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1919

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

April 10, 1919.

I hereby certify that printed copies of the PROCEEDINGS for 1918 were mailed as follows:

Pages	1–64	April	11, 1918.
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EDWARD J. NOLAN,
Recording Secretary.

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1918.

January 15.

HENRY SKINNER, M.D., Sc.D., in the Chair.

Thirty-one persons present.

The Publication Committee reported the presentation of papers for publication as follows:

"The Meteor Crater of Arizona," by Beeby Thompson.

"Contributions a l'histoire naturelle du fer du Canyon Diablo," par Stanilas Meunier.

"New and little-known fishes from the Philippine Islands," by Henry W. Fowler.

Dr. Harley Stamp made a communication entitled: An Anthropological Amateur in Alaska, Siberia, and the Arctic, illustrated by colored lantern slides. (No abstract).

The deaths of Caleb Cresson, December 30, 1917, and Joseph P. Remington, January 1, 1918, members, were announced.

Andrew J. Carty and Annabella E. Richards, were elected members.

The following was ordered to be printed:

NEW AND LITTLE-KNOWN FISHES FROM THE PHILIPPINE ISLANDS.

BY HENRY W FOWLER.

During the past summer the writer had opportunity to study the collection of fishes in the Commercial Museums of Philadelphia, obtained some years previously from the Philippine Government. Dr. William P. Wilson, the Director of the Commercial Museums, very kindly offered every assistance in this work and through him a series of the duplicates, including the more important species of scientific interest, have been received into the collection of the Academy. Though the specimens are usually without detailed localities, most were probably obtained near Manila. Others were collected and shipped to Manila, so that no localities are here noted other than the islands as a whole. In some instances the native names were also preserved, although many have been lost prior to my examination.

The characteristic richness in species of the great East Indian fauna is at once apparent in even a cursory study of such a collection. Twenty-six species are described as new and figured. An imperfectly known rare cardinal-fish is redescribed.

Scoliodon walbeehmii (Bleeker).

Four small examples, the largest about 305 mm. Mouth little longer than wide. Teeth entire or nearly so. Upper jaw with short labial fold. Anal fin length little less than its distance from ventrals. Outer pectoral angle nearly a right angle.

Mobula eregoodoo-tenkee (Cuvier).

Young example with umbilical cord and egg-sac. Tail short, not half length of disk. Teeth numerous, little distinct. Cephalic fins curved inward, and front flange folds upward so tips well overlap. Last gill-openings each side wider than interspace. Small dorsal over ventral. Skin smooth. Color uniform pale brown, edges of cephalic fins darker. Eyes slaty. Disk length 254 mm., width much greater.

Pisoodonophis cancrivorus (Richardson).

Günther gives coloration uniform, with more or less distinct blackish spot forward on dorsal. Bleeker quotes Richardson that the lateral line is not present and in the latter's figure it is so indicated.

My five examples all show it. Richardson's figure has a much smaller eye and has no pores behind the eye. Jordan and Richardson give the chin and throat pale yellow in life, and the pectoral yellowish; in my examples, muzzle and head below dusky or soiled blackish.

Pisoodonophis boro (B. Hamilton).

Several, with very fine longitudinal wrinkles or grooves, mostly parallel, on pharynx Jordan and Richardson omit this species from their check-list, though Günther previously recorded an adult from Zebu.[1]

Hemiramphus limbatus Valenciennes.

Large series, all small, and with broken beaks. These show: Head $4\frac{1}{5}$ to $4\frac{1}{4}$; depth $7\frac{2}{3}$ to $8\frac{2}{3}$; D. II, 12 or 13; A. III, 12 or 13; scales 46 to 52 in lateral row to caudal base, and 6 to 9 more on latter; predorsal scales 42 to 47; snout $2\frac{3}{4}$ to 3 in head measured from upper jaw tip; eye $3\frac{2}{3}$ to $4\frac{1}{5}$; maxillary 3 to $3\frac{3}{5}$; interorbital $3\frac{1}{2}$ to 4; rakers 5 to 7+10 to 17, lanceolate, about $\frac{2}{3}$ of filaments and latter 2 in eye; length 80 to 118 mm.

Probably *Oxyporhamphus brevis* Seale belongs in *Arrhamphus* Günther (type *A. sclerolepis* Günther) or the short-billed forms with short pectorals.

Mugil ruthveni sp. nov. Fig. 1.

Head $3\frac{2}{3}$; depth $3\frac{2}{3}$; D. IV–I, 8; A. III, 8, I; P. I, 14; V. I, 5; scales 30 in lateral series from gill-opening above to caudal base, and 3 more large ones on latter; 11 scales between second dorsal and anal origins; 20 predorsal scales; head width $1\frac{1}{2}$ its length; head depth $1\frac{2}{5}$; snout $3\frac{4}{5}$; eye $4\frac{1}{2}$; mouth width $3\frac{2}{5}$; interorbital $2\frac{2}{5}$; first dorsal spine $1\frac{2}{5}$; first dorsal ray $1\frac{4}{5}$; third anal spine $2\frac{4}{5}$; first anal ray $1\frac{2}{3}$; least depth of caudal peduncle $2\frac{1}{5}$; pectoral $1\frac{1}{3}$; ventral $1\frac{1}{3}$.

Body elongate, with fusiform contour, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth about $1\frac{1}{6}$ its length.

Head robust, somewhat constricted below, profiles alike. Snout moderately broad, convex as viewed above, length nearly half its

[1] The American species described by Goode and Bean and referred to *Pisoodonophis* is evidently different in its serpent-like head, strong neck-muscles and constriction of the head somewhat as in *Derichthys*. It may, therefore, stand as a distinct subgenus.

Omochelys subgen. nov.

Type *Pisoodonophis cruentifer* Goode and Bean.

Differs from subgenus *Pisoodonophis* in having the dorsal inserted behind the pectoral.

(Ὠμός, cruel; ἔγχελυς, eel; with reference to its savage habits.)

width. Eye circular, hind edge about half a pupil-diameter before center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior very narrow. Mouth slightly inferior, corner falls about opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob which fits in depression above. Teeth minute, uniserial in upper jaw, obsolete in mandible. Lips rather fleshy, upper jaw width about half of pupil. Inner buccal folds moderately broad, upper little broader. Tongue small, tip free, elongate. Maxillary exposed, not quite to eye. Lower preorbital edge straight, with minute denticles. Front nostril about last $\frac{2}{5}$ in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, little nearer front nostril than eye. Interorbital broadly convex.

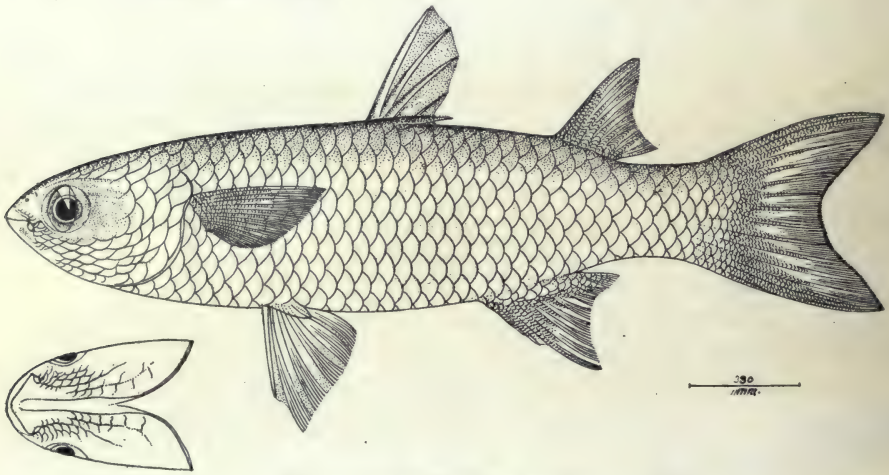

Fig. 1.—*Mugil ruthveni* sp. nov.

Gill-opening forward about midway in eye. Rakers about 30+46, slender, fine, $2\frac{1}{4}$ in filaments and latter about equal eye. Pseudobranchiæ about half of gill-filaments. Isthmus narrowly constricted, smooth.

Scales large, in even longitudinal series. Head scaly, scales smaller below, and extends well forward on snout though not to its edge. Scaly pointed flap along spinous dorsal base $1\frac{3}{5}$ in fin. Short scaly pectoral flap (damaged). Axillary ventral flap $2\frac{3}{4}$ in fin. Broad scaly flap between ventral bases half of fin. Soft dorsal and anal scaly over basal halves. Caudal largely covered with small scales. Pectoral with small scales basally. Ventral scaly. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted about midway between front of eye and caudal base, first spine longest and depressed fin $1\frac{1}{3}$ to soft dorsal origin. Latter nearly an eye-diameter nearer caudal base than spinous dorsal origin, depressed fin $1\frac{1}{4}$ to caudal base. Anal origin nearer caudal base than ventral origin, depressed fin $1\frac{3}{5}$ to caudal base. Caudal emarginate behind, $3\frac{1}{2}$ in head and trunk, lobes about equal. Pectoral short, broad, $1\frac{1}{4}$ to spinous dorsal origin. Ventral inserted about opposite middle in depressed pectoral, $1\frac{3}{4}$ to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, slightly tinted olivaceous on back. Fins all pale, and hind caudal edge narrowly dusky. Iris pale slaty. Peritoneum blackish. No dark blotch at shoulder or pectoral base.

Length 240 mm.

Type, No. 47,478, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Only the type known. The dark hind caudal edge is suggestive of *Mugil sundanensis* Bleeker,[2] but that species has 9 branched anal rays, preorbital deeply notched, snout long as eye, etc.

(Named for Dr. Alexander G. Ruthven, of the University of Michigan, well known among leading herpetologists, who has written on Michigan fishes.)

Mugil ogilbyi sp. nov. Fig. 2.

Head $3\frac{7}{8}$; depth $3\frac{2}{3}$; D. IV–I, 8; A. III, 9; P. I, 14; V. I, 5; scales 28 in lateral series from gill-opening above to caudal base and 4 more large ones on latter; 10 scales between second dorsal and anal origins; 20 predorsal scales; head width $1\frac{1}{2}$ its length; head depth $1\frac{1}{2}$; snout $3\frac{2}{3}$; eye $4\frac{1}{2}$; mouth width $3\frac{1}{5}$; interorbital $2\frac{1}{4}$; first dorsal spine $1\frac{1}{2}$; first dorsal ray $1\frac{7}{8}$; third anal spine $2\frac{3}{5}$; first anal ray $1\frac{4}{5}$; least depth of caudal peduncle $2\frac{1}{8}$; pectoral $1\frac{1}{2}$; ventral $1\frac{1}{2}$.

Body elongate, contour fusiform with lower profile slightly more convex, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth $1\frac{1}{6}$ its length.

Head robust, very slightly constricted below, lower profile slightly more convex and inclined. Snout broad, widely convex as viewed above, length about $\frac{2}{5}$ its width. Eye circular, hind edge anterior to center in head length about diameter of pupil. Adipose-eyelids

[2] Nat. Tijds. Ned. Indie, IV, 1853, p. 265. Benculen-Sumatra. Batavia, Java.

Günther, Cat. Fish. Brit. Mus., III, 1861, p. 425 (copied).

little developed, posterior extends over last fifth of eye and anterior very narrow. Mouth little inferior, and corner falls opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob which fits in depression above. Teeth very minute, uniserial in upper jaw, apparently absent in lower. Lips rather fleshy, width of upper about $\frac{4}{7}$ of pupil. Inner buccal folds moderately broad, upper little broader. Tongue small, tip free, elongate. Maxillary exposed, about to eye. Lower preorbital edge slightly curved, with few very minute obsolete denticles. Front nostril about last $\frac{2}{5}$ in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, little nearer front nostril than eye. Interorbital broadly convex.

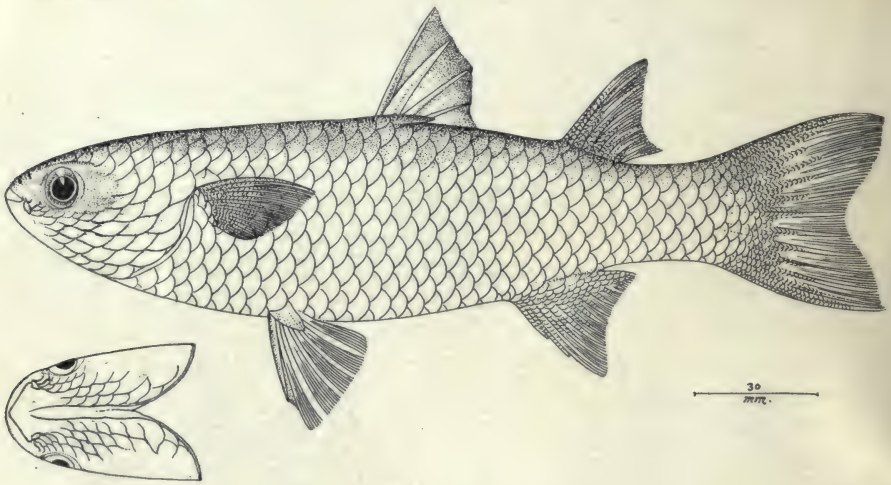

Fig. 2.—*Mugil ogilbyi* sp. nov.

Gill-opening forward about opposite front pupil edge. Rakers about 35+52, slender, fine, $2\frac{1}{5}$ in filaments and latter $1\frac{1}{8}$ in eye. Pseudobranchiæ about $1\frac{1}{2}$ in gill-filaments. Isthmus narrow, constricted, with median groove.

Scales large, in even lengthwise series. Head scaly, scales smaller below, and extend well forward on snout, though not to its edge. Scaly pointed flap along spinous dorsal base half depressed fin length. Scaly flap in pectoral axil $\frac{1}{3}$ of fin. Axillary ventral scaly flap $2\frac{1}{2}$ in fin. Broad scaly flap between ventral bases 2 in fin. Soft dorsal and anal scaly over basal halves. Caudal largely scaly, fewer scales about pectoral basally. Ventral with many small scales. Four scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted midway between hind nostril and caudal base, first spine very slightly longer than second, depressed fin $1\frac{1}{2}$ to soft dorsal origin. Last slightly nearer caudal base than spinous dorsal origin, depressed fin $1\frac{1}{3}$ to caudal base. Anal origin little nearer caudal base than ventral origin, depressed fin $1\frac{3}{4}$ to caudal base. Caudal emarginate behind, about equals head in length, lobes about equal. Pectoral short, broad, $1\frac{1}{2}$ to spinous dorsal. Ventral inserted near last third of depressed pectoral, reaches half way to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, upper surface tinged with olivaceous. Pockets of fallen scales exposed with more or less dusky. Traces of darker lengthwise streaks, one to each row of scales along back. Dorsals and caudal tinted with pale dusky, though hind edge of latter not dark. Pectoral brownish and other fins pale. Iris pale slaty. Peritoneum blackish. No dark shoulder spot or at pectoral base.

Length 210 mm.

Type, 47,479, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,480, paratype, same data. Head $3\frac{7}{8}$; depth $3\frac{2}{5}$; D. IV–I, 8; A. III, 9, 1; scales 29 in lateral series from gill-opening above to caudal base; 11 scales between second dorsal and anal origins; 20 predorsal scales; snout $3\frac{2}{3}$ in head; eye $4\frac{1}{8}$; mouth width $3\frac{1}{3}$; interorbital $2\frac{1}{5}$; length 205 mm.

This species is closely allied with *Mugil alcocki* Ogilby,[3] but differs in the larger head, deeper body, longer snout, etc. Günther does not give the length of the first dorsal spine, though Ogilby remarks "it is noteworthy that neither Cantor or Bleeker have recorded any mullet having the first dorsal spine prolonged, from any part of the Malay Peninsula and Archipelago."

(Named for Mr. J. Douglas Ogilby, the accomplished Australian Ichthyologist of the Queensland Museum.)

Mugil philippinus sp. nov. Fig. 3.

Head $3\frac{4}{5}$; depth $3\frac{4}{5}$; D. IV–I, 8; A. III, 8; P. 1, 13; V. I, 5; scales 30 in lateral series from gill-opening above to caudal base and 3 more large ones on latter; 10 scales between second dorsal and anal origins; 19 predorsal scales; head width $1\frac{1}{2}$ in its length; head depth $1\frac{2}{5}$;

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[3] Ann. Queensland Mus., No. 9, 1908, pp. 21–2. Based on *Mugil subviridis* Day (non Valenciennes).

—Günther, Cat. Fish. Brit. Mus., III, 1861, p. 423, fig. (head below). Madras.

snout 4; eye 4; mouth width $3\frac{2}{5}$; interorbital $2\frac{2}{7}$; first dorsal spine $1\frac{2}{3}$; first dorsal ray $1\frac{7}{8}$; third anal spine 3; first anal ray $1\frac{7}{8}$; least depth of caudal peduncle $2\frac{1}{4}$; pectoral $1\frac{2}{5}$; ventral $1\frac{2}{5}$.

Body elongate, with fusiform contour, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth about $1\frac{1}{4}$ its length.

Head robust, somewhat constricted below, profiles alike. Snout broad, widely convex as viewed above, length about $\frac{3}{5}$ its width. Eye circular, hind edge little anterior to center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior about half so wide. Mouth little inferior, corner falls very slightly behind front nostril. Mandibular angle very

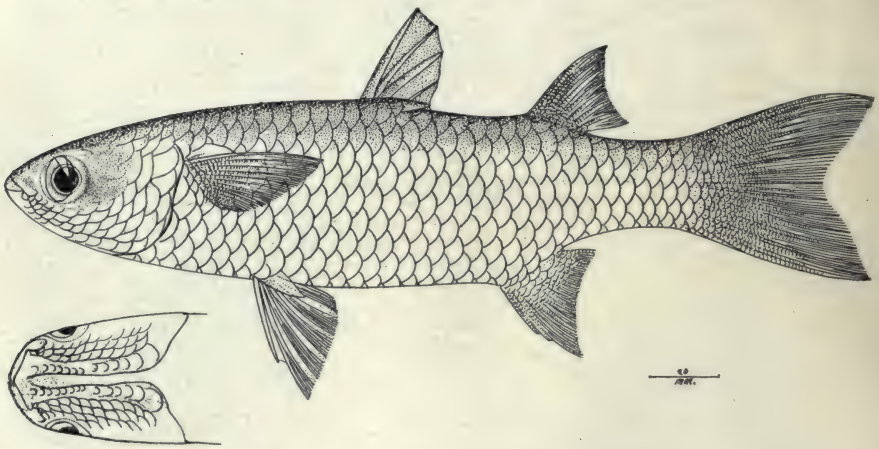

Fig. 3.—*Mugil philippinus* sp. nov.

broad, obtuse, symphysis forming little knob which fits in depression above. Teeth very minute, uniserial in upper jaw, and obsolete in mandible. Lips rather fleshy, width of upper about $\frac{2}{3}$ of pupil. Inner buccal folds moderately broad, upper little wider. Tongue small, tip free, elongate. Maxillary exposed, about reaches eye. Lower preorbital edge not notched, with a few obsolete denticles. Front nostril about last third in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit midway between front nostril and front eye edge. Interorbital broadly convex.

Gill-opening forward about opposite hind pupil edge. Rakers about 38+48, slender, fine, $2\frac{1}{2}$ in filaments and latter equal eye. Pseudobranchiæ about $1\frac{2}{3}$ in gill-filaments. Isthmus narrow, with slight depression.

Scales large, in even longitudinal series. Head scaly, scales smaller below and extend well forward on snout, though not to its edge. Scaly pointed flap along spinous dorsal base about $1\frac{3}{4}$ of first spine length. Scaly flap in pectoral axil about $3\frac{1}{8}$ in fin. Axillary ventral scaly flap about $2\frac{2}{3}$ in fin. Broad scaly flap between ventral bases $2\frac{2}{5}$ in fin. Soft dorsal and anal scaly over basal halves. Caudal largely covered with small scales from base, pectoral likewise. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted about midway between eye front and caudal base, first spine about as long as second, depressed fin $1\frac{1}{3}$ to soft dorsal origin. Last about midway between first dorsal origin and caudal base, depressed fin $1\frac{2}{5}$ to caudal base. Anal origin slightly nearer caudal base than ventral origin, depressed fin $1\frac{1}{2}$ to caudal base. Caudal emarginate behind, $3\frac{2}{3}$ in head and trunk, lower lobe slightly longer. Pectoral short, broad, $1\frac{1}{3}$ to spinous dorsal. Ventral inserted about opposite last fourth of depressed pectoral, $1\frac{4}{5}$ to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, back and upper surfaces with dull olive shades, belly and below paler. Dorsals and caudal tinted with pale dusky. Iris pale slaty. Fins whitish. Peritoneum blackish.

Length 237 mm.

Type, No. 47,481, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,482, paratype, same data. Head $3\frac{4}{5}$; depth $3\frac{3}{4}$; D. IV–I, 8; A. III, 8; scales 30 in lateral series from gill-opening above to caudal base; 11 scales between second dorsal and anal origins; 19 predorsal scales; snout $3\frac{4}{5}$ in head; eye $4\frac{1}{3}$; mouth width $3\frac{1}{5}$; interorbital $2\frac{2}{5}$; length 254 mm. This example figure 3.

Differs from *M. ogilbyi* in the fewer (3) scales after depressed spinous dorsal, slightly larger body scales and first dorsal spine not longer than the second.

Mugil lepidopterus sp. nov. Fig. 4.

Head 4; depth $3\frac{3}{5}$; D. IV–I, 8; A. III, 9; P. I, 12; V. I, 5; scales 30 in lateral series from gill-opening above to caudal base and 3 more large ones on latter; 10 scales between second dorsal and anal origins; 20 predorsal scales; head width $1\frac{2}{5}$ its length; head depth $1\frac{2}{5}$; snout $3\frac{1}{2}$; eye 4; mouth width 3; interorbital $2\frac{1}{6}$; first dorsal spine $1\frac{2}{5}$; first dorsal ray $1\frac{2}{3}$; third anal spine $2\frac{1}{2}$; first anal ray $1\frac{3}{5}$; least depth of caudal peduncle 2; pectoral $1\frac{1}{3}$; ventral $1\frac{1}{3}$.

Body moderately elongate, contour fusiform, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth $1\frac{1}{6}$ its length.

Head moderately robust, somewhat constricted below, profiles alike. Snout broad, convex as viewed above, length nearly half its width. Eye nearly impinging on upper profile, little advanced before center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior very narrow. Mouth slightly inferior, and corner falls about opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob fitting in depression above. Teeth very minute, feeble and uniserial in upper jaw, apparently absent in lower jaw. Lips little fleshy,

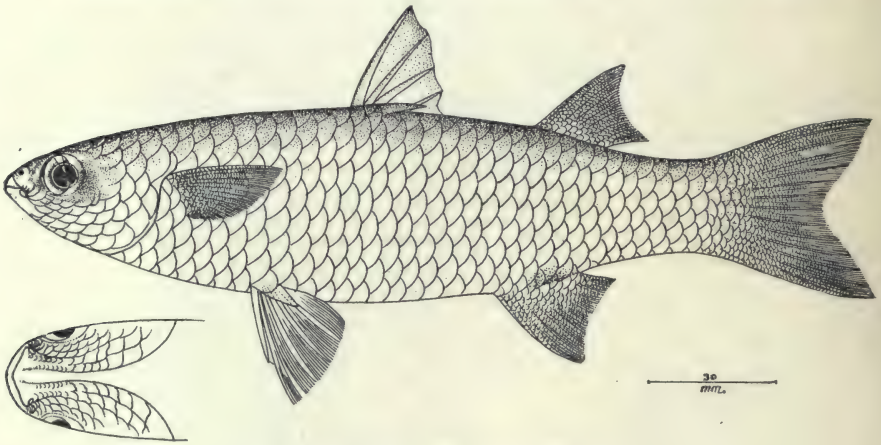

Fig. 4.—*Mugil lepidopterus* sp. nov.

upper jaw width about half of pupil. Inner buccal folds rather narrow. Tongue small, tip free, elongate. Maxillary exposed, reaches eye. Lower preorbital edge slightly convex and finely denticulate. Front nostril about last $\frac{2}{5}$ in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, over and little nearer front nostril than eye. Interorbital broadly and slightly convex, depressed medially.

Gill-opening forward nearly opposite front pupil rim. Rakers about 30+48, slender or finely lanceolate, 3 in filaments and latter about equal eye. Pseudobranchiæ about half of gill-filaments. Isthmus narrowly constricted, with median groove forward.

Scales large, in even longitudinal series, mostly uniform. Head scaly, smaller scales below, extend forward on snout though not

quite to its edge. Scaly pointed flap along spinous dorsal base $1\frac{1}{2}$ in fin. Short scaly axillary pectoral flap 4 in fin. Axillary scaly ventral flap $2\frac{1}{3}$ in fin. Broad scaly flap between ventral bases (damaged). Soft dorsal, anal and caudal all densely scaled, only hind edge of last naked. Pectoral and ventral largely scaly over basal portions. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal midway between snout tip and caudal base, first and second spines subequal, fin $1\frac{1}{2}$ to soft dorsal origin. Latter nearly midway between spinous dorsal origin and caudal base, depressed fin $1\frac{1}{3}$ to caudal base. Anal origin much nearer caudal base than ventral origin, depressed fin $1\frac{2}{3}$ to caudal base. Caudal well emarginate behind, about long as head, lobes about equal. Pectoral short, broad, $1\frac{2}{3}$ to spinous dorsal origin. Ventral inserted about opposite last fourth in pectoral, extends slightly over half way to anal. Vent a scale width before anal.

Color in alcohol faded, dull, uniform brown, slightly olive above. Dorsals slightly dusky above, and same tint very slight along hind caudal edge. Iris dull slaty. Peritoneum black. No dark blotch at shoulder or pectoral base.

Length 206 mm.

Type, No. 47,483, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species is allied with *Mugil dussumieri* Valenciennes[4] in its densely scaled soft dorsal and anal fins. As described by Day[5] *M. dussumieri* would differ in the bent and emarginate preorbital, spinous dorsal origin midway between front eye edge and caudal base, and first spine longest and strongest. Day's fish is also slightly more slender than my example.

(Δεπὶς, scale; πτερὸν, fin; with reference to the scaly rayed vertical fins.)

Corythroichthys matterni sp. nov. Fig. 5.

Head $3\frac{1}{4}$ to vent; depth $7\frac{1}{8}$; D. 25; A. 2; P. 15; C. 6; rings 15+39; snout $2\frac{1}{6}$ in head; eye $5\frac{1}{2}$; pectoral $5\frac{1}{2}$; caudal $1\frac{1}{2}$ in snout; interorbital $2\frac{1}{2}$ in eye.

Body very long, trunk well compressed and deepest midway in its length, and combined with head $1\frac{9}{10}$ in long slender tapering tail. Upper keel each side on back not extending beyond last fourth of

[4] Hist. Nat. Poiss., XI, 1836, p. 109. Bombay, Coromandel.
[5] Fishes of India, II, 1876, p. 352 (non Pl. 74, fig. 4).

dorsal. This replaced by similar parallel keel beginning little below opposite dorsal origin and continued to end of tail. Median lateral keel from pectoral axil, slopes down behind close to lower body keel, and ends opposite beginning of hind section of upper keel along back. Median keel on belly complete from breast to vent. Lower keel along each side of body from head to caudal base, and not interrupted.

Head short, compressed, and upper profile concave. Snout little longer than postocular region, profile concave. Eye circular, rather small, supraorbital keel moderate. Mouth terminally superior, small. Maxillary short, about half of eye. Interorbital concave. Opercle with well-developed horizontal keel, and fine striæ radiate above and below. Slight median keel on snout above occiput, and then continued back obsoletely to dorsal, each one being broken at segment junctures.

Gill-opening small superior oblique slit about its own length above pectoral origin, $1\frac{1}{2}$ in eye.

Fig. 5.—*Corythroichthys matterni* sp. nov.

Rings all firm, and keels without spines. Each ring with numerous transverse striæ.

Dorsal origin slightly behind vent and beginning of second section of upper lateral keel, and extends over 6 abdominal rings. Anal very small, about long as pupil, insertion near last third of ring before dorsal origin. Caudal small, oblong, median rays longest. Pectoral broad basally, long as eye.

Color faded dull brownish in alcohol, ground-color uniform, speckled and finely dotted minutely and irregularly with deeper or darker brown to burnt umber. Side of head with brownish dots and bars, especially on opercle below. Eye crossed by several deep brown radiating bars. Broad deep brown streak from eye along side of snout. From behind each eye obliquely down below deep brown bar, but not united on lower surface of head. Fins all plain and unmarked. Iris pale slaty.

Length 138 mm.

Type, No. 47,484, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species differs from the preceding chiefly in its greatly elongated tail and shorter snout. Of the various synonyms located with *C. spicifer* some approach the present species. Perhaps *Syngnathus biserialis* Kaup[6] is closer, it having D. 26 or 27, rings 16+46 and a much shorter tail. The Indian *Microphis tenuis* Blyth[7] is equally with long tail as my example, snout half the head, D. 24? and rings 16+36.

(For Mr. Edwin S. Mattern of Allentown, Pa., who collected many local fishes for the Academy.)

Doryichthys philippinus sp. nov. Fig. 6.

Head $3\frac{1}{10}$ to vent; depth $14\frac{1}{6}$; D. 40; A. 5; P. 21; C. 5; rings 21+24; snout $1\frac{3}{5}$ in head; eye $8\frac{1}{5}$; pectoral $8\frac{1}{2}$; caudal $5\frac{1}{2}$; interorbital $1\frac{1}{8}$ in eye.

Body very long, especially greatly elongated trunk which broad as deep, and deepest midway in its length, tail $1\frac{5}{6}$ in combined head and trunk. Tail tapers moderately, and not especially slender at caudal base. Upper keel along each side of back to about last

Fig. 6.—*Doryichthys philippinus* sp. nov.

fifth of dorsal. This replaced by similar parallel keel beginning little below about opposite dorsal origin and continued to end of tail. Median lateral keel from pectoral axil, slopes down to lower body edge extent of first three keels along dorsal base and continuous then to caudal base. Median keel on belly complete from breast to vent. Lower keel along each side of body from head to vent, when slightly approximate over first two abdominal keels, then give place to lateral keels.

Head elongate, well compressed, and profiles largely alike. Snout little over twice length of postocular region, profile sloping up behind. Eye circular, moderate, center at last third in head. Mouth terminally superior, small. Maxillary short, about $1\frac{2}{5}$ in eye, expansion equals pupil. Interorbital slightly concave. Well-developed median keel along snout edge above and one each side which extend to middle of interorbital. Occiput and first 2 rings with median keel. Opercle with well-developed horizontal keel, and from its front end 4 less distinct keels radiate obliquely down and back. Opercle and side of rostrum with fine flutings, reticulate and variable.

[6] Cat. Lophobr. Fish., 1856, p. 33.
[7] Journ. Asiat. Soc. Bengal, 1858, p. 272.

Gill-opening small, horizontal, well elevated and little before pectoral origin, about long as pupil.

Rings all firm, and keels each minutely serrate, each ending in slight spine at sutures. Surface of each keel with many fine vertical striæ.

Dorsal origin about opposite vent or about opposite beginning of second section of upper lateral keel, and base extends over 9 abdominal rings. Anal small, length about half of eye, and its insertion on first abdominal ring slightly behind dorsal origin. Caudal small, oblong, median ray longest. Pectoral very broad basally, so its base equals eye-diameter, and length slightly less than its base.

Color in alcohol rather dull brown generally, sides and belly minutely dusted or speckled with dark brownish. Fom side of snout end to eye deep brown streak, then this as well defined dark brown line over postocular region, on side of back to caudal. Also on sides below this dark line various dusky mottlings, most distinct on trunk rings. Iris pale slaty. Fins largely colorless.

Length 173 mm.

Type, No. 47,485, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Allied with *Microphis pleurostictus* Peters, *M. caudatus* Peters and *M. jagorii* Peters, all from the Philippines, but differs at once in the much longer snout.

Scomberoides tala (Cuvier).

Five examples. *Eleira* Jordan and Seale, based on the present species, does not appear really of generic rank. It is characterized by the diverging front canine each side of the lower jaw tip. My examples show this most pronounced in the young, and the teeth gradually erect and inconspicuous with age. Young also without black apical dorsal blotch. *S. moadetta* has enlarged front canines, besides the black apical dorsal blotch.

SELAR Bleeker.

Selar Bleeker, Nat. Tijds. Ned. Indie, I, 1850, pp. 343, 352, 353. Type *Caranx boops* Cuvier, first species.
Trachurops Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 431. Type *Scomber crumenophthalmus* Bloch, monotypic.

The type of *Selar* has not been formally designated, so the above may be adopted. *Trachurops* is thus superseded, as its type species like that of *Selar*, has a deep cross-furrow at the shoulder-girdle at

its juncture with the isthmus, also a small fleshy knob above the furrow.

Jordan and Starks recently contend[8] the use of *Selar* for the *Caranx kalla*, *C. ire* and *C. affinis* group.

Selar boops (Cuvier).

Four adults.

Selar crumenophthalmus (Bloch).

Several examples.

Leiognathus philippinus sp. nov. Fig. 7.

Head 3; depth $2\frac{1}{8}$; D. III, 16; A. III, 14; P. II, 15; V. I, 5; tubes 55 in lateral line to caudal base; about 13 scales in vertical series between spinous dorsal origin and lateral line; about 20? scales in

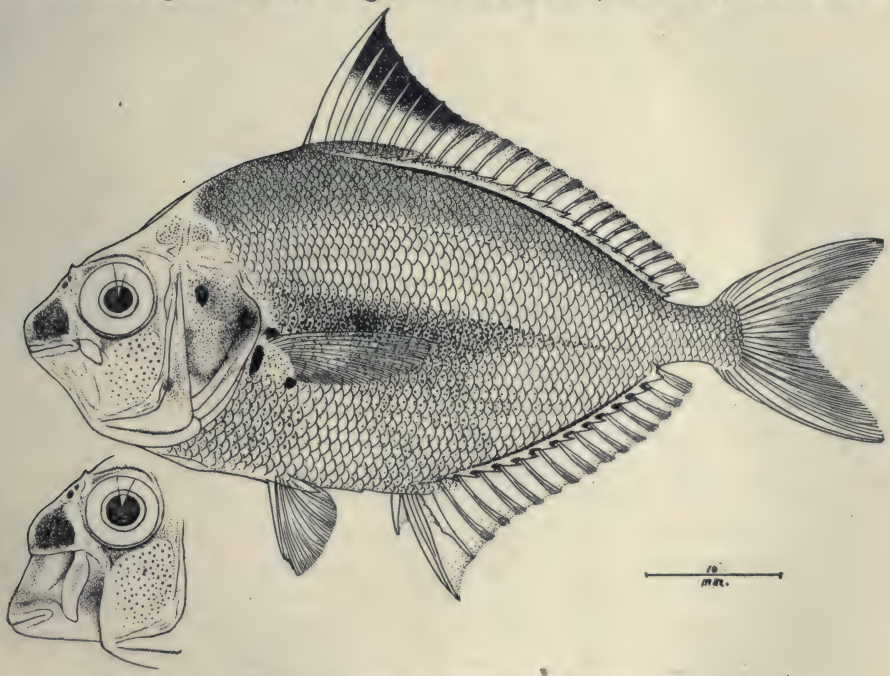

Fig. 7.—*Leiognathus philippinus* sp. nov.

vertical series between spinous anal origin and lateral line; head width $1\frac{7}{8}$ its length; head depth at occiput 1; second dorsal spine $1\frac{2}{5}$; first dorsal ray 3; second anal spine $1\frac{7}{8}$; first anal ray $2\frac{3}{4}$; upper caudal lobe $1\frac{1}{5}$; pectoral $1\frac{1}{4}$; ventral 2; snout $3\frac{4}{5}$; eye $2\frac{2}{5}$; maxillary $2\frac{2}{5}$; interorbital $3\frac{1}{4}$; least depth of caudal peduncle $4\frac{1}{5}$.

[8] Ann. Carnegie Mus., XI, 1917, p. 443.

Body rather elongate, compressed, deepest near middle or origin of spinous anal, and upper profile little more convex anteriorly than lower. Caudal peduncle compressed, least depth $1\frac{2}{5}$ its length.

Head rather deep, compressed, profiles similarly inclined. Snout obtuse, convex over surface, protrudes little beyond lower jaw, long as wide. Eye large, close to upper profile, hind pupil edge midway in head length. Mouth small, with short gape horizontal about half way to eye. Lips thin, narrow. Profile of mandible slightly concave to articulation below, which about opposite front pupil edge. Mouth protractile downward. Teeth fine, small, weak, uniform, brush-like, single row in each jaw. No teeth on mouth roof or tongue. Inner buccal folds rather narrow. Tongue thick fleshy, not distinct. Maxillary hangs down from preorbital about $\frac{2}{5}$ eye-diameter below eye, its expansion 3 in eye. Nostrils together, close before eye about level with upper pupil edge. Interorbital concave. Two short sharp-pointed spines above nostrils. Supraocular ridge finely serrated. Lower preopercle edge well serrated, and serræ largest behind, hind edge entire. Supraocular spine almost meets that of predorsal process.

Gill-opening extends forward about opposite hind pupil edge. Rakers 6+19, lanceolate, trifle less than filaments, which about $2\frac{2}{5}$ in eye. Pseudobranchiæ little longer than gill-filaments. Shoulder-girdle edge within gill-opening with 2 firm low processes, upper trifle above and lower trifle below, pectoral base. Isthmus width $2\frac{1}{2}$ in eye, membranes broadly joined.

Scales small, narrowly imbricated, caducous, and extend forward on chest. Well-developed scaly sheaths along bases of spinous dorsal and anal. Soft dorsal and anal with a series of inconspicuous spines each side basally, fin ray between each pair, and all directed evenly backward. Axillary scaly ventral flap $\frac{3}{4}$ length of spine. Caudal base scaly. Abdomen narrowly compressed, lower face of preanal spine with median groove, spine to vent or midway in space between ventral and anal origins. Short median groove on process of chest. Two small keels extend forward from ventral bases, converge slightly in front. Lateral line convex most its course, reaches caudal base, though with scale interrupted here and there behind. Pores in lateral line simple, each well exposed, and form nearly continuous series.

Spinous dorsal inserted slightly behind pectoral origin, second spine longest, and others graduated down behind to uniformly low soft dorsal. Spinous anal inserted trifle nearer caudal base than

snout tip, first spine about 3 in second, and third about $\frac{4}{5}$. Soft anal like soft dorsal. Caudal well forked, pointed lobes about equal. Pectoral pointed, reaches soft anal origin. Ventral inserted below pectoral origin, fin $\frac{4}{5}$ to anal and spine $\frac{3}{4}$ of fin. Front basal edges of third dorsal and anal spines finely serrated.

Color in alcohol largely pale brownish. Pale diffuse streak from shoulder to caudal base. Below this and on sides of head many dusky dots, crowded at first but becoming sparse below. Along back, close to dorsal base, dusky line. Along anal basally dusky blotch between each basal spine. Near hind opercle edge blackish short line above and another below. Also shorter bar or blotch above pectoral base and another below, axil with dark brown dots. Opercle shaded dusky, also inside of gill-opening. Chest and cheek with dusky dots like on trunk below. Side of snout dusky-brown. Iris slaty-gray. Black blotch on outer portions of second to fifth spinous dorsal membranes.

Length 65 mm.

Type, No. 47,486, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,487 to 47,490, same data, paratypes. These show: Head $3\frac{1}{8}$ to $3\frac{1}{4}$; depth $2\frac{1}{8}$; D. VIII, 16; A. III, 13 or 14; snout $3\frac{1}{5}$ to $3\frac{1}{2}$ in head; eye $2\frac{7}{8}$ to 3; maxillary $2\frac{1}{4}$ to $2\frac{3}{4}$; interorbital $2\frac{3}{4}$ to $3\frac{1}{8}$; length 63 to 68 mm.

Easily distinguished from *L. splendens* by its colors. Falls within *Eubleekeria*.

AURIGEQUULA subgen. nov.

Type *Clupea fasciata* Lacépède.

Breast and lower part of belly naked. Lateral line complete. Second dorsal spine twice or more length of third, conspicuously produced. Second anal spine also elongate.

Characterized chiefly by its elongated second dorsal and anal spines.

(*Auriga*, coachman; *Equula* an old name for *Leiognathus;* with reference to the long whip-like dorsal and anal spines.)

Leiognathus fasciatus (Lacépède).

One example.

Amia melas sp. nov. Fig. 8.

Head $2\frac{2}{5}$; depth $2\frac{2}{3}$; D. VII–I, 9; A. II, 8; P. II, 12; V. I, 5; scales about 21? (according to pockets) in median lateral series from

shoulder to caudal base and possibly 4 more on latter; apparently 2 ? scales above l.l. to spinous dorsal origin and 6? in vertical series below to spinous anal origin; 3 predorsal scales; head width $2\frac{1}{8}$ in its length; head depth at occiput $1\frac{1}{4}$; mandible $1\frac{5}{6}$; fourth dorsal spine 2; second anal spine 2; second dorsal ray $1\frac{1}{5}$; fourth anal ray $1\frac{2}{3}$; least depth of caudal peduncle $2\frac{3}{5}$; caudal $1\frac{2}{5}$; pectoral $1\frac{2}{3}$; ventral $1\frac{1}{2}$; snout $3\frac{1}{2}$ in head measured from upper jaw tip; eye $2\frac{2}{3}$; maxillary $2\frac{1}{5}$; interorbital $3\frac{1}{2}$.

Body well compressed, deep, back moderately elevated, deepest at spinous dorsal origin, slight median predorsal keel and other

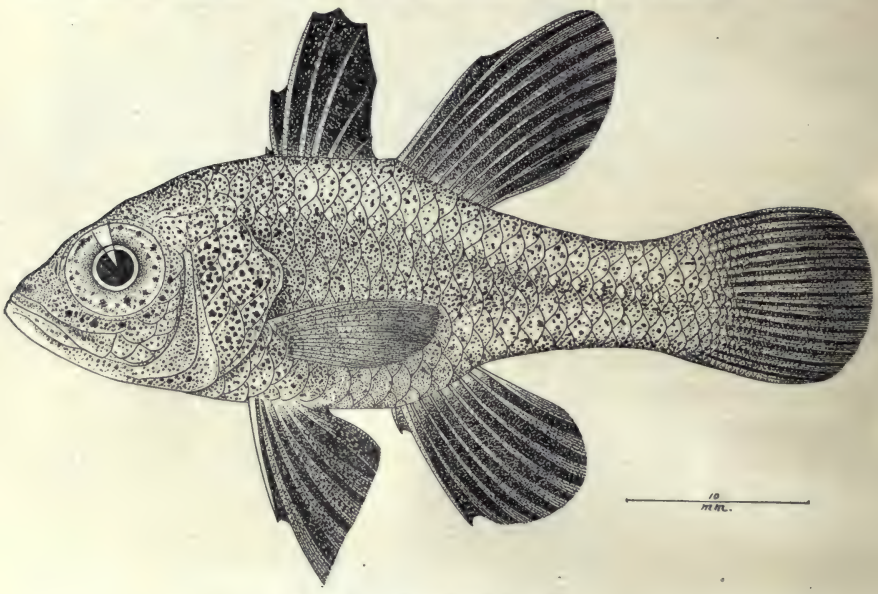

Fig. 8.—*Amia melas* sp. nov.

edges rounded convexly. Caudal peduncle well compressed, least depth about $1\frac{1}{2}$ its length.

Head large, deep, well compressed, flattened sides nearly evenly sloping above and below, and upper profile little more steep than lower. Snout short, surface convex, though profile little concave, and length $\frac{2}{3}$ its width. Eye very large, rounded, impinging on upper profile slightly, and center in head length near hind pupil edge. Mouth large, oblique, and closed lower jaw slightly protruding. Maxillary large, oblique, entirely along upper edge slipping below narrow preorbital, and reaches to pupil center. Terminal maxillary expansion $2\frac{1}{2}$ in eye, hind edge little emarginate. Preorbital width

about 4 in eye. Lips little developed, narrow, firm. Teeth fine, even, short, in moderately wide bands in jaws. Narrow band of similar teeth over vomer to each palatine. Tongue free, depressed, smooth, rounded in front. Front nostril simple pore nearly midway in snout length and hind nostril little larger, close before front eye edge. Interorbital with slight furrow each side in front, slightly convex behind. Preopercle ridge entire, and hind edge minutely serrate. Opercle with 2 small spines along hind edge.

Gill-opening extends forward about opposite front pupil edge. Rakers IV, 1+10, IV, lanceolate, slender, twice length of filaments or 2 in eye. Pseudobranchiæ long as gill-filaments. Isthmus long, constricted forwards, and with deep trenchant keel over greater portion anteriorly.

Scales large, at present mostly fallen, finely ctenoid, and apparently in lengthwise rows. Head scaly, and evidently 2 rows of large scales on cheek. Occiput with number of mucous channels. Apparently scaly flap between ventral bases. At present no axillary ventral scale. Caudal base scaly, otherwise fins naked. Lateral line apparently complete, and largely concurrent with dorsal profile. Tubes? Suprascapula entire.

Spinous dorsal inserted about opposite pectoral origin, fourth spine longest though little longer than third or fifth, second and sixth subequal, and first much shorter than seventh. Soft dorsal inserted about midway between eye centre and caudal base, second ray highest, and depressed fin $1\frac{1}{6}$ to caudal base. Spinous anal inserted opposite soft dorsal origin, first spine about 5 in second. Soft anal like soft dorsal, though much lower, $1\frac{1}{4}$ to caudal base. Caudal (damaged) apparently rounded. Pectoral moderate, reaches about opposite last basal fourth of soft dorsal. Ventral origin slightly before pectoral origin, fin reaches soft anal origin and ventral spine but little short of spinous anal origin. Vent about opposite last seventh of depressed ventral spine.

Color in alcohol rather dark chocolate-brown generally, pockets of fallen scales deeper brownish. Except pectorals all fins blackish-brown, very dark and without spots or markings. Pectoral pale brown. Muzzle and mandible slightly paler than rest of head. Iris dull slaty.

Length 55 mm.

Type, No. 47,491, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Allied with *Apogon nigricans* Day,[9] but differs in the much lower anal, pectoral with pale base, and apparently without traces of the dark vertical bars.

(*Μηλας*, black.)

Amia sealei sp. nov. Fig. 9.

Head $2\frac{2}{5}$; depth $2\frac{3}{4}$; D. VII–I, 9; A. II, 8; P. II, 12; V. I, 5; scales 22 in lateral line to caudal base and 4 more on latter; 2 scales above l.l. to spinous dorsal origin, and 6 in vertical series below to spinous anal origin; 4 predorsal scales; head width $2\frac{1}{5}$ in its length; head depth at occiput $1\frac{2}{5}$; snout $4\frac{1}{5}$; eye $2\frac{7}{8}$; maxillary $2\frac{1}{6}$; interorbital 5; third dorsal spine $2\frac{1}{6}$; second anal spine 3; second dorsal ray $1\frac{4}{5}$;

Fig. 9.—*Amia sealei* sp. nov.

first anal ray $2\frac{1}{8}$; least depth of caudal peduncle $2\frac{2}{3}$; caudal (damaged) about $1\frac{2}{5}$?; pectoral $1\frac{7}{8}$; ventral 2.

Body well compressed, rather deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, though slight median predorsal keel. Caudal peduncle well compressed, least depth about $1\frac{1}{2}$ its length.

Head large, moderately long, compressed, flattened surfaces nearly evenly sloping above and below, upper profile much more inclined than lower, and rather convex. Snout short, surface convex,

[9] Fishes of India, I, 1875, p. 58, Pl. 16, fig. 3. Madras.

also profile, length about $\frac{2}{3}$ its width. Eye large, circular, impinging slightly on upper profile, and head center in length midway between hind pupil and hind eye edges. Mouth moderately large, scarcely inclined from horizontal, and closed lower jaw included within upper. Maxillary large, little inclined, nearly straight, and reaches past eye center nearly opposite hind pupil edge. Terminal maxillary expansion 3 in eye, little emarginate behind, and whole upper maxillary edge slips below preorbital. Preorbital rather narrow, width about 4 in eye. Lips rather narrow, fleshy, firm. Teeth fine, even, short, in narrow bands in jaws. Also similar narrow band over vomer to and on each palatine. Tongue free, depressed, smooth, rather rounded in front. Front nostril lateral on snout, slightly nearer snout tip than eye, in short tube. Hind nostril short vertical slit close before front eye edge. Interorbital with slight furrow each side in front, slightly convex behind. Preopercle ridge entire, and hind edge minutely serrate. Opercle with small spine above and smaller one median on hind edge.

Gill-opening about opposite front pupil edge. Rakers II, 3+12, IV, lanceolate, rather robust, about $\frac{4}{5}$ of filaments and latter 3 in eye. Pseudobranchiæ large as filaments. Isthmus long, constricted forward, and with median trenchant keel anteriorly.

Scales large, finely ctenoid, above lateral line in rows parallel with its course, and below in horizontal rows. Head scaly, cheek with 2 rows of large scales, though hind row greatly crowded or concealed under front row, and scales on opercles moderate. Suborbitals and upper surface of head with numerous mucous channels. Large scaly flap between ventral bases nearly half length of fin. Axillary ventral scale small and inconspicuous. Caudal base covered with small scales, otherwise fins naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, and with appearance as if located on somewhat small obscure accessory scale.

Spinous dorsal inserted about opposite pectoral origin, third spine longest, second and seventh subequally short, though longer than first. Soft dorsal inserted about midway between caudal base and hind eye edge, second ray apparently highest, and depressed fin $1\frac{2}{5}$ to caudal base. Spinous anal inserted opposite second dorsal origin, first spine scarcely $\frac{1}{5}$ of second. Soft anal smaller than soft dorsal, otherwise similar. Depressed anal $1\frac{2}{5}$ to caudal base. Caudal very slightly emarginate behind, lobes rounded. Pectoral moderate, reaches anal, upper rays longest. Ventral inserted slightly

before pectoral origin, reaches vent or $\frac{7}{8}$ to anal. Ventral spine $\frac{2}{3}$ of fin.

Color in alcohol pale brownish generally, slightly paler below. Fins all pale or whitish, except brownish shade on spinous dorsal and scales at caudal base. Latter also with small jet-black round spot, less than half of pupil diameter, just above lateral line. From snout tip narrow blackish-brown line to front of eye and slopes evenly from hind eye edge to caudal base medianly, in straight course, also ends just below black caudal spot. Above this line on snout another given off each side of snout tip, extends up over interorbital then just above lateral line and finally fades out on caudal peduncle above and behind. Pale brown median line from interorbital and borders dorsal bases, continued medially behind to caudal. Opercle with 2 brownish vertical bars. Iris slaty.

Length 66 mm.

Type, No. 47,492, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,493 to 47,499, paratypes, same data. These show: Head $2\frac{2}{5}$ to $2\frac{1}{2}$; depth $2\frac{3}{4}$ to $2\frac{4}{5}$; D. VII–I, 9, I, A. II, 8; scales 23 to 26 in lateral line to caudal base and 4 more on latter; snout $3\frac{2}{3}$ to 4 in head, measured from upper jaw tip, eye $2\frac{1}{2}$ to 3; maxillary $2\frac{1}{10}$ to $2\frac{1}{4}$; interorbital $4\frac{2}{5}$ to $4\frac{4}{5}$; length 63 to 68 mm.

This species appears to differ chiefly in its coloration, especially the narrow lengthwise dark lines and the small black caudal spot above the lateral line, as in *A. exostigma* Jordan and Seale. Though very much narrower, the disposition of these lengthwise dark bands is like those of *A. quadrifascatus* Cuvier.

(For Mr. Alvin Seale, in slight recognition of his work in the Philippine fisheries.)

Amia wilsoni sp. nov. Fig. 10.

Head $2\frac{2}{5}$; depth $2\frac{4}{5}$; D. VIII–I, 9, I; A. II, 8; P. II, 12; A. I, 5; scales 22 in lateral line to caudal base and 3 more on latter; 2 scales above l.l. to spinous dorsal origin, and 6 below to spinous anal origin; about 4 predorsal scales; head width about half its length; head depth $1\frac{2}{5}$; snout 4; eye $2\frac{3}{4}$; maxillary $2\frac{1}{8}$; interobital $4\frac{1}{4}$; third dorsal spine $1\frac{7}{8}$; first dorsal ray $1\frac{2}{5}$; second anal spine $2\frac{3}{4}$; second anal ray $2\frac{1}{8}$; least depth of caudal peduncle $2\frac{1}{4}$; caudal $1\frac{1}{3}$; pectoral $1\frac{3}{5}$; ventral $1\frac{2}{3}$.

Body well compressed, rather deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, though slight median predorsal keel. Caudal peduncle well compressed, least depth about $1\frac{1}{2}$ its length.

Head large, moderately long, compressed, flattened surfaces nearly evenly sloping above and below, profiles about evenly sloping above and below. Snout short, surface convex, length $\frac{2}{3}$ its width. Eye large, circular, impinging slightly on upper profile, and center in head length about hind pupil edge. Mouth well inclined, moderately large, and closed lower jaw slightly included within upper. Maxillary large, well inclined, nearly straight, and reaches eye center. Terminal maxillary expansion 3 in eye, little emarginate behind, and whole upper maxillary edge slips below preorbital. Preorbital rather narrow, width about 4 in eye. Lips rather narrow, fleshy,

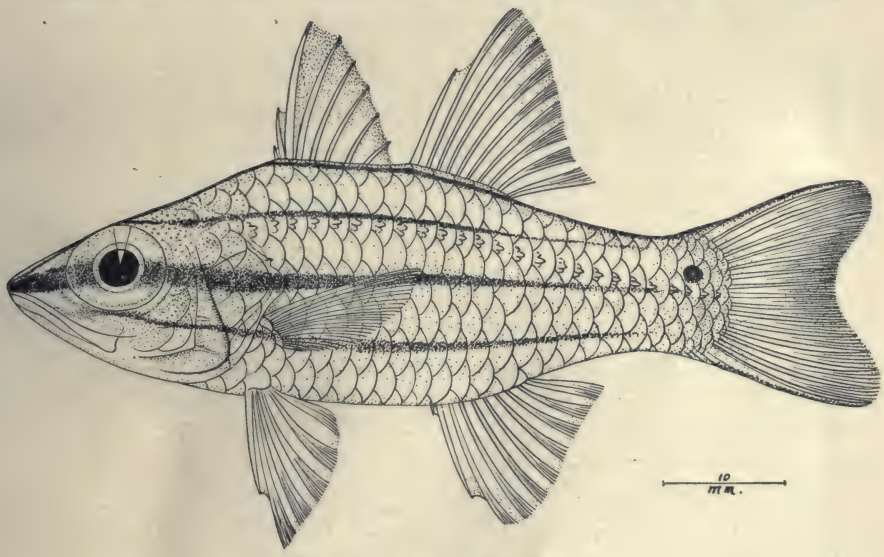

Fig. 10.—*Amia wilsoni* sp. nov.

firm. Teeth fine, even, short, in narrow bands in jaws. Also similar narrow band over vomer to each palatine. Tongue free, depressed, smooth, rather rounded in front. Front nostril lateral on snout, slightly nearer snout tip than eye, in short tube. Hind nostril simple slit at last fourth in snout. Interorbital level. Preopercle ridge entire. Hind and lower preopercle edge finely serrated. Opercle with single small spine.

Gill-opening about opposite front pupil edge. Rakers IV, 3+12, IV, lanceolate, longer than filaments or $2\frac{2}{3}$ in eye. Pseudobranchiæ little longer than filaments. Isthmus long, constricted forwards and with median trenchant keel.

Scales large, finely ctenoid, above lateral line in rows parallel with

its course, and below in horizontal rows. Head scaly, cheek with 2 rows of large scales, and hind row of but several under front row. Opercles with scales of moderate size. Suborbitals, muzzle, preopercle and upper surface of head with numerous mucous channels marked by great numbers of minute pores. Large scaly flap between bases nearly $\frac{2}{7}$ fin length. Axillary ventral scale about $\frac{1}{4}$ of ventral spine. Caudal base covered with small scales, otherwise fins naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, and with appearance as if on somewhat small accessory scale.

Spinous dorsal inserted about opposite pectoral origin, third spine longest, second little shorter than seventh, and first shortest. Soft dorsal inserted about midway between eye center and caudal base, first ray highest and depressed fin $1\frac{2}{5}$ to caudal base. Spinous anal inserted about opposite soft dorsal origin, first spine scarcely $\frac{1}{5}$ of second. Soft anal little smaller than soft dorsal, otherwise similar. Depressed anal $1\frac{1}{2}$ to caudal base. Caudal very slightly emarginate behind, and lobes rounded. Pectoral moderate, reaches nearly to anal, upper rays longest. Ventral inserted well before pectoral origin, reaches beyond vent or about $\frac{7}{8}$ to anal. Ventral spine $1\frac{1}{2}$ in fin.

Color in alcohol pale brownish generally, slightly paler below. Fins all pale, except dusky shade on spinous dorsal terminally. Upper and lower caudal edges slightly dusky. Conspicuous blackish-brown blotch on caudal base just above lateral line, in size about half of pupil. From snout tip narrow blackish-brown line to front of eye, and horizontal from hind eye edge to caudal base medially, also obscure just below caudal spot. On snout and behind eye this line wide as pupil, though on side of body narrows until like other lines. Another parallel narrower line extends from lower eye edge to middle of pectoral base and back towards lower portion of caudal peduncle. On each side of snout above narrow line extends up over interorbital close above lateral line, and fades out behind on upper surface of caudal peduncle. Finally narrow median brownish line begins on interorbital and extends to spinous dorsal, borders base of each dorsal fin and then forms single median line again on post-dorsal to caudal. Iris slaty.

Length 72 mm.

Type, No. 47,505, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Greatly resembles the preceding species, but differs at once in coloration. Besides the presence of the third lateral line below, the larger caudal spot and wider median lateral band anteriorly, there are no dark bars on the opercle.

(To Dr. William P. Wilson, of the Commercial Museums of Philadelphia, to whom I am indebted for the opportunity to study the present collection.)

Amia radcliffei sp. nov. Fig. 11.

Head $2\frac{2}{5}$; depth $2\frac{4}{5}$; D. VII–I, 9, 1; A. II, 8, 1; P. II, 10; V. I, 5; scales 23 in lateral line to caudal base and 4 more on latter; 2 scales between spinous dorsal origin, and lateral line, and 6 scales in vertical

Fig. 11.—*Amia radcliffei* sp. nov.

series to spinous anal origin; 4 predorsal scales; head width 2 in its length; head depth at occiput $1\frac{2}{5}$; snout $3\frac{2}{3}$; eye $3\frac{2}{3}$; maxillary 2; interorbital 5; third dorsal spine $2\frac{1}{5}$; first dorsal ray $1\frac{4}{5}$; second anal spine $3\frac{1}{2}$; second anal ray (damaged) $2\frac{2}{5}$; least depth of caudal peduncle $2\frac{1}{3}$; caudal (damaged) about $1\frac{1}{2}$; pectoral 2; ventral 2.

Body well compressed, moderately deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, predorsal scarcely with median keel. Caudal peduncle well compressed, least depth $1\frac{2}{5}$ its length.

Head large, moderately long, compressed, flattened surfaces slightly swollen below, profiles nearly straight and similarly inclined. Snout moderate, surface convex, length about $\frac{3}{4}$ of width. Eye

large, circular, next to upper profile, and head center in length nearly at hind eye edge. Mouth large, rather well inclined, and closed lower jaw included within upper. Maxillary large, well inclined, nearly straight and reaches past eye center about to hind pupil edge. Terminal maxillary expansion 2 in eye, slightly emarginate behind, and whole upper maxillary edge slips below preorbital: Latter moderate, width 3 in eye. Lips moderate, fleshy, firm. Teeth fine, even, short, in moderately wide bands in jaws. Narrow band over vomer to and on each palatine. Tongue free, depressed, smooth, rounded in front. Inner buccal folds rather narrow. Front nostril short inconspicuous tube about midway in snout. Hind nostril moderate pore close before, and nearer eye, than front nostril. Interorbital generally depressed, with slight furrow each side. Preopercle ridge entire, hind edge finely serrate. Opercle with single small spine.

Gill-opening forward about opposite hind nostril. Rakers II, 4+12, II, rather robust, lanceolate, nearly long as filaments, which 3 in eye. Pseudobranchiæ about long as filaments. Isthmus long, constricted forward, and with median keel, especially trenchant forward.

Scales large, finely ctenoid, above lateral line in rows parallel with its course, and below in horizontal rows. Head scaly, cheek with 2 rows, and opercles with moderate scales. Head above and mandible with numerous mucous channels. Large scaly flap between ventral bases about $\frac{2}{5}$ length of fin. Axillary ventral scale moderate, rounded. Caudal base covered with small scales, fins otherwise naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, large, and with appearance as if located on small obscure accessory scale.

Spinous dorsal inserted slightly behind pectoral origin, or about midway between snout tip and middle of last depressed dorsal ray, all spines slightly curved, third longest, second little longer than seventh, and first very short. Soft dorsal inserted nearly midway between hind eye edge and caudal base, spine $\frac{3}{5}$ of fin, and depressed fin $1\frac{3}{5}$ to caudal base. Spinous anal origin about opposite that of soft dorsal, and with soft anal much smaller than soft dorsal, though reaches about as far posteriorly. First anal spine about $\frac{1}{5}$ length of second. Caudal broad, slightly emarginate behind, and lobes rounded. Pectoral broad, not quite to anal origin. Ventral inserted well before pectoral origin, fin depressed $\frac{3}{4}$ to anal origin, spine about $\frac{5}{7}$ in fin. Vent little nearer depressed ventral tip than anal origin.

Color in alcohol dull brownish, more or less with general dull sooty tint, below well as above. Four obscure dark longitudinal bands, broad at first and narrow behind. First on back above lateral line, then along upper edge of caudal peduncle. Second from shoulder just below lateral line, and crosses latter below hind portion of soft dorsal. Third as band on snout tip, behind eye and crosses opercle back above pectoral to base of lower caudal lobe. Fourth obscurely along lower edge of abdomen. Caudal base with round jet-black spot about size of pupil, slightly above middle. Muzzle sooty-brown. Iris slaty. Fins all pale, outer portion of spinous dorsal brownish, and soft dorsal, anal and caudal all with 3 or 4 rows of small brown spots transversely. Gill-opening edge below broadly dusted dusky-brown, also lower surfaces of ventrals.

Length 90 mm. (caudal damaged).

Type, No. 47,500, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,501 to 47,504, A. N. S. P., paratypes, same data. They show: Head $2\frac{2}{5}$ to $2\frac{1}{2}$; depth $2\frac{7}{8}$ to 3; D. VII–I, 9, 1, and one VII–I, 10, 1; A. II, 8, 1; scales 22 to 24 in l.l. to caudal base and 4 or 5 more on latter; snout $3\frac{3}{5}$ to 4 in head; eye 3 to $3\frac{3}{5}$; maxillary 2; interorbital 5 to $5\frac{1}{2}$; length 75 to 90 mm.

Allied with *Amia hartzfeldi* Bleeker,[10] but that species is figured by its author with the dark caudal spot median basally, and but one blackish bar sub-basally on soft dorsal and anal, also scales on cheek in 4 rows, and maxillary longer.

(For Mr. Louis Radcliffe, of the Bureau of Fisheries at Washington, who studied the cardinal fishes of the Philippines.)

Amia savayensis (Günther).

A large series of this very variable species, 40 to 73 mm. in length. Sixteen agree with Günther's figure in most cases, but as they have long been in formaline the color-pattern has largely faded. In some the dark vertical stripes are very narrow, as the dark bands in all are margined each side with a still darker tint, and all the intervening color fading leaves them increased from the original eight to twice that number. The broad dark band on the caudal peduncle is present only as a saddle above. Every one of these examples have the oblique dark streak from the lower corner of the eye across the cheek. Upon comparison with eight specimens from Apia,

[10] Atlas Ich. Ind. Néerl., VIII, 1876–7, Pl. 69, fig. 2.

Samoa, all smaller, the dark streak from the eye to the preopercle angle is narrow, not quite so wedge-shaped as in the Manila examples. Also some show the dark saddle on the caudal peduncle simply as a dark blotch above the lateral line.

The rest of the series embraces 115 examples; all seem to agree in the dull unicolored caudal. They show underlaid traces of the three vertical broad dark bands of *A. bandanensis,* but only one on the caudal peduncle distinct, while others give place to about six vertical and rather broad bands in the space between the head and last dorsal ray's base.

Apogon savayensis Day[11] may represent a species distinct from the present one, as it is described and figured with the hind caudal edge dusky. It also has three broad dark vertical bands, one from each dorsal and the other a saddle on the caudal peduncle above. It surely approaches more closely Bleeker's *A. bandanensis,* which is figured with a uniform caudal.

A. nubilus Garman[12] is closer to my larger lot of specimens grouped above under the present species, but differs in the dark bar on the caudal basally, the dark broad vertical underlaid shades on the body below the dorsal fins, and the caudal peduncle blotch complete. Jordan and Seale say it is apparently the young of *Amia savayensis* with the markings faded.

Archamia zosterophora (Bleeker). Fig. 12.

Head $2\frac{3}{7}$; depth $2\frac{3}{5}$; D. VI–I, 9, I; A, II, 15; P. II, 12; V. I, 5; scales (pockets) 20 in lateral line to caudal base and 4? more on latter; 2 scales (pockets) above l.l. to spinous dorsal origin, and about 6 below in vertical series to spinous anal origin; 6 predorsal scales; head width $2\frac{1}{3}$ its length; head depth $1\frac{1}{5}$; mandible $1\frac{5}{6}$; third dorsal spine $2\frac{3}{4}$; second dorsal ray $1\frac{1}{2}$; second anal spine $2\frac{3}{4}$; first branched anal ray $1\frac{7}{8}$; least depth of caudal peduncle $2\frac{3}{4}$; upper caudal lobe $1\frac{2}{5}$; pectoral $1\frac{3}{5}$; ventral $2\frac{1}{8}$; snout $4\frac{1}{5}$ in head measured from upper jaw tip; eye $2\frac{4}{5}$; maxillary $2\frac{1}{5}$; interorbital $3\frac{4}{5}$.

Body well compressed, contour rather elongately ovoid with greatest depth at dorsal origin, and edges all convexly rounded. Caudal peduncle well compressed, least depth $1\frac{1}{3}$ its length.

Head deep, well compressed, flattened sides slightly approximated below, and lower profile very much more steep and convex than upper. Snout convex over surface, length about half its width. Eye large, close to upper profile, rounded, and hind edge about

[11] Fishes of India, I, 1875, p. 60, Pl. 16, fig. 5.
[12] Bull. Mus. Comp. Zool., 39, 1903, p. 230, Pl. 1, fig. 1. Suva, Fiji.

midway in head length. Mouth large, well inclined, mandible slightly protruding in front. Maxillary well inclined, straight, reaches opposite last fourth in pupil, and terminal expansion about $2\frac{1}{8}$ in eye, its hind edge slightly emarginate. Upper maxillary edge slips below preorbital except very short part of hind edge. Teeth minute, in narrow bands in jaws and apparently absent from mouth roof. Lips narrow, little fleshy. Tongue free, smooth, depressed, rather narrowly triangular. Inner buccal folds narrow. Front nostril small pore about first third in snout, and hind nostril short slit very close to front eye edge. Interorbital nearly level. Sub-

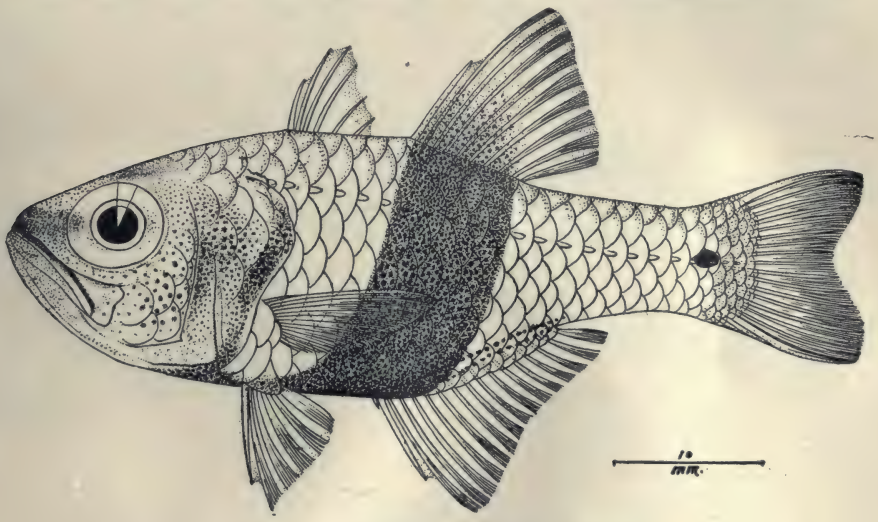

Fig. 12.—*Archamia zosterophora* (Bleeker).

orbital width about half of pupil. Preopercle ridge entire, with broad short spine at angle, and hind edge finely denticulate. Opercle without spine.

Gill-opening forward opposite front eye edge. Rakers 6+14, lanceolate, twice length of filaments or 2 in eye. Pseudobranchiæ long as gill-filaments. Isthmus narrowly compressed, slightly attenuated forwards, with trenchant edge, especially anteriorly.

Scales caducous, large, narrowly imbricated, in longitudinal series, minutely ctenoid. Scales in 2 rows on cheek, and scales on opercles moderate. Axillary ventral scale moderate, broad, pointed, about $\frac{2}{5}$ length of spine. Caudal base scaly, also anal base. Lateral line complete, concurrent with dorsal profile. Tubes large, trifid, well exposed. Bones of head rather cavernous. Suprascapula edge jagged.

Spinous dorsal origin little behind that of pectoral, fin low and spines weak, or slender, third longest with second and fourth subequal, depressed fin not quite reaching soft dorsal. Latter inserted about midway between eye center and caudal base, spine about half fin length, which depressed extends $\frac{3}{5}$ to caudal base. Anal inserted well before soft dorsal origin or about midway between front eye edge and caudal base, first branched ray longest though second subequal, and when depressed neither reach last dorsal ray base. Caudal emarginate, lobes rounded. Pectoral broad, reaches about first third in anal base. Ventral inserted before pectoral origin, reaches anal, and spine $\frac{2}{3}$ of fin. Vent close before anal.

Color in alcohol very pale or light brownish generally, scales on back above obscurely and finely dusted with slightly darker brownish. On postocular, cheek and suborbital a number of dull brown dots, some enlarged slightly. Blackish-brown band from snout tip to eye. On shoulder-girdle behind gill-opening, blackish brown streak forward to breast which same color. This also extends back over belly below, rising up obliquely after ventral bases to second dorsal fin as broad dark band, in width about equal to $1\frac{1}{2}$ eye-diameters. It is also reflected out on soft dorsal basally, but not the anal. All dark area noted made up of large crowded dark specks, larger and more sparse below. At caudal base round jet-black spot, median, and less than half of pupil in diameter. Fins, except coloration of soft dorsal and caudal base as noted, all uniform pale or brownish-white.

Length 58 mm.

Twelve examples from the Philippine Islands. Presented by the Commercial Museums of Philadelphia. Eleven show: Head $2\frac{1}{3}$ to $2\frac{1}{2}$; depth $2\frac{4}{7}$ to $2\frac{2}{3}$; D. VI–I, 9, 1; A. II, 15, 1 or 16, 1, rarely 14, 1; scales 19 or 20 in l.l. (pockets) to caudal base; snout 4 to $4\frac{1}{2}$ in head measured from upper jaw tip; eye $2\frac{4}{5}$ to 3; maxillary $1\frac{4}{5}$ to $2\frac{1}{8}$; interorbital $3\frac{3}{4}$ to 4; length 53 to 63 mm.

I redescribe this species as my material differs somewhat from both the description and figure by Bleeker.[13] This is especially evident in the broad dark band extending forward on the breast, and the black caudal spot not half the pupil diameter. Bleeker's figure does not show the former before the ventral bases and its forward limit is not mentioned in the description. He shows the caudal spot large as the eye. Weber's note[14] does not add sufficient detail to help solve this point.

[13] Atlas Ich. Ind. Néerl., VII, 1873–6, p. 103.
[14] Siboga Exp., Fische, 1913, p. 5.

Epinephelus matterni sp. nov. Fig. 13.

Head $2\frac{3}{5}$; depth 3; D. XI, 15, I; A. III, 8, I; P. II, 16, I; V. I, 5; scales 92 in lateral line to caudal base, and about 6 more on latter; tubes in l.l. 52 to caudal base and 5 more on latter; 17 scales in vertical series above l.l. to spinous dorsal origin; 11 scales in vertical series between soft dorsal origin and l.l.; about 27 scales in vertical series between spinous anal origin and l.l.; head width $1\frac{4}{5}$ its length; head depth at occiput $1\frac{2}{3}$; mandible 2; third dorsal spine $2\frac{3}{5}$; second branched dorsal ray $2\frac{1}{4}$; second anal spine $2\frac{7}{8}$; second branched anal ray $2\frac{1}{4}$; least depth of caudal peduncle $3\frac{1}{5}$; caudal $1\frac{3}{5}$; pectoral $1\frac{1}{2}$; ventral 2; snout $4\frac{1}{4}$ in head measured from upper jaw tip; eye 5; maxillary $2\frac{1}{5}$; interorbital 6.

Fig. 13.—*Epinephelus matterni* sp. nov.

Body robust, elongate, compressed, profiles rather evenly convex, though upper little more so, contour slightly ovoid with greatest depth about base of fifth dorsal spine. Body edges rounded convexly, chest and belly broadly so. Caudal peduncle compressed, length about $\frac{3}{4}$ its least depth.

Head rather large, compressed, greatest width slightly swollen below, profiles similarly inclined and nearly straight. Snout convex over surface, profile obliquely straight, and length about $\frac{3}{5}$ its width. Eye little longer than deep, rounded, close to upper profile and center near first third in head. Mouth oblique, and broad mandible protruding in front. Lips rather broad, thick or fleshy. Maxillary well exposed, reaches about opposite hind pupil edge, and expansion $1\frac{3}{5}$ in eye. Bands of rather small fine teeth in jaws, a few canine-like

in front of upper and along rami of mandible posteriorly, where also in but 2 rows on each ramus. Latter but little elevated inside mouth. Bands of much smaller teeth across vomer and on each palatine. Buccal folds moderately broad in mouth. Tongue depressed, smooth, free, and attenuated. Nostrils close together on side of snout, also close before front eye edge, front one with short tube and short cutaneous flap behind. Preorbital narrow, $2\frac{1}{4}$ in eye. Interorbital slightly convex. Preopercle edge slightly convex behind, finely serrated and with about 5 enlarged denticles around corner. Opercular spines 3, median largest, closer to lower and little posterior.

Gill-opening extending forward opposite front eye edge, and uppermost edge but slightly inclined from horizontal. Rakers IV, 3+9, IV, lanceolate, and longest about equal gill-filaments or $2\frac{1}{3}$ in eye. Pseudobranchiæ about $\frac{3}{4}$ of gill-filaments. Isthmus broad, bevelled in front, with slight keel behind.

Scales all finely ctenoid, largest on trunk, smaller along body edges, especially predorsal, breast and belly. Very small scales on head above, with crowded smaller ones basally, these also extend over postocular and suborbital regions, and cheek. Small scales also crowded about upper part of opercular flap. Very small scales over mandible, and about 10 rows on maxillary. Scales on trunk in more or less horizontal rows, crossing lateral line. Minute scales over basal portions of all fins more or less. Pectoral axil with pit, sheathed above by broad flap covered with small scales. Though of irregular size scales on cheek in about 25 rows from eye to lower preopercle angle. Lateral line of simple inclined tubes little exposed, and its course nearly concurrent with dorsal profile, out on caudal base medianly.

Spinous dorsal inserted little nearer snout tip than origin of soft dorsal, spines graduated down from third which longest, edge deeply notched with cutaneous point behind each spine tip. Soft dorsal inserted midway between spinous dorsal origin and caudal base, fin oblong, rounded in front and behind. Spinous anal inserted little nearer ventral origin than caudal base, second spine longest, third but little shorter, and first $\frac{2}{5}$ of second. Soft anal rounded, also caudal. Pectoral broad, reaches about $\frac{5}{6}$ to anal, and median rays longest. Ventral inserted close behind pectoral base, depressed fin reaching $\frac{3}{5}$ to anal, and spine about $\frac{3}{5}$ fin length. Vent at first third in space between depressed ventral tips and anal origin.

Color in alcohol brownish generally, only paler or much lighter

on extreme lower surface of head, breast and belly. About 5 indistinct deep brown obscure slightly inclined band-like saddles on back, first at predorsal, second on spinous dorsal medially, third just before soft dorsal, fourth at front median region of soft dorsal, and fifth at hind portion of soft dorsal. Whole trunk and head with slightly inclined dark streaks, irregularly and obscurely, slightly wavy, and quite numerous, but not parallel with rows of scales. Also ground-color with many pale blotches, spots or streaks, underlaid and obscure. Head more with speckled or spotted appearance than trunk. Coloration of latter extends on vertical fins more or less basally. Maxillary with brownish streak on scaly area. Fins all with obscure speckled appearance. Iris slaty-gray.

Length 178 mm.

Type, No. 47,506, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species is allied with *E. bontoides* (Bleeker), *E. megachir* (Richardson), *E. diacanthus* (Valenciennes) and *E. maculatus* (Bloch) in its biserial mandibular teeth. It most closely approaches *E. bontoides* in its equidistant opercular spines and mostly ciliated scales. These characters also agree with *E. megachir*, but that species has the pectoral long as its head. From *E. bontoides* it differs at once from any material or accounts I have seen, in color. This has been described as brown above with more or less numerous black dots, which may not be present on the fins.

RHOMBOPLITOIDES gen. nov.

Type *Rhomboplitoides megalops* sp. nov.

This genus of *Lutianidæ* resembles the American *Rhombloplites* in its scaly soft dorsal and anal fins, but differs in squamation, as the scales above the lateral line in oblique rows and those below in horizontal rows. It falls within the *Lutianinæ* in its entire interorbital and dentition.

(*Rhomboplites;* εἶδος, appearance.)

Rhomboplitoides megalops sp. nov. Fig. 14.

Head $2\frac{4}{5}$; depth 3; D. XI, 11, I; A. III, 8; P. II, 15; V. I, 5; scales 51 in lateral line to caudal base and 7 more on latter; 7 scales above l.l. to spinous dorsal origin, and 14 below in vertical row to spinous anal origin; 25 predorsal scales; head width $2\frac{1}{10}$ in its length; head depth at occiput $1\frac{1}{2}$; mandible $2\frac{1}{10}$; third dorsal spine $2\frac{1}{3}$; first branched dorsal ray $3\frac{1}{8}$; third anal spine $2\frac{4}{5}$; first branched anal ray $2\frac{2}{3}$; least

depth of caudal peduncle $3\frac{1}{8}$; caudal $1\frac{3}{7}$; pectoral $1\frac{1}{8}$; ventral $1\frac{3}{4}$; snout $3\frac{3}{5}$ in head measured from upper jaw tip; eye 3; maxillary $2\frac{2}{5}$; interorbital 4.

Body elongate, contour evenly fusiform with greatest depth at fourth dorsal spine base, and edges all convex, or with but slight keel just before dorsal. Caudal peduncle compressed, about long as deep.

Head large, well compressed with flattened sides little approximated below, and profiles evenly and slightly convex. Snout rather conic, convex over surface and slightly so in profile, length about $\frac{3}{4}$ its width. Eye very large, impinging on upper profile, and hind pupil edge near head center in length. Mouth large, oblique, and

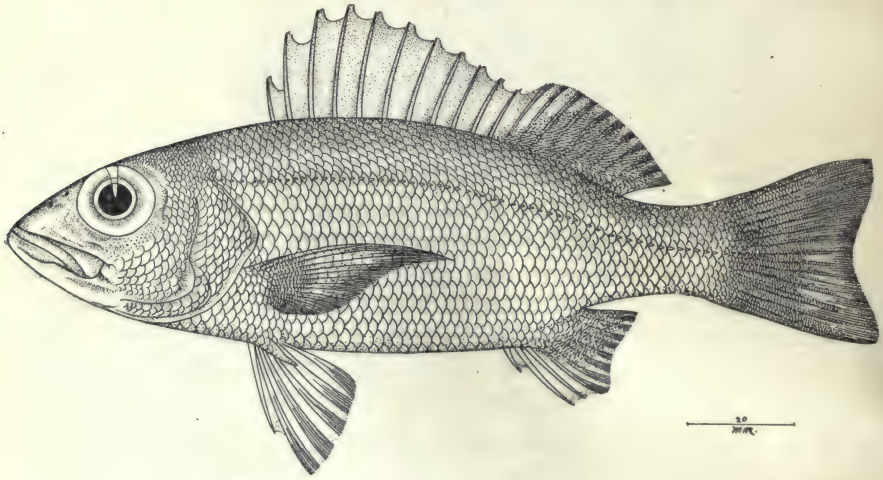

Fig. 14.—*Rhomboplitoides megalops* sp. nov.

gape extends about opposite front nostril. Premaxillaries moderately protractile. Maxillary oblique, upper edge entirely slips below preorbital, reaches first third in eye, and expansion $2\frac{1}{2}$ in eye. Lips thick, firm, tough, largely conceal teeth, lateral in jaws. Teeth in jaws in narrow bands, villiform, and with outer row of simple enlarged well-spaced canines, only visible in profile in front of upper and side of lower. Vomer with an elongate patch of villiform teeth, in outline similar to a narrow kite. Each palatine with narrow well-developed band of villiform teeth. Mandible rather robust, moderately deep, rami little elevated inside mouth, and symphysis slightly protrudes when closed. Buccal folds within mouth rather narrow. Nostrils rather large, simple, front one near last third in

snout length and hind one little larger, elevated, close before eye above. Interorbital about level. Preorbital width narrow, entire slightly less than a third of eye. Preopercle edge minutely denticulate, with slight indenture above angle. Opercle ends in 2 rather weak points.

Gill-opening forward beyond front pupil edge though not quite to front eye edge. Rakers 8+16, lanceolate, robust, nearly half of eye-diameter. Gill-filaments short, about $\frac{3}{5}$ of rakers. Pseudobranchiæ very large, about long as rakers. Isthmus narrowly constricted, with groove in front.

Scales all finely ctenoid, smaller on breast, predorsal, edges of caudal peduncle, and head above. Above lateral scales in slightly inclined rows to dorsal profile, below in horizontal rows. Most of head scaly, except muzzle and broad rim around eye. Front of interorbital naked and squamation from occiput forward about opposite center of eye. Cheek with 5 rows of scales to preopercle ridge, and on preopercle flange row of broad scales with several smaller, scattered irregular scales. Subopercle, interopercle and opercle scaly, also sides of head above. Caudal covered with small scales, also bases of soft dorsal, anal, pectoral and ventral. Pointed free axillary ventral scaly flap, $2\frac{1}{2}$ in fin. Lateral line complete, largely concurrent with dorsal profile, tubes simple and little exposed. On side of caudal peduncle lateral line little superior at first, median at caudal base.

Spinous dorsal inserted little behind pectoral origin, or little nearer soft dorsal origin than snout tip, spines long and slender, fourth longest and others graduated down, fin edge apparently little notched. Soft dorsal origin nearer caudal base than spinous dorsal origin, fin low, rounded or convex, last ray not produced, and not quite reaching caudal base. Anal begins about opposite soft dorsal origin, third spine longest with second little shorter, rayed fin little higher in front than soft dorsal and not extended so far posteriorly. Caudal moderate, hind edge very slightly emarginate. Pectoral long, falcate, reaches vent. Ventral inserted close behind pectoral base or but slightly before spinous dorsal origin, reaches $1\frac{1}{2}$ to anal, spine $1\frac{1}{2}$ in fin. Vent midway between ventral tips and anal origin.

Color in alcohol uniform pale brownish, fins scarcely tinted darker. Iris slaty.

Length 162 mm.

Type, No. 47,507, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Only the type known.

(*Μέγας*, large; *ὤψ*, eye.)

Nemipterus luteus (Bloch).

A single example which agrees with the smaller one figured from Cavite by Jordan and Seale.[15] Though they state "scales about 44" their figure shows 48 tubes in the lateral line, a point in agreement with my example.

MESOPRISTES Bleeker.

Mesopristes Bleeker, Nat. Genees. Arch. Ned. Indie (Topogr. Batav.) II, 1845, p. 523. Type *M. macracanthus* Bleeker (= *Datnia argentea* Cuvier), monotypic.

This genus has been described under *Datnia* Cuvier by Day,[16] but as Cuvier's type is *Coius datnia* B. Hamilton by tautonomy, *Datnia* merges with the sparoids.

Mesopristes plumbeus (Kner). Ayungen.

Datnia plumbea Kner, Sitz. Akad. Wiss. Wien (May 12) 49, 1864, p. 484. Vom Capoder der Insel S. Paul.

—Kner, Reise. Novara, Fische, 1865, p. 48, Pl. 3, fig. 2. "Fundort unsicher, angeblich von Java."

Therapon brevispinis (non Steindachner) Peters, Monatsb. Ak. Wiss. Berlin, 1868, p. 256. Quingoa flum., Provinc Bulacan, Luzon, P. I.

T. brachycentrus Peters, l. c., 1869, p. 705.

? *T. knerii* Bleeker, Atlas Ich. Ind. Néerl., VII, 1873–6, p. 115. Based on T. argenteus (non Cuvier) Kner, Sitz. Ak. Wiss. Wien, 58, 1868, p. 299, Pl. 1, fig. 1. Kandavu, Fiji.

Head 3 to $3\frac{1}{6}$; depth $2\frac{1}{2}$ to $2\frac{3}{4}$; D. XII, 8 to 10; A. III, 8; scales 43 to 50 in lateral line to caudal base, and 3 or 4 more on latter; 7 or 8 scales above l.l. to spinous dorsal origin; 13 to 15 scales below l.l. to spinous anal origin; 16 to 20 predorsal scales; snout $3\frac{1}{4}$ to $3\frac{1}{2}$ in head; eye $3\frac{2}{3}$ to 4; maxillary 3 to $3\frac{1}{4}$; interorbital $3\frac{3}{4}$ to $3\frac{4}{5}$. Body compressed, deepest at front of spinous dorsal. Head compressed, upper profile slightly concave. Snout convex, length $\frac{4}{5}$ its width. Eye rounded, close to upper profile, hind edge little posterior from middle in head length. Maxillary slightly beyond front eye edge, not to pupil. Teeth fine, in bands in jaws, outer row little enlarged. Mouth roof toothless. Tongue free, elongate, rounded in front. Jaws about even. Front nostril slightly nearer eye than snout tip, hind one slit above eye. Hind preopercle edge finely serrate. Interorbital nearly flat. Rakers 9 or 10+18 or 19, lanceolate, 2 in filaments and latter $1\frac{3}{5}$ in eye. Scales small, mostly uniform, smaller

[15] Bull. Bur. Fisher., XXV, 1906 (1907), p. 21.
[16] Fishes of India, I, 1875, p. 71.

along body edges and caudal base. Few small scales on soft dorsal and anal basally, also pectoral. Cheek with 5 rows of scales. L.l. concurrent with back and body scales in nearly parallel rows. Tubes small, simple, greatly exposed. Fourth dorsal spine $1\frac{3}{4}$ in head, fin edge deeply notched. Soft dorsal small, well back, first ray $2\frac{1}{3}$ in head. Second anal spine usually longest, 2 in head, though third often subequal. Caudal very slightly emarginate behind, $1\frac{1}{4}$ in head. Pectoral rounded, $1\frac{3}{4}$ in head. Ventral $1\frac{2}{5}$ in head, spine $1\frac{3}{5}$ in fin. Color in alcohol pale olive brownish above, each row of scales with slightly darker line. Spinous dorsal edge dusky, also soft dorsal, anal and caudal tinted with dusky, other fins pale. Iris pale slaty. Length 116 to 140 mm. Philippine Islands.

A very large series of individuals in the present collection, and they cover the discrepancies found in the accounts listed above. Kner's figure of *D. plumbea* does not show any small scales on the soft dorsal and anal bases. Bleeker has separated *T. kneri*, as Kner gives more numerous scales, and more pointed elevated dorsal and anal, etc. Jordan and Seale entirely overlook[17] Bleeker's reference and list *T. kneri* as "*T. argenteus* Kner," and as the locality Kandavu is in heavy-faced type, they may have thought it distinct from *T. argenteus* Cuvier, under which they place it.

Upeneoides philippinus sp. nov. Fig. 15.

Head $3\frac{2}{5}$; depth $3\frac{3}{4}$; D. VIII–I, 8, I; A. I, 6, I; P. II, 14; V. I, 5; scales 35 in lateral line to caudal base, and 4 more on latter; 3 scales above l.l. to spinous dorsal origin, and 7 below to spinous anal origin; 16 predorsal scales; head width $1\frac{3}{5}$ its length; head depth at occiput $1\frac{1}{4}$; snout $2\frac{1}{2}$; eye $4\frac{2}{5}$; maxillary $2\frac{2}{5}$; interorbital $3\frac{4}{5}$; second dorsal spine $1\frac{1}{3}$; first branched dorsal ray $2\frac{1}{8}$; anal spine 3; first branched anal ray 2; least depth of caudal peduncle $2\frac{3}{5}$; pectoral $1\frac{1}{3}$; ventral $1\frac{2}{3}$.

Body elongately ovate, deepest at spinous dorsal origin, edges all broadly convex. Caudal peduncle well compressed, least depth about $1\frac{7}{8}$ in its length.

Head well compressed, flattened sides slightly converge below, profiles convex and upper more inclined. Snout convex in profile and over surface, nearly long as broad. Eye moderate, rounded, close to upper profile, and hind pupil edge about midway in head length. Mouth moderate, little inclined from horizontal, and lower jaw slightly included in upper. Maxillary reaches about opposite front pupil edge, expansion $1\frac{1}{2}$ in eye. Lips rather narrow, fleshy.

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[17] Bull. Bur. Fisher., 1905 (1906), p. 266.

Teeth granular, in about 3 irregular rows in each jaw. Patch of granular teeth on vomer and each palatine. Inner buccal folds narrow. Tongue fleshy, thick, not free. Mandible shallow, rami not elevated inside mouth. Barbels short, and scarcely extend beyond hind eye edge. Nostrils greatly distant, front one simple pore about last $\frac{2}{5}$ in snout, hind one short slit close before eye. Interorbital very slightly convex. Preorbital broad, width slightly greater than eye. Preopercle edge entire. Opercle with 2 small concealed spines, close and above.

Gill-opening forward about opposite hind nostril. Rakers 6+10, VI, lanceolate, slender, $1\frac{1}{2}$ in filaments, and latter $1\frac{1}{5}$ in eye.

Fig. 15.—*Upeneoides philippinus* sp. nov.

Pseudobranchiæ about half length of gill-filaments. Isthmus narrowly constricted.

Scales uniformly large, finely ctenoid, in lengthwise rows parallel with lateral line. Small scales over most of caudal basally and front of soft dorsal and anal. Head scaly, and 2 rows of scales on cheek to preopercle ridge. Several large scales on exposed maxillary expansion. Pectoral axil with firm adipose scale above. Ventral with free pointed scaly flap $1\frac{2}{3}$ in fin. Broad scaly flap between ventral bases $\frac{1}{3}$ fin length. Lateral line concurrent with dorsal profile, well out on caudal base, tubes well exposed and each with several small branches.

Spinous dorsal inserted little nearer front nostril than second dorsal origin, second spine longest with third and fourth subequal, depressed fin $\frac{4}{5}$ to soft dorsal. Last inserted midway between

spinous dorsal origin and caudal base, first branched ray longest with spine $\frac{3}{5}$ its length, and depressed $\frac{2}{3}$ to caudal base. Anal origin slightly behind second dorsal, fin similar though smaller. Caudal well forked, sharp pointed lobes about equal. Pectoral small, pointed, reaches $1\frac{3}{5}$ to second dorsal origin. Ventral origin close behind pectoral base, though before spinous dorsal origin, reaches $1\frac{7}{8}$ to anal. Ventral spine about $\frac{5}{6}$ of fin.

Color in alcohol faded largely uniform dull brownish, lower surfaces scarcely paler. Spinous dorsal pale, apex broadly jet-black, and median brown horizontal band. Soft dorsal pale with three nearly horizontal dusky bands, uppermost apical and lowermost on hind rays. Caudal whitish, upper lobe crossed by three oblique broad dusky-brown bars, and lower lobe with two, but outer very broad and black. Median caudal rays also dusky. All other fins pale brownish. Iris pale slaty.

Length 180 mm.

Type, No. 47,508, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,509 to 47,511, paratypes, same data. These show: Head $3\frac{1}{5}$ to $3\frac{2}{7}$; depth $3\frac{1}{2}$ to $3\frac{4}{5}$; D. VIII–I, 8, I; A. I, 6, I; scales 35 in lateral line to caudal base and 4 more on latter; 3 scales above l.l. to dorsal origin, and 6 or 7 below to anal origin; 14 predorsal scales; snout $2\frac{3}{4}$ to 3 in head; eye $3\frac{4}{5}$ to $4\frac{1}{6}$; maxillary $2\frac{1}{4}$ to $2\frac{3}{5}$; interorbital $3\frac{1}{2}$ to 4; rakers 7 or 8+13, IV or 14, IV; length 120 to 149 mm.

Allied, if not identical with *Upeneoides vittatus* (Forskål), but apparently differs in the presence of but two black bars on the lower caudal lobe, the outer quite broad. The oldest synomym of *U. vittatus* is *Mullus bandi* Shaw,[18] based on Russell's *Badi goolivinda*.[19] This is doubtless *U. vittatus* and Russell says "the length seldom exceeds six inches." Shaw apparently copies Lacépède's crude figure, showing lower caudal lobe likely for the present or a closely allied species. Russell's figure has three dark lower caudal bars, but obliquely parallel with those of upper lobe! Russell also shows spinous dorsal tip not black, though fin crossed obliquely with three dark bars, and soft dorsal end dark, also fin crossed by two oblique dark bars. *Upeneus bitæniatus* Bennett[20] is simply diagnosed with two golden bands below lateral line, and dorsal and caudal with oblique black streaks.

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[18] Gen. Zool., IV, 1803, p. 615, Pl. 89.
[19] Fishes of Coromandel, II, 1803, p. 43, Pl. 158 (–60). Vizagapatam.
[20] Proc. Zool. Soc. London, 1830–1, p. 59. Mauritius.

Under *Upeneoides vittatus* later writers, as Günther,[21] Bleeker,[22] Day[23] and Sauvage[24] mention the lower caudal lobe with three dark oblique bars. Günther mentions two or three such bars, with adult material about a foot in length. Bleeker's figure shows greater upper portion of spinous dorsal black, only broad pink lengthwise band below middle. It also has soft dorsal apex black with two yellow lengthwise bands. Its caudal differs from Day's figure in innermost black bars leaving only narrow pale area, also tips of both lobes black, and bar next black tip on lower lobe twice wide as one nearer caudal base. Day's figure shows dark bars on lower caudal lobe evenly spaced, of about even width. Sauvage mentions three dark lower caudal bars, but his figure shows all the fins uniform and the body with four dark transverse bands. He includes in his table *U. tæniopterus* with *U. vittatus*, as a group with eight dorsal rays, though Day, who examined Valenciennes type of the former gives but seven.

Compared with *Upeneoides arge* Jordan and Evermann,[25] my examples of the present species differ as the former has pale tipped dorsal and caudal markings different. Jordan and Seale describe as *U. vittatus* Samoan material[26] closely approaching my specimens and refer to it as uete or vete. Two adult examples of *U. vittatus* before me from Tahiti, though in poor condition, still have traces of the fin markings, more as indicated in Bleeker's figure, and with four dark bars on each caudal lobe. Smith and Seale report *U. vittatus*[27] from Mindanao $4\frac{1}{5}$ to 11 inches long with "each lobe of caudal with 5 or 6 oblique dusky bars."

(For the Philippine Islands.)

Upeneoides belaque sp. nov. Fig. 16.

Head $3\frac{1}{4}$; depth $3\frac{1}{4}$; D. VIII–I, 8, 1; A. I, 6, 1; P. 1, 13; V. I, 5; scales 35 in lateral line to caudal base and 4 more on latter; 3 scales above l.l. to spinous dorsal origin, and 7 below to spinous anal origin; predorsal scales 17; head width 2 in its length; head depth at occiput $1\frac{1}{4}$; snout $2\frac{7}{8}$; eye 4; maxillary $2\frac{1}{4}$; interorbital $3\frac{1}{2}$; second dorsal spine $1\frac{1}{4}$; first branched dorsal ray $1\frac{7}{8}$; first branched anal ray $1\frac{4}{5}$;

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[21] Cat. F. Brit. Mus., I, 1859, p. 397.
—Journ. Mus. Godeffroy (F. Südsee) II, 1873–5, p. 55. Samoa and Tahiti.
[22] Atlas Ich. Ind. Néerl., IX, 1877, Pl. 342 (2), fig. 3.
[23] Fishes of India, I, 1875, p. 120, Pl. 30, fig. 2.
[24] Hist. Nat. Madagascar, Pisc., XVI, 1891, p. 219, Pl. 27, fig. 2.
[25] Bull. U. S. F. Com., XXII, 1902 (April 11, 1903), p. 187. Honolulu.
[26] Bull. Bur. Fisher., XXV, 1905 (1906), p. 273. Samoa.
[27] Proc. Biol. Soc. Wash., XIX, 1906, p. 78.

anal spine $2\frac{3}{5}$; least depth of caudal peduncle $2\frac{1}{2}$; upper caudal lobe 1; pectoral $1\frac{1}{4}$; ventral $1\frac{1}{2}$.

Body elongate, compressed, profiles nearly alike and deepest at spinous dorsal origin. Caudal peduncle compressed, least depth $1\frac{1}{2}$ its length.

Head moderately ovate in contour, well compressed, flattened sides scarcely converge above or below, profiles alike and upper little more inclined. Snout convex in profile and over surface, long as broad. Eye moderate, rounded, elevated close to upper profile, and hind pupil edge about midway in head length. Mouth moderate, inclined little from horizontal, and lower jaw slightly included in upper. Maxillary about reaches to pupil center, expansion $1\frac{1}{2}$ in

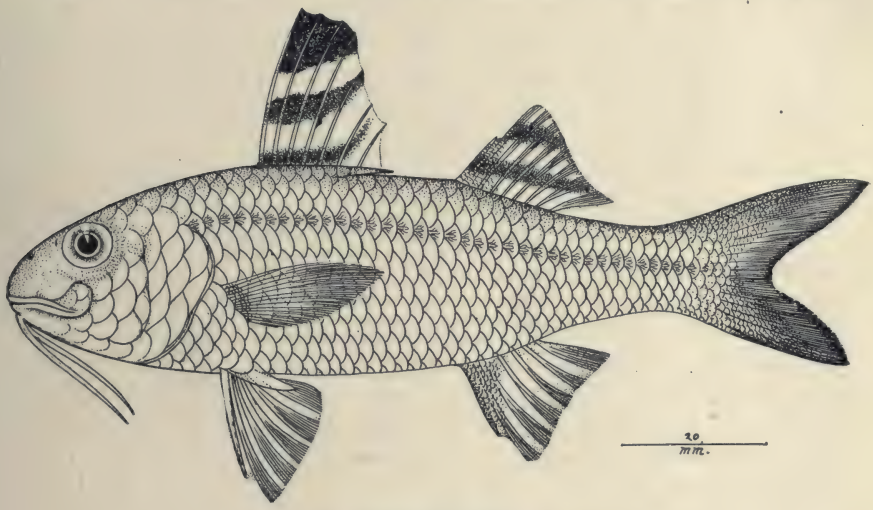

Fig. 16.—*Upeneoides belaque* sp. nov.

eye. Lips narrow, fleshy. Teeth granular in about 3 irregular rows in each jaw. Patch of granular teeth on vomer and each palatine. Inner buccal folds narrow. Tongue thick, fleshy, adnate. Mandible shallow and rami little elevated inside mouth. Barbels short, reach hind preopercle edge. Nostrils well separated, front one simple pore little nearer eye than snout tip, and hind one short slit close before middle of front eye edge. Interorbital slightly elevated convexly, flattened medially. Preorbital broad, width nearly equals eye. Preopercle edge entire. Opercle ends behind in 2 small close-set spines above, concealed by scales.

Gill-opening forward to front eye edge. Rakers 8+20, lanceolate,

slender, $1\frac{1}{5}$ in filaments, and latter $1\frac{1}{3}$ in eye. Pseudobranchiæ about $\frac{2}{3}$ of gill-filaments. Isthmus moderately constricted.

Scales uniformly large, finely ctenoid, in lengthwise rows parallel with lateral line. Small scales over most of caudal base and front of soft dorsal and anal. Head scaly, and 2 rows of scales on cheek to preopercle ridge. Several large scales on exposed maxillary expansion. Pectoral with broad scale above its origin. Ventral with pointed axillary scale very slightly over half of fin length. Broad scaly flap (damaged) between ventral bases. Lateral line concurrent with dorsal profile, well out on caudal base, tubes well exposed as arborescent groupings at each scale base.

Spinous dorsal inserted about midway between front eye edge and second dorsal origin, first spine longest with second and third subequal, depressed fin $\frac{7}{8}$ to second dorsal origin. Last inserted about midway between spinous dorsal origin and caudal base, first branched ray longest, with spine $\frac{3}{5}$ length of first ray and depressed fin $1\frac{1}{2}$ to caudal base. Anal origin slightly behind soft dorsal origin, fin similar. Caudal well forked, sharp pointed lobes about equal. Pectoral small, pointed, reaches about $1\frac{1}{3}$ to second dorsal origin. Ventral origin about opposite pectoral origin, reaches $1\frac{7}{8}$ to anal. Ventral spine about $\frac{4}{5}$ of fin.

Color in alcohol faded largely dull uniform brownish, lower surfaces whitish. Fins all pale, at least ground-color. Spinous dorsal with broad black apex, two dusky horizontal bands, and penultimate membrane dusky. Soft dorsal with upper edge dusky and two pale dusky horizontal bands. Caudal uniform pale brownish, hind edge pale dusky. Iris pale slaty.

Length 120 mm.

Type, No. 47,512, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,513 to 47,517, paratypes, same data. They show: Head 3 to $3\frac{1}{4}$; depth 3 to $3\frac{4}{5}$; D. VIII–I, 8, 1; A. I, 6, 1, rarely I, 7, 1; scales 32 to 35 in l.l. to caudal base and 3 or 4 more on latter; 3 scales above l.l., and 7 below; 16 or 17 predorsal scales; snout $2\frac{1}{2}$ to 3 in head; eye $3\frac{1}{2}$ to 4; maxillary $2\frac{1}{6}$ to $2\frac{1}{2}$; interorbital $3\frac{1}{2}$ to $3\frac{4}{5}$; rakers 8 or 9 +19 to 22; length 69 to 140 mm.

Allied with *Upeneoides sulphureus* but when compared with Sumatran material differs in coloration and more numerous gill-rakers. *U. sulphureus* has but one horizontal dark band on each dorsal besides dark end or border.

(*Belaque*, the native name of the allied *U. sulphureus* at San Fabian, P. I.)

Argyrosomus goldmani (Bleeker).

Small example and two adults which agree with Bleeker's figure, especially in length of second anal spine. My examples show latter $2\frac{4}{5}$ in head, and jaws about even when closed.

Sciaena dussumieri (Valenciennes).

Several examples. Contrary to the contention by Jordan and Thompson[28] that the "substitution of *Sciæna* for *Umbrina* by Bleeker is not warranted by the rules of the International Zoological Congress" in my opinion the type of a genus must be a species originally included in the genus under its distinct original binomial. As Gill designated *S. aquila* Cuvier the type of *Sciæna* Cuvier[29] which evidently was the *Cheilodipterus aquila* previously described by Lacépède and therefore definitely indicated a species not recognized by Linnæus or named in his original account, Gill's action is invalid. The first actual designation of *Sciæna cirrhosa* Linnæus as the type of *Sciæna* Linnæus, by Bleeker,[30] correctly argues that *Sciæna* supersede *Umbrina*, and the designation of *Sciæna umbra* by Jordan and others[31] is invalid.

Polydactylus plebius (Broussonet).

Three examples. Jordan and Evermann are wrong[32] in attempting to fix *Polynemus paradiseus* Linnæus as the type of *Polynemus* Linnæus, as Gill designates *Polynemus quinquarius* Linnæus[33] many years before 1883. *Polydactylus* will therefore remain the correct generic name for the present species.

Pomacentrus violescens Bleeker.

Four examples, which agree in the squamation and general coloration as shown by Bleeker. He gives the pectorals as clear violaceus with their bases commonly with a spot or transverse blackish or dusky streak. *P. philippinus* Evermann and Seale is very closely allied, if not identical. It is figured with 3 rows of scales on the cheek, the lowest on the preopercle limb. Its teeth are said to be small and uniserial.

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[28] Proc. U. S. Nat. Mus., XXXIX, 1911, p. 246.
[29] Proc. Acad. Nat. Sci. Phila., 1861, p. 82.
[30] Arch. Néerl. Sci. Nat. Harlem, XI, 1876, p. 326.
[31] Stanford Univ. Pub. (Genera of Fishes), 1917, p. 13.
[32] L. c., p. 15.
[33] Proc. Acad. Nat. Sci. Phila., 1861, p. 273.

Pomacentrus grammorhynchus sp. nov. Fig. 17.

Head $3\frac{2}{3}$; depth $1\frac{5}{6}$; D. XIII, 15, I; A. II, 15, I; P. II, 16, II; V. I, 5; tubes in upper arch of lateral line 18, and pores in straight section to caudal base 9; 3 scales between spinous dorsal origin and lateral line, and 10 below l.l. to spinous anal origin; 23 predorsal scales; head width $1\frac{2}{5}$ in its length; head depth about $1\frac{1}{8}$; snout 3; maxillary $3\frac{3}{4}$; interorbital $2\frac{1}{2}$; first dorsal spine nearly 4; thirteenth dorsal spine $1\frac{1}{5}$; eighth dorsal ray $1\frac{2}{5}$; second anal spine 2; sixth anal ray $1\frac{4}{5}$; least depth of caudal peduncle $1\frac{7}{8}$; ventral spine $1\frac{3}{4}$.

