupying the interstices between the rocks, as might be a rock pile with fine material water-washed or wind-blown into it until all the crevices were filled up solid. But it occurs in distinct deposits, sometimes alone and entirely free from rock fragments and sometimes mixed with a larger or smaller proportion of rock fragments. When this mixture occurs, the rock fragments are usually so far apart that each rock is entirely surrounded and supported by the powder. Such deposits of powdered rock are often overlaid by a cover of broken rock many feet thick, the individual rocks in places weighing a hundred tons or more. In fact, as far as at present developed, it seems to be a very general feature of the structure of the rim that the lowest material, that lying upon the top of the original surface, is a greater or less depth of this powdered rock, sometimes alone and sometimes mixed with rock fragments, and that on this rests and is supported the whole of the detrital cover which constitutes the crest and outer slopes of the rim.

THE INTERIOR OF THE HOLE.

From the point on the level with the exterior plain on the inside of the rim the walls of the hole slope downward and inwa d at a constantly diminishing angle for a distance varying from 50 to 150 feet, in the same formation as above described as the base of the inside of the rim. At this point the rock walls begin to be covered with a rocky talus corresponding in all respects with the rocky cover on the exterior of the ridge. For about half the circumference of the hole the yellow limestone extends downward to the talus, and for the remaining half it exposes more or less of the whitish sandstone below. The white sandstone is a much weaker rock than the yellow limestone, and at their contact it is noticed that the former is much crushed and disintegrated by the pressure exerted by it in lifting the limestone. This stratum of crushed sandstone varies in thickness up to some ten or fifteen feet as a maximum, and in some places, usually immediately below the limestone, it is reduced to a bed of sand grains absolutely unconnected with each other, and in places a small proportion of even the sand grains have been crushed and broken to fragments and powder.

The very top of the talus slope is in places at an angle of forty degrees, but usually much flatter down to thirty and twenty-five degrees, this rapidly becoming less and less as it recedes from the cliffs until it is lying at an angle of not more than six degrees at the point where it disappears under the central plain. This central plain is an almost circular area of about 1,800 feet in mean diameter, with a surface generally flat but gently rolling within a limit of fifteen feet, with its lowest point a few feet to the east of the central meridian of the hole and about sixty feet south of the center. Shafts have shown the rocky talus to extend under this central plain at about the same angle that it has above for a distance of at least 400 feet, at which point it is some forty-seven feet below the surface and about twenty feet thick. This talus does not extend entirely across the hole. It is absent at points 50 feet southwest and 200 feet southeast of the center of the hole. Exactly where it terminates is not known.

THE SILICA.

It is here necessary to describe more minutely the material of the filling of the central plain. This is identical with the impalpably powdered rock referred to briefly above in the description of the rim. This material, of which there are millions of tons in the rim and the bottom of the hole, consists of the rock of the strata concerned reduced to an extreme state of subdivision. It seems to have been produced principally from the white sandstone, for it is mostly as white as snow and consists of over ninety-nine per cent. silica, although here and there small areas or deposits will be of a slightly yellowish color from the yellow limestone and contain a little carbonate of lime, although this has to a great extent been leached out of it, and much more rarely of a reddish color, either stained by or produced from the top stratum of red sandstone. Under the microscope it is seen to consist of minute fragments of clear transparent quartz with edges and points of extreme sharpness, and no signs of any wearing or rounding are anywhere visible upon its particles. In some areas the material is composed of this material exclusively and it gives no internal evidence of the manner of its production. But in other localities it can be found containing a greater or less percentage of broken sand grains among it which have escaped being crushed out of all recognizable shape. A continuous series of material can be found containing more and more *broken* sand grains and less and less silica (as we have gotten to call the impalpable powder, for want of a better short descriptive name), and then more and more *unbroken* sand grains, and then little bunches of sand grains still adhering together, and so on up to the solid sandstone rock. Its general microscopic appearance is identical with that of a handful of glass fragments produced by a blow. It cannot be quite imitated by grinding the sand grains in a mortar, as the edges and points of the powder thus produced are more blunted and rounder and broken than those of the silica. But it is very closely duplicated by the finest powder produced by firing a high power rifle bullet against a block of the sandstone.

The Interior of the Hole (resumed).

In the central area over which the talus does not extend, the line of the original surface upon which the talus was deposited, and on which the subsequent filling, which now covers this and also a portion of the talus, was deposited, can be very readily recognized. All the material lying above the talus, and above this surface, is horizontally stratified and contains organic remains, such as small shells and no (or but very few and small) rock fragments, while that below this line has no trace of stratification nor of organic remains and contains many rock fragments. In one shaft a beautiful series of rock fragments was observed about twenty feet thick and about twenty feet below the talus, in which the natural order of the rock in place was exactly reversed; that is, the red sandstone was deepest and the yellow limestone and whitish sandstone in that order above it. This series naturally suggested the idea that the surface stratum, having received the blow and started on its aerial flight first when the hole was formed, finished its journey first and was consequently deepest imbedded in the silica which was in process of filling the hole made during the flight of these rocks in the air. Almost immediately after the fall of the last of this series—which must have fallen directly in place as found and which is comparatively rare, as the rocks expelled from the hole had usually (apparently) a greater outward radial component in the direction of their flight—came the rush of talus rocks, which fell in masses on the funnel-shaped cliffs surrounding the hole and forming the interior of the rim, and rushing inward covered the surface of the bottom of the hole to a considerable distance from the foot of the cliffs, in fact probably all except a small area of 300 or 400 feet in diameter in the center. Then, during minutes and hours, settled down over everything about the locality the dense cloud of dust to the depth of many feet. This dust, being the finer portions of the silica above described, was then washed into the center of the hole, filling it in some places a hundred feet deep. This was apparently done by successive wet seasons for many years, during which time, at least in the rainy season, a shallow lake occupied the bottom of the hole; over the bottom of which the sediments were distributed in yearly level strata by wave action. The presence of the rare stone fragments in these sediments and the few now on the surface of the interior plain, far beyond any possible place to which they could have rolled if detached and falling from the cliffs, is difficult of explanation unless it be due to a frozen condition of the central lake, on the surface of which these rocks (and they have not been observed of large size) could slide and on which a very slight initial velocity would take them to their present position, to be there deposited upon the melting of the ice. Ten to fourteen inches of ice was formed on the open water in reservoirs in this locality during the last winter.

No very exact estimate of the amount of this silica dust washed down from the sides of the hole can be made, as the shape of the original bottom of the hole is unknown. It is irregular and in places the sediments are 100 feet thick, and it covers an area of about 1,800 feet in diameter. Moreover, it evidently fills the interstices of the talus of unknown thickness extending over a much greater area. It can only be said that it is a very large amount, many million tons. It probably covered all of the exterior of the rim to an equal or greater depth, all of which is gone. In fact it seems extremely probable that the rock cover of the rim, which is now its most prominent feature, on the surface of which both rocks and meteoric material are much more frequent than in the substance of the rim below, is itself a concentration of material like the present rim, below the rock cover, of mixed silica powder and rock, from which the silica powder has been washed away until the accumulated rock cover, and probably the decreasing rainfall of the country, has preserved the rim now remaining beneath this rock cover in its present form. Also, upon the accident as to whether or not there was a strong wind blowing at the time of the formation of the hole would determine whether or not a great portion of the fine powder produced ever settled on or around the rim at all. Hence, in the opinion of the author, the deficiency in the contents of the present rim to fill the existing hole, and this fact is also a valid objection to the use of their comparative bulks as having any bearing whatever upon the probability of the wreck of the great meteorite lying beneath the bottom of the hole.

The Traces of the Luminous Tail of the Great Meteor.

It occurred to the author that if the meteoric theory of the formation of this crater was correct, such a projectile falling through the atmosphere at the requisite speed must have been surrounded by the usual luminous tail always accompanying such objects. And that as no meteoric material except nickel-iron and magnetite containing nickel had been found in the vicinity, it was a fair deduction that the surface of such meteorite, if it ever existed, was of nickel-iron, and that the luminous tail in such case must have consisted of atomized particles of incandescent magnetite. Pursuant to this idea a search for this material was made with magnets about the locality, and it was found that its presence was absolutely universal over the whole locality inside the hole and out for as far as observed, somewhat over two miles from the hole. It consists of a blackish-gray rather fine-grained powder, strongly attractable by the magnet, crystalline in structure, but not at all so in shape, being in small torn irregular masses with generally intensely fine grains of silica powder adhering so firmly to its surface as to suggest adhesion while in a state of fusion. Of very rare occurrence among it are absolutely round balls with a fused polished surface like intensely fine shot. These, it is supposed, have had time to solidify in the vacuum behind the flying meteor free from the fierce rush of air that had solidified the usual grain in any shape whatever, and they were enabled thus to assume the usual shape of liquid drops.

With considerable labor enough of these particles were collected for analysis, and they were found to contain nickel in but little less proportion to their iron than found in the irons themselves and in the larger pieces of magnetite. This is not a usual substance and, so far as known, is not a constituent of any of the rocks in the neighborhood of the area anywhere adjacent to the same.

On the Fine Silica Powder under the Base of the Rim.

The meteoric theory of the formation of this hole being thought untenable by some previous investigators and the ordinary volcanic action being absent, there has been invoked, to account for its formation, the theory of a single steam explosion, and in fact this theory has been elaborated so far as to try to imagine a state of stress produced by steam which was set off by the blow of a small falling meteorite, much in the same manner that a percussion cap discharges a gun. This was evolved to account for the simultaneous deposition of the meteoric material and the rim. This has been urged in spite of the fact that during the time that the local heat had been increasing in the wet strata there would have inevitably been hot spring action, and that the same thing would have occurred long after the relief of the explosion, and that the traces of this action would have been but little, if any, less evident than those of ordinary volcanic action and are nevertheless totally absent. Yet there is one fact obvious to all observers to-day, to which the author desires to call attention, which makes any such theory of the explosive formation of the hole utterly impossible. This is the fact that the rim is generally founded upon a more or less deep layer of fine silica powder. There is no doubt that the rock fragments forming the rim were all deposited within a few seconds after the hole was made. The great majority were propelled too short a horizontal distance to have had a long trajectory in the air. Now if they had been propelled by a compressed elastic medium, it is evident that on the explosion these compressed gases would have instantly assumed a much higher velocity than the heavy rock particles to which they were imparting velocity and, sweeping by them, would have carried with them every particle of silica powder which had been made by the crushing and yielding of the strata to the strain, and the rocks of the rim would certainly and necessarily have fallen on the bare upturned stratum which had previously formed the surface of the ground around the edge of the hole. To account for the presence of this silica powder on the theory that the hole was formed by a great projectile requires a short preliminary study as to the yielding of hard, brittle and practically incompressible material before a projectile or other blow or even quiet pressure, for the method is much the same in both cases. Briefly, the way in which such substances yield to either a pressure or blow in excess of their power of resistance is, that a cone of material with an apex angle of about ninety degrees is compressed downward into the solid mass of the material from the point of impact. This cone parts from the overlying material, crushes into powder under the force of the pressure or blow, and this powder being still further compressed transmits the pressure upon it in all directions, somewhat like a fluid, although not equally in all directions. The pressure thus generated in the very substance of the material seeks relief and forces a yielding of the solid material around it, which, of course, occurs along the line of least resistance, and bursts the surface upward and outward into a cone-shaped crater around the point of impact or pressure, the angle of which depends largely upon the nature of the material. With ordinary stone this is usually about thirty degrees, but always must be less than forty-five degrees, which is its limit. This crater-like cone is small at first and remains so for weak impacts or small pressures, but if these are greater the process is continued by the formation of larger cones of compressed powder, deeper in the body of the material, which relieve themselves by bursting up wider craters, until the force of the pressure or impact is no longer able to continue the process and the penetration ceases. Thus the depth of the crater always bears a definite relation to its width, and in large impacts it is found that the crater is always surrounded by a cone of cracked and shattered material, which would have been the next material to be expelled if the energy of the blow had been sufficiently great to accomplish this.

The bearing of this upon the formation of a rim composed in part of fine powder is as follows. The broken rocks and débris that are expelled from the hole get their velocity imparted to them by the push of an inelastic powder behind them and not by a compressed elastic gas, and thus when both rock fragments and powder have progressed far enough to free themselves from the pressure of the penetrating projectile they fly on together, mixed powder and rocks, at the same velocity. This powder is not dust in the ordinary acceptation of the word, as fine powder mixed with a large quantity of air which takes a long time to settle out, but is almost unmixed with air in solid masses, particle to particle, like flour in a barrel, so to speak, which masses obey the laws of projectiles and falling bodies, irrespective of the exceedingly minute particles of which they are formed, and are thus deposited in the rim in mixture with and under and over the solid rock masses which accompanied it in its flight, and as quickly; and the powder having started under the rock masses, there is a strong tendency for considerable amounts to remain under them on the final deposition of the mixed masses of material in the rim of the hole after their expulsion.

The Crushed Sandstone at Its Upper Contact with the Limestone and the Shattered Cliffs around the Hole.

The author desires particularly to call attention to these features of the walls surrounding the hole. It is very distinctly marked. It is unqestionably due to excessive pressure. If this cone and crater are due to any form of volcanic action, it is difficult to see how this crushing occurred. The sandstone is amply strong to carry its over-burden without crushing; in fact before the general erosion of this country it probably carried many hundreds or thousands feet more without crushing and pressure from above or below as equal in its crushing effects. Then suppose pressure to gradually accumulate and the overlying strata to bulge up into the dome of which the present cone is the base; there could be accumulated but little excess of pressure to crush the sandstone during this rise, as it would be as free to go up under the weight of its overlying strata as it was to support them quiescent, for such motion would be very slow. Then comes the giving way and the explosion, and the result to the remaining rock left around the hole is a relief from pressure and not an increase of it. It is difficult under any of these conditions to imagine any force tending to crush this sandstone and shatter the surrounding walls in the manner that they are shown to-day. It is difficult to discuss the steam explosion theory, for the reason that nobody has ever seen one or known with certainty of any such action, except the blowing off of the tops or sides of ordinary volcanoes in activity in this manner, which is as different as possible in its effects from the so-called maars. There are a lot of holes, not very uniform nor congruous among themselves, which, for want of a better explanation of their formation, have been ascribed to this source, and to which class Coon Butte has been assigned by Prof. Gilbert, as the result of his investigations. This crushing of strata and shattering the walls is, however, the direct and obvious result of the blow of a great projectile. There is almost instantaneously generated an overwhelming pressure deep down in the rocks, tending to lift the surrounding strata at 1,000 or more feet per second. The great weight and inertia of these strata oppose an enormous obstacle to this sudden movement, and the crushing strains developed crush up the weakest rock until the necessary yielding and velocity have been imparted to the overlying strata. The shattered cliffs and upraised rim show the rock started from its position and in partial transition from the hole, from which it would have been expelled entirely had the blow been a little harder. In this case, however, another rim of crushed and shattered rocks would have been upraised around the enlarged hole.