Body robust, compressed, contour rather deeply ellipsoid, with

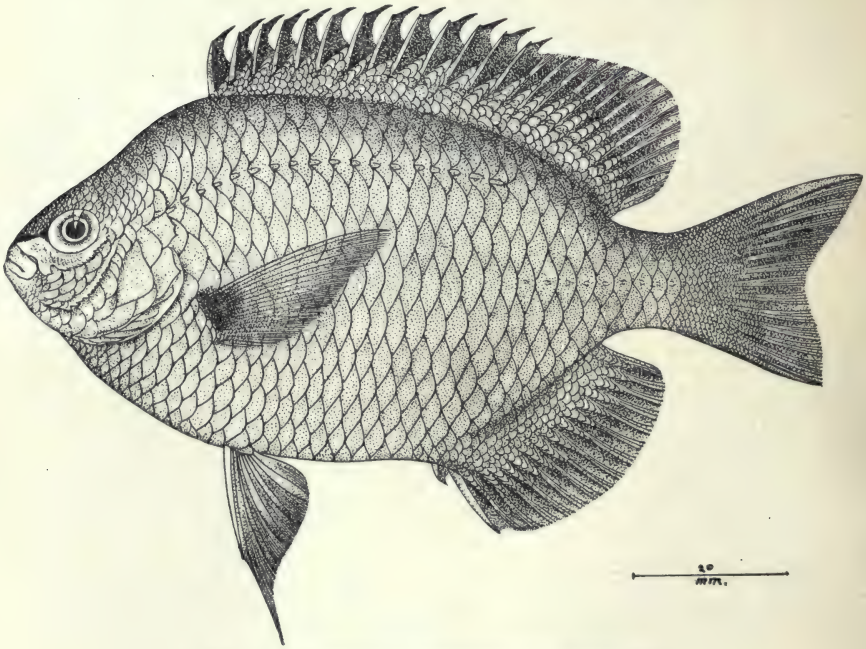

Fig. 17.—*Pomacentrus grammorhynchus* sp. nov.

greatest depth well over median region, predorsal slightly trenchant just before dorsal, otherwise edges convex, and profiles alike. Caudal peduncle compressed, length $\frac{3}{5}$ its least depth.

Head robust, moderately compressed, sides moderately convex, upper profile at first convex, then concave at occipital and predorsal bulging distinctly convexly. Snout convex over surface and in profile, length half its width. Eye rounded, little elevated, and hind pupil edge nearly midway in head length. Mouth broad, gape short, oblique, and jaws about even. Lips fleshy, rather

narrow. Maxillary extends slightly beyond nostril, though not nearly to eye, and slips below preorbital. Teeth rather slender, somewhat compressed, pointed, crowded close to form an even cutting-edge in a single row. No teeth on mouth roof or on tongue. Inner buccal folds broad. Tongue thick, fleshy, apparently free in front. Nostril small pore about midway in snout length. Interorbital evenly convex. Preorbital broad, width about $1\frac{3}{4}$ in eye, ends behind in broad posteriorly directed spine. Lower suborbital and hind preopercle edges serrate, serræ on latter graduated longer below, and lower preopercle edge entire. Opercle with 2 blunt and inconspicuous spines, upper concealed by scales.

Gill-opening forward about opposite front eye edge. Rakers 6+13, lanceolate, about half length of filaments and latter $1\frac{1}{4}$ in eye. Pseudobranchiæ long as gill-filaments. Branchiostegal membrane short fold over short and constricted isthmus.

Scales finely ctenoid, largest over middle of side of trunk and become much smaller all about edges, in lengthwise rows parallel with upper arch of lateral line. All larger scales narrowly imbricated. All fin bases scaly. Short scale between ventral bases about $\frac{1}{4}$ length of spine. Suprascapula with 3 blunt points. Exposure of humeral scale little larger than pupil. Axillary ventral scale broad, pointed, $\frac{1}{4}$ length of spine. Cheek with 3 rows of scales. Suborbitals, preorbital, snout edge, lips and chin naked. Upper arch of l.l. extends below front dorsal rays, concurrent with upper limit of squamation on dorsals. Tubes large, simple, and each extending well over scale exposure. Pores in straight section small, inconspicuous, simple or double irregularly, and not on caudal base.

Spinous dorsal origin about opposite that of pectoral, spines all more or less subequally high, edge of fin notched and slight cutaneous flap behind each spine tip. Soft dorsal inserted about last third in space between upper hind preopercle edge and caudal base, fin rounded with median rays longest. Anal inserted about midway between pectoral origin and caudal base, first spine about $\frac{1}{3}$ of second. Soft anal similar to soft dorsal. Caudal deeply emarginate, upper lobe much larger, $3\frac{1}{8}$ in combined head and trunk. Pectoral broad, about long as upper caudal lobe, reaches hind edge of vent and upper rays longest. Ventral inserted close behind pectoral base, reaches anal, and spine slightly over half length of fin.

Color in alcohol largely chocolate-brown above and posteriorly, head, breast and belly anteriorly paler or faded in appearance. Iris slaty. Dorsals and anals blackish-brown. Caudal pale brown-

ish. Pectoral brownish, with large blackish-brown blotch, nearly large as eye on base mostly above. Ventral blackish-brown, rays and spine pale. Dusky line from snout tip to eye.

Length 115 mm.

Type, No. 47,518, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Allied with *P. melanopterus* Bleeker, but differs in the presence of the dark line from the eye to the snout.

(*Γραμμή*, line; *ῥύγχος*, snout.)

Pomacentrus hebardi sp. nov. Fig. 18.

Head 3; depth 2; D. XIII, 14, I; A. II, 13, I; P. II, 15; V. I, 5; tubes 17 in upper arch of lateral line and 8? pores in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin and 9 below in vertical series to anal origin; 20 predorsal scales; head width $1\frac{4}{5}$ its length; head depth 1; snout $3\frac{2}{5}$; eye $2\frac{4}{5}$; maxillary $3\frac{1}{3}$; interorbital $2\frac{2}{5}$; last dorsal spine $2\frac{1}{3}$; second anal spine 2; eleventh dorsal ray 2?; ninth anal ray $1\frac{4}{5}$; pectoral $1\frac{1}{8}$; ventral spine 2; least depth of caudal peduncle $2\frac{1}{5}$; caudal 1.

Body well compressed, contour evenly and elongately ellipsoid, deepest medianly, and edges convexly rounded. Caudal peduncle compressed, length about $\frac{3}{5}$ its least depth.

Head compressed, moderately large, rather flattened sides evenly converging above and below. Snout rather broad, slightly convex in profile and evenly so over surface, and length $\frac{3}{4}$ its width. Eye rounded, little elevated, and hind pupil edge nearly midway in head length. Mouth small, short gape oblique, and lower jaw very slightly protruded. Lips moderate, fleshy. Maxillary extends back nearly opposite front eye edge. Teeth small, simple, compressed, rather obtuse and form as crowded in a single series nearly even cutting-edge. No teeth on mouth roof. Tongue pointed, depressed and smooth above, free in front. Inner buccal folds broad. Mandibular rami moderately elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital slightly convex. Preorbital width $2\frac{1}{4}$ in eye, with broad flat short spine directed back from hind edge. Suborbital edge with few irregular serræ below. Preopercle edge obliquely forward not quite opposite eye center, and 18 irregular serræ behind, though graduated larger downwards, and lower edge entire. Opercle with 2 obtuse short spines.

Gill-opening forward about opposite last $\frac{2}{5}$ in eye. Rakers 6+13, lanceolate, slightly shorter than filaments, which 2 in eye. Pseudo-

branchiæ a little shorter than gill-filaments. Branchiostegal membrane moderately free over short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges, and at fin bases. Vertical fins covered basally with small scales. Suprascapula entire. Cheek with 3 rows of scales and lowest row on preopercle limb. Lips, chin, preorbital, suborbitals and snout edge narrowly, naked. Scales on snout above and top of head all small. Upper arch of lateral line

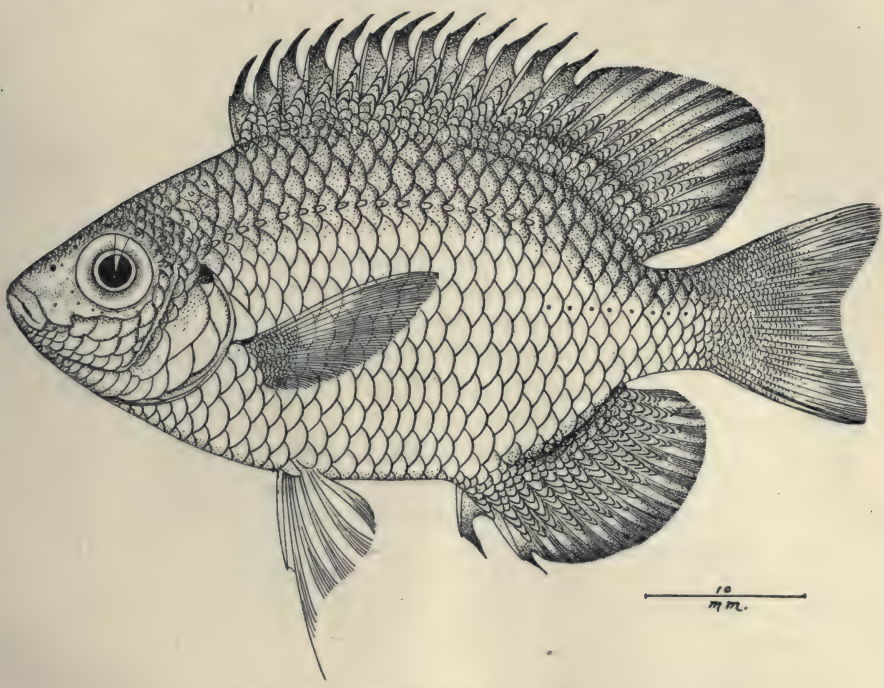

Fig. 18.—*Pomacentrus hebardi* sp. nov.

concurrent with limit of general squamation on dorsals, and extends back opposite soft dorsal origin. Tubes simple, large, extend over first half in each scale exposure. Pores in straight section simple, inconspicuous, and not on caudal base.

Spinous dorsal origin opposite pectoral origin, spines graduated up to fourth when largely subequal to last, fin edge notched and with cutaneous flap behind each spine tip. Soft dorsal origin at last third in space between hind eye edge and caudal base, and hind median rays longest. Spinous anal midway between pectoral origin and

caudal base, first spine about half length of second. Soft anal like soft dorsal. Caudal moderately emarginate behind. Pectoral long, about reaches anal. Ventral inserted close behind pectoral base, first ray ends in filament reaching second anal spine base. Vent close before anal.

Color in alcohol largely uniform brownish above, much paler below. Fins all largely pale, though marginal portions of spinous dorsal and anal dusky. Caudal pale to whitish. Very small dusky spot on uppermost scale of opercle. Another dusky spot, similar and about half size of pupil, at uppermost pectoral ray basally and above. Vent dusky. Iris slaty.

Length 56 mm.

Type, No. 47,519, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,520 to 47,525, paratypes, same data. These show: Head 3 to $3\frac{1}{8}$; depth $1\frac{3}{4}$ to 2; D. XIII, 13, 1 occasionally XIII, 14, 1 or XIII, 15, 1; A. II, 14, 1 sometimes II, 12, 1 or II, 13, 1; tubes in upper arch of l.l. 17, vary 14, 15 and 16; pores in straight section of l.l. 8; snout $3\frac{1}{8}$ to $3\frac{3}{4}$ in head; eye $2\frac{1}{2}$ to $2\frac{3}{5}$; maxillary $2\frac{2}{3}$ to 3; interorbital $2\frac{3}{4}$ to $3\frac{1}{8}$; length 43 to 54 mm. In these examples dusky vent quite characteristic.

Similar to *Pomacentrus moluccensis* Bleeker, but without a pale lengthwise line across anals, as shown in Bleeker's figure.[34] The latter also does not indicate a suborbital spine, which well developed in all of my examples.

(Named for Mr. Morgan Hebard of Philadelphia, an earnest student of Orthoptera, to whom I am indebted for small collections of fishes.)

Pomacentrus burroughi sp. nov. Fig. 19.

Head $3\frac{1}{3}$; depth 2; D. XIII, 14, 1; A. II, 15, 1; P. II, 15; V. I, 5; tubes 13 in upper arch of lateral line, and 10 pores in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 below in vertical series to spinous anal origin; 20 predorsal scales; head width $1\frac{1}{2}$ in its length; head depth 1; snout $3\frac{1}{2}$; eye $3\frac{1}{2}$; maxillary $3\frac{2}{5}$; interorbitals 3; last dorsal spine $1\frac{2}{3}$; second anal spine $1\frac{7}{8}$; fifth dorsal ray $1\frac{1}{4}$; eighth anal ray $1\frac{1}{2}$; pectoral 1; ventral spine $1\frac{4}{5}$; least depth of caudal peduncle 2; caudal about 1.

Body well compressed, contour rather deeply ellipsoid with greatest

[34] Atlas Ich. Ind. Néerl., IX, 1877, Pl. 3, fig. 3.

depth medianly, profiles alike, and edges convexly rounded. Caudal peduncle compressed, length about half its least depth.

Head compressed, rather small, rather flattened sides evenly converge above and below. Snout broad, convex, length $\frac{2}{3}$ its width. Eye rounded, little elevated, hind pupil edge about midway in head length. Mouth small, short gape slightly oblique, and jaws nearly even or with lower very slightly included. Lips rather narrow, fleshy. Maxillary extends back to eye. Teeth small, simple, compressed, pointed, crowded to form rather even cutting-edge,

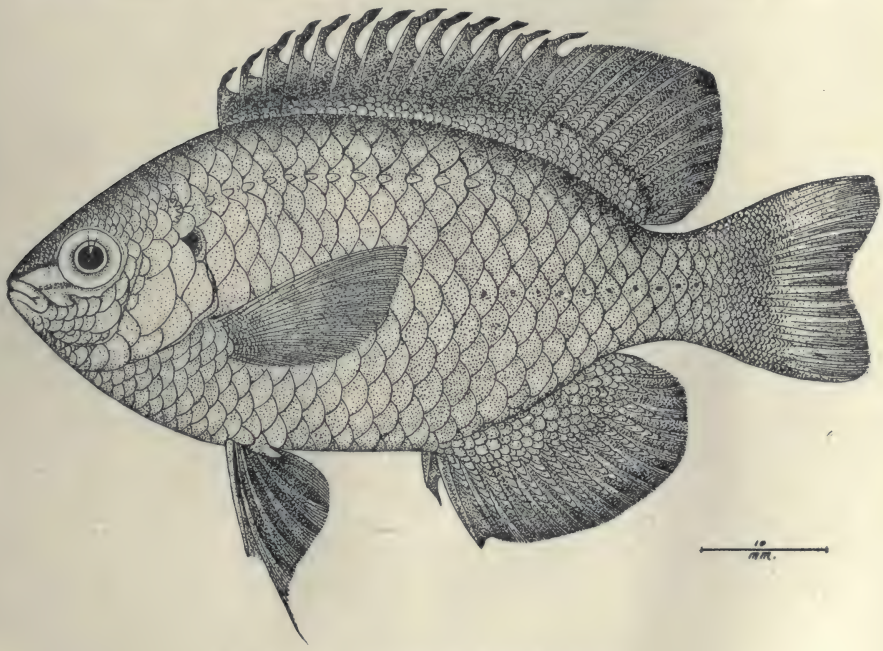

Fig. 19.—*Pomacentrus burroughi* sp. nov.

and in single series. No teeth on mouth roof. Tongue thick, pointed and free in front, smooth. Inner buccal folds broad. Mandibular rami rather well elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital evenly convex. Preorbital width $2\frac{1}{5}$ in eye, slips over upper maxillary edge, and with broad backwardly directed spine below at hind edge. Suborbital edge finely serrate below. Preopercle edge slopes forward with 19 serræ behind, lower edge entire. Opercle with 2 blunt points.

Gill-opening forward opposite front pupil edge. Rakers 6+10,

lanceolate, nearly long as filaments and latter half of eye. Pseudobranchiæ long as gill-filaments. Branchiostegal membrane narrowly over narrow short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges except breast and caudal peduncle above and below. Vertical fins with at least basal half covered with fine crowded scales. Suprascapula entire. Cheek with 2 rows of scales. Lips, preorbital, suborbitals, edge of snout narrowly, and chin, naked. Upper arch of lateral line concurrent with limit of general squamation on dorsals, and extends back to soft dorsal origin. Tubes simple, large, and each well over scale exposure, last nearly to edge. Pores in straight section simple, inconspicuous, one in center of each scale exposure, and not on caudal base.

Spinous dorsal origin opposite that of pectoral, spines graduated up to fourth, after which subequally long to last, and fin edge notched, also cutaneous point behind each spine tip. Soft dorsal inserted nearly at last third in space between upper hind preopercle edge and caudal base, fin rounded, with median rays longest. Spinous anal inserted much nearer pectoral origin than caudal base, first spine nearly $\frac{1}{3}$ of second. Soft anal like soft dorsal. Caudal slightly emarginate, and lobes rounded. Pectoral moderate, not quite reaching anal, though slightly beyond vent. Ventral inserted below hind pectoral base, reaches anal, first ray with slender filamentous tip, and spine half length of fin. Vent close before anal.

Color in alcohol uniform chocolate-brown generally, scarcely paler below. Fins also same general tint, except darker or mostly dusky, pectoral paler, and caudal still more so. Narrow obsolete dark line connects eyes around front of snout, including nostrils in its course. Uppermost opercular scale with conspicuous black blotch, though smaller than pupil. Inner pectoral axil brown, though at base of uppermost ray small black spot, smaller than spot on opercular scale.

Length 70 mm.

Type, No. 47,526, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,527, paratype, same data. Head 3; depth 2; D. XIII, 14; A. II, 14; upper arch of l.l. with 16 tubes and straight portion of 9 pores to caudal base; snout $3\frac{1}{2}$ in head; eye $2\frac{3}{4}$; maxillary $3\frac{1}{8}$; interorbital $3\frac{1}{8}$; length 57 mm.

Allied with *P. tripunctatus* Cuvier, but differs in the absence of the

black ocellus on the back of the tail, which Jordan and Seale state is apparently a distinctive character.[35] Bleeker gives six figures, though none exactly agree with my material.[36]

(For Dr. Marmaduke Burrough, 1798?–1844, who obtained fishes at Manila, which found their way to the Academy collection.)

Pomacentrus opisthostigma sp. nov. Fig. 20.

Head $3\frac{1}{8}$; depth $1\frac{7}{8}$; D. XIV, 12, I; A. II, 15, I; P. II, 15; V. I, 5; tubes 15 in upper arch of lateral line and 10 pores in straight section to caudal base; 4 scales above l.l. to spinous dorsal origin, and 10

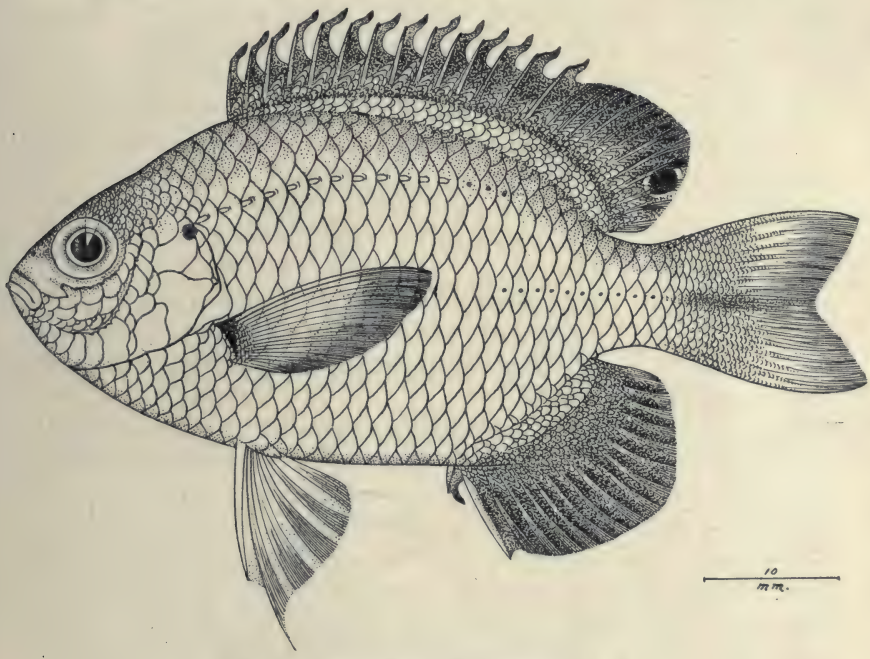

Fig. 20.—*Pomacentrus opisthostigma* sp. nov.

below in vertical series to spinous anal origin; 22 predorsal scales; head width $1\frac{2}{3}$ in its length; head depth 1; snout $3\frac{1}{8}$; eye $3\frac{1}{8}$; maxillary $3\frac{1}{3}$; interorbital $2\frac{4}{5}$; last dorsal spine 2 in head; second anal spine $1\frac{4}{5}$; sixth dorsal ray $1\frac{3}{4}$; eighth anal ray $1\frac{3}{5}$; pectoral 1; ventral spine $1\frac{3}{5}$; least depth of caudal peduncle $2\frac{1}{8}$; caudal about 1?.

Body well compressed, contour rather deeply ellipsoid with greatest depth medianly, profiles largely alike except slightly humped pre-

[35] Bull. Bur. Fisher., XXV, 1905 (1906), p. 281.
[36] Atlas Ich. Ind. Néerl., IX, 1877, Pl. 7, figs. 1–6.

dorsal, and edges convexly rounded. Caudal peduncle compressed, length about $\frac{2}{3}$ its least depth.

Head compressed, moderate, rather flattened sides evenly converging above and below. Snout wide, profile about straight, surface convex, and length $\frac{3}{4}$ its width. Eye rounded, little elevated, hind pupil edge nearly midway in head length. Mouth small, short gape slightly oblique, and jaws about even. Lips rather narrow, fleshy. Maxillary extends back nearly opposite eye. Teeth small, simple, compressed, but little pointed, crowded to form nearly even cutting-edge in single row. No teeth on mouth roof. Tongue thick, pointed, free in front, smooth. Inner buccal folds broad. Mandibular rami rather well elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital convex. Preorbital width 2 in eye, slips over most of upper maxillary edge, and hind edge with 2 short spines directed back. Suborbital edge finely serrate below. Preopercle edge obliquely forward not quite opposite eye center, finely serrate except several broader serræ at lower portion, and lower edge entire. Opercle with 2 short blunt points.

Gill-opening forward opposite front pupil edge. Rakers 8+15, lanceolate, longest $\frac{7}{8}$ of filaments, which $1\frac{4}{5}$ in eye. Pseudobranchiæ long as gill-filaments. Branchiostegal membrane narrowly over short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges and fin bases. Vertical fins finely and closely scaled over basal portions. Suprascapula entire. Cheek with 3 rows of scales. Lips, chin, preorbital, suborbitals and narrow edge of snout naked. Scales on snout above and top of head all small. Upper arch of lateral line concurrent with limit of general squamation on dorsals, extends back opposite twelfth dorsal spine base, though follow by 3 more pores till below front of soft dorsal. Tubes simple, large, well exposed or over first half of scale exposure. Pores in straight section simple, inconspicuous, one in center of each scale exposure, and not on caudal base.

Spinous dorsal origin opposite that of pectoral, spines graduated up to fourth, after which subequally long to last, and fin edge notched with cutaneous flap from behind each spine tip. Soft dorsal inserted at last third between suprascapula and caudal base, fin rounded, with median rays longest. Spinous anal inserted about midway between pectoral origin and caudal base, first spine nearly $\frac{2}{5}$ of second. Soft anal like soft dorsal. Caudal a little emarginate

behind. Pectoral moderate, reaches $\frac{7}{8}$ to anal or about opposite vent. Ventral inserted just behind pectoral base and reaches vent, spine $\frac{2}{3}$ of fin. Vent close before anal.

Color in alcohol brownish generally, paler on belly and lower surface of head. Dorsals and anals deep brown to dusky. Last longest rays of soft dorsal with large black ocellus, not quite large as eye, on terminal portion of fin. Caudal, pectoral and ventral pale brownish. Pectoral axil pale, though external base with blackish-brown vertical wedge-shaped mark on upper portion. Uppermost opercular scale with dusky blotch, much smaller than pupil. Iris slaty.

Length 65 mm. (caudal tips slightly damaged).

Type, No. 47,528, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,529 and 47,530, paratypes, same data. These show: Head $2\frac{7}{8}$ to $3\frac{1}{8}$; depth 2; D. XIV, 13 or XIV, 14; A. II, 15; tubes in upper arch of l.l. 16 and pores in straight section 10 to 12 to caudal base; snout 3 to $3\frac{7}{8}$ in head; eye $2\frac{7}{8}$ to 3; maxillary 3 to $3\frac{1}{8}$; interorbital 3 to $3\frac{1}{4}$; length 41 to 61 mm. All show ocellus on soft dorsal well developed, but preorbital spines very variable, and they may be single or double, even in the same individual.

Apparently unique in its coloration this species is characterized by the large black ocellus behind and terminally on soft dorsal. With the preceding three species this one appears to fall in Bleeker's subgenus *Pseudopomacentrus*.

(*Ὀπίσθεν*, rear; *στιγμα*, spot.)

Pomacentrus lividus (Forster).

Two small examples which do not show any scales on the lower limb of the preopercle, as in Bleeker's figure, and only 2 rows occur on the cheek.

Cheiloprion labiatus (Day).

Two examples. Weber figures the head from his single example[37] and though his text says the scales on the cheek are in $2\frac{1}{2}$ to 3 rows his figure shows 6 or 7. The former numbers are more in agreement with Day's figure, which is called *Pomacentrus labiosus*.[38]

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[37] Siboga Exped. Fische, 1913, p. 342, fig. 73. Beo, Karakelomg I.

[38] Fishes of India, III, 1877, Pl. 81, fig. 2.

Abudefduf antjerius (Cuvier).

Two, which agree as outlined by Bleeker in his limits of color-variation, with reference to the dorsal ocellus absent or at dorsal base behind and diffusely dusky.

Abudefduf philippinus sp. nov. Fig. 21.

Head $2\frac{4}{5}$; depth $1\frac{4}{5}$; D. XIII, 11; A. II, 12; P. I, 14; V. I, 5; tubes in upper part of lateral line 17, and pores in straight section 7; 3 scales above lateral line to spinous dorsal origin and about 8 scales below in vertical row to spinous anal origin; about 14 predorsal

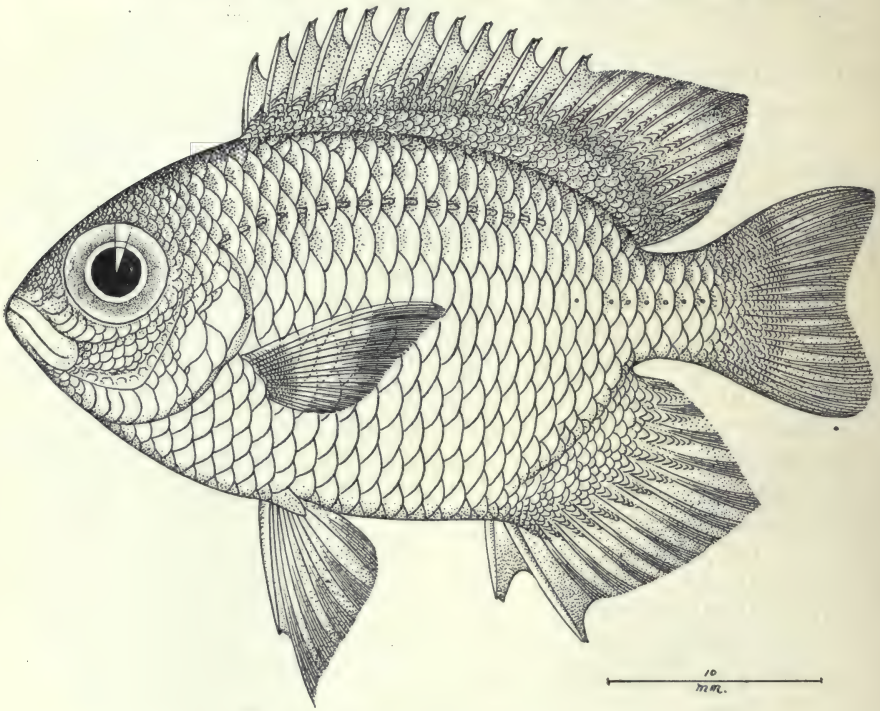

Fig. 21.—*Abudefduf philippinus* sp. nov.

scales; head width $1\frac{2}{3}$ its length; head depth 1; snout $3\frac{1}{4}$; eye $2\frac{1}{4}$; maxillary $3\frac{1}{5}$; interorbital $2\frac{3}{4}$; third dorsal spine 2; thirteenth dorsal spine $2\frac{1}{6}$; fifth dorsal ray $1\frac{2}{5}$?; second anal spine $1\frac{2}{5}$; fifth anal ray $1\frac{2}{7}$; least depth of caudal peduncle $2\frac{1}{5}$; caudal $1\frac{1}{5}$; pectoral $1\frac{1}{5}$; ventral $1\frac{1}{10}$.

Body well compressed, contour orbicular, deepest midway in length, predorsal with slight median keel and other edges convexly rounded. Caudal peduncle compressed, length $1\frac{1}{2}$ in its least depth.

Head moderate, well compressed, evenly constricted above and below, profiles similarly inclined. Snout convex over surface, very slightly so in profile, length $\frac{3}{5}$ its width. Eye large, close to upper profile, and hind pupil edge nearly midway in head length. Mouth well inclined, gape moderate, and jaws about even. Maxillary extends back slightly beyond front eye edge, though not quite to that of pupil, upper edge entirely slips below preorbital. Row of moderate, even, rather crowded, compressed incisors in each jaw, end of each tooth truncate, and whole forms even cutting-edge. No teeth on tongue or mouth roof. Tongue depressed, pointed, free. Inner buccal folds broad. Lips fleshy, moderately wide. Nostril slightly behind middle in snout length. Interorbital convex. Preorbital width $3\frac{1}{4}$ in eye. Hind preopercle edge slopes well forward, so that angle would fall nearly opposite center of eye, and like lower preorbital and suborbital edges, entire.

Gill-opening forward opposite front pupil edge. Rakers 7+16, lanceolate, longest about long as gill-filaments or 3 in eye. Pseudobranchiæ slightly longer than gill-filaments. Isthmus narrowly constricted, trenchant, branchiostegal membrane moderately broad across.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges. Fins all scaly basally. Suprascapula thin, entire, small. Cheek with 4 rows of scales. Opercle with moderate scales, small on interorbital, and still smaller on upper part of snout. Moderate scales on suborbitals and preorbital. Chin, lips, and narrow strip on front of snout naked, though mandible scaly. Scaly ventral flaps damaged. Lateral line with upper branch curving up at first, and then largely concurrent with upper limit of general squamation on dorsal fins, and ends below soft dorsal origin. Tubes simple, large, extend nearly over first half in scale exposure. Pores in horizontal section inconspicuous, small, and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines rapidly graduated up to third, then subequal, fin edge well notched. Soft dorsal origin nearly at last third between upper hind preopercle edge and caudal base, rays graduated up to sixth and seventh, which form sharp point behind. Spinous anal inserted well before soft dorsal, first spine about 3 in second, or fin origin nearly midway between ventral origin and caudal base. Soft anal like soft dorsal. Caudal (damaged) apparently little emarginate behind. Pectoral reaches anal. Ventral inserted below middle of pectoral base,

nearly reaches soft anal origin, and spine nearly $\frac{3}{4}$ fin length. Vent close before anal.

Color in alcohol largely faded dull brownish generally, predorsal, head above and front of back with traces of darker mottlings. Fins all pale uniform brownish. Iris slaty.

Length 41 mm. (caudal tip damaged).

Type, No. 47,531, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

No. 47,532, paratype, same data. It shows: Head $2\frac{4}{5}$; depth $1\frac{4}{5}$; D. XIII, 11; A. II, 12; tubes in upper arch of l.l. 17 and pores in straight portion 7; snout $3\frac{7}{8}$ in head; eye 2; maxillary 3; interorbital $2\frac{3}{4}$; length 36 mm.

Apparently falls within the subgenus *Amblyglyphidodon* Bleeker, and without much in common with the four East Indian species Bleeker describes.

Abudefduf parasema sp. nov. Fig. 22.

Head $3\frac{1}{6}$; depth $2\frac{1}{8}$; D. XIII, 11, I; A. II, 12, I; P. II, 13; V. I, 5; tubes in upper arch of lateral line 13, followed by oblique row of 4 pores and finally 8 pores in horizontal section to caudal base; 2 scales above l.l. and spinous dorsal origin, and 9 below in vertical series to spinous anal origin; 15 predorsal scales; head width $1\frac{2}{3}$ in its length; head depth at hind eye edge 1; snout $3\frac{3}{4}$; eye $2\frac{3}{4}$; maxillary $2\frac{4}{5}$; interorbital $2\frac{4}{5}$; fifth dorsal spine 2; third dorsal ray $1\frac{3}{5}$; second anal spine $1\frac{3}{5}$; third anal ray $1\frac{1}{3}$; least depth of caudal peduncle $2\frac{1}{10}$; caudal (damaged) $1\frac{1}{4}$?; pectoral $1\frac{1}{8}$; ventral spine $1\frac{3}{4}$.

Body well compressed, profiles evenly convex to form even ellipsoid contour, edges rounded, and greatest depth midway in length. Caudal peduncle compressed, length $\frac{3}{4}$ its least depth.

Head moderately large, well compressed, flattened sides evenly and slightly constricted above and below, profiles alike. Snout slightly convex in profile, surface also convex, length $\frac{3}{5}$ its width. Eye large, rounded, little elevated, well advanced. Mouth small, jaws about even. Maxillary small, reaches very slightly beyond front eye edge. Lips thin, narrow. Teeth small, uniserial, ends truncate. Inner buccal folds narrow. Tongue pointed, free, depressed. Nostril at last third in snout, simple pore with slight cutaneous rim. Interorbital convex. Preorbital width about 3 in eye, deeply notched but entire along edge. Preopercle edge entire and slopes forward about opposite hind eye edge.

Gill-opening forward about opposite front pupil edge. Rakers 4+16, lanceolate, slender, about long as filaments or $2\frac{1}{2}$ in eye. Pseudobranchiæ about long as gill-filaments. Isthmus narrowly constricted, short.

Scales ctenoid, narrowly imbricated, in even lengthwise rows, little smaller along body rows. Fins all scaly basally. Suprascapula thin, entire. Cheek with 2 rows of scales. Scales on opercles moderate, small on top of head. Lips, snout broadly, preorbital and suborbitals naked. Broad scaly flap between ventral bases about half length of fin. Ventral axilla with small pointed scale

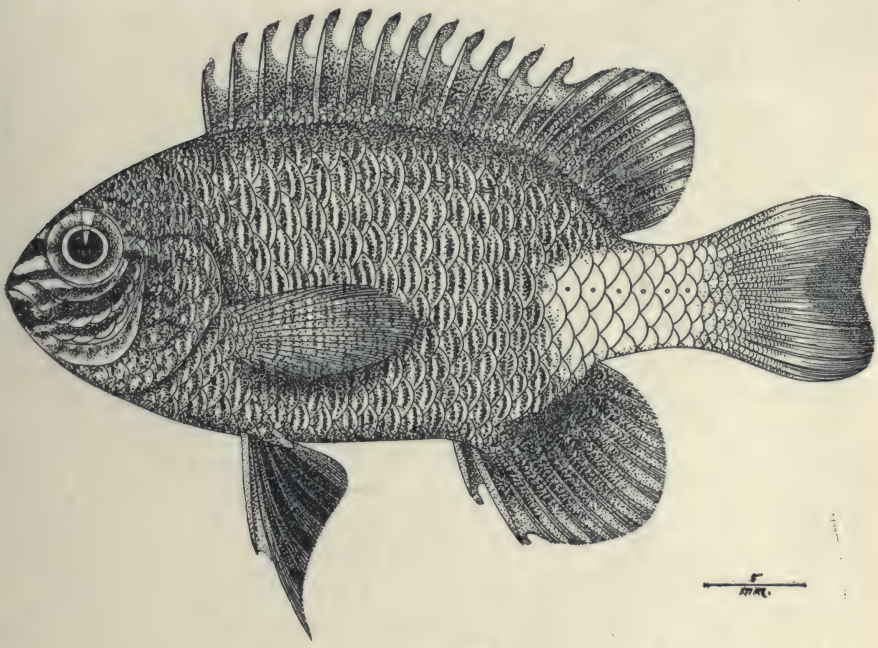

Fig. 22.—*Abudefduf parasema* sp. nov.

about 3 in spine. Height of large humeral scale equals $\frac{2}{3}$ of eye-diameter. Lateral line with upper branch curving up at first and then follows concurrently along back with upper limits of general squamation, though continues as several simple pores to caudal peduncle. Pores in horizontal section small, inconspicuous and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines graduated up to fifth, then subequal, fin edge well notched and slight cutaneous point behind each spine tip. Soft dorsal origin at last third between

spinous dorsal origin and caudal base, rays graduated to fourth which longest. Spinous anal origin little nearer pectoral origin than caudal base, first spine about $\frac{2}{5}$ of second. Soft anal graduated to fifth or longest ray, fin pointed behind like soft dorsal. Caudal small (damaged) and apparently rounded. Pectoral moderate, rather broad, nearly reaches anal. Ventral inserted close behind pectoral base, fin to second anal spine base, and fin length 3 in combined head and trunk length. Vent close before anal.

Color in alcohol deep chocolate-brown, caudal peduncle and caudal fin white in contrast. Vertical fin dusky-brown. Muzzle with 4 oblique dusky-chocolate streaks. Dark bar at pectoral origin and base. Each scale with dark blotch on head and dark vertical bar on each larger scale on trunk. Iris pale slaty. Hind caudal edge with moderately broad pale brown shade. Teeth pale.

Length 43 mm.

Type, No. 47,533, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also, Nos. 47,534 to 47,537, paratypes, same data. These show: Head 3 to $3\frac{1}{8}$; depth 2; D. XIII, 11, 1; A. II, 12, 1; scales 13 to 15 with tubes, then 3 or 4 pores, and finally 8 or 9 pores in horizontal section of lateral line; 2 or 3 scales above l.l. and 8 or 9 below; 17 to 19 predorsal scales; snout $3\frac{1}{3}$ to $3\frac{3}{4}$ in head; eye $2\frac{2}{3}$ to 3; maxillary 3 to $3\frac{3}{4}$; interorbital $2\frac{1}{2}$ to $2\frac{7}{8}$; length 37 to 43 mm.

Related to *Glyphidodon lacrymatus* Quoy and Gaimard,[39] which differs in coloration, the figure without black pectoral blotch and caudal only slightly paler or about same tint as pectoral. *G. lacrymatus* also shows scattered and rather large obscure bluish spots on back. *Abudefduf sapphirus* Jordan and Richardson has somewhat similar head markings, but has the tail and caudal peduncle like rest of body.

(*Παράσημα*, streamer, with reference to the pale tail.)

CTENOGLYPHIDODON subgen. nov.

Type *Abudefduf melanopselion* sp. nov.

Body of oblong contour. Preorbital broad, with entire edge. Hind preopercle edge entire. Gill-rakers very long and slender, also numerous or about 76 on first arch. Front border of snout, or space before nostrils, naked. Preorbitals and suborbitals scaleless. Of three rows of scales on cheek lowest row on preopercle limb.

[39] Voy. Uranie, Zool., 1825, p. 388, Pl. 22, fig. 7.

This subgenus appears unique in its very fine and numerous gill-rakers.

(*Κτεις*, comb; *Glyphidodon*, an old name for *Abudefduf;* with reference to the fine gill-rakers.)

Abudefduf melanopselion sp. nov. Fig. 23.

Head 3; depth $2\frac{1}{8}$; D. XIII, 14, I; A. II, 15, I; P. II, 13; V. I, 5; tubes in upper arch of lateral line 16, followed by 3 pores as one on each scale sloping down behind, then 5 pores in straight section on side of caudal peduncle; 5 scales in vertical series between l.l. and

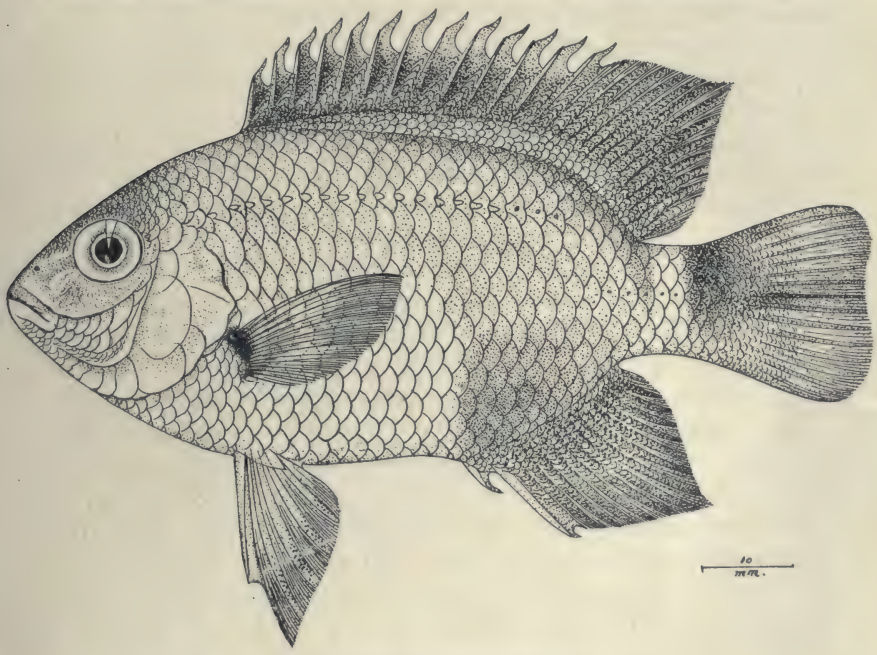

Fig. 23.—*Abudefduf melanopselion* sp. nov.

spinous dorsal origin, and 10 below in vertical series to spinous anal origin; 21 predorsal scales; head width $1\frac{1}{2}$ its length; head depth 1; snout $2\frac{4}{5}$; eye $3\frac{2}{5}$; maxillary $3\frac{2}{3}$; interorbital $2\frac{3}{4}$; last dorsal spine $1\frac{2}{3}$; seventh dorsal ray $1\frac{1}{3}$; least depth of caudal peduncle $2\frac{1}{6}$; second anal spine 2; seventh anal ray $1\frac{2}{7}$; caudal $1\frac{1}{4}$; pectoral $1\frac{1}{5}$; ventral $1\frac{1}{6}$.

Body well compressed, rather deep, and greatest depth median, edges rounded or predorsal scarcely trenchant. Caudal peduncle compressed, least depth twice its length.

Head moderately large, well compressed, evenly constricted above and below, upper profile little more inclined. Snout nearly straight

in profile, convex over surface, length about $\frac{4}{5}$ its width. Eye large, round, close to upper profile and hind pupil edge midway in head length. Mouth slightly inclined, jaws about even, gape short. Maxillary reaches about first $\frac{2}{5}$ in space between nostril and eye, entirely slips below broad preorbital. Teeth as row of rather even crowded compressed incisors, as single cutting-edge, and each tooth with end rather broad, or truncate, though slightly emarginate medially. No teeth on roof of mouth or tongue. Inner buccal folds broad. Tongue free, pointed and depressed. Lips moderately broad. Nostril simple pore slightly before middle in snout length. Interorbital convex. Preorbital width $1\frac{1}{4}$ in eye. Hind preopercle edge slopes well forward or about opposite eye center, and both it and preopercle ridge, also preorbital edge, entire.

Gill-opening forward about opposite hind maxillary end. Rakers 31+45, lanceolate or very slender, $1\frac{1}{2}$ in eye. Gill-filaments 2 in eye, pseudobranchiæ equally long. Isthmus narrowly constricted forward with narrow branchiostegal membrane.

Scales ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges. Fins all scaly basally. Suprascapula thin, entire. Cheek with 2 rows of scales. Scales on opercles moderate and small on top of head. Lips, preorbital, suborbitals and front edge of snout naked, also front of mandible. Scaly flap between ventral bases barely half of spine, and pointed axillary ventral scale about $\frac{2}{5}$ of spine. Height of large humeral scale equals eye-diameter. Lateral line with upper branch curving up at first and then follows concurrently along back with upper limits of general squamation to end below front of soft dorsal. Tubes simple, large, over first half of each scale exposure. Pores in horizontal section small and inconspicuous, and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines rapidly graduated up to third or fourth, then slightly so to last, fin edge well notched, and cutaneous flap from each spine tip behind. Soft dorsal origin little before last third in space between pectoral origin and caudal base, rays graduated to seventh, which longest and forms pointed tip behind reaching back half-way in caudal. Spinous anal origin midway between that of pectoral and caudal base, first spine $\frac{2}{5}$ length of second. Soft anal graduated to seventh ray, fin pointed behind like soft dorsal. Caudal (damaged) apparently truncate behind, broad. Pectoral moderate, $1\frac{1}{3}$ to anal, upper rays longest. Ventral inserted about opposite middle of pectoral base, spine $\frac{3}{5}$

length of fin and latter not quite to anal origin. Vent about midway between ventral spine tip and spinous anal origin.

Color in alcohol pale russet-brown on front, shading off on front of back to chocolate-brown above medianly and posteriorly, which latter tint uniformly over dorsals. Region above anal, caudal fin, and anal fin chocolate-brown, fins of darker tint. Pale transverse streak on caudal peduncle and caudal base with broad dark transverse area. Median caudal rays dusky, outer pale. Dusky-brown blotch on upper half of pectoral base and slightly on humeral scale also. Lower surface of head, breast and belly all pale or light brownish. Lips grayish. Iris pale slaty. Pectoral grayish, paler below. Ventral blackish-brown, front and hind margins broadly pale.

Length 93 mm.

Type, No. 47,538, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

(*Μέλας*, black; *ψέλιον*, bracelet; with reference to the black pectoral bases.)

Chromis scotochilopterus sp. nov. Fig. 24.

Head $3\frac{1}{4}$; depth 2; D. XIII, 11; A. II, 11; P. II, 16; V. I, 5; tubes in upper arch of lateral line 19, and 9 in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 scales in vertical row below to spinous anal origin; predorsal scales about 32; head width $1\frac{2}{5}$ in its length; head depth 1; mandible $2\frac{2}{3}$; fourth dorsal spine 2; fourth dorsal ray $1\frac{1}{3}$; second anal spine $1\frac{1}{2}$; sixth anal ray $1\frac{3}{5}$; least depth of caudal peduncle 2; ventral $1\frac{1}{10}$; snout 4 in head measured from upper jaw tip; eye 3; maxillary $2\frac{2}{5}$; interorbital 3.

Body well compressed, contour deeply ellipsoid, greatest depth midway in its length, edges convex. Caudal peduncle well compressed, length $\frac{3}{4}$ its least depth.

Head large, deep, compressed, flattened sides slightly constricted below, and upper profile slightly steeper. Snout slightly convex in profile, length half its width. Eye large, rounded, scarcely elevated, hind edge but slightly behind center in head length. Mouth oblique, gape moderate, lower jaw slightly protruded. Maxillary reaches slightly beyond front eye edge, not quite to pupil. Lips rather narrow, fleshy. Teeth short, strong, conic, in outer row in each jaw, and those in front little larger than others. Inner teeth fine, minute, crowded close behind outer row. No teeth on roof of mouth or on tongue. Inner buccal folds broad. Rami of mandible but little elevated inside mouth. Nostril about last $\frac{2}{5}$ in snout length,

simple, moderate pore. Interorbital convex. Preorbital partly ensheaths upper maxillary edge, width 3 in eye. Hind preopercle edge slightly emarginate, whole edge entire.

Gill-opening extends forward opposite hind maxillary edge. Rakers 10+13, lanceolate, about $\frac{4}{5}$ of filaments, and latter $1\frac{3}{4}$ in eye. Pseudobranchiæ long as gill-filaments. Isthmus narrowly constricted forwards, with rather narrow branchiostegal membrane across.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows more or less converging behind, and smaller along body edges.

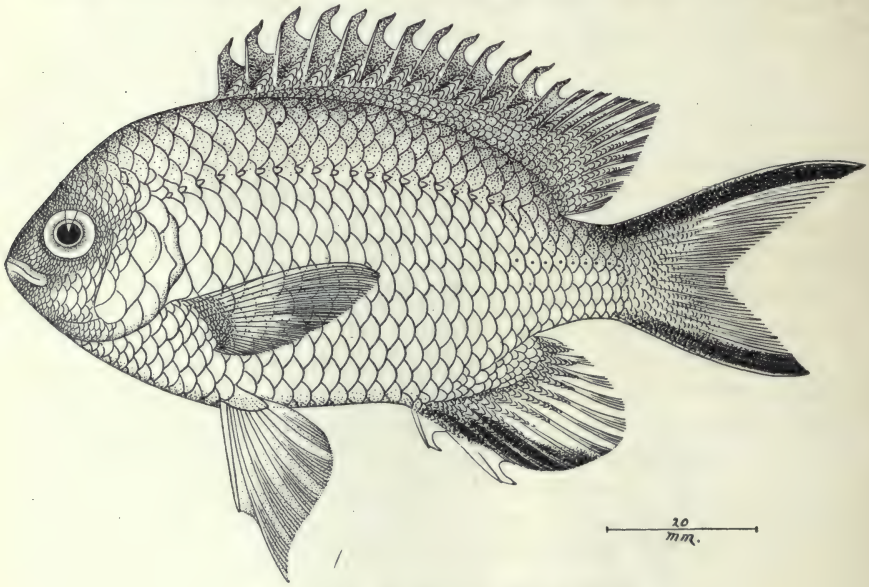

Fig. 24.—*Chromis scotochilopterus* sp. nov.

Fins all scaly basally. Suprascapula small, thin, entire. Head scaly, except lips, and on muzzle, suborbitals and interorbitals smaller scales crowded closely. Cheek with 6 rows of scales, two median rows enlarged. Opercles with moderately large scales. Humeral scale moderate. Ventrals with median scaly flap $\frac{2}{5}$ of fin, and pointed axillary scale $\frac{1}{4}$. Upper branch of lateral line curving up at first, then concurrent with upper limit of general squamation on dorsal fins, and ends below front basal region of soft dorsal. Tubes simple, large, and well over front half of each scale exposure. Pores in horizontal section simple, small, one in middle of each scale exposure, and 2 irregularly on caudal base.

Spinous dorsal inserted about over ventral origin, spines graduated up to fourth after which subequal, fin edge notched and cutaneous flap from behind tip of each spine. Soft dorsal inserted nearly at last fourth in space between pectoral origin and caudal base, rays graduated up to fifth which forms point extending back well beyond caudal base. Spinous anal inserted midway between pectoral origin and caudal base, first spine 3 in second. Soft anal more rounded than soft dorsal, first 6 rays subequal. Caudal deeply forked, about $2\frac{1}{3}$ in combined head and trunk, lobes sharply pointed and upper much longer. Pectoral reaches vent, which close before anal. Ventral reaches slightly beyond vent to anal, and insertion close behind pectoral base. Ventral spine $\frac{2}{3}$ of fin.

Color in alcohol largely dull uniform brownish, scarcely paler below. Some small obscure whitish spots sprinkled on opercles and upper side of head, along middle of side and near depressed pectoral tip. Head brownish above, especially interorbital and upper snout surface. Iris slaty. Spinous dorsal blackish-brown. Soft dorsal blackish-brown basally, which broadly so at first and narrowly behind, rest of fin white. Dark color of this fin also reflected on adjacent region of back. Caudal white, except upper and lower borders broadly, to tips of lobes, which blackish-brown. Anals white, except along front edge of soft anal broad blackish-brown band to hindmost tip of fin. Pectoral pale, with small brownish axillary blotch above, though not extending on outside of fin. Ventral brownish, darker terminally. Apparently whole general coloration more or less olivaceous when fresh.

Length 115 mm.

Type, No. 47,539, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,540, paratype, same data: Head $3\frac{1}{8}$; depth 2; D. XIII, 11; A. II, 11; tubes in upper arch of l.l. 18, and 7 in straight section to caudal base; snout 4 in head measured from upper jaw tip; eye $2\frac{3}{5}$; maxillary $2\frac{4}{5}$; interorbital $3\frac{1}{5}$; length 75 mm.

Allied with *Chromis xanthochir* (Bleeker), but differs in its coloration as represented in his colored figure.[40]

(*Σκοταῖος*, dark; *χειλος*, edge; *πτερον*, fin.)

Chromis philippinus sp. nov. Fig. 25.

Head $3\frac{2}{5}$; depth $1\frac{7}{8}$; D. XII, 11; A. II, 11; P. II, 15; V. I, 5; tubes in upper arch of lateral line about 15, and 9 pores in straight portion

[40] Atlas Ich. Ind. Néerl., IX, 1877, Pl. 3, fig. 5.

to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 below in vertical series to spinous anal origin; about 23 predorsal scales; head width $1\frac{3}{4}$ in its length; mandible $2\frac{7}{8}$; third dorsal spine $2\frac{2}{5}$; twelfth dorsal spine 3; fourth dorsal ray $1\frac{1}{4}$; second anal spine $2\frac{1}{8}$; sixth anal ray $1\frac{1}{2}$; least depth of caudal peduncle 2; pectoral 1; ventral 1; snout $3\frac{1}{2}$ in head measured from upper jaw tip; eye $2\frac{1}{2}$; maxillary 3; interorbital $2\frac{3}{5}$.

Body well compressed, contour somewhat ovoid with greatest depth near spinous dorsal front, and edges all convex. Caudal peduncle compressed, about long as deep.

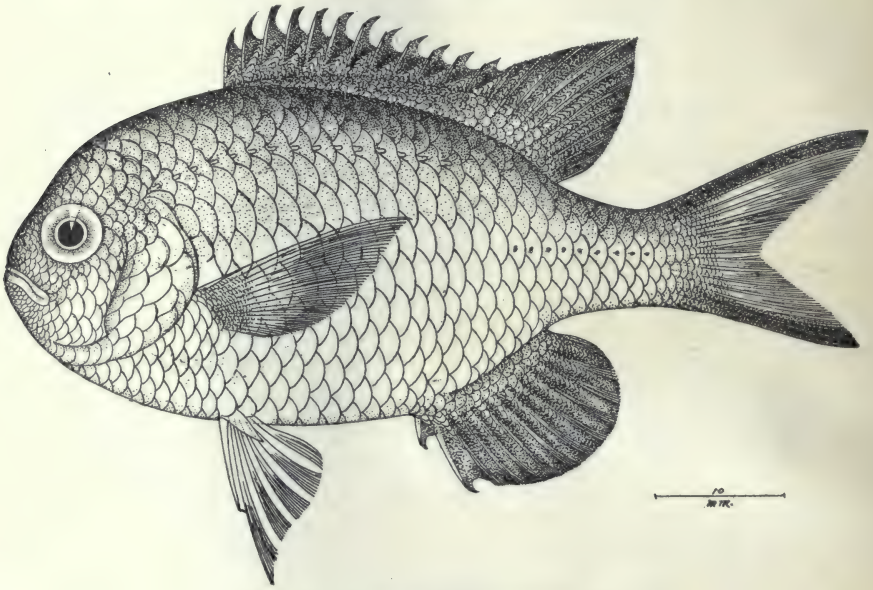

Fig. 25.—*Chromis philippinus* sp. nov.

Head rather large, well compressed, flattened sides slightly constricted below, profiles similarly and nearly evenly convex. Snout convex in profile and over surface, length $\frac{3}{5}$ its width. Eye circular, large, but slightly elevated and hind pupil edge about midway in head length. Mouth small, oblique, gape short, and closed lower jaw slightly protrudes. Maxillary small, extends back very slightly beyond front eye edge. Lips fleshy, rather narrow. Teeth fine, simple, conic, strong, in bands in jaws, and entire outer row enlarged, especially anteriorly. No teeth on mouth roof or on tongue. Inner buccal folds broad. Tongue broad, depressed and free. Nostril simple pore at last $\frac{2}{5}$ in snout. Interorbital convex. Preorbital

ensheaths upper maxillary edge, its width $2\frac{1}{8}$ in eye. Hind preopercle edge obliquely forward opposite hind pupil edge, little emarginate below, and entire.

Gill-opening forward opposite front eye edge. Rakers 9+20, lanceolate, very slender, slightly less than filaments or latter about 2 in eye. Pseudobranchiæ about as long as gill-filaments. Isthmus narrowly constricted, especially anteriorly, with rather narrow branchiostegal membrane across.

Scales finely ctenoid, narrowly imbricated in even lengthwise rows somewhat converging behind, and smaller along body edges. Fins all scaly basally. Suprascapula small, entire. Head scaly, except lips, and on snout and mandible scales quite small. Cheek with 4 rows of scales, and a single row of broad ones on preorbital. Scales on opercle moderate. Humeral scale large as eye. Small scales on breast and pointed scaly flap between ventral bases 3 in fin, and pointed axillary scaly flap about same. Upper branch of lateral line curves up at first, then concurrent with upper limit of general squamation on dorsal fins, and ending below soft dorsal origin. Tubes simple, large, and extend well over each scale or for about first $\frac{2}{3}$ its exposure. Pores in horizontal section mostly simple and single, though some few double, all median on each scale exposure, and not on caudal base.

Spinous dorsal inserted about opposite hind basal pectoral edge, spines slightly graduated to third, others more or less subequal, and fin edge notched. Soft dorsal inserted about last third in space between hind preopercle edge and caudal base, graduated to fourth and fifth rays, which form point behind extending slightly beyond caudal base. Spinous anal inserted nearer pectoral origin than caudal base, first spine nearly $\frac{2}{5}$ length of second. Soft anal little more oblong than soft dorsal, little shorter behind. Caudal deeply forked, subequal lobes sharply pointed, $2\frac{2}{3}$ in combined head and trunk. Pectoral reaches second anal spine base. Ventral inserted below last half of pectoral base, reaches nearly to anal, and spine about $\frac{4}{7}$ of fin. Vent about midway between depressed ventral spine tip and anal origin.

Color in alcohol dark brown above generally, and lower surface paler. Traces of obscure mottling or spots on head above and back especially anteriorly. Under surface of head, with lips pale. Iris slaty. Dorsals blackish-brown, also anals. Caudal with lengthwise blackish-brown band broadly on upper lobe above and lower lobe

below, rest of fin paler or gray-brown. Pectoral and ventral pale brown.

Length 70 mm.

Type, No. 47,541, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,542 to 47,547, paratypes, same data. These show: Head 3 to $3\frac{1}{4}$; depth $1\frac{4}{5}$ to 2; D. XII, 11, once XII, 10; A. II, 11, rarely II, 10 to II, 12; tubes in upper arch of l.l. 15, rarely 14; pores in straight portion of l.l. 10, rarely 9 or 12; snout $3\frac{1}{2}$ to 4 in head measured from upper jaw tip; eye $2\frac{2}{5}$ to $2\frac{7}{8}$; maxillary $2\frac{4}{5}$ to $3\frac{1}{8}$; interorbital $2\frac{2}{3}$ to $2\frac{7}{8}$; length 58 to 75 mm. Some of the smaller ones show a slight depression concavely above eye in upper profile.

Allied with *Chromis ternatensis* (Bleeker), especially in its pale anal and dark edged caudal, though differs in its preorbital not half so wide as in Bleeker's figure.[41] Day's figure of *Heliastes lepidurus*[42] is close in proportions, and is likely identical with the present species. His figure differs in a radiation of scales below the eye and the dark pectoral spot appears above the pectoral base and not on the base of first ray.

HOPLOCHROMIS subgen. nov.

Type *Heliases cœruleus* Cuvier.

Differs from the subgenus *Chromis*, as represented by the preceding species, in the presence of external outwardly directed conic teeth in each jaw.

(*Ὅπλον*, armour; *Chromis;* with reference to the external series of teeth.)

Chromis cœruleus (Cuvier).

Six examples.

Callyodon philippinus sp. nov. Fig. 26.

Head 3; depth $2\frac{2}{5}$; D. IX, 10, I; A. III, 9, I; P. II, 12; V. I, 5; scales in lateral line 19+5 to caudal base and 2 more on latter; 2 scales between spinous dorsal origin and l.l. and 6 below in vertical series to spinous anal origin; 6 predorsal scales; head width 2 in its length; head depth $1\frac{1}{6}$; snout $2\frac{1}{4}$; eye $6\frac{2}{3}$; maxillary 5; interorbital $2\frac{2}{3}$; third dorsal spine 3; first dorsal ray $2\frac{2}{3}$; third anal spine $3\frac{1}{5}$; third anal ray $2\frac{4}{5}$; least depth of caudal peduncle $2\frac{1}{4}$; caudal $1\frac{2}{5}$; pectoral $1\frac{1}{3}$; ventral $1\frac{3}{4}$.

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[41] Atlas Ich. Ind. Néerl., IX, 1877, Pl. 4, fig. 4.
[42] Fishes of India, III, 1877, Pl. 82, fig. 1.

Body compressed, contour elongately ellipsoid, deepest about midway in its length, and edges convexly rounded. Caudal peduncle well compressed, length about $\frac{3}{4}$ its least depth.

Head large, compressed, flattened sides about evenly constricted above and below, and upper profile a little more evenly convex than lower. Snout convex in profile and over surface, long as wide. Eye small, a little elevated, rounded, and its center nearly midway in head length. Mouth small, gape inclined forward, jaws even. Lips thin, broad, not covering teeth. Teeth welded into sharp-edged even cutting-edge. Two large upper posterior canines and larger lower one on each side. Inner buccal membranes broad. Tongue

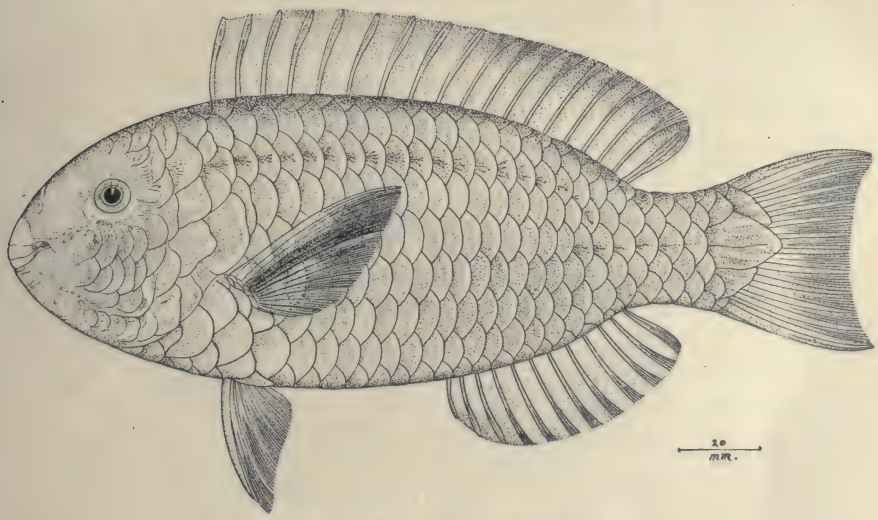

Fig. 26.—*Callyodon philippinus* sp. nov.

thick, depressed, apparently not free. Maxillary not half way in snout, not nearly to front nostril. Nostrils small, lateral, inconspicuous, little separated, hind one about $\frac{2}{3}$ an eye-diameter before eye and both near level of upper eye edge. Interorbital broadly convex. Opercular flap narrow.

Gill-opening extends forward close behind hind nostril. Rakers 32 very short weak flexible points on outer edge of first arch, and about 52 slender setæ-like rakers on inner edge, which latter about $3\frac{1}{2}$ in gill-filaments. Gill-filaments 2 in snout length. Pseudobranchiæ about $\frac{1}{3}$ of gill-filaments. Isthmus narrowly constricted, gill-membranes adnate.

Scales large, cycloid, and those on middle of sides with exposed

width a little less than half of exposed depths. Snout, interorbital, preorbital, muzzle and lower limb of preopercle anteriorly, naked. Cheek with 2 rows of broad scales. Several large scales on opercle. Fins, except base of caudal which covered with large scales, naked. Smaller scales along bases of dorsals and anals. Round scale between ventral bases about $\frac{1}{5}$ of fin, and pointed axillary scale about $2\frac{1}{2}$. Lateral line concurrent with back, slopes down below bases of last dorsal rays and midway along side of caudal peduncle on caudal base. Tubes in first section of lateral line with several branches, all small, main stem most conspicuous and branches small.

Origin of spinous dorsal about over that of pectoral, spines more or less equal, rather flexible adipose ends present, and edge of fin entire. Soft dorsal origin little nearer upper corner of gill-opening than caudal base, membranes very shallowly emarginate along fin edge, and rays subequally high. Anal spines graduated to third, which longest, each ending in flexible adipose-like end. Soft anal like soft dorsal. Closed caudal slightly concave behind, when expanded nearly truncate and corners always sharp-pointed. Pectoral broad, upper rays longest, and fin $\frac{4}{5}$ to anal. Ventral inserted about opposite pectoral origin, fin about $\frac{3}{5}$ to anal, and spine ends in flexible adipose-like tip $\frac{4}{5}$ of fin length. Vent close before anal.

Color in alcohol faded pale brownish with traces of olivaceous. Dorsals marginally with broad pale band length of both fins. Anal with similar submarginal band lengthwise. Caudal uniform brownish. Pectoral pale olive, but second, third and upper portions of fourth branched rays with their intervening rays dark brown, forming a lengthwise dark band. Ventral pale uniform brownish. Upper lip broadly pale, and with narrow line from mouth corner back to eye. Also short pale line from behind eye over postorbital, besides several smaller ones below, at lower edges. Small broken bars and spots of pale brownish on under surface of head. Iris slaty.

Length 215 mm.

Type, No. 47,548, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species somewhat resembles *Callyodon rivulatus* (Valenciennes) as figured by Bleeker,[43] but differs in the coloration, as there are no traces of the green median spots on the soft dorsal, the dark pectoral band is lower on the fin, and it does not show the spots and bars of pale color on the under surface of the head.

[43] Atlas Ich. Ind. Néerl., I, 1862, p. 44, Pl. 9, fig. 3.

Siganus fuscescens (Houttuyn).

Large series, mostly young. These identical with material from Bacon, P. I., upon comparison. All have a dark shoulder-blotch and dark spots or blotches on trunk.

Siganus corallinus (Valenciennes).

One which differs slightly from a Sumatran example in the smaller dark spots on the head, doubtless due to age. Both agree largely with Müller and Schlegel's account. The alleged closely related *Chætodon guttatus* Bloch shows no dark spots on the head. Surely the figure by Quoy and Gaimard of their *Amphacanthus argenteus* cannot refer to this genus as it is shown with five dorsal spines and three anal spines. Its trunk is clouded olive and brown, and there is a white bar on the caudal peduncle.

DROMBUS Jordan and Seale.

ULCIGOBIUS subgen. nov.

Type *Drombus maculipinnis* sp. nov.

Differs from subgenus *Drombus* in the higher spinous dorsal, larger scales and very conspicuous pores on the sides of the head. Ventrals joined, at least for their basal halves.

Probably *D. tutuilæ* Jordan and Seale belongs in the present group.

(*Ulcis*, boil, with reference to the pores on the side of the head; *Gobius*.)

Drombus maculipinnis sp. nov. Fig. 27.

Head 3; depth $3\frac{3}{5}$; D. VI–10; A. I, 7; P. I, 14; V. I, 5; scales 23 in median lateral series from shoulder to caudal base and 3 more on latter; about 7 scales between second dorsal origin and anal origin; about 6? predorsal scales; head width $1\frac{2}{5}$ in its length; head depth at occiput $1\frac{3}{5}$; mandible $3\frac{1}{6}$; first dorsal spine slightly less than head; eighth dorsal ray $1\frac{2}{3}$; last anal ray $1\frac{2}{5}$; least depth of caudal peduncle $2\frac{1}{10}$; pectoral 1; ventral $1\frac{2}{5}$; snout $3\frac{2}{3}$ in head measured from upper jaw tip; eye $4\frac{1}{2}$; maxillary $3\frac{1}{2}$; interorbital about 2 in eye.

Body moderately long, compressed though little robust anteriorly and deepest about second dorsal origin. Body edges all rounded convexly. Caudal peduncle compressed, slightly longer than deep.

Head large, elongate, profiles similar, cheeks and lower sides greatly and evenly swollen backward, with upper head surface more constricted than lower. Snout convex over profile and surface, length $\frac{2}{3}$ its width. Eye moderate, superior, advanced, largely directed upward. Mouth small, broad, gape extends about first $\frac{2}{5}$ in snout. Mandible broad, protrudes, rather shallow. Lips thick,

fleshy, firm. Teeth in rather broad villiform bands in jaws, none on vomer, palatines or tongue. Inner buccal folds both rather broad. Tongue large, thick, oblong, adnate, and front end rather broadly truncate. Nostril small pore in depression at base of snout close before eye, but not visible in superior view. Interorbital deep narrow groove between elevated supraorbital ridges.

Gill-opening entirely lateral, long as space between mandible tip and front eye edge. Rakers 2+6, III, lanceolate, slightly less than filaments, and latter about half of eye. Isthmus broad, width equals snout and half of eye.

Scales large, ctenoid, moderately exposed, in even lengthwise

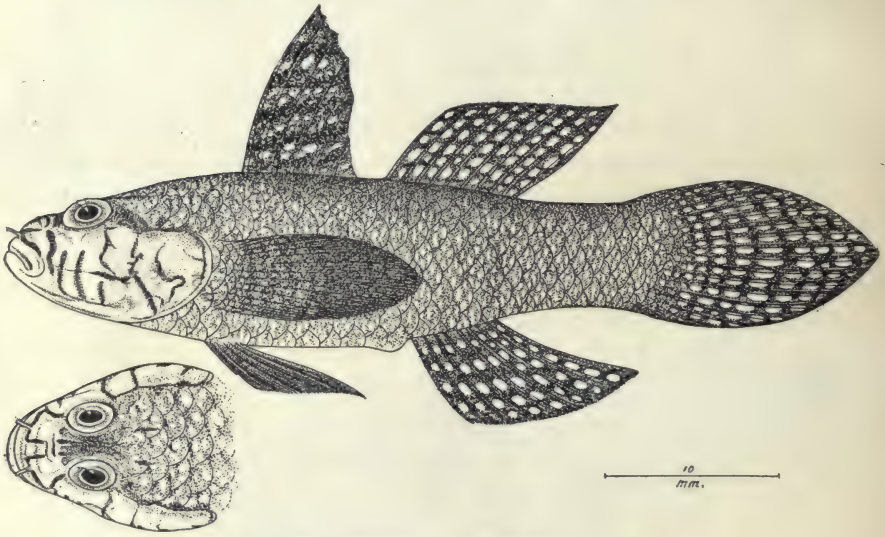

Fig. 27.—*Drombus maculipinnis* sp. nov.

rows. Caudal base scaly. Head scaly, with numerous transverse cutaneous narrow areas on cheek, side of head and snout. Cutaneous flap each side of snout tip nearly equal to pupil in length. Fins other than caudal apparently scaleless and without scaly flaps. No l.l.

Spinous dorsal inserted little nearer mandible tip than last dorsal ray base, first spines elongate, flexible and reach about $\frac{2}{5}$ in second dorsal base. Origin of soft dorsal much nearer caudal base than hind eye edge, median and posterior rays little longer, and last ones reach caudal base. Anal origin close behind dorsal origin, fin similar to soft dorsal only smaller. Caudal elongate and ends in median

point behind. Pectoral large, with broad base, and reaches little beyond anal origin. Ventral inserted below gill-opening close before pectoral base, fins united for their basal halves, and reach large vent close before anal. Ventral spine small, about $\frac{2}{7}$ length of fin.

Color in alcohol dark chocolate-brown, with basal pockets of scales dusky to blackish, and together with paler spots producing a mottled appearance. Fins all blackish or dusky-brown, barred or spotted with whitish. Cutaneous areas on head dark. Iris slaty.

Length 50 mm.

Type, No. 47,549, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Drombus palackyi Jordan and Seale[44] has smaller scales, about 31 in a lateral series, body more slender or with the depth 6 and fins not marked with white.

(*Maculà*, spot; *pinna*, fin.)

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[44] Proc. U. S. Nat. Mus., XXVIII, 1905, p. 797, fig. 15.

MARCH 19.

HENRY SKINNER, M.D., Sc.D., in the Chair.

Fifty persons present.

The death, on February 26, of Samuel Gibson Dixon, M.D., LL.D., Sc.D., President of the Academy, having been announced, the following minute prepared for a special meeting of the Council by John Cadwalader, LL.D., Vice President of the Academy, was read:

This Academy has met the most serious loss in the death of its President, SAMUEL GIBSON DIXON. The death of an officer who has been twenty-two years in the service of such an institution inflicts a loss not easily compensated.

When a man of Dr. Dixon's earnest character, unusual attainments and unflagging zeal in every cause which he espoused, is lost to the community, it becomes a public calamity.

It would be hard to find a man whose services had been of more value to his associates, and to the public generally, than were those of Dr. Dixon.

He was unusually well equipped for efficiency by early education. He thus came to the bar, at that time the commanding profession. The influence of an office discipline as well as Law School instruction still existed, and lawyers were truly men of affairs as well as legal advisers and could adapt themselves to all demands made upon them more readily than could men of any other training.

Having a natural trend of thought and interest in the pursuit of science, he entered the other great learned profession—medicine, after a very thorough preparation. A man in mature life who seeks a new vocation is apt to throw a deeper interest into what he undertakes, as he cannot afford to make another experiment.

Dr. Dixon's work in his profession and here in The Academy of Natural Sciences of Philadelphia, and for many years in his great office, presiding over the Health Department of the State, cannot be properly dealt with in a brief minute. A fitting tribute to his work and memory will be paid at a suitable time.

To-day we meet to record our deep sense of the loss of an able presiding officer, a loyal friend to the institution over which he presided, and a personal colleague whose friendship we all treasured. His colleagues tender to his family profound sympathy in their bereavement.

The death of George Barrie, a member, January 4th, was also announced.

Eruptions of the Costa Rican Volcano Irazú in 1917-18.—Dr. Philip P. Calvert stated that the first and greatest known eruption of Irazú occurred in 1723, from February intermittently to December. A contemporary account by the Spanish Governor of Cartago, Don Diego de la Haya, exists and has been reprinted several times.

A recent report by Prof. Tristán refers to eruptions of "smoke" or of vapors seen by visitors to the old craters in 1844, 1847, 1855, 1859, 1870, 1880, 1884, 1888, and 1910.

La Información, a daily paper of San José, for October 6, 1917, published a despatch from a correspondent who visited the craters of Irazú on the preceding day, in which he stated that they were violently exhaling large columns of steam, rising at times to a height of 70 meters, accompanied by sulphurous odors, rumbling sounds and small volcanic stones.

This notice led Prof. J. Fidel Tristán, accompanied by Señores Alvaro Fernández Peralta and Ewald Starke to visit the volcano on October 19 and 20, 1917. A report (that alluded to above) by Prof. Tristán and Señor Ricardo Fernández Peralta on the observations made on these days was subsequently published in *La Gaceta, Diario Official* (Official publication of the Costa Rican Government), for December 4, 1917. It is accompanied by reproductions of some photographs taken by Prof. Tristán and a plan of the craters in eruption. This report has been reprinted in better form as No. 1, Series A, *Publicaciones, Colegio de Señoritas*, San José, 1917.

Professor Tristán found that craters D, E, G, H, L and M (following the designations of Dr. Karl Sapper) were discharging vapor. A fuller series of the October photographs than were included in this report has been sent by Prof. Tristán to the speaker, as well as others taken by Señores José Maria Tristán on December 19, 1917, and Ricardo Fernández Peralta on December 20, 1917, in the craters, and telephotographs from San José by Prof. Tristán in January, 1918. All these photographs were shown on the screen and the speaker added explanatory remarks based on Prof. Tristán and Señor R. F. Peralta's report, articles from various issues of *La Información* and his own visits to the volcano in 1909 and 1910. The later photographs show the chief discharge as being from crater G. A considerable fall of ash and scoriæ was reported as occurring on December 19 and January 6 and 7, reaching on the last date to San José.

Samples of the ash collected in San José and forwarded by Mr. J. B. Clark, and of ash from the eruption of Poás, of January, 1910, were exhibited under microscopes. The former is much darker than the latter; Prof. Alfaro, director of the National Museum in San José, is quoted in *La Información* of January 8, 1918, as saying that the Irazú ash was produced by decomposition of andesite and contained but little sulphur, while that of Poás was due to calcination of pumice and (when first fallen) contained much sulphuric acid.

The communication was illustrated by lantern views.

Mr. James A. G. Rehn gave an outline of the work of the Southern Arizona Expedition of 1916. (No abstract.)

Mr. Francis R. Cope was elected a member.

The following were elected Correspondents:

George Howard Parker, of Cambridge, Massachusetts;
Alfred Goldsborough Mayer, of Tortugas;
Charles Richard Van Hise, of Madison, Wisconsin;
John Campbell Merriam, of Berkeley, California;
John Henry Comstock, of Ithaca, New York;
Herbert Spencer Jennings, of Baltimore, Maryland;
Frank Rattray Lillie, of Chicago, Illinois.

The following were ordered to be printed:

THE RECTAL TRACHEATION AND RECTAL RESPIRATION OF THE LARVÆ OF ODONATA ZYGOPTERA.

I. RECTAL TRACHEATION OF ARGIA PUTRIDA LARVA.

BY ANNA M. CULLEN.

Argia moesta putrida Hagen is a Zygopterous dragonfly of wide distribution throughout the eastern United States. Its larvæ occur in flowing streams, the material studied having been collected at Cobb's Creek near Beechwood Park, Pennsylvania, May 25, 1914. The larva sectioned was killed in hot Gilson (Bolles Lee, *Microtomist's Vade Mecum*, Third Edition p. 472). It was stained with Delafield's haematoxylin and alcoholic eosin. The rectal tracheation was studied from a series of paraffin sections extending through the sixth, seventh, eighth and ninth segments of the larva.

The *alimentary canal* in this region will be considered first. At the beginning of the hind gut, in the posterior part of the sixth segment, the epithelium has six deep longitudinal folds. In this region the epithelium is somewhat thin. In the anterior half of the seventh segment the alimentary canal is triangular in section. This triangular appearance is caused by three patches of thickened epithelium, one dorsal in position, the others right ventral and left ventral. Between the three patches of thickened epithelium are small areas of thin pigmented epithelium. Tracheæ penetrate the thickened epithelium. No tracheæ enter the thin pigmented epithelium. The alimentary canal in the posterior half of the seventh segment and the beginning of the eighth segment is extremely thin-walled. Toward the middle of segment seven the patches of thickened epithelium disappear and the alimentary canal becomes thin-walled and folded. At first the folds have no definite arrangement but gradually six definite folds appear, three large ones alternating with three small ones. The six folds soon become equal in size and using the clock face notation of Tillyard, the folds occupy the positions of 2, 4, 6, 8, 10, and 12 of the clock face. Toward the posterior end of segment seven the folds gradually disappear and the alimentary canal is thin-walled, and oval, almost rectangular in outline. This part of the larva contains few of the smaller tracheæ, none of which approach the alimentary canal. In the anterior part

of segment eight, the longitudinal rectal folds begin to appear in the epithelium. These folds become deeper and extend all through segment eight and part of segment nine. Of the three folds, one is dorsal, one may be called right latero-ventral and the third left latero-ventral (Fig. 1); in spite of their positions, shown in this figure, they appear to correspond to folds 12, 4, and 8 of the clock face. Between the folds there are thin pigmented areas. Toward the posterior end of segment nine and continuing through segment ten, the folds become gradually less pronounced until they form merely three thickened areas of the rectal wall. Between these areas of thickened epithelium, the rectal wall is extremely thin and projects inward as a ridge. Since there are three areas of thickened epithelium, of course there are three of these thin inwardly projecting ridges. All along through segments eight and nine tracheæ penetrate the thickened epithelium but no tracheæ enter the thin areas. Toward the middle of the ninth segment the thin epithelium between the longitudinal folds becomes spongy. These spongy masses continue through the ninth segment and into the tenth segment. In the latter half of the ninth segment tracheæ penetrate these spongy masses.

Tracheal System.

There are two great dorsal longitudinal tracheæ, called right dorsal trachea, *rdt*, and left dorsal trachea, *ldt*, and two longitudinal lateral tracheæ, *rlt* and *llt*. In the anterior part of segment eight (Fig. 2), each lateral trachea gives off a visceral trachea, the right visceral trachea, *rvs*, and the left visceral trachea, *lvs*, respectively. These extend ventrad, mesad and cephalad in the seventh segment. For some distance there is no branching, but when the right visceral trachea and the left visceral trachea change their course somewhat and each takes up a lateral position a little farther forward, each begins to branch. The branches of the right visceral trachea supply the thickened epithelium on the right side of the alimentary canal, divide and subdivide and finally the smallest tracheoles shown in the diagram penetrate the epithelium. In like manner the branches of the left visceral trachea supply the thickened epithelium of the left side of the alimentary canal. The dorsal thickened epithelium is supplied by small tracheæ whose origin is from another branch of the left visceral trachea.

About the middle of the eighth segment each dorsal trachea gives off a branch, the right dorsal rectal trachea, *rdrt*, and the left dorsal

rectal trachea, $ldrt_1$, respectively. Each of these runs mesad and caudad and enters the dorsal longitudinal fold of the alimentary canal (Fig. 1). Here these tracheæ divide and subdivide, but no anastomosis between the tracheoles of the right dorsal rectal trachea and the left dorsal rectal trachea was found.

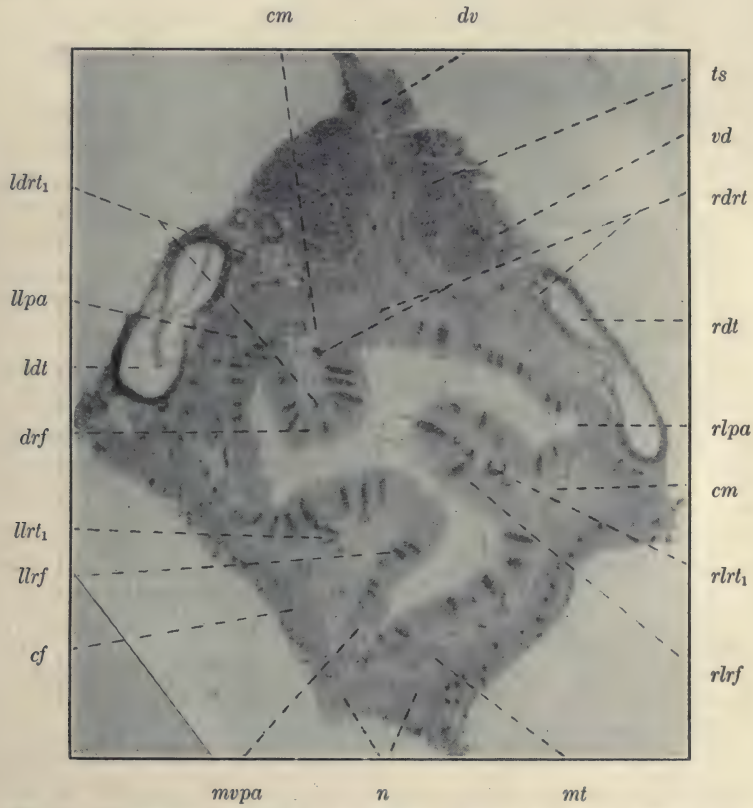


Fig. 1. Transverse section of abdomen of larva of *Argia moesta putrida* ♂ near the middle of the 7th segment (TS. 52, row 4, slide 3) seen from its posterior face. Cuticle and hypodermis removed before embedding. Photographed by Mr. H. A. Walters, using Leitz ocular 4, objective 3. Enlarged 117 diameters.

cf, connective tissue and fat.
cm, circular muscles of gut wall.
drf, dorsal rectal fold.
dv, dorsal vessel.
$ldrt_1$, left dorsal rectal trachea.
ldt, left dorsal trachea.
llpa, left lateral pigmented area.
llrf, left lateral rectal fold.
$llrt_1$, left lateral rectal trachea.
mt, Malpighian tubule.
mvpa, mid-ventral pigmented area.
n, nerve.
r, rectum.
rdrt, right dorsal rectal trachea.
rdt, right dorsal trachea.
rlpa, right lateral pigmented area.
rlrf, right lateral rectal fold.
$rlrt_1$, right lateral rectal trachea.
ts, testis.
vd, vas deferens.

Some distance anterior to the origin of the dorsal rectal tracheæ there arises, on each side, the right lateral rectal trachea, $rlrt_1$, and the left lateral rectal trachea $llrt_1$, from the right visceral trachea and left visceral trachea respectively, at a point just mesad of the origin of each visceral trachea from the lateral trachea. The right lateral rectal trachea extends caudad and sends branches cephalad and caudad which enter the right longitudinal rectal fold. In like manner the left lateral rectal trachea supplies the left longitudinal rectal fold (Fig. 1).

Toward the end of the ninth segment a dorsal trachea appears, $ldrt_{11}$. This originates from the left median caudal gill trachea, *lmcgt*, at the end of the ninth segment. It sends a branch caudad which penetrates the rectal epithelium in the anterior part of the tenth segment. Another branch extends cephalad giving off branches and penetrates the rectal epithelium about the middle of the ninth segment. No trachea corresponding to $ldrt_{11}$, appears on the right side. Toward the end of the ninth segment small tracheæ are noticed in the spongy masses between the longitudinal folds of the rectum. The trachea in the ventral mass originates from a branch of the left lateral trachea at the hind end of the ninth segment. This little trachea extends mesad and cephalad and disappears in the ventral spongy mass about the middle of the ninth segment. The trachea of the left spongy mass originates at the end of the ninth segment from the left dorsal rectal trachea $ldrt_{11}$. It runs cephalad a very short distance and disappears in the left spongy mass. The trachea of the right spongy mass originates at the end of the ninth segment from the right median caudal gill trachea, *rmcgt*. It extends mesad and cephalad a short distance in the right spongy mass where it disappears.

At the end of the ninth and the beginning of the tenth segment there is an anastomosis between the right and left lateral longitudinal tracheæ which meet in the midventral line. Two other tracheæ also take part in this anastomosis. These are a branch from the right and a branch from the left lateral caudal gill tracheæ, *rcgt* and *lcgt*, respectively.

"Observation and experiment with carmine particles on living larvae of *Argia moesta putrida* from the vicinity of Philadelphia showed that a larva watched for two hours may give no sign of *rythmic* rectal contractions, but that these may suddenly begin and then continue for varying periods. They consisted of sets of three rapidly successive contractions, every third contraction being

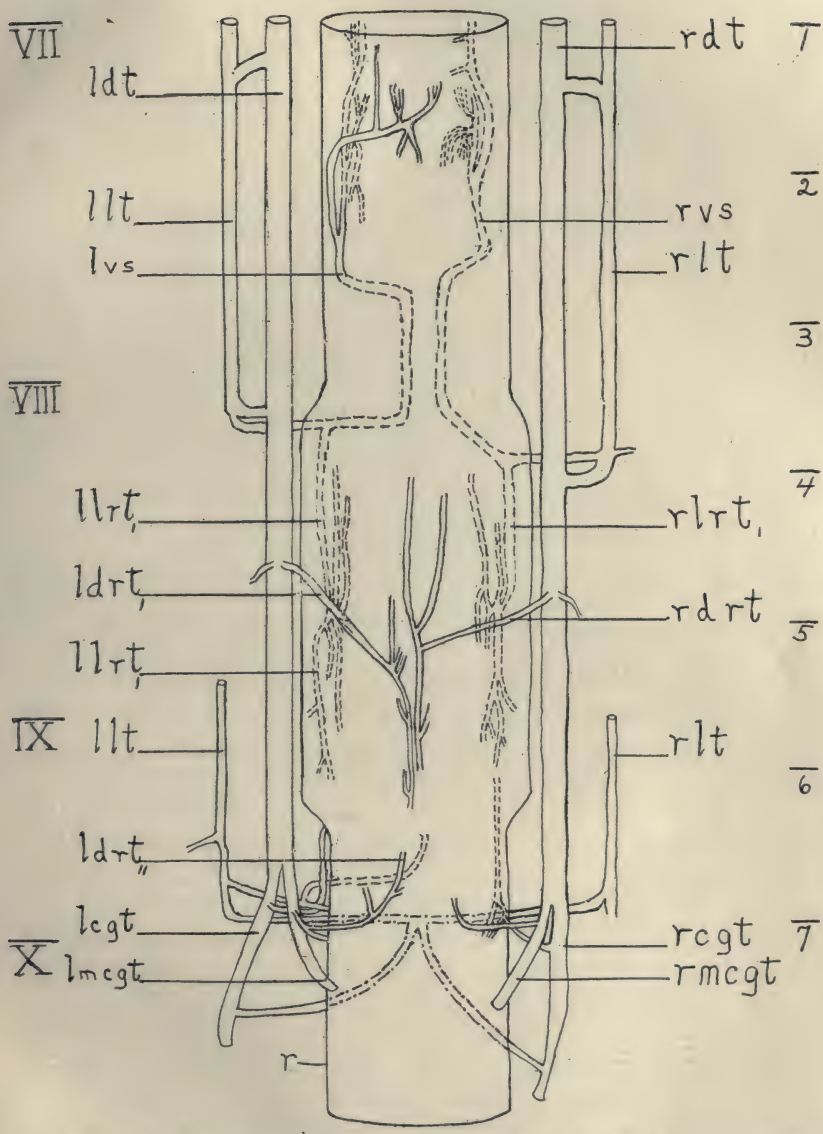


Fig. 2. Diagram of tracheation of the hind-gut of larva of *Argia moesta putrida*, reconstructed from sections. To avoid confusion the tracheæ are represented as lying farther to right and to left from the gut and from each other than is actually the case (compare Fig. 1). Of the tracheæ which supply the gut walls, those which run on the dorsal surface or enter the dorsal longitudinal fold are shown in solid lines; those which run on the ventral surface or enter the lateral folds are shown in broken lines. The tracheæ forming the ventral anastomosis are shown by alternating dots and dashes. The Roman numerals on the left side indicate the anterior ends of the respective abdominal segments, the Arabic numerals on the right the beginning of each row of sections on slide 3 of the series; each row comprises about 60 sections. Abbreviations as in Fig. 1, and as given in the text.

of longer duration than the other two; 32 such sets per minute were noted. At other times sets of five contractions were noted. In some larvae, but not in all, the beginning of a set of rectal contractions was often synchronous with a slight shortening of the abdomen; the lengthening of the abdomen began before the contractions had ended. A rhythmic shortening and lengthening of the abdomen may perhaps furnish an indication of the existence of rectal contractions in an opaque larva. Successive removal of the three caudal gills in one larva was not followed by any immediate beginning of rectal contractions, although such were seen four hours later; the larva was not under continuous observation during all of that time, however." (Calvert, *Ent. News*, XXVI, pp. 441-2.)

In the diagram of the rectal tracheation of *Thaumatoneura* larva figured by Calvert, Plate XVI, *Ent. News*, Vol. XXVI, there is one area of rectal respiration supplied by the right and left dorsal rectal tracheæ and the right and left lateral rectal tracheæ. It seems from the structure of *Argia putrida* larva that there may be two areas of respiration in the alimentary canal walls, a small one in segment seven and a larger respiration area in segments eight and nine. The respiration of the seventh segment may be carried on through the tracheæ supplied by the branches of the right and left visceral tracheæ. The larger respiration area of segments eight and nine is supplied with tracheæ through the branches of the right and left dorsal rectal tracheæ and the right and left lateral rectal tracheæ. In each case the structure of the epithelium of the alimentary canal appears to be the same. In the seventh segment, the three patches of thickened epithelium supply the surface through which respiration may take place. In the eight and ninth segments, the thickened epithelium of the longitudinal rectal folds supplies the surface through which respiration may take place (Fig. 1).

At the present time there is considerable doubt in the minds of observers as to the importance of these areas of respiration. When the caudal gills have been removed, the *Argia putrida* larva continues to live. Respiration may take place all over the surface of the body through the thin body wall. If this is the case, then we may assume that respiration also takes place throughout the length of the hind gut through its wall. The numerous tracheæ found penetrating the thickened epithelium can be explained as necessary because respiration is more difficult in these regions owing to the thickness of the walls, hence the many tracheoles penetrating the thickened epithelium. A comparison with the rectal respiration

areas of Anisopterid larvae seems to strengthen this view. In the rectal gills of these larvae, the minute branches of the tracheæ are separated from the water of the rectum by a very thin epithelium. This seems to show that respiration takes place most actively through a thin epithelium.

II. THE TRACHEAL SUPPLY OF THE RECTUM OF THE LARVA OF ARGIA TALAMANCA FROM JUAN VIÑAS, COSTA RICA.

BY JANET P. JAMIESON.

The rectal epithelium of the water-fall dweller, *Argia talamanca*, presents three main longitudinal folds, one that is "dorsal and a little to the left of the median plane," a second that is "left latero-ventral" and the third that is "right lateral." These folds (Fig. 1.) correspond in position with those of the water-fall dweller *Thaumatoneura* described by Calvert (*Entomological News*, Vol. XXVI, p. 387, and plate XVII, fig. 1.) Those of *A. talamanca* are, however, deeper as may be seen by comparing photographs of the transverse sections, and show a greater complexity. In some parts of the rectum the free edges of the three folds appear to meet in the center of the lumen of the gut. Between the bases of these primary folds the epithelium thins out and becomes darkly pigmented. From the base of each primary fold, is given off a secondary shallower fold, to the right in the case of the dorsal fold, to the left in the case of the left latero-ventral fold and ventrally in the case of the right lateral fold.

Toward the hind end of the rectum the secondary folds disappear and the main folds have practically no depth; this gives an almost cylindrical shape to the hind part of the rectum.

The larva of *Argia putrida* from the vicinity of Philadelphia, described in the preceding paper by Miss Cullen, differing from *A. talamanca* in that it lives in streams of continuously flowing water, shows three simple shallow folds in the rectal epithelium, one dorsal, one right lateral and one left lateral. The epithelium is much denser and thicker than in this water-fall dweller of the same genus, and the thin pigmented areas between the bases of the folds are not so broad.

It has been suggested by Calvert that the more extensive surface area afforded by the greater folding of the rectum together with the thinner, less dense nature of the epithelium of the water-fall dwellers may aid these larvae materially in procuring a supply of

oxygen from the rectum that supplements the supply obtained by the gills when the larva is in the water. The caudal gills of *A. talamanca* are much shorter than those of *A. putrida*. This suggests that there may be a definite ratio between the shortness of the gills and the complexity of the rectal epithelial folds. This theory is strengthened by the fact that Anisopterous larvæ, as described

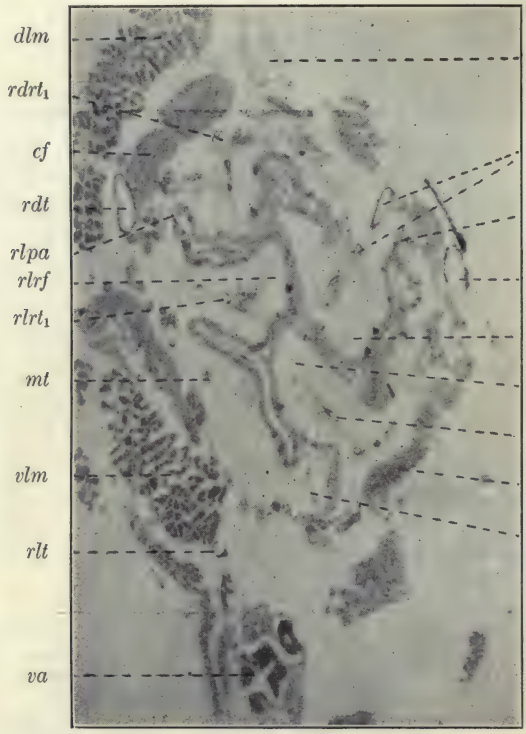


Fig. 1. Transverse section of abdominal organs of larva of *Argia talamanca* ♀ near the hind end of the 8th segment (TS. 12 of row 6, slide 2), seen from its anterior face. Cuticle and hypodermis removed before embedding, also on the left side (right in the figure) the longitudinal muscles. Photographed by Mr. H. A. Walters, using Leitz ocular 4, objective 3. Enlarged 85 diameters.

cf, connective tissue and fat.
dlm, dorsal longitudinal muscle.
drf, dorsal rectal fold.
dv, dorsal vessel.
ldrt$_1$, left dorsal rectal trachea.
ldt, left dorsal trachea.
llpa, left lateral pigmented area.
llrf, left latero-ventral rectal fold.
llrt, left lateral rectal trachea.
llt, left lateral trachea (lies outside of the field of this figure).
mt, Malpighian tubule.
mvpa, mid-ventral pigmented area.
r, rectum.
rdrt$_1$, right dorsal rectal trachea.
rlpa, right lateral pigmented area.
rlrf, right lateral rectal fold.
rlrt$_1$, right lateral rectal trachea.
rdt, right dorsal trachea.
rlt, right lateral trachea.
va, vagina.
vlm, ventral longitudinal muscle.

by Tillyard (*Proceedings of the Linnean Society of New South Wales*, 1915, Vol. XL, Part 3, August 25), have a much greater folding of the rectal epithelium and no caudal gills. To quote him: The rectum presents "six longitudinal double rows of lamellate folds." It is within the thicker, unpigmented portion of the rectal epithelium of *A. talamanca* that the fine ends of the tracheoles which reach the epithelium are embedded. Though the number of these embedded tracheoles is small, numerous tracheæ were traced into the folds and almost to the epithelium. This would suggest that diffusion of oxygen takes place more easily through the unpigmented portions of the folds. The secondary folds increase the diffusion area. The fact that no tracheoles were traced through or even up to the pigmented epithelium between the folds suggests that these areas are reserved for the osmosis of carbonic acid gas from the body tissues into the rectum. For says Tillyard, "It is well known . . . that chitin is a colloid substance which admits of the passage through it of gases by diffusion, and is particularly partial to carbonic acid gas."

The absence of folding of the epithelium at the extreme end of the rectum probably merely facilitates the quick and constant flow of water.

The rectal tracheæ.—The tracheæ that supply the rectum of *A. talamanca* have been studied from a series of transverse sections prepared by and in the possession of Dr. Calvert. Owing to the decay of the anterior rectal epithelium some smaller tracheoles may have been lost.

Two main dorsal longitudinal tracheæ have been traced, one on the left (*ldt* of figs. 1 and 2), the other on the right (*rdt*).

These divide at the posterior end of the ninth segment respectively into the left caudal gill trachea (*lcgt*) and left median caudal gill trachea (*lmcgt*) and into the right caudal gill trachea (*rcgt*) and the right median caudal gill trachea (*rmcgt*).

Within the posterior half of segment VIII arise from the longitudinal dorsal tracheæ, a right dorsal rectal trachea ($rdrt_1$) and a left dorsal rectal trachea ($ldrt_1$), both of which pass mesad and caudad into the dorsal longitudinal rectal fold where they divide and subdivide. Some of the smaller tracheoles enter the epithelium, but no anastomoses were observed.

From the lateral tracheæ (*rlt* and *llt*), which are connected with the dorsal longitudinal trunks in the middle of segment VIII, there come off ventrally in the anterior half of segment VIII, the lateral

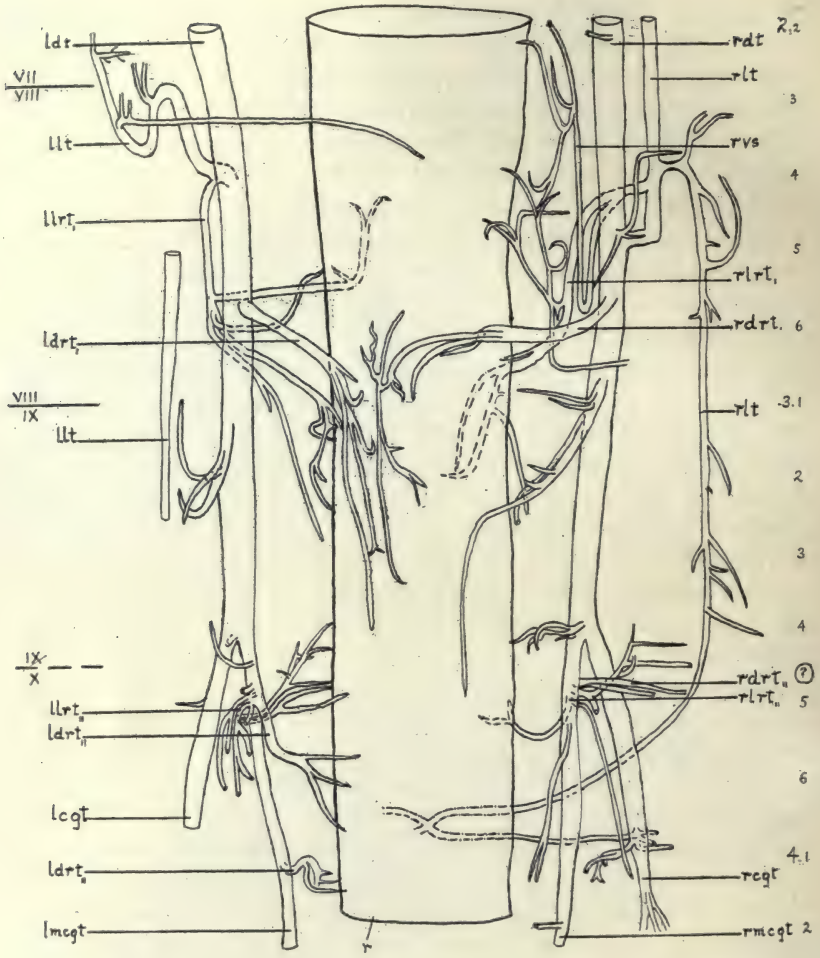


Fig. 2. Diagram of the tracheation of the rectum of larva of *Argia talamanca*, reconstructed from sections. To avoid confusion the tracheæ are represented as lying farther to right and to left from the gut and from each other than is actually the case (compare Fig. 1). Of the tracheæ which supply the gut walls, those which run on the dorsal surface or enter the dorsal longitudinal fold are shown in solid lines; those which run on the ventral surface or enter the lateral folds are shown in broken lines. The ventral anastomosis is shown in dots and dashes. The Roman numerals on the left side indicate the boundaries of the respective abdominal segments; the larger Arabic numerals on the right, the microscopic slides and the smaller Arabic numerals the rows of sections on each slide of the series corresponding to that part of the diagram represented as at the same horizontal level. Each row comprises about 30 sections. Abbreviations as in Figure 1 and as explained in the text.

rectal tracheæ ($rlrt_1$ and $llrt_1$). Each of these passes mesad and caudad and enters the lateral longitudinal rectal fold of its respective side. The origin of the right lateral rectal trachea differs slightly from that of *Thaumatoneura* as worked out by Calvert. Subdivision of these tracheæ occurs and some of the tracheoles enter the epithelium. No anastomosis has been found here. A smaller posterior rectal supply ($llrt_{11}$ and $rlrt_{11}$), is received by the lateral rectal folds from the left and right median caudal gill tracheæ respectively. Some of these tracheoles also enter the epithelium, but no anastomosis occurs.

A small posterior dorsal supply ($ldrt_{11}$) is received by the dorsal longitudinal fold and by the epithelium from the left median caudal gill trachea. The corresponding (?) group on the right has been traced laterad through and around the muscle fiber mass toward the periphery of the body.

The last two paragraphs show slight differences between *Thaumatoneura* and *Argia talamanca*.

Calvert's statement for *Thaumatoneura* may be quoted here for *A. talamanca*. "The only anastomosing tracheæ which have been discovered are the posterior terminations of the right and left [?] lateral longitudinal tracheæ which, assuming a ventral position, meet on the mid-ventral line ventrad of the alimentary canal; in this anastomosis (*anas*) take part also a branch from the right and a branch from the left [?] lateral caudal gill trachea." The interrogation marks signify an incomplete tracing in *Argia talamanca* due to maceration of parts of the anastomosing tracheæ from the left side.

I think I may say that *all* the tracheæ, large and small, that were traced possessed a black pigment that added materially to the ease of tracing. As has been observed for *Thaumatoneura*, this pigment presents the same appearance as that of the areas between the three longitudinal folds of the rectal epithelium.

For material, directions and suggestions in my work I am indebted to Dr. P. P. Calvert, whose treatment of *Thaumatoneura* I have followed for *Argia talamanca*. The sections studied were of "larva No. 2," ♀, from the "nearer waterfall," Juan Viñas, Costa Rica, March 23-26, 1910, which died in attempted rearing; its condition is, therefore, histologically poor. The locality has been described by Calvert in his *Thaumatoneura* paper cited.

III. THE HIND-GUT, ABDOMINAL TRACHEÆ AND RECTAL RESPIRATION IN THE LARVA OF MECISTOGASTER MODESTUS FROM COSTA RICA.

BY MITCHEL CARROLL.

The abdominal viscera, including the rectum, of *Mecistogaster modestus* have been described by Calvert (1911 *b*, p. 452) from a dissection of larva No. 1 (male).

The slides for the following study were loaned by Dr. Calvert from his personal collection. They contain the serial transverse sections of the last five abdominal segments and bases of the median and right caudal gills of female larva No. 3. This larva was one of those obtained by Dr. Calvert from the water collected between the bases of the leaves of a Bromeliad at Juan Viñas, Costa Rica, April 26, 1910 (1911 *a*, pp. 407-408). It was killed in hot water and preserved in alcohol. Before sectioning the chitinous cuticle was removed from the abdominal segments. The stains used were Delafield's haematoxylin and alcoholic eosin. The sections were cut .015 mm. thick.

The Hind-Gut.

The hind-gut may be divided into six distinct parts. A brief description of these divisions is given below.

The Malpighian tubes are attached to the gut at the junction of segments VI and VII., (Calvert, 1911 *b*, Plate XVII, Fig. 8). From this point caudad to section 35 there are twelve longitudinal folds in the epithelium lining the lumen of the gut. The position of these, adopting the "Clock Face Notation" of Tillyard (1916, p. 132), is 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12, where the larger figures indicate longer folds, the small figures shorter folds (Fig. 1 of sect. 20).

All the figures accompanying this paper are of the larva of *Mecistogaster modestus* Selys.