Comparison of the Crater with those Produced by Lesser Projectiles.

The craters formed by the impact of various small projectiles, mostly of soft materials and at low velocities, have been studied in connection with the formation shown in this locality by others, notably by Professor Gilbert, and the forms shown to bear a rather close resemblance to the crater of Coon Butte and its rim. Continuing these comparisons, however, to more violent impacts of heavier bodies at higher velocities, a still closer parallel is noticed. The material for such comparisons is furnished by the investigations of the several more advanced military nations upon the effects of the impact of round shot on masonry and solid rock. These investigations were undertaken about sixty to seventy years ago, with the object of ascertaining the best effects of the ordnance of that day in the breaching of walls, etc., in bombardments. The general result was to establish the fact that the impact of the projectile produced a comparatively shallow crater of conical form about five times the diameter of the projectile, terminating in an almost cylindrical hole some one and a half to twice the diameter of the projectile within which the projectile or its wreck was deposited. This hole was surrounded by a cone of broken and shattered material which started at or below the bottom of the cylindrical hole and enveloped the actual cavity. The depth in solid limestone and sandstone, at velocities at which the best cast iron shot would break up, and estimated, from the powder charges used, to be somewhere about 1,800 feet per second, was a fraction under two diameters of the projectile used. The depth was observed to increase much more slowly than the velocity of the shot, and more slowly still after the velocities at which the shot would break up had been attained. The author has observed from direct experiment that the crater still retains its round form even when the impact of the projectile is as far removed from the vertical as twenty degrees; the only noticeable effect being the greater shattering of the side of the crater against which the angle of impact causes the projectile to bear with most pressure in its penetration. These experiments were made with a high power, small-bore rifle, having an initial velocity of about 2,300 feet per second.

Confirmatory Evidence Obtained by Deeper Exploration Inside Crater.

As, in the judgment of the author and Mr. Barringer, the outside indications all agreed with the theory that the crater had been produced by the impact of a great meteor, it was determined to explore the interior for additional confirmation of this fact and also to endeavor to reach the main mass of such meteor. In pursuance of this object five small prospecting shafts have been put down of depths varying from 30 to 200 feet, and also five bore holes from 305 to 1,003 feet in depth. Although none of these has struck the main body of the meteor, ample confirmatory evidence of the theory of the meteoric formation of this hole has been obtained.

Rock in place in the bottom of the hole has been struck, in the opinion of the author, in two places. First, in shaft No. 2, 510 feet from the center of the hole, in a direction fifteen degrees north of east from the said center and at a depth of 147 feet; and secondly, in bore hole No. 5, at a distance of 250 feet southeast of said center, at a depth of 890 feet. The shaft penetrated the rock in place fifty-three feet and the bore hole 113 feet. In the shaft the rock, while undoubtedly in place, had been so crushed and disintegrated that its substance was that of a bed of loose sand. But the planes and marks of stratification were complete and unbroken and showed an upturning of the crushed, previously level strata to an angle of about forty-five degrees in a direction away from a point slightly north of the center of the hole. In other words, this rock in place dipped downward and outward, closely corresponding to the rock exposed in the walls of the crater above, but was much more shattered and disintegrated.

The rock in place, penetrated by the drill hole, could be distinguished only by its hardness, and, of course, its condition could not be examined. In both cases the rock was sedimentary sandstone without any sign of heat action whatever, either volcanic or by the action of hot water.

The general description of the filling material in the deeper portions of the hole is as follows: For a distance of 60 to 100 feet from the present bottom of the crater, about its center, the hole is filled with sedimentary material evidently deposited in the bottom of shallow water. It is stratified horizontally, as though the sediments had been washed down from the surrounding walls, either by successive wet seasons or successive violent rain storms, and has been deposited in approximately level sheets by wave action in shallow water. This stratified material is full of small shells of various kinds, and contains a number of hard level strata a few inches in depth running through it, as though at times the water had disappeared and the sediments had become baked and indurated by exposure to the sun. Around the sides of the crater this sedimentary filling is much shallower, and its bottom is marked by a bed of broken rock talus which extends outward from the edge of the central plain, dipping towards the center at about six or seven degrees. How far this talus extends is unknown, but at 400 feet from the edge of the central plain it is forty-seven feet beneath the surface and about twenty feet thick. In the neighborhood of the center of the hole this sheet of broken rock does not exist over an undetermined area, in which the sedimentary deposit was considerably deeper than around the edges to the depth above noted. Below the sedimentary deposits in this central area, and underneath the talus elsewhere, the crater is filled with powdered rock of an almost impalpable fineness. In some places this is snow-white and contains over 99.5 per cent. silica. Elsewhere it is of a slightly yellowish tinge, and in places is cemented together by redeposited carbonate of lime. Down to 300 feet below the interior plain there is no change in this material. Through it is scattered sparingly fragments, more or less shattered, of the three strata penetrated by the hole, namely, red sandstone, yellow limestone and white sandstone. There is no order of their deposition, but the three materials are mixed indiscriminately. In shaft No. 2, however, at a depth of sixty-seven feet, there is a series of boulders, scattered rather thickly through the powdered silica for about twenty-five feet in depth, in which the natural order of occurrence of the rocks is exactly inverted. That is, fragments of the surface red sandstone are the deepest, above which come fragments of the middle strata of yellow limestone and at the top are situated fragments of the deepest strata of white sandstone. This formation suggests the idea of the surface material, having first received the impact of the meteorite, started first on its aerial flight, followed by the lower materials in turn as they were reached, and retained this order when falling back into the hole as it was being filled up.

In the central portions of the hole, below 300 feet, the proportion of broken and unbroken sand grains among the powdered silica begins to increase perceptibly, and slightly below this point meteoric material, of a character which will be described below, begins to be noticeable. The filling material continues to get coarser and coarser and contains more and more meteoric material with the increasing depth until the 500-foot level is reached. This point is 900 feet below the former level of the rocky plain at this point and about 1,100 feet below the crest of the rim at its highest point. At the 500-foot level there is but little powdered silica; the material is mostly of broken and unbroken sand grains. Below this point the powdered rock is again met with which is very fine. It is almost, but not quite, as fine as at the surface. This change occurs quite suddenly and is accompanied with a progressive scarcity of meteoric material which is completely absent at 550 feet. From this point down there is again a gradual increase in whole and broken sand grains contained in the material, and at 860 feet it changes color quite suddenly to a reddish-brown sand, which at 890 feet, from the sudden change in hardness and the difficulty of drilling, is almost certainly rock in place. This continues to the fartherest point reached, namely, 1,003 feet below the level of the interior plain.

It is submitted that, regardless of the fact of whether or not the last 100 feet is solid rock or not, that the material penetrated for the last 150 feet must be rock in place; for this reason: The change from white sand to reddish-brown sand is quite marked and sudden, and if this material had been stirred up by the passage of any projectile through it, it would have been so mixed as to be indistinguishable, or at any rate would certainly not have had a definite boundary line between the two materials. For 180 feet below the surface of the plain the filling material is absolutely dry. At this point dampness is perceptible, which increases with the depth until at 200 feet the material is nearly saturated with water; which fact determined the stoppage of the shafts at this point and the use of well-drilling apparatus for the deeper explorations.

Meteoric Material Found in the Lower Portions of the Hole.

The meteoric material found, mixed with filling material, in the hole from the 300- to 500-foot levels is of the following kinds: First, magnetite in the form of scales, closely resembling hammer slag produced by a blacksmith in welding and forging iron. These films occur in varying proportions among the sand. Second, of more sparing occurrence are small particles of brownish magnetite, resembling that picked up on the surface. Third, sand grains wholly or partially coated with magnetite and small bunches of sand grains cemented together with magnetite. The first and third forms have undoubtedly solidified from a state of fusion; the first alone, and the latter when the fused magnetite came in contact with one or more grains of the sand. The appearance of this last form under the microscope is precisely that of broken stone smeared with, and cemented together by, such a fused material as asphalt when prepared for the foundation of an asphalt street. Second, silicate of iron in forms exactly duplicating the first and third forms of the magnetite above specified; that is, in films and adhering to sand grains. This material was at first thought to be magnetite on account of its exact similarity in appearance, except that it was of rather a darker color. But it was distinguished from magnetite by observing its almost complete indifference to the magnet. Analysis confirms this fact, and these blackish scales leave a snow-white skeleton of gelatinous silica of the shape and size of the original fragment on prolonged boiling in hydrochloric acid.

It is supposed that this material was formed when the fused magnetite and silica from the powdered rock were mixed together at a heat sufficient to cause combination. Both these forms contain but a very small proportion of nickel, and as they both occur below the water level in the silica it is probable that the greater portion of the nickel has been leached out of them, on account of the greater solubility of the nickel oxide and the extreme fineness of subdivision of the material. Third, there has been found among the filling material in a few localities, but much more sparingly than the magnetite or the silicate of iron, small round globules of metallic iron surrounded by an envelope of magnetite. These small globules range from one-twenty-fifth to one-fiftieth of an inch in diameter. While it is conceivable that silicate of iron and magnetite might occur in the wreck of terrestrial strata of the character found in this locality, it is extremely improbable, because there is no trace of any of this material in the unpulverized rock forming the strata in question. But it is absolutely inconceivable that these little metallic spheres with their coating of magnetite could exist in any sedimentary strata, such as alone occur in this locality. Small particles of terrestrial metallic iron have, as is well known, been found in certain localities, but not in rock of this nature. And they could not have resisted complete oxidation if the original rock in which they were found had been weathered away and its material subsequently formed into sandstone. Moreover, if they had resisted such complete oxidation, the coating which would form around them would be ordinary hydrated sesquioxide of iron and could not be magnetite. And also such metallic iron as has been found in terrestrial strata has always been found in strongly basic rocks. Whereas the rocks in this locality are extremely acid, in fact almost pure silica.

Two other remarkable phenomena have been noted in the water pumped from these bore holes. This water is clear and without taste or odor, but it contains a small amount of flocculent gelatinous silica floating in it. Also in several places, and it was noted that these places were at the levels at which most of the other meteoric material was found, the first water drawn from the hole in the morning, after standing over night, was found to contain a very considerable amount of dingy green protoxide of iron suspended in it, which upon exposure to the air rapidly oxidized and became converted into a reddish-brown hydrated sesquioxide. The only explanation that can be offered for these phenomena is that, probably, the extremely thin films of silicate of iron have had their iron dissolved by long immersion in water containing carbonic acid, leaving their gelatinous silica skeletons suspended in the water, and that the solution of carbonate of iron may later have lost its carbonic acid in some way, possibly by absorption by lime from the limestone strata, and precipitated out of the protoxide of iron which remains in suspension in the water. It has also been noted that from the deeper portions of the hole, below 600 feet, where the meteoric material has not been found, that the sand itself showed a very minute trace of nickel, which has probably come from the leached meteoric material above it.[1]

The Possible Encounter of Larger Meteoric Material.

The small prospecting shafts above referred to were stopped by water at 200 feet before penetrating to levels at which later explorations showed the meteoric material was to be encountered. This stoppage was caused by their small size and their light timbering, which

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[1] Since this article was written, the author has discovered the presence of a small amount of very finely divided metallic iron among the silica. This has been found, so far, in every sample examined, from the north and south rims as well as from the filling of the central plain. It varies in amount, but its proportion is extremely small. The largest amount has been found among the silica from the filling of the crater, where it exists to the proportion of nearly a quarter of an ounce to the ton. From the north and south rims the amount is less in the order stated; from the south rim it does not amount to a twentieth as much as from the interior of the crater.

This metallic iron was detected, separated and estimated as follows: The silica was passed through a magnetic separator and a very small amount of magnetic material of a dark color collected and weighed. A weighed portion of this was carefully ground in an agate mortar, wet and the finely powdered material washed away from time to time until the material was reduced to about one-tenth of its original bulk. In this residue, by the use of a glass, could be observed a great number of bright, white, shining metallic scales and spangles. They were strongly influenced by a magnet. A solution of copper sulphate was then poured over this residue and the bright white spangles were observed to turn dull red-copper color at once. The finer portions were then observed to be indifferent to the magnet, although the larger ones were still attracted. On prolonged treatment all became indifferent to the magnet. The residue was then washed and the copper in it determined, there being none in it before treatment. As a check the iron was determined in the copper sulphate solution used and wash waters, the solution being pure. Distinct traces of nickel were also observed in this material.

rendered them unfit to penetrate strata in which pressure tending to crush them would be encountered. The five bore holes were all put down within a very small area. Their object was to find out how far down this hole extends. This object was attained by the fifth alone. Three of the previous holes were stopped by encountering substances which, although not determined with certainty, were in all probability larger fragments of the great meteor. The first was found in bore hole No. 1 under the following circumstances: This hole had been put down about 300 feet, being four inches in diameter, when the piping stuck, and a two and one-half inch pipe was then put down to 420 feet and there stuck. A one and one-fourth inch pipe had been put down 630 feet and withdrawn owing to a change in drillers. The hole thus remained idle for some ten days. On resuming work it was found to be filled up to about 380 feet, that is to about forty feet above the end of the two and one-half inch casing. When the drilling was resumed the small pipe very rapidly cleared out the casing and the hole below until it arrived at 480 feet, where it encountered an obstacle that could not be penetrated, although the hole had previously been 150 feet deeper. Against this obstacle the drill was kept rotating two days. It was so hard that it was penetrated less than two inches and would dull the drills almost immediately. It was while rotating upon this obstacle that brown magnetite, resembling that found upon the surface, was gotten from the hole and also the greater number of little iron spheres with magnetite coverings. The obstacle proved impossible to penetrate, and it was attempted to remove it by jetting large quantities of water and also dropping the bit upon it as hard as could be done with so small and weak a line of pipe as one and one-fourth inch, and by this means it was after a long time forced down nearly a foot, thus proving that it was a comparatively small object. As it was impossible to get through it or around it, this hole was then abandoned. The one solution of this matter can be that the hole passed very close to a small fragment of meteoric iron or magnetite when it was first put down, and that the subsequent washing of water through the hole had loosened up this object, which subsequently, by the caving of the hole, slid across it and effectually stopped further progress. The next hole, No. 2, was stopped in much the same manner by an obstacle of apparently the same character at 300 feet. This hole was, however, using a four-inch pipe, and on this account and its less depth the object was much more accessible. Much less magnetite and other meteoric material was obtained from this obstacle than from that in No. 1. It wore out the tempered steel drills in the same way. A drill with chisel edge was then put in and the strong and heavy pipe line, weighing about 3,500 pounds, was then dropped on this obstruction a great number of times. It was driven a very small fraction of an inch each time, possibly between two and one-half and three inches in all. The pipe line was dropped about eight feet each time, which was as much as it would stand without collapsing. And each time the drill struck the obstruction it would ring with a clear metallic sound and rebound some eighteen inches to two feet. This was almost certain proof of the metallic nature of the obstacle, as stone would have crushed and given a dead impact without appreciable rebound.

A small magnet of about half pound in weight was then lowered down the hole on the end of a string. This magnet repeatedly attached itself to the sides of the iron casing in going down, so that ample opportunity was offered to feel the pull necessary to detach it from adhering by its own magnetism to a piece of unmagnetized iron. The pipe casing during this trial was lifted some fifteen to twenty feet above the obstruction. When the magnet passed below the end of the pipe casing it descended perfectly free until it reached the bottom, where it attached itself very firmly to whatever object obstructed the hole, and required a pull of several times as much force to detach it as was necessary to detach it from adhering to the pipe casing at nearly the same depth, and consequently with nearly the same weight of line supporting it. This was repeated many times and there was no doubt about the facts as stated. It was then endeavored to get an impression of the bottom of the hole, but suitable material was not at hand and the impression was not very satisfactory, although it seemed to show a flat bottom to the hole with a crack about one and one-fourth inches wide and of unknown depth with roughly parallel edges across the bottom of the hole. This shape was not like anything observed on any of the surface irons, but was less like what might be expected in a rock boulder. This crack caught the drills and made it almost impossible to rotate upon this obstruction. The magnet brought up a small quantity of iron chips, some of which were undoubtedly from the pipe, having been cut from it by the machinery for rotating it, but others seemed of different nature and fracture from either pipe chips or the steel of the drill, which, moreover, had not lost material of this size and shape. They were thought to be meteoric iron. On analysis the mixed metallic iron gave .4 per cent. of nickel. As the greater proportion of this iron was undoubtedly composed of pipe chips, free from nickel, this was thought to be strongly confirmatory of the probability of the fact that the doubtful material was actually meteoric iron.

The pipe was then withdrawn and three sticks of No. 1 dynamite put down into the hole, in contact with this obstruction, and there exploded. This explosion, which would have certainly shattered any boulder small enough to have been driven by the pipe line even in the open air and much more so under 100 feet of water tamping, had no effect whatever upon the obstruction, except to drive it downward about two inches; and when the pipe was put back into the hole and again dropped on the obstruction it still bounced and rang as before. This hole was then abandoned. Hole No. 4 encountered an obstacle of this kind at about 400 feet which threatened to stop the hole. But from the wear of the drills it was suspected that the obstacle did not cut off all of the hole, and it was found that a two and one-half inch pipe would pass this obstruction which had stopped a four-inch pipe, and this hole was continued down to 600 feet where it was lost for other causes. The last hole, No. 5, did not encounter any such obstacle and was the only one which attained the object of all of them, namely, to find if possible the bottom of the hole. This object having been attained and the five prospecting bore holes proving exceedingly tedious and expensive and the results more or less uncertain, it was determined to abandon this method of proceeding and put down a shaft properly equipped for penetrating the wet ground. This has been done to a depth of 180 feet, and further progress now awaits the installation of the machinery.

The author feels that he can announce the following facts as absolutely proved:

First: That at this locality there is a great hole or crater in the earth which corresponds in all respects, except in its gigantic scale, with impact craters formed in rock by projectiles of considerable size moving at considerable velocities.

Second: That in and around this hole and below its bottom to a distance of over 1,400 feet below the present surface of the plain surrounding it, and the original surface of the place where this hole was formed, every indication of either volcanic or hot spring action is positively absent.

Third: That in and about this hole all signs which might be expected of the impact of such a great projectile are present.

Fourth: That upon the surface of the rim and upon the surrounding plain there has been found and still exists a large quantity of meteoric material, and that the distribution of this material is symmetrical with a line passing through the center of this hole.

Fifth: That this meteoric material was deposited at the same instant of time at which the hole was made.

Sixth: That in and around this hole is an enormous quantity of pulverized rock, produced from the strata penetrated by the hole, in a state of subdivision which can be produced by a violent blow, but cannot be produced by forms of natural erosion.

Seventh: That there can have been no form of natural erosion active in this locality which would have produced this material and have collected it and retained it in the position in which found.

Eighth: That meteoric material has been found among the filling material of this hole at a depth of 900 feet below the surface of the original plain, and 500 feet below the present bottom of the crater, and 400 feet below the surface of the material which fell back into the crater at the instant of its formation.

Ninth: That all of the attendant minor phenomena observed can be explained upon the theory of the impact of a great projectile, and none can be satisfactorily explained upon any other theory.

In view of these positively established facts, the author feels that he is justified, under due reserve as to subsequently developed facts, in announcing that the formation at this locality is due to the impact of a meteor of enormous and hitherto unprecedented size.

Date of the Occurrence.

Fortunately there is a means at hand of obtaining a very good idea of the age or rather the extreme recentness of this phenomenon. That is, aside from the evidence of the hole itself and the lack of erosion of the sharp edges of the ejected rocks themselves, and this in a country of desert sand and furious winds, in which all exposed rocks are rounded and sculptured by wind erosion to a marked degree. This evidence comes from a little red sandstone butte some half a mile north of the north edge of the hole. This, as mentioned in the earlier part of this paper, is a portion of what was once the covering rock of this country and which can be seen at a glance to be in process of rapid removal. Now it happens that a jet of the crushed material and broken rock a little more vigorous than most has fallen across this butte, and it can be traced up the near slope and across the top. Then there is an interval of fifty feet or so in the lee of the hill upon which none was deposited owing to its horizontal velocity, and then it begins again on the plain beyond for a few hundred feet until it terminates. Now this deposit up the near or southern side of the butte, in spite of the evidently rapid erosion to which it is subject, lies on the surface right up to the cap, without any red sandstone material having fallen or having been washed down upon it. From its appearance it might have been deposited yesterday. This will give a superior limit of time within which the fall must have occurred from whatever rate may be assigned to the erosion of the red sandstone buttes. The author would name 10,000 years as the utmost possible limit which could be allowed, and feels that this is much too liberal and that something well inside of 5,000 years is much more nearly in accordance with the facts. In fact, so recent is the appearance of everything in this locality that some stunted cedars, growing on the rim and showing year rings of over 700 years of growth, are not without value in placing a minimum limit within which the fall cannot have occurred.

Size of the Meteorite Forming the Hole.

Of this it is extremely difficult to form any idea from data which would stand critical examination. Professor Gilbert put the necessary minimum as the equivalent of a sphere of 750 feet in diameter, and the probable size as equivalent to a sphere of 1,500 feet in diameter. This seems to the author as most excessive. The problem contains too many unknown factors to make calculation much, if any, better than guesswork. The following facts may be considered as having some bearing in assigning a possible maximum size to the projectile. The artillery tables above referred to give a penetration of something less than two diameters in solid limestone rock for shot at about 1,800 feet per second. Now, from the probable absence of meteoric material in the hole below 500 feet, this is assumed as about its limit of penetration. This corresponds to a penetration of about 900 feet of solid rock on the whole considerably softer than limestone, and would therefore correspond to a sphere of considerably less than 450 feet in diameter, if the velocity were not in excess of 1,800 feet per second. Now what this striking velocity was can only be guessed at, although it is absolutely certain that it was in excess of 1,800 feet per second, in all probability many times in excess of this figure; and it must be kept in mind that the energy would increase as the square of the velocity, and that the cubic contents of the hole excavated would vary directly with the energy exerted. Therefore if the velocity was 9,000 feet per second, or five times that quoted above, a sphere of one-twenty-fifth the weight of the above would deliver the same amount of energy and therefore probably make the same sized hole. The original velocity of any such body is reasonably well known from astronomical considerations and it probably struck the atmosphere at between nine and forty-five miles per second, depending upon the direction of its motion in relation to the motion of the earth. We know that this excessive velocity is very soon dissipated in the smaller meteorites and that they strike the earth with a very moderate velocity; but could such a thin layer as the atmosphere deal in the same manner with a large body? The author is of the opinion that it could not, and that this body probably struck with a large part of its planetary velocity, and that it was extremely small in comparison with anything that would be deduced by assuming for it any such striking velocity as has ever been produced in a terrestrial projectile; but as and for the reason set forth above, he does not feel justified from any known data in naming any definite figure in connection therewith.

The Composition of the Meteorite.

The composition of the outer surface, at least, of this meteorite is fairly well known and appears to have been fairly constant. For the great numbers of specimens picked up around the hole, which must have come indiscriminately from all points of the surface, are of fairly constant composition. That is, metallic iron with very small percentages of carbon, sulphur and phosphorus, with between seven and eight per cent. of nickel and a trace of cobalt. This metallic mass carries about three-fourths of an ounce per ton of platinum and iridium.

As to the interior composition of the meteorite, nothing definite can be known. If the body was a fragment the probability is that it was homogeneous throughout, as there is little or no difference between the fragments from all portions of its surface. If, however, the object was a small spheroid its interior might differ considerably from that of its exterior. It seems improbable that the mass contained any notable proportion of stony material, as nothing of this kind has been observed in the fragments around the rim, nor has prolonged and careful microscopic examination of a very large number of samples of the filling material of the hole from all depths shown anything but the broken débris of the strata penetrated, except the above-mentioned meteoric material, which is all either metallic iron or the direct results of its combustion or union of such products of combustion with the surrounding silica. It is, however, to be noted that a small stone meteorite of several pounds in weight, containing metallic iron sparsely scattered through it, was picked up by Mr. Barringer about two miles from the crater. There is, however, excellent reason for the belief that this object was observed to fall during the winter of 1903. In any event, although the iron contains a proportion of nickel somewhat less than that in the fragments of the great meteorite, yet, after careful and repeated examinations, it has been proved that the metals of the platinum group are certainly absent from this material. Now, although it is conceivable that a stony meteorite containing metallic iron might under some circumstances, such as prolonged heating in a reducing atmosphere, acquire a superficial coating of iron, yet it is entirely inconceivable that such a coating, concentrated upon the surface from a stony interior, could contain a definite and constant proportion of metals of the platinum group and yet leave the iron still contained in the mass entirely without any such constituents. Mr. Barringer's account of these unusual formations at Coon Butte immediately precedes this paper.

The following reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

The regular stated meetings of the year, amounting to sixteen, were held, the average attendance being 26. Communications were made by Messrs. Wetherill, Pilsbry, Harshberger, Crawley, Conklin, Skinner, A. E. Brown, A. P. Brown, Phillips, S. Brown, Rhoads, Van Ingen, Stone, Sharp, Lightfoot, Janney, Jennings and Miss Walter.

Forty-five papers were presented for publication as follows: Henry W. Fowler, 6; H. A. Pilsbry and E. G. Vanatta, 5; Clarence B. Moore, 4; J. Percy Moore, 4; James A. G. Rehn, 4; Howard Crawley, 2; H. A. Pilsbry, 2; John W. Harshberger, 2; H. A. Pilsbry and Y. Hirase, 2; Cyrus R. Crosby, 1; James A. G. Rehn and Morgan Hebard, 1; E. Goldsmith, 1; T. H. Montgomery, Jr., 1; Burnett Smith, 1; Mary J. Rathbun, 1; C. Schrottky, 1; Hugo Bilgram, 1; C. S. Sargent, 1; T. Chalkley Palmer, 1; W. Stone, 1; W. Stone and S. N. Rhoads, 1; D. M. Barringer, 1, and Benjamin C. Tilghman, 1.

Four of these, by Clarence B. Moore, constitute the second part of the thirteenth volume of the *Journal*, for which, with its copious illustrations, we are indebted to the author. Of the others, 29 have been published in the current volume of the *Proceedings*, of which two numbers have been issued, and four are in course of publication; three were withdrawn, two were transferred to the Entomological Section, one was returned to the author and two remain to be acted on.

Eight hundred and forty-eight pages of the *Proceedings*, illustrated by 56 plates; 212 pages of the *Journal*, with 244 half-tone text figures and 6 maps; 344 pages and 11 plates of the *Entomological News*, 296 pages and 7 plates of the *Transactions of the American Entomological Society* (Entomological Section of the Academy) and 138 pages and 51 plates of the *Manual of Conchology* have been published.

In January postal card notices were sent to the members of the Academy requesting those who desired to receive the *Proceedings* to signify such desire on a return card. The result was such a decrease in the mailing list that the published edition was reduced to 1,200.

The statistics of distribution are now as follows:

Proceedings, delivered to members,	206
" exchanged,	578
" to subscribers,	43
	827

JOURNAL, exchanged,	72
" to subscribers,	36
	108

The published edition of the *Journal* remains 500.

Ten members and four correspondents have been elected. The deaths of fourteen members and six correspondents have been announced. Seven members have resigned as follows: Julia S. Robins, Ferdinand Philips, Henry Beates, Jr., James K. Clarke, William T. Shoemaker, F. S. Manderson and Ralph W. Seiss.

Mr. Effingham B. Morris was appointed by the Council, October 30, a member of the Committee on Finance, to fill the vacancy caused by the death of General Isaac J. Wistar.

The Hayden Memorial Geological Award was, on the recommendation of the Council and the special committee, unanimously voted to Charles Doolittle Walcott, LL.D., November 7, in recognition of the value of his individual contributions to geological science and the efficiency of his service as Director of the United States Geological Survey. The official notice of the award was duly forwarded to Dr. Walcott, but the substantial token cannot be delivered immediately, as the remodelling of the medal with an improved portrait and design has been confided to a reliable artist who is now engaged upon the work. It is confidently hoped that the result will be much more satisfactory than the medal heretofore conferred.