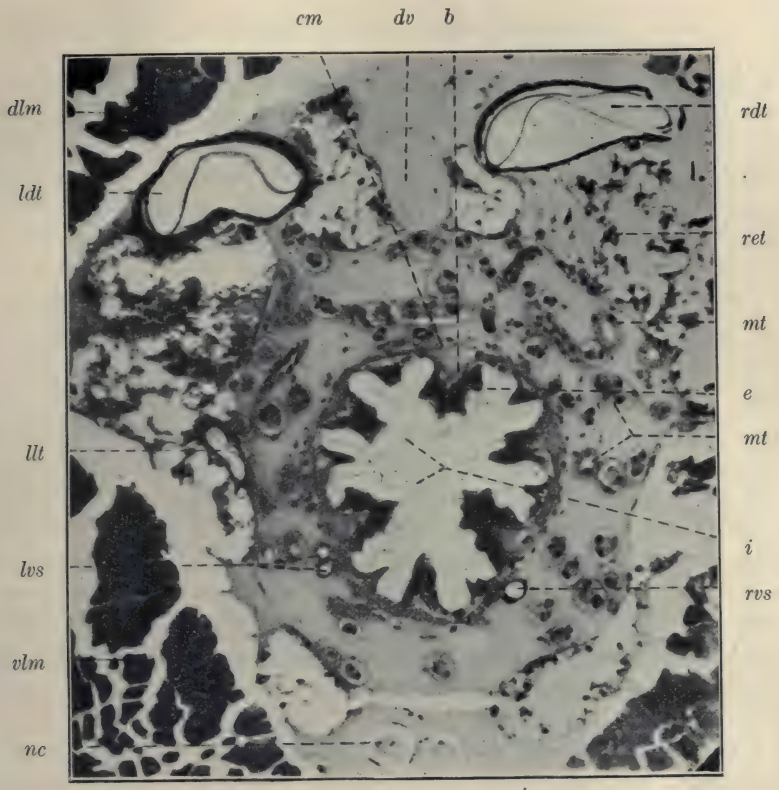
The photographs reproduced in Figures 1-5, were made by Mr. H. A. Walters, using Leitz ocular 4, objective 3. They represent the posterior surfaces of the several sections.

Fig. 1. Part of photograph of transverse section 20 (Short Intestine). Enlarged 142 diameters.

b, basement membrane.
cm, circular muscle coat of the gut.
dlm, dorsal longitudinal muscle.
dv, dorsal vessel.
e, epithelial layer.
f, longitudinal epithelial fold projecting caudad into a pouch (Fig. 3).
i, chitinous intima.
lm, bands of longitudinal muscle.
mt, Malpighian tubule.
nc, nerve cord.
pe, pigmented epithelium.
rad, radial muscle strands.
ret, reticulate connective tissue.
vlm, ventral longitudinal muscle.

Tracheæ as in Figure 6.

Fig. 2. Part of photograph of transverse section 55 (Prerectal Ampulla). Enlarged 100 diameters. Abbreviations as in Figure 1.


cm
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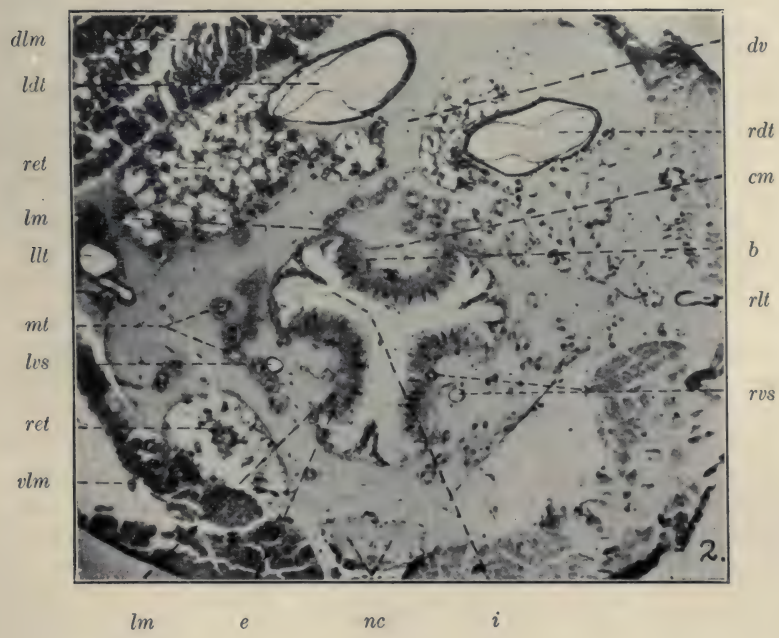
dlm
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This part of the hind-gut, from about section 1 to section 35, anterior part of segment VII (Fig. 6), seems to be homologous with the ileum or small intestine of the Orthoptera (Minot, 1880, pp. 209, 217; Packard, 1898, pp. 316, 317; Bordas, 1898, pp. 48 and 52), and with the small intestine of Anisopterous larvæ (Sadones, 1895, pp. 277, 279, 291; Faussek, 1887, p. 708; Tillyard, 1916, p. 131). In his recent book on the Dragonflies (Tillyard, 1917, pp. 101, 113, 114) Tillyard calls this division of the hind-gut the short intestine; but there is present here no ventral pad of thick columnar epithelium as described by that author and Sadones. In Fig. 1 of sect. 20, we have from within outward: the chitinous intima, *i*; the epithelial layer, *e*; the basement membrane, *b*; and the circular muscular coat, *cm*. The cells of the epithelial layer are not all of the same size. The largest are those of the apical portions of the longer folds. Here the cells are elongate and, in the transverse sections of the ileum, appear somewhat wedge-shaped, with the bases of the wedges next the intima. In the shorter folds, and in the furrows between the folds, the cells are much flatter. The basement membrane follows the folds of the epithelium mesad, leaving, as a result, triedral spaces between itself and the circular muscle coat; these spaces are filled with blood.

Just posterior to section 20 (Fig. 1 and 6, row 4 of slide 1), three (Nos. 4, 8, and 12) of the above six large folds gradually broaden out, become flatter, and transform into the three broad longitudinal bands of thick columnar epithelium seen at section 55 (Fig. 2, row 5 of slide 1). The other nine folds, 1. 2. 3—5. 6. 7—9. 10. 11, consisting of the epithelium mentioned in the preceding paragraph, are also present at this point. Figure 2 represents the appearance of the hind-gut between sections 35 and 80. It is probably homologous with the prerectal ampulla of some Orthoptera (Bordas, 1898, pp. 52, 48) and of Anisopterous larvæ (Sadones, 1895, pp. 280, 295; Tillyard, 1916, Plate 31). Sadones describes two broad bands of thick epithelium separated from one another by folds of a different kind of thin epithelium, in the prerectal ampulla of the larva of *Libellula depressa*. Tillyard's description of this section of the gut agrees with that of Sadones (Tillyard, 1917, pp. 101, 113, 114). The diameter of the gut, too, is here greater than in the parts of the digestive tube immediately preceding and following. But both Sadones and Faussek (1887, pp. 708, 709) state that two kinds of epithelia also occur in the ileum of Anisopterous larvæ. Faussek, indeed, does not mention the occurrence of a prerectal ampulla in Aeschnid larvæ.

Whatever be the true homology of this portion of the gut, it is clearly differentiated from the preceding and following divisions of the alimentary canal by the presence of the three bands of thick columnar epithelium. Histologically this columnar epithelium appears similar to the longitudinal folds of columnar epithelium found further caudad, in the rectal part of the hind-gut. The three bands of columnar epithelium referred to in this, and the preceding paragraph, extend from about section 35 or 40 to section 80 (Fig. 6), that is, through about the middle third or fourth of segment VII. In Fig. 2, in addition to the parts already discussed, we see the intima, *i*, basement membrane, *b*, circular muscular coat, *cm*, and the bands of longitudinal muscle, *lm*. There are six of the latter, but they are not all visible in the photograph. They are located outside the circular muscles, near the bases of the folds, 1, 3, 5, 7, 9, 11. The musculature of the posterior intestine of *Mecistogaster* seems to be similar to that of the insects described by the authors mentioned in this paper.

Caudad to section 80 the gut narrows and the three bands of columnar epithelium gradually assume again the appearance they had cephalad to section 35. That is, the epithelium of these folds becomes indistinguishable histologically from that of the other folds. Indeed, in transverse section, the gut has much the same appearance posterior to section 80 that it has anterior to section 35 (Fig. 1). This portion of the gut, from about section 80 to section 140 (Fig. 6), may correspond to the colon of some Orthoptera (Minot, 1880, pp. 209, 217). Or (which is unlikely), if the portion of the digestive tube immediately following this, instead of the one immediately preceding, is homologous with the prerectal ampulla of Anisopterous larvæ (Sadones, pp. 280, 295), this is homologous with the small intestine of Anisopterous larvæ (Sadones, p. 279; Tillyard, p. 131; Faussek, pp. 708, 709).

At section 110 (Fig. 6), posterior part of segment VII, there are six large folds (Nos. 2, 4, 6, 8, 10, 12), which practically fill the lumen of the gut.

At section 140 the above folds have decreased in size and the gut has become pouched. This pouching increases greatly the diameter of the lumen so that from sections 150 to 160 (Fig. 3 of sec. 150) it is relatively very wide. The longitudinal epithelial folds project caudad into these pouches for some distance. It may be that this pouched portion of the intestine is homologous with the prerectal ampulla of some Orthoptera (Bordas, 1898, pp. 48, 52) and Ani-

sopterous larvæ (Sadones, 1895, pp. 280, 295; Tillyard, 1916, p. 131 and 1917, pp. 101, 113, 114), but the character of the epithelium does not correspond to that described by Tillyard and Sadones. The latter describes and figures two lateral plates of thick epithelium separated from one another by numerous folds of thin epithelium. In this portion of the *Mecistogaster* intestine there is only one kind of epithelium. In the larva under discussion it is not very well preserved, but seems to be similar to that already described as occurring in the first and third divisions of the hind-gut. Then, too, there is no narrowing or constriction of the intestine posterior to this pouched or cæcal region as in the other insects mentioned above; the pouched region passes without any very apparent change in diameter into the rectum.

In the diagram (Fig. 6), the gut between sections 50 and 80 (the part which, as has been suggested, is probably homologous with the prerectal ampulla of other insects) is seen to be supplied with branches from the left and right visceral tracheæ (*lvs*, *rvs*). Some of these tracheoles end just within and some just without, the basement membrane of the large columnar cells of the three broad folds (4, 8 and 12) or bands referred to above. The mid-dorsal (12) and the left ventro-lateral (8) folds are supplied by tracheoles from the left visceral trachea (*lvs*); the right ventro-lateral fold (4) is supplied by branches from the right visceral trachea (*rvs*). No tracheoles have been found penetrating any of the other folds of the gut epithelium thus far mentioned.

The next, or fifth, division of the posterior intestine is the rectum proper. (Minot, 1880, pp. 209, 210, 218; Packard, p. 318; Tillyard, 1916, pp. 131, 140-189 and 1917, pp. 101, 114, 115, 116; Sadones, 1895, pp. 277, 280, 294-315; Faussek, 1887, pp. 708-711; Bordas, 1898, pp. 48, 52.) In Anisopterous larvæ it is this region which functions as the branchial basket (Tillyard). In *Mecistogaster* there is, of course, nothing corresponding to a branchial basket. The so-called rectal glands, which Tillyard (1916, pp. 179-189) has shown to be homologous with the rectal gills, are represented by three broad longitudinal folds of thick columnar epithelium (Fig. 4 of sect. 250), instead of six as in Anisopterous larvæ. These folds occupy the same relative positions (Nos. 4, 8 and 12, of the

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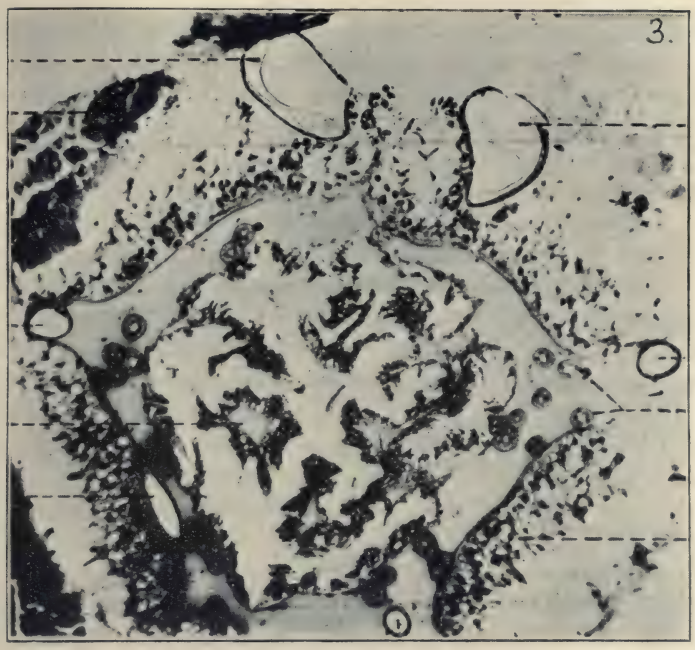
Fig. 3. Part of photograph of transverse section 150 (Pouched Part of the Rectum). Enlarged 115 diameters. Abbreviations as in Figure 1.

Fig. 4. Part of photograph of transverse section 250 (Rectum). Enlarged 114 diameters. Abbreviations as in Figure 1.


3.
ldt
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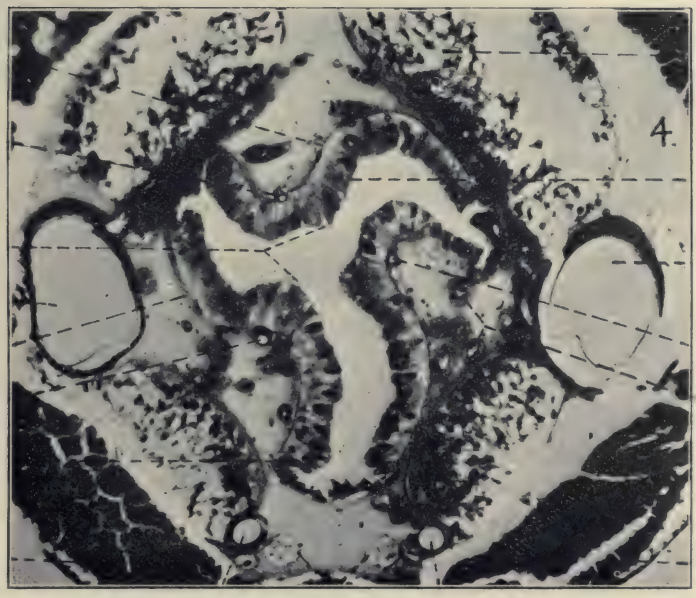
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"Clock Face Notation") as the three folds of columnar epithelium seen from sections 40 to 80 (Figs. 6 and 2). Histologically, too, the epithelia of the folds 4, 8 and 12 of these two portions of the gut appear similar. These folds have been described by Calvert in the larva of this species (1911 *b*, p. 452, Plate XVII, Fig. 10).

The rectum extends from about section 160 to section 380 (Fig. 6), that is, through nearly all of segment VIII, all of segment IX, and the anterior fourth of segment X. Figure 4 represents the appearance of the rectum from section 200 to section 300. From within outward can be seen: the chitinous intima, *i*; the folds of columnar epithelium, *e*; the basement membrane, *b*; the non-continuous circular muscular coat, *cm*; and the longitudinal strands of muscle, *lm*. (These last are located at the positions 1, 3, 5, 7, 9, 11, of the clock face notation, but do not stand out very clearly in the photograph). Spaces between the basement membrane and the circular muscle coat are filled with blood, and Malpighian tubules also extend into them, *e.g.*, in TS. 315, 319, 324, 327, 342, etc. In this part of the rectum almost the entire lining of the gut consists of the epithelium of the three longitudinal folds. The latter are, however, separated by three small pigmented areas (Fig. 4). These are the "non-cellular" bands described by Calvert in larva No. 1, (1911 *b*, p. 452, Plate XVII, Fig. 10). I have examined the original slide containing the rectum of larva No. 1 and found no trace of cells or nuclei in these three areas. In Fig. 4, one of these pigmented bands (*mvpa*) is seen to be midventral, the other two (*rlpa* and *llpa*) are dorso-lateral in position. At section 320, where the longitudinal folds 2, 6, 10 begin to appear in the pigmented bands, the cellular nature of these areas becomes somewhat more apparent. (Compare Cullen, 1918, fig. 1, and Jamieson, 1918, fig. 1.)

Mecistogaster larva No. 1, described by Calvert, was older than No. 3, the subject of this paper. Whether the age of the larva has anything to do with the presence or absence of epithelial cells in the pigmented rectal bands I am unable to say. It does not seem likely that it is a matter of fixation as larvæ No. 1, 2, and 3 were all fixed in the same way (hot water) and at the same time.

The three broad folds of the rectal epithelium and the three small pigmented areas mentioned in the two preceding paragraphs are homologous with similar folds and areas in the rectum of *Thaumatoneura* (Calvert, 1915, p. 387) and *Argia* (Cullen, 1918, p. 77, Fig. 1). The folds are, however, much shallower than in *Thaumatoneura* (Calvert, 1915, Plate XVII, Fig. 1) and *Argia talamanca* (Jamieson, 1918,

p. 82, Fig. 1). They resemble more the folds seen in *Argia moesta putrida* (Cullen, *l.c.*) The epithelium, too, is much thicker (41 to 83 μ) in *Mecistogaster modestus* than in the first two larvæ named above, resembling more *Argia moesta putrida* in this respect also. But on slide 7 of *Thaumatoneura* larva No. 7 (female, Dr. Calvert's personal collection), I found sections where the epithelium of the rectal folds was about as thick (50 or 60 μ) as that of the corresponding region in *Mecistogaster*.[1]

About section 310 (Fig. 6) the three folds (4, 8, 12) of thick columnar epithelium begin to occupy less, and the pigmented areas separating them more, of the gut wall. At section 370 the folds (or rather bands, for they are no longer folds) of columnar epithelium have contracted so as to form only about half of the gut wall. The epithelium of these bands has, however, become much thicker (83μ) than further cephalad. Between these bands are seen three folds (Nos. 2, 6 and 10) of spongy or reticulate connective tissue covered on the lumen side by the more or less broken down epithelium of the pigmented areas mentioned above. While spaces filled with blood and an occasional Malpighian tubule exist between the basement membrane of folds 4, 8 and 12 and the circular muscle coat, the circular muscle fibres are in contact with the spongy tissue of folds 2, 6 and 10.

Folds of spongy tissue, homologous to those in *Mecistogaster*, occur in the rectum of *Thaumatoneura* larva. On slide 7 of *Thaumatoneura* larva No. 7, female, (Dr. Calvert's collection), there are three such folds of reticulate tissue covered by a pigmented epithelium.

About section 373 (Fig. 6) some of the spongy tissue extends out into the hæmocœle.

From section 383 (Fig. 6), anterior part of segment X, caudad to the end of the gut no more is seen of the large columnar cells of the longitudinal folds. This region, from about section 380 to the end of the gut, corresponds to the vestibule or anal part of the rectum of Anisopterous larvæ (Sadones, 1895, pp. 277, 280, 315; Tillyard, 1916, p. 131 and 1917, pp. 101, 114, 115, 116; Faussek, 1887, p. 45). But there are not two kinds of epithelia as described by Sadones for *Libellula depressa*, nor is there any indication of a

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([1] As the larvæ of *Thaumatoneura* and of *Argia talamanca* figured in the papers above cited were unavoidably those which died in attempted rearing, it is perhaps not impossible that the thinness of their epithelia may be a starvation effect.—P. P. Calvert.)

stratification of the epithelium as mentioned by that author (Sadones, Fig. 49). The epithelium covering the six longitudinal folds, although it is not as well preserved in this region as one would wish, seems to consist of a single layer of elongate cells. These, except for the presence of more pigment, are similar to those described for the folds of the first part of the hind-gut. The musculature of the anal part of the *Mecistogaster* intestine is homologous, as is pointed out below, to the musculature of the corresponding region in Anisopterous larvæ.

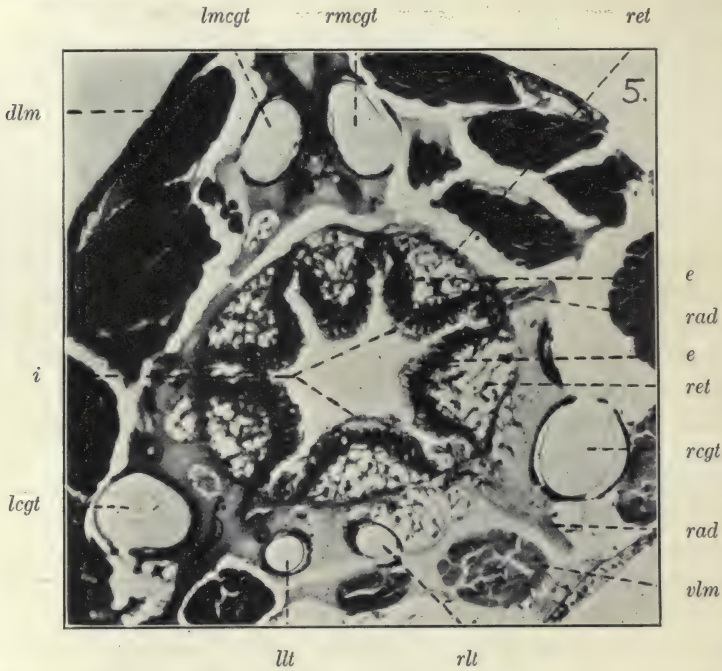

Fig. 5. Part of photograph of transverse section 393 (Anal Part, or Vestibule, of the Rectum). Enlarged 125 diameters. Abbreviations as in Figure 1.

Figure 5 is a photograph of section 393. It illustrates the appearance of this sixth and last division of the hind-gut. In section 393 the following parts can be made out: intima, *i*; pigmented epithelium of the six longitudinal folds, *e* (the epithelium of folds 2, 6 and 10 is continuous with the more or less disintegrated epithelium of the pigmented areas of the preceding division of the gut); basement membrane, *b*; reticulate connective tissue, *ret*; circular muscle layer, *cm*; and the radial muscle strands, *rad*.

Summary of the Divisions of the Hind-Gut, with Homologies.

	PART	HOMOLOGIES	TEXT FIGURE	FOLDS	LOCATION
Small Intestine or Ileum (Tillyard, 1917, pp. 101, 113, 114).	1.	Ileum (Orthoptera) Short Intestine (Anisoptera).	Fig. 1	12 folds (Nos. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12).	Anterior part segment VII Sections 1-35.
	2.	Prerectal Ampulla (Anisoptera, some Orthoptera).	Fig. 2	3 folds of thick columnar epithelium (Nos. 4, 8, 12) and 9 other folds (Nos. 1. 2. 3—5. 6. 7—9. 10. 11).	Middle part segment VII Sections 35-80.
	3.	Colon (some Orthoptera).	(Not figured, similar to Fig. 1)	12 folds (Nos. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12).	Posterior part segment VII Sections 80-140.
Rectum (Tillyard, 1917, pp. 101, 114, 115, 116).	4.	Pouched Region (no reference to such a region found in the literature).	Fig. 3		Anterior part segment VIII Sections 140-160.
	5.	Anterior part of Rectum (most insects) Branchial Basket (Anisoptera).	Fig. 4	3 folds (Nos. 4, 8, 12) of thick columnar epithelium. Toward posterior end folds 2, 6 and 10 are also present.	Segments VIII, IX, X Sections 160-380.
	6.	Anal part of Rectum; Vestibule (Anisoptera).	Fig. 5	6 folds (Nos. 2, 4, 6, 8, 10, 12).	Segment X Section 380 to anus.

There are six of the radial muscle strands. They connect with the rectum at the points 1, 3, 5, 7, 9, 11, of the clock notation as described by Tillyard. Radiating outward they are attached at their peripheral ends to the body wall. They correspond to the radial rectal dilator muscles of Anisopterous larvæ (Tillyard, 1916, pp. 139, 140; Sadones, 1895, p. 316).

As indicated in the above table, Tillyard in his recent excellent book, *The Biology of Dragonflies* (1917, pp. 101, 113, 114, 115, 116), divides the hind-gut of Odonate larvæ into two main parts, the small intestine or ileum and the rectum. The small intestine is subdivided into the short intestine and prerectal ampulla. The first two divisions of the hind-gut in the present larva are evidently homologous with these two parts. But histologically the structure of this part of the intestine in *Mecistogaster* differs from the description given by Tillyard or the other authors mentioned above. The third division of the small intestine, which is called the colon in the table, is not described by Tillyard.

Tillyard's statement (1917, footnote, p. 101) that "in Zygopterid larvæ the rectum is undivided," is hardly true for *Mecistogaster*. In the present larva, as indicated in the above table and described on preceding pages, the rectum (as the term is used by Tillyard) is divided into three distinct regions. These differ from one another both in gross morphology and finer histological structure.

The Tracheæ (Fig. 6).

In the diagram (Fig. 6), in order to represent more clearly the main trunks with their branches, most of the tracheæ have been drawn far laterad to their true position. The correct orientation may be obtained by referring to the photographs of the transverse sections (Figs. 1, 2, 3, 4, 5). The diameters of the tracheæ and gut have been drawn on a scale twice as great as their length. A glance at Fig. 4, of section 250, shows that the rectum is slightly asymmetrical with respect to the epithelial folds of the gut wall. By comparing the mid-dorsal fold (No. 12) with the same fold in *Thaumatoneura* larva (Calvert, 1915, Plate XVII) it was possible to determine the true right and left sides. The latter are correctly represented in the diagram, Fig. 6, showing the distribution of the abdominal tracheæ as seen from the dorsal side.

From the anterior part of segment VII (Fig. 6) the two great *dorsal longitudinal trunks* (*rdt*, *ldt*) run caudad, dorso-lateral to the gut, as far as sections 40 and 60 respectively. At these points

transverse connectives (*dlc*) are given off to the lateral longitudinal tracheæ (*llt*, *rlt*). From about sections 95 to 130 the dorsal trunks are almost in contact with one another and lie dorsal to the gut. At about section 170 on the right, and 180 on the left, two more transverse connectives (*dlc*) connect the dorsal and lateral longitudinal trunks. At section 190 the dorsal tracheæ have moved out laterally and are entirely lateral at section 240 (Fig. 4 of section 250, *ldt* and *rdt*), where they lie on opposite sides of the gut. The anterior or chief left ($ldrt_1$) and right ($rdrt_1$) dorsal rectal tracheæ are given off from the dorsal longitudinal trunks about section 250, posterior part of segment VIII. These dorsal rectal tracheæ run mesad and supply the columnar epithelium of the dorsal rectal longitudinal fold (No. 12), (Figs. 4, and 6, $ldrt_1$ and $rdrt_1$). By the time they have reached section 260, posterior end of segment VIII, the dorsal trunks are really ventro-lateral in position with respect to the gut. At section 320 they are again dorso-lateral in position, and at section 328, caudad to the middle of segment IX, they divide into the median (*lmcgt*, *rmcgt*) and lateral (*lcgt*, *rcgt*) caudal gill tracheæ (Figs. 5 and 6). The lateral gill tracheæ pass to the ventral side of the gut and thence into the lateral gills.

From the left median caudal gill trachea (*lmcgt*) small branches ($ldrt_{11}$) are given off to the dorsal rectal fold at section 345, segment IX, and section 362, segment X. About section 352 a small branch ($llrt_{11}$) is given off to the left ventro-lateral rectal fold.

From the right median caudal gill trachea (*rmcgt*) a branch ($rlrt_{11}$) is given off to the right ventro-lateral rectal fold at section 356. Two other small branches whose course could not be followed, are also given off at about this point.

In the anterior part of segment VII the *lateral longitudinal tracheæ* (*llt*, *rlt*) lie on opposite sides of the gut, beneath the dorsal trunks (Figs. 1 and 6). They remain lateral in position as far as section 180, anterior part of segment VIII. A little caudad to this they pass between the hypodermis and the ventro-lateral muscle masses to the ventral side of the abdomen. They run thence caudad beneath the gut (Figs. 6 and 4, *llt*, *rlt*), but never in contact with it and giving off no branches to it, to section 373, segment X. Here the right lateral longitudinal trachea (*rlt*) passes over to the left side and joins (section 388) the left lateral longitudinal trachea (*llt*), forming an anastomosis (*anas*); separating again almost immediately after (section 391, Fig. 5), they join respectively tracheæ *rcgt* and *lcgt*.

Closed spiracles (Fig. 6, *Sp.* 7) connect with the lateral longitudinal tracheæ (*rlt*, *llt*) at sections 45-49 and 60, segment VII, where the dorsal lateral connectives (*dlc*) are given off to the dorsal longitudinal trunks (*ldt*, *rdt*). There are closed spiracles (*Sp.* 8) also at the corresponding points on the lateral tracheæ in segment VIII, sections 165 and 171. But in addition to the dorsal lateral connectives, there originate here the tracheæ which bifurcate at about section 190 to form the right (*rvs*) and left (*lvs*) visceral tracheæ, and the right ($rlrt_1$) and left ($llrt_1$) lateral rectal tracheæ. The latter may be considered as prolongations caudad of the visceral tracheæ (Figs. 6 and 4).

The left visceral trachea (*lvs*), as shown in Fig. 6, runs cephalad as far as section 1, anterior end of segment VII. Between sections 190 and 155 it lies ventrad to, but not in contact with the gut (Fig. 3, *lvs*); anterior to section 155 it assumes a lateral position (Fig. 1). At section 120 the main trachea divides into three branches. One of these supplies the left ventro-lateral fold (No. 8) of columnar epithelium (Sect. 60). The third branch runs forward to the

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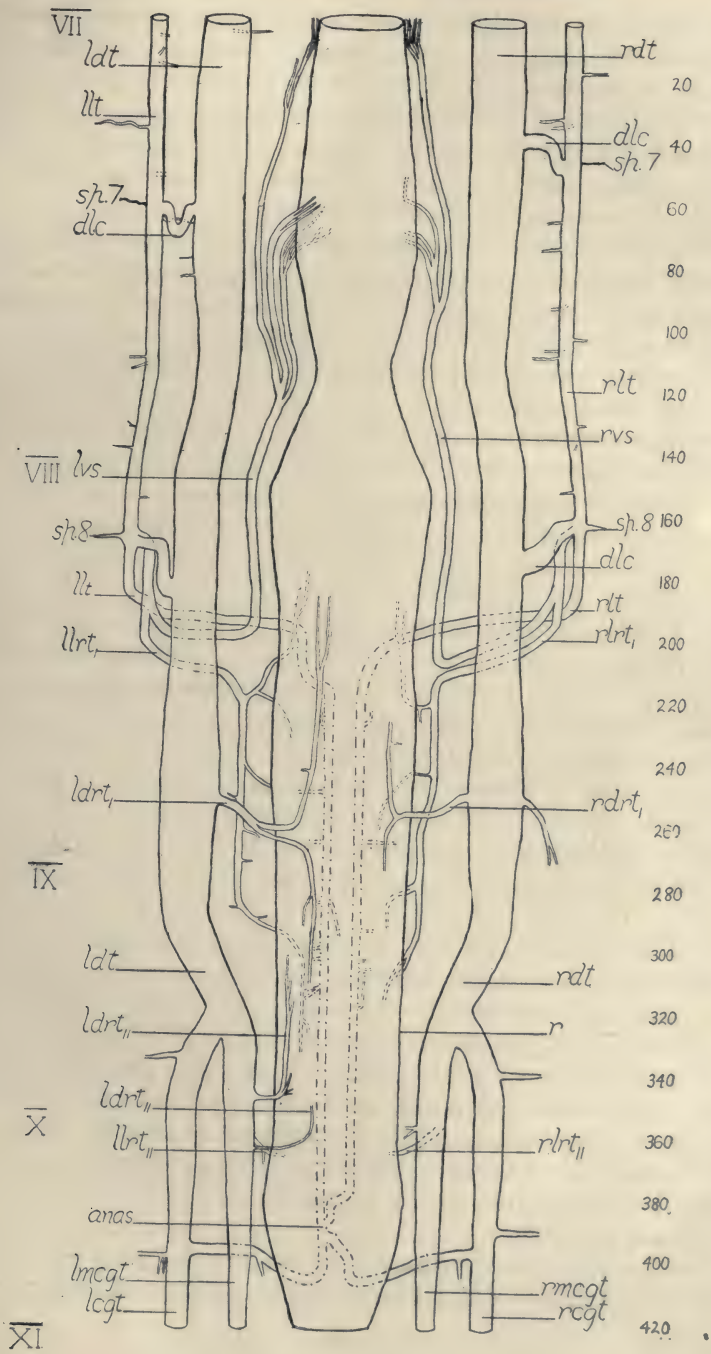
Fig. 6. Diagram of the hind-gut and rectal tracheæ. The abdominal segments are numbered in Roman numerals on the left side of the figure, the microtome sections are numbered in Arabic on the right. The sections are numbered in order (1-420) beginning at the anterior end of the hind-gut (anterior end of segment VII) and proceeding caudad to the posterior end of segment X. The short horizontal lines immediately above the Roman numerals indicate the approximate boundaries of the segments. The meanings of the abbreviations designating the tracheæ are given below.

Those portions of the lateral longitudinal tracheæ which lie ventrad to the gut are represented by lines of alternating dots and dashes, thus .-.-.-.-.-. This has been done to distinguish them from the tracheoles which either run along, or pass into the ventral rectal walls, and are represented by broken lines, thus ----------. The tracheoles which run along or pass into the dorsal rectal wall are represented by solid lines.

Abbreviations.

anas, anastomosis.
dlc, transverse tracheae connecting the dorsal and lateral longitudinal tracheæ.
lcgt, left caudal gill trachea.
$ldrt_1$, anterior or chief left dorsal rectal trachea.
$ldrt_{11}$, posterior or secondary left dorsal rectal trachea.
ldt, left dorsal longitudinal trachea.
llt, left lateral longitudinal trachea.
$llrt_1$, anterior or chief left lateral rectal trachea.
$llrt_{11}$, posterior or secondary left lateral rectal trachea.
lmcgt, left median caudal gill trachea.
lvs, left visceral trachea.
r, rectum.
rcgt, right caudal gill trachea.
$rdrt_1$, anterior or chief right dorsal rectal trachea.
rdt, right dorsal trachea.
$rlrt_1$, anterior or chief right lateral rectal trachea.
$rlrt_{11}$, posterior or secondary right lateral rectal trachea.
rlt, right lateral trachea.
rmcgt, right median caudal gill trachea.
rvs, right visceral trachea.
sp7, unopened spiracle of the 7th abdominal segment.
sp8, unopened spiracle of the 8th abdominal segment.


VII
ldt
llt
sh.7
dlc
VIII
lvs
sh.8
llt
llrt,
ldrt,
IX
ldt
ldrt,,
ldrt,,
X
llrt,,
anas
lmcgt
lcgt
XI
rdt
dlc
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rlt
rvs
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340
360
380
400
420

junction of the Malpighian tubes with the gut where it breaks up into small tracheoles ramifying among these tubes and about the circular muscular coat of the gut.

The distribution of the right visceral trachea (*rvs*) and its branches is similar to that of the left; except that, while it gives off tracheoles to the right ventro-lateral fold (No. 4) of the intestinal epithelium, it gives off none to the dorsal fold.

The left lateral rectal trachea ($llrt_1$) and the right lateral rectal trachea ($rlrt_1$) give off tracheoles respectively, to the left ventro-lateral rectal longitudinal fold (No. 8) and the right ventro-lateral rectal longitudinal fold (No. 4), (Figs. 6 and 4).

It will be seen that, in the main, the abdominal tracheal system of this *Mecistogaster* larva is similar to that described by Calvert for *Thaumatoneura* (1915, Plate XVI, and pp. 388, 389) and by Cullen and by Jamieson for *Argia* (1918, pp. 77, 79, figs. 1, 2; pp. 82, 84, figs. 1, 2). For convenience in comparison I have used the same nomenclature and abbreviations as employed by those authors.

Rectal Respiration.

A glance at Figure 6, shows that the tracheole supply of the hind-gut is not rich, and is limited to those portions of the latter which have been described as having longitudinal folds of thick columnar epithelium. All of the tracheoles have been traced, as far as possible, to their terminations. Owing to the fact that cell boundaries in the intestinal epithelium are indistinct, it could not be absolutely determined if any tracheoles terminate inside cells. Usually the twigs appear to end just within the basement membrane of the columnar epithelium of the rectal folds; so seem to end, for instance, the twigs seen between sections 300 and 320. Sometimes, like the terminations of $llrt_1$ (sections 320 to 340) and the caudal branch of $rdrt_1$ (sections 260-280), the twigs seem to end outside the basement membrane. Sometimes, as in the twigs running cephalad from $llrt_1$ and $rlrt_1$ in sections 178 to 200, the terminations may possibly be within the cells. Others may pass between the cells. But one fact is clearly evident and seems to be significant: all the tracheal twigs end on the basement membrane side of the thick columnar epithelium. The tracheoles are at all points separated from the lumen of the gut by the thickness (41 to 83 micra) of the columnar epithelium.

Furthermore, the columnar epithelium is the only part of the internal rectal wall which has a tracheal supply. No twigs to the

pigmented areas between these folds could be found. The extensive folds of spongy or reticulate tissue, covered on the inside by a thinner epithelium, and extending from about the middle of segment IX to the end of segment X, also seem destitute of tracheoles.

In view of the above facts it seems improbable that any diffusion takes place between gases in the rectal tracheoles and those in the water in the rectum. This conclusion is strengthened if the position of the rectal tracheal twigs in *Mecistogaster* is contrasted with the position of the tracheal gill capillaries in Anisopterous larvæ, where diffusion of oxygen is known to take place. The gill capillaries in Anisopterous larvæ (Tillyard, 1915, p. 425, Figs. 3 and 5; also 1916) lie "in a thin layer of very flattened cells," the gill epithelium. They lie, too, "fairly close up" to the chitinous cuticle of the gill. They are very numerous, excessively fine, and each forms a complete loop. In *Mecistogaster* the tracheal twigs are separated from the chitinous lining of the gut lumen by a thick epithelium, they are not excessively fine, do not form loops, and are not numerous. They are absent, except for one small area (sections 60 to 80), in segment VII, in which, together with segment VIII, lies the gill basket of Anisopterous larvæ (Tillyard, 1916, p. 139).

Nevertheless, there must be other means of respiration in Zygopterid larvæ than that through the caudal gills. Calvert (1911 *b*, p. 455) found in *Mecistogaster modestus*, "as in most, perhaps all, Zygopterous larvæ, the caudal gills may be lost without interfering with growth, development and transformation." Mr. Bodine (1918), has recently succeeded in keeping Zygopterid larvæ, from which the gills had been removed, alive for three and four days when confined at the bottom of a Mason jar filled with stagnant water.

If we exclude respiration through the integument, the only alternative seems to be some sort of rectal respiration. In support of the latter we have Calvert's observations on living larvæ of *Calopteryx maculata*, *Hetaerina americana*, and *Argia moesta putrida* (Calvert, 1915, pp. 437-442). He found regular rhythmic pulsations of the rectum, with inhalations and expirations of water, in these forms may be carried on for long periods. Tillyard (1916, pp. 410-413) found regular rectal pulsations in newly hatched larvæ of *Austrolestes leda* up until they were half an hour or more old, when the movements became intermittent.

If rectal respiration occurs in the larvæ of *Mecistogaster modestus* the only areas which seem morphologically suitable for an exchange

of gases are the longitudinal folds of spongy or reticulate tissue. In this connection it may, or may not, be worth noting that Calvert (1911 *b*, p. 453 and Plate XVII), in dissecting *Mecistogaster* larva No. 1, found, "when the viscus was first opened the three non-cellular bands [folds of spongy tissue just referred to] had the shiny, silvery appearance which suggests enclosed air." But, since these areas either lack entirely or have a very scanty tracheal supply, the oxygen would have to be taken up and carried by the blood.[2]

We are not able to correlate any peculiarity of the tracheation of the larva of *Mecistogaster modestus* with its habit of living in the water between the leaf-bases of epiphytic bromeliads (Calvert, 1911 *a*).

In the study of these slides and in the preparation of the manuscript I am indebted to Dr. Calvert for suggestions, directions, and corrections.

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[2] Tillyard suggests (1917, p. 116) that in Zygopterid larvæ the rectal pads (glands or folds) act as blood-gills, liberating carbonic acid gas from the blood into the rectal water supply, by diffusion, and receiving air in exchange. This hardly seems likely. The blood is separated from the water in the rectum by the basement membrane, the thick (41 to 83 micra) columnar epithelium and the chitinous intima.

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IV. EXPERIMENTAL RESULTS IN ISCHNURA AND ENALLAGMA.

BY JOSEPH HALL BODINE.

(The following paper was written out by Mr. Bodine in nearly the form here presented. Owing to his having entered the war service of the United States, it is unlikely that he will be able to continue these researches for many months. He has placed his manuscript in my hands with the wish that I do with it as I think best. I have made some slight verbal changes, but otherwise the paper represents the author's own observations and conclusions.—*Philip P. Calvert.*)

The problem of the physiology of respiration among insects is by no means a settled one and presents a great many obstacles to its solution, especially in certain aquatic stages.

The types, theories, etc., of respiration found in insects have been much discussed and can be easily learned from any of the more recent text-books of entomology and comparative physiology and hence need not be taken up here. I shall deal entirely with the phenomena among the dragonflies, restricting the problem to the suborder Zygoptera.

The morphological studies upon the structure of the rectum and caudal gills of the larvæ of Zygoptera bring forward several questions, as to the exact function of these parts.

The organs generally supposed to be concerned in the respiration of these larvæ are the caudal tracheal gills, the so-called rectal gills or folds, the body surface and the spiracles. The structure of the rectal gills or folds, especially as regards the distribution of tracheæ to the same is discussed in the papers of Calvert, Jamieson, Cullen and Carroll, and need only be referred to here. (The structure of the caudal gills has been described by Tillyard in 1917, in a paper published after Mr. Bodine's work ceased.—P. P. C.)

Various theories of respiration for these larvæ have been proposed, some of which are quite conflicting and the remainder are based rather upon philosophical, than physiological, ideas.

Briefly stated and outlined these theories are as follows: Réaumur (1742) and Roesel von Rosenhof (1749) regarded the caudal gills

as having a fin-like or rudder-like function, mentioning no respiratory function whatever. Dufour (1852) and Roster (1886) ascribed to them the functions of respiration and locomotion. Sharp (1895), remarking that the nymphs lived after removal of the caudal gills, thought their respiratory function must be of an accessory nature. Heymons (1904) held that the entire body surface serves for respiration in addition to the gill-appendages.

A respiratory function was first attributed to the rectum in this group by Roesel von Rosenhof (1749). Dufour (1852) described the gills in the rectum and from this time on a respiratory function has often been assigned to them. Calvert (1915) has given a detailed account of the manner in which water is taken into and expelled from the rectum, and from these observations, we must undoubtedly ascribe to the rectum a relation to the respiratory functions of the nymph. Tillyard (1916) asserts that in early larval life, immediately after hatching, for a period of half an hour or so, the rectum contracts vigorously and to these contractions assigns a respiratory function, especially since he thinks the caudal gills of the very young larvæ are incapable of carrying on respiration. This conclusion is undoubtedly true, but in later periods of the larval life, he attributes to these intermittent contractions only a possible respiratory function, governed "by the efficacy of the total of other respiratory activities. Respiration through caudal gills, through lateral abdominal gills when they occur and through the integument in such cases as it may occur, all differ from rectal respiration in being practically continuous, carried on without special efforts on the part of the larva. Consequently, if the caudal gills have a poor tracheal supply, or a very tough integument, or if the general integument of the larva be unsuitable for respiration by diffusion, the call on the larva for rectal pulsations must be heavier."

If these statements be true, larvæ which are old and hence have thicker chitin over body and gills ought to show rectal pulsations to a greater degree than the normal larvæ. Such a condition, however, has not been found to be the case in the larvæ examined, but such larvæ have contractions quite like those younger and with softer chitin. Tillyard continues: "If the caudal gills are accidentally lost, we should expect that the rate of rectal respiration would be increased." When the gills are removed one at a time, or all together, no change in rate of rectal respiration has ever been noticed, hence we can be quite sure of the non-respiratory function of these caudal gills.

Tillyard's earlier views (1915) as to the respiration of the Zygopterous larvæ are stated as follows: "Firstly, I shall deal only with the suborder Anisoptera, *i. e.* those dragonflies whose larvæ breathe by means of rectal gills, and shall not consider the somewhat different problem presented by the *Zygoptera, whose larvæ breathe by means of caudal gills.*" (The italics are ours.)

Calvert (1915) says, "From the various data which have been brought together here, it seems reasonable to suppose, at least until much more exact experiments show the limitations of each mode of respiration for different stages and for different species of Zygopterous larvæ, that the general body surface, the caudal processes, the rectal epithelium, certain spiracles and in a few species lateral external abdominal tracheal gills, all contribute to satisfying the needs of the organism for oxygen."

Summing up this historical treatment of the possible functions of these parts in respiration we find that three methods for the taking in of oxygen by the larva are described, (1) by the caudal tracheal gills—(2) by the rectal gills—(3) by the surface of the body (including spiracles).

Each of these will be discussed in turn and reasons for considering them heretofore as entering into the phenomena of respiration, will be given.

I. *The caudal tracheal "gills."* These, three in number, situated on the caudal end of the abdomen, have a structure which seems admirably adapted for a respiratory function. Normally, they are present on the larva throughout its life, but are, at the time of transformation, left behind on the exuvia in their normal position and relation. Their presence, however, does not seem to be necessary, because larvæ with one, two or all of them missing, live apparently normally and transform into the adult in the usual manner. Hence, if they do act as respiratory organs, it must be only in a secondary manner. They do, however, aid the larva in swimming, acting as fins or as rudders. When at rest the larvæ have the tendency to move the abdomen in a wave-like fashion from side to side, the "gills" in this case possibly acting only as mechanical devices for the stirring up of the water and hence in bringing water in which the content of oxygen is richer near the larva.

If they have (as many hold) a respiratory function, how can the larva continue to live and reach maturity, when they are completely removed? This seems to entirely eliminate them (or at least to cast much doubt on their rôle) in a consideration of

respiration. Other organs must take up a respiratory function after the removal of the caudal "gills" from the body, but this idea is scarcely conceivable since it would be almost impossible for the animal to adjust any such structures in so short a time. Since these other organs seem especially adapted to a respiratory function, their existence makes the possible respiratory function of the caudal gills seem quite improbable.

II. *The rectal folds or gills.* The structure of these, associated with the observed intake and outgo of water into the rectum through the anus, seems to warrant their inclusion in the consideration of possible respiratory functions. The only other function which could be assigned to the intake and outgo of water into and from the rectum is that of a locomotor one. This, however, is rather improbable for several reasons. These larvæ, when moving in the water, do so by a worm-like wriggling of the body and do not "shoot" through the water as do the Anisopterous larvæ where the rectum does have a locomotor function. The water when expelled from and taken into the rectum does not create currents strong enough to propel the larva through the water. They are produced when the larva is at rest and in this case do not move it.

The function of respiration, then, can be assigned to the rectum, until another possible means for this function can be found. The possible respiratory function of the skin will have to be considered before one can draw a final conclusion, however.

III. *The skin.* The skin, or hypodermis and chitin, of the larvæ, varies in thickness and hardness according to the length of time from the preceding moulting period. Just after exuviation the chitin is soft and quite transparent. Soon it becomes hard, thickens and becomes quite dark in color. Ramifying throughout the surface of the larva are innumerable, fine, thread-like tracheæ which join larger branches and finally these latter unite with the main tracheal trunks. The thread-like tracheæ being found over the entire surface of the larva's body, afford a very large area exposed directly to the water by which the larva is surrounded. Thus the structure of the skin seems to warrant its consideration as a means of respiration.

IV. *Spiracles.* Spiracles on the thorax and abdomen are supposed to function when the larvæ crawl up out of the water into the air. This idea, perhaps true, need not be considered here because we shall only deal with respiration as carried on when the larvæ are actually submerged. However, when the larvæ come to the

surface, and especially at the time of transformation, respiration must be carried on by this method, since the larvæ have then come to the end of their aquatic existence and no longer need those means of respiration previously employed but rather are ready to begin an aerial existence, hence respiration by means of spiracles.

Experiments.

Various experiments made during 1916 and 1917, seem to throw some light upon the possible respiratory mechanisms of Zygopterous larvæ. The larvæ used were of species of *Ischnura* and of *Enallagma*, obtained from small ponds at Primos, Pennsylvania. Many individuals were employed, the experiments were repeated several times and the data for each set of experiments represent average results.

The normal larva (with three caudal "gills") when observed under a binocular microscope and in a Syracuse watch glass, show rhythmic pulsations in the rectum, in the manner described by Calvert (1915) for the larva of *Hetaerina americana*, *i. e.*, each pulsation consisted of three to four successive contractions of the rectum, followed by a pause. No uniformity, however, in the number of contractions per minute seemed to exist; this was possibly due to age, size and environment of the larvæ under examination. Particles of carmine and of lampblack were also used and these were seen to go in and out of the rectum.

The current of water taken in and expelled was not so forcible that a possible locomotor function could be ascribed to it. The currents were not strong but rather weak and of only sufficient strength to be taken into and expelled from the rectum so that a change of water could be brought about.

The three caudal gills were then removed as follows: the larva was placed under a binocular microscope as above and a fine needle, bent at a right angle was used to remove the gills. The needle was placed on the particular gill to be taken off and the larva pulling away under this stimulus, broke off the gill at its attachment to the posterior end of the abdomen. By this method the three gills were successively removed. The results obtained were the same whether one, two or three gills were removed at the same time or at intervals. The rate of rectal contractions was not increased or decreased at the time of operation and several hours afterward the contractions had not changed their regular normal rhythm.

These larvæ, after the removal of the gills, behaved normally and lived in a regular way, and moulted as did larvæ with gills.

To determine whether the larvæ breathed through the skin several experiments were conducted. Glass battery jars were filled with pond water and into them were put both larvæ with gills and also those from which gills had been removed. A fine gauze was then stretched across the jars about two inches below the water's surface, so that the larvæ could not come up to the air. Larvæ kept under these conditions, as well as those kept in jars from which the gauze was absent, lived for periods of four to six days—depending of course, upon the amounts of available food substances present in the water. The food question, however, can be eliminated, because both the larvæ in the controls, as well as those under experiment, were kept in water obtained from the same pond and were under similar laboratory conditions.

The same experiment, performed in a slightly different way, gave like results. Larvæ, both with and without gills, were put in vials, the ends of which were covered with gauze, and the vials were then dropped into battery jars containing pond water. Larvæ put into distilled water in the same manner as above, lived only one to two days—in all probability due to food and osmotic conditions of their environment.

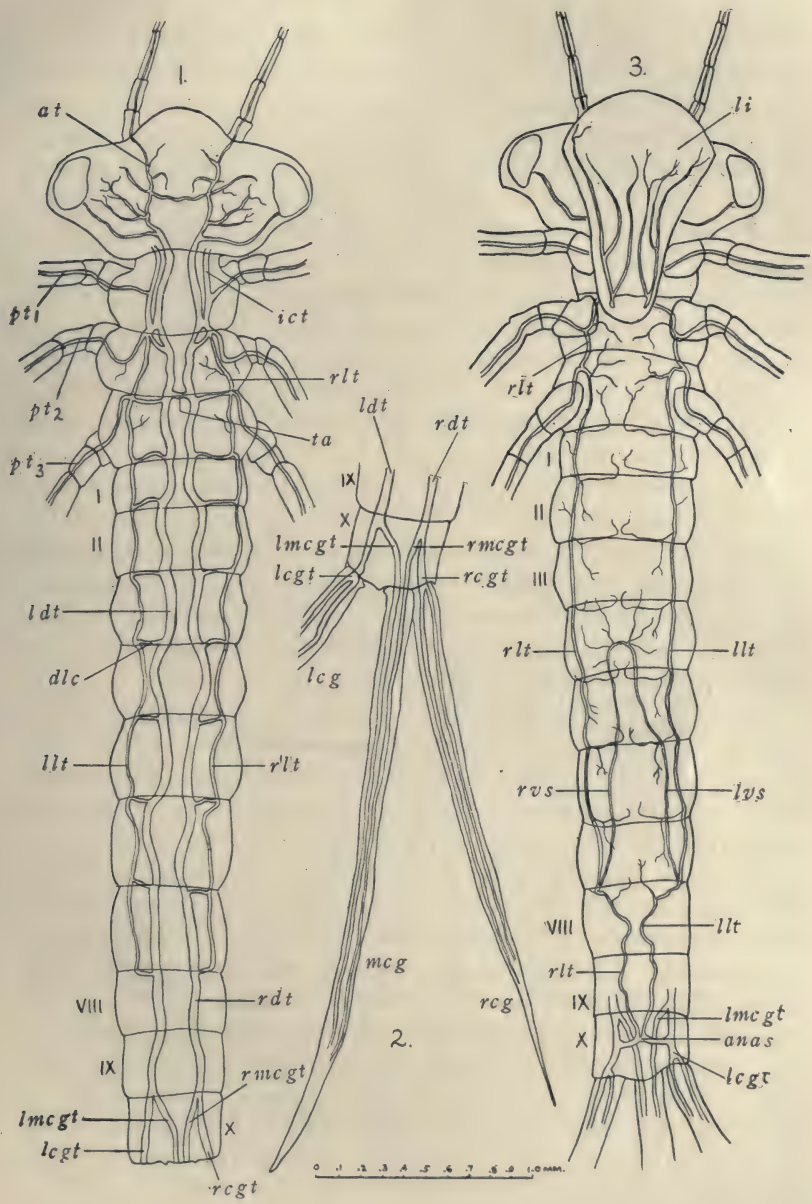
When the water was previously boiled the length of life of the larvæ was greatly reduced—to one and one-half days when under the above conditions. This is doubtless due to lack of food and oxygen in the water used.

Tracheal System of larva of *Enallagma* sp., from Primos, Delaware County, Pennsylvania. Larva No. 101. Drawings made by J. H. Bodine, November 12, 1915. Fig. 1, dorsal view. Fig. 2, dorsal view of hind end of abdomen with caudal gills. Fig. 3, ventral view. From a transparent specimen. (These are, perhaps, the first complete views, dorsal and ventral, of the tracheal system of an Agrionine larva to be published. A highly magnified drawing of the distal part of a caudal gill in lateral view was published by C. G. Carus as long ago as 1827.—P. P. C.)

Abbreviations.

anas, anastomosis of tracheæ in abdominal segment X.
at, antennal trachea.
dlc, transverse trachea connecting dorsal and lateral longitudinal tracheæ.
ict, inferior cephalic trachea (to maxilla and labium).
lcg, left caudal gill.
lcgt, left caudal gill trachea.
ldt, left dorsal trachea.
li, labium.
llt, left lateral trachea.
lmcgt, left median caudal gill trachea.
lvs, left visceral trachea.
mcg, median caudal gill.
pt1, *pt2*, *pt3*, tracheæ of 1st, 2nd and 3rd legs, respectively.
rcg, right caudal gill.
rcgt, right caudal gill trachea.
rdt, right dorsal trachea.
rlt, right lateral trachea.
rmcgt, right median caudal gill trachea.
rvs, right visceral trachea.
ta, thoracic anastomosis.

The Roman numerals denote the numbers of the abdominal segments.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ict
rlt
pt2
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pt3
I
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From these experiments we see, that respiration must be carried on by one of two methods—(1) by the rectum or (2) through the integument. The probability of the passage of the air of the water, through the chitin of the body is quite doubtful. The larvæ used were for the most part of rather hard, thick chitin and the passage of the air through this would be very slow and in all likelihood too small in amount to serve the entire respiratory needs of the larvæ. The possibility of the larvæ getting near or on the surface of the water and taking in air through the spiracles present on the thorax or directly through the skin is excluded, since the larvæ could not get to the surface. The only method left, by which the air could have been taken in, was by means of the rectum. The manner in which the air is taken out of the water by the larval rectum is one of dispute and need not be taken up here. Tillyard (1915) has admirably discussed this question and reference to his work will show the present views.

In experiments made with other objects in view, viz., the action of certain gases or fumes of different chemicals, *e. g.*, ether, chloroform, etc., upon the heart's action, very interesting phenomena were observed with respect to their effects upon the contractions of the rectum. The details of these experiments will not be given now, but their effects on the respiratory phenomena in which we are interested will be considered.

Before the various gases affect the action of the heart, violent contractions of the rectum always precede and very shortly afterward the effects upon the heart's action can be observed. In an animal which has been under the influence of the gas and is recovering, similar contractions of the rectum can be observed before the heart again beats normally. These observations would seem to show that the gas is first taken into the rectum and distributed from it to the other parts of the body. The contractions, when the animal is recovering, would also seem to indicate that air must be carried to the tissues before normal activities could again be resumed.

If the larvæ breathe through the skin, these contractions of the rectum would be quite superfluous. They cannot be due to the action of the gas used, as when the larva was recovering, it was kept in normal atmosphere, away from the effects of the gas. Hence the rectum must in some way act as a respiratory center for the larvæ.

The distribution of the tracheæ, and the general structure of the rectum of the larvæ employed in these experiments correspond

fairly closely to that of the other species studied in the papers by Cullen, Jamieson, Carroll and Calvert.

Whether the air which enters the rectum is carried from it by the tracheæ or whether it diffuses through into the spongy tissue in contact with the basement membrane of the rectum and is then carried by the blood to the different parts of the body, is at present, rather difficult to say on purely physiological grounds and will require more intensive study.

From a morphological study of the species of larvæ used in my experiments, carried out in a way similar to those of Calvert, Jamieson, Cullen and Carroll, I find that the number of tracheæ and of tracheoles, distributed to the rectum is very small—much too small to supply or take up sufficient oxygen for the respiratory needs of the larvæ. Doubtless the greater part of the oxygen diffuses through the spongy bands as suggested by Carroll.

If oxygen from air in the water diffuses through the walls of the rectum and is taken up by the blood and is thus distributed to the various parts of the body, the tracheæ and tracheal trunks must be accessory structures, since otherwise the oxygen would have to be taken up by them from the blood and be distributed by them to the various parts of the body. This is hardly conceivable, since the blood is found to circulate freely to all parts of the body. One fact which would point to such a function of the blood is, that the heart's action when subjected to different gases, is not interfered with until after violent contractions of the rectal wall have taken place, showing that possibly the gas is carried directly to the heart by means of the blood and not by means of the tracheæ. On the other hand, from morphological studies already cited (Calvert, Cullen, Jamieson and Carroll) we see that the tracheal supply to the rectum and especially the manner of ending of the tracheoles, would seem to indicate the possible diffusion of the oxygen through other places than those where these tracheoles end (Carroll). If such a condition is found, the problem becomes one quite different than heretofore supposed—the tracheoles and tracheæ then must play only a secondary rôle in the distribution of oxygen to the body if at all; the blood must be the important means of transportation of oxygen either to the tracheæ, or directly to the various parts of the body.

Tillyard (1916) says regarding the mode of diffusion of air in Zygopterous larvæ: "The diffusion of CO^2 outwards into the rectal water supply, and the diffusion of air inwards, is undoubtedly effected

through the rectal epithelium *without any specialisation of the tracheal supply of that region*, and the exchange must be regarded as being primarily one between the blood of the larva and the water in the rectum, quite irrespective of the tracheal system, which is bound to benefit sooner or later by the change." His idea based almost entirely upon speculative grounds, perhaps can be better justified after the detailed morphological work on the tracheal supply has been done. His attempt, however, to correlate the thickened folds of rectal epithelium of Zygopterous larvæ with the basal pads of Anisopterous larvæ, especially as regards the elimination of carbon dioxide, are, perhaps, not so well founded. The detailed morphological work has shown that these folds are the definite cellular parts of the rectum and have a tracheal supply. The great quantities of spongy tissue present between the folds suggests the supposed function attributed by Tillyard to the folds themselves, viz., the elimination of carbon dioxide.

Conclusions.

1. Zygopterous larvæ breathe by means of the rectum from the time of hatching until transformation.

2. Caudal "gills" serve only in a mechanical way, as rudders in the locomotion of the larvæ.

3. Respiration through the skin of the larva is doubtful, but if it takes place, is only in a very slight degree, not supplying enough oxygen for the respiratory needs of the larva.

4. Regular rhythmic contractions of the rectum take place throughout the aquatic life of larvæ.

5. Rhythm of rectal contractions is not interfered with by removal of the caudal "gills."

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NEW GENERIC NAMES FOR UPPER CRETACEOUS GASTROPODA.

BY BRUCE WADE.

In a recent paper entitled *New and Little Known Gastropoda from the Upper Cretaceous of Tennessee,* published in the Proceedings of The Academy of Natural Sciences of Philadelphia for September, 1917, pp. 280–304, there were several errors which crept in because of the necessity of preparing the paper for publication after the writer left Baltimore and had entered the U. S. Artillery service.

It is the purpose of this brief note to rectify these mistakes and omissions. The family name *Fusidæ* should have been inserted over the genus *Falsifusus* on page 284, and similarly the family name *Busyconidæ* should have been inserted over the genus *Boltenella* on page 285.

The generic term *Hyllus* (page 281) has been found to be much preoccupied and the new name *Parafusus* is here proposed to take its place, the type thus becoming *Parafusus callilateras* and the second species, *Parafusus coloratus.* Similarly the term *Scobina* (page 286) is preoccupied and for the latter the name *Haplovoluta* is proposed, the type species becoming *Haplovoluta bicarinata.* The new Buccinoid genus *Seminola* is not regarded as being preoccupied by the Coleopteroid genus *Seminolus* of Mulsant (1869) although the two are dangerously alike and a different term would have been proposed in the first instance if the writer had been aware of Mulsant's genus.

April 9.

MEETING

IN MEMORY OF SAMUEL GIBSON DIXON, M.D., LL.D., Sc.D.

Edwin Grant Conklin, Ph.D., Sc.D., Vice-President, in the Chair.

The Presiding Officer, in opening the meeting, remarked:

We have met to commemorate the life and public services of a distinguished man, Samuel Gibson Dixon, who has passed forever from our view, but whose influence and labors will remain long after we also shall have joined the "great majority." Others who knew him most intimately in the various phases of his many-sided life and work will speak at length of his services to science, to the State and to this Academy, but as one who was associated with him for many years in the Council of the society, I cannot refrain from calling attention to the many evidences of his ability and foresight which are all around us. This very hall in which we are meeting we owe to his activities. The Academy had a great history when Dr. Dixon became its President. It had great collections, an unexcelled library, a distinguished scientific staff, and a national and international reputation in science, but it was inadequately housed and endowed. With great energy and ability Dr. Dixon set himself to the task of providing a suitable home and a larger endowment for the institution. Contrast the old building with the present group of buildings, the old Library Hall with this cheerful and inspiring one, the old accommodations for the scientific staff with their present work-rooms and laboratories. We might truly write on his memorial tablet, "He found the Academy crumbling serpentine and left it enduring steel and stone."

Dr. Conklin then presented the Hon. John Cadwalader, Vice-President of the Academy; Witmer Stone, Sc.D., and B. Franklin Royer, M.D., who made the following addresses:—

LEGAL ATTAINMENTS OF DOCTOR DIXON.

BY JOHN CADWALADER, LL.D.

Dr. Samuel Gibson Dixon was a man of such varied abilities and had exerted them to such an unusual degree in benefiting his fellow-men that all phases of his life present points of interest and justify the consideration of his career in its different periods.

In his very early years he exhibited such activity of mind and such earnestness of purpose that his father said of him that "there seemed to be no limitation to his development." When a man has been a successful lawyer, a doctor of medicine, filling an important chair in a leading medical school with high scientific attainments; for twenty-two years the President of the Academy of Natural Sciences of Philadelphia, and in 1905 assuming as Commissioner the entire control of and practically creating the Health Department of the Commonwealth of Pennsylvania under the continuous reappointments by four Governors, it may well be said of him that his life has been remarkable and well spent.

The Chairman has spoken and others will speak of his work for the Academy and for sanitary science. I have been asked to refer to those years during which he devoted himself to the law.

The law has been well called "A Jealous Mistress," requiring untiring attention. Dr. Dixon only entered on the threshold of a lawyer's life and, of course, had not reached the stage of distinction which only comes to men after years of experience. I am sure, however, that his study and limited time in practicing the profession had a distinct influence in his career.

The material growth of industries and commercial interests of all kinds has brought into such prominence the "Captains of Industry" and "Napoleons of Finance" that the great profession of the law is not appreciated as it was half a century ago and for centuries before that time. Lord Campbell, in dedicating his "Lives of the Chief Justices of England" to his son Dudley, wrote: "As you have chosen the noble though arduous profession of the law I dedicate these lives to you in the hope that they may stimulate in your bosom a laudable ambition to excel, and that they may teach you industry, energy, perseverance and self-denial," and "ever bear in mind that truly enviable reputation is only to be acquired by

independence of character, by political consistency and by spotless purity both in public and private life."

Dr. Dixon's early leaning was the study of chemistry and from that to medicine generally. His health, however, as he reached manhood was not good and he went to Europe, visiting Vienna in 1873 during the World's Exhibition held in that year. On his return, when about twenty-five years old, he entered the office of his brother, Edwin S. Dixon, and studied law with him and at the Law School of the University of Pennsylvania, being admitted to the Bar on June 30th, 1877.

It is of interest to recall the fact that Dr. Dixon's immediate predecessor as President of the Academy, Gen. Isaac J. Wistar, was also a man of varied pursuits and until the Civil War practiced law.

In 1886 Dr. Dixon received his degree of Doctor of Medicine from the University of Pennsylvania, so that his years at the Bar were not more than six. The importance of those years in rendering more useful his distinguished career in his later activities is not probably recognized by many.

The training in a lawyer's office before the system of acquiring knowledge of the law entirely in a school, as at present, was of great value. A student under a careful preceptor was guided in his reading and studies. He had the advantage of being able to apply his knowledge to the daily business of the office. Typewriters and stenographers and even office boys had not then been introduced, and all letters and papers were copied, notices were served and messages carried by the students. The student then not only acquired practical knowledge of the duties of a lawyer, but he became known to the members of the Bar and clients in a way that enabled him to gain their confidence if it was deserved.

In an office of general practice every kind of business and occupation and the method of being conducted have to be investigated. A lawyer should be an expert accountant and bookkeeper, with an insight into all commercial and manufacturing methods. Until title companies superseded the work of the *conveyancer*, I mean in the correct sense and not that of a *scrivener*, which is usually meant, the lawyer had to possess the closest familiarity with all the incidents connected with real estate and mortgages and the rights of inheritance. In these and many other fields the lawyer of fifty years ago was very truly *Une homme d'affairés*.

The profession of the law is more important in this country than

in any other, as we live under the written Constitutions of the State and the United States. It is extremely difficult for any man not trained in the law to comprehend his duties as a citizen. We all realize if a Legislature or Congress passes an Act that affects our interests we must consult a lawyer to ascertain how we are to meet its requirements. The recent income tax laws are in point. But very few think of the fundamental constitutional regulations that override and control all legislation. It is largely for these reasons that lawyers have been called upon to fill every class of executive duty. A few years ago a greater number of railroads were presided over by lawyers than by any other class of men, and the great trust companies and even banks seek lawyers as their presiding officers.

I have referred to these facts to apply them to the case of our late President. Short as his career was at the Bar, his keen clear intellect had grasped the main principles of the law and he had entered upon a successful professional life. Admitted in 1877, as early as January Term, 1878, his name appears in the Supreme Court Reports. The case referred to was one involving a nice point of law, and the opposing counsel was a leader of the Bar and one of the most distinguished men in the profession, the Hon. Peter McCall. The case was decided in favor of Dr. Dixon's clients, an important fact for a young advocate.

The office of Edwin S. Dixon and Samuel G. Dixon was noted for its accurate and careful attention to every case and matter submitted to it. In connection with cases involving real estate they were especially competent and met on equal terms the Nestors of that branch of the law at that time, Eli K. Price, Edward Olmstead, William Henry Rawle and Henry Wharton. These were the men at that date who practically controlled all transactions involving land titles. The details of a lawyer's practice are not of general interest, and I do not recall any incident in Dr. Dixon's years at the Bar requiring special mention. What he gained in those eight years of study and practice he never forgot, and those who have been associated with him on the Council of the Academy can all testify as to his clear insight and sound judgment on questions affecting its material interests as distinguished from the scientific work which demanded his greater attention.

Dr. Dixon fully appreciated all that Lord Campbell said of the legal profession and followed his precepts while a lawyer and in all of his other relations in life. He knew that to excel "industry, energy, perseverance and self-denial" were essential. The envia-

ble reputation he secured could not have been acquired without "independence of character and by spotless purity in public and private life."

The interesting home owned and lived in for six generations of his mother's family called "Waverly," where he was born, still belongs to them. Adjoining Bartram's Gardens the three hundred acres reached the Schuylkill River, where, from their own wharf, they shipped the farm products and caught the shad in the spring, justly prized from those waters. The city's growth has destroyed these advantages which the earlier generations enjoyed, but it is rare that any home in this country remains in the possession of the sixth generation of any family.

Interesting as was his early home, his late residence, near the romantic Mill Creek and overlooking the beautiful hills beyond Ardmore with the rare trees and shrubbery and attractive farm land, was one in which he might have passed his latter days in the truest enjoyment. He gave himself no rest, however, and even the hottest days of summer were spent at Harrisburg in the strenuous performance of his great work of protecting the people of his State from the scourge of disease.

Dr. Dixon was essentially a Philadelphian. He possessed that modesty and freedom from the desire for notoriety or personal distinction which has marked so many of the great men of our city and State. This building, in which is now safely housed the invaluable collections which he and his predecessors have obtained and his work in securing pure air and preserving the waters of the State from pollution, are far greater monuments than any column that could be erected in his memory. A plain tablet recording his name, but not his deeds, as in the case of Franklin, is all that is necessary. Dr. Dixon's monuments at least cannot be overlooked.

My warm friendship for Dr. Dixon renders it a pleasure to contribute in any way to the respect which is owed to his memory, and as a lawyer to record the fact of his having been one of that brotherhood.

DOCTOR DIXON'S LIFE AND SERVICES TO THE ACADEMY.

BY WITMER STONE, SC.D.

An institution such as this Academy demands the services of many types of men, and of these three seem to stand out most prominently before us. There is the student of the Natural Sciences, entirely absorbed in his researches, who sheds glory upon the society by his discoveries; the benefactor, through whose generosity these researches are made possible; and the executive, the man of affairs under whose direction the institution is developed.

One of these is equally as important as the other in the welfare of the institution, and lacking any one of the three, successful development is impossible.

It is to the last category that Samuel Gibson Dixon primarily belonged, and it is his untiring energy and devotion in guiding the development of this institution, as executive Curator and President for nearly a quarter of a century, that constitute his great gift to this Academy.

But great as were his services as executive, he was more than this. Directly or indirectly he filled the role of benefactor as well, by securing the funds which made possible the development of the plant of the Academy from the modest building which housed our collections twenty-five years ago to the commodious museum, library and laboratories of to-day. Then, too, his experience in medical research gave him a sympathetic interest in the work of the staff and influenced him in guiding the development of the institution along the lines of scientific research which was its original province and to which its reputation has always been due.

The extent of Dr. Dixon's services to this institution and through it to science in general is appreciated by few outside of our officers and members. It was his later labors in the field of preventive medicine and sanitation, as Commissioner of Health of Pennsylvania, that brought him his great renown, not only throughout the extent of this Commonwealth but far beyond its borders as well, and have made his name a byword in every household of the State, coupled always with the thought of public health. But the details of this work, by far his greatest achievement, as well as his career in the law and its influence on his later activities, are treated of by others,

and I must confine myself to a consideration of his services to this Academy.

Dr. Dixon was born on March 23, 1851, in the old Gibson homestead on the Schuylkill River below Bartram's Garden, where his family had resided since 1721. His father, Isaac Dixon, a respected merchant of Philadelphia, and his mother, Ann Gibson, were members of the Society of Friends, and it was under the influence of the quiet Quaker environment so characteristic of our city that his early life was spent.

As a boy he attended the Friends' School at Fifteenth and Race streets and the Mantua Academy in Philadelphia, then in charge of Prof. Hastings. He later received instruction from private tutors with the idea of preparing for Harvard University. Failure in health, however, necessitated a rest from his studies, which was followed by a trip abroad. Upon his return home all thought of a college course was abandoned and he decided to devote himself to business and the study of law. He took a course in the Mercantile College of Philadelphia and then entered the law offices of his brother, Edwin Saunders Dixon, and attended the Law School of the University of Pennsylvania, being admitted to the Bar in 1877. He continued his law practice for six years, but the necessary confinement and constant strain of office work proved too much for his constitution and once more he was forced to seek rest.

Realizing the necessity for a permanent change of occupation, he now conceived the idea of devoting himself to the scientific side of medicine—a subject which in spite of his choice of the law as a profession had always possessed a deep attraction for him. With this object in view he entered the Medical School of the University of Pennsylvania in the autumn of 1883 and received his degree of M.D. in 1886. He won distinction in his studies and while still an undergraduate was appointed an assistant demonstrator in physiology under the late Harrison Allen.

An attack of typhoid fever during the closing part of his course nearly forced him to abandon his studies, but with characteristic determination he continued his work and passed his examinations. Almost immediately afterward he sailed for Europe, in an effort to regain his health in rest and change of scene. Returning in 1888 he was appointed Professor of Hygiene at the University and soon after became Dean of the Auxiliary Department of Medicine.

In 1889 he again spent several months in Europe, this time in various medical schools in special lines of study connected with

his college work. He took courses in Bacteriology, a science then in its infancy, under Crookshank at King's College, London, and under Klein at the College of State Medicine in the same city, while he studied also under Pettenkofer at Munich, investigating methods of sewage disposal, purification of drinking water and other hygienic subjects.

His duties at the University soon became irksome to him and he longed for more opportunity for original research. He had in 1889 anticipated Koch in the discovery of the branched form of the tubercle bacillus, and had conceived the possibility of the use of an attenuated culture as a preventive of tuberculosis. In experiment he had actually produced immunity in a Guinea-pig, and further investigation of the problem was absorbing all his attention.

As a result he withdrew from the University and determined to establish a private laboratory elsewhere. Through the suggestion of Dr. Henry C. Chapman he came to the Academy of Natural Sciences. Dr. Dixon was elected a member of the Academy February 25, 1890; and in the autumn of that year was granted the use of a room at the eastern end of the old Race street building, which he fitted up as a laboratory. Here for several years, personally and through assistants, he carried on active bacteriological researches. He took part in the meetings of the Academy, became a member of the Microscopical and Biological Section and was elected Professor of Microscopic Technology. He again visited Europe soon after establishing his laboratory at the Academy and made the personal acquaintance of Koch, Virchow and other noted foreign bacteriologists.

Dr. Dixon's intimate association with the Academy naturally led him to take a deep interest in the affairs of the institution and at the close of the year 1891 he was elected a Curator, becoming executive Curator in 1893 and President on December 31, 1895, retaining both offices until the time of his death.

With the assumption of the duties of executive Curator his personal researches in Bacteriology at the Academy, for the time being, came to an end, and his whole time and energy were devoted to the Academy's affairs and to the business management of a large estate of which he was executor.

At the time that his Curatorship began there had been little change in the arrangement of the museum since the Academy had first moved to its present site in 1876. There was but one salaried man in charge of the collections, and while several departments

were in the care of the members of the sections or of individual volunteers, the preservation of most of the historic material belonging to the institution was a serious problem. Dr. Dixon, assuming the position of executive Curator without salary, took over all the responsibilities of the museum management, instituting many reforms and introducing more businesslike methods. Needless to say almost his entire time was spent at the Academy.

Shortly after his election to the presidency the munificent bequest of the late Robert H. Lamborn became available, and he was by virtue of his two offices able not only to direct the general appropriation of this fund, but also to carry out in detail the further development of the museum, which had long been hampered by lack of means. Gradually additions were made to the museum staff until all of the perishable collections were under the care of salaried specialists. By constantly conferring with the members of the staff he ascertained the needs of the several departments and these, under his direction, were provided for as far as possible. Modern cases both for storage and exhibition purposes were installed and the way opened for the accumulation and systematic arrangement of the extensive study collections which have been brought together in recent years, and which have made the Academy more than ever a Mecca for systematists from all parts of the country.

Later Dr. Dixon, largely through his personal efforts, secured several appropriations from the State with which the museum building was enlarged, improved and rendered fireproof—while a new library and a commodious lecture hall were erected, providing for two other important branches of the Academy's activities. The details of all this constructive work—plans, contracts and specifications—he insisted upon attending to in person, as well as carefully superintending the building operations as they progressed. The provision of a fireproof stack for the safeguarding of the priceless library of the Academy was a matter of the greatest satisfaction to Dr. Dixon, as it has been to all who are acquainted with its riches.

In the extension of public education at the Academy, Dr. Dixon took an earnest interest and through his influence the Ludwick Institute, of which he was a director and later Vice-President, was led to establish a course of free public lectures at the Academy under the direction of the Lecture Committee, primarily for the benefit of school children and teachers, in which popular courses in various branches of natural history are given every year.

A mere summary of developments and improvements in such an

institution as this mean but little unless one is familiar with early conditions and those which we face to-day. Many can no doubt remember the cramped antiquated museum building of twenty-five years ago—the scarcity or absolute lack of study material and a single Curator in charge, who from force of circumstances could be little more than a Curator. From this you have seen the development of a great modern museum, with an enormous research collection and a competent staff of specialists constantly engaged in its exploitation and in the preparation of valuable scientific contributions for publication in the Academy's *Proceedings*.

Such a development can only be effected through the wise direction and economic management of a competent executive. In carrying it out Dr. Dixon gained nothing but the satisfaction of a good work brought to completion, while it entailed on his part an amount of voluntary sacrifice of time and energy that few men feel like giving. These are facts that do not show on the surface and are easily forgotten, but they should not be lost sight of in estimating the value of such service.

In June, 1905, Dr. Dixon was appointed Commissioner of Health of Pennsylvania, and immediately began the development of the State department which stands to-day as his greatest monument. Through all these years he maintained his office at the Academy, and many of his plans, especially for the enlargement and improvement of the building, were carried to completion during the period when the multifarious duties of his larger office were such that most men would have found them alone impossible. Naturally, of late years with the activities and responsibilities of the Health Department ever increasing, Dr. Dixon was able to devote less and less time to the Academy, but the planning of earlier years had placed the institution on a basis upon which it ran smoothly and needed less and less the detailed attention of the executive. During his long connection with the Academy Dr. Dixon served upon many of its committees, being Chairman of the Building Committee and also of the Committee in charge of the Centenary Celebration in 1912.

In March, 1892, he was appointed to act for the Academy in conjunction with the State Board of Health in making a bacteriological exhibit at the World's Columbian Exposition at Chicago. He little thought at that time that he would in a few years be head of the department that was to supersede the State Board in caring for the health of the Commonwealth.

During the early nineties he made several communications and

presented several papers at the meetings of the Academy, dealing mainly with the development of *Bacillus tuberculosis*, but including also accounts of *Bacillus typhosis* and *Actinomyces* as well as of beri-beri and the bacteriological examination of drinking water. About this time, through his efforts, the Pennsylvania Antituberculosis Society made the Academy its meeting place and Dr. Dixon became its Vice-President, thus emphasizing his interest in what was to become one of his greatest achievements.

In 1898 Dr. Dixon was appointed on the Board of Public Education in Philadelphia and took an active part in improving the hygienic conditions in the city schools. He was Vice-President of the Zoölogical Society of Philadelphia, a Director of the Wistar Institute of Anatomy, trustee of the University of Pennsylvania, Fellow of the College of Physicians, Past President of the Pennsylvania State Medical Society and a member of numerous medical and scientific organizations. In 1909 the University of Pennsylvania conferred upon him the degree of Doctor of Laws, and in 1916 Lafayette College honored him with the degree of Doctor of Science.

In a life so fully occupied with duties of his official and executive position as was Dr. Dixon's there seemed literally no time for recreation. But in the rare moments when he did indulge in holiday trips or in days of rest in the beautiful country place which he had built at Black Rock, near Bryn Mawr, his deep interest in nature asserted itself. He was always quick to notice unusual birds, striking wild flowers or strange insects, and upon his return to the Academy would seek the aid of specialists in determining their identity and learning something of their history, usually adding some original suggestions as a result of his keen powers of observation. Horticulture, too, was a favorite hobby and the Rhododendron thickets and beds of rare plants that he succeeded in establishing at Black Rock Farm were a source of sincere pleasure and gratification to him.

His visits to the famous tuberculosis sanatorium which he had established at Mont Alto were always a great pleasure to him on account of the splendid mountain scenery and the beauty of the more intimate natural surroundings, of which, on his return, he never failed to speak. This love of nature was always in evidence, and from early youth he had delighted in hunting trips with gun and dogs, which led later to moose hunts in Maine and ducking trips to the clubs of the South Atlantic seaboard. But he indulged in such recreation far too little, especially during the later years of his life,

seeming to neglect in his own case the care that he was ever urging upon others to conserve their strength and health.

Even before his appointment as Health Commissioner those who were closely associated with Dr. Dixon were aware of the inroads that constant attention to his business and executive duties were making upon his health, and on several occasions he had suffered a temporary breakdown. His was a nature that must delve into all the details of every matter under consideration, to make sure that there was no possibility of mistake and that nothing had been overlooked. Praiseworthy as is such a practice, probably no constitution can stand it indefinitely, and in the work of the Department of Health it reached the limit of human endurance.

Even during his long illness, which began about the end of July last, Dr. Dixon's indomitable will continued to assert itself, and for a long while he continued to direct the affairs of his department from his sick bed and to consider the more important matters connected with the administration of the Academy. As time went on, however, he became less and less able to make such effort and the final rest from his labors came on February 26, 1918. Dr. Dixon was married in 1881 to Miss Fanny Gilbert, and she and a daughter, Catharine H. Dixon, survive him.

Dr. Dixon had held the office of President of this Academy longer than any other incumbent, with one exception, having just been elected for his twenty-third term, and no other President had seen, during his administration, such a physical expansion and development of the institution. These things speak for themselves and bear testimony of his executive ability and his devotion to the Academy. To the country at large his work as Commissioner of Health is his monument, and he will stand for all time as an example of the highest ideal of faithful service in public office and as an unselfish benefactor of the people in his campaign for public health.

To those of us who knew him here in the halls of the Academy, however, there will always be memories of the personal side of his relations to the institution and to the staff—his kindliness and sympathy, his interest in the work of every individual, and back of it all that constant desire, ever present, ever conspicuous, to advance the Academy's interests and to meet its needs as he saw them; a service, like that rendered as Commissioner of Health, which brought greater benefits to others than it did to himself.

DOCTOR DIXON'S WORK IN SANITARY SCIENCE.

BY B. FRANKLIN ROYER, M.D.

Acting Commissioner of Health, Commonwealth of Pennsylvania.

The foundation of SAMUEL GIBSON DIXON'S unprecedented accomplishments in sanitary science was laid the day he took up the study of law in the offices of his brother, Edwin Saunders Dixon; and the erection of the superstructure began with his matriculation in the Medical Department of the University of Pennsylvania. It was probably because of his scientific bent of mind and his interest in chemistry and in physiological processes, in good part brought about by a break in health and search for recovery in 1881, that he gave up law and studied medicine. So far as his intimate friends in the medical class of 1886 know, he did not, as a student, give any indication, either that he was especially qualifying for or anticipating a career in preventive medicine. While a student, however, he did show unusual interest in chemistry and in the scientific side of physiology and before the completion of his course he had received an appointment from the University Trustees as Assistant Demonstrator in Physiology, the main chair being so ably filled by the late Harrison Allen. Throughout his life Dr. Dixon repeatedly referred to this pleasant association and to the stimulation for research work given him by his early master in physiology.

The major Medical Faculty of the University of Pennsylvania during the years when Dr. Dixon was a student (1882–1886) included a number of intellectual giants. The Professors in 1885 and 1886 as listed in the annual catalogue of the School of Medicine were as follows:

ALFRED STILLÉ, M.D., LL.D., Emeritus Professor of Theory and Practice of Medicine.
HARRISON ALLEN, M.D., Emeritus Professor of Physiology.
JOSEPH LEIDY, M.D., LL.D., Professor of Anatomy.
RICHARD A. F. PENROSE, M.D., LL.D., Professor of Obstetrics and Diseases of Women and Children.
D. HAYES AGNEW, M.D., LL.D., John Rea Barton Professor of Surgery and Professor of Clinical Surgery.
WILLIAM PEPPER, M.D., LL.D., Professor of Theory and Practice of Medicine and Professor of Clinical Medicine.
WILLIAM GOODELL, M.D., Professor of Clinical Gynecology.
JAMES TYSON, M.D., Professor of General Pathology and Morbid Anatomy.
HORATIO C. WOOD, M.D., LL.D., Professor of Materia Medica, Pharmacy and General Therapeutics.
THEODORE G. WORMLEY, M.D., LL.D., Professor of Chemistry and Toxicology.
JOHN ASHHURST, M.D., Professor of Clinical Surgery.
WILLIAM OSLER, M.D., Professor of Clinical Medicine.

The influence of such a remarkable group of America's greatest medical teachers undoubtedly molded the mind destined to chart so original a course along new public health lines later in life.

Graduating with honor in 1886 at the age of thirty-five years, the doctorate degree was given to a man broken in health, and in the early stage of what proved to be mild enteric fever. By special arrangement his final medical examinations were given prior to his sailing for Europe, the prostrating illness not being definitely diagnosed until Queenstown was reached. Here under the care of Dr. W. L. Townsend, in consultation with the celebrated Sir Lauder Brunton, and later joined by the master in therapeutics, the brilliant Dr. Horatio C. Wood, Dr. Dixon won the battle against what his physicians thought would be a fatal illness. Those of us who have been closely associated with Dr. Dixon's work in sanitary science have always felt that the influences of the kindly and helpful Townsend and the stimulation of the brilliant therapeutist Wood, together with the association and life friendship of the learned Sir Lauder Brunton, influenced the young medical mind to study the then infant branch of hygiene—a branch of medicine at that time receiving its greatest impetus on the continent of Europe, particularly in Germany.

After a prolonged holiday in Europe and complete restoration to health, Dr. Dixon returned to Philadelphia in 1888 and was made Professor of Hygiene in the Medical and Scientific Departments of the University of Pennsylvania, and later in the same medical school year was appointed Dean of the Auxiliary Department of Medicine. Dr. Dixon, while holding this Chair, established the first laboratory of hygiene in the University of Pennsylvania and one of the first on the American continent.

In 1889, several months' study in Europe, undertaken with a resolution to perfect himself to teach the science of bacteriology, brought him under the tutorship of Cruikshank, the celebrated bacteriologist in King's College, London, and gave opportunity for taking a special course in bacteriology under Professor Klein of the College of State Medicine in London. It was while a student under Klein that Dixon made a notable observation, one by which he will perhaps be best remembered as a scientific investigator.

As he sat on his stool in Klein's laboratory, looking through the microscope and carefully searching a well stained slide preparation made from a culture of tubercle bacilli, he made the observation that certain of these organisms were club shaped and others appar-

ently had little shoots or branches. Dr. Dixon was very fond of telling of the skepticism in the minds of the other students of this laboratory, and perhaps even in the thought of open minded Klein himself, when they were permitted to look at the branched forms in this microscopic field. Some said the organisms were lying across each other, or that the end of one bacillus projected against the side of another; but Klein said, "Dixon, if this branching is true, you have made a great scientific discovery." He repeated his work, he checked his technique, he wrote a splendid little paper and illustrated it with a drawing which he made himself, showing the new form. That little paper and that small illustration prepared by the youth in research work attracted the attention of the scientific world and fixed a reputation in science.

This brilliant observation in all probability led him into further research in tuberculosis, but in order to still better equip himself as a teacher of hygiene, he did not return to his Chair without having studied with the most noted hygienist of that time, Pettenkofer of Munich. It was in 1889, while studying in the Laboratory of Hygiene, Munich, so far as we know, that he undertook his first studies in purifying large water supplies and the purification of sewage.

On his return to Philadelphia, late in 1889, he was made Professor of Sanitary Engineering in the University of Pennsylvania, and in October, 1889, we find him publishing a paper on the Treatment of Sewage in London. An opportunity has not been had to review the notes of his lectures given during this school year, but those who had the privilege of listening to his instruction, and who are in a position to contrast this instruction with the practices established under his supervision in the State Department of Health of the Commonwealth of Pennsylvania, see worked out in practical detail what was then considered imaginative and by some medical men almost impracticable and visionary.

In 1890, Dr. Dixon gave up his association with the University of Pennsylvania to become Professor of Bacteriology and Microscopic Technology in the Academy of Natural Sciences of Philadelphia, going there solely in the capacity of a scientific worker. Here he was stimulated by the great Leidy.

During his last college teaching year—to be exact, the 19th of October, 1889—the second event in the unusual career of this unusual man occurred. This date is an important one in the career of him to whom we pay tribute tonight. In the experimental

research work undertaken by Dr. Dixon he found that by introducing old cultures of tubercle bacilli into lower animals a certain degree of immunity was produced, and the publication in the *Medical News* of Philadelphia on the above date preceded by more than six months a similar announcement and publication of similar work—that of the celebrated Koch of Germany. Koch announced somewhat reluctantly that a substance could be produced that would prevent the growth of the tubercle bacillus in the human system.

Following Koch's announcement, Dr. Dixon, with authority from American scientific and medical institutions, visited Europe, interviewed Koch, Virchow, DuBois-Raymond, and many others. At this time he had the privilege of admission to Koch's own laboratory. Europe and America were seething with public interest in tuberculosis. Koch's work, as discoverer of the tubercle bacillus and his later work backed by governmental agencies controlling Germany's laboratories, resulted in robbing Dr. Dixon for a long time of that credit of being the first to produce immunity which should have been given him. In recent years American students of tuberculosis have given this credit to Dr. Dixon and to America.

During the latter part of 1890, while working in his laboratory in the Academy of Natural Sciences, Dr. Dixon developed a tubercle bacillus extract that produces in the lower animals and in human beings that same stimulation toward cure in certain types of the disease that has been found by Trudeau, and other students of pulmonary lesions, to be brought about by the various forms of tuberculin. Later, this same preparation was found by surgeons to be effective in the treatment of certain glandular and genito-urinary types of tuberculosis and ophthalmologists found it equally helpful in the treatment of ocular types.

Dr. Dixon's indefatigable energy and originality were no doubt responsible for his selection in 1892 as Executive Curator in the Academy of Natural Sciences, and it is perhaps here and as Curator, that he developed genius for ocular teaching. This experience as Curator, together with his training in hygiene, led to his appointment as a member of the Board of Public Education in 1898. During the greater part of the six year period in the Board of Public Education Dr. Dixon was Chairman of the Committee on Hygiene. It was during this time that the active campaign was conducted for furnishing public school children of the city of Philadelphia with pure drinking

water. The city water supply at this time was unfiltered, the domestic household supply usually being purified by boiling. Filters were installed. In 1902 the Committee on Hygiene began volunteer medical inspection of the Public School children in Philadelphia, the first place in Pennsylvania to undertake such work.

It was while working in his capacity on the Committee on Hygiene that the genius of the man of science stimulated the completion of plans and models (practically invented) for scientific construction of outlets from wash-basins, sinks, and bath-tubs. An illustrated bulletin by the Commissioner of Health as late as May, 1914, shows how actively his interest in such devices continued throughout his busy career as a public health administrator.

As early as 1890 in the annual oration on hygiene before the Pennsylvania State Medical Society in convention at Williamsport, Dr. Dixon gave evidence of public health foresight by visualizing the future work of a State Health organization. In this address, which was later in good part repeated before the State Board of Health of Pennsylvania on Friday evening, May 15, 1891, Dr. Dixon practically forecast the work of a great State Department of Health. Its development came fourteen years later. In that address Dr. Dixon was consistent with his work in later life in that he outlined ideal precautions for protection against tuberculosis, and even suggested a Cabinet Minister of Health to be as useful as a Cabinet Minister of Agriculture for essential national organization.

Dr. Dixon's foundations for administrative work in sanitary science were well and deeply laid in the twenty-two year interval between the time he gave up law to study medicine and during the period of his teaching and research work. When the invitation came to him from Governor Pennypacker in June, 1905, to organize the State Department of Health, provided for by the three Acts of the Legislature of that year, he came to the work with foundation training in science and big business such as no other man in America had. Dr. Dixon had nothing whatever to do with the drafting of the legislation or securing its adoption. In his pursuit of knowledge of preventive medicine, so far as is known, he had not done so with any thought of accepting an executive position such as was offered him by the Governor. The laws creating the Department were drafted by Dr. Charles B. Penrose and it was almost wholly due to the skill, patience and devotion of Dr. Penrose to a subject in which he had become intensely interested while serving as a member

of the Board of Health in Philadelphia that the laws were properly drafted and their approval secured.

In the selection of Dr. Dixon to be the first Commissioner of Health in Pennsylvania, Governor Pennypacker in his autobiography may be quoted:

"The session of the Legislature ended on the 13th day of April. A Department of Health had been created, to which had been given very great authority and power which extended to the person of the individual citizen and might even be regarded as an infringement of his personal liberty. The value and permanence of the legislation would depend upon the manner in which the department would be organized. It was at first suggested to me that it should be placed in charge of Dr....., but that thought I instantly dismissed. I then had an interview with Dr. Charles B. Penrose, who had been very much interested in the matter, and he named to me a gentleman connected with one of the schools in the Western part of the State. I had a talk with this gentleman, but was still not satisfied. Then Dr. Penrose told me he thought Dr. Samuel G. Dixon, President of the Academy of Natural Sciences, would be willing to undertake the task. That suggestion suited me exactly. Dixon consented and I made the appointment. Under his direction it has come to be accepted as the most important and efficient organization for this line of work in the United States. There is good ground for hope that many of the inflammatory diseases due to specific poisons, such as typhoid fever, smallpox, diphtheria and tuberculosis, may be in time stamped out of existence."

Dr. Dixon was commissioned by Governor Pennypacker on the 6th day of June, 1905, and from that day until the day of his death devoted the greater part of each hour that he was awake to the organization and administration of the State Department of Health. The organization was successful almost immediately for the reason that every new step taken by the Department was carefully thought out before being projected, and because the public were fully taken into the confidence of the Commissioner prior to his enforcing any new plan of procedure.

Knowing the common interpretation that the wielding of police authority extending to the person of an individual citizen for the purpose of protecting all might be regarded as an infringement of personal liberty, Dr. Dixon from the beginning tried to change this general acceptance of the public and to make Pennsylvanians see that in civilized life many primitive and individual liberties must be given up to insure the benefits to be had by public health protection. From the very beginning of the State Department of Health the central thought in its educational work was "how may we get close to the people, and how may we make them see public health problems from the viewpoint of benefits to be obtained." Dr. Dixon's preachment, "Pennsylvania's citizens want to be kept well and in good health and are willing to submit to inconveniences if we only show them what to do"—these and similar slogans reached re-

sponsive chords. Pennsylvania liked this new way of being taken into the confidence of an executive.

It is not possible to faithfully treat of Dr. Dixon's work in sanitary science without speaking in some detail of the great public health organization built by him during the last twelve and a half years of his life. It will likely stand as the greatest monument to his memory.

The law creating the Department of Health centralized the authority in the hands of a single executive, giving him greater power than was given to any other officer of the Commonwealth, save the Governor, and perhaps greater authority than is granted any similar official in America.

With all of this authority in the hands of a man known to be ruggedly honest and gentle as a woman, the public had no fear of usurpation of the unusual authority placed in his hands, and during all the period that he was Commissioner of Health many of the unusual powers that might be needed in case of great emergency were never even given trial.

The first organization undertaken was that of the Bureau of Vital Statistics. Under Dr. Dixon's supervision this bureau was so well planned that before it had been in operation a full year the Federal Census Office credited Pennsylvania with having a better organized agency for gathering vital statistics than any other State in the Union. This bureau consists of a central office under the supervision of the State Registrar and more than 1,100 Local Registrars—one for each civil unit in the State, each Local Registrar having a deputy.

The second division of the Department's organization taken up by Dr. Dixon was that of Medical Inspection. Before this division had been in operation a year it was found that all previous plans for public health organization in the civil sub-divisions known as second class townships were inoperative, and that in many of the small boroughs similar inaction was seen.

For the first two years the Division of Medical Inspection was largely engaged in handling epidemics too extensive for local health organizations to cope with, and in helping lame health organizations to form working bodies.

In 1907, however, all second class townships were formed into 720 sanitary districts, and it was suggested to the Legislature that the law providing for school boards to act as Boards of Health therein be repealed. The advice was followed and at once the

Department assumed entire executive supervision over public health matters in a population of more than two million souls.

In all of the countryside, as well as in small boroughs, details were worked out for handling quarantine just as it is done in our large cities. It is fair at this time to say that a great deal of the reduction in sickness from communicable diseases in our larger centers of population is due to establishing proper regulations in the unorganized country villages and on farmsteads, such points prior to that time often feeding infection through food supplies or by visits into the larger centers of population.

The third great division of the Department's organization taken up was that of Sanitary Engineering. One of the Acts upon which the Department is based provided for the prevention of pollution of streams, and Department measures had to be perfected for approving, according to the Act, the plans for all water works and sewage treatment plants. Studies had to be made looking toward the requiring of many cities to build sewage purification works so that municipalities down stream might not be continuously poisoned by filth entering from the neighboring city above.

The amount of work required to supervise and intelligently approve the hundreds of plans brought before the Commissioner in this period of time was in itself almost a full task for one well trained sanitarian. For every set of plans that came before the Commissioner of Health completed and safe for approval in all details, two sets of plans required rejection in some particular, and a goodly number during the early days of the Department required rejection in toto.

The Division of Laboratories was organized as soon as the other divisions were well planned, the organization being made with a threefold purpose in view:

First, to afford doctors in the Commonwealth remote from instruments of precision opportunity to study their cases in a scientific way and to apply modern methods of treatment.

Second, to properly check the operation of water filtration and sewage purification plants and to coördinate the engineering studies with end results.

Third, with the purpose of undertaking such research work as might be advisable.

Division of Distribution of Biological Products.—Early in the history of the Department plans were made for averting the needless sacrifice of life to the ravages of diphtheria. The Attorney

General ruled that the appropriation items were so liberal in their wording that the purchasing of diphtheria antitoxin would be permissible. Stations were established in all populous centers in the Commonwealth and antitoxin was placed within the reach of all Pennsylvania doctors for use in treating the poor.

Divisions of Accounting and Purchasing and Supplies.—From the very beginning of the Department's organization up to the present time systematic keeping and auditing of accounts, and purchasing and distribution of supplies were carried out with precision creditable to a large business concern. Two divisions were devoted to this portion of the Department's business and work, thus giving the executives of the other divisions all of their time for essential public health details.

So firmly had the organization worked out in 1905 been established by 1907, that when the Legislature of that year came to fulfill the campaign pledges of both great political organizations to support an anti-tuberculosis campaign, they deliberately voted $1,000,000 to the Department of Health to start the work. This was done so that the organization incident to the conducting of a chain of dispensaries and the building of tuberculosis sanatoria for the poor might be worked out along the same lines followed in the organization of the new Health Department. To properly undertake this new line of work, two new divisions were organized —one of Tuberculosis Sanatoria and the other of Dispensaries.

This tuberculosis work lay nearest Dr. Dixon's heart and into its organization he put the best that was in him. Twenty-three hundred free beds in three great sanatoria in the Pennsylvania mountains, and one hundred and fifteen dispensaries, each with its quota of physicians and nurses, followed.

The work of these various divisions was extended and broadened from time to time, each division taking on its new load as directed by the Commissioner. Year after year elapsed, Dr. Dixon being appointed by Governor after Governor, and from time to time the Legislature broadened and made heavier the load by providing additional lines of work and liberal funds for its execution.

In 1915 a Bureau of Housing was created. An organization had to be planned to direct work over the entire State with the exception of first class cities, working for the most part through local health organizations in boroughs, second and third class cities. The Bureau was planned to improve living conditions of the poor, and especially to improve sanitary conditions as affecting the lives and health of infants and children and of workers.

Division of Public Service.—A law enacted during the same session of the Legislature provided for the medical inspection of hotel and restaurant employés, and prohibited the use of the common towel and public drinking cup. An additional division had to be organized for handling this work. During the last months of Dr. Dixon's life three additional divisions were planned.

First, a Division for the control of the sale of narcotics, created by a special Act of 1917.

Second, a Division of Child Hygiene, planned and organized to meet the unusual conditions to which the lives of children would be subjected during the high tension period of the war.

Third, a Division for the Treatment of Venereal Diseases, planned not only with the hope of ameliorating suffering and protecting America's selective service men, but with the purpose of placing within reach of the poor those specifics which, when properly applied, might lessen the chances of visitation unto the second and third generations and salvage many lives that might otherwise be wrecked.

Throughout the twelve and a half year period the Commissioner of Health received from his Bureau and Division Chiefs, and through them from the field forces throughout the Commonwealth, information of vital importance to the public. The volume of such information arriving in the central office was enormous, and the subdivisions of the Commissioner's executive staff assisted him in coördinating, digesting, abstracting and reflecting back to the public all those essential details helpful in keeping the public fully informed as to results obtained in making them see that the promises held forth at the time of launching any new line of work were being kept.

The difficulties in the way of perfecting such an organization were not always easily overcome. The Governor, as well as each of his three successors, placed entire confidence in Dr. Dixon and gave him full liberty in organization and freedom from political interference. It is but fair to say that not a single important executive appointment was made to gratify political ambition or to satisfy political recommendation. It very often happened, later in the executive work of Dr. Dixon, that the prominent political leader, who felt hurt that his insistent recommendation could not be complied with, was big enough and broad enough to later come back to Dr. Dixon and say, "I felt at the time you refused my request that you were making a mistake in taking the attitude you did concerning the health organi-

zation. I am convinced, however, that you are right and am glad to tell you so."

During the time that has elapsed since the organization of the Department was fairly well launched in 1906 until the end of 1917, 2,640,000 birth certificates, 1,500,000 death certificates, and 840,000 marriage certificates have been received, catalogued, bound, filed and stored in fireproof vaults of the State Capitol, where they are available for all legal and statistical purposes.

Two hundred thousand persons have been quarantined in rural districts for the various communicable diseases, with subsequent sanitary cleansing and disinfection of premises, and breaking the continuous chain of infection leading from farmstead to town and city and back again to farm. One hundred and twenty thousand dairy farm inspections have been made, and 2,500,000 school children in fourth class district schools have been examined with recommendations to parent or guardian for correcting defects.

Two hundred and eighty-four plans for water works and sewage treatment plants have been filed, studied and approved. 2,274 decrees have been issued requiring the installation of sewage works and water works, and 150 separate pollutions have been removed from streams.

One hundred and seven thousand three hundred and sixty-three patients have been treated at the tuberculosis dispensaries. 1,250,348 visits have been made to the homes of these patients for the purpose of giving practical teaching and sanitary instruction. Nearly 30,000 poor patients have been treated and educated at the Department's tuberculosis sanatoria.

The amount of work done in the Division of Laboratories for physicians of the Commonwealth was enormous, more than 20,000 specimens being examined monthly and scientific reports made to the family doctor.

Since the distribution of antitoxin was begun in 1905 until the end of the last statistical year 300,000 packages of diphtheria antitoxin were distributed free to the poor, 2,000 persons have been immunized against tetanus; nearly 50,000 against smallpox; and large numbers of persons were immunized against typhoid fever.

During the twelve and three quarter years' period when Dr. Dixon was Commissioner of Health in the Commonwealth of Pennsylvania there as appropriated to his Department and expended in the promotion of public health, including the treating of the tuberculous sick, more than twenty million dollars of State

funds, and yet no criticism of this expenditure has been uttered. During this period in his official capacity as Commissioner of Health, he superintended activities extending to every municipality in the Commonwealth. He exercised advisory and supervisory control over the many public health organizations in the State, always leading and setting an example in every line of public health work. These many smaller health organizations, recognizing Dr. Dixon as a central figure, and stimulated by his work, exerted themselves to their utmost. The resulting saving of life is shown by the fact that in the year 1906 when the State Health Department was reorganized, the death rate in the State was 16 per thousand, and in 1917 it had declined to 14.7. This indicates a saving of 120,266 lives in the Commonwealth.

As a fitting stamp of approval of the sanitary work of Dr. Dixon, the Pennsylvania State Medical Society, after eleven years of enforcing police law (and sometimes in a drastic way against medical men), elected him to its highest office. He passed away while serving as President of the Society. His death was mourned most sincerely. The editorial notices written after Dr. Dixon's death were most unusual and show how he had inspired the confidence of the people.

Dr. Conklin.—The addresses to which we have just listened have revealed to us a man of unusual ability and achievements, one who succeeded not merely in one profession but in several, and who has left upon his city, State and nation an enduring impression. "Si monumentum quaeris, circumspice." He died too soon, in the thick of work, in the midst of public service. Now he rests from his labors and his works do follow him. Peace to his ashes, honor to his memory.

ON THE GENERIC POSITION OF SONORELLA WOLCOTTIANA BARTSCH.

BY H. A. PILSBRY.

Sonorella wolcottiana, described from Palm Springs, a health resort at the foot of the San Jacinto Mountains, not far from the Southern Pacific Railroad, has been known hitherto by the original specimens collected by Mrs. H. T. Wolcott in 1903 and by a small series taken by Messrs. Morgan Hebard and J. A. G. Rehn in 1910. Unfortunately, all of these were dead shells. From the close correspondence of the shell to the Sonorellas of Arizona and New Mexico, the species was naturally referred to that genus. The receipt of living specimens taken early in March by Dr. Emmet Rixford of San Francisco, enables me to transfer it to the genus *Micrarionta*, chiefly known by coast Helices, such as *facta*, *gabbi*, *kelleti*, *stearnsiana*, etc. It appears that a group of this genus has been adapted to the arid interior, where they have assumed the appearance of the desert group *Sonorella*.