My thanks are due to those associated with me on the Publication Committee, and especially to the President, for the kindest help and coöperation during a prolonged and trying illness in the spring.

EDWARD J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

By custom and as a result of the plan upon which the Academy is organized, the bulk of its correspondence is now conducted by the several departments directly concerned. The duties of the Corresponding Secretary have been thereby lightened until the correspondence remaining under his charge is nearly limited to formal and routine matters. The most important duty retained by this office is the custody of the records of correspondents. In connection with this an effort is being made to keep in touch with the distinguished scientists whom it has been this Academy's privelege to honor.

Other than through the Hayden Medal, the award of which is restricted both in frequency and field of application, election to corresponding membership is the only dignified means at the disposal of the Academy by which its recognition of scientific eminence can be expressed. It is a most important function of well-established scientific institutions to seek out students who have made discoveries of exceptional merit and to honor and encourage them. But the value of such approval is measured by the care and discrimination with which it is given. If placed indiscriminately upon work of both great and small worth it soon becomes cheapened and degraded to the lower level; but if a high standard be continuously maintained both the giver and the recipient of the honor gain in dignity. In awarding the correspondent's diploma it seems most important that the Academy should keep these principles ever in view, and in no case permit its standard of excellence to be lowered.

During the past year Charles D. Walcott, George T. Moore, John Sterling Kingsley and Harry Fielding Reid were elected correspondents and the first named was awarded the Hayden Medal in gold.

The deaths during the year of the following correspondents were announced from the chair: Alpheus Spring Packard, Alfred Preudhomme de Borre, Henri di Saussure, Victor Raulin, Baron Ferdinand von Richthofen, and Albert von Koelliker.

Eight notices of the death of prominent scientific men were received and acknowledged on behalf of the Academy by suitable letters of sympathy. Congratulatory letters were forwarded to the Entomological Society of Belgium and the Natural History Society of Schleswig-Holstein upon the occasions of the celebration of the fiftieth anniversary of their founding; and to the University of Illinois upon the installation of President Edmund James. From the Sullivant Moss Chapter and the Pennsylvania Society for the Prevention of Tuberculosis were received letters thanking the Academy for the use of rooms in which their meetings were held. Letters of appreciation and thanks for courtesies extended to them were also received from several of the scientific societies which met in Philadelphia during Convocation Week of 1904.

Invitations to the Academy to send delegates were received from the Presidential Installation Committee of the University of Illinois and from three international congresses of learning. The interest of the Academy in the proceedings and its regret at being unable to send delegates were in each case expressed in due form.

Various letters requesting information, the loan of specimens, or the exchange of publications were answered or referred to the proper officers of the Academy.

Following is a summary of the correspondence for the year:

Communications Received.

Acknowledging the Academy's publications,	214
Transmitting publications,	54
Requesting exchanges and the supply of deficiencies,	8
Invitations to learned gatherings,	4
Announcements of death of scientific men,	8
Circulars concerning the administration of scientific institutions, etc.,	15
Photographs of correspondents,	15
Biographies of correspondents,	12
Letters from correspondents,	15
Miscellaneous letters,	35
Total received,	380

Communications Forwarded.

Acknowledging gifts to the Library,	828
Acknowledging gifts to the Museum,	73
Acknowledging photographs and biographies,	17
Requesting the supply of deficiencies in journals,	61
Correspondents' diplomas and notices of election,	9
Letters of sympathy and congratulation,	11
Letters to correspondents,	39
Miscellaneous letters,	46
Copies of Annual Reports,	243
Total forwarded,	1,327

Respectfully submitted,

J. Percy Moore,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The additions to the Library of the Academy for the year ending November 30, 1905, amount to 5,956 pamphlets and parts of periodicals, 849 volumes, 235 maps and 44 photographs and sheets, making a total of 7,084. They were received from the following sources:

Societies, Museums, etc.	2,586
I. V. Williamson Fund	1,793
Editors	760
United States Department of Agriculture	739
General Fund	329
United States Department of the Interior (U. S. Geological Survey)	254
Authors	118

J. A. Meigs Fund	90
Wilson Fund	70
Comité Géologique Russe	21
Sveriges Geologiska Undersokning	18
Dr. S. Solis Cohen	17
Pennsylvania Department of Agriculture	17
United States Department of Commerce and Labor	15
Clarence B. Moore	15
United States War Department	13
Cape of Good Hope Department of Agriculture	13
Edward Potts	13
Ministère des Travaux Publics, France	12
Geological Survey of New Jersey	12
Paul Hagemans	10
H. A. Pilsbry	9
Ministerio de Fomento, Peru	9
Dr. H. C. Chapman	9
Imperial Geological Survey, Japan	8
Department of the Interior, Canada	7
Ethelbert Watts	7
John Corbin	7
Geological Survey of India	6
Dr. S. G. Dixon	6
Library of Congress	5
Department of Mines (Geological Survey), New South Wales	5
Biuroului Geologicu, Roumania	5
Bureau of American Ethnology	4
Philippine Weather Bureau	4
Connecticut Geological and Nat. Hist. Survey	4
United States Fish Commission	3
Illinois State Bureau of Labor	3
Geological and Nat. Hist. Survey, Canada	3
Albert I, of Monaco	3
Department of Mines, Victoria	3
Instituto Geologico, Mexico	3
Commission de la Travaux Géologique, Portugal	3
Direccion General de Estadistica, Argentine Republic	3
Compañia Sud-Americana de Billets de Banco	3
Maryland Geological Survey	2
Botanical Survey of India	2
Geological Survey of Michigan	2
Fish, Forest and Game Commission, New York	2
Geological Survey of Georgia	2
Publication Committee of Academy	2
Bureau of Geology and Mines, Missouri	2
Ethnological Survey, Philippines	2
Pennsylvania State Board of Health	2
Government of India	2
United States Coast and Geodetic Survey	1
Alabama Geological Survey	1
Department of Public Gardens, etc., Jamaica	1
Ames Botanical Laboratory	1
United States Public Health and Marine Hospital Service	1
Mrs. A. M. Smith	1
Missouri World's Fair Commission	1
James A. G. Rehn	1
Board of Scientific Advice, India	1
Commissioners of Inland Fisheries, Massachusetts	1
Congrès Intern. de Nomenclature Botanique, Vienne	1
Kommission zur wissen. Untersuchungen der Deutschen Meere in Kiel	1
William H. Rau	1
Council of the Fridtjof Nansen Fund for the Advancement of Science	1
Henry L. Viereck	1
Department of Mines, West Australia	1
State Commissioner of Fisheries, Pennsylvania	1
Department of Geology and Natural History, Indiana	1

Commission Géologique de Finlande	1	Ornithology	1
United States Census Office	1	Martin I. J. Griffin	1
C. F. Taylor	1	Dr. Thomas Biddle	1
Arthur E. Brown	1	Iowa Geological Survey	1
Hungarian Central Office for		Danish Government	1

They have been distributed to the several departments of the Library as follows:

Journals	4,758	Bibliography	32
Agriculture	842	Encyclopedias	25
Geology	269	Ornithology	24
Geography	251	Ichthyology	21
Botany	234	Mammalogy	19
General Natural History	176	Mineralogy	18
Voyages and Travels	99	Chemistry	17
Entomology	64	Helminthology	13
Anthropology	63	Medicine	10
Physical Science	46	Mathematics	5
Anatomy and Physiology	40	Herpetology	2
Conchology	35	Miscellaneous	21

Sixteen hundred and ninety-seven volumes have been bound, and an additional 204 are now in the hands of the binders. This work places the library in a better condition than it has ever been before, although there still remain a large number of unbound volumes in the Section of Transactions and Periodicals. It is hoped that most of these will receive attention during the coming year. In connection with the binding constant effort is made, in many cases with gratifying success, to complete imperfect volumes and sets.

A shelf-list of the Transactions and Periodicals, the necessity of which was referred to in my last report and which, when finished, will complete this form of record of the contents of the library, has progressed as rapidly as the very limited clerical assistance available will permit. No losses have been ascertained during the past year.

The necessity for more room in some of the departments is pressing. As a temporary relief shelves have been placed on some of the cases, but this arrangement is very undesirable, as the books can only be reached with the aid of a ladder. It is hoped that some means of providing for growth, which will avoid the inconvenience of high shelves without an undue disturbance of the present arrangement of the books, may be adopted by the Library Committee.

It is scarcely necessary to say that the card catalogue is kept up to date, the smallest pamphlets, even when they are excerpts from journals already in the possession of the Academy, being promptly recorded.

Dr. Sharp reports that 64 slides have been purchased and that Dr. H. A. Pilsbry has presented 14, making the number of slides in the collection 1,447. The Schaeffer collection of some 2,000 slides have not yet been catalogued. It is hoped that this will be done during the coming spring.

It gives me pleasure to acknowledge my obligation to my assistant, William J. Fox, for efficient service, both in the Library and in the issue and distribution of the Academy's publications, during my attendance at the meeting of the American Library Association in Portland, Oregon, and earlier in the year during a prolonged and, for a time, critical illness.

Edward J. Nolan,
Librarian.

REPORT OF THE CURATORS.

The collections in the care of the Curators are in excellent condition, and during the year just passed much progress has been made in their study and arrangement.

Repairs have been made to the heating plant and to the roofs, while an appropriation of $20,000 from the State Legislature during the last regular session has made it possible to take preliminary steps toward several important improvements to the building, to be carried out early in the coming year, comprising chiefly an entirely new roof for the older building.

A telephone system connecting the different offices and departments has been installed.

Six new exhibition cases, uniform with those previously provided, and furnishing in all 500 square feet of exhibition space, have been erected for the display of the mounted mammals and birds, Mr. Clarence B. Moore has added another handsome case to accommodate the recent accessions to his archæological collections.

A number of wooden storage cases with panel doors have been procured for skins of large mammals and birds and a similar series of smaller cases for mollusks. Many air-tight tin cases have also been provided for storage of small birds and insects, as well as 245 Schmitt insect boxes.

During the year Mr. Clarence B. Moore has continued his investigations of the Indian mounds of the Gulf States and has added a number of valuable and unique specimens to his collection. Foremost among these is a remarkably beautiful stone vessel, bearing a representation of a duck's head rising from the rim, which was discovered near Moundville, Ala.

Early in the year Mr. Samuel N. Rhoads was sent out in the interests of the Academy to explore the lower Colorado river and adjacent parts of Lower California, Owing to unprecedented floods in the region the expedition was not so successful as had been expected, but a valuable collection of birds and mammals was secured.

Dr. Henry Skinner spent the greater part of the summer in the Huachuca Mountains of southern Arizona collecting for the Museum, and brought back a series of 2,500 insects of exceptional interest as well as a number of valuable reptiles and mollusks.

Through the liberality of Mr. Morgan Hebard, Mr. J. A. G. Rehn was enabled to accompany him on a trip through central Florida collecting Orthoptera, half of the entire series of 4,000 specimens becoming the property of the Academy.

Mr. Stewardson Brown, through an arrangement with the New York Botanic Garden, was also enabled to visit Bermuda with the Director, Dr. N. L. Britton, and a full series of their joint collection, probably the best yet made on the island, has been added to the Academy's Herbarium.

Among the additions to the Museum during the year especial mention must be made of a notable series of about 500 birds from British East Africa, collected by Mr. George L. Harrison, Jr., and deposited in the Academy.

A collection of marine animals on the Florida coast by Mr. George Wood, a series of reptiles obtained for the Academy in Kansas by Mr. C. T. Sands, and a valuable collection of mollusks procured in eastern Cuba by Dr. H. M. Hiller, were also added to the collections.

Detailed accounts of the year's work in several departments are appended. In addition to these, the task of attaching tin tags bearing the catalogue numbers to the entire series of reptiles and batrachians has been completed by Messrs. Rehn and Lorrilliere. The smaller mammalian skulls have also been labelled and systematically arranged, while a rearrangement of a large part of the study series of mammal skins has been effected.

Mr. Fowler has continued the identification and arrangement of the fishes, besides making large collections of local species. Dr. J. Percy Moore has continued his study and care of the Helminthological collection, and Miss H. N. Wardle has made progress in the cataloguing of the archæological material.

A number of mammals received from the Zoological Society of Philadelphia have been mounted or prepared as study specimens in the Taxidermical department, notable among the former being a bull American Bison, a Wild Boar and a Bubaline Antelope.

Besides the services rendered by the Museum staff and the students of the Jessup Fund, the Curators are indebted to Dr. P. P. Calvert, Messrs. Erich Daecke, H. W. Wenzel, H. L. Viereck and E. T. Cresson, Jr., for aid in the Entomological department, and Mr. S. S. Van Pelt in the Herbarium.

The Anti-Tuberculosis Society, Philadelphia Botanical Club, Delaware Valley Ornithological Club and the Entomological Club of the American Association for the Advancement of Science have held meetings at the Academy during the year. At the time of the meeting of the latter body in Philadelphia a general meeting of entomologists was held at the Academy with a view to forming a national organization, and a reception was given by the Botanical Section to the visiting botanists.

The collections have been constantly studied by visiting specialists, and during the year material has been loaned to Walter K. Fisher, E. L. Morris, Miss H. Richardson, Carlton R. Ball, Paul Bartch, C. V. Piper, E. W. Nelson, F. C. Paulmier, W. H. Osgood, E. B. Williamson, H. F. Osborn, R. L. Ditmars, H. L. Clark, F. C. Baker, H. C. Oberholser, G. S. Miller and A. Ortmann.

SAMUEL G. DIXON,
Curator.

REPORT OF THE SPECIAL CURATOR OF THE DEPARTMENT OF MOLLUSCA.

The collections of mollusca remain in good order, through from the crowded condition of the department the specimens of some groups are not as accessible as we would desire. The installation of a series of storage cases has given room for a rearrangement of the fresh-water mussels, which have been reclassified in accordance with Mr. Simpson's recent synopis of the group, and now occupy about 850 square feet of space. Several extensive families of small land snails have been removed from the exhibition series and rearranged in storage cases, leaving merely a few typical species to represent them in the public exhibit. The series of American land snails, rearranged and expanded, is in storage cases, occupying about 600 square feet. The rapid growth of the collection has continued. Mr. Y. Hirase, of Kyoto, has continued his sendings of Japanese mollusca, comprising many new forms.

We have also been favored with a set of duplicates of Japanese fresh-water bivalves from the Imperial Museum at Tokyo.