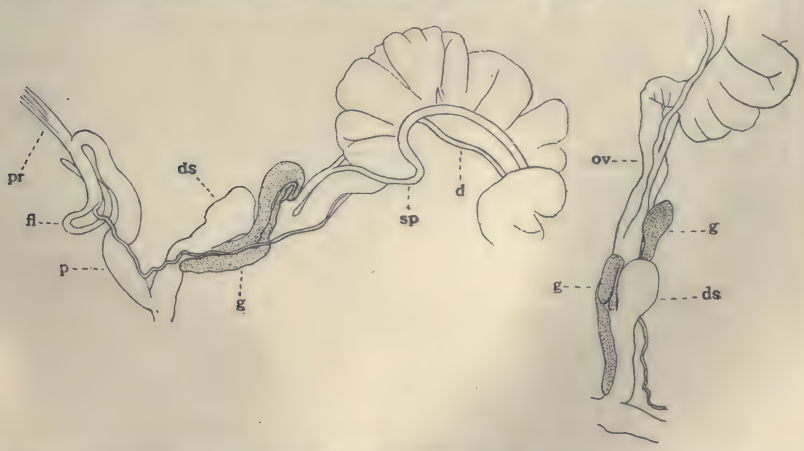


Fig. 1.—Genitalia of *Micrarionta wolcottiana*. In the right figure another view of the ♀ organs. *d*, Diverticulum of the spermathecal duct; *ds*, dart sack; *fl*, flagellum, *g*, mucous glands; *ov*, oviduct; *p*, penis; *pr*, retractor of the penis; *sp*, duct of the spermatheca. The mucous glands are shaded to show their forms more distinctly.

The reproductive organs are illustrated for comparison with *Sonorella* and other Micrariontas. It will be seen that on each side of the

base of the dart sack, the duct of a mucous gland arises. Each duct ascends and expands into a bulb, then is contracted, recurved upon itself, descending, becoming flattened in form of a long, thin-walled gland adhering to the vagina. For the sake of distinctness, these glands and their ducts are shaded in the figures. As usual in the genus, one of the mucous glands rises high over the dart sack, the other being lower, and concealed behind the dart sack in the left hand figure. The spermatheca has an extremely long, thin duct, which bears a long, slender diverticulum. The specimens did not pull well, and the upper part of the oviduct, the albumen gland, spermatheca and ovotestis were broken off.

Length of penis	6.5	mm.
" " epiphallus	5	"
" " flagellum	7	"
" " vagina	7	"
" " dart sack	3	"

Doctor Rixford writes as follows: "About the first of March I spent a few days at Palm Springs, Cal., on the eastern edge of San Jacinto Mountain, and had opportunity to get a few snails. I found only the one variety and no other shells except a small *Physa* which I take to be a common *Physa* of the West Coast. The Helix I have not been able to identify. Judging by the number of dead shells, it must be very numerous in that region, but because it had rained shortly before my visit the live shells were much scattered, having left their summer quarters. On the under surfaces of rocks I found markings of large colonies. In this region the rainfall is only an inch or so a year and the summer temperature much above 100 F. The rocks are granitic."

A NEW CHARACIN FROM PARAGUAY.

BY HENRY W. FOWLER.

Recently the Academy received a small collection from Senor A. De W. Bertoni, secured at Puerto Bertoni, Paraguay. As this contains several interesting fishes: *Otocinclus vittatus* Regan, *Parodon paraguayensis* Eigenmann, *Phalloceros caudimaculatus* (Hensel) and the Characin belonging to the *Tetragonopterinae* described below, this note has been prepared. The Academy is indebted to Senor Bertoni for these interesting gifts to its Museum.

BERTONIOLUS gen. nov.

Type, *Bertoniolus paraguayensis* sp. nov.

Preventral region evenly convex. Maxillary slips below preorbital or only about half its upper edge shielded. Upper teeth 5 each side in inner row as in *Moenkhausia*, and outer series in row parallel. Mandibular teeth uniserial. Upper lip covers premaxillary teeth. Gill-rakers lanceolate. All scales cycloid. Predorsal scales uniform in size. Preventral with normal scales. Anal with rather broad basal scaly sheath its entire length. Caudal base covered with large scales. Lateral line complete, slightly decurved, parallel with rows of scales below.

Allied to *Moenkhausia* Eigenmann and *Markiana* Eigenmann. From the former it is distinguished by the second suborbital in contact with the preopercle below, a point in agreement with *Knodus*. It differs from *Knodus* in the 5 teeth each side in the inner upper row, a character in agreement with *Moenkhausia*. *Markiana* Eigenmann somewhat resembles it, but the anal is more scaly and its unequal short lobed caudal is quite different. In *Bryconamericus* the caudal scales are small, not large as in this genus.

One species in the Parama basin. (For Senor A. De W. Bertoni, the accomplished naturalist of Peurto Bertoni, Paraguay.)

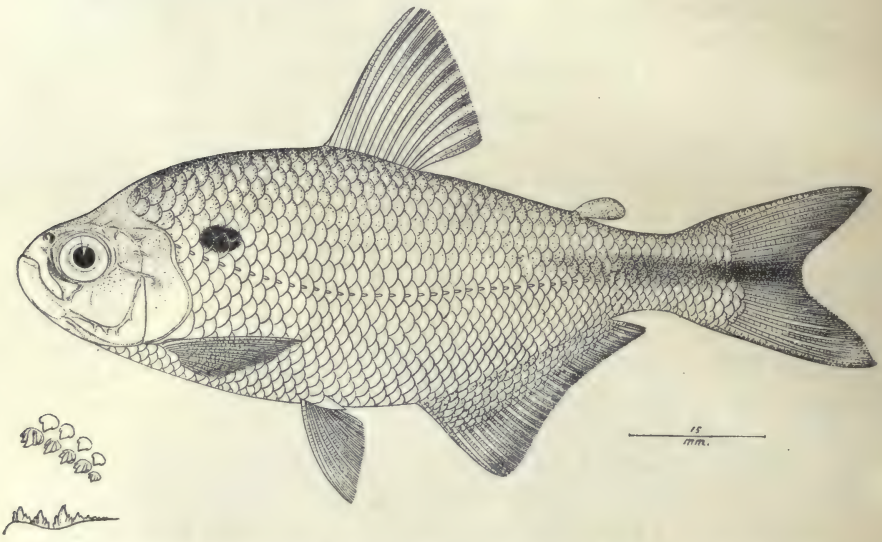
Bertoniolus paraguayensis sp. nov.

Head $3\frac{2}{3}$; depth $2\frac{3}{5}$; D. II, 9; A. II, 27; P. I, 11; V. I, 7; scales 43 in l. l. to caudal base and 3 more on latter; 9 scales above l. l. and 10 below; about 17 predorsal scales; head width 2 in its length; head depth over eye center $1\frac{2}{5}$; snout $3\frac{1}{3}$; eye $3\frac{1}{2}$; maxillary $2\frac{1}{4}$; interorbital

$2\frac{7}{8}$; first branched dorsal ray 1; first branched anal ray $1\frac{7}{8}$; least depth of caudal peduncle $2\frac{1}{4}$; upper caudal lobe 1; pectoral $1\frac{1}{5}$; ventral $1\frac{2}{3}$.

Body elongately ovoid in contour, deepest at dorsal origin, lower profile more evenly convex in front than upper, and well compressed. Predorsal with very slight median ridge, otherwise body edges convex. Caudal peduncle compressed, about long as deep.

Head moderate, upper profile slightly concave and lower little more inclined and convex. Snout convex, short, length half its width. Eye rounded, hind pupil edge little before center in head length. Mouth moderate, horizontal and closed jaws about even.



Lips rather tough, and upper firm, lower broadly free. Teeth alike in jaws, upper biserial with 8 outside and 10 inside, former shorter and tridentate and latter quindentate. Lower jaw with 8 large mostly quindentate teeth and third one each side from front slightly enlarged. Apparently no maxillary teeth. Inner buccal folds thin, moderate. Maxillary slender, slightly oblique from vertical, extends little below eye, and expansion about 3 in eye. Tongue with free edges, elongate, smooth. Mandible moderately deep or rami little elevated in mouth. Nostrils together, close to upper front eye edge. Interorbital convex. Suborbitals broad, and lowest infraorbital entirely covers cheek. Preopercle edge entire. Suborbitals and opercle each with marginal obsolete striæ.

Gill-opening forward to front eye edge. Rakers 10 + 16, lanceolate, slender, about $\frac{2}{3}$ of filaments, and latter 2 in eye. Pseudobranchiæ about half of gill-filaments. Isthmus slender.

Scales cycloid, rather narrowly imbricated, in lengthwise rows parallel with l. l. and become slightly smaller along ventral edge. Caudal with broad basal scaly area, also whole basal extent of anal. L. l. complete, slightly decurved, and each scale with short tube, exposure about half of each scale exposure. Ventral with scaly axillary flap about $\frac{1}{3}$ length of fin.

Dorsal origin about midway between snout tip and hind edge of adipose fin, first branched ray longest and depressed fin half way to caudal base. Origin of adipose fin little nearer depressed dorsal tip than caudal base, adipose fin about long as eye. Anal with long base, first branched ray highest and fin edge nearly straight, so anal origin nearly opposite hind dorsal edge or about midway between hind preopercle edge and caudal base. Caudal well forked, pointed lobes similar, with lower slightly longer. Pectoral low, reaches slightly beyond ventral origin though not quite to that of dorsal. Ventral inserted nearer anal than pectoral origin, fin reaching latter. Vent close before anal.

Color in alcohol faded dull brownish generally, though back slightly darker than other regions. A pale sheen, as if silvery in life, along middle of side, though narrowing on caudal peduncle side where giving place to slight dusky tint and then continued out on caudal medianly to hind edge as blackish streak. Iris pale slaty. Black ellipsoid spot, little smaller than eye, at shoulder. Dorsal slightly tinged with dusky, and fins otherwise pale.

Length 97 mm.

Type No. 47, 686, A. N. S. P. Puerto Bertoni, Paraguay. Senor A. De W. Bertoni.

Only the type known, quite distinct from the allied species of *Bryconamericus* and *Markiana*, etc. The dentition, shown to the left below in the accompanying figure, is enlarged a little over twice that of the indicated line of proportion for the profile drawing.

ON A COLLECTION OF ORTHOPTERA FROM THE STATE OF PARÁ, BRAZIL.

BY JAMES A. G. REHN.

The present study is based on material collected at two localities in the State of Pará, and all of which is now in the collection of the Academy of Natural Sciences of Philadelphia. The localities represented are Igarapé-assú and the vicinity of the city of Pará. The former locality is about one hundred and twenty miles east of the city of Pará, off the main line of the railroad between Pará and Brangança and in primaeval forest conditions.[1] The material from this locality was secured by Mr. H. S. Parish of Toronto, Canada, while that from the vicinity of Pará was taken by Prof. C. F. Baker, while attached to the Museu Goëldi at Pará. Portions of both series have already been recorded by the present author in connection with studies of other series of Brazilian material,[2] a total of forty-eight previously known and seven new species having been reported from the series now completely studied. These figures are not included in the totals here given.

In the present paper are discussed one hundred and nine species, representing seventy-one genera, of which twenty-two species and two genera are described as new. The number of specimens represented is four hundred and twenty-one.

DERMAPTERA.

FORFICULIDÆ.

Doru lineare (Eschscholtz).

1822. *Forficula linearis* Eschscholtz, Entomogr., p. 81. [Santa Catharina, Brazil.]

Igarapé-assú. One female.

ORTHOPTERA.

BLATTIDÆ.

Ectobiinæ.

Anaplecta replicata Saussure and Zehntner.

1893. *Anaplecta replicata* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 25, pl. IV, fig. 12. [Pernambuco, Brazil.]

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[1] The general features of this region have been entertainingly described by Dr. Emilie Snethlage, Director of the Museu Goëldi, in a recent number of the Geographical Review (IV, pp. 41 to 50, 1917).

[2] The Stanford Expedition to Brazil, 1911, J. C. Branner, Director. Dermaptera and Orthoptera I. Trans. Amer. Entom. Soc., XLII, pp. 215 to 308, (1916).

The Stanford Expedition to Brazil, 1911, J. C. Branner, Director. Orthoptera II. Ibid., XLIII, pp. 89 to 154, (1917).

Igarapé-assú. Three males.

These specimens fully agree with the description of the species. The status of three unquestionably related forms, i. e. *lateralis* Burmeister, *minutissima* (DeGeer)[3] and *pumila* (Stål), we are compelled to leave in abeyance for the present, although it is quite probable that one at least is the same as the present species. The original descriptions are so brief that little other than the general relationship of the species can be ascertained from them, and the desired more detailed information can only be gleaned from the types or topotypic material.

Anaplecta bivittata Brunner.

1865. *A[naplecta] bivittata* Brunner, Nouv. Syst. Blatt., p. 63. [Brazil.]

Igarapé-assú. One male.

This specimen shows some points of difference from the original description, but it is apparently the same species. The head is not wholly rust color, as described, the interocular region of the vertex being blackish brown, while the tegminal maculation does not reach the costal margin of the same, but does, however, border the humeral trunk to the distal squarely truncate margin of the maculation.

This is apparently the first definite locality for the species.

Pseudomopinæ.

Pseudomops annulicornis (Burmeister).

1838. *Th[yrsocera] annulicornis* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 500. [Bahia, Brazil.]

Igarapé-assú. Two males, four females.

These specimens fully agree with the description of Walker's *Pseudomops deceptura* from an unknown locality, which is considered a synonym of Burmeister's species by Shelford. The original description of *annulicornis* is extremely brief, so little can be learned

[3] We cannot agree with Shelford in his placing this species as a *Holocompsa* (Trans. Entom. Soc. London, 1908, p. 464) from the evidence of the alleged type. The description and figure given by DeGeer are undoubtedly of an *Anaplecta* and it is not at all difficult to see which species are its closest relatives. It seems evident that Shelford did *not* see the material on which DeGeer based his species and *ad interim* the *Holocompsa* specimen was probably by accident associated with DeGeer's label. DeGeer's original description says of the insect: "Sa couleur est d'un brun noirâtre et très luisant; c'est aussi la couleur de la plaque du corcelet, qui est arrondie, mais dont les deux bords latéraux sont blancs & très transparents." This would clearly apply to an *Anaplecta* of the present group and certain other characters mentioned, as the folding of the wings, make the identification even stronger. The redescription of the "type" by Shelford presents the following features comparable to those quoted above from DeGeer: "Head..... with rufous pubescence. Pronotum fuscous with a recumbent rufous pubescence. Tegmina with marginal area with rufous pubescence." Further comment seems unnecessary.

from it. In all of the specimens the head, the two distal joints of the palpi, the extremities of the femora and tibiæ and the tarsi are black or blackish. In no case is the usual dark transverse arcuate bar of the pronotal disk strongly marked.

The only previous records of the species are from Bahia (Burmeister), Pará (Rehn) and Porto Velho, Rio Madeira, interior Brazil (Rehn).

Pseudomops affinis (Burmeister).

1838. *Th[yrsocera] affinis* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 499. [Surinam.]

Igarapé-assú. Two females. December, 1911 (one). [One; Cornell University.]

Para and Surinam are the only localities from which the species was previously known.

Pseudomops angusta Walker.

1868. *Pseudomops angusta* Walker, Catal. Blatt. Brit. Mus., p. 81. [Santarem, Brazil.]

Igarapé-assú. One female.

As in material already recorded by us,[4] this specimen differs from the original description in the palpi being entirely black, the femora blackish dorsad and the cerci almost entirely black.

Ischnoptera crispula n. sp. (Pl. I, figs. 1–4.)

A species showing certain affinities with the *inca* group on one hand and with the *marginata*, *castanea-rubiginosa* group on the other. It is apparently allied to *I. hebes* Walker,[5] from Santarem, Brazil, agreeing in the general form, the small size, the widely separated eyes, the setose antennæ, the thinly pilose pronotum and tegmina and most of the color features, but differing in the limbs being in large part fuscous instead of "pale testaceous," in the abdomen having the fourth ventral segment uniformly dark with remainder of the same surface of the abdomen, instead of "tawny" as in *hebes*, while the tegmina have the marginal field, and to a lesser degree the costal margin of the tegmina, pale ochraceous and sharply contrasted with the remainder of the tegmina. The genital features of the present species are quite distinctive. We are able to give only color differences to separate the species, as all the structural features mentioned by Walker for *hebes* are shared by the present species, but our experience with the species of this section of the genus indicates that beyond certain permissible fluctuations color features are well fixed. An

[4] Trans. Amer. Entom. Soc., XLII, p. 224, (1916).
[5] Catal. Blatt. Brit. Mus., p. 122, (1868).

examination of the original material of *hebes* will, in all probability, show the older species possesses characteristic genital features.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) (Acad. Nat. Sci. Phila., Type no. 5316.)

Size very small: form moderately depressed: surface moderately polished, of the head, pronotum, tegmina and limbs with sparse, but distinct, erect hairs. Head for its full width visible cephalad of the pronotum, the outline of the eyes and occiput regularly arcuate; interspace between the eyes very broad, equal to one and one-half times the depth of the adjacent portion of the eye: ocelli elliptical, oblique in position, the interspace between them subequal to that between the eyes; palpi with the third joint slightly longer than the fourth, fifth appreciably longer than the third and moderately inflated, excavate face obliquely truncate for the greater portion of the length of the joint: antennæ faintly exceeding the body in length, rather sparsely but regularly setose. Pronotum subtrapezoid in outline, the greatest width, which is distinctly caudad of the middle, contained one and one-half times in the greatest length of the same; cephalic margin moderately arcuate, rounding into the but weakly arcuate, diverging lateral margins, caudo-lateral angles well rounded, caudal margin moderately arcuate, all the margins distinctly though narrowly cingulate: in transverse section the disk is flattened dorsad and distinctly and roundly declivent laterad; surface unimpressed. Tegmina lanceolate-elliptical, the greatest width contained slightly more than three times in the greatest length of the tegmen, distal section surpassing apex of abdomen by nearly the dorsal length of the pronotum: costal margin moderately arcuate proximad and distad; sutural margin in greater portion straight, distad regularly arcuate to the broad and well rounded apex, which is more costal in position: marginal field relatively narrow and abbreviate; anal field elongate pyriform, reaching to two-fifths the length of the tegmen: discoidal vein with sixteen costal rami, several of the distal ones of which are bifurcate; median vein with four rami (made up by bifurcation of two main rami); ulnar vein with three to four rami, the number of both median and ulnar rami very difficult to determine owing to the anastomosing of the veins in the proximal portion of the discoidal field; anal sulcus regularly arcuate in proximal half, straighter distad except for the short distal arcuation near the junction with the sutural margin; axillary veins fourteen in number, as the usually weak adventitious veins are equal in strength to the usually more pronounced principal veins. Wings with the

costal margin straight oblique proximad, very gently arcuate distad, with a faint flattening at the middle of the arcuation: anterior field very broad, broadly rounded distad; intercalated triangle distinct but small: costal veins eleven in number, in general regularly oblique, simple and non-clavate; medio-discoidal area in general faintly wider than the medio-ulnar area, divided into moderately regular, subquadrate areolæ by thirteen cross-veins; median vein simple, direct, unbranched; medio-ulnar area with similar but less numerous and more oblong areolæ; ulnar vein with two complete and seven incomplete rami; axillary vein with two rami. Sixth and seventh dorsal abdominal segments with the structure characteristic of *Ischnoptera*:[6] supra-anal plate large, semi-ovate, very shallowly arcuato-emarginate mesad; slightly sinuate near the cercal bases, peripheral margin and its vicinity with scattered, erect hairs; ventral surface of the plate with a long dextral, subchitinous tooth, which is directed meso-ventrad: cerci moderately elongate, fusiform, depressed, apex narrowly blunted; subgenital plate moderately asymmetrical, sinistral portion of plate arcuate-emarginate ventrad of the cercus, mesal portion of plate similar, the area between obliquely sinuato-truncate, the sinistral style situated sinistrad on the same section, dextral side of the plate deeply rectangulate-emarginate, the dextral style situated on the apex of the rounded lobe between the median and dextral emarginations; styles short, thick, fusiform, unequal, with distal extremity arcuate aciculate; margin of the plate closely haired, dorsal surface of the subgenital plate having at the base of the dextral style a lamellate, suberect, subchitinous process, the free margin of which is unequally bilobate. Cephalic femora armed ventro-cephalad with a typical *Ischnoptera* spine arrangement.[7]

General color blackish brown, the trochanters, ventral surface of the femora, dorsal surface of the tibiæ and flecks on the tarsi ochraceous-buff. Head with the interocular region faintly reddish; eyes black; ocelli naples yellow. Pronotum with the margins, except for the median section of the caudal margin, narrowly ferruginous. Tegmina with the marginal field and an evanescent edging of the scapular field light ochraceous buff. Wings infumate.

Length of body, 7.6 mm.; length of pronotum, 2.3; greatest width of pronotum, 3; length of tegmen, 7.6; greatest width of tegmen, 2.4.

The type is unique.

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[6] See Hebard, Trans. Amer. Entom. Soc., XLII, p. 339 to 340, pls. XVI and XVII, (1916).

[7] See Hebard, Trans. Amer. Entom. Soc., XLII, p. 340, pl. XVII, fig. 1, (1916).

Ischnoptera castanea Saussure. (Pl. I, figs. 13, 14.)

1869. *I[schnoptera] castanea* Saussure, Revue et Magasin de Zoologie, 2e sér., XXI, p. 112. [Brazil.]

Igarapé-assú. One male.

This specimen fully agrees with the original description, as far as it supplies characters derived from the female sex. As the male genital characters have never been described, the following notes on the same should prove of assistance.

Supra-anal plate moderately transverse, the margin broadly arcuate, appreciably flattened in the middle and there very weakly bilobate, cercal emargination decided, regularly concave, margin between apex and cercal emargination moderately arcuate; surface of plate sub-depressed proximo-laterad, with a distinct, broad, median impression on distal half: distal portion of margin very sparsely haired: ventral surface of supra-anal plate with patches of short, agglutinated hairs on the faint lobes of the distal margin, also meso-laterad on the body of the plate, while a distinct, tuberculiform node is situated immediately mesad of the dextral cercus; immediately mesad of the sinistral cercus there projects ventrad a heavy, claw-like process, which is nearly straight and robust in the proximal two-thirds, thence sharply bent mesad and straight acuminate: from immediately ventrad of the dextral cercus springs an unpaired lamellate, articulate process, a portion of the internal genitalia, the dorsal surface of the same bearing in proximal two-thirds a carinate ridge, the apical section rotated dorsad and weakly rostrate, bearing five distinct teeth: genital hook slender, bent recurved, the apex slightly flattened. Subgenital plate faintly asymmetrical, with dextral, sinistral and median emarginations, between which are short, truncate projections of the margin of the plate; sinistral emargination broad, faintly angled mesad; median emargination regular; dextral emargination small but deep and rectangulate; styles unequal in size and development, the sinistral large, straight proximad, acuminate distad, distal half decurved; dextral style smaller, regularly acuminate, decurved; margin of the plate and styles sparsely haired; dorsal surface of the subgenital plate at base of dextral style with an erect, laterad directed, lamellate lobe, bearing at the internal angle of the apex a distinct, dentiform spine.

Ischnoptera imparata n. sp. (Pl. I, figs. 5–8.)

This peculiar species appears to be allied on one hand to *I. castanea* Saussure, and on the other to *I. amazonica* Rehn,[8] but it can be recog-

[8] Trans. Amer. Entom. Soc., XLII, p. 225, (1916).

nized at once by its distinctive form, with tegmina not surpassing the apex of the abdomen, and the type of the male genitalia.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) (Acad. Nat. Sci. Phila., Type no. 5317.)

Size very small: form elongate elliptical; surface moderately polished, sparsely pilose, more heavily so on the limbs. Head exposed cephalad of the pronotum for the greater portion of its width; interspace between the eyes moderately broad, very faintly less than that between the ocelli, which latter are ovate: antennæ one and one-half times as long as the body, closely moniliform, proximal joint faintly shorter than the interspace between the eyes: palpi with the third joint simple, the fourth elongate funnel-shaped, slightly shorter than the third joint, fifth joint moderately inflated, greatest depth at proximal third. Pronotum weakly transverse, the greatest length contained one and one-third times in the greatest width and the latter placed faintly caudad of the middle, general form subtrapezoid; cephalic margin broadly subtruncate, rounding laterad into the lateral margins, which are moderately diverging caudad, faintly arcuate on cephalic two-thirds, thence sharply arcuate to the obtuse caudo-lateral angles; caudal margin arcuato-truncate: disk moderately deplanate, with distinct diverging sulci; narrow lateral portions distinctly deflexed. Tegmina surpassing the apex of the abdomen by less than the length of the pronotum, lanceolate: costal margin moderately arcuate proximad, thence nearly straight to the narrowly rounded apex, which is costal in position; sutural margin straight, except for a short proximal section and distad rounding into the strongly oblique, arcuato-truncate, distal margin: marginal field very narrow, in length nearly equal to two-fifths of the entire tegmen: anal field elongate pyriform, in length equal to about one-half of the tegminal length: costal veins fourteen to fifteen in number; discoidal sectors longitudinal, six in number, with distinct, longitudinal, intercalated nervures and regularly placed transverse nervures, which form rectangulate interspaces; anal sulcus sharply curved distad and joining the sutural margin at a right angle; axillary veins closely placed, with regular intercalated and cross nervures, their structure merged to such an extent that a count is not warranted. Wings falling slightly short of the apex of the tegmina when in repose, greatest width contained one and two-thirds times in greatest length: costal margin regularly arcuate; apex broadly rotundato-rectangulate; peripheral margin more amply arcuate distad than usual: anterior field relatively very broad; intercalated triangle distinct but

small: mediastine vein straight in the greater portion of its length, bearing eight costal veins, remainder of costal veins seven in number, all non-clavate; discoidal vein almost straight; medio-discoidal area broad, divided by sixteen regularly placed, transverse nervures into subquadrate areolets; median vein arcuato-sinuate; medio-ulnar area narrower than the medio-discoidal area, similarly divided, but with veins fewer and less distinct; ulnar vein with one complete ramus, which is bifurcate close to its origin, and three incomplete rami; axillary vein biramose. Dorsal abdominal segments of the type characteristic of *Ischnoptera*:[9] supra-anal plate transverse, lateral margins regularly converging caudad, the distal margin truncate, its vicinity with long, sparse hairs; when viewed from the caudal aspect there is seen to be dextrad, briefly mesad of the cercus, a thick, curved projection, which points mesad, and is distinctly tapering distad, the whole structure well hidden under the margin; cerci relative heavy, rather short, subequal in width for the greater portion of the length, rather abruptly tapering distad, depressed dorsad, rounded ventrad, with a close, adpressed coat of short hairs and scattered, erect, long hairs: subgenital plate moderately asymmetrical; sinistral margin with a broad, deep emargination ventrad of the cercus, relatively short, median section concavo-truncate, dextrad of which is a short, deeply arcuate emargination, with a moderate projection separating it from the oblique subtruncate and then (proximad) arcuate remainder of the same margin; both principal emarginations with their margins somewhat thickened and the plate there appreciably convex in section, between them the plate is concave distad; styles unequal, the sinistral one twice as large as the dextral, situated at the lateral angles of the median subtruncate section, incrassate, tapering, with the apex bispinose, the distal spine larger, decurved, the other spine situated slightly proximad of the apex, straighter; when viewed from the caudal aspect the plate is seen to have an incrassate arm extending mesad from the projection of the dextral margin, this arm reaching to the median line of the body, supplied at the apex with long hairs and on the cephalic face with a number of spines: genital hook sinistral in position, the distal portion sinuate, V-shaped, narrowed at the bend of the structure, slightly thickened and blunt distad. Cephalic femora with ventro-cephalic margin with four large, proximo-mesal spines, these followed distad by a regular series of very short, fine spines; distal spines three in

[9] See Hebard, Trans. Amer. Entom. Soc., XLII, pp. 339 to 340, pls. XVI and XVII, (1916).

number, the extreme distal the larger: median and caudal femora with ventral margins regularly and heavily spined, genicular spine large: caudal tarsi with metatarsus distinctly longer than the remaining joints combined, ventral surface strongly biseriate, pulvilli small.

General color above and on the venter of the abdomen argus brown, paling to antique brown on the veins distad on the tegmina. Head deep blackish fuscous, except for the mouth-parts, labrum and distal half of the clypeus; eyes prout's brown; distal palpal joint weakly washed with mummy brown; ocelli zinc orange; antennæ blackish fuscous, slightly paler proximad and distad. Pronotum with a relatively broad cephalic and lateral border of ochraceous-buff, the bounding line of the two shades appreciably sinuate laterad. Tegmina with the general color strongest at the base of the marginal field, this, in the same area, sharply giving way to ochraceous-buff, which passes distad into a weak shade of the general coloration; distal section of the tegmina very pale, as is the normally covered section of the right tegmen. Wings weakly infuscate, becoming ochraceous distad, the veins similarly but more opaquely colored. Abdomen faintly darker than the general dorsal coloration, more deeply infuscate laterad, the dorsal abdominal fold ochraceous-buff, surrounded by deep fuscous; styles deep fuscous. Limbs ochraceous-buff, coxæ each with a proximal blotch of fuscous, those of the cephalic coxæ much smaller than those of the other limbs.

Length of body, 7.3 mm.; length of pronotum, 2.4; greatest width of pronotum, 2.9; length of tegmen, 6.4; greatest width of tegmen, 2.2.

The type is unique.

Ischnoptera clavator n. sp. (Pl. I, figs. 9–12).

Allied to *I. amazonica*[10] Rehn, from northern Brazil, but differing in the deeper color pattern, more inflated distal palpal joint and the radically different genitalia of the male, the subgenital plate of which bears a relatively large club-like appendage. The supra-anal plate of the female of *clavator* is distinctly U-emarginate mesad, while that of *amazonica* is entire. The species shows relationship to *I. rubiginosa* Walker, having a similarity in the form of the male supra-anal plate, but *clavator* is a larger species with more convergent eyes, a less strongly transverse pronotum, more elongate tegmina and wings, and decidedly different development of the subgenital plate and styles of the male. The female of *rubiginosa* has the

[10] Trans. Amer. Entom. Soc., XLII, p. 225, (1916).

supra-anal plate trigonal with the lateral margins sinuate-emarginate and the apex well rounded and entire, instead of U-emarginate as in *clavator*.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5319.]

Size small: form elongate elliptical, strongly depressed: surface glabrous. Head distinctly projecting cephalad of the pronotum: interspace between the eyes very narrow, hardly more than half that between the ocellar spots, which latter distance is subequal to the greatest length of one of the spots, the spots are large, subreniform in outline: eyes with their greatest cephalic depth equal to about one and one-half times the interocellar width: antennæ slightly longer than the body, moderately hirsute, second and third joints together about two-thirds as long as the proximal joint: third palpal joint of moderate length, slightly arcuate; fourth palpal joint two-thirds as long as third, slightly and evenly enlarging distad; fifth palpal joint slightly longer than the third, inflated, sublanceolate, apex subacute. Pronotum roundly trapezoidal, but moderately transverse, the greatest length contained one and one-half times in the greatest width; cephalic margin weakly arcuate, broadly rounding into the diverging, distinctly arcuate, lateral margins, which pass through the obtusely rounded caudo-lateral angles into the arcuato-truncate caudal margin, all margins finely cingulate and supplied with sparse, well-spaced, long hairs, the cephalic margin, however, with a series of short hairs: disk of pronotum weakly arcuate in section, appreciably declivent laterad, the immediate margin slightly reflexed; oblique sulci indicated but slightly irregular in impression, caudal section of disk weakly depressed. Tegmina elongate lanceolate, surpassing the apex of the abdomen by nearly the length of the pronotum, the width at the distal third greater than that at the proximal third: costal margin straight except for a short proximal arcuation and a brief distal rounding to the apex, which is at the tip of the median vein and very narrowly rounded; sutural margin in general straight, except at distal third, where it regularly and broadly rounds to the immediate apex: marginal field narrow, its distal extremity not quite reaching to the proximal third of the tegmen; scapular field moderately wide, subequal in width; anal field elongate pyriform: costal veins very numerous, regular in position; discoidal rami longitudinal, nine in number (aside from the discoidal vein itself), intercalated nervures regular and all connected by closely placed

and generally regular, transverse sectors; anal sulcus impressed, moderately, strongly arcuate distad, jointing the sutural margin faintly distad of the proximal third; axillary veins and their numerous intercalated accessories regularly placed. Wings reaching almost to the apex of the abdomen, broad, their greatest width contained almost twice in their greatest length; costal margin largely straight oblique proximad, gently arcuate distad, the apex well rounded rectangulate and entirely in the anterior field; peripheral margin of the posterior field regularly arcuate, except for the frequent, short, bulging arcuation at the apex of the axillary vein and rami; intercalated triangle very small; mediastine vein largely straight oblique; discoidal vein straight proximad, weakly arcuate distad; costal veins (including the more distinct ones arising from the mediastine vein) twenty-one in number, oblique, non-clavate; medio-discoidal area distinctly narrower than the medio-ulnar area, appreciably narrowing distad, with the transverse rami rather regularly placed, twenty in number, the majority weakly bent arcuate, the areolets generally subquadrate; median vein simple, of much the same curve as the discoidal vein; medio-ulnar area with the transverse rami less numerous than those of the medio-discoidal area, fifteen in number, incomplete costad, the areolets more rhomboid than quadrate: ulnar vein with two complete and seven incomplete rami; axillary vein with two rami diverging slightly proximad of the middle. Abdomen with the disto-dorsal segments having the structure usual in *Ischnoptera*: supra-anal plate in general subquadrate, very faintly transverse; distal margin bisarcuate laterad of a shallow, median, arcuate emargination, the whole margin, but particularly these arcuate portions, supplied with long bristle-like hairs; surface of disto-dorsal section of the plate with two areas of impression:[11] cerci elongate, styliform, acuminate, depressed dorsad, rounded ventrad, strongly hirsute: subgenital plate asymmetrical; free margin sinistrad with an arcuate emargination, in which is placed the sinistral style, mesad with a transverse, truncate section, in the dextral angle of which is situated the dextral style, dextrad of this is a deep acute-angulate emargination, in which is visible an acute, lamellate projection of the internal genitalia, dextrad of this emargination and mesad of the cercus the margin develops an erect, lamellate peg-like process, which projects dorsad of the supra-anal plate when the parts are in their normal position, the apex of this process is covered with erect,

[11] The presence of these areas may not be a normal condition.

agglutinated hairs, certain of which appear spiniform, the remainder of the margin and a large portion of the ventral surface of the plate with long hairs, many of which are bristle-like; sinistral style strongly arcuate, the apex directed laterad and with a number of distinct but short teeth; dextral style very short, decurved, rounded at the apex, with there a number of similar short teeth. Cephalic femora with the ventro-cephalic margin bearing three median and three distal spines, the latter group increasing in length distad, the area between the two groups with a continuous, regularly spaced series of short, piliform spinules, no disto-dorsal genicular spine present: median and caudal femora with a distinct disto-dorsal genicular spine, ventral margins with large, well-spaced spines: arolia distinct; caudal metatarsus faintly longer than the remaining joints combined.

Allotype: ♀; Same data as type. [Acad. Nat. Sci. Phila.]

The following features are those of difference from the description of the type. Interspace between the eyes wider, more than two-thirds as wide as that between the ocellar spots, which area is nearly twice as great as the greatest length of one of the spots; ocellar spots somewhat smaller and less conspicuous than in the male: eyes with their greatest depth but faintly greater than the interocellar width. Abdomen simple: supra-anal plate moderately transverse, arcuate, the chitin with a median V-emargination which is filled with a semi-opaque membrane,[12] dorsal surface of the plate with a distal, medio-longitudinal, carinate fold, the free margin of the plate with numerous long, bristle-like hairs: subgenital plate large, distal margin arcuate-truncate between the cerci. Cephalic femora with the median group of large spines numbering four.[13]

General tone of the dorsal surface clear dresden brown to mars brown, the venter largely fuscous. Head blackish fuscous, the clypeus and mandibles ochraceous-buff; ocellar spots warm buff: eyes mars brown to mummy brown: antennæ clove brown, the proximal joint faintly ochraceous. Pronotum with the disk blackish fuscous, more or less distinctly divided in two by a medio-longitudinal line of kaiser brown to liver brown; broad lateral margins, a connected and narrower cephalic margin and a detached, usually weaker, caudal margining of warm buff to ochraceous-buff, the dark disk

[12] In two paratypic females this membrane is not apparent, the margin being distinctly and clearly V-emarginate. Apparently this soft area is not a permanent structure and may be due to the hardening of exuded body fluids.

[13] Two paratypic females agree with the allotype in the number of these spines, while the type has but three.

appreciably narrower at a point slightly caudad of the middle. Tegmina of the general dorsal color, very pale on the portion of the dextral tegmen concealed when in repose; proximal section of the humeral trunk blackish fuscous; marginal field pale ochraceous translucent, proximad more or less suffused with the blackish fuscous of the humeral trunk. Wings clear hyaline, except for a slight infuscation of the sub-coriaceous region of the costal veins; venation pencilled in prout's brown. Dorsum of abdomen fuscous, paling to bister along the median line; supra-anal plate of male with a russet tinge, the characteristic *Ischnoptera* fold of the male ochraceous-buff; venter of abdomen becoming ochraceous-tawny meso-proximad. Limbs ochraceous-buff, the coxæ fuscous proximad, spines tawny.

Male (*type*): Length of body, 12.6 mm.; length of pronotum, 3; greatest width of pronotum, 3.6; length of tegmen, 11.9; greatest width of tegmen, 3.7. Female (*allotype*): Length of body, 13.5 mm. length of pronotum, 3.2; greatest width of pronotum, 3.7; length of tegmen, 12.3; greatest width of tegmen, 3.3.

In addition to the type and allotype we have examined two paratypic females, taken at Igarapé-assú. One specimen, while of the body bulk of the others, has the tegmina shorter (11.5).

Xestoblatta[14] **nyctiboroides** (Rehn).

1906. *Ischnoptera nyctiboroides* Rehn, Proc. Acad. Nat. Sci. Phila., 1906, p. 266. [Demerara, British Guiana.]

Igarapé-assú. January 23, 1912. One male.

This specimen, the second known of the species, fully agrees with the original description except that the ulnar vein of the wings has two complete rami on one wing and but one on the other, one incomplete ramus on one wing and none on the other.

Neoblattella conspersa (Brunner).

1865. *Ph[yllodromia] conspersa* Brunner, Nouv. Syst. Blatt., p. 106. [Brazil.]

Igarapé-assú. December, 1911; January 13 to 25, February 6, 1912. Twenty-two males, twenty-five females. [Two: Cornell University.]

This interesting series shows that while the blackish punctulations on the tegmina in this species vary greatly in number and intensity they are never entirely absent, and are always placed on thickened nodes on the veins. In the individuals with the greater number of punctulations these are individually larger than in those specimens with a considerably smaller number of the same. The pattern of the disk of the pronotum varies in intensity and completeness pro-

[14] Vide Hebard, Trans. Amer. Entom. Soc., XLII, p. 370, (1916).

portionately with the tegminal punctulations, in occasional specimens being obsolete or completely absent. The pale transverse line ventrad of the eyes varies considerably in degree of definition, but this is not correlated with the variation in intensity of the dorsal surface. The ventral surface of the abdomen is always marked by a medio-longitudinal bar of blackish brown, this varying individually in width and to a less extent in distinctness.

As one of the females bears an oötheca we know that in the present species the egg-case is carried vertically with the suture dorsad.

Neoblattella titania (Rehn).

1903. *Blatella titania* Rehn, Trans. Amer. Entom. Soc., XXIX, p. 267. [Bartica, British Guiana.]

Igarapé-assú. One female.

This individual fully agrees with the type.

Neoblattella pellucida (Burmeister).

1838. *Bl[atta]pellucida* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 498. [Pará, Brazil.]

Igarapé-assú. January 13 to 25, 1912. Two males, three females.

Cariblatta igarapensis n. sp. (Pl. I, figs. 15–18.)

Closely related to *C. fossicauda*[15] Hebard, differing in the larger size (this species being the largest of the genus), more elongate tegmina and in the form of the subgenital plate of the male; this of a similar type in which the dextral portion is but weakly produced, the sinistral portion alone markedly projecting. In the female the distal portion of the subgenital plate is less strongly produced than is normal for the genus, but the apex is broadly rounded, not appearing at all bilobate.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5237.]

Size relatively large (for the genus): form as usual in the genus: surface moderately polished. Head for its whole width visible cephalad of the pronotum; occipital line, when seen from the dorsum, straight; interspace between the eyes broad, the breadth subequal to the greatest depth of the eye, and slightly less than the distance between the ocellar spots; ocellar spots small, oblique, ovate: third joint of palpi elongate, simple, faintly arcuate; fourth joint very faintly shorter than the third joint, regularly though not greatly expanding distad; fifth joint slightly shorter than the fourth joint, moderately inflated, the flexor margin, when seen from the side, regu-

[15] Trans. Amer. Entom. Soc., XLII, p. 177, pl. XI, figs. 13 to 17, pl. XII, fig 17 and 18, (1916).

larly arcuate, the extensor margin faintly sinuate, apex roundly acute, when seen from the side: antennæ slightly surpassing the body in length; proximal joint large, faintly longer than the second and third joints united. Pronotum rounded sub-hexagonal, transverse, the greatest length contained one and two-fifths times in the greatest width, which is placed distinctly caudad of the middle: cephalic margin weakly arcuate, passing by broadly rounded angles into the oblique, diverging and appreciably arcuate cephalic portions of the lateral margins, which strongly round into the caudal sections of the lateral margins; caudal margin arcuato-truncate, rounded obtuse-angulate laterad: broad lateral portions of the pronotum weakly declivent. Tegmina lanceolate, greatest width contained about three and one-half times in the length of the same, when closed they surpass the apex of the abdomen by about the length of the pronotum: costal margin in large part straight, gently arcuate in the area of the marginal field, sharply and briefly arcuate distad; sutural margin in general straight, with a distal oblique, subarcuate third: apex rather narrowly rounded, slightly costal in position; marginal field reaching about to the proximal third, relatively narrow; scapular field very broad, at proximal third of tegmen equal to one-half the entire width of the same, costal veins elongate, straight, oblique, the distal one of the regular series biramose, eleven in number exclusive of the rami of the distal one; discoidal vein furcate distad, one or both forks again furcate; discoidal sectors longitudinal, four to five in number, exclusive of the median vein itself; anal field elongate pyriform; anal sulcus with its oblique portion nearly straight, reaching the sutural margin at about the proximal third; axillary veins five to six in number. Wings relatively broad: costal margin straight oblique in the greater portion of the proximal half, straight truncate in the region of the costal veins, sharply rounding to the rounded obtuse-angulate apex, which is situated at the apex of the median vein: intercalated triangle distinct, trigonal: mediastine vein simple, with a decided costal clavation at its apex; discoidal vein bifurcate and its divisions again furcate; costal veins ten in number, the distal four of a common origin and hardly clavate, the remainder heavily clavate; medio-discoidal area narrow, dividing into oblong or subquadrate areolets by transverse nervures; median vein simple, largely straight; medio-ulnar area subequal to or faintly narrower than the medio-discoidal area, distad more or less completely intersected by transverse nervures; ulnar vein with two complete rami; axillary vein with three rami originating mesad. Supra-anal plate strongly

transverse, the margin broadly obtuse-angulate with the immediate angle broadly rounded, the median section of the margin supplied with a group of long bristle-like hairs: cerci missing: subgenital plate very similar to that of *fossicauda*, having a large, elongate, quadrate, peg-like projection sinistrad, this, however, being proportionately longer and more compressed than in *fossicauda*; mesad the distal margin is deeply U-emarginate, dextrad of which is a projection less than one-half the length of the sinistral protuberance, dextral margin arcuate: genital hook resembling that of *C. insularis* (Walker), but with the curve of the hook more distad in position. Spination of the limbs typical of the genus.

Allotype: ♂; same data as the type.

Differing from the description of the male in the following features. Occipital line weakly arcuate; interspace between the eyes slightly exceeding the greatest depth of the eye and subequal to the distance between the margins of the antennal scrobes. Supra-anal plate transverse, with a distinct, relatively broad, rounded emargination mesad: cerci greatly surpassing the subgenital plate, tapering, moniliform, apex sharply acuminate: subgenital plate ample, the distal section broad, when seen from the ventral aspect not emarginate or bilobate, weakly channelled when seen from the caudal aspect.

General color above pale old gold, the tegmina and lateral portions of the pronotum semihyaline, the wings almost colorless hyaline with the veins tinted. Ventral surface largely cinnamon-buff to ochraceous-buff. Head of the ventral color, the face with bister bands which in disposition combine features of the patterns of *C. reticulosa* and *craticula*, the ventral facial band clearly defined in the allotype, but not indicated in the type, a detached bister point present at each lateral angle of the clypeal base in the allotype but not indicated in the type; eyes kaiser brown, thickly mottled with bister; antennæ old gold, becoming bister distad. Pronotum with a pattern in bister much like that of *fossicauda* but with the lines more connected and complete, the pattern more intensive and therefore more complete in the allotype than in the type. Wing veins, excepting the costal clavations and radiate veins, old gold, the exceptions bister, the clavations rather weakly so. Dorsum of the abdomen washed with bister laterad, leaving, however, a very narrow, pale margin; venter of abdomen with a proximal median area of bister and narrow submarginal lines of the same color. Tibial spines and the larger femoral spines with their bases surrounded by bister rings.

Type: Length of body, 10 mm.; length of pronotum, 2.2; greatest width of pronotum, 3; length of tegmen, 9.8; greatest width of tegmen, 2.8. Allotype: Length of body, 10 mm.; length of pronotum, 2.3; greatest width of pronotum, 3; length of tegmen, 9.2; greatest width of tegmen, 2.5.

The type and allotype are all the individuals of the species we have seen.

Nyctiborinæ.

Paratropes elegans (Burmeister).

1838. *Ph[oraspis] elegans* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 493. ["Unknown locality," probably Surinam.]

Igarapé-assú. One male, one female.

This species has been recorded from Surinam (Saussure) and Pará, Ega and Sáo Paulo, Brazil (Walker).

Epilamprinæ.

Epilampra grisea (DeGeer).

1773. *Blatta grisea* DeGeer, Mém. Hist. Ins., III, p. 540, pl. 44, fig. 9. [Surinam.]

1903. *Epilampra lucifuga* Rehn, Trans. Amer. Entom. Soc., XXIX, p. 271. [Southern British Guiana.]

Igarapé-assú. January 2 to 23, 1912. Ten males, five females.

The acquisition of this series and the recent re-description of the type of DeGeer's *grisea* by Shelford[16] enables us to place our *lucifuga* as a synonym of this variable species. The material before us exhibits two color forms, one similar to the type of *lucifuga*, the other with the castaneous markings slightly larger and more thickly distributed. In all of the specimens the paired trigonal patches on the pronotum are retained. In none of the specimens is the humeral trunk marked by a solid line, this region having either a series of blotches or almost no infuscation at all.

Apparently this is the only exact Brazilian record of the species.

Epilampra conspersa Burmeister.

1838. *E[pilampra] conspersa* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 505. [Pará, Brazil.]

Igarapé-assú. One female.

This individual agrees fully with the description given by Saussure and Zehntner,[17] although its identity with Burmeister's species is not so certain. The Burmeisterian description is very brief and is considered by Kirby to represent a form different from that studied by Saussure and Zehntner. Personally we cannot express an opinion, but prefer to use Burmeister's name for this handsome species until the type of *conspersa* has been re-examined.

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[16] Trans. Entom. Soc. London, 1907, p. 462.

[17] Biol. Cent.-Amer., Orth., I, p. 64, (1893).

Blattinæ.

Periplaneta americana (Linnæus).

1758. [*Blatta*] *americana* Linnæus, Syst. Nat., X ed., p. 424. ["America."]

Igarapé-assú. One female.

Periplaneta australasiae (Fabricius).

1775. [*Blatta*] *australasiæ* Fabricius, Syst. Entom., p. 271. ["In nave e mari pacifico et regionibus incognitis revertente."]

Igarapé-assú. January 7, 1912. One female.

Panchlorinæ.

Panchlora[18] **exoleta** Burmeister.

1838. *P*[*anchlora*] *exoleta* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 507. [Pará and Bahia, Brazil.]

Igarapé-assú. February 25, 1912. Two males, one female.

Panchlora bidentula Hebard.

1916. *Panchlora bidentula* Hebard, Entom. News, XXVII, p. 221, fig. 1. [Igarapé-assú, State of Pará, Brazil.]

Igarapé-assú. January 17, 1912 (type), no date (paratype). Two males.

Corydiinæ.

Melestora minutissima n. sp. (Pl. I, figs. 22, 23.)

This is the smallest form of the genus, being decidedly under the size of the three previously known species, i. e., *adspersipennis* and *fuscella* Stål from Rio de Janeiro and *fulvella* Rehn from the Misiones, Argentina. Aside from the much inferior size, it differs from *adspersipennis* in the much less transverse pronotum, in the non-sulcate character of the median area of the same and in the dark and less varied coloration. From *fuscella* the new species also differs in the non-sulcate median section of the pronotum and in the non-pellucid character of the lateral portions of the same. From *fulvella*, with the type of which the new form has been compared, the present species also differs in the less strongly transverse and more ovate pronotum, in the tegminal venation becoming obsolete distad, in the relatively longer caudal tarsi and in the fuscous coloration.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5248.]

Size very small: form elongate ovate, depressed: surface moderately polished, regularly but sparsely clothed with silky pile. Head visible cephalad of the pronotum, the outline of the occiput and head arcuate; interspace between the eyes very broad, uniform in width, which is subequal to the greatest depth of the eye, surface of the inter-

[18] For comments on the important characters for diagnostic use in this genus, as well as the synonymy of many of the nominal species of the same, see Hebard, Entom. News, XXVII, pp. 217 to 221, (1916).

space finely rugulose and with regularly placed impressed pits with fine, diverging radial lines: interspace between the antennal scrobes very faintly narrower than that between the eyes, moderately arcuate in section, glabrous: palpi with the fourth joint very slender proximad, regularly expanding distad, the apical margin obliquely truncate; distal article longer than the fourth joint, broad, greatest width at proximal third, margins regularly converging to the acute apex: eyes with facets clearly defined and slightly elevated individually: antennæ at least as long as the body, the proximal segment short moniliform, subglobose, the joints becoming progressively longitudinal distad, regularly pilose. Pronotum transversely short elliptical, the greatest length contained one and one-fifth times in the greatest width: all margins arcuate, the nearest approach to angulation being the weakly suggested latero-caudal angles: oblique depressions distinct, extending from the medio-caudal section toward the usual position of the latero-cephalic angles, then turning mesad and extending subparallel to the cephalic margin, vanishing caudad before reaching the middle line, the enclosed area moderately bullate, with irregularly placed and irregularly indicated slight transverse wrinkles, no medio-longitudinal impression: lateral sections of pronotum weakly declivent. Tegmina coriaceous, haired as the other portions of the body, lanceolate-elliptical, the greatest width contained three times in the greatest length of the tegmen: costal margin lightly and regularly arcuate; sutural margin straight for the greater portion of the proximal two-thirds, arcuate distad; apex rather broadly rounded; the entire costal margin thickened and finely nodulose cingulate: marginal field occupying about the proximal two-fifths, well developed, moderately wide: six well defined costal veins indicated: discoidal field with six definite longitudinal sectors (including the discoidal vein itself), these sinuate, connected by cross-veins and forming quadrate to oblong interspaces, all obsolete distad, becoming lost in the coriaceous shagreenous condition of that region; anal sulcus distinct, impressed, arcuate proximad, straight oblique distad, joining the sutural margin near the proximal third; anal field elongate pyriform; axillary veins three in number, poorly defined. Wings faintly surpassing the tegminal apices when all are in repose. Supra-anal plate transverse, the free margin sinuate-arcuate: cerci moderately long, robust, subfusiform, the apex rather short acute, the whole subdepressed: subgenital plate asymmetrical, from the sinistral side the margin is developed as follows: obliquely arcuate-emarginate ventrad of the cercus, then developed into an acute, peg-

like process, which is narrowly separated from a median rectangulate projection by a distinct but not deep V-shaped emargination, dextrad of the rectangulate projection the margin is briefly arcuate, then strongly oblique truncate. Median and caudal femora with ventral margins finely spined: caudal tarsi hardly shorter than the caudal tibiæ, the metatarsus occupying slightly more than one-half the length of the tarsus: arolia present.

General color mummy brown, becoming buckthorn brown distad on the femora and remainder of the limbs, and blackish-brown on the head and proximal antennal joint. Abdomen becoming auburn mesoproximad. Subgenital plate blackish-brown. Eyes blackish-brown.

Length of body, 6.2 mm.; length of pronotum, 1.5; greatest width of pronotum, 1.7; length of tegmen, 5.3; greatest width of tegmen, 1.7.

The type is unique.

Oxyhaloinæ.

Chorisoneura parishi n. sp. (Pl. I, figs. 19–21.)

This is a most peculiar species, which we are placing in *Chorisoneura* chiefly on account of the peculiar structure of the male subgenital plate. The femora are very weakly spined ventrad, while the general form is distinctly suggestive of an *Anaplecta*, so much so that we are not at all convinced of the proper generic position of the species, the assignment of which is tentative. The insect does not seem to be closely related to any of the described species of *Chorisoneura* and we are unable to give a comparative diagnosis for that reason.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5234.]

Size rather small: form depressed, elongate elliptical: surface moderately polished. Head projecting cephalad of the pronotum when seen from the dorsum: occipital line arcuato-truncate when seen from the dorsum; least interspace between the eyes, which is ventral in position, very broad, subequal to the area between the antennal scrobes; face moderately bullate: palpi with the third joint slender, slightly longer than the fifth joint; fourth joint faintly shorter than the fifth joint, slender proximad and regularly enlarging distad; fifth joint somewhat thickened, elongate elliptical in outline: eyes strongly reniform in basal outline: antennæ slightly exceeding the body in length; third joint nearly twice as long as the second joint, proximal joint moderately enlarged, slightly longer than the third joint. Pronotum transverse, its greatest length contained one and

one-half times in its greatest width: cephalic and caudal margins very faintly arcuate, subparallel, the caudal of greater extent than the cephalic, lateral margins broadly and strongly arcuate, latero-cephalic angles obsolete, latero-caudal angles very faint, greatest width situated slightly caudad of the middle: surface of the disk with a faint, discontinuous, medio-longitudinal impression, also with three pairs of poorly defined impressions, the caudal pair practically delimiting the disk latero-caudad; lateral portions of the pronotum semihyaline, weakly deflexed. Tegmina elongate lanceolate, the greatest width contained about three and one-half times in the greatest length: costal margin moderately arcuate in proximal third, straight thence to the moderately arcuate distal fourth; sutural margin of similar form, but the distal arcuation is somewhat more extensive; apex rounded acuminate, nearly median in position: marginal field of medium width, sharply subdeplanate, extending to the proximal third of tegmen; scapular field broad, comprising but slightly less than half the entire tegminal width; anal field subpyriform, comprising slightly less than one-third the sutural length: costal vein twelve in number, oblique, somewhat sinuate and irregular; discoidal vein bifurcate distad, the sutural ramus sending two rami to the distal section of the sutural margin; median vein in general parallel to the discoidal vein, reaching the sutural margin proximad of the discoidal rami, sending two to three strongly oblique rami suturad; ulnar vein bifurcate; anal sulcus strongly arcuate proximad, straight oblique thence to the apex, which is very briefly arcuate; axillary veins five in number, poorly defined. Wings with the intercalated field relatively large, its axial length about equal to one-third that of the remainder of the wing, strongly arcuate distad, subrectangulate proximad: costal veins eleven in number, the three proximal ones springing from the mediastine vein, the proximal nine all distinctly elongate clavate; discoidal vein straight, simple except for the costal veins; medio-discoidal area broad, its width at broadest point almost equal to that from discoidal vein to costal margin, divided into more or less distinctly quadrate areas by eleven transverse veins; median vein straight except for curving costad toward the discoidal vein near its apex, simple except for several rudimentary rami distad; medio-ulnar area narrow, distinctly less (at broadest points) than half as wide as the medio-discoidal area; axillary vein biramose. Subgenital plate[19] of the slightly asymmetrical type, with the large, compressed

[19] The condition of the material is such that we have refrained from making any effort to ascertain the features of the supra-anal plate.

type of styles, found in a number of species of the genus; form of the plate reading from sinistral portion; first, an infra-cercal, slightly oblique, subtruncate, projecting portion, this rounding into a relatively deep U-shaped emargination to the base of the styles, which are placed in broadly, unequally arcuate emarginations, between which is a slight, acute-angulate projection, dextrad of the styles the margin is developed similarly to the sinistral portion, but the projection is narrower and more acute; styles in length distinctly surpassing the remainder of the subgenital plate, distinctly compressed, subparallel, tapering, ventral margin thickened: cerci elongate, depressed, subfusiform, distad greatly attenuate. Femoral margins with a few weak, short spines; genicular spines strongly developed on median and caudal femora: arolia large.

General color buckthorn brown. Head dull vinaceous-rufous; eyes cinnamon-brown; antennæ with the proximal portion of the dorsal surface lined with mummy brown: palpi clay color. Pronotum dull mars yellow mesad, this flanked by a pair of poorly defined, broad bars of dark auburn, which diverge caudad and fail to reach the caudal margin of the pronotum; lateral portions of the pronotum nearly colorless hyaline. Tegmina with marginal field nearly colorless hyaline; humeral trunk and vicinity dark auburn. Wing weakly washed with buckthorn brown, the inter-marginal costal region washed, and the radiate veins pencilled with mummy brown. Abdomen on both lateral aspects with indefinite marginal bands of mummy brown.

Length of body, 8 mm.; length of pronotum, 1.6; greatest width of pronotum, 2.4; length of tegmen, 6.6; greatest width of tegmen, 1.8.

In addition to the type we have before us a paratypic male bearing the same data as the type. This specimen shows no differences excepting a quadriramose condition of the tegminal discoidal vein, which has one ramus furcate on one tegmen, and biramose on the other.

We take great pleasure in dedicating this interesting and aberrant species to the collector, Mr. Parish, to whose energy we are indebted for several extremely interesting and important series of tropical American Orthoptera.

MANTIDÆ.

Mantinæ.

Acontiothespis eximia (Pascoe).

1882. *Callimantis eximia* Pascoe, Ann. and Mag. Nat. Hist., (5), IX, p. 423. [Nazare, near Pará, Brazil.]

Pará. (C. F. Baker.) One male.

Igarapé-assú. January 19, 1912. Two males, one female.

Kirby[20], who examined Pascoe's type, considers Saussure and Zehntner's *paraensis* to be the same as *eximia*.

The male has not been previously described. In that sex the general form of the head is similar to that found in the female, but the occipital line is weakly concave and the facial scutellum is slightly shallower, though of exactly the same general pattern. The pronotum is of similar form to that of the female but, naturally, slightly more slender. The tegmina are entirely hyaline except the marginal field and the vicinity of the humeral trunk, which are opaque green. The wings are hyaline with the costal margin rather narrowly washed with pomegranate purple, a longitudinal blotch placed on the caudal two-thirds of the radiate field at about two-fifths the length of the wing from the internal margin, bone brown in color. One of the Igarapé-assú males measures as follows: length of body, 19.8 mm.; length of pronotum, 4.4; greatest width of pronotum, 2.2; length of tegmen, 14; length of cephalic femur, 5.2.

All the known records of the species are from the state of Pará, Brazil.

Angela quinquemaculata (Olivier).

1792. *Mantis quinquemaculata* Olivier, Encycl. Méth., Ins., VII, p. 636. [Surinam.]

Igarapé-assú. One male.

This specimen has been compared with a male of the species from Bartica, British Guiana (II–27–1913; H. S. Parish) and agrees in all respects except two. The folded carination of the disto-dorsal abdominal segments is well indicated in the Bartica specimen and not apparent in that from Igarapé-assú. The Bartica specimen is more intensely colored, having the yellow areas between the purplish bars on the wings brighter, but the general weak infuscation of the wings is more extensive in the Brazilian specimen and the distal ferruginous patch on the anterior field of the same is more decided in this individual.

Apparently this is the first Brazilian record of the species.

Macromantis ovalifolia (Stoll).

1813. [*Mantis*] *ovalifolia* Stoll, Natuur. Afbeeld. Beschr. Spooken, etc., pp. 58, 77, pl. XIX, fig. 72. [No locality.]

Igarapé-assú. One male.

This specimen has the marginal field of the tegmina hyaline in the proximal two-fifths and viridi-coriaceous distad. Apparently

[20] Synon. Catal. Orth., I, p. 233, (1904).

this is the first record of the genus from Brazil or from south of the Guianas.

Miopteryginæ.

Musonia[21] **major** Saussure and Zehntner.

1894. *Musonia major* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 165, pl. X, figs. 17 to 19. [South America.]

Igarape-assú. Two males.

These specimens have also been compared with a male of this species from Nouveau Chantier, French Guiana, recorded by Chopard.[22] The form of the supra-anal plate of the male has never been described. From our material it is seen to be elongate lanceolate, with the apex rounded and but faintly surpassing the distal margin of the subgenital plate. There is present on the plate a distinct precurrent median carina.

This is the first record of the species from Brazil.

Vatinæ.

Parastagmatoptera flavoguttata (Serville).

1839. *Mantis flavoguttata* Serville, Hist. Nat. Ins., Orthopt., p. 183. [Cayenne.]

Igarapé-assú. One male.

This specimen is inseparable from males from Nouveau Chantier, French Guiana, determined and recorded by Chopard.

ACRIDIDÆ.

Acrydiinæ.

Eomorphopus granulatus Hancock.

1906. *E[omorphopus] granulatus* Hancock, Genera Insectorum, fasc. 48, Tetriginæ, p. 38, pl. IV, figs. 35 and 35a. [Dutch Guiana.]

Igarapé-assú. January 25, 1912. One male.

Allotettix peruvianus (Bolivar).

1887. *P[aratettix] peruvianus* Bolivar, Ann. Soc. Entom. Belg., XXXI, p. 272. [Pumamarca, Peru.]

Igarapé-assú. Four males, one female.

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[21] The type of this genus was first fixed by the present author, in February, 1904 (Proc. U. S. Nat. Mus., XXVII, p. 568), as *surinama*. Kirby later (Synon, Catal. Orth., I, p. 276—not earlier than November, 1904) indicated *major* Saussure and Zehntner as the type, an unwarranted and untenable designation, as it was not one of the originally included species. As Giglio-Tos has based his recently proposed generic name *Promusonia* on *surinama* (Bull. Soc. Entom. Ital., XLVII, p. 6, (1916)), it is evident that his name is a pure synonym of *Musonia* as properly restricted. As we have already contended (Ibid., p. 567), the generic name *Mionyx* also becomes a synonym of *Musonia*, although at the date of our previous writing no single type had been selected for it. Kirby, however, indicated (Ibid., p. 276) as its type, *lineativentris* Stål, which is apparently congeneric with *surinama*, in addition being with the latter the original basis of *Musonia*. Certain species which have been referred to *Mionyx* are, apparently, not congeneric with *surinama*, and these will require a new generic name.

[22] Ann. Soc. Entom. France, LXXX, p. 332, (1911).

Micronotus caudatus (Saussure).

1861. *T[ettix] caudata* Saussure, Revue et Magasin de Zoologie, 2e sér., XIII, p. 399. [Guiana.]

Igarapé-assú. Three males, five females.

These specimens are typical of this relatively widely distributed species. It seems to us very probable that Bruner's *Tettix gracilis* from Trinidad[23] equals the present species.

Apotettix bruneri (Hancock).

1906. *Apotettix bruneri* Hancock, in Bruner, Proc. U. S. Nat. Mus., XXX, p. 614. [Paraguay.]

Igarapé-assú. One female.

This specimen is inseparable from Paraguayan and Argentinian individuals of the same sex. The range of the species is much extended to the northward by this record.

Tettigidea hancocki Bruner.

1910. *Tettigidea hancocki* Bruner, Ann. Carneg. Mus., VII, p. 131. [Corumbá, Brazil.]

Igarapé-assú. One male.

This specimen fully agrees with the description of *hancocki*, but in size it is somewhat smaller, showing the following proportions: length of body, 8.8 mm.; length of pronotum, 9.1; length of tegmen, 1.7; length of wing distad of pronotum, 2.5; length of caudal femur, 5.4.

The two localities from which this species are known are widely separated, but doubtless it will be found in suitable situations in the intervening region.

Proscopinæ.

Proscopia scabra Klug.

1820. *Proscopia scabra* Klug, in Nees ab Esenbeck, Horæ Physicæ Berolin., p. 19, pl. III, fig. 2. [Pará, Brazil.]

Pará. (C. F. Baker.) One male.

The male is particularly interesting in having a striking type of coloration, a median supra-clypeal area on the lower face, the ventral section of the genæ, the cephalic supracoxal plate, a wash along each side of the meso- and metapleura and the greater portion of the immediate apex of the abdomen, being yellowish. The species *Taxiarchus paraensis* described by us from Obidos, Amazon River,[24] we find to be a synonym of the present species. The unsatisfactory character of Brunner's generic key and lack of comparable material were largely responsible for the reference of this insect to *Taxiarchus*.

[23] Journ. N. Y. Entom. Soc., XIV, p. 145, (1906).
[24] Entom. News, XVII, p. 332, (1906).

Certain of the genera of the present subfamily do not appear at all natural or, if so, are not properly defined.

The species is known from as far south as Bahia and inland to the upper Amazonian region.

Acridinæ (*Truxalinæ* of authors).

Orphulella punctata (DeGeer).

1773. *Acrydium punctatum* DeGeer, Mém. Hist. Ins., III, p. 503, pl. 42, fig. 12. [Surinam.]

Igarapé-assú. Two males, one female.

Pará. (W. M. Mann.) One male, one female. (C. F. Baker.) Three males, seven females.

This series exhibits the usual phases and variations of this plastic and widespread species. But two, these females from Pará, are of the all green phase, while the strongly infuscated phase is represented in the Igarapé-assú and Pará lots. In a relatively large number of specimens the lateral carinæ of the pronotal disk show a more or less decided tendency to become obsolete between the first and second transverse sulci.

Orphulella boucardi (Bruner).

1904. *Linoceratium boucardi* Bruner, Biol. Cent.-Amer., Orth., II, p. 84. [Rio Sarstoon, British Honduras; Panama; San Diego, Department of Magdalena, Colombia.]

Igarapé-assú. February 1, 1912 (one specimen only). Six males, two females.

For comments on the synonymy of this species the student is referred to a recent paper by the author.[25]

Ommexechinæ.

Ommexecha giglio-tosi Bolivar.

1899. *O[mmexecha] giglio-tosi* Bolivar, Revista Chilena Hist. Nat., III, pp. 54, 55. [Caiza, Aguairenda and San Francisco, Bolivian Chaco.]

Igarapé-assú. One male.

This specimen is inseparable from individuals of the same sex previously recorded by us from northern Argentina, except that the disk of the wing is more glaucous and less azure blue.

Pyrgomorphinæ.

Omura congrua Walker.

1870. *Omura congrua* Walker, Catal. Derm. Salt. Brit. Mus., III, p. 504. [Pará, Brazil; Amazon Region; Archidona, Ecuador.]

Igarapé-assú. One male.

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[25] Trans. Amer. Entom. Soc., XLII, p. 277, (1916).

Locustinæ (*Acridinæ* of authors).

Colpolopha obsoleta (Serville).

1831. *Tropinotus obsoletus* Serville, Ann. Sci. Nat., XXII, p. 274. ["Cape of Good Hope."]

Igarapé-assú. One male.

This specimen is inseparable from British Guianan males of the species, which has been recorded from Santarem (Rehn) and Pará (Bruner), Brazil.

Tropidacris collaris (Stoll).

1813. *Gryllus* (*Locusta*) *collaris* Stoll, Natuurl. Afb. Beschyr. Spooken, etc., Trek-springhaanen, pp. 39, register 13, pl. XXIV, fig. 80. [No locality.]

Igarapé-assú. One dated January 17, 1912. One male, two females.

Stenacris cylindrodes (Stål).

1860. *Opsomala cylindrodes* Stål, Kong. Svenska Freg. Eugenies Resa, Ins., p. 325. [Rio de Janeiro, Brazil.]

Igarapé-assú. One female.

This specimen is inseparable from south Brazilian material.

Oxyblepta xanthochlora (Marschall).

1835. *Gryllus xanthochlorus* Marschall, Ann. Wiener Mus., I, p. 215, pl. XVIII, fig. 7. [Brazil.]

Igarapé-assú. One dated January 17, 1912. Two males, two females.

These specimens are only provisionally referred to this species, as the forms of the genus found in northern South America and their relationship is very poorly understood.

Mastusia caeruleipennis Bruner.

1911. *Mastusia caeruleipennis* Bruner, Ann. Carneg. Mus., VIII, p. 86. [Benevides, state of Pará, Brazil.]

Igarapé-assú. Three males, two females.

This species was described from a female, apparently unique. The male sex fully agrees with the important features of the original description, except for the genital characters and those features in which the males of this group show some difference from the female, i. e. smaller size, proportionately narrower interocular space of the vertex, more prominent eyes and slightly more distinct median carina of the pronotum. In size the male specimens before us show the following measurements:

Length of body	22.3 mm.	19 mm.	19.5 mm.
Length of pronotum	4.4 "	4 "	4.3 "
Greatest dorsal (caudal) width of pronotum	2.2 "	2.1 "	2.2 "
Length of tegmen	11 "	9 "	10 "
Length of caudal femur	13.1 "	12.1 "	13.5 "

The male genitalic characters can be briefly described as follows. The disto-dorsal abdominal segment has the distal margin concave mesad, the concavity delimited laterad by a short black projecting tooth; supra-anal plate of the trefoil type found in this genera group, the paired lateral sections strongly rounded, the median distal section short sublinguiform, the dividing emarginations roundly rectangulate, proximal half of plate with a median sulcus, widening distad; cerci developed as broad plates but slightly surpassing the apex of the supra-anal plate, the dorsal section of the plate strongly impressed and depressed, with the apex slightly recurved on the main portion of the cercus, the lateral section, which is thrown into relief by the impressed and recurved sections, being of the sub-falciform pattern found in the cerci of other species of this group of genera, in which species, however, the cerci are not at all lamellate, but instead show modifications of a simpler cercal type; subgenital plate short, when seen from the lateral aspect blunted, the apex strongly pinched dorsad.

The male sex, and to a lesser degree one of the females, shows certain color differences from the original description. The dorsal coloration is appreciably marked off from the darker lateral bars by narrow lines of dull yellow on the head and pronotum, which are continued caudad from the pallid lines on the tegmina mentioned by Bruner. There is also a dark bar, which varies in solidity, across the ventral sections of the genæ, lateral lobes and, more weakly, the pleura, bordering ventrad the yellow described by Bruner. The face is dull pale olivaceous green in both sexes. The caudal femora are clear oil yellow proximad, passing to oil green distad, with the distal extremity somewhat infuscated.

The number of spines on the external margin of the caudal tibiæ varies from six to seven.

Tetratænia surinama (Linnæus). (Pl. I, figs. 24 and 26.)

1764. [*Gryllus*] *surinamus* Linnæus, Mus. Ludovic. Ulric., p. 146. [Surinam.]

Igarapé-assú. Five males.

Pará. (C. F. Baker.) One male, one female.

This series shows the male sex to have a very great amount of variation in size, and apparently to a certain degree locally in the depth of general coloration; in the Igarapé-assú specimens the dorsal surface of the head and pronotum is fully as dark as the lateral (i. e. ventrad of the narrow pale dorso-lateral lines) areas, while the tegmina are more olivaceous, instead of the same area

on the pronotum and the tegmina being distinctly greenish, as in the Pará individuals.

The size extremes (in millimeters) of the Igarapé-assú males and the single female (Pará) seen are as follows:

	♂	♂	♀
Length of body	19.5 mm.	29 mm.	35 mm.
Length of pronotum	4.2 "	5.8 "	6.6 "
Greatest dorsal (caudal) width of pronotum	2.6 "	3.8 "	4.8 "
Length of tegmen	17.6 "	22.7 "	24.6 "
Length of caudal femur	13.6 "	18.6 "	19 "

The species has been recorded from Surinam, "Brazil," Coca (Bolivar) and Valley of Santiago (Giglio-Tos), Ecuador. The two latter records may not refer to true *surinama*.

Tetratænia phila[26] n. sp. (Pl. I, figs. 25 and 27.)

Allied to *T. surinama* (Linnaeus), but differing in the generally smaller size, less strongly bullate occiput, narrower interspace between the eyes, shorter and proportionately broader fastigium, more prominent eyes, in the more slender and more regularly arcuate male cerci, in the less expanded genicular lobes of the median femora and the small dorsal spine of the same region, in the less produced and more robust caudal femora of the male and in the less strongly contrasted coloration.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5284.]

Size small (for the genus): form in general as in *T. surinama*. Head with the occiput regularly bullate-arcuate ascending, but not as elevated as the dorsal surface of the eyes, weakly carinate mesad, the vertex and fastigium moderately declivent; interspace between the eyes subequal in width to the inter-antennal section of the frontal costa; fastigium nearly twice as broad as long, cephalic margin arcuato-obtuse, faintly excavate near the apex, fastigio-facial angle roundly obtuse when seen from the lateral aspect, face gently retreating, bounding border of the fastigium well indicated; frontal costa not strongly indicated ventrad, failing to reach the clypeal suture, moderately narrowed dorsad at the fastigio-facial angle and again to a smaller degree ventrad of the ocellus, thence subequal in width ventrad, surface biseriate punctate dorsad, faintly sulcate ventrad; lateral facial carinæ distinct and gently diverging

[26] From Φιλε, *a friend*.

ventrad: eyes prominent, distinctly elevated dorsad of the vertex, in outline broad ovate, in length twice as long as the infra-ocular portion of the genæ: antennæ almost twice as long as the combined length of the head and pronotum. Pronotum subsellate, greatest width (caudad) of the disk contained one and one-half times in the greatest length; cephalic margin of disk gently arcuate with a shallow median emargination, caudal margin obtuse-angulate with the immediate angle narrowly emarginate; prozona about one and one-half times as long as the metazona, the latter closely cribroso-punctate, transverse sulci deeply impressed; median carina faintly indicated on the prozona, severed by all the transverse sulci, distinct but low and not sharply defined on the metazona, lateral angles rounded, faintly more evident on the metazona than on the prozona; lateral lobes with their greatest depth contained one and one-quarter times in their greatest dorsal length; cephalic margin straight oblique, ventro-cephalic angle rounded obtuse-angulate; ventral margin arcuato-emarginate cephalad, obtuse-angulate mesad, straight oblique ascending caudad, ventro-caudal angle rounded; caudal margin moderately concave. Tegmina reaching to the tips of the caudal femora, apex rounded. Wings reaching to the tegminal tips. Prosternal spine erect, conical, acute; interspace between the mesosternal lobes quadrate, internal margins of the lobes straight, interno-caudal angles rounded; metasternal lobes very narrowly separated caudad. Furcula present as short spiniform points, between which and the cercal bases are placed on each side a single similar point, the abdominal segment bearing the same sublamellate expanded over the cercal base: supra-anal plate elongate trigonal, slightly arcuate-emarginate on each side mesad, apex broadly rounded, margins moderately elevated, the median line of the plate finely sulcate proximad, carinate distad: cerci thick at the base, thence tapering to the subequal distal half, moderately arcuate in form, apex blunt, moderately incurved: subgenital plate considerably produced, distal portion strongly compressed with the apex faintly bulbous, this faintly elevated when seen from the lateral aspect. Cephalic limbs as usual in the genus. Median femora with the dorsal genicular teeth short and blunt, the genicular lobes not strongly developed. Caudal femora slightly more than twice as long as the head and pronotum together, rather robust, not surpassing the tips of the tegmina, genicular lobes acute, pattern of the paginæ regular, moderately impressed: caudal tibiæ slightly shorter than the femora, distal two-thirds expanded, margins there distinctly lamellate,

lamellar brush on internal margin thick, external margin with but a few hairs; external margin with six to seven spines, internal margin with nine spines: caudal tarsi with proximal joint strongly depressed.

Allotype: ♀; same data as type.

Differing from the description of the male in the following features. Frontal costa sulcate for but a short distance ventrad of the ocellus, plane thence ventrad: eyes elevated but slightly dorsad of the vertex, in depth about one and one-half times that of the infra-ocular portion of the genæ: antennæ hardly twice as long as the pronotum alone. Pronotum not as sellate as in the male, the dorsal line not at all concave when seen from the side, greatest dorsal (caudal) width of disk contained about one and one-third times in the greatest dorsal length of the same: prozona about one and one-third times as long as the metazona: lateral lobes of the pronotum with their greatest dorsal length very faintly longer than their greatest depth. Interspace between mesosternal lobes faintly broader than in the male, that between metasternal lobes cuneate and at narrowest point about two-fifths the width of the mesosternal interspace. Ovipositor jaws elongate, slender, compressed, margins irregularly denticulate. Median femora of normal type, as usual in females of this genus.

General color of intensive individuals very dark olive on the dorsal and lateral aspects, ventral surface and abdomen olive-yellow to yellowish olive, mottled in both cases with bottle green, metazona of the dorsum of the pronotum washed with ivy green. The usual four lines on the head, pronotum and pleura relatively narrow, the dorsal pair quite narrow, in color these lines are olive-ocher to olive-yellow, paling to cream-buff or primrose yellow where the ventral pairs are connected on the face; pleural spots three in number. Eyes mars brown to prout's brown; antennæ of the general color, in proximal half weakly subannulate with dull ochraceous, tips briefly cream color. Tegmina with the anal vein lined with the continuation of the dorsal pair of pale lines; anal area sometimes weakly washed with bottle green. Wings with the disk china blue, apex and distal half of periphery clouded with fuscous. Cephalic and median limbs of the ventral color, the mottling of bottle green quite marked, the tibiæ subannulate with fuscous; proximal portion of the femora washed with nopal red. Caudal femora with the external, dorsal and internal faces of the general dorsal color, triannulate with aniline yellow, the proximal annulus incomplete, the median one V-shaped on the lateral face,

ventral face aniline yellow or washed with garnet brown, the proximal portion of the femora washed more or less completely with nopal red; caudal tibiæ deep slate blue, paler along the margins, an incomplete proximal yellowish annulus, spines yellowish, black tipped; caudal tarsi dull greenish, faintly washed with reddish (this probably more extensive and much stronger in life), internal margin of the two proximal joints lined with black.

In the single recessively colored individual before us the dorsal pale lines are greatly subdued and the femoral bands, particularly the caudal ones, are obsolete, while the general color is less distinctly greenish and in places more brownish. The pale antennal tips and the ventral pair of pale bands are, however, as decided as in the intensively colored specimens.

Measurements (in millimeters).

	♂ (Type)	♀ (Allotype)
Length of body	18.7	25.4
Length of pronotum	4	5.2
Greatest width of dorsum of pronotum	2.5	3.9
Length of tegmen	15.1	19
Length of caudal femur	12.2	15.2

In addition to the type and allotype we have before us two paratypic females, which show structural differences only in the faintly more bullate dorsum of the pronotum of one specimen, which is of the recessive type of coloration noted above. An interesting thing concerning one female paratype is that the left antenna was broken off at the sixth joint some time during the life of the insect, and there has been regenerated distad of that joint a terminal joint much longer and appreciably more bulbous than the other segments, which terminal segment, curiously enough, bears a narrow terminal pale marking. Since writing the above we have had placed in our hands a single female of the species from Albina, Surinam, collected May, 1904, by William Schaus, and belonging to the United States National Museum. This individual is more brownish than the Igarapé-assú specimens, with the pattern recessive in character.

CHLOROPSEUSTES[27] new genus.

A member of the Tetratæniæ and allied to *Tetratænia*, *Mastusia* and *Eumastusia*, but completely apterous and in general form strongly resembling species of the Coscineutid genus *Dellia*, from which, however, *Chloropseustes* can be immediately separated by the expanded

[27] From χλωρός *green*, ψευστης *deceiver*.

and marginally lamellate distal sections of the caudal tibiæ, as well as by the character of the genitalia of both sexes. The more fully the other features of the new genus are examined, the more superficial the evident resemblance to *Dellia* is found to be. From all of the allied genera *Chloropseustes* can be separated by its apterous condition, its supra-genicular spiniform process and its highly polished surface; from *Tetratænia* also in the broadly emarginate caudal margin of the pronotal disk, the more (♂) or less (♀) sulcate frontal costa, the simpler subgenital plate of the male and the absence of the clavation of the distal extremity of the median femora found in the male of *Tetratænia*; from *Eumastusia* the new genus differs in the form of the head and general type of the pronotum, as well as sculpture of the same, in the non-compressed male subgenital plate and in the linear, more exserted ovipositor jaws of the female; from *Mastusia* the new genus also differs in the form and sculpture of the head and pronotum, in the emarginate caudal margin of the pronotal disk and in the linear, more exserted, female ovipositor jaws. The coloration of the type species is very distinctive.

Description of Genus.—Apterous. Glabrous. Surface of face, genæ, occiput, pronotum, pleura and proximal abdominal segment with small, raised but low, callose, white areas. Interspace of vertex narrow; fastigium subdeclivent, sulcate; fastigio-frontal region truncate when viewed from lateral aspect; face retreating; frontal costa distinctly (♂) or weakly (♀) sulcate mesad and ventrad, plane dorsad; eyes prominent in both sexes. Pronotum with three very deeply impressed transverse sulci, no lateral and little trace (in male only) of median carinæ; cephalic and caudal margins of disk emarginate mesad; mesonotum not equal to one-third the length of the prozona. Supra-anal plate of male subtrigonal; cerci of male falciform; subgenital plate short, broad. Ovipositor jaws of female elongate, straight, margins weakly denticulate. Prosternal spine sub-compressed, conical, acute. Mesosternal lobes with interspace slightly longitudinal (♂) or slightly transverse (♀). Metasternal lobes contiguous (♂) or narrowly separated (♀). Cephalic and median femora of male subinflated, cephalic genicular lobe larger than caudal lobe on each femur. Caudal femora with a more (♂) or less (♀) pronounced supra-genicular spine, genicular lobes weakly acute; caudal tibiæ expanded distad, with the margins sublamellate, external margin with seven spines, internal margin with nine spines; caudal tarsi elongate, second joint subequal to one-half the length of the metatarsus, third joint subequal to joints one and two together.

Genotype: *C. leucotylus* new species.

Chloropseustes leucotylus[28] n. sp. (Pl, I, figs. 28–31.)

Type: ♂; Igarapé-assú, State of Pará, Brazil. January 17, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5287.]

Size small. Head slightly enlarging cephalad of its insertion in the pronotum; occiput roundly inflated and ascending; vertex with interspace between the eyes very narrow, less than the width of the third antennal joint, caudad of the constriction the vertex is lanceolate sulcato-impressed; fastigium weakly declivent when seen from the lateral aspect, distinctly broader than long when seen from the dorsum, the greatest width subequal to twice the width of the proximal antennal joint, fastigium delicately sulcate medio-longitudinally; fastigio-frontal region vertically truncate to between the antennæ when seen from the lateral aspect, face then strongly retreating, weakly concave; frontal costa indicated to the clypeal suture, narrow, weakly narrowed ventrad of junction with fastigium and faintly so immediately ventrad of the median ocellus, surface of costa dorsad plane with a few punctures, ventrad of ventral margins of antennal scrobes deeply but narrowly sulcate; lateral facial carinæ well indicated, divergent ventrad; eyes quite prominent, large, well elevated dorsad of the vertex, in length about twice that of the infra-ocular portion of the genæ; antennæ about three times as long as the pronotum, simple, joints elongate, very faintly enlarging distad. Pronotum weakly sellate in general form, but dorsal line straight, with greatest dorsal length slightly greater than the greatest dorsal width; cephalic margin of disk subarcuate with shallow, broad, median emargination; caudal margin of disk very broadly and faintly emarginate, with a more pronounced, broad, median V-emargination: median carina very weakly and discontinuously indicated on the prozona; transverse sulci very deeply impressed, the caudal one continuous, the others, three in number, severed by the median carina, a supplementary, short, dorsal sulcus placed between sulci one and two; metazona forming no more than one-fourth of the dorsal length of the pronotum: lateral lobes about one and three-fourths times as long as deep, ventro-caudal angle rounded, caudal margin straight; surface of metazona of lobes faintly punctulate. Mesonotum with caudal margin faintly obtuse-angulate emarginate mesad, the surface ascending dorso-caudad into a blunt, tubercular structure: metanotum with a structure similar to that of mesonotum, but the caudal margin is more decidedly obtuse-angulate emarginate. Tegmina

[28] From λευκος *white*, τυλος *knob*.

and wings completely absent. Abdomen slightly compressed, weakly carinate medio-longitudinally dorsad, extremity slightly recurved: furcula developed as short, broad, rounded well-separated lobes; lateral sections of the segment bearing the furcula sublamellate and projecting over the lateral face of the cercal base, the margin of these lobes arcuate obtuse-angulate: supra-anal plate moderately produced and constricted trigonal, the apex moderately broad, rounded, lateral margins with the cercal emargination broad, moderately deep and regularly arcuate, distal section of plate slightly deflected ventrad from the plane of the proximal portion of the same, the deflected portion with lateral sulci limiting a median rounded "boss": cerci falciform, short, not surpassing the apex of the supra-anal plate, proximal portion of the cerci very broad, then tapering strongly to the relatively slender and moderately acute distal portion, the whole cercus placed so as to incline toward the median line of the body: subgenital plate very short, broad, not at all produced, when seen from the lateral aspect rounded, the dorsal margin broadly U-shaped.[29] Prosternal spine moderately compressed conical, acute, arising from a broad base. Interspace between the mesosternal lobes subcuneate, slightly longer than broad: metasternal lobes touching on their caudal half. Cephalic and median femora moderately inflated, appreciably arcuate, cephalic genicular lobe of each of these femora larger than the caudal lobe of the same. Caudal femora about twice as long as the head and pronotum together, surpassing the apex of the abdomen by nearly one-half the femoral length, moderately slender, external paginæ regularly and distinctly sculptured, genicular lobes moderately acute, median section of dorso-genicular margin with a distinct projecting spine: caudal tibiæ very slightly shorter than the femora, distinctly expanded distad, the margins there considerably lamellate, marginal hairs few in number but individually long and regularly disposed, external margin with seven spines, internal margin with eight to nine spines: caudal tarsi not quite one-half as long as the caudal tibiæ, slender, the first and second joints together but slightly longer than the third, the second joint about one-half the length of the first joint, which is considerably depressed.

Allotype: ♀; same data as the type. [Acad. Nat. Sci. Phila.]

The female differs from the male description in the following features. Interspace between the eyes subequal to the width of the second antennal joint, the vertex caudad of the interspace hardly more

[29] The type has this plate compressed, apparently unnaturally so, and we are taking its marginal form from the paratypic male, which, apparently, represents the normal type.

than finely sulcate: frontal costa less clearly defined ventrad and with the sulcation weaker and sub-obsolete ventrad: eyes not quite twice as long as the infra-ocular portion of the genæ: antennæ about two and one-half times as long as the dorsum of the pronotum. Pronotum slightly shorter, the lateral lobes about one and one-half times as long as deep. Mesonotum and metanotum with marginal form and tuberculiform structure less decided. Supra-anal plate elongate trigonal, strongly arcuate in transverse section, apex rather blunt, surface non-sulcate: cerci short, blunt, styliform: ovipositor valves exserted, elongate, straight, compressed, apices slightly blunted, lateral margins rather finely denticulate, dorsal surface of dorsal valves weakly canaliculate. Interspace between the mesosternal lobes slightly transverse: metasternal lobes narrowly separated. Cephalic and median femora more slender. Caudal femora with dorsal genicular spine less aciculate.

General color calla green to ivy green, passing into more or less clear oil yellow on the lateral lobes of the pronotum (♂), the genæ and lower face (♂) and rostral region (both sexes). The pale spotting ranges from maize yellow, through creamy white to light green-yellow, and is distributed roughly as follows: three paired spots on face, three to four paired markings ventrad of eyes and on genæ, a paired series of eight spots following the usual position of lateral pronotal carinæ extending from eyes to caudal coxæ, another paired series extending from mesonotum to and over dorsum of third to fifth proximal abdominal segments, ventral section of lateral lobes of pronotum with three paired dashes; all these markings placed on strumose tubercles or ridges. Fastigium of male distinctly, of female weakly, pale lemon yellow: antennæ of the color of the face, infuscated distad: eyes mars brown to russet. Abdomen of male occasionally yellowish disto-ventrad: furcula, edge of expansion of disto-dorsal abdominal segment and tips of cerci of male black. Caudal femora with distal extremity and adjacent section of tibiæ cadmium orange to cadmium yellow, strongest on the genicular arches and weakly tinged with the general greenish on the lobes and dorsum: caudal tibiæ with spines black-tipped: caudal tarsi with pulvilli pads scarlet red in some specimens, yellowish (possibly faded) in others.

Measurements (in millimeters).

	♂ (Type)	♀ (Allotype)
Length of body	13.6	17.8
Length of pronotum	2.9	3.1
Greatest (dorsal) width of pronotal disk	2.3	2.8
Length of caudal femur	10.3	1.6

In addition to the type and allotype we have before us a paratypic pair (one—the male—dated January 17, 1912), which show no noteworthy differences from the type material, except that the male has the general coloration more olivaceous, but this we feel is due to drying.

Bucephalacris falcifer n. sp. (Pl. I, figs. 32, 33.)

Apparently a near relative of *B. corallipes* Bruner,[30] from Corumbá, Brazil, agreeing in the robust form, the closely veined tegmina and the coral red caudal tibiæ. The new form differs, however, from *corallipes* in the female sex (the only one known of *corallipes*) having the head higher than wide, in the eyes being less than twice as long as the cephalic margin of the cheek, in the fastigium being distinctly broader than long, in the unbanded pronotum and in the longer tegmina.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5288.]

Size small: form robust: surface of face, lower portion of genæ, pronotum and pleura closely but not very deeply cribroso-punctate, occiput very shallowly punctate. Occiput arcuato-bullate, well elevated dorsad of pronotal level, at highest point faintly flattened; interocular portion of vertex very narrow, hardly more than one-fourth the width of the proximal antennal joint, weakly sulcate in caudal section; fastigium very faintly declivent, the greatest length subequal to the greatest width, in general form pentagonal, the cephalic margin strongly truncate and appreciably cingulate, the surface impressed, weakly nodulose and with a short, rather fine, medio-longitudinal carina: frontal costa dorsad four times as broad as the interocular space and subequal in width ventrad to the median ocellus, ventrad of which the margins are strongly constricted, then diverging an equal amount and obsolete ventrad of this point, the interantennal section of the costa is excavato-sulcate, distinctly punctate, surrounding the ocellus the surface is impresso-punctate, thence faintly sulcate for a short distance and then passing into the punctate face: lateral facial carinæ indicated, but developed only as an angle of the face, moderately diverging ventrad, punctate as the face: eyes quite prominent, more than twice as long as the infra-ocular portion of the genæ, in basal outline broad ovate, slightly flattened cephalad: antennæ lacking. Pronotum narrower than the caudal width of head, faintly constricted mesad, the greatest dorsal width of disk

[30] Ann. Carneg. Mus., VIII, p. 93, (1911).

very slightly less than the greatest dorsal length: cephalic margin of disk obtusely produced with a very broad, shallow emargination: caudal margin of disk very broadly obtuse-angulate: median carina faintly indicated cephalad, more distinctly so on the metazona, obsolete mesad: transverse sulci well impressed, metazona slightly more than one-half of the prozonal length: lateral lobes with the greatest dorsal length subequal to the greatest depth; cephalic margin of lobes straight, slightly oblique, ventro-cephalic angle nearly rectangulate, ventral margin obliquely concave-emarginate cephalad, median angle distinct but obtuse, this margin obliquely subarcuate caudad, ventro-caudal angle obtuse, caudal margin straight, vertical. Tegmina reaching to the apex of the supra-anal plate, moderately broad, distal four-fifths weakly tapering, apex rounded; venation close, particularly proximad. Wings reaching to the tips of the tegmina, very broad, the greatest width contained one and two-fifths times in the greatest length: distal section of anterior and portion of radiate fields subtruncate. Prosternal spine very robust, short, rather blunt, faintly transverse compressed: interspace between the mesosternal lobes with cephalic width faintly greater than the depth, the caudal width very much greater, the interspace regularly narrowing cephalad, median width of interspace very faintly less than that of one of the lobes, ventro-internal angle of the lobes broadly obtuse: metasternal lobes touching caudad. Supra-anal plate with the greatest proximal width subequal to the greatest length, lateral margin subparallel proximad, then moderately and regularly narrowing, distal extremity rather broad, arcuato-truncate, the surface with a pair of shining black tubercles placed mesad at the distal third, proximad the same plate has indications of a medio-longitudinal impression, flanked laterad by a pair of low rounded ridges; margins slightly thickened and elevated: cerci robust, flattened and broad proximad, in general form subfalcate, the tip directed dorsad, strongly tapering from the broad base to the median section, thence weakly tapering to the subacute apex; when viewed from the dorsum the general form of the cercus is straight proximad, then incurved and last with the distal fourth straight, the arcuate distal margin of the broad proximal portion bears several blunt teeth: pallium[31] greatly produced in an erect, distad compressed, falciform process considerably surpassing the subgenital plate, in form this process is gently tapering with a moderately acute apex: subgenital plate short, well

[31] See Scudder, Proc. U. S. Nat. Mus., XX, p. 8, (1897).

rounded when seen from the side, the dorsal free margin V-shaped, the apex faintly rostrate produced, the proximal section of the V-form of the margin slightly embracing the ventral ridge of the pallium. Cephalic and median limbs moderately robust. Caudal femora moderately robust, very faintly shorter than the tegmina, the greatest depth contained three and one-half times in the length of the same, genicular lobes moderately acute, external face regularly patterned: caudal tibiæ slightly shorter than the femora, armed on the external margin with six spines, internal margin with eight spines: caudal tarsi very slender and elongate, the proximal and second joints subequal in length.

Allotype: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila.]

Differing from the description of the type in the following features. Size medium. Interocular portion ofthe vertex slightly wider than the proximal antennal joint, weakly sulcate: fastigium distinctly but not strongly transverse: frontal costa twice as wide as the interocular portion of the vertex, of similar structure to that of the male but the broad portion is plane and non-sulcate, roughly biseriate punctate, ventrad of the ocellus even more strongly constricted and sulcate than in the male, thence obsolete: eyes less prominent than in the male, one and two-thirds times as long as the infra-ocular portion of the genæ, in basal outline slightly broader proportionately than in the male: antennæ nearly twice as long as the head and pronotum together, very slender, filiform. Pronotum with the median carina obsolete except on the metazona, where it is weak but distinct: lateral lobes with the greatest depth very faintly greater than the greatest dorsal length of the same. Interspace between the mesosternal lobes with its cephalic width equal to about one and one-third times the greatest length of the same, the form of which latter expands caudad: metasternal lobes separated by an interspace which at its narrowest point (caudad) is subequal to its greatest length. Ovipositor valves robust, short, the external margins of the dorsal valves crenulate.

General color of the female saccardo olive, becoming weakly mummy brown on the dorsum of the pronotum and faintly so on the face; of the male on the head, pronotum and pleura dusky olive-green, on tegmina buffy citrine. Eyes cinnamon-brown (♂) to prout's brown (♀); antennæ fuscous, becoming black distad, with the extreme apex narrowly vinaceous-rufous, proximal joint more (♂) or less (♀) completely raw sienna. Wings very weakly washed

with fuscous, this more apparent along the costal margin and broadly around the periphery, veins fuscous. Abdomen dresden brown (♂) to brownish olive (♀), the ventral surface faintly more greenish; distal section of the margin of the male supra-anal plate, raised points on the same and distal extremity of the cerci black. Cephalic and median limbs of the general coloration: caudal femora hellebore green (♀) or light hellebore green (♂), the distal extremity english red (♂) to mahogany red (♀), the genicular arches weakly greenish, in the female this weakly suffusing the lobes as well: caudal tibiæ and tarsi nopal red, spines black tipped.

Measurements (in millimeters).

	♂ (Type)	♀ (Allotype)
Length of body	17.6	25.8
Length of pronotum	3.4	5
Greatest dorsal width of pronotal disk	2.8	4.4
Length of tegmen	11	14.8
Length of caudal femur	10.5	14

The type and allotype are the only specimens of this species we have seen.

Vilerna æneo-oculata (DeGeer).

1773. *Acrydium æneo-oculatum* DeGeer, Mém. Hist. Ins., III, p. 502, pl. 42, fig. 11. [Surinam.]

Igarapé-assú. One male.

This specimen is somewhat smaller than British Guiana individuals of the same sex, but is clearly the same species. This Guianan type is known to range south as far as Chapada, Matto Grosso and Rio de Janeiro, Brazil.

Abracris dilecta Walker.

1870. *Abracris dilecta* Walker, Catal. Dermapt. Salt. Brit. Mus., IV, p. 642. [Santarem, Brazil.]

Igarapé-assú. January 17, 1912 (one). Two females.

These specimens are inseparable from a cotypic female of the synonymous *meridionalis*[31] from Demerara, kindly loaned by Prof. Bruner.

Abracris cæruleipennis (Bruner).

1900. *Jodacris* (?) *cæruleipennis* Bruner, Second Rep. Merchants Loc. Invest. Comm. Buenos Aires, p. 68. [Asuncion, Paraguay; Territory of Formosa, Argentina.]

Pará. (C. F. Baker.) One male, one female.

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[31] See Rehn, Trans. Amer. Entom. Soc., XLII, p. 294, (1916).

Igarapé-assú. January 17 and February 1, 1912. Three males, six females.

These specimens have been compared with a typical pair, a female from Asuncion, Paraguay and a male from San Bernardino, Paraguay, loaned by Prof. Bruner, from which they show no important differences, although they are rather different in coloration. The Pará female has the base color pale ochraceous, with no distinct markings on the body, and the external face of the caudal femora unmarked. The male from the same locality has a decidedly varied pattern of the usual contrasted type of the genus, and a distinct oblique dark bar on the external face of the caudal femora, which marking extends to the base as a fine line. The Igarapé-assú males are duller and darker than the Pará male, but are much more variegated than the females. The external femoral bars are present in all of these, continued to the base by a fine line in one. The Igarapé-assú females are very dark and dull, very little contrasted and with the pale paired thoracic lines completely or nearly completely effaced. The color wash of the proximal portion of the wings in all the specimens, as in the typical material, is more bottle green than "blue" as originally described. The same is true of material from other localities in Paraguay and southern Brazil. The ventro-external face of the caudal femora is variable in the extent to which it is suffused with fuscous or blackish. It is always touched with darker in the punctations of the distal two-thirds of the area, which tendency becomes more pronounced and extensive until in the extreme condition that section is almost uniformly colored, but it is never as sharply defined laterad, as solid, or as solid to the base of the femur as in *nebulosa*, *chapadensis*, *dilecta* and *obliqua*. This feature is the one referred to by us as showing variability in the coloration of this margin.[32]

Osmilia flavo-lineata (DeGeer).

1773. *Acrydium flavo-lineatum* DeGeer, Mém. Hist. Ins., III, p. 497, pl. 42, fig. 4. [Surinam.]

Igarapé-assú. January 17, 1912 (one). Thirteen males, twelve females, one juv. male, one juv. female.

These specimens have the disk of the wing more bluish green than in typical individuals of *flavo-lineata*, in which the same area is yellowish, although with a green tinge, the present specimens being

[32] Proc. Acad. Nat. Sci. Phila., 1907, p. 186, (1907). The material there recorded as *signatipes*, as we have shown elsewhere (Trans. Amer. Entom. Soc., XLII, p. 294, (1916)) belongs to *cœruleipennis* and *chapadensis*.

terre-verte as opposed to olive-yellow (Ridgway). The bluish tone, however, is more nearly that of typical *flavo-lineata* than the dark tyrian blue (Ridgway) of *violacea* (Thunberg). We refer the Igarapé-assú series to *flavo-lineata*, but do not consider it typical, as we do material from lower Amazonia and the Guianas. It is possible that *flavo-lineata* and *violacea* may be geographic races of the same species and the present series may show a step in the intergradation, but until more material from a number of additional localities is in hand this cannot be more than suggested. The present series shows the usual amount of structural and general brownish color variation in tone and tegminal maculation found in forms of this genus. We feel that this genus should be placed near *Abracris*, to which it is undoubtedly close in relationship.

Sitalces ovatipennis Bruner.

1908. [*Sitalces*] *ovatipennis* Bruner, Biol. Cent.-Amer., Orth., II, p. 291. [British Guiana.]

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. Three males, three females.

This material has been compared with paratypic specimens from Bartica, British Guiana. While they are always minute the tegmina vary greatly in their exact shape and relative size. There is quite a little variation in the extent to which the blackish of the post-ocular regions and lateral lobes suffuses the dorsum of the thoracic segments and the proximal abdominal segments. This is continuous across the dorsum in some individuals, except for the pale longitudinal lines, and in others is there completely replaced by olivaceous. This is always correlated with general pattern depth and the two represent intensive and recessive extremes.

The species is here first recorded from Brazil.

Sitalces jugatus n. sp. (Pl. I, figs. 34, 35.)

A striking apterous species belonging to the section of the genus containing *S. apterus* (Scudder),[33] *debilis* Rehn and probably others. From *apterus* it differs in the slightly narrower dorsal section of the frontal costa in the female, in the larger auditory tympanum, more slender shaft of the cercus in the male, in the relatively shorter and more robust caudal femora of the male, the more slender caudal tarsi of the same sex and in some difference in the color pattern of

[33] We have examined one male and one female of the original one male and two females of this species, which was described as an *Ommatolampis* (Proc. Boston Soc. Nat. Hist., XVII, p. 273, (1875)), and find it is a *Sitalces*. Its relationship to *jugatus* can be determined from the above diagnosis.

the male. The latter feature consists of the pale callose area in *jugatus* being present only on the pleura, while in *apterus* the ventral portion of the lateral lobes is of similar character.

From *debilis* the new species can be readily separated by its more finely rugoso-punctate surface, much more declivent fastigium, more prominent eyes, less apparent median carina of the pronotum, more elongate auditory tympanum, less strongly carinate dorsal line of the abdomen, stouter female cerci, the more acute extremity of the prosternal process, the less decidedly serrate character of the ventral margin of the caudal femora and the reddish brown coloration. As the male of *debilis* is unknown we cannot compare that sex. Bruner's *nudus* from Santarem, may be closely related, but such information as we are able to secure from his very incomplete and not at all convincing remarks on that species seems to point to their being different.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci Phila., Type no. 5291.]

Size large (for the genus); form robust; surface of head largely, of dorsal thoracic and single proximal abdominal segments strongly, ruguloso-punctate, other proximal abdominal segments faintly sculptured dorsad. Head with the occiput not elevated dorsad of the pronotum, distinctly declivent to and including the vertex and fastigium; interocular width of the vertex very narrow, equal to less than one-half of the interantennal width of the costa, finely sulcate; fastigium rather short, broader than long, cephalic bounding margin of the impresso-punctate surface rectangulate, with a fine median continuation of the sulcus of the vertex: frontal costa faintly produced between the antennal bases, fastigio-facial angle obtuse, facial line considerably retreating, dorso-ocellar section of the costa subequal in width, broad, wider than the proximal antennal joint, non-sulcate, thickly punctate, surface impressed about ocellus, the margins of the costa compressed immediately ventrad of the same, briefly sulcate, thence costa is obsolete: eyes quite prominent, ovate in basal outline, the length twice that of the infra-ocular portion of the genæ: antennæ filiform, elongate, in length twice as long as the head and pronotum together. Pronotum sub-cylindrical, moderately expanding caudad, the greatest caudal width of the disk subequal to the dorsal length of the same, in transverse section faintly tectate: dorsal margin of pronotal disk arcuate produced, faintly and broadly emarginate mesad; caudal margin subtruncate with a very broad and shallow median emargination; median carina faintly and rather irregularly

indicated, no trace of lateral carinæ on shoulders; transverse sulci distinct, but rather finely and narrowly impressed, metazona hardly more than a fourth the length of the remainder of the pronotum: lateral lobes with their greatest depth subequal to two-thirds of the greatest dorsal length of the same; cephalic margin oblique, ventro-cephalic angle rounded obtuse, ventral margin distinctly arcuato-emarginate oblique cephalad, median angle rounded obtuse, caudal section of the ventral margin oblique arcuato-truncate, ventro-caudal angle broadly rounded obtuse. Tegmina and wings absent. Proximal abdominal segment with distinct lateral subcircular auditory tympani. Prosternal spine moderately elongate, erect, conical acute: interspace between the mesosternal lobes quadrate, smaller than one of the lobes; metasternal lobes narrowly separated caudad: surface of mesosternum and metasternum more or less shagreenous, the cephalic half of the mesosternum strongly and closely so. Disto-dorsal abdominal segment with the furcula represented by a pair of the merest nodes, between which the segment is moderately emarginate: supra-anal plate elongate trigonal, apex narrowly rounded, lateral margins with a weak shoulder at two-fifths the length from the base, surface with a broad medio-longitudinal sulcus on proximal half, a pair of inter-marginal, straight, converging impressions, which on account of the shoulder on the lateral margin are more removed from the latter proximad than distad, and the distal area enclosed by the impressions faintly elevated and its surface weakly impressed: cerci short, rather robust, when seen from the dorsum compressed, having the proximal half straight and the distal section directed obliquely meso-caudad, when seen from the lateral aspect having the proximal half deep and weakly narrowing distad, a short, blunt tooth present ventrad on the external face at the point of flexure of the cercus, the distal half narrowing to the blunt but acuminate apex, ventral margin of the distal half with a distinct, blunted but acuminate tooth, this much like the true apex in character: subgenital tooth simple, hardly produced, free margin distinctly emarginato-truncate mesad, the lateral angles being low nodes. Cephalic and median femora robust, inflated, the median ones particularly so. Caudal femora about twice as long as the head and pronotum together, moderately robust, the greatest width contained three and one-half times in the greatest femoral length; dorsal carina with a series of distinct, spaced serrations and an intercalated series of serrulations, ventral carina similarly but more decidedly armed, particularly distad; pagina evenly and deeply engraved; genicular lobes with the distal portion of the

ventral margin distinctly concave, apex bluntly acute-angulate: caudal tibiæ slightly shorter than the femora, moderately sinuate, faintly expanded distad; external margin with seven spines, internal margin with nine spines: caudal tarsi slender, elongate; metatarsus and second joint subequal in length to the third joint.

General color of the dorsum of the thoracic and proximal abdominal segments pale morocco red. General color of the head and abdomen oil yellow, on the occiput and postocular region of the head dull blackish green: venter aniline yellow; cephalic and median femora light cadmium, passing to pyrite yellow on the tibiæ; caudal femora sulphine yellow proximad, passing regularly to olive-green distad; caudal tibiæ and all tarsi olive-green; mesopleura with a decided subcircular spot of buff yellow at the base of the median femora. The clypeal suture and the ventral margin of the genæ are lined with black and the antennal fossæ washed with the same; antennæ of the color of the face proximad, passing to bay mesad and distad; eyes burnt sienna. Abdomen with the proximal segments margined with black, the median segments with paired circular to ovate black spots disposed along the median line; disto-dorsal abdominal segment lined with black next to the supra-anal plate, the extreme tip of the latter similarly blackened; cerci with the points black tipped. Caudal femora with the genicular arches black and a cloud of similar character crossing the base of the genicular lobes; caudal tibiæ with the spines black tipped.

Allotype: ♀; same data as type. [Acad. Nat. Sci., Phila.]

The characters here discussed are supplementary to those given for the male sex. Form very robust: sculpturing as in the male but more decided on the abdominal segments. Interocular width of the vertex slightly more than one-half the interantennal width of the frontal costa, weakly sulcate to bisulcate caudad: fastigium nearly twice as broad as long, cephalic bounding margin of the impresso-punctate surface, obtuse-angulate: frontal costa thickly impresso-punctate dorsad, faintly narrowed at junction with fastigium: eyes slightly less prominent than in the male, their length nearly twice that of the infra-ocular portion of the genæ: antennæ about one and one-half times as long as the head and pronotum together. Pronotum with the greatest caudal width of the disk slightly greater than the greatest length of the same, in transverse section arched: cephalic margin of pronotal disk hardly emarginate, caudal margin less distinctly emarginate than in the male; transverse carina well indicated but more delicate than in the male: lateral lobes slightly deeper in pro-

portion to the length than in the male. Prosternal spine more aciculate than in the male: interspace between the mesosternal lobes slightly transverse, subequal in width to one of the lobes; metasternal lobes separated caudad by a width equal to one-half that between the mesosternal lobes; surface of the sternum punctate instead of shagreenous. Abdomen distinctly carinate mesad to the penultimate segment: supra-anal plate subtectate in section, elongate trigonal in general form, distal section moderately produced caudad with the apex broadly rounded, proximal half with a distinct medio-longitudinal impression, laterad with distinct carinæ, which form the proximo-lateral point of the plate thence strongly converge to the median (longitudinal) section of the plate, represented distad by parallel rounded shoulders, ventro-laterad of which the plate is subcompressed: cerci short, broad at base, tapering, the apex blunted: ovipositor jaws moderately compressed, dorso-lateral margins of the dorsal valves faintly and irregularly crenulate. Cephalic and median limbs normal, not inflated as in the male, rather short. Caudal femora as in the male but differing in the ventral carina having smaller but more numerous teeth.

General color of head, thoracic and abdominal segments and cephalic limbs bay, shading to auburn in places, the venter passing to mummy brown. Fastigium sanford's brown; eyes bronzy argus brown; antennæ of the general color, paler proximad; clypeal suture black mesad and laterad, the paired black spots found on the fourth fifth and sixth segments in the male represented by smaller and weaker dots. Median limbs paler than the cephalic ones, more yellow ocher. Caudal femora bay with the dorsal face sanford's brown, the genicular arches black, the lobes blackish with a decided green tinge; caudal tibiæ and tarsi cedar green, the distal portion black, the spines black tipped.

Measurements (in millimeters).

	♂ (Type)	♀ (Allotype)
Length of body	17	21.4
Length of pronotum	4	4.3
Greatest dorsal (caudal) width of pronotal disk	3.5	4.7
Length of caudal femur	11.4	12.5

In addition to the type and allotype we have examined four male and two female paratypes. Of these one male bears an exact date, January 21, 1912. The series is quite uniform in coloration, shows

no noteworthy variation in structure and exhibits but a negligible amount in size. A single female from Peixe Boi, east of Pará, State of Pará, Brazil, (November to December, 1907; H. B. Merrill), in the collection of the Academy, is inseparable from the typical Igarapé-assú series.

TETTIGONIIDÆ.

Phaneropterinæ.

Ceraia capra n. sp. (Pl. II, figs. 36, 37.)

While we have only the female sex of this species its description is justified by the peculiar and unique form of the subgenital plate, and also by the ambisexual characters separating it from the allied species known only from the male. It is apparently nearest to *C. punctulata* and *dentata* Brunner, but from the former it differs in the annulate antennæ, in the lateral lobes of the pronotum being roundly inserted cephalad, in the greater number of spines on the ventral margin of the caudal femora, in the metasternal lobes being rounded instead of trigonal, in the ventral margin of the ovipositor being crenulate but a short distance distad, in the deeply fissate and bicorniform subgenital plate and in the somewhat greater size. From *dentata* the new form can be readily distinguished by the angulate instead of rotundate mesosternal lobes.

Type: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5310.]

Size moderately large; form well compressed; surface somewhat polished. Head moderately arcuate, weakly elevated dorsad of the general level of the pronotal disk; fastigium subhorizontal, narrow, compressed, particularly proximad, sulcate, the apex faintly bulbous, narrowly in contact with the compressed and slender facial fastigium; eyes but moderately prominent when seen from the dorsum, basal outline subcircular, the depth subequal to that of the infra-ocular portion of the genæ; antennæ broken. Pronotum with the disk deplanate dorsad, greatest caudal width of disk contained one and one-third times in the greatest length of the same; cephalic margin of disk emarginato-truncate, caudal margin strongly arcuate, forming more than the quadrant of a circle; lateral angles of disk rounded, broadly so cephalad, more narrowly so caudad; surface of disk hardly punctulate cephalad, median figure broadly U-shaped, deeply impressed; lateral lobes with their greatest depth distinctly greater than the greatest length, cephalic margin appreciably sinuate, ventro-cephalic angle very broadly arcuato-rotundate, ventral margin broadly rounded subrectangulate, ventro-caudal section

and ventral margin to shortly ventrad of the humeral sinus oblique arcuato-truncate, the infra-humeral section of the margin distinct obtuse-angulate, the humeral sinus rectangulate with the immediate angle rounded. Tegmina surpassing the apices of the caudal femora by about the length of the pronotal disk, in form somewhat elongate, lanceolate, the greatest width contained three and one-third times in the tegminal length; costal margin gently arcuate in distal half, nearly straight in proximal half, sutural margin distad of the anal field straight except for the oblique arcuato-truncate distal fifth, apex rotundato-rectangulate, situated nearer the costal than the main portion of the sutural margin; mediastine vein short, irregular, ramose; humeral and discoidal veins contiguous in proximal two-fifths; median vein diverging slightly proximad of proximal two-fifths of length, bifurcate, the rami reaching the sutural margin; ulnar vein straight except for brief distal arcuation; transverse nervures numerous and regular in discoidal field. Wings surpassing the tegmina in length by a distance nearly equal to the dorsal length of the pronotum, apex moderately acute. Prosternum unspined; mesosternum with the lobes rotundato-acute-angulate; metasternum with the lobes rounded laterad and caudad, hardly any caudo-median production indicated. Abdomen with the disto-dorsal abdominal segment faintly tectate in section, weakly produced mesad, with a distinct but not wide rectangulate emargination, which is bordered laterad by low, rounded, thickened areas of the margin reflexed toward the ventral surface; supra-anal plate reflexed, trigonal; cerci simple, crassate, tapering to delicate apices, gently arcuate; ovipositor slightly more than half again as long as the dorsum of the pronotum, regularly narrowing in depth distad, the proximal half moderately arcuate, distal half straight, the immediate apex obliquely subtruncate, the apex, distal portion of dorsal margin and apex of ventral valves serrulato-denticulate; subgenital plate elongate, compressed, fissate for about one-half its length, the resultant lateral lobes diverging and embracing the base of the ovipositor, each regularly tapering in width to the subaciculate apex. Cephalic and median femora unarmed beneath; cephalic tibiæ with four spines on the dorso-caudal margin; median tibiæ with five to six spines on the same margin. Caudal femora slightly more than two-thirds as long as the tegmina, robust in proximal half; genicular lobes short bispinose; ventro-external margin of caudal femora with eight short, flattened, sublamellate spines, ventro-internal margin with ten similar spines. Tarsi without arolia.

General color of the body and femora yellow ocher (doubtless changed from green by drying), the caudal section of the pronotum, tegmina (except for yellowish wash proximad) and tibiæ warbler green (Ridgway), becoming olive-green distad on the tegmina. Eyes chestnut brown; antennæ multiannulate with fuscous (only proximal portion of antennæ remaining). Tegmina with a longitudinally disposed series of small fuscous spots between the discoidal and median and ulnar veins, these placed one in each quadrate space and the series weaker proximad, distad not reaching the apex, a few weak scattered similar spots in the ulnar-anal area. Ovipositor with the margins edged with mummy brown; infra-cercal plates fuscous proximad. Cephalic tibiæ with foramina fuscous; tibial spines ochraceous, narrowly tipped with black; caudal femora with the vicinity of the bases of the ventral spines auburn.

Length of body (exclusive of ovipositor), 28.6 mm.; length of pronotum, 7.2; greatest (caudal) width of pronotal disk, 5.8; length of tegmen, 45.5; greatest width of tegmen, 10.4; length of caudal femur, 32.8; length of ovipositor, 11.3.

The type of this species is unique.

Parableta integricauda Brunner.

1878. *P[arableta] integricauda* Brunner, Monogr. der Phaneropt., p. 254, pl. V, fig. 78. [Ecuador; Surinam.]

Igarapé-assú. One male.

So far as we are able to determine from the description of this species the Igarapé-assú specimen belongs here. The eyes, however, are not black but auburn, while the tegmina show but two groups of purplish bordered spots along the ulnar vein. Each of these groups is composed of two distinct spots in contact with each other except for the separation of the vein, the sutural one in each case larger than the other.

The only previous exact records are from Coca (Bolivar) and Valley of Santiago (Giglio-Tos), Ecuador.

Scaphura sphex n. sp. (Pl. II, figs. 38–40.)

Allied to *S. nitida*, possessing the same polished surface of the body, tegmina and exposed portions of the wings, the distinctive translucence or even transparency of the tegmina, and form of the same, as well as the characteristic structure of the pronotum. The tegminal corrugations are similar in the two species. From *nitida*, *sphex* differs in the relatively broader tegmina, which are also yellowish hyaline except in the suffused distal fourth, in the wings being hyaline in the same proportion (when at rest) as the tegmina, in the less

thickly plumose proximal section of the antennæ, in the more prominent eyes, in the more slender limbs and in features of the coloration which need not be emphasized on account of color variability in the genus.

Walker's *Aganacris micans*[34] may be related, but the description does not mention the peculiar hyaline character of the tegmina and wings, the former of which is said to be black with a cupreous tinge, the latter blackish.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5303.]

Size medium: form compressed: surface highly polished, the head, ventral portion of the lateral lobes of the pronotum, venter, apex of abdomen and limbs with a greater or lesser amount of whitish pile. Head with the occiput rather strongly inflated, moderately declivent to the fastigium: fastigium but slightly produced, subcompressed, strongly declivent, acuminate when seen from the dorsum, the apex narrowly but strongly rounded, strongly sulcate, ventrad rather broadly in contact with the slightly acute fastigium of the face: median ocellus large; lateral ocelli large, ovate, separated by the fastigium alone: palpi elongate, slender, fifth joint slightly more than half again as long as the third joint: eyes large, prominent, ovate in basal outline, their depth about twice that of the infra-ocular portion of the genæ: antennæ incomplete, proximad moderately plumose. Pronotum short sellate, with the peculiar structural details found in *S. nitida*, when seen from the side the dorsum is strongly concave in cephalic half and deplanate caudad: greatest (caudal) width of the disk equal to about four-fifths the greatest length of the same; cephalic margin of the disk subtruncate, caudal margin strongly arcuate: transverse impression broad, rounded, its center at about cephalic fourth: lateral portions of disk in cephalic half strongly rounded into the lobes, caudad are present distinct angles, which are directed mesocephalad, these passing into the rounded portion; metazona of disk slightly impressed: lateral lobes of the pronotum with the greatest depth one and one-half times in the greatest length of the same; the transverse impression of the dorsum strongly continued on the lateral lobes, caudad of which the surface is somewhat bullate; cephalic margin of the lobes sigmoid, concave dorsad, convex ventrad, ventro-cephalic angle rounded obtuse, ventral margin arcuate oblique, ventro-caudal margin very broadly rounded, caudal margin slightly

[34] Catal. Dermap. Salt. Brit. Mus., V, p. 41, (1871).

oblique, sinuato-truncate, humeral sinus rectangulate. Tegmina surpassing the apices of the caudal femora by somewhat more than the length of the pronotal disk, of the peculiar crinkled character found in *S. nitida*, this being regular proximad in the discoidal field, irregular distad and in the costal field: greatest width of the tegmina at the distal fourth, contained nearly four and three-quarters times in the greatest length; costal margin straight arcuate, briefly arcuate proximad and in the distal fourth; apex well rounded, sutural portion of apex oblique subtruncate; sutural margin concavo-truncate: mediastine vein weak but distinct: humeral and discoidal veins not in contact; median vein diverging from the discoidal vein at the proximal third, bifurcate faintly before its middle; ulnar vein bi- or triramose: stridulating field with the free margin but faintly produced at the apex of the stridulating vein, distad of this gently arcuate; stridulating vein nearly transverse, greatly thickened, subfusiform; speculum greatly elongate, narrow, proximad of the stridulating vein the field is subcoriaceous. Wings projecting distad of the tegmina a distance less than the length of the disk of the pronotum, the apex narrowly rounded. Prosternum elevated in a V-shaped structure, unarmed: mesosternal lobes truncate laterad, rounded rectangulate disto-laterad: metasternal lobes narrow, obliquely arcuate. Disto-dorsal abdominal segment arcuate-emarginate laterad, the distal margin subtruncate mesad, a weak medio-longitudinal impression present: subgenital plate deflexed, trigonal: cerci simple, tapering, arcuate dorsad, the apices very briefly spiniform: subgenital plate narrow, produced, attenuate mesad, projecting almost to the tips of the cerci, the distal margin strongly arcuate-emarginate; styles short, articulate. Limbs slender: cephalic femora subcompressed, moderately deep; cephalic tibiæ with the tympana large, reniform: caudal femora nearly two-thirds as long as the tegmina, moderately inflated proximad, very slender distad, ventro-external margin with six to nine, ventro-internal margin with four spines.

General color shining blue black, the pubescence of the body and limbs white, the plumosity of the antennæ black. Head with a pair of infra-ocular lines of hazel, the clypeus and labrum marked with the same to ochraceous-buff: palpi incompletely lined dorsad with ochraceous-buff: eyes cinnamon-brown. Pronotum with the ventral portion of the lateral lobes narrowly margined with naples yellow. Tegmina faintly buffy hyaline in the proximal three-fourths, distal fourth strongly washed with blackish fuscous; humeral, discoidal, ulnar and anal veins and rami prominently lined with walnut brown

to blackish fuscous; stridulating field similar in tone to the discoidal three-fourths of the tegmina; stridulating vein broadly black, opaque area proximad of same bright mustard yellow; bordering veins of speculum lined with fuscous, first axillary distad with dragon's-blood red, second with black. Wings with base tint as in tegmina, the veins lined with russet. Metapleura marked dorso-laterad with two points of mustard yellow. Abdomen with two proximal segments with paired dots of mustard yellow on dorsal surface. Coxal region marked more or less strongly with the same color. Venter of abdomen obscurely buffy. Median femora faintly and brokenly lined with mustard yellow on cephalic surface; caudal femora at proximal fourth with sublunate spot on mustard yellow on dorsal face.

Length of body, 16.2 mm.; length of pronotum, 4; greatest width of pronotal disk, 3.2; length of tegmen, 24; greatest width of tegmen, 5.2; length of caudal femur, 15.5.

The type of this striking and remarkable mimetic species is unique. The resemblance of it to certain sphecoid wasps is most extraordinary, and suggested the specific name.

Stilpnochlora marginella (Serville).

1839. *Phylloptera marginella* Serville, Hist. Nat. Ins., Orth., p. 405. ["Cape of Good Hope."]

Igarapé-assú. One male.

For comments on this species and close relatives, see a recent summary by the author.[35]

Anaulacomera nodulosa Stål.

1873. *A[naulacomera] nodulosa* Stål, Öfvers. K. Vetensk.-Akad. Förhandl., XXX, p. 43. [Surinam.]

Igarapé-assú. January 17 and February 1, 1912 (two specimens). Four males, four females.

These specimens are referred to Stål's species with some uncertainty, as they are all larger than Stål's measurements, although certain individuals are comparable with the dimensions given by Brunner for the species. The species much resembles *A. albonodulosa*, but has the fastigium proportionately shorter and thicker, the pronotum shorter, the cerci briefer and not completely curved and the tegminal venation coarser.

The species has been definitely recorded from Surinam (also Paramaribo) and Chapada, Matto Grosso, Brazil.

Viadana myrtifolia (Linnæus).

1758. [*Gryllus* (*Tettigonia*)] *myrtifolius* Linnæus, Syst. Nat., X ed., p. 429. [Surinam.]

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[35] Entom. News, XXVIII, pp. 107 to 113, (1917).

Igarapé-assú. One female.

A male from Paramaribo, Surinam, (K. Mayo), in the collection of the Academy of Natural Sciences, is specifically identical with the Igarapé-assú female.

The species has been recorded from Surinam, Cayenne and Pará, Brazil.

Coelophyllum[36] **coriaceum** (Pictet).

1888. *P[rosagoga] coriacea* Pictet, Mém. Soc. Phys. Hist. Nat. Genève, XXX, No. 6, p. 9, pl. 1, figs. 2, 2a. [Guiana.]

Igarapé-assú. January 17, 1912. One female.

This is, apparently, the first record of the species since the original description.

Coelophyllum rectinerve (Brunner).

1891. *Prosagoga rectinervis* Brunner, Verh. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 170, 171. [Upper Amazonas.]

Igarapé-assú. One male, one female.

We have before us another female from Chanchamayo, Peru, which fully agrees with the Igarapé-assú individuals. The male is faintly smaller than the original measurements for that sex, but otherwise the specimens are in complete accord with the description.

The range of the species is now known to extend from the upper reaches of the Amazon to its mouth.

Pseudophyllinæ.

Acanthodis aquilina (Linnæus).

1758. [*Gryllus* (*Tettigonia*)] *aquilinus* Linnæus, Syst. Nat., X ed., p. 430. ["Indiis."]

Pará. (C. F. Baker.) One male.

This specimen is inseparable from an individual of the same sex from Cayenne, determined and presented to the Academy by Saussure. The species is known from localities extending from the mouth to the upper portion of the Amazon, north to the Guianas and Venezuela (Meridá).

Leurophyllum consanguineum (Serville).

1839. *Acanthodis consanguinea* Serville, Hist. Nat. Ins., Orth., p. 454. [Unknown locality.]

Pará. (C. F. Baker.) One male, one immature male.

This species is known to range from southeastern Brazil north to Cayenne, west to eastern Ecuador.

Leurophyllum maculipenne (Serville).

1839. *Platyphyllum maculipenne* Serville, Hist. Nat. Ins., Orth., p. 447. [Brazil.]

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[36] See Rehn, Entom. News, XXVIII, p. 152, (1917).

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. January 29, 1912 (one specimen). Three females.

This striking and beautiful species is well distributed over the Amazonian and Guianan regions.

Bliastes submarginatus (Walker).

1870. *Meroncidius submarginatus* Walker, Catal. Spec. Derm. Salt. Brit. Mus., III, p. 450. [Pará, Brazil.]

Pará. (C. F. Baker.) One female.

Kirby has placed *Bliastes limbatus* Brunner, described from Pará, as a synonym of *submarginatus* [37], with which action we fully agree. In the present specimen the caudal genicular lobes of the median femora are spined, and the spines on the ventro-cephalic margin of the cephalic and median femora number three instead of four as described by Brunner.

Teleutias aduncus Stål.

1874. *T[eleutias] aduncus* Stal, Recens. Orth., II, p. 88. [Unknown locality.]

Pará. (C. F. Baker.) One male.

This specimen fully agrees with the original description and the later one by Brunner. This is the first exact locality known for the species, which was recorded by Brunner from Upper Amazonia.

Diophanes salvifolium (Lichtenstein).

"1796. *Locusta salvifolia* Lichtenstein, Catal. Mus. Hamburg, III, p. 82."

Pará. (C. F. Baker.) One female.

This specimen has the wings with a complete but narrow distal and peripheral edging of whitish, while the hyaline character of the interspaces of the axillary and radiate fields of the wings is very pronounced.

Copiphorinæ.

Copiphora cornuta (DeGeer).

1773. *Locusta cornuta* DeGeer, Mem. Hist. Ins., III, p. 441, pl. 37, fig. 7. (Surinam.]

Pará. (C. F. Baker.) One male.

Igarapé-assú. One female.

These specimens are fully typical of the species, except that the dorso-caudal margin of the median tibiæ bear four to five spines in the Pará individual and five in that from Igarapé-assú. The presence of but three spines on this margin has been considered diagnostic of this species by Karny, but reliance cannot be placed on the number of marginal spines in this instance as in many others, the material before us showing sufficient variation to nullify the

[37] Synon. Catal. Orth., II, p. 331, (1906).

diagnostic value of this feature. We have also before us for study a pair from Paramaribo, Surinam (K. Mayo) and a female from Bartica, British Guiana (March 25, 1913; H. S. Parish), all belonging to the Academy. The five specimens show there is a very decided amount of variation in the intensity of the tuberculation of the fastigium, but all are clearly referable to the same species. Both Guianan females have three spines on the dorso-caudal margin of the median tibiæ, while the Paramaribo male has three spines on this margin on one limb and four on the other.

The species has already been recorded from Pará by Walker and Bruner.

Acantheremus elegans Karny.

1907. *Acantheremus elegans* Karny, Abhandl. k.-k. zool.-botan. Gesell. Wien, IV, heft 3, p. 9, fig. 1. [Surinam.]

Pará. (C. F. Baker.) One female.

This specimen fully agrees with the original description of the species, differing only in the slightly greater size of the specimen before us.

Neoconocephalus nigropunctatus (Redtenbacher).

1891. *Conocephalus nigropunctatus* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 380, 391, pl. III, fig. 32. [Upper Amazon; Brazil; Surinam; Cuba; Cayenne.]

Pará. (C. F. Baker.) Three males, one female.

Benevides, Pará. (H. H. Smith.) Two males. [U. S. N. M.]

Contamano, Rio Ucayali, Peru. October to December, 1912. One male, two females.

The Contamano specimens have been immersed in a liquid preservative and in consequence all have lost their original coloration, but they are identical with the Pará male, and all fully agree with the original description.

Bruner has recorded[38] the species from Pará and Benevides.

Neoconocephalus fratellus (Griffini).

1891. *Conocephalus frater* Redtenbacher (not of Kirby, 1890), Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 381, 399. [Cuba; St. Vincent, Lesser Antilles; Trinidad; Brazil; Upper Amazons.]
1899. *Conocephalus fratellus* Griffini, Misc. Entom., VII, p. 5. (New name.)

Pará. (C. F. Baker.) One male.

The tegmina are appreciably shorter in this specimen than the measurements given for those of the same sex by Redtenbacher; otherwise the specimen is typical.

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[38] Ann. Carneg. Mus., IX, p. 392, (1915).

Homorocoryphus cocanus (Bolivar).

1881. *Conocephalus cocanus* Bolivar, Anales Soc. Españ. Hist. Nat., X, p. 497. [Coca, Ecuador.]

Pará. (C. F. Baker.) Three males, two females.

Pará. (Thayer Expedition.) One female. [M. C. Z.]

These specimens have been compared with a male from Chanchamayo, Peru, in the collection of the Academy, and found to be inseparable.

The species was recorded from Cayenne by Redtenbacher.

Homorocoryphus brunneri (Redtenbacher).

1891. *Conocephalus brunneri* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 385, 423. [Theresopolis, Brazil; Upper Amazons; Buenos Aires and Rosario, Argentina; "Yalapa."]

Igarapé-assú. One female.

Listroscelinæ.

Phlugis marginata (Redtenbacher).

1891. *Thysdrus marginatus* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 534, 537. [Upper Amazonia.]

Pará. (C. F. Baker.) One female.

This specimen, the first known from an exact locality, fully agrees with the original description, except that the caudal femora are slightly shorter.

Phlugis chelifera n. sp. (Pl. II, figs. 41–43.)

Closely related to *P. abnormis* (Redtenbacher),[39] from Retalulen,[40] but differing in the somewhat smaller size; in the male cerci being quite short, not a quarter as long as the subgenital plate; in the internal projection of the paired processes of the disto-dorsal abdominal segment of the male being flattened, vertical, decurved plates, instead of spiniform; and in the subgenital plate of the same sex having the expanded distal section proportionately shorter and more sharply expanded, the proximal angle of the dorsal margin of the expansion slightly recurved acute, and in the vertical margin of the same section, when seen from the side, being distinctly indented proximad.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5321.]

Size medium (for the genus): form subcompressed. Head well seated in the pronotum: occiput and interocular space moderately

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[39] Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 534, 538, pl. IV, fig. 95.

[40] This is apparently an error of transcription for Retahluleu, western Guatemala. Karny was apparently unable to place the locality quoted, and we also have been unable to secure any information concerning it. We feel confident, however, that "Retalulen" is an error for Retahluleu.

declivent cephalad; interspace between the eyes equal in width to one of the eyes, this area supplied with a median impressed point: fastigium of medium width, bilobate and angularly reflexed: face moderately retreating, broadly deplanate: eyes as prominent as usual in the genus, strongly projecting cephalad, when seen from the side the form is ovoid: antennæ surpassing the body in length; proximal joint strongly inflated; second joint moderately inflated. Pronotum of the type usual in the genus, distinctly elongate, metazona well produced, greatest width of the pronotum contained twice in the greatest length of the same: cephalic margin of disk shallowly arcuate-emarginate, caudal margin strongly arcuate; principal sulcus deeply impressed; metazona equal to two-fifths the length of the whole disk; a fine medio-longitudinal impressed line present caudad on the disk; three incomplete transverse sulci indicated on the prozona: lateral lobes two and one-half times as long as their depth, the margin arcuate from the cephalic margin of the disk to the very shallow humeral sinus, faintly flattened ventro-cephalad, caudal margin in general oblique subtruncate from the sinus to the arcuate caudal margin of the disk. Tegmina with length slightly exceeding that of the body, narrow, the greatest width contained over seven times in the length: margins in general straight, subparallel; apex rather narrowly rounded, sutural in position: discoidal vein straight, oblique, joining the costal margin at about its proximal third; number of rami in the marginal field sixteen, these straight and weakly oblique in trend; ulnar vein triramose distad; transverse nervures straight, weakly oblique, in general evenly spaced: tympanal field largely covered by the pronotal extension. Wings surpassing the tegminal apices by half the length of the tegmina, moderately acuminate. Penultimate disto-dorsal abdominal segment large, subcucullate, distal margin broadly arcuato-angulate, the mesal portion of the margin with an overlapping transparent bisinuate lamellation, visible only under fair magnification: disto-dorsal abdominal segment vertical, largely under the penultimate segment, roundly depressed mesad, roundly elevated disto-laterad; free margin with a median very deep U-emargination, laterad of which are paired V-emarginations of subequal depth, the processes between the three emarginations compressed, subfalciform, with their apices subacute and directed ventrad; laterad of the lateral emarginations the segment is produced into subconchate projections, which have a thickened ridge along their dorsal margin and are distinctly concave ventrad, when seen from the side the projections are spatulate, angulato-arcuate

dorsad and distad, narrowly rounded disto-ventrad, sigmoid ventrad: supra-anal plate well hidden, acute-angulate in form: cerci very short, simple, styliform, faintly sinuate, apex blunt: subgenital plate of the elongate, specialized type found in the genus, compressed; when seen from the side the plate is narrowed at the distal third, thence strongly compressed, the dorsal margin arcuate-emarginate with the dorsal angle acute produced; distal margin oblique sinuato-truncate, the disto-ventral angle produced, bluntly angulate, ventral margin angulato-arcuate; when seen from the venter the plate is regularly narrowing distad, the proximal half with a distinct median carina, the distal half narrowly fissate, the apex of the fissure narrowly broadened; when viewed from the dorsum the branches of the plate are seen to be thickened and inflated from the basal excavation of the plate to the disto-dorsal angle, or in the section which is arcuate-emarginate when seen from the side. Cephalic femora with three spines on the ventro-cephalic margin and four on the ventro-caudal margin; cephalic tibiæ with five spines on each ventral margin exclusive of the apical ones. Median femora unspined on margins; median tibiæ with two spines on the ventro-cephalic margin. Caudal femora of the usual type, with nine very small spines on the ventro-external margin and six of the ventro-internal margin.

General color honey yellow, the wings weakly washed with chamois, parts of the head, lateral lobes of the pronotum and limbs tending toward clay color. Eyes walnut brown.

Length of body, 12.4 mm.; length of pronotum, 3.3; greatest width of pronotum, 1.6; length of tegmen, 12.4; greatest width of tegmen, 1.6; length of caudal femur, 9.1.

In addition to the type we have before us four paratypic males, all from Bartica, British Guiana (H. S. Parish; March 6, 24 and 26; April 15, 1913), in the collection of the Academy. These specimens are all slightly larger than the type, but otherwise inseparable. The number of rami in the costal field of the tegmina ranges from fifteen to eighteen. In these specimens the coloration, particularly of the exposed portion of the wings and distad on the tegmina, is strongly approaching cosse green, the limbs also in part washed with weak javel green.

Phlugiola redtenbacheri Karny.

1911. *Phlugiola redtenbacheri* Karny, Abhandl. k.-k. zool.-botan. Gesell. Wien, IV, heft 3, p. 20. [Surinam.]

Branganza, State of Pará. (Miss H. B. Merrill.) One female. [A. N. S. P.]

This specimen fully agrees with the original description and figure. As far as we are aware the two localities given above are all those known for this striking and peculiar genus and species.

Agroeciinæ.

Paralobaspis personata n. sp. (Pl. II, figs. 44, 45.)

Differing from *P. picta*,[41] from Ecuador, the genotype and only previously described species of the genus, in the shorter pronotum and shorter and more arcuate ovipositor, the much shorter tegmina, in the coloration of the mouthparts and the face, the latter being solid black in the present species, in the face being almost without impressed punctations, in the generally unicolorous pronotum, in the unicolorous prosternal spines, in the more unicolorous limbs and in the fewer spines on the ventro-cephalic margins of the cephalic and median femora.

Type: ♀; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5322.]

Size medium: form relatively robust, subcompressed: surface smooth. Head with the exposed dorsal length slightly less than one-half as long as the dorsum of the pronotum, ventral portion of head quite broad, narrowing dorsad: fastigium as characteristic of the genus, its plane in general continuous with the occipital line, the apex with a slightly decurved spine, the general direction of which is cephalad, cephalic margin of the fastigium ventrad of the spine distinctly compressed and carinate: paired ocelli subtrigonal in form, median ocellus small, in general circular: face with the very faintest and very sparsest type of punctation: eyes moderately prominent, irregularly subcircular in basal outline, slightly flattened cephalad and even more weakly so ventro-caudad: antennæ over twice as long as the body; proximal joint with the projection on the disto-internal face rounded dentiform. Pronotum with its dorsal line straight when seen from the side, in transverse section moderately arcuate dorsad, rounding broadly into the lateral lobes: disk of pronotum quite narrow on the cephalic half of the pronotum, moderately expanding on the metazona, cephalic margin of disk with the faintest possible arcuate emargination, caudal margin of disk regularly arcuate; principal transverse sulcus weakly impressed, placed mesad, prozona crossed at its middle by a more decidedly impressed arcuate sulcus, which is weak mesad: lateral lobes of the pronotum twice as long as deep; cephalic margin of the lobes straight oblique, regularly rounding at the ventro-

[41] Boll. Mus. Zool. Anat. Comp. Torino, XIII, No. 311, p. 89, (1898).

cephalic angle into the oblique, but more nearly horizontal, weakly sinuate ventral margin, ventro-caudal angle roundly obtuse, caudal margin oblique, in general straight, with a broad though shallow humeral sinus; surface of lateral lobes moderately undulate, having one center of elevation or "boss" on the prozona, the other in the position of similar structures in the Conocephalinæ. Tegmina slightly surpassing the apices of the caudal femora, subequal in width, the greatest width contained nearly six times in the length: costal margin straight except for short arcuations proximad and distad, sutural margin straight, apex rounded: principal venation simple; median vein diverging distad of the middle of the discoidal vein; reticulations in general irregular, the transverse nervures clearly defined only in the proximal portions of the marginal and discoidal fields. Wings reaching to the apices of the tegmina. Prosternal spines elongate, aciculate, weakly recurved, parallel: mesosternal lobes narrow, very acute, the apices weakly spiniform: metasternal lobes weakly obtuse-angulate, the angle briefly spiniform. Disto-dorsal abdominal segment with an impressed, medio-longitudinal crease, the free margin being produced each side of this into subspiniform projections, supra-coxal sections of the margin broadly and shallowly arcuato-emarginate: cerdi tapering, with the apices rather sharply aciculate, gently arcuate when seen from the side: ovipositor moderately falcate, in length almost equal to twice the length of the pronotal disk, greatest depth of the ovipositor mesad; dorsal margin of ovipositor very faintly curved in distal two-thirds, ventral margin of same regularly arcuate, apex acute: subgenital plate in general trigonal, the margin having a distinct angulate sinuation each side of the median V-emargination. Cephalic femora subequal to the pronotum in length, the ventro-cephalic margin with two spines distad: median femora with three to four spines in the same position on the same margin; all genicular lobes spined excepting the caudal ones of the cephalic femora. Caudal femora about three-fourths as long as the tegmina, robust proximad, narrowed distad, ventro-external margin with eight spines.

General coloration clay color to ochraceous-buff, the abdomen approaching buckthorn brown, the dorsal aspect of the head and pronotum tinted with the same. Head with a large, solid facial area of moderately shining black, which dorsad involves all of the fastigium excepting its dorsal surface, the proximal antennal joint and the entire face, the black area expanding ventrad from as wide as the space between the ventro-cephalic section of the eyes to wider than that

between the latero-proximal angles of the clypeus, extending caudad as broad lines along the juxta-mandibular portion of the genæ, and as three distinct dorso-ventral bars on the proximal half of the clypeus, one median, the others marginal: mandibles largely zinc orange: eyes dresden brown: antennæ yellow ocher, becoming ochraceous tawny distad, with well-spaced annuli of mummy brown, these more closely placed proximad than distad, the same section of the antennæ with the individual joints marked off by narrow shadow annuli of mummy brown; ventral surface of second article barred transversely proximad and distad with mummy brown. Pronotum with a pair of obliquely disposed spots of mummy brown laterad on the rounded shoulder at the cephalic fifth; pair of similar but very much weaker spots are placed immediately caudad of the transverse sulcus, the four spots having a cruciform disposition; area of the median impression washed faintly with mummy brown. Tegmina with their base color mummy brown, the venation, primary and secondary, forming a meshwork of warm buff to light buff. Wings infumate. Ovipositor sanford's brown. Limbs ochraceous-buff, the femoral spines (marginal) fuscous, with a fuscous spot surrounding the base of each, apices of the caudal femora infuscate; external face of the caudal femora with an oblique patterned area of fuscous, consisting of two long lines and portions of a number of generally transverse, briefly arcuate, lines: cephalic tibiæ with a fuscous patch on each face immediately distad of the foramina, the distal extremity also narrowly infuscate; median tibiæ with similar areas in similar positions; caudal tibiæ marked with fuscous proximad and distad, all tibial spines tipped with fuscous, those of ventral surface with fuscous surrounding their bases.

Length of body (exclusive of ovipositor), 20 mm.; length of pronotum, 6.3; greatest width of pronotal disk, 3; length of tegmen, 19.8; greatest width of tegmen, 3.2; length of caudal femur, 14.5.

The type of this most interesting species is unique.

Gryllacrinæ.

Gryllacris harpistylata n. sp. (Pl. II, figs. 46, 47.)

Allied to *G. lævigata* Brunner,[42] but differing in the paired productions of the disto-dorsal abdominal segment being closely placed mesad and spiniform, the whole segment more produced mesad, in the cerci being reduced to brief styliform appendages, in the subgenital plate being large, moderately produced and having greatly

[42] Verhandl. k.-k. zool.-botan. Gesell. Wien, XXXVIII, pp. 321, 344, pl. VIII, fig. 41c. [Upper Amazonia.]

elongate and recurved, hook-like, acute styles, in the smaller general proportions, but actually longer tegmina and wings, in the fewer spines on the ventral margin of the caudal femora, in the restriction of the infuscation of the head to the occiput and fastigium, and in the pronotum being broadly bivittate with fuscous.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5323.]

Size medium: form as usual in the genus, with greatly developed tegmina and wings: surface moderately polished. Head broad, strongly transverse, the face markedly flattened, in fact slightly impressed: occiput strongly arcuate transversely, in side view regularly rounding over the vertex into the face: vertex broad, about one and one-half times as wide as proximal antennal joint, lateral margins subparallel; lateral ocelli ovate, rather small, median ocellus large, elliptical: eyes rather prominent, weakly projecting dorsad, in basal outline elongate-ovoid: antennæ imperfect, at least surpassing the apices of the tegmina and wings, heavy, brittle: third palpal joint moderately arcuate when seen from the side; fourth joint slightly longer than the third joint, straight, tapering proximad in the proximal half, distal half subequal in width, rather narrow; fifth joint slightly longer than the fourth joint, faintly enlarging distad. Pronotum transverse, in general form strongly rounded transversely: cephalic margin of dorsum faintly arcuate produced mesad; caudal margin arcuate laterad, shallowly and broadly arcuato-emarginate mesad; all margins more or less distinctly cingulate: transverse sulci two in number, the cephalic one placed close to the cephalic margin, being intermarginal and deeply impressed on the lateral lobes, the caudal one placed a short distance cephalad of the caudal margin, on the dorsal surface being broadly obtuse-angulate in form, on the lateral lobes carried regularly and straight ventro-cephalad, joining the cephalic transverse sulcus; intervening area, area of humeral shoulders and caudal section of lateral lobes moderately bullate; a medio-longitudinal impressed area is indicated on the middle of the dorsum: lateral lobes of the pronotum subrectangulate in general form, cephalic margin of the lobes straight dorsad, curving through the rounded ventro-cephalic angle into the weakly oblique cephalic two-thirds of the ventral margin, this rounding into the reversed oblique, short caudal third of the same margin, ventro-caudal angle obtuse, caudal margin straight, no humeral sinus present. Tegmina distad becoming coriaceous and pilose, about one and two-thirds times as long as the body, broad, the greatest width at distal fourth and con-

tained but slightly more than three times in the greatest tegminal length; costal margin strongly arcuate in proximal eighth, thence broadly and very shallowly arcuate emarginate to distal third, thence regularly and broadly arcuate to the rounded obtuse-angulate apex; sutural half of distal margin oblique rotundato-truncate, rounding into the sutural margin, which is broadly arcuate, flattened and straight mesad. Wings faintly surpassing the apices of the tegmina, the distal sections as coriaceous and pilose as the tegmina. Prosternum unspined; meso- and metasternal lobes small, rounded laterad. Disto-dorsal abdominal segment large, half domed, dorsal surface with a pair of lateral patches of long pile, a medio-longitudinal impressed cuneiform area placed on the distal half, the free margin mesad supplied with a closely placed pair of slender processes, which when seen from the side are tapering, sinuate, with a recurved apex, these processes reaching as far caudad as the apex of the subgenital plate and their bases placed on each side of the median impression of the segment: cerci simple, tapering, weakly depressed, incomplete in the type, sparse pilose: subgenital plate strongly produced in median linguiform development which is flattened, clothed with long pile and laterad of the base of which spring styles of a most striking type; these being greatly produced, tapering, straight in their distal third, thence regularly arcuate dorsad and mesad, with the apex moderately decurving and produced in a distinct apical spine, the whole of the styles long pilose; the right style is simple, the left is compound, having a dorsal branch forking from the main style near its base, faintly more than one-half as long as the main branch, following the principal arm in attenuation and curve but with an unarmed apex. Cephalic and median femora unarmed beneath; cephalic and median tibiæ with three spines distad on each ventral margin. Caudal femora short, robust, weakly tapering distad, ventro-external margin with four to six spines, ventro-internal margin with three large distal and four minute proximal spines; caudal tibiæ with three external and four internal spines on the dorsal margin.

General coloration between ochraceous-buff and zinc orange, a broad V-shaped patch dorsad between the eyes and a pair of broad sinuate bars on the pronotum at the usual position of the lateral shoulders and also covering the dorsal half of the lateral lobes, bone brown. Eyes blackish fuscous. Tegmina colorless, semi-transparent proximad on marginal and discoidal fields and translucent washed with pale mummy brown distad; venation pencilled with prout's brown, except immediately at the base of the tegmina, where

it is of the general color; anal field weakly suffused and venation heavily pencilled with bone brown. Wings with the venation weakly pencilled with prout's brown. Disto-dorsal abdominal segment with the paired pilose areas touched with kaiser brown, the paired process of the same segment blackish fuscous; femoral and tibial spines tipped with chestnut brown.

Length of body, 18 mm.; length of pronotum, 3.6; greatest width of pronotum, 4.2; length of tegmen, 29.5; greatest width of tegmen, 9.5; length of caudal femur, 9.6.

The type is unique.

Gryllacris cruenta Brunner.

1888. *Gryllacris cruenta* Brunner, Verhandl. k.-k. zool. botan. Gesell. Wien, XXXVIII, pp. 321, 345. [Upper Amazonia.]

Pará. (C. F. Baker.) One female.

This scarce and striking species has been recorded by Griffini, on the basis of a male, from Paramaribo, Surinam.[43] His specimen showed certain differences from the original description, but these he considered to be individual. Our specimen also shows certain differences, but these are only in part those noted by Griffini. Our specimen has the coloration much like that given in the original description, less like that given by Griffini as far as the head and pronotum are concerned. The caudal femora have nine to ten spines on the ventro-internal margin instead of three to four as described, and eight as given by Griffini, while the external margin has seven to eight spines seven are given in the original description and six by Griffini. The caudal tibiæ have five spines on each dorsal margin instead of five internal and seven external as originally described, and six external and five to six internal as described by Griffini. It is evident there is considerable variation individually in the number of these spines and their diagnostic value must not be overrated. The present specimen is slightly smaller than the original measurements of the female, except that the ovipositor is of exactly the same length.

GRYLLIDÆ.

Gryllotalpinæ.

Scapteriscus didactylus (Latreille).

1804. *Gryllotalpa didactyla* Latreille, Hist. Nat. Gen. Crustac. et Ins., XII, p. 122. [Cayenne; Surinam.]

Paramaribo, Surinam. (K. Mayo.) Two females.

Pará. (C. F. Baker.) One female. (Thayer Expedition.) One female. [M. C. Z.]

Igarapé-assú. January 17 (1) and 23 (1), 1912. Five females.

[43] Ann. Mus. Nat. Hungar., XII, p. 249, (1914).

These specimens all represent the long and narrow headed type of the *didactylus-camerani* group. We have no Brazilian material of this species in the collections before us other than those listed above, and it seems quite probable that some of the older records of this species, particularly those of its occurrence at points far removed from the Guianan region, may relate to *camerani* or other species. We have material and records showing the occurrence of *camerani* over the upper and middle Amazonian regions.

The present series shows great size variation, the extremes in the Igarapé-assú series being very great.

Ripipteryx circumcincta Saussure.

1874. *Rhipipteryx circumcincta* Saussure, Miss. Scient. Mexiq., Rech. Zool., VI, p. 358. [South America.]

Pará. (C. F. Baker.) One female.

Igarapé-assú. December, 1911 and January 17, 1912 (two specimens with dates). Four males, thirteen females.

This series is quite uniform in coloration and size. The only exact records we have for the occurrence of this species are those of Bruner of material from Benevides and Pará, State of Pará, Brazil.

Gryllinæ.

Hygronemobius albipalpus (Saussure).

1877. *N[emobius] albipalpus* Saussure, Mélang. Orthopt., II, fasc. V, p. 257. [Rio de Janeiro, Brazil.]

Igarapé-assú. January 17 to 23, 1912. Seven males, fourteen females.

These specimens have been recorded by Hebard in his study of the genus.[44]

Nemobius brasiliensis (Walker).[45]

1869. *Argizala brasiliensis* Walker, Catal. Dermapt. Salt. Brit. Mus., I, p. 61. [Brazil; Santarem, Brazil.]

Igarapé-assú. One male.

This widely distributed and striking species has been recorded from as far south as Paraguay and north to Mexico.

Hemigryllus ortonii (Scudder).

1869. *Nemobius ortonii* Scudder, Proc. Boston Soc. Nat. Hist., XII, p. 330. [Napo or Marañon (Rivers).]

Pará. (C. F. Baker.) One female.

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[44] Entom. News, XXVI, p. 198.

[45] We find that Bruner's *Nemobius argentinus*, recently described from Carcaraña, Argentina (Ann. Carneg. Mus., X, p. 371, (1916)) is identical with the present author's *Nemobius hebardi*, from Buenos Aires and the Misiones, Argentina, described over a year previous (Proc. Acad. Nat. Sci. Phila., 1915, p. 290, figs. 4 and 5, (1915)).

Piexe Boi, east of Pará. November to December, 1907. (H. B. Merrill.) One female.

Igarapé-assú. January 17 and 23, 1912 (two individuals only with dates). Two males, five females.

We have already resurrected and correctly placed this specific name,[46] which antedates Saussure's *kreichbaumeri*, the designation under which this species has been universally reported in the literature. There is some variation in size in individuals of the same sex, but the diagnostic features are always well marked.

Anurogryllus muticus (DeGeer).

1773. *Gryllus muticus* DeGeer, Mém. Hist. Ins., III, p. 520, pl. 43, fig. 2. [Surinam.]

Pará. (C. F. Baker.) One female.

Igarapé-assú. Two females.

The Igarapé-assú specimens are quite different in size, but this is not unusual in the species. The Pará individual is appreciably paler than the Igarapé-assú representatives, being more ferruginous and less fuscous. The three specimens examined all have caudate wings.

APHEMOGRYLLUS[47] new genus.

Related to *Miogryllus* Saussure, differing in the elongate and slender limbs, in the elongate metatarsus of the caudal limbs, in the great reduction in size of the ventral pair of distal spurs of the caudal tibiæ, in the striking disposition of the venation of the lateral field of the tegmina in both sexes, in the greater (♂) or lesser (♀) strangulate character of the entire pronotum and in the tegmina of the male sex having no speculum present and the stridulating area very simply developed.

Generic Description.—Head broader than the pronotum: interantennal portion of face subequal to greatest width of a single antennal scrobe, this area rounded in profile: eyes heptagonoid-ovate in outline, little prominent. Pronotum broader than long, distinctly (♂) or appreciably (♀) strangulate: lateral lobes distinctly longer than deep, the ventral margin obliquely arcuato-truncate. Tegmina of male with dorsal field but weakly developed as a stridulating area, no speculum present; lateral field with two veins in addition to the mediastine vein, these diverging from the base and widely spaced: tegmina of female with venation of lateral field as in male, venation of dorsal field simple. Cephalic tibiæ with a decided;

[46] Trans. Amer. Entom. Soc., XLIII, p. 128, (1916).
[47] From *a*, *without*; *ψηφη voice* and *Gryllus*.

large, external foramen and a small internal one of variable exact size and indication. Caudal tibiæ with each dorsal margin armed with four to five spines; distal spurs of caudal tibiæ three in number on each side, the median the longest in each group, ventral spur on each side short, the two subequal in length: caudal metatarsus elongate, over twice as long as the remaining tarsal joints, dorsal surface armed the whole length of the external margin and distad on the internal margin, internal apical metatarsal spur over one-half as long as third tarsal joint. Ovipositor shorter than caudal femora, straight, apex acuminate, dorsal valves surpassing ventral ones.

Aphemogryllus gracilis n. sp. (Pl. II, figs. 48–53.)

Type: ♂; Igarapé-assú, State of Pará, Brazil. February 6, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5327.]

Size small: form much like species of *Nemobius:* surface moderately polished. Head distinctly broader than the pronotum, moderately inflated: occiput strongly and regularly declivent from its caudal section to the interantennal protuberance; latter region but slightly wider than a single antennal scrobe, well rounded when seen from the side, its lateral margins faintly converging ventrad: ocelli disposed in a broad, depressed triangle, relatively large: palpi relatively short, robust, compressed; forth joint of same subequal to the third, slightly expanding; fifth joint distinctly compressed mesad, gradually expanding distad, the apical margin strongly oblique truncate: antennæ at least as long as the body. Pronotum strangulate when compared with the head, the greatest width about one and one-half times the greatest length: cephalic margin truncate, caudal margin feebly bisinuate, both margin strongly hirsute, the surface of the pronotum with many short, adpressed hairs; a fine medio-longitudinal sulcus present, which becomes weaker caudad: lateral lobes subquadrate, the ventral margin moderately arcuate ascendent caudad, the ventro-cephalic angle broadly rounded, the ventro-caudal obtuse. Tegmina well developed but falling slightly short of the apex of the body; apex well rounded: lateral field relatively broad; mediastine vein simple, preceded by two free veins, these diverging from an identical point near the base of the tegmen, the space between the vein itself and the first free vein quite wide; humeral and discoidal veins close to one another and at several points coalescing; stridulating field relatively simple, no speculum present and normal Gryllid venation quite recognizable; median vein straight, simple; ulnar

vein short, transverse;[48] anal vein following its general direction as the stridulating vein but not thickened, and from the general neighborhood of the usually present Grylloid anal node continuing an arcuate but longitudinal course to the apical margin of the tegmen; axillary veins three in number, the first terminating at the "node," the second continued, following the trend of the anal vein, to a point of fusion distad on the sutural margin, third axullary vein following the sutural margin distad of the "node:" area between the ulnar and median veins mesad and distad wide, with three cross-veins[49] and distad a spurious longitudinal vein; anal and axillary veins connected by a number of cross-veins. Wings caudate, surpassing the closed tegmina by considerably more than the tegminal length. Cerci very elongate, nearly as long as the body, tapering. Subgenital plate moderately produced, spoon-shaped. Cephalic tibiæ with the cephalic face imperforate, but with a smooth elliptical area in the usual tympanal position; caudal face with a large, elongate, elliptico-reniform tympanum. Caudal femora moderately robust, the apex relatively slender: caudal tibiæ armed on the dorso-external margin with four spines, the dorso-internal margin with four to five spines; external distal spurs relatively short, the median one slightly more than a third as long as the metatarsus and half again as long as the dorsal one, ventral spur distinctly shorter than the dorsal one, internal distal spurs with the median and dorsal subequal in length, about one-half as long as the metatarsus, the ventral small and subequal to the ventro-external spur: caudal metatarsus slender, moderately compressed distad; dorso-external margin with seven to nine adpressed spines, dorso-external spur faintly more than one-half as long as the internal one, the latter reaching to slightly distad of the middle of the third tarsal joint.

Allotype: ♀; Igarapé-assú, State of Pará, Brazil. January 23, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila.]

The following features are those of difference from the type.

Pronotum faintly less strangulate; cephalic margin of same very shallowly arcuate-emarginate. Tegmina slightly shorter than in the male, reaching not quite to the middle of the abdomen; humeral and discoidal veins well separated, slightly diverging distad, humeral vein not furcate distad: dorsal field with the median, ulnar, anal and two axillary veins regularly disposed, cross-veins indicated

[48] At least this is the usual position of the ulnar vein in the Gryllinæ.
[49] The ulnar vein (so-called) might be considered another one.

sparsely proximad, more frequently distad. Ovipositor straight, robust, shorter than the caudal femora; apex acuminate, ventral valves shorter than the dorsal ones. Caudal femora with four spines on each dorsal margin: caudal metatarsus with five to six spines on the dorso-external margin.

General coloration of the head, pronotum and dorsum of the abdomen ranging from mummy brown (recessive type) to blackish brown—number one of Ridgway (intensive type), the limbs and ventral surface buckthorn brown (recessive type) to mummy brown in those having the darkest dorsal coloration (intensive); tegmina buffy hyaline to weak fuscous hyaline, the venation of the dorsal coloration. Head unicolorous with the mouth-parts washed with ochraceous-tawny to amber brown; ocelli ochraceous-buff to mars yellow; eyes mottled blackish-brown and dresden brown to mummy brown; palpi of the same coloration as the limbs; antennæ of the general coloration. Wings whitish hyaline, with a brownish tinge in the intensive specimens, with a distinct iridescence, longitudinal veins colored similarly to those of the tegmina. Cerci of the dorsal coloration. Pubescence of the limbs golden. Caudal femora washed more or less completely with the dorsal coloration.

Measurements (in millimeters)

	Length of body (exclusive of ovipositor)	Length of pronotum	Greatest width of pronotum	Length of tegmen	Greatest width of dorsal field of tegmen	Length of wing distad of tegmen	Length of caudal femur	Length of ovipositor
♂								
Igarapé-assú, *type*	8.2	1.2	1.6	4.6	1.5	6.3	4.9	....
Igarapé-assú, *paratype*	7.2	1.3	1.8	4.2	1.4	5.8	5	....
♀								
Igarapé-assú, *allotype*	8.8	1.5	2.2	4.5	1.6	7.3	5.2	3.9
Igarapé-assú, *paratype*	9.5	1.7	2.1	4.5	1.6	7.2	5.5	3.9
Rio Pacaya, Peru, *paratype*	8.7	1.9	2.3	4.7	1.6	8.2	5.6	3.5

In addition to the type and allotype we have examined a paratypic series of seven; one male and three females bearing the same date as the type (one female has no date) and three females from Rio Pacaya, Peru, July, 1912, all in the collection of the Academy. When examined for features of variation we find that the paratypic male has five external and four internal dorsal marginal spines on the caudal tibiæ. The females all have four spines, excepting one from Igarapé-assú which has four internal on one limb and five on the other. The spines on the dorsal margin of the caudal metatarsus

vary from six to eight in number on the external margin and four to six on the internal margin in the paratypes. The paratypic male has the ulnar vein of the tegmina more oblique than in the type and the first cross-vein between the anal and median veins is also more oblique, forming an angle in the anal vein at its juncture, the next cross-vein obliquely sigmoid, while the proximal disposition of the axillary veins of the tegmina is also slightly different. One of the Rio Pacaya females has the humeral vein forked near the base.

Miogryllus convolutus (Johannson).

1763. *Gryllus convolutus* Johannson, Amoen. Acad., VI, p. 399. [Surinam.]

Pará. (C. F. Baker.) Two females.

Igarapé-assú. January 17 to February 6, 1912. Four males, nine females.

These specimens have already been recorded by Hebard in a study of the genus.[50]

Miogryllus verticalis (Serville).

1839. *Gryllus verticalis* Serville, Hist. Nat. Ins., Orth., p. 343. [Cayenne.]

Igarapé-assú. One male.

This macropterous individual has been recorded by Hebard in his study of the genus.[51]

Miogryllus tucumanensis Giglio-Tos.

1894. *G[ryllus] (Miogryllus) tucumanensis* Giglio-Tos, Boll. Mus. Zool. Anat. Comp. Torino, IX, No. 184, p. 41. [San Pablo, Province of Tucuman, Argentina.]

Igarapé-assú. January 17, 1912 (one). Two females.

These specimens fully agree with the description of this species, except for the presence of caudate wings and having the tegmina slightly longer and overlapping. They are, as far as we can determine, representative of the macropterous condition of this species, a phase previously unknown. In the two specimens the tegmina measure 8.4 and 8.5 millimeters in length, while the other dimensions are as given in the original description.

The reference of the species to *Miogryllus* is according to the original author, and merely tentative as far as we are concerned, for its exact relationship to *Gryllodes* remains to be determined, when more is known of the constancy and variation of characters in the latter genus.

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[50] Journ. N. Y. Entom. Soc., XXIII, p. 109, (1915).
[51] Ibid., p. 121, (1915).

As far as known the species has been taken only at the two widely separated localities given above.

Gryllus assimilis (Fabricius).

1775. [*Acheta*] *assimilis* Fabricius, Syst. Entom., p. 280. [Jamaica.]

Pará. (C. F. Baker.) One male, one female.

Peixe-boi, east of Pará. November to December, 1907. (H. B. Merrill.) One male, one female.

Igarapé-assú. Two females.

The Pará and Igarapé-assú specimens have been recorded by Rehn and Hebard in a critical study of *Gryllus* as found in America.[52] The Peixe-boi pair would be represented by the following symbols, as previously established by us: ♂, AVauO1; ♀, AVbuO2.

Oecanthinæ.

Lerneca varipes Walker.

1869. *Lerneca varipes* Walker, Catal. Spec. Derm. Salt. Brit. Mus., I, p. 72. [Amazon Region.]

Igarapé-assú. One female.

This specimen is inseparable from individuals of both sexes of this species from Caparo, Trinidad, comments on which will be published at a later date.

Trigonidiinæ.

Anaxipha[53] **esau** n. sp. (Pl. II, figs. 54, 55.)

Apparently a relative of *A. tibialis* (Saussure), but strongly marked off from any other species, studied or known to us, in the presence of short, curved hairs placed along the veins of the tegmina and also regularly over the intervening areas, the exposed portion of the wings, the body and the limbs being more decidedly haired than usual. From *tibialis* the present species also differs in the shorter and more robust cephalic tibiæ, the shorter caudal metatarsi, in the reduction of the cross-veins in the dorsal field of the female tegmina, in the distinct sculpturing of the main veins of the same and in the more robust general form.

Type: ♀; Igarapé-assú, State of Pará, Brazil. February 1, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5342.]

Size small: form elongate, slender, subcylindrical, wings caudate: surface closely and relatively heavily haired, on the tegmina the hairs

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[52] Proc. Acad. Nat. Sci. Phila., 1915, p. 319, (1915).

[53] For comments on the characters separating *Cyrtoxipha* and *Anaxipha*, see Rehn and Hebard, Entom. News, XXIII, pp. 411 and 412; Proc. Acad. Nat. Sci. Phila., 1916, pp. 300 to 302

are particularly disposed along the longitudinal veins. Head with the greatest width across the eyes subequal to the greatest width at the caudal margin of the pronotum; when seen from the side the interocular section of the head is regularly declivent from the narrowly rounded occiput, interantennal protuberance broadly rounded when seen in the same view, when seen from the dorsum subcompressed; hairs on the rostrum decurved: eyes with axis subvertical, in basal outline broad ovoid, prominent when seen from the dorsum, slightly projecting cephalad: antennæ surpassing the body in length, proximal joint large, moderately deplanate: palpi with the third and fourth joints slender, the third subequal in width; the fourth faintly expanding distad, slightly shorter than the third; fifth joint reversed pyramidical, about one and one-half times as long as the distal margin, which is straight truncate, the joint slightly flattened. Pronotum transverse, its greatest caudal width nearly equal to one and one-half times the greatest length of the same, narrowing cephalad, so that the cephalic width is distinctly less than the caudal width and faintly less than the width of the adjacent portion of the head, in transverse section the pronotum is regularly rounded dorsad and into the lateral lobes; cephalic margin of the dorsum gently arcuate, the caudal margin broadly obtuse-angulate, the immediate angle narrowly rounded, both margins faintly cingulate; hairs on the pronotum large and chætiform, those along the caudal margin directed dorsocaudad, those on the lateral lobes directed cephalad; a short cephalomedian longitudinal sulcus present; lateral lobes longer than deep, rounding into the dorsal surface; ventro-cephalic angle broadly rounded, ventral margin straight, ventro-caudal angle narrowly rounded, caudal margin straight; surface of the lateral lobes obliquely impressed. Tegmina reaching to the apex of the abdomen, pilosity covering the dorsal surface from the region of the humeral angle, the lateral field almost unhaired; lateral field with three veins, of which one parallels the margin, another is very brief, the third reaches the costal margin at about the distal fourth of the field; mediastine, humeral, discoidal and median veins of the tegmina subparallel, straight; ulnar vein arcuate proximad; anal vein bent both proximad and distad, straight between, joining the axillary vein at the distal third of the tegmen; axillary veins two in number, these joining and continuing as a single vein. Exposed portion of the wings projecting distad of the closed tegmina a distance slightly greater than one-half the length of the tegmina, haired similar to the tegmina. Ovipositor no longer than the head and pronotum together, robust, dorsal mar-

gin nearly straight, ventral margin arcuate in distal half, apex acuminate: subgenital plate narrowly fissate-emarginate mesad. Cephalic tibiæ short, broadly fusiform inflated in proximal two-thirds, subequal and subcompressed in distal third; cephalic face with a large elliptico-reniform tympanum, caudal face with a much smaller elliptical tympanum. Caudal femora subequal in length to the tegmina, moderately inflated; caudal tibiæ with three pairs of marginal spurs, which are not opposite in their insertion, the external series slightly more proximal in their position when compared with their equivalent on the internal series, the internal spurs faintly arcuate, their dorso-internal edge also faintly thickened, knife-like and pencilled with blackish; disto-external spurs small; disto-internal spurs very much longer, the dorsal one about two-thirds as long as the metatarsus, the dorso-internal margin thickened and pencilled as on the internal marginal spurs; metatarsi slightly longer than the remaining tarsal joints combined, a single spine present at the disto-internal angle, the internal spur of the metatarsus large, reaching almost to the extremity of the tarsus, slightly falcate, with the dorsal edge thickened and pencilled as is the case with the other internal spurs.

General color ochraceous-buff, the head distinctly and the pronotum faintly washed with weak russet; eyes clear russet; exposed portion of the wings faintly washed with mummy brown, the veins pale; at distal fourth the cephalic and median femora bear narrow, incomplete annuli of weak mummy brown, indications of a similar one are present on the pregenicular section of the caudal femora.

Length of body, 4.6 mm.; length of pronotum, 1; greatest (caudal) width of pronotum, 1.3; length of tegmen, 3.7; length of exposed portion of wing, 2.7; length of caudal femur, 3.6; length of ovipositor, 1.6.

The type of this species is unique.

Anaxipha angusticollis (Saussure).

1874. *Cyrtoxipha angusticollis* Saussure, Miss. Scient. Mex., Rech. Zool., VI, p. 377, pl. 7, fig. 2. [Eastern Cordillera of Mexico.]

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. February 1, 1912 (two). Three females.

This striking species, which shows great diversity in form between the sexes, has the coloration more generally punctate, from the present material, than previous descriptions would lead one to suppose. The agreement with the features of the detailed original description is so full there can be no question of the identity, or at the most the very close relationship of the present material. Chopard reported the species from St. Jean du Maroni, French Guiana, and Bruner

refers material from Cacagualito, Colombia; São Luiz de Caceres, Matto Grosso, Brazil, and British Guiana to it, while Bugaba, Panama is given by Saussure, in the Biologia, as another locality. The form of the whole thorax of the male is so remarkable that its isolation from the other members of the genus is quite marked.

Anaxipha conspersa (Bruner).

1916. *Cyrtoxipha conspersa* Bruner, Ann. Carneg. Mus., X, p. 406. ["Las Juntas" (250 m.), Department of Santa Cruz, Bolivia.]

Pará. (C. F. Baker.) One male.

We have referred this specimen to *conspersa* although it shows several features of difference, which, however, we feel are due to individual or sexual variation, lack of note or over-emphasis in the original description. In our specimen we see no distinct indication of the ridge, "which separates this region (*i. e.*, depressed section of the vertex) from the front." There is, however, a slight elevation covering the base of the inter-antennal protuberance, which may be the feature referred to by Bruner. The other feature is that the whole occiput caudad of the transverse arcuate depression is solidly mars brown.

Anaxipha simulacrum n. sp. (Pl. II, figs. 56–59.)

The slender form, the blackish antennæ and the shape of the cephalic tibiæ and of the ovipositor are quite characteristic of this very distinct species, which has, at a glance, a Cyrtoxiphine appearance. The head and palpi, however, are Anaxiphine in character.

The species is not closely related to any of the other forms known to us.

Type: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5340.]

Size very large (for the genus): form moderately elongate, slender, terete: surface of body moderately shining, with numerous hairs, the marginal ones of the pronotum, particularly laterad, elongate and curved. Head in general vertical, its axis slightly retreating ventro-caudad, its greatest longitudinal length slightly less than the greatest depth (including the mandibles); in lateral view the occiput is well arcuate caudad of and between the eyes, thence very strongly arcuate-declivent to the inter-antennal region, which is rounded obtuse-angulate, the ventral section retreating to the clypeal suture; when seen from the dorsum the occiput is broad, very broad behind the eyes, the narrowest portion of the interocular section slightly less than half the width of the head at the caudal margin of the eyes, the least interocular width subequal to the transverse width

of one of the eyes, width of the interantennal protuberance hardly more than one-half that of the interocular space: when seen from the dorsum the eyes are moderately prominent, when seen in lateral view they are sub-reniform ovoid: antennæ with the proximal joint broad, subdepressed, the internal margin roundly enlarged; remainder of antennæ incomplete: palpi slender, elongate, third joint faintly longer than the fifth and distinctly longer than the fourth joint; fifth joint trumpet-shaped, its length about two and one-half times the distal width, distal truncation faintly oblique. Pronotum slightly longitudinal when seen from the dorsum, regularly rounding transversely, when seen from the dorsum slightly expanding caudad; cephalic margin of the dorsum truncate mesad, caudal margin moderately arcuate, these margins cingulate; dorsum with the medio-longitudinal sulcus indicated on the cephalic two-thirds, very deeply so in the median region, a transverse sulcus weakly indicated mesad: lateral lobes longitudinal, with a distinct caudo-ventral trend; cephalic margin and ventro-cephalic angle regularly and broadly rounded, ventro-caudal angle rounded rectangulate, caudal margin slightly oblique, straight, the vicinity of the ventro-caudal angle strongly impressed. Tegmina slightly surpassing the apex of the abdomen, the closed pair cylindrical when seen from the dorsum, the outline of the dorsal field narrowing in the distal fifth; venation simple, prominent, transverse nervures regularly placed, separating areas which are regularly oblong: lateral field with the discoidal vein straight, regularly but weakly diverging from the humeral vein, incomplete veins costad of the mediastine vein two in number. Wings fully developed, caudate, projecting distad of the tegmina a distance slightly greater than the length of the head and pronotum combined. Ovipositor moderately elongate, relatively slender, very faintly arcuate proximad, more strongly so distad; distal extremity moderately acute, weakly crenulate on the dorsal margin, almost to the weak swelling, which is situated at the distal three-fifths: subgenital plate slightly broader than long, the apex briefly fissate, rounding narrowly into the margins of the plate. Cephalic and median limbs elongate, straight, moderately tapering: cephalic femora subequal to the combined length of the head and pronotum; cephalic tibiæ subequal to the femora in length, the distal half quite slender, both faces of the tibiæ with elongate reniform tympana, those of the two faces subequal in size: median femora faintly shorter than the cephalic ones; tibiæ subequal in length to the cephalic tibiæ and distinctly surpassing the median

femora. Caudal femora moderately robust, tapering, surpassing the apex of the ovipositor and falling but slightly short of the tips of the wings; caudal tibiæ subequal to the femora in length, very slender, the dorsal margins armed with three pairs of spurs, which are not paired in position, those of the external margins being more proximal in position than the corresponding spur on the internal margin, the spurs slender, slightly falcate or but faintly hooked at the apex, their length about two and one-half times the depth of the tibial shaft; disto-external spurs very short, the median one three times as long as the dorsal and nearly twice as long as the ventral one; disto-internal spurs two in number, elongate, weakly falcate, the dorsal one about one-half as long as the metatarsus and half again as long as the ventral one: caudal metatarsi about one-fourth as long as the tibiæ, straight, the dorsal surface with a short recumbent spine on each margin distad, the internal distal spur about one-half again as long as the external one; second tarsal joint elongate cordiform, the third slender.

Allotype: ♂; same data as type. January 26, 1912.

Differing from the description of the type in the following features: Tegmina relatively narrow when seen from the dorsum (the pair in repose), narrowing distad: lateral field of the tegmina relatively broad, subequal in width; mediastine vein diverging regularly from the humeral vein distad, the area between with a number of transverse nervures which divide it into rectangulate spaces; three free veins are present in the proximal section of the lateral field costad of the mediastine vein: humeral vein curving costad at its apex: speculum elongate diamond-shaped, its length about one-half that of the dorsal field of the tegmen, its greatest length slightly more than one-half its length; postaxillary veins three in number; axillary veins two in number. Styles reaching to the apices of the caudate wings.

General color buff-yellow, the pubescence largely golden. In the female there is a medio-longitudinal line of raw umber on the closed tegmina, which is distinct proximad and weakens distad. Eyes fuscous-black; antennæ distad of the proximal joint blackish, the proximal one washed distad with fuscous; second and third tarsal joints of all tarsi washed with fuscous-black; ovipositor rich chestnut brown.

Measurements (in millimeters).

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.	Length of ovipositor.
♂ *type*	6.3	1.5	5.3	5.2	2.5
♀ *allotype*	7	1.4	6	5.5	.....

The type and allotype are the only specimens known to us.

Anaxipha smithi (Saussure).

1897. *Cyrtoxipha smithi* Saussure, Biol. Cent.-Amer., Orth., I, p. 236. [Teapa, Tabasco, Mexico.]

Igarapé-assú. One female.

We have assigned this specimen to *smithi* without having seen Mexican material of either sex, but it agrees with the description, which was based on the male sex, in all features of any importance. Actual comparison may show the Brazilian material to be distinct, but at this time we know of no evidence requiring its separation. The ovipositor is short and robust, much like in *imitator*, but the form of the ovipositor is more robust, with a more decided angle to the dorsal line in *imitator*, while the palpi are more slender and the cephalic tibiæ less robust in *smithi*, the coloration also being different.

Chopard[54] has reported this species from four localities in French Guiana.

Anaxipha aptera (Chopard).

1912. *C[yrtoxipha] aptera* Chopard, Ann. Soc. Entom. France, LXXXI, p. 410, 4 figs. [Charvein, St. Laurent and Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One male.

Paramaribo, Dutch Guiana. (K. Mayo.) One male. [A. N. S. P.]

The wingless condition of the known material of this species may not be a specific character of the form, as quite a few species are known to be dimorphic in this respect. The Pará individual has four reddish brown longitudinal lines on the vertex and occiput, the median pair continued on the interantennal protuberance. The Paramaribo specimen has these absent.

Anaxipha minuta (Linnæus).

1767. [*Gryllus*] *minutus* Linnæus, Syst. Nat., ed. XII, p. 694. ["America" (Surinam according to DeGeer).]

Pará. (C. F. Baker.) One male, one female.

Paramaribo, Dutch Guiana. (K. Mayo.) Three females.

There is so little in the literature to enable us to pin this name down to a definite species, that we are under the necessity of using it for an insect not disagreeing with the insufficient diagnosis, and found in the region from which *minuta* was supposed to have come. The Linnean material is probably not in existence, as Stål did not feel that he had it before him, when preparing the Recensio, although part of the basic material of DeGeer's *testaceus*, which is generally considered synonymous with *minuta*, was in his hands. The present

[54] Ann. Soc. Entom. France, LXXXI, p. 407, (1912).

species shows no features of difference from the Linnean description which might not be due to discoloration of the original material.

Anaxipha cayennensis (Saussure).

1897. *Cyrtoxiphus aztecus* var. *cayennensis* Saussure, Biol. Cent.-Amer., Orth., I, p. 235. [Cayenne.]

Igarapé-assú. (H. S. Parish.) Two males.

We have used for comparison material from British Guiana, and found some slight differences, chiefly in the relative width of the dorsal field of the tegmina, but nothing sufficiently marked or constant to make it advisable to separate the two lots. Saussure considered this merely a variety of *azteca*, but we prefer to give the name specific rank until more is known concerning its relationship to *azteca*, in this following Chopard and Bruner. The former author has recorded the species from Nouveau-Chantier, French Guiana; the latter from Santarem, Brazil. Our material is of similar small size to that reported by Bruner.[55]

Anaxipha nitida (Chopard).

1912. *C[yrtoxipha] nitida* Chopard, Ann. Soc. Entom. France, LXXXI, p. 408, 4 figs. [Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One female.

This individual is fully typical of the present striking and beautiful species, although slightly smaller than the original measurements. The antennæ are broadly white annulate on a fuscous ground, at a point about three millimeters from their bases. The coloration of the antennæ is not mentioned in the original description.

Anaxipha variegata (Chopard).

1912. *C[yrtoxipha] variegata* Chopard, Ann. Soc. Entom. France, LXXXI, p. 407, 4 figs. [St. Laurent and Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One male.

This specimen may prove to be distinct from true *variegata*, as it shows certain color features not mentioned by Chopard, but, at present, we prefer to consider these individuals variations or the color features to have been omitted from the description by Chopard. The antennæ are solid blackish proximad, then follows a broad cream-colored area, which contains two narrow brown annuli, distad of this the color is pale brownish with regularly placed dark brown annuli. The occiput is pale yellow, caudad broadly blackish brown, like the face and between the eyes, in the middle of the yellow area is a transverse bar of blackish brown. The median femora, like the cephalic ones, have a distal pale area colored like the tibiæ, and in addition a median annulus of the same.

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[55] Ann. Carneg. Mus., X, p. 404, (1916).

Anaxipha incompta (Walker).

1869. *Eneoptera incompta* Walker, Catal. Derm. Salt. Brit. Mus., I, p. 67. [Tapayos[Tapajos], Brazil.]

Pará. (C. F. Baker.) One male.

We are identifying this specimen with Walker's species provisionally, or at least until we can ascertain more about the type of the species, as the description is woefully inadequate.

Anaxipha tibialis (Saussure).

1897. *Cyrtoxipha tibialis* Saussure, Biol. Cent. Amer., Orth., I, p. 236, pl. XI, fig. 40. [Teapa, Tabasco, Mexico.]

Pará. (C. F. Baker.) Two males, three females.

These specimens show no differences from the description of *tibialis* and we see no alternative but to record them as that species, although comparison with Mexican material is not at present possible. The two male specimens show differences which demonstrate the presence in males of this species of a broad and a narrow type of tegmina, and consequently of the tympanum, also in both sexes of recessive and intensive types of coloration. In the former of these color types the dark lateral bar is quite narrow, distinctly dorsad on the lateral lobes, and on the tegmina pencils but the immediate vicinity of the mediastine vein; in the intensive type the bar is broad and covers all of the lateral lobes except the ventro-cephalic portion, which is yellow, and on the tegmina suffuses a broad belt costad of the mediastine vein.

As we here understand the species it is not far removed from *imitator* (Saussure), from which it differs in the narrower head and pronotum, slightly different shape of the cephalic tibiæ and more restricted, less solidly infuscate dark areas on the pronotum and tegmina.

Anaxipha paraensis n. sp. (Pl. II, figs. 60–62.)

Apparently related to *A. tolteca* (Saussure), described from eastern Mexico, but differing in the broadly rounded lateral shoulders of the pronotum, and in the shorter and narrower tegmina, which have the speculum more longitudinal. Doubtless other features of difference exist which will become apparent on actual comparison of the two forms.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5343.]

Size relatively large, broad, tegmina well vaulted: surface of body well clothed with hairs, which are bristly on the head and pronotum. Head trigonal in cephalic aspect, faintly deeper than broad: occiput moderately declivent to the inter-antennal region, with numerous

bristles which are directed ventro-cephalad; inter-antennal protuberance equal to about one-half the least width of the inter-ocular region: eyes very prominent when seen from the dorsum, their convexity directed cephalo-laterad, when seen from the side their basal outline is reniform-ovoid, the narrower portion ventrad: antennæ reaching at least to the apices of the wings, the proximal joint enlarged but simple: palpi slender, the third and fifth joints subequal in length, the third joint slightly arcuate; fourth joint about two-thirds as long as the third joint; fifth joint trumpet-shaped, the distal margin very faintly oblique-truncate. Pronotum transverse, strongly and regularly narrowing cephalad, the width at the caudal margin about one-third greater than the length of the pronotum, the dorsum broadly and regularly rounding into the lateral lobes; surface of the dorsum and lateral lobes with scattered curved bristles, the margins, but particularly the cephalic, with a regularly placed series of smaller bristles; cephalic margin of the disk faintly arcuate, the caudal margin more distinctly but weakly arcuate; medio-longitudinal impression distinctly but not deeply indicated on the greater portion of the disk, transverse impression distinct, median, arcuate: lateral lobes distinctly longer than deep, subrectangular; cephalic margin oblique, the ventro-cephalic angle rounded obtuse, ventral and caudal margins each straight, the ventro-caudal angle narrowly rounded rectangulate, the lobes well inbent ventro-caudad. Tegmina broad, distinctly broader than the body, in length slightly surpassing the apex of the body: lateral field broad, subequal in depth; costal margin in greater portion straight, very faint intimation of an emargination mesad, arcuate distad; mediastine vein arcuate proximad and distad, straight for the greater portion of its length, little distant from and subparallel to the humeral vein in the proximal half, the area between these veins crossed by numerous straight transverse nervures; costal section of the marginal field with three incomplete veins, the third of which is a ramus of the mediastine vein: humeral and discoidal veins closely placed, subparallel; median vein parallel to the other veins of the humeral trunk, slightly weaker; stridulating vein regularly arcuate; ulnar vein regularly sigmoid; axillary veins three in number of which the third is strumose; post-axillary veins three in number; speculum roughly diamond-shaped, but slightly longer than broad, the sutural angle the only one of the four which is distinctly rounded, the figure within the speculum complete, ovoid-subcordiform, its area coriaceo-rugulose; apex of the dorsal field of the tegmina slightly acute-angulate. Wings strongly caudate, pro-

jecting distad of the tegmina a distance equal to the length of the tegmina, the exposed portion of the wings faintly fusiform when seen from the side, the dorsal and ventral margins of the same rather thickly hirsute. Styles elongate, slender, tapering, falling but slightly short of the tips of the closed wings: subgenital plate elongate, scoop-shaped, narrowing distad, the distal margin narrowly bisarcuate. Limbs moderately slender, elongate. Cephalic femora moderately tapering; cephalic tibiæ subequal in length to the femora, the proximal five-eighths moderately bullate, the distal three-eighths relatively slender, tympana perforating both faces of the tibiæ, that of the cephalic face relatively large, elongate acute-elliptical, of the caudal face but little more than half that size and ovoid in form. Median tibiæ slightly surpassing the femora in length, but faintly larger in proximal half than in distal half. Caudal femora subequal to the tegmina in length, moderately inflated proximad, tapering thence distad, genicular region very small: caudal tibiæ in length subequal to the femora, three pairs of marginal spurs present, those of the external margin more proximal in position than those of the internal, the spurs nearly straight with the immediate apex briefly hooked; disto-external spurs small, the middle one not more than one-fifth as long as the metatarsus, the dorsal one not more than one-half as long as the middle one, the ventral one about two-thirds as long as the middle one; disto-internal spurs two in number, the dorsal one heavy, tapering, very faintly hooked at the apex, in length slightly more than two-thirds as long as the metatarsus, the ventral spur about three-fifths as long as the dorsal one, more slender: caudal metatarsi slightly less than a fourth as long as the caudal tibiæ, each dorsal margin distad with a single spine, external apical spur about two-thirds as long as the internal one.

General color buckthorn brown, the tegmina dresden brown, the head and thoracic bristles fuscous. The lower face with a weak pattern of liver brown, the interantennal protuberance dorsad with a pair of short, narrow lines of blackish; eyes tawny-olive; antennæ chamois, largely washed on all but the ventral surface with bister. Pronotum, as well as the dorsal surface of the head, with a weak pattern of vandyke brown. Tegmina with the venation lined to a variable degree with bister, those distad on the lateral field with this most evident. Wings with the exposed portion heavily washed with fuscous, the cross veins of the paler general color. Cephalic and median tibiæ weakly marked with fuscous, the tarsi of the same limbs with the same color. Caudal femora with the genicular extremity,

aside from the arches, marked with fuscous, the dorsal surface of the caudal tibiæ and the marginal spurs weakly washed with the same shade.

Length of body, 7 mm.; length of pronotum, 1.4 mm.; greatest width of pronotum (caudad) 2 mm.; length of tegmen, 6 mm.; greatest width of dorsum of tegmen, 2.5 mm.; length of wings distad of tegmen, 4.6 mm.; length of caudal femur, 5.8.

The type of this species is unique.

Anaxipha fistulator n. sp. (Pl. II, figs. 63–66.)

Allied to *A. championi* (Saussure), from Panama, but differing in the more elongate palpi, the distal joint of which is markedly elongate and obliquely truncate distad, in the more sharply inflated and then narrowed cephalic tibiæ, the differently shaped lateral lobes of the pronotum and in the more slender caudal femora. When compared with *A. stramenticia*, described below, *fistulator* is seen to be quite close, but the latter differs in its distinctly larger size, somewhat differently shaped palpi and cephalic tibiæ and has the pronotum more strongly transverse.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5341.]

Size quite large (for the genus): form subdepressed, the tegmina broader than the body, wings long caudate: surface of the body rather thickly covered with hairs, many of those of the head and pronotum chætiform. Head broad sub-cordiform in outline when seen from the cephalic aspect, the greatest width across the eyes but faintly less than the length, the buccal region quite narrow, the occipital outline arcuate transversely; in lateral aspect the dorsum of the head is seen to be strongly, but uniformly declivent to the interantennal protuberance, which broadly rounds caudad to the clypeal suture: eyes moderately exserted and well rounded when seen from the dorsum, in basal outline short and broad ovate: antennæ incomplete, the proximal joint broad: palpi slender, elongate; third joint gently arcuate, faintly shorter than the fifth joint; fourth joint about three-fifths as long as the fifth joint, the latter trumpet-shaped, the distal margin obliquely truncate. Pronotum weakly sellate, strongly narrowing cephalad, the pronotum distinctly transverse, the greatest caudal width more than twice that of the cephalic margin of the disk and equal to one and one-half times the length of the pronotal disk, the dorsum broadly rounding into the lateral lobes: cephalic margin of the disk subtruncate, rounding into that of the lateral lobes; caudal margin of the disk truncate; medio-longitudinal sulcus indicated

over the greater portion of the length of the disk, not reaching either margin, more distinctly indicated cephalad: lateral lobes subquadrate, ventral margin truncate, cephalic margin oblique, sub-truncate, ventro-cephalic angle rounded obtuse, caudal margin straight, ventro-caudal angle broadly rounded rectangulate; impression of lateral lobes moderately indicated, oblique, appreciably in bent ventro-caudad. Tegmina relatively broad, the greatest width of the disk contained about two and one-half times in the length of the same, when in repose the greatest width across the dorsal fields of the tegmina is at three-fifths the length of the tegmina, the margin of the extremity of the field weakly acute-angulate: lateral field moderately broad, subequal in width; mediastine vein moderately but regularly diverging from the humeral vein in proximal half, thence subparallel or weakly converging distad; two free veins present cephalad of the proximal half of the mediastine vein: humeral vein prominent and straight for the greater portion of its length, sharply decurved at its apex; discoidal vein in general paralleling the humeral vein, obtuse-angulate at the distal four-fifths; stridulating vein strongly but not regularly arcuate; axillary veins two in number, post-axillary veins three in number; ulnar vein strongly arcuate in proximal three-fourths; speculum oblique sub-rectangulate, the proximal angle and the distal angle rectangulate, the costal angle weakly obtuse, the sutural angle rounded, the greatest (transverse) width of the speculum subequal to the length, figure of the speculum complete, following the costal outline less distinctly than the others. Wings with the caudate section but slightly shorter than the tegmina, well haired along the dorsal and ventral margins. Subgenital plate relatively small, narrowing distad, the distal margin rather sharply and deeply bisarcuate: styles slightly surpassing the apices of the caudal femora, tapering, robust proximad. Cephalic femora moderately robust, tapering, in length subequal to the head and pronotum combined; cephalic tibiæ subequal to the femora in length, the proximal five-eighths distinctly inflated, the distal section relatively slender, tympanum of the cephalic face large, elongate subelliptical, of the caudal face distinctly smaller, sub-elliptical. Median limbs missing. Caudal femora faintly longer than the tegmina, moderately robust proximad, regularly tapering, very slender distad; caudal tibiæ subequal to the femora in length, slender, the marginal spurs of the same number and disposition as in the other new species of the genus here described; disto-external spurs small, the dorsal one very small, hardly more than a third the length of the median one, the ventral spur

faintly more than half the length of the median one; disto-internal spurs two in number, the dorsal one five-eighths of the length of the metatarsus, the ventral one two-thirds the length of the dorsal one: caudal metatarsi contained about four and one-half times in the length of the tibiæ, the dorsal surface armed distad with a pair of spines, distal spur of the external side two-thirds as long as the internal one.

General color straw yellow, the tegmina more clear yellow ocher, the head with an indefinite tawny wash, the caudate port on of the wings, when closed, washed with weak buckthorn brown. Eyes cinnamon brown.

Length of body, 7.9 mm.; length of pronotum, 1.2; greatest caudal width of pronotum, 1.9; length of tegmen, 6; greatest width of dorsum of tegmen, 2.5; length of exposed caudate section of wing, 5; length of caudal femur, 6.

The type of this species is unique.

Anaxipha stramenticia n. sp. (Pl. II, figs. 67–70.)

This species is apparently more closely related to *granadensis* (Rehn), from Nicaragua, *championi* (Saussure), from Panama, and *fistulator*, described above, than to the other species known to us. From *granadensis* it differs chiefly in the different profile of the head, this having the occiput and fastigium very much less deplanate declivent, in the distal palpal joint being very strongly oblique truncate distad, in the more quadrate lateral lobes of the pronotum, in the dorso-internal spur of the caudal tibiæ being half as long as the metatarsus, and the caudal metatarsal internal spur distinctly surpassing the second tarsal joint, in the sparser tegminal venation of the female (the only sex known of *granadensis*) and in the exact shape of the apex of the ovipositor. From *championi* the new form differs chiefly in the obliquely truncate distal margin of the distal palpal joint and the more decidedly slender distal portion of the cephalic femora, while from *fistulator* it is distinguished chiefly by its smaller size, more sharply narrowed cephalic tibiæ, less strongly transverse pronotum and less attenuate caudal femora.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5345.]

Size medium (for the genus): form relatively elongate, the wings caudate: body and limbs thickly clothed with short hairs, on the head and pronotum many are more elongate and chætiform. Head broad cordiform when seen from the cephalic aspect, the greatest width across the eyes not exceeded by the depth of the head, the occipital line moderately arcuate when seen from the front; in lateral

aspect the dorsal line of the head is moderately declivent from the occiput to the inter-antennal protuberance, which broadly rounds over the ventral section of the facial line to the clypeal sulcus; width of inter-antennal protuberance not quite equal to one-half the least width between the eyes: eyes when seen from the dorsum quite prominent, full, in basal outline broad ovoid, flattened caudad: palpi slender, elongate; third joint in length subequal to the fifth joint, moderately arcuate; fourth joint about three-fifths of the length of the third joint; fifth joint trumpet-shaped, flaring quite markedly, the distal margin rather strongly oblique truncate: antennæ incomplete, the proximal joint broad, distinctly depressed. Pronotum rather small, sub-selliform, weakly enlarging caudad, the dorsum rather broadly rounding into the lateral lobes; cephalic margin of the disk sinuato-truncate, caudal margin arcuato-truncate, medio-longitudinal sulcus distinctly indicated mesad and very briefly cephalad, transverse impression weakly indicated, bisarcuate: lateral lobes subquadrate in form, the margins straight, the angles well rounded; ventro-caudal section moderately but not strongly in-bent. Tegmina but little broader than the body, in length but faintly surpassing the apex of the abdomen: lateral field broad, subequal; mediastine vein regularly diverging from the humeral vein, the area between with weakly indicated transverse nervures, which divide the area into subquadrate areolets; accessory veins of the lateral field three in number, situated costad of the mediastine vein, one simulating and subparalleling the mediastine vein, the other two (which are costad) short and sinuate: humeral and discoidal veins straight in general, subparallel: dorsal field with the greatest width at five-eighths the length from the base, distal margin of the discoidal field rounded obtuse-angulate; stridulating vein bent arcuate; axillary veins two in number (not counting the thickened marginal node); postaxillary veins three in number; ulnar vein moderately sigmoid, more so proximad than distad; speculum oblique subrectangulate, the greatest width of the same (between angles) equal to about three-fourths of the length, proximal angle weakly acute, distal angle rectangulate, costal angle rounded obtuse, sutural angle rather broadly rounded, figure of the speculum complete, unsymmetrical elongate subelliptical. Wings with the caudate portion projecting distad of the tegmina a distance equal to three-fourths of the length of the tegmina. Subgenital plate short, slightly transverse, scoop-shaped, the lateral margins converging distad, the distal extremity with a relatively deep emargination, which is made weakly bisarcuate by a median

triangular projection: styles nearly reaching the tips of the caudate wings. Cephalic femora subequal to the length of the head and pronotum combined, straight, tapering; cephalic tibiæ faintly shorter than the femora, strongly inflated in the proximal half, subequal and moderately slender distad, tympanum of the cephalic face large, elongate elliptical, of the caudal face smaller, subelliptical. Caudal femora faintly shorter than the tegmina, moderately robust proximad, tapering distad: caudal tibiæ subequal to the femora in length, the marginal spines placed as in the other species here described, disto-external spurs very small, the dorsal one minute, disto-internal spurs two in number, the dorsal one half as long as the metatarsus, the ventral one two-thirds as long as the dorsal one: caudal metatarsi with its length contained about three and one-half times in the length of the caudal tibiæ, the dorsal margins each armed distad with a single tooth, distal spur of the internal face reaching to about the middle of the third tarsal joint, the external spur hardly surpassing the middle of the second joint.

Allotype: ♀; same date as the type.

Differing from the description of the type in the following features. Pronotum relatively heavier than in the male, broader in proportion to the width of the head, the caudal margin of the disk weakly produced mesad, rounded, very faintly sinuate laterad of the median production: lateral lobes with the cephalic margin more oblique truncate, the ventro-cephalic angle rounded obtuse. Tegmina narrow, elongate, slightly surpassing the apex of the abdomen (exclusive of the ovipositor), when in repose the lateral margins of the tegmina are subparallel, narrowing at the distal extremity to the narrowly rounded apex: lateral field with the veins more regularly disposed than in the male, straighter, and more distinctly diverging: dorsal field with the anal and axillary (two) veins moderately sinuate, transverse nervures numerous and irregularly distributed. Ovipositor in length subequal to that of the head and pronotum combined, moderately falcate, of medium depth, distal extremity of the dorsal margin and the vicinity of the valvular suture in the distal third with fine strumose denticulations, apex acute.

General color antimony yellow, becoming warm buff on the tegmina, the abdomen with a tendency toward ochraceous-buff, ovipositor tipped with mars brown, the eyes varying from the general color to dresden brown.

Measurements (in millimeters).

	Length of body.	Length of pronotum.	Greatest width of pronotum.	Length of tegmen.	Length of wings distad of closed tegmina,	Length of caudal femur.	Length of ovipositor.
♂, *type*.....	6.2	1.1	1.9	5.2	4.4	5.5	....
♀, *allotype*.....	6	1.3	1.8	5	4	5.5	2.3

In addition to the type and allotype we have before us a paratypic pair, bearing the same data as the type. These specimens show no differences worthy of remark.

Eneopterinæ.

Aphonomorphus major Chopard.

1912. *A[phonomorphus] major* Chopard, Ann. Soc. Entom. France, LXXXI, p. 429, 3 figs. [St. Laurent du Maroni, French Guiana.]

Igarapé-assú. One female.

This specimen is somewhat damaged and the form of the distal palpal joint is not satisfactorily ascertainable, but in all other important ambisexual features our specimen agrees with the description of *major*, which was based on the male. The dorso-internal margin of the caudal tibiæ has one more spine (six instead of five) than Chopard gives, but this is probably a purely individual feature.

Aphonomorphus griseus Chopard.

1912. *A[phonomorphus] griseus* Chopard, Ann. Soc. Entom. France, LXXXI, p. 430, 2 figs. [La Forestière, French Guiana.]

Igarapé-assú. January 17, 1912. One male.

We are assigning this specimen here although it shows at least one point of difference from Chopard's description. This is in the presence of but two, instead of three, spines on the dorso-external margin of the caudal metatarsi. Our specimen has the body length slightly greater than Chopard's measurement, and the distal palpal joint seems rather elongate to answer the original "aussi long que large." However, the features of agreement are so pronounced and the features of difference those of possible individual variation, or of exact interpretation of the proportions of a relatively difficult shape to describe, that we consider our present course of reference best.

Aphonomorphus surdus n. sp. (Pl. II, figs. 71–74.)

Apparently allied to *A. variegatus* and *griseus* Chopard, from Cayenne, and *A. conspersus* Bruner, from Bolivia. From *variegatus* it differs chiefly in the different spination of the caudal tibiæ, in the different coloration, in the more elongate limbs, in the smaller ocelli, in the greater general size, in the deeply sulcate subgenital plate of the male, and in the fewer mediastine rami of the tegmina. From *griseus* it differs in the greater general size, in the smaller ocelli, in the lateral lobes of the pronotum being longer and shallower in propor-

tion, in the pronotum being less narrowed cephalad, in the more elongate limbs, in the deeply sulcate subgenital plate of the male and in the different coloration. From *conspersus* the new form differs in the smaller, non-attingent ocelli, the more fusiform cephalic tibiæ, the generally less robust limbs, the more elongate caudal metatarsal spurs, and the less strongly divided subgenital plate of the male and in certain features of the coloration. Comparison can hardly be made with *lividus* (Burmeister), as its diagnosis is so brief and indefinite that the recognition of the species without the re-examination of the type would be purely guess-work.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5363].

Size medium: form elongate, quite slender, subcompressed surface of body and limbs rather thickly pilose, this generally adpressed; of tegmina microscopically adpressed pilose. Head no wider than the cephalic section of the pronotum, depth of the head subequal to the width across the eyes: occiput gently declivent cephalad, the fastigium plane and non-excavate; when seen in lateral outline the interantennal angle is rounded obtuse-angulate: ocelli of medium size, placed in an arcuate line, the median one rather small, elliptical, transverse, separated from the lateral ocelli by faintly more than the length of the median ocellus, fossetted; lateral ocelli large, subcircular, flattened, placed longitudinal, separated from the eyes by less than their own diameter: rostrum with the interantennal width faintly greater than the width of the proximal antennal segment, briefly fossulate dorsad: eyes moderately prominent, in basal outline broad subpyriform: palpi moderately elongate; third joint long; the fourth somewhat shorter, narrow at its base; fifth joint as long as the fourth joint, produced securiform, the distal width slightly less than the length of the joint, flexor margin nearly straight with a distal rounding to the arcuato-truncate distal margin, extensor margin gently concave: antennæ elongate; proximal joint moderately depressed, narrowed proximad. Pronotum transverse, the greatest median length contained one and one-half times in the greatest caudal width of the same; in transverse section arcuate, rather broadly rounding into the lateral lobes: cephalic margin subtruncate; caudal margin strongly bisinuate, decidedly produced arcuate mesad; lateral borders of disk moderately diverging caudad; cephalic and caudal margins cingulate, the former with this moderately, the latter extremely, broad; pyriform impressions of the disk large, broad; lateral lobes of the pronotum one and one-half times as

long as deep, somewhat impressed ventrad; ventro-cephalic angle broadly rounded, ventral margin arcuate, ventro-caudal angle rounded obtuse and broadly lamellato-cingulate, the other margins rather narrowly cingulate. Tegmina surpassing the tips of the caudal femora by about the length of the pronotum; when seen from the dorsum the lateral borders of the dorsal fields of the tegmina regularly converge distad: lateral field of uniform depth in the proximal third, thence regularly narrowing distad; mediastine vein with five rami; lateral field with five proximal free veins; hyaline intercalated field very elongate, reaching to the proximal third of the lateral field: dorsal field rather narrow, five times as long as greatest breadth, regularly narrowing in distal half; between the median and the short anal vein there is but a brief section of the ulnar vein which is distinctly traceable, all the other longitudinal nervures irregular and sinuate, the cross-veins irregularly distributed and oblique sectors not clearly defined; anal and the two axillary veins oblique, straight, regularly disposed, connected by numerous cross-veins. Wings surpassing the tegmina by slightly more than the length of the pronotum. Cerci very slender, elongate, reaching almost to the tips of the wings, clothed with numerous, rather adpressed, short hairs and sparse, erect, long hairs, decurved: subgenital plate elongate scaphiform, subcompressed, with a deep medio-longitudinal sulcus on the ventral surface; distal margin U-emarginate. Limbs moderately slender, third joint of tarsi slender. Cephalic tibiæ with an elongate elliptical foramen on the cephalic face, caudal face imperforate. Caudal femora moderately slender, about two-thirds as long as the tegmina: caudal tibiæ very faintly shorter than the caudal femora; dorsal surface armed distad as follows: on external margin with five major spines, on internal margin with six, those of the internal slightly longer than those of the external; the intercalated spinulations placed, on external margin—3 (or 4), 4, 2, 1, on internal margin—1, 2 (or 3), 2, 1, 0; dorso-internal distal spur over twice as long as the ventral, almost as long as the metatarsus; external distal spurs short: caudal metatarsi armed on the dorso-external margin with a single (distal) spinulation, on the dorso-internal margin with three spinulations, metatarsal spurs very long, the internal slightly longer than the external, faintly arcuate when seen from the side, arcuate proximad when seen from the dorsum.

Allotype: ♀ ; same data as type. [Acad. Nat. Sci. Phila.]

Differing from the description of the male (type) in the following

features. Size larger: form and vestiture similar. Head slightly deeper than width across the eyes: ocelli similar to those of the male but slightly smaller. Pronotum with cephalic margin distinctly arcuato-emarginate; lateral borders of disk less distinctly diverging caudad than in the male. Tegmina surpassing the tips of the caudal femora: mediastine vein with eight rami; lateral field with five free veins proximad: dorsal field with its width contained slightly more than five times in the tegminal length. Cerci very elongate, appreciably surpassing the tips of the wings: subgenital plate of the type usual in the female sex of the genus, moderately compressed: ovipositor in length surpassing that of the caudal femora by not more than one-half the dorsal length of the pronotum, slender, compressed, moderately decurved in proximal half, thence straight; apical valves acute lanceolate, ventro-external surface of valves shagreenous, the ventral surface crassly crenate-dentate, the productions unequal and irregular in size, these arranged in several series. Caudal tibiæ with the intercalated spinulations numbering 3 (or 5), 3, 2, 1 (or 2) on the external margin; 2, 3 (or 4), 1, 1, 0 on the internal margin.

General coloration of the male buckthorn brown, of the female between cinnamon-brown and dresden brown, in both sexes with an overlying coloration of points of mummy brown and blackish fuscous; pubescence pale golden. Head with the ocelli bordered dorsad by a transverse, poorly defined band of fuscous; ocelli naples yellow; eyes hazel, obliquely and rather irregularly barred dorsad with three lines of fuscous; antennæ multiannulate with mummy brown on an ochraceous-buff ground, the contrast decided in the male, hardly apparent in the female. Pronotum with the cephalic and caudal margins beaded with fuscous except in the male, where the caudal margin is unmarked dorsad. Tegmina with the median vein strongly, closely and quite regularly beaded with blackish fuscous, except in proximal fifth, spot at base of humeral trunk blackish fuscous; dorsal surface with five oblique clouds of fuscous in the female, the cross-veins largely lined with fuscous, in the male no clouds are indicated and but a few cross-veins are pencilled; lateral field of female with cross-veins pencilled with fuscous; longitudinal veins all lined with dull ochraceous-tawny; intercalated field washed with mummy brown in the male, nearly clear hyaline in the female. Limbs thickly and closely speckled with fuscous in the female, in the male this hardly indicated on the caudal limbs, and much less distinctly so on the others than in the female; caudal

femora with the ventral margin broadly beaded with fuscous distad; caudal tibiæ with the spines and spurs annulate mesad with fuscous. Ovipositor with the tips fuscous.

♂ (type). Length of body, 19.5 mm.; length of pronotum, 3; greatest (caudal) width of pronotum, 4.4; length of tegmen, 19; greatest width of dorsal field of tegmen, 3.9; length of caudal femur, 12.8.

♀ (allotype). Length of body, 18 mm.; length of pronotum, 3.6; greatest (caudal) width of pronotum, 5; length of tegmen, 22.2; greatest width of dorsal field of tegmen, 4.4; length of caudal femur, 15; length of ovipositor, 16.

The type and allotype are the only individuals of the species seen by us. It is evident that the male is in a recessive type of coloration, the female in an intensive one.

EXPLANATION OF PLATES I AND II.

Plate I.

Fig. 1.—*Ischnoptera crispula* new species. Wing of male (type). (×6.)
Fig. 2.—*Ischnoptera crispula* new species. Pronotum of male (type). Dorsal view. (×6.)
Fig. 3.—*Ischnoptera crispula* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)
Fig. 4.—*Ischnoptera crispula* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)
Fig. 5.—*Ischnoptera imparata* new species. Wing of male (type). (×8.)
Fig. 6.—*Ischnoptera imparata* new species. Pronotum of male (type). Dorsal view. (×6.)
Fig. 7.—*Ischnoptera imparata* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)
Fig. 8.—*Ischnoptera imparata* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)
Fig. 9.—*Ischnoptera clavator* new species. Wing of male (type). (×4.)
Fig. 10.—*Ischnoptera clavator* new species. Pronotum of male (type). Dorsal view. (×6.)
Fig. 11.—*Ischnoptera clavator* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)
Fig. 12.—*Ischnoptera clavator* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)
Fig. 13.—*Ischnoptera castanea* Saussure. Genital orifice of male. Igarapé-assú, Brazil. Caudal elevation. (Greatly enlarged.)
Fig. 14.—*Ischnoptera castanea* Saussure. Subgenital plate of male. Igarapé-assú, Brazil. Ventral view. (Greatly enlarged.)
Fig. 15.—*Cariblatta igarapensis* new species. Pronotum of male (type). Dorsal view. (×6.)
Fig. 16.—*Cariblatta igarapensis* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)
Fig. 17.—*Cariblatta igarapensis* new species. Wing of male (type). (×5.)
Fig. 18.—*Cariblatta igarapensis* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)
Fig. 19.—*Chorisoneura parishi* new species. Pronotum of male (type). Dorsal view. (×7.)
Fig. 20.—*Chorisoneura parishi* new species. Tegmen and wing of male (type). (×7.)

Fig. 21.—*Chorisoneura parishi* new species. Subgenital plate of male (type). (Greatly enlarged.)
Fig. 22.—*Melestora minutissima* new species. Dorsal view of male (type). (×7.)
Fig. 23.—*Melestora minutissima* new species. Apex of abdomen of male (type). Ventral view. (Greatly enlarged.)
Fig. 24.—*Tetratænia surinama* (Linn.). Median femur of male. Pará, Brazil. (Greatly enlarged.)
Fig. 25.—*Tetratænia phila* new species. Median femur of male (type). (Greatly enlarged.)
Fig. 26.—*Tetratænia surinama* (Linn.). Caudal femur of male. Pará, Brazil. (×3.)
Fig. 27.—*Tetratænia phila* new species. Caudal femur of male (type). (×3.)
Fig. 28.—*Chloropseustes leucotylus* new genus and species. Lateral view of male (type). (×2¼.)
Fig. 29.—*Chloropseustes leucotylus* new genus and species. Pronotum of male (type). Dorsal view. (×7.)
Fig. 30.—*Chloropseustes leucotylus* new genus and species. Apex of abdomen of male (type). Lateral elevation. (×7.)
Fig. 31.—*Chloropseustes leucotylus* new genus and species. Apex of abdomen of female (allotype). Lateral elevation. (×7.)
Fig. 32.—*Bucephalacris falcifer* new species. Apex of abdomen of male (type). Dorsal view. (×7.)
Fig. 33.—*Bucephalacris falcifer* new species. Apex of abdomen of male (type). Lateral elevation. (×7.)
Fig. 34.—*Sitalces jugatus* new species. Apex of abdomen of male (type). Lateral elevation. (×6.)
Fig. 35.—*Sitalces jugatus* new species. Apex of abdomen of male (type). Dorsal view. (×6.)

Plate II.

Fig. 36.—*Ceraia capra* new species. Meso- and metasternal lobes of female (type). (×3.)
Fig. 37.—*Ceraia capra* new species. Ovipositor and subgenital plate of female (type). (×2.)
Fig. 38.—*Scaphura sphex* new species. Lateral view of tegmen of male (type). (×1½.)
Fig. 39.—*Scaphura sphex* new species. Head of male (type). Dorsal outline. (×5½.)
Fig. 40.—*Scaphura sphex* new species. Pronotum of male (type). Lateral elevation. (×3.)
Fig. 41.—*Phlugis chelifera* new species. Apex of abdomen of male (type).[56] Dorsal view. (Greatly enlarged.)
Fig. 42.—*Phlugis chelifera* new species. Apex of abdomen of male (type).[56] Ventral view. (Greatly enlarged.)
Fig. 43.—*Phlugis chelifera* new species. Apex of abdomen of male (type).[56] Lateral elevation. (Greatly enlarged.)
Fig. 44.—*Paralobaspis personata* new species. Pronotum of female (type). Lateral elevation. (×3.)
Fig. 45.—*Paralobaspis personata* new species. Ovipositor of female (type). (×4.)
Fig. 46.—*Gryllacris harpistylata* new species. Apex of abdomen of male (type) Dorsal view. (Greatly enlarged.)
Fig. 47.—*Gryllacris harpistylata* new species. Apex of abdomen of male (type). Lateral elevation. (Greatly enlarged.)
Fig. 48.—*Aphemogryllus gracilis* new genus and species. Tegmen of male (type). Dorsal field. (×8.)
Fig. 49.—*Aphemogryllus gracilis* new genus and species. Tegmen of male (type). Lateral field. (×8.)

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[56]Cerci and supra-anal plate drawn from paratype as they are flexed inward in type.

Fig. 50.—*Aphemogryllus gracilis* new genus and species. Head and pronotum of male (type). Dorsal view. (Greatly enlarged.)

Fig. 51.—*Aphemogryllus gracilis* new genus and species. Palpus of male (type). (Greatly enlarged.)

Fig. 52.—*Aphemogryllus gracilis* new genus and species. Caudal tarsus and extremity of tibia of male. Internal face. (Greatly enlarged.)

Fig. 53.—*Aphemogryllus gracilis* new genus and species. Ovipositor of female (allotype). (×11.)

Fig. 54.—*Anaxipha esau* new species. Caudal tarsus and extremity of tibia of female (type). External face. (Greatly enlarged.)

Fig. 55.—*Anaxipha esau* new species. Cephalic tibia of female (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

Fig. 56.—*Anaxipha simulacrum* new species. Dorsal field of tegmen of male (allotype). (×7.)