The study of the mollusca collected by Mr. J. H. Ferriss and the Curator in the Southwestern expedition of 1903 has now been completed and a full report thereon prepared. The collections made in the Southwest by Dr. H. Skinner, T. D. A. Cockerell, Joshua and Albert Baily and others have been included in this report.

A series of Alabama mollusks, supplementing that obtained last year, has been purchased from the veteran collector, H. H. Smith.

Numerous members of the Academy and correspondents of the Curator have also contributed largely to the collection. A list of these gifts is given in the Accessions to the Museum.

Seventeen papers, based chiefly upon new material, have been published during the year by the Special and Assistant Curators of the department.

All of the Pliocene invertebrate fossils in our possession have been gathered together and installed in two large cases in the gallery formerly occupied by birds.

A large part of the Special Curator's time has been occupied with the preparation and publication of the *Manual of Conchology*, in which the family *Achatinidæ* is dealt with.

Mr. E. G. Vanatta has continued his efficient work as assistant in the department throughout the year.

H. A. Pilsbry,
Special Curator.

REPORTS OF THE SECTIONS.

The Mineralogical and Geological Section.

The Section has this year with increased zeal and yet better results continued its meetings and field excursions.

There have been nine meetings, with an average attendance of over 14. Communications were made by Dr. Florence Bascom, on the Piedmont belt of Pennsylvania, and on the crystalline rocks of the Coatesville and Phœnixville Quadrangle; by Mr. Gilbert Van Ingen, on fossils of southwestern Arkansas (illustrated by lantern slides); by Mr. S. H. Hamilton, on moulders' sands; by Mr. F. Lynwood Garrison, on Santo Domingo (illustrated by lantern slides); by Miss Mary S. Holmes, on asphaltum in California; by Dr. Benjamin L. Miller, on the geology of eastern Virginia; by Mr. T. G. Ridpath, on deep wells near Philadelphia; and a dozen shorter communications with various discussions.

There were 6 field excursions, with an average attendance of about 33. The parties visited: 1. Upper Cretaceous beds within a dozen miles southeast of Camden, N. J.; 2. Crystalline rocks and their minerals near the southern edge of Delaware County; 3. Portions of the New Red Gwynedd Shales and Norristown Shales, also Hudson River Shales, all in Bucks County, near Chalfont, Doylestown and Grenoble; 4. Portions of the New Red Norristown Shales and No. 11 Limestone in Buckingham Township, Bucks County; 5. Portions of the New Red Norristown Shales, Perkasie Shales, Pottstown Shales and trap near Lambertville, N. J.; 6. Some mineral places in the crystalline rocks near West Chester.

At the time of the Buckingham excursion some exceptionally interesting fossil saurian bones were found in a hole dug at the expense of the Section, under the guidance of Mr. John S. Ash, of Holicong, and on his land. The Section has had the digging continued. Mr. William J. Sinclair, of Princeton, has kindly undertaken the study of the bones, and later on will report upon them to the Academy.

The membership of the Section has increased by four—two members and two contributors.

The following officers of the Section have been elected for the year 1906:

Director,	Benjamin Smith Lyman.
Vice-Director,	George Vaux, Jr.
Recorder and Secretary,	Miss Mary S. Holmes.
Treasurer,	Miss Emma Walter.
Conservator,	Frank J. Keeley.

Respectfully submitted by order of the Section,

BENJ. SMITH LYMAN,

Director.

THE BIOLOGICAL AND MICROSCOPICAL SECTION.

The Section held its usual monthly meetings with an increased attendance and has also met on several occasions for informal discussion. The members present have offered numerous specimens, both mounted and unmounted, for exhibition, and several addresses have been made, among which may be mentioned the following:

Fisheries of the Dogger Bank, by Dr. Benjamin Sharp; Micro-Chemical

Analysis, by Dr. Henry Leffmann; Urinary Analysis, by Dr. Thomas S. Stewart; The Abbé Theory of Microscopic Vision, by Mr. F. J. Keeley.

The Conservator reports, as an important addition to the collection during the past year, a microscope which had belonged to Dr. Samuel G. Morton, presented by Mrs. Thomas H. Montgomery. This instrument, made by W. & S. Jones, of London, is of a type originating in the latter part of the eighteenth century and not previously represented in the Academy. Two Beck Star microscopes with objectives were purchased, and a portrait of Dr. Abbé was presented by Mr. F. J. Keeley.

The following officers were elected for the year 1906:

Director,	J. Cheston Morris, M.D.
Vice-Director,	T. Chalkley Palmer.
Treasurer,	Thomas S. Stewart, M.D.
Recorder,	Charles S. Boyer.
Conservator,	F. J. Keeley.
Corresponding Secretary,	S. L. Schumo.

Charles S. Boyer,
Recorder.

The Entomological Section.

The usuall ten monthly meetings have been held since the last report, with an average attendance of twelve persons.

Verbal communications have been made by nearly all the members and associates of the Section. These have been permanently put on record in the *Entomological News*.

This journal has been continued and Volume XVI completed with 344 pages and 11 plates. Five tin cases and 40 boxes have been purchased to care for the additions and for better and safer housing of the collections in general.

The Conservator spent five weeks collecting in the Huachuca Mountains, Cochise County, Arizona, and brought back 3,000 specimens, a number being new to science and many new to our cabinets. The larger part of these have been incorporated into the collections of the different orders of insects. Mr. G. C. Davis presented his valuable collection of Ichneumonoidea, containing 3,617 specimens, including his types. The entire additions during the year numbered 12,935 specimens.

The collections are in an excellent state of preservation, largely brought about by improvements in cases and boxes. The Conservator gratefully acknowledges assistance from Dr. P. P. Calvert, Mr. J. A. G. Rehn, Mr. E. T. Cresson, Jr., and Mr. Henry L. Viereck. One member and three associates have been elected during the year.

At a meeting held December 28, 1905, the following persons were elected officers for the ensuing year:

Director, ...	Philip Laurent.
Vice-Director, ...	H. W. Wenzel.
Treasurer, ...	E. T. Cresson.
Recorder, ...	Henry Skinner, M.D.
Secretary, ...	Frank Haimbach.
Conservator, ...	Henry Skinner, M.D.
Publication Committee, . . .	James H. Ridings, C. W. Johnson.

Henry Skinner,
Recorder.

The Botanical Section.

The Botanical Section reports the collections at present to be in excellent condition, the Conservator having devoted most of his time to mounting and distributing the accumulation of material which has been on hand for some years. Progress has been made in the mounting of the Short Herbarium, and the MacElwee plants have been in large part mounted and are ready for cataloguing and distribution. It is expected that this work will be completed early in the coming year.

The additions to the Herbarium during the year consist of 4,850 sheets and, while not so large numerically as those of the year previous, contain many specimens not formerly represented in the collections.

Contributions have been received from Messrs. Charles S. Williamson, George Hartnell, Dr. John W. Harshberger, Benjamin H. Smith, Samuel S. Van Pelt, E. G. Vanatta, Joseph Crawford, Witmer Stone, the Conservator, and others, with exchanges from the New York Botanical Gardens and the United States Department of Agriculture.

The Academy's expedition to Fulton County, Pa., in June, added 94 sheets of plants from that region; and the exploration of Bermuda, under the joint auspices of the Academy and the New York Botanical Garden, brought back probably the most comprehensive collection of vascular plants ever taken from the islands, consisting of more than 400 numbers and 4,000 individual specimens, to be divided between the two institutions. This will make a very valuable addition to the Herbarium, as the flora of that group of islands was previously represented by only a small collection made by Mr. Witmer Stone in 1888.

These plants, now being studied in the Academy's Herbarium, will contribute much to our knowledge of that flora, by adding many species to the already published lists as well as eliminating a number erroneously recorded through incorrect determinations.

The Academy has purchased a collection of 100 specimens of Utah plants from Mr. W. A. Garrett, and the Botanical Section a set of Dr. Charles H. Shaw's British Columbia plants, Pringle's Mexican collections for 1903 and 1904 and Heller's California collections for the present year. The greater number of these have been mounted and distributed through the Herbarium.

The Philadelphia Botanical Club has added to the local Herbarium 325 sheets. It has held its meetings in the Herbarium during the year. As a further mark of activity it has just published a book on the local flora entitled *Handbook of the Flora of Philadelphia and Vicinity*, which should prove to be particularly valuable to students, and act as a stimulus to the further study of the plants of the region.

The year has been notable for the number of visitors to the Herbarium. The meeting of the American Association for the Advancement of Science, held in Philadelphia during Christmas week, brought together a number of the most eminent botanists of the country, many of these paying their first visit to our Herbarium and spending much time there during the session.

An informal reception, tendered by the Botanical Section and Philadelphia Botanical Club on the evening of December 29, proved a pleasant occasion, more than fifty of the visiting botanists attending.

On the afternoon of December 31 the Sullivant Moss Chapter held its meeting in the Herbarium, most of its members for the first time having the opportunity of examining the collections of Muhlenberg, Sullivant and others contained in the Herbarium. This occasion brought together many of the most eminent students of the mosses and hepatics.

During the year many other visiting botanists have availed themselves of the opportunity for study offered in the Herbarium and Library, and specimens have been loaned for study to Messrs. E. L. Morris, Carlton R. Ball and C. V. Piper. Assistance has been rendered by the Conservator to students and others in determining plants and giving other information.

At the annual meeting of the Section the following were elected as the officers to serve the coming year:

Director,	Benjamin H. Smith.
Vice-Director,	Joseph Crawford.
Recorder,	Charles S. Williamson.
Treasurer and Conservator,	Stewardson Brown.

Respectfully submitted,

Stewardson Brown,

Conservator.

The Ornithological Section.

During the past year the Conservator has devoted his attention mainly to a rearrangement of the study collection of bird skins which had become overcrowded through the large accessions of the past two years.

Ten additional moth-proof cases have been procured, which have permitted a thorough rearrangement of most of the Passeres and Picariæ, and the necessary relabelling of the trays has been completed.

A large number of recently acquired specimens, temporarily arranged in wooden cases, have been interpolated in their proper places and catalogued.

But little progress was made in the transfer of the mounted collection to its new quarters, owing to the fact that the new cases were not completed until the close of the year; but with those now available and others in the course of erection, the transfer of the remaining specimens should be practically completed during the coming year.

Among the important accessions during the past year are the series of 500 birds from British East Africa deposited by Mr. George L. Harrison, Jr., and the collection of Lower Californian birds obtained by the Rhoads expedition, upon each of which the Conservator has prepared a report for the Academy's *Proceedings*.

A large number of the African birds were entirely new to our collection, many of them having been discovered during the past decade.

Another accession of note was a series of winter birds from South Carolina and of breeding specimens from New Hampshire, received from Mr. Nathan Clifford Brown, the specimens being exquisitely prepared in his well-known manner.

The Delaware Valley Ornithological Club has added several specimens to its collection of local birds, including a section of tree trunk showing the work of the Pileated Woodpecker. The transfer of a part of this collection to the two new cases provided last year adds greatly to its attractiveness as well as to its safety.

The Club has continued to hold its meetings at the Academy with mutual benefit, and a number of visiting ornithologists have made use of the collections.

Mr. Paul Lorrilliere has rendered valuable assistance during the year in the care of the collections.

At the annual meeting of the Section the following officers were elected:

Director, ...	Spencer Trotter, M.D.
Vice-Director, ...	George Spencer Morris.
Secretary, ...	William A. Shryock.
Recorder, ...	Stewardson Brown.
Treasurer and Conservator, . .	Witmer Stone.

WITMER STONE,
Conservator.

The annual election of Officers, Councillors and Members of the Committee on Accounts to serve during 1906 was held with the following result:

PRESIDENT, ...	Samuel G. Dixon, M.D.
VICE-PRESIDENTS, ...	Arthur Erwin Brown, Edwin G. Conklin, Ph.D.
RECORDING SECRETARY, . . .	Edward J. Nolan, M.D.
CORRESPONDING SECRETARY, . .	J. Percy Moore, Ph.D.
TREASURER, ...	George Vaux, Jr.
LIBRARIAN, ...	Edward J. Nolan, M.D.
CURATORS, ...	Arthur Erwin Brown, Samuel G. Dixon, M.D., Henry A. Pilsbry, Sc.D., William S. Vaux, Jr.
COUNCILLORS TO SERVE THREE YEARS,	Thomas A. Robinson, Charles B. Penrose, M.D., Charles Morris, Benjamin Sharp, M.D.

Committee on Accounts, . . .	Charles Morris, Samuel N. Rhoads, Dr. C. Newlin Peirce, John G. Rothermell, Howard Crawley.
Councillor to serve an unexpired term of two years, . . .	Horatio C. Wood, M.D.

COUNCIL FOR 1906.

Ex-officio.—Samuel G. Dixon, M.D., Edwin G. Conklin, Ph.D., Arthur Erwin Brown, Edward J. Nolan, M.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., and William S. Vaux, Jr.

To serve Three Years.—Thomas A. Robinson, Chas. B. Penrose, M.D., Charles Morris, Benjamin Sharp, M.D.

To serve Two Years.—Thomas Fenton, M.D., Edwin S. Dixon, John Cadwalader, Horatio C. Wood, M.D.

To serve One Year.—Dr. C. Newlin Peirce, Philip P. Calvert, Ph.D Thomas Biddle, M.D., and Frederick Prime.

Curator of Mollusca, . . .	Henry A. Pilsbry, Ph.D.
Assistant Librarian, . . .	William J. Fox.
Assistants to Curators, . . .	Witmer Stone, Henry Skinner, M.D., Stewardson Brown, J. Percy Moore, Ph.D., Edward G. Vanatta, Henry W. Fowler, J. A. G. Rehn, H. Newell Wardle.
Taxidermist, ...	David McCadden.
Jessup Fund Students, . . .	H. Newell Wardle, J. A. G. Rehn, Francis Pennell.
Janitors, ...	Charles Clappier, Daniel Heckler, James Tague, Jacob Aebley.

ELECTIONS DURING 1905.

MEMBERS.

January 17.—Howard DeHoney, M.D., A. Sidney Carpenter, Courtland Y. White, M.D.

February 21.—Samuel S. Van Pelt.

March 21.—Arthur H. Fisher.

April 18.—Robert D. Carson, Edward C. Knight.

October 17.—Rev. J. A. Tomlinson, Ezra T. Cresson, Jr.

November 21.—C. H. Smyth, Jr.

CORRESPONDENTS.

April 18.—George T. Moore, Ph.D., John Stirling Kingsley, Charles D. Walcott, LL.D.

May 16.—Harry Fielding Reid.

ADDITIONS TO MUSEUM.

ARCHÆOLOGY.

DR. E. A. PALMER. Stone spearhead, Florida.

MRS. CHARLES SCHAEFFER. Beaded shoulder straps, made and worn by the Athabascans of Great Slave Lake, Canada, and tobacco pouch, bead and porcupine quill embroidery, made by the Athabascans of Great Slave Lake, Canada.

LEWIS ALLAN WRIGHT. Model of snowshoes, made by the Iroquois of Canada.

CLARENCE B. MOORE. Many valuable additions to his collection of Indian antiquities from the mounds of the Southern States.

ARTHUR WILLCOX. Collection of Indian implements and bones, Brunswick county, Virginia.

MAMMALS.

OTTO BEHR. Least Weasel (*Putorius cicognani*), Sullivan county, Pennsylvania, and two Wild Cats (*Lynx ruffus*), Sullivan county, Pennsylvania, mounted.

DR. P. P. CALVERT. Two Brown Bats, Philadelphia.

MRS. THOMAS R. HILL. Red Bat (*Lasiurus borealis*).

GEORGE M. KERR. Skull of Buffalo (*Bison bison*).

PAUL L. LORRILLIERE. Skull of Skunk and skin of Red Squirrel (*Sciurus hudsonicus*).

PURCHASED. Skunk (*Mephitis putida*), Delaware county, Pennsylvania; Philippine Buffalo *Anoa;* skin of Blue Glacier Bear (*Ursus dalli*) with skull, "Mt. St. Elias"; nine mammal skins, Circle, Wyoming.

F. L. and J. A. G. REHN. *Putorius noveboracensis*, Huntingdon county, Pennsylvania.

S. N. RHOADS EXPEDITION TO LOWER CALIFORNIA. One hundred and seventeen mammal skins.

S. N. RHOADS. *Oryzomys palustris*, Cumberland county,]New Jersey.

C. F. SANDS. *Spermophilus tridecemlineatus*. Kansas.

CURWEN STODDARDT, JR. Japanese Lap Dog, mounted in taxidermical department.

JOSEPH WILLCOX. Four mammalian skulls, Kissimmee River, Florida.

DR. H. C. WOOD. Skull of Virginia Deer (*Odocoileus virginianus*), South Carolina.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared as follows: Mounted: Wild Boar (*Sus scrofa*), Bridled Wallaby (*Onychogale frenata*), Red-faced Spider Monkey (*Ateles paniscus*), Bubaline Antelope (*Bubalis buselaphus*), Pig-tailed Macaque (*Macacus nemestrinus*). To be mounted: Azara's Capuchin (*Cebus azaræ*), Japanese Macaque (*Macacus*), Nilgiri Langur (*Semnopithecus johni*), Anoa (*Anoa depressicornis*). Skin and skull: Mexican Deer (*Odocoileus* sp.), Yellow-rumped Aguti (*Dasyprocta agouti*), Wood Brocket (*Mazama rufa*), Corsac Fox (*Canis corsac*), Doguera Baboon (*Papio doguera*), Burmese Civet (*Virera megaspila*), Taira (*Galera barbara*), Moor Macaque (*Macacus maurus*), Black-footed Ferret (*Putorius nigripes*), Bridled Weasel (*Putorius frenatus*), Little Striped Skunk (*Spilogala ringens*). For skeletons: Bison (*Bison bison*), Kangaroo (*Macropus robustus*), Tiger (*Felis tigris*). Skull: Lion-tailed Macaque (*Macacus leoninus*).

Birds.

Mrs. Alexander. Small collection of mounted birds.

Edward Allen. Yellow-billed Cuckoo (*Coccygus americanus*).

Nathan C. Brown. One hundred and twenty-four bird skins from Camden, South Carolina, and sixty-one from New Hampshire.

Henry G. Bryant. Red-tailed Hawk.

R. D. Carson. Rose-breasted Grosbeak (*Zamelodia ludoviciana*).

H. Walker Hand. Corn Crake (*Crex crex*), Cape May, New Jersey.

George L. Harrison, Jr. (*on deposit*). Four hundred and eighty skins of African birds.

Theodore L. Harrison. Baikal Teal (*Nettion formosum*).

Dr. W. E. Hughes. Skin of Blue Heron (*Ardea herodias*), Salem, New Jersey, and Hybrid Duck.

W. W. Justice, Jr. Six skins of sea birds, Broadwater, Virginia.

S. N. Rhoads Expedition to Lower California. Two-hundred and fifty-eight bird skins.

Mrs. Charles Schaeffer. Four skins of *Loxia leucoptera* and one *Colymbus holboelli*.

E. A. Smythe. Alcoholic carcass of *Æstrelata hasitata*, Virginia.

R. R. Tafel. Collection of bird eggs, including one of the Ivory Gull (*Pagophila alba*), Franz Josef Land.

Dr. H. R. Wharton. Female Gadwall (*Chaulelasmus streperus*), Salem, New Jersey.

George B. Wood. Skeleton of Brown Pelican (*P. fuscus*), Palm Beach, Florida.

Dr. H. C. Wood. Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*).

Robert T. Young. Nine bird skins, Boulder, Colorado.

Witmer Stone. Harlequin Duck (*Histrionicus histrionicus*).

Delaware Valley Ornithological Club. Several birds and nests for local collection, and section of tree trunk showing work of Pileated Woodpecker.

Zoological Society of Philadelphia. *Archibuteo lagopus sanctijohannis*, *Falco sparveroides*, *Serinus canaria*, *Cyanops canniceps*, *Estrilda vinacea*, *Uroloncha leucogastroides*, *Pteroglossus aracari*, and *Ganga Cockatoo*.

Reptiles and Batrachians.

Jacob Aeblay. Three specimens of Bufo and Hyla.

Stewardson Brown. Two Toads, Bermuda

Otto Eggeling. Two specimens of *Pseudobranchus striatus*.

H. W. Fowler. Water Snake and several Frogs, Collingdale, Delaware county, Pennsylvania.

H. W. Fowler and B. W. Griffiths. Several Batrachians, Montgomery county, Pennsylvania.

H. W. Fowler and T. D. Keim. Series of Frogs and Turtles from May's Landing, New Jersey, including a number of *Rana virgatipes*. Small collection of Reptiles and Batrachians, Nottingham, Chester county, Pennsylvania, and Cecil county, Maryland.

S. H. Hamilton. One Toad, Trenton, New Jersey.

Charles S. Hart. Stuffed specimen of Cobra from Ceylon.

C. J. Hunt and P. Lorrilliere. Fourteen Reptiles and Batrachians, Pine Barrens of New Jersey.

Dr. W. E. Hughes. Copperhead (*Agkistrodon contortrix*), Fulton county, Pennsylvania.

Paul L. Lorrilliere. Garter Snake (*Eutaenia sirtalis*) and Black Snake (*Zamenis constrictor*), Delaware county, Pennsylvania.

Dr. S. A. S. and D. G. Metheny. Four jars of Snakes and Lizards, Taurus Mountains, Asia Minor.

F. L. and J. A. G. Rehn. Collection of Reptiles and Batrachians, Huntingdon county, Pennsylvania.

S. N. Rhoads Expedition to Lower California. A small collection of Reptiles.

Andreas Rusnac. Two *Bufo vulgaris*, Hungary.

C. T. Sands. Collection of Reptiles, Peabody, Kansas.

Dr. H. Skinner. Sixteen species of Reptiles, Huachuca Mountains, Arizona.

Witmer Stone. Frogs, Fulton county, Pennsylvania.

E. G. Vanatta. Several Frogs and Snakes, Chestertown, Maryland.

H. T. Wolf. Large series of *Diemyctilus viridiscens*, Pike county, Pennsylvania.

George B. Wood. Two Snakes, Palm Beach, Florida.

Zoological Society of Philadelphia. Black Iguana (*M. cornuta*).

Fishes.

Jacob Aebley. Three Sunfish, Philadelphia.

Dr. A. P. Brown. Lamprey (*Petromyzon marinus*), Sewell, New Jersey.

Stewardson Brown. Collection of Fishes, Bermuda.

Dr. S. G. Dixon. Jar of Black-nosed Dace, Cranberry, North Carolina.

W. J. Epting. Two jars of Fishes, Somerset county, Maine.

H. W Fowler and T. D. Keim. Collection of Fishes, Holmesburg, Philadelphia, and Bristol, Pennsylvania.

H. W. Fowler and T. D. Keim. Collection of Fishes from May's Landing, New Jersey.

H. W. Fowler and T. D. Keim. Collections of Fishes, Nottingham, Chester county, Pennsylvania, and Cecil county, Maryland.

H. W. Fowler and B. W. Griffiths. Collection of Fishes, Roberts Run, Montgomery county, Pennsylvania.

H. W. Fowler, D. N. McCadden and P. L. Lorrilliere. Collection of Fishes, Stone Harbor, New Jersey.

H. W. Fowler. Collection of Fishes, Bacon Hill, Maryland.

W. J. Fox. Twenty-five species of Marine Fishes, Sea Isle City, New Jersey.

C. J. Hunt and P. Lorrilliere. Pike, Pine Barrens, New Jersey

T. D. Keim. *Hippocampus*, Cape May, New Jersey.

Philip Laurent. Two dried Fishes, Anglesea, New Jersey.

C. J. Pennock. Two Fishes, Delaware.

C. P. Ray. Goldfish.

J. A. G. Rehn. *Lepomis auritus*, Lehigh Gap, Pennsylvania.

S. N. Rhoads Expedition to Lower California. Five jars of Fishes.

S. N. Rhoads. Specimen of Eel.

Dr. H. Senior. Five Marine Fishes, Sea Isle City, New Jersey.

Curwen Stoddart, Jr. Stuffed Fish, Bermuda.

Witmer Stone. Specimens of Dace, Fulton county, Pennsylvania.

E. G. Vanatta. Collection of Fishes, Chestertown, Maryland.

Lt. H. L. Willoughby. Jew-fish head, Fort Lauderdale, Florida.

Herman T. Wolf. Goldfish.

Otto Wolf. Head of Muskallunge.

George B. Wood. Collection of Fishes, Palm Beach, Florida.

Recent Mollusca.

Jacob Aebley. *Vallonia pulchella* Müll. and *Unio complanatus* 'Sol' Dill., from Philadelphia, Pennsylvania.

T. H. Aldrich. Three species of *Somatogyrus* from Alabama.

John A. Allen. Sixty-seven trays of mollusca from Maine, Ohio, Pennsylvania and Washington.

C. F. Ancey. Fifteen species of land and marine shells from North Africa.

Joshua and Albert Baily. Twenty-five species of land shells from Pennsylvania, New Mexico and California.

F. C. Baker. Five species of land and fresh-water shells from Northern United States.

H. C. Borden. *Physa* from Philadelphia, Pennsylvania.

Stewardson Brown. Sixteen species of land shells from Ohiopyle, Pennsylvania, and Bermuda.

F. W. Bryant. Six species of land and fresh-water shells from California.

Owen Bryant. *Odostomia* and types of *Paludestrina salsa* from Cohasset, Massachusetts.

G. H. Clapp. Ten species of land shells from Maine, Pennsylvania, Alabama and West Indies.

T. D. A. Cockerell. Thirty-five species of land shells from Colorado, New Mexico and England.

H. S. Colton. *Chætopleura apiculata* Say, Woods Hole, Massachusetts.

H. S. Conard. Fifteen species of land and marine shells from Washington.

C. H. Conner. Three species of fresh-water shells from New Jersey.

J. C. Cox. *Couthouya gracilis* Braz., Port Jackson, New South Wales.

Dr. W. H. Dall. Fourteen species of land and marine shells from North America and Easter Island.

L. E. Daniels. Twelve species of land and fresh-water shells from Indiana.

Dr. S. G. Dixon. Four species of marine and fresh-water shells from Maine and North Carolina.

Dr. C. S. Dolly. *Pecten* from Girgenti, Italy.

H. Drinker. *Ostrea cristagalli* L., from the China Sea.

J. H. Ferriss. Fifty-one trays of American land and fresh-water shells.

Alfred M. Garvin. Seven species of marine shells from St. Thomas, West Indies.

A. Da Costa Gomez. Two species of *Amnicola* from Guatemala.

H. A. Green. Three species of *Polygyra* from Polk county, North Carolina.

S. H. Hamilton. Six species of land and fresh-water shells from Pennsylvania and New Jersey.

Morgan Hebard. Two bulimoid land shells from New Providence, Bahamas.

Charles Hedley. *Capulus violaceus* Ang., from Queensland.

Dr. H. M. Hiller. Twenty-five sets of Cuban shells.

A. A. Hinkley. Six species of American land and fresh-water shells.

Y. Hirase. Two hundred and forty-three species of Japanese shells.

T. Iwakawa. Twenty-six trays of Japanese *Corbicula*.

Howard Jones. Six species of marine shells from New Jersey.

T. D. Keim and H. W. Fowler. *Unio complanatus* 'Sol.' Dillw., Chester county, Pennsylvania.

N. W. Lermond. Fourteen species of land shells from Maine and England.

H. N. Lowe. Two sets of *Agriolimax* from California.

J. G. Malone. Twelve species of land and fresh-water shells from Oregon.

R. F. Miller. Five species of land and fresh-water shells from Philadelphia, Pennsylvania.

Clarence B. Moore. One hundred and forty-one trays of shells from Florida. and one hundred and forty-nine from Alabama.

J. P. Moore. Nineteen species of marine shells from Massachusetts.

Olof O. Nylander. Seven sets of *Lymnæa* from Maine.

Dr. A. E. Ortmann. Twenty-eight trays of land and fresh-water shells from Ohio, Pennsylvania and New Jersey.

H. A. Pilsbry. Sixty-six species of land and fresh-water shells from Cazenovia, New York; four hundred and thirty-five trays of shells from the Southwestern United States, and seventy-three from other places.

Purchased. Two hundred and five trays of shells from Alabama, etc. Also a large series of Coosa River shells.

J. A. G. Rehn. *Polygyra auriculata* Say, from Palatka, Florida.

S. N. Rhoads. Twenty sets of American land and fresh-water shells.

J. Ritchie, Jr. Twelve species of land shells from Japan and Massachusetts.

Sloman Rous. *Tropidophora foveolata* M. and P., from Cape of Good Hope, South Africa.