Fig. 57.—*Anaxipha simulacrum* new species. Head and pronotum of female (type). Lateral elevation. (Greatly enlarged.)

Fig. 58.—*Anaxipha simulacrum* new species. Cephalic tibia of female (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

Fig. 59.—*Anaxipha simulacrum* new species. Ovipositor of female (type). (Greatly enlarged.)

Fig. 60.—*Anaxipha parœnsis* new species. Dorsal field of tegmen of male (type). (×7.)

Fig. 61.—*Anaxipha parœnsis* new species. Palpus of male (type). (Greatly enlarged.)

Fig. 62.—*Anaxipha parœnsis* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

Fig. 63.—*Anaxipha fistulator* new species. Dorsal field of tegmen of male (type). (×7.)

Fig. 64.—*Anaxipha fistulator* new species. Pronotum of male (type). Lateral elevation. (Greatly enlarged.)

Fig. 65.—*Anaxipha fistulator* new species. Palpus of male (type). (Greatly enlarged.)

Fig. 66.—*Anaxipha fistulator* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

Fig. 67.—*Anaxipha stramenticia* new species. Dorsal field of tegmen of male (type). (×7.)

Fig. 68.—*Anaxipha stramenticia* new species. Head and pronotum of male (type). Lateral elevation. (Greatly enlarged.)

Fig. 69.—*Anaxipha stramenticia* new species. Ovipositor of female (allotype). (Greatly enlarged.)

Fig. 70.—*Anaxipha stramenticia* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

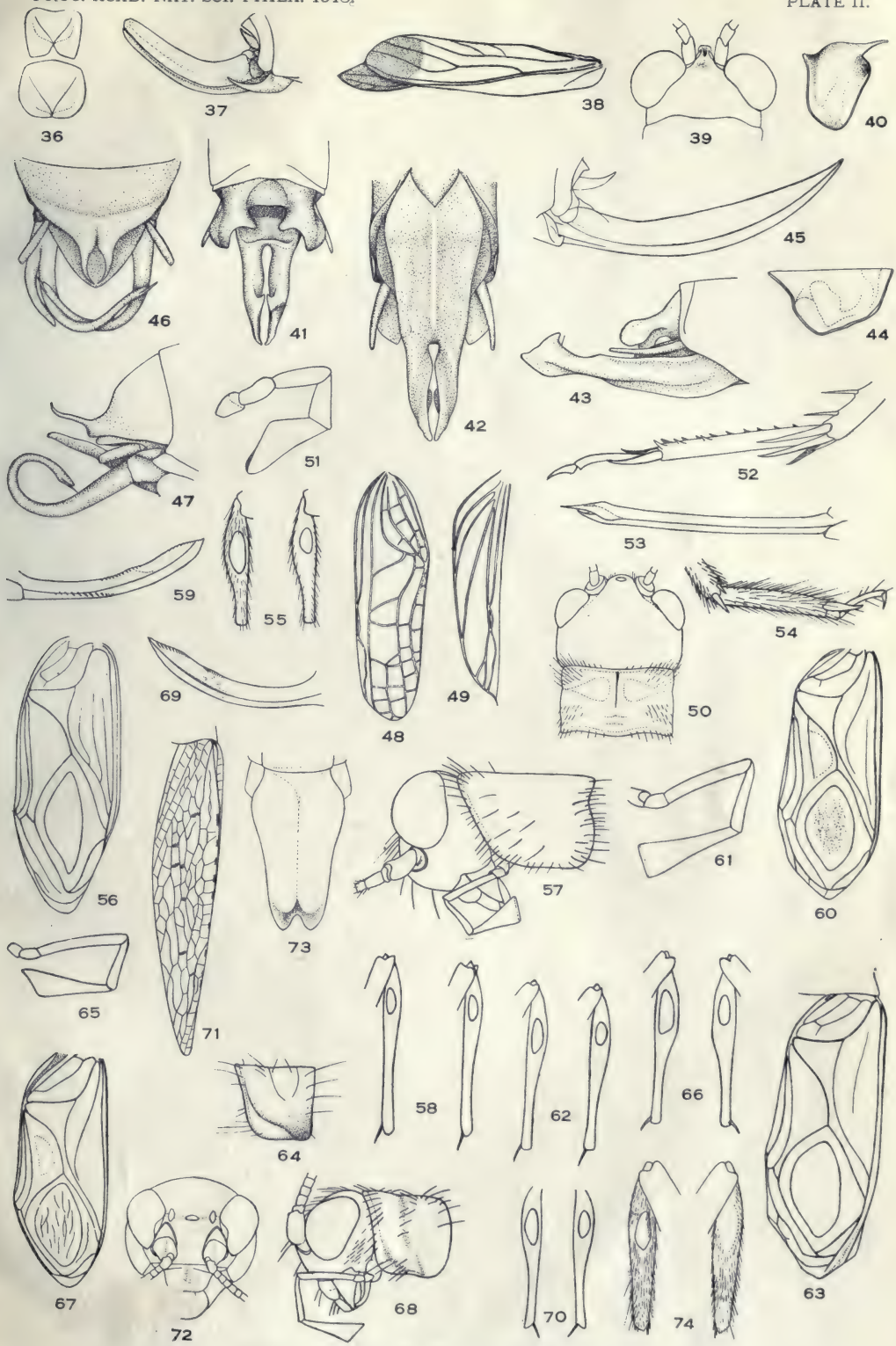
Fig. 71.—*Aphonomorphus surdus* new species. Dorsal field of tegmen of male (type). (×2½.)

Fig. 72.—*Aphonomorphus surdus* new species. Head of male (type). Cephalic view. (Greatly enlarged.)

Fig. 73.—*Aphonomorphus surdus* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)

Fig. 74.—*Aphonomorphus surdus* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

REHN. ORTHOPTERA FROM PARÁ.



REHN ORTHOPTERA FROM PARÁ.

TWO NEW SHELLS FROM HAYTI.

BY E. G. VANATTA.

Odontosagda abbotti n. sp. Figs. 1, 2.

Shell small, depressed, translucent white. Apex large, obtuse, spire low-conic, sutures distinct, whorls $4\frac{2}{3}$, slowly increasing, somewhat contabulate, body whorl convex, subangular above the periphery, contracted below. Surface smooth, indistinct, irregular, the longitudinal striæ, seen under a lens, without spiral sculpture. Umbilicus wide, deep, well-like, its width contained about 4.5 times in the diameter of the shell. Aperture lunate, peristome simple, acute, convexly arched above, depressed arcuate below. Columella slightly reflexed, parietal callus very thin. Palatal wall with traces of a callus at the periphery and base, near the peristome. At a distance of about one-fourth of a whorl within the aperture, two short, high, white teeth or lamellæ may be seen. These and a third tooth are visible through the translucent base. One very oblique transverse tooth is situated near the periphery, another longer one is placed spirally on the base, and traces of the third very short one may be indistinctly seen through the shell, on the columellar wall, close to the suture, within the umbilicus.

1

2

Alt., 1.22; diam., 2.1; aperture alt., .75; diam., .83 mm.

The types are in the collection of The Academy of Natural Sciences of Philadelphia, tray No. 118,240, from The General's Cave, one mile west of Jeremie, Hayti. Found in débris collected by Dr. W. L. Abbott at the base of a cliff about 300 yards from the seashore.

This species differs from *O. hilli* Pfr., of Cuba, which it resembles most in shape, by being smaller, the palatal lamellæ are shorter. The apex and umbilicus are also smaller. It also differs from *O. blandi* Weinl., of Hayti by having a more depressed spire, fewer whorls. It is also smaller, the palatal lamina near the periphery is not lunate the basal lamina is shorter and the umbilicus is larger.

Obeliscus abbotti n. sp. Fig. 3.

Shell elongate, subcylindrical, whorls 6, imperforate. Apex obtuse, very wide, large, suture impressed and crenulate, surface nearly smooth, under the lens irregularly longitudinally substriate. Aperture high, narrow, oval, outer lip, partially broken, thin, evenly arcuate, not very convex, base narrow, columella rather thick with an indistinct indication of a truncation at the base, parietal callus comparatively thick.

3

Alt., 5.56; diam., 1.5; aperture alt., 1.5; diam., .93 mm.

The types are in the Academy's collection, tray No. 118,244, from The General's Cave, west of Jeremie, Hayti. Found with the above species in débris collected by Dr. W. L. Abbott, in whose honor these two species are named.

Obeliscus abbotti differs from *O. swiftiana* Pfr. by being smaller, more cylindrical; the apex is more obtuse and the suture is crenulate.

BIRDS OF THE PANAMA CANAL ZONE, WITH SPECIAL REFERENCE TO A COLLECTION MADE BY MR. LINDSEY L. JEWEL.

BY WITMER STONE.

Through the generosity of several of its members the Academy of Natural Sciences has come into possession of a collection of some four hundred bird skins obtained by the late Lindsey Louin Jewel in the Canal Zone, Panama.

Mr. Jewel was stationed in the Zone from late in 1910 to the early part of 1913, engaged in engineering work, and had also been appointed Vice-Consul at Colon.

His beautifully prepared skins are accompanied by numerous notes on the habits, nests and eggs of many of the species. Unfortunately these do not cover all of the species, his death having prevented his return to the Zone, where he had hoped to complete his study of the bird life. They have, however, been used so far as they go in the following list, and as *all* the field notes, coloration of the soft points and description of the eggs and nests are to be credited to Mr. Jewel, it was thought unnecessary to make use of quotation marks; moreover, as there was frequently duplication in notes referring to several specimens of the same species, verbatim quotation was not practicable. Some few of Mr. Jewel's notes refer to specimens which were sent to the American Museum of Natural History, but they have been included wherever the species was unrepresented in the collection, Mr. W. DeW. Miller having kindly sent me a list of such specimens.

Mr. Jewel published an annotated list of the North American birds observed by him during his stay on the isthmus in *The Auk*, 1913, pp. 422–429, with a brief introduction describing the condition of the Zone at the time his collection was made, but did not identify any of the resident species. Some brief mention of his work and a list of birds of the Zone compiled by him from Ridgway's "Birds of North and Middle America" appeared in *The Canal Record* for January 28, 1914, pp. 219–220.

We have no record of a collection of birds having been made on the isthmus until 1847, when Lafresnaye described a number of specimens obtained there by DeLattre, a French collector, who was on his way to South America. This collection was purchased by Dr. Thomas B.

Wilson and is still preserved in this Academy, along with Dr. Wilson's other material. (Revue Zoologique, 1847, pp. 67–79.) No further collections were made in the Canal Zone so far as we are aware until the late fifties, when James McLeannan, of New York, who was stationed on the isthmus, began sending specimens to George N. Lawrence, who described them in the Annals of the New York Lyceum of Natural History and other scientific journals, issuing a final catalogue in three instalments. (Ann. N. Y. Lyc. Vol. VII, 1861–2, pp. 288–302, 315–334, 461–479, and Vol. VIII, pp. 294–360.)

During the winter of 1860–61 John R. Galbraith, son of William Galbraith, a well-known New York taxidermist, went to Panama and aided McLeannan in collecting for Mr. Lawrence. Some 390 species in all were obtained by the two collectors and their specimens are now in the American Museum of Natural History. In March, 1863, the noted British ornithologist, Osbert Salvin, visited McLeannan and in that year and later extensive collections were made for him and sent to England, all of which are now in the British Museum with the rest of the Salvin collection.

An account of the collections sent to him by McLeannan is published by Mr. Salvin in the Proceedings of the Zoological Society of London, 1864, pp. 342–373, and covers 272 species. From his introduction we learn that at the time of his visit McLeannan was trackmaster at Lion Hill (Loma del Leon) station on the Panama Railway, the second station after leaving Colon and about ten miles from the coast. It was situated "in the densest tropical forest, so wet that even in the dry season the trails were confined to the low hills, the swamps being impenetrable." Now we learn from Mr. Jewel that this famous locality is swallowed up in Gatun Lake.

In 1895, the Italian ornithologist Festa made a considerable collection at Punta de Sabana, Darien, and incidentally recorded a few species from Colon and Panama city.

In March, 1900, Mr. W. W. Brown, Jr., spent twenty-eight days at Loma del Leon, collecting for Mr. Outram Bangs, and secured 752 skins representing 148 species. He also secured a collection of 86 species in the vicinity of Panama city on the Pacific side of the isthmus, where the country is much drier with a scrubby growth.

At the same time that Mr. Jewel was making his collection Mr. E. A. Goldman visited the isthmus in the interests of the United States Biological Survey, but with the exception of descriptions of some new species obtained by him his collection has not yet been reported upon.

Mr. Jewel's collection represents 236 species and was made mainly

at Gatun, some three miles north of the historic Loma del Leon. Other localities where he collected were Agua Clara, Mindi and Mt. Hope, between Gatun and Colon; Toro Point, across the harbor from the latter city, and Ft. Lorenzo on the sea front just west of the Zone border. A few specimens were also secured at Tabernilla, almost half way across the isthmus, and at Pedro Miguel and Miraflores, nearer to Panama.

While the ornithology of the Canal Zone is supposed to be pretty well known, every large collection from the region contains a few species not hitherto reported, and in view of the increased interest in the country due to the opening of the canal it has seemed desirable to add to my report on Mr. Jewel's collection the names of such other species as have been recorded from the region, so that we may have a complete list of the avifauna. In making this compilation, in addition to the papers above quoted, the "British Museum Catalogue of Birds"; "Biologia Centrali-Americana" and Ridgway's "Birds of North and Middle America" have been consulted. It is possible that a few of the species recorded do not occur in the Canal Zone, as in some cases "Panama" has been understood as referring to the city while it may have been intended to denote the isthmus in general.

From the light that Dr. Frank M. Chapman has thrown upon the distribution of neotropical bird life in his "Distribution of Bird Life in Colombia" we now recognize the importance of what he terms "the Panama fault" and realize that many species are absent from the Canal Zone and its immediate vicinity which occur in the mountains of Chiriqui to the west and in the highlands of eastern Panama. As Chapman has shown, the subtropical and higher life zones are entirely lacking in the lower country of the Canal Zone, so that only the tropical fauna remains; subtropical species, therefore, which are usually quoted as occurring from Costa Rica to Ecuador have a gap in their range coextensive with the low ground of the isthmus.

In the list which follows the species not contained in the Jewel collection are placed in their proper systematic position, but have their numbers enclosed in brackets. North American migrants are marked with an asterisk.

TINAMIDÆ.

[1.] **Tinamus castaneiceps** Salvadori. Chestnut-headed Tinamou.

2. **Crypturus soui modestus** (Cabanis). Pileated Tinamou.

Female, Tabernilla, March 19, 1911. Iris brownish-yellow, bill fuscous lighter below, feet yellowish-green.

One of a pair flushed in a thicket by a stream. They usually run

and hide but fly strongly when forced, evidently common but hard to find. Have seen them also near Gatun. This bird contained an egg ready to lay, very large for the size of the bird.

ODONTOPHORIDÆ.

3. **Odontophorus guianensis marmoratus** (Gould).

Two males, Gatun, September 3, 1911, and February 22, 1912. Iris brown, bare skin of face orange, bill black, feet dark greenish-slate.

On September 3, a covey of nine was flushed from rocks in the forest. They fly straight away when disturbed and are strong on the wing. Never seen in the open.

CRACIDÆ.

[4.] **Crax panamensis** Ogilvie-Grant. Panama Curassow.

[5.] **Penelope cristata** (Linnæus). Crested Guan.

6. **Ortalis cinereiceps** (Gray). Gray-headed Guan.

Female, five miles south of Gatun, November 9, 1911. Iris grayish-brown, bill black-grayish at tip, feet steel-gray.

Shot from a flock of four.

COLUMBIDÆ.

[7.] **Columba rufina pallidicrissa** (Chubb). Pale-vented Pigeon.

[8.] **Columba subvinacea subvinacea** (Lawrence). Ruddy Pigeon.

[9.] **Columba nigrirostris** Sclater. Short-billed Pigeon.

10. **Columba speciosa** Gmelin. Scaled Pigeon.

Male, Gatun, May 21, 1911. Iris brown, bill coral-red with white tip, feet purplish.

Found in a low flat thicket on the bank of Gatun dam and flew in rather labored manner for the forest.

11. **Chaemepelia rufipennis rufipennis** (Bonaparte). Ruddy Ground Dove.

Male and female, Gatun, February 12 and 26, 1911. Iris red, bill light with darker tip, feet reddish-pink.

A very common species in low lands along streams, sometimes flying into the jungle growth when flushed. A nest found August 18, 1912, was a flat platform of twigs built on and between two fair-sized limbs of a tree eighteen feet from the ground in second-growth pasture. Eggs two, .89 x .65 and .86 x .66 ins.

12. **Chaemepelia minuta elaeodes** Todd. Plain-breasted Ground Dove.

A pair, Miraflores, March 5, 1911. Iris light yellowish-brown, bill grayish, feet pink.

13. Claravis pretiosa (Ferrari-Perez). Blue Ground Dove.

A pair, Gatun, April 20, 1911. Iris light pinkish-yellow, bill greenish with a dark line on the culmen and gonys, feet pink.

Female was about to oviposit.

14. Leptotila verreauxi verreauxi (Bonaparte). Verreaux's Dove.

Two males, Gatun, May 28, and Minti, October 7, 1911. Iris light yellowish-orange, bill black, feet coral red, circumorbital area deep blue.

The latter specimen is largely in the juvenal plumage.

The call of this bird was a single "coo," very deceptive as to distance, and in quality resembling two notes of a chord.

15. Leptotila cassini cassini (Lawrence). Cassin's Dove.

A male from Gatun, August 6, 1911; female, Trinidad River, March 12, 1911. Iris light yellow, bill black, circumorbital space coral-red, feet red.

Found in the forest along the trails. This bird has a peculiar habit of bobbing the head and tail, but the movement is not a movement of the entire body as in the sandpipers.

Nest a frail platform of sticks in a large bush, overhanging the trail through a heavily overgrown pasture, at Gatun. Egg, 1.15 x .83 ins.

[16.] **Oreopeleia montana** (Linnæus). Ruddy Quail Dove.

RALLIDÆ.

17. Aramides cajanea (P. L. S. Müller). Cayenne Wood Rail.

A male from the Chagres River, below Gatun, June 21, 1911, and a female from Gatun, April 28, 1912, are lighter colored than specimens from the Orinoco delta, especially as regards the gray of the throat and fore breast. Iris red, bill greenish at the tip passing into yellow basally, feet deep reddish-pink.

A nest found April 27, 1913, at Toro Point, on the edge of woods at the head of a small stream, was made from a bunch of leaves and trash lodged on top of the bushes, eight feet up. A few strips of dead banana leaves, some twigs and a few green leaves had apparently been added to the mass already there. There was one egg, 2.06 x 1.34 ins. The bird sat very close and would not leave until the bush was shaken.

***18. Porzana carolina** (Linnæus). Sora.

A female from Toro Point, October 1, 1911. Iris reddish-brown, bill yellowish-green, tarsi greenish-olive.

Shot on the bare beach at the foot of a cliff.

19. Creciscus albigularis (Lawrence). White-throated Crake.

Two males secured at Gatun, April 4, 1911, and April 14, 1912; also a jet black downy young from the same locality, September 21, 1911, evidently only recently hatched. Adult: iris reddish-brown, bill sooty-black above green on the sides and lighter below, feet greenish-black. Young: iris black, bill white, feet brownish-horn.

Found in heavy grass in dry field near a marshy flat. Bird had a striking whistle of alarm and a "gathering call" when running similar to that of the Bobwhite.

20. Ionornis martinicus (Linn).

Female, Gatun Lake, July 9, 1911. Iris reddish-brown, bill bright red with greenish-yellow tip and purplish-blue frontal shield, feet yellow.

Flushed from a small grassy island, dove when shot, but stayed under water but a short time.

HELIORNITHIDÆ.

21. Heliornis fulica (Boddaert). American Finfoot.

Female, Gatun Lake, February 23, 1913. Iris brown, lids red, bill red passing into white on lower part of the mandible, feet barred-black and yellowish-white.

A very shy bird. Its call is a peculiar "bark" of one to three notes. This specimen was nearly ready to incubate.

COLYMBIDÆ.

[22.] **Colymbus dominicus brachyrhynchus** Chapman. Mexican Grebe.

LARIDÆ.

***23. Hydrochelidon nigra surinamensis** (Gmelin). Black Tern.

Female, Gatun Lake, December 3, 1911. Iris brown, bill black, feet blackish-brown.

***24. Sterna hirundo** Linnæus. Common Tern.

Male, shot from a flock, Gatun Lake, December 3, 1911, and a solitary female, from same locality, June 9, 1912 (in Amer. Mus. Nat. Hist.). Iris brown, bill black lighter at the tip and reddish at base, feet light orange-brown.

CHARADRIIDÆ.

***25. Aegialitis semipalmata** (Bonaparte). Semipalmated Plover.

A pair from Toro Point, July 23, 1911, shot from a flock of eight on the mud flats. Iris black, bill black with a narrow yellow-orange band from the nostrils underneath the mandible in a half ring, feet greenish-yellow.

It was also present, August 4, 1912, and September 4, 1911.

[26.] **Aegialitis collaris** (Vieillot). Collared Plover.

*27. **Oxyechus vociferus vociferus** (Linnæus). Killdeer.

One specimen, Gatun, February 18, 1912.

RECURVIROSTRIDÆ.

*28. **Himantopus mexicanus** (P. L. S. Müller). Black-necked Stilt.

A female, Gatun, November 12, 1911. Iris reddish-brown, bill blackish, feet deep pink.

Observed for a week on the edge of the hydraulic fill of Gatun dam.

SCOLOPACIDÆ.

*29. **Numenius hudsonicus** Latham. Hudsonian Curlew.

A female, Gatun, October 18, 1911, shot from flock of four feeding in a pasture on grasshoppers and butterflies. Iris brown, bill dusky-greenish becoming black at the tip, feet grayish-blue.

*[30.] **Macrorhamphus griseus griseus** (Gmelin). Dowitcher.

*[31.] **Totanus melanoleucus** (Gmelin). Greater Yellowlegs.

*32. **Totanus flavipes** (Gmelin). Lesser Yellowlegs.

A solitary male obtained at Gatun, May 21, 1911, and a flock of half a dozen seen at the same place August 27, 1911. A female was also obtained at Mindi, October 7, 1911. Iris brown, bill black, feet yellow.

Frequented a grassy marsh below the dam.

*33. **Helodromas solitarius solitarius** (Wilson). Solitary Sandpiper.

Female, Gatun, September 10, 1911 (not preserved); male, Mt. Hope, April 13, 1913. Iris brown, bill greenish becoming black terminally, feet green.

A flock of four were seen September 10 in a small running stream.

*34. **Actitis macularia** (Linnæus). Spotted Sandpiper.

Specimens obtained at Gatun, February 22, September 4 and October 1, 1911, and April 28, 1912; also at Pedro Miguel, April 23, 1911, Toro Point, August 4, 1912.

The individual obtained April 23 alighted on a dead tree top, four feet above the water, an unusual action in a wader.

*35. **Bartramia longicauda** (Bechstein). Field Plover.

Two males, Gatun, October 12, 1911. Iris brown, bill yellowish with dusky tip, feet yellowish-green.

Flushed in an open field.

*36. **Ereunetes pusillus** (Linnæus). Semipalmated Sandpiper.

Female, Toro Point, September 4, 1911. Iris, bill and feet black.

One of a few associated with many *Pisobia minutilla* on the beach.

*37. **Tryngites subruficollis** (Vieillot). Buff-breasted Sandpiper.

One of a pair found on dry pasture land at Gatun, October 18, 1911. Iris brown, bill dusky-greenish, feet greenish.

*38. **Pisobia minutilla** (Vieillot). Least Sandpiper.

Two males, Toro Point, September 4, 1911. Iris brown, bill black, feet dusky-greenish.

Obtained from a flock of a dozen or more on the beach.

Another was obtained at Mt. Hope, August 31, 1913.

*39. **Pisobia maculata** (Vieillot). Pectoral Sandpiper.

Two females obtained at Mindi, in a grassy marsh, October 7 and 22, 1911. Iris black, bill blackish-green, feet greenish.

*[40.] **Pisobia fuscicollis** (Vieillot). White-rumped Sandpiper.

*41. **Gallinago delicata** (Ord.). Wilson's Snipe.

Male, Mindi, October 22, 1911, one of a bag of twelve killed in a grassy marsh. Iris brown, bill dusky-green tipped with black, feet yellowish-green.

JACANIDÆ.

42. **Jacana nigra** (Gmelin). Black Jacana.

Three specimens, male and female, Gatun Lake, July 9, 1911, where it was very common, and a female from Agua Clara, Trinidad River, March 12, 1911. A specimen in the American Museum of Natural History was obtained at Mindi, November 3, 1911. Iris greenish-yellow, bill greenish fading to pink at the base and yellow below at the base, frontal shield lavender, feet green washed with blue, wing spur bright yellow.

A common species on grassy knolls in the lake.

[43.] **Jacana melanopygia** (Sclater). Black-rumped Jacana.

EURYPYGIDÆ.

[44.] **Eurypyga major** Hartlaub. Greater Sun Bittern.

IBIDIDÆ.

[45.] **Harpiprion cayennensis** (Gmelin). Cayenne Ibis.

CICONIIDÆ.

[46.] **Mycteria americana** Linnæus. Wood Ibis.

ARDEIDÆ.

[47.] **Ardea herodias lessonii** Wagler. Great Blue Heron.

[48.] **Egretta candidissima** (Gmelin). Snowy Egret.

[49.] **Herodias egretta** (Gmelin). American Egret.

50. **Florida caerulea** (Linnæus). Little Blue Heron.

Two males, Chagres River, below Gatun, February 19, 1911, one in

the immature white plumage, the other in the adult blue. Iris bright yellow, bill light blue shading to black at the tip, feet greenish.

A most abundant species, to be seen at almost any time in almost any quantity.

51. Hydranassa tricolor ruficollis (Gosse). Louisiana Heron.

Female, Gatun, February 18, 1912. Iris bright yellow, bill sooty-black on the culmen, pale yellow at the gonys, bare skin yellow, feet greenish.

***52. Nycticorax nycticorax nævius** (Boddaert). Black-crowned Night Heron.

An immature female, Mindi, October 29, 1911. Dull gray and somewhat streaked below, but with the top of the head and interscapulum greenish-black.

[53.] Cochlearius zeledoni Ridgway. Zeledon's Boatbill.

[54.] Pilherodius pileatus (Boddaert). Capped Heron.

55. Butorides striata (Linnæus). Black-crowned Heron.

Two males, Gatun, June 9, 1912, and July 16, 1911. Iris bright yellow, bill black with yellow at the base and the gonys, feet yellow.

***56. Butorides virescens hypernotius** Oberholser. West Indian Green Heron.

Male, Gatun, September 17, 1911. Iris bright yellow, maxilla black with pale tomia, mandible greenish-yellow, feet greenish-yellow.

[57.] Tigrisoma lineatum (Boddaert). Tiger Bittern.

[58.] Tigrisoma cabanisi Heine. Cabanis' Tiger Bittern.

59. Ixobrychus exilis (Gmelin). Least Bittern.

Female, Mt. Hope, September 13, 1913. Iris bright yellow, bill dusky above, yellow below, feet yellowish.

A crippled bird, nearly starved.

***[60.] Botaurus lentiginosus** (Montagu). American Bittern.

ANATIDÆ.

[61.] Cairina moschata (Linnæus). Muscovy Duck.

[62.] Dendrocygna autumnalis (Linnæus). Black-bellied Tree Duck.

***[63.] Anas platyrhynchos** Linnæus. Mallard.

***[64.] Dafila acuta** (Linnæus). Pintail.

***65. Querquedula discors** (Linnæus). Blue-winged Teal.

Female, Mindi, October 22, 1911. Iris brown, bill greenish-black paler below, feet dull yellow with dark joints and webs.

This bird has rusty stains on the plumage of the entire lower parts. One of a flock on the Mindi marshes.

***66. Marila affinis** (Eyton). Lesser Scaup Duck.

Female, Gatun, November 25, 1911. Iris brown, bill blackish, feet bluish-gray with black joints and webs.

The species was abundant on Gatun Lake on November 26.

PHALACROCORACIDÆ.

67. Phalacrocorax vigua vigua (Vieillot). Brazilian Cormorant.

Female, Gatun Lake, December 17, 1911. One of a flock roosting in a dead tree in the water. It is in the brown immature plumage.

SULIDÆ.

68. Sula leucogastra (Boddaert). Booby.

Female in brown immature plumage secured at sea sixty miles north of Colon, December 4, 1910. Iris grayish-white, bill dark bluish-horn color lighter at the tip, tarsi bluish-white, feet yellowish.

PELECANIDÆ.

[69.] **Pelecanus occidentalis** Linnæus. Brown Pelican.

FREGATIDÆ.

[70.] **Fregata minor palmerstoni** (Gmelin). Pacific Man-o'-war Bird.

CATHARTIDÆ.

[71.] **Gypagus papa** (Linnæus). King Vulture.

[72.] **Cathartes aura aura** (Linnæus). Turkey Vulture.

[73.] **Catharista urubu** (Vieillot). Black Vulture.

FALCONIDÆ.

74. Ibycter americanus (Boddaert). Red-throated Caracara.

Male, Rio Indis, four miles from Gatun, November 19, 1911. Iris, bare skin of throat and face and tarsi orange red, claws black, bill yellow, cere grayish-blue.

[75.] **Milvago chimachima** (Vieillot). Yellow-headed Caracara.

***76. Circus hudsonius** (Linnæus). Marsh Hawk.

Female, Gatun, December 11, 1910. Iris dark brown, bill horn color black at tip, cere and feet yellow.

One of a pair which beat along the shores of Gatun Lake daily for a week or more. A common species in winter.

[77.] **Micrastur melanoleucus** (Vieillot). Black and White Hawk.

[78.] **Micrastur mirandollei** (Schlegel).

79. Micrastur guerilla interstes Bangs. Cassin's Barred Hawk.

Male, Agua Clara, May 19, 1912, and female, Gatun, August 27, 1911, both in immature plumage, are referred to this species. The male is marked above with indistinct buff transverse spots on the wings and interscapulum and with narrow dark-brown bars below. The female is plain buff except on the sides of the breast and flanks, where there are a few transverse brown bands partially obscured by the buff feathers. Iris grayish-brown, cere yellowish or olive-green,

bill horn color, mandible yellow at base almost all yellow in female, feet yellow.

The latter bird was shot from a perch in low bushes in the forest near a small marshy stream. Its stomach was filled with remains of slugs, batrachians and small lizards.

[80.] **Geranospizias niger** (DuBus). Blackish Crane Hawk.

[81.] **Accipiter collaris** Kaup. Semi-collared Hawk.

[82.] **Accipiter bicolor** (Vieillot). Four-banded Hawk.

*[83.] **Accipiter velox** (Wilson). Sharp-shinned Hawk.

*84. **Buteo platypterus** (Vieillot). Broad-winged Hawk.

Adult male, Gatun, December 13, 1911, and female in striped plumage, Gatun, November 30, 1911. Iris grayish-brown, bill black bluish at the base, cere greenish-yellow, feet yellow.

Male shot in the heavy forest, the other in a clearing near the edge of the forest.

*85. **Buteo swainsoni** Bonaparte. Swainson's Hawk.

Female, Mindi, October 22, 1911. Quite dark above and below. Iris brownish-gray, bill grayish-blue with dusky tip, cere dull greenish, feet pale yellow.

Another specimen was given to the U. S. Biological Survey.

86. **Asturina nitida** (Latham). Shining Buzzard Hawk.

Male, Gatun, November 3, 1911. This interesting specimen is in immature striped plumage and is referred to this species on the basis of comparison with adults, as I have no authentic specimens in this stage of plumage. The light bases and margins to the feathers of the head are pale buff, those of the back and wings more strongly rusty. Below the throat is nearly white, but the rest of the ground color tawny-buff. The brown spots are very coarse. The primaries are cream with blackish tips, with a rusty suffusion where the colors join. There are narrow dusky cross bars, fewer on the primaries than on the secondaries, so that the under part of the closed wing is almost uniform creamy buff, except for the dusky terminal portion. Iris grayish-brown, bill black, cere and feet yellow.

Stomach contained a large lizard and the gullet a fair sized mouse.

87. **Rupornis magnirostris ruficauda** (Sclater and Salvin). Large-billed Hawk.

Female, Trinidad River, eight miles south of Gatun, March 24, 1912. Iris bright yellow, bill black, bluish at base, cere and feet yellow.

[88.] **Busarellus nigricollis** (Latham). Black-collared Hawk.

[89.] **Urubitinga urubitinga** (Gmelin). Brazilian Eagle.

90. Urubitinga anthracina (Nitzsch). Mexican Black Hawk.

Male, Ft. Lorenzo, January 7, 1912. Iris brown, bill blue-black, base and cere and feet yellow.

Shot from a palm tree. It had been feeding on carrion in the marsh.

[91.] Leucopternis semiplumbea Lawrence. Semiplumbeous Hawk.

92. Leucopternis ghiesbreghti (DuBus). Ghiesbrecht's Hawk.

Female, Gatun, February 22, 1911, and another not now in the collection, July 28, 1912. Iris dark brown, bill grayish-blue dusky at tip, cere and orbital ring bluish, feet pale yellow.

Shot in the thick forest. Had a peevish whistled note. Another female was shot previously at the same spot; it is always found in the jungle timber, and had apparently just deposited eggs.

[93.] Morphnus guianensis (Daudin). Guiana Crested Eagle.

[94.] Thrasaetus harpyia (Linnæus). Harpy Eagle.

[95.] Spiziastur melanoleucus (Vieillot). Black and White Eagle.

[96.] Spizaetus ornatus (Daudin). Manduit's Hawk Eagle.

97. Spizaetus tyrannus (Wied.). Tyrant Hawk Eagle.

Female, Gatun, February 4, 1912. Iris bright orange, bill blue-black, cere slaty, toes yellow.

Shot in the forest.

98. Harpagus bidentatus (Latham). Double-toothed Hawk.

Male, Gatun, June 9, 1912. Iris purplish-red, bill black, slaty on the sides and beneath, cere greenish, tarsi yellow.

[99.] Herpetotheres cachinnans (Linnæus). Laughing Hawk.

[100.] Elanoides forficatus (Linnæus). Swallow-tailed Kite.

[101.] Leptodon uncinatus (Temmink). Red-collared Kite.

[102.] Ictinea plumbea (Gmelin). Plumbeous Kite.

***[103.] Falco columbarius** Linnæus. Pigeon Hawk.

104. Falco albigularis Daudin. White-throated Hawk.

Female, Toro Point, August 4, 1912. Iris brown, bill black, blue-gray at base, cere and feet rich yellow.

Shot flying along the beach.

***105. Cerchneis sparveria sparveria** (Linnæus). Sparrow Hawk.

Male, Gatun, January 29, 1911. Several others killed and given away—March 5, 1911, April 4, 1911.

[106.] Pandion haliaetus carolinensis (Gmelin). Osprey.

TYTONIDÆ.

107. Tyto perlata guatemalae (Ridgway). Central American Barn Owl.

Male, Gatun, August 1, 1911. Iris black, bill whitish ivory.

One of a pair living in ventilators of a building in the town. Always came out at dusk and flew in the same direction.

BUBONIDÆ.

[108.] **Rhinoptynx clamator** (Vieillot). Striped Horned Owl.

[109.] **Otus choliba** (Vieillot). Choliba Screech Owl.

[110.] **Otus vermiculatus** (Ridgway). Vermiculated Screech Owl.

[111.] **Pulsatrix perspicillata perspicillata** (Latham). Spectacled Owl.

[112.] **Ciccaba nigrolineata nigrolineata** Sclater. Black and White Owl.

[113.] **Ciccaba virgata virgata** Cassin. Cassin's Owl.

PSITTACIDÆ.

114. **Ara macao** (Linnæus). Scarlet Macaw.

A cage bird said to have been taken on the upper Trinidad.

[115.] **Ara chloroptera** Gray. Red, Blue and Green Macaw.

[116.] **Ara ambigua** (Bechstein). Buffon's Macaw.

[117.] **Ara severa** (Linnæus). Severe Macaw.

[118.] **Eupsittula ocularis** (Sclater and Salvin). Veragua Parrot.

[119.] **Pyrilia haematotis coccinicollaris** (Lawrence). Red-necklaced Parrot.

[120.] **Amazona autumnalis salvini** (Salvadori). Salvin's Parrot.

[121.] **Amazona ochrocephalus panamensis** (Cabanis). Panama Parrot.

122. **Amazona farinosa inornata** (Salvadori). Plain-colored Parrot.

Female, Gatun, June 4, 1911. Iris brown in young bird, red in adult; bill horn color with yellowish spot on side, cere grayish becoming darker with age, feet dark gray becoming yellow in adult, bare skin of chin and around the eye white.

Found in heavy forest sitting motionless in a large tree with two others, probably young. Gullet was filled with very hard white seeds.

123. **Pionus menstruus** (Linnæus). Blue-headed Parrot.

Female, Trinidad River, near Agua Clara, March 12, 1911. Iris brown, bill lighter at base and with a large red spot on the sides of the mandible, cere black.

A noisy species.

124. **Brotogeris jugularis** (Müller). Tovi Parrakeet.

Two females, Gatun, May 14, and Toro Point, April 2, 1911. Iris brown, bill and feet light gray-brown, cere very light ashy.

Remarkably swift in flight and usually shy.

ALCEDINIDÆ.

125. **Streptoceryle torquata torquata** (Linnæus). Ringed Kingfisher.

Female, Chagres River, four miles below Gatun, February 19, 1911. Eyes black, bill black, feet bluish-black.

Found all along the river. They are comparatively shy and hard to approach, dashing out of the foliage and holding close to the shore in the shadow of the banks.

*126. **Streptoceryle alcyon alcyon** (Linnæus). Belted Kingfisher.

Male, Toro Point, October 1, 1911. Iris brown, bill black, feet dark brown.

One of six or eight migrants.

127. **Chloroceryle amazona** (Latham). Amazon Kingfisher.

Male, Gatun River, July 8, 1911. Iris brown, bill and feet black. Shot three miles up the river, well into the forest.

128. **Chloroceryle americana isthmica** (Goldman). Isthmian Green Kingfisher.

Two females, Gatun, January 29 and April 18, 1911; male, Chagres River, near the sea, June 11, 1911. Iris dark brown, bill and feet black.

The most common Kingfisher.

[129.] **Chloroceryle inda** (Linnæus). Green and Rufous Kingfisher.

130. **Chloroceryle aenea aenea** (Pallas). Least Green Kingfisher.

Male, Gatun, July 9, 1911. Iris black, bill black with pale stripe on the gonys, feet sooty-brown.

MOMOTIDÆ.

131. **Urospatha martii semirufa** (Sclater). Greater Rufous Motmot.

Male, Gatun, August 18, 1912. Iris dark brown, bill and feet black.

Stomach contained a small red crab, entire.

132. **Momotus subrufescens conexus** (Thayer and Bangs). Small-billed Motmot.

Male, Gatun, March 17, 1912. Iris reddish-brown, bill black, feet flesh color.

133. **Electron platyrhynchus minor** (Hartert). Lesser Broad-billed Motmot.

Two males, Gatun, August 20, 1911, and April 28, 1912. Iris brown, bill and feet black.

Found in heavy forest.

[134.] **Hylomanes momotula obscurus** Nelson. Panama Tody Motmot.

NYCTIBIIDÆ.

135. **Nyctibius griseus panamensis** Ridgway. Panama Potoo.

Male, Gatun, August 11, 1912. Iris golden yellow, bill blackish, feet light brown.

[136.] **Nyctibius grandis** (Gmelin). Great Potoo.

CAPRIMULGIDÆ.

137. **Nyctidromus albicollis albicollis** (Gmelin). Parauque.

Male and female, Gatun, February 5, 1911, and April 7, 1912. Iris brown, bill brown, feet gray-brown.

May be flushed from the ground in almost any medium thick growth,

where it rests in the shade. Female specimen flushed from eggs laid on the bare ground on an old path. They measured 1.10 x .84 and 1.12 x .86 ins.

[138.] **Stenopsis cayennensis albicauda** (Lawrence). White-tailed Stenopsis.

[139.] **Antrostomus rufus rufus** (Boddaert). Rufous Goatsucker.

***140. Chordeiles virginianus virginianus** (Gmelin). Nighthawk.

Female, Gatun, October 3, 1911. Bill black, tarsi grayish.

One of a flock feeding overhead.

***141. Chordeiles acutipennis texensis** (Lawrence). Texas Nighthawk.

Male and female, Gatun, December 10, 1911.

MICROPODIDÆ.

142. Chaetura cinereiventris fumosa (Salvin). Smoky Swift.

Male, Gatun, May 14, 1911.

One of a flock feeding along the base of a hill over a wild banana plantation. Sexual organs well developed.

143. Chaetura chapmani Hellmayr. Chapman's Swift.

Two females, Gatun, July 9, 1911. Iris dark-brown, bill black, tarsi sooty-brown.

Two of a large flock feeding over the jungle below Gatun dam. This seems to be the first record of this species from Panama.

This species was described by Mr. Hellmayr (Bull. Brit. Orn. Club, xix, p. 62, 1907) from a Trinidad specimen collected by Dr. F. M. Chapman and recorded by him as *C. cinereicauda* Cassin (Bull. Amer. Mus. Nat. Hist., 1895, p. 324). Before describing it as distinct Mr. Hellmayr sent me a specimen of this and allied forms for comparison with Cassin's type. As he has stated, I found Cassin's specimen to be identical with *C. brachyura* (Jardine). At the same time I found a specimen of the proposed *C. chapmani* in the Academy collection, and a comparison of this with the Panama specimens before me positively confirms my identification. This extends the range of the species northward, as it was previously known only from Trinidad and French Guiana according to Hellmayr.

TROCHILIDÆ.

144. Threnetes ruckeri (Bourcier). Rucker's Hermit.

Two males, Gatun, February 12, 1911, and January 28, 1912. Iris black; maxilla black above with a narrow yellow strip on each side from the base, mandible yellow with a black tip, feet pink.

A bird of the jungle, a noisy species.

145. Glaucis hirsuta affinis (Lawrence). Lesser Hairy Hermit.

Two males and a female, Gatun, February 5 and May 7, 1911, and April 30, 1911. Iris black, maxilla black, mandible yellow with black tip, feet flesh color.

A bird of the thick jungle, always well below the top foliage.

Four nests found April 30 hung on blades of thorny palm leaves fastened with cobweb. May 7, one nest contained two pure white eggs, .35 x .61 and .34 x .62 in.

146. Phoethornis adolphi saturatus Ridgway. Dusky Hermit.

Two males, Gatun, April 9, 1911. Iris black, maxilla black, mandible bright yellow abruptly black near tip, feet flesh color.

Frequently seen but always near the same spot, a stretch of jungle just west of Gatun dam. They seldom fly over twelve inches from the ground, usually under the foliage, darting about like bees. They are very noisy, chirping constantly one note at a time and then several rapid notes of varying pitch. This sounds so like several birds that I have more than once crept close and looked long to find a single individual perched on a leaf stem a few inches from the ground, beating his little tail up and down as though he would break himself in two and chirping away for dear life. Once I saw one leave a leaf stem about eight inches from the ground and hanging on invisible wings revolve around and around as if he were a weight suspended at the end of a thread, first one way and then the other as if winding and unwinding. Then with great energy he flew in a figure eight back and forth over the same path, and the figure was not over eighteen inches long. (Jewel.)

147. Phoethornis longirostris cephalus (Bourcier and Mulsant). Nicaraguan Hermit.

Two males and a female, Gatun, February 12, May 7 and 30, 1911. Iris black, bill black with base of mandible yellow, feet pink.

A bird of the thick jungle. Its nest was hung on the underside of a broad leaf at the pendant tip. It was a compact cup of grass stalks wrapped onto the leaf tip with spiders' webs, the nest tapering down below the end of the leaf. The bird sits facing the leaf with his bill pointed straight up against it. The broad point of the leaf arches overhead like a roof. (Jewel.)

148. Phaeochroa cuvieri cuvieri (DeLattre and Bourcier). Cuvier's Hummingbird.

Two males, Gatun, April 14, 1914. Iris brown, bill black, basal half of mandible pink, feet black.

149. Florisuga mellivora (Linnæus). Jacobin Hummingbird.

Two males and two females, Gatun, April 14, May 30, and April 9, May 21, 1911. Iris, bill and feet black.

Stomach filled with very small insects of a greenish metallic lustre. A bird of the jungle.

150. Polyerata amabilis (Gould). Lovely Hummingbird

Three males, Gatun, January 1, February 11, 1912, and April 9, 1911. Iris dark brown, bill black yellowish below with black tip, feet black.

Shot in the jungle.

151. Lepidopyga caeruleogularis (Gould). Duchassain's Hummingbird.

Three males and a female, Gatun, March 2, 1911, and May 30, August 11, 1912; two other males, Mt. Hope, August 31, 1913, and Ft. Lorenzo, January 7, 1912. Iris and feet black, maxilla black, mandible pink with a black tip.

152. Saucerottia edwardi (DeLattre and Bourcier). Wilson's Hummingbird.

Three males, Gatun, April 14, 1911 (2), March, 1912. Iris, feet and maxilla black, mandible pale tipped with black.

Obtained in the forest.

[**153.**] **Saucerottia niveoventer** (Gould). Snowy-breasted Hummingbird.

154. Amazilia tzacatl tzacatl (De la Llave). Rieffer's Hummingbird.

Two males and two females, Gatun, July 4, 1911, May 30, 1912, and May 7, 1911, January 14, 1912. Iris and feet black, bill black purplish about the nostrils and below.

A nest found April 30 was on the horizontal limb of a shrub, five feet from the ground, a dainty cup of light yellow silky vegetable fiber, with a few gray lichens on the outside, all held together by a network of spiders' webs. Contained two fresh eggs May 7. Another nest about fifteen feet from the ground in similar situation found May 7 contained one egg and one young bird. (Jewel.)

It seems to the writer that it will be necessary to revert to the generic name *Amazilia* Lesson for these birds. When Dr. Oberholser proposed to adopt *Amizilis* Gray (Proc. Acad. Nat. Sci. Phila., 1899, p. 206) he asked me to verify some references for him and through a misunderstanding a quotation from Gray's large work, "Genera of Birds," was quoted as from his "List of Genera of Birds, 1840." This, however, does not affect the main question and is mentioned in order to correct an obvious error for which I am mainly responsible.

The generic name *Amizilis* does occur in Gray's 1840 "List" as correctly quoted in the 1910 edition of the "A. O. U. Check-List," *i. e.*, p. 14, with the following as its basis:

A. latirostris (Sw.) *n.* Ois. M., pl. 12. *Or. amizili* Less.

The A. O. U. committee accepted *Orthorhynchus amizili* Less. as the type on the basis of Gray's use of it alone in his 1855 edition of the

"List." As a matter of fact, in all editions of the "List" we find on the title page "with an indication of the typical species of each genus" and the citation of a species in any edition is rightly regarded as a type designation for the genus under which it is quoted. Where two names are cited as above the second is obviously intended as a synonym of the first and is usually a reference to a plate or figure of the species. Gray's own statement on the title page, moreover, proves that he was citing but a single species under each genus.

In the present case he misidentified the *Cynanthus latirostris* of Swainson, thinking it the same as *Orthorhynchus amizili* Lesson, and did not correct his error until the 1855 edition. Upon this basis *C. latirostris* becomes the type of *Amizilis* Gray, 1840, which, therefore, becomes a synonym of *Cynanthus* Swainson, 1827.

Amazilia Lesson, L'Echo du Monde Sav. ser. 2, viii, No. 32, Oct. 22, 1843, col. 757, seems to be the first name available for the present genus. Mr. Ridgway (Birds of N. and Mid-America, vol. V, p. 405) quotes five species as mentioned by Lesson, and of these I would designate *Ornismia cinnamomea* Less. (=*O. rutila* DeLattre) as the type of *Amazilia* Lesson.

155. Hylocharis eliciae (Bourcier and Mulsant). Elicia's Golden-tail.

Male, Gatun, July 28, 1912. Iris black, bill bright red, terminal third black, feet blackish.

[156.] Damophila panamensis Berlepsch. Panama Hummingbird.

157. Chlorostilbon assimilis Lawrence. Allied Emerald.

Male and female, Gatun, April 5, 1912, and October 14, 1911. Iris and feet black, maxilla black, mandible orange-brown tipped with black.

158. Thalurania colombica colombica (Bourcier). Colombian Wood Nymph.

Four males and two females, Gatun, May 14, June 4 (2), 1911, February 4, 1912, and May 28, 1911, July 28, 1912. Iris and bill black the latter yellowish at extreme base, feet black, under side of toes pink.

Found in the jungle.

[159.] Chalybura buffoni (Lesson). Buffon's Plumeleteer.

160. Anthracothorax nigricollis nigricollis (Vieillot). Black-throated Mango.

Two males and a female, Gatun, May 14, 21 and 28, 1911. Iris, bill and feet black.

In wild banana thickets on the edge of the jungle.

[161.] Heliothryx barroti (Bourcier and Mulsant). Barrot's Fairy.

[162.] Anthoscenus longirostris longirostris (Vieillot). Long-billed Star-throat.

[163.] **Lophornis delattrei** (Lesson). DeLattre's Coquette.

[164.] **Popelairia conversii aequatorialis** (Berlepsch and Taczanowski). Salvin's Thorn-tail.

TROGONIDÆ.

165. **Curucujus massena** (Gould). Massena Trogon.

Two males and two females, April 13, 1911, March 2, 1913, and June 11, 1911, March 2, 1913. Iris brownish-yellow in male, brown in female, bill red in male; mandible yellow, maxilla black in female, feet grayish-brown.

Female, June 11, contained an egg nearly ready to deposit, pure glossy white.

[166.] **Curucujus melanurus macrourus** (Gould). Large-tailed Trogon.

[167.] **Curucujus clathratus** (Salvin). Lattice-tailed Trogon.

168. **Trogon strigilatus chionurus** (Sclater and Salvin). White-tailed Trogon.

Male, Gatun, September 3, 1911. Iris dark brown, eyelids light blue, bill dull yellowish-green with a sooty terminal area, feet whitish.

Found in open forest.

169. **Chrysotrogon caligatus** (Gould). Gartered Trogon.

Male, Rio Trinidad, March 31, 1912. Iris brown, eyelids yellow, bill greenish-gray.

170. **Trogonurus curucui tenellus** (Cabanis). Graceful Trogon.

Two males and a female, Gatun, August 6 (pair), December 3, 1911. Iris brown or black, eyelids grayish-blue, bill yellowish-green, feet grayish-lead.

Found in heavy forest.

CUCULIDÆ.

*171. **Coccyzus americanus americanus** (Linnæus). Yellow-billed Cuckoo.

Female, Mindi, October 22, 1911.

172. **Piaya cayana thermophila** (Sclater). Central American Squirrel Cuckoo.

Female, Toro Point, March 3, 1912. Iris red, eyelids greenish-yellow, bill greenish-yellow, feet blackish-slate.

[173.] **Neomorphus salvini** Sclater. Salvin's Ground Cuckoo.

174. **Coccycua rutila panamensis** (Todd). Panama Cuckoo.

Male, Gatun, February 27, 1912. Iris and eyelids red, bill greenish-yellow, feet greenish-gray, mouth black inside.

[175.] **Dromococcyx phasianellus** (Spix). Pheasant Cuckoo.

[176.] **Crotophaga sulcirostris** Swainson. Groove-billed Ani.

177. **Crotophaga ani** Linnæus. Ani.

A pair, Gatun, August 11, 1912, and a male, Mt. Hope, June 1, 1913. Iris brown, bill and feet black.

A nest belonging to these birds in bush three feet from ground, a

bulky cup of sticks, weed stalks with rootlets inside, and a few green leaves partly covering the eggs, which were five in number, 1.37 x 1.01 to 1.46 x 1.05 ins., blue covered with white chalky deposit. The bird slipped off and crawled away through the weeds.

178. Tapera naevia excellens (Sclater). Northern Striped Cuckoo.

Male, Gatun, November 5, 1911. Iris light reddish-brown, maxilla brown, black on the culmen, mandible pale-horn, feet grayish-blue.

Stomach filled with grasshoppers.

CAPITONIDÆ.

179. Capito maculicoronatus maculicoronatus Lawrence. Spotted-crowned Barbet.

Male, Mt. Hope, February 22, 1913. Iris brown, bill and feet blue-gray.

RAMPHASTIDÆ.

[180.] Ramphastos swainsonii Gould. Swainson's Toucan.

[181.] Ramphastos ambiguus Swainson. Wagler's Toucan.

182. Ramphastos piscivorus brevicarinatus (Gould). Short-tailed Toucan.

Two males, Gatun, July 4 and 30, 1911. Iris bottle-green, bill yellowish-green with a triangular orange streak on the side of the maxilla, mandible bluish at base shading into the yellowish-green subterminally, ends of both blood red, a narrow black band all around the base, bare skin around the eye and throat green, feet bluish-green.

Call is loud and piercing, repeated rapidly and almost constantly.

[183.] Selenidera spectabilis Cassin. Cassin's Aracari.

184. Pteroglossus torquatus torquatus (Gmelin). Collared Aracari.

Male, Gatun, February 22, 1911. Iris bright yellow, bare skin around the eye and lores dark red, bill with a narrow white band around the base, mandible dark-horn color with one light spot beneath, maxilla black at end with a black stripe the full length of the culmen, sides lighter with reddish-brown shading near base, edge of "teeth" black, feet olive-green.

Shot on the edge of the jungle.

GALBULIDÆ.

[185.] Jacamerops aurea (Müller). Great Jacamar.

BUCCONIDÆ.

186. Notharchus tectus subtectus (Sclater). Black-breasted Puff Bird.

Three females, Gatun, January 27, 28, 1912, and March 2, 1913. Iris brown, bill black, feet blue-black.

Stupid birds found in second growth, usually feeding on termites' nests, fluttering to the nest and then back to their perches.

[187.] **Notharchus hyperrhynchus dysoni** (Sclater). Dyson's Puff Bird.

[188.] **Notharchus pectoralis** (Gray). Black-breasted Puff Bird.

[189.] **Ecchaunornis radiatus fulvidus** (Salvin and Godman). Fulvous Puff Bird.

190. **Malacoptila panamensis panamensis** Lafresnaye. Panama Malacoptila.

Male, Agua Clara, May 19, 1912, and female, Gatun Lake, March 30, 1913. Iris red, bill dusky above greenish below, feet grayish-green.

[191.] **Monasa fidelis** Nelson. Golden Nun Bird.

[192.] **Monasa similis** Nelson. Cerro Azul Nun Bird.

[193.] **Nonnula frontalis** Sclater. Panama Nonnula.

PICIDÆ.

194. **Centurus subelegans wagleri** (Salvin and Godman). Wagler's Woodpecker.

Three males, Tabernilla, March 19, Miraflores, March 5, and Toro Point, April 2, 1911, and female, Gatun, September 10, 1911. Iris brown, bill black, feet dark olive.

The specimen taken March 19 was one of a brood just leaving a nest in a dead stub about eighteen feet from the ground in an open field. Another nest in a hole, fifteen feet up in dead stub, April 28, 1912, contained two eggs, .94 x .70 and .93 x .69 in.

195. **Melanerpes pucherani pucherani** (Malherbe). Pucherani's Woodpecker.

Two males, Gatun, April 4 and May 30, 1911. Iris brown, bill black, feet greenish-gray.

First bird had nest hole in dead tree in a clearing.

[196.] **Chloronerpes callopterus** Lawrence. Panama Woodpecker.

197. **Celeus loricatus loricatus** (Reichenbach). Fraser's Woodpecker.

A pair, Mindi, October 22, 1911. Iris reddish-brown, bill pale greenish-yellow with dusky culmen, feet gray-green.

198. **Ceophloeus lineatus mesorhynchus** (Cabanis and Heine). Panama Pileated Woodpecker.

Male, Mt. Hope, August 31, 1913, and male, Gatun, November 12, 1911. Iris yellowish-white, bill brown, feet grayish-blue.

199. **Scapaneus malherbii** (Gray). Malherbe's Woodpecker.

A pair, Gatun, November 12, 1911. Iris golden-yellow, bill brown, feet grayish-blue.

200. **Picuminis olivaceus panamensis** Ridgway. Panama Piculet.

Female, Gatun, May 28, 1911. Iris brown, bill black, feet greenish. Young male, Mindi, September 17, 1911.

FORMICARIIDÆ.

201. **Cymbilaimus lineatus fasciatus** Ridgway. Fasciated Ant-Shrike.

Female, Gatun, May 26, 1912. Iris carmine, bill black above gray below, feet blue-gray.

202. Taraba transandeana transandeana (Sclater). Holland's Ant-Shrike.

Male, Rio Siri, twenty miles from Gatun, November 19, 1911, and female, Gatun, March 29, 1911. Iris brownish-orange, bill black, feet bluish-gray. Female, Gatun, March 29, 1911. Iris red-orange.

Stomach of latter specimen contained many ants and a lizard three inches and a half in length, the legs and tail of which had been cut off and swallowed separately.

203. Thamnophilus radiatus nigricristatus (Lawrence). Black-crested Ant-Shrike.

Male, Tabernilla, March 19, 1911. Iris dull greenish-yellow, bill black above, bluish below, feet dark-bluish. Female, Gatun, April 30, 1911. Iris light yellow.

Found in clearings near the jungle.

204. Erionotus punctatus atrinucha (Salvin and Godman). Slaty Ant-Shrike.

Two males and two females, Gatun, July 30, 1911, February 11, 1912, and May 7, May 30, 1911. Iris brown, bill black above blue-gray below, feet grayish-blue.

Nest found May 7, 1911, in the horizontal fork of a horizontal limb, twelve feet from the ground, in a thick jungle. A very frail and pensile cup of grass stalks covered over on the sides loosely but heavily with fuzzy green moss, bottom so thin that there seemed danger of the eggs falling through. Contained one egg, .64 x .85 in., white, with a broad wreath of rufous brown spots at the larger end.

A bird of the jungle.

205. Microrhopias boucardi virgata (Lawrence). Panama Ant-Wren.

Female, Gatun, January 21, 1912. Iris black, bill black with blue tomial stripe, feet blue-gray.

A noisy, active, arboreal species, an inhabitant of the jungle.

206. Myrmotherula surinamensis (Gmelin). Surinam Ant-Wren.

Female, Rio Siri, March 31, 1912. Iris brown, bill brownish-black paler below, feet blue-gray.

Found in a clearing along the bank of the river. Nest pensile at end of slender branch six feet from ground, made of fine grasses with curtain of green moss on exposed side. Eggs two, July 13, 1912, .67 x .51 and .69 x .53 in., grayish-white, heavily speckled, mottled and washed with shades of cinnamon-brown, with a heavier wreath around the larger end.

[207.] **Myrmotherula pygmaea** (Gmelin). Pigmy Ant-Wren.

208. Cercomacra nigricans Sclater. Black Tyrannine Antbird.

Two males, Colon, February 25, 1913, Toro Point, August 4, 1912. Iris brown, bill black, feet slaty.

209. Cercomacra tyrannina tyrannina (Sclater). Tyrannine Antbird.

Female, Gatun, July 30, 1911. Iris grayish-brown, bill black above pale grayish-brown below, feet blue-gray.

Shot in a forest thicket.

[210.] Myrmopagis melaena (Sclater). Black Ant-Wren.

211. Myrmopagis fulviventris (Lawrence). Lawrence's Ant-Wren.

Three males and a female, Gatun, May 14, 1911, January 21, July 21, 1912, and June 25, 1911. Iris light yellow, bill bluish-black lighter below, feet pinkish, toes blue.

Found in low wet forest, near the ground, creeping about the shrubbery like a warbler or vireo.

212. Myrmeciza boucardi panamensis Ridgway. White-bellied Antbird.

Male and female, Tabernilla, March 19, 1911, and Pedro Miguel, May 5, 1912. Iris reddish-brown, bill black, feet pale.

The pair collected March 19 had their stomachs filled with ants and I watched them for some time hopping back and forth along a trail of leaf-cutter ants.

213. Myrmeciza exsul exsul Sclater. Sclater's Antbird.

Two males and a female, Gatun, July 2, 1911, March 24, 1912, and August 6, 1911. Iris brown, skin around the eye blue, bill black, feet bluish-gray.

A noisy species, inhabiting the thick jungle.

214. Ramphocaenus rufiventris rufiventris. Northern Long-billed Ant-Wren.

Female, Gatun, June 25, 1911. Iris brown, bill grayish-brown, feet blue-gray.

A forest bird.

[215.] Microbates cinereiventris semitorquatus (Lawrence). Half-collared Ant-Wren.

[216.] Anaplops bicolor (Lawrence). Bicolored Ant-Thrush.

217. Gymnocichla nudiceps nudiceps (Cassin). Bare-crowned Antbird.

Two males, Gatun, February 5 and April 9, and one Tabernilla, April 8, 1911. Iris dark brown, bill black, feet blue-gray.

Several individuals were seen in the jungle climbing along roots and low stems; never saw one on the ground.

218. Hylophylax naevioides (Lafresnaye). Spotted Antbird.

Two males, Gatun, May 14 and August 20, 1911. Iris brown, bill black, feet blue-gray.

Nest found in fork of small bush in the forest, about four feet from the ground, a thin pensile cup containing two nearly feathered young.

219. Formicarius moniliger panamensis Ridgway. Panama Antbird.

Female. Iris brown, bill black, feet brownish, bare skin pale bluish-gray.

[220.] **Phaenostictus mcleannani mcleannani** (Lawrence). McLeannan's Ant-Thrush.

221. Pittasoma michleri michleri Cassin. Michler's Ant-Pitta.

Male and female, Gatun, July 21, 1912, and August 13, 1911. Iris brown, bill black whitish below, feet blue-gray.

A shy species found in the heavy jungle. Had a very loud penetrating whistled call, "*qua, qua, qua,*" etc., slower toward the end, gave it several times on the ground and then flew to a perch about twenty feet up and repeated it several times more.

[222.] **Hylopezus perspicillatus perspicillatus** (Lawrence). Lawrence's Antbird.

DENDROCOLAPTIDÆ.

[223.] **Synallaxis pudica pudica** Sclater. Slaty Synallaxis.

224. Automolus pallidigularis pallidigularis Lawrence. Pale-throated Automolus.

Male, Gatun, August 13, 1911. Iris brown, bill dusky-horn, feet grayish-olive.

Shot on the ground in the forest. Nest on open tops of twigs, dead leaves, etc., lined with fine grass, slightly elbow-shaped, and about twelve inches long; situated in a tree fork, seven feet up; eggs, two fresh, .83 x .62 in.

225. Xenops genibarbis mexicanus (Sclater). Mexican Xenops.

Three males, Gatun, November 30, 1911, January 21 and May 26, 1912. Iris brown, bill black, feet dark blue-gray.

Found in the forest.

226. Sclerurus guatemalensis (Hartlaub). Guatemalan Sclerurus.

Two males, Gatun, August 20, 1911, and February 22, 1912. Iris dark brown, maxilla black, mandible pale brownish-yellow with dusky tip, feet blackish-brown.

Nest found August 20 was elbow-shaped, made of twigs, leaf skeletons, weed stalks, rootlets, etc., lined with fine leaf skeletons and four feathers. Eggs, .97 x .64 and .92 x .61 in., glossy white, smaller one very sparingly specked with deep rich brown, larger one more heavily marked with spots and specks of olive-brown.

[227.] **Sclerurus mexicanus mexicanus** Sclater. Mexican Sclerurus.

228. Glyphorhynchus cuneatus pectoralis (Sclater). Northern Wedge-bill.

Male and female, Gatun, July 21, 1912, and March 22, 1911. Iris brown, bill blackish, feet bluish-black.

Found creeping about tree trunks in heavy jungle.

[229.] **Deconychura typica** Cherrie. Cherrie's Dechonicura.

[230.] **Dendrocincla homochroa ruficeps** (Sclater and Salvin). Panama Ruddy Dendrocincla.

231. Dendrocincla lafresnayi ridgwayi (Oberholser). Brown Dendrocincla.

Two males, Gatun, May 21 and August 20, 1911. Iris grayish-brown, bill black, gonys light blue, feet blue.

In company with the next species on tree trunks in the forest.

[232.] **Dendrocolaptes sancti-thomae sancti-thomae** (Lafresnaye). Barred Wood-Hewer.

[233.] **Xiphorhynchus punctigulus punctigulus** (Ridgway). Spotted-throated Wood-Hewer.

234. Xiphorhynchus nanus nanus (Lawrence). Lawrence's Wood-Hewer.

Two males and two females, May 21 and June 25, 1911; March 29, 1911, and July 21, 1912. Iris brown, bill blackish, feet bluish-horn color.

A rather common forest bird.

235. Xiphorhynchus lacrimosus lacrimosus (Lawrence). Black-striped Wood-Hewer.

Female, Gatun, November 12, 1911. Iris brown, maxilla horn color, mandible pale bluish-white, feet bluish-gray.

Shot from a tree trunk in the submerged area of Gatun Lake.

[236.] **Picolaptes lineaticeps lineaticeps** Lafresnaye. Streaked-headed Wood-Hewer.

237. Campylorhamphus venezuelensis (Chapman). Venezuelan Sicklebill.

Male, Gatun, April 14, 1911. Iris brown, bill light reddish-brown, feet fuscous.

Was picking dead wood from the rotted end of a tree limb, searching for boring insects or larvæ.

TYRANNIDÆ.

238. Copurus leuconotus Lafresnaye. White-backed Copurus.

Male and female, Gatun, February 18, 1912. Iris brown, bill and feet black.

[239.] **Placostomus superciliaris** (Lawrence). Lawrence's Spade-billed Flycatcher.

240. Craspedoprion aequinoctialis (Sclater). Equinoctial Flycatcher.

Two females, Gatun, December 18, 1910, and August 6, 1911. Iris black, bill black above pinkish below, feet gray-blue.

Found in wild banana thickets and in the forest.

[241.] **Rhynchocyclus marginatus** Lawrence. Yellow-margined Flycatcher.

[242.] **Rhynchocyclus cinereiceps** (Sclater). Gray-headed Flycatcher.

243. Rhynchocyclus flavo-olivaceus Lawrence. Yellow-olive Flycatcher.

Male and female, Gatun, July 2 and May 28, 1911. Iris brownish-gray, bill black above whitish below, tarsi grayish-brown.

A forest species.

Nest hung loosely from a branch over the water, composed of a mass of very long brown fibers, entrance from the bottom, passage extending up about eight inches to nest proper, which was compactly built; contained three young May 28. Another nest exactly like this one was placed a few feet below, close to the water and contained one egg, light reddish-brown, with deeper colored spots forming a wreath at the larger end. The lower nest had been water-soaked. The female specimen was sent to the American Museum of Natural History.

244. Myiopagis placens accola Bangs. **Panama Placid Flycatcher.**

Male, Gatun, October 17, 1911. Iris brown, bill brown above pale below, feet brownish-black.

Shot from a small hedge near the lake shore. Specimen not in the collection.

245. Todirostrum cinereum finitimum Bangs. **Northern Tody Flycatcher.**

Male and female, Gatun, February 27, 1912, and April 21, 1911. Iris light yellow, bill black, base and tip of mandible white.

Nest found late in March, suspended from tip of twig ten feet from the ground, pensile and shaped like an inverted pear, opening on the side at about one-third the height. Nest ten and a half inches high and three in outside diameter at bottom, made of plant fibers, weed bark and fine grasses, covered on exposed side with brown fuzzy seeds. Progress in building was very slow but on April 21 it contained two eggs, .46 x .63 in. Two other nests contained two eggs each—April 30, 1911, and June 23, 1912.

[246.] Todirostrum nigriceps Sclater. **Black-headed Tody Flycatcher.**

247. Todirostrum schistaceiceps Sclater. **Slate-headed Tody Flycatcher.**

Male and female, Pedro Miguel, May 5, 1912, and a male, Gatun, February 16, 1912. Iris brown, bill black paler below, feet blue-gray.

[248.] Oncostoma cinereigulare (Sclater). **Bent-billed Flycatcher.**

249. Oncostoma olivaceum (Lawrence). **Lawrence's Bent-billed Flycatcher.**

Two males and a female, March 26, November 3 and November 26, 1911. Iris yellowish-white, bill dusky paler below, feet grayish.

Has a peculiar clear note, a short song or trill of several notes. Found in the dry jungle and in groves.

250. Atalotriccus pilaris pilaris (Cabanis). **Pigmy Flycatcher.**

Two males, Pedro Miguel, April 23, 1911, and May 5, 1912. Iris yellowish-white, bill dusky paler below, feet pale-brownish.

Found in second growth. Call a trill, resembling the last syllable of the Wood Pewee's note (*Myiochanes virens*) prolonged.

251. Pipromorpha oleaginea parca (Bangs). **Bangs' Pipromorpha.**

Two males and a female, Gatun, July 4, November 30, May 14, 1911. Iris brown, bill black lighter below, feet brownish-flesh.

A forest species.

Nest found May 14 hung on a long slender vine between the trunks of large trees, about six feet up. A long pear-shaped structure with entrance on the side, made of green moss and fine grasses. Eggs three, pure white, .58 x .78, .57 x .76 and .56 x .75 in.

252. Mionectes olivaceus olivaceus Lawrence. Olivaceous Mionectes.

Male, Gatun, August 20, 1911. Iris brown, bill black paler basally and below, feet light grayish-brown.

Found in the forest.

[253.] Leptopogon pileatus Cabanis. Brown-capped Leptopogon.

[254.] Leptopogon flavovirens Lawrence. Yellow-green Leptopogon.

[255.] Capsiempis flaveola (Lichtenstein). Yellow Flycatcher.

[256.] Tyranniscus vilissimus parvus (Lawrence). Lesser Paltry Flycatcher.

257. Camptostoma pusillum flaviventre (Sclater and Salvin). Yellow-bellied Camptostoma.

Two males, Gatun, April 21, 1911, and May 26, 1912. Iris brown, bill fuscous paler below, tarsi black.

Shot from a small tree in an open marshy flat.

258. Elaenia martinica subpagana (Sclater and Salvin). Northern Elaenia.

Two females, Gatun, April 21, 1912, and Pedro Miguel, April 23, 1911. Iris brown, bill fuscous lighter below, feet blackish.

Found on the edge of swampy thickets.

Nest found April 23 saddled on a horizontal limb eight feet from the ground; a shallow and compact cup three inches in diameter, made of fine rootlets, twigs, etc., covered with green moss and gray lichens and lined with dove feathers. Two eggs, .64 x .86 in., white, with small cinnamon-brown blotches and spots in a wreath at the larger end. Another nest at Mt. Hope, April 13, 1913, was exactly like this one; eggs, two.

259. Elaenia chiriquensis chiriquensis Lawrence. Lawrence's Elaenia.

A male and female, Gatun, July 2, 1911, January 27, 1912, and a female, Miraflores, March 5, 1911. Iris brown, bill fuscous lighter below, feet bluish-black.

260. Legatus albicollis (Vieillot). Striped Flycatcher.

Male, Gatun, May 2, 1911. Iris brown, bill and feet black.

Shot on the edge of the jungle.

[261.] Sublegatus glaber Sclater and Salvin. Smooth Flycatcher.

262. Myiozetetes cayanensis cayanensis (Linnæus). Cayenne Flycatcher.

Three females, Gatun, January 29, May 21 and July 16, 1911. Iris brown, bill and feet black.

Nest adorned like others of the genus and contained one egg March 17, 1912, .62 x .87 in. Another, May 21, 1911, contained three eggs, .63 x .84 and .64 x .85 in.

Found in a marshy thicket. On January 29 there was a large flock feeding in the tree tops in wet woodland.

263. Myiozetetes texensis columbianus (Cabanis and Heine). Colombian Flycatcher.

Two males and two females, February 12, April 9, 1911, and April 14, 1911, April 21, 1912. Iris light yellow, bill and tarsi black.

A bird of the open, and never found far from water.

Nest on horizontal stem of a bush leaning over the water, eight feet above the surface, constructed of plant bark, weed stalks and grasses, lined with very fine grass, bulky but compact, opening on side, nearly spherical, six inches in diameter. Contained three fresh eggs April 9, .64 x .90 and .68 x .94 in., white, finely speckled with cinnamon-brown. Another exactly similar nest found April 14 in same situation held two fresh eggs.

264. Myiozetetes granadensis Lawrence. Gray-capped Flycatcher.

Male, Gatun, July 2, 1911. Iris gray, bill and feet black.

Nest as in the last species.

Found in thickets.

265. Pitangus lictor (Lichtenstein). Lictor Flycatcher.

Female, Gatun, July 9, 1911. Iris brown, bill and feet black.

Contained an egg nearly ready for deposit.

[266.] Coryphotriccus albovittatus (Lawrence). White-ringed Flycatcher.

267. Myiodynastes maculatus nobilis (Sclater). Noble Flycatcher.

Two males and a female, Gatun, November 26, 1911, March 30, 1913, and November 30, 1911. Another not in the collection was taken January 21, 1912. Iris brown, bill black above pinkish below with black tip, feet bluish-black.

Found in the jungle and in clearings along the edge.

[268.] Myiodynastes luteiventris Sclater. Sulphur-bellied Flycatcher.

269. Megarynchus pitangua mexicanus (Lafresnaye). Boat-billed Flycatcher.

Female and young, Ft. Lorenzo, June 2, 1911. Iris brown, bill and feet black.

Nest belonging to these birds was a shallow mass of sticks, thirty-five feet up in a tree.

[270.] Onychorhynchus mexicanus fraterculus Bangs. Colombian Royal Flycatcher.

[271.] Cnipodectes subbrunneus (Sclater). Brown Flycatcher.

[272.] Cnipodectes minor Sclater. Lesser Brown Flycatcher.

273. Terenotriccus erythrurus fulvigularis (Salvin and Godman). Fulvous-throated Flycatcher.

Two females, Gatun and Rio Trinidad, August 6, 1911, March 31, 1912. Iris brownish-black, bill sooty above whitish below, feet buffy.

Found in the forest.

274. Myiophobus fasciatus furfurosus (Thayer and Bangs). Bran-colored Flycatcher.

Male and female, Gatun, March 26 and November 3, 1911. Iris brown, bill black lighter below, feet black.

In second growth thickets and in thick jungle.

275. Myiobius barbatus atricaudus (Lawrence). Black-tailed Myiobius.

Male and female, Gatun, June 25 and August 13, 1911. Iris black, bill black above, mandible grayish-blue with black tip, feet dark gray.

In thickets on the forest edge. Nest a pendant bell-shaped structure with entrance beneath the passage going up and over into the nest cavity; made of dead leaves and fine vegetable fiber, lined with vegetable silk and fine fibers. Situated on a branch overhanging a stream in the forest. Eggs two, rich deep rufous, wreathed about the larger end with deeper shade of the same, .65 x .50 in.

Another pair found building July 30 had finished their nest by August 6. Eggs two, .64 x .50 and .67 x .50 in. Location and materials exactly as in the former one.

[276.] Myiobius xanthopygus sulphureipygius (Sclater). Sulphur-rumped Myiobius.

***[277.] Empidonax flaviventris** (Baird). Yellow-bellied Flycatcher.

***[278.] Empidonax virescens** (Vieillot). Acadian Flycatcher.

[279.] Empidonax albigularis Sclater and Salvin. White-throated Flycatcher.

***[280.] Empidonax minimus** (Baird). Least Flycatcher.

***[281.] Empidonax traillii traillii** (Audubon). Traill's Flycatcher.

***[282.] Empidonax traillii alnorum** Brewster. Alder Flycatcher.

***[283.] Myiochanes richardsoni richardsoni** (Swainson). Western Wood Pewee.

***[284.] Myiochanes virens** (Linnæus). Wood Pewee.

Male, Gatun, November 3, 1911. Iris brown, bill black above yellow below, feet black.

One of several migrants, calling repeatedly. Specimen not in the collection.

[285.] Myiochanes brachytarsus (Sclater). Short-legged Wood Pewee.

Two males and two females, Gatun, January 14, 1912, February 16, 1913, and April 4, 1911, January 1, 1912. Iris brown, bill black above, mandible rich yellow, feet black.

Found in trees in low flat jungle. Note very similar to that of the preceding but with weaker accent.

***[286.] Myiarchus crinitus** (Gmelin). Great-crested Flycatcher.

287. Myiarchus ferox panamensis (Lawrence). Panama Flycatcher.

Two males, Ft. Lorenzo, June 11, and Toro Point, July 23, 1911. Iris brown, bill and feet black.

Found in low bushes along the river bank and seashore.

288. Myiarchus nigriceps Sclater. Black-crested Flycatcher.

A pair, Gatun, February 4, 1912, and a male, Gatun, November 26, 1911. Iris brown, bill and feet black.

289. Tyrannus dominicensis dominicensis (Gmelin). Gray Kingbird.

Female, Gatun, February 16, 1912. Bill and feet black.

***290. Tyrannus tyrannus** (Linnæus). Kingbird.

Female, Toro Point, April 27, 1913.

A solitary migrant, perfectly silent.

291. Tyrannus melancholicus satrapa (Cabanis and Heine). Lichtenstein's Kingbird.

Two males and two females, Gatun, December 3, February 5, 1911, and February 12, March 26, 1911. Iris brown, bill black, feet blue-black.

A very common species in shrubbery along the lake, apparently always near water.

Nest a thin cup of vine stalks and tendrils in a bush, five feet up, contained three eggs March 20, 1912, .98 x .71, .99 x .70 and .98 x .72 in.

292. Muscivora tyrannus (Linnæus). Swallow-tailed Flycatcher.

Female, Mindi, October 29, 1911. Iris brown, bill and feet black. Shot from a small tree in a pasture.

PIPRIDÆ.

293. Pipra mentalis ignifera Bangs. Southern Yellow-thighed Manakin.

Three males, Gatun, April 30, August 27, 1911, and February 22, 1912.

Found in trees in low flat jungle.

294. Pipra velutina Berlepsch. Velvety Manakin.

Female, Gatun, July 30, 1911. Iris brown, bill black above grayish below, feet blue-black.

A bird of the forest.

[295.] Chiroprion lanceolata (Wagler). Sharp-tailed Manakin.

[296.] Laniocera rufescens (Sclater). Rufous Manakin.

297. Manacus vitellinus (Gould). Gould's Manakin.

Three males and a female, Gatun, February 22, April 9 and 14, 1911, and April 14, 1911. Iris and bill black, feet reddish-orange.

Always found in fairly thick jungle. Flies with wing beats almost as rapid as those of a hummingbird, seen in shrubs and bushes, never high up nor on the ground. Makes a snapping noise exactly like knocking two stones together and another sound like tearing heavy cloth.

Nest hung on a fork of a horizontal twig of a small bush five feet from the ground, a very frail shallow cup, made of strips of plant bark, hair-like rootlets and grass stalks. Eggs two, heavily incubated (April 14), .62 x .82 in., grayish, heavily streaked longitudinally with varying shades of brown. Another nest contained two fresh eggs May 7, 1911.

COTINGIDÆ.

298. Tityra semifasciata costaricensis Ridgway. Costa Rican Tityra.

Male, Ft. Lorenzo, February 26, 1911, and female, Gatun, February 23, 1913. Iris reddish, bare skin around the eye and base of bill red, tip of bill black, feet gray.

Found along the shores of the lake and river.

[299.] Erator albitorques (DuBus). Fraser's Erator.

[300.] Platypsaris homochrous (Sclater). One-colored Becard.

301. Pachyrhamphus polychropterus cinereiventris (Sclater). Gray-billed Becard.

Male and female, Gatun, June 25 and 18, 1911. Iris black, bill blue-gray with black tip, feet blue-black.

Nest found June 18 in a crotch of a small tree twenty-five feet from the ground, an enormous pile of strips of dead banana leaves, plant fibers, weeds, bark, etc. A small opening on one side. Eggs three, two of which hatched the same day. The young are hatched naked and blind, reddish in color. Eggs grayish-lavender, streaked and scrawled with deeper brownish.

[302.] Pachyrhamphus dorsalis Sclater. Bogota Becard.

303. Pachyrhamphus cinereus (Boddaert). Cinereous Becard.

Male, Gatun, May 26, 1912. Iris brown, bill blue-gray with black tip, feet light gray.

304. Pachyrhamphus cinnamomeus Lawrence. Cinnamon Becard.

Two males, Gatun, July 4, 1911, and February 22, 1912. Iris brown, bill black above, mandible blue-gray, feet blue-gray.

Found in the forest.

[305.] Microtriccus brunneicapillus (Lawrence). Brown-capped Tyrannulet.

306. Tyrannulus elatus reguloides (Ridgway). Riker's Yellow-crowned Tyrannulet.

Male, Toro Point, March 3, 1912. Iris buffy-white, feet grayish-blue.

307. Elainopsis gaimardii macilvainii (Lawrence). McIlvaine's Flycatcher.

Male, Gatun, July 4, 1911. Iris brown, bill blue-black lighter at base below, feet blue-black.

Found along the forest trail. Has a quaint single call of Flycatcher quality.

I follow Mr. Ridgway in placing this genus in the Cotingidæ, though I cannot but feel that its affinities are with the Tyrannidæ.

[308.] Lipaugus holerythrus holerythrus Sclater and Salvin. Rufous Lipaugus.

[309.] Lathria unirufa clara Ridgway. Panama Lathria.

[310.] Sirystes albogriseus (Lawrence). Panama Sirystes.

311. Attila citreopygus citreopygus (Bonaparte). Sclater's Attila.

Male, Gatun, July 2, 1911. Iris gray-brown, bill sooty-black paler at base of mandible, feet blue.

A dull stupid bird, perching high up in the forest.

[312.] **Cotinga nattererii** (Boissoneau). Naterer's Cotinga.

313. **Querula purpurata** (Müller). Purple-throated Fruit Crow.

Male and female, Gatun, June 23, 1912. Iris brown, bill blue-gray black at tip, feet black.

It flocks in the forest, a shy species.

HIRUNDINIDÆ.

*314. **Riparia riparia** (Linnæus). Bank Swallow.

Male, Gatun, September 23, 1911.

Shot from a flock of migrants.

315. **Iridoprocne albilineata** (Lawrence). Mangrove Swallow.

Two males and a female, Gatun, July 17, May 30, 1911, and July 17, 1911. Iris brown, bill blue-black, feet black.

Common along the Chagres River, where it nests in holes in partly submerged stumps.

316. **Pygochelidon cyanoleuca** (Vieillot). Blue and White Swallow.

Male and female, Gatun, July 7 and 16, 1911. Iris dark brown, bill and feet black.

On the former date a flock was coursing over the lawns and clearings. On the latter some two hundred were lined up on a telephone wire.

[317.] **Neochelidon tibialis** (Cassin). White-thighed Swallow.

*318. **Hirundo erythrogaster** Boddaert. Barn Swallow.

Male and female, Gatun, April 20 and May 30, 1911.

A common migrant through April. The unusually late female specimen showed a breeding tendency, as several eggs were well started. It was associated with a flock of *Iridoprocne albilineata*.

319. **Progne chalybea chalybea** (Gmelin). Gray-breasted Martin.

Male, Gatun, February 4, 1912. Another was obtained at the same place April 13, 1911, but is not in the collection. Iris brown, bill and feet black.

Nest in holes usually inaccessible on account of the mud and water.

*[320.] **Petrochelidon lunifrons tachina** Oberholser. Lesser Cliff Swallow.

320a. **Stelgidopteryx serripennis** (Audubon). Rough-winged Swallow.

A male, Gatun, December 18, 1910, is typical of this species except for a slight subterminal dusky blotch on the longest under tail coverts. It is quite uniform above and is thus distinguished at a glance from specimens of *S. ridgwayi*. This occurrence is apparently farther south than any previously recorded.

321. Stelgidopteryx ruficollis uropygialis (Lawrence). Panama Rough-winged Swallow.

A male and two females, Gatun, July 9, 1911, and June 3, 1912, November 5, 1911. Iris brown, bill and feet dull black.

The last specimen has two pure white quills in the wing.

POLIOPTILIDÆ.

322. Polioptila superciliaris superciliaris Lawrence. Lawrence's Gnatcatcher.

Male, Gatun, January 1, 1912. Iris brown, bill black, mandible blue-gray at base, feet black.

Found in second growth.

TROGLODYTIDÆ.

[323.] Heleodytes albobrunneus Lawrence. White-headed Cactus Wren.

324. Thryophilus modestus elutus Bangs. Panama Wren.

Two males, Gatun, April 30 and December 24, 1911. Iris golden brown, bill black, mandible bluish-gray with black tip, feet blue-gray.

In thickets near the jungle.

[325.] Thryophilus rufalbus castanonotus Ridgway. Chestnut-backed Wren.

326. Thryophilus galbraithii galbraithii (Lawrence). Galbraith's Wren.

A pair, Gatun, June 23, 1912, and a male, Gatun, April 14, 1912. Iris reddish-brown, bill dusky paler below, feet blue-gray.

In thickets.

327. Thryophilus castaneus castaneus (Lawrence). Bay Wren.

Male, female and nestling, Gatun, February 18, March 15, 1911, and July 28, 1912. Iris reddish-brown, bill black lighter below, feet black.

Found in heavy undergrowth in damp jungle-thickets. Song loud and ringing, resembling that of *Thryothorus ludovicianus*, but much longer.

Nest a loosely built elbow-shaped affair, made almost entirely of a round-stemmed grass and lined with finer stems of the same, a few coarser stems and reddish-brown vine tendrils on the outside. Loosely placed in vines, four feet up, by a stream; contained one fresh egg, July 28, measuring .90 x .59 in.

328. Troglodytes musculus inquietus (Baird). Panama House Wren.

Male and female, Gatun, February 26, 1911; male, Gatun, September 17, 1911, and female and young, Ft. Lorenzo, June 11, 1911. Iris gray-brown, bill and feet brown.

In thickets along the lake shore, cocoanut groves, etc.

A nest was built in a floating boathouse, on a beam under the roof, made of weed stalks, small twigs and a few feathers inside. Also contained a small cast snake skin and part of a kodak film. The

first two eggs were destroyed and three more were laid June 5, light pink heavily speckled with rufous brown with wreath effect at large end, .74 x .56 and .75 x .55 in. After these were taken three more were laid and hatched. The boathouse was moved two hundred yards after the nest was built, but the birds were not disturbed by the change of location.

329. Henicorhina prostheleuca pittieri (Cherrie). Pittier's Wood Wren.

Male, Gatun, February 22, 1912. Iris brown, bill and feet black.

330. Leucolepis lawrencii (Sclater). Lawrence's Musician Wren.

Male and female, Gatun, July 30, 1911, and April 9, 1911. Iris brown, bill black, feet light brown, bare skin around the eye bluish-green.

A bird of the jungle.

Nest found in low wet forest two feet from the ground on May 7, 1911. It consisted of a long tube or tunnel with the nest proper at the far end, built of sticks, twigs and dead leaves, lined with grasses. Eggs two, .65 x .92 and .65 x .89 in., white, very finely and sparingly speckled with brown, one almost immaculate.

[331.] Pheugopedius hyperythrus (Salvin and Godman). Tawny-bellied Wren.

332. Pheugopedius fasciato-ventris albigularis (Sclater). Panama Black-bellied Wren.

Male, Gatun, June 25, 1911. Iris bright brown, bill black bluish-gray below, feet bluish-gray.

Shot in a jungle thicket on a small stream.

[333.] Microcerculus luscinia Salvin. Panama Nightingale Wren.

MIMIDÆ.

[334.] Dumetella carolinensis (Linnæus). Catbird.

TURDIDÆ.

335. Planesticus grayi casius (Bonaparte). Bonaparte's Thrush.

Male, Miraflores, March 5, 1911; female, Pedro Miguel, May 5, 1912. Iris dark brown, bill dark yellow greenish at base, feet pale yellow.

Call note resembles that of the American Robin (*P. migratorius*). Frequents tall trees in the jungle.

Nest in fork of a small tree in second growth timber, twelve feet from the ground, Pedro Miguel, April 23, 1911; a typical cup with base of weed and cattle manure, and built of twigs, straw, dead leaves and moss, with a lining of rootlets and tendrils. Eggs three, fresh, .86 x 1.24 and .88 x 1.23 ins., greenish-blue heavily marked with various shades of brown, mainly at the larger end.

Another nest in same vicinity, May 5, 1912, contained three incubated eggs, 1.12 x .83 and 1.13 x .84 ins. A third set of three measured 1.04 x .72 and 1.06 x .73 ins.

[336.] **Planesticus obsoletus** (Lawrence). Lawrence's Thrush.

*[337.] **Hylocichla ustulata swainsonii** (Cabanis). Olive-backed Thrush.

*[338.] **Hylocichla fuscescens fuscescens** (Vieillot). Veery.

VIREONIDÆ.

339. **Vireosylva flavoviridis flavoviridis** Cassin. Yellow-green Vireo.

Male, Agua Clara, May 19, 1912. Iris red, bill and feet pale blue-gray.

*[340.] **Vireosylva olivacea** (Linnæus). Red-eyed Vireo.

*[341.] **Lanivireo flavifrons** (Vieillot). Yellow-throated Vireo.

342. **Pachysylvia viridiflava** (Lawrence). Yellow-green Pachysylvia.

Male, Mt. Hope, February 22, 1913; female, Gatun, May 30, 1912. Iris whitish yellow, bill and feet pinkish.

343. **Pachysylvia aurantiifrons aurantiifrons** (Lawrence). Lawrence's Pachysylvia.

Male, Pedro Miguel, May 5, 1912.

Shot from a tree in a wild banana jungle.

344. **Pachysylvia decurtata** (Bonaparte). Gray-headed Pachysylvia.

Male and young, Gatun, July 4 and June 25, 1911. Iris dark brown, bill gray-brown, feet bluish-gray.

Found in the forest.

[345.] **Vireolanius pulchellus viridiceps** Ridgway. Panama Shrike-Vireo.

*[346.] **Bombycilla cedrorum** Vieillot. Cedar Waxwing.

[347.] **Anthus parvus** Lawrence. Panama Pipit.

MNIOTILTIDÆ.

*348. **Mniotilta varia** (Linnæus). Black and White Warbler.

Male, Gatun, March 26, 1911.

*349. **Protonotaria citrea** (Boddaert). Prothonotary Warbler.

Male, Toro Point, October 1; female, Mindi, October 7, 1911.

*[350.] **Vermivora chrysoptera** (Linnæus). Golden-winged Warbler.

*[351.] **Vermivora peregrina** (Wilson). Tennessee Warbler.

*[352.] **Dendroica magnolia** (Wilson). Magnolia Warbler.

*[353.] **Dendroica coronata** (Linnæus). Myrtle Warbler.

*[354.] **Dendroica virens** (Gmelin). Black-throated Green Warbler.

*[355.] **Dendroica cerulea** (Wilson). Cerulean Warbler.

*[356.] **Dendroica fusca** (Müller). Blackburnian Warbler.

*357. **Dendroica pensylvanica** (Linnæus). Chestnut-sided Warbler.

Two males and one unsexed, Gatun, March 31, 1911 (molt completed), February 4, 1912 (molt begun), February 22, 1912.

***358. Dendroica castanea** (Wilson). Bay-breasted Warbler.

Three males, Gatun, November 3, 1911 (2), and Toro Point, April 27, 1913, and one unsexed, Gatun, February 16, 1913.

***359. Dendroica aestiva aestiva** (Gmelin). Yellow Warbler.

Four males and two females, Gatun, March 26 (2), March 29, November 5, 1911, and August 29 and December 24, 1911.

360. Dendroica erithachorides Baird. Panama Yellow Warbler.

Four males, Mt. Hope, February 9 and August 31, 1913, and Toro Point, July 23 and October 1, 1911. Iris black, bill and feet olive-brown.

In bushes along the shore.

***361. Oporornis formosus** (Wilson). Kentucky Warbler.

Female, Gatun, February 22, 1911.

***362. Oporornis philadelphia** (Wilson). Mourning Warbler.

Male and female, Gatun, April 7 and 14, 1912. (Male not in the collection.)

[363.] Oporornis tolmiei (Townsend). McGillivray's Warbler.

***364. Seiurus aurocapillus** (Linnæus). Ovenbird.

Female, Gatun, November 26, 1911.

***[365.] Seiurus motacilla** (Vieillot). Louisiana Water Thrush.

***366. Seiurus noveboracensis noveboracensis** (Gmelin). Water Thrush.

Male, Gatun, March 29, 1911; female, Gatun, April 14, 1911.

Found regularly all winter.

***367. Wilsonia canadensis** (Linnæus). Canada Warbler.

Male, Gatun, April 28, 1912.

***[368.] Wilsonia citrina** (Boddaert). Hooded Warbler.

***369. Setophaga ruticilla** (Linnæus). Redstart.

Three males, Gatun, March 26 and November 26, 1911, April 28, 1912; female, Gatun, April 14, 1912.

370. Basileuterus rufifrons mesochrysus (Sclater). Sclater's Warbler.

Male and an unsexed specimen, Gatun, April 7, 1912, and Pedro Miguel, April 23, 1911. Iris brown, bill fuscous, feet light flesh-color.

371. Basileuterus semicervinus veraguensis (Sharpe). Buff-rumped Warbler.

Female, Rio Siri, March 31, 1912. Iris brown, bill blackish.

Frequents river banks and overhanging tree-roots. Flits its wings like a Kinglet (*Regulus*), flashing its bright rump. Has a beautiful clear ringing song, somewhat like that of the Ovenbird (*Seiurus aurocapillus*), but more striking because the crescendo rises higher. The bird also walks like an Ovenbird and feeds along the water's edge like a Water Thrush (*S. noveboracensis*).

FRINGILLIDÆ.

*[372.] **Zamelodia ludoviciana** (Linnæus). Rose-breasted Grosbeak.

373. Cyanocompsa concreta cyanescens Ridgway. Panama Blue Grosbeak.

Two males and a female, Gatun, July 30, 1911; August 11, 1912; June 18, 1911. Iris brown, bill bluish-horn color, feet black.

Nest a frail cup of fine twigs lined with vine tendrils in crotch of bush five feet up in a thicket. Eggs two, bluish-white, wreathed heavily at the larger end with reddish and purplish brown, .82 x .71 in.

A bird of thickets and heavy forest.

374. Oryzoborus funereus Sclater. Lesser Rice Grosbeak.

Male, Ft. Lorenzo, June 21, 1911.

Associates with the next.

375. Sporophila aurita (Bonaparte). Hicks' Seedeater.

Three males and three females, Gatun, March 22, April 13, December 24, 1911; June 25, 1911, June 2 and August 11, 1912. Iris brown, bill blackish-horn, feet gray-brown.

Nest a thin-walled cup, made entirely of fine reddish-brown tendrils, situated in the terminal twigs of a small sapling, fifteen feet from the ground. Eggs two, heavily incubated (June 25), white, very heavily marked all over with brown and with some wash of lavender at the larger end, .66 x .51 in. Another nest August 11, 1912, contained two eggs nearly fresh, .69 x .53 and .70 x .53 in.

Occurs in flocks of a dozen feeding on seeds in grass and shrubbery in open places and in second growth.

[376.] **Sporophila grisea schistacea** (Lawrence). Slate-colored Seedeater.

[377.] **Sporophila minuta minuta** (Linnæus). Minute Seedeater.

[378.] **Sporophila gutturalis** (Lichtenstein). Yellow-bellied Seedeater.

379. Tiaris olivacea pusilla (Swainson). Mexican Grassquit.

Male and female, Gatun, December 24, 1911, and April 7, 1912. Iris brown, bill horn-brown, feet gray-brown.

Common in second growth.

380. Volatinia jacarini splendens (Vieillot). Blue-black Grassquit.

Three males and two females, March 22 and November 26, 1911, July 21, 1912; April 13 and December 24, 1911. Iris black, bill black above bluish below, feet blue-black.

Flocks with *Sporophila aurita*.

Nest (July 21, 1912) in clump of weeds, two feet from the ground, a frail thin-walled cup of fine vine tendrils or rootlets. Eggs two, fresh, pale bluish or greenish-white heavily spotted with brown, lavender and burnt umber, denser at the larger end, .69 x .51 and .68 x .51 in.

[381.] **Amaurospiza concolor** Cabanis. Cabanis' Seedeater.

382. Pitylus grossus (Linnæus). Slate-colored Grosbeak.

Male, Gatun, June 25, 1911. Iris dark brown, bill salmon-pink, tarsi dull black.

Found in clearing in the forest.

[383.] Caryothraustes poliogaster scapularis Ridgway. Lesser Bishop Grosbeak.

384. Saltator magnoides intermedius (Lawrence). Panama Buff-throated Saltator.

Female, Gatun, April 30, 1911. Iris greenish-brown, bill black, feet fuscous.

Nest (April 30) in shrubbery in clearing two feet up, a bulky compact cup set on a light base of sticks, made of strips of banana leaves and plant bark and lined with brown rootlets and vine tendrils. Eggs two, nearly fresh, blue with a few spots of black in a wreath near the larger end, .72 x 1.03 and .75 x 1.01 ins.

A common species in thickets adjoining the forest; very quiet.

385. Saltator atriceps lacertosus Bangs. Panama Black-headed Saltator.

Female, Agua Clara, March 12, 1911. Iris brown, bill black, feet grayish-horn color.

A fairly common species. Has a loud and peculiarly harsh call.

Nest (April 30) three feet up in a shrub grown over with vines, a rather small open cup. Eggs two, bluish-green wreathed with black at the larger end, 1.13 x .76 and 1.12 x .79 ins. Another nest in same sort of situation (March 24, 1912), made of weed stalks and tendrils, contained two fresh eggs, 1.07 x .76 and 1.06 x .75 ins.

386. Saltator albicollis isthmicus (Sclater). Panama Streaked Saltator.

A male, Pedro Miguel, May 5, 1912, and female, Tabernilla, April 18, 1911. Iris gray-brown, bill black, feet pale brown.

[387.] Astragalinus psaltria croceus (Jouy). Central American Goldfinch.

***388. Spiza americana** (Gmelin). Dickcissel.

Male and two unsexed specimens, Gatun, June 16, March 16 and February 18, 1912; male, Miraflores, March 5, 1911, and female, Mindi, October 15, 1911.

March 16, a flock was seen along the river bank; the others were alone.

389. Arremonops conirostris conirostris (Bonaparte). Lafresnaye's Sparrow.

Male, Gatun, April 18, 1911; female, Ft. Lorenzo, June 11, 1911. Iris light brown, bill black lighter below, feet gray-brown.

Nest (April 18) in a tussock of grass against a stump about a foot from the ground, an open cup of dead leaves, strips of bark and weed stalks lined with light-brown rootlets. Eggs two, plain white, .71 x .93 and .72 x .93 in. Two other nests (June 2 and June 11) were

found, but of same materials, one in a shrub six feet from the ground. Eggs, two in each, were fresh; those in the latter one were larger, 1.06 x .72 and 1.05 x .74 ins.

390. Arremon aurantiirostris Lafresnaye. Orange-billed Sparrow.

Male, Gatun, August 27, 1911. Iris brown, bill salmon-red, feet pale brown.

Found in the forest.

CŒREBIDÆ.

391. Coereba mexicana (Sclater). Mexican Banana-quit.

Three males, Gatun, April 4, June 25 and November 3, 1911. Iris brown, bill and feet black.

In thickets and second growth.

392. Dacnis cayana ultramarina (Lawrence). Ultramarine Dacnis.

Two males and two females, Gatun, June 4, November 26, 1911, and July 2, 1911, April 7, 1912. Iris reddish-brown, bill dull black above paler below, feet light brown.

Found in the jungle as well as in groves.

393. Cyanerpes cyaneus (Linnæus). Blue Honey-Creeper.

Two males and a female, Gatun, July 2, 1911, April 14, 1912, and December 24, 1911. Iris brown, bill black, feet red.

Common in second growth.

[394.] Cyanerpes lucidus (Sclater and Salvin). Shining Honey-Creeper.

395. Chlorophanes spiza guatemalensis (Sclater). Northern Green Honey-Creeper.

Female, Gatun, June 4, 1911. Iris brown, bill black lighter below, feet bluish-gray.

TANAGRIDÆ.

396. Tanagra crassirostris (Sclater). Thick-billed Euphonia.

Two males, Gatun, November 3, 1911, and April 4, 1912; male and female, Mindi, October 22 and September 17, 1911; male, Toro Point, March 3, 1912, and male, Mt. Hope, June 1, 1913. Iris brown, maxilla black with a bluish spot on each side, mandible bluish-gray, feet dark gray.

Seen frequently in second growth and in trees in open ground.

[397.] Tanagra fulvicrissa (Sclater). Fulvous-vented Euphonia.

[398.] Tanagra luteicapilla (Cabanis). Yellow-crowned Euphonia.

[399.] Tanagra minuta humilis (Cabanis). White-vented Euphonia.

400. Tangara larvata fanny (Lafresnaye). Mrs. Wilson's Tanager.

Male, Mindi, October 15, 1911, and female, Gatun, April 30, 1911. Iris brown, bill black, feet blue-black.

Usually seen on the edge of the jungle.

401. Tangara inornata (Gould). Plain-colored Tanager.

Male and female, Gatun, April 7, 1912, and May 30, 1911. Iris brown, bill black blue-gray below, feet blue-gray.

Found on the edge of the jungle.

[402.] Tangara gyroloides (Lafresnaye). Blue-rumped Green Tanager.

[403.] Tangara lavinia (Cassin). Lavinia's Tanager.

404. Thraupis cana cana (Swainson). Blue Tanager.

Two females, Toro Point, April 2, 1911, and also taken at Gatun, March 2, 1911. Iris brown, bill black above blue-gray below, feet dark grayish-blue.

A fairly abundant bird in thickets and cocoanut groves.

405. Thraupis palmarum melanoptera (Sclater). Black-winged Tanager.

Three males, Gatun, March 2, 1913; Toro Point, July 23, 1911, and Ft. Lorenzo, January 7, 1912.

Found in cocoanut groves.

[406.] Ramphocelus luciani Lafresnaye. Bonaparte's Tanager.

407. Ramphocelus icteronotus Bonaparte. Yellow-rumped Tanager.

Male and female, Gatun, February 12, and a female, Gatun, April 30, 1911. Iris reddish-brown, bill light blue with dark edges and tip, feet dark blue.

Common in thickets along the edge of the jungle.

Nest five feet up in clump of shrubbery, a very compact cup, made of vines on the outside, dead leaves, plant fibers and finally a lining of brown and black rootlets. Eggs two, nearly fresh (April 30), blue with heavy blackish blotches on large end forming a cap, .67 x .93 in. Another nest (May 14) exactly the same, with the same sort of vine wrapped around the outside. Eggs two, fresh, .73 x .95 in., blue, with black spots more scattered.

408. Ramphocelus dimidiatus isthmicus Ridgway. Panama Crimson-backed Tanager.

Three males, Mindi, September 17, 1911; Tabernilla, March 19, 1911, and Gatun, April 5, 1912; two females Ft. Lorenzo, June 21, 1911, and Miraflores, March 5, 1911. Iris reddish-brown, bill black above, mandible white for basal two-thirds (uniform dusky in female), feet black.

A fairly common species in thickets.

Nest a frail shallow cup, made of strips of plant bark and dead leaves, lined with finer grass stalks and a few black hairs, ten feet up in a bush. Eggs two (June 11), blue, with irregular spots and scrawls of black about the larger end, one much more extensively spotted than the other, .96 x .66 and .96 x .69 in. Another nest (March 3, 1912) at Toro Point contained two fresh eggs, .94 x .70 in.

*[409.] **Piranga rubra rubra** (Linnæus). Summer Tanager.

*[410.] **Piranga erythromelas** (Vieillot). Scarlet Tanager.

411. **Phoenicothraupis fuscicauda** Cabanis. Dusky-tailed Ant-Tanager.

Two males, Gatun, May 30, 1911, and January 21, 1912; two others, Agua Clara, March 12, 1911, and Mt. Hope, June 1, 1913; two females, Gatun, May 14, 1911, and Agua Clara, March 12, 1911. Iris brown, bill black (brown in female), feet gray suffused with pink.

Found in thickets and in the jungle. It has a guttural scolding note somewhat similar to that of a wren but with more volume.

Nest in a cluster of orchids on a vine eight feet up; a cup made of dead leaves wound tightly with green vines and lined with brown rootlets. Two fresh eggs (May 14), glossy white, .66 x 1.01 and .65 x .95 ins.

Stomach of one of the birds contained many insects, a few seeds and a small snake.

[412.] **Heterospingus rubrifrons** (Lawrence). Lawrence's Tanager.

413. **Tachyphonus rufus** (Boddaert). Boddaert's Tanager.

Male and female, Tabernilla, April 8, 1911, and female, Gatun, May 7, 1911. Iris brown, bill and feet bluish.

Nest (May 7) in a clump of leaves of wild banana two feet from the ground. Eggs two, .70 x .94 and .71 x .96 in., gray spotted and scrawled with black very much like those of *Agelaius phœniceus*.

414. **Tachyphonus luctuosus** Lafresnaye and D'Orbigny. White-shouldered Tanager.

Male, Gatun, February 11, 1912. Iris grayish-brown, bill black with wedge-shaped blue spot on the sides, tarsi blackish-slate.

[415.] **Tachyphonus delatrii** Lafresnaye. Tawny-crested Tanager.

416. **Eucometis cristata** (DuBus). Gray-crested Tanager.

Two males, Gatun, February 5 and July 9, 1911, and an unsexed specimen, March 3, 1912. Iris reddish-brown, bill black, feet flesh color.

Found in thick undergrowth of jungle.

Nest a loosely built cup, formed entirely of slender round fibers and very fine reddish-brown tendrils, situated in a bush. Two eggs, partly incubated (July 9), gray, heavily marked with blotches and smears of smoky-brown and blackish, .94 x .70 and .92 x .69 in.

[417.] **Mitrospingus cassini** Lawrence. Cassin's Tanager.

418. **Rhodinocichla rosea eximia** Ridgway. Panama Thrush Tanager.

Two males, Tabernilla, March 19, 1911, and Pedro Miguel, May 5, 1912; female, Mt. Hope, February 20, 1913. Iris light brown, bill blue-gray dusky at base, feet bluish-black.

Found in thickets. Song very striking; a loud clear whistle of two

notes or syllables, repeated several times. More often two birds near together sing at the same time, but in a different pitch, as if one song was an accompaniment to the other.

I follow Dr. Hubert Lyman Clark in placing this bird in the Tanagridæ and have altered Mr. Ridgway's vernacular name "Thrush Warbler" as suggested by Dr. Clark (cf. *The Auk*, 1913, p. 11).

ICTERIDÆ.

[419.] **Zarhynchus wagleri wagleri** (Gray). Wagler's Oropendula.

[420.] **Gymnostinops montezuma** (Lesson). Montezuma Oropendula.

[421.] **Cacicus microrhynchus** (Sclater and Salvin). Small-billed Cacique.

422. **Cacicus vitellinus** Lawrence. Lawrence's Cacique.

Male, near Agua Clara on the Trinidad River, March 12, 1911. Iris bright blue, bill light lemon-yellow, feet black.

One of a flock that were building nests in a fair-sized tree on the river bank. Many nests were under way, but none advanced enough to judge of their size.

423. **Cassidix orizivora violea** Bangs. Colombian Rice Grackle.

Female, Gatun Lake, July 16, 1911. Iris buffy-yellow, bill and feet black.

Shot from a tree top; was alone.

*[424.] **Dolichonyx oryzivorus** (Linnæus). Bobolink.

425. **Amblycercus holosericeus** (Lichtenstein). Prevost's Cacique.

Female, Gatun, February 5, 1911. Iris very light yellowish-brown, bill light greenish-yellow, feet bluish-gray.

An inhabitant of the jungle.

[426.] **Leistes militaris** (Linnæus). Red-breasted Blackbird.

*[427.] **Icterus spurius** (Linnæus). Orchard Oriole.

*[428.] **Icterus galbula** (Linnæus). Baltimore Oriole.

[429.] **Icterus giraudii** Cassin. Giraud's Oriole.

430. **Icterus mesomelas salvinii** (Cassin). Salvin's Oriole.

Three males, Gatun, February 18 (2) and 22, 1912; two females, Gatun, May 14 and 28, 1911, and a male, Toro Point, August 4, 1912. Iris brown, bill bluish-gray darker on culmen, feet grayish-blue.

Found in wild banana thickets and in trees.

[431.] **Megaquiscalus major macrourus** (Swainson). Great-tailed Grackle.

CORVIDÆ.

432. **Cyanocorax affinis zeledoni** Ridgway. Talamanca Jay.

Male, Gatun, January 1, 1912; another not in the collection was secured August 13, 1911, at the same place.

Found in the forest in small flocks, shy and hard to approach.

November 19.

Thomas H. Fenton, M. D., in the Chair.

Twenty-seven persons present.

The Publication Committee reported the presentation of papers under the following titles for publication in the Proceedings:—

"On the generic position of Sonorella wolcottiana," by H. A. Pilsbry (April 30, 1918).

"A new Characin from Paraguay," by Henry W. Fowler (May 2, 1918).

"Two New Shells from Haiti," by E. G. Vanatta (July 1, 1918).

"Birds of the Panama Canal Zone, with special reference to a collection made by Mr. Lindsey L. Jewel," by Witmer Stone (October 10, 1918).

"Mollusca of the Southwestern States. IX, The Santa Catalina, Rincon, Tortillita and Galiuro Mountains. X, The Mountains of the Gila Headwaters," by Henry A. Pilsbry and James H. Ferriss (November 8, 1918).

A paper entitled "The Northeastern Florida Coast Revisited," by Clarence B. Moore, was presented May 6, 1918, for publication in the Journal, completing the sixteenth volume of the second series.

The deaths of the following members were announced:—

Frank Miles Day,
William F. Dreer,
Theodore H. Conderman,
Isaac Norris, M. D.,
William F. DuBois.

The following was ordered to be published:

MOLLUSCA OF THE SOUTHWESTERN STATES—IX, THE SANTA CATALINA, RINCON, TORTILLITA AND GALIURO MOUNTAINS. X, THE MOUNTAINS OF THE GILA HEADWATERS.

BY HENRY A. PILSBRY AND JAS. H. FERRISS.[1]

The Santa Catalina, in Pima County, north of Tucson, is one of the large ranges of Southern Arizona, about forty-five miles in length, including its Tanque Verde and Rincon outliers, with an extreme width of twenty-five miles. Mount Lemon with an elevation of 9,150 feet is heavily forested with yellow pine, quaking asp, cork bark fir (*Abies arizonica*), Douglas spruce (*Pseudotsuga mucronata*), cypress (*Cupressus arizonica*), other coniferous trees, large oaks and an alder as tall as a pine. The male fern and the brake stand here four feet in height. The Douglas spruce are eight feet in diameter. There is a forest gloom at mid-day, and a ground covering indicating a timber growth of many years without interruption by fires or lumbering. Winter often brings ten feet of snow. With numerous trout streams, it has the attractions, summer and winter, of the deep forests along the Canadian border without their annoying insects.

In quantity and number of species of the smaller snails the north slope of Mount Lemon has the best record so far. The odor-shooting, rough-coated Sonorella also is here in large numbers under the fallen bark of the Douglas spruce and the dead poles of the quaking asp and cork bark fir. Unlike his brethren with a polished coat, this snail seeks food and cover similar to those used by the Polygyras of timbered areas in the Mississippi valley and eastward.

The humid forest conditions of the region around Lemon Mountain prevail at Soldier Camp, Kellogg's Peak, Alder Canyon, Alder Springs. The Spud Rock Ranger Station and other high peaks of the Rincon section, except in lacking cork bark fir, also follow Mount Lemon closely in forest conditions. They have the large oaks and conifers, the quaking asp, and the heavy floor of humus underfoot, but not quite as many snails.

In the valleys of Bear Wallow and Sabino creeks, at the heart of the Santa Catalinas, the Arizonians of lower and hotter levels have

[1] The field work covered by this report was by Ferriss, assisted in the Blue River region and the Mogollon Mountains by the late L. E. Daniels.

built villages of summer cottages. It is about a full day's journey from Tucson on horseback. A small saw mill furnishes building material for this summer society, for a sanitarium now under construction and for the copper mines over the ridge at the foot of Marble Peak.

Except in the valley of the San Pedro river and the village of Oracle only a few miners, ranch men and forest rangers are to be found in all this group of ranges. There are more bears and mountain lions than people.

The southern slopes of the Catalinas, the foot hills and mesas, and the Galiuro and Tortillita ranges are not heavily forested. At best it is low, open woods or desert shrubbery, through which the granite rocks and precipices glisten in the sun. The soil is dry, though often covered with fallen leaves and growing vegetation. A few Sonorellas and some of the smaller snails may be found at all altitudes in the rock slides, the talus, on all sides of the mountain, and in any kind of rock, especially smooth and stratified rock; sometimes also under fallen timber, or in small piles of boulders.

In the dry season, among dry and hot rocks, dead shells will be the rule. Here one must dig a full eight hour day for a live one. We find a two-foot bar of half inch octagonal steel very helpful. The bar should have a two-inch chisel edge flattened out at each end, one of these turned at a right angle like a hoe. It will weigh one and three-quarter pounds; a good digger, a jimmy for rock work, and a helpful staff in steep and rough places.

Sonorella is something of a rambler, more so than *Ashmunella* or *Oreohelix*, and upon damp days scouts may be met out in the fallen leaves far from their rocky homes. Often single, dead, lie along the trails where there is no shelter in the vicinity for snail kind. In 1913, on the south side of the Santa Catalinas in the dry season, day after day but one or two living Sonorellas were found. It was the same about Brush Corral Ranger Station, on the north side, in the rocky slides of the canyons nearly on a level with the river. In one of these slides of three or more feet in depth, three hundred good "bones" were found but none alive. It was also the same kind of collecting in the Galiuros and the Tortillitas in the winter of 1917–18.

A small deep slide of "porphyry" or shale, shaded partially with rose bushes, elder or gooseberry bushes, makes an ideal home for the Southwestern snails.

The Galiuro range, in Graham County, and the Tortillita range, in Pinal County, as yet unsurveyed, seem to have an elevation of

about 7,000 or 8,000 feet, granite or other igneous rock prevailing, and with but a little timber. A few ledges of sharp-pointed limestone, dolomite probably, had no attraction for the snails. The entire region at present is inaccessible except to horsemen and pedestrians and these should carry their own food and shelter. We did, and lived like kings before the war.

One of us (Ferriss) collected a few days, less than a week, in the Santa Catalinas, Mount Lemon and Soldier Camp, in 1910; again much of the time from May to October in 1913, on the southern slope, around Mount Lemon, Soldier Camp, Marble Peak and on the northern mesa, about Brush Corral. Again a month was spent in 1917, at Sabino Basin, Bear Creek, and Brush Corral, the Rincon Peaks and the Galiuros. The guide, Frank Cole, on a hunting trip, brought in Sonorellas from the Tortillitas and from the Cañada del Oro section of the Santa Catalinas. Many inviting prospects in these mountains remain neglected. They surely contain species still unknown.

Life is rapid in snaildom, decay a slow process in an arid climate; and possibly these fat cemeteries in the basements of Sonorella slides merely represent the natural death rate of many years. It may be that one living inhabitant to one hundred skeletons is the right proportion. However an impression grows upon the collector as he digs in the arid foothills, that in earlier times there were periods or seasons more favorable to snail life—seasons with more moisture, more vegetation, and a deeper humus. The steep mountain gulches with walls on either side thrown above the surrounding surface quite plainly speak of days when the floods were greater than any known in modern times. These boulder bulwarks contain potsherds and other evidence of human occupation; also Sonorellas. As collecting grounds they are often preferable to the large slides farther up the mountain. Among these boulders, in the hot sunlight, we found the largest Sonorella. Measured crudely in the field it had a diameter of 33 millimeters.

In collecting Sonorellas and Oreohelices from arid to humid zones in the same canyon or mountain, one gets the impression that the differences of size are mainly a matter of the breed; that they are racial, rather than due to length of growing season, supply of food or climatic comforts. We naturally search ideal environments of food, shade and shelter for robust races, and expect to meet the pigmy forms in hot, dry and barren places. Often what we find is the reverse of this. On one climb in 1918, at Kitt's Peak, a large

and robust *Sonorella* was found at a low elevation in a barrier of boulders, so dry and barren the snails would necessarily lie dormant a large part of the year. At a thousand feet higher, beside a stream of running water, came in a much smaller breed; and, 1500 feet above number two, with an ideal situation as to a moist atmosphere, food, shelter and snail comfort, lived a pigmy *Sonorella* of about 12 millimeters in diameter.

Again on the Kaibab Plateau in 1909, every colony of *Oreohelix strigosa depressa* seemed a little different from all other colonies. At Two Spring Canyon with running water all the way, the pigmies were at the higher station in a grove of quaking asp. Every colony increased in size and color brilliance at a regular pace down the canyon. Here seemed proof positive of the advantage of a longer growing season. Over the ridge in Snake Gulch the order was reversed, for the larger shells were at the top in a dry situation, and their size seemingly decreased in proportion to the mileage as we descended along a running stream. In Jacobs Canyon, running parallel to Snake Gulch, dry all the way, the large and gaudy shells were midway, the smaller and paler above and below. Food conditions may have had some influence in the development of these races but if so the evidence was not apparent. In the field we meet contradictions continually beyond our understanding, but perhaps we may have a better comprehension before the survey of the Southwest is completed.

HELICIDÆ.

Sonorella odorata n. sp. Pl. III, figs. 1 to 4.

The shell is depressed, umbilicate, the umbilicus contained about $7\frac{1}{3}$ times in the diameter of shell; buffy-citrine below, somewhat lighter than isabella color above, with a chestnut brown band at the shoulder. The first half whorl has irregular radial wrinkles soon passing into a low granulation, the last embryonic whorl granular, over which there are close decurrent threads, interrupted into short dashes on the upper part of the whorl. Subsequent whorls are very minutely granular, somewhat dull, the granulation effaced at the base, which is more glossy. The last whorl shows also numerous faint spiral striae. The whorls are quite convex, the early ones increasing slowly, the last widening rapidly, rather abruptly descending close to the aperture. The aperture is elliptical-lunate; peristome is narrowly expanded throughout, dilated at the columellar insertion.

Alt. 11.4, diam. 19.5 mm.; $4\frac{1}{2}$ whorls (type).
" 13.4, " 23.3 " $4\frac{2}{3}$ " (Station 18, 1917).
" 13.2, " 22 " (Station 18, 1917).

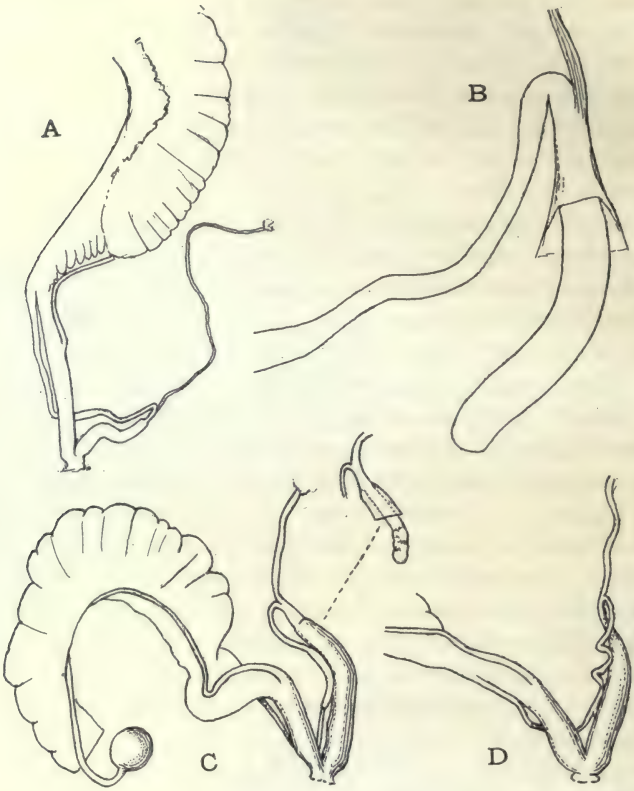


Fig. 1. Genitalia of *S. odorata*. *a*, No. 119,032; *b*, penis-papilla of same much enlarged; *c*, No. 119,035, with detail of penis-papilla; *d*, No. 119,034.

The sole is tripartite in color, the side areas being somewhat darker. The back and head are quite dark in most alcoholic specimens, black in life, the tips of the tubercles lighter.

The penis is small, containing a cylindric papilla with rounded end, about two-thirds as long as the penis. The penial retractor is inserted upon the epiphallus not far from its base. The flagellum is present as a very minute but distinct bud in most of the specimens opened, but in two it was not seen though looked for. In the specimen No. 119,032 (figs. 1*a*, *b*,), the male organs are evidently not fully developed, the penis and epiphallus being small and short, while the retractor muscle is correspondingly longer, making the total length about normal, the individual being of full size though not adult. Measurements of the organs in mm. follow:

Locality.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Penial retractor.	Vagina.	Spermatheca and duct.	Diameter of shell.	Number.
Head of Alder Canyon . . .	6.6	. . .	7.5	trace	7	6	. . .	20	119,033
" " " . . .	6.5	4	7.2	0	8.5	7	. . .	20	119,033
N.-E. side Mt. Lemon .	6	3.3	8	trace	5	4.5	. . .	19	119,034
" " " .	6	4	5	trace	7	4	. . .	24	119,035
" " " .	7	5	8	trace	6	5	. . .	. .	119,035
S. of spring, Mt. Lemon[2] . .	3.5	2	3.2	0	13.5	5	. . .	20	119,032
S. o. marmoris, Station 36	10.7	6.5	8	dist.	. . .	8	. . .	20	109,075*a*

Santa Catalinas above 7500 ft.: Mt. Lemon, Stations 5 and 6 (1911), 32 and 37 (1913), on the trail to Webber's and other places. Soldier Camp, Bear Wallow, Head of Alder Canyon (type loc., No. 119,033). Kellogg Peak, southeastern side.

Rincons at station 22, Spud Rock Ranger Station, and Station 20, on the north slope.

It lives in deep humid forest in colonies, as our eastern helices do, under logs and bark of quaking asp and Arizona fir, sometimes by dozens. Only at Spud Rock it was found deep in rocks, also humid. It is a timber snail of the Canadian zone forest. In general aspect the shell reminds one of the Californian helices.

This is a common snail in the heavily wooded upper levels of the Santa Catalinas, taken at many stations. When picked up it emits a strong unpleasant odor recalling that of the goldenrod of Thunderhead mountain in East Tennessee (probably *Solidago odora*). This was first noticed at Kellogg Peak. When picked up the snail shot out two or three drops of liquid six inches or more (evidently expelled from the lung as the foot is retracted). One often smelled them before finding any. But three or four shells broken by mice or squirrels were noticed in the course of collecting, and it may be that the snail-eaters object to the smell.

By the genitalia this species is related to *S. clappi* of the Santa Rita range, and *S. ferrissi* of the Dragoons, though differing from both in several details. The shell is most like *S. clappi*. It differs from other Santa Catalina species by the minute granulation of the surface, which gives it a dull, silky luster.

The color is rather variable. At Soldier Camp (Fig. 4), Cañada

[2] Specimen not fully mature.

del Oro and some other places the general hue is cinnamon or cinnamon-buff, opaque, and the size small, diam. 18 to 20 mm. The smallest adult seen measures 17 mm. in diameter.

Specimens from the Rincons, Station 22 (1917), are pale cinnamon or greenish above, fading to a pale, bluish-gray on the base, the band with narrow, indistinct paler borders or without them. The lip is conspicuously brown-edged. The umbilicus is generally wider than in the Catalina shells. One perfect shell and another broken one in this lot are albinos, or at least the tint is very pale, and there is no band. These shells are found deep in a rock slide in a quaking asp thicket. At Station 20 (1917), on the northern slope of the Rincons, two dead but fresh shells were found in a day's search.

Sonorella odorata marmoris n. subsp. Pl. III., figs. 6 to 6*b*.

The shell is more solid than *S. odorata*, opaque; cinnamon, paler around the umbilicus and on both sides of the chestnut-brown band. Last whorl is decidedly more depressed than in *S. odorata*, and is narrower as viewed from above. The umbilicus is wider. The aperture is much smaller.

Alt. 10.4, diam. 20 mm.; $4\frac{2}{3}$ whorls (type).
" 9, " 18 " $4\frac{1}{2}$ " "

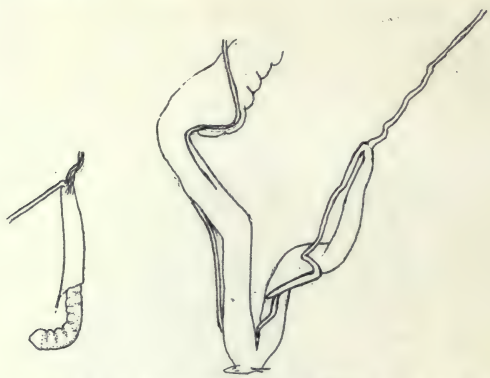


Fig. 2. Genitalia of *S. o. marmoris*, No. 109,079, with detail of penis-papilla.

Santa Catalina Mountains: Marble Peak, on the east side above the rock slide; old Dan's Gulch on the northwest side, type loc.; ridge running toward Mt. Lemon; Ferriss 1911 and 1913. Type No. 109,075 A. N. S. P.; paratypes 109,075*a*, also in Ferriss collection.

Genitalia (fig. 2) in general similar to *S. odorata* but the penis and papilla are decidedly longer and there is a flagellum, well developed for a *Sonorella*. Measurements of the organs are given in the table on page 287.

It lives in relatively dry rock slides, with the smooth *Sonorella marmorarius*, high on Marble Peak and its flanks, thus differing in habits from *S. odorata*. The shell is readily separable from *odorata*, and perhaps it should be considered a separate species. It has the same peculiar odor.

Sonorella sabinoensis n. sp. Pl. IV, figs. 1 to 5*d*.

The shell is rather narrowly umbilicate (width of umbilicus contained 8 times in that of shell in the type specimen), rather solid; cinnamon-buff, broadly zoned with white (or whitish) on both sides of the chestnut-brown band above the periphery. The surface is glossy; embryonic whorls having the usual sculpture of the *hachitana* group, granular, with divaricating protractive threads below and retractive above; subsequent whorls delicately marked with growth-lines. Suture descends moderately in front. The aperture is large, oblique, rotund-oval. Peristome narrowly expanded, dilated at the umbilical insertion.

Alt. 12, diam. 21.2 mm.; aperture 12x13 mm.; 4½ whorls.

Santa Catalina mountains, Arizona, in Sabino canyon (type loc. Station 16, 1913) and its tributaries, Sycamore canyon and Mt. Lemon Fork, from about 3000 to 6000 feet elevation. Also Rock and Vantana canyons, west of Sabino, and Bear canyon eastward.

It is a species of the dry, sun-baked rock-slides, living ones found only deep in the crevices, in the lower levels of desert vegetation. The Sabino Basin, Sycamore and Bear canyon localities are below the pine belt, in arid country, with some oak, juniper and sycamore. The species is not known to occur in the humid upper forest.

Genitalia (fig. 3, *a–d*) resembling those organs in *S. marmorarius*. The penis is thin, not swollen basally. The penis-papilla is slender and corrugated, as in the other species, and nearly as long as the penis (fig. 3*a*). The flagellum is either minute or wanting.

Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	
109,097	10	7	8	0	9	Type, fig. 3*c*.
109,092	9.5	8	7	0	7.3	
109,094	10.5	10	9	—1	9	Fig. 3*d*.
109,087	9	7	6	0.3	8.5	
109,098	8.5	8	6.5	0.5	6.5	Fig. 3*a*, *b*.

Shells from the type station measure from 20 to 24 mm. diameter. The relative size of the aperture also varies within rather wide limits. In the type specimen (pl. IV, figs. 2-2*b*) the width of aperture is con-

tained about 1.63 times in that of the shell, and in another locotype (pl. IV, figs. 3–3*b*) it is contained nearly 1.8 times. In the smaller mouthed individuals the umbilicus is somewhat larger and less covered, and the last whorl, viewed from above, is not so wide. We have tried in vain to use these characters for a separation of the series (some hundreds of shells); but while the extremes in size of aperture appear quite distinct, the distinction could not be carried through, as nearly every station supplied individuals with large, intermediate and small apertures.

The specimens from low in Sabino canyon usually have more solid, thicker shells than those from higher; but this is not always the case.

It is a species of the arid mountains, confined to lower elevations than *S. marmorarius*.

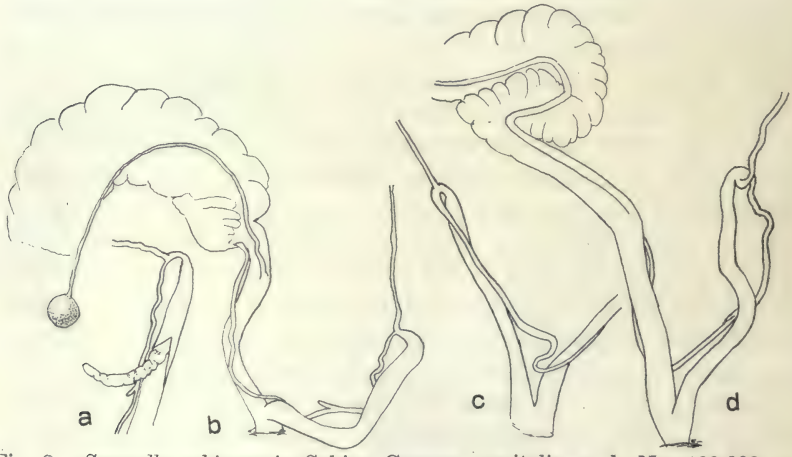


Fig. 3. *Sonorella sabinoensis*, Sabino Canyon, genitalia. *a*, *b*, No. 109,098; *c*, No. 109,097; *d*, No. 109,094.

The smallest shells, diam. 19 mm., were found at Station 15, low in Sabino canyon (about 4,000 ft.); but others up to 25 mm. diam. occur in the same place. The largest, 27 mm. diam. are from Station 9, 1913, the bluffs opposite Station 15. One of this lot is figured, pl. IV, figs. 4–4*b*.

The degree of depression is variable in the same lot. Specimens selected from a station on Vantana canyon measure:

Alt. 14.5	diam. 26,	mm.	(largest).
" 13.2	" 25,	"	(most depressed).
" 16.4	" 24.8,	"	(" elevated).
" 12.2	" 20,	"	(smallest).

Figures 5 to 5*d* are depressed and elevated shells from Bear canyon.

Sonorella sabinoensis occidentalis n. subsp. Pl. V, figs. 1 to 1*b*.

The shell appears indistinguishable from *S. sabinoensis*.

Alt. 16,	diam.	28	mm.;	5	whorls.
" 17.3	"	27	"	5	"
" 16	"	25	"		
" 14	"	23.7	"	$4\frac{1}{2}$	"
" 14	"	22.3	"	$4\frac{1}{2}$	"

This form is separated from *S. sabinoensis* solely on account of the difference in the penis, which is enlarged at the base in *occidentalis*, slender in *sabinoensis*. While the Pima canyon shells are distinguishable from the large-mouthed typical forms of *sabinoensis*, we can find no difference in the *sabinoensis* with slightly smaller aperture, such as those from Sabino canyon Station 9 (which agree in genitalia with the type of *sabinoensis*). No specimens with the penis swollen basally were found among the numerous Sabino canyon individuals opened.

The head and back are hair brown, fading to drab on the sides, the tail and entire sole being dull chamois to dull cream-buff.

Western end of the Santa Catalinas; type No. 119,491, from Station 36, east side of Pima canyon. Also on the west side, Station 37 (Pusch Ridge); Station 43 (1917), northeast of Sutherland's ranch, in the foothills; Station 45, in the large canyon north of Romero canyon (eastward from Sutherland's).

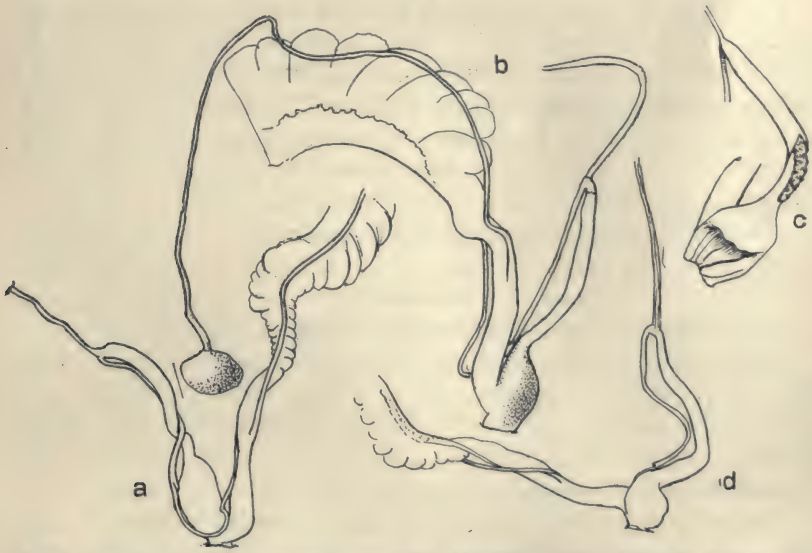


Fig. 4. Genitalia of *S. s. occidentalis*. *a*, No. 118,052. *b*, No. 118,045, with detail of penis and papilla at *c*; *d*, No. 118,056, canyon north of Romero Canyon.

Genitalia (Fig. 4*a–d*). The penis is slender except at the base where it is suddenly dilated. Internally there is a short, sinuous fleshy fold and several minor folds in the dilated part of the penis where it passes into the atrium, which also contains several fleshy ridges. The papilla is long, slender and corrugated. Penial retractor is terminal and enveloping base of the epiphallus, as usual. The epiphallus is nearly as long as penis, with a slight distal swelling in place of a flagellum. The vagina is shorter than the penis. Measurements of the organs in mm. follow:

Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Locality.
118,045	10	8	8	0	6	32	Sta. 36.
118,052	8.5	6	7.5	minute	4	23	Sta. 37.
118,056	9	6.5	7.5	"	6		" 45.

The series of 60 specimens from Pima canyon consist chiefly of dead shells. The average size appears to be slightly less in the specimens from the western side of the canyon, forming the eastern slope of Pusch Ridge.

There are three "dead" specimens from "Pusa Ridge" (? = Pusch Ridge) in the U. S. National Museum, No. 271,011, collected by Barber. The diameter is about 22 mm.

The specimens from the canyon north of Romero (opening northwestward), Station 45 (1917), have the same range of variation noted in Sabino canyon *S. sabinoensis*. There are depressed, more openly umbilicate shells, together with smaller, usually less depressed shells with relatively larger aperture and smaller umbilicus, $\frac{1}{3}$ to $\frac{1}{2}$ covered by the expansion of the columellar lip; also a few specimens transitional in these characters. 14 examined.

Alt. 15.4, diam. 27.3 mm., $4\frac{3}{4}$ whorls (largest).
" 15.6, " 23 " $4\frac{1}{2}$ "
" 14.3 " 22 " (smallest).

The genitalia do not differ from Pima canyon shells.

Seven shells from Station 43 (1917) measure: diam. 21, 21.5, 23.5, 23.7, 24, 24.4, 24.4 mm.

All of the localities for this form are in the arid lower zone of the range.

Sonorella sabinoensis buehmanensis n. subsp. Pl. V, figs. 2 to 3*b*.

Typically the shell differs from *S. sabinoensis* by being more solid and more elevated, only very slightly paler near the shoulder band, and with nearly one whorl more in examples of the same diameter.

Alt. 16.7,	diam.	25.6 mm.;	$5\frac{1}{3}$	whorls	(type; Figs. 2–2*b*).
" 17,	"	25.2 "	$5\frac{1}{4}$	"	(topotype).
" 15.7	"	23 "	5+	"	(").
" 17.7	"	25.8 "	5	"	(Sta. 43).
" 13.7	"	21.5 "	$4\frac{3}{4}$	"	(" ").
" 13	"	21 "	$4\frac{2}{3}$	"	(" ").

Buehman canyon, in the eastern part of the Santa Catalina Mountains, the type from Station 44 (1913), near the Korn Kobb mine. Also at Stations 41, head of Sycamore gulch, tributary to Buehman canyon, 42, Buehman canyon at the Brush Corral, and station 43, Buehman canyon a mile below the Brush Corral Ranger Station.

Fig. 5. Genitalia of *Sonorella sabinoensis buehmanensis*, No. 109,196.

There is considerable variation in the shells from Buehman canyon, in size, degree of elevation and number of whorls; yet unless anatomical differences are found, we consider them all of one race. As yet, only the typical form has been dissected.

Specimens from Station 41 (1913), from the head of Sycamore Gulch, have the umbilicus slightly more open than in typical *buehmanensis*, and the borders of the shoulder-band are paler; thus approaching the larger forms of *S. sabinoensis*.

In Stations 42 and 43 the size varies widely, and the smaller specimens have only a fraction of a whorl more than *sabinoensis*, from which they differ by the smaller aperture. One figured (pl. V, figs. 3–3*b*, Station 43) measures: alt. 13.7, diam. 21 mm. In the same lots the larger shells have a diameter of 25 mm. or slightly more.

Like other species of the dry lower mountains, living snails are rare. In one rock slide in Buehman Canyon, 360 fairly good "bones" were found, and only 8 living snails.

Sonorella hesterna n. sp. Pl. IV, figs. 6, 6*a*, 6*b*.

A long series of dead shells was taken at Station 148 (1917) in a rock slide on the south side of the Tucson-Benson highway, near the cave on Shaw's ranch, southern foothills of the Rincons, at about 3,500 feet. They are smaller and more solid than *S. rinconensis*, and the umbilicus is somewhat smaller. It is more depressed and has a wider umbilicus than *S. sabinoensis*. In color and surface it resembles the latter species. The freshest shells are between cinnamon and tawny-olive, fading around the umbilicus, white on both sides of the chestnut-brown band. The suture descends rather abruptly to the aperture, but not quite so deeply as in *S. hachitana*.

Alt. 13.5, diam. 22.4 mm. (type).
" 14.7, " 25.9 "

In a series of 37 adult examples, the smallest measures 20.1 mm. in diameter, the largest 25.9 mm. They run as follows:

Diam.	20–20.9	mm.,	4	specimens.
"	21–21.9	"	11	"
"	22–22.9	"	7	"
"	23–23.9	"	9	"
"	24–24.9	"	4	"
"	25–25.9	"	2	"

The station is an extremely arid one. It is a true desert *Sonorella*. The status of the form is uncertain, but it can scarcely be linked with any of the Santa Catalina or Rincon species, so that, while we do not like to describe a *Sonorella* without examination of the soft anatomy, there seems nothing else to do in this case. Its status may be revised when living examples come to hand.

Sonorella marmorarius n. sp. Pl. III, figs. 9, 9*a*, 9*b*.

The shell is depressed, rather solid, umbilicate (the width of umbilicus contained about 7 times in that of the shell, suddenly widening at the last whorl to about double its former width); light pinkish cinnamon, paler around the umbilicus, and whitish on both sides of the chestnut-brown band above the periphery. The surface is glossy. Embryonic shell of 1½ whorls, the last of which is densely, irregularly granular, with indistinct protractive and retractive threads (when unworn), subsequent whorls delicately marked with growth-lines, and under the lens showing some weak spiral impressed lines in places on the upper surface of the last whorl. The suture descends rather deeply in front. Aperture is quite oblique, oval. Peristome expanded throughout, with a gray edge, somewhat thickened within, the margins generally connected by a roughened callous ridge in fully adult shells.

Alt. 14 diam. 25 mm.; aperture 11.2x13.6 mm.; $4\frac{3}{4}$ whorls.

Marble Peak, Santa Catalina Mountains, Arizona; type loc. Station 26, 1913, quartzite slide on Marble Peak. Also found at Station 3, 1911, slide above Apache mine; Station 4, 1911, top of ridge south of the Peak; Station 38, 1913, north side of Marble Peak; "Joliet Cave," and other stations on the same mountain.

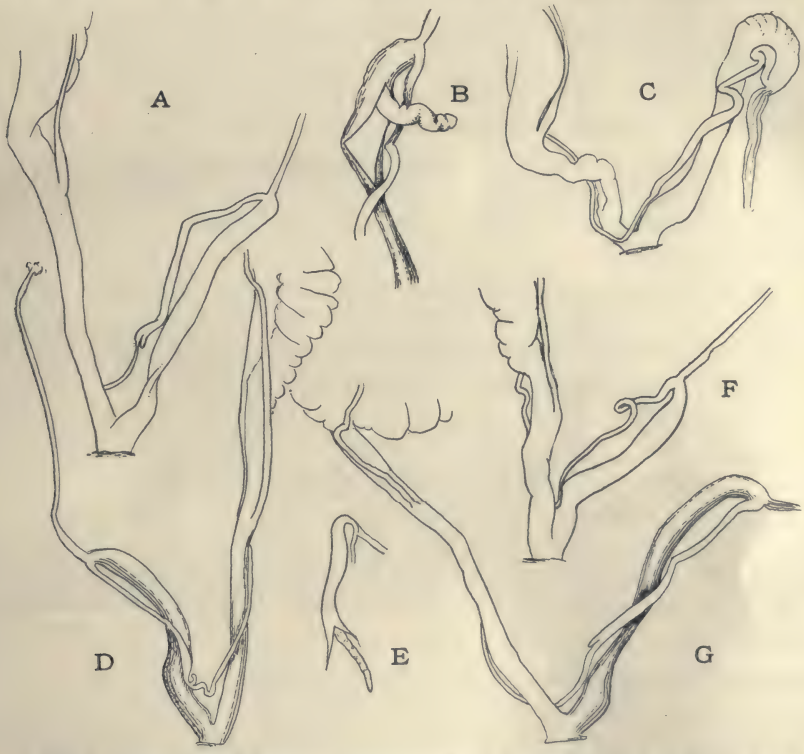


Fig. 6. Genitalia of *Sonorella marmorarius*, *a*, No. 109,077; *b*, *c*, No. 109,071; *d*, No. 109,039; *e*, No. 109,083; *f*, No. 109,084; *g*, No. 109,078.

Genitalia (Fig. 6*a–g*). The penis is thin-walled, very weakly or usually not noticeably enlarged near the atrium, containing a slender tapering, corrugated papilla, half to two-thirds or more the length of penis. Epiphallus somewhat shorter than penis, typically terminating in a little flagellum, but this is often rudimentary or wanting. Penial retractor long, inserted on apex of penis and base of epiphallus. The vagina is but little shorter than the penis. Lengths of the organs in mm. follow, the specimens all from stations on Marble Peak:

Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Retractor.	Vagina.	Station.	Fig.
109,078	12.5	7.3	8	—1	.....	10	26	6*g*.
109,077	12	8	10	1	8	11	26	6*a*.
119,039	9	6	7.3	1	12	8.5	4(1911).	6*d*.
119,040	10	8.5	7	0.5	.....	9.5	3(1911).	...
109,074	11.5	10	9	1	.....	9	.....	...
109,083	8.5	7	.....	0.5	.....	7	22	6*e*.
109,084	9	7	.....	0	11	5.5	.....	6*f*.
109,080	12.5	6	.....	0	.....	7	38	...
109,071	11.5	6	7.3	0	.....	6	Cave	6*b*, *c*.

This species is closely related to *S. hachitana* (Dall) and *S. compar* Pils. It has the peristome more thickened within than the former and differs from *S. compar*[3] by the more solid shell, more thickened peristome, etc.

The more widely open umbilicus distinguishes it readily from other Sonorellas of the *hachitana* group found in the Santa Catalinas.

Other specimens of the original lot from the type locality measure:

Alt. 15 diam. 26.3 mm. Alt. 13.8, diam. 24 mm.
" 15.3 " 24.6 " " " " 23 "
" 13 " 23.6 " " 12.5, " 22 "

The largest examples were taken at Station 3, two measuring:

Alt. 16.4, diam. 28.2 mm.; 5 whorls.
" 17 " 28 " 5 "

Marble Peak and Apache Camp have oak, juniper and sycamore wood on the lower slopes; the crest of the ridge, the head of the main "slide," is in the pine belt.

Sonorella marmorarius limifontis n. subsp. Pl. III, figs. 5, 5*a*, 5*b*.

The shell is depressed, openly umbilicate (the width of umbilicus contained 7 times in that of the shell); whitish, faintly buff near the suture and on the spire, having the usual chestnut-brown band. Last whorl wide, very deeply descending in front. Surface glossy, weakly marked with growth-lines as in related species of the *hachitana* group, and showing weak traces of impressed spiral lines on the upper surface of the last whorl. The last whorl descends deeply and abruptly in front. The aperture is very oblique, rounded-oval. Peristome somewhat expanded, slightly thickened within.

[3] *Sonorella compar*, new name for *Sonorella ashmuni* Pils., Proc. A. N. S. Phila. 1905, p. 259, pl. 17, figs. 9–14. Not *S. ashmuni* Bartsch.

On comparison with the type of *S. ashmuni*, this species is seen to differ conspicuously by the more depressed and more openly umbilicate shell.—H.A.P.

Alt. 13.3, diam. 22.3 mm.; 5 whorls.
" 14 " 23 " scarcely 5 whorls.
" 16 " 26.5 " 5 whorls.

Santa Catalina Mountains at Station 17, bluffs near Mud Springs, on Pine Canyon.

The last whorl descends more than in *S. marmorarius*, the aperture is more oblique, and the color of adults is paler. The immature shells have more of a cinnamon tint than the adults.

The spiral lines mentioned in the description are usually very faint, often scarcely discernible, but in the largest example they are quite distinct. The umbilicus sometimes varies to somewhat smaller than in the type specimen.

Mud Springs, on Pine Canyon, a branch of Sabino above Sabino Basin, is a walled hole in the mud. It is on the trail from Sabino Basin to Soldier's Camp, the elevation about 7,000 ft. It is in the pine zone. The *Sonorella* was found in the first rocks east of the spring along the trail. Also at the foot of a high cliff, in stratified "porphyry," in a ravine heavily wooded with cypress (*Cupressus arizonica*), about a mile southeast of the springs.

Sonorella marmorarius imula n. subsp. Pl. III, figs. 7, 7*a*.

At Stations 17 and 19 (1917), on a limestone hill 6 miles west of Brush Corral Ranger Station, north of Alder Springs, in the northern foothills of the Catalinas, many specimens were taken, chiefly dead, differing from typical *marmorarius* by the somewhat darker color, and by having about a half of a whorl more in examples of similar diameter.

Alt. 26.5, diam. 15 mm.; $5\frac{1}{3}$ whorls.

Eighty-five specimens from Station 19, all of the adults collected, measure as follows:

Diam. in mm	22.3	22.4	22.5	22.6	22.9	23	23.1	23.2
Number of specimens	1	1	1	3	1	3	1	3
Diam. in mm.	23.3	23.4	23.5	23.6	23.7	23.9	24	24.1
Number of specimens	2	3	2	2	3	1	4	2
Diam. in mm	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9
Number of specimens	6	2	6	4	5	3	2	3
Diam. in mm	25	25.1	25.3	25.4	25.5	25.6	25.9	26
Number of specimens	4	2	2	2	2	1	2	1
Diam. in mm	26.2	26.3	26.4	26.5				
Number of specimens	1	1	1	1				

As the error in measuring may be at least 0.1 mm., it will be seen, if a curve is plotted, that the mode for diameter is at about 24.4 mm., and the total variation 2.1 mm. in either direction.

A specimen having the umbilicus exceptionally narrow is illustrated in pl. 4, figs. 8–8*b*. The spire is also narrower than in the typical form; yet it seems unlikely that there is more than one species in the lot.

Sonorella galiurensis n. sp. Pl. V, figs. 5 to 6*b*.

The shell is umbilicate (the width of umbilicus contained about 9 times in that of the shell), between cinnamon-brown and sayal-brown in color, fading on the base, and much paler on both sides of the broad chestnut-brown band above the periphery. Glossy; embryonic whorls closely pitted-granulate, with the usual protractive threads; subsequent whorls lightly marked with irregular growth-lines. The last whorl is wide and descends somewhat in front. The peristome is narrowly expanded. The parietal callus usually has a thickened edge in fully adult shells.

Alt. 16.7,	diam.	27.5	mm.;	5	whorls.	(type, Sta. 30).
" 16,	"	27.4	"	5	"	(Sta. 30).
" 16.4,	"	25	"	5	"	(Sta. 30).
" 16.7	"	30.5	"	5	"	(Sta. 34).

Galiuro Mountains at the following Stations (1917):

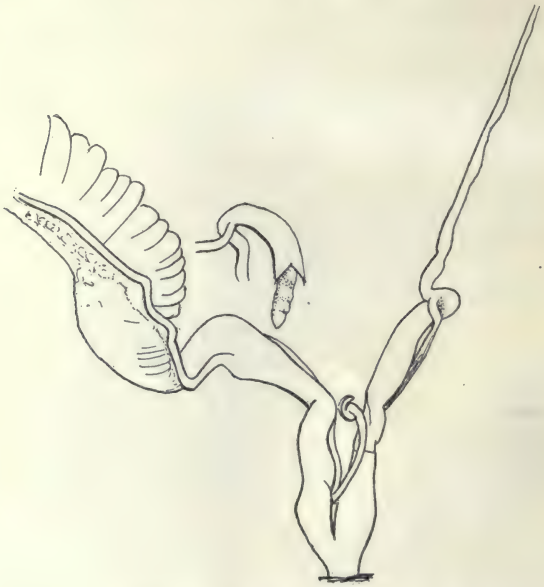


Fig. 7. Genitalia of *Sonorella galiurensis*, No. 118,122.

24. Southern slope of mountains at eastern gate of John Rhodes' ranch, among boulders on mesa.
26. Rhodes' canyon.
27. Northern slope, amphitheatre on Whitlock ranch.
28. Foot of main gulch facing north, same amphitheatre.
29. Farther up same gulch.
30. "Porphyry" slide on trail 1½ miles south of Copper Creek Mining Camp. Type locality.
31. Camp at smelter, Copper Creek.
32. Rock slide sloping west, on trail half way between Copper Creek Camp and Table Mountain.
33. "Porphyry" slide in forks of creek 2 miles east of Table Mountain.
34. Slide near the preceding.
35. Cliffs on northeastern slope of Table Mountain.

Genitalia (fig.7). The general proportions are as in *S. marmorarius*. The penis has a long, very thin sheath about the basal part, not seen in *marmorarius;* its lower portion is somewhat swollen and has several small longitudinal folds within. Retractor muscle long. Papilla weakly annulate, about half as long as the penis. There is the usual short flagellum. The vagina about equals the penis in length.

Length of penis	10	mm.
papilla	5	"
epiphallus	7	"
flagellum	1.5	"
vagina	9	"

Museum No. . . . . 118,122.

This form is much like *S. marmorarius*. The shell is slightly more capacious and darker colored, and there is some difference in the penis. Its habitat is separated from that of *marmorarius* by the valley of the San Pedro River. The elevation is much less than that inhabited by *S. marmorarius*.

20 living specimens from Station 30, all taken, measure as follows:

Diameters in mm. . .	25	25.5	26	26.5	27	27.5	28	29
No. specimens . . .	(1)	(1)	(2)	(2)	(3)	(2)	(8)	(1)

17 specimens from Station 24, a southern slope:

Diameters	24	24.5	25	26	26.5	27	28	28.5	30.5
No. specimens	(1)	(2)	(3)	(2)	(4)	(1)	(2)	(1)	(1)

Sonorella tortillita n. sp. Pl. V, figs. 4, 4*a*, 4*b*.

The shell is umbilicate (width of umbilicus contained about 8½ times in that of the shell), pinkish buff, fading to white around the umbilicus and paler near the chestnut-brown band which revolves above the periphery of the last whorl and shows very narrowly above the suture on most of the penult whorl. The surface is glossy;

embryonic shell about $1\frac{1}{3}$ whorls, the first half whorl having some radial wrinkles, the rest of the embryonic portion closely irregularly granulose, and having fine, rather indistinct, tangential (protractive) threads, often visible only near the suture. Subsequent whorls have the usual fine growth-lines. The whorls increase slowly at first, the last one very wide, suture descending slightly in front. The aperture is rounded oval-lunate. Peristome is well expanded.

Alt. 15.5, diam. 27 mm.; aperture alt. 14.3, width 15.8 mm.; $4\frac{2}{3}$ whorls.

Tortillita Mountains, Pinal Co., Arizona, the type, No. 118,053, from Station 41 (1917), east side of Hog Canyon; also found at Station 40, west side of same canyon near the cement dam, and Station 42, south slope of mountains east of Hog Canyon.

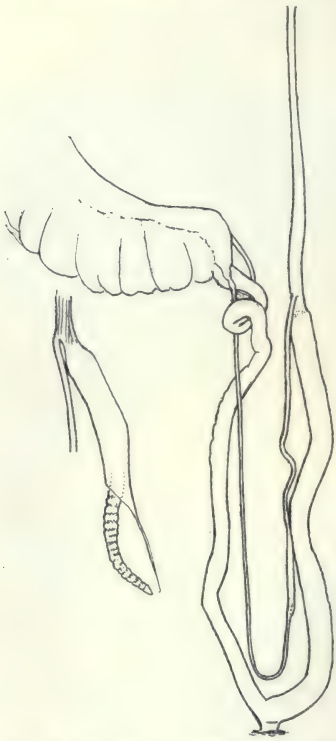


Fig. 8. Genitalia of *Sonorella tortillita* with detail of the penis-papilla.

Genitalia (Fig. 8). The penis is very long and rather slender, with muscular walls, containing a long, slender, corrugated, tapering papilla. The epiphallus is shorter than the penis, without a distinct flagellum, though there seems to be a rudimentary one concealed in the integument. The penial retractor is long. Length of vagina is about equal to the penis.

By the long penis and vagina this species is related to *S. rinconensis*, but in that snail these organs are far longer. *S. santaritana* is even more like *S. tortillita* in genitalia, but the shell is flatter, the whorls of smaller caliber. None of the Santa Catalina species has the vagina and penis nearly so long as in *S. tortillita*. The larger shells referred to *S. sabinoensis occidentalis* are closely similar.

The embryonic sculpture described is in large part effaced in the fully adult shells found. The color, too, is somewhat faded. In the young and barely full-grown examples it is decidedly darker than described.

The largest specimen from the type locality measures 17.2x28.6 mm.; the smallest, 12.5x23.2 mm.; very few are under 25 mm. diameter. The largest shell in the lot from the west side of Hog Canyon measures 17.5x30 mm.

The Tortillitas are arid mountains without forest.

Sonorella rinconensis Pils. & Ferr.

Sonorella rinconensis Pilsbry & Ferriss, Proc. A. N. S. Phila. 1909, p. 517, fig. 1, pl. 22, figs. 1–3, 5, 7.[4]

Rincon range: Rincon Peak and Wrong Mountain; Mt. Mica, only those from Rincon Peak dissected. This species was not encountered in the localities visited in 1917. It inhabits elevations above 7,500 ft., occurring in granitic rocks.

Thysanophora hornii (Gabb).

Santa Catalina Mountains: Stations 3 and 9, near mouth of Sabino Canyon, 4,500 ft. Station 13, mouth of Bear Canyon, 4,500 ft. Station 40, Alder Springs, 8,000 ft. Southern foothills of Rincon Mountains near the cave, Station 191 (1918). Galiuro Mountains.

Thysanophora ingersolli (Blaud).

Santa Catalina Mountains: Mt. Lemon at Stations C, 19, 31, 34, 37, etc., at 9,000 to 9,500 ft.

ENDODONTIDÆ.

Gonyodiscus cronkhitei (Nc.)

Santa Catalina Mountains: Station 21, Desert Laboratory Plantation, 8,500 ft. Soldier Camp. Bear Wallow. Around Mt. Lemon at Station C, spring on west side; Station 19, Congdon's Cabin; Station 28, marshy spring; Station 37; Station 22, old Lemon trail; Station 31, aspens, new trail; Station 34, 9,000 to 9,500 ft.

Rincon Mountains: Spud Rock and Catalina saddle.

Radiodiscus millecostatus Pils. & Ferr.

Santa Catalina Mountains: Environs of Mt. Lemon, Stations C, 19, 28, 30, 31, 34, 37 and some others, at elevation of 7,000 to 9,500 ft. Bear Wallow. Kellogg Peak. Generally distributed and locally very abundant, especially in the aspen zone.

Helicodiscus arizonensis P. & F.

Santa Catalina Mountains: Station 1, near weir, Sabino Canyon, 4,500 ft. Station 27, Bear Wallow. Marble Peak at Station 25, 8,500 ft., and Station 26, 8,000 ft. Rincon Mountains: Spud Rock. Galiuro Mountains, Station 24 (1917).

[4] The reference to figures "1–4, 7" as given in our paper was incorrect.

Punctum californicum Pils.

Santa Catalina Mountains: trail from Webber's to Lemon Mountain.

VITRINIDÆ.

Vitrina alaskana Dall.

Santa Catalina Mountains: Station 37, north side of Mt. Lemon 9,000 ft.; trail to Webber's place.

ZONITIDÆ.

Polita indentata umbilicata (Ckll.).

Santa Catalina Mountains: Station A, Bear Wallow Creek. West side Mt. Lemon at Station C. Marble Peak at Stations 25 and 26, 8,000–8,500 ft. Trail from Webber's place to Mt. Lemon. Alder Spring. Rincon Mountains at Station 21 (1917), Catalina Saddle, and Spud Rock. Galiuro Mountains, Station 24.

Striatura milium meridionalis (P. & F.).

Santa Catalina Mountains: Station A, Bear Wallow Creek; Soldier's Camp; Station 21, Desert Laboratory plantation, 8,500 ft.; Mt. Lemon at Stations 22, 28, 31, 37, at 9,000 to 9,500 ft.; trail to Webber's Cabin; Alder Spring.

Zonitoides arborea (Say).

Santa Catalina Mountains: Station 21, Desert Laboratory plantation, 8,500 ft. Soldier Camp. Stations 19, 22, 37 on Mt. Lemon, at about 9,000 ft. Station 25, northwest ridge of Marble Peak, 8,500 ft. Rincon Mountains, Station 20 (1917).

Zonitoides minuscula alachuana (Dall).

Santa Catalina Mountains: Mt. Lemon, Bear Wallow; Kellogg Peak and Alder Spring. Rincon Mountains.

Zonitoides singleyana (Pils.).

Rincon Mountains.

Euconulus fulvus (Mull.).

Santa Catalina Mountains: Alder Springs. Soldier Camp. Station 27, Bear Wallow Creek. Mt. Lemon at Station C, 19, 22, 28, 30, 31, 34. Common up to 9,500 ft. Ridge from Marble Peak, southwest, 8,500 ft.; south side of Marble Peak. Rincon Mountains.

VALLONIIDÆ.

Vallonia cyclophorella Ckll.

Santa Catalina Mountains: Mt. Lemon at Stations 19, 22, 30, 31, 37, at about 9,000–9,500 ft. Marble Peak, quartzite slide on south side, 8,000 ft.

Vallonia perspectiva Sterki.

Santa Catalina Mountains: Marble Peak, in quartzite slide on south side, 8,000 ft., rare. Galiuro Mountains: Whitlock ranch on the northern slope.

PUPILLIDÆ.

Pupoides marginata (Say).

Southern foothills of Rincon Mountains near the cave, Shaw's Ranch, Station 148 (1918).

Pupilla hebes (Ancey).

Santa Catalina Mountains: Mt. Lemon, at head of the aspen gulch, and ¼ mile below, on the new trail, 9,500 ft., and on the north side, 9,000 ft. Among those from the last locality, Station 37, 6 out of 128 were albinos. Station 22, ridge near Marshall Pass. It occurred in some abundance in all the localities except Station 22.

Pupilla hebes nefas Pils. & Ferr.

Pupilla hebes form *nefas* P. &. F., Proc. A. N. S. Phila., 1910, p. 135.

Santa Catalina Mountains: Station 20, northeast side of Kellogg Peak, 8,500 ft., Station 27, Bear Wallow, 214 specimens. Soldier Camp, 63 specimens. Station 21, Desert Laboratory Station, 8,500 ft., 84 specimens. Station 22, ridge near Marshall Pass, rare. Station 29, Leaning Rock, south side Mt. Lemon, 9,500 ft., 15 specimens. Station 25, ridge of Marble Peak towards Mt. Lemon, 8,500 ft., 57 specimens. Station 26, "quartzite" slide on Mt. Lemon, 8,000 ft., 2 specimens. Station 28, marshy spring near trail, Mt. Lemon, 1 specimen. Rincon Mountains: Spud Rock; Catalina Saddle.

P. h. nefas almost always has a small parietal tooth, and is usually a little longer than *P. hebes*, with between 6 and 7 whorls. It differs from *P. syngenes* by having no crest behind the lip, though there is usually a shallow, wide depression there.

In only one of the numerous stations mentioned above were *hebes* and *nefas* found together. That was Station 22, where very few shells were taken. Lots from all of the other stations, frequently copious, were either all *hebes* or all *nefas*.

Elsewhere *P. h. nefas* has been found only in two places in the Chiricahua Mountains, at elevations estimated from 7,500 to 8,000 ft. It was not associated there with dextral *hebes*, which was found at another Chiricahua locality. We are now disposed to rank *P. h. nefas* as a well-marked subspecies.

Chaenaxis intuscostata (Clapp).

Southern foothills of the Rincons, near the Tucson-Benson highway, near the cave, Shaw's ranch, at about 3,500 ft.

Gastrocopta ashmuni (Sterki).

Santa Catalina Mountains: Slide on Marble Peak, 8,000 ft., rare.

Galiuro Mountains: Whitlock ranch, on the northern slope.

Gastrocopta cochisensis (Pils. & Ferr.).

Santa Catalina Mountains: Alder Springs and Station 25, southwest ridge of Marble Peak, 8,500 ft. The shells were dirty when collected, like *B. quadridens.*

Gastrocopta dalliana (Sterki).

Santa Catalina Mountains: Station 3, mouth of Sabino Canyon, 4,500 ft.

Gastrocopta pellucida hordeacella (Pils.).

Southern foothills of Rincon Mountains near the cave, Shaw's ranch, Station 148 (1918), at about 3,500 ft.

Gastrocopta bilamellata (St. & Clapp).

Galiuro Mountains.

Gastrocopta quadridens (Pils.).

Santa Catalina Mountains: Stations 30, 31, 37, and all around Mt. Lemon at 9,000 to 9,500 ft. Soldier Camp, one specimen. When found alive, the shell is rather copiously plastered with dirt, probably attached by the mucous of the animal.

Gastrocopta pilsbryana (Sterki).

Santa Catalina Mountains: Station 3, mouth of Sabino Canyon, 4,500 ft. Alder Springs, very abundant. Station 27, Bear Wallow. Station 18, Soldier Camp, 8,500 ft. Station 21, Desert Laboratory plantation, 8,500 ft. Station 22, near Marshall Pass, old Mt. Lemon trail, 9,000 ft. Station 28, marshy spring, Mt. Lemon trail, 9,000 ft. Trail to Webber's cabin. Station 31, north side of Mt. Lemon. Station 26, quartzite slide on Marble Peak, 8,000 ft. Galiuro Mountains at Whitlock ranch. Rincon Mountains: Spud Rock.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.).

Santa Catalina Mountains: Station 25, ridge to peak Mt. Lemon, 8,500 ft.; Station 26, slide on Marble Peak, 8,000 ft. Rincon Mountains: Spud Rock.

Vertigo modesta insculpta Pils.

The shell is similar to *V. modesta* in contour, but differs by being closely and rather sharply striate on the intermediate whorls; the first whorl smooth, the last less striate than those preceding. There

is a narrow but moderately high crest close behind the outer lip. The color is chestnut-brown, becoming paler towards the apex. When alive both animal and shell are black. Teeth fine, a small supraparietal denticle being developed. The parietal and lower palatal folds are rather large. Length 2.6, diam. 1.35 mm.; $5\frac{1}{2}$ whorls.

Except in external sculpture, this form resembles *V. modesta* from Alaska, figured in Proc. A. N. S. Phila. for 1900, pl. 23, fig. 2. By its sharp striation *V. m. insculpta* is quite distinct from all other large Vertigos of the Rocky Mountains, but there is a smaller form of *V. modesta* in Labrador which is striate on the spire.

It is very abundant between 9,000 and 9,500 ft. on Mt. Lemon, in and near the aspen zone, where several hundred specimens were collected.

Very beautiful albino specimens occurred in the colonies from Stations 30, 31, and 37, Mt. Lemon.

Other localities for *V. m. insculpta* are: Santa Catalina Mountains: Soldier Camp. Mt. Lemon at Stations 19, 22, 28, 30, 31, 34, 37, at 8,500 to 9,500 ft.

Vertigo coloradensis inserta Pils.

In the original *V. c. basidens* from Bland, New Mexico, there is one parietal tooth and the basal is at the foot of the columella, remote from the lower palatal. In the Santa Catalina series there is often a small angular lamella, and the basal fold stands close to the lower palatal.

This form replaces *V. c. basidens* in the Canadian zone of the Santa Catalinas. The type is from Bear Wallow.

Santa Catalina Mountains: Desert Laboratory plantation, 8,500 ft.; Bear Wallow Creek, 8,500 ft.; Soldier Camp. Mt. Lemon at Stations 19, 22, 28, 31, 9,000 to 9,500 ft.; Alder Springs. Rincon Mountains at Station 20.

V. c. inserta differs from *V. c. arizonensis* by the development of a basal fold, and all of the teeth are larger.

Recent studies of the group have convinced us that *Vertigo columbiana utahensis* Sterki is identical with *V. coloradensis* Ckll. The former name is therefore superfluous. Our record of *V. c. utahensis* from the Chiricahua Mountains, in these *Proceedings* for 1910, p. 144, should be changed to *V. coloradensis*.

ANCYLIDÆ

Gundlachia californica Rowell.

Santa Catalina Mountains: Sabino Canyon, at Alkali Spring, Lowell U. S. Ranger Station, on leaves of *Plantinus wrighti*.

Very few examples are in the *Gundlachia* stage; none were found in the septate stage. Many have the narrow, high, oblique shape of septates, but without septum. Many of them reached the normal size of septates, then had a resting stage during which the shell became blackened, subsequently resuming growth along the margins, forming a narrow, oblique shell somewhat like *A. parallelus* in outline. Other examples become wider, about as in *A. rivularis*, in the second period of growth. The early stages are similar in all, having the usual *Ferrissia* sculpture.

Those individuals in the *Gundlachia* stage do not appear specfically separable from *G. californica*.

PHYSIDÆ.

Physa virgata Gld.

Small specimens which appear to belong to this species were taken in lower Sabino Canyon, with *Gundlachia*.

List of Collecting Stations in the Santa Catalina, Rincon, Tortillita and Galiuro Mountains.

For the Santa Catalinas and Rincons, these stations can be located and approximate elevations ascertained by reference to the U. S. Geological Survey topographic map, Tucson Quadrangle. As different sets of station numbers were unfortunately used in different years, these numbers can only be used in connection with the dates.

SANTA CATALINA

Stations of 1913 (J. H. F.)

1. Sabino Canyon, bluffs on east side of creek at water gauge dam. Elevation about 4,500 ft.
2. Same, quarter mile farther up.
3. Rock slides near camp at "Picnic Grounds," Sabino Canyon.
4. Slide north of camp, 4,800 ft.
5. Mountain east of camp.
6. About 2 miles along trail to Soldier's Camp. 5,000 ft.
7. Spring near Ranger Station at mouth of Sabino Canyon (*Physa* and *Gundlachia*) 4,500 ft.
8. Mouth of Sabino, foot of bluff, west side. 4,500 ft.
9. Rocks 1 mile above camp.
10. Vantana Canyon at its mouth; a small dry canyon next west of Sabino, not named on topographic map. *Ca.* 4,500 ft.
11. Rock Canyon, in "quartzite" bluff. This is the second small canyon west of Sabino. About 4,500 feet.
12. Vantana Canyon, west side of east mouth. Same elevation.
13. Bear Canyon, east side. 14, same, west side, near 13.
15. Mile above camp in Sabino, on mountain slope, west side. About 5,000 ft.
16. Slide below preceding, about the same elevation.
17. First rocks below Mud Springs, on Pine Canyon (a branch of Sabino above Sabino Basin). Mud Springs are about 9 miles south of Soldier's Camp. About 7,000 ft.
18. Soldier's Camp.

19. Congden Camp.
20. Northeastern side Kellogg Peak.
21. Carnegie Desert Laboratory experiment station, Marshall Pass.
22. Ridge running down east side Lemon Mountain.
23. Ridge running south from Soldier's Camp towards Mud Springs.
24. West side of Marble Peak ridge.
25. Top of same ridge.
26. "Quartzite" slide south side of Marble Peak (same as Station 3, 1910; Station 4, 1910, is the top of same slide).
27. Ridge south of Hinkley Camp.
28. Marshy spring on Lemon Mountain trail.
29. Leaning Rock, south side Lemon Mountain.
30. Aspen Gulch, parallel with main trail to Lemon Mountain. 31, quarter mile below 30, where gulch is close to trail. 32, quarter mile farther down. 33, foot of trail at the stream. Little shells very abundant at these stations and the next.
34. Cold Spring.
35. Southeast side of Marble Peak, about Apache Camp and "Joliet Cave."
36. Northwest side Marble Peak near "Old Dan's Cabin."
37. Westfall's mine.
38. North side Marble Peak near the Daley mine.
39. Goodale's house.
40. Alder Spring, Peck Canyon (one of the head branches of Buehman Canyon). Alder Spring is about 12 miles east of Soldier's Camp Ranger Station; Brush Corral Ranger Station is about 8 miles farther down Buehman Canyon.
41. Buehman Canyon: "Quartzite" slide, Sycamore Spring.
42. Buehman Canyon: Forest Ranger pasture near lower fence, Brush Corral.
43. Buehman Canyon. Lower on the stream, towards Korn Kobb mine.
44. Buehman Canyon. Near the mine.
45. John Lyon's mountain (east of San Pedro River and Rincon Mountains, north of the Little Dragoon Mountains). The rock is granite, and only *Thysanophora hornii* was found.

Stations of 1917 (J. H. F.).

(Santa Catalina Range.)

12. Main fork of Sabino Creek, at camp in Sabino Basin.
13. Head of Bear Creek (*Gundlachia* and *Physa*).
14. Head of Bear Canyon.
15. Northeast corner of Sabino Basin, on trail to Soldier's Camp. Boulder dykes along gulches.
16. Same as Station 12, in slides of mountain facing north.
17. Southwest side of Sabino Basin, big mountain in the "Window Range."
18. Brush Corral, crossing of Peck Canyon, Alder Springs.
19. Limestone mountain in foothills of S. Catalinas, San Pedro slope.

(Rincon Mountains.)

20. North side of the high Rincon peaks.
21. Saddle camp, between Santa Catalinas and Rincons.
22. Ridge west of Spud Rock Ranger Station, in aspens.
23. Drift debris of San Pedro River above Mammoth.

(Galiuro Mountains.)

24. Drift of boulders near southeast gate of the forest reserve pasture.
25. In slides, creek bank, above John Rhodes' ranch house.
26. In slides head of the same gulch as 25.
27. In No. 4 slope in amphitheatre of the mountains on Whitlow ranch, east of Sombrero Peak.
28 and 29. Other slides in the same vicinity.
30. On trail two miles south of Copper Creek mining camps.

31. Slide west across gulch from smelter, Copper Creek.
32. On trail to Table Mountain about half way from last station.
33. West of abandoned copper camp, creek running north, east of Table Mountain, in slide east of said creek.
34. Slides in same vicinity.
35. Cliffs, northeast rim of Table Mountain.

(Western slope of Santa Catalina Range.)

36. East side of Pima Canyon.
37. West side of Pima Canyon.
38. Drift debris of Pima Canyon.
39. Fork of the Canada del Oro near the foot of Marble Peak.
43. Northeast of Sutherland's ranch, in the foothills.
44. First large canyon north of Romero Canyon, and south of the Sutherland ranch.
45. About one mile east of Station 44.

(Tortillita Mountains.)

40. West side of Hog Canyon, in basin near cement dam.
41. East side of Hog Canyon, on the mountain top.

X—Mountains of the Gila Headwaters: The Blue and White Mountains, Arizona, and the Mogollon Mountains, New Mexico.

The malacological survey of these ranges, which lie in Graham, Apache and Greenlee counties, Arizona, and Socorro county, New Mexico, was begun by one of us (Ferriss) in 1913, and continued by Ferriss and L. E. Daniels in 1914. In 1900 Dr. E. O. Wooten, well known for his work on New Mexican botany, made a ten-day trip in the Mogollons, in course of which he crossed the range from Willow Creek to Mogollon and ascended the eastern flank of Mogollon Peak to almost 9,000 feet. The type of *Ashmunella mogollonensis* was collected on this occasion. So far as we know, no other mollusks had been taken in the region of the Gila headwaters prior to the collections here described.

A few mollusks collected between the San Pedro River and Clifton, Arizona, are included, as they are geographically intermediate between the regions considered in articles IX and X.

Early in September, 1913, Ferriss left Tucson with Frank Cole, the guide of tourists and naturalists, for Mt. Thomas in southern Apache county, 11,496 feet above sea level. Traveling by wagon, brief stops were made in the Graham Mountains and upper end of the Peloncillo range. At Clifton the wagon was stored, saddle horses and pack mules secured, and the trail followed to Metcalf.

From Clifton to the Double Circle ranch on Eagle Creek it is rough country, mostly forested, and with sufficient rock for snail cover, but the snails do not like it. The trail here ran northwesterly

for about 35 miles, then directly north 16 miles on Eagle Creek to the southern rim of the Blue Mountains. Pupas and Vallonias were found at Honeymoon Ranger Station, and Oreohelix a mile or two farther on, fifty miles from Clifton.

The rim of the Blue has a wall of broken granite. We found *Ashmunella mogollonensis* and a grayish form of *Oreohelix cooperi*, the latter also in the quaking asp and cork-bark fir groves of the vicinity.

The route lay northwesterly again, across the K. P. *cienaga*, down Corduroy and Fish Creeks and across Black River, to Reservation Creek in Apache Co. This high plateau has a continuous forest of the largest yellow pine, blue spruce, Douglas spruce, thickets of quaking asp and alder. Pupæ and *Oreohelix* were the principal snails. Few were found on the dome-like summit of Mt. Thomas.

Along Black river *Oreohelices*, from pale to nearly black, from high to low, were in every rock pile.

On the return trip the Raspberry trail from the rim of the Blue Mountain to Cosper's ranch on the Blue river was taken. Down the Blue and San Francisco rivers *Ashmunella*, *Sonorella* and *Oreohelix* were found in the slides investigated, but the journey was a hurried one. This ground was thoroughly covered in the journey of 1914.

An account of the journey of 1913 may be found in Nautilus for January, 1919.

On the expedition of 1914, Ferriss was accompanied by Mr. L. E. Daniels.[5] Part of the route taken in 1913 was retraced—from Clifton, Graham Co., Arizona, up the San Francisco and Blue Rivers to Cosper's ranch, a distance of about 50 miles. From this point they continued up the Blue River, northeast, to its head, and to Luna, Socorro Co., New Mexico. From Luna the party turned southeast, across the San Francisco Mountains (which lie south of Luna), and by way of Alma to the Mogollon Mountains. Some account of this trip was given in Nautilus XXVIII, February, 1915, pp. 109–113. The Ashmunellas collected were described and figured in Nautilus XXIX, June, July and August, 1915, to which the reader is referred for these matters. A map showing the collecting stations in the Mogollons may be found on page 331.

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[5] We have to record the death of Mr. Daniels, October 23, 1918. He was a companion of both authors on collecting trips of some months' duration, and it is a real sorrow that he will no longer share the labors of the trail or the cheer of the evening camp fire.

The San Francisco and the Blue rivers have been seriously torn up by floods in recent years, but many of the snails remain. Nearly all the farmers have been swept out. Oreohelices, Sonorellas or Ashmunellas exist in every favorable situation from Clifton to Bob Cat on the interstate boundary, except in a few short stretches of these rivers where the snails seem to have a dislike for the soil, the chemistry of the rocks, or something not traced. This is about fifty miles in a straight line, and thus very long miles.

Again on the Luna road to Alma, in New Mexico, *Oreohelix* was found on the crest of the San Francisco Mountains, and the largest colony, with many albinos, came from the Rio Saliz, a small stream draining the San Francisco Mountains eastward into the San Francisco River.

The Mogollons might be called a federation of sharp peaks. It is not a high plateau like the White and Blue mountain region, yet the forest conditions and tree associations are almost identical. On the Bursam wagon road from Mogollon to Willow Creek, ascending to 9,000 feet, and usually running along the north slope of the peaks, the conditions for snails are ideal. *Ashmunella mogellonensis* and *Oreohelix cooperi* were soon picked whenever logs or stones were turned in this (for snail hunters) two-day journey. At two points *Oreohelix barbata* was found with the other two species. Afterward, when the canyons facing west and south were explored the smaller Ashmunellas were found in colonies with the three above mentioned. *Sonorella* has not yet been found in the Mogollon range. In the extreme southern part of Arizona (Chiricahua range) the large toothless Ashmunellas are in colonies with the smaller toothed forms and *Oreohelix barbata* with them. Also a *Sonorella* and sometimes *Holospira*. Three species of *Sonorella* have been found in one slide; but the general Arizona rule still remains one species of the genera of Helices to a colony.

The banks of the canyons running west, in the Mogollons, were abrupt, and the south bank furnished shade and cover. In Big Dry Canyon, running directly south, the banks were so abrupt and close together that snails were living on both sides of the stream, and in the greatest abundance within our experience.

The wide differences in the Ashmunellas of the Mogollons and the presence of the Chiricahua *Oreohelix barbata* seem to indicate an alluring future for Mogollon conchology. We believe that the deeper canyons, penetrating farther into the large mountains, had greater riches than Big Dry, lying in between them. Here too in the

canyon streams live the mountain trout, friendly and well conditioned, but they are not the cut-throat trout of the Colorado.

On the whole the Mogollons, in scenery and camping delights, are not far behind the White and Blue Mountain region of eastern Arizona. Silver City is the nearest and most convenient railway station, and moreover it lies in a region unexplored by the snail fraternity.

One more killing was made on the return to Clifton, a colony of Sonorellas at Steeple Rock, Sept. 14. Thus this event of 1914 had a continuous run of two months and seven days.

Aside from the minute Canadian Zone snails which have a wide distribution at high levels, and the minutiæ of the desert foothills such as *Thysanophora hornii*, *Succinea avara*, the small *Zonitoides*, etc., there are several forms showing close affinity between the San Francisco-Mogollon region and the Chiricahua Range. The species *Sonorella binneyi*, *Ashmunella chiricahuana* and *Orohelix barbata* of the Chiricahuas are represented here by *S. binneyi franciscana*, *A. mogollonensis* and *O. barbata*. The toothed Ashmunellas are of nearly related species, and the same group of forms extends farther east in New Mexico to the Black Range. None of the species mentioned are found in the northern or Dos Cabezas part of the Chiricahua range, their habitats being from 80 to over 100 miles south of the regions now under consideration. The intervening region is at the present time too dry for the existence of these snails.

HELICIDÆ.

Sonorella grahamensis n. sp. Pl. VI, figs. 7, 7*a*, 7*b*.

The shell is umbilicate (the width of umbilicus contained about $8\frac{1}{2}$ times in the diameter of shell), very *thin*, tawny-olive, paler at the base, with the usual band; not very glossy; under the lens showing the usual weak growth-lines, and both above and below there are *numerous spiral impressed lines*. Whorls slowly increasing at first, the last rapidly widening, descending in front. Aperture rounded-oval, quite oblique. Peristome is thin, very little expanded.

Alt. 10, diam. 19 mm.; umbilicus 2.2 mm.; $4\frac{1}{2}$ whorls.

Genitalia (fig. 9). The penis has a well developed sheath at the base, and contains a long, tapering papilla. The penial retractor is inserted at the base of epiphallus and apex of penis as in the *hachitana* group. There is a short flagellum. The organs measure:

Length of penis 9 mm.; papilla 7; epiphallus 6; flagellum 0.5; penial retractor 4.7; vagina 7; spermatheca and duct 19 mm.

Fig. 9. Genitalia of *S. grahamensis*, with two details of the penis-papilla. Type specimen.

Mt. Graham, in the Pinaleno Range, Graham Co., Arizona, type No. 109,101 A. N. S. P., collected by J. H. Ferriss, 10-14-1913.

Graham Mountain is composed of crumbling granite (similar to that of Nine-mile Water Hole in the Dos Cabezas range), and is very dry on both north and south sides. On top there is yellow pine and quaking asp forest. Camp was made in Stockton Pass, and a couple of hours' collecting done at Mud Spring, on the summit. Besides *Sonorella* and *Oreohelix*, *Vitrina alaskana* was abundant, and two young Vallonias were found. The Pinaleno Range lies in line with the Chiricahua system, though separated by a rather wide mesa, in which the Southern Pacific R. R. runs, from the northern end of the Dos Cabezas Mountains.

S. grahamensis is not closely related to any other species known to us. The delicate, spirally striate shell and the rather fusiform penis-papilla are characteristic.

Micrarionta praesidii n. sp. Pl. VI, figs. 8, 8*a*, 8*b*.

The shell is depressed, umbilicate (the width of umbilicus contained about 5.7 times in the diameter), thin. The "dead" shell is grayish white above, pale ecru-drab below, with some radial white streaks, and at the shoulder a narrow, faintly traced gray band which becomes cinnamon towards the aperture. Under a lens fine gray spiral lines are seen in places on the base. The initial half whorl is smooth;

next whorl has hyphen-like tubercles parallel with the suture, not closely placed; subsequent whorls have faint growth-lines only; there is no trace of spiral striæ.

The whorls are rather strongly convex, at first slowly increasing, the last very wide, rather deeply descending in front. The aperture is strongly oblique, nearly circular, faintly washed with ochraceous within. The peristome is sharp, very little expanded except at the columellar insertion where it is broadly dilated; terminations connected by a rather long, quite thin parietal callus.

Alt. 8.5, diam. 16 mm.; umbilicus 2.8 mm.; $4\frac{1}{2}$ whorls.

Fort Grant, at foot of the Graham Range, Graham Co., Arizona, the type, No. 58,121 A. N. S. P., collected by Dr. George H. Horn.

By the sculpture of the embryonic shell, as well as the general appearance, this snail resembles *Micrarionta hutsoni* Clapp, which is smaller, more depressed, with a larger umbilicus. It is somewhat intermediate in form, between *hutsoni* and *indioensis*. If it really belongs to *Micrarionta*, and there is no mistake about the locality, it is widely separated from its congeners.

The single specimen has been in the collection for many years. It had been labelled *H. strigosa* Gld.

Dr. Horn, the distinguished coleopterist, was stationed at Fort Grant sometime after 1863. He collected a number of shells in that vicinity, which were described by W. M. Gabb in the American Journal of Conchology for October, 1866, pp. 330, 331, as follows:

Helix hornii Gabb. [*Thysanophora hornii*].

H. strigosa Gld. "The largest specimen I have seen of the species" [=*Sonorella* sp. undet.].

H. minuscula [*Zonitoides minuscula alachuana*?].

Pupa (*Modicella*) *arizonensis* Gabb [=*Pupoides marginata* var.].

Pupa hordacea Gabb [*Pupoides hordacea*].

The locality is given as "Fort Grant, at the junction of the Arivapa and San Pedro Rivers;" but that junction is really a long day's travel—fully fifty miles—westward; yet it may have been the nearest definite landmark to be found on maps of the time.

The "*H. strigosa*" mentioned by Gabb is a *Sonorella* 25 mm. in diameter, of the *S. hachitana* group. The upper part of the peristome is broken away, and the shell is bleached; we do not recognize the species.

Of the *Zonitoides* several live specimens are preserved. They probably came from around a spring. All of the other shells mentioned are such as live among rocks in arid foothills. The speci-

men of *Pupa hordacea* seems to have been given to Mr. Binney; the other species taken by Dr. Horn are in the collection of the Academy.

As Dr. Horn was also at Gila Bend, Yuma and other places in western Arizona, the possibility of an erroneous locality label for the specimen of *M. praesidii* is to be considered. That specimen was not mentioned in Gabb's paper, but he would doubtless have considered it a small "*H. strigosa*".

Sonorella rooseveltiana (Berry). Pl. VI, figs. 9, 9*a*, 9*b*.

Nautilus XXXI, July, 1917, p. 14.

Roosevelt, Gila Co., Arizona, 2200 ft. elevation. Figures of the type, supplied by Dr. Berry, are here given for comparison with the forms of adjacent counties. They are 1.6 natural size, the diameter being 16.5 mm.

S. rooseveltiana appears to belong to the *hachitana* group, but the single specimen dissected was quite immature. It is, we believe, the only mollusk reported from Gila County.

Sonorella delicata n. sp. Pl. VI, figs. 6, 6*a*, 6*b*.

The shell is umbilicate (umbilicus contained slightly over 6 times in diameter of shell), thin, somewhat translucent, light ochraceous-buff with several pale or whitish oblique streaks on the last whorl, and a cinnamon-brown band above the periphery. Glossy, having the usual weak irregular growth-lines. The embryonic whorls are nearly smooth, but short, protractive threads may be seen near the suture.

The last whorl is wide and descends rather slowly in front. The aperture is strongly oblique, rounded-oval. Peristome thin, expanded, with a dull brown edge.

Alt. 10.5, diam. 18.3 mm.; $4\frac{1}{2}$ whorls.

Genitalia (fig. 10) remarkable for the small size of the male organs. The length of penis is about one-fifth the diameter of the shell, very slender, having a stout basal sheath, and containing a short, cylindric papilla. The epiphallus is longer than the penis, terminating in a short flagellum.

Length of penis	3.5	mm.
papilla	1.2	"
epiphallus	4.5	"
flagellum	0.4	"
vagina	5.5	"

Northern end of the Peloncillo Range, about 6 miles south of the Gila River, on the toll road between Solomonsville and Clifton,

Graham Co., Arizona; in a "malpais" rock slide, about 4,800 ft. elevation, type No. 109,110 A. N. S. P. paratypes in Ferriss Coll.; collected by J. H. Ferriss, 11-14-1913.

The shell recalls *S. bowiensis* Pils., differing by the wider last whorl, smaller aperture and somewhat smaller umbilicus; also much less distinct sculpture of the embryonic whorls. The genitalia, examined in several individuals, differ by the very small size of the male organs, relatively even smaller than in *S. hachitana* and its

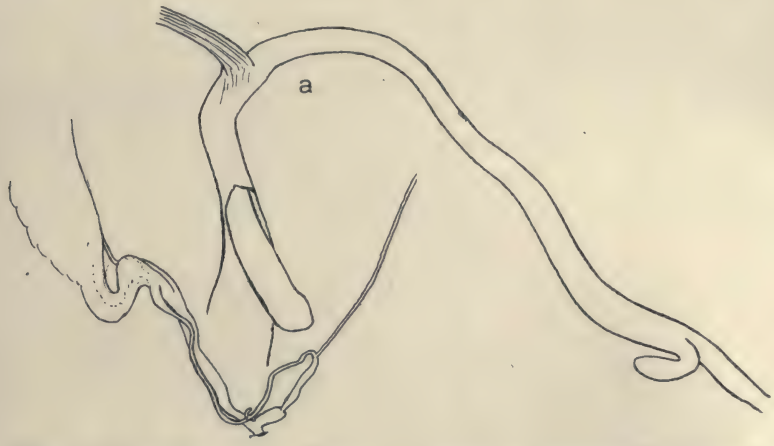

Fig. 10. Genitalia of *S. delicata*. *a*, outline of penis-papilla, epiphallus and flagellum.

immediate relatives. It differs from these by the cylindric penis-papilla with bluntly conic end. The genitalia of *S. walkeri* P. & F., of the Santa Ritas, have considerable similarity.

The living animal has an odor like *S. odorata* in the Santa Catalinas.

Sonorella cæruliluminis n. sp. Pl. VI, figs. 1 to 4.

The shell is depressed, umbilicate, the umbilicus contained about 8 times in the total diameter, somewhat translucent, nearly isabella color, having a chestnut-brown band at the shoulder, showing above the suture on the penult and usually half of the next earlier whorl, and without white bordering bands, though the shell may be slightly paler there. It is somewhat translucent throughout. Surface glossy. Embryonic portion of $1\frac{1}{2}$ whorls, at first with some radial ripples, then irregularly pitted-granulose, with weak oblique threads as in others of the *S. hachitana* group. First post-embryonic whorl is weakly striate *and minutely papillose;* later whorls with sculpture of delicate, irregular growth-lines only. The whorls are moderately

convex, the last descending slowly in front. The aperture is rounded oval-lunate, large. Peristome expands a little and is dilated at the columellar insertion.

Alt. 14.6, diam. 25 mm.; alt. of aperture 12.3, width 14.3 mm.; $4\frac{1}{2}$ whorls (type, Station 18).

Blue and San Francisco Rivers, Graham Co., Arizona, the type (No. 119,048 A. N. S. P.) from Station 18 (1914), San Francisco River 6 miles above its confluence with the Blue River. Found also at Stations 5, 8, 10, 15, 16, 17, 19, 20 (1914), and 89, 91 (1913); from Ash Canyon, 6 miles above Clifton, to the mouth of Sardine Creek on the Blue River. The higher of these colonies are at little more than 4,000 ft.

While closely related to *S. hachitana*, it differs from that by the absence of white bands bordering the shoulder-band, and of a white umbilical area, by the suture descending less deeply and not so abruptly in front, and by the smooth penis-papilla.

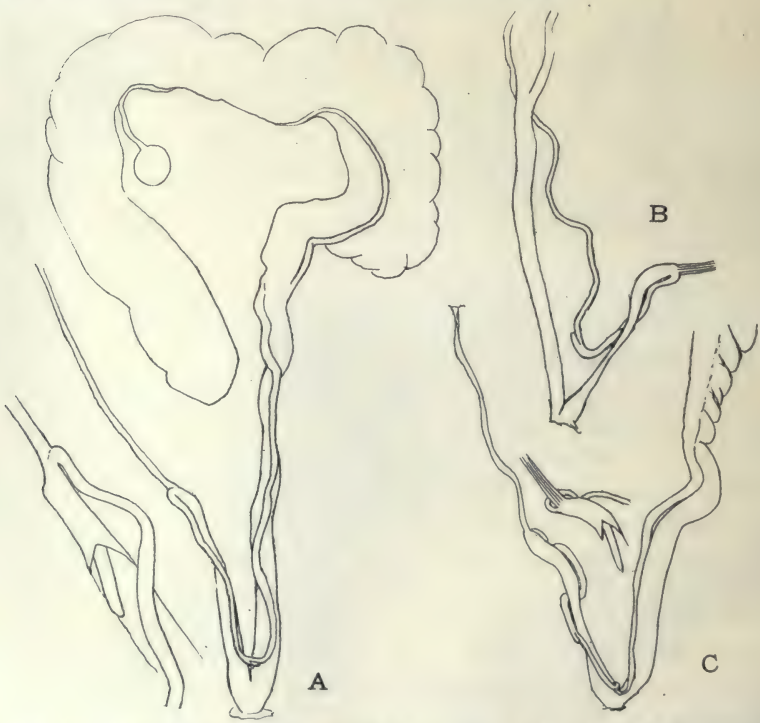

Fig. 11. Genitalia of *Sonorella cœruliluminis*. *a*, No. 119,048, Station 18, typical, with enlarged detail of penis-papilla; *b*, No. 119,042, Station 19; *c*, Station 16, No. 119,046.

The head and back are blackish brown, fading downward and backward to dark grayish brown, the tail paler. The sole has lateral bands somewhat darker than the central field (No. 119,048).

Genitalia (fig. 11) generally similar to *S. hachitana*. The penis is very slender, its retractor muscle longer; penis-papilla slender, *smooth*, with tapering end. A short flagellum is present. The epiphallus is nearly as long as the penis. The vagina is generally longer than the penis.

In one specimen dissected, Station 20 (fig. 12*a*), the penis is about a third longer, its *papilla very long*, three times the usual length or more. The flagellum also is much longer. Such differences would usually be thought specific, yet I have not found any differences in the shells from this locality.

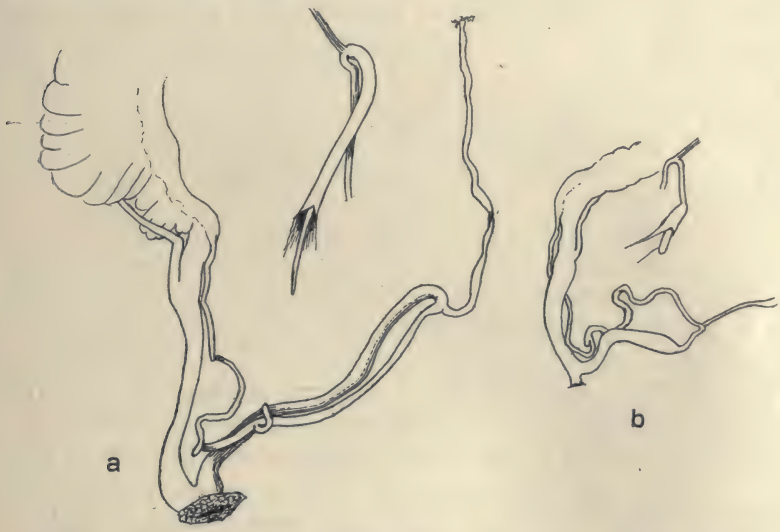

Fig. 12. *a*, Genitalia of *S. cœruliffuminis var.*, 119,047, from Station 20, Blue River. *b*, *S. binneyi franciscana* No. 119,044.

Measurements of genitalia of *S. cœruliffuminis*.

Collecting Station	18	19	16	20
Penis	8.5	7.5	7	12
Penis-papilla	3	3.5	4	11
Epiphallus	8	6	7	8.7
Flagellum	0.6	0.7	0.5	2
Retractor	..	..	10	13
Vagina	15	14	8	9.5
Museum No	119,048	119,042	119,046	119,047

The size of the shell is rather variable, the extremes of diameter in a series from Station 17 being 20 and 24.6 mm. The largest specimen noticed measures 26.4 mm. An individual without a dark band is photographed in fig. 4. It is from Station 19, Blue River, at the mouth of Pigeon Creek. Two other shells from this station are illustrated in figs. 2, 2*a* and 3, 3*a*.

Sonorella binneyi franciscana n. subsp. Pl. VI, figs. 5, 5*a*, 5*b*.

The shell is umbilicate (width of umbilicus contained 9 to 10 times in that of shell), light pinkish cinnamon with some paler or white oblique streaks and indistinctly paler on both sides of a chestnut-brown band above the periphery. This band shows above the suture of the last half of the penult whorl. The surface is glossy; embryonic shell of about 1½ whorls, the first half having some radial ripples, the next whorl minutely granulate, having oblique, curved threads, protractive below, retractive above; the later whorls with fine, unequal growth-lines. The whorls are convex, slowly increasing at first, the last rapidly widening, descending a little in front. The aperture is unusually large, shortly oval-lunate. The peristome is very narrowly expanded, straightened and dilated towards the columellar insertion.

Alt. 11.6, diam. 19mm., aperture 9.8x11.5 mm.; 4½ whorls.

San Francisco River, Graham Co., Arizona; type locality, Station 92 (1913), above Sardine Creek. Also taken at Station 93 in the same vicinity, and at Station 13 (1914), 2 miles above Harper's. Ferriss and Daniels.

The head and back are dark grayish brown shading into dark vinaceous drab downward and backward, the tail light colored.

Genitalia (Fig. 12*b*). The penis contains a cylindric papilla with blunt, rounded end. The epiphallus is about twice as long as the penis, and bears a small flagellum. The *penial retractor inserts on the epiphallus some distance (over ¾ mm.) above the penis.* The vagina is nearly or about as long as the penis. Measurements follow:

Station	13	13	93
Length of penis	5	6	7 mm.
papilla	2	2.3	3.5 "
epiphallus	10.5	10	10.5 "
flagellum	0.5	0.7	small
penial retractor	3.3	..	..
vagina	4.7	5	5.5 mm.
Museum No	119,044	119,044	109,413

By its genitalia and shell this subspecies is closely related to *S.*

binneyi P. & F., of the southern Chiricahuas. The blunt penis-papilla, and especially the insertion of the penial retractor on the epiphallus some distance beyond the apex of the penis, are alike in both. There are, however, some differences in the proportions of the organs, the epiphallus and penis-papilla being longer relative to the penis in *S. b. franciscana*, and the last whorl of *franciscana* is a little wider, viewed from above.

The diameter, in specimens seen, is from 17 to 19.3 mm.

Ashmunella pilsbryana Ferriss.

Ashmunella pilsbryana Ferriss, Nautilus XXVII, 1914, p. 109.
Ashmunella pilsbryana Ferriss & Pilsbry, Nautilus XXIX, 1915, p. 42, pl. 2, fig. 3.

Arizona: Along the San Francisco River, from near Harper's Ranch to 2 miles above the mouth of the Blue River, Graham and Greenlee Counties, Arizona.

Ashmunella mogollonensis (Pils.).

Ashmunella chiricahuana mogollonensis Pilsbry, Proc. A. N. S. Phila., 1905, p. 252, pl. 16, figs. 101,102.
Ashmunella mogollonensis Pilsbry, Nautilus XXIX, 1915, p. 42. Pilsbry & Ferriss, Proc. A. N. S. Phila., 1917, p. 93, pl. 7, fig. 10 (shell), and pl. 10, fig. 3 (genitalia).

Professor E. O. Wooten, who discovered this snail, crossed the Mogollon Range from Willow to Silver Creeks, along what is now called the Bursam road. He also made an excursion from the West Fork of the Gila towards Mogollon Peak, reaching a point about $1\frac{1}{2}$ miles due east of the Peak, in the forks of Whitewater Creek, at about 9,000 ft. It was probably here that he obtained the type of *A. mogollonensis*, though it is also common along Silver Creek and the Bursam Road.

Specimens were taken along Silver Creek and the Bursam Road at Stations 38, 42, 43, 44, 45, from about 7,500 to 9,000 ft. elevation, and at Station 46, Little Turkey Creek, at about 9,000 ft.

It is rather variable in size, specimens from Station 38 measuring from 16.5 to 21 mm. diameter, those from Station 46 from 17 to 19 mm. Other localities in the Mogollons are Station 51, head of Mineral Creek, where there are some beautiful albino shells, and 70, 76, 79, on Dry Creek, the shells mostly large.

In Arizona it was taken in 1913 at Stations 59, 84, 86, all on or near the rim of the Blue Mountains, at 5,500 to 12,000 feet. The shells average larger than in the Mogollons, very few being under 20 mm. in diameter. Specimens from Station 59 measure:

Alt. 11.5 diam. 22.8 mm. $5\frac{3}{4}$ whorls.
" 11 " 21 " $5\frac{3}{4}$ "
" 8.5 " 18.3 " $5\frac{1}{3}$ "

Extremes of size, Station 86.

Alt. 11 diam. 22.8 mm. $5\frac{3}{4}$ whorls.
" 10 " 19.5 " $5\frac{3}{4}$ "

A. mogollonensis differs from *A. chiricahuana* by the very small and short penis, scarcely differentiated from the epiphallus; the absence of a penial retractor muscle; and the more capacious spermatheca, which is sacculate distally in some individuals. There are also differences in the proportions of the organs, but whether constant or not can be determined only by measuring a long series. In both the epiphallus is very long. The shells can be distinguished by the minute but deeply engraved spiral lines of *A. mogollonensis*.

Other species of *Ashmunella* from the Mogollon Mountains were described in Nautilus XXIX, 1915, as follows:

Ashmunella tetrodon Pils. & Ferr. Dry Creek.
Ashmunella tetrodon mutator Pils. & Ferr. Dry Creek.
Ashmunella tetrodon inermis Pils. & Ferr. Dry Creek.
Ashmunella danielsi Pils. & Ferr. Cave Spring Canyon.
Ashmunella danielsi dispar Pils. & Ferr. Little Whitewater Creek.

Oreohelix cooperi (W. G. B.). Pl. VII, figs. 1 to 6a.

Mogollon Mountains, Socorro Co., New Mexico: Willow Creek, Stations 46–48, at from about 8,300 to nearly 9,000 ft.; Silver Creek and along the Bursam Road (above Mogollon), at about 7,500 to 9,000 ft., Stations 39, 40, 42, $42\frac{1}{2}$, 43, 44; also Station 35.

The specimens from these localities closely resemble those figured by us from the Black Range, N. M. (in these *Proceedings* for 1917, pl. 9, figs. 5–9), but there is greater variation in contour, as in pl. VII, figs. 6, 6*a* from Station $42\frac{1}{2}$, near the crest of the range, measuring

Alt. 13, diam. 21 mm.
" 16.5, " 20 "

The commonest form is like that shown in pl. 9, fig. 7 of our paper of 1917; the size generally from 21 to 23 mm. diam. A large shell from Station 48 measures, alt. 16.4, diam. 23.3 mm. At Stations 39 and 40 they are smaller, diam. 18 to 20 mm. The size is independent of elevation, as there are larger shells both above and below these stations in the Willow Creek region.

In Arizona the same "Black Range form" of *cooperi* was found on the southern slope of the Blue Mountains, Station 59 (1913),

in Cosper's pasture, Station 58 (pl. VII, fig. 1) and farther northward in the southern part of Apache Co., on Mt. Thomas, White Mountains, at Station 75 (1913). In all of these stations there are the same capacious whorls and frequently very high spire noted in the Mogollons.

All of the preceding inhabit high elevations, and all were found under logs and leaves in heavy timber, as in the Black Range of New Mexico. The following lots were all among rocks (pl. VII, figs. 2–5*b*).

Farther down the Blue River (in Greenlee Co., Arizona), the species was found as far as Station 23, east side of the river 2 miles above the mouth of Grant Creek (pl. VII, figs. 5–5*b*). While there is abundant intergradation with the shells of higher elevations just noticed, the majority of the shells are more openly umbilicate. Many have the spire very high, but this is variable in all the lots. Three examples from Station 23 figured measure:

Alt.	16,	diam.	26.5 mm.,	umbilicus	4.7	mm.
"	18,	"	24 "	"	4.5	"
"	17.8	"	23 "	"	3	"

The shells from Station 25 are almost as large; those from Stations 26 to 32 (going up the river) are smaller. Specimens from Station 29, 1 mile above Blue River Ranger Station (pl. VII, figs. 2–2*b*) measure:

Alt.	17,	diam.	22.3	mm.
"	18	"	22.2	"
"	15	"	22	"
"	15.6,	"	18	"

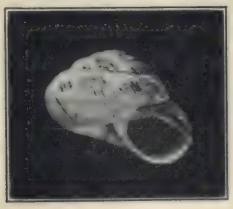

Fig. 13. *Oreohelix cooperi*, albino, Station 29.

There are some beautiful albino specimens in this lot (fig. 13). Other examples are figured (pl. VII, figs. 3, 3*a*) from Station 27, near the Blue River Ranger Station, where the shells are very dark colored. One measures, alt. 13, diam. 20.5, umbilicus 5 mm.

A series from Station 36, Mt. Lisa, Lisa Creek, Socorro Co., N. M., 20 miles north of Alma, is similar to those of Station 29, also with not a few albino shells.

The Blue River series shows all gradations of shape between very high shells, those of the typical *cooperi* contour, and an openly umbilicate shell with whorls of small caliber. The sculpture varies from that of Black Range *cooperi* to more effaced, the striation and spirals weak.

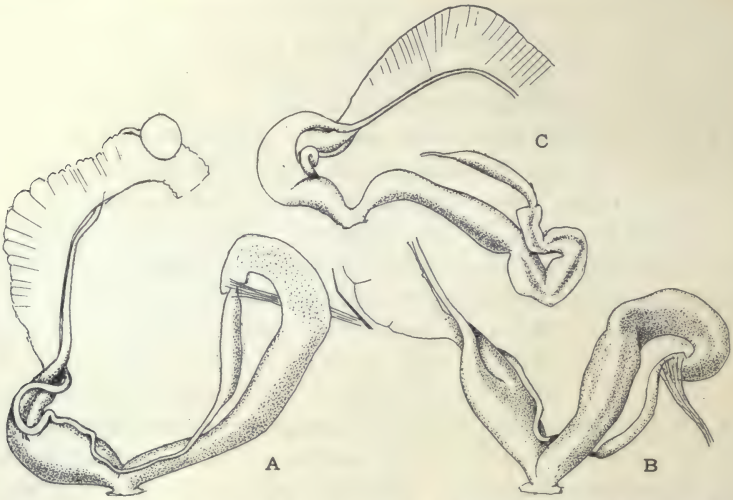

Fig. 14. Genitalia of *Oreohelix cooperi*. *a*, Cosper's pasture; *b*, Blue River, Station 26; *c*, form *apache*, Black River, Station 81.

The genitalia (figs. 14*a*, *b*, *c*) agree with those organs in *O. cooperi* from the Black Range, N. M., figured in these *Proceedings* for 1917, p. 101, fig. 5. The internally ribbed portion of the penis forms more than half of the total length of that organ, as in all forms of *O. cooperi*. Measurements in mm. follow. Numerous other specimens opened but not measured were seen to agree with those illustrated. They are distinguishable at sight from all forms of *O. strigosa*.

Station.	Penis.	Internally ribbed part of penis.	Epiphallus.	Vagina.	Diam. of Shell.	Museum No.
26 (1914).	16	9	6	6	23	119,151
58 (1913).	17	10	7	5	21	109,173
35 (1914).	13	7.5	...	...	20	119,152
36 (1914).	13	8	...	...	21	119,153
23 (1914).	18	10	...	7	24	119,150
76 (1913).	19	10.5	6	...	23	109,184
81 (1913).	18	9.5	...	4.5	23	109,180
81 (1913).	17.5	8	6.3	...	...	109,180

Preparations are figured from Stations 26, Blue River (fig. 14*b*), 58, Cosper's pasture (fig. 14*a*) and 81, Black River (fig. 14*c*). The specimen dissected from Station 36 is an albino.

O. cooperi form *apache*, new form (pl. VII, figs. 7 to 8*a*). Rather large size, dark or very dark coloring and subobsolete sculpture (the spirals being especially weak) characterize the shells taken along the Black River and Fish Creek, in Apache County, Arizona. The shell is generally quite depressed and as openly umbilicate as the forms of *O. strigosa*. The diameter is usually from 22 to 26 mm. Few have the spire very high, and none are as high as many of the Blue River shells.

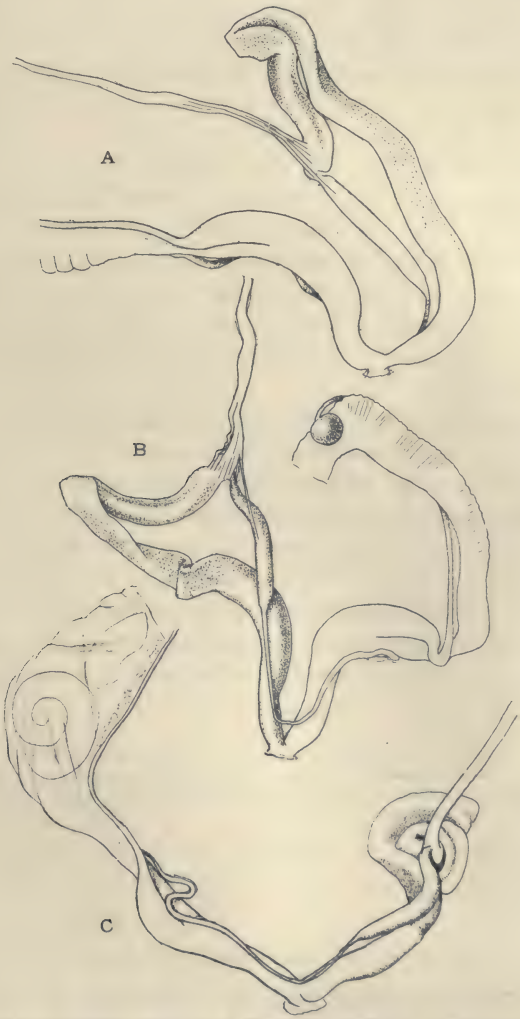

Fig. 15. Reproductive organs of *Oreohelix strigosa meridionalis*, the middle figure drawn from the type specimen.

Alt. 15, diam. 24 mm., umbilicus 4.5 mm.

Type No. 109,184, from Station 76 (1913), Black River 2 miles above Fish Creek. It was taken also at Stations 53, 60–62, 64, 66, 68, 69, 71, 72, 76–81, 83 of the expedition of 1913.

On account of the form and sculpture of this large series, so unlike the usual forms of *cooperi*, it appears best to name it. The Blue River series varies from the *apache* type to the normal *cooperi* form. Indeed, specimens could be selected from the Mogollon series agreeing with *apache*, though they are quite exceptional there. The genitalia are either practically typical *cooperi*, as at Station 76, or the costate part of the penis may be relatively a trifle longer, as at Station 81 (fig. 14*c*).

Oreohelix strigosa meridionalis n. subsp. Pl. VII, fig. 9.

The shell is depressed and very openly umbilicate, the last whorl subangular above the aperture; otherwise resembling *O. c. apache*. Striation weak, subobsolete spiral lines only very faintly developed.

Alt. 14.4, diam. 24.5 mm.; umbilicus 6 mm. wide; $5\frac{1}{2}$ whorls.

Y Salt House branch of Eagle Creek, Graham Co., Arizona; type No. 109,186 A. N. S. P. Also taken on the Black River near the horseshoe bend.

By the shells alone we would hardly separate this form from *O. cooperi apache;* yet the genitalia were found to be like *O. s. depressa*.

The genitalia (fig. 15) agree with those of *O. s. depressa* and various allied forms except that the organs are longer in shells of similar diameter; yet in Colorado *depressa* this is a rather variable character, and it is somewhat affected by the conditions of preservation. The penis is very long, its internally costate portion hardly one-third of the entire length, having about 4 principal ribs within; the internally papillose portion flattened, weakly ribbed within, sometimes having a trilobed section distally. Measurements of the organs in mm. follow:

Station (1913).	Penis.	Internally costate portion.	Epi-phallus.	Vagina.	Diameter of shell.	Fig.	Museum No.
56	33	9	10	9	24	15*b*	109,186
.....	31	10	8	10	.....	15*a*	109,177
71	19.5	6	5	6.5	22	.....	109,179
.....	28	7.5	6	8	21.5	15*c*	109,190

O. s. meridionalis differs from *O. s. depressa* by the distinctly smoother shell.

Oreohelix barbata Pils.

The occurrence of this species in the Mogollons was a surprise, as it was described from the Cave Creek region of the Chiricahuas, far to the south. It does not inhabit the dryer northern half of the Chiricahua range, and its distribution is therefore conspicuously discontinuous. It evidently changes much more slowly than the Ashmunellas, though some little differentiation may be seen as noted below.

In *Dry Creek*, it was taken in the slides with *Ashmunella*, at Stations 62, 64, 68, 70, 72, 75, 77, 78 and 79. In most of these colonies it reaches large size, even larger than in the Chiricahuas. Two examples from Station 79 measure: height 8, diam. 16 mm., and height 9, diam. 15.4 mm. Usually there are several circular fringes on the last whorl above the periphery, and more on the base than in Chiricahua examples. In the latter, fringes above are exceptional. Counting that at the periphery, there are usually 8 to 11 spiral wreaths in Dry Creek *barbata*, 6 to 10 in Chiricahuan specimens. In some lots the cuticular appendages are mostly or quite lost in the adult stage. Some consist partly of smaller individuals; and at Stations 64 and 75 all are small, 11–12 mm. in diameter.

Cave Spring Canyon, Station 57. Very small, about 10 mm. diameter, and agreeing well with *O. b. minima* P. & F. (Proc. A. N. S. Phila. 1910, p. 94, fig. 15) from Rucker Canyon, Chiricahuas. There is probably no direct relationship, each being presumably a diminutive race of the normal larger forms of their respective ranges. These small forms show decadence by the deep descent of the last whorl to the aperture.

Willow Creek, Station 46. This is on the eastern slope of the Mogollon watershed. The size is small, diameter about 11 mm. Cuticular appendages usually deciduous.

Thysanophora hornii (Gabb).

Arizona: Station 45 (1913), John Lyon's Mountain, north of the Little Dragoons. Blue River, Station 18 (1914), and Little Blue River, Greenlee Co.

New Mexico: Station 76, Dry Creek, west side of the Mogollon Mountains.

Thysanophora ingersolli (Bld.).

Arizona: Reservation Creek, 9,500 ft.; Fish Creek; Horseshoe bend of Black River, and 2 miles above, at 9–10,000 ft. Apache Co. Cosper's pasture, Graham Co.

New Mexico: Stations 38, 42, 45, 51, 57 in the Mogollon Mountains, abundant.

ENDODONTIDÆ.

Gonyodiscus cronkhitei (Nc.).