Rev. J. Rowell. Two species of *Epiphragmophora* from California.

Andres Rusnak. Fourteen species of land and fresh-water shells from Hungary.

Mrs. Charles Schaeffer. *Succinea avara* Say, from Alberta.

Bohumel Shimek. Five species of fresh-water shells from Nicaragua.

C. T. Simpson. *Cerion* and *Cepolis* from Florida.

Dr. H. Skinner. A large series of six species of land shells from Carr Cañon, Huachuca Mountains, Arizona.

B. H. Smith. *Succinea avara* Say, from Gunnison county, Colorado, and *Anculosa carinata* Brug, from Huntingdon, Pennsylvania.

R. E. C. Stearns. *Punctum* from Los Angeles, California.

Witmer Stone. Five species of land shells from Fulton county, Pennsylvania.

D. Thaanum. Twenty-one species of Hawaiian land and marine shells.

Mrs. A. E. Vanatta. Fifteen species of marine shells from Lee county, Florida.

E. G. Vanatta. Sixteen trays of shells from Pennsylvania and Maryland.

T. Van Hyning. Nine trays of land shells from near Des Moines, Iowa.

H. L. Viereck. Four species of shells from New Jersey and New Mexico.

Bryant Walker. Twenty-nine trays of American shells.

J. F. Whiteaves. *Goniobasis columbensis* Wh., from British Columbia.

Joseph Willcox. Twenty-four trays of shells from Florida.

H. W. Winkley. Two trays of *Paludestrina salsa* from Branford, Connecticut.

H. T. Wolf. Two species of fresh-water shells from aquarium.

G. B. Wood. *Octopus* from Palm Beach Florida.

Worms.

H. S. Colton. *Ammotrypane.*

H. S. Conard. Nemertean, Washington.

Dr. S. G. Dixon. Specimen of *Anguilla*, Maine.

V. N. Edwards, *Nereis pelagica.*

H. W. Fowler. Two Leaches and a Nematode; *Placobdella rugosa* and *Nephthys buccra.*

T. L. Hankinson. *Macrobdella decora.*

Dr. J. W. Harshberger. *Nereis bairdii*, Bermuda.

Philip Laurent. *Nephthys picta*, Cape May, New Jersey.

J. Percy Moore. (Collected summer 1904.) Four hundred and sixty-five bottles of Polychæta. Twelve bottles of Leaches, Michigan.

T. Payne. *Hæmopsis marmoratus*, Indiana.

Miss N. M. Stearns. *Dendrocœlium.*

E. G. Vanatta. Specimens of *Dendrobœna octœdra*, Maryland.

E. G. Vanatta. Two *Helodrillus.*

Joseph Willcox. Four Annelids, Florida.

H. T. Wolf. *Macrobdella decora*, Pike county, Pennsylvania.

Insects.

W. M. Beekley. Two Lepidoptera, Florida.

W. Beutenmuller. Two Lepidoptera, New York; six Coleoptera, North Carolina.

C. R. Biederman. Twenty-four insects, Arizona.

P. Biolley. One hundred and twelve Orthoptera, Costa Rica.

D. A. Borelli. Fifty-six Orthoptera, Italy.

C. S. Brimley. Fifteen Orthoptera, North Carolina.

. Brugger. Ninety-eight Orthoptera, Pennsylvania.

P. P. Calvert. Twenty-five Hymenoptera, Africa; two Hemiptera, Indiana; three Coleoptera, Indiana.

D. M. Castle. Six Coleoptera, Florida; five Orthoptera, South California.

T. D. A. Cockerell. Three insects, Colorado and New Mexico.

W. J. Coxey. One Lepidoptera, Arizona.

E. Daecke. Two types Diptera, New Jersey.

G. C. Davis. Three thousand six hundred and seventeen Hymenoptera, United States.

Jacob Doll. Thirty-one Lepidoptera, North America.

H. C. Fall. Two types Coleoptera, California and Kansas.

C. P. Gillette. Three hundred and twenty-five Orthoptera, Colorado.

D. Graenicher. Fifteen types Hymenoptera, Wisconsin.

G. M. Greene. Nineteen insects, Glenolden, Pennsylvania.

Frank Haimbach. Eighty-eight insects, Pennsylvania and New Jersey.

H. S. Harbeck. One Hymenoptera, Philadelphia.

M. Hebard. Four hundred Orthoptera, North and South America.

L. Howell. Five Coleoptera, Pennsylvania.

G. T. Keeney. Two Cocoons, Florida.

Joseph McFarland. One hundred insects, Yosemite; twenty-seven, Banff; fifteen, Oregon.

S. A. S. and D. G. Metheny. Five Orthoptera, Asia Minor.

G. R. Pilate. Eight Coleoptera, Dayton, Ohio.

Edward Potts. Twenty-seven Moths, Media, Pennsylvania.

J. A. G. Rehn. Two hundred and eighteen Orthoptera, Pennsylvania and New Jersey.

David Rust. Twelve Orthoptera, Pennsylvania.

G. R. Savage. One Moth, Philadelphia.

M. T. S. Schaeffer. One hundred and forty-three insects, Canada.

W. P. Seal. Twenty-five Mosquitoes, New Jersey.

Henry Skinner. One hundred exotic Lepidoptera; fifty-one Lepidoptera, Japan; seven Lepidoptera, United States; two Coleoptera, Arizona; twenty-five insects, New Jersey; thirty-five insects, Castle Rock, Pennsylvania; five insects, Kern county, California; three thousand insects, Huachuca Mountains, Arizona. Academy Expedition.

B. H. Smith. One hundred Coleoptera, Colorado.

J. B. Smith. Fifty-five Noctuidæ, United States.

H. H. Severin. Four Orthoptera, Pennsylvania.

W. Stone. Thirty-nine insects, New Jersey; three hundred and forty, Fulton county, Pennsylvania.

Miss E. H. Thomas. Nine Lepidoptera, India.

E. G. Vanatta. One Coleopter, Pennsylvania.

J. Willcox. Fifteen insects, Florida.

Purchased. Two hundred and fifty Butterflies, Paraguay, E. W. Snyder; seven hundred and ninety-seven Orthoptera, Japan, Y. Hirase; four hundred and sixty-two Moths, Venezuela, C. W. Johnson; five hundred Orthoptera, Chili, C. S. Reed; one hundred and fifty-two Orthoptera, Burma, A. V. B. Crumb; one thousand insects, Colombia, E. B. Williamson; three hundred and thirty Butterflies, Surinam, G. Mayo; three hundred and one Hymenoptera (types, cotypes, paratypes), H. L. Viereck; sixty-five Orthoptera in return for identifications, United States National Museum, from various parts of the world; seventy-six Orthoptera in return for identifications, University of Kansas, Western United States.

Other Invertebrates.

H. S. Colton. Type of *Pinnotheres strombi* Rath., Clearwater Harbor, Florida.

Henry S. Conard. Three Crustaceans from Washington, and one *Asterias*.

Dr. S. G. Dixon. A collection of *Limnoria* from Maine and *Cambarus* from North Carolina.

D. N. McCadden, H. W. Fowler and P. Lorrilliere. A collection of invertebrates from Ocean City, New Jersey.

H. W. Fowler. Three Crustaceans from Pennsylvania, New Jersey and Maryland.

H. W. Fowler and T. D. Keim. Series of *Cambarus*, Holmesburg, Pennsylvania.

William J. Fox. *Cancer irroratus*, Sea Isle City, New Jersey.

B. W. Griffiths and H. W. Fowler. Three *Cambarus* from Abrams, Pennsylvania.

Herbert N. Lowe. *Estheria* from Santa Barbara, California.

Clarence B. Moore, Stewardson Brown and Henry W. Fowler. Five jars of Crustacea and Echinoderms from the Florida Keys.

J. P. Moore. One hermit Crab and three species of *Cambarus* from North Carolina and Massachusetts.

Dr. A. E. Ortmann. Four species of *Cambarus* from Western Pennsylvania.

Dr. Charles B. Penrose. *Euspongia officinalis* from the south coast of Cuba.

H. A. Pilsbry. *Dichelaspis mulleri* Coker, from Lake Worth Inlet, Florida, and four lots of *Cypris* from Texas.

E. G. Vanatta. Two jars of *Cambarus diogenes* Gir., from near Chestertown, Maryland.

H. L. Viereck. Two species of Crabs from Ocean City, New Jersey.

Joseph Willcox. *Clione sulphurea* Leidy, Sarasota Bay, Florida.

G. B. Wood. A collection of Crabs from West Palm Beach, Florida.

Vertebrate Fossils.

Thomas W. South. Fossil Horse Tooth, Riverton, N. J.

Estate of Lewis Woolman. Tray of fossil Shark teeth and fossil Fish.

Invertebrate Fossils.

Dr. H. C. Chapman. *Ostrea* from Rome, Italy, and *Numulites gizehensis* Ehr. from Pyramid of Cheops, Egypt.

J. H. Ferriss. Fossil from the drift, Joilet, Illinois.

Dr. Griffith. *Balanus concavus* Bronn., Caloosahatchee, Florida.

Clarence B. Moore. *Lucina* from Key Marco, Florida.

H. A. Pilsbry. Sixteen species of fossil mollusca from Province of Santa Clara, Cuba.

Burnett Smith. *Ecphora quadricostata* Say, St. Mary's River, Maryland.

Joseph Willcox. Four fossils from Caloosahatchee River, Florida.

L. Woolman. Fossil wood from Medford, New Jersey.

J. M. Hartman. Slabs of invertebrate fossils, Juniata county, Pennsylvania.

Minerals.

Miss H. Cubbison. Small collection of minerals.

Mrs. J. W. Queen. Basaltic column, Giant's Causeway.

F. P. Hendly. Two slabs of schist with dendritic formation.

T. J. Lewis. Large quartz crystal, Overbrook, Pennsylvania.

William S. Vaux Collection. A number of specimens purchased.

Plants.

Hugo Bilgram. *Diachœa cylindrica* Bilgram (type).

Stewardson Brown. Two hundred and twenty-eight Pennsylvania and New Jersey plants.

Joseph Crawford. One hundred and sixty-six Pennsylvania plants.

Prof. Charles Gruber. Nine sheets of *Cratægus*.

Dr. John W. Harshberger. Two hundred and seven Pocono plants.

George Hartnell. Forty-four plants, Wyoming county, New York.

C. D. Lippincott. Abnormal flower of *Lilium superbum*.

Miss Sadie Mulford. *Viola mulfordæ*.

Benjamin H. Smith. Forty Colorado and Pennsylvania plants.

Witmer Stone. Ninety-five Pennsylvania plants.

E. G. Vanatta. Thirty Maryland plants.

Samuel S. Van Pelt. One hundred and sixty-seven Pennsylvania and New Jersey plants.

Mrs. Mary E. Williams. Ten South Florida plants.

C. S. Williamson. Three hundred and sixty-four North American plants.

Exploration of Bermuda. Four hundred and eleven sheets.

Botanical Section. Five hundred and forty-seven sheets Shaw's British Columbia plants; one hundred and ten sheets New England plants; three hundred sheets Pringle's Mexican plants.

Philadelphia Botanical Club. Fifteen sheets North American plants.

New York Botanical Garden Exchange. Forty-nine West Indian plants.

U. S. Department of Agriculture Exchange. Two hundred and seventeen sheets of grasses.

Microscope.

Mrs. Thomas H. Montgomery. Microscope, formerly the property of Dr. Samuel George Morton.

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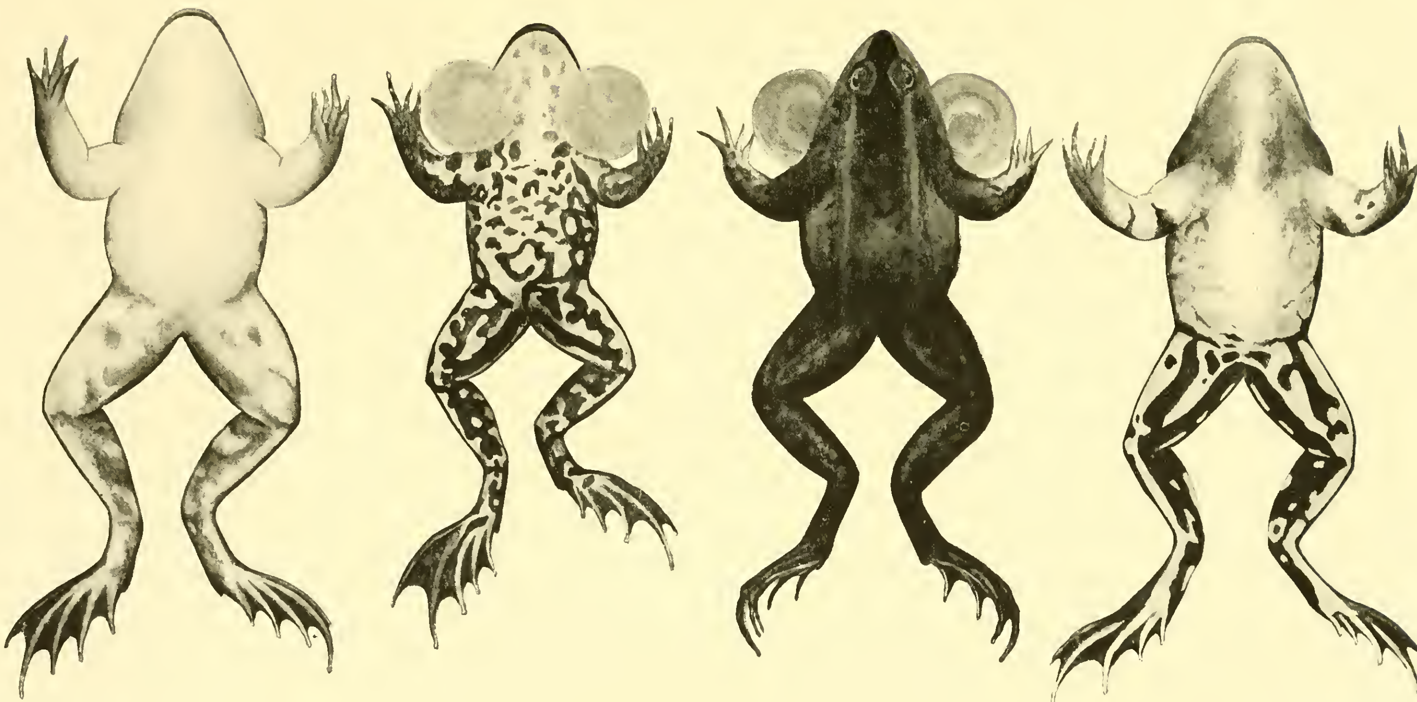