Arizona: Cosper's pasture, 11,000 ft., and rim of the Blue Mountains, 12,000 ft., Graham Co.; Blue River, Station 29 (1914), Greenlee Co. White Mountain Camp at Mt. Thomas, 13,500 ft., Apache Co.

New Mexico: Stations 36, 42, 45, 46, 57 in the Mogollon Mountains, abundant.

Radiodiscus millecostatus Pils. & Ferr.

Arizona: Little Blue River, Greenlee Co.; Cosper's pasture and Station 59, head of "hot air trail" rim of Blue Mountains, 12,000 ft., Graham Co.; Reservation Creek, Apache Co.

New Mexico: Station 45, Willow Creek, Mogollon Mountains.

Helicodiscus arizonensis (P. & F.).

Arizona: Cosper's ranch, on the Blue River, 5,060 ft.

New Mexico: Stations 36, 42, 55, 57, Mogollon Mountains.

Punctum conspectum (Bld.).

Arizona: Station 75 (1913), Thomas Peak, Apache Co.

New Mexico: Willow Creek, Mogollon Mountains, at Station 45 (1914).

These shells appear to be somewhat more glossy than the Californians compared, the spiral striation better developed, and the riblets irregularly developed; yet we would hesitate to separate the specimens from this widely spread west coast species.[6]

Punctum pygmaeum (Drap.).

Arizona: Station 70 (1913), Black River near the Horseshoe bend; somewhat abundant. This is the first record of the species for Arizona.

ZONITIDÆ.

Polita hammonis electrina (Gld.).

Arizona: Station 80 (1913), Black River. One example. There are no spiral striæ.

Polita indentata umbilicata (Ckll.).

Arizona: Blue River at Cosper's ranch, 5,060 ft., and Stations

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[6] A form of this species was collected in great numbers about bushes in a meadow at the west end of Oswego, Clackamas Co., Oregon, by Mr. John A. Allen in 1913 and 1914. It differs from typical *P. conspectum* by the larger size and decidedly higher, conic spire, and may be called *Punctum conspectum alleni*. The type measures, alt. 1.7, diam. 2.3 mm. (No. 111,413 *a*, A. N. S. P.). A specimen of *P. conspectum* received from Bland measures, alt. 1.25, diam. 2.1 mm.—H. A. P.

18, 29 (1914); Little Blue; rim of Blue Mountains, 12,000 ft.; also in Apache Co. on Fish Creek, 10,500 ft.

New Mexico: Stations 38, 42, 46, 55, Mogollon Mountains.

Striatura milium meridionalis (P. & F.).

Arizona: Cosper's pasture, 11,000 ft., Graham Co.; Black River and Reservation Creek, 9,500 ft., Apache Co.

New Mexico: Station 57, south fork of Whitewater Creek, Mogollon Mountains.

Zonitoides arborea (Say).

Arizona: Station 29, Blue River; Cosper's pasture and rim of the Blue Mountains, Graham Co.; Reservation Creek and Fish Creek, Apache Co. Up to 12,000 ft.

New Mexico: Stations 38, 42, 46, 50, in the Mogollon Mountains.

Zonitoides minuscula alachuana (Dall)..

Arizona: Graham Mountain, Graham Co.; Station 6, foot of Copper King Mountain. Reservation Creek, Apache Co.

New Mexico: Big Dry Creek, Mogollon Mountains.

Zonitoides singleyana (Pils.).

Arizona: Station 6 (1914), foot of Copper King Mountain, 1 mile below Harper's, Graham Co.

Euconulus fulvus (Müll.).

Arizona: Station 58, Cosper's pasture, 59, rim of Blue Mountains, Graham Co.; Reservation Creek and Station 75, White Mountain Camp, 13,500 ft.

New Mexico: Stations 38, 42, 45, 46, 47, 50, 53, in the Mogollon Mountains.

VITRINIDÆ.

Vitrina alaskana Dall.

Arizona: Rim of Blue Mountains, 12,000 ft., Graham Co.; Reservation Creek, Apache Co., 9,000 ft.

New Mexico: Stations 45, 46, Willow Creek, Mogollon Mountains.

VALLONIIDÆ.

Vallonia perspectiva Sterki.

Arizona: Graham Mountains; Cosper's ranch of the Blue River, 5,060 ft.; Ole Hagen's ranch on Eagle Creek. Abundant.

New Mexico: Station 38, Silver Creek above Mogollon, and 57, south branch Whitewater Creek; also Big Dry Creek, Mogollon Mountains.

Vallonia cyclophorella Ckll.

Arizona: Cosper's pasture and rim of Blue Mountains, Graham Co.; Reservation Creek, Apache Co. 9,500 to 12,000 ft.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.).

Arizona: Graham Mountain; Little Blue River; Cosper's on the Blue River; rim of Blue Mountains, Graham Co.; Fish Creek, Apache Co.

New Mexico: Stations 38, 42, 46, Mogollon Mountains.

Pupilla blandi pithodes Pils. & Ferr.

Arizona: Reservation Creek, and head of Black River, Apache Co.; Cosper's pasture, Graham Co. New Mexico: Stations 38, 45, 46, 47, 53 Willow Creek, Mogollon Mountains, at about 9,500–10,000 ft.

This is the same race found in great abundance along the summit of the Black Range, N. M. It is larger, especially wider, than typical *P. blandi*, the crest is weaker the striation stronger. The lip is but little thickened within, and the three teeth are well developed. It is of a walnut-brown color.

Length	3.7,	diam.	1.7 mm.;	$7\frac{1}{2}$	whorls.		115,361 A. N. S. P.
"	3.25	"	1.75 "	$6\frac{1}{2}$	"		
"	3.05	"	1.7 "	$6\frac{1}{3}$	"		

Pupilla hebes (Ancey).

Arizona: Cosper's pasture and rim of Blue Mountains, Stations 58, 59, Graham Co.; Reservation Creek, Apache Co. 9,500 to 12,000 feet.

Gastrocopta ashmuni (Sterki).

Arizona: Cosper's ranch on the Blue River, 5,060 ft.; Ole Hagen's ranch, Eagle Creek. Very few found.

New Mexico: 8 Stations in the Mogollon range.

Gastrocopta dalliana (Sterki).

Arizona: Station 6 (1914), foot of Copper King Mountain, near Harper's place; Ole Hagen's, Eagle Creek, Graham Co.

Gastrocopta quadridens Pils.

New Mexico: Stations 42 and 47, Silver and Willow Creeks, Mogollon Mountains.

Gastrocopta pilsbryana (Sterki).

Arizona: Graham Mountains; Ole Hagen's on Eagle Creek; Cosper's ranch, Blue River; Little Blue River; Cosper's pasture; Horseshoe of Black River; Fish Creek. From about 5,000 to 11,000 ft.

New Mexico: Stations 38, 45, 47, 50, on Silver, Willow, Turkey and Big Dry Creeks, Mogollon Mountains. It is generally distributed over the wooded country covered in this report.

Vertigo ovata Say.

Arizona: Station 6, foot of Copper King Mountain, 1 mile below Harper's place, Graham Co.

Vertigo concinnula Ckll.

New Mexico: Stations 38, 42, 45, 50, 53 (1914), on Silver, Willow and Turkey Creeks, Mogollon Mountains, Socorro Co.

Vertigo coloradensis arizonensis P. & V.

Arizona: Red Sack, Graham Mountains; Horseshoe bend of Black River, Apache Co.

New Mexico: Station 38, Silver Creek, 53, Willow Creek, 50, Turkey Creek, 57, south fork Whitewater Creek, Mogollon Mountains.

Vertigo modesta insculpta Pils.

Arizona: Cosper's pasture and rim of Blue Mountains; Graham Co.; Reservation Creek, White Mountains, Apache Co.

Columella alticola (Ingersoll).

New Mexico: Station 45, Willow Creek, Mogollon Mountains.

SUCCINEIDÆ.

Succinea avara Say.

Arizona: *Cienega* near Solomonsville, Graham Co.

New Mexico: Station 46, Willow Creek, Mogollon Mountains.

PHYSIDÆ.

Physa virgata Gld.

Arizona: Stations 19 and 20, Blue River.

Physa sp. undet.

Arizona: Reservation Creek, near the Big Spring, Apache Co. With only immature specimens and broken adults an identification is difficult.

UNIONIDÆ.

Anodonta dejecta Lewis.

Arizona: Black River, southern border of Apache Co.

"Subfossil" valves of this species are found in the banks of the Santa Cruz river at Tucson.

Collecting Stations of J. H. Ferriss in Graham, Greenlee and Apache Counties, Arizona, in 1913.

47. Near Mud Springs, trail on summit of Big Graham Mountains.
48. Tank 10 miles south of Solomonsville (*Physa* only).
49. Swampy place 7 miles south of Solomonsville (*Physa* only).
50. Rock slide on the right side of the toll road, 6 miles south of Coronado. Peloncillo Range.
51. Eagle Creek.
52. Eagle Creek, 3 miles above the fork, east bank.

53–54. Eagle Creek, 5 miles above the forks.
55. Eagle Creek, 5 miles above the forks, west side.
56. Y Salt House branch (west fork) of Eagle Creek, ½ mile above Hot Air Salt House.
57. 4 miles above mouth of Y salt house branch on Hot Air trail.
58. Cosper's pasture, top of the Blue Mountains, 12,000 ft.
59. Southern rim of the Blue Mountains.
60. Fish Creek, beaver dam camp. Apache Co.
61–65. Rock slides along Fish Creek.
66–72. Black River, near Horseshoe bend.
73. Reservation Creek, 2 miles below Big Springs.
74. Camp 4 miles below Big Springs (*Physa* and *Pisidium*).
75. Head of Black River, camp 2 miles below summit of Thomas Peak (summit 13,500 ft.). White Mts., Apache Co., Ariz.
76–83. Black River, 2 miles above Fish Creek.
84. Y Salt House trail, rim of Blue Mountains, 12,000 ft.
85. Below the same.
86. Raspberry or East Eagle trail, 3 miles above Cosper's place on the Blue River.
87–88. Between Cosper's and the Little Blue River.
89. Mouth of the Little Blue River, 4,000 ft.
90. Spring 3 miles below mouth of Little Blue (*Physa*).
91. Sardine Creek 1 mile above mouth.
92. San Francisco River opposite Sardine Creek.
93. Rock slide on the east bank of San Francisco River, 3 miles below Station 92.

Collecting Stations of J. H. Ferriss and L. E. Daniels in Graham and Greenlee Counties, Arizona, and Socorro County, New Mexico, 1914. List compiled by Daniels.

4. Gila River drift at Guthrie, Arizona. (Stations on the San Francisco River.)
5. Ash Canyon one mile below Harper's on the "Frisco" (San Francisco) River, six miles above Clifton, Arizona.
6. One mile below Harper's, west side of Frisco River, foot of Copper King Mountain.
7, 8. Ash Canyon, above Station 5.
9. Branch of Ash Canyon below Station 5, one mile below Harper's.
10. Ash Canyon opposite Station 5, one mile below Harper's.
11. Top of Copper King Mountain, N. W. of Colorado Mine. 6 miles above Clifton. Elevation 4,500 ft.
12. Top of Copper King Mountain, west of Colorado Mine. 4,500 ft.
13. Slide on east bank of Frisco River, two miles above Harper's ranch and eight miles above Clifton.
14. Frisco River, two miles above mouth of Blue River.

(*Stations on the immediate banks of the Blue River, Greenlee Co., Arizona.*)

15. Four miles up from the mouth of the Blue River.
16. Five miles up the Blue River.
17, 18. Six miles up the Blue River.
19. Blue River at mouth of Pigeon Creek.
20. One mile down the Blue River from Base Line Ranger Station, east bank.
21. Little Blue River; same as Station 89 (1913).
22. "The Chimneys," three miles above Cosper's Ranch. Elevation 5,853 ft.
23. East side of Blue River one half mile below Grant Creek. 6000 ft.
24. One mile above Grant Creek, east side of Blue River.
25. Near Geo. Thompson's Ranch, three miles below Blue Post Office.
26. One mile above Blue Post Office. Elevation 6,100 ft.
27, 28. Near Blue Ranger Station.
29. One mile above Blue Ranger Station. (Twenty-one miles south of Luna, New Mexico, and 65 miles north of Clifton, Arizona.)
30. East side of Blue River, nearly at the top of the mountain.
31. Blue River south of the saw mill.

(*Stations in New Mexico.*)

32. East side of Blue River, one mile north of saw mill.
33. East side of Blue River, three miles north of saw mill.
34. Mill Hollow, near top of hill, San Francisco Mountain, 8,500 ft.; about 8 miles southwest from Luna.
35. Near the Alma Wagon Road, 10 miles from Luna, in a rock slide surrounded by poplars. Crest of San Francisco Mountains.
36. Saliz Mountain, east side of Saliz Creek, 20 miles north of Alma, elevation 7,000 ft.

(*Stations in the Mogollon Range.*)

List compiled by Ferriss. Approximate positions are shown in fig. 16.

37–41. Along Silver Creek above Mogollon City.
42. Near saw mill, head of Silver Creek.
43, 44. Bursam Road, between Silver and Willow Creeks.
45–49. Willow Creek.
50. Turkey Creek.
51, 52. Head of Mineral Creek.
53, 54. Head of Willow Creek.
55. Little Whitewater Creek.
56–58. South Fork of Little Whitewater.
59. Cave on Spring Creek.
60–80. Big Dry Creek.

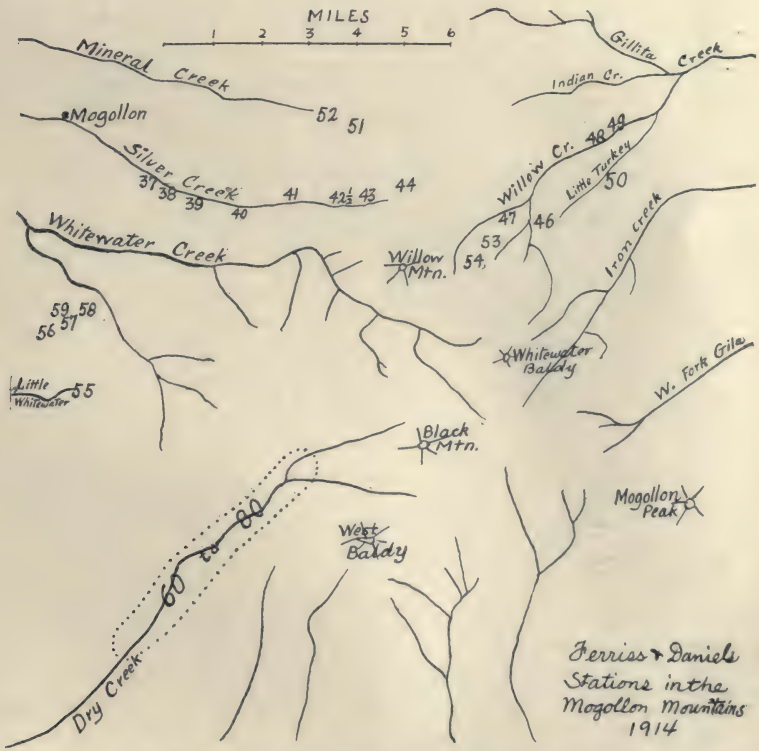


Fig. 16. Part of the Mogollon Mountains, Socorro Co., N. M. Canyons traced from U. S. Geological Survey Topographic Map, Mogollon Quadrangle, and reduced ½.

Explanation of Plates III to VII.

Plate III.—Figs. 1*a*, 1*b*, 2.—*Sonorella odorata* n. sp. Station 18 (1917), a gulch 75 yards east of Alder Spring. No. 119,501.

Figs. 3, 3*a*, 3*b*.—*Sonorella odorata* n. sp., type. Head of Alder Canyon. No. 119,033.

Fig. 4.—*Sonorella odorata* n. sp. Form with narrow umbilicus. Station 18 (1913), Soldier Camp. No. 119,499.

Figs. 5–5*b*.—*Sonorella marmorarius limifontis* n. subsp., type. Station 17 (1913), bluffs near Mud Spring. No. 119,500.

Figs. 6, 6*a*, 6*b*.—*Sonorella odorata marmoris* n. subsp., type. Station 36 (1913), Old Dan Gulch, northwestern side of Marble Peak. No. 109,075.

Figs. 7, 7*a*.—*Sonorella marmorarius imula* n. subsp., type. Station 17 (1917), limestone hill, 6 miles northwest of Brush Corral, in the northern foothills. No. 119,503.

Figs. 8–8*b*.—*Sonorella mormorarius imula* n. subsp. Station 19 (1917), same limestone hill. No. 119,502.

Figs. 9–9*b*.—*Sonorella marmorarius* n. sp., type. Station 26 (1913), Marble Peak. No. 109,078.

Plate IV.—Figs. 1–1*b*.—*Sonorella sabinoensis* n. sp. Half mile west of camp near mouth of Sabino canyon. No. 109,094.

Figs. 2–2*b*.—*Sonorella sabinoensis* n. sp., type. Station 16, mouth of Sabino Canyon. No. 109,097.

Figs. 3–3*b*.—*Sonorella sabinoensis* n. sp. Station 16 (1913). No. 119,487.

Figs. 4–4*b*.—*Sonorella sabinoensis* n. sp. Station 9, 2 miles above camp near mouth of Sabino Canyon. No. 119,488.

Figs. 5, 5*a*, and 5*b*–5*d*. *Sonorella sabinoensis* n. sp. Bear Canyon, Station 13 (1913). Depressed and elevated individuals. No. 119,490.

Figs. 6–6*b*. *Sonorella hesterna* n. sp., type. Station 148 (1917), Shaw ranch, southern foothills of the Rincons. No. 119,489.

Plate V.—Figs. 1–1*b*.—*Sonorella sabinoensis occidentalis* n. subsp., type. Station 36 (1917), south side of Pima Canyon. No. 119,491.

Figs. 2–2*b*.—*Sonorella sabinoensis buehmanensis* n. subsp., type. Station 44 (1913), Buehman Canyon near Korn Kobb mine. No. 109,198.

Figs. 3–3*b*.—*Sonorella sabinoensis buehmanensis* n. sp. Station 43 (1913). Buehman Canyon. No. 119,492.

Figs. 4–4*b*.—*Sonorella tortillita* n. sp. Station 41 (1917), east side of Hog Canyon, Tortillita Mountains. No. 118,053.

Figs. 5–5*b*.—*Sonorella galiurensis*, n. sp. Station 30 (1917). Trail 1½ miles south of Copper Creek mining camp, Galiuro Mountains. Top and face views of type, base of a paratype. No. 119,493.

Figs. 6–6*b*.—*Sonorella galiurensis* n. sp. These views of a topotype. No. 119,493*a*.

Plate VI.—Figs. 1–1*b*. *Sonorella cæruliffuminis* n. sp., type. Station 18 (1914), west side of Blue River 6 miles above mouth. No. 119,048.

Figs. 2, 2*a*, 3, 3*a*.—*Sonorella cæruliffuminis* n. sp. Station 19, Blue River at mouth of Pigeon Creek. No. 119,042.

Fig. 4.—*Sonorella cæruliffuminis* n. sp. An albino specimen from the same station. No. 119,316.

Fig. 5.—*Sonorella binneyi franciscana* n. subsp., type. Station 92 (1913), east side of San Francisco River above Sardine Creek. No. 119,052.

Figs. 6–6*b*.—*Sonorella delicata* n. sp. Type. No. 109,110.

Figs. 7–7*b*.—*Sonorella grahamensis* n. sp. Type. No. 109,101.

Figs. 8–8*b*.—*Micrarionta præsidii* n. sp. Type. No. 58,121.

Figs. 9–9*b*.—*Sonorella rooseveltiana* Berry. Type ×1.6. No. 3733 Berry collection.

PLATE VII.—Fig. 1.—Station 58 (1913), *Oreohelix cooperi* (W. G. B.). Cosper's pasture, rim of Blue Mountains. No. 109,173.

Figs. 2–2*b*.—*O. cooperi*. Station 29 (1914), west side Blue River, 1 mile above Blue River Ranger Station, Arizona. No. 119,178.

Figs. 3, 3*a*.—*O. cooperi*. Station 27, near preceding station. No. 119,179.

Fig. 4.—*O. cooperi*. Station 32, east side Blue River, N. M. No. 119,497.

Figs. 5–5*b*.—*O. cooperi*. Station 23, east side Blue River. No. 2.

Figs. 5–5*b*.—*O. cooperi*. Station 23, east side Blue River, 2 miles below mouth of Grant Creek, Arizona. No. 119,150.

Figs. 6, 6*a*. *O. cooperi*. Station 42½, Bursam Road, head of Silver Creek, Mogollon Mts., 8,000 ft. No. 119,498.

Fig. 7.—*O. cooperi apache* n. subsp., type. Station 76 (1913), Black River, 2 miles above Fish Creek. No. 109,184.

Figs. 8, 8*a*.—*O. cooperi apache*. Station 53 (1914). Black River. No. 109,183.

Fig. 9.—*Oreohelix strigosa meridionalis* n. subsp., type. Y Salt House Fork of Eagle Creek. No. 109,186.

December 17th.

Mr. Charles Morris in the Chair.

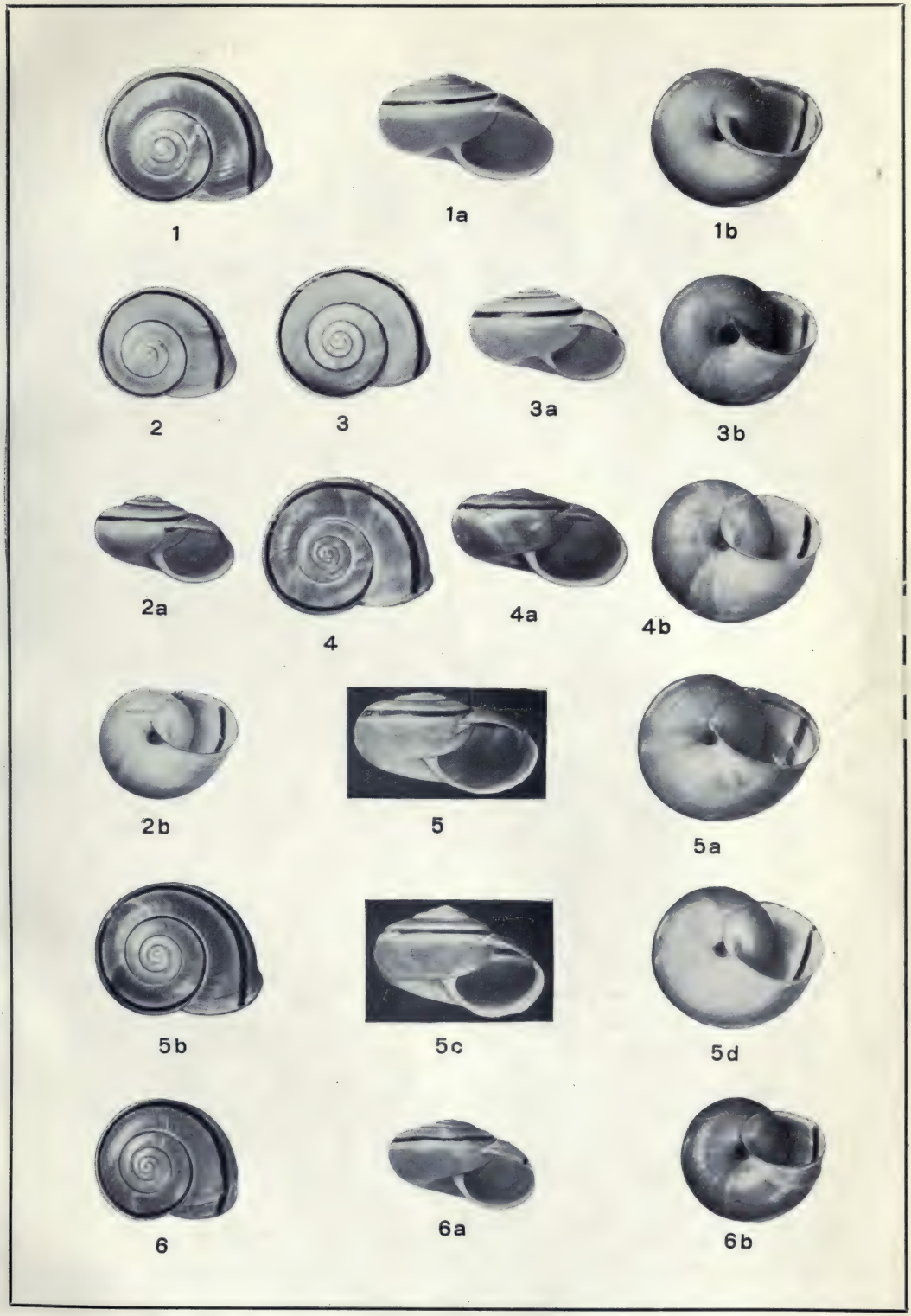
Twenty-one persons present.

The deaths of the following members were announced:

Herbert Norris, M.D.
Benjamin H. Smith.
A. Robinson McIlvaine.

The reception of the following papers was reported:

PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.



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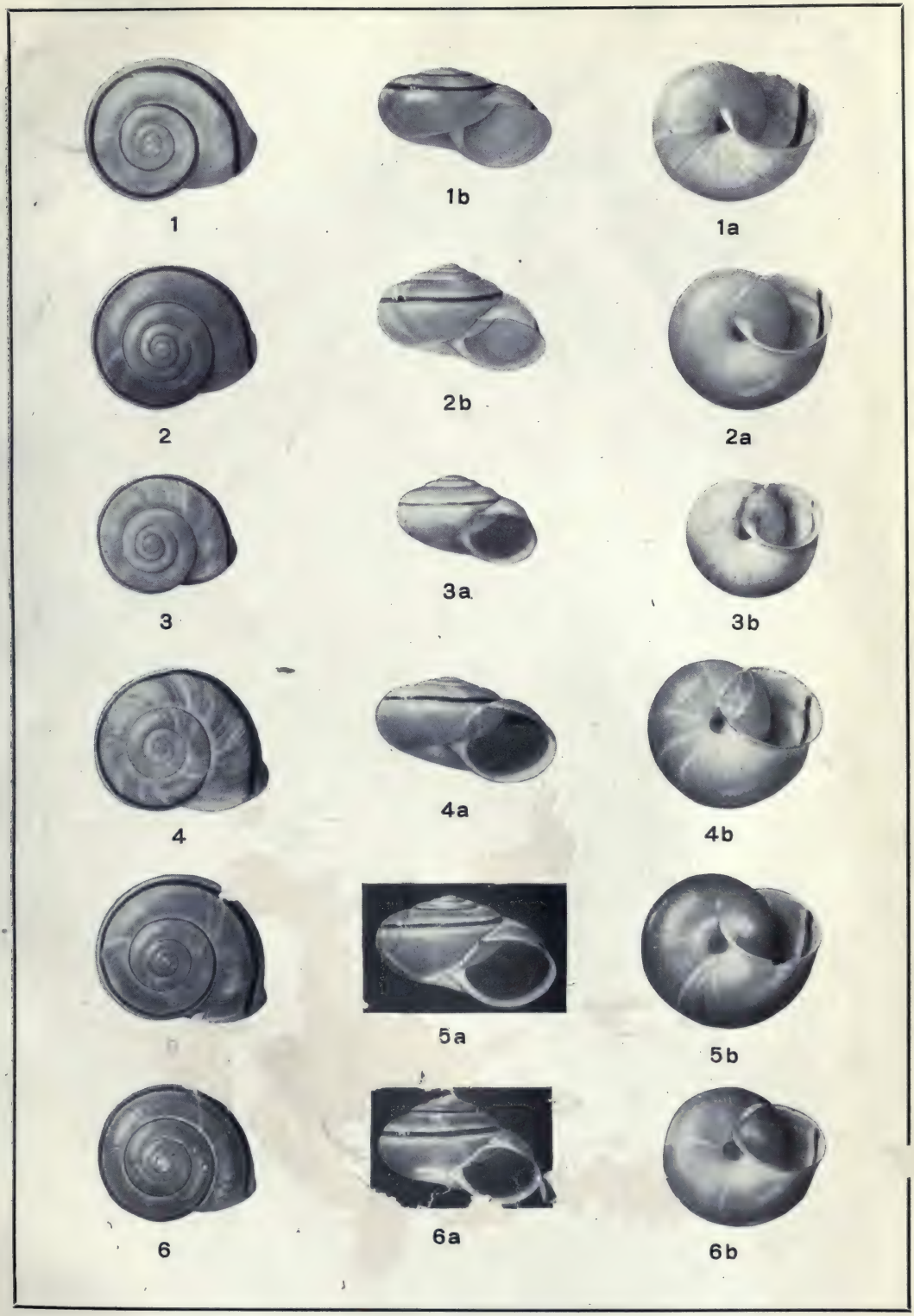

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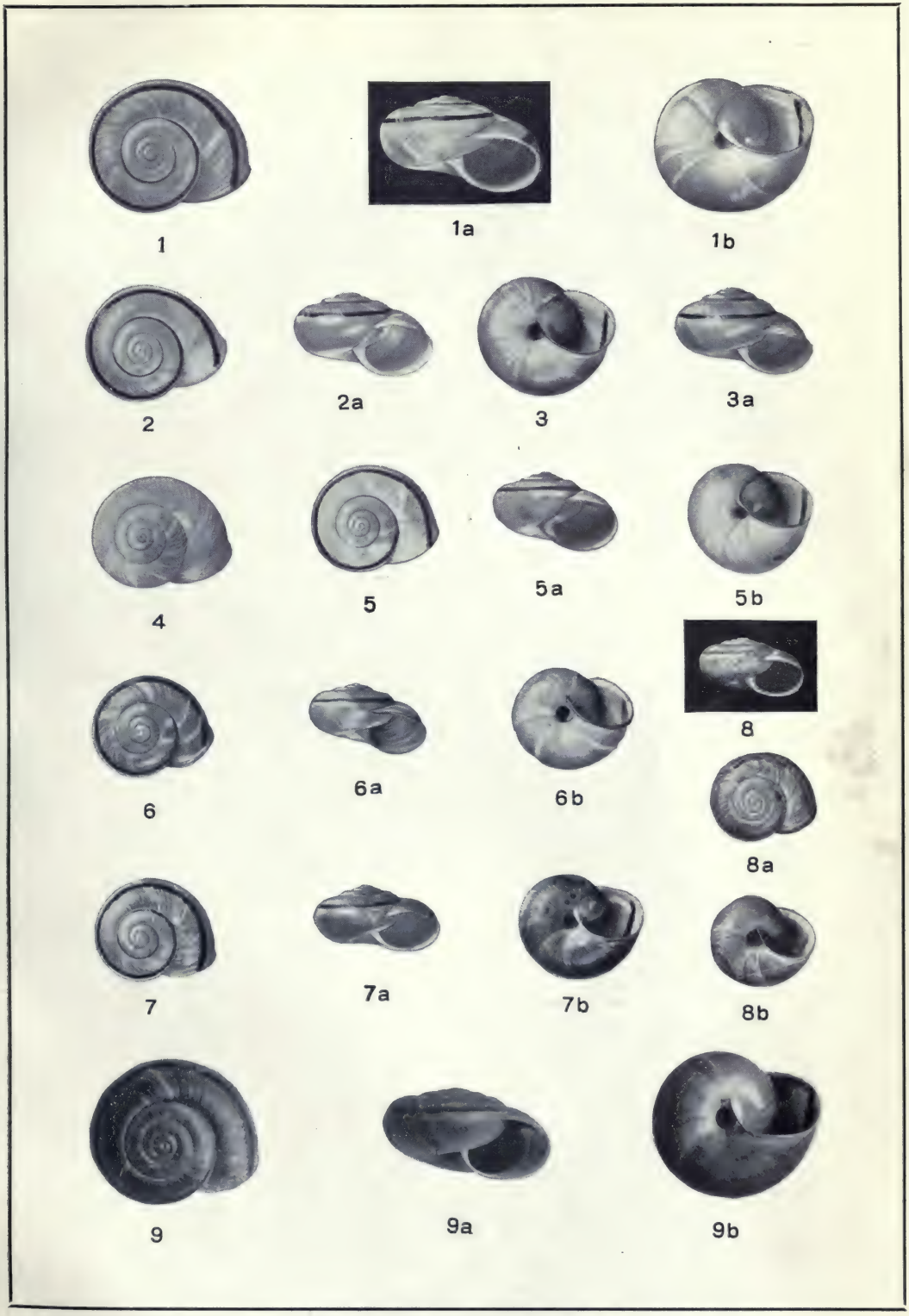
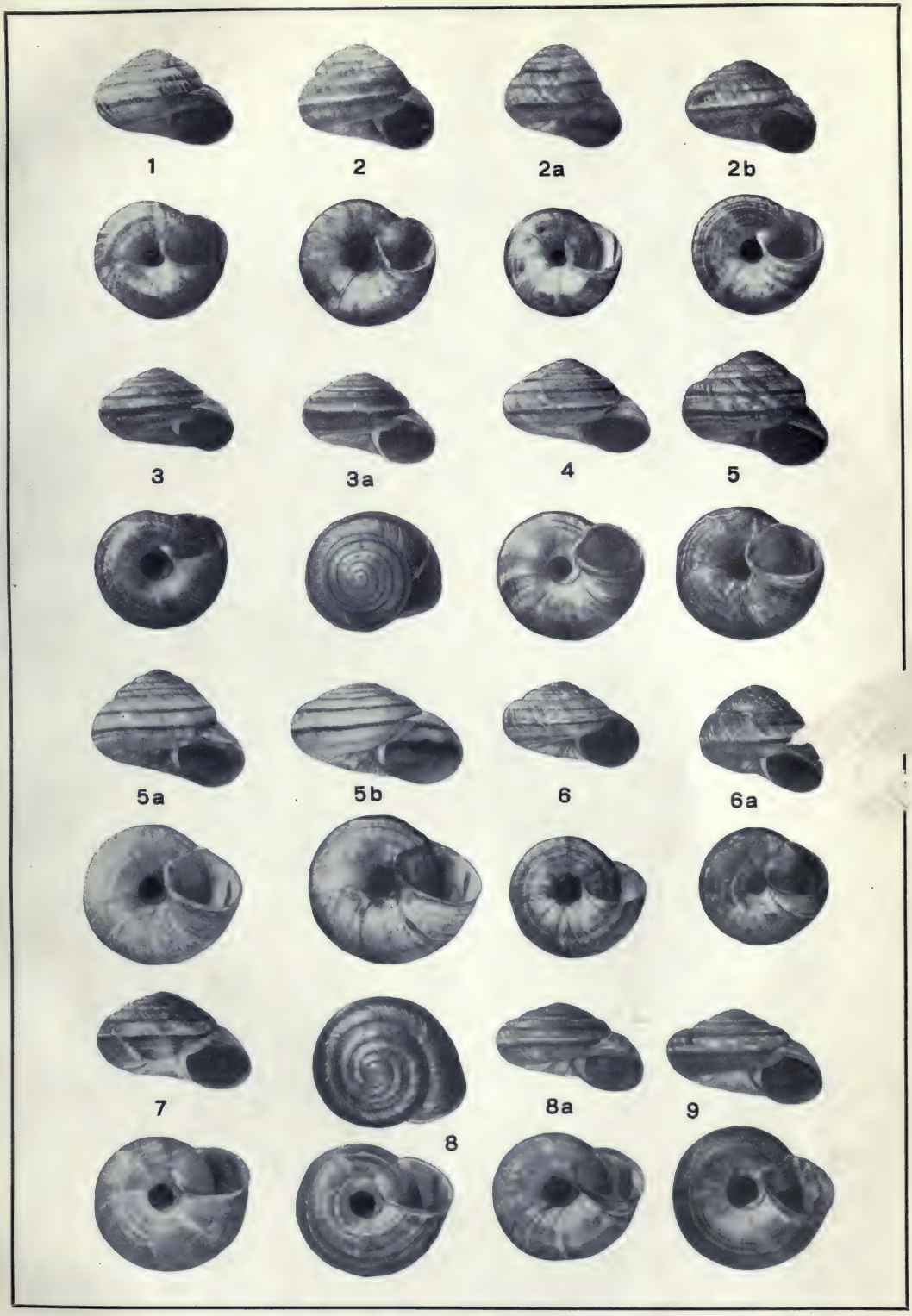


PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.



PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.

NOTE ON GISTEL'S GENERA OF FISHES.

BY DAVID STARR JORDAN.

In 1848, Johannes Gistel of Stuttgart published a peculiarly confused and crabbed volume called *Naturgeschichte des Thierreichs, für höhere Schulen,* containing new generic names offered as substitutes for old ones, and in every department of Zoölogy. Most of the names he proposed to change were regarded by him, often without reason, as being preoccupied. The book seems to have been overlooked by workers in systematic zöology, and in every field.

In this paper I give the names of genera of fishes, as offered by Gistel. Nearly all of these occur in Gistel's introductory pages, these having their pagination in Roman. For a transcript of the names referring to fishes I am indebted to Mr. Barton A. Bean of the U. S. National Museum, and to Mr. C. Davies Sherborn of the British Museum. I have later received a copy of the book itself through the courtesy of Mr. E. P. Van Duzee of the California Academy of Sciences.

Of Gistel's new names, the following seem to be valid:

ABRON Gistel, p. X, replaces *Platystoma* Agassiz.

DAPALIS, p. XI, replaces *Smerdis* Ag. (fossil).

ENIXE, p. IX, replaces *Drepane* Cuvier, and also the substitute name, *Harpochirus* Cantor, 1849.

HYPODYTES, p. VIII, intended to replace *Apistus* or *Apistes* Cuvier; but its use by Quoy and Gaimard is especially mentioned and the language used (highly elliptical) ("*Aspistes* Quoy, Astrol., Fisch.") would indicate that *Apistus longispinis* should be taken as type. This species is type of *Paracentropogon* Bleeker, which name *Hypodytes* should apparently replace.

NOTACMON, p. IX, replaces *Eurynotus* Ag. (fossil).

ODONUS, p. XI, is offered as a substitute for *Xenodon* Rüppell (1835), preoccupied. It is prior to *Erythrodon* Rüppell and *Pyrodon* Kaup, also offered as substitutes. But Swainson in 1839 called the same genus *Zenodon,* but whether offered by Swainson as a substitute or as a characteristic piece of carelessness is not made clear, most likely the latter. Fowler accepts *Zenodon* as a substitute for

Xenodon, instead of *Erythrodon*. The question of *Zenodon* versus *Odonus* may be left for later decision.

PIRENE, p. IX, replaces *Dascyllus* Cuvier, on account of the earlier *Dascillus*. But *Dascyllus* has been sometimes spelled *Dascillus*.

PERIURGUS, p. X, replaces *Microps* Ag. (fossil).

PROSCINETES, p. X, replaces *Microdon* Ag. (fossil); this is prior to *Polypsephis* Hay, 1899, also a substitute for *Microdon*.

SECUTOR, p. IX, replaces *Deveximentum* Fowler. *Secutor* is apparently intended as a substitute for *Equula*, but Gistel indicates as his type *Equula insidiator*. He says: "*Equula* (*E. insidiator*, Fisch.) *Secutor* N." *Centrogaster equula* Gmelin is, however, the tautotype of *Equula* Cuv., which is a synonym of *Leiognathus* Lac. *Secutor* (*Deveximentum*) is tangibly different from *Leiognathus* (*Scomber edentulus* Bloch) as a genus or sub-genus.

STREPHON replaces *Brontes* C. & V. if distinct from *Arges* C. & V.

STROTES replaces *Platysomus* Ag. (fossil).

In case names differing from older ones only in gender or some minor point in spelling are to be rejected as preoccupied, the following additional names of Gistel would become tenable:

ANALITHIS, p. X, intended to replace *Platyrhina* M. & H. on account of the prior *Platyrhinus*. This antedates Garman's substitute name of *Discobatus*.

ALAZON, p. X, intended to replace *Pœcilia*, on account of the earlier *Pœcilus*.

ENGLOTTOGASTER, p. IX, to replace *Oreinus* on account of *Oreina*. But the genus *Oreinus* is of doubtful validity.

FURO, p. IX, to replace *Eugnathus* Ag., (fossil) on account of the prior *Eugnatha*.

MYRMILLO, p. X, to replace *Mustelus* Cuv. on account of the prior *Mustela* L. It is equivalent to *Pleuracromylon* Gill.

PEDITES, p. IX, to replace *Macropodus* Lac., an ill-formed name, on account of the prior *Macropus*. This may perhaps be allowed.

PRENES, to replace *Scatophagus* Cuv., on account of *Scatophaga*. This is prior to Cantor's substitute name of *Cacodoxus* (1849).

RHADAMISTA, p. VIII, is offered instead of *Ctenodus* (fossil) on account of the prior *Ctenodon*.

AGOREION, p. X; presumable type *Acanthoderma spinosum* Agassiz (fossil). This is offered as a substitute for "*Scleroderma* Agassiz," used in Fungi, and in the form of *Sclerodermus* for a genus of bees. But I find no genus "*Scleroderma*" in Agassiz's works. The name is probably a slip of memory, for *Acanthoderma* Agassiz (1848), which is really preoccupied, *Acanthoderma* Cantraine (1835); on this supposition *Agoreion* may be provisionally accepted in place of *Acanthoderma*.

SCROPHA, p. VIII, is offered in place of *Ceratodus* (fossil), on account of *Ceratodon*.

Other names suggested as substitutes are plainly inadmissible. These among fishes are the following, arranged in the order given by Gistel (the alphabetical order of the names to be displaced):

CARCHARIAS, p. VIII, for *Acanthias* Risso, on account of the prior *Acanthia*. But *Acanthias* is a synonym of *Squalus* L., as properly restricted, and *Carcharias* is twice preoccupied.

PELONECTES, p. VIII, for *Acanthodes* Ag., said to be preoccupied, which it is not, but is replaceable by the original form *Acanthoëssus* Ag.

GREMILLA, p. VIII, for *Acerina* Cuvier, but *Acerina* Güldenstädt, *Cernua* Schäfer and *Gymnocephalus* Bl. & Schn. are older.

ADIAPNEUSTES, p. VIII, substitute for *Acrodus* Ag. (1838), wrongly regarded as preoccupied by *Acrodon* Zimm. (1840).

HISTIODROMUS, p. VIII, for *Anastomus* Gronow, 1763; revived by Scopoli, 1777, therefore not preoccupied by *Anastomus* Illiger, 1835.

NOMALUS, p. VIII, for *Ancylodon*, preoccupied by another substitute name; *Macrodon* Schinz (1822).

CERDO, p. VIII, as substitute for *Asellus* Klein. Klein mentions *Asellus* only in a footnote under *Callarias* (*Gadus*). The name "*Cerdones*" appears in connection with the cod-fish, and *Cerdo* may be regarded as a synonym of *Gadus* L.

SCROFARIA, p. VIII, a needless substitute for *Ausonia* Risso, itself a synonym of *Luvarus* Raf.

GLISCUS, p. VIII, substitute for *Blochius* Volta (fossil) for no reason, save Gistel's objection to personal names, in his scheme allowable only among plants and the very lowest animals.

THALASSOKLEPHTES, p. VIII, a substitute for *Caninoa* Nardo, because it is improper to compare a prince (Charles Lucien

Bonaparte, prince of Canino) to a shark; *"Ist denn der Prinz von Canino mit einen Hayen vergleichlich?"*

CAPELLARIA, p. VIII, for *Chironectes* Cuvier, preoccupied, but already replaced by *Antennarius* Cuv.

CÆSO, p. VIII, a substitute for "*Chrysophrys* Rüppell," that is for *Chrysophrys berda* Rüpp.; a synonym of *Sparus*.

ECHEMYTHES, p. VIII, an unexplained substitute for *Chrysotosus* Lac., itself a synonym of *Lampris*.

RONCHIFEX, p. VIII, a substitute for *Cossyphus* Cuv., preoccupied, but *Bodianus* Bloch and *Harpe* Lac., are still older names for the same genus.

PODAGER, p. IX, a substitute for *Gerres* Cuvier, on account of *Gerris*, an older name of a genus of insects. *Podager* is preoccupied in birds and thus cannot replace *Gerres*. We must use *Catochœnum* Cantor (1849) if *Gerres* is discarded; but *Gerres* and *Gerris* are words from different roots.

SYNERGUS, p. IX, a substitute for *Megalurus* Ag. (fossil) preoccupied in mammals. But *Synergus* is also preoccupied (Hartig, 1840, a genus of bees). I have therefore proposed the new name *Urocles* Jordan as a substitute for both *Megalurus* and *Synergus*, the type being *Megalurus lepidotus* Ag.

ELLOPS, p. IX, a substitute for *Helops*, a genus of sturgeons, ἔλλοφ being the original Greek form.

APECHES, p. IX, a substitute for *Johnius* Bloch, a personal name.

NEANIS, p. IX, a substitute for *Julis* Cuvier, regarded as preoccupied by *Julus* L. But the two words are of different origin and meaning.

EXOLES, p. IX, a substitute for *Lamia* Bon., itself a synonym of *Lamna* Cuvier.

APEPTON, p. IX, a substitute for *Gouania* Nardo, a personal name.

ANEPISTOMON, p. IX, a substitute for the preoccupied name *Leptorhynchus* Smith, itself a synonym of *Ophisurus* Lac., as restricted.

SPANIUS, p. IX, a substitute for the preoccupied name, *Leptosoma* Nardo, which is itself probably a synonym of *Monochirus* Raf.

MAINA, p. IX, a substitute for *Lethrinus* Cuvier, regarded as preoccupied by *Lethrus* Fabricius, a genus of beetles.

MASSARIA, p. IX, a substitute for *Liparis*, on the ground that the latter is used in botany.

ORODINUS, p. IX, a substitute for *Lophotes* Giorna, 1803, for no reason.

PASCHALTESTES, p. IX, a substitute for *Macquaria* Cuv. & Val., a personal name, before it was applied to the river Macquarie.

ARNION, p. X, an unexplained substitute for *Mugil* L.

PLECTROSTOMA, p. X, a substitute for *Oxyrhina* Ag., preoccupied. Both names are synonymous with *Isurus* Raf.

EUPORISTA, p. X, a synonym for *Plagusia* Bon, preoccupied. Both names are synonymous with *Symphurus* Raf.

DEPORTATOR, p. X, a substitute for *Plotosus* Lac., on account of the similarity of *Plotosus* to *Plotus* L.

DEMIURGA, p. X, a substitute for *Rhina* Bonaparte, a genus of rays, on account of *Rhina* (Oliver, 1807), a genus of beetles. But *Rhina*, in this connection dates from Schneider (1801). The name *Rhina* was also employed by various writers in place of *Squatina*, its first binomial use in this connection dating from 1810, although occurring in polynomial reprints from Klein at earlier periods.

If *Rhina* is used for *Squatina*, the name *Demiurga* should replace *Rhamphobatis* Gill (1861), itself also a substitute for *Rhina* Schneider.

CREOTROCTES, p. X, a substitute for *Pelamys* C. & V. (1831) subsequent to *Palamita* Bonaparte, 1832, also a substitute for the same preoccupied name, itself a synonym of *Sarda* Cuvier, 1829. If *Sarda* Plumier (1802) (=*Ocyurus* Gill) is accepted *Palamita* would hold.

DENIUS, p. X, a substitute for *Sargus* Cuvier, preoccupied; both are synonyms of *Diplodus* Raf.

BORBORODES, p. X, a substitute for *Scymnus* Cuvier, preoccupied in beetles. But the substitute name of *Scymnorhinus* Bonaparte (1846) has priority.

PEROPTERA, p. XI, a substitute for *Perioptera* Gistel, but I find neither name elsewhere.

ORTHOCOLUS, p. XI, a substitute for *Thymallus* Cuv., regarded as preoccupied by *Thymalus* Latreille (1803), a genus of beetles. But the root-words of the two names are different, and as a substitute for *Thymallus*, *Choregon* Minding (1832) is prior to *Orthocolus*.

TROMPE, p. XI, 109; an unexplained substitute for *Toxotes* Cuvier (1817), perhaps on account of the later *Toxotus* (1821).

APHOBUS, p. XI, a substitute for *Trachidermus* Heckel, preoccupied as *Trachyderma*. But *Centridermichthys* Richardson (1844) for the same group has priority over *Aphobus*.

CHÆTICHTHYS, p. XI, a substitute for *Trichodon* Cuvier, regarded as preoccupied by *Trichoda* and *Trichodes*, but the root-meaning of *Trichodon* is different.

LITHULCUS, p. XI, a substitute for *Trichopodus* (*Trichopus*) Lac. (1802, p. 125), because used in botany. But the same genus had been already called *Osphromenus* by the same author (p. 116).

ENDYNAMA, p. XIII, 108; a substitute for *Chrysophrys* Cuvier, itself a synonym of *Sparus* L., as restricted.

EUPNŒA, p. 105; type *Plagusia lactea* Bon., a synonym of *Symphurus* Raf.

ATTILUS, p. 109; a needless synonym of *Umbrina* Cuvier, "*der Schattenfisch.*"

MELANTHA, p. 109; a needless synonym of *Corvina* Cuvier, "*die Seekrähe.*"

NEW GENERA OF FISHES.

BY DAVID STARR JORDAN.

In the preparation of a catalogue of the generic names which have been applied to fishes, the writer has noted a number of valid genera and subgenera, which have either received no name or are recorded under a name already preoccupied. Some of these form the subject of the present paper.

AORIA Jordan.

Type: *Bagrus lamarrii* Cuv. & Val.

A substitute for *Macrones* Duméril, preoccupied by *Macrones* Newman, 1841, a genus of *Coleoptera.*

AZURELLA Jordan.

Type: *Pomacentrus bairdi* Gill, *Microspathodon bairdi* Jordan.

This genus resembles *Microspathodon* Günther, with which it agrees in the peculiar dentition (uniserial, movable teeth) and in general structure, differing in having the vertical fins not elevated and the caudal simply limate. The nostril in *Azurella bairdi* is much larger than in *Microspathodon dorsalis,* which species we infer is congeneric with *M. chrysurus* (Cuv. & Val.), the little-known type of the genus. The genus *Stegastes* Jenyns (*S. imbricatus*) (1842) is probably identical with *Microspathodon* (Günther, 1862) and of earlier date. This matter demands further investigation.

COTYLICHTHYS Jordan.

Type: *Cotylis fimbriata* Müller & Troschel.

The genus *Cotylis,* as first indicated by Müller (Wiegmann's Archiv., 1843, p. 297), contains but a single species, *Cotylis nudus* M. &. T. = *Lepadogaster nudus* Bl. & Schn. = *Gobiesox gyrinus* Jordan & Evermann, 1896 (not *Cyclotperus nudus* L., a species as yet unrecognized). *Cotylis* M. & T. (*nudus* = *gyrinus*) is a synonym of *Gobiesox* Lacépède; *fimbriata* therefore requires a new name, as above.

EPERLANIO Jordan.

Type: *Osmerus albatrossis* Jordan and Gilbert, the "Kadiak Smelt".

This genus or subgenus differs from *Osmerus* in the very long anal fin of twenty rays. The teeth are much weaker than in *Osmerus,*

though stronger than in *Spirinchus*, the scales smaller, the gill-rakers longer and the lower jaw heavier. *Eperlanus* is an old name of the European smelt, *Osmerus eperlanus* L. It has been already used as a synonym of *Osmerus*. *Eperlanio* is an unused variant.

ERYTHROCLES Jordan.

Type: *Erythrichthys schlegeli* Bleeker, the name a substitute for *Erythrichthys* Temminck & Schlegel, preoccupied by *Erythrichthys* Bonaparte (Saggio, 1831), based on *Salmo erythrinus* L. and therefore a synonym of *Erythrinus* (Gronow) Scopoli. *Erythrocles* is one of several very closely related genera, *Emmelichthys* Richardson, *Boxaodon* Guichenot, *Inermia* Poey, *Dipterygonotus* Bleeker and *Plagiogeneion* Forbes, but it seems to be distinct from all of these, whatever their relation to one another.

EXTRARIUS Jordan.

Type: *Hybopsis tetranemus* Gilbert.

This genus is distinguished by the presence on each side of two maxillary barbels as in the old-world genus *Barbus*. In other regards it agrees with *Macrhybopsis* Cockerell (*Gobio gelidus* Girard). No other known species of American minnow or chub has more than two barbels.

IRILLION Jordan.

Type: *Coregonus oregonius* Jordan and Snyder.

This genus differs from the other offshoots of *Coregonus* in the long sharp nose, firm jaws, and in the very large adipose fin. It frequents mountain streams and is as gamy as a trout. The name is from "the merry wild Irillion rejoicing from fields of snow" of Dunsany's dream world.

NAUTOPÆDIUM Jordan.

Type: *Porichthys plectrodon* Jordan & Gilbert = *Batrachus porosissimus* Cuv. & Val.

This genus is closely allied to *Porichthys* Girard (*notatus*), differing mainly in the palatine dentition. There are but four or five teeth on each palatine, one or two of them developed as a strong canine. In *Porichthys* there are many small palatine teeth, none of them canine-like. The name, *Nautopœdium* (ναυτοπαιδίον, sailor-boy), refers to the button-like luminous spots, which have suggested the vernacular name of "Midshipman".

OSHIMIA Jordan.

Type: *Micracanthus marchei* Sauvage.

Name a substitute for *Micracanthus* Sauvage, 1878, preoccupied

by *Microcanthus* Swainson, 1839, a misprint or misspelling of the same word. This name is given in honor of Mr. Masamitsu Oshima, scientific expert of Formosa and author of an admirable memoir (now in press) on the river fishes of Formosa.

RHEOCLES Jordan & Hubbs.

Type: *Eleotris sikoræ* Sauvage.

This genus belongs to the *Atherinidæ*, as Dr. Boulenger has suggested. It is characterized by its robust form and its few gill-rakers (about 10), which as figured by Sauvage (Poissons de Madagascar) are notably short and thick.

SYLETOR Jordan.

Type: *Pisoodonophis cruentifer* Goode & Bean.

This eel, one of the few which burrows into the flesh of fishes, is clearly not a *Pisoodonophis*. "Its peculiar and savage physiognomy due to the constriction of its neck" and the snake-like form of the head with the powerful muscular enlargements of the cheeks distinguish it adequately from the other *Ophichthoid* eels with blunt teeth (σῦλήτωρ, a spoiler).

UNAGIUS Jordan.

Type: *Cryptophthalmus robustus* Franz (1910).

The name *Cryptophthalmus* is preoccupied in crustacea (Rafinesque, 1812) and in mollusks (Ehrenberg, 1831). *Unagius* may be substituted for it. *Unagi* is the Japanese word for eel.

UROCLES Jordan.

Type: *Megalurus lepidotus* Ag. (fossil).

This name is offered as a substitute for *Megalurus* Agassiz, 1833, preoccupied in birds (Horsfield, 1820), and for *Synergus* Gistel (1848), preoccupied in Hymenoptera, both these having the same type.

VERATER Jordan.

Type: *Oligopus ater* Risso = *Pteridium atrum* Filippi & Verany.

Substitute for *Pteridium* F. & V., preoccupied by *Pteridium* Scopoli, 1777, which is a substitute for *Pteraclis* Gronow, 1763 and 1772, the use in 1772 unquestionably binomial.

PNICTES Jordan.

Type: *Achiropsis asphyxiatus* Jordan & Goss.

This species of sole described from Goyaz, Brazil, differs from *Achiropsis* Steindachner and from all other soles in the complete obliteration of the gill opening of the right or eyed side.

ERREX Jordan.

Type: *Glyptocephalus zachirus* Lockington. This species, the "Rex Sole" of the San Francisco fishermen, an excellent food-fish,

differs from *Glyptocephalus* Gottsche, and from all other flounders, in the very long and falcate pectoral fin of the right side, this fin being longer than the head.

AINIA Jordan.

Type: *Callopterus agassizi* Thiollière (fossil).

A substitute name for *Callopterus* Thiollière, 1858, preoccupied as *Callopterus* Chaud., 1838, a beetle. The name is from the department of Ain, in France, where the fossil in question was found.

RAIAMAS Jordan.

Type: *Cyprinus bola* Hamilton.

A substitute name for *Bola* Günther, 1868, preoccupied by Hamilton. The species, *Raiamas bola* is well known to anglers in India, as "*Rajah mas*".

TARSISTES Jordan.

Type: *Rhynchobatis* Philippi, 1858.

A substitute for the latter name, preoccupied as *Rhynchobatus*. The genus is founded on a large ray with a linear, flat, paddle-like snout, rounded at tip somewhat as in *Polyodon* and *Mitsukurina*. Philippi gave to this animal no specific name. It may be called *Tarsistes philippii* (τάρσος, an oar-blade). The type is from the island of Juan Fernandez, off the coast of Chili.

VIGIL Jordan.

Type: *Pleurolepis pellucidus* Agassiz.

A substitute for *Pleurolepis* Agassiz, preoccupied in fossil fishes. The type species is placed by Jordan and Evermann in *Ammocrypta*, but *Vigil pellucidus* differs from *Ammocrypta beani* in having the sides of the head scaly, the sides of body largely scaled and the mouth much smaller. The name *Vigil* (on the watch) alludes to the habit of lying motionless, buried in the sand, only the alert eyes being visible.

ORQUETA Jordan.

Type: *Micropteryx polycentrus* Kner.

Replaces *Micropus* Kner (S. B. Akad. Wiss. Wein, 1868, p. 28), that name being four times preoccupied; *Orqueta* differs from *Chloroscombrus* Girard in the very much larger number of dorsal spines. The name *Orqueta* is a Spanish vernacular for *Chloroscombrus orqueta* Jordan and Gilbert on the west coast of Mexico.

The following annual reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

While the Recording Secretary has been able personally to discharge the duties of his office during the year, he is indebted to the Assistant Librarian, William J. Fox, for indispensable coöperation, for which grateful acknowledgment is due. As was the case last year, the statistics of administration have been prepared by Mr. Fox.

Dr. J. Percy Moore and Dr. Philip P. Calvert have placed the Secretary under obligation by acting as Recording Secretary during the earlier meetings of the Academy and the Council, for which sincere thanks are given. The By-Laws provide for the closing of the academic year with the last of November. Since that period last year meetings have been held on December 18, 1917; January 15th, February 19th, March 19th, April 9th, April 16th and November 16th of the current year.

The meeting of April 9th was held in commemoration of the President, Samuel Gibson Dixon, M.D., LL.D., Sc.D., who died February 2d. Dr. Dixon had been elected a member of the Academy February 25, 1890. He had served as President since 1896. The progress of the society during the twenty-two years which have since elapsed is Dr. Dixon's best memorial. Details of his services to science will be found in the proceedings of the memorial meeting held in April. As a mark of respect to the memory of Dr. Dixon the election of his successor in the presidency was by resolution postponed until the annual meeting.

Communications were made at the meetings during the year by Messrs. Harley Stamp, Philip P. Calvert, James A. G. Rehn, Witmer Stone, Edwin G. Conklin, John Cadwalader, Benjamin F. Royer and Henry Skinner.

In addition to the Proceedings of the Dixon Memorial Meeting papers were presented for publication by Henry A. Pilsbry, F. J. Keeley, Henry W. Fowler, Anna M. Cullen, Janet P. Jameson, Mitchell Carroll, Joseph Hall Bodine, Bruce Wade, James A. G. Rehn and E. G. Vanatta.

The sixteenth volume of the JOURNAL was completed by the publication of a beautifully illustrated paper by Clarence B. Moore on the aboriginal antiquities of Florida.

Three hundred and thirty-seven pages of the PROCEEDINGS were issued with five plates.

The Entomological Section (the American Entomological Society) has published four hundred and thirty-seven pages of the TRANSACTIONS, illustrated by twenty-nine plates. Four hundred pages of the ENTOMOLOGICAL NEWS, illustrated by twenty plates, have been issued.

Parts ninety-six and ninety-seven of the MANUAL OF CONCHOLOGY, comprising one hundred and eighty-eight pages, have been completed by Dr. Pilsbry and distributed.

Four members and seven correspondents have been elected. Their names are recorded in the PROCEEDINGS as issued.

The deaths of nine members were announced.

Resignation of membership by G. B. Heckel was accepted.

The death of Joseph Willcox, October 1st, deprived the Academy of the services of one who had been interested in the mineralogical work of the society since his election to membership in December, 1867. He had served for years as Custodian of the Isaac Lea collections, a position which he held at the time of his death.

The Ludwick Institute Free Lecture Courses were delivered at the Academy on Mondays, Thursdays and Fridays, January 7th to April 26th, by Witmer Stone, B. Franklin Royer, James A. G. Rehn, Spencer Trotter, Henry A. Pilsbry, J. Percy Moore and J. Fletcher Street. It was necessary early in the year, conforming to government regulations, to change the lectures scheduled for Monday evenings to Thursday evenings. To economize fuel it was also necessary to give a portion of the course in the more easily heated library hall. Ten of the lectures were on the natural history of Philadelphia and vicinity, especially adapted to school-children. The latter were by Messrs. Stone, Moore, Street, Pilsbry and Rehn.

Meetings of the Pennsylvania Audubon Society, the Babies' Welfare Association, and the Philadelphia Pediatric Society were held in the Lecture Hall.

EDWARD J. NOLAN, *Recording Secretary.*

REPORT OF THE CORRESPONDING SECRETARY.

The following scientific men, all Americans, were elected correspondents: John Henry Comstock, Herbert Spencer Jennings, Frank Rattray Lillie, Alfred Goldsborough Mayor, John Campbell Merriam, George Howard Parker, and Charles Richard Van Hise.

During the course of the year President Charles R. Van Hise and Prof. Samuel W. Williston died. It is probable that the interruption of correspondence with European countries prevented the verification of the reported deaths of others.

Foreign correspondence, which has been steadily decreasing during the progress of the war, fell this year to its lowest ebb.

Invitations were received to participate in the celebration of the semi-centennial of the founding of the Kansas Academy of Science and of the two-hundred-and-fiftieth anniversary of the University of Lund. Prof. Samuel W. Williston was appointed a delegate to the former and a letter of congratulation sent to the latter.

From the Académie des Sciences, Belles-Lettres et Artes de Rouen was received a copy of a resolution passed at a fête held at the Academy on July Fourth expressing admiration for the course, material and moral, taken by the United States and its President "in defense of the Liberty, Law, Justice and Civilization of the World". A letter of similar import was received from Émile Rivirèe, a correspondent of the Academy.

Inquiries for information were answered as usual.

Statistics of the correspondence follow:

Communications received:

Acknowledging the receipt of the Academy's publications	69
Transmitting publications to the Academy	30
Requesting exchanges or the supply of deficiencies	6
Invitations to learned gatherings, celebrations, etc	2
Notices of deaths of scientific men	2
Circulars concerning the administration of scientific and educational institutions, etc	8
Photographs and biographies of correspondents	3
Letters from correspondents / Miscellaneous letters	56
Total received	176

Communications forwarded:

Acknowledging gifts to the Library	680
Requesting the supply of deficiencies	155
Acknowledging gifts to the Museum	76
Acknowledging photographs and biographies	3
Letters of sympathy or congratulation, addresses, etc	5
Diplomas and notices of election of correspondents and delegates' credentials	8
Miscellaneous letters	121
Annual reports and circulars sent to correspondents	14
Total forwarded	1,062

Respectfully submitted,

J. Percy Moore, *Corresponding Secretary.*

REPORT OF THE LIBRARIAN.

The efficient services reported last year as having been rendered during the concluding months of 1917 by the Assistant Librarian, William J. Fox, have been continued and the growth of the library represented by the following report is the result:

The total additions amount to 4,503, consisting of 4,061 pamphlets and parts of periodicals, 293 volumes, 148 maps and one framed portrait.

They were received from the following sources:

Exchanges	2,024
Isaiah V. Williamson Fund	1,209
United States Department of Agriculture	688
General Appropriation for the Purchase of Books	88
Authors	62
Pennsylvania State Library	56
United States Department of the Interior	54
Editors	40
American Entomological Society	30
Imperial Department of Agriculture of the British West Indies	22
Trustees of the British Museum	16
New York Agricultural Experiment Station	15
Samuel G. Gordon	12
Secretaria de Agricultura y Fomento, Mexico	11
California State Commission of Horticulture	9
Cuerpo de Ingenieros de Minas del Peru	9
Water Supply Commission of Pennsylvania	9
Utah Agricultural College Experiment Station	8
James Aitken Meigs Fund	8
United States Department of Commerce and Labor	8
Vermont Agricultural Experiment Station	8
New York State Board of Charities	8
Carleton College	7
Thomas B. Wilson Fund	6
Mrs. Samuel G. Dixon	6
South Dakota School of Mines	6
Edward J. Nolan	6
Publication Committee of the Academy	5
Commission of Conservation, Canada	5
Dr. Henry Skinner	5
Queensland Department of Mines	4
Indiana University	4
United States War Department	3
Government of India	3
Witmer Stone	3
Department of Conservation and Development, New Jersey	3
California Fish and Game Commission	3
Department of Fisheries, Bengal, Bihar and Orissa	2

University of Wyoming	2
National Academy of Sciences	2
Geological Survey of Georgia	2
New South Wales State Fisheries	2
Canada Department of the Interior	2
Lowell Observatory	2
American Iron and Steel Institute	2
Escola Superior de Agricultura e Medicina Veterinaria, Pinheiro	2
Michigan Geological and Biological Survey	2
Nova Scotia Department of Agriculture	2
Roger Williams Park Museum	2
Florida State Geological Survey	2
W. L. Abbott, M.D.	2
Louisiana State Museum	1
Pan-American Union	1
Clarence B. Moore	1
Illinois State Mining Board	1
Universidad Nacional, Mexico	1
Board of Water Supply, New York City	1
Observatorio de Madrid	1
Colorado Museum of Natural History	1
Philip P. Calvert	1
Scripps Institution for Biological Research	1
William J. Fox	1
Delaware Valley Ornithological Club	1
Estacion Sismologica de Cartuja	1
Iowa Geological Survey	1
New York Archeological Association	1
Commissioners of Fisheries and Game, Massachusetts	1
Zoölogical Society of Philadelphia	1
Mechanics' Institute, San Francisco	1
Scientific Society of San Antonio	1
J. B. Haines	1
Government of Formosa	1
Hawaiian Entomological Society	1
D. J. Bullock	1
Department of Trade and Customs, Australia	1
Los Angeles County Museum of Natural History and Art	1
Argentine Government	1
Instituto de Butantan	1
Art and Museum Commissioners, Grand Rapids	1
Department of Marine and Fisheries, Canada	1
St. Louis Natural History Museum Association	1

They have been distributed to the various departments of the library as follows:

Journals	2,858	Physical Science	11
Agriculture	754	Ichthyology	11
Geology	373	Mammalogy	9
Geography	145	Conchology	8
Botany	118	Medicine	8
General Natural History	37	Mathematics	7
Entomology	25	Chemistry	5
Voyages and Travels	20	Herpetology	3
Mineralogy	19	Bibliography	2
Anatomy and Physiology	17	Helminthology	2
Ornithology	15	Philology	1
Anthropology	11	Miscellaneous	44

The following journals are new to the library:

American Anatomical Memoirs. Philadelphia.
Art and Museum Commissioners, Grand Rapids. Annual Report.
Biochemical Journal. London.
Biological Board of Canada. Bulletin.
Brooklyn Botanic Garden. Memoirs.
Escola Superior de Agricultura e Medicina Veterinaria, Pinheiro. Archives.
Geographic Society of Chicago. Publications.
Illinois Natural History Society. Transactions.
Instituto de Butantan. Collectanea de Trabalhos, 1901–17.

Instituto Geologico de Espana. Memorias.
International Journal of American Linguistics. New York.
Journal of General Physiology. Baltimore.
Journal Russe de Zoologie. Petrograd.
Junta de Ciencias Naturals de Barcelona. Publicacions. Series Geologica.
Kansas Academy of Science. Bulletin.
Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, Mathematisk-fisiske Meddelelser.
Laboratorio de Plasmogenia de la Habana. Boletin.
Madison Botanical Congress. Proceedings, 1893.
New York State Archeological Association, Morgan Chapter. Researches and Transactions.
New Zealand Journal of Science and Technology. Wellington.
Pan American Record. Los Angeles.
Royal Geographical Society. Supplement of the Geographical Journal.
St. Louis Natural History Museum Association. Bulletin.
Societa Italiana dei Microscopisti. Bollettino.
Soil Science. New Brunswick, N. J.
South African Institute for Medical Research. Publications.
South Australia Director of Mines and Government Geologist. Annual Report.
South Australian Museum. Records.
Staten Island Institute of Arts and Sciences. Museum Bulletin.

Twelve hundred and twenty-five volumes and parts of periodicals were used on the premises, while 59 volumes were borrowed.

Four hundred and thirty-three volumes have been bound.

The resignation of Furman S. Wilde as Assistant to the Librarian was accepted. He has since been serving with the army in France.

Five hundred and nine serials and twenty-two volumes have been returned to the Superintendent of Public Documents, Washington.

The continued coöperation of Miss Wardle in library service is gratefully acknowledged.

EDWARD J. NOLAN, *Librarian.*

REPORT OF THE CURATORS.

The past year, on account of unprecedented conditions incident to the war, has not been one in which any important work outside the usual routine of the museum has been possible. Fuel restrictions have prevented the heating of the public halls and during certain days necessitated the closing of the work-rooms. One of our janitors left our employ early in the year and in order to meet additional expenses elsewhere we have managed to avoid the necessity of filling this position. The absence of several volunteer workers during most of the year, and of Mr. Rehn for several weeks, all on work connected with the war has hindered the progress of research work to some extent, while the serious illness of Dr. Skinner has kept him from his office for over two months. Notwithstanding these hindrances, however, the Curators feel that they may con-

gratulate themselves upon having been able to maintain the usual Museum activities without any detriment to the collections or their arrangement during these trying times.

Early in the summer a competent steam engineer was engaged to examine the entire heating plant and to draw up plans for remedying serious defects in the present system as well as for the installation of new boilers. We were fortunate enough to secure two Spencer boilers, which have been placed in the engine house and have already proved very satisfactory, although some of the repiping is still unfinished. The expense of these important improvements is covered by an appropriation made at the last session of the State Legislature and referred to in our last report.

The falling of certain sections of plaster ceiling has necessitated the removal of all the ceiling covering in the mineralogical hall, with the intention of substituting a sheet metal ceiling at the earliest opportunity.

Additional exhibits have been added to the collection of native trees, to the local collection of birds and nests presented by the Delaware Valley Ornithological Club, to the Clarence B. Moore collection of Indian antiquities and to the William S. Vaux collection of minerals.

Numerous classes of school-children have visited the Museum during the year and various duplicate specimens, especially sets of labelled minerals, have been presented to schools in Philadelphia and vicinity.

During the year Dr. Skinner made some important entomological collections in the White Mountains of New Hampshire.

Dr. Stone spent several weeks in making an exhaustive collection of the flora of southern Cape May County, N. J., and some local field work was carried on by other members of the Museum staff. Mr. Clarence B. Moore has also continued his explorations of the Indian mounds of the Southern States and presented the Academy with valuable material. Details of work in the several departments follow.

Mammals.

A number of valuable specimens received from the Zoölogical Society of Philadelphia have been prepared as skins or skeletons, while a large number of skeletons and skulls previously prepared in the rough have been macerated, numbered and placed in the study series. This work was carried on by the taxidermist, Mr. David McCadden. Besides entering accessions the entire register of the

Rhoads collection, numbering 4,390 entries, has been copied into the regular mammal catalogue.

Specimens have been loaned during the year to Dr. J. A. Allen and Mr. A. H. Howell.

Birds.

A number of accessions to the local collection have been placed on exhibition and much of the collection rearranged and relabelled. The services of Miss Ruth Faries were secured during nine months of the year and much needed clerical work was accomplished. Several temporary catalogues were copied into the regular Academy register, including that of the Hoopes collection, making a total of some 14,000 entries. In addition new labels were prepared for all the skins of the lower families of Passeres in the study collection, as well as of the Tanagridæ and most of the Fringillidæ.

The eggs in the Pennock collection and many of those in the Drown collection were placed in glass-covered boxes and catalogued, while many unmounted specimens of birds were converted into skin specimens.

Dr. Stone, although mainly occupied with the executive duties of the Museum, revised several of the families in the study collection and prepared a report on the Jewel collection of Panama birds, which has been published in the Proceedings.

The most notable accessions received during the year were the Mrs. W. A. Drown collection of bird eggs and mounted birds, and a collection of Colombian birds obtained by purchase.

Dr. H. C. Oberholser, Mr. W. E. C. Todd, Mr. Edwin Ashby and Mr. F. H. Kennard have made use of the collections, while specimens have been loaned to Mr. Todd, Mr. C. B. Cory and Dr. C. W. Richmond.

Reptiles and Fishes.

Mr. Henry W. Fowler, who has had charge of the fishes as well as of the reptiles, reports that 1,783 fishes have been received during the year, which have all been catalogued and labelled. He has also critically identified some 400 species of fishes. These comprised specimens in the Academy collection from Brazil, Panama, the West Indies and Australia as well as our entire series of African fishes and a collection from Samoa loaned by Capt. C. F. Silvester, from which the Academy will receive duplicates.

Two papers were published in the Proceedings on Philippine fishes and on a collection received from Paraguay. Progress was

made on the critical study of the series of flying fishes, half-beaks and green gars.

General care of the collections (both of fishes and reptiles) has occupied considerable time, necessitating the rebottling and cleansing of many specimens.

Mr. Fowler did some field work in Perry County, Pa., and Cape May Co., N. J. Specimens of reptiles were loaned during the year to the American Museum of Natural History. Mr. Alex. Ruthven, Dr. Thomas Barbour, Mr. F. N. Blanchard and Mr. Alvin Seal spent some days in studying material at the Academy.

Mollusks.

Dr. Henry A. Pilsbry, curator of Mollusca, reports that accessions to the conchological department have been received from sixty-seven persons and institutions. Among them may be mentioned a series of Congo mollusks from the American Museum of Natural History, including paratypes of many new species, and a considerable number of Hawaiian mollusks received from the Bishop Museum and from Prof. W. A. Bryan. Mr. J. H. Ferriss shared his Arizona collections of 1917 and 1918 with the Academy and Prof. Junius Henderson has presented series of his Idaho and Colorado collections.

The revision of the Academy collection of Pupillidæ has been continued in connection with the publication of a second volume on this group in the Manual of Conchology. In collaboration with Mr. Ferriss a report on the mollusks of the Santa Catalina mountains and the Mogollon mountains, Arizona, has been prepared for publication. Mr. E. G. Vanatta has continued the arrangement of the exhibition series of shells and Miss Caroline Ziegler has made good progress in cataloguing the specimens. Considerable time has been given to the determination of material for correspondents.

Mr. J. A. Ferriss, W. H. Clapp and Edwin Ashby have spent some time in studying in the department during the year, and specimens were loaned to Mr. E. P. Chase, Dr. Paul Bartsch and Mr. J. B. Henderson. Mr. R. T. Jackson also borrowed some fossil mollusca.

Insects.

The department of Entomology has had the usual care and attention given to it by those in charge. Dr. Henry Skinner and Mr. E. T. Cresson, Jr., have looked after all the orders except the Orthoptera, which have had the attention of Mr. J. A. G. Rehn. The

accessions for the year amount to 2,953 specimens, most of which have been incorporated in the collection.

A number of families have been rearranged: the Scarabædiæ, Rhipiphoridæ, Stylopidæ, Cleridæ, Malachidæ, Meloidæ and Buprestidæ in the Coleoptera; the Scathophagidæ, Sepsidæ and Ephydridæ in the Diptera, and the large series of exotic Noctuidæ among the Lepidoptera. Some valuable material in the last order collected by Dr. Skinner in the White Mountains of New Hampshire was incorporated in the collection. In the order Hemiptera the family Cicadidæ has been rearranged in accordance with identifications made by Mr. Wm. T. Davis, and in the Hymenoptera the H. L. Viereck types of *Andrena* have been placed in the type series.

In the Orthoptera besides the mounting and rearrangement of material, studies have been made of an extensive series of Brazilian material and three papers prepared and published upon it. A study has also been made of our African material as well as of several African collections loaned for identification, of which the Academy will receive a series of duplicates. A paper was also published in the PROCEEDINGS on the North American Eumastæinæ, while correspondence by Mr. Rehn has resulted in the receipt of valuable material in return for determination.

Several visiting entomologists, especiallly Dr. E. C. Van Dyke, have made use of the collections and material has been loaned to J. R. Malloch, J. S. Hine and R. W. Dawson.

PLANTS.

Mr. Stewardson Brown, who has had charge of the herbarium, reports that during the year the herbarium of the late Charles S. Williamson, presented by his sister Miss Mary Williamson, has been distributed throughout the herbarium so that the specimens are now readily accessible with the other material. The J. J. Carter herbarium, the gift of Mr. H. S. Gatchell, has been in a great part mounted ready for stamping and distribution. Numerous other collections received from various sources have been mounted by Miss Ada Allen, who has been continued as an aid in this work.

The local collection has received considerable attention from Mr. S. S. Van Pelt, who has mounted many specimens that have been received. Mr. Bayard Long has also given the collection considerable critical study.

MINERALS AND ROCKS.

The Curators are indebted to Mr. F. J. Keeley, Curator of the William S. Vaux collection, and to Mr. Samuel G. Gordon, a student

on the Jessup Fund, for the care of this department. Mr. Gordon has labelled and catalogued a number of accessions to the Wm. S. Vaux and the general collections and prepared a check list of the entire series. The William S. Vaux collection now numbers about 9,000 specimens, nearly half of which are on exhibition; the Academy general series, 10,500 specimens, of which about 1,000 are exhibited, and the Adam Seybert collection, which is kept separate, 1,825 specimens, while there are 80 falls of meteorites represented.

The duplicate specimens not on exhibition are arranged systematically in storage cases immediately below the exhibition series so that they may be consulted with the greatest ease.

Mr. Gordon has overhauled a large number of mineral and rock specimens received at various times and cleaned and labelled such as are of value. The rock series now in the Academy's possession, including the first and second Pennsylvania Geological Survey collections, amounts to about 19,000 specimens.

The most important accession during the year was the Mrs. W. A. Drown collection, presented by Miss Emily Drown, comprising some 6,000 specimens. It was especially notable for the large number of species represented, a number of which were new to our collection.

Archæology.

Miss H. N. Wardle has overhauled several thousand specimens mostly belonging to the Haldemann collection, which were stored in the basement, and has cleansed and identified them, entering some 2,000 in the catalogue. Little new material was obtained during the year.

Mr. Clarence B. Moore's expedition during the spring of 1918 explored territory along the Apalachacola River, the Flint River to Bainbridge, Ga., and the Florida coast from St. Andrew's Bay to Crystal River. The result demonstrated how thorough had been his earlier exploration of the same region, as little new material was obtained. Pottery and artifacts regarded as duplicates were presented by Mr. Moore to the Museum of the American Indian, Heye Foundation. Owing to necessary repairs to his boat Mr. Moore was compelled to abandon his usual autumn expedition.

Throughout the year the undersigned Curators have been without the advice and counsel of their associate Maj. Henry Tucker, who since the entry of America into the war has been in the service of his country in the medical corps of the Army.

Witmer Stone, *Chairman*,
Henry A. Pilsbry.

Report of the Curator of the William S. Vaux Collections, December 1, 1918.

Efforts during the past year, in the direction of securing as many rare and unusual species as possible, have resulted in the addition of no less than 127 species not hitherto represented in the William S. Vaux collection, of which number 87 were purchased and 40 selected from the Drown collection.

This brings the total number of distinct species in the collection up to 804, not including meteorites, hydrocarbons, varieties or doubtful species.

Altogether the number of accessions during the year exceeded 800, of which 104 were purchased, 700 derived from the Drown collection, 3 presented by Mr. Thomas Harvey and 3 presented by Mr. Samuel G. Gordon, who has continued his valuable services in caring for the collection.

Respectfully submitted,

F. J. Keeley, *Curator Wm. S. Vaux Collection.*

REPORTS OF THE SECTIONS.

Biological and Microscopical Section.—The Section held six stated meetings during the year, a reduction of the usual number due to war regulations and the influenza epidemic.

Communications on various subjects were made by members, among whom may be mentioned Messrs. T. C. Palmer, Hugo Bilgram, Dr. Thomas S. Stewart, F. J. Keeley, B. F. Ray, Walter Palmer, Dr. L. A. Faught and C. S. Boyer.

The following officers were elected for the year 1919:

Director.....J. Cheston Morris, M.D.
Vice-Director.....T. Chalkley Palmer.
Recorder and Corresponding Secretary..Charles S. Boyer.
Treasurer.....Thomas S. Stewart, M.D.
Conservator.....F. J. Keeley.

Charles S. Boyer, *Recorder.*

Entomological Section.—Six stated meetings were held during the year, with an average attendance of eleven persons. The deaths of Erich Daecke, a contributor, and Benjamin H. Smith, a member, were announced. Arthur H. Napier and George M. Greene were elected members, and Francis M. James, Louis B. LaPlace, Carl Lorup, A. Reginald Allen and Max Reyher were elected con-

tributors. Interesting communications were made by R. C. Williams, Jr., J. A. G. Rehn, P. P. Calvert, Henry Skinner, Philip Laurent, Herman Hornig, Dr. P. W. Whiting, and Dr. J. Bequaert.

The following officers and committee were elected to serve for 1919:

Director.....Philip Laurent.
Vice-Director.....R. C. Williams, Jr.
Treasurer.....E. T. Cresson.
Conservator.....Henry Skinner.
Secretary.....J. A. G. Rehn.
Recorder.....George M. Greene.
Publication Committee.....E. T. Cresson,
Philip P. Calvert,
E. T. Cresson, Jr.

E. T. Cresson, Jr., *Recorder*.

Botanical Section.—The following officers were elected to serve during the year 1919:

Director.....Joseph Crawford.
Vice-Director.....Alexander MacElwee.
Recorder.....John W. Eckfeldt, M.D.
Treasurer.....Stewardson Brown.
Conservator.....Stewardson Brown.

John W. Eckfeldt, M.D., *Recorder*.

Mineralogical and Geological Section.—The Section held four meetings, with the usual attendance. Prof. Wright discussed the topography of the upper James River; there were also discussions of peat growth, and of Tertiary coal. Other mineralogical and geological matters were discussed.

The Section made six field excursions with an average attendance of eleven. The excursions were not formally announced, but were orally noted. The excursions were all in the crystalline region of Delaware County, except one in that of the Gulph region of Montgomery County.

The deaths of Prof. Carter, Mr. Schumo, Mr. DuBois and Joseph Willcox were announced. They were active members of the Section, and particularly interested in the field excursions. Mr. DuBois was for many years an efficient member of the excursion committee.

The officers elected for the coming year are:

Director.....Benjamin Smith Lyman.
Vice-Director.....F. J. Keeley.
Recorder and Secretary.....Wm. B. Davis.
Treasurer.....Benjamin Smith Lyman.
Conservator.....George Vaux, Jr.

BENJAMIN SMITH LYMAN, *Director*.

ORNITHOLOGICAL SECTION.—The Section has done much to encourage ornithological activity at the Academy during the year. The meetings of the Delaware Valley Ornithological Club and Pennsylvania Audubon Society have been held in the building and have helped to stimulate interest in this department of the Academy.

At the annual meeting of the Section the following officers were elected for the year 1919:

Director.....Spencer Trotter, M.D.
Vice-Director.....George Spencer Morris.
Recorder.....Stewardson Brown.
Secretary.....William A. Shryock.
Treasurer and Conservator.....Witmer Stone.

WITMER STONE, *Conservator*.

The annual election of Officers, Councillors and members of the Committee on Accounts was held December 17th, with the following result:

PRESIDENT.....John Cadwalader, A.M., LL.D.
VICE-PRESIDENTS.....Edwin G. Conklin, Ph.D., Sc.D.,
Henry Skinner, M.D., Sc.D.
RECORDING SECRETARY.....Edward J. Nolan, M.D., Sc.D.
CORRESPONDING SECRETARY.....J. Percy Moore, Ph.D.
TREASURER.....George Vaux, Jr.
LIBRARIAN.....Edward J. Nolan, M.D., Sc.D.
CURATORS.....Witmer Stone, A.M., Sc.D.,
Henry A. Pilsbry, Sc.D.,
Henry Tucker, M.D.,
Spencer Trotter, M.D.
COUNCILLORS TO SERVE THREE YEARS.Philip P. Calvert, Ph.D.,
Frank J. Keeley,
Walter Horstmann,
T. Chalkley Palmer.

COMMITTEE ON ACCOUNTS.....Charles Morris,
Samuel N. Rhoads,
John G. Rothermel,
Thomas S. Stewart, M.D.,
Walter Horstmann.

COUNCIL FOR 1919.

Ex-Officio.—John Cadwalader, A.M., LL.D., Edwin G. Conklin, Ph.D., Sc.D., Henry Skinner, M.D., Sc.D., Edward J. Nolan, M.D., Sc.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D., Spencer Trotter, M.D.

To serve three years.—Philip P. Calvert, Ph.D., Frank J. Keeley, Walter Horstmann, T. Chalkley Palmer.

To serve two years.—Charles P. Penrose, M.D., LL.D., Ph.D., Charles Morris, Wm. E. Hughes, M.D., Spencer Trotter (elected Curator).

To serve one year.—Edwin S. Dixon, Robert G. LeConte, M.D., George Spencer Morris, Henry Skinner, M.D. (elected Vice-President).

COUNCILLOR.....George Vaux, Jr.
CURATOR OF MOLLUSCA.....Henry A. Pilsbry, Sc.D.
CURATOR OF WILLIAM S. VAUX COLLECTION.....Frank J. Keeley.
ASSISTANT LIBRARIAN.....William J. Fox.
ASSISTANTS TO CURATORS.....Henry Skinner, M.D., Sc.D.,
Stewardson Brown,
Edward G. Vanatta,
Henry W. Fowler,
James A. G. Rehn,
Ezra T. Cresson, Jr.
AID IN ARCHÆOLOGY.....Harriet Newell Wardle.
AID IN HERBARIUM.....Ada Allen.
Taxidermist.....David McCadden.
Janitors.....Charles Clappier,
Daniel Hechler,
Jacob Aebly,
Adam E. Hechler.

STANDING COMMITTEES, 1919.

FINANCE.—Effingham B. Morris, John Cadwalader, A.M., LL.D., Edwin S. Dixon, Walter Horstmann, and the Treasurer.

PUBLICATION.—Henry Skinner, M.D., Sc.D., Witmer Stone, A.M., Sc.D., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D., Sc.D.

LIBRARY.—Henry Tucker, M.D., George Vaux, Jr., Frank J. Keeley.

INSTRUCTION AND LECTURES.—Henry Skinner, M.D., Sc.D., Henry A. Pilsbry, Sc.D., Charles Morris, James A. G. Rehn, George S. Morris.

ELECTIONS IN 1918.

MEMBERS.

January 15.—Andrew J. Carty, Annabella E. Richards, Ph.D.
March 19.—Francis R. Cope.
April 16.—Geo. M. Greene.

CORRESPONDENTS.

March 19.—John Henry Comstock of Ithaca, N. Y.; Herbert Spencer Jennings of Baltimore, Frank Rattray Lillie of Chicago, Alfred Goldsborough Mayor of Princeton, N. J., John Campbell Merriam, Ph.D., of Berkeley, Cal., Geo. Howard Parker, Sc.D., of Cambridge, Mass., Charles Richard Van Hise, Ph.D., LL.D., of Madison, Wis.

ADDITIONS TO THE MUSEUM.

1918.

Mammals.

Dr. J. P. Moore. Skin and skull of New York Weasel (*Putorius noveboracensis*), Delaware Co., Penna.

Zoölogical Society of Philadelphia. Specimens prepared in the following manner: For mounting (skulls separate): Lion (*Felis leo*) ♂. Indian Antelope (*Antilope cervicapra*) ♂. As skin and skeleton: Orang-utan (*Pongo pygmœus*). Wild Horse (*Equus prezavelskii*) ♀. As skeleton: Warthog (*Phacochœrus africanus*). Indian Tapir (*Tapirus indicus*). As skin and skull: Pinché Marmoset (*Œdipomidas œdipus*). Texan Eyra Cat (*Felis cacomitli*). Fishing Cat (*Felis viverrina*). Binturong (*Arctitis binturong*). Thibetan Blue Bear (*Ursus pruinosus*). Sun Bear (*Helarctos malayanus*). Sloth Bear (*Melursus labiatus*). Mexican Raccoon (*Procyon lotor hernandezi*). Common Duiker (*Cephalophus grimmi*). Indian Antelope (*Antilope cervicapra*) ♀. Audad (*Ovis tragelaphus*) young. Coypu Rat (*Myopotamus coypu*). Common Dasyure (*Dasyurus maculatus*). Squirrel-like Phalanger (*Petaurus sciureus*). As skulls: Mandrill Baboon (*Papio mormon*) ♀. Woolly Spider Monkey (*Brachyateles arachnoides*). Humboldt's Woolly Monkey (*Lagothrix lagotricha*). Steller's Sea-lion (*Eumetopias stelleri*). Cape Hyrax (*Procavia capensis*). Lund's Opossum (*Didelphis albiventris*).

Birds.

Henry S. Bissex. Collection of mounted birds.

Miss Emily Drown. Mrs. W. A. Drown's collection of birds' eggs and mounted birds.

J. W. Holman. Two Barred Owls (*Syrnium nebulosum*), West Creek, N. J.

Mrs. L. H. Parks. Collection of North American birds' eggs.

Mrs. Frank Saracool. Mounted Short-eared Owl (*Asio accipitrinus*).

Zoölogical Society of Philadelphia. Specimens prepared as follows: As skin and skeleton: Black-footed Penguin (*Spheniscus demersus*). As skeleton: Somaliland Ostrich (*Struthio molybdophanes*). As skin: Black Vulture (*Catharista urubu*). As skulls: Canvas-back Duck (*Marila valisineria*). Upland Goose (*cloephaga magellanica*). Crested Curassow (*Crax alector*). Golden Eagle (*Aquila chrysaetos*). Brazilian Caracara (*Polyborus tharus*). Barn Owl (*Aluco pratincola*).

Reptiles and Amphibians.

A. de W. Bertoni. Small collection of reptiles and amphibians. Puerto Bertoni, Paraguay.

Dr. Henry Fox. Two toads (*Scaphiopus holbrooki*) and one salamander. Clarksville, Tenn.

Philip Laurent. Skink (*Eumeces lineatus*). Gunntown, Fla.

Fishes.

H. W. Aitken. Small collection of fishes. Connecticut and Florida.

A. de W. Bertoni. Small collection of fishes. Puerto Bertoni, Paraguay.

Samuel C. Castner. Two specimens of Remora (*Leptecheneis naucrates*). Cape May, N. J. Rabbit fish (*Lagocephalus laevigatus*). Cape May, N. J.

Field Museum of Natural History. (By exchange). Thirty-four Atherine fishes.

Museum of Comparative Zoölogy. (For determination). Ninety-two loaches and three hundred and ninety-two cyrinoid fishes. India.

Philadelphia Commercial Museum. Large collection of fishes. Philippine Islands. Many interesting additions to the Academy's collection.

C. T. Ramsden. Jar of *Domitator maculatus* (Bloch). Guantanamo, Cuba.

Insects.

S. F. Aaron. Two katydids, Berks County, Pennsylvania.

W. L. Abbott. Three insects, North Carolina.

C. P. Alexander. Twenty crane-fly larvæ, United States.

W. L. McAtee. Fifteen Psyllidæ, United States.

Annette F. Braun. Thirty-eight Microlepidoptera, Ohio.

B. Preston Clark. Twenty-five *Argynnis*, Asia and Africa.

T. D. A. Cockerell. Fifteen exotic bees. Six fossil insects, one Coccid.

W. J. Coxey. Two moths, Assam.

R. W. Dawson. Three *Serica*, United States.

W. T. Davis. One Orthopteron, Florida.

Emily Drown. Large collection of Lepidoptera.

Exchange. Two *Catocala titonia*, Missouri.

Exchange. Two hundred Ephydridæ.

J. H. Ferriss. Five Acrididæ, Arizona.

H. Fox. Fifty-five Orthoptera, Tennessee.

J. M. Geddes. One hundred and twelve insects, British Guiana.

G. M. Green. Eight Meloids, Virginia; four Orthoptera, Maryland; two Diptera, United States.

Wagner Green. Eight Coleoptera, United States.

Morgan Hebard. Six Blattidæ, Colombia; two Acrididæ, California.

Frank M. Jones. Forty-one Orthoptera, United States.

H. H. Knight. Thirty-five Hemiptera, United States.

Philip Laurent. Three Orthoptera, Florida.

Charles Liebeck. One Earwig, Canada.

Werner Marchard. Four Orthoptera and Hemiptera, United States.

J. P. Moore. One Hymenopteron, Utah.

Robert K. Nabours. Five Acrididæ, Texas and Mexico.

J. K. Primm. Two Coleoptera, New Jersey.

Purchased. Five hundred and seventy-five Orthoptera, Madagascar.

Henry Skinner. Three moths, Florida; thirty insects, New Hampshire.

Recent Mollusca.

Dr. W. L. Abbott. Forty trays of shells from Haiti and Tennessee.

J. Aebly. Three lots of marine shells from Greece.

Alabama Museum of Natural History. Two trays of *Lepyrium*.

C. C. Allen. Fifty-seven shells from Southeast United States.

American Museum Expedition. Seventy African land shells.

Charles H. Baker. Four lots of shells from Florida.

F. C. Baker. *Amnicola clarkei* Pils. from Oneida Lake, New York.

Dr. Fred Baker. *Tethys californica* Cooper from La Jolla, California.

E. B. Bartram. Five trays of shells from Florida.

Dr. Joseph Bequaert. Two hundred and seventy-seven trays of shells from Europe and Africa.

Bernice Pauahi Bishop Museum. Thirty-eight lots of *Lyropupa* from the Hawaiian Islands.

S. S. Berry. Four trays of shells from California and Wyoming.

Louis H. Bregy. *Meretrix petechialis* Lam.

Prof. W. A. and E. J. Bryan. One hundred and ninety-six trays of Hawaiian shells.

E. P. Chace. Five marine shells from California.

Asa C. Chandler. Eight lots of fresh water shells from Oregon.

Dr. A. W. Cheever. Six trays of New England shells.

G. H. Clapp. *Liguus solidus* Say from Big Pine Key, Florida.

W. F. Clapp. Ten trays of land shells from the Philippine Islands and North America.

T. D. A. Cockerell. Eleven trays of shells from New Mexico.

Emily Collins Collection. *Epitonium pretiosa* Lam.

Ph. Dautzenberg. Four African land shells.

C. B. DeHaven. Twelve marine shells from California.

Miss Emily Drown. Four trays of shells.

Dr. Florentino Felippone. Two *Mytilus* from South America.

J. H. Ferriss. Three hundred and seventeen trays of shells from southwestern United States.

J. H. Ferriss and L. E. Daniels. Thirty-five trays of land shells from Arizona and New Mexico.

G. M. Greene and F. Homer. *Planorbis corneus rubra* B. from an aquarium in Philadelphia, Pennsylvania.

D. L. Brewer Hall Collection. Thirty-five lots of shells.

J. B. Henderson. Seven lots of *Dentalium* from Florida and Cuba.

Junius Henderson. Ninety-eight trays of shells from Colorado and Idaho.

A. Jacot. Three land shells from Ithaca, New York.

L. A. Keene. Eight species of *Unionidæ* from Illinois.

C. H. Knowlton. Two land shells from Vermont.

Mrs. A. F. Letson. Five marine shells from the Hawaiian Islands.

O. S. Lewis. Four trays of shells from Tennessee, Virginia and Indiana.

Bayard Long. Nineteen trays of shells from the Eastern United States.

Dr. Henry Loomis. Four hundred and forty-seven lots of Japanese shells (purchased).

H. N. Lowe. Thirty-seven land and marine shells from California.

J. G. Malone. Three slugs from Oregon.

E. H. Matthews. Four Australian marine shells.

Rev. H. E. Meyer. Twenty-two trays of shells.

Clarence B. Moore. Nine trays of shells from Florida.

Dr. J. P. Moore. Two fresh water shells from Utah.

Mrs. Ida S. Oldroyd. Ten lots of shells from Western America.

C. R. Orcutt. Three trays of shells from Texas.

Dr. H. A. Pilsbry. Twenty-seven lots of shells from Arizona and the Hawaiian Islands.

Dr. H. A. Pilsbry and J. H. Ferriss. Seven trays of Arizona shells.

E. J. Post. Three species of shells from Canada.

Purchased. Sixty-three species of land shells.

Clare W. Ravenel. Twenty-one species of marine shells from Florida.

Dr. Emmet Rixford. *Micrarionta wolcottiana* Bart. from Palm Springs, California.

S. Raymond Roberts. *Corbula contracta* Say from off Nantucket Shoals, Massachusetts.

Mariano S. Roig. Sixty-two Cuban marine shells.

C. Henry Roney. *Crepidula fornicata* L.

Estate Dr. B. Sharp. Three lots of shells.

H. H. Smith. Three land shells from Tennessee.

Lloyd B. Smith. Twelve land shells from Haiti.

Dr. V. Sterki. Four trays of North American land shells.

J. K. Strecker, Jr. Five lots of shells from Texas.

Mrs. Mary Ludwig Suydam. Collection of marine shells.

D. Thaanum. Two Hawaiian marine shells.

E. G. Vanatta. Five trays of shells.

Bryant Walker. Six lots of shells from Texas and Canada.

Mrs. Nina Winchester. Eighty marine shells from the Philippine Islands.

Other Invertebrates.

H. W. Aitken. Several crabs, Connecticut and Florida.

Emily Collins Collection. A barnacle and coral.

C. B. De Haven. *Chthamalus fissus* Dar. from Santa Barbara, California.

Dr. Florentino Felippone. Two lots of *Balanus niveus* Dar. from South America.

H. E. Hubert. *Balanus improvisus* D. from Lake Pontchartrain, Louisiana.

Philip Laurent. Small collection of Crustacea, Florida.

Dr. Henry Loomis. Twenty-nine trays of crabs and *Brachiopoda*, purchased.

Mrs. Mary Ludwig Suydam. A sponge and corals.

Vertebrate Fossils.

Miss Ruth Ann Sullivan. Mammoth tooth (*Mammut primigenius*), Alaska.

Fossil Invertebrate.

S. S. Berry. *Tetraclita rubescens* Dar. from Pt. Loma, California.

David Dallam. One slab of *Brachiopoda*.

Miss Emily Drown. *Nucula* from England.

E. J. Post. Two trays of *Brachiopoda* from Canada.

Lloyd B. Smith. *Turritella gabbi* B. and P. from Tierra Nueva, Haiti.

Accessions: Minerals.

Morrell G. Biernbaum. Quartz, Rowlandville, Phila., Pa.; Spinel, Franklin, N. J.; Microcline, Frankford, Pa.; Muscovite, Broad and Olney Ave., Phila., Pa.; Copper, Schwenksville, Pa.

Mrs. M. B. Bradbury. Collection of minerals of Dr. N. R. Bradner.

Miss Emily Drown. Collection of 6000 minerals.

Dr. J. B. S. Egee. Picrophyll, Bavaria.

Horace M. Engle. Molybdenite and Molybite, Ontario, Canada.

Harold Evans. Pyrite, Moore Sta., N. J.

V. W. Field. Cyanite and Sphalerite, Idaho.

Hugh Alexander Ford. Chabazite, Avondale, Delaware Co., Pa.

Samuel G. Gordon. Orthoclase, St. Peters, Pa.; Talc, Lafayette, Pa.; Byssolite, Cornwall, Pa.; Ferruginous Quartz, Lehigh Co., Pa.; Aragonite, Sterling Hill, N. J.; Pyrrhotite, MacAfee, N. J.; Calamine, Friedensville, Pa.; Pyrrhotite, Gottschall's Mine, Berks Co., Pa.; Calcite, Stilbite, Chabazite, Laumontite, Calcite, Trap Rock, Berks Co., Pa.; Hematite, Garnet, Knauertown, Chester Co., Pa.; Limonite, Upper Alsace, Berks Co., Pa.; Turgite, Udree's Mine, Berks Co., Pa.; Jefferisite, Brinton's Quarry, Chester Co., Pa.; Chabazite, Natrolite, Lenni, Delaware Co., Pa.; Titanite, Frankford, Pa; Graphite, Zircon, Stilpnomelane, Chalcopyrite, Hopewell Mine, Warwick, Chester Co., Pa.; Magnetite, Chrysocolla, Aragonite, Pyrite, Chalcopyrite, Jones Mine, Berks Co., Pa.; Limonite, Fleetwood, Berks Co., Pa.; Albite, Paterson, N. J.; Calcite, Amelia, Va.; Albite, Frankford, Pa.; Laumontite, Ward's Quarry, Delaware Co., Pa.; Quartz, Overbrook, Phila., Pa.; Siderite, Ward's Quarry, Delaware Co., Pa.; Orthoclase, O'Neill's Quarry, Frankford, Pa.; Calcite, Trap Rock, Berks Co., Pa.; Deweylite, Magnetite, Lafayette, Pa.; Covellite, Chalcopyrite, Calamine, Phoenixville, Pa.; Stilbite, Frankford, Phila., Pa.; Stilbite, Prehnite, Apophyllite, Trap Rock, Berks Co., Pa.; Wavellite (7 specimens), Beraunite, Hellertown, Pa.; Serpentine, Aragonite, Asbestos, Easton, Pa.; Calcite, Stilbite, Paterson, N. J.; Microcline, Aragonite, Crocidolite, Calcite, Orthoclase, Galena, Pyroxene, Willemite, Garnet, Franklin, N. J.; Kaolin in limonite geodes, Oreland, Pa.

H. Herwegh. Limonite pseudo-Pyrite, Howard House, Delaware Co., Pa.; four stalactites, Crystal Cave, Kutztown, Berks Co., Pa.

Charles W. Hoadley. Microcline, Valhalla, N. Y.

Frank P. Howe. Calamine, Embreeville, Tenn.

Thos. Harvey. Fifteen minerals from Delaware Co., Pa.

Howard Kulp. Calcite, Howellville, Chester Co., Pa.

Bently R. Morrison. Chalcopyrite, Falls of French Creek, Chester Co., Pa.; Orthoclase, Falls of French Creek, Pa.

Frederick Oldach. Prehnite, Calcite, Stilbite, Apophyllite, Trap Rock, Berks Co., Pa.

Col. W. A. Roebling (by exchange). Amber, Roebling, N. J.; Mixite, Tintic, Utah; Ettringite, Bellerberg, Germany, and Tombstone, Ariz.; Tamarugite, Tarapaca, Chile; Elpidite, Greenland; Svanbergite, Wermland, Sweden; Hibschite, Aussig, Bohemia; Crestmoreite, Riverside, Cal.

Dr. John F. Rose. Vermiculite, Roseite (4 specimens), West Nottingham, Chester Co., Pa.; Ligniform asbestus, Molybdenite, West Nottingham, Pa.

Harry W. Trudell. Gypsum, Falls of French Creek, Chester Co., Pa.

H. L. Willig. Margarite, Pequea Mine, Lancaster Co., Pa.; Picrolite, Chromite, Deweylite, Wood's Chrome Mine, Lancaster Co., Pa.; Talc, White Rock, Lancaster Co., Pa.; Calcite, Wabank, Lancaster Co., Pa.; Limonite pseudo-pyrite, Chestnut Hill, Lancaster Co., Pa.; Galena, Rutile, Chloritoid, Pequea Mine, Lancaster Co., Pa.; Pyrrhotite, Cornog, Chester Co., Pa.; Tourmaline, Smoky Quartz, Gap Mines, Lancaster Co., Pa.; Tourmaline, Welsh Mt., Lancaster Co., Pa.; Cacoxenite, Beartown, Lancaster Co., Pa.; Kaolin, Narvon, Lancaster Co., Pa.; Calcite, Billmeyer Station, Lancaster Co., Pa.; Fluorite, Lancaster Co., Co., Pa.; Silicified Wood, Elizabethtown, Lancaster Co., Pa.; Tennantite, Bamfordville, Lancaster Co., Pa.; Asbestus, White Rock, Lancaster Co., Pa.

H. F. Zerger. Pyrite, Columbia, Pa.; Andradite, Serpentine, Cornwall, Pa.

Purchased. For Wm. S. Vaux Collection 104 specimens.

Herbarium.

Dr. W. L. Abbott. Small collection of plants from Doubling Gap, Cumberland Co., Pa.

H. G. Allebach. *Helenium nudiflorum*, Green Lane, Pa.

Walter M. Benner. 14 specimens from Easton, Pa.

O. H. Brown. 115 sheets of flowering plants, Cape May, N. J.

Macy Carhart. Small series of ferns from New Jersey.

CHARLES C. DEAN. A small collection of local plants.

EXCHANGE. N. Y. Botanic Garden, 123 sheets of Jamaican plants; Gray Herbarium, 556 sheets of Newfoundland and Labrador plants.

H. L. FISHER. *Plantago major*, Annandale, N. S.

C. D. FRETZ. 44 sheets of plants, Bucks Co., Pa.

F. J. KEELEY. *Camptosaurus rhigophius*, Chester Co., Pa.

BAYARD LONG. 30 sheets of Eragrostis peregrina, eastern Penn'a and N. J.

J. P. OTIS. 25 local plants and a small collection from California.

HAROLD W. PRETZ. 460 sheets of plants, Lehigh Co., Pa.

PURCHASED by the Academy. 1000 specimens of New England plants. By the Botanical Section 475 New England plants, 170 Florida plants and 350 Californian plants.

GEO. REDLES. Fertile fronds of *Mattenccia struthiopteris* from Wissahickon Creek.

WITMER STONE. *Ilex opaca*, Cape May Pt., N. J.

U. S. DEPT. AGRICULTURE. (Through Dr. C. L. Shaw.) Plants from Chester Co., Pa., from herbarium of Dr. Ezra Michener.

ARCHÆOLOGY.

MISS DEWEY. Dance Spear and Belt from South America.

MISS EMILY DROWN. Roman Antiquities, etc.

MRS. L. BROWN HALL. Arrowpoint.

PHILIP INMAN. Arrowpoints from Florida.

CLARENCE B. MOORE. Additions to the Moore Collection.

C. HENRY RONEY. Aboriginal workshop material from near Bethlehem, Pa.

BY PURCHASE. Collection of ethnographica from the Pacific and from South America.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED OR REFERRED TO IN THE PROCEEDINGS FOR 1918.

Species described as new are indicated by heavy-faced, synonyms by italic numerals.

GENERAL INDEX.

1918