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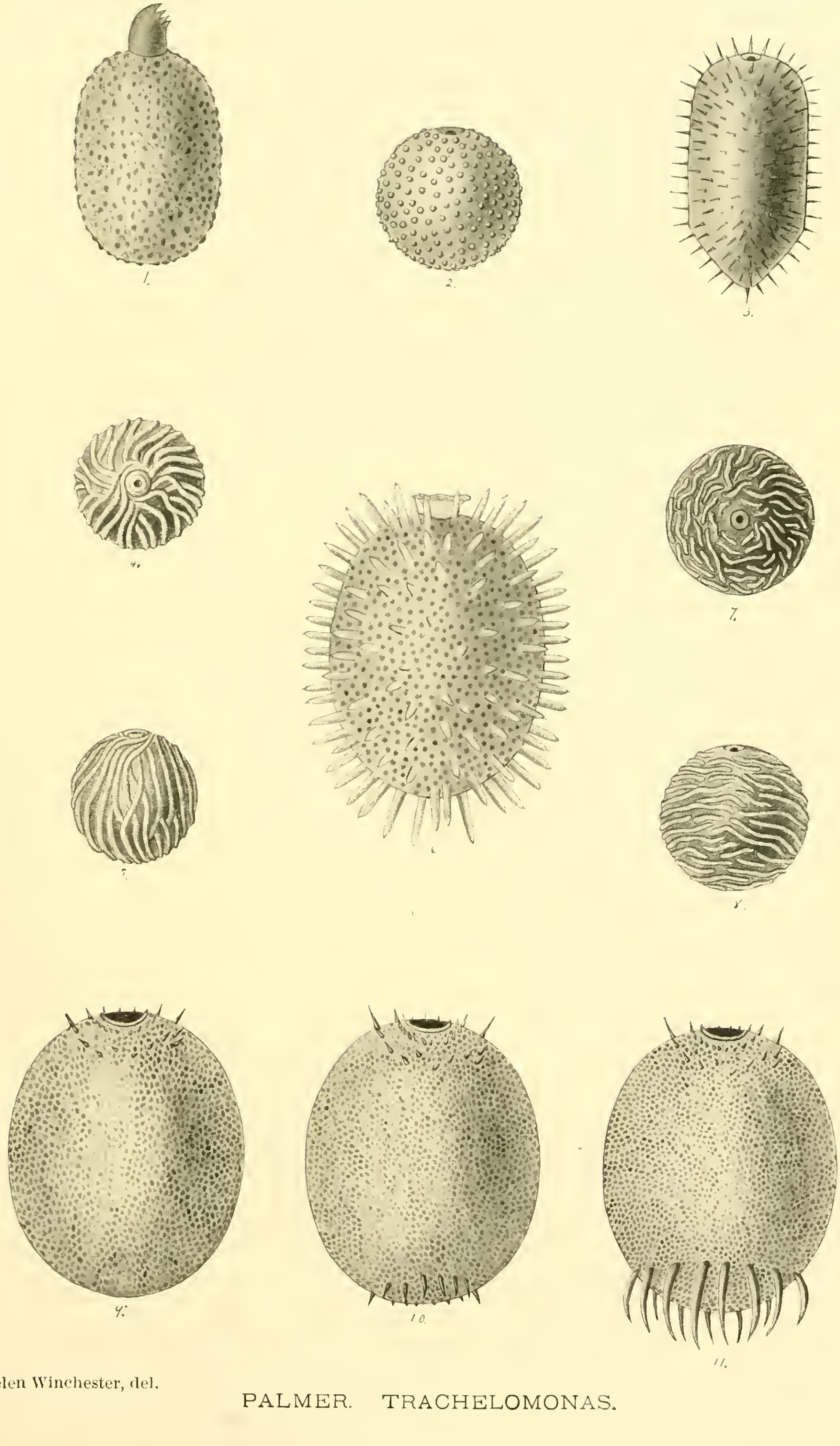

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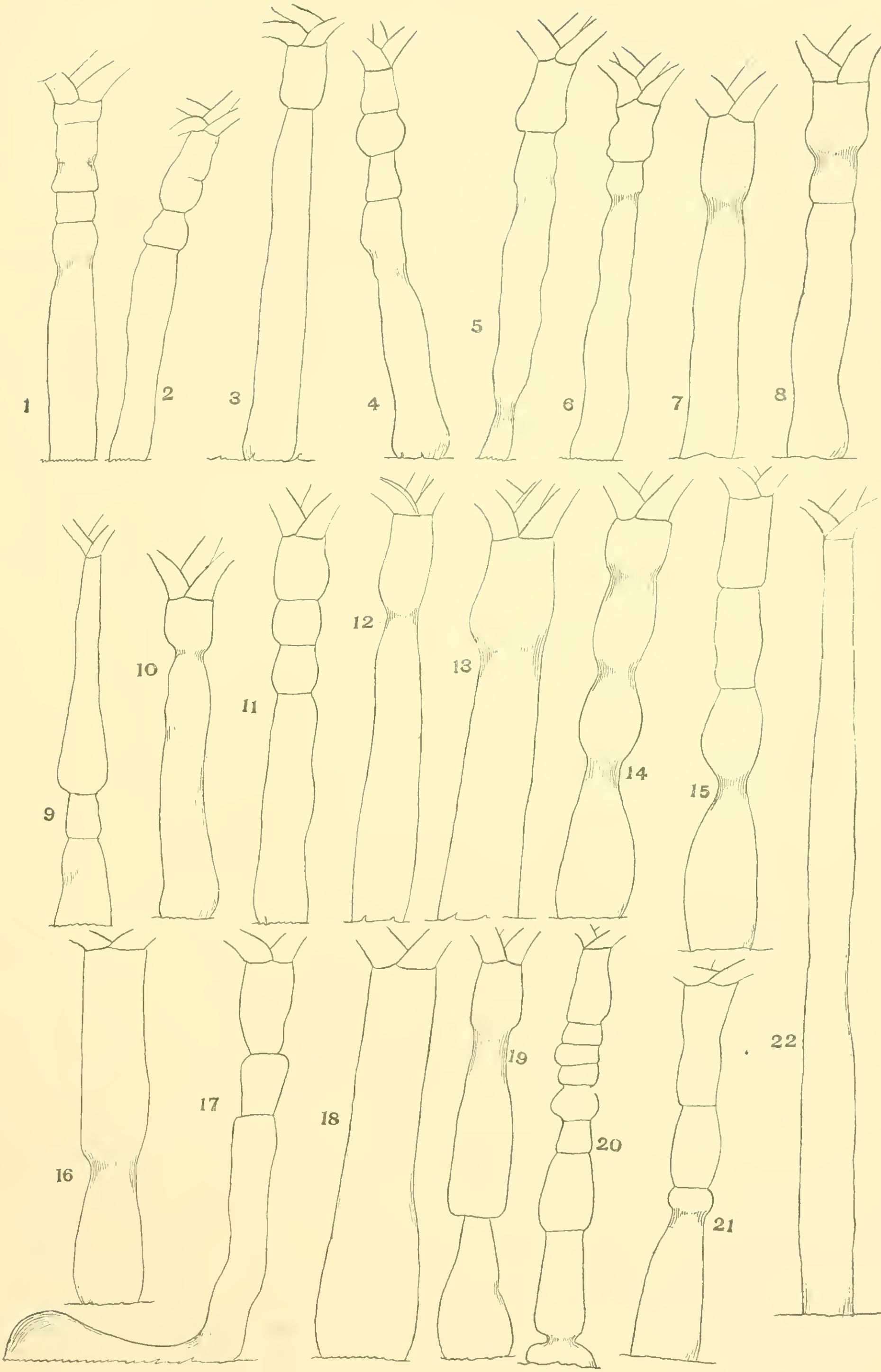

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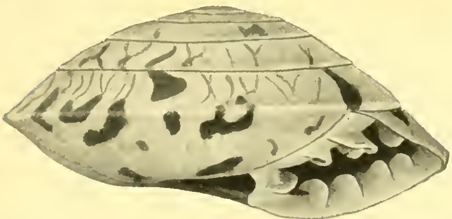

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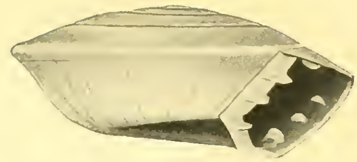

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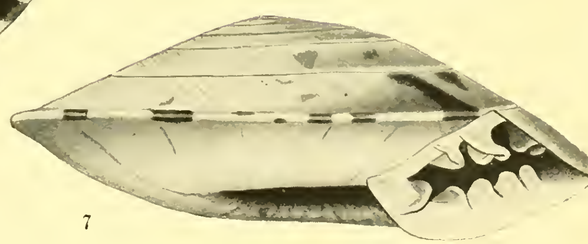

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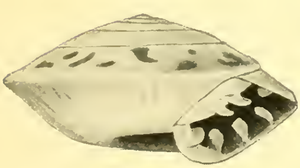

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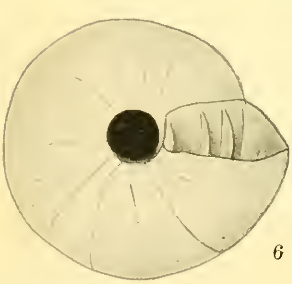

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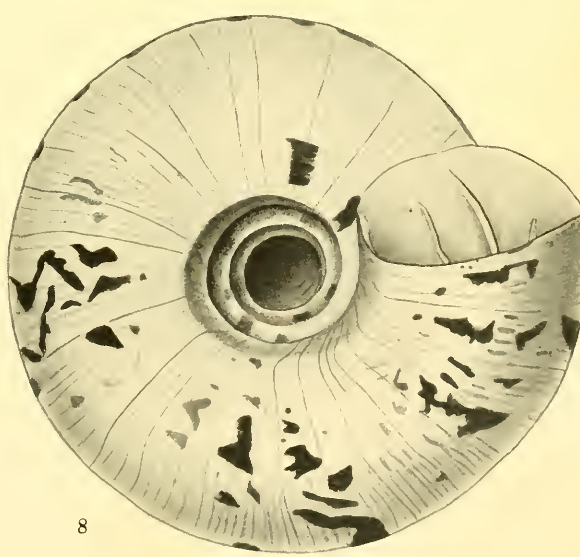

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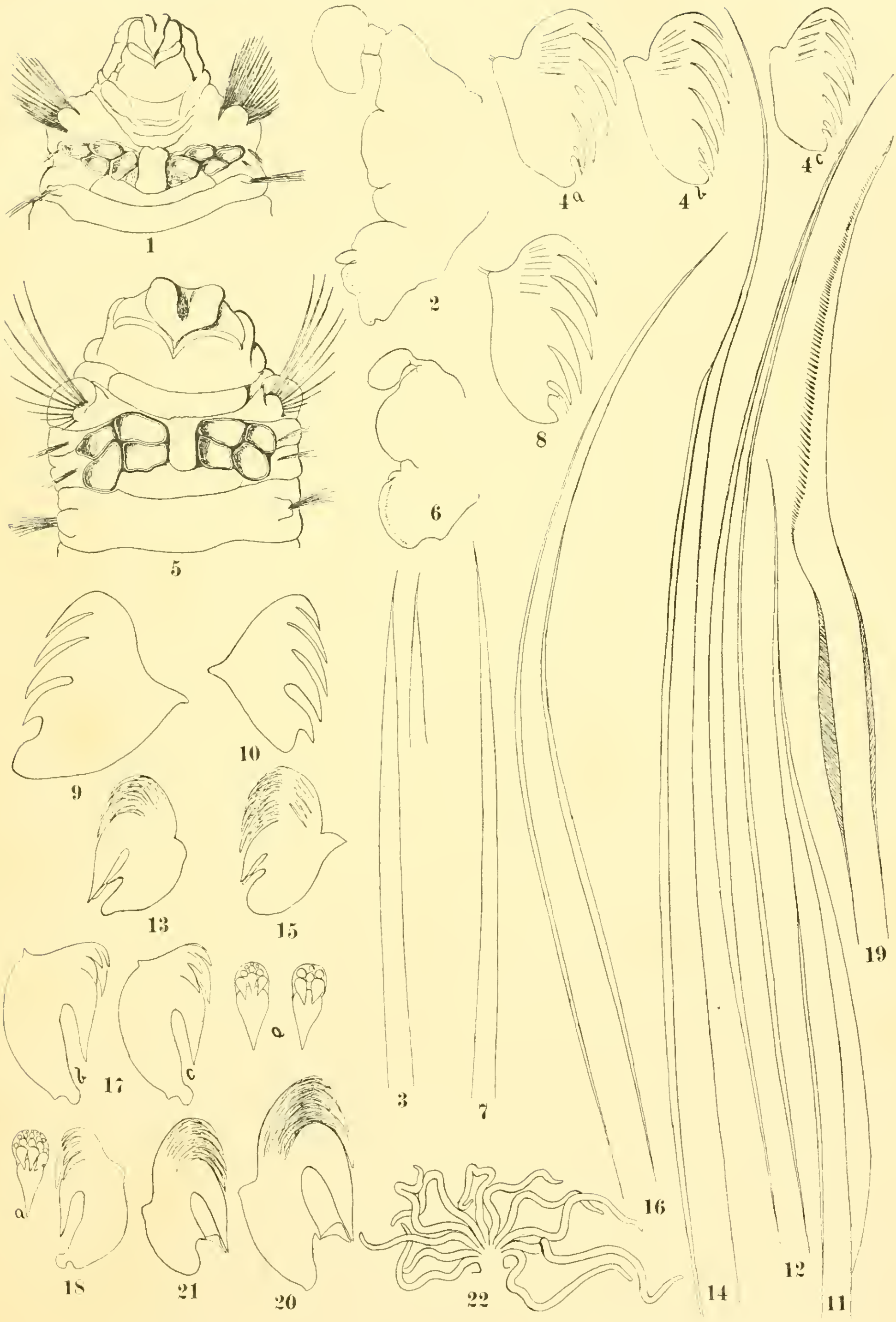

MOORE. AMPHARETIDÆ AND TEREBELLIDÆ.